WSM

WORKSHOP MANUAL
KUBOTA EXCAVATOR

KX018-4, KX019-4

Kubota

KiSC issued 05, 2013 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
KX015-4 KX016-4	For European Union	D782-BH-5
KX018-4 KX019-4	For European Union	D902-BH-2

■ **IMPORTANT**

- **Refer to the information of the engine below.**
- Engine model : D782-E3B, D902-E3B
- Web PDF-Code : No.9Y111-00133
- Hard Copy-Code : No.9Y121-00133
- CD-ROM-Code : No.9Y131-00133

June, 2011

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Record of Revisions

Last digit of the Code No.	Date	Page	Main Revised Point and Corrective Measures	Remarks
1	2012.06.29	2-G1	Max. torque/rpm (kW/rpm → N·m/rpm, HP/rpm → kgf·m/rpm)	M.M
		3-M5	The value of a graph is filled in.	
			Diagram of hydraulic circuit for KX018-4 • Travel motors is changed. • Return hose routing (T2 goes through the oil cooler. T1 goes into the oil tank.)	
			Diagram of hydraulic circuit for KX019-4 • Return hose routing (T2 goes through the oil cooler. T1 goes into the oil tank.)	
2	2013.05.27	I-9, 10, 11, 14	• KX019-4 SF is newly adopted. (SF: Short-Front model)	M.M
		G-18, 25, 34		
		3-M1	• Amendment to DIAGRAM OF HYDRAULIC CIRCUIT (AUX-port)	
		3-S100	• Description added [Measuring the main pump flow (when measuring the combinedflow of P1 and P2)]	
		3-S101	• Measured values for pump flow added	
		3-S108	• Measured values for swivel motor drain volume added	
		3-S109	• Measured values for travel motor drain volume added	
3				
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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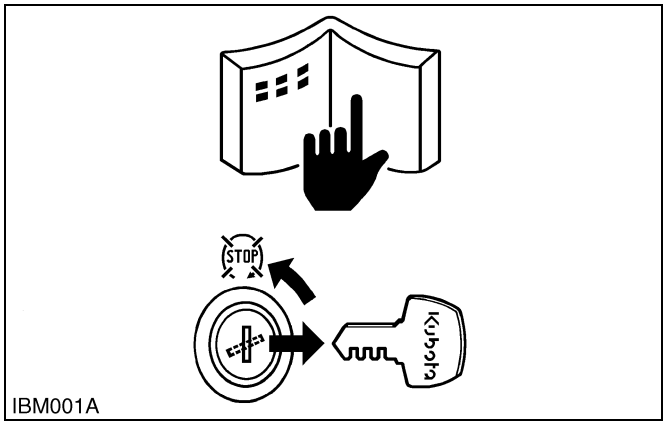
2. IN THE INTEREST OF WORK SAFETY

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

(1) Precautions Before Working on the Mini-Excavator



IBM001A

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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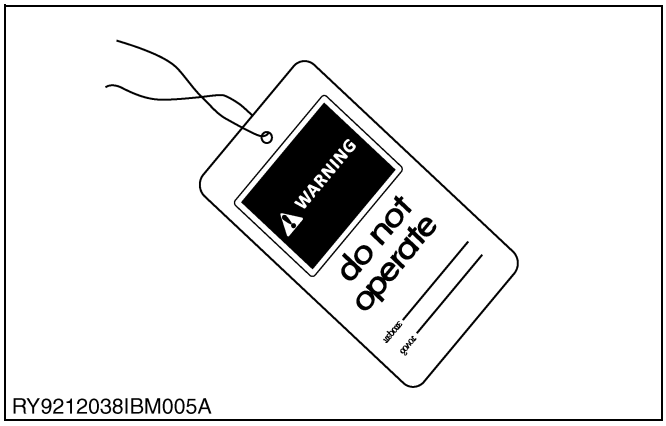

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- When performing maintenance on the equipment, hang the DO NOT OPERATE sign where it will be obvious from and around the driver's seat.
- When performing maintenance or repairs, always lower attachments to the ground, stop the engine and set the brake.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

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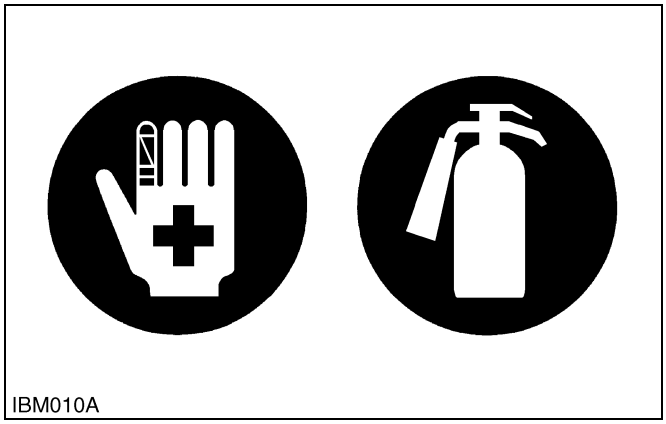
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Be Ready for an Emergency

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

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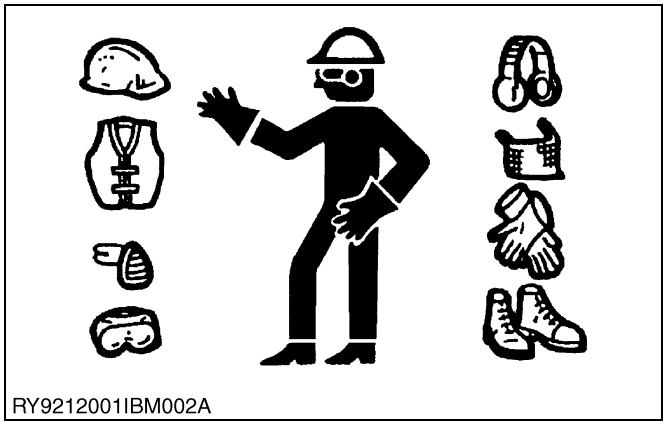
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- Wear clothes appropriate for working on equipment. Do not wear loose-fitting clothes as they may catch on the machine controls.
- When working on the equipment, use all safety gear, such as a helmet, safety glasses and shoes, that are required by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

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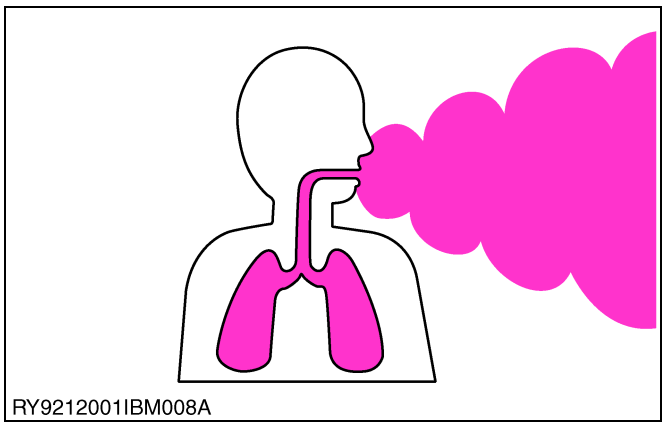
(2) Precautions Before Working on the Equipment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- Stop the machine on a hard and level location and make sure the area around the machine is free of obstacles and hazardous materials. When parking the machine indoors, select a spot that can be properly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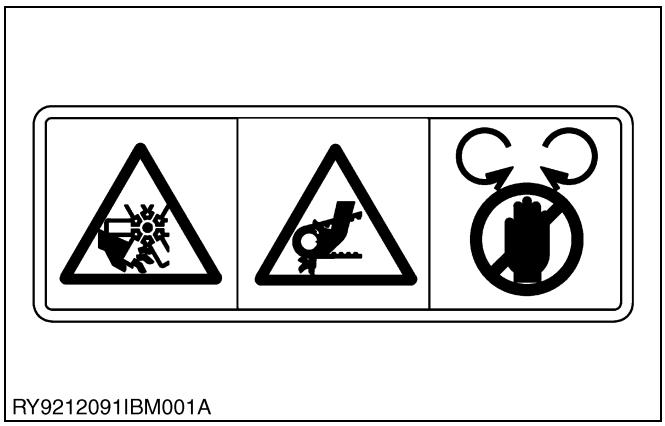
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- Whenever it is necessary to open the engine covers or hood in order to service the machine, always prop them open.
- If it is absolutely necessary to run the engine while working on the machine, make sure you are clear of all rotating or moving parts.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

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

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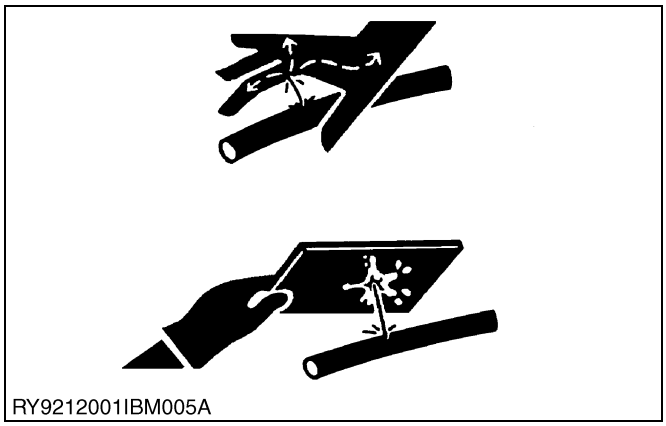
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- The pressure in the hydraulic circuit stays at pressure even after the engine stops. Before removing parts, such as hydraulic devices from the machine, first release the pressure. Please note that when releasing residual pressure, the machine itself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

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No Smoking or Open Flames while Fueling

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

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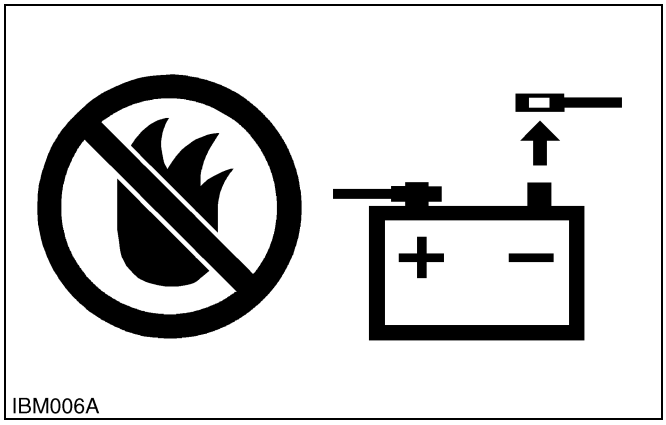
IBM006A

- 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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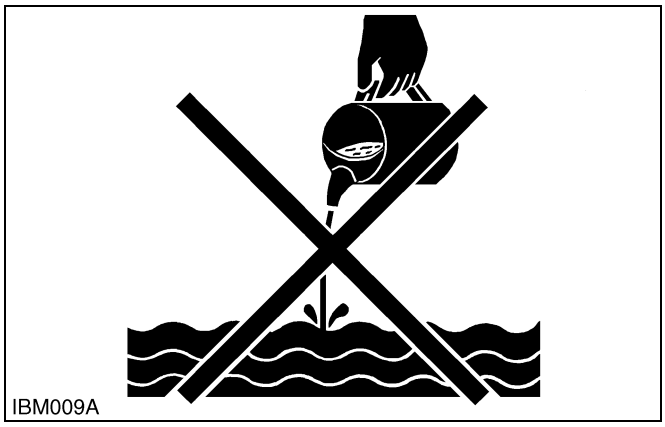
IBM009A

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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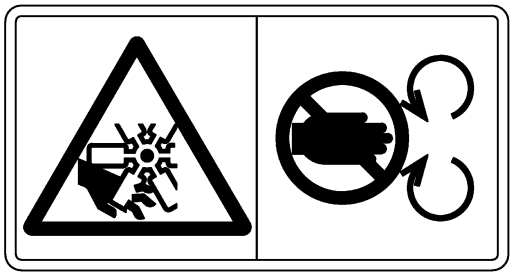
3. LABELS DISPLAYED TO PROMOTE WORK SAFETY

[1] LOCATIONS

(1)



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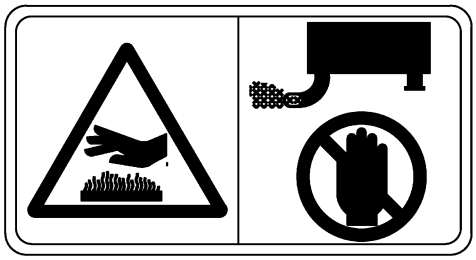

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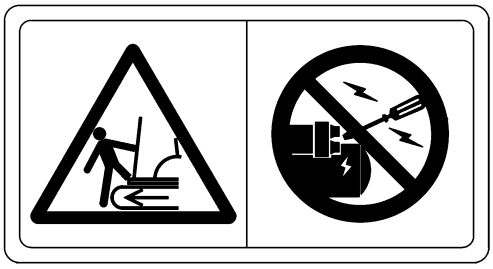

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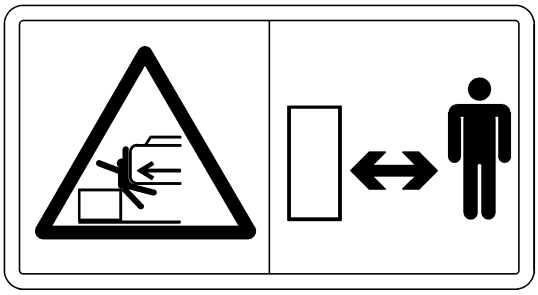

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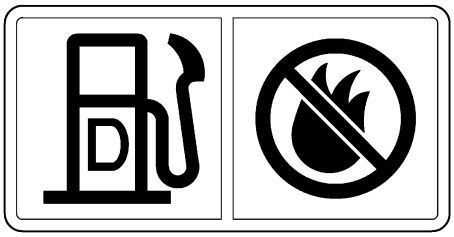

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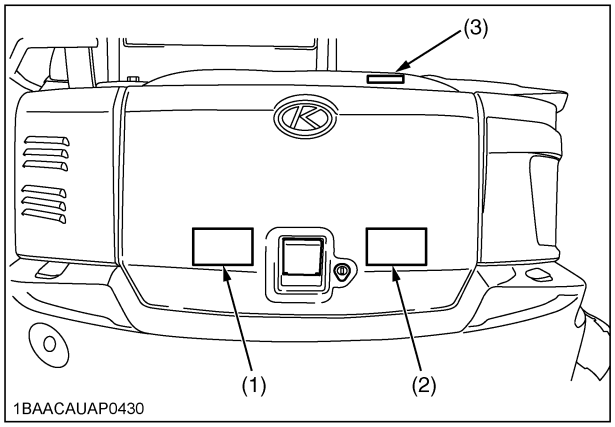

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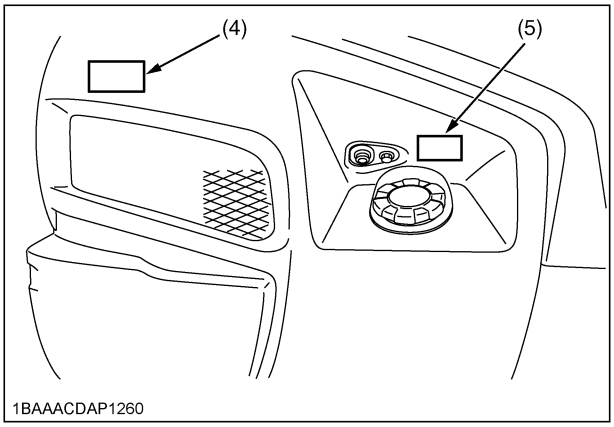

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(2)

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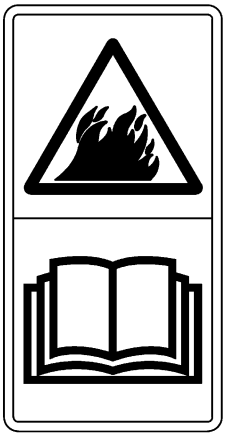

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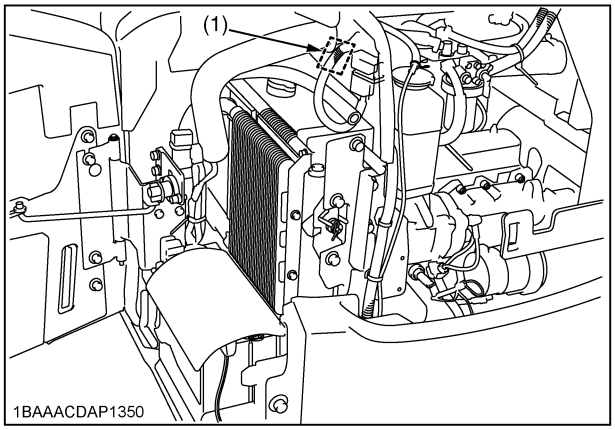

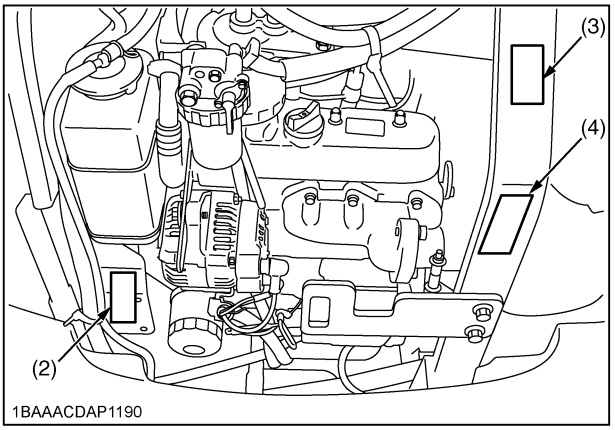

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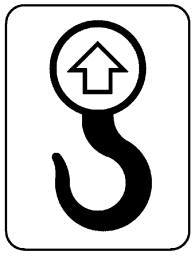

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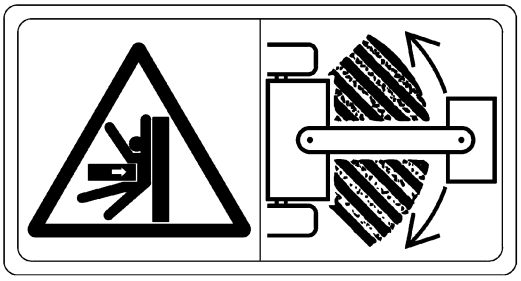

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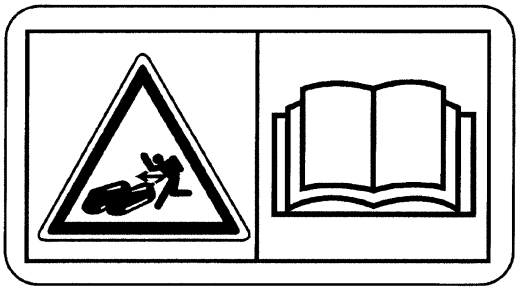

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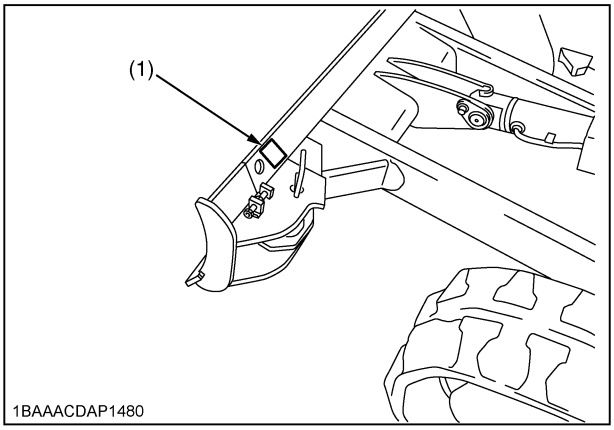

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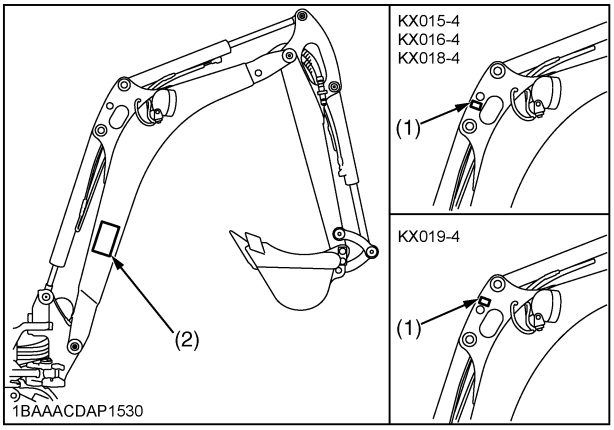

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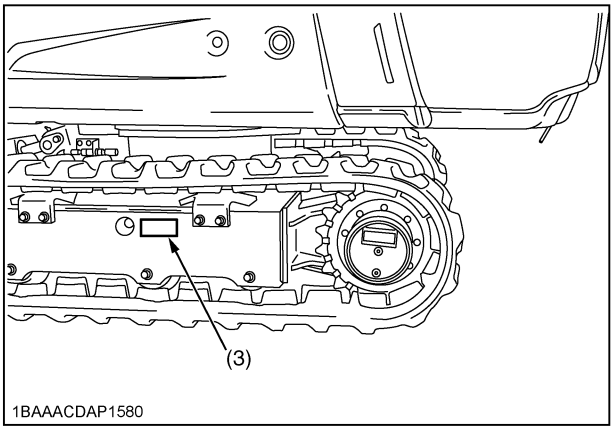

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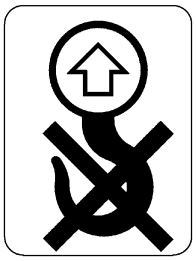

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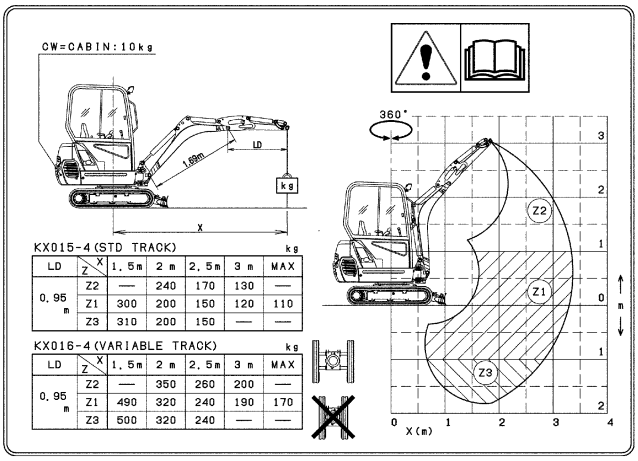
(2) [KX015-4, KX016-4 (Cabin)]



KX015-4 (STD TRACK) kg

LD	Z \ X	1.5m	2m	2.5m	3m	MAX
0.95 m	Z2	—	240	170	130	—
	Z1	300	200	150	120	110
	Z3	310	200	150	—	—

KX016-4 (VARIABLE TRACK) kg

LD	Z \ X	1.5m	2m	2.5m	3m	MAX
0.95 m	Z2	—	350	260	200	—
	Z1	490	320	240	190	170
	Z3	500	320	240	—	—

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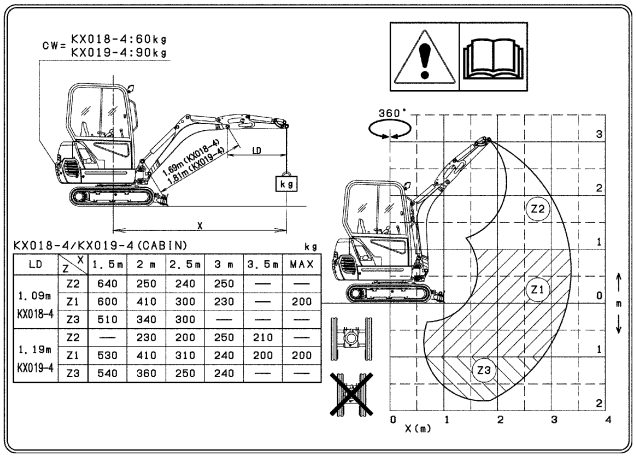
(2) [KX018-4, KX019-4 (Cabin)]



KX018-4/KX019-4 (CABIN) kg

LD	Z \ X	1.5m	2m	2.5m	3m	3.5m	MAX
1.09m KX018-4	Z2	640	250	240	250	—	—
	Z1	600	410	300	230	—	200
	Z3	510	340	300	—	—	—
1.19m KX019-4	Z2	—	230	200	250	210	—
	Z1	530	410	310	240	200	200
	Z3	540	360	250	240	—	—

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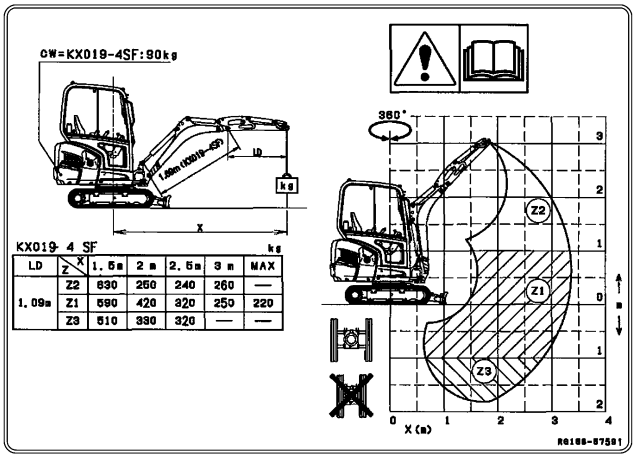
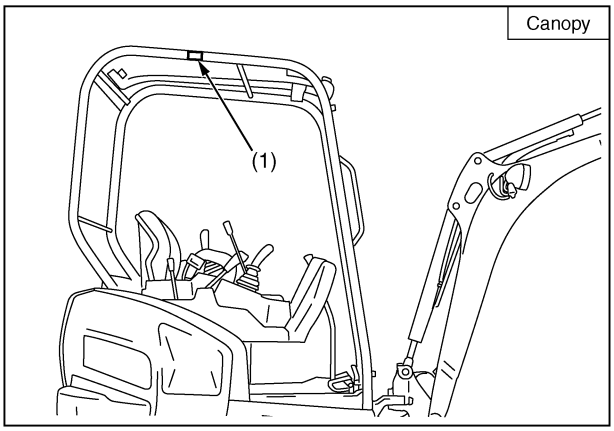
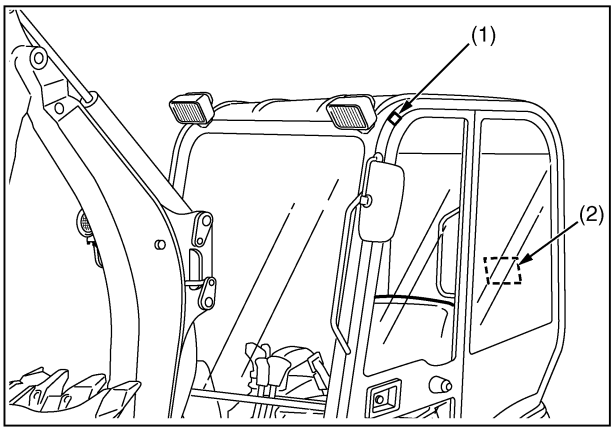
(2) [KX019-4SF (Cabin)]



KX019-4 SF kg

LD	Z \ X	1.5m	2m	2.5m	3m	MAX
1.09m	Z2	630	260	240	260	—
	Z1	590	420	320	250	220
	Z3	510	330	320	—	—





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■ **NOTE**

- **SF: Short Front**

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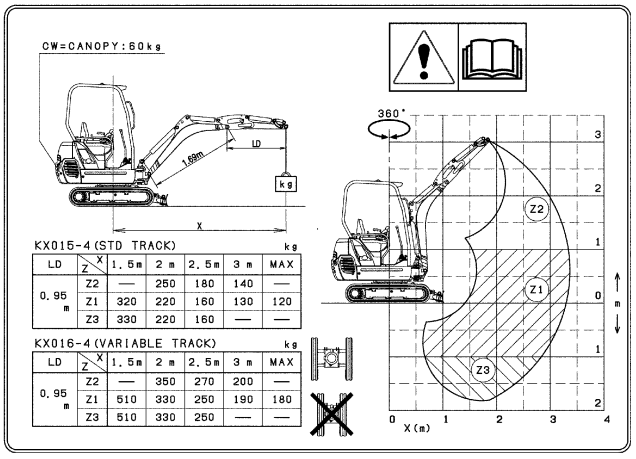
(1) [KX015-4, KX016-4 (Canopy)]



KX015-4 (STD TRACK) kg

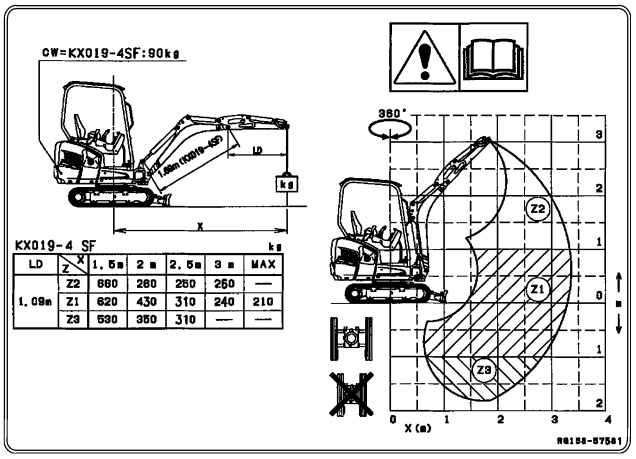
LD	Z \ X	1.5m	2m	2.5m	3m	MAX
0.95m	Z2	—	250	180	140	—
	Z1	320	220	160	130	120
	Z3	330	220	160	—	—

KX016-4 (VARIABLE TRACK) kg

LD	Z \ X	1.5m	2m	2.5m	3m	MAX
0.95m	Z2	—	350	270	200	—
	Z1	510	330	250	190	180
	Z3	510	330	250	—	—

1BAAACDAP217E

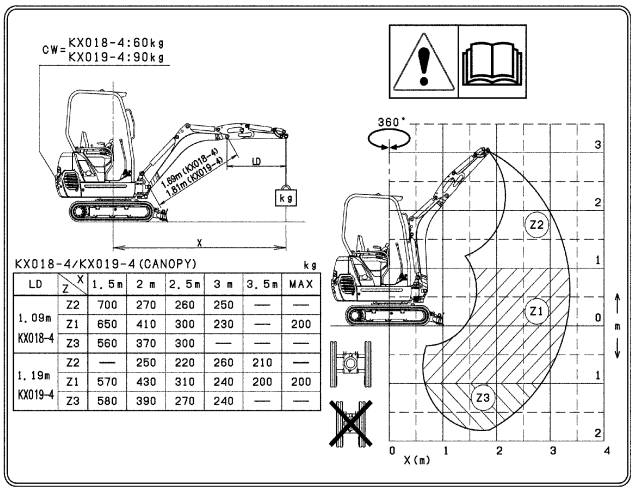
(1) [KX019-4SF (Canopy)]



KX019-4 SF kg

LD	Z \ X	1.5m	2m	2.5m	3m	MAX
1.09m	Z2	660	280	250	250	—
	Z1	620	430	310	240	210
	Z3	530	350	310	—	—

(1) [KX018-4, KX019-4 (Canopy)]

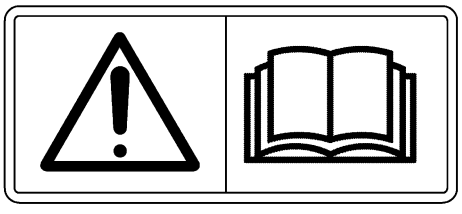


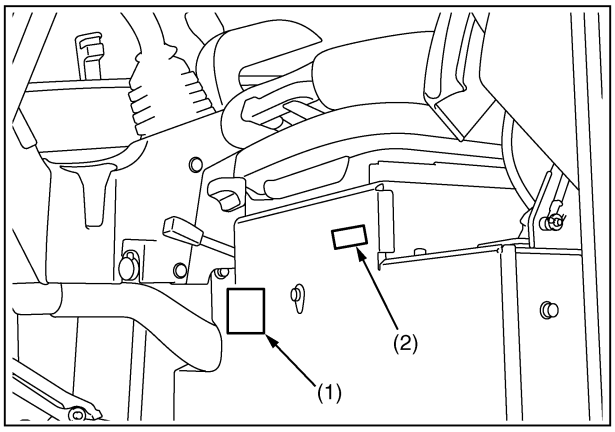
KX018-4/KX019-4 (CANOPY) kg

LD	Z \ X	1.5m	2m	2.5m	3m	3.5m	MAX
1.09m KX018-4	Z2	700	270	260	250	—	—
	Z1	650	410	300	230	—	200
	Z3	560	370	300	—	—	—
1.19m KX019-4	Z2	—	250	220	260	210	—
	Z1	570	430	310	240	200	200
	Z3	580	390	270	240	—	—

1BAAACDAP218E

(2)





RY9212095ICI002A

RY9212095INI0005US0

[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		KX018-4		KX019-4	
Type		Canopy	Cabin	Canopy	Cabin
Machine weight		1620 kg 3571 lbs	1720 kg 3792 lbs	(STD) 1680 kg 3704 lbs	(STD) 1780 kg 3924 lbs
				(SF) 1675 kg 3693 lbs	(SF) 1775 kg 3913 lbs
Operating weight		1695 kg 3737 lbs	1795 kg 3957 lbs	(STD) 1755 kg 3869 lbs	(STD) 1855 kg 4090 lbs
				(SF) 1750 kg 3858 lbs	(SF) 1850 kg 4079 lbs
Standard bucket	Volume (CECE)	0.040 m^3			
	Width (with side cutter)	452 mm (472 mm) 17.8 in. (18.6 in.)			
Engine	Type (water cooled 4 cycle Diesel)	3 cylinder			
	Model name	D902-BH-2			
	Total displacement	898 cm^3			
	Output (ISO 9249)	11.8 kW			
	Rated speed	2300 rpm			
Performance	Swing speed	9.1 rpm			
	Travel speed	2.2 km / h / 4.0 km / h			
	Ground pressure	25.5 kPa 0.26 kgf/cm^2	26.5 kPa 0.27 kgf/cm^2	26.5 kPa 0.27 kgf/cm^2	27.4 kPa 0.28 kgf/cm^2
	Climbing angle	30 deg			
Blade (width and height)		990 / 1300 x 230 mm 39 / 51.2 x 9.1 in.			
Boom swing angle	Left	1.27 rad (73 deg)			
	Right	0.99 rad (57 deg)			
Pressure connection for attachments	Max. displacement (Theoretical)	27.7 L/min			
	Max. pressure	21.6 MPa (220.0 kgf/cm^2 , 3130 psi)			
Fuel tank capacity		21 L			

■ **NOTE**

- **Above dimensions are based on the machine with JPN bucket.**
  JPN = made in Japan
- **Above dimensions are based on the machine with rubber crawlers.**
- **Machine weight : with 35 kg (77 lbs) standard bucket and fully served.**
- **Operating weight : with 75 kg (165 lbs) operator, 35 kg (77 lbs) standard bucket and fully served.**
- **Specifications subject to change without notice.**
- **STD: Standard, SF: Short Front**

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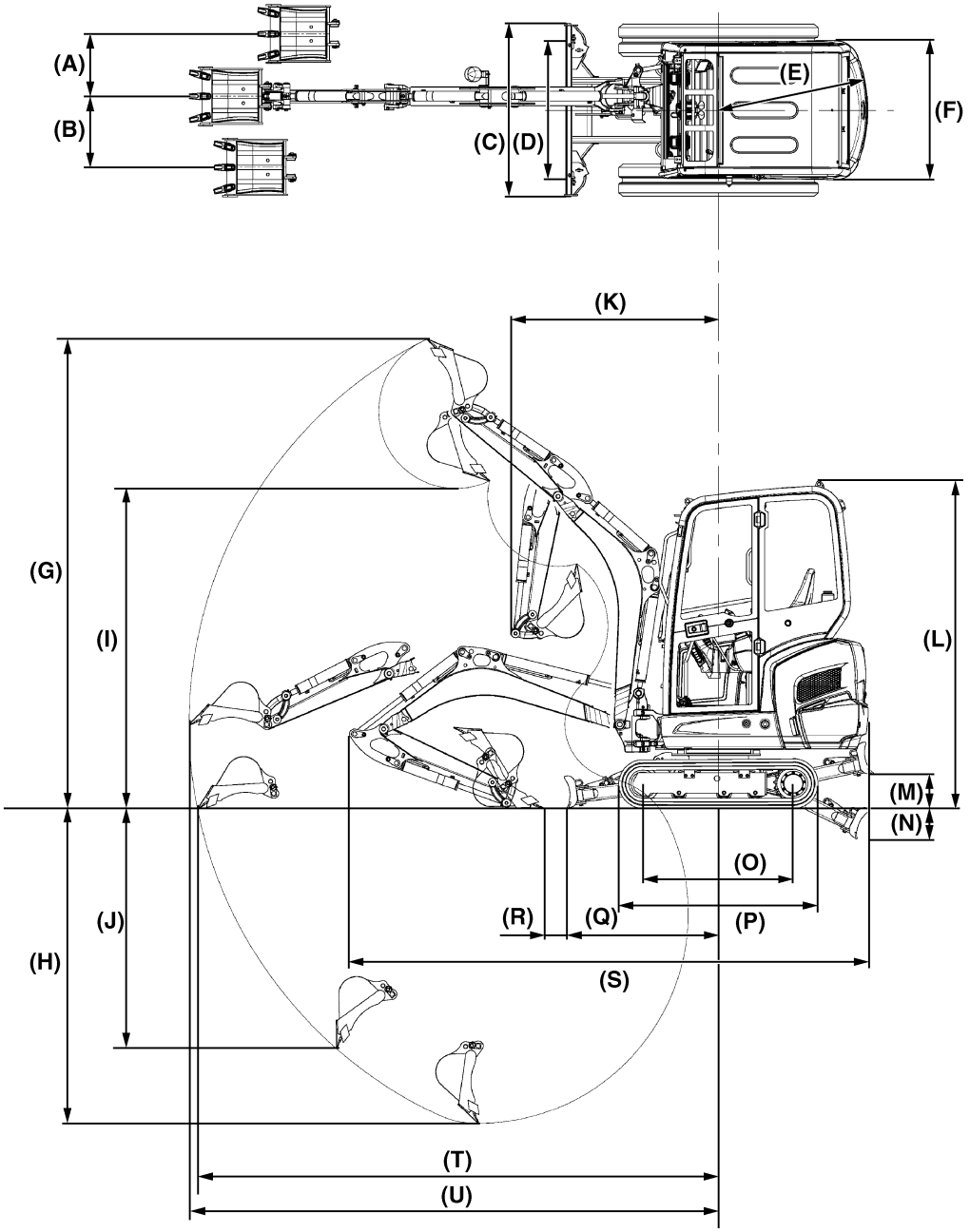
5. DIMENSIONS



RY9212091INI002A

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
KX018-4	450 mm 17.7 in.	510 mm 20.1 in.	1300 mm 51.2 in.	990 mm 39.0 in.	1070 mm 42.1 in.	990 mm 39.0 in.	3450 mm 135.8 in.	2480 mm 97.6 in.

	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)
KX018-4	2380 mm 93.7 in.	1940 mm 76.4 in.	1480 mm 58.7 in.	2350 mm 91.7 in.	230 mm 9.1 in.	230 mm 9.1 in.	1230 mm 48.4 in.	1590 mm 62.6 in.

	(Q)	(R)	(S)	(T)	(U)
KX018-4	1080 mm 42.5 in.	60 mm 2.4 in.	3710 mm 146.1 in.	3860 mm 152 in.	3920 mm 154.3 in.

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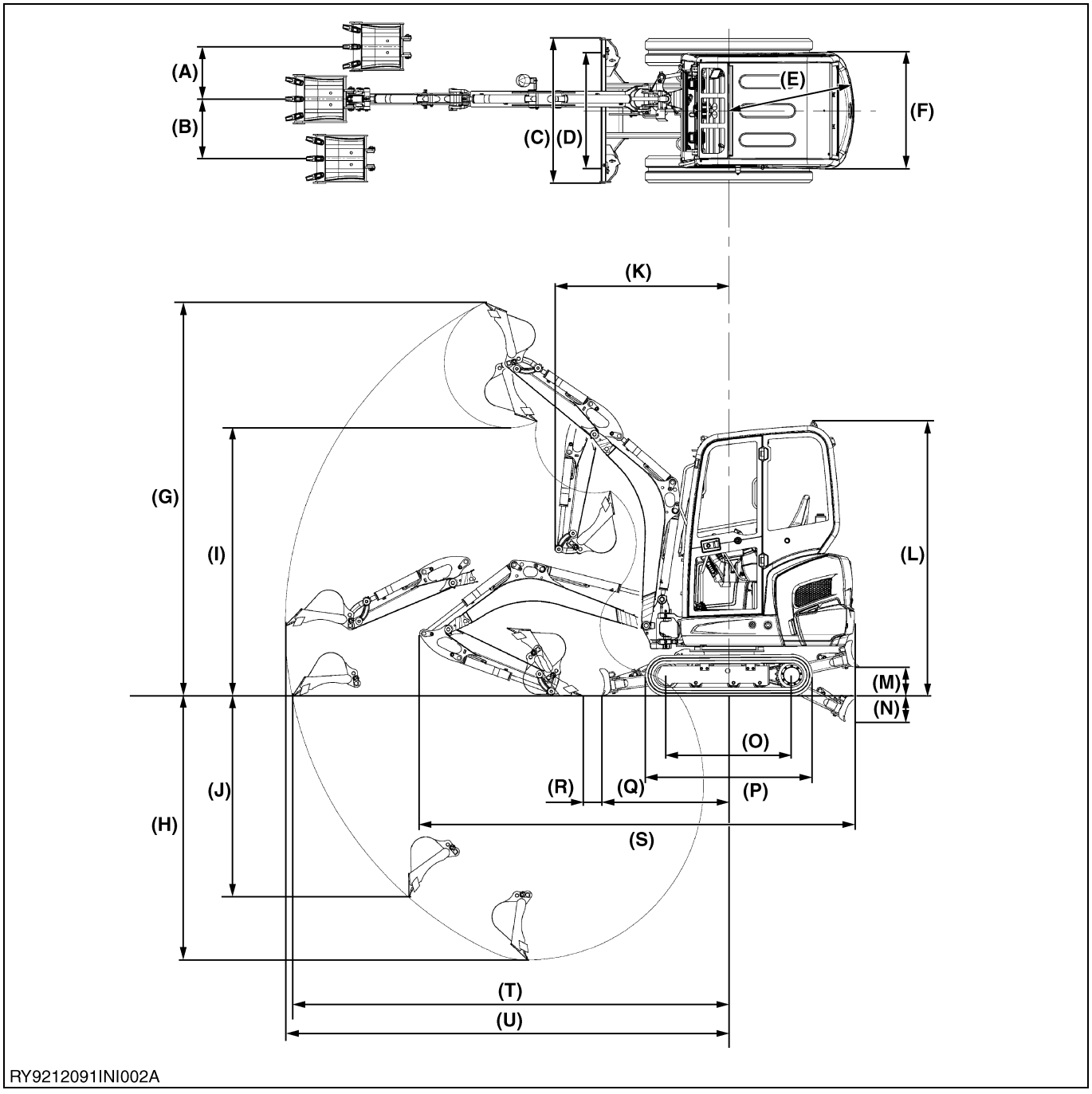

RY9212091INI002A

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
KX019-4	450 mm 17.7 in.	510 mm 20.1 in.	1300 mm 51.2 in.	990 mm 39.0 in.	1100 mm 43.3 in.	990 mm 39.0 in.	3620 mm 142.5 in.	2580 mm 101.6 in.

	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)
KX019-4	2560 mm 100.8 in.	2140 mm 84.3 in.	1520 mm 58.7 in.	2350 mm 91.7 in.	230 mm 9.1 in.	230 mm 9.1 in.	1230 mm 48.4 in.	1590 mm 62.6 in.

	(Q)	(R)	(S)	(T)	(U)
KX019-4	1080 mm 42.5 in.	100 mm 3.9 in.	3860 mm 152 in.	4070 mm 160.2 in.	4120 mm 162.2 in.

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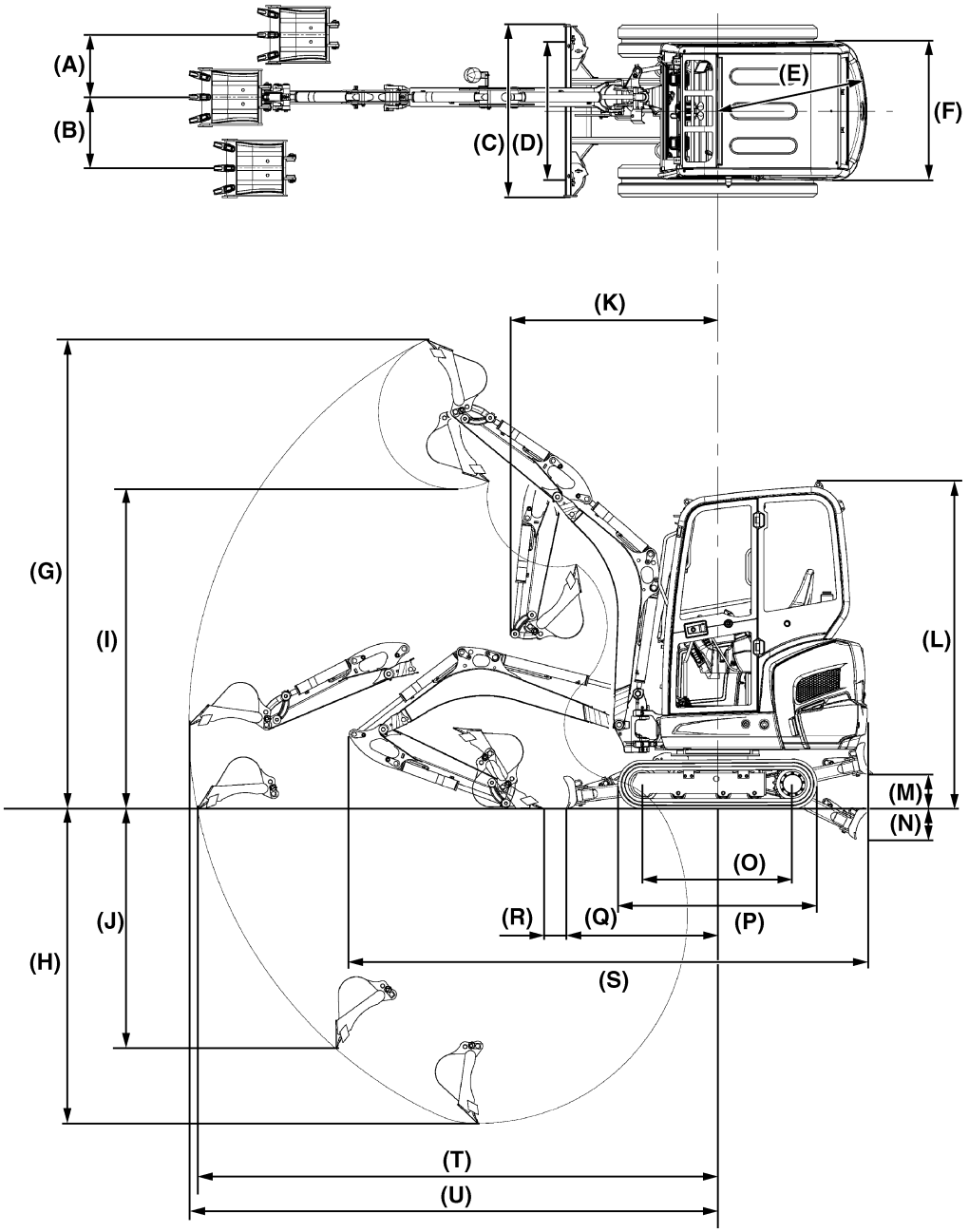


RY9212091INI002A

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
KX019-4SF	450 mm 17.7 in.	510 mm 20.1 in.	1300 mm 51.2 in.	990 mm 39.0 in.	1100 mm 43.3 in.	990 mm 39.0 in.	3450 mm 135.8 in.	2480 mm 97.6 in.

	(I)	(J)	(K)	(L)	(M)	(N)	(O)	(P)
KX019-4SF	2380 mm 93.7 in.	1940 mm 76.4 in.	1480 mm 58.7 in.	2350 mm 91.7 in.	230 mm 9.1 in.	230 mm 9.1 in.	1230 mm 48.4 in.	1590 mm 62.6 in.

	(Q)	(R)	(S)	(T)	(U)
KX019-4SF	1080 mm 42.5 in.	60 mm 2.4 in.	3755 mm 147.8 in.	3860 mm 152 in.	3920 mm 154.3 in.

■ **NOTE**

- **SF: Short Front**

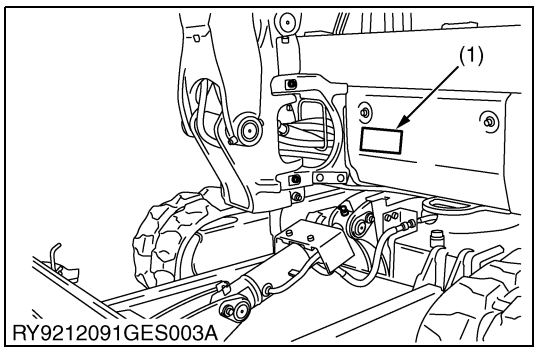
RY9212095INI0007US0

G GENERAL

GENERAL

CONTENTS

1. MACHINE INDENTIFICATION



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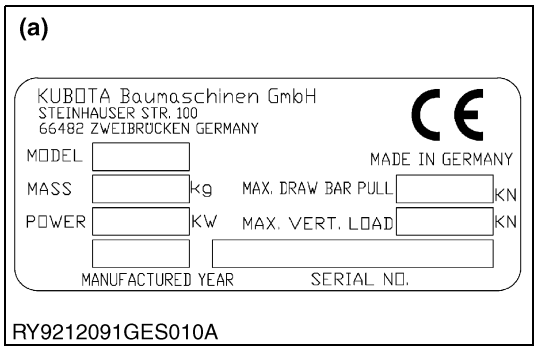

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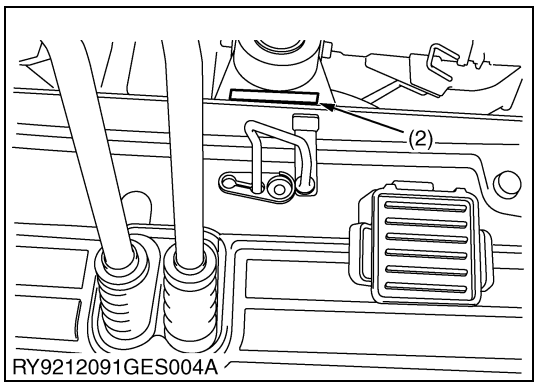

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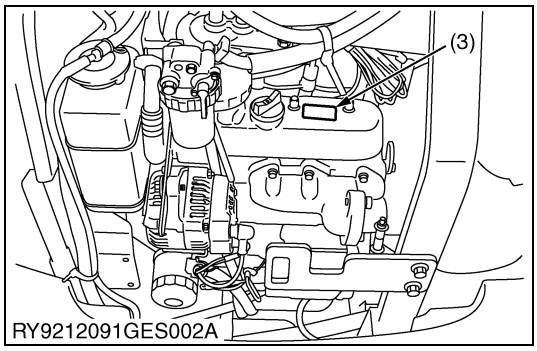

RY9212091GES002A

When consulting about this mini-excavator, please provide the model of the mini-excavator, its frame and engine numbers and the number of hours on the hour meter.

(1) Mini-excavator Nameplate (Model, frame number, engine number)
(2) Frame Number
(3) Engine Number

(a) Model Nameplate

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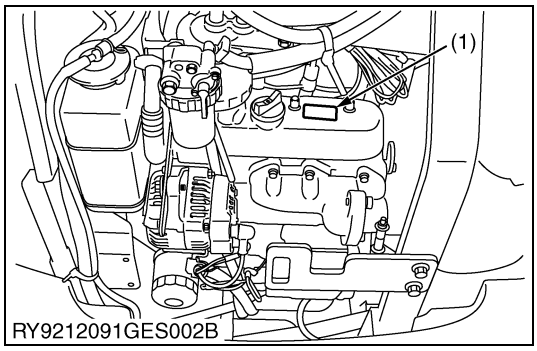
2. ENGINE INDENTIFICATION

[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

Year Manufactured

Letter or Number	Year	Letter 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		

*The letters **I**, **O**, **Q**, **U** and **Z** are not used.

Month Manufactured

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

*The letter **I** and **O** are not used.

(a) (b)(c) (d)

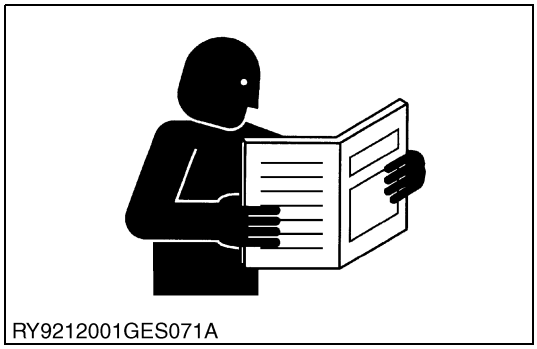
e.g. V2607 - 8 HA001

(a) Engine Model : **V2607-DI**
(b) Year Manufactured : The **8** indicates **2008**.
(c) Month : April is indicated by either **G** or **H**.
(d) Lot Number : (Either **0001 to 9999** or **A001 to Z999**)

(1) Engine Model and Serial Number

RY9212091GEG0016US0

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.

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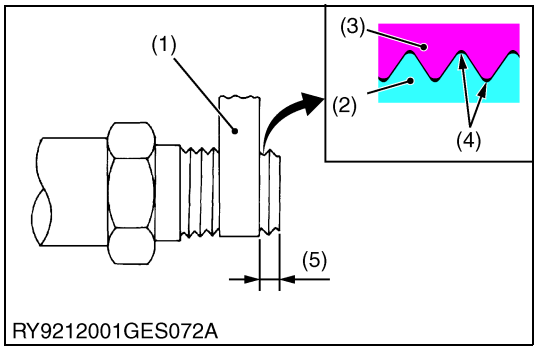


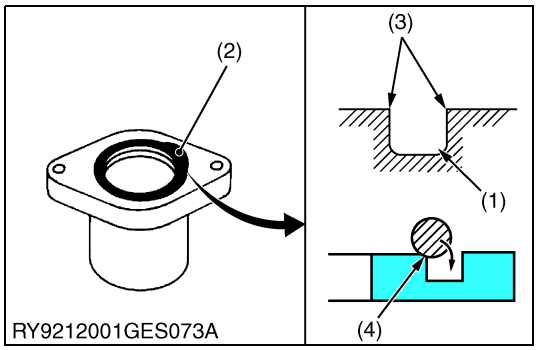
RY9212001GES072A

Plumber's Tape

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

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

RY9212001GEG0012US0



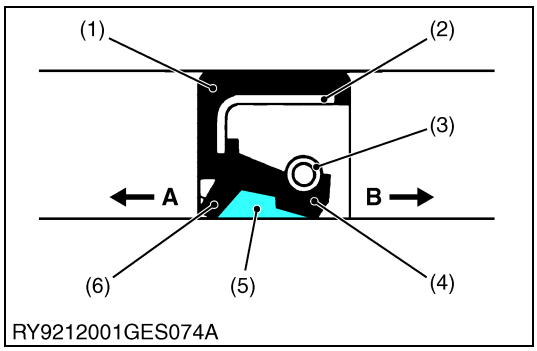
RY9212001GES073A

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)

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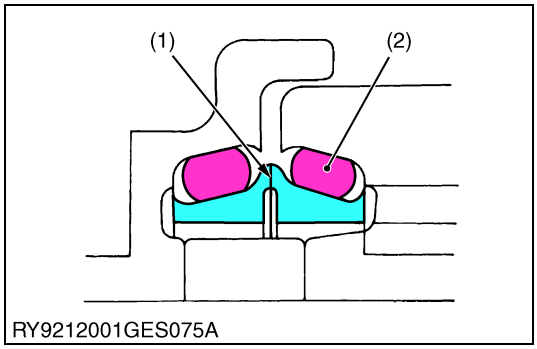

Floating Seal

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

(1) Surrounding Surfaces (2) O-Ring

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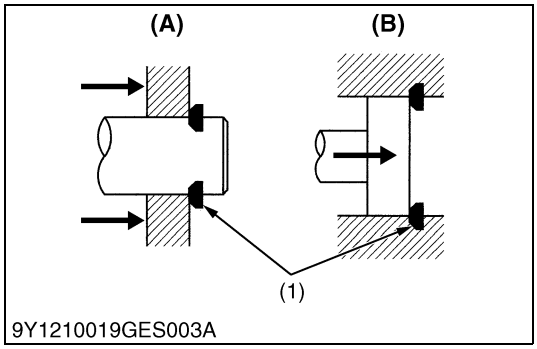

Snap Ring Related

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

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

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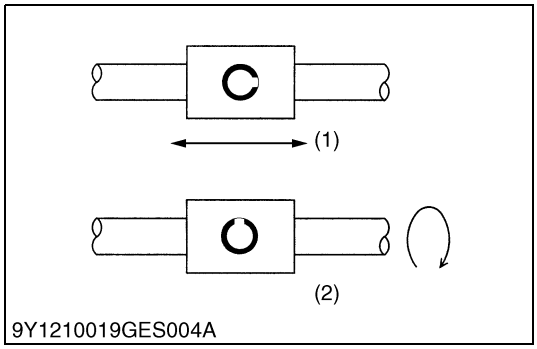
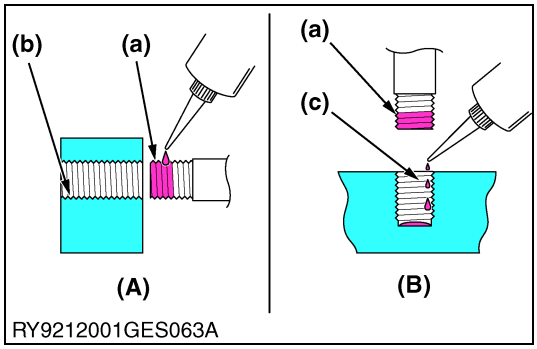


Spring Pins

- 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

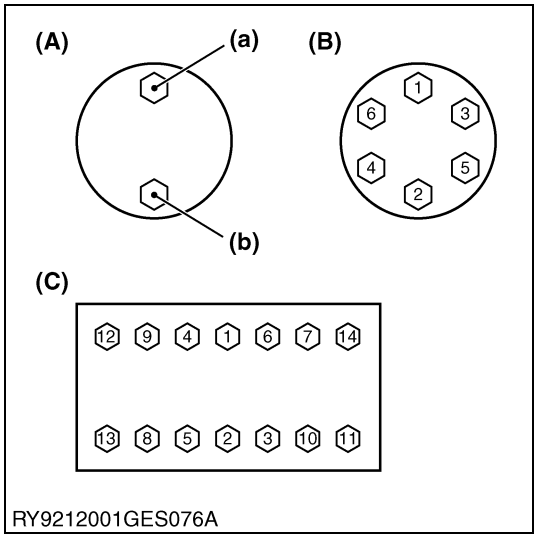


Adhesive

- 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.

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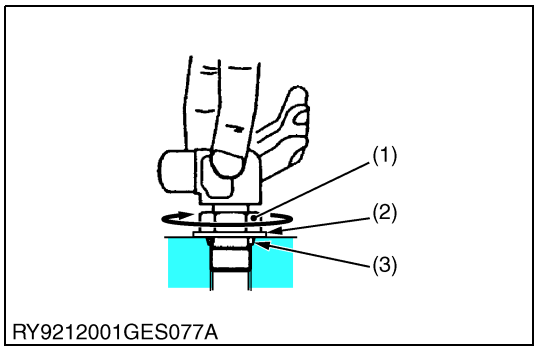
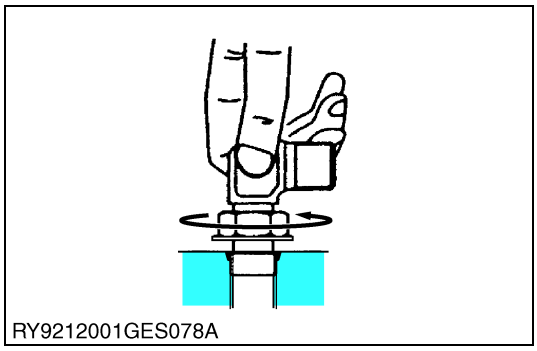


RY9212001GES077A

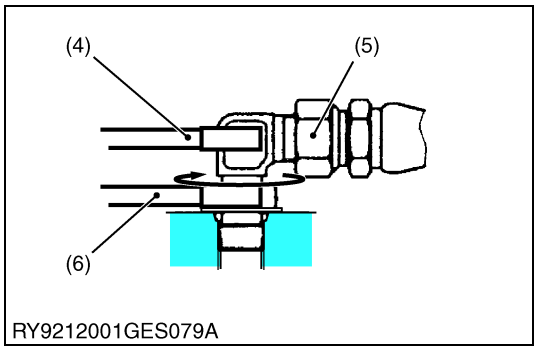
Elbow with Male Seat Assembly Procedure

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

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


RY9212001GES078A

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

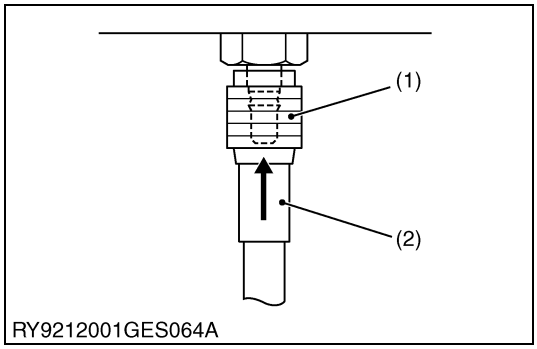


RY9212001GES079A

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

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

RY9212001GEG0021US0



RY9212001GES064A

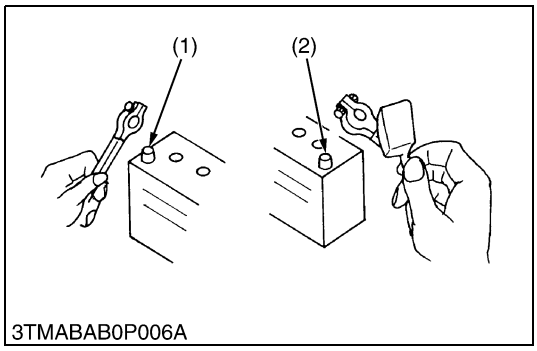
Installing and Removing Quick Couplings

- To remove a quick hose coupling, push the fitting (2) in the direction of the arrow and pull on the plastic part (1) 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. PRECAUTIONS WHEN HANDLING 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.

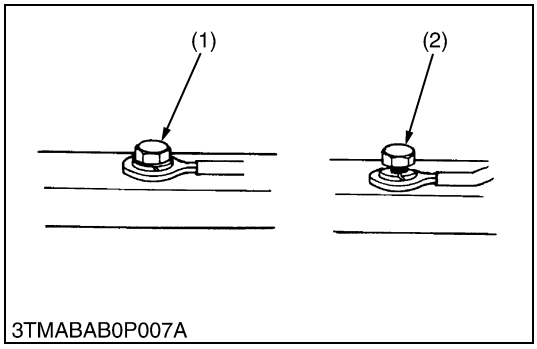
■ **IMPORTANT**

- **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

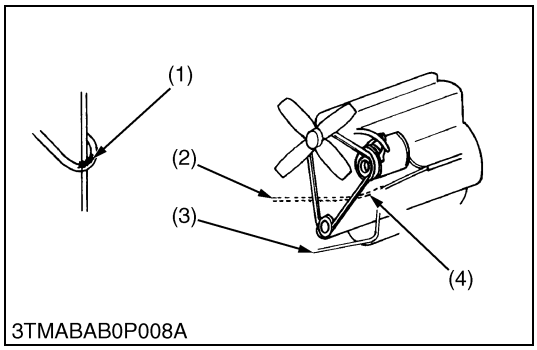


3TMABAB0P007A

- Tighten wiring terminals securely.

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

RY9212001GEG0024US0

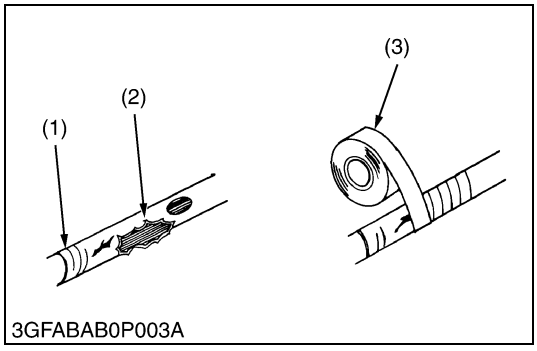


3TMABAB0P008A

- Keep wiring away from hazards.

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

RY9212001GEG0025US0

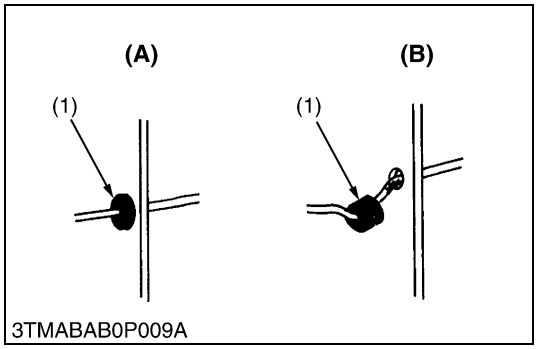


3GFABAB0P003A

- Immediately repair or replace old or damaged wiring.

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

RY9212001GEG0026US0

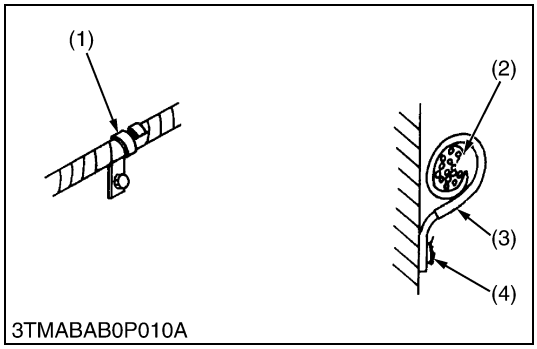


3TMABAB0P009A

- Insert grommet securely.

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

RY9212001GEG0027US0

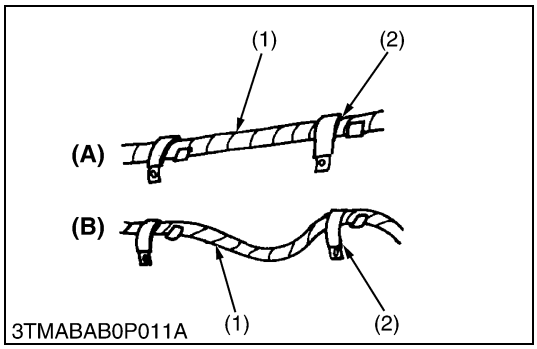


3TMABAB0P010A

- 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

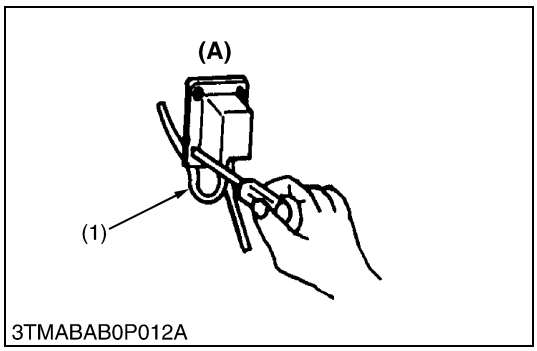


3TMABAB0P011A

- 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

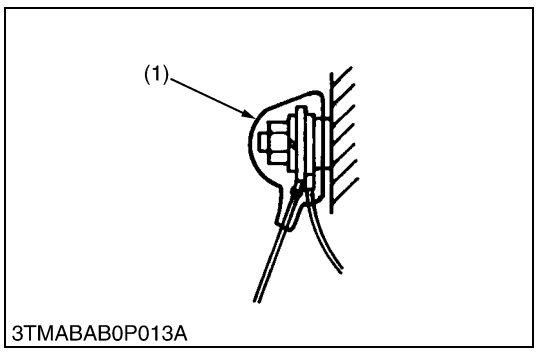


3TMABAB0P012A

- Do not pinch or bind wiring when installing parts.

(1) Wire
(A) Incorrect

RY9212001GEG0030US0



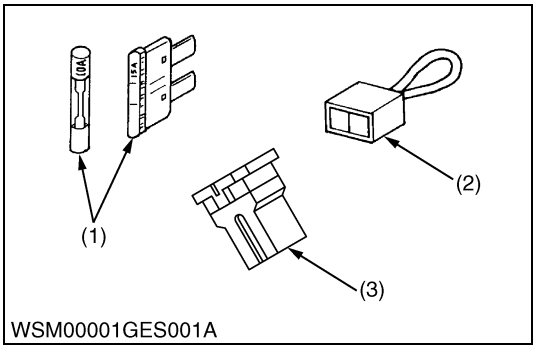
3TMABAB0P013A

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

(1) Cover (Install Covers Securely)

RY9212001GEG0031US0

[2] FUSES



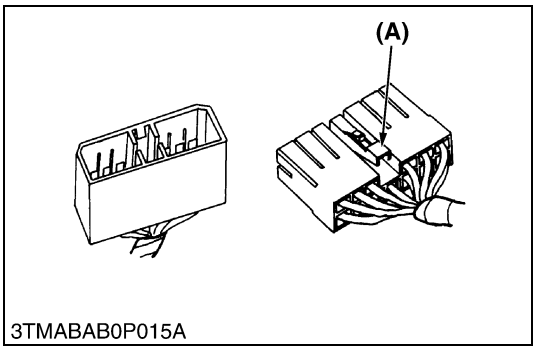
WSM00001GES001A

- 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] CONNECTORS

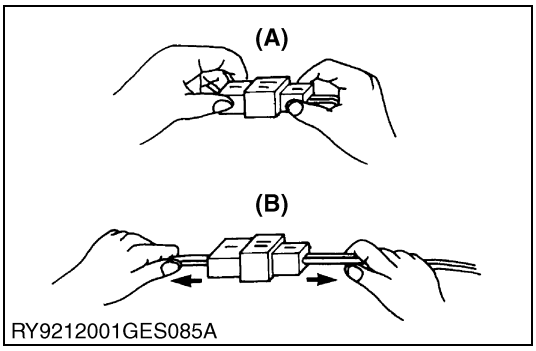


3TMABAB0P015A

- Press the lock to disconnect locking connectors.

(A) Push

RY9212001GEG0033US0

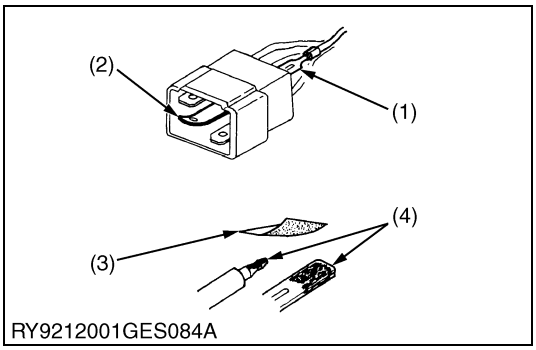


RY9212001GES085A

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

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

RY9212001GEG0034US0

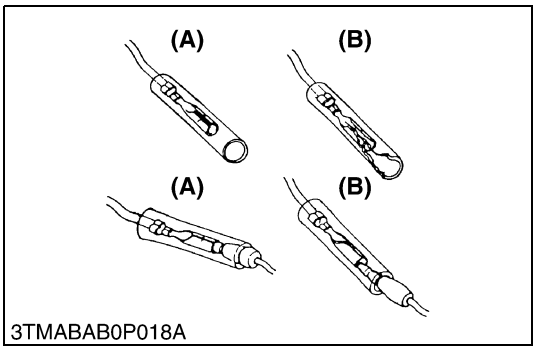


RY9212001GES084A

- 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

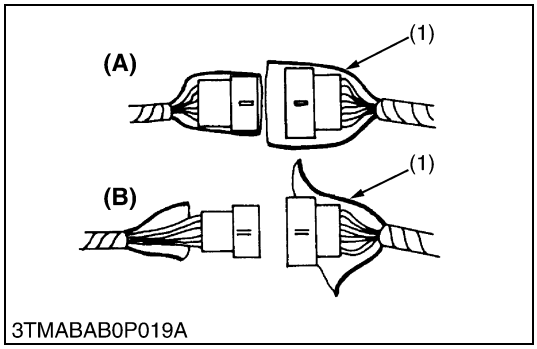


3TMABAB0P018A

- Female connectors must not be spread too far open

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

RY9212001GEG0036US0



3TMABAB0P019A

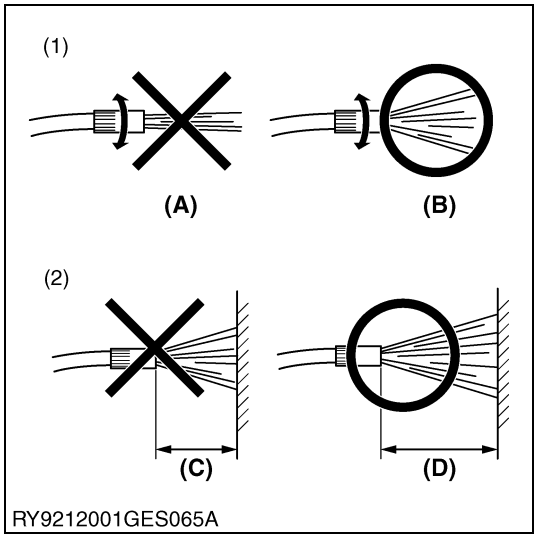
- The plastic covers of connectors must cover them completely.

(1) Cover

(A) Correct
(B) Incorrect

RY9212001GEG0037US0

[4] WASHING THE MINI-EXCAVATOR 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 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.
(Ex.)
(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

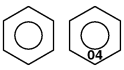
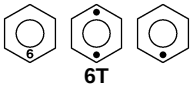
(A) Blasting
(B) Wide Spray
(C) Less Than 2 m (80 in.)
(D) Over 2 m (80 in.)

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			Ordinariness			Aluminum			Ordinariness		
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

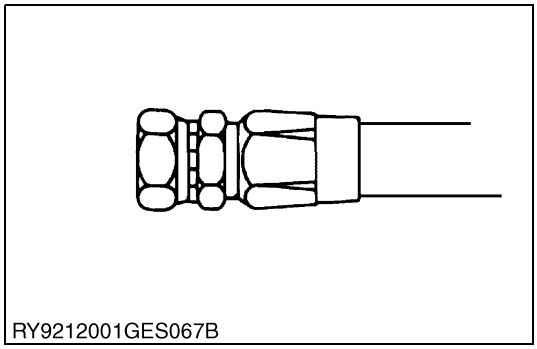
[2] TORQUES OF STUD BOLTS

Material of opponent part	Ordinariness			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

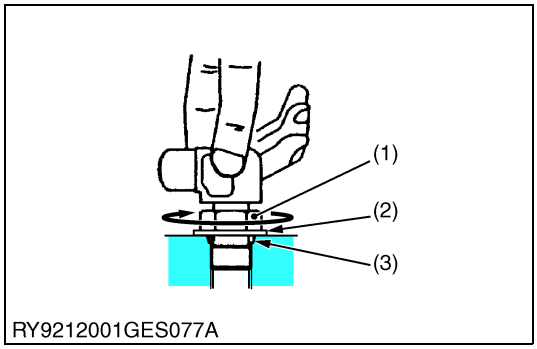


RY9212001GES067B

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)



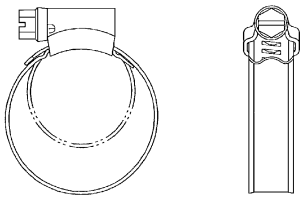
RY9212001GES077A

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

Tightening torque	φ10-φ16	69741-72873	2.5 to 3.5 N·m 0.3 to 0.4 kgf·m 1.8 to 2.6 lbf·ft
	φ13-φ20	69481-11163	2.5 to 3.5 N·m 0.3 to 0.4 kgf·m 1.8 to 2.6 lbf·ft
	φ15-φ24	69741-72814	4.0 to 5.0 N·m 0.4 to 0.5 kgf·m 3.0 to 3.7 lbf·ft
	φ22-φ32	69741-72844	4.0 to 5.0 N·m 0.4 to 0.5 kgf·m 3.0 to 3.7 lbf·ft
	φ26-φ38	69741-72824	4.0 to 5.0 N·m 0.4 to 0.5 kgf·m 3.0 to 3.7 lbf·ft
	φ40-φ60	69481-15184	5.0 to 6.0 N·m 0.5 to 0.6 kgf·m 3.7 to 4.4 lbf·ft
	φ38-φ50	69741-72834	5.0 to 6.0 N·m 0.5 to 0.6 kgf·m 3.7 to 4.4 lbf·ft
	φ50-φ65	69741-72854	5.0 to 6.0 N·m 0.5 to 0.6 kgf·m 3.7 to 4.4 lbf·ft
	φ68-φ85	69481-04591	5.0 to 6.0 N·m 0.5 to 0.6 kgf·m 3.7 to 4.4 lbf·ft

RY9212091GEG0019US0

6. OIL AND WATER CAPACITY TABLE

Item		KX018-4, KX019-4	Notes
Engine Oil (When changing filter)		3.6 L (0.95 U.S.gal)	Shell Havella T10 W30 D10W30 Super
Coolant	Canopy	2.7 L (0.71 U.S.gal)	Anti-freeze Esso G03-11BVLK
	Cabin	2.9 L (0.77 U.S.gal)	
	Reserve Tank	0.56 L (0.15 U.S.gal)	
Fuel		21 L (5.55 U.S.gal)	Diesel
Hydraulic Fluid	Total oil capacity	28 L (7.40 U.S.gal)	Nuto H46
	Inside tank (middle of gauge)	15.5 L (4.09 U.S.gal)	
Travel Motor		330 ml (20.1 cu.in.)	Shell Spirax MA 80W
Idler Assembly		30 ml (1.8 cu.in.)	Engine Oil SAE #30CD
Track Roller		40 ml (2.4 cu.in.)	Engine Oil SAE #30CD

RY9212095GEG0009US0

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	Fuel injection nozzle injection pressure	check																		every 1500 hrs	*3
12	Front idler and track roller oil	change																		every 2000 hrs	*4
13	Alternator and starter motor	check																		every 2000 hrs	
14	Injection pump	check																		every 3000 hrs	*3
15	Radiator system	rinse																		every 2 years	
16	Fuel line and Intake air line	replace																		every 2 years	*2

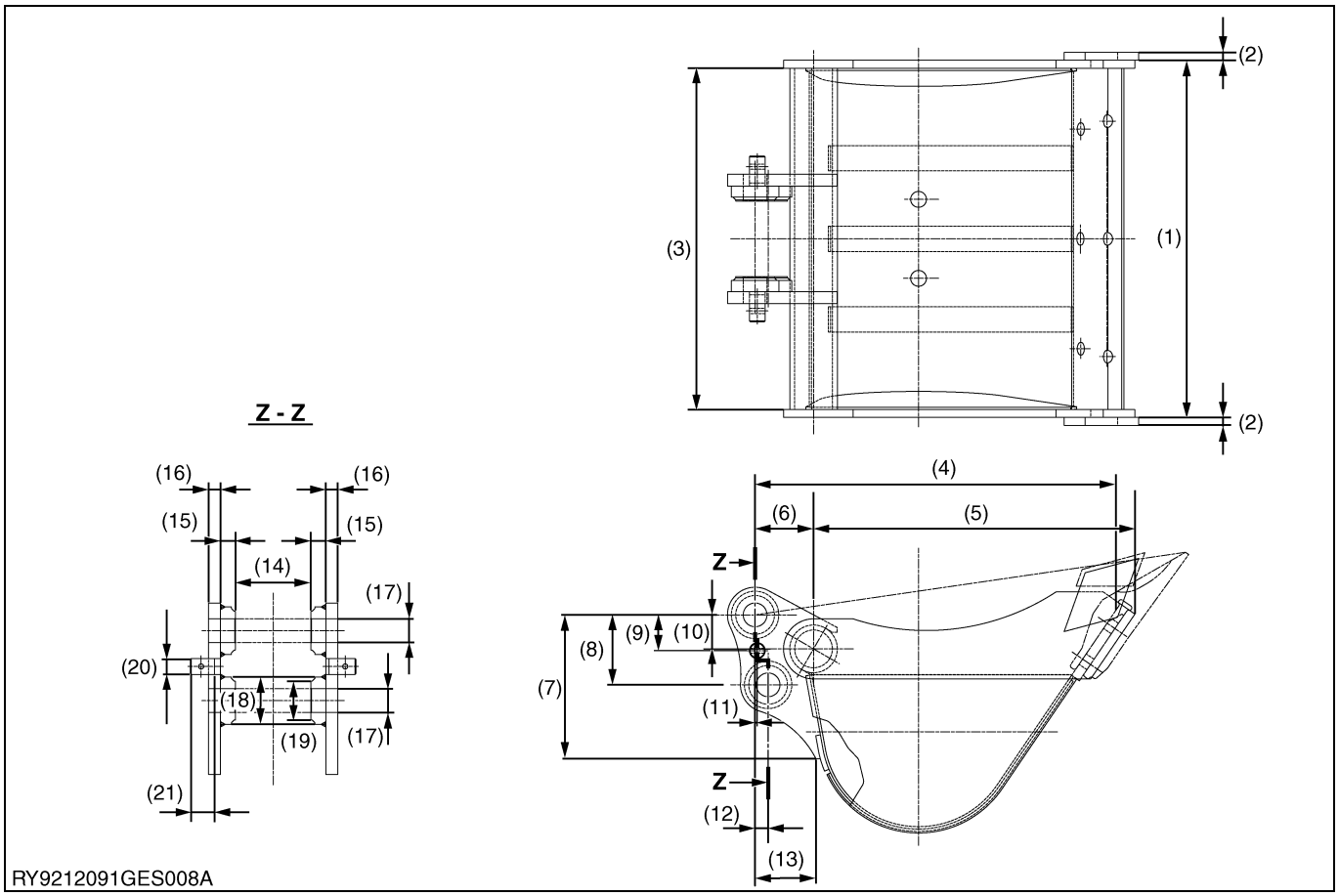
■ **IMPORTANT**

- **● : First operation**
- ***1 : When using a hydraulic breaker over 20 % → every 800 h (Hydraulic oil) / every 300 h (Return filter)**
  When using a hydraulic breaker over 40 % → every 400 h (Hydraulic oil) / every 300 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.**

RY9212091GEG0015US0

8. DESCRIPTION OF PARTS

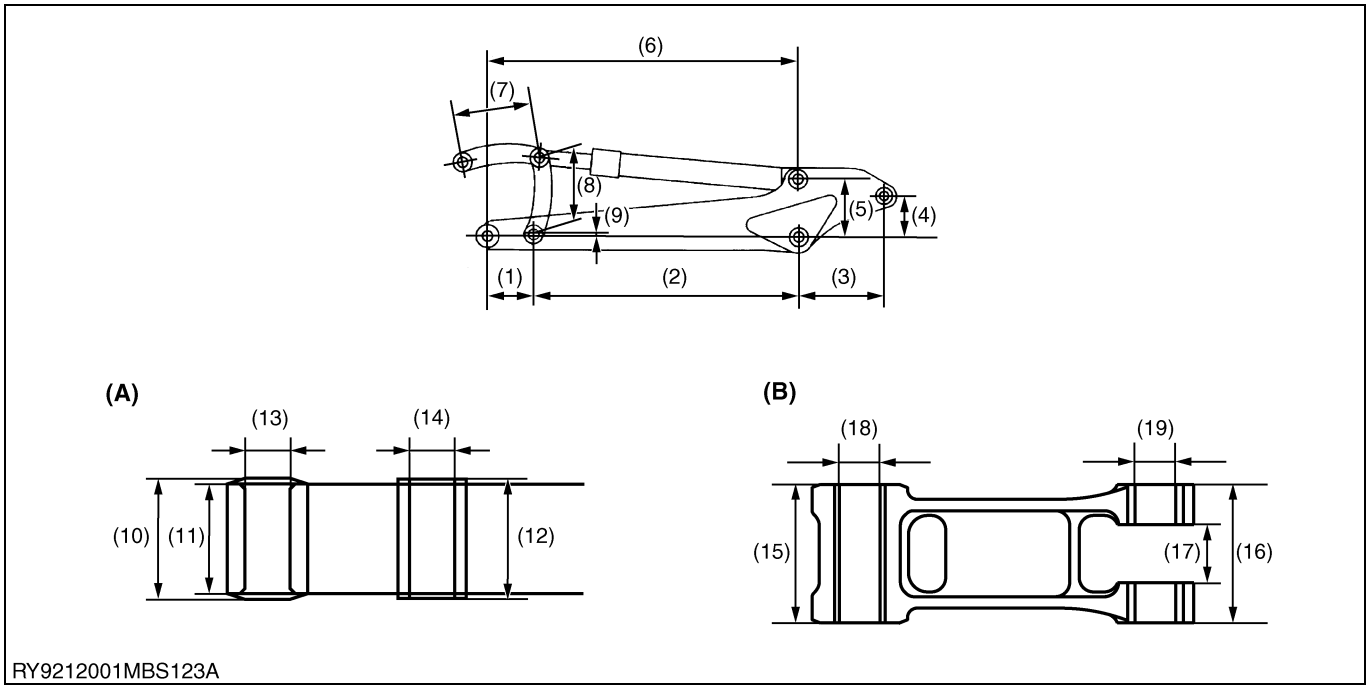
[1] BUCKET



No.		No.		No.		No.		No.	
(1)	452 mm 18 in.	(6)	74 mm 2.9 in.	(11)	2.8 mm 0.1 in.	(16)	15 mm 0.6 in.	(21)	34 mm 1.3 in.
(2)	10 mm 0.4 in.	(7)	182 mm 7.2 in.	(12)	16.5 mm 0.6 in.	(17)	ϕ30 mm ϕ1.2 in.		
(3)	432 mm 17 in.	(8)	88.5 mm 3.5 in.	(13)	77 mm 3.0 in.	(18)	ϕ60 mm ϕ2.4 in.		
(4)	457 mm 18 in.	(9)	45.3 mm 1.8 in.	(14)	95.5 mm 3.8 in.	(19)	ϕ49 mm ϕ1.9 in.		
(5)	407 mm 16 in.	(10)	43 mm 1.7 in.	(15)	19 mm 0.7 in.	(20)	ϕ20 mm ϕ0.8 in.		

RY9212095GEG0001US0

[2] BUCKET INSTALLATION RELEVANT DIMENSIONS



RY9212001MBS123A

(A) Arm tip **(B) Bucket, link 1**

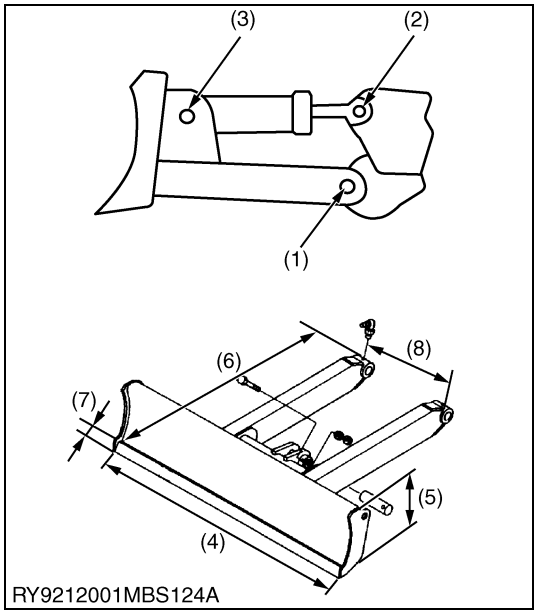
No.	KX018-4	KX019-4	No.	KX018-4	KX019-4	No.	KX018-4	KX019-4	No.	KX018-4	KX019-4
(1)	83 mm 3.3 in.		(6)	759 mm 29.9 in.		(11)	92 mm 3.6 in.		(16)	125.5 mm 4.94 in.	
(2)	1007 mm 39.65 in.	(STD) 1107 mm 43.58 in. (SF) 1007 mm 39.65 in.	(7)	183 mm 7.20 in.		(12)	125.5 mm 4.94 in.		(17)	45.5 mm 1.79 in.	
(3)	170 mm 6.69 in.		(8)	180 mm 7.09 in.		(13)	ϕ38 mm 1.5 in.		(18)	ϕ38 mm 1.5 in.	
(4)	123.5 mm 4.86 in.		(9)	5 mm 0.2 in.		(14)	ϕ38 mm 1.5 in.		(19)	ϕ38 mm 1.5 in.	
(5)	180 mm 7.09 in.		(10)	95.5 mm 3.76 in.		(15)	95.5 mm 3.76 in.				

■ **NOTE**

- **STD: Standard, SF: Short Front**

RY9212095GEG0002US0

[3] BLADE

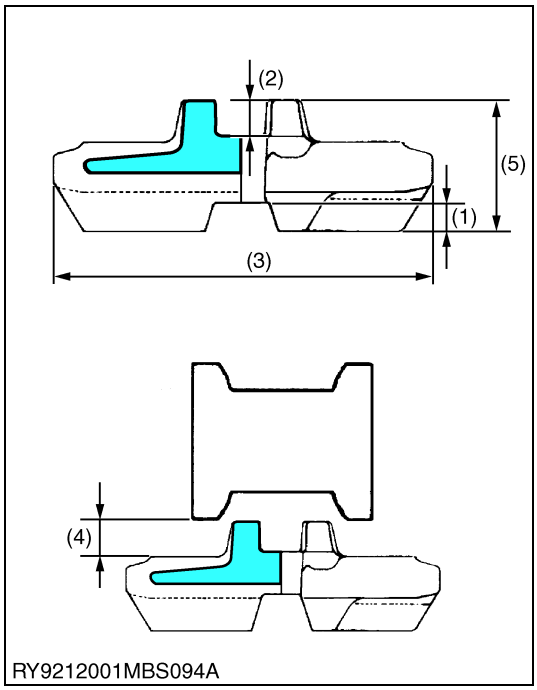


RY9212001MBS124A

	KX018-4	KX019-4	Remarks
(1) Pin diameter × length	ϕ30 x 92.5 mm ϕ1.2 x 3.6 in.		
(2) Pin diameter × length	ϕ30 x 75 mm ϕ1.2 x 3.0 in.		
(3) Pin diameter × length	ϕ30 x 75 mm ϕ1.2 x 3.0 in.		
(4) Blade width	990 / 1300 mm 39.0 / 51.2 in.		shorten / extend
(5) Blade height	221 mm 8.7 in.		
(6) Blade length	712 mm 28.0 in.		
(7) Blade tip plate height × thickness	50 × t10 mm 2.0 × t0.39 in.		
(8) Length between blade arms	424 mm 16.7 in.		

RY9212095GEG0003US0

[4] RUBBER CRAWLER

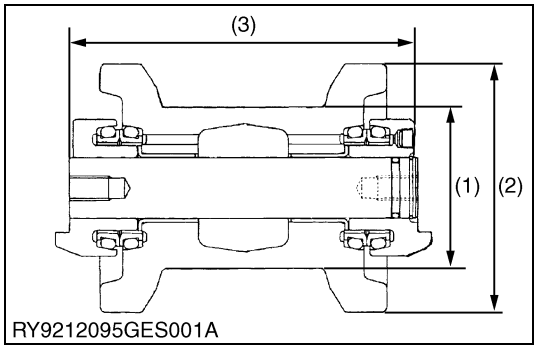


RY9212001MBS094A

Identification mark (Steel cord lapping position)	∞
(1) Lug height	23 mm 0.91 in.
(2) Link height	15.5 mm 0.61 in.
(3) Crawler width	230 mm 9.06 in.
(4) Crawler sag distance	10 to 15 mm 0.39 to 0.59 in.
(5) Crawler height	65 mm 2.6 in.
Number of core metal	70
Circumference	3360 mm 132.3 in.
Core metal pitch	48 mm 1.9 in.

RY9212095GEG0004US0

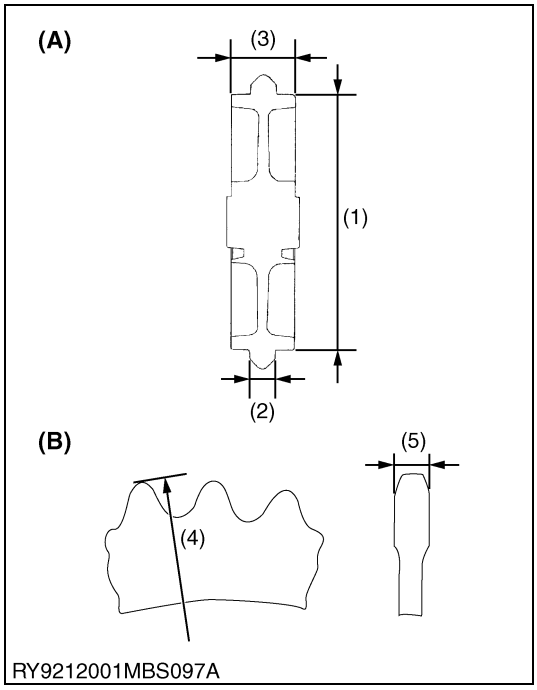
[5] TRUCK ROLLER, IDLER, SPROCKET



RY9212095GES001A

		Remarks
(1) Guide diameter	ϕ73 mm ϕ2.9 in.	
(2) Outer diameter	ϕ117 mm ϕ4.61 in.	
(3) Roller width	135 mm 5.31 in.	

RY9212095GEG0005US0



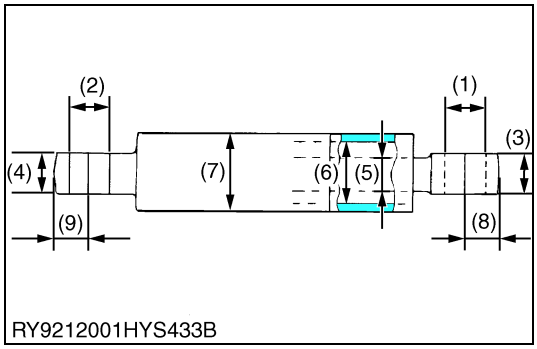
RY9212001MBS097A

		Remarks
(1) Idler O.D.	ϕ222 mm ϕ8.74 in.	
(2) Guide width	ϕ28.1 mm ϕ1.11 in.	
(3) Idler width	61 mm 2.4 in.	
(4) Sprocket wheel O.D.	ϕ286 mm ϕ11.3 in.	
(5) Sprocket wheel width	22 mm 0.87 in.	

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

RY9212095GEG0006US0

[6] CYLINDER

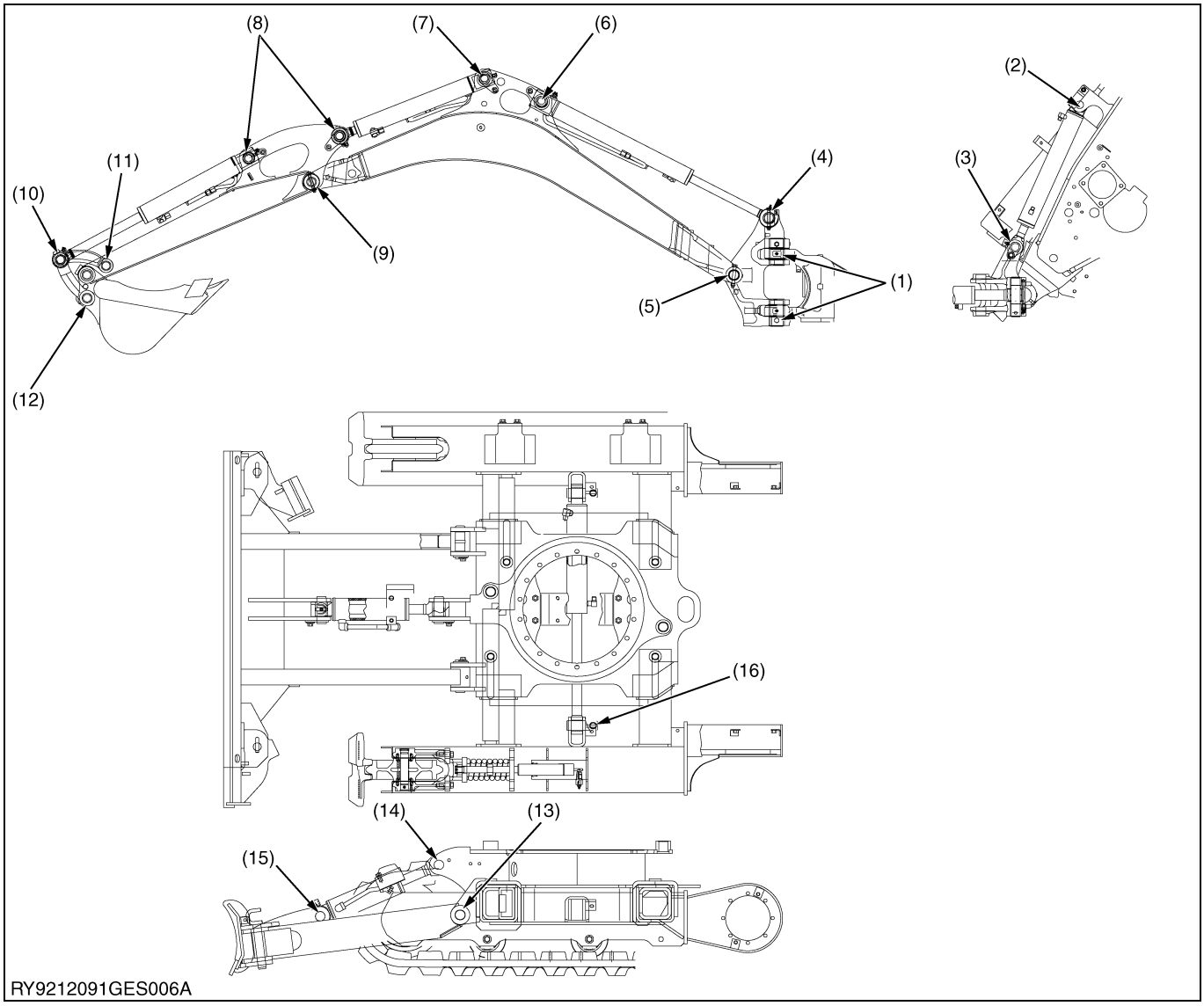


RY9212001HYS433B

	KX018-4, KX019-4					
	Boom	**Arm**	**Bucket**	**Swing**	**Blade**	**Track**
(1)	35 mm 1.4 in.	30 mm 1.2 in.	30 mm 1.2 in.	30 mm 1.2 in.	30 mm 1.2 in.	30 mm 1.2 in.
(2)	35 mm 1.4 in.	30 mm 1.2 in.	30 mm 1.2 in.	30 mm 1.2 in.	30 mm 1.2 in.	30 mm 1.2 in.
(3)	45 mm 1.8 in.	45 mm 1.8 in.	45 mm 1.8 in.	35.5 mm 1.4 in.	44.8 mm 1.8 in.	34.8 mm 1.4 in.
(4)	45 mm 1.8 in.	45 mm 1.8 in.	45 mm 1.8 in.	34.8 mm 1.4 in.	44.8 mm 1.8 in.	34.8 mm 1.4 in.
(5)	30 mm 1.2 in.	35 mm 1.4 in.	35 mm 1.4 in.	30 mm 1.2 in.	30 mm 1.2 in.	30 mm 1.2 in.
(6)	60 mm 2.4 in.	60 mm 2.4 in.	60 mm 2.4 in.	55 mm 2.2 in.	65 mm 2.6 in.	60 mm 2.4 in.
(7)	70 mm 2.8 in.	70 mm 2.8 in.	70 mm 2.8 in.	65 mm 2.6 in.	75 mm 3.0 in.	70 mm 2.8 in.
(8)	37.5 mm 1.5 in.	32.5 mm 1.3 in.	34.5 mm 1.4 in.	30 mm 1.2 in.	32.5 mm 1.3 in.	30 mm 1.2 in.
(9)	37.5 mm 1.5 in.	35 mm 1.4 in.	35 mm 1.4 in.	32.5 mm 1.3 in.	30 mm 1.2 in.	30 mm 1.2 in.
Max. Compressed length	765 mm 30.1 in.	609 mm 24.0 in.	545 mm 21.5 in.	625 mm 24.6 in.	348 mm 13.7 in.	528 mm 20.8 in.
Stroke	469 mm 18.5 in.	362 mm 14.3 in.	291 mm 11.5 in.	355 mm 14.0 in.	111 mm 4.4 in.	310 mm 12.2 in.

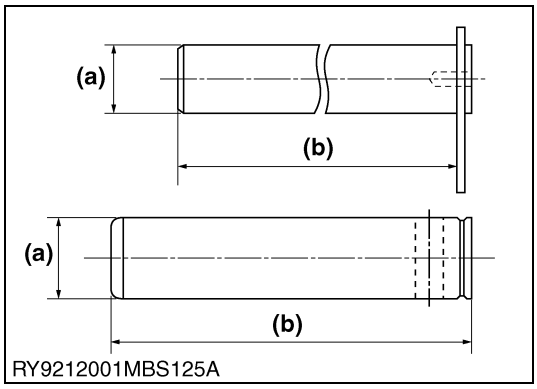
RY9212095GEG0007US0

[7] DIAGRAM AND LIST OF FRONT PINS



RY9212091GES006A

(To be continued)



RY9212001MBS125A

(Continued)

No.	Item	Qty	
(1)	Pin Diameter and Length	2	ϕ50 × 109 mm ϕ2.0 × 4.3 in.
(2)	Pin Diameter and Length	1	ϕ30 × 118 mm ϕ1.2 × 4.6 in.
(3)	Pin Diameter and Length	1	ϕ30 × 86.5 mm ϕ1.2 × 3.4 in.
(4)	Pin Diameter and Length	1	ϕ35 × 160 mm ϕ1.4 × 6.3 in.
(5)	Pin Diameter and Length	1	ϕ35 × 257 mm ϕ1.4 × 10.1 in.
(6)	Pin Diameter and Length	1	ϕ35 × 144 mm ϕ1.4 × 5.7 in.
(7)	Pin Diameter and Length	1	ϕ35 × 144 mm ϕ1.4 × 5.7 in.
(8)	Pin Diameter and Length	2	ϕ30 × 103 mm ϕ1.2 × 4.1 in.
(9)	Pin Diameter and Length	1	ϕ30 × 191 mm ϕ1.2 × 7.5 in.
(10)	Pin Diameter and Length	1	ϕ30 × 176.5 mm ϕ1.2 × 6.9 in.
(11)	Pin Diameter and Length	1	ϕ30 × 176.5 mm ϕ1.2 × 6.9 in.
(12)	Pin Diameter and Length	2	ϕ30 × 169 mm ϕ1.2 × 6.7 in.
(13)	Pin Diameter and Length	2	ϕ30 × 92.5 mm ϕ1.2 × 3.6 in.
(14)	Pin Diameter and Length	1	ϕ30 × 75 mm ϕ1.2 × 3.0 in.
(15)	Pin Diameter and Length	1	ϕ30 × 75 mm ϕ1.2 × 3.0 in.
(16)	Pin Diameter and Length	2	ϕ30 × 95 mm ϕ1.2 × 3.7 in.

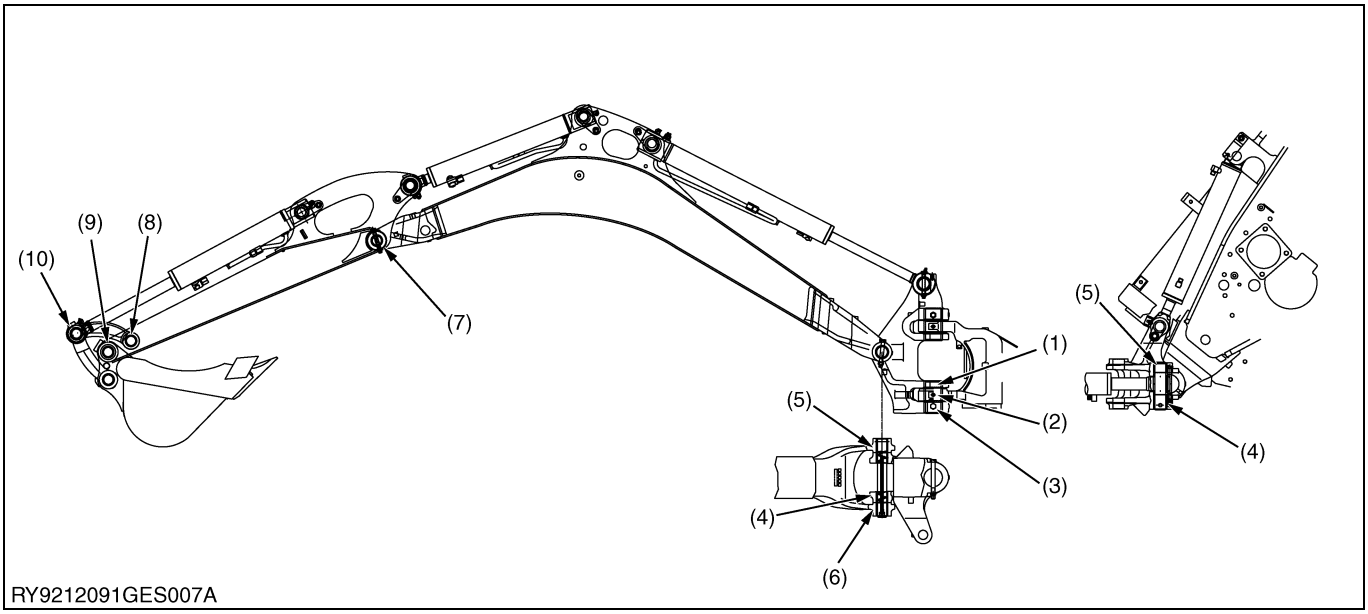
■ **NOTE**

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

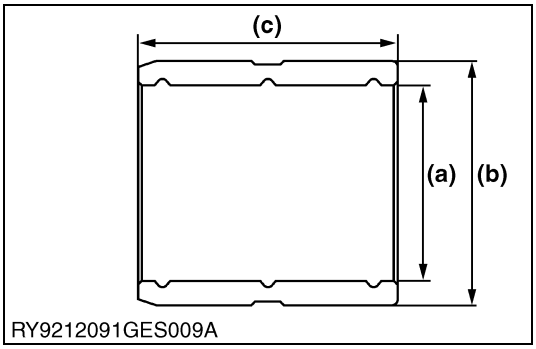
(a) Pin Diameter **(b) Pin Length**

RY9212091GEG0009US0

[8] LIST OF FRONT BUSHING DIMENSIONS



RY9212091GES007A



RY9212091GES009A

No.	Item	Qty		Material Quality
(1)	I.D. x O.D. x Length	2	ϕ50 × 60 × 37 mm ϕ2.0 × 2.4 × 1.5 in.	S43C or S45C
(2)	I.D. x O.D. x Length	2	ϕ50 × 60 × 40 mm ϕ2.0 × 2.4 × 1.6 in.	STKM16A or S43C
(3)	I.D. x O.D. x Length	2	ϕ50 × 60 × 28 mm ϕ2.0 × 2.4 × 1.1 in.	S43C or S45C
(4)	I.D. x O.D. x Length	2	ϕ35 × 43 × 48 mm ϕ1.4 × 1.7 × 1.9 in.	S43C or S45C
(5)	I.D. x O.D. x Length	2	ϕ35 × 43 × 32 mm ϕ1.4 × 1.7 × 1.3 in.	S43C or S45C
(6)	I.D. x O.D. x Length	1	ϕ35 × 43 × 44 mm ϕ1.4 × 1.7 × 1.7 in.	
(7)	I.D. x O.D. x Length	2	ϕ30 × 38 × 35 mm ϕ1.2 × 1.5 × 1.4 in.	STKM16A or S43C
(8)	I.D. x O.D. x Length	2	ϕ30 × 38 × 35 mm ϕ1.2 × 1.5 × 1.4 in.	CK45
(9)	I.D. x O.D. x Length	2	ϕ30 × 38 × 40 mm ϕ1.2 × 1.5 × 1.6 in.	CK45 or STKM16A
(10)	I.D. x O.D. x Length	2	ϕ30 × 38 × 40 mm ϕ1.2 × 1.5 × 1.6 in.	CK45 or STKM16A

■ **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.**

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

RY9212091GEG0011US0

9. WEIGHTS OF PARTS

	KX018-4	KX019-4		KX018-4	KX019-4
Track Frame (Center)	100.5 kg 221.6 lbs		Cabin	161 kg 354.9 lbs	
Track Frame (Left)	69.4 kg 153.0 lbs		Canopy	60 kg 132.3 lbs	
Track Frame (Right)	69.4 kg 153.0 lbs		Pump	14 kg 30.9 lbs	
Swivel Frame	182.1 kg 401.5 lbs		Travel Motor	18 kg 39.7 lbs	
Swing Bracket	19.5 kg 43.0 lbs		Swivel Motor	15 kg 33.1 lbs	
Boom	61.9 kg 136.5 lbs	(STD) 66.8 kg 147.3 lbs (SF) 61.9 kg 136.5 lbs	Sprocket	4.3 kg 9.5 lbs	
Arm	29.6 kg 65.3 lbs	(STD) 31.8 kg 70.1 lbs (SF) 29.6 kg 65.3 lbs	Front Idler, ASSY	18.8 kg 41.4 lbs	
Bucket	28.4 kg 62.6 lbs		Front Idler	9.3 kg 20.5 lbs	
Blade	53.4 kg 117.7 lbs		Control Valve	23.9 kg 52.7 lbs	23.9 kg 52.7 lbs
Weight	60 kg 132.3 lbs	90 kg 198.4 lbs	Boom Cylinder	14 kg 30.9 lbs	
Rubber Crawler	54.5 kg 120.1 lbs		Arm Cylinder	12 kg 26.5 lbs	
Arch	25.5 kg 56.2 lbs		Bucket Cylinder	10.7 kg 23.6 lbs	
Engine	72 kg 158.7 lbs		Swing Cylinder	10.5 kg 23.1 lbs	
Hydraulic Oil Tank	3.2 kg 7.1 lbs		Blade Cylinder	8.3 kg 18.3 lbs	
Fuel Tank	2.6 kg 5.7 lbs		Track Cylinder	9 kg 19.8 lbs	
Swivel Bearing	17 kg 37.5 lbs		Rotary Joint	12.7 kg 28.0 lbs	
Battery	12 kg 26.5 lbs		Right Pilot Valve	1.9 kg 4.2 lbs	2.0 kg 4.4 lbs
Track Roller	5.5 kg 12.1 lbs		Left Pilot Valve	1.9 kg 4.2 lbs	2.0 kg 4.4 lbs

The weights given above are calculated, so the weight of actual parts may vary slightly.

■ **NOTE**

- **STD: Standard, SF: Short Front**

RY9212095GEG0008US0

10. QUALITY SPECIFICATIONS

Item			Factory specification				The condition of measurement or remarks
			KX018-4		KX019-4		
			Std. value	Tolerance	Std. value	Tolerance	
[Principal spec.] JIS, A8404							
Dimensions		Transport length	3725 mm 146.7 in.	± 75 mm ± 3.0 in.	3859 mm 151.9 in.	± 77 mm ± 3.0 in.	
		Overall width	1000/1300 mm 39.4/51.2 in.	± 13 mm ± 0.5 in.	1000/1300 mm 39.4/51.2 in.	± 13 mm ± 0.5 in.	
		Overall height with canopy	2334 mm 91.9 in.	± 23 mm ± 0.9 in.	2334 mm 91.9 in.	± 23 mm ± 0.9 in.	On hard ground
		Overall height with cabin	2351 mm 92.6 in.	± 23 mm ± 0.9 in.	2351 mm 92.6 in.	± 23 mm ± 0.9 in.	On hard ground
Machine weight		Canopy	1620 kg 3571 lbs	± 32 kg ± 71 lbs	1680 kg 3704 lbs	± 34 kg ± 75 lbs	With 35 kg (77 lbs) standard bucket and fully served
		Cabin	1720 kg 3792 lbs	± 34 kg ± 75 lbs	1780 kg 3924 lbs	± 36 kg ± 79 lbs	
Operating weight		Canopy	1695 kg 3737 lbs	± 32 kg ± 71 lbs	1755 kg 3869 lbs	± 34 kg ± 75 lbs	With 75 kg (165 lbs) operator, 35 kg (77 lbs) standard bucket and fully served
		Cabin	1795 kg 3957 lbs	± 34 kg ± 75 lbs	1855 kg 4090 lbs	± 36 kg ± 79 lbs	
Perfor-mance	Swivelling speed		9.1 rpm	± 0.9 rpm	9.1 rpm	± 0.9 rpm	At engine rated speed, efficiency 100 %
	Travelling speed	Low, forward	2.2 km/h 1.37 mph	± 0.2 km/h ± 0.14 mph	2.2 km/h 1.37 mph	± 0.2 km/h ± 0.14 mph	In travelling on the level ground with travelling condition at engine rated speed, oil temperature : 50 ± 5 °C (122 ± 9 °F)
		High, forward	4.0 km/h 2.49 mph	± 0.4 km/h ± 0.25 mph	4.0 km/h 2.49 mph	± 0.4 km/h ± 0.25 mph	
		Low, backward	2.2 km/h 1.37 mph	± 0.2 km/h ± 0.14 mph	2.2 km/h 1.37 mph	± 0.2 km/h ± 0.14 mph	
		High, backward	4.0 km/h 2.49 mph	± 0.4 km/h ± 0.25 mph	4.0 km/h 2.49 mph	± 0.4 km/h ± 0.25 mph	
	Climbing ability		30 deg	More than	30 deg	More than	At engine rated speed, oil temperature : 50 ± 5 °C (122 ± 9 °F)
Undercarriage Dimensions		Min. swing radius	1070 mm 42.1 in.	± 22 mm ± 0.9 in.	1100 mm 43.3 in.	± 22 mm ± 0.9 in.	
		Clearance height under upper structure	420 mm 16.5 in.	± 8 mm ± 0.3 in.	420 mm 16.5 in.	± 8 mm ± 0.3 in.	On hard ground (reference to 3 mm (0.12 in.) contract by grabity)
		Tumbler center distance	1227 mm 48.3 in.	± 37 mm ± 1.5 in.	1227 mm 48.3 in.	± 37 mm ± 1.5 in.	
		Crawler total length	1579 mm 62.2 in.	± 47 mm ± 1.9 in.	1579 mm 62.2 in.	± 47 mm ± 1.9 in.	On hard ground
		Crawler total width	994/1294 mm 39.2/48.58 in.	± 26 mm ± 1.0 in.	994/1294 mm 39.2/48.58 in.	± 26 mm ± 1.0 in.	
		Track shoe width	230 mm 9.1 in.	± 5 mm ± 0.2 in.	230 mm 9.1 in.	± 5 mm ± 0.2 in.	
		Ground clearance of under carriage	147 mm 5.8 in.	± 4 mm ± 0.2 in.	147 mm 5.8 in.	± 4 mm ± 0.2 in.	On hard ground (reference to 3 mm (0.12 in.) contract by grabity, with cover of bottom)

Item			Factory specification				The condition of measurement or remarks
			KX018-4		KX019-4		
			Std. value	Tolerance	Std. value	Tolerance	
Engine	Model name	D902-BH-2	–	–	–	–	
	Engine output, ISO 9249		11.8 kW	± 0.3 kW	11.8 kW	± 0.3 kW	
	Rated speed		2300 rpm	–	2300 rpm	–	
	Displacement		898 cc	–	898 cc	–	
Hydraulic pumps	Kind & Q'ty of pumps		Variable displacement pump × 2 + gear pump × 2	–	Variable displacement pump × 2 + gear pump × 2	–	
	Flow rate		17.3 × 2 10.4, 6.2 L/min	–	17.3 × 2 10.4, 6.2 L/min	–	
	Hydraulic pressure	P1, P2	230 kgf/cm^2 22.6 MPa 226 bar 3280 psi	+10, -5 kgf/cm^2 +1, -0.5 MPa +10, -5 bar +100, -70 psi	230 kgf/cm^2 22.6 MPa 226 bar 3280 psi	+10, -5 kgf/cm^2 +1, -0.5 MPa +10, -5 bar +100, -70 psi	At measuring point on the machine
		P3	220 kgf/cm^2 21.6 MPa 216 bar 3130 psi	+10, -5 kgf/cm^2 +1, -0.5 MPa +10, -5 bar +100, -70 psi	220 kgf/cm^2 21.6 MPa 216 bar 3130 psi	+10, -5 kgf/cm^2 +1, -0.5 MPa +10, -5 bar +100, -70 psi	
		P4	49 kgf/cm^2 4.8 MPa 48 bar 700 psi	+2, -3 kgf/cm^2 +0.2, -0.3 MPa +2, -3 bar +30, -40 psi	49 kgf/cm^2 4.8 MPa 48 bar 700 psi	+2, -3 kgf/cm^2 +0.2, -0.3 MPa +2, -3 bar +30, -40 psi	

Item			Factory specification				The condition of measurement or remarks
			KX018-4		KX019-4		
			Std. value	Tolerance	Std. value	Tolerance	
Front dimensions	Bucket capacity	CECE, Heapted	0.040 m^3 0.052 yd^3	± 0.002 m^3 ± 0.002 yd^3	0.040 m^3 0.052 yd^3	± 0.002 m^3 ± 0.002 yd^3	With bucket recommended by kubota with japanese standard bucket
		SAE, Heapted	0.040 m^3 0.052 yd^3	± 0.002 m^3 ± 0.002 yd^3	0.040 m^3 0.052 yd^3	± 0.002 m^3 ± 0.002 yd^3	
	Bucket width		450 mm 17.7 in.	± 10 mm ± 0.4 in.	450 mm 17.7 in.	± 10 mm ± 0.4 in.	Kubota's recommended bucket without side-cutter
	Boom swing angle	Left	75 deg	± 2.0 deg	75 deg	± 2.0 deg	
		Right	59 deg	± 2.0 deg	59 deg	± 2.0 deg	
	Max. reach		3918 mm 154.3 in.	± 59 mm ± 2.3 in.	4120 mm 162.2 in.	± 60 mm ± 2.4 in.	At boom swing 0 angle
	Max. reach at ground reference plane		3860 mm 152.0 in.	± 58 mm ± 2.3 in.	4065 mm 160.0 in.	± 60 mm ± 2.4 in.	At boom swing 0 angle
	Min. level floor radius		1238 mm 48.7 in.	± 23 mm ± 0.9 in.	1182 mm 46.5 in.	± 25 mm ± 1.0 in.	At boom swing 0 angle with level posture of bucket
	Max. digging depth		2384 mm 93.9 in.	± 48 mm ± 2.0 in.	2575 mm 101.4 in.	± 50 mm ± 2.0 in.	
	Max. vertical digging depth		2016 mm 79.4 in.	± 40 mm ± 1.6 in.	2142 mm 84.3 in.	± 43 mm ± 1.7 in.	
	Max. height of cutting edge		3456 mm 136.1 in.	± 69 mm ± 2.7 in.	3623 mm 142.6 in.	± 71 mm ± 2.8 in.	
	Max. dumping height		2380 mm 93.7 in.	± 48 mm ± 1.9 in.	2558 mm 100.7 in.	± 50 mm ± 2.0 in.	
	Min. radius of equipment and attachment		1473 mm 58.0 in.	± 44 mm ± 1.7 in.	1523 mm 60.0 in.	± 45 mm ± 1.8 in.	
	Min. radius of equipment and attachment (at left swing end)		1127 mm 44.4 in.	± 34 mm ± 1.3 in.	1145 mm 45.1 in.	± 34 mm ± 1.3 in.	
	Offset distance of bucket	Right	447 mm 17.6 in.	± 12 mm ± 0.5 in.	447 mm 17.6 in.	± 12 mm ± 0.5 in.	From boom swing pivot
		Left	551 mm 20.1 in.	± 16 mm ± 0.6 in.	511 mm 20.1 in.	± 16 mm ± 0.6 in.	From boom swing pivot
Blade dimension	Blade size	Width	990/1300 mm 39/51.2 in.	± 5 mm ± 0.2 in.	990/1300 mm 39/51.2 in.	± 5 mm ± 0.2 in.	
		Height	226 mm 8.9 in.	± 5 mm ± 0.2 in.	226 mm 8.9 in.	± 5 mm ± 0.2 in.	
	Blade max. lifting		249 mm 9.8 in.	± 12 mm ± 0.5 in.	242 mm 9.5 in.	± 12 mm ± 0.5 in.	
	Blade max. lowering		218 mm 8.6 in.	± 11 mm ± 0.4 in.	214 mm 8.4 in.	± 11 mm ± 0.4 in.	
Volume of the fuel reservoir			21.5 L	± 1.1 L	21.5 L	± 1.1 L	
Volume of hydraulic reservoir			20.8 L	± 1.0 L	20.8 L	± 1.0 L	Machine 24 L, hydraulic oil tank 15 L
[Dimensions]							
Play of front at bucket			73 mm 2.9 in.	93 mm less than 3.7 in. less than	73 mm 2.9 in.	93 mm less than 3.7 in. less than	Under pressing force : 30 kgf (66 lbf)
Quantity of front inclination			0 mm 0.0 in.	10 mm less than 0.4 in. less than	0 mm 0.0 in.	10 mm less than 0.4 in. less than	

Item		Factory specification				The condition of measurement or remarks
		KX018-4		KX019-4		
		Std. value	Tolerance	Std. value	Tolerance	
Blade inclination on level		0 mm 0.0 in.	10 mm less than 0.4 in. less than	0 mm 0.0 in.	10 mm less than 0.4 in. less than	
Min. clearancer of boom and bucket teeth		57 mm 2.2 in.	± 6 mm ± 0.2 in.	81 mm 3.2 in.	± 8 mm ± 0.3 in.	
Approach angle		27.0 deg	± 2.7 deg	27.0 deg	± 2.7 deg	
Crawler tracks height		349 mm 13.7 in.	± 7 mm ± 0.3 in.	349 mm 13.7 in.	± 7 mm ± 0.3 in.	On hard ground
Maxi. crawler tracks height		349 mm 13.7 in.	± 7 mm ± 0.3 in.	349 mm 13.7 in.	± 7 mm ± 0.3 in.	On hard ground
[Engine performance]						
Max. engine speed without load		2600 rpm	Less than	2600 rpm	Less than	
Max. engine speed without load	at P1 relief	–	More than	–	More than	
	at P1 + P2 relief	2300 rpm	More than	2300 rpm	More than	Arm cylinder + bucket cylinder
	at P1 + P2 + P3 relief	2300 rpm	More than	2300 rpm	More than	Arm cylinder + bucket cylinder + blade cylinder
Idling engine speed		1350 rpm	± 50 rpm	1350 rpm	± 50 rpm	
[Under carriage performance]						
Travel motor break at slope	Left	300 mm 11.8 in.	Less than	300 mm 11.8 in.	Less than	Static at slope 20 ° inclination, during 10 minute
	Right	300 mm 11.8 in.	Less than	300 mm 11.8 in.	Less than	Static at slope 20 ° inclination, during 10 minute
Max. tractive force	L, forward	1448 kgf 14.2 kN 3192 lbf	± 143 kgf ± 1.4 kN ± 7279 lbf	1448 kgf 14.2 kN 3192 lbf	± 143 kgf ± 1.4 kN ± 7279 lbf	Slip at more than 65% of the theretical torque, oil temp 50 °C
	H, forward	724 kgf 7.1 kN 1596 lbf	± 71 kgf ± 0.7 kN ± 0 lbf	724 kgf 7.1 kN 1596 lbf	± 71 kgf ± 0.7 kN ± 0 lbf	
Gap in straight travelling	Low, forward	600 mm 23.6 in.	Less than	600 mm 23.6 in.	Less than	Travelling 10 m (394 in.) at engine rated speed, oil temperature : 50 ± 5 °C (122 ± 9 °F)
	High, forward	600 mm 23.6 in.	Less than	600 mm 23.6 in.	Less than	
	Low, forward with blade	600 mm 23.6 in.	Less than	600 mm 23.6 in.	Less than	Travelling 10 m (394 in.) with blade lift-lower at engine rated speed, oil temperature : 50 ± 5 °C (122 ± 9 °F)
	Low, backward with blade	600 mm 23.6 in.	Less than	600 mm 23.6 in.	Less than	
Travel motor drain amount	During rotation	0.5 L/min 30.5 cu.in.	Less than	0.5 L/min 30.5 cu.in.	Less than	1F / 2F
	When blocked	5.0 L/min 305 cu.in.	Less than	5.0 L/min 305 cu.in.	Less than	
Adjustment sag in crawler tension		10 to 15 mm 0.40 to 0.59 in.	–	10 to 15 mm 0.40 to 0.59 in.	–	Rubber crawler

Item		Factory specification				The condition of measurement or remarks
		KX018-4		KX019-4		
		Std. value	Tolerance	Std. value	Tolerance	
[Front performance]						
Max. digging force, arm		846 kgf 8.3 kN 1866 lbf	– 5 % more than	795 kgf 7.8 kN 1754 lbf	– 5 % more than	At teeth root [arm cylinder length : 758 mm (29.8 in.)]
Max. digging force, bucket		1621 kgf 15.9 kN 3574 lbf	– 5 % more than	1621 kgf 15.9 kN 3574 lbf	– 5 % more than	At teeth root [bucket cylinder length : 630 mm (24.8 in.)]
Boom speed	Up (Ground to max. up)	2.0 s	± 0.3 s	2.0 s	± 0.3 s	Arm extend. Bucket dump with no load. oil temperature : 50 ± 5 °C (122 ± 9 °F) exclude cution
	Down (max. up to Ground)	2.7 s	± 0.3 s	2.7 s	± 0.3 s	Cylinder full stroke, oil temperature : 50 ± 5 °C (122 ± 9 °F)
Arm speed	Crowd	3.4 s	± 0.3 s	3.4 s	± 0.3 s	Cylinder full stroke, oil temperature : 50 ± 5 °C (122 ± 9 °F)
	Dump	2.4 s	± 0.3 s	2.4 s	± 0.3 s	Cylinder full stroke, oil temperature : 50 ± 5 °C (122 ± 9 °F)
Bucket speed	Crowd	2.7 s	± 0.3 s	2.7 s	± 0.3 s	Cylinder full stroke, oil temperature : 50 ± 5 °C (122 ± 9 °F)
	Dump	2.0 s	± 0.3 s	2.0 s	± 0.3 s	Cylinder full stroke, oil temperature : 50 ± 5 °C (122 ± 9 °F)
Blade speed	Up	1.5 s	± 0.3 s	1.5 s	± 0.3 s	Cylinder full stroke oil temperature : 50 ± 5 °C (122 ± 9 °F)
	Down	2.0 s	± 0.3 s	2.0 s	± 0.3 s	Cylinder full stroke oil temperature : 50 ± 5 °C (122 ± 9 °F)
Variable Track Speed	Expand	5.0 s	± 0.3 s	5.0 s	± 0.3 s	Cylinder full stroke, oil temperature : 50 ± 5 °C (122 ± 9 °F)
	Retract	3.8s	± 0.3 s	3.8 s	± 0.3 s	Cylinder full stroke, oil temperature : 50 ± 5 °C (122 ± 9 °F)
Arm cylinder cavitation		5 mm 0.2 in.	Less than	5 mm 0.2 in.	Less than	At engine idling speed, oil temperature : 95 ± 5 °C (203 ± 9 °F) with heaped bucket capacity
Reach at max. height		2191 mm 86.3 in.	± 219 mm ± 8.6 in.	2231 mm 87.8 in.	± 223 mm ± 8.8 in.	
Reach at max. dumping height		1987 mm 78.2 in.	± 119 mm ± 4.7 in.	2019 mm 79.5 in.	± 121 mm ± 4.8 in.	At bucket pin

Item		Factory specification				The condition of measurement or remarks
		KX018-4		KX019-4		
		Std. value	Tolerance	Std. value	Tolerance	
Bucket bottom height at arm vertical		770 mm 30.3 in.	± 23 mm ± 0.9 in.	883 mm 34.8 in.	± 26 mm ± 1.0 in.	At level bucket profile
Bucket wrist angle		184.0 °	± 3 °	184.0 °	± 3 °	
[Swivel, Swing performance]						
Swivel torque	Left	254.9 kgf·m 2.5 kN·m 18082 ft·lbf	– 15 % more than	254.9 kgf·m 2.5 kN·m 18082 ft·lbf	More than 85 %	With max. reach at engine rated speed, oil temperature : 50 ± 5 °C (122 ± 9 °F)
	Right					
Max. angle of swivel motor at slope		25 deg	More than	25 deg	More than	With bucket load = JIS heaped Q'ty × density 1.8
Swivel motor break at slope		120 mm 4.7 in. (30 deg)	Less than	120 mm 4.7 in. (30 deg)	Less than	During 1 minute at slope inciniation 20 ° with above load
Swivel start-up speed		2.1 s	± 0.2 s	2.1 s	± 0.2 s	During 0 to 90 ° swivel at engine rated speed, oil temperature : 50 ± 5 °C (122 ± 9 °F)
Swivel motor drain amount	During rotation	0.1 L/min 6.1 cu.in.	–	0.1 L/min 6.1 cu.in.	–	Actual measured values may very with the machine
	When blocked	0.3 L/min 18 cu.in.	–	0.3 L/min 18 cu.in.	–	
Swing speed	Left	4.7 s	± 0.3 s	4.7 s	± 0.3 s	At engine rated speed, oil temperature : 50 ± 5 °C (122 ± 9 °F)
	Right	3.9 s	± 0.3 s	3.9 s	± 0.3 s	
Swing Lock	Left	6.0 mm 0.2 in.	Less than	6.0 mm 0.2 in.	Less than	Cylinder displacement during 0 to 90 ° swivel at engine rated speed, oil temperature : 50 ± 5 °C (122 ± 9 °F) after digging 100 times
	Right					
[Cylinder performance]						
Cylinder oil sealing capacity (New machine reference value)	Boom	15 mm 0.6 in.	Less than	15 mm 0.6 in.	Less than	Cylinder displacement during 10 minute at oil temperature : 50 ± 5 °C (122 ± 9 °F) with max. reach & bucket load = JIS heaped Q'ty × density1.8
	Arm	10 mm 0.4 in.	Less than	10 mm 0.4 in.	Less than	
	Bucket	4.0 mm 0.2 in.	Less than	4.0 mm 0.2 in.	Less than	
	Blade	13 mm 0.5 in.	Less than	13 mm 0.5 in.	Less than	
Cylinder oil sealing capacity (Allowable limit)	Boom	75 mm 3.0 in.	Less than	75 mm 3.0 in.	Less than	
	Arm	50 mm 2.0 in.	Less than	50 mm 2.0 in.	Less than	
	Bucket	20 mm 0.8 in.	Less than	20 mm 0.8 in.	Less than	
	Blade	26 mm 1.0 in.	Less than	26 mm 1.0 in.	Less than	

Item			Factory specification				The condition of measurement or remarks
			KX018-4		KX019-4		
			Std. value	Tolerance	Std. value	Tolerance	
Boom cushioning performance		30 °C (86 °F)	3 sec	Less than	3 sec	Less than	
		50 °C (122 °F)	0.5 to 1.5 sec	–	0.5 to 1.5 sec	–	
		80 °C (176 °F)	0.3 sec	More than	0.3 sec	More than	
Auxiliary flow rate			27.7 L/min	–	27.7 L/min	–	Without load and Max rpm
[Control lever load/stroke]							
Boom lever		Raise	0.98 kgf 9.6 N 2.2 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	1.15 kgf 11.3 N 2.5 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	Measurement under 20 mm (0.79 in.) from the grip tip
		Lower	0.98 kgf 9.6 N 2.2 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	1.20 kgf 11.8 N 2.7 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	Measurement under 20 mm (0.79 in.) from the grip tip
Arm lever		Crowd	0.98 kgf 9.6 N 2.2 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	1.15 kgf 11.3 N 2.5 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	Measurement under 20 mm (0.79 in.) from the grip tip
		Dump	0.98 kgf 9.6 N 2.2 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	1.20 kgf 11.8 N 2.7 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	Measurement under 20 mm (0.79 in.) from the grip tip
Bucket lever		Crowd	0.98 kgf 9.6 N 2.2 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	1.20 kgf 11.8 N 2.7 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	Measurement under 20 mm (0.79 in.) from the grip tip
		Dump					
Swivel lever		Right	0.98 kgf 9.6 N 2.2 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	0.95 kgf 9.3 N 2.1 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	Measurement under 20 mm (0.79 in.) from the grip tip
		Left					
Blade lever		Raise	2.65 kgf 26.0 N 5.8 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	2.65 kgf 26.0 N 5.8 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	Measurement under 20 mm (0.79 in.) from the grip tip
		Lower					
Travel lever	Left	Forward	1.84 kgf 18.0 N 4.1 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	1.84 kgf 18.0 N 4.1 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	Measurement under 20 mm (0.79 in.) from the grip tip
		Back					
	Right	Forward	1.84 kgf 18.0 N 4.1 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	1.84 kgf 18.0 N 4.1 lbf	± 0.5 kgf ± 4.9 N ± 1.1 lbf	Measurement under 20 mm (0.79 in.) from the grip tip
		Back					
Throttle lever		Raise	4.59 kgf 45.0 N 10.1 lbf	± 1.5 kgf ± 14.7 N ± 3.3 lbf	4.59 kgf 45.0 N 10.1 lbf	± 1.5 kgf ± 14.7 N ± 3.3 lbf	Measurement under 30 mm (1.2 in.) from the grip tip
		Lower					
Swing pedal		Left	6.12 kgf 60.0 N 13.5 lbf	± 0.68 kgf ± 6.7 N ± 1.5 lbf	6.12 kgf 60.0 N 13.5 lbf	± 0.68 kgf ± 6.7 N ± 1.5 lbf	Measurement at the end of pedal
		Right					
Safety lock lever		Up	2.75 kgf 27 N 6.1 lbf	± 1.0 kgf ± 9.8 N ± 2.2 lbf	2.75 kgf 27 N 6.1 lbf	± 1.0 kgf ± 9.8 N ± 2.2 lbf	Measurement under 20 mm (0.79 in.) from the grip tip
		Down	6.93 kgf 68 N 15.3 lbf	± 1.0 kgf ± 9.8 N ± 2.2 lbf	6.93 kgf 68 N 15.3 lbf	± 1.0 kgf ± 9.8 N ± 2.2 lbf	Measurement under 20 mm (0.79 in.) from the grip tip
Track lever		Up	6.12 kgf 60.0 N 13.5 lbf	± 1.02 kgf ± 10.0 N ± 2.2 lbf	6.12 kgf 60.0 N 13.5 lbf	± 1.02 kgf ± 10.0 N ± 2.2 lbf	Measurement under 20 mm (0.79 in.) from the grip tip
		Down					
Auxilliary port pedal		Left	6.12 kgf 60.0 N 13.5 lbf	± 0.68 kgf ± 6.7 N ± 1.5 lbf	–	–	Measurement at the end of pedal
		Right					
Boom lever		Raise	72 mm 2.8 in.	± 10 mm ± 0.4 in.	84 mm 3.3 in.	± 10 mm ± 0.4 in.	Measurement at the grip tip
		Lower					
Arm lever		Crowd	72 mm 2.8 in.	± 10 mm ± 0.4 in.	84 mm 3.3 in.	± 10 mm ± 0.4 in.	Measurement at the grip tip
		Dump					

Item			Factory specification				The condition of measurement or remarks
			KX018-4		KX019-4		
			Std. value	Tolerance	Std. value	Tolerance	
Bucket lever		Crowd	72 mm 2.8 in.	± 10 mm ± 0.4 in.	74 mm 2.9 in.	± 10 mm ± 0.4 in.	Measurement at the grip tip
		Dump					
Swivel lever		Left	72 mm 2.8 in.	± 10 mm ± 0.4 in.	74 mm 2.9 in.	± 10 mm ± 0.4 in.	Measurement at the grip tip
		Right					
Blade lever		Raise	88 mm 3.5 in.	± 10 mm ± 0.4 in.	88 mm 3.5 in.	± 10 mm ± 0.4 in.	Measurement at the grip tip
		Lower					
Travel lever	Left	Forward	81 mm 3.2 in.	± 10 mm ± 0.4 in.	81 mm 3.2 in.	± 10 mm ± 0.4 in.	Measurement at the grip tip
		Back	83 mm 3.3 in.	± 10 mm ± 0.4 in.	83 mm 3.3 in.	± 10 mm ± 0.4 in.	Measurement at the grip tip
	Right	Forward	81 mm 3.2 in.	± 10 mm ± 0.4 in.	81 mm 3.2 in.	± 10 mm ± 0.4 in.	Measurement at the grip tip
		Back	83 mm 3.3 in.	± 10 mm ± 0.4 in.	83 mm 3.3 in.	± 10 mm ± 0.4 in.	Measurement at the grip tip
Swing pedal		Right	16 mm 0.6 in.	± 10 mm ± 0.4 in.	16 mm 0.6 in.	± 10 mm ± 0.4 in.	Measurement at the end of pedal
		Left					
Track lever		Extend	32 mm 1.3 in.	± 10 mm ± 0.4 in.	32 mm 1.3 in.	± 10 mm ± 0.4 in.	Measurement at the grip tip
		Shorten					
Auxilliary port pedal		Right	16 mm 0.6 in.	± 10 mm ± 0.4 in.	–	–	Measurement at the end of pedal
		Left					

Spec. shows with rubber crawler,std.arm,bucket recommended by KUBOTA

RY9212095GEG0011US0

KX019-4SF

Item		Factory specification		The condition of measurement or remarks
		Std. value	Tolerance	
[Principal spec.] JIS, A8404				
Dimensions	Transport length	3755 mm 147.8 in.	± 75 mm ± 3.0 in.	
Machine weight	Canopy	1675 kg 3693 lbs	± 32 kg ± 71 lbs	With 35 kg (77 lbs) standard bucket and fully served
	Cabin	1775 kg 3913 lbs	± 34 kg ± 74 lbs	
Operating weight	Canopy	1750 kg 3858 lbs	± 34 kg ± 74 lbs	With 75 kg (165 lbs) operator, 35 kg (77 lbs) standard bucket and fully served
	Cabin	1850 kg 4079 lbs	± 36 kg ± 78 lbs	
Front dimensions	Max. reach	3918 mm 154.3 in.	± 59 mm ± 2.3 in.	At boom swing 0 angle
	Max. reach at ground reference plane	3860 mm 152.0 in.	± 58 mm ± 2.3 in.	At boom swing 0 angle
	Min. level floor radius	1238 mm 48.7 in.	± 23 mm ± 0.9 in.	At boom swing 0 angle with level posture of bucket
	Max. digging depth	2384 mm 93.9 in.	± 48 mm ± 2.0 in.	
	Max. vertical digging depth	2016 mm 79.4 in.	± 40 mm ± 1.6 in.	
	Max. height of cutting edge	3456 mm 136.1 in.	± 69 mm ± 2.7 in.	
	Max. dumping height	2380 mm 93.7 in.	± 48 mm ± 1.9 in.	
	Min. radius of equipment and attachment	1473 mm 58.0 in.	± 44 mm ± 1.7 in.	
	Min. radius of equipment and attachment (at left swing end)	1127 mm 44.4 in.	± 34 mm ± 1.3 in.	
[Front performance]				
Max. digging force, arm		846 kgf 8.3 kN 1866 lbf	– 5 % more than	At teeth root [arm cylinder length: 758 mm (29.8 in.)]
Reach at max. height		2191 mm 86.3 in.	± 219 mm ± 8.6 in.	
Reach at max. dumping height		1987 mm 78.2 in.	± 119 mm ± 4.7 in.	At bucket pin
Bucket bottom height at arm vertical		770 mm 30.3 in.	± 23 mm ± 0.9 in.	At level bucket profile

■ **NOTE**

- **Only about the changed points from KX019-4 to KX019-4SF.**

RY9212095GEG0012US0

1 MACHINE BODY

SERVICING

CONTENTS

1. FRONT EQUIPMENT

[1] BUCKET INSTALLATION AND REMOVAL

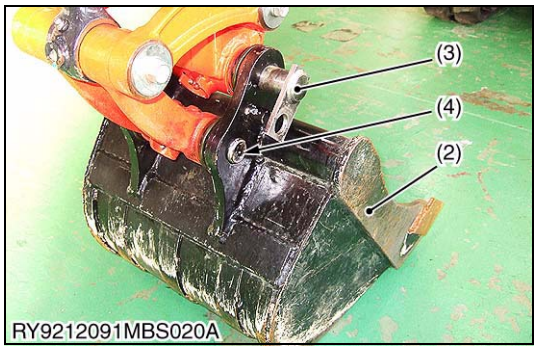
CAUTION

- **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 a 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.

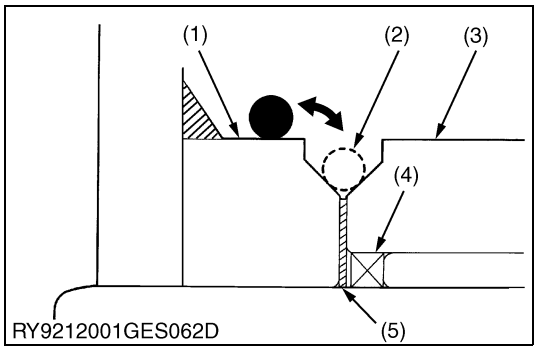
CAUTION

- **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



Attaching the Bucket

1. Before attaching the bucket, put O-rings in the bucket's bosses.
2. Reverse the steps of removing the bucket to attach it.
3. Press the O-ring into the groove.

(1) Bucket
(2) O-Ring
(3) Arm
(4) Dust Seal
(5) Shim

RY9212091MBS0023US0

[2] FRONT EQUIPMENT ATTACHMENT AND REMOVAL

CAUTION

- **Each of the devices and the hydraulic and lubricating oils are hot and/or under high pressure immediately after operating the mini-excavator. 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

Removing Front Equipment

1. Compress the bucket cylinder and the arm cylinder completely and set it on the ground.
2. Suspend the boom cylinder from a nylon sling. Remove the pin on the boom cylinder rod side.
   After removing the pin, compress the boom cylinder completely.
3. Remove the work light harness and all the hydraulic hoses at the base of the boom.
4. After suspending the boom and the arm from a nylon sling, remove the pin at the base of the boom and remove the front equipment.

RY9212091MBS0024US0

Attaching the Front Equipment

Perform the procedures in reverse to attach the equipment.

RY9212091MBS0025US0

[3] BLADE REMOVAL AND MOUNTING

Removing the Blade

1. Put the mini-excavator on hard, level ground, swivel the frame to 90 ° and set the bucket and blade on the ground.
2. 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.

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

RY9212091MBS0002US0

Mounting the Blade

Perform the procedures in reverse to attach the equipment.

RY9212001MBS0038US0

2. SWIVEL FRAME

[1] WEIGHT DISASSEMBLY/ASSEMBLY

Removing the Right Engine Cover

1. Remove the four right engine cover mounting bolts, the fuel tank cap and then the right engine cover.

(1) Cap ASSY
(2) Bolt
(3) Engine cover

RY9212091MBS0005US0

2. Remove the gas-filled damper, snap pins and flat washers inside the engine cover then slide it toward the right of the mini-excavator to remove it.

(1) Snap Pin, Flat Metal Washer
(2) Gas-Filled Damper
(3) Inside of Engine Cover

RY9212091MBS0006US0

Removing the Weight

1. Attach two eyebolts 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.

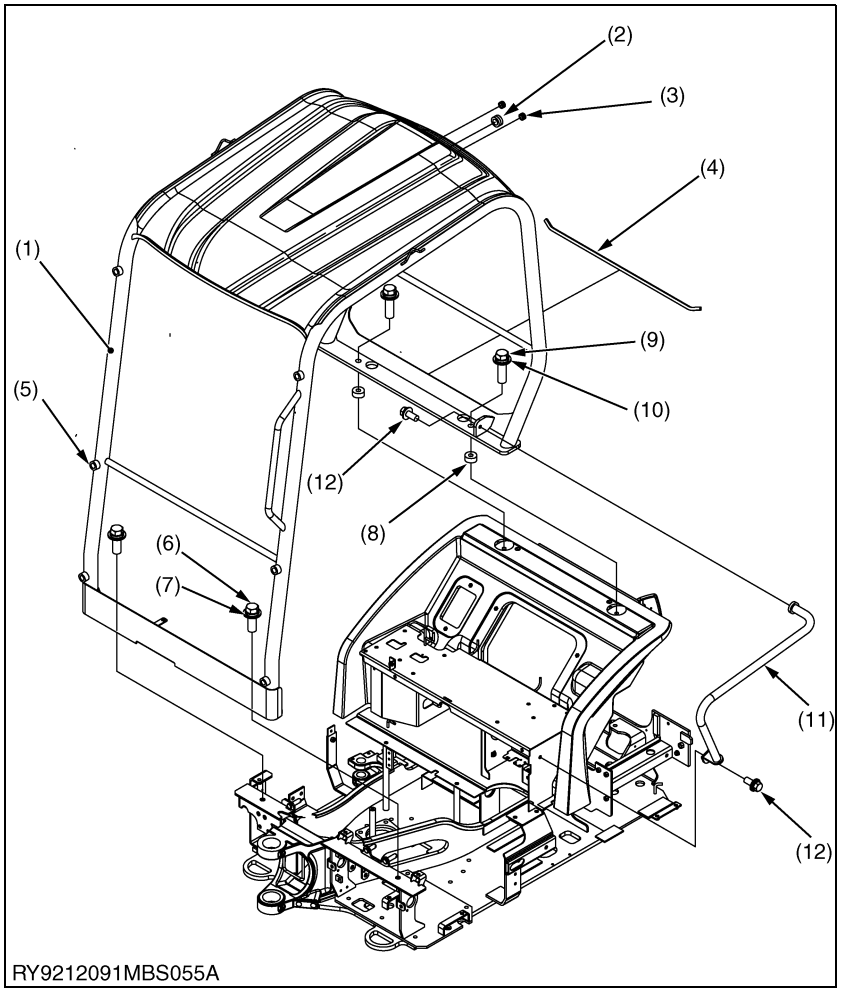
Tightening torque	Weight (1)	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft

Apply thread lock (Loctite AN302-71).

(1) Weight
(2) Bolt

RY9212091MBS0007US0

[2] CANOPY REMOVAL AND MOUNTING



(1) ROPS canopy
(2) Grommet
(3) Grommet
(4) Trim (750, T5U)
(5) Plug
(6) Bolt (M14 x 1.5)
(7) Flat metal washer
(8) Collar
(9) Bolt (M14 x 1.5)
(10) Flat metal washer
(11) Handrail

Tightening torque	Bolt (9)	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).

RY9212091MBS0062US0

[3] FUEL TANK REMOVAL AND MOUNTING

Removing the Right Engine Cover

1. Remove the four right engine cover mounting bolts, the fuel tank cap and then the right engine cover.

(1) Cap ASSY
(2) Bolt
(3) Engine cover

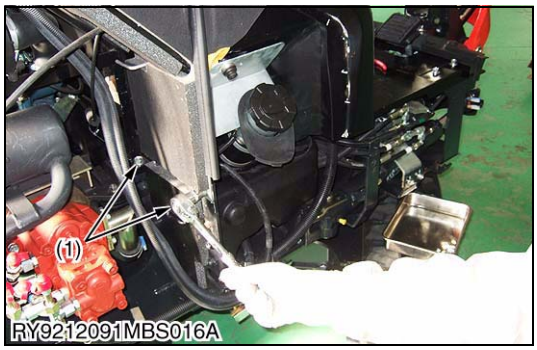
RY9212091MBS0005US0

Removing the Side Cover

1. Remove the three bolts and then the cover.

(1) Bolt
(2) Cover

RY9212091MBS0027US0



Removing the Fuel Tank

1. Remove the two bolts.

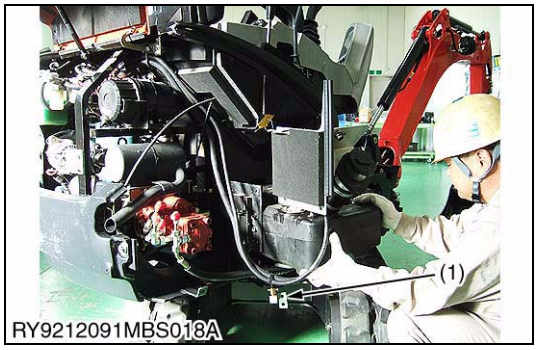
(1) Bolt

RY9212091MBS0028US0

2. Remove the three bolts, the hose guide and the bracket.

(1) Bolt
(2) Hose Guide
(3) Bracket

RY9212091MBS0029US0

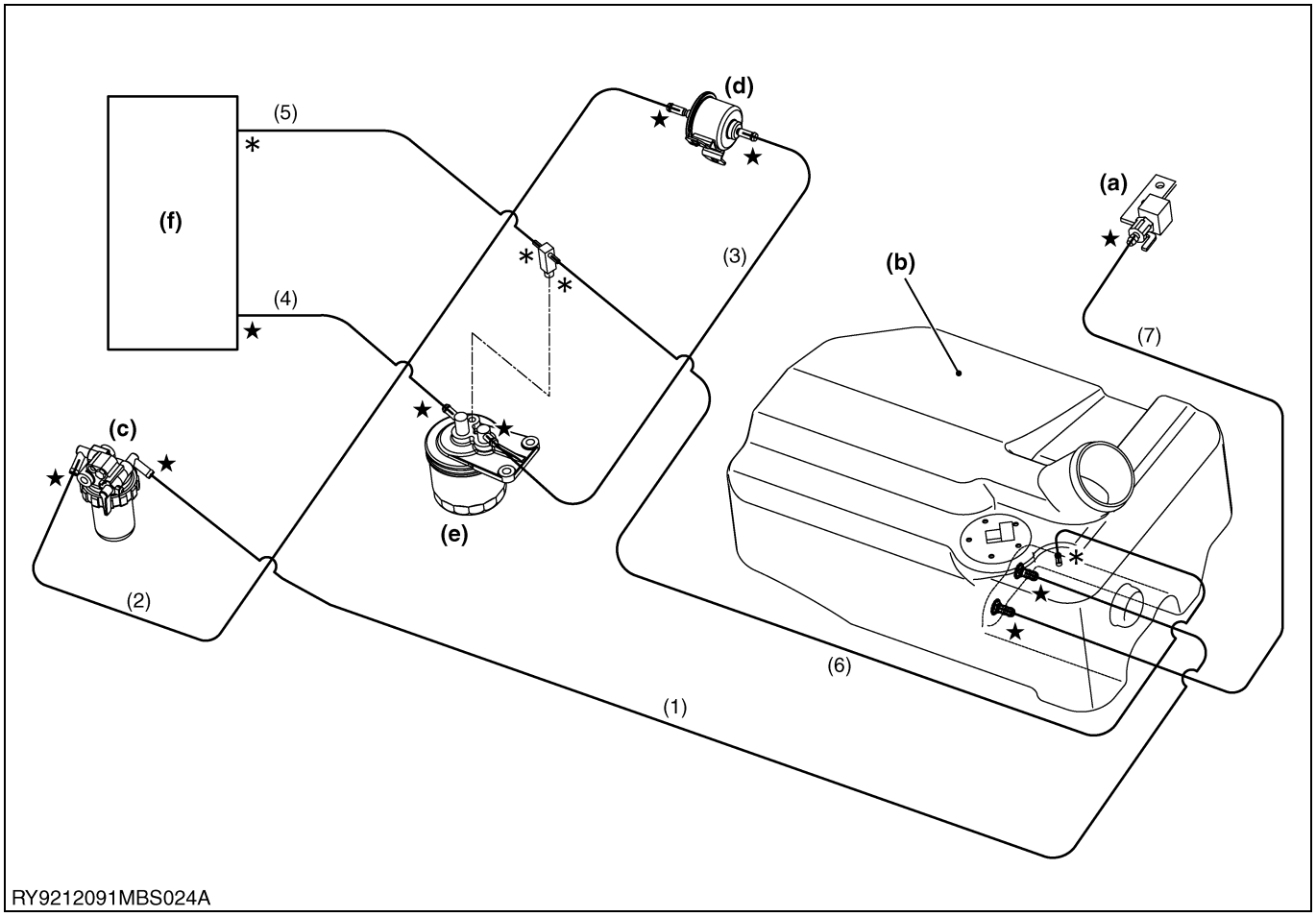


3. After draining all of the fuel out of the fuel tank, remove the two bolts and then remove the water drain-cock.
4. Remove the fuel tank assembly and remove the fuel hoses on the fuel tank side.

(1) Water Drain Cock

RY9212091MBS0030US0

Fuel Hose Routing



RY9212091MBS024A

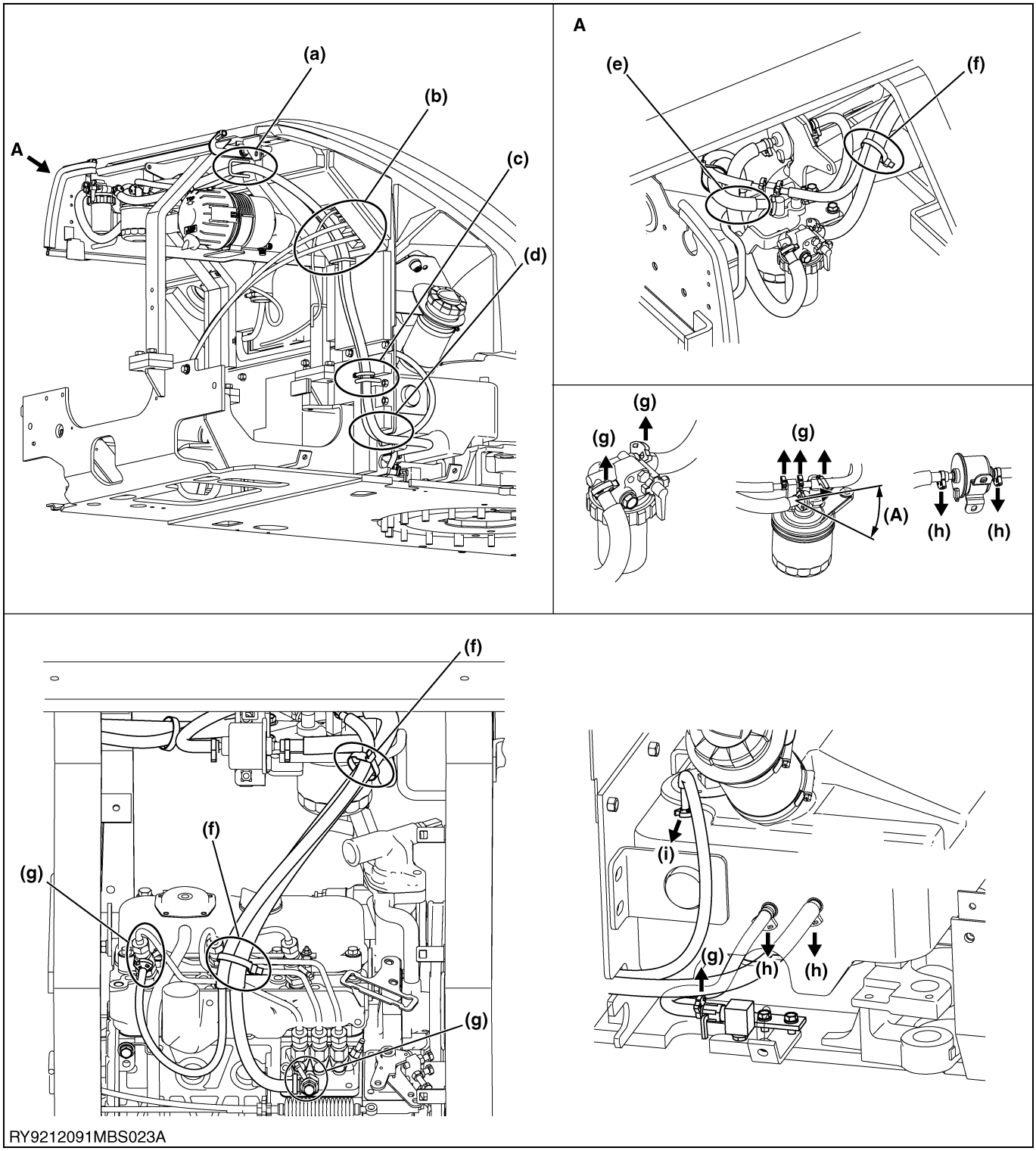
(a) Water Drain Cock **(c) Water Separator** **(e) Fuel Filter** **(f) Engine**
(b) Fuel Tank **(d) Fuel Pump**

Number	Fuel Tube Length	Protective Tube Length	Number	Fuel Tube Length	Protective Tube Length
(1)	1500 mm 59.1 in.	1450 mm 57.1 in.	(5)	650 mm 25.6 in.	400 mm 15.7 in.
(2)	440 mm 17.3 in.	390 mm 15.4 in.	(6)	1900 mm 74.8 in.	1830 mm 72.0 in.
(3)	300 mm 11.8 in.	–	(7)	–	–
(4)	550 mm 21.7 in.	440 mm 17.3 in.			

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

RY9212091MBS0031US0

Positions of Fuel Hose Clamps and Guides



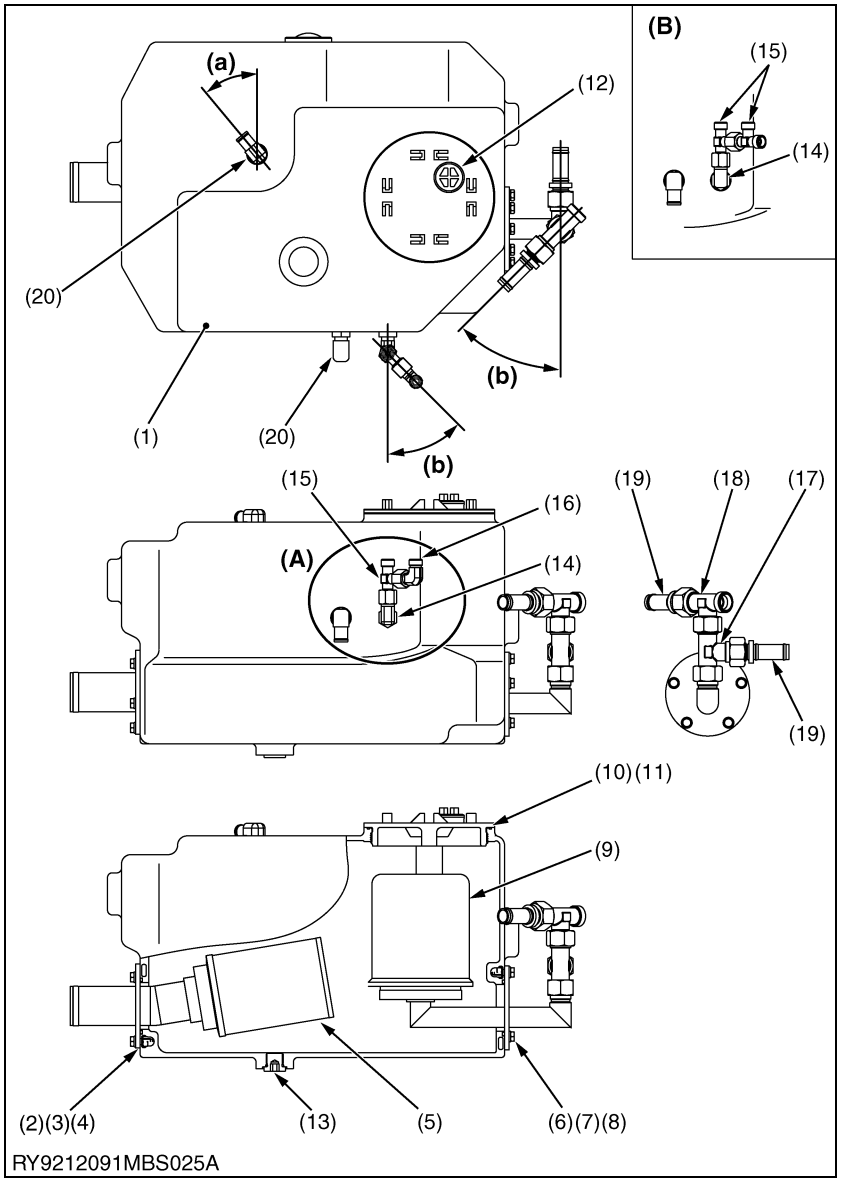
RY9212091MBS023A

(a) Pass on the Inside of Guides and Cables
(b) Pass Through Guides
(c) Fasten Clamped Hoses to Guides
(d) Pass Through the Notch
(e) Pass on the Outside of Pipe
(f) Clamp the Hose
(g) Clamp Facing Upwards
(h) Clamp Facing Downwards
(i) Clamp Facing Outwards
(A) 45 °

RY9212091MBS0032US0

[4] HYDRAULIC OIL TANK

(1) Hydraulic Oil Tank Components



RY9212091MBS025A

No.	Parts Name	Q'ty
(1)	Assy tank, oil	1
(2)	Cover, Tank suction	1
(3)	O-ring	1
(4)	Bolt, Sems	5
(5)	Filter, Suction	1
(6)	Cover, Tank return	1
(7)	O-ring	1
(8)	Bolt, Sems	5
(9)	Filter, Return	1
(10)	Plug	1
(11)	O-ring 2.0*129.5	1
(12)	Plug (G3/4)	1
(13)	Plug (M18 × 1.5)	1
(14)	Joint, Pipe	1
(15)	Adapter	**(A)** 1
		(B) 1
(16)	Elbow pipe	1
(17)	T-adapter	1
(18)	T-adapter	1
(19)	Adapter	2
(20)	Adapter (G1/4 – 13)	2

(a) 40 °
(b) 45 °

(A) KX015-4, KX016-4, KX018-4
(B) KX019-4

Tightening torque	Bolt (4), (8)	9.8 to 11.3 N·m 1.0 to 1.15 kgf·m 7.2 to 8.33 lbf·ft
	Plug (13)	60.0 to 65.0 N·m 6.2 to 6.6 kgf·m 44.0 to 48.0 lbf·ft

RY9212091MBS0033US0

[5] ENGINE

(1) Engine Removal and Mounting

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


RY9212091MBS026A

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

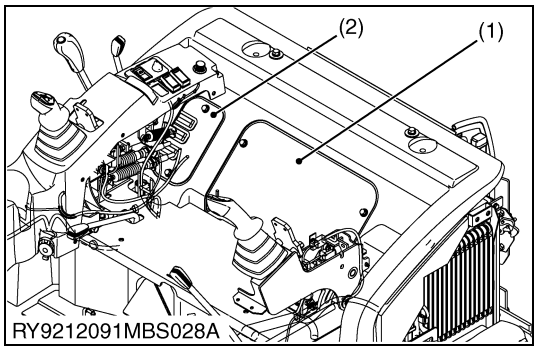
RY9212091MBS0035US0

RY9212091MBS027A

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

(1) Weight

RY9212091MBS0036US0

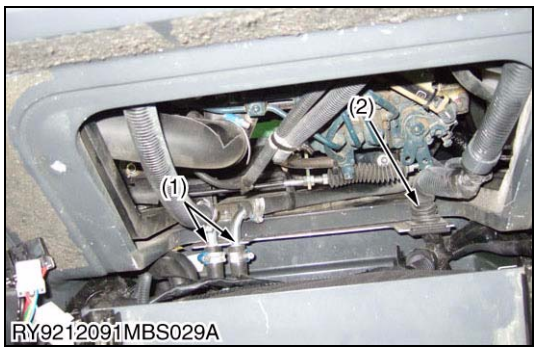


RY9212091MBS028A

3. Remove the front cover and seat assembly.
4. Remove the right cover, accelerator, dozer and track cable.

(1) Front Cover (2) Right Cover

RY9212091MBS0037US0



RY9212091MBS029A

5. Loosen the hose clamp and remove the heater hose.
6. Remove the wiring harnesses around the engine.

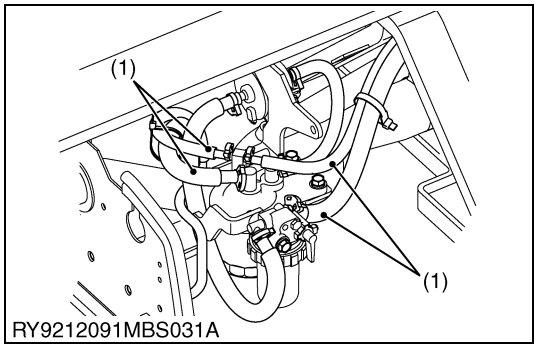
(1) Heater Hose (2) Wiring Harness

RY9212091MBS0038US0

7. Remove the seat support mounting bolts, slide the seat support toward the front of the body and remove the cover.

(1) Cover

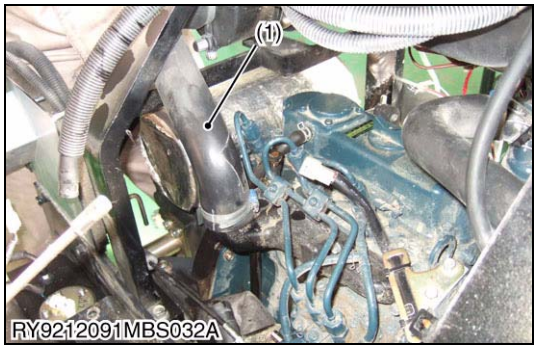
RY9212091MBS0039US0



8. Remove the fuel lines.

(1) Fuel Line

RY9212091MBS0040US0



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

(1) Intake Hose

RY9212091MBS0041US0

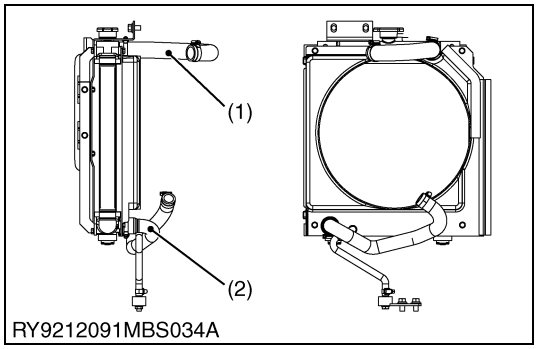
10. Remove the radiator mounting bolts.
11. Remove the arch mounting bolts.
    Use a crane to suspend the arch with a nylon sling.

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

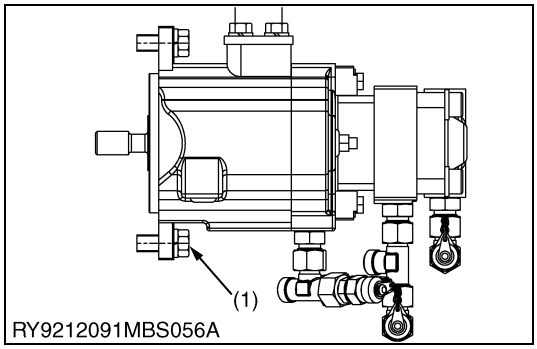
RY9212091MBS0042US0



12. Loosen and remove the upper and lower radiator hoses.
    Upper hose: engine side
    Lower hose: radiator side

(1) Upper Hose (2) Lower Hose

RY9212091MBS0043US0

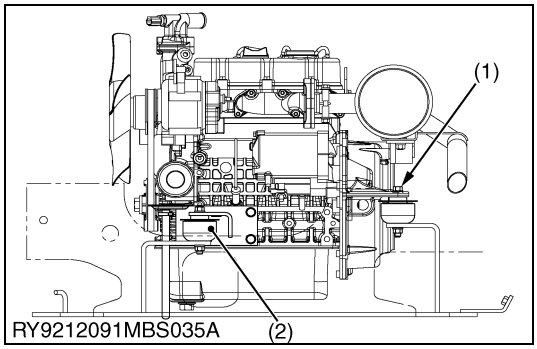


13. Remove the pump mounting bolts and separate it from the pump coupling.

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

(1) Bolt

RY9212091MBS0044US0



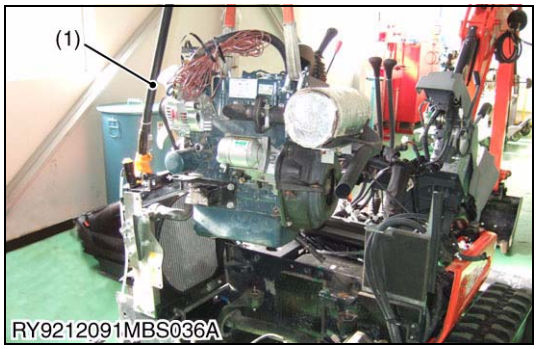
14. Remove the mounting nut of the anti-vibration rubber. (4 places)
15. Remove the harness connected to the starter.

Tightening torque	Nut (1)	39.2 to 45.1 N·m 4.0 to 4.6 kgf·m 28.9 to 33.3 lbf·ft

Apply threadlock

(1) Nut (2) Anti-Vibration Rubber

RY9212091MBS0045US0

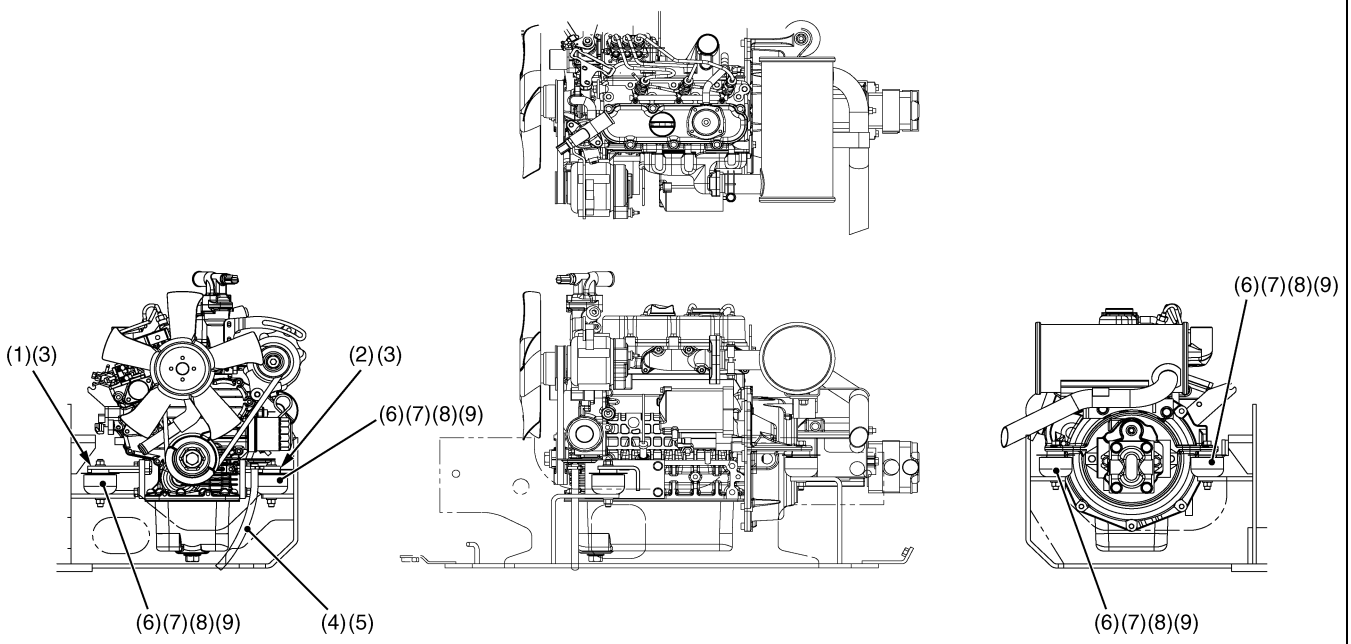


16. Attach two shackles to the engine, connect a nylon sling to these and suspend it with a crane.

(1) Nylon Sling

RY9212091MBS0046US0

(2) Engine Mounts



RY9212091MBS037A

(1) Engine, Front Bracket
(2) Engine, Rear Bracket
(3) Bolt
(4) Fuel Tube
(5) Fuel Clamp
(6) Cushion
(7) Spring Washer
(8) Nut
(9) Cover

Tightening torque	Nut (8)	39.2 to 45.1 N·m 4.0 to 4.6 kgf·m 29.0 to 33.2 lbf·ft

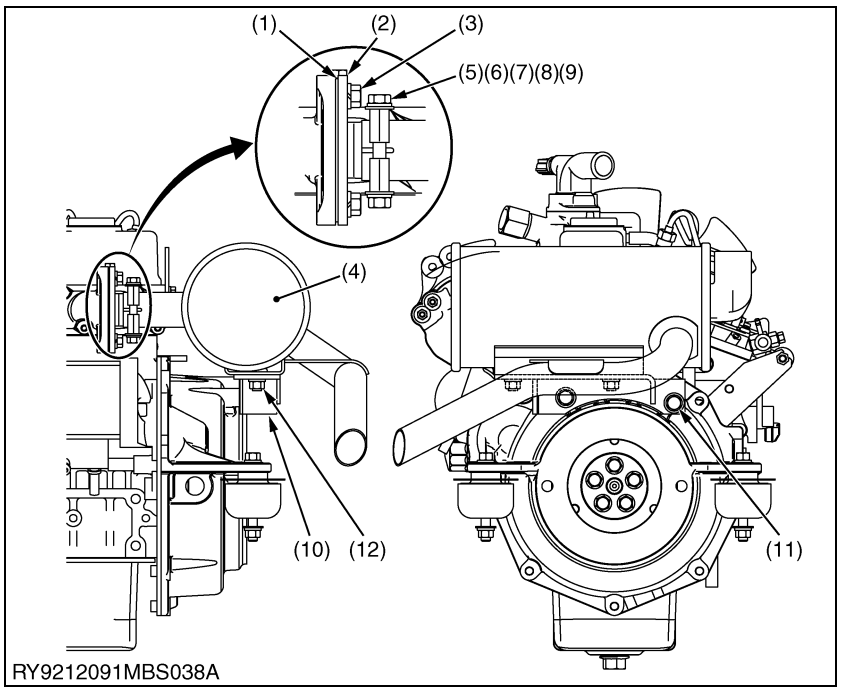
Apply threadlock

■ **IMPORTANT**

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

RY9212091MBS0047US0

(3) Muffler



(1) Muffler Gasket
(2) Muffler Flange
(3) Bolt
(4) Muffler
(5) Muffler Flange Clamp
(6) Bolt
(7) Flat Metal Washer
(8) Spring Washer
(9) Nut
(10) Muffler Bracket
(11) Bolt
(12) Nut

Muffler ASSY Installation Procedures

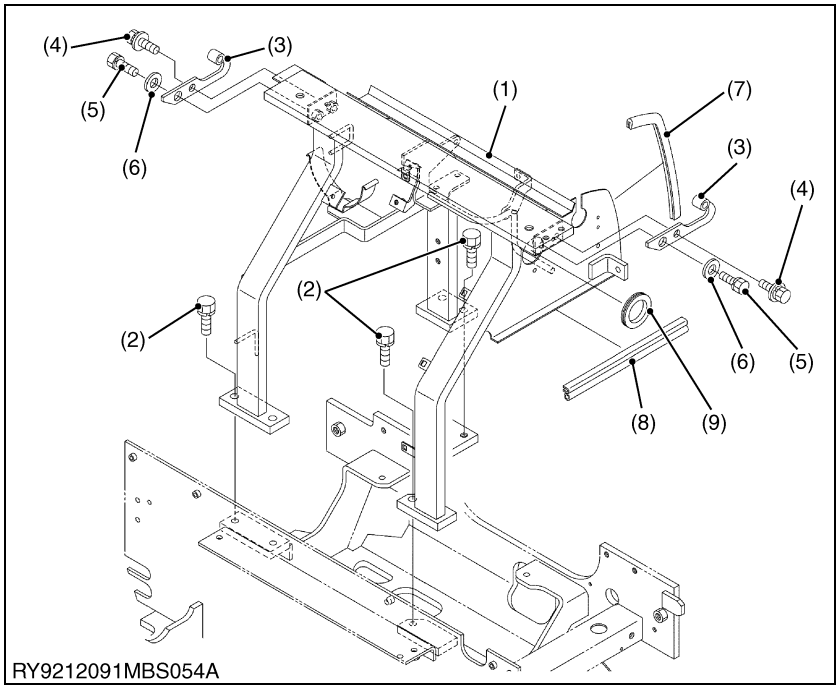
1. Lightly tighten bolts (12), (11), and (6).
2. Tighten bolt (12).
3. Tighten bolt (11).
4. Tighten bolt (6).

Tightening torque	Bolt (12)	39.2 to 45.1 N·m 4.0 to 4.6 kgf·m 29.0 to 33.2 lbf·ft
	Bolt (11)	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 lbf·ft
	Bolt (6)	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.2 lbf·ft

RY9212091MBS0048US0

(4) Arch

Arch Assembly



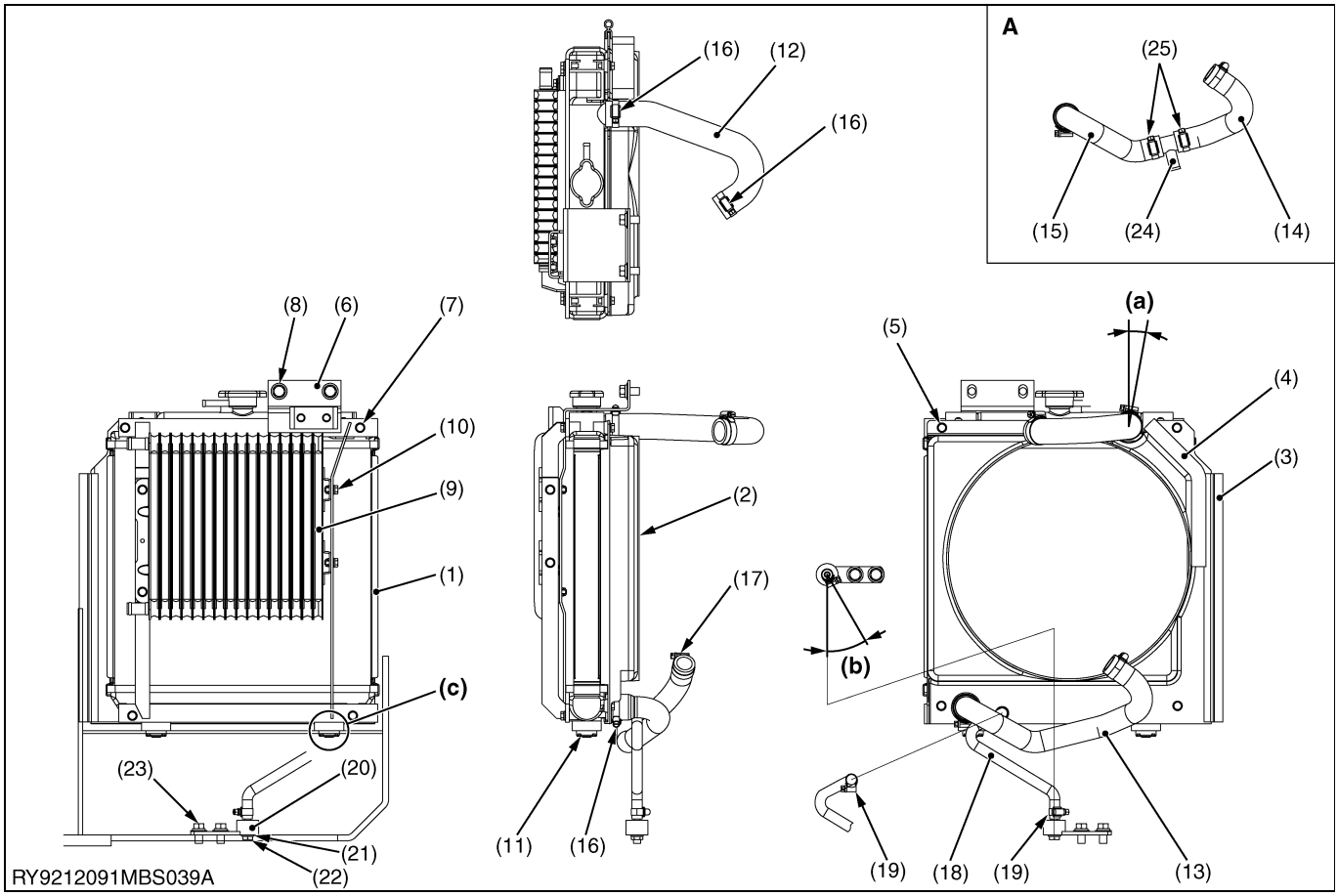
(1) Arch Frame
(2) Bolt
(3) Support
(4) Bolt
(5) Bolt
(6) Flat Metal Washer
(7) Trim
(8) Rubber Seal
(9) Grommet

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).

RY9212091MBS0021US0

(5) Radiator, Oil Cooler



(1) Assy Radiator
(2) Shroud, Fan
(3) Seal Rubber (340)
(4) Sponge (SHROUD)
(5) Bolt, W Sems (PHILLIPS)
(6) Bracket, Oil Cooler
(7) Bolt, W Sems (Phillips)
(8) Bolt, W Sems
(9) Cooler, Oil
(10) Bolt, W Sems (Phillips)
(11) Cushion, Radiator
(12) Hose (Wp, Upper)
(13) Hose (Wp, Lower)
(14) Hose (Wp, Lower 1)
(15) Hose (Wp, Lower 2)
(16) Hose Clamp 25 to 40 mm
(17) Hose Clamp 20 to 32 mm
(18) Hose (Wp, Drain)
(19) Hose Clamp 10 to 16 mm
(20) Adapter (Drain)
(21) Washer, Seal
(22) Plug
(23) Bolt, W Sems
(24) Pipe, Water
(25) Hose Clamp 20 to 32 mm

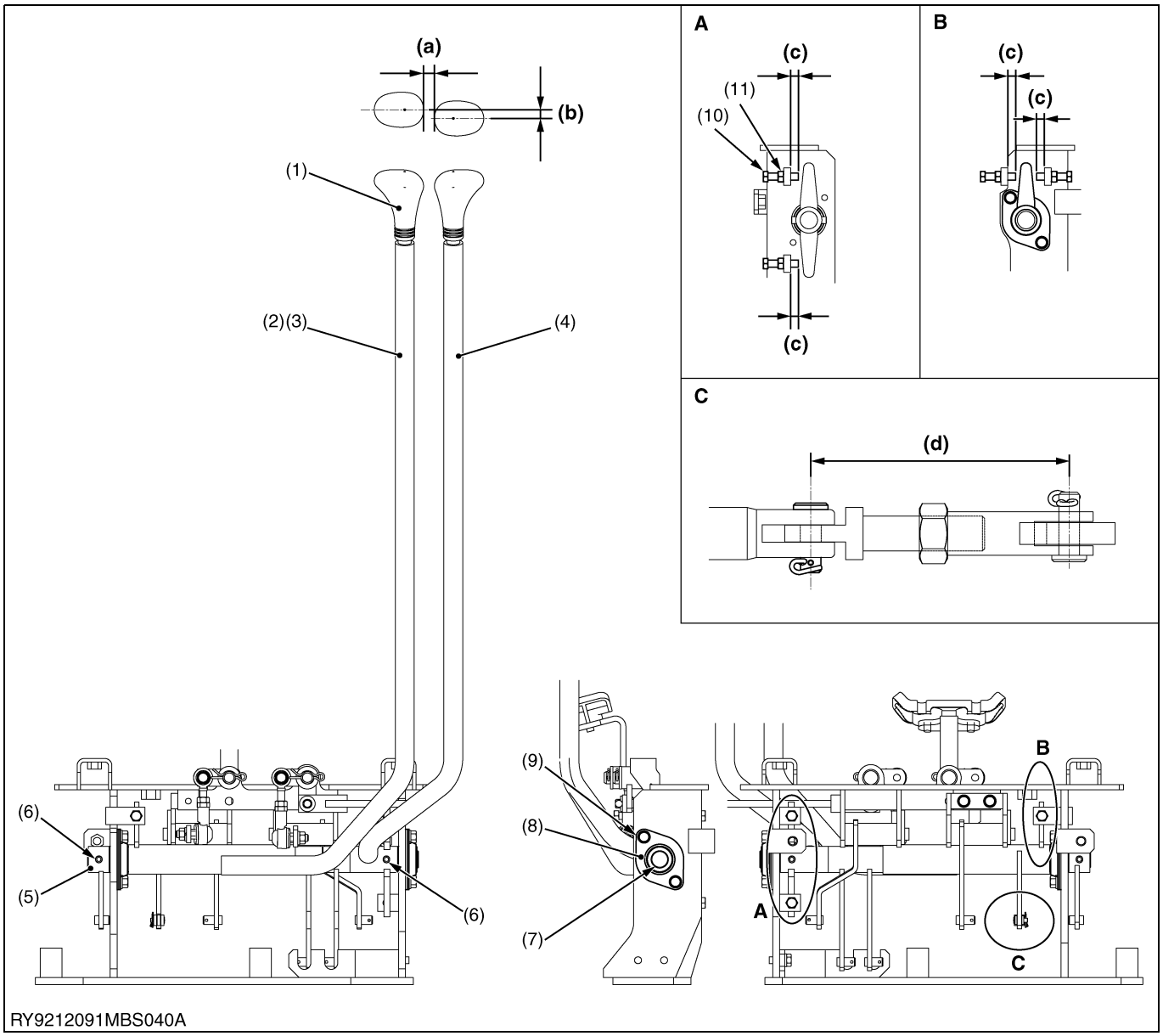
A : Cabin Version
(a) 10 °
(b) 25 °
(c) Be Sure that the Tab is Fully Inserted into the Hole in the Bracket.

RY9212091MBS0049US0

[6] OPERATING LEVER ASSEMBLY

(1) Travel Lever

Components



RY9212091MBS040A

(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

(a) 15 to 25mm (0.59 to 0.98 in.)
(b) 5 mm (0.2 in.)
(c) 9 mm (0.4 in.)
(d) 59.5 mm (2.34 in.)

RY9212091MBS0050US0

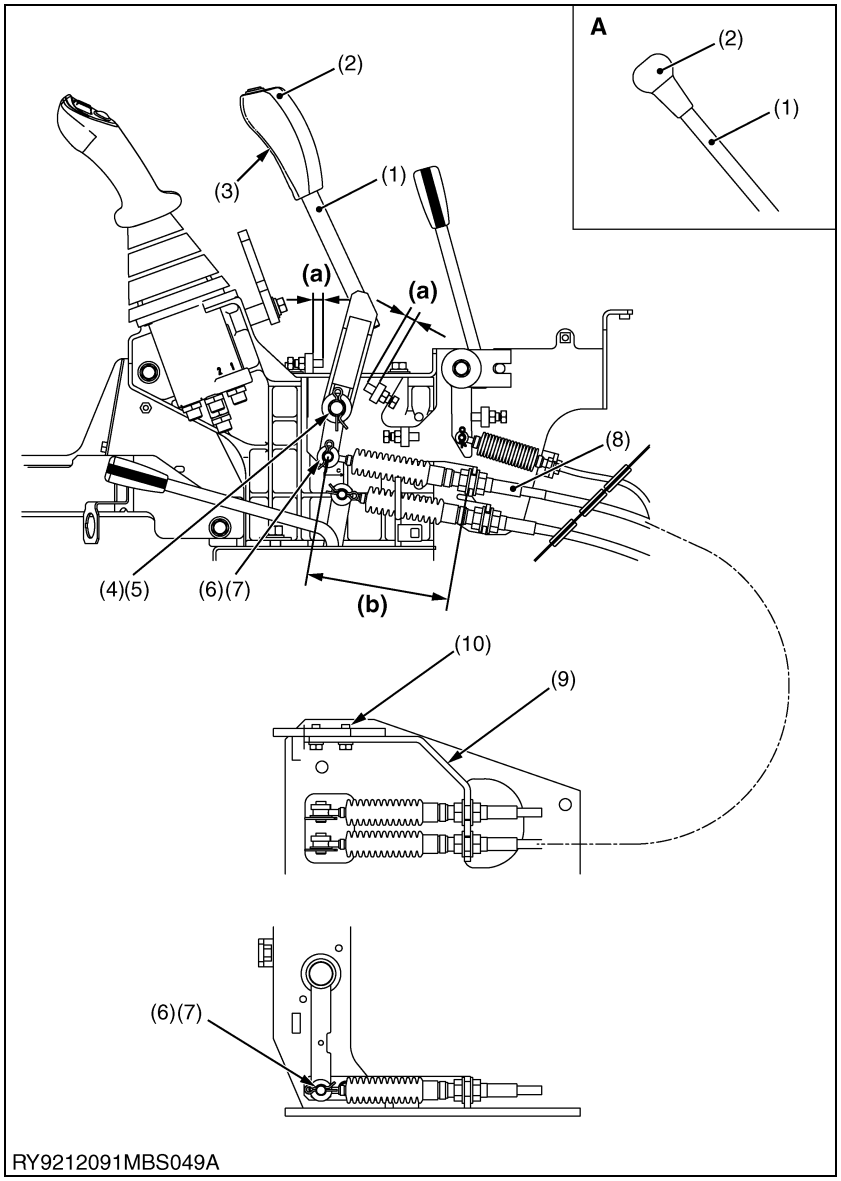
Spring Pin Installation

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

RY9212091MBS0051US0

(2) Blade Lever

Components



RY9212091MBS049A

(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

(a) 10 mm (0.39 in.)
(b) 146 mm (5.75 in.)

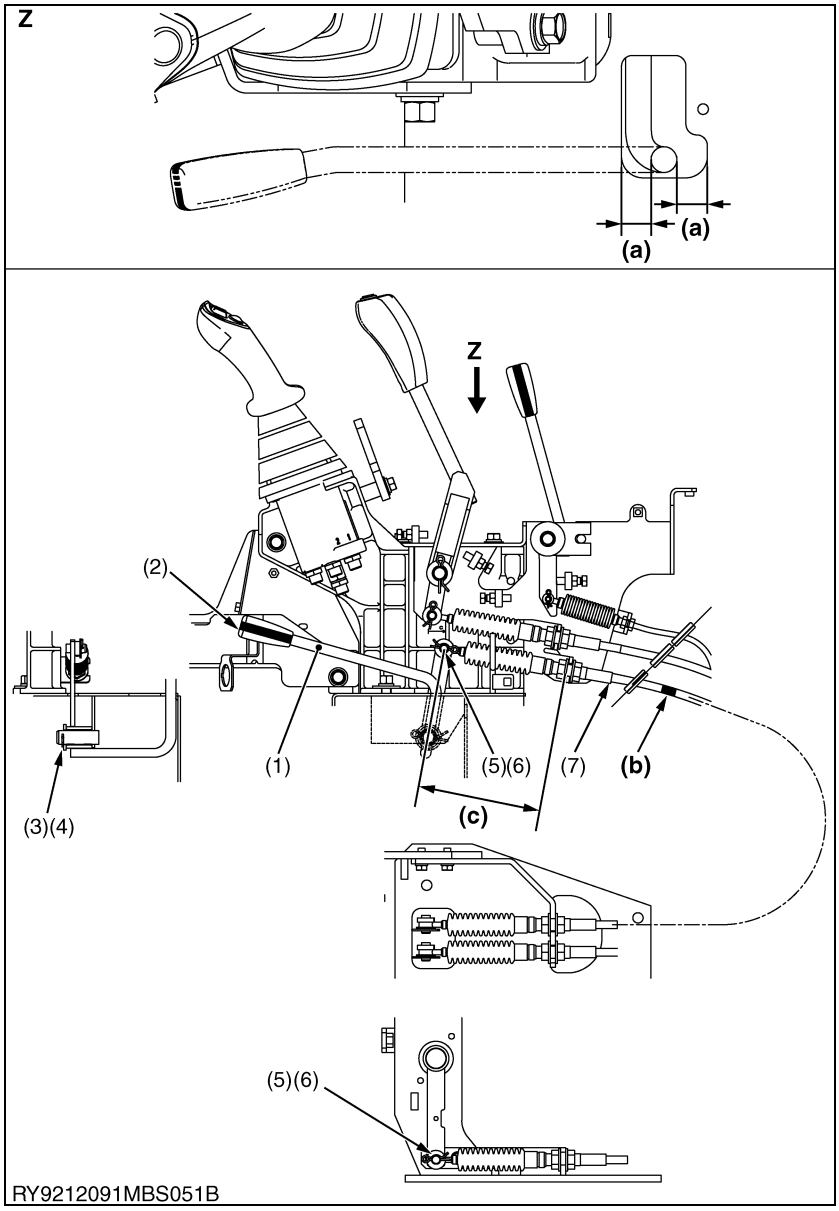
■ **IMPORTANT**

- **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.**

RY9212091MBS0052US0

(3) Adjustable Track Lever

Components



(1) Adjustable track lever ASSY
(2) Lever grip
(3) Flat metal washer
(4) Snap pin
(5) Flat metal washer
(6) Snap pin
(7) Adjustable track cable

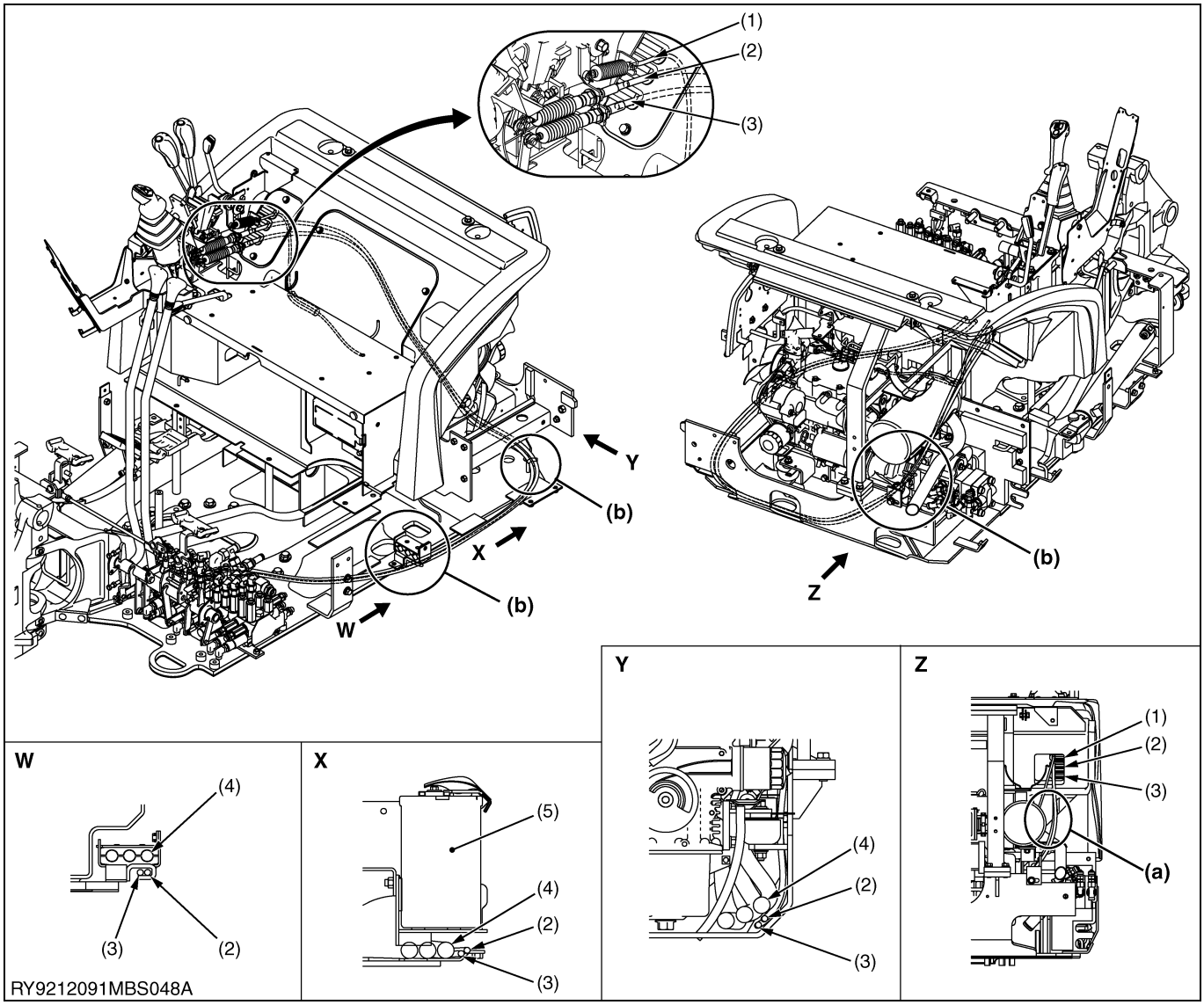
(a) The gaps should be uniform
(b) White tape
(c) 146 mm, 5.75 in.

■ **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.**

RY9212091MBS0053US0

(4) Overall Routing of Blade and Adjustable Track Cables

Components

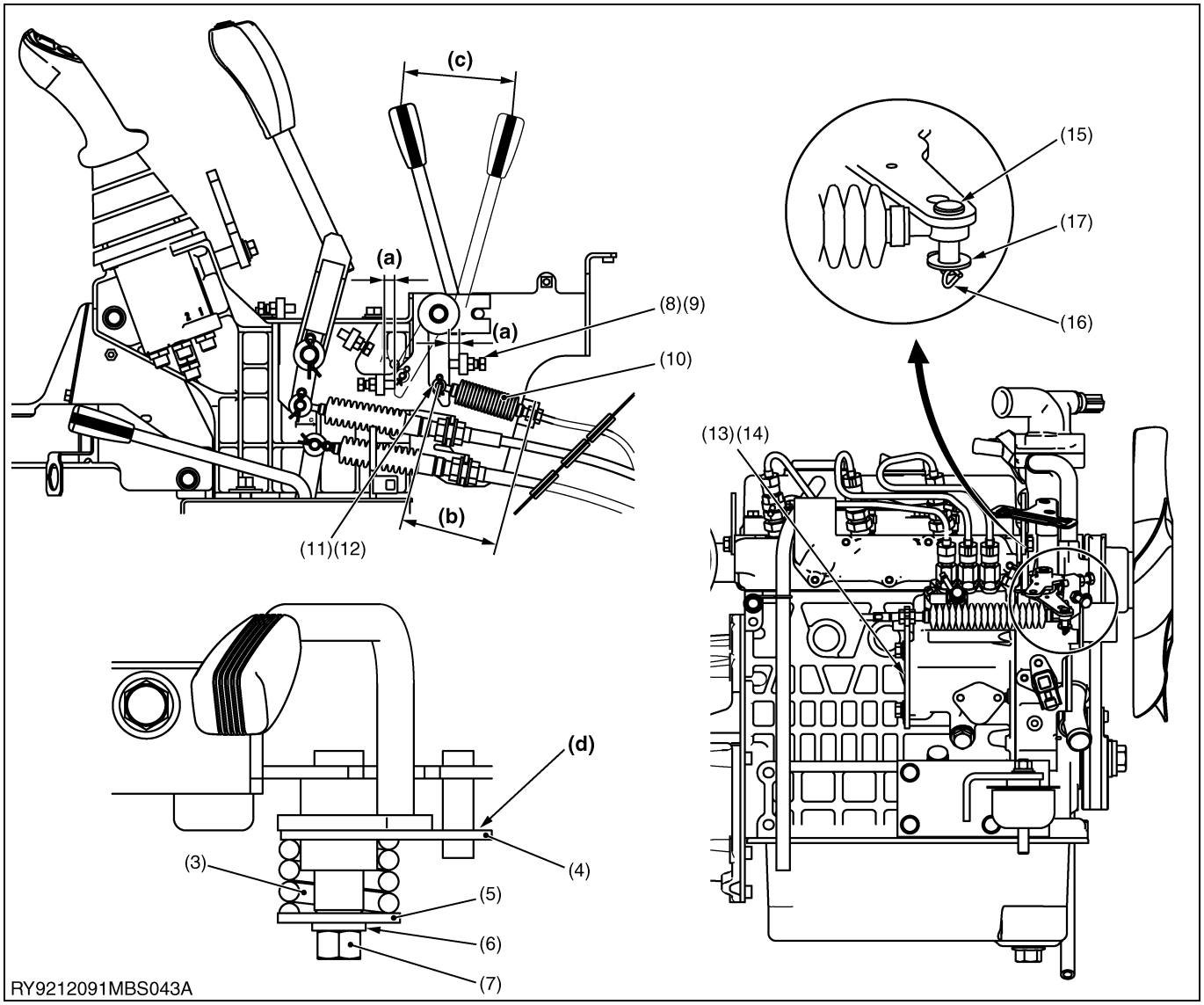


(1) Accelerator Cable
(2) Blade Cable
(3) Adjustable Track Cable
(4) Delivery Hose
(5) Battery
(a) No Contact with the Muffler
(b) Guide Rod

RY9212091MBS0054US0

(5) Accelerator Lever

Components



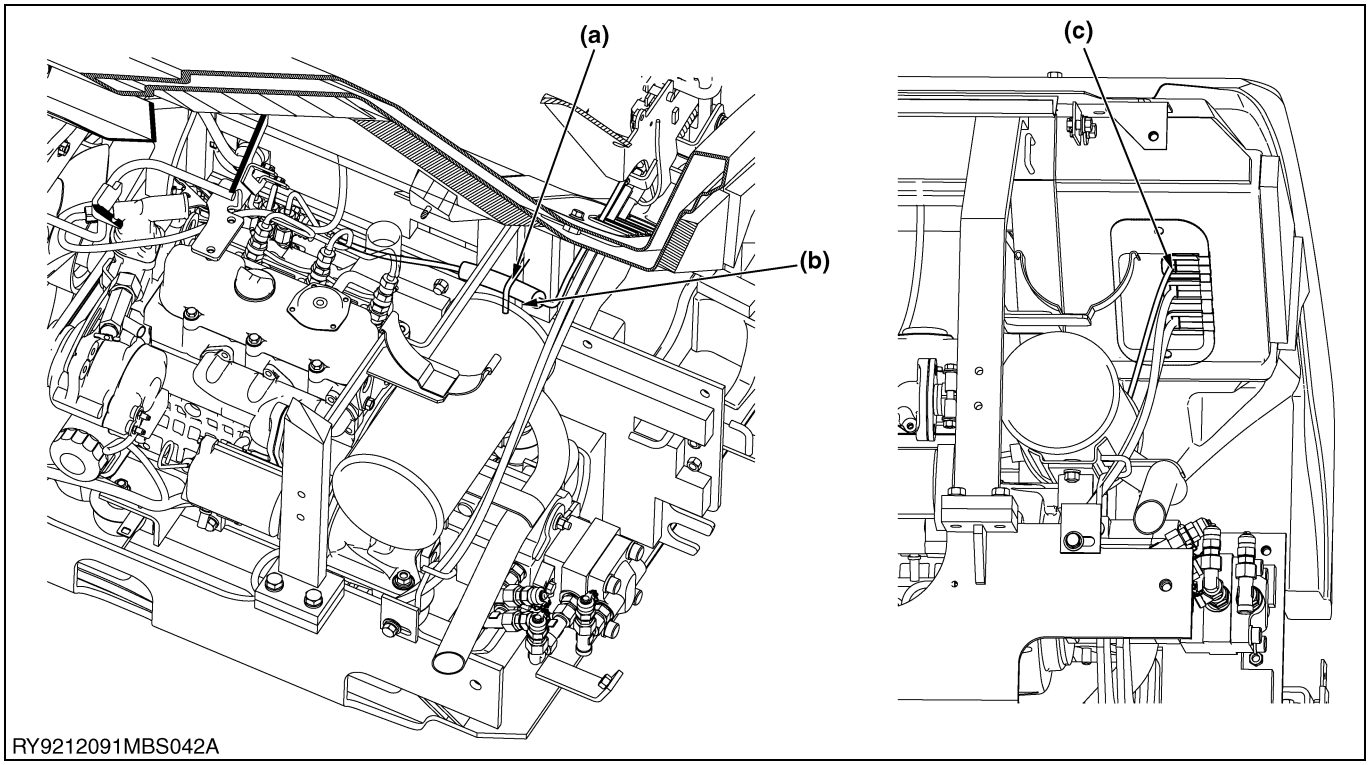
(1) Accelerator lever ASSY
(2) Grip
(3) Spring
(4) Plate
(5) Shim
(6) Spring washer
(7) Bolt
(8) Bolt
(9) Nut
(10) Accelerator cable
(11) Flat metal washer
(12) Snap pin
(13) Accelerator support
(14) Bolt
(15) Pin
(16) Snap pin
(17) Flat metal washer

(a) 10 mm (0.39 in.)
(b) 95 mm (3.7 in.)
(c) 109 mm (4.29 in.)
(d) Greased side

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

RY9212091MBS0055US0

(6) Accelerator Cable Routing



RY9212091MBS042A

(a) Hang the sponge of the blade cable on the guide rod of the arch.

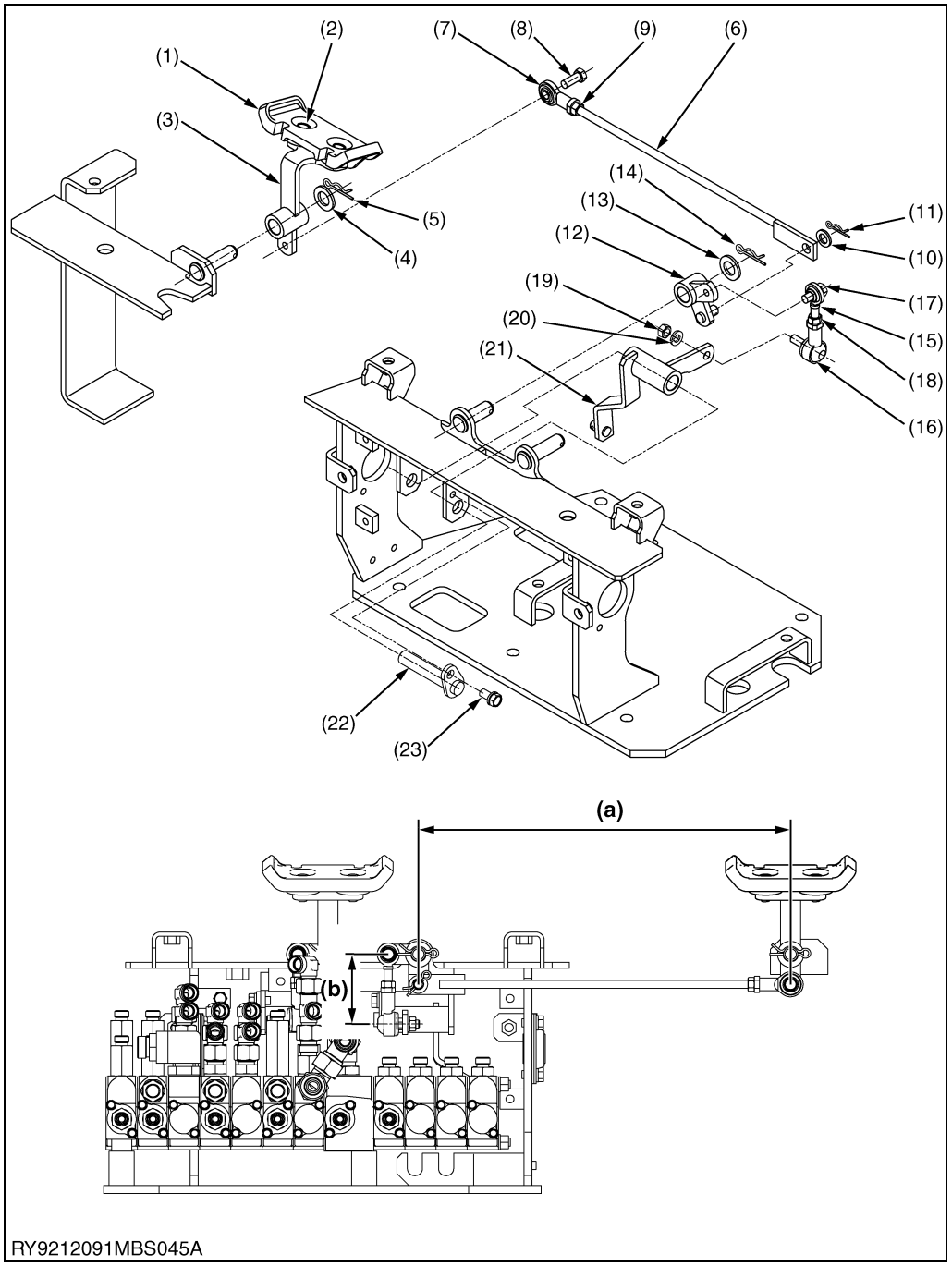
(b) Do not allow it to touch the muffler

(c) Pass through the top hole

RY9212091MBS0056US0

(7) Swing Pedal

Components



RY9212091MBS045A

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

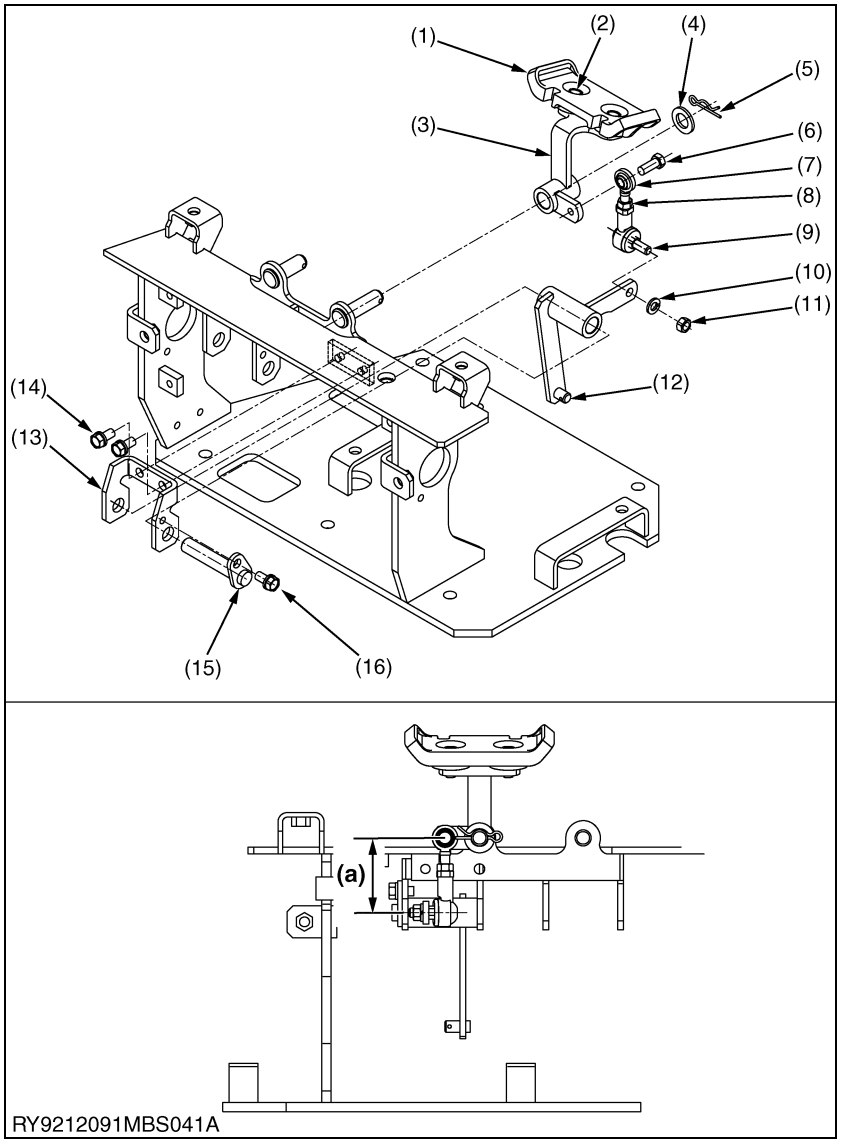
(a) 370 mm (14.6 in.)
(b) 70 mm (2.8 in.)

Tightening torque	Nut (19)	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.1 to 15.2 lbf·ft

RY9212091MBS0057US0

(8) AUX Pedal

Components



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

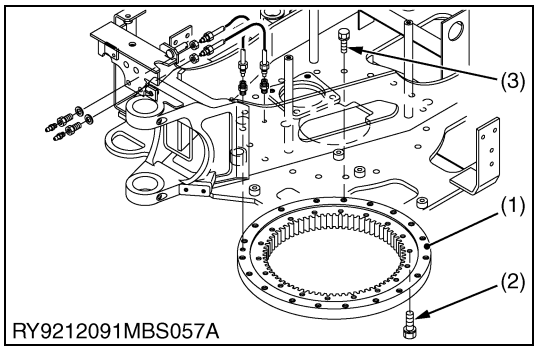
(a) 65 mm (2.6 in.)

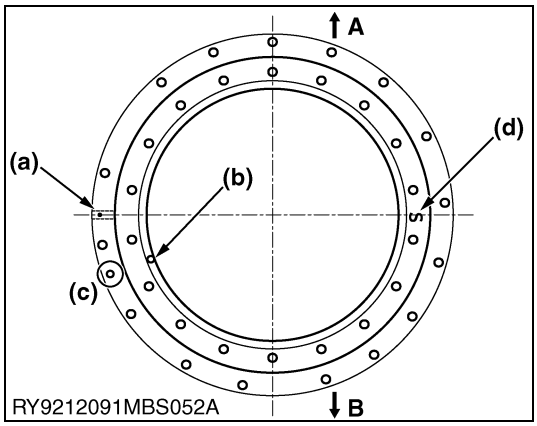
Tightening torque	Nut (11)	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.1 to 15.2 lbf·ft

RY9212091MBS0058US0

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 (M12 x 40)	18
(3)	Bolt (M12 x 40)	19

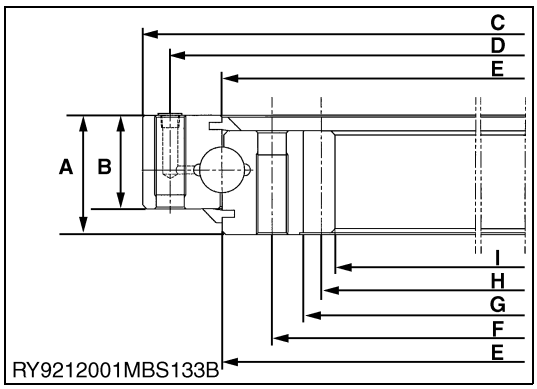
2. Assembly position
   Mount the inner tire soft zone ('S' mark) **(d)** on the left side of the body.
3. Swivel Bearing Torque
   After tightening lightly, tighten the bolts to the torques indicated below diagonally.

Tightening torque	Bolt (2), (3)	103.0 to 118.0 N·m 10.5 to 12.0 kgf·m 76.0 to 87.0 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

RY9212095MBS0002US0

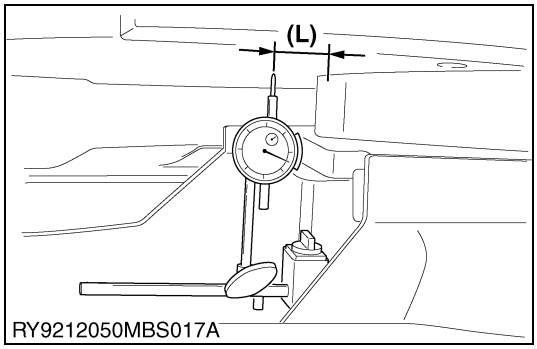


(2) Exterior Dimensions of Swivel Bearing

No. in Figure	External Dimensions
A	35 mm (1.4 in.)
B	30 mm (1.2 in.)
C	ϕ462 mm (ϕ18.2 in.)
D	P.C.D.440 mm (17.3 in.)
E	ϕ398 mm (ϕ15.7 in.)
F	P.C.D.362 mm, 14.3 in.
G	ϕ342 mm (ϕ13.5 in.)
H	P.C.D.328.5 mm (12.9 in.)
I	ϕ319.5 mm (ϕ12.6 in.)

RY9212091MBS0017US0


RY9212091MBS060A



RY9212050MBS017A


RY9212091MBS058A


RY9212091MBS059A

(3) Measuring Swivel Bearing Play

1. Attach a dial gauge and a clamp to hold the dial gauge to the front of the mini-excavator. (The point to measure depends on the model.)
2. Extend the arm completely and put the bucket in an extended position.
   Set the dial gauge to its zero point.
3. Lift the mini-excavator using the attachment and read the dial gauge. Take this measurement a number of times and use the average of these as the final measurement.

CAUTION

- **Take the measurement 3 times, average them and use the result as the measured value.**

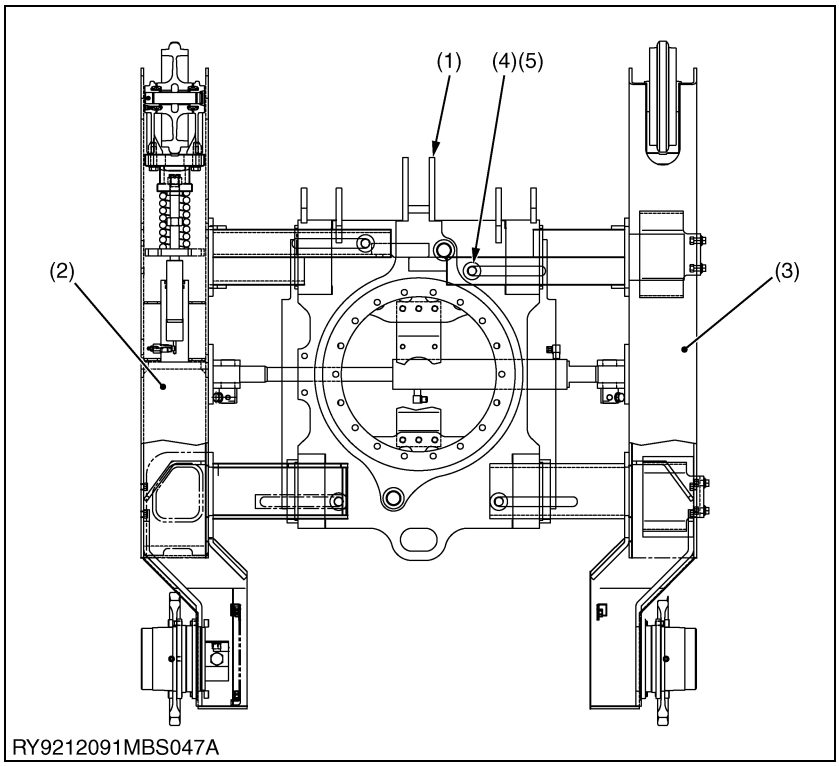
(L):A point 50mm (2.0 in.) from the swivel race	Factory specification	1.6 mm 0.06 in.
	Allowable limits	3.2 mm 0.13 in.

(L) Measurement Point

RY9212091MBS0020US0

[2] TRACK FRAME ASSEMBLY

Track Frame Assembly Procedures



(1) Track Frame, Center
(2) Track Frame, Left
(3) Track Frame, Right
(4) Stopper Bolt
(5) Spring Washer

1. Stopper Bolt Torque

Tightening torque	Bolt (4)	367.7 to 431.5 N·m 37.5 to 44.0 kgf·m 271.2 to 318.3 lbf·ft

Apply thread lock (Loctite AN302-71 equivalent).

2. Greasing the left and right of the track frame
Apply grease to the entire circumference of the right and left track frames.

RY9212091MBS0063US0

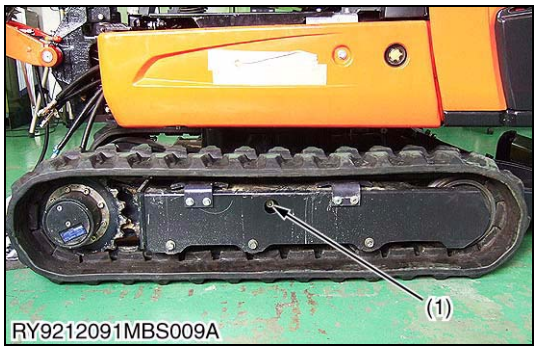
[3] TRACK

(1) Rubber Track Disassembly/Assembly

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



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

RY9212091MBS0008US0

Loosening the Track

1. Jack up the body using the front 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.

RY9212091MBS0009US0

Removing the Rubber Tracks

1. Lift the body slightly and move the track in forward direction **A**. Slide the track in the sideways direction at the front idler to remove it.

A : Forward Direction **B : Direction to Slide the Track**

RY9212091MBS0010US0

Assembling the Rubber Tracks

1. With the body lifted slightly, put the track on from the sprocket side.
2. Hold the rubber track with your hand on the outside, slowly turn it in the forward direction **A**, and set it on the stepped area of the front idler.

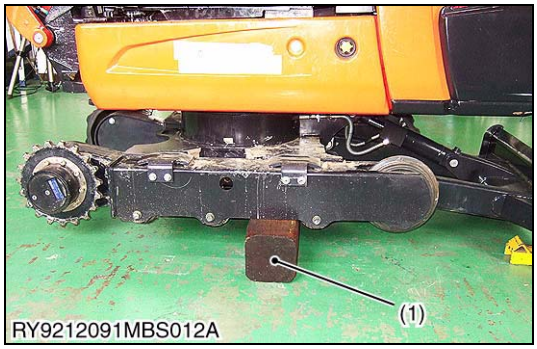
CAUTION

- **Make sure to assemble the rubber track in the correct orientation.**
- **Be careful not to get your hand caught.**
- **Once the tracks are mounted, lower the mini-excavator and drive it backwards to make sure the tracks are on securely.**

RY9212095MBS0003US0

[4] FRONT IDLER

(1) Front Idler Disassembly/Assembly



Removing the Idler

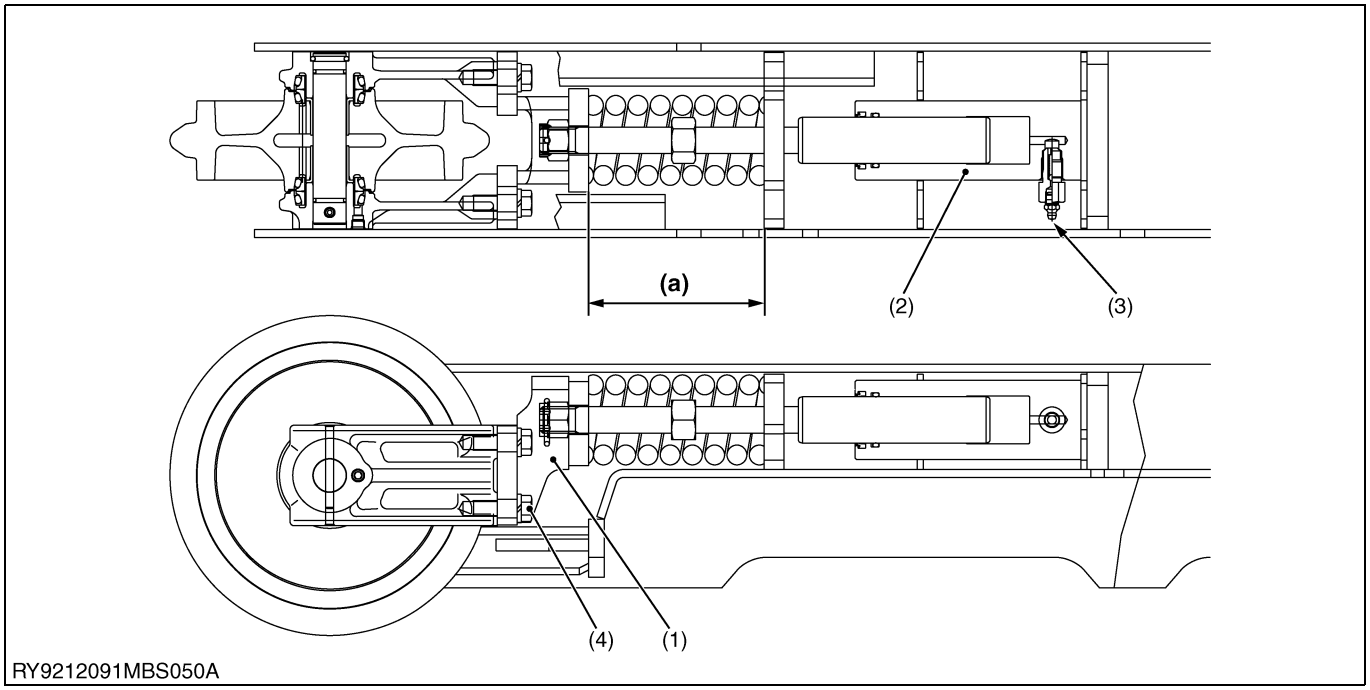
1. Remove the track.
   (Refer to the chapter "Track Assembly/Disassembly.")
   Jack up the mini-excavator with the front and the blade and place timbers or the like under the frame.

2. Separate the front idler from the frame.

(1) Block (2) Front Idler

RY9212091MBS0011US0

(2) Front Idler Components



(1) Front Idler, ASSY
(2) Cylinder, ASSY
(3) Grease Nipple
(4) Bolt
(a) Preset Length : 130 ± 0.5 mm (5.12 ± 0.02 in.)

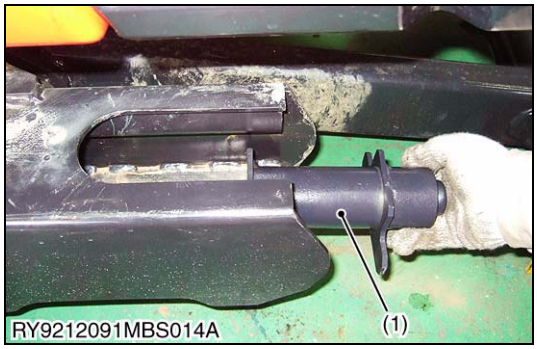
Tightening torque	Bolt (4)	77.4 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 lbf ft

Apply thread lock (Loctite AN302-71 equivalent).

RY9212091MBS0060US0

[5] CYLINDER ASSEMBLY

(1) Cylinder Assembly Disassembly/Assembly



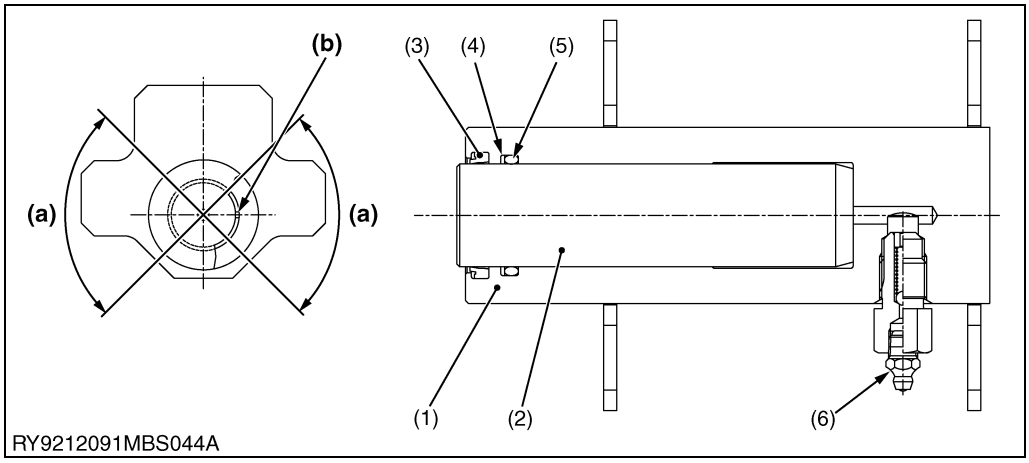
Removing the Cylinder ASSY

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

RY9212091MBS0012US0

(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

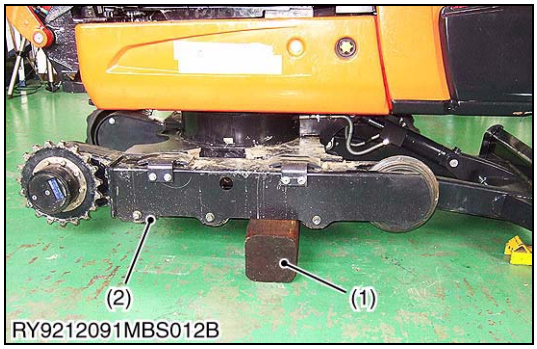
Tightening torque	Nipple ASSY (6)	98.0 to 108.0 N·m 10.0 to 11.0 kgf·m 72.0 to 79.7 lbf·ft

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

RY9212091MBS0064US0

[6] TRACK ROLLER

(1) Track Roller Disassembly/Assembly



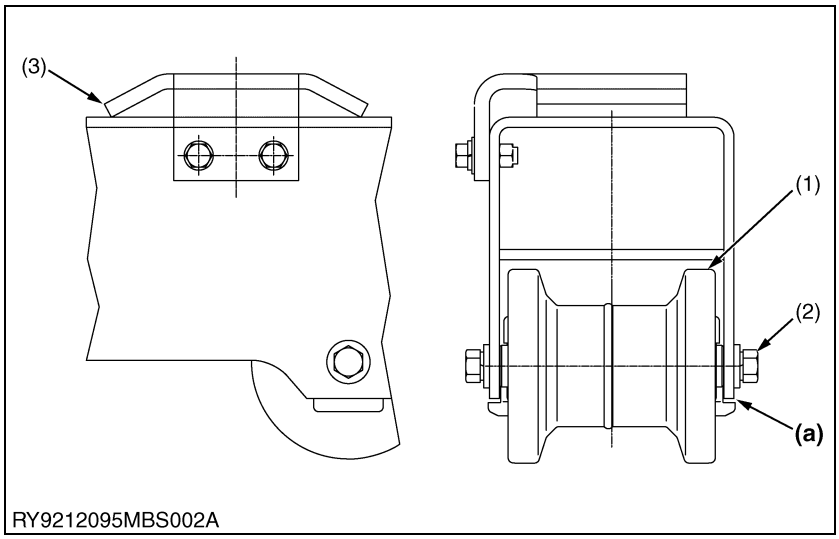
Removing the Track Roller

1. Remove the track.
   (Refer to the chapter "Track Assembly/Disassembly".)
   Jack up the mini-excavator 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.

(1) Block (2) Track Roller

RY9212091MBS0015US0

Mounting the track roller



(1) Track Roller, Assy
(2) Bolt
(3) Flat Metal Washer

(a) Less than 1.5 mm (0.06 in.)
(Gap between Working Surfaces)

Tightening torque	Track roller assy (1)	103.0 to 117.7 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 lbf·ft
	Flat metal washer (3)	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 lbf·ft

Apply thread lock (Loctite AN302-71 equivalent).

RY9212095MBS0001US0

2 ENGINE

GENERAL

CONTENTS

1. ENGINE

[1] ENGINE SPECIFICATIONS

		KX015-4, KX016-4	KX018-4, KX019-4
Model		D782-BH-5	D902-BH-2
Number of cylinder		3	
Bore × Stroke		67 × 73.6 mm 2.64 × 2.90 in.	72 × 73.6 mm 2.83 × 2.91 in.
Displacement		778 cc (47.48 in^3)	898 cc (54.80 in^3)
Minimum bare idling speed		1370 to 1470 rpm	
Maximum bare speed		2690 rpm	2740 rpm
Compression ratio		24	
Max. output / rpm	Net	9.6 / 2300 kW/rpm 12.9 / 2300 HP/rpm	11.9 / 2300 kW/rpm 16.0 / 2300 HP/rpm
	Gross	9.9 / 2300 kW/rpm 13.3 / 2300 HP/rpm	12.3 / 2300 kW/rpm 16.5 / 2300 HP/rpm
Max. torque / rpm	Net	43.9 / 1800 N·m/rpm 4.48 / 1800 kgf·m/rpm	53.2 / 1800 N·m/rpm 5.42 / 1800 kgf·m/rpm
	Gross	45.2 / 1800 N·m/rpm 4.61 / 1800 kgf·m/rpm	54.6 / 1800 N·m/rpm 5.57 / 1800 kgf·m/rpm
Dimensions; L × W × H		453.2 × 395.8 × 560.4 mm 17.8 × 15.6 × 22.1 in.	475.7 × 396 × 564 mm 18.7 × 15.6 × 22.2 in.
Dry weight		63.5 kg 140 lbs	72.0 kg 158.7 lbs
Valve clearance		0.16 mm 0.006 in.	
Firing sequence		1-2-3	
Combustion chamber		Spherical type (E-VTCS)	
Compression pressure		3.53 to 4.02 MPa 36.0 to 41.0 kgf/cm^2 512 to 583 psi	
Compression pressure (allowable limit)		2.55 MPa 26.0 kgf/cm^2 370 psi	
Fuel consumption ratio (rated engine rpm)	Net	261.3 g/kW·h 194.9 g/HP·h 0.430 lb/HP·h	252.7 g/kW·h 188.5 g/HP·h 0.416 lb/HP·h
	Gross	253.4 g/kW·h 189.0 g/HP·h 0.417 lb/HP·h	244.4 g/kW·h 182.3 g/HP·h 0.402 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)		0.95 g/kW·h ≥ 0.70 g/PS·h ≥	
Fan belt		RPF 2325	

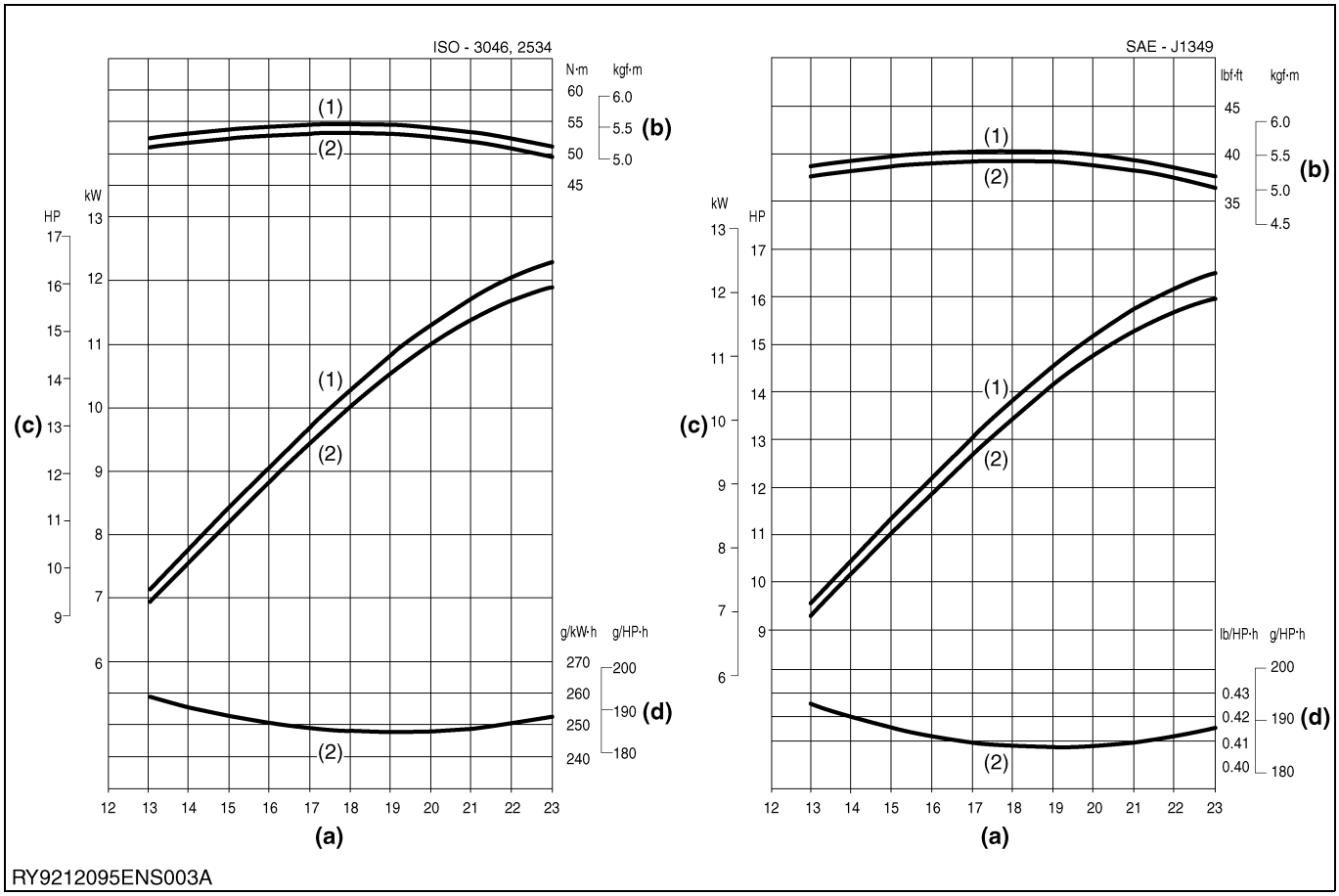
		KX015-4, KX016-4	KX018-4, KX019-4
Alternator		12 V (480 W)	
Charging current		40 A	
Regulation voltage		14.2 to 14.8 V	
Battery	ETN	545 024 030	
	DIN	54524	
	JIS	12V45AH, 55B24R	
Electrolyte gravity		1.28 ± 0.01	
Starter		12 V (1.2 kW)	12 V (1.4 kW)
Grow plug		0.9 Ω	

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

RY9212091END0002US0

[2] PERFORMANCE CURVE

D902-BH-2



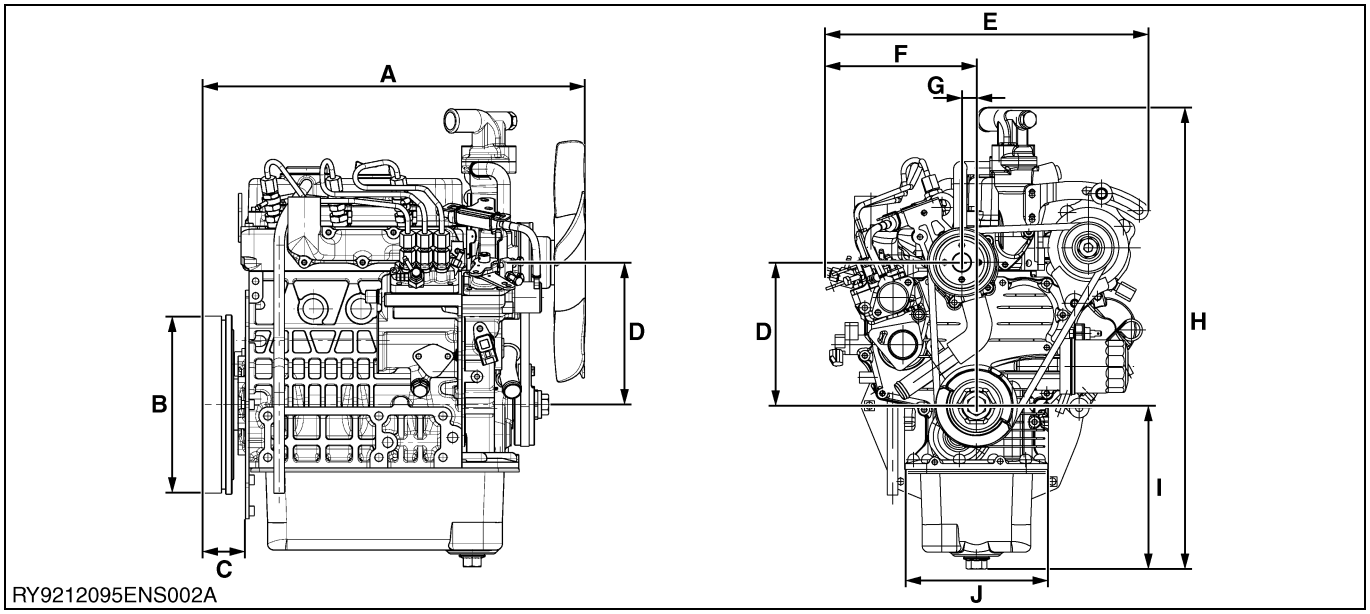
RY9212095ENS003A

(1) Gross int.
(2) Net int.

(a) Engine Speed (rpm × 100)
(b) Torque
(c) Brake Horsepower
(d) Specific Fuel Consumption

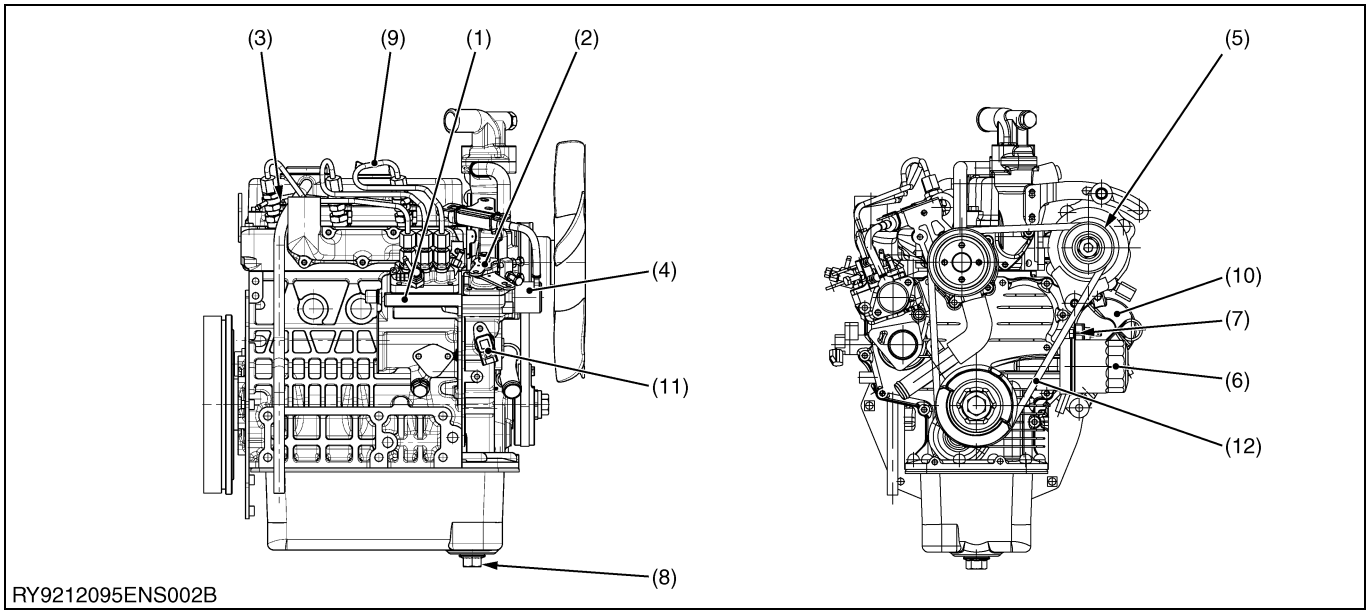
RY9212095END0002US0

[3] DIMENSIONS



A	470.5 mm (18.5 in.)	**F**	186 mm (7.32 in.)
B	ϕ218 mm (ϕ8.58 in.)	**G**	18 mm (0.71 in.)
C	51.5 mm (2.03 in.)	**H**	564 mm (22.2 in.)
D	175 mm (6.89 in.)	**I**	199.6 mm (7.86 in.)
E	396 mm (15.6 in.)	**J**	174 mm (6.85 in.)

Component layout



No.	Part name	No.	Part name	No.	Part name
(1)	Injection pump	(5)	Alternator	(9)	Oil inlet plug
(2)	Speed control lever	(6)	Oil filter	(10)	Starter
(3)	Glow plug	(7)	Oil switch	(11)	Revolution sensor
(4)	Engine stop solenoid	(8)	Drain plug (Oil)	(12)	V-belt

RY9212095END0001US0

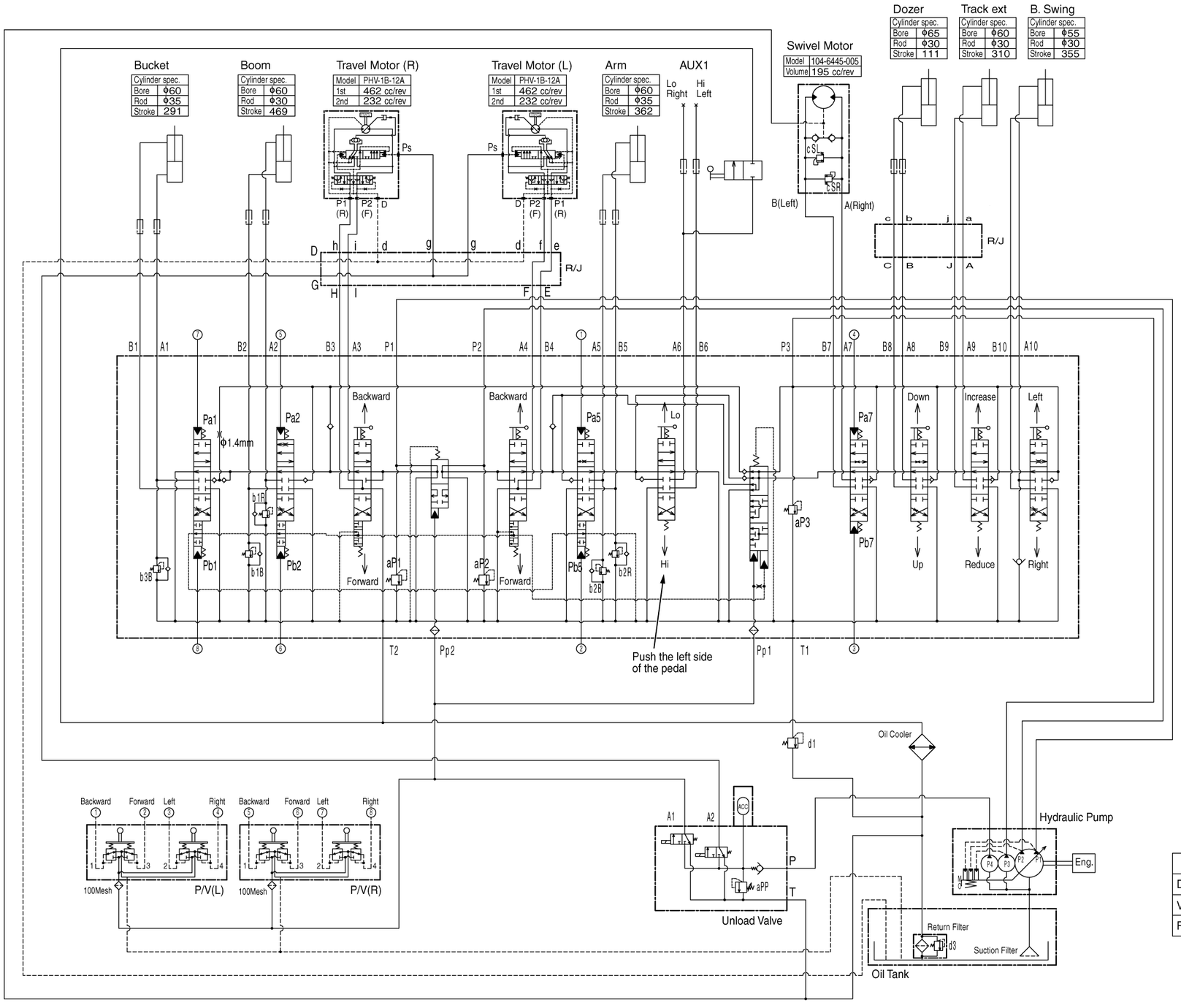
3 HYDRAULIC SYSTEM

MECHANISM

CONTENTS

1. DIAGRAM OF HYDRAULIC CIRCUIT

[1] DIAGRAM OF HYDRAULIC CIRCUIT [KX018-4]



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

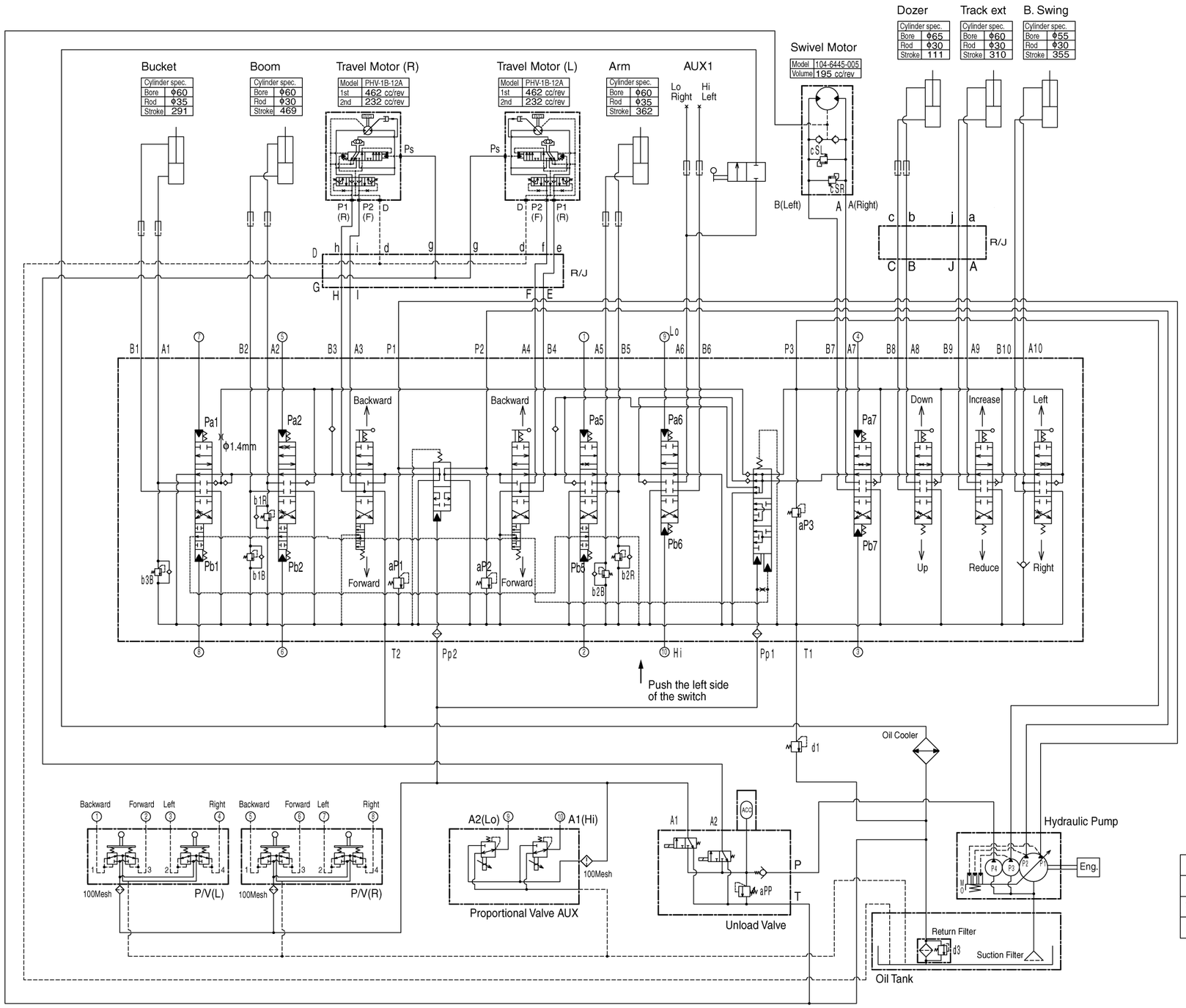
Mark	Relief Pressure (MPa)		
aP1	Main P1		21.6
aP2	Main P2		21.6
aP3	Main P3		20.6
aPp	Pilot Primary		4.0
b1B	Boom	Bottom	17.0
b1R		Rod	27.5
b2B	Arm	Bottom	23.5
b2R		Rod	23.5
b3B	Bucket	Bottom	23.5
b3R		Rod	—
cSL	Swivel Motor	LH	13.2
cSR		RH	13.2
d1	Main Return		0.35
d3	Return Filter By-pass		0.2

	P1	P2	P3	Pp
Drive Speed (rpm)	2300	2300	2300	2300
Volume (cc/rev)	7.5	7.5	4.5	2.7
Pump Flow (L/min)	17.3	17.3	10.4	6.2

KX018-4 Hydraulic Schematic

RY9212095HYT003US

[2] DIAGRAM OF HYDRAULIC CIRCUIT [KX019-4]



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 Low Pressure
⑩	AUX1 High Pressure

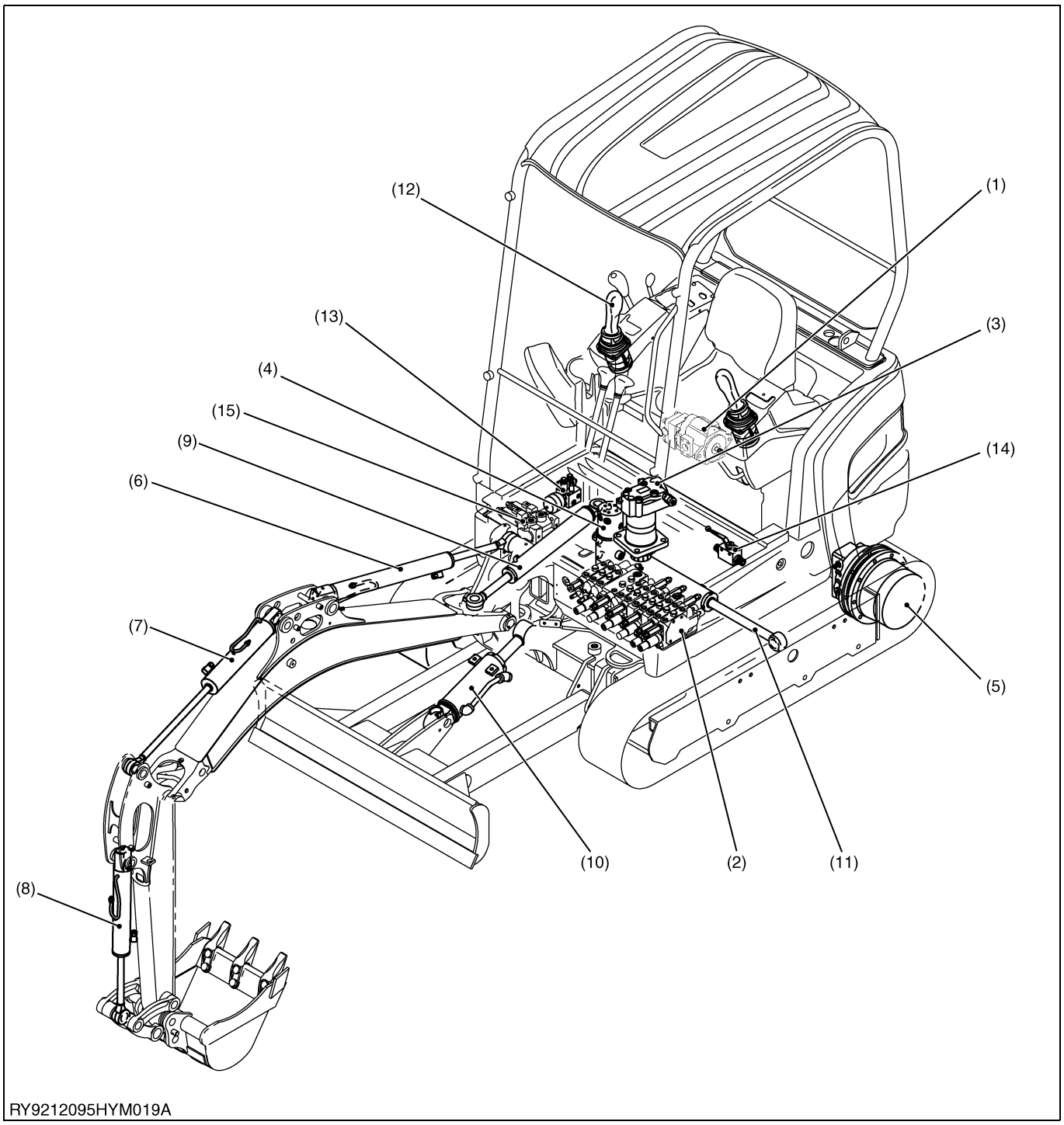
Mark	Relief Pressure (MPa)		
aP1	Main P1		21.6
aP2	Main P2		21.6
aP3	Main P3		20.6
aPp	Pilot Primary		4.0
b1B	Boom	Bottom	17.0
b1R		Rod	27.5
b2B	Arm	Bottom	23.5
b2R		Rod	23.5
b3B	Bucket	Bottom	23.5
b3R		Rod	—
cSL	Swivel Motor	LH	13.2
cSR		RH	13.2
d1	Main Return		0.35
d3	Return Filter By-pass		0.2

	P1	P2	P3	Pp
Drive Speed (rpm)	2300	2300	2300	2300
Volume (cc/rev)	7.5	7.5	4.5	2.7
Pump Flow (L/min)	17.3	17.3	10.4	6.2

KX019-4 Hydraulic Schematic

RY9212095HYT004US

2. HYDRAULIC DEVICE LAYOUT

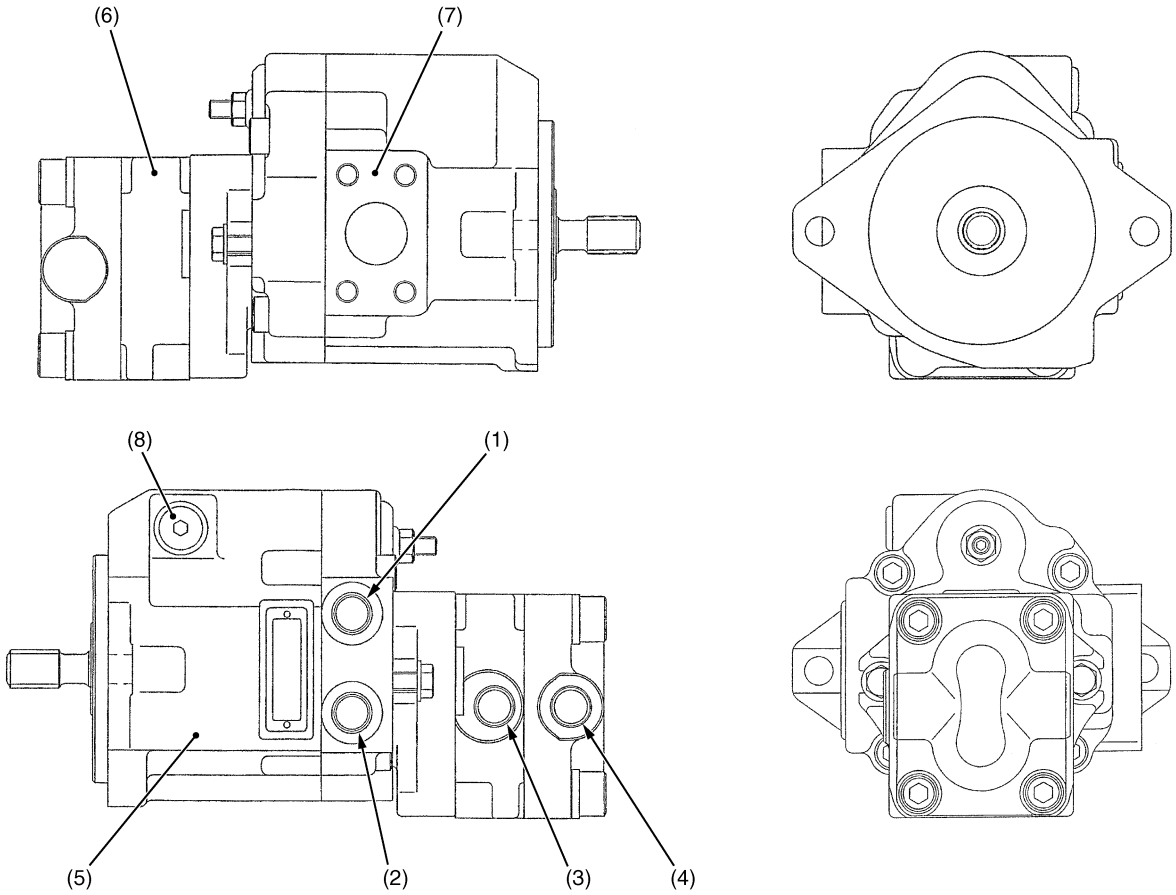


(1) Pump
(2) Control Valve
(3) Swivel Motor
(4) Swivel Joint
(5) Travel Motor
(6) Boom Cylinder
(7) Arm Cylinder
(8) Bucket Cylinder
(9) Swing Cylinder
(10) Blade Cylinder
(11) Track Cylinder
(12) Pilot Valve (Control)
(13) Unload Valve
(14) Third Line Valve
(15) AUX Solenoid Valve

RY9212095HYM0038US0

3. PUMP

[1] SPECIFICATIONS

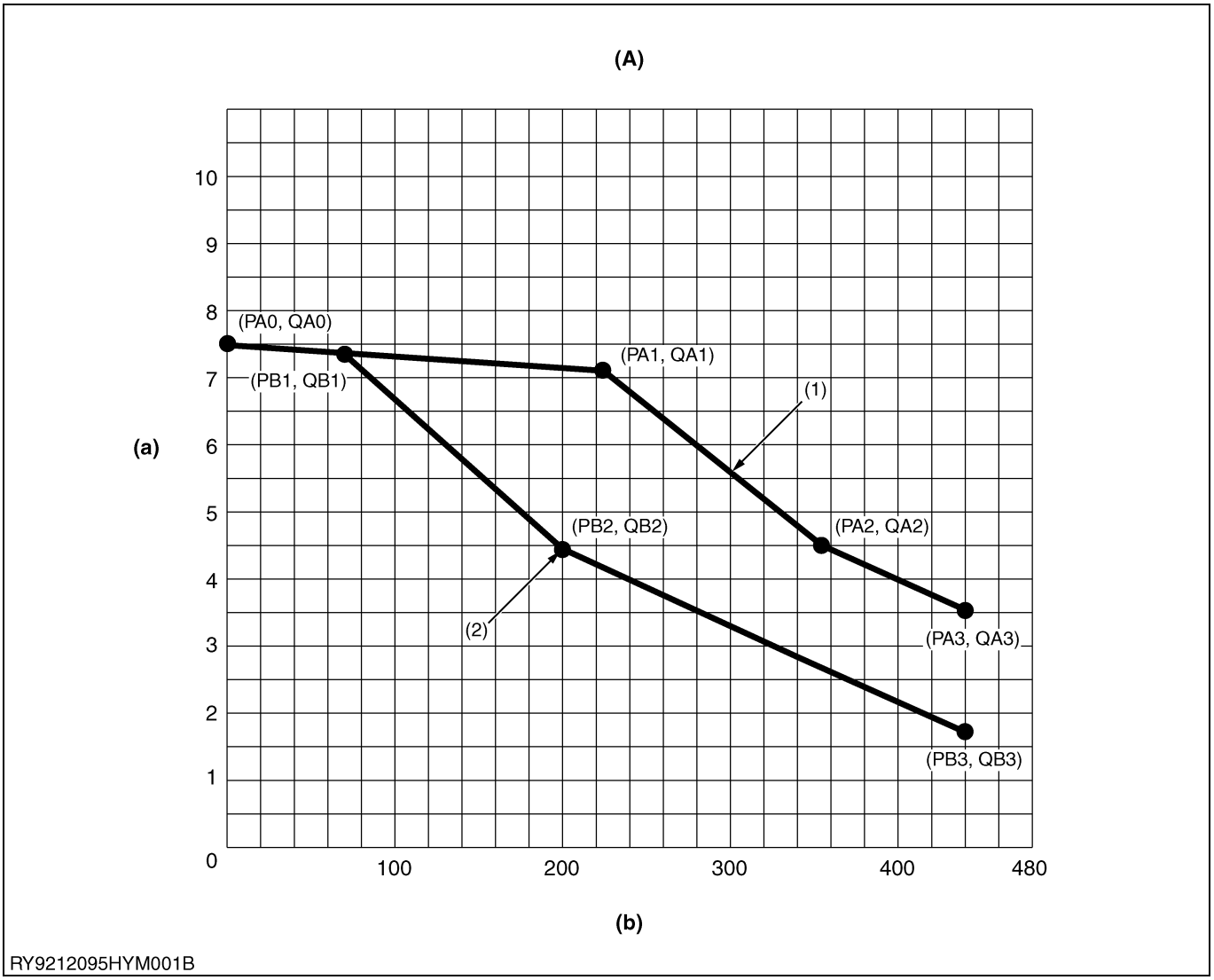


RY9212091HYM002A

(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		KX018-4	KX019-4	Notes
Maker		Fujikoshi (Ltd.)		
Model		PVD-00B-15P-5G3-49782A		
Rated RPM		2300 rpm		
Direction of Rotation		Right		
Max. Displacement	Piston Pumps P1+ P2	7.5 + 7.5 cc/rev 0.46 + 0.46 cu.in./rev		
	Gear Pump P3	4.5 cc/rev 0.27 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	20.6 MPa 210 kgf/cm^2 2990 psi		
	Pilot Pump P4	3.9 MPa 40 kgf/cm^2 570 psi		

RY9212095HYM0001US0



RY9212095HYM001B

(1) P3 = 0.5 MPa (5 kgf/cm^2, 70 psi)

(2) P3 = 20.6 MPa (210 kgf/cm^2, 2990 psi)

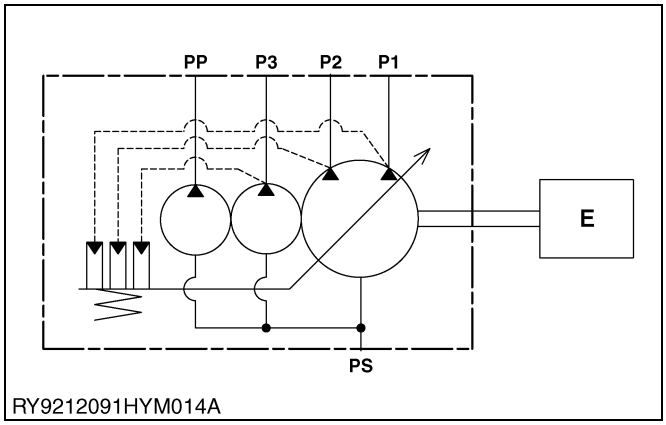
(A) Horsepower Control Curve (Reference: Bench Test)

(a) Discharge Flow: q1 = q2 (cc/rev)

(b) Discharge Pressure: P1 + P2 (kgf/cm^2)

Shaft speed: 2300 rpm			
At gear pump pressure: P_3 = 0.5 MPa		**At gear pump pressure: P_3 = 20.6 MPa**	
Pressure (MPa)	**Delivery flow (cc/rev)**	**Pressure (MPa)**	**Delivery flow (cc/rev)**
PA0 = 0.0	QA0 = 7.5 (Target value)		
PA1 = 21.9	QA1 = 7.1 (Target value)	PB1 = 6.9	QB1 = 7.4 (Target value)
PA2 = 34.7	QA2 = 4.5 (Target value)	PB2 = 19.6	QB2 = 4.5 (Target value)
PA3 = 43.2	QA3 = 3.5 (Target value)	PB3 = 43.2	QB3 = 1.7 (Target value)

RY9212095HYM0002US0



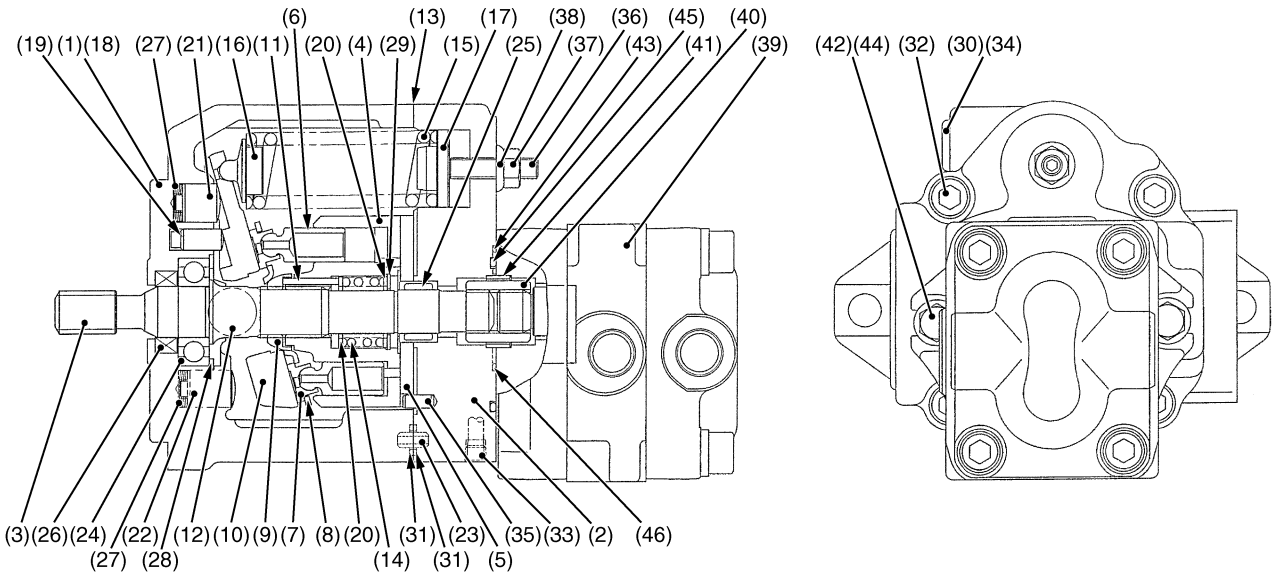
RY9212091HYM014A

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



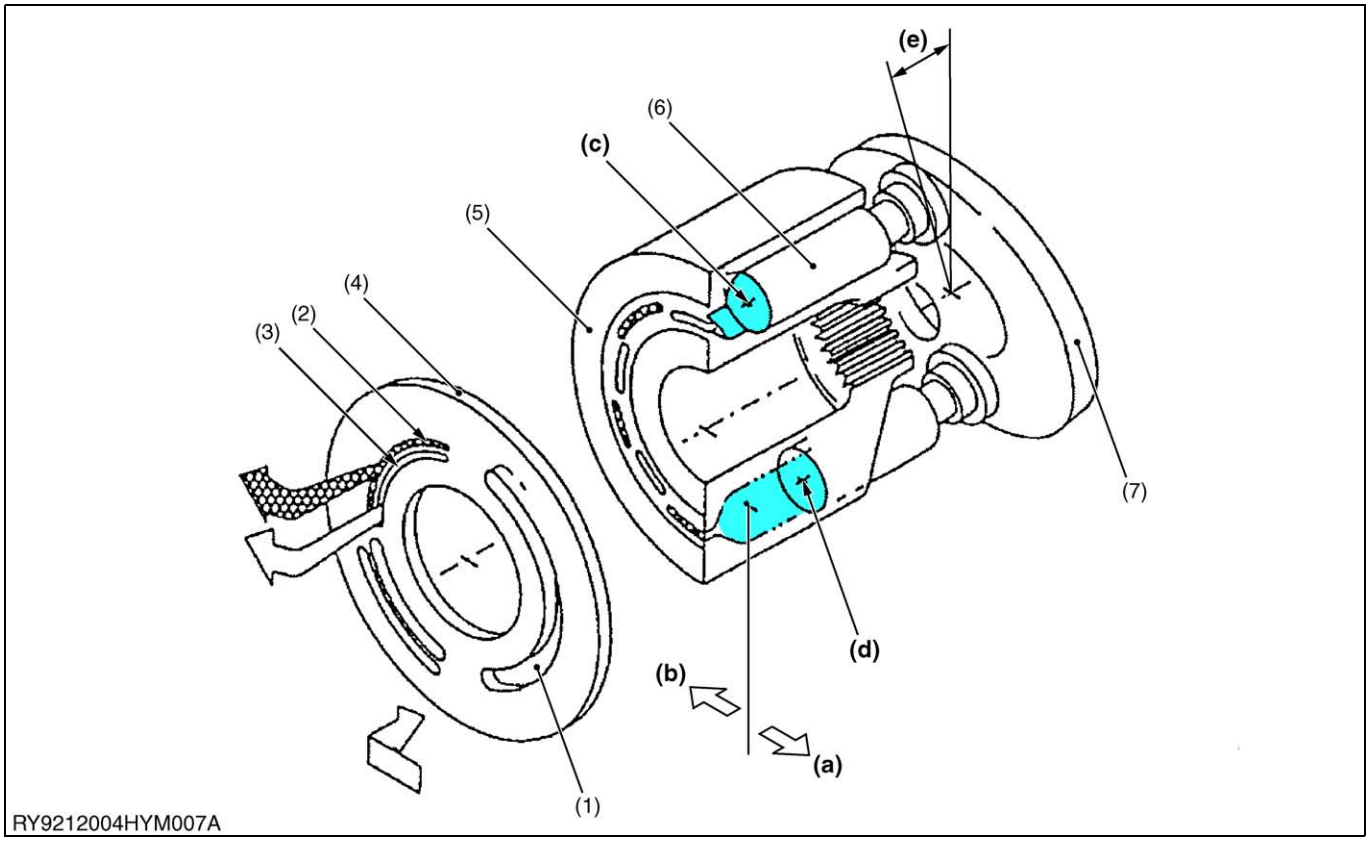
RY9212091HYM003A

No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(1)	Body-S	1		(24)	Bearing	1	
(2)	Body-H	1		(25)	Needle Bearing	1	
(3)	Shaft	1		(26)	Oil Seal	1	
(4)	Cylinder Barrel	1		(27)	Coned Disk Springs	8	
(5)	Valve Plate	1		(28)	Snap Ring	1	JIS B 2804 42 Hole
(6)	Piston	10		(29)	Snap Ring	1	JIS B 2804 28 Hole
(7)	Shoe	10		(30)	O-ring	1	JIS B 2401, 1B, P11
(8)	Shoe Holder	1		(31)	O-ring	2	JIS B 2401, 1B, P8
(9)	Barrel Holder	1		(32)	Screw	4	JIS B 1176 M10 × 40 12T
(10)	Swash Plate	1		(33)	Plug	4	
(11)	Needle	3		(34)	Plug	1	
(12)	Ball	2		(35)	Spring Pin	1	JIS B 2808 5 × 12 AW
(13)	Packing	1		(36)	Screw	1	JIS B 1177 M8 × 30
(14)	Spring C	1		(37)	Nut	1	JIS B 1181 M8
(15)	Spring T	1		(38)	Seal Washer	1	
(16)	Spring Holder	1		(39)	Gear Pump Kit	1	
(17)	Spring Guide	1		(40)	Coupling	1	
(18)	Pin	1		(41)	Collar	1	
(19)	Rod G	1		(42)	Screw	2	JIS B 1180 M8 × 25 11T
(20)	Retainer	2		(43)	O-ring	1	JIS B 2401, 1B, P7
(21)	Stopper Pin A	1		(44)	Washer	2	JIS B 2401, 1B, G55
(22)	Stopper Pin B	1		(45)	O-ring	1	JIS B 2401, 1B, P8
(23)	Pin	1		(46)	O-ring	1	

RY9212091HYM0012US0

[3] FUNCTION AND STRUCTURE

(1) Pump Operating Principles

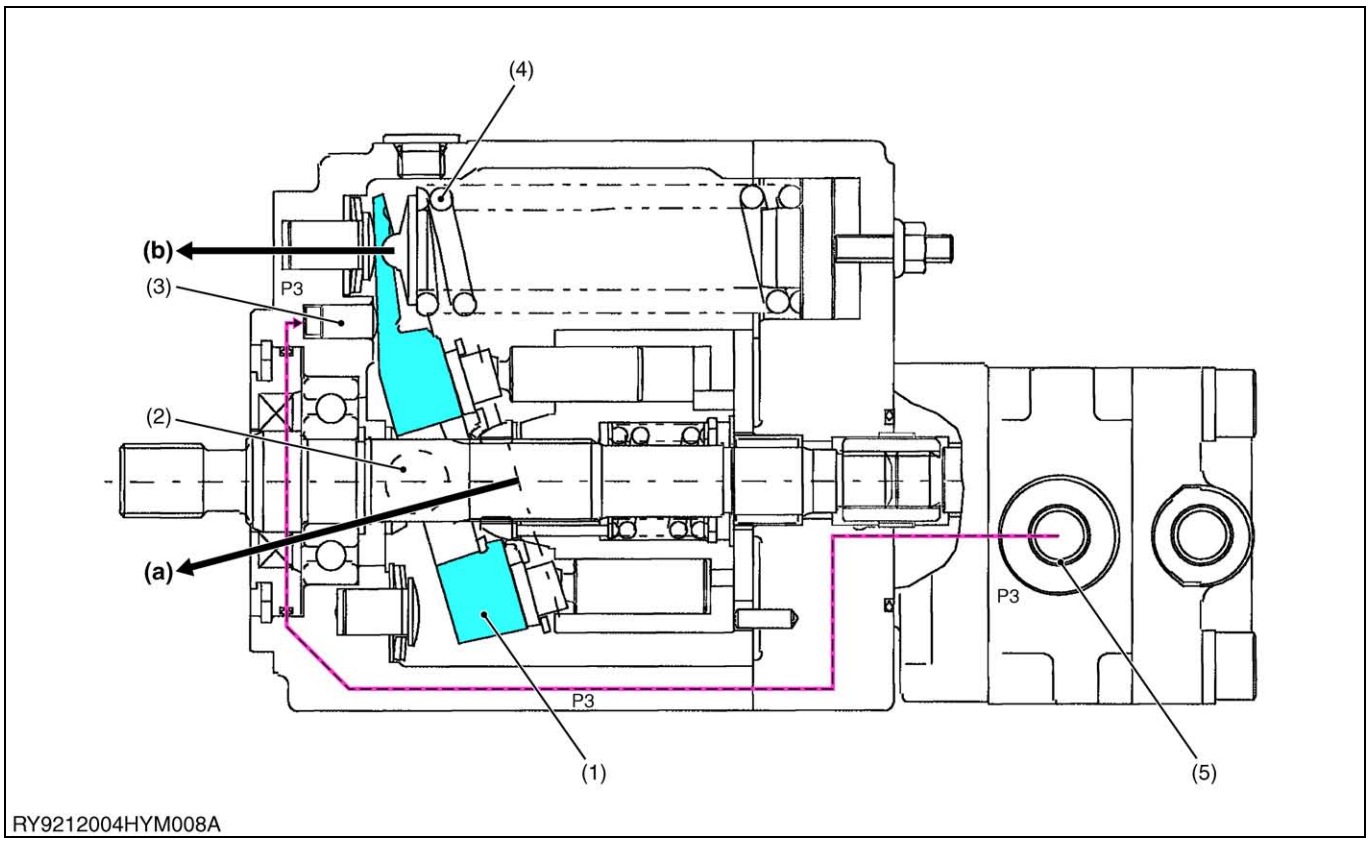


(1) Suction Port
(2) Discharge Port (P1)
(3) Discharge Port (P2)
(4) Valve Plate
(5) Cylinder Barrel
(6) Piston
(7) Swashplate
(a) Intake Cycle
(b) Discharge Cycle
(c) Top Dead Center
(d) Bottom Dead Center
(e) Tilt Angle

- 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 swashplate as they slide on the top of the swashplate; 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 swashplate, as the swashplate'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 swashplate, so the discharge quantity from the outside (P1) and the inside (P2) of the valve plate is identical. Furthermore, as the swashplate is in one place, even when the swashplate 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



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

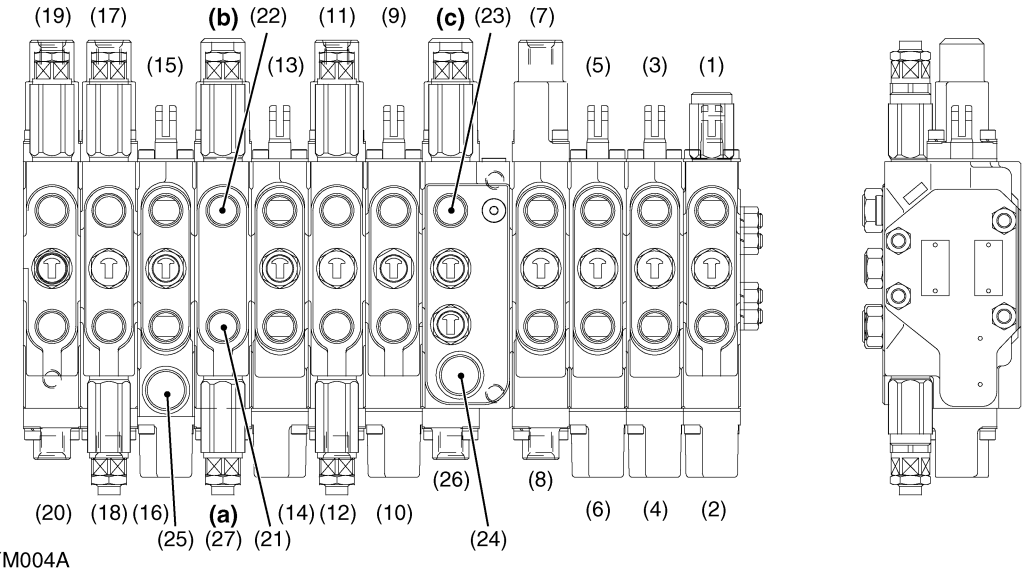
Set Horsepower Control Mechanism

- Although the pump discharge quantity alters the swashplate angle, the swashplate 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 swashplate'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 swashplate. 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 swashplate 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 swashplate, so the characteristic P-Q shifts, which maintains the horsepower at a fixed level, including the gear pump. (Total Horsepower Regulator)

RY9212091HYM0011US0

4. CONTROL VALVE

[1] SPECIFICATIONS



RY9212091HYM004A

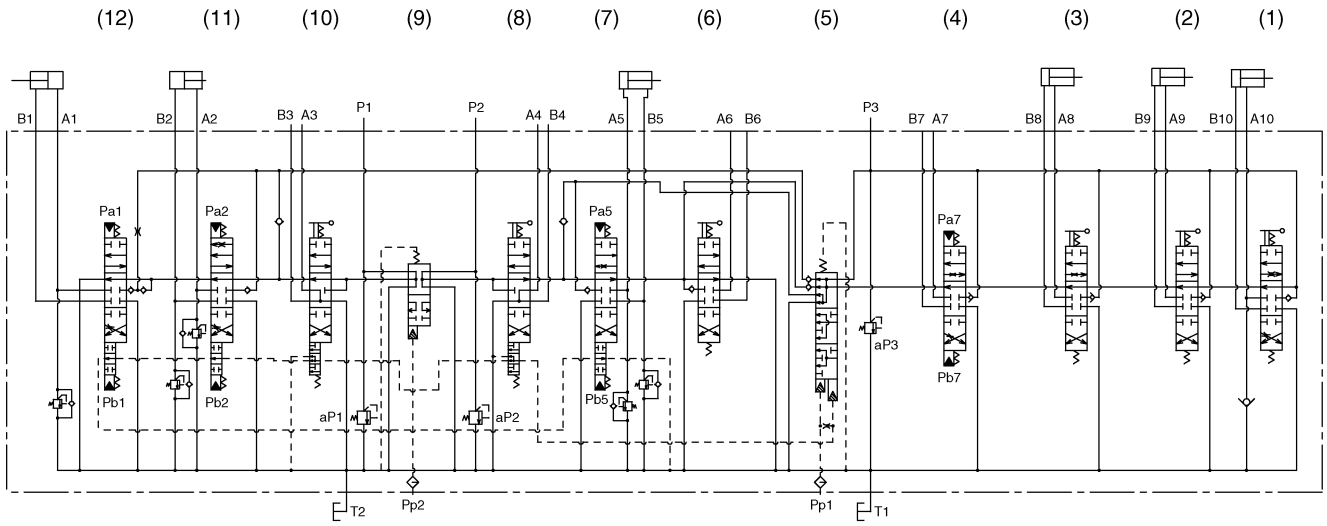
(1) Swing Rod
(2) Swing Bottom
(3) Track EXT Rod
(4) Track EXT Bottom
(5) Blade Rod
(6) Blade Bottom
(7) Swivel Right (Pa7)
(8) Swivel Left (Pb7)
(9) AUX (Pa6)
(10) AUX (Pb6)
(11) Arm Bottom (Pa5)
(12) Arm Rod (Pb5)
(13) Travel Left Reverse
(14) Travel Left Forward
(15) Travel Right Reverse
(16) Travel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

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

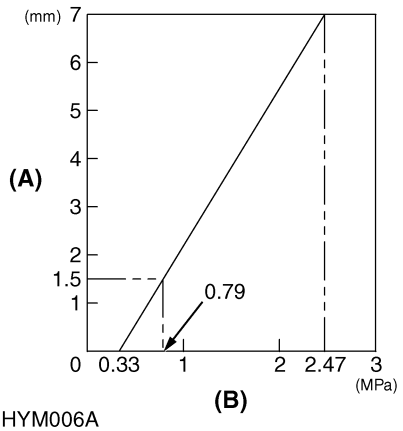
Item		KX018-4	KX019-4	Remarks
Maker		Hydrocontrol		
Model		EV310079	EV310080	
Main relief valve pressure setting	P1, P2	21.6 MPa 220 kgf/cm^2 3130 psi		at 17.3 L/min 1060 cu.in./min 4.6 USGPM
	P3	20.6 MPa 210 kgf/cm^2 2990 psi		at 10.4 L/min 635 cu.in./min 2.8 USGPM
Overload relief valve pressure setting	Bucket (19)	23.5 MPa 240 kgf/cm^2 3410 psi		at 5 L/min 300 cu.in./min 1.3 USGPM
	Boom (18)	17.0 MPa 174 kgf/cm^2 2500 psi		at 5 L/min 300 cu.in./min 1.3 USGPM
	Boom (17)	27.5 MPa 280 kgf/cm^2 3970 psi		at 5 L/min 300 cu.in./min 1.3 USGPM
	Arm (11), (12)	23.5 MPa 240 kgf/cm^2 3410 psi		at 5 L/min 300 cu.in./min 1.3 USGPM

RY9212095HYM0004US0

[2] DIAGRAM OF HYDRAULIC CIRCUIT



RY9212091HYM005A



RY9212091HYM006A

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

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

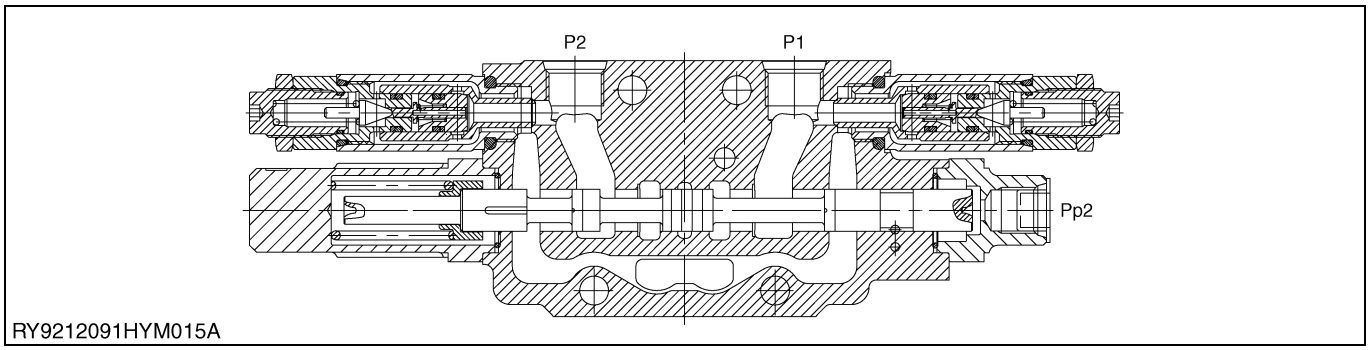
RY9212095HYM0037US0

[3] FUNCTION AND STRUCTURE

(1) Cross-section of Each Section

[A] P1 Line

Inlet Section



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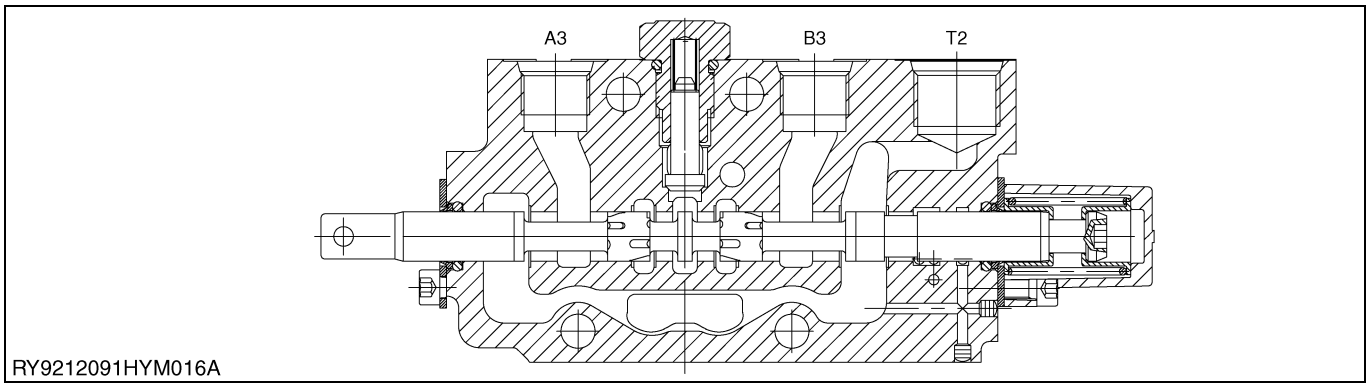
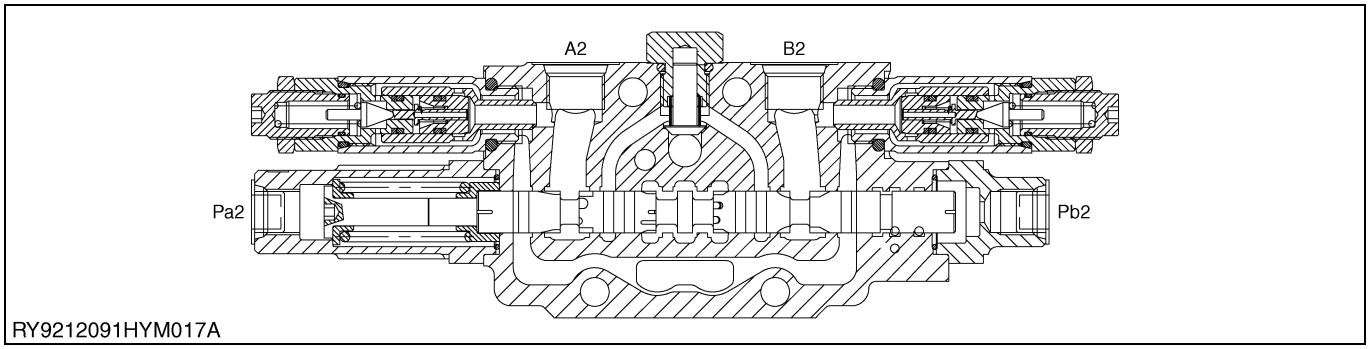
Travel Right Section



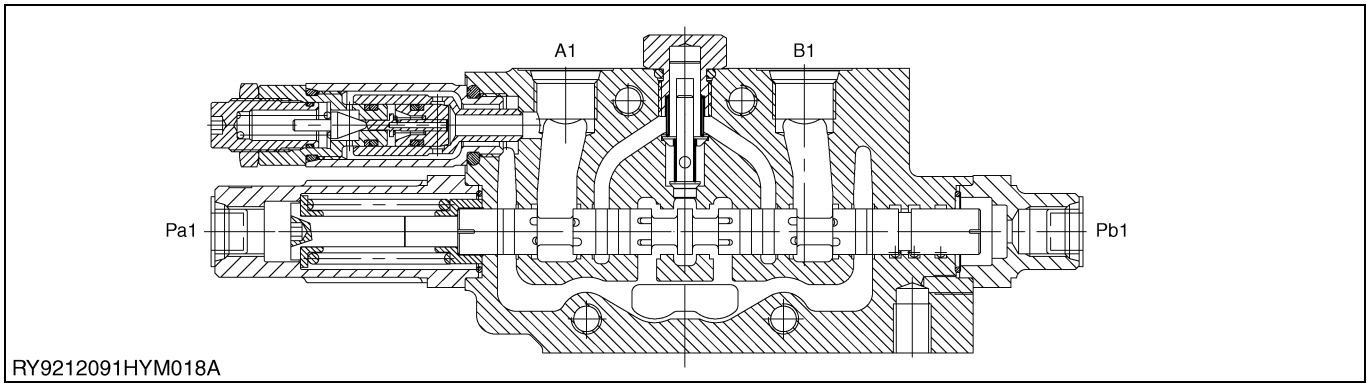
RY9212091HYM0024US0

Boom Section



RY9212091HYM0025US0

Bucket Section



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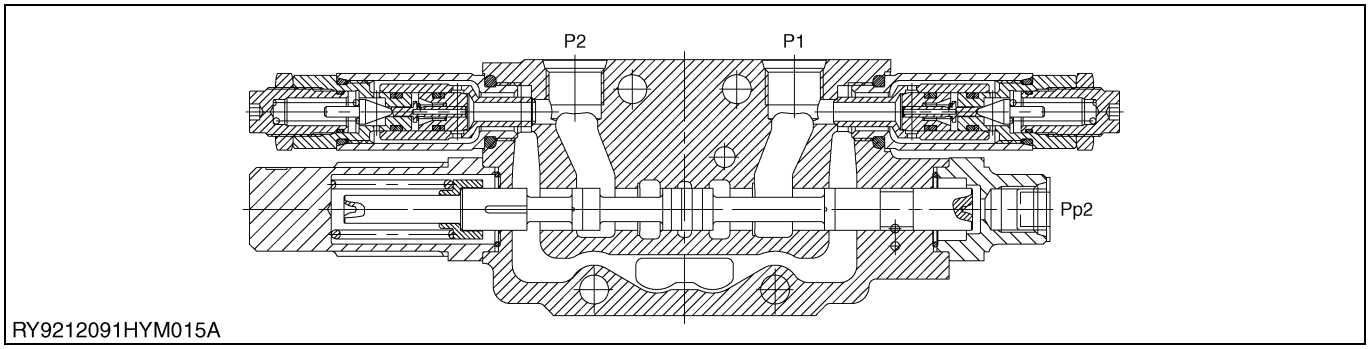
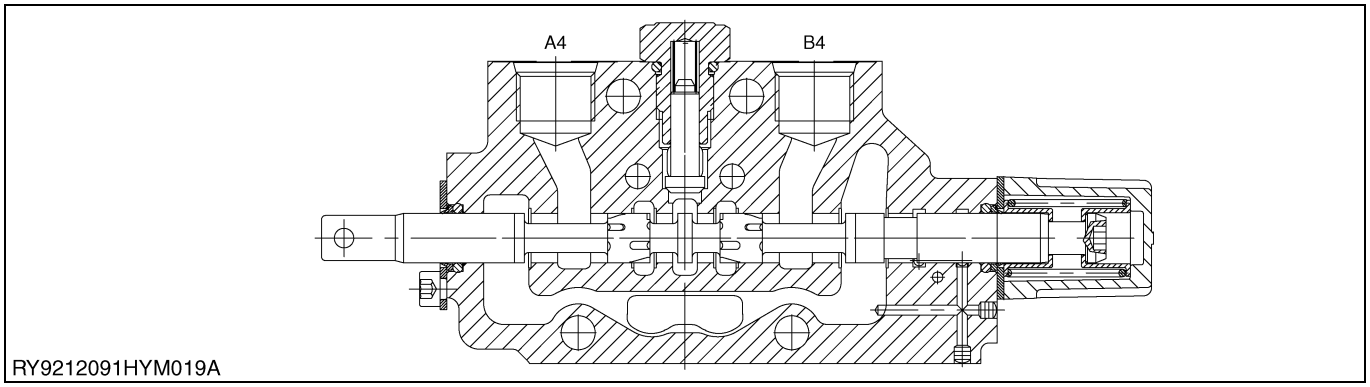
[B] P2 Line

Inlet Section



RY9212091HYM0017US0

Travel Left Section



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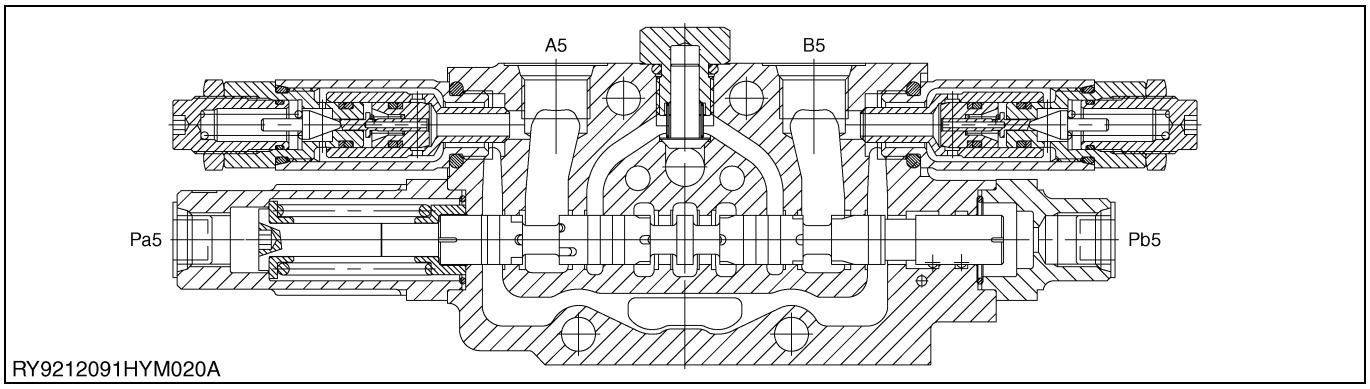
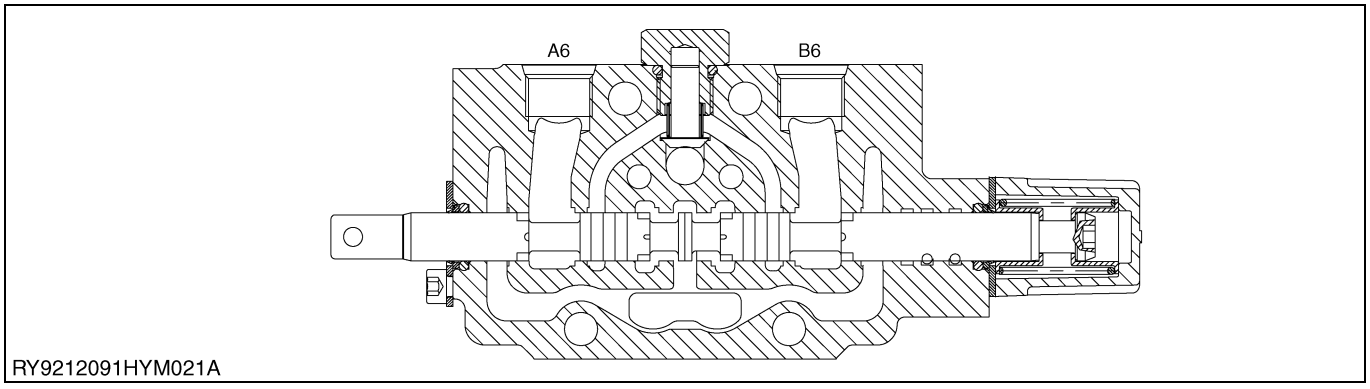
Arm Section



RY9212091HYM0028US0

AUX Section

(KX018-4: Mechanical model, KX019-4: Hydraulic model)



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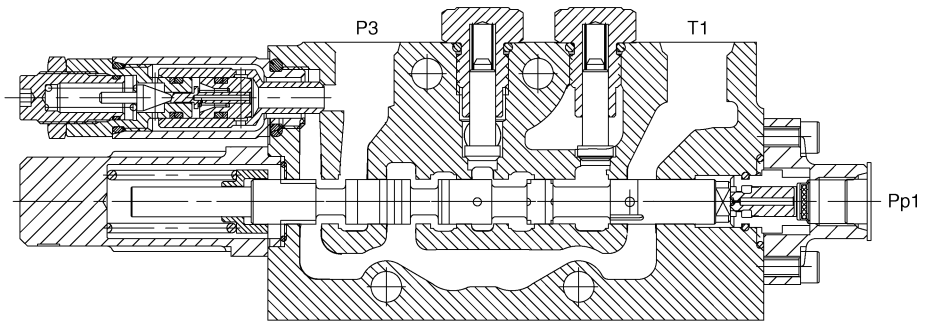
[C] P3 Line

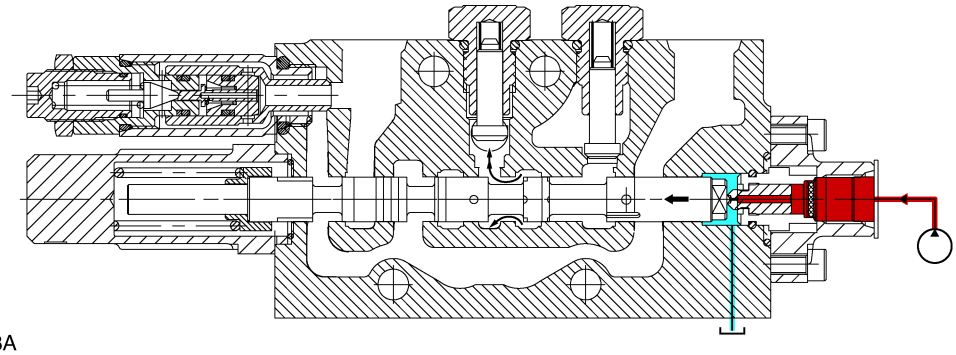
Communication Valve Section

Step 1 (Raises Unload Lever)



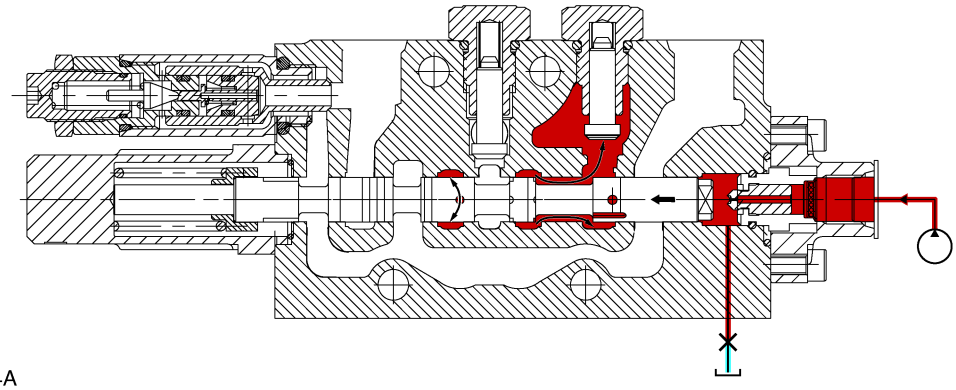
RY9212091HYM022A

Step 2 (Lowers Unload Lever)



RY9212091HYM023A

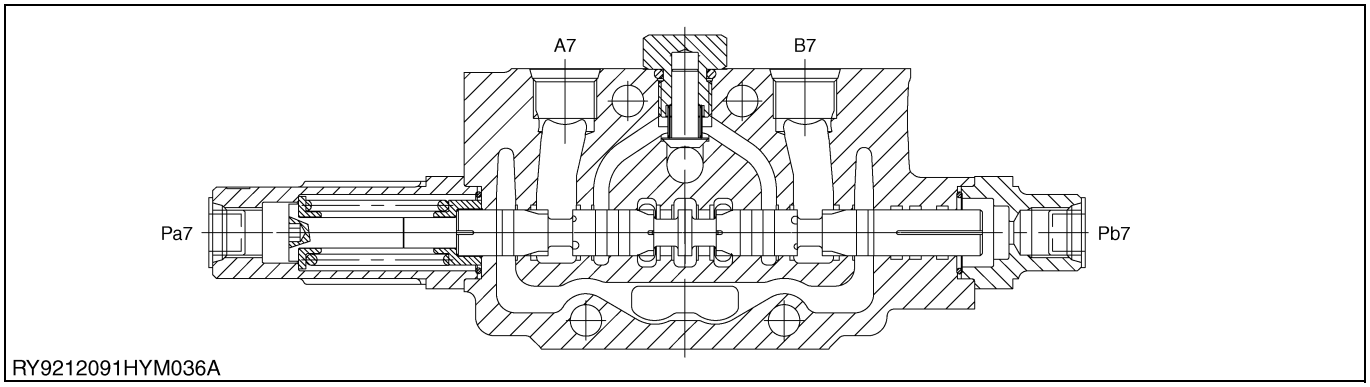
Step 3 (Travel + Front Operation)



RY9212091HYM024A

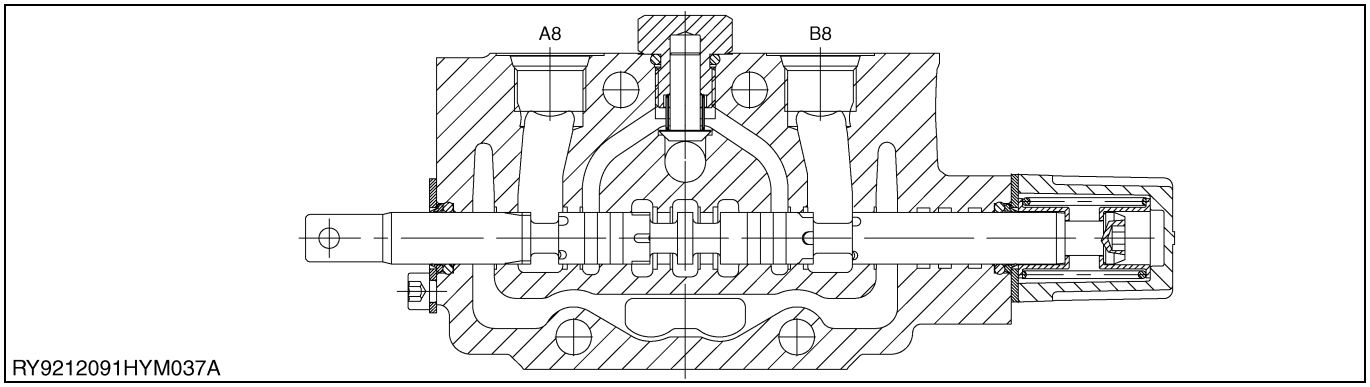
RY9212091HYM0030US0

Swivel Section



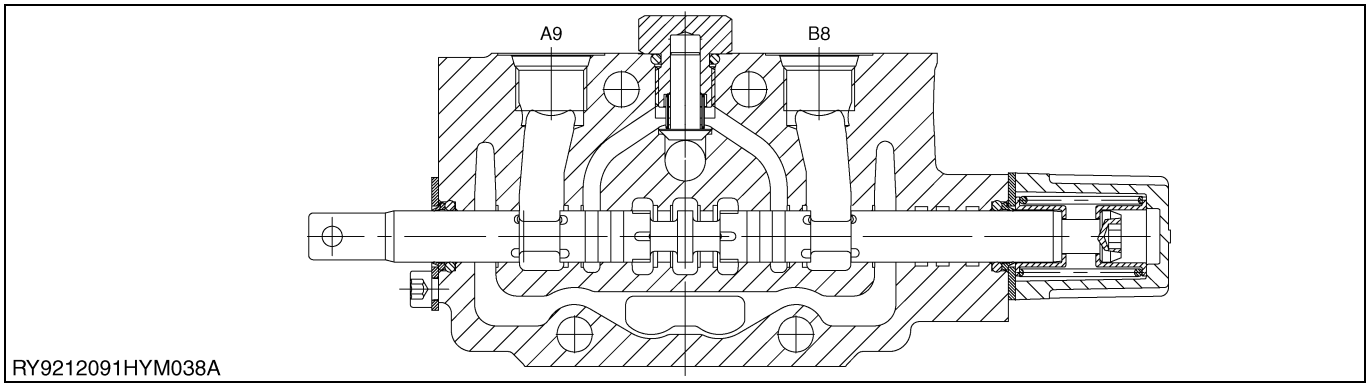
RY9212091HYM0031US0

Blade Section



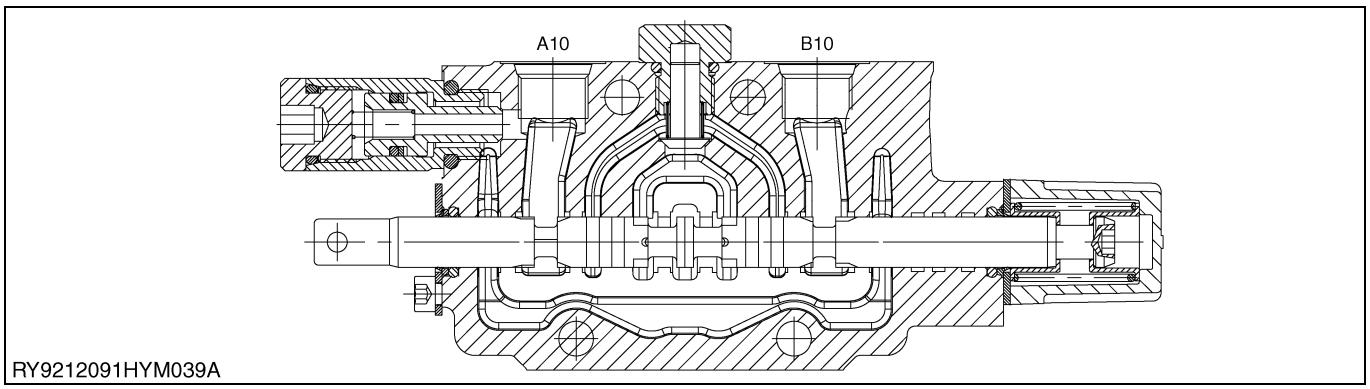
RY9212091HYM0032US0

Variable Track Section



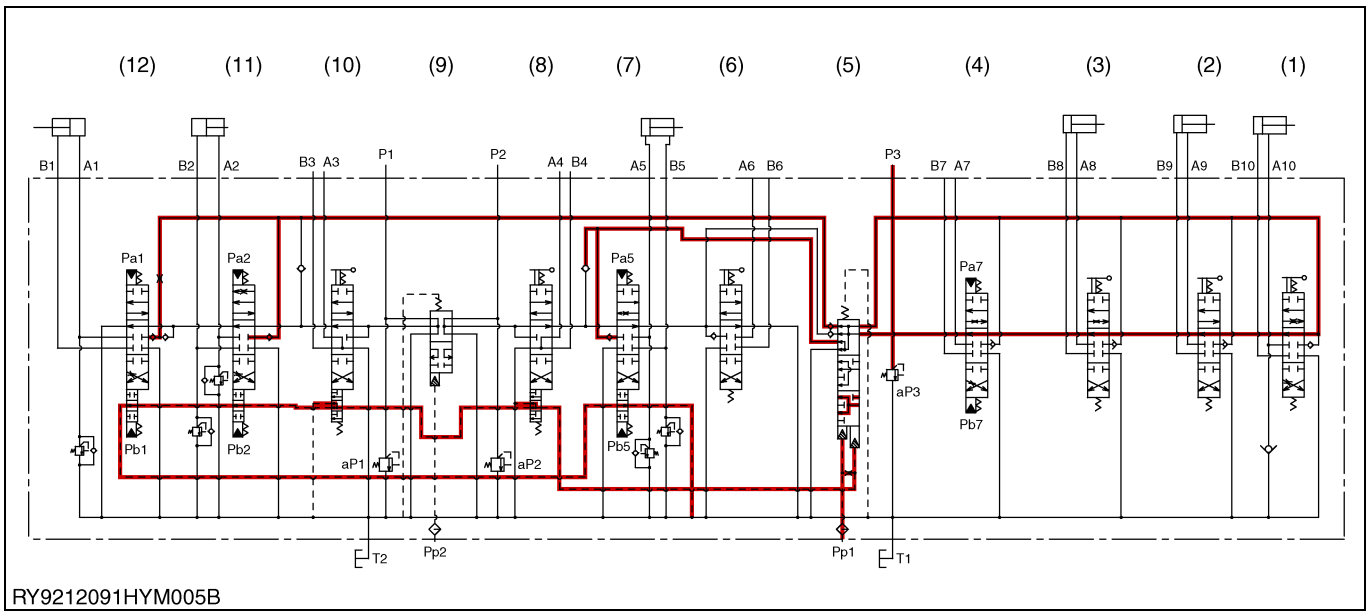
RY9212091HYM0033US0

Swing Section



RY9212091HYM0034US0

(2) Straight Travel Circuit



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

RY9212095HYM0036US0

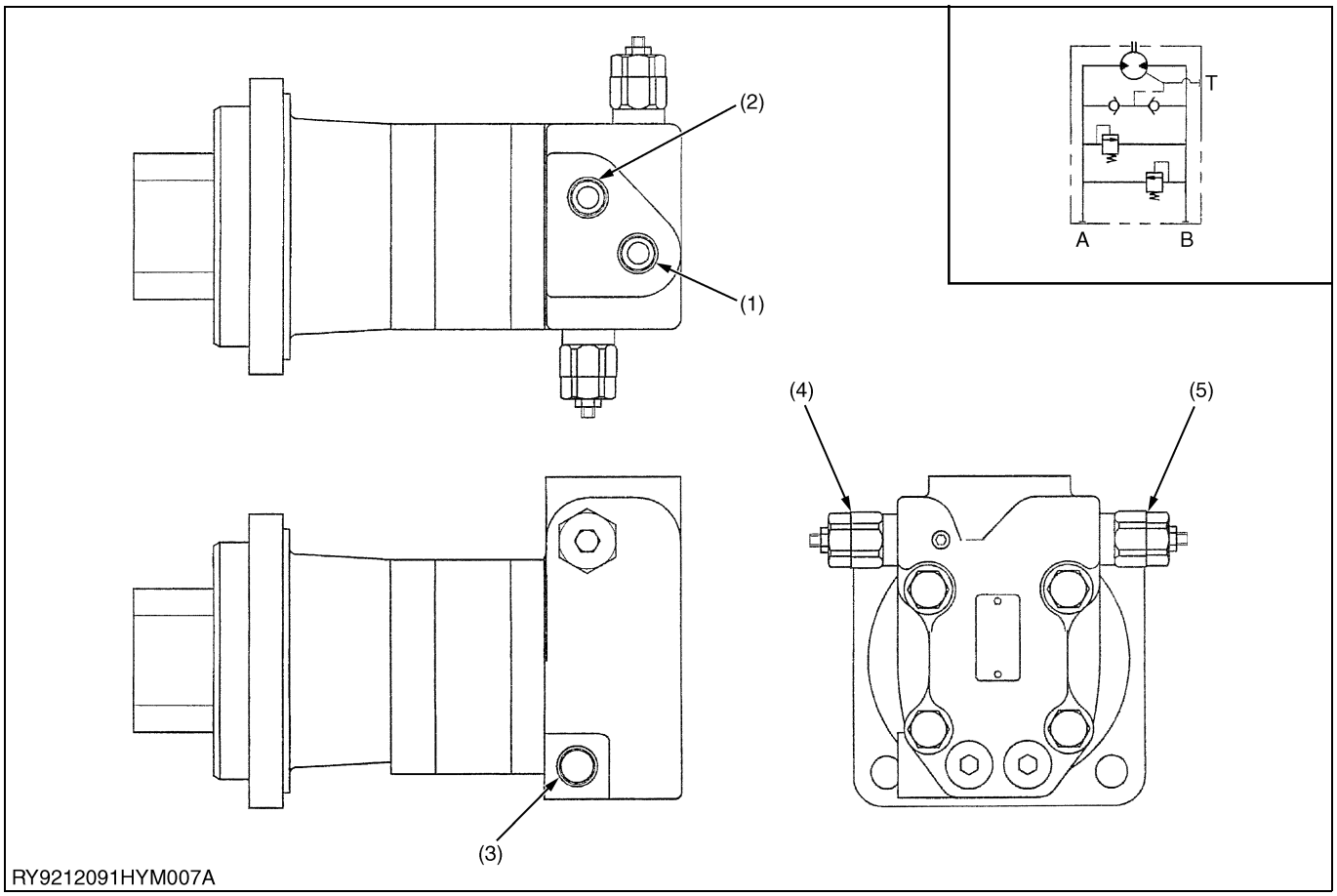
- The travel straight forward signal line is connected with the tank circuit by the left/right travel switch when it is in neutral, and the main spool of the communication valve remains in the neutral position.
- By switching to travel left or right, the pilot lines becomes one and if an attachment on 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 communication valve.
- When the main spool of the communication valve is completely switched, the oil supplied from P3 passes through the check valve inside the communication 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.

RY9212091HYM0035US0

5. SWIVEL MOTOR

[1] SWIVEL MOTOR

(1) Specifications



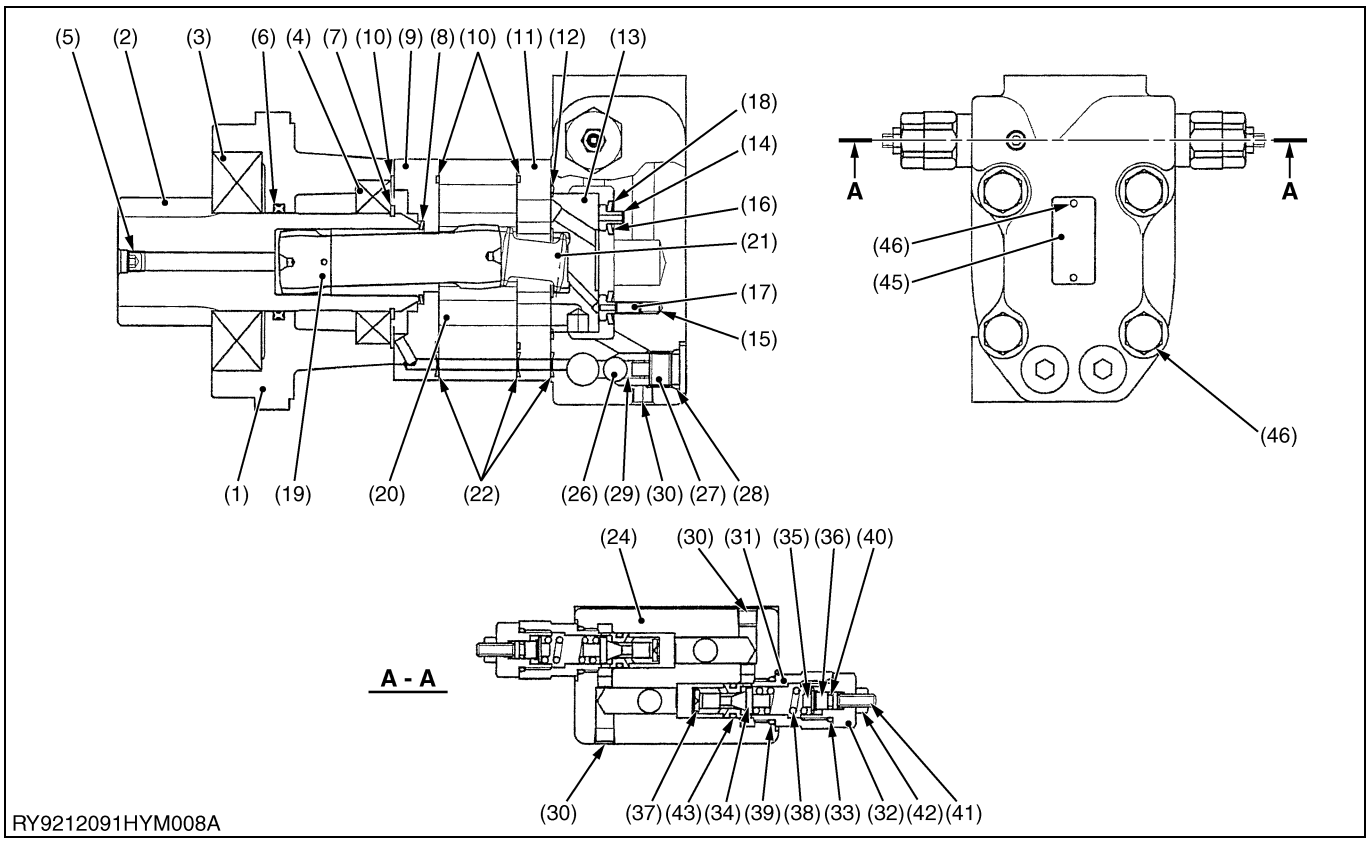
RY9212091HYM007A

(1) Port A
(2) Port B
(3) Drain Port
(4) Relief Valve (R)
(5) Relief Valve (L)

Item		Notes
Maker	Eaton (Ltd.)	
Model	104-6445-005	
Total Displacement	195 cc/rev 11.9 cu.in./rev	
Rated Flow	30 L/min 1800 cu.in./min	
Theoretical RPM	53.3 rpm	at 10.4 L/min 635 cu.in./min 2.75 USGPM
Relief Valve Pressure	13.2 MPa 135 kgf/cm^2 1910 psi	at 10 L/min 610 cu.in./min 2.64 USGPM

RY9212091HYM0036US0

(2) Components

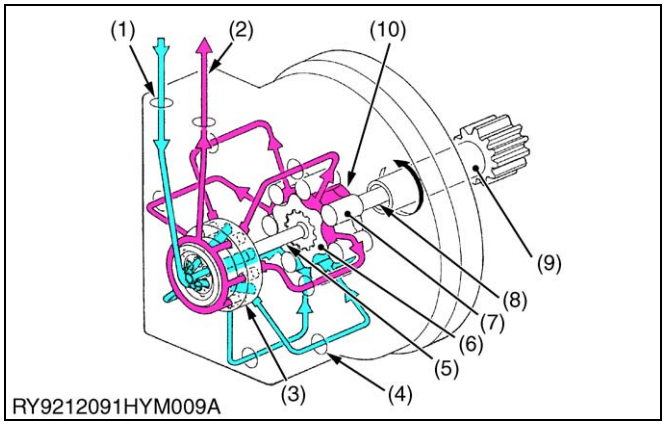


No.	Name of part	Qty	Notes	No.	Name of part	Qty	Notes
(1)	Bearing housing	1		(24)	Valve housing	1	
(2)	Pinion gear	1		(25)	Relief cartridge	2	Includes nos. 31 to 43
(3)	Ball bearing	1	6308 LLU	(26)	Steel ball	2	
(4)	Ball bearing	1	6207	(27)	Plug	2	
(5)	Plug	1	R1/8	(28)	O-ring	2	1BP14
(6)	X-ring	1		(29)	Spring	2	
(7)	Retaining ring	1		(30)	Plug	3	R1/8
(8)	Shaft face seal	1		(31)	Cartridge	2	
(9)	Wear plate	1		(32)	Screw guide	2	
(10)	O-ring	3	AS568-041	(33)	O-ring	2	1BP16
(11)	Valve plate	1		(34)	Needle valve	2	
(12)	O-ring	1	AS568-038	(35)	Spring seat	2	
(13)	Valve	1		(36)	Compression spring	2	
(14)	Balancing plate	1		(37)	Orifice plate	2	
(15)	Spring	2		(38)	Spring	2	
(16)	Inner face seal	1		(39)	O-ring	2	1BP18
(17)	Pin	2		(40)	O-ring	2	1BP5
(18)	Outer face seal	1		(41)	Hex set screw	2	
(19)	2K drive	1		(42)	Hex nut	2	
(20)	Geroler	1		(43)	O-ring	2	1BP12
(21)	Valve drive	1		(44)	Nameplate	1	
(22)	O-ring	3	AS568-011	(45)	Rivet	2	
(23)	Valve housing ASSY	1	Includes nos. 24 to 43	(46)	Hex bolt	4	

RY9212091HYM0037US0

(3) Function and Structure

[A] Operating Principles

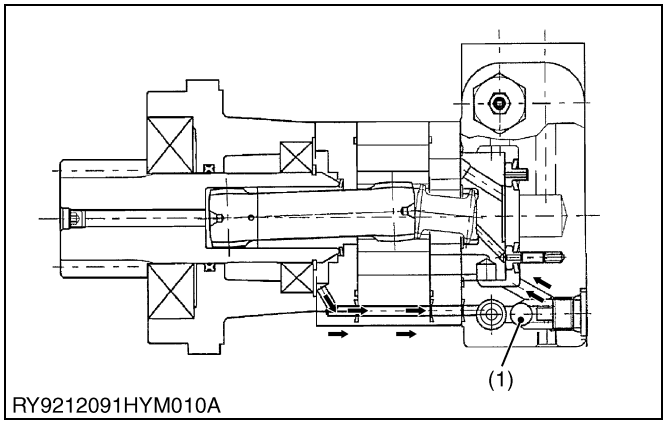


- Pressurized oil from port A (1) flows into the rotor sub-assembly (10) via valve (3) and valve plate (4). The rotor sub-assembly (10) is made up of a stator (7) and seven rotors (6) and is secured by a housing. The rotor (6) has six external teeth, which make seven chambers inside the rotor sub-assembly (10).
- Valve (3) has 12 oil ports, which are divided into half as many each of A ports (1) and B ports (2). The valve plate (4) has seven oil ports, and these ports are connected with the seven chambers of the rotor sub-assembly (10). As a result, the seven oil ports of the valve plate (4) are linked to the circuit to the rotor sub-assembly (10) by connection to any one of the 12 oil ports of the valve (3). Thus, the rotor (3) initiates planetary motion and transmits power to the drive shaft (8) and pinion (9). Further, the rotation of the rotor (6) is transmitted via the valve driveshaft (5) to the valve (3).
- Consequently, the rotation of the valve (3) results in the oil ports of the valve plate (4) shifting in sequence with the oil ports of the valve (3), with which it is in contact; so the pressurized oil that flows into the rotor sub-assembly (10) also flows into a different chamber in sequence, so the motor rotates continuously.

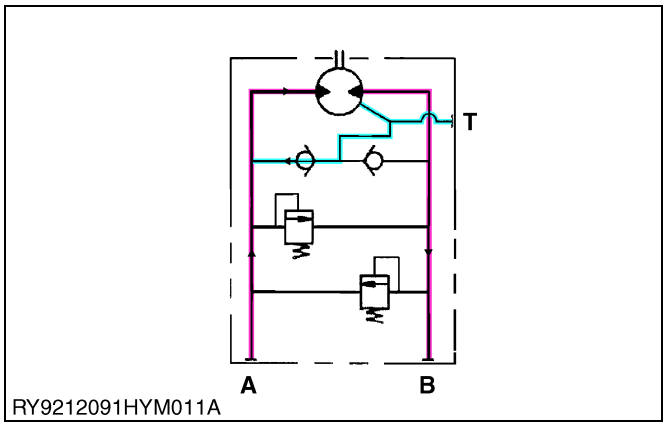
(1) Port A
(2) Port B
(3) Valve
(4) Valve Plate
(5) Valve Driveshaft
(6) Rotor
(7) Stator
(8) Driveshaft
(9) Pinion
(10) Stator

RY9212091HYM0038US0

[B] Make Up Circuit



RY9212091HYM010A



RY9212091HYM011A

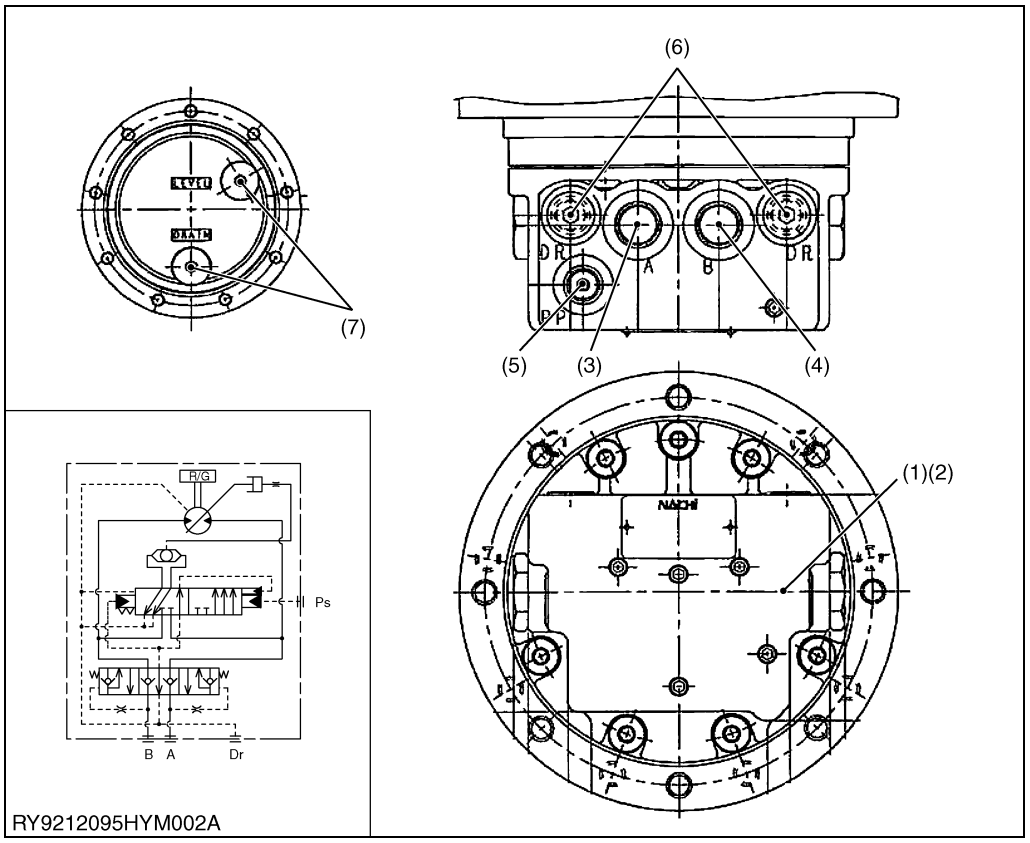
- If the swivel is decelerated with the pressurized oil supplied via port A, the motor rotates due to the inertia of the swiveling equipment, and the motor drives the pump. As a result, the load shifts to the port A side.
- In order to prevent this, the oil on the return side passes through the poppet in the make up circuit and is supplied to the port A side.

(1) Ball

RY9212091HYM0002US0

6. TRAVEL MOTOR

[1] SPECIFICATIONS

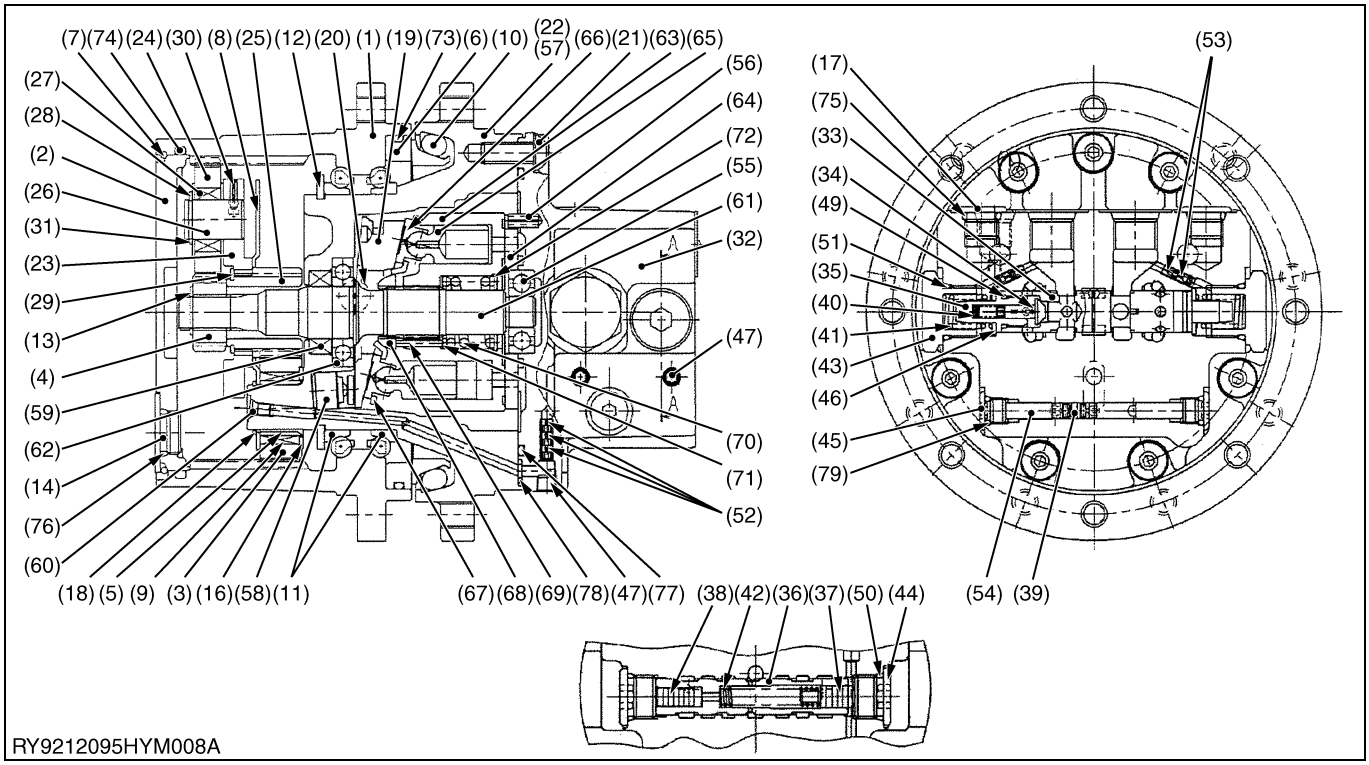


(1) Counterbalance valve
(2) Travel 2-speed
(3) A port (G3/8)
(4) B port (G3/8)
(5) PP Port (G1/8) (2-speed travel switch)
(6) Drain port (G1/4)
(7) Lubricating oil fill/drain ports (G3/8)

Item	KX018-4	KX019-4	Notes
Maker	NACHI		
Model	PHV-1B-12A-T-9099A		
Motor displacement 1-speed/2-speed	18.3 / 9.2 cc/rev 1.12 / 0.56 cu.in./rev		
Reduction Ratio	1 : 36.96		
Max Pressure	21.6 MPa 220 kgf/cm^2 3130 psi		
Max Flow	17.3 L/min 1060 cu.in./min 4.57 USGPM		
Max Output Torque (Decelerator)	1581 N·m 162.0 kgf·m 1172 lbf·ft		
Max Output RPM 1-speed/2-speed (Decelerator)	37.4 / 74.4 rpm		
Max Output RPM 1-speed/2-speed (Motor)	945 / 1880 rpm		
2-speed control pilot pressure (PP)	0.5 MPa 5 kgf/cm^2 70 psi		

RY9212095HYM0005US0

[2] COMPONENTS



No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(1)	Body	1		(12)	Snap Ring	1	3 Pieces
(2)	Cover	1		(13)	Snap Ring	1	JIS B 2804 for Shaft Size 13
(3)	Gear	4		(14)	Plug	2	
(4)	Gear	1		(15)	Motor, Assy	1	
(5)	Ring	4		(16)	Thrust Washer	4	
(6)	Seal Ring	1		(17)	Plug	2	
(7)	Snap Ring	1		(18)	Snap Ring	4	JIS B 2804 for Shaft Size 13
(8)	Thrust Plate	1		(19)	Swash Plate	1	
(9)	Needle	96		(20)	Ball	2	JIS B 1501 Size 15 / 32
(10)	Floating Seal	1	1 Set	(21)	Screw	7	
(11)	Bearing	2		(22)	Pin	1	

(a) Gear assy

No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(23)	Carrier 2	1		(28)	Thrust Washer	6	
(24)	Gear	3		(29)	Snap Ring	1	JIS B 2804 for Shaft Size 26
(25)	Gear	1		(30)	Spring Pin	3	
(26)	Pin	3		(31)	Snap Ring	3	
(27)	Needle	39					

(To be continued)

(Continued)

(b) Body assy (Motor 1)

No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(32)	Body 1	1		(45)	Plug	2	
(33)	Spool	1		(46)	Ring	2	
(34)	Check Valve	2		(47)	Plug	15	
(35)	Spring Guide	2		(48)	O-ring	2	JIS B 2401 Class 1B P8
(36)	Spool	1		(49)	O-ring	2	
(37)	Spool B	1		(50)	O-ring	2	JIS B 2401 Class 1B P14
(38)	Spool C	1		(51)	O-ring	2	JIS B 2401 Class 1B P18
(39)	Shuttle Spool	1		(52)	Orifice	7	
(40)	Spring V1	2		(53)	Orifice	4	
(41)	Spring V2	2		(54)	Pin	2	
(42)	Spring V3	1		(55)	Bearing	1	
(43)	Plug	2		(56)	Spring Pin	1	
(44)	Plug	2					

(c) Body assy (Motor 2)

No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(57)	Body 2	1		(59)	Oil Seal	1	
(58)	Control Piston	1		(60)	Metal Plug	1	

(d) Shaft assy

No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(61)	Shaft	1		(62)	Bearing	1	

(e) Cylinder barrel assy

No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(63)	Cylinder Barrel	1		(68)	Barrel Holder	1	
(64)	Valve Plate	1		(69)	Pin	3	
(65)	Piston	9		(70)	Spring C	1	
(66)	Shoe	9		(71)	Retainer	2	
(67)	Shoe Holder	1		(72)	Snap Ring	1	JIS B 2804 for Roll Size 28

(f) Seal kit

No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(73)	O-ring	1	JIS B 2401 Class 1A G130	(75)	O-ring	2	JIS B 2401 Class 1B P11
(74)	O-ring	1		(76)	O-ring	2	JIS B 2401 Class 1B P14

(g) Seal kit

No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(50)	O-ring	2	JIS B 2401 Class 1B P14	(77)	O-ring	1	JIS B 2401 Class 1B G105
(51)	O-ring	2	JIS B 2401 Class 1B P18	(78)	O-ring	1	JIS B 2401 Class 1B P6
(59)	Oil Seal	1		(79)	O-ring	2	JIS B 2401 Class 1B P3

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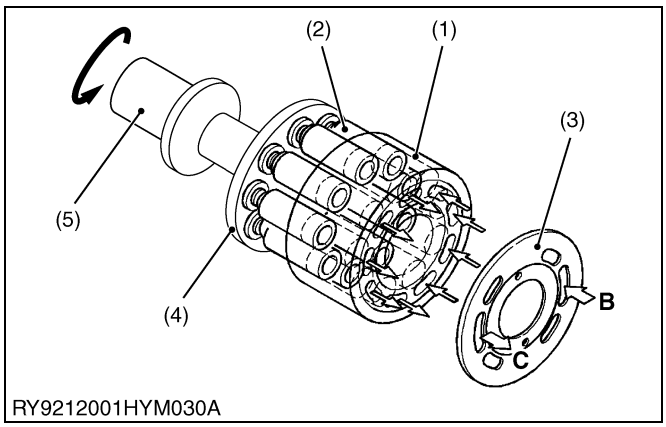
[3] FUNCTION AND STRUCTURE

(1) Operating Principles



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- 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

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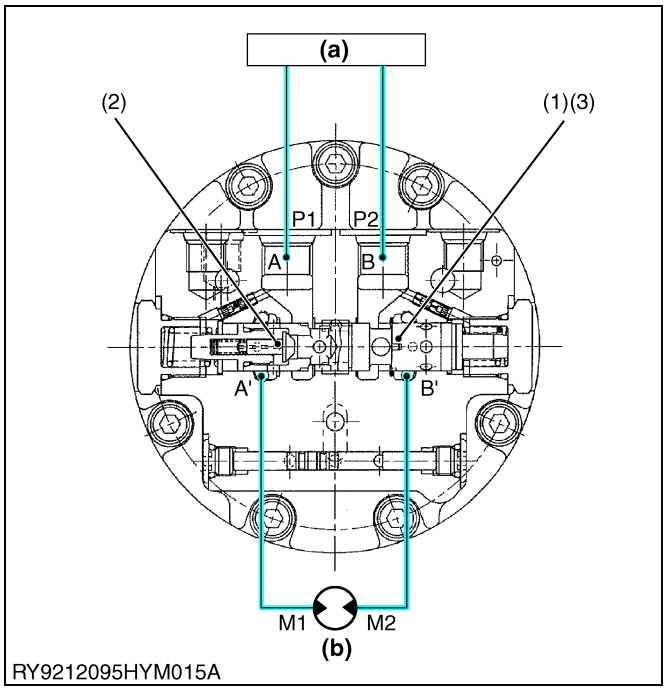
(2) Counterbalance



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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

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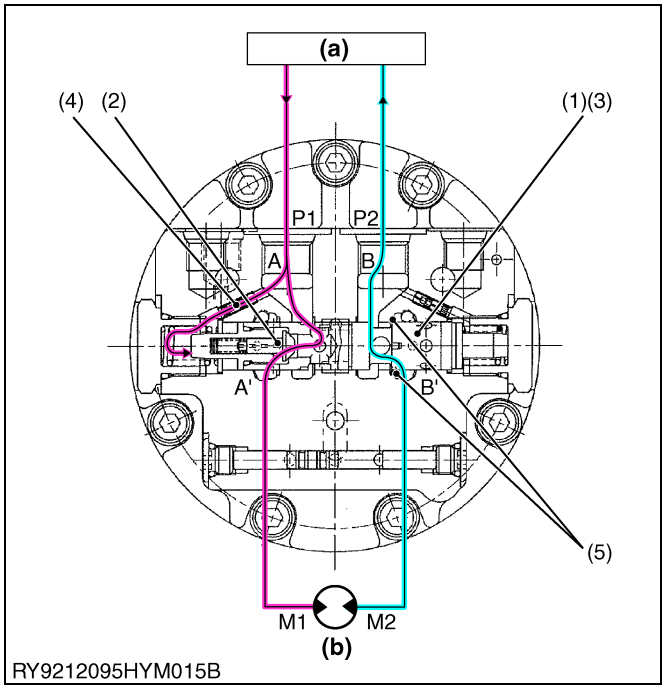


RY9212095HYM015B

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)**.

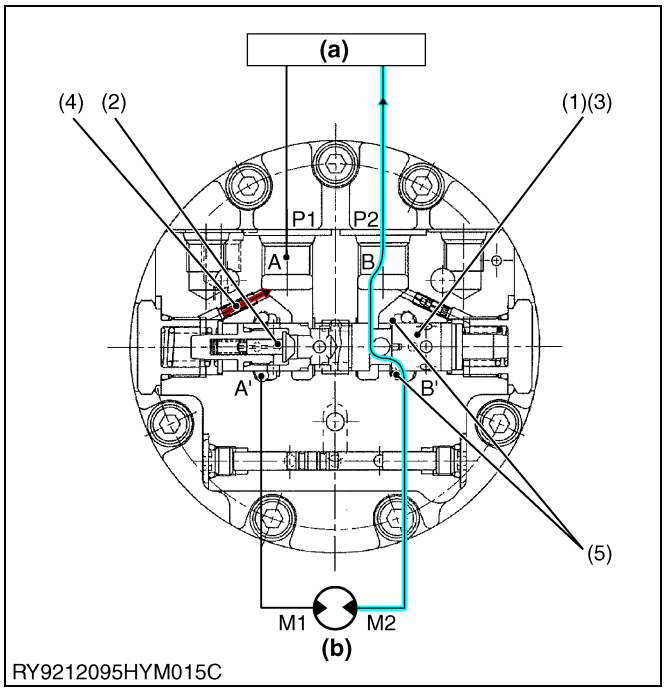
As the pump's discharge pressure rises further, the plunger moves further to the right, enlarging the opening of the orifice at the plunger notch, thus reducing the back pressure

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.

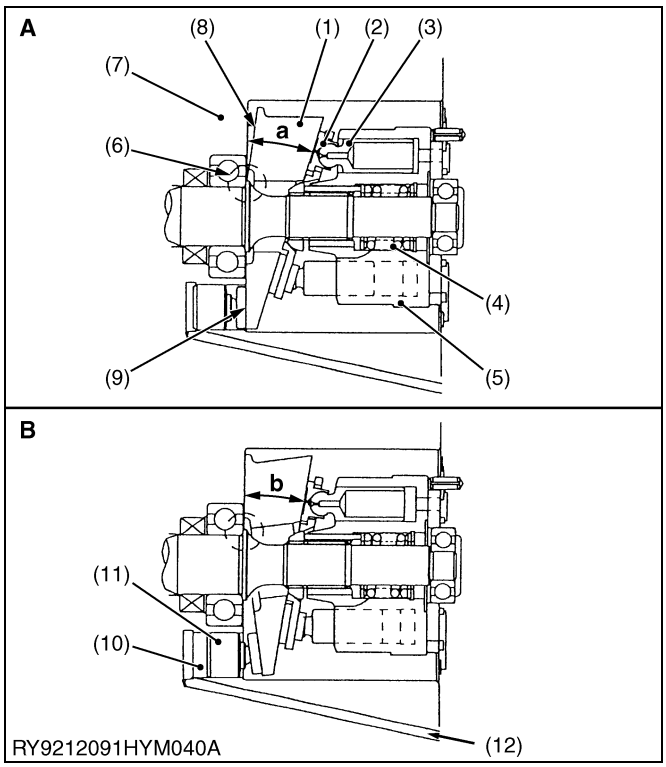
By controlling the speed of the plunger, the motor is stopped without generating cavitation while also absorbing the shock pressure from the inertia of the motor.

(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

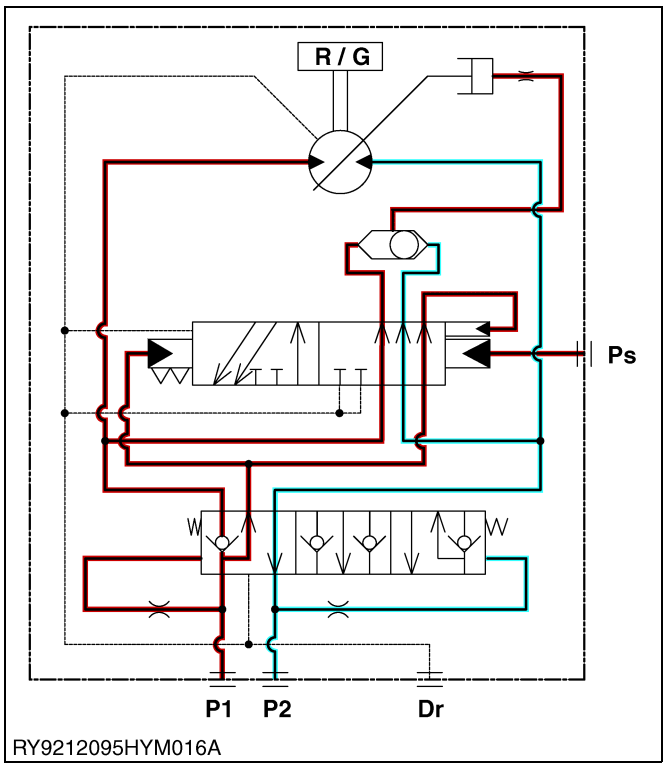


- The swashplate has two surfaces, I and II, opposite the sliding surfaces of the shoes, and these are supported by the two balls mounted in the body 2.
- The balls are in an an eccentric position above the center of rotation, so when in 1st speed, surface I is pressed against body 2 by the force of the oil pressure that drives the piston and by the force of the spring inside the cylinder barrel; consequently the swashplate 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 swashplate until it touches body 2 and holds the swashplate 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 swashplate to its 1st speed state. Consequently, it is always in 1st at takeoff.

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

RY9212091HYM0018US0

(4) Auto Deceleration Function



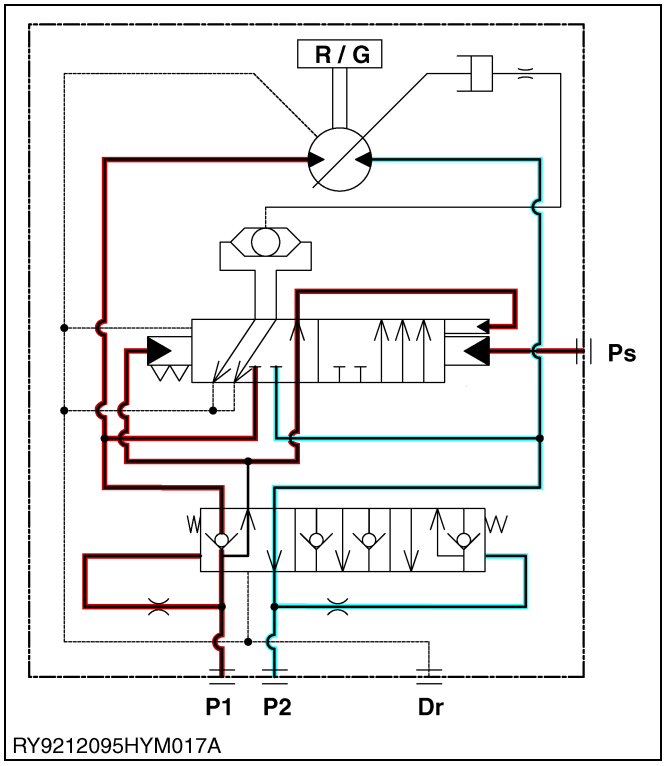
When under low load

When the mini-excavator is traveling in 2nd speed, if the travel load becomes great, this function gives priority to power for traveling, automatically decelerating to 1st speed (low-speed). When the load is low, it operates in the 2nd speed (high-speed).

When the green button on top of the blade lever is pressed, it actuates the solenoid of the unload valve, thus guiding oil from the pilot pump to the PS port. When pressure oil flows to the PS port, it moves the 2-speed spool to the left.

While the motor load pressure acts on both sides of the 2-speed spool and although a force is exerted on the right due to the difference in area, when it is at low pressure, the force on the 2-speed spool is such that the motor load X 2-speed spool area (left) < pilot area under pressure X Ps + motor load X 2-speed spool area (right). As a consequence, the 2-speed spool is pressed to the left and hydraulic oil from P1 is supplied to the 2-speed switch piston.

RY9212095HYM0030US0



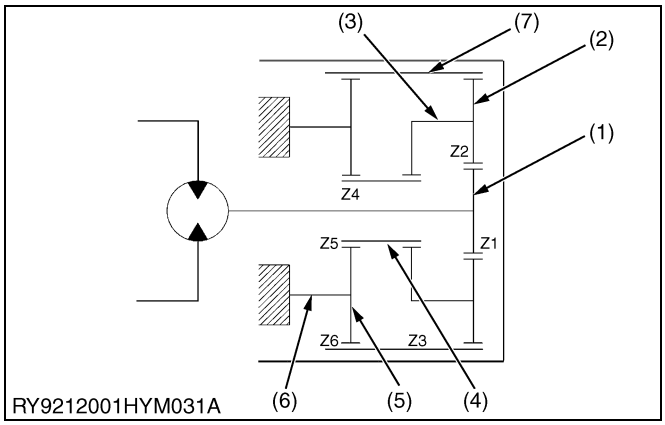
RY9212095HYM017A

When the load is heavy

The motor load pressure rises, so the motor load X 2-speed spool area (left) > pilot area under pressure X Ps + motor load X 2-speed spool area (right), thus moving the 2-speed spool to the right and switching to 1-speed (low). When traveling in 1st speed, pressurized oil is not applied to the PS port, so it acts the same as when under a heavy load.

RY9212095HYM0031US0

(5) Decelerator



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- 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

7. HYDRAULIC CYLINDER

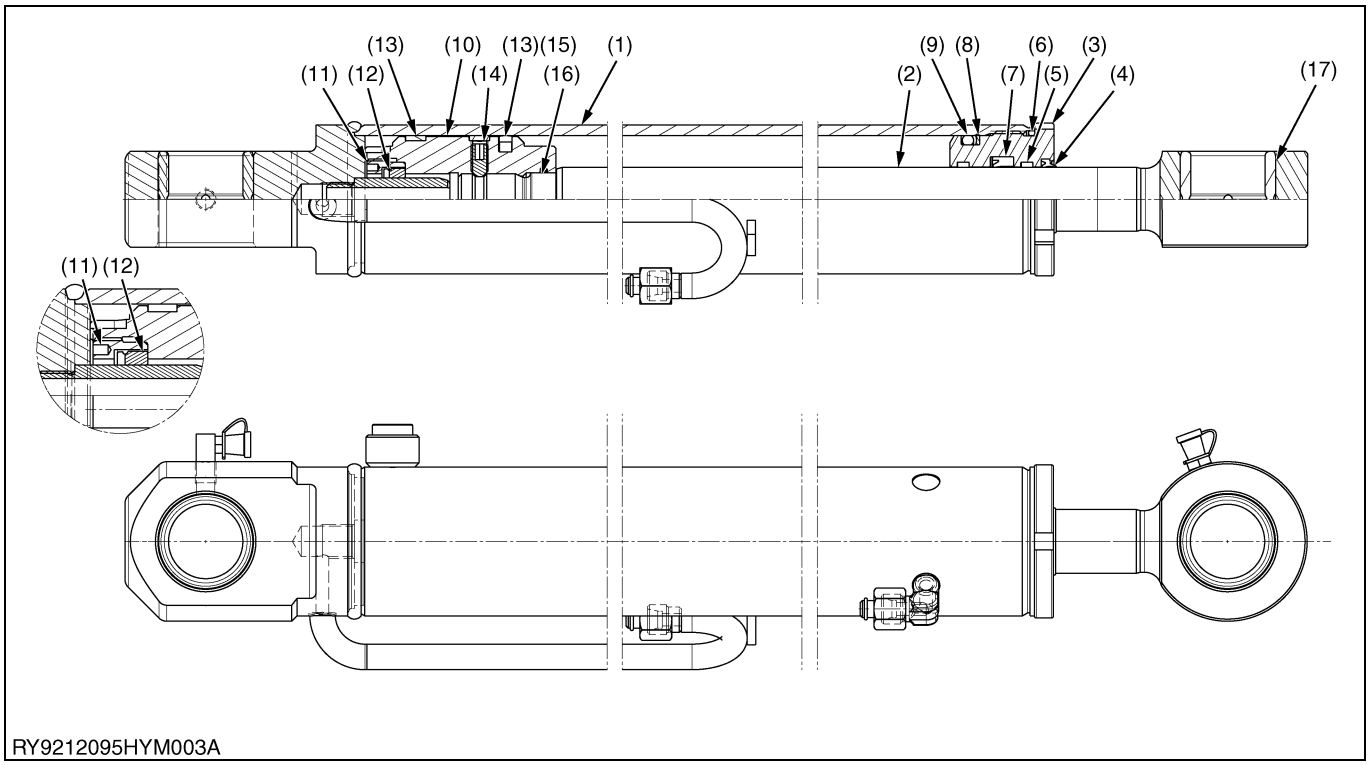
[1] BOOM CYLINDER

(1) Specifications

Maker	LEDUC
Tube outer diameter	ϕ70 mm (2.8 in.)
Tube inner diameter	ϕ60 mm (2.4 in.)
Rod diameter	ϕ30 mm (1.2 in.)
Stroke	469 mm (18.5 in)
Max compressed length	765 mm (30.1 in)

RY9212095HYM0007US0

(2) Components

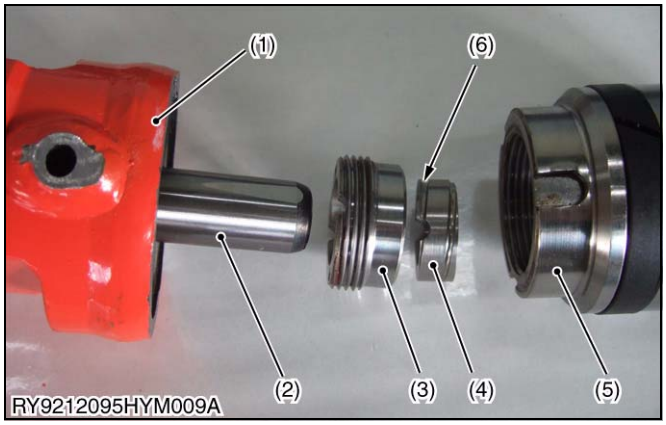


RY9212095HYM003A

No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(1)	Cylinder Tube	1		(10)	Piston	1	
(2)	Cylinder Rod	1		(11)	Damping Ring Locking Screw	1	
(3)	Cylinder Head	1		(12)	Damping Ring	1	
(4)	Wiper Seal	1		(13)	Guide Ring	2	
(5)	Guide Ring	2		(14)	Locking Screw	1	
(6)	O-ring	1		(15)	Piston Seal	1	
(7)	Rod Seal	1		(16)	O-ring	1	
(8)	Back-up Ring	1		(17)	Pin Bushing	2	
(9)	O-ring	1					

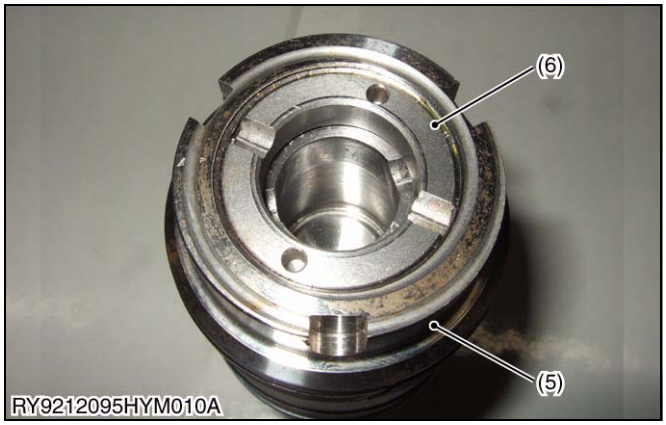
RY9212095HYM0008US0

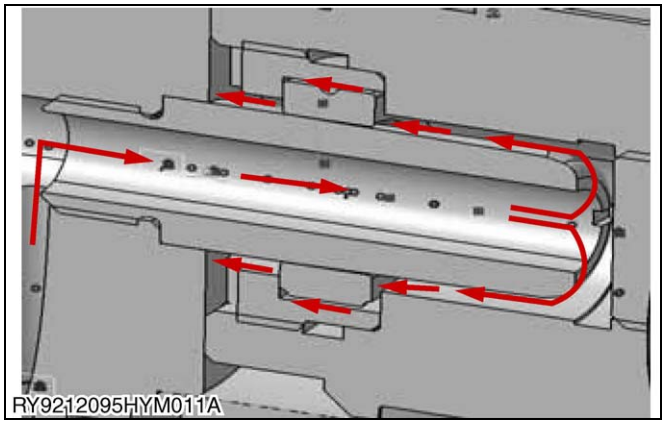
(3) Function and Structure

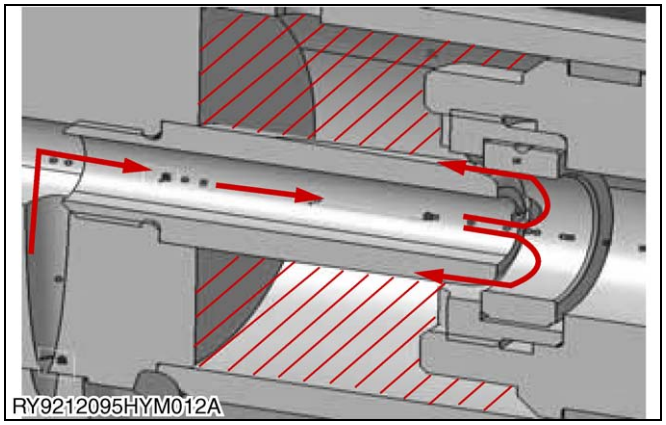


(1) Cylinder Tube
(2) Cushion Tube
(3) Screw Ring
(4) Cushion Ring
(5) Piston
(6) Spiral

RY9212095HYM0032US0



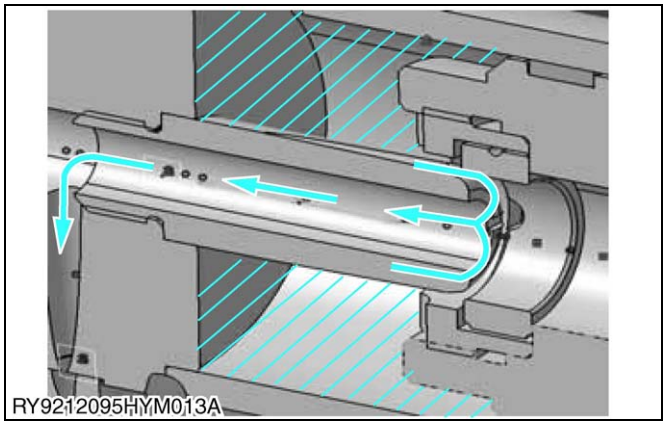


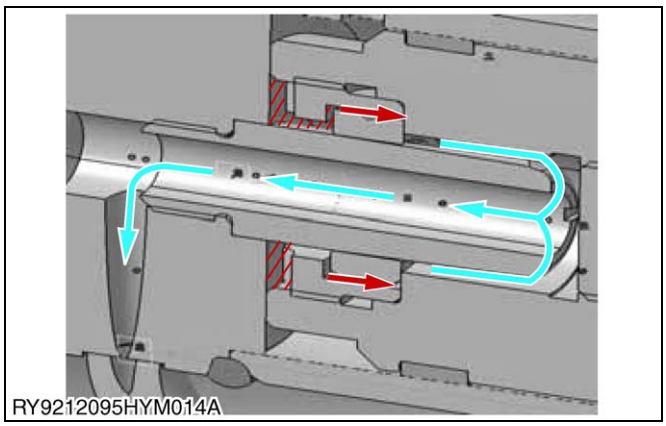


When cylinder is extended (boom lowered)

The oil flowing from the bottom of the cylinder flows from inside the cushion tube→through the gap between the cushion tube and the piston→spiral in the cushion ring→through the gap between the cushion tube and the screw ring and from the groove in the top of the screw ring to the spiral in the top of the piston, thus moving the piston in the direction of extending it.

RY9212095HYM0033US0


RY9212095HYM013A


RY9212095HYM014A

When cylinder is compressed (cushioning function)

- Cushion function on the lift end of the boom

When the piston comes into the cushion tube, the hydraulic oil is expelled through the slit in the cushion tube and its passing through the spiral in the cushion ring closes it down automatically, slowing the operation of the cylinder and softening the shock on the lift end of the boom.

RY9212095HYM0034US0

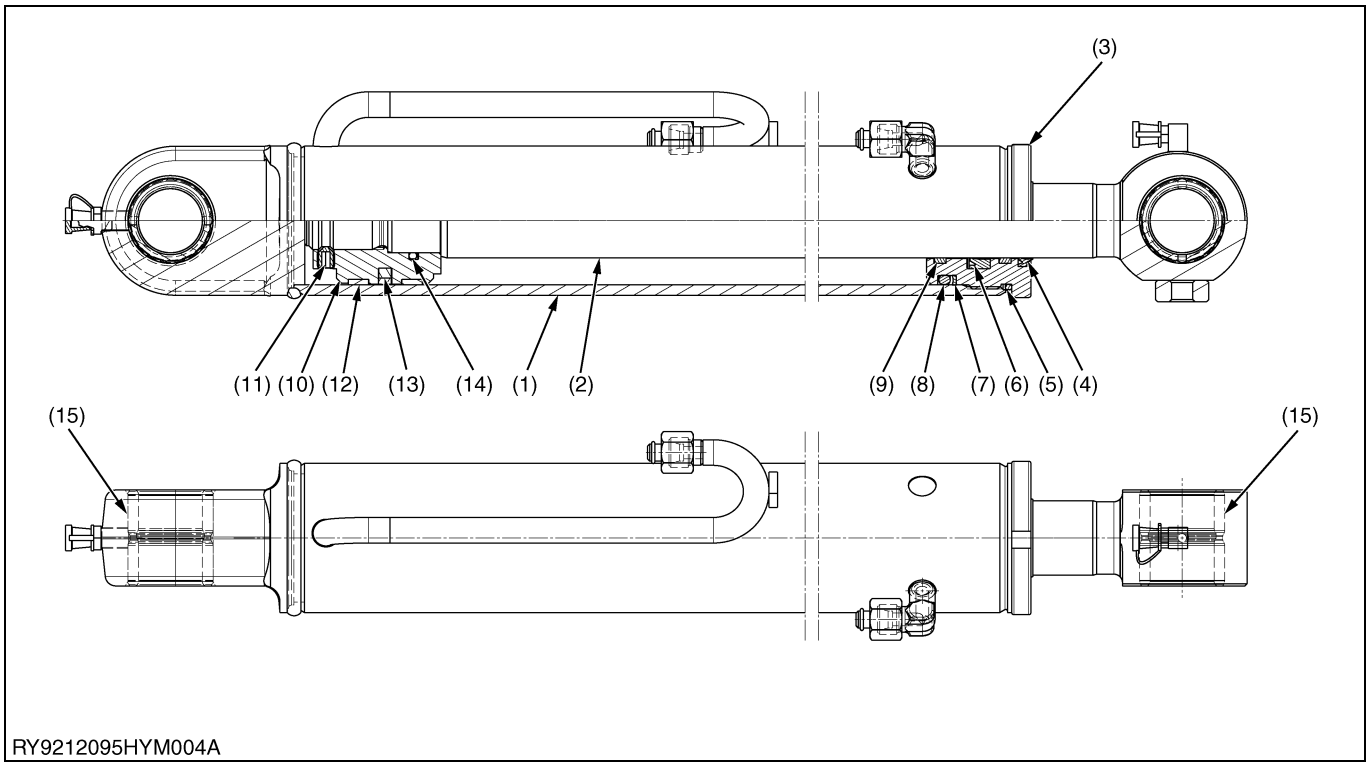
[2] ARM CYLINDER

(1) Specifications

Maker	LEDUC
Tube outer diameter	ϕ70 mm (2.8 in.)
Tube inner diameter	ϕ60 mm (2.4 in.)
Rod diameter	ϕ35 mm (1.4 in.)
Stroke	362 mm (14.3 in)
Max compressed length	609 mm (24.0 in)

RY9212095HYM0012US0

(2) Components



RY9212095HYM004A

No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(1)	Cylinder Tube	1		(9)	Guide Ring	2	
(2)	Cylinder Rod	1		(10)	Piston	1	
(3)	Cylinder Head	1		(11)	Locking Screw	1	
(4)	Wiper Seal	1		(12)	Guide Ring	2	
(5)	O-ring	1		(13)	Piston Seal	1	
(6)	Rod Seal	1		(14)	O-ring	1	
(7)	Back-up Ring	1		(15)	Pin Bushing	2	
(8)	O-ring	1					

RY9212095HYM0013US0

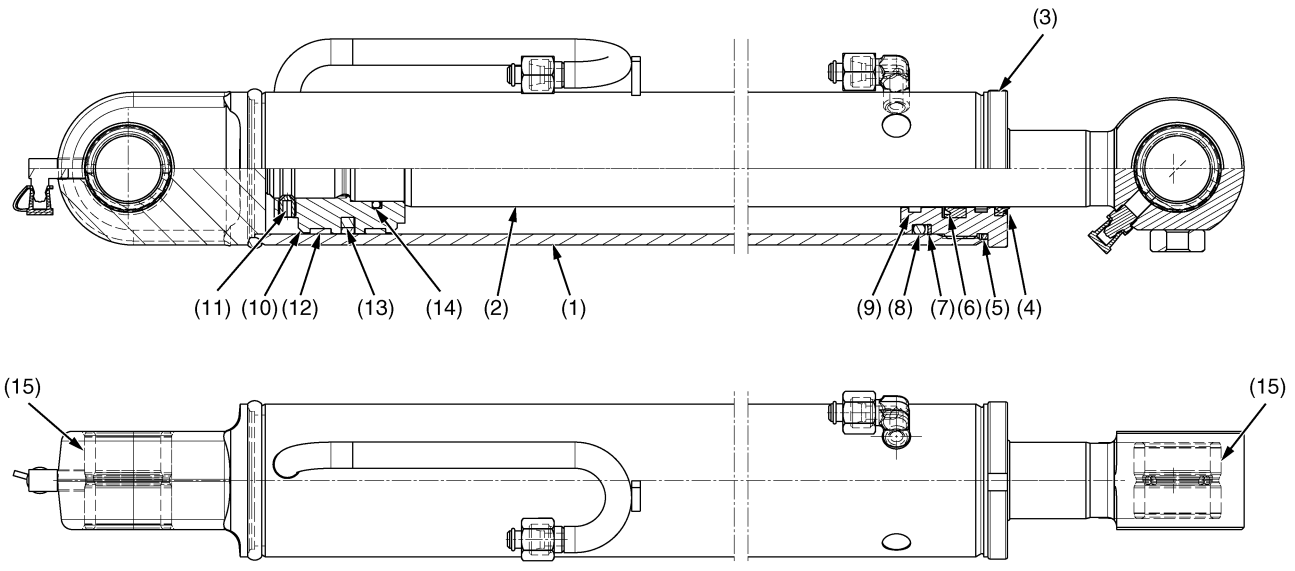
[3] BUCKET CYLINDER

(1) Specifications

Maker	LEDUC
Tube outer diameter	ϕ70 mm (2.8 in.)
Tube inner diameter	ϕ60 mm (2.4 in.)
Rod diameter	ϕ35 mm (1.4 in.)
Stroke	291 mm (11.5 in)
Max compressed length	545 mm (21.5 in)

RY9212095HYM0014US0

(2) Components



RY9212095HYM005A

No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(1)	Cylinder Tube	1		(9)	Guide Ring	2	
(2)	Cylinder Rod	1		(10)	Piston	1	
(3)	Cylinder Head	1		(11)	Locking Screw	1	
(4)	Wiper Seal	1		(12)	Guide Ring	2	
(5)	O-ring	1		(13)	Piston Seal	1	
(6)	Rod Seal	1		(14)	O-ring	1	
(7)	Back-up Ring	1		(15)	Pin Bushing	2	
(8)	O-ring	1					

RY9212095HYM0015US0

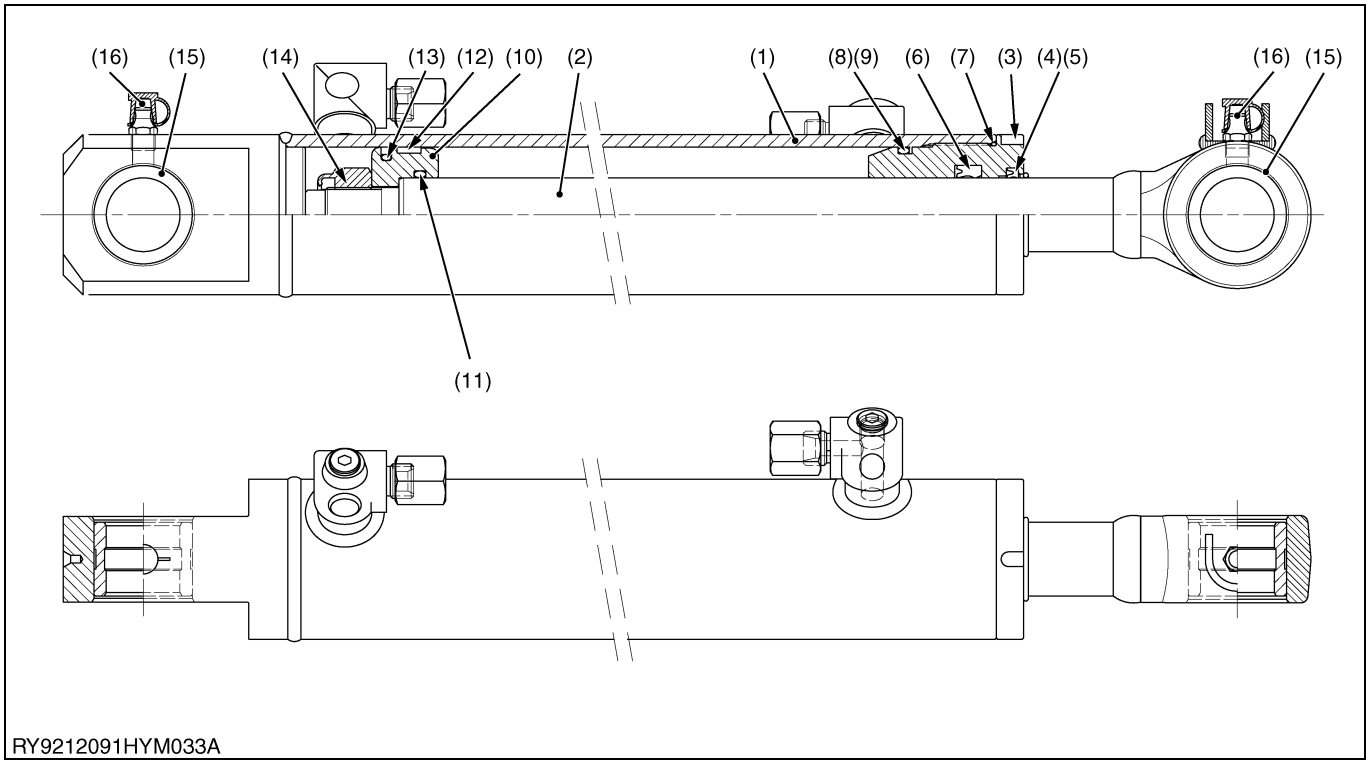
[4] SWING CYLINDER

(1) Specifications

Maker	Roquet
Tube outer diameter	ϕ65 mm (2.6 in.)
Tube inner diameter	ϕ55 mm (2.2 in.)
Rod diameter	ϕ30 mm (1.2 in.)
Stroke	355 mm (14.0 in)
Max compressed length	625 mm (24.6 in)

RY9212091HYM0046US0

(2) Components



RY9212091HYM033A

No.	Name of part	Qty	Notes	No.	Name of part	Qty	Notes
(1)	Cylinder tube ASSY	1		(9)	Backup ring	1	
(2)	Piston rod ASSY	1		(10)	Piston	1	
(3)	Cylinder head	1		(11)	O-ring	1	
(4)	Wiper ring	1		(12)	Slide ring	1	
(5)	Snap ring	1		(13)	Seal ring	1	
(6)	U-ring	1		(14)	Nut	1	
(7)	O-ring	1		(15)	Pin bushing	2	
(8)	O-ring	1		(16)	Grease nipple	2	

RY9212091HYM0047US0

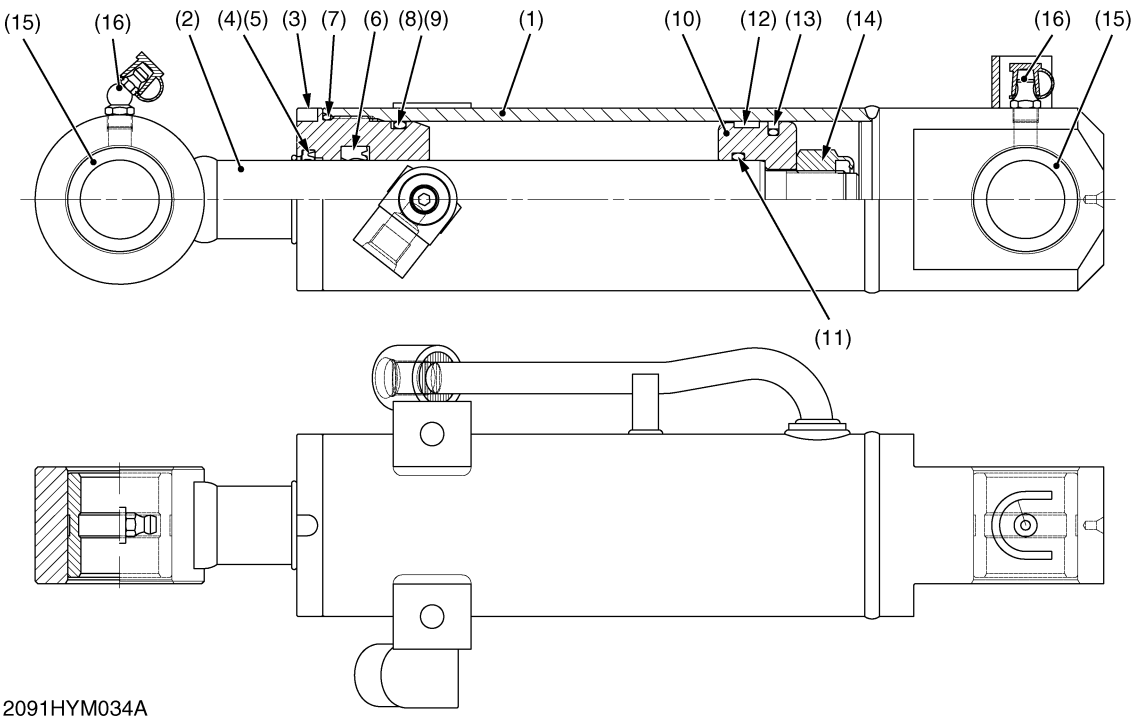
[5] BLADE CYLINDER

(1) Specifications

Maker	Roquet
Tube outer diameter	ϕ75 mm (3.0 in.)
Tube inner diameter	ϕ65 mm (2.6 in.)
Rod diameter	ϕ30 mm (1.2 in.)
Stroke	111 mm (4.4 in)
Max compressed length	348 mm (13.7 in)

RY9212095HYM0016US0

(2) Components



RY9212091HYM034A

No.	Name of part	Qty	Notes	No.	Name of part	Qty	Notes
(1)	Cylinder tube ASSY	1		(9)	Backup ring	1	
(2)	Piston rod ASSY	1		(10)	Piston	1	
(3)	Cylinder head	1		(11)	O-ring	1	
(4)	Wiper ring	1		(12)	Slide ring	1	
(5)	Snap ring	1		(13)	Seal ring	1	
(6)	U-ring	1		(14)	Nut	1	
(7)	O-ring	1		(15)	Pin bushing	2	
(8)	O-ring	1		(16)	Grease nipple	2	

RY9212091HYM0049US0

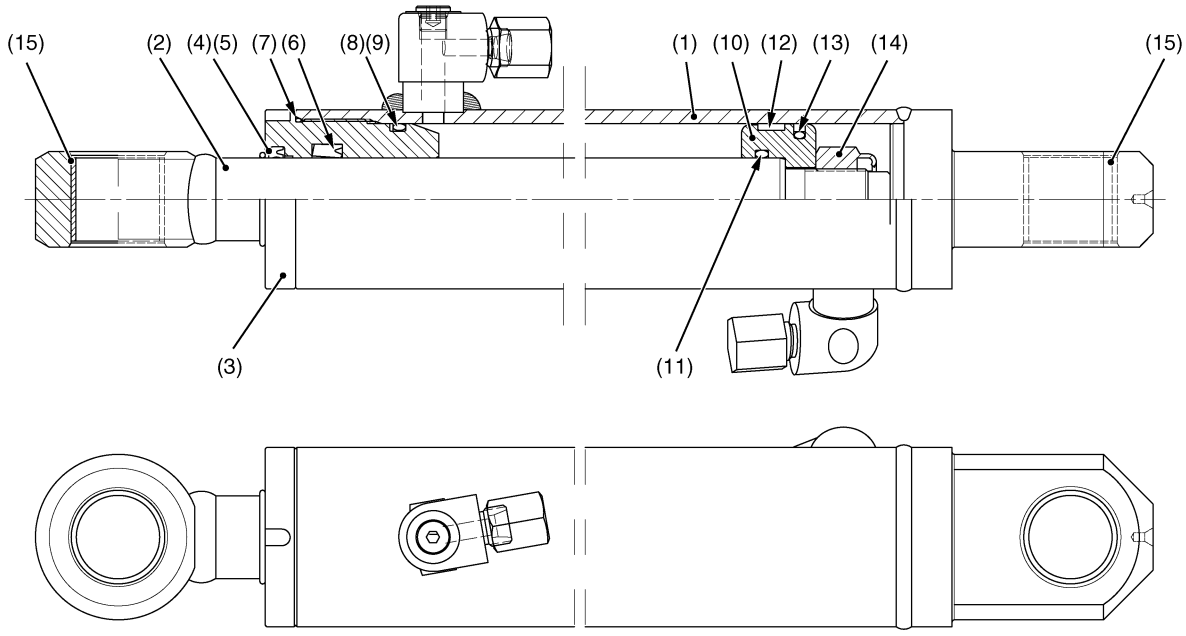
[6] ADJUSTABLE TRACK CYLINDER

(1) Specifications

Maker	Roquet
Tube outer diameter	ϕ70 mm (2.8 in.)
Tube inner diameter	ϕ60 mm (2.4 in.)
Rod diameter	ϕ30 mm (1.2 in.)
Stroke	310 mm (12.2 in)
Max compressed length	528 mm (20.8 in)

RY9212095HYM0017US0

(2) Components



RY9212091HYM035A

No.	Name of part	Qty	Notes	No.	Name of part	Qty	Notes
(1)	Cylinder tube ASSY	1		(9)	Backup ring	1	
(2)	Piston rod ASSY	1		(10)	Piston	1	
(3)	Cylinder head	1		(11)	O-ring	1	
(4)	Wiper ring	1		(12)	Slide ring	1	
(5)	Snap ring	1		(13)	Seal ring	1	
(6)	U-ring	1		(14)	Nut	1	
(7)	O-ring	1		(15)	Pin bushing	2	
(8)	O-ring	1					

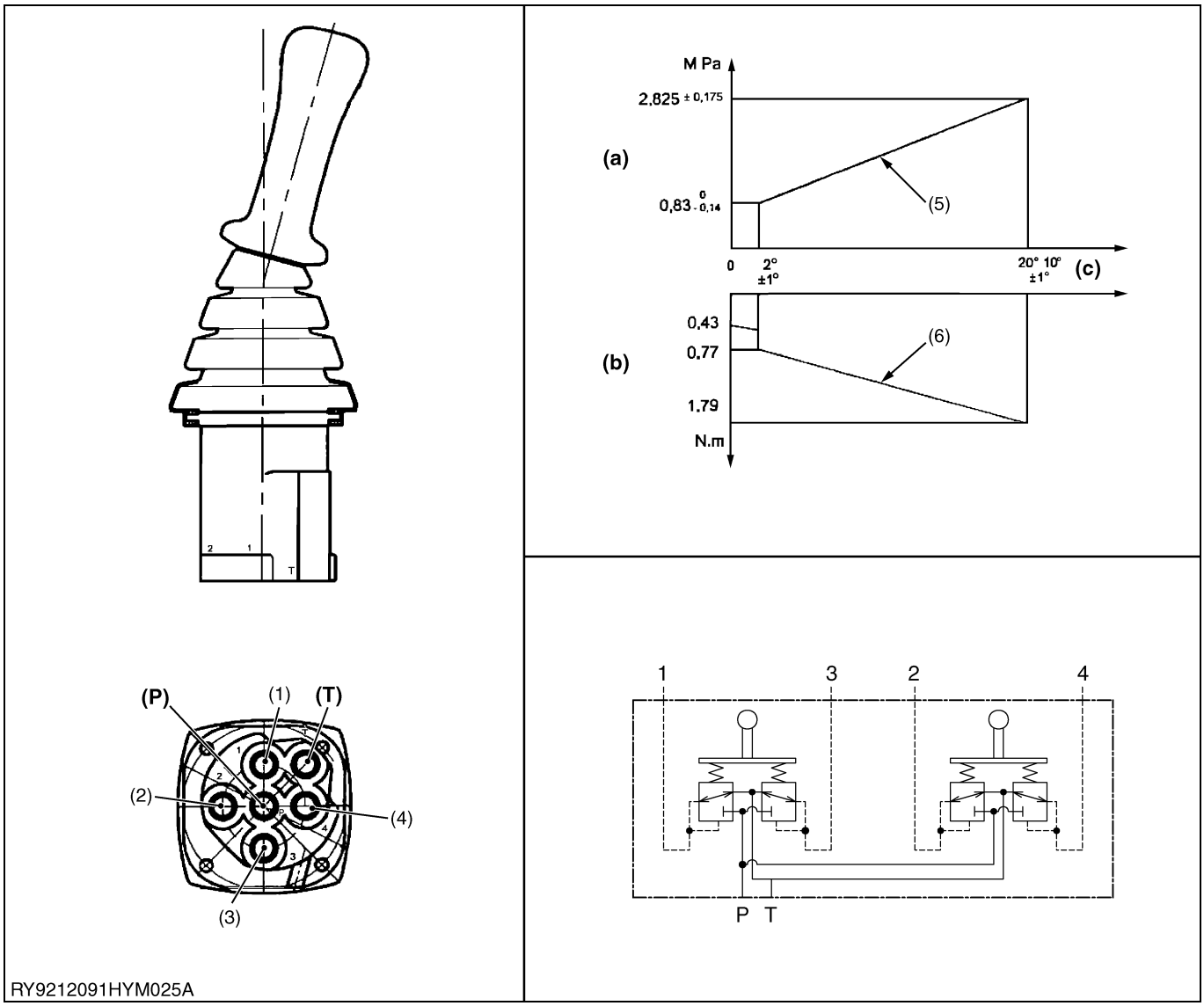
RY9212091HYM0051US0

8. PILOT VALVE

[1] PILOT VALVE (BOOM, ARM, BUCKET, SWIVEL) [KX018-4]

(1) Specifications

1. Pilot Valve Left



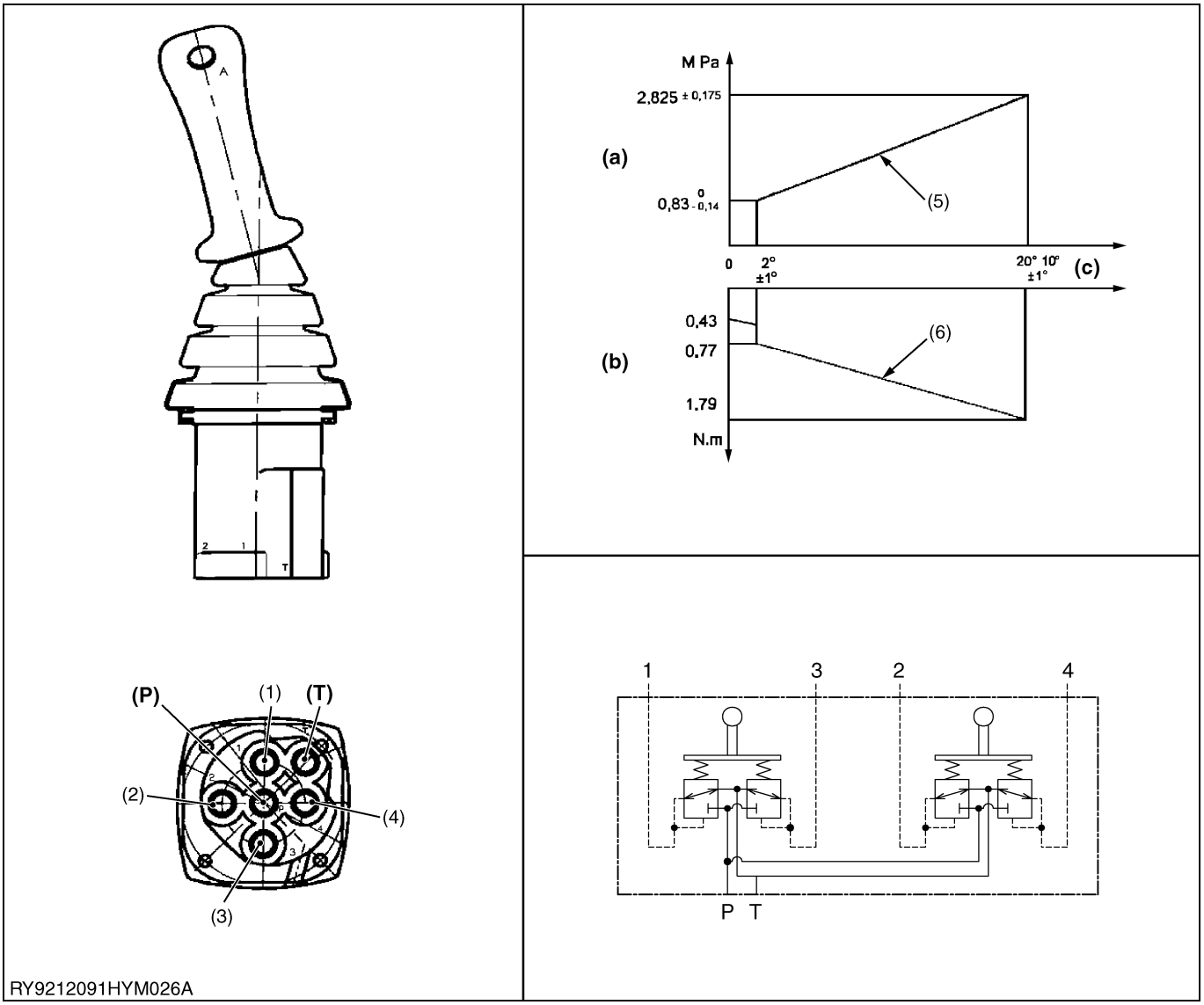
RY9212091HYM025A

(1) Port 1 (Arm Rake)
(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

RY9212091HYM0008US0

2. Pilot Valve Right



RY9212091HYM026A

(1) Port 1 (Lift Boom)
(2) Port 2 (Dump Rake)
(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)

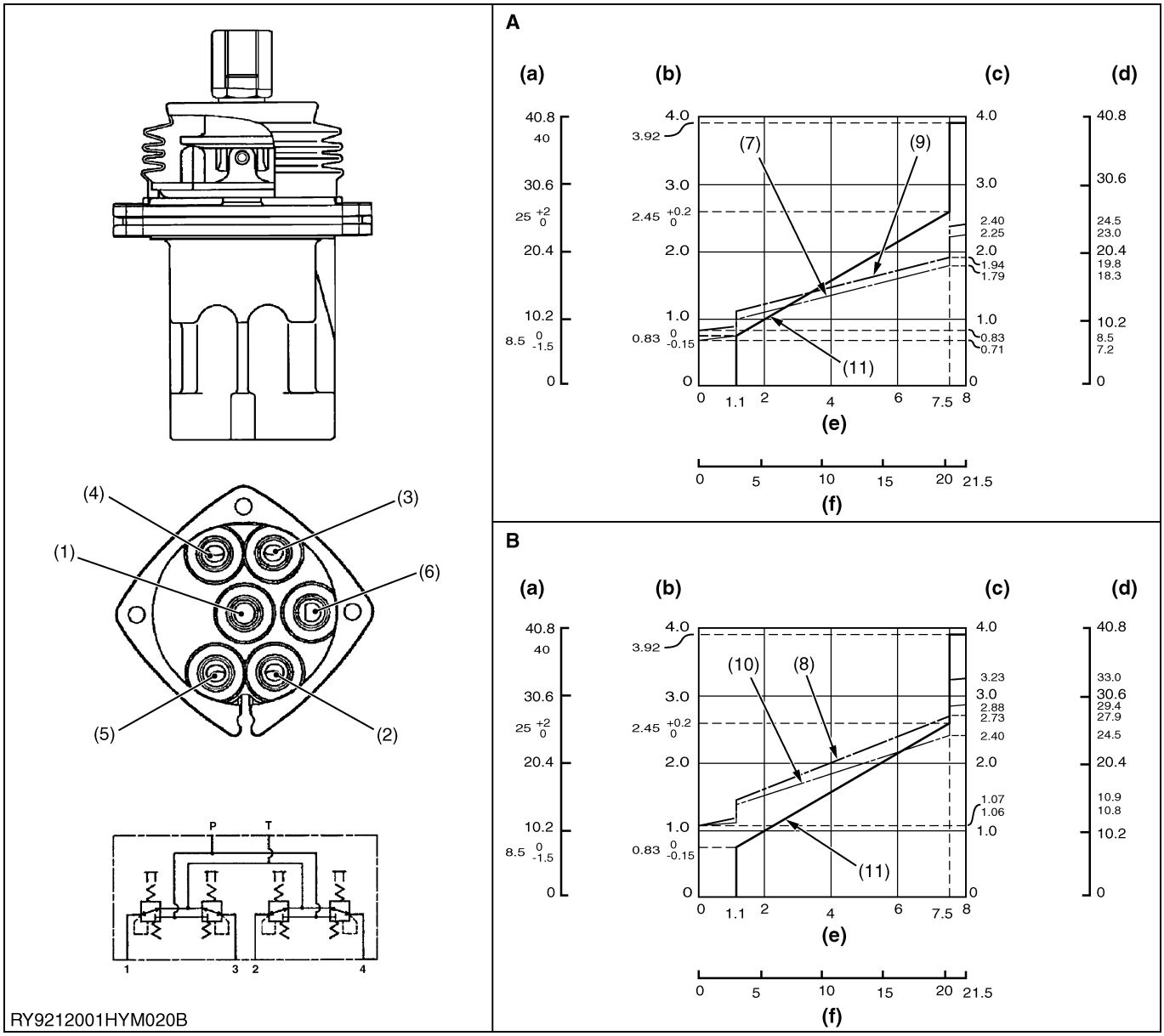
Maker	Rexroth
Model	4TH5E187-11 / ST235M04S058
Secondary pressure	Noted separately

RY9212091HYM0009US0

[2] PILOT VALVE (BOOM, ARM, BUCKET, SWIVEL) [KX019-4]

(1) Specifications

1. Pilot Valve Left



(1) Port P
(2) Port 1 (swivel left)
(3) Port 2 (arm dump)
(4) Port 3 (swivel right)
(5) Port 4 (arm rake)
(6) Port T
(7) Independent operation torque (port 1)
(8) Independent operation torque (port 2)
(9) Independent operation torque (port 3)
(10) Independent operation torque (port 4)
(11) Secondary pressure

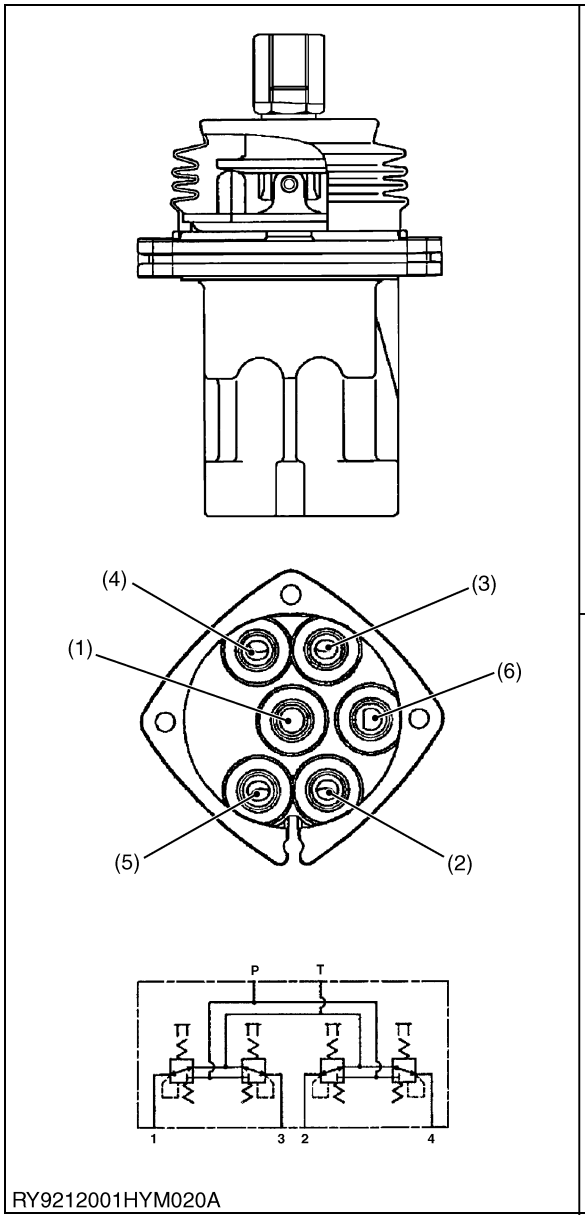
A : Port 1, 3
B : Port 2, 4

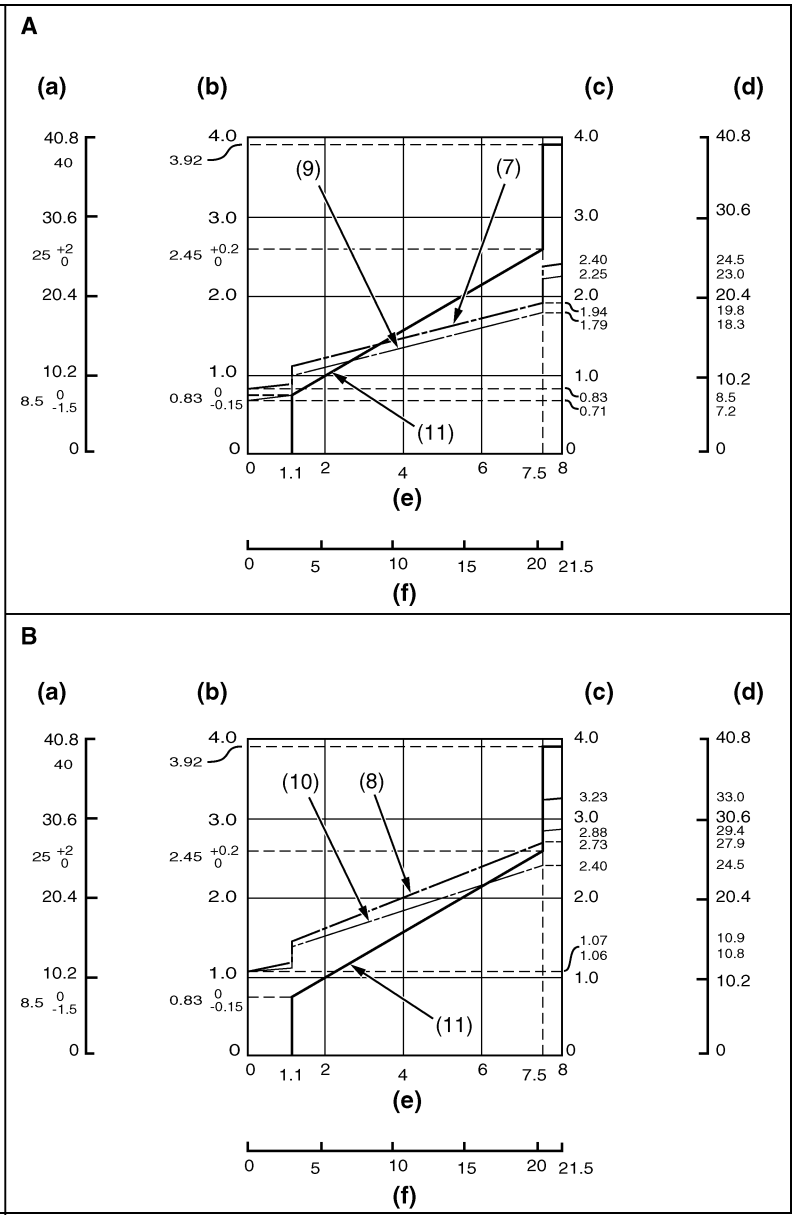
(a) Secondary pressure (kgf/cm^2)
(b) Secondary pressure (MPa)
(c) Operating torque (N·m)
(d) Operating torque (kgf·cm)
(e) Pushrod stroke (mm)
(f) Operating angle (deg)

Maker	KPM (Kawasaki Precision Machinery)
Model	PV48M2160A (LH)
Secondary pressure	Noted separately

RY9212001HYM0109US0

2. Pilot Valve Right





(1) Port P
(2) Port 1 (bucket rake)
(3) Port 2 (lower boom)
(4) Port 3 (dump bucket)
(5) Port 4 (lift boom)
(6) Port T
(7) Independent operation torque (port 1)
(8) Independent operation torque (port 2)
(9) Independent operation torque (port 3)
(10) Independent operation torque (port 4)
(11) Secondary pressure

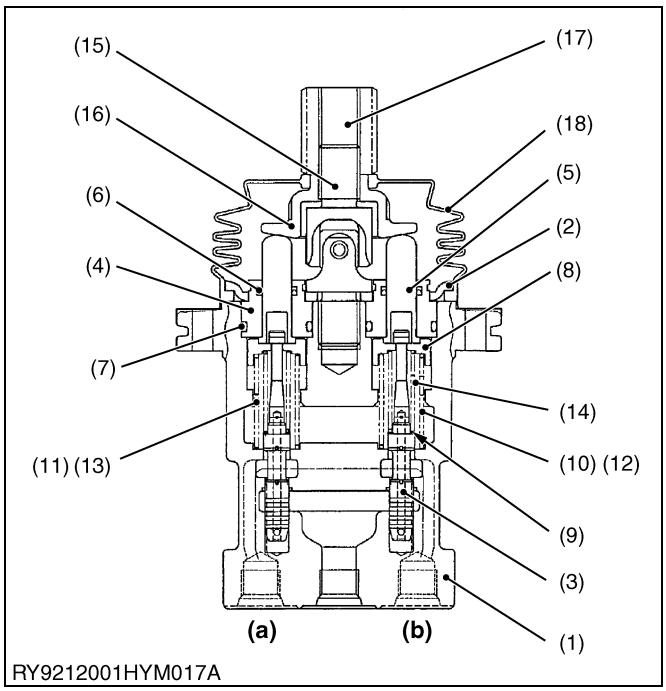
A : Port 1, 3
B : Port 2, 4

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

Maker	KPM (Kawasaki Precision Machinery)
Model	PV48M2161 (RH)
Secondary pressure	Noted separately

RY9212001HYM0110US0

(2) Components



RY9212001HYM017A

Pilot valves left and right

No.	Name of part	Q'ty	Notes
(1)	Casing	1	
(2)	Plate	1	
(3)	Spool	4	
(4)	Plug	4	
(5)	Pushrod	4	
(6)	Seal	4	
(7)	O-Ring	4	
(8)	Spring seat	4	
(9)	Washer 2	4	
(10)	Spring	1	For port 1
(11)	Spring	1	For port 2
(12)	Spring	1	For port 3
(13)	Spring	1	For port 4
(14)	Spring	4	
(15)	Joint	1	
(16)	Round plate	1	
(17)	Adjusting nut	1	
(18)	Bellows	1	

(a) Port 2, 4 **(b) Port 1, 3**

RY9212001HYM0111US0

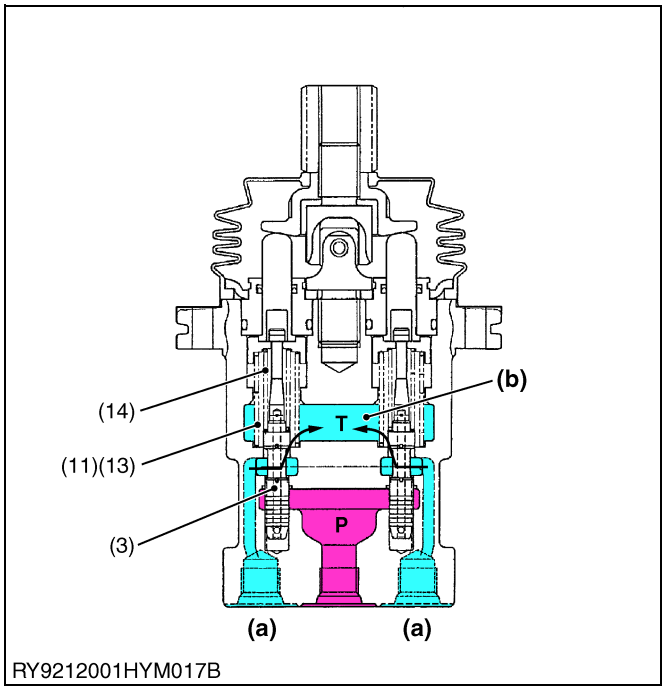
(3) Function and Structure

[A] Function

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

RY9212001HYM0001US0

[B] Operation



RY9212001HYM017B

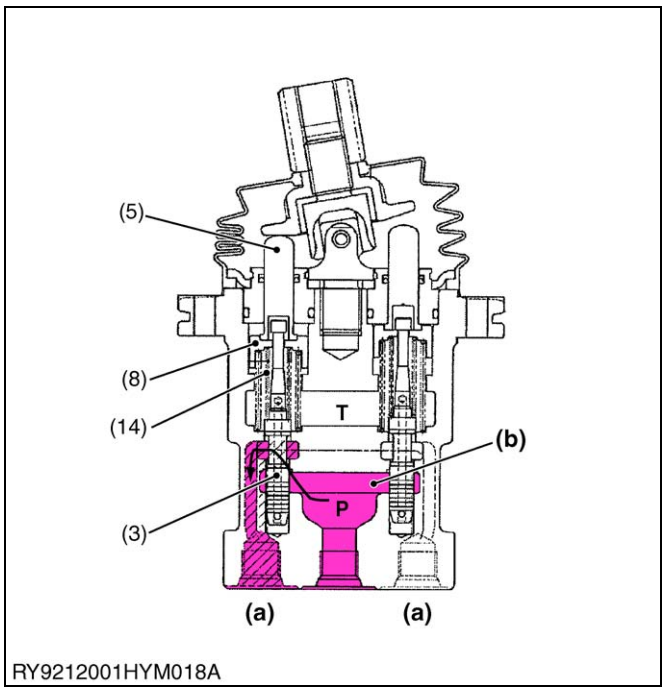
1. When the control lever is in neutral

The force of the secondary pressure setting spring (14) does not press on the spool (3). As a result, the spool is held in a neutral position by return spring (11) or (13). At such time, the output port (control valve port) **(a)** and port T **(b)** are connected.

(3) Spool
(11) Return Spring
(13) Return Spring
(14) Secondary Pressure Setting Spring

(a) Output Port
(b) Port T

RY9212001HYM0112US0



RY9212001HYM018A

2. When the control lever has been actuated

When the control lever is actuated, the pushrod (5) presses down on the spool (3) via the spring seat (8) and the secondary pressure setting spring (14). When doing so, port P **(b)** and the output port **(a)** are connected, so the oil from the pilot pump flows through the output port to the control valve.

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

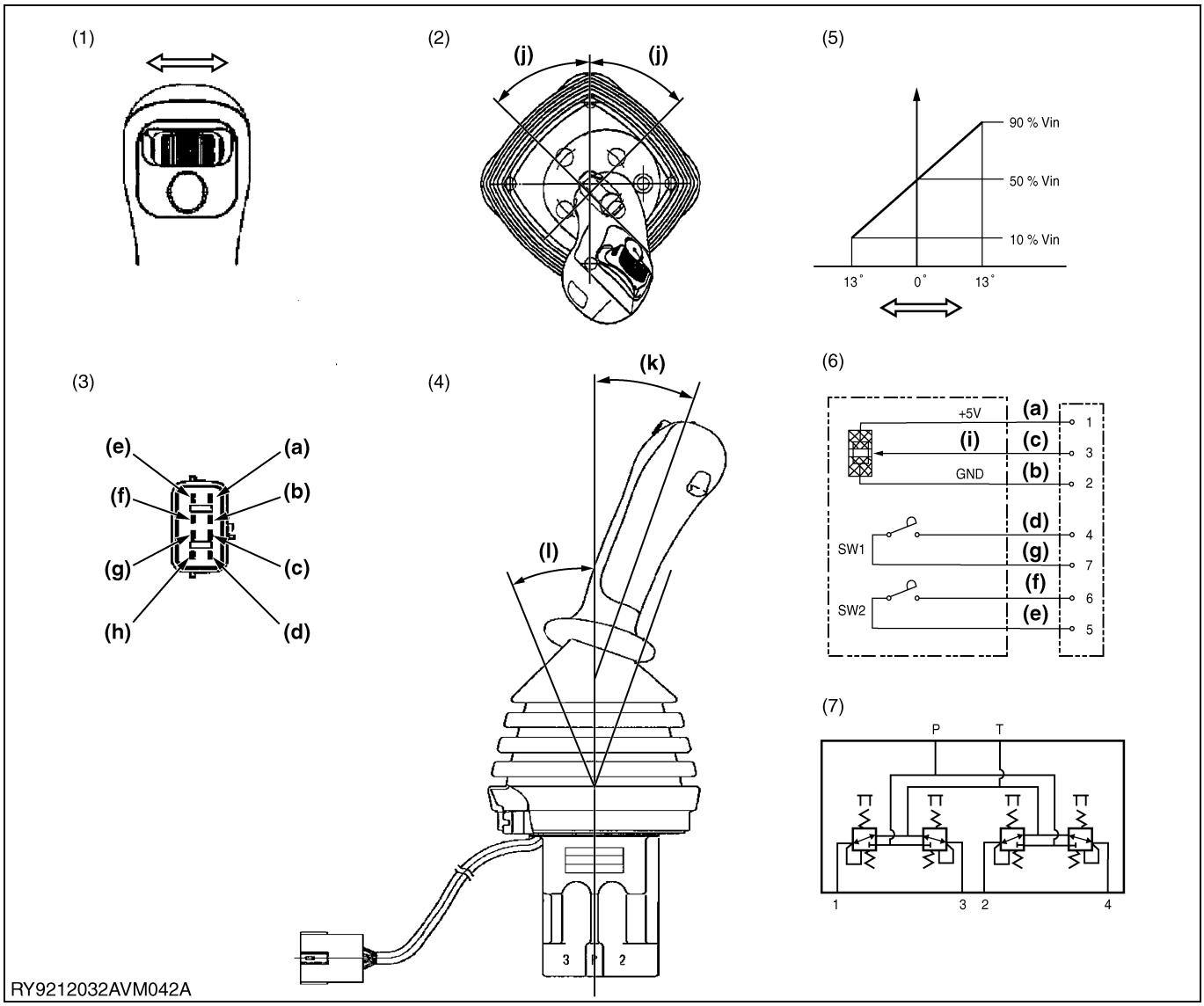
(3) Spool
(5) Pushrod
(8) Spring Seat
(14) Secondary Pressure Setting Spring

(a) Output Port
(b) Port P

RY9212001HYM0113US0

Knob Switch Configuration and Functions

Operating lever right



(1) Knob's slide switch
(2) Remote operation control knob (w/ one-way hold)
(3) Harness coupler
(4) Side view of entire knob
(5) Knob characteristics
(6) Characteristic circuit diagram
(7) Diagram of Hydraulic Circuit

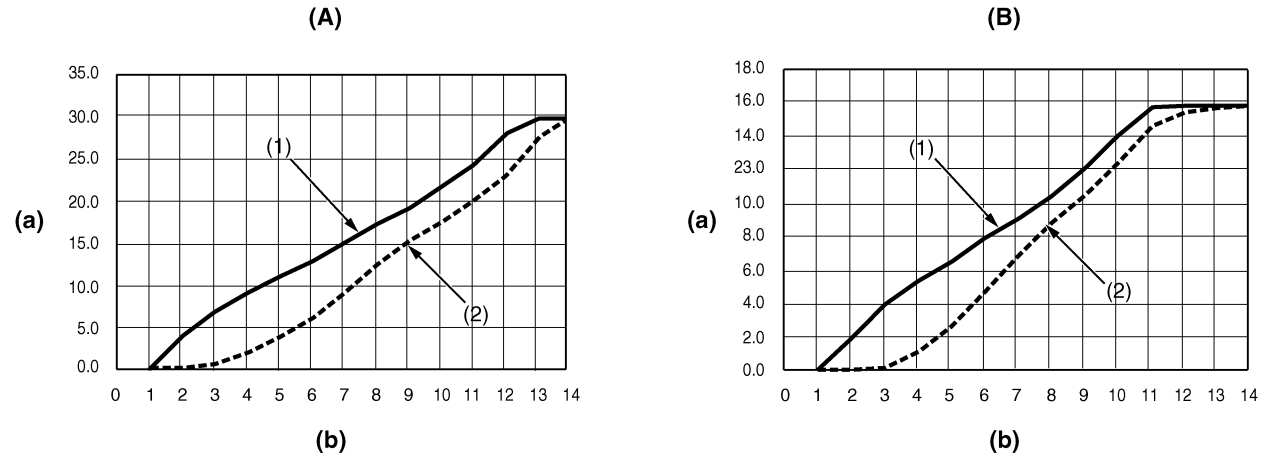
(a) Red
(b) Black
(c) White
(d) Blue
(e) Gray
(f) Yellow
(g) Green
(h) Blanking pin
(i) Proportional control
(j) 45 °
(k) 19 °
(L) 21.5 °

This knob switch comes equipped with an IC chip that processes the signal of the potentiometer.

1. Service mode: set up in the service mode of the meter panel.
2. Knob control: Output can be controlled with the left/right knob switch to suit operating conditions.
3. Breaker operation: the button on the front of the operation lever can be used to switch to one-way hold.

RY9212032HYM0044US0

Relationship between Lever Operation and Hydraulic Flow (Proportional Control)



RY9212095HYM018A

(1) Right
(2) Left

(A) Max Engine RPM
(B) Min Engine RPM

(a) Flow volume L/min
(b) Max Flow Setting (Limit Value)

The relationship between pressure P, flow Q and lever knob operation (limit value) changes proportionally as shown in the figures above.

CAUTION

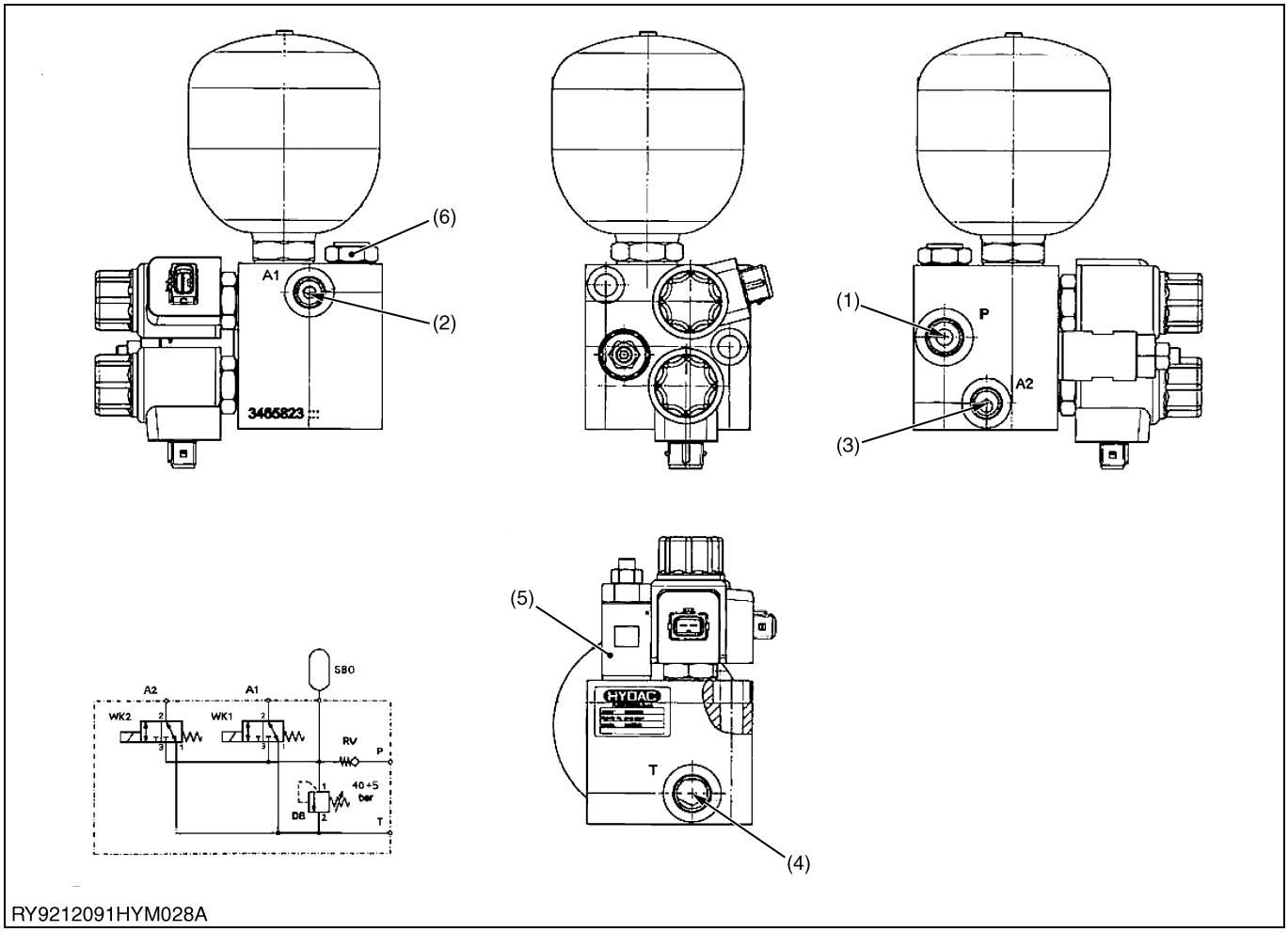
- **Actual measured values may vary with the machine.**

RY9212095HYM0028US0

9. UNLOAD VALVE

[1] 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 + 0.5 MPa 40 + 5.0 kgf/cm^2 600 + 70 psi

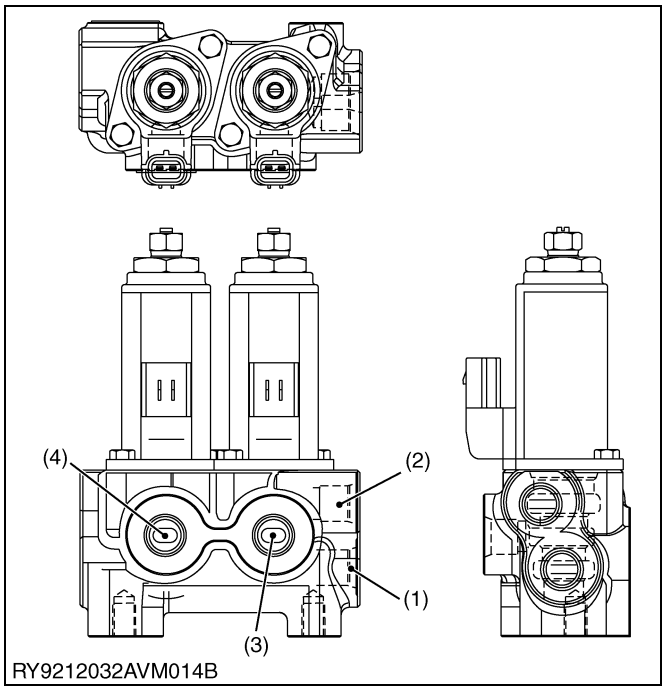
RY9212095HYM0029US0

10. AUX SOLENOID VALVE

[1] SPECIFICATIONS

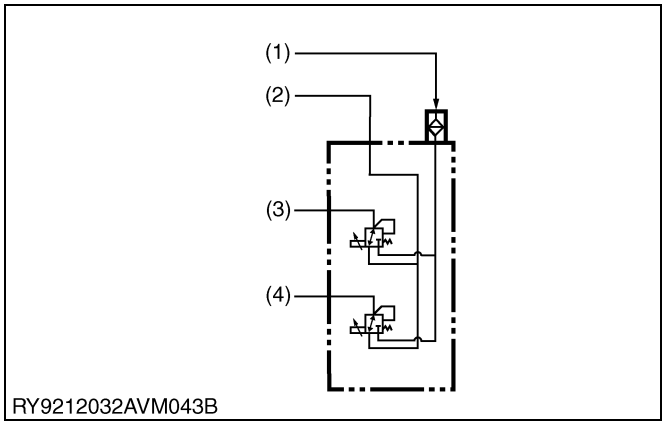
Proportional Control Solenoid Valve (S/P Valve)

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



RY9212032AVM014B

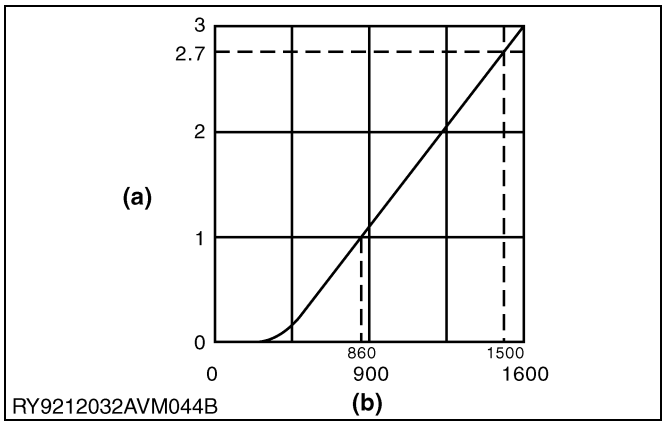
Item	Specifications
Max operating pressure (input pressure)	3.9 MPa 40 kgf/cm^2 570 psi
Allowable back pressure (pressure T)	1.0 MPa 10 kgf/cm^2 100 psi
Maximum proportional valve operating flow volume (input flow volume)	15.6 L/min, 4.1 GPM
Drain volume when solenoid off	0.4 L/min ≥ (at 20 cST, port P pressure = 4.9 MPa, 50 kgf/cm^2, 710 psi)
Waterproof Standard	JIS D 0203 S2 equivalent
Vibration Proof Standard	JIS D 1601–1995
Hydraulic Oil Grade	ISO VG32 to 68 equivalent
Hydraulic Oil Contamination Level	NAS Class 10 or less
Electrical Specifications	Rated Amperage: 1600 mA Coil resistance: 3.2 ± 0.5 Ω (at 20 deg C, 68 deg F)
Secondary pressure control range	0 to 2.7 MPa 0 to 27 kgf/cm^2 0 to 390 psi



RY9212032AVM043B

(1) P port
(2) T port
(3) A1 port (Hi)
(4) A2 port (Low)

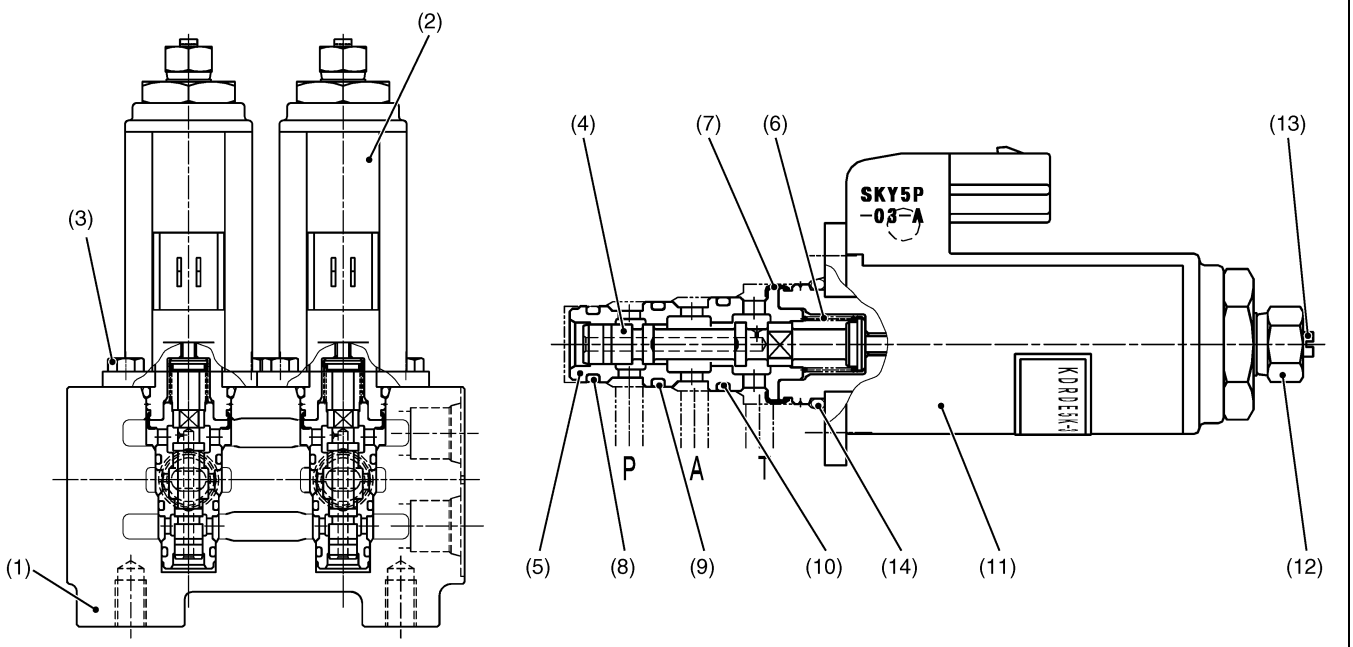
(a) Secondary pressure (MPa)
(b) Input amperage (mA)



RY9212032AVM044B

RY9212095HYM0018US0

[2] COMPONENTS



RY9212095HYM006A

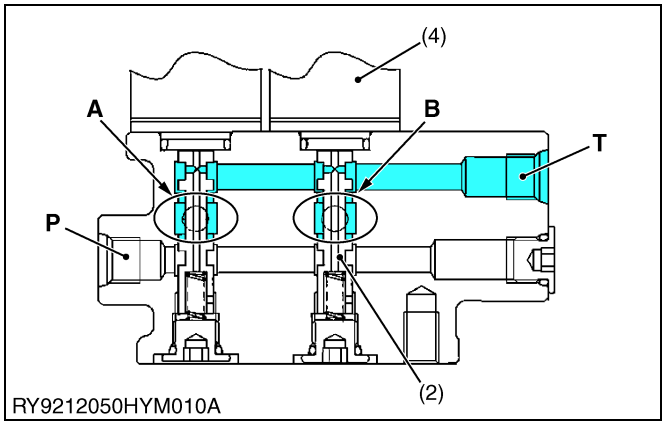
No.	Name of part	Qty	Notes	No.	Name of part	Qty	Notes
(1)	Casing	1		(8)	O-ring	2	
(2)	Magnetic proportioning reducing valve	2		(9)	O-ring	2	
(3)	Hex bolt	4		(10)	O-ring	2	
(4)	Spool	2		(11)	Solenoid	2	
(5)	Sleeve	2		(12)	Seal nut	2	
(6)	Spring	4		(13)	Adjusting screw	2	
(7)	Retaining ring	2		(14)	O-ring	2	

RY9212095HYM0035US0

[3] FUNCTION AND STRUCTURE

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

RY9212095HYM0019US0



RY9212050HYM010A

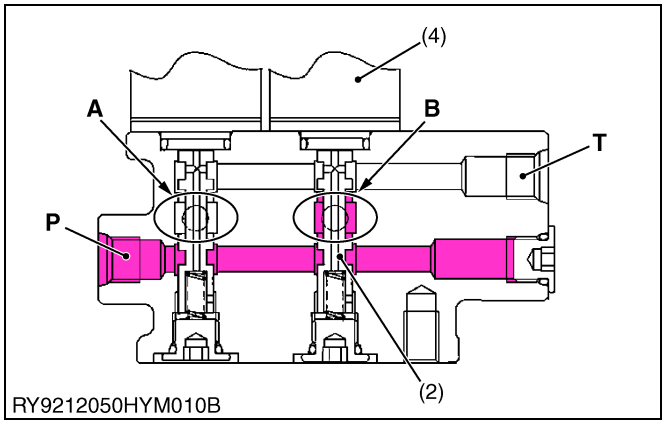
1. When the solenoid is off

When the solenoid (4) is off, port P and Port A are cut off by the spool (2). Port A and port T are connected, so no pressure is produced at port A.

(2) Spool
(4) Solenoid

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

RY9212095HYM0020US0



RY9212050HYM010B

2. When the solenoid is on

When the solenoid (4) is on, the spool (2) is pressed down, connecting port P and port A. And as port A and port T are cut off, the oil from port P flows to port A.

(2) Spool
(4) Solenoid

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

RY9212095HYM0021US0

SERVICING

CONTENTS

1. PUMP

[1] PUMP DISASSEMBLY/ASSEMBLY

CAUTION

- **When removing a hydraulic device after operating the mini-excavator, 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 mini-excavator. 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.**

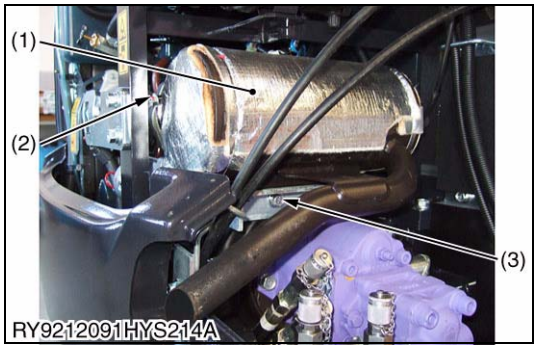
RY9212001MBS0004US0

Removing the Right Engine Cover

1. Remove the four right engine cover mounting bolts, the fuel tank cap and then the right engine cover.

(1) Cap ASSY
(2) Bolt
(3) Engine cover

RY9212091MBS0005US0

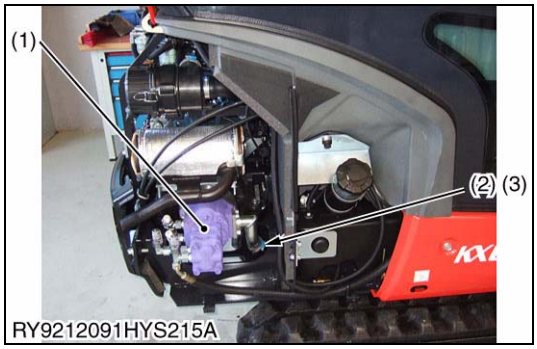


Removing the Muffler

1. Loosen the muffler clamp, then remove the two muffler bracket mounting bolts and the muffler.

(1) Muffler
(2) Muffler Clamp
(3) Bolt

RY9212091HYS0128US0

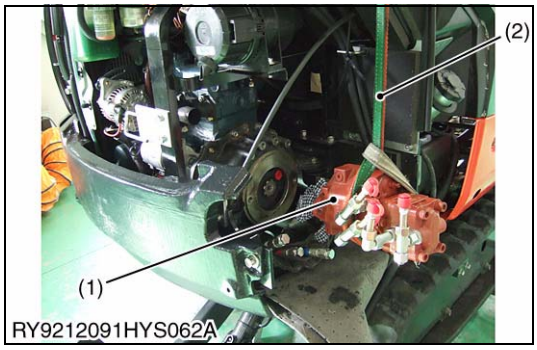


Removing the Main Pump

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) Piston Pump ASSY
(2) Hose Clamp
(3) Suction Hose

RY9212091HYS0029US0

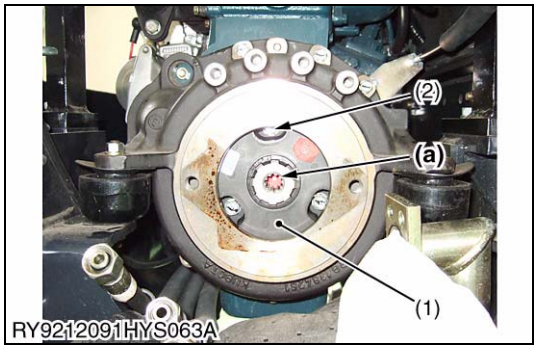


3. Suspend the pump by a nylon sling and support it with a crane. Remove the bolts in two locations,and pull the shaft of the pump suspended by the crane from the coupling.

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

RY9212091HYS0030US0



Spline section grease application

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

RY9212091HYS0031US0

Tightening the coupling assembly bolts

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

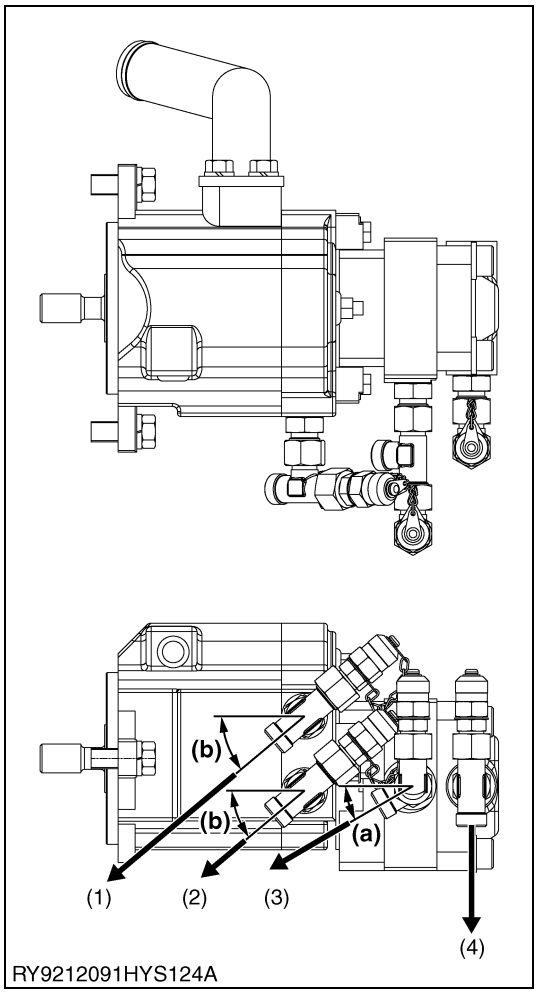
Tightening torque	Bolt (coupling) (2)	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 lbf·ft

■ **IMPORTANT**

- **Do not apply a threadlock.**

RY9212091HYS0032US0

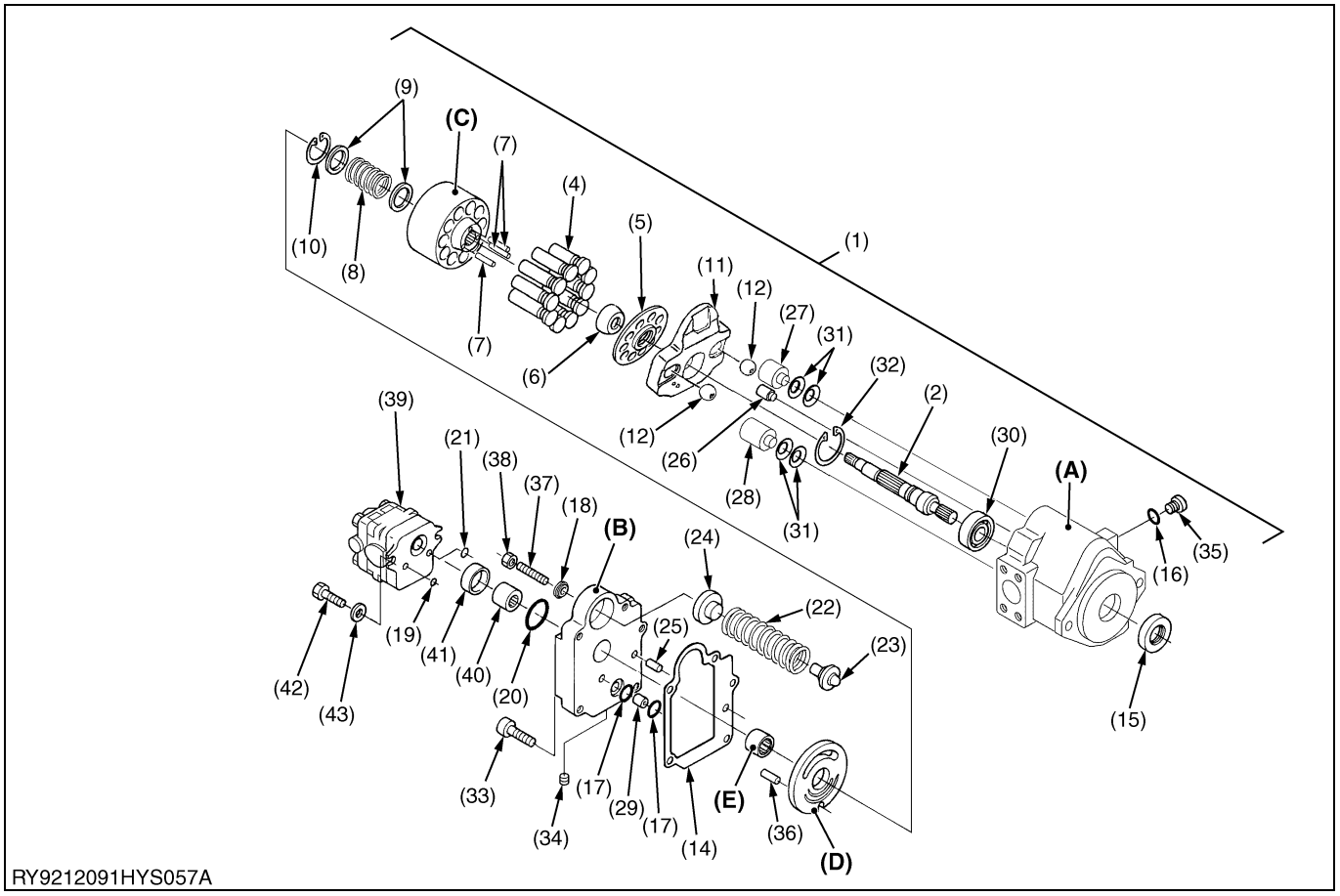
Pump Adapter Angles



(1) P1
(2) P2
(3) P3
(4) P4
(a) 30 °
(b) 40 °

RY9212091HYS0129US0

[2] PUMP DISASSEMBLY PROCEDURES



(A) Body S **(C) Cylinder Barrel** **(D) Valve Plate** **(E) Needle Bearing**
(B) Body H

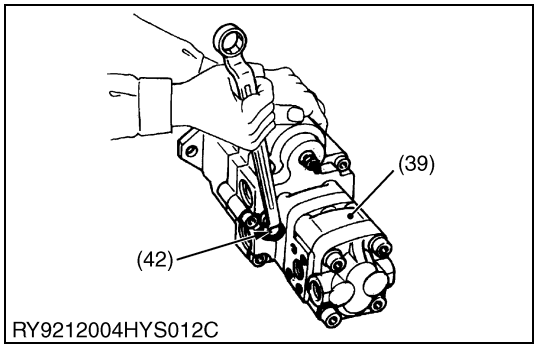
No.	Name of part	Qty	No.	Name of part	Qty	No.	Name of part	Qty
(1)	Piston pump ASSY **(A)** to **(E)** (2) to (43)	1	(16)	O-ring	1	(30)	Ball bearing	1
(2)	Shaft	1	(17)	O-ring	1	(31)	Disc spring	8
(3)	Cylinder ASSY (4) to (10)	1	(18)	Seal washer	1	(32)	Internal circlip	1
(4)	Piston ASSY	10	(19)	O-ring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

RY9212091HYS0001US0

(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



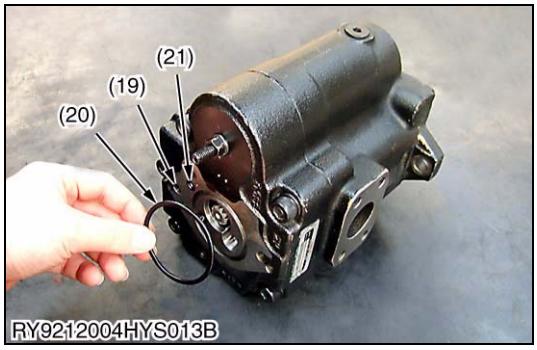
RY9212004HYS012C

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

- Tool to use: M13 wrench

(39) Gear Pump
(42) Bolt (M8 x 25)

RY9212091HYS0002US0



RY9212004HYS013B

2. Remove the O-rings.

(19) O-Ring
(20) O-Ring
(21) O-Ring

RY9212091HYS0003US0

RY9212004HYS015B

3. Loosen the nut enough and remove the set screw

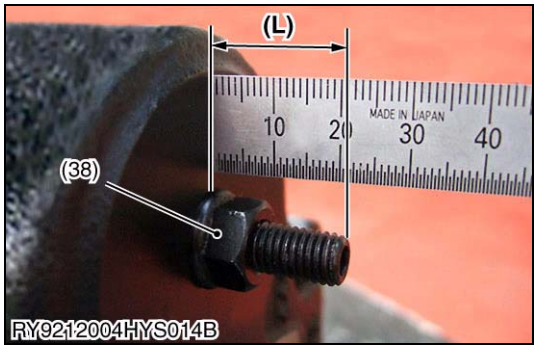
■ **IMPORTANT**

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

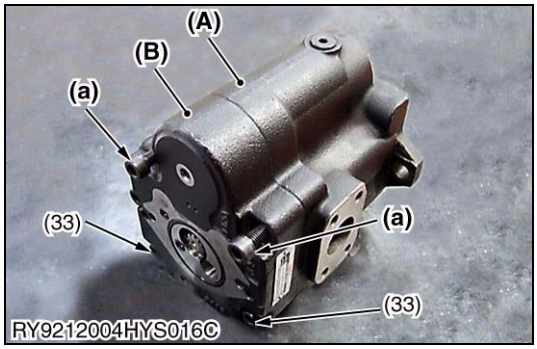
- Tool to use: M13 socket wrench, M4 hex socket

(37) Set Screw
(38) Nut

RY9212091HYS0004US0



RY9212004HYS014B



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.

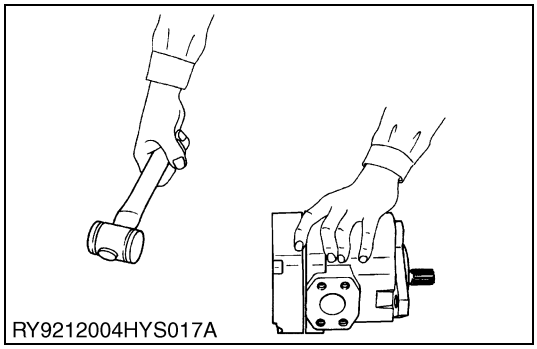
- Tool to use: M8 hex socket

■ **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

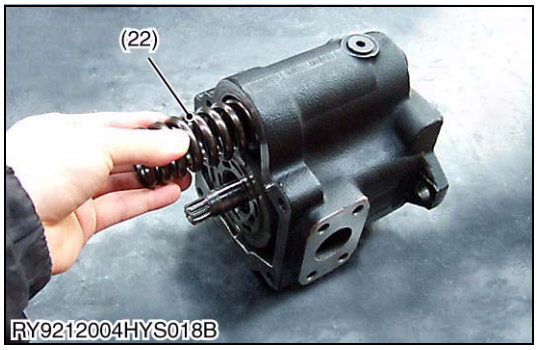


5. Remove the valve plate, gasket, spring and O-ring from body S.

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

(22) Spring

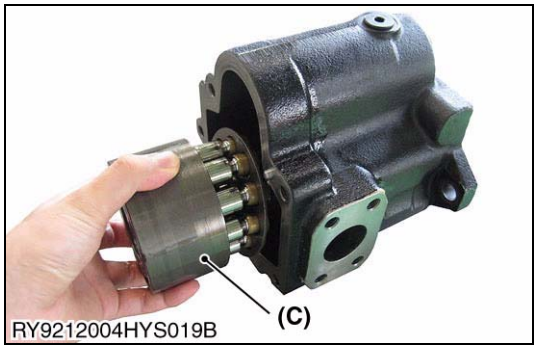
RY9212091HYS0006US0



6. Remove the cylinder barrel from body S.

(C) Cylinder Barrel

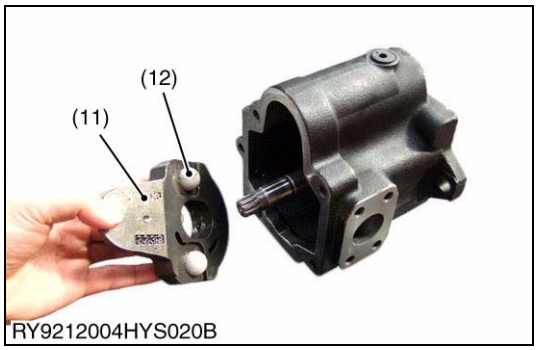
RY9212091HYS0007US0

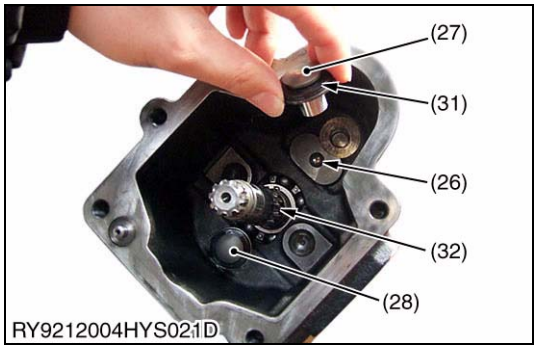


7. Remove the spring holder, swashplate and ball from body S.

(11) Swashplate
(12) Ball

RY9212091HYS0008US0

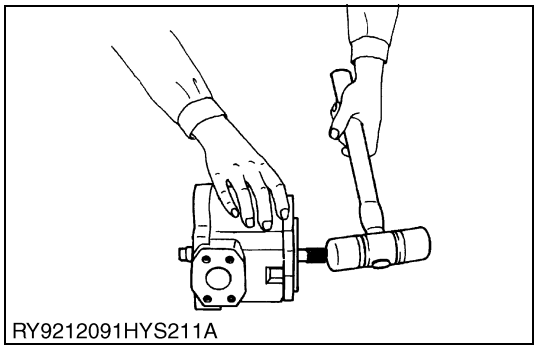




8. Remove stopper pin A, stopper pin B, disc spring, rod and snap ring.

(26) Rod
(27) Stopper Pin A
(28) Stopper Pin B
(31) Disc Spring
(32) Internal Circlip

RY9212091HYS0009US0



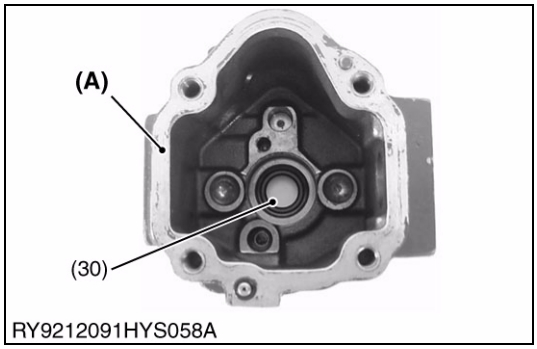
9. Tap the shaft lightly with a plastic hammer and remove the seal holder (with oil seal and O-ring) and the shaft (w/ ball bearing) from body S.

- Tool to use: Plastic hammer

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

RY9212091HYS0281US0

(2) Assembly Procedures



RY9212091HYS058A

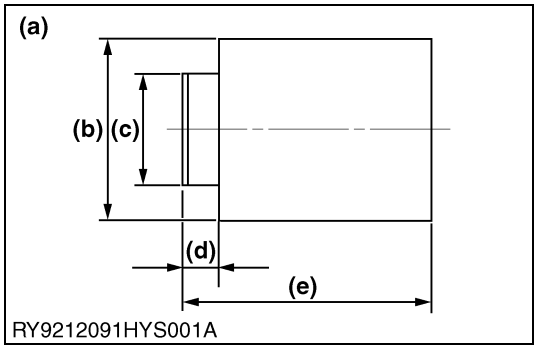
1. Use jig **(a)** to install the oil seal in body S.

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

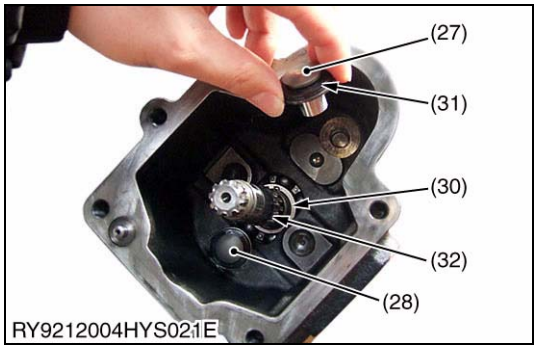
(30) Oil Seal
(A) Body S

(a) Jig
(b) ϕ31.7 mm (1.25 in.)
(c) ϕ19.8 mm (0.78 in.)
(d) 10 mm (0.39 in.)
(e) 115 mm (4.53 in.)

RY9212091HYS0010US0



RY9212091HYS001A



RY9212004HYS021E

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.**
- **The R face of the disc springs should face down.**

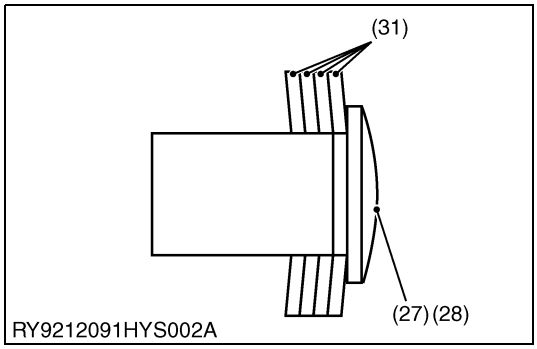
(2) Shaft
(27) Stopper Pin A
(28) Stopper Pin B
(30) Ball Bearing
(31) Disc Spring
(32) Internal Circlip

RY9212091HYS0011US0

Disc spring installation orientation

(27) Stopper Pin A
(28) Stopper Pin B
(31) Disc Spring

RY9212091HYS0130US0



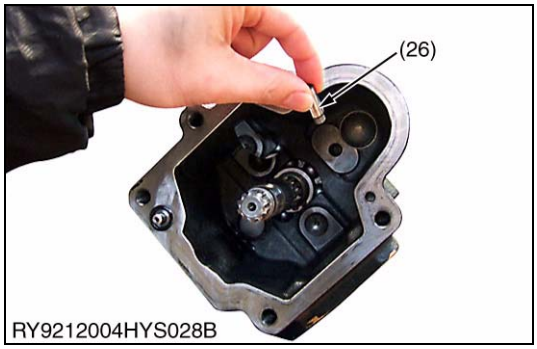
RY9212091HYS002A

3. Install the rod into body S.

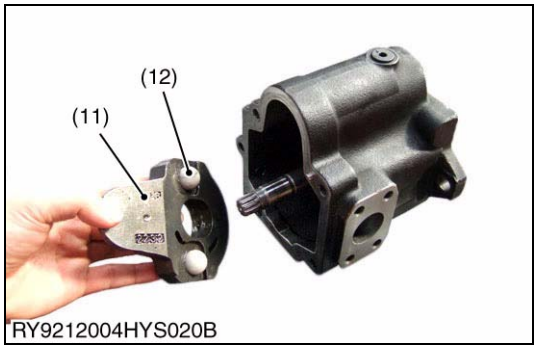
■ **IMPORTANT**
- **Replace used O-rings with new ones.**

(26) Rod

RY9212091HYS0012US0



RY9212004HYS028B

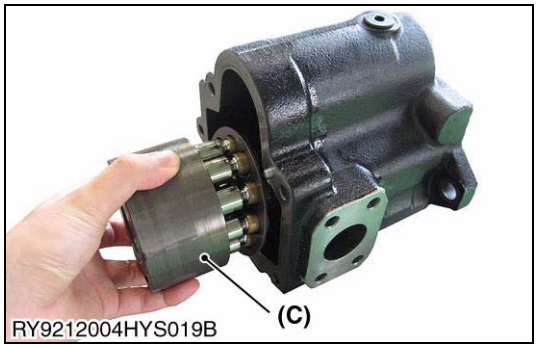


4. Mount the balls on the swashplate and install it in body S.

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

(11) Swashplate (12) Ball

RY9212091HYS0013US0

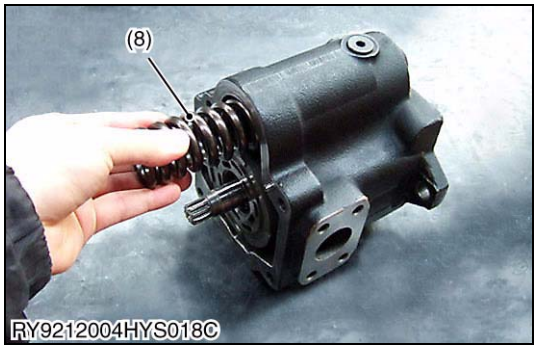


5. After mounting the springs in the cylinder barrel, install the three pins and the barrel holder, then carefully install the shoe holder with the pistons installed in it into body S.

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

(C) Cylinder Barrel

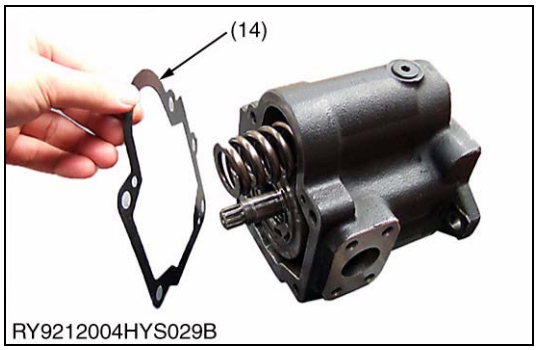
RY9212091HYS0022US0



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

(8) Spring

RY9212091HYS0014US0

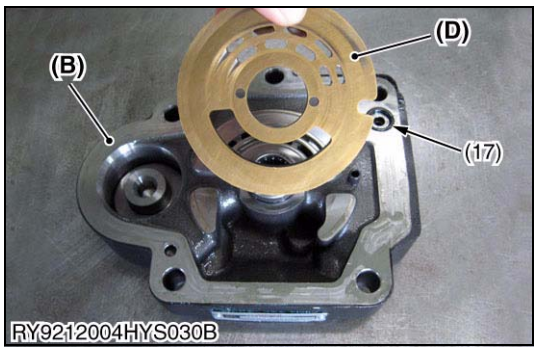


7. Insert the locating pin in the mating face of body S and mount the gasket.

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

(14) Gasket

RY9212091HYS0015US0



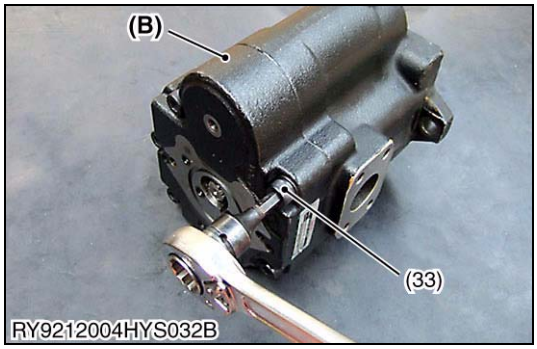
8. Align the valve plate to the spring pins of body H and gently put it on.

■ **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.**

(17) O-Ring

(B) Body H
(D) Valve Plate

RY9212091HYS0016US0



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

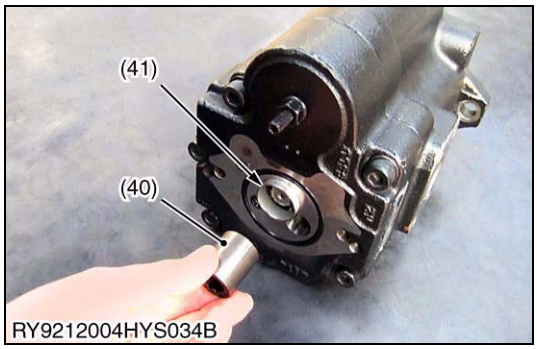
10. Fasten the hex set screw with a hex nut at the same length as was sticking out prior to disassembly.

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.**

RY9212091HYS0018US0

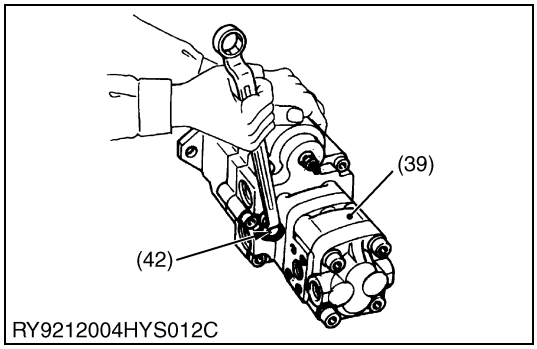


11. Install three O-rings to the mating surfaces of the gear pump and the piston pump kit.
Install a collar and a coupling to the connecting part of the gear pump.

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

(40) Coupling (41) Collar

RY9212091HYS0019US0



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

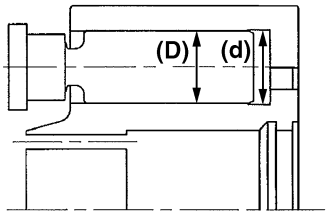
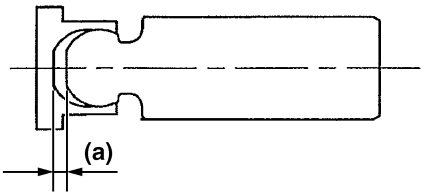
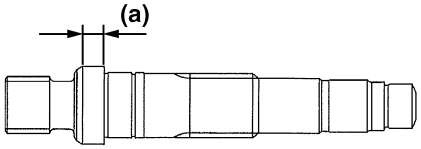
- Tool to use: M13 wrench

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

(39) Gear Pump (42) Bolt

RY9212091HYS0020US0

[3] SERVICE STANDARDS FOR PUMP PARTS

Part	Service Standard
Piston Assembly Cylinder Barrel	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
Valve Plate	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

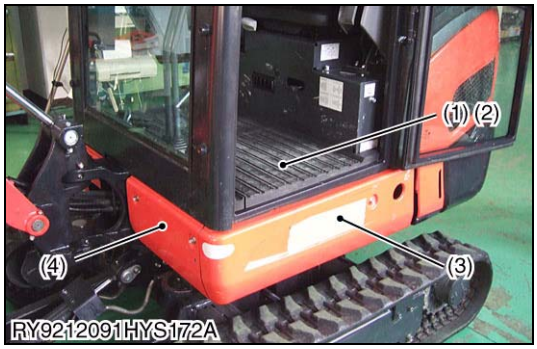
2. CONTROL VALVE

[1] CONTROL VALVE REMOVAL AND INSTALLATION

CAUTION

- **When removing a hydraulic device after operating the mini-excavator, 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 mini-excavator. 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.**

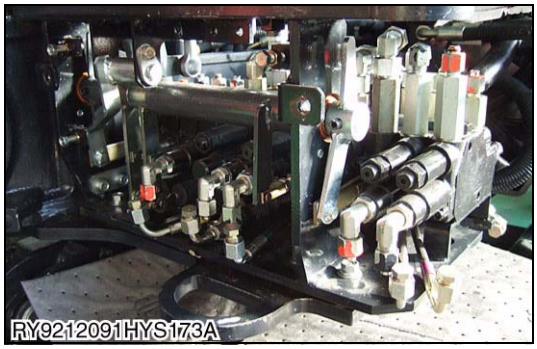
RY9212001MBS0004US0



1. Remove the step cover and the step.
2. 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)

RY9212091HYS0131US0

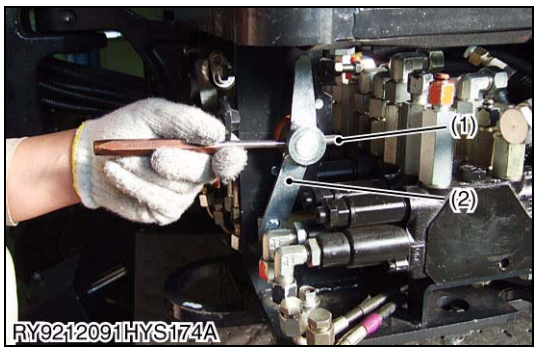


3. Attach the breather hose of the hydraulic fluid tank to the vacuum pump, and apply vacuum pressure to the hydraulic fluid tank.
4. Disconnect all hydraulic hoses and electrical wiring from the control valve.

CAUTION

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

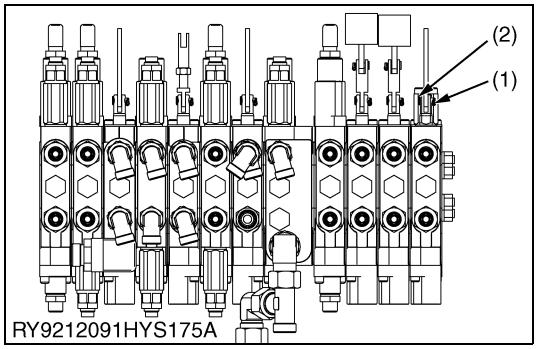
RY9212091HYS0111US0



5. Remove the spring pin and then remove the lever (travel right).

(1) Spring Pin
(2) Lever (Travel Right)

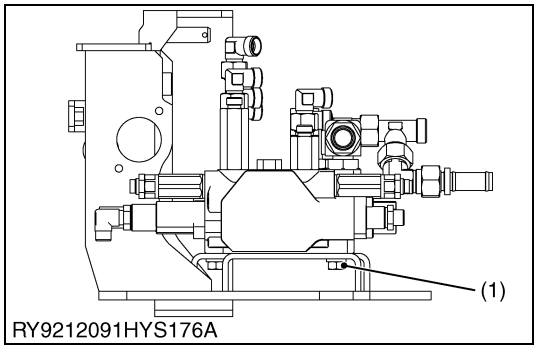
RY9212091HYS0132US0



6. Disconnect all snap pins and joint pins from the control valve.

(1) Snap Pin
(2) Joint Pin

RY9212091HYS0133US0



RY9212091HYS176A

7. Remove the three bolts and then the control valve.

■ **IMPORTANT**

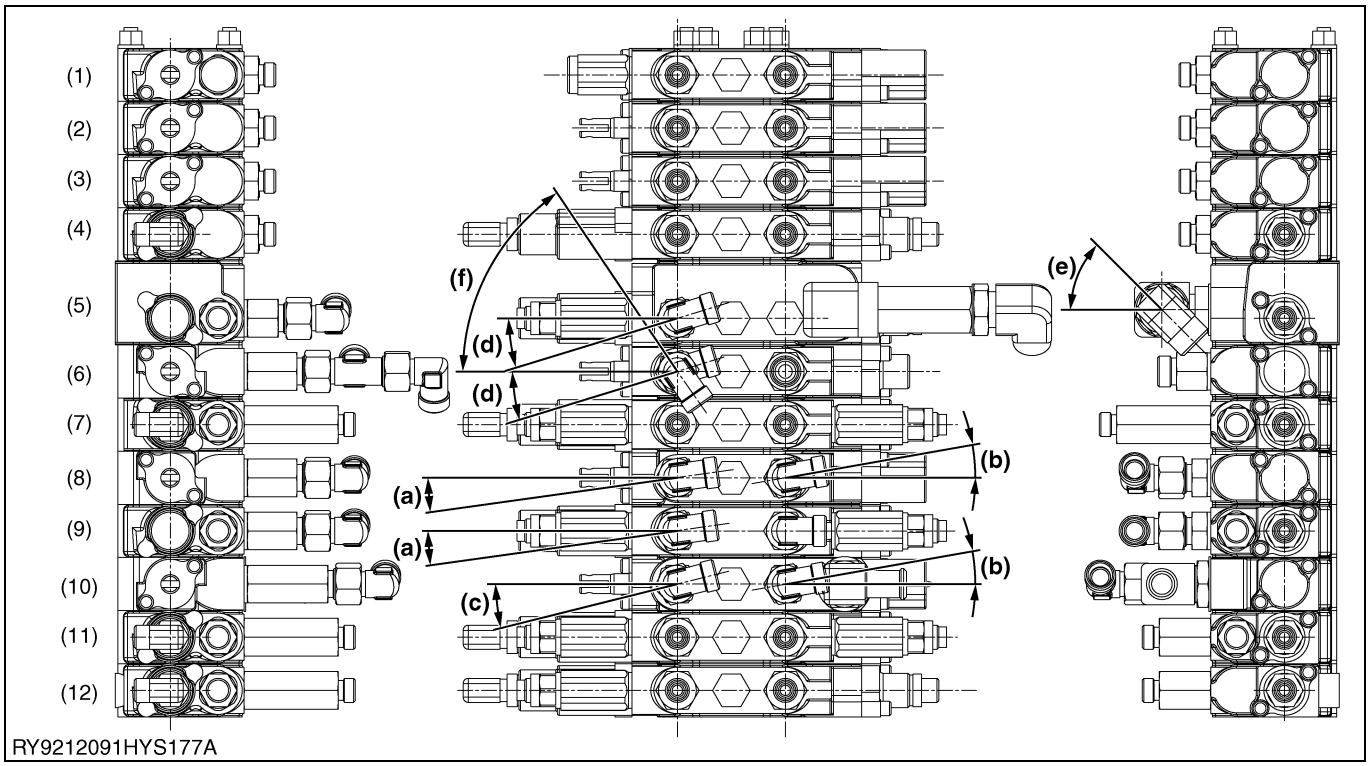
- **Apply thread lock (Loctite AN302-71 equivalent).**

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

RY9212091HYS0134US0

Control Valve Adapter Installation Angles



RY9212091HYS177A

(1) Swing
(2) Track
(3) Blade
(4) Swivel
(5) P3, T2
(6) AUX
(7) Arm
(8) Travel Left
(9) P1, P2
(10) Travel Right
(11) Boom
(12) Bucket

(a) 8 °
(b) 14 °
(c) 17 °
(d) 45 °
(e) 56 °

RY9212095HYS0079US0

[2] CONTROL VALVE DISASSEMBLY/ASSEMBLY PROCEDURES

Precautions during Disassembly / Assembly

Precautions during Disassembly

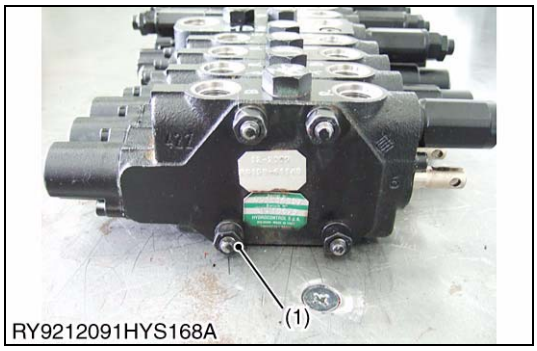
1. Generally, hydraulic devices are precision machined, and disassembly should therefore be conducted in a clean environment to prevent entry of debris into the narrow interstices formed in the device structure.
2. Always use clean tools and cleaning oil.
3. After removing from the machine, first wash 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.)

RY9212001HYS0140US0



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

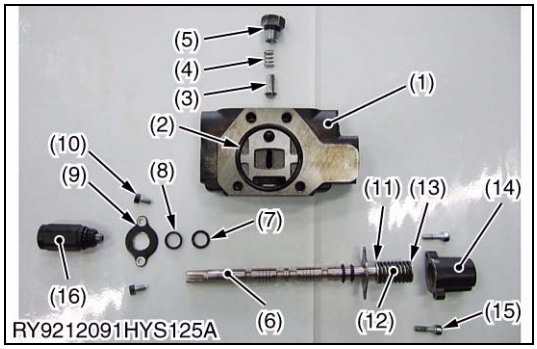
2. Pull out each section with a tie rod, and arrange in order on a workbench.

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

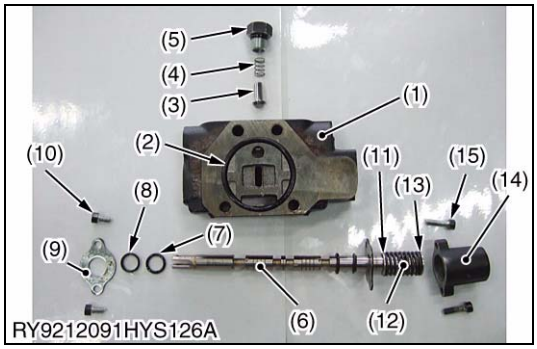


Spool Section (Swing) Components

No. in Fig.	Name of part	Qty	Tightening torque	Notes
(1)	Valve housing	1		
(2)	O-ring	1		
(3)	Poppet	1		
(4)	Spring	1		
(5)	Plug	1	40.0 N·m 4.1 kgf·m 30.0 lbf·ft	
(6)	Spool	1		
(7)	O-ring	2		
(8)	Dust seal	2		
(9)	Seat	2		
(10)	Bolt	2	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	
(11)	Spring seat	2		
(12)	Spring	1		
(13)	Bolt	1	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	Loctite
(14)	Cap	1		
(15)	Bolt	2	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	

No. in Fig.	Torque for anti-void valve
(16)	39.2 N·m 4.0 kgf·m 28.9 lbf·ft

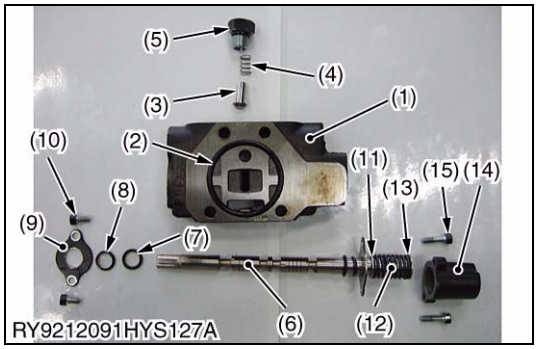
RY9212091HYS0136US0



Spool Section (Track) Components

No. in Fig.	Name of part	Qty	Tightening torque	Notes
(1)	Valve housing	1		
(2)	O-ring	1		
(3)	Poppet	1		
(4)	Spring	1		
(5)	Plug	1	40.0 N·m 4.1 kgf·m 30.0 lbf·ft	
(6)	Spool	1		
(7)	O-ring	2		
(8)	Dust seal	2		
(9)	Seat	2		
(10)	Bolt	2	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	
(11)	Spring seat	2		
(12)	Spring	1		
(13)	Bolt	1	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	Loctite
(14)	Cap	1		
(15)	Bolt	2	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	

RY9212091HYS0137US0



Spool Section (Blade) Components

No. in Fig.	Name of part	Qty	Tightening torque	Notes
(1)	Valve housing	1		
(2)	O-ring	1		
(3)	Poppet	1		
(4)	Spring	1		
(5)	Plug	1	40.0 N·m 4.1 kgf·m 30.0 lbf·ft	
(6)	Spool	1		
(7)	O-ring	2		
(8)	Dust seal	2		
(9)	Seat	2		
(10)	Bolt	2	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	
(11)	Spring seat	2		
(12)	Spring	1		
(13)	Bolt	1	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	Loctite
(14)	Cap	1		
(15)	Bolt	2	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	

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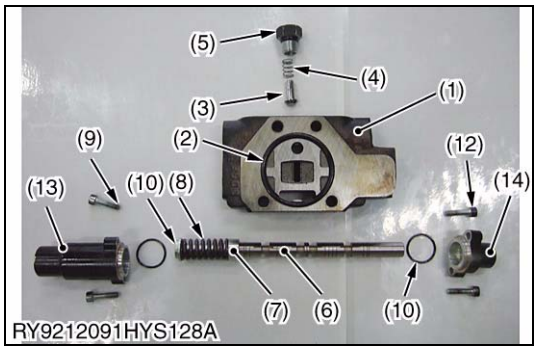

Spool Section (Swivel) Components

No. in Fig.	Name of part	Qty	Tightening torque	Notes
(1)	Valve housing	1		
(2)	O-ring	1		
(3)	Poppet	1		
(4)	Spring	1		
(5)	Plug	1	40.0 N·m 4.1 kgf·m 30.0 lbf·ft	
(6)	Spool	1		
(7)	Spring seat B	1		
(8)	Spring	1		
(9)	Spring seat A	1		
(10)	Bolt	1	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	Loctite
(11)	O-ring	2		
(12)	Bolt	4	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	
(13)	Cap A	1		
(14)	Cap B	1		

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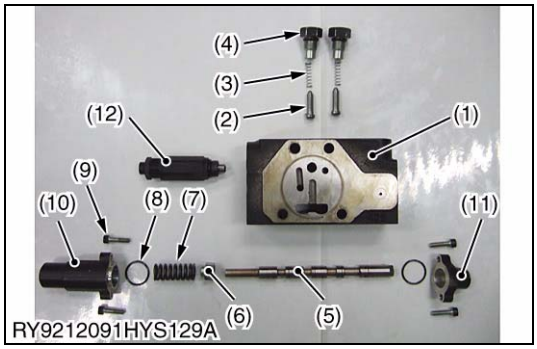

Spool Section (Communication Valve) Components

No. in Fig.	Name of part	Qty	Tightening torque	Notes
(1)	Valve housing	1		
(2)	Poppet	2		
(3)	Spring	2		
(4)	Plug	2	40.0 N·m 4.1 kgf·m 30.0 lbf·ft	
(5)	Spool	1		
(6)	Spring seat	1		
(7)	Spring	1		
(8)	O-ring	2		
(9)	Bolt	4	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	
(10)	Cap A	1		
(11)	Cap B	1		

No. in Fig.	Valve ASSY (relief) pressure setting	Tightening torque	Notes
(12)	20.1 MPa 205 kgf/cm^2 2920 psi	39.2 N·m 4.0 kgf·m 28.9 lbf·ft	

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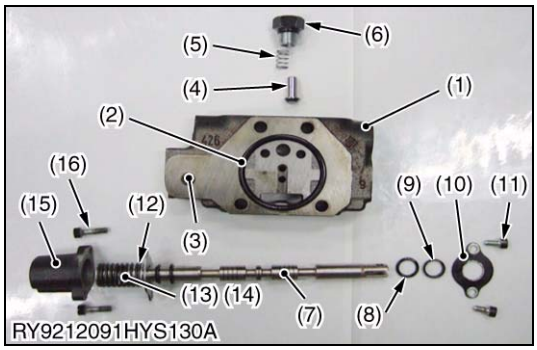

Spool Section (AUX) Components

No. in Fig.	Name of part	Qty	Tightening torque	Notes
(1)	Valve housing	1		
(2)	O-ring	1		
(3)	O-ring	1		
(4)	Poppet	1		
(5)	Spring	1		
(6)	Plug	1	40 N·m 4.1 kgf·m 30 lbf·ft	
(7)	Spool	1		
(8)	O-ring	2		
(9)	Dust seal	2		
(10)	Seat	2		
(11)	Bolt	2	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	
(12)	Spring seat	2		
(13)	Spring	1		
(14)	Bolt	1	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	Loctite
(15)	Cap	1		
(16)	Bolt	2	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	

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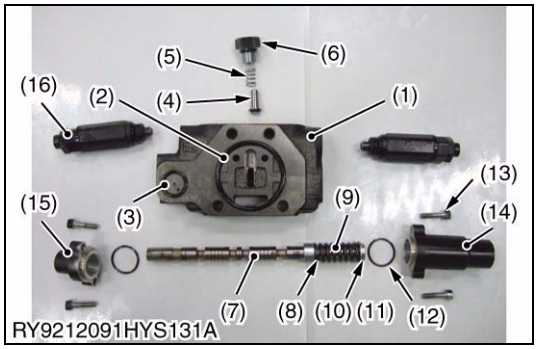

Spool Section (Arm) Components

No. in Fig.	Name of part	Qty	Tightening torque	Notes
(1)	Valve housing	1		
(2)	O-ring	1		
(3)	O-ring	1		
(4)	Poppet	1		
(5)	Spring	1		
(6)	Plug	1	40 N·m 4.1 kgf·m 30 lbf·ft	
(7)	Spool	1		
(8)	Spring seat B	1		
(9)	Spring	1		
(10)	Spring seat A	1		
(11)	Bolt	1	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	Loctite
(12)	O-ring	2		
(13)	Bolt	1	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	
(14)	Cap A	1		
(15)	Cap B	1		

No. in Fig.	Valve ASSY (Relief) Pressure Setting	Tightening torque	Notes
(16)	23.5 MPa 240 kgf/cm^2 3410 psi	39.2 N·m 4.0 kgf·m 28.9 lbf·ft	

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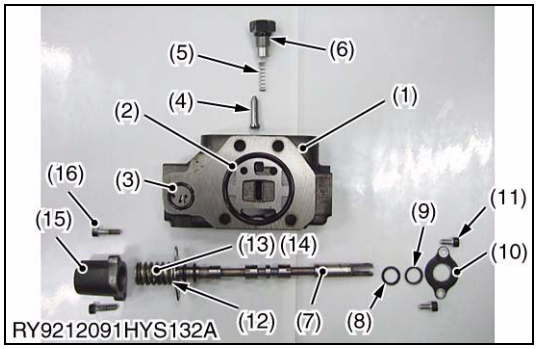

Spool Section (Travel Left) Components

No. in Fig.	Name of part	Qty	Tightening torque	Notes
(1)	Valve housing	1		
(2)	O-ring	1		
(3)	O-ring	1		
(4)	Poppet	1		
(5)	Spring	1		
(6)	Plug	1	40 N·m 4.1 kgf·m 30 lbf·ft	
(7)	Spool	1		
(8)	O-ring	2		
(9)	Dust seal	2		
(10)	Seat	2		
(11)	Bolt	2	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	
(12)	Spring seat	2		
(13)	Spring	1		
(14)	Bolt	1	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	Loctite
(15)	Cap	1		
(16)	Bolt	2	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	

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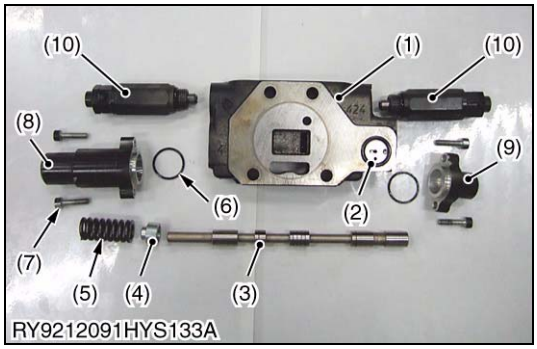

Spool Section (Inlet) Components

No. in Fig.	Name of part	Qty	Tightening torque	Notes
(1)	Valve housing	1		
(2)	O-ring	1		
(3)	Spool	1		
(4)	Spring seat	1		
(5)	Spring	1		
(6)	O-ring	2		
(7)	Bolt	4	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	
(8)	Cap A	1		
(9)	Cap B	1		

No. in Fig.	Valve ASSY (Relief) Pressure Setting	Tightening torque	Notes
(10)	20.6 MPa 210 kgf/cm^2 2990 psi	39.2 N·m 4.0 kgf·m 28.9 lbf·ft	

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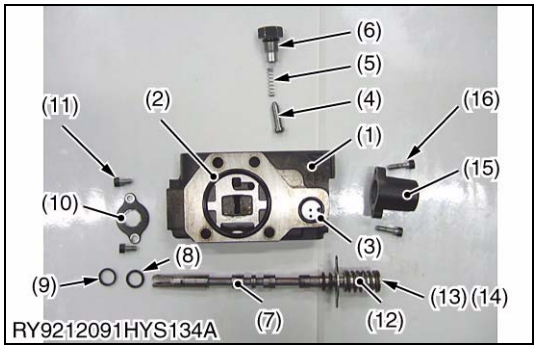

Spool Section (Travel Right) Components

No. in Fig.	Name of part	Qty	Tightening torque	Notes
(1)	Valve housing	1		
(2)	O-ring	1		
(3)	O-ring	1		
(4)	Poppet	1		
(5)	Spring	1		
(6)	Plug	1	40 N·m 4.1 kgf·m 30 lbf·ft	
(7)	Spool	1		
(8)	O-ring	2		
(9)	Dust seal	2		
(10)	Seat	2		
(11)	Bolt	2	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	
(12)	Spring seat	2		
(13)	Spring	1		
(14)	Bolt	1	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	Loctite
(15)	Cap	1		
(16)	Bolt	2	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	

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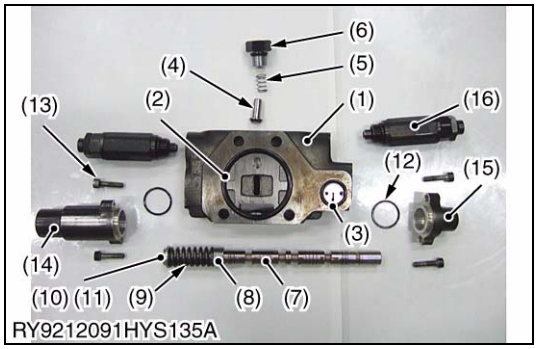

Spool Section (Boom) Components

No. in Fig.	Name of part	Qty	Tightening torque	Notes
(1)	Valve housing	1		
(2)	O-ring	1		
(3)	O-ring	1		
(4)	Poppet	1		
(5)	Spring	1		
(6)	Plug	1	40 N·m 4.1 kgf·m 30 lbf·ft	
(7)	Spool	1		
(8)	Spring seat B	1		
(9)	Spring	1		
(10)	Spring seat A	1		
(11)	Bolt	1	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	Loctite
(12)	O-ring	2		
(13)	Bolt	1	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	
(14)	Cap A	1		
(15)	Cap B	1		

No. in Fig.	Valve ASSY (Relief) Pressure Setting	Tightening torque	Notes
(16)	23.5 MPa 240 kgf/cm^2 3410 psi	39.2 N·m 4.0 kgf·m 28.9 lbf·ft	

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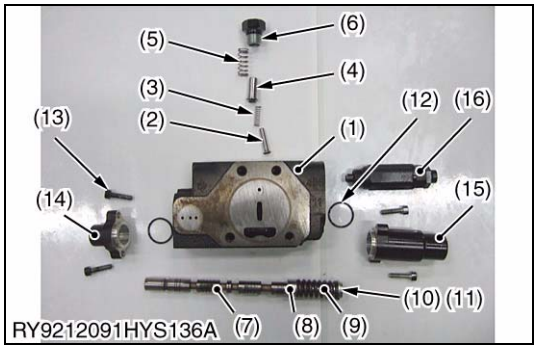

Spool Section (Bucket) Components

No. in Fig.	Name of part	Qty	Tightening torque	Notes
(1)	Valve housing	1		
(2)	Poppet	1		
(3)	Spring	1		
(4)	Poppet	1		
(5)	Spring	1		
(6)	Plug	1	40 N·m 4.1 kgf·m 30 lbf·ft	
(7)	Spool	1		
(8)	Spring seat B	1		
(9)	Spring	1		
(10)	Spring seat A	1		
(11)	Bolt	1	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	Loctite
(12)	O-ring	1		
(13)	Bolt	4	5.0 N·m 0.5 kgf·m 4.0 lbf·ft	
(14)	Cap B	1		
(15)	Cap A	1		

No. in Fig.	Valve ASSY (Relief) Pressure Setting	Tightening torque	Notes
(16)	23.5 MPa 240 kgf/cm^2 3410 psi	39.2 N·m 4.0 kgf·m 28.9 lbf·ft	

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3. SWIVEL MOTOR

[1] SWIVEL MOTOR REMOVAL AND INSTALLATION

CAUTION

- **When removing a hydraulic device after operating the mini-excavator, 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 mini-excavator. 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.**

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Removing the step

1. Remove the step.

(1) Step

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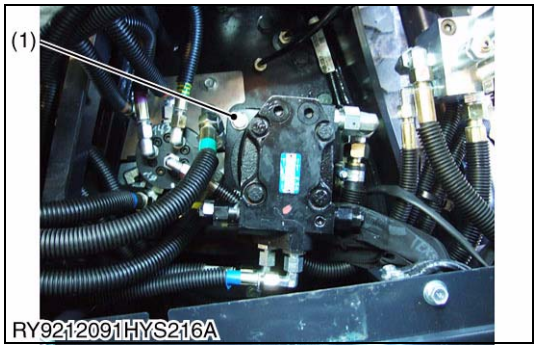

Removing the Swivel Motor

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

(1) Bolt

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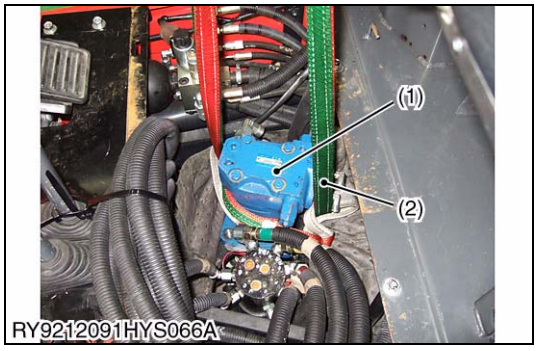

3. Suspend the motor ASSY (swivel) from a nylon sling and hoist it up with a crane.

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

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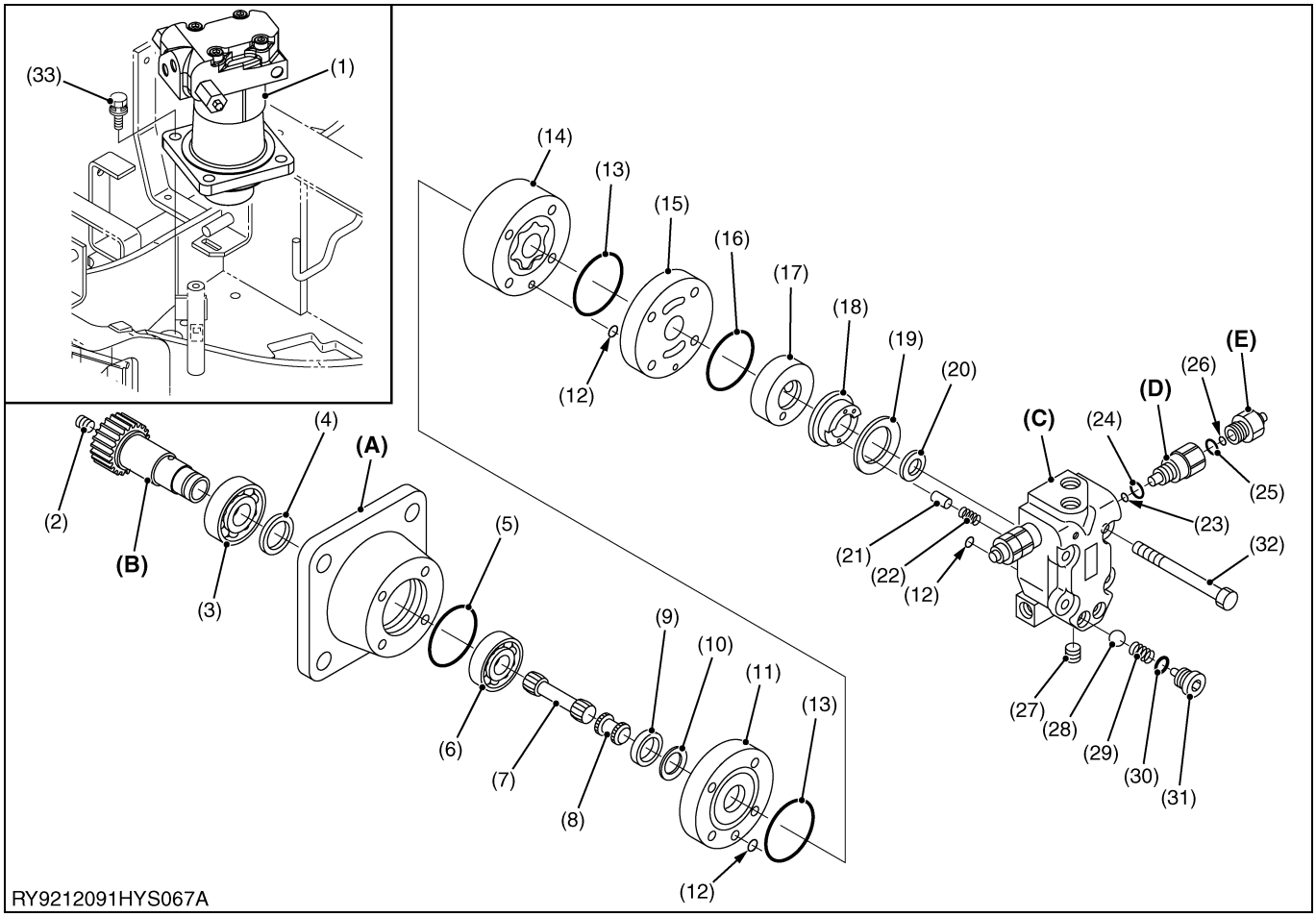
[2] SWIVEL MOTOR DISASSEMBLY/ASSEMBLY PROCEDURES



(A) Bearing Housing **(C) Valve Housing** **(D) Cartridge** **(E) Screw Guide**
(B) Pinion Gear Shaft

No.	Parts Name	Q'ty	Remarks	No.	Parts Name	Q'ty	Remarks
(1)	Assy Motor, Swivel	1	**(A)**, **(B)**, **(C)** to **(E)**, (2), (34)	(18)	Plate	1	
(2)	Plug	1		(19)	Seal	1	
(3)	Bearing, Ball	1		(20)	Seal	1	
(4)	X-Ring	1		(21)	Pin	2	
(5)	O-Ring	1		(22)	Spring	2	
(6)	Bearing, Ball	1		(23)	O-Ring	2	
(7)	Shaft, Drive	1		(24)	O-Ring	2	
(8)	Valve, Drive	1		(25)	O-Ring	2	
(9)	Retainer	1		(26)	O-Ring	2	
(10)	Seal	1		(27)	Plug	3	
(11)	Plate	1		(28)	Ball	2	
(12)	O-Ring	3		(29)	Spring	2	
(13)	O-Ring	2		(30)	O-Ring	2	
(14)	Roller	1		(31)	Plug	2	
(15)	Plate, Valve	1		(32)	Bolt	4	
(16)	O-Ring	1		(33)	Bolt	4	
(17)	Valve	1					

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(1) Disassembly Procedures

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

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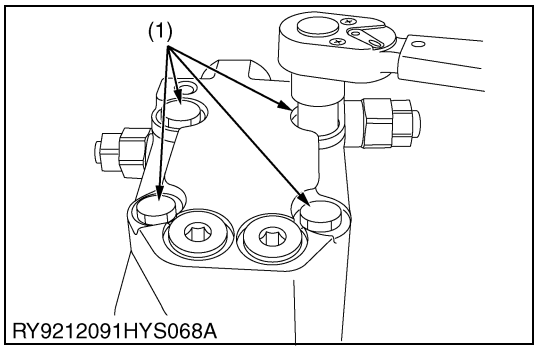

1. With the valve bearing facing up, clamp the flanged part in a vise and remove the four hex bolts.

(1) Hex Bolt

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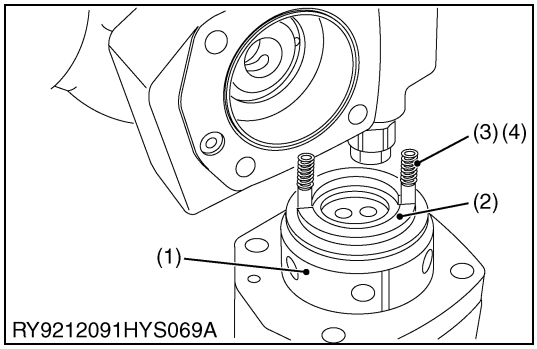

2. Remove the valve housing ASSY, balancing plate and the valve. Take care not to lose the springs and pins.

(1) Valve
(2) Balancing Plate
(3) Spring
(4) Pin

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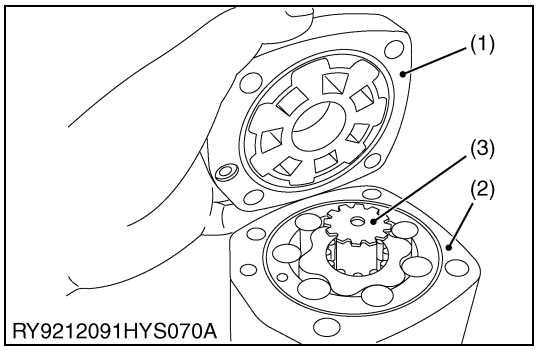

3. Remove the valve plate, valve drive and geroler.

(1) Valve Plate
(2) Geroler
(3) Valve Drive

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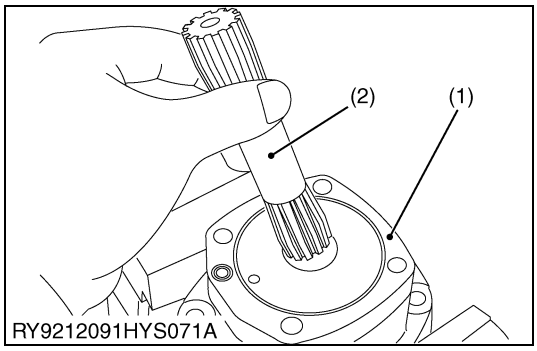

4. Remove the drive and wear plate.

(1) Wear Plate
(2) Drive

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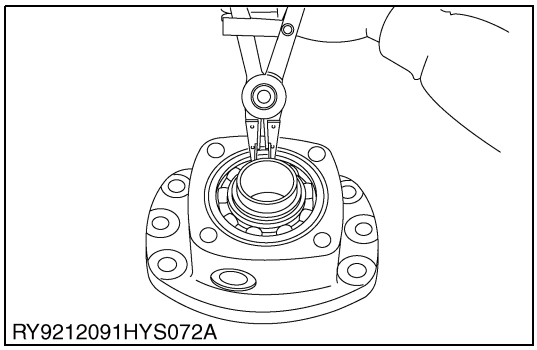

5. Remove the retaining ring.

■ **IMPORTANT**

- **Do not remove the pinion gear ASSY unless it is necessary to do so.**

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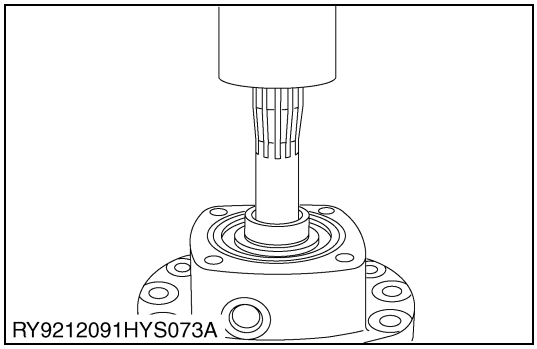
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6. Remove the pinion gear shaft with a press.

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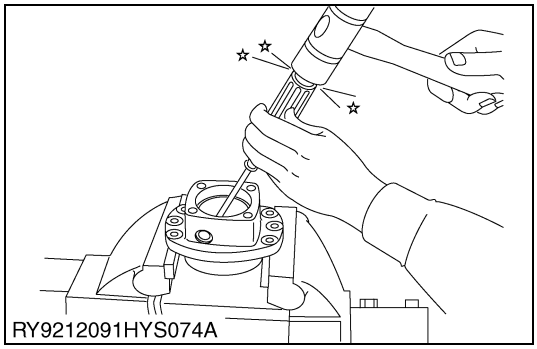
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7. Remove the ball bearing.

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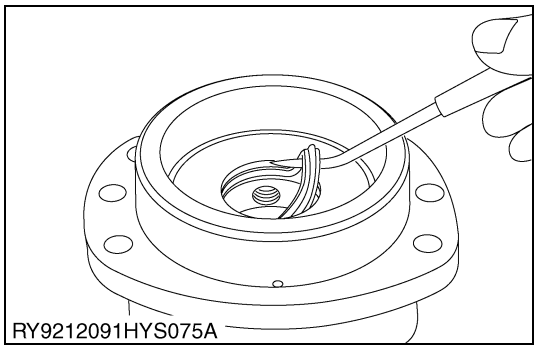
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8. Remove the X-ring.

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(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.**

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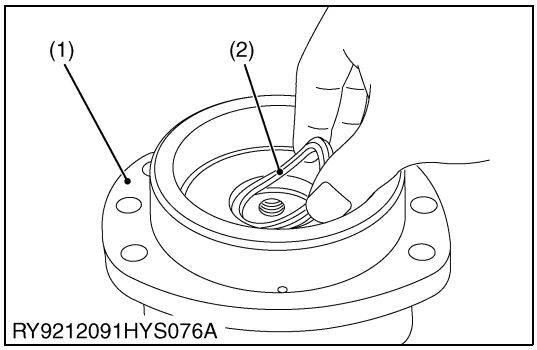

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1. Install the X-ring in the bearing housing.

(1) Bearing Housing (2) X-Ring

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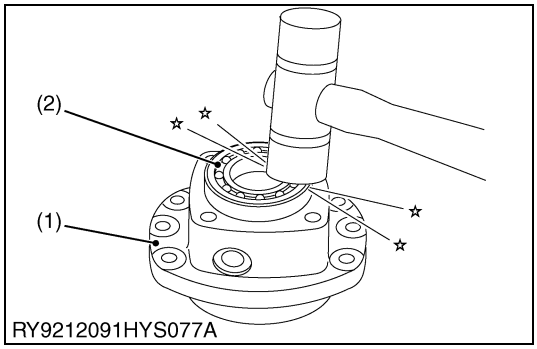

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2. Install the bearing in the bearing housing.

(1) Bearing Housing (2) Bearing

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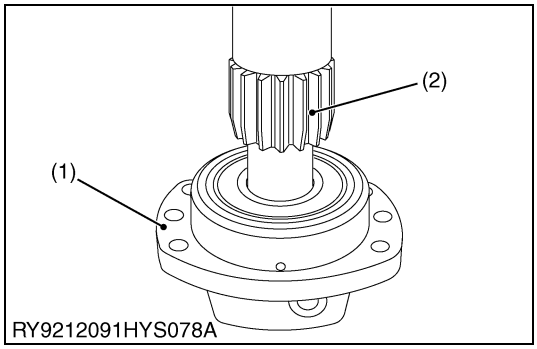

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3. Use a press to install the pinion shaft in the bearing housing.

(1) Bearing Housing (2) Pinion Shaft

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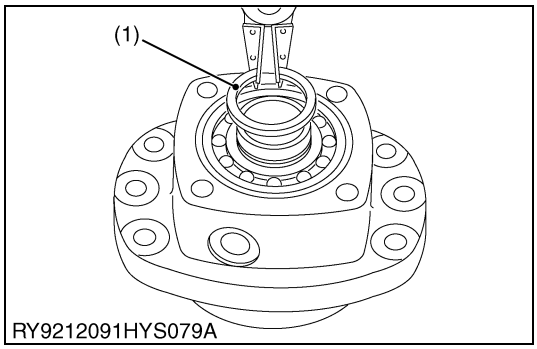

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4. Install the retaining ring.

(1) Retaining Ring

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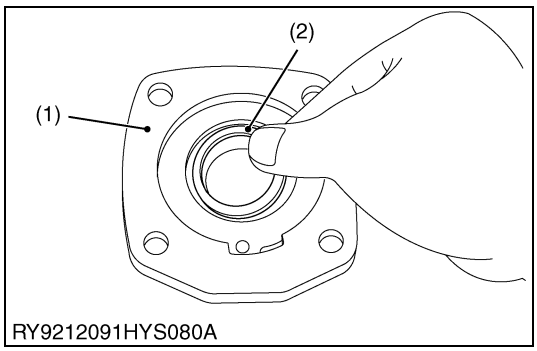

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5. Install the shaft face seal in the wear plate.

(1) Wear Plate (2) Shaft Face Seal

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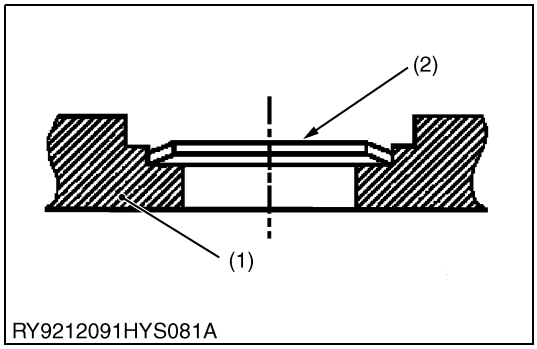
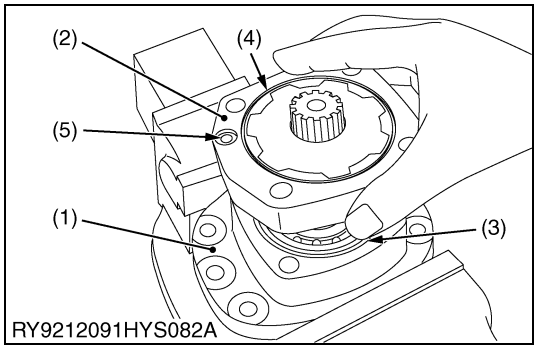


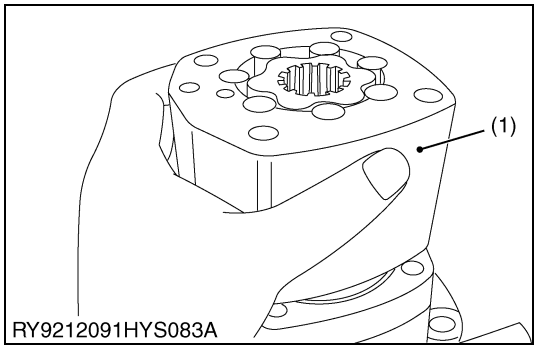
RY9212091HYS081A



6. Install the O-ring and and drive in the bearing housing.
   Install the O-rings in the wear plate.

(1) Bearing Housing
(2) Wear Plate
(3) O-Ring
(4) O-Ring
(5) O-Ring

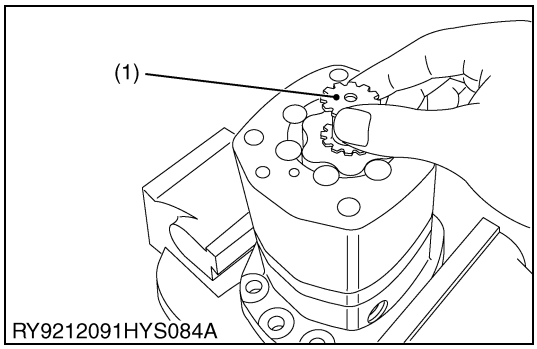
RY9212091HYS0163US0



7. Install the geroler.
   Install the geroler so its drain hole and the drain hole of the wear plate line up.

(1) Geroler

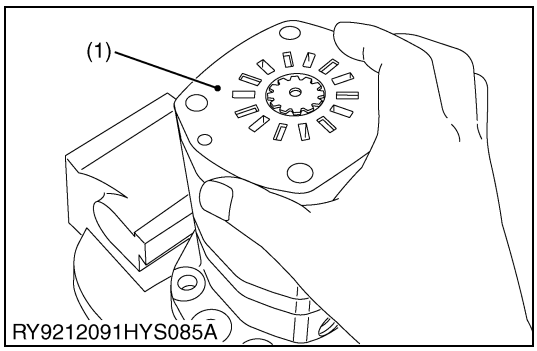
RY9212091HYS0164US0



8. Install the valve drive.

(1) Valve Drive

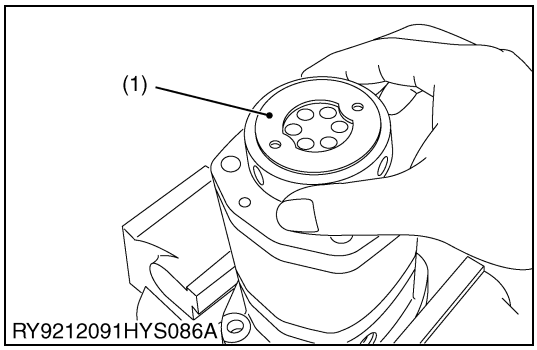
RY9212091HYS0165US0



9. Install the O-ring in the wear plate.
   Install the valve plate.
   Install the valve plate so its drain hole and the drain hole of the geroler line up.

(1) Valve Plate

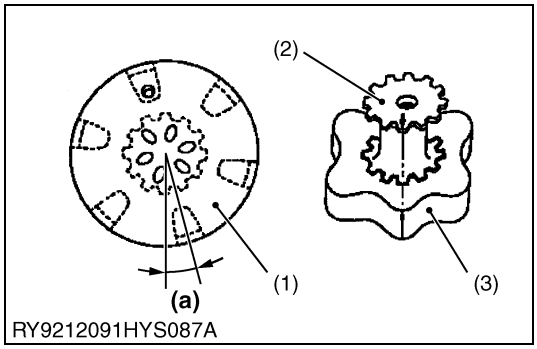
RY9212091HYS0166US0



10. Install the valve.

(1) Valve

RY9212091HYS0167US0



RY9212091HYS087A

Valve Timing

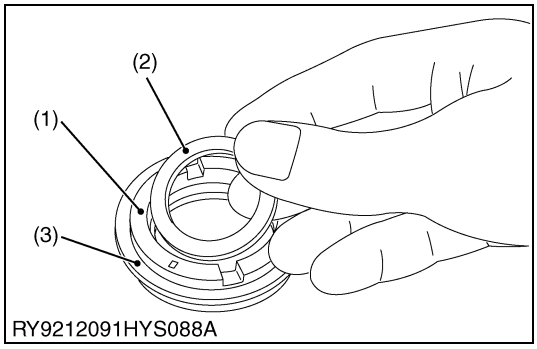
Line up the tip of a spline tooth of the valve drive with the outside tooth of the geroler/star as in the diagram and mark the tip of the valve drive's tooth with a magic marker or the like. Install the parts so the marked spline tooth of the valve drive is 15° off-center of one of the holes on the side of the valve (turn the valve 15° counterclockwise).

CAUTION

- **The motor will rotate in reverse if the valve timing is incorrect.**

(1) Valve
(2) Valve Drive
(3) Geroler/Star
(a) 15 °

RY9212091HYS0168US0

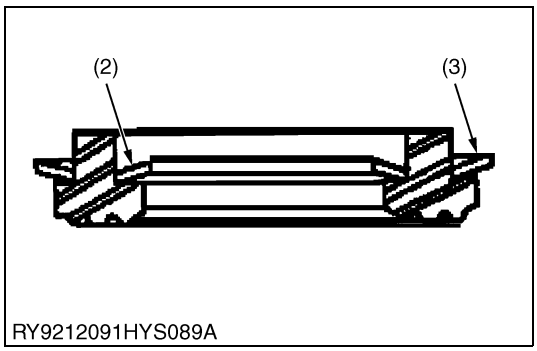


RY9212091HYS088A

11. Install the inner and outer face seals on the balancing ring.

(1) Balancing Ring
(2) Inner Face Seal
(3) Outer Face Seal

RY9212091HYS0169US0



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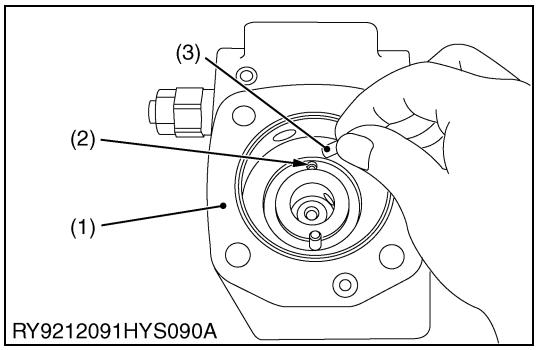
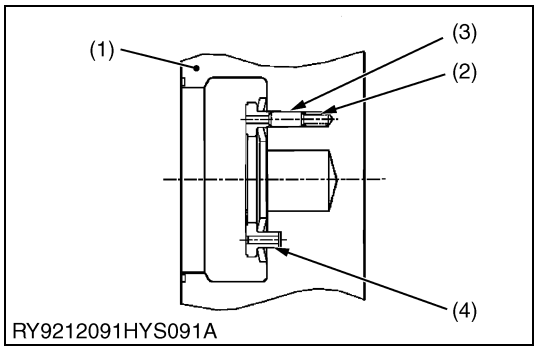


RY9212091HYS090A

12. Install the two springs into the two holes inside the valve housing.
    Install the two pins into these same holes.

(1) Valve Housing
(2) Spring
(3) Pin

RY9212091HYS0170US0

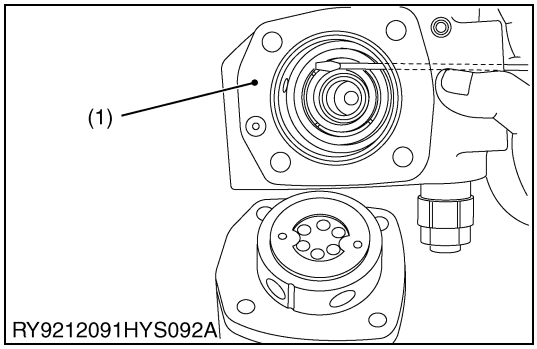


RY9212091HYS091A

13. Line up the balancing ring's pin groove with the two pins fitted into the valve housing and install the balancing ring in the valve housing.

(1) Valve Housing
(2) Spring
(3) Pin
(4) Balancing Ring

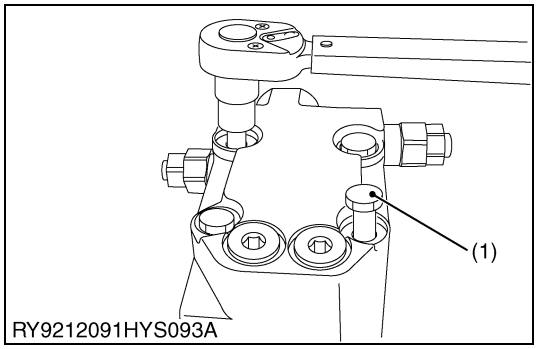
RY9212091HYS0171US0



14. Install the valve housing ASSY.
    Insert a tool such as a screwdriver through a port hole and hold the balancing plate while installing the ASSY to keep the balancing ring from coming out.

(1) Valve Housing ASSY

RY9212091HYS0172US0

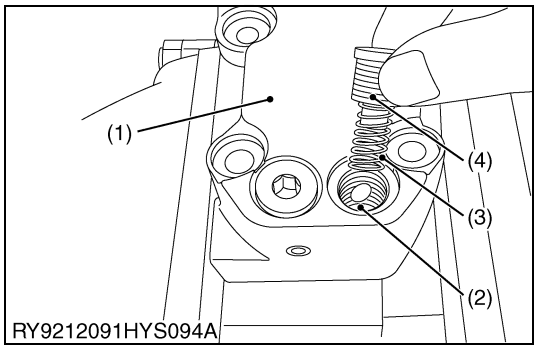


15. Install and tighten the hex bolts.

Tightening torque	Hex bolt (1)	53 N·m 5.4 kgf·m 39 lbf·ft

(1) Hex Bolt

RY9212091HYS0173US0

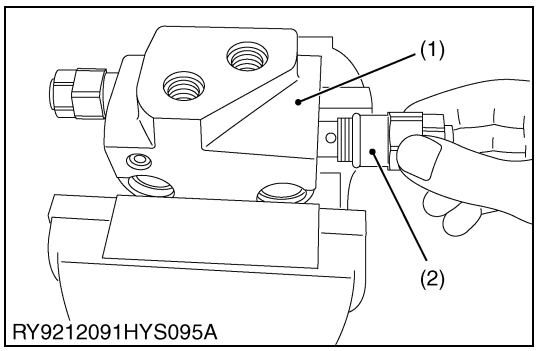


16. Install the steel ball and spring check plug into the valve housing.

Tightening torque	Check plug (4)	59 N·m 6 kgf·m 44 lbf·ft

(1) Valve Housing
(2) Steel Ball
(3) Spring
(4) Check Plug

RY9212091HYS0174US0



17. Install the relief valve into the valve housing.

Tightening torque	Relief valve (2)	98 N·m 10 kgf·m 72 lbf·ft

(1) Valve Housing
(2) Relief Valve

RY9212091HYS0175US0

4. SWIVEL JOINT

[1] SWIVEL JOINT REMOVAL AND INSTALLATION

CAUTION

- **When removing a hydraulic device after operating the mini-excavator, 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 mini-excavator. 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

Stabilizing the Mini-excavator

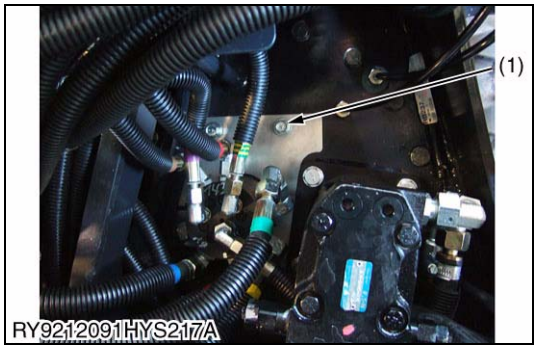
1. Position the mini-excavator on hard, level ground, operating the equipment and blade to lift the body.

DANGER

- **Put blocks under the crawler to prevent the mini-excavator from lowering.**

(1) Block

RY9212091HYS0043US0



Removing the Hydraulic Hoses

1. Disconnect all the hydraulic hoses on the swivel joint shaft side (inside the swivel frame) and mount plugs and caps on the adapters and hoses.
2. Remove the four bolts and the bottom cover.
3. Remove the bottom cover from the track frame.
4. Disconnect all the hydraulic hoses from the body side (inside the track frame).
   Mount plugs and caps on the adapters and hoses.

(1) Bolt

RY9212091HYS0044US0

Swivel Joint Removal

1. To prevent the swivel joint from dropping, support the underside of the body with a hydraulic jack.
2. Remove the six swivel joint mounting bolts.

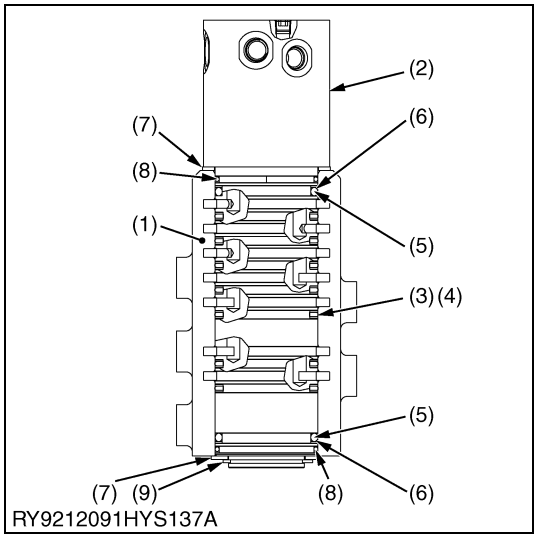
IMPORTANT

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

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

(1) Bolt (2) Bolt

RY9212095HYS0074US0



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Swivel Joint Assembly

1. Grease the D-ring and insert in the body.
2. Install backup rings on both sides of the D-ring
3. Grease the O-ring (5) and insert in the body.
4. Install a backup ring on the outside of the O-ring (5).
5. Grease the O-ring (8) and insert in the body.
6. Set the collar in the body and after inserting the shaft, secure it with a circlip.

■ **IMPORTANT**

- **Install the circlip with its sharp edge facing the other side from loaded direction.**

(1) Body
(2) Shaft
(3) D-Ring
(4) Backup Ring
(5) O-Ring
(6) Backup Ring
(7) Collar
(8) O-Ring
(9) Circlip

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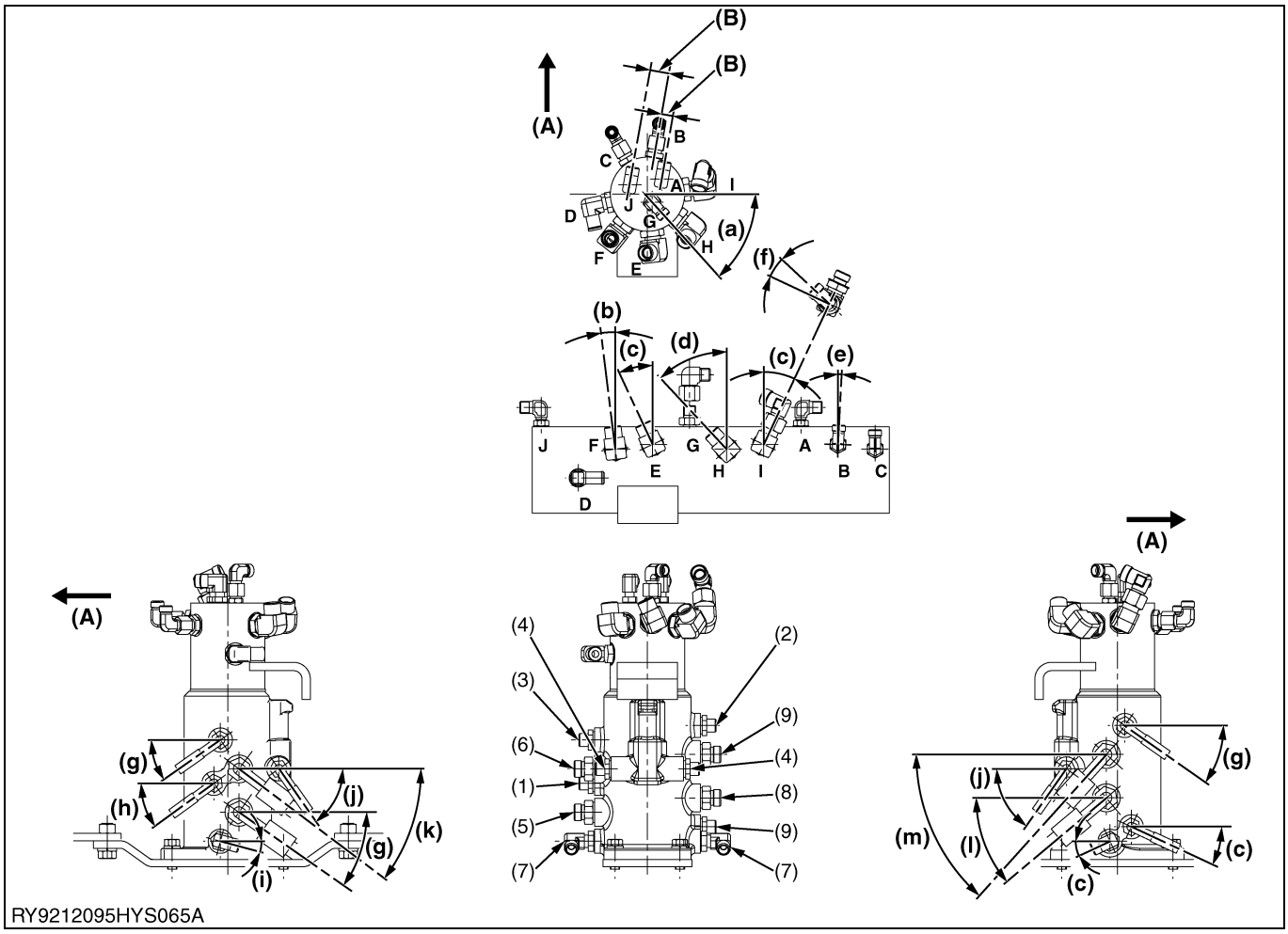
Swivel Joint Adapter Angle



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(1) Track (Rod)
(2) Dozer (Rod)
(3) Dozer (Bottom)
(4) Drain
(5) Left Backward
(6) Left Forward
(7) 2-Speed Pilot
(8) Right Forward
(9) Right Backward
(10) Track (Bottom)

(A) Front of Machine
(B) Parallel

(a) 48 °
(b) 7 °
(c) 25 °
(d) 43 °
(e) 3 °
(f) 18 °
(g) 35 °
(h) 36 °
(i) 15 °
(j) 55 °
(k) 37 °
(l) 40 °
(m) 48 °

RY9212095HYS0073US0

5. TRAVEL MOTOR

[1] TRAVEL MOTOR REMOVAL AND INSTALLATION

CAUTION

- **When removing a hydraulic device after operating the mini-excavator, 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 mini-excavator. 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.**

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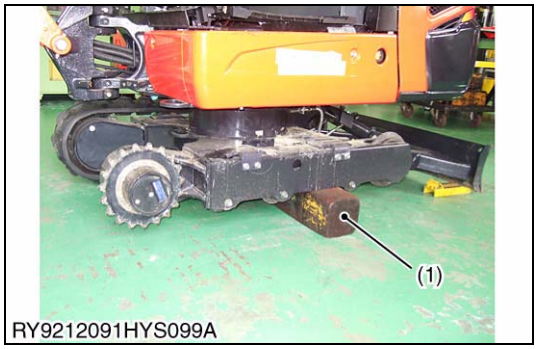


Removing the travel motor

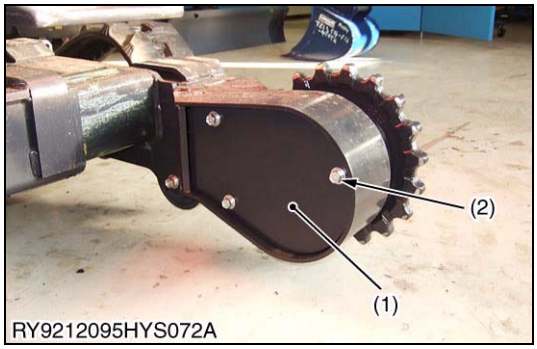
1. Remove the crawler track. Refer to the chapter Crawler Track for the removal and installation of the crawler track.

DANGER

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

(1) Block

RY9212091HYS0038US0



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

(1) Cover (2) Bolt

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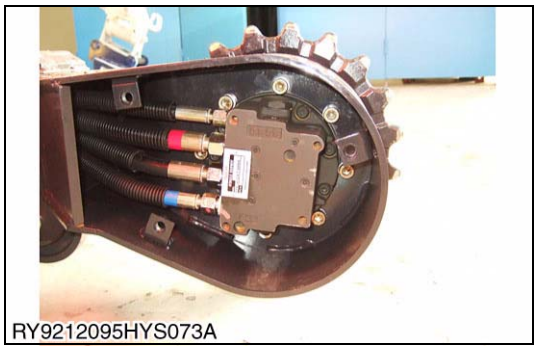

3. Connect a vacuum pump to the breather hose of the hydraulic oil tank and exert negative pressure inside the tank. Disconnect the hydraulic hoses.

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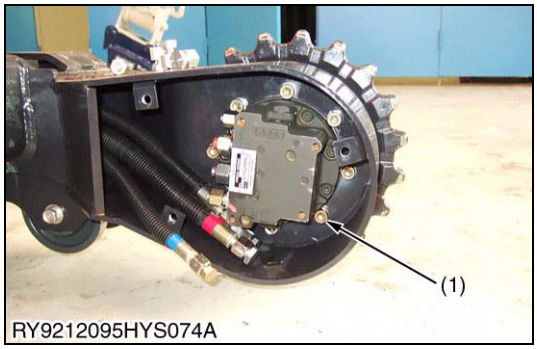

4. Temporarily suspend the travel motor with a nylon sling and remove the nine bolts.

IMPORTANT

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

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

(1) Bolt

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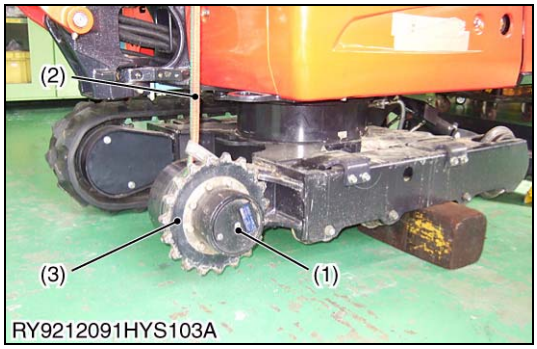

5. Suspend the wheel motor ASSY from a crane and remove it.

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

Tightening torque	Sprocket (3)	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) Nylon Sling
(3) Sprocket

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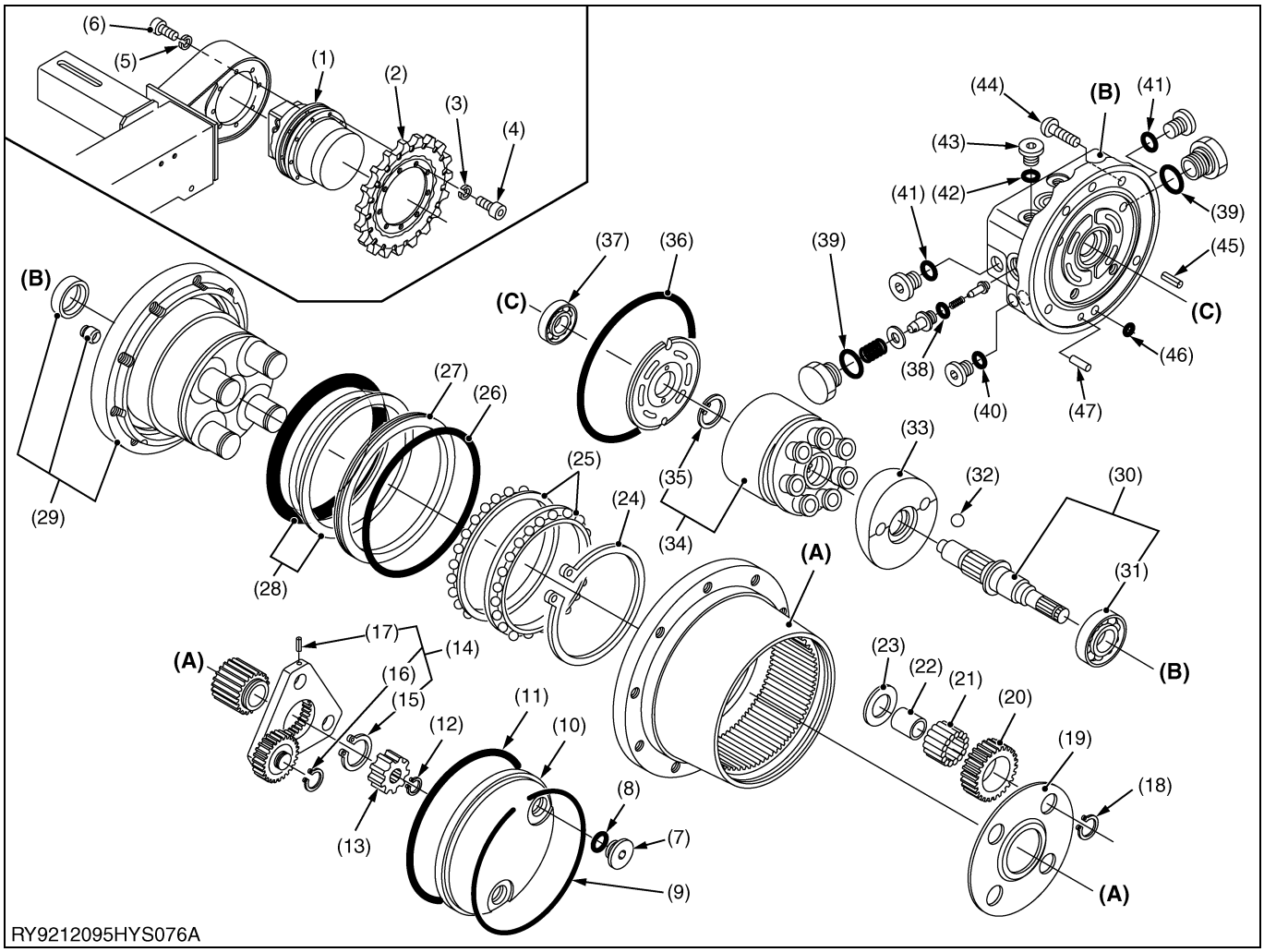
[2] TRAVEL MOTOR DISASSEMBLY/ASSEMBLY PROCEDURES



(A) Gear Case **(B) Body 1**

(To be continued)

(Continued)

No.	Name of part	Qty	No.	Name of part	Qty
(1)	Wheel motor ASSY	1	(25)	Bearing	2
(2)	Drive sprocket	1	(26)	O-ring	1
(3)	Spring washer	9	(27)	Seal ring	1
(4)	Hex socket bolt	9	(28)	Floating seal	1
(5)	Spring washer	8	(29)	Body, ASSY (motor, 2)	1
(6)	Hex socket bolt	8	(30)	Shaft, ASSY	1
(7)	Plug	2	(31)	Ball bearing	1
(8)	O-ring	2	(32)	Steel ball	2
(9)	Snap ring	1	(33)	Swashplate	1
(10)	Cover	1	(34)	Cylinder block, ASSY	1
(11)	O-ring	1	(35)	Internal circlip	1
(12)	External circlip	1	(36)	O-ring	1
(13)	Gear	1	(37)	Ball bearing	1
(14)	Gear ASSY	1	(38)	O-ring	2
(15)	External circlip	1	(39)	O-ring	2
(16)	External circlip	3	(40)	O-ring	2
(17)	Spring pin	3	(41)	O-ring	2
(18)	External circlip	4	(42)	O-ring	2
(19)	Thrust plate	1	(43)	Plug	2
(20)	Gear	4	(44)	Screw	7
(21)	Needle	86	(45)	Spring pin	1
(22)	Ring	4	(46)	O-ring	1
(23)	Flat metal washer	4	(47)	Pin	1
(24)	External circlip	1			1

RY9212095HYS0088US0

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.

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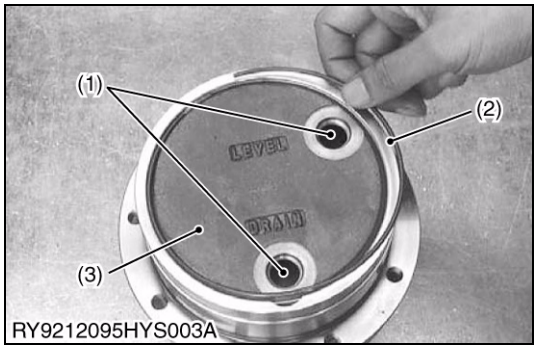
(1) Disassembly Procedures

[A] Reduction Gear



1. Remove the two plugs (G3/8).
2. Remove the snap ring.
3. Remove the cover.
   - Tool to use : M8 hex socket

(1) Plug
(2) Snap Ring
(3) Cover

RY9212095HYS0014US0

4. Remove the O-ring from the body.
5. Remove the snap ring and gear.

(1) O-Ring
(2) Snap Ring
(3) Gear

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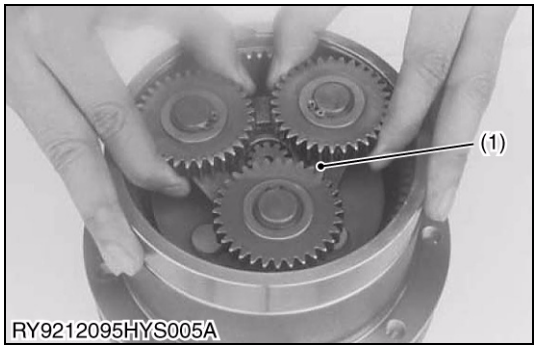

6. Remove the holder and sub-assembly.

(1) Holder and Sub-Assembly

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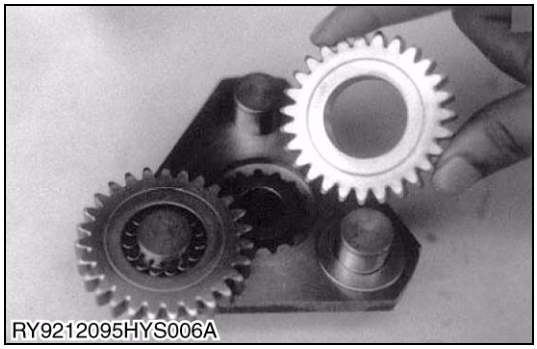

7. Remove the three snap rings, three thrust washers, three gears, thirty-nine needles and three thrust washers.

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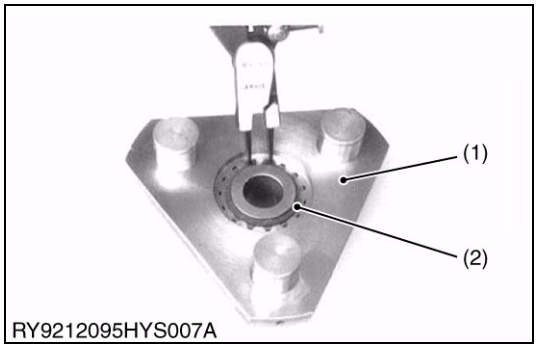

8. Remove the snap ring from the holder and sub-assembly.

(1) Holder and Sub-Assembly
(2) Snap Ring

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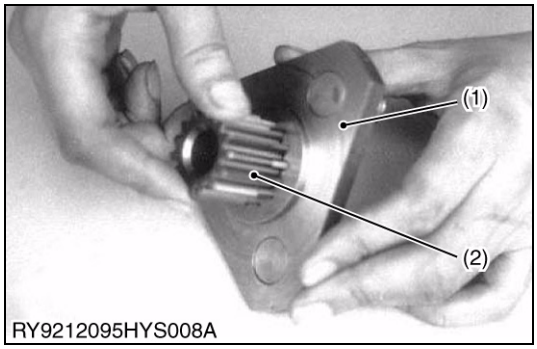

9. Remove the gear from the holder and sub-assembly.

(1) Holder and Sub-Assembly (2) Gear

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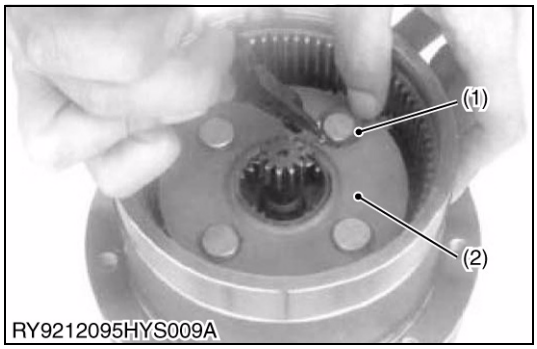

10. Remove the four snap rings and the thrust plate.

(1) Snap Ring (2) Thrust Plate

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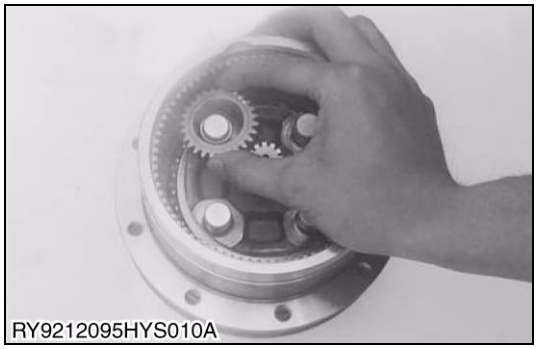

11. Remove the four gears, ninety-six needles, four thrust washers and four rings.

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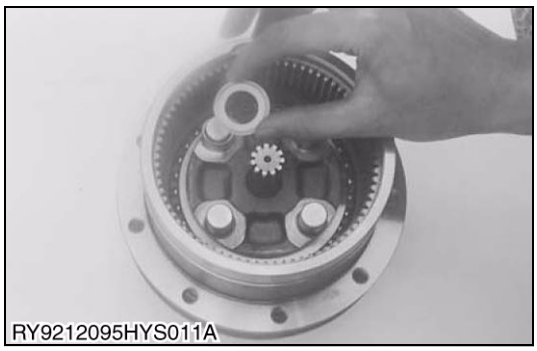
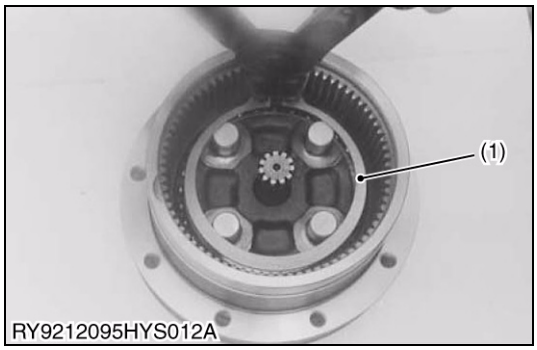
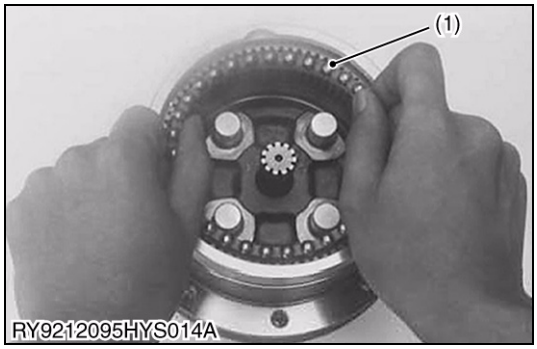




12. Remove the snap ring.

(1) Snap Ring

RY9212095HYS0022US0

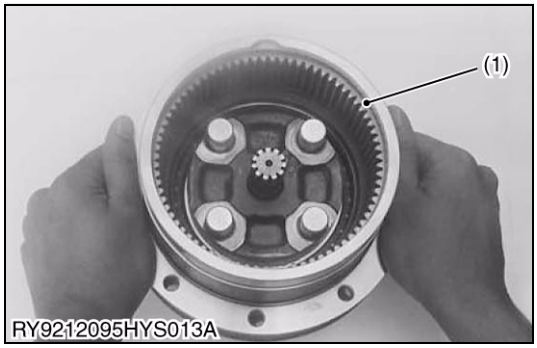


13. Remove the steel balls with retainer and the internal ring of bearing from the speed reducer.

■ **IMPORTANT**
- **Pay attention not to lose the balls from retainer.**

(1) Steel Balls with Retainer

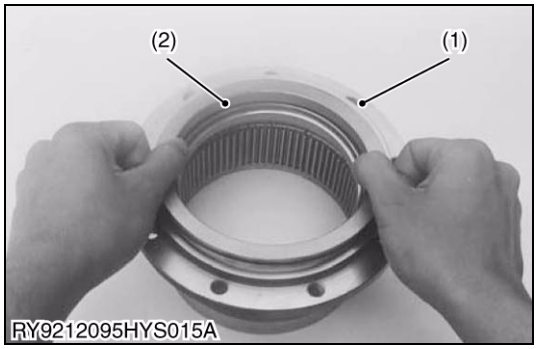
RY9212095HYS0023US0



14. Remove the speed reducer.

(1) Speed Reducer

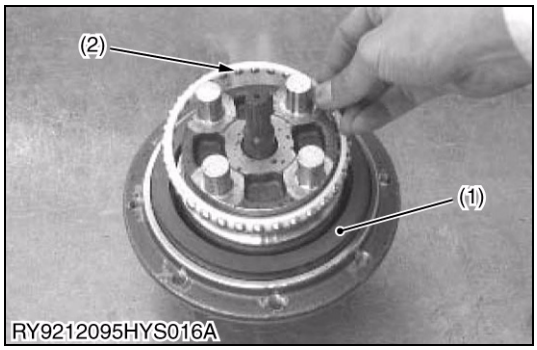
RY9212095HYS0024US0



15. Remove the seal ring from the speed reducer.

(1) Speed Reducer (2) Seal Ring

RY9212095HYS0025US0

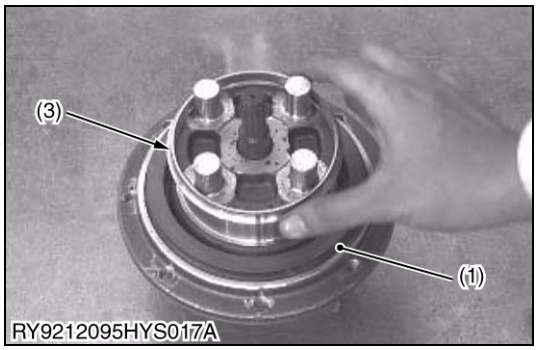


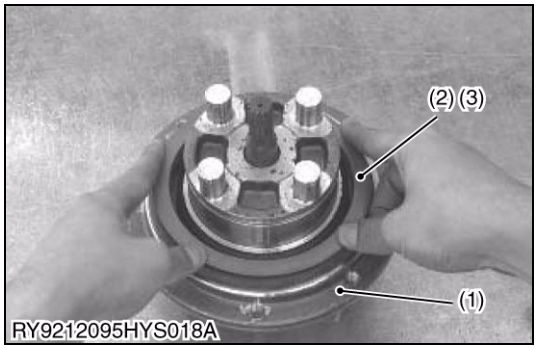
16. Remove the steel balls with retainer and the internal ring of bearing from the hydraulic motor.

■ **IMPORTANT**
- **Pay attention not to lose the balls from retainer.**

(1) Hydraulic Motor (3) Internal Ring of Bearing
(2) Steel Balls with Retainer

RY9212095HYS0026US0



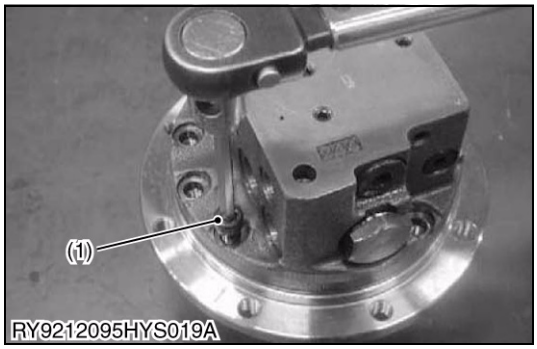


17. Remove the floating seal with O-ring from the hydraulic motor.

(1) Hydraulic Motor
(2) O-Ring
(3) Floating Seal

RY9212095HYS0027US0

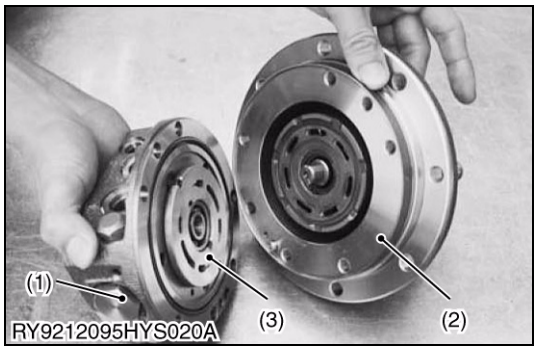
[B] Motor



1. Remove the seven hexagon socket head cap bolts.
   - Tool to use : M5 hex socket

(1) Bolt

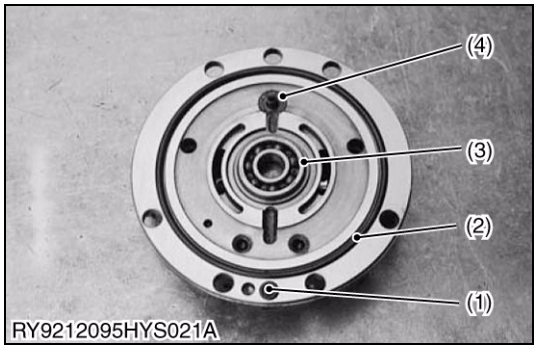
RY9212095HYS0028US0



2. Separate body 1 from body 2 and remove the valve plate.

(1) Body 1
(2) Body 2
(3) Valve Plate

RY9212095HYS0029US0

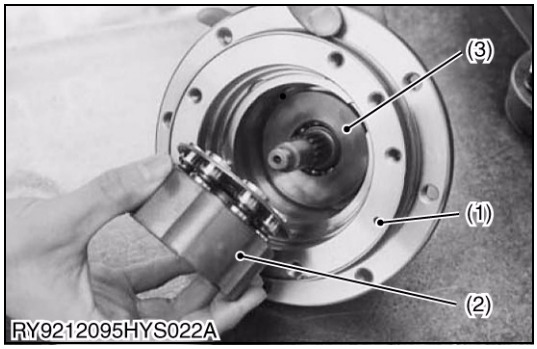


3. Remove the two O-rings from the body-1.

■ **IMPORTANT**
- **The bearing and spring pins are not able to disassemble, because they are press-fitted.**

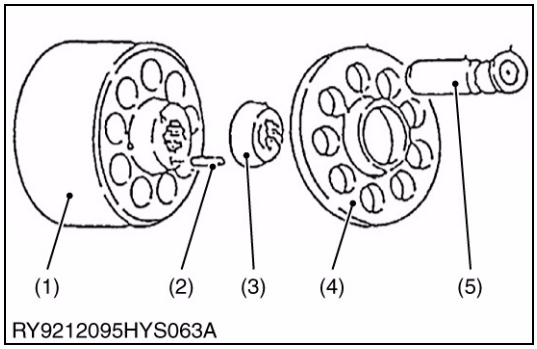
(1) O-Ring
(2) O-Ring
(3) Bearing
(4) Spring Pin

RY9212095HYS0030US0



4. Remove the cylinder barrel, ASSY and swash plate from body 2.

RY9212095HYS0031US0

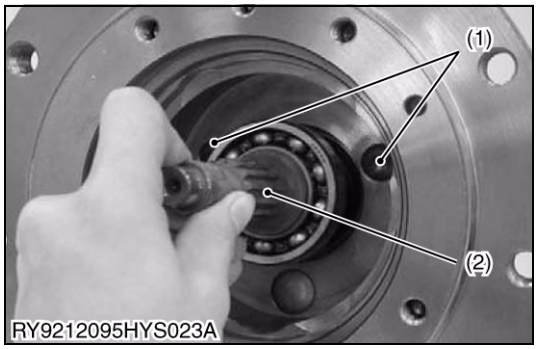


RY9212095HYS063A

5. Remove the nine piston-shoe assemblies, shoe holder, retainer holder and three pins.

(1) Cylinder Barrel
(2) Pin
(3) Retainer Holder
(4) Shoe Holder
(5) Piston

RY9212095HYS0032US0



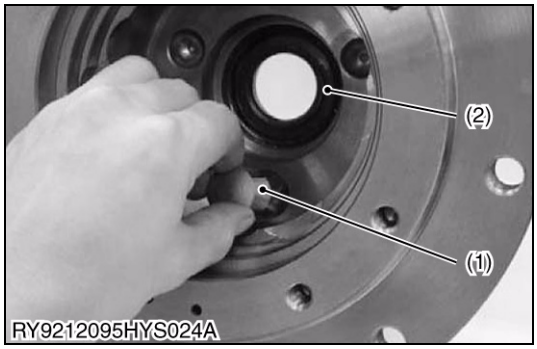
RY9212095HYS023A

6. Remove the shaft from the body-2.

■ **IMPORTANT**
- **The bearing is not able to dissemble, because they are press-fitted.**

(1) Ball
(2) Shaft

RY9212095HYS0033US0



RY9212095HYS024A

7. Remove the 2-speed piston from body 2.
8. Remove the oil seal from body 2.

(1) 2-Speed Piston
(2) Oil Seal

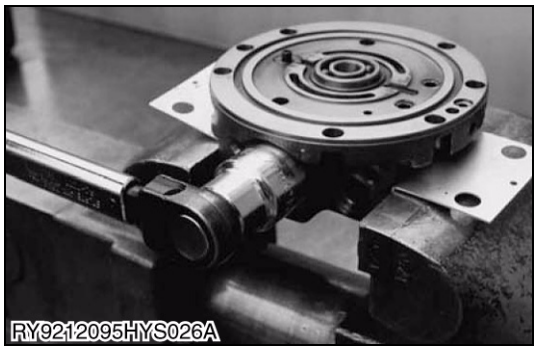
RY9212095HYS0034US0


RY9212095HYS025A

9. Remove the two plugs with O-rings from the body-1.
10. Remove the two spring, two rings and spool assembly.
- Tool to use : Hexagon size : 27 mm

■ **IMPORTANT**
- **The spool assembly is not able to disassemble.**

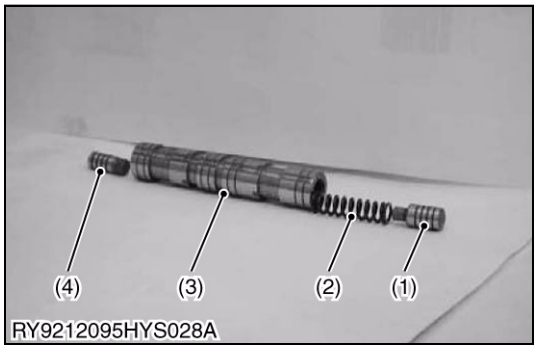
RY9212095HYS0035US0


RY9212095HYS026A


RY9212095HYS027A

11. Remove the two plugs with O-rings from the body-1.
    - Tool to use : M8 hex socket

RY9212095HYS0036US0

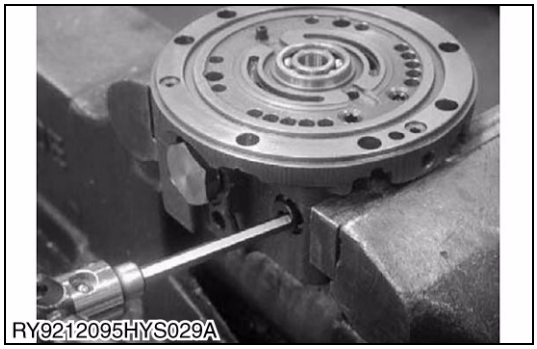


RY9212095HYS028A

12. Remove the spring, two-speed spool, spool-B and spool-C.

(1) Spool-B
(2) Spring
(3) Two-Speed Spool
(4) Spool-C

RY9212095HYS0037US0

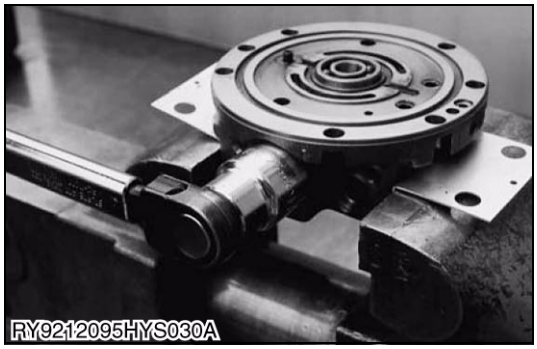

RY9212095HYS029A

13. Remove the two plugs with O-rings from the body-1.
14. Remove the two needles and shuttle spool.
    - Tool to use : M5 hex socket

RY9212095HYS0038US0

(2) Assembly Procedures

[A] Motor



1. Insert the spring ASSY, rings (both sides) and springs (both sides) into body 1 in order.

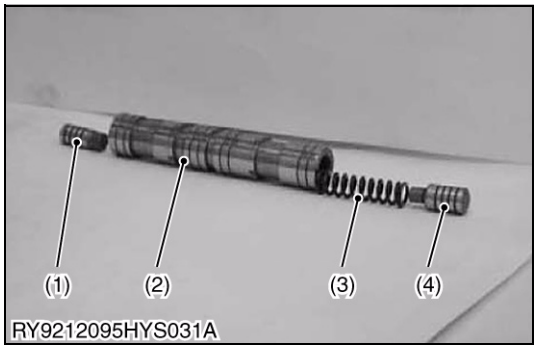
■ **IMPORTANT**
- **The spool should slide smoothly on its own.**
- **Apply hydraulic oil to the spool.**

2. Install the O-rings (both sides) and tighten the plugs (both sides).

Tightening torque	Plug	127 to 167 N·m 13 to 17 kgf·m 93.7 to 123.0 lbf/ft

- Tool to use: M27 socket wrench

RY9212095HYS0039US0

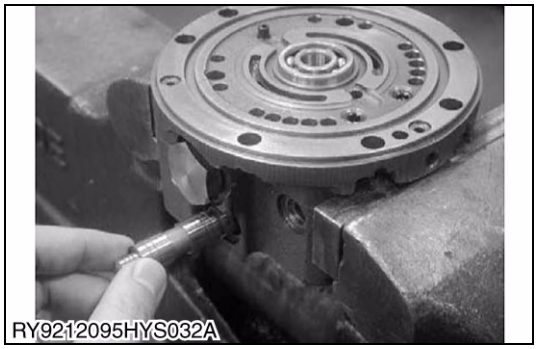


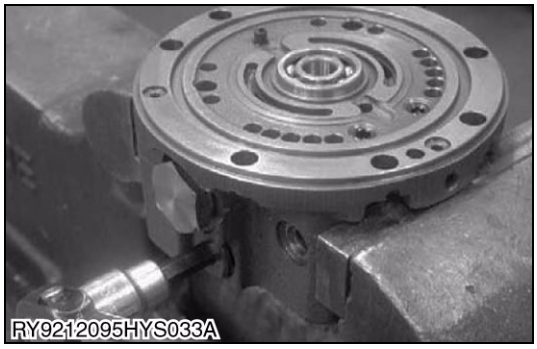
3. Insert spool C, the 2-speed spool, the spring and spool B into body 1 in order.

■ **IMPORTANT**
- **The spools should slide smoothly on their own.**
- **Apply hydraulic oil to the spools.**

(1) Spool C
(2) Spool (2-Speed)
(3) Spring
(4) Spool B

RY9212095HYS0040US0





4. Screw the two plugs (1pc / side) with two O-rings (1pc / side).

Tightening torque	Plug	46 to 51 N·m 4.7 to 5.2 kgf·m 34 to 38 lbf·ft

- Tool to use : M8 hex socket

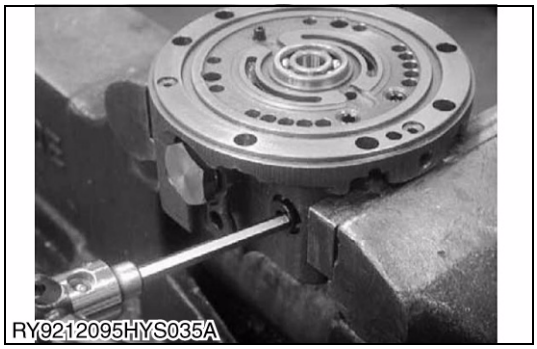
RY9212095HYS0041US0


RY9212095HYS034A

5. Insert the shuttle spool and the needles (both sides) into body 1.

■ **IMPORTANT**
- **The spool should slide smoothly on its own.**
- **Apply hydraulic oil to the spool.**

RY9212095HYS0042US0

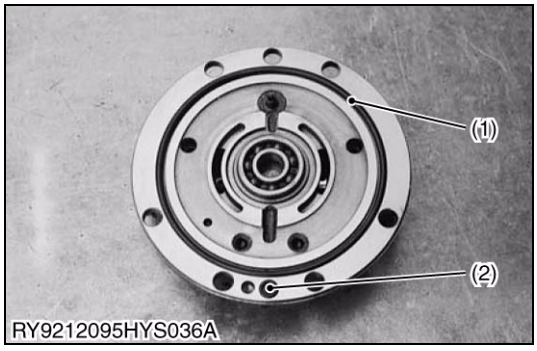

RY9212095HYS035A

6. Screw the two plugs (1pc / side) with two O-rings (1pc / side).

Tightening torque	Plug	5.9 N·m 0.6 kgf·m 4.4 lbf·ft

- Tool to use : M5 hex socket

RY9212095HYS0043US0



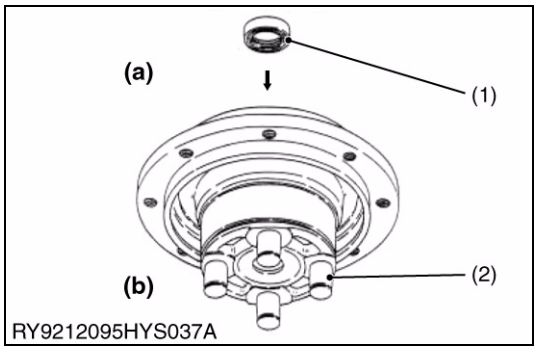
RY9212095HYS036A

7. Install the O-rings (two) into body 1.

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

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

RY9212095HYS0044US0



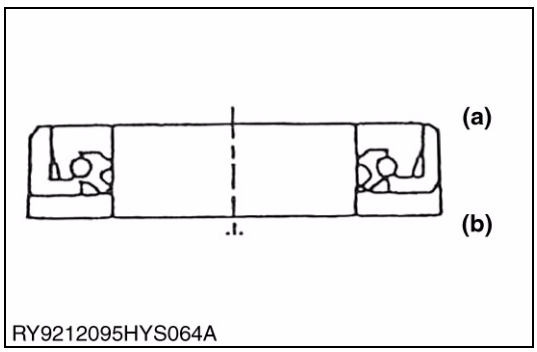
RY9212095HYS037A

8. Press the oil seal into body 2.

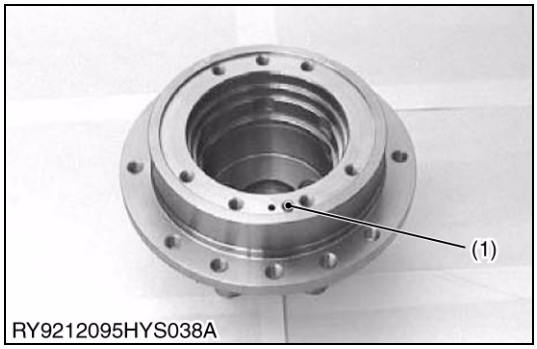
■ **IMPORTANT**
- **Fill the gap between the lips of the oil seal with grease.**
- **Take care to face the oil seal in the right direction.**

(1) O-Ring **(a) Up**
(2) O-Ring **(b) Down**

RY9212095HYS0045US0



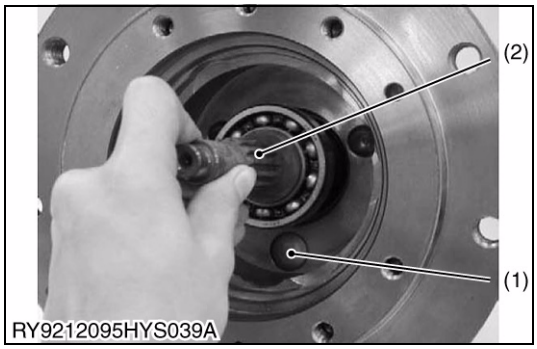
RY9212095HYS064A



9. Install the parallel pin into body 2.

(1) Parallel Pin

RY9212095HYS0046US0



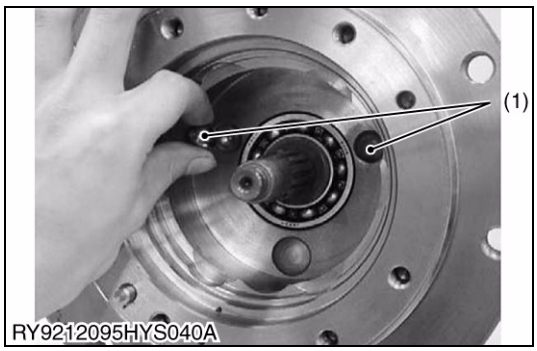
10. Place the control piston into the body-2.
11. Place the shaft into the body-2.

■ **IMPORTANT**

- **Pay attention not to damage the oil seal with the shaft. A oil seal which damaged should be replaced.**

(1) Control Piston (2) Shaft

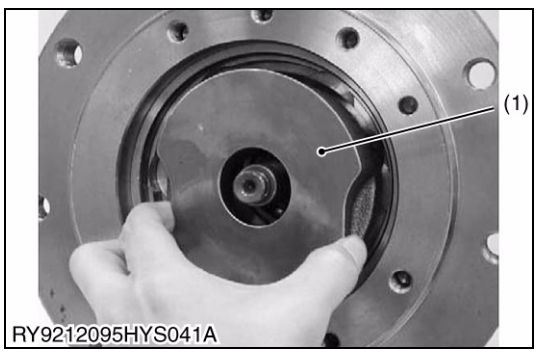
RY9212095HYS0047US0



12. Apply grease to the two balls and install them in body 2.

(1) Ball

RY9212095HYS0048US0



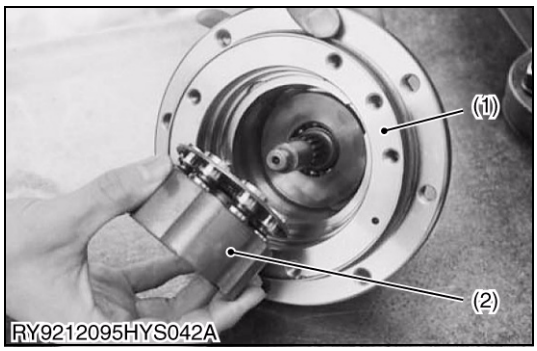
13. Install the swash plate into body 2.

■ **IMPORTANT**

- **After installing it, make sure the swashplate moves smoothly.**

(1) Swashplate

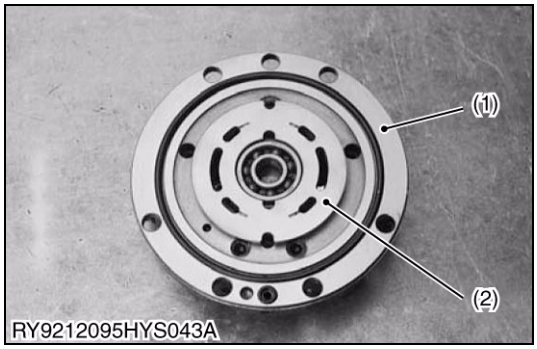
RY9212095HYS0049US0



14. Inset the cylinder barrel assembly into the body-2 so that the shoes contact the swash plate.

(1) Body-2 (2) Cylinder Barrel Assembly

RY9212095HYS0050US0

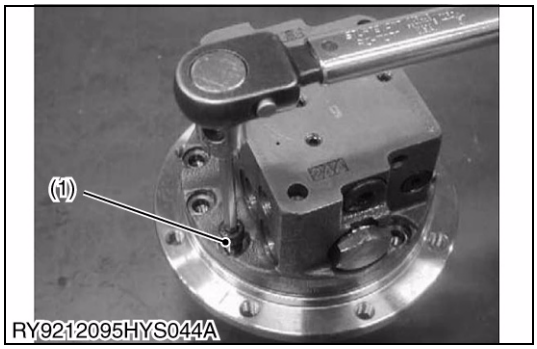


15. Install the valve plate into body 1.

■ **IMPORTANT**
- **Take care to install the valve plate facing the right direction.**
- **Apply grease to the back of the valve plate so it does not fall out.**

(1) Body 1 (2) Valve Plate

RY9212095HYS0051US0



16. Put body 1 and body 2 together and fasten them with the hex bolts. (7 places)

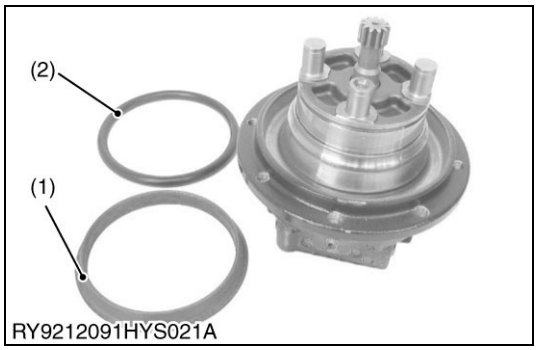
Tightening torque	Bolt	28.4 to 30.4 N·m 2.9 to 3.1 kgf·m 21.0 to 22.4 lbf/ft

- Tool to use: M5 hex socket

(1) Bolt

RY9212095HYS0052US0

[B] Reduction Gear

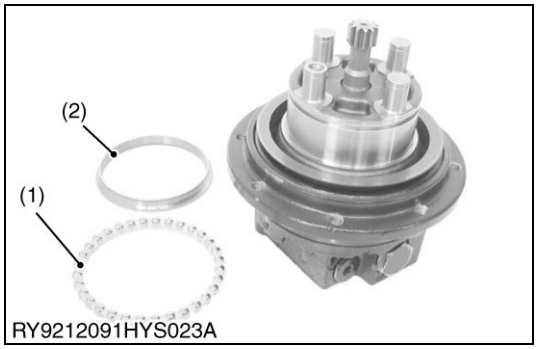


1. Install the floating seal and O-ring on the body.

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

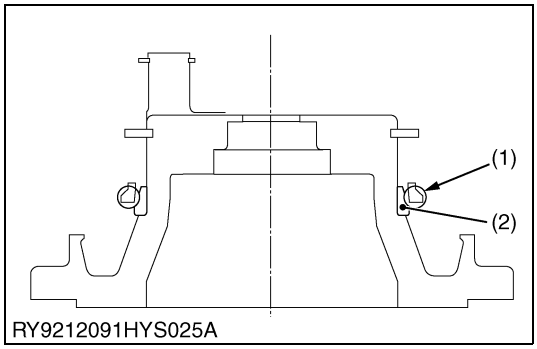
(1) Floating Seal (2) O-Ring

RY9212091HYS0227US0



RY9212091HYS023A


RY9212091HYS024A



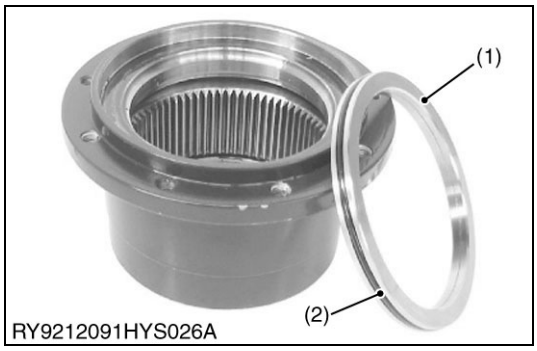
RY9212091HYS025A

2. Install the ring inside the bearing and the retainer with steel balls on the body in that order. (1 set)

■ **IMPORTANT**
- **Take care that the ring inside the bearing and the retainer face the right way. (See cross-section)**
- **The steel balls may come out of the retainer, so take care not to lose any.**

(1) Retainer with Steel Balls (2) Ring Inside the Bearing

RY9212091HYS0229US0



RY9212091HYS026A

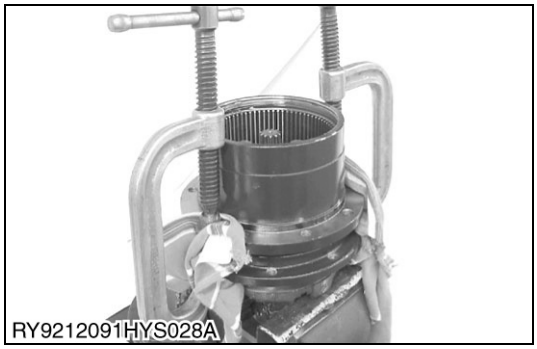

RY9212091HYS027A

3. Insert the seal ring with its O-ring installed into the gear case.

■ **IMPORTANT**
- **Apply grease to the O-ring.**
- **Insert with the seal face up.**

(1) Seal Ring (2) O-Ring

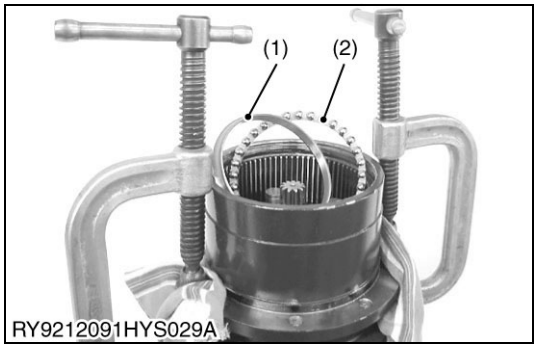
RY9212091HYS0230US0


RY9212091HYS028A

4. Install the gear case onto the body.

■ **IMPORTANT**
- **Use a vice or hydraulic press to press the hydraulic motor flange and the gear case flange together.**

RY9212091HYS0231US0



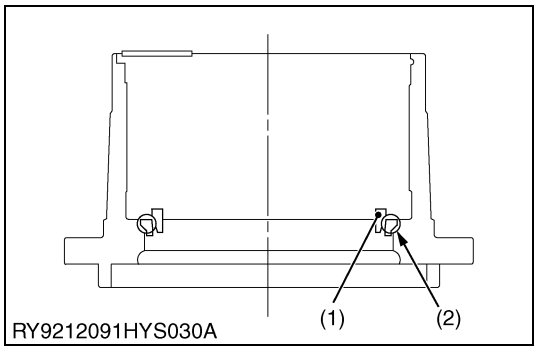
RY9212091HYS029A

5. Install the the retainer with steel balls and the ring inside the bearing into the body in that order.

■ **IMPORTANT**
- **Take care to install the ring inside the bearing and the retainer facing the right direction.**

(1) Ring Inside the Bearing (2) Retainer with Steel Balls

RY9212091HYS0232US0



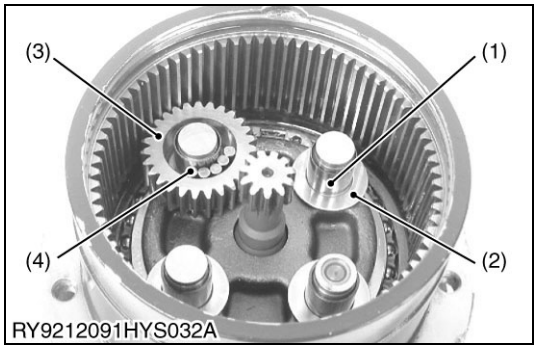
RY9212091HYS030A


RY9212091HYS031A

6. Hold the bearing in place with a snap ring.

■ **IMPORTANT**
- **Use the thickness of the snap ring to adjust the bearing pre-load pressure.**

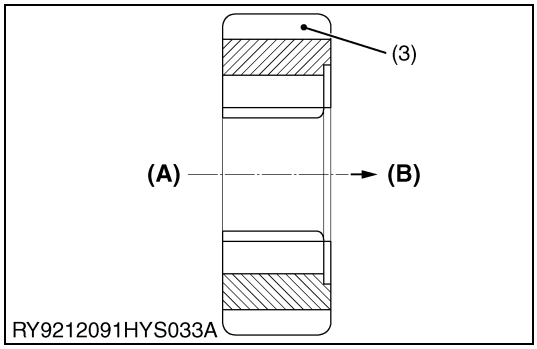
RY9212091HYS0233US0



7. Install the ring, flat washer, gear and needle in that order.

(1) Ring
(2) Flat Metal Washer
(3) Gear
(4) Needle
(A) Thrust Plate Side
(B) Washer Side

RY9212091HYS0234US0

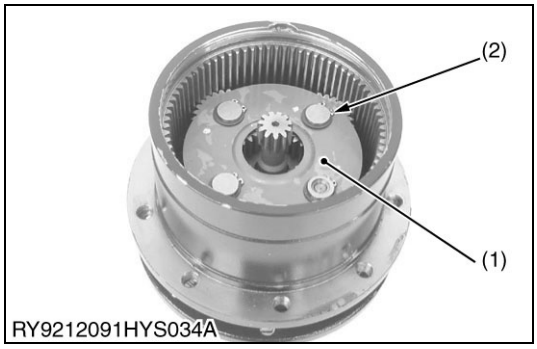


8. Install the thrust plate and secure it with snap rings.

■ **IMPORTANT**
- **Install the thrust plate with the side whose inner diameter sticks up facing up.**
- **Install the snap rings so their edges are up (cover side).**

(1) Thrust Plate
(2) Snap Ring

RY9212091HYS0235US0

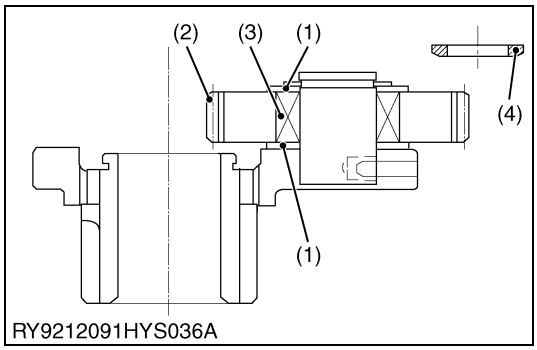


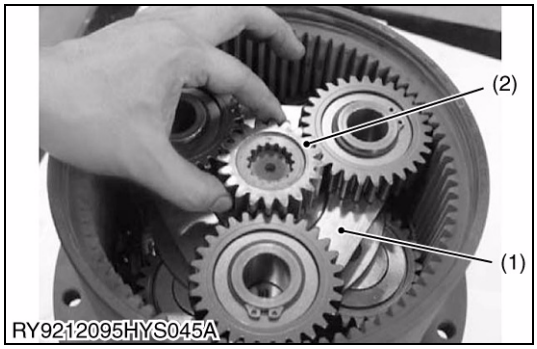
9. Install the thrust washer, gear, needles and thrust washer in that order, then secure them with snap rings to assemble the holder ASSY.

■ **IMPORTANT**
- **Install the snap rings so their edges are up (cover side).**

(1) Thrust Washer
(2) Gear
(3) Needle
(4) Snap Ring

RY9212091HYS0236US0





10. Install the holder ASSY and the gear in that order into the body.

(1) Holder ASSY (2) Gear

RY9212095HYS0053US0

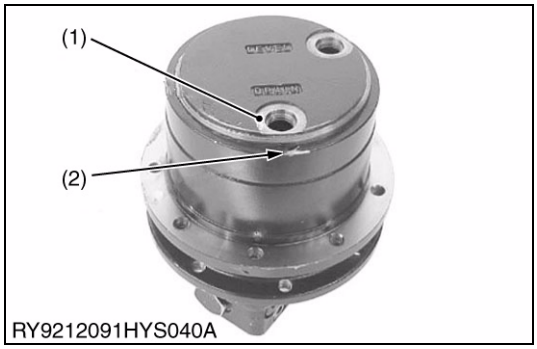
11. Place the O-ring to the body.

■ **IMPORTANT**

- **Apply grease to the O-ring.**

(1) O-Ring

RY9212095HYS0054US0



12. Fill with gear oil and install the cover.

■ **IMPORTANT**

- **Take care not to damage the O-ring.**
- **Install the cover so the word "DRAIN" lines up with the notch in the body.**

(1) Cover (2) Notch Position

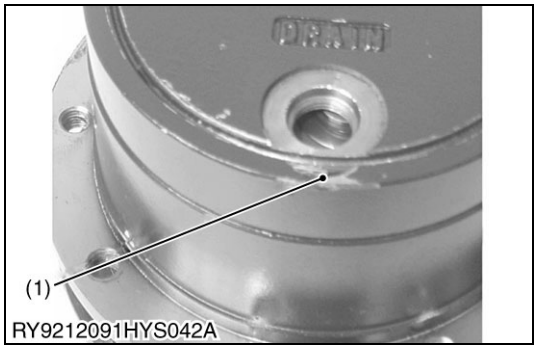
RY9212091HYS0240US0

13. Install a snap ring to secure the cover.

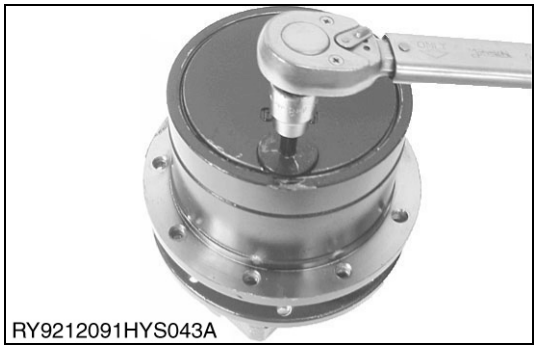
■ **IMPORTANT**

- **Use a slotted screwdriver against the end of the snap ring and wedge it in along the circumference.**

RY9212091HYS0241US0



RY9212091HYS042A


RY9212091HYS043A

14. Install the plug.

■ **IMPORTANT**
- **Tighten the plug on the "DRAIN" side first and use the leverage on the snap ring to keep the cover from turning.**

Tightening torque	Plug	46 to 51 N·m 4.7 to 5.2 kgf·m 34 to 38 lbf·ft

(1) Snap Ring End

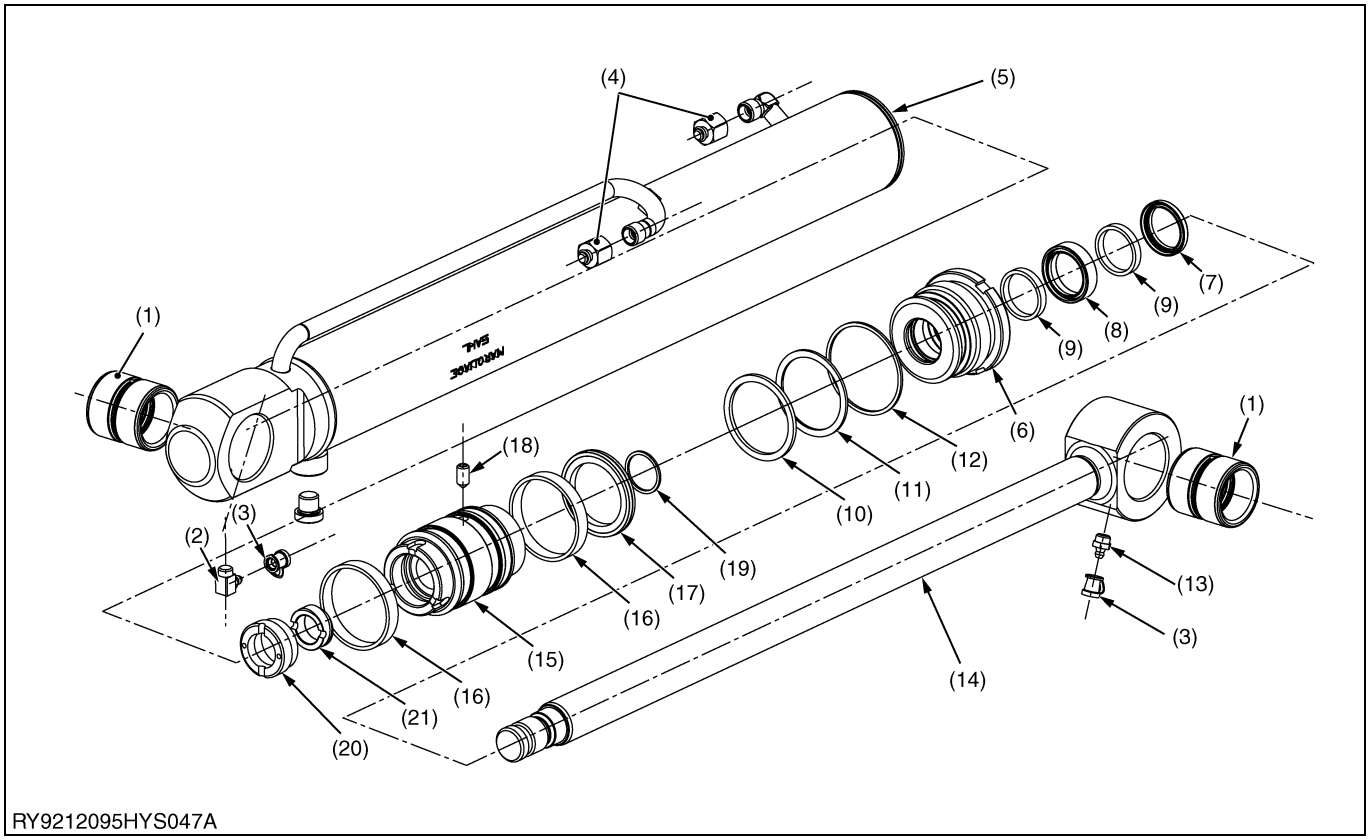
RY9212091HYS0242US0

6. HYDRAULIC CYLINDER

[1] HYDRAULIC CYLINDER DISASSEMBLY/ASSEMBLY PROCEDURES

(1) Cylinder Components

Boom Cylinder



RY9212095HYS047A

No.	Name of part	Qty	No.	Name of part	Qty
(1)	Bushing	2	(12)	O-ring	1
(2)	Grease nipple	1	(13)	Grease nipple	1
(3)	Plug	2	(14)	Cylinder rod	1
(4)	Plug	2	(15)	Piston	1
(5)	Cylinder tube	1	(16)	Guide ring	2
(6)	Cylinder head	1	(17)	Piston seal	1
(7)	Wiper ring	1	(18)	Lock screw	1
(8)	U-ring	1	(19)	O-ring	1
(9)	Guide ring	2	(20)	Cushion ring lock screw	
(10)	O-ring	1	(21)	Cushion ring	
(11)	Backup ring	1			

RY9212095HYS0055US0

(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.

RY9212095HYS0004US0

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

(1) Cylinder Head

RY9212095HYS0010US0

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

(1) Cylinder Head

RY9212095HYS0006US0

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

RY9212095HYS0011US0

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

RY9212095HYS0012US0

6. Remove the set screw.

■ **IMPORTANT**
- **There is one set screw punched in place.**
- **After removing it, use a hand tap to clean out the piston side.**
- **If the set screw is damaged during removal, replace it with a new one.**

(1) Set Screw

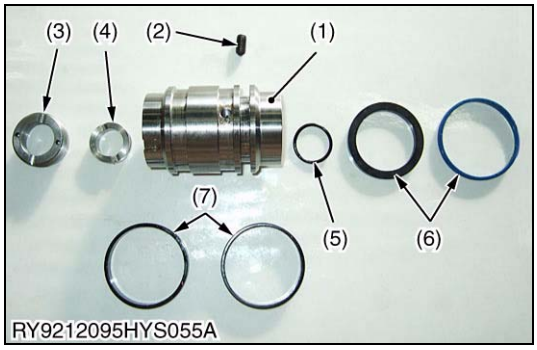
RY9212095HYS0009US0

7. Use a hook wrench to loosen the piston.
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) Piston

RY9212095HYS0056US0



Piston components

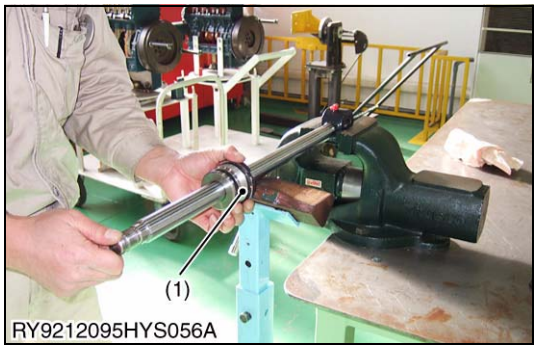
(1) Piston
(2) Set Screw
(3) Cushion Ring, Lock Screw
(4) Cushion Ring
(5) O-Ring
(6) Piston Seal
(7) Guide Ring

RY9212095HYS0057US0

8. Remove the rod from the cylinder head.

(1) Cylinder Head

RY9212095HYS0058US0



Cylinder Head Components

(1) Cylinder Head
(2) U-Ring
(3) Guide Ring
(4) Wiper Ring
(5) O-Ring
(6) Backup Ring
(7) O-Ring

RY9212095HYS0059US0

(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

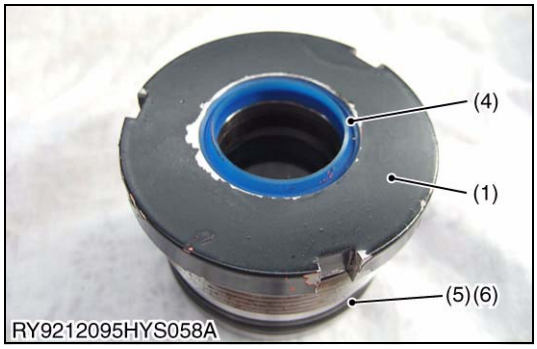
Cylinder Head Assembly

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 or 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) Wiper Ring
(3) Guide Ring
(4) U-Ring
(5) O-Ring
(6) Backup Ring
(7) O-Ring

RY9212095HYS0060US0

Piston Assembly

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

(1) Guide Ring
(2) Piston Seal
(3) O-Ring

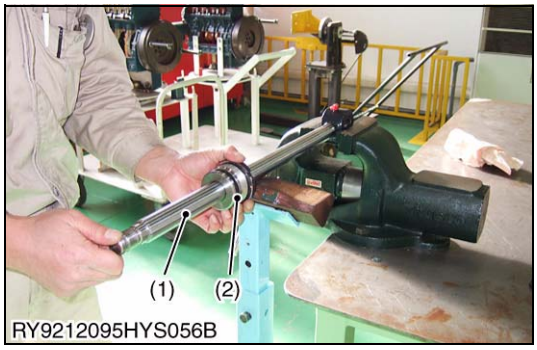
RY9212095HYS0061US0

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

RY9212095HYS0013US0


RY9212095HYS060A

7. Install the piston.

■ **IMPORTANT**
- **Tighten the piston to the specified torque.**

RY9212095HYS0062US0

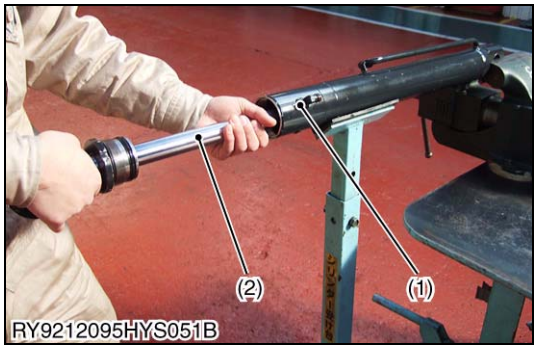
RY9212095HYS053A

8. Install the set screw.

■ **IMPORTANT**
- **Tighten the set screw to the specified torque.**
- **Apply Loctite 243.**
- **After tightening the set screw, punch it in one spot to keep it from coming out.**

(1) Set Screw

RY9212095HYS0063US0

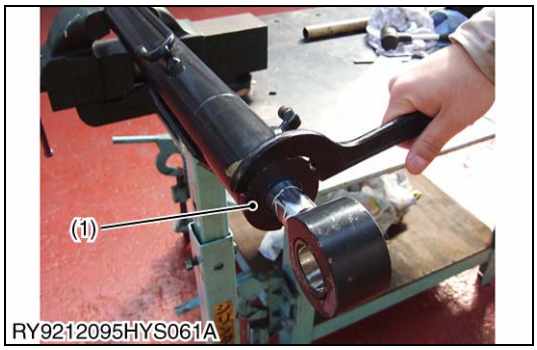


RY9212095HYS051B

9. 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

RY9212095HYS0064US0



RY9212095HYS061A

10. Tighten the cylinder head with a hook wrench.

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

(1) Cylinder Tube

RY9212095HYS0065US0


RY9212095HYS062A

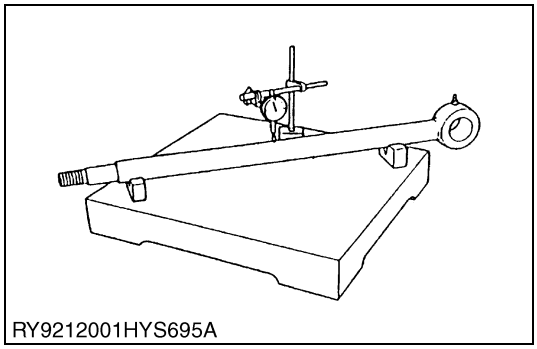
11. Firmly bend the lock washer into the cylinder head groove.

RY9212095HYS0066US0

Torque

		KX018-4	KX019-4	Notes
Boom Cylinder	Cylinder head	200 to 300 N·m 20.4 to 30.5 kgf·m 148 to 221 lbf/ft		
	Piston	230 to 340 N·m 23.5 to 34.6 kgf·m 170 to 250 lbf/ft		
	Set screw	20 N·m 2.0 kgf·m 15 lbf·ft		
Arm Cylinder	Cylinder head	250 to 300 N·m 25.5 to 30.5 kgf·m 185 to 221 lbf/ft		
	Piston	310 to 460 N·m 31.7 to 46.9 kgf·m 229 to 339 lbf/ft		
	Set screw	20 N·m 2.0 kgf·m 15 lbf·ft		
Bucket Cylinder	Cylinder head	250 to 300 N·m 25.5 to 30.5 kgf·m 185 to 221 lbf/ft		
	Piston	310 to 460 N·m 31.7 to 46.9 kgf·m 229 to 339 lbf/ft		
	Set screw	20 N·m 2.0 kgf·m 15 lbf·ft		
Swing Cylinder	Cylinder head	250 to 300 N·m 25.5 to 30.5 kgf·m 185 to 221 lbf/ft		(Loctite 222)
	Piston	280 to 315 N·m 28.6 to 32.1 kgf·m 207 to 232 lbf/ft		(Loctite 262)
Blade Cylinder	Cylinder head	350 to 400 N·m 35.7 to 40.7 kgf·m 259 to 295 lbf/ft		(Loctite 222)
	Piston	280 to 315 N·m 28.6 to 32.1 kgf·m 207 to 232 lbf/ft		(Loctite 262)
Track Cylinder	Cylinder head	250 to 300 N·m 25.5 to 30.5 kgf·m 185 to 221 lbf/ft		(Loctite 222)
	Piston	280 to 315 N·m 28.6 to 32.1 kgf·m 207 to 232 lbf/ft		(Loctite 262)

RY9212095HYS0067US0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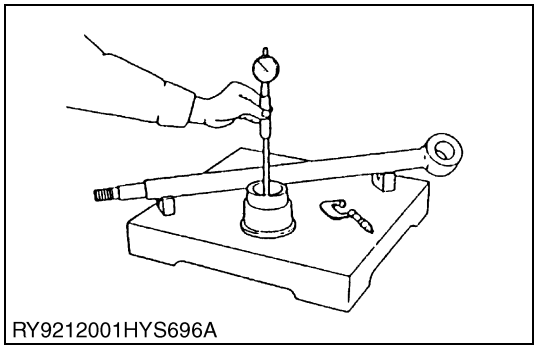
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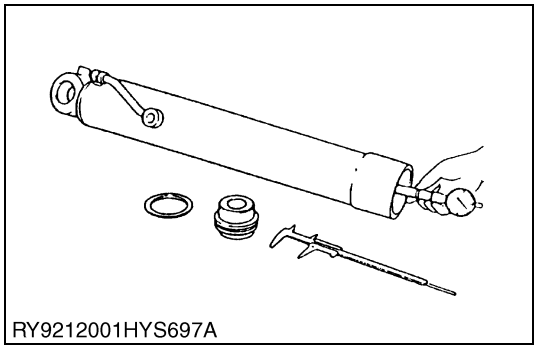

RY9212001HYS697A

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 : 0.05 mm (0.002 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.

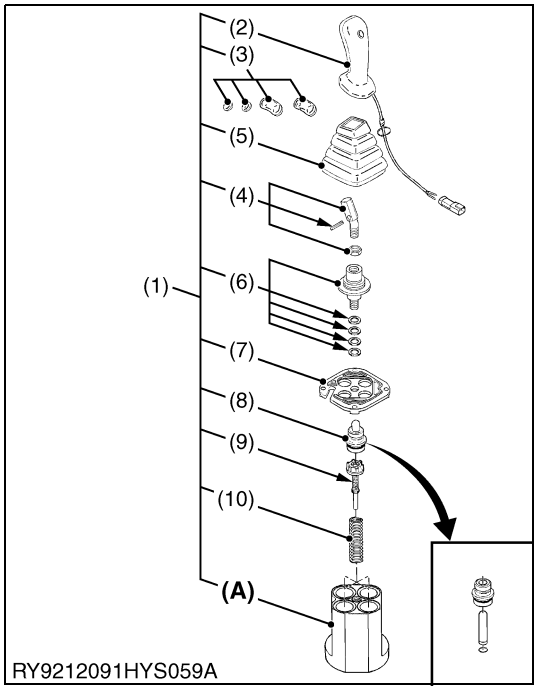
	Rod size	Gap
Factory specification	ϕ60 mm ≥ ϕ2.4 in. ≥	0.05 to 0.30 mm 0.002 to 0.01 in.
	ϕ65 to 115 mm ϕ2.6 to 4.53 in.	0.05 to 0.35 mm 0.002 to 0.01 in.
	ϕ120 mm ≤ ϕ4.72 in. ≤	0.05 to 0.40 mm 0.002 to 0.02 in.
Allowable limits	ϕ60 mm ≥ ϕ2.4 in. ≥	0.60 mm 0.02 in.
	ϕ65 to 115 mm ϕ2.6 to 4.53 in.	0.70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

RY9212001HYS0469US0

7. PILOT VALVE

[1] PILOT VALVE (CONTROL) DISASSEMBLY/ASSEMBLY PROCEDURES [KX018-4]

(1) Pilot Valve Components

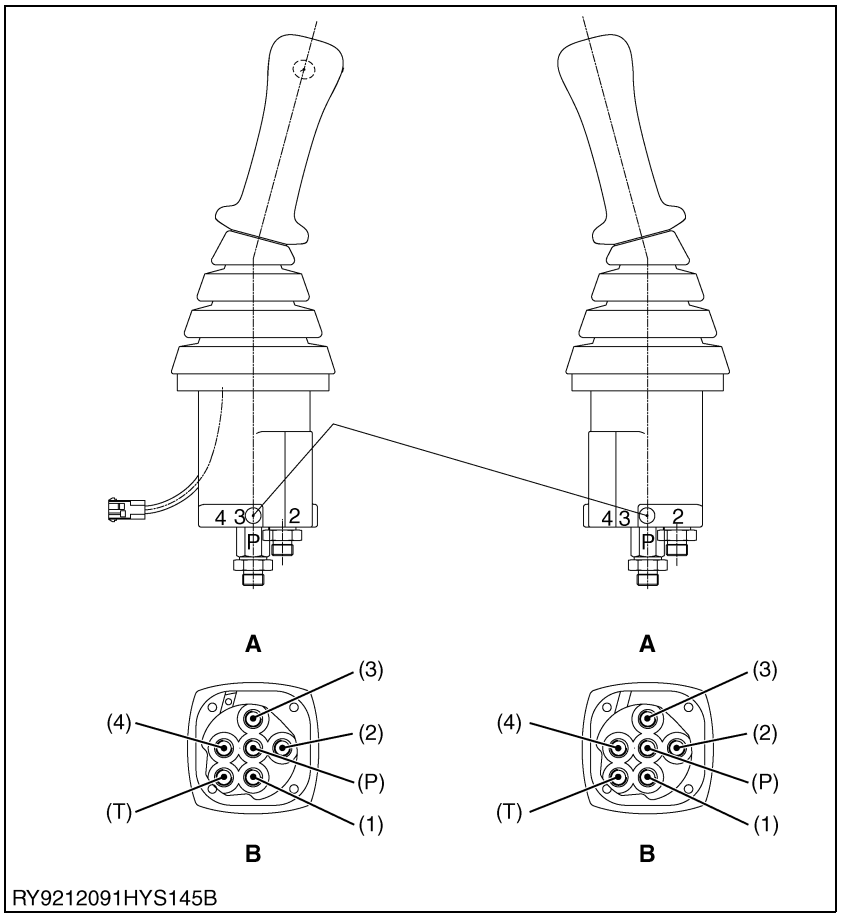


RY9212091HYS059A

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 actuator	Brown
(P)	P port	White
(T)	T Port	

Left P/V

	Position Used	Hose tape color
(1)	Arm actuator	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

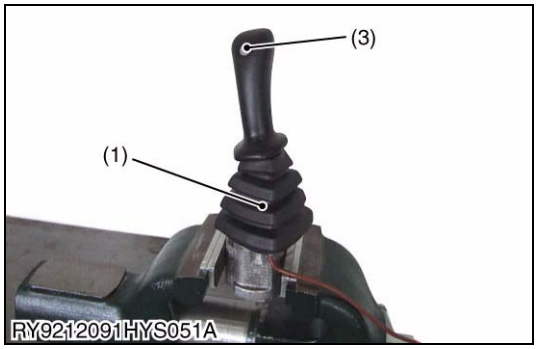
RY9212091HYS0258US0

(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



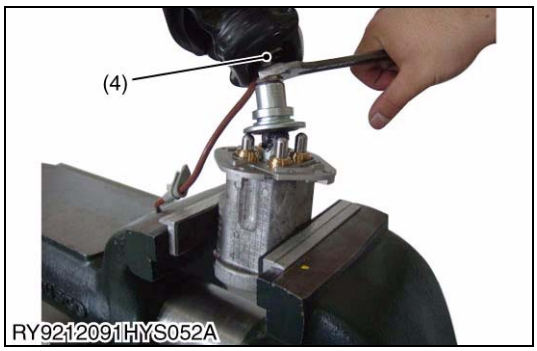
1. Secure the pilot valve in a vice and remove the button.

IMPORTANT

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

(1) Valve ASSY (3) Button

RY9212091HYS0259US0

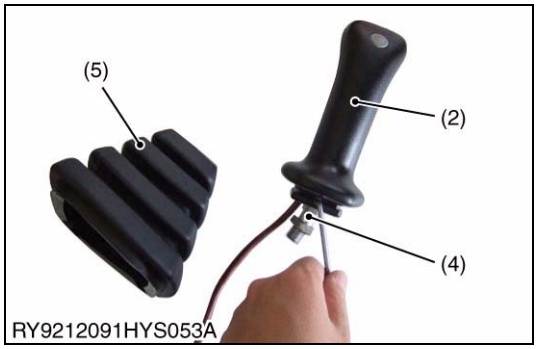


2. Loosen the nut and remove the lever ASSY.

- Tool to use: 19 mm wrench

(4) Lever ASSY

RY9212091HYS0260US0

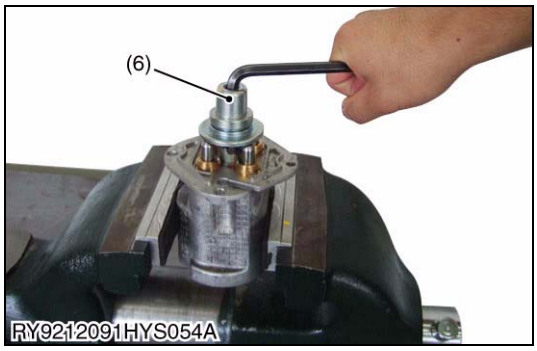


3. Remove the rubber boot from the handle.
   Remove the pin and separate the handle and lever ASSY.

- Tool to use: 19 mm wrench

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

RY9212091HYS0261US0



4. Remove the nut (disc).

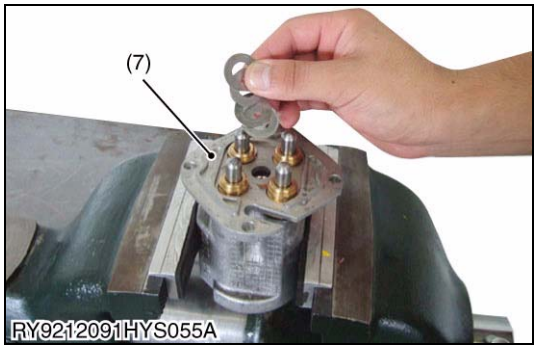
- Tool to use: M8 hex socket

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

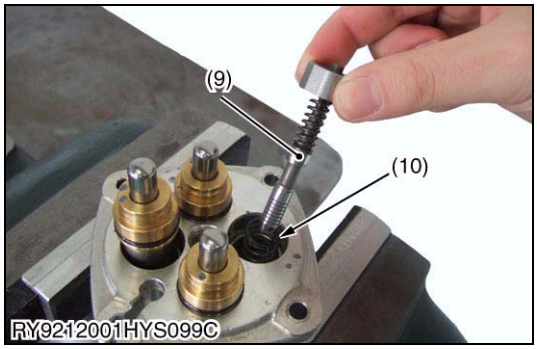
RY9212091HYS0263US0

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

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

RY9212001HYS0487US0

2. Install the return spring in the casing.

■ **IMPORTANT**

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

(10) Spring

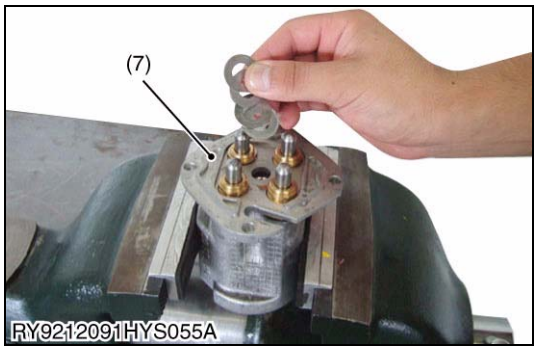
RY9212091HYS0266US0

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.**

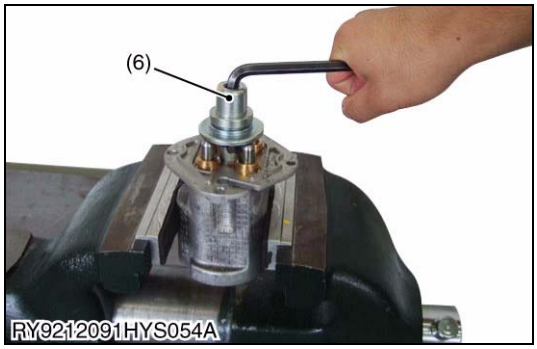
RY9212001HYS0490US0

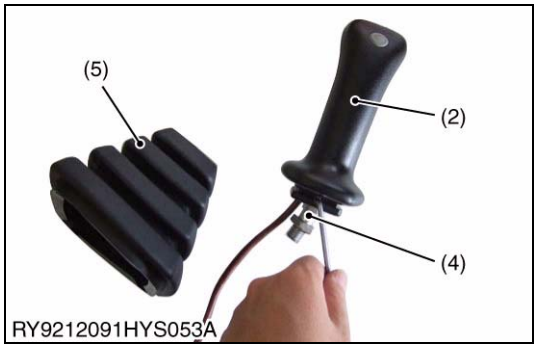


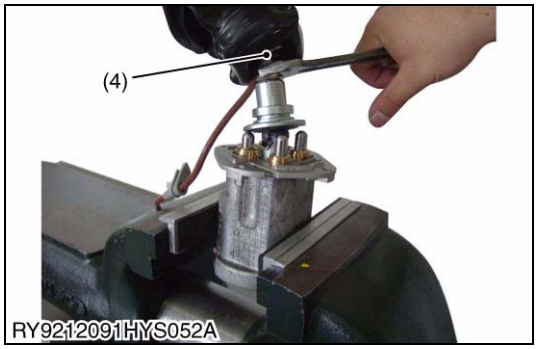
4. Install the plates and four shims.

(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

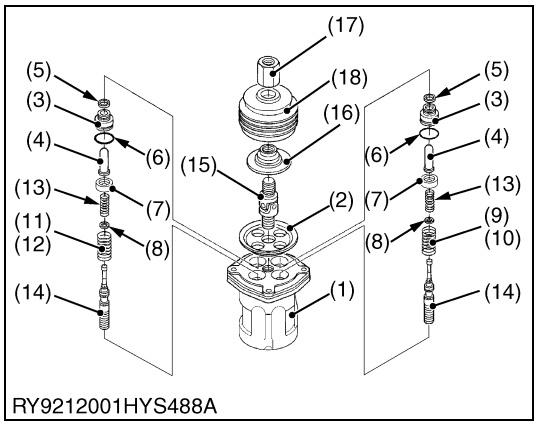
RY9212091HYS0270US0

8. Apply grease to the crown of the plugs.

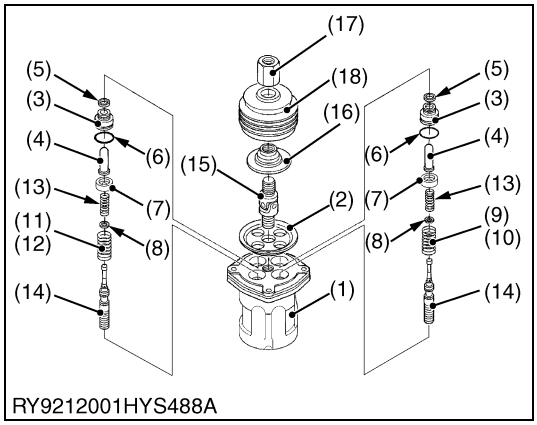
RY9212091HYS0271US0

[2] PILOT VALVE (CONTROL) DISASSEMBLY/ASSEMBLY PROCEDURES [KX019-4]

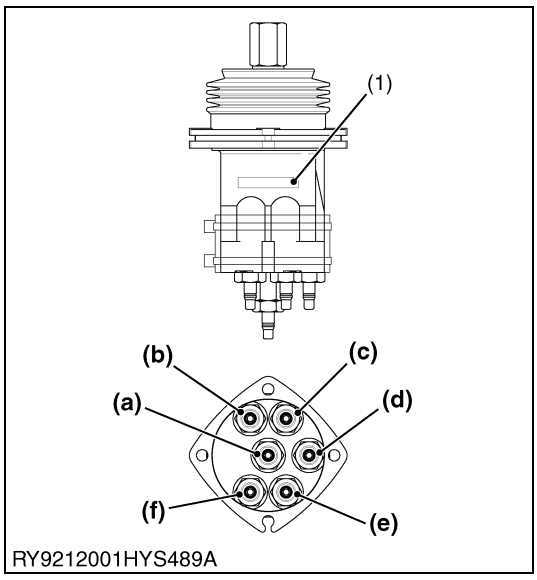
(1) Pilot Valve Components



RY9212001HYS488A



RY9212001HYS488A



RY9212001HYS489A

Left Pilot Valve

No.	Part Name	Q'ty	No.	Part Name	Q'ty
(1)	Casing	1	(10)	Spring	1
(2)	Plate	1	(11)	Spring	1
(3)	Plug	4	(12)	Spring	1
(4)	Pushrod	4	(13)	Spring	4
(5)	Seal	4	(14)	Spool	4
(6)	O-Ring	4	(15)	U-Joint	1
(7)	Seat (Spring)	4	(16)	Nut (Round Plate)	1
(8)	Washer 2	4	(17)	Nut (Adjusting)	1
(9)	Spring	1	(18)	Boot	1

RY9212001HYS0473US0

Right Pilot Valve

No.	Part Name	Q'ty	No.	Part Name	Q'ty
(1)	Casing	1	(10)	Spring	1
(2)	Plate	1	(11)	Spring	1
(3)	Plug	4	(12)	Spring	1
(4)	Pushrod	4	(13)	Spring	4
(5)	Seal	4	(14)	Spool	4
(6)	O-Ring	4	(15)	Nut (Round Plate)	1
(7)	Seat (Spring)	4	(16)	Nut (Adjusting)	1
(8)	Washer 2	4	(17)	Nut (Adjusting)	1
(9)	Spring	1	(18)	Boot	1

RY9212001HYS0474US0

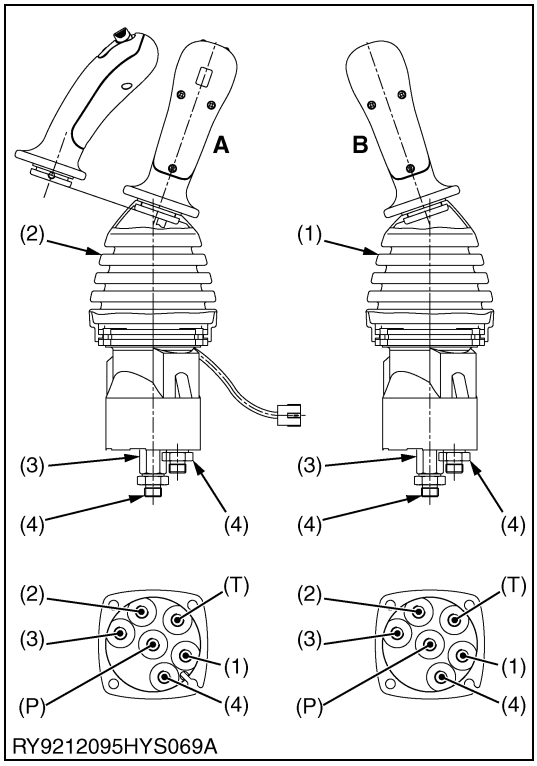
Differentiating between Pilot Valves

The layout of the return springs of the pilot valves differ left and right and are not interchangeable.

(1) Location of Kubota Part No. Stamp
(a) P port
(b) Port 3
(c) Port 2
(d) T Port
(e) Port 1
(f) Port 4

RY9212095HYS0068US0

Pilot Valve Hydraulic Hose Connection Points



Right P/V

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

Left P/V

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

A : Right pilot valve **B : Left pilot valve**

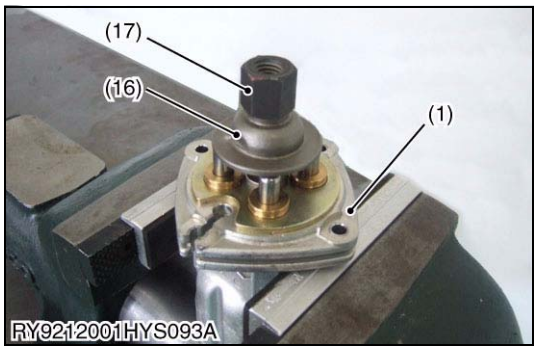
RY9212095HYS0080US0

(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



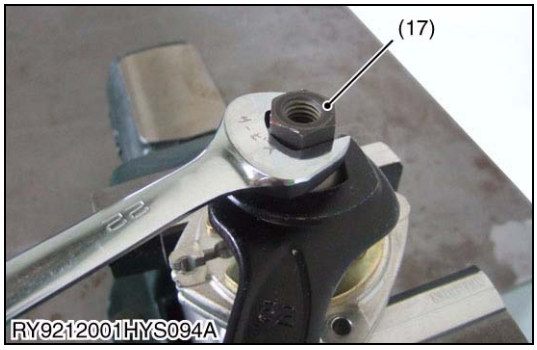
1. Clamp the pilot valve in a vise.

■ **IMPORTANT**

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

(1) Casing
(16) Nut (disc)
(17) Nut (adjustment)

RY9212001HYS0477US0

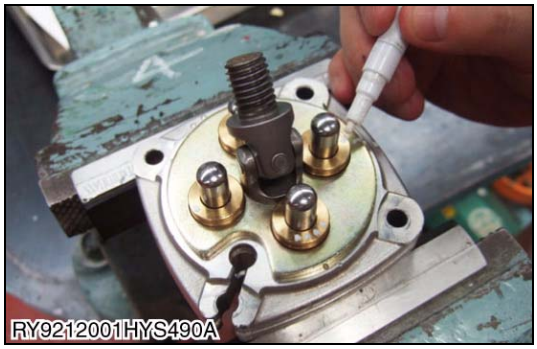


2. Use two wrenches on the nuts (adjustment 16 and disc 17) to remove them.

- Tools to use : 22 mm and 32 mm (0.87 in. and 1.3 in.) wrenches

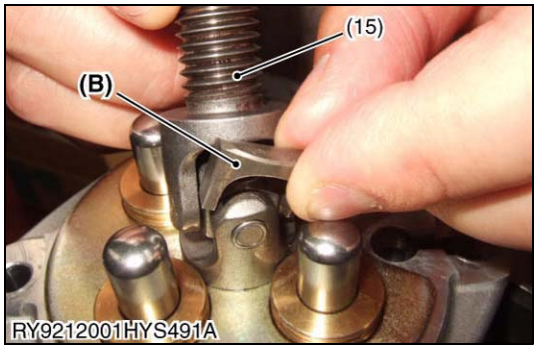
(17) Nut (adjustment)

RY9212001HYS0478US0

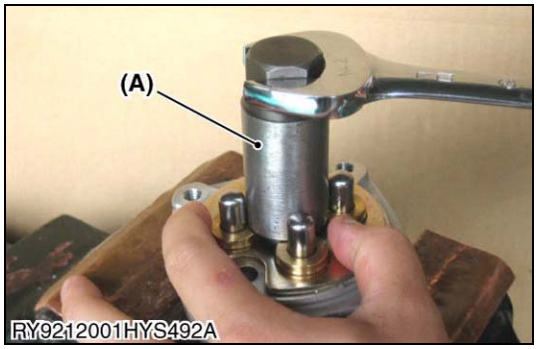


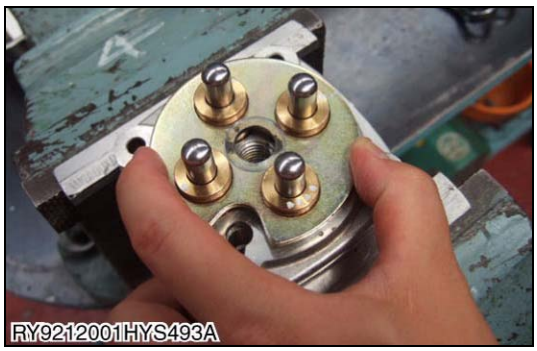
3. Mark the relationship of holes to the casing.

RY9212001HYS0479US0



4. After mounting tool **(B)** on the U-joint (15), use tool **(A)** to turn the U-joint counterclockwise and loosen it.



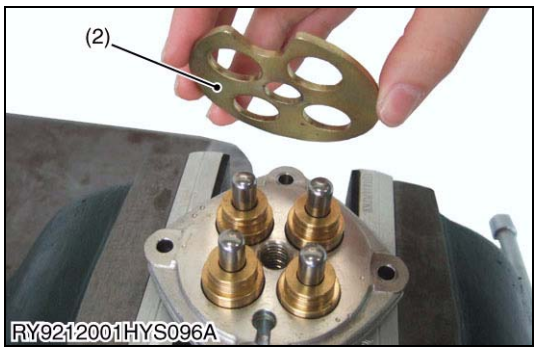


CAUTION

- **When removing the U-joint, take care that it does not pop off.**

(A) Tool **(B) Tools (2)**

RY9212001HYS0480US0



5. Remove the plate.

(2) Plate

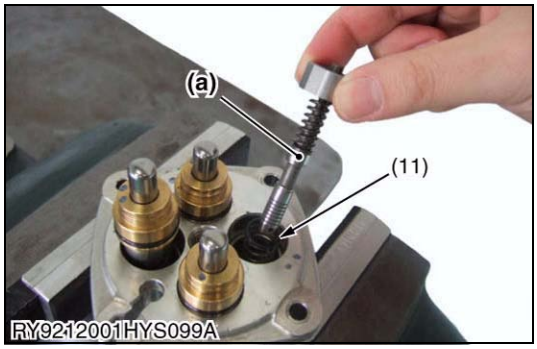
RY9212001HYS0481US0

6. Slip a slotted screwdriver in the groove in the plug (3) to remove the plug.

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.**

(3) Plug

RY9212001HYS0482US0

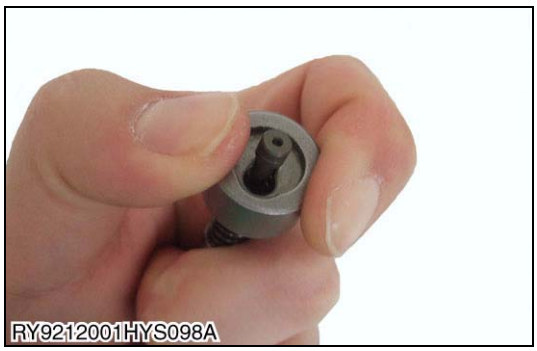


7. Remove the reducing valve ASSY **(a)** and the return spring (11).

IMPORTANT
- **Tag the springs to positively ID which port they go to.**

(11) Spring
(a) Reducing valve ASSY

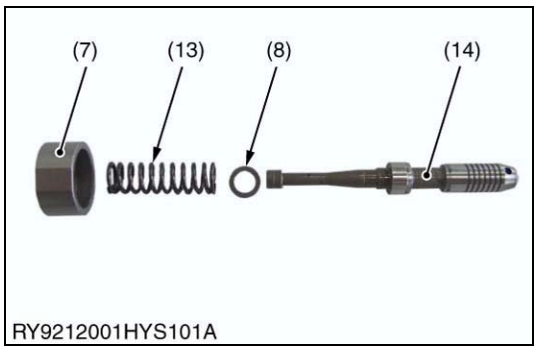
RY9212001HYS0483US0



8. To disassemble the reducing valve, press the spring seat in and while compressing the secondary pressure spring, shift the spring seat to the side and remove it from the spool via the larger hole.

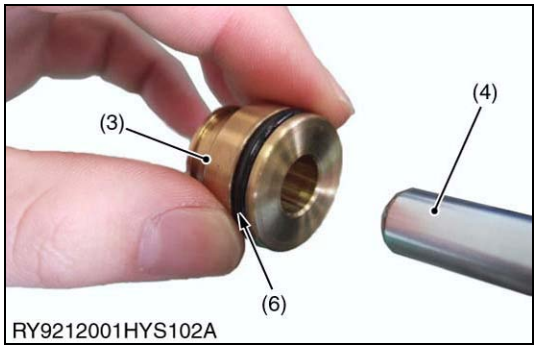
IMPORTANT
- **Be careful not to scratch the surface of the spool.**
- **Do not depress the spring seat 6 mm (0.2 in.) ≤.**
- **Do not disassemble the reducing valve unless there is a problem with it.**

Components of the Reducing Valve



(7) Spring seat
(8) Metal washer 2
(13) Spring
(14) Spool

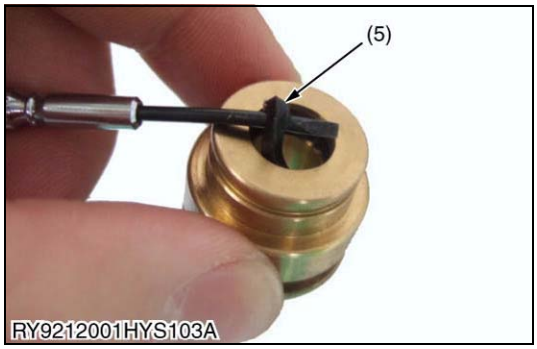
RY9212001HYS0484US0



9. Remove the plug (3) from the pushrod (4).

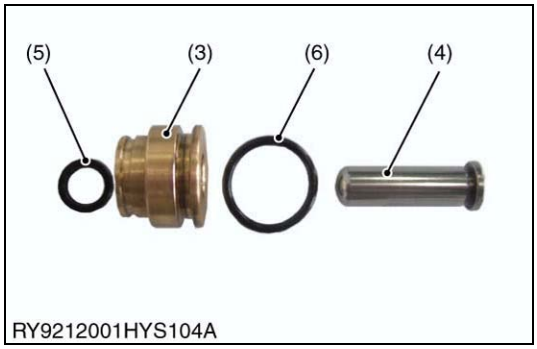
(3) Plug
(4) Pushrod
(6) O-Ring

RY9212001HYS0485US0



10. Remove the O-ring (6) and seal (5) from the plug (3).

■ **IMPORTANT**
- **Use a mini slotted screwdriver.**
- **Be careful not to scratch the inside surface of the plug.**



Components of the Plug

(3) Plug
(4) Pushrod
(5) Seal
(6) O-Ring

RY9212001HYS0486US0

(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

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

RY9212001HYS0487US0

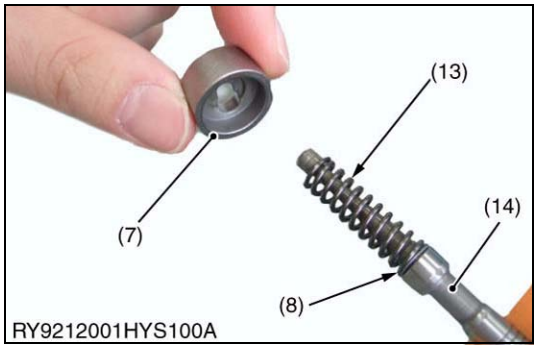
2. Install the return spring (11) in the casing.

■ **IMPORTANT**

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

(11) Spring

RY9212001HYS0488US0



3. Install the metal washer (8), spring (13) and spring seat (7) in order to the spool (14).

■ **IMPORTANT**

- **Do not depress the spring seat 6mm (0.2 in.) or more.**
- **Be careful not to scratch the spool.**

(7) Spring seat
(8) Metal washer 2
(13) Spring
(14) Spool

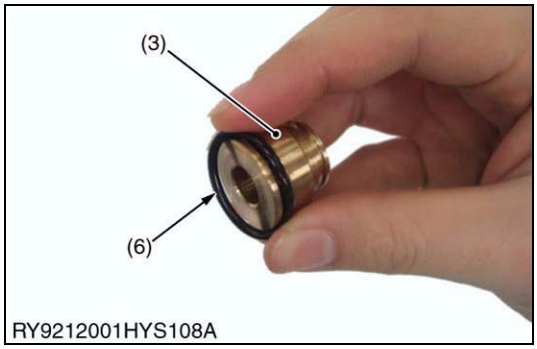
RY9212001HYS0489US0

4. Install the reducing valve ASSY.
   After installing it, make sure the spool moves smoothly.

■ **IMPORTANT**

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

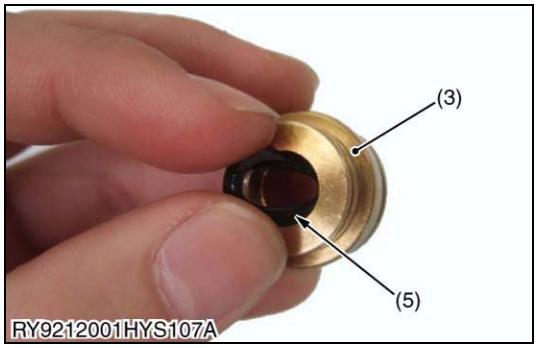
RY9212001HYS0490US0



5. Install the O-ring (6) on the plug (3).

(3) Plug
(6) O-Ring

RY9212001HYS0491US0

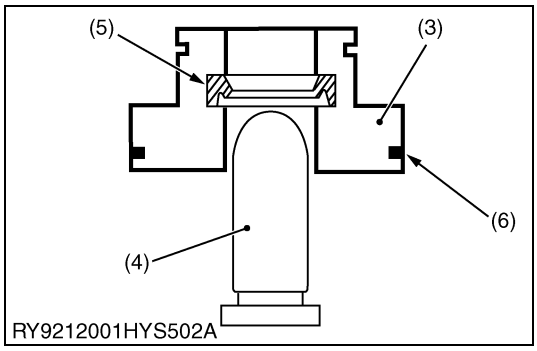


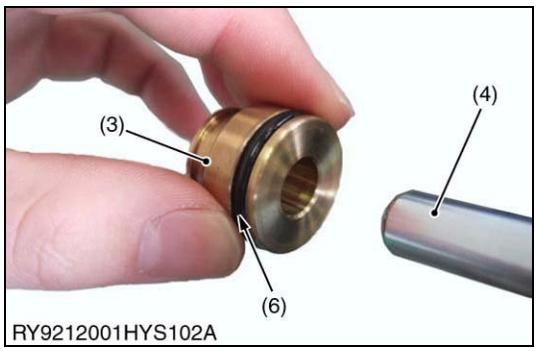
6. Install the seal (5) on the plug (3).

■ **IMPORTANT**
- **Be careful that the seal faces the right direction.**
- **Apply hydraulic oil on the circumference and lip of the seal.**

(3) Plug
(4) Pushrod
(5) Seal
(6) O-Ring

RY9212001HYS0492US0





7. Install the plug (3) on the pushrod (4).

■ **IMPORTANT**
- **Apply hydraulic oil to the pushrod.**

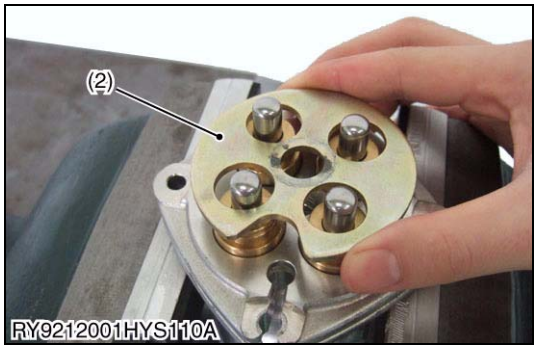
(3) Plug
(4) Pushrod
(6) O-Ring

RY9212001HYS0493US0

8. Install the plug ASSY into the case.
   If the return spring is too stiff, use the plate to install the ASSY.

■ **IMPORTANT**
- **Be careful not to scratch the hole of the casing by prying on the spool.**
- **Take care so the plug ASSY does not go flying.**

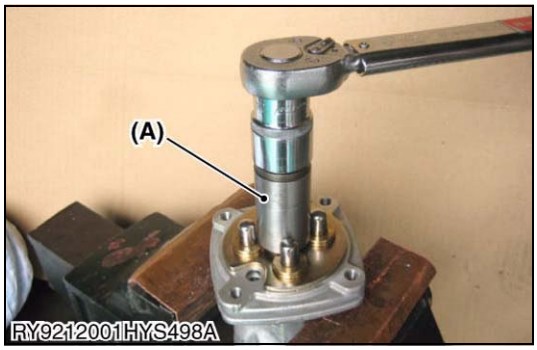
RY9212001HYS0494US0



9. Install the plate.

(2) Plate

RY9212001HYS0495US0

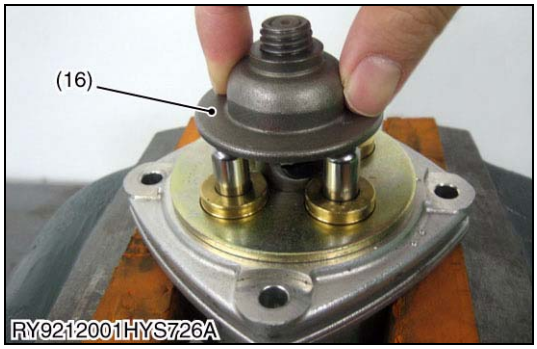


10. Install the U-joint.

Tightening torque	U-joint	44 to 50 N·m 4.5 to 5.1 kgf·m 32 to 37 lbf·ft

(A) Tool

RY9212001HYS0496US0



11. Install the nut (disc) (16) on the universal joint.
Tighten it until it touches all four pushrods equally.

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 to the correct position.**

(16) Nut (disc)

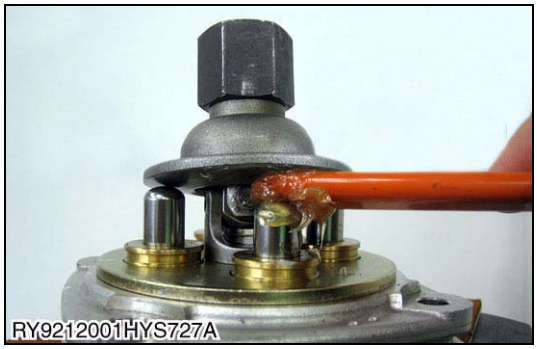
RY9212001HYS0497US0

12. Tighten the nut (adjustment).
Put the wrench on the bolt width of the disc and tighten the nut.

- Tools to use : 22 mm (0.87 in.) wrench (or socket), 32 mm (1.3 in.) wrench

Tightening torque	Nut (adjustment)	63.7 to 73.5 N·m 6.5 to 7.5 kgf·m 47.0 to 54.2 lbf·ft

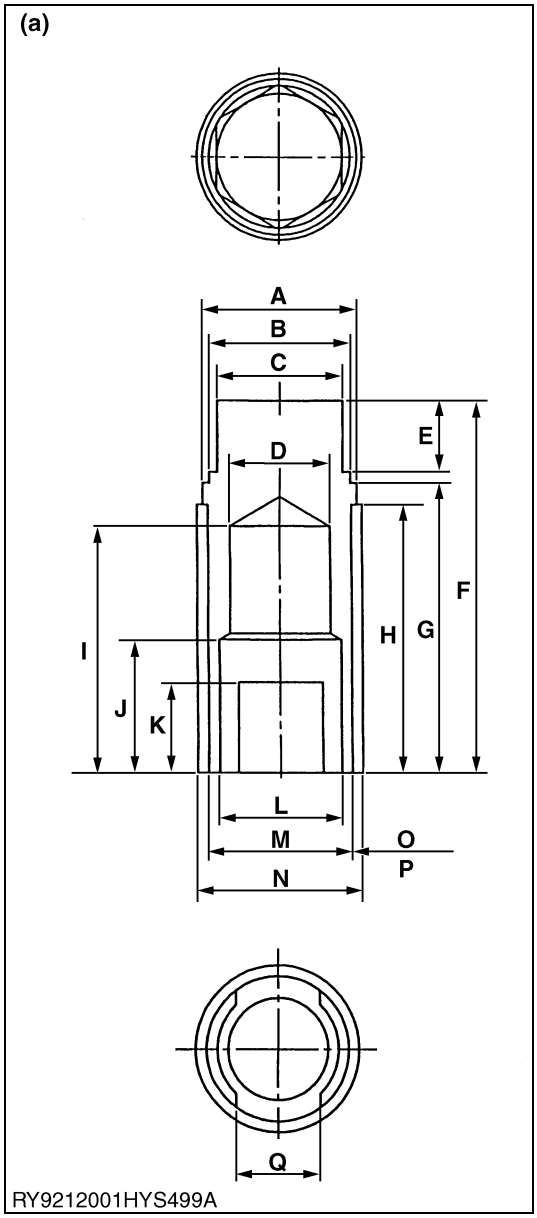
RY9212001HYS0498US0



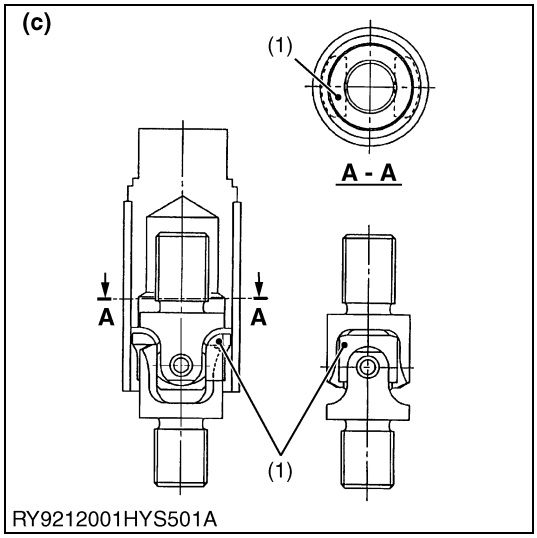
13. Apply grease to the rotating parts of the universal joint and to the ends of the pushrods.

RY9212001HYS0499US0

(4) U-joint Tightening Tool

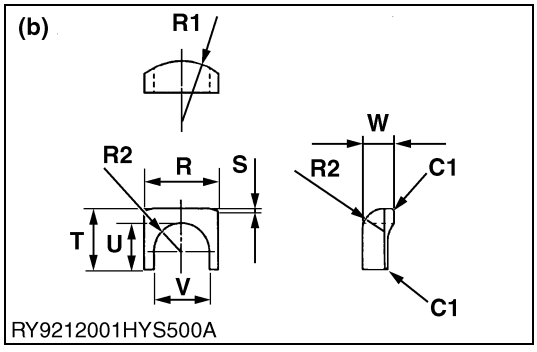


RY9212001HYS499A



RY9212001HYS501A

A	ϕ29 mm (ϕ1.142 in.)
B	ϕ26.5 mm (ϕ1.043 in.)
C	23.5 mm (0.925 in.) (nut width)
D	ϕ19 mm (ϕ0.748 in.)
E	13 mm (0.512 in.)
F	69 mm (2.717 in.)
G	54 mm (2.126 in.)
H	50 mm (1.968 in.)
I	46 mm (1.811 in.)
J	25 mm (0.984 in.)
K	17 mm (0.669 in.)
L	ϕ23 mm (ϕ0.906 in.)
M	ϕ27 mm (ϕ1.063 in.)
N	ϕ31 mm (ϕ1.220 in.)
O	Hole H 6
P	Axle n 6
Q	16 mm (0.6299 in.)
R	15.5 mm (0.6102 in.)
S	0.5 mm × 15 mm (0.0197 in. × 0.591 in.)
T	12.5 mm (0.492 in.)
U	9.5 mm (0.374 in.)
V	11.6 mm (0.457 in.)
W	6.5 mm (0.256 in.)
C1	0.5 mm (0.0197 in.) bevel
R1	R 13 mm (0.512 in.)
R2	R 5.8 mm (0.228 in.)
R3	R 4.5 mm (0.177 in.)



RY9212001HYS500A

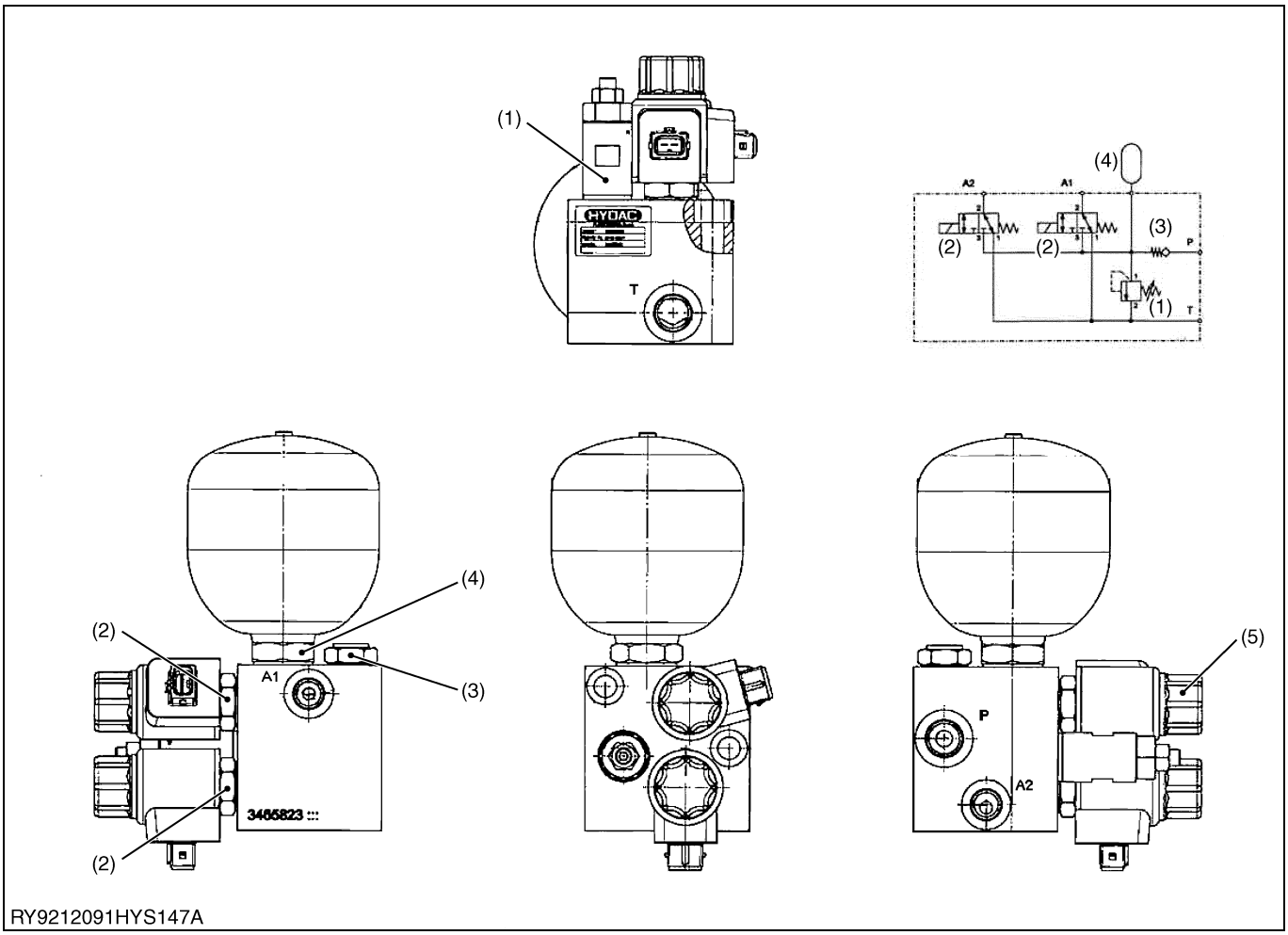
(1) Bushing

(a) U-Joint Tightening Tool, Detailed Schematic
(b) Bushing, Detailed Schematic
(c) Assembled U-Joint

RY9212001HYS0500US0

8. UNLOAD VALVE

[1] UNLOAD VALVE 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	

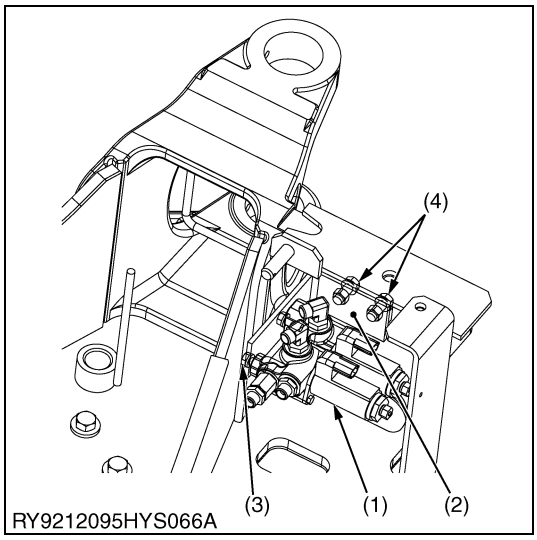
■ **IMPORTANT**

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

RY9212091HYS0273US0

9. AUX SOLENOID VALVE

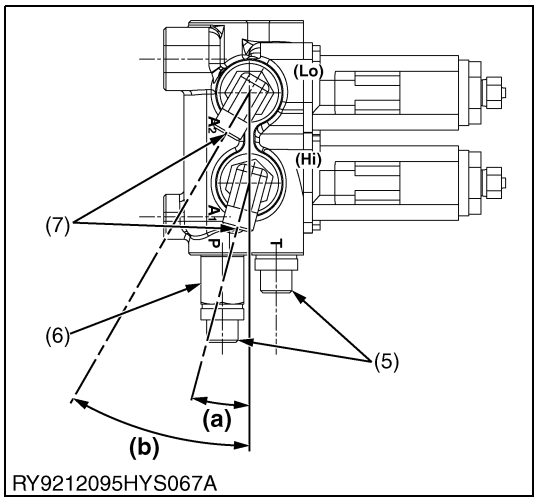
[1] AUX SOLENOID VALVE REMOVAL AND INSTALLATION



RY9212095HYS066A

No.	Name of part	Number
(1)	Valve ASSY	1
(2)	Bracket, SP	1
(3)	Bolt	2
(4)	Bolt	2
(5)	O-adapter	2
(6)	Adapter	1
(7)	Joint, pipe	2

Tightening torque	Bolt (3)	26 to 32 N·m 2.7 to 3.2 kgf·m 20 to 23 lbf/ft
	Bolt (4)	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 lbf·ft



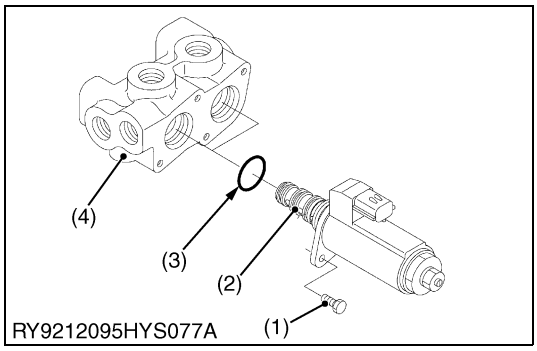
RY9212095HYS067A

Adapter angle

(a) 15 ° **(b) 30 °**

RY9212095HYS0081US0

[2] AUX SOLENOID DISASSEMBLY/ASSEMBLY GUIDE



RY9212095HYS077A

Tightening torque	Hex bolt (1)	7 ± 1 N·m 0.7 ± 0.1 kgf·m 5.2 ± 0.7 ft·lbs

■ **NOTE**

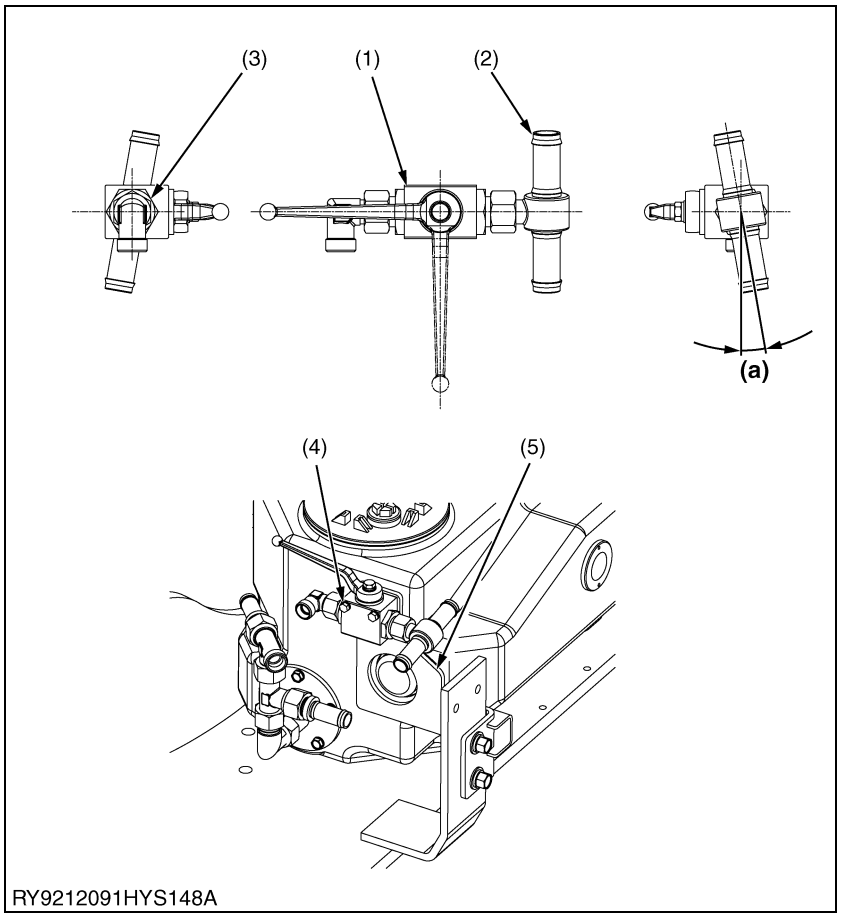
- **The adjustment nut on top of the solenoid is set in advance when shipped from the factory.**
- **Service port flow. Do not adjust the feel with this nut. (Adjust according to the digital panel procedures.)**

(1) Hex bolt (M5 × 0.8) (3) O-Ring
(2) Proportional control solenoid (4) Case

RY9212095HYS0071US0

10. THIRD LINE VALVE

[1] THIRD LINE VALVE DISASSEMBLY/ASSEMBLY GUIDE



RY9212091HYS148A

(1) Third line cock
(2) T adapter
(3) Adapter
(4) Bolt
(5) Bracket, oil tank

(a) 10 °

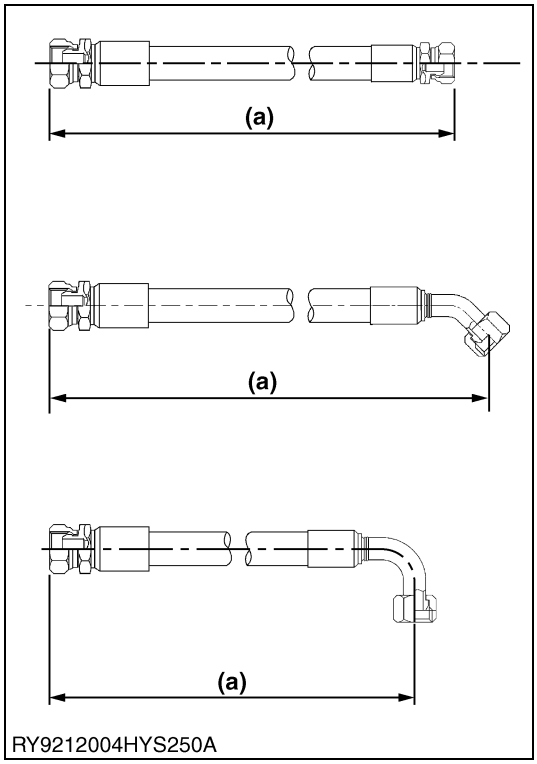
Tightening torque	Bolt (4)	3.0 to 4.0 N·m 0.3 to 0.4 kgf·m 2.0 to 3.0 lbf/ft

RY9212091HYS0274US0

11. ROUTING OF HYDRAULIC HOSES

[1] HYDRAULIC HOSE SPECIFICATIONS

(1) Total Length of Hydraulic Hose

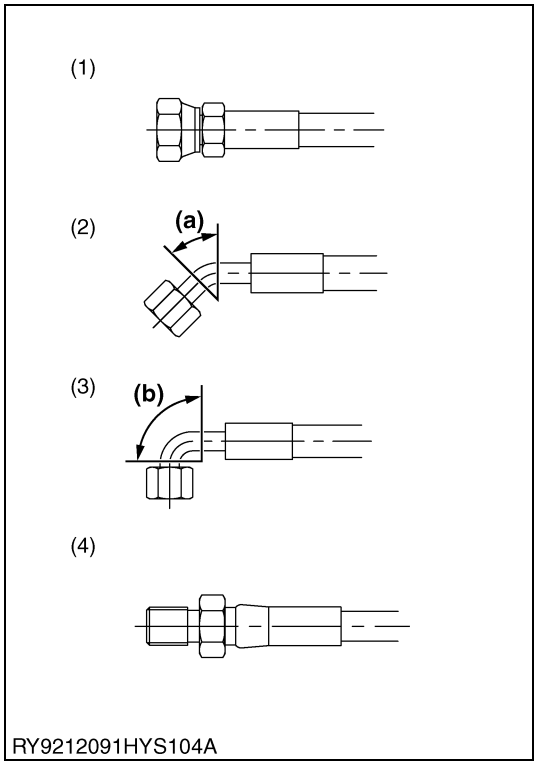


RY9212004HYS250A

(a) Total Length

RY9212004HYS0147US0

(2) Types of Connector Fittings (Screw)



RY9212091HYS104A

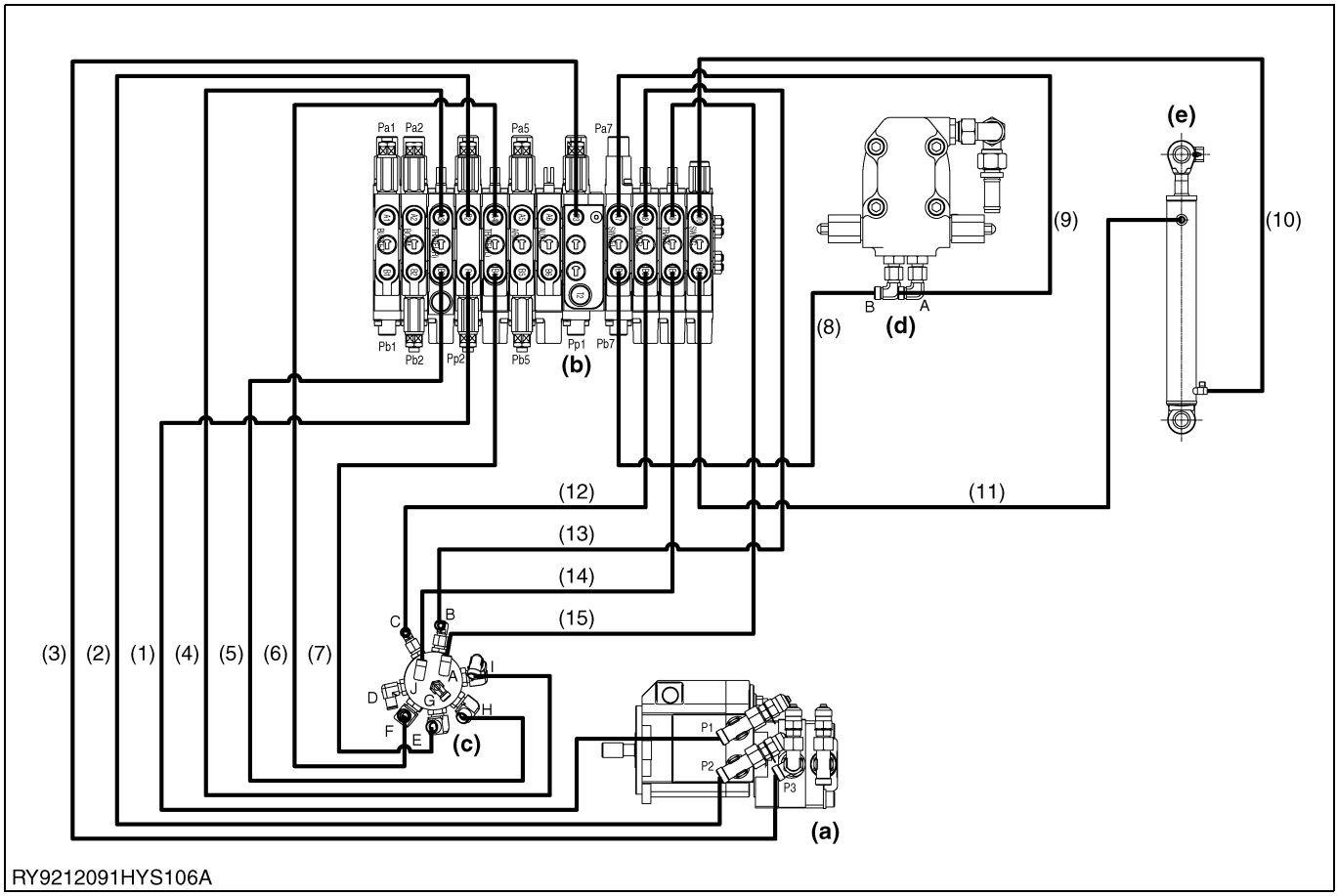
(1) C Type (Straight)
(2) CR4 Type (45°)
(3) CR9 Type (90°)
(4) CM Type (Male Thread)

(a) 45 °
(b) 90 °

RY9212091HYS0047US0

[2] ROUTING OF HYDRAULIC HOSES

(1) Delivery Hose Routing



RY9212091HYS106A

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

(To be continued)

(Continued)

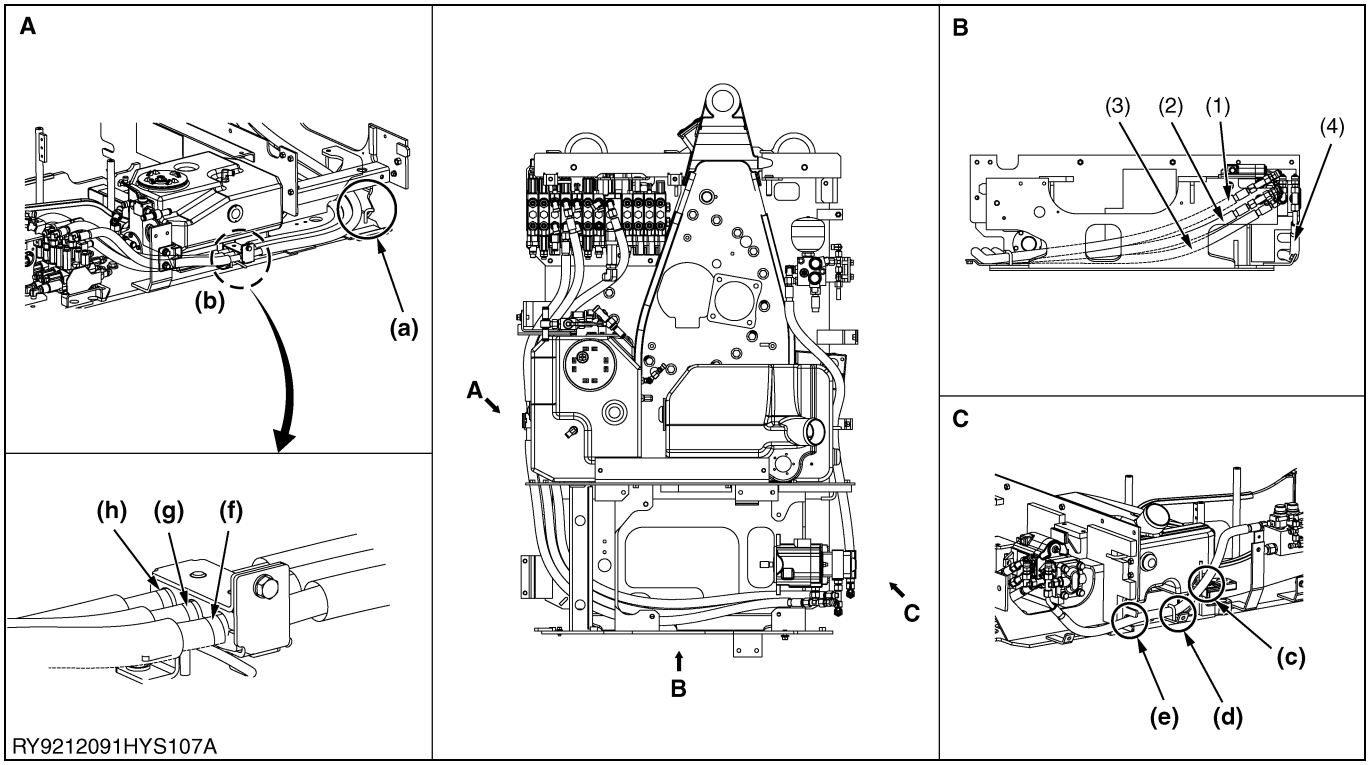
■ Table of Hydraulic Hoses

No.	Function	Hose					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	P1	1840 mm (72.4 in.)	3/8	4 x White	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	Pump (P1) to C/V (P1)
(2)	P2	1840 mm (72.4 in.)	3/8	4 x Red	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	Pump (P2) to C/V (P2)
(3)	P3	1940 mm (76.4 in.)	3/8	4 x Blue	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	Pump (P3) to C/V (P3)
(4)	Travel right forward	685 mm (27.0 in.)	3/8	2 x Green	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	C/V (A3) to R/J (I)
(5)	Travel right rear	655 mm (25.8 in.)	3/8	2 x Yellow	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	C/V (B3) to R/J (H)
(6)	Travel left forward	505 mm (19.9 in.)	3/8	2 x Blue	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	C/V (A4) to R/J (F)
(7)	Travel left rear	505 mm (19.9 in.)	3/8	2 x Red	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	C/V (B4) to R/J (E)
(8)	Swivel left	540 mm (21.3 in.)	1/4	2 x Gray	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (B7) to Swivel motor (B)
(9)	Swivel right	620 mm (24.4 in.)	1/4	2 x Blue	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (A7) to Swivel motor (A)
(10)	Swing left	1290 mm (50.8 in.)	1/4	2 x Green	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (A10) to Swing CYL bottom
(11)	Swing right	1400 mm (55.1 in.)	1/4	2 x Yellow	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (B10) to Swing CYL rod
(12)	Blade down (bottom)	350 mm (13.8 in.)	1/4	2 x Brown	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	PWR	C/V (B8) to R/J (C)
(13)	Blade up (rod)	420 mm (16.5 in.)	1/4	2 x Red	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	PWR	C/V (A8) to R/J (B)
(14)	Track cylinder (Rod)	350 mm (13.8 in.)	1/4	2 x Pink	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (A9) to R/J (A)
(15)	Track cylinder (Bottom)	270 mm (10.6 in.)	1/4	2 x Yellow -red	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (B9) to R/J (J)

- PWR: Plastic corrugated tube

RY9212091HYS0049US0

(2) Delivery Hose Clamp Positions



(a) Pass Inside the Guide
(b) Mark Location
(c) Pass on the Outside of Guide
(d) Hang on the Guide
(e) Pass through the Notch
(f) White
(g) Red
(h) Blue

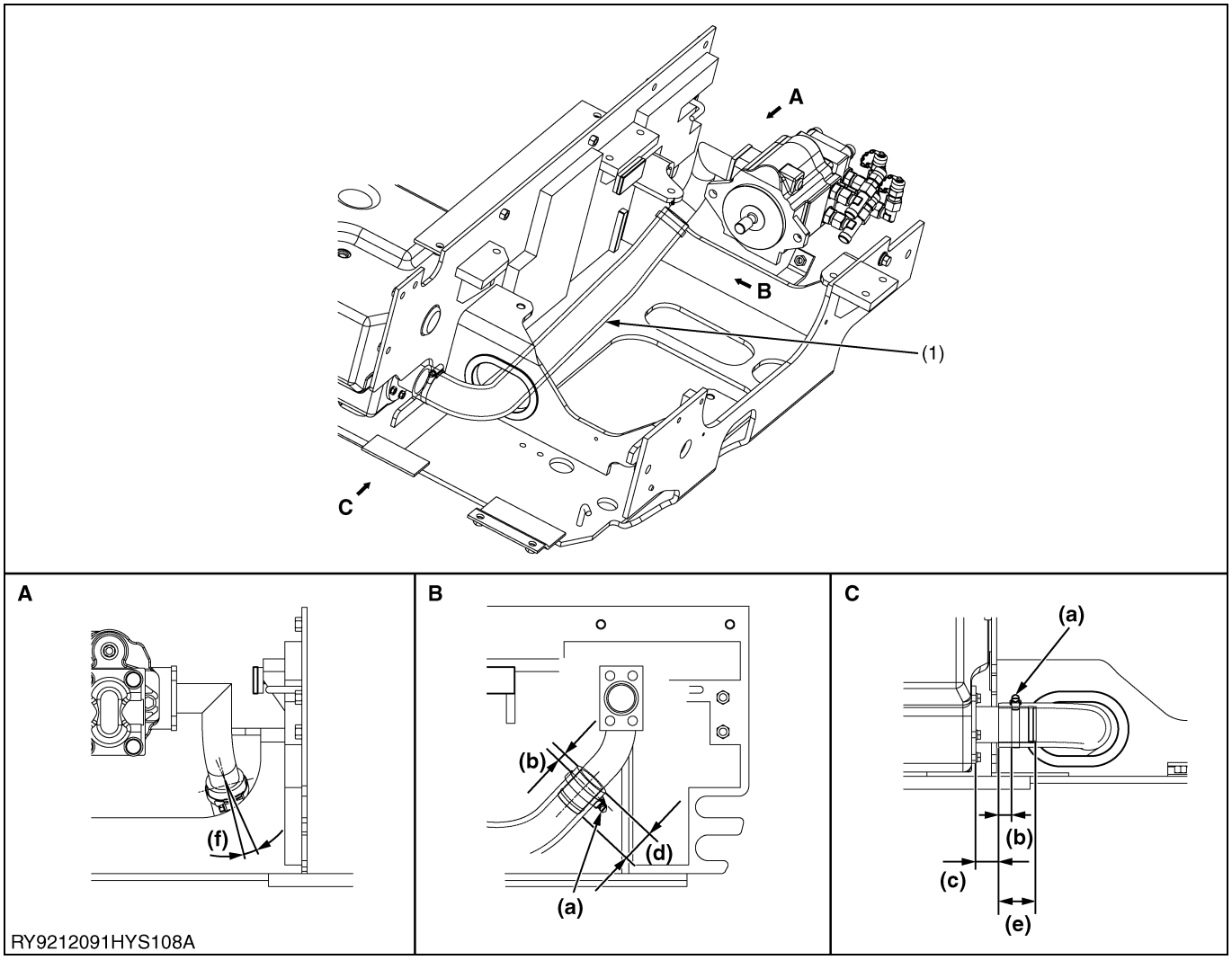
■ Table of Hydraulic Hoses

No.	Function	Hose					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	P1	1840 mm (72.4 in.)	3/8	4 x White	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	Pump (P1) to C/V (P1)
(2)	P2	1840 mm (72.4 in.)	3/8	4 x Red	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	Pump (P2) to C/V (P2)
(3)	P3	1940 mm (76.4 in.)	3/8	4 x Blue	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	Pump (P3) to C/V (P3)
(4)	P4	1080 mm (42.5 in.)	3/8		17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	CR4·C	M18	PWR	Pump (P4) to unload V

- PWR: Plastic corrugated tube

RY9212091HYS0050US0

(3) Suction Hose Routing



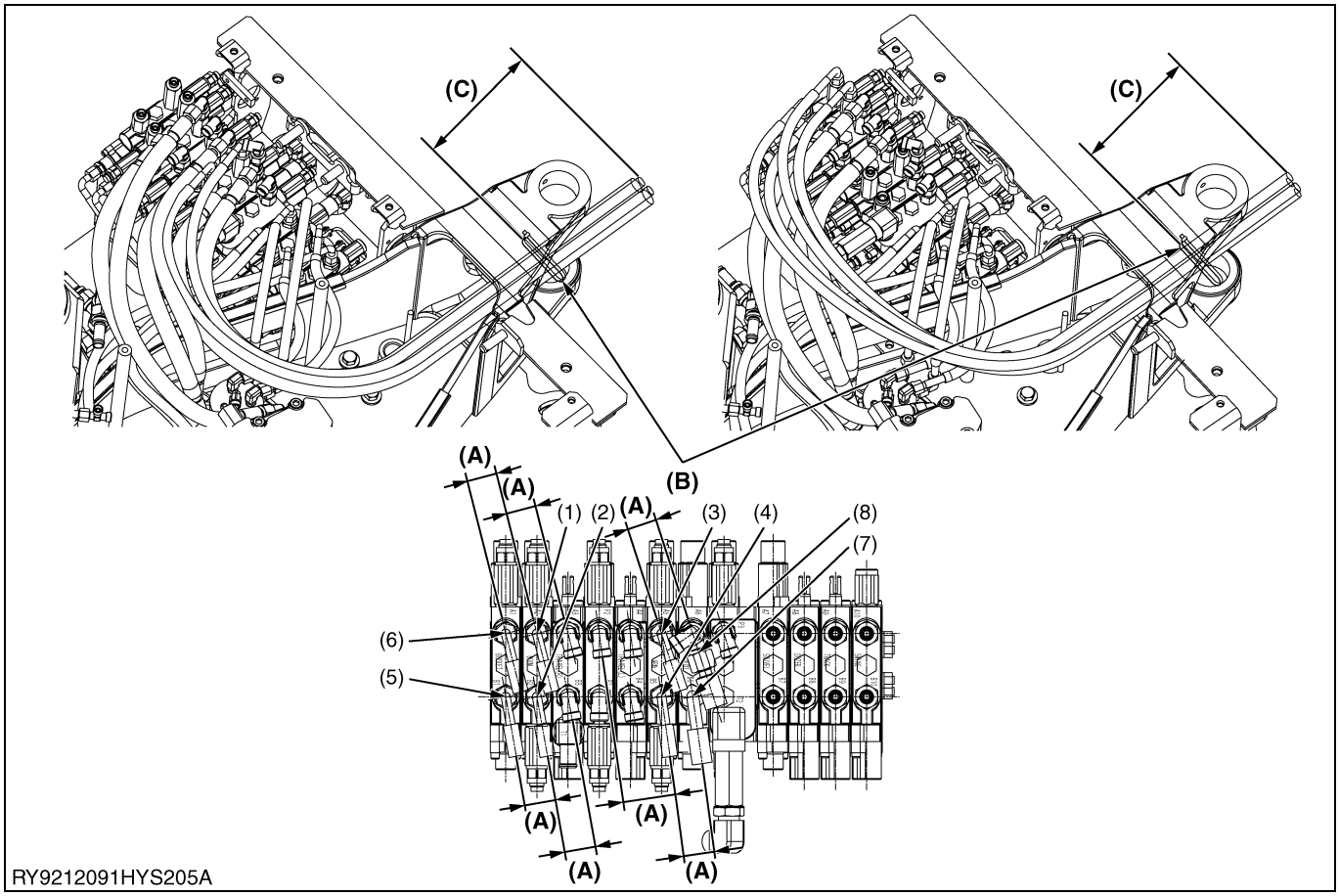
(a) Hose Clamp **(c) 26.5 mm (1.0 in)** **(e) 43 mm (1.7 in)** **(f) 10 °**
(b) 15 mm (0.6 in) **(d) 40 mm (1.6 in)**

■ Table of Hydraulic Hoses

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

RY9212091HYS0051US0

(4) Front Hose Routing



(A) Parallel **(B) Clamp hoses (1) to (8)** **(C) 300 mm (11.8 in)**

■ Table of Hydraulic Hoses

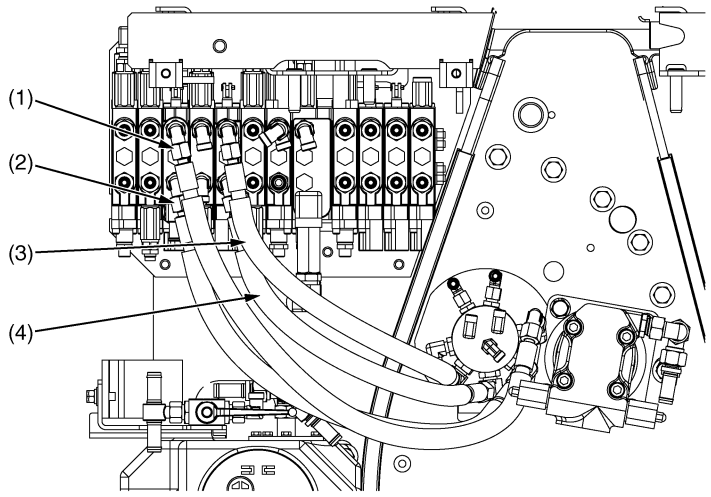
No.	Function	Hose					Fitting		Guard	Position Used	Model	
		Total length	Size	Tape color	O.D.	I.D.	Type	Size			KX 018-4	KX 019-4
(1)	Boom up	1380 mm (54.3 in.)	1/4	2 x Green	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (A2) to Hose	❍	❍
		1610 mm (63.4 in.)					CM·C			Hose to Boom CYL rod	❍	❍
(2)	Boom down	1420 mm (55.9 in.)	1/4	2 x Yellow	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (B2) to Hose	❍	❍
							CM·C			Hose to Boom CYL bottom	❍	❍
(3)	Arm crowd	1270 mm (50.0 in.)	1/4	2 x Gray	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (A5) to Hose	❍	❍
		1300 mm (51.2 in.)					CM·C			Hose to Arm CYL bottom	❍	❍
(4)	Arm dump	1260 mm (49.6 in.)	1/4	2 x Blue	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (B5) to Hose	❍	❍
		1520 mm (59.8 in.)					CM·C			Hose to Arm CYL rod	❍	❍
(5)	Bucket dump	1490 mm (58.7 in.)	1/4	2 x Orange	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (B1) to Hose	❍	
		2520 mm (99.2 in.)					CM·C			Hose to Bucket CYL rod		❍
		2680 mm (105.5 in.)										

No.	Function	Hose					Fitting		Guard	Position Used	Model	
		Total length	Size	Tape color	O.D.	I.D.	Type	Size			KX 018-4	KX 019-4
(6)	Bucket crowd	1440 mm (56.7 in.)	1/4	2 x White	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (A1) to Hose	❍	❍
		2300 mm (90.6 in.)					CM·C			Hose to Bucket CYL bottom	❍	
		2460 mm (96.9 in.)										❍
(7)	AUX (Hi)	1250 mm (49.2 in.)	3/8	2 x Brown	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	CR9·C	M18	PWR	C/V (B6) to Hose	❍	❍
		2200 mm (86.6 in.)					CM·C			Hose to AUX left	❍	
		2300 mm (90.6 in.)										❍
(8)	AUX (Lo)	1220 mm (48.0 in.)	3/8	2 x White	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	C/V (A6) to Hose	❍	❍
		2200 mm (86.6 in.)					CM·C			Hose to AUX right	❍	
		2300 mm (90.6 in.)										❍

- PWR: Plastic corrugated tube

RY9212095HYS0089US0

(5) Travel Hose Routing



RY9212091HYS110A

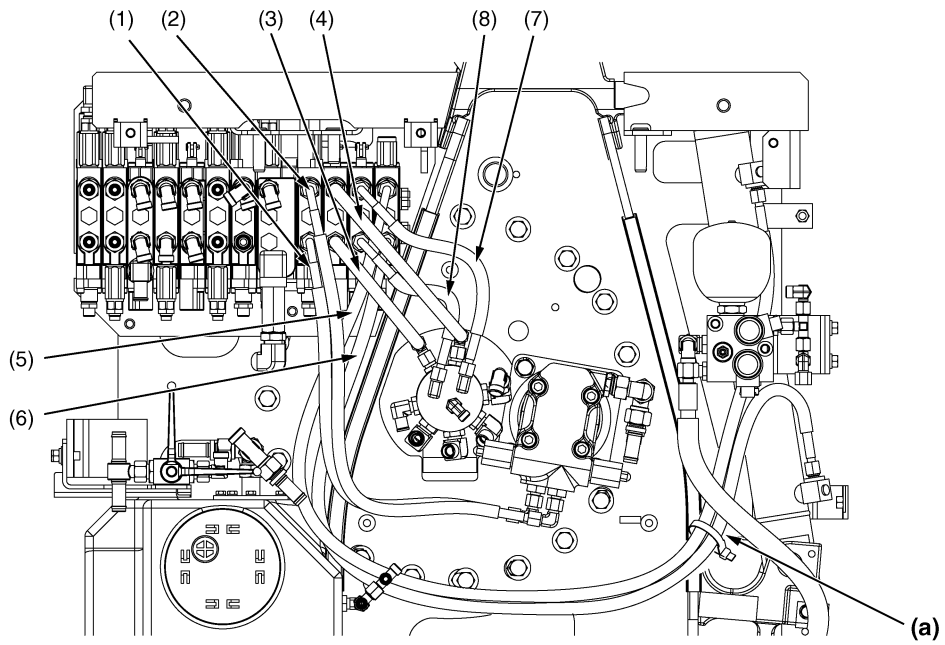
■ Table of Hydraulic Hoses

No.	Function	Hose					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	Travel right forward	685 mm (27.0 in.)	3/8	2 x Green	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	C/V (A3) to R/J (I)
(2)	Travel right rear	655 mm (25.8 in.)	3/8	2 x Yellow	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	C/V (B3) to R/J (H)
(3)	Travel left forward	505 mm (19.9 in.)	3/8	2 x Blue	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	C/V (A4) to R/J (F)
(4)	Travel left rear	505 mm (19.9 in.)	3/8	2 x Red	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	C·C	M18	PWR	C/V (B4) to R/J (E)

- PWR: Plastic corrugated tube

RY9212091HYS0053US0

(6) Routing of Swivel, Blade, Swing and Adjustable Track Hoses



RY9212091HYS111A

(a) Clamp

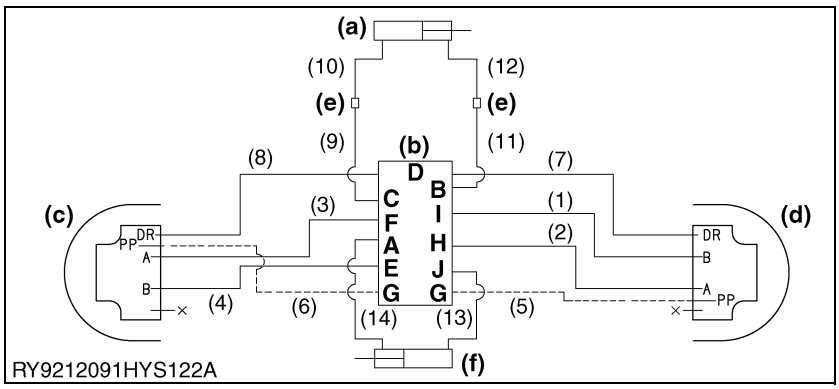
■ Table of Hydraulic Hoses

No.	Function	Hose					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	Swivel left	540 mm (21.3 in.)	1/4	2 x Gray	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (B7) to Swivel motor (B)
(2)	Swivel right	620 mm (24.4 in.)	1/4	2 x Blue	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (A7) to Swivel motor (A)
(3)	Blade down (bottom)	350 mm (13.8 in.)	1/4	2 x Brown	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	PWR	C/V (B8) to R/J (C)
(4)	Blade up (rod)	420 mm (16.5 in.)	1/4	2 x Red	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	PWR	C/V (A8) to R/J (B)
(5)	Swing left	1290 mm (50.8 in.)	1/4	2 x Green	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (A10) to Swing CYL bottom
(6)	Swing right	1400 mm (55.1 in.)	1/4	2 x Yellow	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (B10) to Swing CYL rod
(7)	Track cylinder (Rod)	350 mm (13.8 in.)	1/4	2 x Pink	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (A9) to R/J (A)
(8)	Track cylinder (Bottom)	270 mm (10.6 in.)	1/4	2 x Yellow -green	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	C/V (B9) to R/J (J)

- PWR: Plastic corrugated tube

RY9212091HYS0054US0

(7) Track Frame Hose Routing



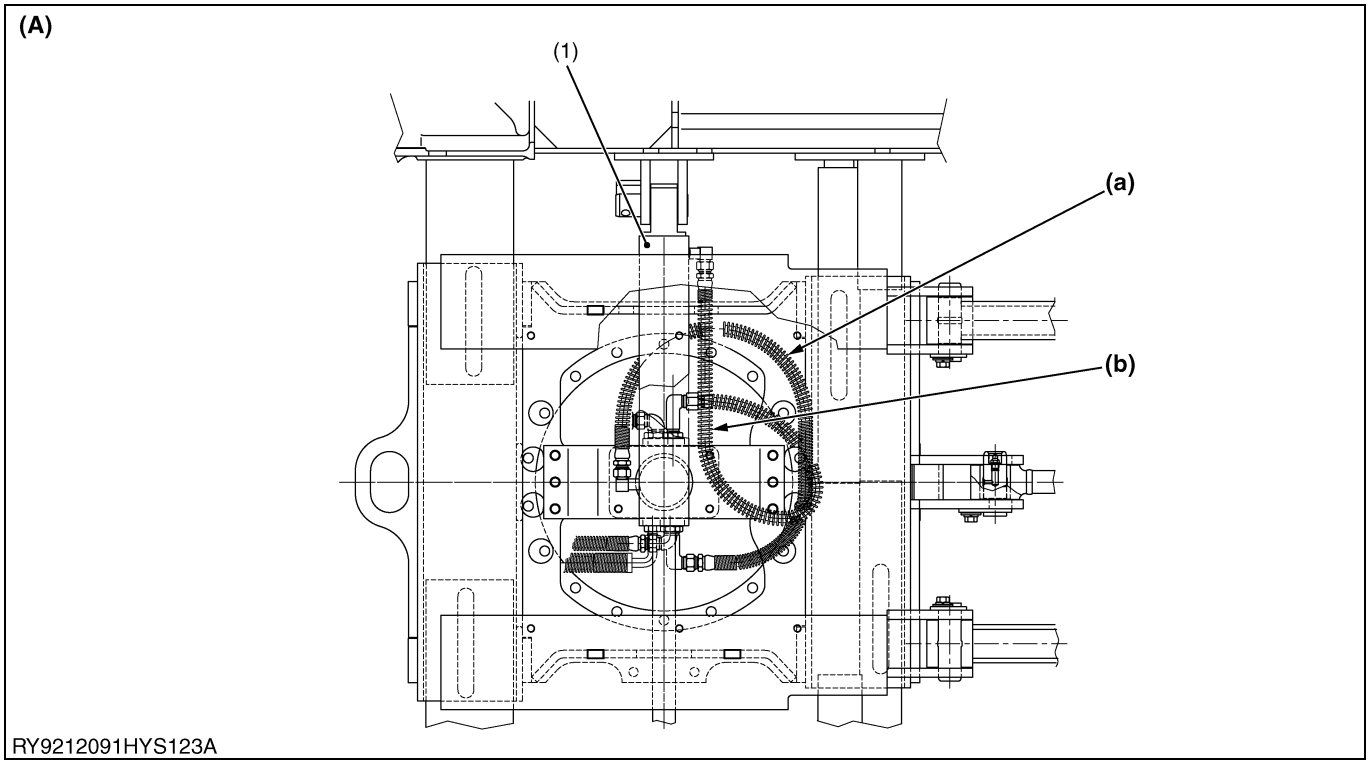
(a) Blade Cylinder
(b) Rotary Joint
(c) Wheel Motor Left Side
(d) Wheel Motor Right Side
(e) Blade Joint
(f) Track Cylinder

R/J side		Travel motor / cylinder side
A	Variable track (compress)	Cylinder rod side
B	Lift blade	Cylinder rod side
C	Lower blade	Cylinder bottom side
D	Drain	L/R drain port
E	Left backward	Left B (bottom side)
F	Left forward	Left A (upper side)
G	2-speed pilot	L/R travel 2-speed
H	Right backward	Right A (bottom side)
I	Right forward	Right B (upper side)
J	Variable track (extend)	Cylinder bottom side

- R/J: Rotary joint

RY9212091HYS0055US0

Track Cylinder Hose Routing



(1) Track Cylinder
(A) View from Under Track Frame
(a) To Cylinder Rod Side
(b) To Cylinder Bottom Side

RY9212091HYS0056US0

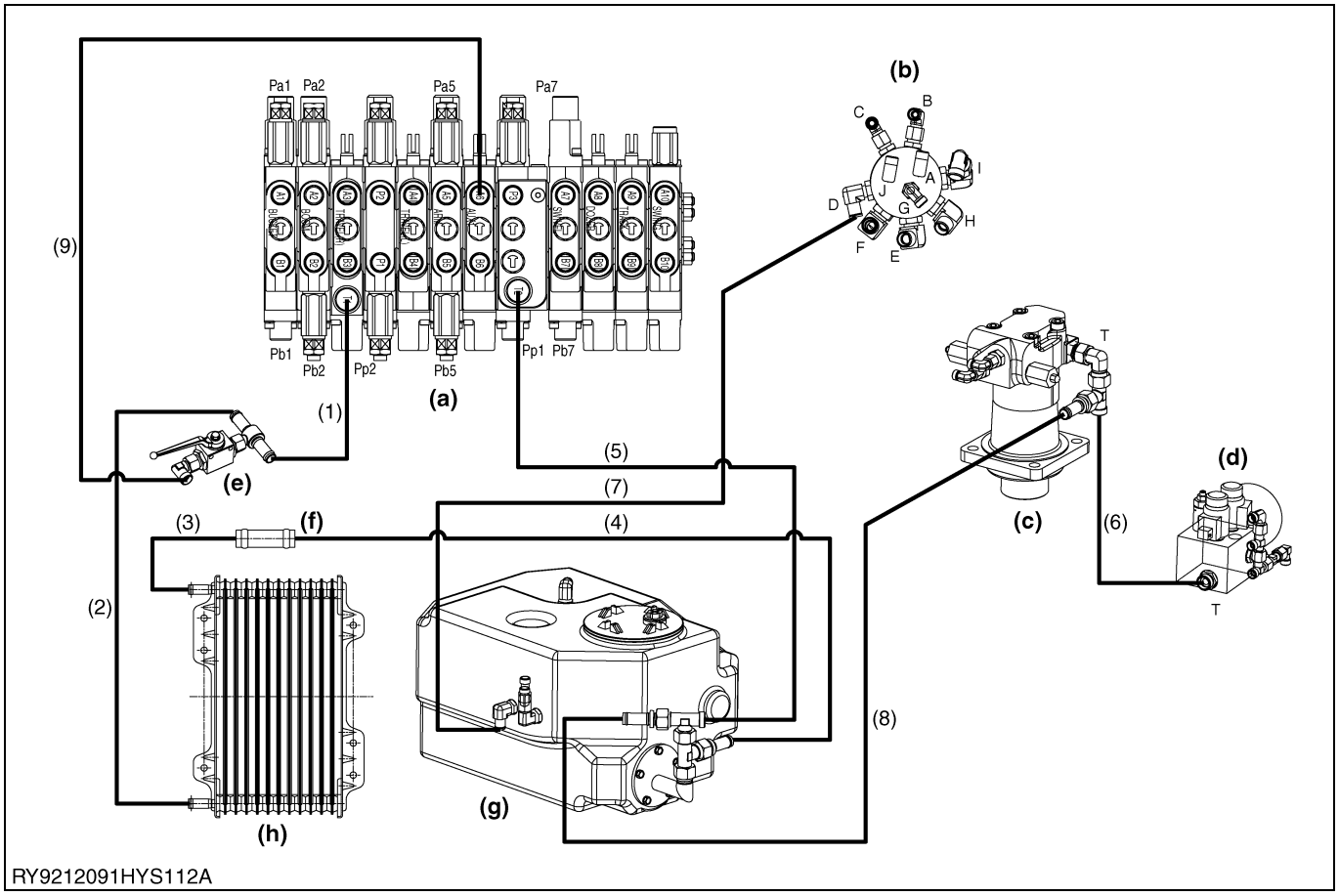
■ Table of Hydraulic Hoses

No.	Function	Hose					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	Travel right forward	920 mm (36.2 in.)	3/8	2 x Red	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	CR9·C	M18	PWR	R/J (i) to Travel motor R (P2)
(2)	Travel right rear	920 mm (36.2 in.)	3/8		17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	CR9·C	M18	PWR	R/J (h) to Travel motor R (P1)
(3)	Travel left forward	920 mm (36.2 in.)	3/8	2 x Red	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	CR9·C	M18	PWR	R/J (f) to Travel motor L (P2)
(4)	Travel left rear	920 mm (36.2 in.)	3/8		17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	CR9·C	M18	PWR	R/J (e) to Travel motor L (P1)
(5)	Travel right 2-speed	900 mm (35.4 in.)	1/4	2 x Blue	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	PWR	R/J (g) to Travel motor R (Ps)
(6)	Travel left 2-speed	900 mm (35.4 in.)	1/4	2 x Blue	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	PWR	R/J (g) to Travel motor L (Ps)
(7)	Drain	880 mm (34.6 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	R/J (d) to Travel motor R (D)
(8)	Drain	880 mm (34.6 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	R/J (d) to Travel motor L (D)
(9)	Blade down	275 mm (10.8 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14		R/J (c) to blade joint
(10)	Blade down	340 mm (13.4 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	Overall length, spring	Blade joint to blade CYL bottom
(11)	Blade up	275 mm (10.8 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14		R/J (b) to blade joint
(12)	Blade up	340 mm (13.4 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	Overall length, spring	Blade joint to blade CYL rod
(13)	Track extend	670 mm (26.4 in.)	1/4	2 x White	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	R/J (j) to track CYL bottom
(14)	Track compress	760 mm (29.9 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14	PWR	R/J (a) to track CYL rod

- PWR: Plastic corrugated tube

RY9212095HYS0002US0

(8) Return Hose Routing



RY9212091HYS112A

(a) Control valve **(c) Swivel motor** **(e) Third line valve** **(g) Oil tank**
(b) Rotary joint **(d) Unload valve** **(f) Pipe** **(h) Oil cooler**

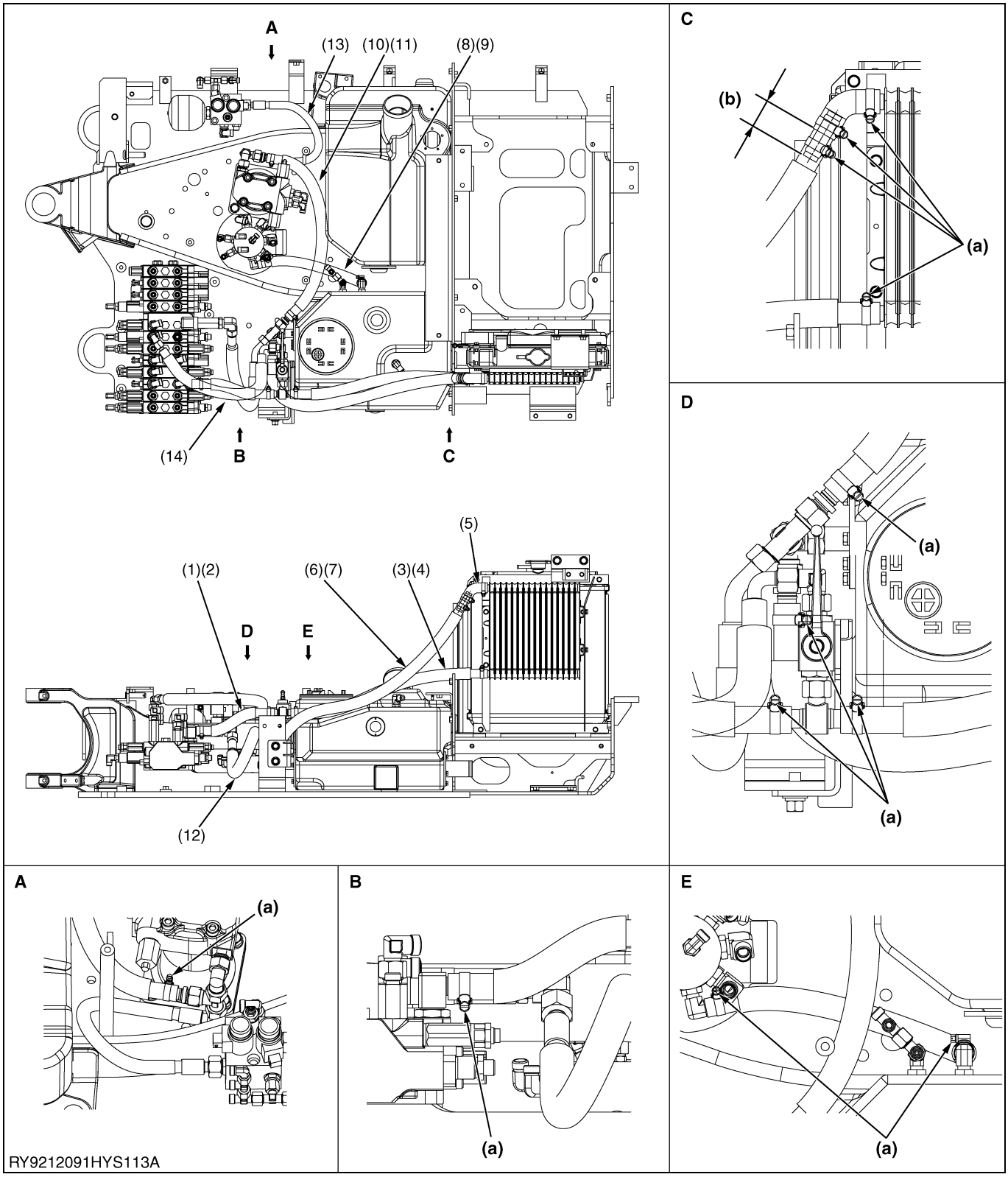
■ Table of Hydraulic Hoses

No.	Function	Hose		Guard	Position Used
		Total length	Size		
(1)	Oil cooler IN	225 mm (8.9 in.)			C/V (T2) to third line valve (T-joint)
(2)	Oil cooler IN	550 mm (21.7 in.)			Third line valve (T-joint) to oil cooler (lower)
(3)	Oil cooler OUT				Oil cooler (upper) to pipe
(4)	Oil cooler OUT	760 mm (29.9 in.)			Pipe to oil tank (IN)
(5)	Oil cooler bypass	540 mm (21.3 in.)	1/2	PWR	C/V (T1) to oil tank (IN)
(6)	Unload valve return	485 mm (19.1 in.)	1/2	PWR	Unload valve (T) to swivel motor T
(7)	Travel motor drain	375 mm (14.8 in.)			R/J (D) to oil tank (IN)
(8)	Swivel motor drain	645 mm (25.4 in.)			Swivel motor T to oil tank (IN)
(9)	Third line	450 mm (17.7 in.)	3/8	PWR	C/V (A6) T-joint (AUX 1 LOW) to third line valve T-joint

- PWR: Plastic corrugated tube

RY9212091HYS0058US0

(9) Return Hose Clamp Position



(a) Hose clamp **(b) 30mm (1.2 in)**

(To be continued)

(Continued)

■ Table of Hydraulic Hoses

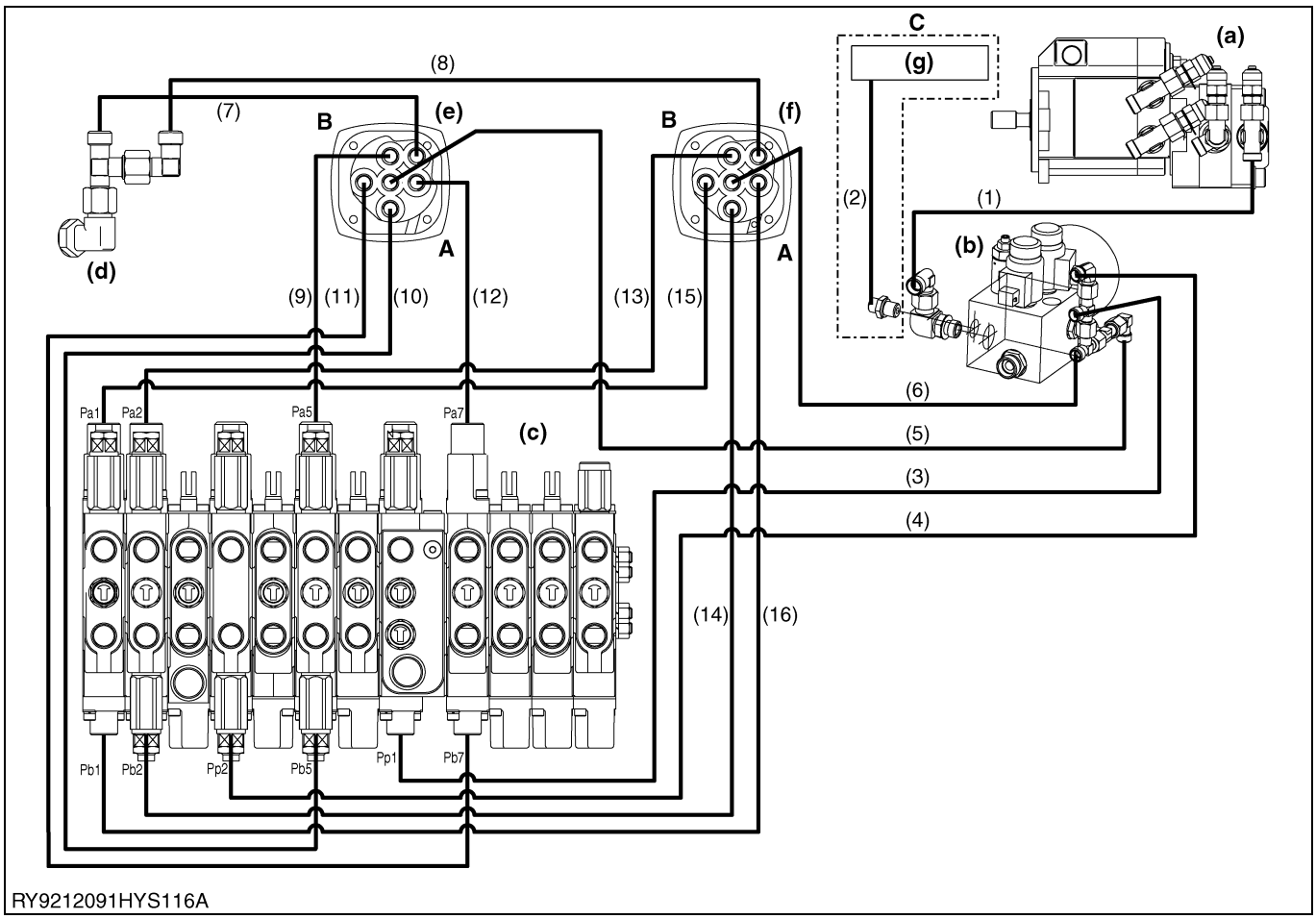
No.	Function	Hose	Position Used
		Total length	
(1)	Oil cooler IN	225 mm (8.9 in.)	C/V (T2) to third line valve (T-joint)
(2)	Protective tube	175 mm (6.9 in.)	Use on low-pressure hose 2
(3)	Oil cooler IN	550 mm (21.7 in.)	Third line valve (T-joint) to oil cooler (lower)
(4)	Protective tube	500 mm (19.7 in.)	Use on low-pressure hose 3
(5)	Oil cooler OUT		Oil cooler (upper) to pipe
(6)	Oil cooler OUT	760 mm (29.9 in.)	Pipe to oil tank (IN)
(7)	Protective tube	710 mm (28.0 in.)	Use on low-pressure hose 6
(8)	Travel motor drain	375 mm (14.8 in.)	R/J (D) to oil tank (IN)
(9)	Protective tube	325 mm (12.8 in.)	Use on low-pressure hose 8
(10)	Swivel motor drain	645 mm (25.4 in.)	Swivel motor T to oil tank (IN)
(11)	Protective tube	595 mm (23.4 in.)	Use on low-pressure hose 10

No.	Function	Hose				Fitting		Guard	Position Used
		Total length	Size	O.D.	I.D.	Type	Size		
(12)	Oil cooler bypass	490 mm (19.3 in.)	1/2	20.4 mm (0.8 in.)	12.7 mm (0.5 in.)	CR4·C	M22	PWR	C/V (T1) to oil tank (IN)
(13)	Unload valve return	485 mm (19.1 in.)	1/2	20.4 mm (0.8 in.)	12.7 mm (0.5 in.)	C·CR9	M22	PWR	Unload valve (T) to swivel motor T
(14)	Third line	450 mm (17.7 in.)	3/8	17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	CR9·C	M18	PWR	C/V (A6) T-joint (AUX LOW) to third line valve T-joint

- PWR: Plastic corrugated tube

RY9212091HYS0059US0

(10) Pilot Hose Routing (KX018-4)



(a) Pump
(b) Unload valve
(c) Control valve
(d) Oil tank
(e) Pilot valve (L)
(f) Pilot valve (R)
(g) Rotary joint (g)
A : Front
B : Rear
C : KX016-4

(To be continued)

(Continued)

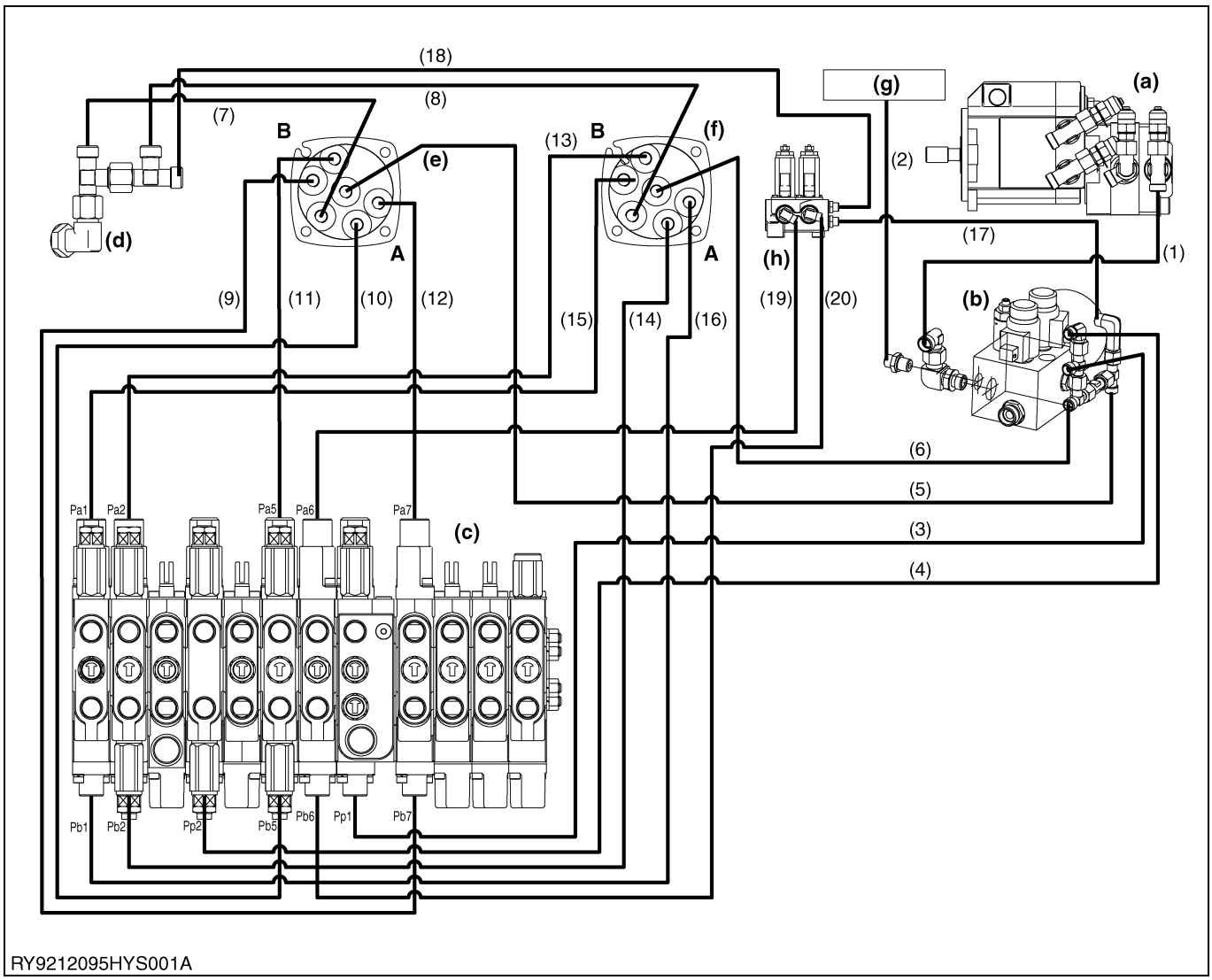
■ Table of Hydraulic Hoses

No.	Function	Hose					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	P4	1080 mm (42.5 in.)	3/8		17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	CR4·C	M18	PWR	Pump (P4) to unload V
(2)	2-speed signal	440 mm (17.3 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	PWR	Unload V (A2) to R/J (g)
(3)	Travel straight forward	940 mm (37.0 in.)	1/4	2 x Blue	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14	PWR	Unload V (A1) to C/V (PP1)
(4)	Travel lock release	1090 mm (42.9 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14	PWR	Unload V (A1) to C/V (PP2)
(5)	Pilot P, LH	1620 mm (63.8 in.)	1/4	2 x White	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14		Unload V to P/V (L) P
(6)	Pilot P, RH	1075 mm (42.3 in.)	1/4	2 x White	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14		Unload V to P/V (R) P
(7)	Pilot T, LH	1585 mm (62.4 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14		PV (tank) L to O/T
(8)	Pilot T, RH	1085 mm (42.7 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14		PV (tank) R to O/T
(9)	Arm bottom (crowd)	2270 mm (89.4 in.)	3/16	2 x Green	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,1) to C/V (Pa5)
(10)	Arm rod (dump)	2030 mm (79.9 in.)	3/16	2 x Blue	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,3) to C/V (Pb5)
(11)	Swivel LH	1960 mm (77.2 in.)	3/16	2 x Red	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·C	M14		PV (L, 2) to C/V (Pb7)
(12)	Swivel RH	2240 mm (88.2 in.)	3/16	2 x Yellow	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,4) to C/V (Pa7)
(13)	Boom rod (raise)	1850 mm (72.8 in.)	3/16	2 x Gray	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,1) to C/V (Pa2)
(14)	Boom bottom (lower)	1700 mm (66.9 in.)	3/16	2 x Light blue	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,3) to C/V (Pb2)
(15)	Bucket bottom (crowd)	1920 mm (75.6 in.)	3/16	2 x Pink	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,2) to C/V (Pa1)
(16)	Bucket rod (dump)	1700 mm (66.9 in.)	3/16	2 x Brown	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,4) to C/V (Pb1)

- PWR: Plastic corrugated tube

RY9212091HYS0062US0

(11) Pilot Hose Routing (KX019-4)



RY9212095HYS001A

(a) Pump
(b) Unload Valve
(c) Control Valve
(d) Oil tank
(e) Pilot valve (L)
(f) Pilot valve (R)
(g) Rotary joint (g)
(h) AUX1 solenoid valve
A : Front
B : Rear

(To be continued)

(Continued)

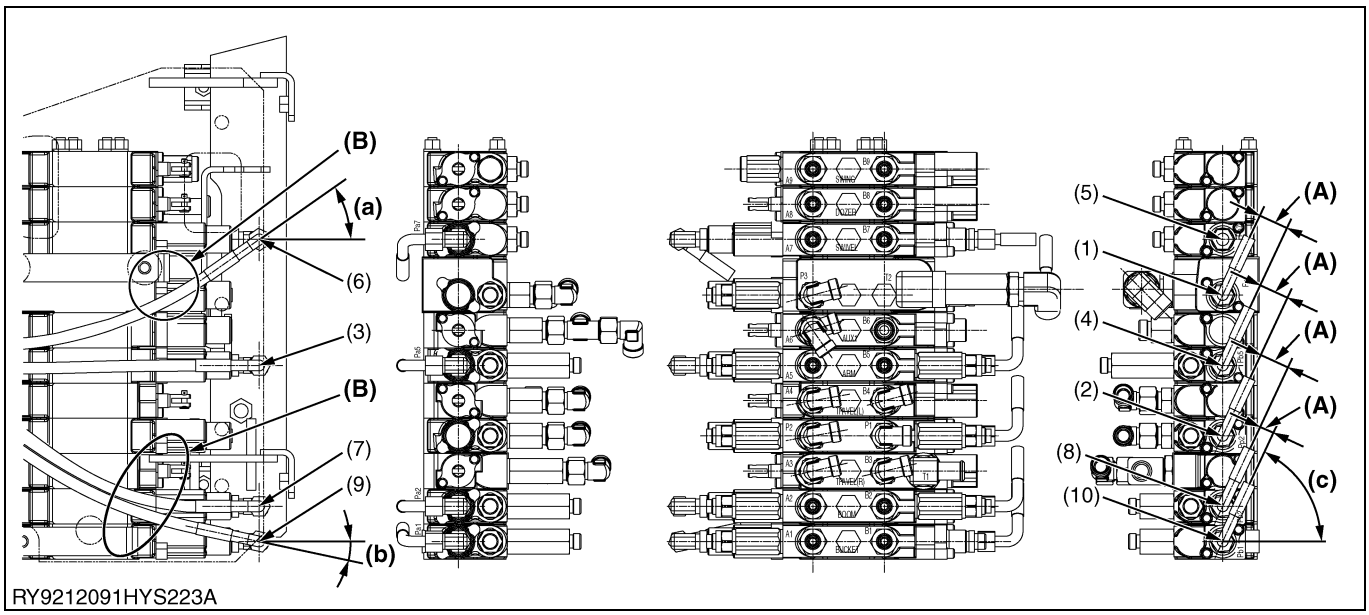
■ Table of Hydraulic Hoses

No.	Function	Hose					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	P4	1080 mm (42.5 in.)	3/8		17.4 mm (0.7 in.)	9.5 mm (0.4 in.)	CR4·C	M18	PWR	Pump (P4) to unload V
(2)	2-speed signal	440 mm (17.3 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	PWR	Unload V (A2) to R/J (g)
(3)	Travel straight forward	940 mm (37.0 in.)	1/4	2 x Blue	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14	PWR	Unload V (A1) to C/V (PP1)
(4)	Travel lock release	1090 mm (42.9 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14	PWR	Unload V (A1) to C/V (PP2)
(5)	Pilot P, LH	1620 mm (63.8 in.)	1/4	2 x White	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14		Unload V to P/V (L) P
(6)	Pilot P, RH	1075 mm (42.3 in.)	1/4	2 x White	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14		Unload V to P/V (R) P
(7)	Pilot T, LH	1585 mm (62.4 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14		PV (tank) L to O/T
(8)	Pilot T, RH	1085 mm (42.7 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14		PV (tank) R to O/T
(9)	Arm bottom (crowd)	2270 mm (89.4 in.)	3/16	2 x Green	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,4) to C/V (Pa5)
(10)	Arm rod (dump)	2030 mm (79.9 in.)	3/16	2 x Blue	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L, 2)? C/V (Pb5)
(11)	Swivel LH	1960 mm (77.2 in.)	3/16	2 x Red	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·C	M14		PV (L,1) to C/V (Pb7)
(12)	Swivel RH	2240 mm (88.2 in.)	3/16	2 x Yellow	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,3) to C/V (Pa7)
(13)	Boom rod (raise)	1850 mm (72.8 in.)	3/16	2 x Gray	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,4) to C/V (Pa2)
(14)	Boom bottom (lower)	1700 mm (66.9 in.)	3/16	2 x Light blue	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,2) to C/V (Pb2)
(15)	Bucket bottom (crowd)	1920 mm (75.6 in.)	3/16	2 x Pink	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,1) to C/V (Pa1)
(16)	Bucket rod (dump)	1700 mm (66.9 in.)	3/16	2 x Brown	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,3) to C/V (Pb1)
(17)	AUX solenoid P	250 mm (9.8 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR4·C	M14		Unload V to solenoid V P
(18)	AUX solenoid T	720 mm (28.3 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR4·C	M14	PWR	Solenoid V to O/T
(19)	AUX Lo	1430 mm (56.3 in.)	1/4	Yellow x Green	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14	PWR	Solenoid V (A2) to C/V (Pa6)
(20)	AUX Hi	1120 mm (44.1 in.)	1/4	2 x Pink	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	PWR	Solenoid V (A1) to C/V (Pb6)

- PWR: Plastic corrugated tube

RY9212095HYS0082US0

(12) Pilot Hose Routing (Control Valve) (KX018-4)



(A) Parallel **(a) 35 °** **(b) 12 °** **(c) 65 °**
(B) Don't contact to the bracket

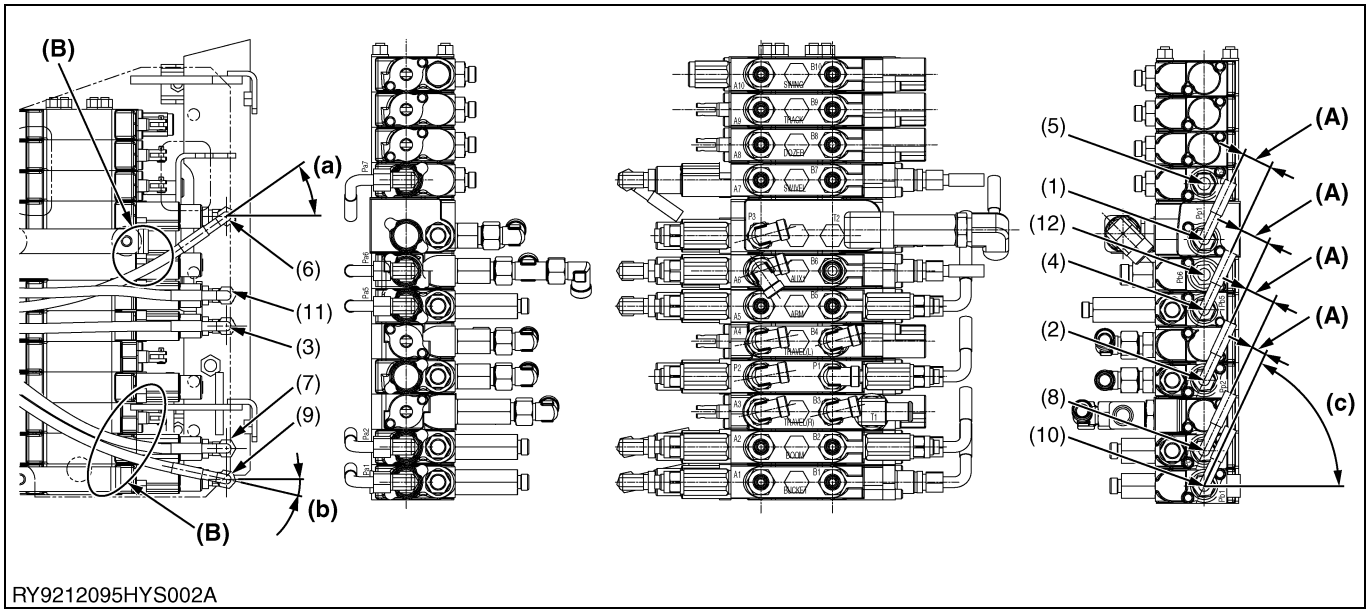
■ Table of Hydraulic Hoses

No.	Function	Hose					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	Travel straight forward	940 mm (37.0 in.)	1/4	2 x Blue	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14	PWR	Unload V (A1) to C/V (PP1)
(2)	Travel lock release	1090 mm (42.9 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14	PWR	Unload V (A1) to C/V (PP2)
(3)	Arm bottom (crowd)	2270 mm (89.4 in.)	3/16	2 x Green	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,1) to C/V (Pa5)
(4)	Arm rod (dump)	2030 mm (79.9 in.)	3/16	2 x Blue	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,3) to C/V (Pb5)
(5)	Swivel LH	1960 mm (77.2 in.)	3/16	2 x Red	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·C	M14		PV (L, 2) to C/V (Pb7)
(6)	Swivel RH	2240 mm (88.2 in.)	3/16	2 x Yellow	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,4) to C/V (Pa7)
(7)	Boom rod (raise)	1850 mm (72.8 in.)	3/16	2 x Gray	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,1) to C/V (Pa2)
(8)	Boom bottom (lower)	1700 mm (66.9 in.)	3/16	2 x Light blue	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,3) to C/V (Pb2)
(9)	Bucket bottom (crowd)	1920 mm (75.6 in.)	3/16	2 x Pink	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,2) to C/V (Pa1)
(10)	Bucket rod (dump)	1700 mm (66.9 in.)	3/16	2 x Brown	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,4) to C/V (Pb1)

- PWR: Plastic corrugated tube

RY9212095HYS0090US0

(13) Pilot Hose Routing (Control Valve) (KX019-4)



RY9212095HYS002A

(A) Parallel
(B) Not to come in contact with the bucket
(a) 35 °
(b) 12 °
(c) 65 °

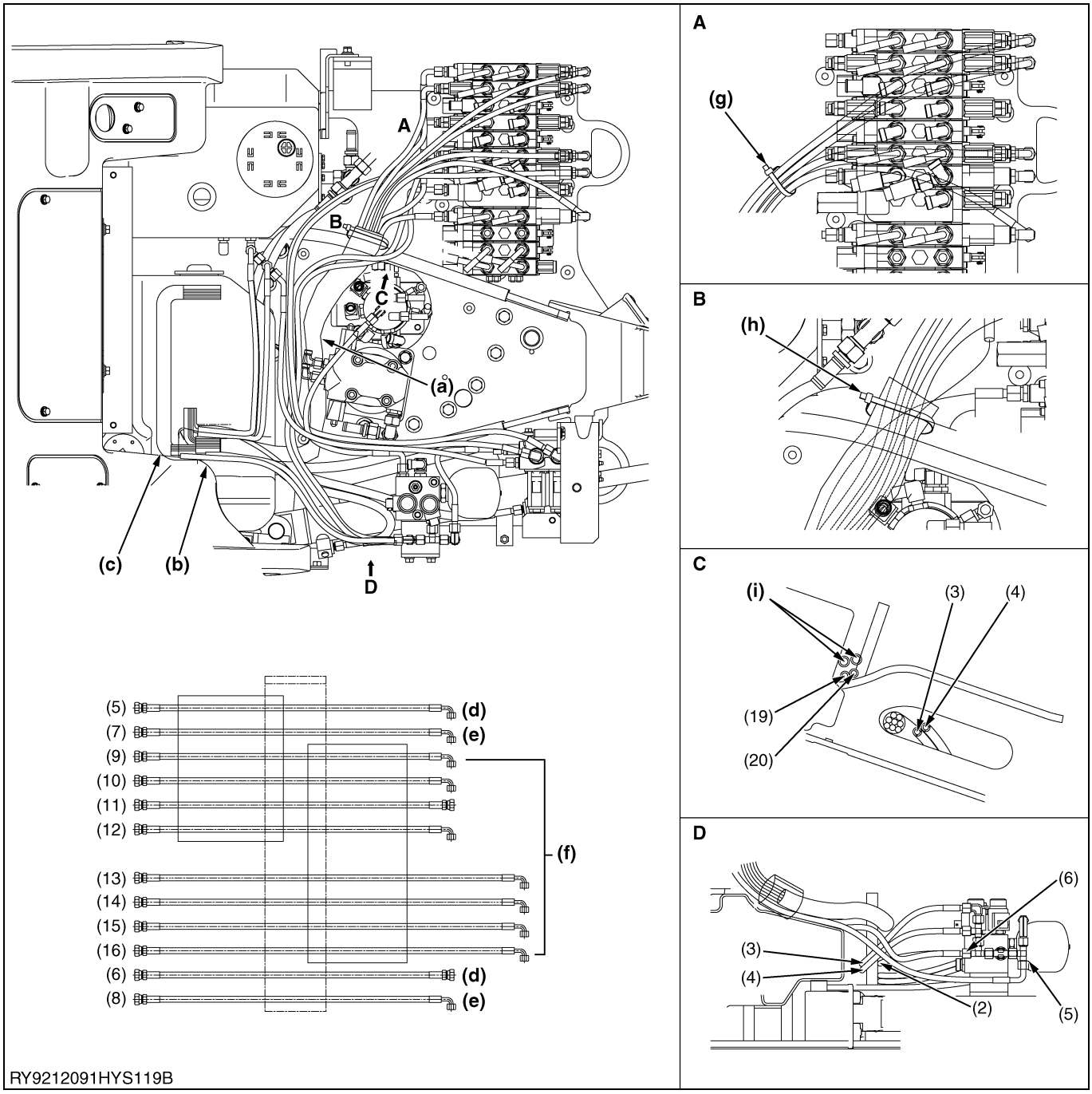
■ Table of Hydraulic Hoses

No.	Function	Hose					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(1)	Travel straight forward	940 mm (37.0 in.)	1/4	2 x Blue	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14	PWR	Unload V (A1) to C/V (PP1)
(2)	Travel lock release	1090 mm (42.9 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14	PWR	Unload V (A1) to C/V (PP2)
(3)	Arm bottom (crowd)	2270 mm (89.4 in.)	3/16	2 x Green	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,1) to C/V (Pa5)
(4)	Arm rod (dump)	2030 mm (79.9 in.)	3/16	2 x Blue	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,3) to C/V (Pb5)
(5)	Swivel LH	1960 mm (77.2 in.)	3/16	2 x Red	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·C	M14		PV (L, 2) to C/V (Pb7)
(6)	Swivel RH	2240 mm (88.2 in.)	3/16	2 x Yellow	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,4) to C/V (Pa7)
(7)	Boom rod (raise)	1850 mm (72.8 in.)	3/16	2 x Gray	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,1) to C/V (Pa2)
(8)	Boom bottom (lower)	1700 mm (66.9 in.)	3/16	2 x Light blue	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,3) to C/V (Pb2)
(9)	Bucket bottom (crowd)	1920 mm (75.6 in.)	3/16	2 x Pink	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,2) to C/V (Pa1)
(10)	Bucket rod (dump)	1700 mm (66.9 in.)	3/16	2 x Brown	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,4) to C/V (Pb1)
(11)	AUX Lo	1430 mm (56.3 in.)	1/4	Yellow x Green	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14	PWR	Solenoid V (A2) to C/V (Pa6)
(12)	AUX Hi	1120 mm (44.1 in.)	1/4	2 x Pink	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	PWR	Solenoid V (A1) to C/V (Pb6)

- PWR: Plastic corrugated tube

RY9212095HYS0083US0

(14) Entire Pilot Hose Routing



(a) Section A
(b) Section B
(c) Section C
(d) Unload valve
(e) Oil tank
(f) Control valve
(g) Clamp
(h) Clamp from above the protective cover.
(i) Swing cylinder hoses

(To be continued)

(Continued)

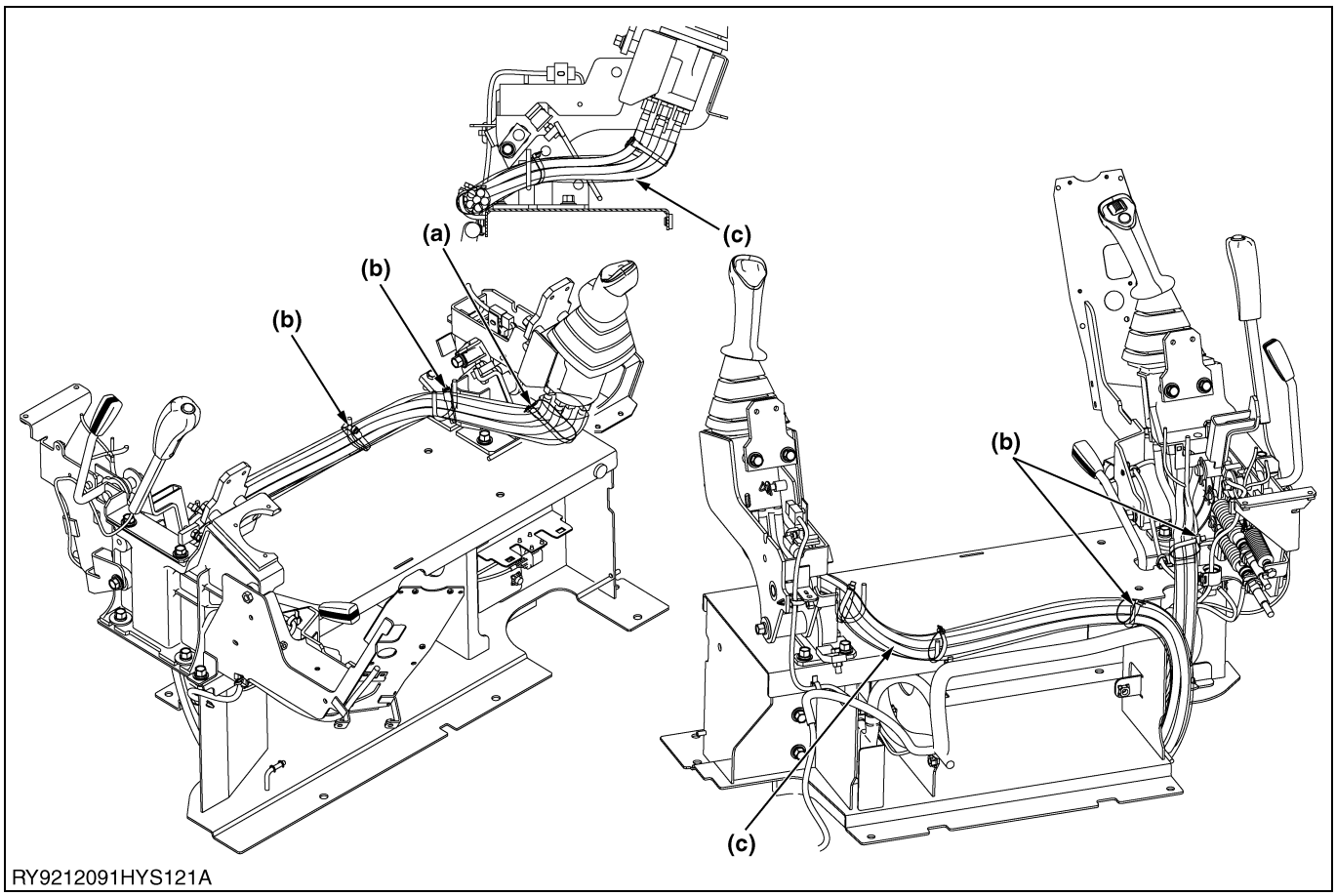
■ Table of Hydraulic Hoses

No.	Function	Hose					Fitting		Guard	Position Used
		Total length	Size	Tape color	O.D.	I.D.	Type	Size		
(2)	2-speed signal	440 mm (17.3 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	PWR	Unload V (A2) to R/J (g)
(3)	Travel straight forward	940 mm (37.0 in.)	1/4	2 x Blue	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14	PWR	Unload V (A1) to C/V (PP1)
(4)	Travel lock release	1090 mm (42.9 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14	PWR	Unload V (A1) to C/V (PP2)
(5)	Pilot P, LH	1620 mm (63.8 in.)	1/4	2 x White	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	CR9·C	M14		Unload V to P/V (L) P
(6)	Pilot P, RH	1075 mm (42.3 in.)	1/4	2 x White	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14		Unload V to P/V (R) P
(7)	Pilot T, LH	1585 mm (62.4 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14		PV (tank) L to O/T
(8)	Pilot T, RH	1085 mm (42.7 in.)	1/4		11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14		PV (tank) R to O/T
(9)	Arm bottom (crowd)	2270 mm (89.4 in.)	3/16	2 x Green	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,1) to C/V (Pa5)
(10)	Arm rod (dump)	2030 mm (79.9 in.)	3/16	2 x Blue	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,3) to C/V (Pb5)
(11)	Swivel LH	1960 mm (77.2 in.)	3/16	2 x Red	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·C	M14		PV (L, 2) to C/V (Pb7)
(12)	Swivel RH	2240 mm (88.2 in.)	3/16	2 x Yellow	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (L,4) to C/V (Pa7)
(13)	Boom rod (raise)	1850 mm (72.8 in.)	3/16	2 x Gray	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,1) to C/V (Pa2)
(14)	Boom bottom (lower)	1700 mm (66.9 in.)	3/16	2 x Light blue	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,3) to C/V (Pb2)
(15)	Bucket bottom (crowd)	1920 mm (75.6 in.)	3/16	2 x Pink	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,2) to C/V (Pa1)
(16)	Bucket rod (dump)	1700 mm (66.9 in.)	3/16	2 x Brown	8.2 mm (0.3 in.)	4 mm (0.2 in.)	C·CR9	M14		PV (R,4) to C/V (Pb1)
(19)	AUX Lo	1430 mm (56.3 in.)	1/4	Yellow x Green	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·CR9	M14	PWR	Solenoid V (A2) to C/V (Pa6)
(20)	AUX Hi	1120 mm (44.1 in.)	1/4	2 x Pink	11.8 mm (0.5 in.)	6.4 mm (0.3 in.)	C·C	M14	PWR	Solenoid V (A1) to C/V (Pa6)

- PWR: Plastic corrugated tube

RY9212095HYS0091US0

(15) Pilot Hose Routing (Around the Driver's Seat)



(a) Clamp.

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

(c) Conceal the bundle of hoses with a cover.

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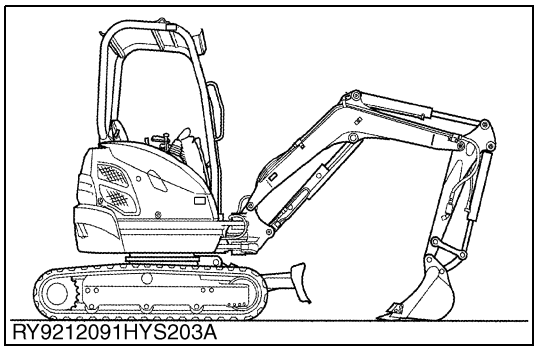
12. MEASURING THE PERFORMANCE OF HYDRAULIC DEVICES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Hydraulic System Pressure Release Procedure

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

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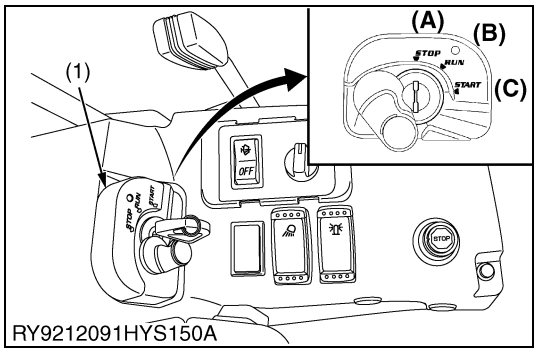

RY9212091HYS150A

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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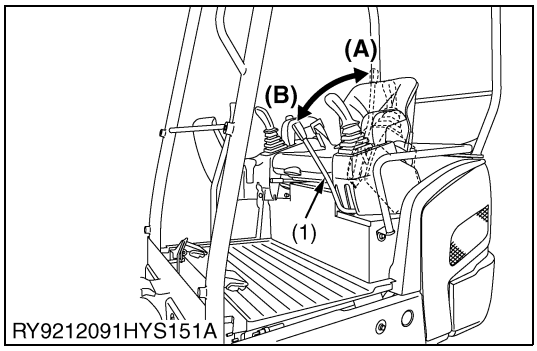

RY9212091HYS151A

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

(1) Machine Lock Lever

(A) Release
(B) Lock

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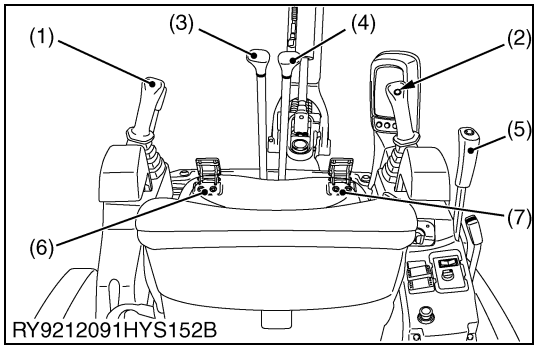
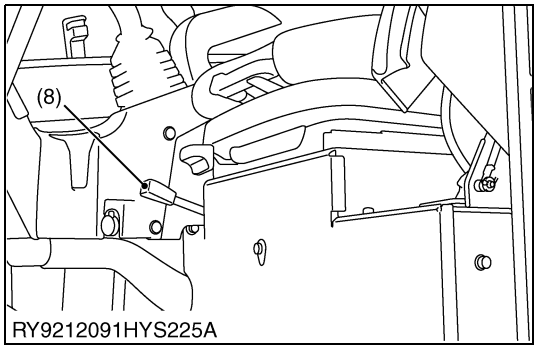


RY9212091HYS152B

4. Operate each control lever for the boom, arm, bucket and swivel to their full stroke.
5. Operate the travel lever, blade lever, track lever, swing pedal and service port pedal each to full stroke.
   (For KX019-4 only:
   For the pressure release of the KX019-4's AUX line, switch on the AUX of the meter panel and shift the knob switch to full stroke.)
6. Place the machine's lock lever in the "Lock" position, and the engine starter switch to the "STOP" position.



RY9212091HYS225A

(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
(8) Track lever

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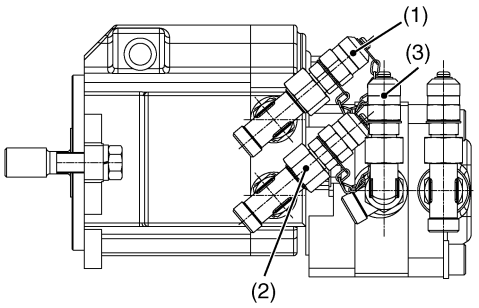

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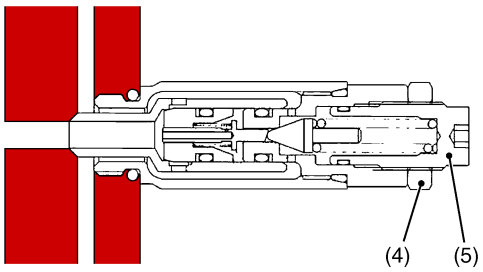

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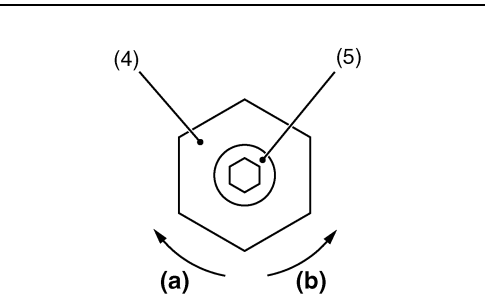

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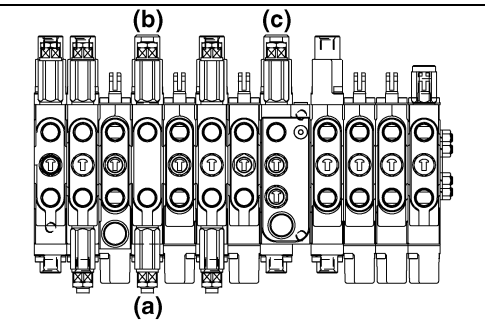

RY9212091HYS170A

Main Relief Valve Pressure

Procedure for Measuring the Main Relief Valve

1. Place the mini excavator 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

RY9212091HYS0275US0

Points to Measure	Bench Data	Actual Measured Values (Reference)
Main P1 (aP1) Main P2 (aP2)	21.6 MPa 220 kgf/cm^2 3130 psi	22.1 to 23.6 MPa 225 to 240 kgf/cm^2 3210 to 3380 psi
Main P3 (aP3)	20.6 MPa 210 kgf/cm^2 2990 psi	21.1 to 22.6 MPa 215 to 230 kgf/cm^2 3063 to 3233 psi
Pilot primary pressure (aPP)	3.9 MPa 40 kgf/cm^2 570 psi	4.5 to 5.0 MPa 46 to 51 kgf/cm^2 660 to 730 psi

CAUTION

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

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

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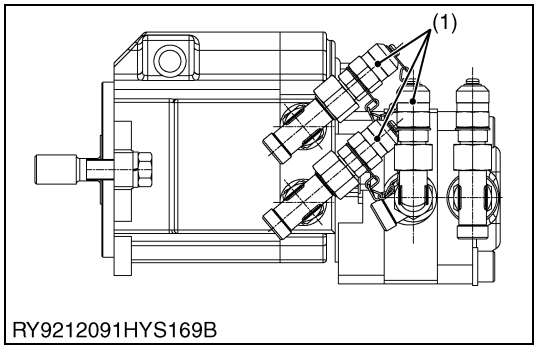

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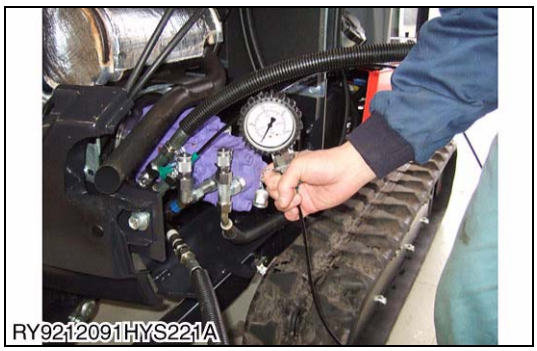
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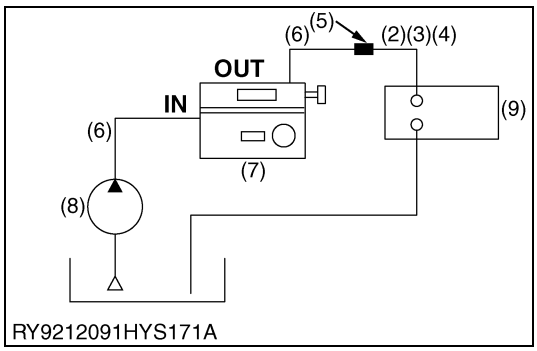


RY9212091HYS171A

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

Measurement preparation

1. Place the mini-excavator 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

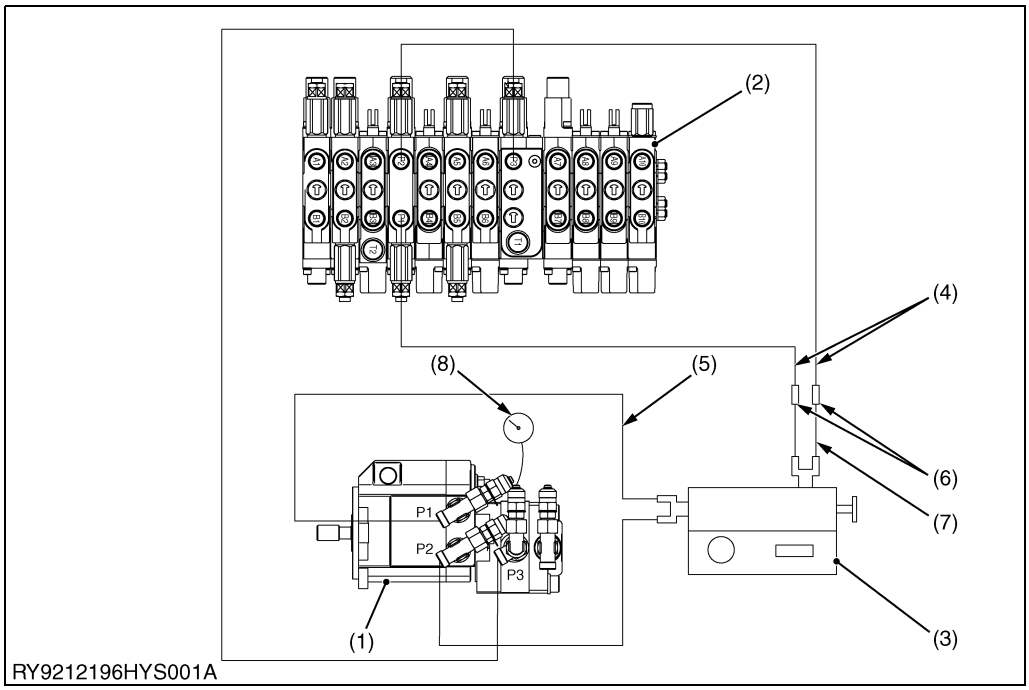
(1) Pump Pressure Detection Port
(2) P1 Hose
(3) P2 Hose
(4) P3 Hose
(5) Adapter
(6) Test Hose
(7) Flow Meter
(8) Pump
(9) Control Valve

RY9212091HYS0277US0

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.



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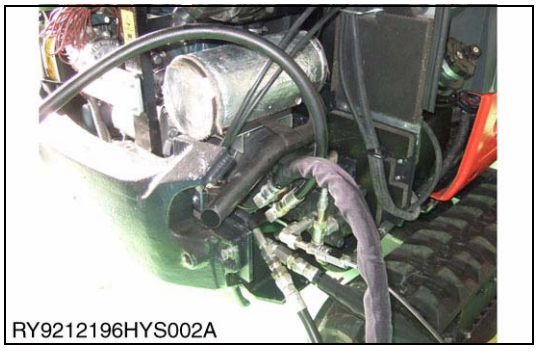

RY9212196HYS002A

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 a test hose to the P1 and P2 discharge ports and connect the flow meter on the IN side. (Use an adapter to combine the flows.)
6. Attach a branch 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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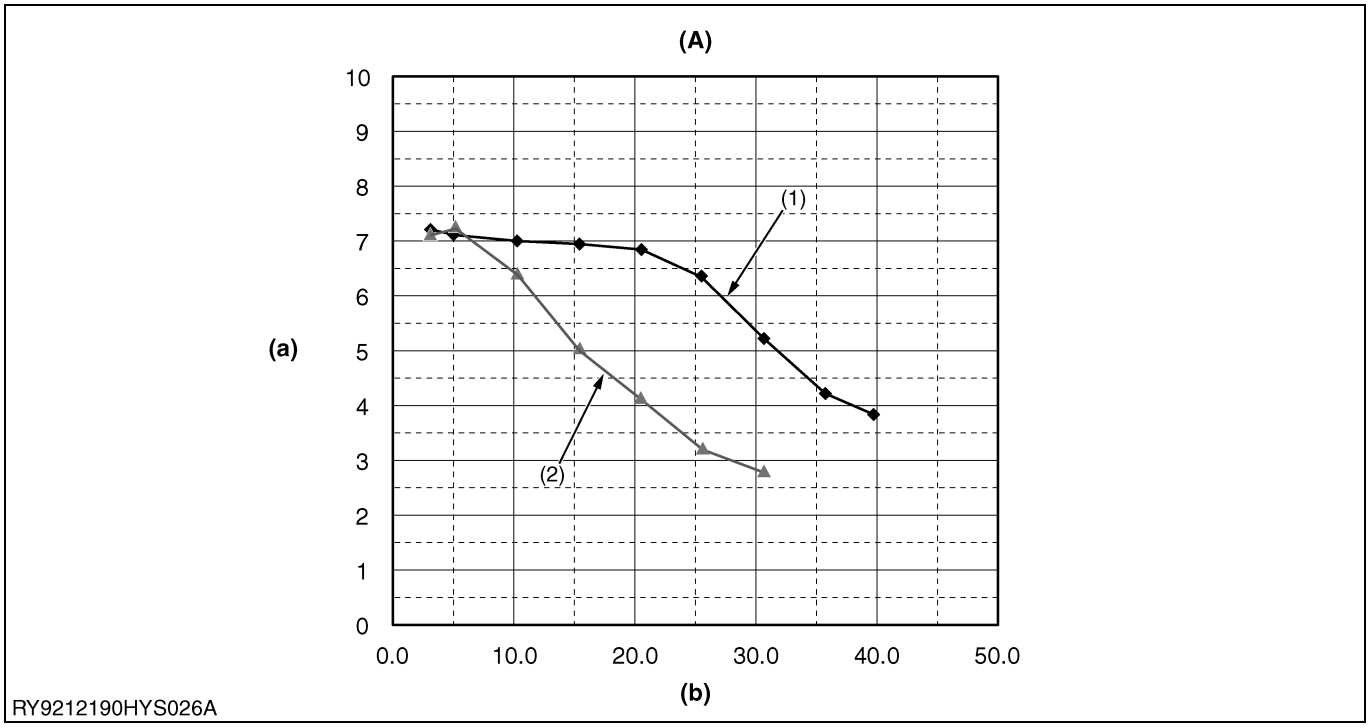
Pump flow actual measurement values



(1) P3 = 0.5 MPa (5 kgf/cm^2, 70 psi)
(2) P3 = 20.1 MPa (205 kgf/cm^2, 2920 psi)

(A) Horsepower curve

(a) Flow Rate: q1 = q2 [cc/rev] q1: P1 Flow rate q2: P2 Flow rate

(b) Pressure: P1 + P2 [MPa] (flow meter indicated value) x 2

Engine RPM 2300 rpm			
P3 Loadless (P3 = 0.5 MPa)		P3 Relief (P3 = 20.6 MPa)	
Pressure	Flow Rate	Pressure	Flow Rate
3.1 MPa	7.2 cc/rev	3.1 MPa	7.1 cc/rev
5.1 MPa	71 cc/rev	5.1 MPa	7.2 cc/rev
10.2 MPa	7.0 cc/rev	10.2 MPa	6.4 cc/rev
15.3 MPa	6.9 cc/rev	15.3 MPa	5.0 cc/rev
20.4 MPa	6.8 cc/rev	20.4 MPa	4.1 cc/rev
25.5 MPa	6.3 cc/rev	25.5 MPa	3.2 cc/rev
30.6 MPa	5.2 cc/rev	30.6 MPa	2.8 cc/rev
35.7 MPa	4.2 cc/rev	35.0 MPa	
39.8 MPa	3.8 cc/rev	39.0 MPa	

CAUTION

- **Measured values may vary depending on the machine.**
- **This data is of values converted to the rated RPM.**
- **The usage limit is 80% of the discharge volume.**

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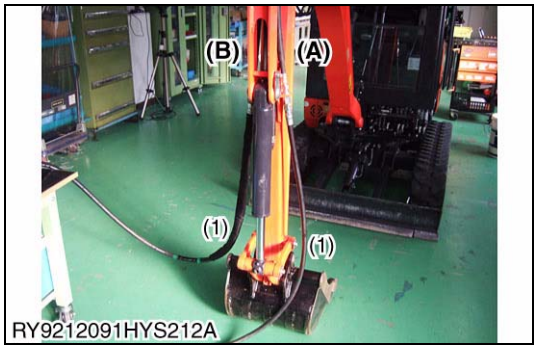

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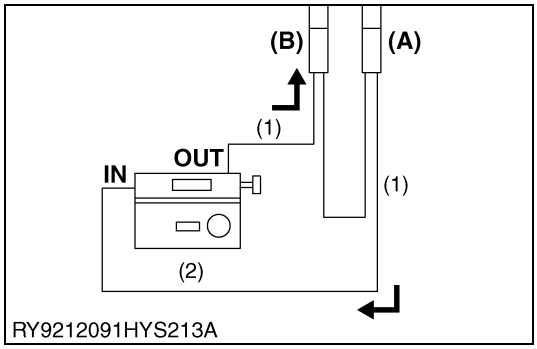


RY9212091HYS213A

Actual AUX PQ Value Measurement

Measurement preparation

1. Place the mini excavator 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.

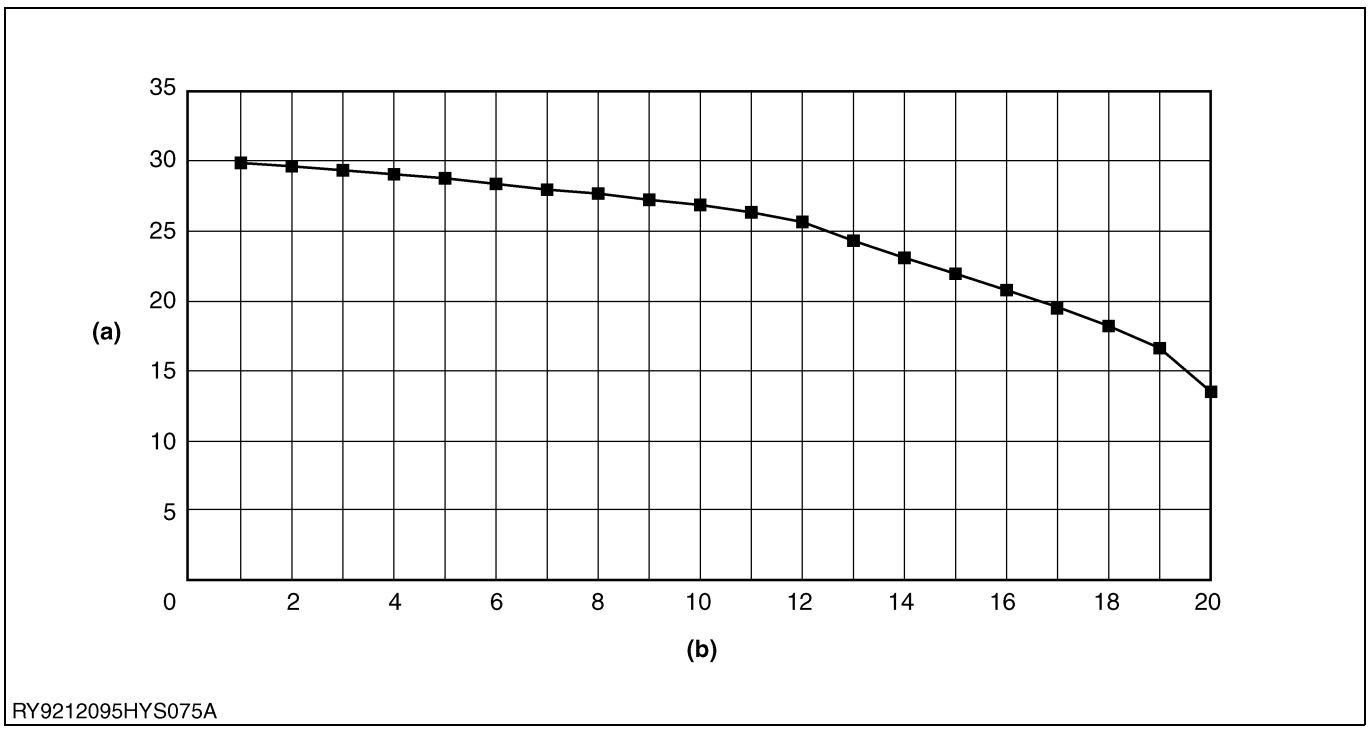
■ IMPORTANT

- **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

RY9212091HYS0282US0

Actual Measured Values



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

CAUTION

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

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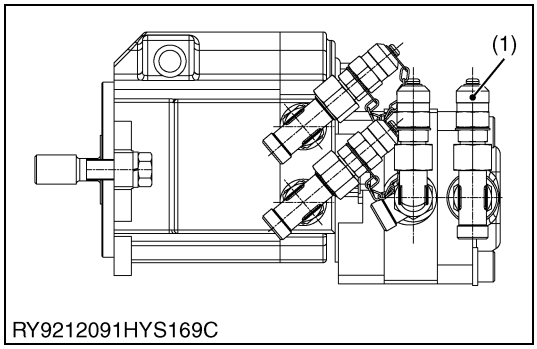
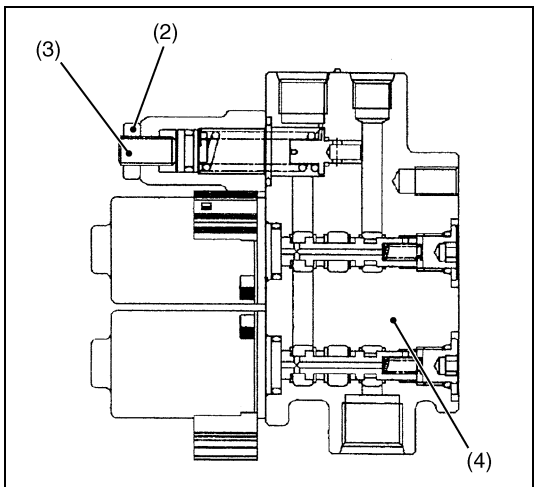


RY9212091HYS169C



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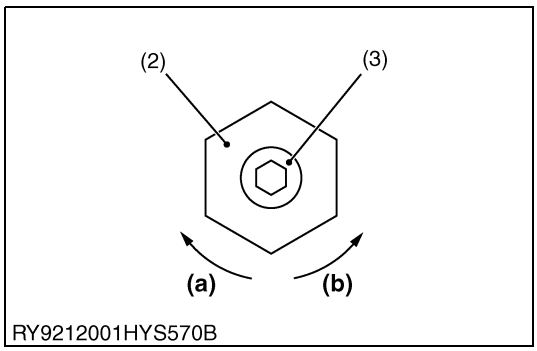

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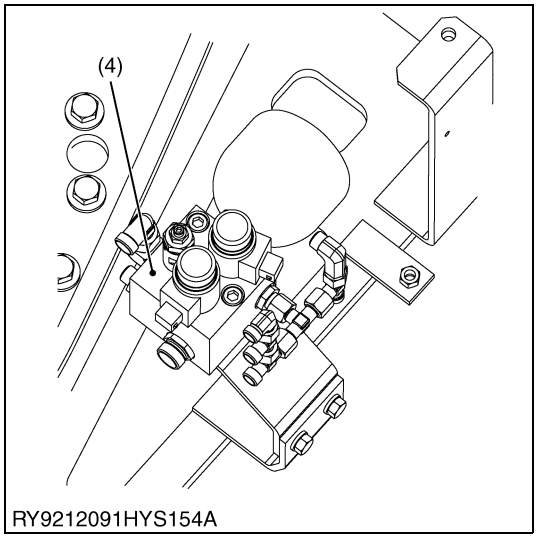


RY9212091HYS154A

Pilot Pressure

Pilot Primary Pressure Measuring Procedure

1. Place the mini excavator 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).

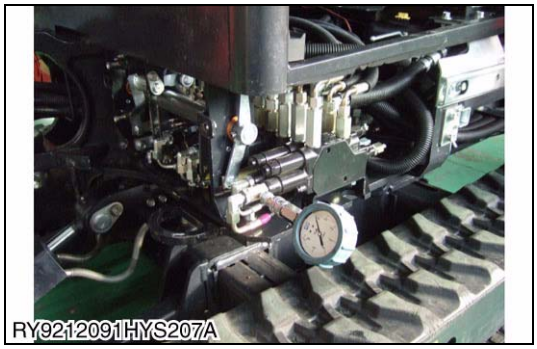
Pilot Primary Pressure Adjustment Method

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

RY9212091HYS0278US0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Pilot Secondary Primary Pressure Measuring Procedure

1. Place the mini excavator 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).

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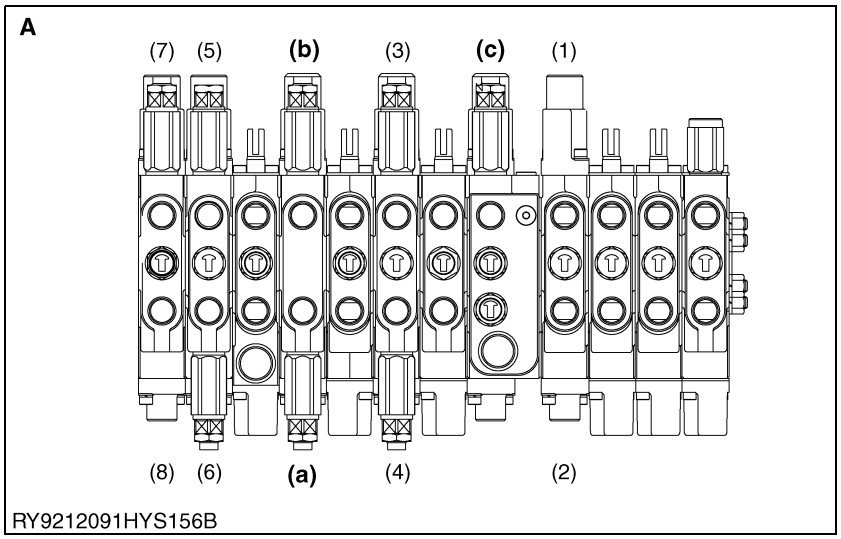

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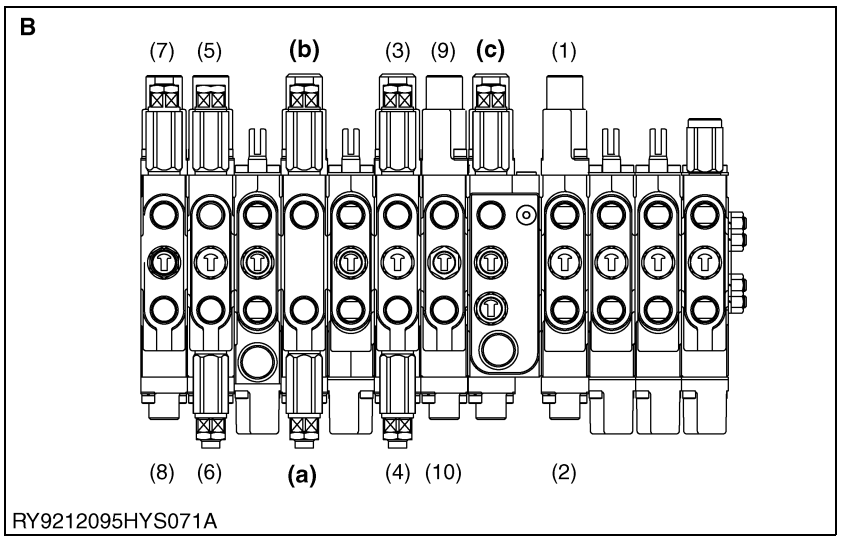


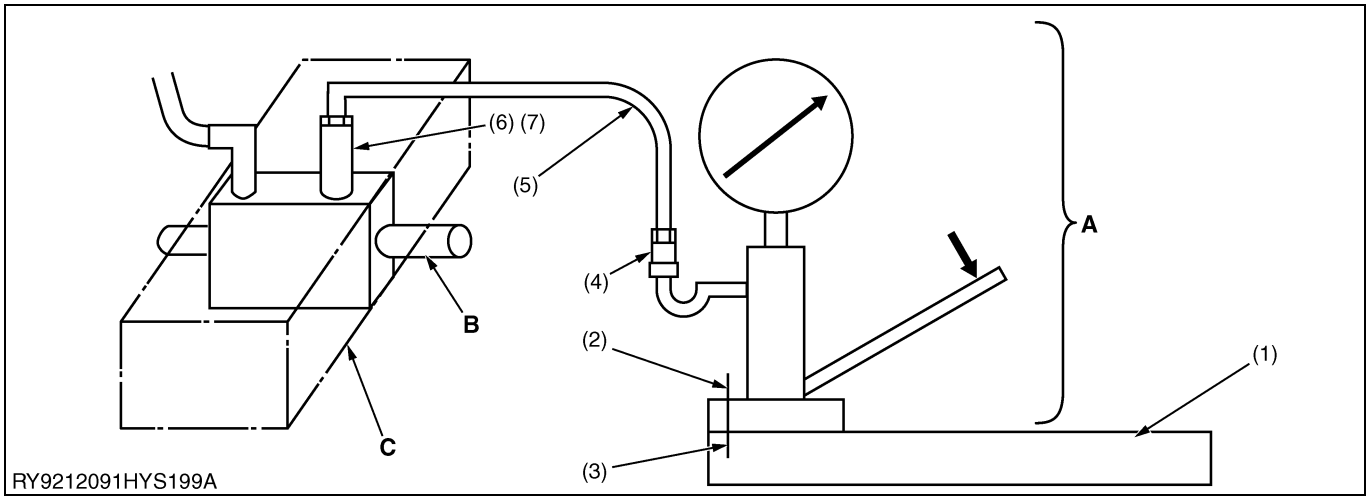
RY9212095HYS071A

(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) AUX (Low)
(10) AUX (Hi)

A : KX018-4
B : KX019-4
(a) Main P1 relief valve(aP1)
(b) Main P2 relief valve (aP2)
(c) Main P3 relief valve (aP3)

RY9212095HYS0077US0

Overload Relief Valve Pressure Measurement Procedure



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 x 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 mini excavator 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.**

RY9212091HYS0124US0

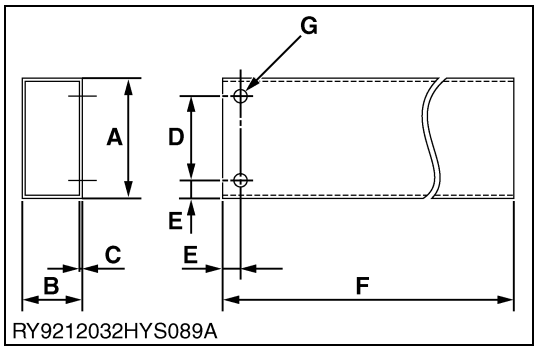
Inspection Points		Bench Data	Measurement Values (Reference)
Boom	Bottom (b1B)	17.0 Mpa 170 kgf/cm^2 2500 psi	17 ± 1 MPa 170 ± 10 kgf/cm^2 2500 ± 145 psi
	Rod (b1R)	27.5 Mpa 280 kgf/cm^2 3990 psi	27.5 ± 1 MPa 280 ± 10 kgf/cm^2 3990 ± 145 psi
Arm	Bottom (b2B)	23.5 Mpa 240 kgf/cm^2 3410 psi	23.5 ± 1 MPa 240 ± 10 kgf/cm^2 3410 ± 145 psi
	Rod (b2R)	23.5 Mpa 240 kgf/cm^2 3410 psi	
Bucket	Bottom (b3B)	23.5 Mpa 240 kgf/cm^2 3410 psi	

CAUTION

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

RY9212091HYS0125US0

Measurement Equipment



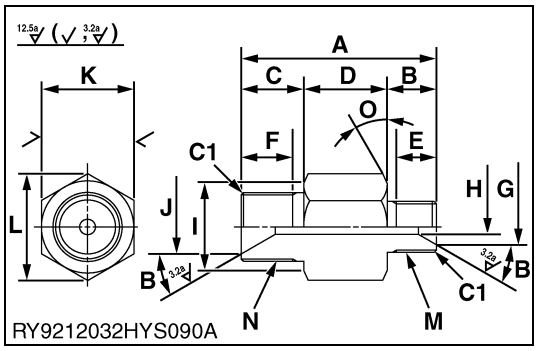
RY9212032HYS089A

(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

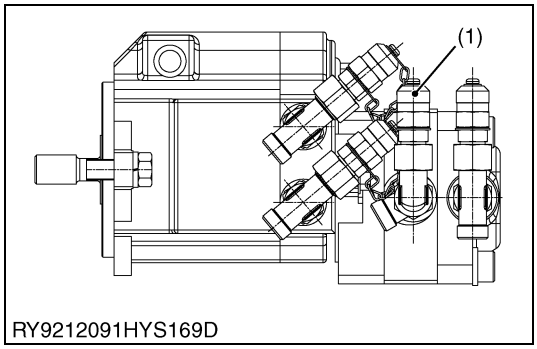


RY9212032HYS090A

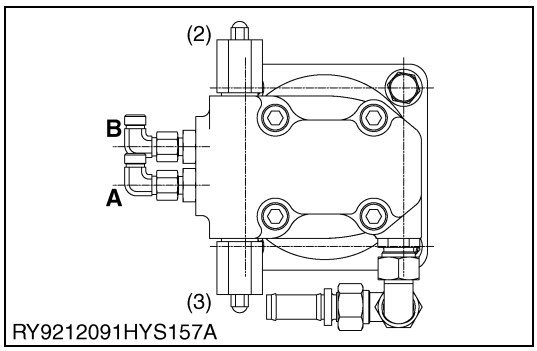
(4) Pipe joint (M12-G2)

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 °

RY9212091HYS0127US0



RY9212091HYS169D



RY9212091HYS157A

Swivel Relief Valve Pressure

1. Place the mini excavator 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. 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 relief pressure reading at maximum engine speed.
   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).

■ **NOTE**

- **When measuring the relief valve pressure of the swivel motor on the pump inspection port side, the pressure is higher than the relief valve pressure setting.**
  For a more accurate measurement, attach the pressure gauge to the discharge port side of the swivel motor.

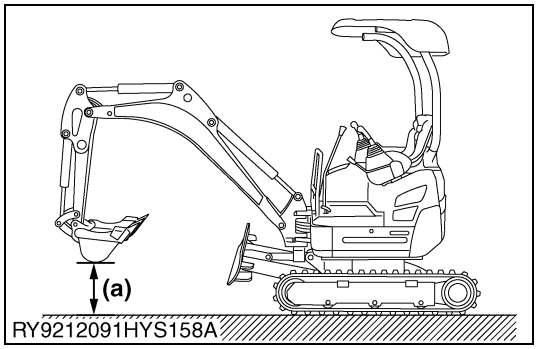
Inspection Points		Bench Data	Actual Measured Values (Reference)
Swivel relief valve	LH (cSL)	13.2 MPa 135 kgf/cm^2 1910 psi	16.0 MPa 160 kgf/cm^2 2300 psi
	RH (cSR)		

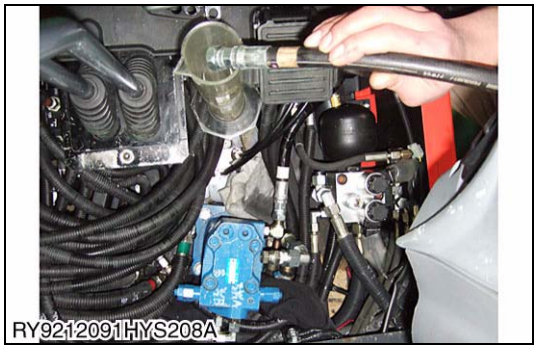
CAUTION

- **Actual measured values may vary with the machine.**
- **This is the actual measurement value at the engine rotating speed 1500 rpm.**

(1) P3
(2) Left Swivel Relief Valve (cSL)
(3) Right Swivel Relief Valve (cSR)

RY9212091HYS0280US0





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 mini excavator 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 average value.

CAUTION

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

Motor Drain Volume (Actual Measured Values)

Inspection Points		Right	Left
Swivel motor drain volume	When turning	0.095 L/min 5.80 cu.in.	0.092 L/min 5.61 cu.in.
	When locked	0.24 L/min 14.64 cu.in.	0.297 L/min 18.12 cu.in.

(a) 20 to 40 cm (7.9 to 16 in.)

RY9212091HYS0101US0


RY9212091MBS053A


RY9212091HYS209A

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 mini excavator 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 average value.

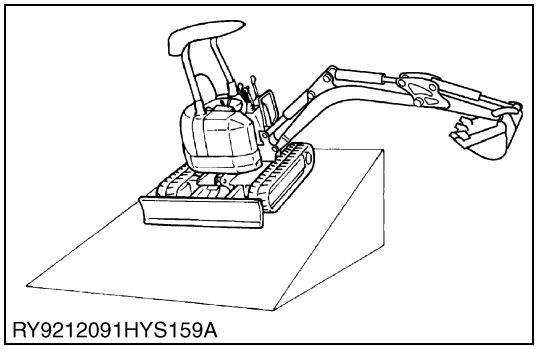
CAUTION

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

Motor Drain Volume (Actual Measured Values)

Inspection Points		1st	2nd
Travel motor drain volume	When turning	0.013 L/min 0.79 cu.in.	0.053 L/min 3.23 cu.in.
	When locked	0.037 L/min 2.26 cu.in.	0.1 L/min 6.10 cu.in.

RY9212091HYS0102US0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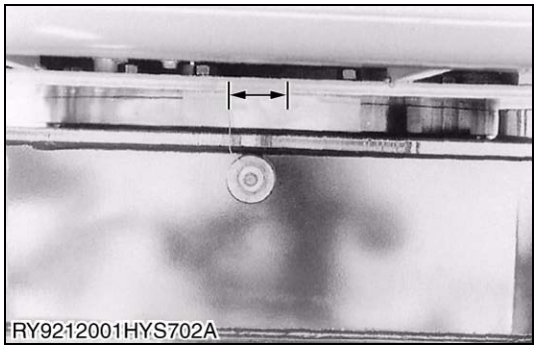

RY9212001HYS702A

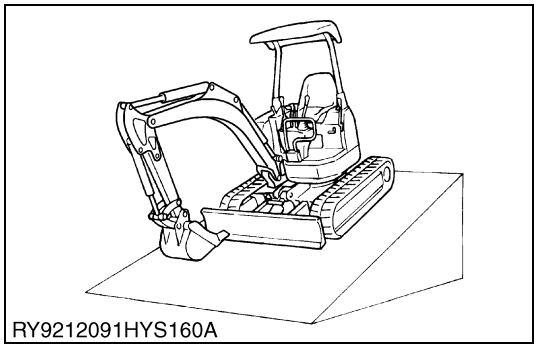
Swivel Block Performance

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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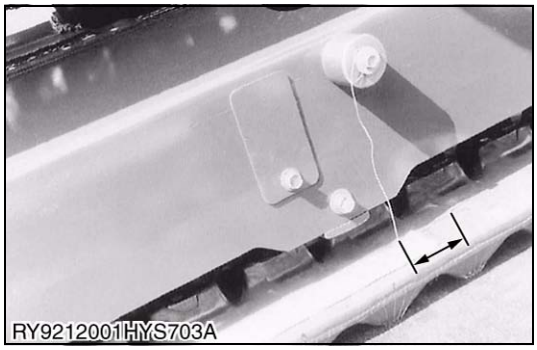
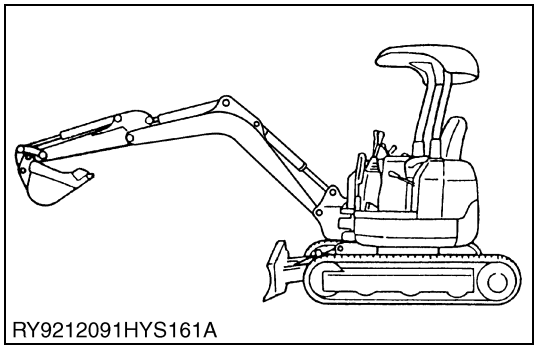

RY9212001HYS703A

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.

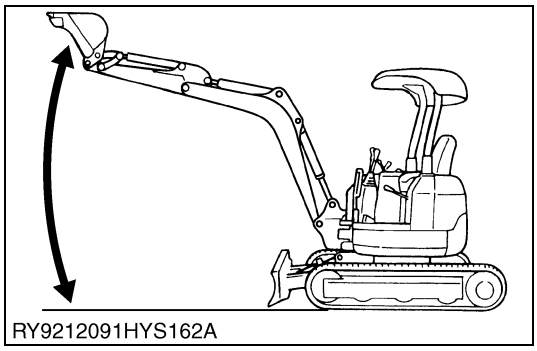
RY9212091HYS0103US0


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

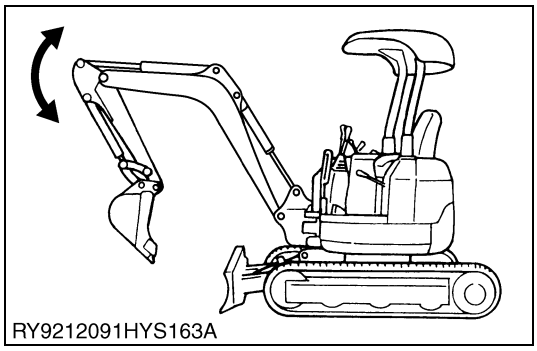

RY9212091HYS162A

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)

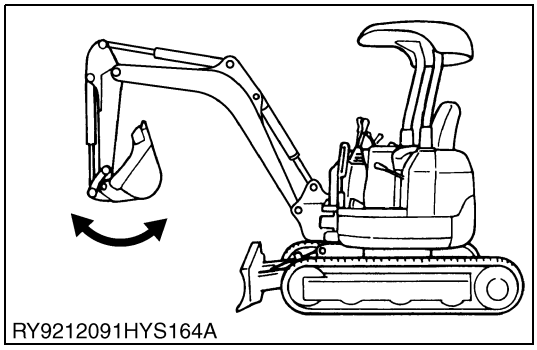
RY9212091HYS0104US0


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.

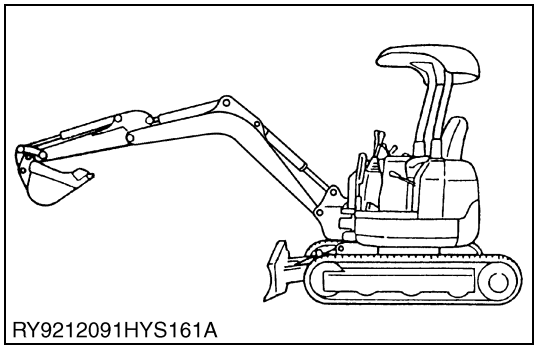
RY9212091HYS0081US0


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.

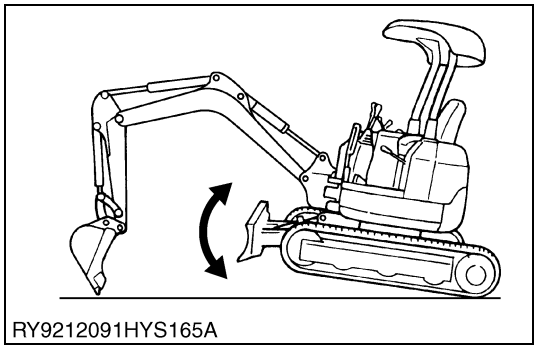
RY9212091HYS0082US0


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.

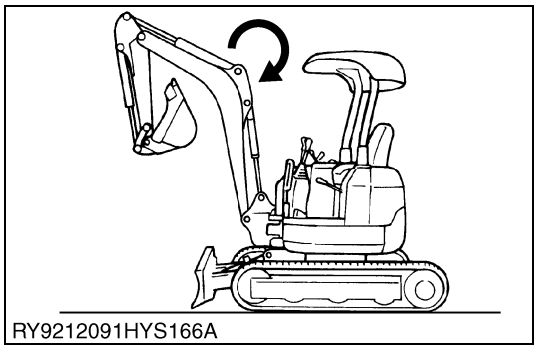
RY9212091HYS0083US0


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

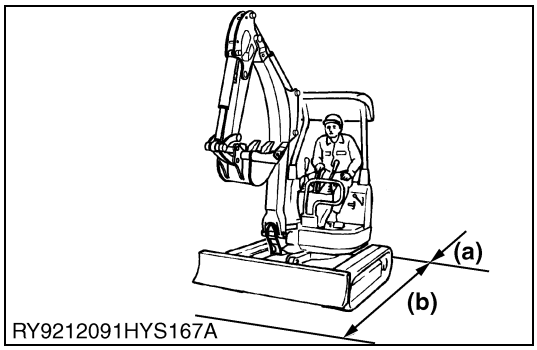
Measurement of required swivel time

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



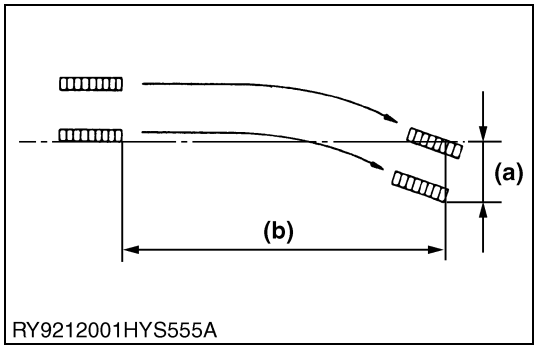
RY9212091HYS167A

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



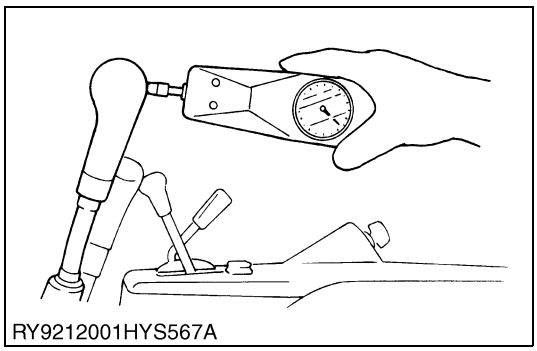
RY9212001HYS555A

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.**

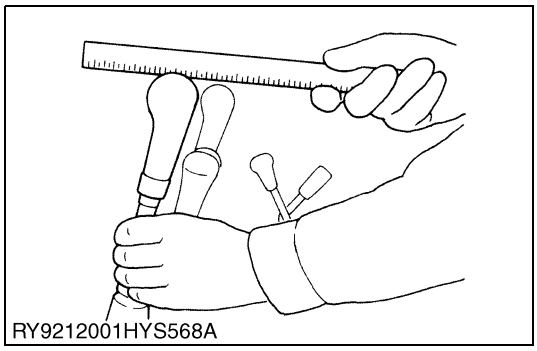
RY9212091HYS0087US0


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

13. 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 front does not move or is 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	Check the crawler tension and accumulated earth	Remove earth from around crawler and adjust crawler tension	–
Defective travel pilot valve operation	Measure travel pilot valve secondary pressure	Travel pilot valve disassembly, cleaning or replacement	
Control valve spool sticks	Inspect control valve spool for sticking	Control valve spool disassembly and cleaning	
Counterbalance valve spool sticks	Inspect travel motor counterbalance spool	Travel motor counterbalance valve disassembly, cleaning or replacement	
Defective travel motor	Measure travel motor drain volume	Travel motor disassembly, replacement	
Internal leak in the swivel joint	Remove the travel outlet hose of the swivel joint, plug it and measure the relief pressure	Swivel joint seal replacement	

RY9212091HYS0091US0

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	

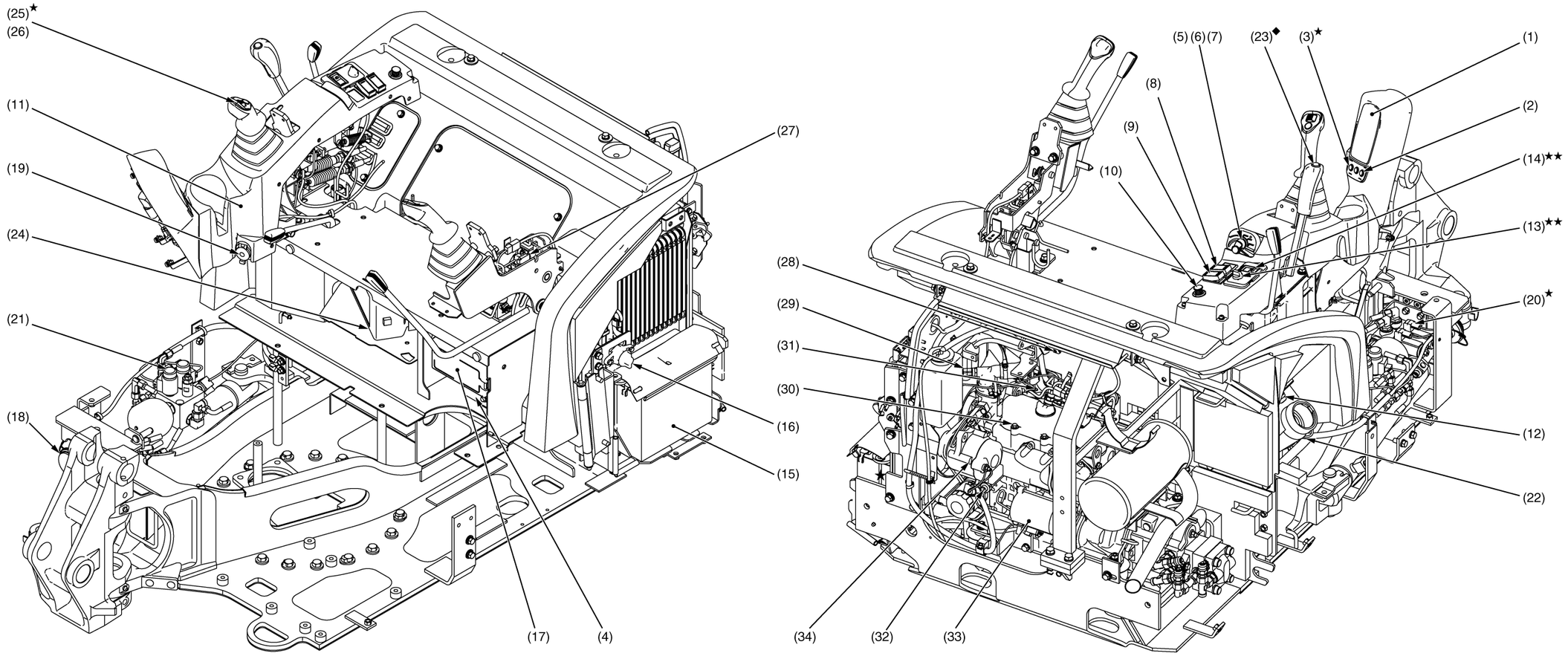
RY9212091HYS0092US0

4 ELECTRICAL SYSTEM

SERVICING

CONTENTS

1. ELECTRONIC EQUIPMENT LAYOUT



No.	Part Name
(1)	LCD meter panel
(2)	Switch, Panel
(3)★	Switch, AUX activation
(4)	ECU (Main)
(5)	Switch, Starter
(6)	Key, Anti theft
(7)	Antenna, Anti theft
(8)	Switch, Work light
(9)	Switch, Beacon
(10)	Switch, Engine Stop

No.	Part Name
(11)	Buzzer, LCD meter
(12)	Fuel level audible indication
(13)★★	Switch, Heater
(14)★★	Switch, Wiper
(15)	Battery
(16)	Switch, Battery Isolater
(17)	Fuse box
(18)	Horn
(19)	Power outlet
(20)★	Valve, Assy (AUX SOL)

No.	Part Name
(21)	Valve, Assy (Unload)
(22)	Sensor, Fuel
(23)◆	Switch, Travel 2-speed
(24)	Heater
(25)★	Valve, Assy (Pilot, RH, AX)
(26)	Valve, Assy (Pilot, R)
(27)	Switch, Lever lock
(28)	Pump, Fuel
(29)	Sensor, Water temperature
(30)	Sensor, Rotation

No.	Part Name
(31)	Soloenoid, Engin stop
(32)	Switch, Engine oil pressure
(33)	Starter
(34)	Alternator

[Remarks]

★-mark: KX019-4 only

★★-mark: Cabin only

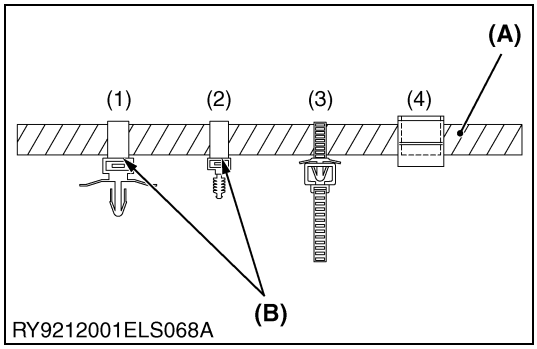
◆-mark: Except KX015-4

RY9212091ELT001US

2. 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.

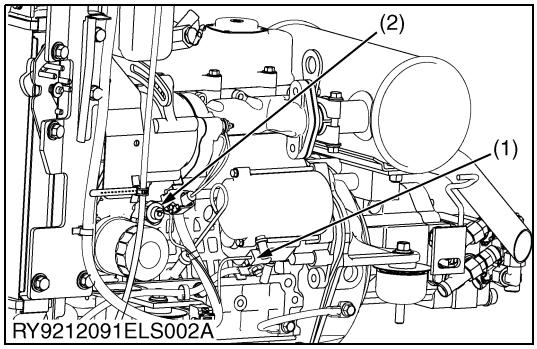
RY9212001ELS0025US0

[2] 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

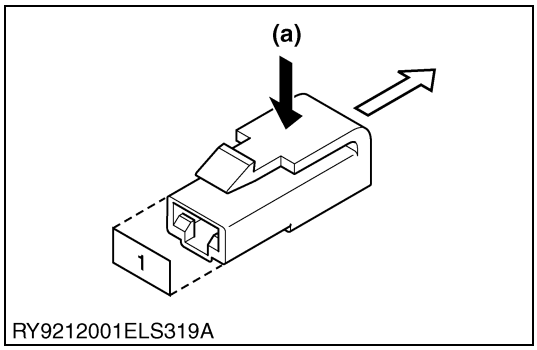
[3] UNPLUGGING ELECTRICAL CONNECTORS AND WIRING LAYOUT



RY9212091ELS002A

(1) Starter S-Terminal Connector
(2) Engine Oil Switch Connector

RY9212091ELS0054US0



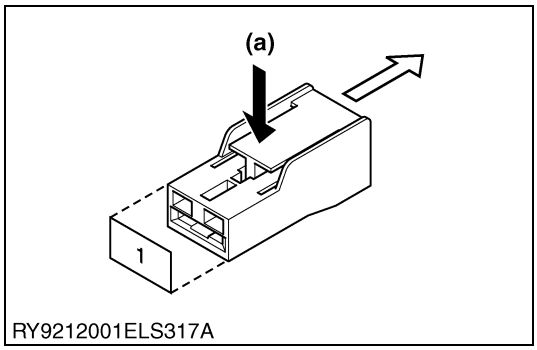
RY9212001ELS319A

(1) Starter S-terminal Connector

Connector No.	Place Used
CN37	Inside engine compartment

(a) Press Lock and Unplug

RY9212091ELS0002US0



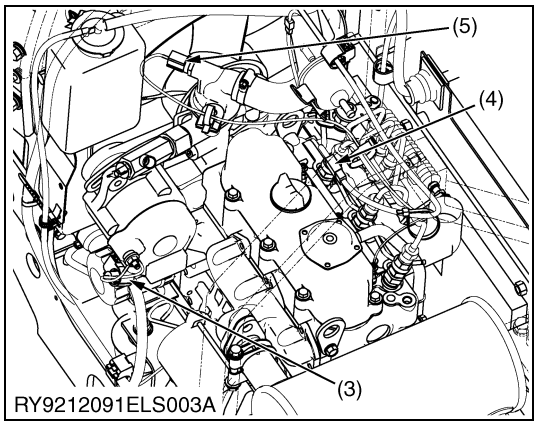
RY9212001ELS317A

(2) Engine oil switch connector

Connector No.	Place Used
CN28	Inside engine compartment

(a) Press Lock and Unplug

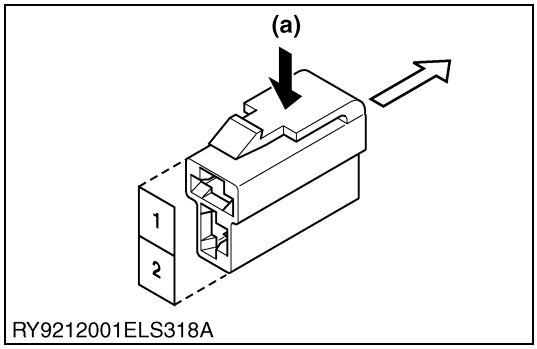
RY9212091ELS0003US0



RY9212091ELS003A

(3) Alternator Connector
(4) Fuel Pump Connector
(5) Water Temperature Sensor Connector

RY9212091ELS0055US0



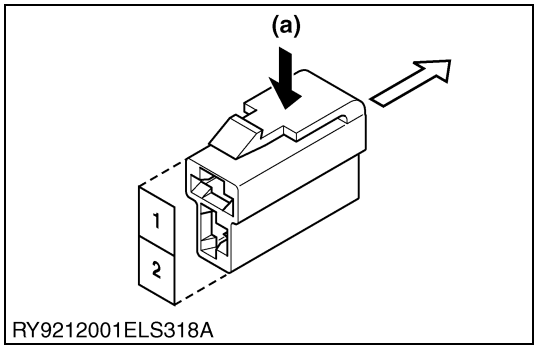
RY9212001ELS318A

(3) Alternator Connector

Connector No.	Place Used
CN25	Inside engine compartment

(a) Press Lock and Unplug

RY9212091ELS0004US0



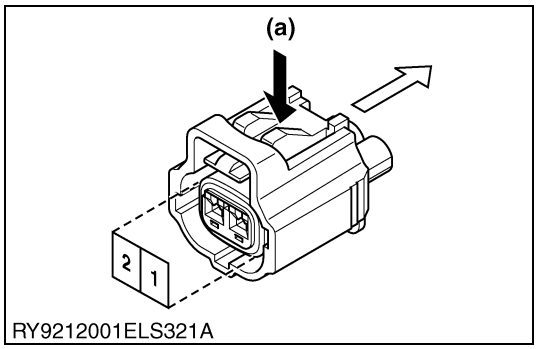
RY9212001ELS318A

(4) Fuel Pump Connector

Connector No.	Place Used
CN24	Inside engine compartment

(a) Press Lock and Unplug

RY9212091ELS0005US0



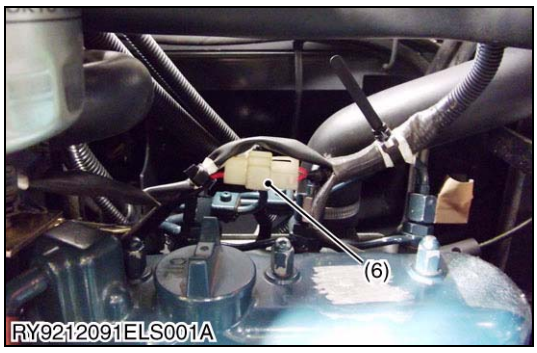
RY9212001ELS321A

(5) Water Temperature Sensor Connector

Connector No.	Place Used
CN32	Inside engine compartment

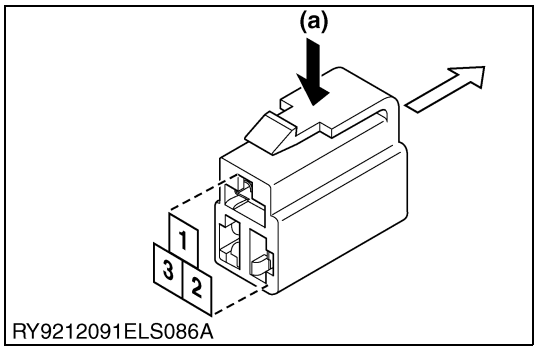
(a) Press Lock and Unplug

RY9212091ELS0006US0



(6) Engine Stop Solenoid Connector

RY9212091ELS0056US0



RY9212091ELS086A

(6) Engine Stop Solenoid Connector

Connector No.	Place Used
CN36	Inside engine compartment

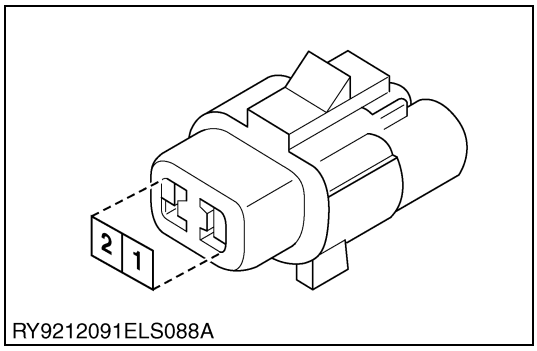
(a) Press Lock and Unplug

RY9212091ELS0007US0

(7) Fuel sensor connector

(8) Fuel supply warning switch connector

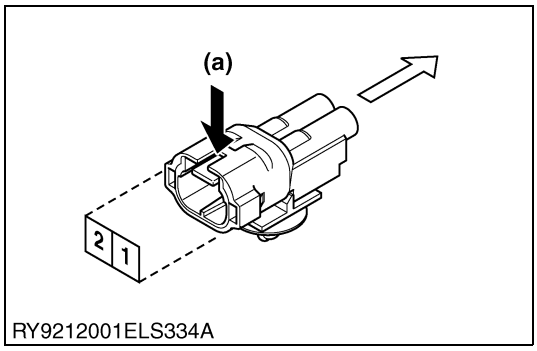
RY9212091ELS0057US0



(7) Fuel Sensor Connector

Connector No.	Place Used
CN23	Swivel frame center

RY9212091ELS0008US0

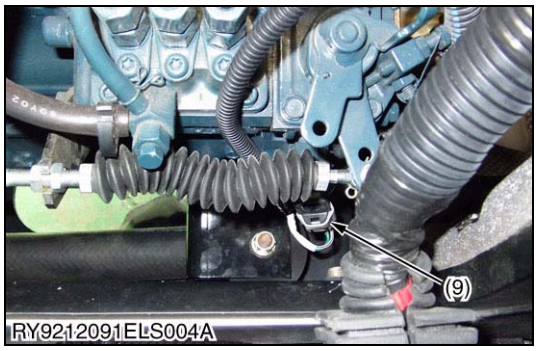


(8) Fuel Supply Warning Switch Connector

Connector No.	Place Used
CN515	Above the fuel filler

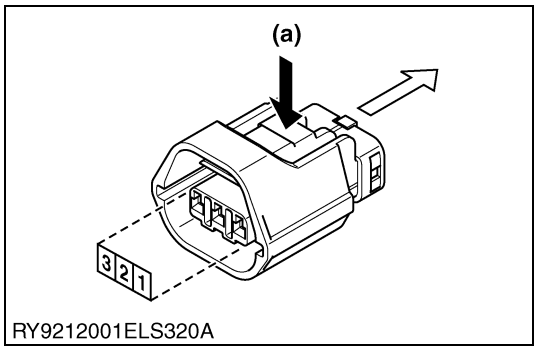
(a) Press lock and unplug

RY9212091ELS0009US0



(9) Rotation Sensor Connector

RY9212091ELS0058US0

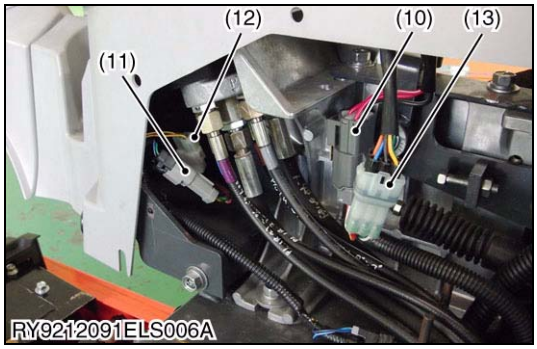


(9) Rotation Sensor Connector

Connector No.	Place Used
CN33	Inside engine compartment

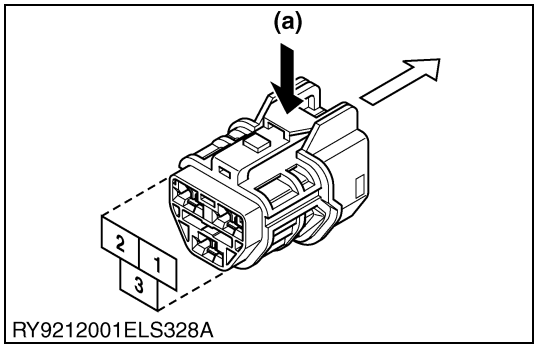
(a) Press Lock and Unplug

RY9212091ELS0010US0



(10) Key Switch Connector
(11) Horn Switch Connector
(12) Meter LCD Buzzer Connector
(13) Anti-Theft Antenna Connector

RY9212091ELS0059US0

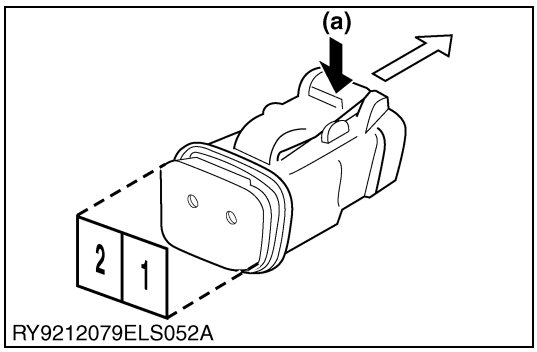


(10) Key Switch Connector

Connector No.	Place Used
CN14	Inside right control cover

(a) Press Lock and Unplug

RY9212091ELS0011US0

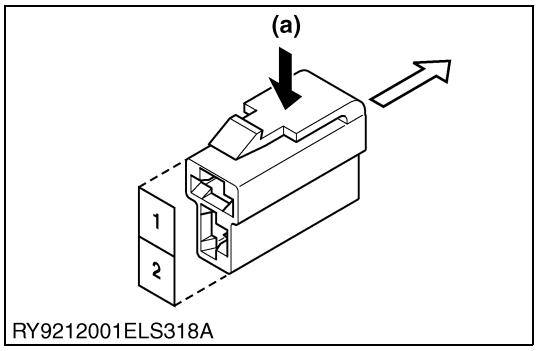


(11) Horn Switch Connector

Connector No.	Place Used
CN21	Inside right control cover

(a) Press Lock and Unplug

RY9212091ELS0012US0

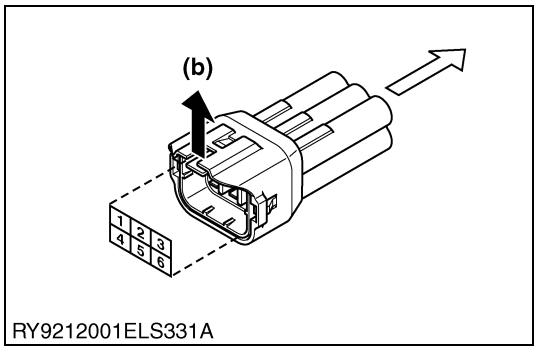


(12) Meter LCD Buzzer Connector

Connector No.	Place Used
CN250	Inside right control cover

(b) Press Lock and Unplug

RY9212091ELS0013US0

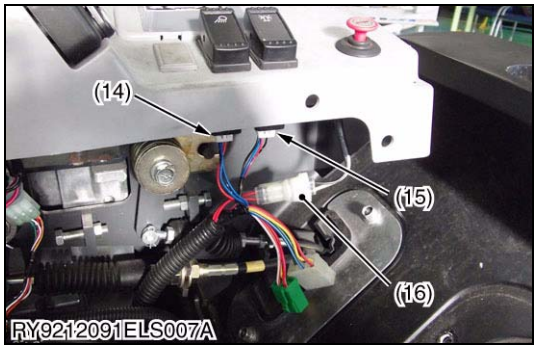


(13) Anti-theft Antenna Connector

Connector No.	Place Used
CN441	Inside right control cover

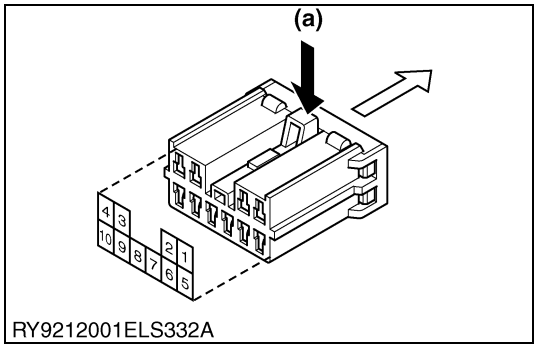
(b) Lift Up on the Lock and then Unplug

RY9212091ELS0014US0



(14) Work Light Switch Connector
(15) Beacon Switch Connector
(16) Engine Stop Switch Connector

RY9212091ELS0060US0

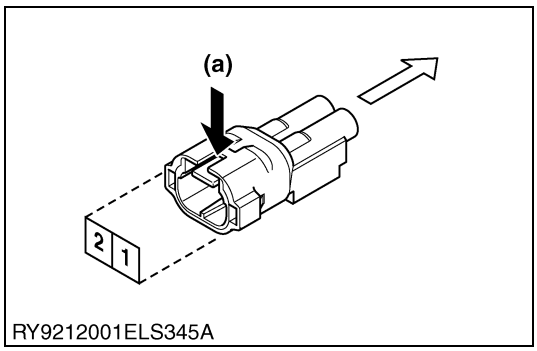


(14) Work Light Switch Connector
(15) Beacon Switch Connector

Connector No.	Place Used
CN830, CN842	Inside right control cover

(a) Press Lock and Unplug

RY9212091ELS0015US0

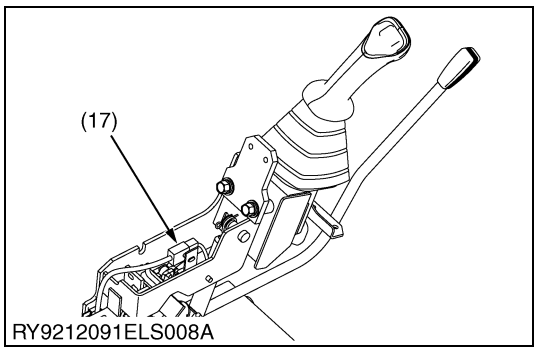


(16) Engine Stop Switch Connector

Connector No.	Place Used
CN510	Inside right control cover

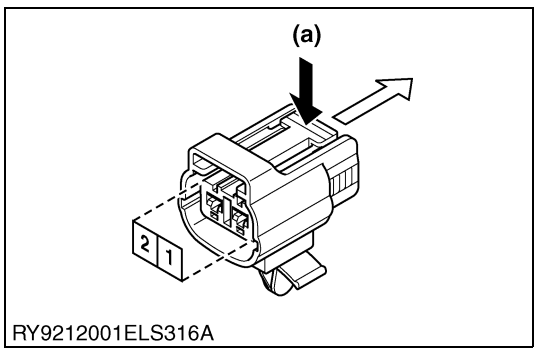
(a) Press Lock and Unplug

RY9212091ELS0016US0



(17) Lever Lock Switch Connector

RY9212091ELS0061US0

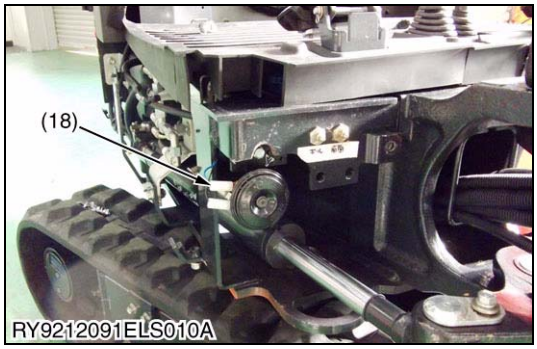


(17) Lever Lock Switch Connector

Connector No.	Place Used
CN11	Inside left control cover

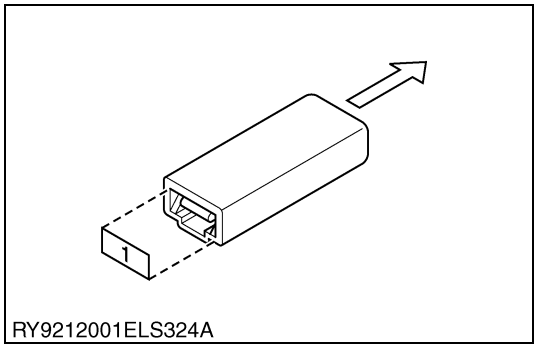
(a) Press Lock and Unplug

RY9212091ELS0017US0



(18) Horn Connector

RY9212091ELS0063US0

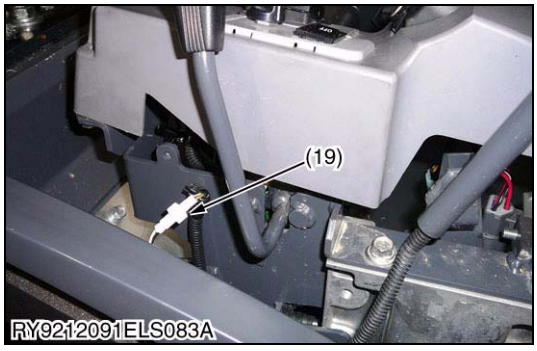


(18) Horn Connector

Connector No.	Place Used
CN45, CN46	In front of the swivel frame

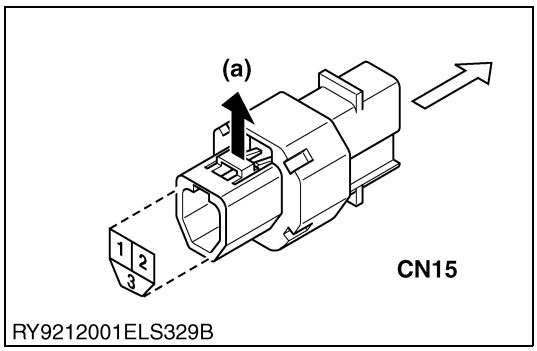
Squeeze the connector and pull

RY9212091ELS0019US0



(19) Travel 2-Speed Switch Connector

RY9212091ELS0064US0

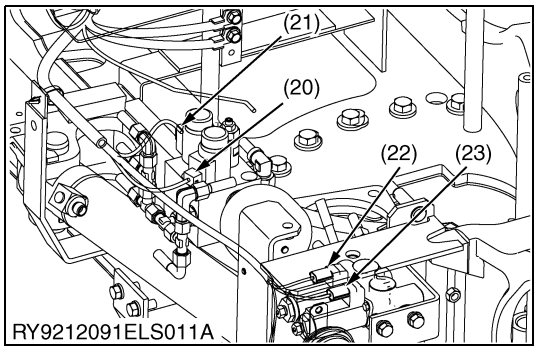


(19) Travel 2-speed Switch Connector (apart from KX015-4)

Connector No.	Place Used
CN15	Rear of control panel

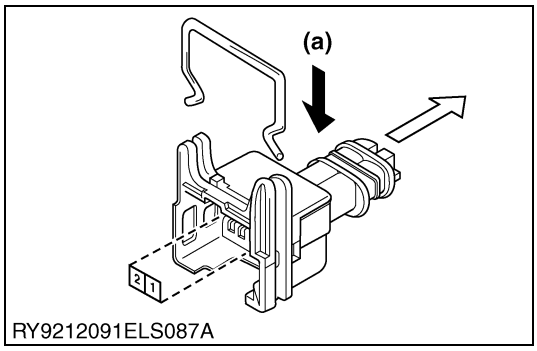
(a) Press Lock and Unplug

RY9212091ELS0020US0



(20) Lever lock solenoid connector
(21) Travel 2-speed solenoid connector
(22) AUX left solenoid connector
(23) AUX right solenoid connector

RY9212091ELS0065US0



(20) Lever Lock Solenoid Connector

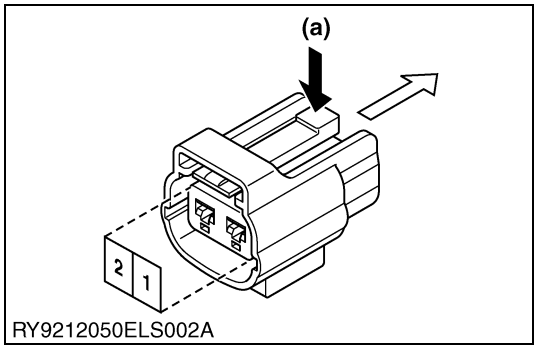
Connector No.	Place Used
CN12	Under steps

(21) Travel 2-speed Solenoid Connector (Except KX015-4)

Connector No.	Place Used
CN13	Under steps

(a) Press the Retainer and Unplug

RY9212091ELS0021US0



(22) AUX Left Solenoid Connector (KX019-4 only)

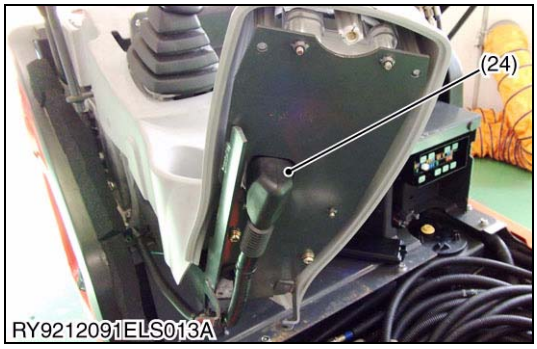
Connector No.	Place Used
CN426	Under steps

(23) AUX Right Solenoid Connector (KX019-4 only)

Connector No.	Place Used
CN427	Under steps

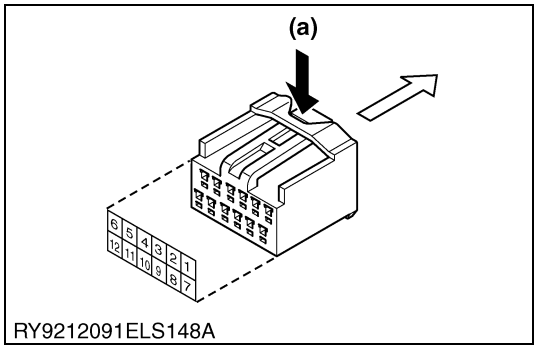
(a) Press lock and unplug

RY9212091ELS0066US0



(24) LCD meter connector

RY9212091ELS0067US0

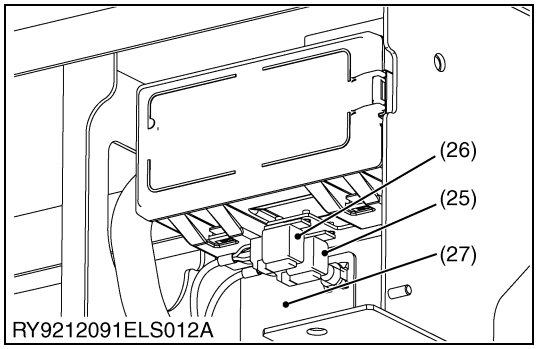


(24) LCD Meter Connector

Connector No.	Place Used
CN2	Inside meter panel box

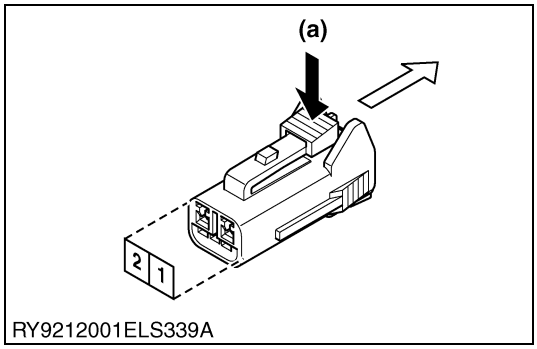
(a) Press lock and unplug

RY9212091ELS0022US0



(25) CAN communication connector
(26) Function expansion connector
(27) Main ECU connector

RY9212091ELS0068US0

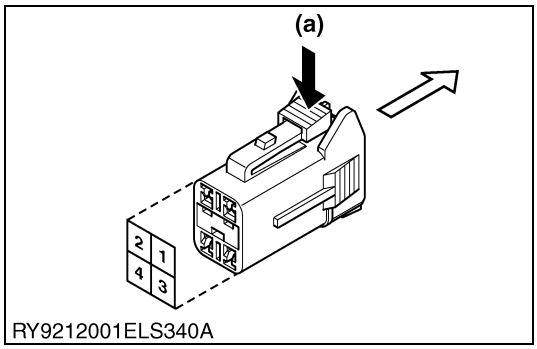


(25) CAN Comm Connector

Connector No.	Place Used
CN6	Under the seat

(a) Press lock and unplug

RY9212091ELS0023US0

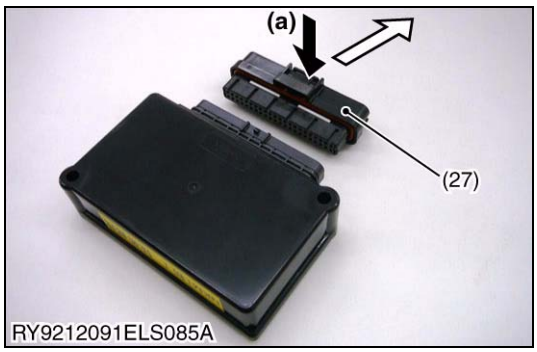


(26) Function Expansion Connector

Connector No.	Place Used
CN850	Under the seat

(a) Press lock and unplug

RY9212091ELS0024US0

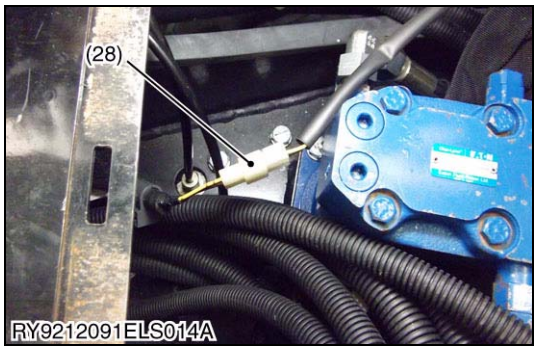


(27) Main ECU Connector

Connector No.	Place Used
CN1	Under the seat

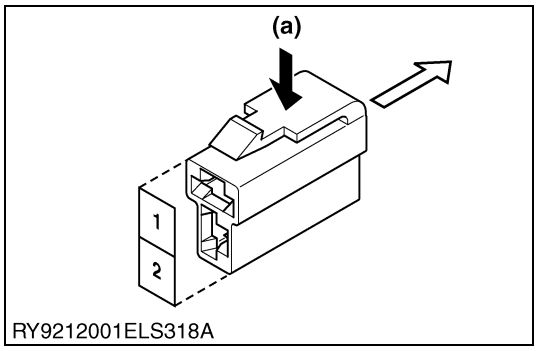
(a) Press lock and unplug

RY9212091ELS0025US0



(28) Work light harness connector

RY9212091ELS0069US0

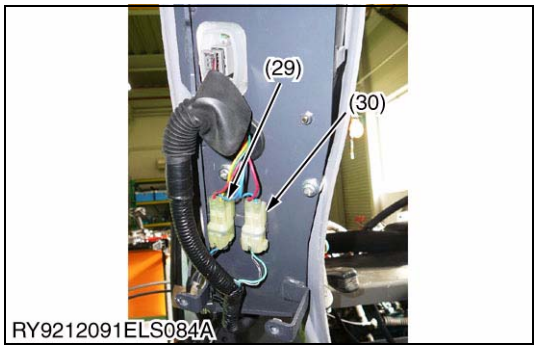


(28) Work Light Harness Connector

Connector No.	Place Used
CN18	Swivel frame center

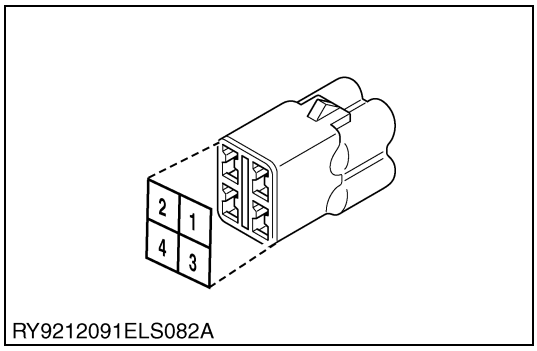
(a) Press lock and unplug

RY9212091ELS0026US0



(29) Harness switch connector (30) AUX activation switch connector

RY9212091ELS0070US0

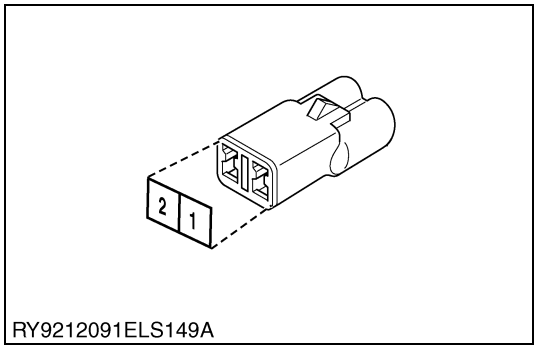


(29) Harness Switch Connector

Connector No.	Place Used
CN431	Under the panel

Lift up the lock on the mating connector and unplug

RY9212091ELS0071US0



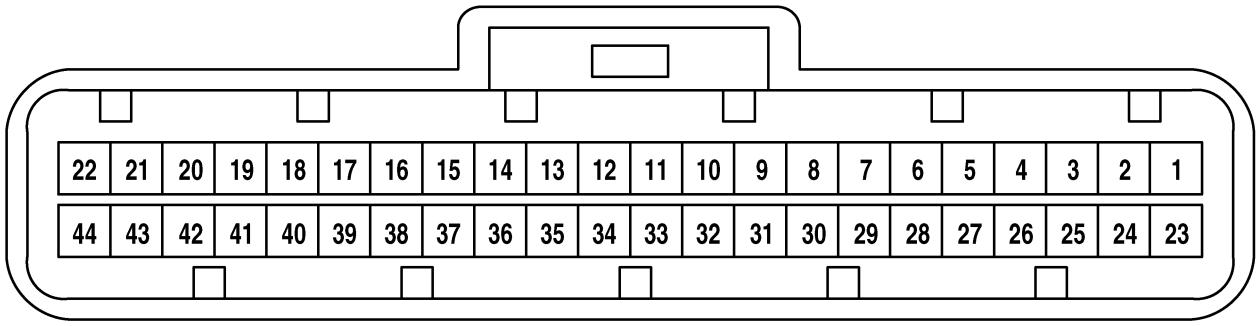
(30) AUX Activation Switch Connector

Connector No.	Place Used
CN432	Under the panel

Lift up the lock on the mating connector and unplug

RY9212091ELS0209US0

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 setup SW	28	Display selector SW
7	–	29	AUX control POT
8	Water temperature sensor	30	Fuel sensor
9	Charge	31	Engine oil SW
10	Front worklight SW	32	AUX hold SW
11	Starter SW	33	Travel speed SW (Hand SW)
12	AUX activation SW	34	Lever lock SW
13	TXD (RF unit)	35	AUX solenoid (–)
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 (Solenoid power supply)
22	AUX (L) solenoid	44	AUX (R) solenoid

RY9212091ELS0027US0

3. 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 (limit) 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 (limit) 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 fob?	The fob and/or keyring are interfering with communication between the key and the antenna.	Get rid of the fob and/or ring.

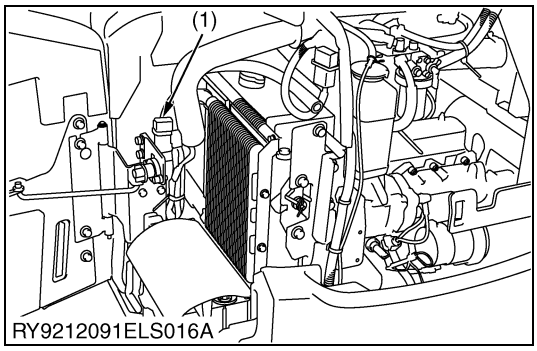
Engine starts even with unregistered keys

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

4. CHECKS

[1] POWER AND GROUND



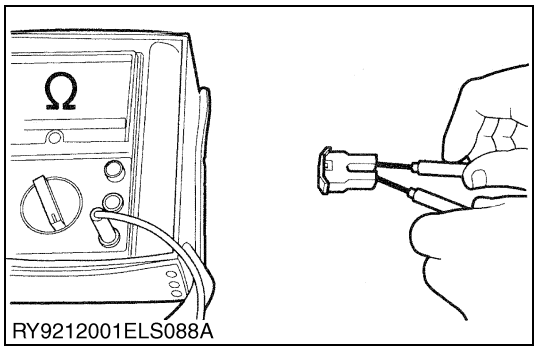
Slow-blow fuses

■ **IMPORTANT**

- **When replacing a slow-blow fuse, always use the same capacity fuse and replace it after determining why it blew.**

(1) Slow-Blow Fuses

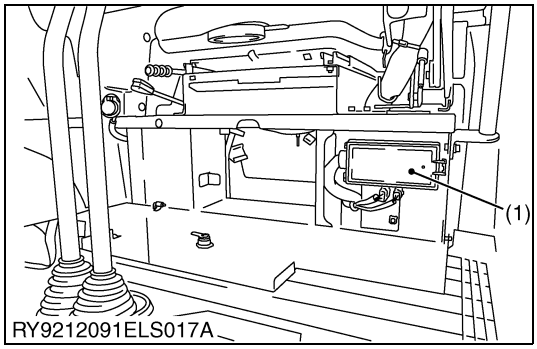
RY9212091ELS0047US0



Inspecting slow-blow fuses

Measurement parameter: check continuity across its terminals

RY9212091ELS0048US0



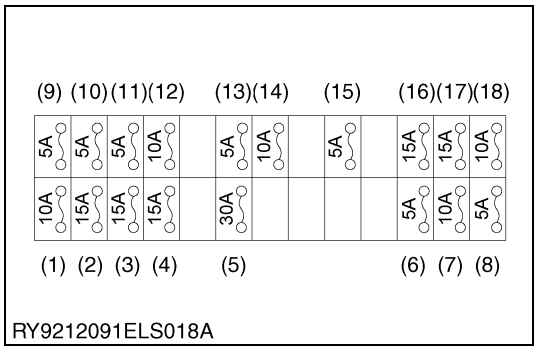
Fuses

■ **IMPORTANT**

- **When replacing a fuse, always use the same capacity fuse and replace it after determining why it blew.**

(1) Fuse Box

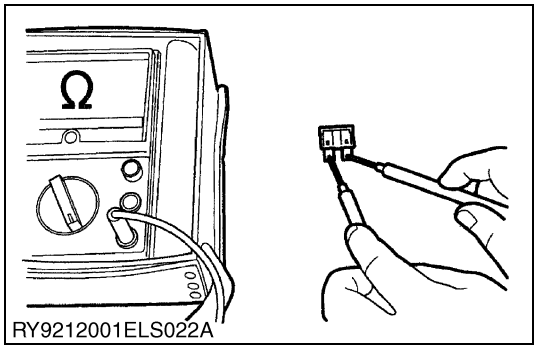
RY9212091ELS0049US0



Fuse capacities and circuits

(1)	Blower Motor	(10)	Lever Lock
(2)	Radio (AC)	(11)	Fuel Pump
(3)	Wiper, Washer	(12)	ECU (AC)
(4)	Electrical Outlet	(13)	Relay Source
(5)	Engine Stop	(14)	Alternator
(6)	ECU (+B)	(15)	Room Light
(7)	Horn Switch	(16)	Beacon
(8)	Meter (+B)	(17)	Work Light
(9)	Starter	(18)	Horn

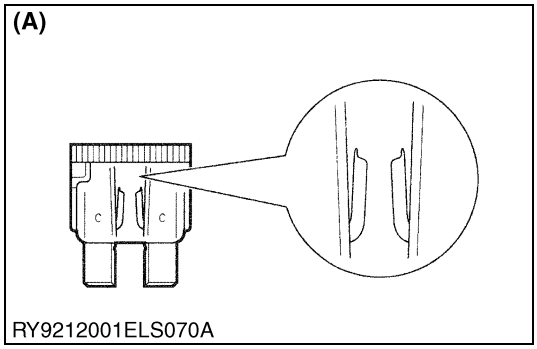
RY9212091ELS0046US0



Inspecting fuses

- Measurement parameter : check continuity across its terminals

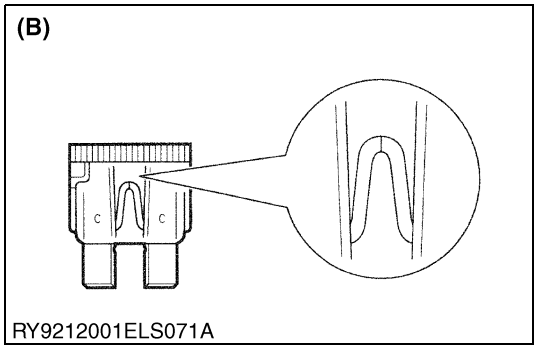
RY9212001ELS0031US0



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.

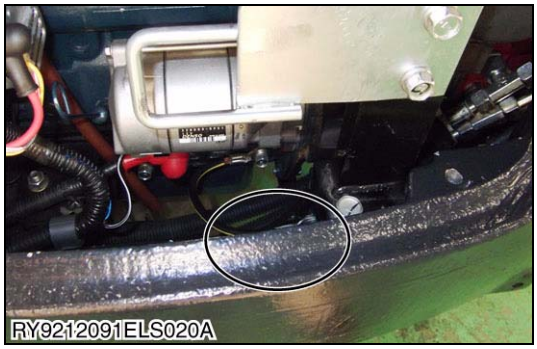


2. When a fuse blows due to a repetitive, intermittent current.
   A repetitive, intermittent current produces a blown fuse such as shown at left **(B)**. In general, this kind of blown fuse occurs after a relatively long period of time, so it does not happen very often.
   With this kind of blown fuse, it is OK to replace it with a fuse of the same capacity.

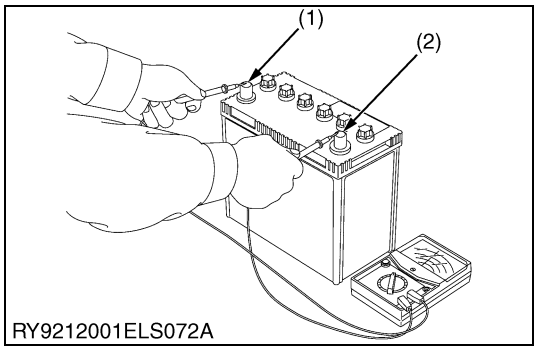
(A) Fuse Blown by Current Overload (B) Fuse Blown by Thermal Fatigue

RY9212001ELS0032US0

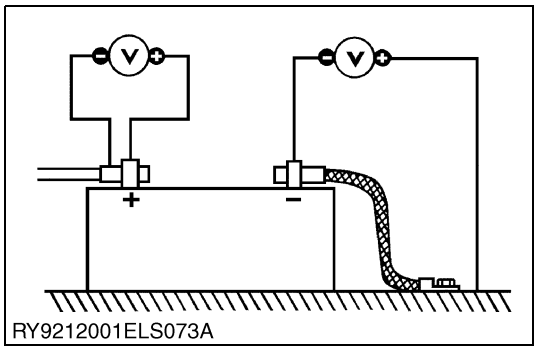

RY9212091ELS019A


RY9212091ELS020A

RY9212091ELS021A



RY9212001ELS072A



RY9212001ELS073A

Ground

Check whether GND wire(s) are securely connected to the body.

RY9212091ELS0029US0

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 12V

Check the condition of terminal connections

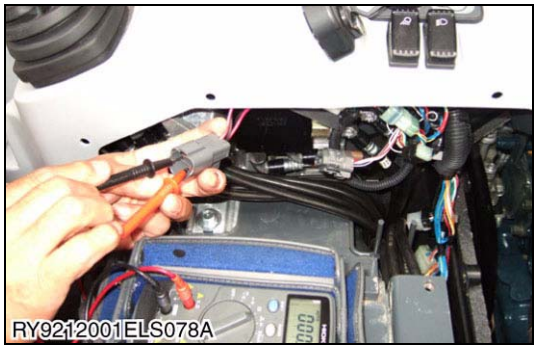
1. Put an electrical load on the battery. (E.g.: Turn the key switch to RUN and turn a worklight on.
2. Connect the (+) side if the circuit tester to the (+) terminal of the battery and the (-) side of the circuit tester to the (+) battery cable. Measure the voltage.
3. Connect the (-) side if the circuit 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.

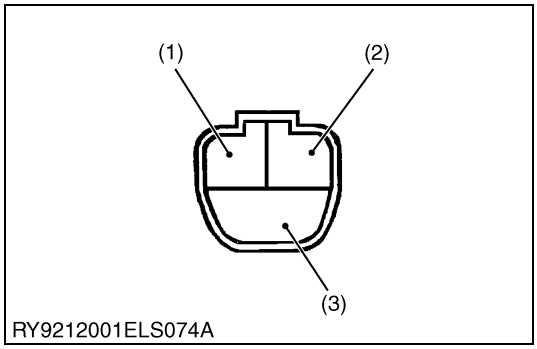
Voltage between terminals	Factory specification	At least DC 0.1 V

(1) (-) Terminal (2) (+) Terminal

RY9212001ELS0034US0

[2] STARTING AND STOPPING DEVICES


RY9212001ELS078A



RY9212001ELS074A

Key switch

Checks

1. Remove the key switch's 3P connector.
2. Turn the key switch to the RUN position and then check the continuity between the red / white wire terminal of the connector on the key switch side and the red wire terminal on the connector.
3. Turn the key switch to the START position and then check the continuity between the black/white wire terminal of the connector on the key switch side and the red wire terminal on the connector.

Key switch circuit table

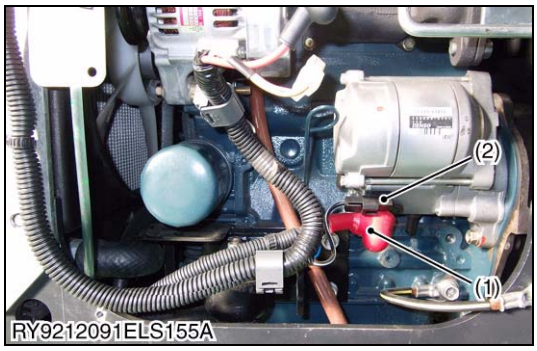
(●—● : Continuity)

Position	(3)	(1)	(2)
STOP			
RUN	●	●	
START	●	●	●

RY9212050ELS011A

(1) Red / White
(2) Black / White
(3) Red

RY9212001ELS0035US0



RY9212091ELS155A

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

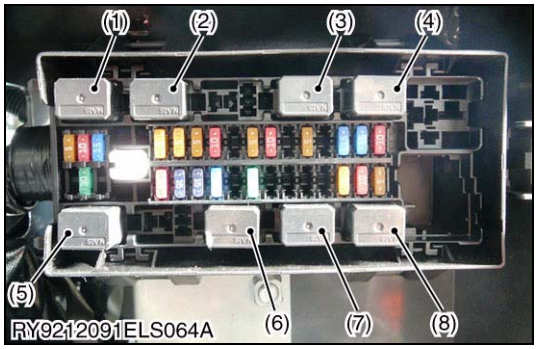
1. Remove the connector from the starter's S terminal.
2. Connect the (+) of the circuit tester to the connector on the harness side and the (–) to the body.
3. Put the machinery operation lock lever in the lock position and measure the voltage with the key switch held in the START position.

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

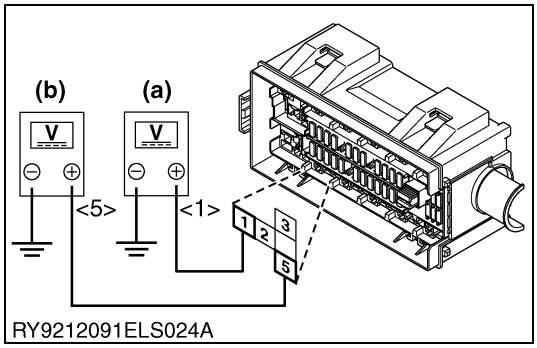
RY9212091ELS0207US0



Relay capacities and circuits

(1) Beacon (20 A)
(2) Work Light (20 A)
(3) Cab (20 A)
(4) Auto Release (20 A)
(5) Horn (20 A)
(6) Glow (20 A)
(7) Engine Stop (20 A)
(8) Heater (20 A)

RY9212091ELS0030US0



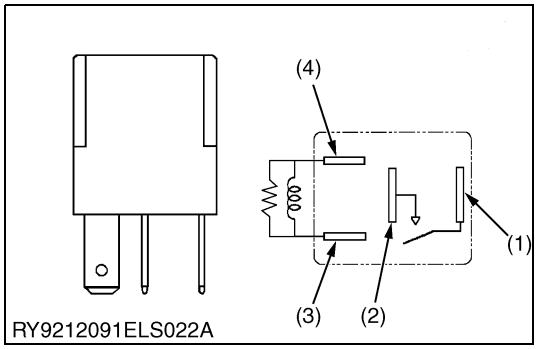
Auto-Release Relay Voltage Test

1. Remove the auto-release 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)	Auto-release relay fusebox side	<1>	Body GND	–
(b)	Auto-release relay fusebox side	<5>	Body GND	–

Normal: 11 to 14 V (battery voltage)
Irregular: Large discrepancy from normal value

RY9212091ELS0031US0



Auto-release Relay Inspection

1. Key Switch: STOP
2. Remove the auto-release relay.
3. Measure the resistance based on the table below.

Measurement	Relay Terminal (+ terminal side)	Relay Terminal (– terminal side)
(a)	(3)	(4)

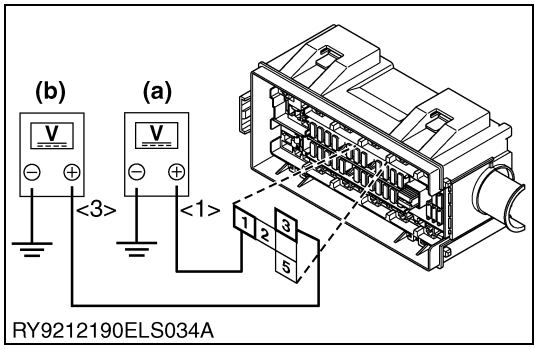
Normal: 108 to 132 Ω
Irregular: Large discrepancy from normal value

4. Test the continuity based on the table below.

Measurement	Relay Terminal (+ terminal side)	Relay Terminal (– terminal side)
(a)	(1)	(2)

Normal: Not continuous
Irregular: Continuous

RY9212091ELS0032US0



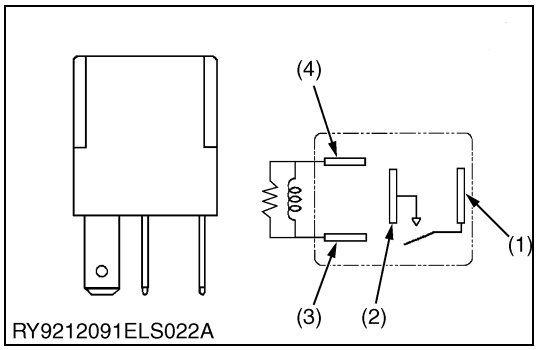
Glow Relay Voltage Test

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	–

Normal: 11 to 14V (battery voltage)
Irregular: Large discrepancy from normal value

RY9212091ELS0050US0



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)

Normal: 108 to 132 Ω
Irregular: Large discrepancy from normal value

4. Test the continuity based on the table below.

Measurement	Relay Terminal (+ terminal side)	Relay Terminal (- terminal side)
(a)	(1)	(2)

Normal: Not continuous
Irregular: Continuous

RY9212091ELS0051US0

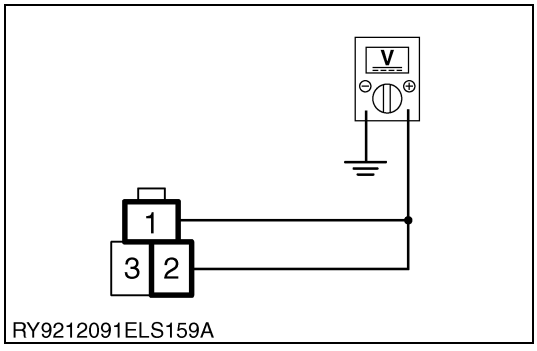
Engine stop solenoid connector voltage

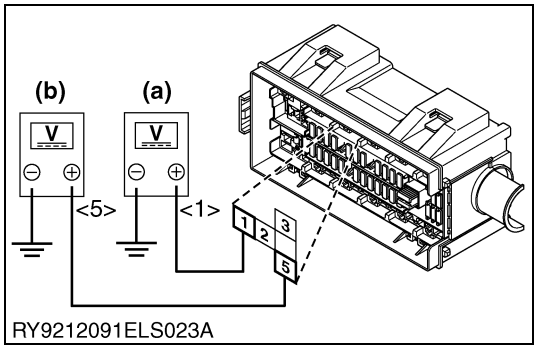
1. Remove the engine stop solenoid's 3P connector.
2. Turn the key switch to RUN and measure the voltage between connector terminal 1 on the wire harness side and the body. Turn the key switch to START and measure the voltage between connector terminal 2 on the wire harness side and the body.
3. If the measurement meets factory specs, it is OK.

Measured voltage	Factory specification	11 to 14 V (battery voltage)

(1) Engine Stop Solenoid Connector

RY9212091ELS0208US0





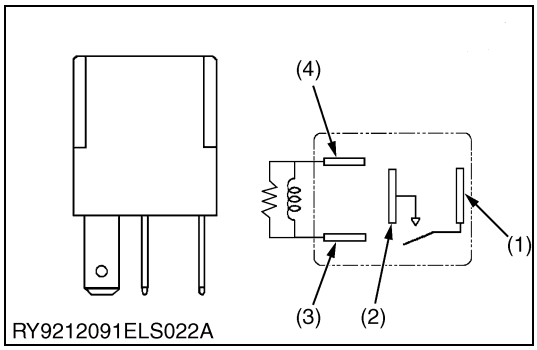
Engine Stop Relay Voltage Test

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	<5>	Body GND	–

Normal: 11 to 14V (battery voltage)
Irregular: Large discrepancy from normal value

RY9212091ELS0052US0



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)

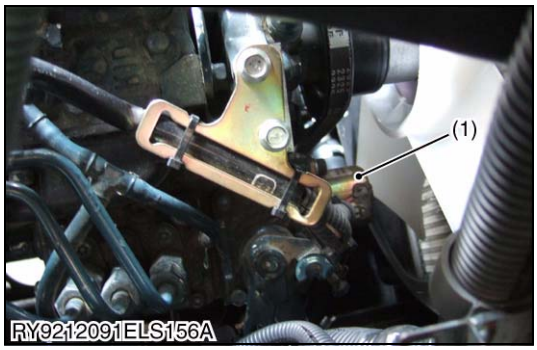
Normal: 108 to 132 Ω
Irregular: Large discrepancy from normal value

4. Test the continuity based on the table below.

Measurement	Relay Terminal (+ terminal side)	Relay Terminal (- terminal side)
(a)	(1)	(2)

Normal: Not continuous
Irregular: Continuous

RY9212091ELS0053US0

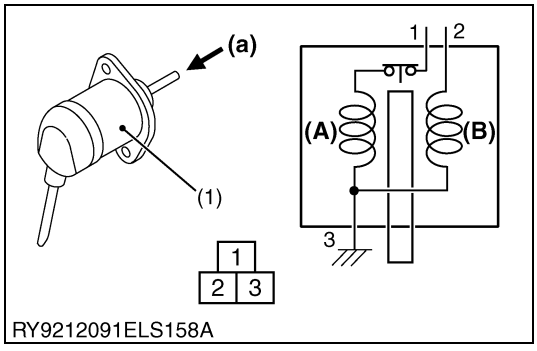


Engine stop solenoid

1. Disconnect the engine stop solenoid from the engine.
2. Apply DC12V 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 terminal 3 (body GND).

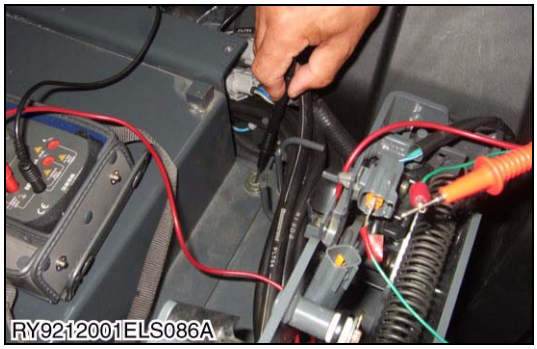
Measured items	(+)	(–)	Factory specification
Holding coil	Terminal 2	Terminal 3	22.2 Ω

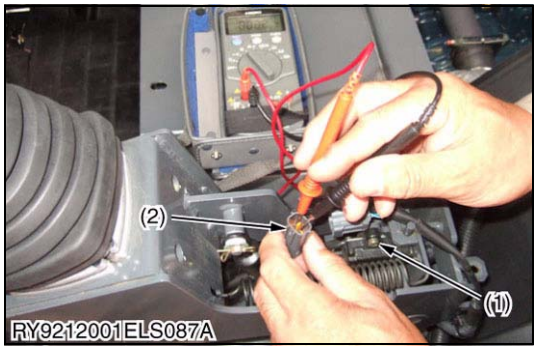
4. If not, replace the engine stop solenoid with new one.



(1) Engine Stop Solenoid
(A) Pull-In Coil
(B) Holding Coil
(a) Pull In

RY9212091ELS0210US0


RY9212001ELS086A



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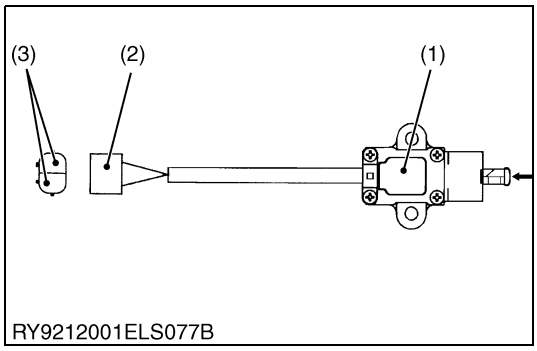


RY9212001ELS077B

Switch (limit) connector voltage

1. Remove the 2P connector of the lever lock switch (limit).
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)

RY9212001ELS0045US0

Switch (limit)

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.

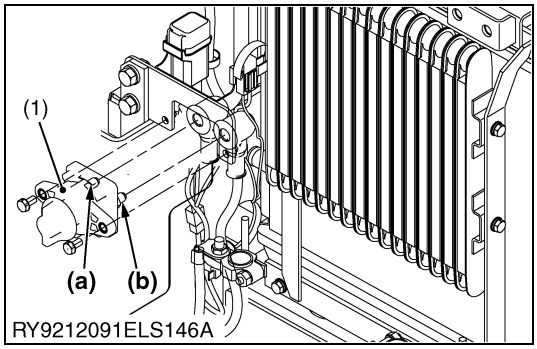
Key switch circuit table

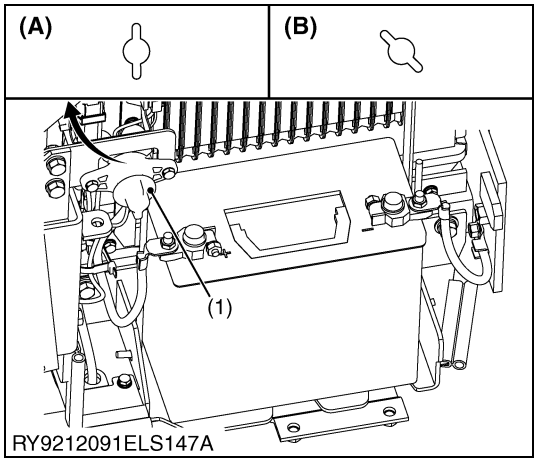
Position	Black	Black	
FREE (Lever up)			No continuity
PUSH (Lever down)	●	●	Continuity

RY9212050ELS012A

(1) Limit Switch
(2) Connector
(3) Terminals (Black Wire)

RY9212001ELS0046US0





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	Assessment Results
Normal: Continuity (OK)	
Error: No continuity (NG)	

5. Put it in the OFF position **(B)** in the same way and if there is no continuity, it is OK.

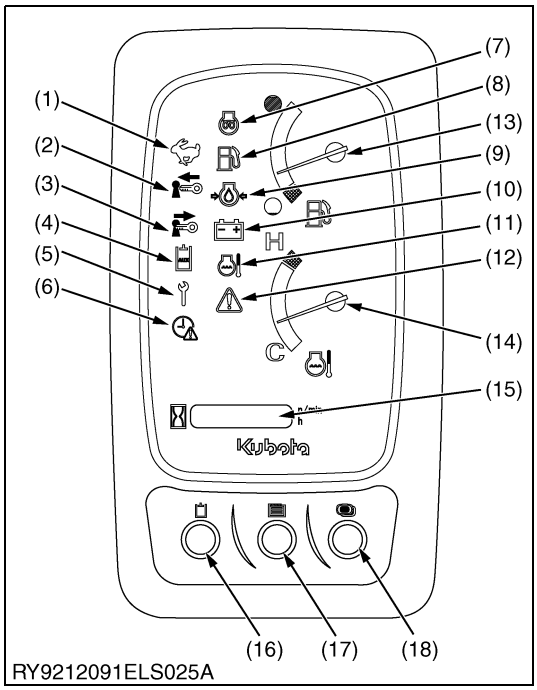
Criteria	Assessment Results
Normal: No continuity (OK)	
Error: Continuity (NG)	

(1) Battery isolator
(a) Terminal
(b) Terminal
(A) ON
(B) OFF

RY9212091ELS0199US0

5. METER PANEL

[1] NAMES AND FUNCTIONS OF METERS AND SWITCHES

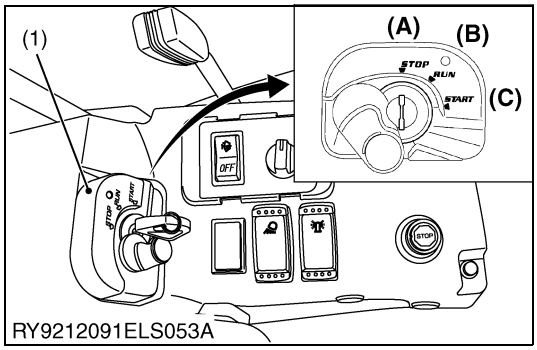


RY9212091ELS025A

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)	Activate AUX switch (KX019-4 only)	
(17)	User switch (SW1)	
(18)	Toggle display switch (SW2)	Toggles the display or sets/selects options

RY9212091ELS0033US0

[2] NORMAL MODE



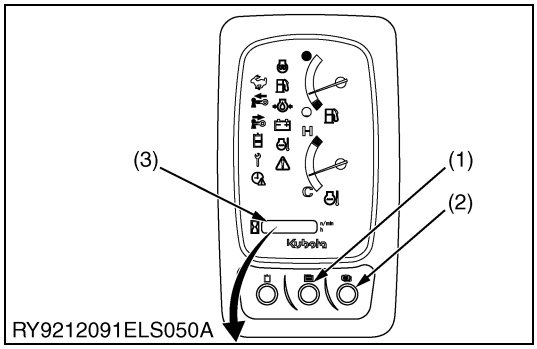
RY9212091ELS053A

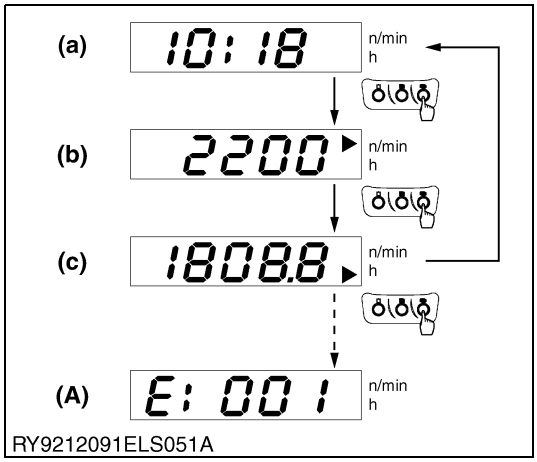
1. Turn the starter key to the position "RUN".

(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.

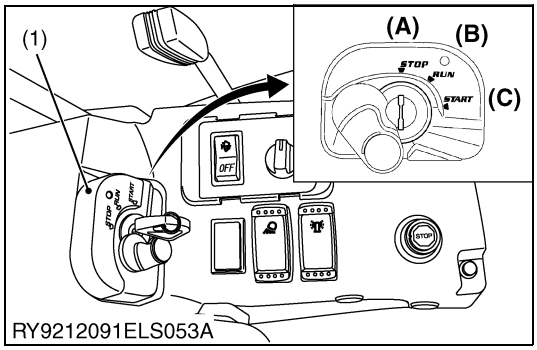
(1) User switch (SW1)
(2) Toggle display switch (SW2)
(3) LCD screen

(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.)

RY9212091ELS0035US0

[3] USER SETTINGS MODE

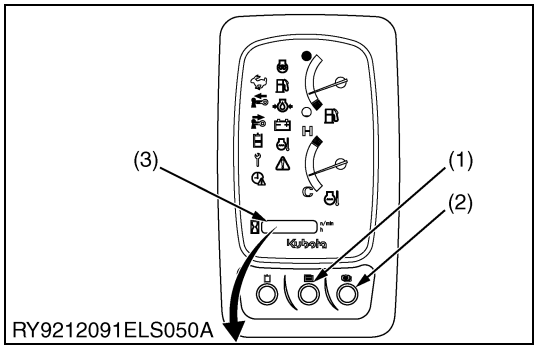


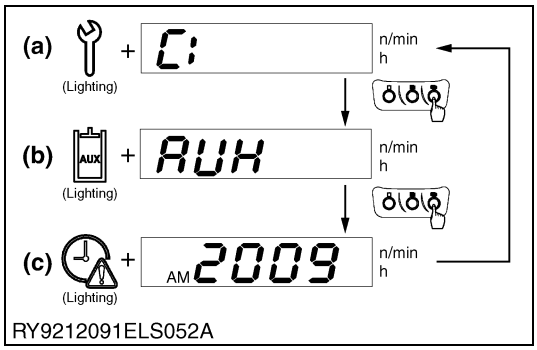
1. Turn the starter key to the position "RUN".

(1) Key Switch

(A) STOP
(B) RUN
(C) START

RY9212091ELS0034US0



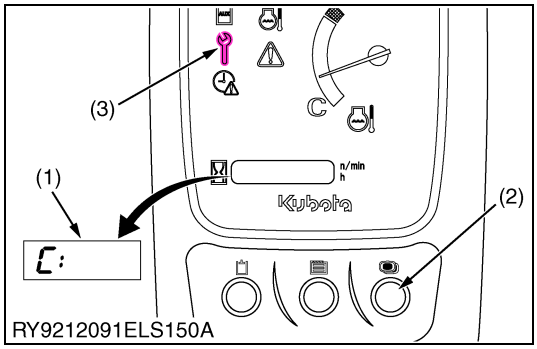


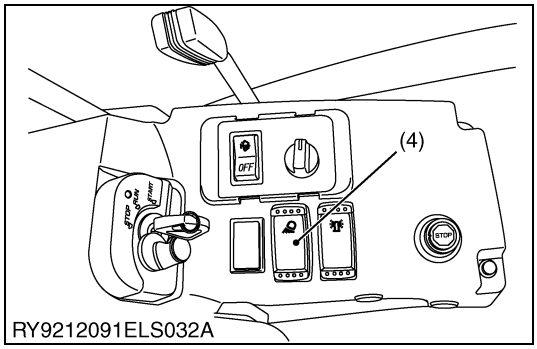
2. Pressing SW1 switches from the normal mode to the user settings mode.
3. Pressing SW2 toggles the item displayed on the LCD screen (3) in a loop.

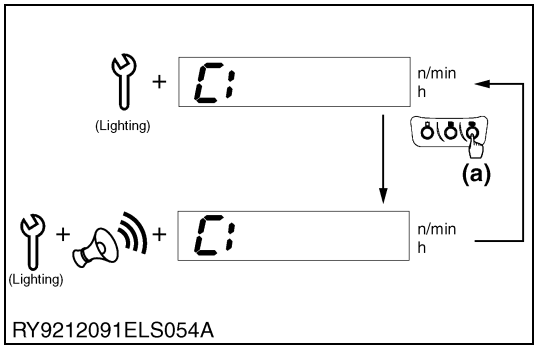
(1) User switch (SW1)
(2) Toggle display switch (SW2)
(3) LCD screen

(a) Periodic Inspection Check Mode
(b) AUX Settings Mode (KX019-4 only)
(c) Time Setting Mode

RY9212091ELS0036US0







Switching to the Periodic Inspection Item Display Screen

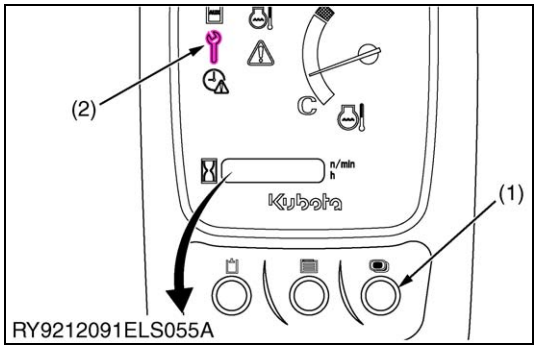
1. After switching to the user settings mode, press SW2 and select the periodic inspection mode.
2. After turning the work light switch ON/OFF once, pressing and holding SW2 switches the display to the periodic inspection item display screen.

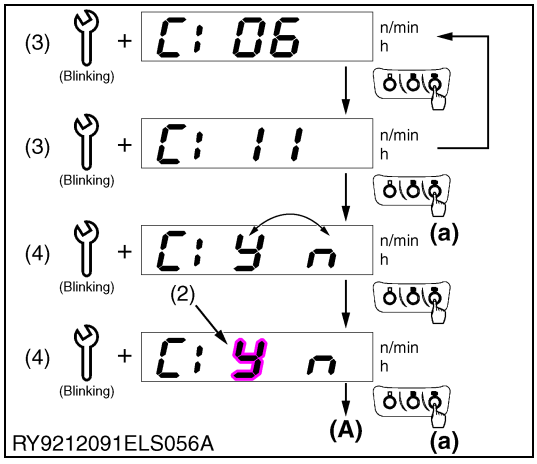
- If there are no periodic inspection items, when SW2 is held down, the buzzer will beep two times and the screen display will not change.

(1) Periodic Inspection Mode
(2) Toggle display switch (SW2)
(3) Periodic inspection light
(4) Work light switch

(a) Press and hold SW2

RY9212091ELS0037US0





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) Toggle display switch (SW2)
(2) Blinks
(3) Periodic inspection item
(4) Checking inspection individually

(a) Press and hold SW2
(A) Normal mode

RY9212091ELS0038US0

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	–
C: _ 1 0	Front idler and track roller oil
C: _ 1 1	Breather filter

RY9212091ELS0073US0

[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

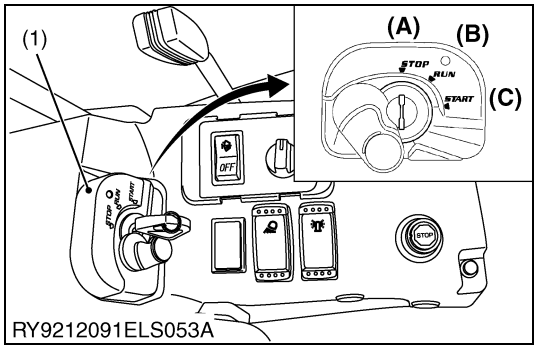
	Number	Item	Display	Notes
[D] Dealer Settings (SET-4)	no-01	AUX knob setting	nob-R	
	no-02	AUX activation point setting (with attachment)	2:– – – –	
	no-03	AUX activation point setting (no attachment)	3:– – – –	
	no-04	AUX feeling adjustment	4:– – – –	
	no-05	Model setting	5 1:OOO	When ECU replaced
	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

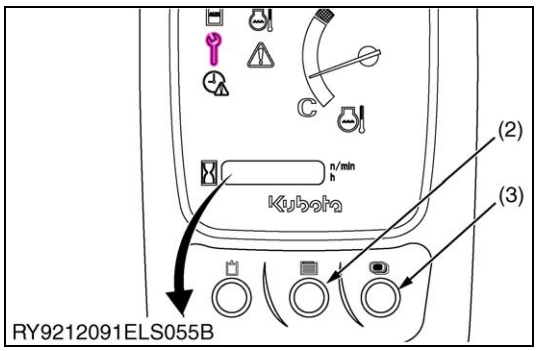
RY9212091ELS0075US0

[A] Tester (SET-1)

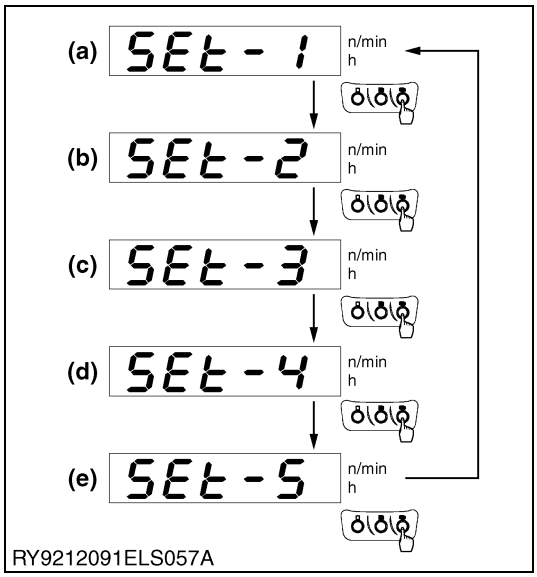
Guide to Using the Tester Mode, Check to See the Conditions of the Various Sensors and the Information of Switches



RY9212091ELS053A



RY9212091ELS055B



RY9212091ELS057A

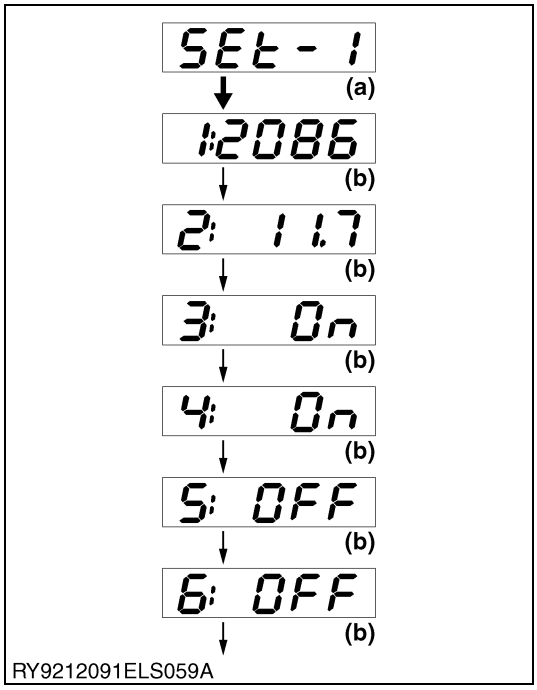
1. With SW2 pressed down, turn the starter key to the [RUN] position to enter the service dealer mode. "SET-1" is displayed on the LCD screen.
2. Pressing SW2 toggles the items displayed on the LCD screen in a loop.
3. Display "SET-1" and press and hold SW2 to enter the SET-1 tester mode. (to [SET-1 Tester Content Description])

(1) Key switch
(2) User switch (SW1)
(3) Toggle display switch (SW2)

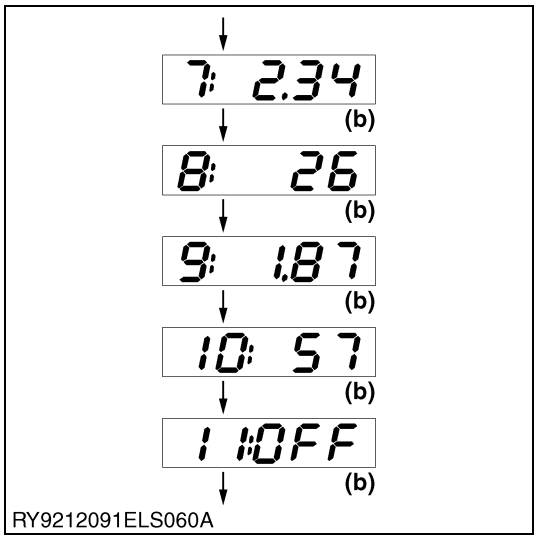
(A) STOP
(B) RUN
(C) START

(a) Tester
(b) Read error history
(c) Clear error history
(d) Dealer settings
(e) Read entire error history

RY9212091ELS0040US0



RY9212091ELS059A



RY9212091ELS060A

SET-1 Tester Content Description

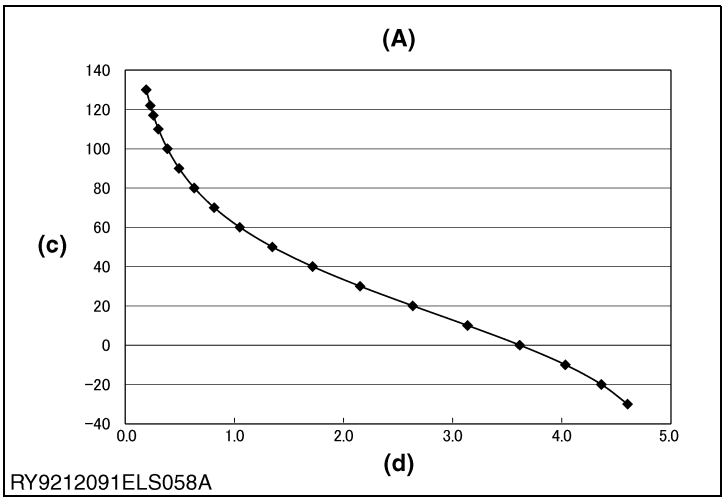
■ **NOTE**
- **Press SW1: Back**
- **Press SW2: Forward, switch**
- **Press and hold SW1: Back all the way (Return to SET-1)**
- **Press and hold SW2: Set**

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

Displayed Item	Description
7. Water temperature voltage	Ex.: 2.34V Ex.: 26°C (78.8°F) Displays water temperature voltage and temperature 0 °C (32 °F) → 3.61 V 100 °C (212 °F) → 0.39 V
8. Water temperature	
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

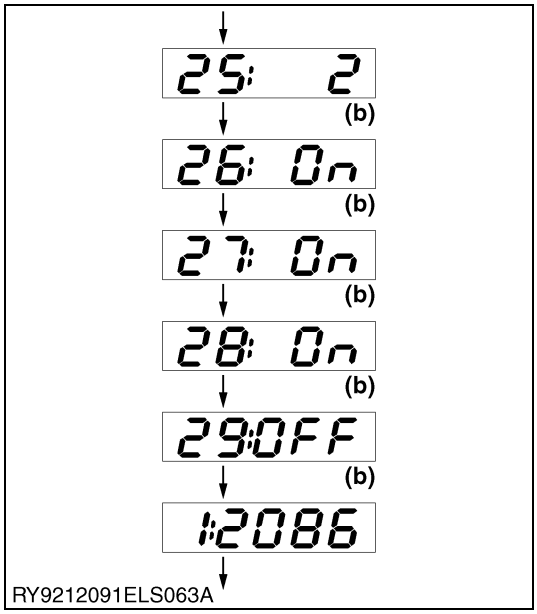
RY9212091ELS0078US0

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	

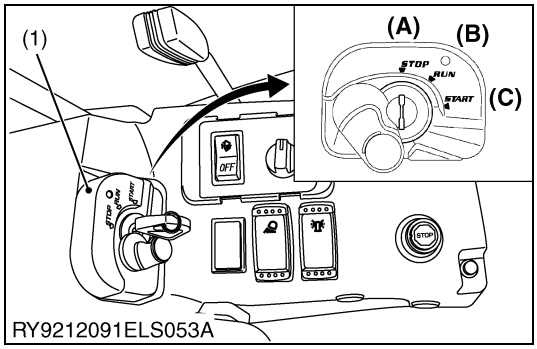
(b) Press SW2

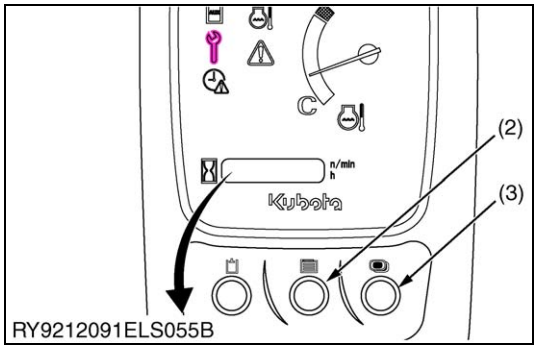
RY9212091ELS0080US0

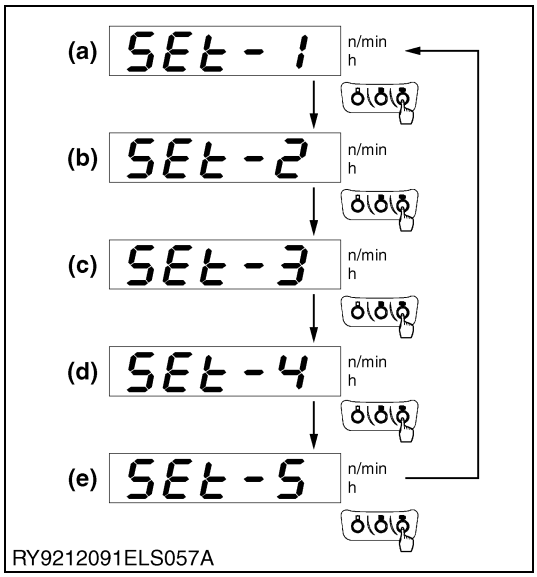
[B] Read Error History (SET-2)

[C] Read Entire Error History (SET-5)

Guide to Checking the History of Errors in the Past







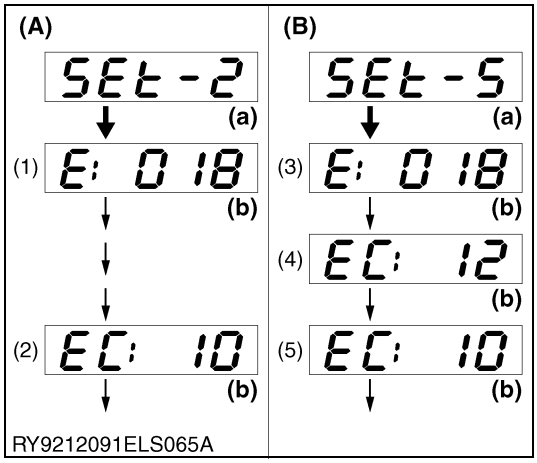
1. With SW2 pressed down, turn the starter key to the [RUN] position to enter the service dealer mode. "SET-1" is displayed on the LCD screen.
2. Pressing SW2 toggles the items displayed on the LCD screen in a loop.
3. Display either SET-2 or SET-5, then press and hold SW2 to enter either the SET-2 read 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 switch (SW1)
(3) Toggle display 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

RY9212091ELS0043US0



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]

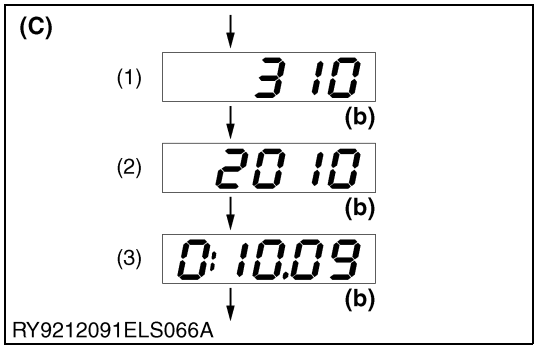
	Displayed Item	Description
(1)	Error item	Ex.: Error code 18 (Displays when an error has occurred. When there are no errors or after the entire error history has been cleard, the screen will display SET-2 and will not change any further.
(2)	No. of errors (Total number of errors does not display)	Ex.: 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

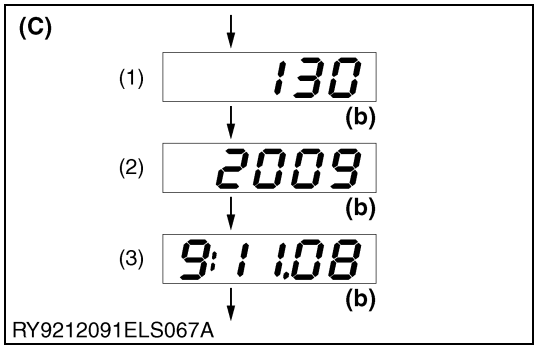
RY9212091ELS0081US0



	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

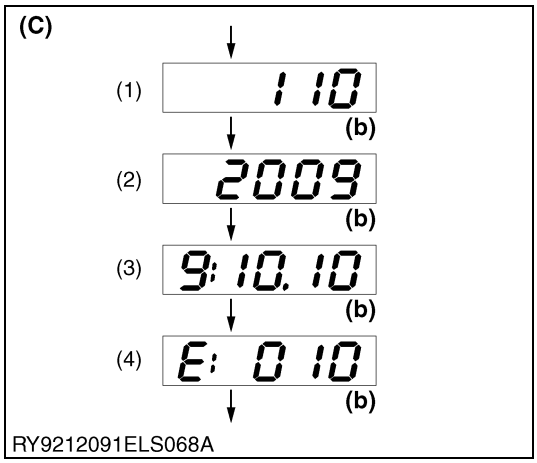


RY9212091ELS067A

	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

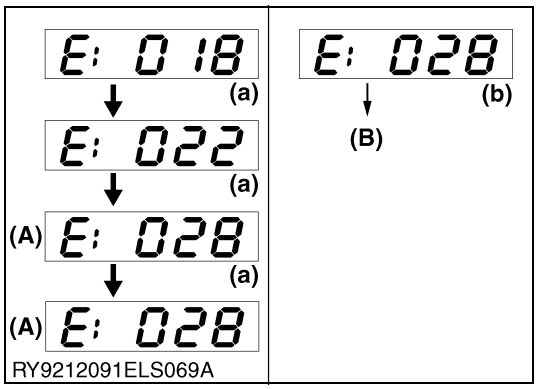


RY9212091ELS068A

	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.)

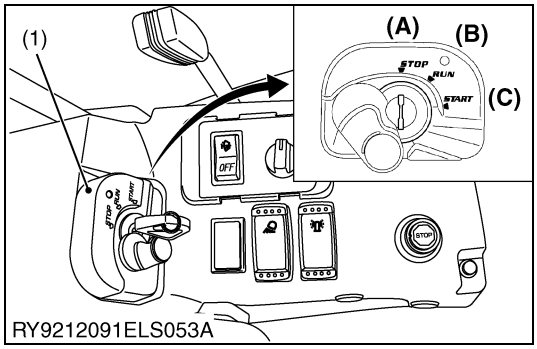
- As **E:028** (External 12 V short error) **(A)** is the last error, the display on the screen will not switch even if SW2 is pressed.

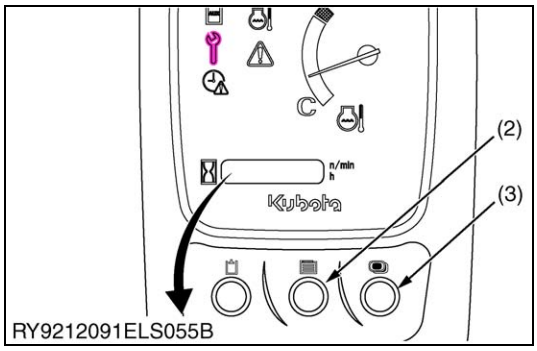
(A) E:028 (External 12 V Short Error) **(a) Press and Hold SW2**
(B) Service Dealer Mode Screen **(b) Press and Hold SW1**

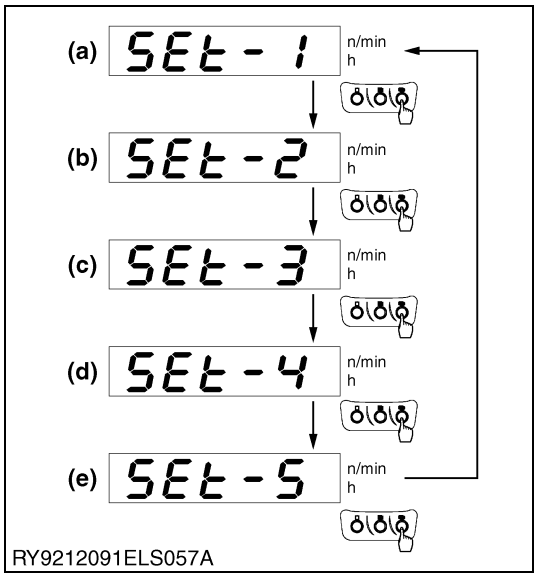
RY9212091ELS0085US0

[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 switch (SW1)
(3) Toggle display 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

RY9212091ELS0045US0

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)

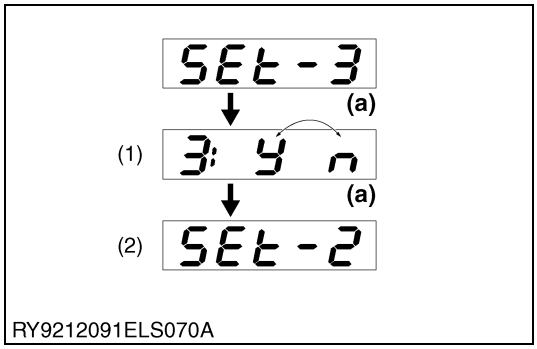
After the error history is cleared, hour meter when first error occurred	No error history	100 h
After the error history is cleared, year when first error occurred		2009
After the error history is cleared, month and day when first error occurred		2/3

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**

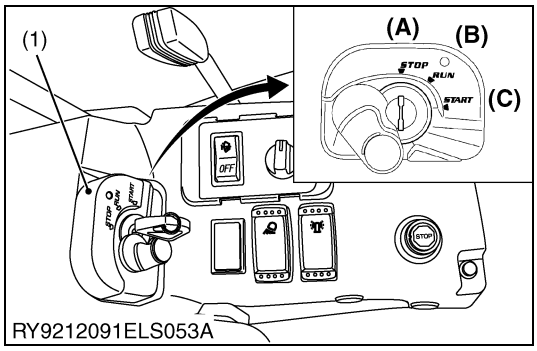
	Explanation of Display	Operation
(1)	YES/NO selections Y: Clears error history (YES) N: Does not clear (NO)	Select YES/NO by pressing SW2 or SW1. The selected item blinks.
(2)	Return to SET-2 Read Error History	Pressing and holding SW2 confirms the choice and the buzzer beeps three times.

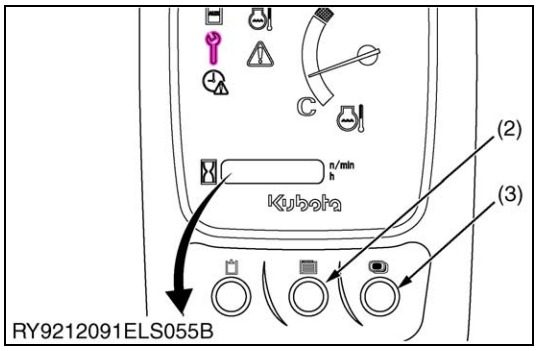
(a) Press and Hold SW2

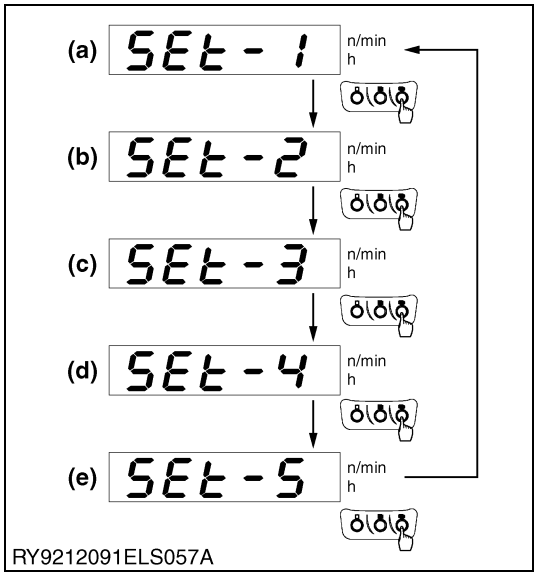
RY9212091ELS0086US0

[E] Dealer Settings (SET-4)

Guide to Making Various Settings, such as Model and AUX Settings







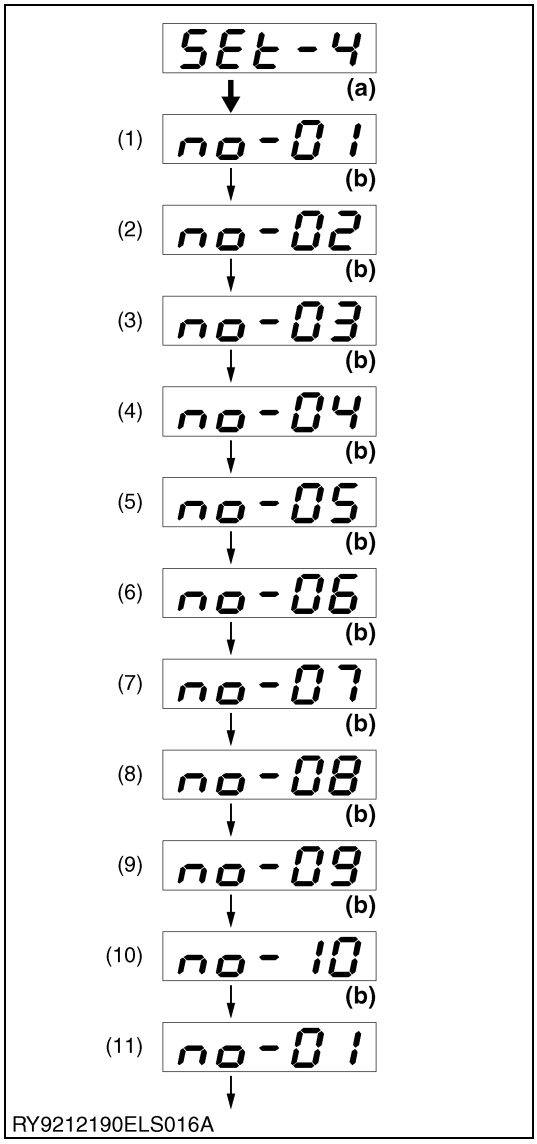
1. With SW2 pressed down, turn the starter key to the [RUN] position to enter the service dealer mode. "SET-1" is displayed on the LCD screen.
2. Pressing SW2 toggles the items displayed on the LCD screen in a loop.
3. Display "SET-4" and press and hold SW2 to enter the SET-4 dealer settings mode. (To [SET-4 Table of Dealer Settings])

(1) Key switch
(2) User switch (SW1)
(3) Toggle display 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

RY9212091ELS0044US0



RY9212190ELS016A

SET-4 Table of Dealer Settings

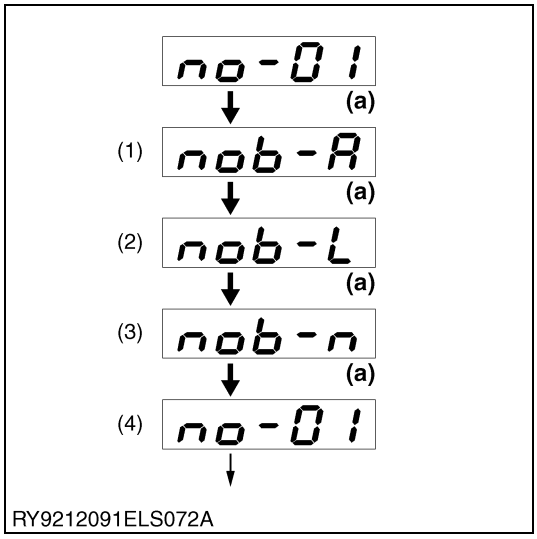
■ **NOTE**
- **Press SW1: Back**
- **Press SW2: Forward, switch**
- **Press and hold SW1: Back all the way (Return to SET-4)**
- **Press and hold SW2: Set**

	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"	

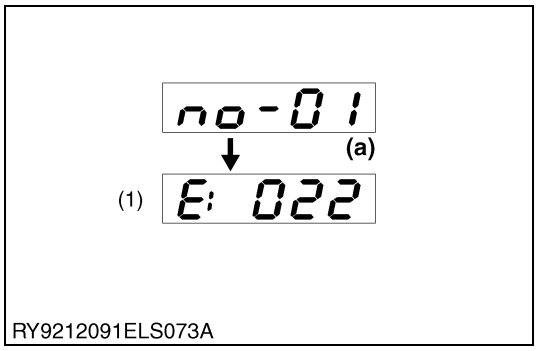
★: KX019-4 only

(a) Press and Hold SW2 **(b) Press SW2**

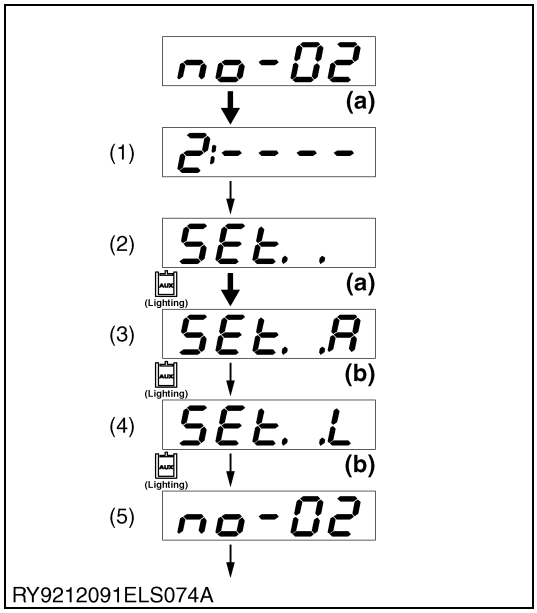
RY9212190ELS0041US0



RY9212091ELS072A



RY9212091ELS073A



RY9212091ELS074A

Guide to No-01 AUX Knob Settings

Readjusting the modified AUX knob setting

	Explanation of Display	Operation
(1)	AUX knob right end setting	With the slide lever of the AUX knob all the way to the right, press and hold SW2
(2)	AUX knob left end setting	With the slide lever of the AUX knob all the way to the left, press and hold SW2
(3)	AUX knob neutral setting	With the slide lever of the AUX knob in the neutral position, press and hold SW2
(4)	After completing the settings, go back to "No-01 AUX knob settings"	The buzzer beeps three times

- If the AUX is set to OFF or if the knob is not level when the mode is entered, the screen will not advance.

When there is an error with AUX knob settings

	Description	Explanation
(1)	Error code displayed	Ex.: Error code 22

(a) Press and hold SW2

RY9212091ELS0088US0

Guide to No-02 AUX Activation Point Setting (with Attachment)

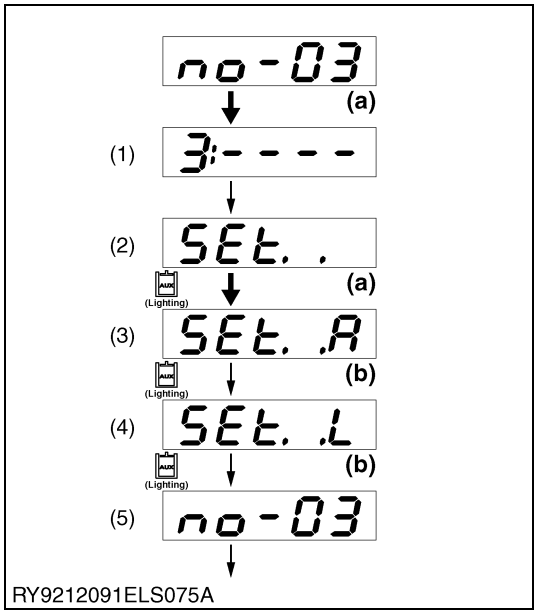
When the AUX proportional valve or spool has been replaced by new one:

	Explanation of Display	Operation
(1)	2:---- : Standing by for engine start up and lever lock release	The display screen is switched automatically by engine start up and lever lock release, therewithal AUX lamp lights
(2)	SET. . : Waiting for MAX acceleration	Switch to the MAX acceleration point Place the attachment in its specified position and press and hold SW2.
(3)	SET. .R : Taking right measurement	After moving the attachment, press SW2
(4)	SET. .L : Taking left measurement	After moving the attachment, press SW2
(5)	After completing the settings, go back to "No-02 AUX activation point settings"	The buzzer beeps three times

- If the AUX is set to OFF or if the knob is not level when the mode is entered, the screen will not advance.

(a) Press and hold SW2 **(b) Press SW2**

RY9212091ELS0089US0



RY9212091ELS075A

Guide to No-03 AUX Activation Point Setting (no Attachment)

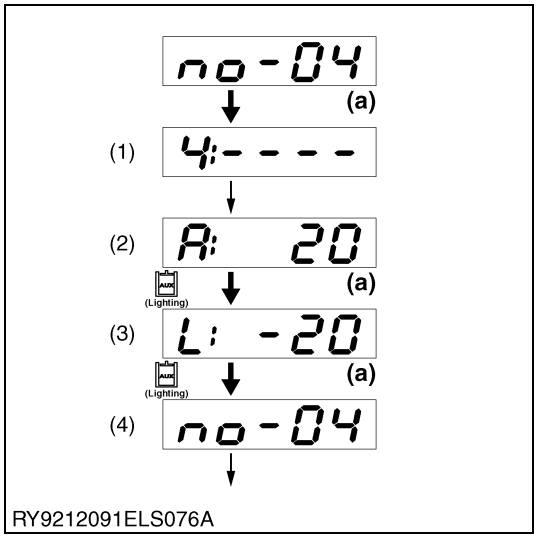
When the AUX proportional valve or spool has been replaced by new one:

	Explanation of Display	Operation
(1)	3:---- : Standing by for lever lock release and engine start up	The display screen is switched automatically by the lever lock release and engine start up, therewithal AUX lamp lights
(2)	SET. . : Waiting for MAX acceleration	Switch to the MAX acceleration point Press and hold SW2
(3)	SET. .R : Taking right measurement	If the right pressure rises suddenly, press SW2
(4)	SET. .L : Taking left measurement	If the left pressure rises suddenly, press SW2
(5)	After completing the settings, go back to "No-03 AUX activation point settings"	The buzzer beeps three times

- Attach a pressure gauge to port P2 on the main pump and check the rise of pressure at the AUX.
- If the AUX is set to OFF or if the knob is not level when the mode is entered, the screen will not advance.

(a) Press and hold SW2 **(b) Press SW2**

RY9212091ELS0090US0



RY9212091ELS076A

Guide to No-04 AUX Feeling Adjustment

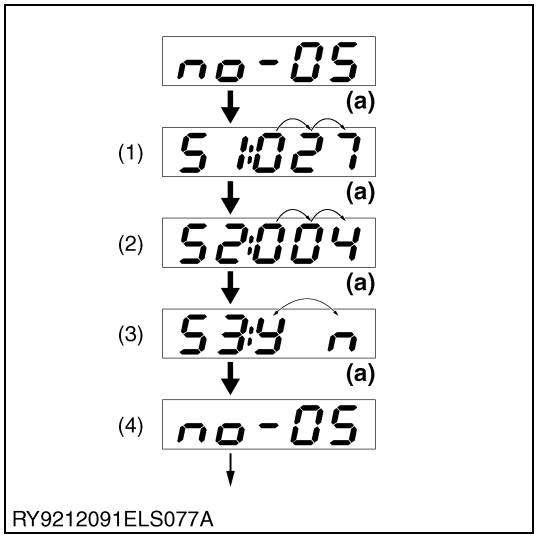
If the AUX control feels different:

	Explanation of Display	Operation
(1)	4:---- : Standing by for lever lock and engine start up	The display screen is switched automatically by engine start up and lever lock release, therewithal AUX lamp lights
(2)	Ex.:R: 20, right fine adjustment +20 Press SW1 and SW2 to raise and lower the number	Right fine adjustment (+40 to -40) Enter the number and then press and hold SW2
(3)	Ex.: L: 20, left fine adjustment -20 Press SW1 and SW2 to raise and lower the number	Left fine adjustment (+40 to -40) Enter the number and then press and hold SW2
(4)	After completing settings, return to No-04 Feeling Adjustment	The buzzer beeps three times

- If the AUX is set to OFF or if the knob is not level when the mode is entered, the screen will not advance.

(a) Press and hold SW2 **(b) Press SW2**

RY9212091ELS0091US0



RY9212091ELS077A

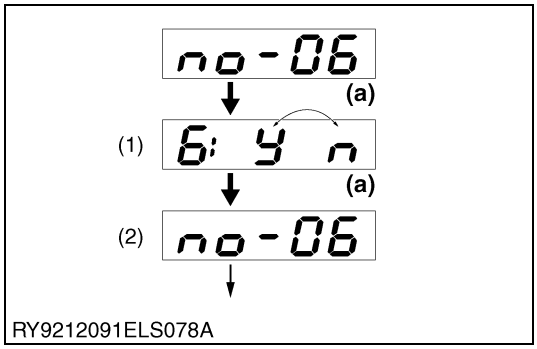
Guide to No-05 Model Setting

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 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 KX019-4, select "Has AUX"
(4)	Return to No-05 Model Setting	The buzzer beeps three times

(a) Press and Hold SW2

RY9212091ELS0092US0



RY9212091ELS078A

Guide to No-06 Method for Eliminating Periodic Guidance

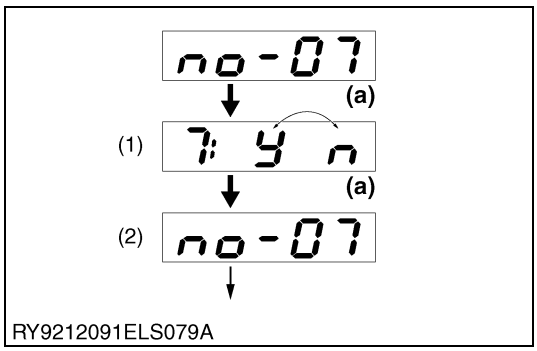
Procedure for changing the deleting steps for the periodic checkup guide

	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

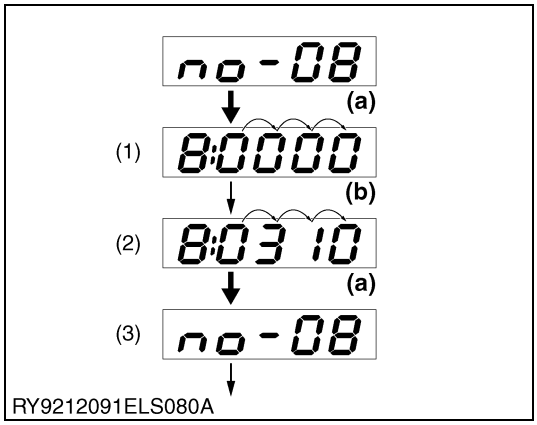
Guide to No-07 Turning Display of Periodic Guidance ON/OFF

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

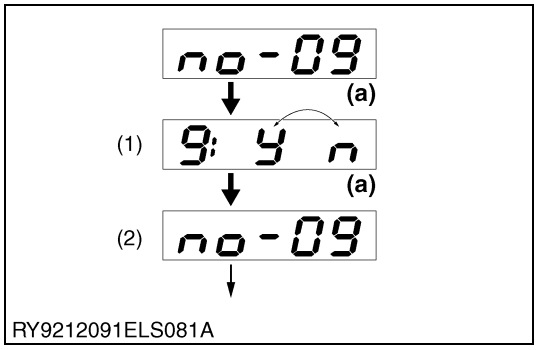
Guide to No-08 Periodic Inspection Offset Time Adjustment

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

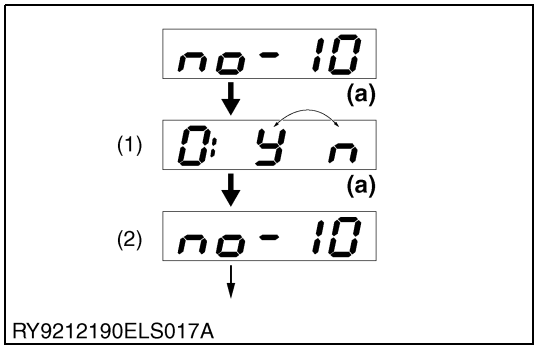
Guide to No-09 Requesting to Set Time for Guidance Display

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



RY9212190ELS017A

Guide to No-10 Travel Alarm Function

Procedure for changing ON/OFF setting for the travel alarm function.

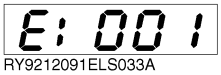
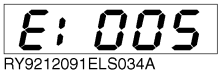
	Explanation of Display	Operation
(1)	Y: ON N: OFF Select YES/NO by pressing SW2 or SW1 The selected item blinks	YES/NO selections Pressing and holding SW2 completes the setting
(2)	Return to No-10 Guide to Travel Alarm Function	The buzzer beeps three times

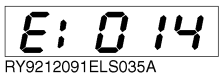
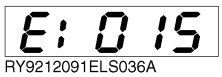
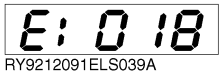
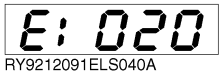
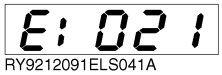
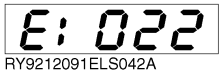
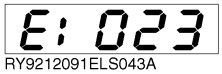
- When the travel alarm is ON, SP adjustment function is not available. Both uses the same electronic signal, which can not be used at the same time.

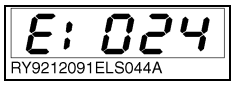
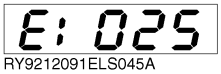
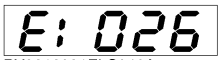
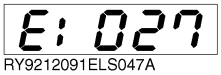
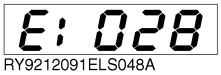
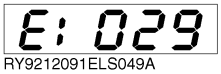
(a) Press and Hold SW2

RY9212190ELS0058US0

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 goes out.
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 goes out.

	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 goes out.
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	AUX knob switch system error  RY9212091ELS042A	 (red) (Blinking)	The AUX knob switch has developed a system fault.	The machine can be operated but the AUX port will not function.
23	AUX R (Port 1) system error  RY9212091ELS043A	 (red) (Blinking)	AUX port right solenoid system has developed a fault.	The machine can be operated but AUX port right will not function.

	LCD display	LED	Problem / Error	Preliminary Measure
24	AUX L (Port 2) system error  RY9212091ELS044A	 (red) (Blinking)	AUX port left solenoid system has developed a fault.	The machine can be operated but AUX port left will not function.
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	Anti theft system error  RY9212091ELS046A	 (red) (Blinking)	There is no response from the anti theft antenna.	The machine cannot be started: if there is more than one key or another metal object on the keyring, remove the key from the ring. If the message does not disappear, it means that the key may be damaged. Try using a spare key.
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 goes out.

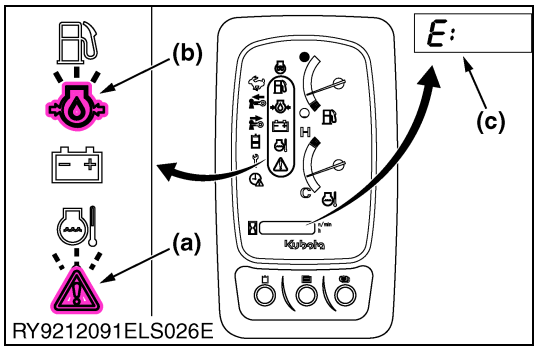
RY9212091ELS0074US0

6. TROUBLESHOOTING (METER PANEL)

[1] ENGINE RELATED SYSTEM

(1) Engine Oil Pressure Error (E:014)

[A] Checking Via the LCD Panel Display



RY9212091ELS026E

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)

RY9212091ELS0097US0

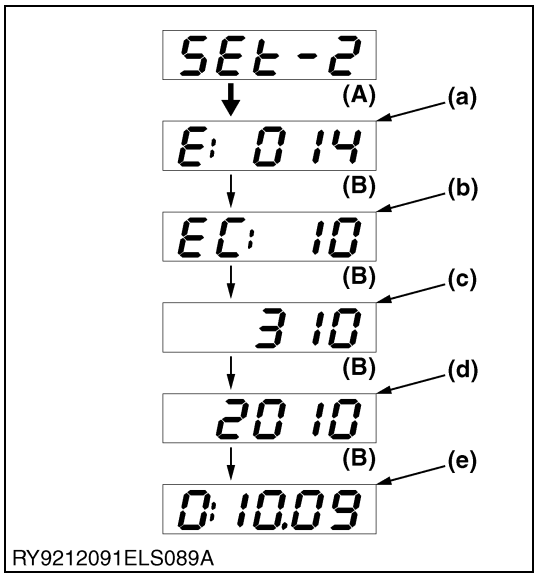
[Test Conditions]

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

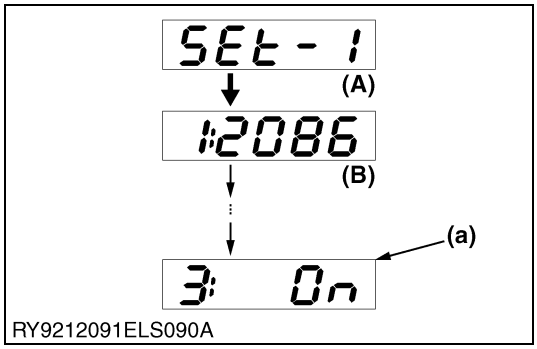
2. Reading the Error History

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

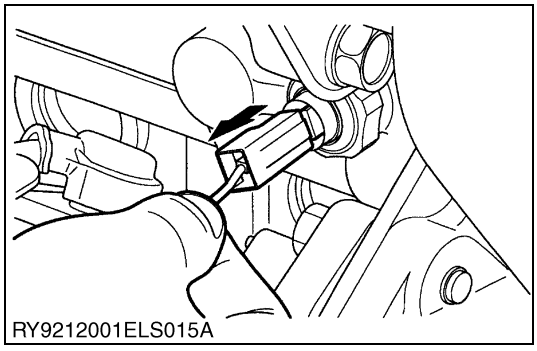
1. Checking fuses is not necessary.

RY9212001ELS0008US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0


RY9212001ELS015A

3. Cause of Disconnects

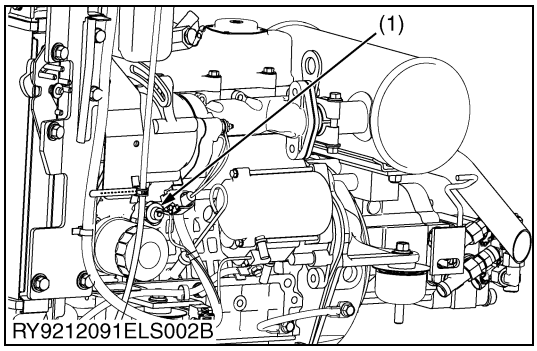
[Inspection Conditions]

1. Key switch: STOP
2. Engine oil switch connector CN28 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

RY9212091ELS0101US0



RY9212091ELS002B

4. Cause of Short

[Inspection Conditions]

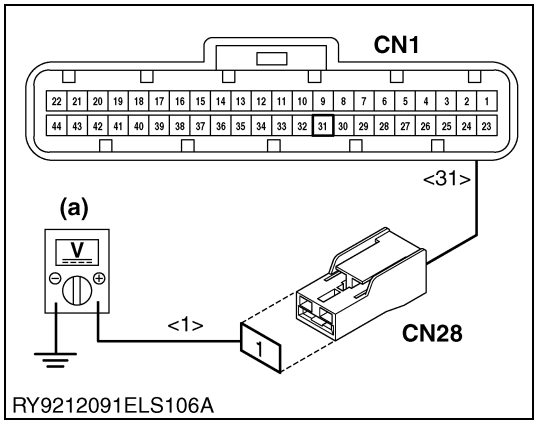
1. Key switch: STOP
2. One of the engine oil switch wires is pinched against or is touching the body.
   If the insulation is stripped, repair it properly and check the operation of the engine oil switch again in the tester mode.

Assessment Criteria
Normal: Not shorted
Error: Shorted

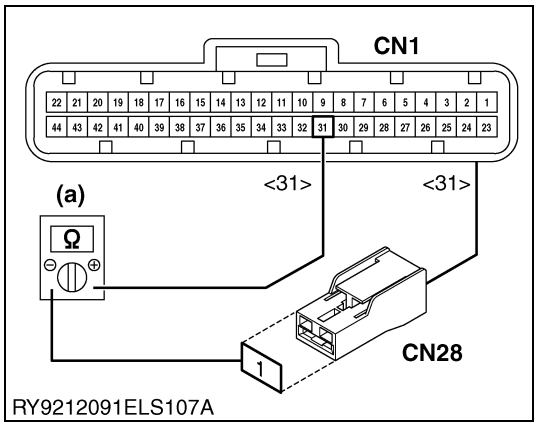
(1) Engine Oil Switch

RY9212091ELS0102US0

[C] Testing with a Circuit Tester



RY9212091ELS106A



RY9212091ELS107A

1. Checking the Voltage

[Test Conditions]

1. Disconnect engine oil switch connector CN28.
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 CN28	<1>	Body ground	–

Normal: 12V (battery voltage)
Error: Greatly different from 12 V

RY9212091ELS0103US0

2. Checking Continuity

[Test Conditions]

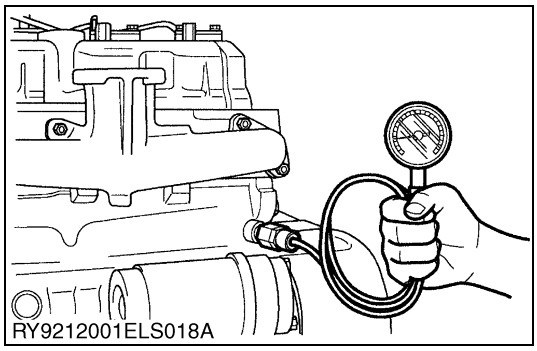
1. Key switch: STOP
2. Disconnect the main ECU connector CN1.
3. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Engine oil switch connector CN28	<1>	Main ECU connector CN1	<31>

Normal: Continuous
Error: Not continuous

RY9212091ELS0104US0

[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

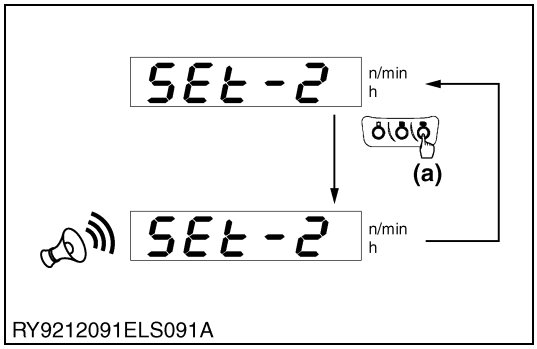
Assessment Criteria
Normal: Within allowable limits
Error: Outside allowable limits

RY9212091ELS0204US0

2. Settings after replacing device

1. No settings required.

RY9212001ELS0013US0



RY9212091ELS091A

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	Assessment Results
Normal: Error history cleared (OK)	
Error: Error history failed to clear (NG)	

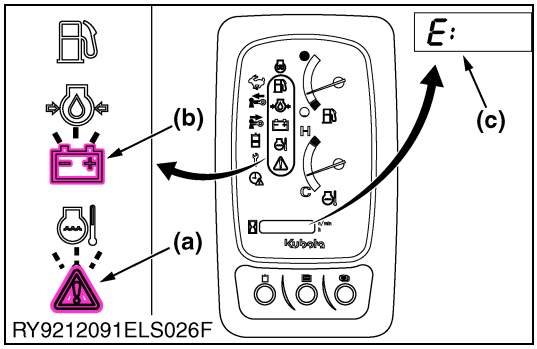
- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

(a) Press and hold SW2

RY9212091ELS0105US0

(2) Charging System Error (E:016)

[A] Checking Via the LCD Panel Display



RY9212091ELS026F

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)

RY9212091ELS0106US0

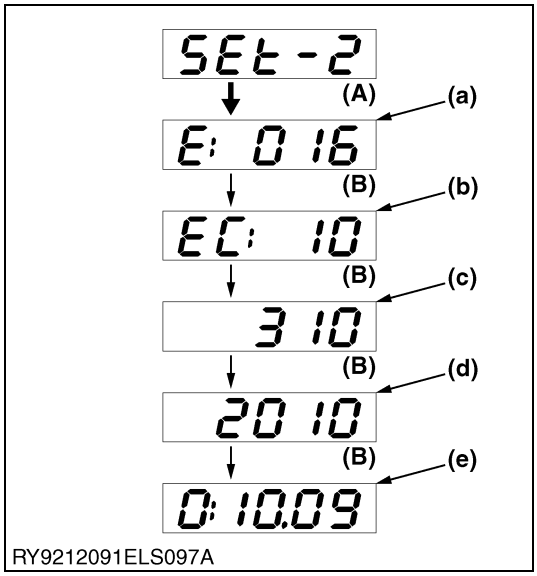
[Inspection Conditions]

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

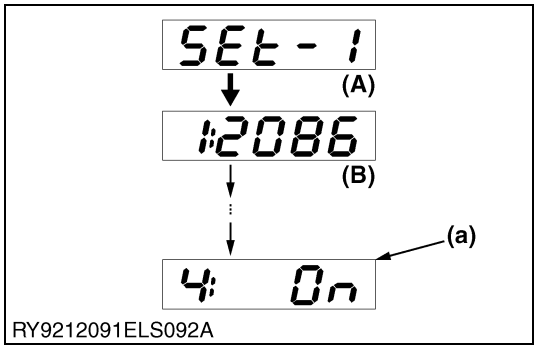
2. Reading the Error History

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.

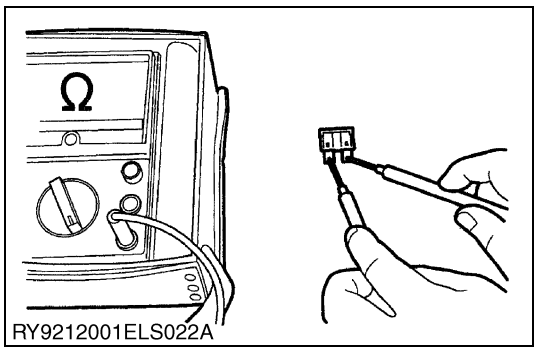
	Nor-mal	Charg-ing lamp	Dis-con-nected	Charg-ing lamp	Shorted	Charg-ing lamp
Key Off	OFF	Not lit	OFF	Not lit	OFF	Not lit
Key On	ON	Lit	OFF	Not lit	ON	Lit
Key Start	OFF	Not lit	OFF	Not lit	ON	Lit

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

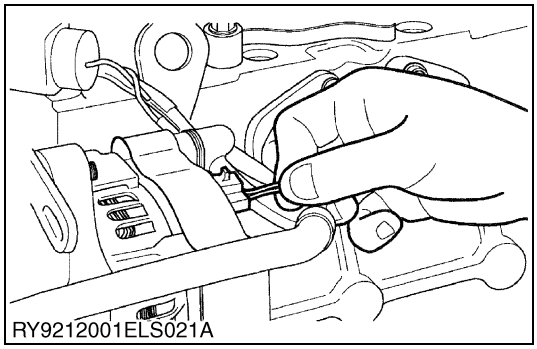
Check whether the alternator fuse (10A) is blown.

RY9212001ELS0064US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0


RY9212001ELS021A

3. Cause of Disconnects

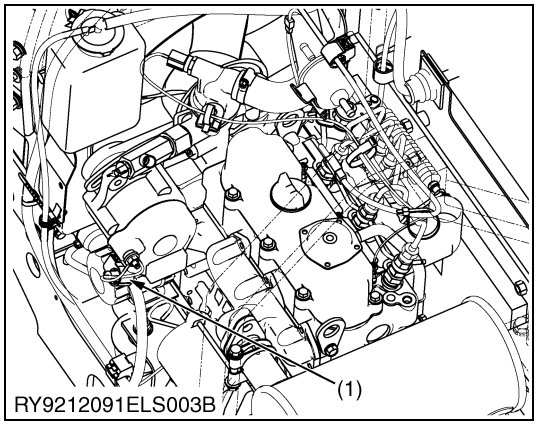
[Inspection Conditions]

1. Key switch: STOP
2. Charging switch connector CN25 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

RY9212091ELS0110US0



4. Cause of Short

[Inspection Conditions]

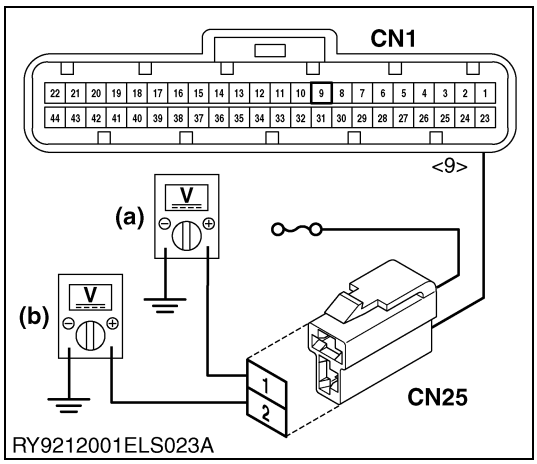
1. Key switch: STOP
2. One of the wires of the charging switch connector CN25 is pinched against or is touching the body.
   If the insulation is stripped, repair it properly and check the operation of the charging switch again in the tester mode.

Assessment Criteria
Normal: Not shorted
Error: Shorted

(1) Alternator Connector

RY9212091ELS0111US0

[C] Testing with a Circuit Tester



1. Checking the Voltage

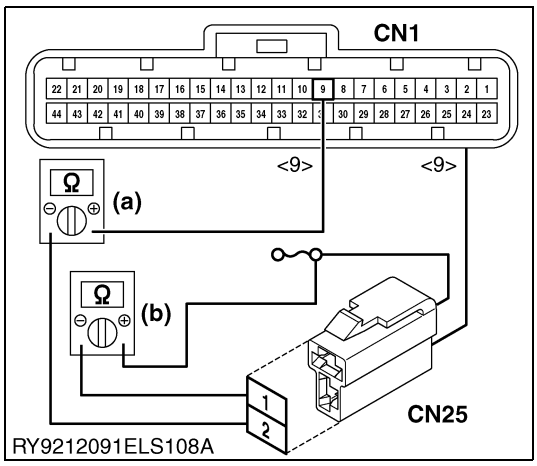
[Test Conditions]

1. Disconnect charging switch connector CN25.
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 CN25	<1>	Body ground	–
(b)	Alternator connector CN25	<2>	Body ground	–

Normal: 12 V
Error: Greatly different from 12 V

RY9212091ELS0112US0



2. Checking Continuity

[Test Conditions]

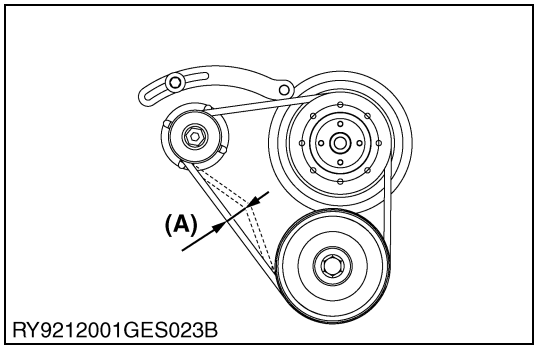
1. Key switch: STOP
2. Disconnect the main ECU connector CN1.
3. Remove the alternator fuse (10A).
4. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Alternator connector CN25	<2>	Main ECU connector CN1	<9>
(b)	Alternator fuse (10A)	–	Alternator connector CN25	<1>

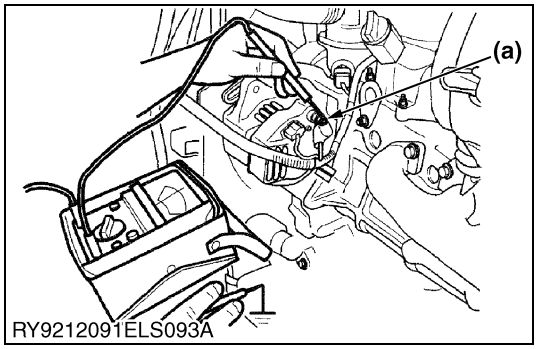
Normal: Continuous
Error: Not continuous

RY9212091ELS0113US0

[D] Testing the Equipment Itself



RY9212001GES023B



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 12V, 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 12V), then the alternator itself or the regulator is faulty.

Criteria
Normal : Within factory specification
Error : Outside factory specification

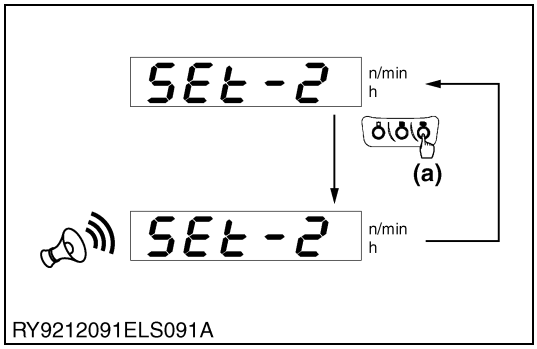
(A) Displacement 7 to 9 mm (0.3 to 0.4 in.) **(a) Terminal B**

RY9212091ELS0114US0

2. Settings after replacing device

1. No settings required.

RY9212001ELS0013US0



RY9212091ELS091A

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	Assessment Results
Normal: Error history cleared (OK)	
Error: Error history failed to clear (NG)	

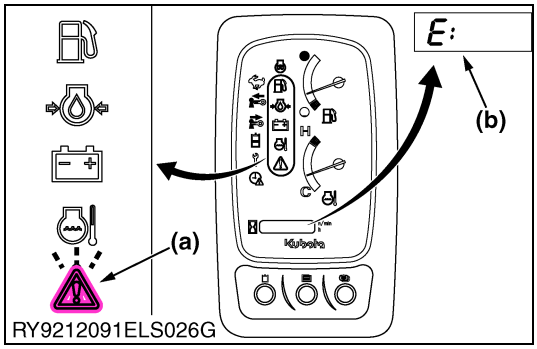
- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

(a) Press and hold SW2

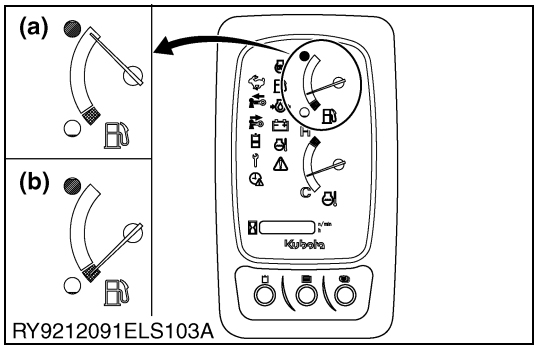
RY9212091ELS0105US0

(3) Fuel Sensor Error (E:017)

[A] Checking Via the LCD Panel Display



RY9212091ELS026G



RY9212091ELS103A

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)

RY9212091ELS0115US0

[Inspection Conditions]

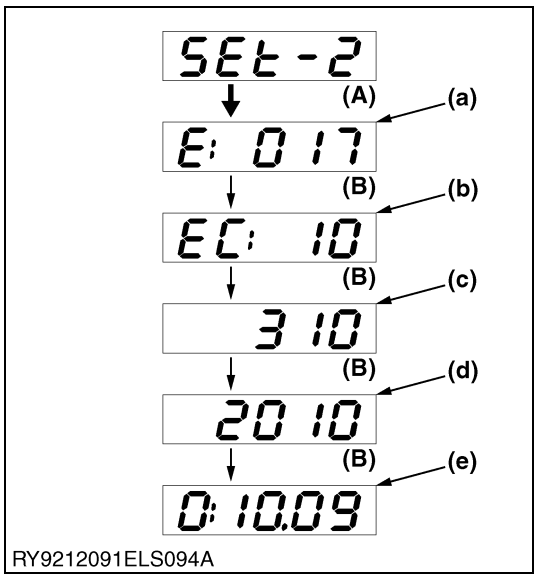
1. Key switch: RUN

Assessment Criteria	Assessment Results
Normal: Not disconnected (OK)	
Error: Disconnected (NG)	
Error: Shorted (NG)	

(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

RY9212091ELS0116US0



RY9212091ELS094A

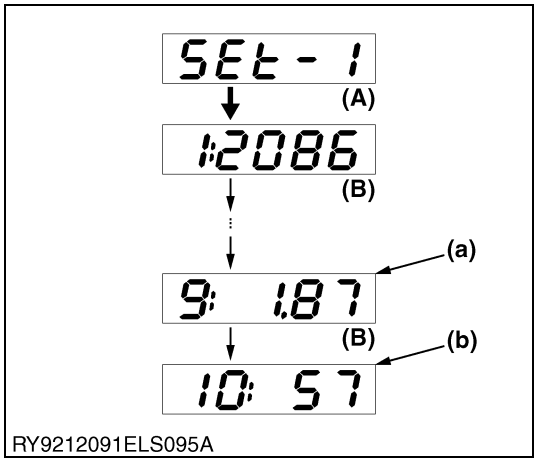
2. Reading the Error History

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

RY9212091ELS005B

3. Cause of Disconnects

[Inspection Conditions]
1. Key switch: STOP
2. Fuel sensor connector CN23 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

RY9212091ELS0119US0

RY9212091ELS005B

4. Causes when a short

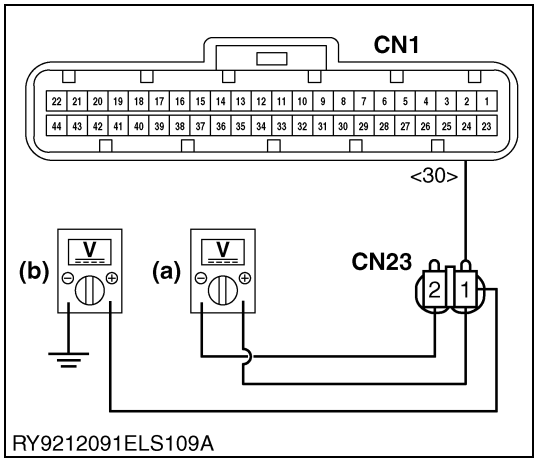
[Test Conditions]
1. Key switch : STOP
2. The fuel sensor wire is pinched against or touching the body. If the insulation is damaged, repair it properly and check the voltage and resistance for the fuel again in the tester mode.

Criteria
Normal : no short
Error : shorted

(1) Fuel Sensor

RY9212091ELS0120US0

[C] Testing with a Circuit Tester



RY9212091ELS109A

1. Checking the Voltage

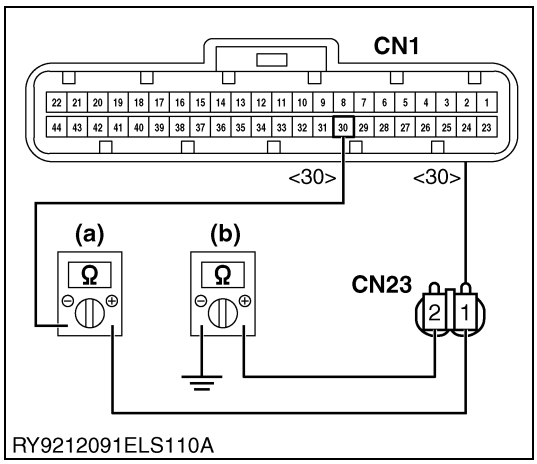
[Test Conditions]

1. Disconnect fuel sensor connector CN23.
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 CN23	<1>	Fuel sensor connector CN23	<2>
(b)	Fuel sensor connector CN23	<1>	Body ground	–

Normal: About 0.8 V
Error: Greatly different from 0.8 V

RY9212091ELS0121US0



RY9212091ELS110A

2. Checking Continuity

[Test Conditions]

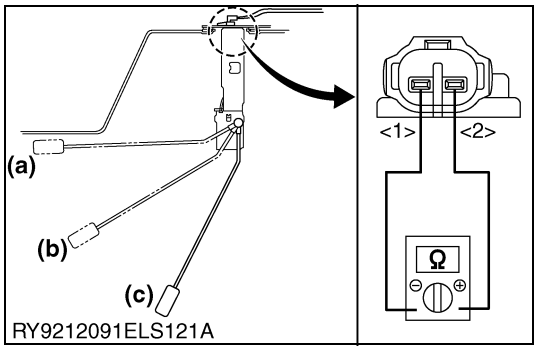
1. Key switch: STOP
2. Disconnect the main ECU connector CN1.
3. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Fuel sensor connector CN23	<1>	Main ECU connector CN1	<30>
(b)	Fuel sensor connector CN23	<2>	Body ground	–

Normal: Continuous
Error: Not continuous

RY9212091ELS0122US0

[D] Checking the Equipment Itself



RY9212091ELS121A

1. Inspecting the Fuel Sensor

[Test Conditions]

1. Key switch: STOP
2. Disconnect connector CN23 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

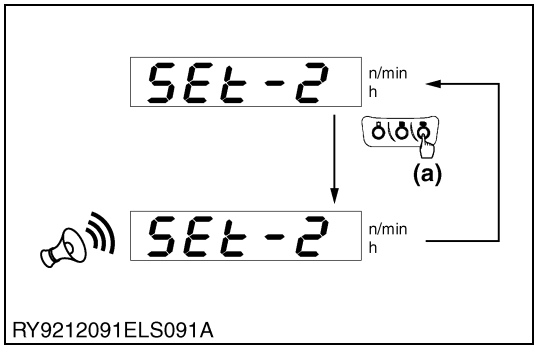
(a) Full Tank
(b) Half Tank
(c) Empty

RY9212091ELS0123US0

2. Settings after replacing device

1. No settings required.

RY9212001ELS0013US0



RY9212091ELS091A

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	Assessment Results
Normal: Error history cleared (OK)	
Error: Error history failed to clear (NG)	

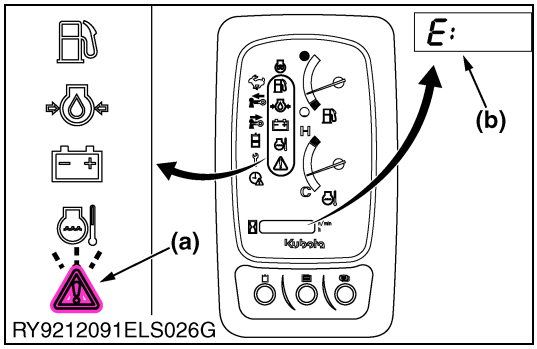
- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

(a) Press and hold SW2

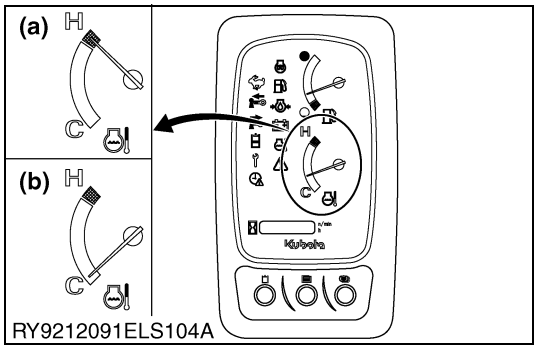
RY9212091ELS0105US0

(4) Water Temperature Sensor Error (E:018)

[A] Checking Via the LCD Panel Display



RY9212091ELS026G



RY9212091ELS104A

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)

RY9212091ELS0124US0

[Inspection Conditions]

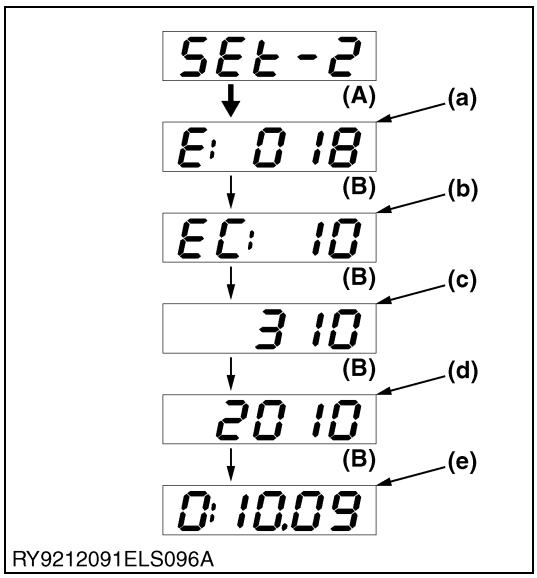
1. Key switch: RUN

Assessment Criteria	Assessment Results
Normal: Not disconnected (OK)	
Error: Disconnected (NG)	
Error: Shorted (NG)	

(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.

RY9212091ELS0125US0



RY9212091ELS096A

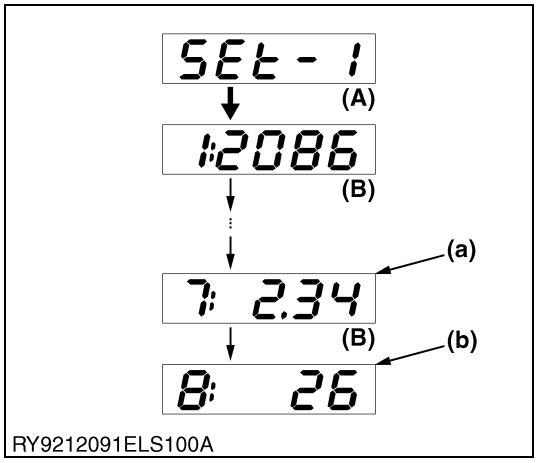
2. Reading the Error History

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

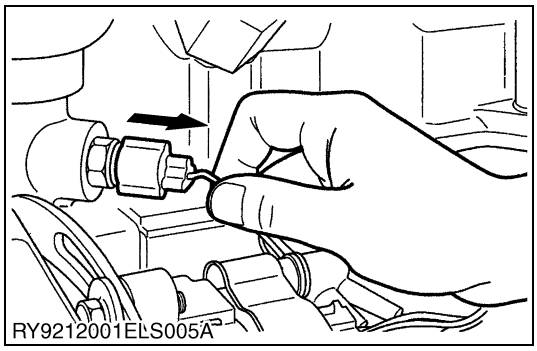
1. Checking fuses is not necessary.

RY9212001ELS0008US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0


RY9212001ELS005A

3. Cause of Disconnects

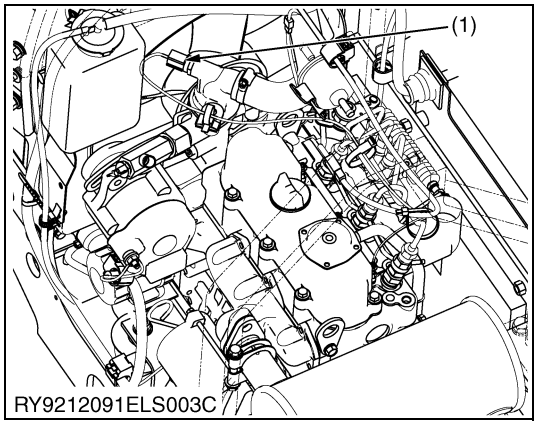
[Inspection Conditions]

1. Key switch: STOP
2. Water temperature sensor connector CN32 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

RY9212091ELS0128US0



RY9212091ELS003C

4. Cause of Short

[Inspection Conditions]

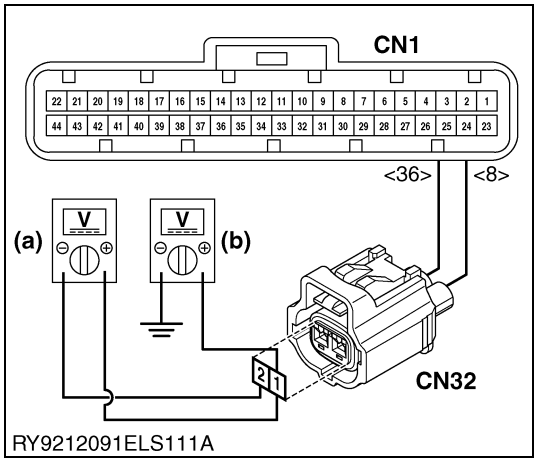
1. Key switch: STOP
2. One of the water temperature sensor wires is pinched against or is touching the body.
   If the insulation is stripped, repair it properly and check the water temperature sensor voltage and temperature again in the tester mode.

Assessment Criteria
Normal: Not shorted
Error: Shorted

(1) Water Temperature Sensor

RY9212091ELS0129US0

[C] Testing with a Circuit Tester



1. Checking the Voltage

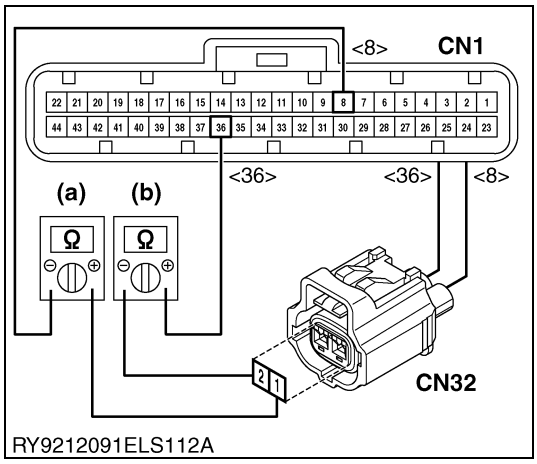
[Test Conditions]

1. Disconnect the water temperature sensor connector CN32.
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 CN32	<1>	Water temperature sensor connector CN32	<2>
(b)	Water temperature sensor connector CN32	<1>	Body ground	–

Normal: 5 V
Error: Greatly different from 5 V

RY9212091ELS0130US0



2. Checking Continuity

[Test Conditions]

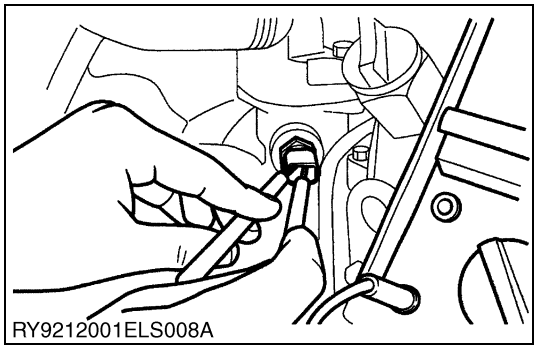
1. Key switch: STOP
2. Disconnect the main ECU connector CN1.
3. Test continuity as per the table below.

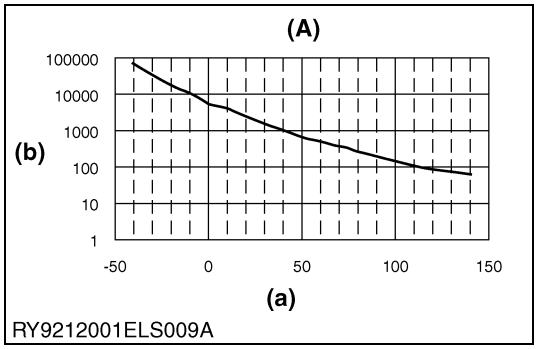
Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Water temperature sensor connector CN32	<1>	Main ECU connector CN1	<8>
(b)	Water temperature sensor connector CN32	<2>	Main ECU connector CN1	<36>

Normal: Continuous
Error: Not continuous

RY9212091ELS0131US0

[D] Checking the Equipment Itself


RY9212001ELS008A



RY9212001ELS009A

1. Inspecting the Water Temperature Sensor

[Test Conditions]

1. Key switch: STOP
2. Disconnect connector CN32 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

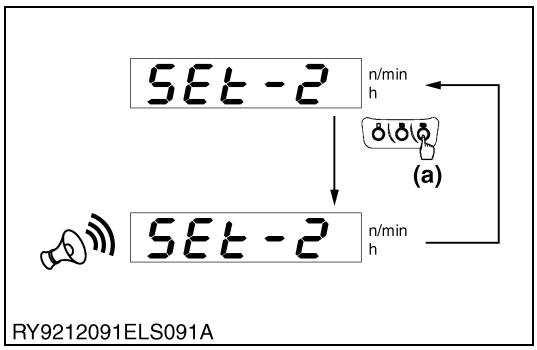
(A) Water Temperature and Resistance
(a) Temperature (°C)
(b) Resistance (Ω)

RY9212091ELS0132US0

2. Settings after replacing device

1. No settings required.

RY9212001ELS0013US0



RY9212091ELS091A

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	Assessment Results
Normal: Error history cleared (OK)	
Error: Error history failed to clear (NG)	

- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

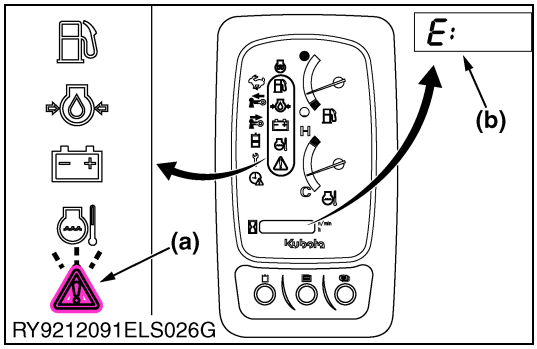
(a) Press and hold SW2

RY9212091ELS0105US0

[2] MACHINE RELATED SYSTEM

(1) Lever Lock System Error (E:020)

[A] Checking Via the LCD Panel Display



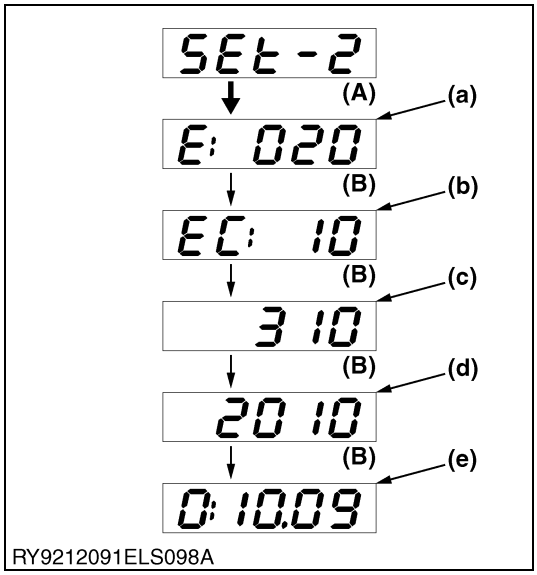
RY9212091ELS026G

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)

RY9212091ELS0133US0



RY9212091ELS098A

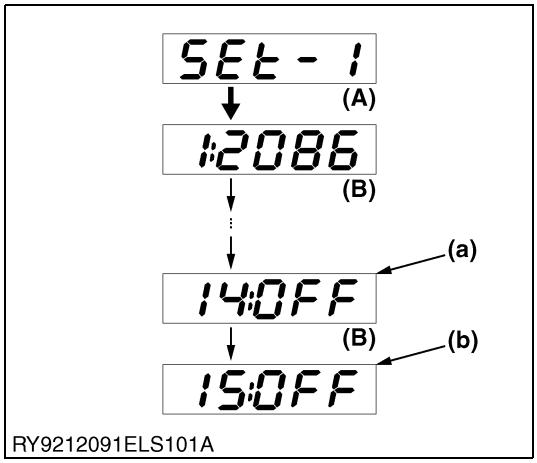
2. Reading the Error History

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



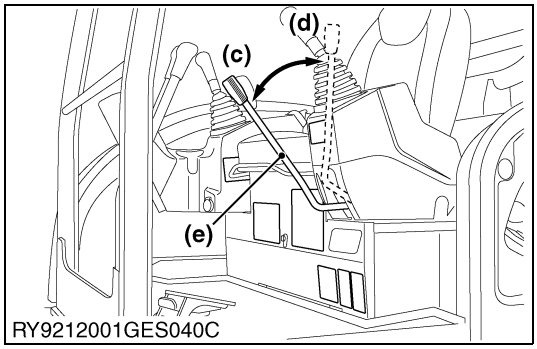
RY9212091ELS101A

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	OFF	ON

Assessment Criteria
Normal: Not disconnected
Error: Disconnected
Error: Shorted

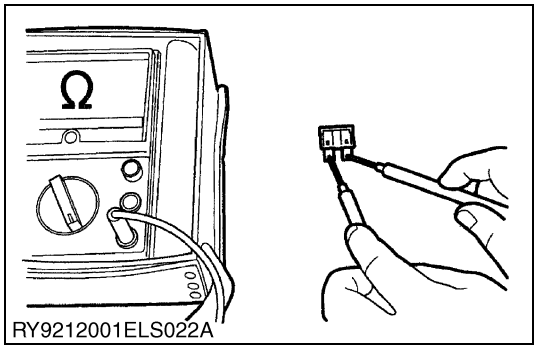


RY9212001GES040C

(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

RY9212091ELS0135US0

[B] Inspecting Each Device Visually and Physically



1. Checking fuses

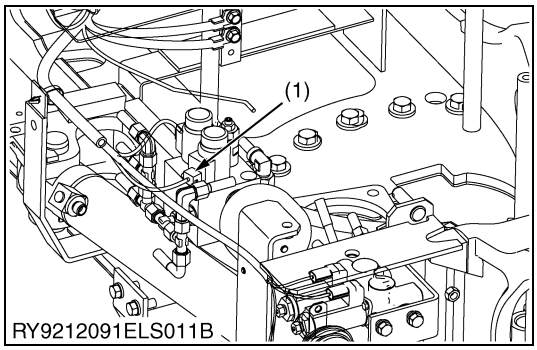
1. Check whether the 5A lever lock fuse is blown.

RY9212001ELS0088US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0

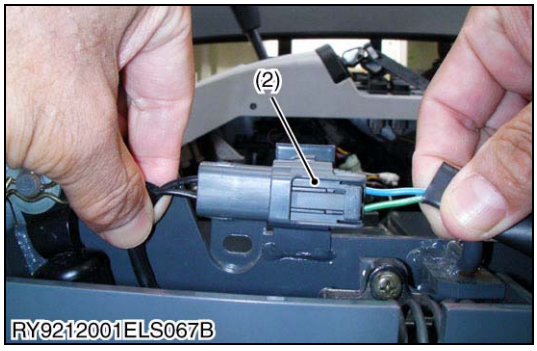


3. Cause of Disconnects

[Inspection Conditions]

1. Key switch: STOP
2. Lever lock switch connector CN11 disconnected.
3. Lever lock solenoid connector CN12 disconnected.
4. Break of wiring continuity somewhere in the middle.

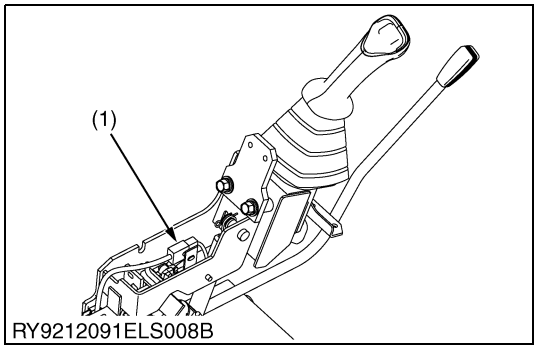
Pull on the harness bundle and make sure the harness does not come unplugged. [Pull with a maximum force of 3 kgf (30 N, 7 lbf)] If it comes unplugged, plug the connector back in and check the operation of the lever lock switch and solenoid in the tester mode again.



Assessment Criteria	Assessment Results
Normal: Not disconnected (OK)	
Error: Disconnected (NG)	

(1) Lever lock solenoid connector CN12 (2) Lever lock switch connector CN11

RY9212091ELS0136US0



4. Cause of Short

[Inspection Conditions]

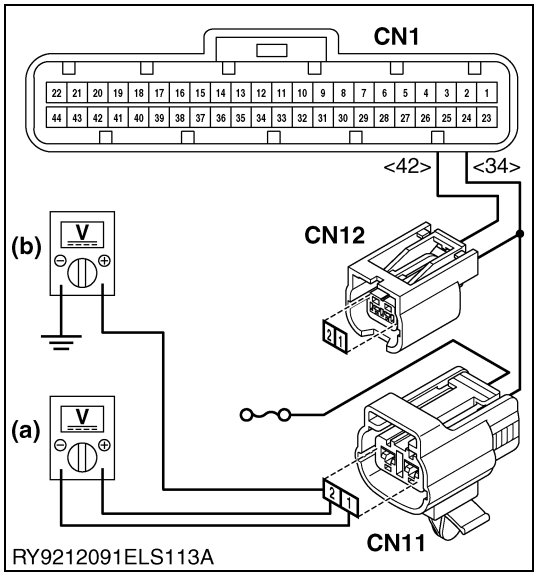
1. Key switch: STOP
2. One of the wires of the lever lock switch connector CN11 and/or lever lock solenoid connector CN12 is pinched against or is touching the body.
   If the insulation is stripped, repair it properly and check the operation of the lever lock switch and solenoid again in the tester mode.

Assessment Criteria
Normal: Not shorted
Error: Shorted

(1) Lever Lock Switch Connector CN11

RY9212091ELS0137US0

[C] Testing with a Circuit Tester



RY9212091ELS113A

1. Checking the Voltage (Lever Lock Switch)

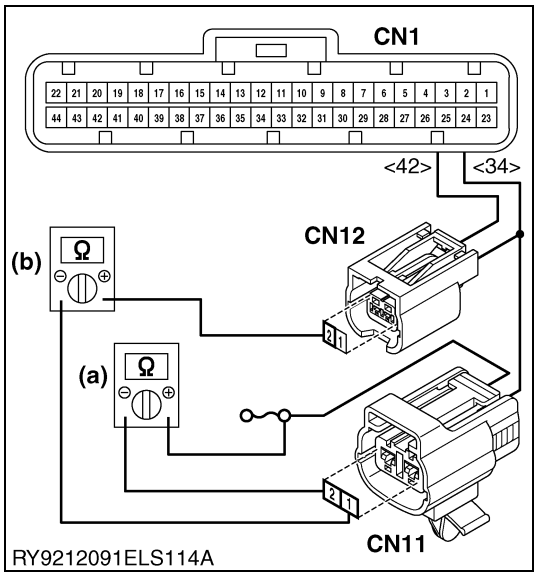
[Test Conditions]

1. Disconnect the lever lock switch connector CN11.
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 CN11	<2>	Lever lock switch connector CN11	<1>
(b)	Lever lock switch connector CN11	<2>	Body ground	–

Normal: 12 V
Error: Greatly different from 12 V

RY9212091ELS0138US0



RY9212091ELS114A

2. Checking Continuity (Lever Lock Switch)

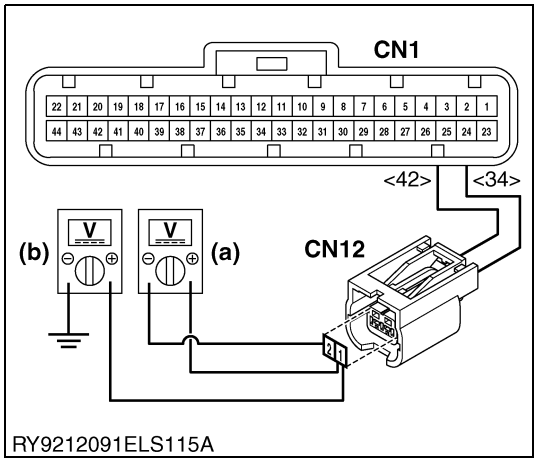
[Test Conditions]

1. Key switch: STOP
2. Disconnect lever lock switch connector CN11 and lever lock solenoid connector CN12.
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 CN11	<2>
(b)	Lever lock solenoid connector CN12	<2>	Lever lock switch connector CN11	<1>

Normal: Continuous
Error: Not continuous

RY9212091ELS0139US0



RY9212091ELS115A

3. Checking the Voltage (Lever Lock Solenoid)

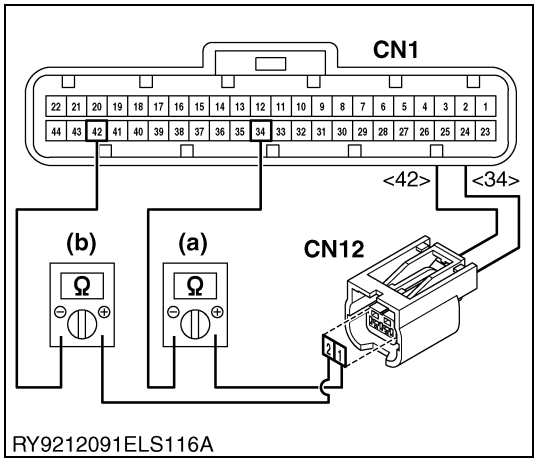
[Test Conditions]

1. Leaving the lever lock switch CN11 connected, disconnect lever lock solenoid connector CN12.
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 CN12	<1>	Lever lock solenoid connector CN12	<2>
(b)	Lever lock solenoid connector CN12	<1>	Body ground	–

Normal: 12 V
Error: Greatly different from 12 V

RY9212091ELS0140US0



RY9212091ELS116A

4. Checking Continuity (Lever Lock Solenoid)

[Test Conditions]

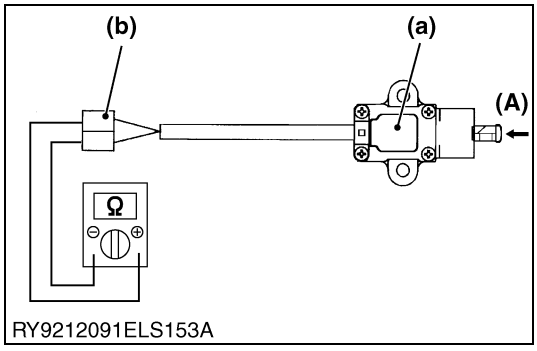
1. Key switch: STOP
2. Disconnect the main ECU connector CN1.
3. Disconnect the lever lock solenoid connector CN12.
4. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Lever lock solenoid connector CN12	<1>	Main ECU connector CN1	<34>
(b)	Lever lock solenoid connector CN12	<2>	Main ECU connector CN1	<42>

Normal: Continuous
Error: Not continuous

RY9212091ELS0141US0

[D] Checking the Equipment Itself



RY9212091ELS153A

1. Inspecting the Lever Lock Switch

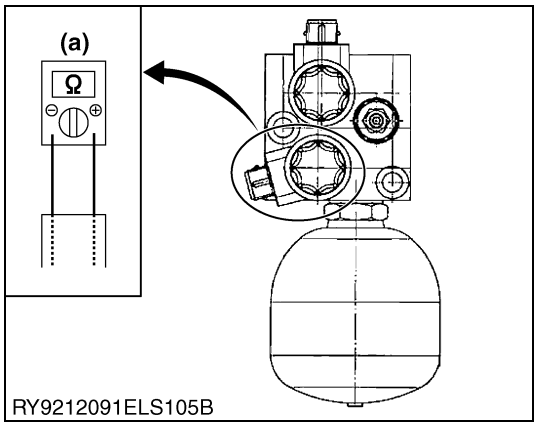
[Inspection Conditions]

1. Key switch: STOP
2. Disconnect the lever lock switch connector CN11 from the machine, press the switch and check for simple continuity.

Assessment Criteria
Normal: Not disconnected
Error: Disconnected

(a) Lever Lock Switch
(b) Lever Lock Switch Connector
(A) Press the Switch

RY9212091ELS0142US0



RY9212091ELS105B

2. Inspecting the Lever Lock Solenoid

[Inspection Conditions]

1. Key switch: STOP
2. Disconnect lever lock solenoid connector CN12 from the equipment and test the solenoid independently.

Lever lock solenoid	Factory Specification	12 Ω ± 10 %

Assessment Criteria	Assessment Results
Normal: Not disconnected (OK)	
Error: Disconnected (NG)	

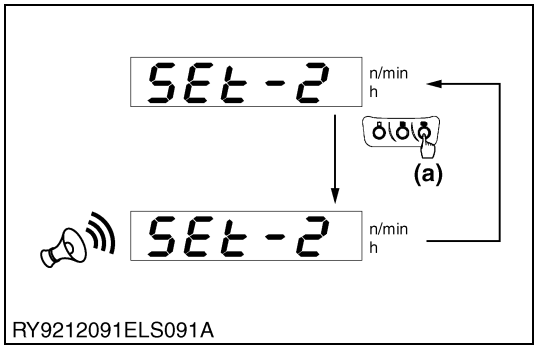
(a) Lever lock solenoid terminals

RY9212091ELS0143US0

3. Settings after replacing device

1. No settings required.

RY9212001ELS0020US0



RY9212091ELS091A

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	Assessment Results
Normal: Error history cleared (OK)	
Error: Error history failed to clear (NG)	

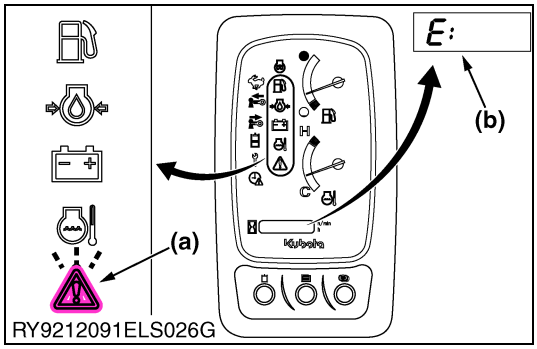
- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

(a) Press and hold SW2

RY9212091ELS0205US0

(2) Travel 2-Speed System Error (E:021) (Other than KX015-4)

[A] Checking Via the LCD Panel Display



RY9212091ELS026G

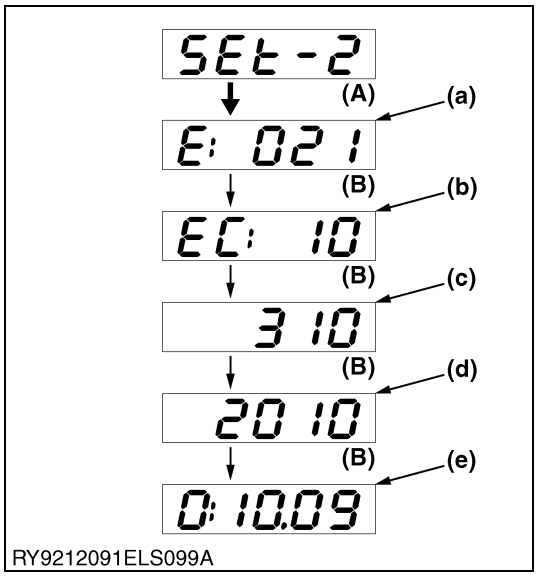
1. LCD Panel Display Content

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)

RY9212091ELS0144US0



RY9212091ELS099A

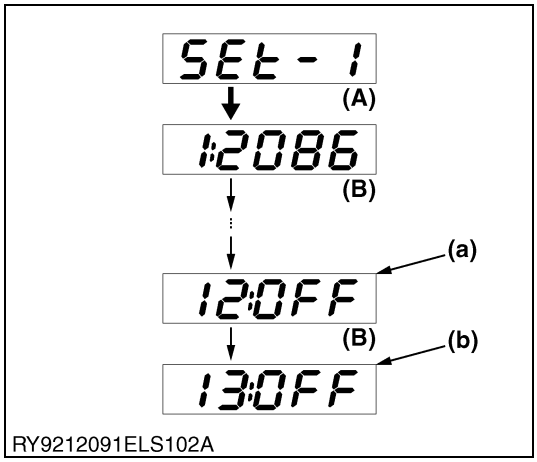
2. Reading the Error History

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.

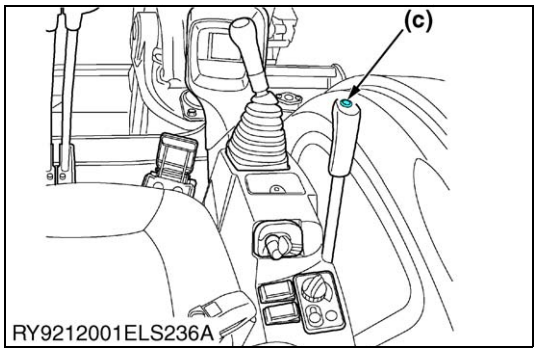
E.g.) Given a history with the last error on October 9, 2010 at 310 hours.

(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	OFF	Not lit
2-speed solenoid ON	ON	Lit	OFF	Lit	OFF	Not lit
2-speed solenoid OFF	OFF	Not lit	ON	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

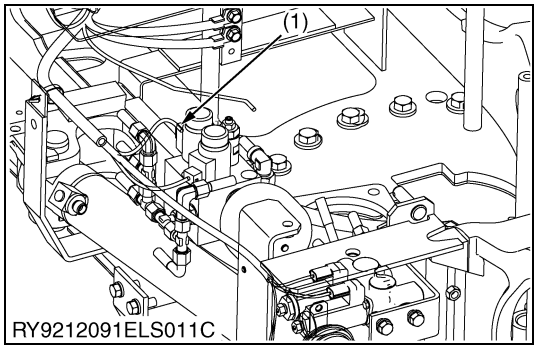
1. Checking fuses is not necessary.

RY9212001ELS0008US0

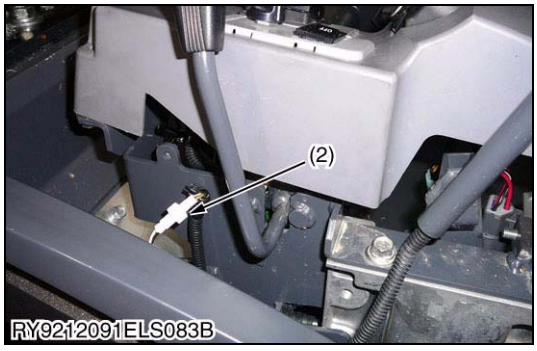
2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0



RY9212091ELS011C



RY9212091ELS083B

3. Cause of Disconnects

[Inspection Conditions]

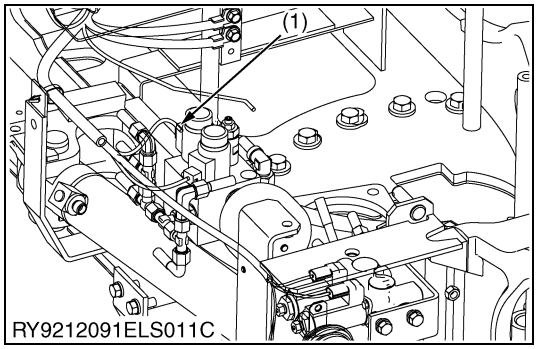
1. Key switch: STOP
2. 2-speed solenoid connector CN13 disconnected.
3. 2-speed switch connector CN15 disconnected.
4. Break of wiring continuity somewhere in the middle.

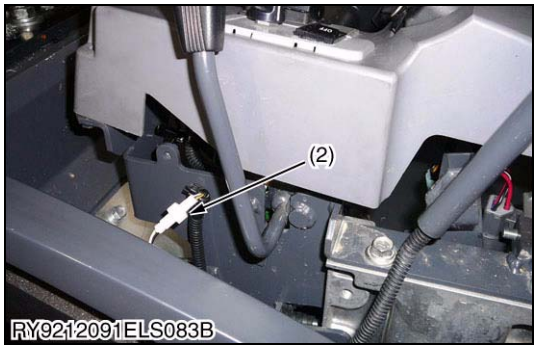
Pull on the harness bundle and make sure the harness does not come unplugged. [Pull with a maximum force of 3 kgf (30 N, 7 lbf)] If it comes unplugged, plug the connector back in and check the 2-speed switch and solenoid in the tester mode again.

Assessment Criteria	Assessment Results
Normal: Not disconnected (OK)	
Error: Disconnected (NG)	

(1) 2-speed solenoid connector CN13 (2) 2-speed switch connector CN15

RY9212091ELS0147US0





4. Cause of Short

[Inspection Conditions]

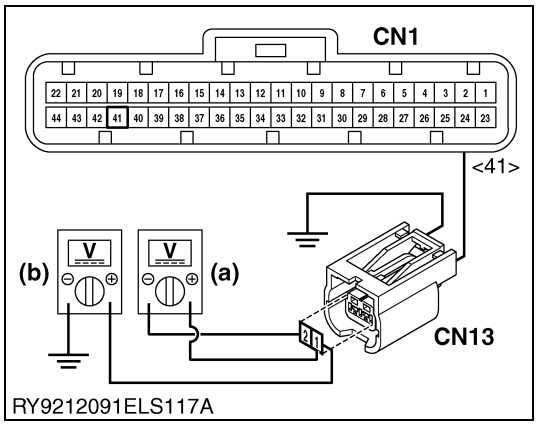
1. Key switch: STOP
2. One of the wires of the 2-speed switch connector CN15 and/or 2-speed solenoid connector CN13 is pinched against or is touching the body
   If the insulation is stripped, repair it properly and check the 2-speed solenoid and switch again in the tester mode.

Assessment Criteria	Assessment Results
Normal: Not shorted (OK)	
Error: Shorted (NG)	

(1) 2-speed solenoid connector CN13 (2) 2-speed switch connector CN15

RY9212091ELS0148US0

[C] Testing with a Circuit Tester



1. Checking the Voltage (2-Speed Solenoid)

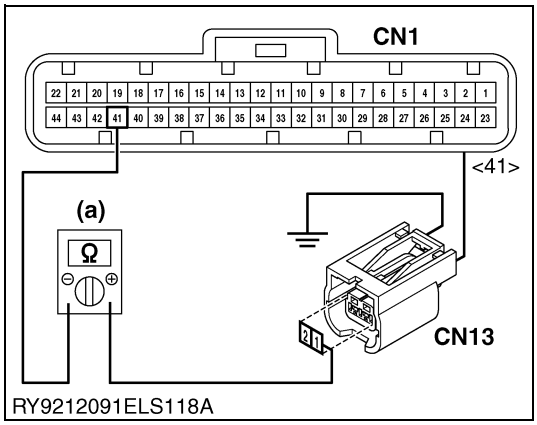
[Test Conditions]

1. Disconnect the travel 2-speed solenoid connector CN13.
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 CN13	<1>	2-speed solenoid connector CN13	<2>
(b)	2-speed solenoid connector CN13	<1>	Body ground	–

Normal: 12 V
Error: Greatly different from 12 V

RY9212091ELS0149US0



2. Checking Continuity (2-Speed Solenoid)

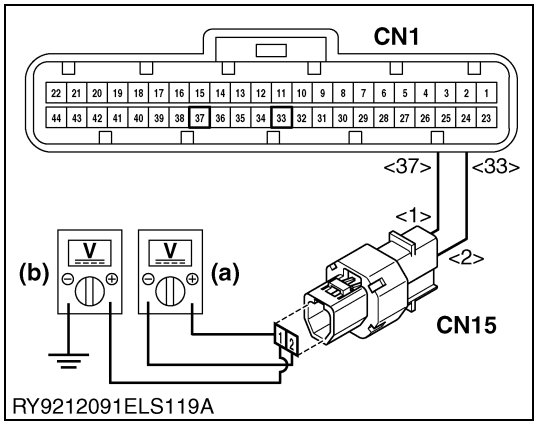
[Test Conditions]

1. Key switch: STOP
2. Disconnect the travel 2-speed solenoid connector CN13.
3. Disconnect the ECU connector CN1.
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 CN13	<1>	Main ECU connector CN1	<41>

Normal: Continuous
Error: Not continuous

RY9212091ELS0150US0



3. Checking the Voltage (2-Speed Switch)

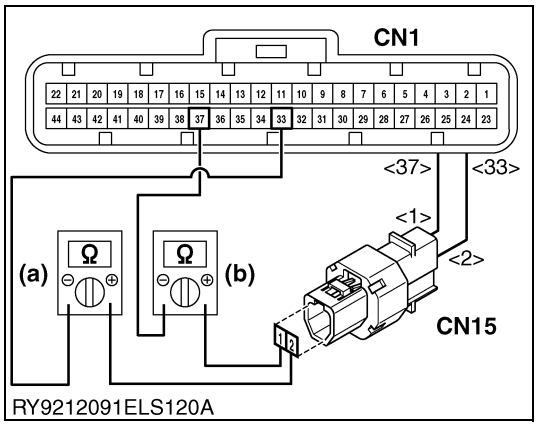
[Test Conditions]

1. Disconnect the 2-speed switch connector CN15.
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 CN15	<1>	2-speed switch connector CN15	<2>
(b)	2-speed switch connector CN15	<1>	Body ground	–

Normal: 12 V
Error: Greatly different from 12 V

RY9212091ELS0151US0



4. Checking Continuity (2-Speed Switch)

[Test Conditions]

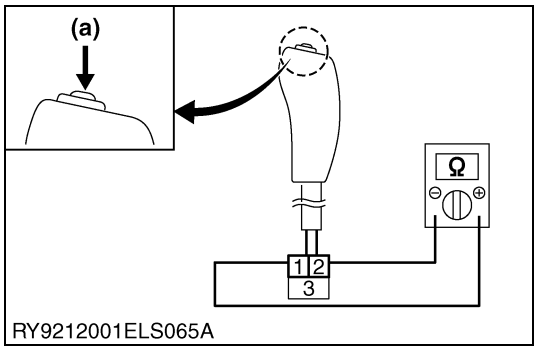
1. Key switch: STOP
2. Disconnect the ECU connector CN1.
3. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	2-speed switch connector CN15	<2>	Main ECU connector CN1	<33>
(b)	2-speed switch connector CN15	<1>	Main ECU connector CN1	<37>

Normal: Continuous
Error: Not continuous

RY9212091ELS0152US0

[D] Checking the Equipment Itself



1. Inspecting the 2-Speed Switch

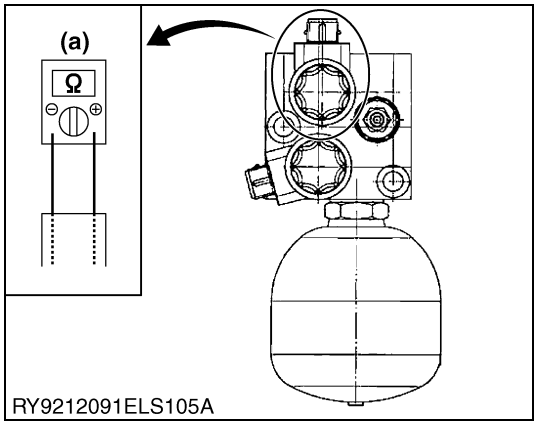
[Inspection Conditions]

1. Key switch: STOP
2. Disconnect the 2-speed switch connector CN15 from the machine, press the switch and check for simple continuity.

Assessment Criteria
Normal: Not disconnected
Error: Disconnected

(a) 2-Speed Switch

RY9212091ELS0153US0



2. Inspecting the 2-Speed Solenoid

[Inspection Conditions]

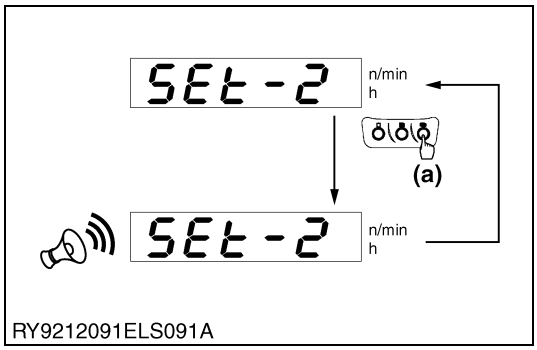
1. Key switch: STOP
2. Disconnect 2-speed solenoid connector CN13 from the equipment and test the solenoid independently.

2-speed solenoid	Factory Specification	8 Ω ± 15 %

Assessment Criteria	Assessment Results
Normal: Within standard range (OK)	
Error: Outside standard range (NG)	

(a) 2-speed solenoid terminal

RY9212091ELS0154US0



RY9212091ELS091A

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	Assessment Results
Normal: Error history cleared (OK)	
Error: Error history failed to clear (NG)	

- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

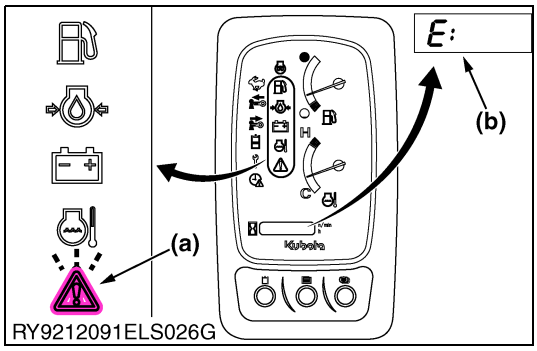
(a) Press and hold SW2

RY9212091ELS0205US0

[3] POWER SUPPLY SYSTEM

(1) Over-Voltage (E:025)

[A] LCD Panel Display Content

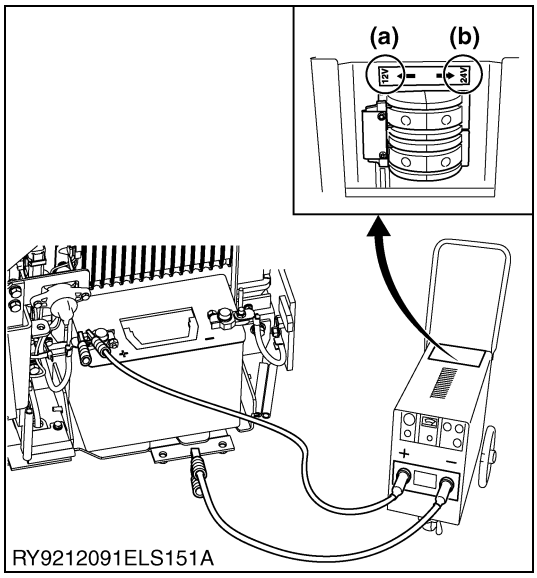


1. LCD Panel Display Content

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)

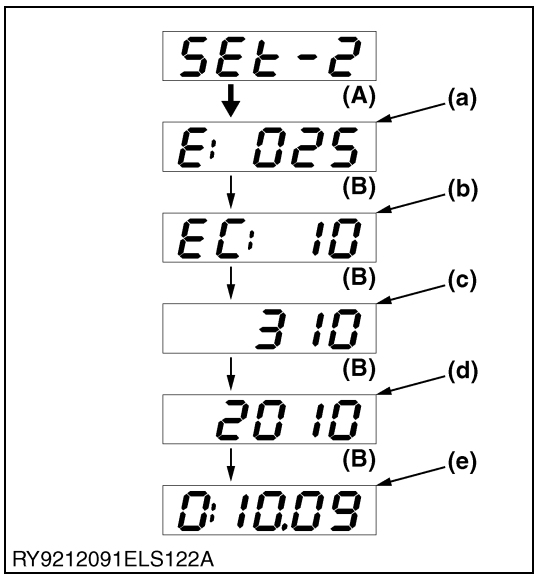
RY9212091ELS0155US0



Check whether the machine has been jump started with a 24 V battery.

(a) 12 V
(b) 24 V

RY9212091ELS0203US0



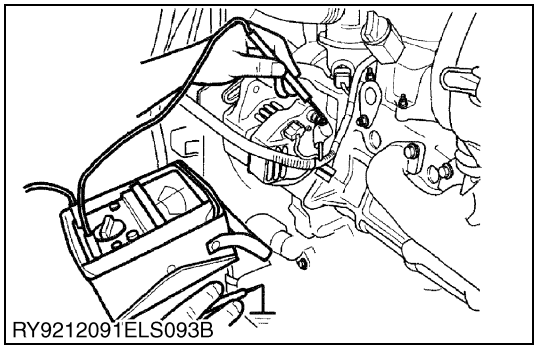
2. Reading the Error History

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

RY9212091ELS0156US0

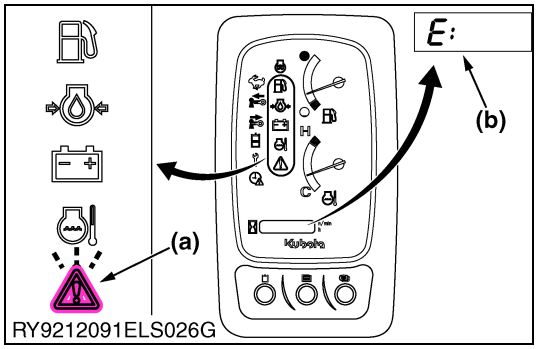

RY9212091ELS093B

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



RY9212091ELS026G

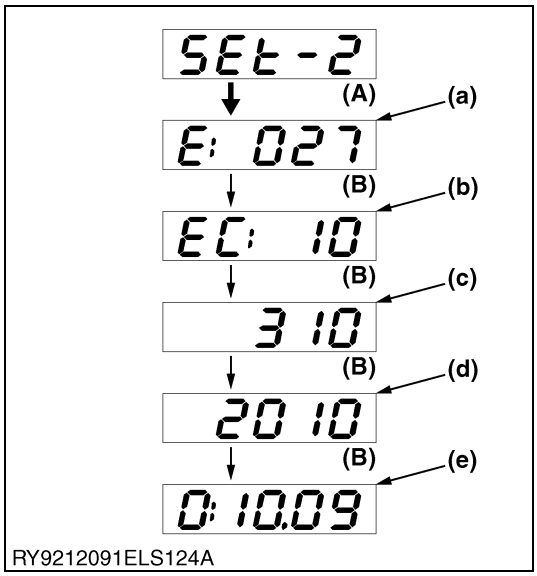
1. LCD Panel Display Content

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)

RY9212091ELS0158US0



RY9212091ELS124A

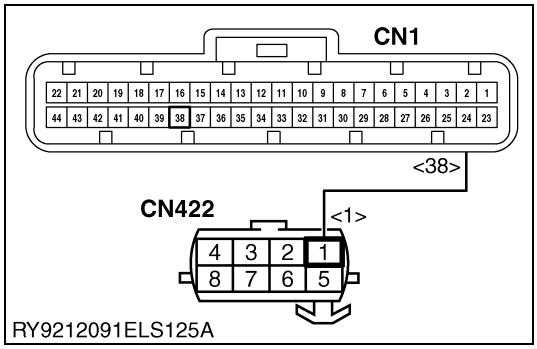
2. Reading the Error History

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



RY9212091ELS125A

3. Inspecting the 5 V Line

[Inspection Conditions]

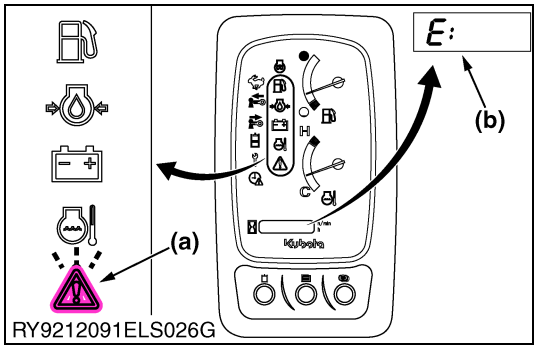
1. Check whether any lines are pinched against or touching the body. If the insulation is stripped, repair it properly and check the meter's display again.

- AUX control connector CN422 (only KX019-4)

RY9212091ELS0160US0

(3) External 12 V Short Error (E:028)

[A] LCD Panel Display Content

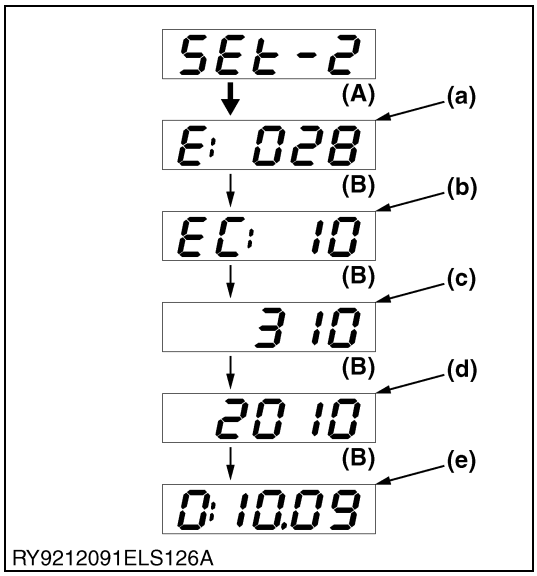


1. LCD Panel Display Content

1. Check if the warning lamp **(a)** on the LCD panel is blinking in red.

(a) Warning lamp
(b) Error message E:028 (12V Short Error)

RY9212091ELS0161US0



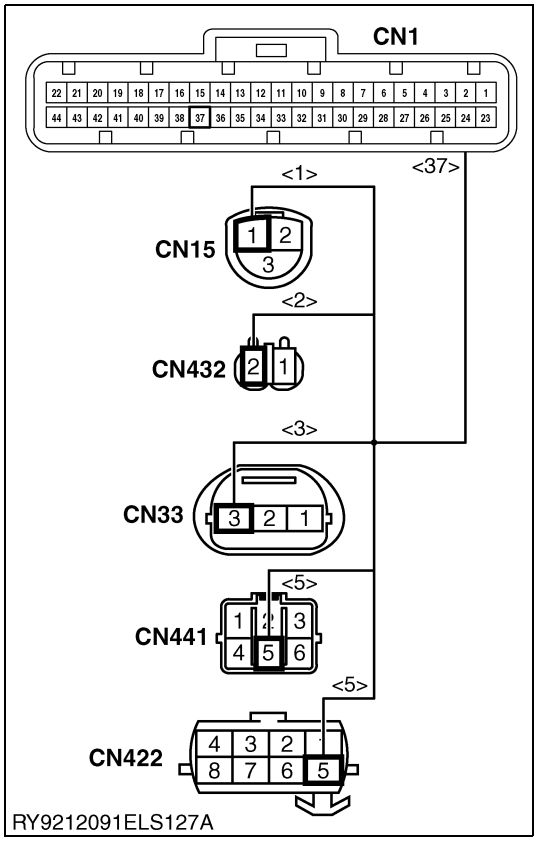
2. Reading the Error History

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



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.

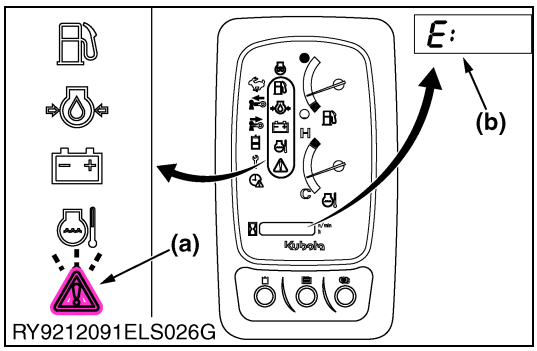
- 2-speed switch connector CN15 (except KX015-4)
- AUX activation switch connector CN432 (only KX019-4)
- Engine RPM sensor connector CN33
- Anti-theft connector CN441
- AUX control connector CN422 (only KX019-4)

RY9212091ELS0163US0

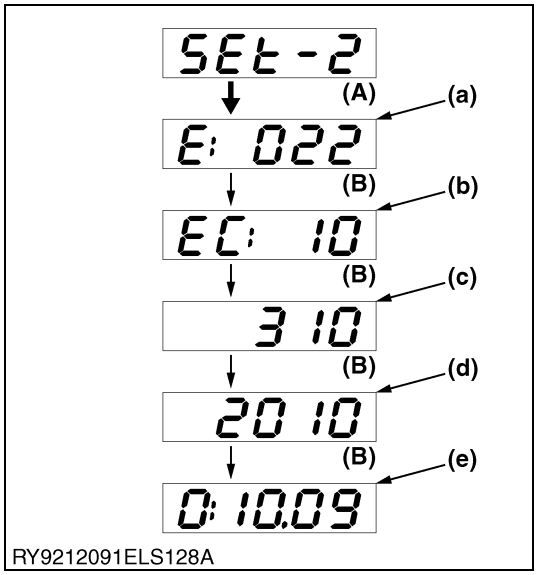
[4] AUX SYSTEM

(1) AUX Knob Error (E:022) (KX019-4 Only)

[A] Checks Using the LCD Panel



RY9212091ELS026G



RY9212091ELS128A

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:022 (AUX knob error)

RY9212091ELS0164US0

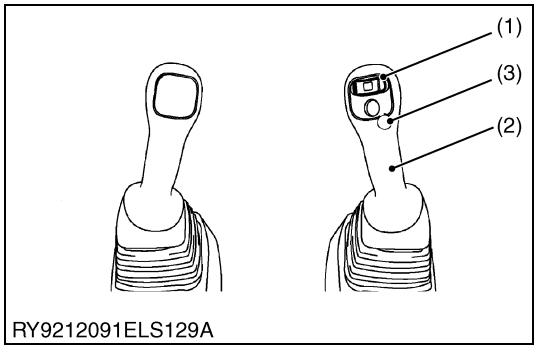
2. Reading the Error History

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.

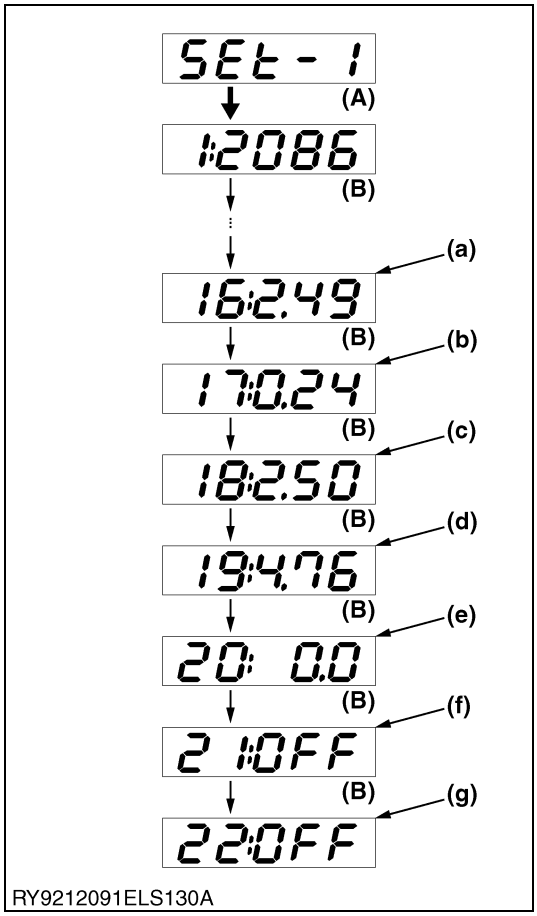
E.g.) Given a history with the last error on October 9, 2010 at 310 hours.

(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

RY9212091ELS0165US0



RY9212091ELS129A



RY9212091ELS130A

3. Tester Mode

1. Select the tester mode.
2. Start the engine.
3. Test the voltage of the AUX slider lever as per the table below.

	Voltage Range	Setting Value		
		Left (small)	Right (large)	Middle (medium)
AUX slider lever	0.24 to 4.76V	0.24 to 2.0V	2.99 to 4.76V	0.99 to 4.0V

	Normal	Disconnected	Shorted
AUX hold switch ON	ON	OFF	OFF

Assessment Criteria	Assessment Results
Normal: Not disconnected (OK)	
Error: Disconnected (NG)	
Error: Shorted (NG)	

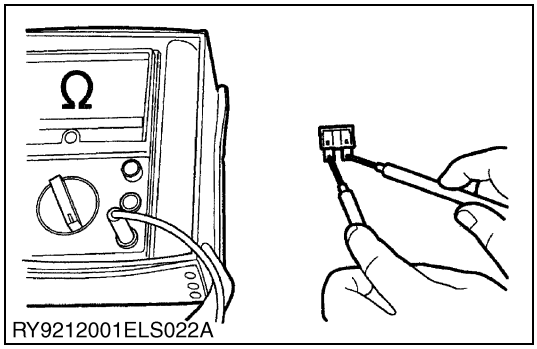
(1) AUX slider lever
(2) AUX control lever
(3) AUX hold switch

(A) Press and hold SW2
(B) Press SW2

(a) AUX slider lever voltage (current value)
(b) AUX slider lever voltage (set value left)
(c) AUX slider lever voltage (set value neutral)
(d) AUX slider lever voltage (set value right)
(e) AUX amperage
(f) AUX hold switch
(g) AUX activation switch

RY9212091ELS0166US0

[B] Inspecting Each Device Visually and Physically



RY9212001ELS022A

1. Checking fuses

1. Check whether the control elements fuse 5 A is blown.

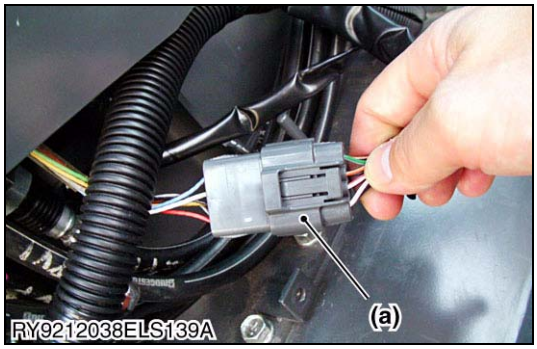
Criteria	Assessment Results
Normal: no brake (OK)	
Error: has a brake (NG)	

RY9212038ELS0194US0

2. Checking relays

Checking relays is not necessary.

RY9212038ELS0154US0



3. Cause of Disconnects

[Inspection Conditions]

Key switch: STOP

[Inspection Points]

1. AUX control connector CN422 disconnected.
2. Break of wiring continuity somewhere in the middle.

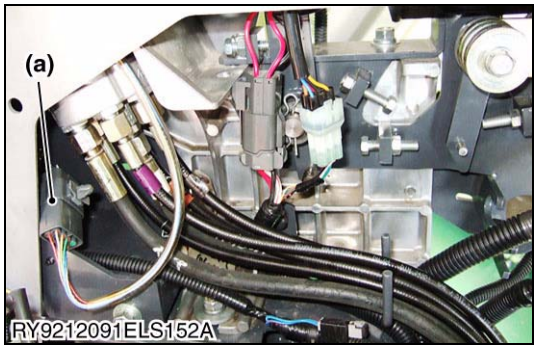
[Method of Checking]

Pull on the harness bundle and make sure the wires and plugs do 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 AUX slider lever voltage in the tester mode again.

Assessment Criteria	Assessment Results
Normal: Not disconnected (OK)	
Error: Disconnected (NG)	

(a) AUX control connector CN422

RY9212091ELS0167US0



4. Cause of Short

[Inspection Conditions]

Key switch: STOP

[Method of Checking]

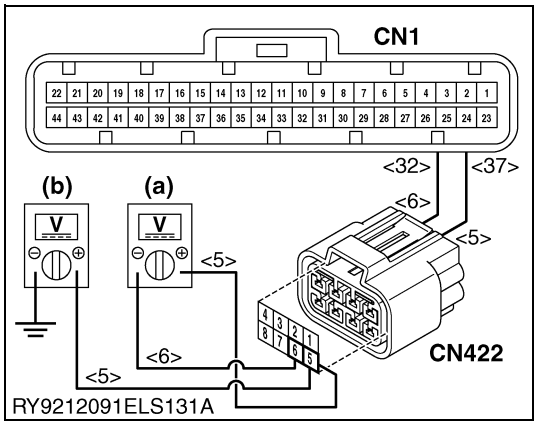
One of the AUX control connector CN422 wires is pinched against or is touching the body. If the insulation is stripped, repair it properly and check the AUX slider lever voltage again in the tester mode.

Assessment Criteria	Assessment Results
Normal: Not shorted (OK)	
Error: Shorted (NG)	

(a) AUX control connector CN422

RY9212091ELS0168US0

[C] Testing with a Circuit Tester



1. Voltage check (AUX Hold Switch)

[Measurement Conditions]

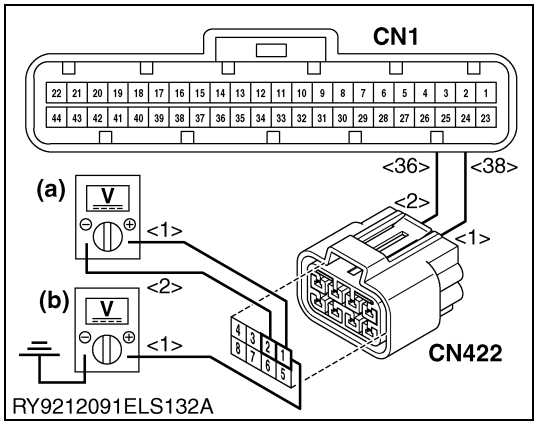
1. Disconnect the AUX switch connector CN422.
2. Key switch : RUN
3. Measure the voltage based on the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.	Assessment Results
(a)	AUX switch connector CN422	<5>	AUX switch connector CN422	<6>	
(b)	AUX switch connector CN422	<5>	Body GND	–	

Normal : 12 V (OK)

Error : Large discrepancy from 12 V (NG)

RY9212091ELS0169US0



2. Voltage check (AUX Switch)

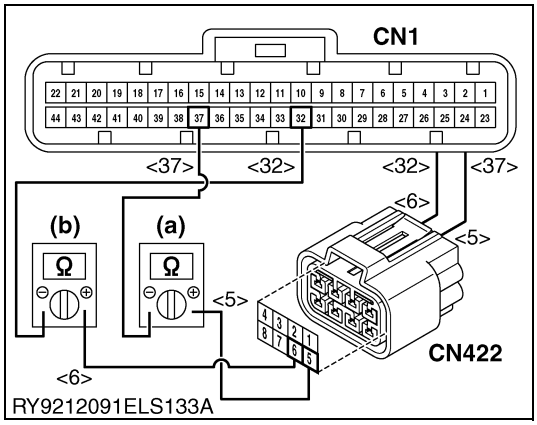
[Measurement Conditions]

1. Disconnect the AUX switch connector CN422.
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.	Assessment Results
(a)	AUX switch connector CN422	<1>	AUX switch connector CN422	<2>	
(b)	AUX switch connector CN422	<1>	Body GND	–	

Normal : 5 V (OK)
Error : Large discrepancy from 5 V (NG)

RY9212091ELS0170US0



3. Continuity Test (AUX Hold Switch)

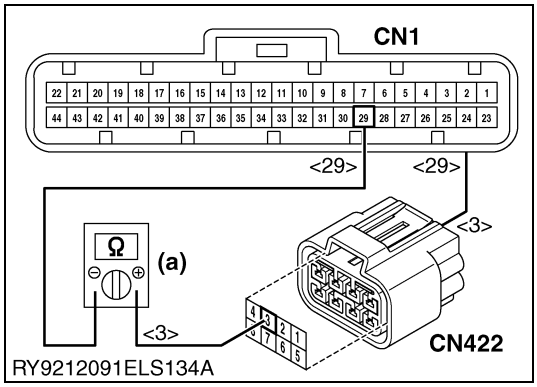
[Test Conditions]

1. Key switch: STOP
2. Disconnect the AUX control connector CN422.
3. Disconnect the main ECU connector CN1.
4. Test continuity as per the table below.

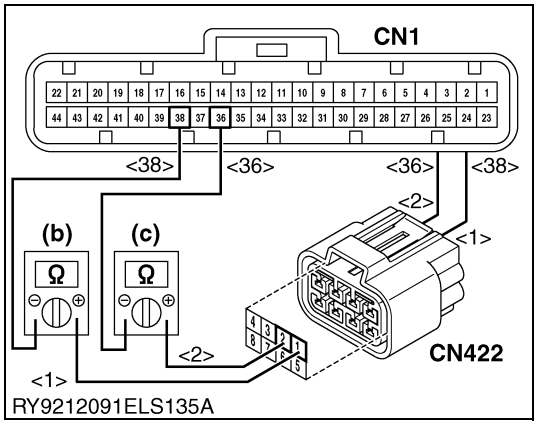
Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.	Assessment Results
(a)	AUX control connector CN422	<5>	Main ECU connector CN1	<37>	
(b)	AUX control connector CN422	<6>	Main ECU connector CN1	<32>	

Normal: Continuous (OK)
Error: Not continuous (NG)

RY9212091ELS0171US0



RY9212091ELS134A



RY9212091ELS135A

4. Continuity Test (AUX Slider Lever)

[Test Conditions]

1. Key switch: STOP
2. Disconnect the AUX control connector CN422.
3. Disconnect the main ECU connector CN1.
4. Test continuity as per the table below.

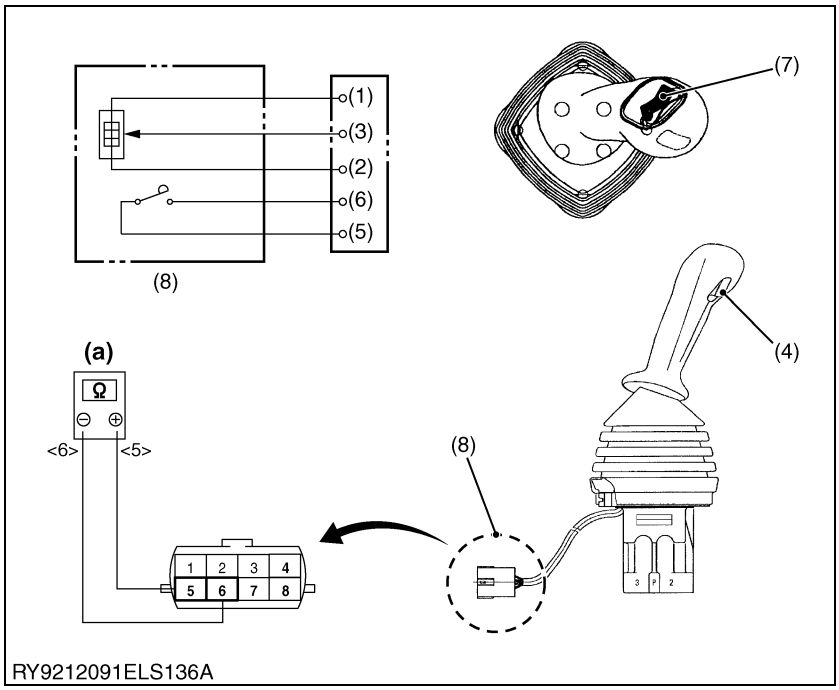
Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.	Assessment Results
(a)	AUX control connector CN422	<3>	Main ECU connector CN1	<29>	
(b)	AUX control connector CN422	<1>	Main ECU connector CN1	<38>	
(c)	AUX control connector CN422	<2>	Main ECU connector CN1	<36>	

Normal: Continuous (OK)
Error: Not continuous (NG)

RY9212091ELS0172US0

[D] Checking the Equipment Itself

1. Testing the Right Operation Lever Switch



RY9212091ELS136A

(1) 5V input
(2) Ground
(3) Proportional output
(4) AUX hold switch
(5) 12 V
(6) AUX hold switch line (to ECU32)
(7) AUX slider lever
(8) AUX control connector

[Inspection Conditions]

1. Put the key switch in the STOP position.
2. Disconnect the AUX control connector CN422 from the machine and make tests.
3. Press the switch (4) and test for continuity.

Test Point	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.	Assessment Results
(a)	AUX control connector	<5>	AUX control connector	<6>	

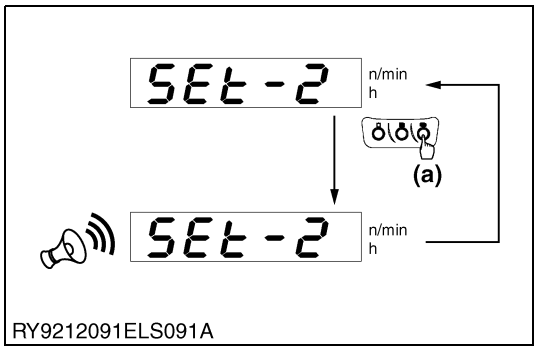
Normal: Continuous (OK)
Error: Not continuous (NG)

RY9212091ELS0173US0

2. Settings after Replacing Equipment

Make settings again in the service/dealer mode (AUX knob settings).

RY9212091ELS0174US0



RY9212091ELS091A

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	Assessment Results
Normal: Error history cleared (OK)	
Error: Error history failed to clear (NG)	

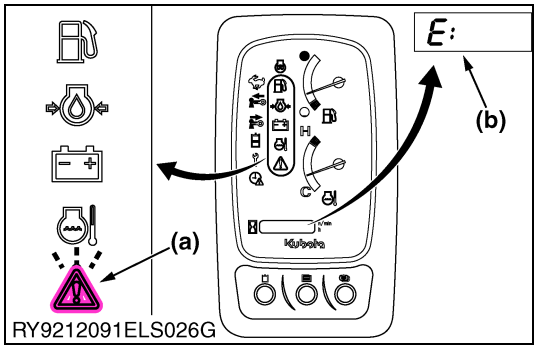
- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

(a) Press and hold SW2

RY9212091ELS0105US0

(2) AUX Solenoid Error (E:023, E:024) (KX019-4 Only)

[A] Checks Using the LCD Panel



RY9212091ELS026G

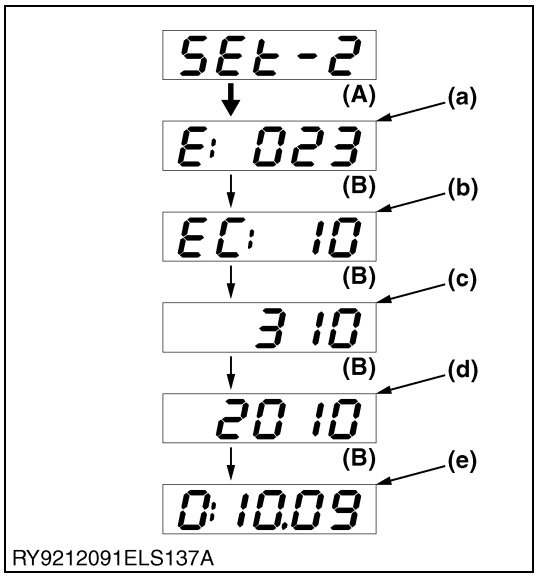
1. LCD Panel Display Content

1. Check if the warning lamp **(a)** on the LCD panel is blinking in red.

(a) Warning lamp

(b) Error message E:023 or E:024
(E:023 AUX right solenoid error)
(E:024 AUX left solenoid error)

RY9212091ELS0175US0



RY9212091ELS137A

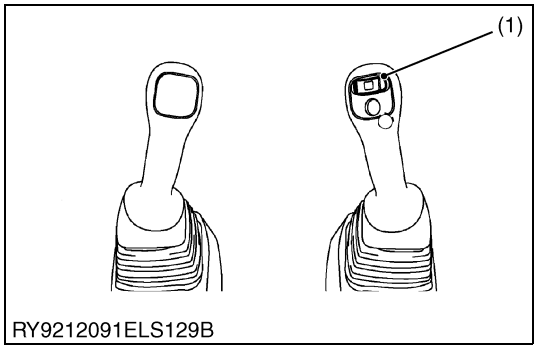
2. Reading the Error History

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

RY9212091ELS0176US0



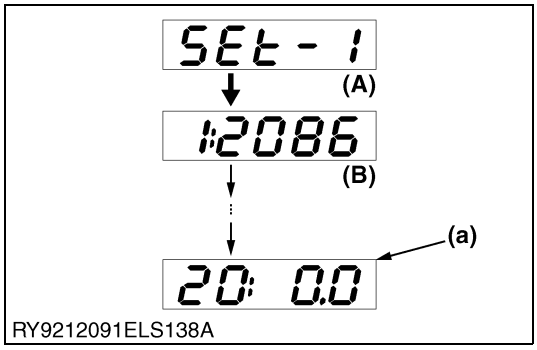
RY9212091ELS129B

3. Tester Mode

1. Select the tester mode.
2. Start the engine.
3. Test the ampere of the AUX solenoids as per the table below.

	AUX Slider Lever Position		
AUX amperage	**Left**	**Center**	**Right**
	0.5 to 2.0A	0 to 0.2A	0.5 to 2.0A

Assessment Criteria	**Assessment Results**
Normal: Not disconnected (OK)	
Error: Disconnected (NG)	
Error: Shorted (NG)	



RY9212091ELS138A

(1) AUX slider lever
(a) AUX amperage
(A) Hold down SW2
(B) Press SW2

RY9212091ELS0177US0

[B] Inspecting Each Device Visually and Physically

1. Checking fuses

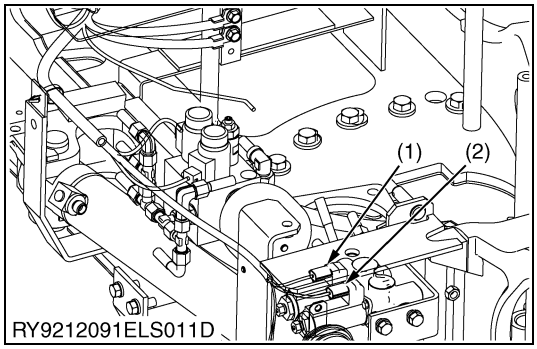
1. Checking fuses is not necessary.

RY9212001ELS0008US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0



3. Cause of Disconnects

[Inspection Conditions]

Key switch: STOP

[Inspection Points]

1. AUX solenoid connectors CN426 and CN427 disconnected.
2. Break of wiring continuity somewhere in the middle.

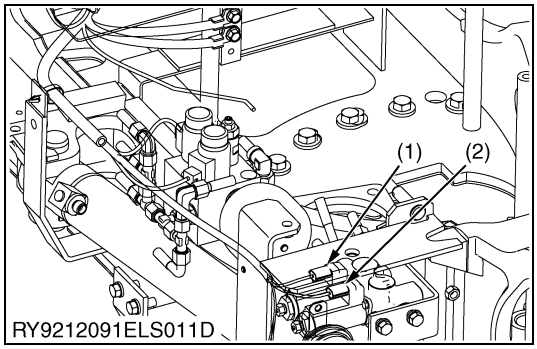
[Method of Checking]

Pull on the harness bundle and make sure the wires and plugs do 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 AUX solenoid amperage again in the tester mode.

Assessment Criteria	Assessment Results
Normal: Not disconnected (OK)	
Error: Disconnected (NG)	

(1) AUX left solenoid connector CN426 (2) AUX right solenoid connector CN427

RY9212091ELS0178US0



4. Cause of Short

[Inspection Conditions]

Key switch: STOP

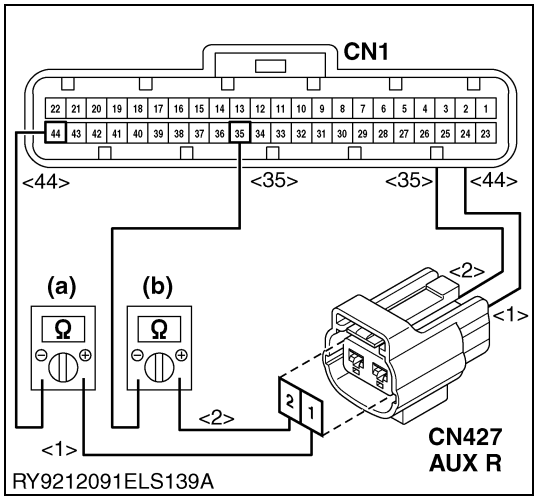
[Method of Checking]

One of the AUX solenoid connector wires is pinched against or is touching the body. If the insulation is stripped, repair it properly and check the AUX solenoid amperage again in the tester mode.

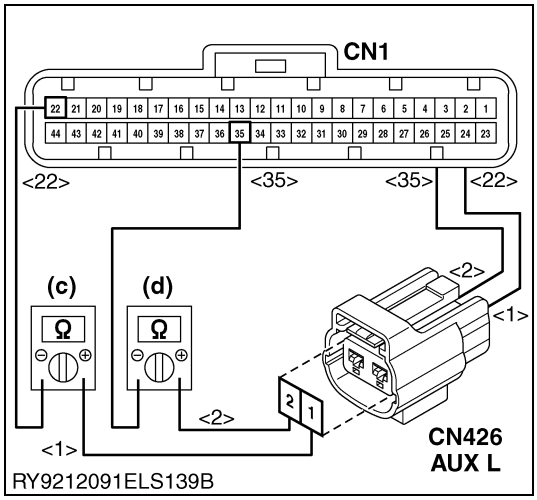
Assessment Criteria	Assessment Results
Normal: Not shorted (OK)	
Error: Shorted (NG)	

(1) AUX left solenoid connector CN426 (2) AUX right solenoid connector CN427

RY9212091ELS0179US0

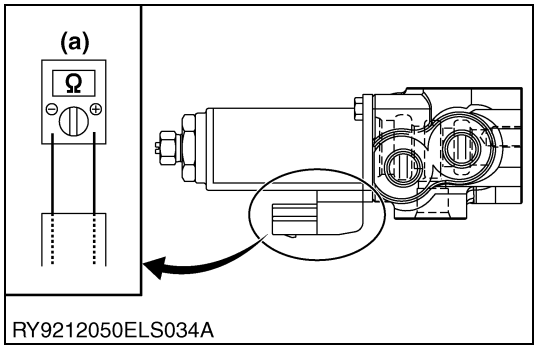


RY9212091ELS139A



RY9212091ELS139B

[C] Checking the Equipment Itself



RY9212050ELS034A

5. Continuity Test (AUX Solenoid)

[Test Conditions]

1. Key switch: STOP
2. Disconnect the main ECU connector CN1.
3. Disconnect the AUX solenoid connectors CN426 and CN427.
4. Test continuity as per the table below.

Mea-sure-ment	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.	Assess-ment Results
(a)	AUX right solenoid connector CN427	<1>	Main ECU connector CN1	<44>	
(b)	AUX right solenoid connector CN427	<2>	Main ECU connector CN1	<35>	
(c)	AUX left solenoid connector CN426	<1>	Main ECU connector CN1	<22>	
(d)	AUX left solenoid connector CN426	<2>	Main ECU connector CN1	<35>	

Normal: Continuous (OK)
Error: Not continuous (NG)

RY9212091ELS0180US0

1. Testing the AUX Solenoid

[Test Conditions]

1. Key switch : STOP
2. Disconnect AUX solenoid connector from the machine and test the solenoid separately.

AUX solenoid	Factory Specification	3.2 ± 0.5 Ω (at 20 °C, 68 °F)

Assessment Criteria	Assessment Results
Normal : no break (OK)	
Error : has a break (NG)	

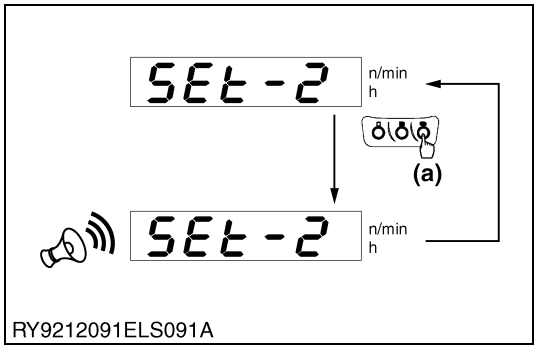
(a) AUX solenoid terminals

RY9212091ELS0181US0

2. Settings after Replacing Equipment

1. Make the AUX activation point settings again.

RY9212091ELS0182US0



RY9212091ELS091A

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	Assessment Results
Normal: Error history cleared (OK)	
Error: Error history failed to clear (NG)	

- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

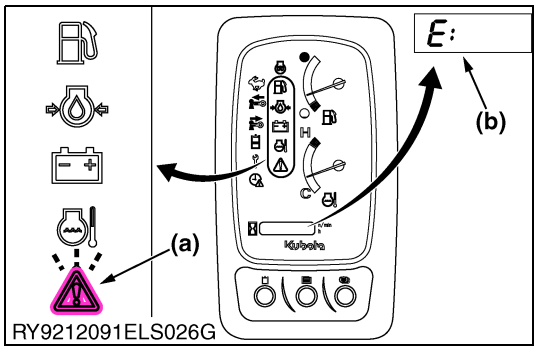
(a) Press and hold SW2

RY9212091ELS0105US0

[5] COMMUNICATION SYSTEM

(1) CAN Communication Error (E:001)

[A] LCD Panel Display Content



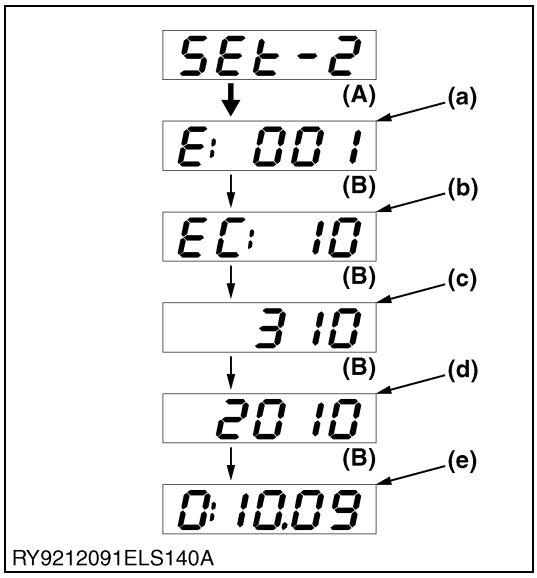
RY9212091ELS026G

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)

RY9212091ELS0183US0



RY9212091ELS140A

2. Reading the Error History

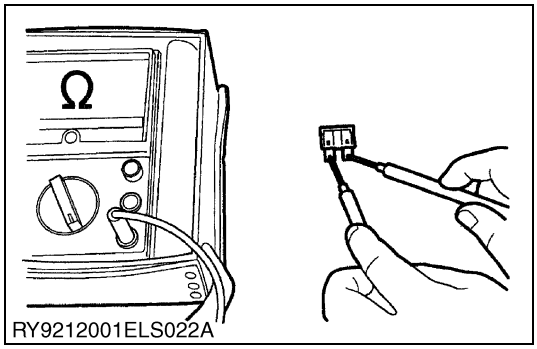
1. Select the error history reading mode.
2. Read the error history and check the date (year, month, day) and hour meter of the last error.

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

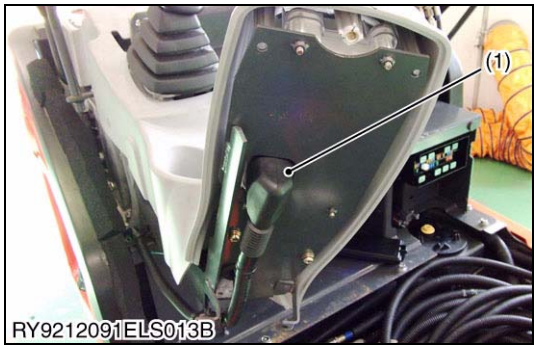
1. Check whether the main ECU (+B) 5 A fuse is blown.

RY9212091ELS0185US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0



3. Cause of Disconnects

[Test Conditions]

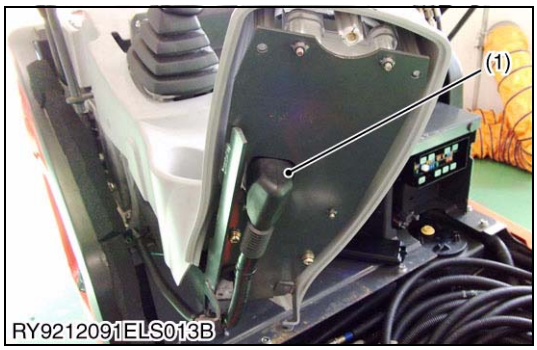
1. Key switch: STOP
2. LCD meter connector CN2 disconnected.
3. Break of wiring continuity somewhere in the middle.

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 CN2

RY9212091ELS0186US0



4. Cause of Short

[Inspection Conditions]

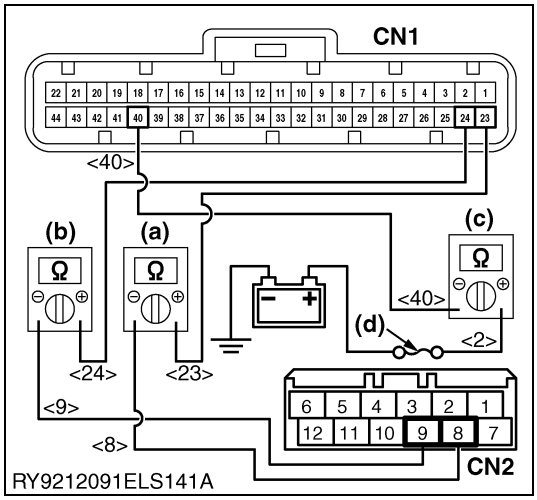
1. Key switch: STOP
2. One of the LCD meter connector CN2 wires is pinched against or is touching the body. If the insulation is stripped, repair it properly.

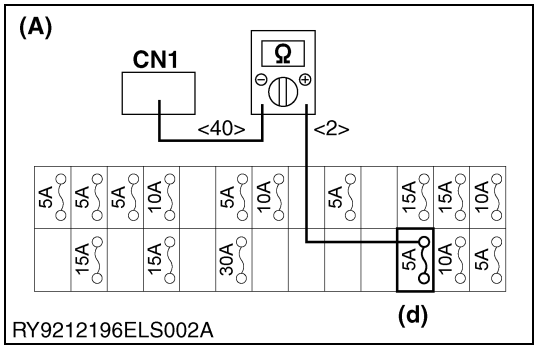
Assessment Criteria
Normal: Not shorted
Error: Shorted

(1) LCD Meter Connector CN2

RY9212091ELS0187US0

[C] Testing with a Circuit Tester





1. Checking Continuity

[Test Conditions]

1. Key switch: STOP
2. Disconnect the main ECU connector CN1.
3. Disconnect the LCD meter connector CN2.
4. Remove the ECU (+B) 5 A fuse.
5. Check for continuity in the combinations shown in the table below.

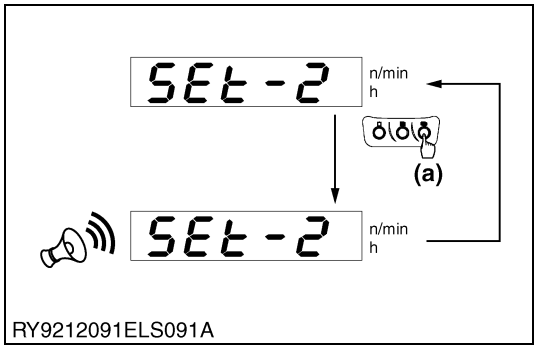
Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.
(a)	Main ECU connector CN1	<23>	LCD meter connector CN2	<8>
(b)	Main ECU connector CN1	<24>	LCD meter connector CN2	<9>
(c)	Meter (+B) 5 A fuse	<2>	Main ECU connector CN1	<40>

Normal: Continuous
Error: Not continuous

(A) (c) Measurement Details **(d) ECU (+B) 5A Fuse**

RY9212091ELS0188US0

[D] Testing the Equipment Itself



RY9212091ELS091A

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	Assessment Results
Normal: Error history cleared (OK)	
Error: Error history failed to clear (NG)	

- After clearing the error history, the buzzer will sound and the screen will not switch even if SW2 is pressed and held.

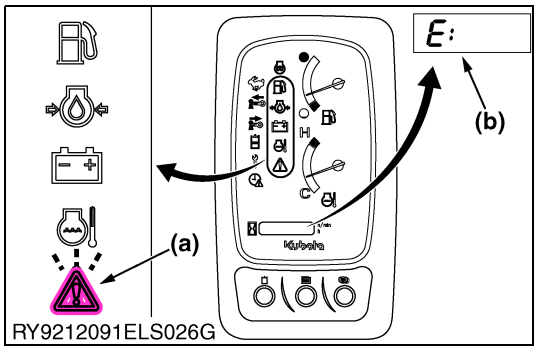
(a) Press and hold SW2

RY9212091ELS0206US0

[6] ANTI-THEFT SYSTEM

(1) Anti-Theft System Error (E:026)

[A] LCD Panel Display Content



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)

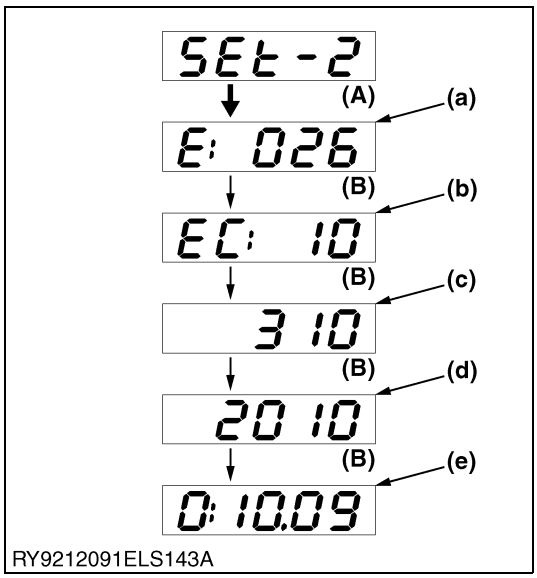
RY9212091ELS0189US0

[Test Conditions]

1. Key switch : STOP
2. Check whether the anti-theft indicator is blinking or not.

(a) Anti-theft indicator

RY9212091ELS0190US0



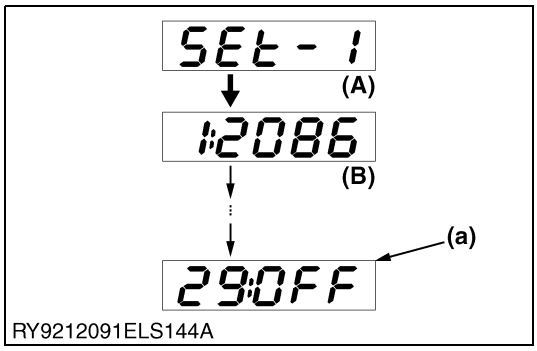
2. Reading the Error History

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

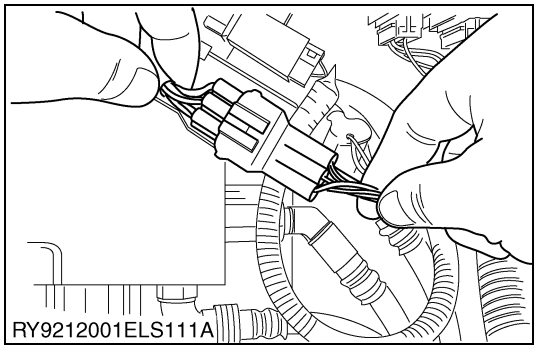
1. Checking fuses is not necessary.

RY9212001ELS0008US0

2. Checking relays

1. Checking relays is not necessary.

RY9212001ELS0009US0



3. Cause of Disconnects

[Test Conditions]

1. Key switch: STOP
2. Anti-theft connector CN441 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	Assessment Results
Normal: Not disconnected (OK)	
Error: Disconnected (NG)	

RY9212091ELS0193US0

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.

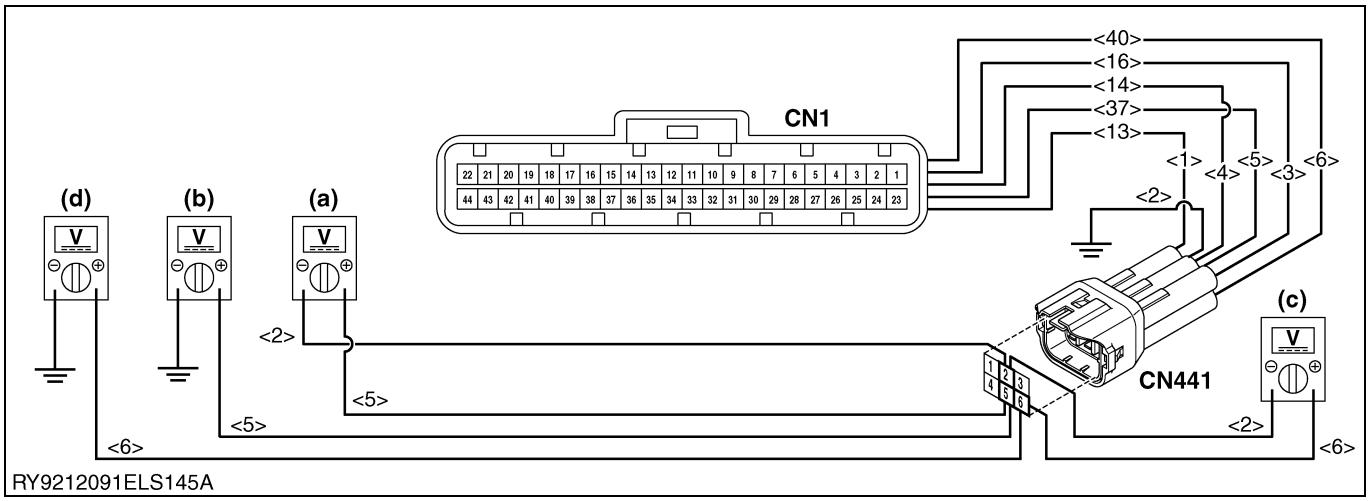
Assessment Criteria	Assessment Results
Normal: Not shorted (OK)	
Error: Shorted (NG)	

(1) Anti-theft connector

RY9212091ELS0194US0

[C] Testing with a Circuit Tester

1. Checking the Voltage



[Test Conditions]

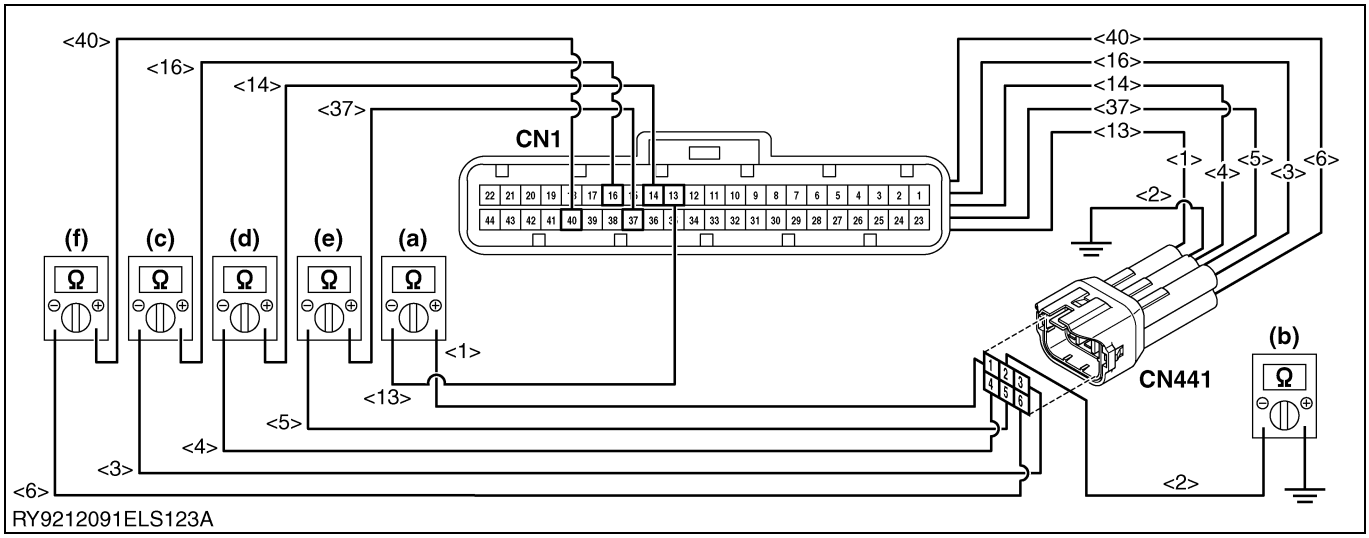
1. Disconnect the anti-theft connector CN441.
2. Key switch: RUN
3. Test the voltage as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.	Assessment Results
(a)	Anti-theft connector CN441	<5>	Anti-theft connector CN441	<2>	
(b)	Anti-theft connector CN441	<5>	Body ground	–	
(c)	Anti-theft connector CN441	<6>	Anti-theft connector CN441	<2>	
(d)	Anti-theft connector CN441	<6>	Body ground	–	

Normal: Stable at about 10 V (OK)
Error: Greatly different from 10 V (NG)

RY9212091ELS0195US0

2. Checking Continuity



[Test Conditions]

1. Key switch: STOP
2. Disconnect the anti-theft connector CN441.
3. Disconnect the ECU connector CN1.
4. Test continuity as per the table below.

Measurement	Connector Name (+ terminal side)	Pin No.	Connector Name (– terminal side)	Pin No.	Assessment Results
(a)	Anti-theft connector CN441	<1>	Main ECU connector CN1	<13>	
(b)	Anti-theft connector CN441	<2>	Body ground	–	
(c)	Anti-theft connector CN441	<3>	Main ECU connector CN1	<16>	
(d)	Anti-theft connector CN441	<4>	Main ECU connector CN1	<14>	
(e)	Anti-theft connector CN441	<5>	Main ECU connector CN1	<37>	
(f)	Anti-theft connector CN441	<6>	Main ECU connector CN1	<40>	

Normal: Continuous (OK)
Error: Not continuous (NG)

RY9212091ELS0196US0

[D] Checking the Equipment Itself

1. Inspecting the Anti-Theft Antenna

[Test Conditions]

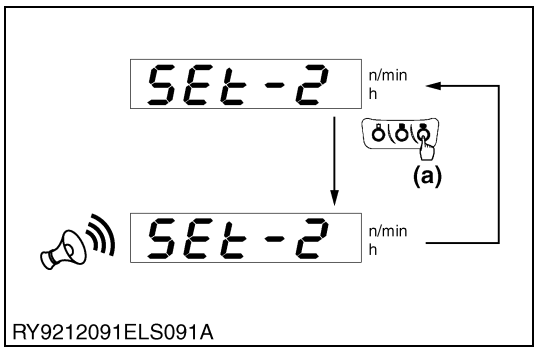
1. Key switch: STOP
2. Replace with a new antenna.
3. Make sure neither the warning lamp nor the warning display comes on.

RY9212091ELS0197US0

2. Settings after replacing device

1. No settings required.

RY9212001ELS0013US0



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.

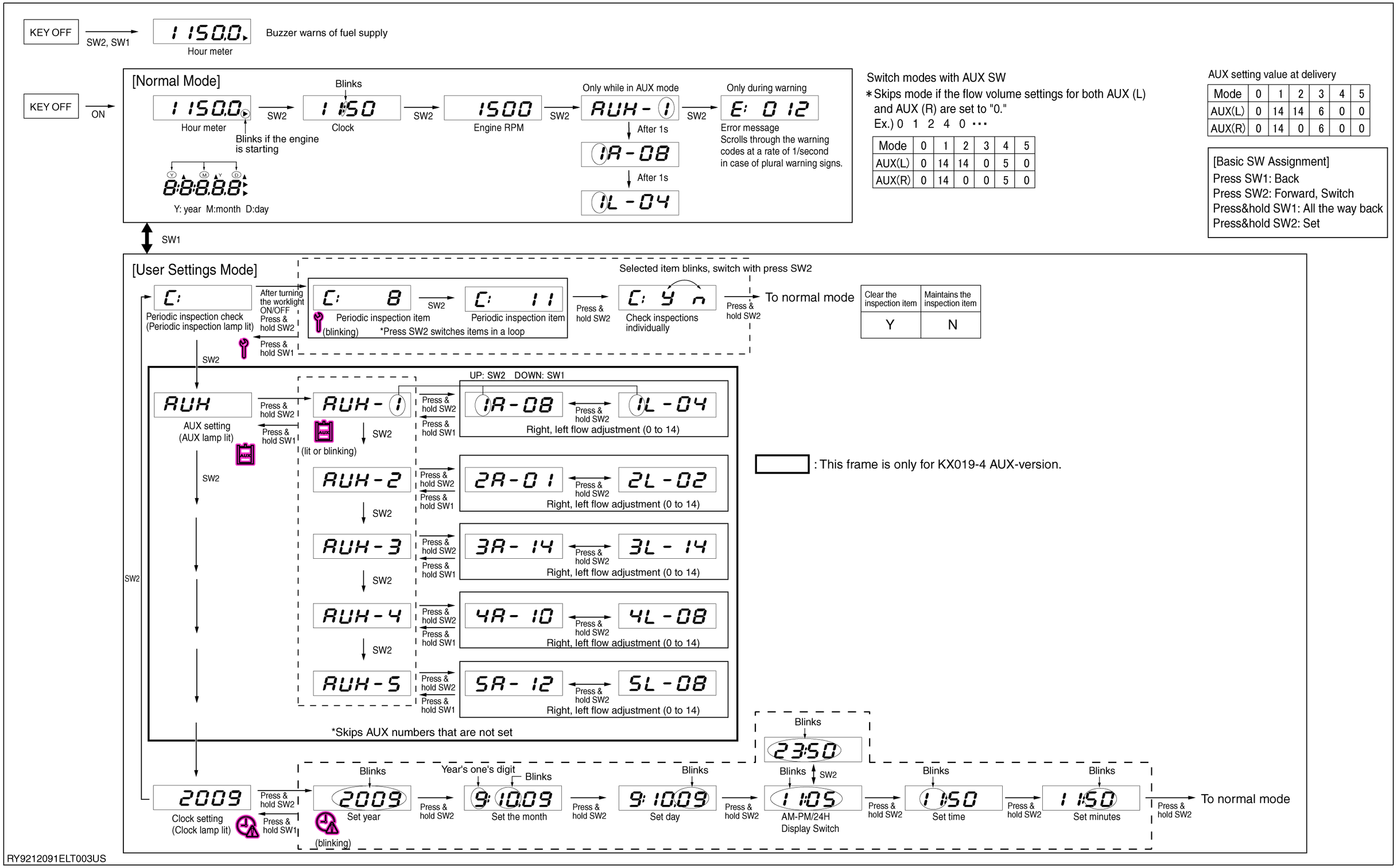
Assessment Criteria	Assessment Results
Normal: Error history cleared (OK)	
Error: Error history failed to clear (NG)	

- 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

RY9212091ELS0105US0

7. FLOW CHART OF THE NORMAL AND USER SETTINGS MODES



Switch modes with AUX SW

* Skips mode if the flow volume settings for both AUX (L) and AUX (R) are set to "0."
  Ex.) 0 1 2 4 0 ···

Mode	0	1	2	3	4	5
AUX(L)	0	14	14	0	5	0
AUX(R)	0	14	0	0	5	0

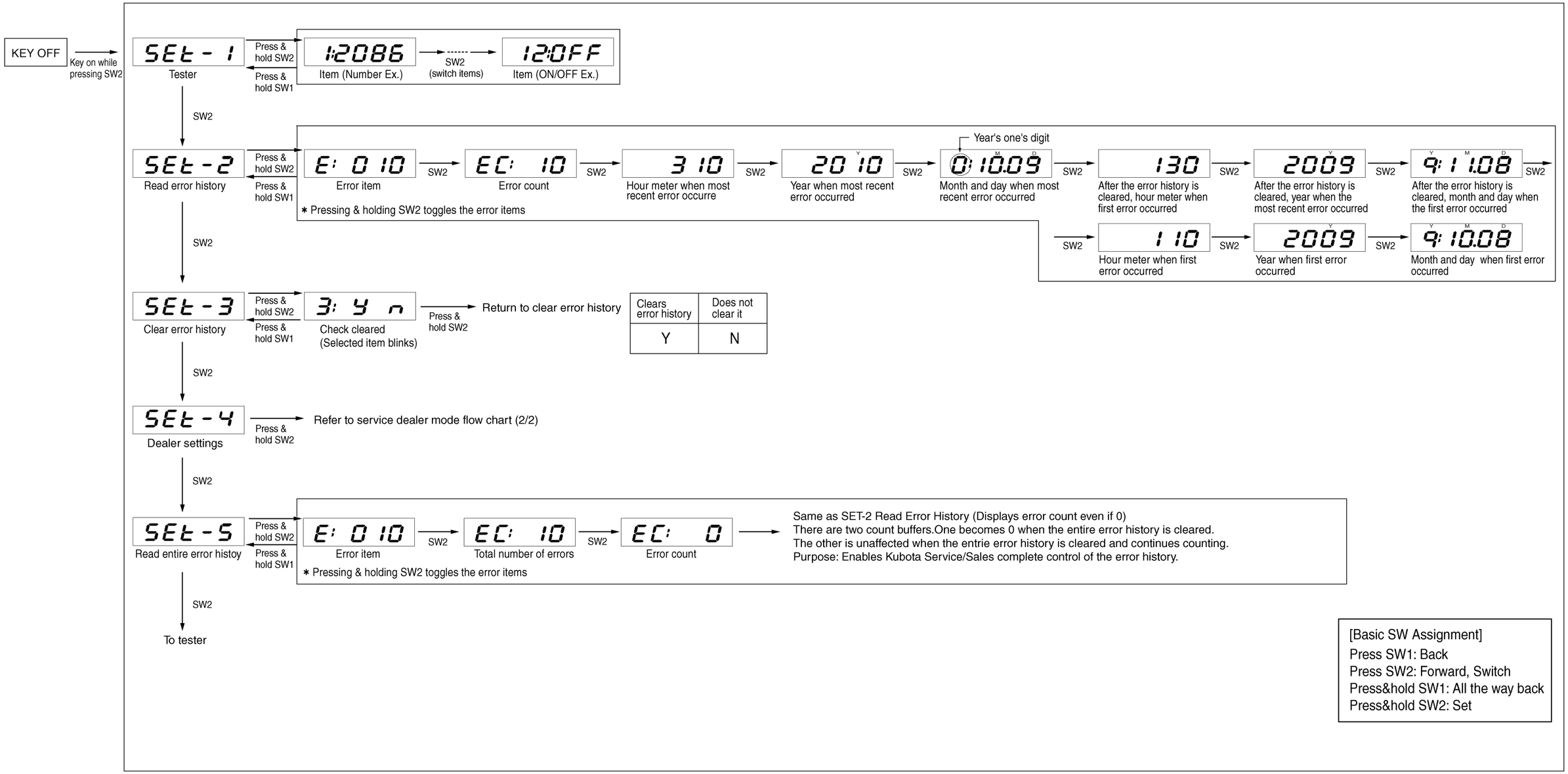
AUX setting value at delivery

Mode	0	1	2	3	4	5
AUX(L)	0	14	14	6	0	0
AUX(R)	0	14	0	6	0	0

[Basic SW Assignment]
Press SW1: Back
Press SW2: Forward, Switch
Press&hold SW1: All the way back
Press&hold SW2: Set

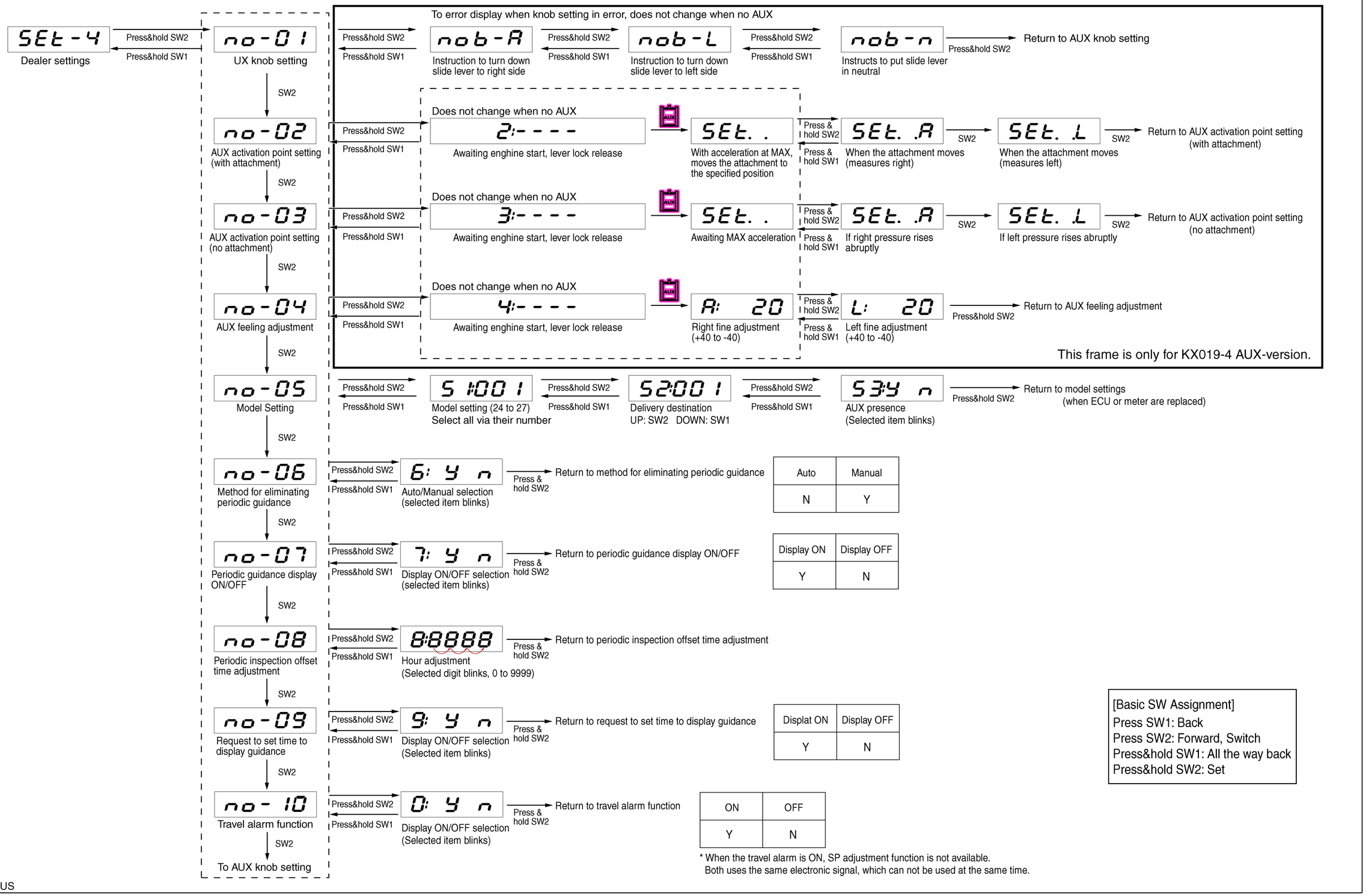
RY9212091ELT003US

8. SERVICE DEALER MODE FLOW CHART (1/2)



RY9212091ELT005US

9. SERVICE DEALER MODE FLOW CHART (2/2)



5 CABIN

SERVICING

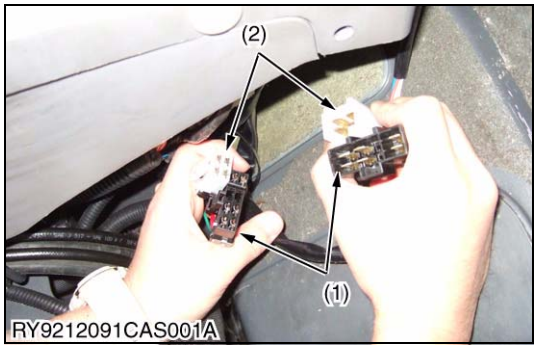
CONTENTS

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.

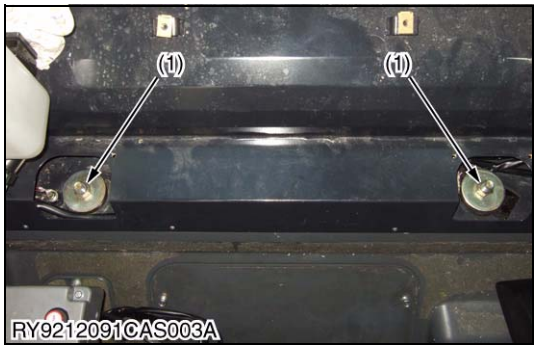
   Slide the seat toward the front of the mini-excavator and disconnect the two connectors of the cabin harness and the excavator's main harness.

(1) Main Harness Connector (2) Wiper Harness Connector

RY9212091CAS0001US0

2. Support the top of the cabin with a nylon sling.

RY9212091CAS0002US0

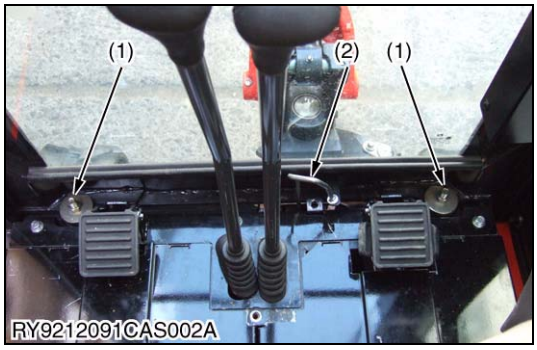


3. Remove the two cabin mounting nuts toward the back of the mini-excavator.
4. Remove the floor mat and the two cabin mounting nuts toward the front of the mini-excavator.

■ **IMPORTANT**

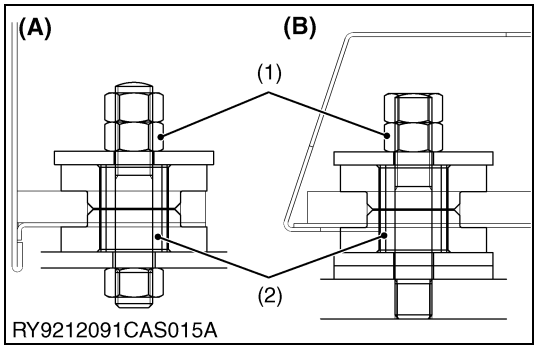
- **Move the swivel lock pin to the swivel frame side.**

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) (2) Swivel Lock Pin

RY9212091CAS0003US0



RY9212091CAS015A

- Stud Bolt Installation

Tightening torque	Stud (front) Stud (rear)	107.9 to 125.5 N·m 11.0 to 12.8 kgf·m 59.6 to 92.5 lbf·ft

Apply thread lock (Loctite AN320-72 equivalent).

(1) Nut (Cab)
(2) Stud

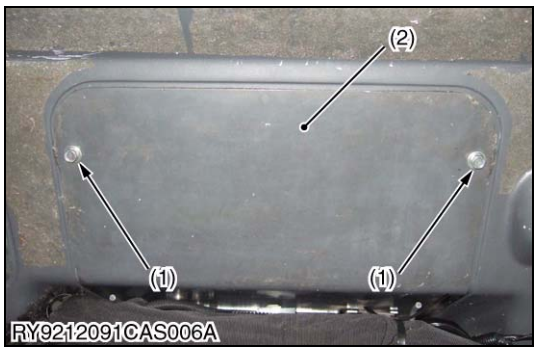
(A) 2 Places at Front of Excavator
(B) 2 Places at Rear of Excavator

RY9212091CAS0025US0

5. Carefully lift the cabin off.

RY9212091CAS0026US0

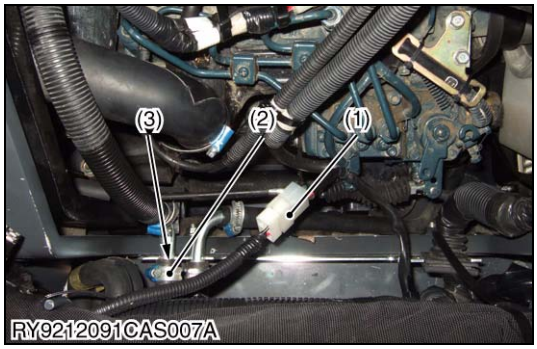
2. HEATER REMOVAL AND INSTALLATION



1. Remove the bolts and then the cover.

(1) Bolt (2) Cover

RY9212091CAS0027US0



2. Remove the 3P connector from the blower motor.
3. Loosen the hose clamp and remove the hose.

CAUTION

- **Make sure the coolant is cool before performing this work.**

(1) 3P Connector (3) Hose
(2) Hose Clamp

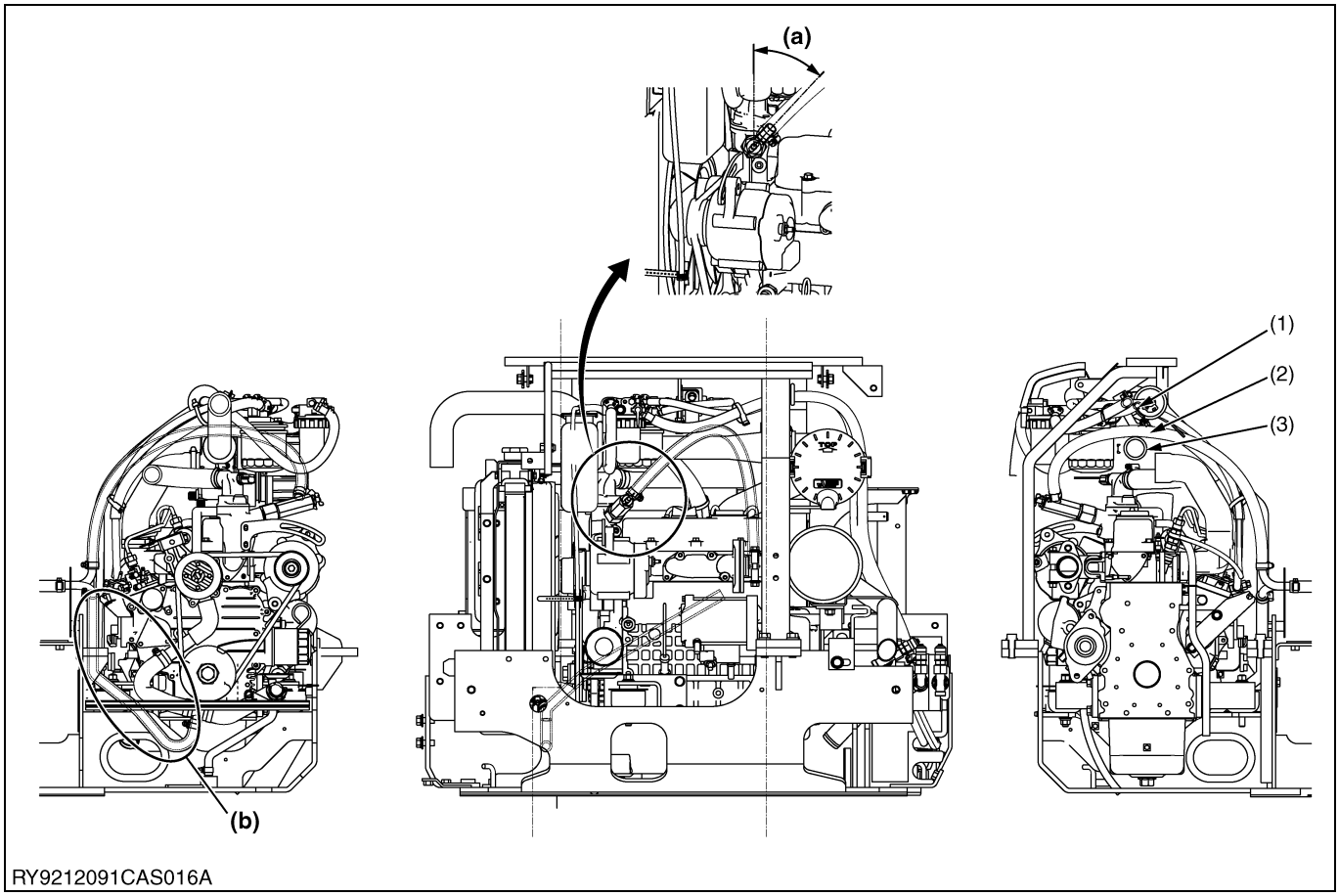
RY9212091CAS0028US0

4. Remove the three bolts and then the heater assembly.

(1) Bolt

RY9212091CAS0029US0

Heater Hose Routing



RY9212091CAS016A

(1) Fuel pipe
(2) Heater hose
(3) Inlet hose

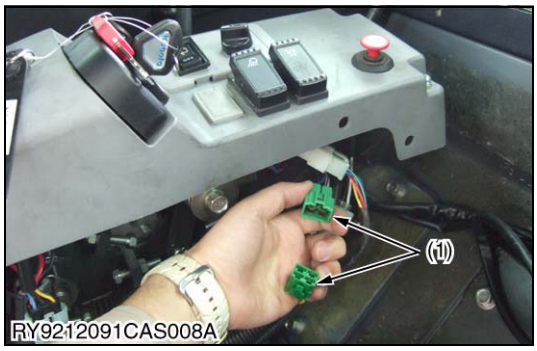
(a) 45 °
(b) No contact with the engine in the swivel frame

RY9212091CAS0030US0

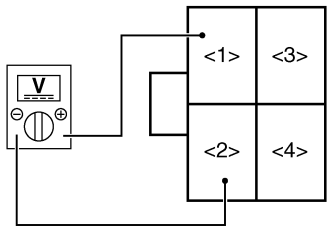
3. CHECKS

[1] HEATER RELATED

(1) Blower Switch

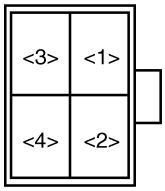


(A)



RY9212091CAS017A

(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 terminals 1 and 2 of the connector on the harness side.
4. If the voltage is different from the battery voltage (DC 11 to 14V), 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)

RY9212091CAS0005US0

Blower Switch Test

1. Check the continuity between each of the terminals according to the table below.
2. If continuity exists, it is normal.

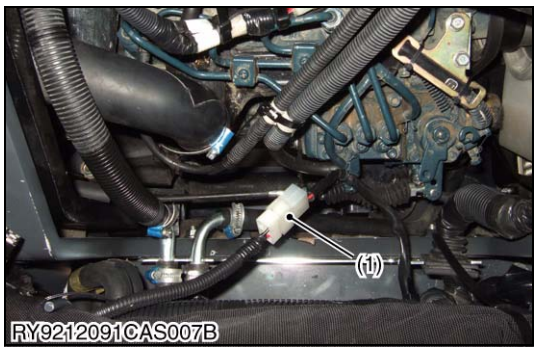
Position	<2>	<3>	<4>	<1>
Rated load		80 W	58 W	135 W
OFF	●			
Lo	●	●	●	
Hi	●	●		●

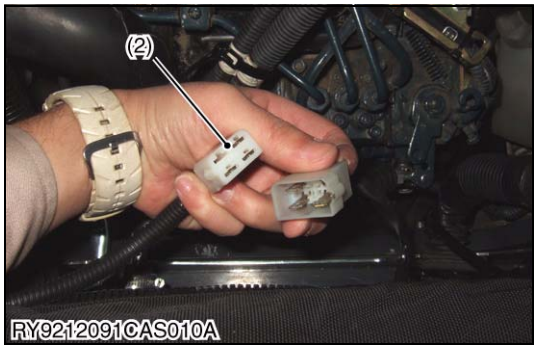
RY9212091CAS019US

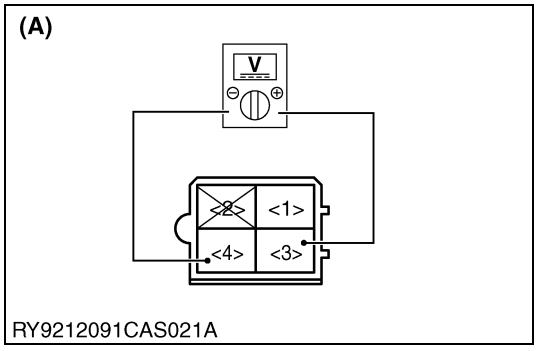
(B) 4P Connector (Switch Side)

RY9212091CAS0006US0

(2) Blower Motor







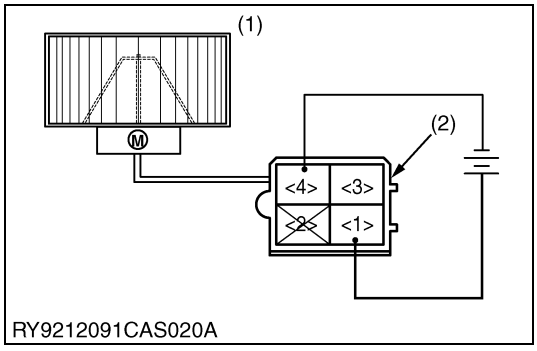
Connector Voltage

1. Remove the 3P 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 14V), then there is a fault in the wire harness, blower motor relay, the fuse and/or the starter switch.

(1) 3P Connector
(2) 3P Connector (Main Harness Side)

(A) 3P Connector (Main Harness Side)

RY9212091CAS0007US0



Blower Motor Test

1. Turn the blower motor by hand and check whether it turns smoothly.
2. Remove the 3P 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.

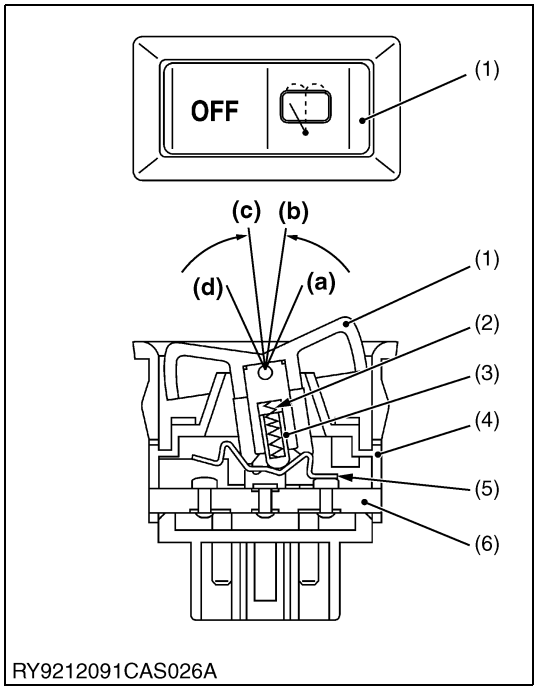
(1) Blower Motor
(2) 3P Connector (Blower Motor Side)
(3) Battery (12V)

<1>, <3>:(+) Terminal
<4> :(-) Terminal

RY9212091CAS0008US0

[2] WINDOW WASHER RELATED

(1) Wiper Switch



RY9212091CAS026A

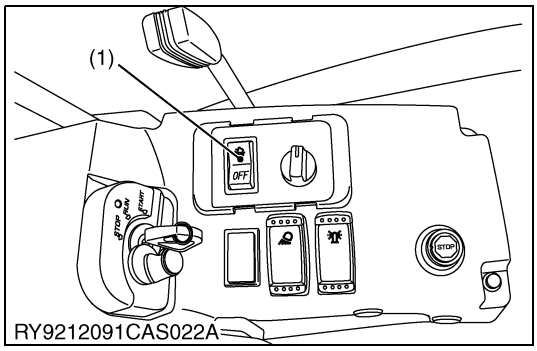
This switch has four positions, namely **(a)**, **(b)**, **(c)**, and **(d)** as indicated in the figure. Turn the starter key to the [RUN] position and press the knob to position **(b)** to operate the wiper motor.**If you press it in to position (a)**, the window washer operates and when you release 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)

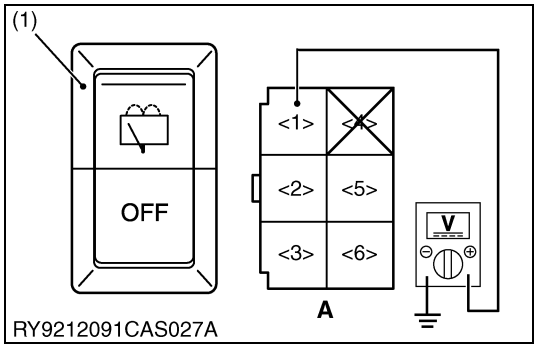
RY9212091CAS0009US0



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 14V), it is normal.

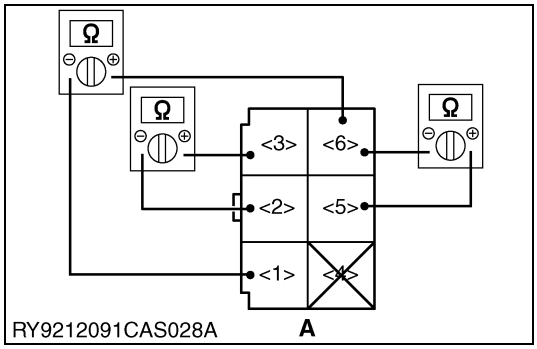


RY9212091CAS027A

(1) Wiper Switch

A : 6P Connector (Harness Side)

RY9212091CAS0010US0



Checking the Wiper Switch

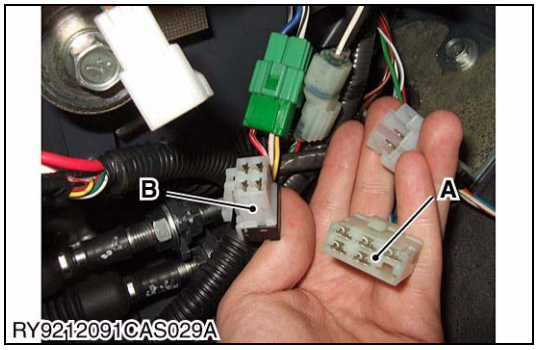
1. Test the continuity between each of the terminals according to the table below.
2. If continuity exists, it is normal.

Position	<3>	<2>	<1>	<6>	<5>
WASH1	●	●		●	●
ON			●	●	
OFF				●	●
WASH2	●	●	●	●	

RY9212001CAS094US

A : 6P Connector (Switch Side)

RY9212091CAS0011US0

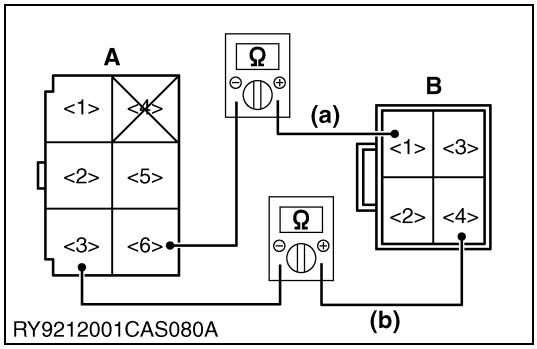


Checking the Cab Wiper Power Harness

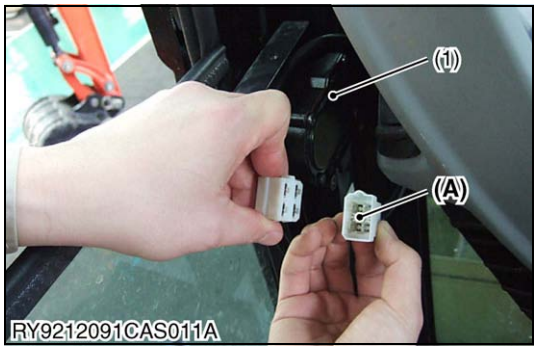
1. Disconnect the 6P connector from the wiper switch and the 4P connector from the cab wiper power harness.
2. Check the continuity between the terminals on both sides of the harness.
3. If continuity exists, it is normal.

(a) Wiper Motor Line
(b) Washer Motor Line
A : 6P Connector
B : 4P Connector

RY9212091CAS0012US0



(2) Wiper Motor

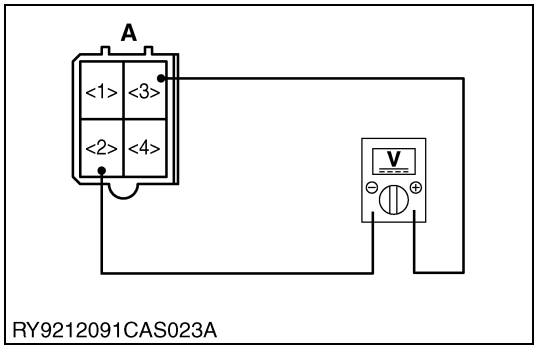


Connector Voltage

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 2 and 3 of the connector on the harness side.
5. If it is the same as the battery voltage (DC 11 to 14V), it is normal.

(1) Wiper Motor
A : 4P Connector (Harness Side)

RY9212091CAS0013US0



RY9212091CAS023A

Testing the Motor Separately

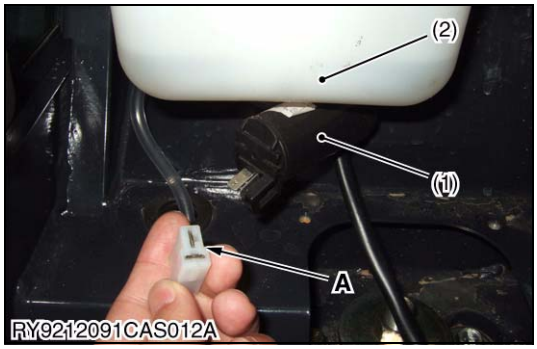
1. Raise the wiper blade so there is no load on it.
2. Switch the starter switch to [RUN] and the wiper switch to ON.
3. If the wiping angle is as in the table, it is normal.

No load wiping angle	Factory specification	58 to 62 °

A : 4P Connector (Harness Side)

RY9212091CAS0014US0

(3) Washer Motor



RY9212091CAS012A

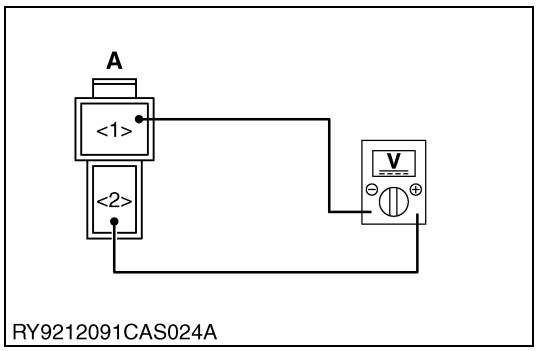
The window washer operates via a small, electric hi-speed motor and consists of a tank, pump and nozzle.

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)

RY9212091CAS0015US0



RY9212091CAS024A

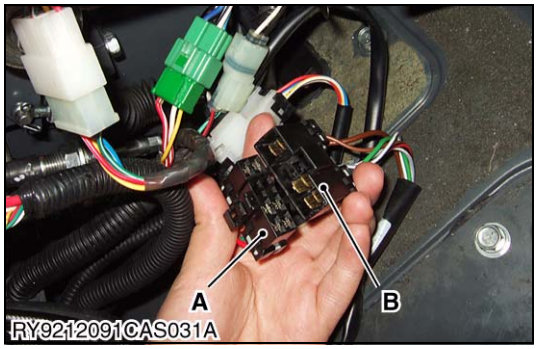
Connector Voltage

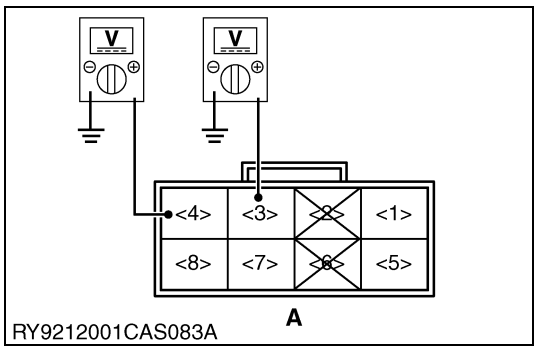
1. Remove the 2P connector from the washer motor.
2. Press down on the [OFF] side of the wiper switch. (so only the window washer operates)
3. Measure the voltage between terminals 1 and 2 of the connector on the harness side.
4. If it is the same as the battery voltage (DC 11 to 14V), it is normal.

A : 2P Connector (Harness Side)

RY9212091CAS0016US0

[3] LIGHTING EQUIPMENT RELATED



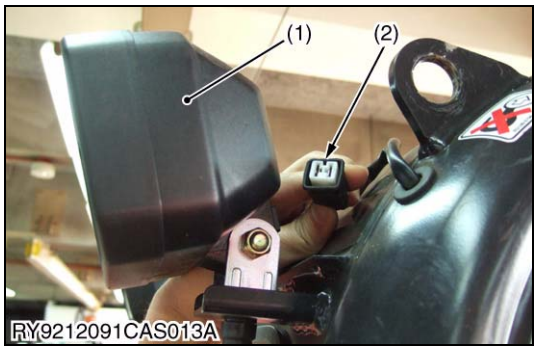


Connector Voltage

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 14V), it is normal.

A : 8P Connector (Cab Power Harness Side) **B : 8P Connector (Cab Harness Side)**

RY9212091CAS0017US0

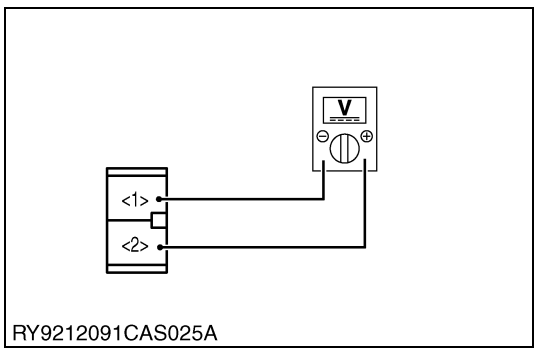


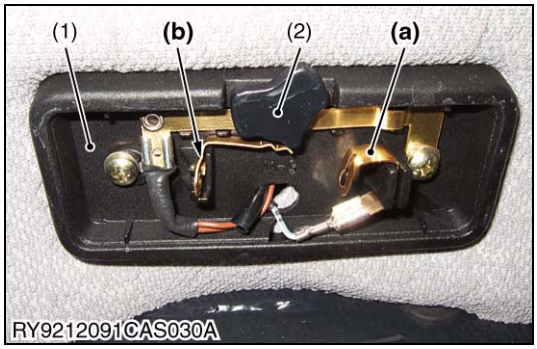
Terminal Voltage (Cab Work Light)

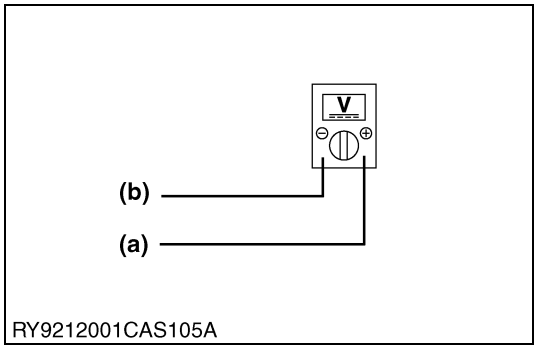
1. Remove the grommet and then the 2P work light harness.
2. Switch the starter switch to [RUN] and the cab work light switch to ON.
3. Measure the voltage between GND and the work light terminal 2(+) on the harness side.
4. If it is the same as the battery voltage (DC 11 to 14V), the terminal voltage is normal.

(1) Work Light (2) Grommet

RY9212091CAS0018US0





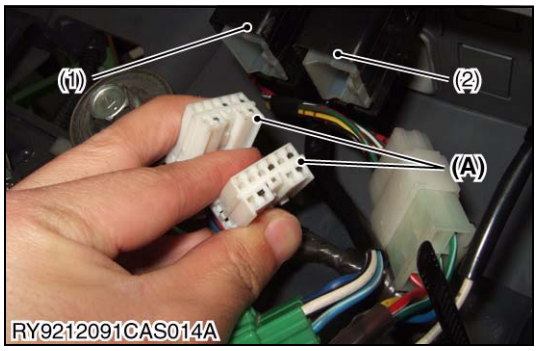


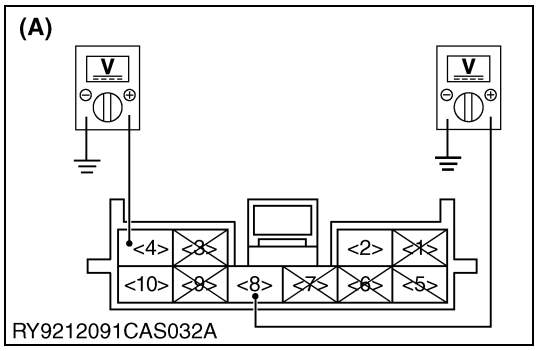
Terminal Voltage (Interior Light)

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 14V), the terminal voltage is normal.

(1) Interior Light Assembly
(2) Interior Light Switch
(a) (+) Terminal
(b) GND Terminal

RY9212091CAS0019US0





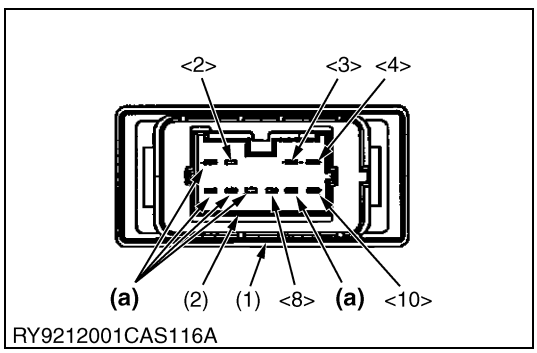
Work Light Switch / Beacon Switch

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 8 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 14V), it is normal.

(1) Work Light Switch
(2) Beacon Switch
(3) 10P Connector (Harness Side)
(A) 10P Connector (Harness Side)

RY9212091CAS0020US0



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.

	<8>	<2>	<3>	<10>	<4>
ON	○	○		○	○
OFF	○		○		

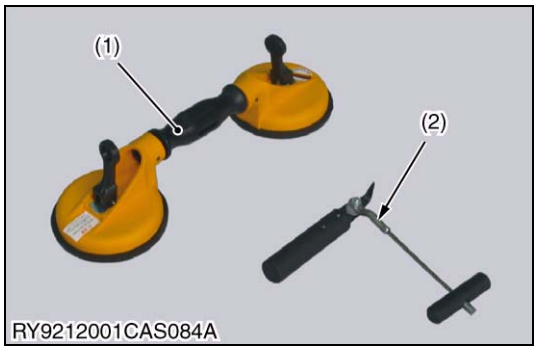
RY9212001CAS119A

(1) Work Light Switch / Beacon Switch
(2) 10P Connector (Switch Side)
(a) (Free)

RY9212091CAS0021US0

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)

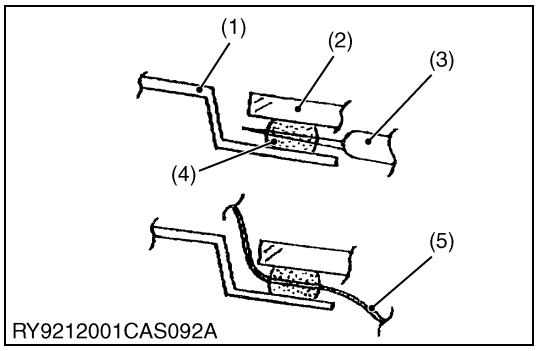
■ **NOTE**

- **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



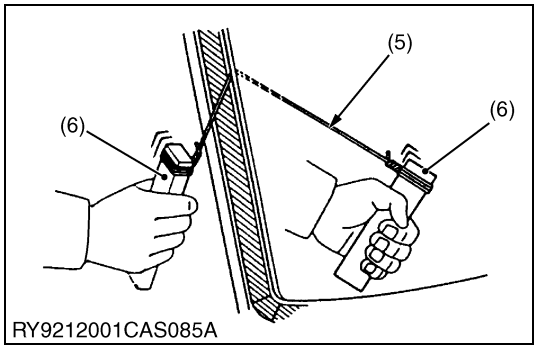
1. Mask off painted surface around the glass to protect them from scratching while removing/installing glass.
2. Remove the glass.

[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.

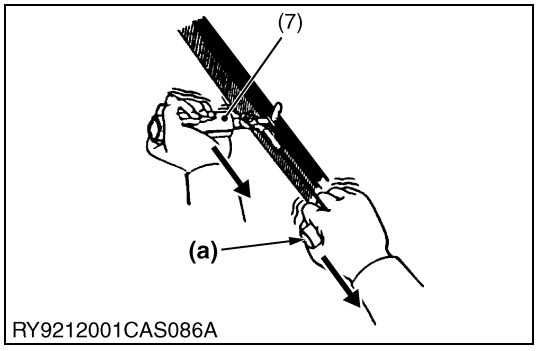
[When using an adhesive cutter (completely ruins the glass)]

- Insert the adhesive cutter into the adhesive.
- Pull on part **(a)** of the cutter and cut the glass out.



CAUTION

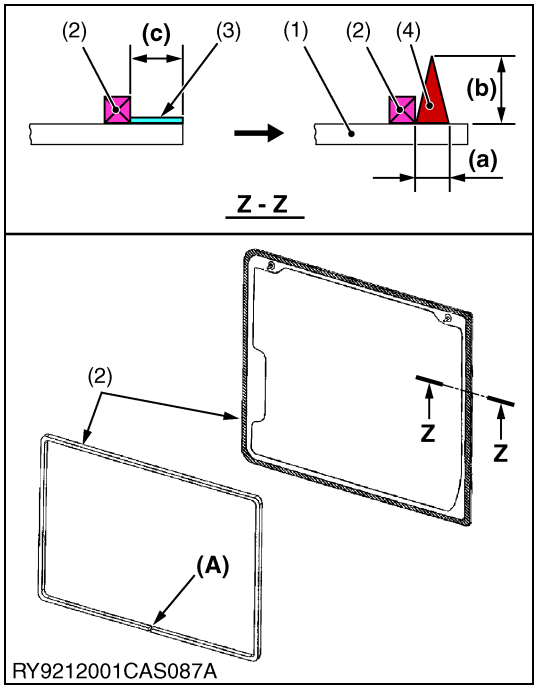
- **If the piano wire gets very hot in one place, it may break. Avoid rubbing it with much force against the edge of the glass.**
- **Be careful not to cut yourself on fragments of glass or the blade of the cutter.**



(1) Cab Frame
(2) Glass
(3) Awl
(4) Adhesive
(5) Piano Wire
(6) Wood
(7) Adhesive Cutter

RY9212001CAS0086US0

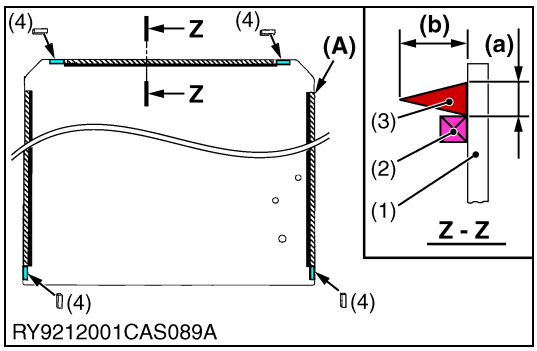
[3] INSTALLING WINDOWS



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 lightly 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**

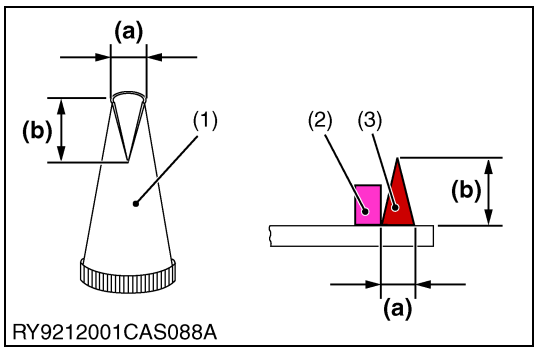
RY9212001CAS0087US0



- 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

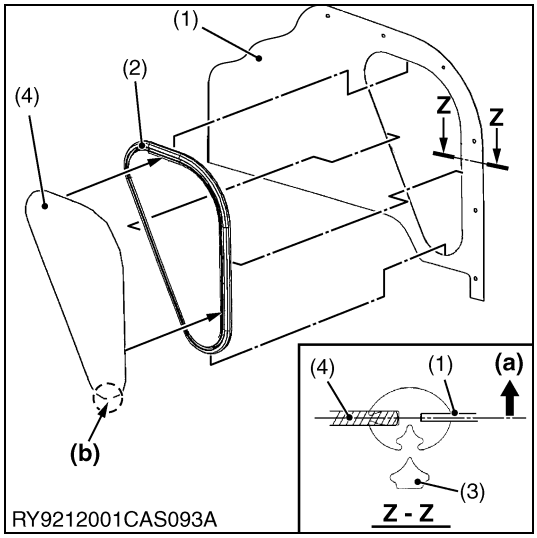
■ **NOTE**

- **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
	AC main relay broken	Replace
	Brushes have poor contact	Replace
	Blown fuse	Replace
	Miswiring or poor connections	Check and repair
Not enough air flow (air flow does not change to speed 3)	Relay damaged	Replace
	Blower fan switch broken	Replace
Not enough air flow (other)	Blower not tight enough	Check and repair
	Blower deformed	Replace
	Blower hitting its casing	Check and repair
	Something blocking the inlet	Check and repair
	Frost on the evaporator	Clean or replace
	Filter clogged	Clean or replace
	Vent ducts clogged or detached	Check and repair
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

RY9212091CAS0024US0

Electrical Wiring Diagram (KX018-4,KX019-4)

60498-77721 W/H (Cab)

60498-77741 W/H(Canopy)

60498-77751 W/H(Beacon)

RB257-53361 W/H(Front)

Electrical Circuit Diagram (KX018-4,KX019-4)

LCD Meter

ECU(main)

(KX018-4 only)

Glow Plug

Glow Relay

Engine Stop SW

Anti Theft ESS Relay

Starter

Anti Restart Relay

Beacon

Beacon Switch

Beacon Relay

Tail (RR,Left)

Head (RF,Left)

Head (RF,Right)

Tail (RR,Right)

Work Lamp

Work Lamp

Work Lamp

Work Lamp

Front Light Relay

Front Light SW

Fuel Pump

Alternator

Key SW

Battery

Pattery Isolator

Meter LCD Fuse

Meter-IB

Relay Source

Front Work Light

Fuelpump

Alternator

Engine Rev.Sol

ECU(main)-IB

ECU(main)-AC

Starter

Tail (RR,Left)

Tail (RF,Left)

Head (RF,Left)

Head (RF,Right)

Tail (RR,Right)

Front Work Light SW

Work Lamp SW

Charge SW

ACC

IG(Start)

12V-Out

AC SW (ACC Power Supply)

Work Lamp Out

Starter SW

Engine Revolution IN

Electric Governor

Lever Lock SW (Left)

Analog GND

AUX Activation SW (KX018-4 only)

Remote Walking SW

Fuel Sensor

Water Temp Sensor

Oil SW

Travel Horn Lock SW (Right)

Travel Speed Sensor (Hard SW)

AUX control port 1

AUX control port 2

AUX Hold SW

Horn SW (KX018-4 only)

Right Grip

AUX Control Pot

Travel Speed SW

Travel Speed Sensor (Auto Gear)

Engine Oil SW

LCD Meter Fuel Warning SW

Lever Lock SW(R)

Lever Lock SW(L)

Horn Relay

Horn

Horn Main

Horn SW

Lever Lock

Beacon

Room Light

Wiper Motor

Wiper Washer

Cab Relay

Heater Fan

Heater Relay

Heater Switch

Heater (Defrost) (Shield Sirocco)

Radio

Speaker (R)

Speaker (L)

Room Light

Electrical Outlet

Electrical Outlet

Radio

Cab GND

Buzzer

Buzzer Relay

Buzzer Out1

Anti Theft Horn Relay

Anti Theft Relay

Buzzer Auto Release Relay

Glow Relay

Lever Lock SOL

Travel Speed SOL

Panel SW (User Select)

Panel SW (Display Select)

Display Selector SW

AUX B.Solenoid

AUX SOL (R)

AUX SOL (L)

AUX SOL (-)

Anti Theft Indicator LED

Travel Speed SOL

Panel SW (Display Select)

Display Selector SW

AUX B.Solenoid

AUX SOL (R)

AUX SOL (L)

AUX SOL (-)

Lever Lock SW(L)

Lever Lock SW(R)

Walk-Up Out

Walk-Up SW

Walk-Up Out

GND

ACC

IG(Start)

GND

Meter-IB

Relay Source

Front Work Light

Fuelpump

Alternator

Engine Rev.Sol

ECU(main)-IB

ECU(main)-AC

Starter

Horn Main

Horn SW

Lever Lock

Beacon

Room Light

Key SW

Battery

Pattery Isolator

Meter LCD Fuse

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