WSM

WORKSHOP MANUAL
KUBOTA EXCAVATOR

KX030-4

Kubota

KiSC issued 12, 2017 A

TO THE READER

This workshop manual provides safety information for service activity, general information such as specifications and dimensions of the machine, mechanisms and structure descriptions of the machine, and service procedures with setting values.

Information
- Information section contains safety service descriptions and safety label information.

General
- General section contains specifications for the machine, identification for the machine and the engine, general maintenance information.

Mechanism
- Mechanism section contains the structures of mechanisms and explains their functions.

Servicing
- Servicing section contains information and procedures for troubleshooting and repair works with service specifications and limit tables, torque specifications, items to be inspected and adjusted. The reader should follow these instructions to complete any servicing safely, correctly and quickly.
- In this WSM, value of the service specifications and limits are defined as followings.
  - **Service specifications:**
    It is the new machine's specification ex-factory. It is mainly based on quality standard, drawings, or actual measurements conducted by KUBOTA. This value is used to judge if a machine has a problem when testing and troubleshooting. Still, normal wear-related deterioration of the service specification must be taken in account based on machine's operating hours, application or maintenance.
    Service specifications are based on the machine which attached the specified bucket.
  - **Service limits:**
    Specification which corresponds to the recommended performance limit taking in account long term wear. The machine is supposed to have insufficient performance for proper and safe work and a repair or overhaul would be required.

All of the illustrations, photographs, specifications and other information in this manual were created based on the latest model at the time of publication.
KUBOTA reserves the right to change all of the information at any time without notice.
If the engine servicing information is necessary, please refer to the following engine WSM.

KX030-4

Engine model	WSM title	WSM PDF No.
V1505-E4-BH-3	05-E4B SERIES,05-E4BG SERIES	9Y111-07841 (English) 9Y111-14261 (Standard German) 9Y111-14251 (French) 9Y111-14251 (Italian) 9Y111-14271 (Spanish)

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REVISION HISTORY

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CONTENTS

1. INFORMATION

SAFETY FIRST 1-1
1. For working safety 1-1
1.1 Working precautions 1-1
1.2 Preparing for emergencies 1-2
1.3 Working cautions 1-2
1.4 Starting the machine safely 1-3
1.5 Preventing fires 1-4
1.6 Preventing acid burns 1-4
1.7 Discarding waste fluid 1-4
2. Safety labels 1-5
2.1 Safety labels placement 1-5
2.2 Safety labels maintenance 1-9

2. GENERAL

GENERAL WORKING INSTRUCTIONS 2-1
1. General working precautions 2-1
2. Wrapping thread seal tape 2-1
3. Replacing O-rings 2-1
4. Replacing oil seals 2-1
5. Replacing floating seals 2-2
6. Installing circlips 2-2
7. Installing spring pins 2-2
8. Applying thread lock 2-3
9. Tightening bolts and nuts 2-3
10. Connecting hydraulic hoses 2-3
11. Installing elbows with male seat 2-3
12. Connecting and disconnecting quick hose couplings 2-4
13. Handling the battery 2-4
14. Handling electrical wiring 2-4
15. Handling fuses 2-6
16. Handling connectors 2-6
17. Washing the machine with a high pressure washer 2-7
PRELIMINARY WORKING INSTRUCTIONS 2-9
1. Vacuuming the hydraulic tank 2-9
2. Releasing residual pressure of hydraulic circuit 2-9
3. Bleeding the air from the hydraulic cylinder 2-10
4. Removing the battery 2-10
5. Jacking up the machine 2-11
TIGHTENING TORQUES 2-13
1. Bolts and nuts tightening torque 2-13
2. Stud bolts tightening torque 2-13
3. Hydraulic hose fittings tightening torque 2-14
4. Hydraulic hoses tightening torque (taper thread) 2-14
5. Locknuts of adapters with O-ring tightening torque (straight thread) 2-14
6. Adapters tightening torque (taper thread) 2-15
7. Hose clamps tightening torque 2-15
GENERAL MACHINE INFORMATION 2-17
1. Machine model identification 2-17
2. Engine model identification 2-17
3. Specifications 2-19
4. Machine dimensions 2-21
5. Maintenance 2-23
5.1 Maintenance intervals table 2-23

5.2 Lubricants quantity 2-27
5.3 Recommended lubricants 2-28
5.4 Daily check 2-29
5.4.1 Walk-around inspection 2-29
5.4.2 Cleaning the dust valve 2-29
5.4.3 Checking the engine oil level 2-29
5.4.4 Checking the coolant level 2-29
5.4.5 Checking the radiator and oil cooler 2-30
5.4.6 Checking the fan belt 2-30
5.4.7 Checking the exhaust system leakage 2-31
5.4.8 Checking the hydraulic oil level 2-31
5.4.9 Checking the water separator 2-31
5.4.10 Greasing the bucket and bucket linkage 2-31
5.4.11 Greasing the swing bracket 2-32
5.4.12 Greasing the other greasing points 2-32
5.4.13 Checking the fuel level 2-33
5.4.14 Checking the washer liquid level 2-33
5.4.15 Checking the electrical equipment 2-33
5.5 Every 50 hours 2-33
5.5.1 Draining the fuel tank 2-33
5.5.2 Checking the battery 2-34
5.5.3 Greasing the swivel gear 2-36
5.5.4 Checking the track tension 2-36
5.5.5 Adjusting the track tension 2-37
5.5.6 Cleaning the water separator 2-38
5.6 Every 200 hours 2-39
5.6.1 Greasing the swivel bearing 2-39
5.6.2 Checking and cleaning the air filter 2-39
5.6.3 Checking and cleaning the air cleaner elements 2-39
5.6.4 Checking the radiator hoses and clamps 2-40
5.6.5 Checking the fuel line and intake air line 2-40
5.7 Every 250 hours 2-41
5.7.1 Adjusting the fan belt 2-41
5.7.2 Greasing the pilot valve linkage 2-41
5.8 Every 500 hours 2-42
5.8.1 Replacing the engine oil and engine oil filter 2-42
5.8.2 Replacing the travel motor gear oil 2-43
5.8.3 Replacing the fuel filter 2-43
5.8.4 Replacing the return filter 2-44
5.9 Every 1000 hours 2-44
5.9.1 Replacing the in-line filter 2-44
5.9.2 Replacing the hydraulic oil and suction filter 2-45
5.9.3 Replacing the air filter 2-46
5.9.4 Replacing the air cleaner elements 2-46
5.9.5 Replacing the pilot filter 2-47
5.10 Every 1500 hours 2-47
5.10.1 Checking the injection nozzles 2-47
5.11 Every 2000 hours 2-48
5.11.1 Replacing the engine oil in the front idler and track roller 2-48
5.11.2 Checking the alternator 2-49
5.11.3 Checking the starter motor 2-50
5.12 Every 3000 hours 2-51
5.12.1 Checking the fuel injection pump 2-51
5.13 Every 1 year 2-51
5.13.1 Safety inspection 2-51
5.14 Every 2 years 2-52
5.14.1 Replacing the radiator hoses and hose clamps 2-52
5.14.2 Replacing the fuel line and intake air line 2-53

5.14.3 Replacing the coolant 2-53
5.15 Every 6 years 2-54
5.15.1 Replacing the hydraulic hoses 2-54

3. MACHINE BODY

MECHANISM 3-1
1. Machine devices layout 3-1
2. Bucket 3-3
2.1 Bucket dimensions 3-3
3. Arm 3-5
3.1 Arm dimensions 3-5
4. Boom 3-8
4.1 Boom dimensions 3-8
5. Blade 3-9
5.1 Blade dimensions 3-9
6. Steel track 3-9
6.1 Steel track dimensions 3-9
7. Rubber track 3-10
7.1 Rubber track dimensions 3-10
8. Front idler 3-10
8.1 Front idler dimensions 3-10
9. Sprocket 3-10
9.1 Sprocket dimensions 3-10
10. Track roller 3-11
10.1 Track roller dimensions 3-11
11. Carrier roller 3-11
11.1 Carrier roller dimensions 3-11
12. Pins, bushings, and shims 3-12
12.1 Pin, bushing, and shim dimensions 3-12
SERVICING 3-17
1. Service specifications 3-17
1.1 Service specifications for machine body 3-17
2. Testing 3-19
2.1 Measuring the front attachment horizontal play 3-19
2.2 Measuring the swivel bearing vertical play 3-20
2.3 Measuring swing bracket vertical clearance 3-21
2.4 Measuring the operating force for levers and pedals 3-21
3. Repairing 3-22
3.1 Bucket 3-22
3.1.1 Removing the bucket 3-22
3.2 Arm 3-23
3.2.1 Removing the arm 3-23
3.3 Boom 3-24
3.3.1 Removing the boom 3-24
3.4 Blade 3-25
3.4.1 Removing the blade 3-25
3.5 Counterweight 3-26
3.5.1 Removing and installing the counterweight 3-26
3.6 Canopy 3-27
3.6.1 Removing and installing the canopy 3-27
3.7 Cabin 3-28
3.7.1 Removing and installing the cabin 3-28
3.8 Lever lock 3-29
3.8.1 Removing and installing the lever lock 3-29
3.9 Travel control lever 3-31
3.9.1 Installing the travel control lever 3-31
3.10 Blade control lever 3-33
3.10.1 Installing the blade control lever 3-33

3.11 Swing control pedal 3-34
3.11.1 Installing the swing control pedal 3-34
3.12 AUX control pedal 3-36
3.12.1 Installing the AUX control pedal 3-36
3.13 Swivel bearing 3-37
3.13.1 Installing the swivel bearing 3-37
3.14 Steel track 3-37
3.14.1 Removing and installing the steel track 3-37
3.15 Rubber track 3-40
3.15.1 Removing and installing the rubber track 3-40
3.16 Front idler 3-41
3.16.1 Removing the front idler 3-41
3.16.2 Front idler components 3-42
3.16.3 Disassembling the front idler 3-42
3.16.4 Assembling the front idler 3-43
3.17 Tension spring 3-44
3.17.1 Removing and installing the tension spring 3-44
3.18 Grease cylinder 3-45
3.18.1 Removing the grease cylinder 3-45
3.19 Track roller 3-45
3.19.1 Removing and installing the track roller 3-45
3.19.2 Track roller components 3-47
3.19.3 Disassembling the track roller 3-47
3.19.4 Assembling the track roller 3-47
3.20 Carrier roller 3-48
3.20.1 Removing and installing the carrier roller 3-48

4. ENGINE

MECHANISM 4-1
1. Engine device layout 4-1
2. Engine specifications 4-3
3. Engine dimensions 4-5
4. Engine performance curves 4-6
SERVICING 4-9
1. Troubleshooting 4-9
1.1 Engine troubleshooting 4-9
2. Service specifications 4-11
2.1 Service specifications for engine 4-11
3. Testing 4-11
3.1 Measuring engine compression pressure 4-11
3.2 Measuring engine oil pressure 4-11
4. Repairing 4-12
4.1 Fuel hose and tank 4-12
4.1.1 Removing and installing fuel tank 4-12
4.1.2 Fuel hose routing 4-14
4.2 Engine 4-17
4.2.1 Removing and installing engine 4-17
4.2.2 Installing engine mount 4-19
4.2.3 Installing radiator 4-20
4.2.4 Removing and installing muffler 4-20
4.2.5 Installing the alternator 4-21
4.3 Special jigs and tools 4-22
4.3.1 Engine compression pressure measuring kit 4-22

5. HYDRAULIC SYSTEM

MECHANISM 5-1
1. Hydraulic device layout 5-1
2. Hydraulic pump 5-2

2.1 Hydraulic pump specifications....5-2
2.2 Hydraulic pump hydraulic circuit....5-3
2.3 Piston pump P-Q performance....5-4
2.4 Hydraulic pump function and structure....5-5
2.4.1 Piston pump working principles....5-5
2.4.2 Horsepower control....5-6
3. Control valve....5-7
3.1 Control valve specifications....5-7
3.2 Control valve hydraulic circuit....5-10
3.3 Control valve spool shift performance....5-11
3.4 Control valve function and structure....5-12
3.4.1 Straight traveling circuit....5-12
3.4.2 Boom lock valve....5-15
3.4.3 AUX1 converge circuit....5-16
4. Swivel motor....5-17
4.1 Swivel motor specifications....5-17
4.2 Swivel motor function and structure....5-19
4.2.1 Swivel motor working principles....5-19
4.2.2 Shockless function....5-19
4.2.3 Swivel motor parking brake....5-20
4.2.4 Make-up circuit....5-20
5. Travel motor....5-21
5.1 Travel motor specifications....5-21
5.2 Travel motor function and structure....5-24
5.2.1 Travel motor working principles....5-24
5.2.2 Automatic deceleration....5-25
5.2.3 Anti-cavitation function....5-27
5.2.4 Counterbalance valve....5-29
5.2.5 Travel motor decelerator....5-32
6. Hydraulic cylinder....5-33
6.1 Hydraulic cylinder specifications....5-33
6.2 Hydraulic cylinder function and structure....5-34
6.2.1 Hydraulic cylinder cushioning....5-34
7. Swivel joint....5-35
7.1 Swivel joint specifications....5-35
8. Pilot control valve....5-37
8.1 Pilot control valve specifications....5-37
8.2 Pilot control valve performance diagram....5-39
8.3 Pilot control valve function and structure....5-39
9. Unload valve....5-41
9.1 Unload valve specifications....5-41
9.2 Unload valve function and structure....5-42
9.2.1 Unload valve working principles....5-42
10. Proportional valve....5-43
10.1 AUX1 proportional valve specifications....5-43
10.2 AUX2 proportional valve specifications....5-45
10.3 AUX1 proportional valve performance diagram....5-45
10.4 Proportional valve function and structure....5-46
10.4.1 Proportional valve working principles....5-46
11. Third line valve....5-47
11.1 Third line valve specifications....5-47
SERVICING....5-49
1. Troubleshooting....5-49
1.1 Hydraulic troubleshooting for front attachment....5-49
1.2 Hydraulic troubleshooting for swivel....5-51
1.3 Hydraulic troubleshooting for traveling....5-52
2. Service specifications....5-53
2.1 Service specifications for hydraulic system....5-53

3. Testing 5-55
3.1 Measuring hydraulic devices 5-55
3.1.1 Measuring boom cylinder speed 5-55
3.1.2 Measuring arm cylinder speed 5-56
3.1.3 Measuring bucket cylinder speed 5-56
3.1.4 Measuring blade cylinder speed 5-56
3.1.5 Measuring swing cylinder speed 5-57
3.1.6 Measuring swivel speed 5-57
3.1.7 Measuring travel speed 5-57
3.1.8 Measuring cylinder internal leakage 5-58
3.1.9 Measuring travel motor internal leakage 5-59
3.1.10 Measuring swivel motor internal leakage 5-59
3.1.11 Testing travel straightness 5-60
3.2 Measuring hydraulic pump 5-62
3.2.1 Measuring piston pump P-Q performance 5-62
3.2.2 Measuring AUX flow rate 5-65
3.3 Measuring control valve 5-70
3.3.1 Measuring main relief valve pressure 5-70
3.3.2 Measuring overload relief valve 5-71
3.4 Measuring swivel motor 5-72
3.4.1 Measuring swivel motor overload relief valve pressure 5-72
3.4.2 Measuring swivel motor drain 5-73
3.5 Measuring travel motor 5-74
3.5.1 Measuring travel motor drain 5-74
3.6 Measuring pilot control valve 5-75
3.6.1 Measuring pilot primary pressure 5-75
3.6.2 Measuring pilot secondary pressure 5-76
4. Repairing 5-76
4.1 Hydraulic pump 5-76
4.1.1 Removing and installing the hydraulic pump 5-76
4.1.2 Hydraulic pump components 5-78
4.1.3 Disassembling the piston pump 5-79
4.1.4 Assembling the piston pump 5-81
4.1.5 Installing adapter layout for the hydraulic pump 5-86
4.1.6 Installing hydraulic pump coupling 5-87
4.1.7 Hydraulic pump maintenance standard 5-88
4.2 Control valve 5-88
4.2.1 Removing and installing the control valve 5-88
4.2.2 Control valve components 5-91
4.2.3 Disassembling and assembling control valve 5-98
4.2.4 Installing adapter layout for control valve 5-99
4.3 Swivel motor 5-102
4.3.1 Removing and installing the swivel motor 5-102
4.3.2 Swivel motor components 5-103
4.3.3 Disassembling the swivel motor 5-103
4.3.4 Assembling the swivel motor 5-106
4.3.5 Installing adapter layout for the swivel motor 5-112
4.4 Travel motor 5-113
4.4.1 Removing and installing the travel motor 5-113
4.4.2 Travel motor components 5-115
4.4.3 Disassembling the travel motor 5-117
4.4.4 Assembling the travel motor 5-121
4.5 Hydraulic cylinder 5-130
4.5.1 Cylinder components 5-130
4.5.2 Disassembling hydraulic cylinder 5-131
4.5.3 Assembling hydraulic cylinder 5-133
4.5.4 Measuring hydraulic cylinder 5-136
4.6 Pilot control valve 5-137

4.6.1 Removing and installing the pilot control valve 5-137
4.6.2 Pilot control valve components 5-139
4.6.3 Disassembling the pilot control valve (basic) 5-139
4.6.4 Assembling the pilot control valve (basic) 5-142
4.6.5 Disassembling the pilot control valve (Hi-spec) 5-144
4.6.6 Assembling the pilot control valve (Hi-spec) 5-146
4.6.7 Installing adapter layout for the pilot control valve 5-149
4.7 Unload valve 5-151
4.7.1 Unload valve components 5-151
4.7.2 Disassembling and assembling the unload valve 5-151
4.7.3 Installing adapter layout for the unload valve 5-153
4.8 Swivel joint 5-154
4.8.1 Removing and installing the swivel joint 5-154
4.8.2 Installing adapter layout for the swivel joint 5-156
4.9 Proportional valve 5-157
4.9.1 Removing and installing the AUX1 proportional valve 5-157
4.9.2 Removing and installing the AUX2 proportional valve 5-157
4.9.3 Disassembling and assembling the AUX1 proportional valve 5-158
4.9.4 Disassembling and assembling the AUX2 proportional valve 5-158
4.9.5 Installing adapter layout for the AUX1 proportional valve 5-159
4.9.6 Installing adapter layout for the AUX2 proportional valve 5-159
4.10 Third line valve 5-160
4.10.1 Removing and installing the third line valve 5-160
4.10.2 Third line valve components 5-160
4.10.3 Installing adapter layout for the third line valve 5-160
4.11 Hydraulic hose 5-161
4.11.1 Length description of hydraulic hoses 5-161
4.11.2 Metal fittings of hydraulic hoses 5-161
4.11.3 Delivery hoses routing (Basic) 5-162
4.11.4 Delivery hoses routing (Hi-spec) 5-164
4.11.5 Front hoses routing 5-166
4.11.6 Travel and blade hoses routing 5-168
4.11.7 Drain hoses routing 5-169
4.11.8 Pilot hoses routing (Basic) 5-171
4.11.9 Pilot hoses routing (Hi-spec) 5-173
4.12 Special jigs and tools 5-176
4.12.1 Overload relief valve measuring kit 5-176
4.12.2 Travel motor special jigs and tools 5-177
4.12.3 Universal joint tightening jig 5-180

6. ELECTRICAL SYSTEM

MECHANISM 6-1
1. Electrical circuit 6-1
1.1 Electrical circuit general description 6-1
1.1.1 Electrical circuit diagram description 6-1
1.1.2 Electrical circuit diagram unit symbol 6-1
1.1.3 Electrical wiring color coding 6-2
1.1.4 Electrical wiring clamp 6-2
1.1.5 Bus description 6-3
1.1.6 Composite terminal description 6-3
1.2 Functional electrical circuit 6-4
1.2.1 Power supply electrical circuit diagram 6-4
1.2.2 Main ECU input -1 electrical circuit diagram 6-5
1.2.3 Main ECU input -2 electrical circuit diagram 6-6
1.2.4 Main ECU output electrical circuit diagram 6-7
1.2.5 Communication electrical circuit diagram 6-8
1.2.6 Accessory -1 electrical circuit diagram 6-9
1.2.7 Accessory -2 electrical circuit diagram 6-10

1.2.8 Cabin electrical circuit diagram 6-11
1.2.9 Engine electrical circuit diagram 6-12
2. Connector 6-13
2.1 Connector handling precaution 6-13
2.2 Connector diagram description 6-13
3. Electrical device 6-14
3.1 Electrical device layout 6-14
3.2 Fuse and relay layout 6-16
3.3 Slow blow fuse layout 6-16
3.4 Communication port layout 6-16
4. General description for AUX control on Hi-spec 6-17
5. Meter panel 6-18
5.1 Meter panel function 6-18
5.2 Display mode 6-19
5.3 Operating normal mode 6-19
5.4 Operating user setting mode 6-19
5.4.1 Operating periodic check mode 6-19
5.4.2 Operating AUX flow rate setting mode 6-21
5.4.3 Operating clock setting mode 6-21
5.5 Service dealer mode table 6-23
SERVICING 6-25
1. Troubleshooting 6-25
1.1 Electrical troubleshooting 6-25
1.2 Error warning table 6-27
1.3 Lamp warning list 6-28
2. Service dealer mode 6-29
2.1 Entering service dealer mode 6-29
2.2 Operating SET-1 (Tester mode) 6-29
2.3 Operating SET-2 (Reading error history) 6-30
2.4 Operating SET-3 (Clearing error history) 6-30
2.5 Operating SET-4 (Dealer setting) 6-30
2.5.1 Operating SET-4 (Dealer setting) No-01 (AUX knob switch setting) 6-31
2.5.2 Operating SET-4 (Dealer setting) No-02 (AUX start-up point setting (w/ attachment)) 6-31
2.5.3 Operating SET-4 (Dealer setting) No-03 (AUX start-up point setting (w/o attachment)) 6-32
2.5.4 Operating SET-4 (Dealer setting) No-04 (AUX start-up point fine adjustment) 6-32
2.5.5 Operating SET-4 (Dealer setting) No-05 (Model setting) 6-32
2.5.6 Operating SET-4 (Dealer setting) No-06 (Clearing periodic check alert) 6-33
2.5.7 Operating SET-4 (Dealer setting) No-07 (Informing periodic check alert) 6-33
2.5.8 Operating SET-4 (Dealer setting) No-08 (Time offset for periodic check) 6-33
2.5.9 Operating SET-4 (Dealer setting) No-09 (Clock setting alert) 6-34
2.5.10 Operating SET-4 (Dealer setting) No-10 (Travel buzzer function) 6-34
2.5.11 Operating SET-4 (Dealer setting) No-11 (Travel speed shift switch) 6-34
2.5.12 Default settings for SET-4 (Dealer setting) 6-34
2.6 Operating SET-5 (Reading all error history) 6-34
3. Handling error warning 6-35
3.1 Handling E:001 CAN communication error 6-35
3.2 Handling E:005 High coolant temperature 6-36
3.3 Handling E:014 Engine oil pressure error 6-37
3.4 Handling E:015 Engine overheating 6-38
3.5 Handling E:016 Battery charging error 6-39
3.6 Handling E:017 Fuel sensor error 6-40
3.7 Handling E:018 Water temperature sensor error 6-41
3.8 Handling E:020 Lever lock solenoid error 6-42
3.9 Handling E:021 Travel speed shift system error 6-43
3.10 Handling E:022 AUX1 knob switch error 6-45
3.11 Handling E:023 AUX1 RH solenoid error 6-46
3.12 Handling E:024 AUX1 LH solenoid error 6-47
3.13 Handling E:025 Battery overcharging 6-49

3.14 Handling E:026 Anti-theft antenna error 6-49
3.15 Handling E:027 5 V short 6-50
3.16 Handling E:028 12 V error 6-51
ANTI-THEFT SYSTEM 6-55
1. Registering the black key 6-55

7. AIR CONDITIONING AND HEATER SYSTEM

MECHANISM 7-1
1. Heater system general description 7-1
2. Heater device layout 7-1
3. Heater unit 7-1
3.1 Heater unit specifications 7-1
3.2 Heater unit function and structure 7-2
3.2.1 Heater core 7-2
3.2.2 Blower 7-2
3.2.3 Heater valve 7-2
SERVICING 7-3
1. Troubleshooting 7-3
1.1 Heater system troubleshooting 7-3
2. Testing 7-4
2.1 Checking the fan switch 7-4
2.2 Checking the blower motor 7-5
3. Repairing 7-5
3.1 Heater unit 7-5
3.1.1 Removing and installing the heater unit 7-5
3.2 Heater hose 7-7
3.2.1 Heater hose routing 7-7

8. APPENDICES

APPENDICES 8-1
1. Servicing information 8-1
1.1 Service specifications for machine body 8-1
1.2 Service specifications for hydraulic system 8-3
1.2.1 Piston pump P-Q performance 8-7
1.2.2 AUX P-Q performance 8-8
1.3 Service specifications for engine 8-12
1.4 Service dealer mode 8-12
1.4.1 Default settings 8-12
1.4.2 Tester mode 8-12
2. Meter flow chart 8-15
3. Hydraulic circuit diagram 8-18
3.1 Hydraulic circuit diagram for basic specification 8-18
3.2 Hydraulic circuit diagram for Hi spec 8-19
4. Wire harness 8-20
4.1 Wire harness 8-20
5. Electrical circuit diagram 8-26
5.1 Electrical circuit diagram for Hi-spec 8-26

ABBREVIATIONS

Abbreviations	Definitions	Abbreviations	Definitions
A/C	Air conditioning	ID	Inner diameter
AC	Alternating Current	ISO	International Standards Organization
ACC	Accessory	J/C	Joint Connector
AI	Auto Idle	JIS	Japanese Industry Standard
API	American Petroleum Institute	LED	Light Emitting Diode
Approx.	Approximately	LH	Left Hand side
AS	Auto Stop	MAX	Maximum
ASSY.	Assembly	MIL	Military Standards
ASTM	American Society for Testing and Materials	MIN	Minimum
AUX	Auxiliary	NC	Normally Closed
C/V	Control Valve	NO	Normally Opened
CAB	Cabin	OD	Outer diameter
CAN	Controller Area Network	P/V	Pilot Valve
CECE	Committee for European Construction Equipment	RH	Right Hand side
CNP	Canopy	RMS	Root Mean Square
CRS	Common Rail System	SAE	Society of Automotive Engineers
DIN	Deutsches Institut für Normung (German Institute for Standards)	SBF	Slow Blow Fuse
DOC	Diesel Oxidation Catalysts	SCV	Suction Control Valve
DPF	Diesel Particulate Filters	SI	Système Internationale
ECU	Electronic Control Unit	S/J	Swivel joint
EGR	Exhaust Gas Recirculation	SOL	Solenoid
e.g.	exempli gratia	spec.	Specification
EN	Europäische Norm (European standard)	SW	Switch
Eng	Engine	TPSS	Two Pattern Selection System
etc.	et cetera	WSM	Work Shop Manual
GND	Ground		-

1. INFORMATION

SAFETY FIRST

Read the safety instructions in the manual and on the safety labels very carefully to avoid personal injury.
The safety symbols, precautions and safety labels offer instructions regarding safety regulations for machine operation.
It is essential that you read and follow them.

⚠ DANGER
- **Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.**

⚠ WARNING
- **Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**

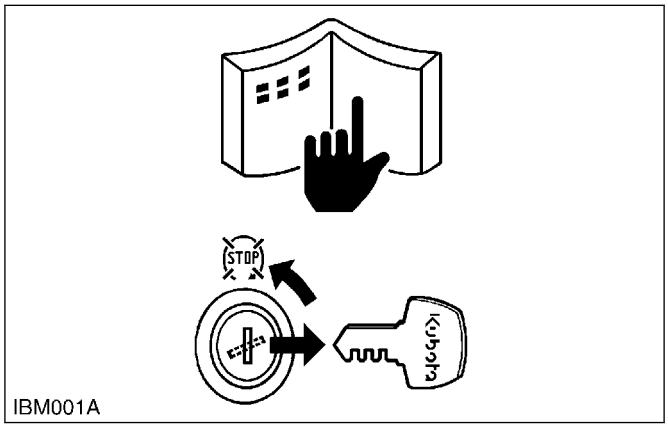
⚠ CAUTION
- **Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.**

■ IMPORTANT
- **Indicates that equipment or property damage could result if instructions are not followed.**

■ NOTE
- **Gives helpful information.**

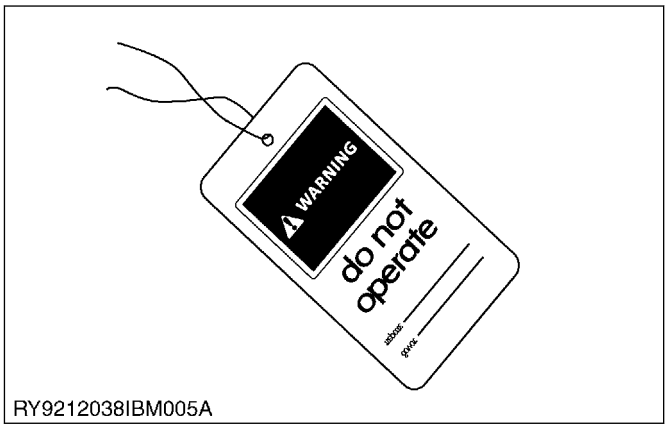
1. For working safety

1.1 Working precautions



IBM001A

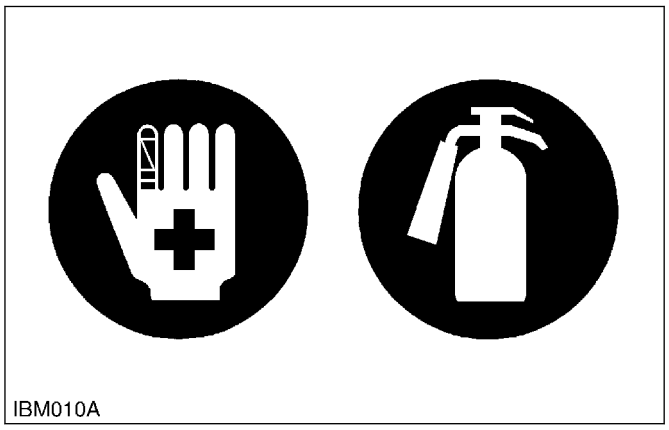
- Please understand all safety instructions and safety labels in this manual.
- Stop the engine when leaving the operator's seat for cleaning, checking, and adjusting the machine.
- Park the machine on a firm and level ground to check the machine safely.

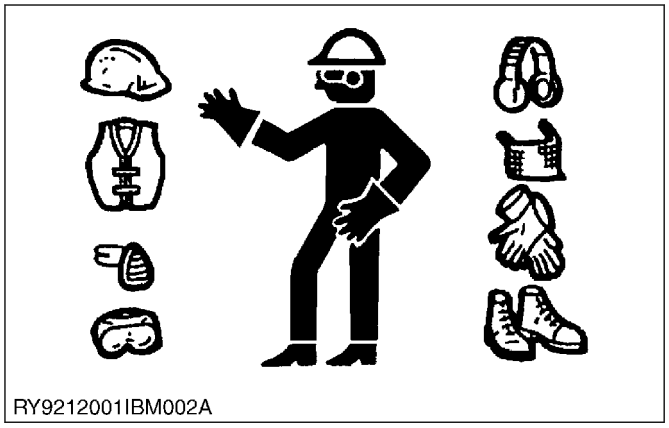


RY9212038IBM005A

- Hang a **DO NOT OPERATE** tag near the operator's seat.
- When doing maintenance and repairing, lower the front attachment to the ground, stop the engine, and attach the warning sign so it is clearly visible.
- Do not use worn or cracked tools. Use tools in a proper way with enough strength.

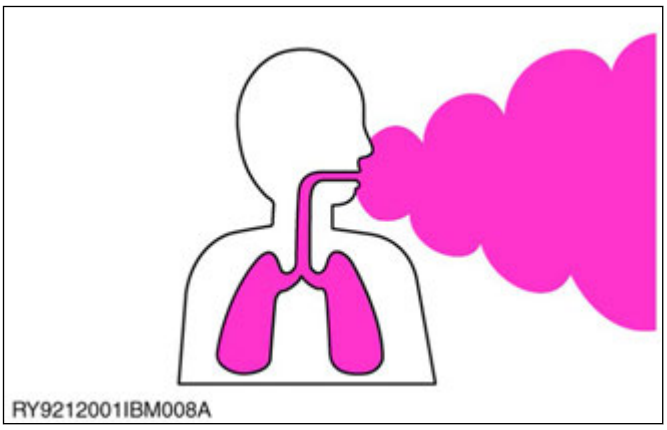
1.2 Preparing for emergencies


IBM010A


RY9212001IBM002A

- Keep a first aid kit and fire extinguisher ready at all times.
- Keep the emergency contact telephone numbers near your telephone.
- Wear the uniform suited for service working. Do not wear loose clothes as they could get caught on the control lever.
- When checking the machine, use proper protective equipment (for example helmet, eye protector, and protective shoes).
- Do not check the machine after you have consumed alcohol or drugs or when you are tired.

1.3 Working cautions


RY9212001IBM008A

- Park the machine on a stable and level ground. Keep the machine away from obstacles and hazardous materials.
- In cases of working indoors, make sure to ventilate the work area.
- Do not allow third parties to come near the machine.
- Maintain machine clean. Remove dirt, debris, and oil attached to the machine.

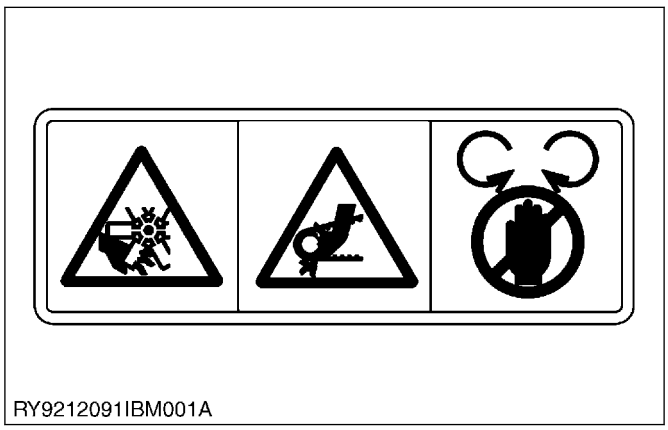
RY9212001IBM003A

- Make sure you have the support of 3 points (both hands and one foot) to get on or off the machine.

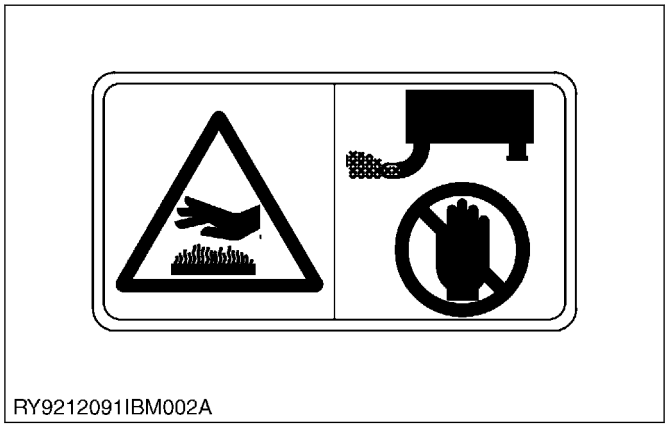
1.4 Starting the machine safely

RY9212001IBM004A

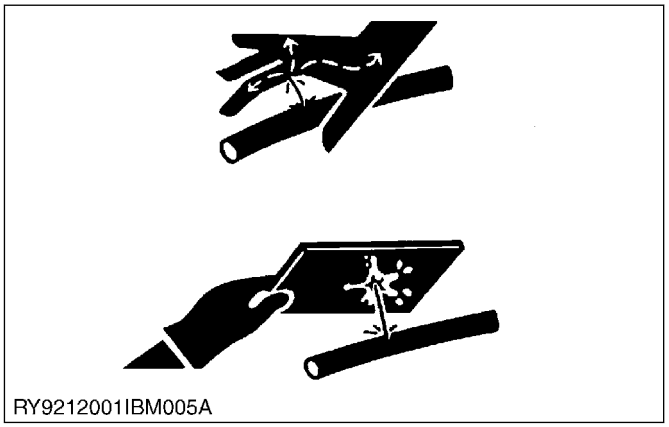
- Confirm if it is safe around the machine from the operator's seat before starting the engine.
- Do not start the engine if not seated in the operator's seat.
- Confirm that the pilot levers are in neutral before starting the engine.


RY9212091IBM001A

- Lock the cover and bonnet when starting the machine with cover and bonnet opened.
- Keep away from rotating and moving objects.
- Keep tools and waste cloth away from the rotating and moving objects.


RY9212091IBM002A

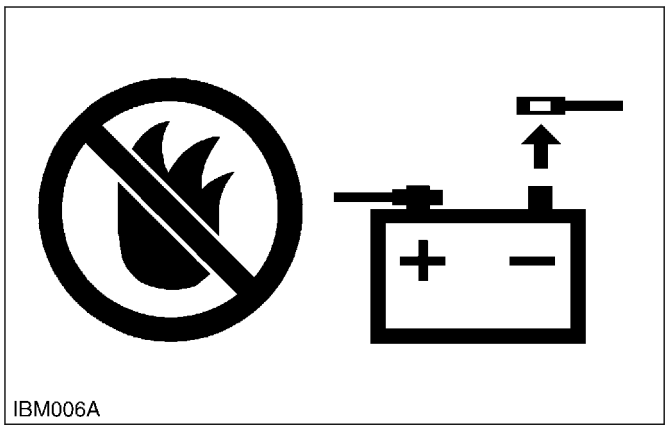
- Do not work immediately after has stopping the engine. The engine, muffler, radiator, and hydraulic devises are extremely hot.
- Do not remove caps and plugs soon after has stopping the engine. Since, the temperature and pressure of coolant, hydraulic oil, and the fuel are still high.


RY9212001IBM005A

- Do not short starter circuit to start the engine. This is dangerous and might damage the machine.
- When opening the radiator cap, confirm coolant temperature and release pressure.
- Release residual pressure of the hydraulic circuit before removing the hydraulic devices.
- Pay attention when releasing pressure of hydraulic circuit, as the machine or front attachment might move unexpectedly.
- Wear safety glasses and gloves when checking for oil leakage.

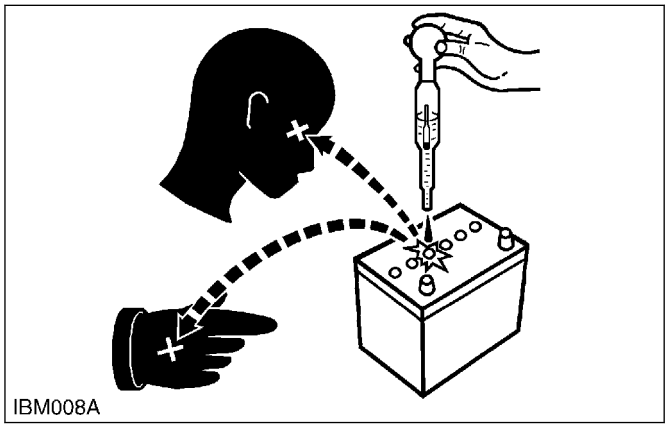
1.5 Preventing fires

RY9212001IBM006A


IBM006A

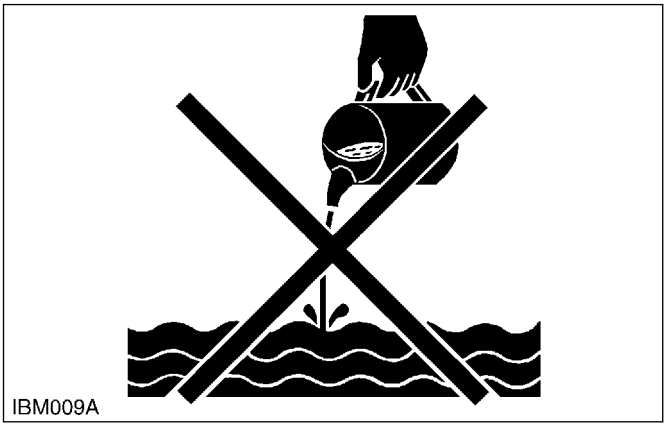
- Keep fire (welding sparks, grinding sparks, cigarettes) away from fuel.
- Wipe off the fuel off when spilled.
- Keep fire (welding sparks, grinding sparks, cigarettes) away from the battery. The battery produces oxygen and hydrogen gas which are flammable.
- When disconnecting the battery cable, make sure to disconnect the negative (-) terminal first.
- When connecting the battery cable, make sure to connect the positive (+) terminal first.

1.6 Preventing acid burns


IBM008A

- Keep electrolyte away from your eyes, hands and clothing. Sulfuric acid in battery electrolyte is poisonous and it can burn your skin and clothing and cause blindness. If you spill electrolyte on yourself, clean yourself with water and get medical aid immediately.

1.7 Discarding waste fluid

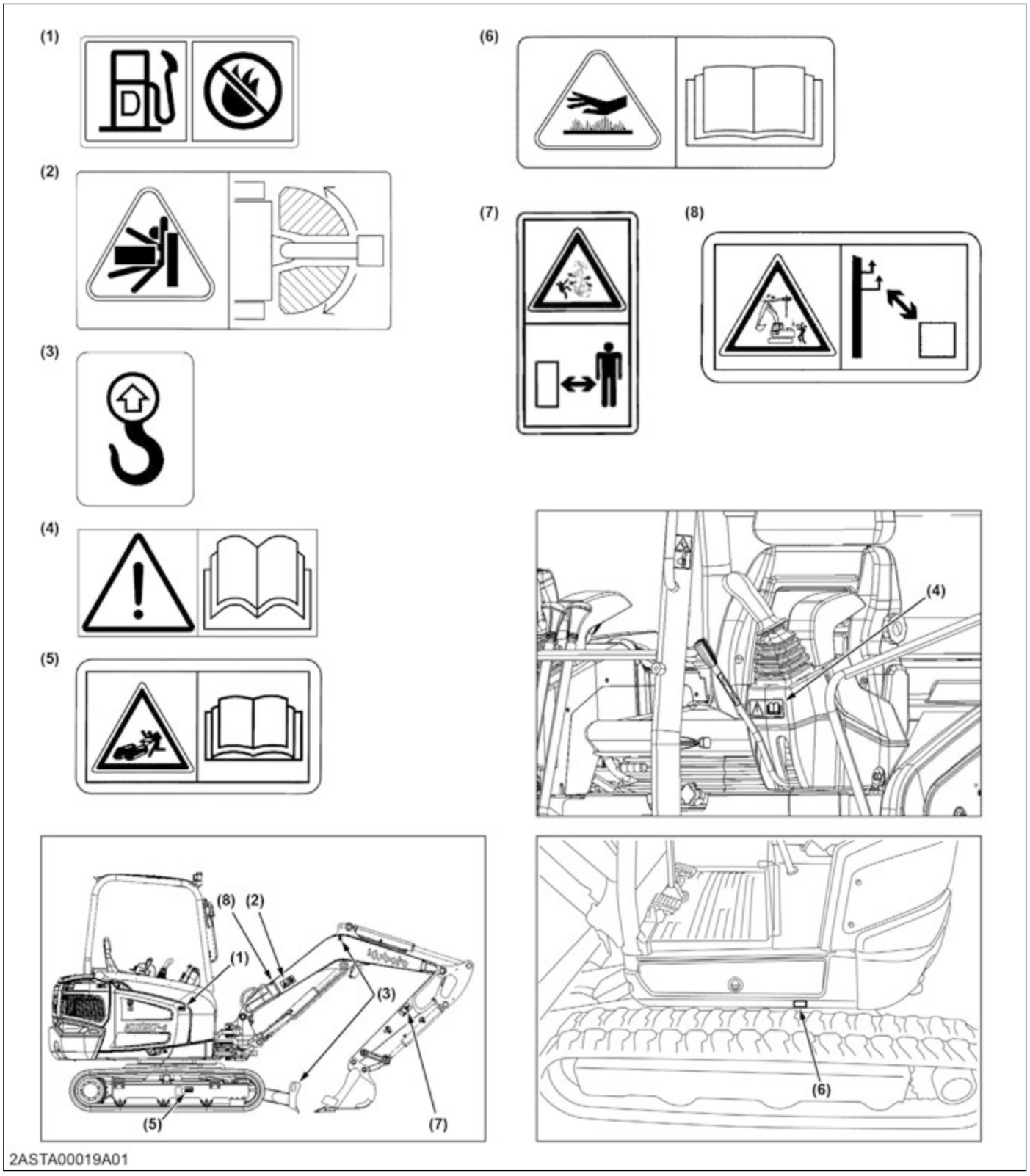

IBM009A

- Do not discard fluids to the ground, down the drain, into a stream, pond, or lake.
- Obey related environmental protection regulations when you discard oil, fuel, coolant, electrolyte and other hazardous wastes.

2. Safety labels

2.1 Safety labels placement

Read the safety instructions on safety label very carefully to avoid personal injury.



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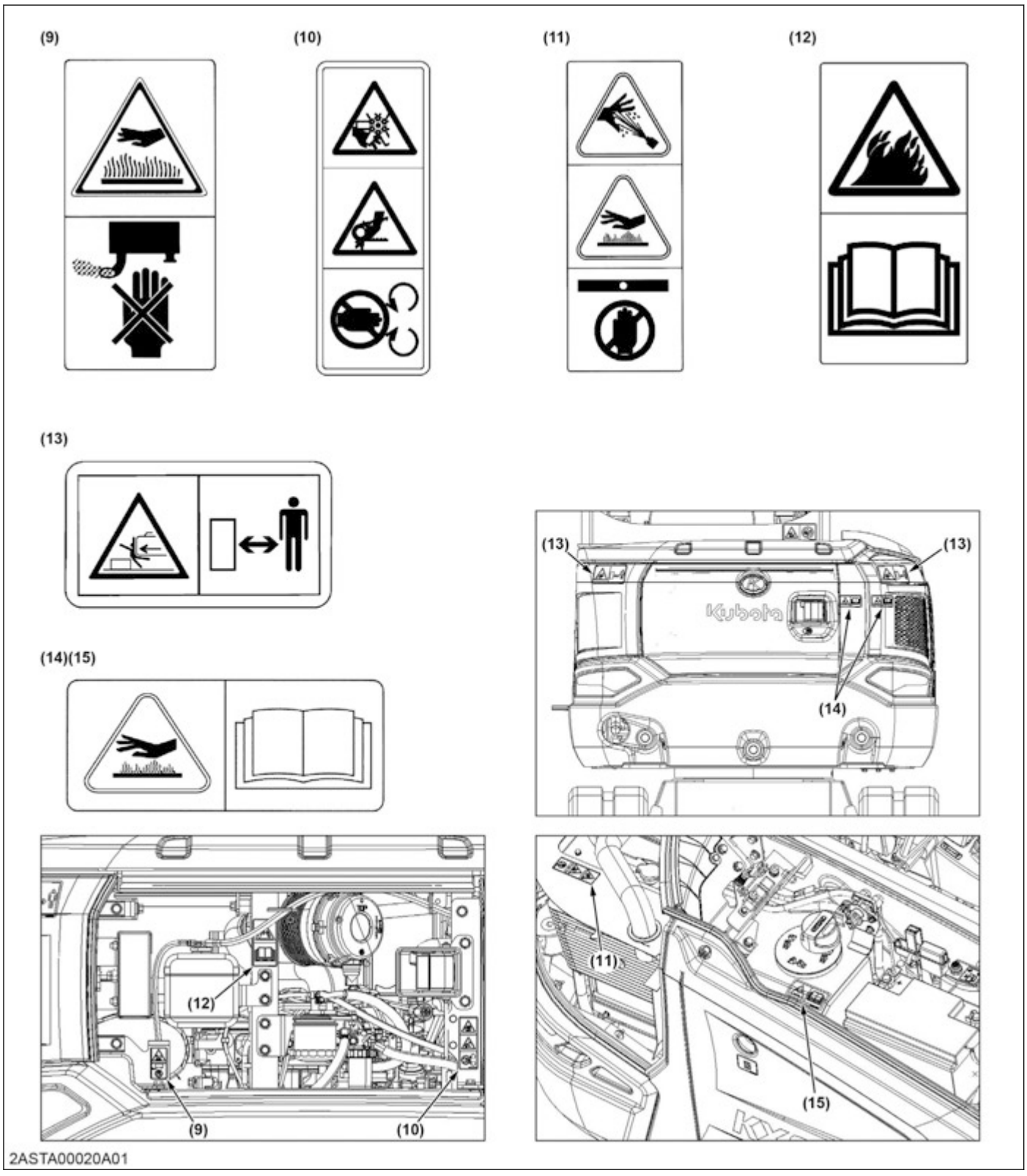
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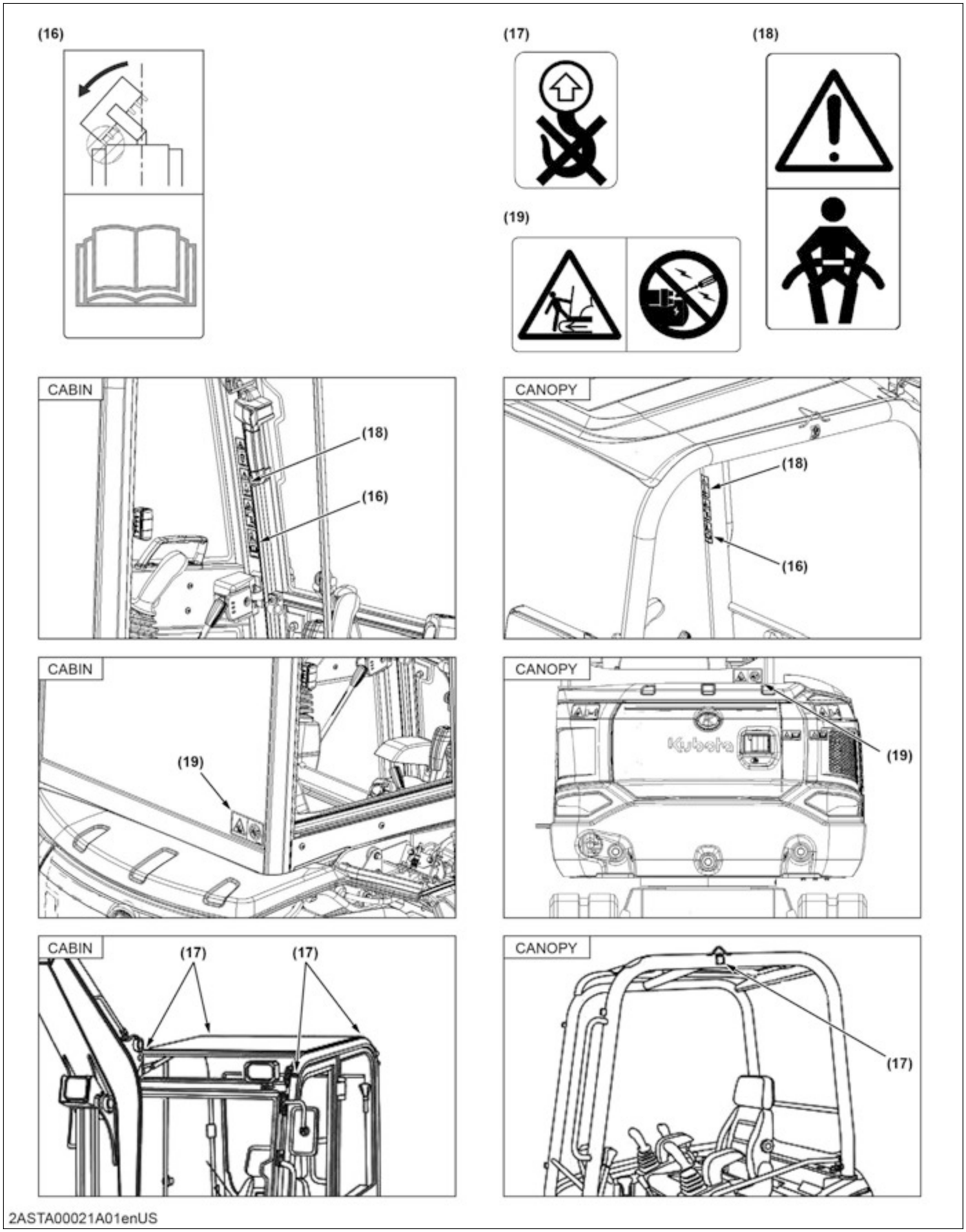
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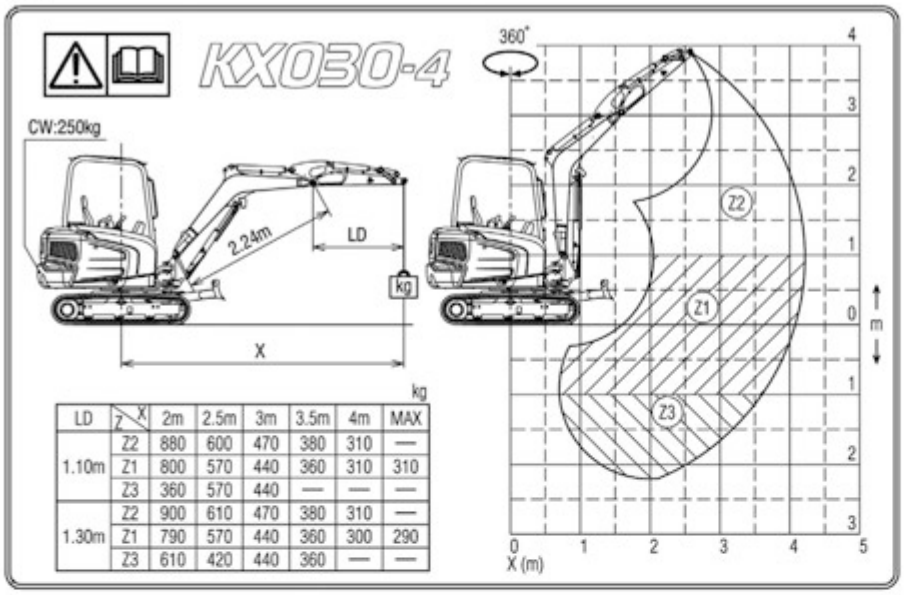
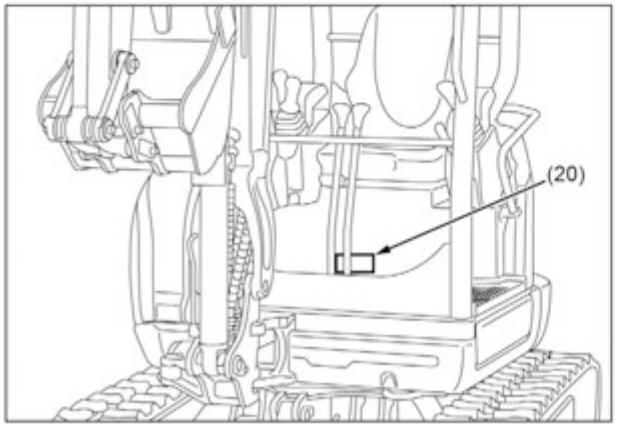


kg

LD	Z \ X	2m	2.5m	3m	3.5m	4m	MAX
1.10m	Z2	880	600	470	380	310	—
	Z1	800	570	440	360	310	310
	Z3	360	570	440	—	—	—
1.30m	Z2	900	610	470	380	310	—
	Z1	790	570	440	360	300	290
	Z3	610	420	440	360	—	—



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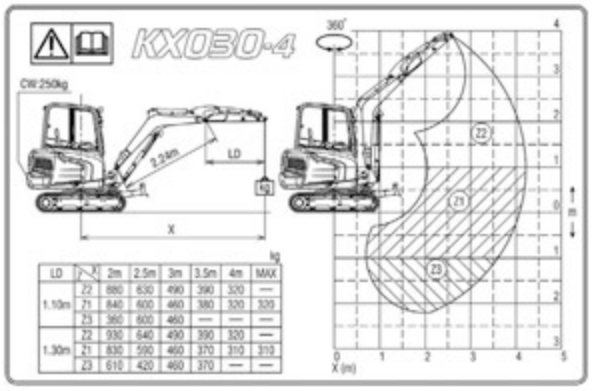
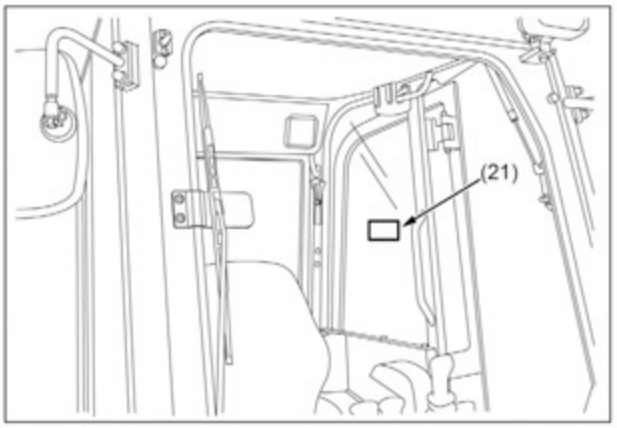
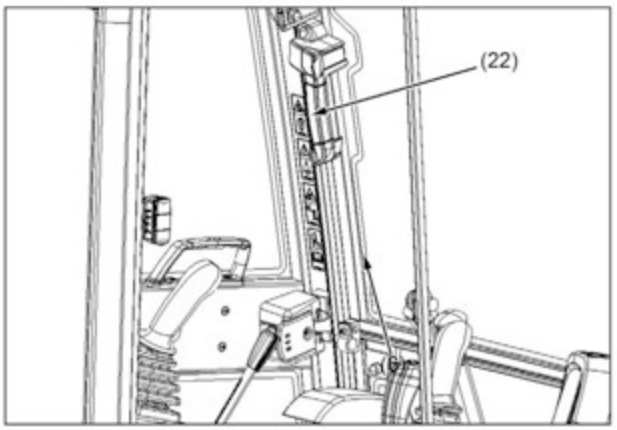
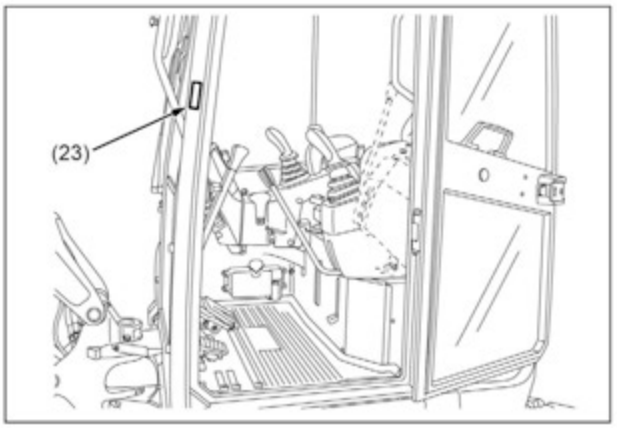








2QHNS00061A01

2.2 Safety labels maintenance

- Keep safety labels clean and free from obstructing material.
- Clean safety labels with soap and water, and soft cloth.
- Replace damaged or missing safety labels with new labels.
- If a component with safety labels affixed is replaced with new part, make sure new labels are attached in the same locations as the replaced components.
- Mount new safety labels by applying on a clean dry surface and pressing any bubbles to the outside edge.

2. GENERAL

GENERAL WORKING INSTRUCTIONS

1. General working precautions

- When servicing, observe the safety regulations in operator's manual and workshop manual.
- Clean the machine before maintenance.
- Before working, remove the negative (-) terminal from the battery, or turn off the battery isolator switch.
- Disassemble the machine at a clean location.
- Whenever a special tool is required, use the special tool that KUBOTA recommends. Make any special tools which are used occasionally according to the illustrations in this manual.
- Use genuine KUBOTA parts to ensure safety and machine performance.

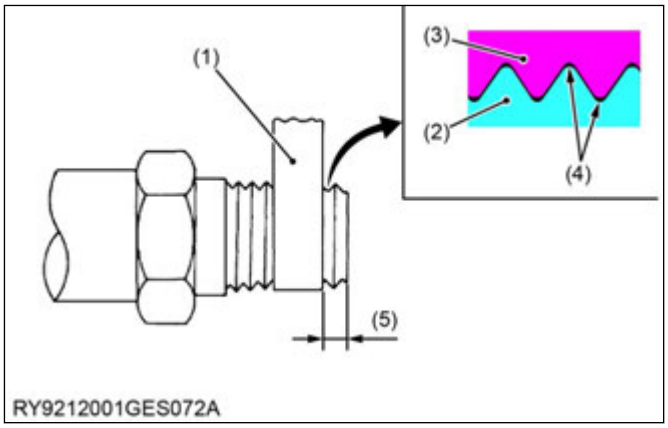
RY9212001GES071A

2. Wrapping thread seal tape

1. Wrap the thread seal tape 2 or 3 revolutions around taper threads.
2. Tighten the taper thread with the specified torque.

NOTE

- **Do not loosen taper thread after tightened to avoid oil leakage.**
- **Do not warp the thread seal on the first and second threads to avoid the thread seal contaminating in the hydraulic circuit.**



RY9212001GES072A

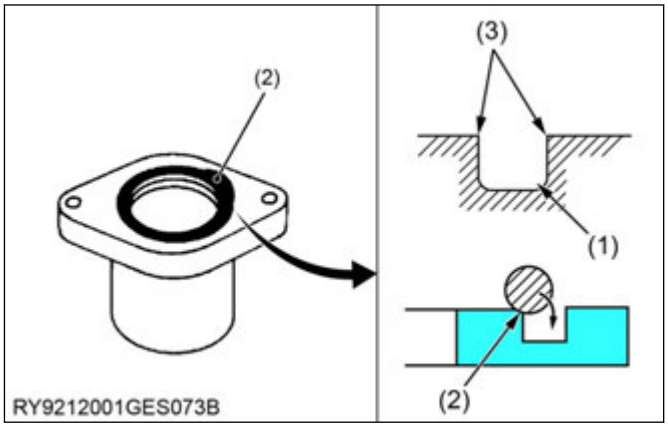
(1) Thread seal tape
(2) Male thread
(3) Female thread
(4) Clearance
(5) First and second threads

3. Replacing O-rings

1. Remove the burr and clean the O-ring groove.
2. Grease the O-ring. Do not apply any grease to the floating seal.
3. Put the O-ring in the groove.

NOTE

- **Do not kink the O-ring.**
- **Remove the burr to avoid the O-ring from damage by the burr.**



RY9212001GES073B

(1) O-ring groove
(2) O-ring
(3) Burr

4. Replacing oil seals

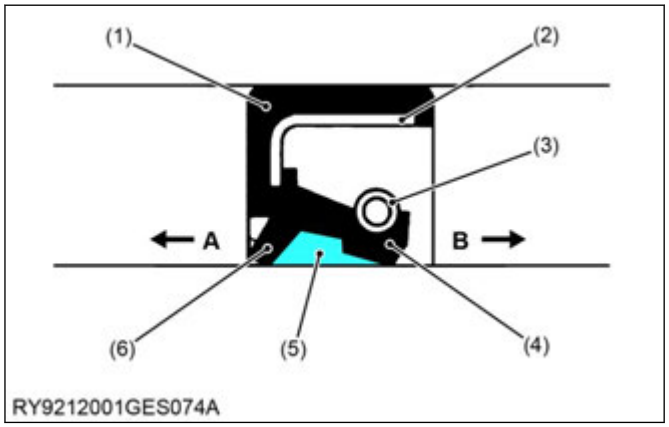
1. Do not face the lip of the oil seal in the wrong direction. Face the main lip toward the material to be sealed.

2. Use a press to install the oil seal until it seats firmly in the boss.

■ NOTE
- **In cases of installing without a press, hit the oil seal with hammer lightly, straightly and evenly to install.**

3. Grease the seal lip and dust lip.

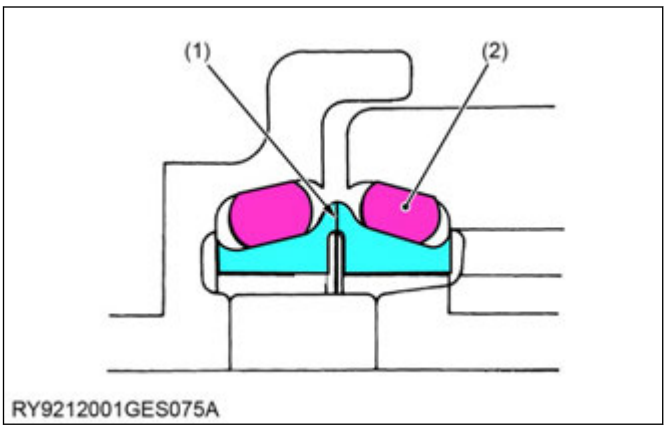
■ NOTE
- **If the seal has a dust lip, grease the gap between the lips.**
- **After oil seals are replaced, grease the moving parts around the lip to prevent the dry surfaces from wearing against each other when the engine is started.**



(1) Packing
(2) Metal ring
(3) Spring
(4) Seal lip
(5) Grease
(6) Dust lip
A: Air side
B: Oil side

5. Replacing floating seals

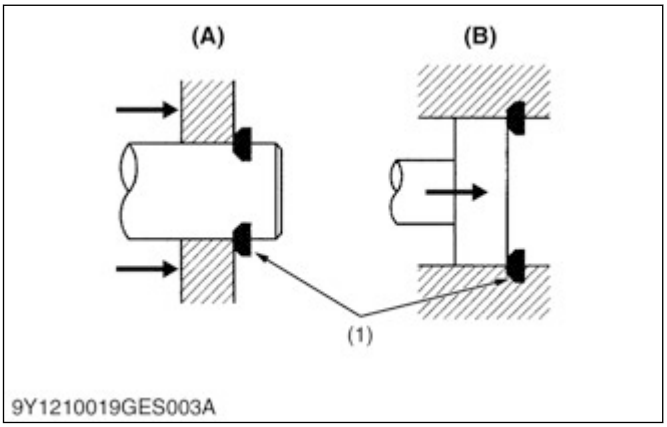
1. Apply oil to both sides of the O-ring and the contact surface properly.
2. Do not kink the O-ring when installing the floating seal.
3. Apply oil thinly to the sliding surfaces.
4. Install the floating seal in parallel to the sliding surfaces, O-ring, and housing.
5. After installing, rotate the floating seal 3 revolutions to make an oil film on the sliding surface.



(1) Sliding surface
(2) O-ring

6. Installing circlips

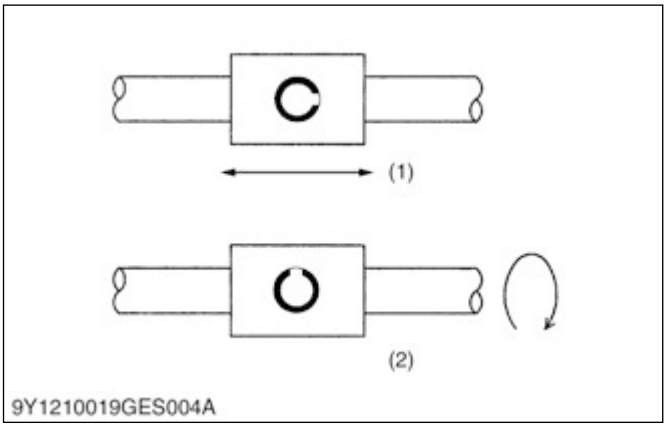
1. When installing the circlip, set the surface of the edge in the direction of the received force.



(1) Circlip
(A) External circlip
(B) Internal circlip

7. Installing spring pins

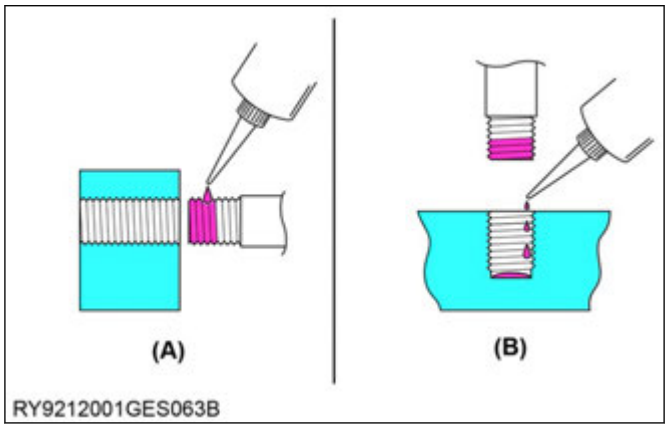
1. Install the slit of spring pin in the direction that receive the force.



(1) Parallel force
(2) When rotating

8. Applying thread lock

1. Clean and dry the location where thread lock will be applied with a solvent, so it is free of moisture, oil and dirt.
2. Apply thread lock all around the threads of the bolt except the top thread.
3. If the threads are large, accordingly apply the thread lock all around the bolt hole as well.

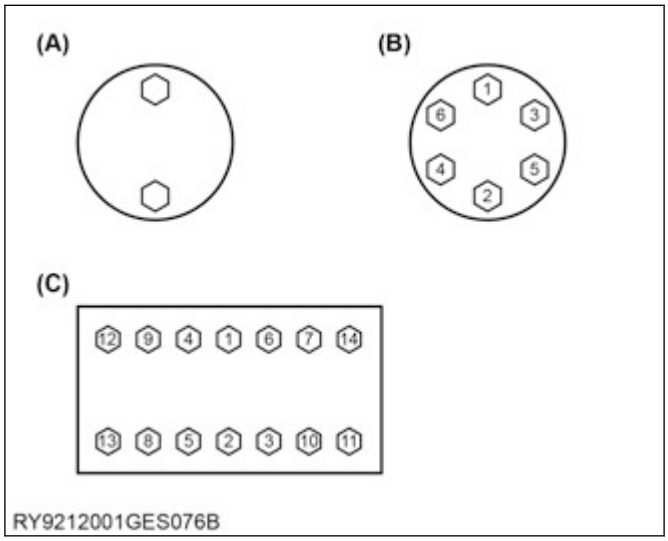


(A) Bolt hole (bolt, nuts) (B) Screw hole

9. Tightening bolts and nuts

1. Tighten bolts and nuts with their specified torque.

■ NOTE
- **Tighten bolts and nuts alternately top to bottom, left to right so the torque is distributed evenly.**
- **Tighten bolts and nuts divided into two or three times.**



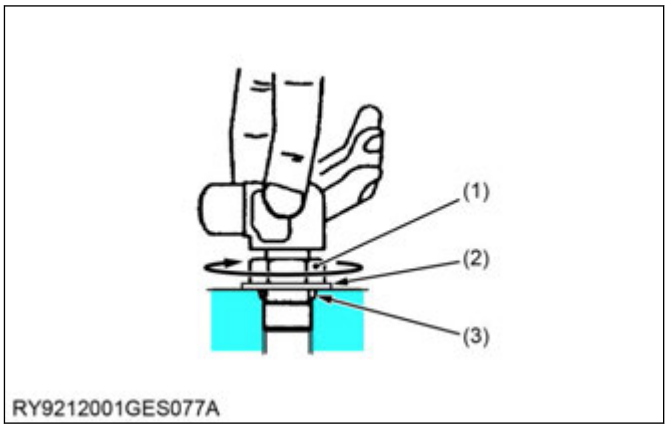
(A) Alternately
(B) Diagonally
(C) Center to outside

10. Connecting hydraulic hoses

1. Clean the inside of the hose fittings.
2. Tighten with the specified torque.
3. Apply pressure on the hydraulic hose to check for oil leakage.

11. Installing elbows with male seat

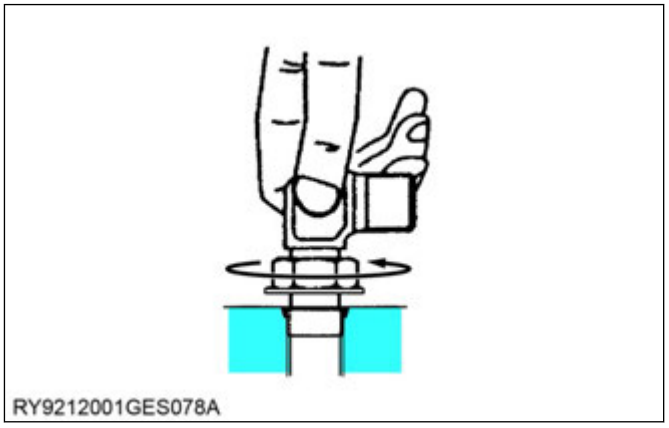
1. Clean the male seat surface and the seal.
2. Loosen the locknut until the top end.
3. Install the elbow by hand tightening until the male seat touches to the material surface.



(1) Locknut
(2) Seat
(3) Seal (O-ring)

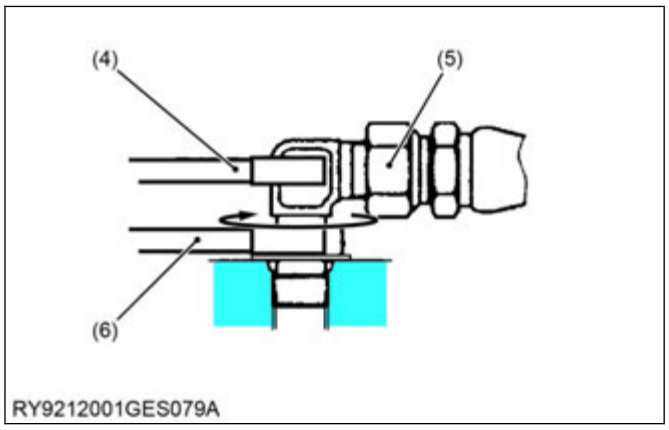
4. Adjust direction for the elbow.

■ NOTE
- **Do not loosen more than one revolution.**



5. Tighten the locknut with the specified torque.

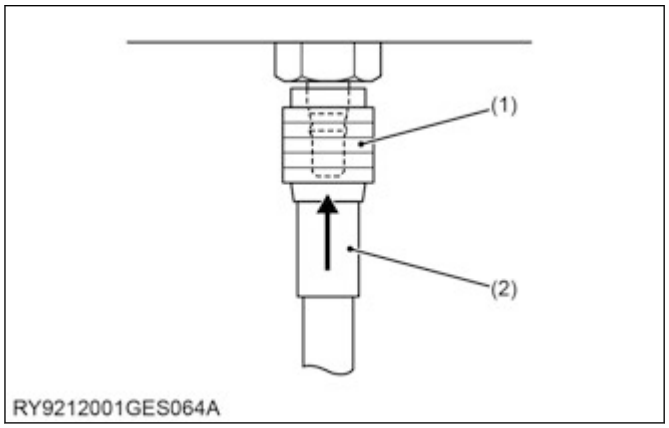
■ NOTE
- **Check for oil leakage.**



(4) Wrench (6) Torque wrench
(5) Hose

12. Connecting and disconnecting quick hose couplings

1. Push the metal fittings in the direction of the arrow mark.

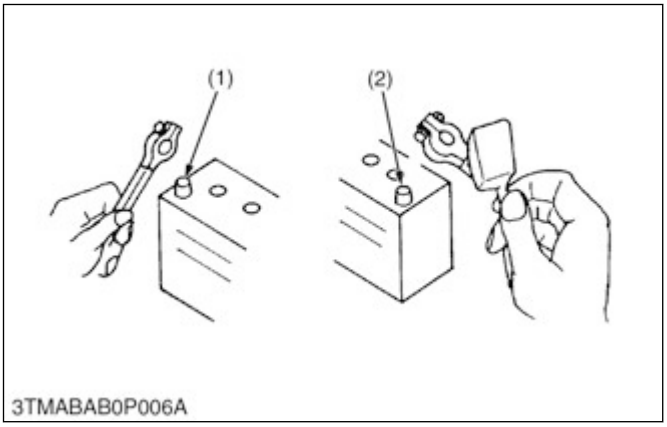


(1) Plastic part (2) Metal fitting

2. Pull the plastic part in the opposite direction of the arrow mark.
3. Disconnect the quick hose coupling.
4. Push the quick hose coupling in the direction of the arrow mark to connect.
5. Confirm that the hose is installed correctly.

13. Handling the battery

⚠ CAUTION
- **Disconnect negative (-) terminal first.**
- **Connect positive (+) terminal first.**

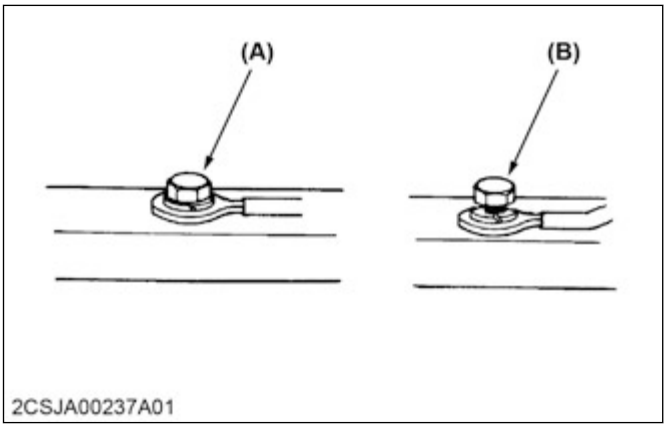


(1) Battery negative (-) terminal (2) Battery positive (+) terminal

14. Handling electrical wiring

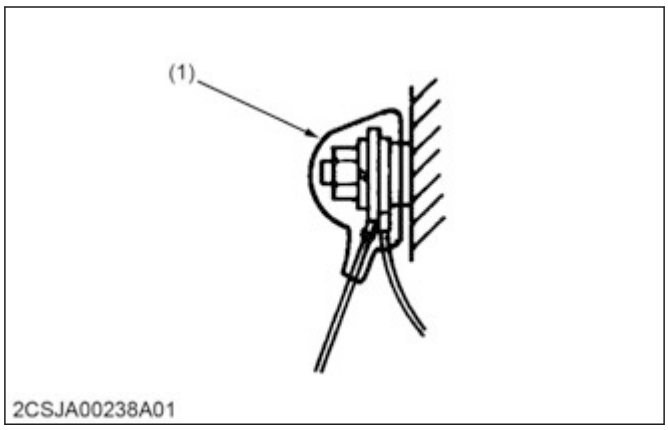
⚠ CAUTION
- **Do not contact an unprotected electrical wiring to other components.**
- **Do not clamp the electrical wiring to fuel hoses.**
- **Check for damage and poor connection of the electrical wiring.**
- **Do not alter the electrical device and wiring.**

- Tighten the electrical terminals securely.



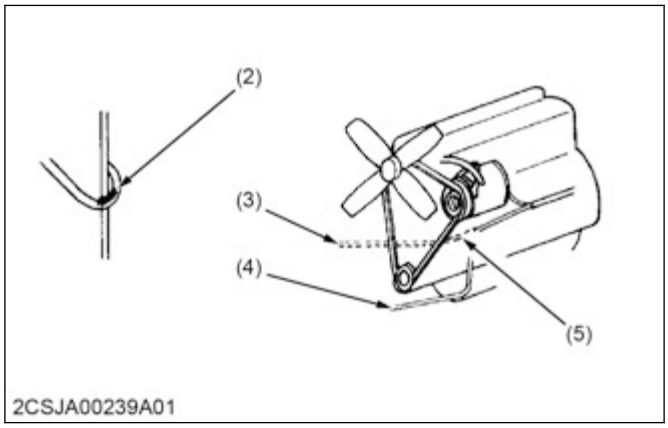
(A) Correct (B) Incorrect (the bolt is loose)

- Check the electrical terminal protection and clamping conditions before connecting the battery cable.



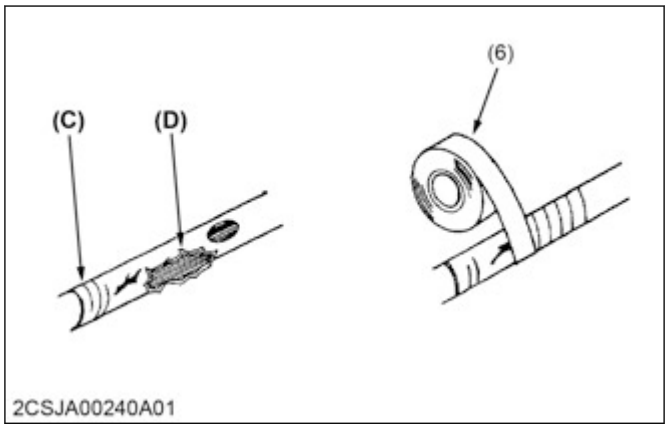
(1) Covered completely

- Keep the wiring away from hazards.



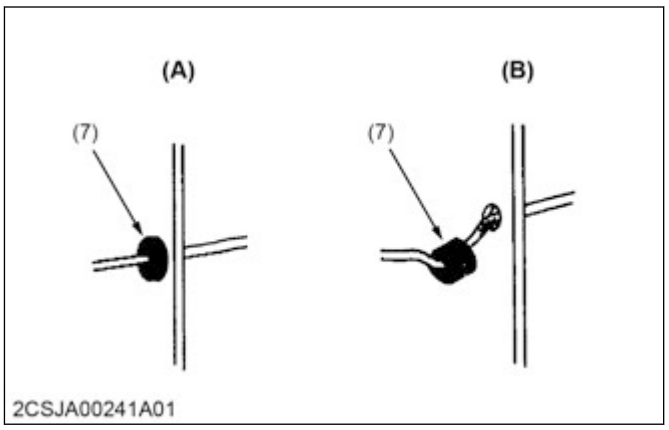
(2) Hazardous position
(3) Wiring position (poor)
(4) Wiring position (good)
(5) Hazardous position

- Repair or replace the damaged or old wiring immediately.



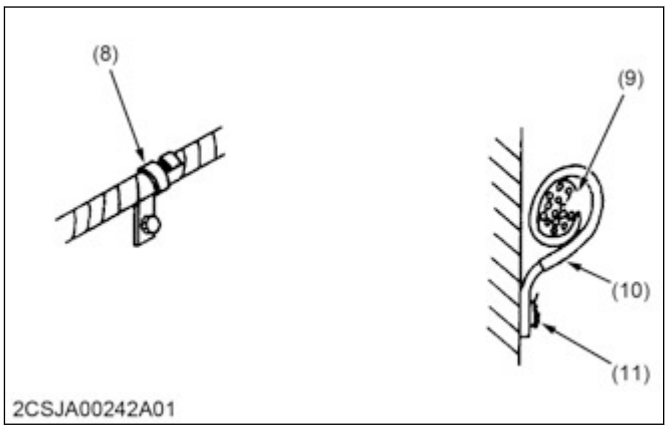
(6) Insulating tape
(C) Damaged
(D) Torn

- Install the grommet securely.



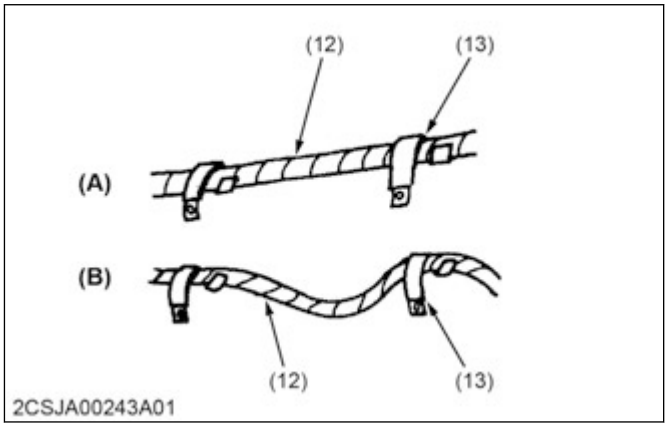
(7) Grommet
(A) Correct
(B) Incorrect (poor installation)

- Clamp the electrical wiring securely. Do not damage the electrical wiring by the clamp.



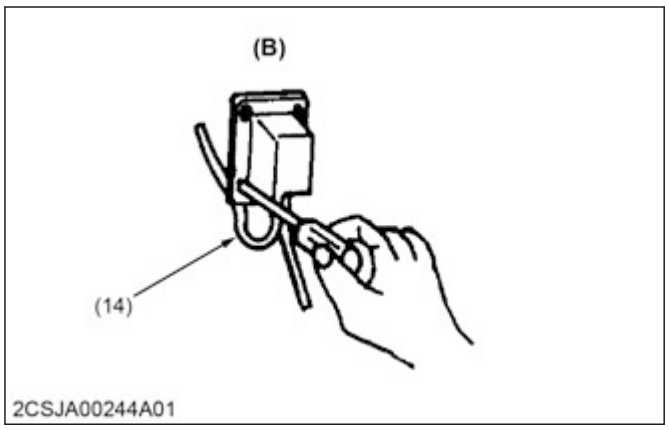
(8) Clamp (clamp spirally)
(9) Electrical wiring
(10) Clamp
(11) Welding point

- Clamp the electrical wiring correctly. Do not slack, twist, and pull.
- In cases of connecting the electrical wiring to moving or vibrating locations, make sure to clamp the electrical wiring loosely.



(12) Electrical wiring
(13) Clamp
(A) Correct
(B) Incorrect

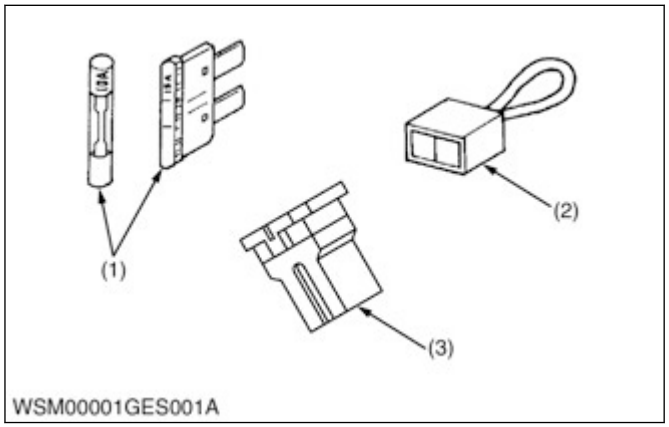
- Do not pinch the electrical wiring when installing parts.



(14) Electrical wiring (B) Incorrect

15. Handling fuses

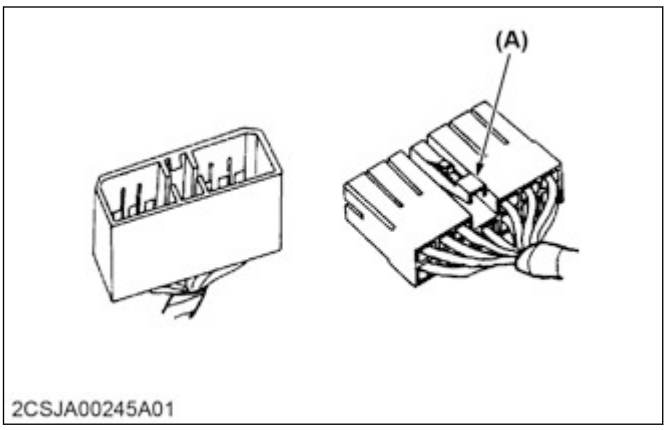
- Always use fuses of the specified capacity.
- Do not use steel or copper wiring instead of fuse.
- Do not install work light or radio without auxiliary power line.
- Do not install auxiliaries to the fuses. The fuses may blow.



(1) Fuse (3) Slow blow fuse
(2) Fusible link

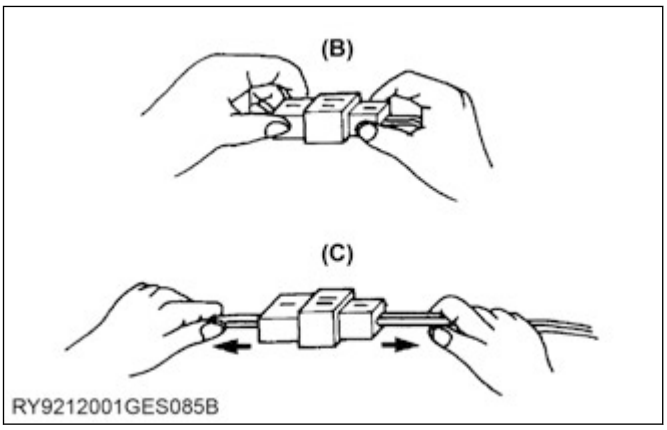
16. Handling connectors

- Press the lock securely when disconnecting the locking connectors.



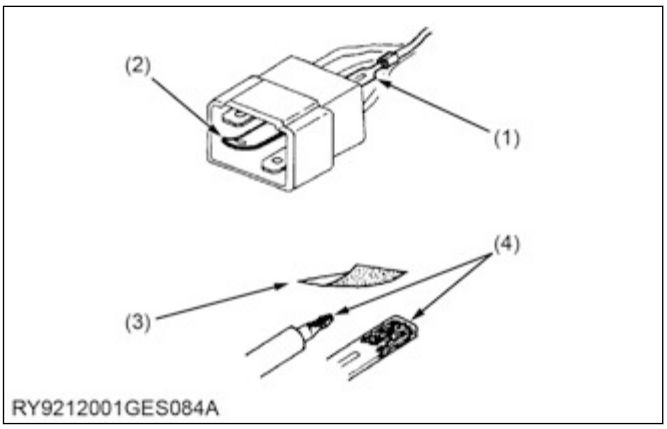
(A) Press

- Pull the connector body securely when disconnecting the connectors.
- Do not pull the wire harness to separate.



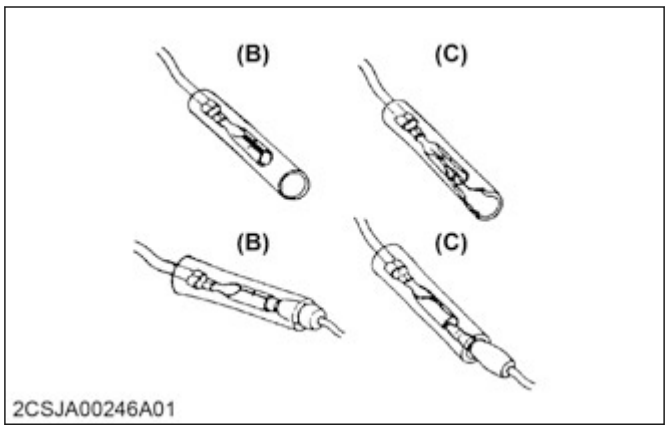
(B) Correct (C) Incorrect

- Make sure the terminal condition of the connectors that is not bent, rusty, etc..
- Remove rust with sandpaper.



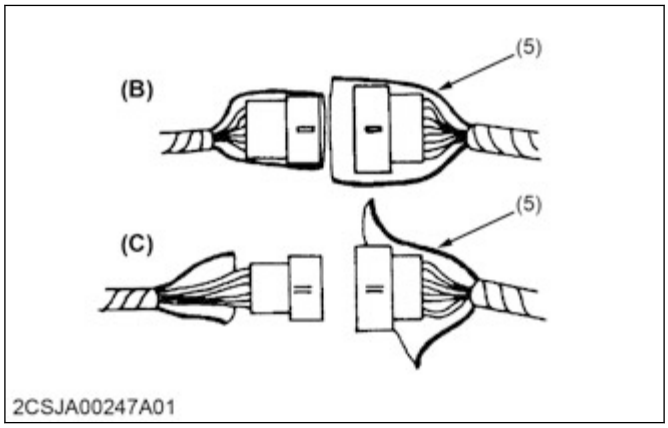
(1) Missing terminal (4) Rust
(2) Bent terminal
(3) Sandpaper

- Cover the female bullet terminals and male bullet terminals securely with the waterproof plastic covers.
- Make sure that the connection of bullet terminals are inserted till the deep end.



(B) Correct (C) Incorrect

- Cover the female connectors and male connectors securely with the waterproof plastic covers.



(5) Cover (C) Incorrect
(B) Correct

17. Washing the machine with a high pressure washer

Use a high pressure washer properly to avoid personal injuries and machine damages.

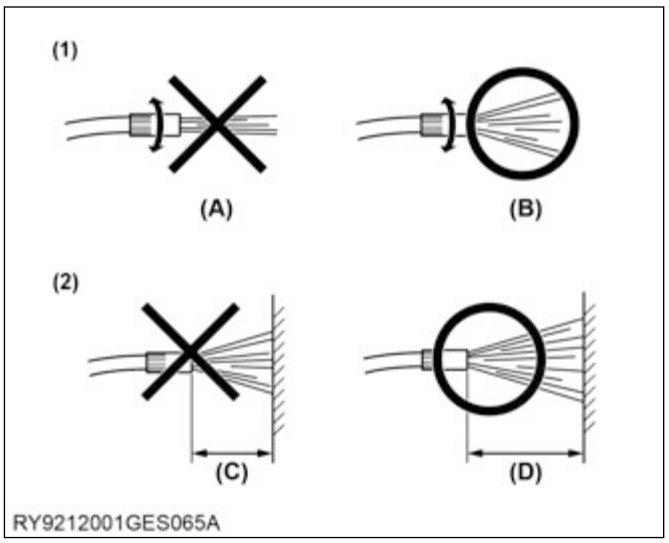
⚠ CAUTION

- **Damaged or cut electrical wiring may cause a fire.**
- **Damaged hydraulic hoses or oil seals may cause an injury due to gushing hydraulic oil.**

■ IMPORTANT

- **Water infiltration may cause machine problems.**

- Adjust the high pressure washer nozzle for a wide spray. Do not adjust for a blast.
- Spray the water at least 2 m away from the machine.



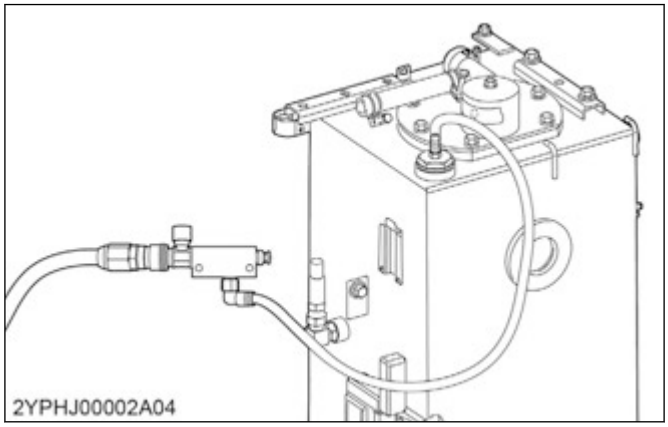
(1) Adjusting the washer power (C) Less than 2 m (80 in.)
(2) Washing distance (D) Over 2 m (80 in.)
(A) Blasting
(B) Wide spray

PRELIMINARY WORKING INSTRUCTIONS

1. Vacuuming the hydraulic tank

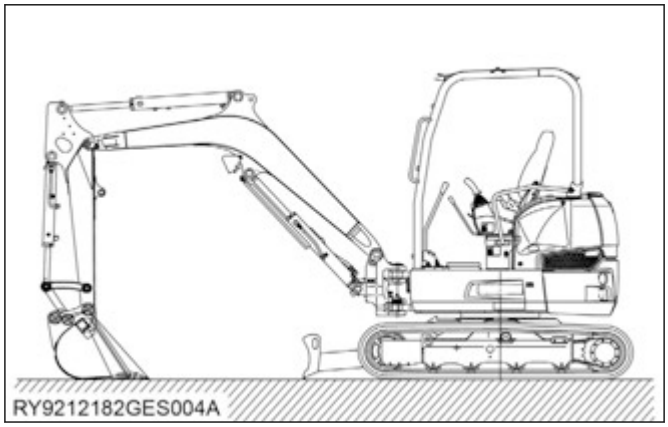
In case of removing the hydraulic devices and hydraulic hoses, vacuum the hydraulic tank to reduce the hydraulic oil leakage.

1. Replace the oil tank cap with a vacuum plug.
2. Plug the air breather hose or any other opening vent on the hydraulic tank.
3. Connect the vacuum pump and vacuum plug with a hose.
4. Connect an air hose to the vacuum pump and vacuum the hydraulic tank.

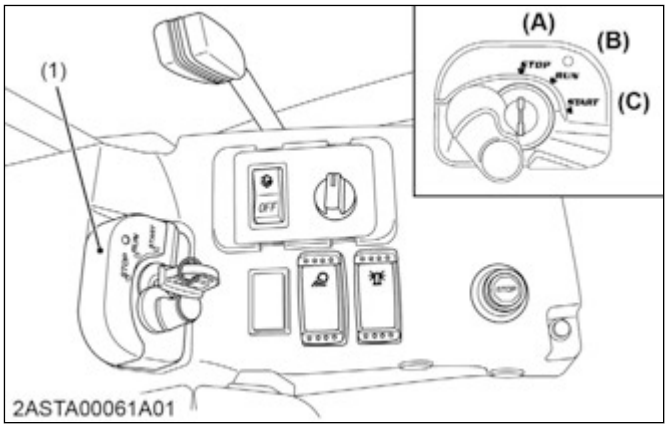


2. Releasing residual pressure of hydraulic circuit

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

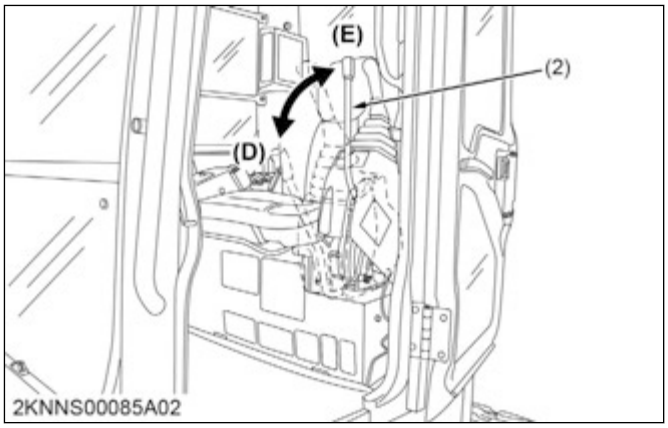


2. Turn the starter switch to **[RUN]** without starting the engine.



(1) Starter switch
(A) **[STOP]**
(B) **[RUN]**
(C) **[START]**

3. Lower the lever lock.

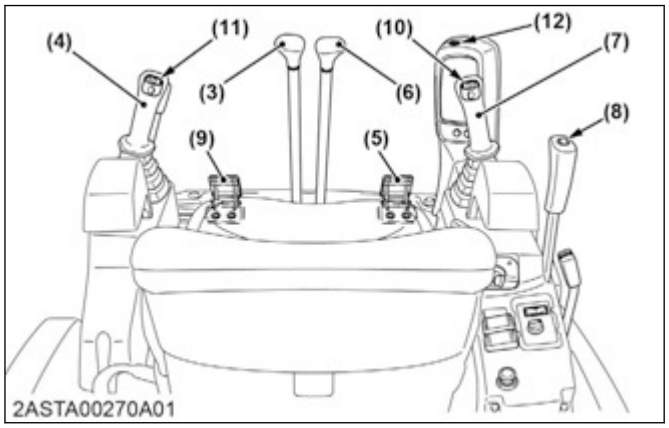


(2) Lever lock
(D) Release
(E) Lock

4. Operate pilot control lever (boom, arm, bucket, and swivel) several times in full-stroke.
5. Operate the travel control lever several times in full-stroke.
6. Operate the blade control lever several times in full-stroke.
7. Operate the swing pedal several times in full-stroke.

8. Operate AUX control pedal (knob switches) several times in full-stroke.

■ NOTE
- **In case of Hi-spec,**
  - **– activate AUX function by the switch on the meter panel and set the maximum flow rate.**
  - **– activate AUX function by the switch on the meter panel and rotate the AUX2 dial to the maximum flow rate.**



(3) LH travel lever
(4) LH pilot control lever
(5) Swing control pedal
(6) RH travel control lever
(7) RH pilot control lever
(8) Blade control lever
(9) AUX1 control pedal (basic)
(10) AUX1 knob switch (Hi-spec only)
(11) AUX2 knob switch (Hi-spec only)
(12) AUX2 dial (Hi-spec only)

9. Raise the lever lock and turn the starter switch to **[STOP]**.

3. Bleeding the air from the hydraulic cylinder

Bleed air from the hydraulic cylinder after removing and disassembling the hydraulic cylinder to prevent cavitation and seizure of the internal parts.

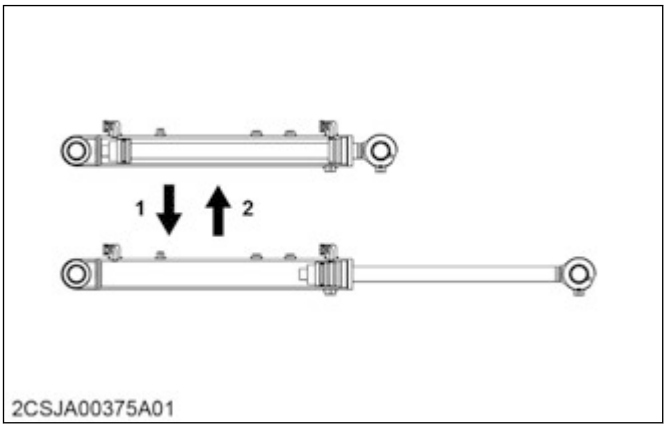
1. Set the engine speed to less than 1500 rpm.

■ IMPORTANT
- **If the engine speed is higher than 1500 rpm, the seals and bushings may be damaged.**

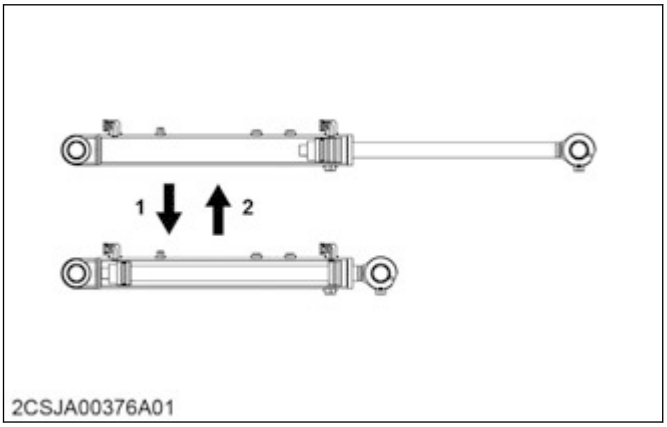
2. Compress and extend the hydraulic cylinder slowly to bleed air.

■ IMPORTANT
- **Do not relief the main relief valve of the hydraulic cylinder at the end of stroke.**

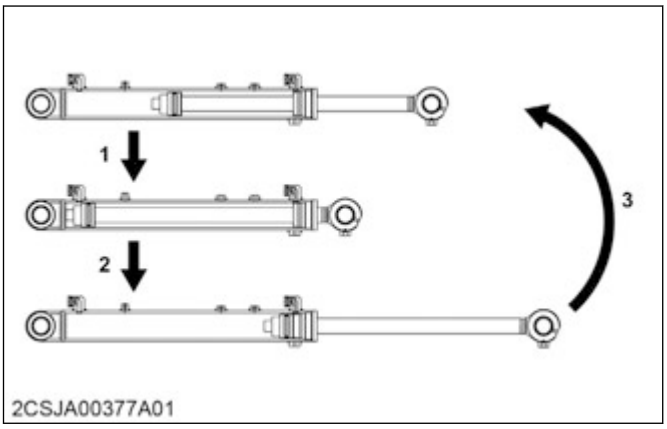
Compressed stroke end



Extended stroke end



Middle stroke



4. Removing the battery

⚠ CAUTION
- **Keep a fire (welding sparks, grinding sparks, cigarettes) away from the battery. The battery produces oxygen and hydrogen gas which are flammable.**
- **Disconnect the negative (-) terminal first when removing the battery cable.**

- **Connect the positive (+) terminal first when connecting the battery cable.**

Removing

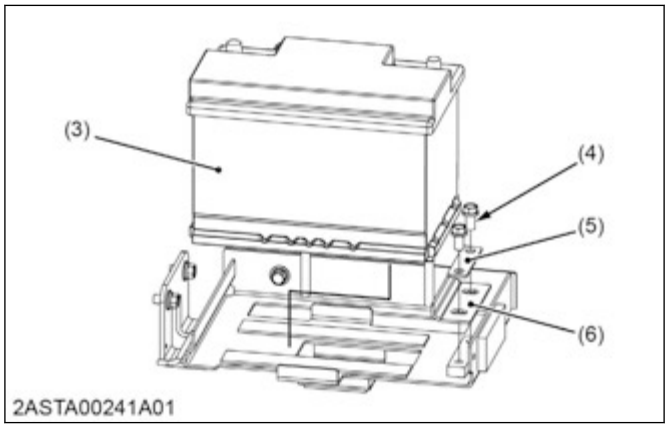
1. Disconnect the battery cables from the battery.

(1) Negative (-) terminal (2) Positive (+) terminal

NOTE

- **Wrap the insulating tape to the terminal after removing.**

2. Remove the two bolts.
3. Remove the plate and battery holder.



(3) Battery (6) Battery holder
(4) Bolt (M10 × 20) ×2
(5) Plate

4. Remove the battery.

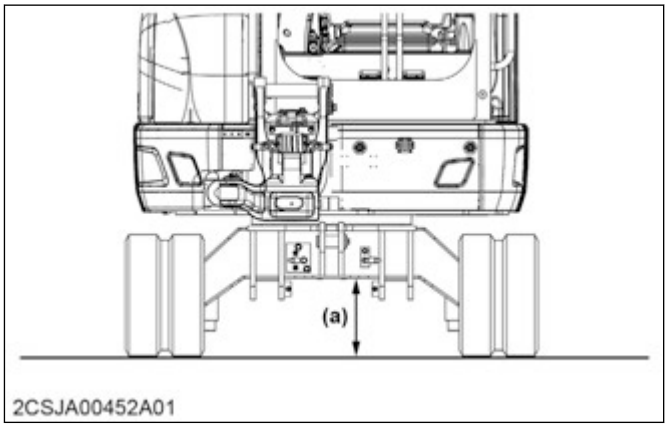
5. Jacking up the machine

CAUTION

- **Do not work underneath when the machine is jacked up.**
- **Put the machine on the jack stands securely when lifting the machine.**

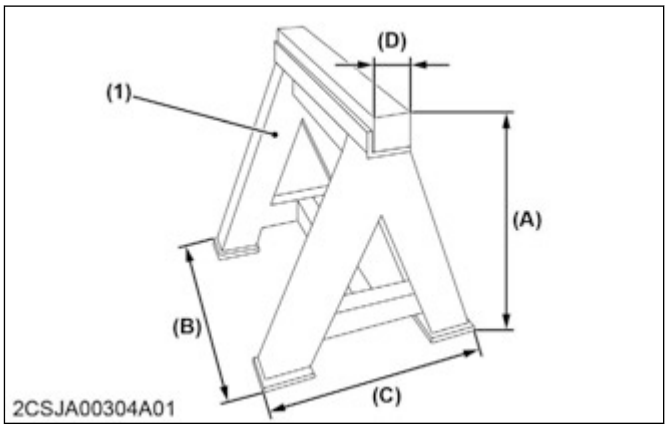
Preparing

1. Park the machine on firm and level ground.
2. Prepare the proper jack stands based on dimension (a).



(a) 296 mm (11.7 in.)

Recommended jack stand



(1) Jack stand

Items	Dimensions
(A)	520mm 20.5in.
(B)	500mm 19.7in.
(C)	440mm 17.3in.
(D)	75mm 3.0in.

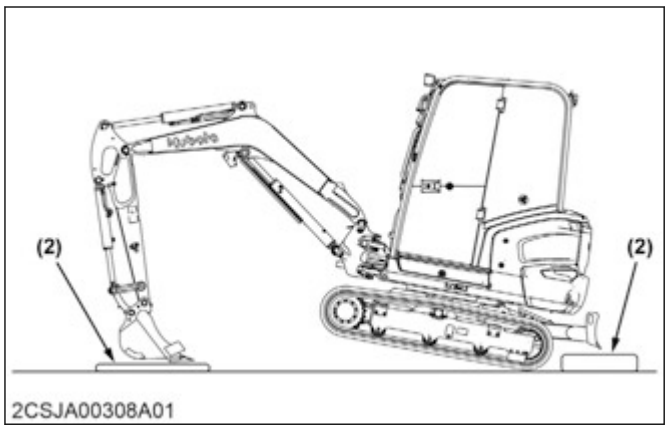
Jacking up the machine

1. Swivel the upper structure of the machine for 180 degrees so that the blade is behind the operator.

NOTE

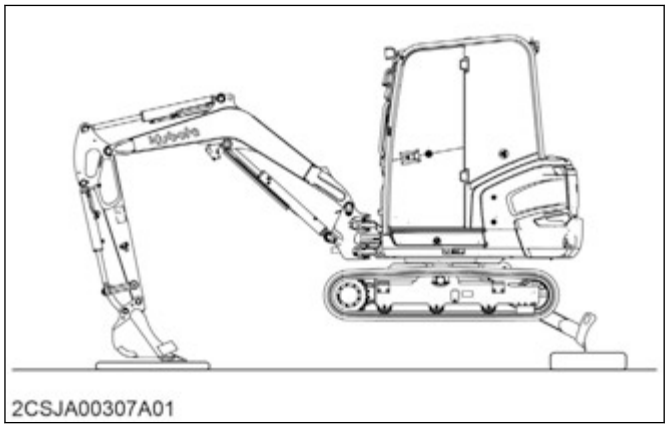
- **Put a cushioning materials under the bucket and blade.**

2. Operate the arm, boom, and blade to jack up the front of the machine.

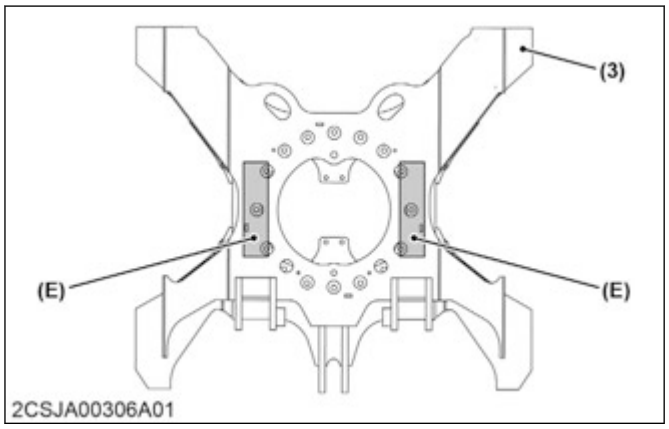


(2) Cushion

3. Operate the blade to jack up the rear of the machine.

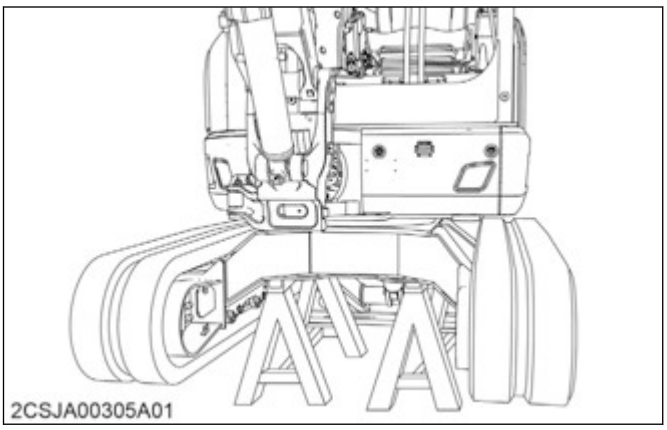


4. Put the two jack stands under the track frame.



(3) Track frame (E) Contact surface

5. Lower the machine and put the machine on the jack stands.



6. Place the bucket and blade on the ground.

TIGHTENING TORQUES

1. Bolts and nuts tightening torque

■ NOTE

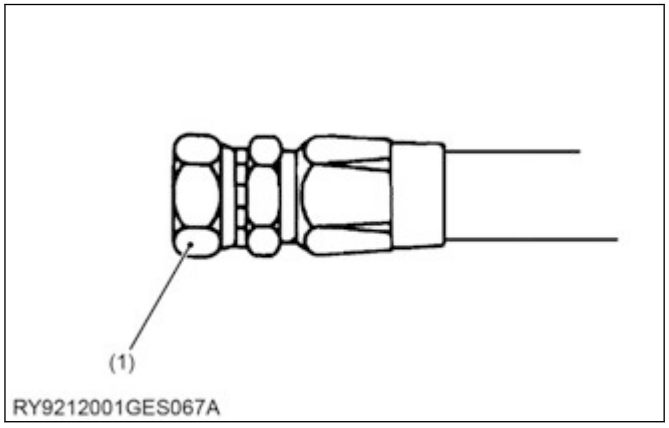
- **Screws, bolts and nuts which tightening torques are not specified in this workshop manual should be tightened according to the table below.**

Mark on top of bolt	4 4T (4.6)						7 7T (8.8)						9 9T (9.8-10.9)		
Materi-al	Steel			Aluminum			Steel			Aluminum			Steel		
Units	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	0.80 to 0.95	5.8 to 6.8	7.9 to 8.8	0.80 to 0.90	5.8 to 6.5	9.81 to 11.2	1.00 to 1.15	7.24 to 8.31	7.9 to 8.8	0.80 to 0.90	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 12.0	76.0 to 86.7
M14	108 to 125	11.0 to 12.8	79.6 to 92.5	-	-	-	124 to 147	12.6 to 15.0	91.2 to 108	-	-	-	167 to 196	17.0 to 20.0	123 to 144
M16	167 to 191	17.0 to 19.5	123 to 141	-	-	-	197 to 225	20.0 to 23.0	145 to 166	-	-	-	260 to 304	26.5 to 31.0	192 to 224
M18	246 to 284	25.0 to 29.0	181 to 209	-	-	-	275 to 318	28.0 to 32.5	203 to 235	-	-	-	344 to 402	35.0 to 41.0	254 to 296
M20	334 to 392	34.0 to 40.0	246 to 289	-	-	-	368 to 431	37.5 to 44.0	272 to 318	-	-	-	491 to 568	50.0 to 58.0	362 to 419

2. Stud bolts tightening torque

Material	Steel			Aluminum		
Units	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	–	–	–

3. Hydraulic hose fittings tightening torque



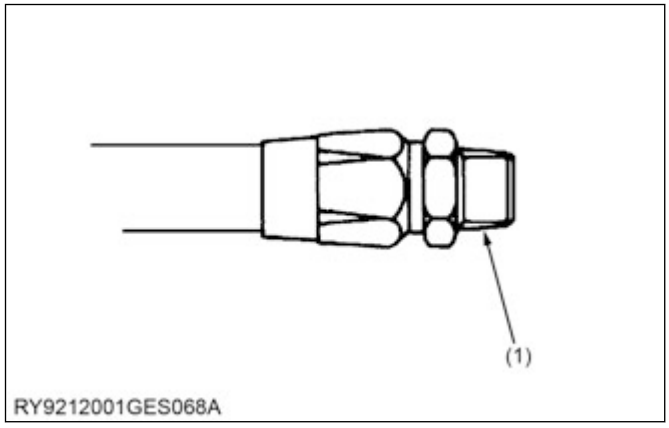
(1) Union nut

Units	N·m	kgf·m	lbf·ft
1/8	7.8 to 11.8	0.8 to 1.2	5.8 to 8.7
1/4	24.5 to 29.2	2.5 to 3.0	18.1 to 21.5
3/8	37.2 to 42.1	3.8 to 4.3	27.5 to 31.0
1/2	58.8 to 63.7	6.0 to 6.5	43.4 to 46.9
3/4	117.6 to 127.4	12.0 to 13.0	86.7 to 94.0
1	181.3 to 191.1	18.5 to 19.5	133.8 to 140.9
1-1/4	220.5 to 230.3	22.5 to 23.5	162.8 to 170.0

Units	N·m	kgf·m	lbf·ft
9/16-18 (ORS type)	35.2 to 43.1	3.6 to 4.4	26.0 to 31.8
11/16-16 (ORS type)	60.0 to 73.5	6.0 to 7.5	44.3 to 54.2
13/16-16 (ORS type)	70.6 to 86.2	7.2 to 8.8	52.1 to 63.6
1-14 (ORS type)	105.8 to 129.4	10.8 to 13.2	78.0 to 98.4

Units		N·m	kgf·m	lbf·ft
DN4-1/8	M12 × 1.5	15 to 20	1.5 to 2.0	11.1 to 14.8
DN6-1/4	M14 × 1.5	15 to 20	1.5 to 2.0	11.1 to 14.8
DN8-5/16	M16 × 1.5	30 to 35	3.1 to 3.6	22.1 to 25.8
DN10-3/8	M18 × 1.5	40 to 45	4.1 to 4.6	29.5 to 33.2
DN12/ DN13-1/2	M22 × 1.5	50 to 55	5.1 to 5.6	36.9 to 40.6

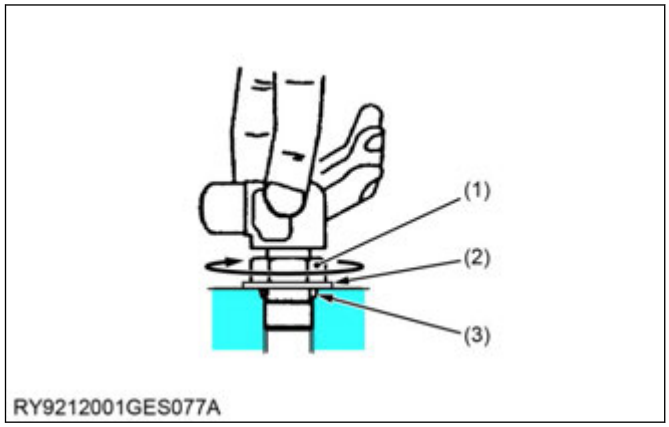
4. Hydraulic hoses tightening torque (taper thread)



(1) Taper thread

Units	N·m	kgf·m	lbf·ft
1/8	19.6 to 29.4	2.0 to 3.0	14.5 to 21.6
1/4	36.6 to 44.1	3.7 to 4.5	27.0 to 32.5
3/8	68.6 to 73.5	7.0 to 7.5	50.6 to 54.2
1/2	83.4 to 88.3	8.5 to 9.0	61.6 to 65.1
3/4	166.6 to 181.3	17.0 to 18.5	122.9 to 133.7

5. Locknuts of adapters with O-ring tightening torque (straight thread)

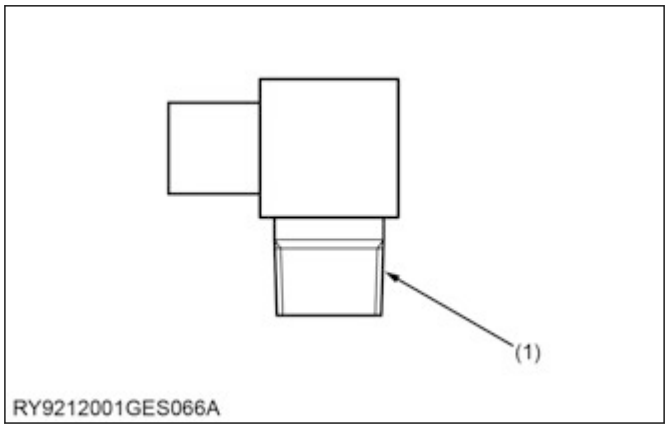


(1) Locknut
(2) Seat
(3) Seal (O-ring)

Units	N·m	kgf·m	lbf·ft
1/8	15.0 to 16.5	1.5 to 1.7	11.1 to 12.1
1/4	24.5 to 29.4	2.5 to 3.0	18.1 to 21.5
3/8	49.0 to 53.9	5.0 to 5.5	36.2 to 39.7
1/2	58.8 to 63.7	6.0 to 6.5	43.4 to 46.9
3/4, 1	117.6 to 127.4	12.0 to 13.0	86.74 to 93.96
1-1/4	220.5 to 230.3	22.5 to 23.5	162.7 to 169.8

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

6. Adapters tightening torque (taper thread)

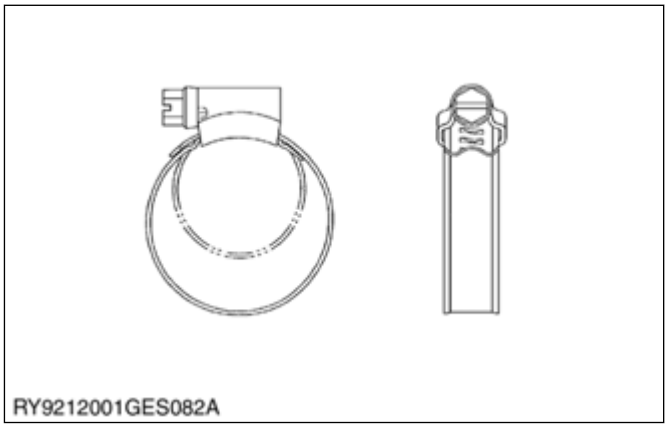


(1) Taper thread

Units	N·m	kgf·m	lbf·ft
1/8	19.6 to 29.4	2.0 to 3.0	14.5 to 21.6
1/4	36.3 to 44.1	3.7 to 4.5	27.0 to 32.5
3/8	68.6 to 73.5	7.0 to 7.5	50.6 to 54.2
1/2	83.4 to 88.3	8.5 to 9.0	61.6 to 65.1
3/4	166.6 to 181.3	17.0 to 18.5	122.9 to 133.7

7. Hose clamps tightening torque

Steel band type



Used for hydraulic hoses

Units	N·m	kgf·m	lbf·ft
ϕ10-ϕ16	4.0	0.41	2.95
ϕ13-ϕ20			
ϕ16-ϕ25			
ϕ22-ϕ32			
ϕ25-ϕ40			
ϕ40-ϕ60			
ϕ32-ϕ50			
ϕ50-ϕ70			

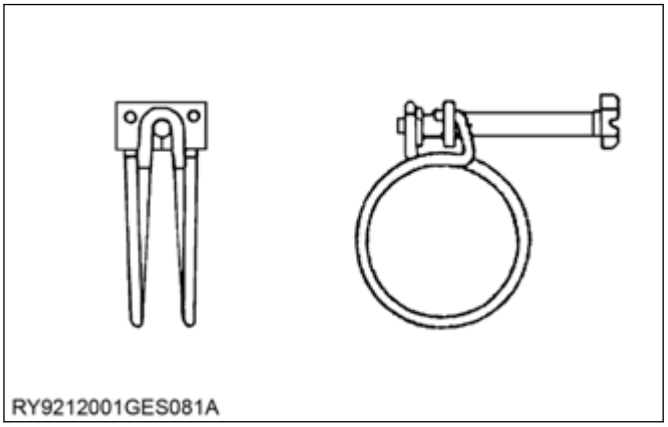
Used for water hoses

Units	N·m	kgf·m	lbf·ft
ϕ10-ϕ16	3.0	0.31	2.21
ϕ13-ϕ20			
ϕ16-ϕ25	4.5	0.46	3.32
ϕ22-ϕ32			
ϕ25-ϕ40			
ϕ40-ϕ60			
ϕ32-ϕ50			
ϕ50-ϕ70			

Used for air hoses

Units	N·m	kgf·m	lbf·ft
ϕ10-ϕ16	2.5	0.25	1.84
ϕ13-ϕ20			
ϕ16-ϕ25			
ϕ22-ϕ32			
ϕ25-ϕ40			
ϕ40-ϕ60			
ϕ32-ϕ50			
ϕ50-ϕ70			

Wire band type


RY9212001GES081A

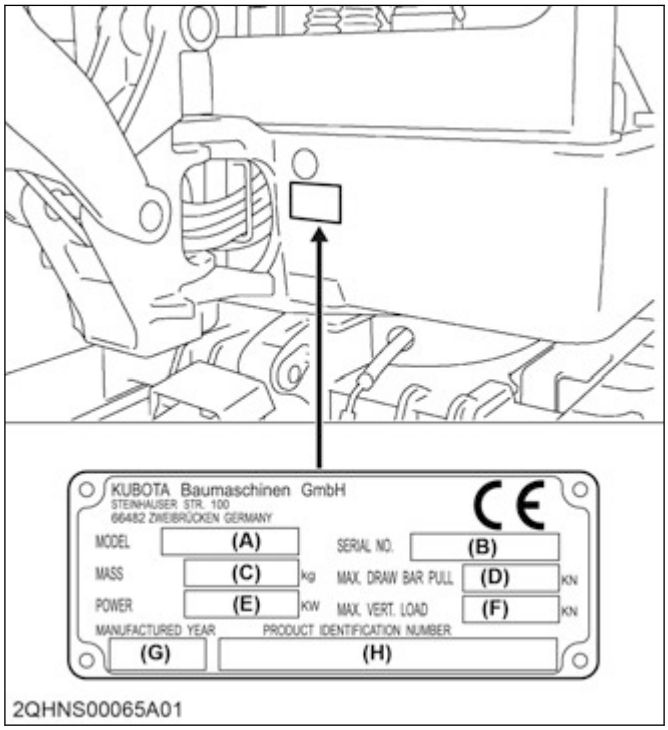
Units	N·m	kgf·cm	lbf·ft
ϕ13-ϕ20	2.5 to 3.4	25 to 35	1.9 to 2.5
ϕ15-ϕ25	4.9 to 5.9	50 to 60	3.7 to 4.3
ϕ19-ϕ28			
ϕ22-ϕ32			
ϕ26-ϕ38			
ϕ32-ϕ44			
ϕ44-ϕ56			
ϕ50-ϕ65			
ϕ58-ϕ75			
ϕ60-ϕ80			
ϕ68-ϕ85			
ϕ77-ϕ95			

GENERAL MACHINE INFORMATION

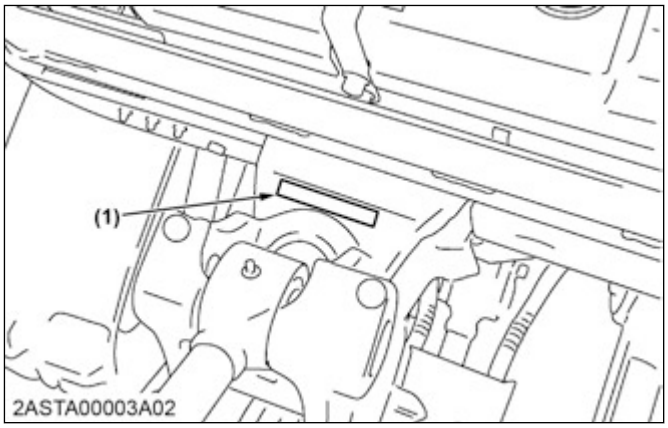
1. Machine model identification

■ IMPORTANT

- **Before contacting customer support, note the excavator model, serial number, engine type, engine serial number, and hour meter.**



(A)	Model
(B)	Serial number
(C)	Operating weight
(D)	Maximum pulling capacity at the towing eyes
(E)	Engine performance
(F)	Maximum vertical load at the towing eyes
(G)	Year of manufacturing
(H)	Product identification number PIN

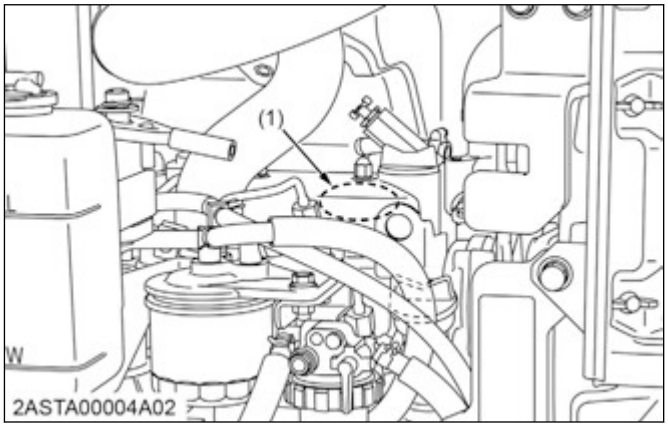


(1) Serial number

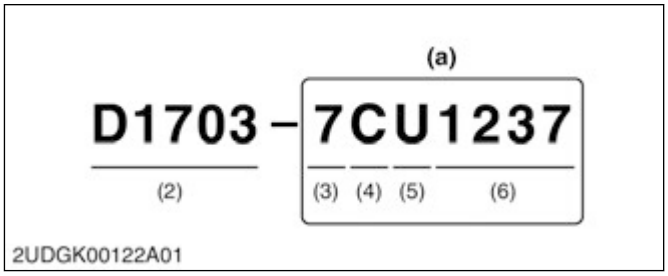
2. Engine model identification

■ IMPORTANT

- **Before contacting customer support, note the excavator model, serial number, engine type, engine serial number, and hour meter.**



(1) Engine model and serial number



(2) Engine model
(3) Engine series
(4) Production year
(5) Production month
(6) Lot number
(a) Engine serial number

Engine serial number

The engine serial number identifies the engine series, production year, production month, and lot number.

Engine series

Number or letter	Series
1	05 (include: WG)
2	V3
3	08
4	SM (include: WG)
5	Air-cooled gasoline
6	GZ, OC, AC, EA, E
7	03
8	07
A	EA, RK
B	03 (KET production)

Production year

Number or letter	Year	Number or letter	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		

Production month and lot number

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

(Continued)

3. Specifications

Model			KX030-4			
Type			Canopy		Cabin	
			Rubber track	Steel track	Rubber track	Steel track
Machine weight*1			2720 kg	2825 kg	2790 kg	2895 kg
Operating weight*2			2795 kg	2900 kg	2865 kg	2970 kg
Bucket	Capacity (CECE)		0.059 m^3			
	Width with teeth (without teeth)		505 mm (480 mm)			
Engine	Type		Water-cooled four-cylinder diesel engine			
	Model name		V1505-E4-BH-3			
	Displacement		1498 cm^3			
	Engine performance (ISO 9249)		17.7 kW (24.1 HP)			
	Rated speed		2250 min^{-1}(rpm)			
	Maximum speed		2470 min^{-1}(rpm)			
Performance	Swivel speed Swivel frame		9.5 min^{-1}(rpm)			
	Travel speed	High speed	4.5 km/h			
		Low speed	2.9 km/h			
	Ground pressure (without operator)		25.9 kPa (0.26 kgf/cm^2)	26.9 kPa (0.27 kgf/cm^2)	26.6 kPa (0.27 kgf/cm^2)	27.6 kPa (0.28 kgf/cm^2)
	Climbing performance		36% (20 degrees)			
	Max. lateral sway		27% (15 degrees)			
Blade	Width × height		1500 × 300 mm			
Swing angle of the boom	Left		1.34 rad (77 degrees)			
	Right		0.99 rad (57 degrees)			
AUX1 port connector	Max. flow rate (theoretical)		49.5 L/min			
	Max. pressure		23.5 MPa (235 bar)			
AUX2 port connector*3	Max. flow rate (theoretical)		18.0 L/min			
	Max. pressure		19.6 MPa (196 bar)			
Fuel tank capacity			48 L			
Pulling capacity at the towing eyes			70500 N			
Vertical load at the towing eyes			7200 N			
Noise level		LpA	76.5 dB (A)			
		LwA (2000/14/EC)	93 dB (A)			
Vibration*4	Hand arm system (ISO 5349-2: 2001)	Digging	less than 2.5 m/s^2 RMS			
		Leveling	less than 2.5 m/s^2 RMS			
		Driving	less than 2.5 m/s^2 RMS			
		Idling	less than 2.5 m/s^2 RMS			
	Whole body (ISO 2631-1: 1997)	Digging	less than 0.5 m/s^2 RMS			
		Leveling	less than 0.5 m/s^2 RMS			
		Driving	less than 0.5 m/s^2 RMS			

(Continued)

Model			KX030-4
Vibration*4	Whole body (ISO 2631-1: 1997)	Idling	less than 0.5 m/s^2 RMS

*1 With standard bucket 55 kg, operating readiness established.

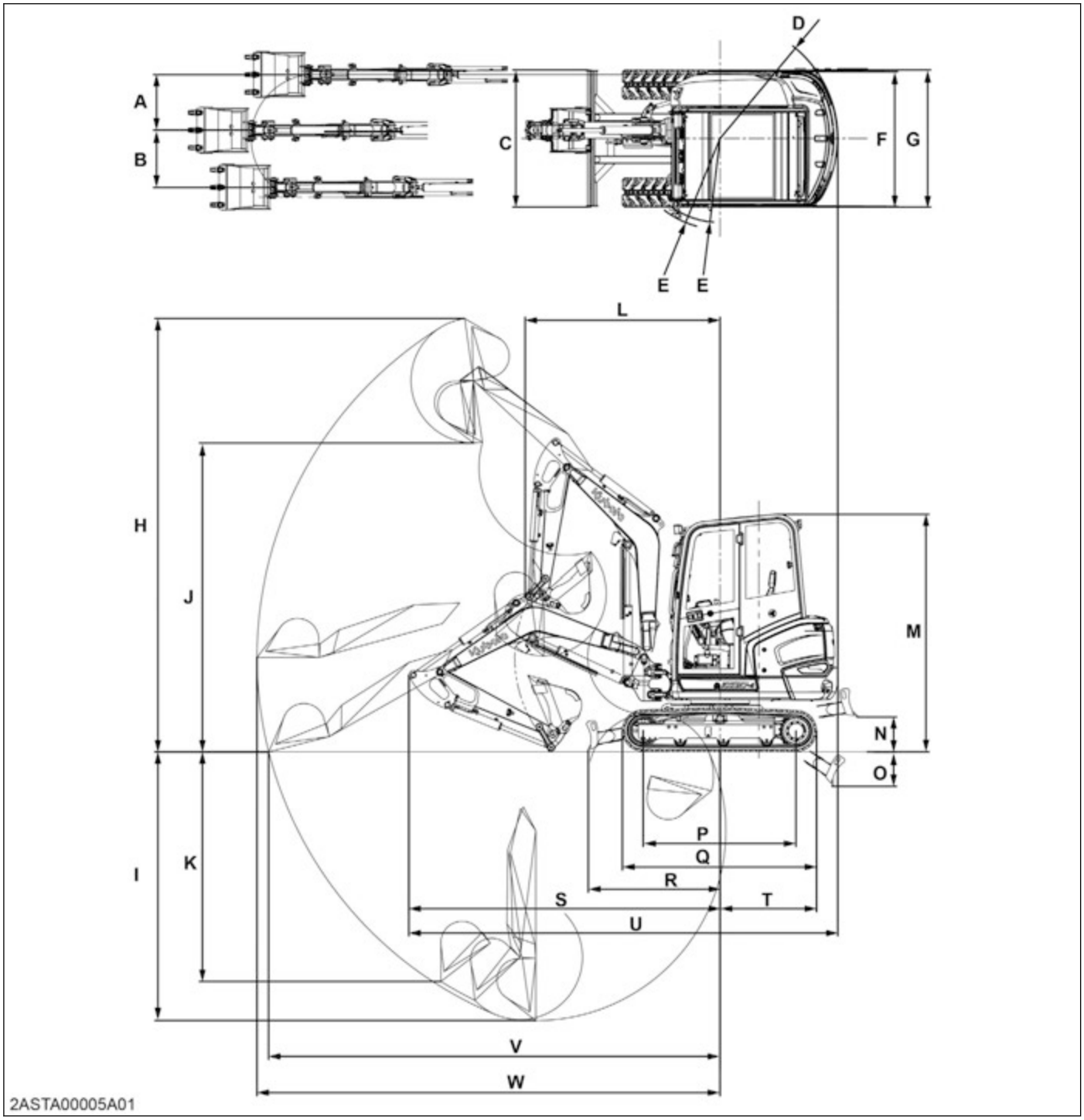
*2 Machine weight, including operator 75 kg.

*3 Only for KX030-4 Hi-spec.

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

The main specifications are subject to change without prior notice.

4. Machine dimensions



Canopy specification (1300 mm arm)

A	B	C	D	E	F	G	H	I	J	K	L
570 mm 22.4 in.	580 mm 22.8 in.	1500 mm 59.1 in.	1200 mm 47.2 in.	860 mm 33.9 in.	1380 mm 54.3 in.	1500 mm 59.1 in.	4560 mm 179.9 in.	2870 mm 113.0 in.	3240 mm 127.6 in.	2460 mm 96.9 in.	1950 mm 76.8 in.
M	N	O	P	Q	R	S	T	U	V	W	-
2420 mm 95.3 in.	350 mm 13.8 in.	350 mm 13.8 in.	1560 mm 61.4 in.	1980 mm 78.0 in.	1420 mm 55.9 in.	3370 mm 132.7 in.	980 mm 38.6 in.	4570 mm 179.9 in.	4760 mm 187.4 in.	4880 mm 192.1 in.	-

Cabin specification (1300 mm arm)

A	B	C	D	E	F	G	H	I	J	K	L
570 mm 22.4 in.	580 mm 22.8 in.	1500 mm 59.1 in.	1200 mm 47.2 in.	930 mm 36.6 in.	1380 mm 54.3 in.	1500 mm 59.1 in.	4560 mm 179.9 in.	2870 mm 113.0 in.	3240 mm 127.6 in.	2460 mm 96.9 in.	1950 mm 76.8 in.
M	N	O	P	Q	R	S	T	U	V	W	-
2420 mm 95.3 in.	350 mm 13.8 in.	350 mm 13.8 in.	1560 mm 61.4 in.	1980 mm 78.0 in.	1420 mm 55.9 in.	3370 mm 132.7 in.	980 mm 38.6 in.	4570 mm 179.9 in.	4760 mm 187.4 in.	4880 mm 192.1 in.	-

Canopy specification (1100 mm arm)

A	B	C	D	E	F	G	H	I	J	K	L
570 mm 22.4 in.	580 mm 22.8 in.	1500 mm 59.1 in.	1200 mm 47.2 in.	860 mm 33.9 in.	1380 mm 54.3 in.	1500 mm 59.1 in.	4430 mm 174.4 in.	2670 mm 105.1 in.	3110 mm 122.4 in.	2260 mm 89.0 in.	1920 mm 75.6 in.
M	N	O	P	Q	R	S	T	U	V	W	-
2420 mm 95.3 in.	350 mm 13.8 in.	350 mm 13.8 in.	1560 mm 61.4 in.	1980 mm 78.0 in.	1420 mm 55.9 in.	3350 mm 131.9 in.	980 mm 38.6 in.	4550 mm 179.1 in.	4570 mm 179.9 in.	4690 mm 184.6 in.	-

Cabin specification (1100 mm arm)

A	B	C	D	E	F	G	H	I	J	K	L
570 mm 22.4 in.	580 mm 22.8 in.	1500 mm 59.1 in.	1200 mm 47.2 in.	930 mm 36.6 in.	1380 mm 54.3 in.	1500 mm 59.1 in.	4430 mm 174.4 in.	2670 mm 105.1 in.	3110 mm 122.4 in.	2260 mm 89.0 in.	1920 mm 75.6 in.
M	N	O	P	Q	R	S	T	U	V	W	-
2420 mm 95.3 in.	350 mm 13.8 in.	350 mm 13.8 in.	1560 mm 61.4 in.	1980 mm 78.0 in.	1420 mm 55.9 in.	3350 mm 131.9 in.	980 mm 38.6 in.	4550 mm 179.1 in.	4570 mm 179.9 in.	4690 mm 184.6 in.	-

■ NOTE

- **Dimensions are based on the machine with rubber tracks.**
- **Dimensions are based on the machine with standard bucket.**
- **Specifications are subjected to change without prior notice.**

5. Maintenance

5.1 Maintenance intervals table

Operator maintenance chart

Check item		Tasks	Hours of operation indicator										Maintenance intervals	Pages
			50	100	150	200	250	300	350	400	450	500		
Walk-around inspection		Check											Daily	2-29
Dust valve		Cleaning											Daily	2-29
Engine oil level		Check											Daily	2-29
Coolant level		Check											Daily	2-29
Radiator and oil cooler		Check											Daily	2-30
Fan belt		Check											Daily	2-30
Exhaust system leakage		Check											Daily	2-31
Hydraulic oil level		Check											Daily	2-31
Water separator		Check											Daily	2-31
Bucket and bucket linkage		Grease											Daily	2-31
Front attachments	Swing bracket	Grease											Daily	2-32
	Other greasing points	Grease											Daily	2-32
Fuel level		Check											Daily	2-33
Washer liquid level		Check											Daily	2-33
Electrical equipment		Check											Daily	2-33
Fuel tank		Drain	○	○	○	○	○	○	○	○	○	○	50 h	2-33
Battery		Check	○	○	○	○	○	○	○	○	○	○	50 h	2-34
Swivel gear		Grease	○	○	○	○	○	○	○	○	○	○	50 h	2-36
Track tension		Check	○	○	○	○	○	○	○	○	○	○	50 h	2-36
		Adjust	○	○	○	○	○	○	○	○	○	○	50 h	2-37
Water separator		Cleaning	○	○	○	○	○	○	○	○	○	○	50 h	2-38
Swivel bearing		Grease				○				○			200 h	2-39
Air filter *1		Check				○				○			200 h	2-39
		Cleaning				○				○			200 h	
Air cleaner *1		Check				○				○			200 h	2-39
		Cleaning				○				○			200 h	
Radiator hoses and hose clamps		Check				○				○			200 h	2-40
Fuel line and intake air line		Check				○				○			200 h	2-40

*1 If there is a lot of dust, air filters must be cleaned or replaced more often.

Check item		Tasks	Hours of operation indicator										Maintenance intervals	Pages
			550	600	650	700	750	800	850	900	950	1000		
Walk-around inspection		Check											Daily	2-29
Dust valve		Clean											Daily	2-29
Engine oil level		Check											Daily	2-29
Coolant level		Check											Daily	2-29
Radiator and oil cooler		Check											Daily	2-30
Fan belt		Check											Daily	2-30
Exhaust system leakage		Check											Daily	2-31
Hydraulic oil level		Check											Daily	2-31
Water separator		Check											Daily	2-31
Bucket and bucket linkage		Grease											Daily	2-31
Front attachments	Swing bracket	Grease											Daily	2-32
	Other greasing points	Grease											Daily	2-32
Fuel level		Check											Daily	2-33
Washer liquid level		Check											Daily	2-33
Electrical equipment		Check											Daily	2-33
Fuel tank		Drain	○	○	○	○	○	○	○	○	○	○	50 h	2-33
Battery		Check	○	○	○	○	○	○	○	○	○	○	50 h	2-34
Swivel gear		Grease	○	○	○	○	○	○	○	○	○	○	50 h	2-36
Track tension		Check	○	○	○	○	○	○	○	○	○	○	50 h	2-36
		Adjust	○	○	○	○	○	○	○	○	○	○	50 h	2-37
Water separator		Clean	○	○	○	○	○	○	○	○	○	○	50 h	2-38
Swivel bearing		Grease		○				○				○	200 h	2-39
Air filter *1		Check		○				○				○	200 h	2-39
		Clean		○				○				○	200 h	
Air cleaner *1		Check		○				○				○	200 h	2-39
		Clean		○				○				○	200 h	
Radiator hoses and hose clamps		Check		○				○				○	200 h	2-40
Fuel line and intake air line		Check		○				○				○	200 h	2-40

*1 If there is a lot of dust, air filters must be cleaned or replaced more often.

Skilled personnel maintenance chart

Servicing	Tasks	Hours of operation indicator *										Maintenance intervals	Pages
		50	100	150	200	250	300	350	400	450	500		
Fan belt	Adjust					○					○	250 h	2-41
Pilot control valve linkage	Grease					○					○	250 h	2-41
Engine oil and engine oil filter	Replace										○	500 h	2-42
Travel motor gear oil *3	Replace	●									○	500 h	2-43
Fuel filter	Replace										○	500 h	2-43
Return filter *2	Replace					●					○	500 h	2-44
In-line filter	Replace											1000 h	2-44
Hydraulic oil and suction filter *2	Replace											1000 h	2-45
Air filter *1	Replace											1000 h	2-46
Air cleaner elements*1	Replace											1000 h	2-46
Pilot filter	Replace											1000 h	2-47
Injection nozzle	Check	Servicing by KUBOTA dealer.										1500 h	2-47
Engine oil in front idler and track roller	Replace	Servicing by KUBOTA dealer.										2000 h	2-48
Alternator and starter motor	Check	Servicing by KUBOTA dealer.										2000 h	2-49 2-50
Fuel injection pump	Check	Servicing by KUBOTA dealer.										3000 h	2-51
Safety inspection *4	Check											Annually	2-51
Radiator hoses and hose clamps	Replace	Servicing by KUBOTA dealer.										Every 2 years	2-52
Fuel lines and intake air hoses	Replace	Servicing by KUBOTA dealer.										Every 2 years	2-53
Coolant	Replace											Every 2 years	2-53
Hydraulic hoses	Replace	Servicing by KUBOTA dealer.										Every 6 years	2-54

* The servicing identified with ● must be carried out once the specified hours of operation after initial commissioning have been reached.
*1 If there is lot of dust, the air filters and the fresh air filters must be cleaned or replaced more often.
*2 When using a breaker over 20% → every 800 h.
When using a breaker over 40% → every 400 h.
When using a breaker over 60% → every 300 h.
When using a breaker over 80% → every 200 h.
*3 Earlier if necessary.
*4 At least annually

Servicing	Tasks	Hours of operation indicator *										Maintenance intervals	Pages
		550	600	650	700	750	800	850	900	950	1000		
Fan belt	Adjust					○					○	250 h	2-41
Pilot control valve linkage	Grease					○					○	250 h	2-41
Engine oil and engine oil filter	Replace										○	500 h	2-42
Travel motor gear oil *3	Replace										○	500 h	2-43
Fuel filter	Replace										○	500 h	2-43
Return filter*2	Replace										○	500 h	2-44
In-line filter	Replace										○	1000 h	2-44
Hydraulic oil and suction filter *2	Replace										○	1000 h	2-45
Air filter *1	Replace										○	1000 h	2-46
Air cleaner elements*1	Replace										○	1000 h	2-46
Pilot filter	Replace										○	1000 h	2-47
Injection nozzle	Check	Servicing by KUBOTA dealer.										1500 h	2-47
Engine oil in front idler and track roller	Replace	Servicing by KUBOTA dealer.										2000 h	2-48
Alternator and starter motor	Check	Servicing by KUBOTA dealer.										2000 h	2-49 2-50
Fuel injection pump	Check	Servicing by KUBOTA dealer.										3000 h	2-51
Safety inspection *4	Check											Annually	2-51
Radiator hoses and hose clamps	Replace	Servicing by KUBOTA dealer.										Every 2 years	2-52
Fuel lines and intake air hoses	Replace	Servicing by KUBOTA dealer.										Every 2 years	2-53
Coolant	Replace											Every 2 years	2-53
Hydraulic hoses	Replace	Servicing by KUBOTA dealer.										Every 6 years	2-54

* The servicing identified with ● must be carried out once the specified hours of operation after initial commissioning have been reached.
*1 If there is lot of dust, the air filters and the fresh air filters must be cleaned or replaced more often.
*2 When using a breaker over 20% → every 800 h.
When using a breaker over 40% → every 400 h.
When using a breaker over 60% → every 300 h.
When using a breaker over 80% → every 200 h.
*3 Earlier if necessary.
*4 At least annually

5.2 Lubricants quantity

Items		Quantity	Remarks
Engine oil	Engine	4.5 L 1.19 U.S.gals	Including engine oil filter
	Front idler	75 cc 4.6 cu.in.	-
	Track roller	80 cc 4.9 cu.in.	-
	Carrier roller	60 cc 3.7 cu.in.	-
Coolant	Without reserve tank	2.4 L 0.63 U.S.gals	Canopy specification
		2.6 L 0.69 U.S.gals	Cabin specification
	Reserve tank	0.6 L 0.16 U.S.gals	At **[FULL]** mark
Hydraulic oil	All hydraulic system	42 L 11.1 U.S.gals	-
	Hydraulic oil tank	34 L 8.98 U.S.gals	At center of gauge
Fuel	Fuel tank	48 L 12.7 U.S.gals	-
Gear oil	Travel motor	0.35 L 0.09 U.S.gals	-

5.3 Recommended lubricants

Items	Recommendation			Filled at factory		Note
	Ambient temperature conditions	Viscosity	Quality standard	Brand	Type	
Engine oil	In winter or at low temperature	SAE 10W SAE 20W	API CF* API CI-4 API CJ-4	-	-	• When diesel fuel with a high sulfur content (between 0.50% and 1.00%) is used, the engine oil and engine oil filter must be replaced at shorter intervals. • Never use diesel fuel with a sulfur content exceeding 1.00%.
	In summer or at high temperature	SAE 30 SAE 40 SAE 50		-	-	
	All weather	15W-40 *		Shell	Rimula R4L*	
Coolant	-	-	SAE J1034* MB 325.0* ASTM D3306* D4985	ROWE	Hightec Antifreeze AN G48* (-37°C)*	• Always use distilled water to mix with anti-freeze. • Always follow the recommendations of the coolant manufacturer for the mixing ratio. Do not mix with other coolants.
Grease	-	NLGI-2*	DIN 51825 KP2K-30*	Mobil	Mobilux EP2*	
	-	NLGI-1	-	WEICON	Antiseize Standard	• Only use during the first 50 working hours (on all greasing points around the swing block).
Hydraulic oil	In winter or at low temperature	ISO 32 ISO 46*	-	Shell	Tellus S2M46*	
	In summer or at high temperature	ISO 46 ISO 68	-	-	-	
Gear oil	In winter or at low temperature	SAE 75 SAE 80	MIL-L-2105C*	-	-	
	In summer or at high temperature	SAE 90 SAE 140		-	-	
	All weather	80W-90*		Shell	Spirax MA80W*	
Fuel	-	-	EN 590 ASTM D975	-	-	• For preparing the excavator for use in winter, fill the fuel tank with winter diesel and allow the engine to run for a few minutes. • Never use diesel fuel with a sulfur content exceeding 1.00%.

* These lubricants are used by the manufacturer for the initial filling.

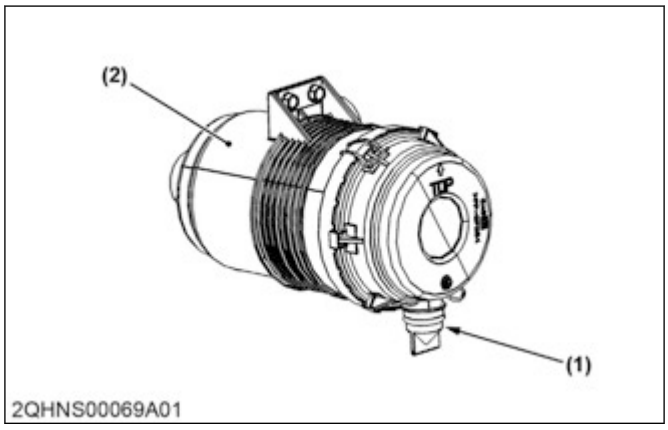
5.4 Daily check

5.4.1 Walk-around inspection

1. Check the excavator for visible damage, loose nuts and screws, and leaks.
2. Check and remove the accumulated dirt adjacent to hot components, such as engine, exhaust manifold, and muffler.
3. Check and remove the accumulated residues from leaves, straw, pine needles, twigs, bark and other flammable materials.
4. Check the safety instructions on the excavator. They must be complete and legible.
5. Ensure that the emergency hammer is present for the cabin specification.

5.4.2 Cleaning the dust valve

1. Press the dust valve several times or remove to clean inside.



(1) Dust valve (2) Air cleaner

5.4.3 Checking the engine oil level

■ IMPORTANT

- **If the oil level is too high or too low, the engine might be damaged during operation.**

Preparing

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

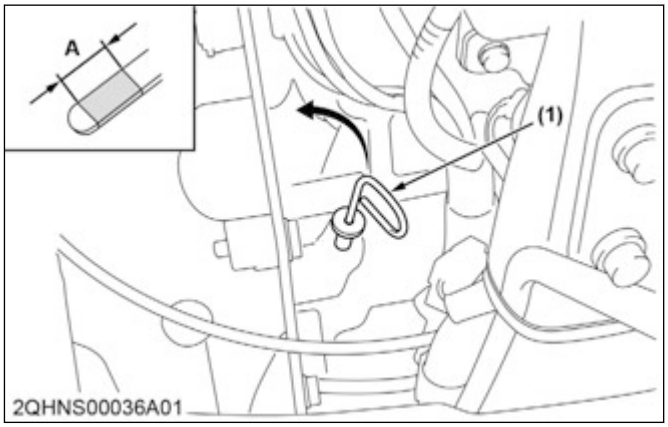
Checking

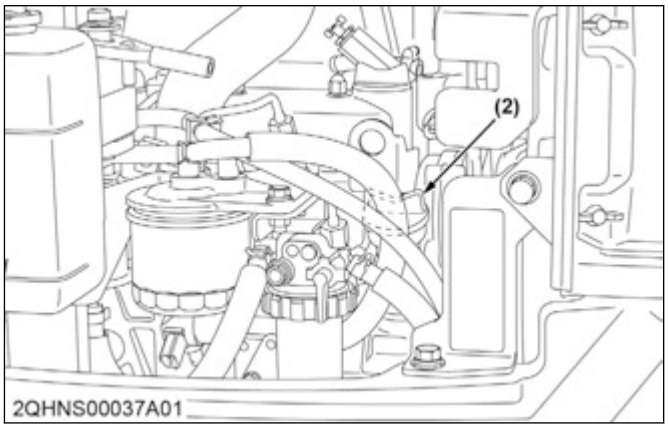
1. Pull the engine oil gauge out from the engine and wipe the engine oil off.

   ■ NOTE

   - **Check the engine oil level 5 minutes after stopping the engine.**

2. Insert the engine oil gauge fully into the engine oil gauge port.
3. Pull the engine oil gauge out from the engine again and check the engine oil level.





(1) Engine oil gauge A: Correct oil level range
(2) Oil filler port

4. Replenish the engine oil if necessary.

Recommended lubricants

Engine oil	In winter or at low ambient temperature	API CF, API CI-4, API CJ-4 SAE 10W, SAE 20W
	In summer or at high ambient temperature	API CF, API CI-4, API CJ-4 SAE 30, SAE 40, SAE 50
	All weather	API CF, API CI-4, API CJ-4 15W-40

5.4.4 Checking the coolant level

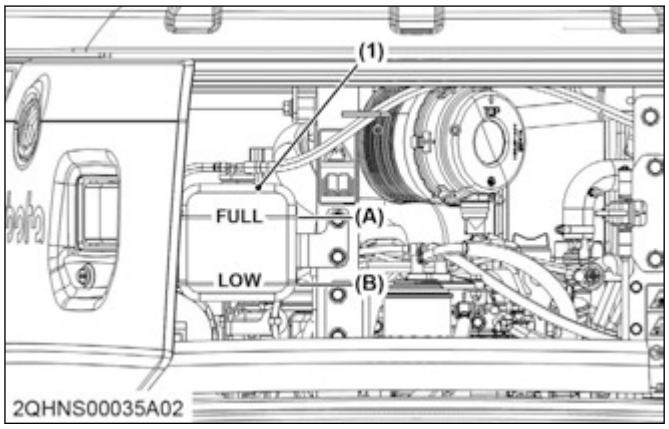
Preparing

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Checking

1. Check the coolant level is between the **[FULL]** and **[LOW]**.

■ NOTE
- **Check the coolant level in the reserve tank after the engine has cooled down.**



(1) Reserve tank (B) **[LOW]**
(A) **[FULL]**

2. Replenish the coolant into the reserve tank if necessary.

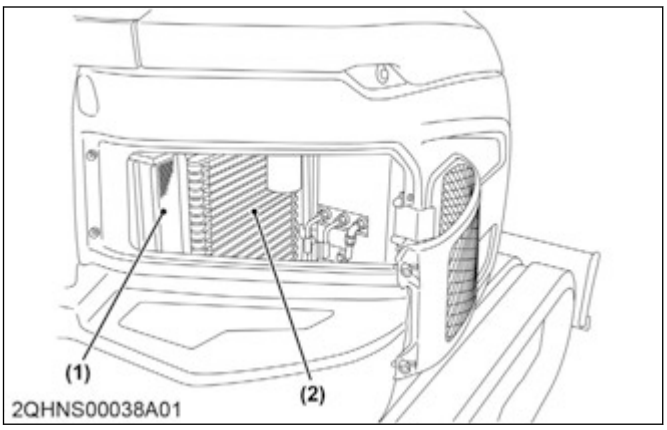
■ IMPORTANT
- **Do not replenish the coolant exceeding the [FULL].**
- **Do not mix the coolant with dirty or salt water.**
- **In case that the coolant level decreases soon after replenishing, there is a possibility of cooling system leakage. Repair the leakage before starting the engine.**

5.4.5 Checking the radiator and oil cooler

⚠ CAUTION
- **Wear the eye protector when cleaning the radiator and oil cooler with compressed air.**

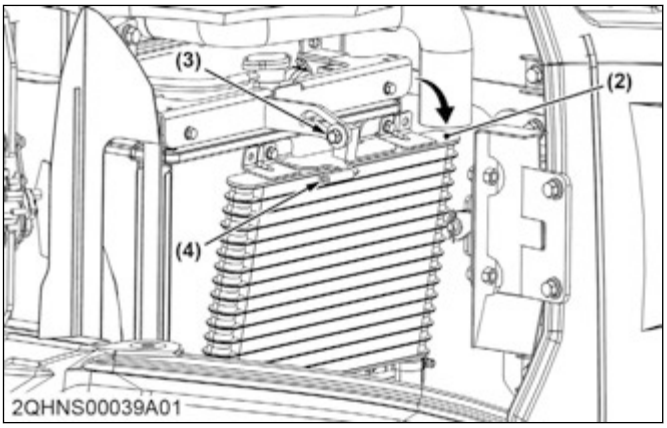
Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Checking
1. Check if the fins of the radiator and oil cooler are clogged.



(1) Radiator (2) Oil cooler

2. Remove the bolt and pull the handle to tilt the oil cooler.



(2) Oil cooler (4) Handle
(3) Bolt (M8 × 20)

3. Remove the dirt by compressed air if necessary.

■ IMPORTANT
- **Pressure of compressed air must be under 205 kPa (2.1 kgf/cm^2, 30 psi).**

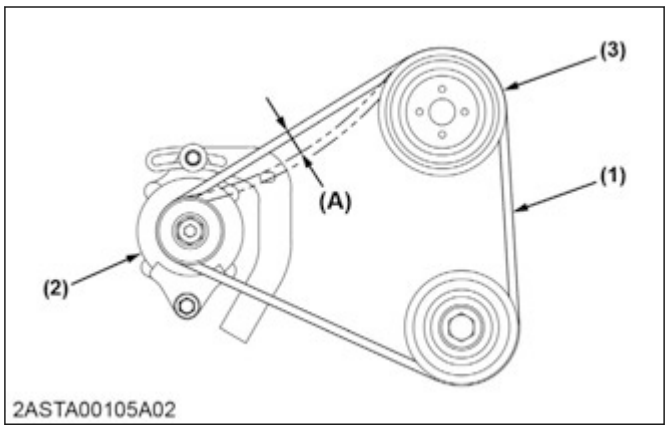
4. Check the radiator and oil cooler for damage.
5. Return the oil cooler to the original position and install the bolt.

5.4.6 Checking the fan belt

⚠ CAUTION
- **Stop the engine, remove the key, and hang a DO NOT OPERATE tag near the operator's seat when checking and adjusting the fan belt.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Checking
1. Check the crack and damage of the fan belt and replace if necessary.
2. Push position (A) to check the fan belt tension.



(1) Fan belt
(2) Alternator
(3) Pulley

3. Adjust the fan belt tension if necessary.

Service specifications

(A) Fan belt tension	7 to 9 mm	Push with 60 to 70 N Push with 6 to 7 kgf

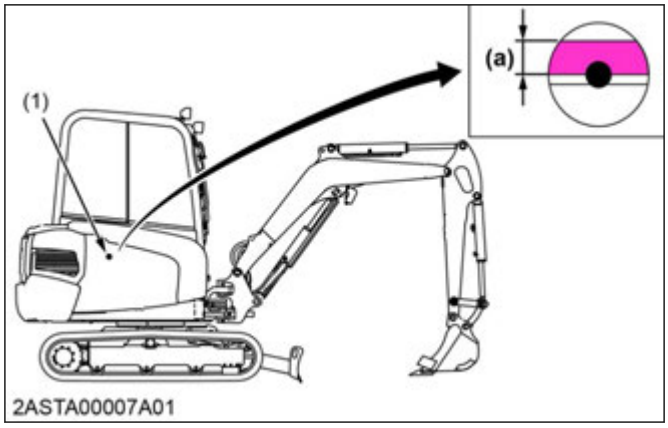
5.4.7 Checking the exhaust system leakage

⚠ CAUTION
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**
  - **Pressure in the fuel line is high.**

1. Check the leakage, tightness, and cracks of exhaust system.
2. Repair the leakage or loosen parts before starting the engine.

5.4.8 Checking the hydraulic oil level

1. Park the machine on firm and level ground.
2. Operate the machine to hydraulic oil checking position.



(1) Hydraulic oil gauge
(a) Normal range

3. Check the hydraulic oil level at hydraulic oil temperature between 10 to 30 ℃.
4. Replenish the hydraulic oil if necessary.

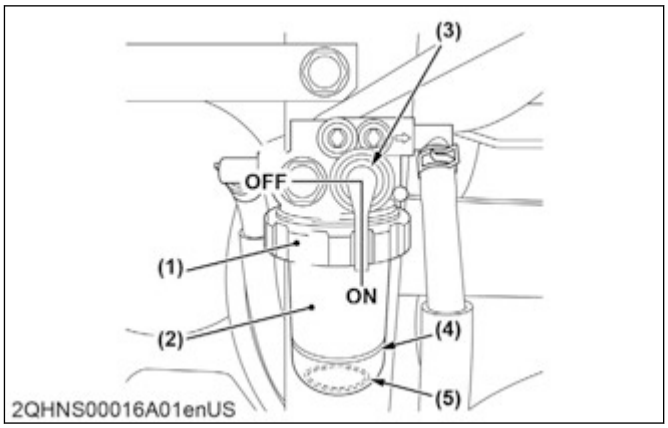
■ IMPORTANT
- **Clean around on the hydraulic oil tank before replenishing the hydraulic oil to avoid dust contamination.**
- **Do not use or mix different oil.**

Recommended lubricants

Hydraulic oil	In winter or at low ambient temperature	ISO 32, ISO 46
	In summer or at high ambient temperature	ISO 46, ISO 68

5.4.9 Checking the water separator

1. Check the water level by the float position.



(1) Water separator
(2) Cup
(3) Water separator handle
(4) Mark
(5) Float

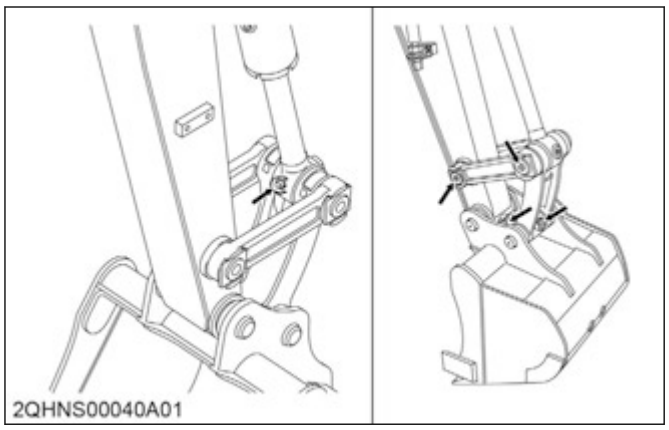
2. Clean the water separator if necessary.

5.4.10 Greasing the bucket and bucket linkage

■ IMPORTANT
- **Grease the machine before working.**
- **In case of working the machine in water, grease again after finish working.**

1. Operate the bucket so that the greasing points are accessible.
2. Stop the engine.
3. Grease each grease fitting.

■ NOTE
- **Clean around the grease fittings before and after greasing.**



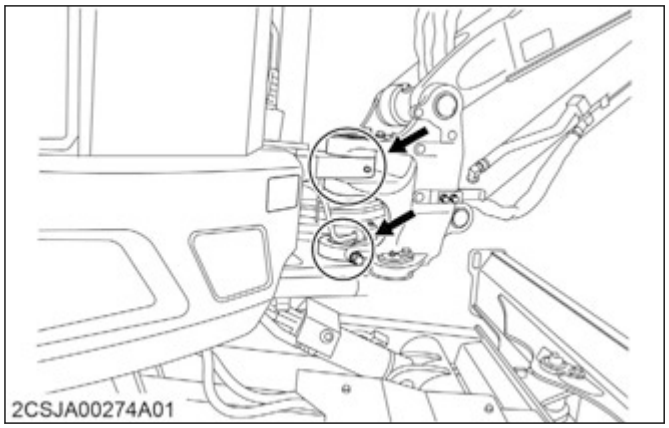
5.4.11 Greasing the swing bracket

■ IMPORTANT
- **Grease the machine before working.**
- **In case of working the machine in water, grease again after finish working.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Greasing
1. Grease the each grease fitting.

■ NOTE
- **Clean around the grease fittings before and after greasing.**



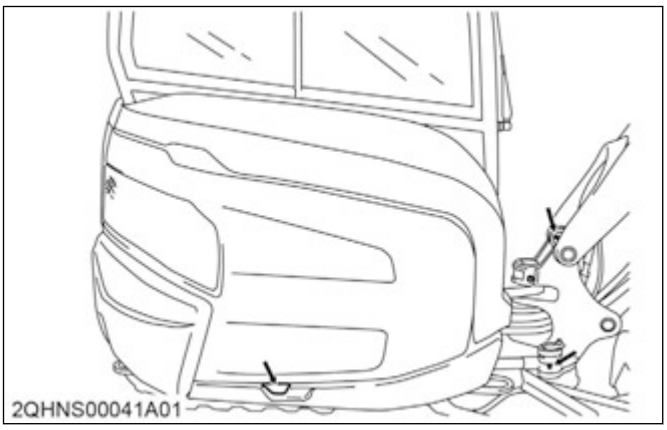
5.4.12 Greasing the other greasing points

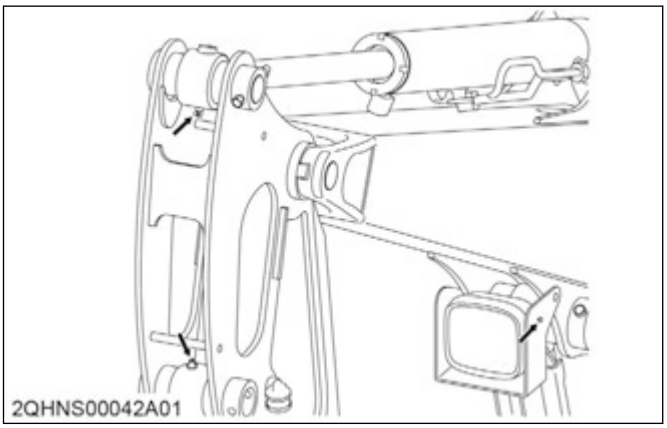
■ IMPORTANT
- **Grease the machine before working.**
- **In case of working the machine in water, grease again after finish working.**

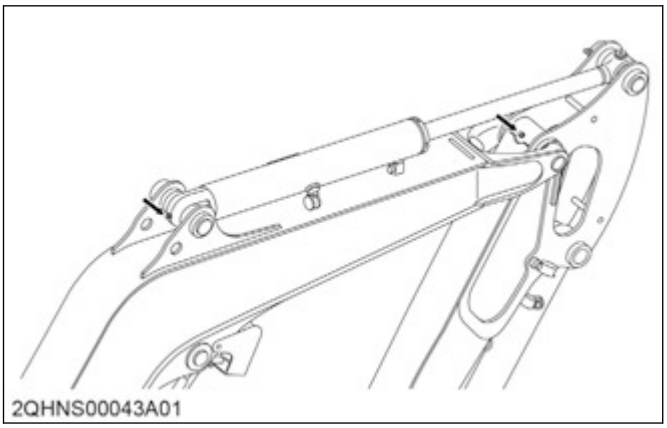
Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

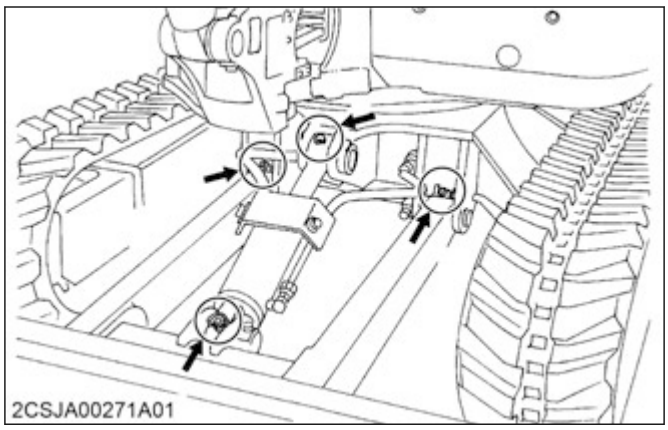
Greasing
1. Grease the each grease fitting.

■ NOTE
- **Clean around the grease fittings before and after greasing.**
- **Greasing the swivel gear and swivel bearing are not necessary for daily check.**









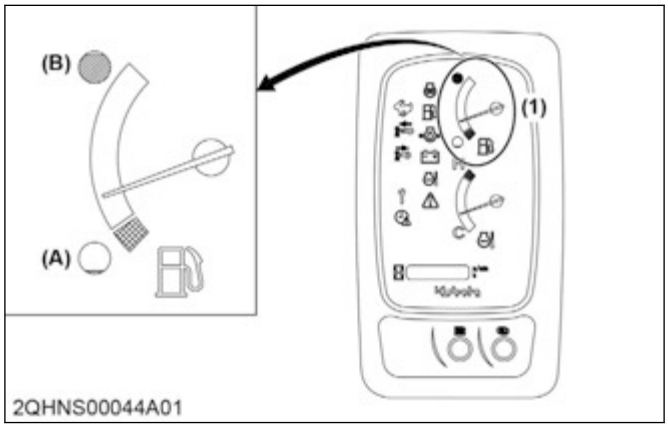
5.4.13 Checking the fuel level

WARNING
- **Keep fire and flammable items away from the working area.**

IMPORTANT
- **If the fuel is empty, do not start the engine to avoid mixing the air into the fuel system.**
- **Replenish the fuel into the fuel tank fully before parking overnight to prevent condensation accumulations in the fuel tank.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Checking
1. Turn the key switch to **[RUN]**.
2. Check the fuel level.



(1) Fuel gauge (B) Full
(A) Empty

3. Replenish the fuel if necessary.

Recommended lubricant

Diesel fuel	EN 590 ASTM D975

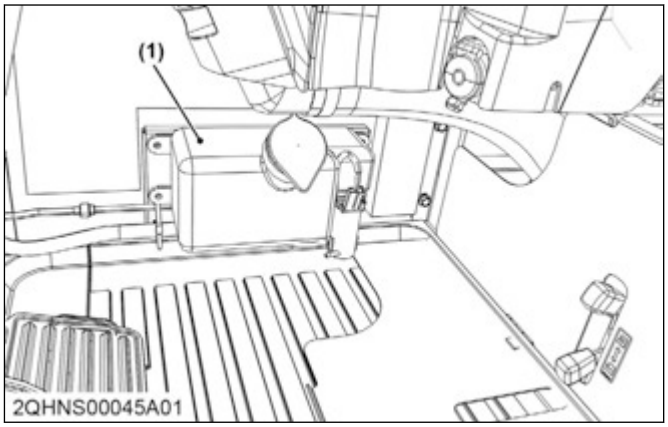
5.4.14 Checking the washer liquid level

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Checking
1. Check the washer liquid level.

IMPORTANT
- **Do not turn on the washer motor when the washer tank is empty to avoid damaging the washer motor.**

2. Replenish the washer tank if necessary.



(1) Washer tank

5.4.15 Checking the electrical equipment

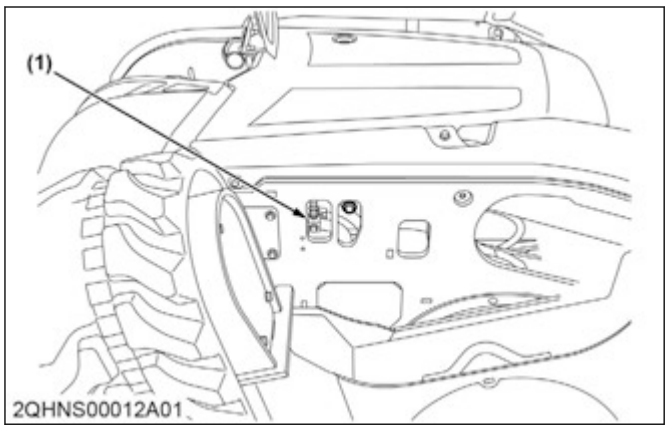
1. Check the function of the room light.
2. Check the function of the work light.
3. Check the function of the beacon.
4. Check the function of the blower motor.
5. Check the function of the washer system.
6. Check the tightness and condition of all accessible electrical wires and connectors.
7. Repair or replace damaged parts.
8. Check the rust and dirt of the fuses and clean if necessary.

5.5 Every 50 hours

5.5.1 Draining the fuel tank

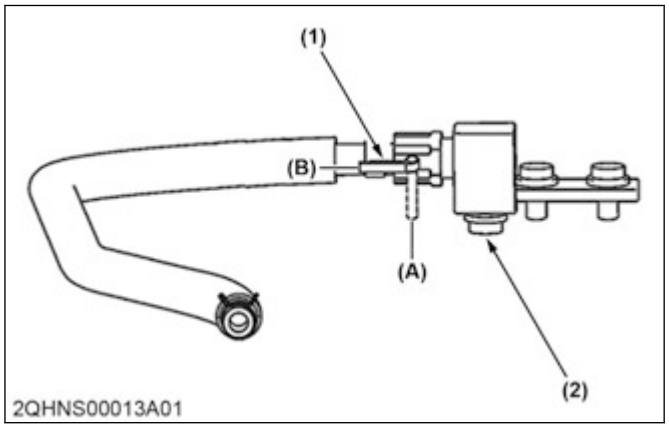
WARNING
- **Keep fire and flammable items away from the working area.**

1. Operate the swivel to put a tray under the drain plug on firm and level ground.



(1) Drain valve

2. Lower the bucket and blade to the ground and stop the engine.
3. Put a tray under the drain plug for receiving the water mixed fuel.
4. Close the drain valve.
5. Remove the drain plug.



(1) Drain valve
(2) Drain plug
(A) Close
(B) Open

6. Open the drain valve to drain the water mixed fuel.
7. Close the drain valve and install the drain plug with a new washer.

5.5.2 Checking the battery

DANGER

- **In case of the electrolyte level is below the "LOWER" mark, do not use or charge the battery to avoid battery explosion.**

WARNING

- **Do not remove the vent caps while the engine is running.**
- **Keep electrolyte away from your eyes, hands and clothing. Sulfuric acid in battery electrolyte is poisonous and it can burn your skin and clothing and cause blindness. If you spill electrolyte on yourself, clean yourself with water and get medical aid immediately.**
- **Do not use metal tools when cleaning battery terminals. It may cause short-circuit.**
- **Do not open a maintenance free battery.**

CAUTION

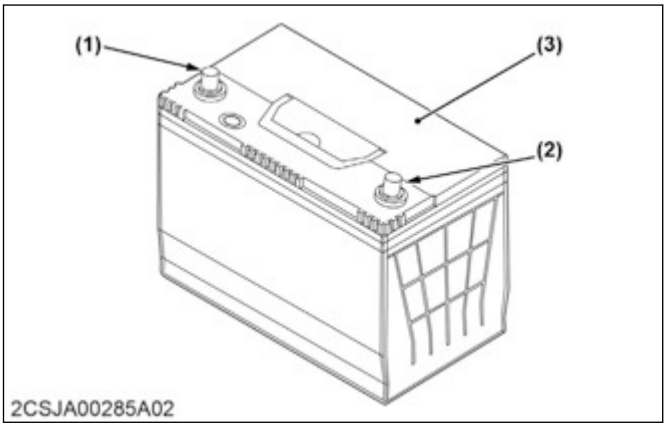
- **Keep a fire (welding sparks, grinding sparks, cigarettes) away from the battery. The battery produces oxygen and hydrogen gas which are flammable.**
- **Disconnect the negative (-) terminal first when removing the battery cable.**
- **Connect the positive (+) terminal first when connecting the battery cable.**

IMPORTANT

- **In case of using a maintenance free battery, checking the electrolyte level and density are not necessary. Check the battery condition with the indicator and replace the battery if necessary.**

Checking the battery terminal

1. Check the condition of the battery terminal.

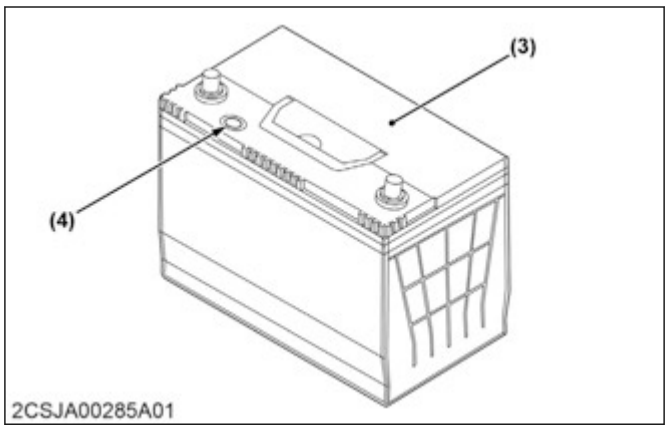


(1) Positive (+) terminal
(2) Negative (-) terminal
(3) Battery

2. Clean the battery terminal and grease with petroleum jelly if necessary.

Checking the battery indicator

1. Check the battery condition with the battery indicator.



(3) Battery (4) Indicator

Battery condition (indicator color)

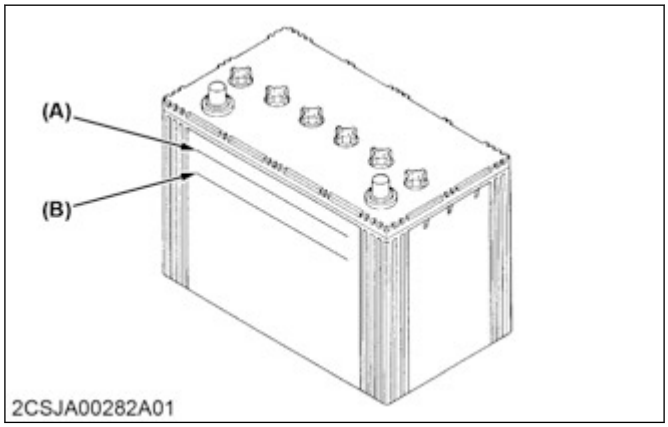
Blue	Red	White
Normal	Need charging	Need replacing

■ NOTE
- **Follow the battery manufacture's manual for details when checking the battery indicator.**

Checking the electrolyte level

1. Check the electrolyte level is between the upper and lower level line.
2. Replenish the distilled water if necessary.

■ IMPORTANT
- **Do not replenish the distilled water exceeding the upper level line.**

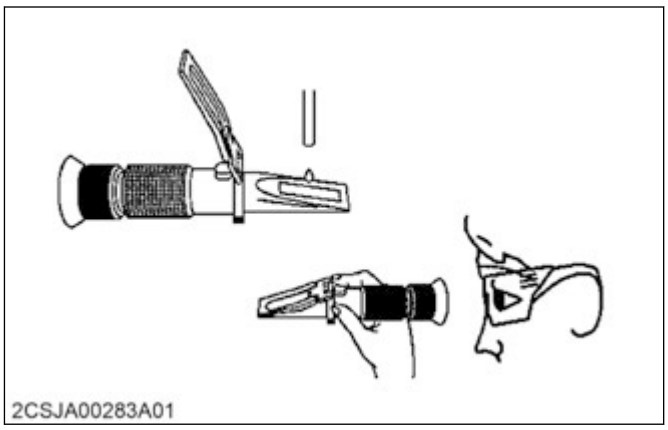


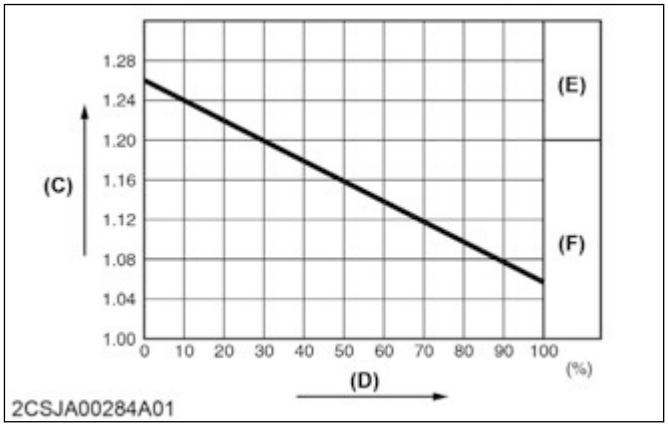
(A) Upper level line (B) Lower level line

Checking the electrolyte density

⚠ CAUTION
- **Wear the protective gloves, work clothing and eye protector to protect your skin and eyes from sulfuric acid in battery electrolyte.**

1. Remove the vent caps from the battery.
2. Measure the density of electrolyte with the refractometer and charge the battery if necessary..



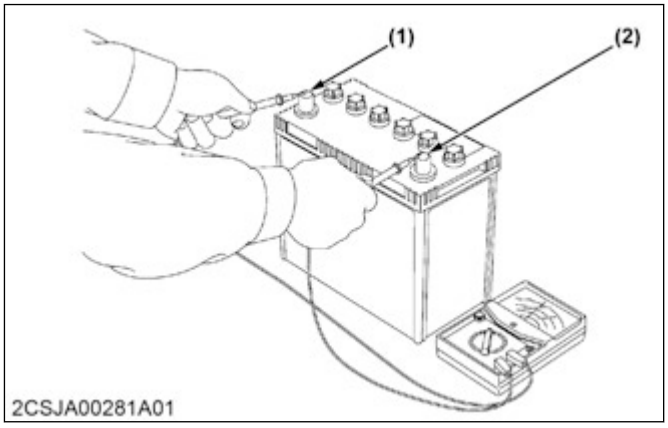


(C) Electrolyte density (F) Charging is necessary
(D) Discharge
(E) Normal

3. Install the vent caps.

Checking the battery voltage

1. Check the battery voltage with a voltage tester.



(1) Positive terminal (+) (2) Negative terminal (-)

Battery voltage	Higher than 12 V

2. Check the electrolyte density in case that the battery voltage is lower than the service specification.

■ IMPORTANT
- **Replace the maintenance free battery in case that the battery voltage is lower than 12 V.**

Charging the battery

⚠ CAUTION
- **Do not charge the maintenance free battery.**
- **Wear the protective gloves, work clothing and eye protector to protect your skin and eyes from sulfuric acid in battery electrolyte.**
- **In case of working indoors, make sure to ventilate the work area.**

1. Check the electrolyte level and replenish the distilled water if necessary.
2. Disconnect the battery cables from the battery.
3. Remove the vent caps.
4. Connect the battery to the charger.

■ NOTE
- **Follow the battery charger manufacture's manual for details when charging the battery.**

5. Charge the battery.

■ IMPORTANT
- **Charge the battery in normal speed.**
- **Charge the battery in fast speed only for emergencies because fast speed charge may shorten the battery life.**

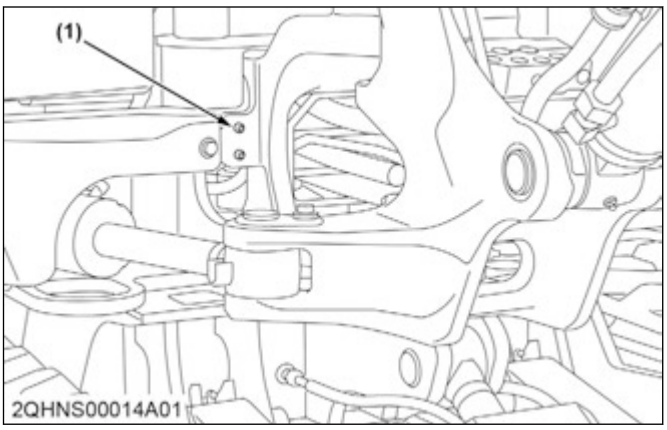
6. Check the electrolyte level after charging and replenish the distilled water if necessary.
7. Install the vent caps.
8. Connect the battery cables.

5.5.3 Greasing the swivel gear

⚠ CAUTION
- **Keep any persons or objects away from the swivel range.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Greasing
1. Grease the swivel gear from the grease fitting.



(1) Grease fitting (for swivel gear)

■ NOTE
- **The grease amount should be approximately 50 g (20 to 30 pumps with the grease gun) at each position.**

2. Swivel the upper structure of the machine 90 degrees for 3 times to grease the gear.
3. Swivel the upper structure of the machine 360 degrees several times to distribute the grease evenly.

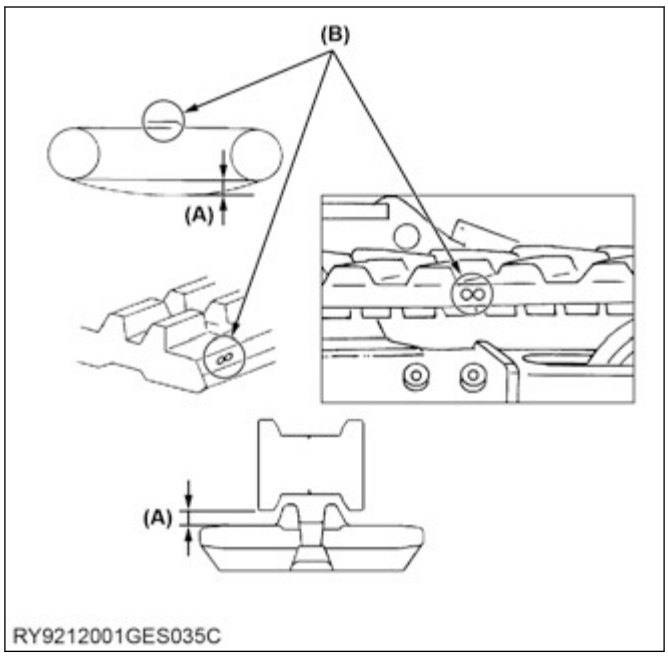
5.5.4 Checking the track tension

⚠ CAUTION
- **Put the machine on the jack stands securely when jacking up the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**

■ IMPORTANT
- **Wear amount is increased if the tracks are too tight or loose.**
- **The tracks may be derailed if the tracks are too loose.**

Preparing
1. Remove dirt such as stones caught between the tracks and sprockets, track rollers, and front idlers.
2. Jack up the machine on firm and level ground. Secure the machine on the jack stands.

Checking the rubber track tension
1. Rotate the track to set the match mark right over the carrier roller.
2. Check the track tension.



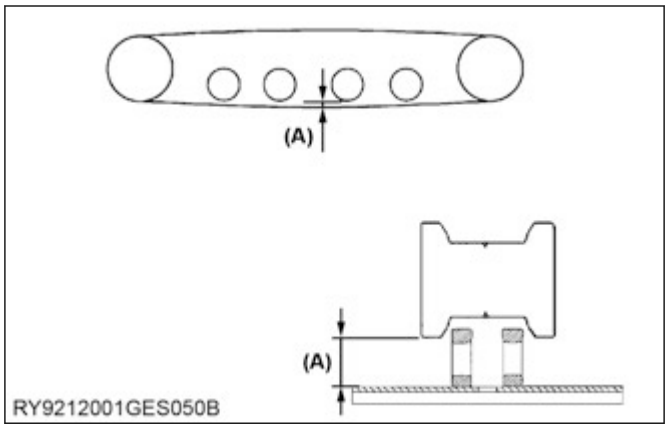
(A) Tension dimension (B) Match mark

Service specification

(A)	10 to15 mm 0.39 to 0.59 in.	

Checking the steel track tension

1. Check the track tension.



(A) Tension dimension

Service specification

(A)	80 to 85 mm 3.1 to 3.3 in.

5.5.5 Adjusting the track tension

CAUTION

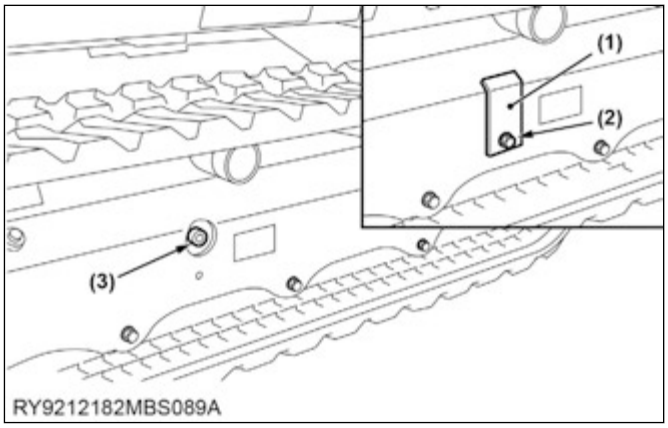
- **Put the machine on the jack stands securely when jacking up the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

Preparing

1. Remove dirt such as stones caught between the tracks and sprockets, track rollers, and front idlers.
2. Jack up the machine on firm and level ground. Secure the machine on the jack stands.

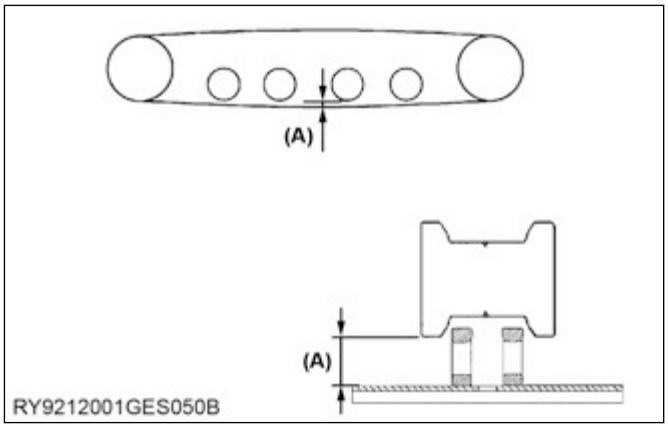
Tightening the track tension

1. Remove the bolt and cover.
2. Put grease into the grease fitting to extend the grease cylinder.



(1) Cover (3) Grease fitting
(2) Bolt

3. Adjust the distance between the track and track roller in range.



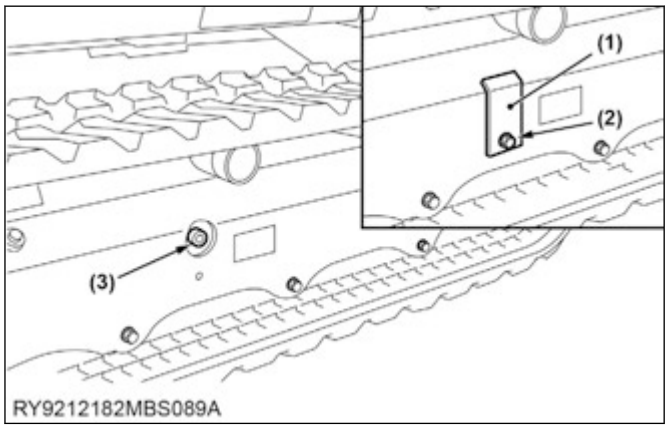
Service specifications

(A)	Rubber track	10 to15 mm 0.39 to 0.59 in.
	Steel track	80 to 85 mm 3.1 to 3.3 in.

4. After adjustment, rotate the rubber track two revolutions and check the distance.

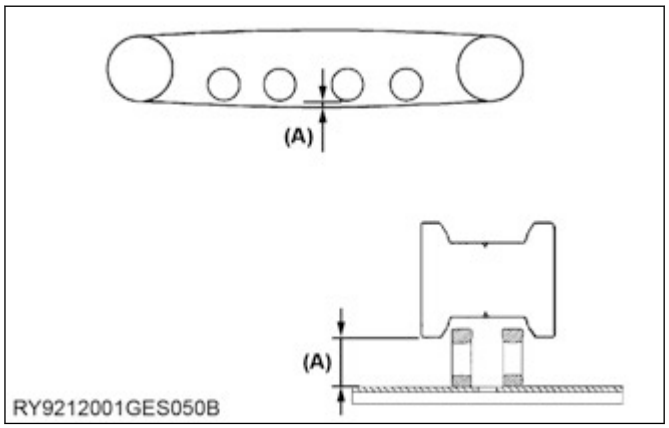
Loosening the track tension

1. Remove the cover.
2. Press a socket wrench onto the base of the grease fitting and loosen it slowly.



(1) Cover
(2) Bolt
(3) Grease fitting

3. Adjust the distance between the track and track roller in range.



Service specifications

(A)	Rubber track	10 to15 mm 0.39 to 0.59 in.
	Steel track	80 to 85 mm 3.1 to 3.3 in.

4. Tighten the grease fitting.

Tightening torque

(2) Grease fitting	98 to 108 N·m 10 to 11 kgf·m 72 to 80 lbf·ft	-

5. After adjustment, rotate the rubber track two revolutions and check the distance.

5.5.6 Cleaning the water separator

WARNING

- **Keep fire and flammable items away from the working area.**

IMPORTANT

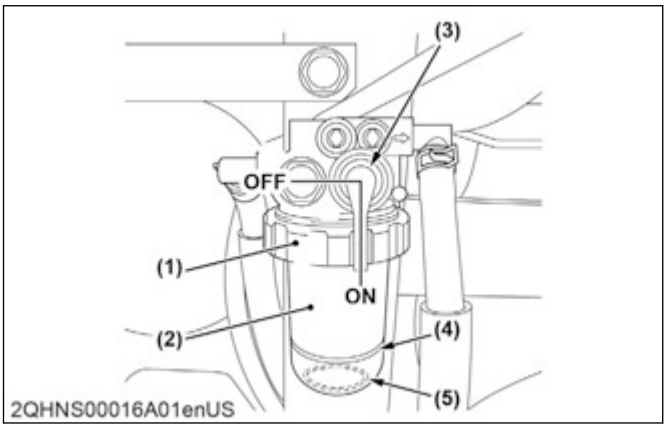
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**
- **Do not reuse removed O-rings for assembling to avoid oil leakage.**

Preparing

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

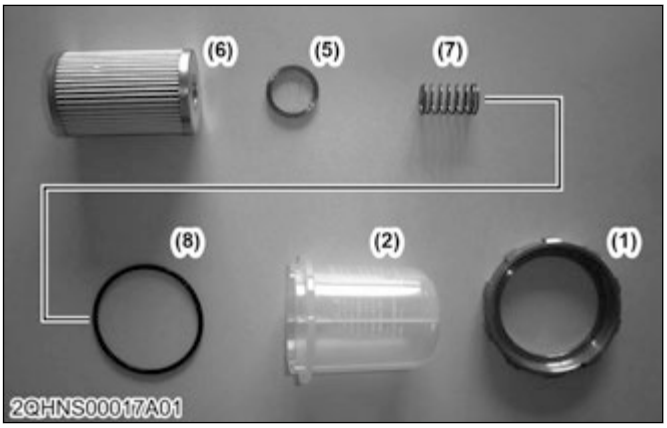
Cleaning

1. Turn the water separator lever to the **[OFF]**.



(1) Retainer ring
(2) Cup
(3) Water separator lever
(4) Line
(5) Float

2. Loosen the retainer ring to remove the cup.



(1) Retainer ring
(2) Cup
(5) Float
(6) Filter
(7) Spring
(8) O-ring

3. Remove the water mixed fuel from the cup.
4. Clean the cup with clean fuel.

5. Check damage and dirt of the filter and replace if necessary.
6. Apply fuel to the O-ring, assemble the water separator, and install the retainer ring by hand tightening.
7. Turn the water separator lever to the **[ON]**.
8. Turn the starter switch to **[RUN]** to bleed the air from the fuel line.

5.6 Every 200 hours

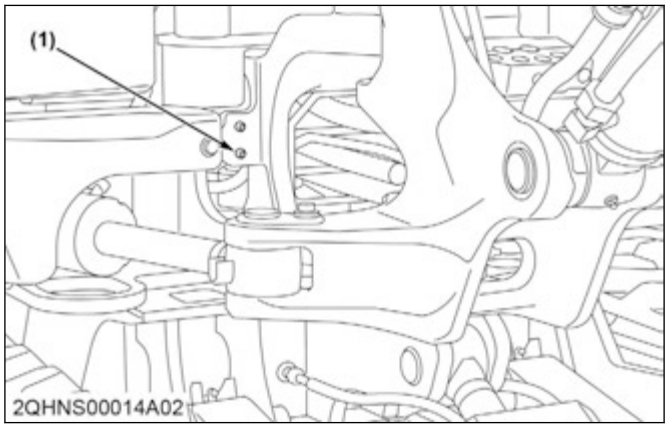
5.6.1 Greasing the swivel bearing

Preparing

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Greasing

1. Grease the swivel bearing from the grease fitting.



(1) Grease fitting (for swivel bearing)

IMPORTANT

- **The grease amount should be 10 g (approximately 5 pumps with the grease gun) for each position.**
- **Do not grease excessively to avoid damaging the seal of the swivel bearing.**

2. Swivel the upper structure of the machine 90 degrees for 3 times to grease the gear.
3. Swivel the upper structure of the machine 360 degrees several times to distribute the grease evenly.

5.6.2 Checking and cleaning the air filter

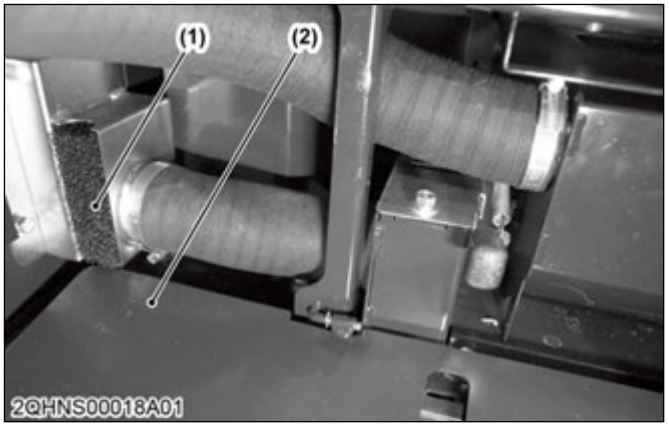
CAUTION

- **Wear eye protector when cleaning the air filter with compressed air.**

IMPORTANT

- **In case of using the machine in extremely dusty conditions, check and clean or replace the air filter more frequently.**

1. Unlock and open the cover.

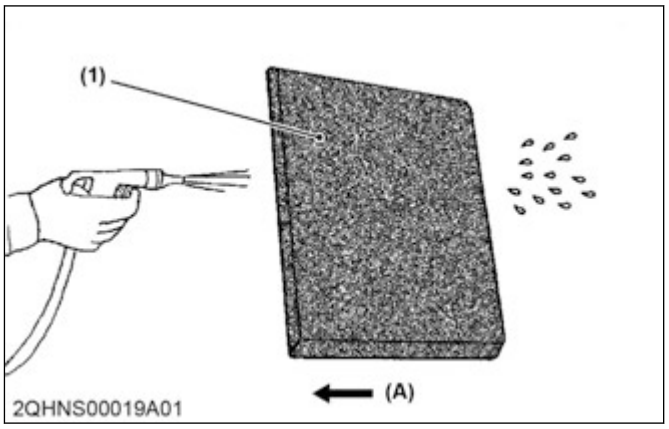


(1) Air filter (2) Cover

2. Remove the air filter.
3. Check damage and dirt of the air filter and replace if necessary.
4. Clean the air filter with compressed air from opposite direction of the intake air flow.

IMPORTANT

- **Pressure of the compressed air must be under 205 kPa (2.1 kg/cm^2, 30 psi).**



(1) Air filter (A) Intake air flow

5. Install the air filter.

5.6.3 Checking and cleaning the air cleaner elements

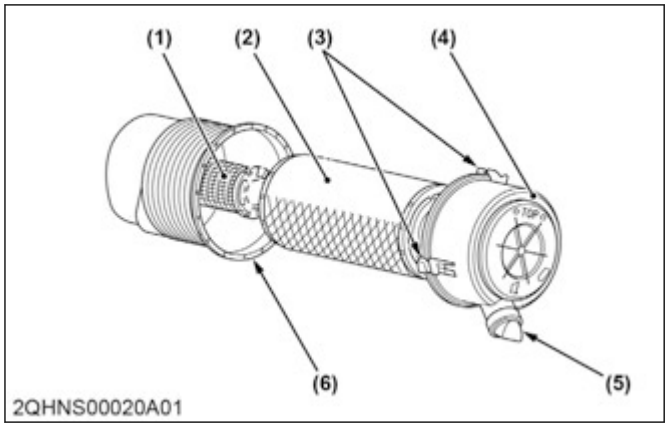
CAUTION

- **Wear eye protector when cleaning the outer element with compressed air.**

■ IMPORTANT
- **In case of using the machine in extremely dusty conditions, check and clean or replace the outer element more frequently.**
- **Do not start the engine without installing the filter elements.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Checking and cleaning
1. Open the clips and remove the cover.



(1) Inner element
(2) Outer element
(3) Clip
(4) Cover
(5) Dust valve
(6) Air cleaner case

2. Remove the outer element from the air cleaner case.
3. Check the outer element for damage and dirt and replace it if necessary.
4. Clean the outer element with compressed air.

■ IMPORTANT
- **Pressure of the compressed air must be under 500 kPa (5.1 kg/cm^2, 73 psi).**
- **Blow the compressed air from inside the element to outside.**
- **Do not clean the outer element with fluids.**

5. Clean the air cleaner case and cover without removing the inner element.
6. Clean the dust valve.
7. Install the outer element and cover.

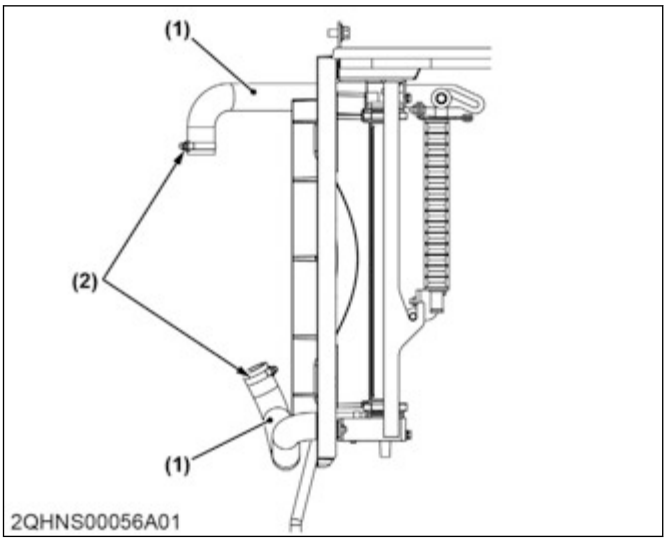
■ IMPORTANT
- **Install the cover so that the top mark faces upwards.**

5.6.4 Checking the radiator hoses and clamps

⚠ CAUTION
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Checking
1. Check the radiator hoses and replace if necessary.
2. Check the tightness of the hose clamps and tighten if necessary.



(1) Radiator hose
(2) Hose clamp

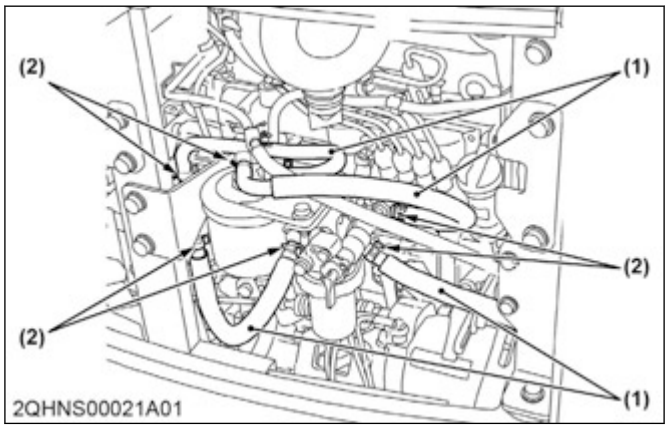
5.6.5 Checking the fuel line and intake air line

⚠ CAUTION
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

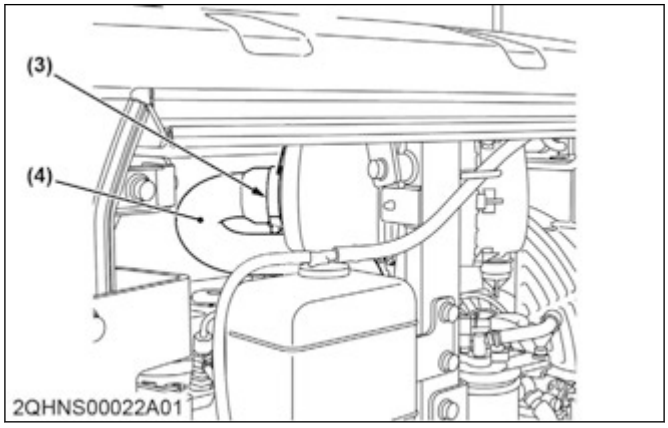
Checking

1. Check the fuel hoses and replace if necessary.
2. Check the tightness of the hose clamps and tighten if necessary.



(1) Fuel hose (2) Hose clamp

3. Check the intake air pipe and hose. Replace if necessary.
4. Check tightness of the intake air pipe and hose clamps. Tighten if necessary.



(3) Intake air pipe (4) Hose clamp

5.7 Every 250 hours

5.7.1 Adjusting the fan belt

⚠ CAUTION

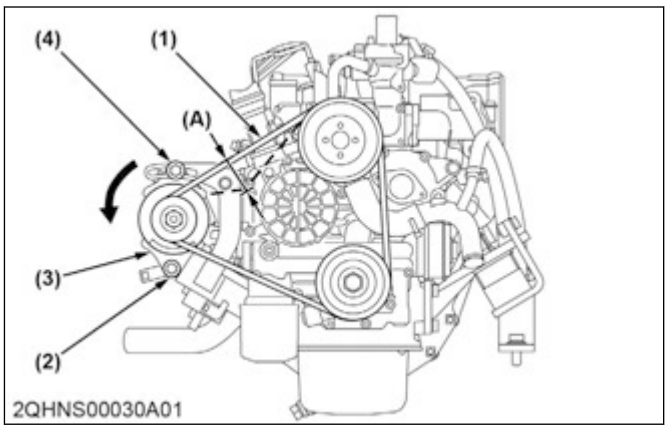
- **Stop the engine, remove the key, and hang a DO NOT OPERATE tag near the operator's seat when checking and adjusting the fan belt.**

Preparing

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Adjusting

1. Loosen the bolt and nut. Move the alternator to adjust the fan belt tension.



(1) Fan belt (4) Nut (M10)
(2) Bolt (M8 × 30)
(3) Alternator

Service specification

(A) Fan belt tension	7 to 9 mm	Push with 60 to 70 N Push with 6 to 7 kgf

2. Tighten the bolt and nut.

Tightening torque

(2) Bolt	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.1 to 15.2 lbf·ft	-
(4) Nut	39.2 to 45.1 N·m 4.0 to 4.6 kgf·m 28.9 to 33.3 lbf·ft	-

3. Start the engine and check if the fan belt is not slipping.

5.7.2 Greasing the pilot valve linkage

⚠ CAUTION

- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**

Preparing

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.
2. Release the residual pressure.

Greasing

1. Pull up the boot on the pilot control valve.

(1) Universal joint (3) Boot
(2) Push rod

2. Grease the universal joint and push rod.

5.8 Every 500 hours

5.8.1 Replacing the engine oil and engine oil filter

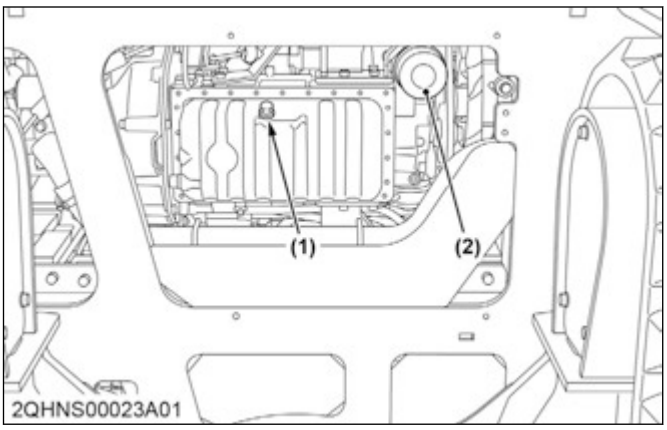
⚠ CAUTION
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, muffler, and oil are extremely hot.**
  - **Pressure in the engine oil line is high.**

Preparing

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Replacing

1. Put a tray under the drain plug for receiving the engine oil.



(1) Drain plug (2) Engine oil filter

2. Remove the drain plug and drain all of the engine oil.

■ NOTE
- **Remove the filler cap to drain the engine oil faster.**

3. Install the drain plug with the washer.
4. Put a tray under the engine oil filter for receiving the engine oil.
5. Remove the engine oil filter with a filter wrench.
6. Apply the engine oil to the O-ring and install the new engine oil filter by hand tightening.

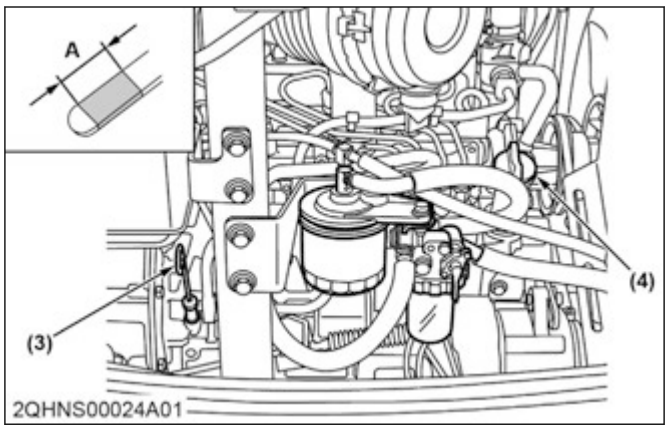
■ IMPORTANT
- **Do not tighten the engine oil filter strongly with the filter wrench.**

7. Fill the engine oil from the oil filler port up to the maximum level of the engine oil gauge.

Recommended lubricants

Engine oil	4.5 L 1.19 U.S.gals	In winter or at low ambient temperature API CF, API CI-4, API CJ-4 SAE 10W, SAE 20W
		In summer or at high ambient temperature API CF, API CI-4, API CJ-4 SAE 30, SAE 40, SAE 50
		All weather API CF, API CI-4, API CJ-4 15W-40

8. Check the engine oil level with the engine oil gauge.



(3) Engine oil gauge A: Required oil level range
(4) Engine oil filler port

9. Start the engine in idling speed and leave it for 5 minutes.
10. Replenish the engine oil if necessary.

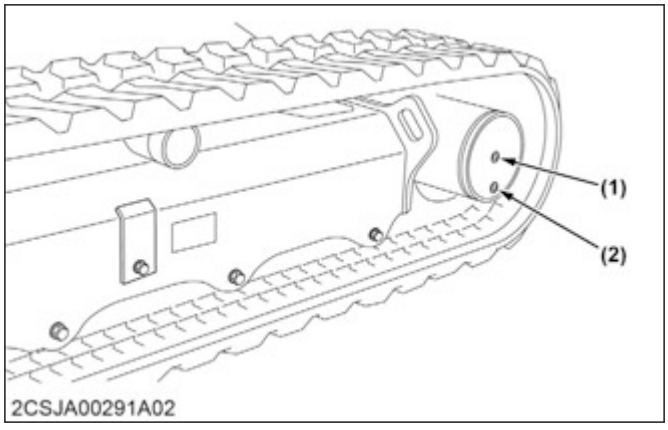
5.8.2 Replacing the travel motor gear oil

IMPORTANT
- **Initial replacement is 50 hours.**

1. Travel the machine for a while to warm up the gear oil.

NOTE
- **It is difficult to drain the gear oil in case that the gear oil is cold.**

2. Travel the machine so that the drain port is in the bottom position on firm and level ground.



(1) Oil filler and check port (2) Drain port

3. Lower bucket and blade to the ground and stop the engine.
4. Put a tray under the drain port for receiving the gear oil.
5. Remove the drain plug and drain all of the gear oil.
6. Install the drain plug with the new O-ring.
7. Remove the oil filler plug and replenish the gear oil.

Recommended lubricants

Gear oil	0.35L 0.09 U.S.gals	In winter or at low ambient temperature SAE 75, SAE 80
		In summer or at high ambient temperature SAE 90, SAE 140
		All-weather 80W-90

8. Check the oil level from the oil filler and check port.
9. Install the oil filler plug with the new O-ring.

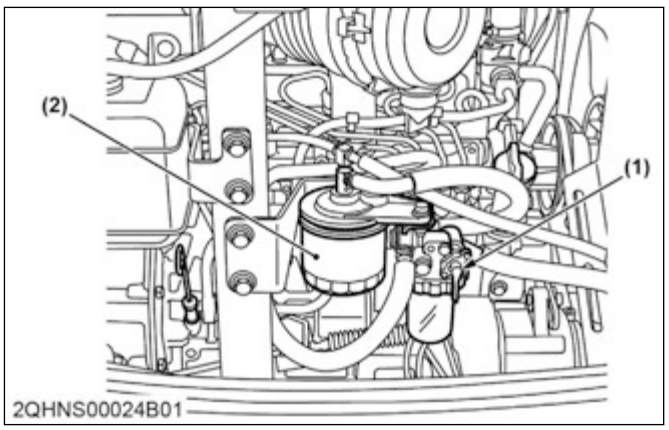
5.8.3 Replacing the fuel filter

WARNING
- **Keep fire and flammable items away from the working area.**

CAUTION
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Replacing
1. Turn the water separator lever to **[OFF]**.
2. Remove the fuel filter with the filter wrench.



(1) Water separator lever (2) Fuel filter

3. Apply the fuel to the O-ring and install the new fuel filter by hand tightening.

IMPORTANT
- **Do not tighten the filter strongly with the filter wrench.**

4. Turn the water separator lever to the **[ON]**.
5. Turn the starter switch to **[RUN]** to bleed the air from the fuel line.

6. Check the leakage from the fuel filter and tighten the filter slightly with the filter wrench if it is leaking.

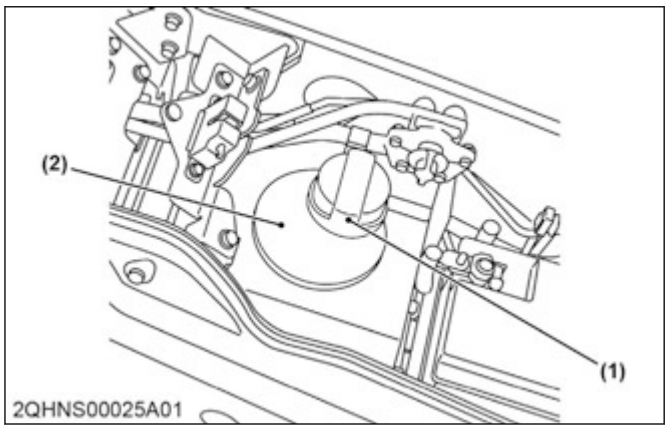
5.8.4 Replacing the return filter

⚠ CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**

■ IMPORTANT
- **Do not reuse removed O-rings for assembling to avoid oil leakage.**

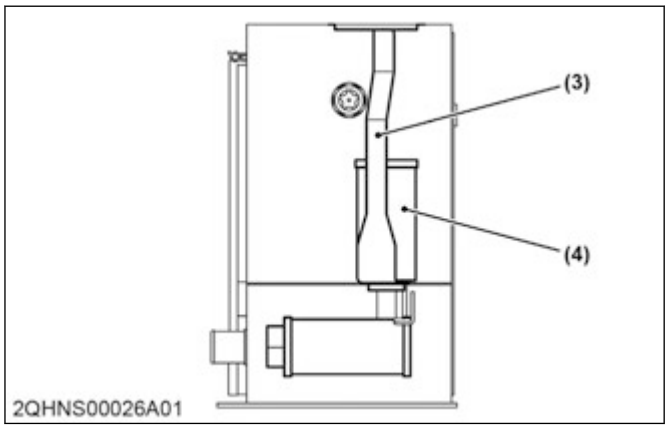
Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Replacing
1. Remove the breather filter and cover.



(1) Breather filter (2) Cover

2. Remove the return filter with the filter support from the hydraulic oil tank.



(3) Filter support (4) Return filter

3. Remove the filter support from the return filter.
4. Install the filter support to the new return filter.
5. Apply the hydraulic oil to the O-ring and install the return filter with the filter support to hydraulic oil tank.
6. Check the hydraulic oil level and replenish if necessary.

Recommended lubricants

Hydraulic oil	In winter or at low ambient temperature	ISO 32, ISO 46
	In summer or at high ambient temperature	ISO 46, ISO 68

7. Apply the hydraulic oil to the O-ring and install the cover.

Tightening torque

(2) Cover	26.0 to 31.0 N·m 2.7 to 3.2 kgf·m 19.2 to 22.9 lbf·ft

8. Apply the hydraulic oil to the O-ring and install the breather filter by hand tightening.

5.9 Every 1000 hours

5.9.1 Replacing the in-line filter

⚠ CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.
2. Release the residual pressure.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

1. Remove the lower cover.

(1) Lower cover

2. Disconnect the hydraulic hose with the white tape.

NOTE
- **Put waste cloths under the pilot control valve.**

3. Replace the in-line filter.

(2) In-line filter

4. Connect the hydraulic hose with the white tape to the in-line filter.
5. Install the lower cover.

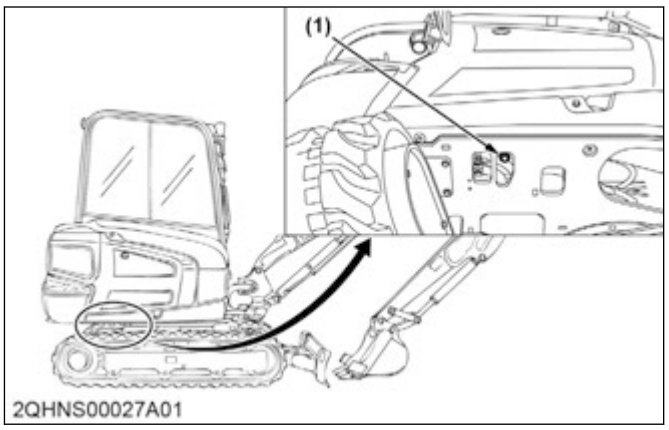
5.9.2 Replacing the hydraulic oil and suction filter

CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**

IMPORTANT
- **Do not reuse removed O-rings to assemble to avoid oil leakage.**

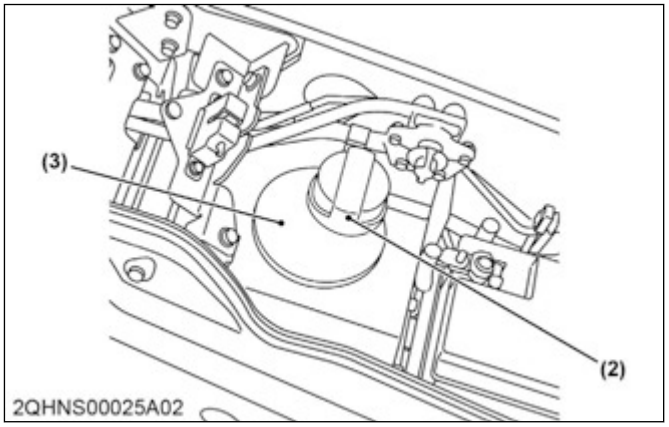
NOTE
- **Replace the return filter at the same time.**

1. Operate the swivel to put a tray under the drain plug on firm and level ground.



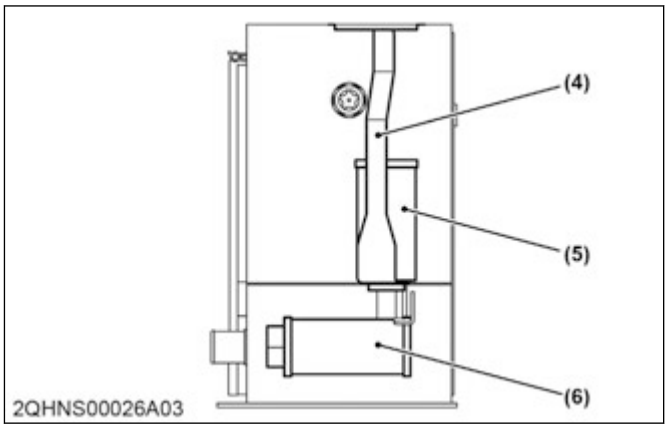
(1) Drain plug

2. Operate the machine to the hydraulic oil checking position.
3. Put a tray under the drain plug for receiving the hydraulic oil.
4. Remove the drain plug and drain all of the hydraulic oil.
5. Install the drain plug.
6. Remove the breather filter and cover.



(2) Breather filter (3) Cover

7. Remove the filter support with the return filter from the hydraulic tank.



(4) Filter support (6) Suction filter
(5) Return filter

8. Replace the suction filter.

Tightening torque

(6) Suction filter	58.8 to 68.6 N·m 6.0 to 7.0 kgf·m 43.4 to 50.6 lbf·ft

9. Install the filter support with the new return filter.
10. Replenish the hydraulic oil.

■ IMPORTANT
- **Clean around the oil filler port on the hydraulic tank before replenishing the hydraulic oil.**
- **Do not use or mix different oil.**

Recommended lubricants

Hydraulic oil	34 L 9.0 U.S.gals	In winter or at low ambient temperature ISO 32, ISO 46
		In summer or at high ambient temperature ISO 46, ISO 68

11. Apply the hydraulic oil to the O-ring and install the cover.

Tightening torque

(3) Cover	26.0 to 31.0 N·m 2.7 to 3.2 kgf·m 19.2 to 22.9 lbf·ft

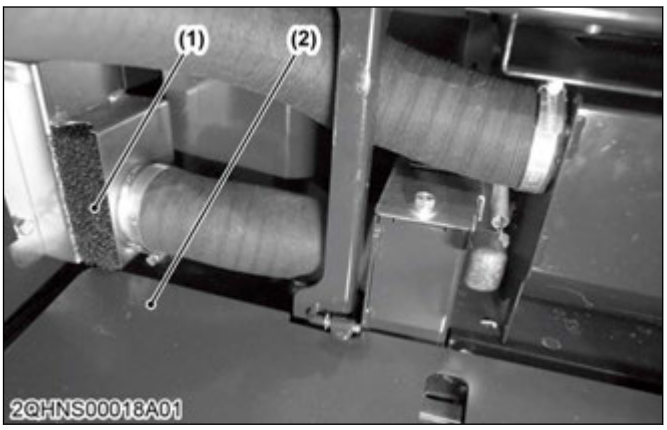
12. Apply the hydraulic oil to the O-ring and install the breather filter by hand tightening.
13. Start the engine and operate all of the hydraulic devices several times to bleed air in the hydraulic circuit.
14. Operate the machine to the hydraulic oil level check position.
15. Check the hydraulic oil level with the sight glass and replenish if necessary.

■ NOTE
- **Make sure that the oil level is in the center to third quarter of the sight glass.**

5.9.3 Replacing the air filter

■ IMPORTANT
- **In case of using the machine in extremely dusty conditions, check and clean or replace the air filter more frequently.**

1. Unlock and open the cover.



(1) Air filter (2) Cover

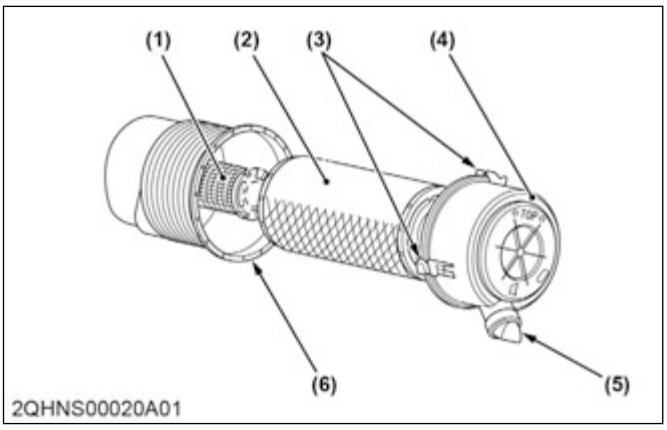
2. Remove the air filter from the support.
3. Install the new air filter.

5.9.4 Replacing the air cleaner elements

■ IMPORTANT
- **In case of using the machine in extremely dusty conditions, check and clean or replace the air filter element more frequently.**
- **Do not start the engine without installing the filter elements.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Replacing
1. Open the clips and remove the cover.



(1) Inner element (5) Dust valve
(2) Outer element (6) Air cleaner case
(3) Clip
(4) Cover

2. Remove the outer element from the air cleaner case.
3. Clean the air cleaner case and cover without removing the inner element.
4. Clean the dust valve.
5. Replace the inner element.
6. Install the new outer element.

7. Install the cover.

IMPORTANT
- **Install the cover so that the top mark faces upwards.**

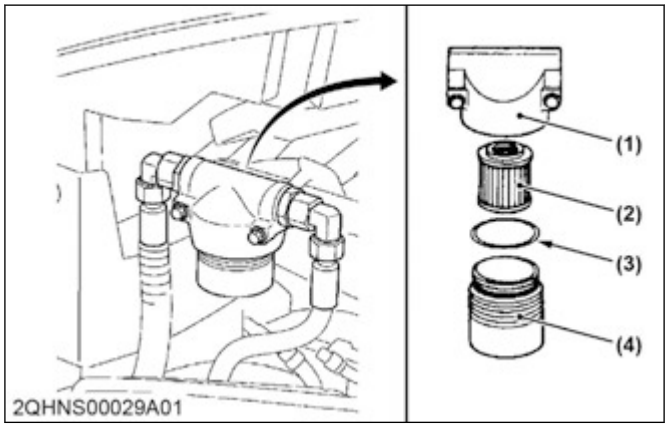
5.9.5 Replacing the pilot filter

CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Release the residual pressure of the hydraulic circuit.**

IMPORTANT
- **Do not reuse removed O-rings for assembling to avoid oil leakage.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.
2. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

Replacing
1. Remove the pilot filter case from the head cover.



(1) Head cover
(2) Element
(3) O-ring
(4) Case

NOTE
- **Put waste cloths under the pilot filter.**

2. Replace the element, apply the hydraulic oil to the O-ring, and install the case by hand tightening.
3. Start the engine in idling speed and leave it for a while.
4. Check the hydraulic oil level and replenish if necessary.

Recommended lubricants

Hydraulic oil	In winter or at low ambient temperature	ISO 32, ISO 46
	In summer or at high ambient temperature	ISO 46, ISO 68

5.10 Every 1500 hours

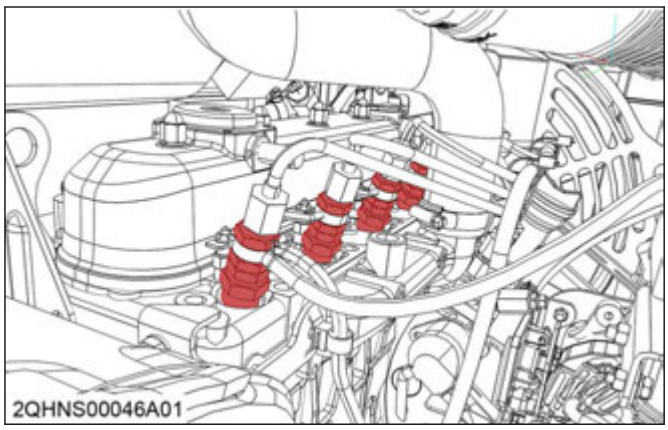
5.10.1 Checking the injection nozzles

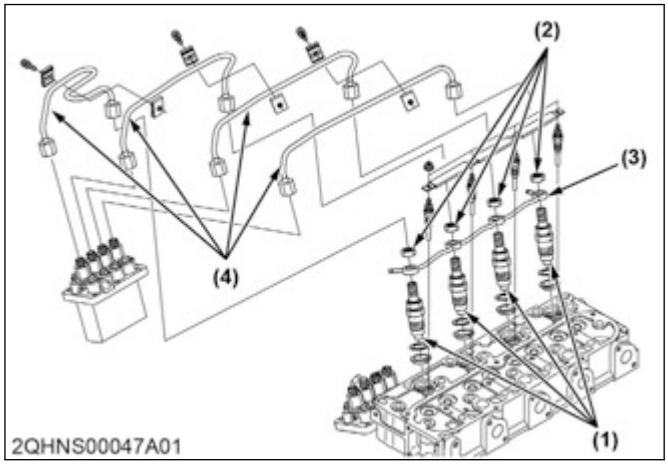
WARNING
- **Keep fire and flammable items away from the working area.**

CAUTION
- **Make sure that there are no person in the injecting direction.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

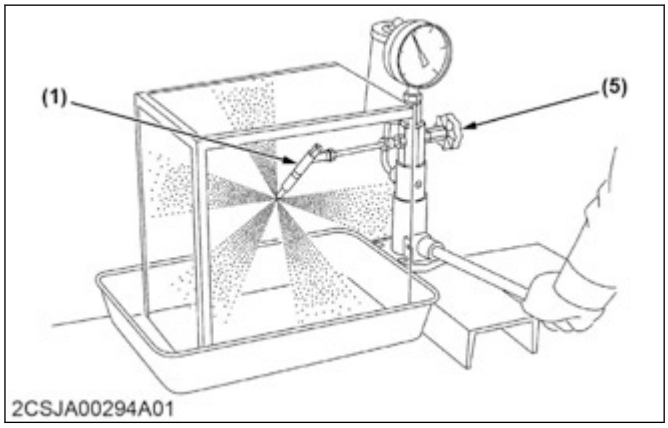
Checking
1. Remove the injection pipes, 4 nuts, and over flow pipe.
2. Remove the injection nozzles from the engine.





(1) Injection nozzle ×4
(2) Nut ×4
(3) Over flow pipe
(4) Injection pipe nut

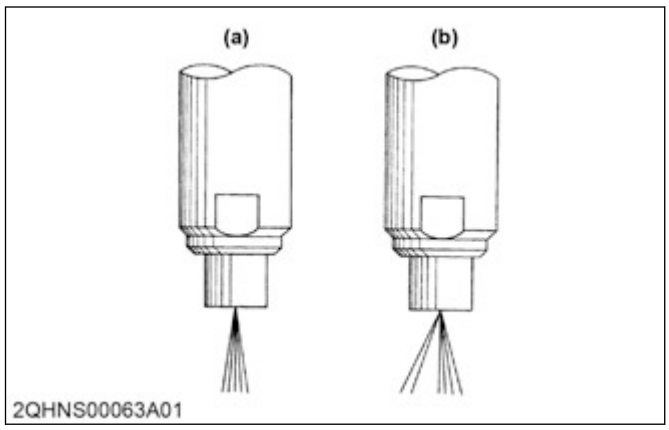
3. Set the injection nozzle to the nozzle tester.
4. Operate the lever of the nozzle tester slowly until injecting from the tip of the injection nozzle.
5. Measure the pressure when injecting.



(1) Injection nozzle
(5) Nozzle tester

Fuel injection pressure	13.7 MPa 139.7 kgf/cm^2 1987 psi

6. Check the condition of injection.



(a) Normal
(b) Need to replace

7. Replace the injection nozzle if necessary.

Tightening torque

(1) Injection nozzle	49 to 68 N·m 5.0 to 7.0 kgf·m 37 to 50 lbf·ft	-
(4) Injection pipe nut	25 to 34 N·m 2.5 to 3.5 kgf·m 18 to 25 lbf·ft	-

5.11 Every 2000 hours

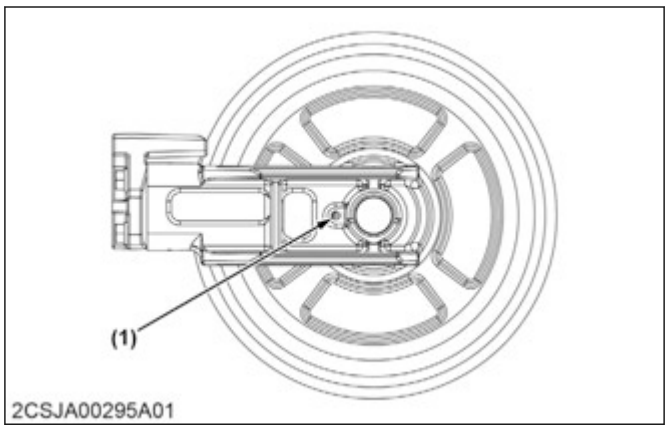
5.11.1 Replacing the engine oil in the front idler and track roller

⚠ CAUTION
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

■ IMPORTANT
- **Be sure to install the tracks in the correct direction.**

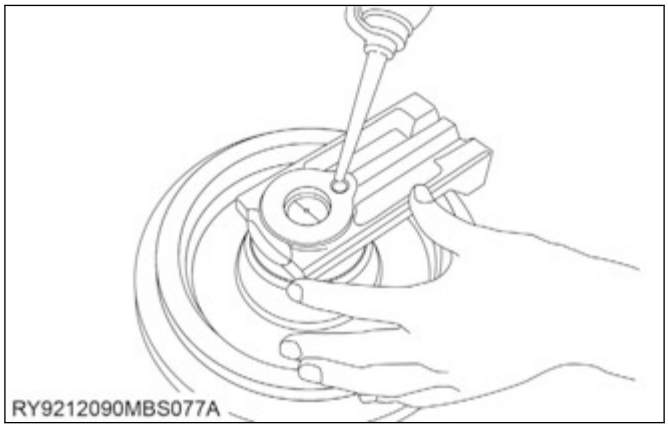
Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.
2. Remove the two tracks.
3. Remove the two front idlers.
4. Remove all of the track rollers.

Changing the engine oil in the front idler
1. Remove the plug.



(1) Plug

2. Drain the engine oil from the front idler.
3. Fill up the new engine oil to specified volume.



Recommended lubricant

Front idler	Approximately 75 cc Approximately 4.57 cu.in.	CF, CF-4, CI-4, CJ-4 SAE #30CD

4. Tighten the plug and install the two front idler assemblies to the machine.

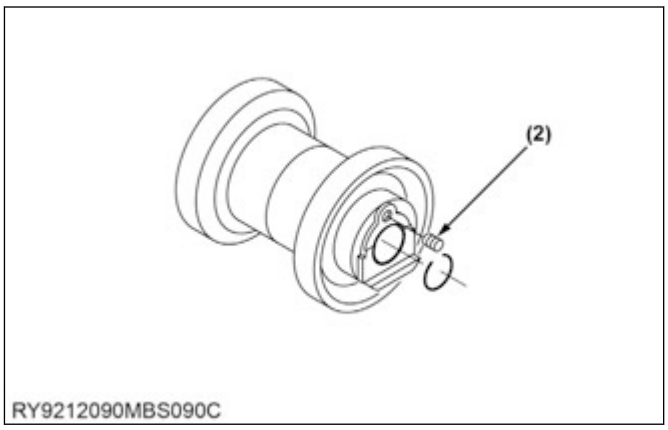
Tightening torque

(1) Plug (R1/8)	10 N·m 1.0 kgf·m 7.4 lbf·ft	Thread lock (Loctite 262)

5. Install the tracks and adjust the track tension.

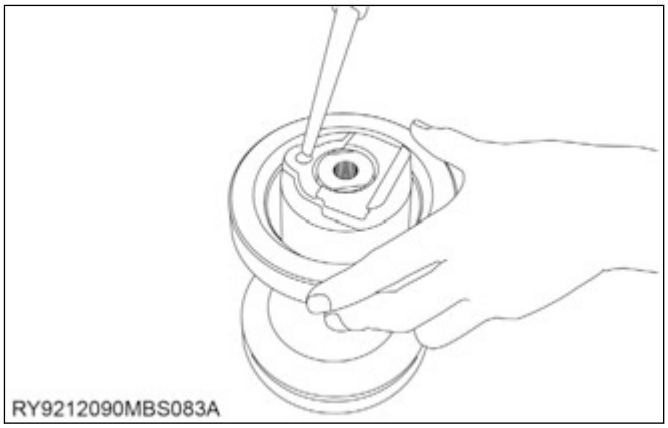
Changing the engine oil in the track roller

1. Remove the plug.



(2) Plug

2. Drain the engine oil from the track roller.
3. Fill up the new engine oil to specified volume.



Recommended lubricant

Track roller	Approximately 80 cc Approximately 4.9 cu.in.	CF, CF-4, CI-4, CJ-4 SAE #30CD

4. Tighten the plug and install the track rollers to the machine.

Tightening torque

(2) Plug	10 N·m 1.0 kgf·m 7.4 lbf·ft	Thread lock (Loctite 503)

5. Install the tracks and adjust the track tension.

5.11.2 Checking the alternator

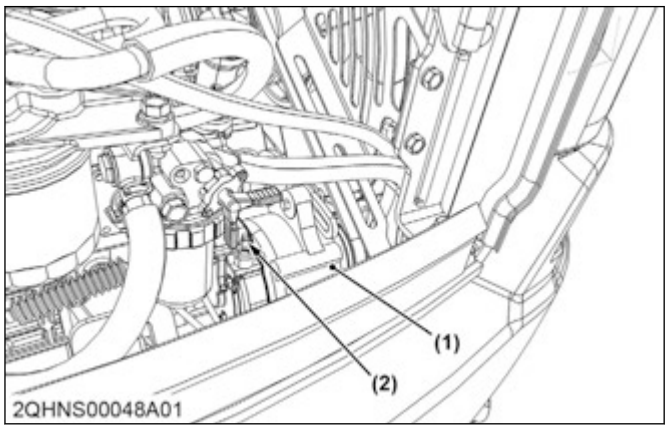
WARNING
- **Keep hands, body, tools and waste cloth away from the rotating fan and belt.**
- **Do not clamp the electrical wiring to fuel hoses.**

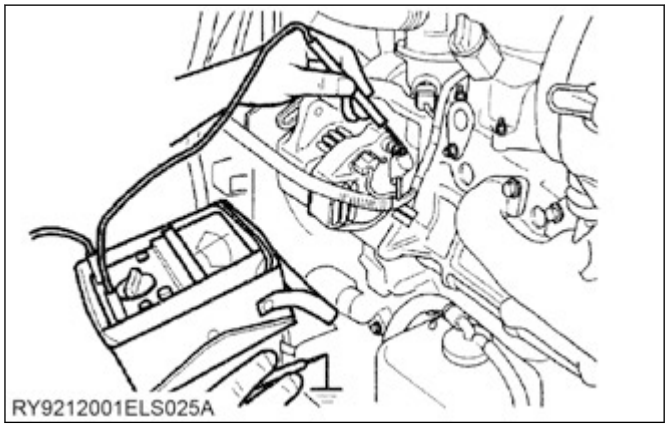
CAUTION
- **Do not alter the electrical device and wiring.**

1. Check the connections of the battery terminals.
2. Check the connections of the alternator terminal and connector.
3. Check the conduction of the slow blow fuse.
4. Check the tension of the fan belt.
5. Start the engine.
6. Check the abnormal noise heard from the alternator.

■ NOTE
- **If abnormal noise is heard from the alternator, there are possibilities of bearing deterioration, loosened or damaged fan belt, and wear of the pulley.**

7. Measure the voltage of the alternator between the terminal B and body ground.





(1) Alternator (2) Terminal B

Normal	Engine stop	Engine running
	12 V	Approximately 14 V

■ NOTE
- **If the voltage of alternator is not normal, check each component part following the engine WSM.**

5.11.3 Checking the starter motor

⚠ WARNING
- **Do not clamp the electrical wiring to fuel hoses.**

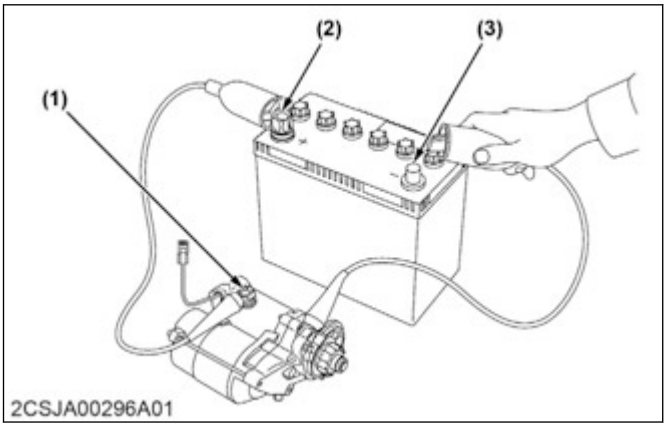
⚠ CAUTION
- **Do not alter the electrical device and wiring.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.
2. Remove the battery.
3. Disconnect all of the wire harnesses from the starter motor.
4. Remove the starter motor from the engine.

Checking the motor
1. Connect terminal C to the battery positive (+) terminal and connect the starter motor body to the battery negative (-) terminal.

■ IMPORTANT
- **Fix the starter motor when testing.**

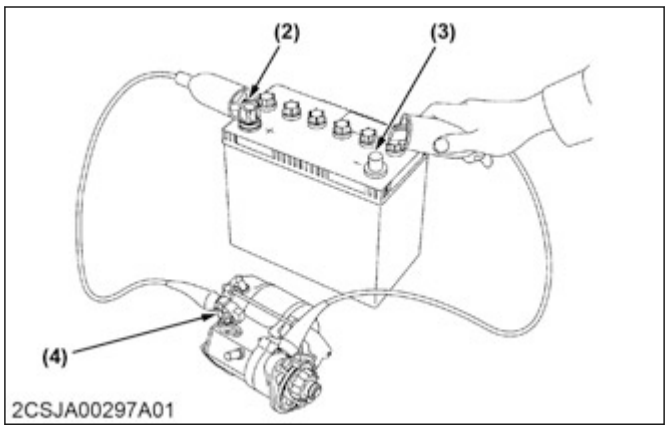
■ NOTE
- **If the starter motor does not operate, starter motor is damaged. Repair or replace the starter motor following the engine WSM.**



(1) Terminal C (3) Negative (-) terminal
(2) Positive (+) terminal

Checking the magnetic switch
1. Connect terminal S to the battery positive (+) terminal and connect the starter motor body to the battery negative (-) terminal.

■ NOTE
- **If the pinion gear does not come out, the magnetic switch is damaged. Repair or replace the starter motor following the engine WSM.**



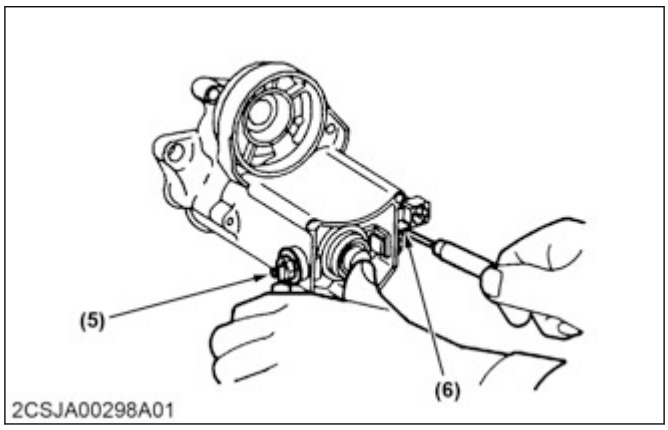
(2) Positive (+) terminal
(3) Negative (-) terminal
(4) Terminal S

Checking the conduction of the magnetic clutch

1. Push in the plunger and check the conduction between the terminal C and terminal B with a circuit tester.

■ NOTE

- **If there is no conduction, the magnetic clutch is damaged. Replace the starter motor following the engine WSM.**



(5) Terminal C
(6) Terminal B

5.12 Every 3000 hours

5.12.1 Checking the fuel injection pump

⚠ WARNING

- **Keep fire and flammable items away from the working area.**

⚠ CAUTION

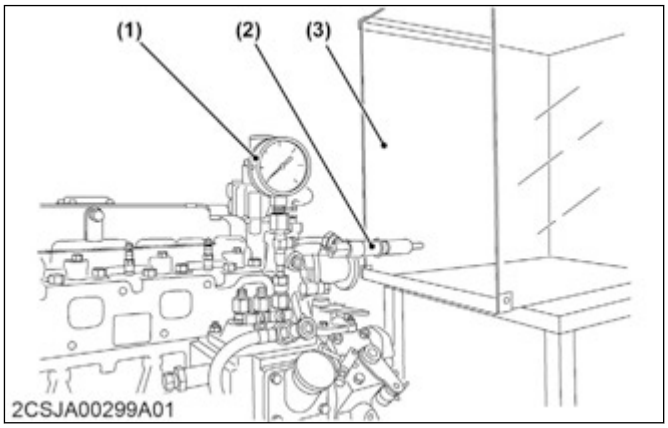
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**
  - **Pressure in the fuel line is high.**

Preparing

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Checking

1. Remove the engine stop solenoid.
2. Remove the injection pipes and injection nozzles.
3. Install the pressure tester to the fuel injection pump.



(1) Fuel injection pump pressure tester
(2) Injection nozzle
(3) Protection cover

4. Install the injection nozzle to fuel injection pump pressure tester joint.
5. Set the speed control lever to the maximum speed position.
6. Crank the engine with the stater and measure the pressure.

Fuel injection pressure	13.7 MPa 139.7 kgf/cm^2 1987 psi

7. If the pressure is lower than 13.7 MPa, replace the fuel injection pump following the engine WSM.

■ IMPORTANT

- **Do not disassemble the fuel injection pump assembly.**

5.13 Every 1 year

5.13.1 Safety inspection

- All safety inspections are based on the national worker's protection regulations, safety regulations and technical specifications applicable to the country in which the machine is operated.
  The owner should arrange for the safety inspections to be performed at specified intervals according to national rules and regulations.
- Based on their technical training and experience, the qualified personnel should have sufficient knowledge in the domain of the machine described here and be familiar with the applicable national work safety regulations, accident prevention regulations and the generally accepted technical

rules so that they can assess the sound operating condition of the machine.
- The qualified person must keep his appraisal and evaluation neutral and must not be influenced by personal, economic or operational interests. The inspection is a visual and functional check of all components for condition and completeness and of the effectiveness of the safety devices.
  The performance of the inspection must be documented in the form of an inspection report containing at least the following information:
  – Date and scope of the inspection indicating all pending checks.
  – Result of the inspection with a report of the determined faults.
  – Assessment with respect to commencing or continuing operation.
  – Information on necessary follow-up inspections.
  – Name, address, and signature of the inspector.
- The owner/employer (company) is responsible for the observance of the inspection intervals. The acknowledgement and the elimination of the determined faults must be confirmed by the owner/employer in writing, along with the date, in the inspection report.
- The inspection report must be kept on file at least until the next inspection.

5.14 Every 2 years

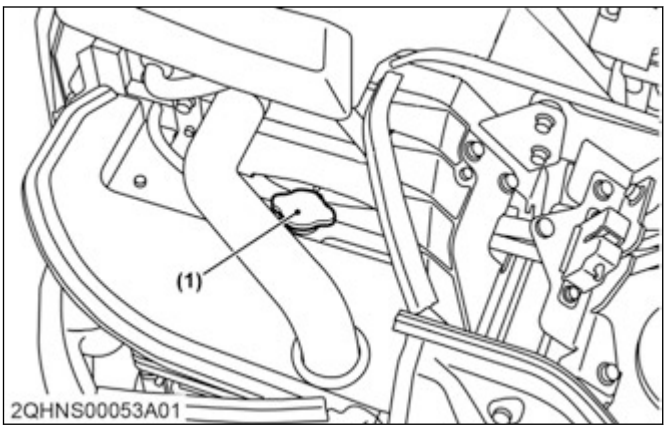
5.14.1 Replacing the radiator hoses and hose clamps

⚠ WARNING
- **Do not open the radiator cap soon after the engine has stopped. There is a possibility of serious burn injury due to the coolant blow out from the radiator.**

⚠ CAUTION
- **Do not work soon after the engine has stopped.**
  – Engine, fuel, and oil are extremely hot.

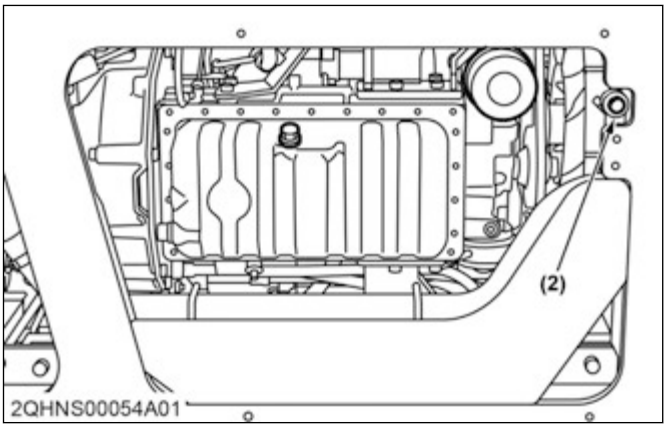
Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Replacing
1. Remove the radiator cap.



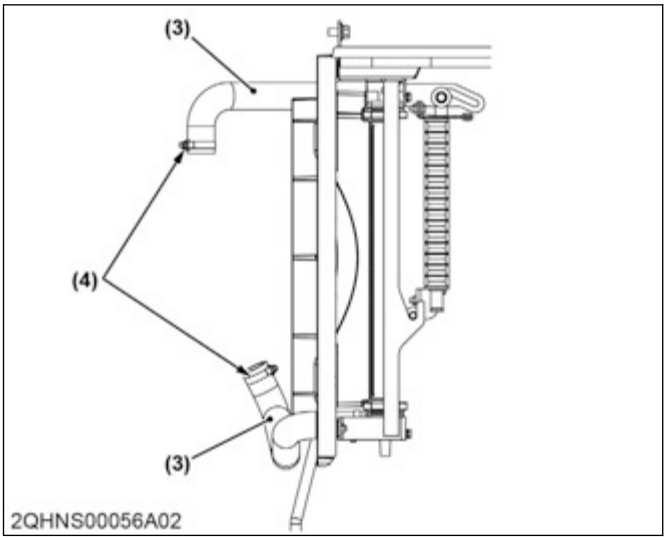
(1) Radiator cap

2. Put a tray for receiving the coolant.
3. Remove the drain plug and drain all of the coolant.



(2) Drain plug

4. Install the drain plug.
5. Replace the radiator hoses and hose clamps.



(3) Radiator hose (4) Hose clamp

6. Replenish the new coolant.

Coolant quantity

Coolant	Canopy	2.4 L 0.63 U.S.gals	50% anti-freeze
	Cabin	2.6 L 0.69 U.S.gals	
	Reserve tank	0.6 L 0.16 U.S.gals	

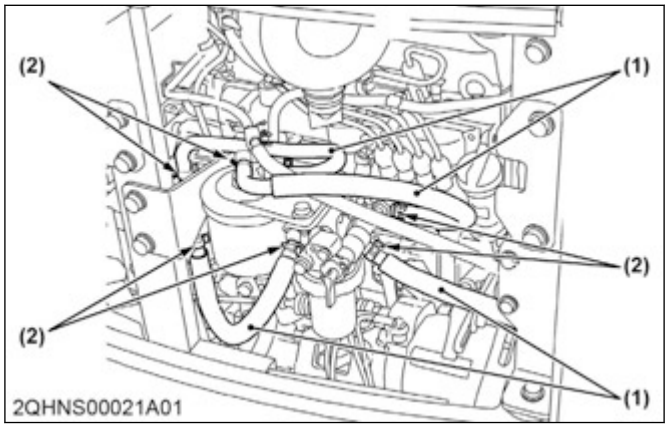
7. Start the engine in idle speed and leave it for 5 minutes.
8. Replenish the coolant if necessary.
9. Check leakage of the coolant.

5.14.2 Replacing the fuel line and intake air line

WARNING
- **Keep fire and flammable items away from the working area.**
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, muffler, and oil are extremely hot.**
  - **Pressure in the fuel line is high.**

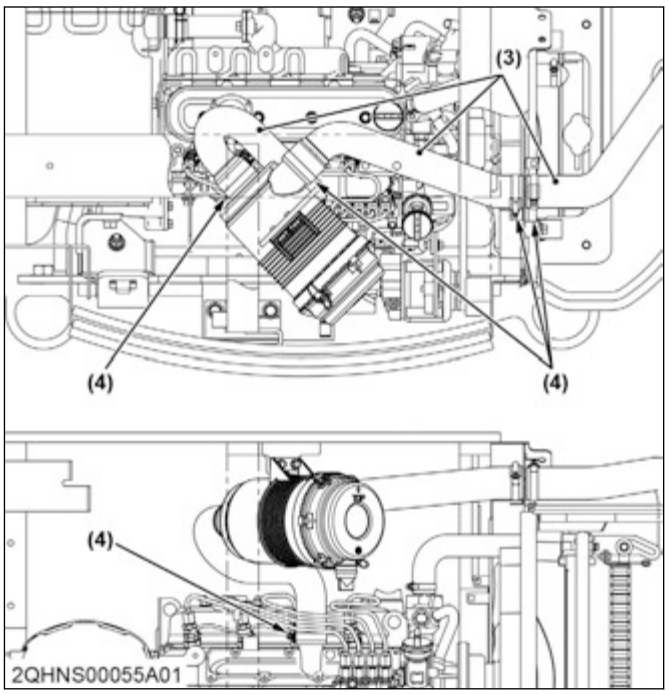
Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

Replacing
1. Replace all of the fuel hoses and clamps.



(1) Fuel hose (2) Hose clamp

2. Replace all of the intake air hoses and clamps.



(3) Intake air hose (4) Hose clamp

5.14.3 Replacing the coolant

WARNING
- **Do not open the radiator cap soon after the engine has stopped. There is a possibility of serious burn injury due to the coolant blow out from the radiator.**

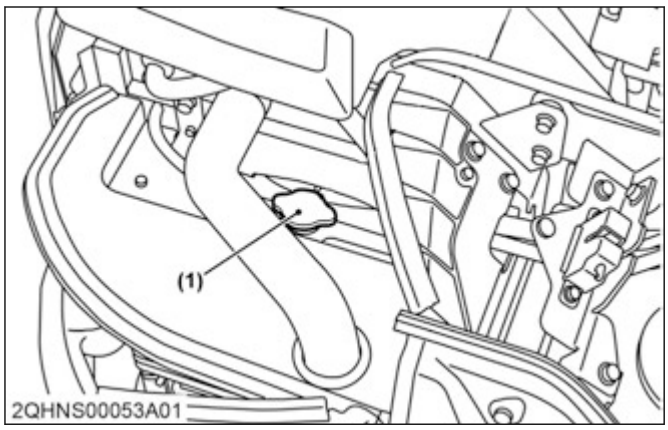
CAUTION
- **Do not work soon after the engine has stopped.**
  - **Engine, fuel, and oil are extremely hot.**

NOTE
- **Replace the radiator hoses and hose clamps at the same time.**

Preparing
1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.

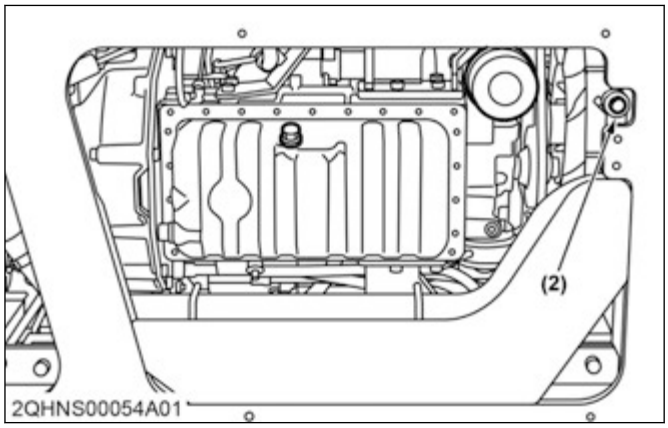
Replacing
1. Check the fins of radiator and oil cooler. If the fins are clogged with dirt, remove the dirt using compressed air.

   IMPORTANT
   - **Pressure of compressed air must be under 205 kPa (2.1 kgf/cm^2, 30 psi).**
2. Remove the radiator cap.



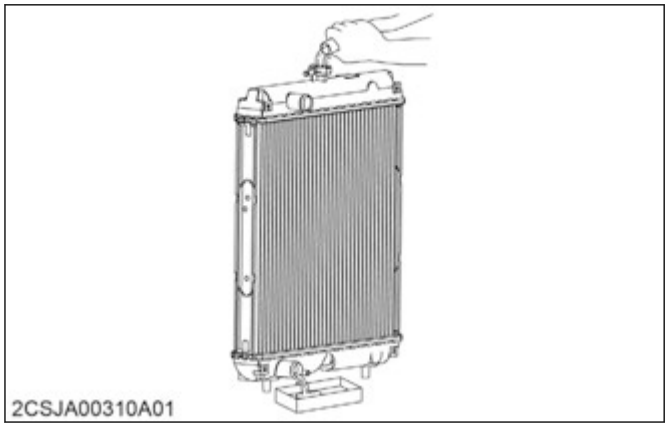
(1) Radiator cap

3. Put a tray for receiving the coolant.
4. Remove the drain plug and drain all of the coolant.



(2) Drain plug

5. Clean inside of the radiator with water.



■ IMPORTANT
- **Do not apply excessive pressure to the radiator to avoid the radiator from bursting. The coolant pressure inside the radiator must be below 0.9 kgf/cm^2.**

6. Close the drain valve and fill up the radiator with water for flushing.
7. Install the radiator cap
8. Start the engine in idle speed for flushing with water in the coolant circuit.

■ NOTE
- **Warm up the water until the thermostat is opened.**
- **In case of heater specification, activate the heater.**

9. Drain the water and refill new water again for flushing repeatedly.
10. Repeat several times until the drained water is clean.
11. Close the drain plug and fill up the radiator with new coolant.

■ IMPORTANT
- **Do not fill the coolant into the reserve tank exceeding [FULL] level.**
- **Do not mix the coolant with dirty or salt water.**
- **Do not operate the machine without coolant.**

Coolant quantity

Coolant	Canopy	2.4 L 0.63 U.S.gals	50% anti-freeze
	Cabin	2.6 L 0.69 U.S.gals	
	Reserve tank	0.6 L 0.16 U.S.gals	

12. Start the engine in idle speed and leave it for 5 minutes.

■ NOTE
- **In case of heater specification, activate the heater.**

13. Check the coolant level and replenish the coolant if necessary.

5.15 Every 6 years

5.15.1 Replacing the hydraulic hoses

⚠ CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

■ IMPORTANT
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing

1. Park the machine on firm and level ground, lower bucket and blade to the ground, and stop the engine.
2. Release the residual pressure.

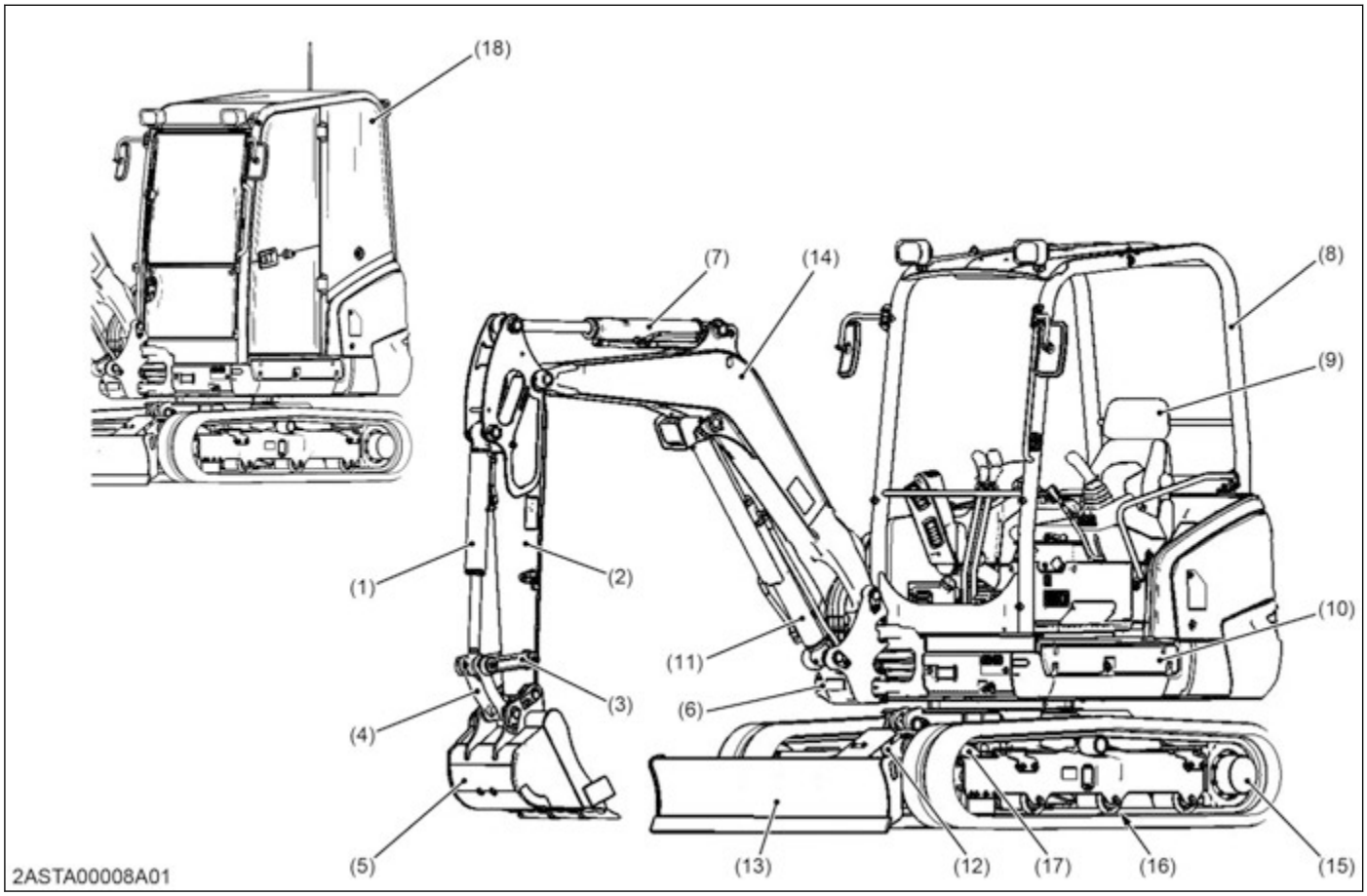
Replacing

1. Drain the hydraulic oil.
2. Replace all of the hydraulic hoses.

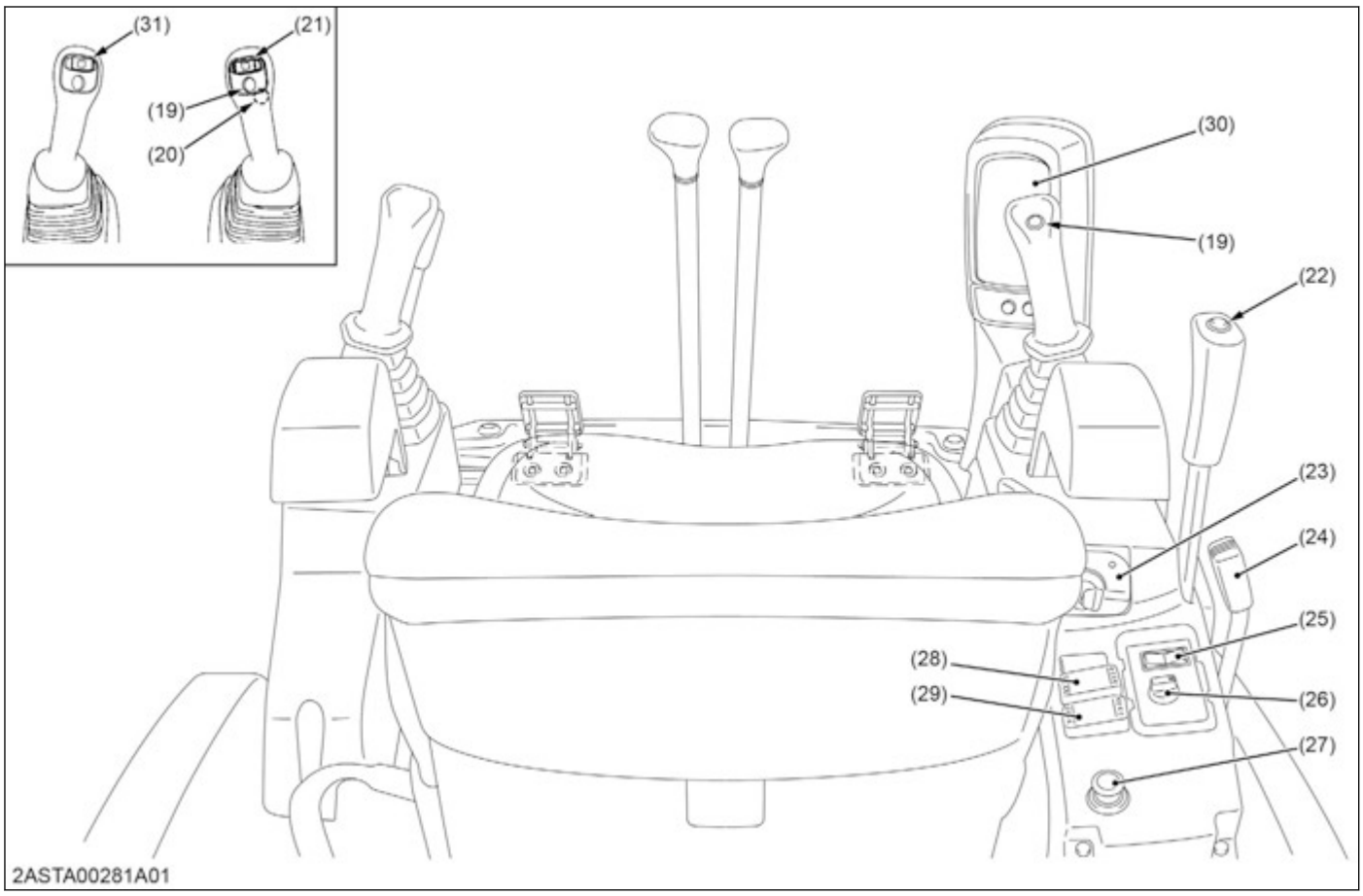
3. MACHINE BODY

MECHANISM

1. Machine devices layout



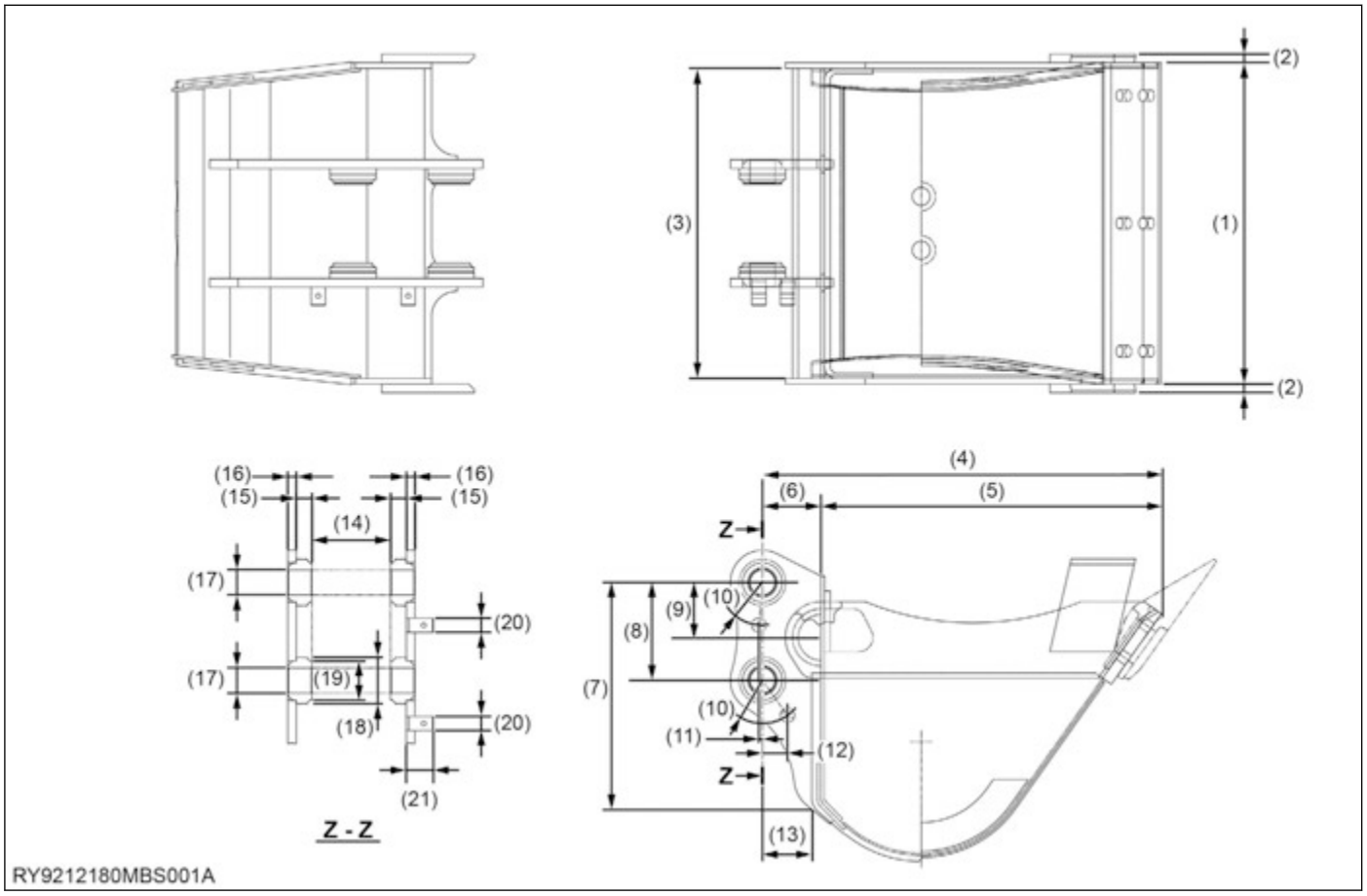
(1) Bucket cylinder
(2) Arm
(3) Bucket link 2 and 3
(4) Bucket link 1
(5) Bucket
(6) Swing bracket
(7) Arm cylinder
(8) Canopy
(9) Seat
(10) Swing frame
(11) Boom cylinder
(12) Blade cylinder
(13) Blade
(14) Boom
(15) Travel motor
(16) Track roller
(17) Front idler
(18) Cabin



(19) Horn switch
(20) One way hold switch (Hi-spec only)
(21) AUX1 knob switch (Hi-spec only)
(22) Travel speed switch
(23) Starter switch
(24) Accelerator lever
(25) Wiper / Washer switch (Cabin only)
(26) Heater switch (Cabin only)
(27) Engine stop switch
(28) Working light switch
(29) Beacon switch
(30) Meter panel
(31) AUX2 knob switch (Hi-spec only)

2. Bucket

2.1 Bucket dimensions



■ NOTE

- **The bucket is attached to define all specifications and service specifications.**

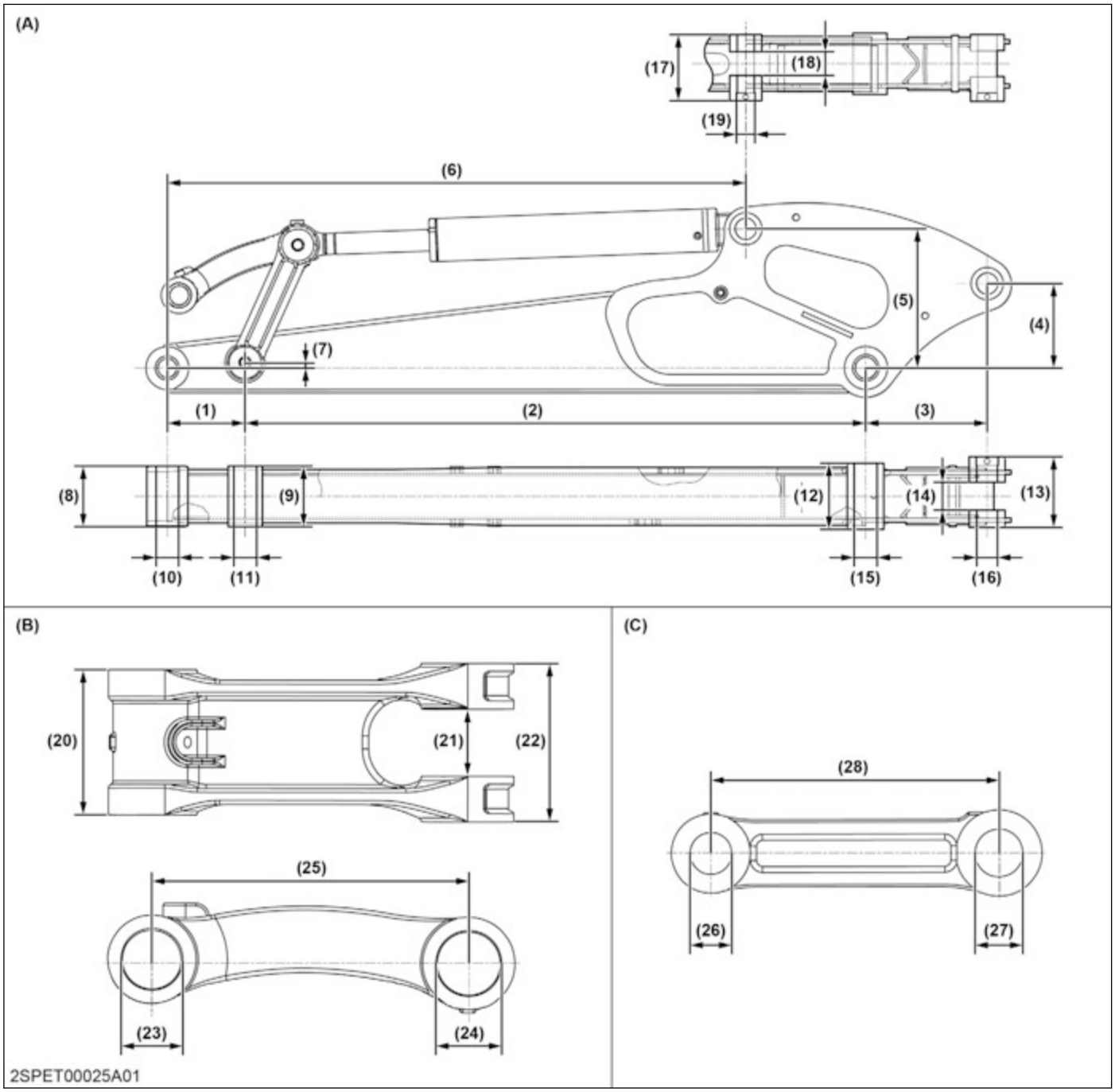
Items	Dimensions	Items	Dimensions
(1)	480 mm 18.9 in.	(12)	28 mm 1.1 in.
(2)	12 mm 0.5 in.	(13)	115 mm 4.5 in.
(3)	480 mm 18.9 in.	(14)	134 mm 5.3 in.
(4)	594 mm 23.4 in.	(15)	25 mm 1.0 in.
(5)	509 mm 20.0 in.	(16)	12 mm 0.5 in.
(6)	85 mm 3.3 in.	(17)	ϕ37 mm ϕ1.5 in.
(7)	322 mm 12.7 in.	(18)	ϕ80 mm ϕ3.1 in.
(8)	135 mm 5.3 in.	(19)	ϕ64 mm ϕ2.5 in.

(Continued)

Items	Dimensions	Items	Dimensions
(9)	78.5 mm 3.1 in.	(20)	ϕ20 mm ϕ0.8 in.
(10)	60 mm 2.4 in.	(21)	34 mm 1.3 in.
(11)	14.5 mm 0.6 in.	-	-

3. Arm

3.1 Arm dimensions



(A) Arm (B) Bucket link 1 (C) Bucket link 2, 3

NOTE

- **(10), (11), (15), (23), and (24) show inner dimensions with installed bushings.**

Standard arm (1300 mm)

Items	Dimensions	Items	Dimensions
(1)	144 to 146 mm 5.67 to 5.75 in.	(15)	ϕ40 mm ϕ1.57 in.
(2)	1155 mm 45.5 in.	(16)	ϕ40 mm ϕ1.57 in.
(3)	285 to 287 mm 11.22 to 11.30 in.	(17)	163 mm 6.41 in.
(4)	176 to 178 mm 6.93 to 7.01 in.	(18)	51 mm 2.00 in.
(5)	258 to 260 mm 10.16 to 10.24 in.	(19)	ϕ40 mm ϕ1.57 in.
(6)	1075 to 1079 mm 42.32 to 42.48 in.	(20)	134 mm 5.28 in.
(7)	8.5 to 11.5 mm 0.33 to 0.45 in.	(21)	51 mm 2.01 in.
(8)	134 mm 5.28 in.	(22)	144 mm 5.67 in.
(9)	144 mm 5.67 in.	(23)	ϕ35 mm ϕ1.38 in.
(10)	ϕ35 mm ϕ1.38 in.	(24)	ϕ40 mm ϕ1.57 in.
(11)	ϕ35 mm ϕ1.38 in.	(25)	240 mm 9.45 in.
(12)	150 mm 5.91 in.	(26)	ϕ35 mm ϕ1.38 in.
(13)	163 mm 6.41 in.	(27)	ϕ40 mm ϕ1.57 in.
(14)	51 mm 2.00 in.	(28)	240 mm 9.45 in.

Short arm (1100 mm)

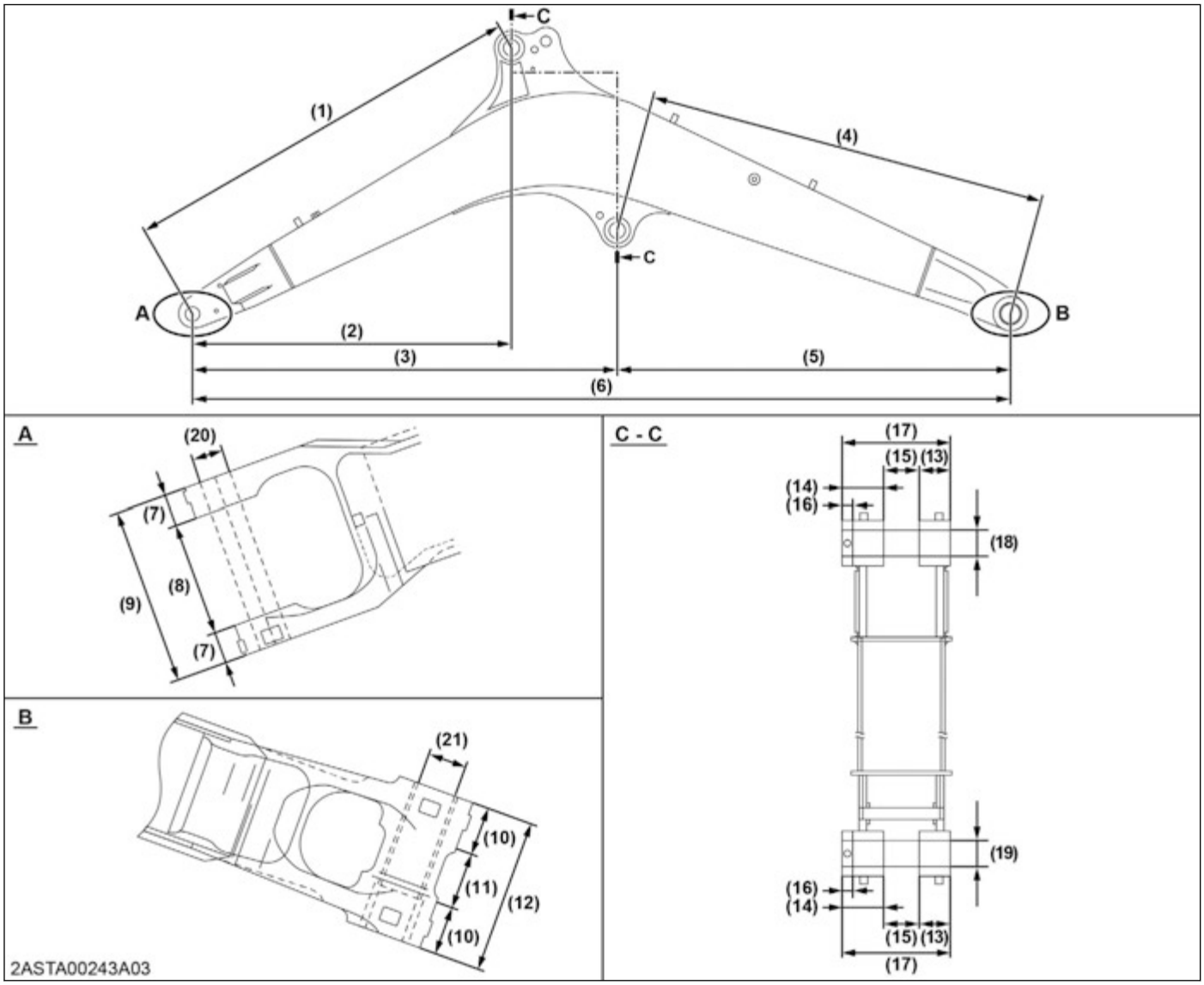
Items	Dimensions	Items	Dimensions
(1)	144 to 146 mm 5.67 to 5.75 in.	(15)	ϕ40 mm ϕ1.57 in.
(2)	955 mm 37.6 in.	(16)	ϕ40 mm ϕ1.57 in.
(3)	285 to 287 mm 11.22 to 11.30 in.	(17)	163 mm 6.41 in.
(4)	176 to 178 mm 6.93 to 7.01 in.	(18)	51 mm 2.00 in.
(5)	258 to 260 mm 10.16 to 10.24 in.	(19)	ϕ40 mm ϕ1.57 in.
(6)	1074.5 to 1078.5 mm 42.30 to 42.46 in.	(20)	134 mm 5.28 in.
(7)	8.5 to 11.5 mm 0.33 to 0.45 in.	(21)	51 mm 2.01 in.
(8)	134 mm 5.28 in.	(22)	144 mm 5.67 in.

(Continued)

Items	Dimensions	Items	Dimensions
(9)	144 mm 5.67 in.	(23)	ϕ35 mm ϕ1.38 in.
(10)	ϕ35 mm ϕ1.38 in.	(24)	ϕ40 mm ϕ1.57 in.
(11)	ϕ35 mm ϕ1.38 in.	(25)	240 mm 9.45 in.
(12)	150 mm 5.91 in.	(26)	ϕ35 mm ϕ1.38 in.
(13)	163 mm 6.41 in.	(27)	ϕ40 mm ϕ1.57 in.
(14)	51 mm 2.00 in.	(28)	240 mm 9.45 in.

4. Boom

4.1 Boom dimensions



A: Arm side edge B: Frame side edge

NOTE

- **(21) Shows inner dimensions with installed bushing.**

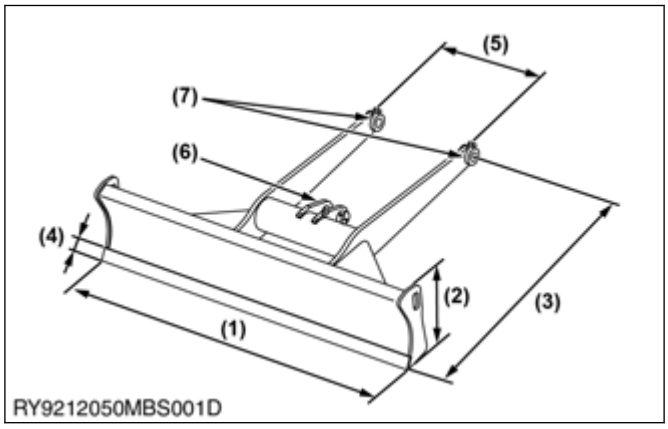
Items	Dimensions	Items	Dimensions
(1)	1185 to 1187 mm 46.65 to 46.73 in.	(12)	194.7 to 195 mm 7.6 to 7.67 in.
(2)	917 to 923 mm 36.10 to 36.34 in.	(13)	54 mm 2.13 in.
(3)	1109 to 1121 mm 43.66 to 44.13 in.	(14)	71 mm 2.80 in.

(Continued)

Items	Dimensions	Items	Dimensions
(4)	1154 to 1156 mm 45.13 to 45.51 in.	(15)	50.5 to 51.5 mm 1.99 to 2.03 in.
(5)	1122 to 1128 mm 44.17 to 44.41 in.	(16)	11 mm 0.43 in.
(6)	2237 to 2243 mm 88.07 to 88.31 in.	(17)	175.5 to 176.5 mm 6.91 to 6.95 in.
(7)	36 mm 1.42 in.	(18)	ϕ40 mm ϕ1.57 in.
(8)	150.6 to 151.1 mm 5.93 to 5.95 in.	(19)	ϕ40 mm ϕ1.57 in.
(9)	222.6 to 223.1 mm 8.76 to 8.78 in.	(20)	ϕ40 mm ϕ1.57 in.
(10)	50 mm 1.97 in.	(21)	ϕ40 mm ϕ1.57 in.
(11)	95 mm 3.74 in.	-	-

5. Blade

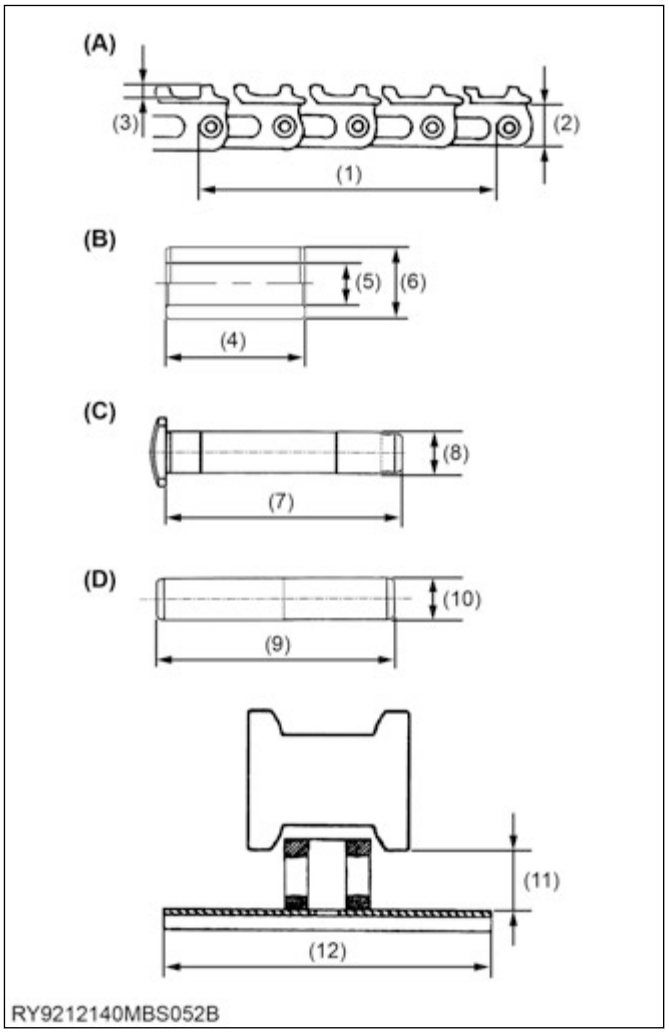
5.1 Blade dimensions



Items	Dimensions
(1)	1500 mm 59.06 in.
(2)	282 mm 13.56 in.
(3)	1100 mm 40.31 in.
(4)	65 mm 2.56 in.
(5)	430 mm 16.93 in.
(6)	ϕ45.1 to 45.3 mm ϕ1.77 to 1.78 in.
(7)	ϕ40.1 to 40.3 mm ϕ1.58 to 1.59 in.

6. Steel track

6.1 Steel track dimensions

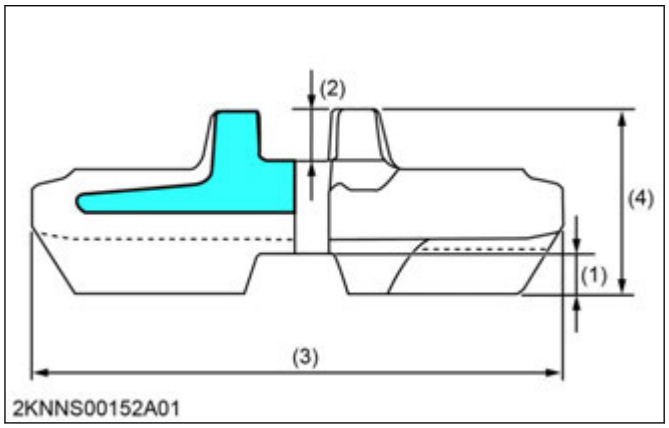


(A) Steel track
(B) Bushing
(C) Master pin
(D) Pin

Items	Dimensions
(1) Link length	406.4 mm 16 in.
(2) Height	90.5 mm 3.56 in.
(3) Grouser height	16.5 mm 0.65 in.
(4) Bushing length	55 mm 2.2 in.
(5) Bushing inner diameter	ϕ17 mm ϕ0.67 in.
(6) Bushing outer diameter	ϕ28 mm ϕ1.1 in.
(7) Master pin length	96.5 mm 3.8 in.
(8) Master pin outer diameter	ϕ16.8 mm ϕ0.66 in.
(9) Pin length	97 mm 3.8 in.
(10) Pin outer diameter	ϕ17 mm ϕ0.67 in.
(11) Track tension dimension	75 to 80 mm 3.0 to 3.1 in.
(12) Width	300 mm 11.8 in.
Number of links	40

7. Rubber track

7.1 Rubber track dimensions



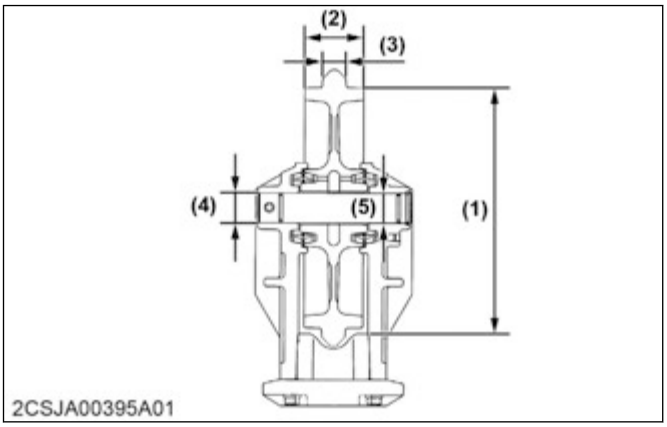
Items	Dimensions
(1) Lug height	19.5 mm 0.77 in.
(2) Link height	24.0 mm 0.94 in.

(Continued)

Items	Dimensions
(3) Width	300 mm 11.81 in.
(4) Height	75.5 mm 2.97 in.

8. Front idler

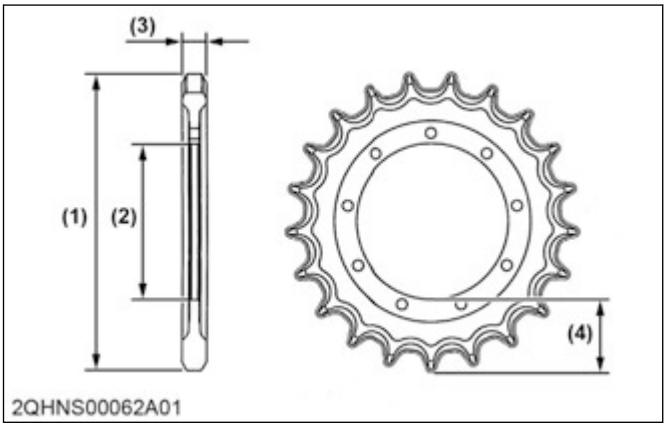
8.1 Front idler dimensions



Items	Dimensions
(1) Idler outer diameter	ϕ292 mm ϕ11.5 in.
(2) Guide width	30 mm 1.18 in.
(3) Idler width	72 mm 2.83 in.
(4) Shaft outer diameter	ϕ30 mm ϕ1.18 in.
(5) Bushing inner diameter	ϕ30 mm ϕ1.18 in.

9. Sprocket

9.1 Sprocket dimensions

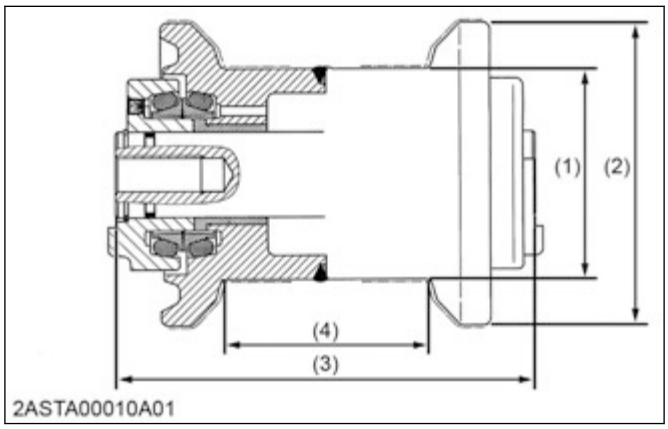


Items	Dimensions
(1) Sprocket outer diameter	ϕ359 to 362 mm ϕ14.13 to 14.25 in.
(2) Sprocket inner diameter	ϕ190 mm 7.48 in.
(3) Sprocket width	29 to 31 mm 1.14 to 1.22 in.
(4) Gear height	85.5 mm 3.37 in.

Items	Dimensions
(1) Outer diameter	ϕ76.3 mm ϕ3.0 in.
(2) Outer diameter	ϕ30 mm ϕ1.2 in.

10. Track roller

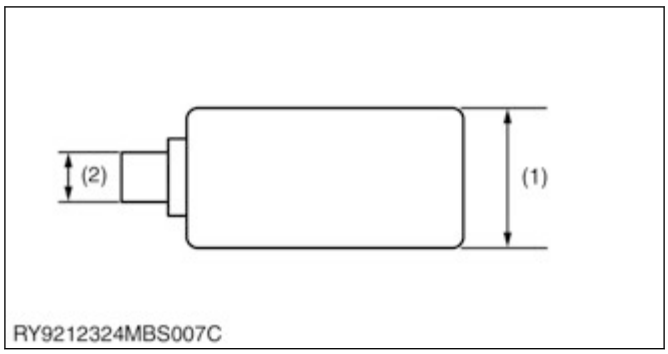
10.1 Track roller dimensions



Items	Dimensions
(1) Guide diameter	ϕ80.0 mm ϕ3.1 in.
(2) Outer diameter	ϕ124.0 mm ϕ4.88 in.
(3) Roller width	175.0 mm 6.89 in.
(4) Guide width	81.0 mm 3.2 in.

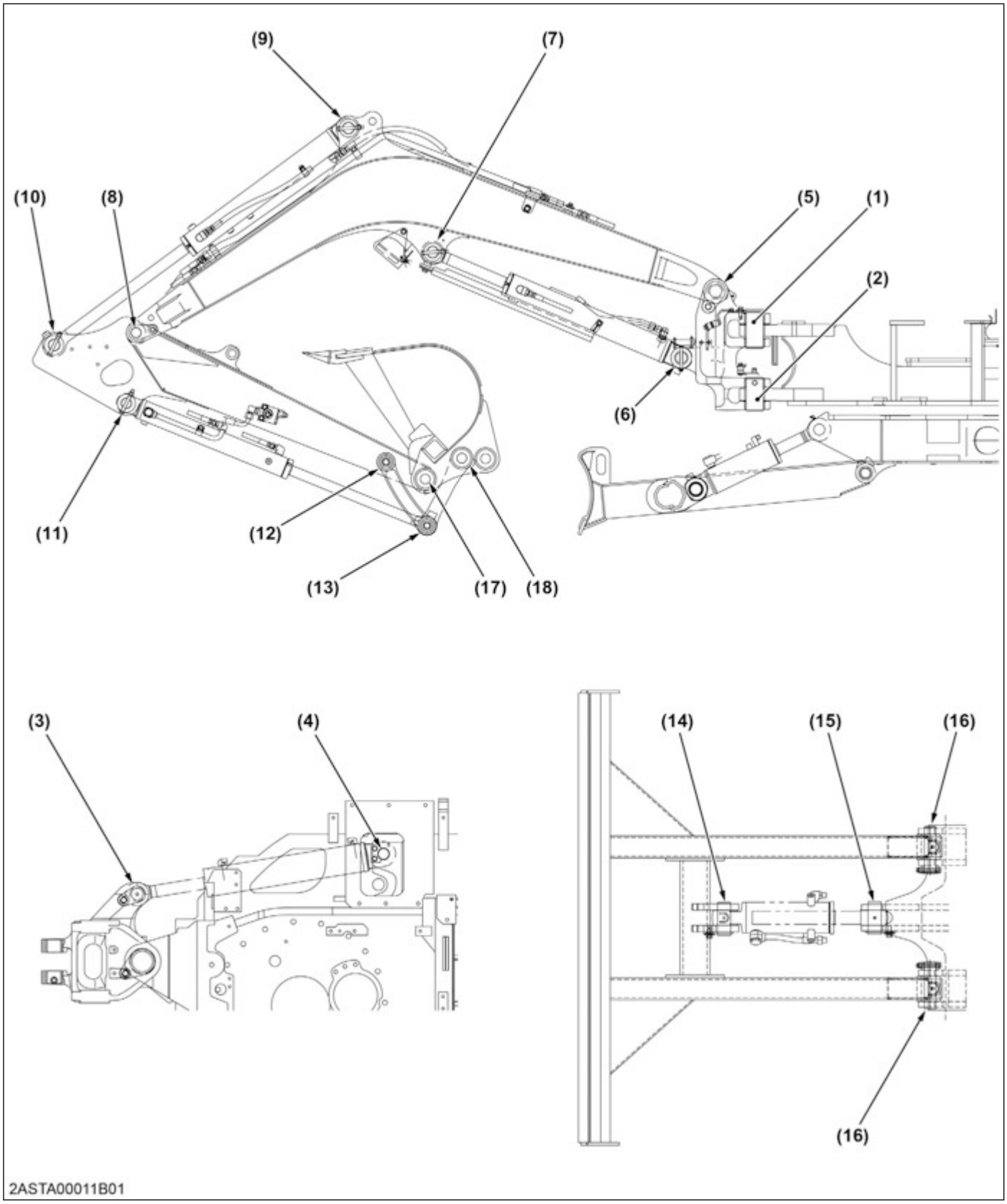
11. Carrier roller

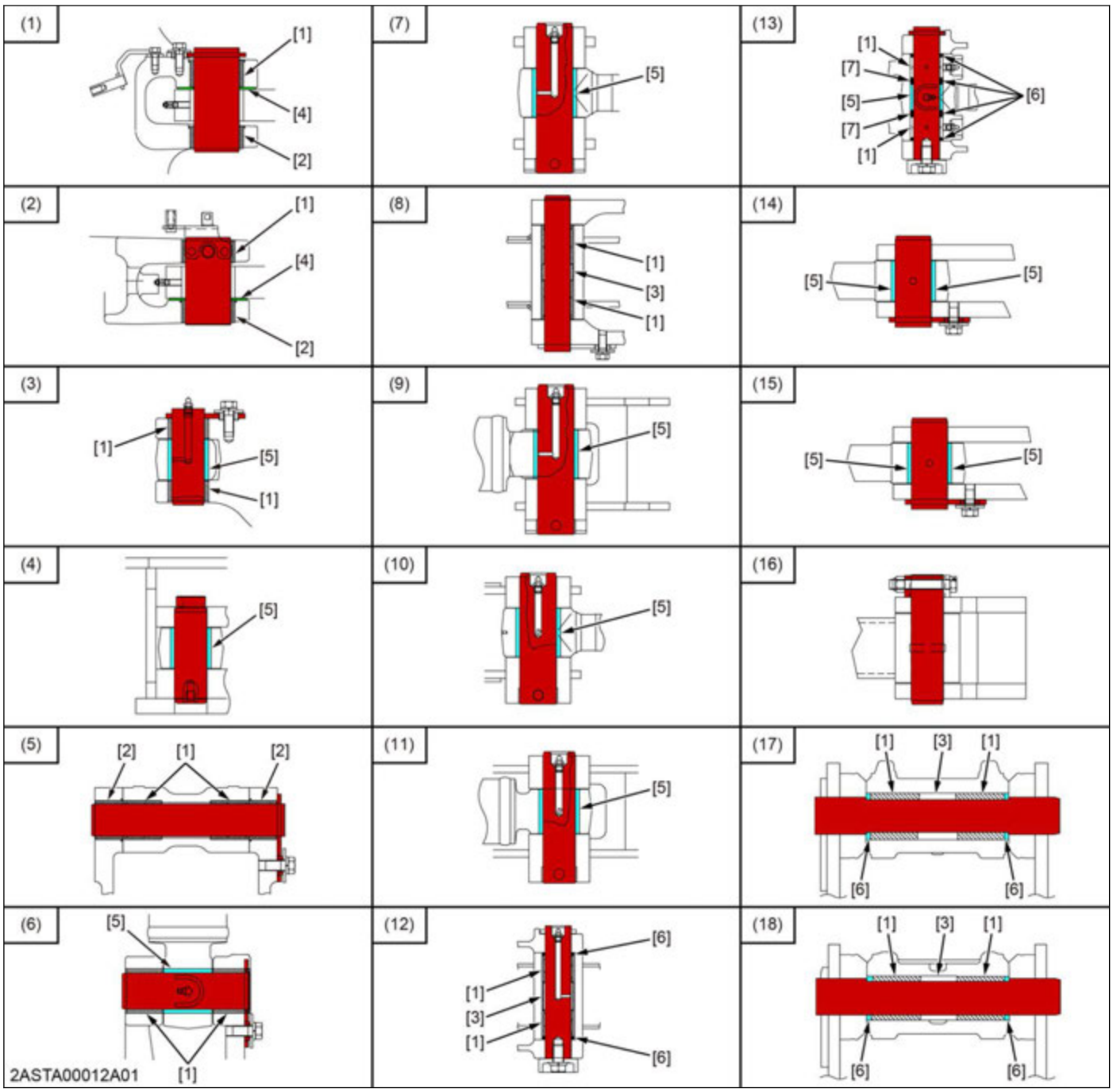
11.1 Carrier roller dimensions



12. Pins, bushings, and shims

12.1 Pin, bushing, and shim dimensions





(1) Swing bracket upper side - Frame
(2) Swing bracket lower side - Frame
(3) Swing bracket - Swing cylinder (rod side)
(4) Swing cylinder (bottom side) - Frame
(5) Swing bracket - Boom
(6) Swing bracket - Boom cylinder (bottom side)
(7) Boom - Boom cylinder (rod side)
(8) Boom - Arm
(9) Boom - Arm cylinder (bottom side)
(10) Arm - Arm cylinder (rod side)
(11) Arm - Bucket cylinder (bottom side)
(12) Bucket link (2, 3) - Arm
(13) Bucket link (1) - Bucket cylinder (rod side)
(14) Blade - Blade cylinder (bottom side)
(15) Frame - Blade cylinder (rod side)
(16) Blade - Frame
(17) Arm - Bucket
(18) Bucket link (1) - Bucket

IMPORTANT

- **Dimensions of pins and bushings correspond to new and unused parts.**
- **Bushing dimensions are in not assembled condition. After assembling, bushing generally slightly shrinks.**

Dimensions table (mm unit)

No.	Pin		[1] Bushing [2] Bushing [3] Collar		[4] Thrust collar	Shim	[5] Cylinder bushing	[6] Dust seal [7] Dust seal
	Diameter × length	Diameter tolerance	ID × OD × length	Bushing ID tolerance	ID × OD × thickness	ID × OD × thickness	ID × OD × length	ID × OD × thickness
(1)	ϕ60 × 154	-0.02 -0.05	[1] 60 × 72 × 58 [2] 60 × 72 × 27	+0.12 +0.09	[4] 61 × 100 × 3.0	-	-	-
(2)	ϕ60 × 128	-0.02 -0.05	[2] 60 × 72 × 27 [2] 60 × 72 × 30	+0.12 +0.09	[4] 61 × 100 × (2.0 or 2.5 or 3.0)	-	-	-
(3)	ϕ 35 × 100	-0.05 -0.08	[1] 35 × 45 × 24	+0.07 +0.04	-	36 × 70 × (1.5 or 0.5 or 1.0)	[5] 35 × 45 × 40	-
(4)	ϕ35 × 116	-0.03 -0.06	-	-	-	36 × 70 × (1.5 or 0.5 or 1.0)	[5] 35 × 45 × 35	-
(5)	ϕ40 × 284	-0.05 -0.08	[1] 40 × 50 × 50 [2] 40 × 48 × 37	+0.13 +0.10	-	41 × 75 × (0.5 or 1.0)	-	-
(6)	ϕ40 × 180	-0.05 -0.08	[1] 40 × 50 × 50	+0.07 +0.04	-	41 × 75 × (0.5 or 1.0)	[5] 40 × 50 × 60	-
(7)	ϕ40 × 182	-0.05 -0.08	-	-	-	41 × 75 × (0.5 or 1.0)	[5] 40 × 50 × 50	-
(8)	ϕ40 × 227	-0.05 -0.08	[1] 40 × 50 × 50 [3] 45.3 × 48.5 × 48	+0.13 +0.10	-	41 × 80 × (0.2 or 0.6)	-	-
(9)	ϕ40 × 182	-0.05 -0.08	-	-	-	41 × 75 × (0.5 or 1.0)	[5] 40 × 50 × 45	-
(10)	ϕ40 × 169	-0.05 -0.08	-	-	-	41 × 65 × (0.5 or 1.0)	[5] 40 × 50 × 45	-
(11)	ϕ40 × 169	-0.05 -0.08	-	-	-	41 × 65 × (0.5 or 1.0)	[5] 40 × 50 × 45	-
(12)	ϕ35 × 206	-0.05 -0.08	[1] 35 × 45 × 45 [3] 39.5 × 42.7 × 43	+0.13 +0.10	-	-	-	[6] 35 × 45 × 4.2
(13)	ϕ40 × 206	-0.05 -0.08	[1] 40 × 48 × 36	+0.07 +0.10	-	41 × 65 × (0.5 or 1.0)	[5] 40 × 50 × 40	[6] 40 × 48 × 4.2
(14)	ϕ45 × 113	-0.05 -0.08	-	-	-	46 × 70 × (0.5 or 1.0)	[5] 45 × 55 × 50	-
(15)	ϕ45 × 113	-0.05 -0.08	-	-	-	46 × 70 × (0.5 or 1.0)	[5] 45 × 55 × 50	-
(16)	ϕ40 × 151	-0.05 -0.08	-	-	-	-	-	-
(17)	ϕ35 × 233	-0.05 -0.08	[1] 35 × 45 × 45 [3] 39.5 × 42.7 × 33	+0.13 +0.10	-	-	-	[6] 35 × 45 × 4.2

(Continued)

No.	Pin		[1] Bushing [2] Bushing [3] Collar		[4] Thrust collar	Shim	[5] Cylinder bushing	[6] Dust seal [7] Dust seal
	Diameter × length	Diameter tolerance	ID × OD × length	Bushing ID tolerance	ID × OD × thickness	ID × OD × thickness	ID × OD × length	ID × OD × thickness
(18)	ϕ35 × 233	-0.05 -0.08	[1] 35 × 45 × 45 [3] 39.5 × 42.7 × 33	+0.13 +0.10	-	-	-	[6] 35 × 45 × 4.2

Dimensions table (inch unit)

No.	Pin		[1] Bushing [2] Bushing [3] Collar		[4] Thrust collar	Shim	[5] Cylinder bushing	[6] Dust seal [7] Dust seal
	Diameter × length	Diameter tolerance	ID × OD × length	Bushing ID tolerance	ID × OD × thickness	ID × OD × thickness	ID × OD × length	ID × OD × thickness
(1)	ϕ2.36 × 6.06	-0.00079 -0.00197	[1] 2.36 × 2.83 × 2.28 [2] 2.36 × 2.83 × 1.06	+0.00472 +0.00354	[4] 2.40 × 3.94 × 0.118	-	-	-
(2)	ϕ2.36 × 5.04	-0.00079 -0.00197	[2] 2.36 × 2.83 × 1.06 [2] 2.36 × 2.83 × 1.18	+0.00472 +0.00354	[4] 2.40 × 3.94 × (0.079 or 0.098 or 0.118)	-	-	-
(3)	ϕ1.38 × 3.94	-0.00197 -0.00315	[1] 1.38 × 1.77 × 0.945	+0.00276 +0.00157	-	1.42 × 2.80 × (0.059 or 0.020 or 0.039)	[5] 1.38 × 1.77 × 1.57	-
(4)	ϕ1.38 × 4.57	-0.00118 -0.00236	-	-	-	1.42 × 2.80 × (0.059 or 0.020 or 0.039)	[5] 1.38 × 1.77 × 1.38	-
(5)	ϕ1.57 × 11.2	-0.00197 -0.00315	[1] 1.57 × 1.97 × 1.97 [2] 1.57 × 1.89 × 1.46	+0.00512 +0.00394	-	1.61 × 2.95 × (0.020 or 0.039)	-	-
(6)	ϕ1.57 × 7.09	-0.00197 -0.00315	[1] 1.57 × 1.97 × 1.97	+0.00276 +0.00157	-	1.61 × 2.95 × (0.020 or 0.039)	[5] 1.57 × 1.97 × 2.36	-
(7)	ϕ1.57 × 8.94	-0.00197 -0.00315	-	-	-	1.61 × 2.95 × (0.020 or 0.039)	[5] 1.57 × 1.97 × 1.97	-
(8)	ϕ1.57 × 8.94	-0.00197 -0.00315	[1] 1.57 × 1.97 × 1.97 [3] 1.78 × 1.91 × 1.89	+0.00512 +0.00394	-	1.61 × 3.15 × (0.008 or 0.024)	-	-
(9)	ϕ1.57 × 7.17	-0.00197 -0.00315	-	-	-	1.61 × 2.95 × (0.020 or 0.039)	[5] 1.57 × 1.97 × 1.77	-
(10)	ϕ1.57 × 6.30	-0.00197 -0.00315	-	-	-	1.61 × 2.56 × (0.020 or 0.039)	[5] 1.57 × 1.97 × 1.77	-
(11)	ϕ1.57 × 6.30	-0.00197 -0.00315	-	-	-	1.61 × 2.56 × (0.020 or 0.039)	[5] 1.57 × 1.97 × 1.77	-

(Continued)

No.	Pin		[1] Bushing [2] Bushing [3] Collar		[4] Thrust collar	Shim	[5] Cylinder bushing	[6] Dust seal [7] Dust seal
	Diameter × length	Diameter tolerance	ID × OD × length	Bushing ID tolerance	ID × OD × thickness	ID × OD × thickness	ID × OD × length	ID × OD × thickness
(12)	ϕ1.38 × 8.11	0 0	[1] 1.38 × 1.77 × 1.77 [3] 1.55 × 1.68 × 1.69	+0.00512 +0.00394	-	-	-	[6] 1.38 × 1.77 × 0.17
(13)	ϕ1.57 × 8.11	-0.00197 -0.00315	[1] 1.57 × 1.89 × 1.42	+0.00512 +0.00394	-	1.61 × 2.56 × (0.020 or 0.039)	[5] 1.57 × 1.97 × 1.57	[6] 1.57 × 1.89 × 0.17
(14)	ϕ1.77 × 4.45	-0.00197 -0.00315	-	-	-	1.81 × 2.76 × (0.020 or 0.039)	[5] 1.77 × 2.17 × 1.97	-
(15)	ϕ1.77 × 4.45	-0.00197 -0.00315	-	-	-	1.81 × 2.76 × (0.020 or 0.039)	[5] 1.77 × 2.17 × 1.97	-
(16)	ϕ1.57 x 5.94	-0.00197 -0.00315	-	-	-	-	-	-
(17)	ϕ1.38 × 9.17	-0.00197 -0.00315	[1] 1.38 × 1.77 × 1.77 [3] 1.56 × 1.68 × 1.30	+0.00512 +0.00394	-	-	-	[6] 1.38 × 1.77 × 0.17
(18)	ϕ1.38 × 9.17	-0.00197 -0.00315	[1] 1.38 × 1.77 × 1.77 [3] 1.56 × 1.68 × 1.30	+0.00512 +0.00394	-	-	-	[6] 1.38 × 1.77 × 0.17

SERVICING

1. Service specifications

1.1 Service specifications for machine body

- Standard measurement condition,
  - Hydraulic oil and devices temperature: 50 ℃ (Including motor, pump and cylinders)
  - Engine speed: maximum speed

Items				Units	Service specifications		Service limits
					Value	Tolerance	Value
Wear	Pin			-	-	-	1 mm wear on pin outer diameter.
	Bushing			-	-	-	1 mm wear on bushing inner diameter.
Play	Swivel bearing (vertical play)			mm in.	0.84 0.033	-	1.68 0.066
	Front attachment			mm in.	less than 73 less than 2.8	-	146 5.7
Clearance	Swing bracket (vertical clearance)			mm in.	0.5 0.02	-	-
	Front attachment (each pin)			mm in.	0.5 0.02	-	-
	Front attachment (pins of bucket link 2, 3)			mm in.	1.0 0.04	-	-
Force	Control lever	Pilot control lever (Basic)	Forwards	N kgf	9.6 0.98	±4.9 ±0.50	-
			Backwards	N kgf	9.6 0.98	±4.9 ±0.50	-
			LH and RH	N kgf	9.6 0.98	±4.9 ±0.50	-
		Pilot control lever (Hi-spec)	Forwards	N kgf	11.8 1.2	±4.9 ±0.50	-
			Backwards	N kgf	11.3 1.2	±4.9 ±0.50	-
			LH and RH	N kgf	9.3 0.95	±4.9 ±0.50	-
		Travel control lever	Forwards	N kgf	21.6 2.2	±4.9 ±0.50	-
			Backwards	N kgf	21.6 2.2	±4.9 ±0.50	-
		Blade control lever	Forwards	N kgf	24.0 2.5	±4.9 ±0.50	-
			Backwards	N kgf	24.0 2.5	±4.9 ±0.50	-

(Continued)

Items				Units	Service specifications		Service limits
					Value	Tolerance	Value
Force	Control lever	Lever lock	Raising	N kgf	27 2.8	±9.8 ±1.0	-
			Lowering	N kgf	68 6.9	±9.8 ±1.0	-
		Accelerator lever	Forwards	N kgf	39.2 4.0	±14.7 ±1.5	-
			Backwards	N kgf	34.3 3.5	±14.7 ±1.5	-
		Swing control pedal	LH	N kgf	44.1 4.5	±6.7 ±0.68	-
			RH	N kgf	44.1 4.5	±6.7 ±0.68	-
		AUX control pedal	LH	N kgf	48.0 4.9	±6.7 ±0.68	-
			RH	N kgf	48.0 4.9	±6.7 ±0.68	-
Dimension	Track	Steel track	Width	mm in.	300.0 11.8	-	-
			Link length	mm in.	406.4 16	-	416.4 16.4
			Height	mm in.	90.5 3.56	-	85.5 3.37
			Grouser height	mm in.	16.5 0.65	-	8.0 0.3
			Bushing length	mm in.	55.0 2.2	-	-
			Bushing inner diameter	mm in.	ϕ17.0 ϕ0.67	-	ϕ19.0 ϕ0.75
			Bushing outer diameter	mm in.	ϕ28.0 ϕ1.1	-	ϕ26.5 ϕ1.04
			Master pin length	mm in.	96.5 3.8	-	-
			Master pin outer diameter	mm in.	ϕ16.8 ϕ0.66	±0.05 ±0.0020	ϕ15.5 ϕ0.61
			Pin length	mm in.	97 3.8	-	-
			Pin outer diameter	mm in.	ϕ17 ϕ0.67	-	ϕ15.5 ϕ0.61
			Number of links	-	40	-	-
			Tension dimension	mm in.	75.0 3.0	0 to 5.0 0 to 0.1	-
		Rubber track	Lug height	mm in.	19.5 0.77	-	-
			Link height	mm in.	24.0 0.94	-	-
			Width	mm in.	300 11.81	-	-

(Continued)

Items				Units	Service specifications		Service limits
					Value	Tolerance	Value
Dimension	Track	Rubber track	Height	mm in.	75.5 2.97	-	-
			Tension dimension	mm in.	10.0 0.4	0 to 5 0 0 to 0.2	-
	Carrier roller	Outer diameter		mm in.	ϕ76.3 ϕ3.0	-	ϕ73.3 ϕ2.9
	Front idler	Outer diameter		mm in.	ϕ272.0 ϕ10.7	0 to 2.0 0 to 0.08	ϕ268 ϕ10.6
		Guide width		mm in.	30.0 1.2	-	26 1.0
		Idler width		mm in.	72.0 2.8	-	-
	Sprocket	Outer diameter		mm in.	ϕ361 ϕ14.21	-2.0 to +1.0 -0.08 to 0.04	-
		Inner diameter		mm in.	ϕ190 ϕ7.48	-	-
		Sprocket width		mm in.	30 1.18	±1.0 ±0.04	26 1.02
		Gear height		mm in.	85.5 3.37	-	82.5 3.25
	Tension spring	Steel track	Spring dimension	mm in.	174.3 6.86	±0.5 ±0.020	-
		Rubber track	Spring dimension	mm in.	174.3 6.86	±0.5 ±0.020	-
	Track roller	Guide diameter		mm in.	80.0 3.1	-	65 2.8
		Guide width		mm in.	81.0 3.2	-	91 3.6
		Outer diameter		mm in.	ϕ124.0 ϕ4.88	-	ϕ114 ϕ4.5
		Roller width		mm in.	175.0 6.89	-0.5 -0.020	-

2. Testing

2.1 Measuring the front attachment horizontal play

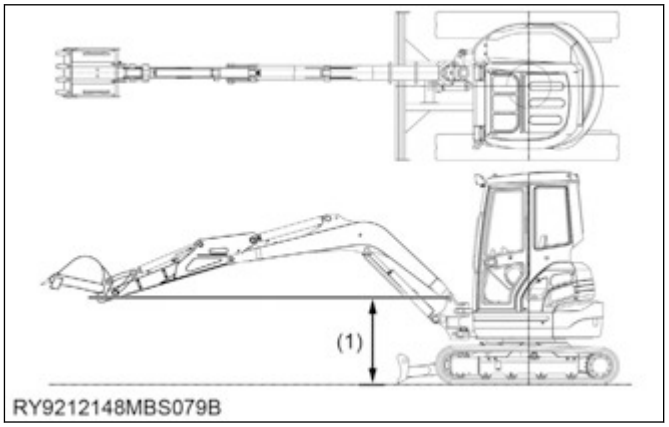
Measure the play of the front attachment to check the wear condition of the pins and bushings.

■ IMPORTANT

- **The measured value is the sum of all clearances in each pin and bushing connection.**
- **Start to adjust with shims from the pin connection that has the largest play.**
- **Consider the swivel gear backlash when measuring the front attachment play.**

Preparing

1. Dump the arm and bucket to the stroke end.
2. Set the boom support pin and bucket pin in a straight line.



(1) Boom support pin height

3. Stop the engine.

Measuring

1. Press the bucket to the right side by 50 N (5 kgf, 11 lbs) to set the zero point.

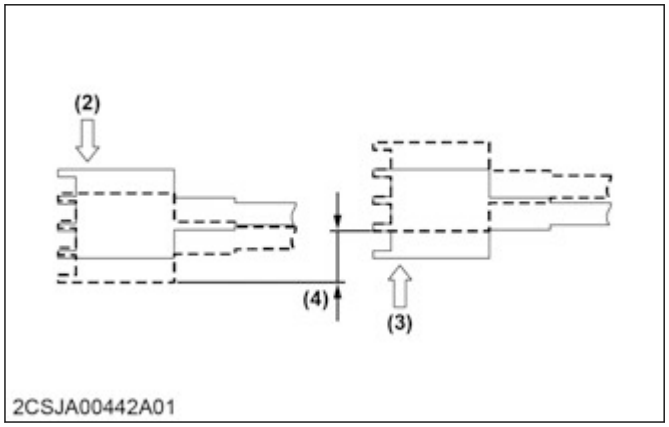
NOTE

- **Set a pole or put a mark on ground to recognize the zero point.**

2. Press the bucket to the left side by 300 N (30 kgf, 67 lbs) and measure the value of play.

NOTE

- **Measure distance from the zero point to stroke end with a scale or measuring tape.**



(2) 50 N (5 kgf, 11 lbs)
(3) 300 N (30 kgf, 67.4 lbs)
(4) Play

3. Measure 3 times to calculate the average.
4. Measure in the opposite direction as well.

Service specification

Play	less than 73 mm less than 2.8 in.

Service limit

Play	146 mm 5.7 in.

Adjusting

1. Install the designated shim to each pin for reducing each clearance.

IMPORTANT

- **Install the designated shims to both sides equally to reduce the clearance.**

Service specifications

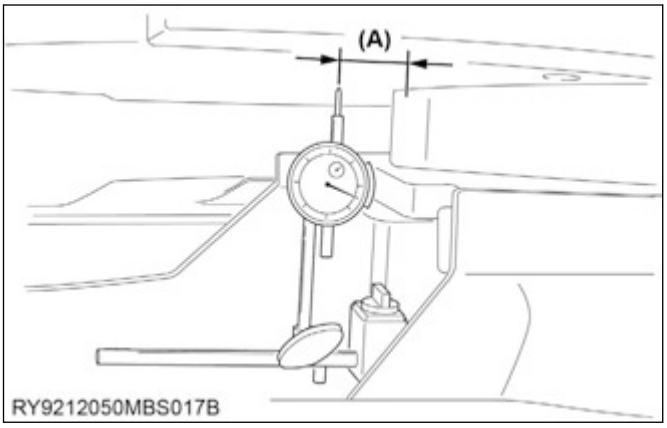
Clearance	Each pin	0.5 mm 0.02 in.
	Pin of bucket link 2, 3	1.0 mm 0.04 in.

2.2 Measuring the swivel bearing vertical play

Measure the play of the swivel bearing to check the wear condition of the ball, inner ring and outer ring.

Preparing

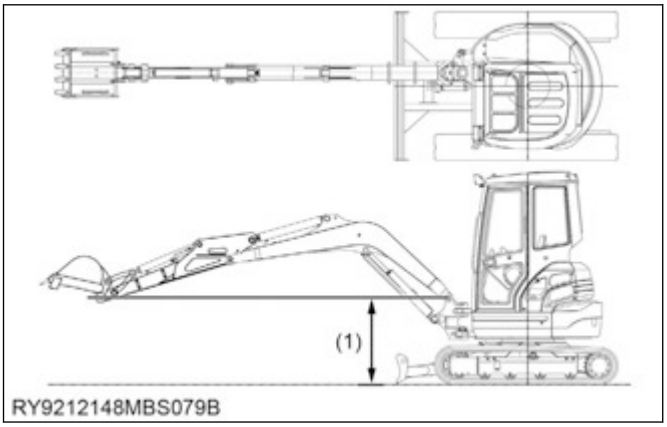
1. Fix the dial gauge by magnet to the track frame and contact the tip of the dial gauge.



(A) 50 mm (1.97 in.)

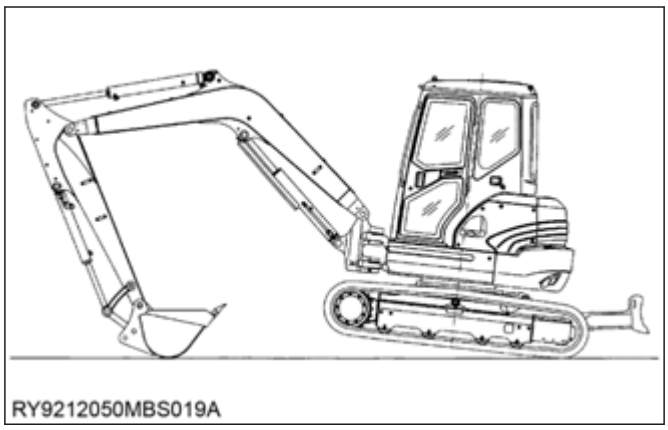
Measuring

1. Dump the arm and bucket to the stroke end.
2. Set the boom support pin and bucket pin in a straight line.



(1) Boom support pin height

3. Set the dial gauge to zero.
4. Jack up the machine with the front attachments and measure with the dial gauge.



5. Measure 3 times to calculate the average.

Service specification

Play	0.84 mm 0.033 in.

Service limit

Play	1.68 mm 0.066 in.

2.3 Measuring swing bracket vertical clearance

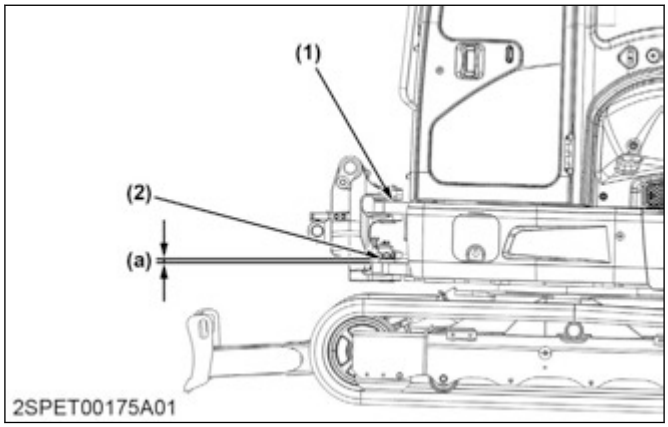
Measure the clearance of the swing bracket vertical clearance to check the wear condition of the thrust collar, swing bracket, and track frame.

Preparing

1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
2. Remove the front attachment.

Measuring

1. Measure the lower side clearance between the swing bracket and track frame with a feeler gauge.



(1) Upper thrust collar (2) Lower thrust collar

Service specification

(a) Clearance	0.5 mm 0.002 in.

Adjusting

1. Replace the upper thrust collar.

NOTE
- **Install the 3.0 mm thickness thrust collar.**
- **Grease the thrust collar.**

2. Replace the lower thrust collar.

NOTE
- **Adjust the clearance with the 3.0, 2.5, or 2.0 mm thickness thrust collars.**

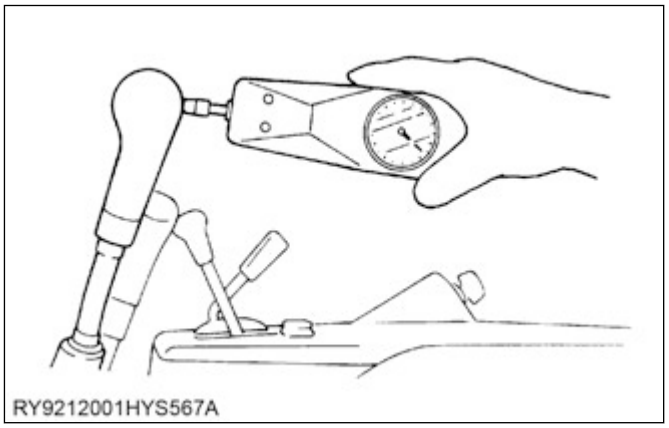
2.4 Measuring the operating force for levers and pedals

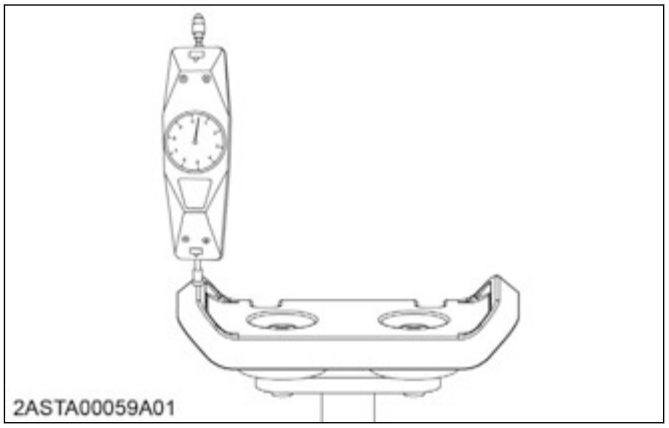
Measure the operating force for levers and pedals to check the wear or fixation condition of its internal parts.

CAUTION
- **Make sure the lever lock is raised before the measurement.**

Measuring

1. Start the engine and accelerate the engine speed to approximately 2250 rpm.
2. Set an operating force measuring device to the lever or pedal.
   - Levers: At 20 mm below from the grip edge
   - Pedals: At the pedal edge





3. Operate the lever or pedal and measure the force right before the lever or pedal reaches the end.
4. Measure 3 times to calculate the average.

Service specifications

Operating force	Pilot control lever (Basic)	Forwards	4.7 to 14.5 N 0.48 to 1.48 kgf
		Backwards	4.7 to 14.5 N 0.48 to 1.48 kgf
		LH and RH	4.7 to 14.5 N 0.48 to 1.48 kgf
	Pilot control lever (Hi-spec)	Forwards	6.9 to 16.7 N 0.7 to 1.7 kgf
		Backwards	6.4 to 16.2 N 0.7 to 1.7 kgf
		LH and RH	4.4 to 14.2 N 0.45 to 1.45 kgf
	Travel control lever	Forwards	16.7 to 26.5 N 1.7 to 2.7 kgf
		Backwards	16.7 to 26.5 N 1.7 to 2.7 kgf
	Blade control lever	Forwards	19.1 to 28.9 N 2.0 to 3.0 kgf
		Backwards	19.1 to 28.9 N 2.0 to 3.0 kgf
	Lever lock	Raising	17.2 to 36.8 N 1.8 to 3.8 kgf
		Lowering	58.2 to 77.8 N 5.9 to 7.9 kgf
	Accelerator lever	Raising	24.5 to 53.9 N 2.5 to 5.5 kgf
		Lowering	19.6 to 49 N 2.0 to 5.0 kgf
	Swing control pedal	LH	37.4 to 50.8 N 3.82 to 5.18 kgf
		RH	37.4 to 50.8 N 3.82 to 5.18 kgf
	AUX control pedal	LH	41.3 to 54.7 N 4.21 to 5.58 kgf
		RH	41.3 to 54.7 N 4.21 to 5.58 kgf

3. Repairing

3.1 Bucket

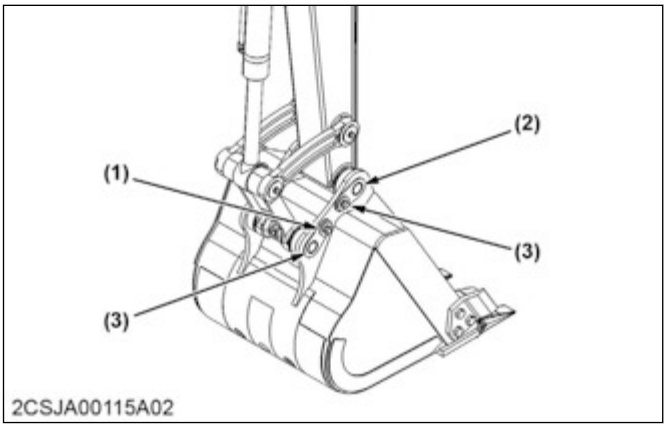
3.1.1 Removing the bucket

CAUTION

- **Do not put your finger into the pinhole, especially when adjusting the hole position.**

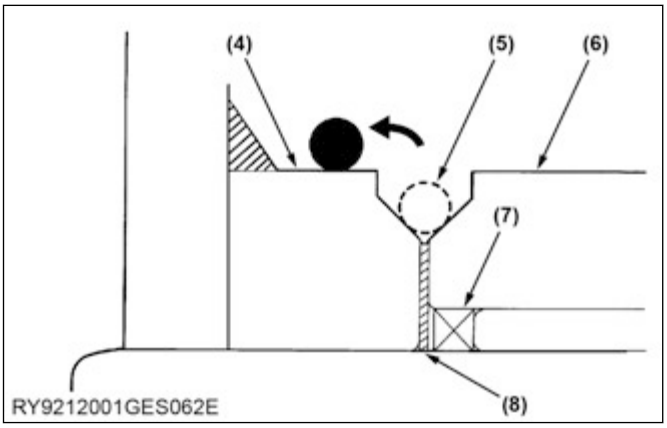
Removing

1. Place the bucket on level ground.
2. Stop the engine and release residual pressure.
3. Remove the two bolts.



(1) Pin
(2) Pin
(3) Bolt (M16 × 30) ×2

4. Remove the O-ring from a groove.



(4) Bucket
(5) O-ring
(6) Arm
(7) Dust seal
(8) Shim

5. Hit the two pins with a hammer and a round bar to remove.
6. Start the engine to lift the boom carefully. The bucket will be removed.

Mass

(4) Bucket	Approximately 56.3 kg Approximately 124.1 lbs

3.2 Arm

3.2.1 Removing the arm

CAUTION

- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Do not put your finger into the pinhole, especially when adjusting the hole position.**

IMPORTANT

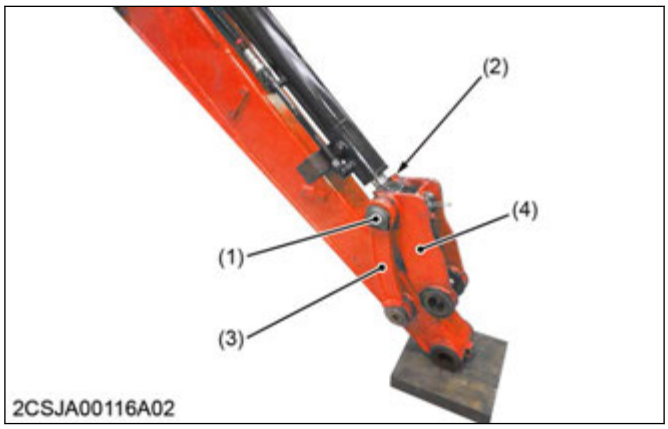
- **Install plugs to the removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing

1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
2. Remove the bucket.

Removing

1. Dump the bucket to the stroke end and lower the arm to the ground.
2. Remove the pin fixing bolt of bucket cylinder rod side.
3. Hit the pin with a hammer and a round bar to remove the link 1, 2, and 3.



(1) Pin
(2) Link 2
(3) Link 3
(4) Link 1

4. Attach a nylon sling to bucket cylinder and hoist for support.

(5) Bucket cylinder
(6) Pin
(7) Nylon sling

5. Disconnect the hydraulic hoses from the bucket cylinder.
6. Remove both the bucket cylinder bottom pin and the bucket cylinder.

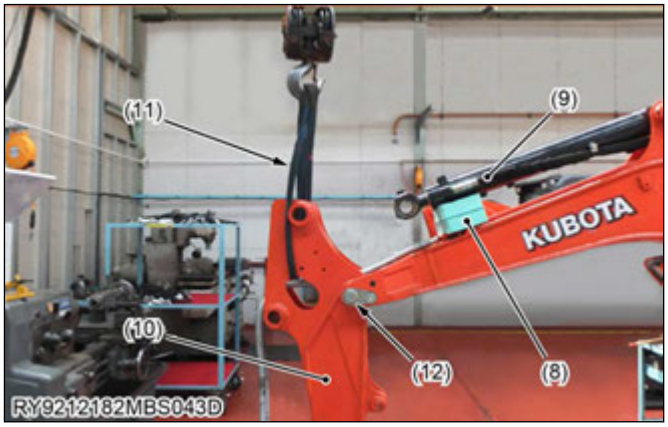
Mass

(5) Bucket cylinder	Approximately 19.3 kg Approximately 42.5 lbs

NOTE

- **This value does not include the mass of the hydraulic oil.**

7. Put a supporting block under the arm cylinder for support.
8. Attach a nylon sling to the arm and hoist for support.
9. Remove all of the hydraulic hoses.
10. Remove the pin on the rod side of the arm cylinder.
11. Remove the pin and the arm.



(8) Supporting block
(9) Arm cylinder
(10) Arm
(11) Nylon sling
(12) Pin

Mass

(10) Arm	Standard arm specification	Approximately 62.2 kg Approximately 137.1 lbs
	Short arm specification	Approximately 54.0 kg Approximately 119.1 lbs

3.3 Boom

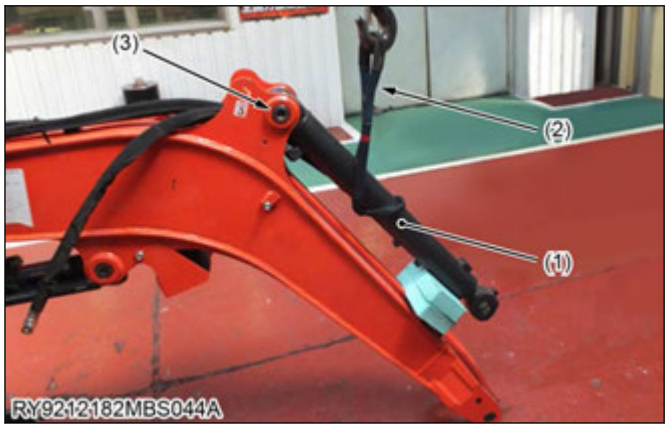
3.3.1 Removing the boom

⚠ CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Do not put your finger into the pinhole, especially when adjusting the hole position.**

■ IMPORTANT
- **Install plugs to the removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing
1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
2. Remove the arm.

Removing
1. Lower the boom end to the ground.
2. Attach a nylon sling to the arm cylinder and hoist for support.
3. Disconnect all of the hydraulic hoses from the arm cylinder.
4. Remove the pin on the bottom side of the arm cylinder.



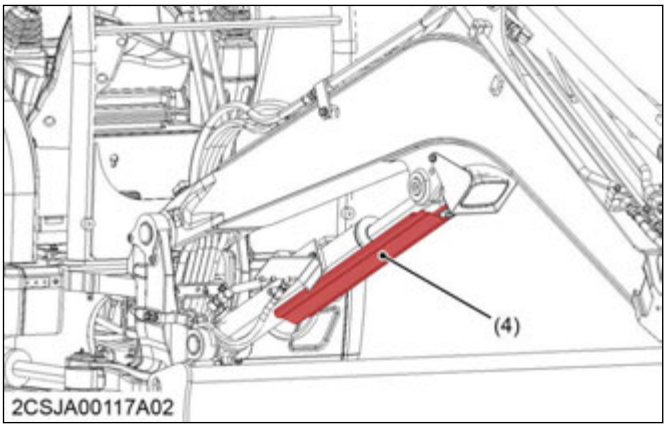
(1) Arm cylinder
(2) Nylon sling
(3) Pin

Mass

(1) Arm cylinder	Approximately 24.4 kg Approximately 53.8 lbs

■ NOTE
- **This value does not include the mass of hydraulic oil.**

5. Remove the cylinder cover from the boom cylinder.



(4) Cylinder cover

6. Attach a nylon sling to the boom cylinder and hoist for support.
7. Disconnect all of the hydraulic hoses.
8. Remove both the boom cylinder pins and the boom cylinder.

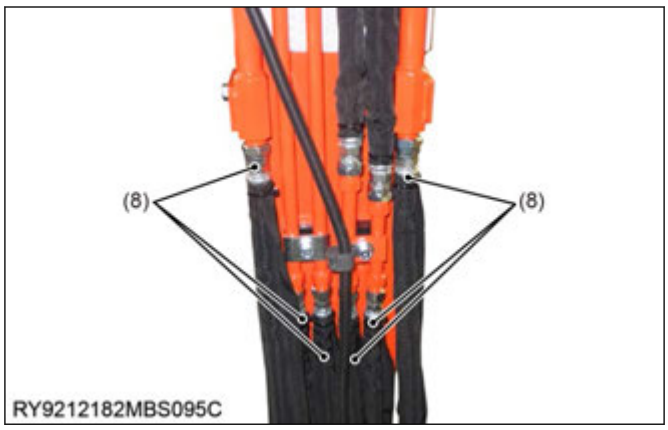
(5) Nylon sling
(6) Boom cylinder
(7) Pin

Mass

(6) Boom cylinder	Approximately 25.7 kg Approximately 56.7 lbs

■ NOTE
- **This value does not include the mass of the hydraulic oil.**

9. Disconnect all of the wire harnesses for work light and hydraulic hoses.



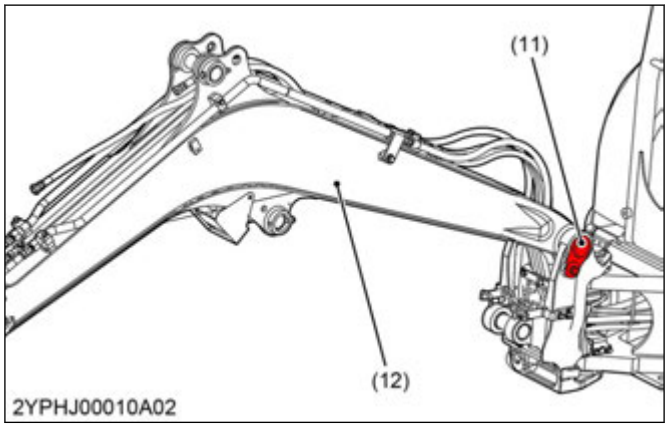
(8) Hydraulic hose

10. Attach a nylon sling to the boom and hoist for support.

NOTE
- **Install a shackle to the boom.**

(9) Nylon sling (10) Shackle

11. Remove the boom support pin and the boom.



(11) Boom support pin (12) Boom

Mass

(12) Boom	Approximately 122 kg Approximately 269 lbs

3.4 Blade

3.4.1 Removing the blade

CAUTION
- **Lower the front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Do not put your finger into the pinhole, especially when adjusting the hole position.**

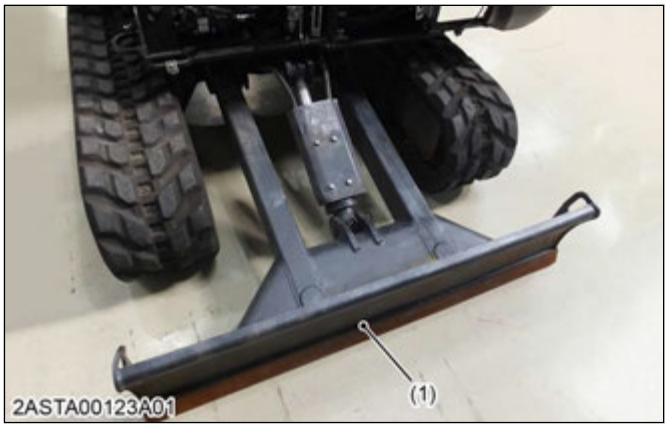
IMPORTANT
- **Install plugs to the removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing

1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

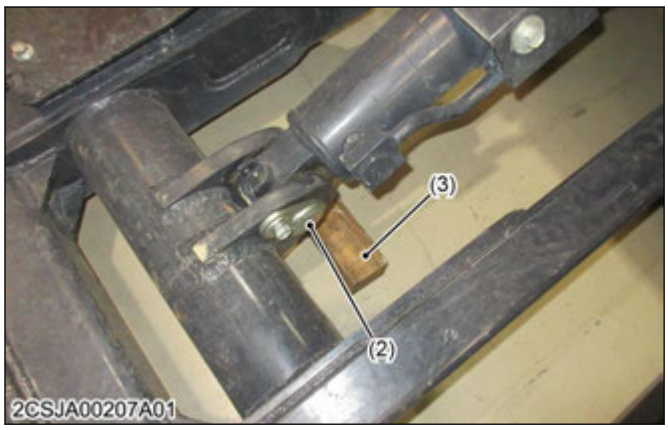
Removing

1. Swivel the upper structure 90 degrees against the blade.
2. Lower the bucket and blade to the ground and stop the engine.



(1) Blade

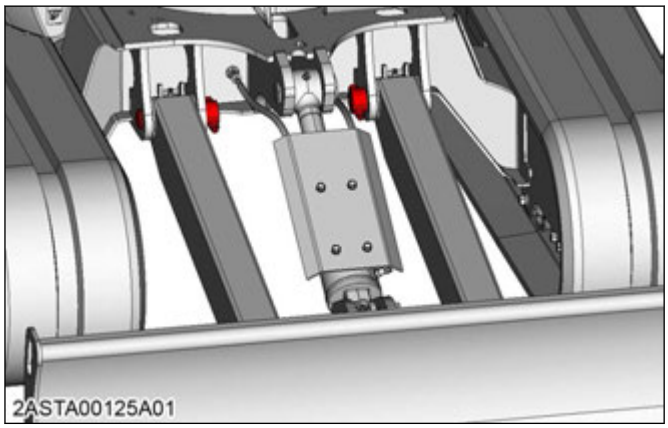
3. Put a supporting block under the blade cylinder and remove the cylinder bottom pin.



(2) Cylinder bottom pin (3) Supporting block

4. Remove all of the hydraulic hoses from the blade cylinder.
5. Attach 3 nylon slings on the blade (right end, left end, and center pin hole) and hoist for support.

6. Remove the two pins from the blade and blade assembly.



Mass

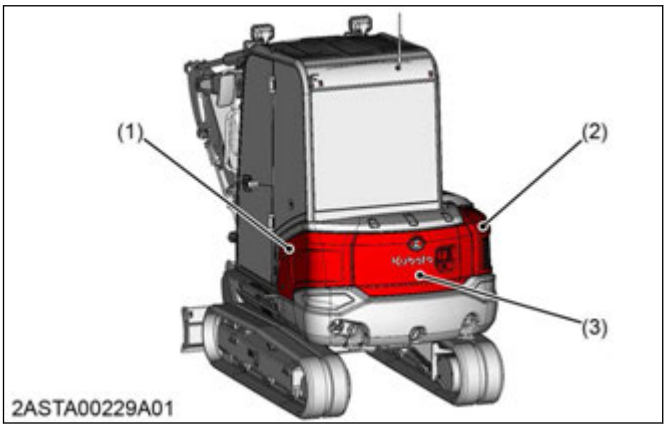
(1) Blade	Approximately 101 kg Approximately 223 lbs

3.5 Counterweight

3.5.1 Removing and installing the counterweight

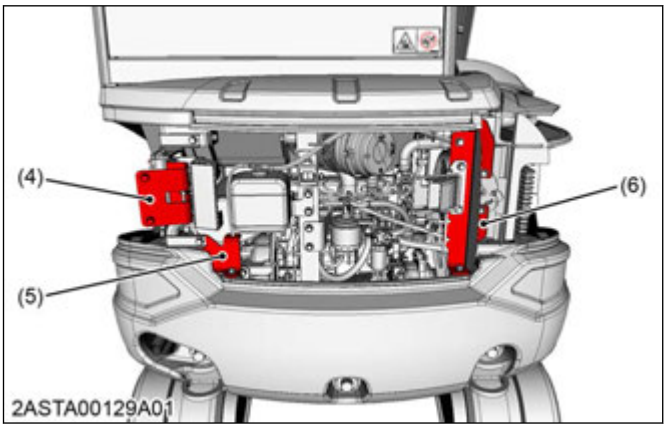
Removing

1. Remove the LH, RH, and rear bonnet.



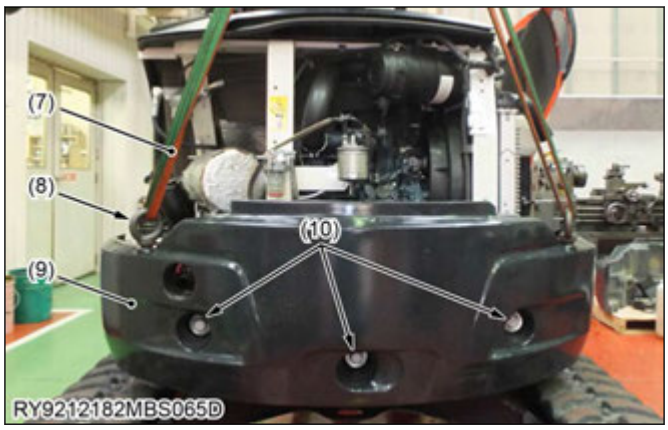
(1) LH bonnet (3) Rear bonnet
(2) RH bonnet

2. Remove the rear bonnet hinge, stay, and partition plate.



(4) Rear bonnet hinge (6) Partition plate
(5) Stay

3. Install two eye bolts to the counterweight.
4. Attach nylon sling to the eye bolts and hoist for support.
5. Remove the three bolts.



(7) Nylon sling
(8) Eye bolt
(9) Counterweight
(10) Bolt (M20 × 90) ×3

6. Remove the counterweight carefully.

(9) Counterweight

Mass

(9) Counterweight	Approximately 250 kg Approximately 551 lbs

Installing

Tightening torque

(10) Bolt	367.7 to 431.5 N·m 37.5 to 44.0 kgf·m 271.2 to 318.2 lbf·ft	Thread lock (Loctite 301)

3.6 Canopy

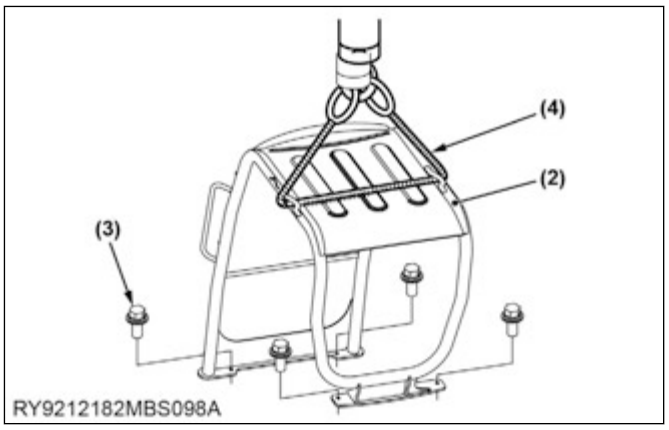
3.6.1 Removing and installing the canopy

Removing

1. Lower the bucket and blade to the ground. Stop the engine.
2. Remove the 2 bolts and handrail.

(1) Handrail

3. Attach a nylon sling to the canopy and hoist for support.
4. Remove the 4 bolts.



(2) Canopy
(3) Bolt (M14 × 60) ×4
(4) Nylon sling

5. Remove the canopy.

(2) Canopy

Mass

(2) Canopy	Approximately 79.5 kg Approximately 175.3 lbs

Installing

Tightening torque

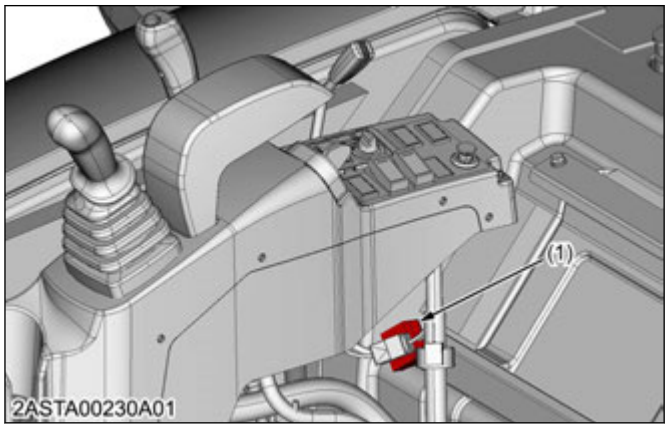
(3) Bolt	123.6 to 147.1 N·m 12.6 to 15.0 kgf·m 91.2 to 108.5 lbf·ft	Thread lock (Loctite 301-70)

3.7 Cabin

3.7.1 Removing and installing the cabin

Removing

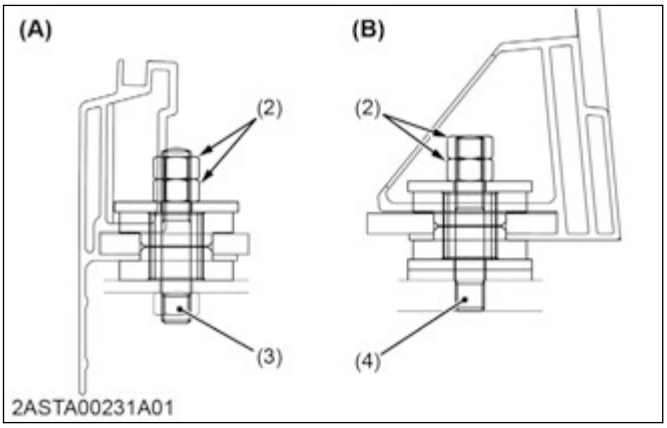
1. Lower the blade and bucket to the ground. Stop the engine.
2. Slide the seat forwards and remove the cabin harness.



(1) Cabin harness

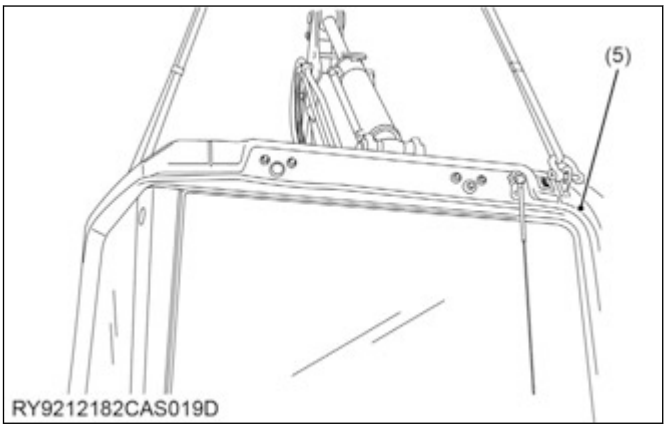
3. Remove the 8 nuts in the front and rear.

(2) Nut (M14) ×8



(2) Nut (M14) ×8
(3) Stud bolt (front)
(4) Stud bolt (rear)
(A) Front
(B) Rear

4. Attach the nylon sling to the cabin and hoist to remove.



(5) Cabin

Mass

(5) Cabin	Approximately 140 kg Approximately 309 lbs

Installing

Tightening torque

(2) Nut	107.9 to 125.5 N·m 11.0 to 12.8 kgf·m 79.6 to 92.6 lbf·ft	-
(3), (4) Stud bolt	62 to 73 N·m 6.3 to 7.4 kgf·m 45.7 to 53.8 lbf·ft	Thread lock (Loctite 301-70)

3.8 Lever lock

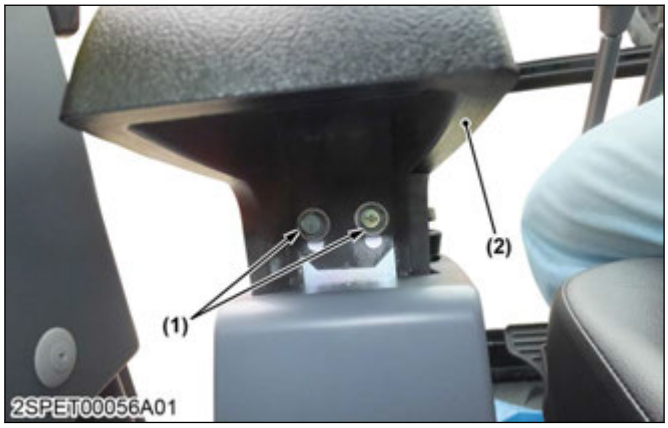
3.8.1 Removing and installing the lever lock

CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Lower the front attachments to the ground, and stop the engine.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

IMPORTANT
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

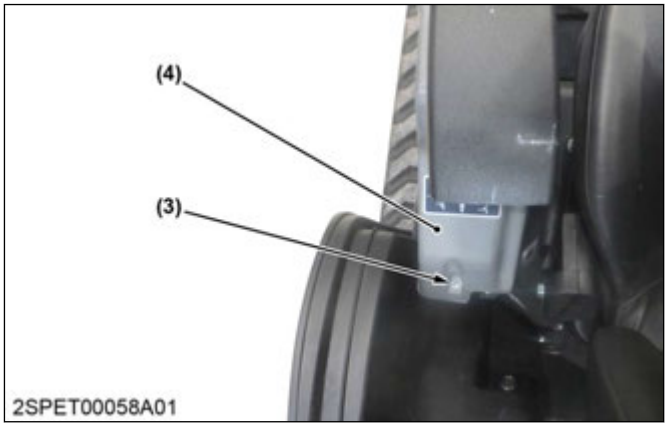
Removing

1. Remove the two bolts and arm rest.



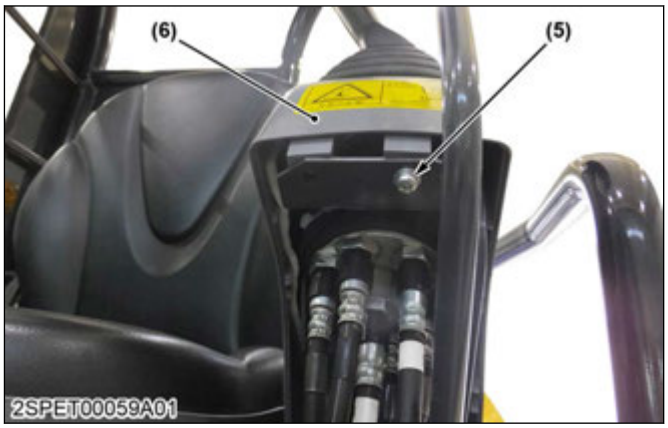
(1) Bolt (M8 × 20) ×2 (2) Arm rest

2. Remove the two screws and lower cover.



(3) Screw ×2 (4) Lower cover

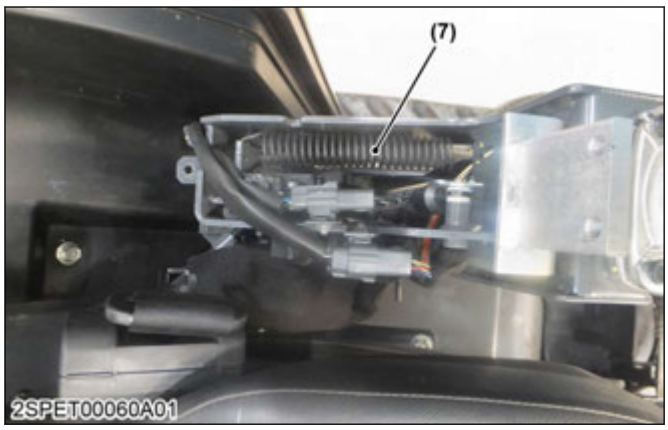
3. Remove the screw and upper cover.



(5) Screw (6) Upper cover

4. Remove the spring.

CAUTION
- **Be careful that the spring may pop out rapidly when removing.**

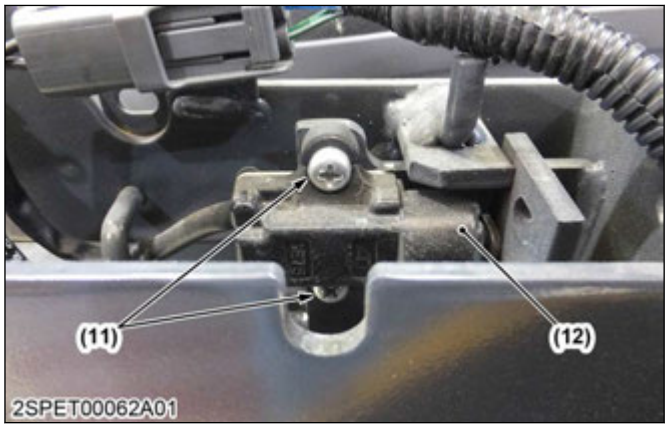


(7) Spring

5. Remove the two split pins, two washers, and damper.

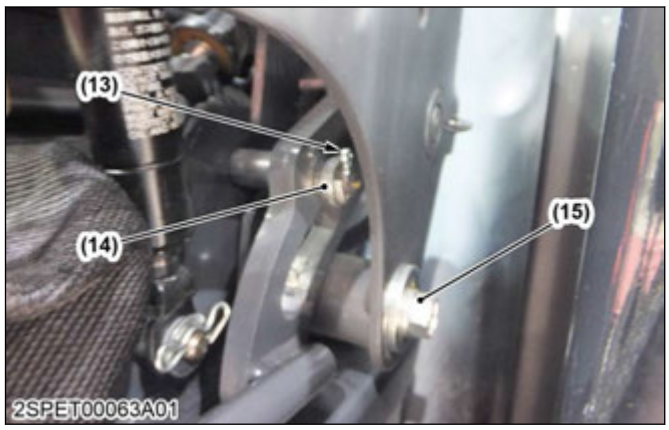
(8) Split pin ×2
(9) Washer ×2
(10) Damper

6. Remove the two screws and lever lock switch.



(11) Screw ×2
(12) Lever lock switch

7. Remove the LH bonnet and all of the hydraulic hoses from the LH pilot control valve.
8. Remove the split pin and washer.



(13) Split pin
(14) Washer
(15) Bolt (M10 × 20)

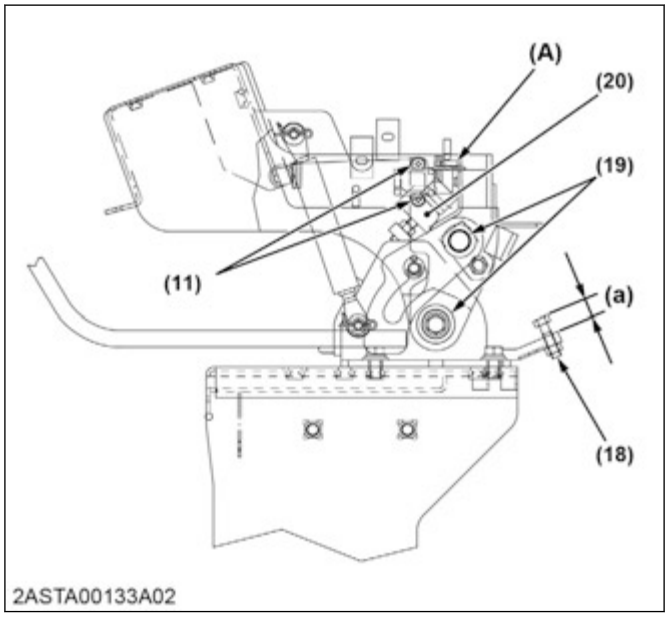
9. Remove the bolt and lever lock.

■ NOTE
- **Slide the lever lock leftwards to remove.**

10. Remove the bolt, pin, and unload lever.

(16) Bolt (M10 × 20)
(17) Pin

Installing



(11) Screw ×2
(18) Stopper bolt
(19) Bushing ×2
(20) Cushion

■ IMPORTANT

- **Install the rod side of the damper to the lower base.**
- **Grease the bushings.**

■ NOTE

- **Remove the stopper bolt when installing the damper.**
- **Adjust the cushion position to contact the unload lever bracket onto the lever lock stopper bracket (A) when lowering the lever lock.**

Tightening torque

(11) Screw	3.9 to 4.9 N·m 0.4 to 0.5 kgf·m 2.9 to 3.6 lbs·ft	Thread lock (Loctite 307 - 70)

Adjusting dimension

(a)	15 mm 0.59 in.

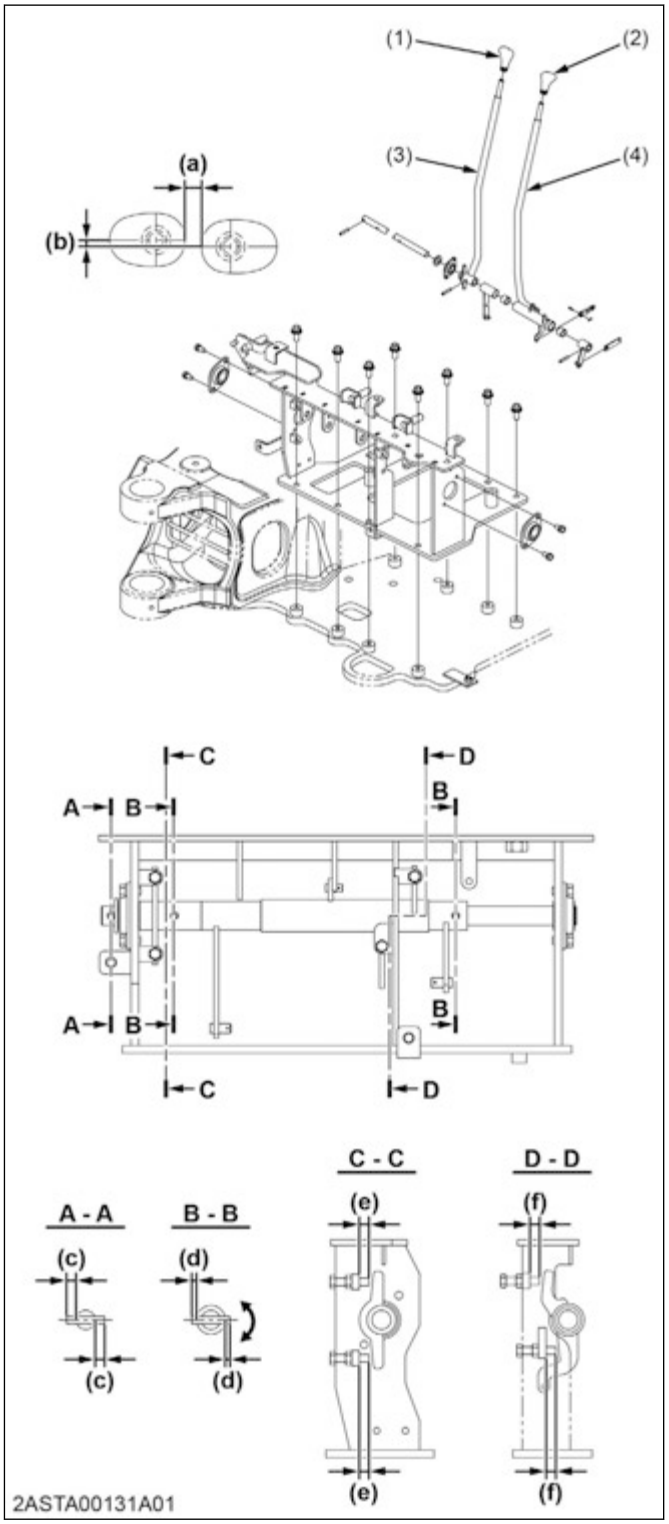
3.9 Travel control lever

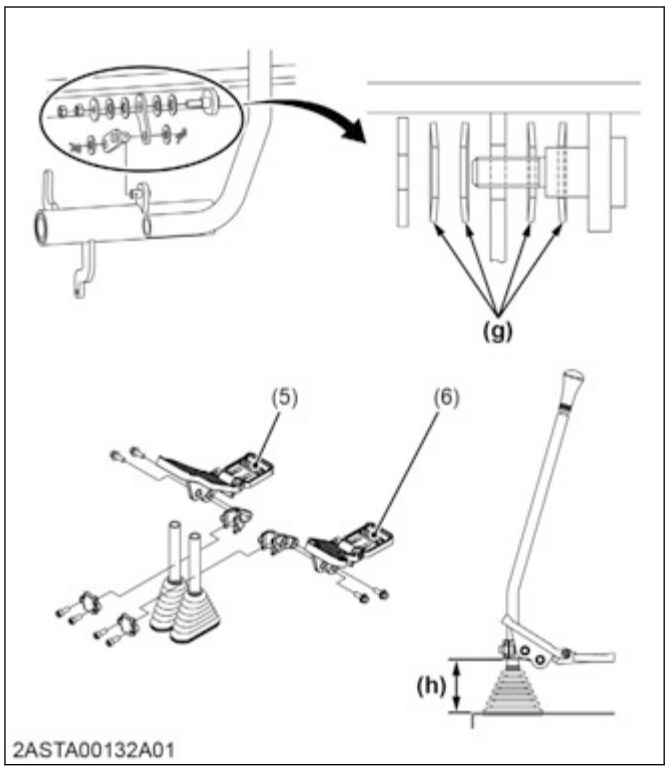
3.9.1 Installing the travel control lever

⚠ CAUTION

- **Lower the front attachments to the ground and stop the engine.**

Installing





(1) Grip (travel RH)
(2) Grip (travel LH)
(3) Lever (travel RH)
(4) Lever (travel LH)
(5) Pedal (travel RH)
(6) Pedal (travel LH)

■ NOTE

- **Install the spring plates (g) in correct direction.**

Adjusting dimensions

(a)	5 to 15 mm 0.2 to 0.6 in.
(b)	less than 5.0 mm less than 0.20 in.
(c)	10 mm 0.40 in.
(d)	5.0 mm 0.20 in.
(e)	10 mm 0.40 in.
(f)	10 mm 0.40 in.
(h)	105 mm 4.1 in.

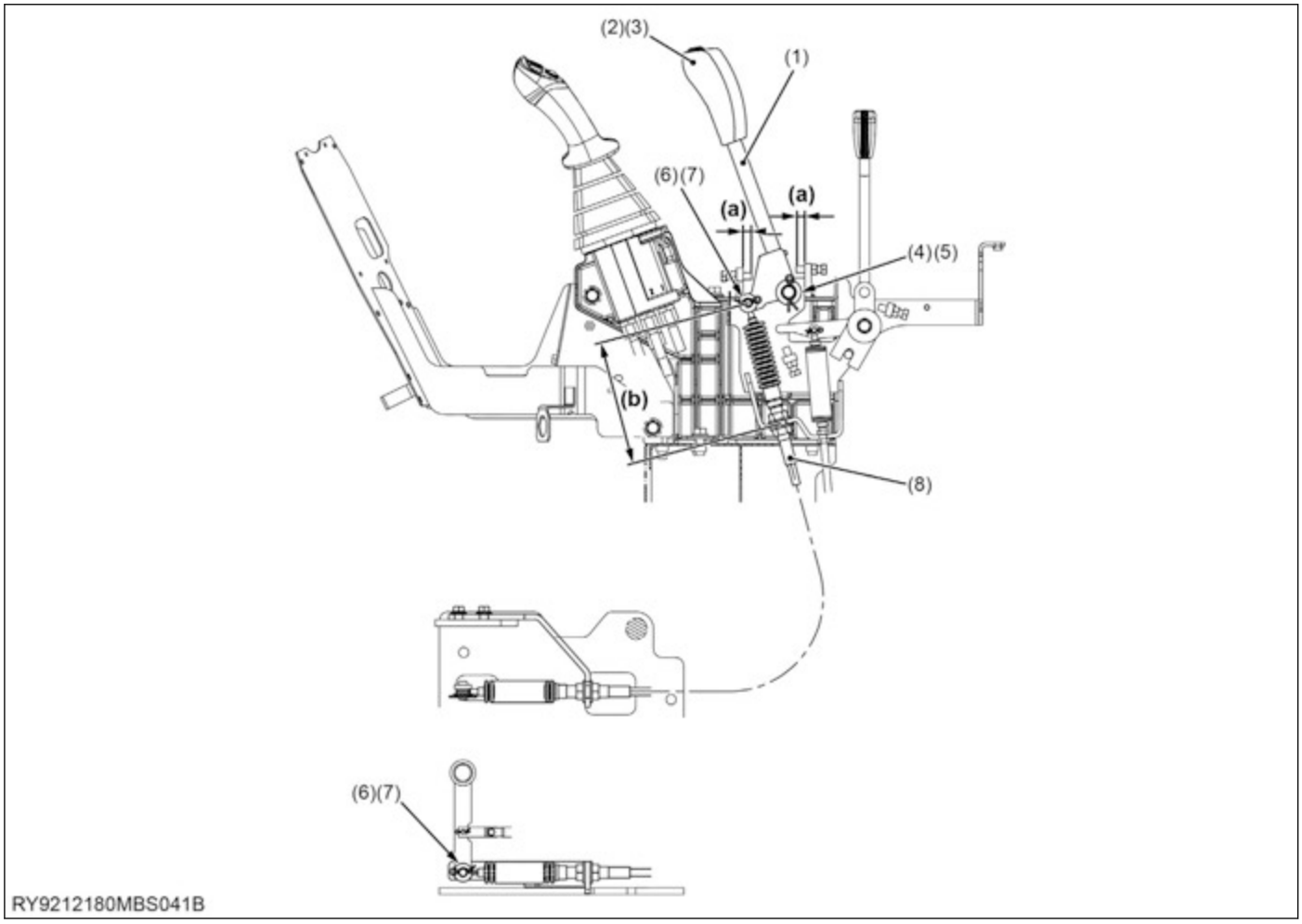
3.10 Blade control lever

3.10.1 Installing the blade control lever

CAUTION
- **Lower the front attachments to the ground and stop the engine.**

NOTE
- **Install the blade cable through the hose guide with the pilot hose.**

Installing



(1) Blade lever
(2) Grip
(3) Screw
(4) Washer
(5) Snap pin
(6) Washer
(7) Snap pin
(8) Blade cable

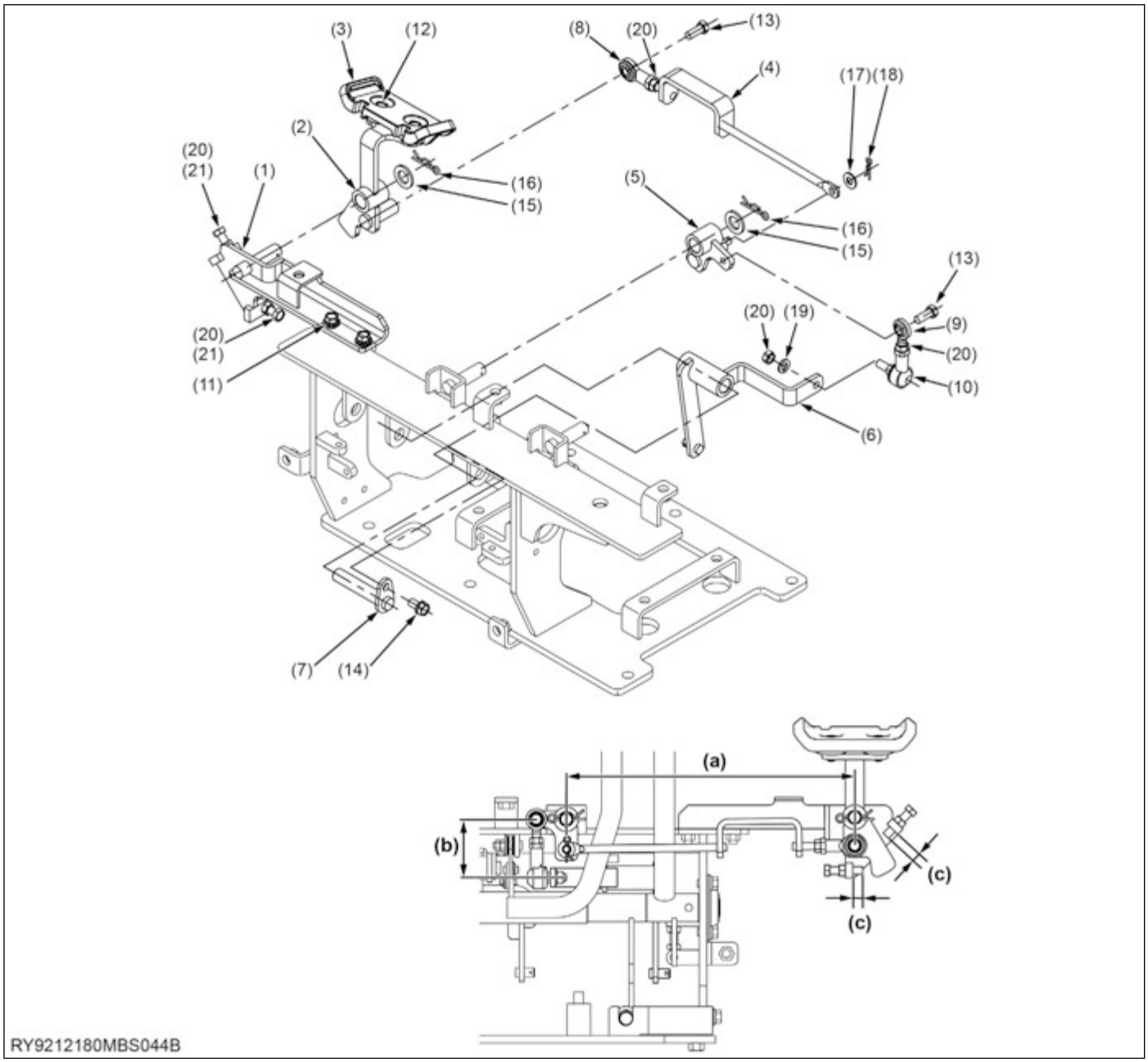
Adjusting dimension

(a)	10 mm 0.40 in.	(b)	148 mm 5.8 in.

3.11 Swing control pedal

3.11.1 Installing the swing control pedal

Installing



(1) Bracket
(2) Pedal lever
(3) Swing control pedal
(4) Rod
(5) Link 1
(6) Link 2
(7) Shaft
(8) Rod end (RH)
(9) Rod end screw (RH)
(10) Rod end (LH)
(11) Bolt (M8 × 20)
(12) Bolt (M8 × 20)
(13) Bolt (M8 × 20)
(14) Bolt (M8 × 16)
(15) Washer
(16) Snap pin
(17) Washer
(18) Snap pin
(19) Spring washer
(20) Nut
(21) Bolt

■ IMPORTANT

- **Make sure that the control valve spool moves smoothly in full stroke.**

■ NOTE

- **Install the swing control pedal so that the notched side faces toward the front of machine.**

Tightening torque

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

Adjusting dimension

(a)	306 mm 12.0 in.	(b)	62 mm 2.4 in.
(c)	10 mm 0.39 in.	-	-

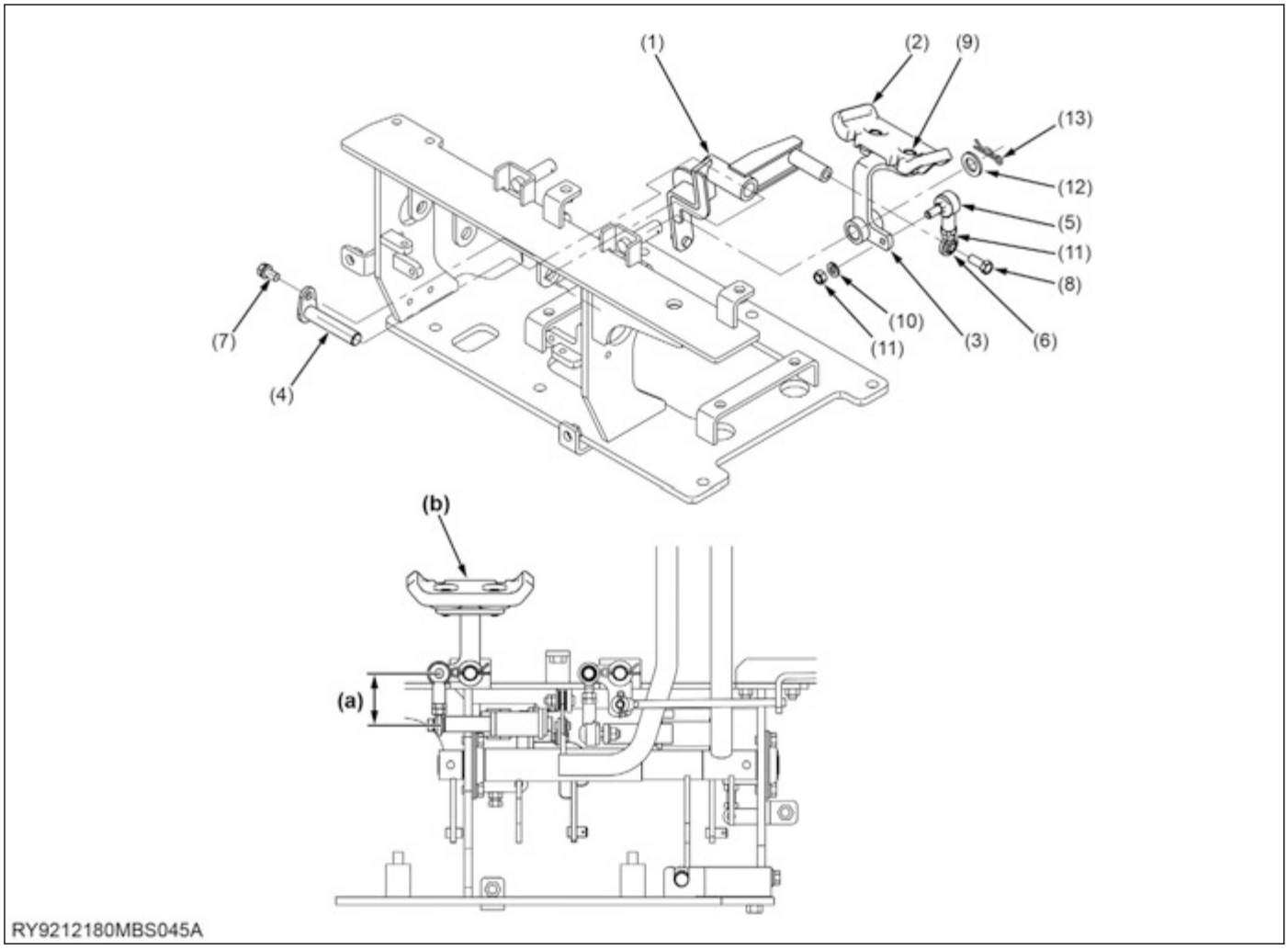
3.12 AUX control pedal

3.12.1 Installing the AUX control pedal

Installing

■ NOTE

- **The AUX control pedal is only installed for basic model.**



(1) Link assembly
(2) AUX control pedal
(3) Lever
(4) Shaft
(5) Rod
(6) Rod end
(7) Bolt (M8 × 1.25)
(8) Bolt (M8 × 1.25)
(9) Bolt (M8 × 1.25)
(10) Spring washer
(11) Nut
(12) Washer
(13) Snap pin

■ IMPORTANT

- **Make sure that the control valve spool moves smoothly in full stroke.**

Tightening torque

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

Adjusting dimension

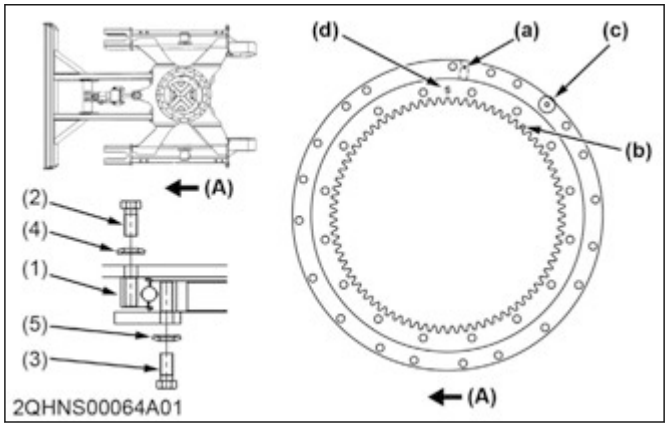
(a)	62 mm 2.4 in.	(b)	180°

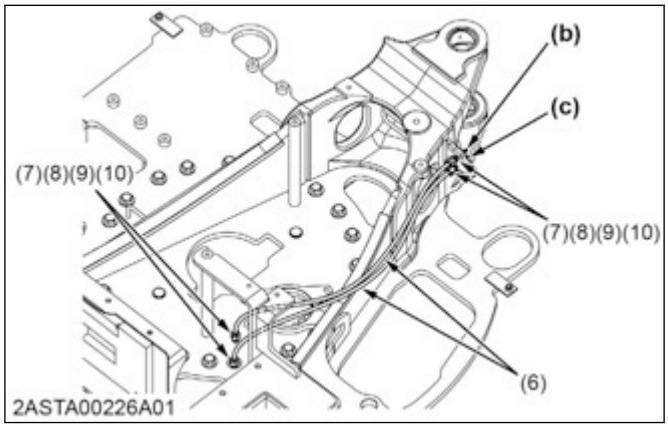
3.13 Swivel bearing

3.13.1 Installing the swivel bearing

Installing

1. Set the **[S]** mark on the right side of the machine and mount the swivel bearing by finger tightening.





(1) Swing bearing
(2) Bolt (M16 × 35) ×20
(3) Bolt (M16 × 35) ×16
(4) Spring washer
(5) Spring washer
(6) Grease tube
(7) Adapter
(8) Nut
(9) Sleeve
(10) Sleeve
(a) Ball insertion opening (outer ring soft zone)
(b) Filler hole for bearing teeth
(c) Filler hole for ball bearing
(d) **[S]** mark (inner ring soft zone)
(A) Front of machine

2. Tighten the 36 bolts.

■ IMPORTANT
- **Tighten the bolts in order alternately.**

3. Grease the bearing teeth.

Tightening torque

(2) (3) Bolt	259.9 to 304.0 N·m 26.5 to 31.0 kgf·m 191.7 to 224.0 lbf·ft	Thread lock (Loctite 301-70)

3.14 Steel track

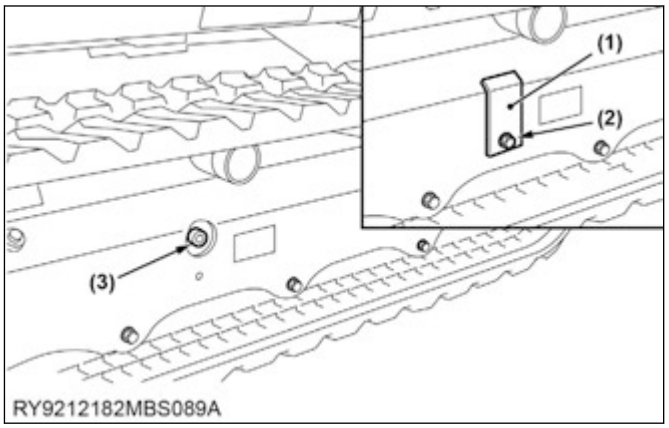
3.14.1 Removing and installing the steel track

⚠ CAUTION
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **– Do not stand in front of the grease fitting.**
  - **– Loosen the grease fitting slowly.**

■ IMPORTANT
- **Be sure to install the steel track in the correct direction.**
- **In case of exchanging the steel track to rubber track, it is possible to exchange and not needed to adjust the dimension of the tension spring.**

Removing

1. Remove the bolt and cover.



(1) Cover
(2) Bolt (M10 × 20)
(3) Grease fitting

2. Press a socket wrench onto the base of the grease fitting and loosen it slowly.
3. Jack up the machine and remove the grease from the grease cylinder completely.

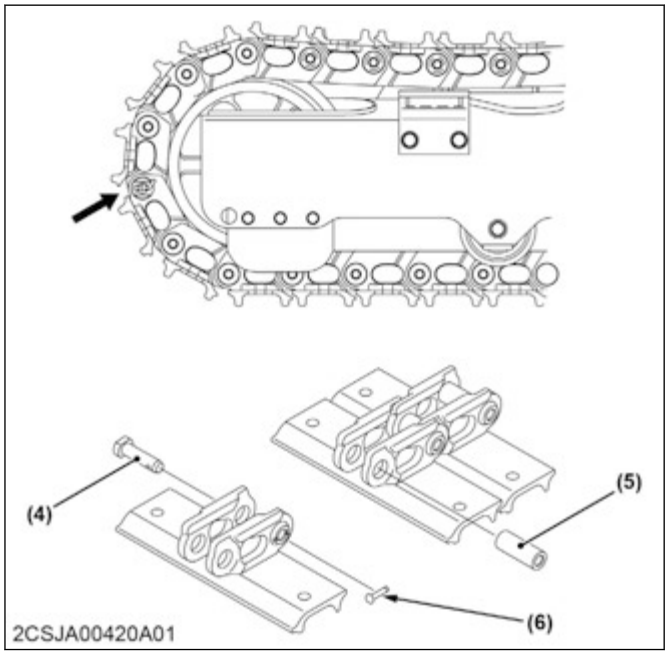
■ NOTE
- **The grease comes out by own weight of the track.**

4. Tighten the grease fitting.

Tightening torque

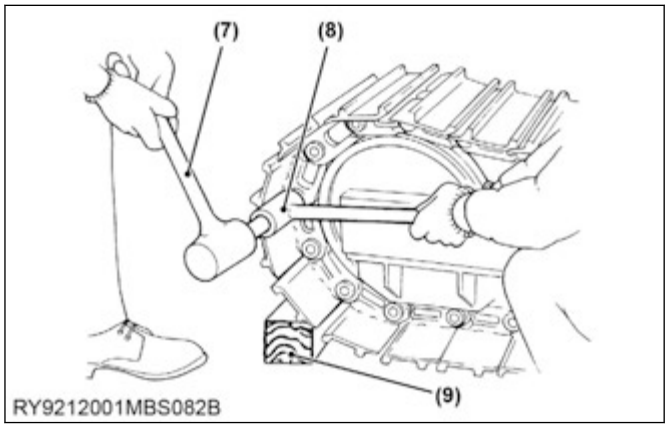
(3) Grease fitting	98.0 to 107.8 N·m 10.0 to 11.0 kgf·m 72.3 to 79.5 lbf·ft	-

5. Slowly rotate the travel motor until the master pin is in front of the front idler.
6. Remove the locking pin from the master pin.



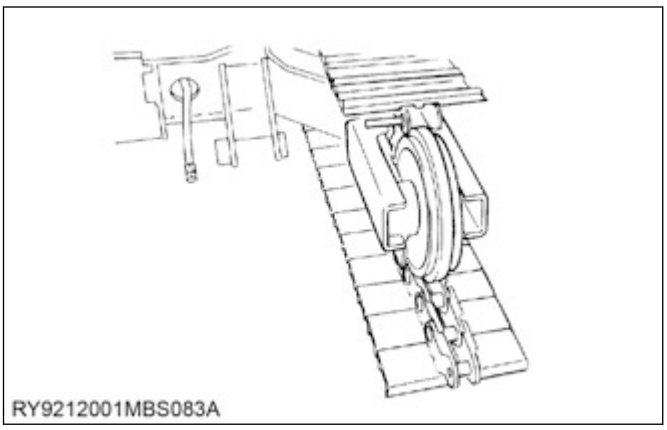
(4) Master pin
(5) Master link
(6) Locking pin

7. Remove the master pin with a hammer and jig.



(7) Hammer
(8) Jig
(9) Support block

8. Slowly rotate the travel motor backwards to remove the steel track.

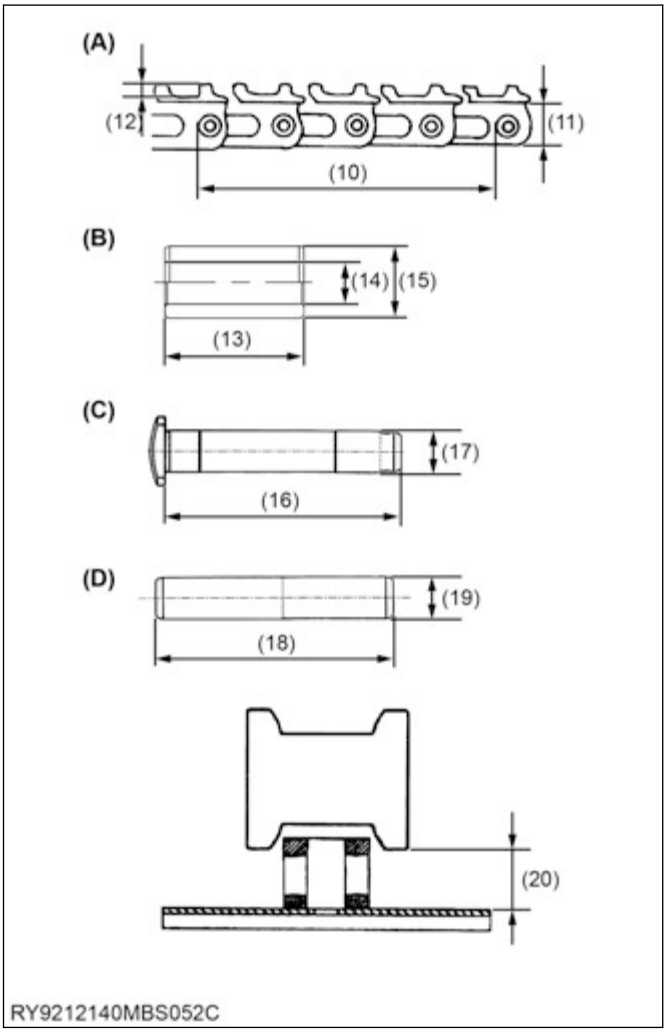


Mass

Steel track	Approximately 174 kg Approximately 384 lbs

Measuring

1. Check the steel track dimensions.



(A) Steel track
(B) Bushing
(C) Master pin
(D) Pin

Service specifications

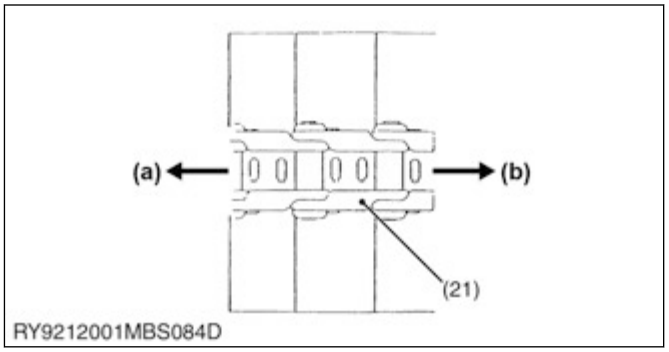
(10) Link length	406.4 mm 16.0 in.
(11) Height	90.5 mm 3.6 in.
(12) Grouser height	16.5 mm 0.65 in.
(13) Bushing length	55.0 mm 2.2 in.
(14) Bushing inner diameter	ϕ17.0 mm ϕ0.67 in.
(15) Bushing outer diameter	ϕ28.0 mm ϕ1.1 in.
(16) Master pin length	96.5 mm 3.8 in.
(17) Master pin outer diameter	ϕ16.8 mm ϕ0.66 in.
(18) Pin length	97 mm 3.8 in.
(19) Pin outer diameter	ϕ17 mm ϕ0.67 in.
(20) Track tension dimension	75 mm 3.0 in.

Service limits

(10) Link length	416.4 mm 16.4 in.
(11) Height	85.5 mm 3.37 in.
(12) Grouser height	8.0 mm 0.3 in.
(13) Bushing length	-
(14) Bushing inner diameter	ϕ19.0 mm ϕ0.75 in.
(15) Bushing outer diameter	ϕ26.5 mm ϕ1.04 in.
(16) Master pin length	-
(17) Master pin outer diameter	ϕ15.5 mm ϕ0.61 in.
(18) Pin length	-
(19) Pin outer diameter	ϕ15.5 mm ϕ0.61 in.

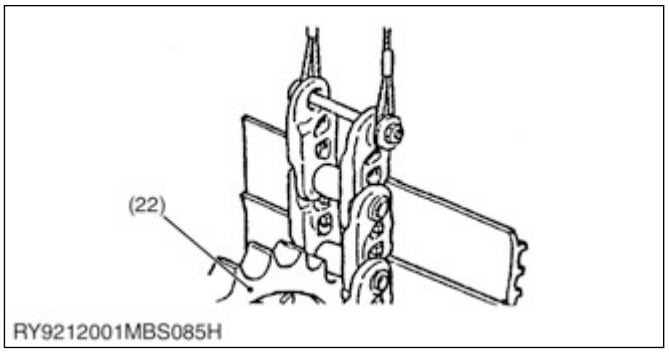
Installing

1. Jack up the machine and put the steel track under the track roller as it protrudes a little from the sprocket.



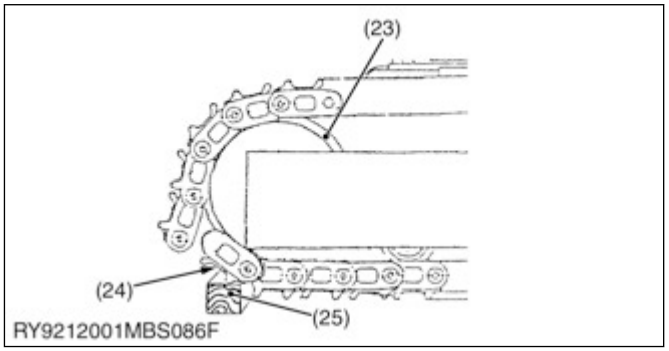
(21) Master link
(a) Sprocket side
(b) Front idler side

2. Hoist the steel track by the crane and install the steel track on the sprocket.



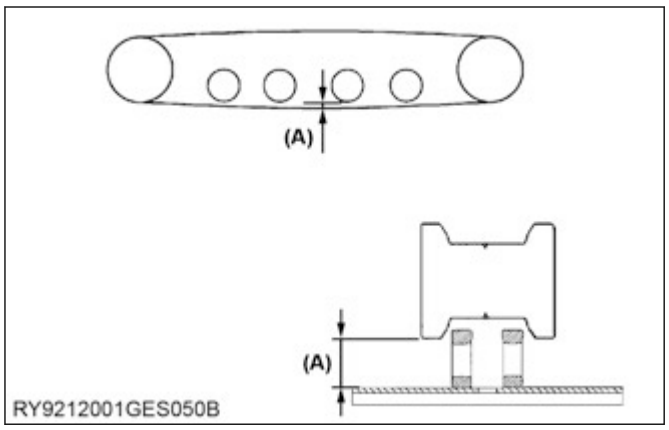
(22) Sprocket

3. Slowly rotate the travel motor forwards to mesh with the steel track.
4. Mesh with the steel track in a full circle and stop rotating the travel motor.
5. Set a support block under the track.



(23) Idler
(24) Track
(25) Support block

6. Adjust the hole position and install the master pin and locking pin.
7. Bend the tip of the locking pin.
8. Put grease into the grease fitting to extend the grease cylinder.
9. Adjust the distance between the steel track and track roller in range.
10. After adjustment, rotate the steel track two revolutions and check the distance.



(A) Tension dimension

Service specification

(A)	75 to 80 mm 3.0 to 3.1 in.

3.15 Rubber track

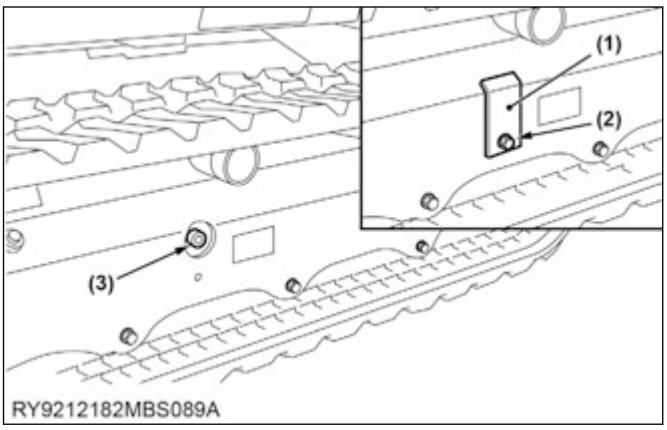
3.15.1 Removing and installing the rubber track

⚠ CAUTION
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **– Do not stand in front of the grease fitting.**
  - **– Loosen the grease fitting slowly.**

■ IMPORTANT
- **Be sure to install the rubber track in the correct direction.**
- **It is not possible to exchange the rubber track to the steel track due to the track frame structure.**

Removing

1. Remove the bolt and cover.



(1) Cover
(2) Bolt (M10 × 20)
(3) Grease fitting

2. Press a socket wrench onto the base of the grease fitting and loosen it slowly.
3. Jack up the machine and remove the grease from the grease cylinder completely.

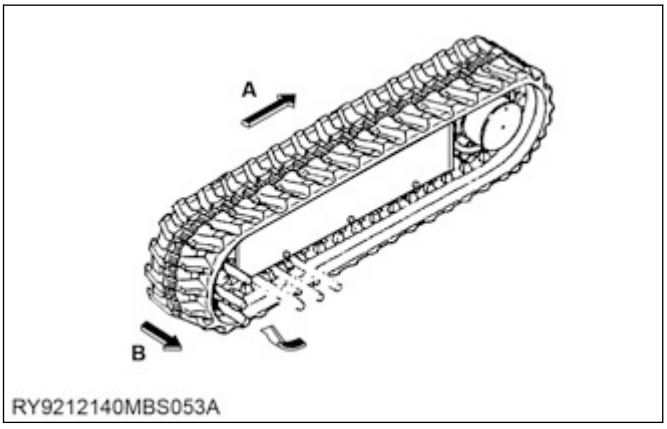
■ NOTE
- **The grease comes out by own weight of the track.**

4. Tighten the grease fitting.

Tightening torque

(3) Grease fitting	98.0 to 108.0 N·m 10.0 to 11.0 kgf·m 72.3 to 79.7 lbf·ft	-

5. Insert the three or four steel pipes between the rubber track links.
6. Slowly rotate the travel motor until rubber track derails from idler.
7. Remove the rubber track.



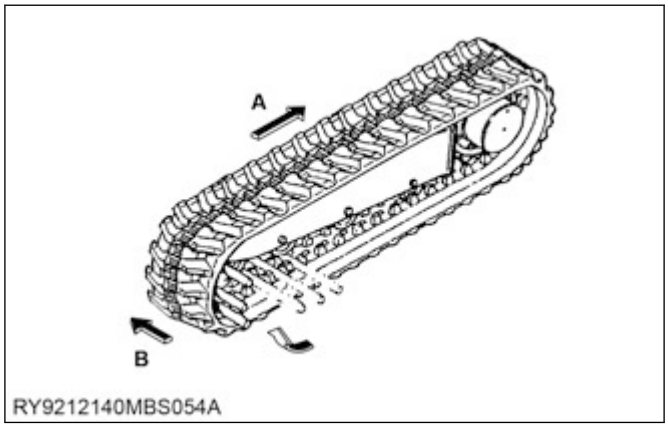
Mass

Rubber track	Approximately 124 kg Approximately 273 lbs

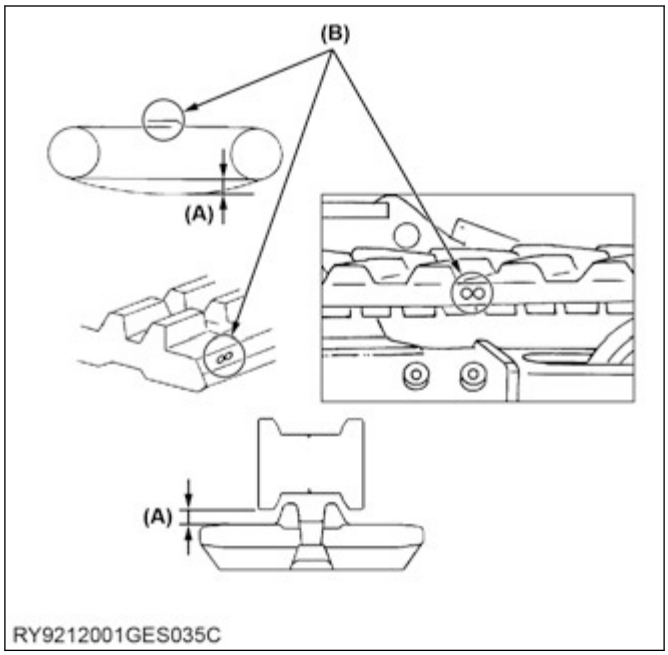
Installing

1. Jack up the machine and set the rubber track on the sprocket.

2. Insert three or four steel pipes in rubber track lower side.
3. Slowly rotate the travel motor forwards until the pipes comes between the idler and rubber track.
4. Stop rotating the travel motor.
5. Slide the rubber track to B direction to mesh the rubber track.



6. Remove the pipes.
7. Set the match mark right over the carrier roller.
8. Put grease into the grease fitting to extend the grease cylinder.
9. Adjust the distance between the rubber track and track roller in range.
10. After adjustment, rotate the rubber track two revolutions to check the distance.



(A) Tension dimension (B) Match mark

Service specification

(A)	10 to15 mm 0.39 to 0.59 in.	

3.16 Front idler

3.16.1 Removing the front idler

⚠ CAUTION

- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

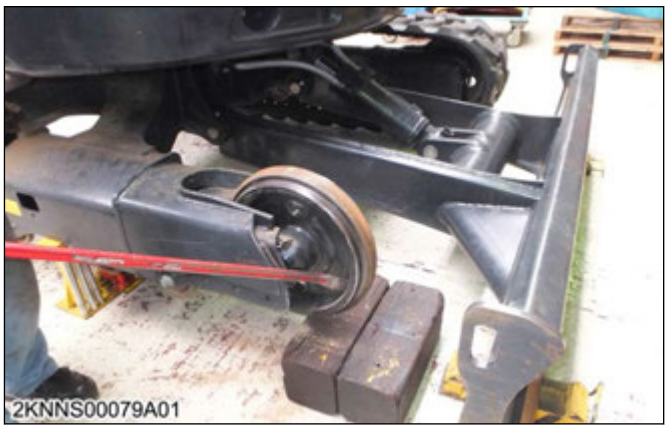
Preparing

1. Remove the track.

Removing

1. Jack up the machine and set the supporting block under the track frame.

2. Set the supporting block under the front idler and remove the front idler from the track frame.

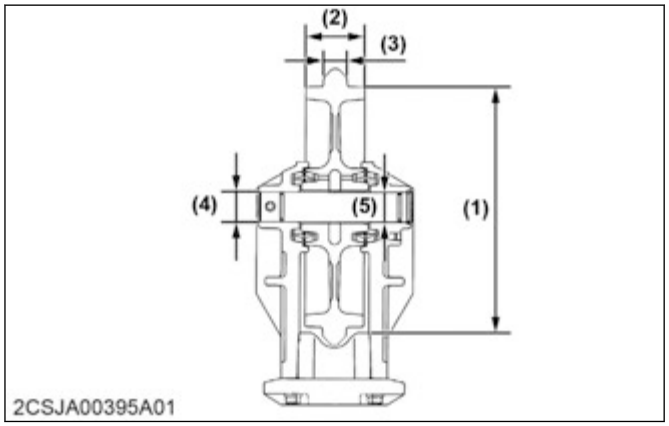


Mass

Front idler	Approximately 14.3 kg Approximately 31.5 lbs

Measuring

1. Check the front idler dimensions.



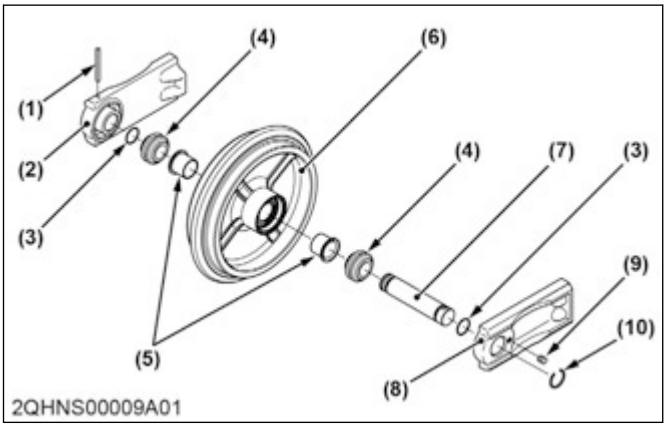
Service specifications

(1) Idler outer diameter	ϕ272 mm ϕ11.5 in.
(2) Guide width	30 mm 1.18 in.
(3) Idler width	72 mm 2.83 in.
(4) Shaft outer diameter	ϕ30 mm ϕ1.18 in.
(5) Bushing inner diameter	ϕ30 mm ϕ1.18 in.

Service limits

(1) Idler outer diameter	ϕ268 mm ϕ10.6 in.
(2) Guide width	26 mm 1.0 in.
(3) Idler width	-
(4) Shaft outer diameter	ϕ29 mm ϕ1.14 in.
(5) Bushing inner diameter	ϕ31 mm ϕ1.22 in.

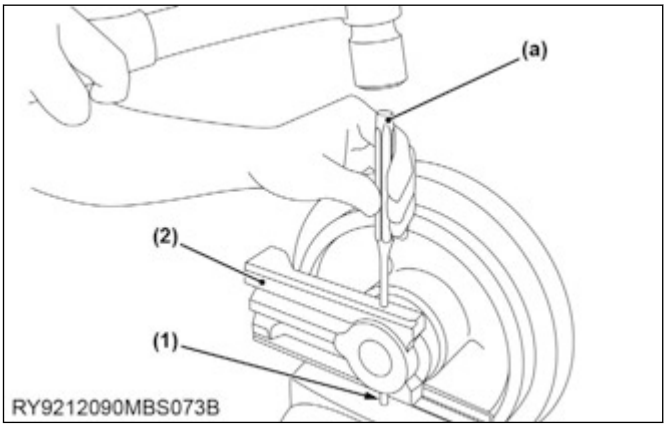
3.16.2 Front idler components



(1) Pin
(2) RH bracket
(3) O-ring
(4) Floating seal
(5) Bushing
(6) Idler
(7) Shaft
(8) LH bracket
(9) Plug (R1/8)
(10) External circlip

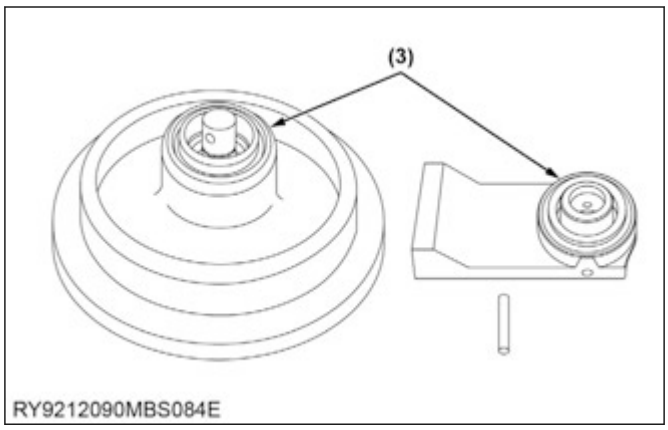
3.16.3 Disassembling the front idler

1. Remove the plug from RH bracket and drain the oil.
2. Remove the spring pin with a pin punch and remove the LH bracket.



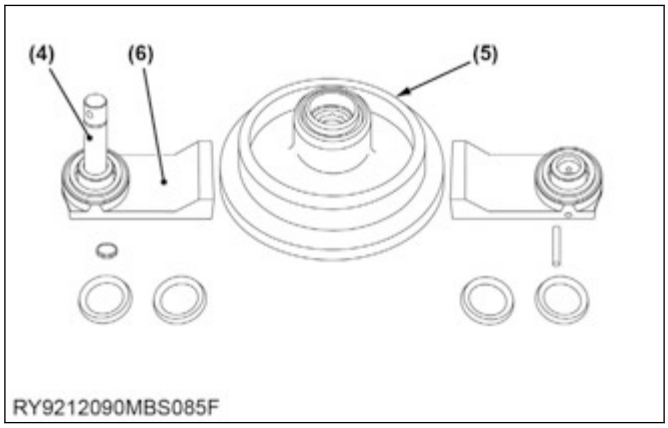
(1) Spring pin
(2) LH bracket
(a) Pin punch

3. Remove the floating seal.



(3) Floating seal

4. Remove the shaft and RH bracket from the idler.



(4) Shaft
(5) Idler
(6) RH bracket

3.16.4 Assembling the front idler

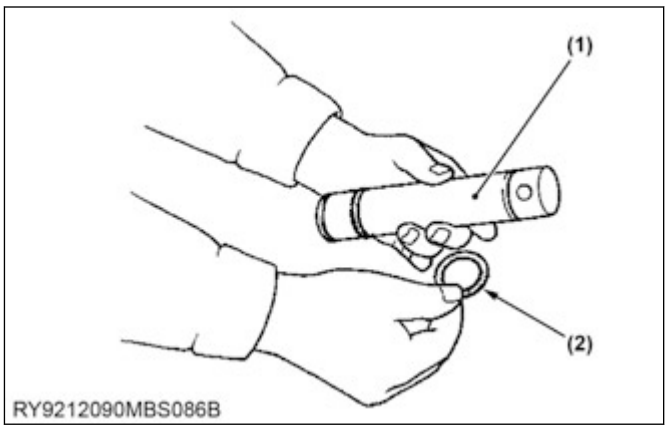
■ IMPORTANT

- **Clean the O-ring and installing portion.**
- **Lubricate the sliding surfaces of the floating seal.**
- **Do not twist the floating seal and O-ring.**
- **After assembling, rotate the front idler three revolutions to make an oil film on the sliding surface.**

1. Install the O-ring to the shaft.

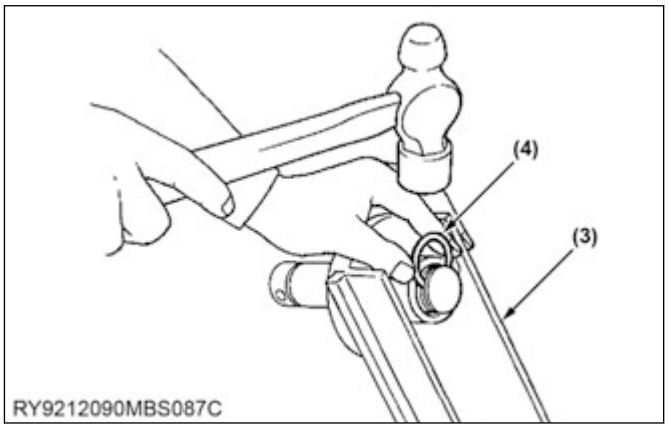
■ NOTE

- **Lubricate the O-ring.**



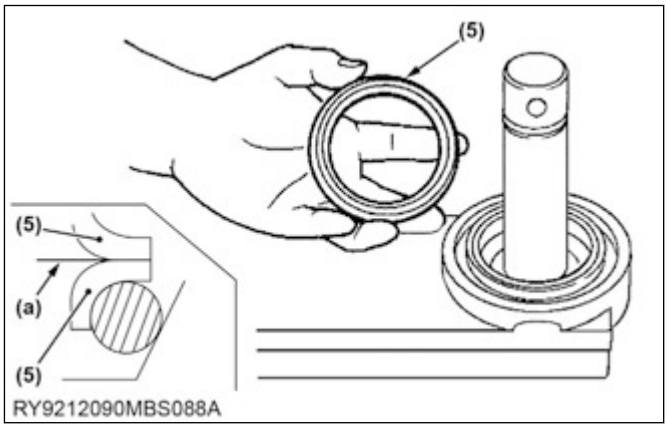
(1) Shaft
(2) O-ring

2. Install the shaft to the RH bracket.



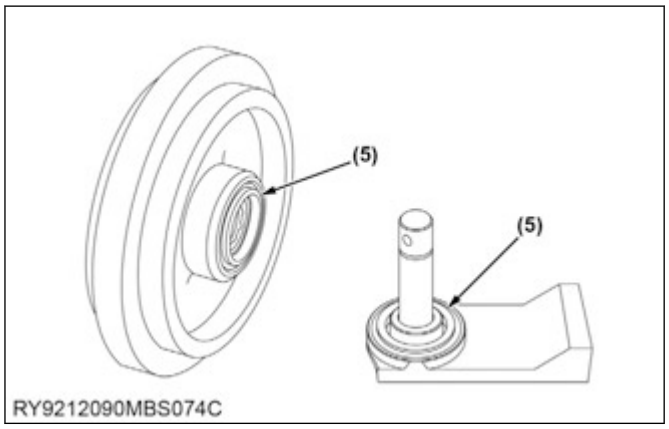
(3) RH bracket
(4) External circlip

3. Install one floating seal to the RH bracket.



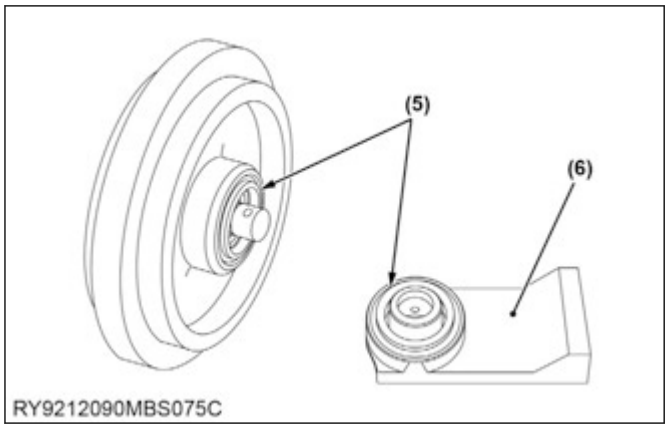
(5) Floating seal
(a) Sliding surfaces

4. Install a floating seal to the idler.



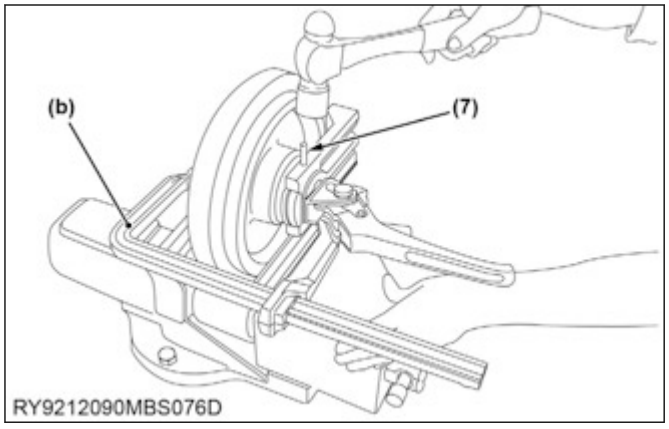
(5) Floating seal

5. Set a floating seal on the idler and LH bracket.



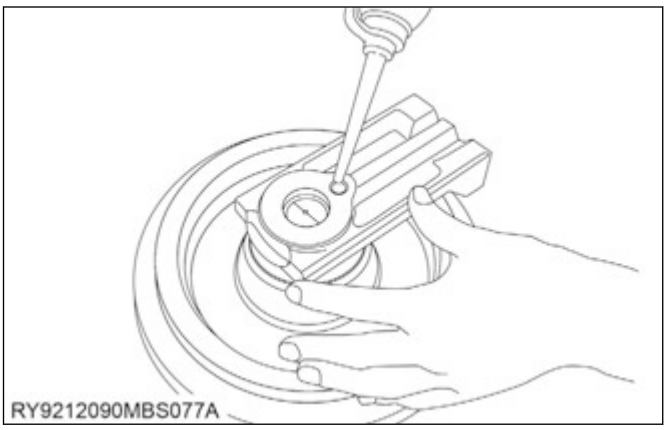
(5) Floating seal (6) LH bracket

6. Align the shaft hole and LH bracket hole and fix with a clamp.
7. Insert the spring pin.



(7) Spring pin (b) Clamp

8. Fill with engine oil from the plug hole.



Recommended lubricant

Front idler	Approximately 75 cc Approximately 4.57 cu.in.	CF, CF-4, CI-4, CJ-4 SAE #30CD

Tightening torque

Plug (R1/8)	10 N·m 1.0 kgf·m 7.4 lbf·ft	Thread lock (Loctite 262)

3.17 Tension spring

3.17.1 Removing and installing the tension spring

⚠ CAUTION

- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

Preparing

1. Remove the track.
2. Remove the front idler assembly.

Removing

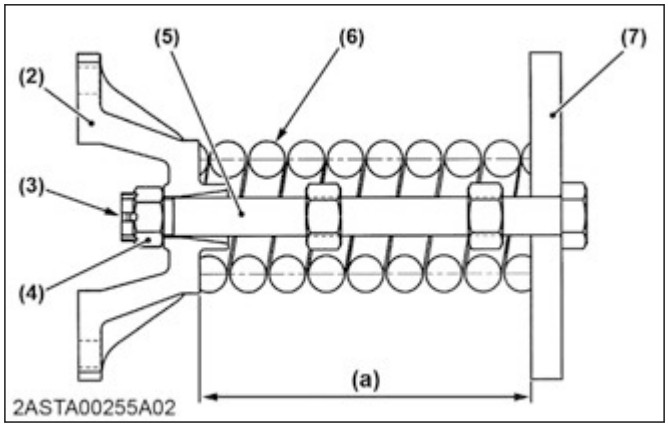
1. Remove the tension spring from the track frame.

(1) Tension spring

Mass

(1) Tension spring	Approximately 3.7 kg Approximately 8.2 lbs

Installing



(2) Spring seat
(3) Split pin
(4) Slotted nut
(5) Bolt
(6) Spring
(7) Spring seat

Service specifications

(a) Spring dimension	Steel track	173.8 to 174.8 mm 6.84 to 6.88 in.
	Rubber track	

3.18 Grease cylinder

3.18.1 Removing the grease cylinder

CAUTION
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

Preparing
1. Remove the track.
2. Remove the front idler assembly.
3. Remove the tension spring.

Removing
1. Remove the grease cylinder from the track frame.

(1) Grease cylinder

Mass

(1) Grease cylinder	Approximately 4.0 kg Approximately 8.8 lbs

3.19 Track roller

3.19.1 Removing and installing the track roller

CAUTION
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

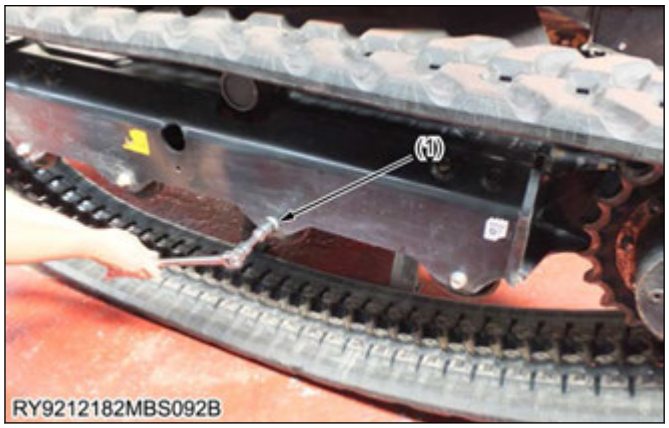
Preparing
1. Jack up the machine. Secure the machine on the jack stands.

Removing
1. Press a socket wrench onto the base of the grease fitting and loosen it slowly. Wipe away the grease.
2. Install the grease fitting after fully loosening the track.

Tightening torque

Grease fitting	98.0 to 107.8 N·m 10 to 11 kgf·m 72.0 to 79.5 lbf·ft	-

3. Remove the bolt and track roller.

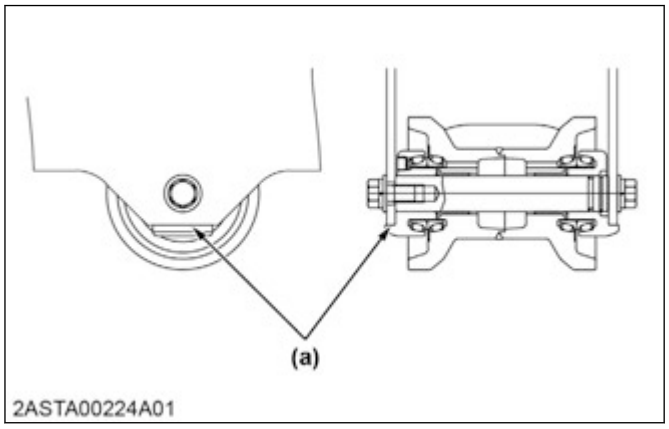


(1) Bolt (M16 × 40)

Mass

Track roller	Approximately 7.3 kg Approximately 16.1 lbs

Installing



Tightening torque

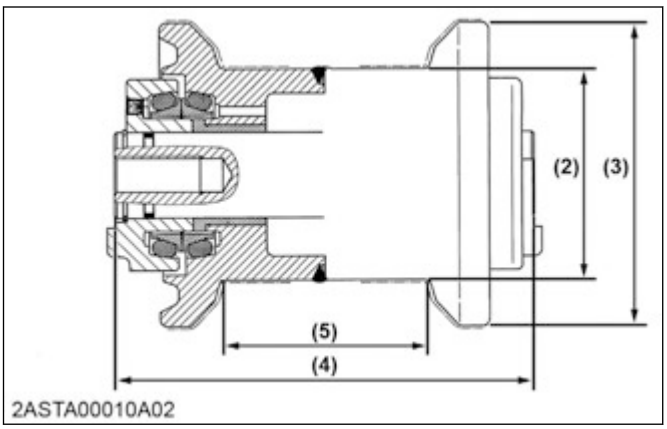
(1) Bolt	103.0 to 117.7 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 lbf·ft	Thread lock (female thread side) (Loctite 301-70)

Adjusting dimension

(a) Clearance	less than 2 mm less than 0.079 in.

Measuring

1. Check the track roller dimensions.



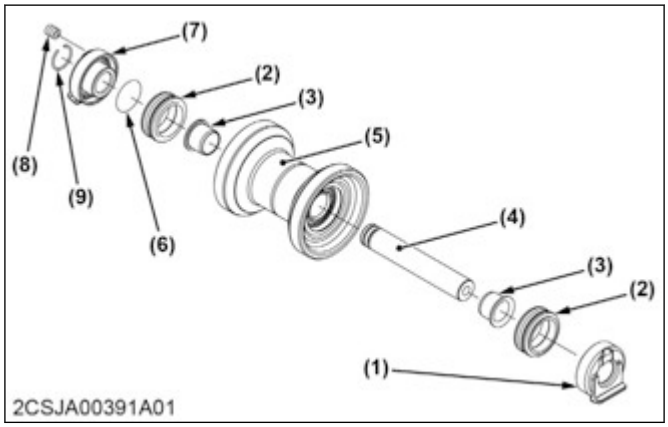
Service specifications

(2) Guide diameter	ϕ80 mm ϕ3.1 in.
(3) Outer diameter	ϕ124 mm ϕ4.9 in.
(4) Roller width	175 mm 6.9 in.
(5) Guide width	81 mm 3.2 in.

Service limits

(2) Guide diameter	ϕ65 mm ϕ2.8 in.
(3) Outer diameter	ϕ114 mm ϕ4.5 in.
(4) Roller width	-
(5) Guide width	91 mm 3.6 in.

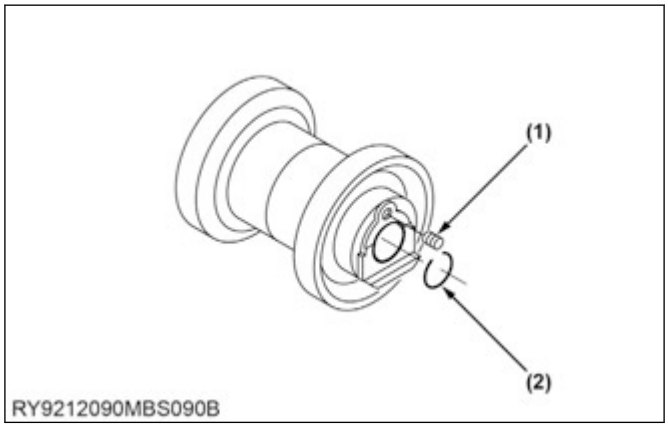
3.19.2 Track roller components



(1) Bracket 1
(2) Floating seal
(3) Bushing
(4) Shaft
(5) Track roller
(6) O-ring
(7) Bracket 2
(8) Plug (R1/8)
(9) External circlip

3.19.3 Disassembling the track roller

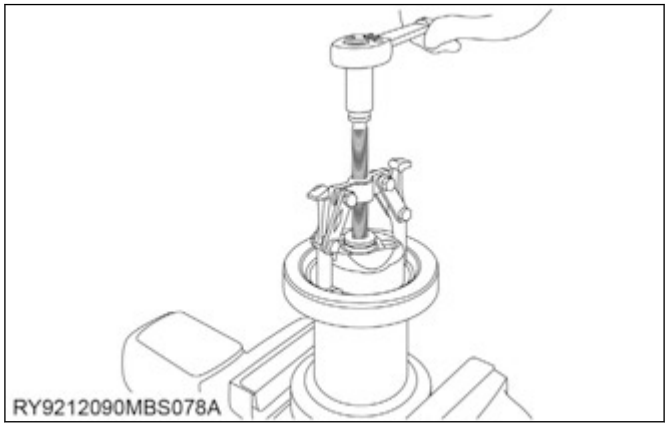
1. Remove the plug to drain the oil.



(1) Plug (R1/8)
(2) External circlip

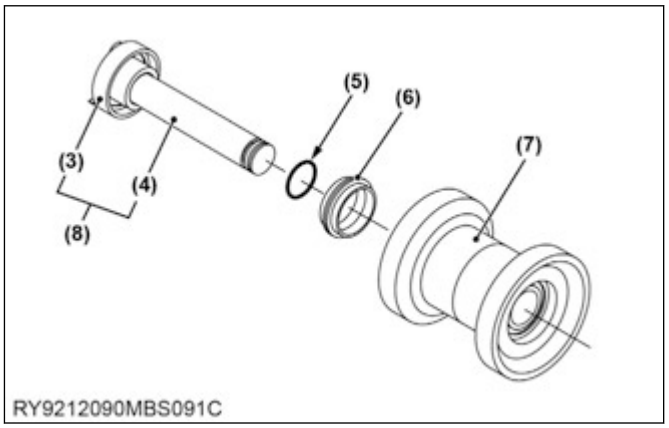
2. Remove the external circlip.
3. Remove the bracket and floating seal.

■ NOTE
- **Use a puller to remove the bracket.**



4. Remove the shaft assembly and floating seal.
5. Remove the shaft from the bracket 2.

■ NOTE
- **Use a press to remove the bracket 2.**

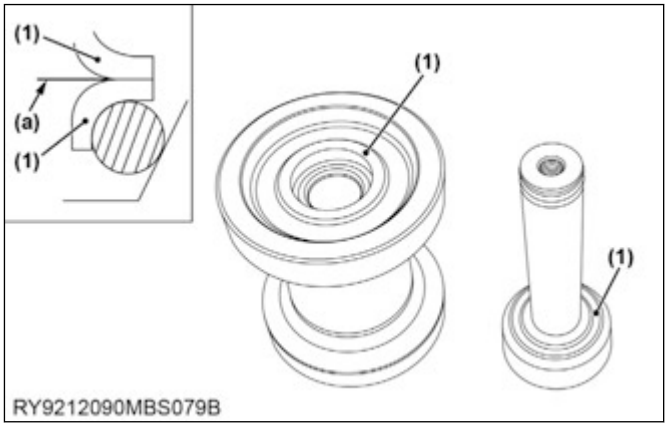


(3) Bracket 2
(4) Shaft
(5) O-ring
(6) Floating seal
(7) Track roller
(8) Shaft assembly

3.19.4 Assembling the track roller

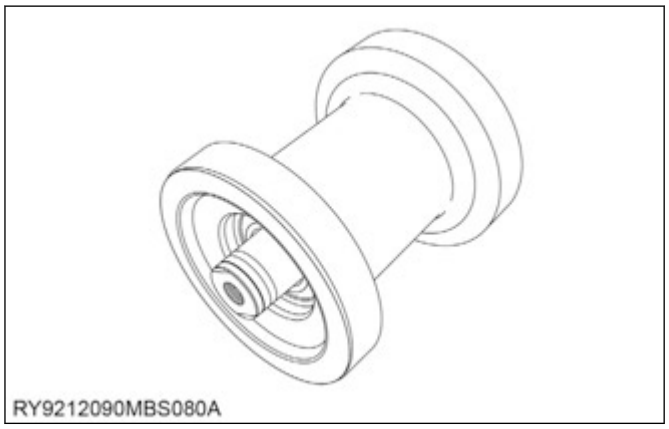
■ IMPORTANT
- **Clean the O-rings to assemble.**
- **Install floating seals and O-rings correctly. Do not kink or incline to install.**
- **Apply oil slightly to the sliding surface of the floating seals.**

1. Install the floating seal.

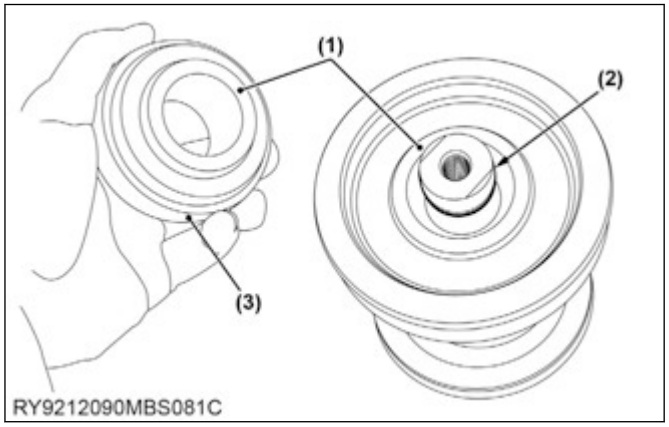


(1) Floating seal
(a) Sliding surface

2. Install the shaft assembly.


RY9212090MBS080A

3. Install the O-ring to the shaft assembly.
4. Install the floating seal and bracket 1.

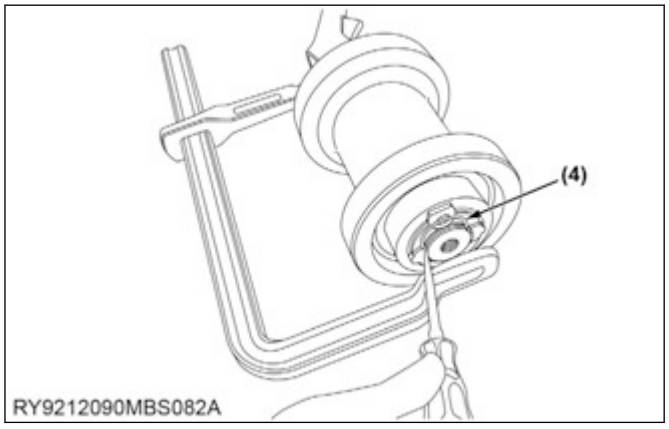


RY9212090MBS081C

(1) Floating seal
(2) O-ring
(3) Bracket 1

5. Install the external circlip.

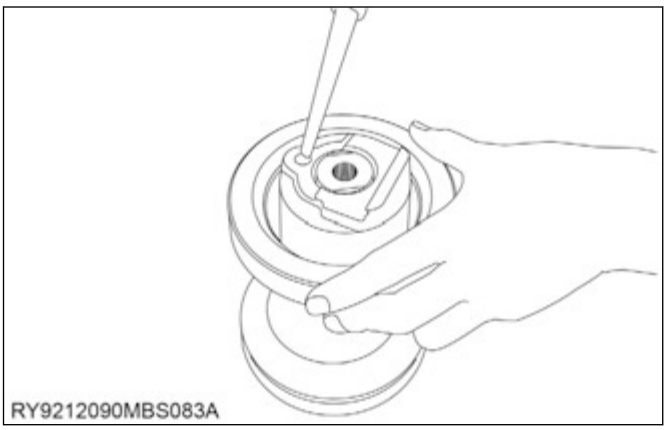
NOTE
- **Clamp the bracket 1 to install the external circlip.**



RY9212090MBS082A

(4) External circlip

6. Apply engine oil and install the plug.


RY9212090MBS083A

Recommended lubricant

Track roller	Approximately 80 cc Approximately 4.9 cu.in.	CF, CF-4, CI-4, CJ-4 SAE #30CD

Tightening torque

Plug	10 N·m 1.0 kgf·m 7.4 lbf·ft	Thread lock (Loctite 503)

3.20 Carrier roller

3.20.1 Removing and installing the carrier roller

CAUTION
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

Preparing

1. Jack up the machine. Secure the machine on the jack stands.

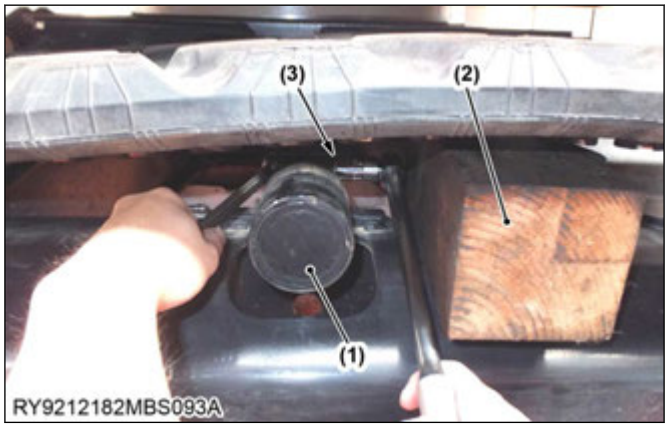
Removing

1. Press a socket wrench onto the base of the grease fitting and loosen it slowly. Wipe away the grease.
2. Install the grease fitting after fully loosening the track.

Tightening torque

Grease fitting	98.0 to 107.8 N·m 10 to 11 kgf·m 72.0 to 79.5 lbf·ft	-

3. Set a supporting block between the track and track frame.
4. Remove the nut and carrier roller.



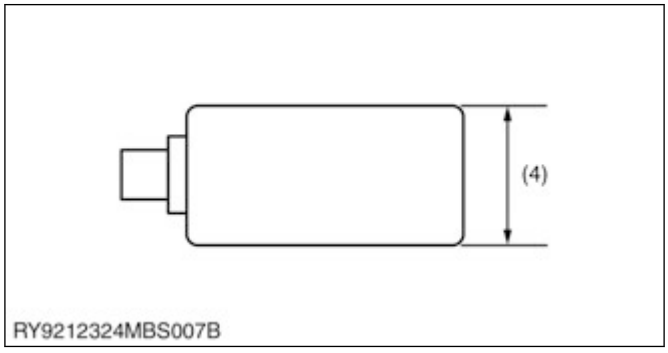
(1) Carrier roller
(2) Supporting block
(3) Nut

Mass

(1) Carrier roller	Approximately 2.4 kg Approximately 5.3 lbs

Measuring

1. Check the outer diameter.



Service specification

(4) Outer diameter	ϕ76.3 mm ϕ3.0 in.

Service limit

(4) Outer diameter	ϕ73.3 mm ϕ2.9 in.

Installing

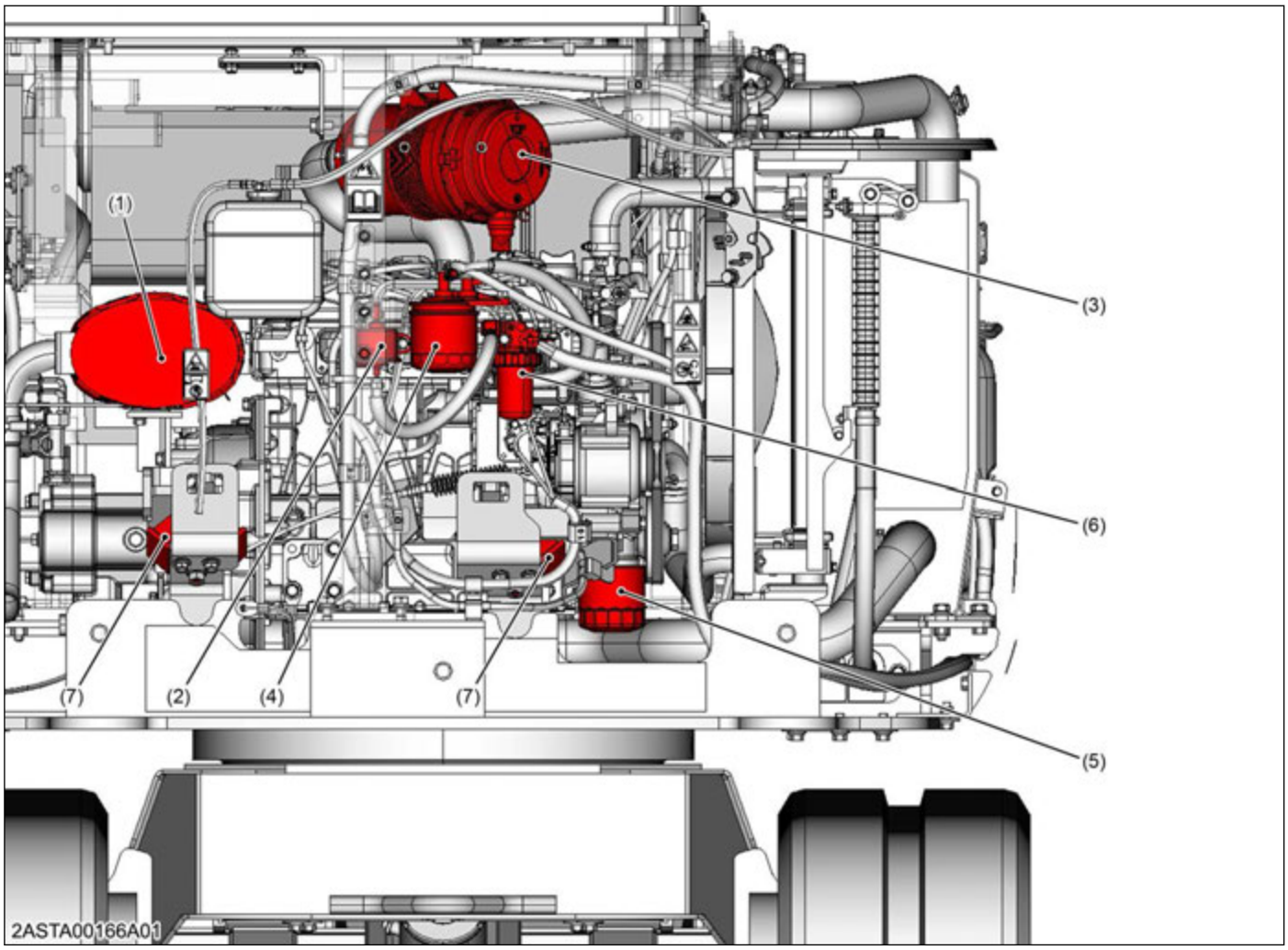
Tightening torque

(3) Nut	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft	Thread lock (Loctite 301-70)

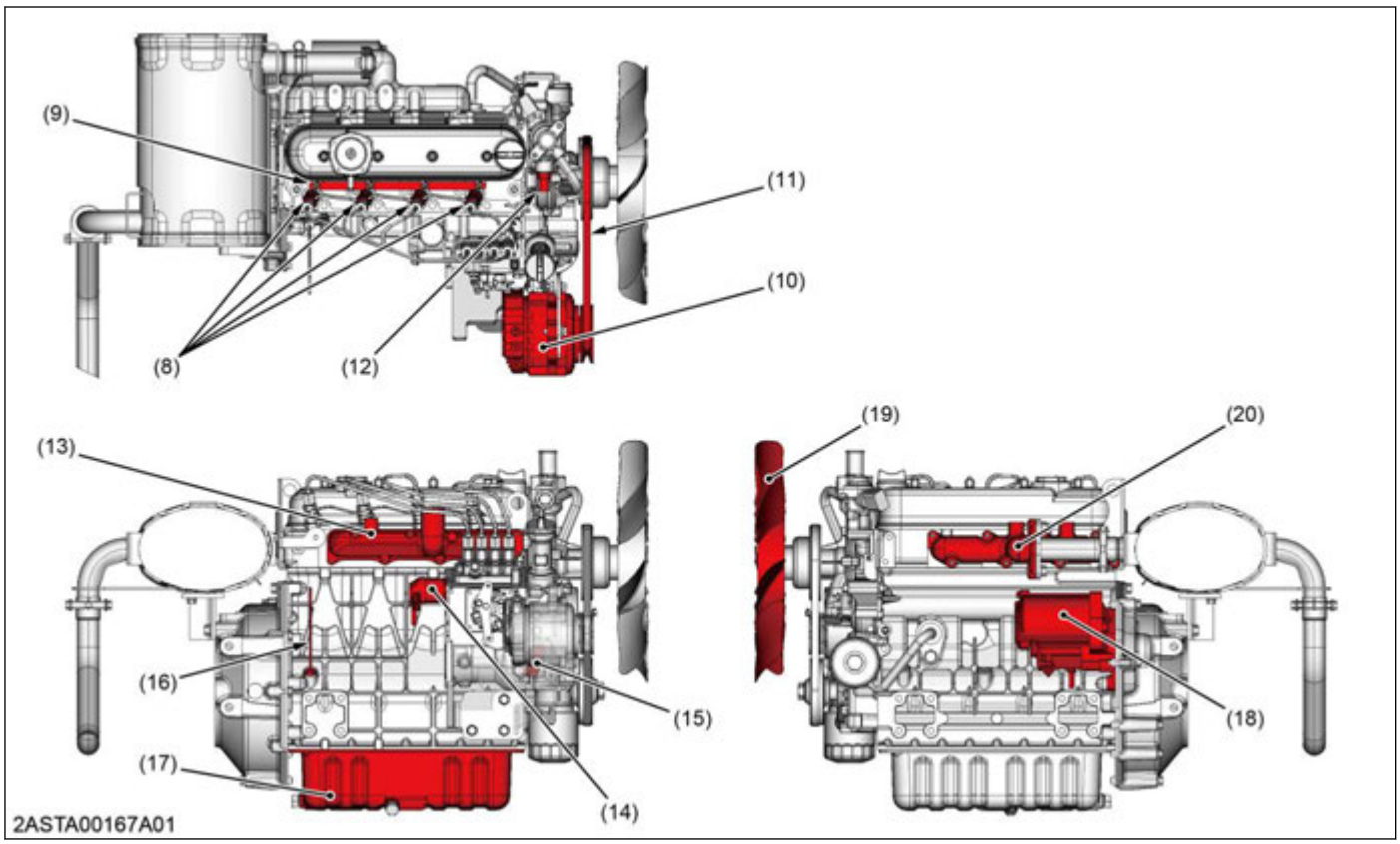
4. ENGINE

MECHANISM

1. Engine device layout



(1) Muffler
(2) Fuel pump
(3) Air cleaner
(4) Fuel filter
(5) Engine oil filter
(6) Water separator
(7) Vibration-proof rubber



(8) Injection nozzle
(9) Glow plug
(10) Alternator
(11) Fan belt
(12) Water temperature sensor
(13) Intake manifold
(14) Engine stop solenoid
(15) Engine speed sensor
(16) Engine oil gauge
(17) Oil pan
(18) Starter motor
(19) Fan
(20) Exhaust manifold

2. Engine specifications

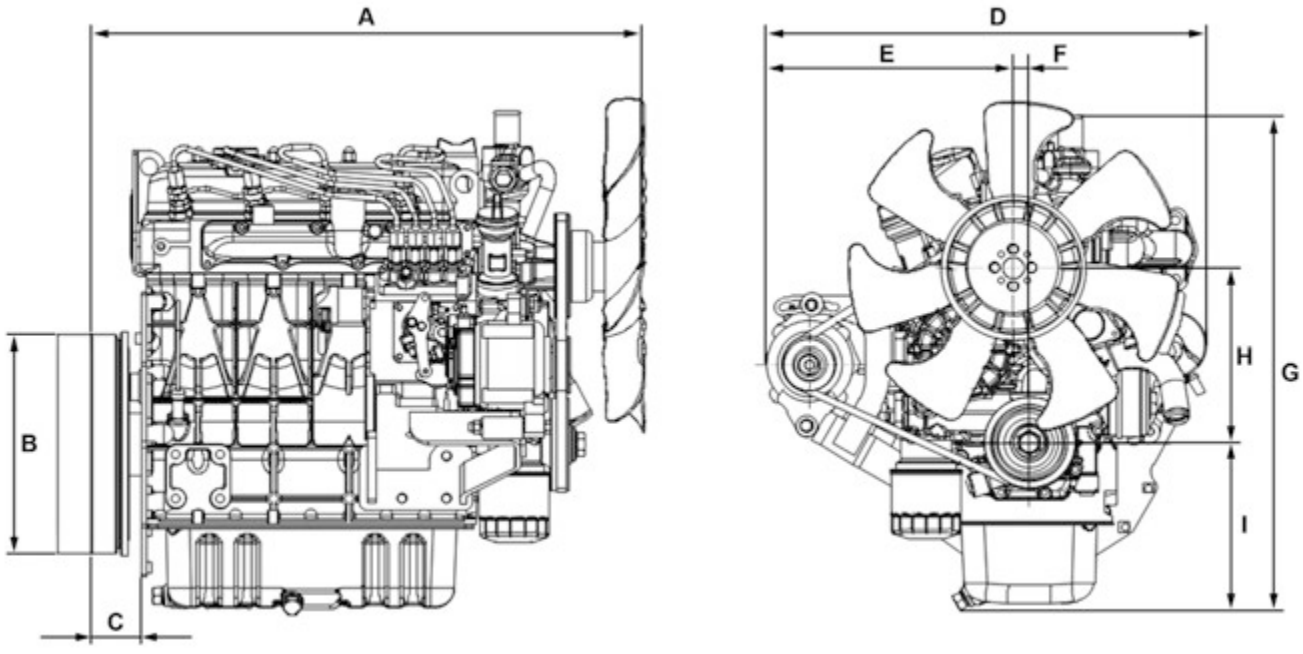
Items		Specifications
Model		V1505-E4-BH-3
Number of cylinders		4
Cylinder bore × stroke		78 × 78.4 mm 3.07 × 3.09 in.
Displacement		1498 cm^3 91.4 cu.in.
Idling speed	Cabin	1250 to 1350 min^{-1}(rpm)
	Canopy	1050 to 1150 min^{-1}(rpm)
Rated speed		2250 min^{-1}(rpm)
Maximum speed		2470 min^{-1}(rpm)
Compression ratio		24.0 : 1
Rated output / Speed	Net SAE J1349 ISO 9249	17.7 kW / 2250 min^{-1}(rpm) 23.7 HP / 2250 min^{-1}(rpm)
	Net ISO 3046, 2534	18.1 kW / 2250 min^{-1}(rpm) 24.3 HP / 2250 min^{-1}(rpm)
	Gross SAE J1349 ISO 9249	18.4 kW / 2250 min^{-1}(rpm) 24.7 HP/ 2250 min^{-1}(rpm)
Max torque / Speed	Net SAE J1349 ISO 9249	87.1 N·m / 1700 min^{-1}(rpm) 8.9 kgf·m / 1700 min^{-1}(rpm) 64.2 lbf·ft / 1700 min^{-1}(rpm)
	Net ISO 3046, 2534	88.1 N·m / 1700 min^{-1}(rpm) 9.0 kgf·m / 1700 min^{-1}(rpm) 65.0 lbf·ft / 1700 min^{-1}(rpm)
	Gross SAE J1349 ISO 9249	89.4 N·m / 1700 min^{-1}(rpm) 9.1 kgf·m / 1700 min^{-1}(rpm) 65.9 lbf·ft / 1700 min^{-1}(rpm)
Machine dimensions (L × W × H)		565.5 × 392.6 × 612.1 mm 22.3 × 15.5 × 24.1 in.
Dry weight		116 kg 256 lbs
Valve clearance		0.145 to 0.185 mm 0.0057 to 0.0073 in.
Fuel injection order		1-3-4-2
Combustion chamber		Swirl combustion chamber
Compression pressure		3.73 to 4.11 MPa 38.0 to 41.9 kgf/cm^2 541 to 596 psi
Fuel consumption (at rated speed)	Net (SAE)	264.6 g/kW·h 197.3 g/HP·h 0.435 lb/HP·h
	Net (ISO)	258.4 g/kW·h 192.7 g/HP·h 0.425 lb/HP·h
	Gross (SAE)	254.5 g/kW·h 189.9 g/HP·h 0.418 lb/HP·h

(Continued)

4. ENGINE

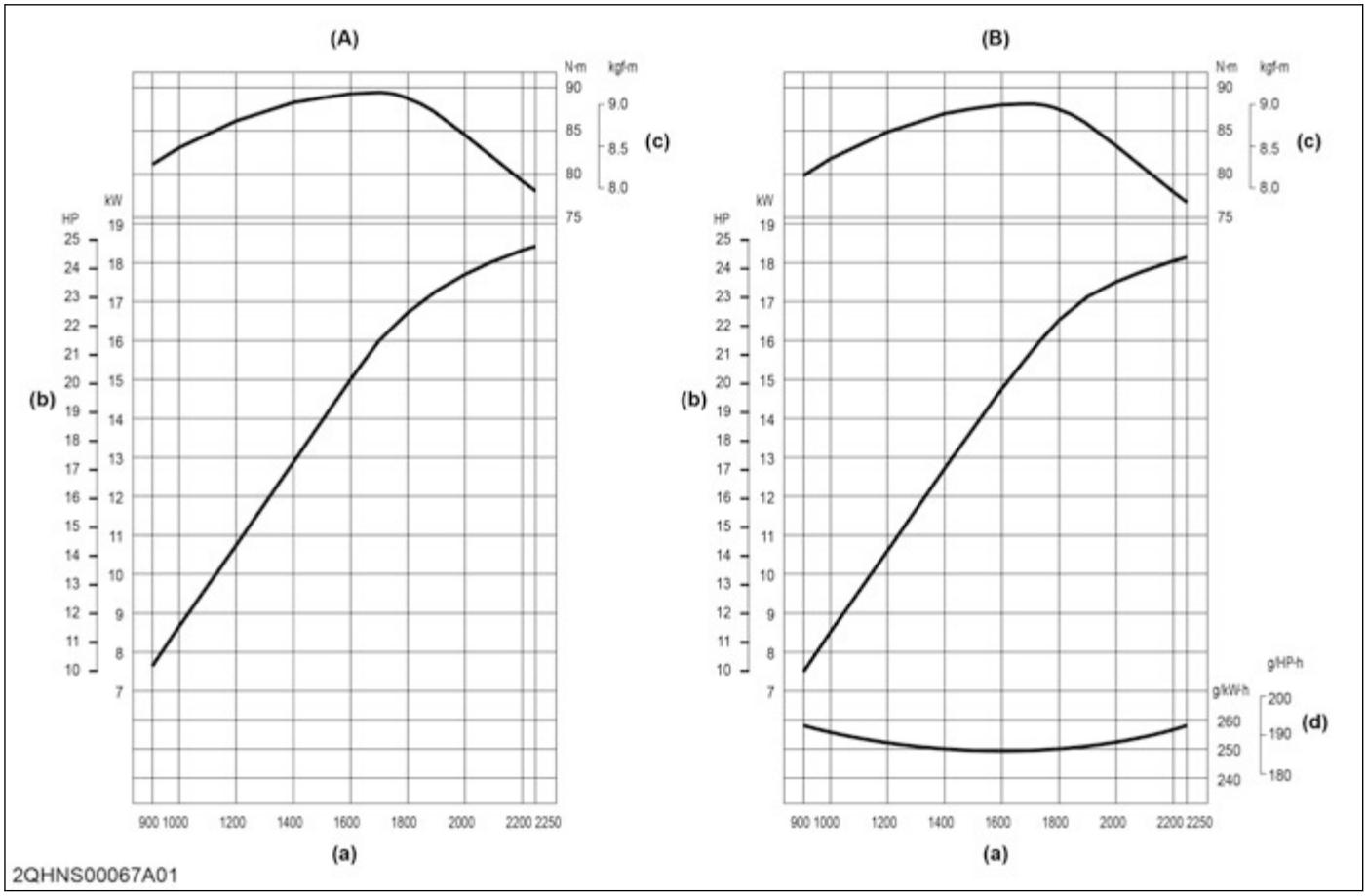
Items		Specifications
Fuel injection pressure		13.7 MPa 139.7 kgf/cm^2 1987 psi
Engine oil pressure (at rated speed)		196 to 441 kPa 2.0 to 4.5 kgf/cm^2 28.4 to 64.0 psi
Engine oil consumption (at rated speed)		0.50 g/kW·h 0.68 g/PS·h 0.00082 lb/HP·h
Alternator		12 V, 480 W
Charging current		40 A
Regulator adjusted voltage		14.2 to 14.8 V
Battery	JIS	80D26R
Battery fluid ratio		1.27 to 1.29%
Starter motor		12 V, 1.4 kW
Glow plug		1.0 Ω

3. Engine dimensions

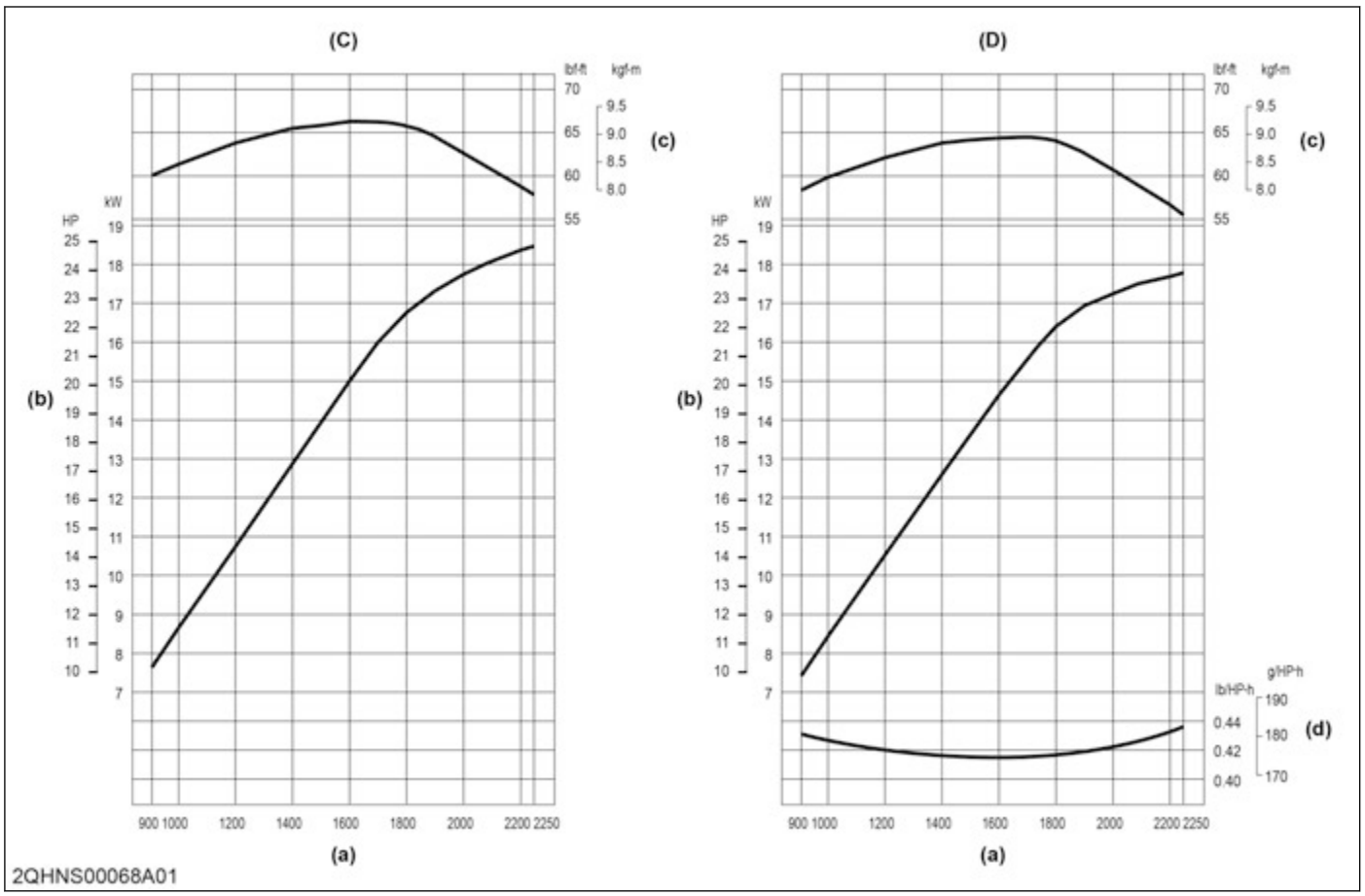


No.	Dimensions	No.	Dimensions
A	619 mm 24.4 in.	F	18 mm 0.7 in.
B	ϕ247 mm ϕ9.72 in.	G	567.2 mm 22.3 in.
C	56 mm 2.2 in.	H	200 mm 7.9 in.
D	503.8 mm 19.8 in.	I	192.7 mm 7.6 in.
E	238.4 mm 9.39 in.	-	-

4. Engine performance curves



(A) Net (ISO 3046, 2534)
(B) Gross (ISO 3046, 2534)
(a) Engine speed
(b) Output
(c) Torque
(d) Fuel consumption rate



(C) Net (SAE J1349, ISO 9249)
(D) Gross (SAE J1349, ISO 9249)
(a) Engine speed
(b) Output
(c) Torque
(d) Fuel consumption rate

SERVICING

1. Troubleshooting

1.1 Engine troubleshooting

The engine does not start

Causes	Inspections	Actions
The lever lock is in the LOCK position.	Check the position of the lever lock.	Raise the lever lock.
The fuel is too viscous.	Check the fuel filter, fuel tank and water separator.	Remove the water from the water separator. Replace the fuel filter. Replace the fuel.
Air or water is mixed in the fuel system.	Check the fuel filter, fuel tank and water separator.	Remove the water from the fuel tank or water separator. Purge the fuel line.
The engine oil and fuel become to too high viscous due to low temperature.	-	Use specified fuel or engine oil.
The battery voltage is too low. The starter motor speed is low.	Check the battery voltage.	Recharge or replace the battery.

Insufficient engine power

Causes	Inspections	Actions
The fuel level is low.	Check the fuel level by the fuel gauge.	Refuel.
The air cleaner is clogged.	Check if the air cleaner is clogged.	Clean the outer element. Replace the inner and outer element of the air cleaner.
Piston ring is damaged. Valve is damaged.	Check the engine compression pressure.	Follow the engine WSM to repair.

The exhaust gas color is abnormal

Causes	Inspections	Actions
The fuel quality is low.	-	Change to proper quality fuel.
Too much engine oil is filled.	Check the engine oil level with the engine oil gauge.	Drain the engine oil to adjust the oil level.

Overheating (the water temperature is in the red zone)

Causes	Inspections	Actions
The coolant level is low.	Check the coolant level in the reserve tank.	Fill the reserve tank with the coolant.
The radiator fins are clogged.	Check if the radiator fins are clogged. Check the coolant pipe.	Clean the radiator.
The radiator cap is damaged.	Check the radiator cap.	Replace the radiator cap.
The thermostat is damaged.	Check the thermostat.	Replace the thermostat.

(Continued)

Causes	Inspections	Actions
The engine oil level is low.	Check the engine oil level with the engine oil gauge.	Fill with the engine oil.
The fan belt is damaged.	Check the fan belt. Check the tension of the fan belt.	Replace the fan belt. Adjust the fan belt tension.
The water pump seal is damaged.	Check the water pump seal.	Replace the water pump seal.
Rust is mixed in the coolant.	Check the condition of the coolant.	Replace the coolant.
The cylinder head gasket is damaged.	Check the damage and oil leakage around the cylinder head.	Replace the cylinder head gasket.
The fuel injection timing is incorrect.	Check if the injection timing is correct.	Adjust the injection timing.
Low quality fuel.	-	Change to the recommended quality fuel.

2. Service specifications

2.1 Service specifications for engine

Items			Units	Service specifications		Service limits
				Value	Tolerance	Value
Pressure	Compression pressure		MPa kgf/cm^2 psi	3.92 40.0 569	±0.19 ±2.0 ±28	2.26 23.0 327
	Engine oil	Idling	kPa kgf/cm^2 psi	-	-	49 0.5 7.1
		Rated speed	kPa kgf/cm^2 psi	319 3.25 46.25	±122 ±1.25 ±17.75	147 1.5 21.3
Dimension	Fan belt		mm in.	8.0 0.32	±1.0 ±0.04	-

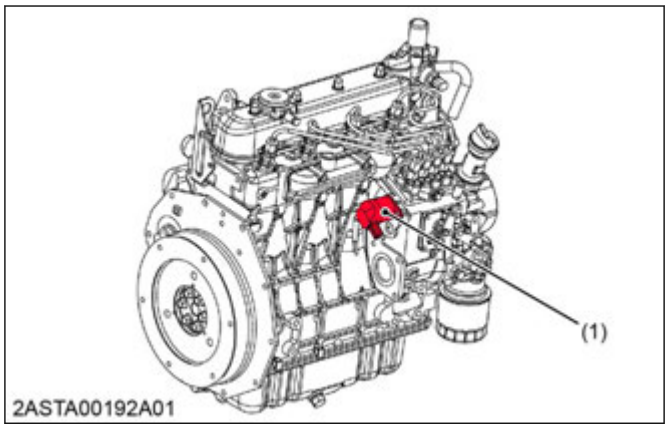
3. Testing

3.1 Measuring engine compression pressure

CAUTION
- **Keep hands and body away from the rotating fan and belt.**

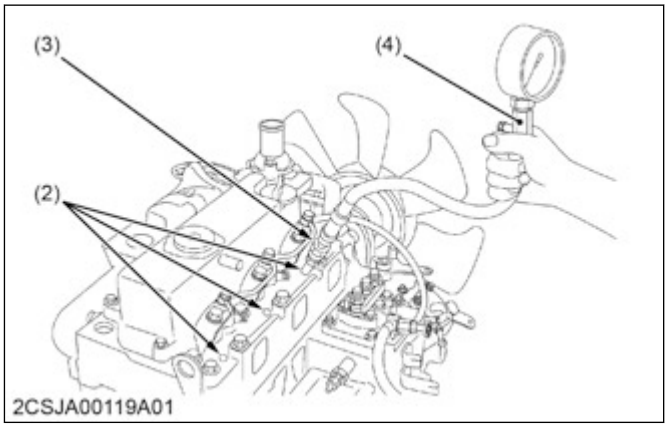
IMPORTANT
- **Measure each cylinder individually to measure the correct value.**

Preparing
1. Warm up the engine.
2. Stop the engine.
3. Disconnect the connector of the engine stop solenoid to stop the supply of fuel.



(1) Engine stop solenoid

4. Remove all of the glow plugs and install a compression tester with adapter to the glow plug hole.



(2) Glow plug hole
(3) Adapter
(4) Compression tester

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

Service specification

Compression pressure	3.73 to 4.11 MPa 38.0 to 42.0 kgf/cm^2 541 to 597 psi

Service limit

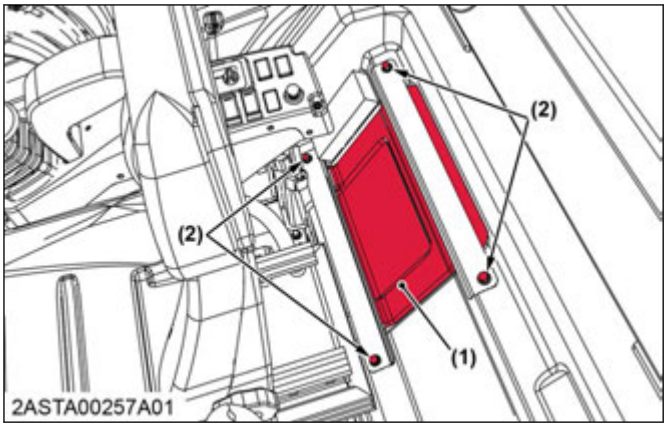
Compression pressure	2.26 MPa 23.0 kgf/cm^2 327 psi

3.2 Measuring engine oil pressure

CAUTION
- **Do not work soon after the engine has stopped.**

– Engine, fuel, and oil are extremely hot.
– Pressure in the engine oil line is high.
- **Keep hands and body away from the rotating fan and belt.**
- **Make sure the lever lock is raised before the measuring.**

Preparing
1. Move the operator seat forwards.
2. Remove the four bolts and the cover.

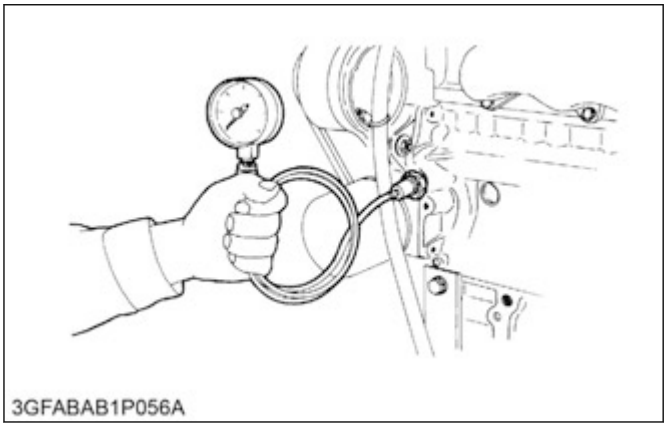


(1) Cover (2) Bolt (M8 × 16) ×4

3. Remove the engine oil pressure switch.

(3) Engine oil pressure switch

4. Install a pressure tester.



■ IMPORTANT
- **Wrap the thread seal tape to the pressure tester adapter to avoid oil leakage.**

5. Warm up the engine.

Measuring
1. Start the engine.
2. Measure the engine oil pressure at the idling speed.
3. Measure the oil pressure at the rated speed.
4. After measuring the engine oil pressure, install the engine oil pressure switch with the specified torque.

■ IMPORTANT
- **Wrap the thread seal tape to the engine oil pressure switch to avoid oil leakage.**

Tightening torque

Engine oil pressure switch	15 to 19 N·m 1.5 to 2.0 kgf/cm^2 11 to 14 lbf·ft	-

Service specifications

Engine oil pressure	At rated speed	197 to 441 kPa 2.0 to 4.5 kgf/cm^2 28.5 to 64.0 psi

Service limits

Engine oil pressure	At idling speed	49 kPa 0.5 kgf/cm^2 7.1 psi
	At rated speed	147 kPa 1.5 kgf/cm^2 21.3 psi

4. Repairing

4.1 Fuel hose and tank

4.1.1 Removing and installing fuel tank

⚠ CAUTION
- **Lower the front attachments to the ground and stop the engine.**
- **Keep fire and flammable items away from the working area.**

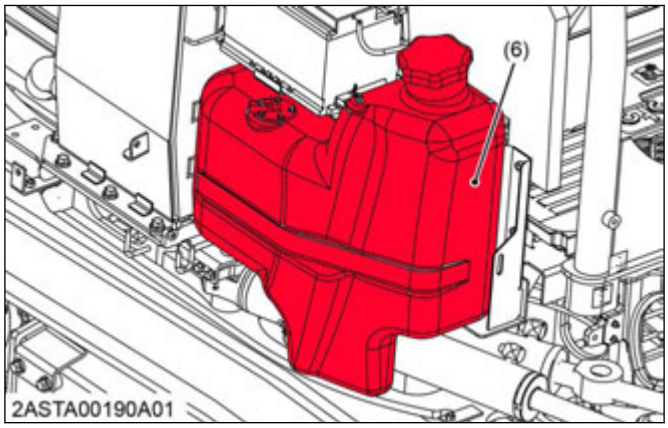
Removing
1. Remove the RH cover and RH bonnet.

(1) RH cover (2) RH bonnet

2. Remove the band.
3. Disconnect the fuel hoses and connector.

(3) Band (5) Connector
(4) Fuel hose

4. Remove the fuel tank.



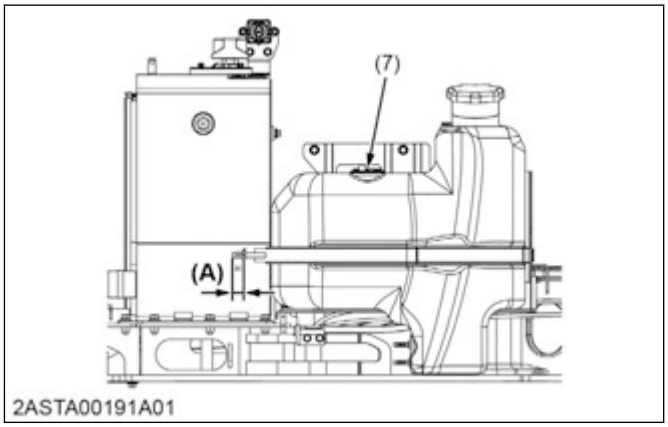
(6) Fuel tank

Mass

(6) Fuel tank	Approximately 4 kg Approximately 8.8 lbs

NOTE
- **This value is fuel tank empty weight.**

Installing



(7) Fuel sensor bolt

Tightening torque

(7) Fuel sensor bolt	3 to 4 N·m 0.3 to 0.4 kgf·m 2 to 3 lbf·ft	-

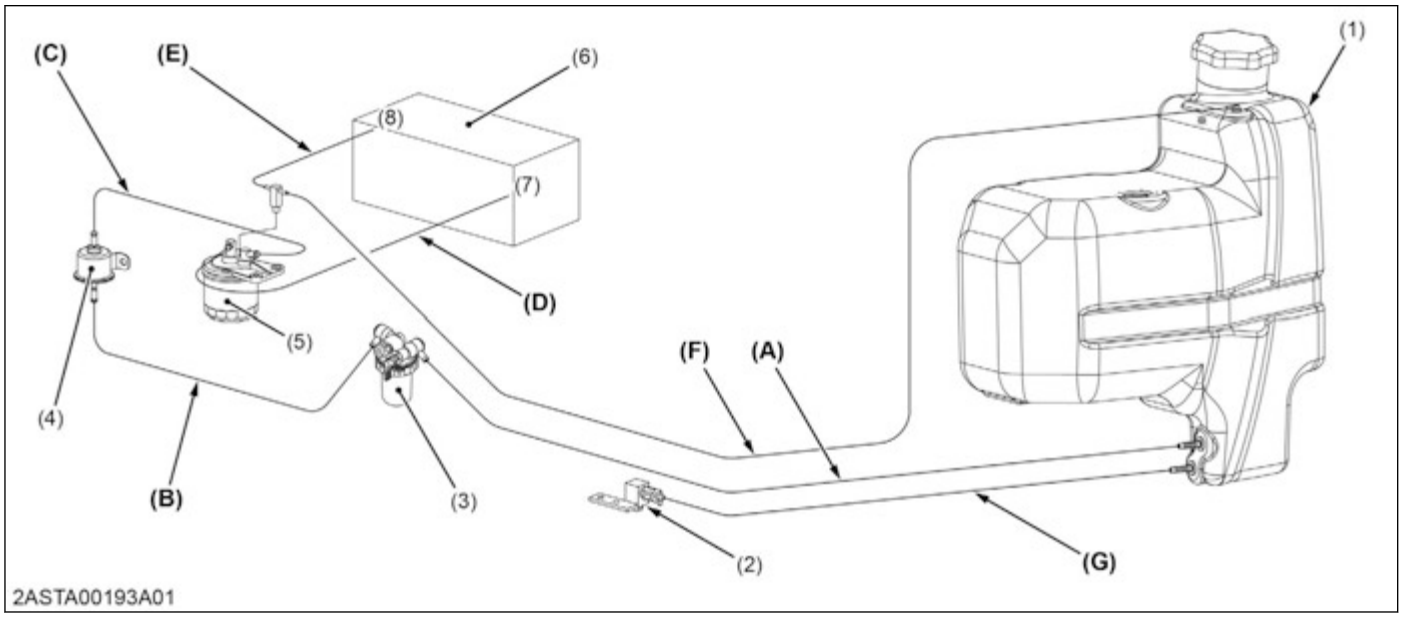
Adjusting dimension

(A)	24 to 30 mm 0.94 to 1.18 in.

4.1.2 Fuel hose routing

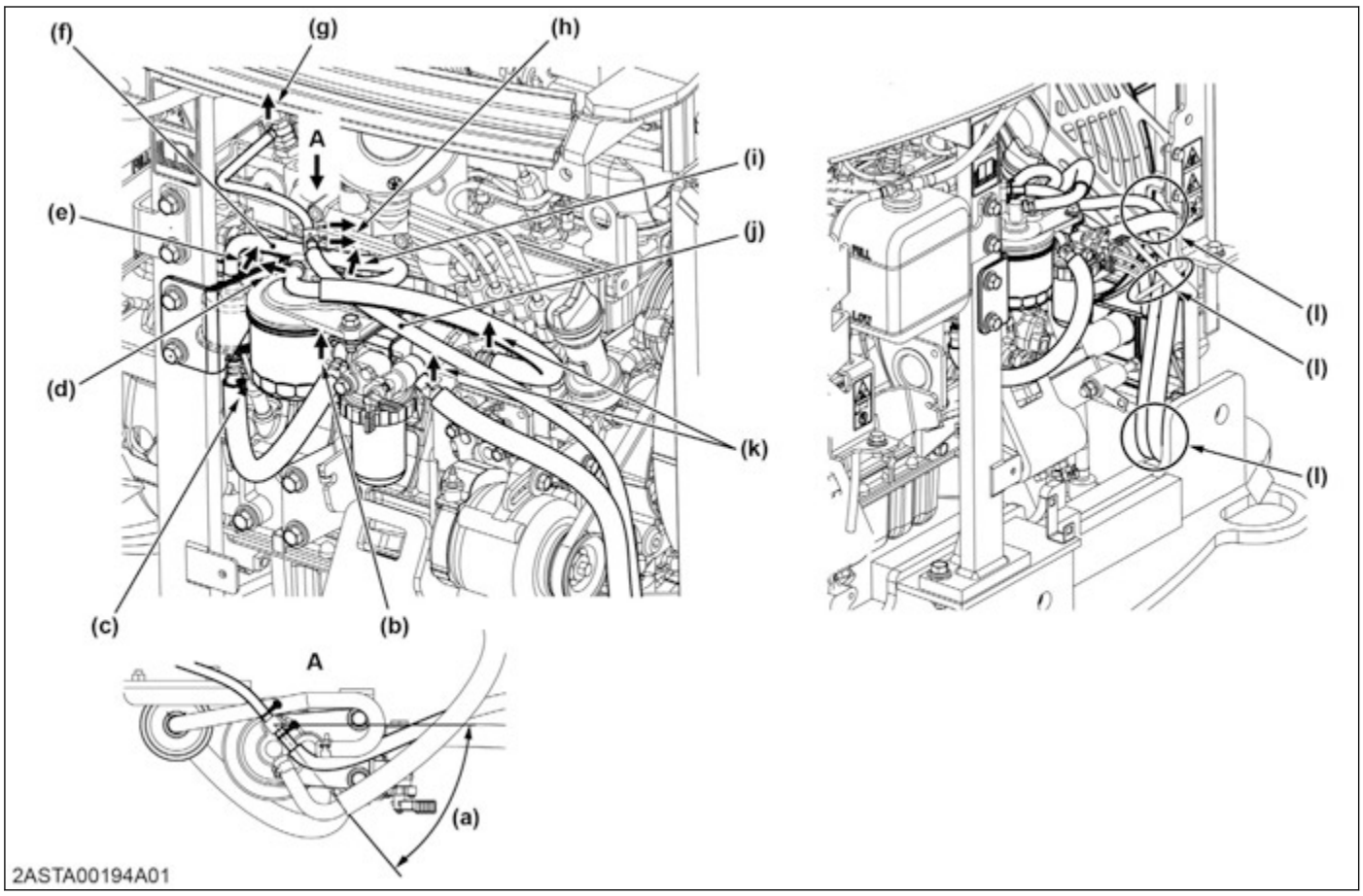
⚠ CAUTION

- **Do not contact the fuel hoses to sharp edges, high temperature parts, and rotating parts.**
- **Do not stretch the fuel hoses excessively.**
- **Do not clamp with electrical wiring.**

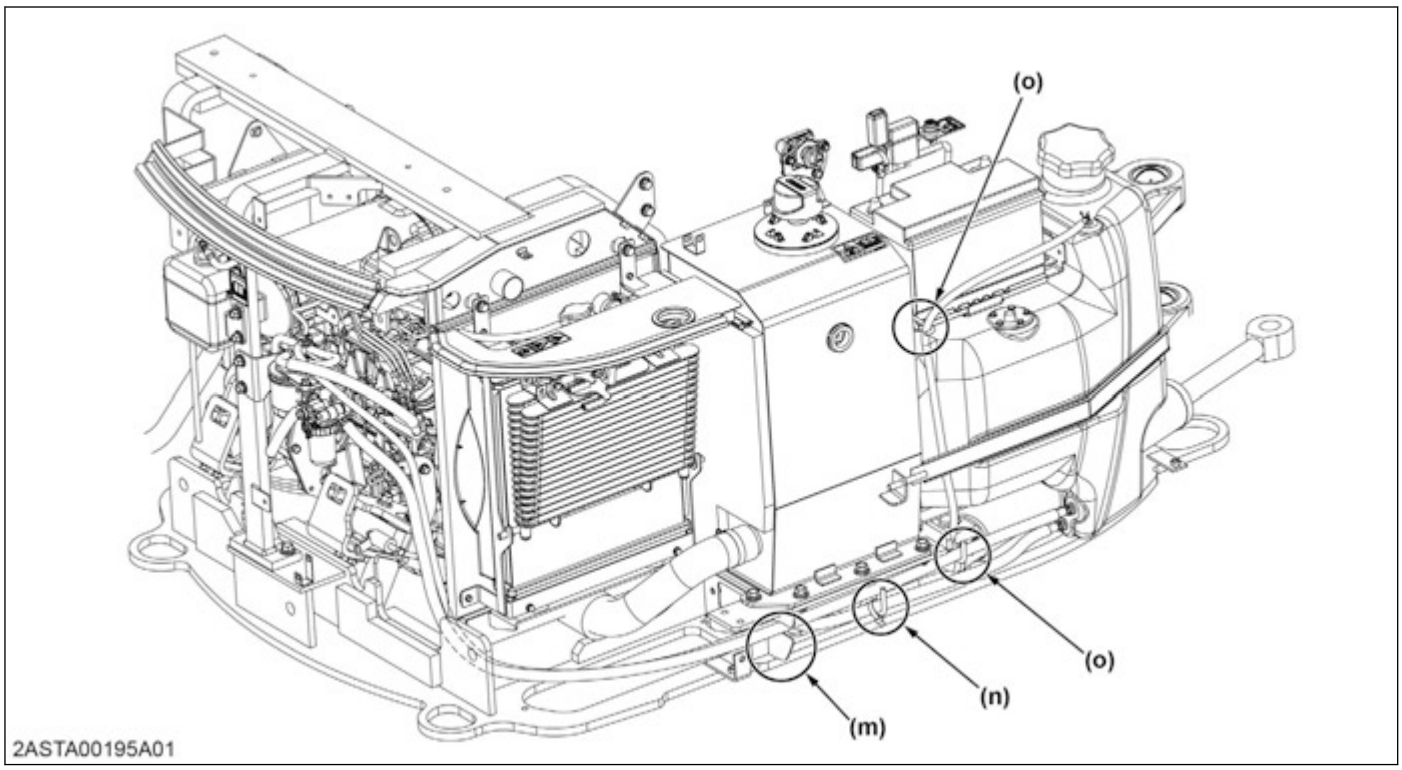


(1) Fuel tank
(2) Drain
(3) Water separator
(4) Fuel pump
(5) Fuel filter
(6) Engine
(7) Injection pump
(8) Return

No.	Hose		Protection tube	
	Length	Inner diameter	Length	Inner diameter
(A)	1780 mm 68.9 in.	ϕ9 mm ϕ0.35 in.	1630 mm 64.2 in.	ϕ15 mm ϕ0.59 in.
(B)	300 mm 11.8 in.	ϕ9 mm ϕ0.35 in.	230 mm 9.1 in.	ϕ15 mm ϕ0.59 in.
(C)	306 mm 12.0 in.	ϕ8 mm ϕ0.31 in.	-	-
(D)	360 mm 14.2 in.	ϕ8 mm ϕ0.31 in.	230 mm 9.1 in.	ϕ15 mm ϕ0.59 in.
(E)	320 mm 12.6 in.	ϕ5 mm ϕ0.20 in.	-	-
(F)	2500 mm 98.4 in.	ϕ5 mm ϕ0.20 in.	2400 mm 94.5 in.	ϕ10 mm ϕ0.39 in.
(G)	600 mm 23.6 in.	ϕ8 mm ϕ0.31 in.	490 mm 19.3 in.	ϕ15 mm ϕ0.59 in.



- (a) 50°
- (b) Align the clamp face up.
- (c) Align the clamp face right 45°.
- (d) Align the clamp face out.
- (e) Align the clamp face engine side.
- (f) Hose (fuel pump to fuel filter) should not contact with adapter and bracket.
- (g) Align the clamp face up.
- (h) Align the clamp face out.
- (i) Align the clamp face out.
- (j) Hose (fuel filter to tank) should not contact with hose (fuel filter to fuel pump).
- (k) Face the clamp to angle up.
- (l) Pass through the guide.



- (m) Pass through the notch.
- (n) Clamp with guide.
- (o) Pass through the guide.

4.2 Engine

4.2.1 Removing and installing engine

CAUTION

- **Do not work soon after stopped the engine.**
  - **Engine, fuel, and oil are extremely hot.**
  - **Pressure in the fuel line is high.**
- **Do not install the fuel hose as below.**
  - **Contact to sharp edges, high temperature parts, and rotating parts.**
  - **Stretch excessively, deform, or clamp with electrical wiring.**
- **Keep fire and flammable items away from the working area.**

IMPORTANT

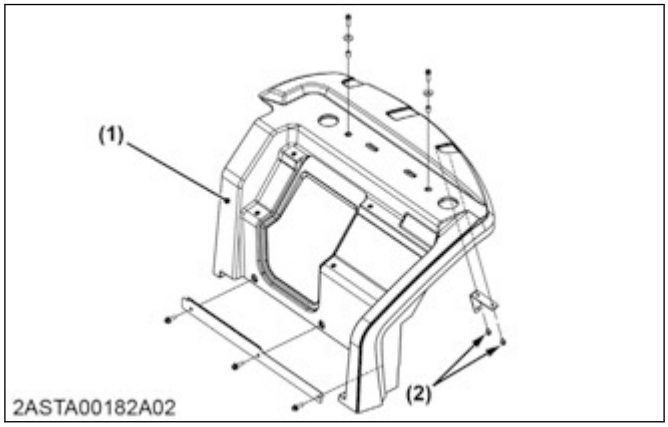
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**
- **Install plugs or covers to the removed fuel hoses, radiator hoses, and air conditioning hoses to avoid dust contamination.**

Preparing

1. Disconnect the battery cable from negative (-) terminal.
2. Install the vacuum pump to the hydraulic oil tank and vacuum the hydraulic oil tank.
3. Drain the coolant.
4. Remove the rear and RH bonnets, LH cover, and LH swivel cover.
5. Remove the rear bonnet hinge, stay, and partition plate.
6. Remove the cabin or canopy.
7. Remove the counterweight.
8. Remove the muffler.
9. Disconnect all of the hydraulic hoses from the hydraulic pump.
10. Remove the hydraulic pump.

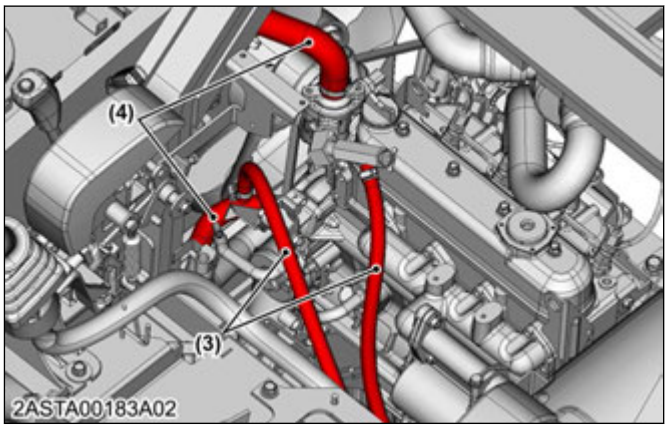
Removing

1. Remove the 7 bolts and the center bonnet.



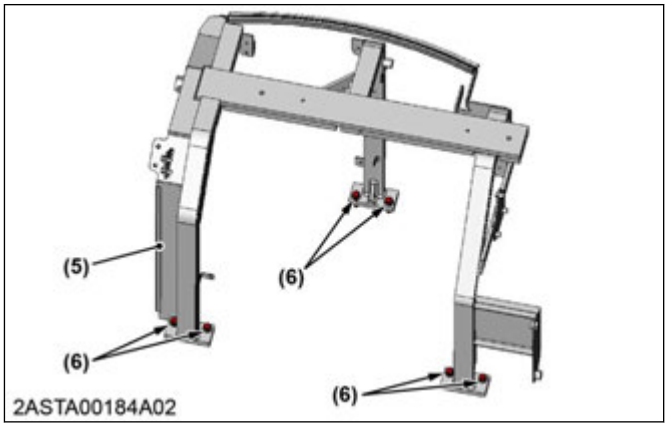
(1) Center bonnet (2) Bolt (M8 × 16) ×7

2. Disconnect the heater and radiator hose.



(3) Heater hose (4) Radiator hose

3. Disconnect all of the connectors for engine speed sensor, water temperature sensor, engine stop solenoid, oil pressure switch, glow plug, alternator, and starter motor.
4. Disconnect the ground cable.
5. Disconnect all of the fuel hose.
6. Remove the accelerator cable.
7. Remove the 6 bolts and the arch frame.

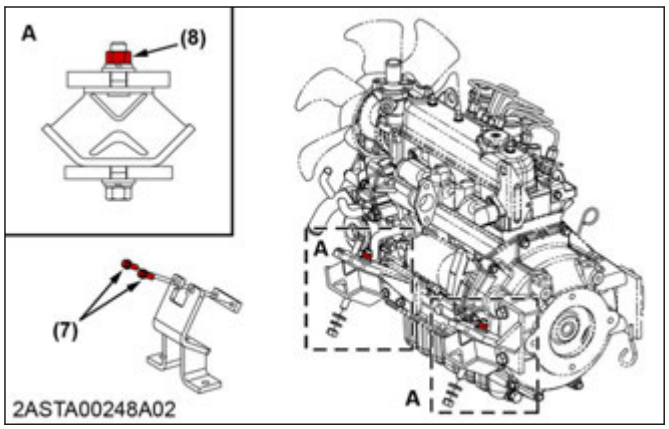


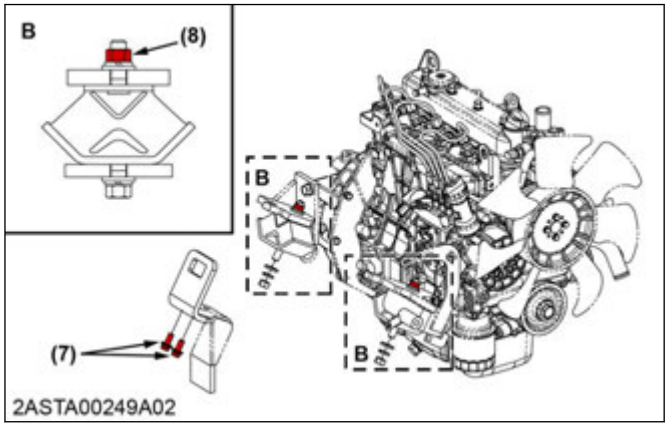
(5) Arch frame (6) Bolt (M12 × 45) ×6

Mass

(5) Arch frame	Approximately 47 kg Approximately 104 lbs

8. Remove the 8 bolts and 4 nuts.





(7) Bolt (M10 × 25) ×8 (8) Nut (M12) ×4

9. Attach a nylon sling with 2 shackles and hoist the engine to remove.

(9) Nylon sling

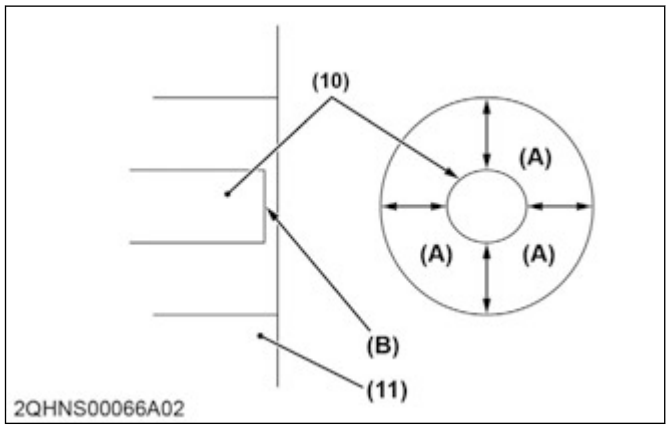
Mass

Engine	Approximately 93 kg Approximately 205 lbs

■ NOTE

- **This value is the engine dry weight.**

Installing



(10) Tail pipe (11) Counter weight

■ IMPORTANT

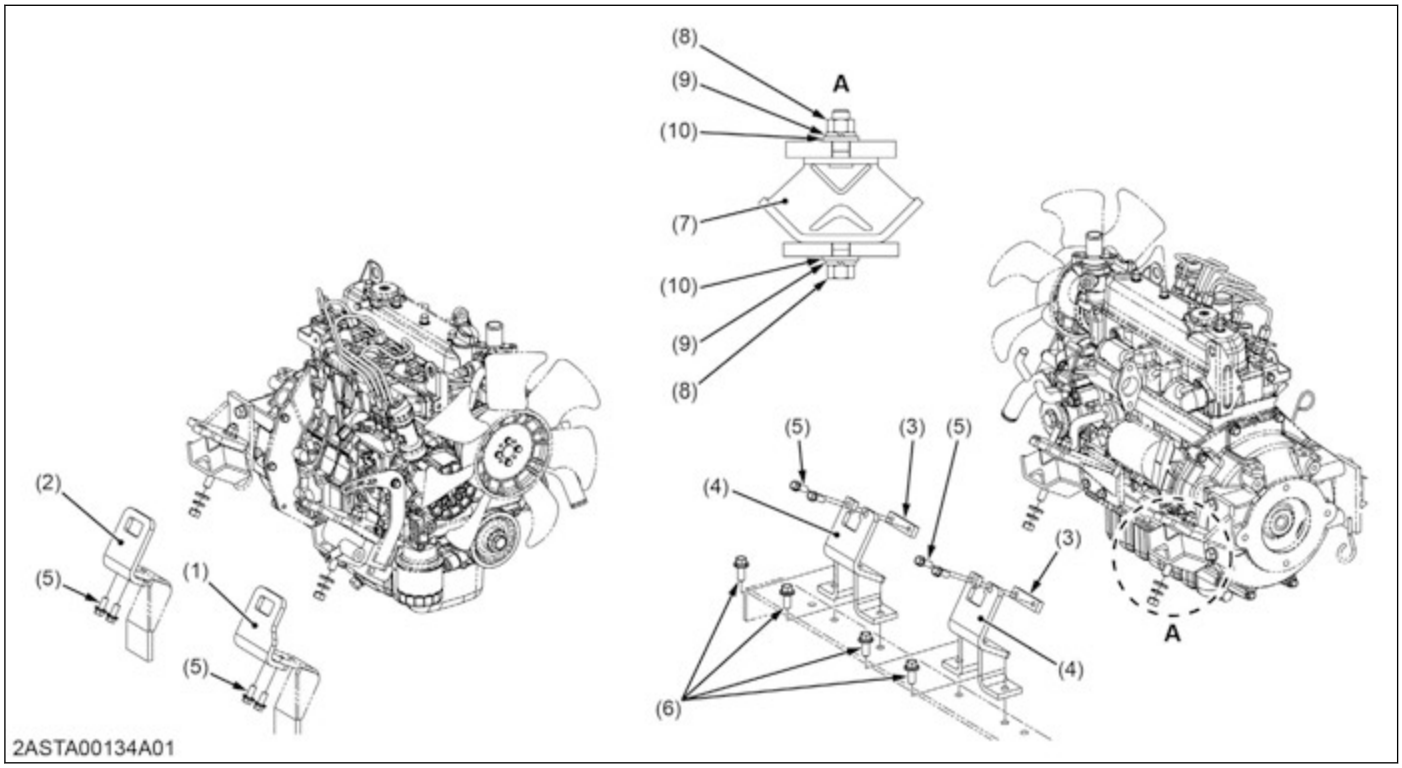
- **Leave a clearance (A) of approximately 20 mm (0.79 in.) between the tail pipe of the muffler and the counterweight.**
- **(B) Do not protrude the pipe from the counterweight.**

Tightening torque

(2) Bolt	17.7 to 20.6 N·m 1.80 to 2.10 kgf·m 13.1 to 15.2 lbf·ft	-
(6) Bolt	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft	Thread lock (Loctite 301-70)
(8) Nut	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft	Thread lock (Loctite 301-70)

4.2.2 Installing engine mount

Installing



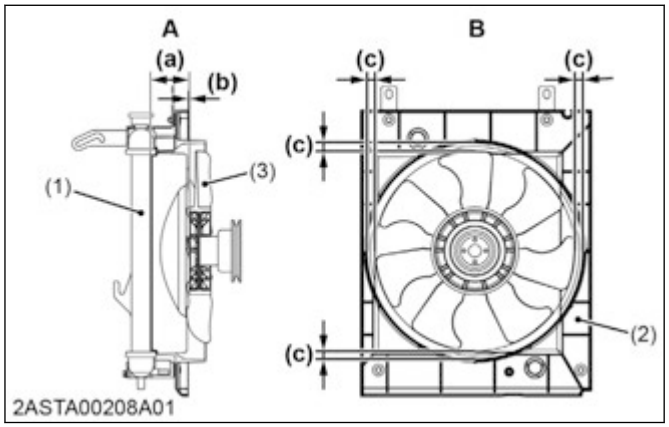
(1) Support 1
(2) Support 2
(3) Plate
(4) Support 3
(5) Bolt (M10 × 25) ×8
(6) Bolt (M12 × 35) ×4
(7) Cushion ×4
(8) Nut ×8
(9) Spring washer ×8
(10) Washer ×8

Tightening torque

(4) Nut	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft	Thread lock (Loctite 310-70)
(6) Bolt	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft	Thread lock (Loctite 310-70)

4.2.3 Installing radiator

Installing



(1) Radiator
(2) Fan shroud
(3) Fan

Adjusting dimensions

(a)	70 to 78 mm 2.76 to 3.07 in.
(b)	6 to 13 mm 0.24 to 0.51 in.
(c)	more than 10 mm more than 0.39 in.

4.2.4 Removing and installing muffler

CAUTION

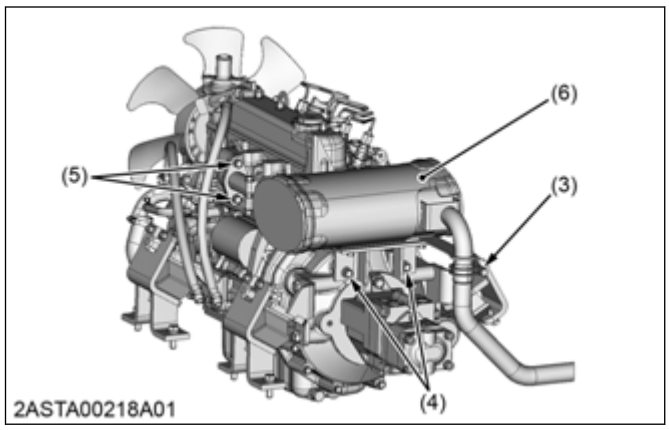
- **Do not work soon after stopped the engine.**
  - **Engine, fuel, and oil are extremely hot.**

Removing

1. Remove the LH bonnet.

(1) Rear bonnet
(2) LH bonnet

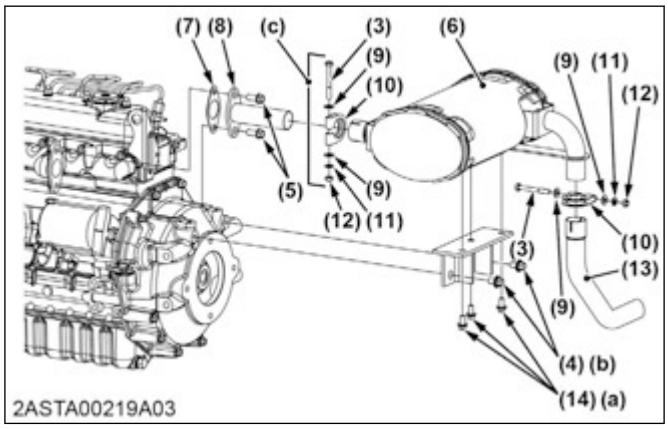
2. Remove the 5 bolts and muffler assembly.



(3) Bolt (M8 × 65)
(4) Bolt (M10 × 20) ×2
(5) Bolt (M10 × 25) ×2
(6) Muffler

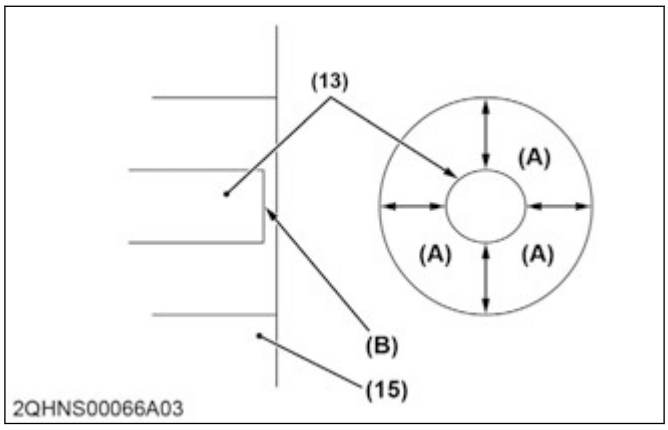
Installing

1. Install the muffler flange.
2. Install the pipe to muffler.
3. Tighten bolts (a), (b), and (c) in order.



(3) Bolt (M8 × 65)
(4) Bolt (M10 × 20) ×2
(5) Bolt (M10 × 25) ×2
(6) Muffler
(7) Gasket
(8) Flange
(9) Washer
(10) Pipe band
(11) Spring washer
(12) Nut
(13) Pipe
(14) Bolt (M8 × 20)

4. Leave the clearance between the pipe and counterweight.



(13) Pipe
(15) Counterweight

- (B) Do not protrude the tail pipe from weight.

Adjusting dimension

(A)	20 mm 0.79 in.

Tightening torque

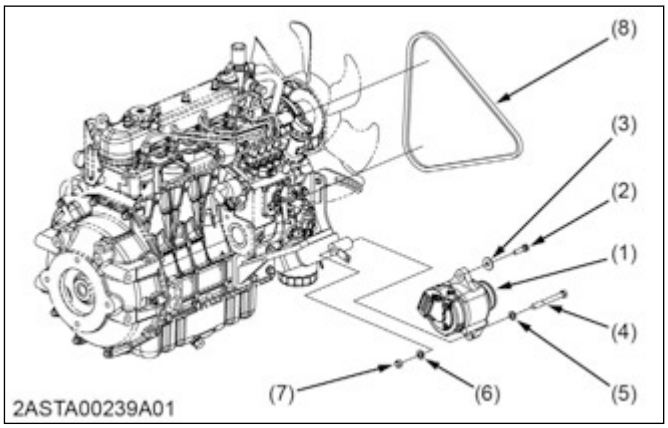
(3) Bolt	17.7to 20.6 N·m 1.8 to 2.1 kgf·m 13.1 to 15.2 lbf·ft	-
(4) Bolt	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft	-
(5) Bolt	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 10.8 to 12.6 lbf·ft	-
(14) Bolt	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.3 to 20.3 lbf·ft	-

4.2.5 Installing the alternator

Installing

■ IMPORTANT

- **Make sure to adjust the fan belt tension after installing the alternator.**

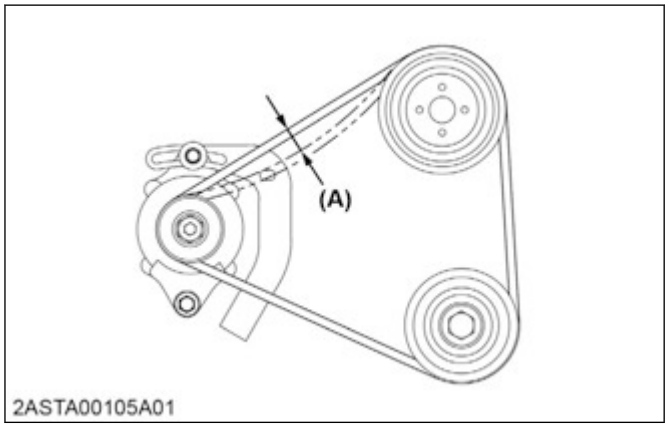


(1) Alternator
(2) Bolt (M8 × 30)
(3) Washer
(4) Bolt (M10 × 85)
(5) Washer
(6) Spring washer
(7) Nut (M10)
(8) Fan belt

Tightening torque

(2) Bolt	17.7 to 20.6 N·m 1.8 to 2.1 kgf·m 13.1 to 15.2 lbf·ft	-
(7) Nut	39.2 to 45.1 N·m 4.0 to 4.6 kgf·m 28.9 to 33.3 lbf·ft	-

Adjusting



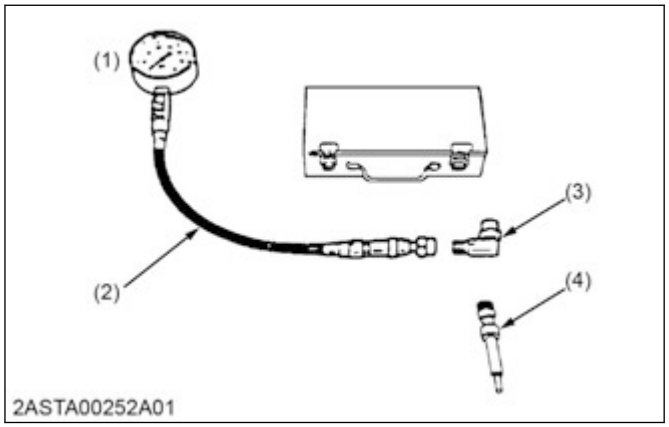
Service specification

(A)	7 to 9 mm 0.28 to 0.35 in.	Push with 60 to 70 N Push with 6.12 to 7.14 kgf Push with 13.49 to 15.74 lbf

4.3 Special jigs and tools

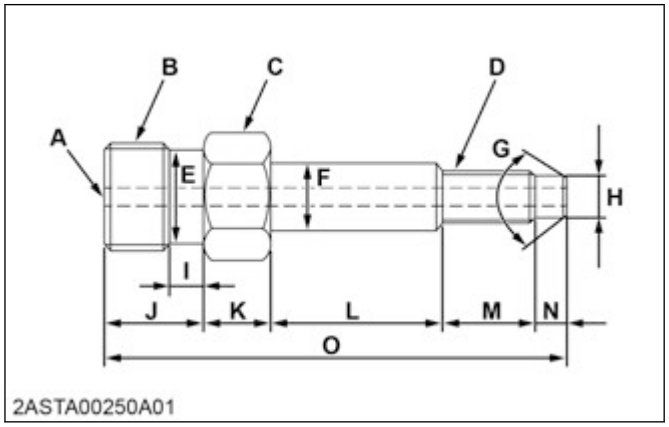
4.3.1 Engine compression pressure measuring kit

Diesel engine compression tester



(1) Pressure gauge
(2) Hose assembly
(3) L joint
(4) Adapter

Adapter

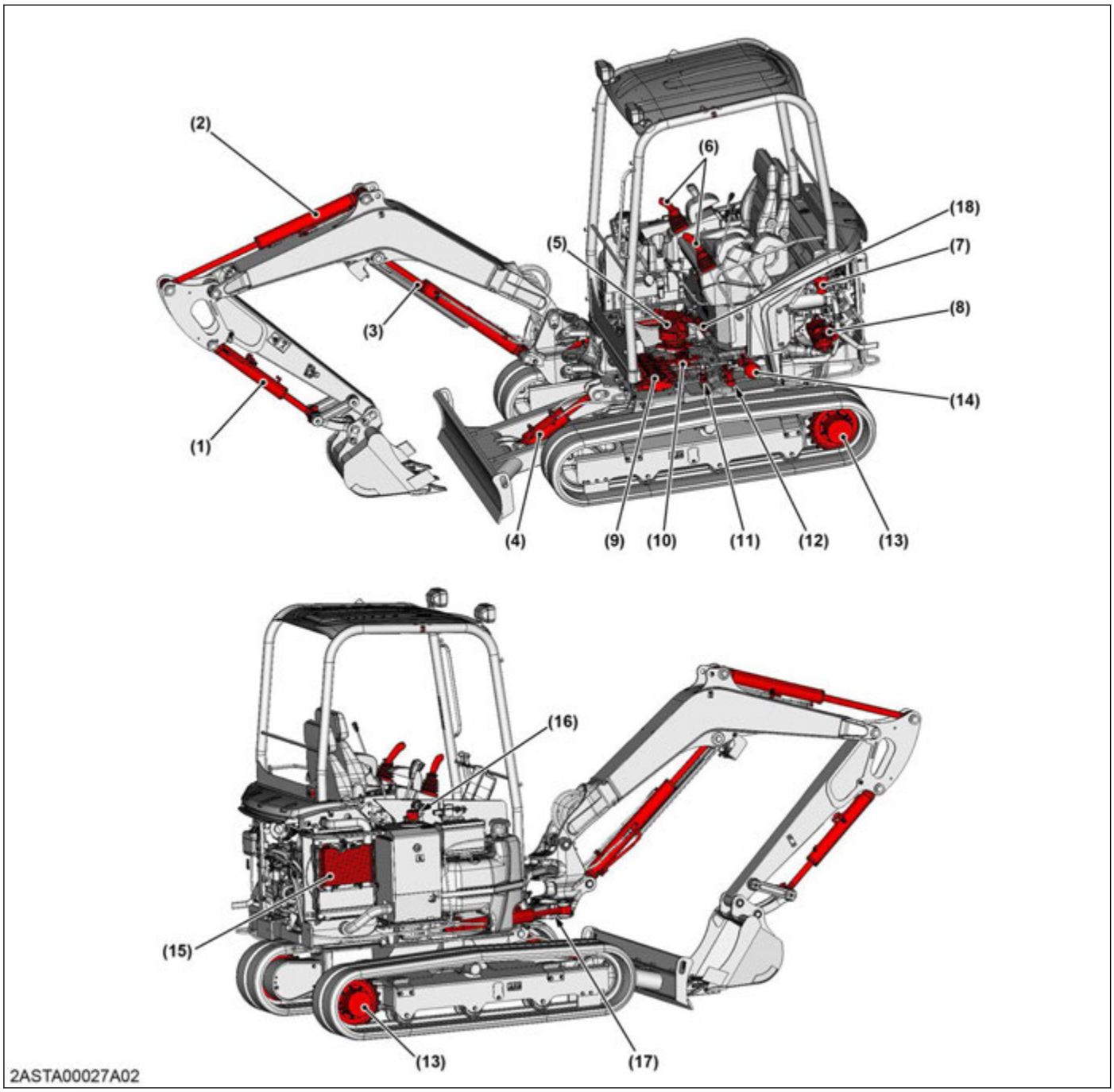


A	ϕ3 mm drill ϕ0.12 in. drill
B	5/8-18UNF
C	M17
D	M8×1.0
E	ϕ13 mm ϕ0.51 in.
F	ϕ10 mm ϕ0.39 in.
G	119°
H	ϕ6.6 mm ϕ0.26 in.
I	5 mm 0.20 in.
J	15 mm 0.59 in.
K	10 mm 0.39 in.
L	26 mm 1.02 in.
M	15 mm 0.59 in.
N	7 mm 0.28 in.
O	73 mm 2.87 in.

5. HYDRAULIC SYSTEM

MECHANISM

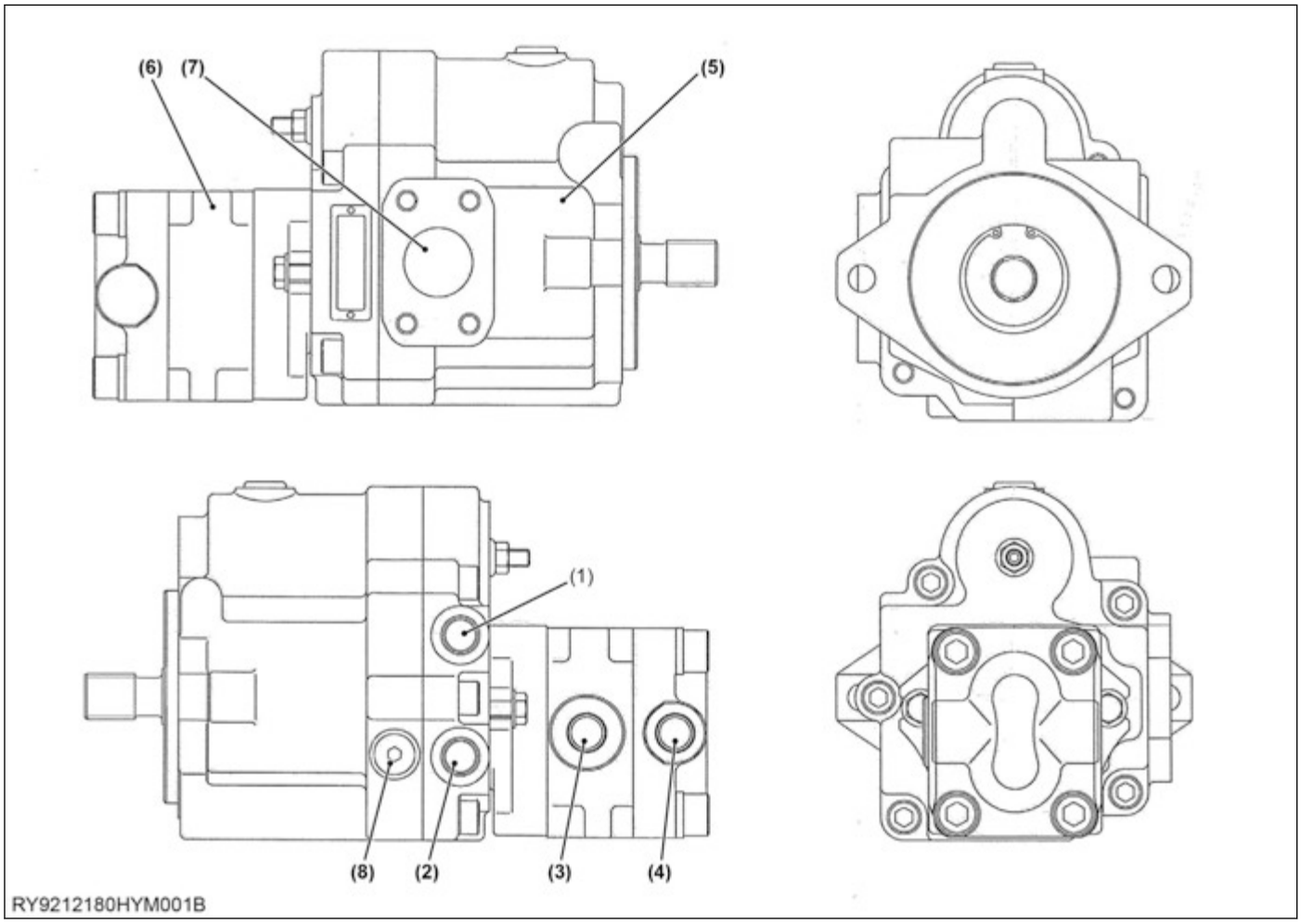
1. Hydraulic device layout



(1) Bucket cylinder
(2) Arm cylinder
(3) Boom cylinder
(4) Blade cylinder
(5) Swivel motor
(6) Pilot control valve
(7) Pilot filter
(8) Hydraulic pump
(9) Control valve
(10) Swivel joint
(11) Third line valve
(12) AUX1 proportional valve (Hi-spec only)
(13) Travel motor
(14) Unload valve
(15) Oil cooler
(16) Breather filter
(17) Swing cylinder
(18) AUX2 proportional valve (Hi-spec only)

2. Hydraulic pump

2.1 Hydraulic pump specifications



(5) Piston pump (6) Gear pump (7) Suction port (8) Lubrication port

Items		Specifications
Manufacturer		Nachi-Fujikoshi
Model		PDV-1B-28P-8G3-5860A
Rated rotational speed		2250 rpm
Maximum displacement	Piston pump (P1+P2)	14+14 cc/rev 0.85+0.85 cu.in./rev
	Gear pump (P3)	8 cc/rev 0.49 cu.in./rev
	Gear pump (P4)	2.7 cc/rev 0.16 cu.in./rev
Maximum flow rate	Piston pump (P1+P2)	34.3+34.3 L/min 9.1+9.1 U.S. gal/min
	Gear pump (P3)	19.6 L/min 5.2 U.S. gal/min

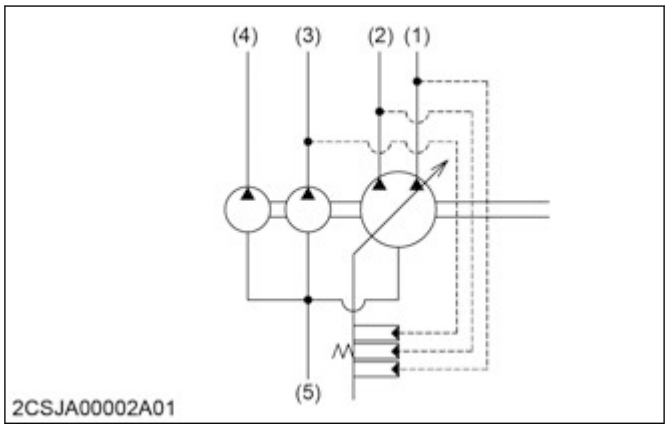
(Continued)

Items		Specifications
Maximum flow rate	Gear pump (P4)	6.6 L/min 1.7 U.S. gal/min
Maximum pressure	Piston pump (P1+P2)	23.5+23.5 MPa 240+240 kgf/cm^2 3408+3408 psi
	Gear pump (P3)	19.6 MPa 200 kgf/cm^2 2843 psi
	Gear pump (P4)	3.9 MPa 40 kgf/cm^2 566 psi

Port location table

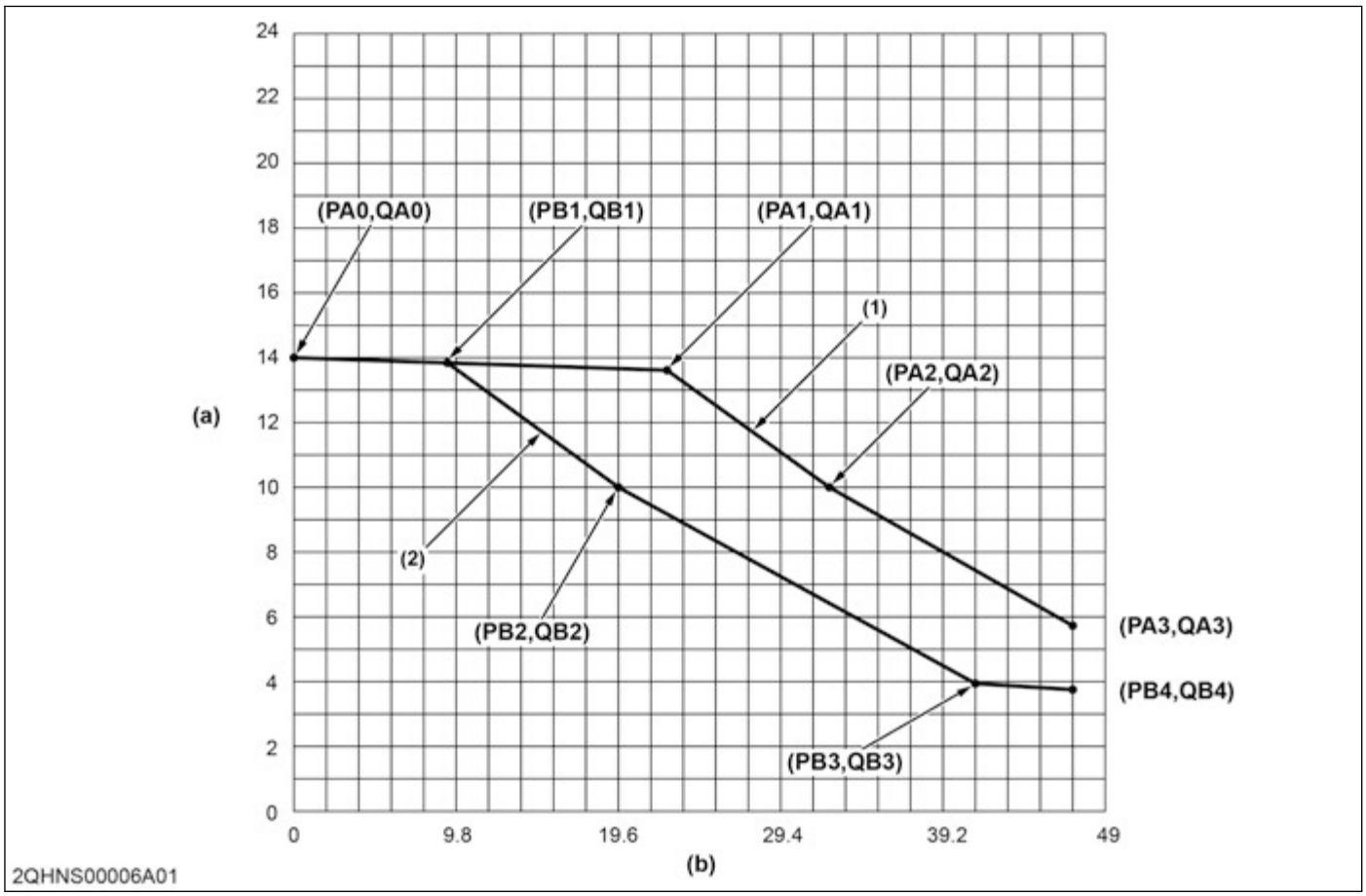
No.	Port	Location	No.	Port	Location
(1)	P1	Control valve (P1)	(3)	P3	Control valve (P3)
(2)	P2	Control valve (P2)	(4)	P4	Pilot filter

2.2 Hydraulic pump hydraulic circuit



(1) Piston pump discharging port (P1)
(2) Piston pump discharging port (P2)
(3) Gear pump discharging port (P3)
(4) Gear pump discharging port (P4)
(5) Suction port (S1)

2.3 Piston pump P-Q performance



(1) P3 no load
(2) P3 load (relief)

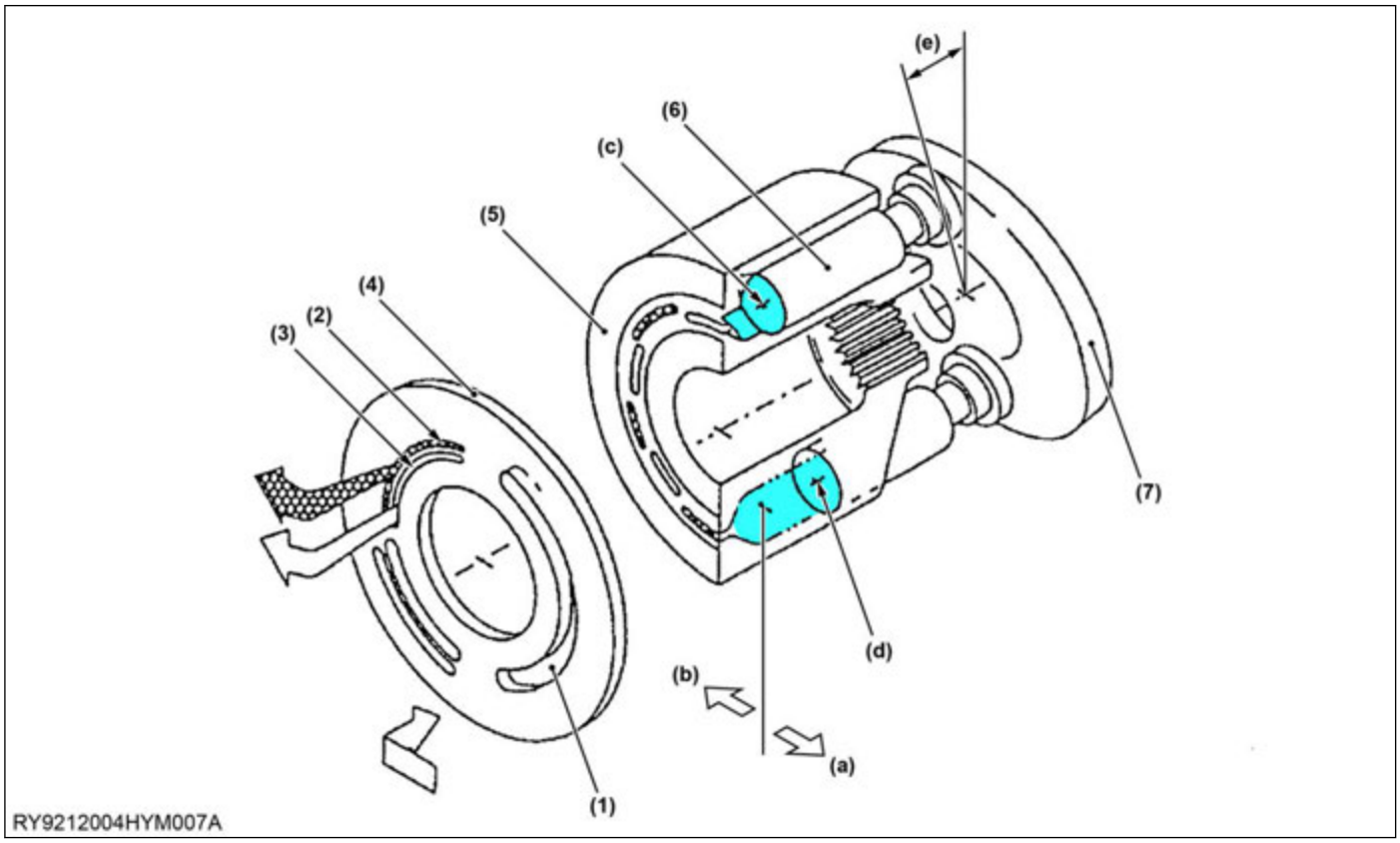
(a) Discharging flow rate: Q1 = Q2 (cc/rev)

(b) Discharging pressure: P1 + P2 (MPa)

Pump speed: 2250 rpm			
P3 no load (0.49 MPa)		P3 load (relief) (19.6 MPa)	
Discharging pressure (MPa)	Discharging flow rate (cc/rev)	Discharging pressure (MPa)	Discharging flow rate (cc/rev)
PA0 = 0	QA0 = 14.2	PB1 = 9.4	QB1 = 13.8
PA1 = 22.5	QA1 = 13.6	PB2 = 19.2	QB2 = 10.0
PA2 = 32.3	QA2 = 9.8	PB3 = 40.9	QB3 = 3.9
PA3 = 47.0	QA2 = 5.7	PB4 = 47.0	QB4 = 3.7

2.4 Hydraulic pump function and structure

2.4.1 Piston pump working principles

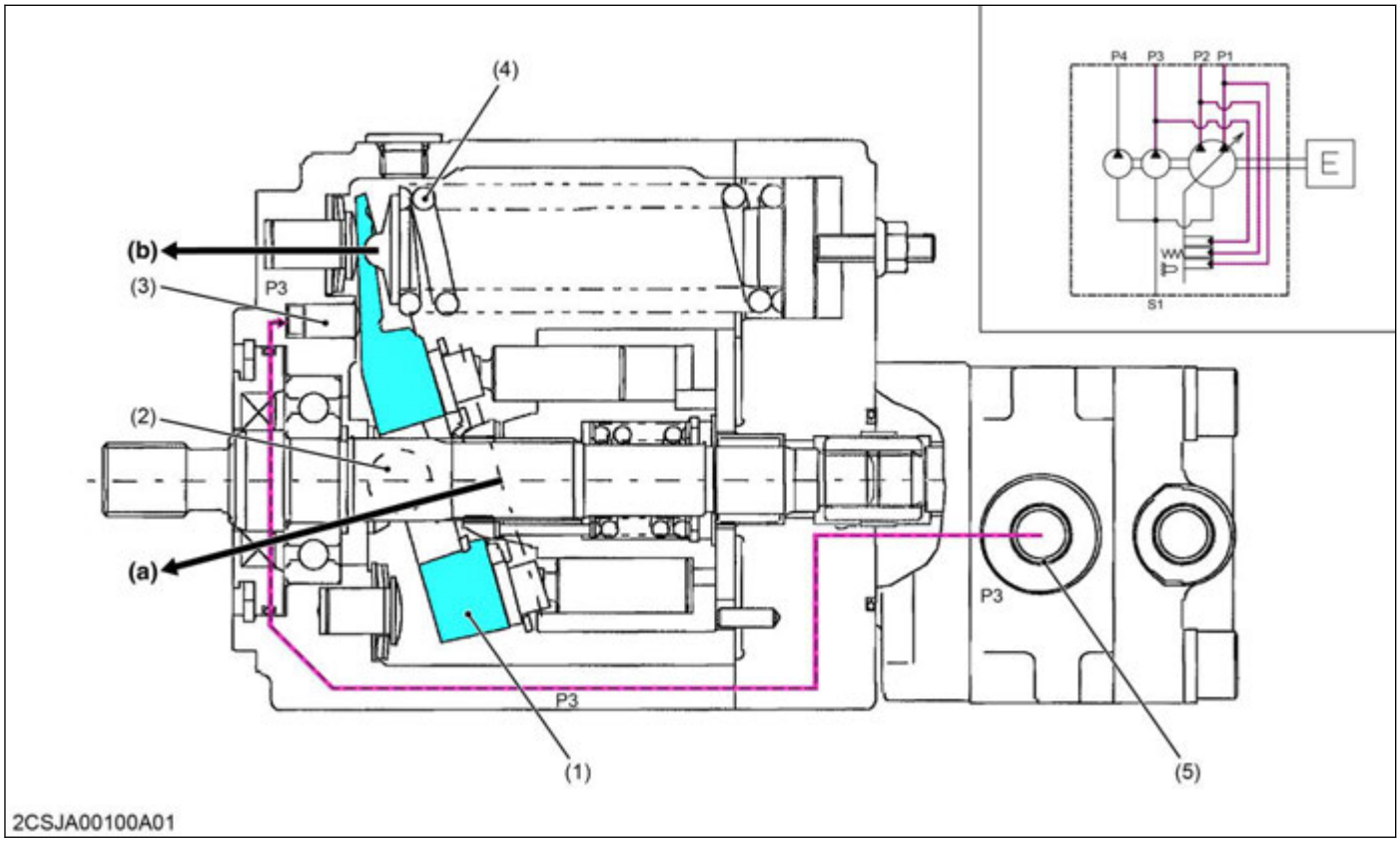


(1) Suction port
(2) Discharging port (P1)
(3) Discharging port (P2)
(4) Valve plate
(5) Cylinder block
(6) Piston
(7) Swash plate
(a) Suction side
(b) Discharging side
(c) Top dead center
(d) Bottom dead center
(e) Tilt angle

- The engine is connected to the cylinder block by the shaft.
- The cylinder block is composed of a number of pistons.
- The pistons are reciprocated inside the cylinder block according to the rotation of the cylinder block and the angle of the swash plate.
- The piston pump suctions and discharges the hydraulic oil with their reciprocating motion.
  - Suction process
    - The pistons are pulled out from the cylinder block.
    - Hydraulic oil is suctioned into the cylinder block through the valve plate.
  - Discharging process
    - The pistons are pushed into the cylinder block.
    - Hydraulic oil is discharged from the cylinder block through the valve plate.
- Suction and discharging flow rate depends on angle of the swash plate.

2.4.2 Horsepower control

The piston pump reduces the discharging flow rate to control horsepower consumption.



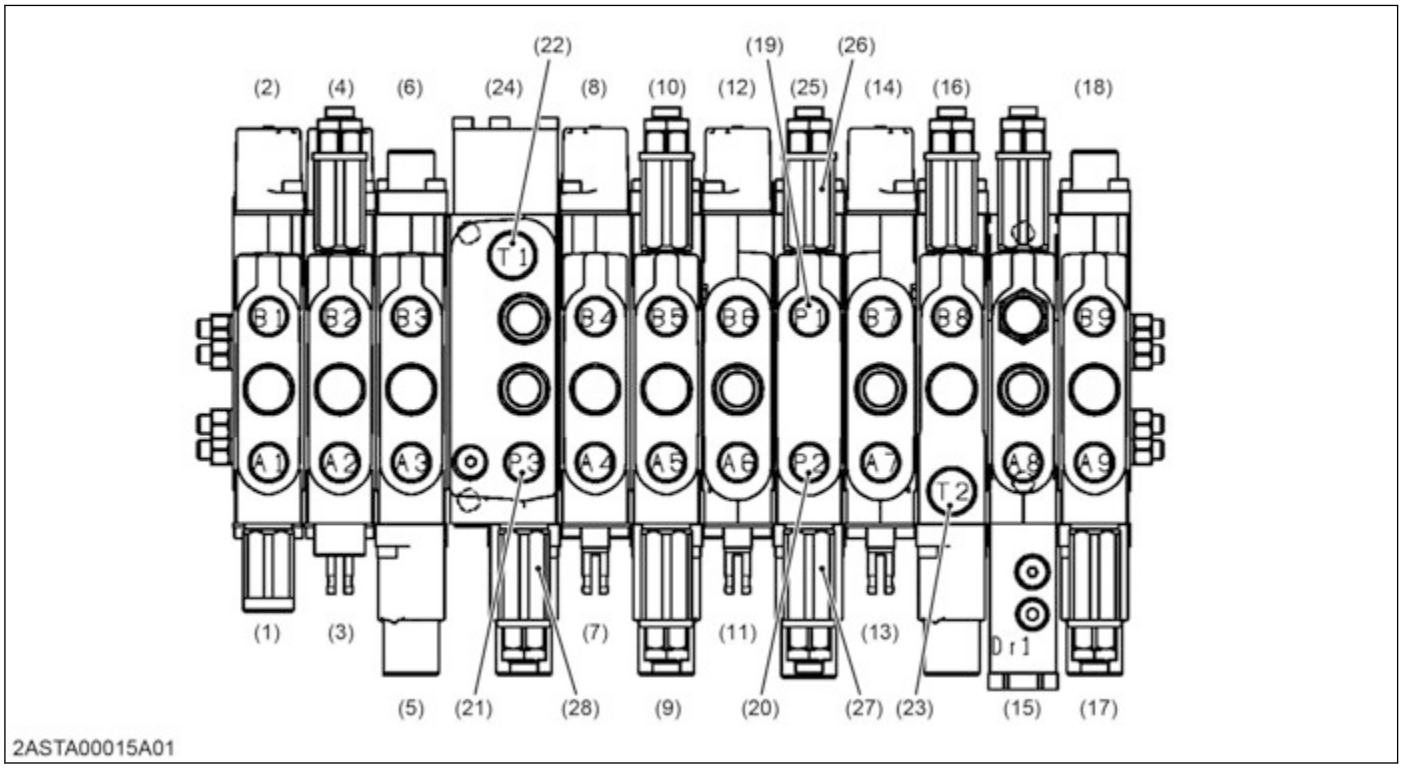
(1) Swash plate
(2) Ball
(3) Control pin
(4) Spring
(5) P3
(a) Load F1
(b) Spring force F2

- The spring presses the swash plate in direction (b) to tilt the swash plate in maximum angle. The discharging flow rate is maximized.
- In case of high load on P1 and P2,
  - P1 and P2 pressurized oil push back the pistons from discharging port.
  - The pistons press the swash plate in direction (a) to decrease the swash plate angle.
  - The discharging flow rate decreases to lower horse power consumption.
- In case of high load on P3,
  - P3 pressurized oil pushes the control pin to decrease angle of the swash plate.
  - Then, the discharging flow rate is reduced to lower the consumed horsepower.

3. Control valve

3.1 Control valve specifications

Basic



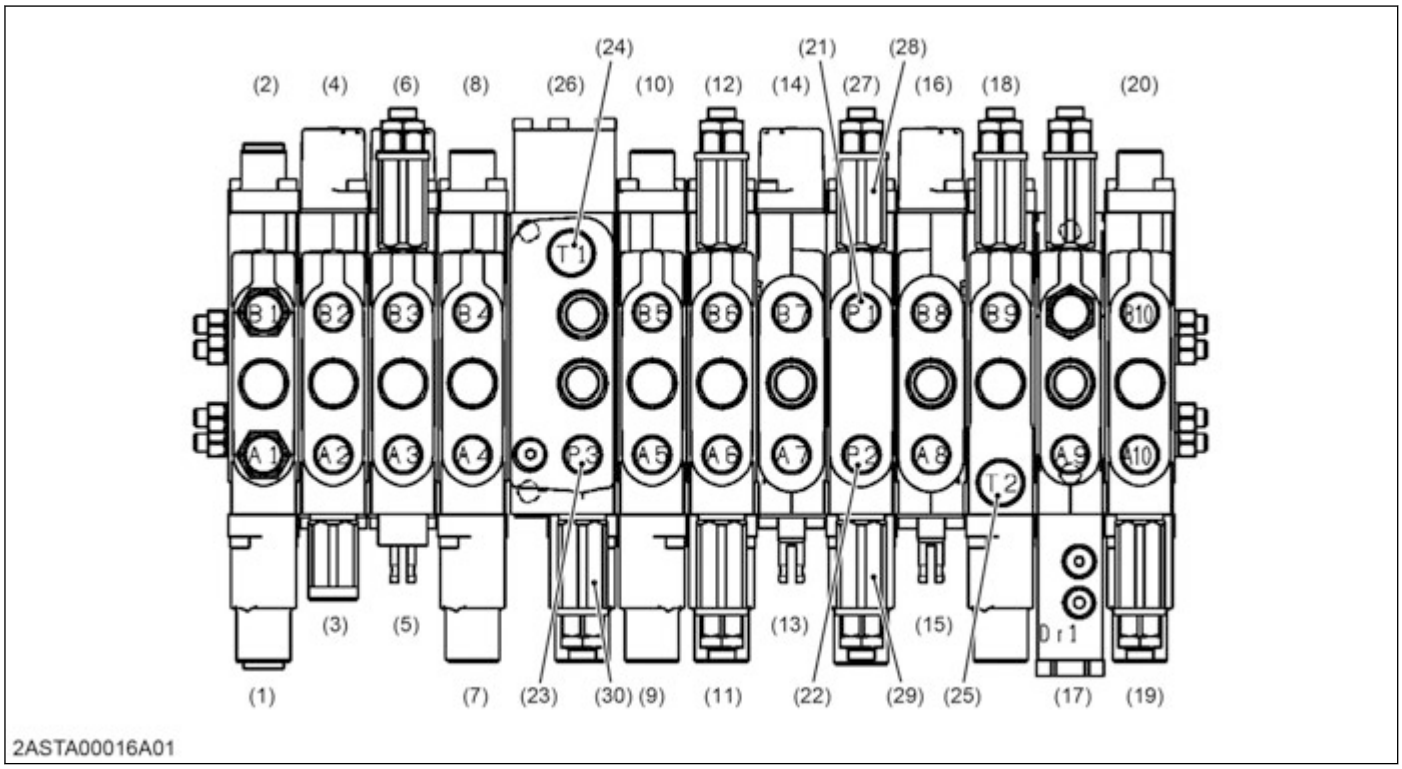
(26) P1 main relief valve (27) P2 main relief valve (28) P3 main relief valve

Items		Specifications	Remarks
Manufacturer		Hydro control	-
Model		EV310177	-
Main relief valve setting pressure	(26) P1 (27) P2	23.5 MPa 240 kgf/cm^2 3408 psi	At 32 L/min At 8.5 U.S. gal/min
	(28) P3	19.6 MPa 200 kgf/cm^2 2843 psi	At 18 L/min At 4.8 U.S. gal/min
Overload relief valve setting pressure	(15) Boom bottom (b1B)	26.5 MPa 270 kgf/cm^2 3844 psi	At 5.0 L/min At 1.3 U.S. gal/min
	(16) Boom rod (b1R)		
	(9) Arm rod (b2R)		
	(10) Arm bottom (b2B)		
	(17) Bucket bottom (b3B)		
	(3) Blade bottom (b4B)		

Port location table

No.	Port	Location	No.	Port	Location
(1)	Mechanical link	Swing RH	(14)	-	Travel RH forwards
(2)	-	Swing LH	(15)	Pa8	Pilot control valve RH (1) Boom lift
(3)	Mechanical link	Blade lift	(16)	Pb8	Pilot control valve RH (3) Boom lower
(4)	-	Blade lower	(17)	Pa9	Pilot control valve RH (2) Bucket crowd
(5)	Pa3	Pilot control valve LH (4) Swivel RH	(18)	Pb9	Pilot control valve RH (4) Bucket dump
(6)	Pb3	Pilot control valve LH (2) Swivel LH	(19)	P1	Hydraulic pump (P1)
(7)	Mechanical link	AUX RH	(20)	P2	Hydraulic pump (P2)
(8)	-	AUX LH	(21)	P3	Hydraulic pump (P3)
(9)	Pa5	Pilot control valve LH (3) Arm dump	(22)	T1	Tank
(10)	Pb5	Pilot control valve LH (1) Arm crowd	(23)	T2	Tank
(11)	Mechanical link	Travel LH backwards	(24)	PP1 PP3	Swivel motor (PP) Unload valve (C) Pilot pressure
(12)	-	Travel LH forwards	(25)	PP2	Unload valve (B) Pilot pressure
(13)	Mechanical link	Travel RH backwards	-	-	-

Hi-spec



(28) P1 main relief valve (29) P2 main relief valve (30) P3 main relief valve

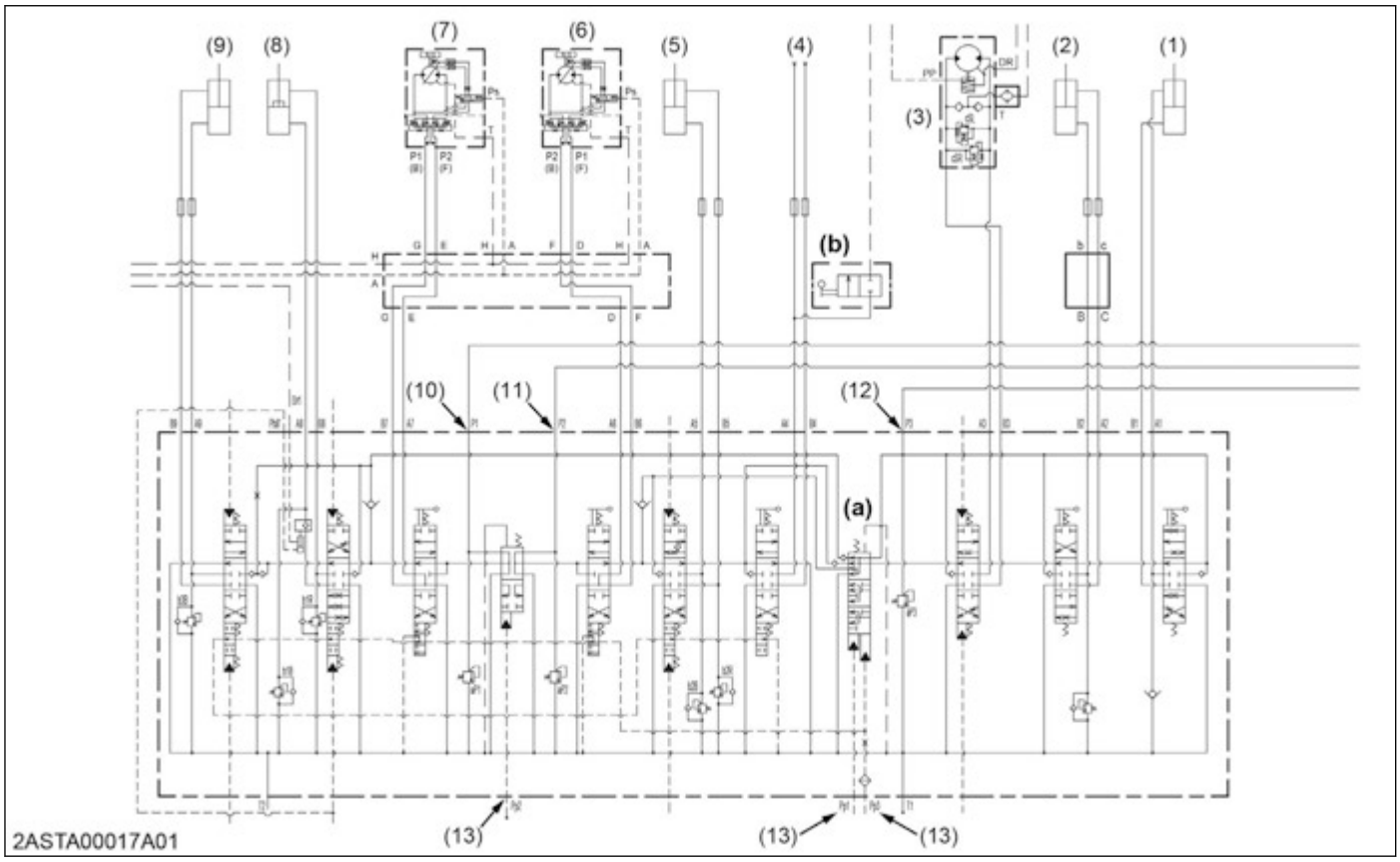
Items		Specifications	Remarks
Manufacturer		Hydro control	-
Model		EV310144	-
Main relief valve setting pressure	(28) P1 (29) P2	23.5 MPa 240 kgf/cm^2 3408 psi	At 32 L/min At 8.5 U.S. gal/min
	(30) P3	19.6 MPa 200 kgf/cm^2 2843 psi	At 18 L/min At 4.8 U.S. gal/min
Overload relief valve setting pressure	(17) Boom bottom (b1B)	26.5 MPa 270 kgf/cm^2 3844 psi	At 5.0 L/min At 1.3 U.S. gal/min
	(18) Boom rod (b1R)		
	(11) Arm bottom (b2B)		
	(12) Arm rod (b2R)		
	(19) Bucket bottom (b3B)		
	(6) Blade bottom (b4B)		

Port location table

No.	Port	Location	No.	Port	Location
(1)	Pa1	AUX2 RH	(15)	Mechanical link	Travel RH forwards
(2)	Pb1	AUX2 LH	(16)	-	Travel RH backwards
(3)	Mechanical link	Swing RH	(17)	Pa9	Pilot control valve RH (4) Boom lift
(4)	-	Swing LH	(18)	Pb9	Pilot control valve RH (2) Boom lower
(5)	Mechanical link	Blade lift	(19)	Pa10	Pilot control valve RH (1) Bucket crowd
(6)	-	Blade lower	(20)	Pb10	Pilot control valve RH (3) Bucket dump
(7)	Pa4	Pilot control valve LH (3) Swivel RH	(21)	P1	Hydraulic pump (P1)
(8)	Pb4	Pilot control valve LH (1) Swivel LH	(22)	P2	Hydraulic pump (P2)
(9)	Pa5	Proportional valve (A2) AUX RH	(23)	P3	Hydraulic pump (P3)
(10)	Pb5	Proportional valve (A1) AUX LH	(24)	T1	Tank
(11)	Pa6	Pilot control valve LH (4) Arm crowd	(25)	T2	Tank
(12)	Pb6	Pilot control valve LH (2) Arm dump	(26)	PP1 PP3	Swivel motor (PP) Unload valve (C) Pilot pressure
(13)	Mechanical link	Travel LH backwards	(27)	PP2	Unload valve (B) Pilot pressure
(14)	-	Travel LH forwards	-	-	-

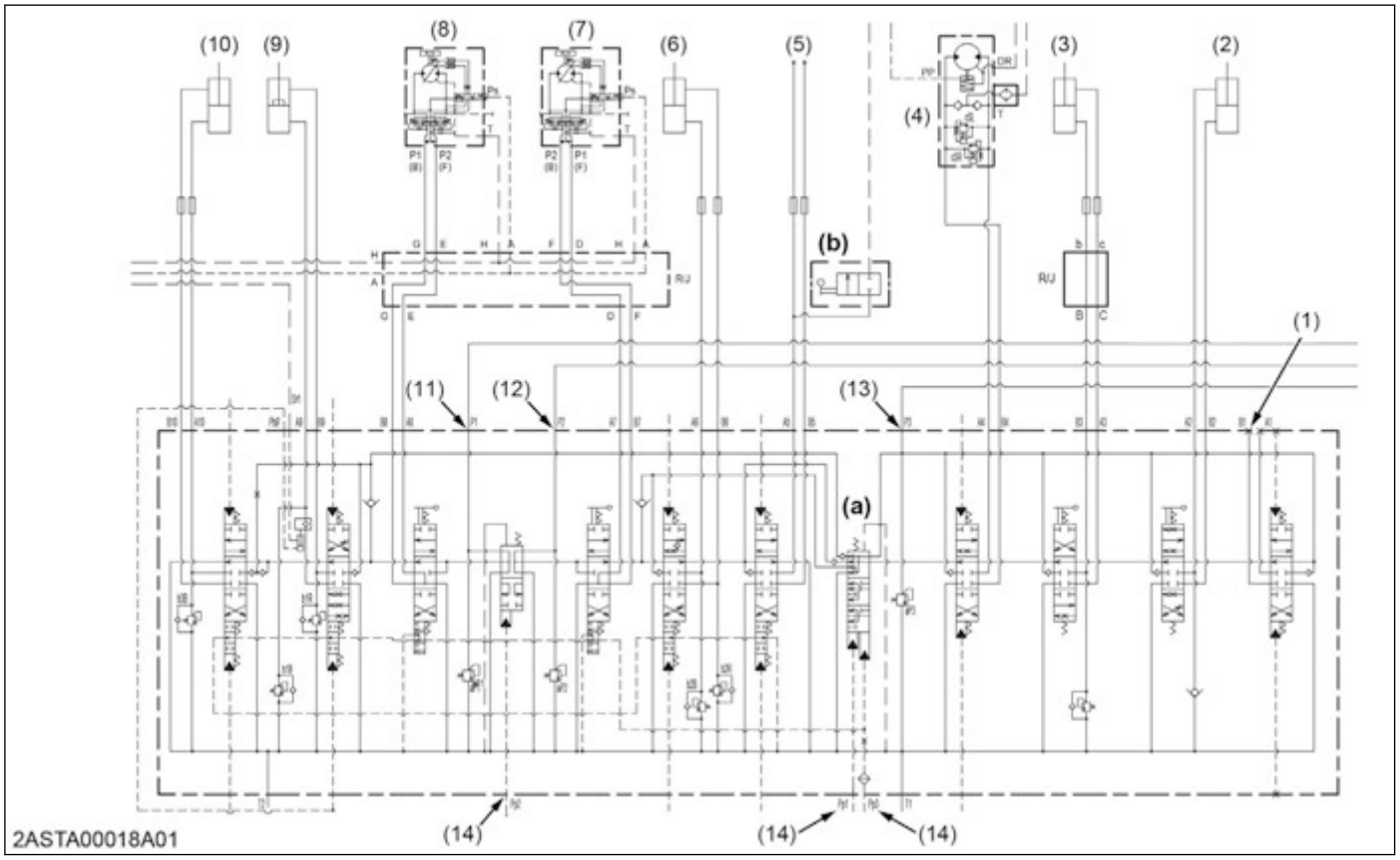
3.2 Control valve hydraulic circuit

Basic



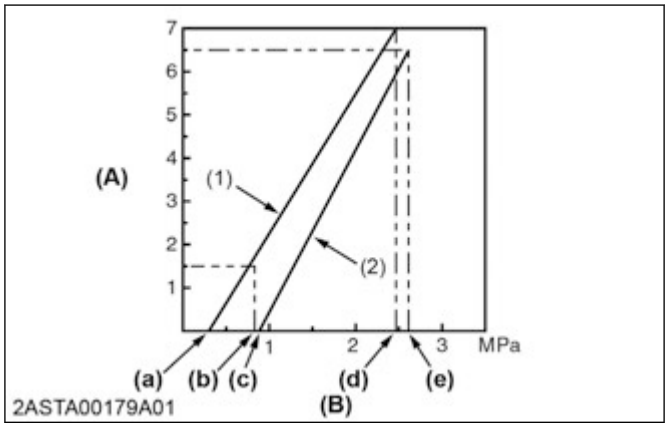
(1) Swing cylinder
(2) Blade cylinder
(3) Swivel motor
(4) AUX1 port
(5) Arm cylinder
(6) Travel motor LH
(7) Travel motor RH
(8) Boom cylinder
(9) Bucket cylinder
(10) Port P1
(11) Port P2
(12) Port P3
(13) Port P4
(a) Communication valve
(b) Third line valve

Hi-spec



(1) AUX2 port
(2) Swing cylinder
(3) Blade cylinder
(4) Swivel motor
(5) AUX1 port
(6) Arm cylinder
(7) Travel motor LH
(8) Travel motor RH
(9) Boom cylinder
(10) Bucket cylinder
(11) Port P1
(12) Port P2
(13) Port P3
(14) Port P4
(a) Communication valve
(b) Third line valve

3.3 Control valve spool shift performance



(1) Other
(2) Communication valve
(A) Spool stroke (mm)
(B) Pilot pressure (MPa)

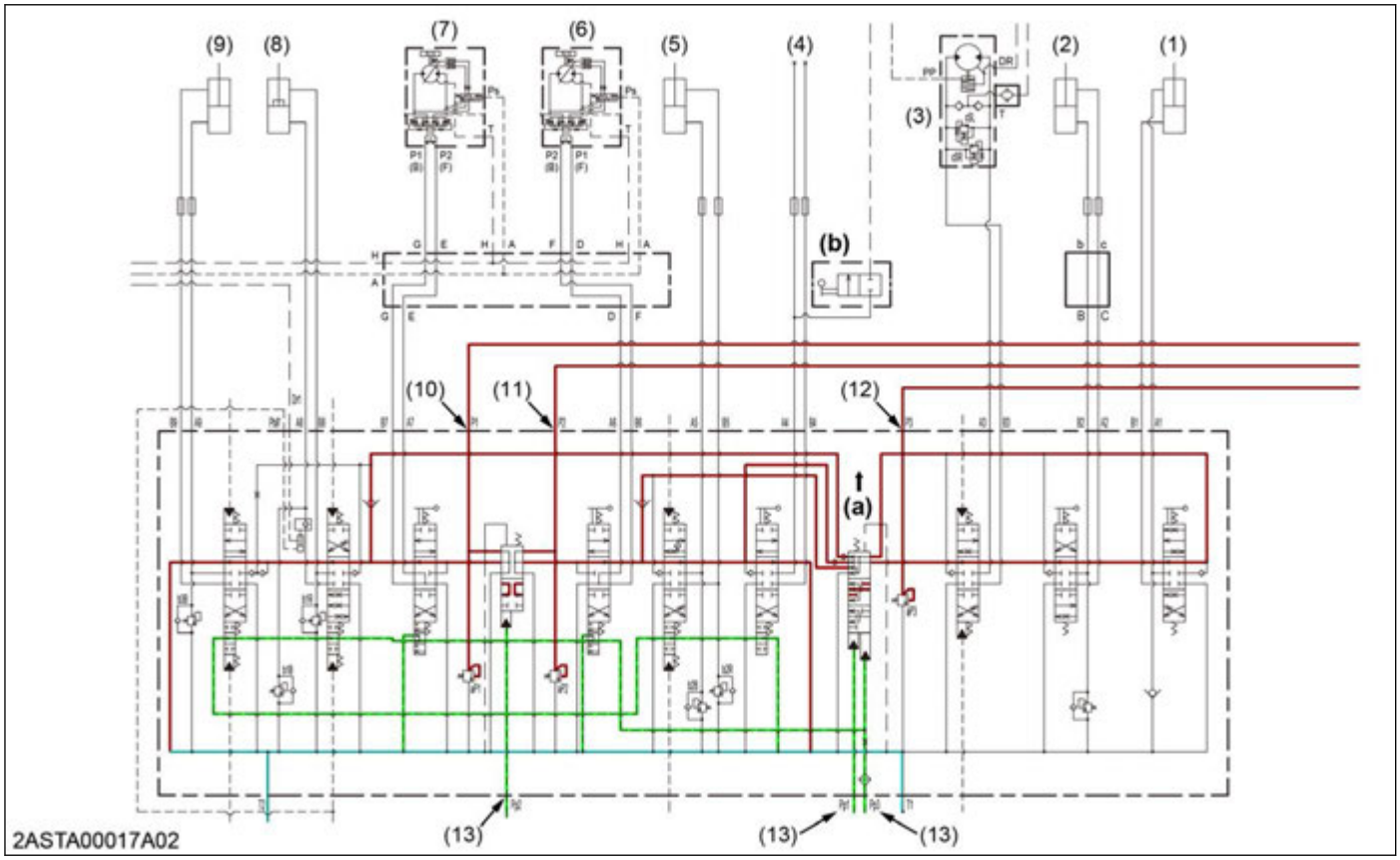
Items	Pressures
(a)	0.33 MPa 3.37 kgf/cm^2 47.86 psi
(b)	0.79 MPa 8.06 kgf/cm^2 114.58 psi
(c)	0.82 MPa 8.36 kgf/cm^2 118.93 psi
(d)	2.47 MPa 25.19 kgf/cm^2 358.24 psi
(e)	2.55 MPa 26.00 kgf/cm^2 369.85 psi

3.4 Control valve function and structure

3.4.1 Straight traveling circuit

In case of the simultaneous operation of travel and front attachments, P1 and P2 pressurized oil flows independently to each travel motor to ensure the straight travel.

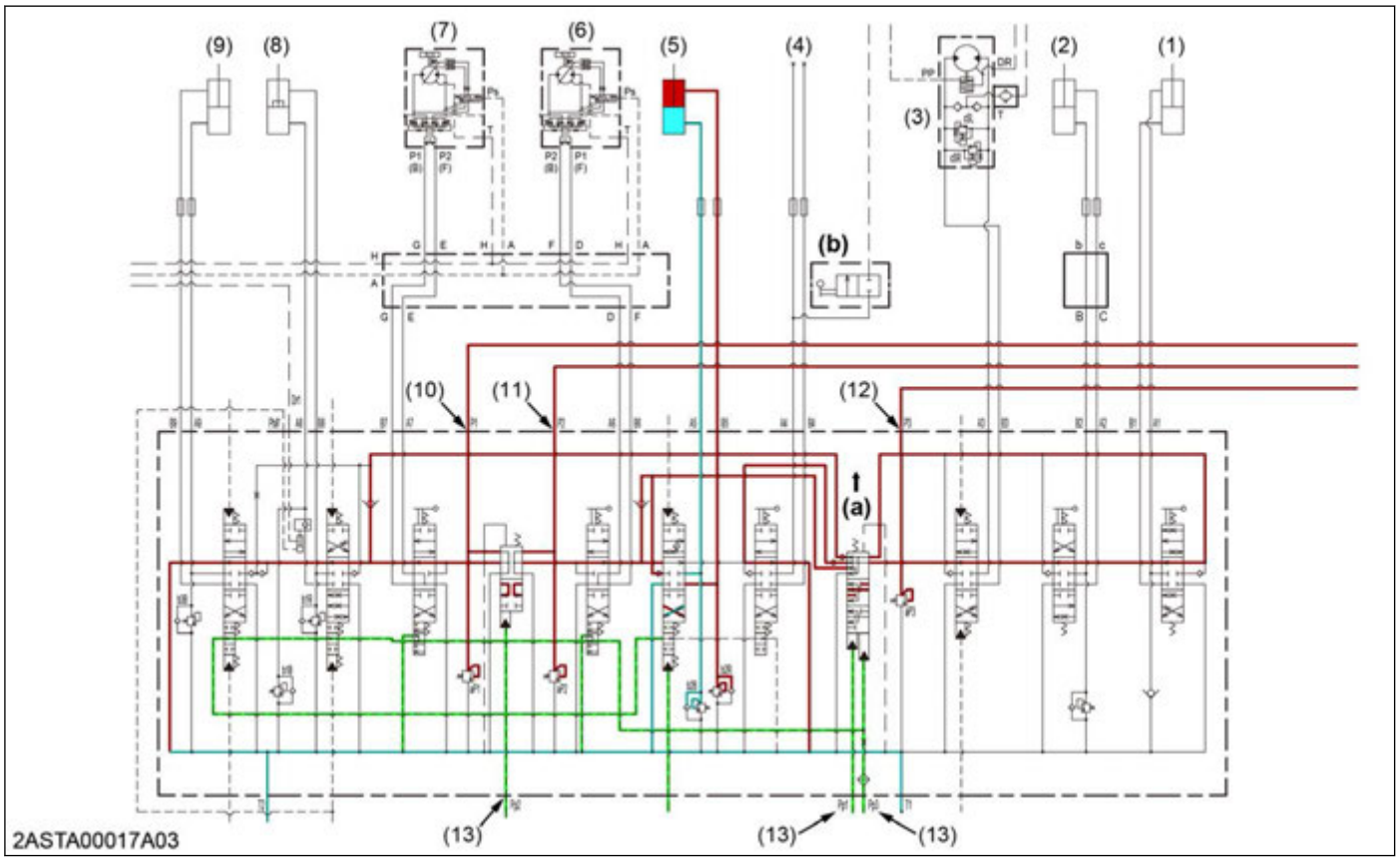
Not operating any sections



(1) Swing cylinder
(2) Blade cylinder
(3) Swivel motor
(4) AUX1 port
(5) Arm cylinder
(6) Travel motor LH
(7) Travel motor RH
(8) Boom cylinder
(9) Bucket cylinder
(10) Port P1
(11) Port P2
(12) Port P3
(13) P4 pressurized oil
(a) Communication valve
(b) Third line valve

- Pp1 pressurized oil shifts the communication valve to the middle position when the lever lock is lowered.
- All pressurized oil returns to the tank.

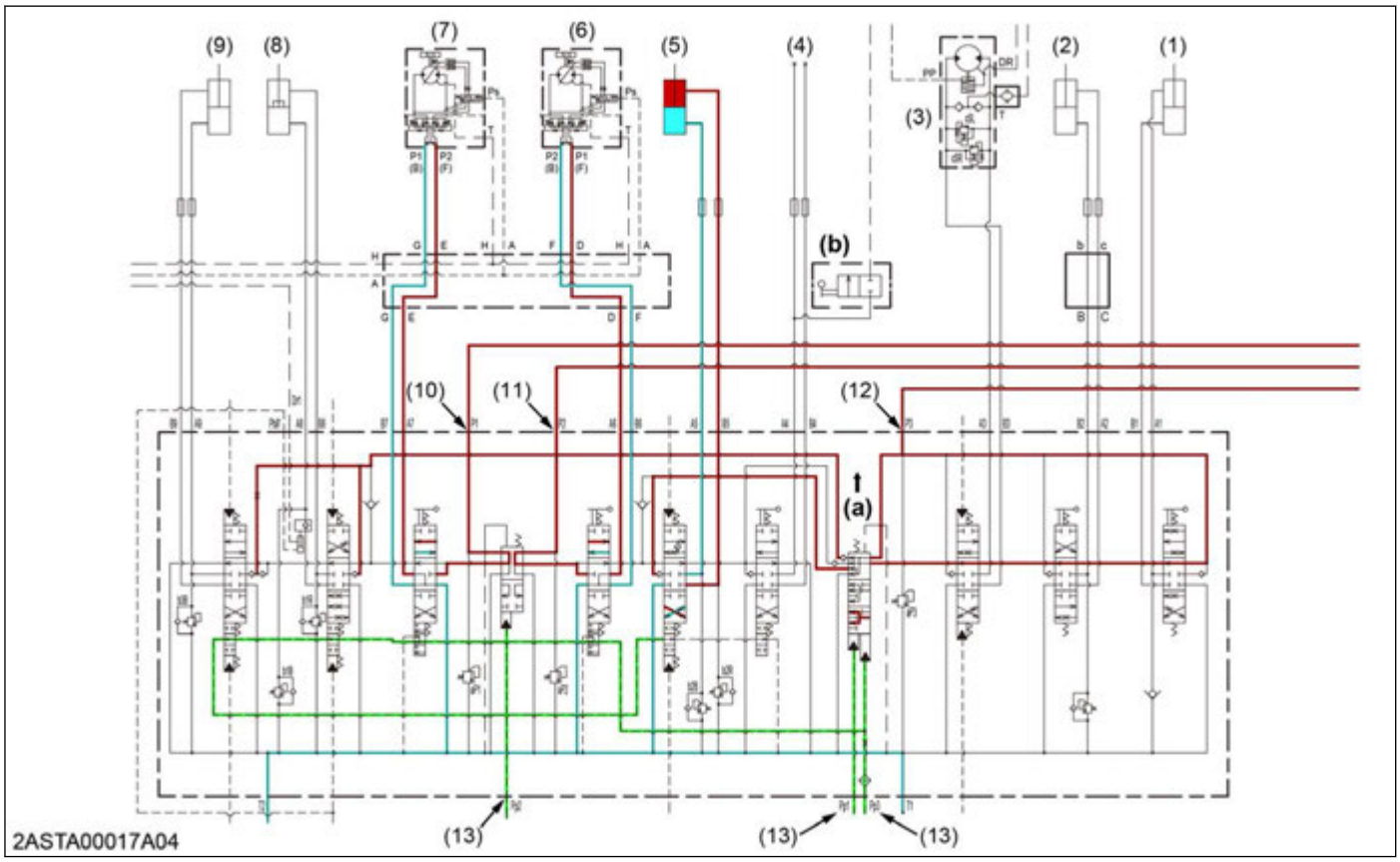
Operating the arm (travel in neutral)



(1) Swing cylinder
(2) Blade cylinder
(3) Swivel motor
(4) AUX1 port
(5) Arm cylinder
(6) Travel motor LH
(7) Travel motor RH
(8) Boom cylinder
(9) Bucket cylinder
(10) Port P1
(11) Port P2
(12) Port P3
(13) P4 pressurized oil
(a) Communication valve
(b) Third line valve

- Pp3 pressurized oil in the signal circuit returns to tank through the spools of the travel sections.
- The communication valve spool stays in the middle position.
- P2 pressurized oil flows to the arm cylinder.

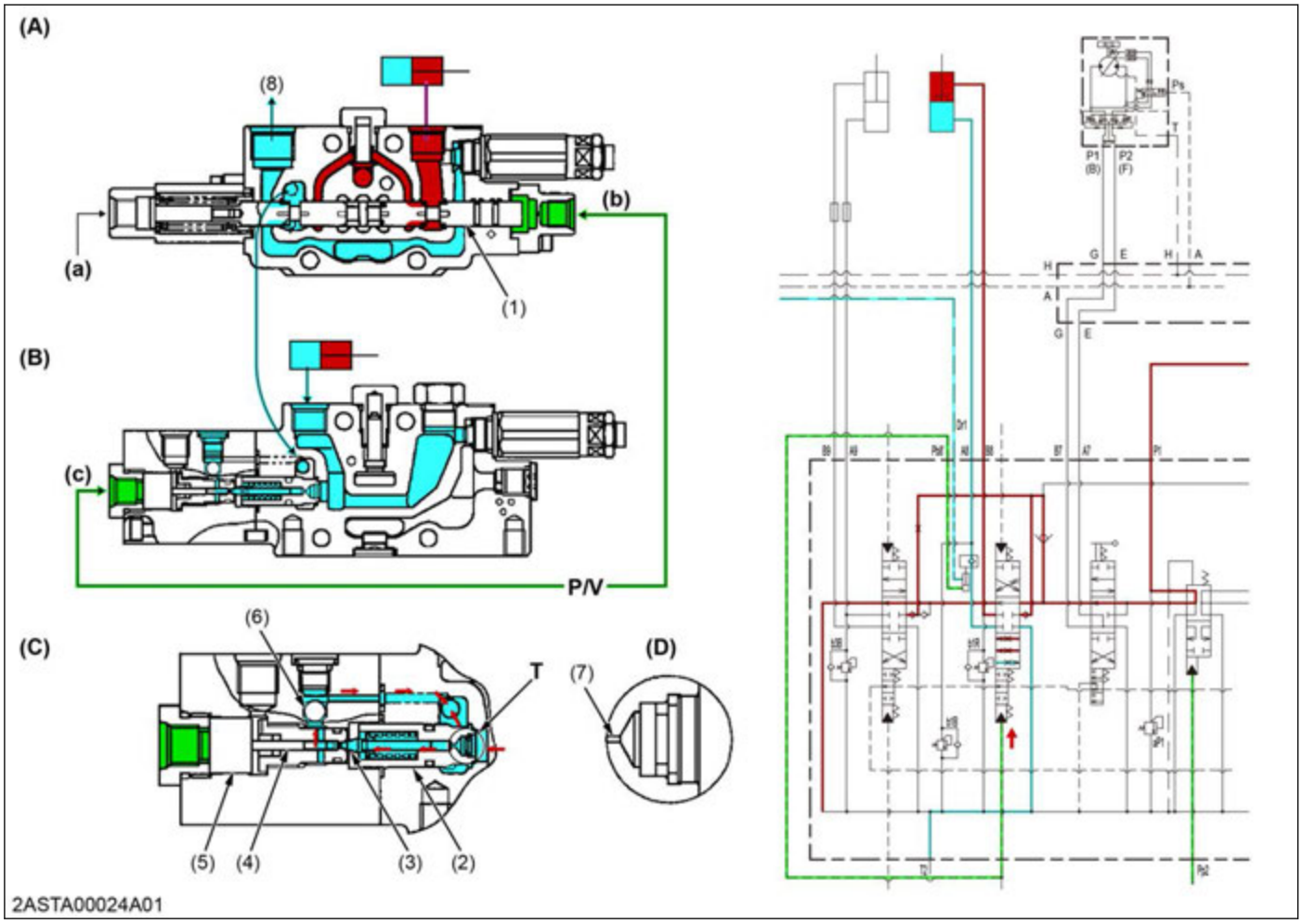
Operating the arm and travel



(1) Swing cylinder
(2) Blade cylinder
(3) Swivel motor
(4) AUX1 port
(5) Arm cylinder
(6) Travel motor LH
(7) Travel motor RH
(8) Boom cylinder
(9) Bucket cylinder
(10) Port P1
(11) Port P2
(12) Port P3
(13) P4 pressurized oil
(a) Communication valve
(b) Third line valve

- Pp3 pressurized oil is cut off at spool in the arm section.
- Tank passage of the signal circuit is closed at the travels spools.
- The signal circuit pressure increases to shift the communication valve.
- P3 pressurized oil flows to the arm cylinder.
- P1 and P2 pressurized oil flows independently to each travel motor ensure the straight travel.

3.4.2 Boom lock valve

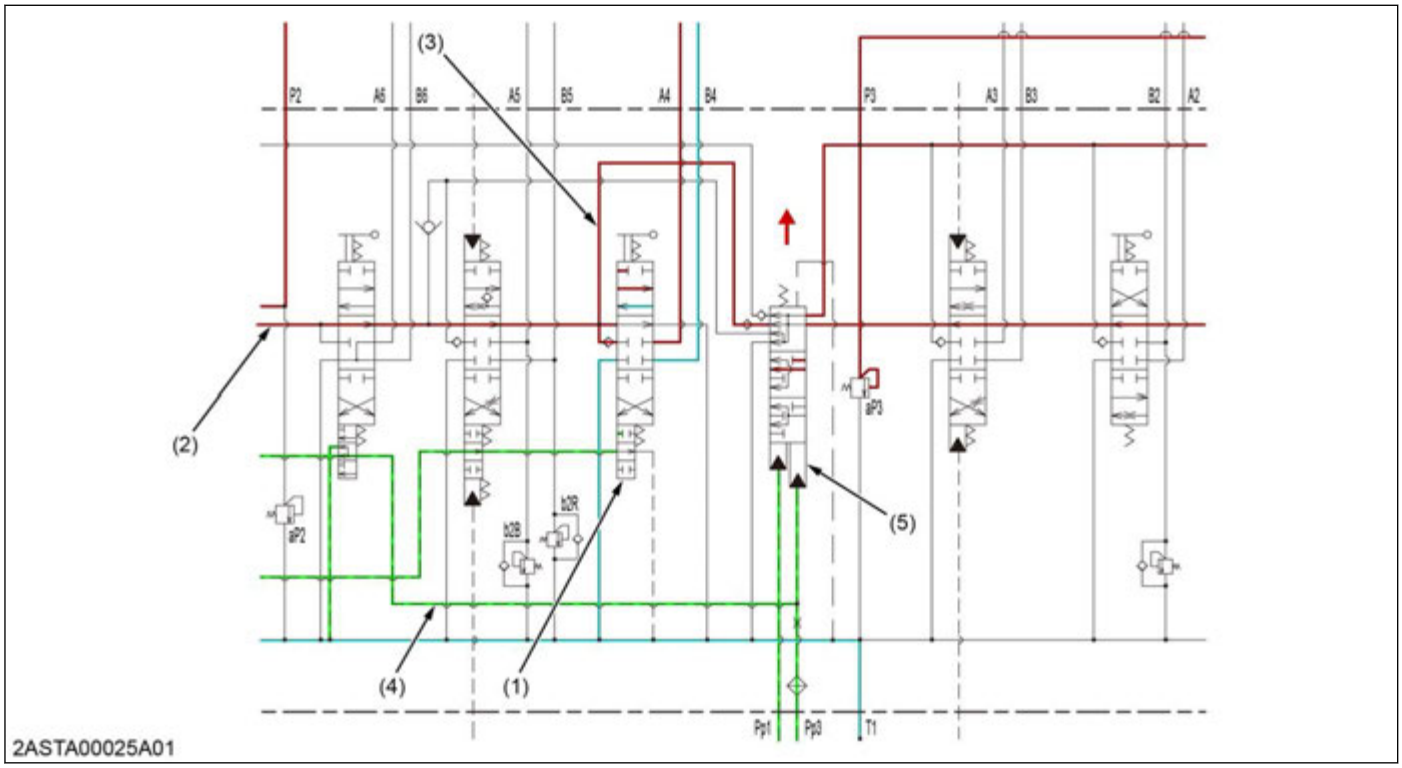


(1) Spool
(2) Boom lock valve
(3) Needle valve
(4) Piston A
(5) Piston B
(6) Check valve
(7) Orifice
(8) To oil cooler
(A) Boom switching section
(B) Boom lock valve section
(C) Boom lock valve (detailed view)
(D) T section (detailed view)
(a) Boom lift pilot pressure (port Pb8)
(b) Boom lower pilot pressure (port Pa8)
(c) Boom lock valve pressure (port Pb8')

- In case of not operating the boom,
  - The check valve shuts off the hydraulic oil from the boom cylinder bottom circuit to prevent internal leakage.
- In case of lowering the boom
  - Pilot pressurized oil flows into port Pb8 to shift the spool.
  - P1 pressurized oil flows to the boom cylinder rod side.
  - Pilot pressurized oil flows into port Pb8' to open the boom lock valve.
  - The hydraulic oil from the boom cylinder bottom returns to the tank through the opened check valve.

3.4.3 AUX1 converge circuit

Converge P2 and P3 flow for AUX1.

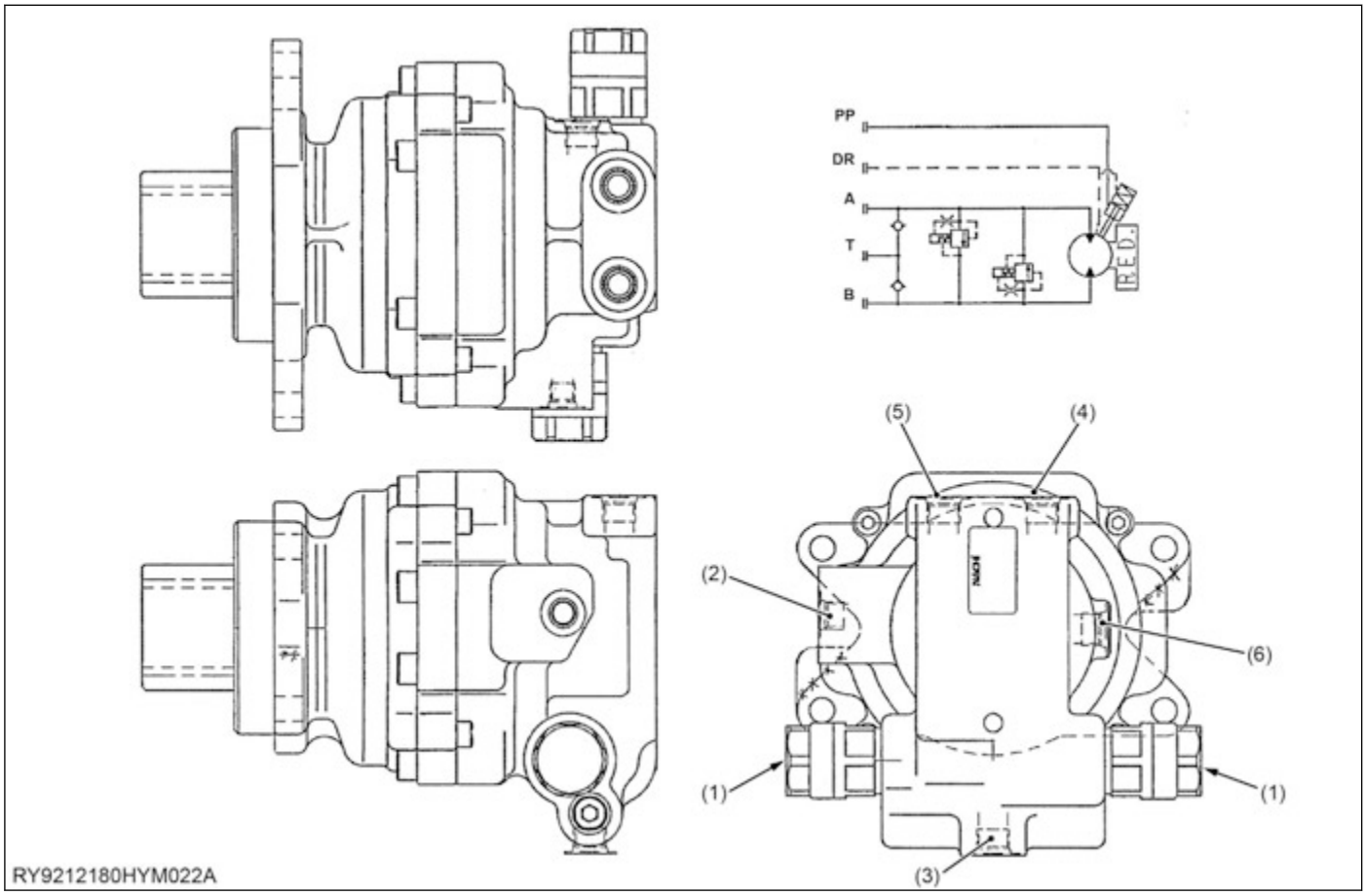


(1) AUX1 section
(2) P2 pressurized oil
(3) P3 pressurized oil
(4) Signal circuit
(5) Communication valve

- Pp1 pressurized oil shifts the communication valve spool to the middle position.
- Pp3 pressurized oil returns to the tank through the travel sections and the communication valve spool stays in the middle position.
- P3 pressurized oil converges with P2 pressurized oil in the AUX1 section to increase the AUX1 flow rate.
- In case of operating travel,
  - Pp3 pressurized oil shifts the communication valve spool.
  - P3 pressurized oil does not converge with P2 pressurized oil and flows to AUX1 port.

4. Swivel motor

4.1 Swivel motor specifications



(1) Relief valve

Items	Specifications
Manufacturer	Nachi-Fujikoshi
Model	PCR-1B-05A-P-8290A
Motor displacement	22.1 cc/rev 1.35 cu.in./rev
Reduction gear ratio	10
Maximum flow rate	18.4 L/min 4.9 U.S. gal/min
Theoretical rotational speed	81 rpm
Theoretical output torque	530 N·m 54 kgf·m 391 lbf·ft
Relief valve setting pressure	17.7 MPa 180 kgf/cm^2 2567 psi
Mechanical brake torque	higher than 68.4 N·m higher than 7.0 kgf·m higher than 50.5 lbf·ft
Parking brake release pressure	less than 4.9 MPa less than 50 kgf/cm^2 less than 711 psi

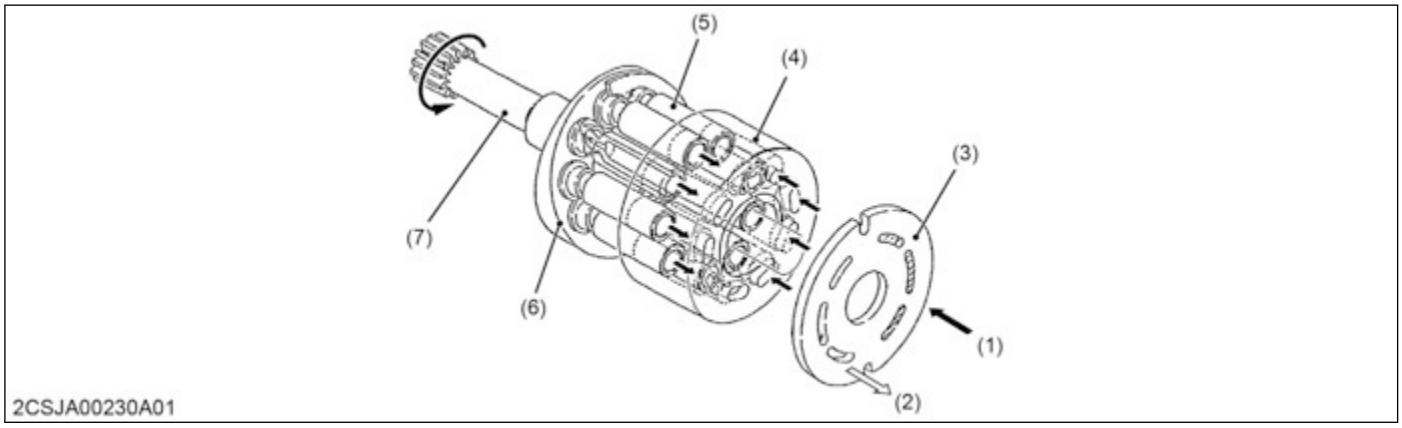
Port location table

No.	Port	Using location	No.	Port	Using location
(2)	PP	Unload valve (B) Parking brake	(5)	A	Control valve (Pb4) Swivel LH
(3)	M	Control valve (T1) Make-up	(6)	Drain port	Tank
(4)	B	Control valve (Pa4) Swivel RH	-	-	-

4.2 Swivel motor function and structure

4.2.1 Swivel motor working principles

Convert fluid energy (pressurized oil flow) into shaft rotation.
Rotating in LH direction (oil flow from port A)

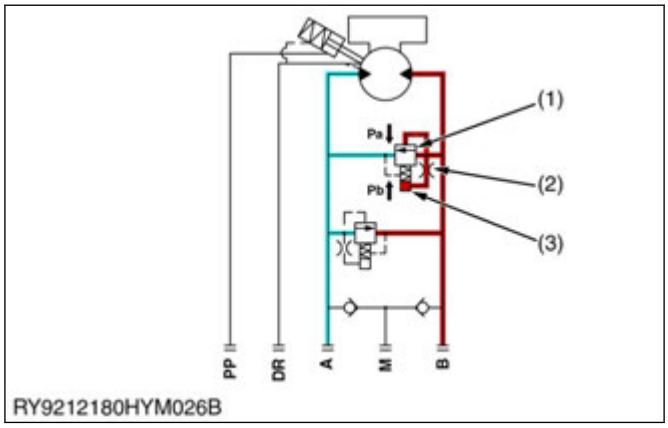


(1) Port A
(2) Port B
(3) Valve plate
(4) Cylinder block
(5) Piston
(6) Swash plate
(7) Shaft

- Input process
  - The pressurized oil flows into the cylinder block from the port A through the valve plate.
  - The pressurized oil pushes the piston.
  - The piston pushes the swash plate.
  - The piston slides down on the swash plate to generate the rotational force with the cylinder block.
  - Stops to supply pressurized oil to the piston at the lowest point.
- Output process
  - The piston slides up on the swash plate by rotational force from port A side.
  - The piston pushes out the hydraulic oil inside the cylinder block from port B.

4.2.2 Shockless function

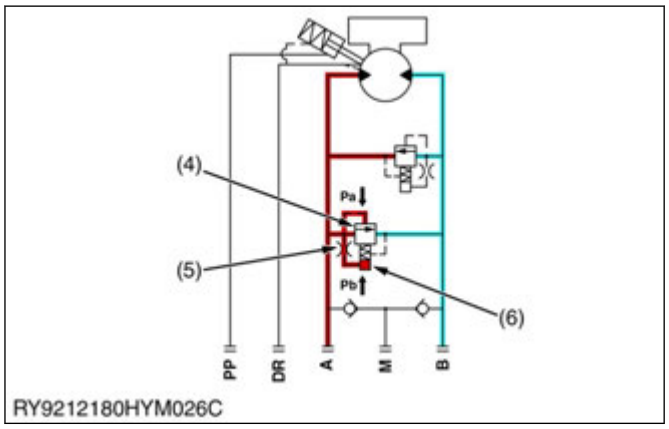
Reduces shock for starting and stopping the swivel motor.
Stopping → Starting



(1) Relief valve
(2) Orifice
(3) Chamber B

- Port B pressurized oil flows into the chamber B through the orifice in the relief valve.
- The orifice reduces the flow rate of port B pressurized oil to make gradual response of Pb.
- Pa is higher than Pb for a moment due to the gradual response of Pb.
- The relief valve opens to let the port B pressurized oil flow into the port A.
- Reduces the flowing oil to the swivel motor and decreases the starting shock.
- Chamber B will be filled with port B pressurized oil.
- Pb with spring force becomes higher than Pa and the relief valve is closed.

Rotating → Stopping

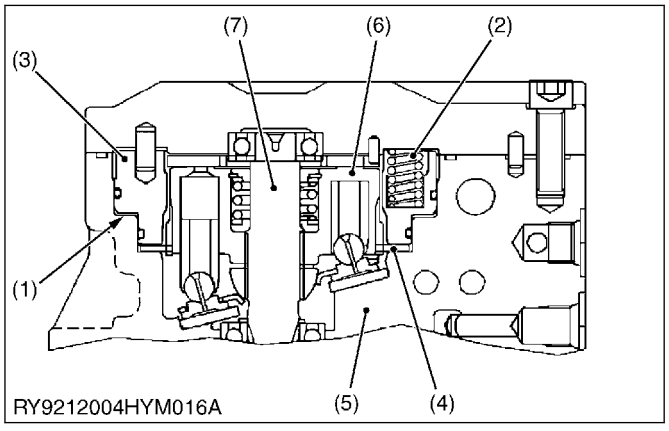


(4) Relief valve
(5) Orifice
(6) Chamber A

- Port A pressure increases by inertial force.
- Port A pressurized oil flows into the chamber A through the orifice in the relief valve.
- The orifice reduces the flow rate of port A pressurized oil to make gradual response of Pb.
- Pa is higher than Pb for a moment due to gradual response of Pb.
- The relief valve opens and oil flows from port A into port B.
- The shock during stopping is decreased while the relief valve is open.
- Chamber A will be filled with compressed oil from port A.
- Pb with spring force becomes higher than Pa and the relief valve is closed.

4.2.3 Swivel motor parking brake

Stops the swivel motor rotation as a negative brake.



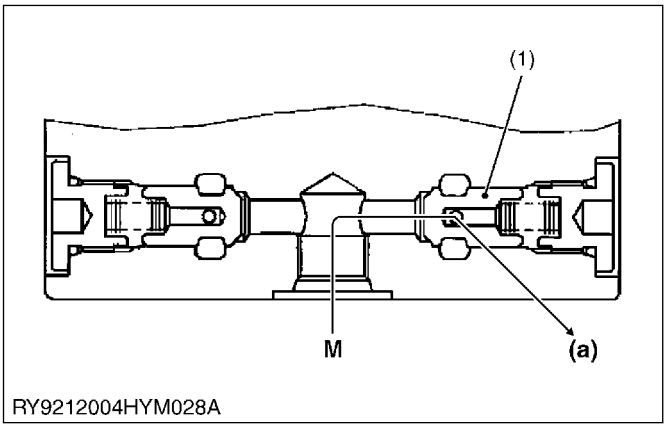
(1) Brake piston chamber
(2) Spring
(3) Brake piston
(4) Friction plate
(5) Case
(6) Cylinder block
(7) Shaft

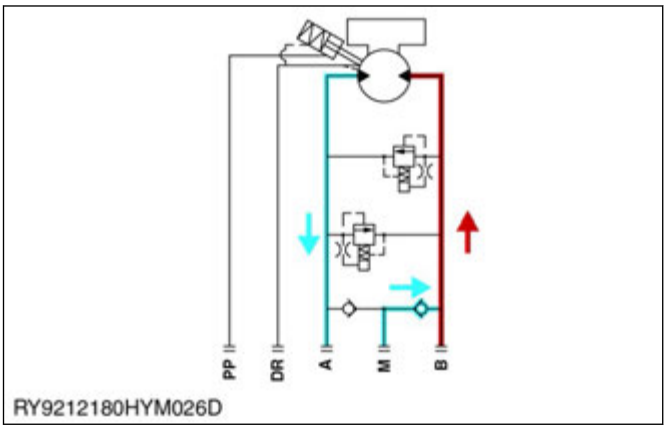
- Activating the parking brake (raising the lever lock)
  - The spring presses the brake piston.
  - The friction plate is wedged between the case and brake piston and is engaged with the shaft.
  - The swivel motor cannot rotate.
- Deactivating the parking brake (lowering the lever lock)
  - P4 pressurized oil flows into the brake piston chamber.
  - P4 pressurized oil pushes the brake piston to compress the spring.
  - The friction plate disengages the shaft and the swivel motor is able to rotate.

4.2.4 Make-up circuit

Prevents cavitation in case of decelerating the swivel motor.

Decelerating the swivel motor





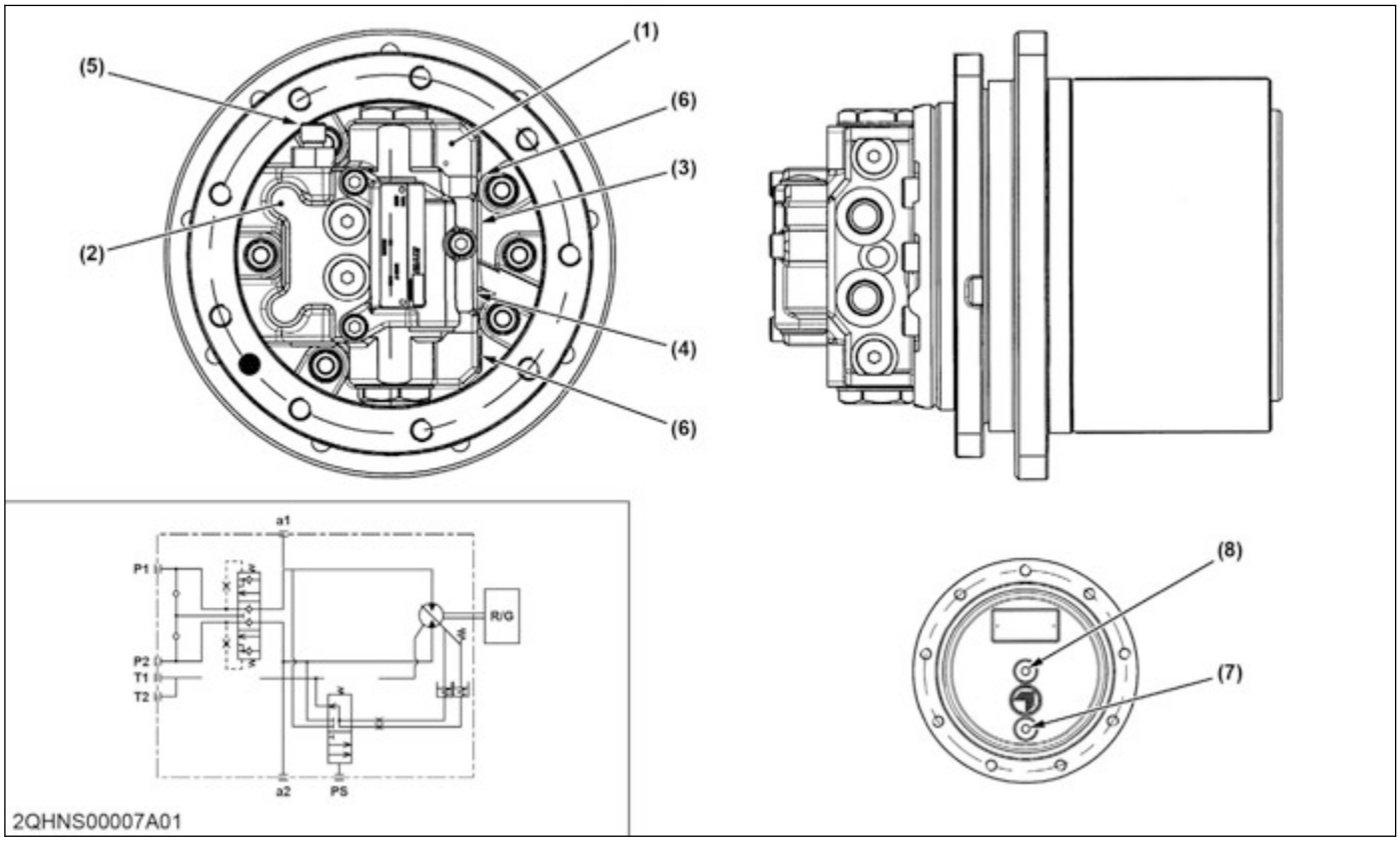
(1) Poppet
(a) To port M

- The primary pressure (port B) decreases due to the inertial force.
- Port M oil flows into the primary line (port B) through the check valve to prevent cavitation.

5. Travel motor

5.1 Travel motor specifications

Basic



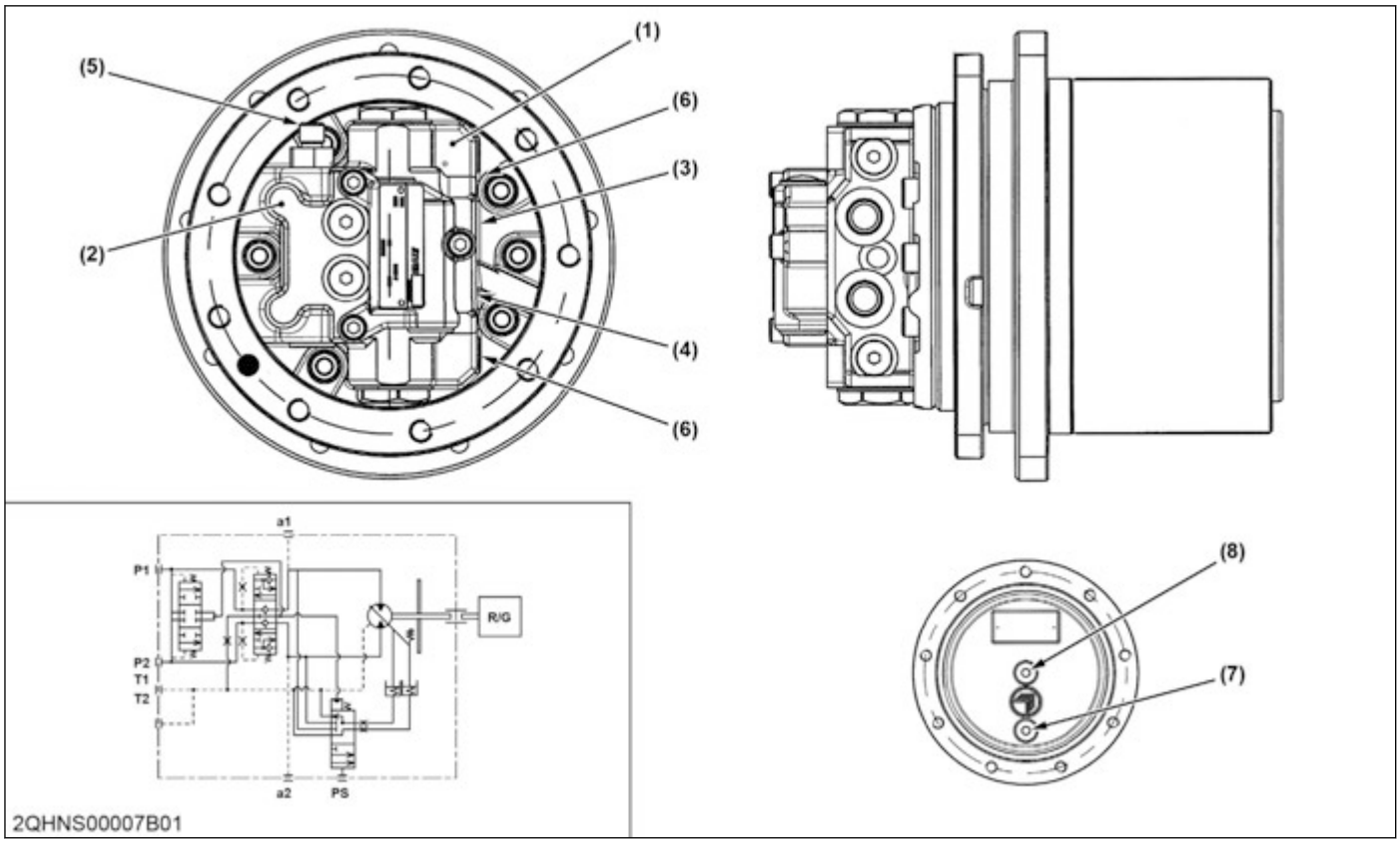
(1) Counterbalance valve (2) Travel speed shift spool (7) Drain port (8) Oil filler and check port

Items		Specifications
Manufacturer		KYB
Model		MAG-18V-230E-1
Motor displacement	Low speed	18.4 cc/rev 1.12 cu.in./rev
	Hi speed	11.6 cc/rev 0.71 cu.in./rev
Reduction gear ratio		1: 41.9
Maximum pressure		23.5 MPa 240 kgf/cm^2 3408 psi
Maximum flow rate		32.2 L/min 8.5 U.S.gals/min
Theoretical rotational speed	Low speed	41.7 rpm
	High speed	66.4 rpm
Theoretical output torque	Low speed	2885 N·m 282 kgf·m 2128 lbf·ft
	High speed	1814 N·m 178 kgf·m 1338 lbf·ft

Port location table

No.	Port	Location	No.	Port	Location
(3)	P1	Swivel joint (F) Backwards (RH)	(5)	PS	Swivel joint (A) Travel speed shift
		Swivel joint (G) Backwards (LH)			
(4)	P2	Swivel joint (D) Forwards (RH)	(6)	T1, T2	Swivel joint (H) Drain
		Swivel joint (E) Forwards (LH)			

Hi-spec



(1) Counterbalance valve (2) Travel speed shift spool (7) Drain port (8) Oil filler and check port

Items		Specifications
Manufacturer		KYB
Model		2T701C2K042003
Motor displacement	Low speed	18.4 cc/rev 1.12 cu.in./rev
	High speed	11.6 cc/rev 0.71 cu.in./rev
Reduction gear ratio		1: 41.9
Maximum pressure		23.5 MPa 240 kgf/cm^2 3408 psi
Maximum flow rate		31.5 L/min 8.5 U.S.gals/min

(Continued)

Items		Specifications
Theoretical rotational speed	Low speed	40.9 rpm
	High speed	64.8 rpm
Theoretical output torque	Low speed	2883 N·m 282 kgf·m 2126 lbf·ft
	High speed	1818 N·m 178 kgf·m 1340 lbf·ft
Automatic deceleration shifting pressure		18.3 to 20.7 MPa 187 to 211 kgf/cm^2 2654 to 3002 psi

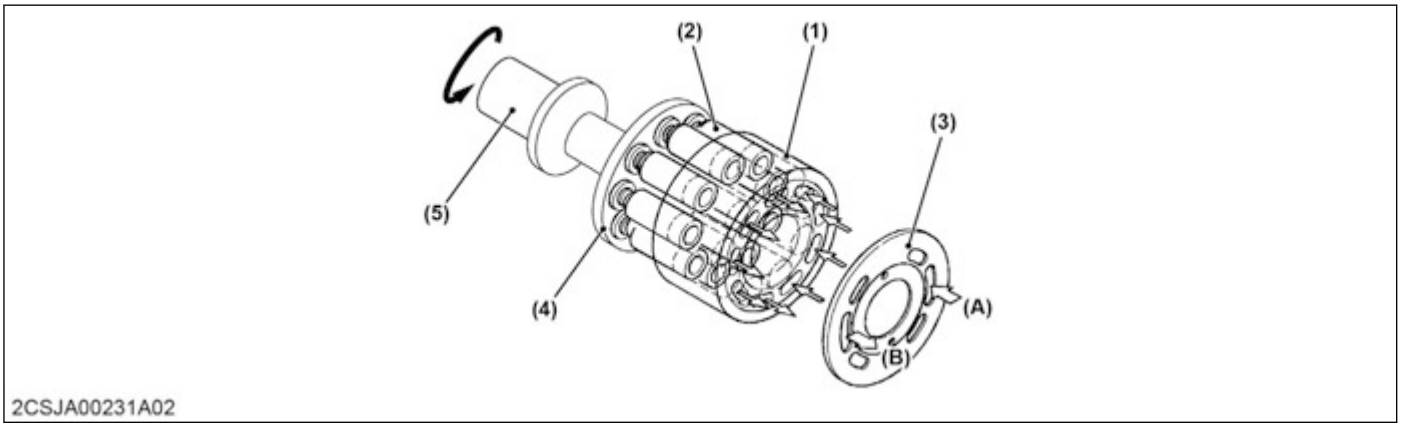
Port location table

No.	Port	Location	No.	Port	Location
(3)	P1	Swivel joint (F) Backwards (RH)	(5)	PS	Swivel joint (A) Travel speed shift
		Swivel joint (G) Backwards (LH)			
(4)	P2	Swivel joint (D) Forwards (RH)	(6)	T1, T2	Swivel joint (H) Drain
		Swivel joint (E) Forwards (LH)			

5.2 Travel motor function and structure

5.2.1 Travel motor working principles

Converts fluid energy (pressurized oil flow) into shaft rotation.
Rotating in LH direction (oil flow from port B)

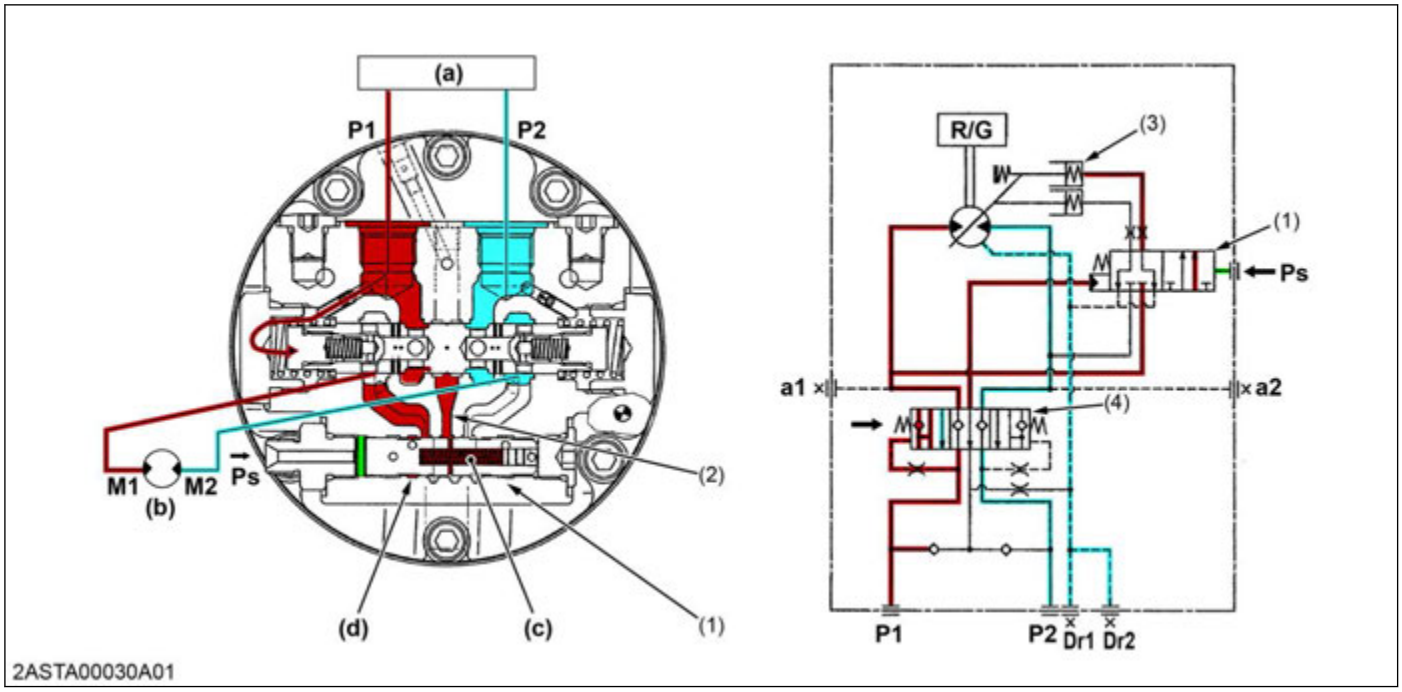


(1) Cylinder block
(2) Piston
(3) Valve plate
(4) Swash plate
(5) Shaft
(A) Port B
(B) Port C

- Input process
  - The pressurized oil flows into the cylinder block from the port B through the valve plate.
  - The pressurized oil pushes the piston.
  - The piston pushes the swash plate.
  - The piston slides down on the swash plate to generate rotational force with the cylinder block.
  - Stops to supply pressurized oil to the piston at the lowest point.
- Output process
  - The piston slides up on the swash plate by rotational force from port B side.
  - The piston pushes out the hydraulic oil inside the cylinder block from port C.

5.2.2 Automatic deceleration

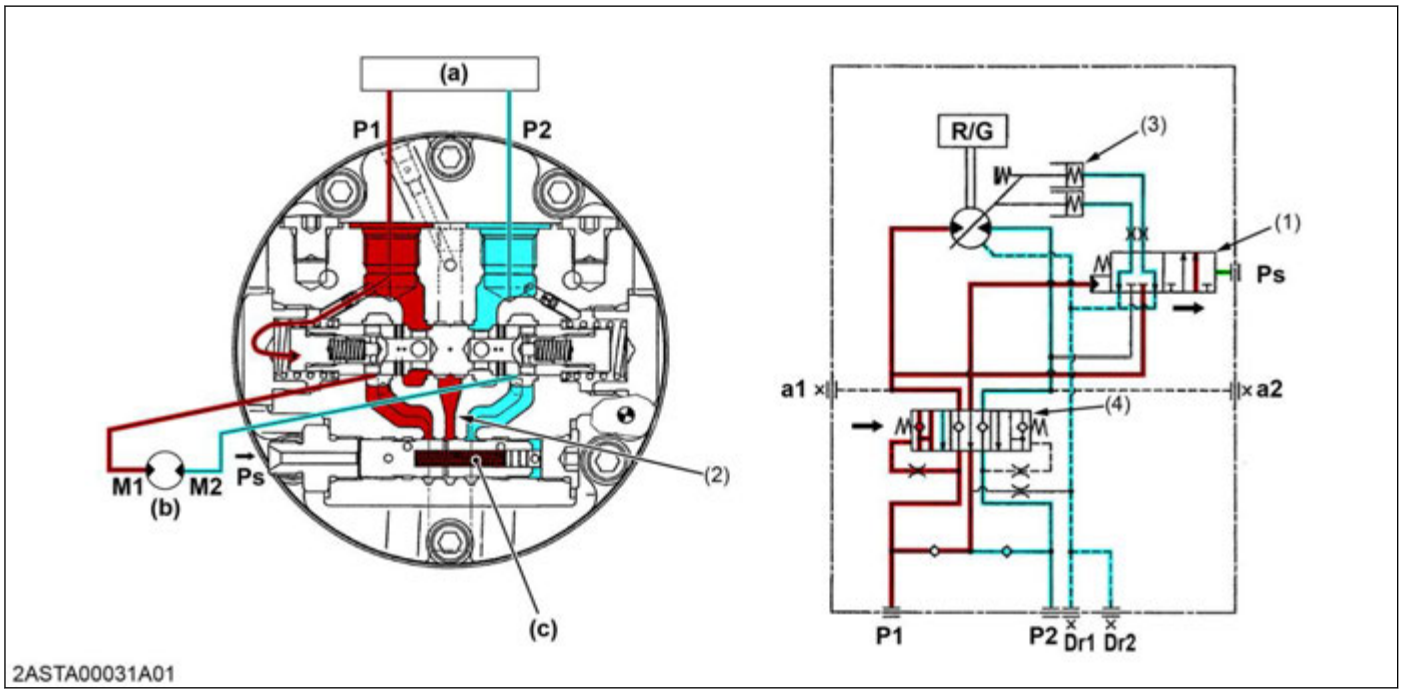
Decelerate the travel speed from high to low automatically under high loading.
Traveling in high speed (low load)



(1) Travel speed shift spool
(2) Motor loading pressure chamber
(3) Travel speed shift piston
(4) Counterbalance valve
(a) Control valve
(b) Motor
(c) Motor loading pressure
(d) To speed switching piston

- P4 pressurized oil pushes the travel speed shift spool to high speed side through the port PS.
- P1 pressurized oil pushes the travel speed shift piston to low speed side through the counterbalance valve.
- Port PS pressure is higher than P1 pressure with spring force and travel speed shift spool switches to high speed side.
- The travel speed shift piston presses the swash plate to increase the swash plate angle and the machine travels at high speed.

Traveling under high load



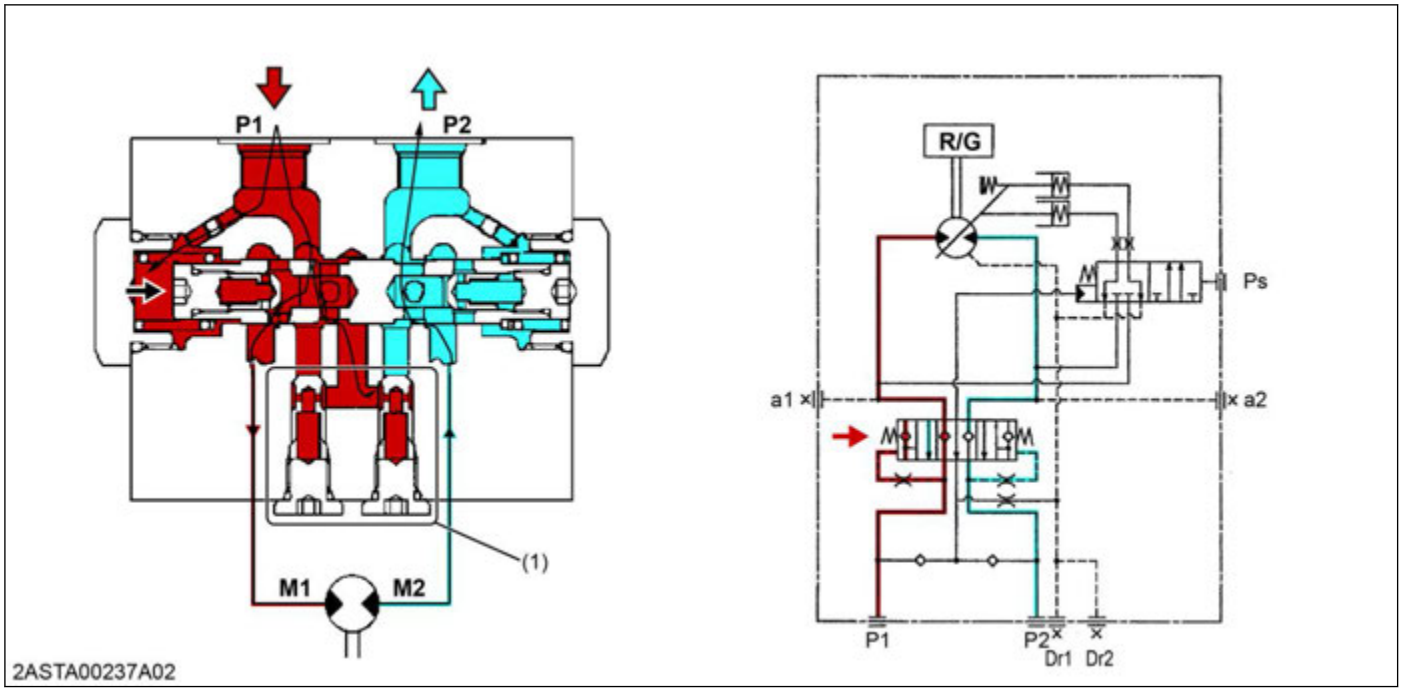
(1) Travel speed shift spool
(2) Motor loading pressure chamber
(3) Travel speed shift piston
(4) Counterbalance valve
(a) Control valve
(b) Motor
(c) Motor loading pressure

- In case of high loading while traveling (such as climbing a slope), the primary pressure (P1) will increase by external force.
- The primary pressure (P1) with spring force is higher than port PS pressure and travel speed shift spool switches to low speed side.
- Oil in the travel speed shift piston returns to the tank through drain port.
- The swash plate angle decreases and travel speed changes to low speed automatically.

5.2.3 Anti-cavitation function

Prevents cavitation in the case of decelerating the travel motor.

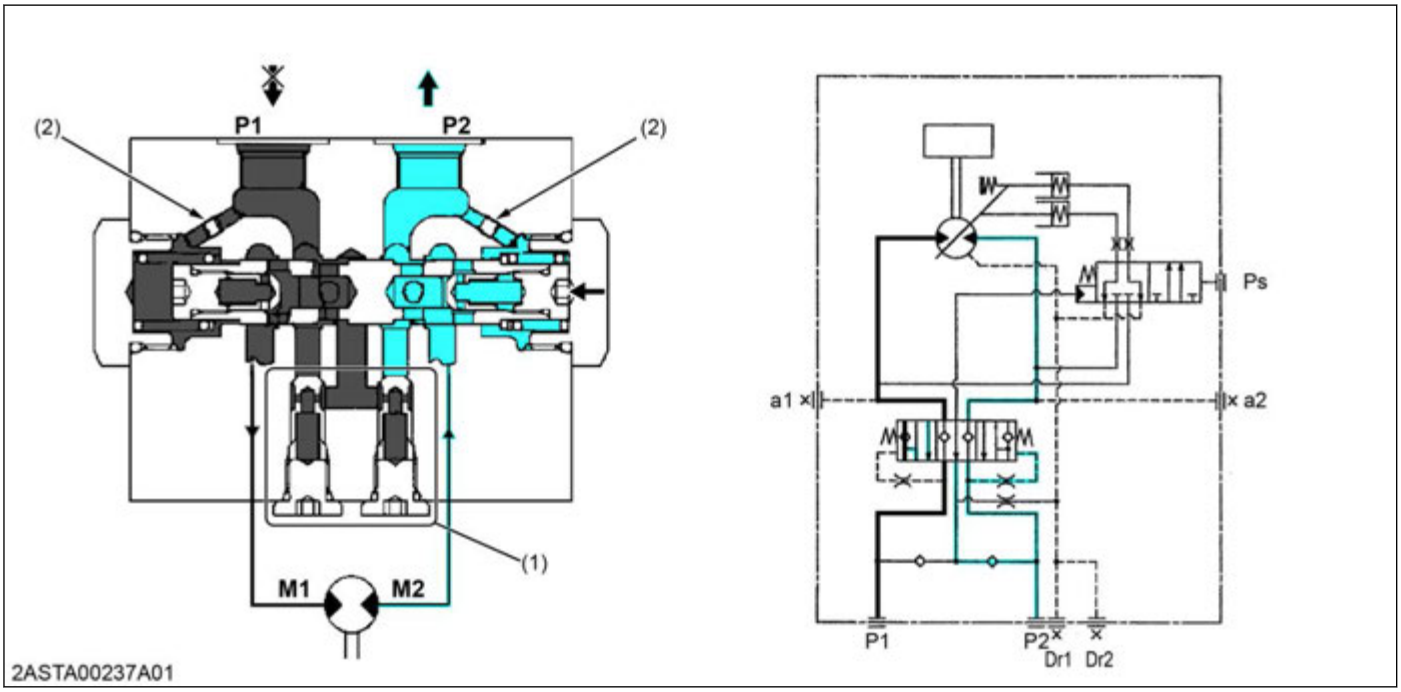
Rotating the travel motor



(1) Check valve

- P1 pressurized oil flows into the counterbalance valve through the check valve and closes the check valve for the return oil from the travel motor.
- The pressurized oil flows into the travel motor (M1) through the counterbalance valve to rotate the travel motor.
- P1 pressurized oil pushes the counterbalance valve to RH side through the orifice.
- The return oil flows to the tank from the travel motor (M2) through the counter balance valve.

Decelerating the travel motor



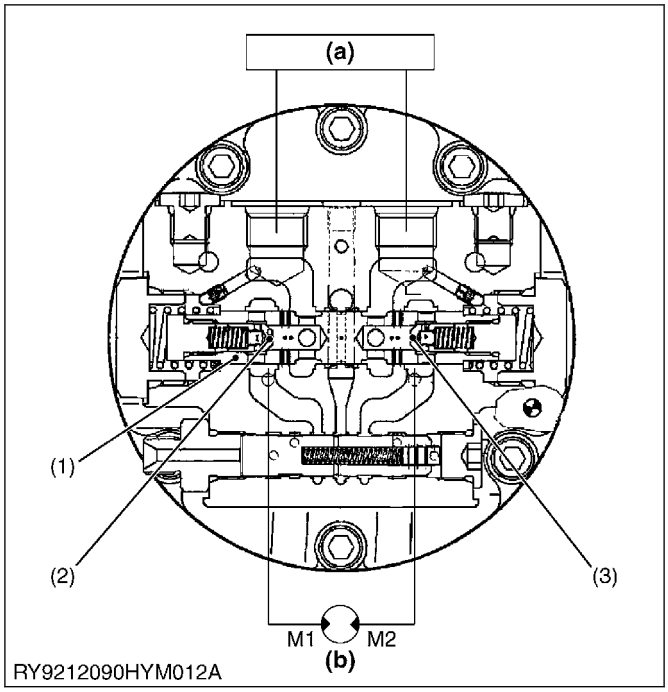
(1) Check valve (2) Orifice

- The travel motor suctions the oil from the primary oil line (M1) due to the inertial force, while decelerating.
- The return oil flows into the primary oil line (M1) through the check valve due to the negative pressure in the primary oil line (M1) and prevent cavitation in the primary oil line (M1).
- Due to the working of the orifices, the counterbalance valve shifts to the neutral position gradually.

5.2.4 Counterbalance valve

Three functions which are preventing internal oil leakage between M1 and M2 when stopping the travel motor, keeping travel motor rotation constantly under any load, and reducing shock from stopping.

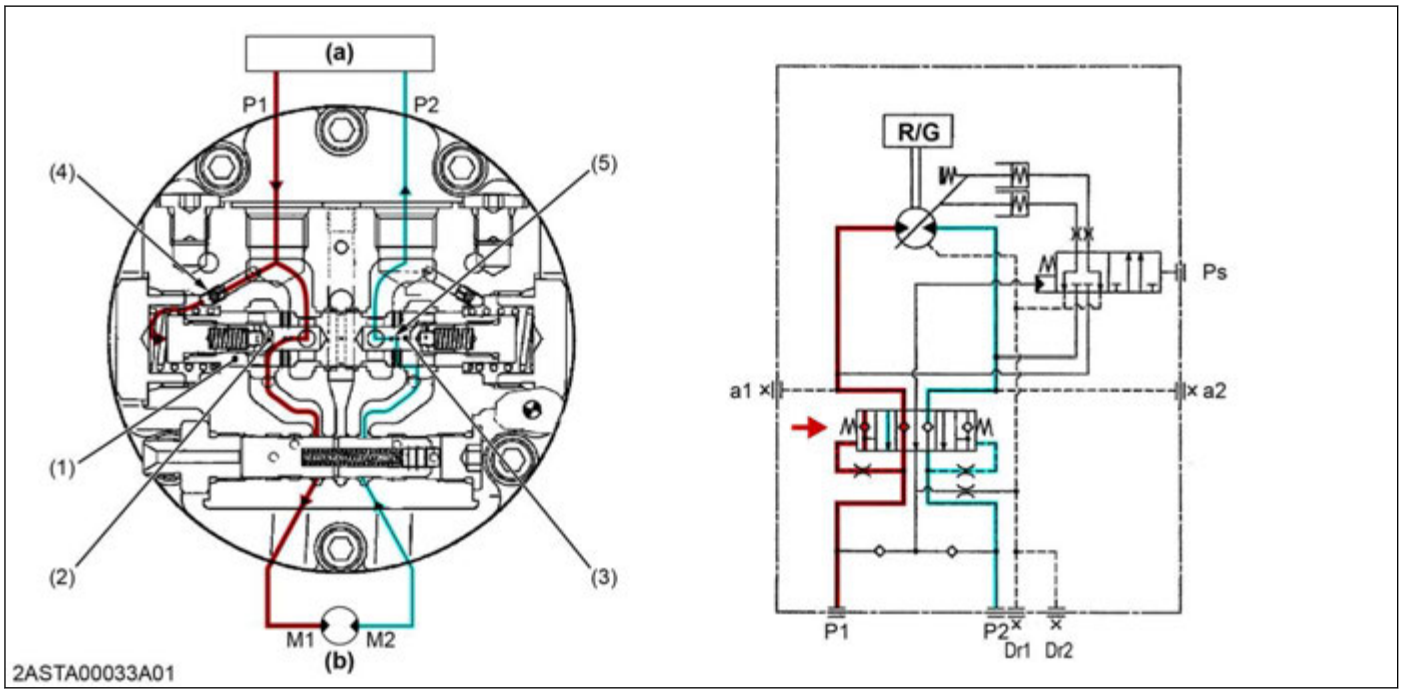
Stopping



(1) Plunger
(2) Check valve LH
(3) Check valve RH
(a) Control valve
(b) Motor

- When stopping the travel motor, the plunger, the check valve LH, and the check valve RH cuts off internal leakage between the port M1 and the port M2 of the travel motor to stop the motor rotation securely.

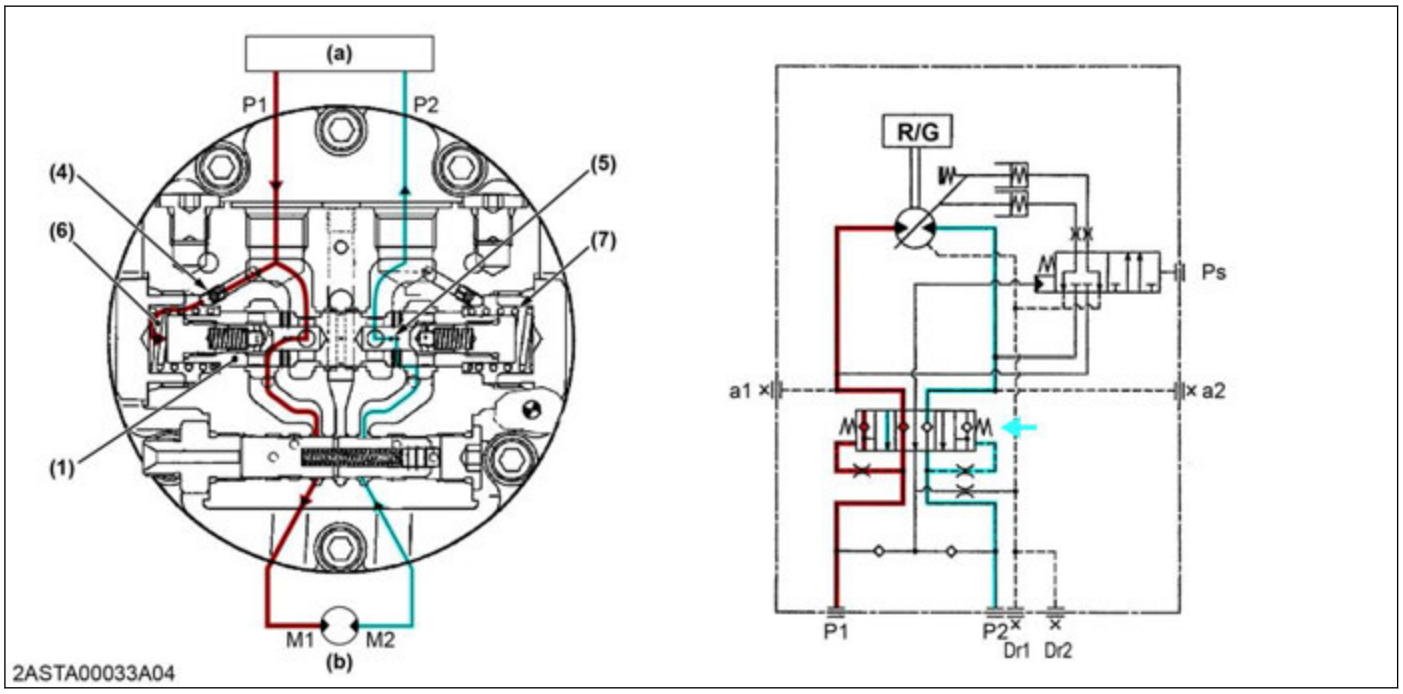
Stopping → Rotating



(1) Plunger
(2) Check valve LH
(3) Check valve RH
(4) Orifice LH
(5) Plunger notch
(a) Control valve
(b) Motor

- P1 pressurized oil flows to port M1 through the check valve LH.
- The orifice LH reduces the oil flow and delays the plunger to shift to RH direction.
- Secondary pressurized oil (M2) is cut off by check valve LH.
- The primary pressure (M1) increases and the plunger is pushed through the orifice LH to RH direction.
- The secondary pressurized oil (M2) flows to port P2 through the notch inside the plunger.
- The back pressure raises due to the restricted flow between port M2 and the plunger.
- The primary pressure (M1) increases more and presses the plunger to RH direction to the stroke end.
- The oil passage in the line M2 is completely opened and the oil returns to the tank freely.
- Back pressure in line M2 decreases.

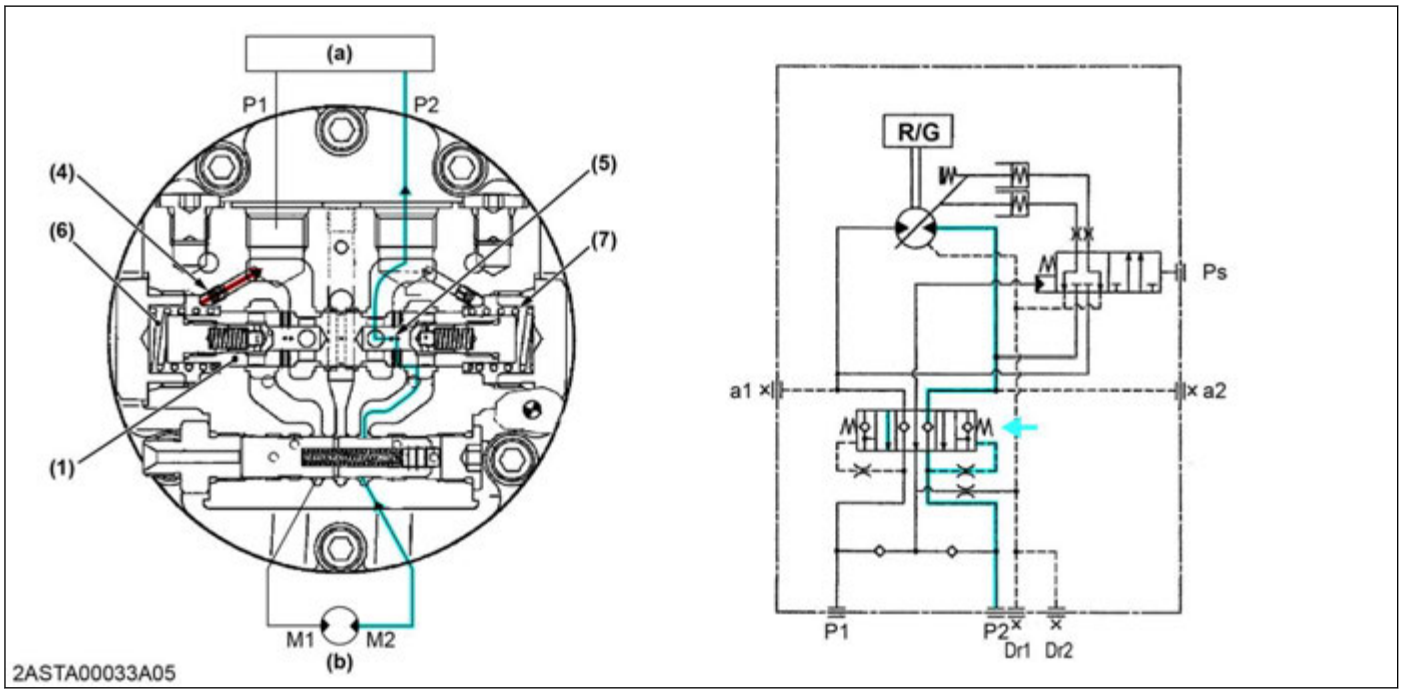
Counterbalance function



(1) Plunger
(4) Orifice LH
(5) Plunger notch
(6) Pressure chamber LH
(7) Spring RH
(a) Control valve
(b) Motor

- Traveling speed will be increasing by gravity force on the down slope.
- The travel motor speed is increased due to the gravity force and the primary pressure (M1) decreases.
- The plunger is returned back slightly due to the decreased primary pressure (M1).
- The outer passage of the orifice closes, then all return oil from port M2 flows through the notch inside the plunger to restrict oil flow.
- Reduction of the oil returning to the tank line prevents increasing travel speed by external force.

Rotating → Stopping

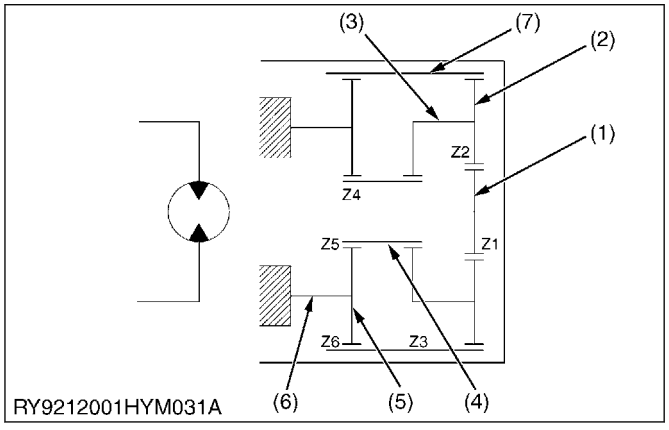


(1) Plunger
(4) Orifice LH
(5) Plunger notch
(6) Pressure chamber LH
(7) Spring RH
(a) Control valve
(b) Motor

- Primary pressure (M1) decreases and secondary pressure (M2) increases by inertial force.
- No pressurized oil flows from port P1 and the plunger starts returning to LH direction.
- Secondary pressurized oil (M2) flows to port P2 through the notch inside the plunger and prevents the line M1 pressure to drop down suddenly.
- The plunger presses out the oil in pressure chamber LH through the orifice LH.
- The plunger returns to neutral position gradually.
- The travel stopping shock is decreased by gradual response of counterbalance valve.

5.2.5 Travel motor decelerator

Decelerate the input rotation speed to increase the output torque.



(1) Drive gear
(2) First planetary gear
(3) First planetary carrier
(4) Second sun gear
(5) Second planetary gear
(6) Second planetary carrier
(7) Ring gear (housing)

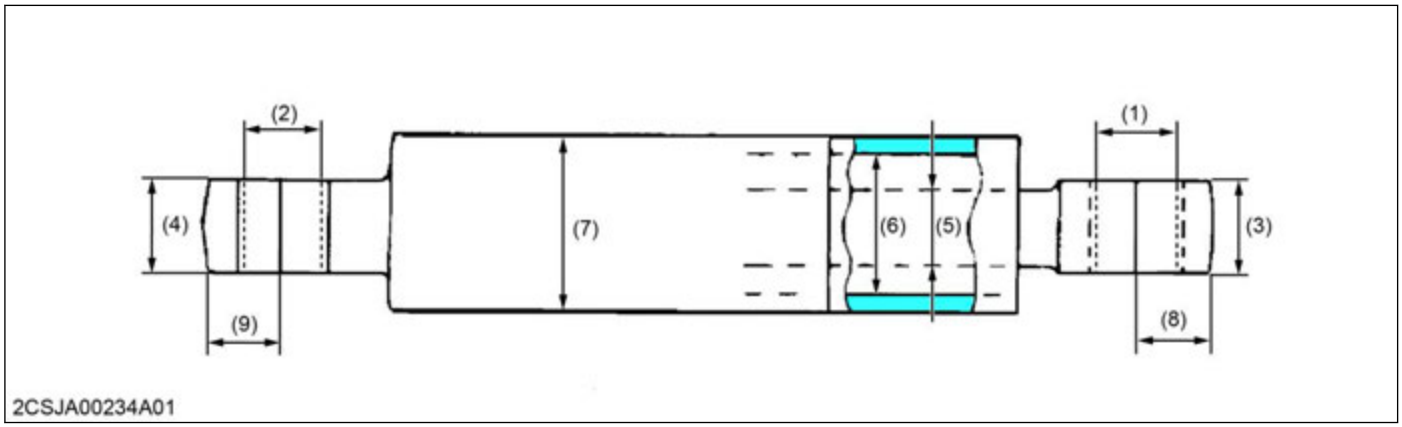
- The drive gear meshes with the first planetary gear.
- The second sun gear meshes with the second planetary gear.
- The second planetary gear is fixed with the frame.
- The first planetary gear and second planetary gear are meshed with the ring gear.
- Driving force from the motor is transmitted by the drive gear and decreases the rotating speed by each gear.
- The decelerated drive force is transmitted to the ring gear via the second planetary gear of the second planetary carrier which is fixed to the final stage of the decelerator.
- Input rotation is opposite the output rotation.

6. Hydraulic cylinder

6.1 Hydraulic cylinder specifications

■ NOTE

- **All hole dimensions show inner dimensions with installed bushings.**

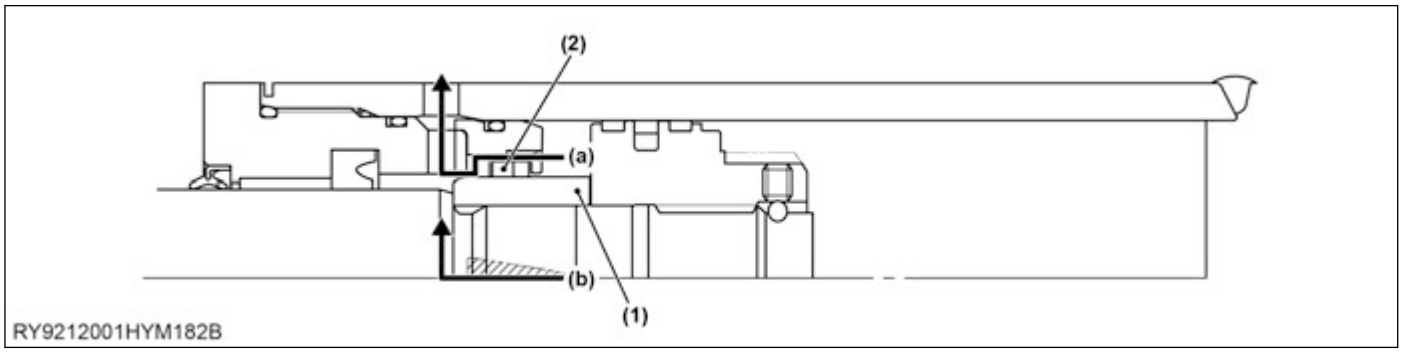


Items	Dimensions				
	Boom	Arm	Bucket	Swing	Blade
(1)	ϕ40 mm ϕ1.57 in.	ϕ40 mm ϕ1.57 in.	ϕ40 mm ϕ1.57 in.	ϕ35 mm ϕ1.38 in.	ϕ45 mm ϕ1.77 in.
(2)	ϕ40 mm ϕ1.57 in.	ϕ40 mm ϕ1.57 in.	ϕ40 mm ϕ1.57 in.	ϕ35 mm ϕ1.38 in.	ϕ45 mm ϕ1.77 in.
(3)	ϕ50 mm ϕ1.97 in.	ϕ50 mm ϕ1.97 in.	50 mm 1.97 in.	ϕ45 mm ϕ1.77 in.	ϕ55 mm ϕ2.17 in.
(4)	60 mm 2.36 in.	50 mm 1.97 in.	50 mm 1.97 in.	ϕ40 mm ϕ1.57 in.	ϕ55 mm ϕ2.17 in.
(5)	ϕ40 mm ϕ1.57 in.	ϕ40 mm ϕ1.57 in.	ϕ40 mm ϕ1.57 in.	ϕ35 mm ϕ1.38 in.	ϕ45 mm ϕ1.77 in.
(6)	ϕ70 mm ϕ2.76 in.	ϕ70 mm ϕ2.76 in.	ϕ70 mm ϕ2.76 in.	ϕ70 mm ϕ2.76 in.	ϕ90 mm ϕ3.54 in.
(7)	ϕ85 mm ϕ3.35 in.	ϕ85 mm ϕ3.35 in.	ϕ85 mm ϕ3.35 in.	ϕ85 mm ϕ3.35 in.	ϕ105 mm ϕ4.13 in.
(8)	40 mm 1.57 in.	40 mm 1.57 in.	40 mm 1.57 in.	37.5 mm 1.48 in.	42.5 mm 1.67 in.
(9)	40 mm 1.57 in.	40 mm 1.57 in.	40 mm 1.57 in.	37.5 mm 1.48 in.	42.5 mm 1.67 in.
Minimum length	860 mm 33.86 in.	879 mm 34.61 in.	769 mm 30.28 in.	686 mm 27.01 in.	422 mm 16.61 in.
Stroke	542 mm 21.34 in.	591 mm 23.27 in.	374 mm 14.72 in.	432.5 mm 17.03 in.	115 mm 4.53 in.
Manufacturer	Burnside Euro Ltd.	Burnside Euro Ltd.	Burnside Euro Ltd.	Burnside Euro Ltd.	Burnside Euro Ltd.

6.2 Hydraulic cylinder function and structure

6.2.1 Hydraulic cylinder cushioning

Decelerate the cylinder speed at end of stroke to reduce operating shock.

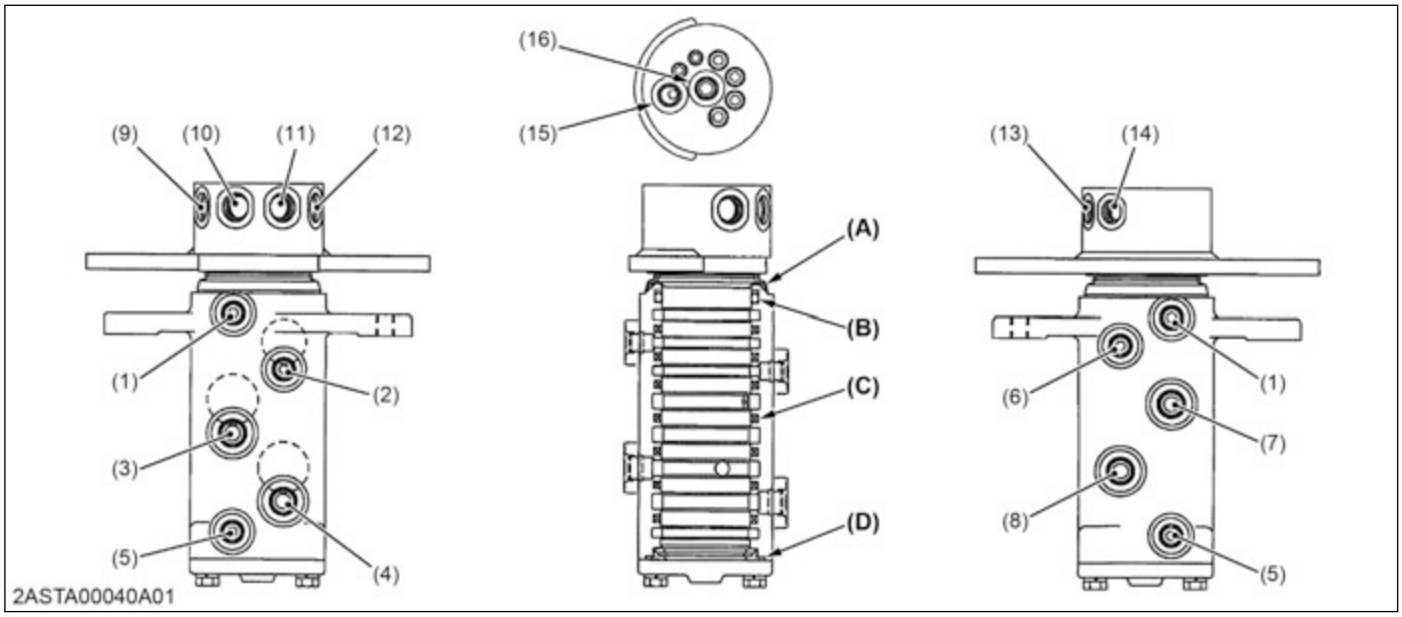


(1) Cushion bearing (2) Cushion seal (a) Oil flow through slit (b) Pressed oil flow by piston

- The cushion bearing enters into cushion seal at end of stroke.
- The hydraulic oil flows through the slit to decelerate the cylinder speed.

7. Swivel joint

7.1 Swivel joint specifications



(A) Oil seal (B) U seal (C) O-ring (D) Thrust ring

Items	Specifications
Manufacturer	Nachi Fujikoshi
Rotational speed	15 rpm
Rotational torque (no loading)	50 N·m 5.1 kgf·m 36.9 lbf·ft
Hydraulic oil temperature range	-20 to 100 ℃ -4 to 212 ℉
Pressure capacity	35.0 MPa 357 kgf/cm^2 5076 psi

Port location table

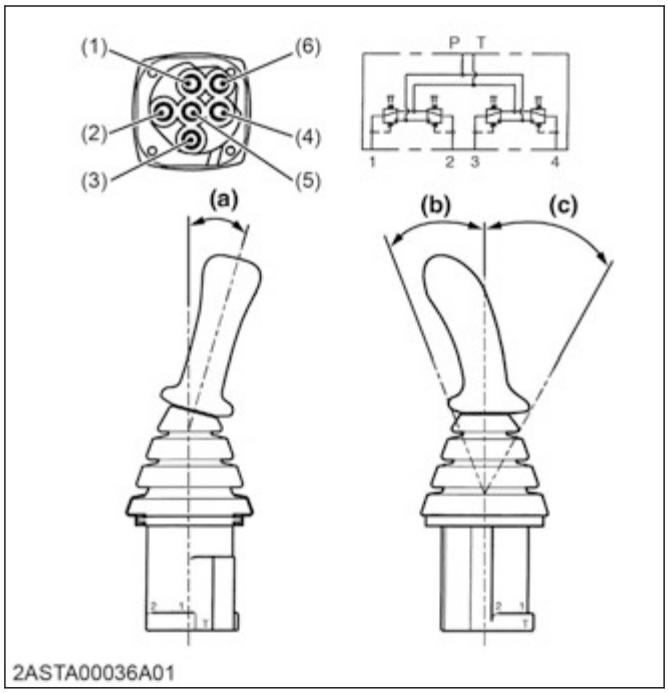
Lower side			Upper side			
No.	Port (swivel joint)	Location	No.	Port (swivel joint)	Location	
					Basic	Hi-spec
(1)	A	Travel motor (PS) Travel speed shift	(9)	f	Control valve (B6)	Control valve (B7)
(2)	C	Blade cylinder (rod)	(10)	d	Control valve (A6)	Control valve (A7)
(3)	E	Travel motor (P2) RH, forwards	(11)	g	Control valve (B7)	Control valve (B8)
(4)	G	Travel motor (P1) RH, backwards	(12)	e	Control valve (A7)	Control valve (A8)
(5)	H	Travel motor (T)	(13)	c	Control valve (A2)	Control valve (A3)
(6)	B	Blade cylinder (bottom)	(14)	b	Control valve (B2)	Control valve (B3)
(7)	D	Travel motor (P1) LH, forwards	(15)	a	Unload valve (A)	Unload valve (A)
(8)	F	Travel motor (P2) LH, backwards	(16)	h	Tank	Tank

8. Pilot control valve

8.1 Pilot control valve specifications

Basic

LH pilot control valve



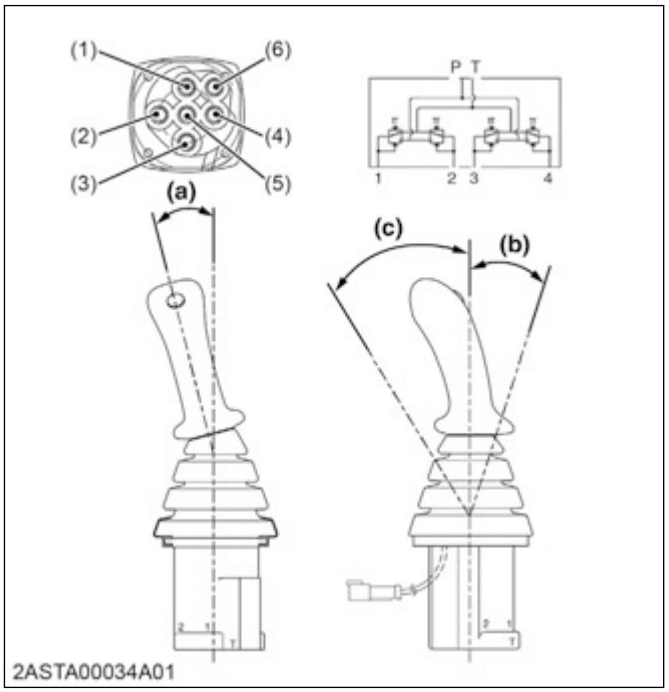
(a) Tilting angle of the lever: 15°
(b) Single operation angle: 20°
(c) Simultaneous operation angle: 28°

Items	Specifications
Manufacturer	Rexroth
Model	4TH5E187-11 / TT43M04S057

Port location table

No.	Port	Location
(1)	1	Control valve (Pa5) Arm crowd
(2)	2	Control valve (Pa3) Swivel LH
(3)	3	Control valve (Pb5) Arm dump
(4)	4	Control valve (Pb3) Swivel RH
(5)	P	Control valve (PP2) Pilot pressure
(6)	T	Tank

RH pilot control valve



(a) Tilting angle of the lever: 19°
(b) Single operation angle: 20°
(c) Simultaneous operation angle: 28°

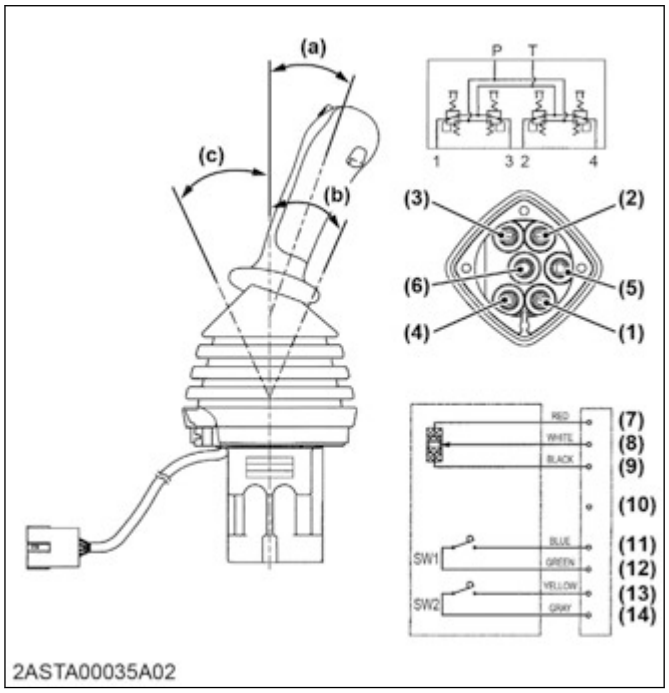
Items	Specifications
Manufacturer	Rexroth
Model	4TH5E187-11 / ST235M04S158

Port location table

No.	Port	Location
(1)	1	Control valve (Pa8) Boom lift
(2)	2	Control valve (Pa9) Bucket crowd
(3)	3	Control valve (Pb8) Boom lower
(4)	4	Control valve (Pb9) Bucket dump
(5)	P	Control valve (PP1) Pilot pressure
(6)	T	Tank

Hi-spec

LH pilot control valve



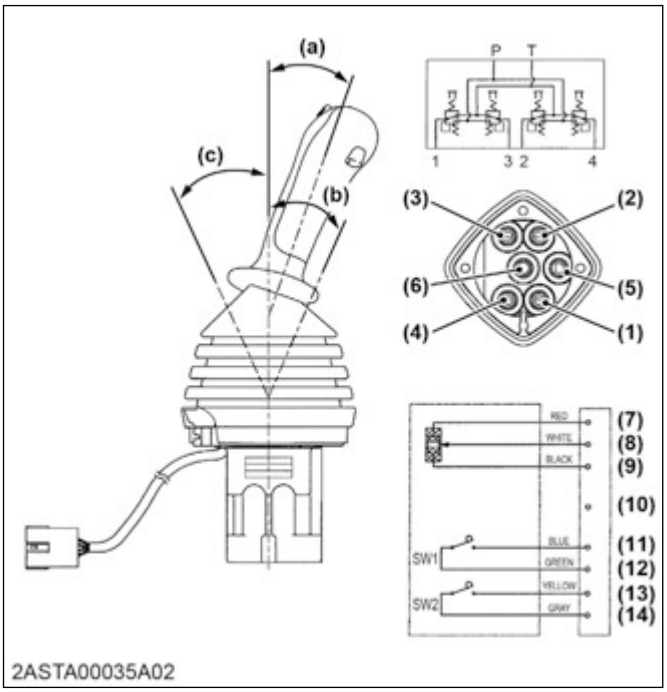
(7) 5 V power input
(8) Proportional output
(9) Ground
(10) - (blank)
(11) Switch 1
(12) Switch 1
(13) Switch 2
(14) Switch 2
(a) Tilting angle of the lever: 19°
(b) Single operation angle: 19°
(c) Simultaneous operation: 21.5°

Items	Specifications
Manufacturer	KPM (Kawasaki Precision Machinery)
Model	PV48M2157C

Port location table

No.	Port	Location
(1)	1	Control valve (Pb4) Swivel LH
(2)	2	Control valve (Pb6) Arm dump
(3)	3	Control valve (Pa4) Swivel RH
(4)	4	Control valve (Pa6) Arm crowd
(5)	P	Control valve (PP2) Pilot pressure
(6)	T	Tank

RH pilot control valve



(7) 5 V power input
(8) Proportional output
(9) Ground
(10) - (blank)
(11) Switch 1
(12) Switch 1
(13) Switch 2
(14) Switch 2
(a) Tilting angle of the lever: 19°
(b) Single operation angle: 19°
(c) Simultaneous operation: 21.5°

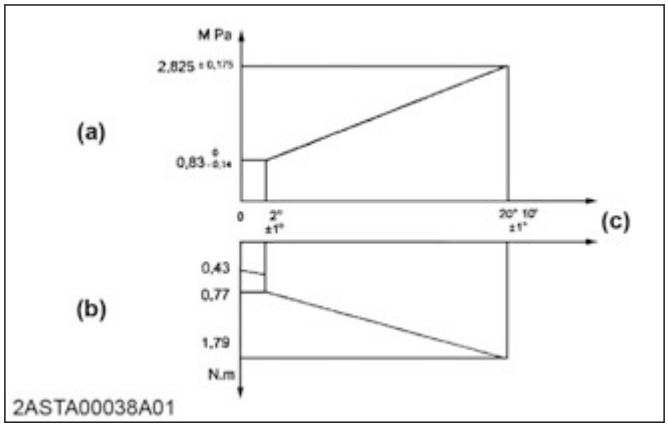
Items	Specifications
Manufacturer	KPM (Kawasaki Precision Machinery)
Model	PV48M2158C
Input voltage	5 V

Port location table

No.	Port	Location
(1)	1	Control valve (Pa10) Bucket crowd
(2)	2	Control valve (Pb9) Boom lower
(3)	3	Control valve (Pb10) Bucket dump
(4)	4	Control valve (Pa9) Boom lift
(5)	P	Control valve (PP1) Pilot pressure
(6)	T	Tank

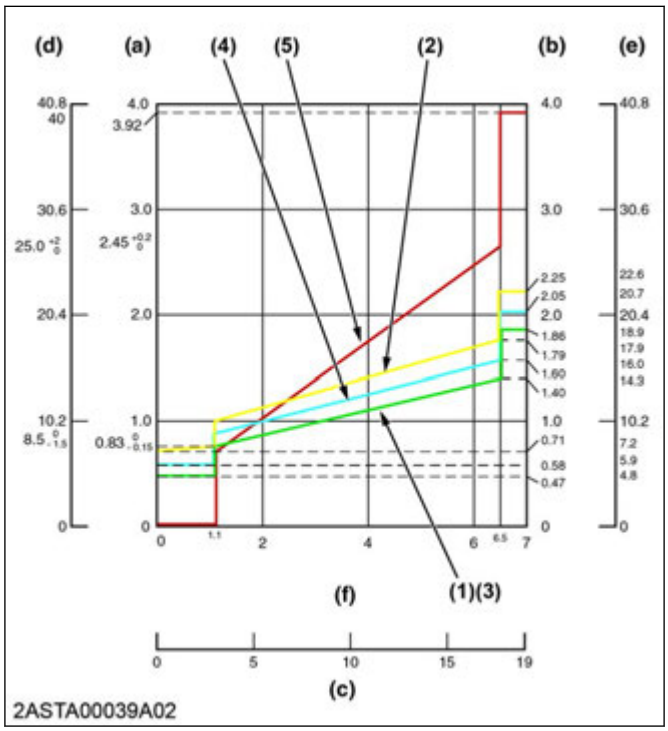
8.2 Pilot control valve performance diagram

Basic



(a) Secondary pressure (MPa)
(b) Operating torque (N·m)
(c) Operating angle (deg)

Hi-spec

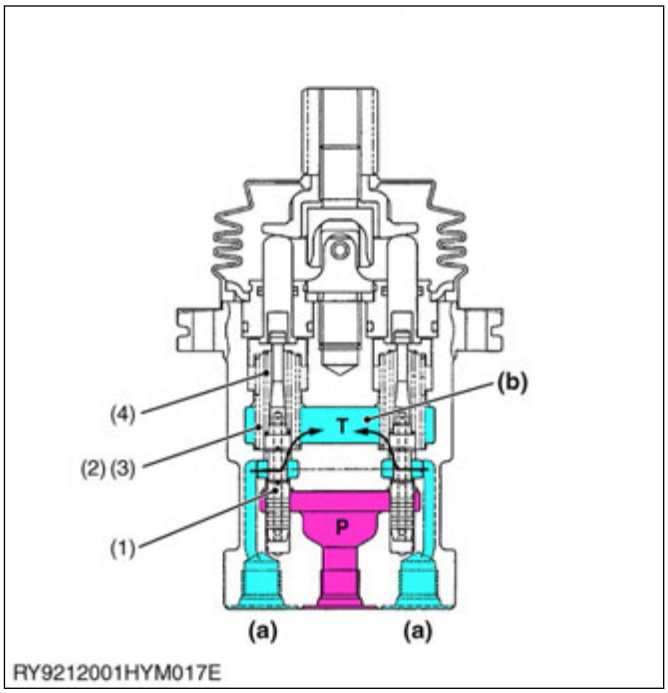


(1) Single operation torque (Port 1)
(2) Single operation torque (Port 2)
(3) Single operation torque (Port 3)
(4) Single operation torque (Port 4)
(5) Secondary pressure
(a) Secondary pressure (MPa)
(b) Operating torque (N·m)
(c) Operating angle (deg)
(d) Secondary pressure (kgf/cm^2)
(e) Operating torque (kgf·cm)
(f) Push rod stroke (mm)

8.3 Pilot control valve function and structure

Reduces pressure of P4 pressurized oil to control the direction and stroke of spool in the control valve.

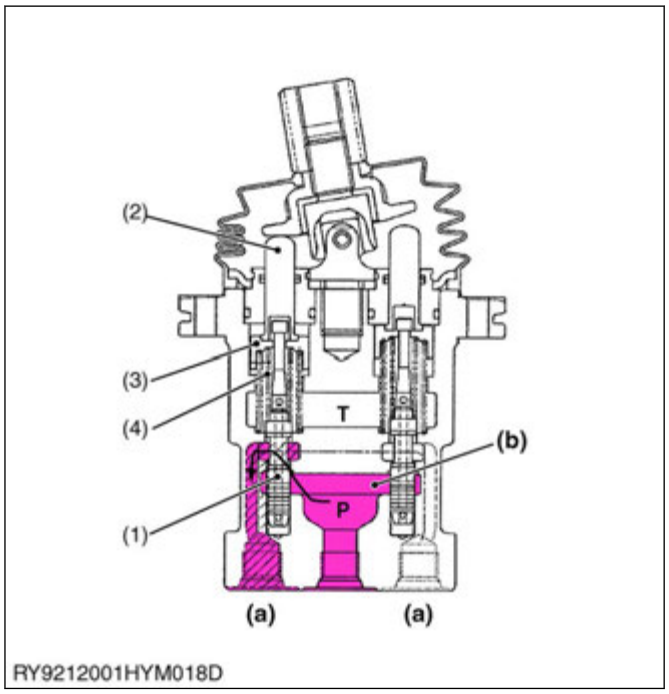
Not operating



(1) Spool
(2) Return spring
(3) Return spring
(4) Primary setting spring
(a) Output port
(b) Port T

- P4 pressurized oil is cut off by the spool.
- Output port is connected to the tank.

Operating

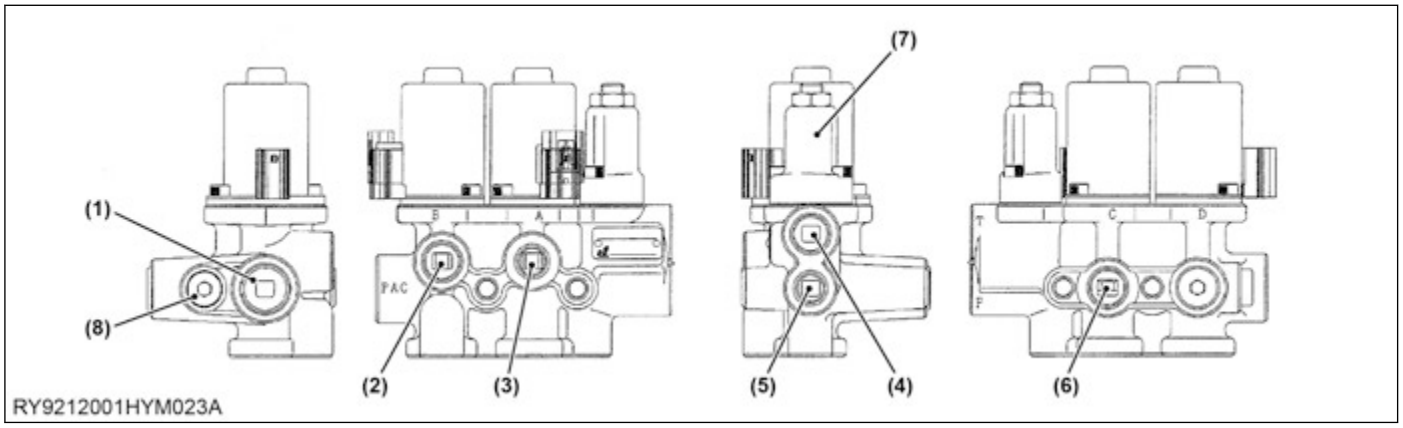


(1) Spool
(2) Push rod
(3) Spring seat
(4) Primary setting spring
(a) Output port
(b) Port P

- The push rod pushes the spring seat.
- The spring seat pushes the spool through the spring.
- The spool reduces the P4 pressure to the outlet port due to spool stroke.
- Reduced P4 pressurized oil flows to the control valve through the output port.

9. Unload valve

9.1 Unload valve specifications



(7) Pilot primary pressure relief valve
(8) Check valve

Items	Specifications	Remarks
Manufacturer	Nishina Industrial	-
Rated Voltage	12 V	-
Pilot primary pressure relief valve setting pressure	4.3 to 4.6 MPa 43.8 to 46.9 kgf/cm^2 624 to 667 psi	At temp. 50 ℃, 6 L/min At temp 144 ℉, 1.6 U.S.gals/min
Internal leakage volume port P → port T	less than 0.13 L/min less than 0.034 U.S.gals/min	At 2.5 MPa At 25.5 kgf/cm^2 At 363 psi
Internal leakage volume port PAC → other ports	0.1 ml/min 0.026 U.S.gals/min	At 4.3 MPa At 43.8 kgf/cm^2 At 624 psi

Port location table

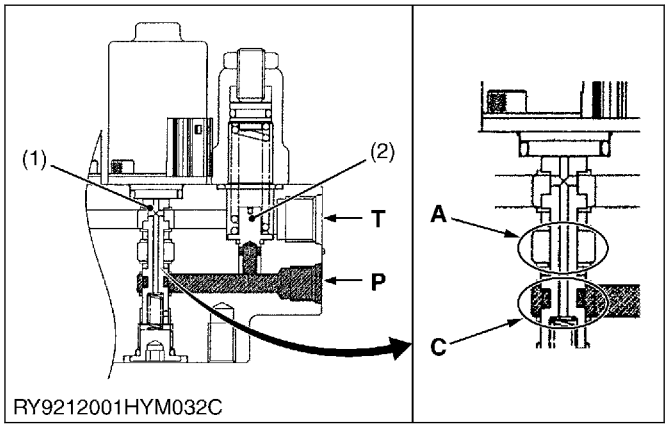
No.	Port	Location	No.	Port	Location
(1)	PAC	Accumulator	(4)	T	Tank
(2)	A	Travel motor (PS) Travel speed shift	(5)	P	- (plugged)
(3)	B	Control valve (Pp2)	(6)	C	Pilot filter
		Pilot control valve (P)			Control valve (Pp3)
		Swivel motor (PP) Parking brake	(-)	D	- (plugged)

9.2 Unload valve function and structure

9.2.1 Unload valve working principles

Composed of two solenoid valves. One solenoid valve activates the pilot control valves, cuts tank return passage in the control valve to enable pressurized oil of P1, P2, and P3, and deactivates the swivel motor negative brake. The other shifts the travel speed.

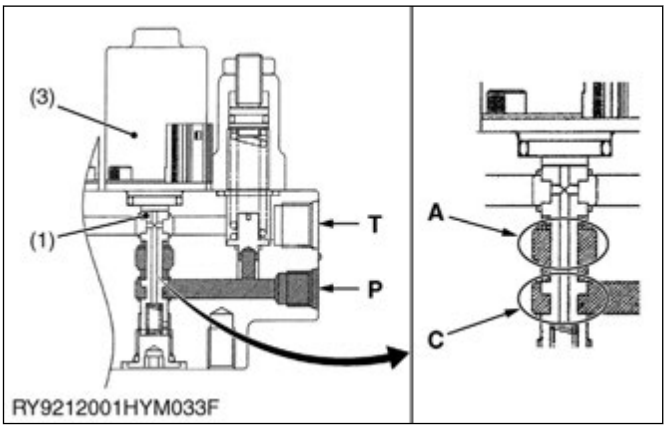
Activating pilot control valves, deactivating swivel motor parking brake



(1) Spool
(2) Plunger
A Port A
C Port C
P Port P
T Port T

- In case of the solenoid valve (pilot control valves, swivel motor parking brake) OFF,
  - P4 pressurized oil is cut off by the spool.
  - No oil flows to the pilot control valves and swivel motor parking brake.
  - Pilot control valves are deactivated and the swivel motor parking brake is activated.
- In case of the solenoid valve (pilot control valves, swivel motor parking brake) ON,
  - P4 pressurized oil flows to the pilot control valves through the opened spool and able to operate the machine.
  - P4 pressurized oil flows to the swivel motor through the opened spool to deactivate the parking brake.

Shifting travel speed

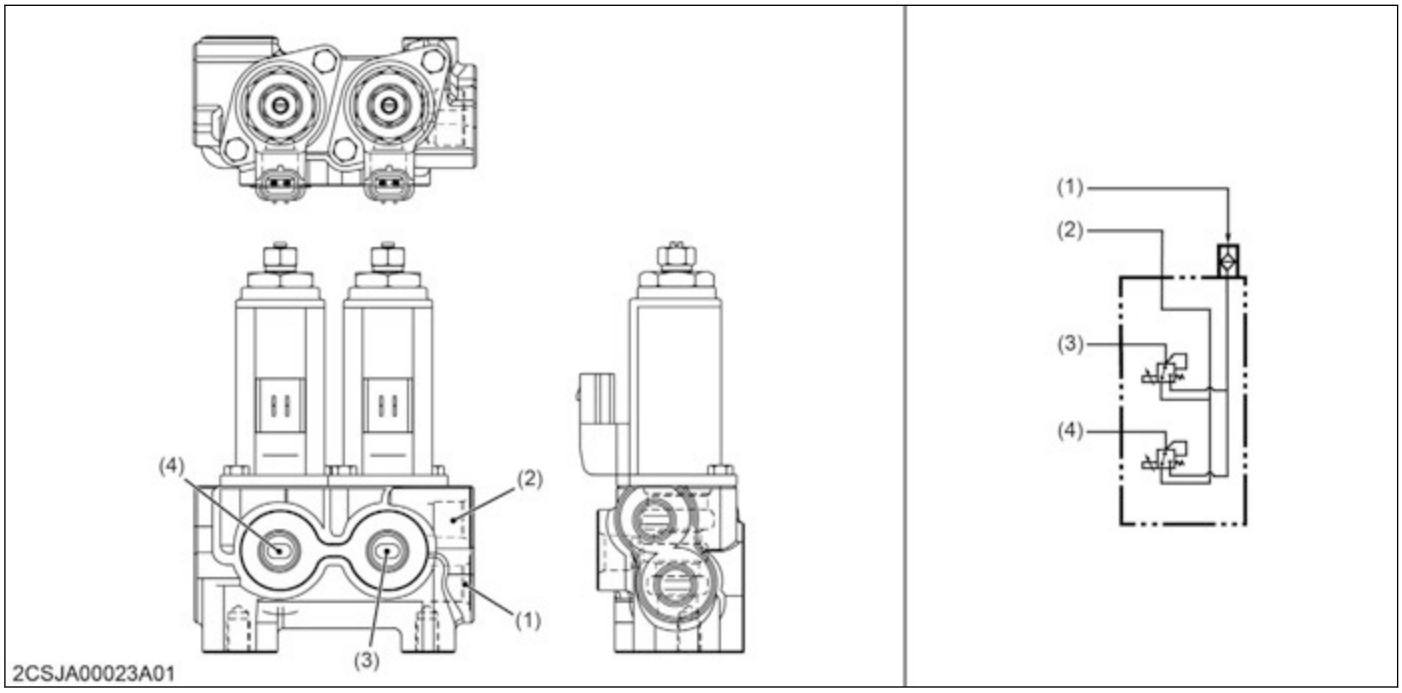


(1) Spool
(3) Solenoid
A Port A
C Port C
P Port P
T Port T

- In case of the solenoid valve (travel speed shift) OFF,
  - P4 pressurized oil is cut off by the spool.
  - No oil flows to the travel speed shift spool and travel is low speed.
- In case of the solenoid valve (travel speed shift) ON,
  - P4 pressurized oil flows to the travel speed shift spool through the opened spool and shifts travel to high speed.

10. Proportional valve

10.1 AUX1 proportional valve specifications

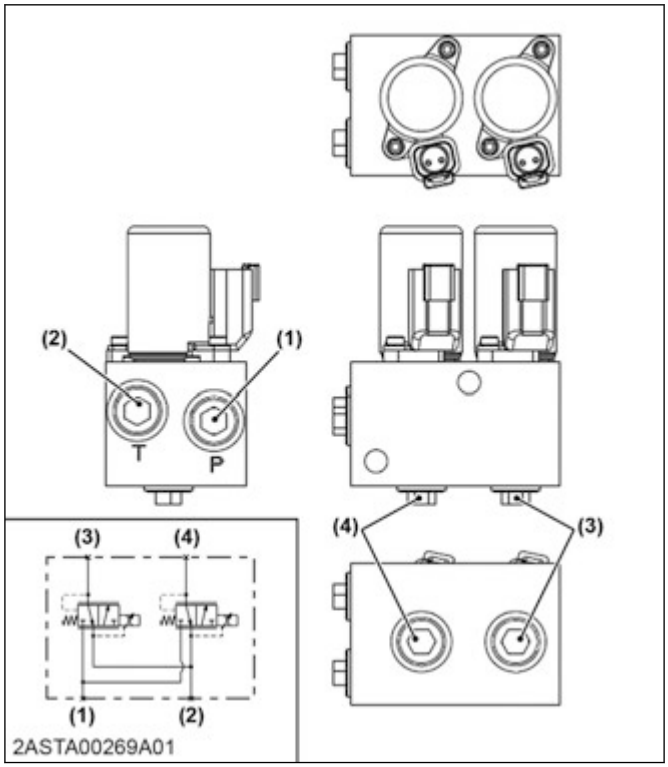


Items	Specifications	Remarks
Manufacturer	KPM (Kawasaki Precision Machinery)	-
Rated pressure	7 MPa 71.4 kgf/cm^2 1015 psi	Port P pressure
Allowable back pressure	1.0 MPa 10.2 kgf/cm^2 145 psi	Port T pressure
Maximum flow rate	10 L/min 2.6 U.S. gal/min	Per one valve
Drain flow rate	less than 0.4 L/min less than 0.1 U.S. gal/min	At port P pressure 4.9 MPa At port P pressure 49.9 kgf/cm^2 At port P pressure 710 psi
Temperature range	-20 to 90 ℃ -4 to 194 ℉	-
Maximum contamination limits	NAS grade 10 and below	-
Rated current	1600 mA	-
Coil resistance	2.7 to 3.7 Ω	At 20 ℃ At 68 ℉
Voltage	12 V	-
Secondary pressure setting range	0 to 2.7 MPa 0 to 27.5 kgf/cm^2 0 to 392 psi	-

Port location table

No.	Port	Location	No.	Port	Location
(1)	P	Swivel motor (PP) Pilot pressure	(3)	A1	Control valve (Pb5) AUX1 LH
(2)	T	Tank	(4)	A2	Control valve (Pa5) AUX1 RH

10.2 AUX2 proportional valve specifications

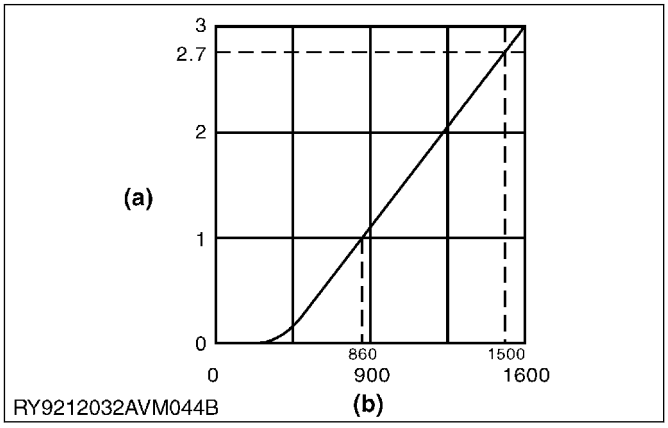


Items	Specifications	Remarks
Manufacturer	HYDRAFORCE	-
Rated pressure	3.0 MPa 30.6 kgf/cm^2 435 psi	Port P pressure
Rated flow rate	2 L/min 0.5 U.S. gal/min	Per one valve
Drain flow rate	less than 0.125 L/min less than 0.03 U.S. gal/min	At port P pressure 2.5 MPa At port P pressure 25.8 kgf/cm^2 At port P pressure 365 psi
Temperature range	-40 to 100 ℃ -40 to 212 ℉	-
Rated power	8.6 W	Per one valve
Rated voltage	12 V	-

Port location table

No.	Port	Location
(1)	P	Unload valve (P) Pilot pressure
(2)	T	Unload valve (T)
(3)	Pa1	Control valve (Pa1) AUX2 RH
(4)	Pb1	Control valve (Pb1) AUX2 LH

10.3 AUX1 proportional valve performance diagram



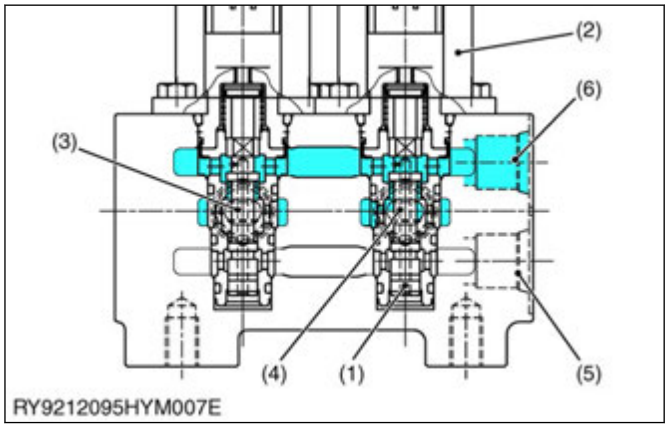
(a) Secondary pressure (MPa) (b) Input current (mA)

10.4 Proportional valve function and structure

10.4.1 Proportional valve working principles

Variably adjust P4 oil pressure according to input current to flow the adjusted pilot pressurized oil into the pilot port of the control valve.

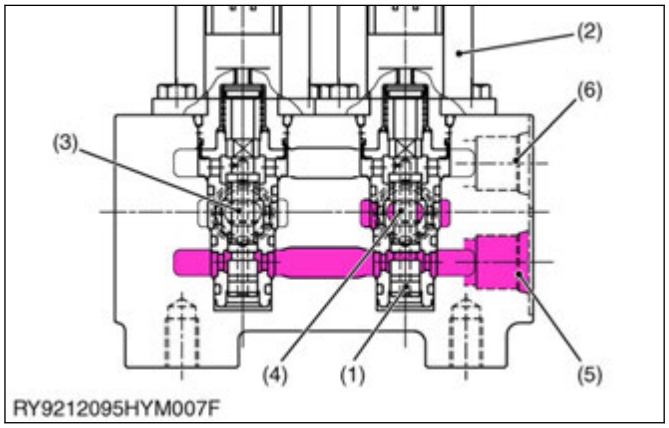
Solenoid OFF



(1) Spool
(2) Solenoid
(3) Port A
(4) Port B
(5) Port P
(6) Port T

- P4 pressurized oil is cut off by the spool.
- No hydraulic oil flows to AUX1 section of the control valve.

Solenoid ON

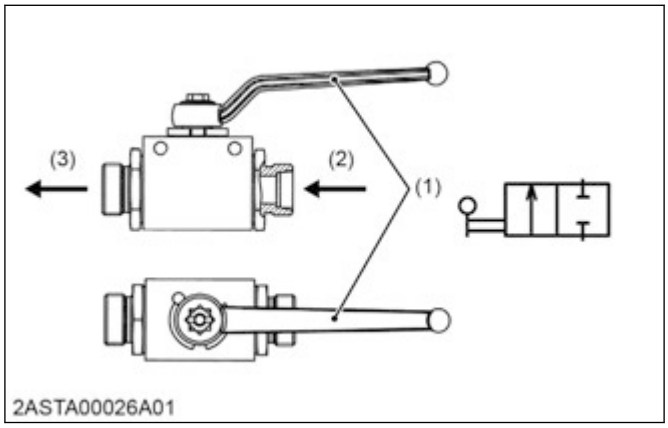


(1) Spool
(2) Solenoid
(3) Port A
(4) Port B
(5) Port P
(6) Port T

- The spool is pushed down to connect port P to port B.
- P4 pressurized oil flows to AUX1 section of the control valve through the opened spool.
- The spool opening area is able to control variably according to AUX operation.

11. Third line valve

11.1 Third line valve specifications



(1) Switching lever

Items	Specifications	Remarks
Manufacturer	HYDAC	-
Maximum pressure	50 MPa 510.0 kgf/cm^2 7252 psi	-
Hydraulic oil temperature range	-10 to 80 ℃ -14 to 176 ℉	-

No.	Port	Location
(2)	-	Control valve (A4)
(3)	-	Hydraulic oil tank Oil cooler

SERVICING

1. Troubleshooting

1.1 Hydraulic troubleshooting for front attachment

All of the front attachments does not operate or operate slowly

Causes	Inspections	Actions
The engine is malfunctioning.	Measure the engine speed.	Adjust each part of the engine.
The hydraulic oil level is low. The hydraulic oil quality is low.	Check for the hydraulic oil level and oil quality.	Replenish or replace the hydraulic oil.
The suction line or suction filter is clogged.	Check if the suction line or suction filter is clogged.	Clean the suction line. Replace the suction filter.
The pilot filter is clogged.	Check if the pilot filter is clogged.	Replace the pilot filter.
The pilot primary pressure relief valve setting pressure is too low.	Measure the pilot primary pressure.	Adjust or replace the pilot primary pressure relief valve.
The pilot primary pressure relief valve spring is weaken or damaged.	Measure the pilot primary pressure.	Adjust or replace the pilot primary pressure relief valve.
The pilot primary pressure relief valve is clogged by contamination.	Measure the pilot primary pressure.	Clean or replace the pilot primary pressure relief valve.
The pilot pump is damaged.	Check for damage of the pilot pump.	Replace the pilot pump.
The main relief valve setting pressure is too low.	Measure the main relief valve pressure.	Adjust or replace the main relief valve.
The main relief valve spring is weaken or damaged.	Measure the main relief valve pressure.	Adjust or replace the main relief valve.
The main relief valve is clogged by contamination.	Measure the main relief valve pressure.	Clean or replace the main relief valve.
The hydraulic pump coupling is damaged.	Check for damage of the hydraulic pump coupling.	Replace the hydraulic pump coupling.
The drive shaft of the hydraulic pump is damaged.	Check for damage of the hydraulic pump drive shaft.	Replace the hydraulic pump drive shaft.
The internal parts of the hydraulic pump are damaged or worn.	Measure the hydraulic pump P-Q performance. Check for damage of the internal parts of the hydraulic pump.	Repair or replace the internal parts of the hydraulic pump.

The pilot control valve RH or LH does not operate or operates slowly

Causes	Inspections	Actions
The pilot line filter is clogged.	Check if the pilot line filter is clogged.	Clean the pilot line filter.
The pilot control valve spring is weaken or damaged.	Measure the pilot secondary pressure.	Replace the pilot control valve.
The pilot control valve is clogged by contamination.	Measure the pilot secondary pressure.	Clean or replace the pilot control valve.

Power of the entire hydraulic system is weak

Causes	Inspections	Actions
The pilot primary pressure relief valve setting pressure is too low.	Measure the pilot primary pressure.	Replace the pilot primary pressure relief valve.
The pilot primary pressure relief valve spring is weaken or damaged.	Measure the pilot primary pressure.	Adjust or replace the pilot primary pressure relief valve.
The pilot primary pressure relief valve is clogged by contamination.	Measure the pilot primary pressure.	Clean or replace the pilot primary pressure relief valve.
The main relief valve setting pressure is too low.	Measure the main relief valve pressure.	Adjust or replace the main relief valve.
The main relief valve spring is weaken or damaged.	Measure the main relief valve pressure.	Adjust or replace the main relief valve.
The main relief valve is clogged by contamination.	Measure the main relief valve pressure.	Clean or replace the main relief valve.

One of the cylinders does not operate or operates slowly

Causes	Inspections	Actions
The pilot control valve spring is weaken or damaged.	Measure the pilot secondary pressure.	Replace the pilot primary pressure relief valve.
The pilot control valve is clogged by contamination.	Measure the pilot secondary pressure.	Clean or replace the pilot control valve.
The overload relief valve setting pressure is too low.	Measure the overload relief valve pressure.	Adjust the overload relief valve.
The overload relief valve spring is weaken or damaged.	Measure the overload relief valve pressure.	Replace the control valve travel section.
The overload relief valve is clogged by contamination.	Measure the overload relief valve pressure.	Clean or replace the control valve travel section.
The spool of the control valve is damaged or stuck.	Check for damage or sticking of the control valve.	Disassemble and clean or replace the control valve section.

Large amount of the cylinder leakage

Cause	Inspections	Actions
The overload relief valve setting pressure is too low.	Measure the overload relief valve pressure.	Adjust the overload relief valve.
The overload relief valve spring is weaken or damaged.	Measure the overload relief valve pressure.	Replace the control valve travel section.
The overload relief valve is clogged by contamination.	Measure the overload relief valve pressure.	Clean or replace the control valve travel section.
The spool of the control valve is damaged or stuck.	Check for damage or sticking of the control valve.	Disassemble and clean or replace the control valve section.
The internal leakage of the cylinder is too much.	Measure the cylinder internal leakage. Check for damage of the seal.	Repair or replace the cylinder.

1.2 Hydraulic troubleshooting for swivel

The swivel does not operate or operates slowly

Causes	Inspections	Actions
The pilot control valve spring is weaken or damaged.	Measure the pilot secondary pressure.	Replace the pilot primary pressure relief valve.
The pilot control valve is clogged by contamination.	Measure the pilot secondary pressure.	Clean or replace the pilot primary pressure relief valve.
The spool of the control valve swivel section is damaged or stuck.	Check for damage or sticking of the control valve swivel section.	Disassemble and clean or replace the control valve swivel section.
The overload relief valve setting pressure is too low.	Measure the overload relief valve pressure.	Adjust the overload relief valve.
The overload relief valve spring is weaken or damaged.	Measure the overload relief valve pressure.	Replace the overload relief valve.
The overload relief valve is clogged by contamination.	Measure the overload relief valve pressure.	Clean or replace the overload relief valve.
The internal leakage or drain of the swivel motor is too much.	Measure the swivel motor internal leakage. Measure the swivel motor drain.	Repair or replace the swivel motor.
The friction plate for swivel motor parking brake does not disengage correctly.	Check for wear or sticking of the friction plate.	Repair or replace the friction plate.

The swivel is overrunning

Causes	Inspections	Actions
The pilot control valve spring is weaken or damaged.	Measure the pilot secondary pressure.	Replace the pilot primary pressure relief valve.

(Continued)

Causes	Inspections	Actions
The pilot control valve is clogged by contamination.	Measure the pilot secondary pressure.	Clean or replace the pilot primary pressure relief valve.
The spool of the control valve swivel section is damaged or stuck.	Check for damage or sticking of the control valve swivel section.	Repair or replace the control valve swivel section.
The overload relief valve setting pressure is too low.	Measure the overload relief valve pressure.	Adjust the overload relief valve.
The overload relief valve spring is weaken or damaged.	Measure the overload relief valve pressure.	Replace the overload relief valve.
The overload relief valve is clogged by contamination.	Measure the overload relief valve pressure.	Clean or replace the overload relief valve.
The make-up poppet of the swivel motor is damaged or stuck.	Check for damage or sticking of the make-up poppet.	Clean or replace the make-up poppet.
The internal leakage or drain of the swivel motor is too much.	Measure the swivel motor internal leakage. Measure the swivel motor drain.	Repair or replace the swivel motor.

1.3 Hydraulic troubleshooting for traveling

Does not travel, travel slowly, or not running straight

Cause	Inspections	Actions
The track tension is too loosen or tighten. Dirt is clogged to the base carrier.	Check the track tension. Check for dirt clogging.	Adjust the track tension. Clean the base carrier.
The travel control lever or mechanical link is malfunctioning.	Check the travel control lever and mechanical link.	Adjust or replace the travel control lever and mechanical link.
The spool of the control valve travel section is damaged or stuck.	Check for damage or sticking of the control valve travel section.	Disassemble and clean, or replace the control valve travel section.
The spool of the counterbalance valve is damaged or stuck.	Check for damage or sticking of the counterbalance valve.	Disassemble and clean, or replace the counterbalance valve.
The internal leakage or drain of the travel motor is too much.	Measure the travel motor internal leakage. Measure the travel motor drain.	Disassemble or replace the travel motor.
The internal leakage of the swivel joint.	Disconnect the travel outlet hose of the swivel joint and install a plug, and then measure the relief pressure.	Replace the seal of the swivel joint.

2. Service specifications

2.1 Service specifications for hydraulic system

■ NOTE

- **Standard measurement condition,**
  - **– Hydraulic oil and devices temperature: 50 ℃ (Including motor, pump and cylinders)**
  - **– Engine speed: Maximum speed**
  - **– Hydraulic cylinder speed not including cushioning.**

Items			Unit	Service specifications		Service limits
				Value	Tolerance	Value
Pressure	Main relief valve	P1 (aP1)	MPa kgf/cm^2 psi	23.5 239.6 3408	-0.5 to 1.0 -5 to 10 -73 to 144	-
		P2 (aP2)	MPa kgf/cm^2 psi	23.5 239.6 3408	-0.5 to 1.0 -5 to 10 -73 to 144	-
		P3 (aP3)	MPa kgf/cm^2 psi	19.6 199.8 2843	-0.5 to 1.0 -5 to 10 -73 to 144	-
	Pilot primary pressure relief valve	Pilot primary (aPP)	MPa kgf/cm^2 psi	4.3 43.8 624	-0.3 to 0.2 -3 to 2 -44 to 29	-
	Overload relief valve	Boom bottom (b1B)	MPa kgf/cm^2 psi	26.9 274.2 3901	±1.0 ±10.0 ±144	-
		Boom rod (b1R)	MPa kgf/cm^2 psi	26.4 268.8 3825	±1.0 ±10.0 ±144	-
		Arm bottom (b2B)	MPa kgf/cm^2 psi	26.3 268.0 3813	±1.0 ±10.0 ±144	-
		Arm rod (b2R)	MPa kgf/cm^2 psi	26.5 269.6 3836	±1.0 ±10.0 ±144	-
		Bucket bottom (b3B)	MPa kgf/cm^2 psi	26.3 267.9 3811	±1.0 ±10.0 ±144	-
		Blade bottom (b4B)	MPa kgf/cm^2 psi	25.9 263.6 3751	±1.0 ±10.0 ±144	-
		Swivel RH (cSR)	MPa kgf/cm^2 psi	17.3 176.4 2509	±1.0 ±10.0 ±144	-
		Swivel LH (cSL)	MPa kgf/cm^2 psi	17.0 173.3 2466	±1.0 ±10.0 ±144	-
Flow rate	Piston pump (P1 + P2) (Engine speed: 2250 rpm, no load, maximum flow rate)		L/min U.S.gals/min	65.6 17.3	-	52.4 13.9

(Continued)

Items			Unit	Service specifications		Service limits
				Value	Tolerance	Value
Flow rate	AUX1 (Engine speed: 2250 rpm, no load, maximum flow rate)		L/min U.S.gals/min	53.1 14.0	-	-
	AUX2 (Engine speed: 2250 rpm, no load, maximum flow rate)		L/min U.S.gals/min	19.3 5.1	-	-
Internal leakage	Hydraulic cylinder	Boom (10 min, engine stop)	mm in.	less than 20 less than 0.79	-	100 3.94
		Arm (10 min, engine stop)	mm in.	less than 11 less than 0.43	-	55 2.17
		Bucket (10 min, engine stop)	mm in.	less than 10 less than 0.39	-	50 1.96
		Blade (10 min, engine stop)	mm in.	less than 25 less than 0.98	-	50 1.97
	Swivel motor	Stopped the engine Activating negative brake	mm in. degrees	0 0 0	-	26 1.02 5
		Running the engine in idle speed Releasing negative brake	mm in. degrees	less than 157 less than 6.18 less than 30	-	157 6.18 30
	Travel motor	(20 degrees slope)	mm in.	less than 300 less than 11.8	-	-
Drain	Swivel motor	RH and LH (Rotating)	L/min U.S.gals/min	0.150 0.04	-	1.0 0.26
		RH and LH (Relief)	L/min U.S.gals/min	0.360 0.10	-	6.0 1.6
	Travel motor	Low speed (Rotating)	L/min U.S.gals/min	0.060 0.016	-	0.4 0.11
		High speed (Rotating)	L/min U.S.gals/min	0.125 0.033	-	-
		Low speed (Relief)	L/min U.S.gals/min	0.720 0.190	-	-
		High speed (Relief)	L/min U.S.gals/min	0.84 0.222	-	-
Speed	Boom cylinder	Lifting (ground to highest)	s	2.6	±0.3	-
		Lowering (highest to ground)	s	2.5	±0.3	-
	Arm cylinder	Crowding	s	2.8	±0.3	-
		Dumping	s	3.0	±0.3	-
	Bucket cylinder	Crowding	s	2.7	±0.3	-
		Dumping	s	1.9	±0.3	-

(Continued)

Items			Unit	Service specifications		Service limits
				Value	Tolerance	Value
Speed	Blade cylinder	Lifting (lowest to highest)	s	2.0	±0.3	-
		Lowering (highest to lowest)	s	2.6	±0.3	-
	Swing cylinder	Swing RH	s	5.5	±0.3	-
		Swing LH	s	5.5	±0.3	-
	Swivel motor	RH	rpm s/3 rotation	9.5 18.9	±0.9 -1.6 to +2.0	-
		LH	rpm s/3 rotation	9.5 18.9	±0.9 -1.6 to +2.0	-
	Travel motor	High speed with rubber track	km/h mph s/10 m	4.5 2.80 8.00	±0.4 ±0.25 -0.65 to +0.78	-
		Low speed with rubber track	km/h mph s/10 m	2.9 1.80 12.41	±0.3 ±0.19 -1.16 to +1.43	-
		High speed with steel track	km/h mph s/10 m	4.3 2.67 8.37	±0.4 ±0.25 -0.65 to +0.78	-
		Low speed with steel track	km/h mph s/10 m	2.7 1.68 13.33	±0.3 ±0.19 -1.16 to +1.43	-
Travel straightness (10 m, 32.8 ft)			mm in.	-	-	600 23.6

3. Testing

3.1 Measuring hydraulic devices

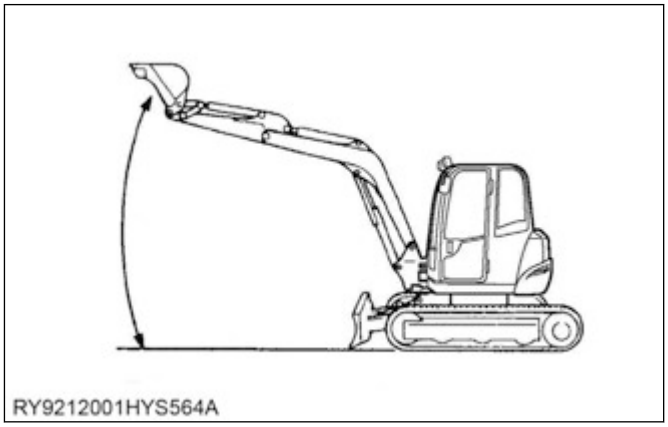
3.1.1 Measuring boom cylinder speed

⚠ CAUTION
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Dump arm to the stroke end, dump bucket to the stroke end, lower boom to the stroke end, and accelerate engine to the maximum speed.
3. Lift the boom to the stroke end in full-stroke operation to measure the boom cylinder speed.

   ■ NOTE
   - **Do not include cushion range.**

4. Measure three times to calculate average.
5. Measure the boom lowering speed as well.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Service specifications

Boom cylinder speed	Lifting (Ground to Highest)	2.3 to 2.9 s
	Lowering (Highest to Ground)	2.2 to 2.8 s

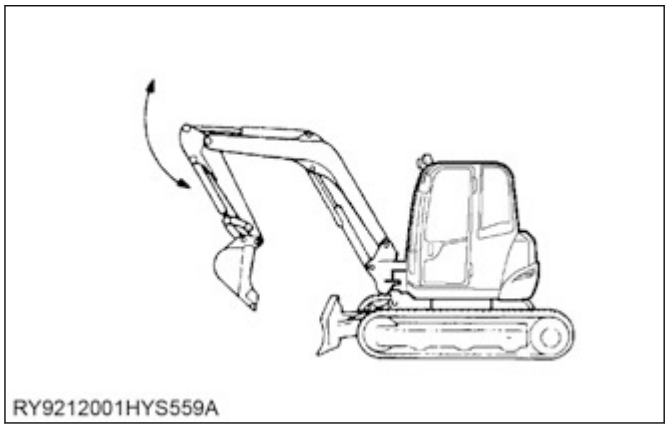
3.1.2 Measuring arm cylinder speed

CAUTION
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 °C (122±9 °F).
2. Dump arm to the stroke end and accelerate engine to the maximum speed.
3. Crowd arm to the stroke end in full-stroke operation to measure the arm cylinder speed.

NOTE
- **Do not hit bucket to ground or blade.**

4. Measure three times to calculate average.
5. Measure the arm dumping speed as well.


RY9212001HYS559A

Service specifications

Arm cylinder speed	Crowding	2.5 to 3.1 s
	Dumping	2.7 to 3.3 s

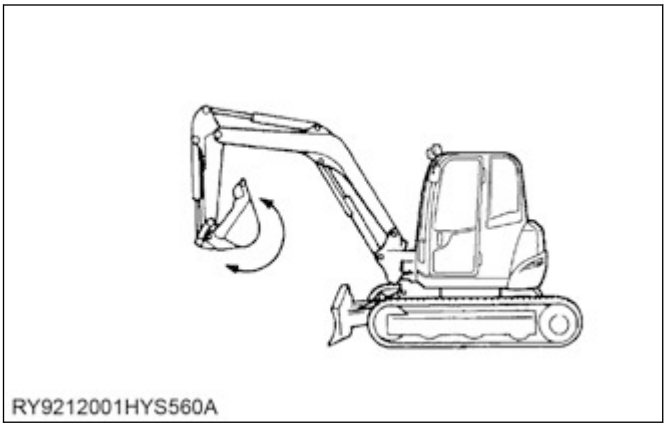
3.1.3 Measuring bucket cylinder speed

CAUTION
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 °C (122±9 °F).
2. Dump bucket to the stroke end and accelerate engine to the maximum speed.
3. Crowd bucket to the stroke end in full-stroke operation to measure the bucket cylinder speed.

NOTE
- **Do not hit bucket to ground or blade.**

4. Measure three times to calculate average.
5. Measure the bucket dumping speed as well.


RY9212001HYS560A

Service specifications

Bucket cylinder speed	Crowding	2.4 to 3.0 s
	Dumping	1.6 to 2.2 s

3.1.4 Measuring blade cylinder speed

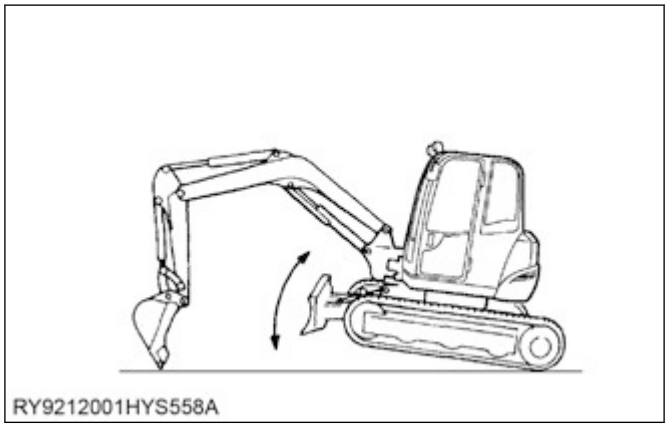
CAUTION
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 °C (122±9 °F).
2. Jack up the machine by front attachments, lower blade to the stroke end, and accelerate engine to the maximum speed.

NOTE
- **Do not hit ground at blade lower end.**

3. Lift the blade to the stroke end in full-stroke operation to measure the blade cylinder speed.
4. Measure three times to calculate the average.

5. Measure the blade lowering speed as well.


RY9212001HYS558A

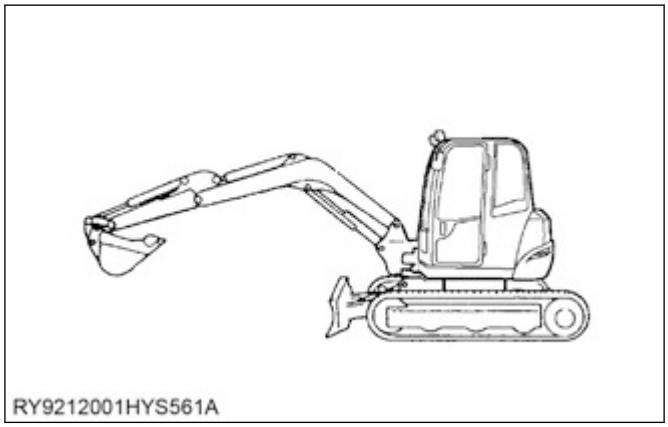
Service specifications

Blade cylinder speed	Lifting (Lowest to Highest)	1.7 to 2.3 s
	Lowering (Lowest to Highest)	2.3 to 2.9 s

3.1.5 Measuring swing cylinder speed

CAUTION
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Dump arm to the stroke end, crowd bucket to the stroke end, set bucket bottom surface to one meter from ground, and accelerate engine to the maximum speed.
3. Swing boom from the left end to the right end in full-stroke operation to measure the swing cylinder speed.
4. Measure three times to calculate average.
5. Measure the reverse direction speed as well.


RY9212001HYS561A

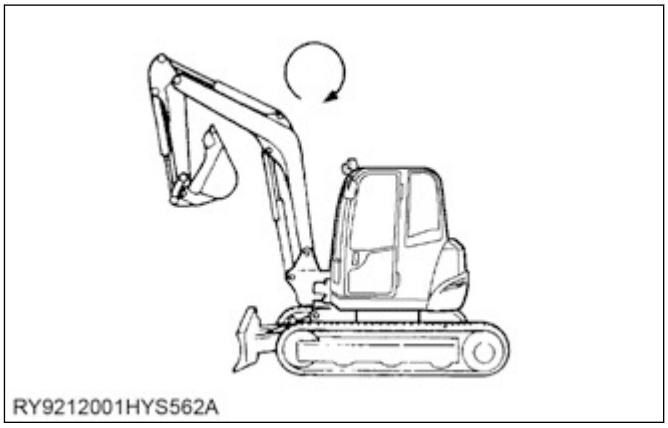
Service specifications

Swing cylinder speed	Swing RH	5.2 to 5.8 s
	Swing LH	5.2 to 5.8 s

3.1.6 Measuring swivel speed

CAUTION
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Lift boom to the stroke end, crowd arm to the stroke end, crowd bucket to the stroke end, and accelerate engine to the maximum speed.
3. Swivel to left in full-stroke operation until the swivel speed reaches a uniform speed and measure the swivel speed for three rotations.
4. Measure three times to calculate average.
5. Measure the right swivel speed as well.


RY9212001HYS562A

Service specifications

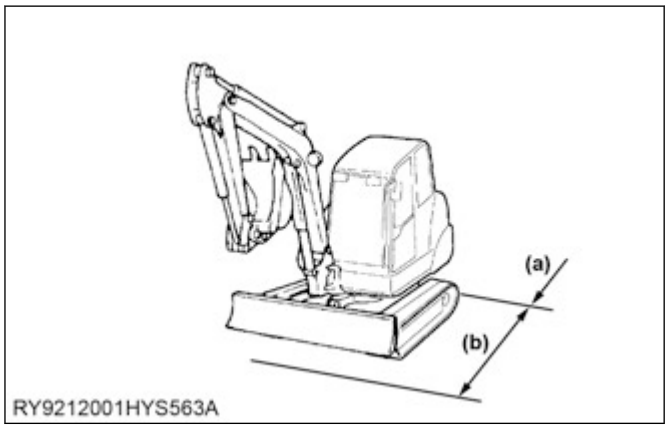
Swivel speed	RH	17.3 to 20.9 s/three rotations (8.6 to 10.4 rpm)
	LH	

3.1.7 Measuring travel speed

CAUTION
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set machine to traveling position and accelerate engine to the maximum speed.
3. Running start 5 meters (16.4 ft) and measure time for 10 meters (32.8 ft) forwards travel operation in full-stroke.

4. Measure 3 times to calculate average.



(a) Running start distance (5 m) (b) Measuring distance (10 m)

Service specifications

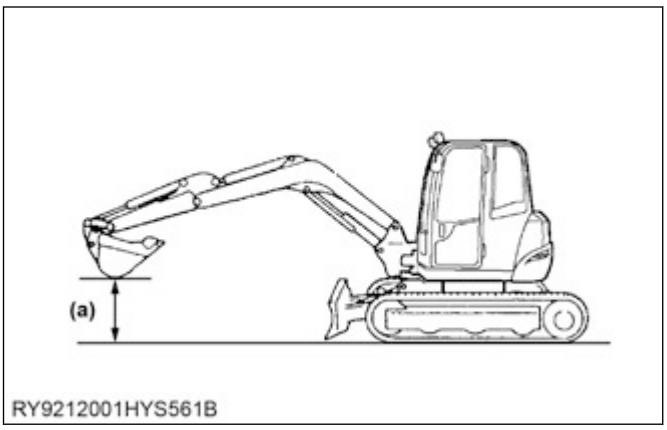
Travel speed	Rubber track	High speed	7.35 to 8.78 s/ 10 m 4.1 to 4.9 km/h 2.55 to 3.05 mph
		Low speed	11.25 to 13.84 s/10 m 2.6 to 3.2 km/h 1.61 to 1.99 mph
	Steel track	High speed	7.72 to 9.15 s/ 10 m 3.9 to 4.7 km/h 2.42 to 2.92 mph
		Low speed	12.17 to 14.76 s/10 m 2.4 to 3.0 km/h 1.49 to 1.87 mph

3.1.8 Measuring cylinder internal leakage

⚠ CAUTION
- **Keep out any persons or objects from the machine.**

Measuring the boom, arm and bucket cylinder

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Put a weight (soil) on the bucket with approximately 97.2 kg (214.3 lbs).
3. Park the machine on firm and level ground.
4. Dump arm to the stroke end, crowd bucket to the stroke end, set bucket bottom surface to 1 meter from the ground, and stop the engine.

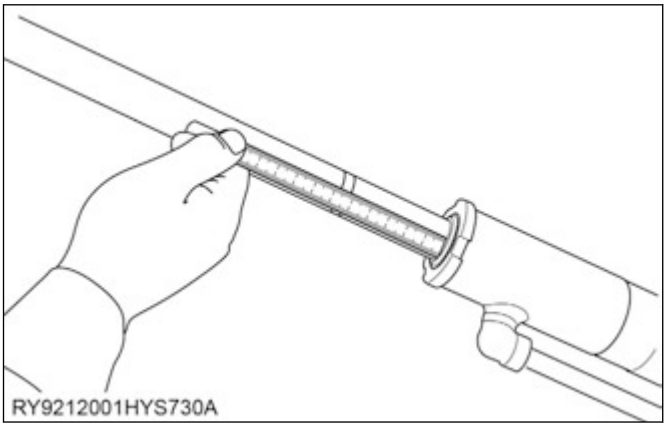


(a) 1 m

5. Put a mark on the boom, arm, and bucket cylinder rods.
6. Measure internal leakage for each cylinders after waiting 10 minutes.

■ NOTE
- **Measure compressed distance of the rod for the boom cylinder.**
- **Measure extended distance of the rod for the arm cylinder.**

7. Measure three times to calculate the average.



Service specifications

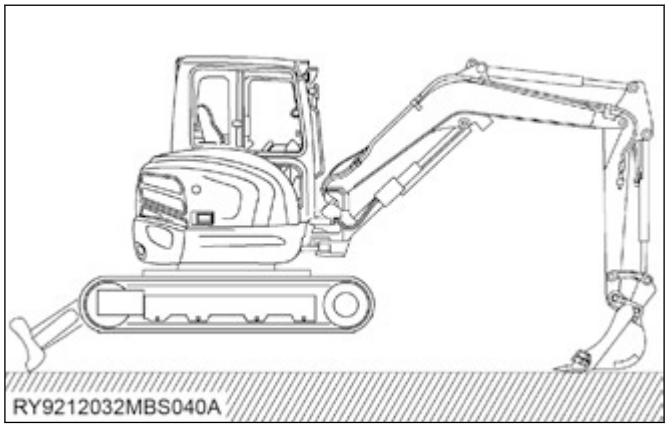
Internal leakage	Boom cylinder	less than 20 mm less than 0.79 in.
	Arm cylinder	less than 11 mm less than 0.43 in.
	Bucket cylinder	less than10 mm less than 0.39 in.

Service limits

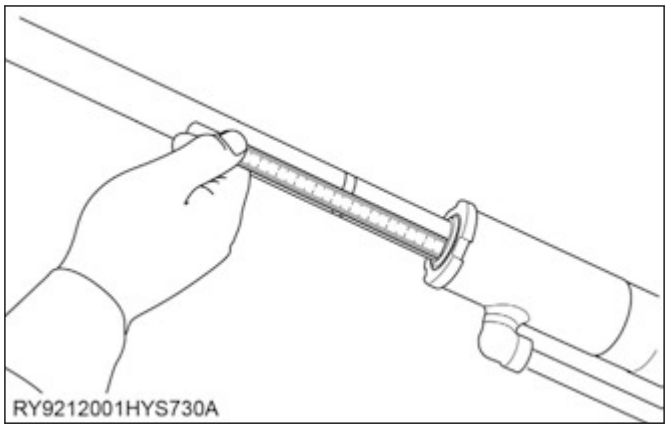
Internal leakage	Boom cylinder internal leakage	100 mm 3.94 in.
	Arm cylinder internal leakage	55 mm 2.17 in.
	Bucket cylinder internal leakage	50 mm 1.97 in.

Measuring the blade cylinder

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Operate the front attachment and blade to jack up the machine.
3. Extend the blade fully and crowd the arm to vertical position.



4. Stop the engine and put a mark on the blade cylinder rod.
5. Measure internal leakage for each cylinder after waiting 10 minutes.
6. Measure three times to calculate the average.



Service specification

Internal leakage	Blade cylinder	less than 25 mm less than 0.98 in.

Service limit

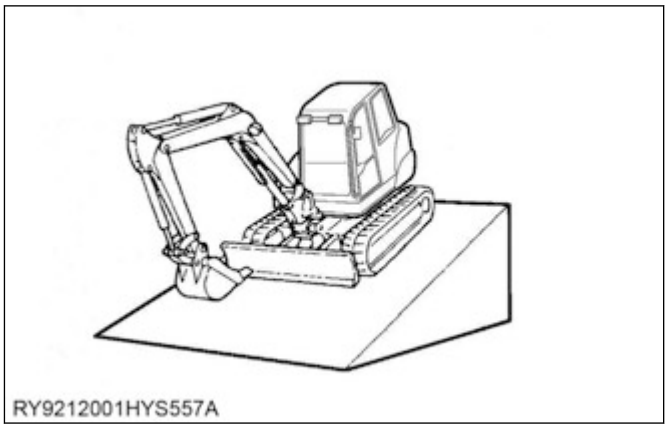
Internal leakage	Blade cylinder	50 mm 1.97 in.

3.1.9 Measuring travel motor internal leakage

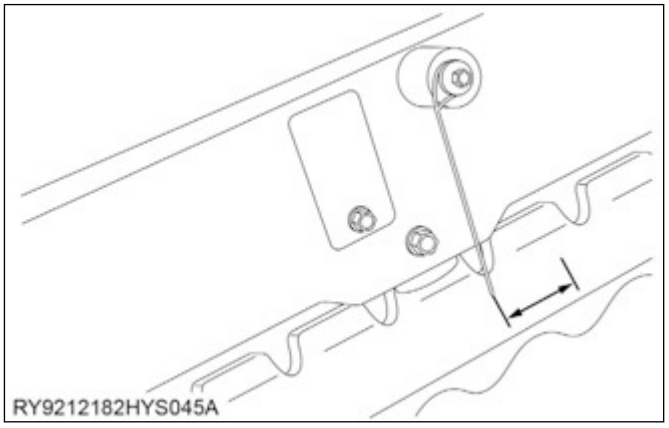
⚠ CAUTION

- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Park the machine on firm and 20 degrees slope.
3. Set the machine to traveling position and stop the engine.



4. Put a mark on track frame and track.
5. Measure the internal leakage for between track frame and track, after 10 minutes.
6. Measure 3 times to calculate the average.



Service specification

Internal leakage	Travel motor (20 degrees slope)	less than 300 mm less than 11.8 in.

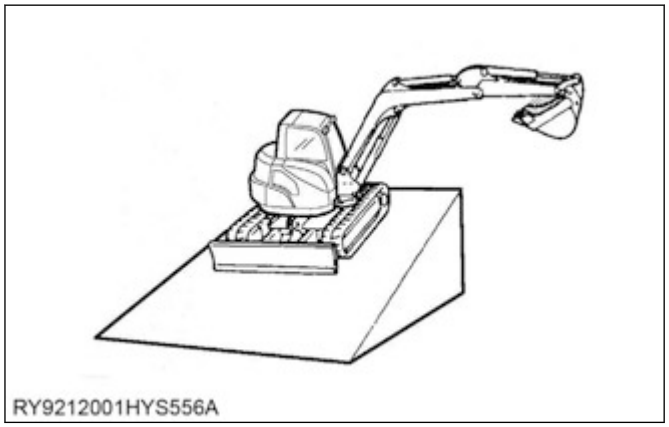
3.1.10 Measuring swivel motor internal leakage

⚠ CAUTION

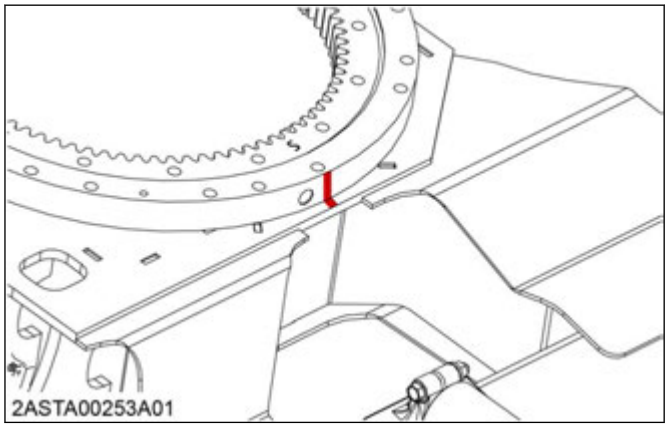
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Put a weight (soil) on the bucket with approximately 97.2 kg (214.3 lbs).
3. Park the machine on firm and 20 degrees slope. Swivel the machine 90 degrees against the slope.

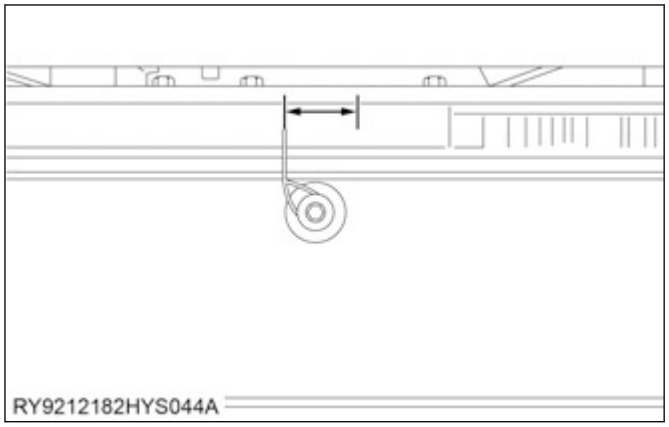
4. Dump the arm to the stroke end, crowd the bucket to the stroke end, set the boom support pin and the bucket pin in straight line.



5. Put a mark on the swivel bearing and track frame.



6. Lower the lever lock and measure internal leakage for between the swivel bearing and the track frame after waiting 1 minute.
   - Activating the negative brake (Stopping the engine).
   - Releasing the negative brake (Running the engine in idle speed).
7. Measure 3 times to calculate the average.
8. Measure opposite direction (180 degrees) as well.



Service specifications

Internal leakage	Swivel motor (Stopping the engine, activating negative brake)	0 mm 0 in. 0 degrees
	Swivel motor (Running the engine in idle speed, releasing negative brake)	10 mm 0.39 in. 1.9 degrees

Service limits

Internal leakage	Swivel motor (Stopping the engine, activating negative brake)	26 mm 1.02 in. 5 degrees
	Swivel motor (Running the engine in idle speed, releasing negative brake)	157 mm 6.18 in. 30 degrees

3.1.11 Testing travel straightness

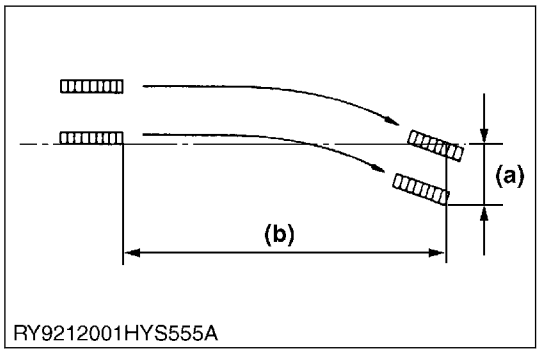
CAUTION
- **Keep out any persons or objects from the machine.**

1. Warm-up the hydraulic oil and devices to 50±5 °C (122±9 °F).
2. Adjust tension for left and right track equally.
3. Set the machine to the traveling position.
4. Mark the starting position.
5. Accelerate the engine to the maximum speed.
6. Operate the travel control lever in the full stroke to travel forwards for 10 meters (32.8 ft).

NOTE
- **Make sure to start the machine straightly.**

7. Measure the distance (a).
8. Measure three times to calculate the average.

9. Measure the distance for backwards travel as well.



(a) Distance (b) 10 meters (32.8 ft)

Service limit

Travel straightness (10 m, 32.8 ft)	600 mm 23.6 in.

3.2 Measuring hydraulic pump

3.2.1 Measuring piston pump P-Q performance

There is a possibility of the hydraulic pump trouble in case of slow speed of hydraulic devices and power lack of the hydraulic force. Measure the hydraulic pump P-Q performance to be normal or not.

⚠ CAUTION

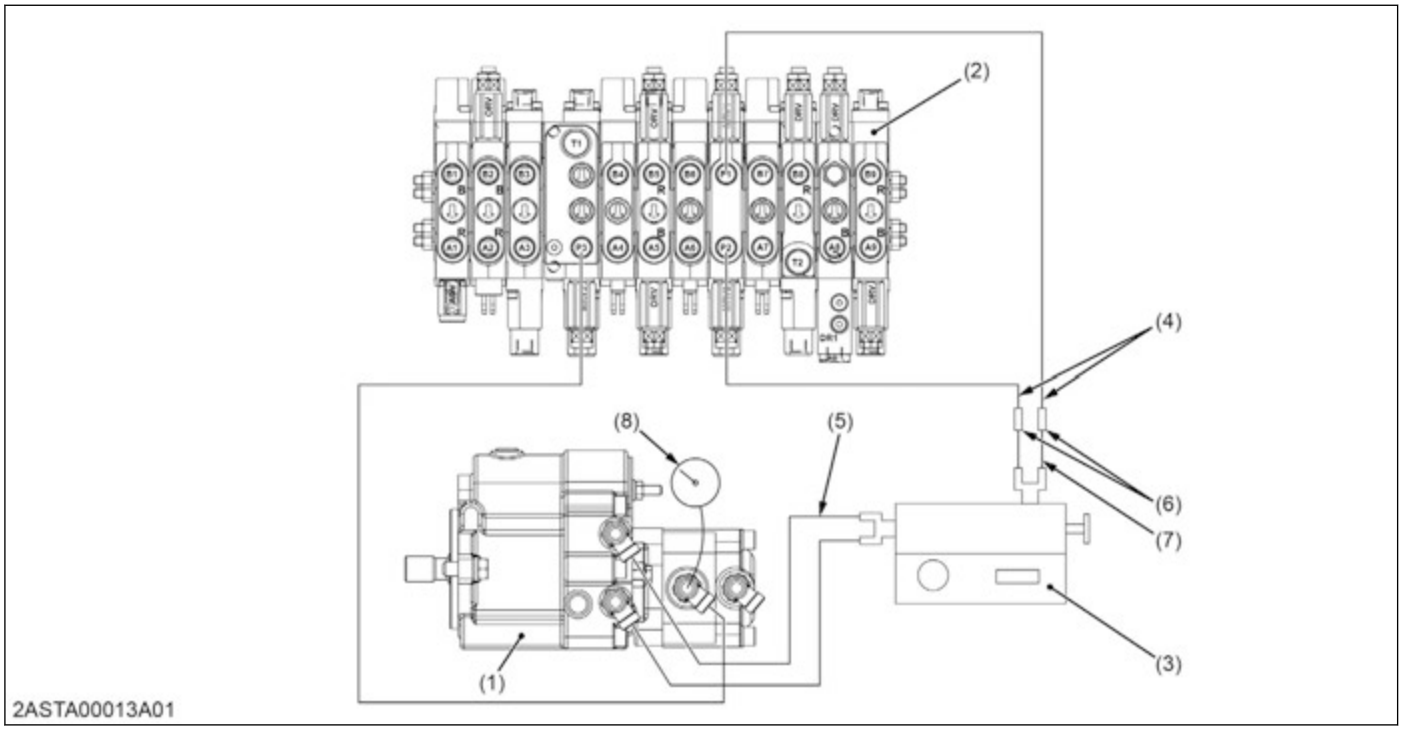
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Keep any persons or objects away from the machine.**

■ IMPORTANT

- **Open the loading valve (restrictor valve) of the flow meter completely before starting the engine to avoid damaging the flow meter and pressure gauge.**
- **Install the plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing

1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
4. Connect test hose (B) to hydraulic pump and flow meter **[IN]** port.
5. Connect test hose (A) to flow meter **[OUT]** port and delivery hose.
6. If the pressure gauge is not attached on the flow meter, install the pressure gauge to port P on the hydraulic pump.
7. Install the pressure gauge to port P3.
8. Remove the vacuum pump and check for oil leakage.



(1) Hydraulic pump
(2) Control valve
(3) Flow meter
(4) Delivery hose
(5) Test hose (B)
(6) Adapter
(7) Test hose (A)
(8) Pressure gauge

Measuring

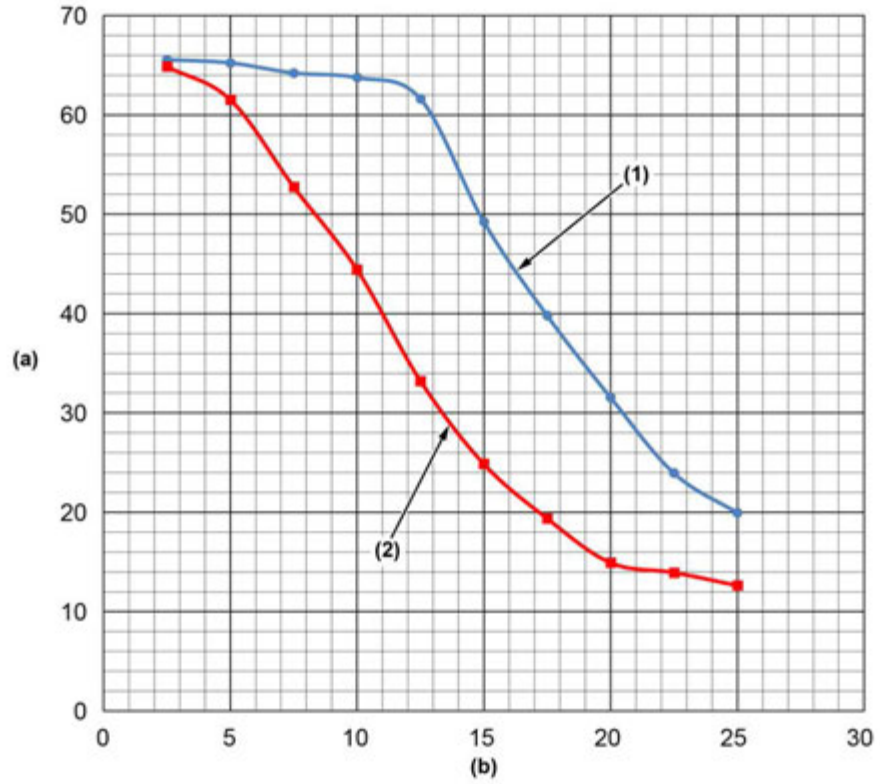
1. Open the loading valve (restrictor valve) of the flow meter completely and start up engine.
2. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
3. Set the engine speed to the maximum.

■ NOTE

- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

4. Measure the flow rate without P3 load.
   a. Close the loading valve (restrictor valve) gradually until setting pressure of main relief valve and measure flow rate and engine speed in each load pressure by following service specifications.
   b. Measure flow rate three times and calculate the average flow rate.
5. Measure the flow rate with P3 load (relief).
   a. Keep lifting the blade to end stroke to relief the P3.
   b. Close the loading valve (restrictor valve) until main relief valve value gradually and measure flow rate and engine speed in each load pressure.
   c. Measure flow rate three times and calculate the average flow-rate.
6. Convert all of the flow rate values to rated engine speed.

Service specification



(1) P1+P2 (P3 no load) (2) P1+P2 (P3 load (relief)) (a) Flow rate (L/min) (b) Pressure (MPa)

Pressure		Flow rate (converted to 2250 rpm)			
		P3 no load		P3 load (relief)	
MPa	psi	L/min	U.S. gal/min	L/min	U.S. gal/min
2.5	363	65.6	17.3	64.9	17.1
5.0	725	65.2	17.2	61.5	16.2
7.5	1088	64.2	16.9	52.8	13.9
10.0	1450	63.7	16.8	44.4	11.7
12.5	1813	61.6	16.3	33.2	8.8
15.0	2175	49.2	13.0	24.9	6.6
17.5	2538	39.8	10.5	19.4	5.1
20.0	2900	31.5	8.3	14.9	3.9
22.5	3263	23.9	6.3	13.9	3.7
25.0	3625	19.9	5.3	12.6	3.3

Service limit

- The service limit is 80% of the service specification.

3.2.2 Measuring AUX flow rate

⚠ CAUTION

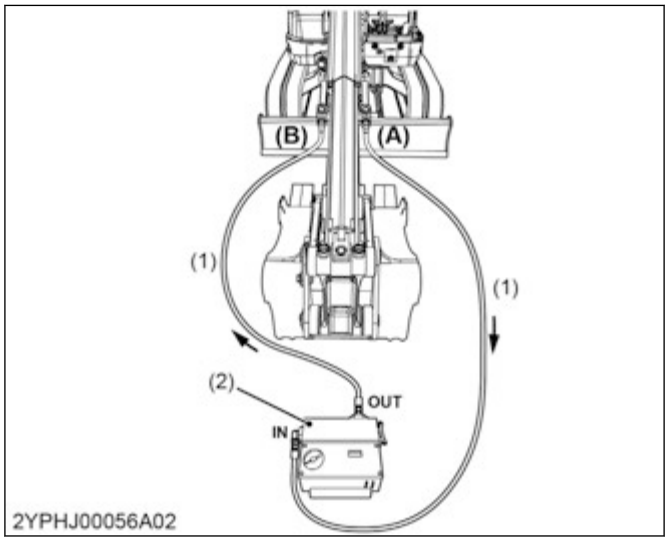
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Keep any persons or objects away from the machine.**

■ IMPORTANT

- **Open the loading valve (restrictor valve) fully before starting the engine to avoid damaging the flow meter and pressure gauge.**
- **Install the plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing

1. Park the machine on firm and level ground and stop the engine.
2. Release the residual pressure of the hydraulic circuit.
3. Connect test hose AUX LH discharging port to flow meter **[IN]** port.
4. Connect test hose AUX RH discharging port to flow meter **[OUT]** port.



(1) Test hose
(2) Flow meter
(A) AUX LH discharging port
(B) AUX RH discharging port

Measuring

1. Open the loading valve (restrictor valve) of flow meter fully and start the engine.
2. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
3. Set the engine speed to the maximum.

■ NOTE

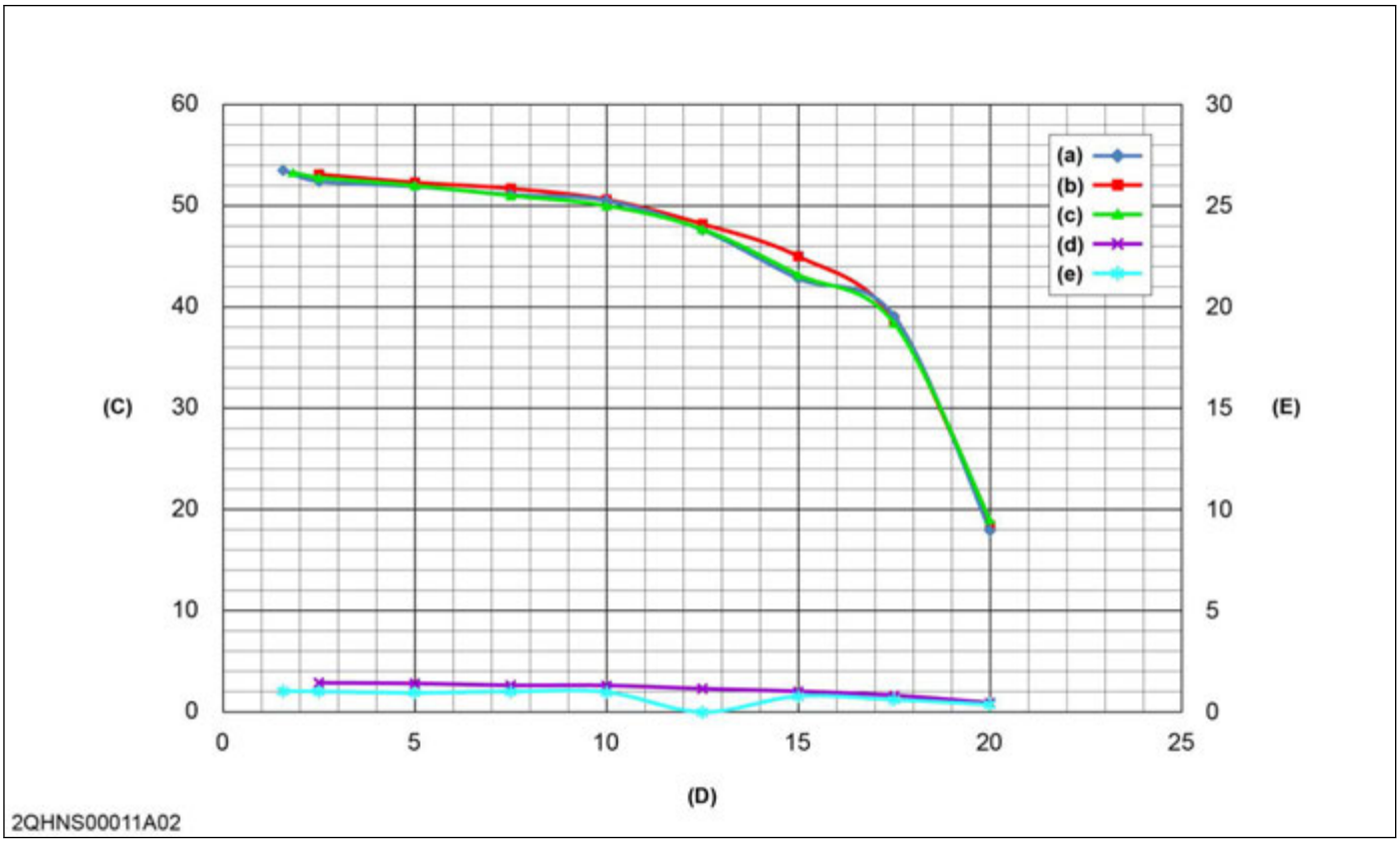
- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

4. Close the loading valve (restrictor valve) gradually until setting pressure of main relief valve and measure flow rate and engine speed in each loading pressure.
5. Measure flow rate three times and calculate the average flow rate.
6. Convert all of the flow rate values to rated engine speed.

■ NOTE

- **If there is a need to measure opposite side (RH discharging), exchange the both hoses between LH and RH.**

Service specification



(C) Flow rate (L/min)
(D) Pressure (MPa)
(E) Back pressure (MPa)
(a) AUX1 LH (third line open)
(b) AUX1 LH (third line close)
(c) AUX1 RH (third line close)
(d) Back pressure (third line close)
(e) Back pressure (third line open)

AUX1 LH (Third line open)

Pressure		Discharging flow rate (converted to 2250 rpm)		Back pressure	
MPa	psi	L/min	U.S. gal/min	MPa	psi
2.5	363	52.4	13.8	1.01	146
5.0	725	51.9	13.7	0.95	138
7.5	1088	51.1	13.5	1.01	146
10.0	1450	50.5	13.3	0.98	142
12.5	1813	47.6	12.6	0.85	123
15.0	2176	42.8	11.3	0.78	113
17.5	2538	39.1	10.3	0.61	88
20.0	2901	17.9	4.7	0.37	54
22.5	-	-	-	-	-

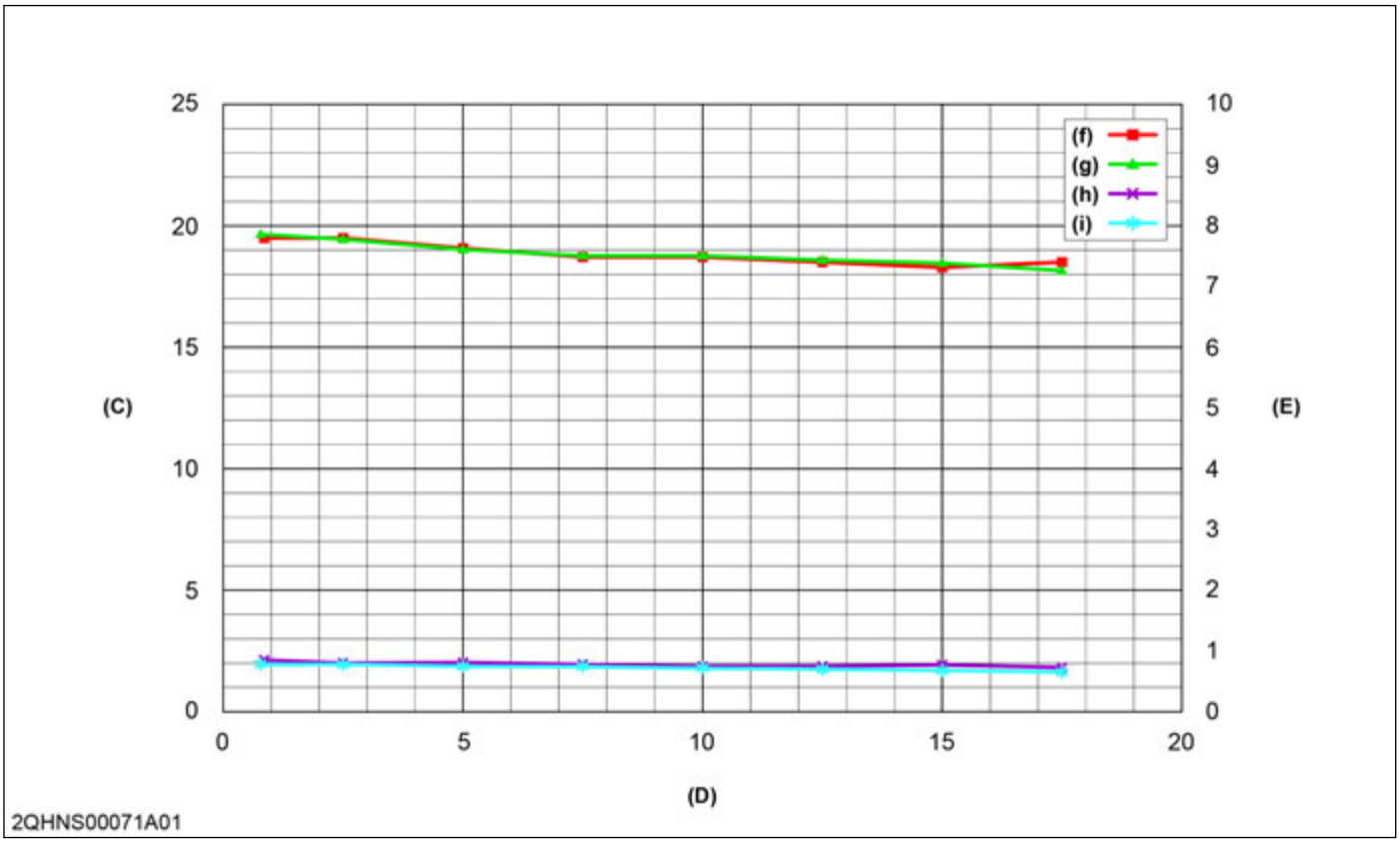
AUX1 LH (third line close)

Pressure		Discharging flow rate (converted to 2250 rpm)		Back pressure	
MPa	psi	L/min	U.S. gal/min	MPa	psi
2.5	363	53.1	14.0	1.44	209
5.0	725	52.3	13.8	1.41	204
7.5	1088	51.7	13.7	1.32	191
10.0	1450	50.6	13.4	1.31	190
12.5	1813	48.2	12.7	1.15	167
15.0	2176	45.0	11.9	1.02	148
17.5	2538	38.7	10.2	0.82	119
20.0	-	18.4	4.9	0.45	65
22.5		-	-	-	-

AUX1 RH (third line close)

Pressure		Discharging flow rate (converted to 2250 rpm)		Back pressure	
MPa	psi	L/min	U.S. gal/min	MPa	psi
2.5	363	52.8	13.9	1.30	189
5.0	725	52..0	13.7	1.27	184
7.5	1088	51.0	13.5	1.21	175
10.0	1450	50.0	13.2	1.15	167
12.5	1813	47.7	12.6	1.09	158
15.0	2176	43.2	11.4	0.98	142
17.5	2538	38.4	10.1	0.76	110
20.0	-	19.0	5.0	0.44	64
22.5		17.5	4.6	0.39	57

Service specification



(C) Flow rate (L/min)
(D) Pressure (MPa)
(E) Back pressure (MPa)
(f) AUX2 LH
(g) AUX2 RH
(h) Back pressure (AUX2 LH)
(i) Back pressure (AUX2 RH)

AUX2 LH

Pressure		Discharging flow rate (converted to 2250 rpm)		Back pressure	
MPa	psi	L/min	U.S.gals/min	MPa	psi
2.5	508	19.3	5.1	0.8	116
5.0	725	19.1	5.0	0.8	116
7.5	1088	18.8	5.0	0.8	116
10.0	1450	18.7	4.9	0.8	116
12.5	1813	18.4	4.9	0.8	116
15.0	2176	18.2	4.8	0.7	102
17.5	2538	18.4	4.9	0.7	102

AUX2 RH

Pressure		Discharging flow rate (converted to 2250 rpm)		Back pressure	
MPa	psi	L/min	U.S.gals/min	MPa	psi
2.5	508	19.4	5.1	0.8	116
5.0	725	19.1	5.0	0.7	102
7.5	1088	18.9	5.0	0.7	102
10.0	1450	18.9	5.0	0.7	102
12.5	1813	18.6	4.9	0.7	102
15.0	2176	18.5	4.9	0.7	102
17.5	2538	18.1	4.8	0.7	102

3.3 Measuring control valve

3.3.1 Measuring main relief valve pressure

There is a possibility of the main relief valves trouble in case of power lack of the hydraulic force. Measure the relief pressure of main relief valves to be normal or not.

⚠ CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Keep any persons or objects away from the machine.**

■ IMPORTANT
- **Install the plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing
1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
4. Install pressure gauges to each detection ports.

(1) Port P1
(2) Port P2
(3) Port P3

5. Remove the vacuum pump and check oil leakage in each piping hose in idling.

Measuring
1. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set the engine speed to the maximum.

■ NOTE
- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

3. Operate the front attachment pilot control lever gradually until main relief valve relieves.

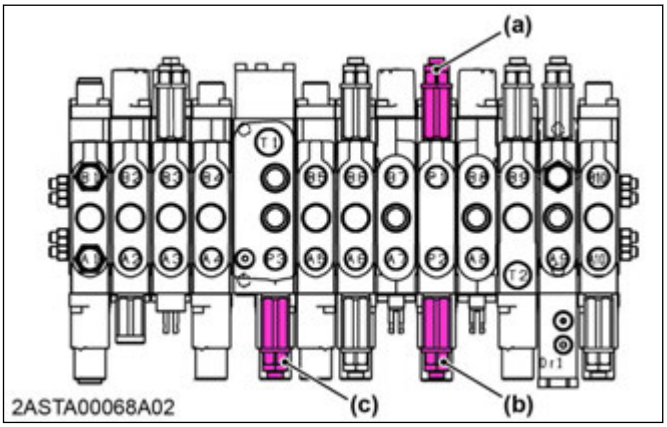
■ NOTE
- **P1 main relief valve: boom, bucket**
- **P2 main relief valve: arm, AUX1**
- **P3 main relief valve: blade, swivel, swing, AUX2 (hi-spec only)**

4. Measure the relief pressure 3 times to calculate average.

Service specifications

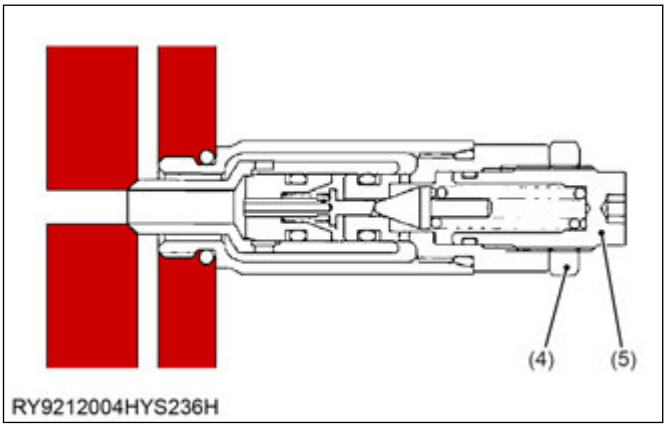
P1 main relief valve pressure	22.5 to 24.0 MPa 229.4 to 244.7 kgf/cm^2 3263 to 3481 psi
P2 main relief valve pressure	22.5 to 24.0 MPa 229.4 to 244.7 kgf/cm^2 3263 to 3481 psi
P3 main relief valve pressure	17.4 to 18.9 MPa 177.4 to 192.7 kgf/cm^2 2524 to 2741 psi

Adjusting



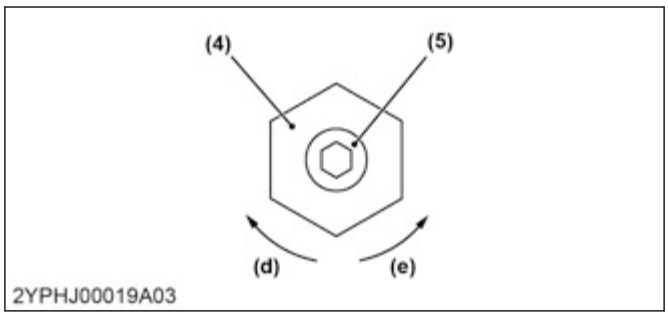
(a) P1 main relief valve
(b) P2 main relief valve
(c) P3 main relief valve

1. Loosen the locknut of relief valve.



(4) Locknut
(5) Adjusting screw

2. Set the position of adjusting screw to adjust relief pressure and tighten the locknut.



(4) Locknut
(5) Adjusting screw
(d) Increase relief pressure
(e) Decrease relief pressure

Tightening torque

(4) Locknut	19.6 N·m 2.0 kgf·m 14.5 lbf·ft	-

3. Operate pilot control lever in engine maximum speed and check the main relief pressure.

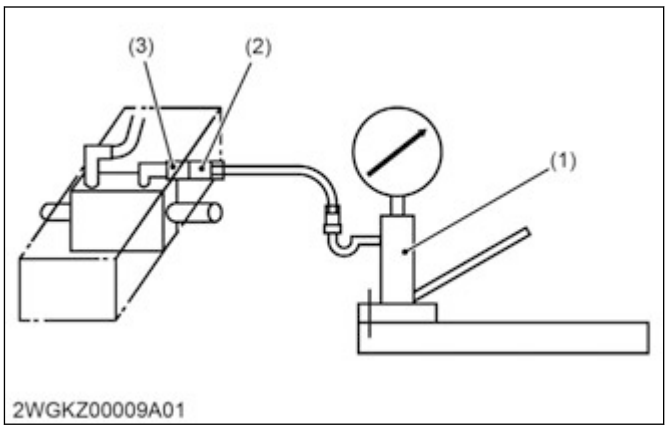
3.3.2 Measuring overload relief valve

There is a possibility of the overload relief valves trouble in case of power lack of the hydraulic force. Measure the relief pressure of the overload relief valve to check the condition of the overload relief valve.

⚠ CAUTION
- **Lower front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

■ IMPORTANT
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing
1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
4. Disconnect high pressure hose which is connected to the overload relief valve.
5. Install the pressure measurement kit.



(1) Pressure measurement kit
(2) Pipe fittings
(3) Pipe fittings

6. Remove the vacuum pump.

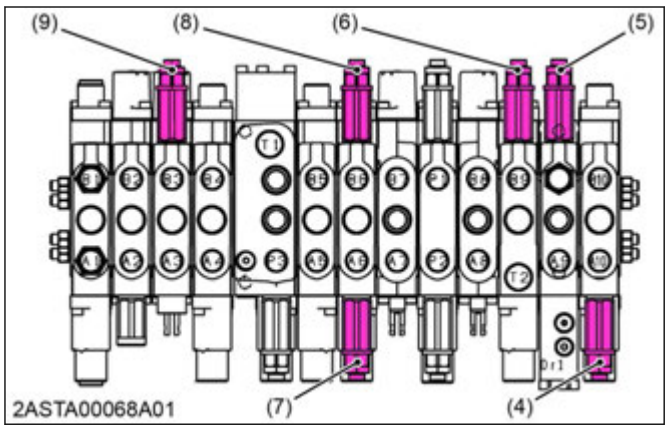
Measuring
1. Apply pressure to relief the overload relief valve with the pressure measurement kit and measure the pressure when the overload relief valve relieves.
2. Measure three times to calculate the average.

Service specifications

Boom	Bottom (b1B)	25.9 to 27.9 MPa 264.2 to 284.2 kgf/cm^2 3756 to 4046 psi
	Rod (b1R)	25.4 to 27.4 MPa 258.8 to 278.8 kgf/cm^2 3680 to 3970 psi
Arm	Bottom (b2B)	25.3 to 27.3 MPa 258.0 to 278.0 kgf/cm^2 3668 to 3958 psi
	Rod (b2R)	25.5 to 27.5 MPa 259.6 to 279.6 kgf/cm^2 3691 to 3981 psi
Bucket	Bottom (b3B)	25.3 to 27.3 MPa 257.9 to 277.9 kgf/cm^2 3666 to 3956 psi
Blade	Bottom (b4B)	24.9 to 26.9 MPa 253.6 to 273.6 kgf/cm^2 3606 to 3896 psi

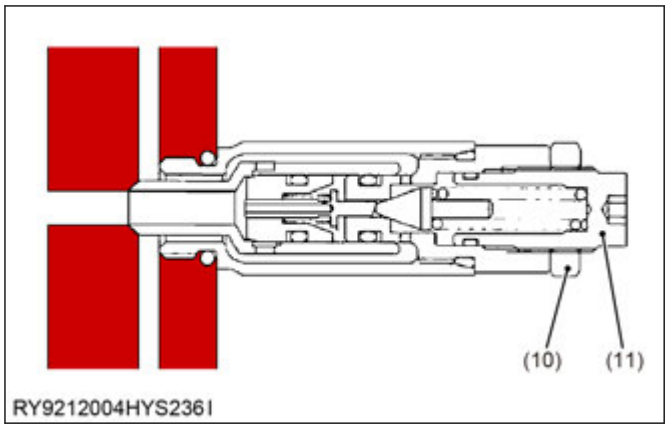
Adjusting

■ IMPORTANT
- **Adjust overload relief pressure only if the overload relief pressure is too low.**
- **Do not set the overload relief pressure exceeded to the setting pressure to avoid damage on the machine components.**



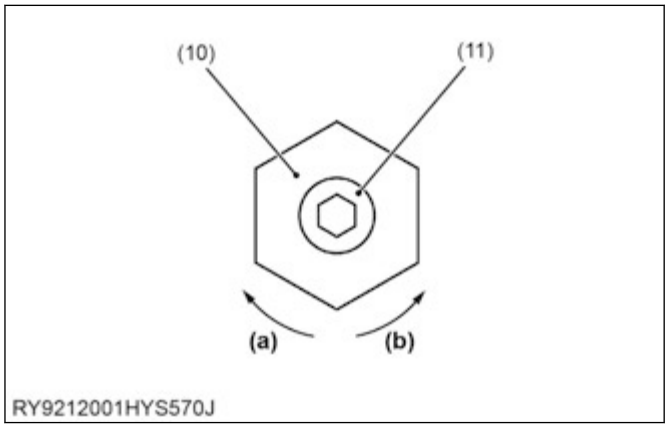
(4) Bucket (Bottom)
(5) Boom (Bottom)
(6) Boom (Rod)
(7) Arm (Bottom)
(8) Arm (Rod)
(9) Blade (Bottom)

1. Loosen the locknut of relief valve.



(10) Locknut
(11) Adjusting screw

2. Set the position of adjusting screw to adjust relief pressure and tighten the locknut.



(10) Locknut
(11) Adjusting screw
(a) Increase relief pressure
(b) Decrease relief pressure

Tightening torque

(10) Locknut	19.6 N·m 2.0 kgf·m 14.5 lbf·ft	-

3. Check the overload relief pressure with the pressure measurement kit.

3.4 Measuring swivel motor

3.4.1 Measuring swivel motor overload relief valve pressure

Check if the relief pressure is normally. Replace as needed.

⚠ CAUTION

- **Lower front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

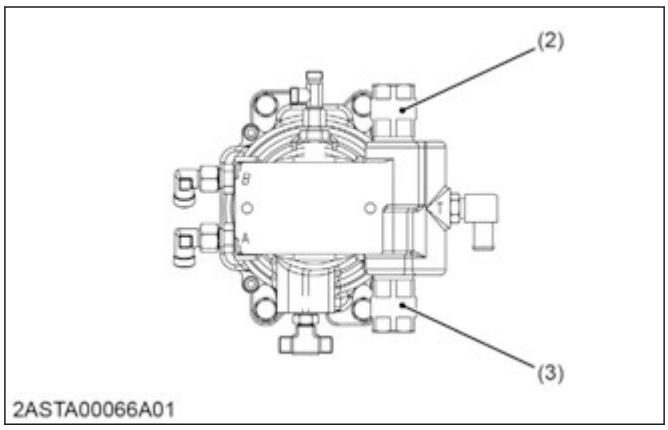
■ IMPORTANT

- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing

1. Park the machine on firm and level ground, and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the pressure gauge to P3 detection port.

(1) Main relief valve pressure detection port of pump 3



(2) Swivel LH relief valve (3) Swivel RH relief valve

4. Make sure to check oil leakage.

Measuring

1. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set the engine speed to the maximum.

NOTE
- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

3. Block the swivel motor to rotate by hitting the bucket against a solid object.
4. Slowly operate the swivel against the solid object and measure the pressure when overload relief valve relieves.
5. Measure the pressure three times and calculate the average pressure.

Service specifications

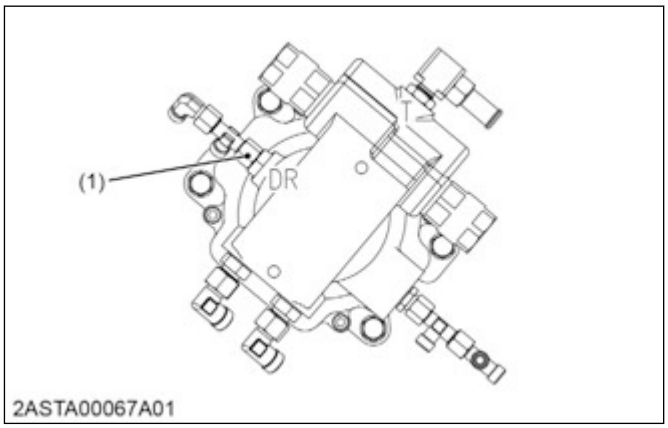
Swivel motor overload relief pressure	RH	16.3 to 18.3 MPa 166.4 to 186.4 kgf/cm^2 2364 to 2654 psi
	LH	

3.4.2 Measuring swivel motor drain

CAUTION
- **Lower front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Keep out any persons or objects from the machine.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

Preparing

1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
4. Remove the drain hose.
5. Install the test hose to swivel motor drain port.



(1) Drain port

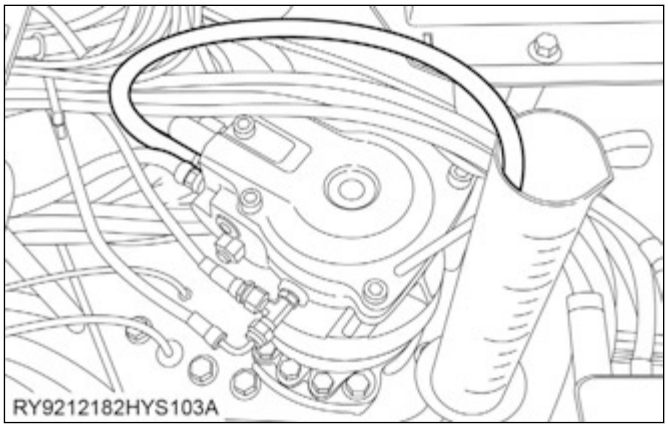
6. Remove the vacuum pump.

Measuring

1. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set the engine speed to the maximum.

NOTE
- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

3. Operate swivel in full stroke and collect the drain oil in the measuring cup.



4. Measure the drain amount for one minute.
5. Measure three times to calculate the average.
6. Measure the opposite direction as well.

Service specifications

RH and LH (rotating)	0.15 L/min 0.04 U.S. gal/min
RH and LH (relief)	0.36 L/min 0.10 U.S. gal/min

3.5 Measuring travel motor

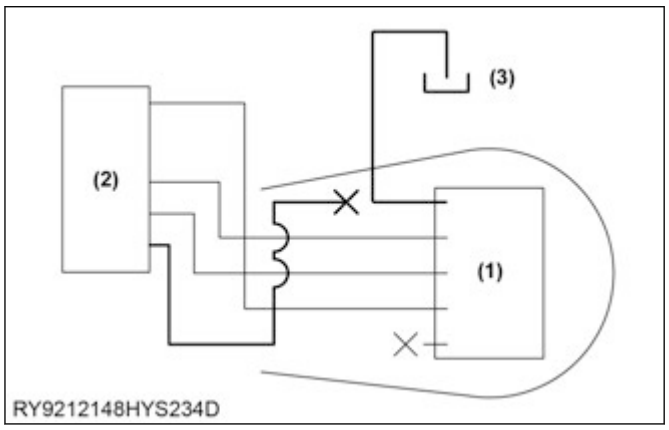
3.5.1 Measuring travel motor drain

CAUTION

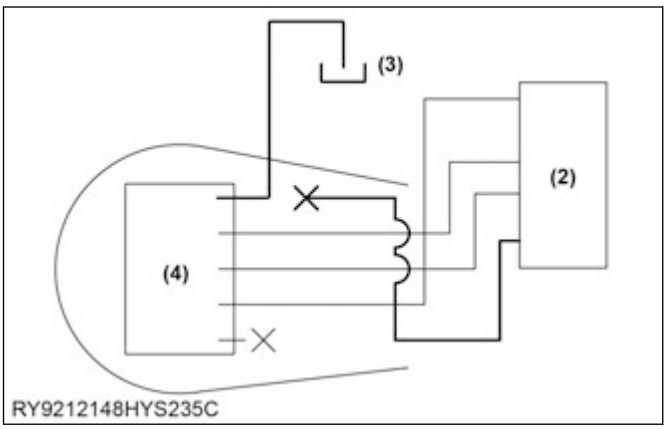
- **Lower front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Keep out any persons or objects from the machine.**
- **Keep your body away from rotating track.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **When jacking up the machine, set a jack stands under the machine.**

Preparing

1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
4. Remove travel motor drain hose and install a plug.
5. Install the test hose to travel motor drain port.



(1) Travel motor RH
(2) Swivel joint
(3) Measuring cup



(2) Swivel joint
(3) Measuring cup
(4) Travel motor LH

6. Remove the vacuum pump.
7. Jack up the machine and set a jack stands under the track frame.

Measuring

1. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set the engine speed to the maximum.

NOTE

- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

3. Operate travel in full stroke and collect the drain oil in the measuring cup.

4. Measure the drain amount for one minute.
5. Measure three times to calculate the average.
6. Measure the opposite side as well.

Service specifications

Low speed (rotating)	0.060 L/min 0.016 U.S. gal/min
High speed (rotating)	0.125 L/min 0.033 U.S. gal/min
Low speed (relief)	0.720 L/min 0.190 U.S. gal/min
High speed (relief)	0.840 L/min 0.222 U.S. gal/min

Service limit

Low speed (rotating)	0.4 L/min 0.11 U.S.gals/min

3.6 Measuring pilot control valve

3.6.1 Measuring pilot primary pressure

⚠ CAUTION
- **Lower front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

■ IMPORTANT
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing
1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Connect the pressure gauge to P4 detection port.

(1) Port P4

Measuring
1. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set the engine speed to the maximum.

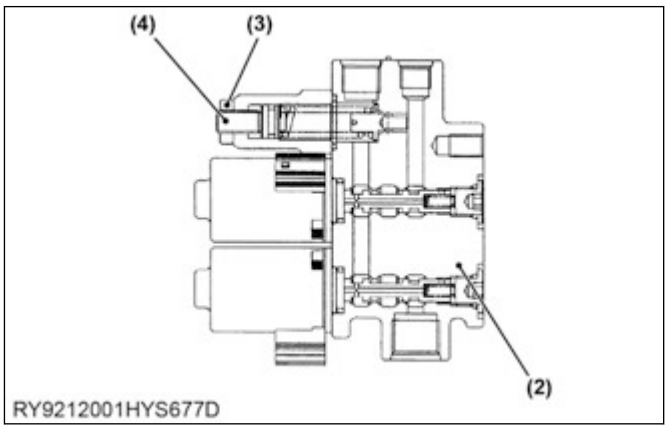
■ NOTE
- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

3. Measure pilot primary pressure when unloaded.
4. Measure three times to calculate average.

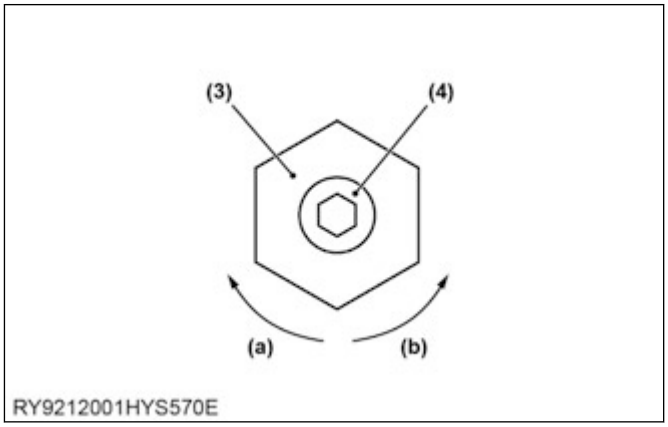
Service specification

Pilot primary pressure	4.0 to 4.5 MPa 40.7 to 45.8 kgf/cm^2 580.1 to 594.6 psi

Adjusting
1. Loosen the locknut of relief valve.
2. Set position of adjusting screw to adjust relief pressure and tighten the locknut.



(2) Unload valve
(3) Locknut
(4) Adjusting screw



(3) Locknut
(4) Adjusting screw
(a) Increase relief pressure
(b) Decrease relief pressure

Tightening torque

(3) Locknut	15.7 N·m 1.6 kgf·m 11.6 lbf·ft	-

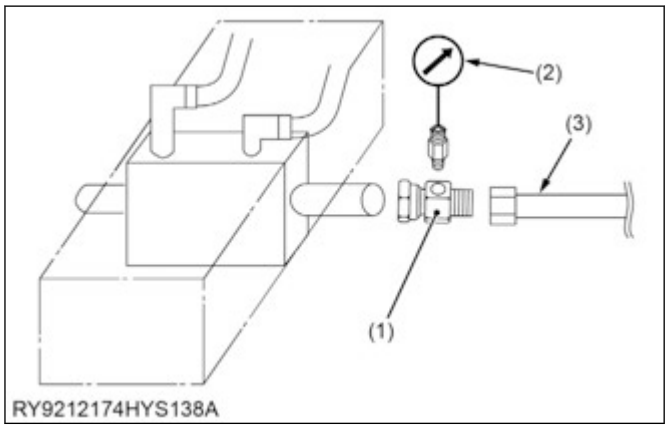
3. Operate control lever at engine maximum and check pilot primary pressure.

3.6.2 Measuring pilot secondary pressure

⚠ CAUTION
- **Lower front attachments to the ground and stop the engine.**
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Keep out any persons or objects from the machine.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

■ IMPORTANT
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparation
1. Park the machine on firm and level ground and stop the engine.
2. Release residual pressure of hydraulic circuit.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
4. Connect T-joint to pilot port of control valve and install pressure gauge.



(1) T-joint (3) Test hose
(2) Pressure gauge

5. Remove the vacuum pump and make sure to check oil leakage in each piping hose in idling.

Measuring
1. Warm up the hydraulic oil and devices to 50±5 ℃ (122±9 ℉).
2. Set the engine speed to the maximum.

■ NOTE
- **In case of the machine is air conditioning specification, it is necessary to turn off the air conditioning switch.**

3. Operate lever in full stroke and measure pressure.
4. Measure 3 times to calculate average.

4. Repairing

4.1 Hydraulic pump

4.1.1 Removing and installing the hydraulic pump

⚠ CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

■ IMPORTANT
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing
1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

Removing
1. Remove the rear bonnet.
2. Remove the LH bonnet.

(1) Rear bonnet (2) LH bonnet

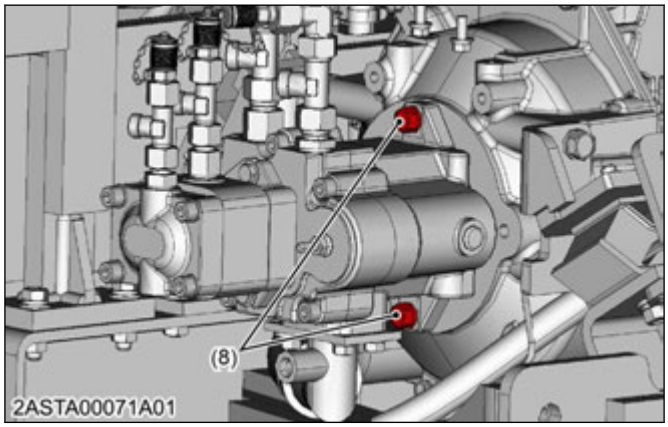
3. Disconnect the hydraulic hoses.
4. Loosen clamp to disconnect suction hose.
5. Remove suction flange.

(3) Suction hose
(4) Suction flange

6. Remove muffler.
7. Attach nylon sling and hoist the hydraulic pump for support.

(5) Muffler
(6) Nylon sling
(7) Hydraulic pump

8. Remove 2 bolts.



(8) Bolt (M12 × 30) ×2

9. Pull-out the hydraulic pump from the coupling.

Mass

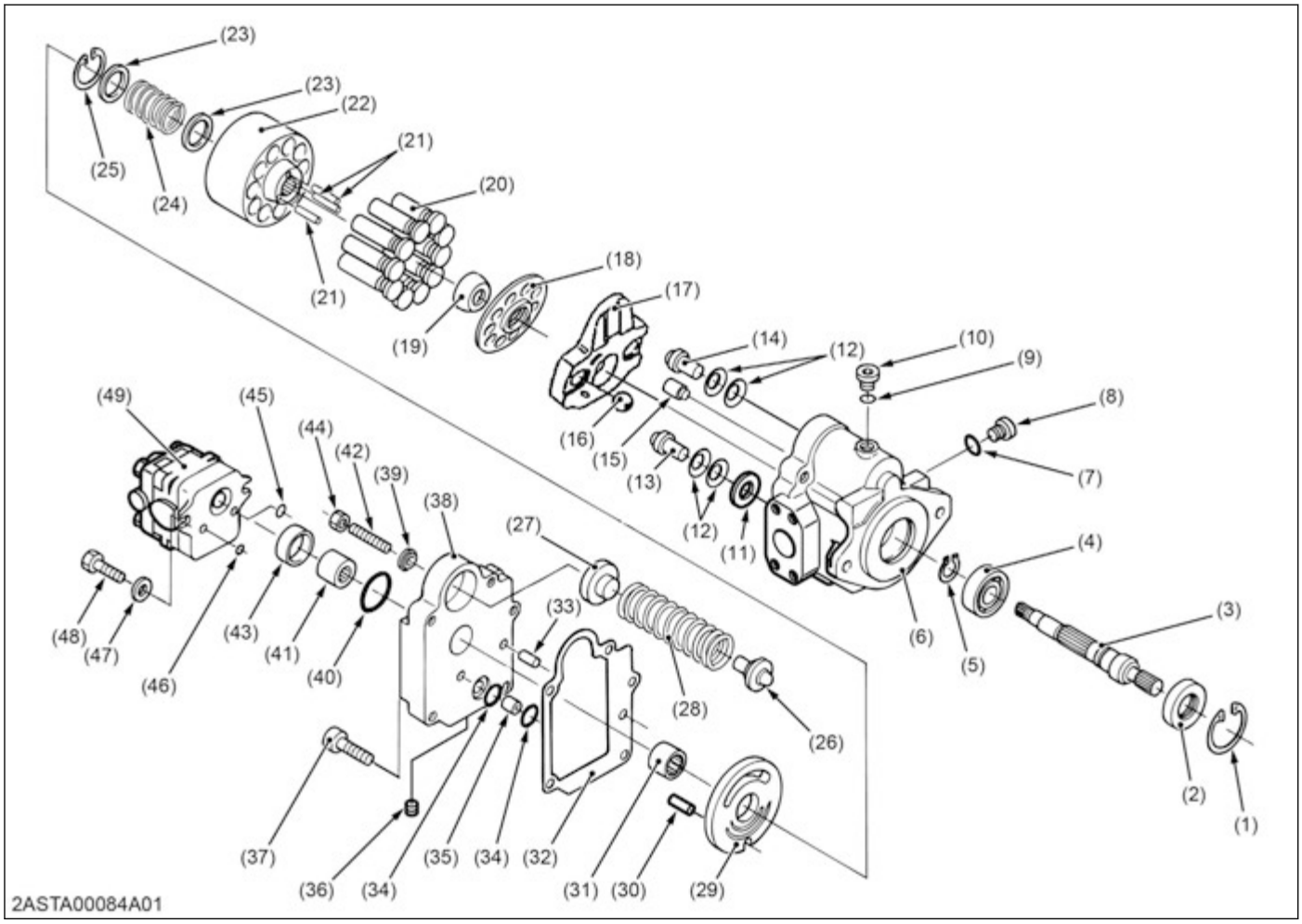
(7) Hydraulic pump	Approximately 18 kg Approximately 40 lbs

Installing

Tightening torque

(8) Bolt	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 lbf·ft	-

4.1.2 Hydraulic pump components



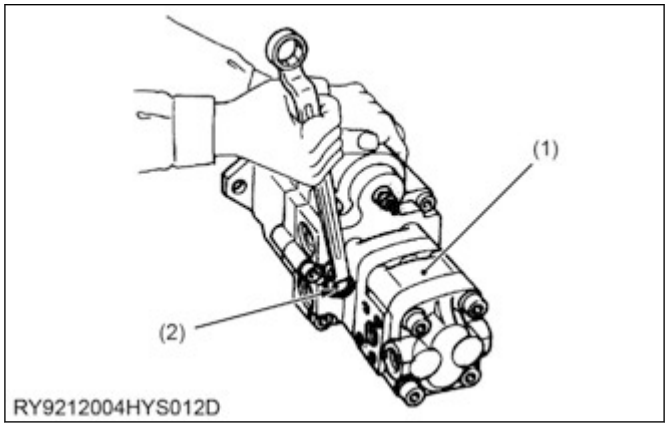
(1) Internal circlip
(2) Oil seal
(3) Shaft
(4) Ball bearing
(5) External circlip
(6) Body S
(7) O-ring
(8) Plug
(9) O-ring
(10) Plug
(11) Metal washer
(12) Spring plate ×4
(13) Stopper pin B
(14) Stopper pin A
(15) Control pin
(16) Ball ×2
(17) Swash plate
(18) Shoe holder
(19) Barrel holder
(20) Piston, ASSY ×10
(21) Pin ×3
(22) Cylinder block
(23) Retainer ×2
(24) Spring
(25) Internal circlip
(26) Spring holder
(27) Spring guide
(28) Compression spring
(29) Valve plate
(30) Spring pin
(31) Needle bearing
(32) Gasket
(33) Pin
(34) O-ring ×2
(35) Hole pin
(36) Plug
(37) Cap bolt ×5
(38) Body H
(39) Washer
(40) O-ring
(41) Coupling
(42) Adjusting screw
(43) Collar
(44) Lock nut
(45) O-ring
(46) O-ring
(47) Washer ×2
(48) Bolt ×2
(49) Gear pump

4.1.3 Disassembling the piston pump

IMPORTANT

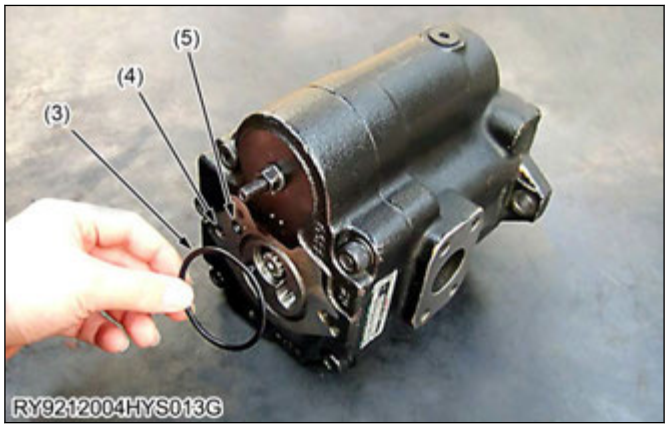
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**

1. Remove the 2 bolts and remove the gear pump.



(1) Gear pump
(2) Bolt (M8 × 25)

2. Remove the O-rings.

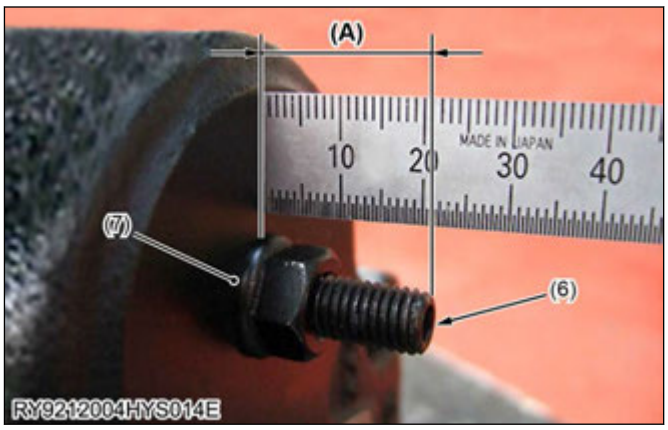


(3) O-ring
(4) O-ring
(5) O-ring

3. Measure length of the adjusting screw.

IMPORTANT

- **Note the set-length of adjusting screw before loosening.**
- **Horse power control performance depends on set-length of adjusting screw.**



(6) Adjusting screw
(7) Locknut
(A) Set-length

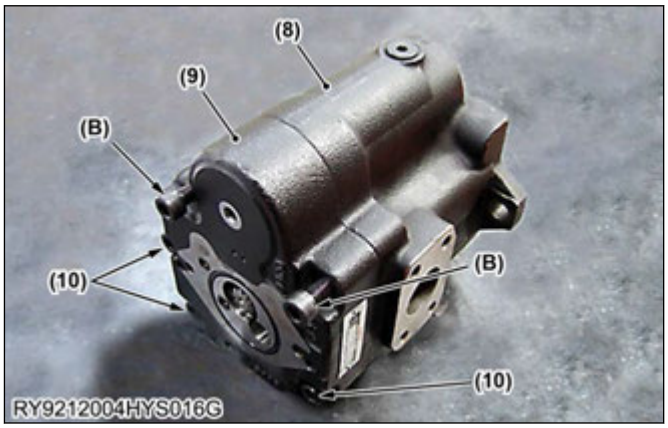
4. Remove the nut and adjusting screw.

(6) Adjusting screw

5. Remove the 2 cap bolts from upper side.
6. Install the 2 slightly longer cap bolts (for stopper) loosely.

NOTE

- **Insert the cap bolts for only 10 mm (0.39 in.).**



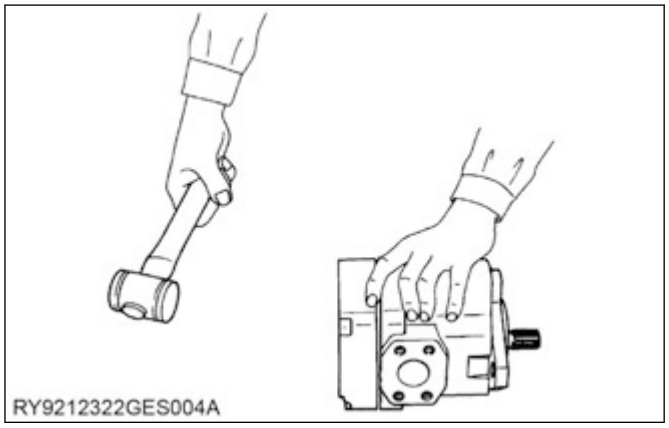
(8) Body S
(9) Body H
(10) Cap bolt (M10 × 45) ×5
(B) Cap bolt (M10 × 65) ×2

7. Remove 3 cap bolts from lower side.

8. Separate body H and body S.

■ NOTE

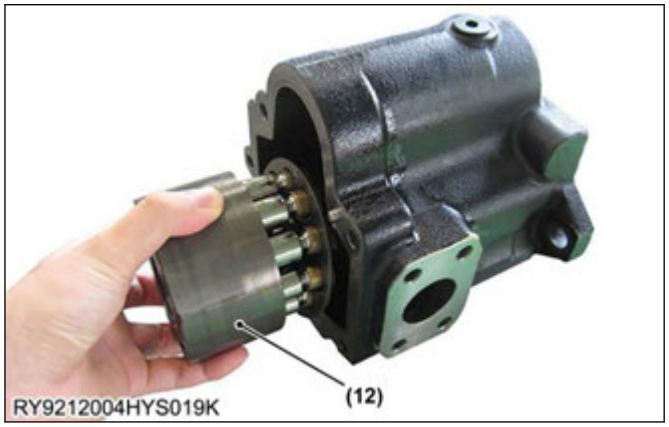
- **If it is difficult to remove the body H, hit with the plastic hammer slightly to give a shock.**



9. Remove 2 cap bolts (for stopper) from upper side.
10. Remove the valve plate, gasket, compression spring, and O-ring.

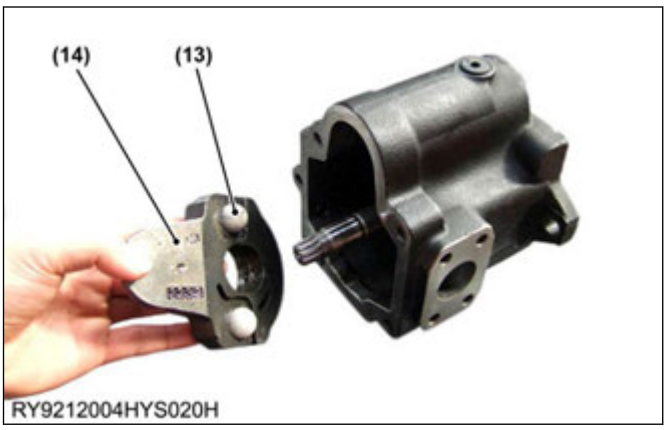
(11) Compression spring

11. Remove the cylinder block.



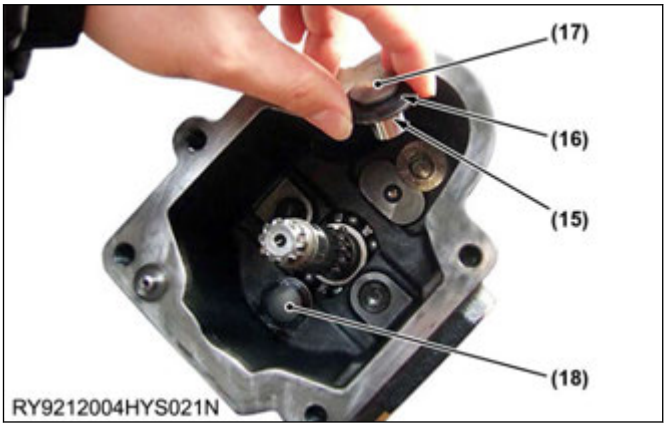
(12) Cylinder block

12. Remove the spring holder, swash plate, and ball.



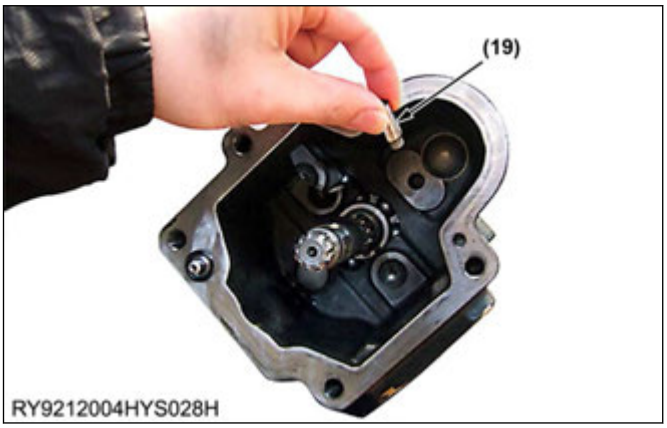
(13) Ball
(14) Swash plate

13. Remove the stopper pin A, stopper pin B, diaphragm springs, metal, and washer.



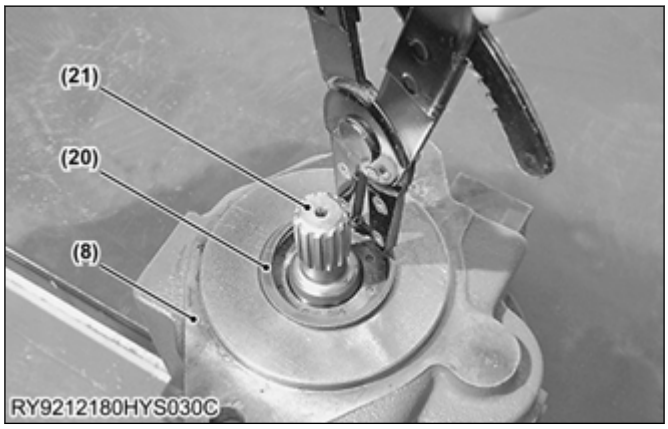
(15) Metal washer
(16) Diaphragm spring ×2
(17) Stopper pin A
(18) Stopper pin B

14. Remove the control pin.



(19) Control pin

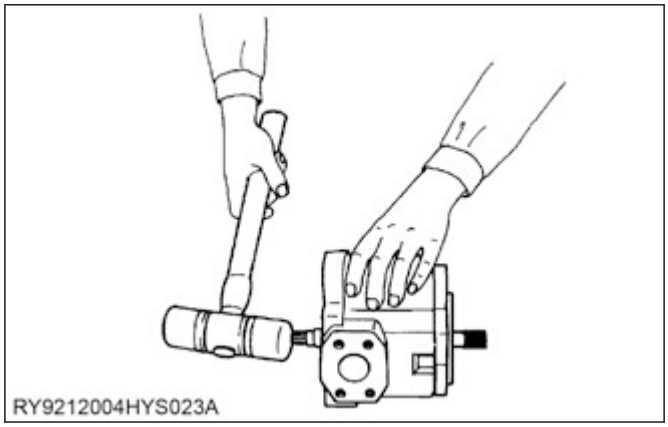
15. Remove circlip from body S.



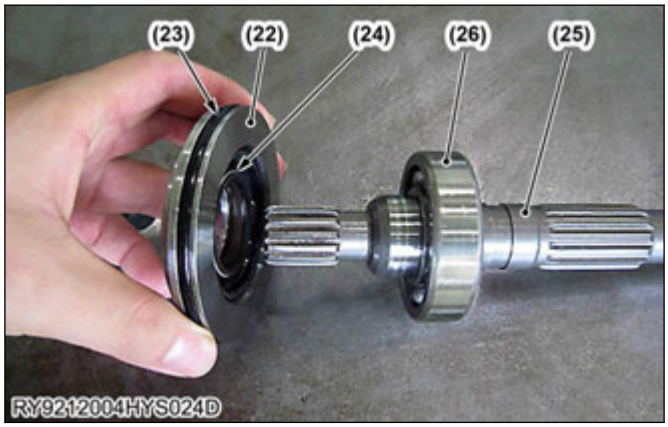
(8) Body S
(20) Circlip
(21) Shaft

16. Hit the shaft with hammer to remove the shaft, seal holder (with oil seal and O-ring), and ball bearing.

NOTE
- **Use the plastic hammer only.**



17. Remove the seal holder from the shaft.
18. Remove the O-ring and oil seal from the shaft.



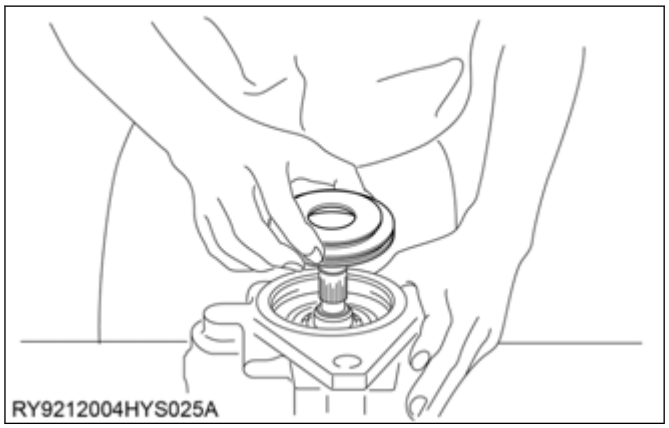
(22) Seal holder
(23) O-ring
(24) Oil seal
(25) Shaft
(26) Ball bearing

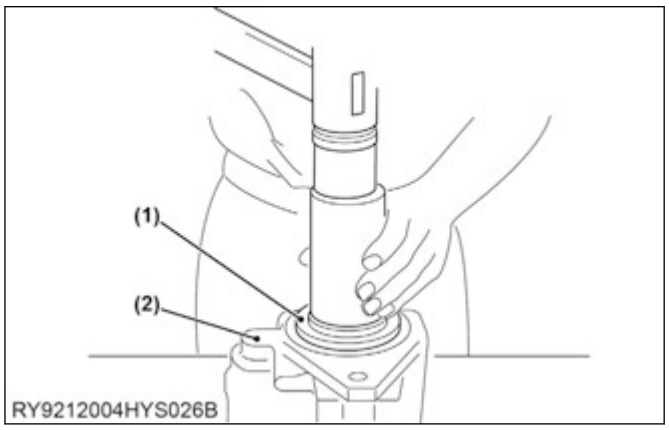
4.1.4 Assembling the piston pump

IMPORTANT
- **Do not reuse removed O-rings and oil seals for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **To avoid seizure and rust, apply lubricants or greases to every seal and part surface when assembling.**
- **After assembling, clean the out side of hydraulic component.**
- **To prevent seizure and cavitation after assembling, fill the hydraulic oil from the lubrication port fully.**

1. Install the shaft (with ball bearing), oil seal, and internal circlip in order to the body S.

■ NOTE
- **Grease the oil seal and O-ring.**
- **Use the seal holder installation jig and plastic hammer to install the seal holder.**

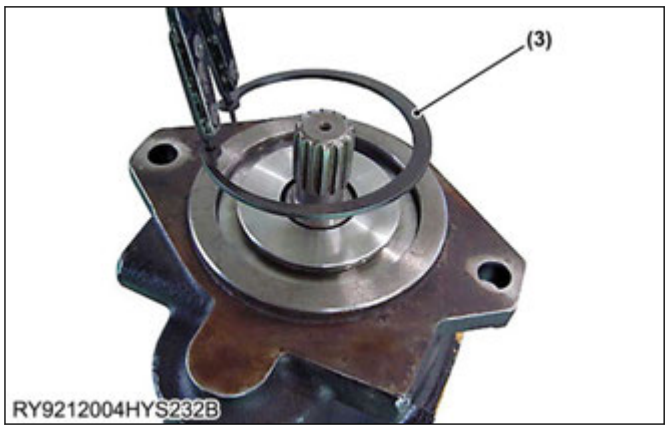




(1) Seal holder (2) Body S

2. Install the internal circlip.

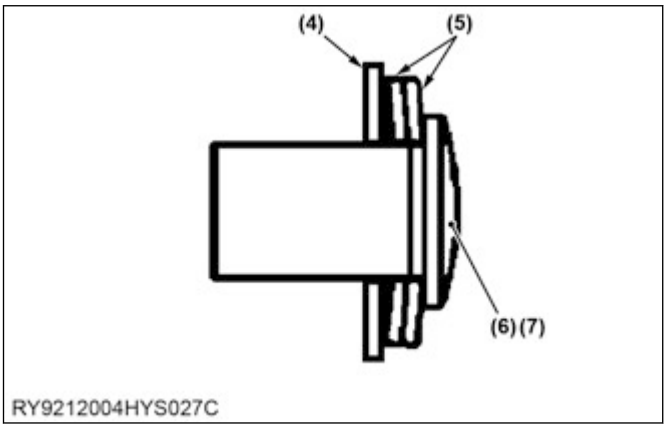
■ NOTE
- **Set the curved surface to the seal holder side.**



(3) Internal circlip

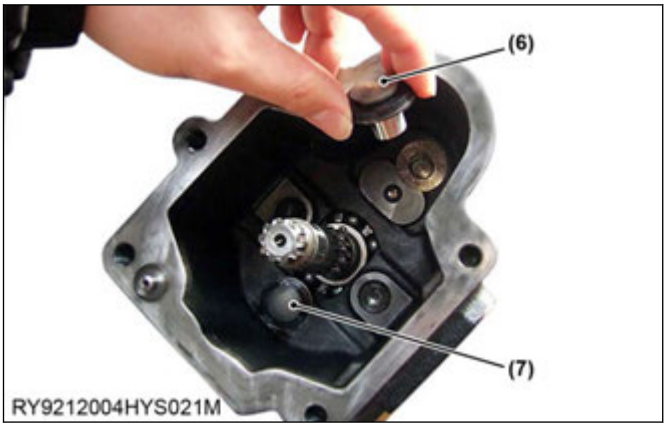
3. Install the two diaphragm springs and metal washer to stopper pin A and stopper pin B.

■ NOTE
- **Make sure to install the diaphragm spring and metal washer in correct direction.**



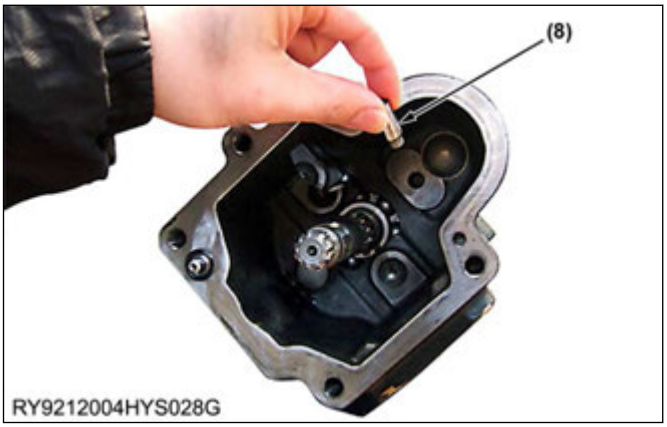
(4) Metal washer (7) Stopper pin B
(5) Diaphragm spring
(6) Stopper pin A

4. Install the stopper pin A and stopper pin B to body S.



(6) Stopper pin A (7) Stopper pin B

5. Install the control pin to the body S.

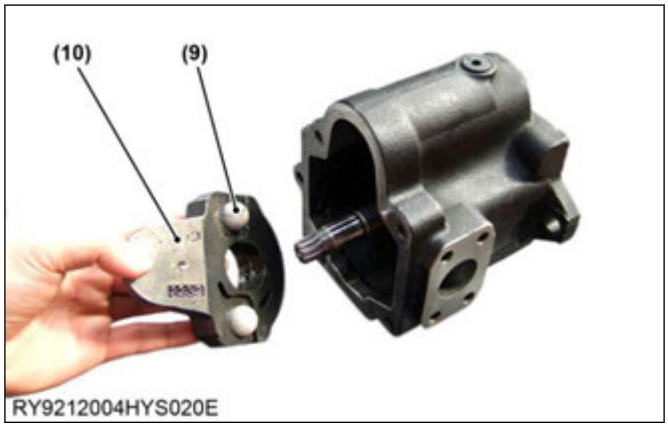


(8) Control pin

6. Install the ball to the swash plate.

NOTE
- **Grease the ball to avoid ball from coming off.**

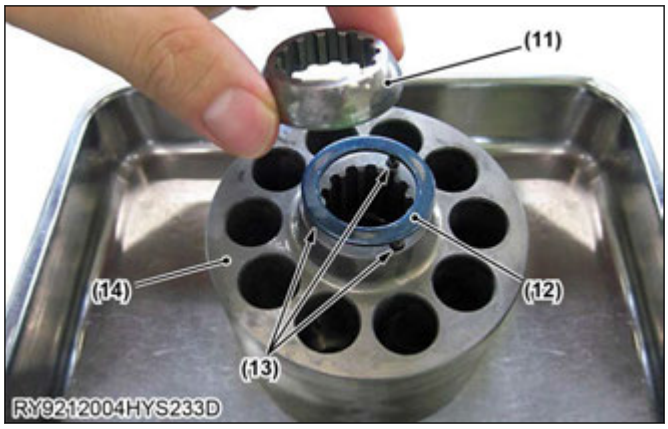
7. Install the swash plate.



(9) Ball
(10) Swash-plate

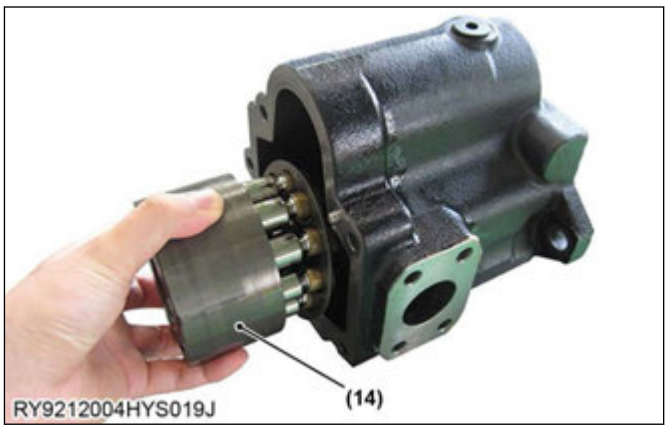
8. Install the needle, three pins, washer, and shoe holder to the cylinder block.

NOTE
- **Apply hydraulic oil to the each part to avoid seizure and rust.**



(11) Shoe holder
(12) Washer
(13) Pin
(14) Cylinder block

9. Install the cylinder block.



(14) Cylinder block

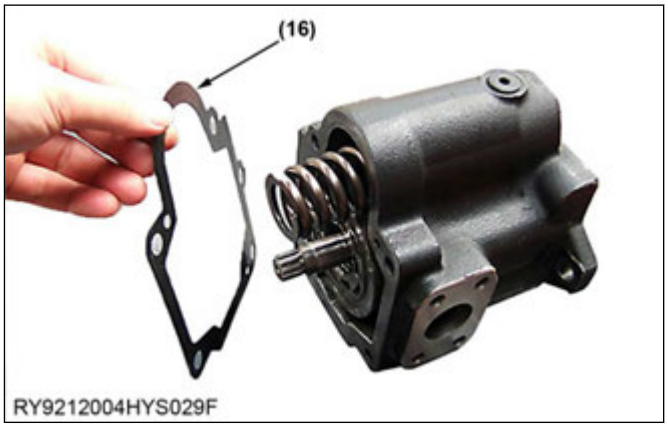
10. Install the spring holder to the compression spring.

NOTE
- **Grease the spring holder.**

11. Install the compression spring to the swash plate.

(15) Compression spring

12. Install the gasket to the mating surface.

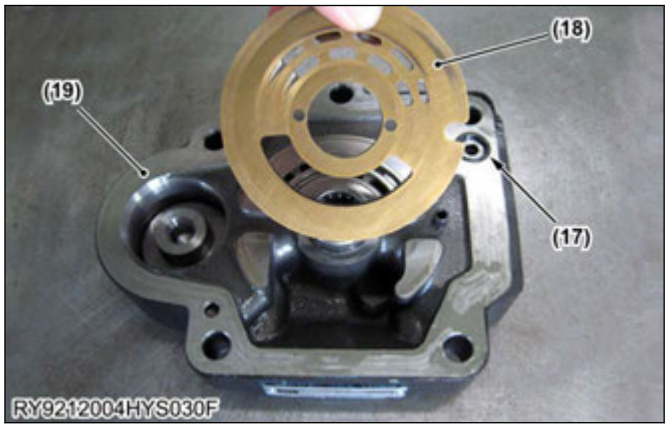


(16) Gasket

13. Install the valve plate.

NOTE
- **Make sure to install the valve plate in correct direction.**
- **Apply hydraulic oil to the valve plate.**

- **Set the valve plate gently to avoid damaging.**

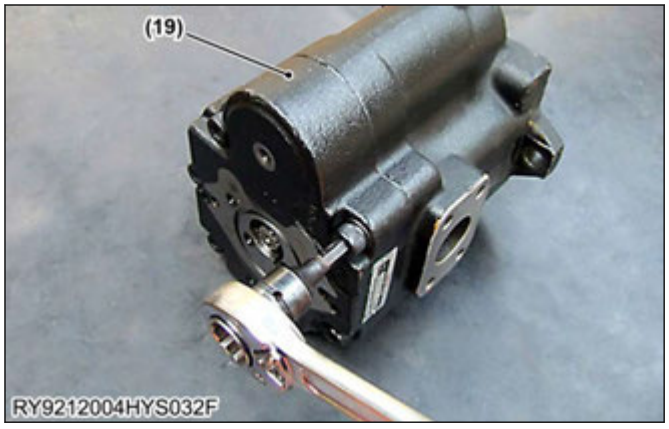


(17) O-ring
(18) Valve plate
(19) Body H

14. Install the two slightly longer cap bolts to upper side.

(A) Cap bolt

15. Install the three cap bolts to lower side.
16. Remove the two longer cap bolts from upper side to replace to the regular two cap bolts.
17. Tighten five cap bolts with the specified torque.



(19) Body H

Tightening torque

Cap bolt	51.0 to 64.7 N·m 5.2 to 6.6 kgf·m 37.6 to 47.7 lbf·ft	-

18. Tighten the adjusting screw with the specified torque.

■ IMPORTANT

- **Set-length should be exactly same as before disassembling.**

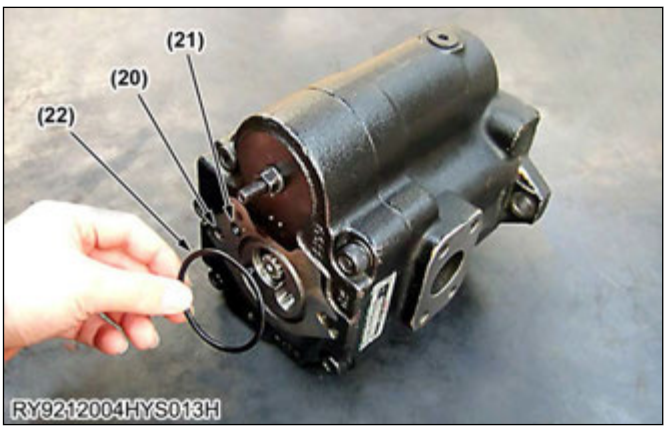
Tightening torque

Lock nut	14.7 to 19.6 N·m 1.5 to 2.0 kgf·m 10.8 to 14.5 lbf·ft	-

19. Install the O-rings.

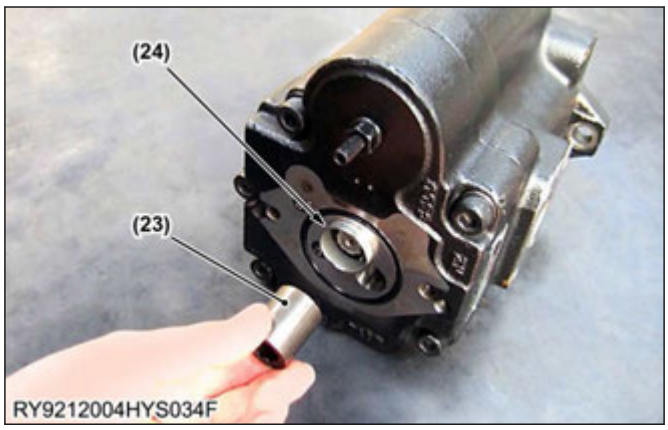
■ NOTE

- **Grease the O-rings.**



(20) O-ring
(21) O-ring
(22) O-ring

20. Install the collar and the coupling.

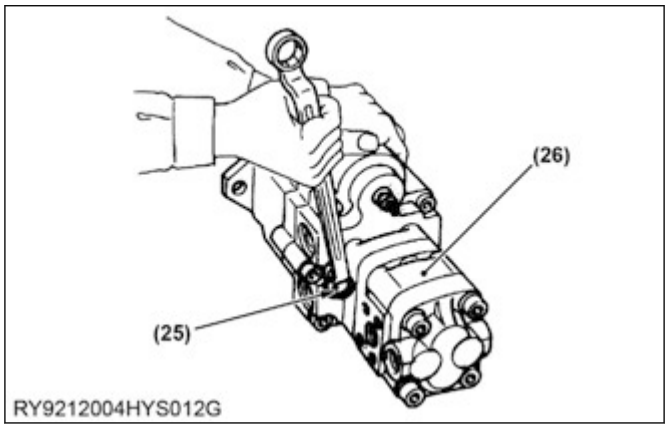


(23) Coupling (24) Collar

21. Install the gear pump.

■ NOTE

- **After reassembling, make sure that the hydraulic pump is rotating smoothly.**

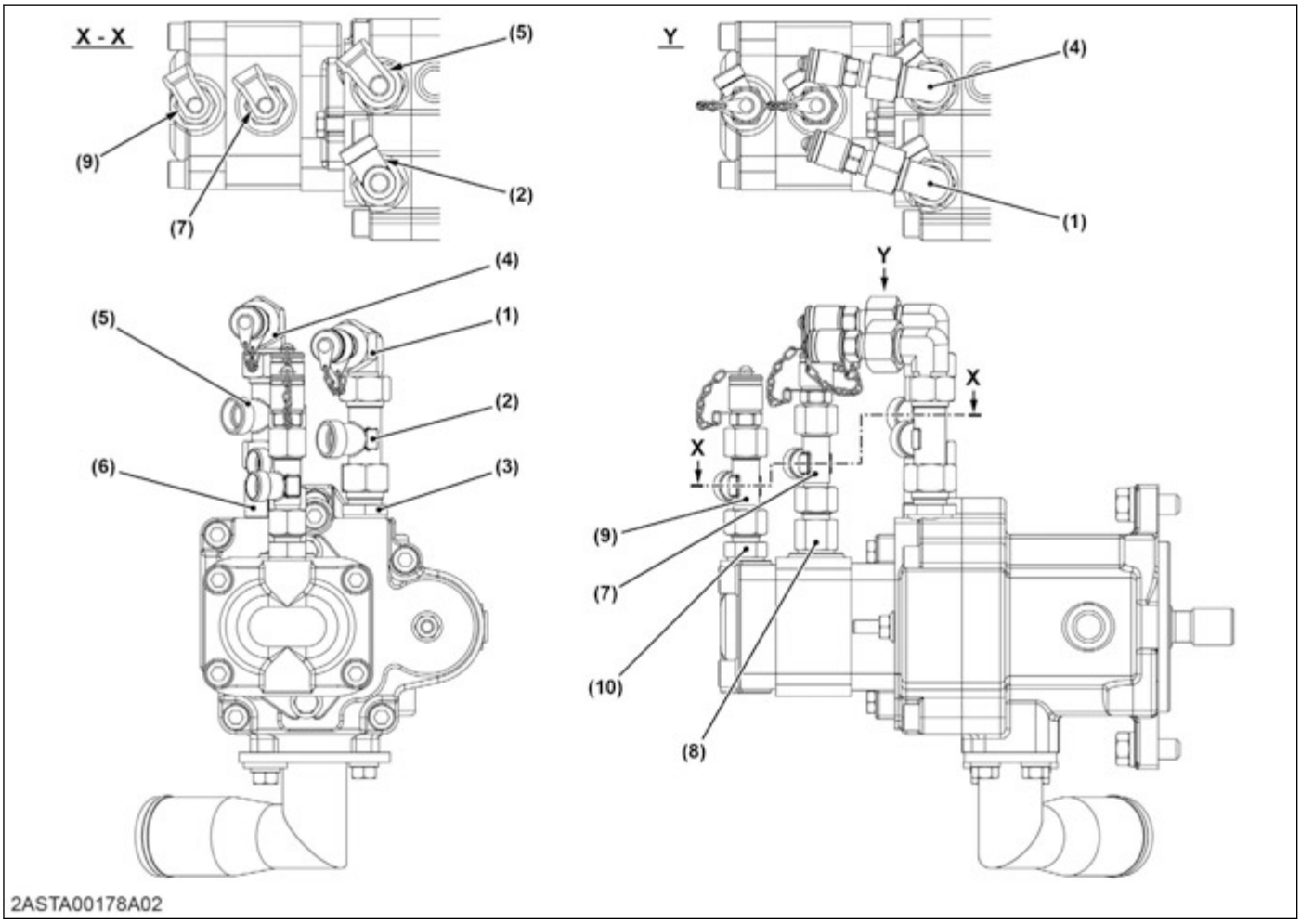


(25) Bolt (M8 × 25) ×2 (26) Gear pump

Tightening torque

(25) Bolt	19.6 to 23.5 N·m 2.0 to 2.4 kgf·m 14.5 to 17.4 lbf·ft	-

4.1.5 Installing adapter layout for the hydraulic pump

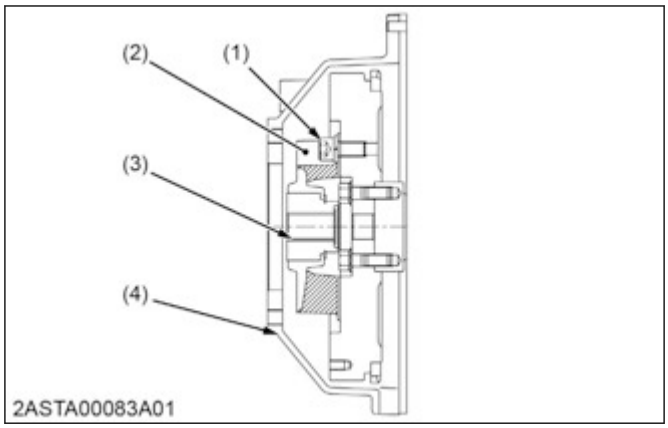


Adapter No.	Adapter size	Angle	Adapter No.	Adapter size	Angle
(1)	M22-M22	18°	(6)	G1/2-M22	-
(2)	M22-M22-M22	58°	(7)	M18-M18-M18	58°
(3)	G1/2-M22	-	(8)	G3/8-M18	-
(4)	M22-M22	10°	(9)	M18-M18-M18	60°
(5)	M22-M22-M22	50°	(10)	G3/8-M18	-

4.1.6 Installing hydraulic pump coupling

1. Grease the spline.
2. Grease coupling seating surface a little and tighten the bolts.

IMPORTANT
- **Grease the spline of the pump coupling.**
- **Do not grease the pump coupling body.**
- **Do not apply thread lock.**

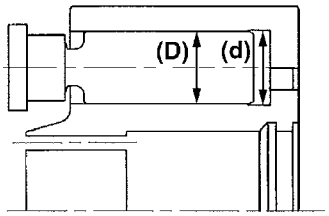
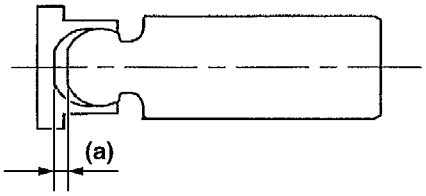
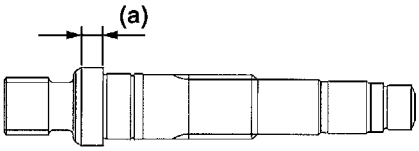


(1) Bolt
(2) Coupling
(3) Spline
(4) Housing

Tightening torque

(1) Bolt	103.0 to 117.7 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 lbf·ft	-

4.1.7 Hydraulic pump maintenance standard

Parts	Maintenance	Service limits
Piston Cylinder block Valve plate	Check the clearance between the piston and cylinder block.  RY9212004HYS035A ■ **NOTE** • **Clearance is the difference between (d) and (D).**	0.05 mm 0.002 in.
	Check the play (a) between the piston and shoe.  RY9212004HYS036A	0.2 mm 0.008 in.
Shaft	Check the wear amount of oil seal installing location (a).  RY9212004HYS037A	0.25 mm 0.01 in.

4.2 Control valve

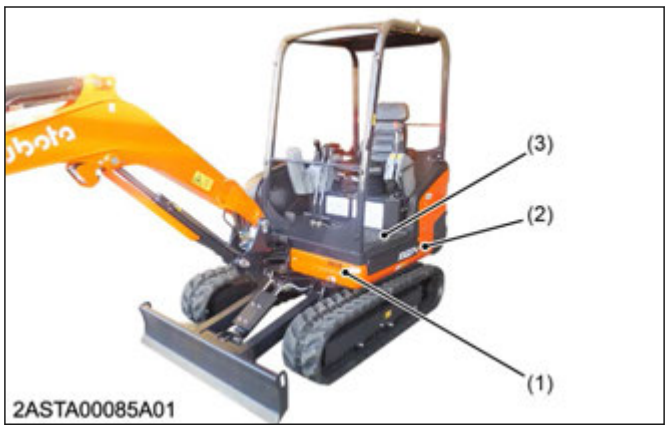
4.2.1 Removing and installing the control valve

⚠ CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

■ **IMPORTANT**
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

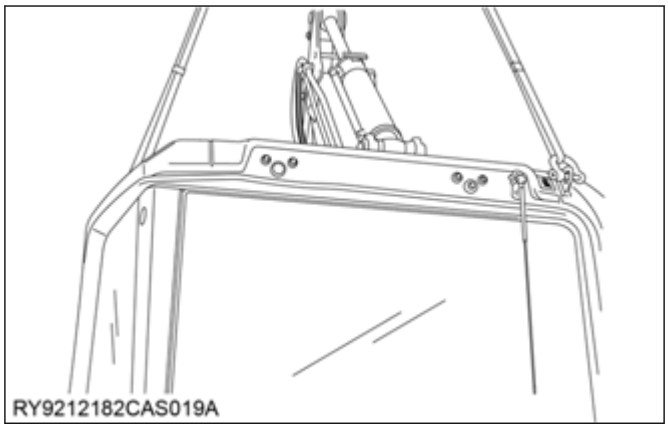
Preparing
1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

Removing
1. Remove the front swivel cover.
2. Remove the LH swivel cover.
3. Remove the step cover and step plate.



(1) Front swivel cover
(2) LH swivel cover
(3) Step cover and step plate

4. Remove the cabin or canopy.



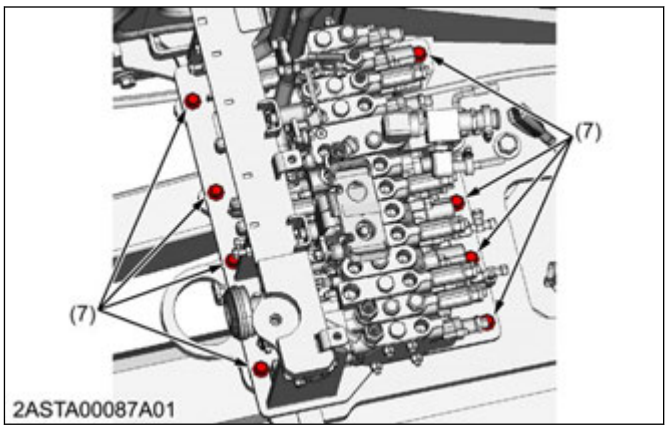
5. Disconnect all of the hydraulic hoses, mechanical links, and wire harnesses.

(4) Hydraulic hose
(5) Wire harness
(6) Mechanical link

IMPORTANT

- **Put a mark on disconnected hydraulic hoses to reconnect each hose correctly.**

6. Remove the 8 bolts.

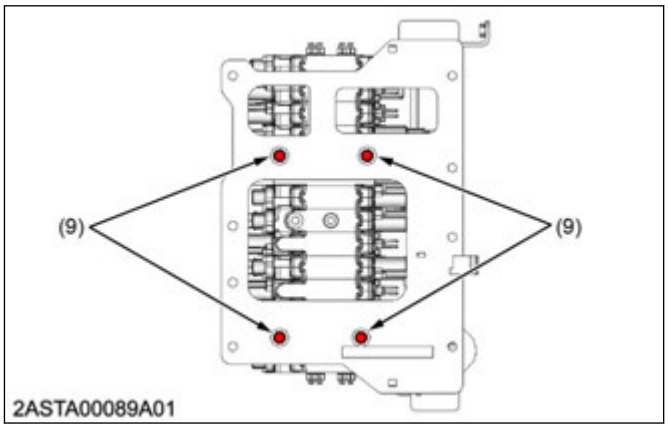


(7) Bolt (M10 × 25) ×8

7. Attach a nylon sling and hoist the control valve.

(8) Nylon sling

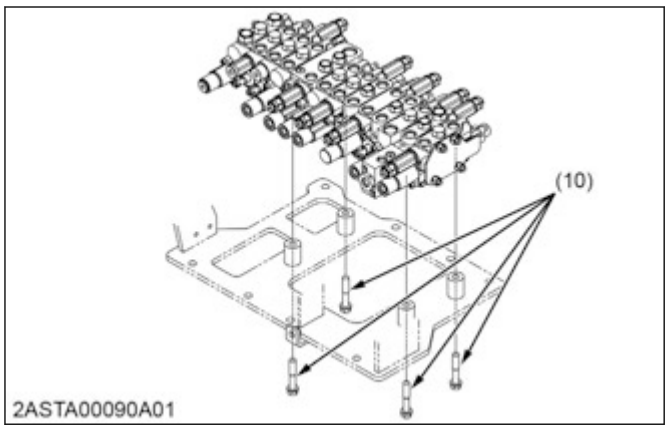
8. Remove the 4 bolts.



(9) Bolt (M10 × 55) ×4

Installing

1. Tighten the 4 bolts with the specified torque.

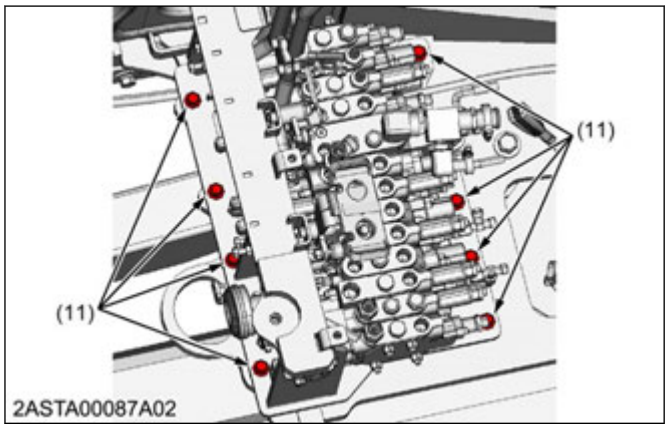


(10) Bolt (M10 × 55) ×4

Tightening torque

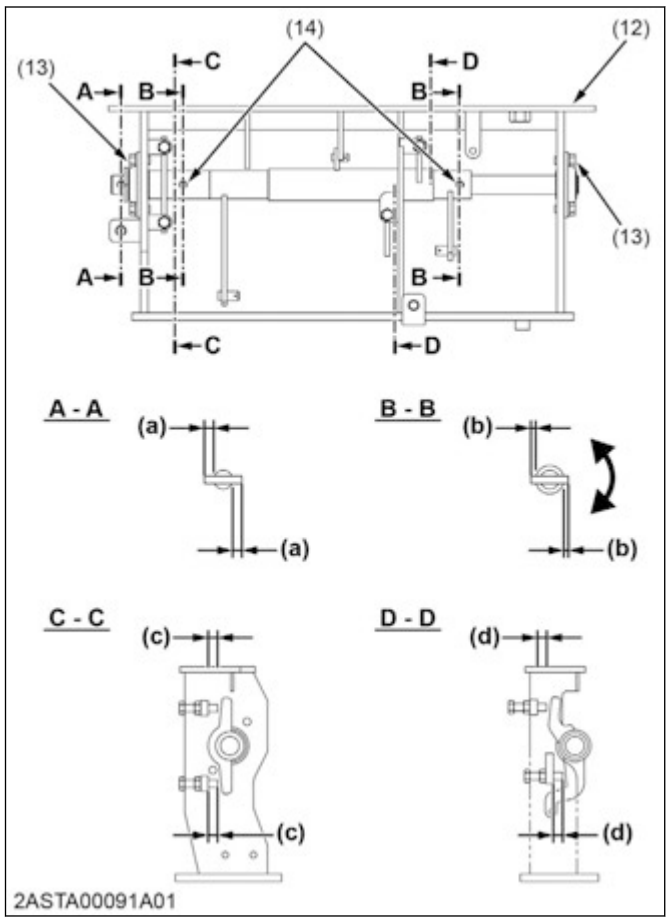
(10) Bolt	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 lbs·ft	Thread lock (Loctite 301-70)

2. Tighten the 8 bolts.



(11) Bolt (M10 × 25) ×8

3. Adjust the control valve bracket.

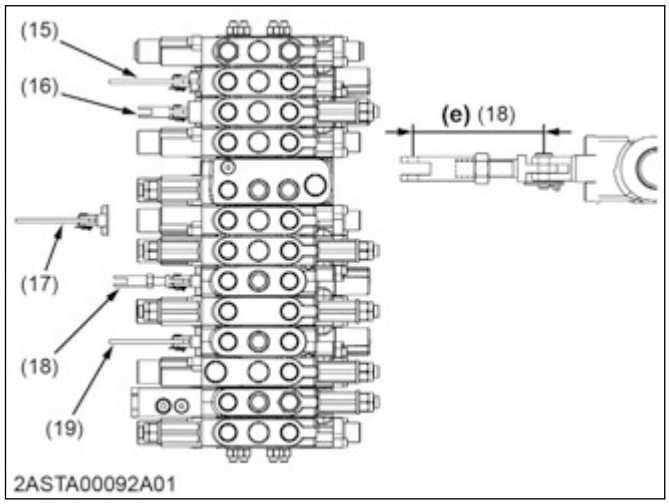


(12) Bracket
(13) Flange bearing
(14) Slit

Adjusting dimensions

(a)	10 mm 0.39 in.	(c)	10 mm 0.39 in.
(b)	5 mm 0.20 in.	(d)	10 mm 0.39 in.

4. Connect the links.



(15) Swing link
(16) Blade link
(17) AUX1 link (Basic only)
(18) Travel LH link
(19) Travel RH link

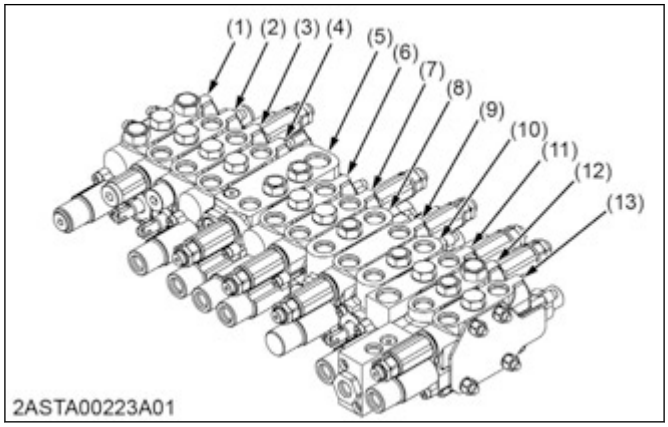
Adjusting dimension

(e)	119 mm 4.7 in.

5. Connect the hydraulic hoses and wire harness.
6. Install the cabin or canopy.
7. Install the LH and front swivel cover.
8. Install the step cover and step plate.

4.2.2 Control valve components

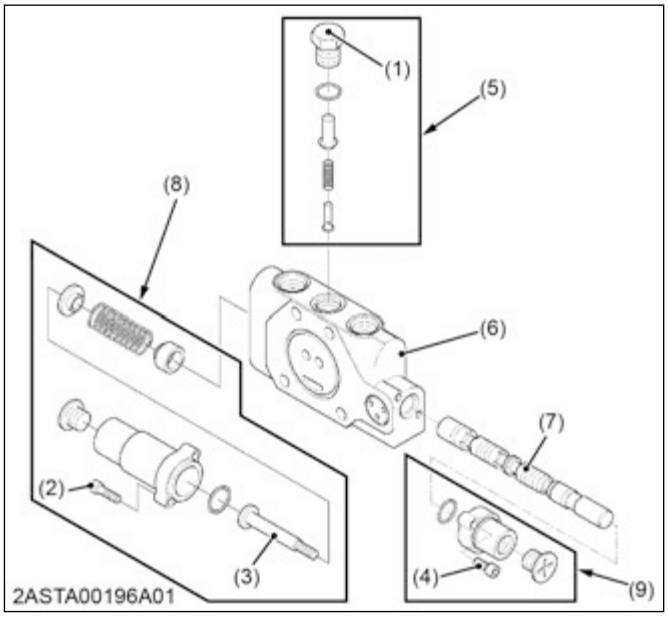
4.2.2.1 Control valve section components



(1) AUX 2 (Hi-spec only)
(2) Swing
(3) Blade
(4) Swivel
(5) Confluence valve
(6) AUX 1
(7) Arm
(8) Travel LH
(9) Inlet
(10) Travel RH
(11) Boom
(12) Boom lock section
(13) Bucket

NOTE
- **This control valve is for Hi-spec.**

4.2.2.2 Control valve AUX2 section (Hi-spec only)

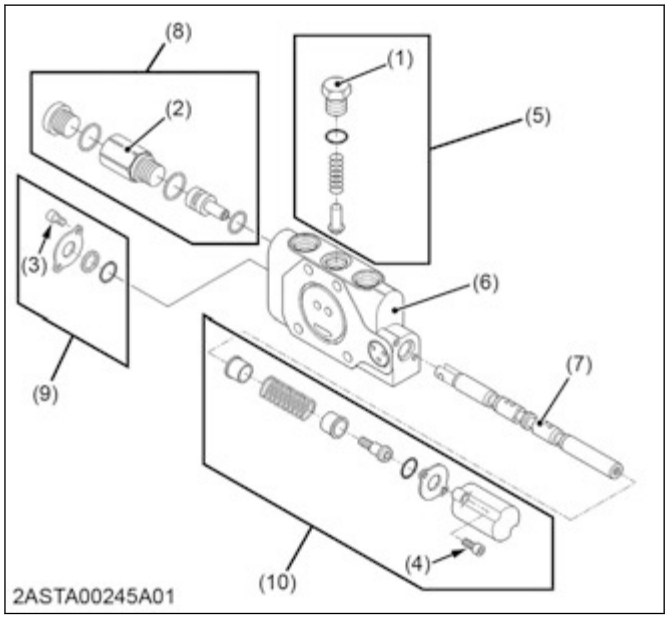


(1) Plug
(2) Bolt
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Cap assembly
(9) Cap assembly

Tightening torque

(1) Plug	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-
(3) Bolt	3.92 to 4.90 N·m 0.40 to 0.50 kgf·m 2.89 to 3.61 lbf·ft	Thread lock
(4) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-

4.2.2.3 Control valve swing section

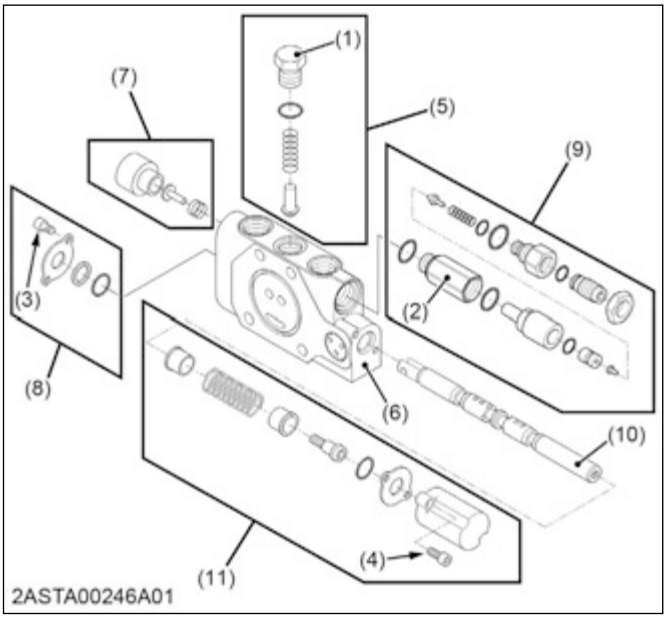


(1) Plug
(2) Anti-cavitation valve
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Anti-cavitation valve assembly
(9) Cover assembly
(10) Cap assembly

Tightening torque

(1) Plug	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Anti-cavitation valve	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(3) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	Thread lock
(4) Bolt	3.92 to 4.90 N·m 0.40 to 0.50 kgf·m 2.89 to 3.61 lbf·ft	-

4.2.2.4 Control valve blade section

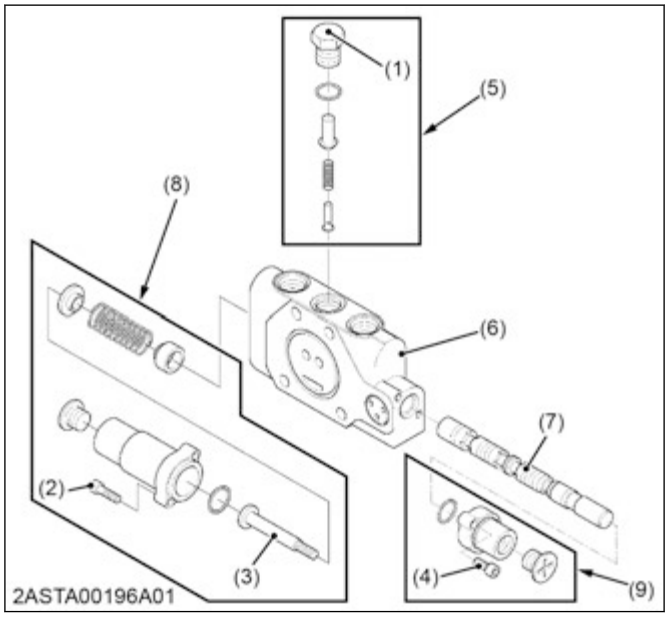


(1) Plug
(2) Adapter
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Cap assembly
(8) Cover assembly
(9) Overload relief valve assembly
(10) Spool
(11) Cap assembly

Tightening torque

(1) Plug	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Adapter	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-
(3) Bolt	3.92 to 4.90 N·m 0.40 to 0.50 kgf·m 2.89 to 3.61 lbf·ft	Thread lock
(4) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-

4.2.2.5 Control valve swivel section

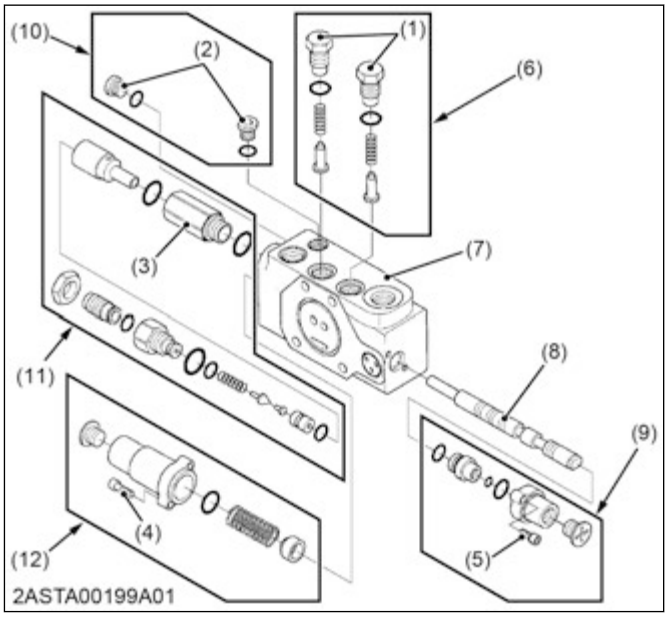


(1) Plug
(2) Bolt
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Cover assembly
(9) Cap assembly

Tightening torque

(1) Plug	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-
(3) Bolt	3.92 to 4.90 N·m 0.40 to 0.50 kgf·m 2.89 to 3.61 lbf·ft	Thread lock
(4) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-

4.2.2.6 Control valve confluence valve section



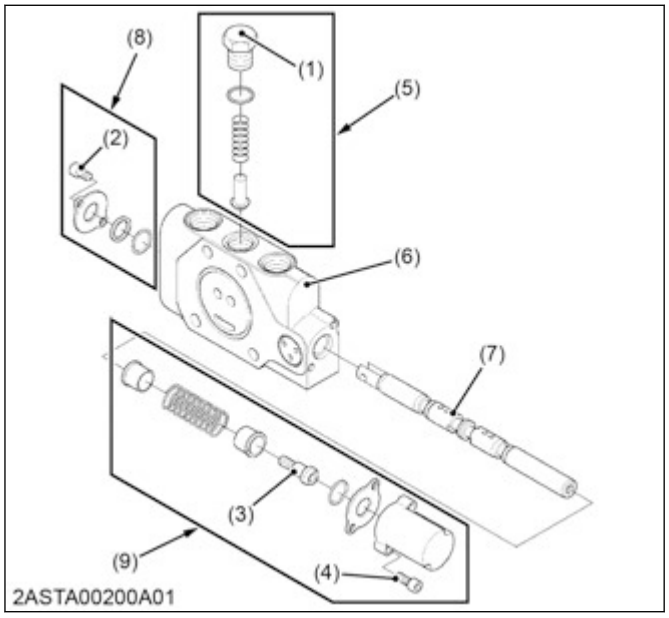
(1) Plug ×2
(2) Plug ×2
(3) Relief valve
(4) Bolt
(5) Bolt
(6) Plug assembly 1
(7) Valve body
(8) Spool
(9) Cap assembly
(10) Plug assembly
(11) Relief valve assembly
(12) Cap assembly

Tightening torque

(1) Plug	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Plug	17.61 to 18.59 N·m 1.80 to 1.90 kgf·m 12.94 to 13.66 lbf·ft	-
(3) Relief valve	3.92 to 4.90 N·m 0.40 to 0.50 kgf·m 2.89 to 3.61 lbf·ft	-
(4) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-
(5) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-

4.2.2.7 Control valve AUX1 section

Basic

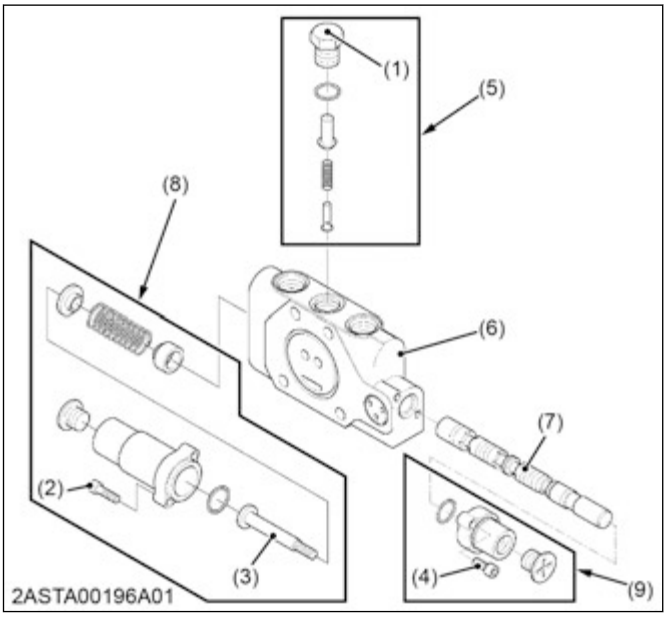


(1) Plug
(2) Bolt
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Cover assembly
(9) Cap assembly

Tightening torque

(1) Plug	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-
(3) Bolt	3.92 to 4.90 N·m 0.40 to 0.50 kgf·m 2.89 to 3.61 lbf·ft	Thread lock
(4) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-

Hi-spec

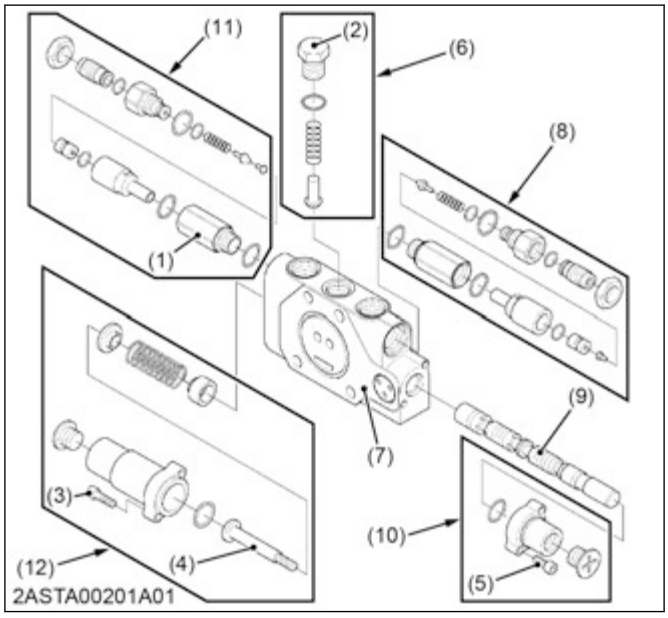


(1) Plug
(2) Bolt
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Cap assembly
(9) Cap assembly

Tightening torque

(1) Plug	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-
(3) Bolt	3.92 to 4.90 N·m 0.40 to 0.50 kgf·m 2.89 to 3.61 lbf·ft	Thread lock
(4) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-

4.2.2.8 Control valve arm section

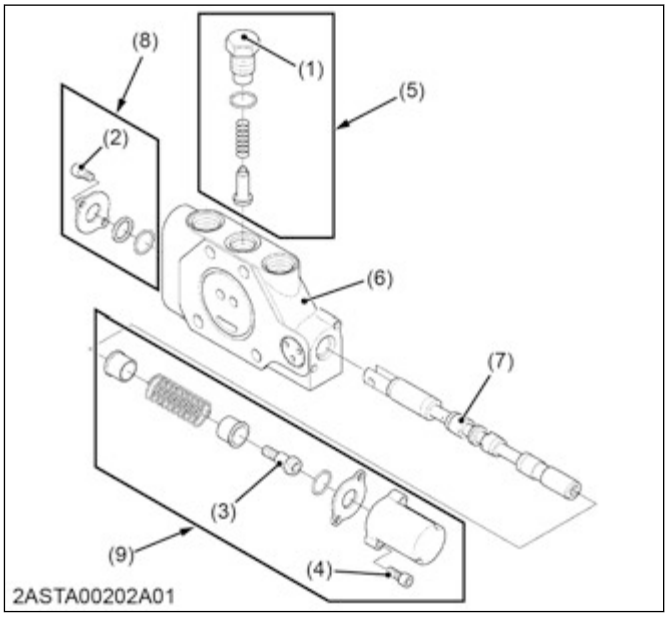


(1) Relief valve
(2) Plug
(3) Bolt
(4) Bolt
(5) Bolt
(6) Plug assembly
(7) Valve body
(8) Overload relief valve assembly
(9) Spool
(10) Cap assembly
(11) Overload relief valve assembly
(12) Cap assembly

Tightening torque

(1) Relief valve	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Plug	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(3) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-
(4) Bolt	3.92 to 4.90 N·m 0.40 to 0.50 kgf·m 2.89 to 3.61 lbf·ft	Thread lock
(5) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-

4.2.2.9 Control valve travel LH section

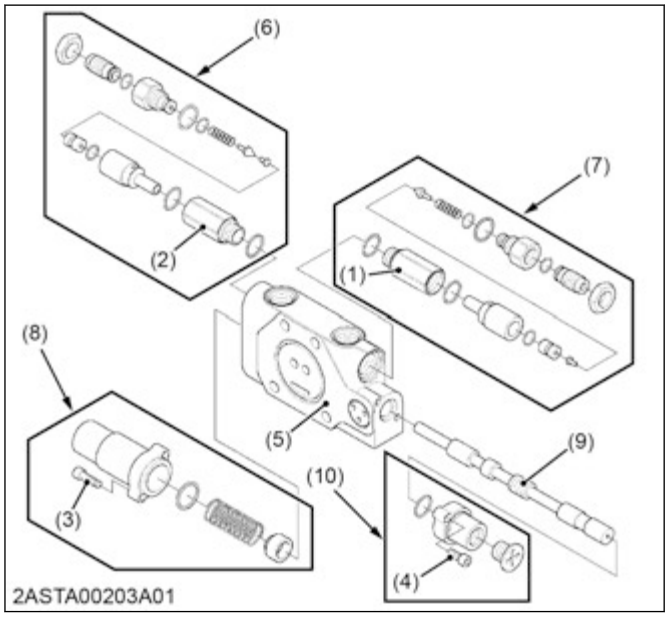


(1) Plug
(2) Bolt
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Cover assembly
(9) Cap assembly

Tightening torque

(1) Plug	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-
(3) Bolt	3.92 to 4.90 N·m 0.40 to 0.50 kgf·m 2.89 to 3.61 lbf·ft	Thread lock
(4) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-

4.2.2.10 Control valve inlet section

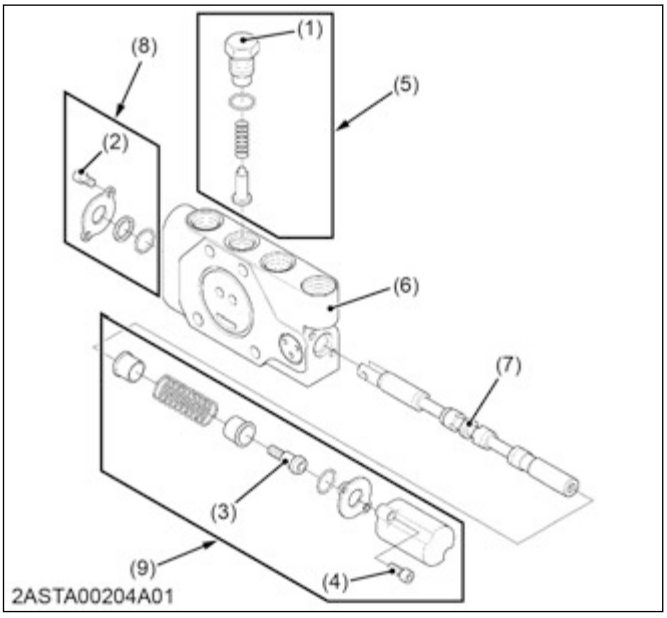


(1) Relief valve
(2) Relief valve
(3) Bolt
(4) Bolt
(5) Valve body
(6) Relief valve assembly
(7) Relief valve assembly
(8) Cap assembly
(9) Spool
(10) Cap assembly

Tightening torque

(1) Relief valve	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Relief valve	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(3) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-
(4) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-

4.2.2.11 Control valve travel RH section

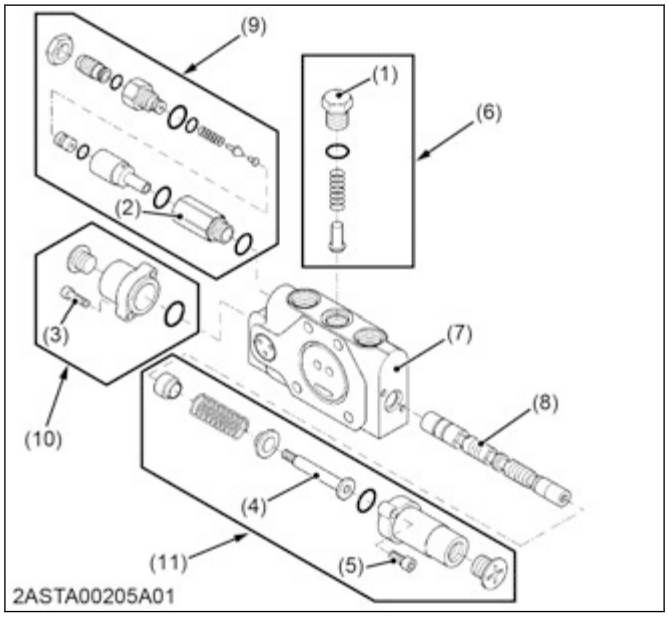


(1) Plug
(2) Bolt
(3) Bolt
(4) Bolt
(5) Plug assembly
(6) Valve body
(7) Spool
(8) Cover assembly
(9) Cap assembly

Tightening torque

(1) Plug	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-
(3) Bolt	3.92 to 4.90 N·m 0.40 to 0.50 kgf·m 2.89 to 3.61 lbf·ft	Thread lock
(4) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-

4.2.2.12 Control valve boom section

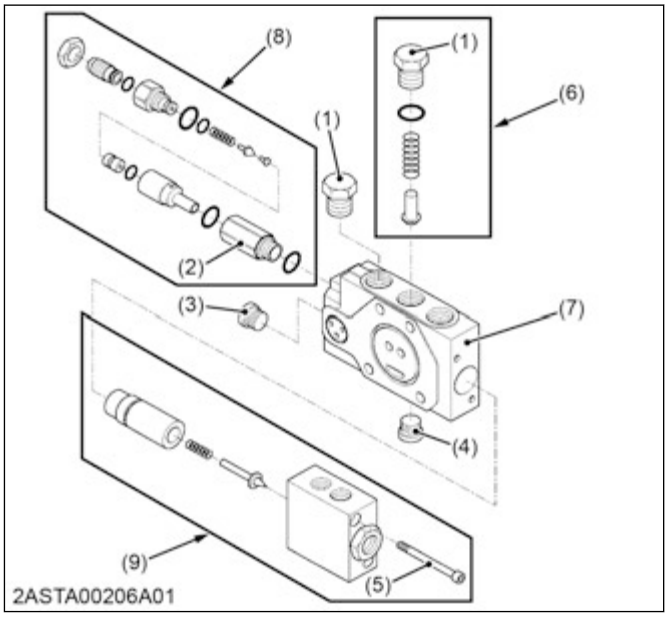


(1) Plug
(2) Adapter
(3) Bolt
(4) Bolt
(5) Bolt
(6) Plug assembly
(7) Valve body
(8) Spool
(9) Relief valve assembly
(10) Cap assembly
(11) Cap assembly

Tightening torque

(1) Plug	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Relief valve	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(3) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-
(4) Bolt	3.92 to 4.90 N·m 0.40 to 0.50 kgf·m 2.89 to 3.61 lbf·ft	Thread lock
(5) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-

4.2.2.13 Control valve boom lock section

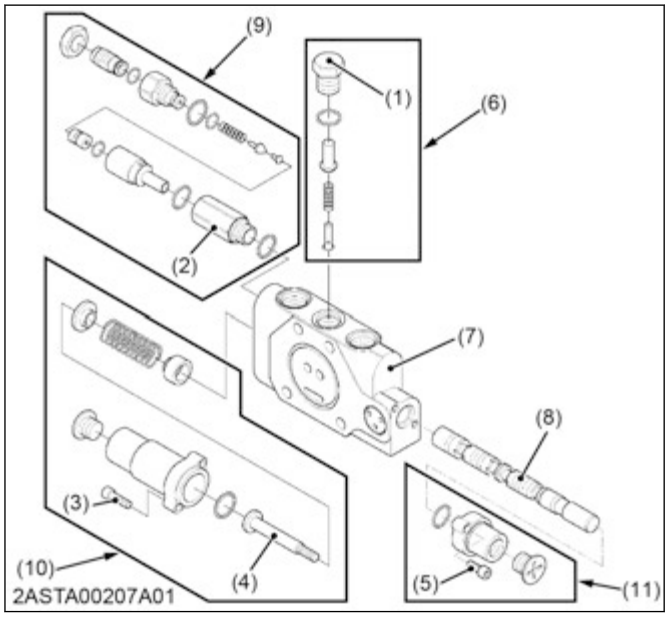


(1) Plug
(2) Adapter
(3) Bolt
(4) Bolt
(5) Bolt
(6) Plug assembly
(7) Valve body
(8) Relief valve assembly
(9) Boom lock valve case assembly

Tightening torque

(1) Plug	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Relief valve	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(3) Bolt	24.55 to 29.45 N·m 2.50 to 3.00 kgf·m 18.19 to 21.81 lbf·ft	-
(4) Bolt	17.61 to 18.59 N·m 1.80 to 1.90 kgf·m 12.94 to 13.66 lbf·ft	-
(5) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-

4.2.2.14 Control valve bucket section



(1) Plug
(2) Adapter
(3) Bolt
(4) Bolt
(5) Bolt
(6) Plug assembly
(7) Valve body
(8) Spool
(9) Relief valve assembly
(10) Cap assembly
(11) Cap assembly

Tightening torque

(1) Plug	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(2) Relief valve	37.24 to 41.16 N·m 3.8 to 4.2 kgf·m 27.45 to 30.35 lbf·ft	-
(3) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-
(4) Bolt	3.92 to 4.90 N·m 0.40 to 0.50 kgf·m 2.89 to 3.61 lbf·ft	Thread lock
(5) Bolt	5.88 to 6.86 N·m 0.60 to 0.70 kgf·m 4.34 to 5.06 lbf·ft	-

4.2.3 Disassembling and assembling control valve

■ IMPORTANT

- **Do not reuse removed O-rings, oil seals, seal rings, and dust seals for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

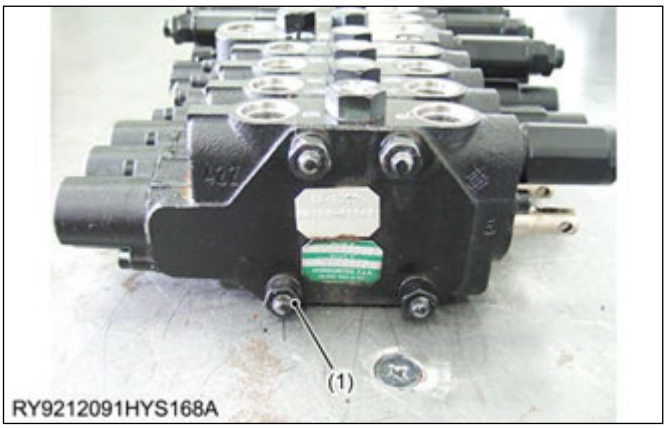
Disassembling

1. Remove the 4 nuts.

■ NOTE

- **Fix the nuts on the other side with a ring wrench.**

2. Remove the rods to disassemble each section.



(1) Nut

Assembling

■ IMPORTANT

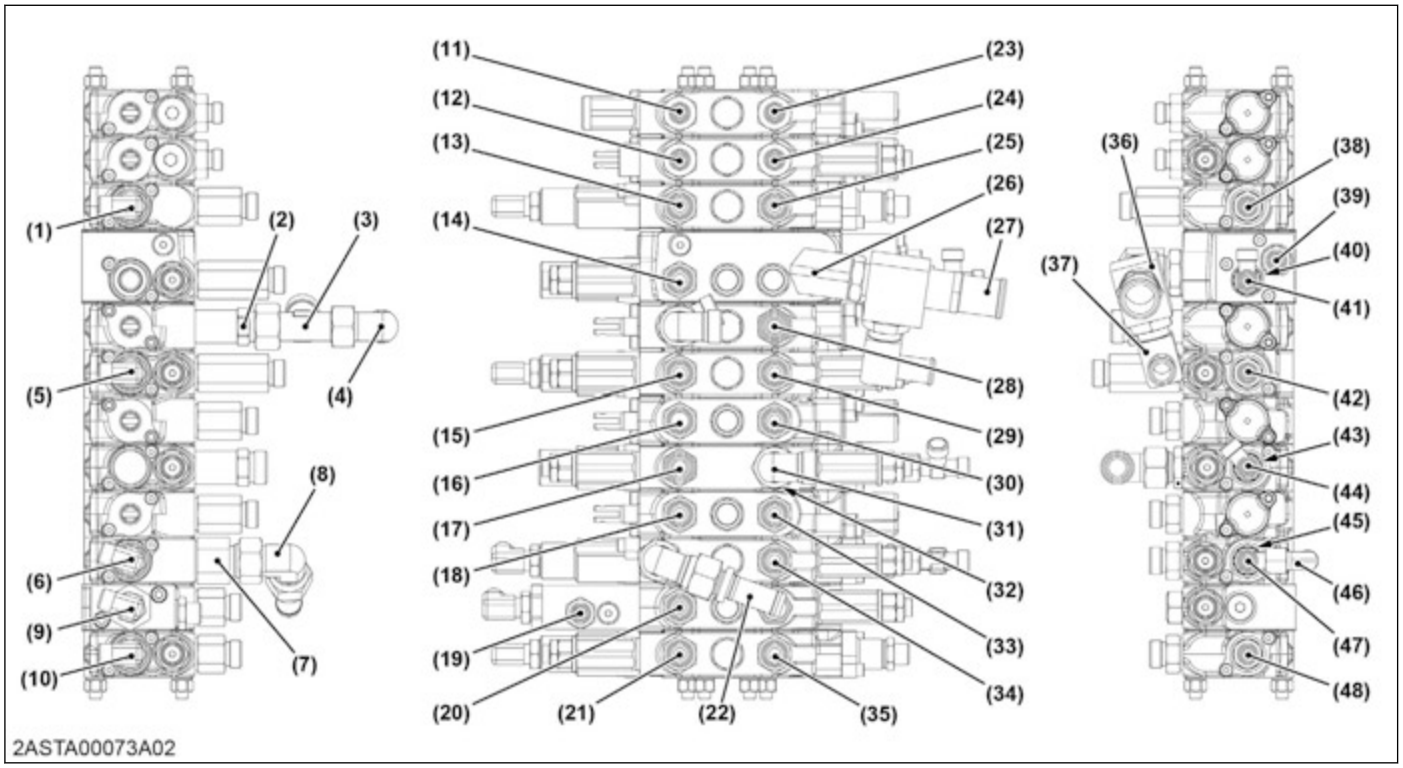
- **To avoid distortion by assembling, alternately tighten the nuts in diagonal direction, separate the tightening into 2 or 3 times and tighten each nut evenly.**

Tightening torque

(1) Nut	16.6 to 17.6 N·m 1.7 to 1.8 kgf·m 12.3 to 13.0 lbf·ft	-

4.2.4 Installing adapter layout for control valve

Basic

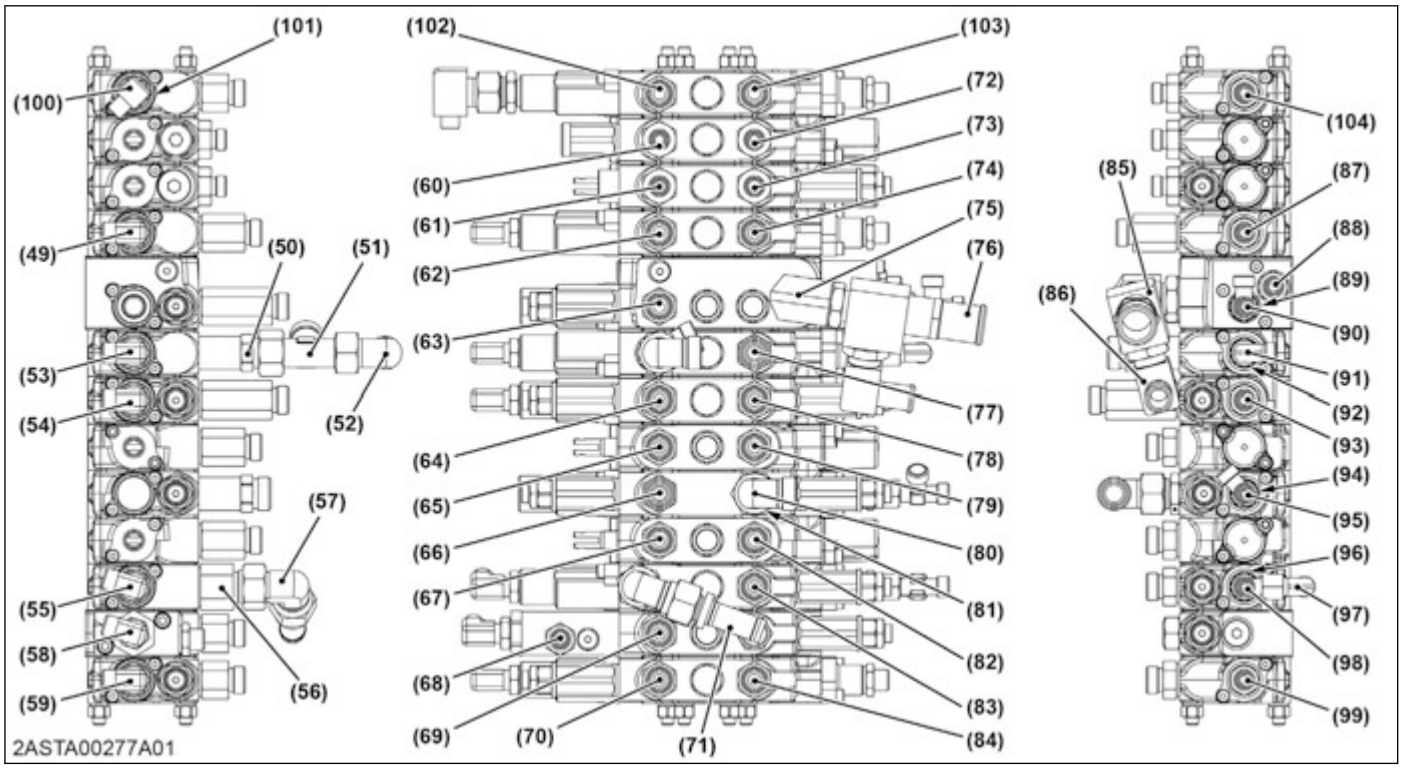


Adapter No.	Adapter size	Angle	Adapter No.	Adapter size	Angle
(1)	G1/4-M14	-	(25)	G3/8-M18	-
(2)	G3/8-M22	-	(26)	G1/2-G1/2	8°
(3)	M22-M22-M22	25°	(27)	G1/2-ϕ25 (check valve)	-
(4)	M22-M22	-	(28)	G3/8-M22	-
(5)	G1/4-M14	-	(29)	G3/8-M18	-
(6)	G1/4-M14	17°	(30)	G3/8-M18	-
(7)	G1/2-M22	-	(31)	M22-M22	-
(8)	M22-M22	20°	(32)	G3/8-M22	-
(9)	G1/4-M14	17°	(33)	G3/8-M18	-
(10)	G1/4-M14	-	(34)	G3/8-M18	-
(11)	G3/8-M14	-	(35)	G3/8-M18	-
(12)	G3/8-M14	-	(36)	G1/2-G1/2-G1/2	15°
(13)	G3/8-M18	-	(37)	G1/2-ϕ15.9	-
(14)	G3/8-M18	-	(38)	G1/4-M14	-
(15)	G3/8-M18	-	(39)	G1/4-M14	-
(16)	G3/8-M18	-	(40)	G1/4-M14	-
(17)	G3/8-M22	-	(41)	M14-M14-M14	-
(18)	G3/8-M18	-	(42)	G1/4-M14	-
(19)	G1/4-M14	-	(43)	G1/4-M14	-
(20)	G3/8-M18	-	(44)	M14-M14-M14	50°

(Continued)

Adapter No.	Adapter size	Angle	Adapter No.	Adapter size	Angle
(21)	G3/8-M18	-	(45)	G1/4-M14	-
(22)	M22-ϕ16.2	-	(46)	M14-M14	-
(23)	G3/8-M14	-	(47)	M14-M14-M14	-
(24)	G3/8-M14	-	(48)	G1/4-M14	-

Hi-spec



Adapter No.	Adapter size	Angle	Adapter No.	Adapter size	Angle
(49)	G1/4-M14	-	(77)	G3/8-M22	-
(50)	G3/8-M22	-	(78)	G3/8-M18	-
(51)	M22-M22-M22	25°	(79)	G3/8-M18	-
(52)	M22-M22	-	(80)	M22-M22	-
(53)	G1/4-M14	-	(81)	G3/8-M22	-
(54)	G1/4-M14	-	(82)	G3/8-M18	-
(55)	G1/4-M14	17°	(83)	G3/8-M18	-
(56)	G1/2-M22	-	(84)	G3/8-M18	-
(57)	M22-M22	20°	(85)	G1/2-G1/2-G1/2	15°
(58)	G1/4-M14	17°	(86)	G1/2-ϕ15.9	-
(59)	G1/4-M14	-	(87)	G1/4-M14	-
(60)	G3/8-M14	-	(88)	G1/4-M14	-
(61)	G3/8-M14	-	(89)	G1/4-M14	-
(62)	G3/8-M18	-	(90)	M14-M14-M14	-
(63)	G3/8-M18	-	(91)	G1/4-M14	-

(Continued)

Adapter No.	Adapter size	Angle	Adapter No.	Adapter size	Angle
(64)	G3/8-M18	-	(92)	M14-M14	-
(65)	G3/8-M18	-	(93)	G1/4-M14	-
(66)	G3/8-M22	-	(94)	G1/4-M14	-
(67)	G3/8-M18	-	(95)	M14-M14-M14	50°
(68)	G1/4-M14	-	(96)	G1/4-M14	-
(69)	G3/8-M18	-	(97)	M14-M14	-
(70)	G3/8-M18	-	(98)	M14-M14-M14	-
(71)	M22-ϕ16.2	-	(99)	G1/4-M14	-
(72)	G3/8-M14	-	(100)	M14-M14	40°
(73)	G3/8-M14	-	(101)	G1/4-M14	-
(74)	G3/8-M18	-	(102)	G3/8-M18	-
(75)	G1/2-G1/2	8°	(103)	G3/8-M18	-
(76)	G1/2-ϕ25 (check valve)	-	(104)	G1/4-M14	-

4.3 Swivel motor

4.3.1 Removing and installing the swivel motor

CAUTION

- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

IMPORTANT

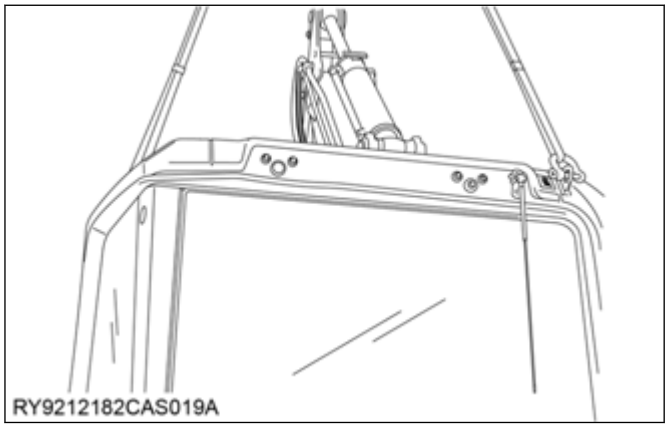
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing

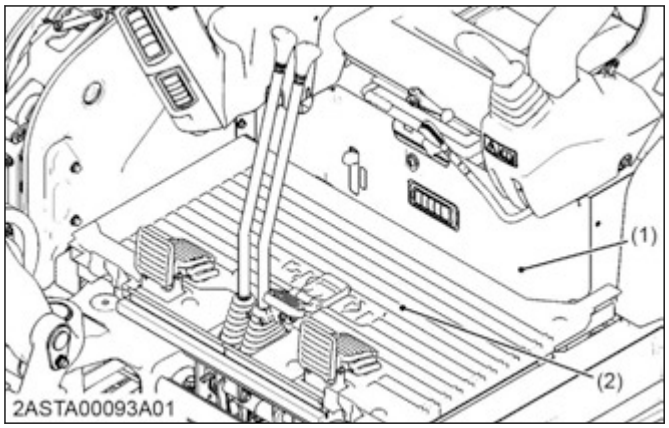
1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

Removing

1. Remove the canopy or cabin.

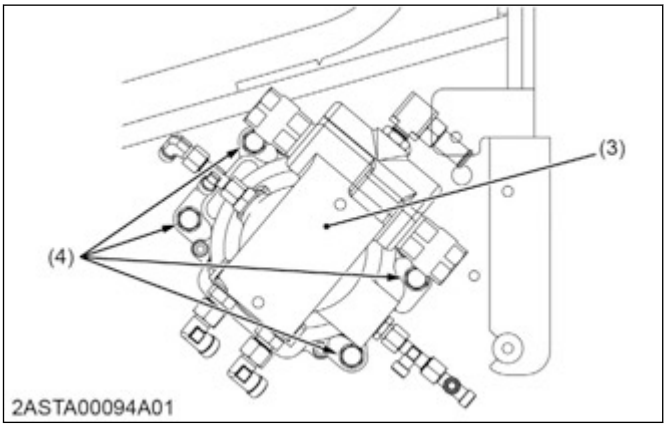


2. Remove the step and cover.



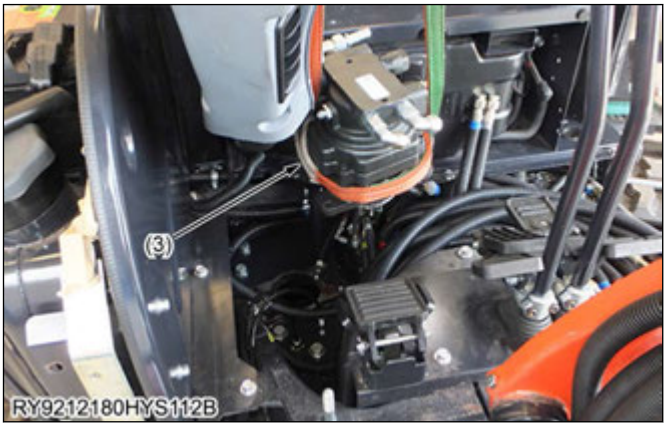
(1) Cover (2) Step

3. Disconnect the hydraulic hoses from swivel motor.
4. Remove 4 bolts.



(3) Swivel motor (4) Bolt (M12 × 40) ×4

5. Attach a nylon sling and hoist the swivel motor to remove.



(3) Swivel motor

Mass

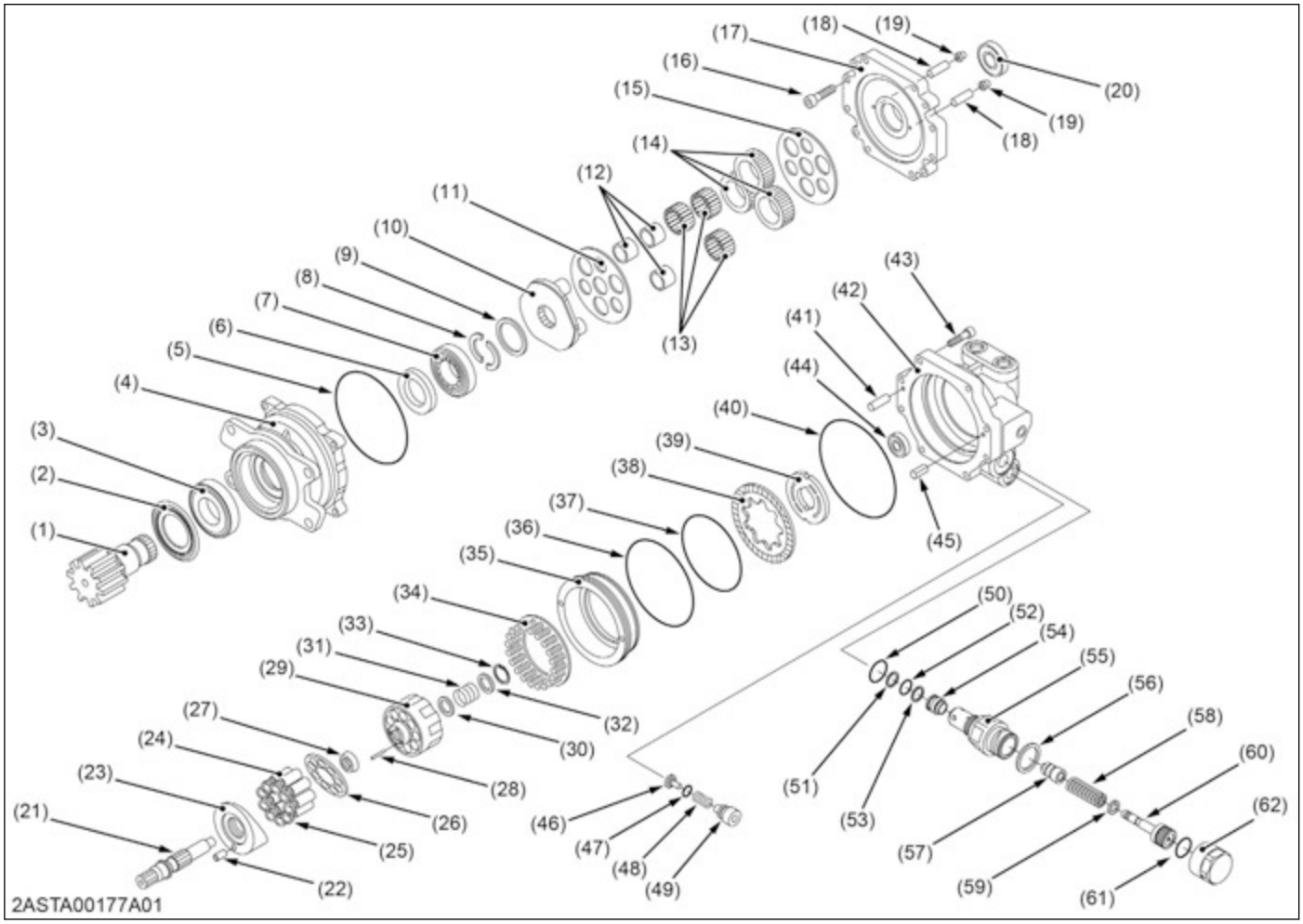
(3) Swivel motor	Approximately 23 kg Approximately 51 lbs

Installing

Tightening torque

(4) Bolt	103.0 to 117.7 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 lbf·ft	Thread lock (Loctite 301-70)

4.3.2 Swivel motor components



(1) Pinion shaft
(2) Ring seal
(3) Bearing
(4) Gear case
(5) O-ring
(6) Oil seal
(7) Bearing
(8) Preload collar ×2
(9) Ring
(10) Holder
(11) Thrust plate
(12) Collar ×3
(13) Needle ×54
(14) Planetary gear ×3
(15) Thrust plate
(16) Cap bolt ×4
(17) Plate
(18) Pin ×2
(19) Filter ×2
(20) Bearing
(21) Shaft
(22) Pin
(23) Swash plate
(24) Piston ×9
(25) Shoe ×9
(26) Retainer plate
(27) Retainer holder
(28) Pin ×3
(29) Cylinder block
(30) Spring washer
(31) Spring
(32) Spring washer
(33) Internal circlip
(34) Spring
(35) Brake piston
(36) O-ring
(37) O-ring
(38) Friction plate
(39) Valve plate
(40) O-ring
(41) Pin
(42) Housing
(43) Cap bolt ×4
(44) Bearing
(45) Spring pin
(46) Check valve ×2
(47) O-ring ×2
(48) Spring ×2
(49) Plug ×2
(50) O-ring ×2
(51) Buckup ring ×2
(52) O-ring ×2
(53) Buckup ring ×2
(54) Seat ×2
(55) Retainer ×2
(56) O-ring ×2
(57) Poppet ×2
(58) Spring ×2
(59) Spacer ×2
(60) Piston ×2
(61) O-ring ×2
(62) Cap ×2

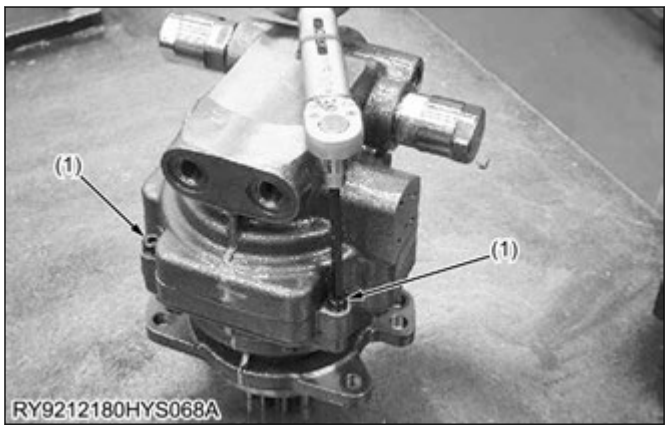
4.3.3 Disassembling the swivel motor

■ IMPORTANT

- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**

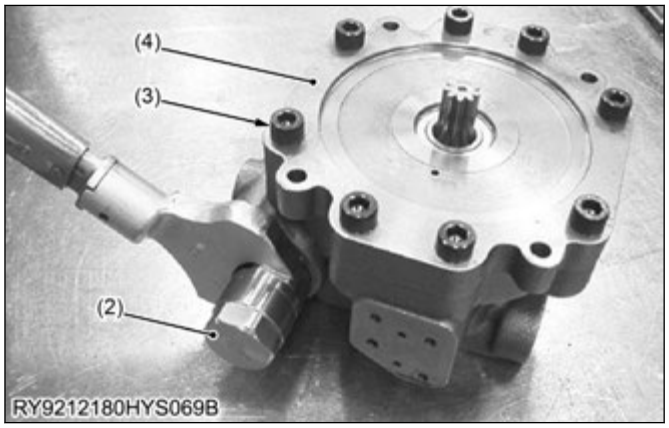
Disassembling swivel motor

1. Remove the 4 cap bolts and the swivel motor assembly from the gear case.



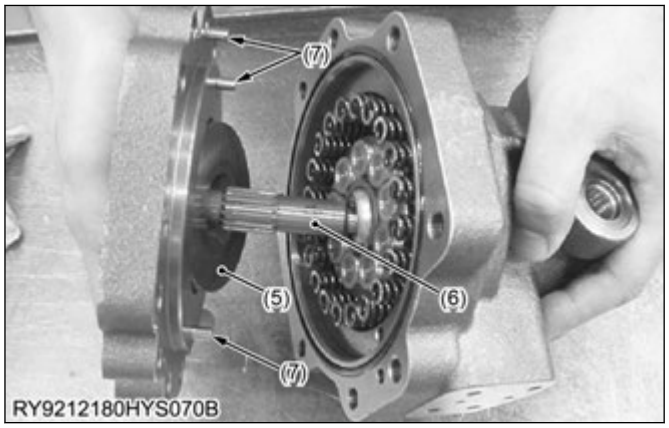
(1) Bolt ×4

2. Remove the relief valve assembly, 8 cap bolts and plate S.



(2) Relief valve assembly
(3) Bolt ×8
(4) Plate S

3. Remove the swash plate and shaft assembly.

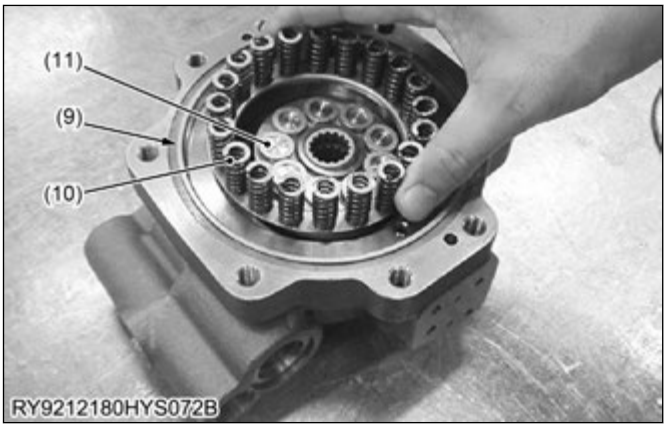


(5) Swash plate
(6) Shaft assembly
(7) Pin

4. Remove 2 filters and 3 pins.

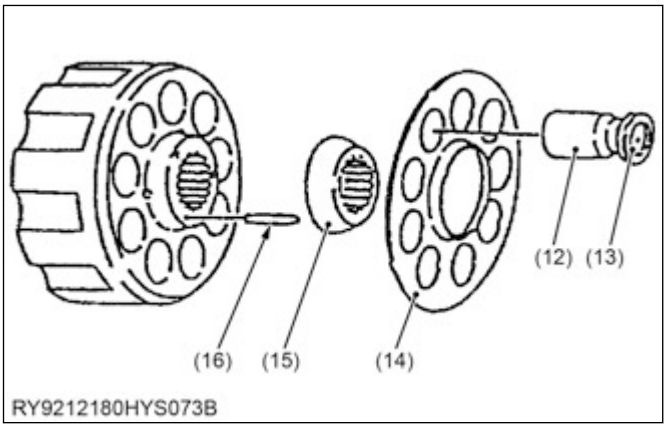
(8) Filter ×2

5. Remove the O-ring, spring assembly, and cylinder block assembly in order.



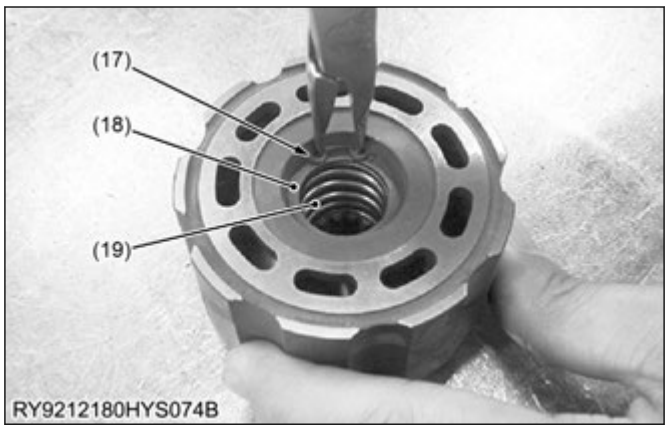
(9) O-ring
(10) Spring assembly
(11) Cylinder block assembly

6. Disassemble the cylinder block assembly.



(12) Piston
(13) Shoe
(14) Shoe holder
(15) Cylinder block holder
(16) Pin

7. Remove the circlip, retainer, and spring.



(17) Circlip
(18) Retainer
(19) Spring

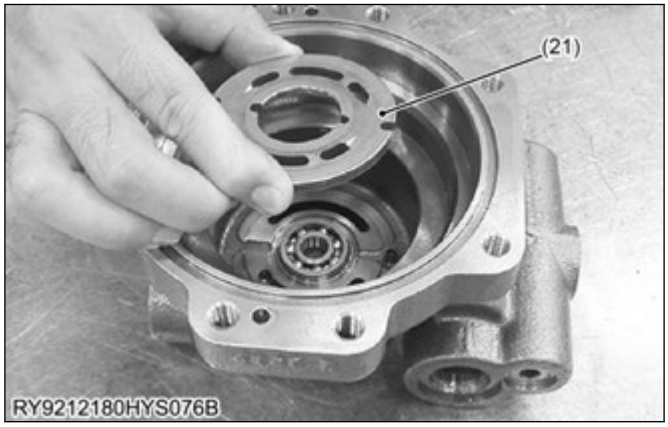
8. Remove the brake piston and O-ring.

CAUTION
- **Hold brake piston with hand to avoid brake piston from popping out.**

NOTE
- **Blow air through the port PP to remove brake piston.**

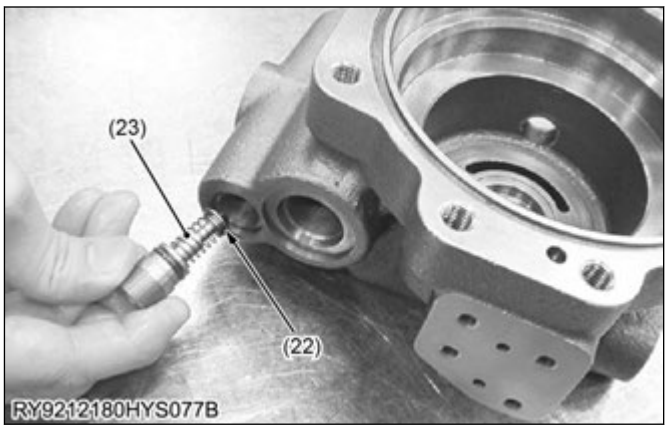
(20) Brake piston

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



(21) Valve plate

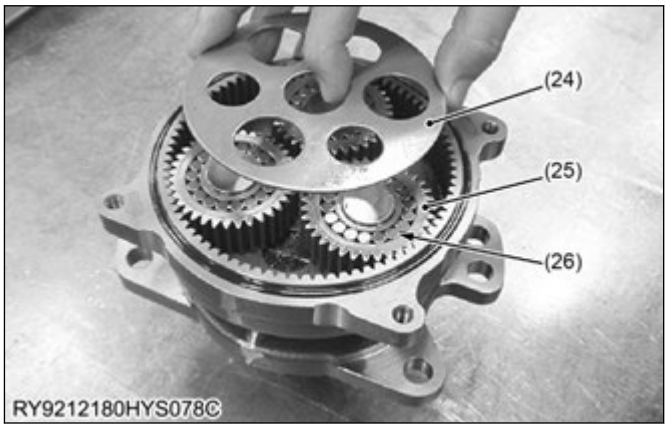
10. Remove the check valve and spring.



(22) Check valve
(23) Spring

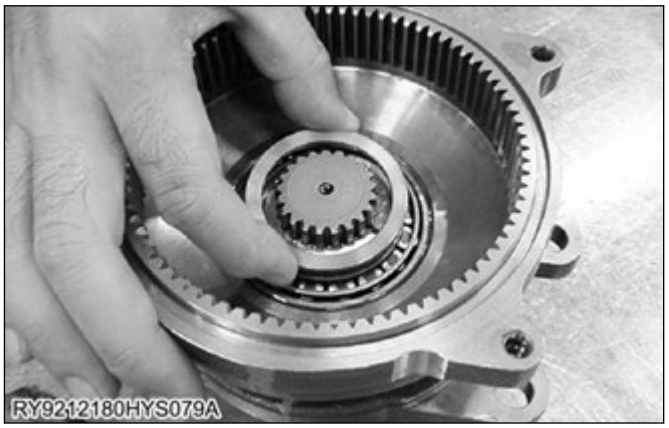
Disassembling gear case

1. Remove the thrust plate planetary gear, and needle bearing.



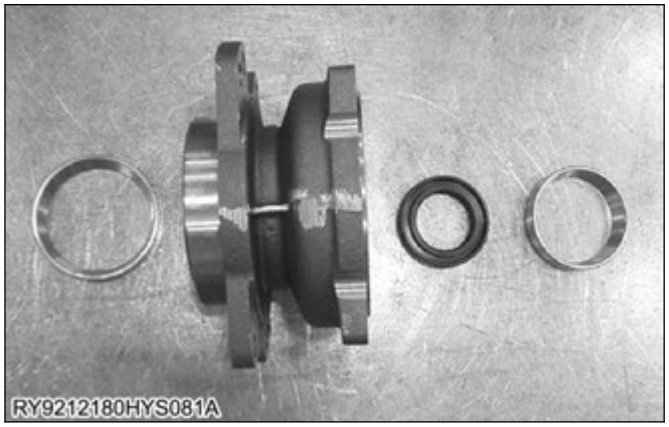
(24) Thrust plate
(25) Planetary gear
(26) Needle bearing

2. Remove the ring and collar.

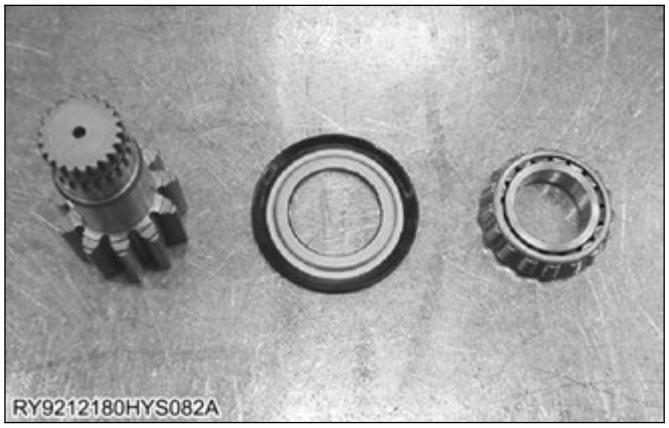


3. Remove the pinion shaft.

4. Remove the outer bearing and oil seal.



5. Remove the inner bearing and ring seal.



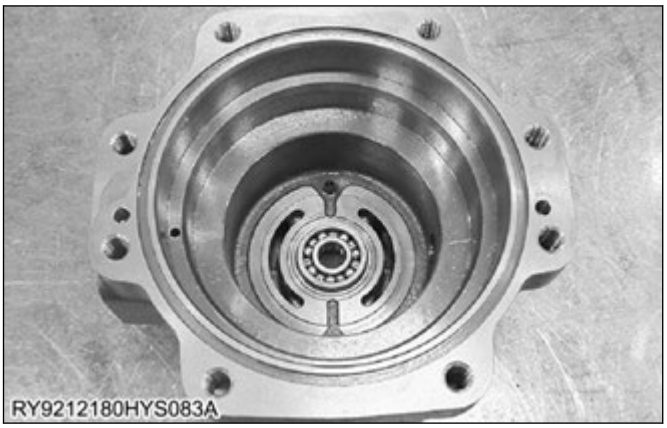
4.3.4 Assembling the swivel motor

■ IMPORTANT

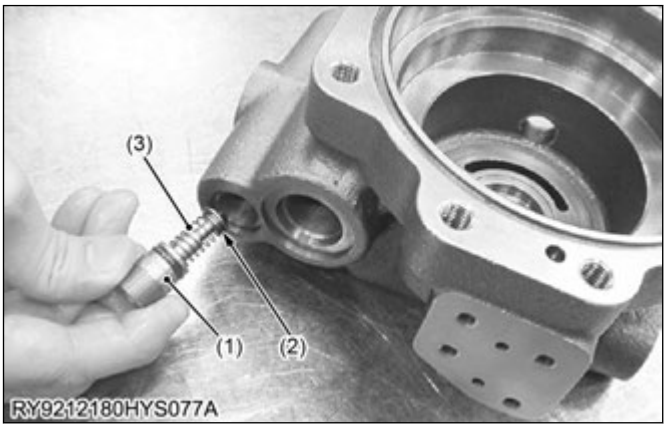
- **Do not reuse removed O-rings, oil seals, and seal rings for assembling to avoid oil leakage.**
- **Do not reuse removed bearings.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

Assembling swivel motor

1. Install the bearing on the housing.



2. Install the check valve, spring and plug.



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

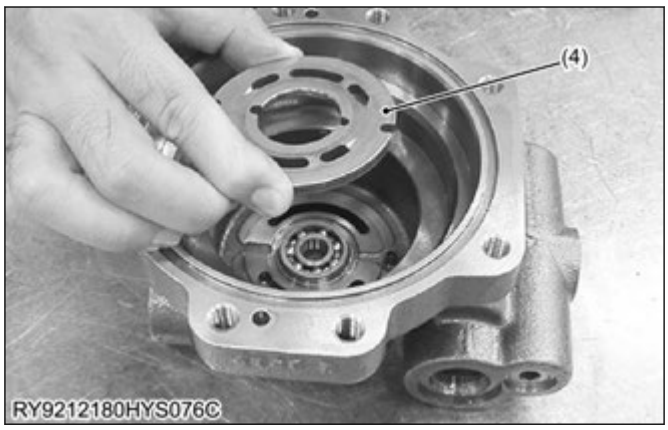
Tightening torque

(1) Plug	58.8 N·m 6.0 kgf·m 43.4 lbf·ft	-

3. Install the valve plate.

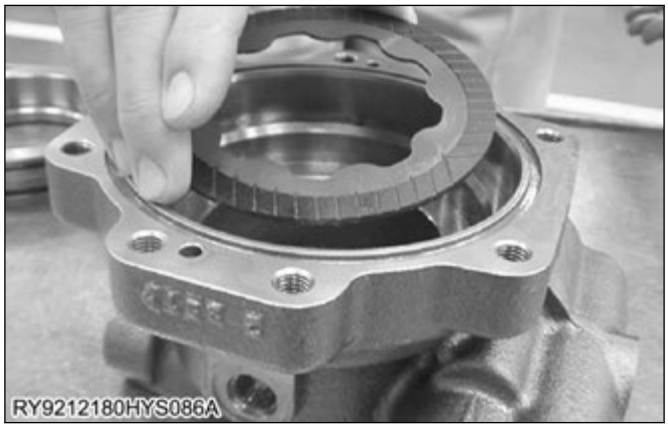
■ IMPORTANT

- **Iron surface of the valve plate is facing to the inlet and outlet ports of the housing.**
- **Brass surface of the valve plate is facing to the cylinder block.**

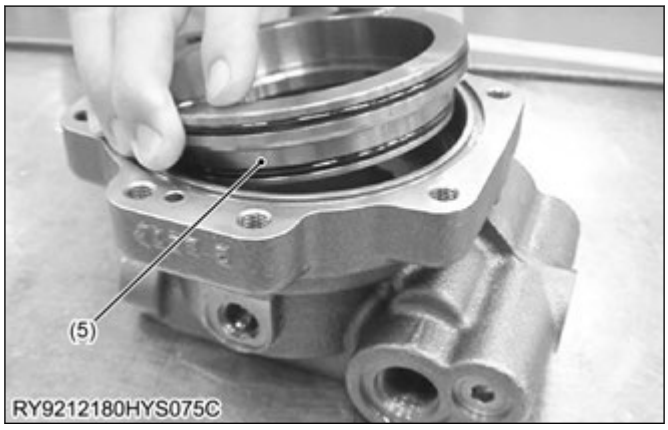


(4) Valve plate

4. Install the disc plate.

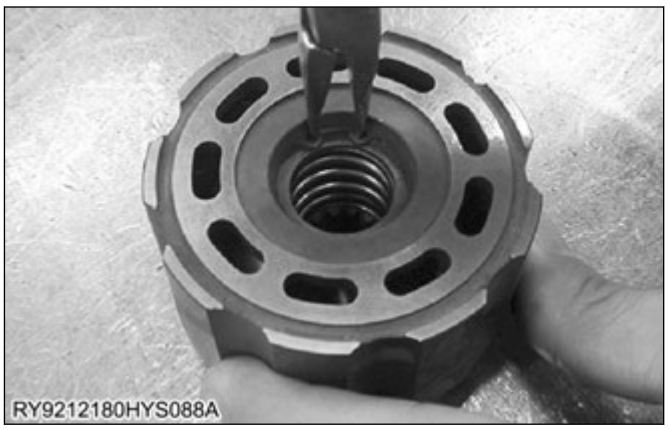


5. Install the brake piston assembly.

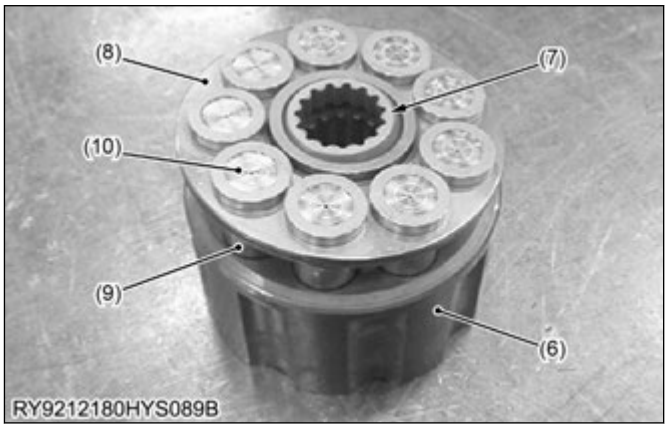


(5) Brake piston assembly

6. Install the retainer and spring C on the cylinder block and fix them with the circlip.

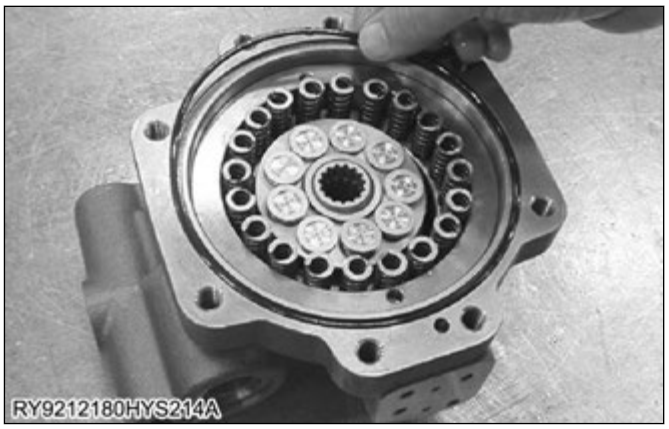


7. Install three pins, cylinder block holder, and shoe holder on the cylinder block.

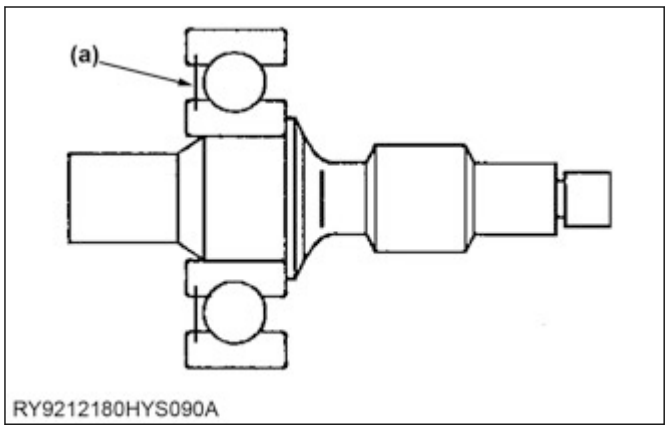


(6) Cylinder block
(7) Cylinder block holder
(8) Shoe holder
(9) Piston
(10) Shoe

8. Install the cylinder block assembly, spring assembly, and O-ring.



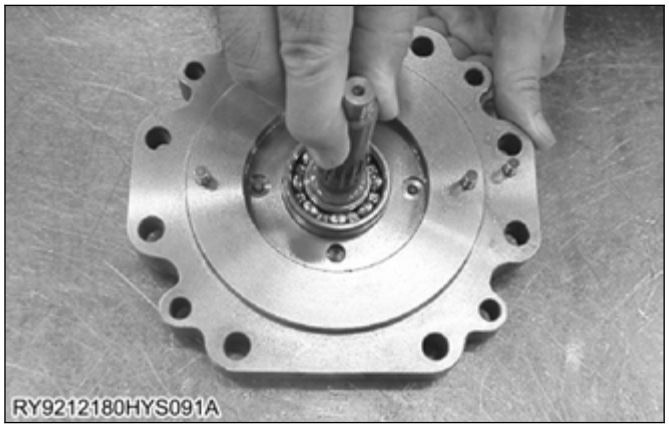
9. Install the bearing into the shaft.

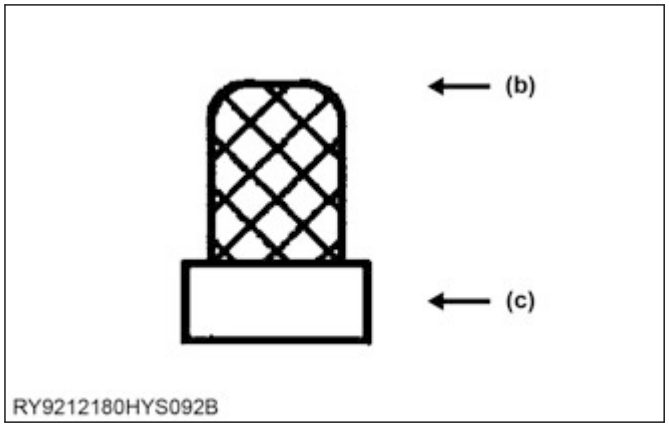


(a) Shield side

10. Install 2 filters and shaft assembly on the plate S.

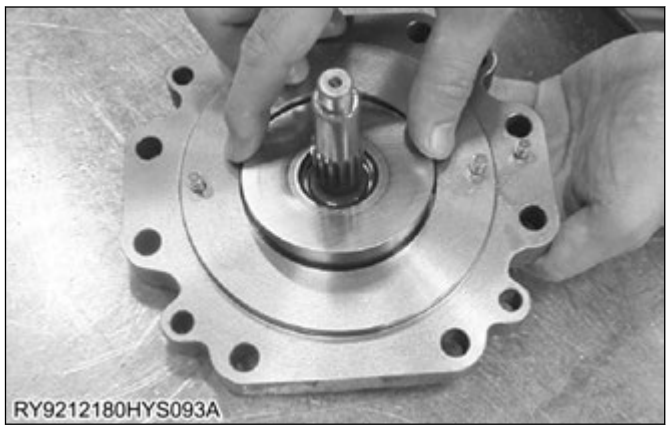
IMPORTANT
- **Install the filter in correct direction.**



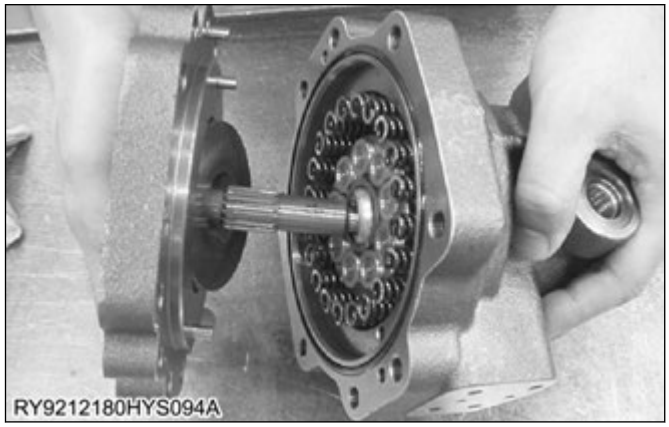


(b) Inserting hole side (c) Inserting hole back side

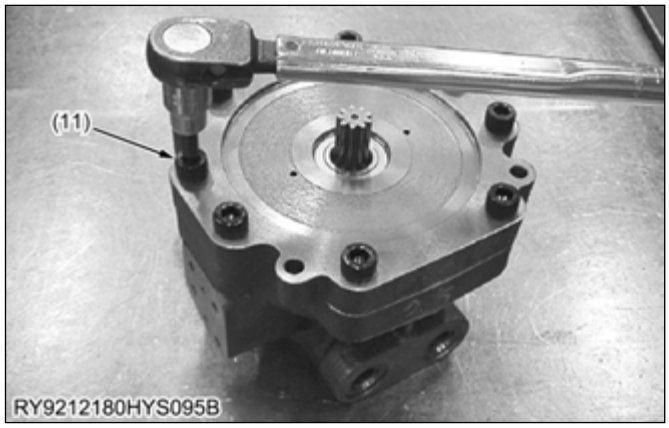
11. Install the swash plate.



12. Assemble the housing and plate S.



13. Install the 8 cap bolts.

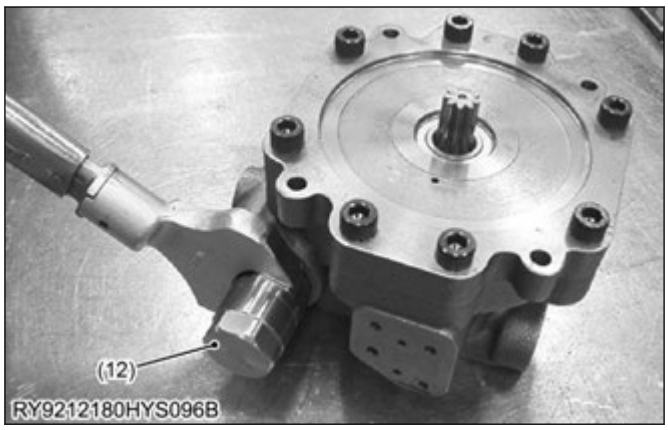


(11) Bolt (M10 × 35) ×8

Tightening torque

(11) Bolt	59 N·m 6.0 kgf·m 44 lbf·ft	-

14. Install the relief valve.



(12) Relief valve

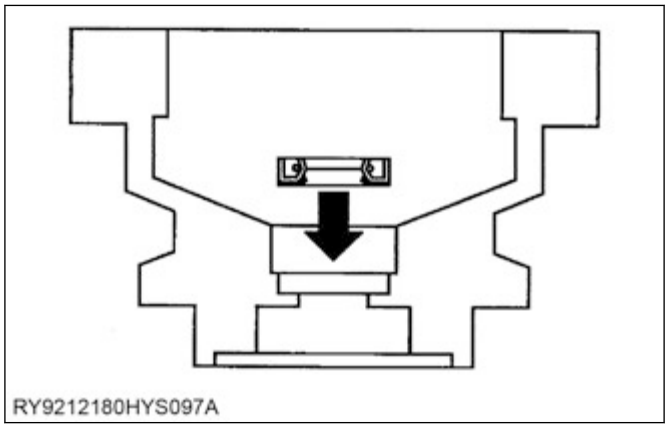
Tightening torque

(12) Relief valve	147 N·m 15 kgf·m 108 lbf·ft	-

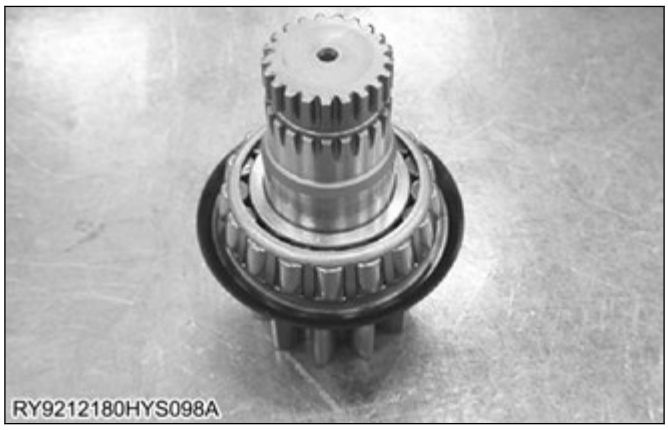
Assembling the gear case

1. Install the oil seal.

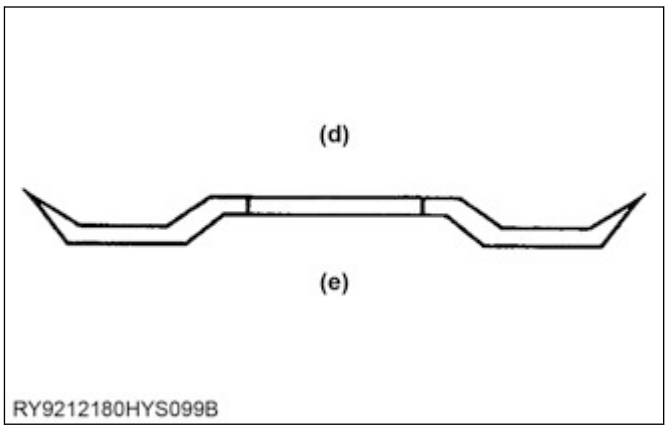
IMPORTANT
- **Install the oil seal in correct direction.**



2. Install the ring seal on the pinion shaft.



IMPORTANT
- **Install the ring seal in correct direction.**



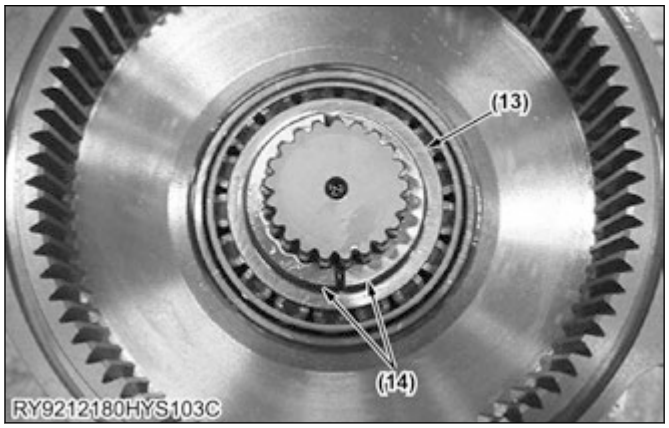
(d) Bearing side (e) Pinion hole

3. Install the outer bearing into the housing.

4. Install the outer bearing into the housing.

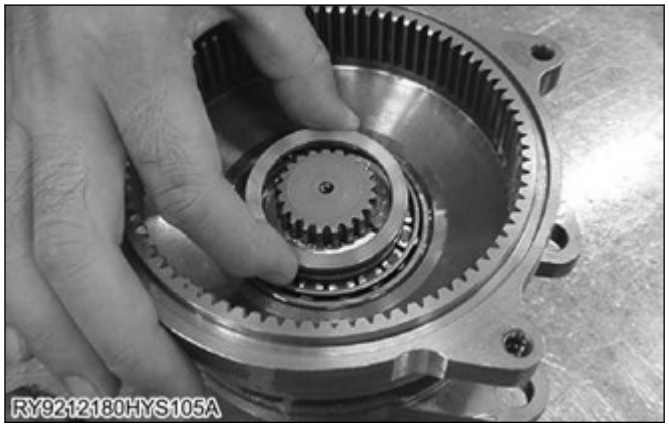
5. Put grease into the bearing section of the housing. Insert the pinion shaft into the housing.

6. Turn the housing over and install the inner bearing. Install the collar.

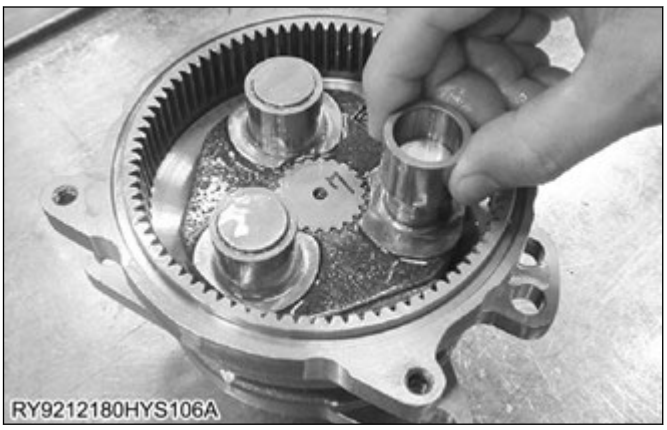


(13) Inner bearing (14) Collar

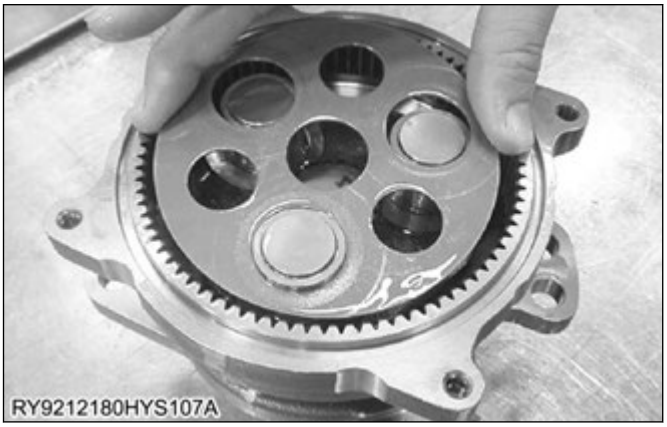
7. Install the ring.



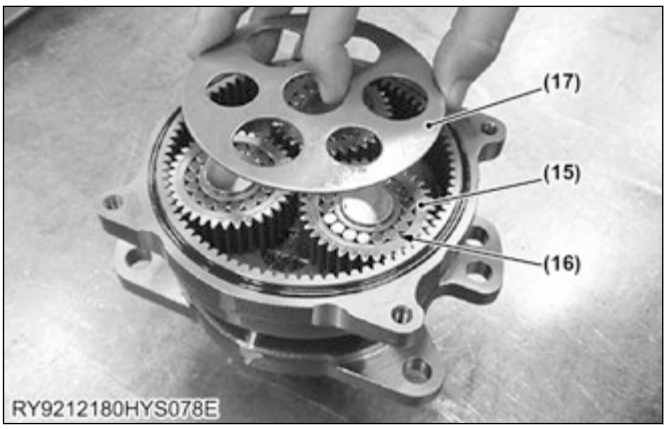
8. Install the carrier 1 and the 3 rings on the shaft.



9. Install the thrust plate.



10. Install the planetary gear and the 3 needles on the shaft. Install the thrust plate.

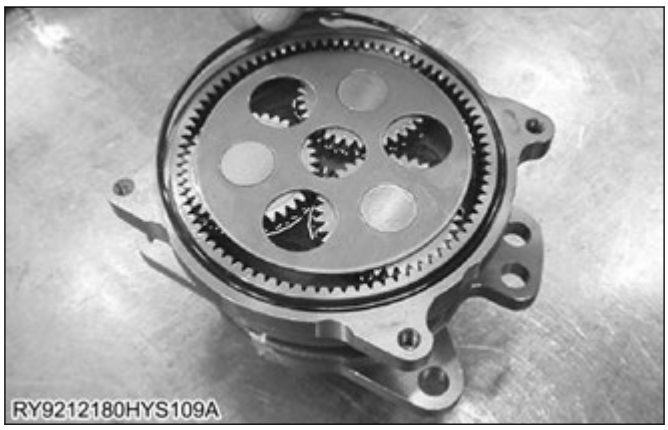


(15) Planetary gear (17) Thrust plate
(16) Needle

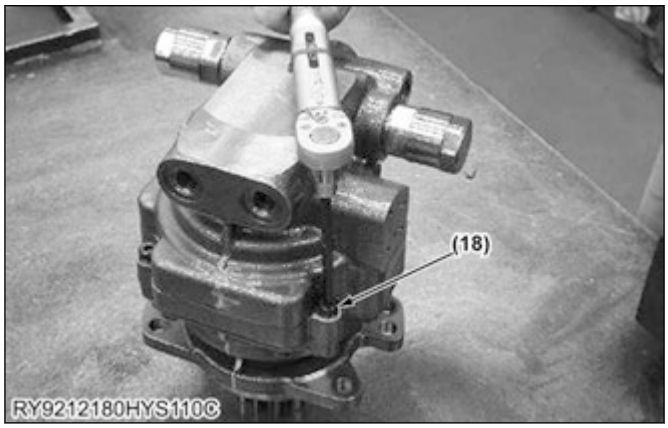
11. Replenish the hydraulic oil into the housing up to 3 to 4 mm below from the top of the thrust plate. Install the O-ring.

■ IMPORTANT

- **Remove hydraulic oil from the contact surface of the thrust plate in case that the oil adheres.**



12. Install the swivel motor on the gear case with the 4 cap bolts.

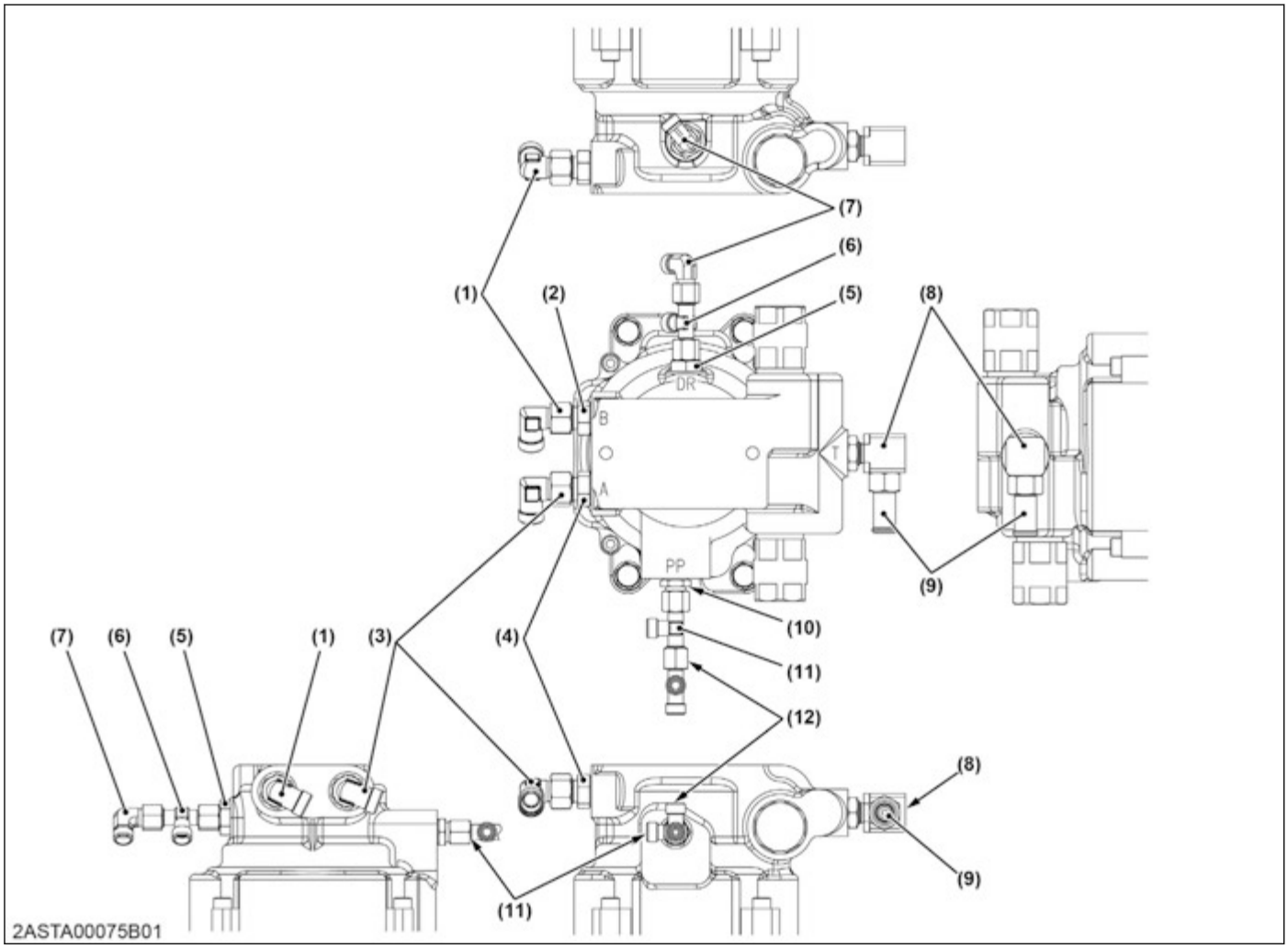


(18) Bolt (M8 × 35) ×4

Tightening torque

(18) Bolt	29 N·m 3.0 kgf·m 22 lbf·ft	Thread lock (Three Bond 1305 or equivalent)

4.3.5 Installing adapter layout for the swivel motor



Adapter No.	Adapter size	Angle	Remarks
(1)	M18-M18	27°	-
(2)	G3/8-M18	-	-
(3)	M18-M18	20°	-
(4)	G3/8-M18	-	-
(5)	G3/8-M14	-	-
(6)	M14-M14-M14	50°	-
(7)	M14-M14	50°	-
(8)	G3/8-G3/8	-	-
(9)	G3/8-ϕ16	-	-
(10)	G1/4-M14	-	-
(11)	M14-M14-M14	-	-
(12)	M14-M14-M14	45°	Hi-spec only

4.4 Travel motor

4.4.1 Removing and installing the travel motor

CAUTION

- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**
- **Put the machine on the jack stands securely when lifting the machine.**
- **Do not work underneath when the machine is jacked up.**
- **Keep hands and body away from the rotating track.**
- **To avoid from having a direct high pressure release of the grease,**
  - **Do not stand in front of the grease fitting.**
  - **Loosen the grease fitting slowly.**

IMPORTANT

- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

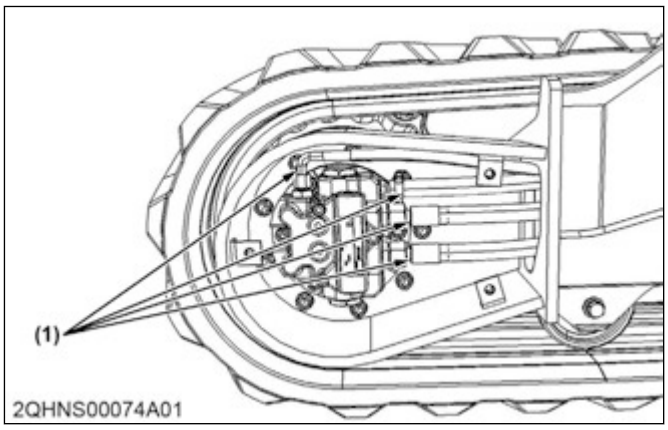
Preparing

1. Remove the track.

2. Jack up the machine and support with the support block or stand.
3. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

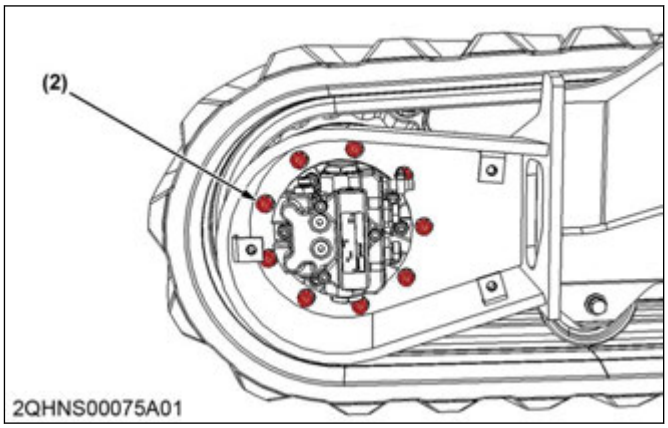
Removing

1. Remove 3 bolts.
2. Remove the cover.
3. Remove four hydraulic hoses.



(1) Hydraulic hose

4. Attach a nylon sling and hoist the travel motor for support.
5. Remove 9 bolts.



(2) Bolt (M12 × 30) ×9

6. Hoist the travel motor to remove. Place to level ground.

(3) Nylon sling
(4) Sprocket
(5) Bolt (M12 × 30) ×9
(6) Travel motor

7. Remove 9 bolts.
8. Remove the sprocket.

Mass

(6) Travel motor	Basic specification	Approximately 42 kg Approximately 93 lbs
	Hi-spec	Approximately 32 kg Approximately 71 lbs

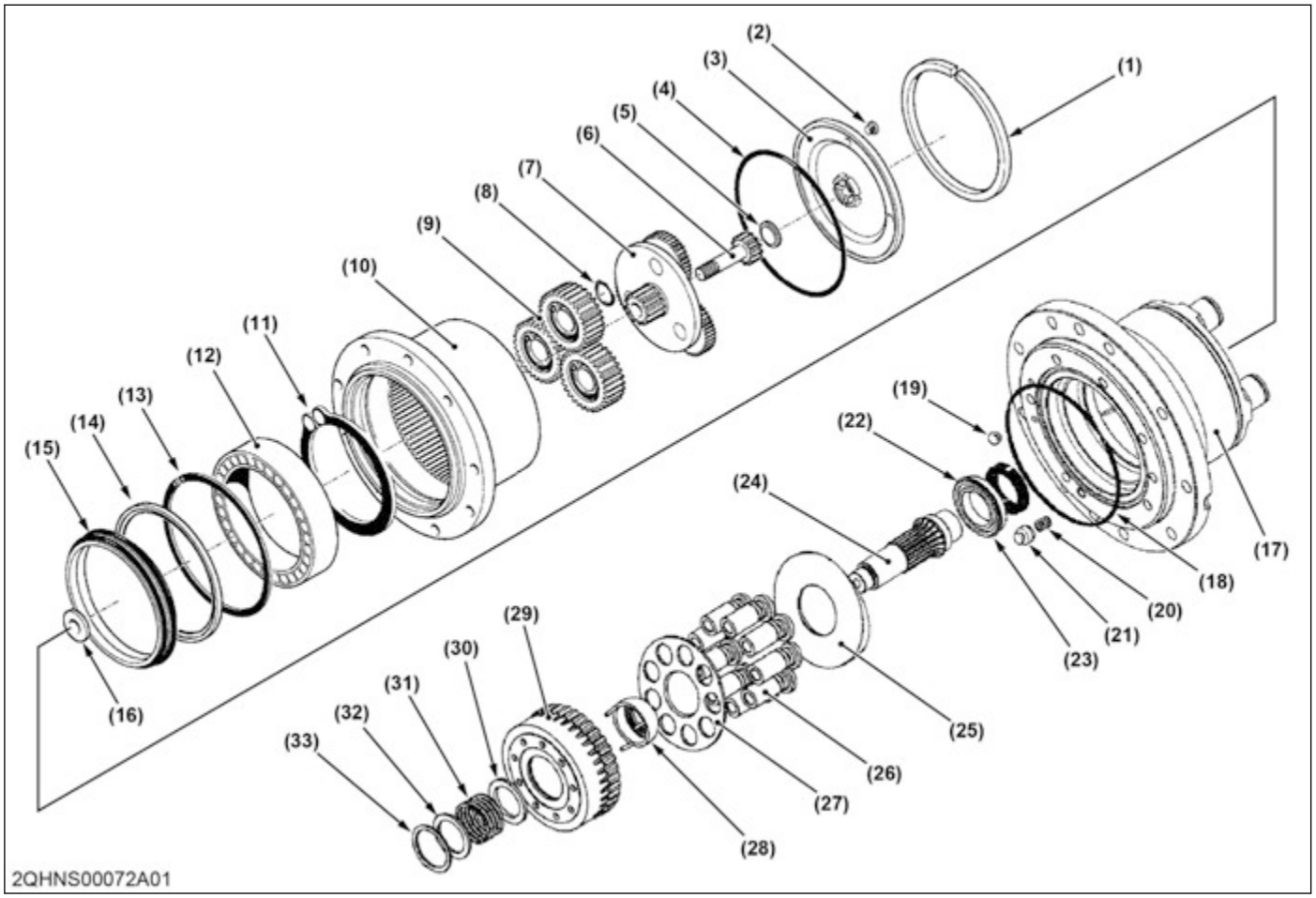
Installing

Tightening torque

(2) (5) Bolt	103.0 to 117.7 N·m 10.5 to 12.0 kgf·m 75.9 to 86.8 lbf·ft	Thread lock (Loctite 301-70)

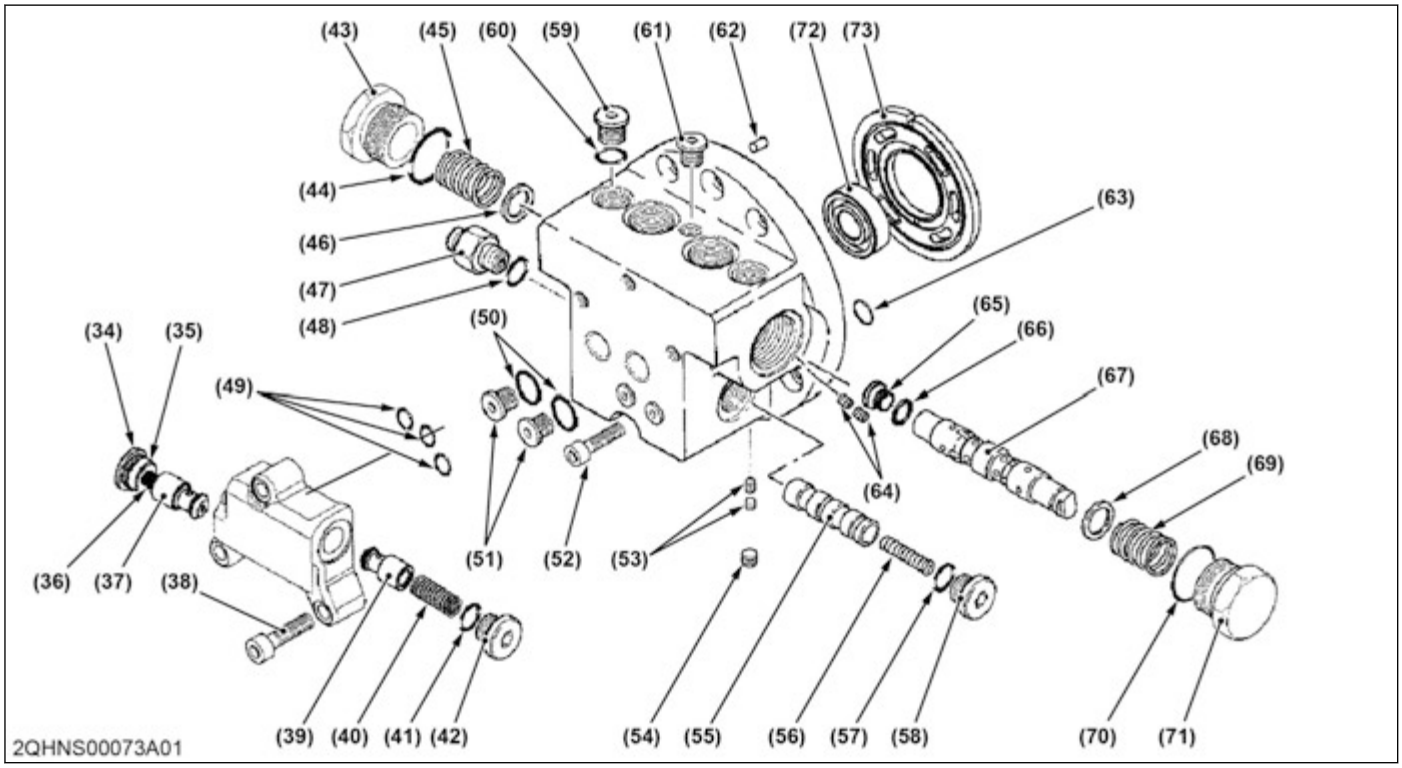
4.4.2 Travel motor components

Gear case



(1) External circlip
(2) Plug with o-ring
(3) Cover
(4) O-ring
(5) Pad
(6) Drive gear
(7) Gear assembly
(8) External circlip
(9) Planetary gear
(10) Gear case
(11) External circlip
(12) Bearing
(13) External circlip
(14) Spacer
(15) Gasket
(16) Centering ring
(17) Flange holder
(18) O-ring
(19) Steel ball
(20) Spring
(21) Piston
(22) Oil seal
(23) Ball bearing
(24) Shaft
(25) Swash plate
(26) Piston
(27) Retainer plate
(28) Retainer holder
(29) Cylinder block
(30) Spring washer
(31) Spring
(32) Spring washer
(33) Internal circlip

Motor



(34) Plug
(35) O-ring
(36) Anti-cavitation spring
(37) Poppet
(38) Cap bolt
(39) Poppet
(40) Anti-cavitation spring
(41) O-ring
(42) Plug
(43) Plug
(44) O-ring
(45) Spring
(46) Spring washer
(47) Adapter
(48) O-ring
(49) O-ring
(50) O-ring
(51) Plug
(52) Cap bolt
(53) Oriffice
(54) Plug
(55) Speed switching spool
(56) Speed switching spring
(57) O-ring
(58) Plug
(59) Plug
(60) O-ring
(61) Plug
(62) Parallel pin
(63) O-ring
(64) Oriffice
(65) Plug
(66) O-ring
(67) Counterbalance plunger
(68) Spring washer
(69) Spring
(70) O-ring
(71) Plug
(72) Ball bearing
(73) Valve plate

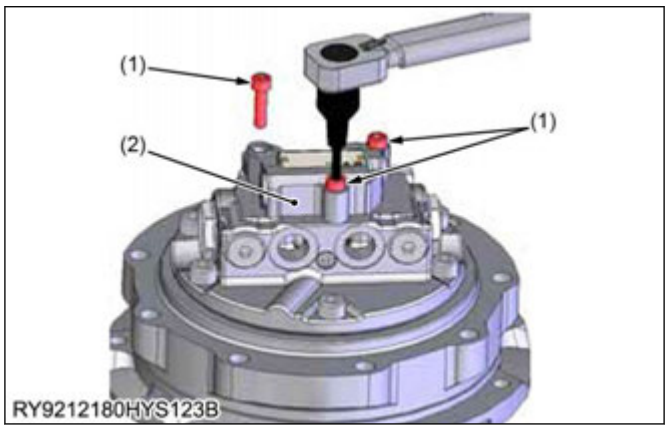
4.4.3 Disassembling the travel motor

IMPORTANT

- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**

Disassembling the motor

1. Remove the cap bolts.
2. Remove the valve assembly.

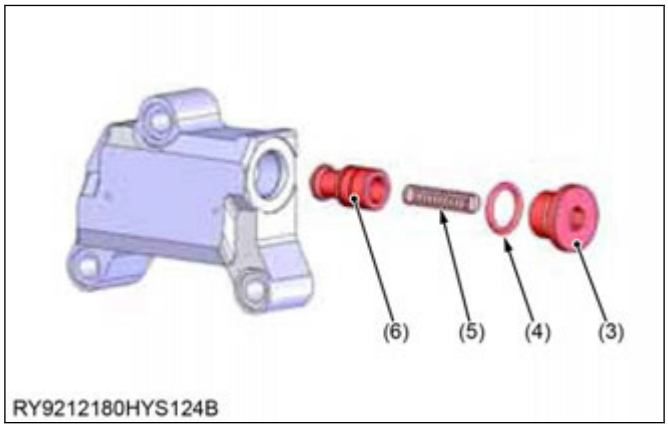


(1) Cap bolt (M6 × 25) ×3 (2) Valve assembly

3. Remove the plug, spring and check valve.

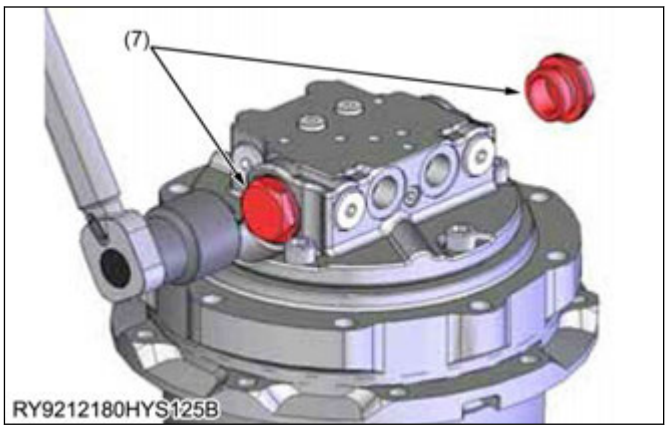
IMPORTANT

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



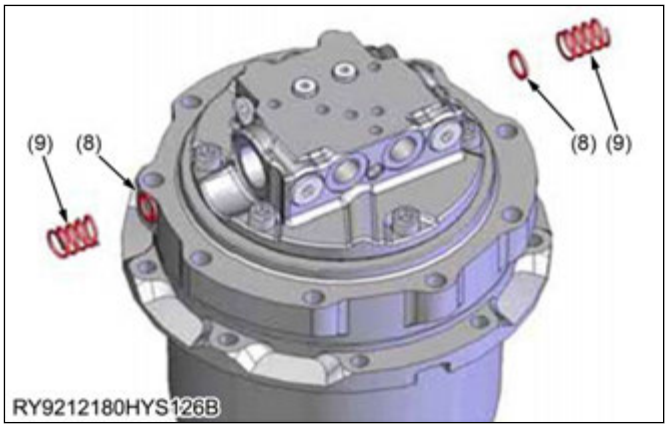
(3) Plug (6) Check valve
(4) O-ring
(5) Spring

4. Remove the cap.



(7) Cap

5. Remove the spring and spring seat.

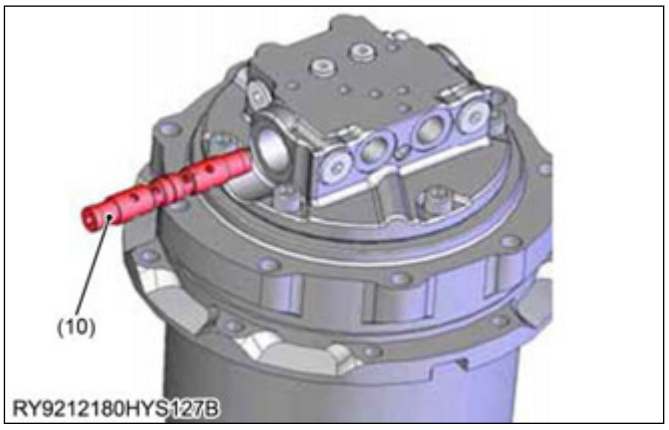


(8) Spring seat (9) Spring

6. Remove the counterbalance valve spool.

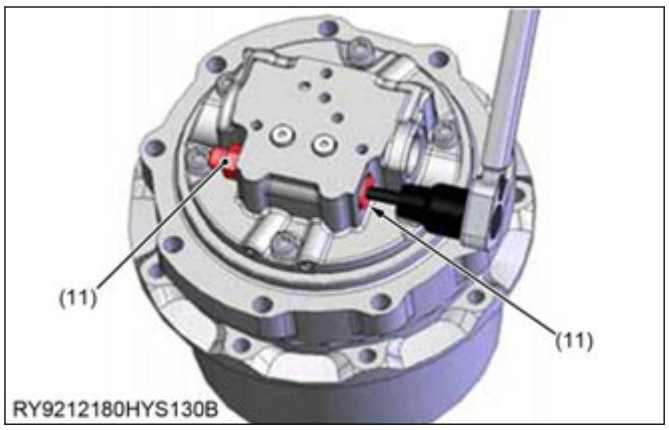
IMPORTANT

- **Do not scratch the spool.**



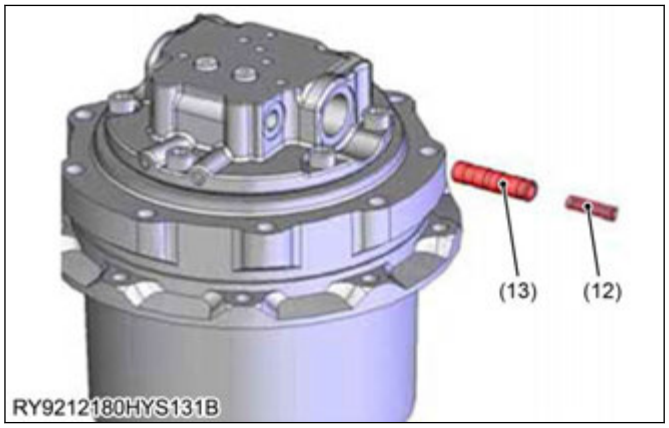
(10) Counterbalance spool

7. Remove the plug.



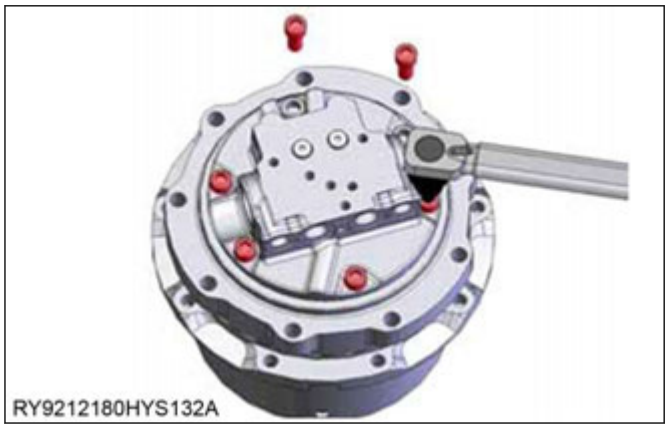
(11) Plug

8. Remove the spring and spool.



(12) Spring (13) Spool

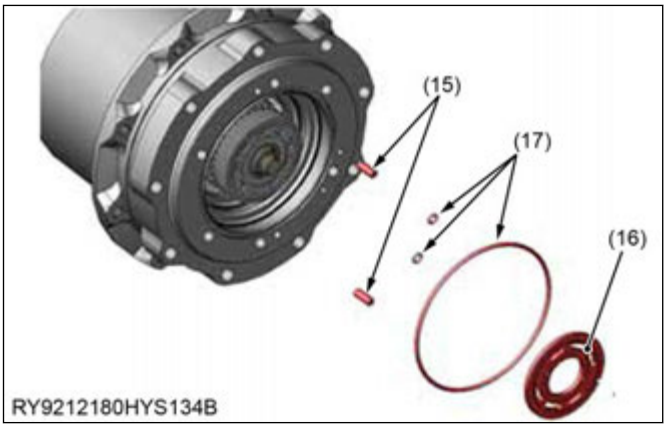
9. Remove the cap bolts.



10. Remove the valve body with plastic hammer.

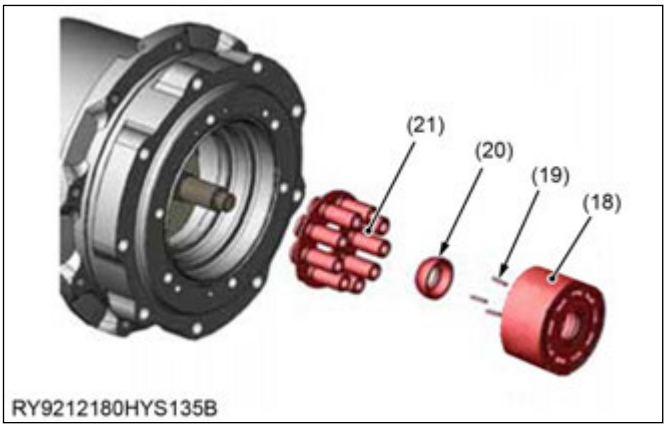
(14) Valve body

11. Remove the pin, valve plate, and O-ring.



(15) Pin (17) O-ring
(16) Valve plate

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

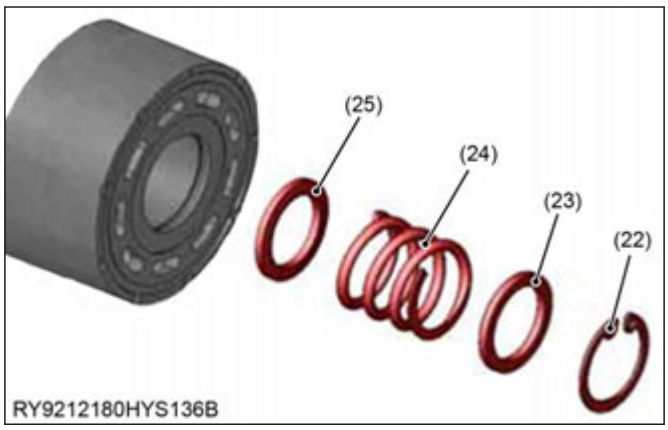


(18) Cylinder block (21) Retainer plate piston
(19) Pin
(20) Retainer holder

13. Remove the circlip, washer, spring and spring seat.

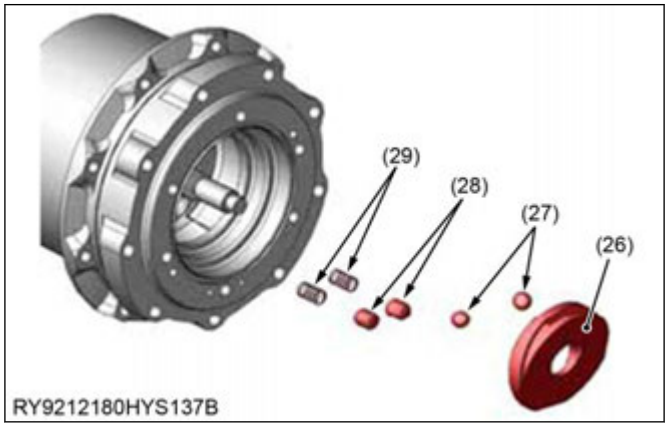
CAUTION

- **Make sure that the inner ring may pop out rapidly when removing the circlip.**



(22) Circlip
(23) Washer
(24) Spring
(25) Spring seat

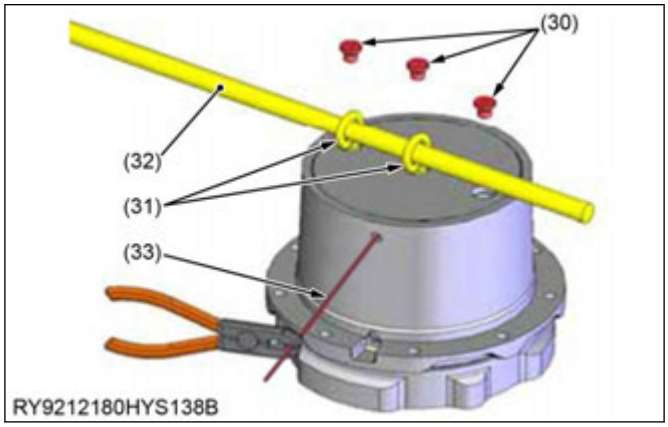
14. Remove swash plate, steel ball, piston and spring.



(26) Swash plate
(27) Steel ball
(28) Piston
(29) Spring

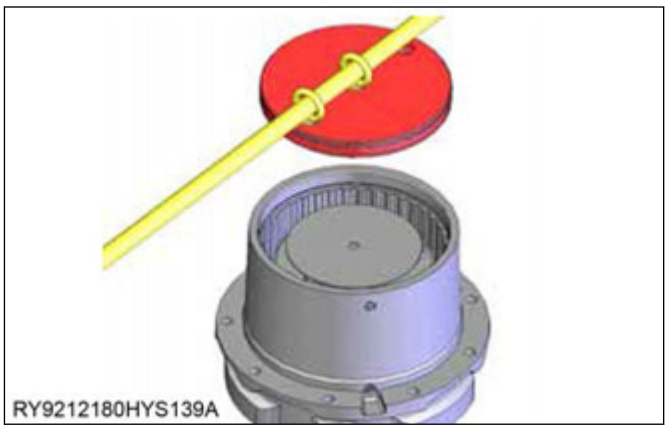
Disassembling the gear case

1. Remove the plug.
2. Install the 2 eye bolts to insert the rod.
3. Turn the rod until the wire tip becomes visible inside the plug hole and pull out the wire with nipper.

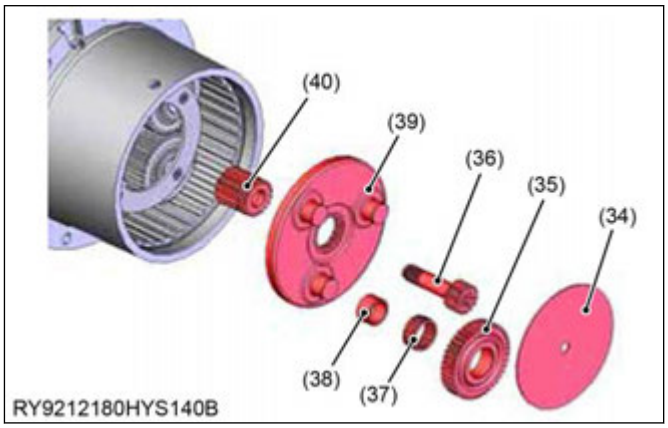


(30) Plug
(31) Eye bolt (M10)
(32) Rod
(33) Wire

4. Remove the cover.



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

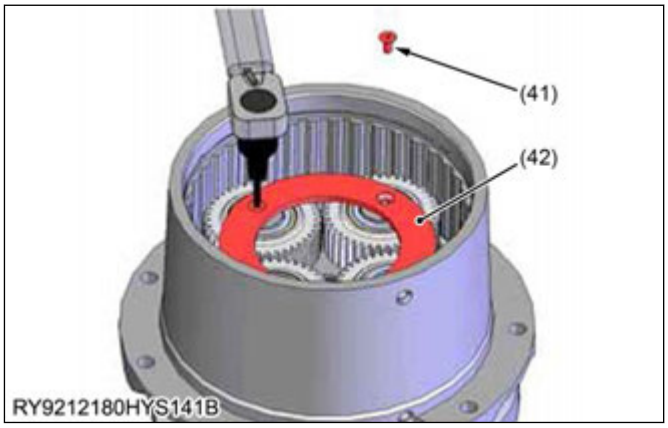


(34) Thrust plate
(35) Gear
(36) Drive gear
(37) Needle bearing
(38) Inner race
(39) Holder
(40) Sun gear

6. Remove the screw and thrust plate.

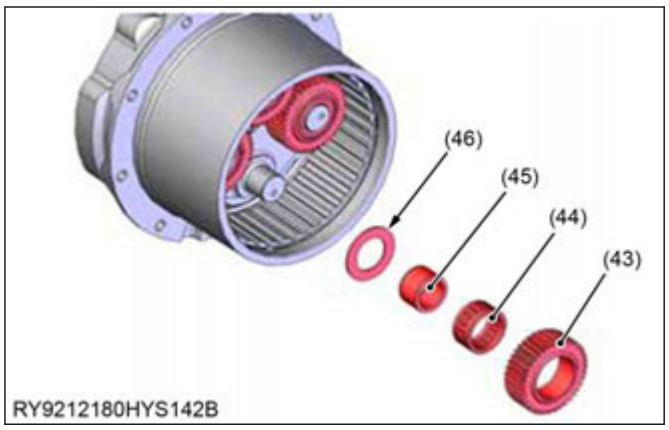
NOTE

- **The screw is coated with thread lock, warm it with a heat gun in advance before loose.**



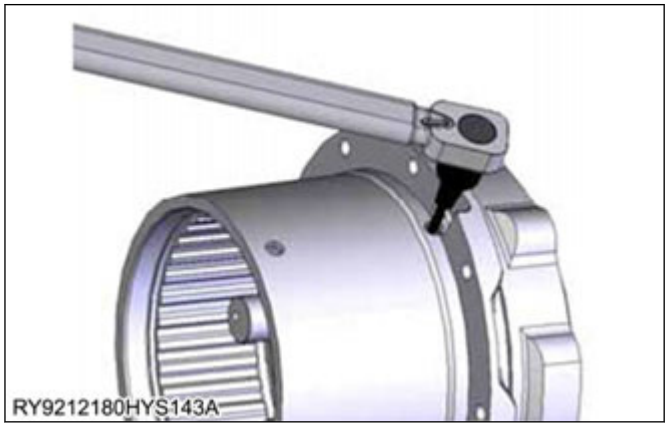
(41) Screw
(42) Thrust plate

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

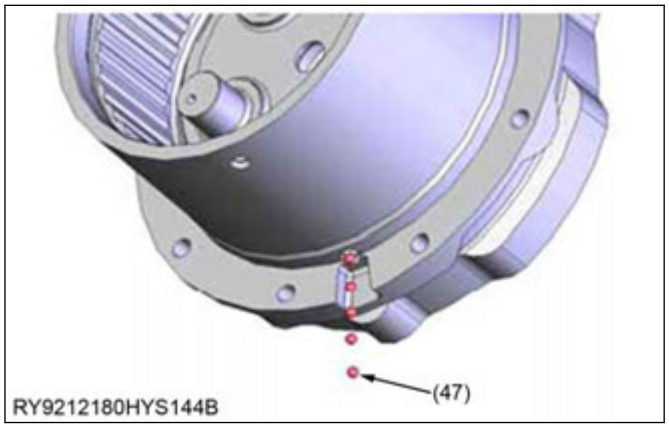


(43) Gear
(44) Needle bearing
(45) Inner race
(46) Thrust washer

8. Remove the plug.



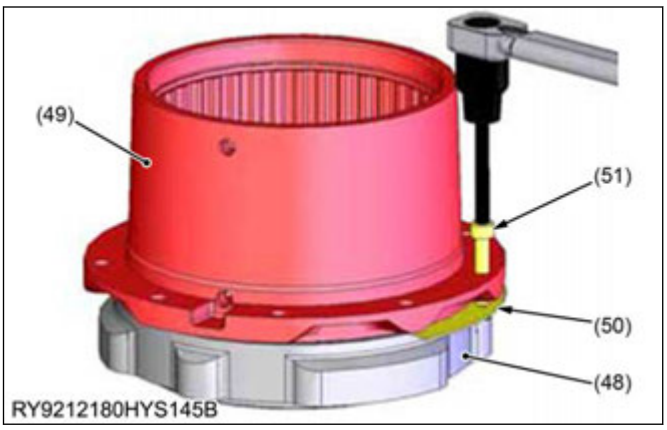
9. Pull the steel balls out from the plug hole.



(47) Steel ball (109 pcs)

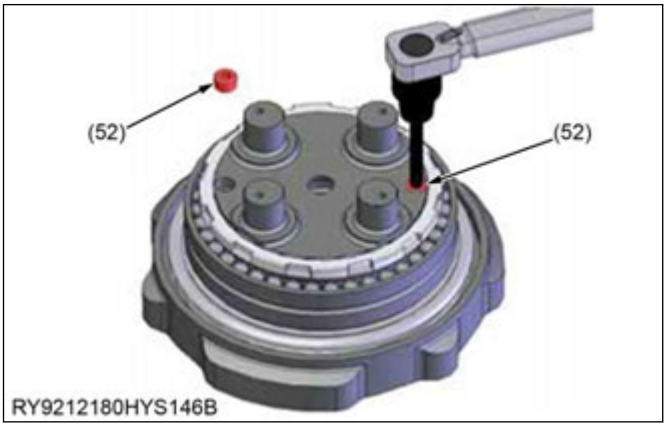
10. Remove the housing.

NOTE
- **Insert the plate between the flange holder and the housing.**
- **Tighten 3 cap bolts equally to remove the housing.**



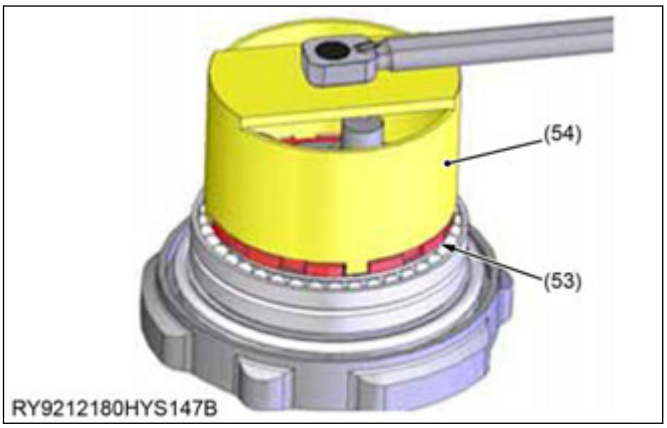
(48) Flange holder
(49) Housing
(50) Plate
(51) Bolt (M12 × 1.75)

11. Remove the plug.



(52) Plug

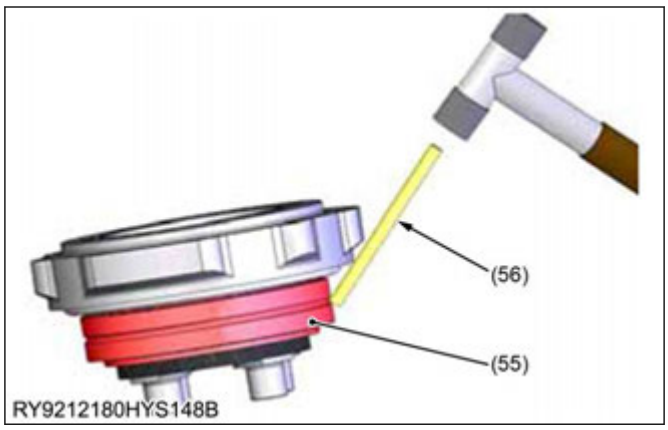
12. Remove the ring nut with jig.



(53) Ring nut
(54) Jig (S-1)

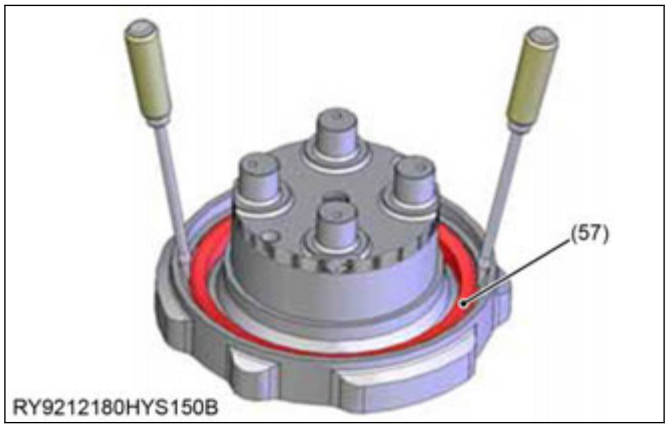
13. Remove the angular bearing.

NOTE
- **Hit the steel ball groove with a rod and hammer.**



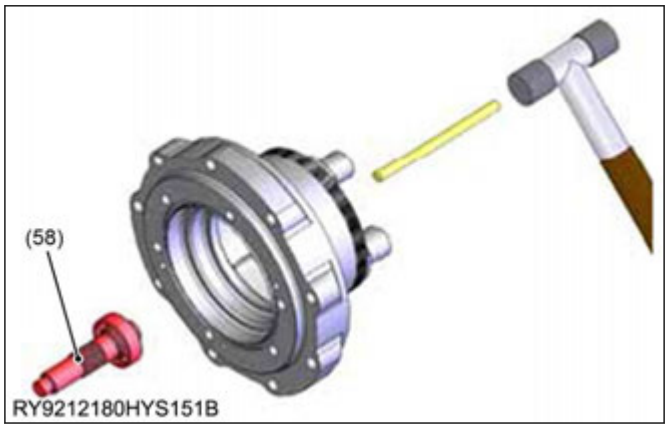
(55) Angular bearing (56) Rod

14. Remove the floating seal.



(57) Floating seal

15. Remove the shaft.

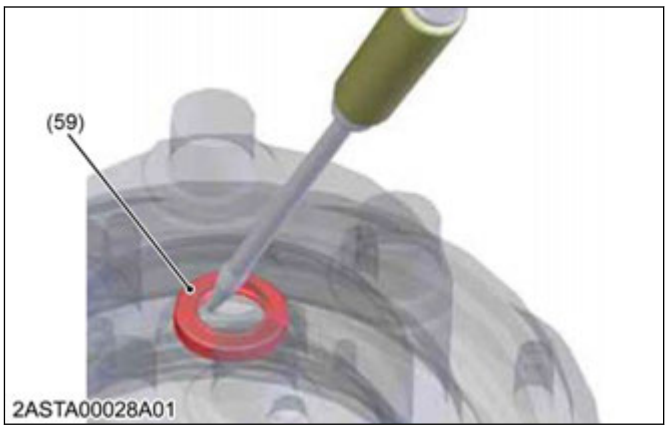


(58) Shaft

16. Remove the oil seal.

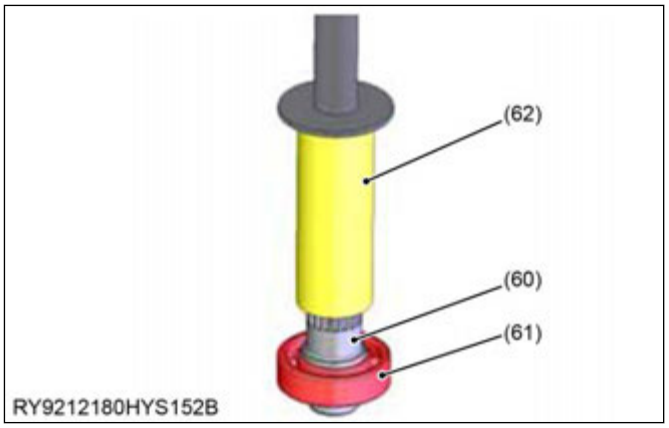
■ IMPORTANT

- **Do not reuse the removed oil seal when you install it.**



(59) Oil seal

17. Remove the ball bearing from the shaft.



(60) Shaft (62) Jig (S-2)
(61) Ball bearing

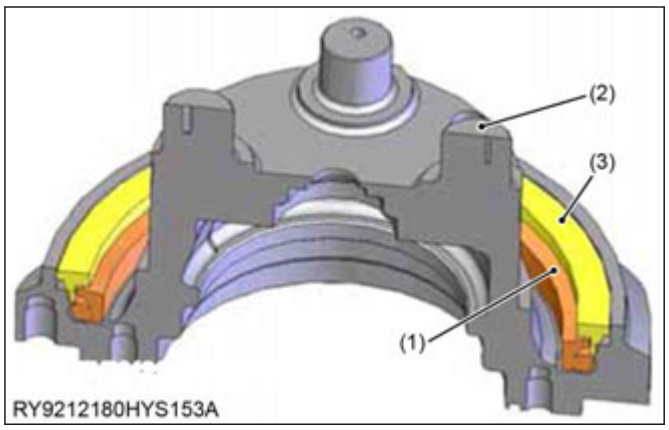
4.4.4 Assembling the travel motor

■ IMPORTANT

- **Do not reuse removed O-rings and floating seals for assembling to avoid oil leakage.**
- **Do not reuse removed bearings.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

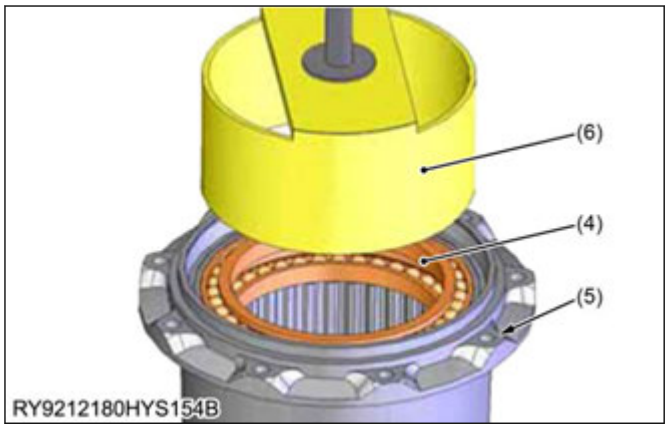
Assembling the gear case

1. Install the floating seal on the flange holder with jig after greasing the floating seal.



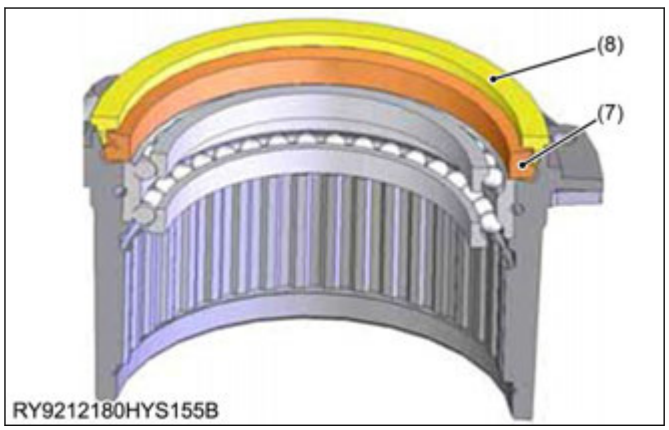
(1) Floating seal
(2) Flange holder
(3) Jig (S-3)

2. Press fit the bearing into the housing.



(4) Bearing
(5) Housing
(6) Jig (S-4)

3. Install the other floating seal on the housing.

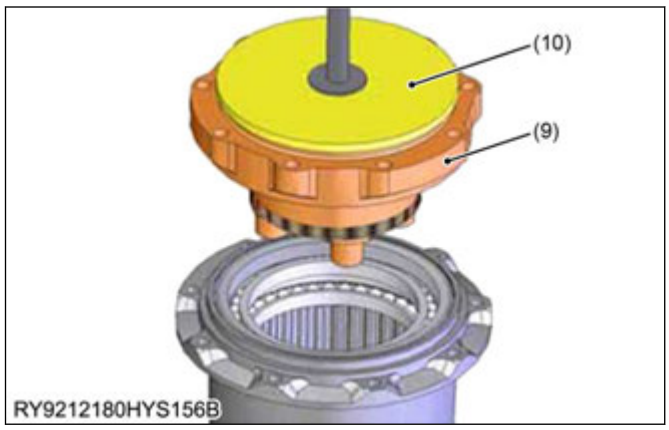


(7) Floating seal
(8) Jig (S-3)

4. Install the flange holder on the housing.

■ IMPORTANT

- **Before install the flange holder, clean the sealing face of the floating seal and apply the gear oil on the sealing face.**

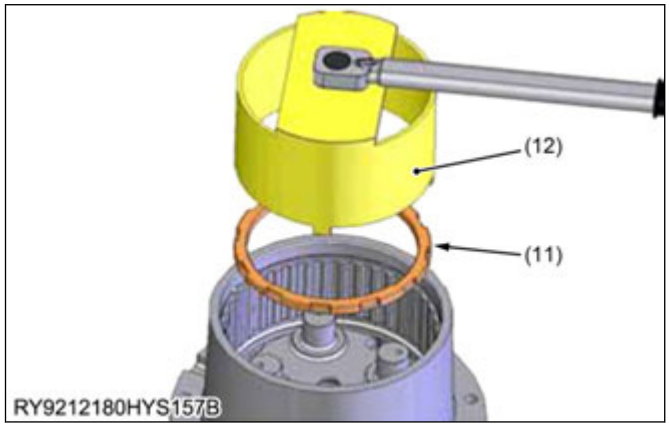


(9) Flange holder
(10) Jig (S-5)

5. Install the angular bearing with ring nut.

■ IMPORTANT

- **Do not reuse the removed angular bearing.**

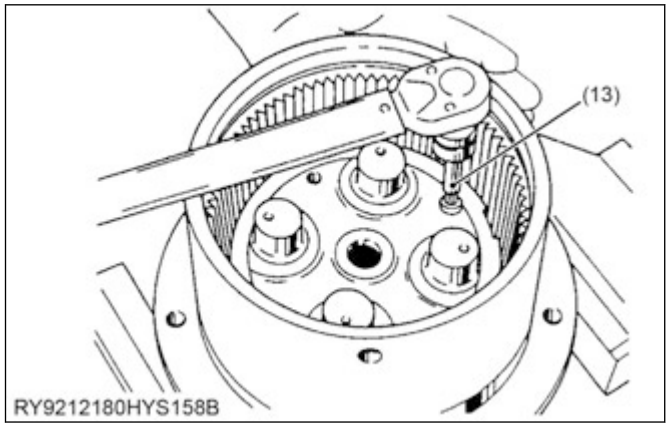


(11) Ring nut
(12) Jig (S-1)

Tightening torque

(11) Ring nut	186.2 to 205.8 N·m 19 to 21 kgf·m 137.4 to 151.7 lbf·ft	-

6. Install the plug.

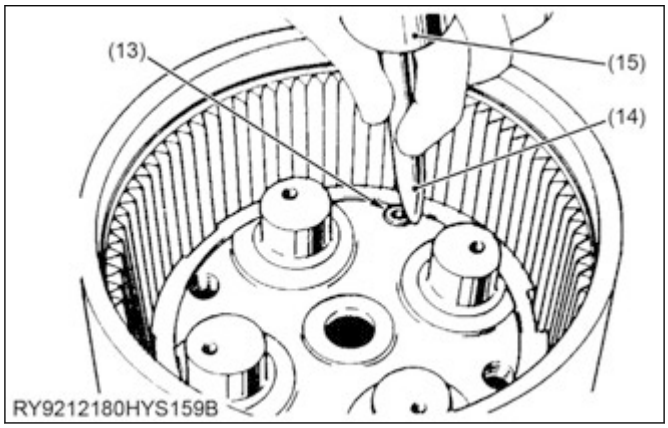


(13) Plug

Tightening torque

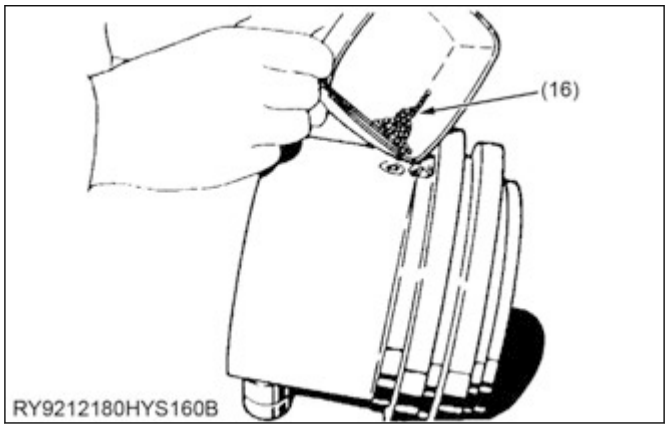
(13) Plug	9.8 to 19.6 N·m 1.0 to 2.0 kgf·m 7.2 to 14.5 lbf·ft	-

7. Swage 2 places beside the plug with a punch to prevent loosening of the plug.



(13) Plug
(14) Punch
(15) Hammer

8. Put the steel ball in plug hole.

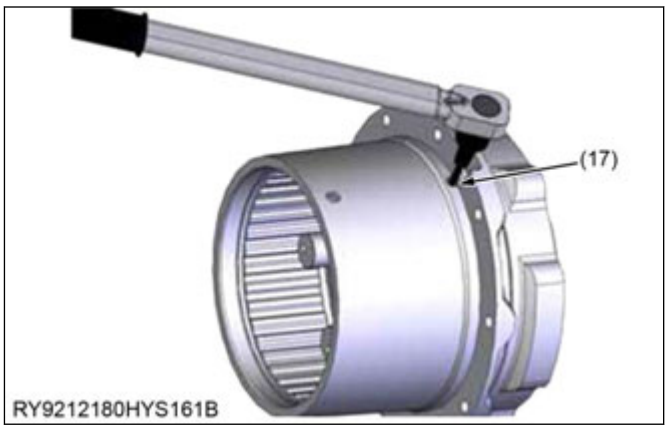


(16) Steel ball (109 pcs)

9. Wrap the thread seal tape around the plug and install the plug.

IMPORTANT

- **Tighten the plug until the plug head is fully inserted.**

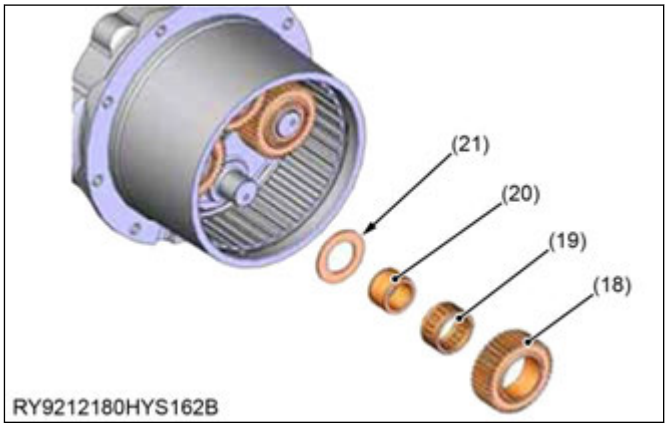


(17) Plug

Tightening torque

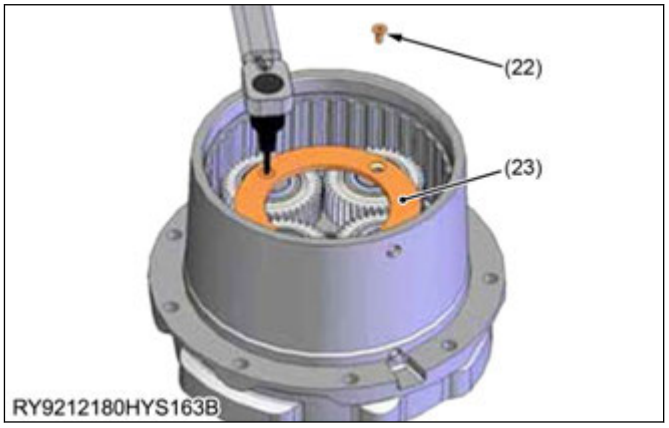
(17) Plug	6.8 to 8.8 N·m 0.7 to 0.9 kgf·m 5.0 to 6.5 lbf·ft	-

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



(18) Gear
(19) Needle bearing
(20) Inner race
(21) Thrust washer

11. Install the thrust plate with screw.

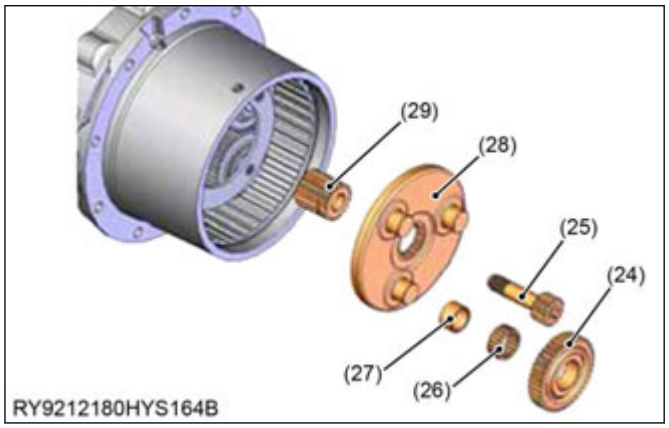


(22) Bolt
(23) Thrust plate

Tightening torque

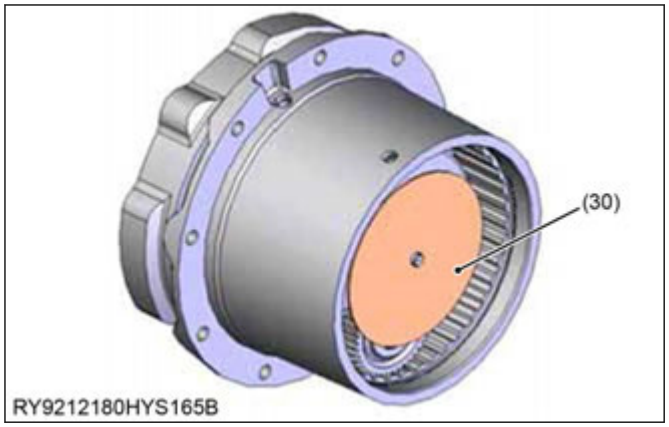
(22) Bolt	12.1 to 13.3 N·m 1.24 to 1.35 kgf·m 8.93 to 9.80 lbf·ft	Thread lock (Loctite 262)

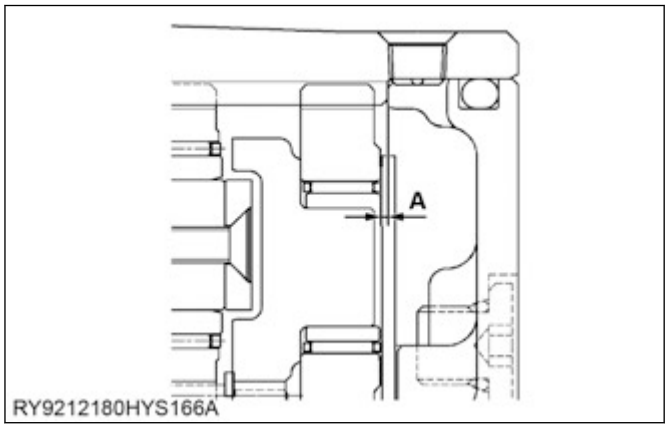
12. Install the sun gear (is installed circlip), inner race, needle bearing , holder, drive gear and gear.



(24) Planetary gear A
(25) Drive gear
(26) Needle bearing
(27) Inner race
(28) Holder
(29) Sun gear

13. Install the thrust plate.





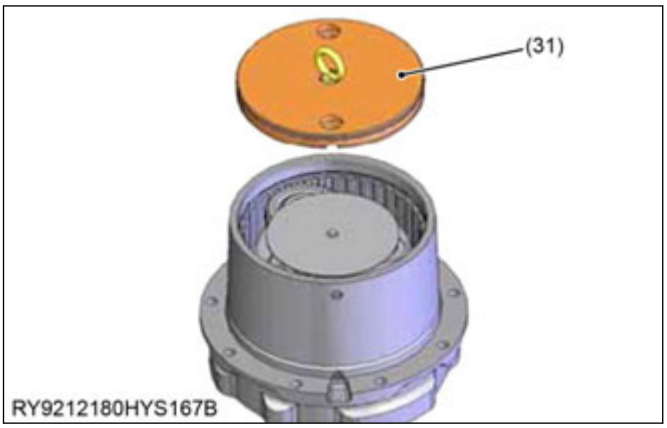
(30) Thrust plate

Adjusting dimensions

A	0.3 to 0.7 mm 0.01 to 0.03 in.	0.8 to 1.3 mm 0.03 to 0.05 in.	1.4 to 1.8 mm 0.06 to 0.07 in.
Thrust plate thickness	1.8 mm 0.07 in.	2.3 mm 0.09 in.	2.8 mm 0.11 in.

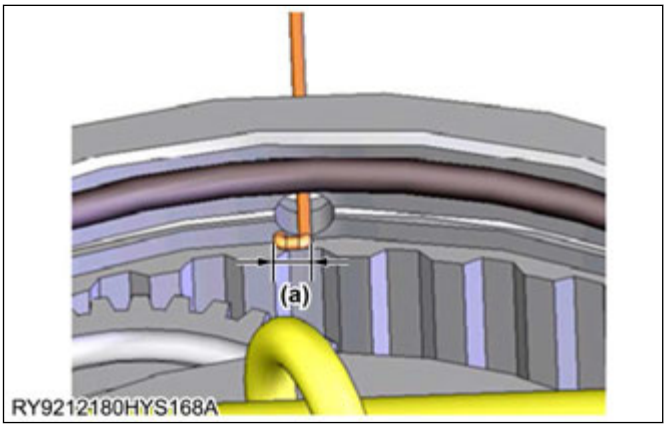
14. Install the cover so that plug thread hole and notch of cover are aligned.

■ IMPORTANT
- **Grease the O-ring before install the cover.**



(31) Cover

15. Bend the wire tip, insert the bent section, and hook it on the notch of cover.

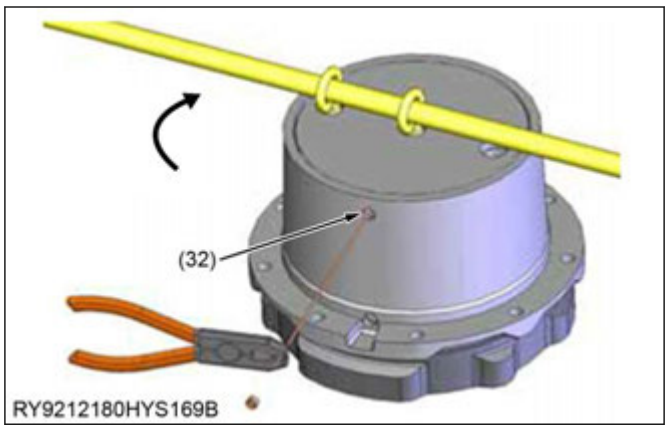


Adjusting dimension

(a)	6.0 mm 0.23 in.

16. Turn the cover until the wire makes one turn. And cut the wire with nipper.

■ IMPORTANT
- **Wrap the thread seal tape around the plug.**



(32) Plug

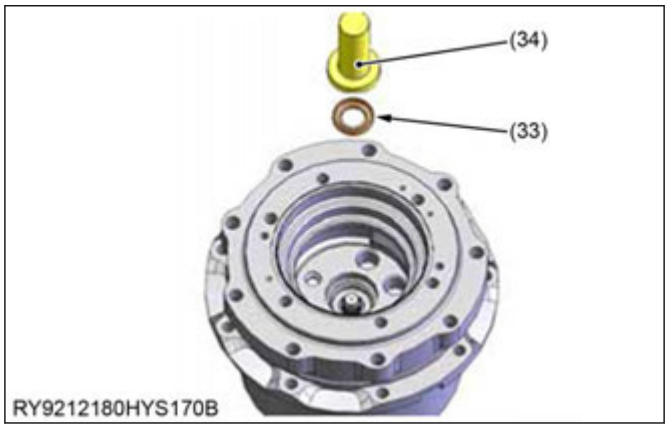
Tightening torque

(32) Plug	6.8 to 8.8 N·m 0.7 to 0.9 kgf·m 5.0 to 6.5 lbf·ft	-

Assembling the motor

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

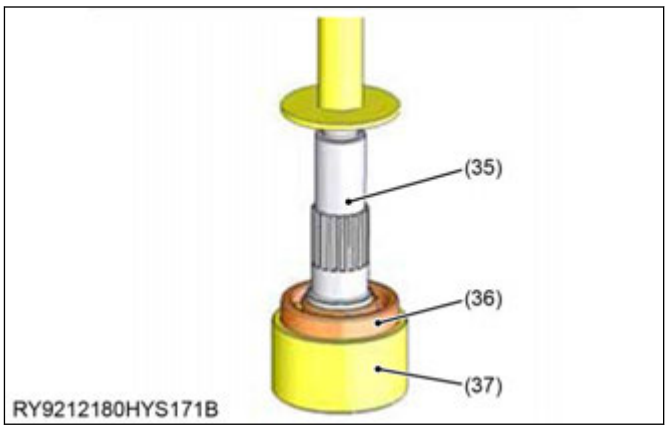
IMPORTANT
- **Do not reuse the oil seal.**



(33) Oil seal (34) Jig (S-6)

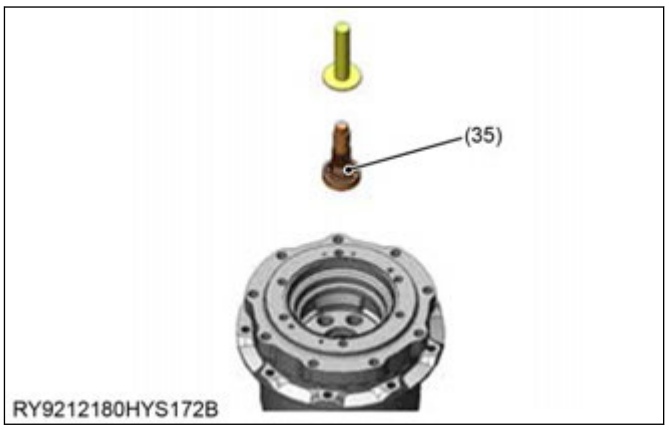
2. Press fit the ball bearing into the shaft.

NOTE
- **Install the new ball bearing.**



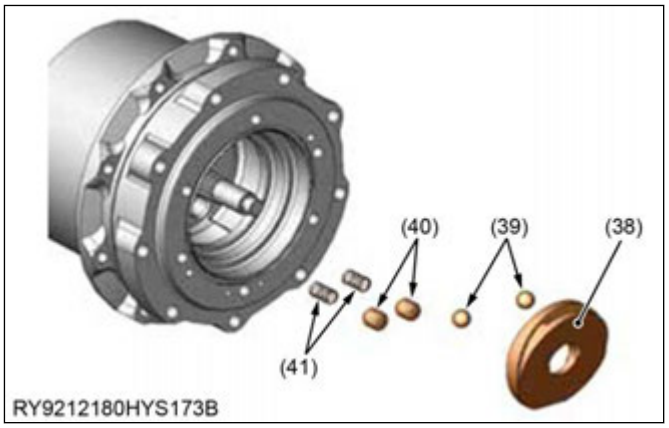
(35) Shaft (37) Jig (S-7)
(36) Ball bearing

3. Grease the slide section and side of the oil seal. And press fit the shaft into the flange holder.



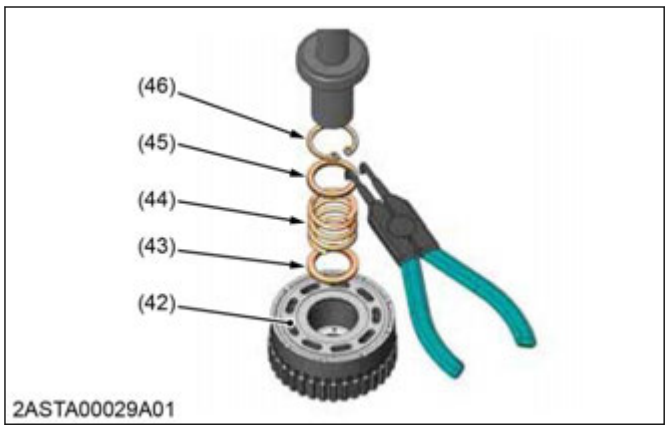
(35) Shaft

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



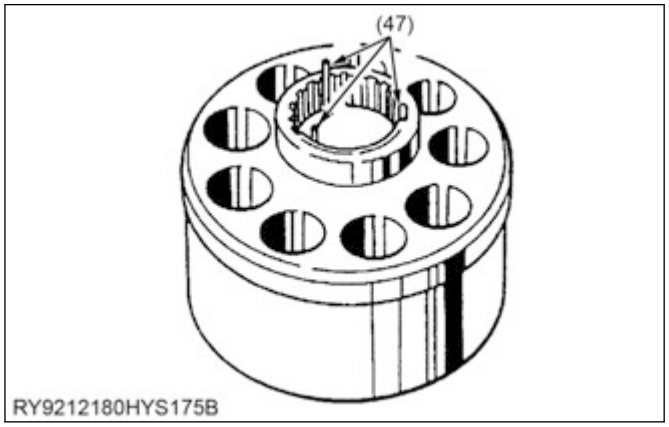
(38) Swash plate (41) Spring
(39) Steel ball
(40) Piston

5. Install the collar, spring, washer and circlip on the cylinder block.



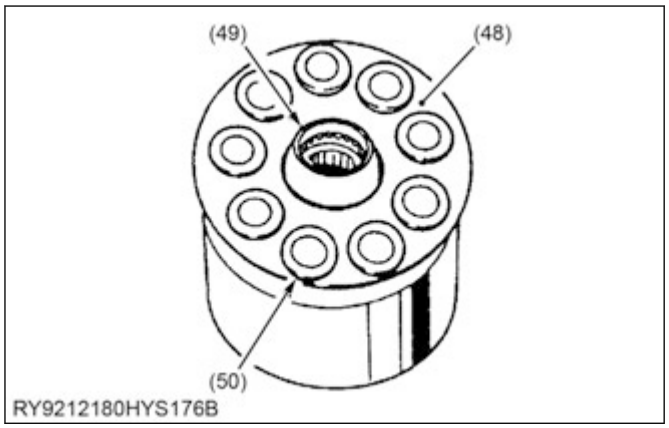
(42) Cylinder block
(43) Collar
(44) Spring
(45) Washer
(46) Circlip

6. Grease the pins and install to cylinder block.



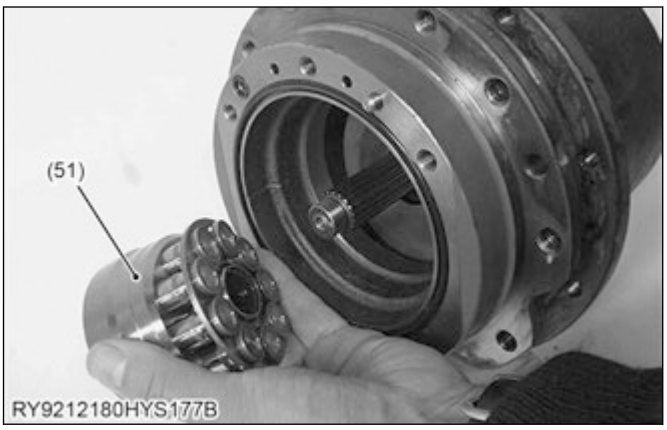
(47) Pin

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



(48) Retainer holder
(49) Retainer plate
(50) Piston

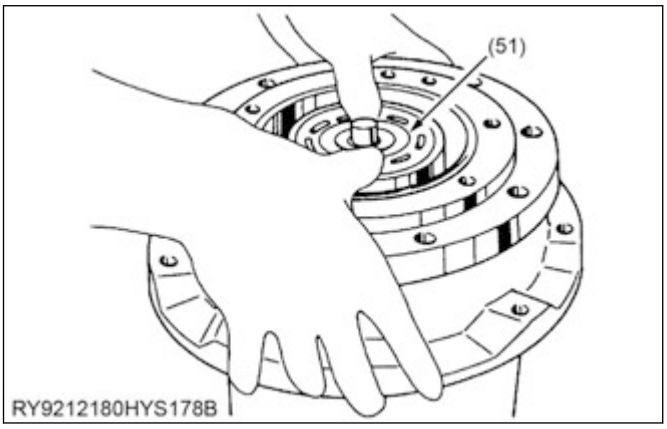
8. Install the cylinder block assembly.



(51) Cylinder block assembly

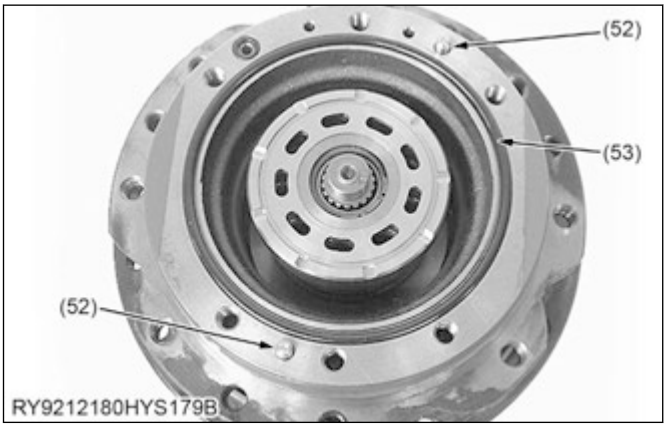
9. Press the cylinder block by hand to check that the spring is functioning.

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



(51) Cylinder block assembly

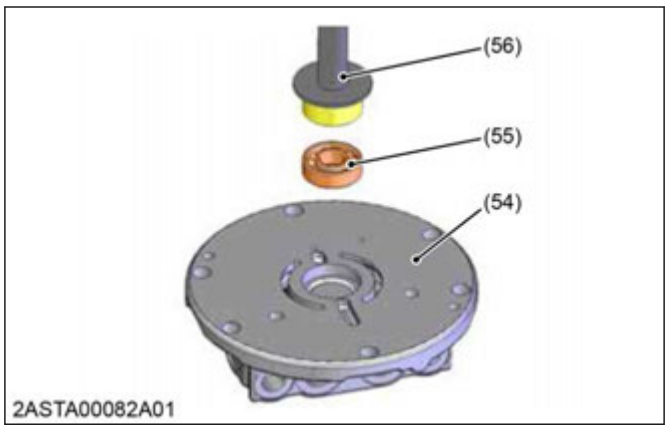
10. Install the pins and O-ring on the flange holder.



(52) Pin
(53) O-ring

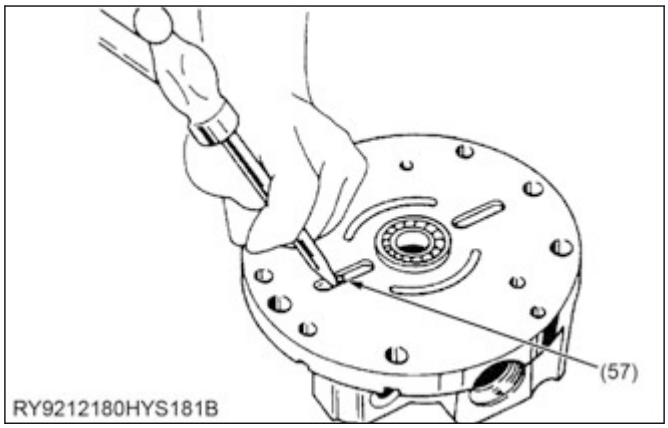
11. Press fit the ball bearing into the valve body.

NOTE
- **Install the new ball bearing.**



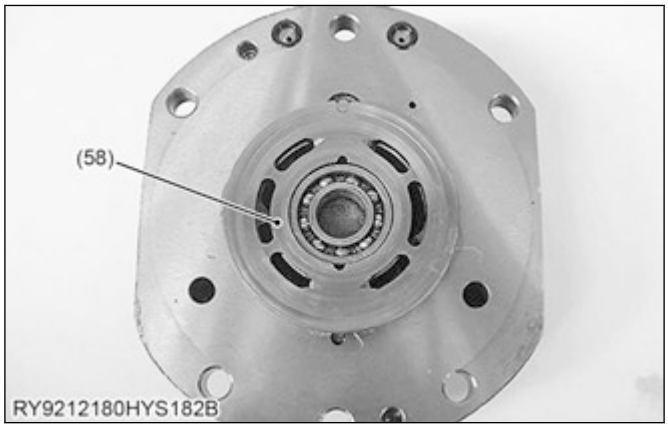
(54) Valve body
(55) Ball bearing
(56) Jig (S-8)

12. Install the pin and swage 1 place around the pin.



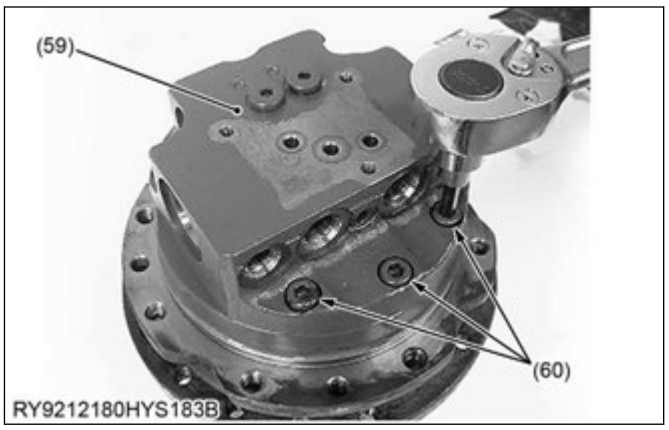
(57) Pin

13. Grease the backside of the valve plate and install it on the valve body.



(58) Valve plate

14. Install the valve body with cap bolts.

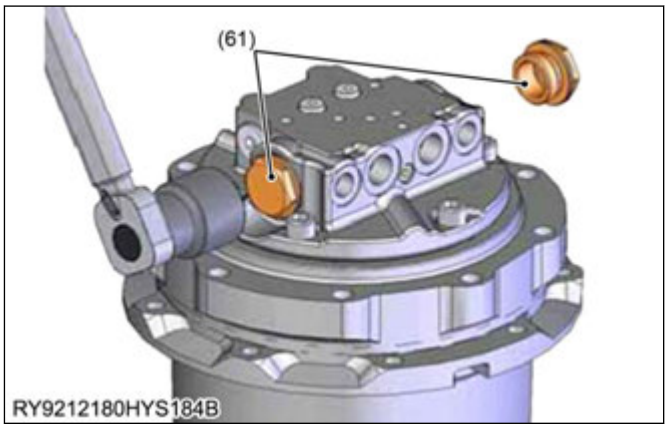


(59) Valve body
(60) Cap bolt ×6

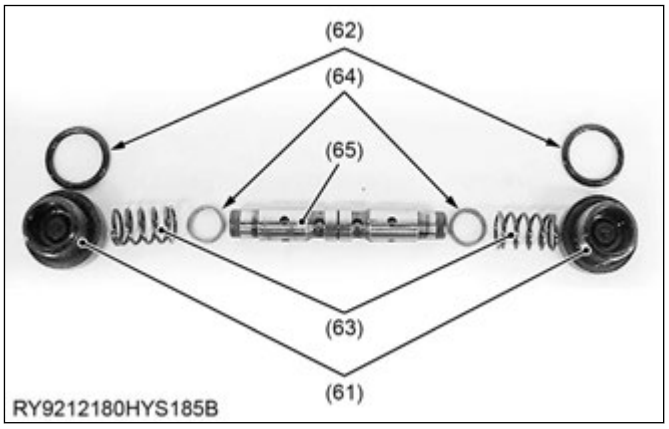
Tightening torque

(60) Cap bolt	58.8 to 68.6 N·m 6.0 to 7.0 kgf·m 43.4 to 50.5 lbf·ft	-

15. Install the shaft and swash plate in order.



(61) Cap

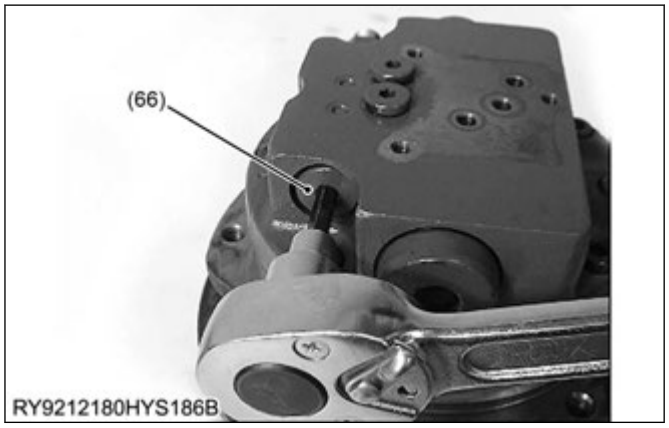


(61) Cap
(62) O-ring
(63) Spring
(64) Spring seat
(65) Counterbalance spool

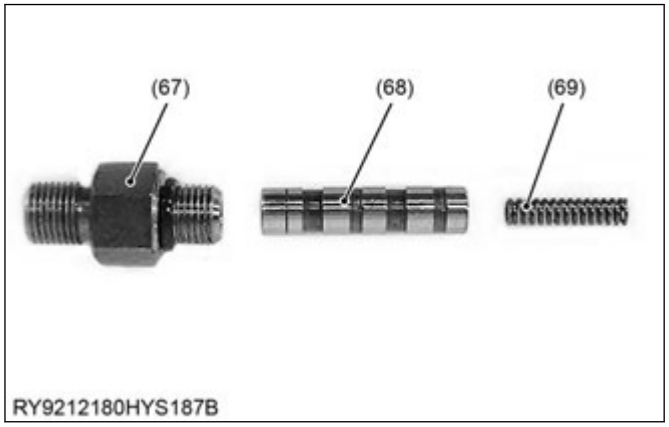
Tightening torque

(61) Cap	235 to 245 N·m 24.0 to 25.0 kgf·m 173 to 181 lbf·ft	-

16. Install the spring, spool and plug.



(66) Plug

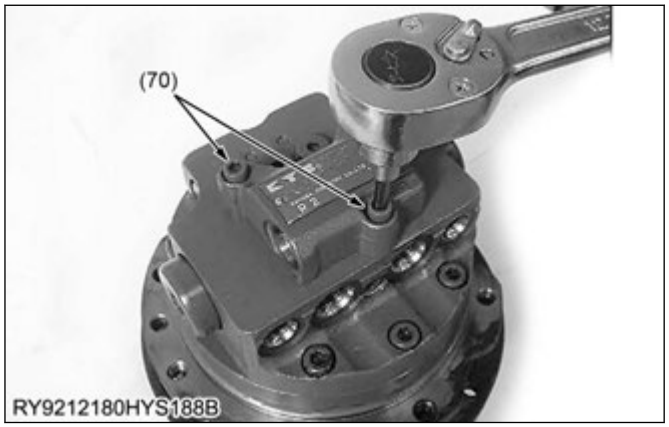


(67) Plug
(68) Spool
(69) Spring

Tightening torque

(66) Plug	49.0 to 58.8 N·m 5.0 to 6.0 kgf·m 36 to 43 lbf·ft	-

17. Install the O-ring on the valve body and tighten the cap bolts.

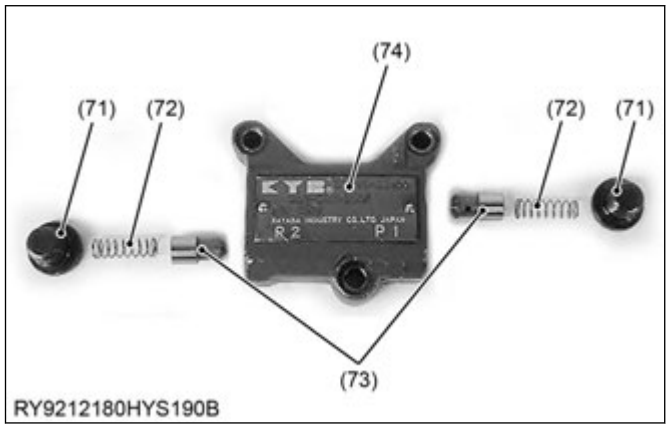


(70) Cap bolt ×3

Tightening torque

(70) Cap bolt	35.0 to 38.8 N·m 3.6 to 4.0 kgf·m 26.0 to 28.6 lbf·ft	-

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

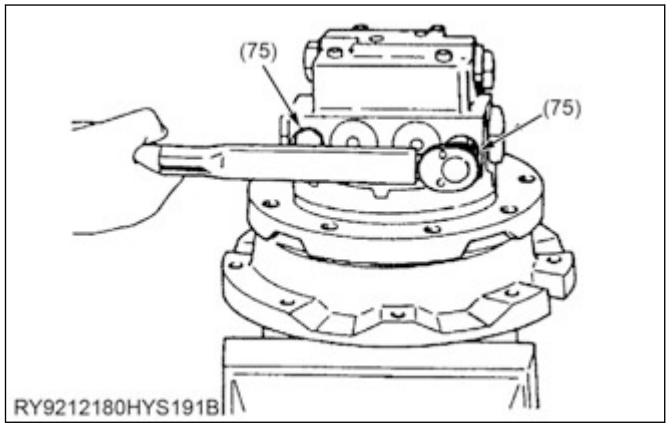


(71) Plug
(72) Spring
(73) Check valve
(74) Valve body

Tightening torque

(71) Plug	49.0 to 58.8 N·m 5.0 to 6.0 kgf·m 36 to 43 lbf·ft	-

19. Install the Plug.

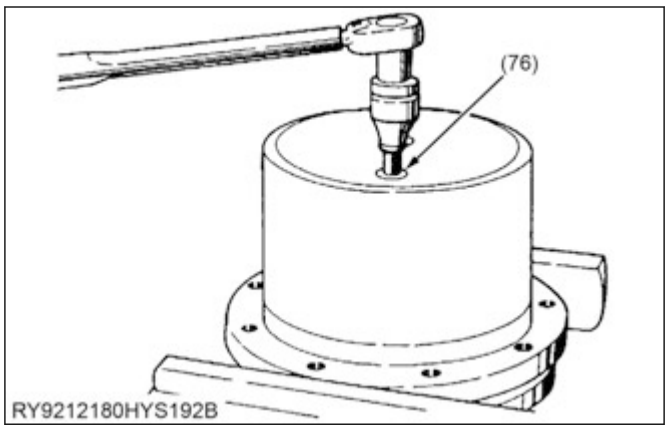


(75) Plug

Tightening torque

(75) Plug	21.6 to 23.6 N·m 2.2 to 2.4 kgf·m 16.0 to 17.4 lbf·ft	-

20. Fill in 0.6 L of gear oil from the plug hole. And tighten the plug.



(76) Plug

Tightening torque

(76) Plug	21.6 to 23.6 N·m 2.2 to 2.4 kgf·m 16.0 to 17.4 lbf·ft	-

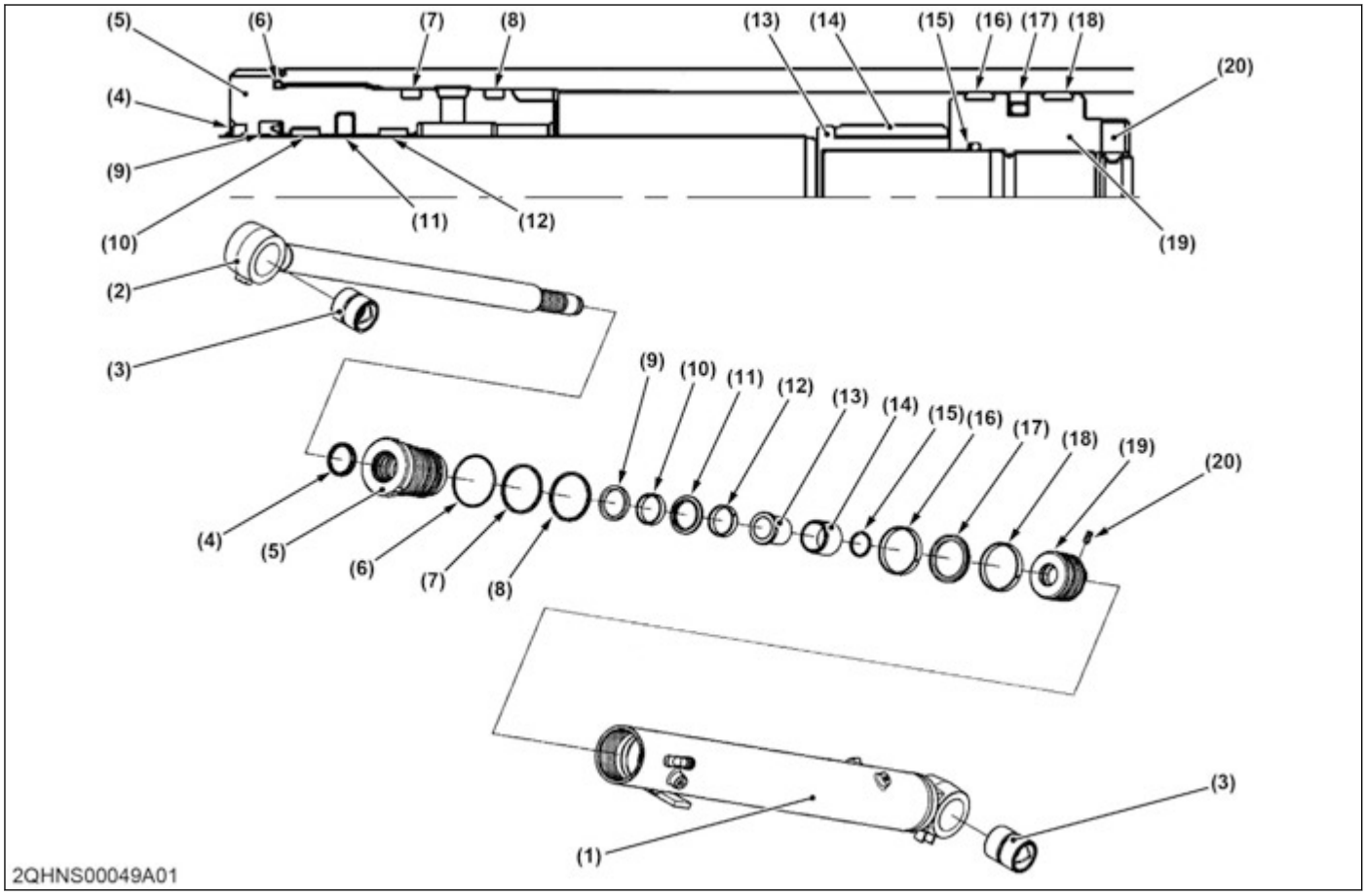
Recommended lubricants

Gear oil	0.5 L 0.09 U.S.gals	In winter or at low temperatures SAE 75, SAE 80
		In summer or at high ambient temperatures SAE 90, SAE 140
		All-weather 80W-90

4.5 Hydraulic cylinder

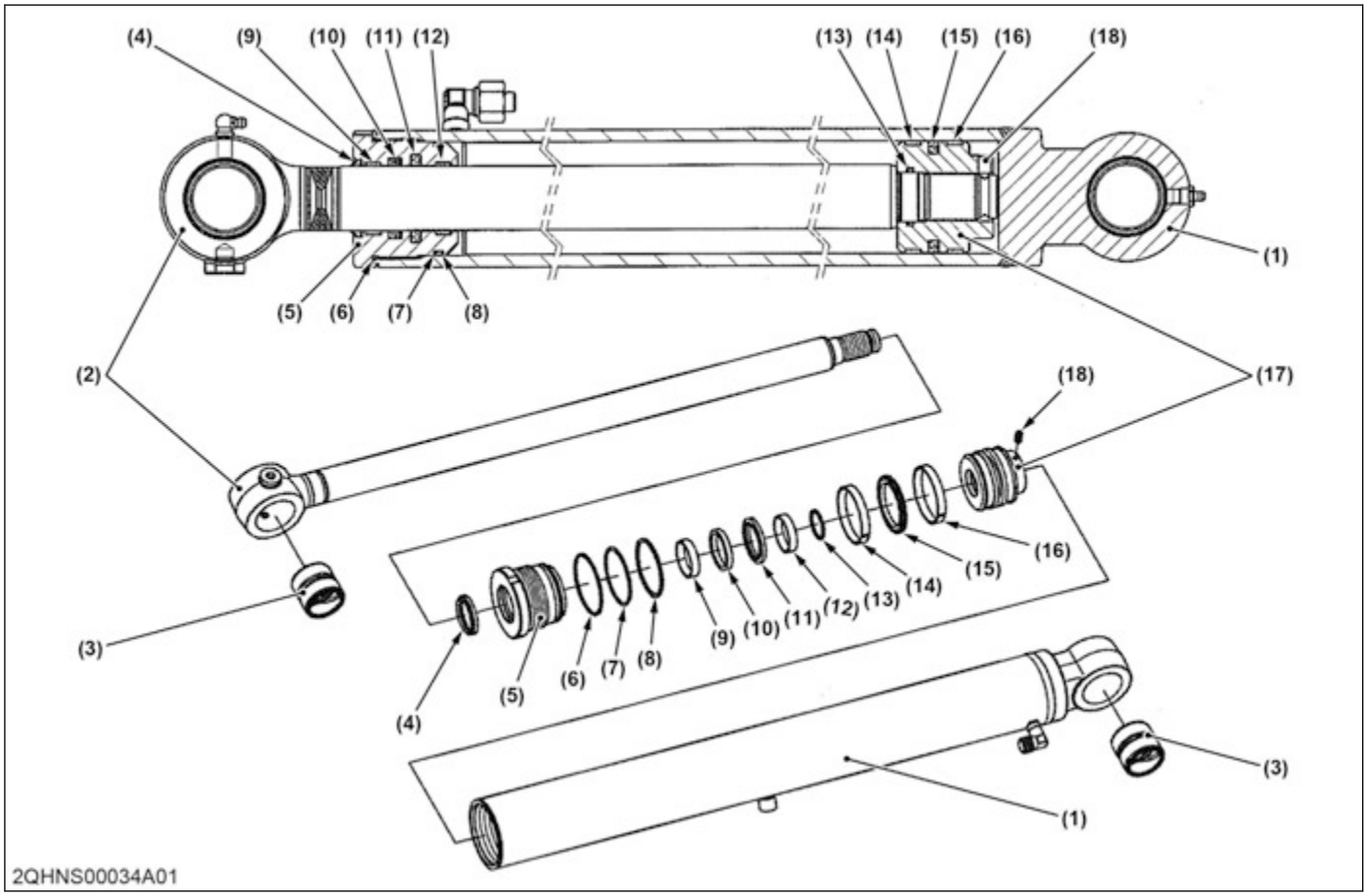
4.5.1 Cylinder components

4.5.1.1 Boom cylinder components



(1) Cylinder tube
(2) Piston rod
(3) Bushing
(4) Dust seal
(5) Cylinder head
(6) O-ring
(7) Seal ring
(8) Seal ring
(9) Oil seal
(10) Slide ring
(11) Seal ring
(12) Slide ring
(13) Inner cushion bearing
(14) Cushion bearing
(15) O-ring
(16) Slide ring
(17) Seal ring
(18) Slide ring
(19) Piston
(20) Set screw

4.5.1.2 Arm, bucket, swing and blade cylinder components



(1) Cylinder tube
(2) Piston rod
(3) Bushing
(4) Dust seal
(5) Cylinder head
(6) O-ring
(7) Back-up ring
(8) O-ring
(9) Slide ring
(10) Oil seal
(11) Seal ring
(12) Slide ring
(13) O-ring
(14) Slide ring
(15) Seal ring
(16) Slide ring
(17) Piston
(18) Set screw

4.5.2 Disassembling hydraulic cylinder

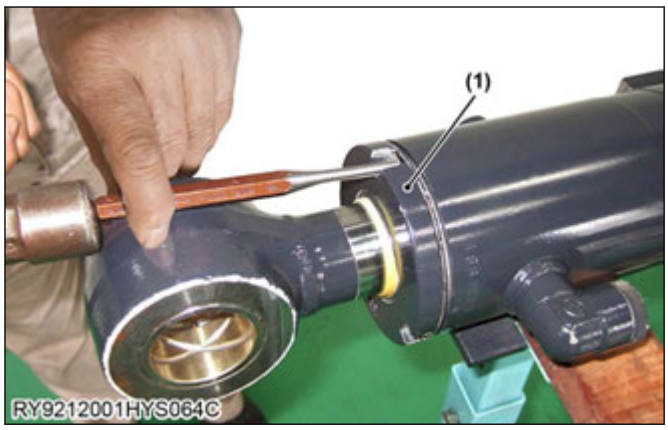
■ IMPORTANT

- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**

Disassembling the piston rod

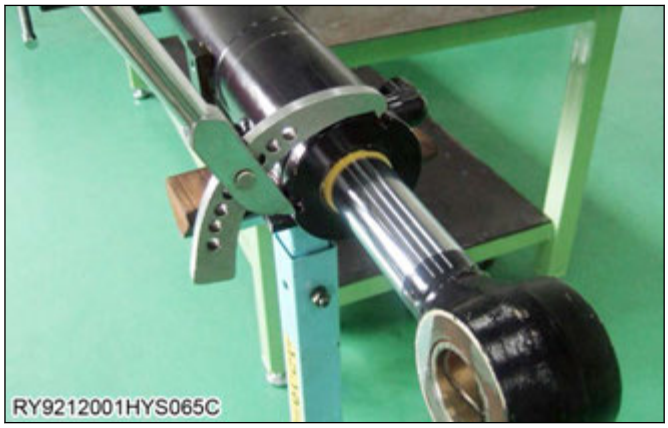
1. Drain the hydraulic oil.
2. Fasten the bottom side of cylinder in a vice. Support the cylinder with stand.

3. Hit the cylinder head with hammer and pin punch to open the rotation stopper.



(1) Cylinder head

4. Loosen the cylinder head with hook wrench or key wrench to remove.



5. Remove the piston rod and cylinder head.

NOTE
- **Remove plugs before pulling out the piston rod and cylinder head.**
- **Put oil pan on the cylinder head side.**

(1) Cylinder head (2) Piston rod

6. Fasten the piston rod assembly in a vice. Support the piston rod assembly with stand.

IMPORTANT
- **Do not damage the rod. Put a cushion under the rod for support.**

7. Remove the set screw.

NOTE
- **Set screw is swaged in 2 locations. Remove the swage by hand drill to loosen the set screw.**
- **Screw a tap (M8 × 1.25) after removed the set screw.**

(3) Set screw

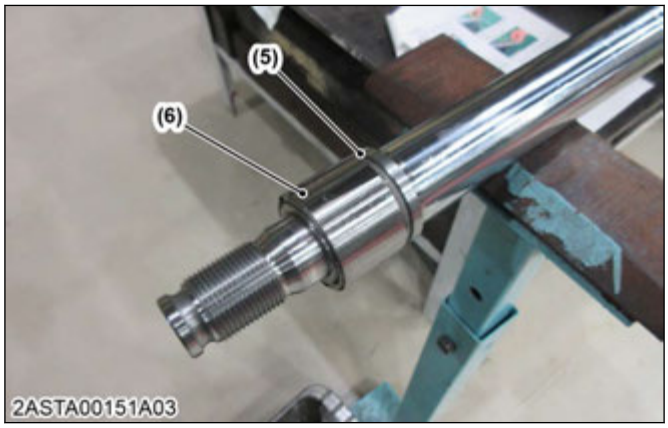
8. Loosen the piston with wrench.

(4) Piston

9. Remove the piston.

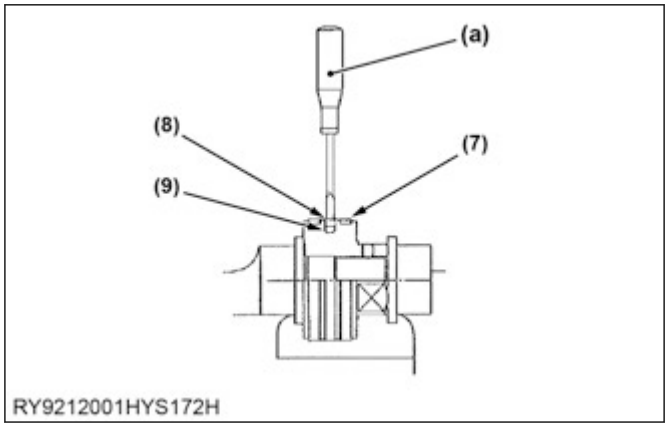
(4) Piston

10. Remove the cushion bushing and inner cushion bushing.



(5) Inner cushion bushing (6) Cushion bushing

11. Remove the slide ring by hand.



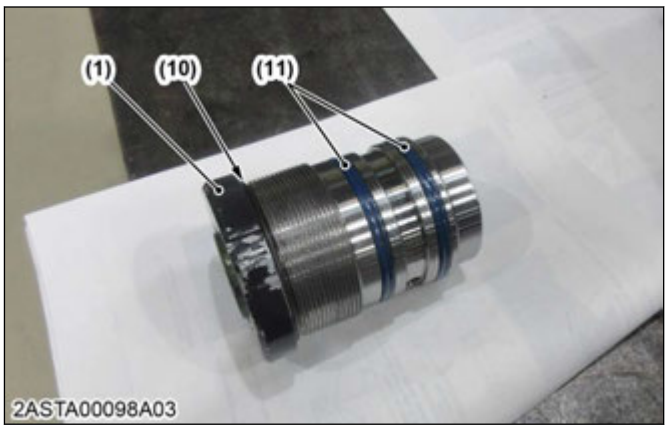
(7) Slide ring (a) Flat tip screwdriver
(8) Seal ring
(9) O-ring

12. Remove the seal ring and O-ring.

■ NOTE
- **Use a flat tip screwdriver to remove.**

Disassembling the cylinder head

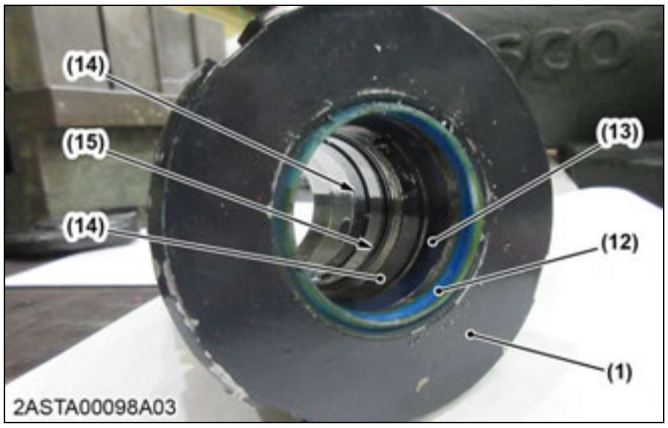
1. Remove the O-ring and seal rings.



(1) Cylinder head (11) Seal ring
(10) O-ring

2. Remove the dust seal, oil seal, slide rings and seal ring.

■ NOTE
- **Use a flat tip screwdriver to remove.**



(1) Cylinder head (14) Slide ring
(12) Dust seal (15) Seal ring
(13) Oil seal

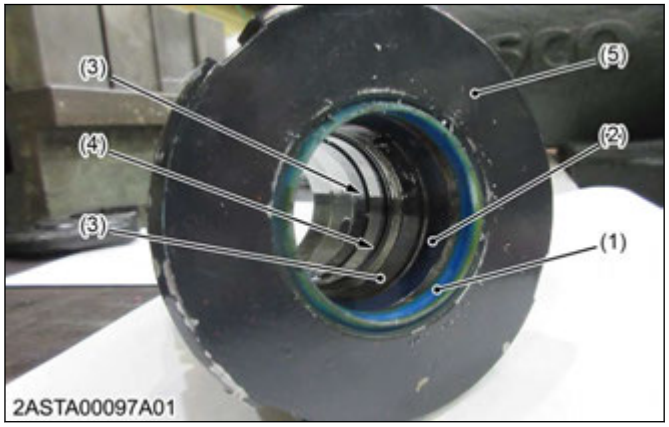
4.5.3 Assembling hydraulic cylinder

■ IMPORTANT
- **Do not reuse removed O-rings, oil seals, seal rings, and dust seals for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

Assembling the cylinder head

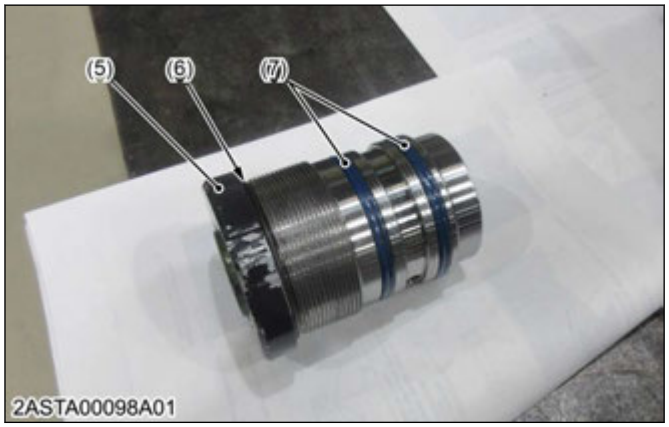
1. Install the dust seal, oil seal, slide ring and seal ring.

■ NOTE
- **Apply hydraulic oil to inside of the cylinder head before installing.**
- **Make sure not to damage the seal. Check for damages after the seal is installed.**



(1) Dust seal
(2) Oil seal
(3) Slide ring
(4) Seal ring
(5) Cylinder head

2. Install the O-ring and seal rings.



(5) Cylinder head
(6) O-ring
(7) Seal ring

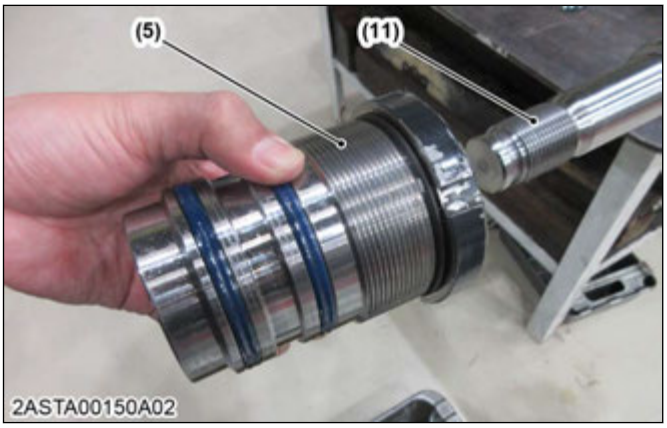
Assembling the piston rod

1. Screw a tap (M8 × 1.25) to thread hole of the set screw.
2. Install the seal ring and slide rings.

(8) Slide ring
(9) Seal ring
(10) Piston

3. Fasten the bottom side of cylinder in a vice.
4. Install the cylinder head into the piston rod carefully.

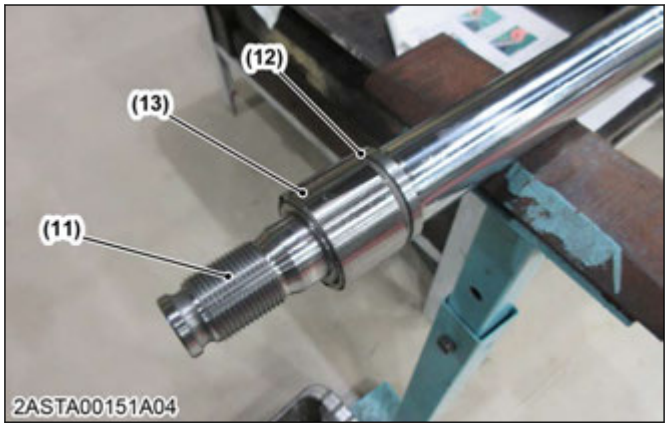
■ NOTE
- **Apply hydraulic oil to cylinder head (seal ring and O-ring).**
- **Do not damage the wiper ring and U-ring.**



(5) Cylinder head
(11) Piston rod

5. Install the inner cushion bearing and cushion bearing to the piston rod.

■ NOTE
- **Only for boom cylinder.**
- **Apply hydraulic oil to the holder and cushion bearing.**
- **Make sure that the cushion bearing faces to correct direction.**



(11) Piston rod
(12) Inner cushion bearing
(13) Cushion bearing

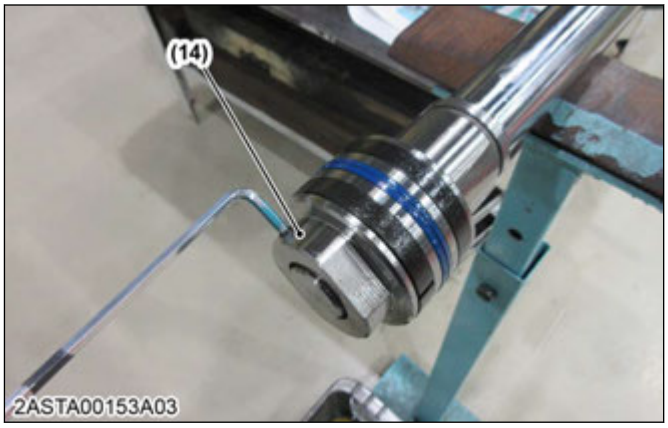
6. Tighten the piston onto the rod with the specified torque.

(10) Piston

Tightening torque

Boom	(10) Piston	300 N·m 30.6 kgf·m 221 lbf·ft	-
Arm		380 N·m 38.8 kgf·m 280 lbf·ft	-
Bucket		350 N·m 35.7 kgf·m 258 lbf·ft	-
Swing		300 N·m 30.6 kgf·m 221 lbf·ft	-
Blade		800 N·m 81.6 kgf·m 590 lbf·ft	-

7. Tighten the set screw with the specified torque.



(14) Set screw

Tightening torque

Boom	(14) Set screw	13 N·m 1.33 kgf·m 9.59 lbf·ft	-
Arm			-
Bucket			-
Swing			-
Blade		32 N·m 3.26 kgf·m 23.6 lbf·ft	-

8. Swage the set screw by hitting 2 punches to the circumference of the set screw.

9. Fasten the bottom side of cylinder in a vice.
10. Install the piston rod to the cylinder tube.

NOTE
- **Apply hydraulic oil to the piston rod.**

(11) Piston rod (15) Cylinder tube

11. Tighten the cylinder head by hook wrench or key wrench.

(5) Cylinder head

Tightening torque

Boom	(5) Cylinder head	400 N·m 40.8 kgf·m 295 lbf·ft	-
Arm			-
Bucket			-
Swing			-
Blade		600 N·m 61.2 kgf·m 443 lbf·ft	-

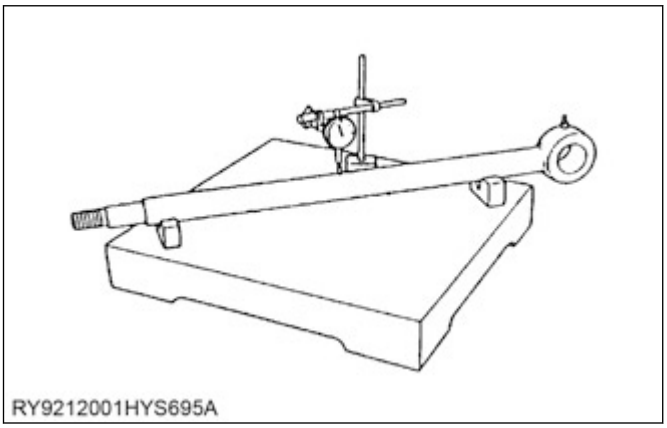
12. Set the rotation stopper.

4.5.4 Measuring hydraulic cylinder

4.5.4.1 Measuring hydraulic cylinder bending

1. Put the cylinder rod on the V blocks.
2. Set a dial gauge on center of the rod.
3. Rotate the cylinder rod slowly to measure.

■ NOTE
- **The half of measured value is bending of the rod. Replace if exceeded the service limit.**



Service specification

Bending	less than 0.05 mm less than 0.002 in.

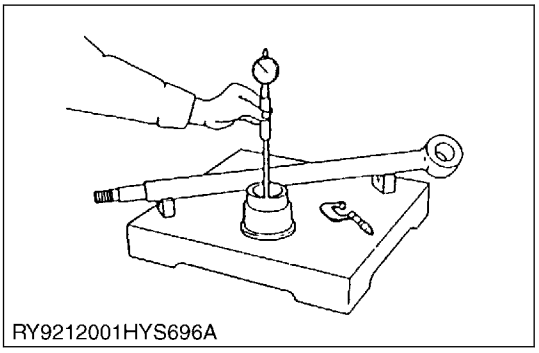
Service limit

Bending	0.5 mm 0.02 in.

4.5.4.2 Measuring hydraulic cylinder rod and head clearance

1. Measure the external diameter of cylinder rod and internal diameter of cylinder head (inside of bushings) to calculate the clearance.

■ NOTE
- **Replace if exceeded the service limit.**



Service specifications

Clearance	Boom cylinder	less than 0.25 mm less than 0.01 in.
	Arm cylinder	
	Blade cylinder	
	Swing cylinder	less than 0.3 mm less than 0.012 in.
	Bucket cylinder	

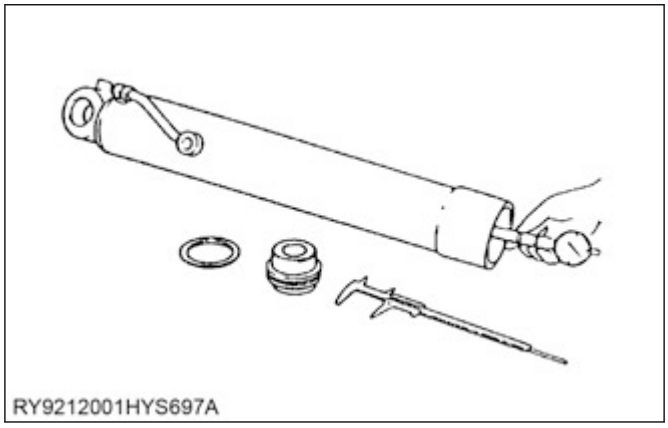
Service limits

Clearance	Boom cylinder	0.4 mm 0.016 in.
	Arm cylinder	
	Blade cylinder	
	Swing cylinder	0.5 mm 0.02 in.
	Bucket cylinder	

4.5.4.3 Measuring hydraulic cylinder tube and piston wear ring clearance

1. Measure the internal diameter of cylinder tube and external diameter of cylinder wear ring to calculate the clearance.

NOTE
- **Replace if exceeded the service limit.**



Service specifications

Clearance	Boom cylinder	0.05 to 0.35 mm 0.002 to 0.014 in.
	Arm cylinder	
	Blade cylinder	
	Swing cylinder	
	Bucket cylinder	

Service limits

Clearance	Boom cylinder	0.7 mm 0.028 in.
	Arm cylinder	
	Blade cylinder	
	Swing cylinder	
	Bucket cylinder	

4.6 Pilot control valve

4.6.1 Removing and installing the pilot control valve

CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

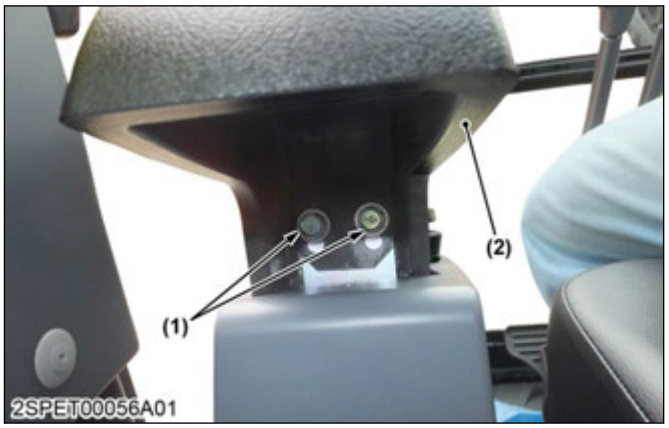
IMPORTANT
- **Install plugs to the removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing

1. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

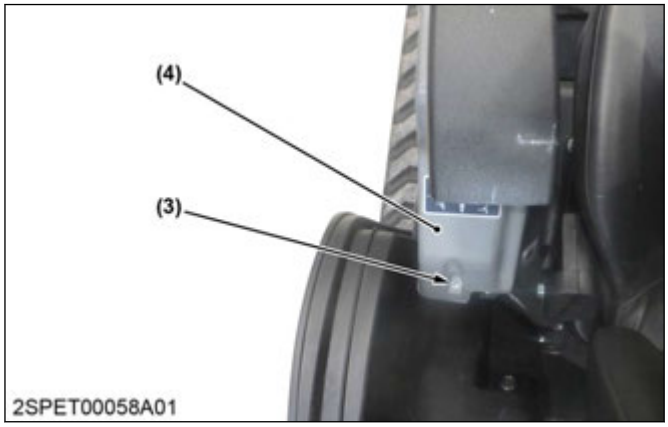
Removing

1. Remove the 2 bolts and arm rest.



(1) Bolt (M8 × 16) ×2 (2) Arm rest

2. Remove the 2 screws and lower cover.

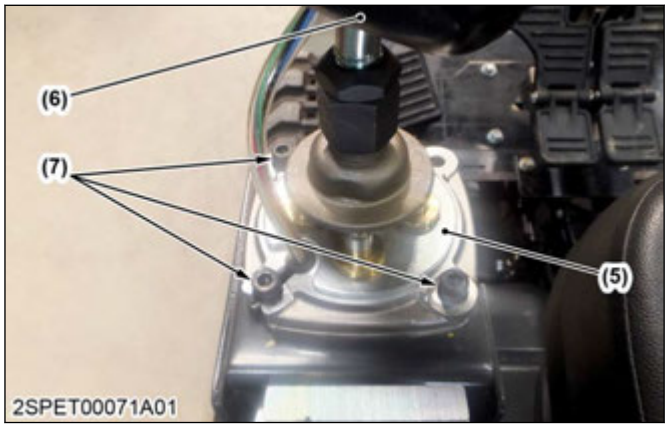


(3) Screw ×2 (4) Lower cover

3. Disconnect all of the hydraulic hoses and connector from the LH pilot control valve.

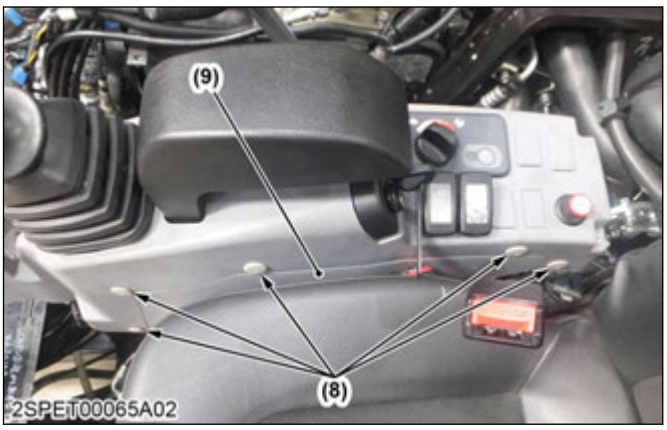
■ NOTE
- **Put marks on the disconnected hydraulic hoses to reconnect each hose correctly.**

4. Remove the boot from the LH pilot control valve.



(5) LH pilot control valve (7) Cap bolt ×3
(6) Boot

5. Remove the 3 cap bolts and LH pilot control valve.
6. Remove the 5 clips and panel.



(8) Clip ×5 (9) Panel

7. Remove the 2 bolts and arm rest.

(10) Bolt (M8 × 16) ×2 (11) Arm rest

8. Remove the 2 screws and bolt.

(12) Screw ×2 (14) Cover
(13) Bolt (M6 × 16)

9. Disconnect all of the connectors from the cover and remove the cover.
10. Disconnect all of the hydraulic hoses and connectors from the RH pilot control valve.

■ NOTE
- **Put marks on the disconnected hydraulic hoses to reconnect each hose correctly.**

11. Remove the boot from the RH pilot control valve.

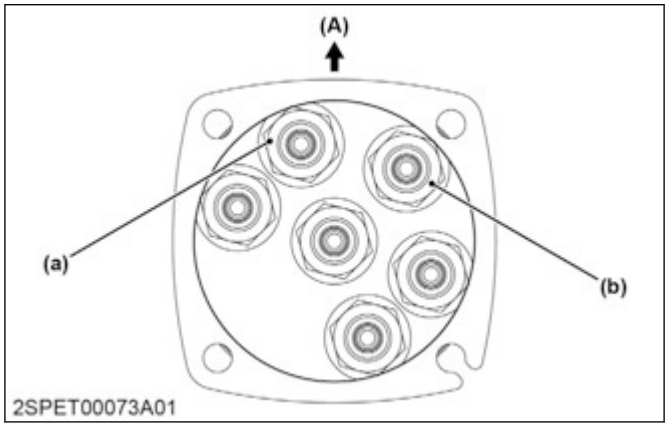
(15) RH pilot control valve
(16) Boot
(17) Cap bolt ×3

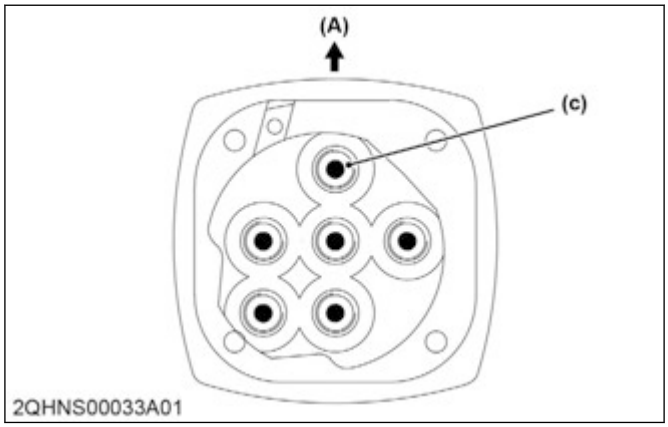
12. Remove the 3 cap bolts and pilot control valve.

Installing

■ NOTE

- **Make sure to connect the hydraulic hoses correctly.**

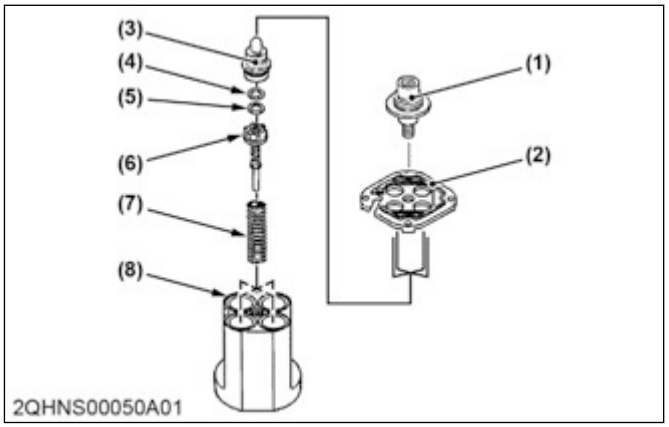




(a) Port 2
(b) Port T
(c) Port 3
(A) Forward

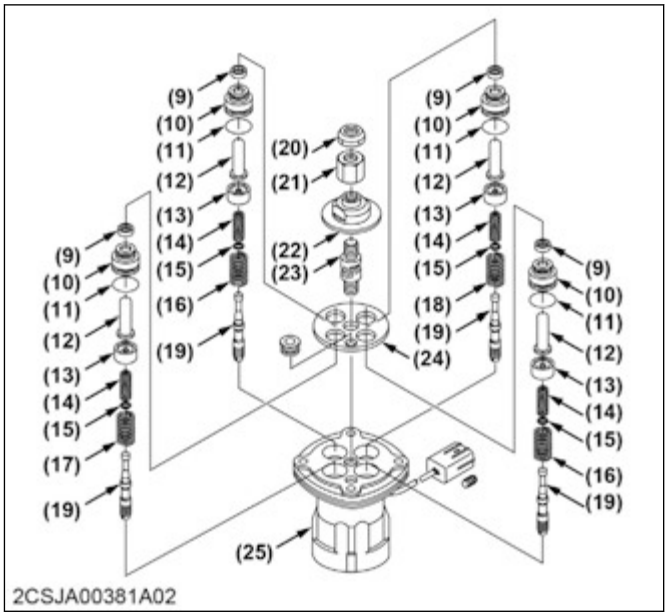
4.6.2 Pilot control valve components

Basic



(1) Universal joint
(2) Plate
(3) Plug assembly ×4
(4) Seal ×4
(5) O-ring ×4
(6) Pressure reducing valve ×4
(7) Spring ×4
(8) Casing

Hi-spec



(9) Seal ×4
(10) Plug ×4
(11) O-ring ×4
(12) Push rod ×4
(13) Spring seat ×4
(14) Spring ×4
(15) Seat ×4
(16) Spring (port 1 and 3) ×2
(17) Spring (port 2)
(18) Spring (port 4)
(19) Spool ×4
(20) Lock nut
(21) Adjusting nut
(22) Disc nut
(23) Universal joint
(24) Plate
(25) Casing

4.6.3 Disassembling the pilot control valve (basic)

■ IMPORTANT

- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**

- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**

Disassembling the pressure reducing valves

1. Fasten the pilot control valve (operating) in a vice.
2. Remove the universal joint.

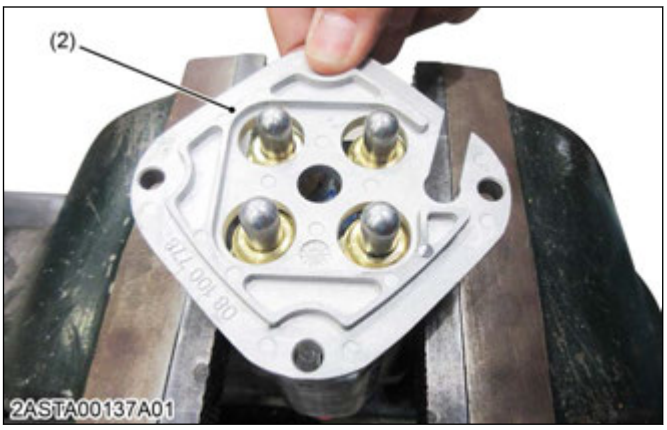
NOTE
- **Loosen the universal joint slowly to avoid the pressure reducing valves from popping out.**

(1) Universal joint

3. Put a mark on the casing and pressure reducing valves.

NOTE
- **Make sure to install pressure reducing valves in the same locations.**

4. Remove the plate.



(2) Plate

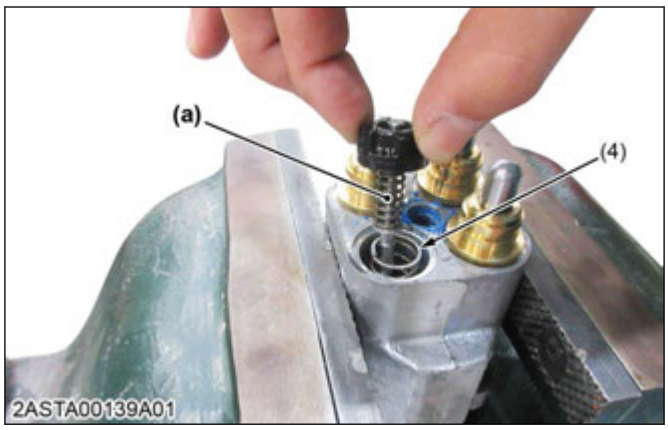
5. Remove the plugs.

NOTE
- **Use a slotted screwdriver to remove.**
- **Hold the plug with hand to avoid from popping out.**
- **Make sure not to damage the plugs.**

(3) Plug

6. Remove the pressure reducing valves assembly and spring.

NOTE
- **Put marks on each removed springs for reassembling.**

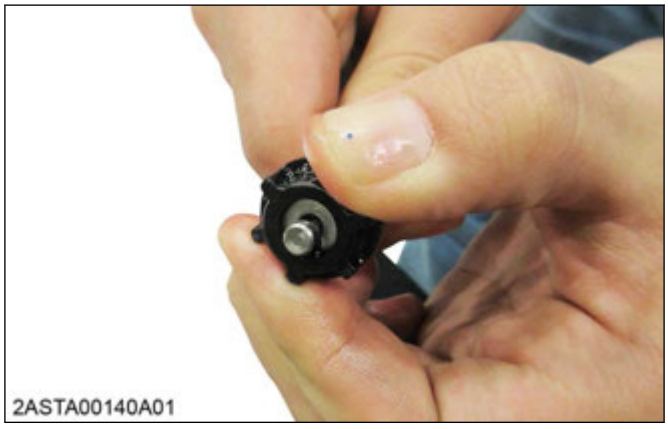


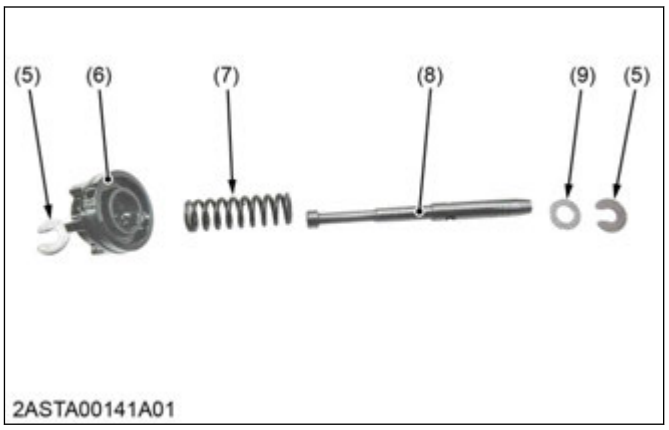
(4) Spring
(a) Pressure reducing valve

Disassembling the pressure reducing valves

1. Remove the spring seat.

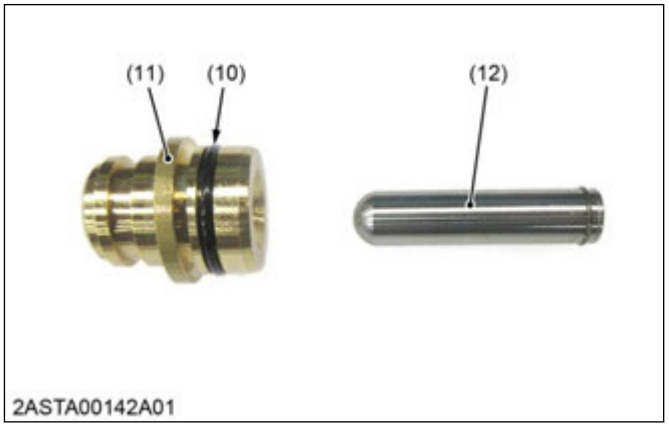
NOTE
- **Press the spring seat to compress the spring and slide to remove.**
- **Do not damage the spool.**
- **Do not compress the spring more than six millimeters.**





(5) Seat
(6) Spring seat
(7) Spring
(8) Spool
(9) Washer

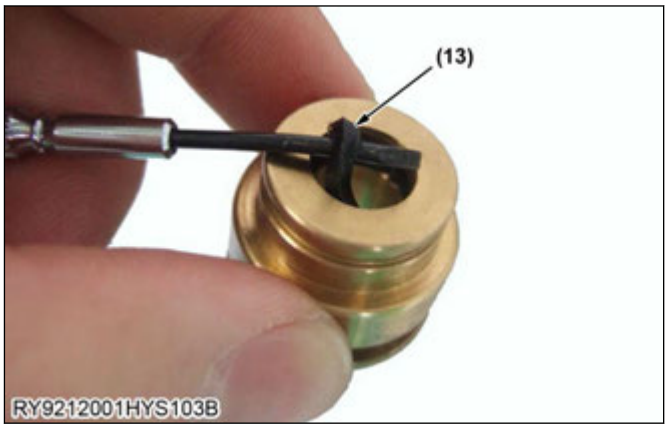
2. Remove the push rod from the plug.



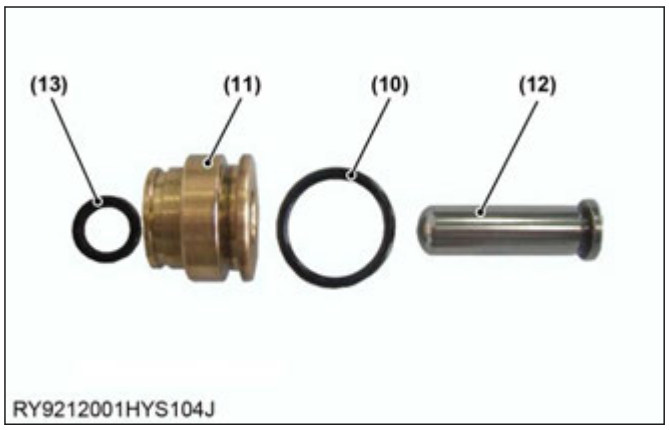
(10) O-ring
(11) Plug
(12) Push rod

3. Remove the O-ring and seal from the plug.

NOTE
- **Do not damage the plug.**



(13) Seal



(10) O-ring
(11) Plug
(12) Push rod
(13) Seal

4.6.4 Assembling the pilot control valve (basic)

■ IMPORTANT

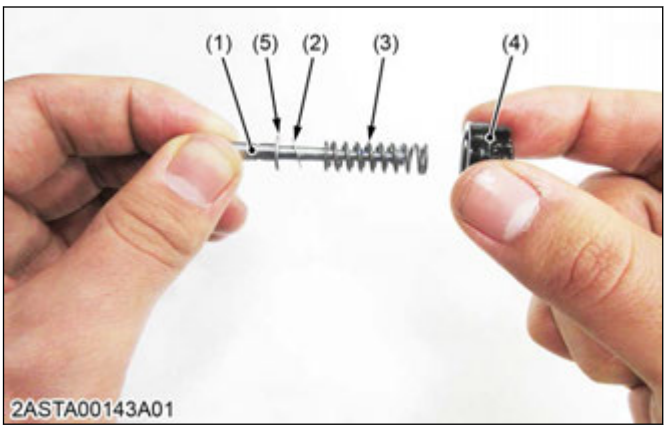
- **Do not reuse removed O-rings and oil seals for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

Assembling the pressure reducing valves

1. Assemble the seat, spring, and spring seat to the spool, in order.

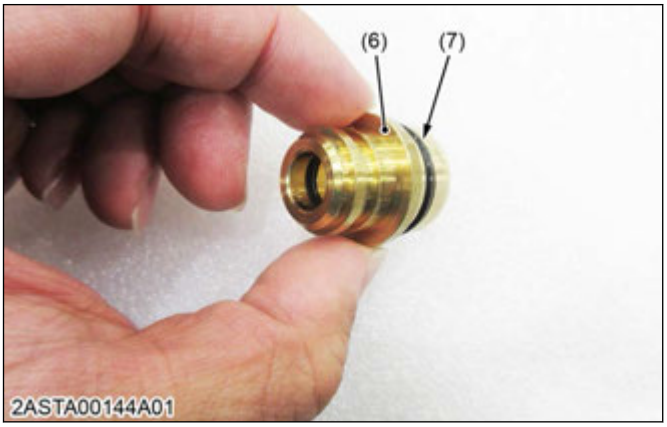
■ IMPORTANT

- **Do not compress the spring more than six millimeters.**



(1) Spool
(2) Washer
(3) Spring
(4) Spring seat
(5) Seat

2. Install the O-ring to the plug.

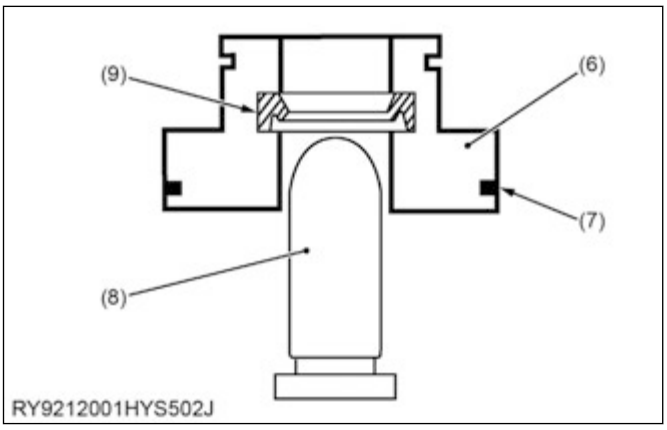


(6) Plug
(7) O-ring

3. Install the seal to the plug.

■ NOTE

- **Apply hydraulic oil to the seal.**
- **Install the seal in correct direction.**

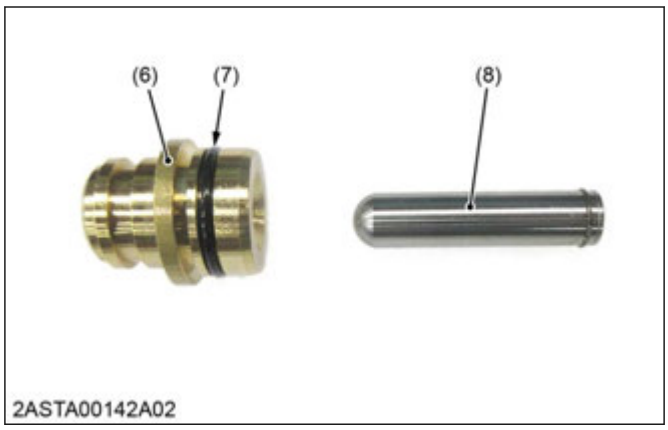


(6) Plug
(7) O-ring
(8) Push rod
(9) Seal

4. Install the push rod to the plug.

■ NOTE

- **Apply hydraulic oil to the plug.**

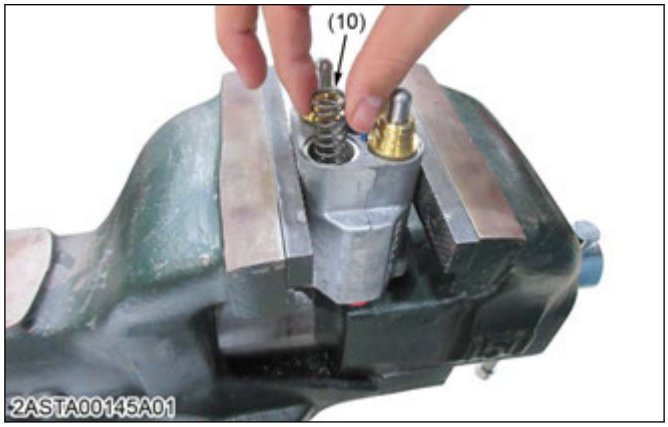


(6) Plug
(7) O-ring
(8) Push rod

Installing the pressure reducing valves

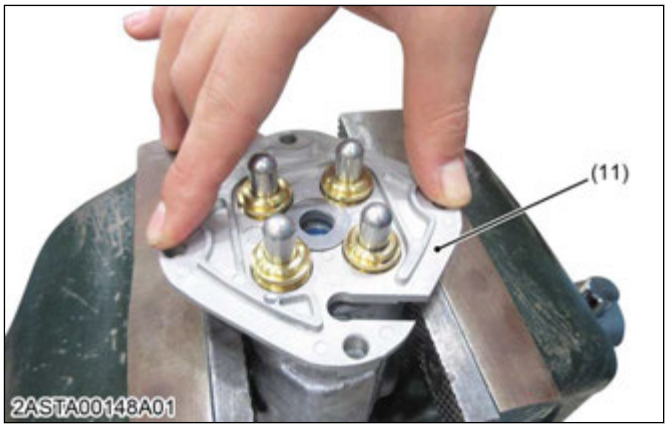
1. Install the springs, pressure reducing valves, and plugs to the casing, in order.

NOTE
- **Install each parts to same location.**



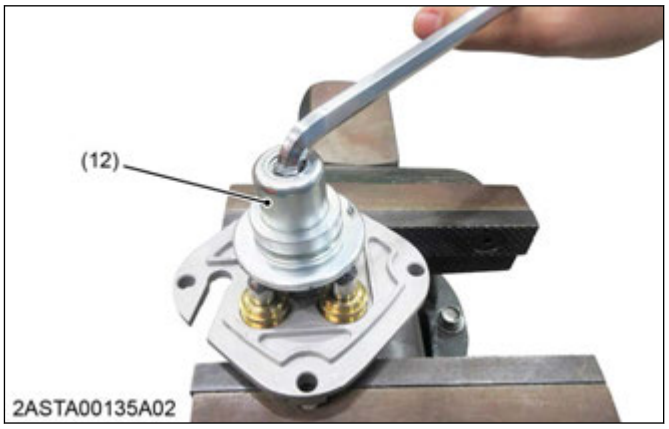
(10) Spring

2. Install the plate.



(11) Plate

3. Install the universal joint.



(12) Universal joint

Tightening torque

(12) Universal joint	45 to 55 N·m 4.6 to 5.6 kgf·m 33.2 to 40.6 lbf·ft	Thread lock (Loctite 262)

4. Grease the universal joint and push rod.

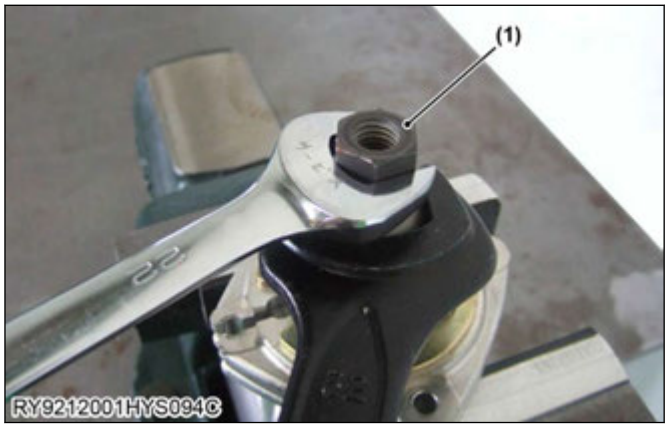
4.6.5 Disassembling the pilot control valve (Hi-spec)

■ IMPORTANT

- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**

Disassembling the pressure reducing valves

1. Fasten the pilot control valve (operating) in a vice.
2. Remove the adjusting nut and disc nut.



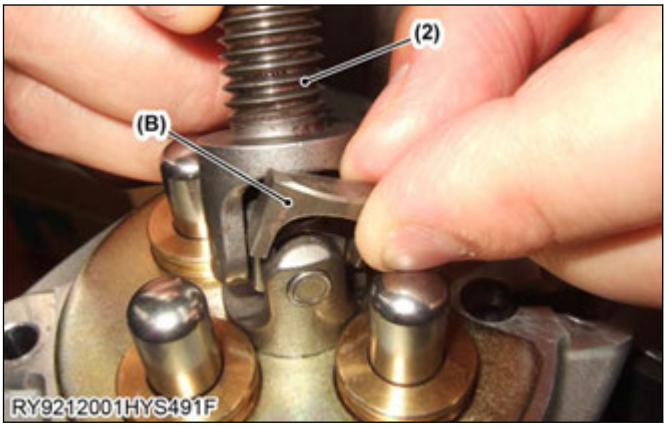
(1) Adjusting nut

3. Put a mark on the casing and pressure reducing valves.

■ NOTE

- **Make sure to install pressure reducing valves in same locations.**

4. Install the jig B to the universal joint.

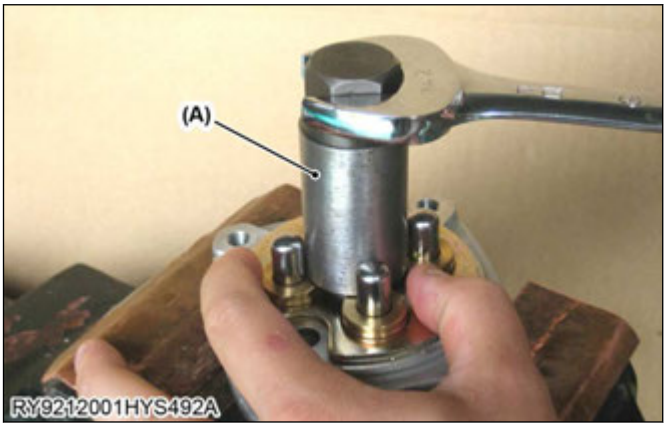


(2) Universal joint (B) Jig B ×2

5. Remove the universal joint. Use the jig A to loosen.

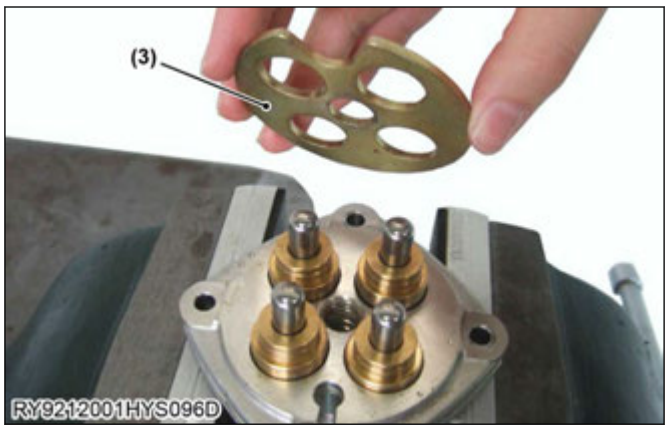
■ NOTE

- **Loosen the universal joint slowly to avoid the pressure reducing valves from popping out.**



(A) Jig A

6. Remove the plate.



(3) Plate

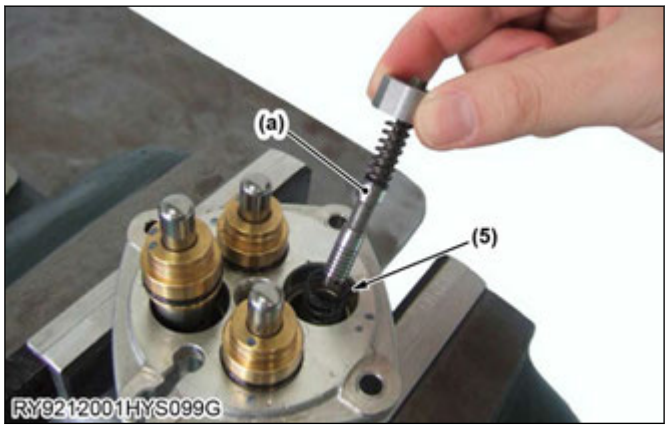
7. Remove the plug.

NOTE
- **Use a slotted screwdriver to remove.**
- **Hold the plug with hand to avoid from popping out.**
- **Make sure not to damage the plug.**

(4) Plug

8. Remove the pressure reducing valves assembly and springs.

NOTE
- **Put a mark on each removed spring and install them to same locations.**

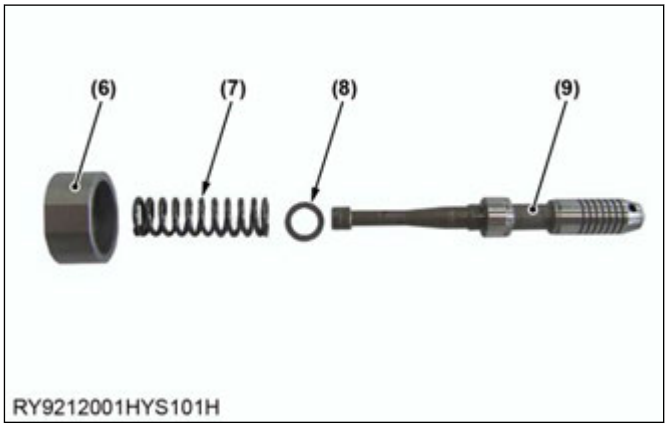


(5) Spring
(a) Pressure reducing valve

Disassembling the pressure reducing valves

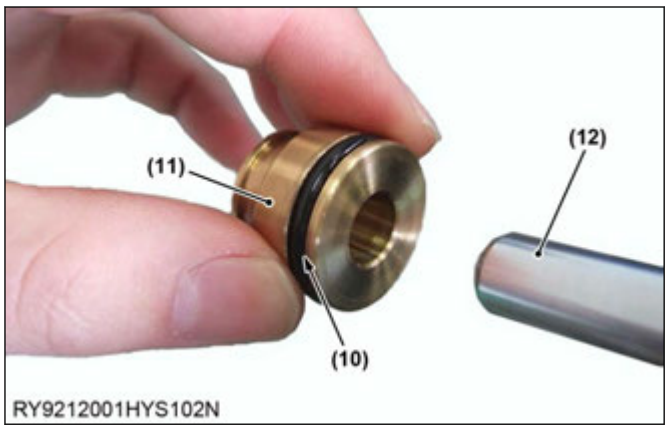
1. Remove the spring seat.

NOTE
- **Press the spring seat to compress the spring and slide to remove.**
- **Do not damage the spool.**
- **Do not compress the spring more than six millimeters.**



(6) Spring seat
(7) Spring
(8) Seat 2
(9) Spool

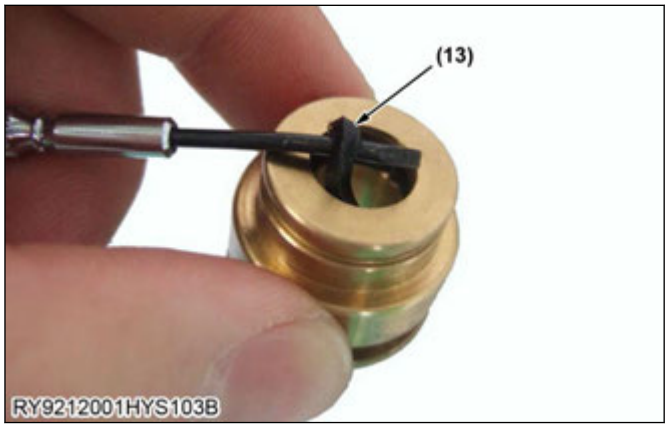
2. Remove the push rod from the plug.



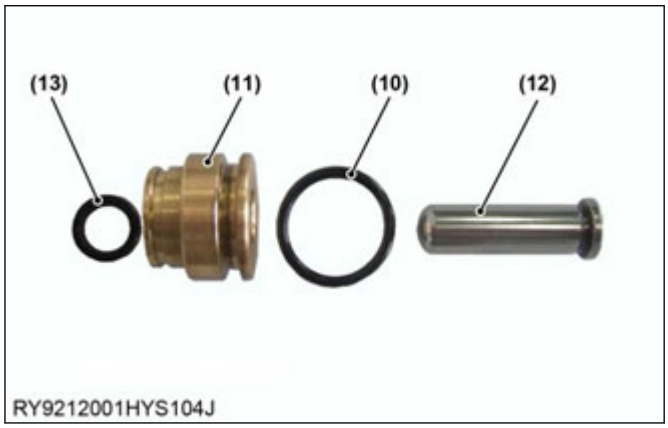
(10) O-ring
(11) Plug
(12) Push rod

3. Remove the O-ring and seal from the plug.

■ NOTE
- **Do not damage the plug.**



(13) Seal



(10) O-ring
(11) Plug
(12) Push rod
(13) Seal

4.6.6 Assembling the pilot control valve (Hi-spec)

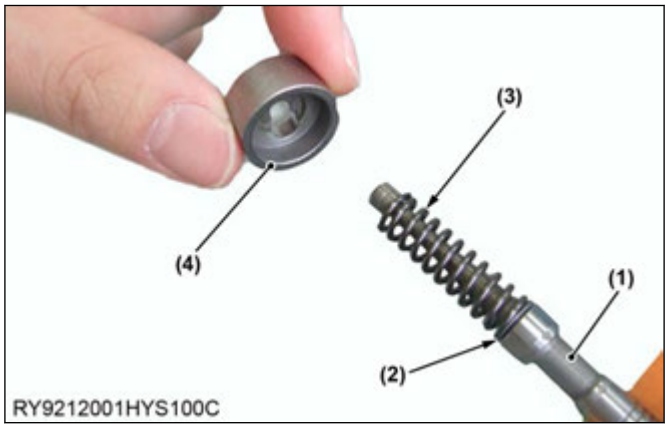
■ IMPORTANT
- **Do not reuse removed O-rings and oil seals for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

Assembling the pressure reducing valves

1. Assemble the seat, spring, and spring seat to the spool, in order.

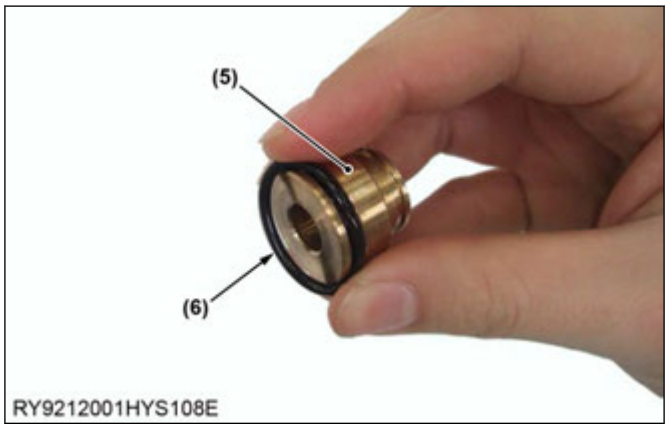
IMPORTANT

- **Do not compress the spring more than six millimeters.**



(1) Spool
(2) Seat 2
(3) Spring
(4) Spring seat

2. Install the O-ring to the plug.

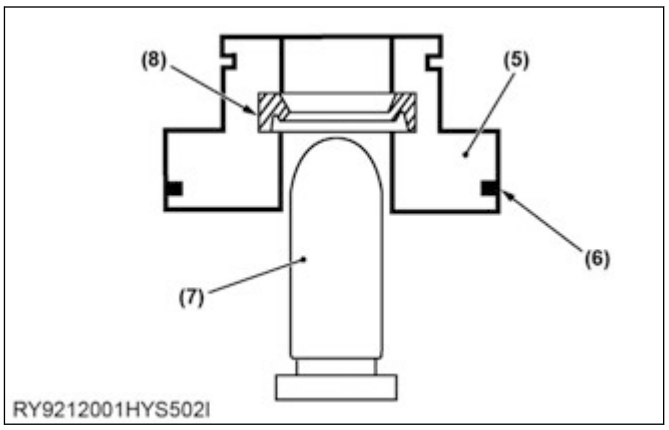


(5) Plug
(6) O-ring

3. Install the seal to the plug.

NOTE

- **Apply hydraulic oil to the seal.**
- **Install the seal in correct direction.**

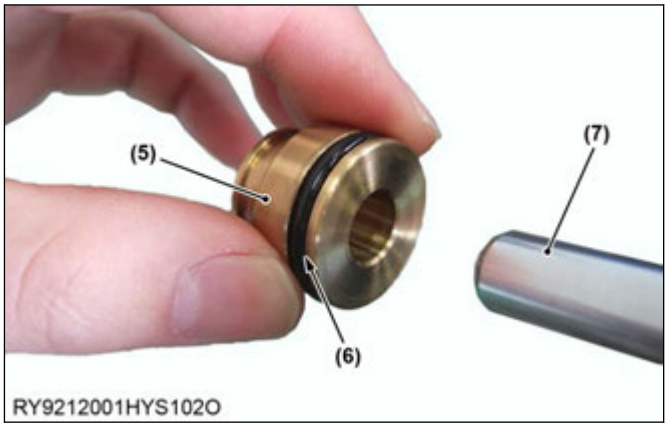


(5) Plug
(6) O-ring
(7) Push rod
(8) Seal

4. Install the push rod to the plug.

NOTE

- **Apply hydraulic oil to the plug.**



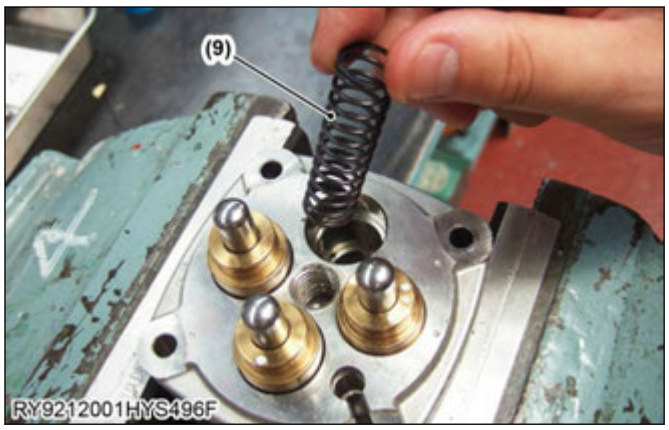
(5) Plug
(6) O-ring
(7) Push rod

Installing the pressure reducing valves

1. Install the springs, pressure reducing valves, and plugs to the casing, in order.

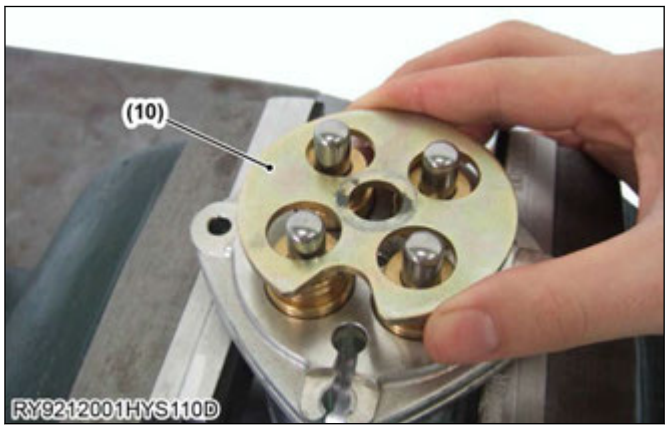
NOTE

- **Install each parts to same location.**



(9) Spring

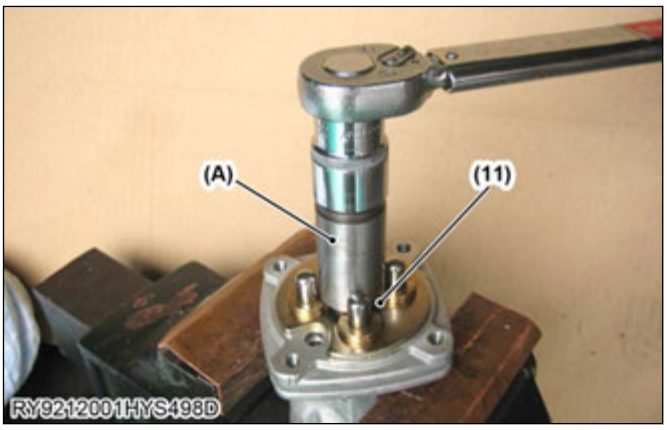
2. Install the plate.



(10) Plate

3. Install the universal joint.

NOTE
- **Use the jig A to install.**



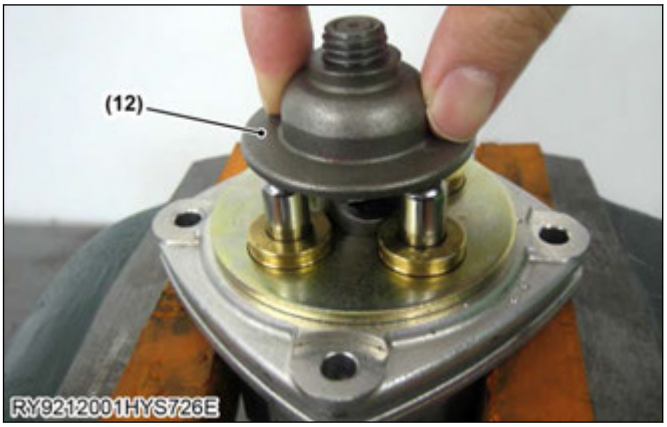
(11) Universal joint (A) Jig A

Tightening torque

(11) Universal joint	44 to 50 N·m 4.5 to 5.1 kgf·m 32.5 to 36.9 lbf·ft	-

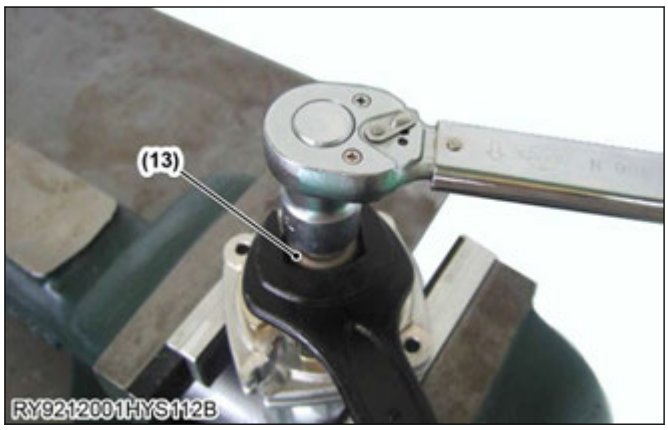
4. Install the disc nut.

NOTE
- **Tighten the disc nut until the tip of the four push rods of the pressure reducing valves touches evenly.**
- **Do not screw in the disc nut excessively to avoid the machine from malfunctioning.**



(12) Disc nut

5. Tighten the adjusting nut.



(13) Adjusting nut

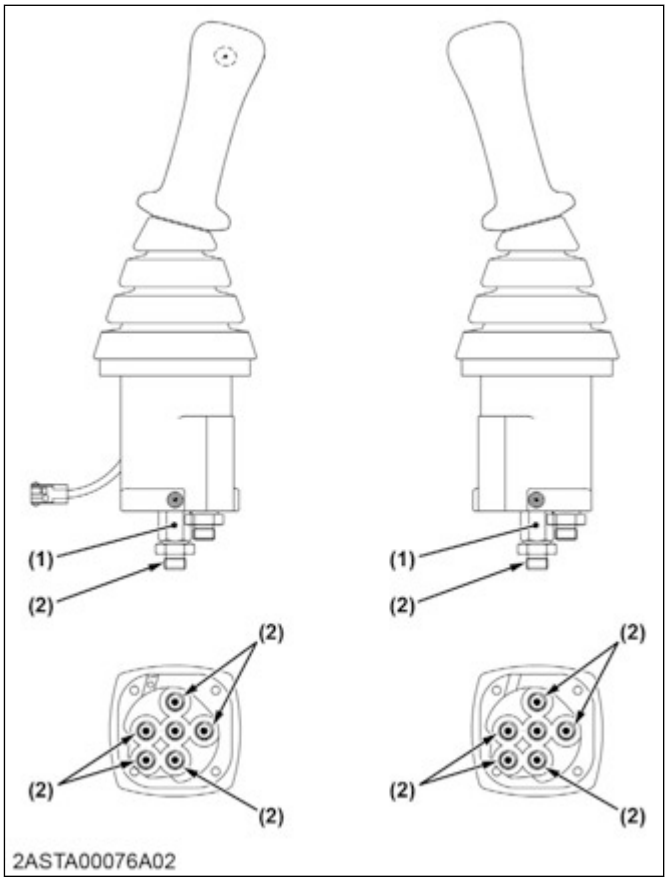
Tightening torque

(13) Adjusting nut	63.7 to 73.5 N·m 6.5 to 7.5 kgf·m 47.0 to 54.2 lbf·ft	-

6. Grease the universal joint and push rods.

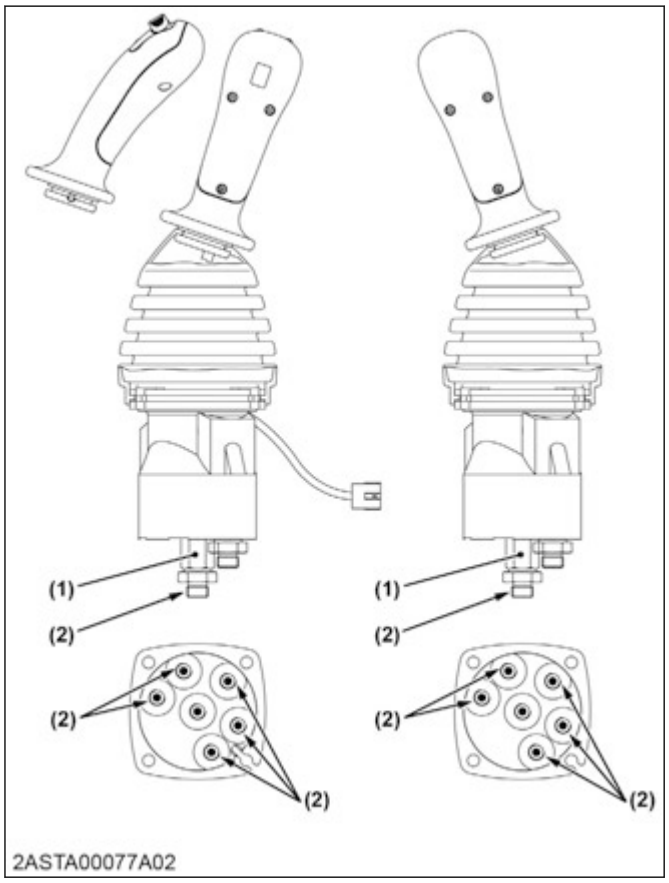
4.6.7 Installing adapter layout for the pilot control valve

Basic



Adapter No.	Adapter size	Adapter angle
(1)	G1/4-G1/4 (filter)	-
(2)	G1/4-M14	-

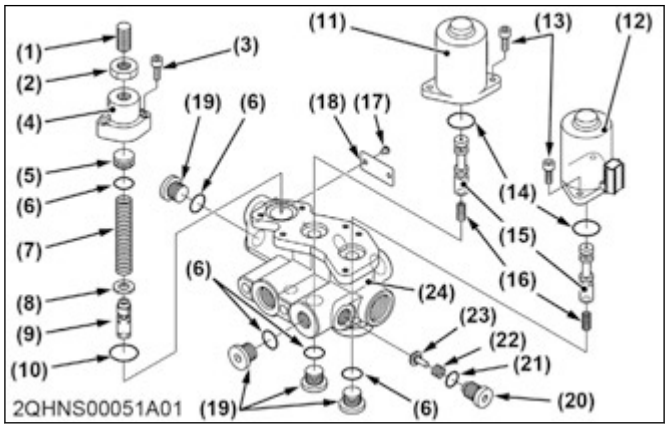
Hi-spec



Adapter No.	Adapter size	Adapter angle
(1)	G1/4-G1/4 (filter)	-
(2)	G1/4-M14	-

4.7 Unload valve

4.7.1 Unload valve components



(1) Adjusting screw
(2) Locknut
(3) Cap bolt ×2
(4) Cover
(5) Plug
(6) O-ring ×5
(7) Spring
(8) Spring seat
(9) Plunger
(10) O-ring
(11) Solenoid
(12) Solenoid
(13) Cap bolt ×4
(14) O-ring ×2
(15) Spool ×2
(16) Spring ×2
(17) Screw
(18) Plate
(19) Plug ×4
(20) Plug
(21) O-ring
(22) Spring
(23) Plunger
(24) Valve body

4.7.2 Disassembling and assembling the unload valve

■ IMPORTANT

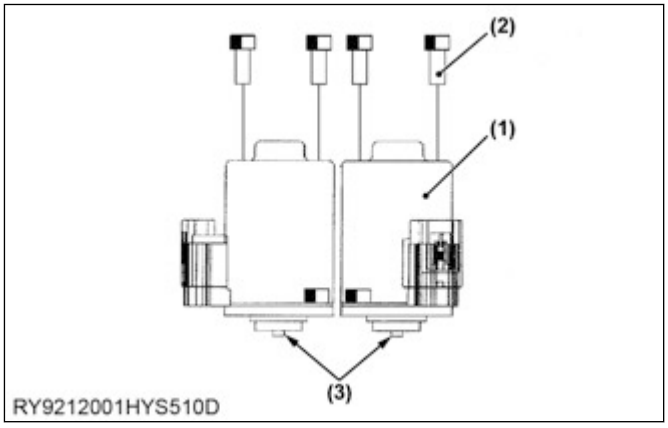
- **Do not reuse removed O-rings for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

Disassembling

1. Remove four cap bolts and the solenoid.

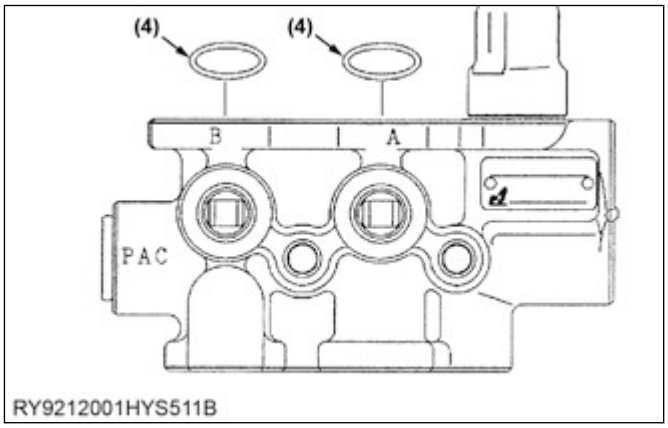
■ NOTE

- **Make sure not to drop the push rod.**



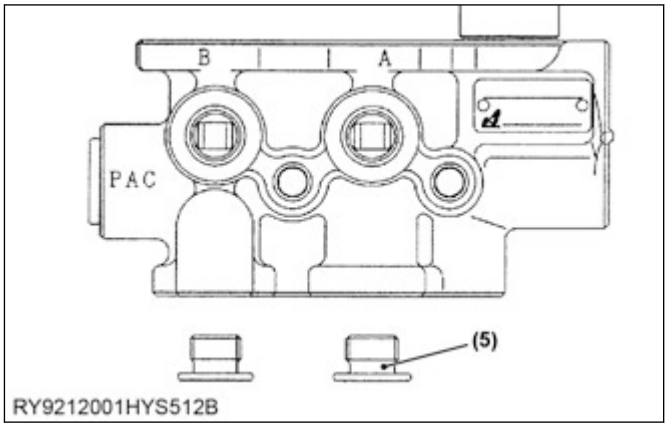
(1) Solenoid
(2) Cap bolt
(3) Push rod

2. Remove two O-rings.



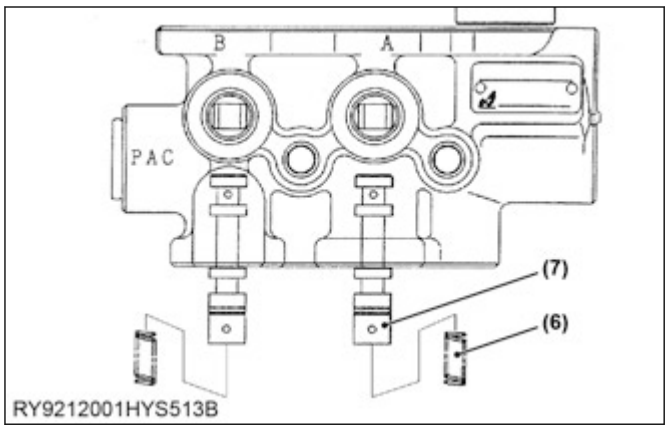
(4) O-ring

3. Remove two flanged plugs.



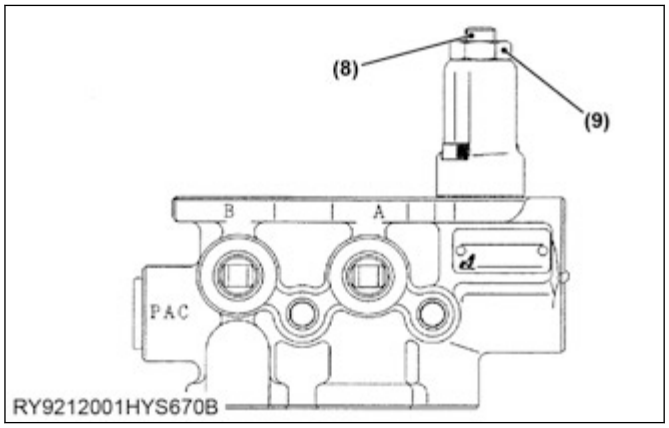
(5) Flanged plug

4. Remove the spring and spool.



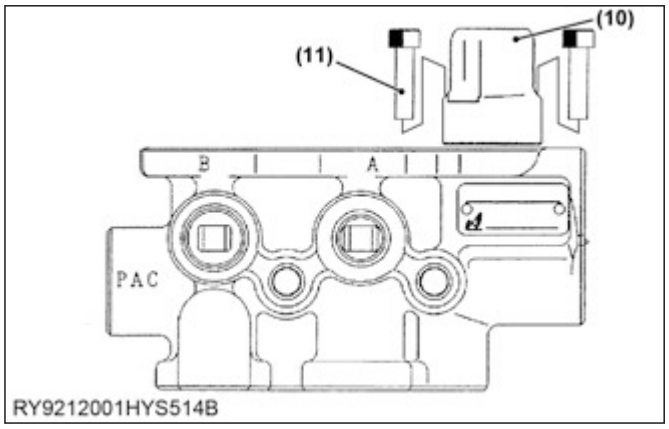
(6) Spring (7) Spool

5. Remove the nut and adjusting screw.



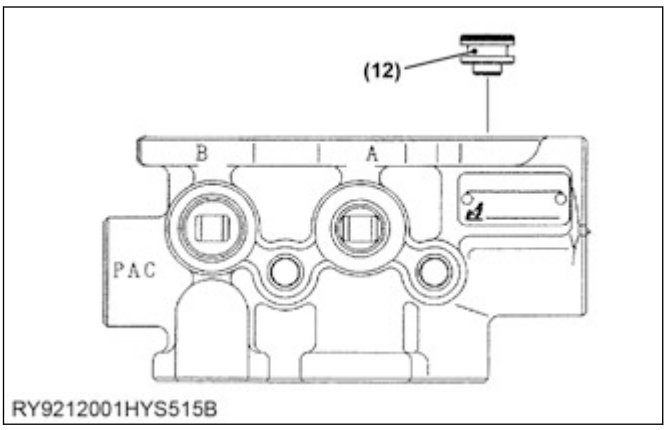
(8) Adjusting screw (9) Nut

6. Remove cap bolts and the cover.



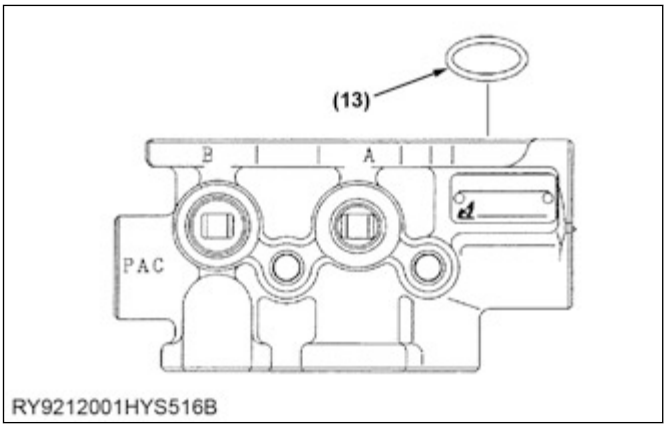
(10) Cover (11) Cap bolt

7. Remove the plug.



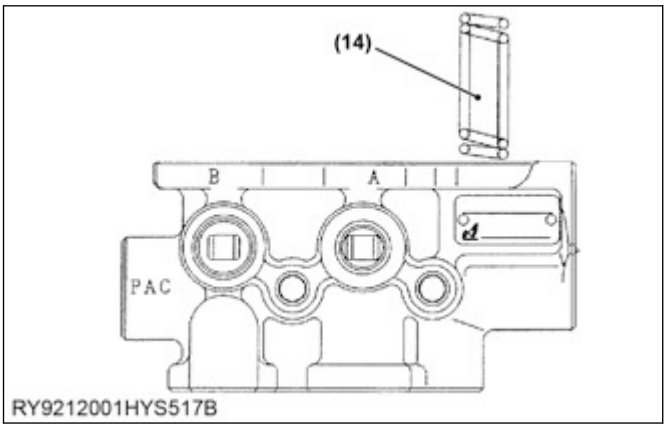
(12) Plug

8. Remove the O-ring.



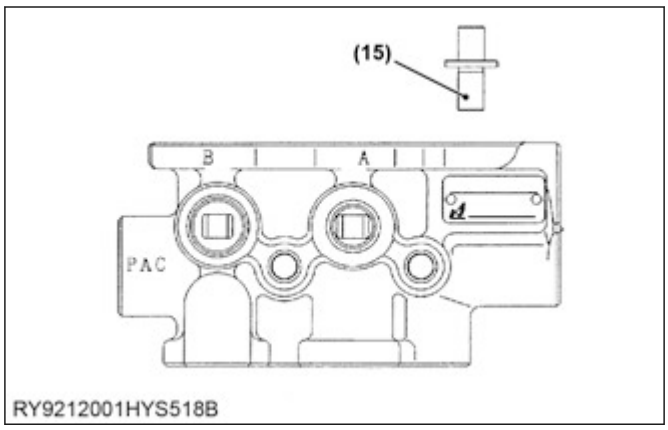
(13) O-ring

9. Remove the spring.



(14) Spring

10. Remove the plunger.



(15) Plunger

Assembling

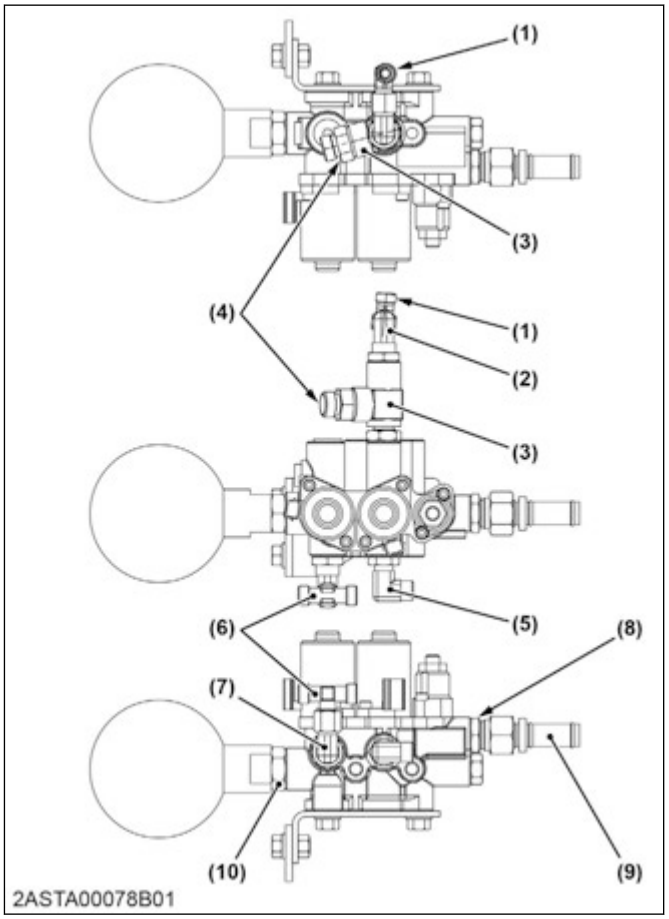
■ IMPORTANT

- **When installing the solenoid to the body, set the O-ring to the solenoid before installing.**
- **Grease the O-rings.**
- **Apply hydraulic oil to spools and plungers.**

Tightening torque

(5) Flanged plug	26.5 N·m 2.7 kgf·m 19.6 lbf·ft	-
(2) (11) Cap bolt	3.92 N·m 0.4 kgf·m 2.9 lbf·ft	
(9) Nut	15.7 N·m 1.6 kgf·m 11.6 lbf·ft	

4.7.3 Installing adapter layout for the unload valve



Adapter No.	Size	Angle
(1)	M14-M14	6°
(2)	G3/8-M14	-
(3)	G3/8-G3/8-G3/8	15°
(4)	G3/8-M18	-
(5)	G1/4-M14	-
(6)	M14-M14-M14	-
(7)	G3/8-M14	-
(8)	G3/8-M22	-
(9)	M22-ϕ16.2	-
(10)	G3/8-G1/2	-

4.8 Swivel joint

4.8.1 Removing and installing the swivel joint

⚠ CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

■ IMPORTANT
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing
1. Remove the canopy or cabin.
2. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.
3. Remove the swivel motor.

Removing
1. Disconnect all of the hydraulic hoses on swivel frame side.

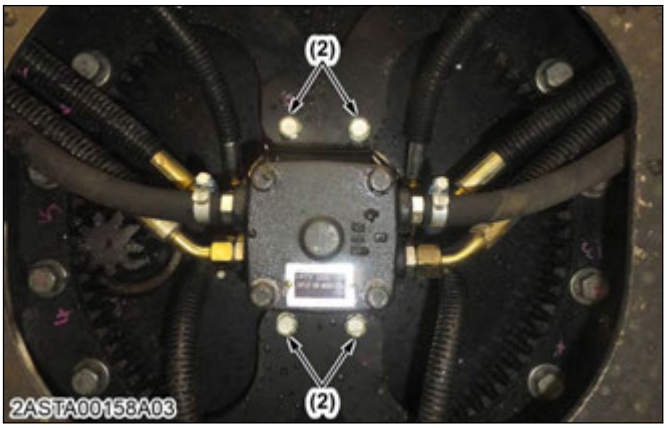
(1) Swivel joint

2. Remove the bottom cover of the track frame.
3. Disconnect all of the hydraulic hoses on the bottom side.

4. Attach a nylon sling and hoist the swivel joint for support.

5. Remove four mounting bolts.

■ IMPORTANT
- **Loosen the bolts slowly to avoid the swivel joint from falling.**



(2) Bolt (M12 × 35) ×4

6. Remove the swivel joint carefully.

(1) Swivel joint

Mass

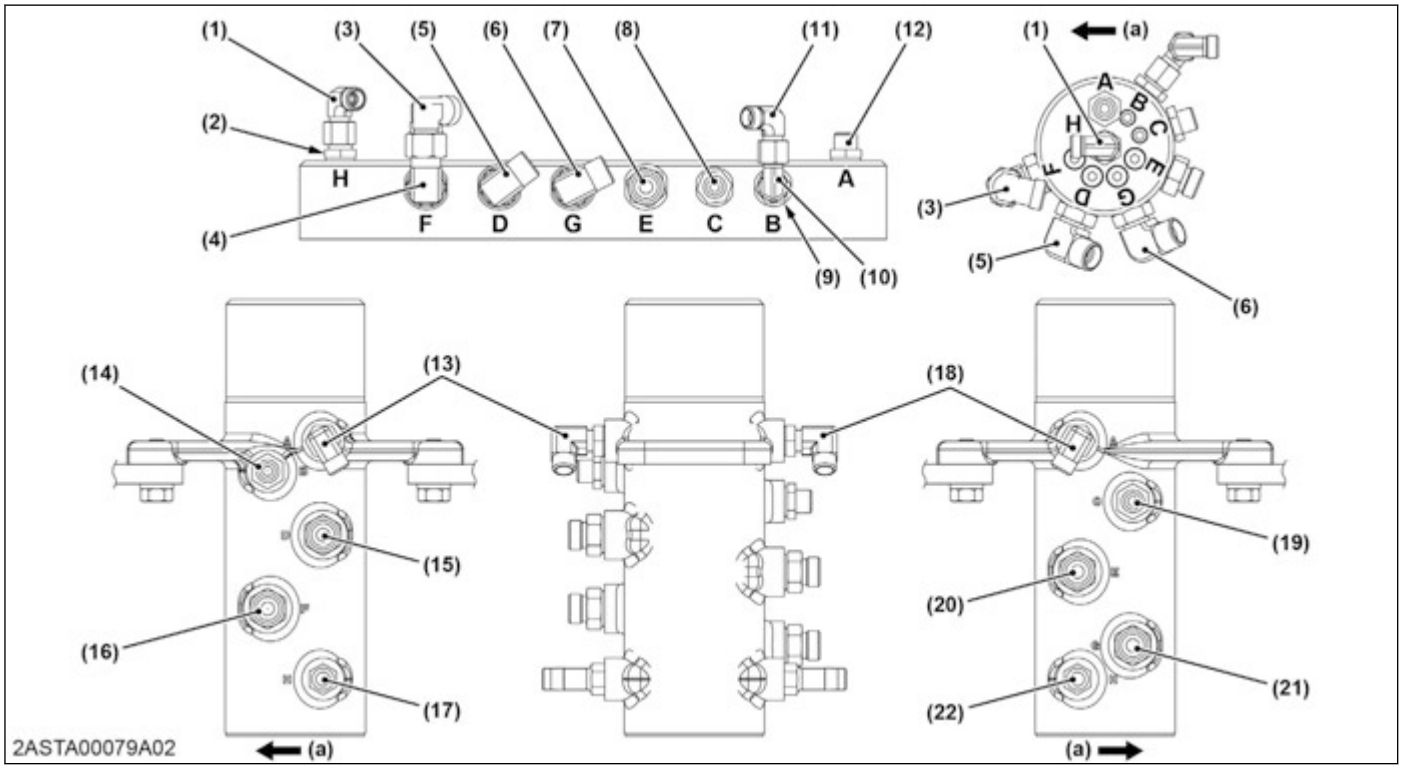
(1) Swivel joint	Approximately 11.5 kg Approximately 25.4 lbs

Installing

Tightening torque

(2) Bolt	77.5 to 90.2 N·m 7.9 to 39.2 kgf·m 57.2 to 66.5 lbf·ft	Thread lock (Loctite 302-71)

4.8.2 Installing adapter layout for the swivel joint



(a) Forward

Adapter No.	Adapter size	Angle	Adapter No.	Adapter size	Angle
(1)	M14-M14	-	(12)	G1/4-M14	-
(2)	G1/4-M14	-	(13)	G1/4-M14	60°
(3)	M18-M18	13°	(14)	G1/4-M14	-
(4)	G3/8-M18	-	(15)	G3/8-M22	-
(5)	G3/8-M18	37°	(16)	G3/8-M22	-
(6)	G3/8-M18	27°	(17)	G/1/4-ϕ13	-
(7)	G3/8-M18	-	(18)	G1/4-M14	60°
(8)	G1/4-M14	-	(19)	G1/4-M14	-
(9)	G1/4-M14	-	(20)	G3/8-M22	-
(10)	M14-M14	-	(21)	G3/8-M22	-
(11)	M14-M14	-	(22)	G/1/4-ϕ13	-

4.9 Proportional valve

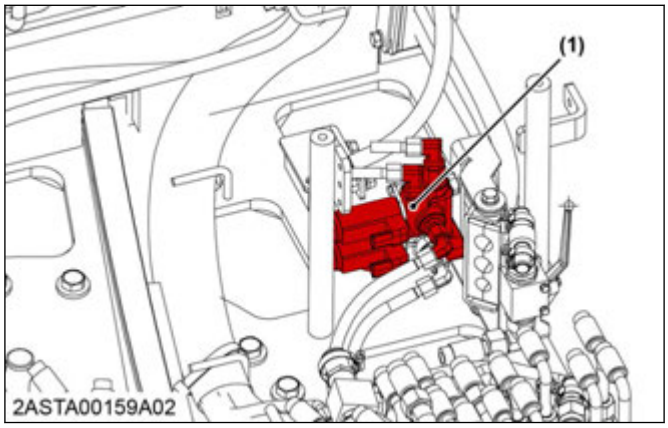
4.9.1 Removing and installing the AUX1 proportional valve

⚠ CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

■ IMPORTANT
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

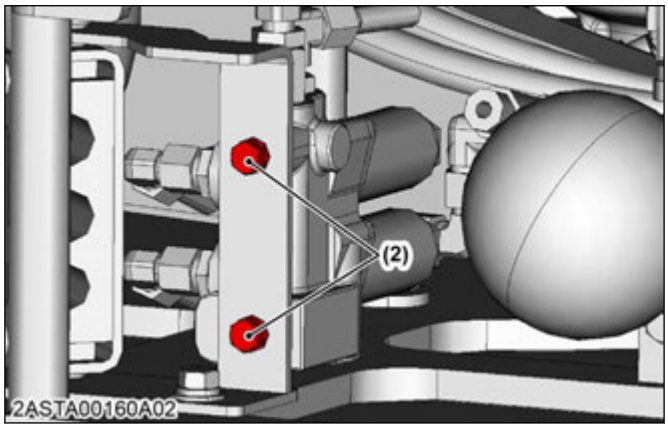
Preparing
1. Remove the front swivel cover, LH swivel cover and floor plate.
2. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

Removing
1. Disconnect all of the hydraulic hoses and connectors from the AUX1 proportional valve.



(1) AUX1 proportional valve

2. Remove the 2 bolts and AUX1 proportional valve.



(2) Bolt (M8 × 16) ×2

Installing

Tightening torque

(2) Bolt	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.3 to 20.1 lbf·ft	-

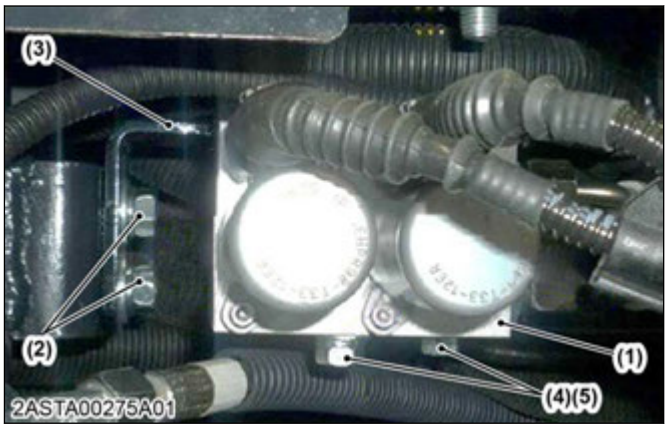
4.9.2 Removing and installing the AUX2 proportional valve

⚠ CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

■ IMPORTANT
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

Preparing
1. Remove the floor plate.
2. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

Removing
1. Disconnect all of the hydraulic hoses and connectors from the AUX2 proportional valve.



(1) AUX2 proportional valve
(2) Bolt (M10 × 20) ×2
(3) Bracket
(4) Bolt (M8 × 65) ×2
(5) Washer ×2

2. Remove the 4 bolts and AUX2 proportional valve and bracket.

Installing

Tightening torque

(2) Bolt	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.3 to 41.1 lbf·ft	-
	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.3 to 20.1 lbf·ft	-

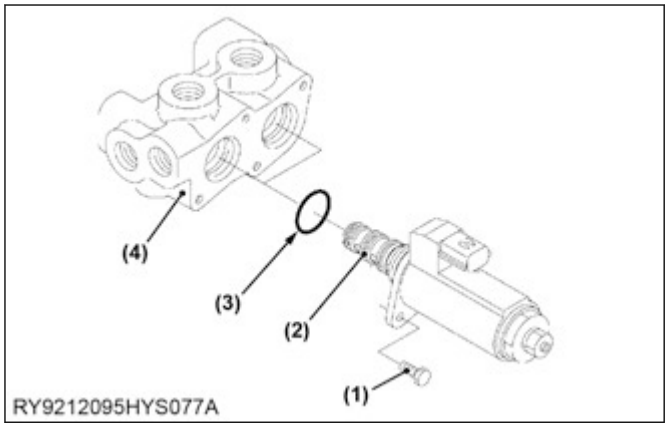
4.9.3 Disassembling and assembling the AUX1 proportional valve

IMPORTANT

- **Do not reuse removed O-rings for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

Disassembling

1. Remove the cap bolt, proportional solenoid, and O-ring.



(1) Cap bolt
(2) Proportional solenoid
(3) O-ring
(4) Case

Assembling

Tightening torque

(1) Cap bolt	6 to 8 N·m 0.6 to 0.8 kgf·m 4.5 to 5.9 lbf·ft	-

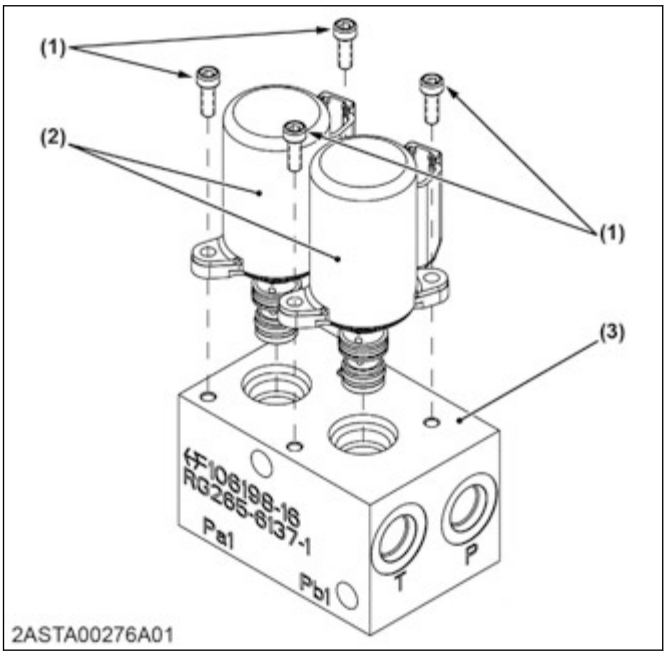
4.9.4 Disassembling and assembling the AUX2 proportional valve

IMPORTANT

- **Do not reuse removed O-rings for assembling to avoid oil leakage.**
- **Work at clean work space with clean tools and lubricants when assembling and disassembling working for hydraulic devices.**
- **Check scratches or damages carefully on the sliding and mating surface for every part. There might be cause of the oil leakage.**
- **Do not wipe parts with waste clothes, etc. to avoid fibers waste contaminating. Use air pressure when cleaning the parts.**
- **Apply lubricants or greases to every seal to avoid damage when assembling.**

Disassembling

1. Remove the cap bolts, proportional solenoid, and O-ring.



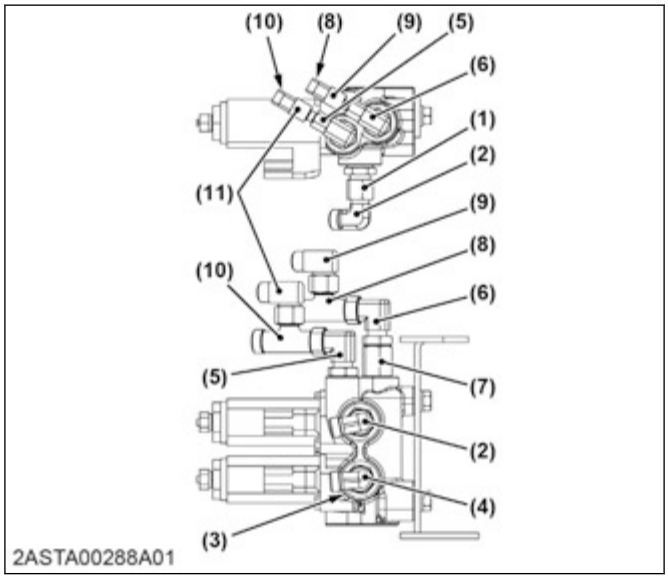
(1) Cap bolt ×4
(2) Proportional solenoid ×2
(3) Valve body

Assembling

Tightening torque

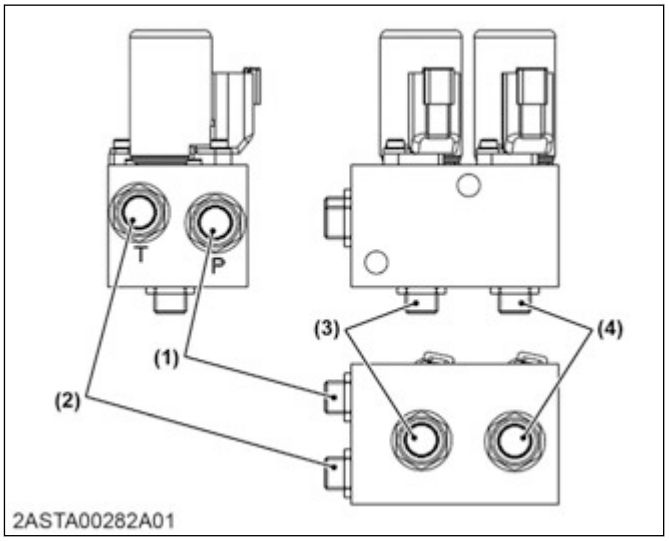
(1) Cap bolt	2 N·m 0.2 kgf·m 1.5 lbf·ft	-

4.9.5 Installing adapter layout for the AUX1 proportional valve



Adapter No.	Adapter size	Angle
(1)	G1/4-M14	-
(2)	M14-M14	12°
(3)	G1/4-M14	-
(4)	M14-M14	5°
(5)	G1/4-M14	30°
(6)	G1/4-M14	30°
(7)	G1/4-G1/4	-
(8)	M14-M14-M14	-
(9)	M14-M14	-
(10)	M14-M14-M14	-
(11)	M14-M14	-

4.9.6 Installing adapter layout for the AUX2 proportional valve



Adapter No.	Adapter size	Angle
(1)	G1/4-M14	-
(2)	G1/4-M14	-
(3)	G1/4-M14	-
(4)	G1/4-M14	5°

4.10 Third line valve

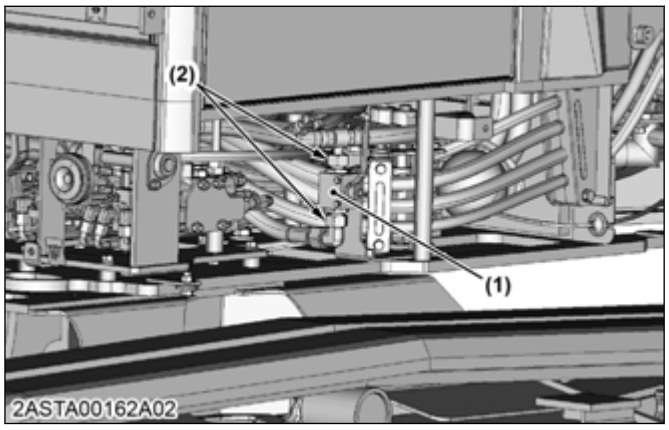
4.10.1 Removing and installing the third line valve

⚠ CAUTION
- **The hydraulic devices and oil are extremely hot. Handle with care before preparation, measurement, and restoration.**
- **Before disconnecting the hydraulic hoses, release the residual pressure first.**

■ IMPORTANT
- **Install plugs to removed hydraulic hoses and adapters to avoid oil leakage and dust contamination.**

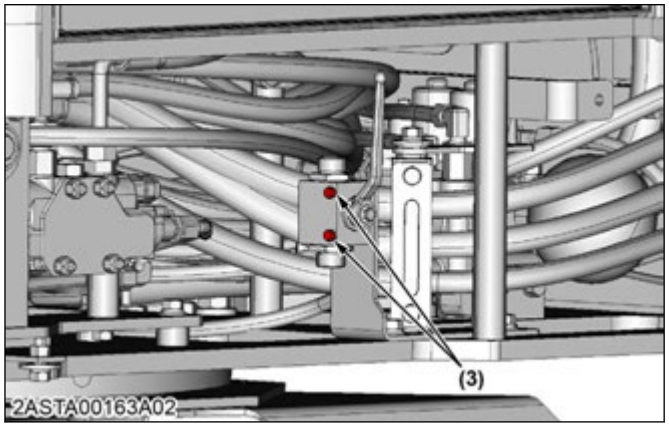
Preparing
1. Remove the front swivel cover and LH swivel cover.
2. Install the vacuum pump to the hydraulic tank and vacuum the hydraulic tank.

Removing
1. Disconnect all of the hydraulic hoses.



(1) Third line valve (2) Adapter (M22)

2. Remove 2 bolts.



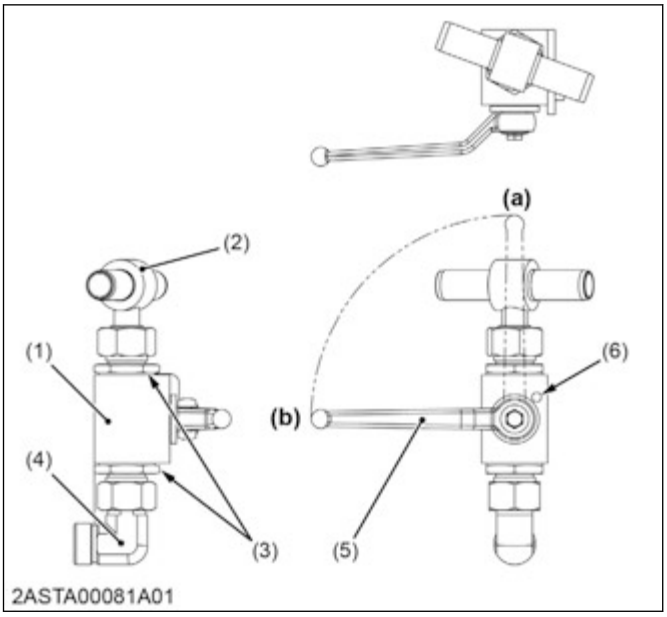
(3) Bolt (M5 × 45) ×2

Installing

Tightening torque

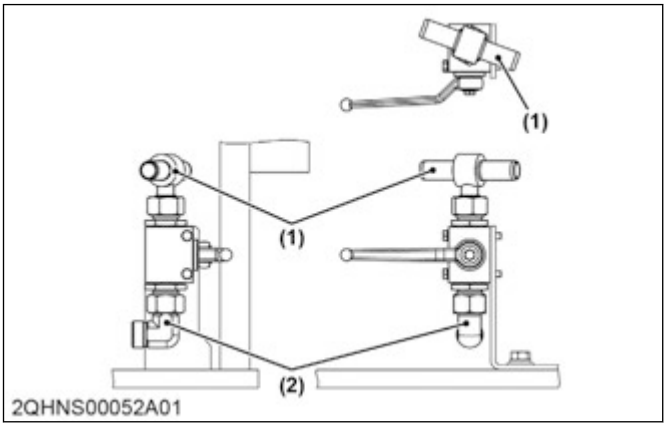
(2) Adapter	50 to 55 N·m 5.1 to 5.6 kgf·m 36.9 to 40.6 lbf·ft	-
(3) Bolt	3 to 4 N·m 0.3 to 0.4 kgf·m 2.21 to 2.95 lbf·ft	-

4.10.2 Third line valve components



(1) Body
(2) Adapter
(3) Adapter ×2
(4) Adapter
(5) Lever
(6) Spring pin
(a) Close (AUX RH side is linked to C/V AUX RH)
(b) Open (AUX RH side is linked to C/V AUX RH and oil cooler)

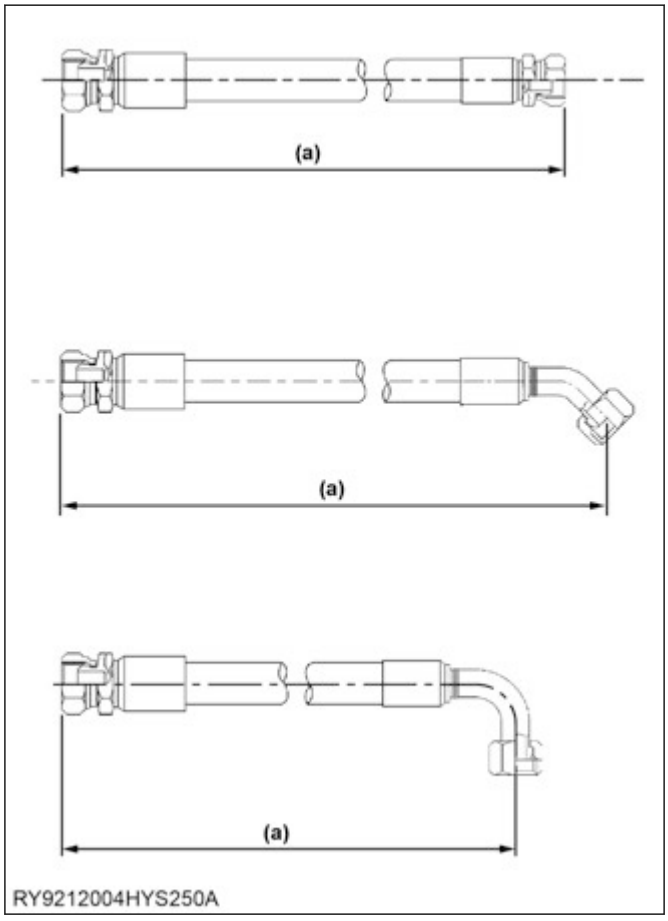
4.10.3 Installing adapter layout for the third line valve



Adapter No.	Adapter size	Angle
(1)	M22-ϕ16-ϕ16	20°
(2)	M22-M22	-

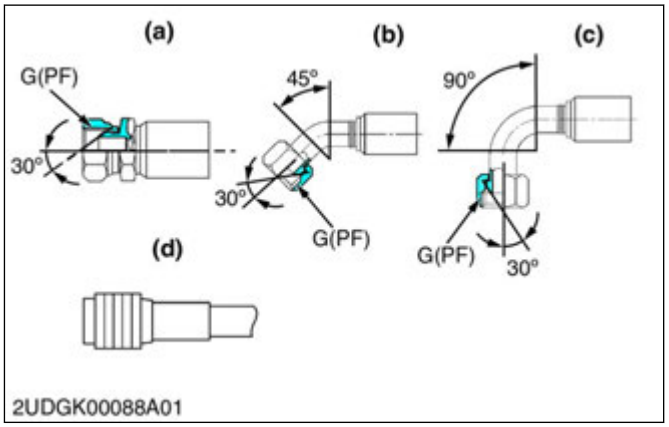
4.11 Hydraulic hose

4.11.1 Length description of hydraulic hoses



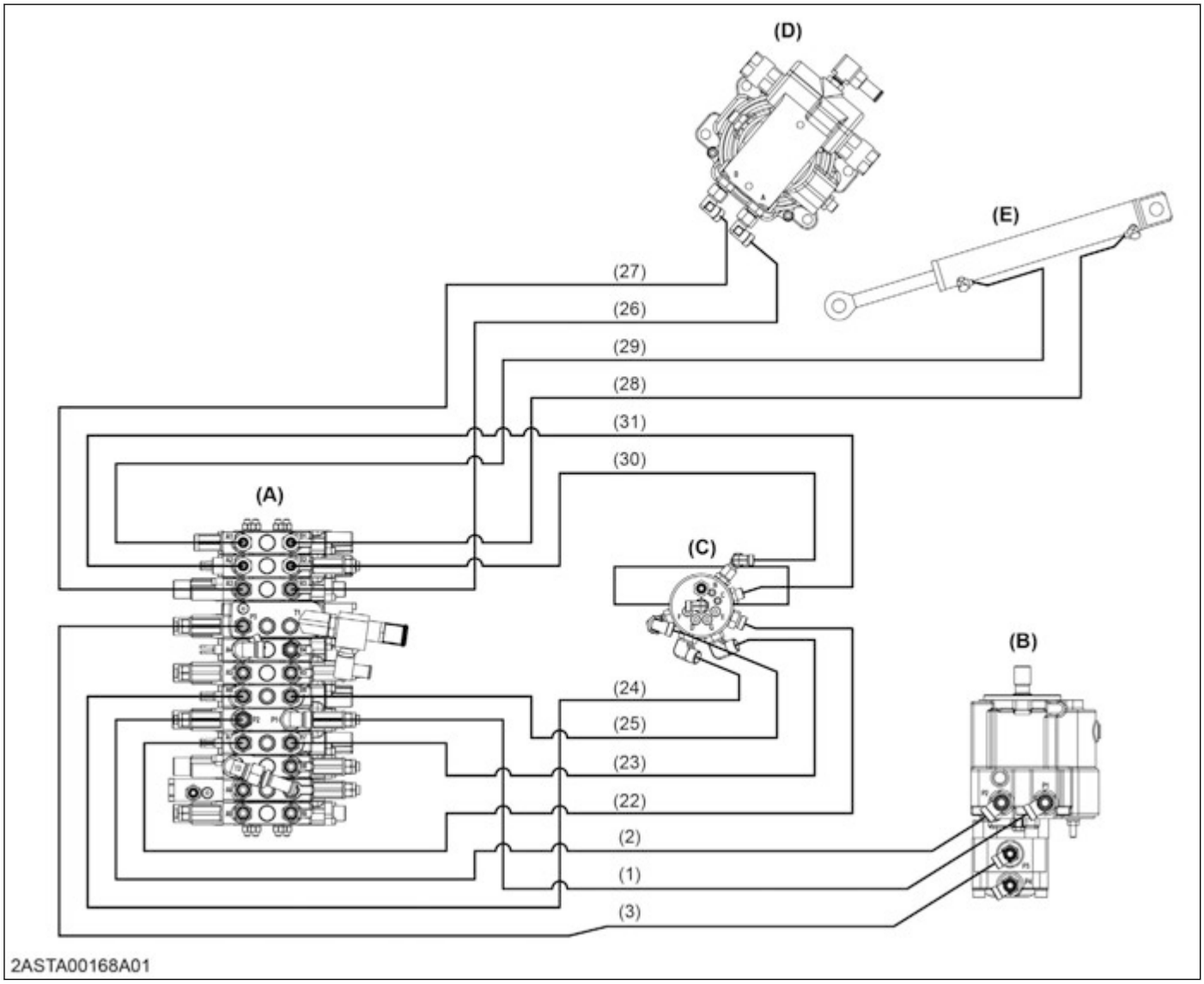
(a) Length

4.11.2 Metal fittings of hydraulic hoses



(a) Straight type parallel pipe thread (Male 30° seat)
(b) 45° type parallel pipe thread (Male 30° seat)
(c) 90° type parallel pipe thread (Male 30° seat)
(d) Quick hose coupling type

4.11.3 Delivery hoses routing (Basic)



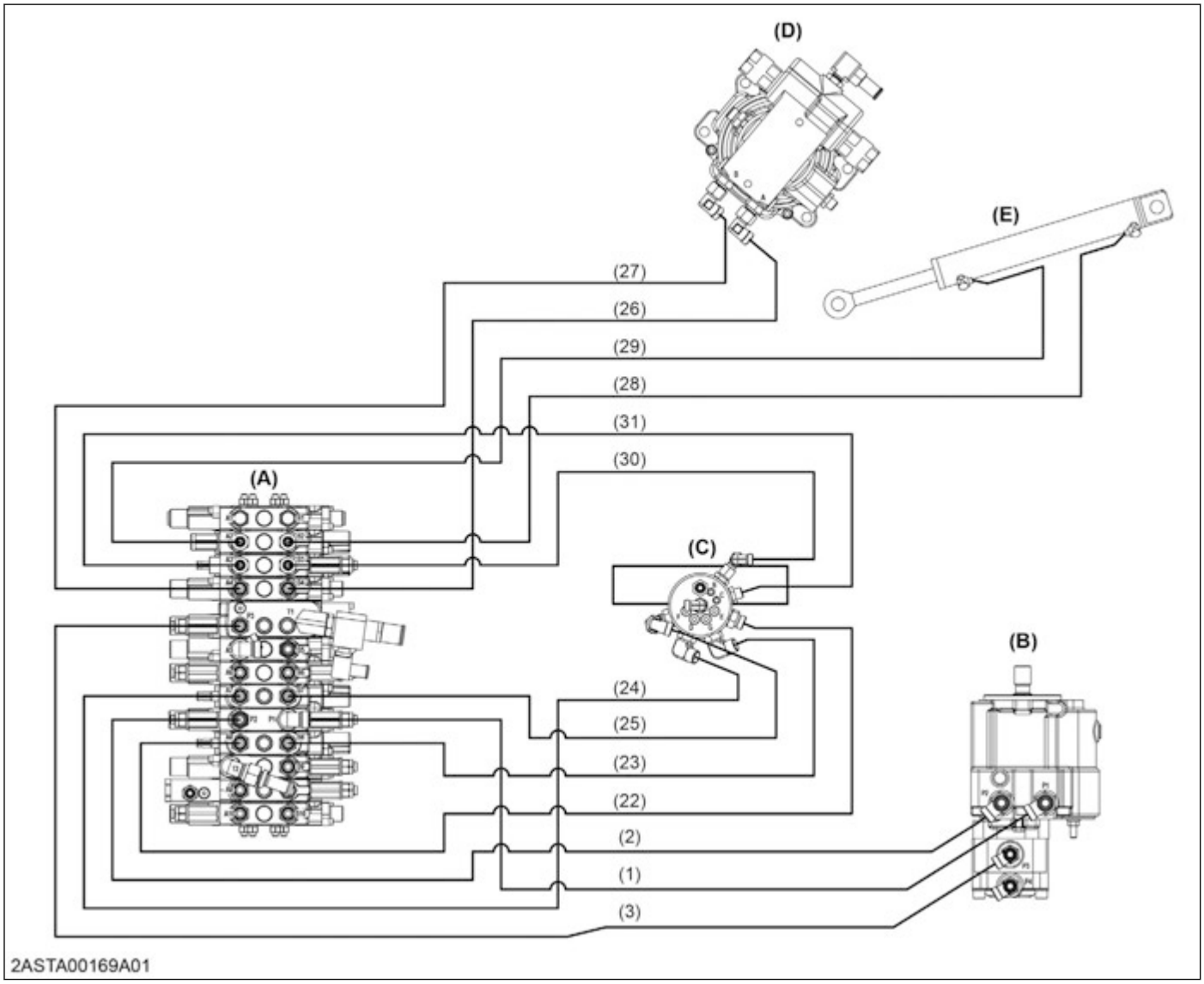
(A) Control valve
(B) Hydraulic Pump
(C) Swivel joint
(D) Swivel motor
(E) Swing cylinder

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal Fittings (RH)	
(1)	Hydraulic pump (P1) - C/V (P1)	1185 mm 46.65 in.	White - White	M22 Straight	M22 Straight	Corrugated tube
(2)	Hydraulic pump (P2) - C/V (P2)	1190 mm 46.85 in.	Red - Red	M22 Straight	M22 90°	Corrugated tube
(3)	Hydraulic pump (P3) - C/V (P3)	1380 mm 54.33 in.	Blue - Blue	M18 Straight	M18 90°	Corrugated tube
(22)	C/V - S/J (travel RH forwards)	1030 mm 40.55 in.	Green - Green	M18 90°	M18 Straight	Corrugated tube
(23)	C/V - S/J (travel RH backwards)	960 mm 37.80 in.	Yellow - Yellow	M18 90°	M18 Straight	Corrugated tube
(24)	C/V - S/J (travel LH forwards)	900 mm 35.43 in.	Blue - Blue	M18 90°	M18 Straight	Corrugated tube

(Continued)

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal Fittings (RH)	
(25)	C/V - S/J (travel LH backwards)	905 mm 35.63 in.	Red - Red	M18 90°	M18 Straight	Corrugated tube
(26)	C/V - S/J (swivel LH)	700 mm 27.56 in.	Gray - Gray	M18 90°	M18 Straight	Corrugated tube
(27)	C/V - S/J (swivel RH)	760 mm 29.92 in.	Blue - Blue	M18 90°	M18 Straight	Corrugated tube
(28)	C/V - Swing cylinder (swing LH)	1690 mm 66.54 in.	Green - Green	M14 90°	M14 Straight	Corrugated tube
(29)	C/V - Swing cylinder (swing RH)	1815 mm 71.46 in.	Yellow - Yellow	M14 90°	M14 Straight	Corrugated tube
(30)	C/V - S/J (blade lift)	1065 mm 41.93 in.	Brown - Brown	M14 90°	M14 Straight	Corrugated tube
(31)	C/V - S/J (blade lower)	1100 mm 43.31 in.	Red - Red	M14 90°	M14 Straight	Corrugated tube

4.11.4 Delivery hoses routing (Hi-spec)



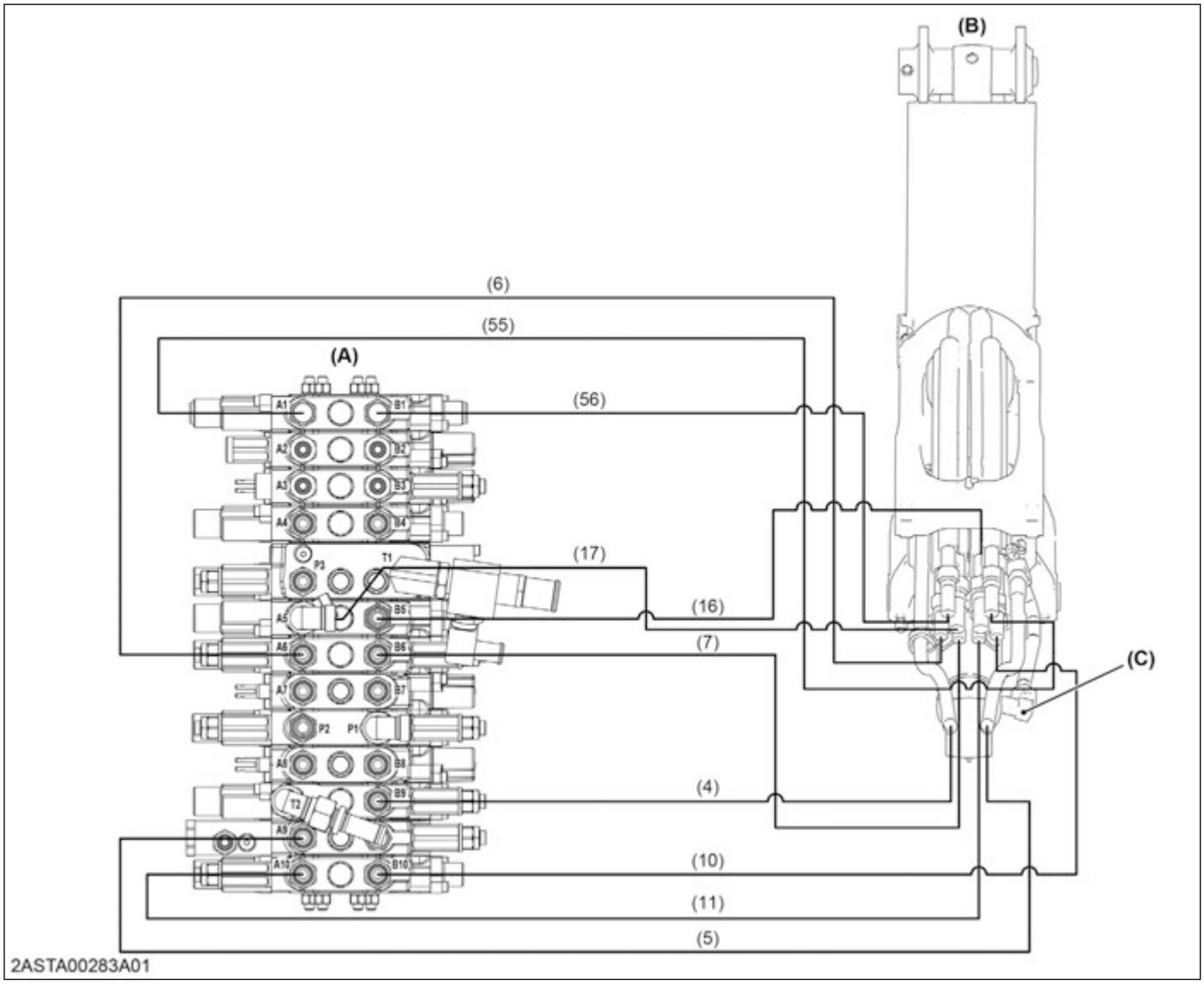
(A) Control valve
(B) Hydraulic Pump
(C) Swivel joint
(D) Swivel motor
(E) Swing cylinder

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal Fittings (RH)	
(1)	Hydraulic pump (P1) - C/V (P1)	1185 mm 46.65 in.	White - White	M22 Straight	M22 Straight	Corrugated tube
(2)	Hydraulic pump (P2) - C/V (P2)	1190 mm 46.85 in.	Red - Red	M22 Straight	M22 90°	Corrugated tube
(3)	Hydraulic pump (P3) - C/V (P3)	1380 mm 54.33 in.	Blue - Blue	M18 Straight	M18 90°	Corrugated tube
(22)	C/V - S/J (travel RH forwards)	1030 mm 40.55 in.	Green - Green	M18 90°	M18 Straight	Corrugated tube
(23)	C/V - S/J (travel RH backwards)	960 mm 37.80 in.	Yellow - Yellow	M18 90°	M18 Straight	Corrugated tube
(24)	C/V - S/J (travel LH forwards)	900 mm 35.43 in.	Blue - Blue	M18 90°	M18 Straight	Corrugated tube

(Continued)

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal Fittings (RH)	
(25)	C/V - S/J (travel LH backwards)	905 mm 35.63 in.	Red - Red	M18 90°	M18 Straight	Corrugated tube
(26)	C/V - S/J (swivel LH)	700 mm 27.56 in.	Gray - Gray	M18 90°	M18 Straight	Corrugated tube
(27)	C/V - S/J (swivel RH)	760 mm 29.92 in.	Blue - Blue	M18 90°	M18 Straight	Corrugated tube
(28)	C/V - Swing cylinder (swing LH)	1690 mm 66.54 in.	Green - Green	M14 90°	M14 Straight	Corrugated tube
(29)	C/V - Swing cylinder (swing RH)	1815 mm 71.46 in.	Yellow - Yellow	M14 90°	M14 Straight	Corrugated tube
(30)	C/V - S/J (blade lift)	1065 mm 41.93 in.	Brown - Brown	M14 90°	M14 Straight	Corrugated tube
(31)	C/V - S/J (blade lower)	1100 mm 43.31 in.	Red - Red	M14 90°	M14 Straight	Corrugated tube

4.11.5 Front hoses routing



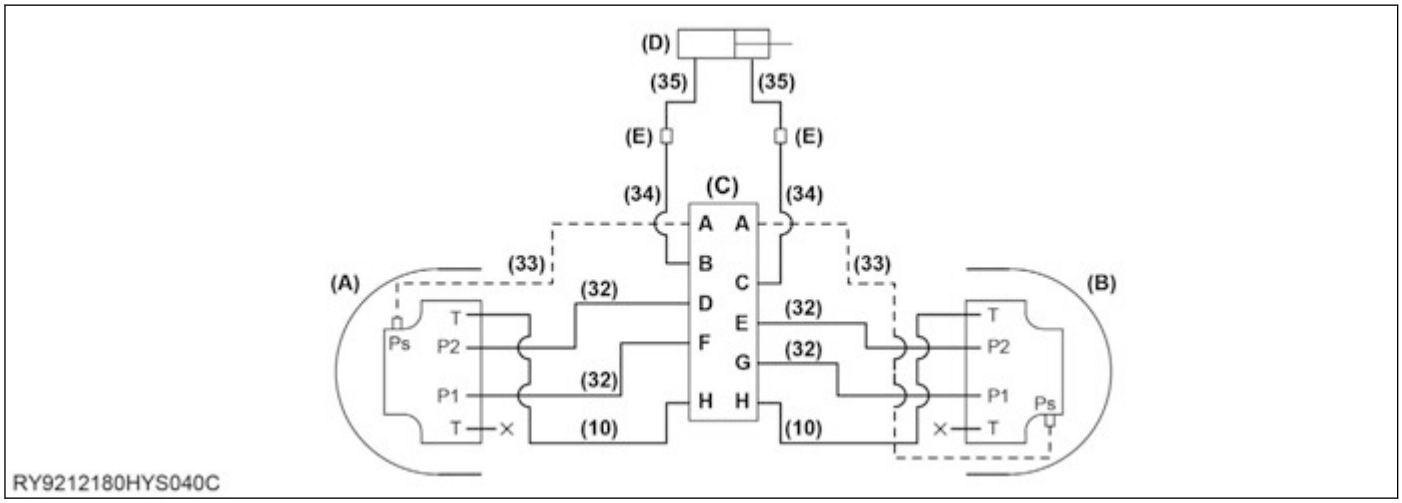
(A) Control valve (B) Boom (C) Boom cylinder

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal Fittings (RH)	
(4)	C/V - Boom cylinder (boom lift)	2065 mm 81.30 in.	Green - Green	M18 90°	M18 Straight	Corrugated tube
(5)	C/V - Boom cylinder (boom lower)	2230 mm 87.80 in.	Yellow - Yellow	M18 90°	M18 Straight	Corrugated tube
(6)	C/V - Arm cylinder (arm crowd)	1410 mm 55.51 in.	Gray - Gray	M18 90°	M18 Straight	Corrugated tube
(7)	C/V - Arm cylinder (arm dump)	1380 mm 54.33 in.	Blue - Blue	M18 90°	M18 Straight	Corrugated tube
(10)	C/V - Bucket cylinder (bucket dump)	1695 mm 66.73 in.	Orange - Orange	M18 90°	M18 Straight	Corrugated tube

(Continued)

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal Fittings (RH)	
(11)	C/V - Bucket cylinder (bucket crowd)	1710 mm 67.32 in.	White - White	M18 90°	M18 Straight	Corrugated tube
(16)	C/V - Pipe (AUX1 LH)	1260 mm 49.61 in.	Brown - Brown	M22 90°	M22 Straight	Corrugated tube
(17)	C/V - Pipe (AUX1 RH)	1410 mm 55.51 in.	White - White	M22 Straight	M22 Straight	Corrugated tube
(55)	C/V - Hose (AUX2 RH)	1240 mm 48.81 in.	White - White	M18 90°	M18 Straight	Corrugated tube
(56)	C/V - Hose (AUX2 LH)	1060 mm 41.73 in.	Brown - Brown	M18 90°	M18 Straight	Corrugated tube

4.11.6 Travel and blade hoses routing

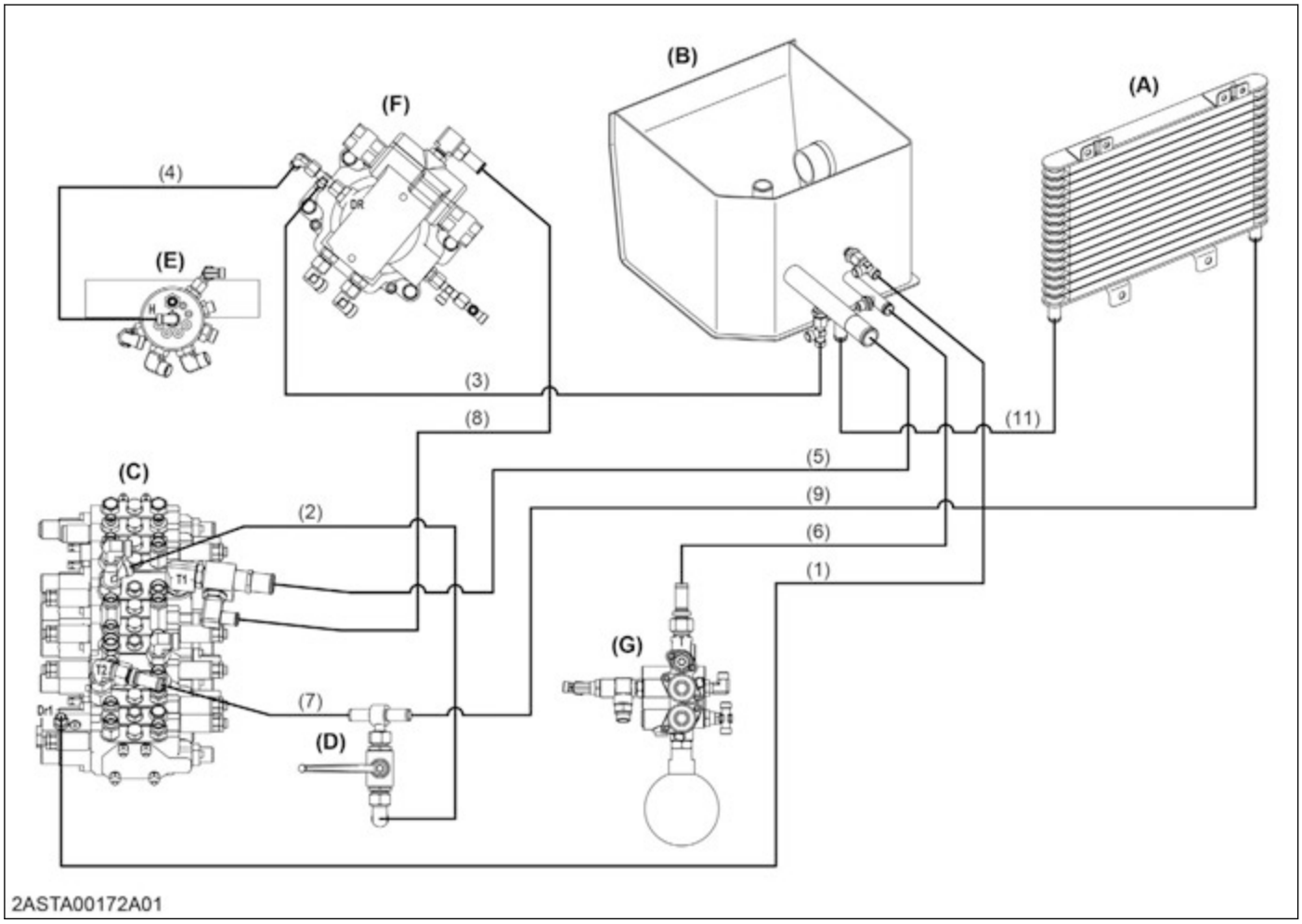


RY9212180HYS040C

(A) Travel motor RH
(B) Travel motor LH
(C) Swivel joint
(D) Blade cylinder
(E) Blade joint

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal fittings (RH)	
(10)	S/J (H) - Travel motor (drain port)	880 mm 34.65 in.	-	-	-	-
(32)	S/J (D, E) - Travel motor (forwards and backwards port)	910 mm 35.83 in.	-	M22 45°	M22 Straight	Corrugated tube
(33)	S/J (A) - Travel motor (high speed port)	1030 mm 40.55 in.	-	M14 90°	M14 Straight	Corrugated tube
(34)	S/J (B, C) - Blade Joint	300 mm 11.81 in.	-	M14 90°	M14 Straight	Corrugated tube
(35)	Blade Joint - Blade cylinder	480 mm 18.90 in.	-	M14 Straight	M14 Straight	Spring guard

4.11.7 Drain hoses routing



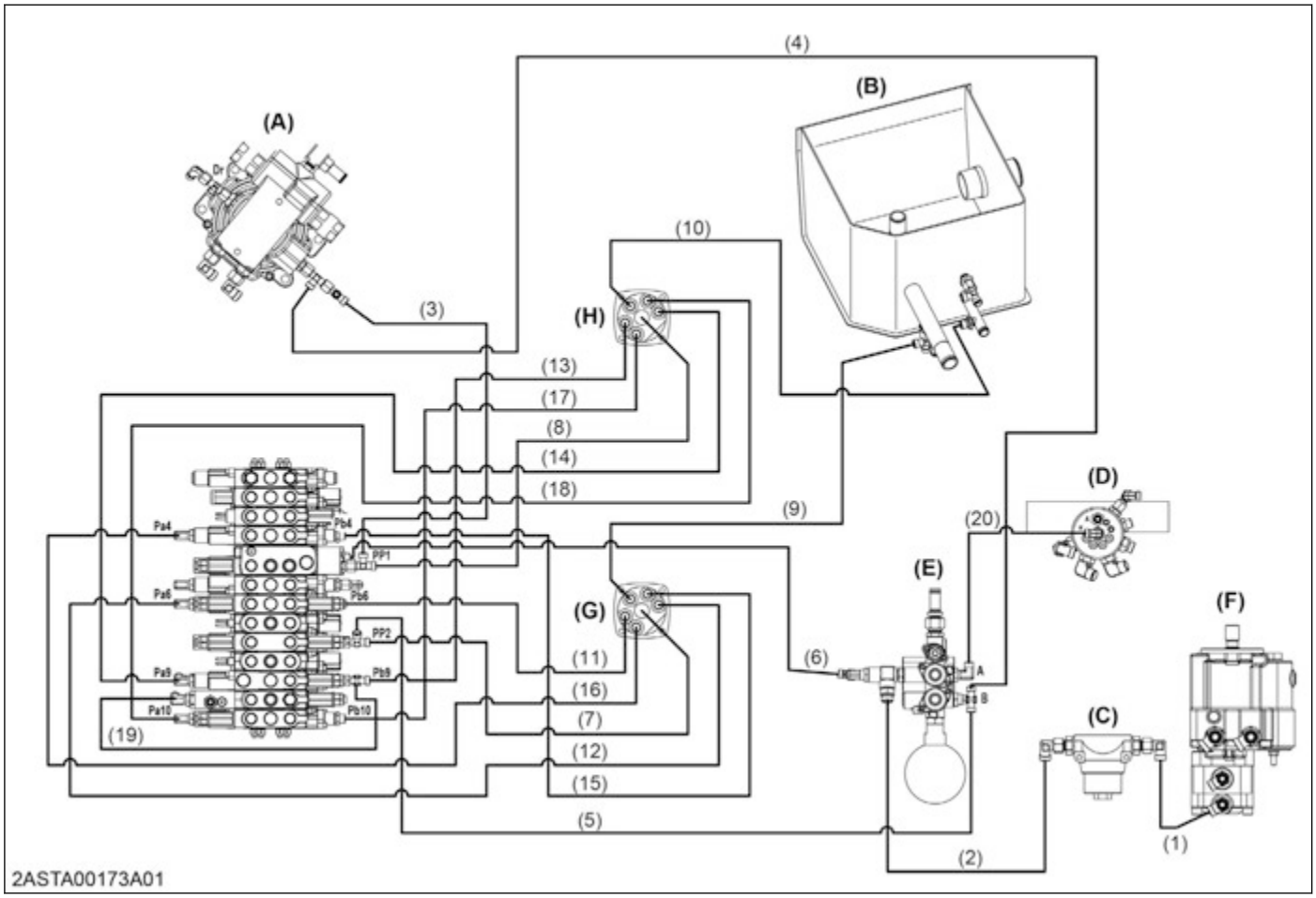
(A) Oil cooler
(B) Oil tank
(C) Control valve
(D) Third line valve
(E) Swivel joint
(F) Swivel motor
(G) Unload valve

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal fittings (RH)	
(1)	C/V (Dr1) - Hydraulic oil tank	1430 mm 56.30 in.	-	M14 Straight	M14 Straight	Corrugated tube
(2)	Third line valve - C/V (AUX RH)	530 mm 20.87 in.	-	M22 Straight	M22 Straight	Corrugated tube
(3)	Swivel motor (drain port) - Hydraulic oil tank	675 mm 17.13 in.	Gray - Gray	M14 Straight	M14 Straight	Corrugated tube
(4)	S/J (H) - Swivel motor (drain port)	435 mm 32.28 in.	Yellow - Green	M14 45°	M14 Straight	Corrugated tube
(5)	C/V (T1) - Hydraulic oil tank	820 mm 32.28 in.	-	-	-	-
(6)	Unload valve (T) - Hydraulic oil tank	550 mm 21.65 in.	-	-	-	Corrugated tube
(7)	C/V (T2) - Third line valve	275 mm 10.83 in.	-	-	-	Corrugated tube

(Continued)

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal fittings (RH)	
(8)	Swivel motor (make up) - C/V (T1)	1070 mm 42.13 in.	-	-	-	Corrugated tube
(9)	Third line valve - Oil cooler	2090 mm 82.28 in.	-	-	-	Corrugated tube
(11)	Oil cooler - Return pipe	-	-	-	-	Corrugated tube

4.11.8 Pilot hoses routing (Basic)



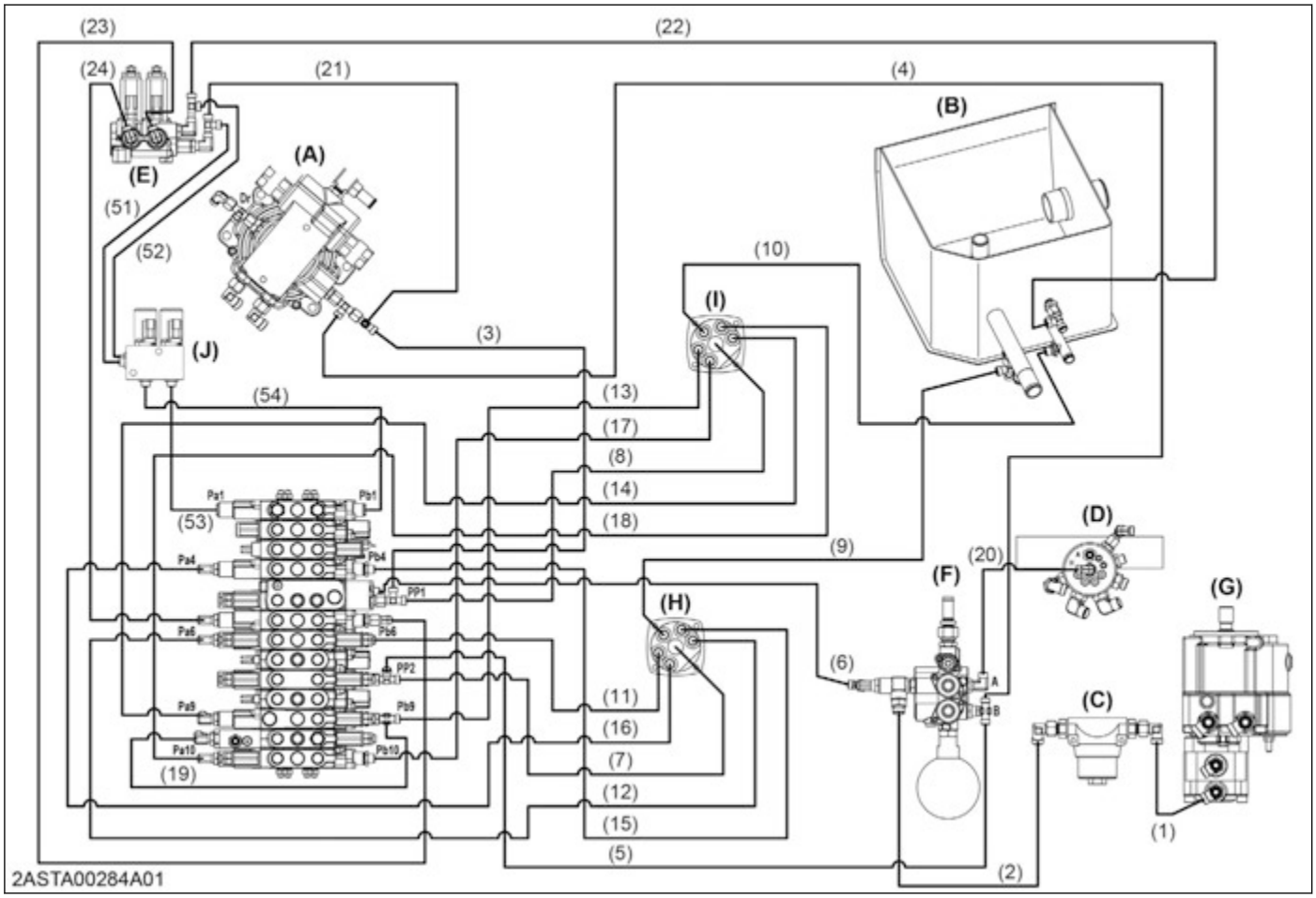
(A) Swivel motor
(B) Oil tank
(C) Pilot filter
(D) Swivel joint
(E) Unload valve
(F) Hydraulic pump
(G) Pilot control valve (LH)
(H) Pilot control valve (RH)

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal fittings (RH)	
(1)	Hydraulic pump (P4) - Pilot filter	370 mm 14.57 in.	-	M18 90°	M18 Straight	Corrugated tube
(2)	Pilot filter - Unload valve (C)	940 mm 37.01 in.	Yellow - Yellow	M18 Straight	M18 Straight	Corrugated tube
(3)	C/V (Pp1) - Swivel motor (PP)	880 mm 34.65 in.	White - White	M14 90°	M14 Straight	Corrugated tube
(4)	Unload valve (B) - Swivel motor (PP)	580 mm 22.83 in.	Blue - Blue	M14 Straight	M14 90°	Corrugated tube
(5)	Unload valve (B) - C/V (Pp2)	1170 mm 46.06 in.	-	M14 Straight	M14 45°	Corrugated tube
(6)	Unload valve (C) - C/V (Pp3)	390 mm 15.35 in.	-	M14 Straight	M14 45°	Corrugated tube
(7)	C/V (Pp2) - LH pilot control valve (P)	1585 mm 62.40 in.	White - White	M14 90°	M14 Straight	-

(Continued)

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal fittings (RH)	
(8)	C/V (Pp1) - RH pilot control valve (P)	1945 mm 76.57 in.	White - White	M14 45°	M14 Straight	-
(9)	LH Pilot control valve (T) - Hydraulic oil tank	1635 mm 64.37 in.	-	M14 Straight	M14 90°	-
(10)	RH pilot control valve (T) - Hydraulic oil tank	1990 mm 78.35 in.	-	M14 Straight	M14 90°	-
(11)	Pilot control valve - C/V (arm dump)	1590 mm 62.60 in.	Blue - Blue	M14 Straight	M14 45°	-
(12)	Pilot control valve - C/V (arm crowd)	1830 mm 72.05 in.	Green - Green	M14 Straight	M14 90°	-
(13)	Pilot control valve - C/V (boom lower)	2060 mm 81.10 in.	White - Blue	M14 Straight	M14 90°	-
(14)	Pilot control valve - C/V (boom lift)	2240 mm 88.19 in.	Gray - Gray	M14 Straight	M14 90°	-
(15)	Pilot control valve - C/V (swivel LH)	1570 mm 61.81 in.	Red - Red	M14 Straight	M14 45°	-
(16)	Pilot control valve - C/V (swivel RH)	1795 mm 70.67 in.	Yellow - Yellow	M14 Straight	M14 90°	-
(17)	Pilot control valve - C/V (bucket dump)	2110 mm 83.07 in.	Brown - Brown	M14 Straight	M14 45°	-
(18)	Pilot control valve - C/V (bucket crowd)	2335 mm 91.93 in.	Pink - Pink	M14 Straight	M14 90°	-
(19)	C/V (boom lower) - C/V (lock release)	300 mm 11.81 in.	-	M14 Straight	M14 90°	-
(20)	Unload valve (A) - S/J (A)	670 mm 26.38 in.	-	M14 Straight	M14 90°	Corrugated tube

4.11.9 Pilot hoses routing (Hi-spec)



(A) Swivel motor
(B) Oil tank
(C) Pilot filter
(D) Swivel joint
(E) AUX1 proportional valve
(F) Unload valve
(G) Hydraulic pump
(H) Pilot control valve (LH)
(I) Pilot control valve (RH)
(J) AUX2 proportional valve

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal fittings (RH)	
(1)	Hydraulic pump (P4) - Pilot filter	370 mm 14.57 in.	-	M18 90°	M18 Straight	Corrugated tube
(2)	Pilot filter - Unload valve (C)	940 mm 37.01 in.	Yellow - Yellow	M18 Straight	M18 Straight	Corrugated tube
(3)	C/V (Pp1) - Swivel motor (PP)	880 mm 34.65 in.	White - White	M14 90°	M14 Straight	Corrugated tube
(4)	Unload valve (B) - Swivel motor (PP)	580 mm 22.83 in.	Blue - Blue	M14 Straight	M14 90°	Corrugated tube
(5)	Unload valve (B) - C/V (Pp2)	1170 mm 46.06 in.	-	M14 Straight	M14 45°	Corrugated tube
(6)	Unload valve (C) - C/V (Pp3)	390 mm 15.35 in.	-	M14 Straight	M14 45°	Corrugated tube
(7)	C/V (Pp2) - LH pilot control valve (P)	1585 mm 62.40 in.	White - White	M14 90°	M14 Straight	-

(Continued)

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal fittings (RH)	
(8)	C/V (Pp1) - RH pilot control valve (P)	1945 mm 76.57 in.	White - White	M14 45°	M14 Straight	-
(9)	LH pilot control valve (T) - Hydraulic oil tank	1635 mm 64.37 in.	-	M14 Straight	M14 90°	Corrugated tube
(10)	RH pilot control valve (T) - Hydraulic oil tank	1990 mm 78.35 in.	-	M14 Straight	M14 90°	Corrugated tube
(11)	Pilot control valve - C/V (arm dump)	1590 mm 62.60 in.	Blue - Blue	M14 Straight	M14 45°	-
(12)	Pilot control valve - C/V (arm crowd)	1830 mm 72.05 in.	Green - Green	M14 Straight	M14 90°	-
(13)	Pilot control valve - C/V (boom lower)	2060 mm 81.10 in.	White - Blue	M14 Straight	M14 90°	-
(14)	Pilot control valve - C/V (boom lift)	2240 mm 88.19 in.	Gray - Gray	M14 Straight	M14 90°	-
(15)	Pilot control valve - C/V (swivel LH)	1570 mm 61.81 in.	Red - Red	M14 Straight	M14 45°	-
(16)	Pilot control valve - C/V (swivel RH)	1795 mm 70.67 in.	Yellow - Yellow	M14 Straight	M14 90°	-
(17)	Pilot control valve - C/V (bucket dump)	2110 mm 83.07 in.	Brown - Brown	M14 Straight	M14 45°	-
(18)	Pilot control valve - C/V (bucket crowd)	2335 mm 91.93 in.	Pink - Pink	M14 Straight	M14 90°	-
(19)	C/V (boom lower) - C/V (lock release)	300 mm 11.81 in.	-	M14 Straight	M14 90°	-
(20)	Unload valve (A) - S/J (A)	670 mm 26.38 in.	-	M14 Straight	M14 90°	Corrugated tube
(21)	AUX1 proportional valve (P) - Swivel motor (PP)	660 mm 25.98 in.	White - White	M14 Straight	M14 90°	Corrugated tube
(22)	AUX1 proportional valve (P) - Hydraulic oil tank	850 mm 33.46 in.	-	M14 Straight	M14 90°	Corrugated tube
(23)	AUX1 proportional valve (AUX1 LH) - C/V	365 mm 14.37 in.	Pink - Pink	M14 Straight	M14 90°	Corrugated tube
(24)	AUX1 proportional valve (AUX1 RH) - C/V	640 mm 25.20 in.	Yellow - Green	M14 Straight	M14 90°	Corrugated tube
(51)	AUX2 proportional valve (P) - AUX1 proportional valve (P)	460 mm 18.11 in.	White - White	M14 45°	M14 Straight	Corrugated tube
(52)	AUX2 proportional valve (T) - AUX1 proportional valve (T)	460 mm 16.14 in.	-	M14 45°	M14 Straight	Corrugated tube

(Continued)

No.	Point of use	Hose				Guard
		Length	Tape color	Metal fittings (LH)	Metal fittings (RH)	
(53)	AUX2 proportional valve (Pa1) - C/V	1100 mm 43.31 in.	-	M14 90°	M14 Straight	-
(54)	AUX2 proportional valve (Pb1) - C/V	600 mm 23.62 in.	-	M14 90°	M14 Straight	-

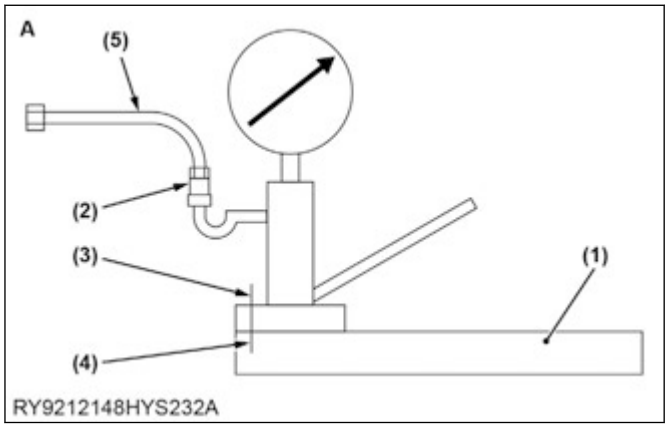
4.12 Special jigs and tools

4.12.1 Overload relief valve measuring kit

CAUTION

- **When measuring overload relief pressure, use a test hose which has enough pressure endurance.**

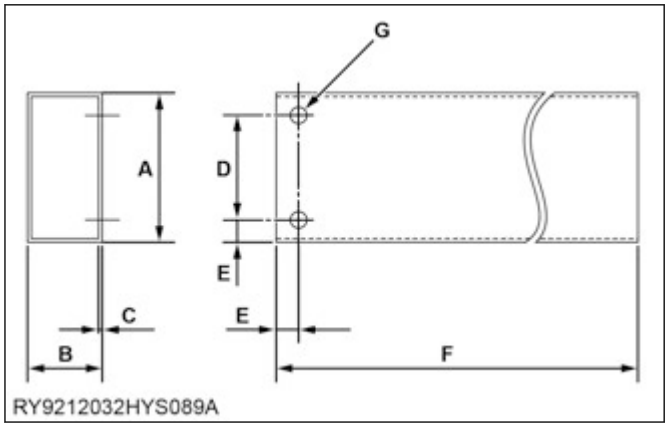
Tester



A Nozzle tester

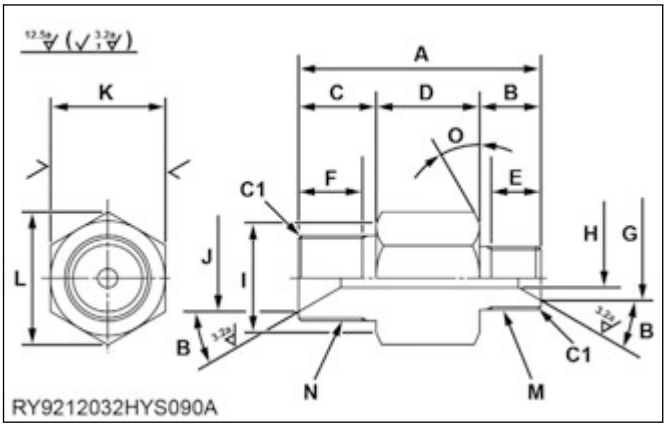
No.	Parts name	Quantity
(1)	Support	1
(2)	Pipe fittings (M12 · G2)	1
(3)	Bolt (M10 × 35)	2
(4)	Nut (M12)	2
(5)	Test hose	1

Support



No.	Size
A	100 mm 3.94 in.
B	50 mm 1.97 in.
C	2.3 mm 0.09 in.
D	70 mm 2.76 in.
E	15 mm 0.59 in.
F	600 mm 23.62 in.
G	11 mm 0.43 in.

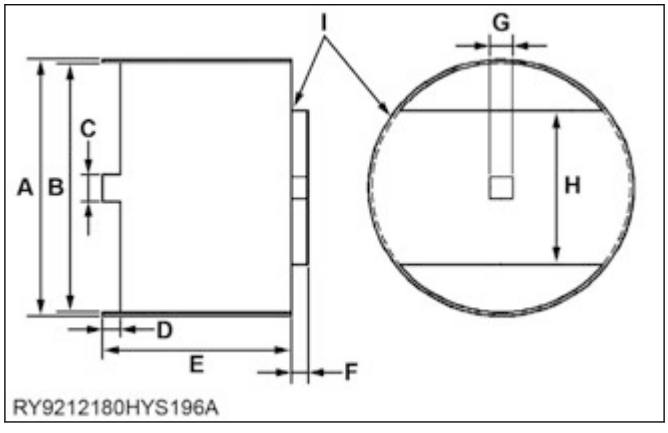
Pipe fittings (M12-G1/4)



No.	Size
A	47 mm 1.85 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 ϕ0.31 in.
H	ϕ3 mm ϕ0.12 in.
I	ϕ8 mm ϕ0.71 in.
J	ϕ9±0.2 mm ϕ0.37±0.01 in.
K	19 mm 0.75 in.
L	21.9 mm 0.86 in.
M	M12 x 1.5
N	G1/4
O	0.52 rad 30°

4.12.2 Travel motor special jigs and tools

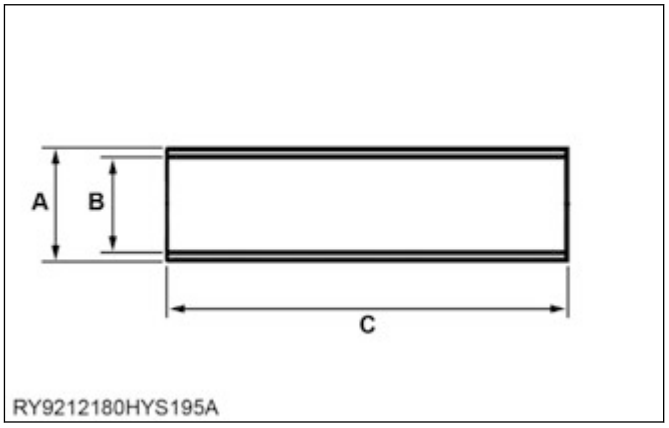
(S-1)Ring nut fastening tool



No.	Size
A	ϕ150 mm ϕ5.85 in.
B	ϕ146 mm ϕ5.69 in.
C	4-16 mm 0.63in.
D	10 mm 0.39 in.
E	107 mm 4.17 in.
F	9.0 mm 0.35 in.
G	□12.8 to 13.0 mm □0.50 to 0.51 in.
H	90 mm 3.51 in.
I	90 mm 3.51 in.

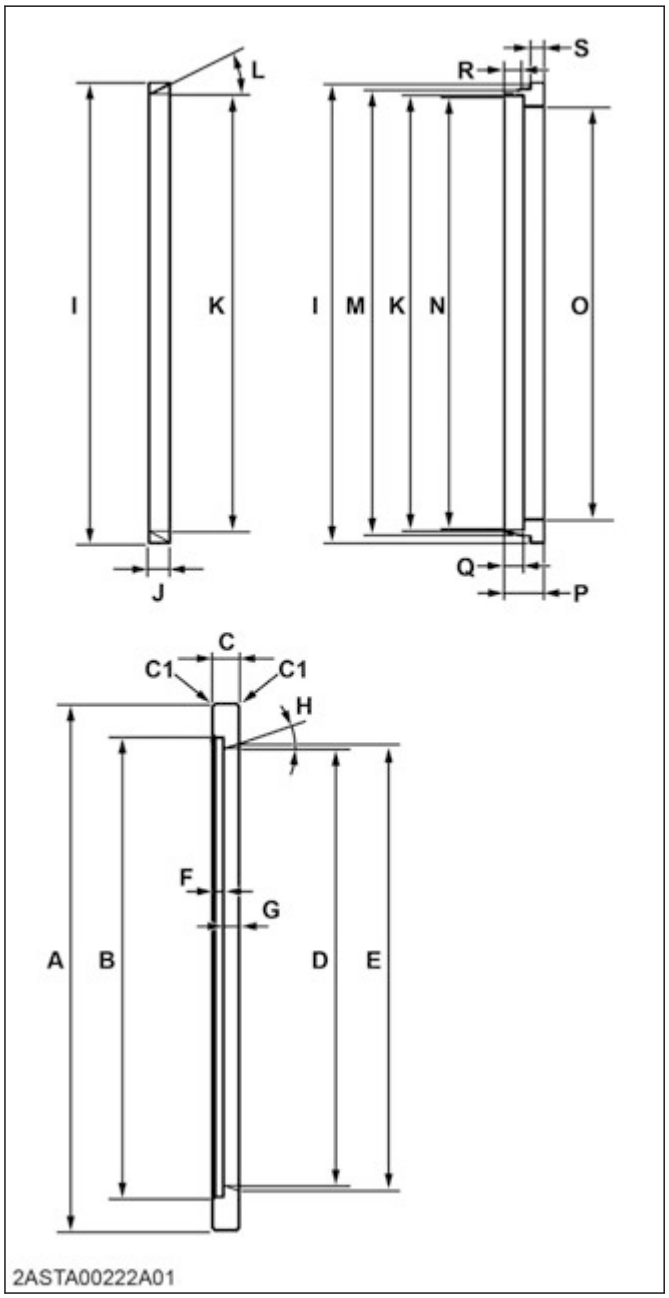
- Weld on (I).

(S-2) Ball bearing removing tool



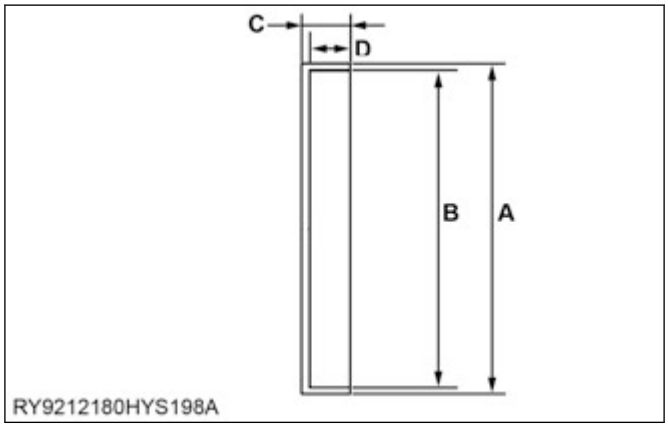
No.	Size
A	ϕ29 mm ϕ1.13 in.
B	ϕ25 mm ϕ0.98 in.
C	100 mm 3.9 in.

(S-3) Floating seal assembling tool



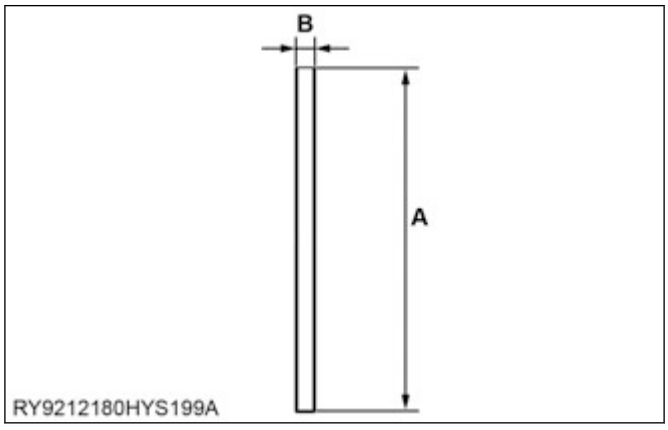
No.	Size
A	ϕ205 mm ϕ8.0 in.
B	179.2 to 179.3 mm 6.989 to 6.993 in.
C	10 mm 0.39 in.
D	170.2 mm 6.64 in.
E	173.4 mm 6.76 in.
F	4.0 mm 0.16 in.
G	6.0 mm 0.23 in.
H	15°
I	ϕ179.3 to 179.5 mm ϕ6.99 to 7.00 in.
J	8.0 mm 0.31 in.
K	ϕ170.1 to 170.3 mm ϕ7.99 to 8.00 in.
L	14 to 15° in.
M	ϕ174 mm ϕ6.79 in.
N	ϕ169 mm ϕ6.59 in.
O	ϕ161 mm ϕ6.28 in.
P	15 mm 0.59 in.
Q	7.5 mm 0.29 in.
R	7.0 mm 0.27 in.
S	5.0 mm 0.20 in.
C1	Chamber 1.0 mm

(S-4) Angular bearing press-fit tool



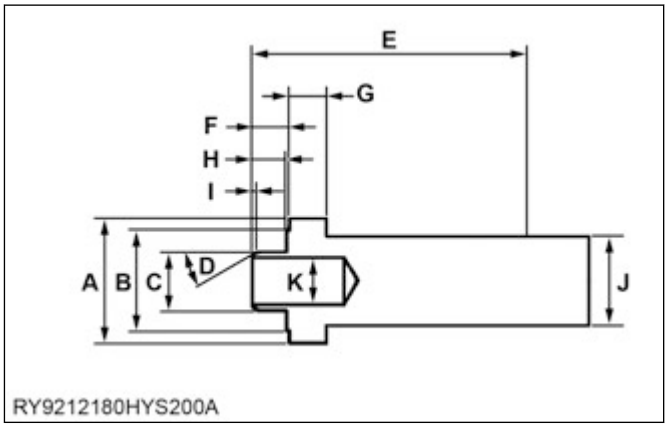
No.	Size
A	ϕ165 mm ϕ6.44 in.
B	ϕ158 mm 6.16 in.
C	24 mm 0.94 in.
D	20 mm 0.78 in.

(S-5) Flange holder press-fit tool



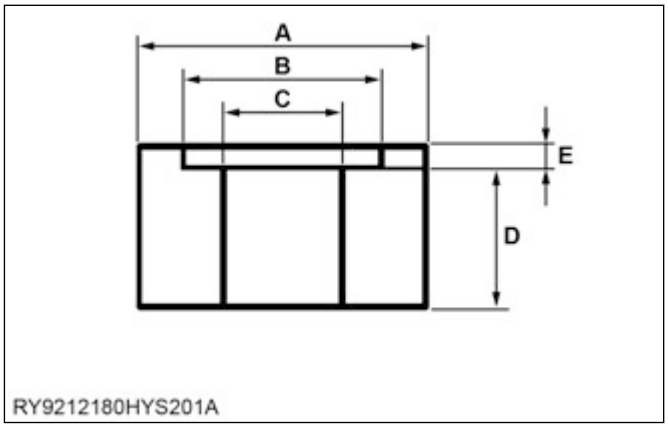
No.	Size
A	ϕ180 mm ϕ7.02 in.
B	9.0 mm 0.35 in.

(S-6) Oil seal press-fit tool



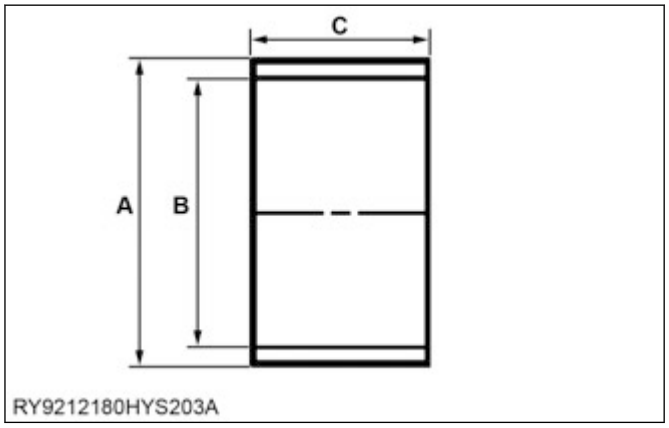
No.	Size
A	ϕ42 mm ϕ1.64 in.
B	ϕ34 mm ϕ1.33 in.
C	ϕ19.6 to 19.8 mm ϕ0.76 to 0.77 in.
D	30°
E	110 mm 4.29 in.
F	12 mm 0.47 in.
G	12 mm 0.47 in.
H	11 mm 0.47 in.
I	2.0 mm 0.078 in.
J	ϕ30 mm ϕ1.17 in.
K	ϕ16 mm 0.62 in.

(S-7) Ball bearing press-fit tool



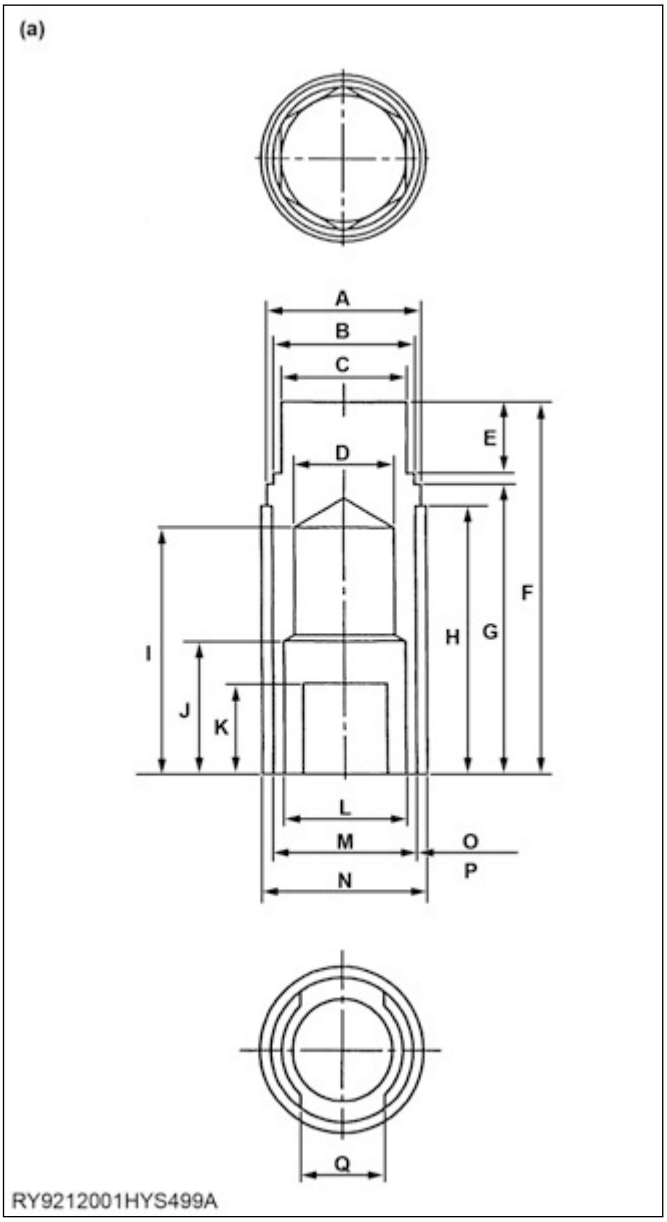
No.	Size
A	ϕ60 mm ϕ2.34 in.
B	ϕ42.005 to 42.100 mm ϕ1.640 to 1.642 in.
C	ϕ25 mm ϕ0.975 in.
D	35 mm 1.365 in.
E	5.0 mm 0.195 in.

(S-8) Ball bearing press-fit tool



No.	Size
A	ϕ36 mm ϕ1.40 in.
B	ϕ32 mm ϕ1.25 in.
C	20 mm 0.78 in.

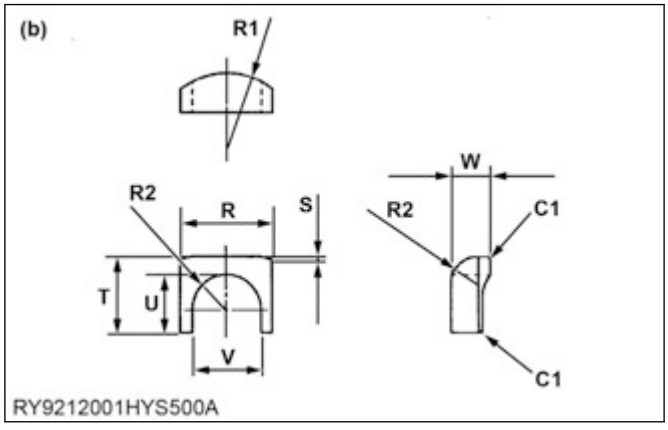
4.12.3 Universal joint tightening jig



(a) Universal joint tightening jig detail view

No.	Size
A	ϕ29 mm ϕ1.14 in.
B	ϕ26.5 mm ϕ1.04 in.
C	23.5 mm 0.93 in.
D	ϕ19 mm ϕ0.75 in.
E	less than 13 mm less than 0.51 in.
F	less than 69 mm less than 2.72 in.
G	54 mm 2.13 in.
H	50 mm 1.97 in.
I	46 mm 1.81 in.
J	25 mm 0.98 in.
K	17 mm 0.67 in.
L	ϕ23 mm ϕ0.91 in.
M	ϕ27 mm ϕ1.06 in.
N	ϕ31 mm ϕ1.22 in.
O	H6 mm
P	N6 mm
Q	ϕ16 mm ϕ0.63 in.

No.	Size
R	15.5 mm 0.61 in.
S	0.5 × 15 mm 0.02 × 0.59 in.
T	12.5 mm 0.49 in.
U	9.5 mm 0.37 in.
V	less than 11.6 mm less than 0.46 in.
W	less than 6.5 mm less than 0.26 in.
C1	0.5 mm chamfer 0.02 in. chamfer
R1	R13 mm R0.51 in.
R2	R5.8 mm R0.23 in.



(b) Bushing detail view

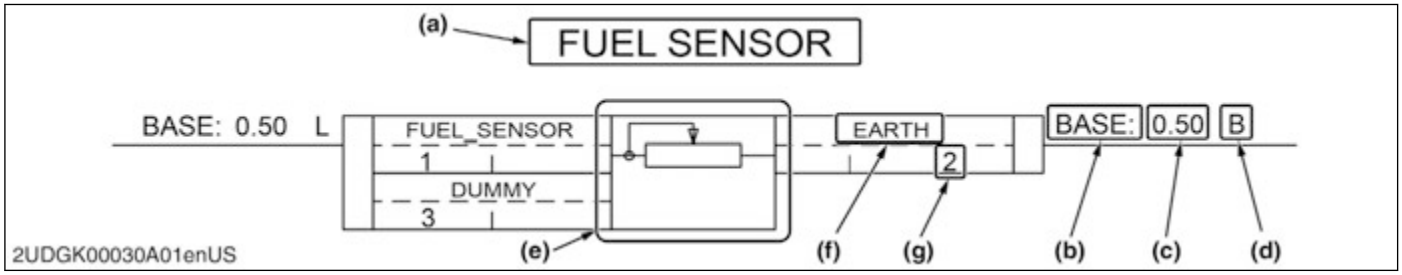
6. ELECTRICAL SYSTEM

MECHANISM

1. Electrical circuit

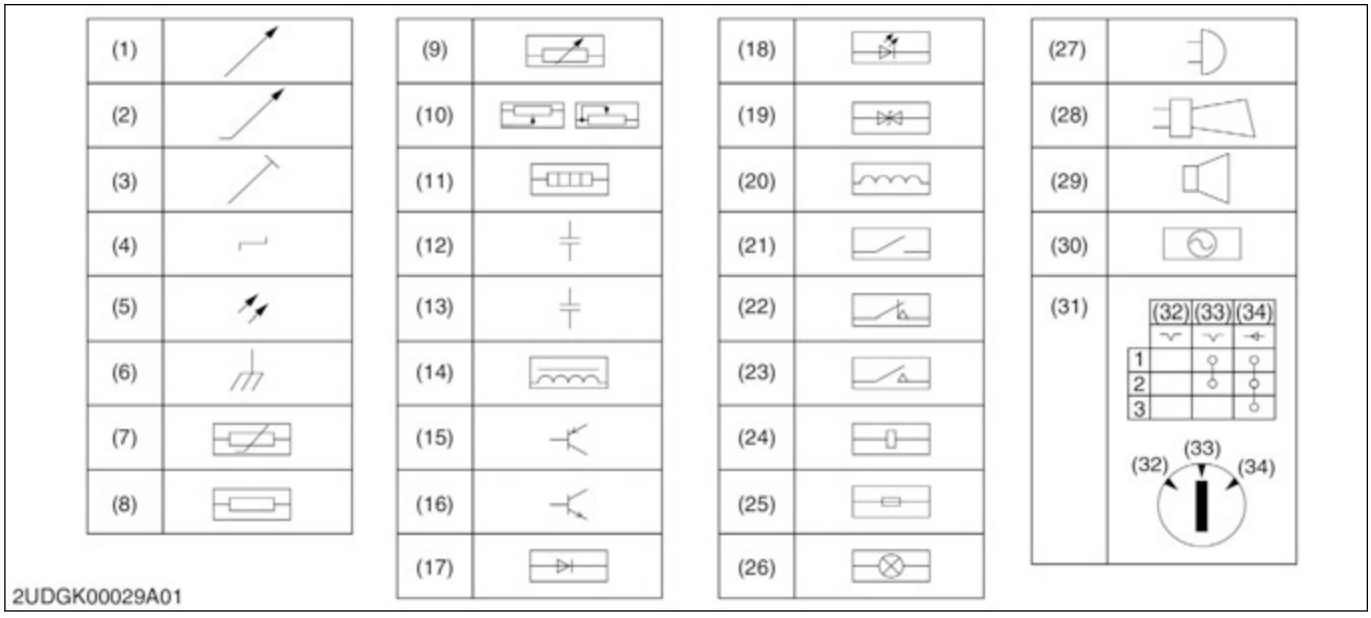
1.1 Electrical circuit general description

1.1.1 Electrical circuit diagram description



(a) Part name
(b) Specification code
(c) Electrical wiring size
(d) Wiring color coding
(e) Unit symbol
(f) Pin name
(g) Pin number
(h) Connector name

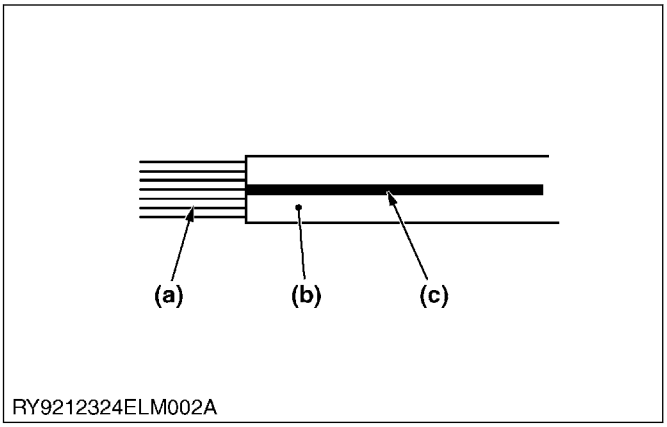
1.1.2 Electrical circuit diagram unit symbol



(1) Variable
(2) Nonlinear variable
(3) Fixed setting
(4) Step variable
(5) Non-ionizing radiation (NIR)
(6) Body GND
(7) Thermistor
(8) Resistor
(9) Variable resistor
(10) Potentiometer with sliding contact
(11) Heating element
(12) Capacitor
(13) Electrolytic capacitor
(14) Magnetic core inductance
(15) PNP transistor
(16) NPN transistor
(17) Semiconductor diode
(18) Light-emitting diode (LED)
(19) Two-way breakdown diode
(20) Coil
(21) NO (normally open)
(22) Auto-resetting NC (normally closed)
(23) Auto-resetting NO (normally open)
(24) Relay coil
(25) Fuse
(26) Lamp
(27) Buzzer
(28) Horn
(29) Speaker
(30) AC voltage source
(31) Starter switch
(32) STOP
(33) RUN
(34) START

1.1.3 Electrical wiring color coding

Wiring color	Color code	Wiring color	Color code
Black	B	Blue/Green	L/G
Green	G	Blue/Orange	L/O
Blue	L	Blue/Red	L/R
Pink	P	Blue/White	L/W
Red	R	Blue/Yellow	L/Y
White	W	Yellowish green/Blue	LG/L
Yellow	Y	Yellowish green/Red	LG/R
Brown	BR	Yellowish green/White	LG/W
Gray	GR	Yellowish green/Yellow	LG/Y
Yellowish green	LG	Orange/White	O/W
Orange	O	Pink/White	P/W
Light blue	SB	Pink/Blue	P/L
Black/Green	B/G	Red/Black	R/B
Black/Blue	B/L	Red/Green	R/G
Black/Pink	B/P	Red/Blue	R/L
Black/Violet	B/V	Red/White	R/W
Black/Red	B/R	Red/Yellow	R/Y
Black/White	B/W	Violet/White	V/W
Black/Yellow	B/Y	White/Black	W/B
Brown/Black	BR/B	White/Green	W/G
Brown/Yellow	BR/Y	White/Blue	W/L
Brown/Red	BR/R	White/Red	W/R
Green/Black	G/B	White/Yellow	W/Y
Green/Blue	G/L	Yellow/Black	Y/B
Green/Red	G/R	Yellow/Green	Y/G
Green/White	G/W	Yellow/Blue	Y/L
Green/Yellow	G/Y	Yellow/Red	Y/R
Blue/Black	L/B		

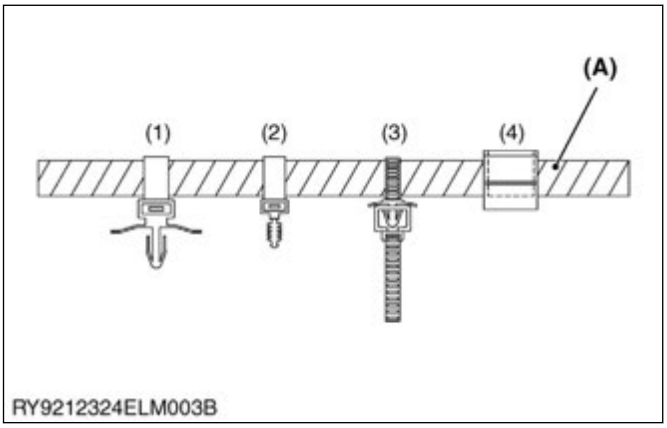


(a) Electric wiring size (mm^2)
(b) Base color
(c) Stripe color

- 1.25–Y/R

1.25 mm^2 (electric wiring size)
Y: Yellow (base color)
R: Red (stripe color)

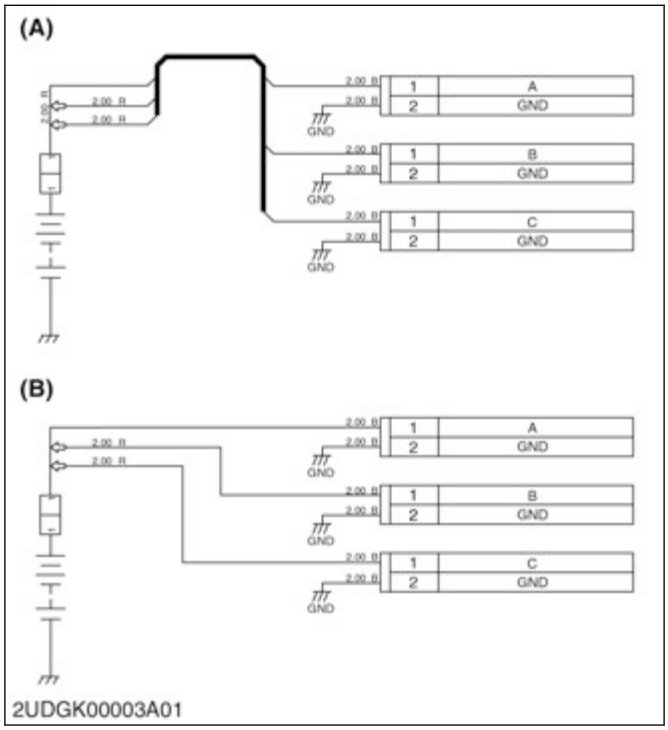
1.1.4 Electrical wiring clamp



(1) Anchor type (insert to the anchor)
(2) Screw type (insert to the screw end)
(3) Plug-in type (insert until it locks)
(4) Plug-in type (insert until it locks)
(A) Wire harness

1.1.5 Bus description

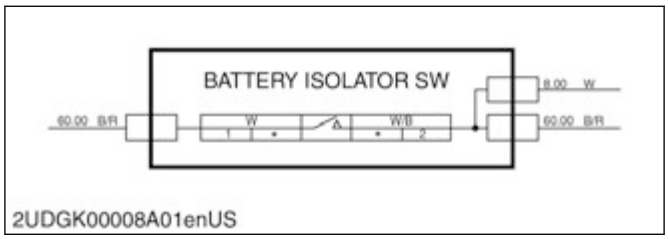
Bus simplifies complex circuits with many branches.

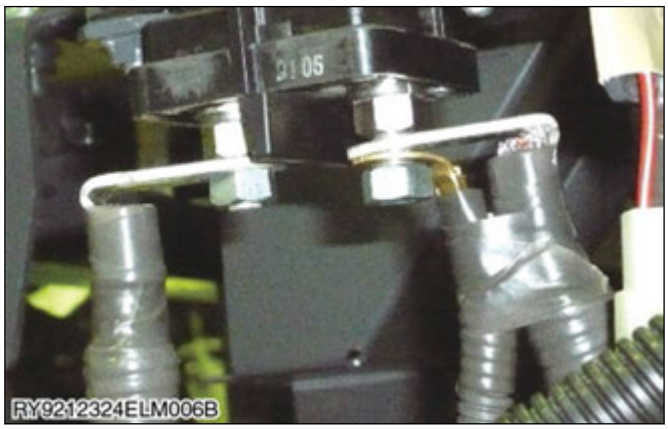


(A) Diagram with bus (B) Diagram without bus

1.1.6 Composite terminal description

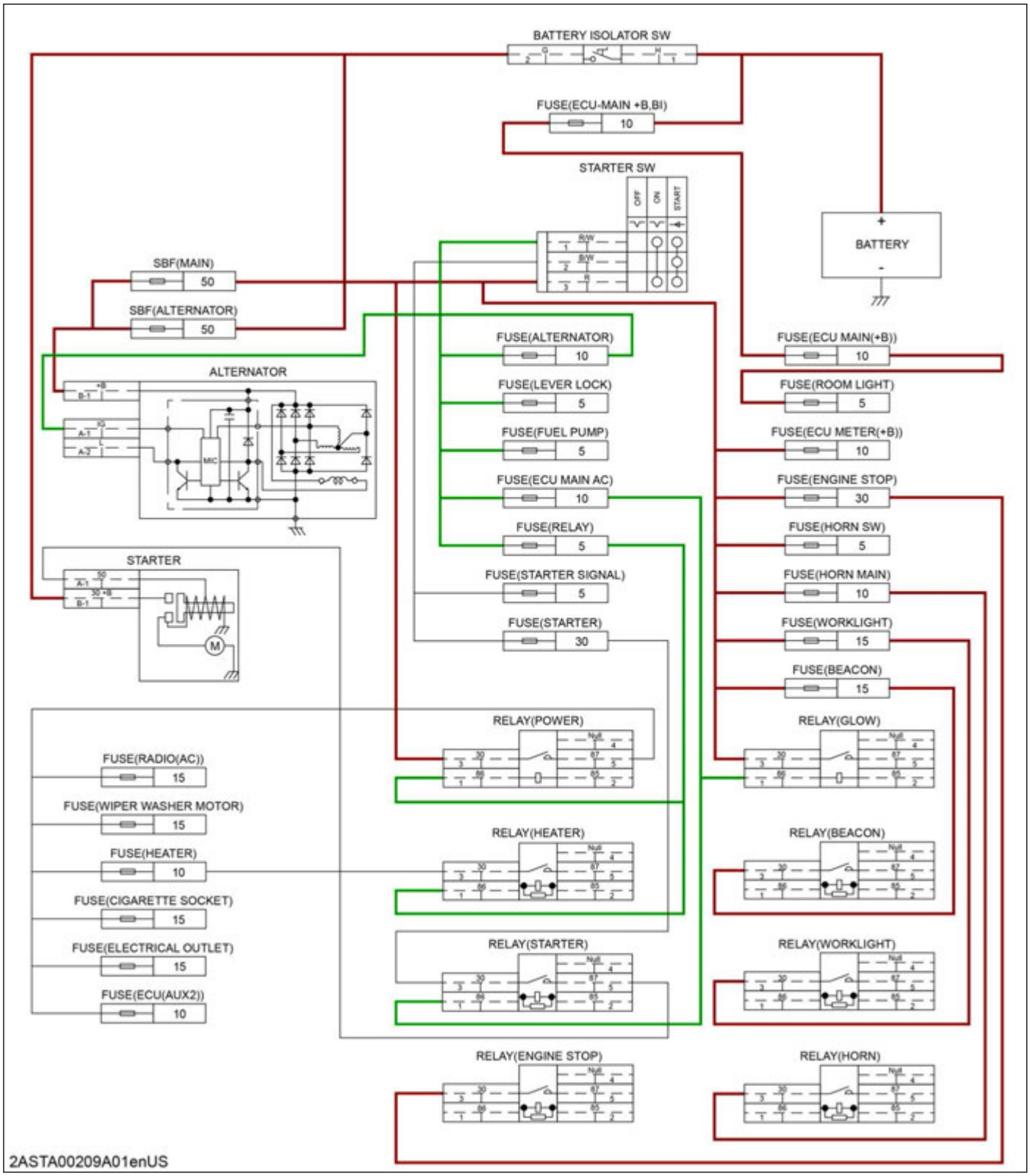
Connect two or more terminals together to a device.





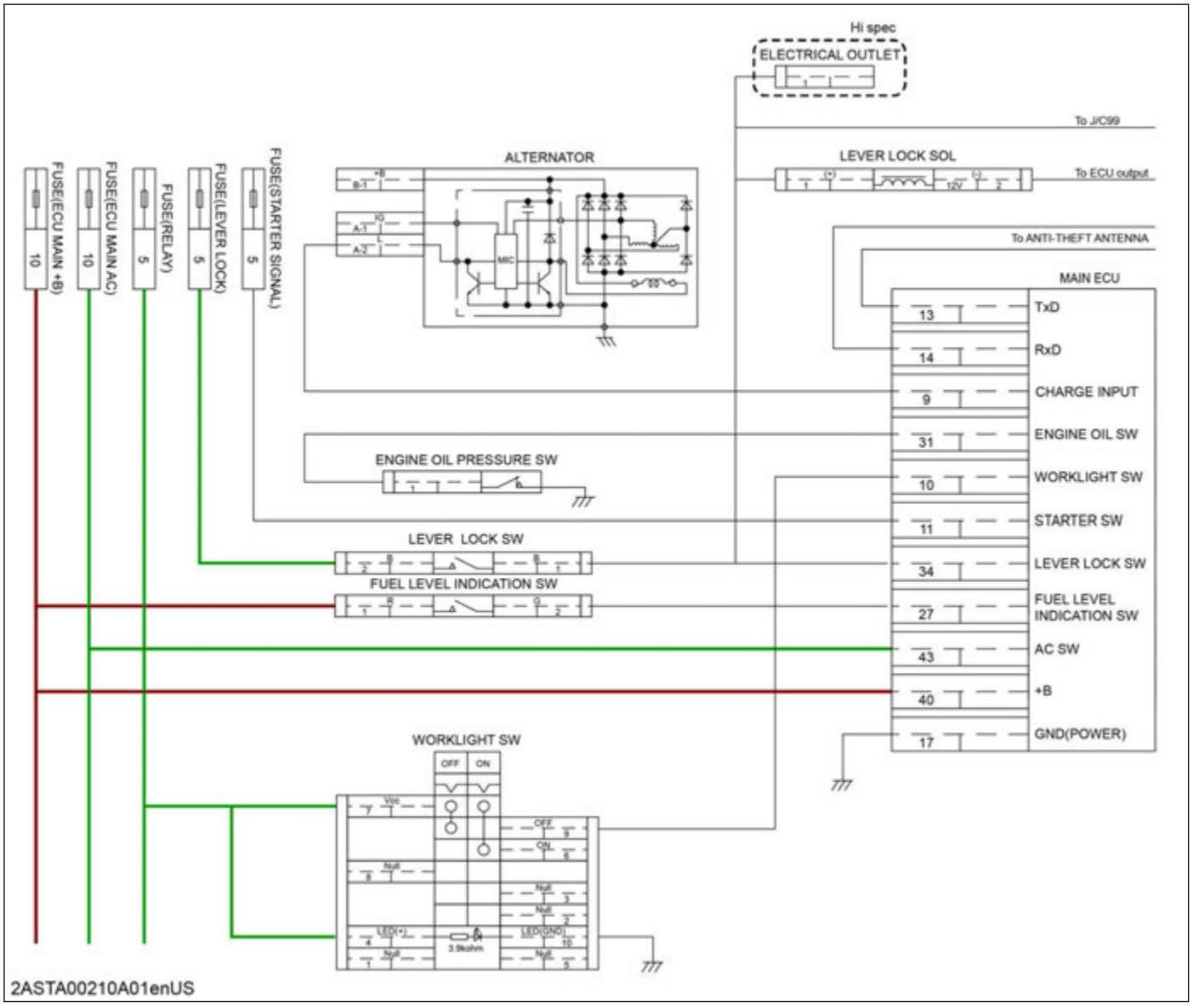
1.2 Functional electrical circuit

1.2.1 Power supply electrical circuit diagram

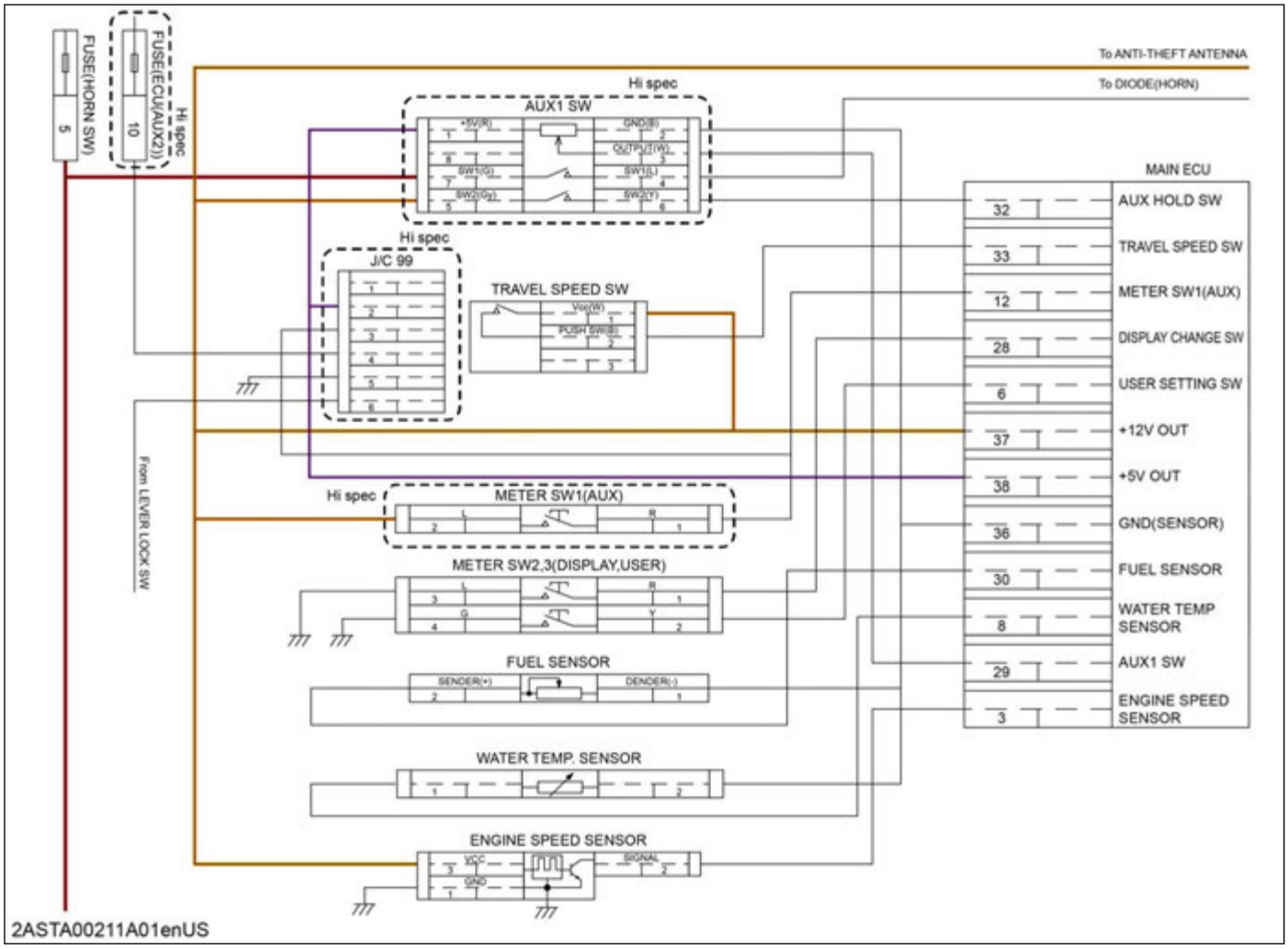


- In case of stopping the engine, the battery applies approximately 12.0 V.
- In case of running the engine, the alternator applies approximately 14.5 V.
- Generating of the alternator charges the battery and supplies power to all electrical devices.
- There are 2 general powers which are +B (SBF main) and ACC (starter switch **[RUN]**).

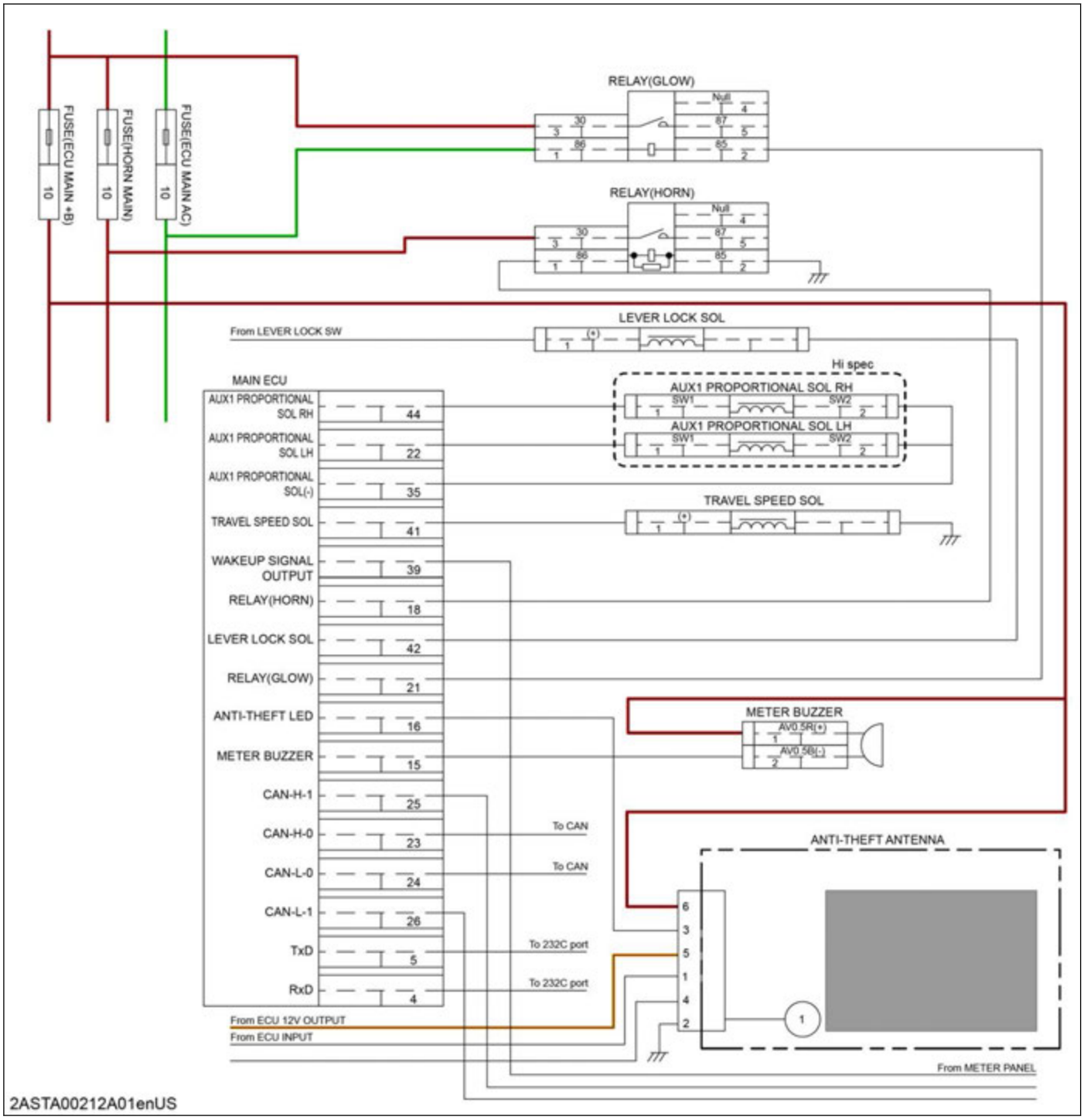
1.2.2 Main ECU input -1 electrical circuit diagram



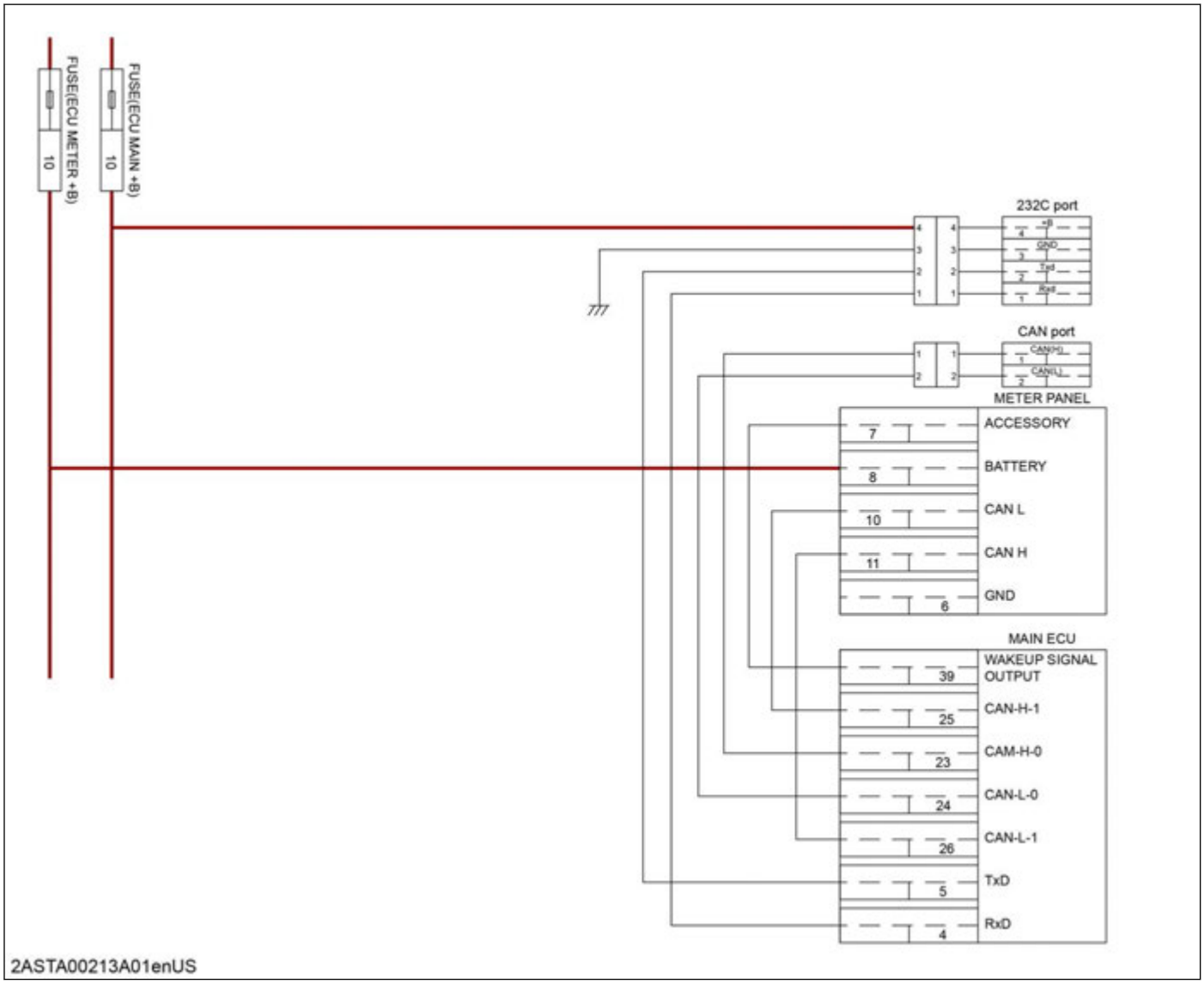
1.2.3 Main ECU input -2 electrical circuit diagram



1.2.4 Main ECU output electrical circuit diagram

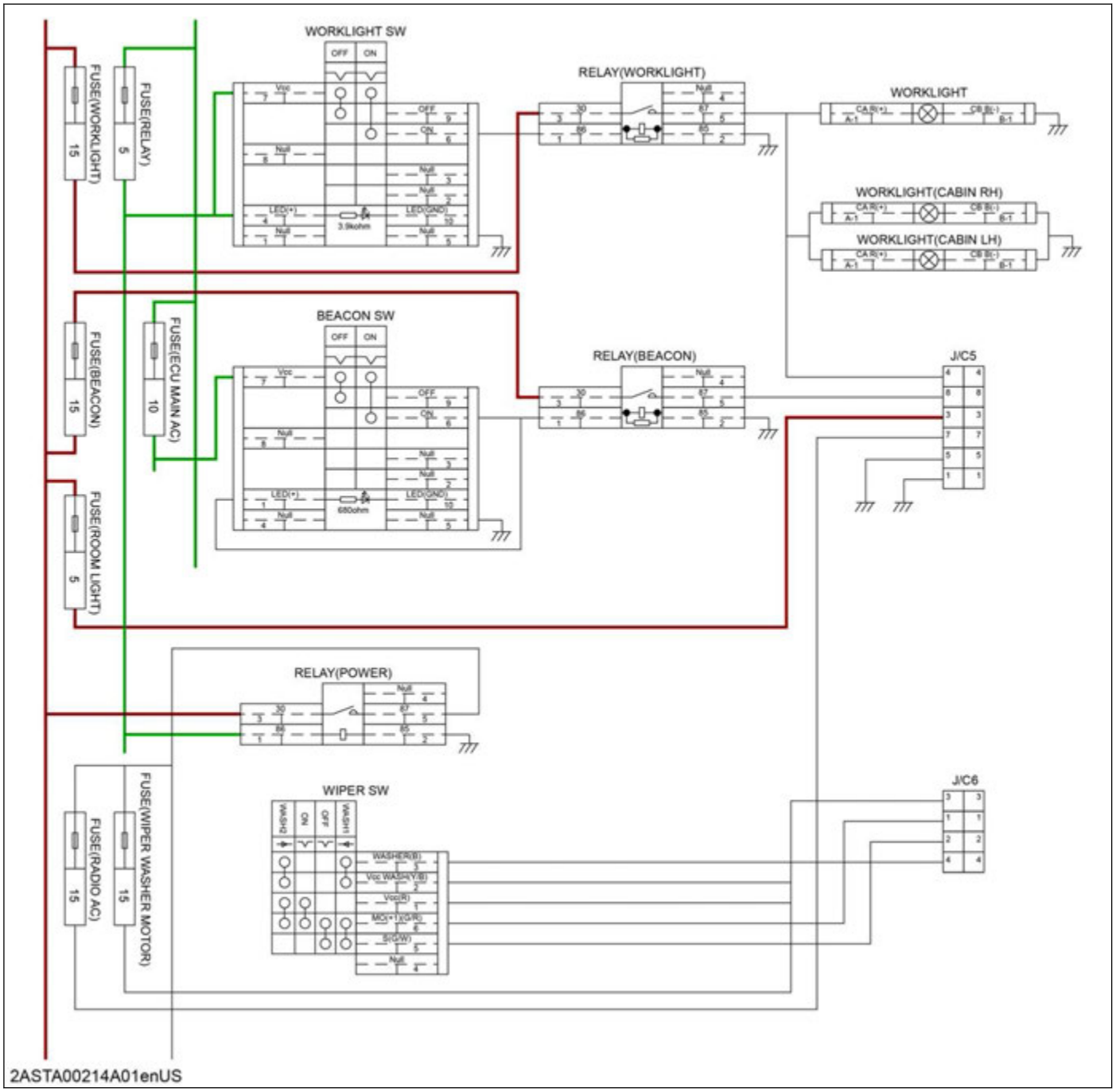


1.2.5 Communication electrical circuit diagram

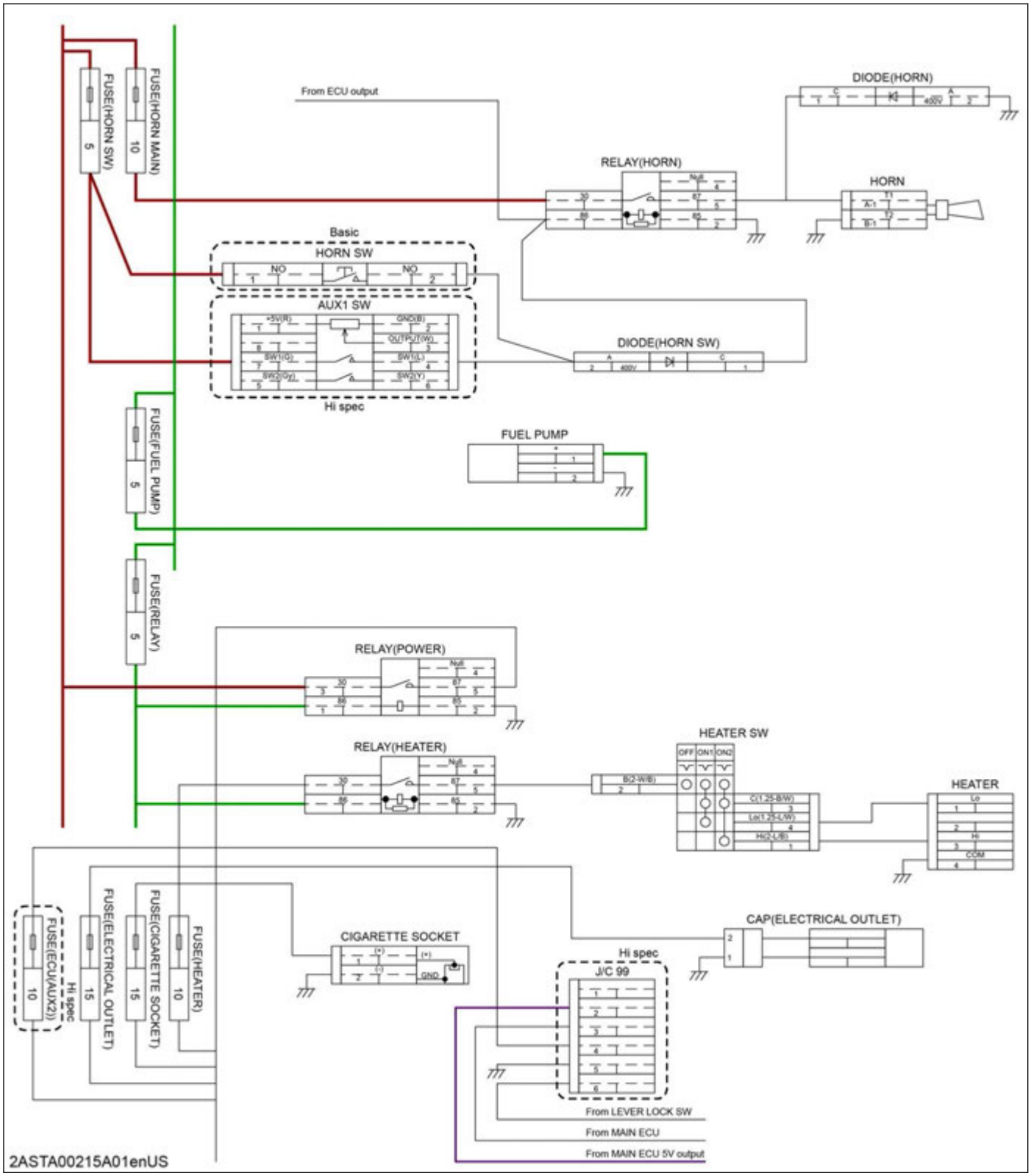


- CAN is communication network between each ECU (includes meter) to exchange information to each other.
- CAN port is used for connecting on board diagnostic software.
- RS232C port is used for writing software into ECU.

1.2.6 Accessory -1 electrical circuit diagram

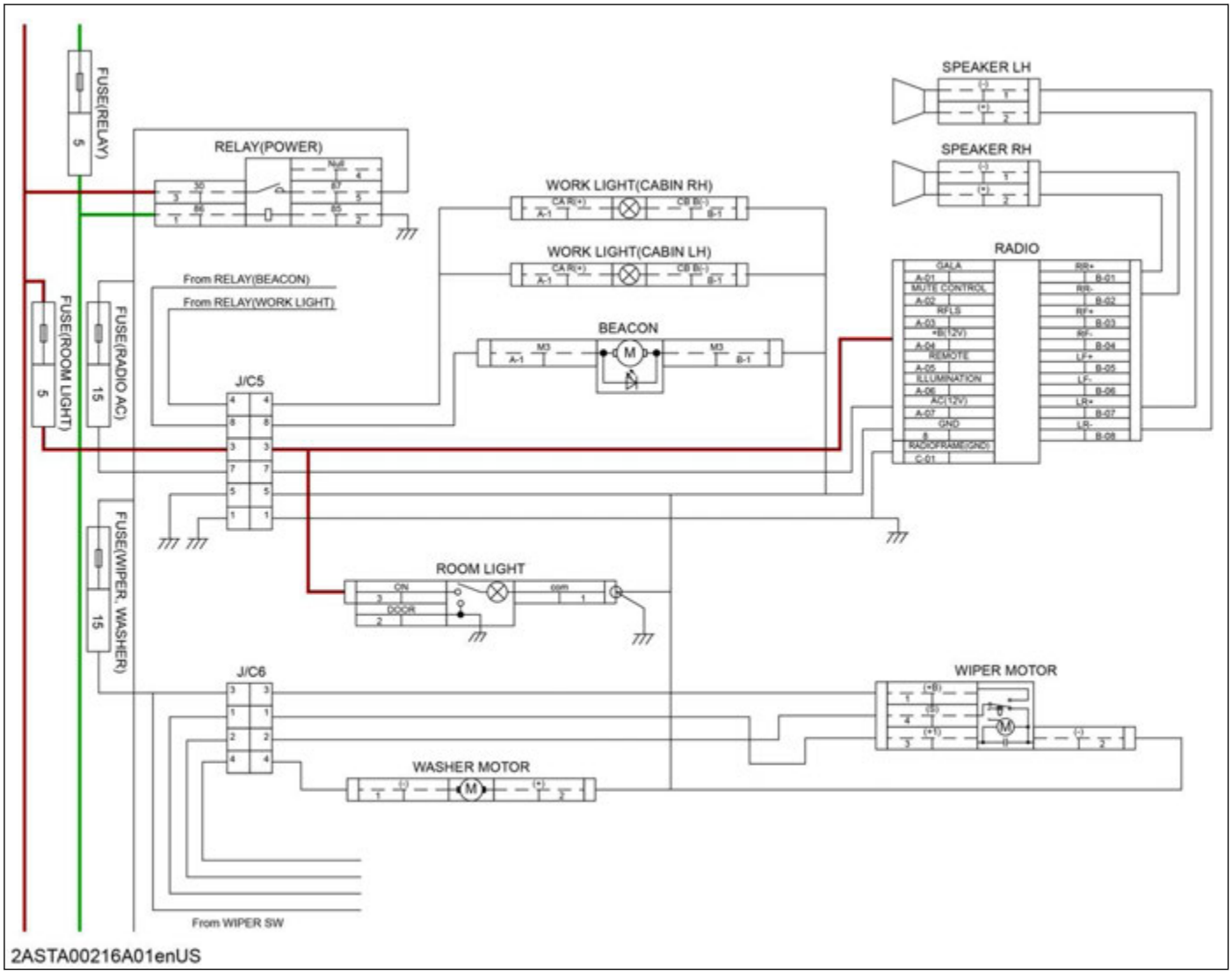


1.2.7 Accessory -2 electrical circuit diagram

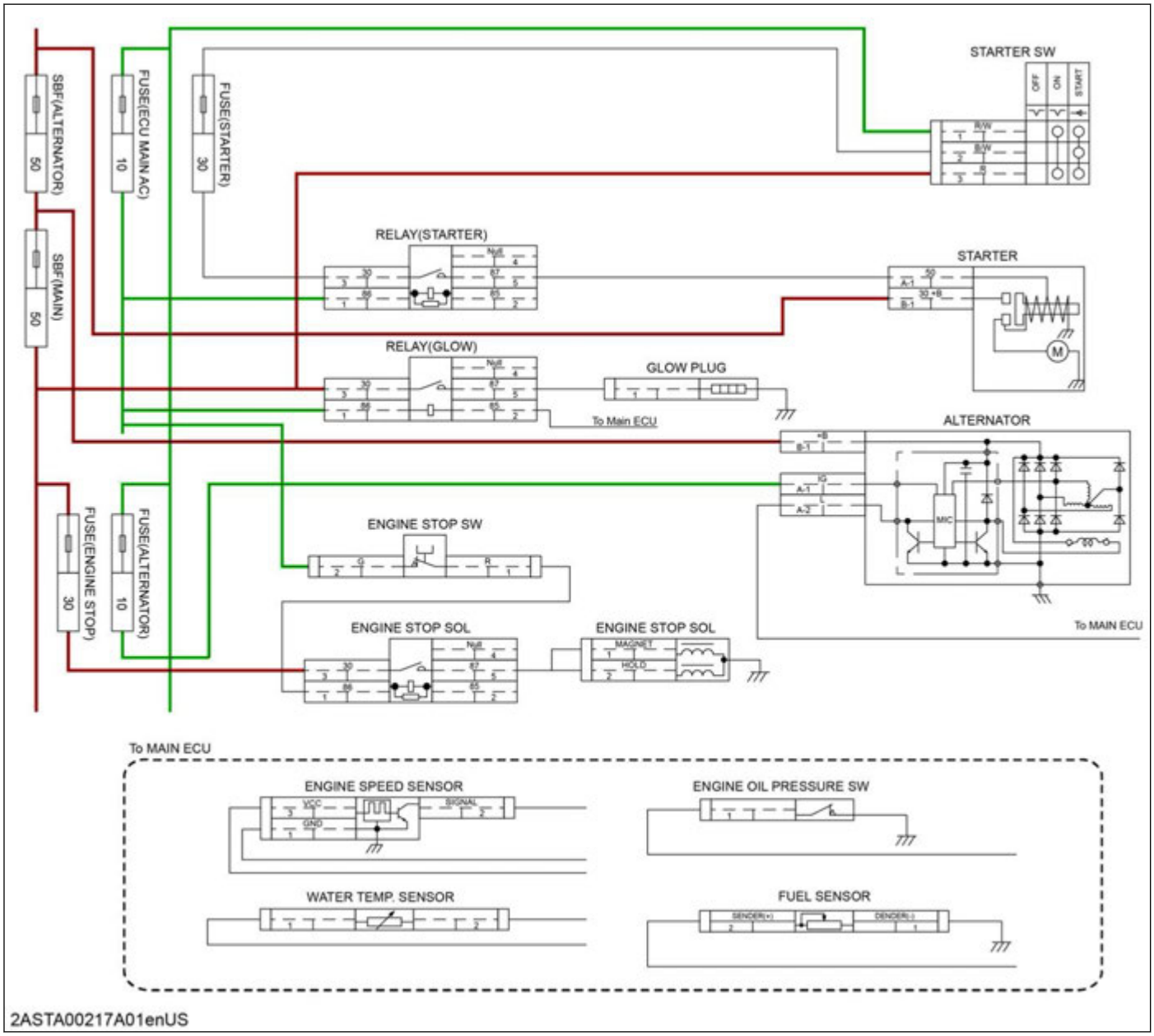


- The electrical outlet connector is connected Hi-spec harness as electrical power to control AUX2.

1.2.8 Cabin electrical circuit diagram



1.2.9 Engine electrical circuit diagram



2. Connector

2.1 Connector handling precaution

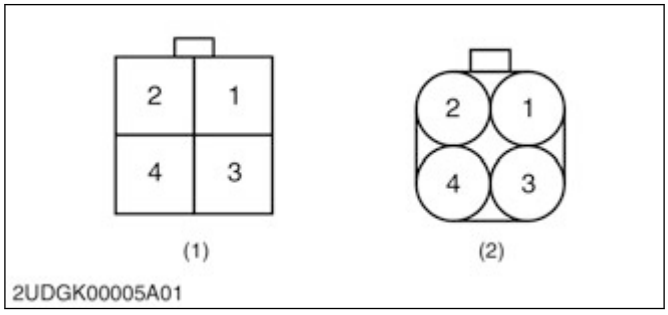
IMPORTANT

- **When disconnecting a connector, grasp the connector to pull it out. Do not pull by the wiring.**
- **When disconnecting a locking type connector, release the lock and pull it out.**
- **When removing the waterproof plastic cover of the connector, do not allow water to enter the connector.**
- **Correct any connector terminal deformations. Ensure that there is no protruding, loose, or rusty wiring.**
- **Ensure that the locking type connector is locked when inserted.**

2.2 Connector diagram description

Fewer than 10 pins

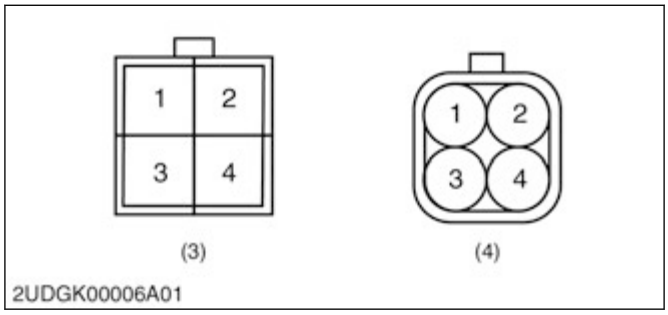
Female



(1) Non-waterproof (2) Waterproof

Number 1 is arranged from top right.

Male

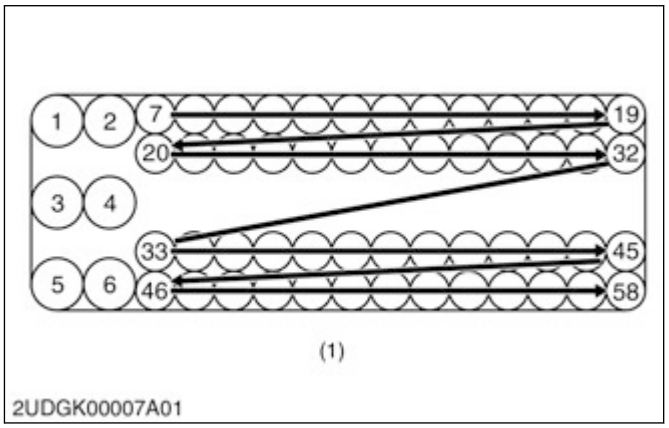


(3) Non-waterproof (4) Waterproofed

Number 1 is arranged from top left.

More than 11 pins

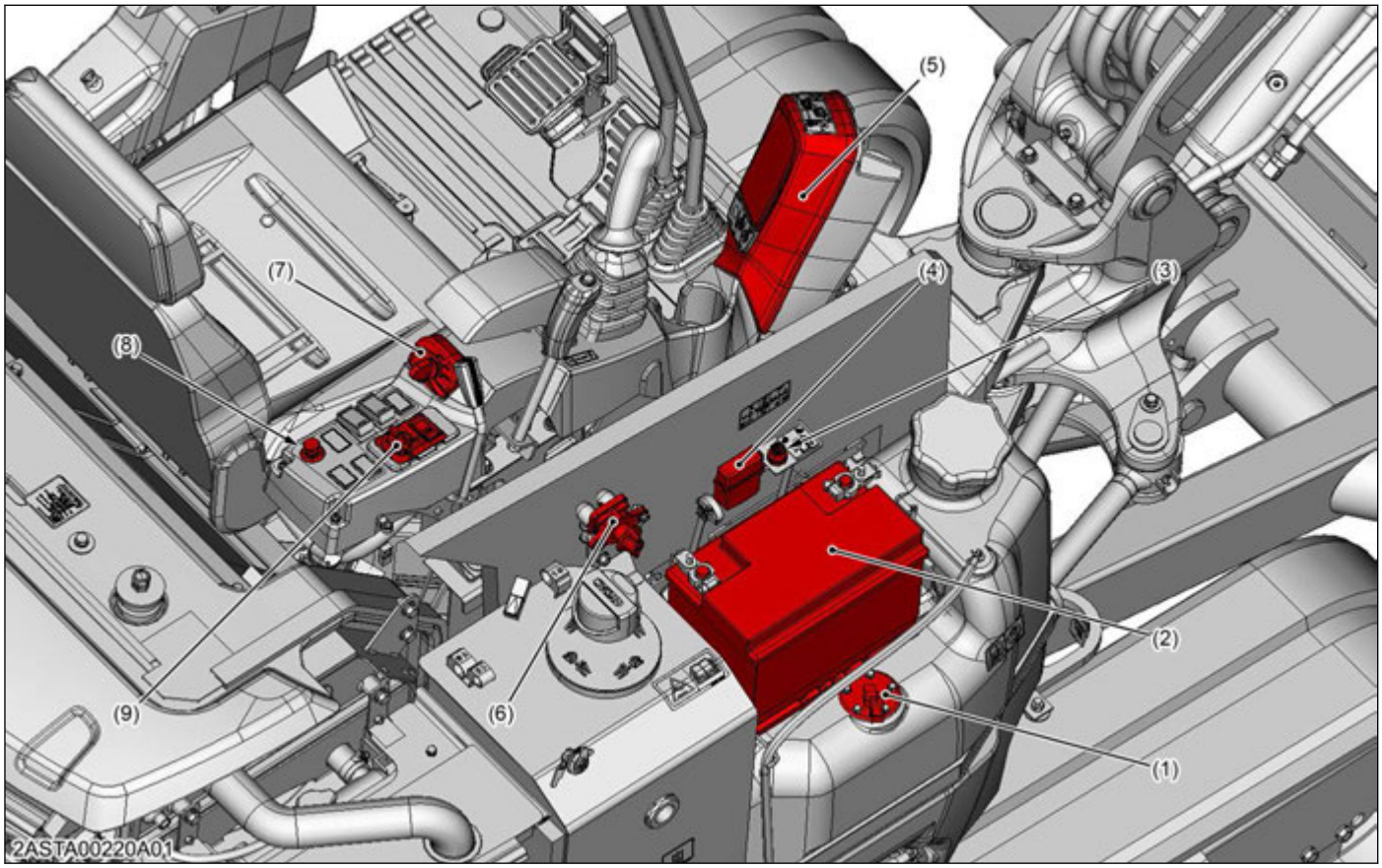
Female



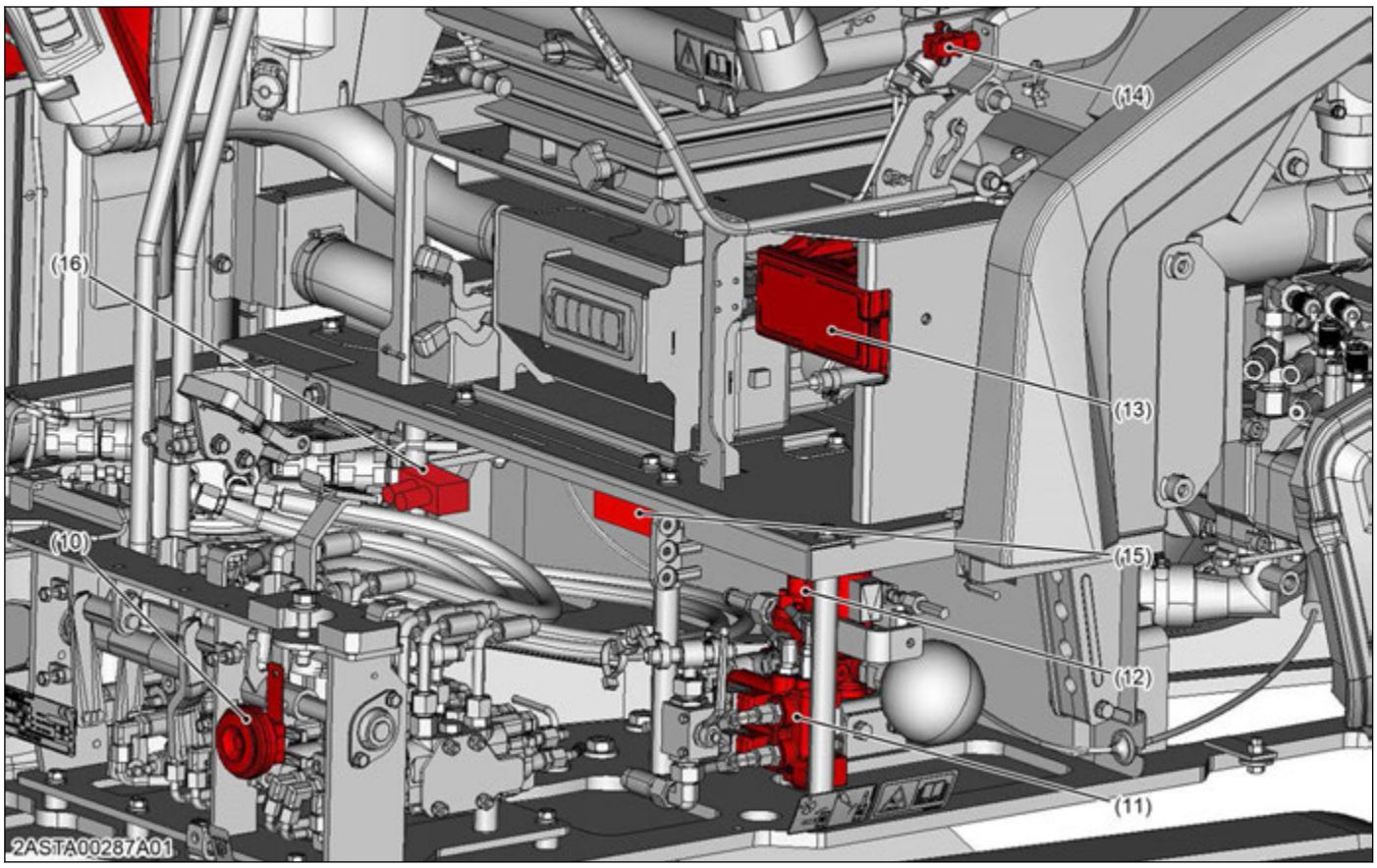
(1) Main ECU connector (female)

3. Electrical device

3.1 Electrical device layout

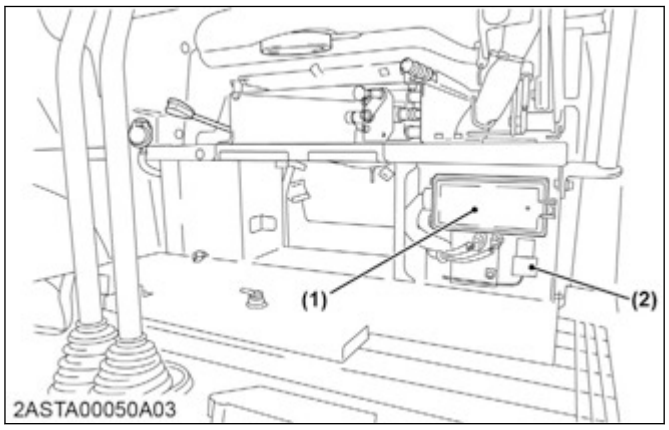


(1) Fuel sensor
(2) Battery
(3) Fuel level indicator switch
(4) Slow blow fuse
(5) Meter panel
(6) Battery isolator
(7) Starter switch
(8) Accelerator dial
(9) Engine stop switch



(10) Horn switch
(11) AUX1 proportional valve
(12) Unload valve
(13) Fuse box
(14) Limit switch
(15) ECU (AUX2)
(16) AUX2 proportional valve

3.2 Fuse and relay layout



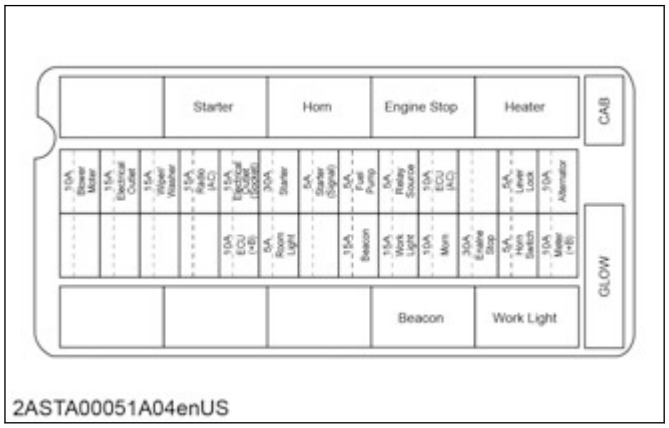
(1) Fuse and relay box (2) AUX2 relay

NOTE

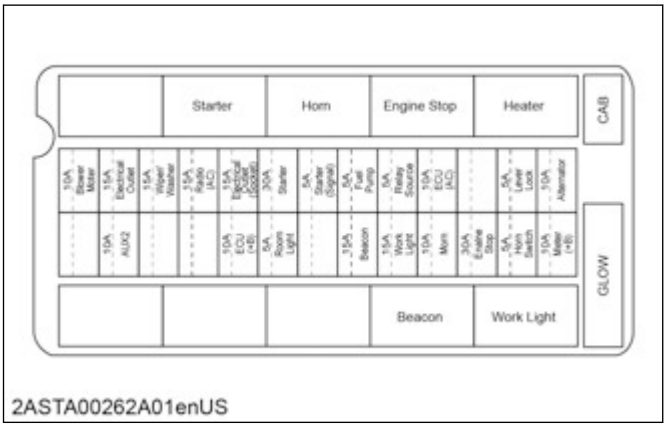
- **AUX2 relay is installed only for AUX2 specification.**

(3) Spare fuse

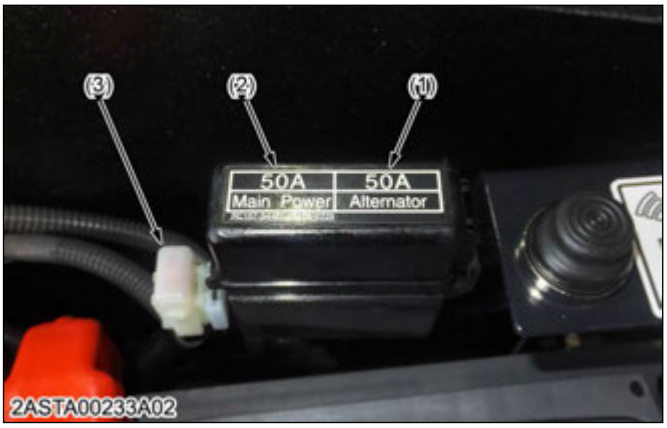
Fuse label (basic)



Fuse label (Hi-spec)

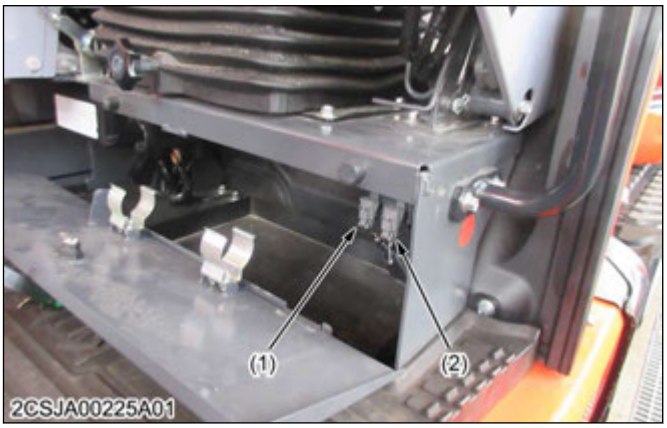


3.3 Slow blow fuse layout



(1) Alternator (50 A) (3) ECU-MAIN (+B) (10 A)
(2) Main power (50 A)

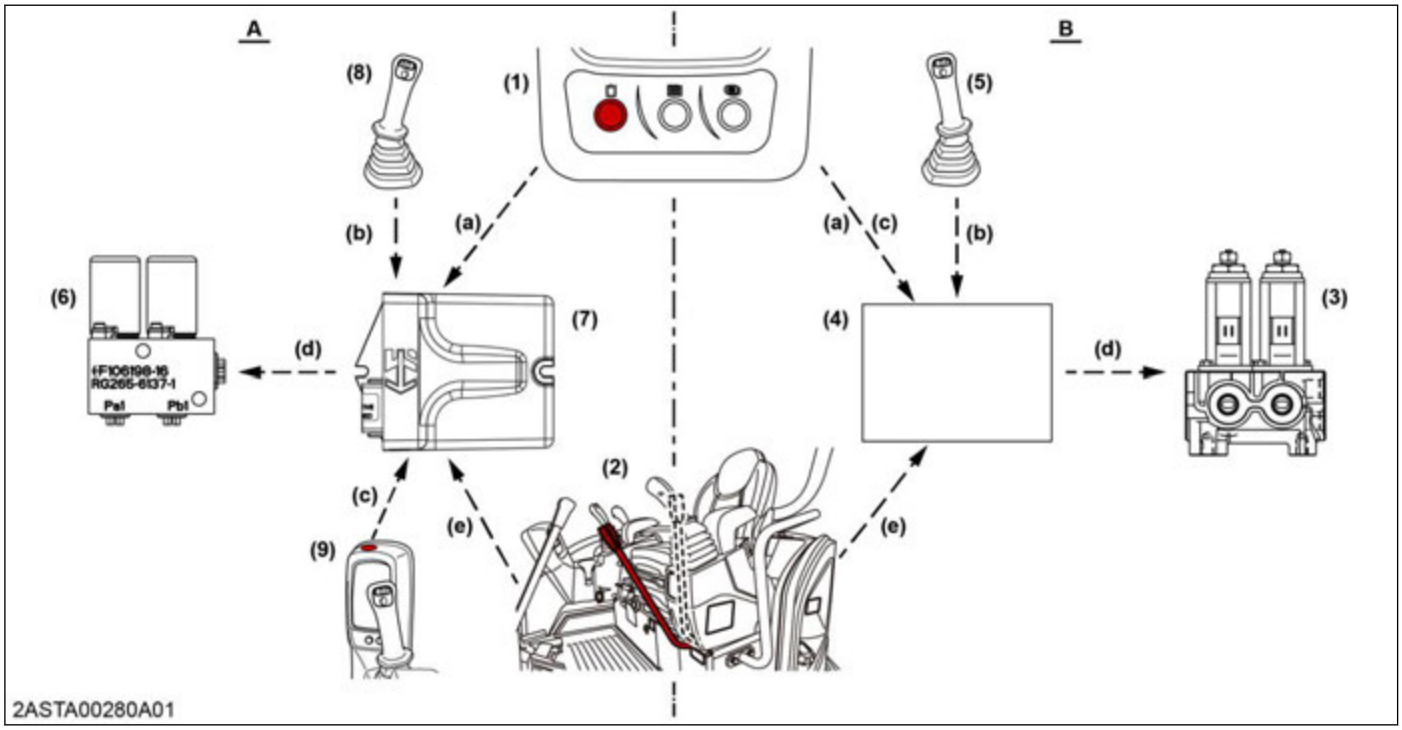
3.4 Communication port layout



(1) CAN connector (2) 232C connector

4. General description for AUX control on Hi-spec

There are two specifications for this model which are Basic and Hi-spec. Hi-spec machine is able to variably control the flow rate of AUX1 and AUX2.



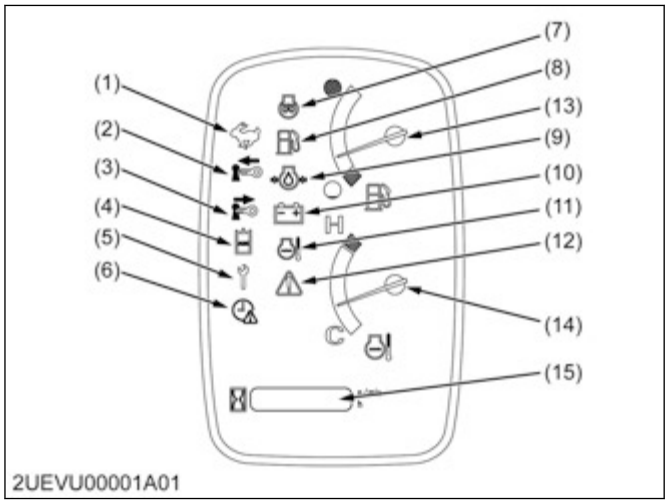
(1) Meter panel
(2) Lever lock switch
(3) AUX1 proportional valve
(4) Main ECU
(5) RH pilot control lever
(6) AUX2 proportional valve
(7) ECU (AUX2)
(8) LH pilot control lever
(9) AUX2 dial
A: AUX2 proportional control
B: AUX1 proportional control
(a) Activation (AUX activate SW operation)
(b) Knob switch operation
(c) Flow rate setting
(d) Flow rate control
(e) Activation (lowering the lever lock)

- AUX1 and AUX2 are activated by lowering the lever lock and pressing AUX activate switch.
- AUX1 and AUX2 are controlled by each ECU separately.
  - AUX1
    - The flow rate can be adjusted with the knob switch on the RH pilot control lever and meter panel setting.
    - The main ECU receives signals from RH pilot control lever, AUX activate switch, and lever lock switch.
    - The main ECU outputs current to the AUX1 proportional solenoid valve to control AUX1 flow rate.
  - AUX2
    - The flow rate can be adjusted with the knob switch on the LH pilot control lever and AUX2 dial.
    - The ECU (AUX2) receives signals from LH pilot control lever, AUX2 dial, and AUX activate switch.
    - The ECU (AUX2) outputs current to the AUX2 proportional solenoid to control AUX2 flow rate.

5. Meter panel

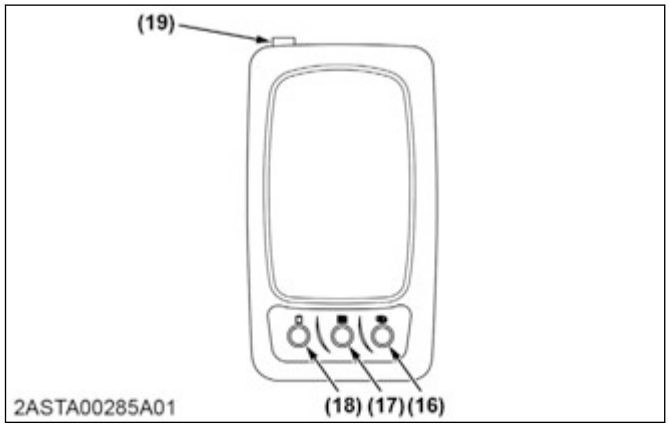
5.1 Meter panel function

Panel



No.	Name	Function
(1)	Travel speed shift lamp	Light - high speed
(2)	Key insertion lamp	Blink - requesting to insert key (registered key)
(3)	Key pull out lamp	Blink - requesting to pull out key (registered key), forgetting to pull out key
(4)	AUX lamp	Blink - AUX setting, AUX error
(5)	Periodic check lamp	Blink - requesting periodic check Blink or light - periodic check mode
(6)	Clock setting lamp	Blink - set clock, clock offset
(7)	Glow lamp	Light - warming up the engine
(8)	Low fuel warning lamp	Blink - low fuel
(9)	Engine oil pressure lamp	Light - engine oil pressure switch is ON, low engine oil
(10)	Charging lamp	Light - low battery voltage
(11)	Coolant high temperature warning lamp	Blink - high coolant temperature
(12)	Warning lamp	Blink - warning (error) occurred
(13)	Fuel meter	–
(14)	Coolant temperature meter	–
(15)	LCD	–

Switch



(16) Display switch (SW3)
(17) User switch (SW2)
(18) AUX switch (SW1)
(19) AUX2 dial

Switch name	Operation	Symbol	Function
SW3	Press	----►	Select a mode Increase a number
	Press and hold	——►	Set a mode
SW2	Press	----►	Decrease a number
	Press and hold	——►	Return to a mode
SW1	Press	-	AUX activation
AUX2 dial	Rotate clockwise	-	Increase AUX2 flow rate
	Rotate counter-clockwise	-	Decrease AUX2 flow rate

NOTE

- **SW1 is installed in the meter panel only for Hi-spec.**
- **AUX2 dial is installed in the meter panel only for AUX2 specification.**

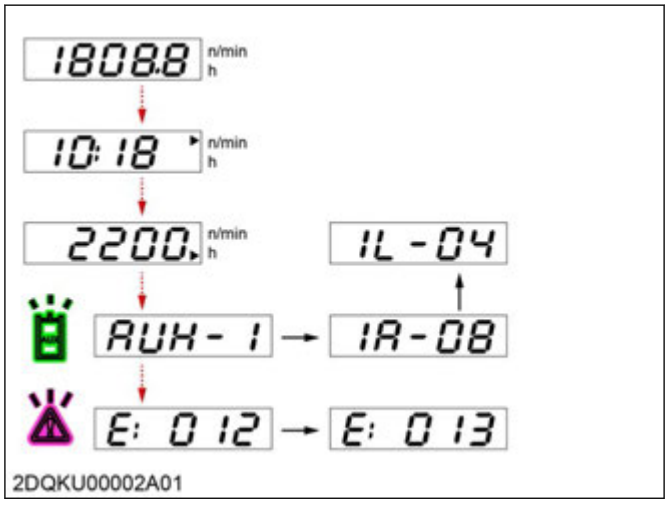
5.2 Display mode

Mode	Function	Operation
Normal mode	Clock	Turn starter switch to **[RUN]** (press SW3 to change display).
	Tachometer (engine speed)	
	Hour meter	
	AUX flow rate (Hi spec only)	Display when AUX activated.
	Error code	Display when an error has occurred.
User setting mode	Periodic check information	Press SW2 in the normal mode.
	AUX flow rate setting (Hi spec only)	
	Clock setting	
Service dealer mode	Tester mode	Turn starter switch to **[RUN]** while pressing SW3.
	Read error history	
	Clear error history	
	Dealer setting	
	Read all error history	

5.3 Operating normal mode

Displays five items which are hour meter, clock, tachometer (engine speed), AUX and error codes.

1. Turn the starter switch to **[RUN]**.
2. Press SW3 to change function.
   - Hour meter → Clock → Tachometer → AUX → Error code



NOTE

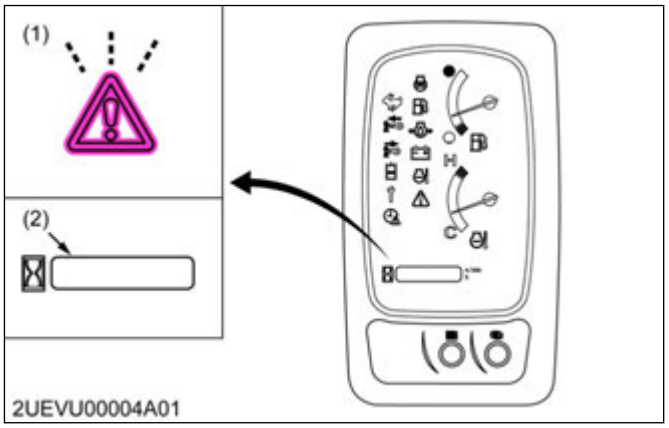
- **Normally, the error code is not displayed.**
- **Display AUX only for Hi-spec.**

In case of AUX activation

- Change display automatically in every one second.
  AUX number → Flow rate RH → Flow rate LH

In case of error

- The warning lamp blinks and the error code is displayed on the LCD.

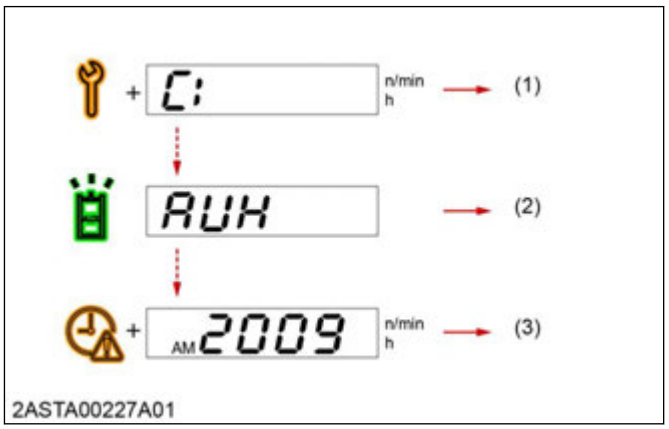


(1) Warning lamp (2) LCD

5.4 Operating user setting mode

Displays three functions which are periodic check mode, AUX flow rate setting, and clock setting.

1. Press SW2 in the normal mode.
2. Press SW3 to change function.
   - Periodic check mode → AUX flow rate setting → Clock setting



(1) Periodic check mode (3) AUX flow rate setting
(2) Clock setting

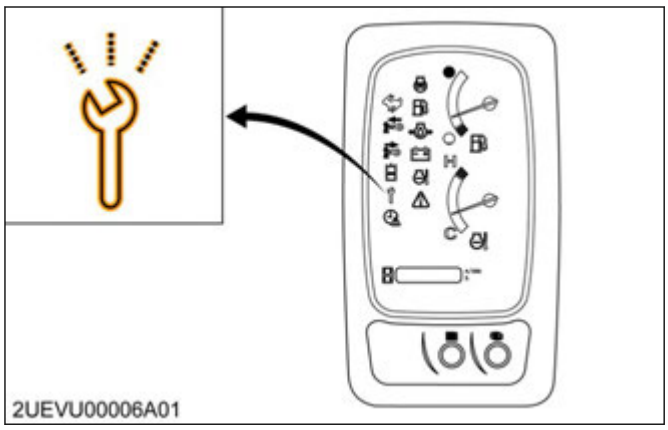
NOTE

- **Does not display AUX flow rate setting if the machine is basic spec.**

5.4.1 Operating periodic check mode

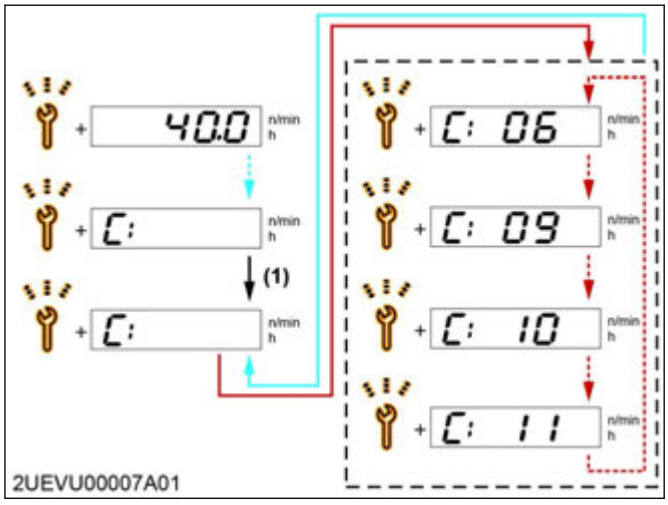
In case of periodic check alert

- Inform about periodic check by setting operation time (hour meter).
- The periodic check lamp blinks and a beep sounds before 10 hours of the periodic check.



Checking the periodic check code

1. Press SW2 when the periodic check lamp blinks.
2. Push the work light switch to set from ON to OFF.
3. Press and hold SW3 to display the periodic check code.



(1) Push the work light switch:
OFF to ON to OFF

(2) Work light switch

NOTE

- **If there are 2 or more check items, press SW3 to display the other periodic check codes.**

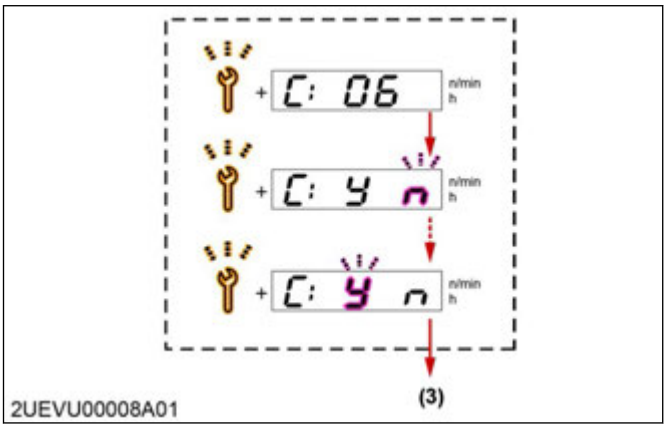
Periodic check code list

No.	Items
C:_01	Engine oil
C:_02	Hydraulic oil
C:_03	Air cleaner element
C:_04	Fuel filter cartridge
C:_05	Engine oil filter
C:_06	Drive motor gear oil
C:_07	Hydraulic oil return filter
C:_08	Hydraulic oil suction filter
C:_09	Pilot filter
C:_10	Track roller oil, front idler oil
C:_11	Breather filter

Clearing the periodic check alert manually

- After checking the machine, clear the periodic check alert.

1. Display the periodic check code.
2. Press and hold SW3.
3. Press SW3 to make "Y" blink instead of "N".
4. Press and hold SW3.



(3) User setting mode

NOTE

- **If there are 2 or more periodic check alerts, clear them one by one.**
- **In case of "SET-4"/"no-06" is "Y", the periodic check alert will be cleared automatically by turning the starter switch repeatedly to [RUN] and [STOP] 10 times (clearing periodic check alert: Auto).**

Alternative settings for periodic check

NOTE

- **There are 3 settings for periodic check in the service dealer mode.**

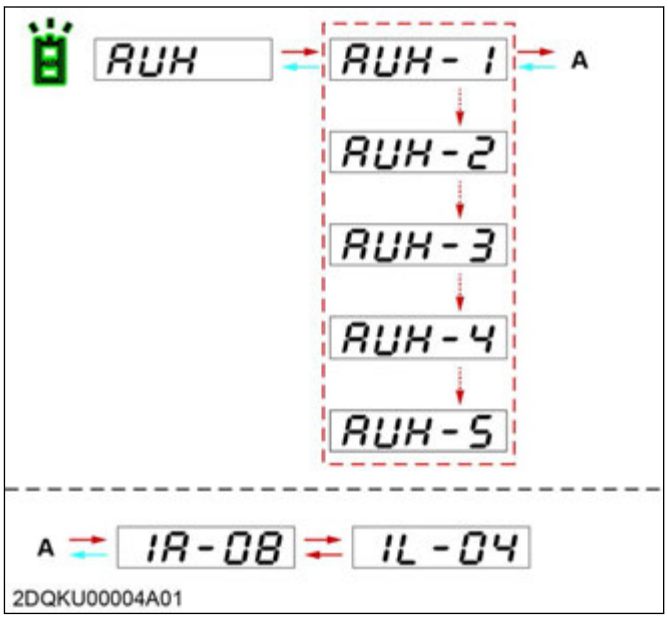
- Clearing the periodic check alert
  - Select automatic or manual.

    - "Y": (manual) Clear the periodic check alert manually.
    - "N": (automatic) Turn the starter switch repeatedly to **[RUN]** and **[STOP]** 10 times.
- Informing periodic check alert
  - Select informing or not informing of the periodic check alert.
    - "Y": Inform of the periodic check by blinking the lamp and beeping buzzer.
    - "N": Does not inform periodic check as alert.
- Time offset for periodic check
  - This setting is about the time offset between the hour meter and periodic check hour.
  - Input the old hour meter times after replacing the ECU.

5.4.2 Operating AUX flow rate setting mode

Set AUX flow rate for RH side and LH side of each "AUX-1" to "AUX-5".

1. Press SW2 to enter user setting mode.
2. Press SW2 or SW3 to select "AUX" (AUX flow rate setting mode).
3. Press and hold SW3 to display "AUX-1".
   a. Press and hold SW3 to display "1R-oo".
      i. Press SW2 or SW3 to set AUX1 RH flow rate from "00" to "14".
      ii. Press and hold SW3 to display "1L-oo".
      iii. Press SW2 or SW3 to set AUX1 LH flow rate from "00" to "14".
      iv. Press and hold SW2 to return to "AUX-1".
   b. Press SW3 to display "AUX-2".
      i. Set flow rate from "AUX-2" to "AUX-5" with same steps as "AUX-1" (procedure 3-a and 4 to 7).
      ii. When finish all of the settings, press and hold SW3 on "AUX-o" to return "AUX".

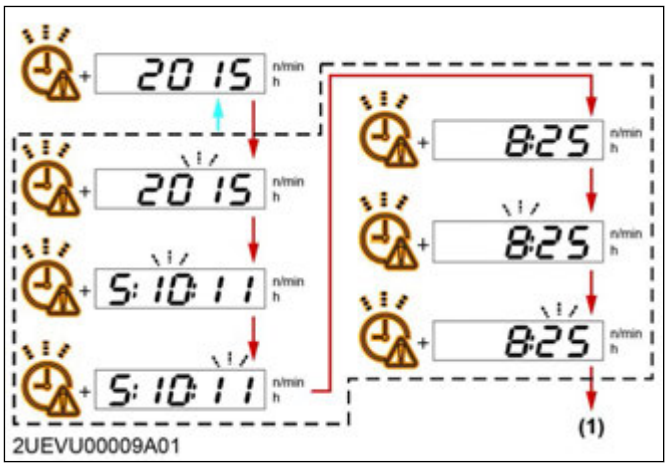


5.4.3 Operating clock setting mode

Set the calendar and clock.

1. Press SW3 in the user setting mode to display the clock settings.
2. Press and hold SW3 to make the number (year) blink.
3. Press SW2 and SW3 to select numbers and press and hold SW3 to set.
4. Set in the following order - year, month, date, 12 h or 24 h, hour, and minute.

   2015/10/11 AM 8:25



(1) Normal mode

Other settings for clock

NOTE

- **One clock setting is done in the service dealer mode.**

- Clock setting lamp
  - Clock setting lamp display or non-display setting.

- “Y”: (display) Inform of time offset by blinking clock setting lamp.
- “N”: (non-display) Inform of time offset without blinking the clock setting lamp.

5.5 Service dealer mode table

The service dealer mode is used for maintenance such as checking the machine condition, setting parameters, adjusting the devices and etc. Turn the starter switch to **[RUN]** while pressing SW3 to enter the service dealer mode.

■ IMPORTANT

- **It is necessary to set all of the items after replacing the main ECU.**

■ NOTE

- **"SET-4"/"no-01" to "no-04" are only used for Hi spec.**
- **Turn the starter switch to [STOP] to exit the service dealer mode.**

Mode	Item	Detail	
SEt-1	Tester mode	Displays the machine information, status of sensors and solenoids.	
SEt-2	Reading error history	Displays the previous error code and hour meter from memory.	
SEt-3	Clearing error history	Clears error history of "SET-2".	
SEt-4	Dealer setting	no-01 AUX knob switch setting (Hi spec only)	Sets the left and right ends and neutral for the AUX knob switch. • Required setting after replacing the AUX knob switch.
		no-02 AUX start-up point settings (with attachment) (Hi spec only)	Sets the start-up point of the AUX with attachment. • Required setting after replacing an attachment or cylinder. • Required setting after repairing a hydraulic device.
		no-03 AUX start-up point settings (without attachment) (Hi spec only)	Sets the start-up point of the AUX without attachment. • Required setting after replacing an attachment or cylinder. • Required setting after repairing a hydraulic device.
		no-04 AUX fine setting (Hi spec only)	Fine setting for the start-up point of the actuator (cylinder) attached to AUX.
		no-05 Model setting	Individual setting for the machine.
		no-06 Clearing periodic check alert	Selects clearing method for periodic check alert.
		no-07 Informing periodic check alert	Selects blinking or not blinking periodic check lamp when periodic check term.
		no-08 Time offset for periodic check	Time offset between hour meter and periodic check hour.

(Continued)

Mode	Item	Detail	
SEt-4	Dealer setting	no-09 Clock setting alert	Displays or not displays clock setting lamp when the clock is offset.
		no-10 Travel buzzer function	Enables or disables the travel buzzer.
		no-11 Travel speed shift switch Select hand or foot	Selects hand or foot for the travel speed shift switch.
SEt-5	Reading all error history	Displays the previous error code and hour meter from memory. • Unable to clear in "SET-3" (clear error history).	

SERVICING

1. Troubleshooting

1.1 Electrical troubleshooting

The starter motor does not work

Causes	Inspections	Actions
The anti-theft system is activated.	Turn the starter switch to **[RUN]** and check if the key pull-out lamp is blinking.	Use the registered key.
The ground terminals are disconnected or connected loosely.	Check for the connection of the relating ground terminals to the machine.	Tighten the loosened ground terminal.
The battery has discharged or is damaged.	Check for the battery voltage.	Recharge or replace the battery.
The fuse or slow blow fuse has blown.	Check if the fuses and slow blow fuses for the lever lock, starter, starter signal, and ECU main AC has blown.	Specify the cause of the fuse blowing and replace the fuse.
The starter relay is malfunctioning.	Check for the conduction of the starter relay.	Replace the starter relay.
The wire harnesses are damaged.	Check for the conduction of the relating wire harnesses of the starter motor, starter switch, lever lock switch.	Repair or replace the wire harness.
The starter switch is damaged.	Check for the conduction between the starter switch terminals.	Replace the starter switch.
The lever lock switch is damaged or adjusted improperly.	Check for the conduction between the lever lock switch terminals.	Adjust or replace the lever lock switch.
The starter motor is malfunctioning.	Measure the voltage of the starter motor. Check for the starter motor.	Replace the starter motor.

The engine does not start

Causes	Inspections	Actions
Engine stop solenoid relay is malfunctioning.	Check for the conduction of the engine stop solenoid relay.	Replace the engine stop solenoid relay.
Engine stop solenoid switch is damaged.	Check for the conduction between the engine stop solenoid switch terminals.	Replace the engine stop solenoid switch.
Wire harnesses are damaged.	Check for the conduction of the relating wire harnesses of the starter, starter switch, and lever lock switch.	Repair or replace the wire harness.
Engine stop solenoid is malfunctioning.	Check for the conduction of the engine stop solenoid connector.	Replace the engine stop solenoid.
Engine stop switch is pulled to stop the engine.	Check the engine stop switch position.	Turn off the engine stop switch.

The engine does not start occasionally

Cause	Inspection	Action
The anti-theft antenna does not recognize the key.	Check if there is interference from the metal attachments on the key ring.	Remove the metal attachments from the key ring.

The engine starts with the not registered key

Cause	Inspection	Action
The anti-theft settings are OFF.	Check the anti-theft settings.	Turn ON the anti-theft settings. Register the keys.

AUX2 does not work

Causes	Inspections	Actions
The AUX function is not activated.	Check the activation of the AUX function on the meter panel.	Activate the AUX function.
The AUX2 flow rate is set to minimum.	Check the position of the AUX2 dial.	Adjust the AUX2 flow rate with the AUX2 dial.
The AUX2 knob switch connector is disconnected.	Check the connection of the AUX2 knob switch connector.	Reconnect the AUX2 knob switch connector.
The AUX2 knob switch malfunctions.	Check the conduction of the AUX2 knob switch.	Replace the grip of the pilot lever.
The wire harnesses are damaged.	Check for the conduction of the relating wire harnesses.	Repair or replace the wire harness.
The AUX2 dial malfunctions.	Check for the conduction of the AUX2 dial.	Replace the potentiometer of the AUX2 dial.
The AUX2 proportional valve malfunctions.	Check for the conduction of the AUX2 proportional valve.	Replace the AUX2 proportional valve.

1.2 Error warning table

NOTE

- **Warning lamp lights in red (excluding "E:005").**

Display	Lamp	Error	Cause(s)
E: 001	-	CAN communication error	• There is no communication between the main ECU and the meter.
E: 005		High coolant temperature	• Coolant temperature is higher than 117 ℃ and lower than 122 ℃.
E: 014		Engine oil pressure error	• Oil switch is ON while the engine is running.
E: 015		Engine overheating	• Coolant temperature is higher than 122 ℃.
E: 016		Battery charging error	• Charge switch is ON while the engine is running.
E: 017	-	Fuel sensor error	• Breaking in fuel sensor.
E: 018	-	Coolant temperature sensor error	• Breaking or short circuit of the coolant temperature sensor.
E: 020	-	Lever lock system error	• Short circuit of the lever lock solenoid.
E: 021	-	Travel speed shift system error	• Short circuit of the travel speed shift solenoid.
E: 022	-	AUX nob switch system error	• Breaking or short circuit of the AUX nob switch.
E: 023	-	AUX RH solenoid error	• Breaking or short circuit of the AUX RH solenoid.
E: 024	-	AUX LH solenoid error	• Breaking or short circuit of the AUX LH solenoid.
E: 025	-	Battery overcharging	• Battery overcharging.
E: 026	-	Anti-theft antenna error	• Antenna error.
E: 027	-	5 V error	• Short circuit in the 5 V line.
E: 028	-	12 V error	• Short circuit in the 12 V line.

1.3 Lamp warning list

NOTE

- **Anti-theft lamp is only for anti-theft specification**

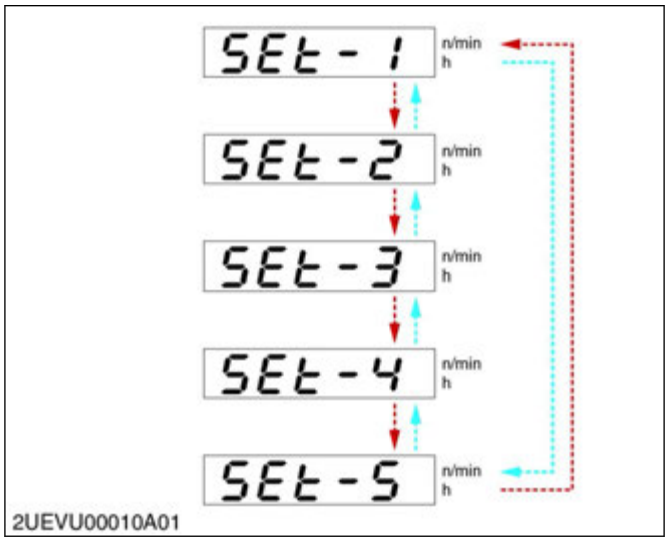
Display	Lamp	Error	Probable cause(s)
-		Low fuel	• Fuel level is low.
-		Periodic check	• 10 hours before periodic check. • Past the periodic check term.
-		Anti-theft	• Started the engine with a non-registered key. • Started the engine with the red key. • Forgot to remove the key.
-		Clock error	• Time on the clock is off.
-		Lever lock	• Start the engine while holding down the lever lock.

2. Service dealer mode

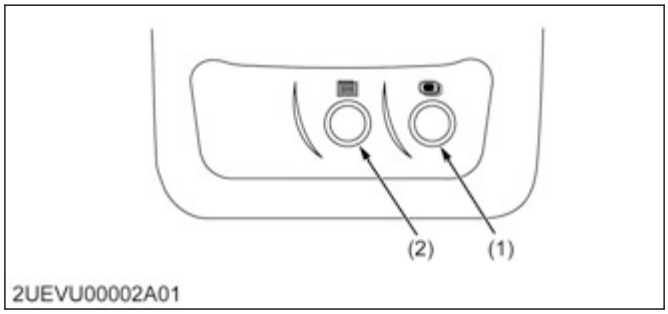
2.1 Entering service dealer mode

Entering service dealer mode

1. Turn the starter switch to **[RUN]** while pressing SW3.
2. Display "SET-1".
3. Press SW3 to select the functions (modes).
4. Press and hold SW3 to enter the needed function (mode).
5. Press and hold SW2 to return selected functions (mode).
6. Turn the starter switch to **[STOP]** to exit the service dealer mode.



Switch



(1) Display switch (SW3) (2) User switch (SW2)

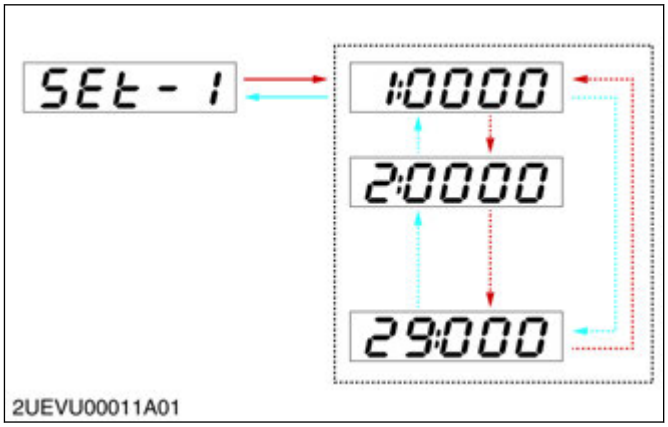
Switch name	Operation	Symbol	Function
SW3	Press	----►	Select a mode Increase a number
	Press and hold	——►	Sets a mode
SW2	Press	----►	Decrease a number
	Press and hold	——►	Return to a mode

2.2 Operating SET-1 (Tester mode)

Displays the machine information, status of sensors, and solenoids.

Operating SET-1 (Tester mode)

1. Set "SET-1" in the service dealer mode.
2. Press SW2 or SW3 to select a number of the tester (from "1" to "29").
3. Press and hold SW2 to return to "SET-1".



Tester mode item list

Number	Item	Display
1	Engine speed	"oooo" rpm
2	Battery voltage	"oo.o "V
3	Oil SW	"ON" or "OFF"
4	Battery charge SW	"ON" or "OFF"
5	Starter SW	"ON" or "OFF"
6	Work light SW	"ON" or "OFF"
7	Coolant temperature sensor (voltage)	"o.oo" V
8	Coolant temperature sensor (temperature)	"oo"°C
9	Fuel sensor (voltage)	"o.oo" V
10	Fuel sensor (resistance)	"ooo" Ω
11	Fuel feed SW	"ON" or "OFF"
12	Travel speed shift switch	"ON" or "OFF"
13	Travel speed shift solenoid	"ON" or "OFF"
14	Lever lock SW	"ON" or "OFF"
15	Lever lock SOL	"ON" or "OFF"
16	AUX 1 knob SW (voltage) and travel pressure sensor (voltage)	"o.oo" V
17	AUX 1 knob SW (setting voltage left)	"o.oo" V

(Continued)

Number	Item	Display
18	AUX 1 knob SW (setting voltage neutral)	"o.oo" V
19	AUX 1 knob SW (setting voltage right)	"o.oo" V
20	AUX 1 SOL (current)	"o.oo" A
21	AUX hold SW	"ON" or "OFF"
22	AUX switch	"ON" or "OFF"
23	AUX1 RH setting	"oo" × 10 mA
24	AUX1 LH setting	"oo" × 10 mA
25	Key type	"0" (Unknown) "1" (Red) "2" (Black) "3" (Yellow) "4" (Green) "5" (Red Yellow) "6" (Red Green)
26	Anti-theft key analysis (registered key)	"ON" (Match) "OFF" (Mismatch)
27	Anti-theft mode	"ON" (Deactivation) "OFF" (Activation)
28	Key	"ON" (Existence) "OFF" (Non-existence)
29	Anti-theft antenna	"ON" (Error) "OFF" (Normal)

2.3 Operating SET-2 (Reading error history)

Display the previous error code and hour meter from the memory.

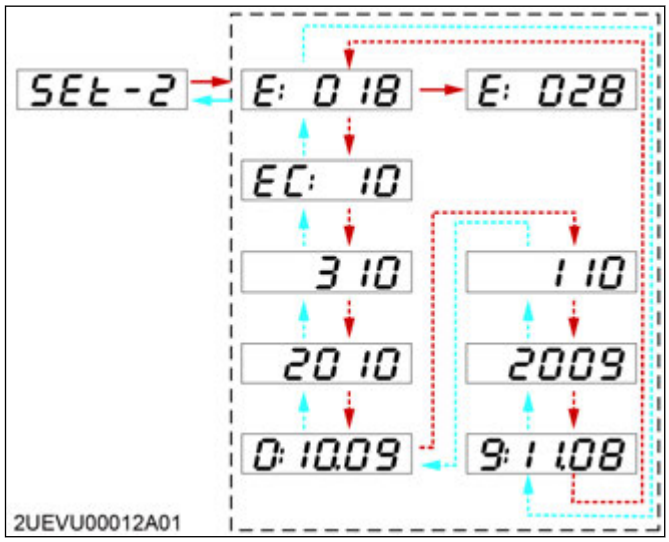
■ NOTE

- **Display seven items for each error code.**
  - **Number of times**
  - **Recent hour meter**
  - **Recent year**
  - **Recent month and date**
  - **First hour meter**
  - **First year**
  - **First month and date**
- **Set "SET-3" to clear error history.**
- **The first error memory is stored starting from the last "SET-3" error history clear.**

1. Set "SET-2" in the service dealer mode.
2. Display the previous error code from the memory.
3. Press SW2 or SW3 to change the item.
4. Press and hold SW3 to display other error codes.
5. Press and hold SW2 to return to "SET-2".

"E018": Issued 10 times
Recent data: 310 h, 2010/10/9

First data: 110 h, 2009/11/8



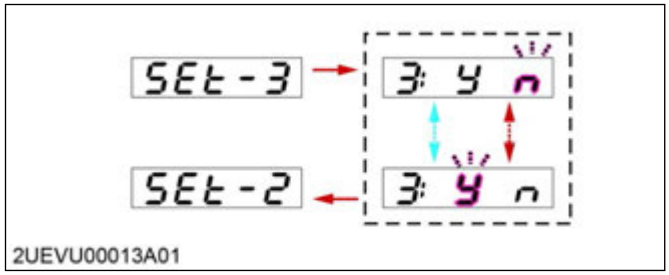
2.4 Operating SET-3 (Clearing error history)

Clear error history from memory.

1. Set the "SET-2" in the service dealer mode.
2. Press SW2 or SW3 to make "Y" or "N" blink.
3. Press and hold SW3 to set.

■ NOTE

- **"SET-3" (Reading error history) is cleared.**
- **"SET-5" (Reading all error history) cannot be cleared.**



"Y"	Clear

2.5 Operating SET-4 (Dealer setting)

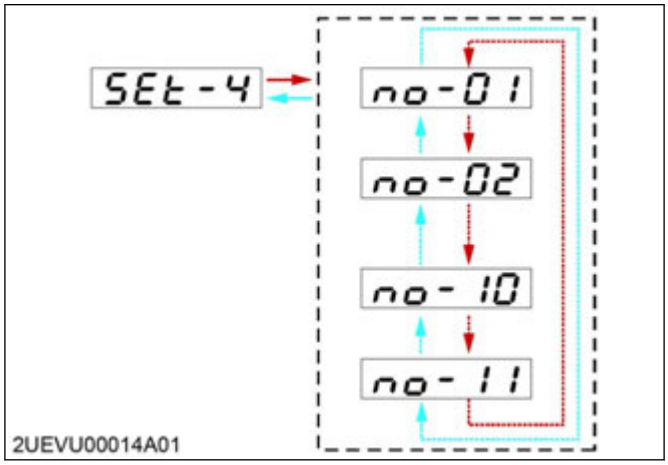
Individual settings for each machine (11 items).

1. Set "SET-4" in the service dealer mode.
2. Press SW3 to change function from "no-01" to "no-11".
3. Press and hold SW3 to set function.

4. Press and hold SW2 to return to "SET-2".

■ NOTE

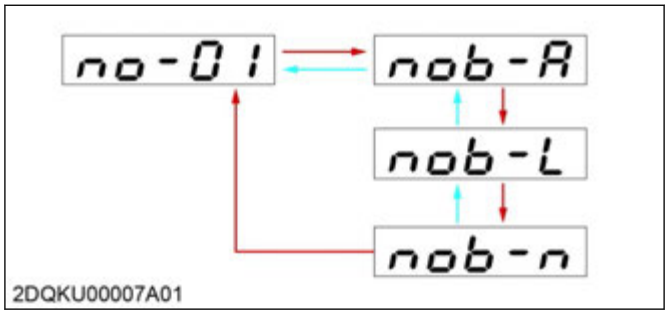
- **"no-01", "no-02", "no-03", and "no-04" are settings for proportional AUX specification.**



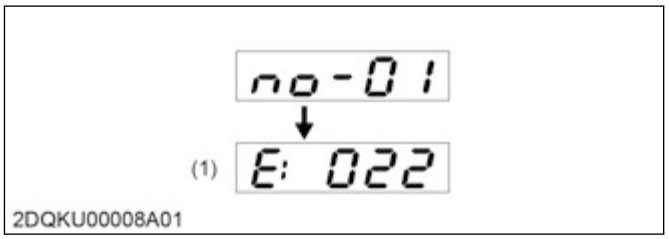
2.5.1 Operating SET-4 (Dealer setting) No-01 (AUX knob switch setting)

Set RH end, LH end, and neutral of the AUX knob switch.

1. Set the "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-01".
3. Press and hold SW3 to set.
4. When display "nob-R", slide to hold AUX knob switch to RH end and press and hold SW3.
5. When display "nob-L", slide to hold AUX knob switch to LH end and press and hold SW3.
6. When display "nob-n", take hands off from AUX knob switch to stay in neutral and press and hold SW3.
7. Beep buzzer to return to "no-01".



In case of problem with knob switch



(1) E:022 AUX knob switch error

2.5.2 Operating SET-4 (Dealer setting) No-02 (AUX start-up point setting (w/ attachment))

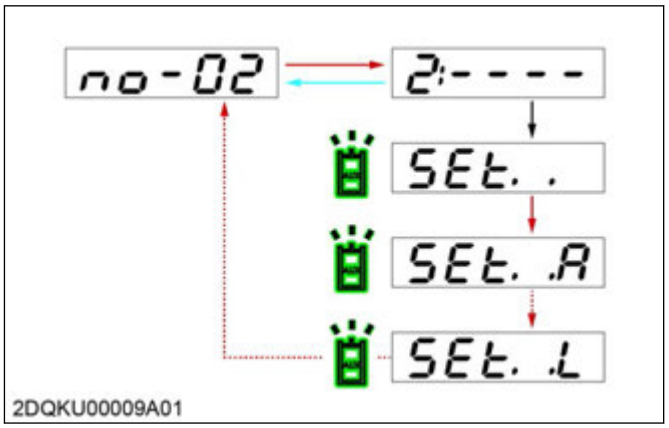
Adjust start-up point for AUX with mounting attachment.

1. Set the "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-02".
3. Press and hold SW3 to set.
4. When display "2: ----", start the engine and lower the lever lock.
5. When display "SET.." with lighting AUX lamp, raise engine speed to maximum and move front attachment to correct position.

■ IMPORTANT

- **The attachment will start to move automatically in the setting. Make sure to be free of any obstructions around the machine.**

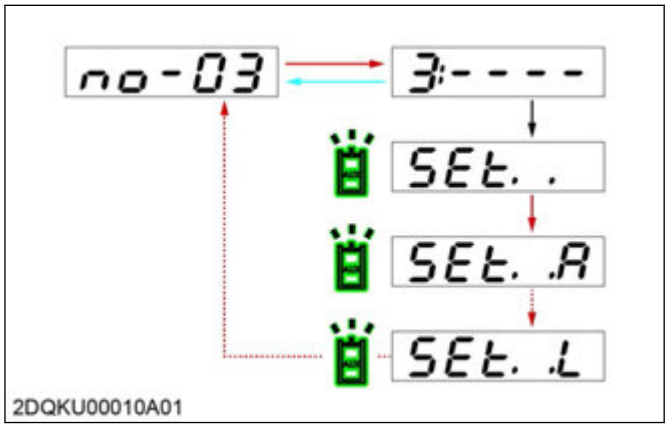
6. When ready for setting, press and hold SW3.
7. Display "SET..R" with lighting AUX lamp.
   When starting to move attachment to RH side automatically, press SW3.
8. Display "SET..L" with lighting AUX lamp.
   When starting to move attachment to LH side automatically, press SW3.
9. Beep buzzer to return to "no-02".



2.5.3 Operating SET-4 (Dealer setting) No-03 (AUX start-up point setting (w/o attachment))

Adjust start-up point for AUX without mounting attachment. Install pressure gauges on AUX discharging ports.

1. Install 2 pressure gauges on AUX discharging RH and LH ports.
2. Set the "SET-4" in the service dealer mode.
3. Press SW2 or SW3 to select "no-03".
4. Press and hold SW3 to set.
5. When display "3: ----", start the engine and lower the lever lock.
6. When display "SET.." with lighting AUX lamp, raise engine speed to maximum.
7. When ready for setting, press and hold SW3.
8. Display "SET..R" with lighting AUX lamp.
   When rising pressure on RH side pressure gauge automatically, press SW3.
9. Display "SET..L" with lighting AUX lamp.
   When rising pressure on LH side pressure gauge automatically, press SW3.
10. Beep buzzer to return to "no-03".



2.5.4 Operating SET-4 (Dealer setting) No-04 (AUX start-up point fine adjustment)

Adjust start-up point when is out of alignment between knob switch feeling and moving attachment.

1. Set the "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-04".
3. Press and hold SW3 to set.
4. When display "4: ----", start the engine and lower the lever lock.
5. When display "R: 20" with lighting AUX lamp, adjust to input number from -40 to 40.

NOTE

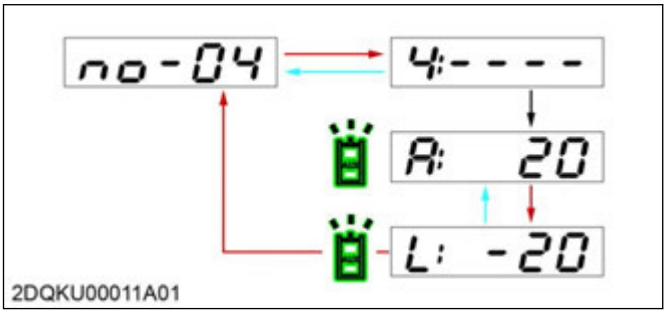
- **Increase number: press SW3**
  Decrease number: press SW2

6. Press and hold SW2.
7. When display "L: 20" with lighting AUX lamp, adjust to input number from -40 to 40.

NOTE

- **Increase number: press SW3**
  Decrease number: press SW2

8. Press and hold SW2.
9. Beep buzzer to return to "no-04".



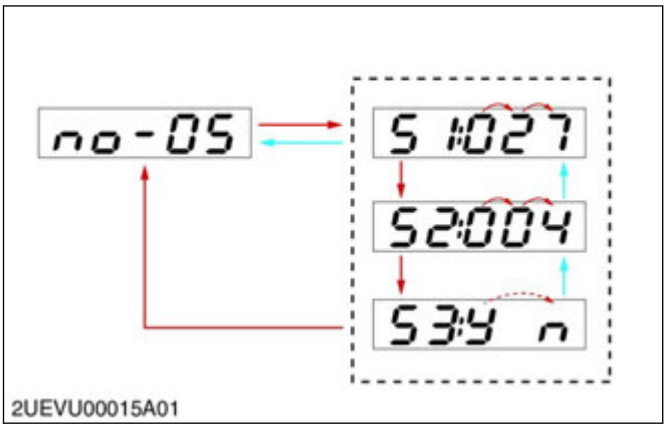
2.5.5 Operating SET-4 (Dealer setting) No-05 (Model setting)

Settings for each model (three items).

1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-05".
3. Press and hold SW3 to set.
4. Set the following three items -model, region, AUX function.
5. Press and hold SW2 to return to "no-05".

NOTE

- **Press and hold SW2 or SW3: next or previous digit**
  Press SW2 or SW3: above or below number



51. Model

001	U17, U-17, U17-3, U17-3α, U-17-5S 017CR	024	KX015-4
002	U-20-3S, U20-5S, U20-3α 020CR	025	KX016-4
003	U25, U-25S	026	KX018-4
012	KX027-4	027	KX019-4
013	KX030-4	028	U27-4

52. Region

001	Japan
002	North America
003	Australia
004	EU
007	Others

53. Proportional AUX

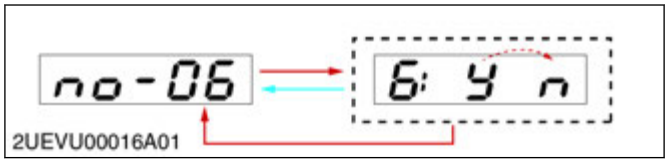
"Y"	Proportional AUX (Kubota software control)
"N"	Other

Default setting

51	13
52	004
53	Y: Hi-spec N: Basic

2.5.6 Operating SET-4 (Dealer setting) No-06 (Clearing periodic check alert)

Select clearing method for periodic check alert.
1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-06".
3. Press and hold SW3 to set.
4. Press SW2 or SW3 to make "Y" or "N" blink.
5. Press and hold SW3 to set and return to "no-06".



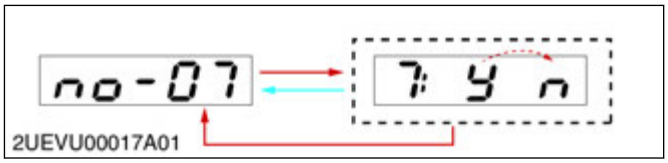
"Y"	Manual	Clear periodic check alert manually.
"N"	Auto	Turn the starter switch repeatedly to **[RUN]** and **[STOP]** 10 times to clear periodic check alert.

Default setting

EU	"Y"
JP, NA, AU, Other	"N"

2.5.7 Operating SET-4 (Dealer setting) No-07 (Informing periodic check alert)

Inform (lamp blinking) or pass (lamp not blinking) the periodic check term.
1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-07".
3. Press and hold SW3 to set.
4. Press SW2 or SW3 to make "Y" or "N" blink.
5. Press and hold SW3 to set and return to "no-07".



"Y"	Inform	Inform the periodic check alert 10 hours in advance.
"N"	Pass	Dose not inform the periodic check.

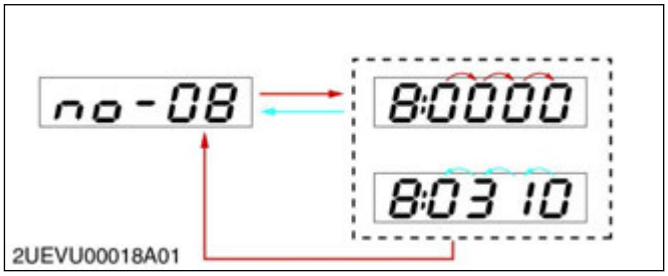
Default setting

EU, JP, NA, AU, Other	"Y"

2.5.8 Operating SET-4 (Dealer setting) No-08 (Time offset for periodic check)

The time offset between the hour meter and periodic check hour. Required setting after replacing the ECU.
1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-08".
3. Press and hold SW3 to set.
4. Press SW2 or SW3 to set the offset hours.

■ NOTE
- **Press and hold SW2 or SW3: next or previous digit.**
  Press SW2 or SW3: above or below numbers.

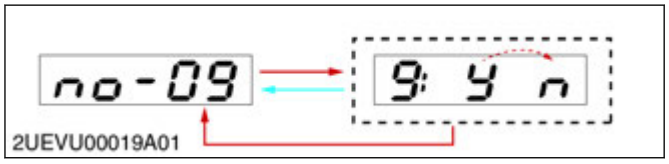


5. Press and hold SW3 to set and return to "no-08".

2.5.9 Operating SET-4 (Dealer setting) No-09 (Clock setting alert)

Setting if the clock setting lamps blinks or not when the time on the clock is off.

1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-09".
3. Press and hold SW3 to set.
4. Press SW2 or SW3 to make "Y" or "N" blink.
5. Press and hold SW3 to set and return to "no-09".



"Y"	Inform the clock setting alert when the time on the clock is off.
"N"	Does not inform the clock setting alert.

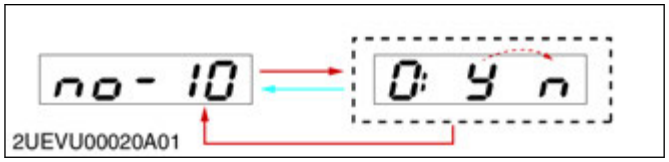
Default setting

EU, JP, NA, AU, Other	"Y"

2.5.10 Operating SET-4 (Dealer setting) No-10 (Travel buzzer function)

Activation or deactivation of the travel buzzer.

1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-10".
3. Press and hold SW3 to set.
4. Press SW2 or SW3 to make "Y" or "N" blink.
5. Press and hold SW2 to return to "no-10".



"Y"	Activation
"N"	Deactivation

Default setting

AU	"Y"
JP, NA, EU, Other	"N"

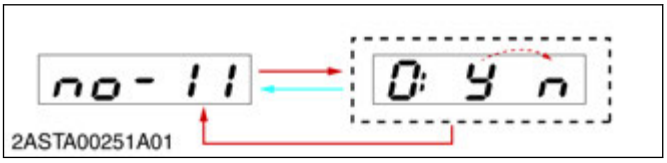
■ NOTE

- **This setting is only for controlled travel buzzer in the original ECU.**

2.5.11 Operating SET-4 (Dealer setting) No-11 (Travel speed shift switch)

Select hand switch or foot switch for the travel speed shift.

1. Set "SET-4" in the service dealer mode.
2. Press SW2 or SW3 to select "no-11".
3. Press and hold SW3 to set.
4. Press SW2 or SW3 to make "Y" or "N" blink.
5. Press and hold SW2 to return to "no-11".



"Y"	Foot
"N"	Hand

Default setting

EU, NA, JP, AU, Other	"N"

2.5.12 Default settings for SET-4 (Dealer setting)

	KX030-4 EU	
	Basic	**Hi-spec**
"no-05" Model setting	"1: 013" "2: 004" "3: N"	"1: 013" "2: 004" "3: Y"
"no-06" Clearing periodic check alert	"Y"	
"no-07" Informing periodic check alert	"Y"	
"no-09" Clock setting alert	"Y"	
"no-10" Travel buzzer function	"N"	
"no-11" Travel speed shift switch	"N"	

2.6 Operating SET-5 (Reading all error history)

Display all error details from the memory.

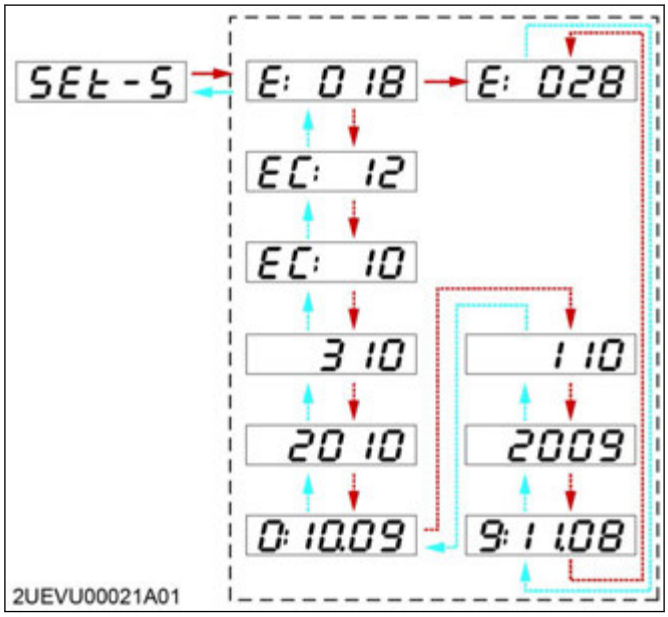
■ NOTE

- **Display eight items for each error code.**
  - **Number of times**
  - **Number of times after clearing error history**

  - **Recent hour meter**
  - **Recent year**
  - **Recent month and date**
  - **First hour meter**
  - **First year**
  - **First month and date**
- **This history is not erased even if the "SET-3" (clearing error history) is done.**

1. Set "SET-5" in the service dealer mode.
2. Displays the previous error code from memory.
3. Press SW2 or SW3 to change the item.
4. Press and hold SW3 to display other error codes.
5. Press and hold SW2 to return to "SET-5".

"E:018": Issued 12 times and 10 times after clearing history
Recent data 310 h, 2010/10/9
First data: 110 h, 2009/11/8



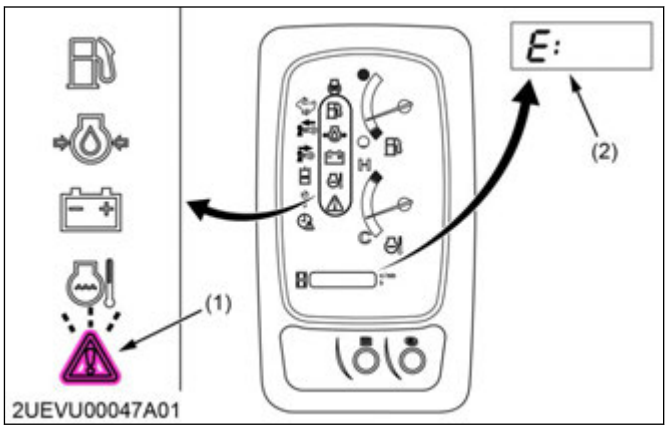
3. Handling error warning

3.1 Handling E:001 CAN communication error

There is no communication between the main ECU and the meter panel.

Checking on the meter panel

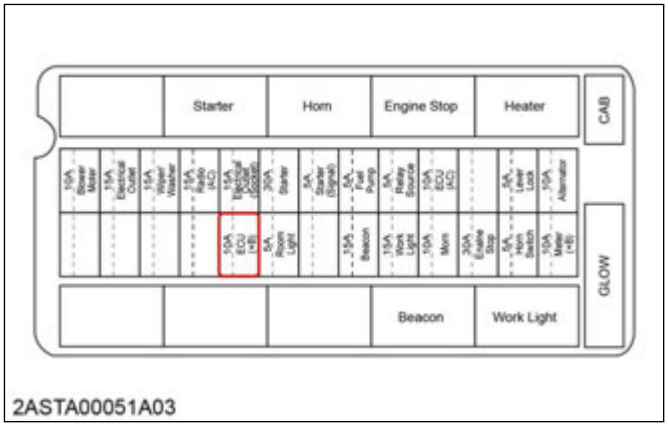
1. Check the meter panel.



(1) Warning lamp
(2) "E:001" CAN communication error

Checking devices

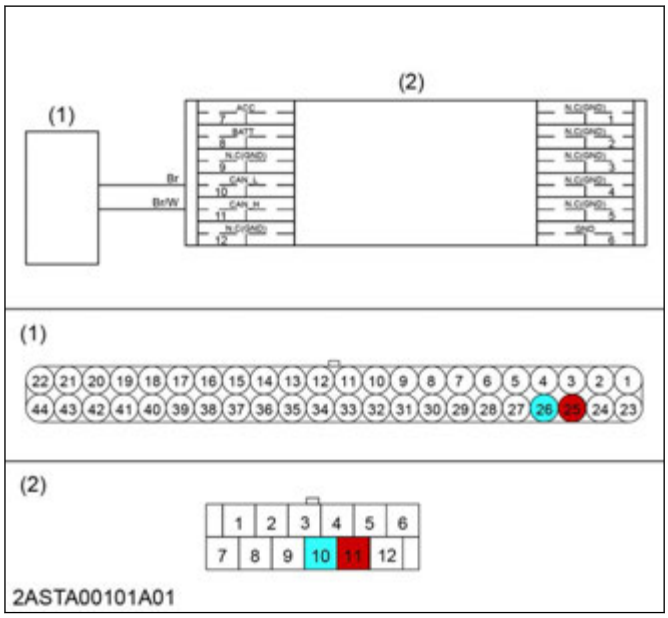
1. Check the fuse (ECU-MAIN (+B) 10 A).



2. Check the main ECU and meter panel.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check by turning the starter switch to **[RUN]**.
   - Check the cover of the wiring for damage and that they are not touching the body.

(1) Meter panel connector

Checking the wire harness



(1) Main ECU connector (2) Meter panel connector

1. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the main ECU connector and meter panel connector.

	CAN-HIGH	CAN-LOW
(1) Main ECU connector	25	26
(2) Meter panel connector	11	10

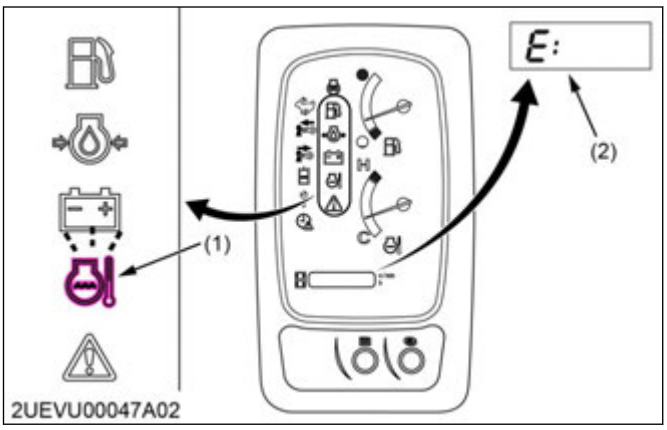
Normal	Conduction

3.2 Handling E:005 High coolant temperature

Coolant temperature is higher than 117 ℃ and lower than 122 ℃.

Checking on the meter panel

1. Check the meter panel.



(1) Coolant temperature lamp (2) "E:005" High coolant temperature

2. Check the engine coolant temperature in tester mode.

"SET-1" Tester	"8: oo ℃" Coolant temperature ℃	lower than 117 ℃

NOTE

- **If the engine coolant temperature rises over 122 ℃, the ECU displays "E:015".**

Checking devices

1. Check the engine coolant level.

2. Check the radiator fin and radiator cap condition.

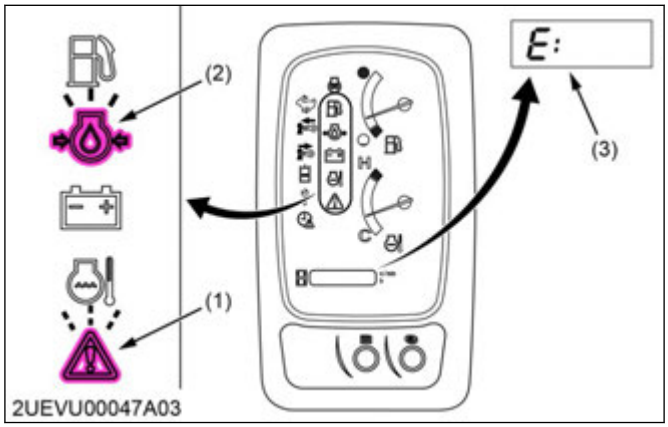
(1) Radiator

3.3 Handling E:014 Engine oil pressure error

Engine oil pressure switch is ON while the engine is running.

Checking on the meter panel

1. Check the meter panel.



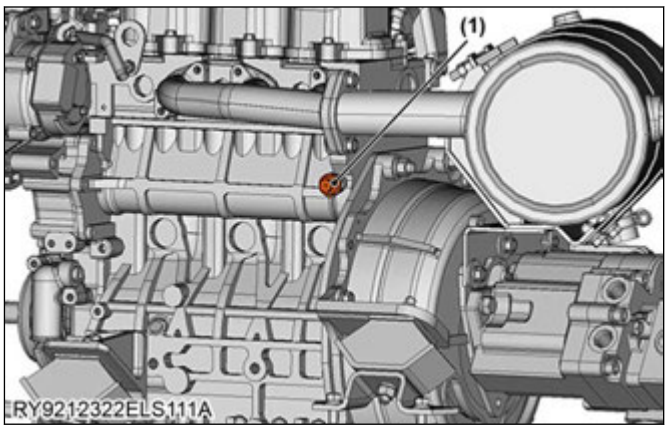
(1) Warning lamp
(2) Oil lamp
(3) "E:014" Engine oil pressure error

2. Check the oil switch in tester mode.

"SET-1" Tester	"3: ON/OFF" Oil switch	Engine stopped	Engine running
		"ON"	"OFF"

Checking devices

1. Check the oil switch.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.



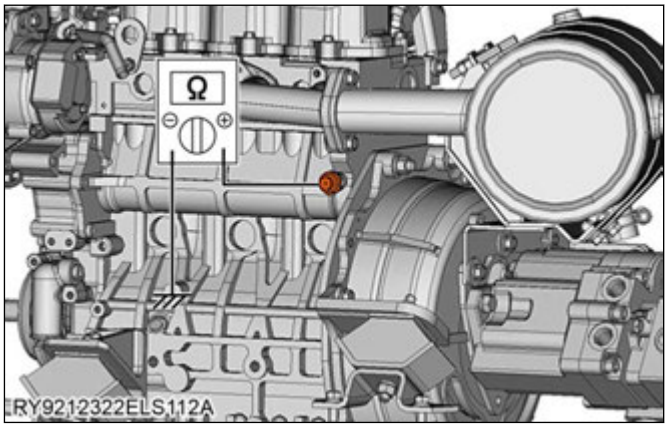
(1) Oil switch

2. Check the engine.
   - Check the engine oil level.
   - Measure the engine oil pressure.

NOTE
- **The oil pressure switch will turn on if the pressure is lower than 49 kPa.**

	Idling	Rated speed
Normal	68 kPa 0.69 kgf/cm^2 9.9 psi	197 to 441 kPa 2.0 to 4.5 kgf/cm^2 28.5 to 64.0 psi

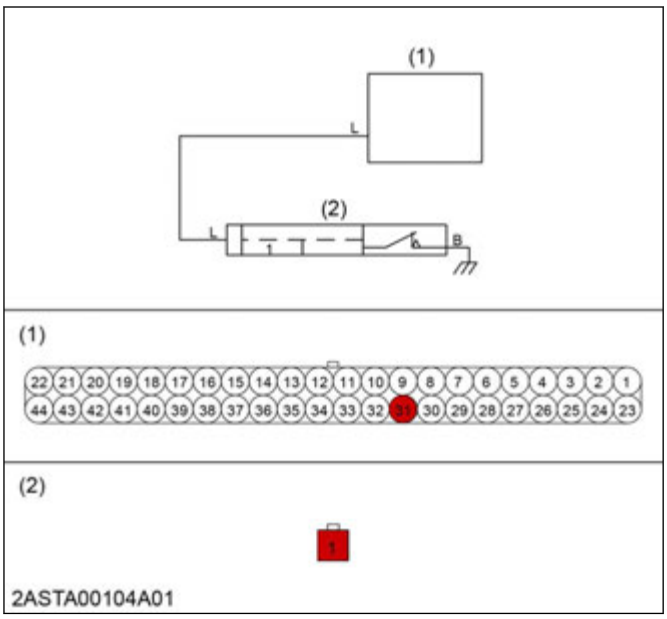
3. Measure the resistance of the oil pressure switch.
   - Disconnect the oil switch connector.
   - Measure between the oil pressure switch terminal and body GND.



	Engine stopped	Engine running
Normal	Conduction	Non-conduction

Checking the wire harness

1. Measure the voltage of the wire harness.
   - Disconnect the engine oil pressure switch connector and turn the starter switch to **[RUN]**.



(1) Main ECU connector (2) Engine oil pressure switch connector

	(+)	(-)
(2) Engine oil pressure switch connector	1	Body ground

Normal	Starter switch at **[STOP]**	Starter switch at **[RUN]**
	0 V	12 V

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the engine oil pressure switch connector and the main ECU connector.

	Engine oil pressure switch connector
(1) Main ECU connector	31
(2) Engine oil pressure switch connector	1

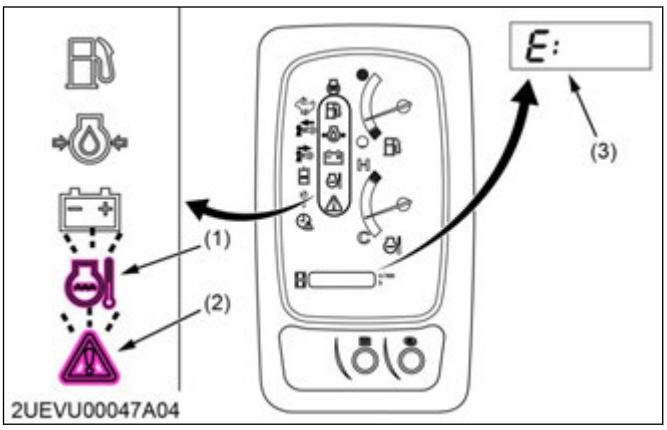
Normal	Conduction

3.4 Handling E:015 Engine overheating

Coolant temperature is higher than 122 ℃.

Checking on the meter panel

1. Check the meter panel.



(1) Coolant temperature lamp (3) "E:015" Engine overheating
(2) Warning lamp

2. Check the engine coolant temperature in tester mode.

"SET-1" Tester	"8: ∞ ℃" Coolant temperature ℃	lower than 117 ℃

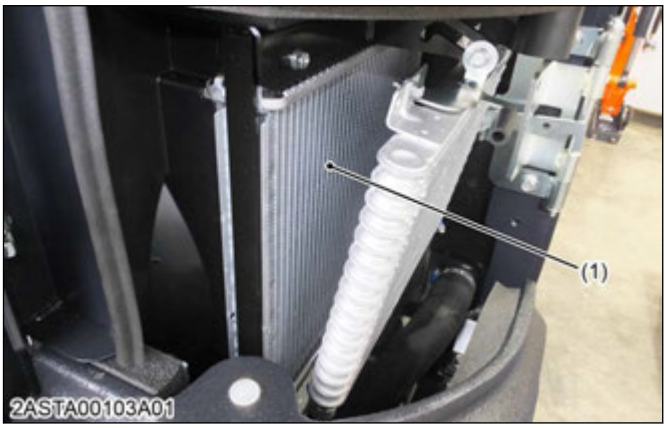
■ NOTE

- **If the engine coolant temperature is between 117 to 122 ℃, the ECU displays "E:005".**

Checking devices

1. Check the engine coolant level.

2. Check the radiator grill, fin, and cap condition.



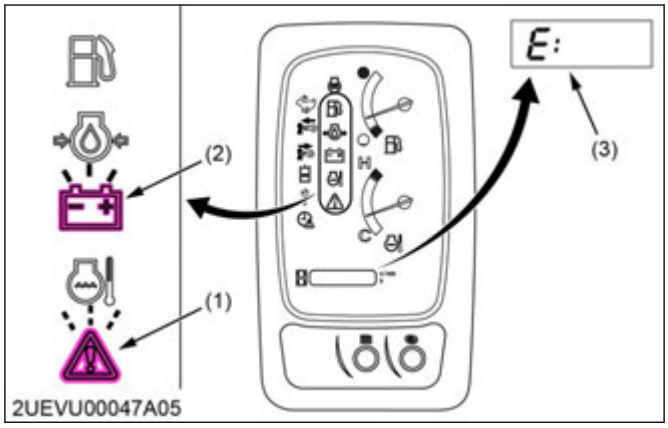
(1) Radiator

3.5 Handling E:016 Battery charging error

The charge switch is ON (no output from L terminal of the alternator) while the engine is running (over 700 rpm).

Checking on the meter panel

1. Check the meter panel.



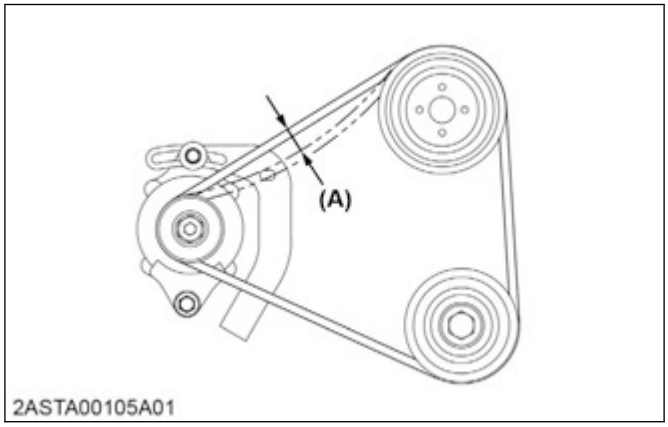
(1) Warning lamp
(2) Charging lamp
(3) "E:016" Battery charging error

2. Check the charging switch in tester mode.

"SET-1" Tester	"4: ON/OFF" Charging switch	Engine stopped	Engine running
		"ON"	"OFF"

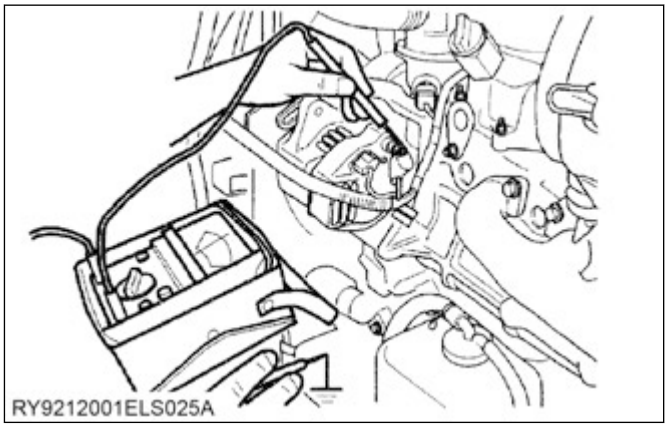
Checking devices

1. Check the alternator.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and to check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.
2. Check the engine.
   - Check if the fan belt is broken, loose or if it is slipping.



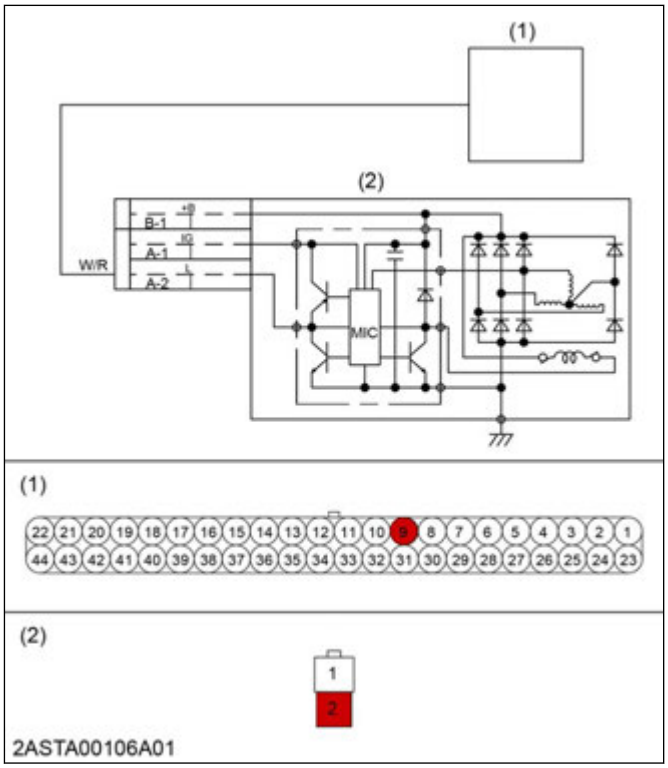
Normal	Fan belt deflection (A)	7 to 9 mm

3. Measure the voltage of the alternator.
   - Measure the voltage between terminal B of the alternator and body GND.



Normal	Engine stopped	Engine running
	12 V	Approximately 14 V

Checking the wire harness



(1) Main ECU connector
(2) Alternator connector

1. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the main ECU connector and the alternator connector.

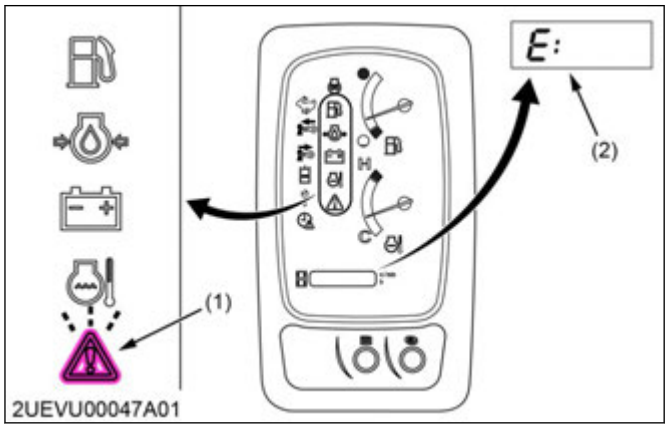
	12 V
(1) Main ECU connector	9
(2) Alternator connector	2

3.6 Handling E:017 Fuel sensor error

Fuel sensor resistance is over 135 Ω (broken wiring).

Checking on the meter panel

1. Check the meter panel.



(1) Warning lamp (2) "E:017" Fuel sensor error

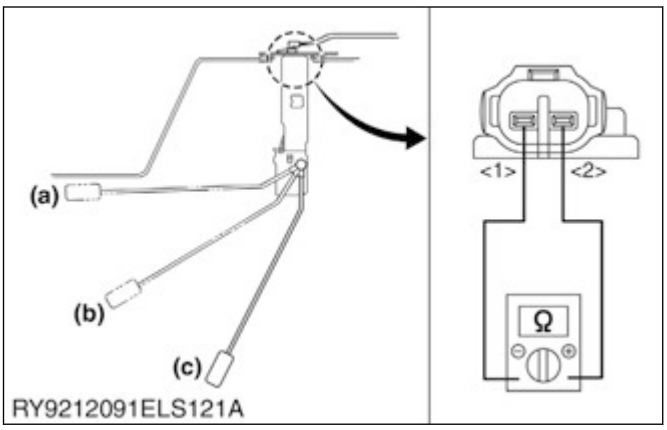
2. Check the fuel sensor in tester mode.

"SET-1" Tester	"10: ooo Ω" Sensor resistance value	3±1 to 110±2.5 Ω

Checking devices

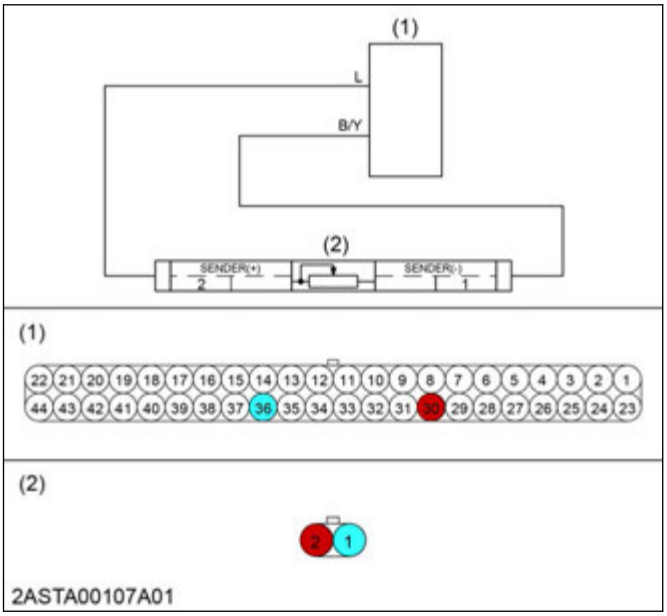
1. Check the fuel sensor.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.

2. Measure the resistance of the fuel sensor.
   - Disconnect the fuel sensor connector.



Float position	(a)	(b)	(c)
Resistance	2 to 4 Ω	32.5 Ω	109 to 111 Ω

Checking the wire harness



(1) Main ECU connector (2) Fuel sensor connector

1. Measure the voltage of the wire harness.
   - Disconnect the fuel sensor connector.

	(+)	(-)
(2) Fuel sensor connector	2	1

Normal	Starter switch at **[STOP]**	Starter switch at **[RUN]**
	0 V	12 V

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the fuel sensor connector and main ECU connector.

	12 V	Ground
(1) Main ECU connector	30	36
(2) Fuel sensor connector	2	1

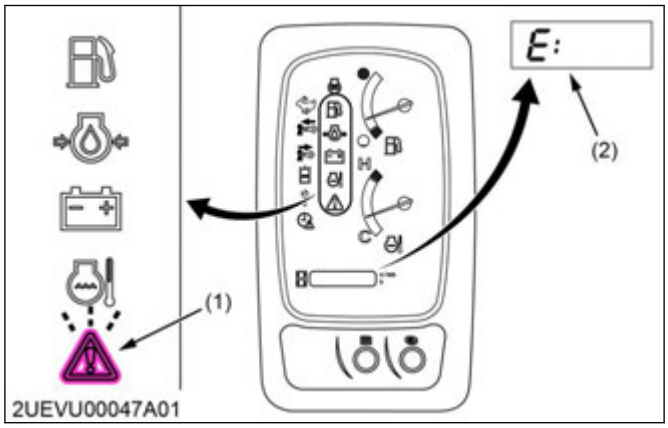
Normal	Conduction

3.7 Handling E:018 Water temperature sensor error

Water temperature is lower than -50 ℃ or higher than 150 ℃ (broken wiring or short-circuit).

Checking on the meter panel

1. Check the meter panel.



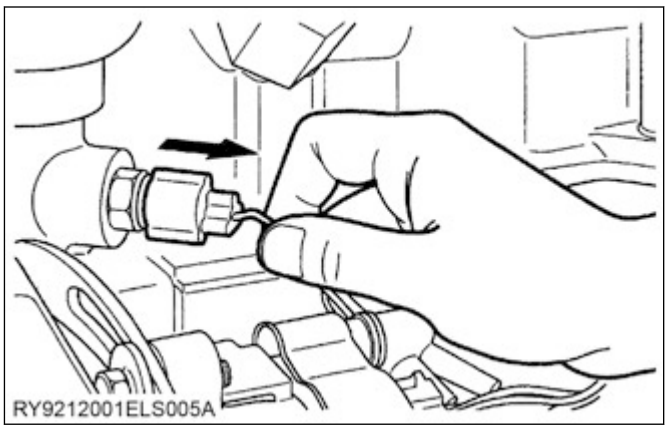
(1) Warning lamp
(2) "E:018" Water temperature sensor error

2. Check the engine water temperature sensor in tester mode.

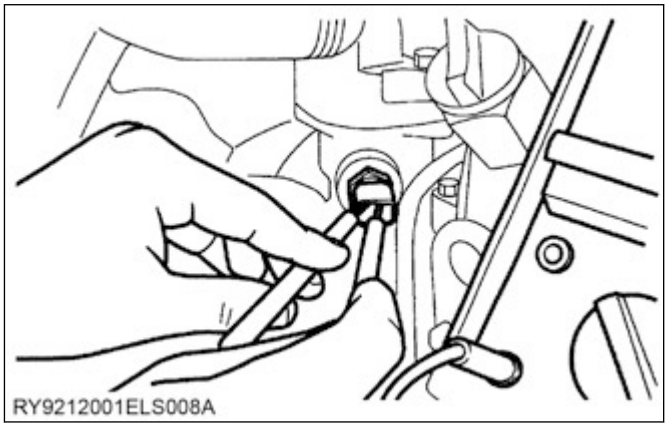
"SET-1" Tester	"8: oo ℃" Water temperature ℃	-49 to 149 ℃

Checking devices

1. Check the water temperature sensor.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.

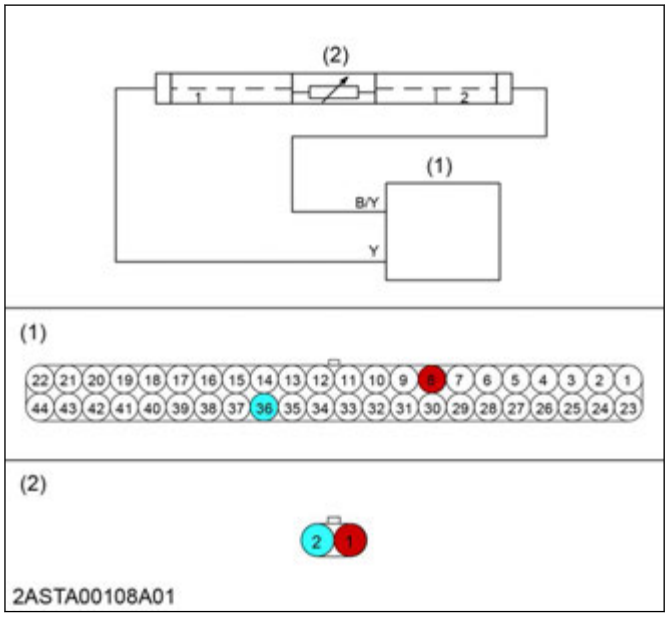


2. Measure the resistance of the water temperature sensor.
   - Disconnect the water temperature sensor connector.



Water temperature	-20 ℃	50 ℃	110 ℃
Resistance	15.04 kΩ	0.81 kΩ	0.14 kΩ

Checking the wire harness



(1) Main ECU connector (2) Water temperature sensor connector

1. Measure the voltage of the wire harness.
   - Disconnect the water temperature sensor connector and turn the starter switch to **[RUN]**.

	(+)	(-)
(2) Water temperature sensor connector	1	2

Normal	Starter switch **[STOP]**	Starter switch **[RUN]**
	0 V	5 V

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the water temperature sensor connector and main ECU connector.

	5 V	GND
(1) Main ECU connector	8	36
(2) Water temperature sensor connector	1	2

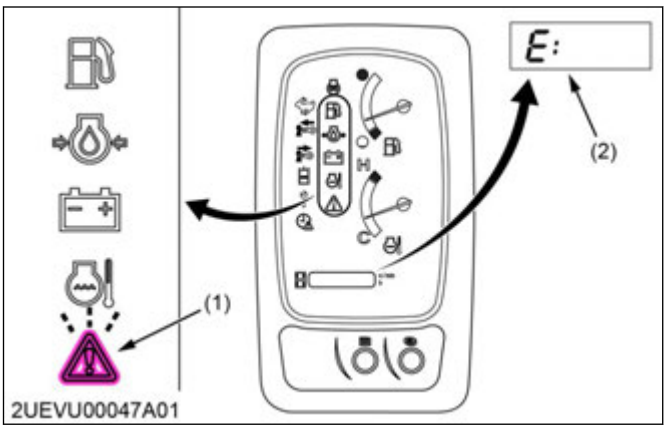
Normal	Conduction

3.8 Handling E:020 Lever lock solenoid error

Short circuit in the lever lock solenoid line.

Checking on the meter panel

1. Check the meter panel.



(1) Warning lamp (2) "E:020" lever lock solenoid error

2. Check the lever lock switch and the lever lock solenoid in tester mode.

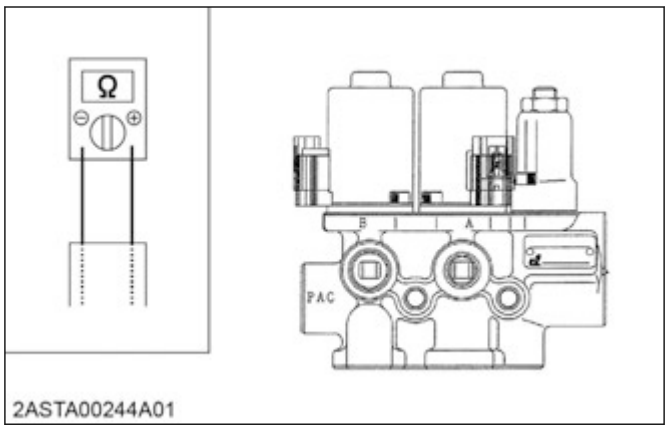
		Lever lock down	Lever lock up
"SET-1" Tester	"14: ON/OFF" Lever lock switch	"OFF"	"ON"
	"15: ON/OFF" Lever lock solenoid	"OFF"	"ON"

Checking devices

1. Check the lever lock switch.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.

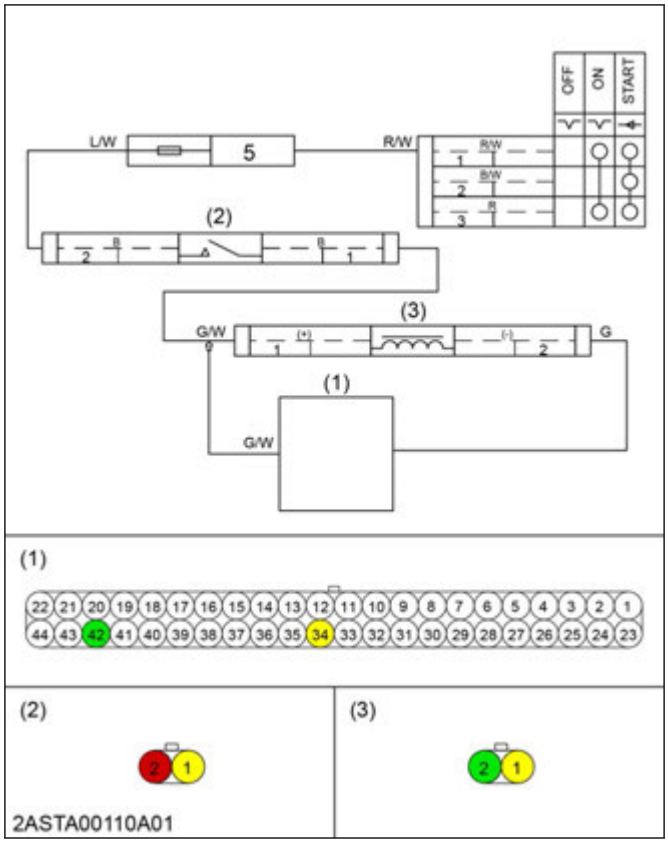
(1) Lever lock switch connector

2. Measure the resistance of the lever lock solenoid.
   - Disconnect the lever lock solenoid connector.



Normal	8 to 12 Ω

Checking the wire harness



(1) Main ECU connector
(2) Lever lock switch connector
(3) Lever lock solenoid connector

1. Measure the voltage of the wire harness.
   - Disconnect the lever lock solenoid connector and operate the lever lock switch.

	(+)	(-)
(3) Lever lock solenoid connector	1	2

Normal	Lever lock switch **[OFF]** (Up)	Lever lock switch **[ON]** (Down)
	0 V	12 to 14 V

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the lever lock switch connector, lever lock solenoid connector and main ECU connector.

	Lever lock switch connector input signal	**Lever lock solenoid connector input signal**
(1) Main ECU connector	34	42
(2) Lever lock switch connector	1	-
(3) Lever lock solenoid connector	1	2

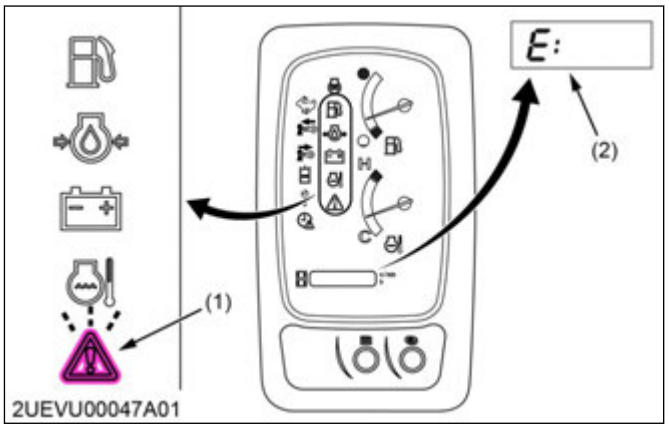
Normal	Conduction

3.9 Handling E:021 Travel speed shift system error

Short circuit in the travel speed solenoid line.

Checking on the meter panel

1. Check the meter panel.



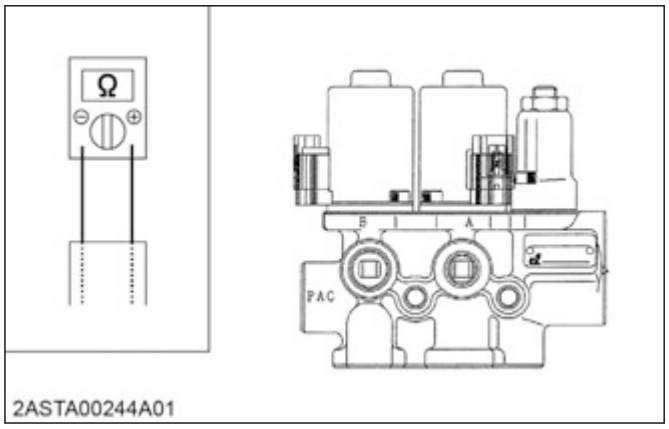
(1) Warning lamp
(2) "E:021" Travel speed shift system error

2. Check the travel speed shift solenoid in tester mode.

"SET-1" Tester		Travel speed shift switch ON	Travel speed shift switch OFF
	"12": Travel speed shift switch	"ON"	"OFF"
	"13": Travel speed shift solenoid	"ON"	"OFF"

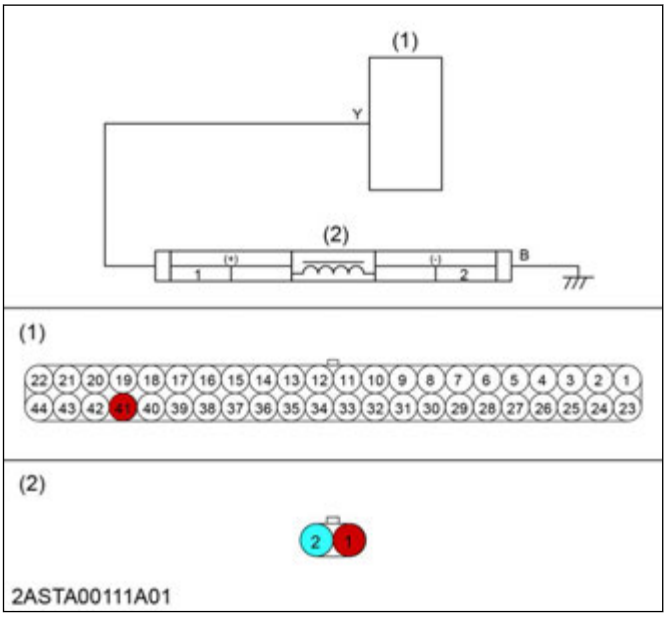
Checking devices

1. Check the travel speed shift solenoid.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.
2. Measure the resistance of the travel speed shift solenoid.
   - Disconnect the travel speed shift solenoid connector.



Normal	8 to 12 Ω

Checking the wire harness



(1) Main ECU connector (2) Travel speed shift solenoid connector

1. Measure the voltage of the wire harness.
   - Disconnect the travel speed shift solenoid connector and main ECU connector.

	(+)	(-)
(2) Travel speed shift solenoid connector	1	2

Normal	Travel speed shift switch connector at **[OFF]**	Travel speed shift switch connector at **[ON]**
	0 V	12 to 14 V

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the travel speed shift solenoid connector and main ECU connector.

	12 V	GND
(1) Main ECU connector	41	-
(2) Travel speed shift solenoid connector	1	2
Body ground	-	○

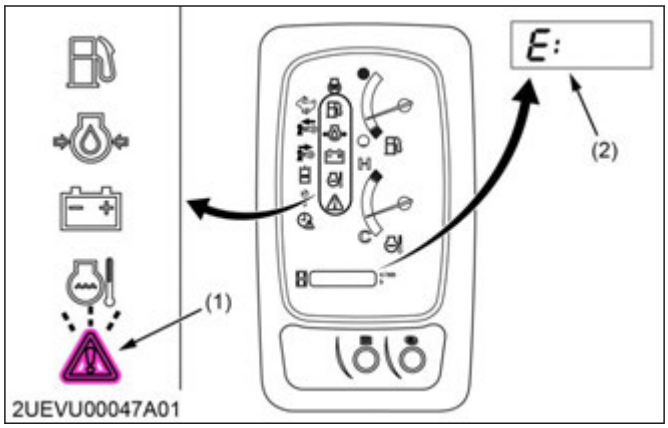
Normal	Conduction

3.10 Handling E:022 AUX1 knob switch error

Short circuit in the AUX1 knob switch line.

Checking on the meter panel

1. Check the meter panel.



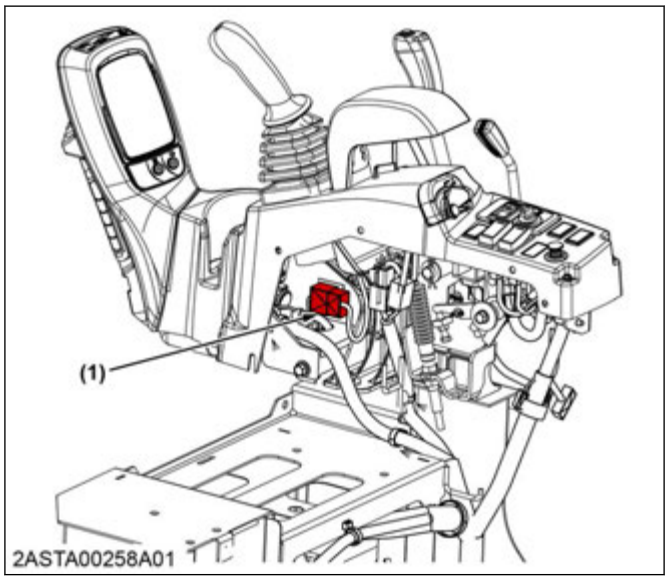
(1) Warning lamp
(2) "E:022" AUX1 knob switch breaking or short

2. Check the AUX1 knob switch in tester mode.

"SET-1" Tester	"16: oo.o V" AUX1 knob switch	0.26 to 4.74 V

Checking devices

1. Check the pilot control lever RH connector.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wires for damage and that they are not touching the body.



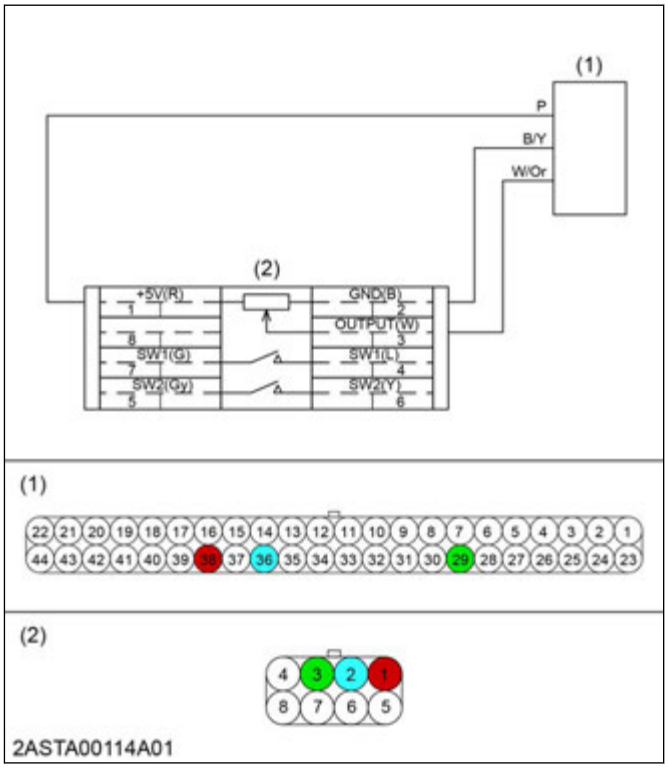
(1) Pilot control lever RH connector

2. Measure the resistance of AUX1 knob switch.

	Resistance
Between 1 and 2	10 kΩ to 100 kΩ
Between 1 and 3	
Between 2 and 3	

3. Check the main ECU.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wires for damage and that they are not touching the body.

Checking the wire harness



(1) Main ECU connector
(2) Pilot control lever RH connector

1. Measure the voltage of the wire harness.
   - Disconnect the Pilot control lever RH connector.

	(+)	(-)
(2) Pilot control lever RH connector	1	2

Normal	Starter switch at **[STOP]**	Starter switch at **[RUN]**
	0 V	5 V

2. Check conduction for the wire harness.
   - Turn the key switch to **[STOP]** and disconnect the pilot control lever RH connector and main ECU connector.

	5 V	Signal	GND
(1) Main ECU connector	38	29	36
(2) Pilot control lever RH connector	1	3	2

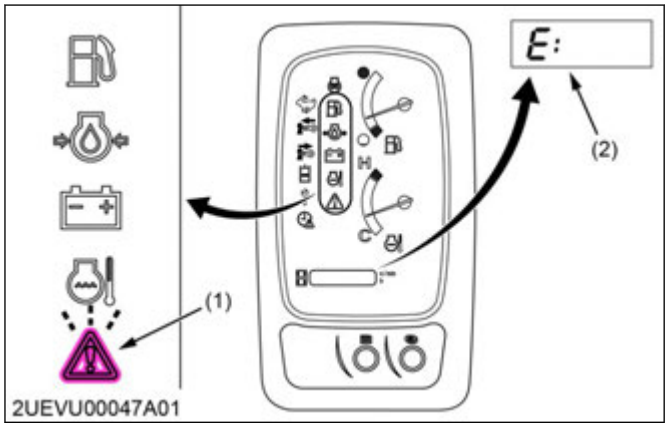
Normal	Conduction

3.11 Handling E:023 AUX1 RH solenoid error

Breaking or short in the AUX1 RH solenoid line.

Checking on the meter panel

1. Check the meter panel.



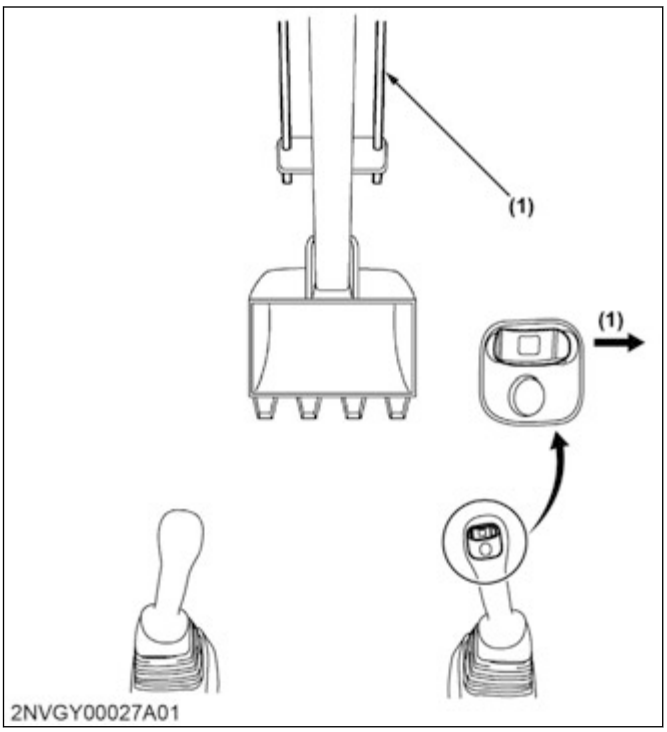
(1) Warning lamp
(2) "E:023" AUX1 RH solenoid breaking or short

2. Check the AUX1 RH solenoid in tester mode.

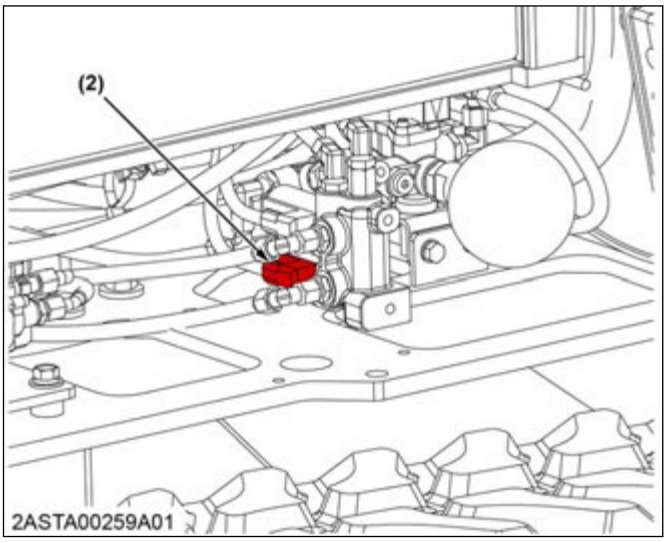
"SET-1" Tester	"20: 0.0 A" AUX1 RH SOL (current)	Pressing the AUX1 knob switch RH 0 to 1.7 A

Checking devices

1. Check the AUX1 RH solenoid.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.

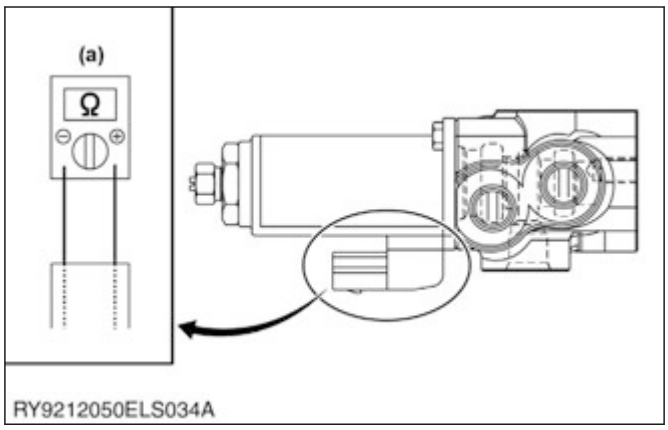


(1) AUX1 knob RH



(2) AUX1 RH solenoid

2. Measure the resistance of the AUX1 RH solenoid.
   - Disconnect the AUX1 RH solenoid connector.

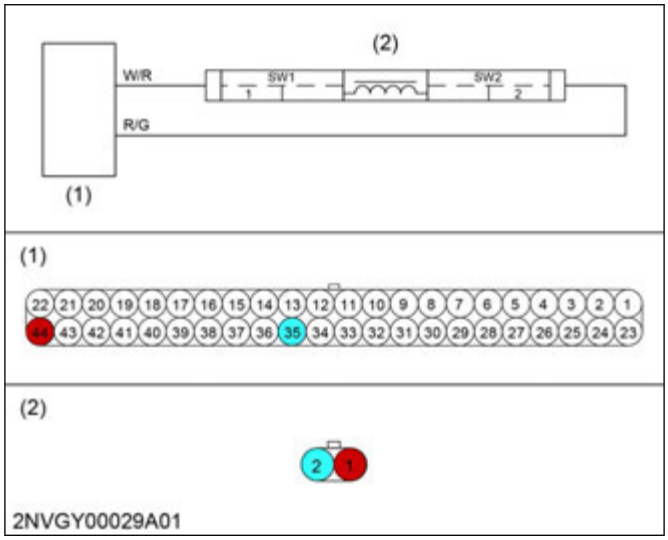


(a) Tester

Normal	2.7 to 3.7 Ω

3. Check the main ECU.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wires for damage and that they are not touching the body.

Checking the wire harness



(1) Main ECU connector (2) AUX1 RH solenoid connector

1. Measure the voltage of the wire harness.
   - Disconnect the AUX1 RH solenoid connector.

	(+)	(-)
(2) AUX1 RH solenoid connector	1	2

Normal	Starter switch at **[STOP]**	Starter switch at **[RUN]**
	0 V	12 V

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the AUX1 RH solenoid connector and the main ECU connector.

	12 V	GND
(1) Main ECU connector	44	35
(2) AUX1 RH solenoid connector	1	2

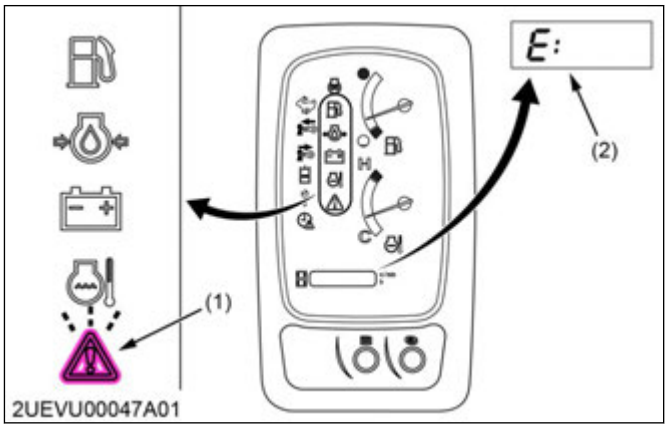
Normal	Conduction

3.12 Handling E:024 AUX1 LH solenoid error

Breaking or short in the AUX1 LH solenoid line.

Checking on the meter panel

1. Check the meter panel.



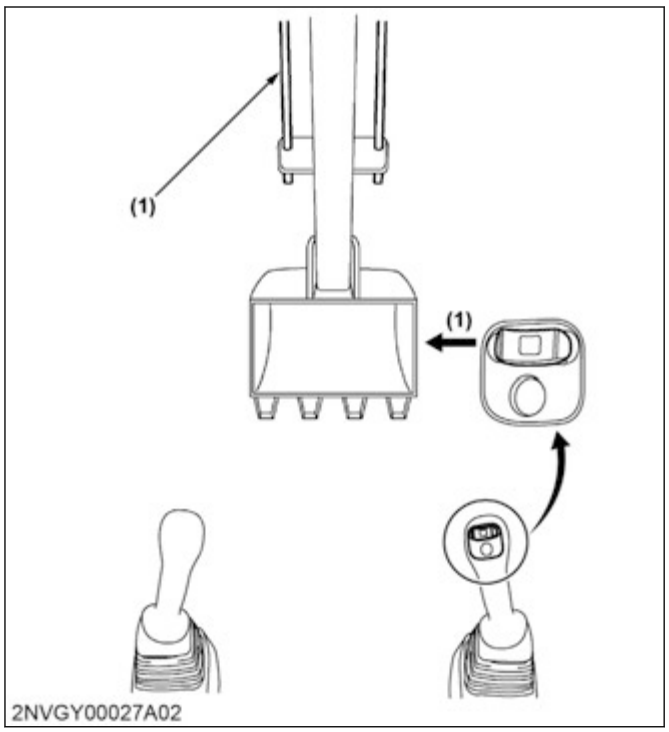
(1) Warning lamp (2) "E:024" AUX1 LH solenoid breaking or short

2. Check the AUX1 LH solenoid in tester mode.

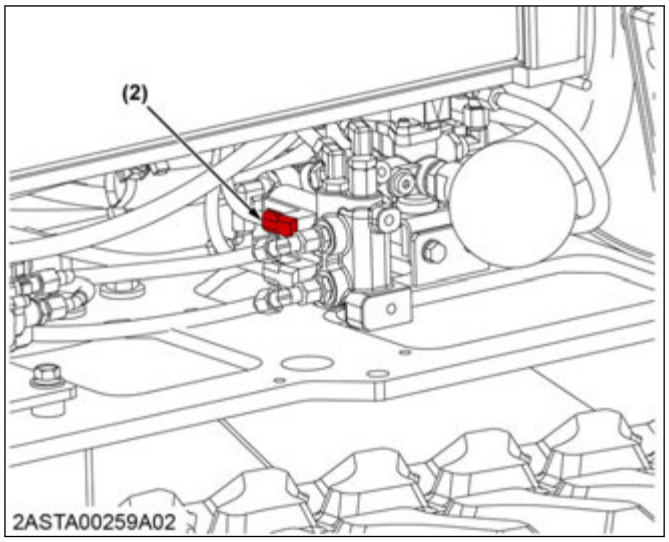
"SET-1" Tester	"20: 0.0 A" AUX1 1 SOL (current)	Pressing the AUX1 nob switch LH 0 to 1.7 A

Checking devices

1. Check the AUX1 LH solenoid.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.

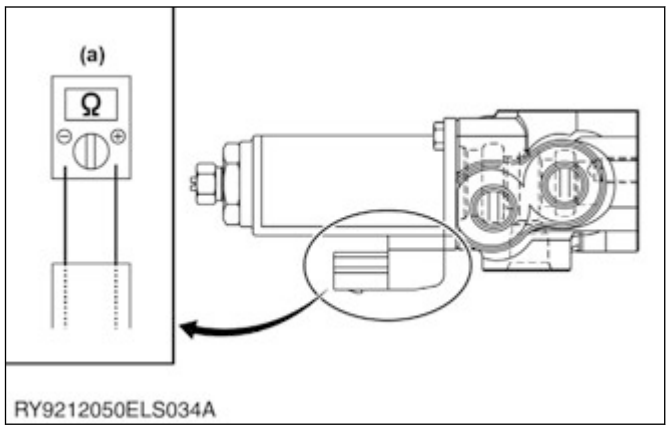


(1) AUX1 LH



(2) AUX1 LH solenoid

2. Measure the resistance of the AUX1 LH solenoid.
   - Disconnect the AUX1 LH solenoid connector.

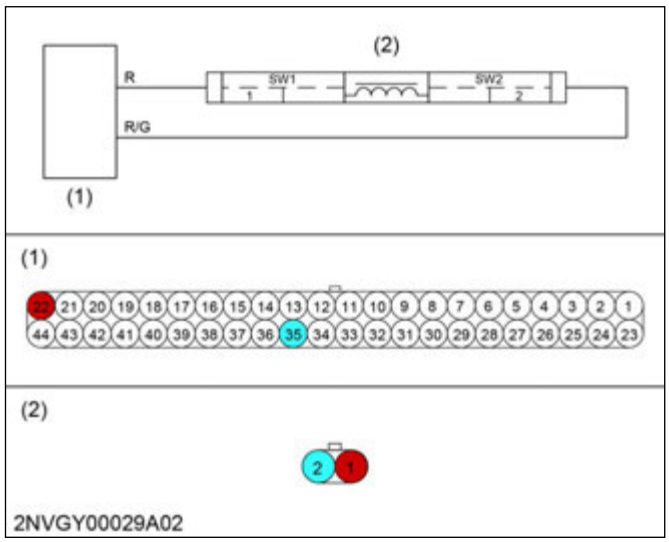


(a) Tester

Normal	2.7 to 3.7 Ω

3. Check the main ECU.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in the tester mode.
   - Check the cover of the wires for damage and that they are not touching the body.

Checking the wire harness



(1) Main ECU connector (2) AUX1 LH solenoid connector

1. Measure the voltage of the wire harness.
   - Disconnect the AUX1 LH solenoid connector.

	(+)	(-)
(2) AUX1 LH solenoid connector	1	2

Normal	Starter switch at **[STOP]**	Starter switch at **[RUN]**
	0 V	12 V

2. Check conduction for the wire harness.

- Turn the starter switch to **[STOP]** and disconnect the AUX1 LH solenoid connector and the main ECU connector.

	12 V	GND
(1) Main ECU connector	22	35
(2) AUX1 LH solenoid connector	1	2

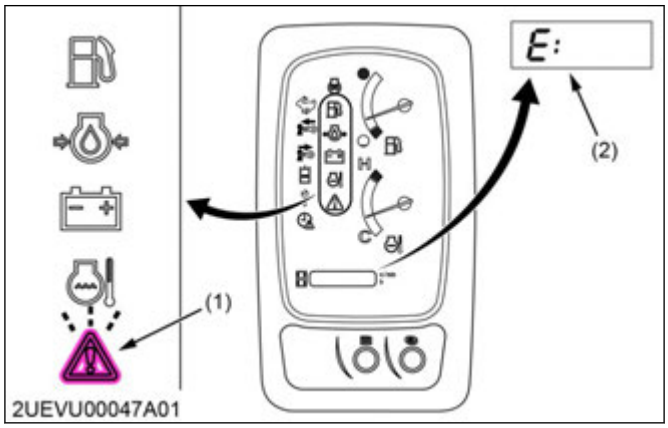
Normal	Conduction

3.13 Handling E:025 Battery overcharging

Power supply voltage is over 18 V.

Checking on the meter panel

1. Check the meter panel.



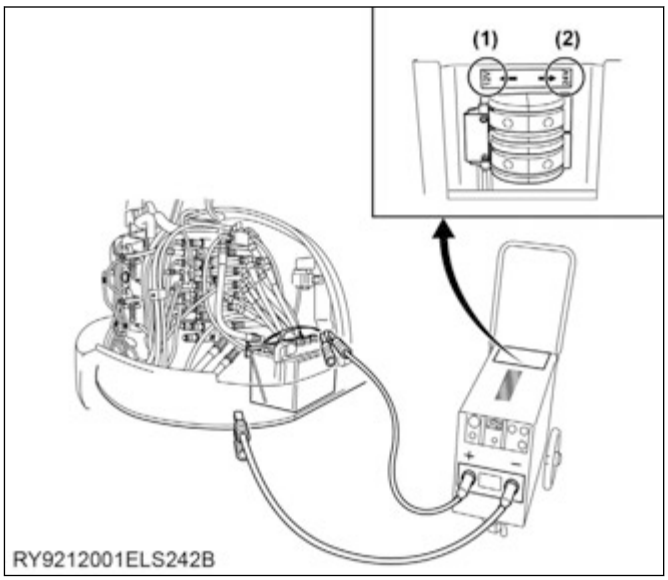
(1) Warning lamp (2) "E:025" battery overcharging

2. Check the battery voltage in tester mode.

"SET-1" Tester	"2: oo.o V" Battery voltage	Engine stop	Engine running
		12.0 V	Approximately 14.0 V

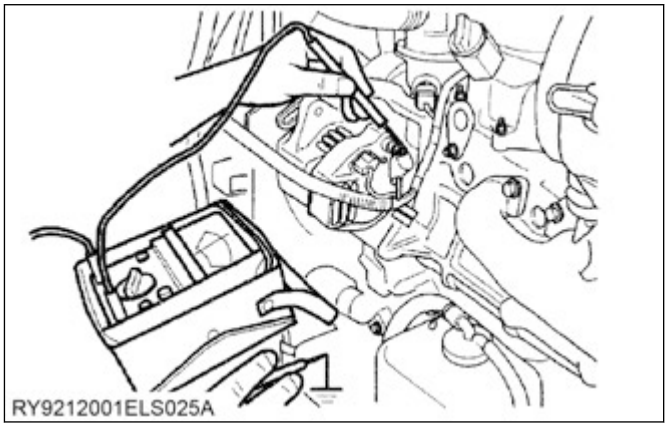
Checking devices

1. Check the battery.
   - Make sure to use the 12 V jump starter. Do not use 24 V jump starter.
   - Make sure to use the 12 V battery. Do not use 24 V battery.



(1) 12 V (2) 24 V

2. Measure the voltage of the alternator.
   - Measure the voltage between terminal B of the alternator and body GND.



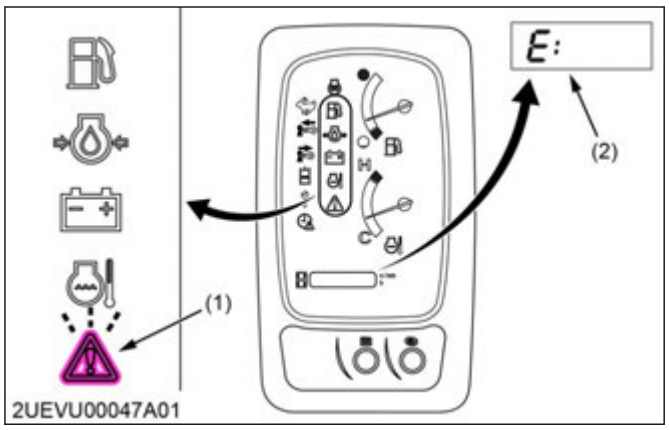
Normal	Engine stopped	Engine running
	12 V	Approximately 14 V

3.14 Handling E:026 Anti-theft antenna error

No signal from the anti-theft antenna.

Checking on the meter panel

1. Check the meter panel.



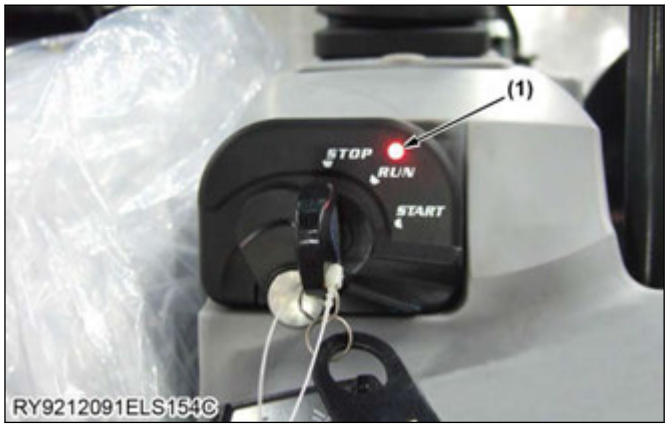
(1) Warning lamp (2) "E:026" Anti-theft antenna error

2. Check the anti-theft antenna in tester mode.

"SET-1" Tester	"29: ON/OFF" Anti-theft antenna	"OFF"

Checking devices

1. Check the anti-theft antenna.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect connectors and check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.
   - Check whether the anti-theft lamp is blinking or not.



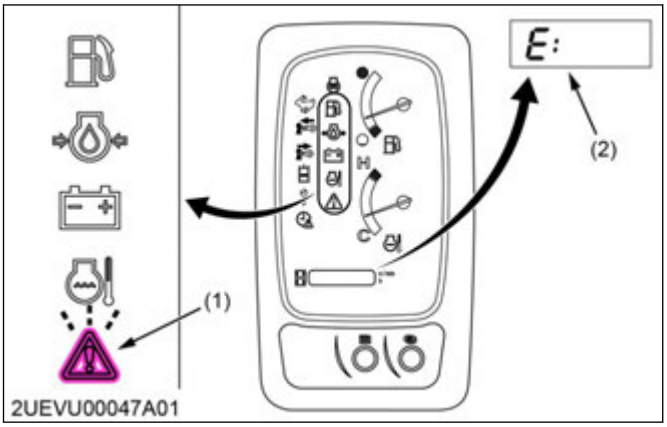
(1) Anti-theft lamp (2) Anti-theft antenna connector

3.15 Handling E:027 5 V short

Short circuit in the 5 V line.

Checking on the meter panel

1. Check the meter panel.



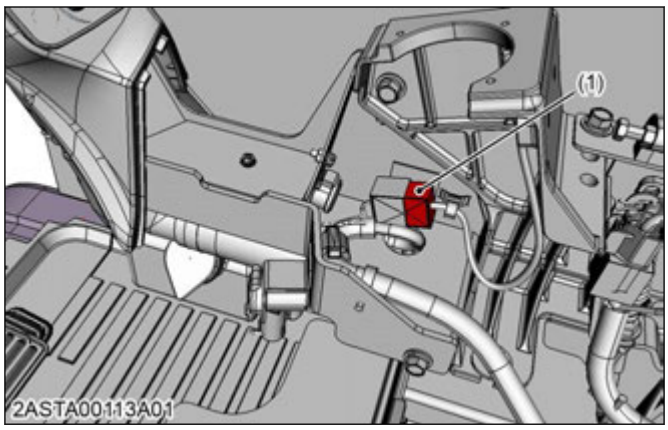
(1) Warning lamp (2) "E: 027" 5 V short

2. Check the AUX knob switch in tester mode.

"SET-1" Tester	"15: oo.o V" AUX knob switch	0.26 to 4.74 V

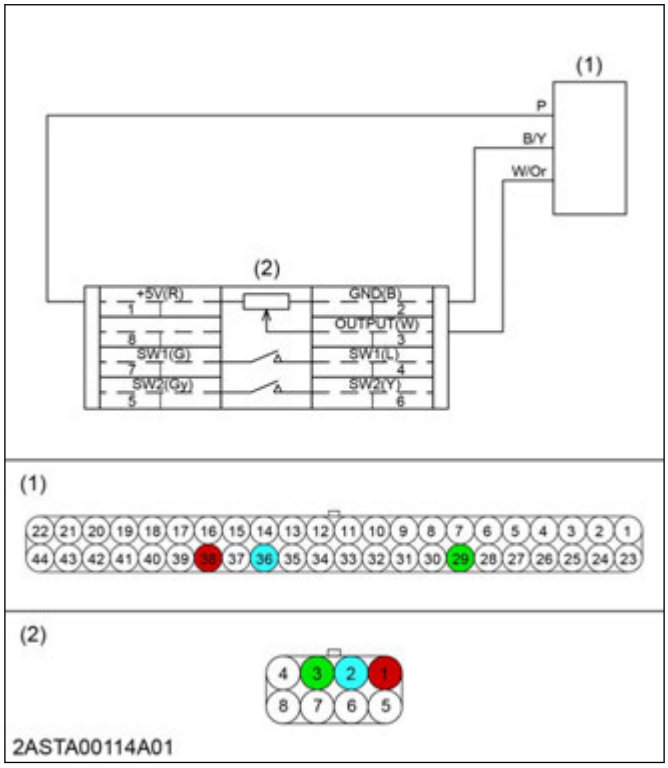
Checking devices

1. Check the AUX knob switch.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.



(1) AUX knob switch

Checking the wire harness



(1) Main ECU connector (2) AUX knob switch connector

1. Measure the voltage of the wire harness.
   - Disconnect the engine speed sensor connector and anti-theft antenna connector.

	(+)	(-)
(2) AUX knob switch connector	1	2

Normal	Starter switch at **[STOP]**	Starter switch at **[RUN]**
	0 V	5 V

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the AUX knob switch connector and the main ECU connector.

	5 V	Signal	GND
(1) Main ECU connector	38	29	36
(2) AUX knob switch connector	1	3	2

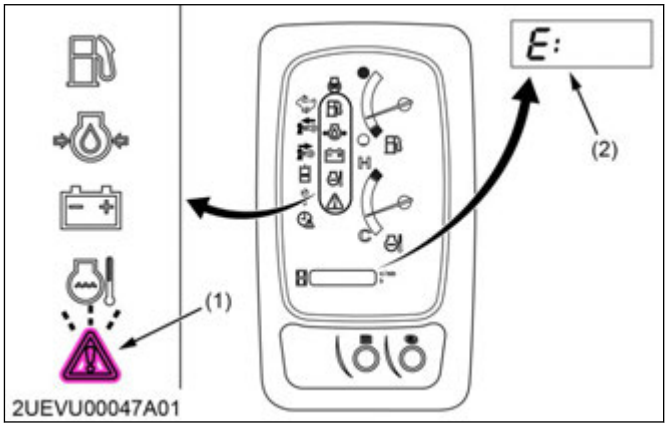
Normal	Conduction

3.16 Handling E:028 12 V error

Short circuit in the 12 V line.

Checking on the meter panel

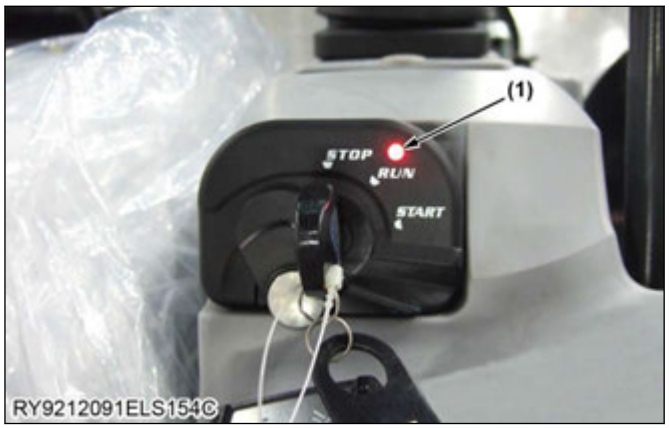
1. Check the meter panel.



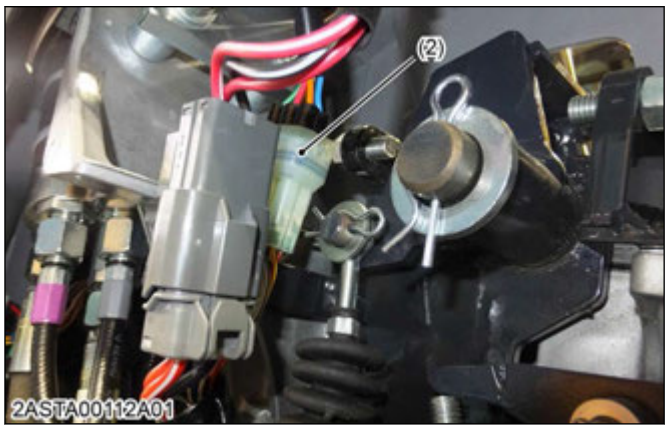
(1) Warning lamp (2) "E:028" 12 V error

Checking devices

1. Check the anti-theft antenna, engine speed sensor, travel speed shift switch, AUX switch and meter panel.
   - Check the connectors for loose connection or poor contact.
   - Disconnect and reconnect the connectors and check in tester mode.
   - Check the cover of the wiring for damage and that they are not touching the body.
   - Check whether the anti-theft lamp is blinking or not.



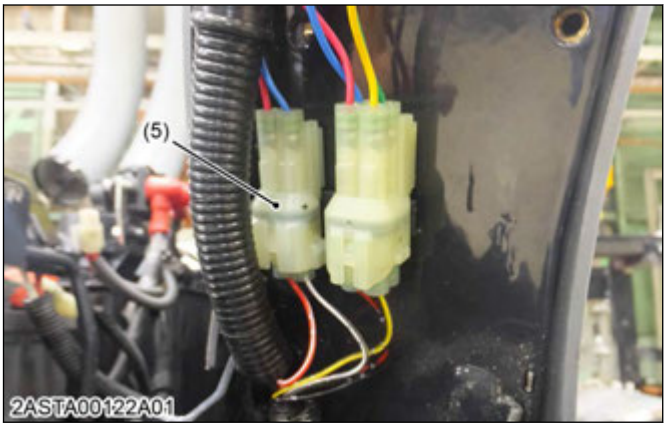
(1) Anti-theft lamp



(2) Anti-theft antenna connector

(3) Engine speed sensor connector

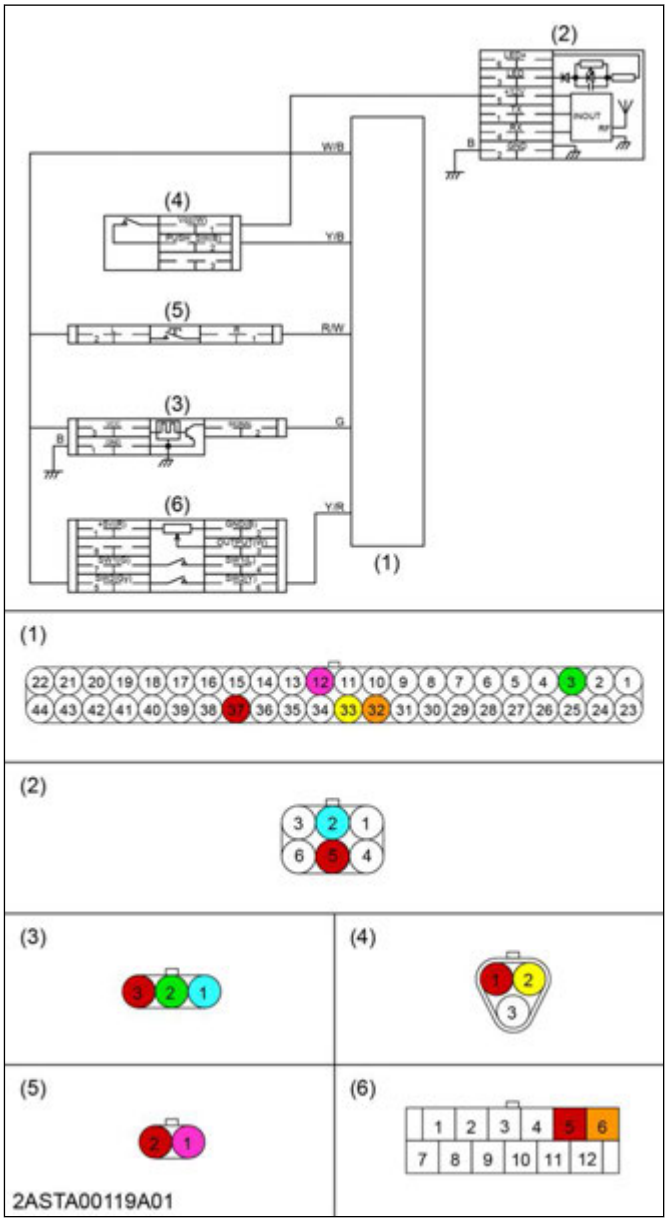
(4) Travel speed shift switch connector



(5) AUX switch connector

(6) Meter panel connector

Checking the wire harness



(1) Main ECU connector
(2) Anti-theft antenna connector
(3) Engine speed sensor connector
(4) Travel speed shift switch connector
(5) AUX switch connector
(6) Meter panel connector

1. Measure the voltage of the wire harness.
   - Disconnect the engine speed sensor connector and anti-theft antenna connector.

	(+)	(-)
(2) Anti-theft antenna connector	5	2
(3) Engine speed sensor connector	3	1
(4) Travel speed shift switch connector	1	2
(5) AUX switch connector	2	1
(6) Meter panel connector	5	6

Normal	Starter switch at **[STOP]**	Starter switch at **[RUN]**
	0 V	12 V

2. Check conduction for the wire harness.
   - Turn the starter switch to **[STOP]** and disconnect the anti-theft antenna, engine speed sensor, travel speed shift switch, AUX switch, meter panel, and the main ECU connector.

	12 V	GND	Signal
(1) Main ECU connector	37	-	3
(2) Anti-theft antenna connector	5	2	-
(3) Engine speed sensor connector	3	1	2
(4) Travel speed shift switch connector	1	-	-
(5) AUX switch connector	2	-	-
(6) Meter panel connector	5	-	-
Body ground	-	○	-

	GND (Travel speed shift switch)	GND (AUX switch)	GND (Meter panel)
(1) Main ECU connector	33	12	32
(2) Anti-theft antenna connector	-	-	-
(3) Engine speed sensor connector	-	-	-
(4) Travel speed shift switch connector	2	-	-
(5) AUX switch connector	-	1	-
(6) Meter panel connector	-	-	6
Body ground	-	-	-

Normal	Conduction

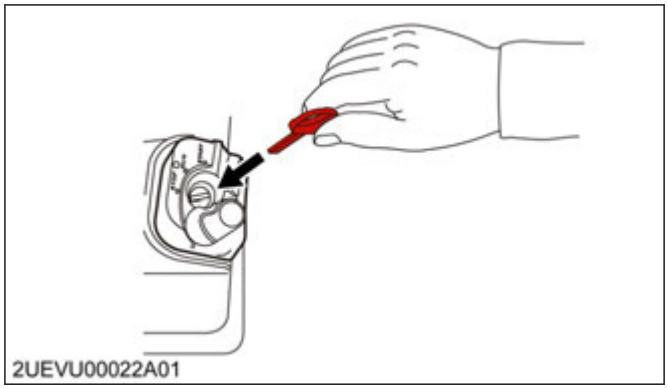
ANTI-THEFT SYSTEM

1. Registering the black key

■ IMPORTANT

- **Delete the previous registration of the black keys when registering other new black keys.**
- **If the red key is lost, it is not able to register black keys.**
- **Do not put the metal ring or fob with the red or black keys. It may cause that the key cannot be registered or that the machine cannot be turned on.**
- **Do not bundle the red or black keys together. It may cause that the key cannot be registered or that the machine cannot be turned on.**
- **All black keys, which should be used on the machine, must be registered (old and new black keys).**

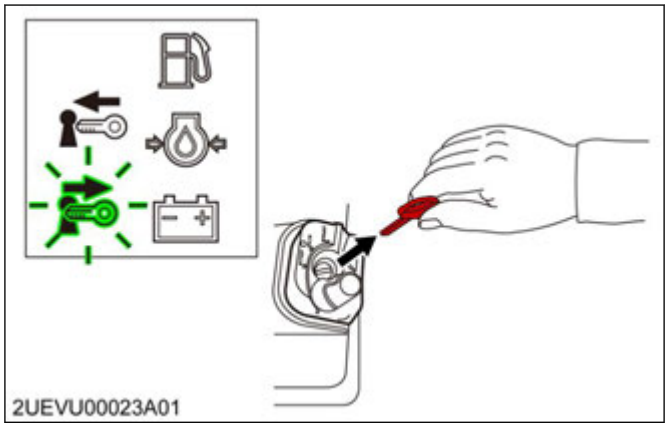
1. Insert the red key into the starter switch and press SW3.



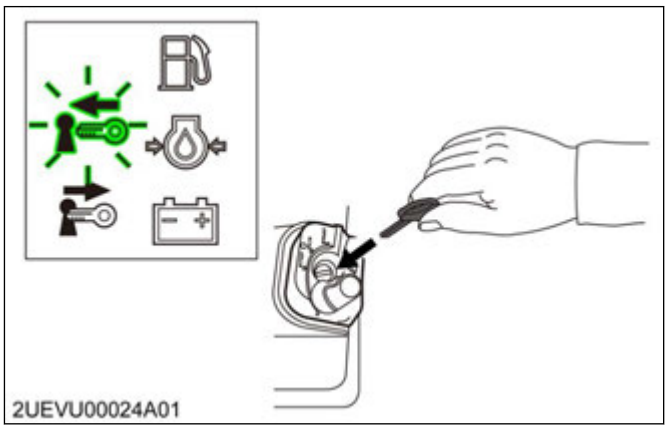
■ NOTE

- **Do not turn the starter switch.**

2. Remove the red key when the key pull out lamp turns on.



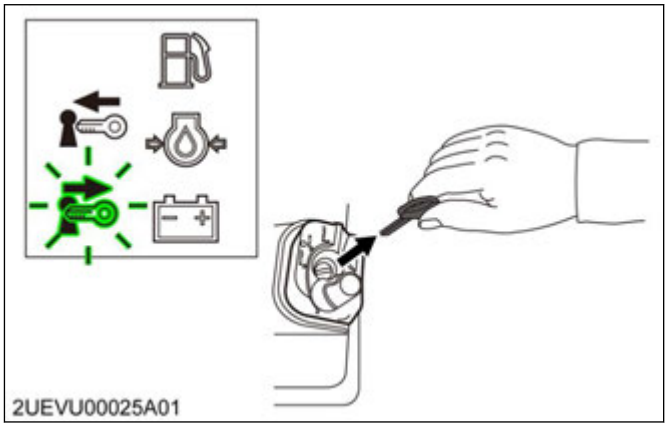
3. Insert the black key when the key insertion lamp turns on.



■ NOTE

- **Do not turn the starter switch.**

4. Remove the black key when the key pull out lamp turns on.



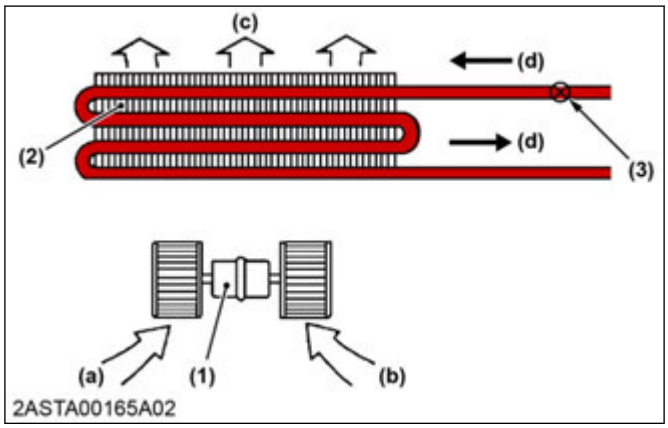
5. Turn the starter switch to **[RUN]** with the black key after completing all of the key registrations.

7. AIR CONDITIONING AND HEATER SYSTEM

MECHANISM

1. Heater system general description

The temperature is controlled by a heating cycle using the heat of engine coolant.

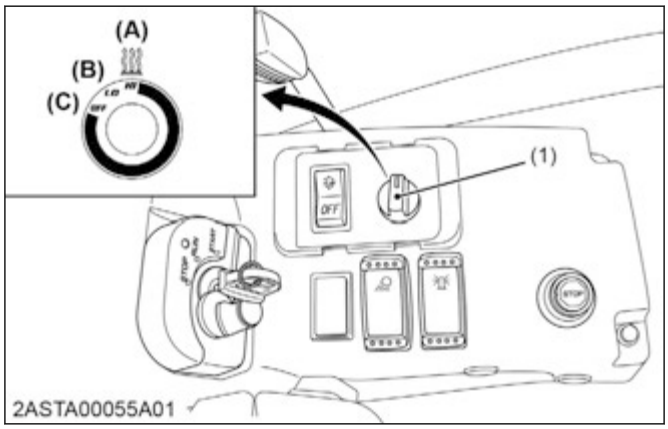


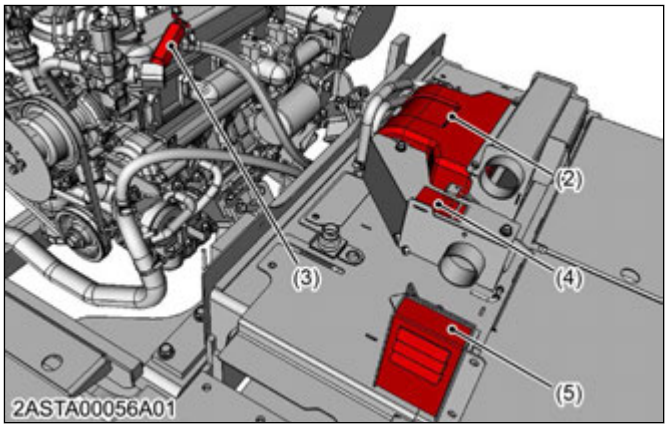
(1) Blower
(2) Heater core
(3) Heater valve
(a) Cabin air
(b) Ambient inlet air
(c) Hot air
(d) Coolant

Heating cycle

- The heated coolant flows into the heater core through the heater valve and heats up the cabin and ambient inlet air by the heat convection.
- The heater valve controls the flow rate of the heated coolant. The heated air temperature increases in case that the flow rate increases.
- The coolant returns to the engine.

2. Heater device layout

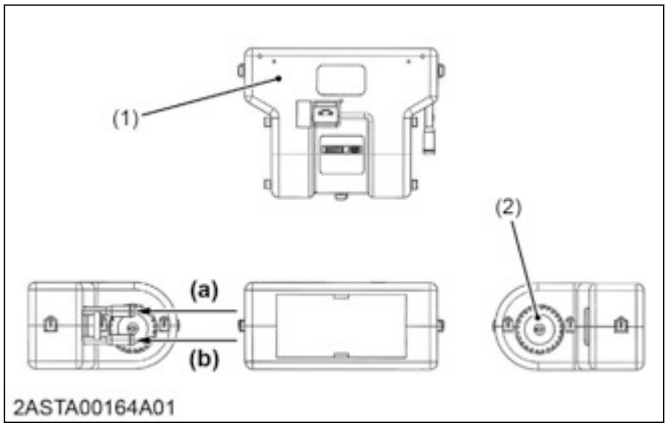




(1) Fan switch
(2) Heater unit
(3) Heater valve
(4) Cabin air inlet
(5) Ambient air inlet
(A) **[HI]**
(B) **[LO]**
(C) **[OFF]**

3. Heater unit

3.1 Heater unit specifications



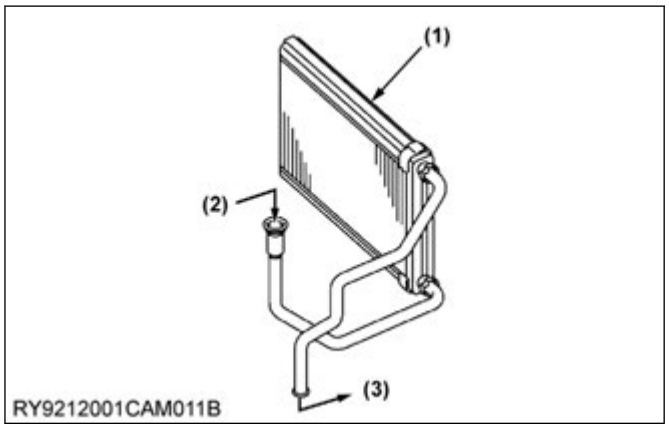
(1) Heater unit
(2) Blower motor
(a) Coolant IN
(b) Coolant OUT

Items	Specifications	Remark
Heating capacity	4.1 kW	Air flow 239 m^3/h
Mass	1.7 kg	-
Current	5.6 A	-

3.2 Heater unit function and structure

3.2.1 Heater core

Heats up the air which flows through the heater core by the heat convection.

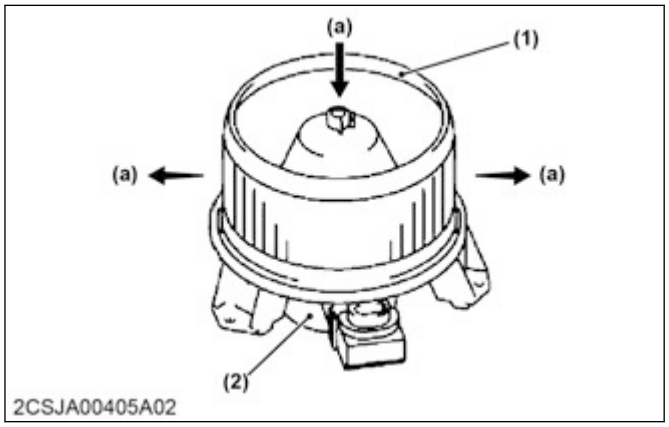


(1) Heater core
(2) Coolant inlet
(3) Coolant outlet

- The heated coolant flows into the heater core.
- The heater core heats up the air which flows through the heater core by the heat convection.

3.2.2 Blower

Blows the air to the evaporator and heater core.

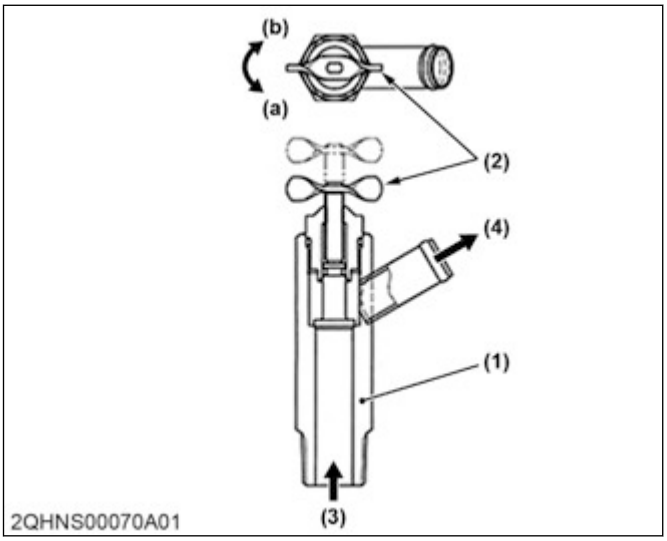


(1) Fan
(2) Blower motor
(a) Air flow

- The blower motor rotates the fan.
- The fan blows the air from inside to outside.
- The air flows to the evaporator and heater core.

3.2.3 Heater valve

Adjusts the coolant flow rate.



(1) Heater valve
(2) Lever
(3) Coolant inlet
(4) Coolant outlet
(a) Open
(b) Closed

- The heater valve opens and the coolant flows into the heater core.

SERVICING

1. Troubleshooting

1.1 Heater system troubleshooting

Not heating effectively

Cause	Inspections	Actions
The heater hose is bent or damaged. The heater hose is pinched.	Check the bend and damage of the heater hoses.	Replace the heater hose.
The connectors are disconnected or connected loosely.	Check the connection of the relating connectors.	Reconnect the connector. Replace the electrical wiring.
The fuse or slow blow fuse has blown.	Check the conduction of the related fuses and slow blow fuses.	Specify the cause of the fuse blowing and replace the fuse.
The heater valve is damaged.	Check the damage of the heater valve.	Replace the heater valve.

Insufficient air flow

Causes	Inspections	Actions
The air filters are clogged.	Check the condition of the air filters.	Clean or replace the air filter.
The air vent is clogged.	Check the condition of the air vents.	Clean the air vent.
The connector is connected insecurely.	Check the connection of the related connectors.	Reconnect the connector.
The fan switch is damaged.	Check the conduction of the fan switch.	Replace the fan switch.
The fan is deformed.	Check the deformation of the fan.	Replace the blower.
The blower motor malfunctions.	Check the motion of the blower motor.	Replace the blower.
Blower resister is damaged.	Check the resistance of the blower resister.	Replace the blower resistor.
The air duct has detached.	Check the connections of the air ducts.	Reinstall the air duct.
The wire harness is damaged.	Check the conduction of the related wire harnesses.	Repair or replace the wire harness.
Air duct is clogged.	Check the condition of the air ducts.	Clean the air duct. Replace the air duct.

No air flow

Causes	Inspections	Actions
The fuse or slow blow fuse has blown.	Check the conduction of the related fuses and slow blow fuses.	Specify the cause of the fuse blowing and replace the fuse.
The relay malfunctions.	Check the conduction of the related relays.	Replace the relay.
The air duct has detached.	Check the connections of the air ducts.	Reinstall the air duct.
The connector is disconnected.	Check the connection of the related connectors.	Reconnect the connector.
The wire harness is damaged.	Check the conduction of the related wire harnesses.	Repair or replace the wire harness.
The fan switch is damaged.	Check the conduction of the fan switch.	Replace the fan switch.
The fan is deformed.	Check the deformation of the fan.	Replace the blower.
The blower motor malfunctions.	Check the motion of the blower motor.	Replace the blower.
Blower resister is damaged.	Check the resistance of the blower resister.	Replace the blower resister.
Air duct is clogged.	Check the condition of the air ducts.	Clean the air duct. Replace the air duct.
The air vent is clogged.	Check the condition of the air vents.	Clean the air vent. Replace the air vent.

Noise

Causes	Inspections	Actions
The blower motor malfunctions.	Check the noise of the blower motor.	Replace the blower.
The fan is deformed.	Check the noise the fan. Check the deformation of the fan.	Replace the blower.
The air duct has detached.	Check the connections of the air ducts.	Reinstall the air duct.
Air duct is clogged.	Check the condition of the air ducts.	Clean the air duct. Replace the air duct.
The air vent is clogged.	Check the condition of the air vents.	Clean the air vent. Replace the air vent.

2. Testing

2.1 Checking the fan switch

Check the conduction of the fan switch in each operation to check the condition of the fan switch.

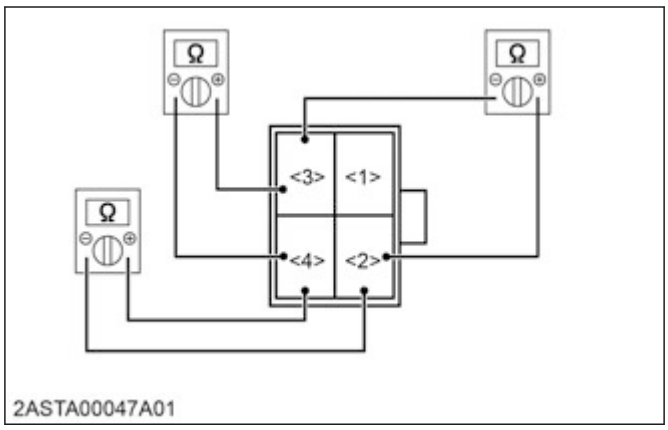
Preparing

1. Stop the engine.
2. Disconnect the battery cable from negative (-) terminal.
3. Disconnect all of the connector from the fan switch.

Checking

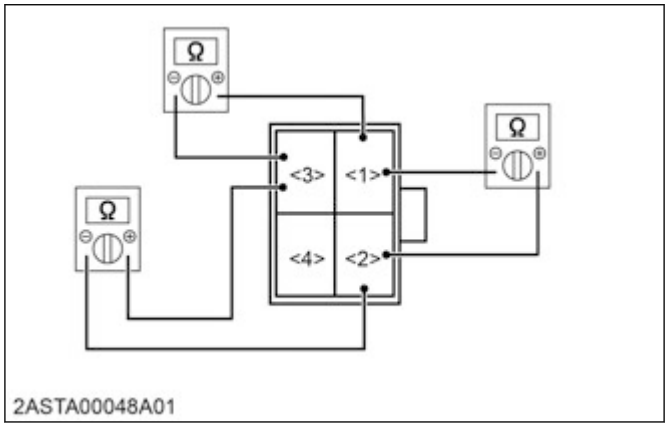
1. Check the conduction of the fan switch **[LO]** operation.

(1) Fan switch connector



- The terminal 2 and 3 conducts
- The terminal 2 and 4 conducts
- The terminal 3 and 4 conducts

2. Check the conduction of the fan switch **[HI]** operation.



- The terminal 1 and 2 conducts
- The terminal 1 and 3 conducts
- The terminal 2 and 3 conducts

2.2 Checking the blower motor

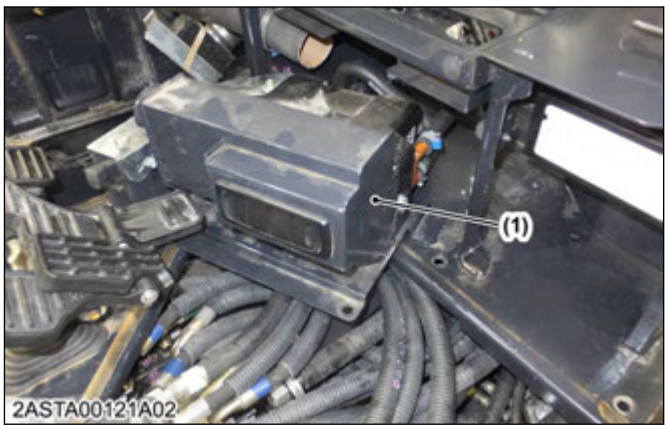
CAUTION
- **Stop the engine before working.**
- **Do not work soon after the engine has stopped.**
  - **Coolant is extremely hot.**

Preparing

1. Remove the heater unit.

Checking

1. Remove the blower motor from the heater unit.

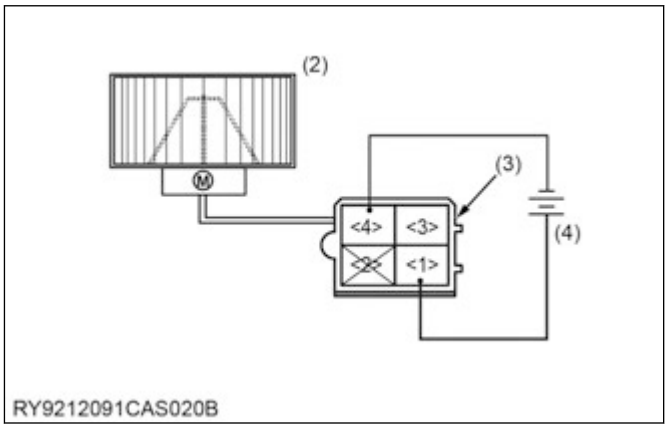


(1) Heater unit

2. Rotate the blower motor by hand and check that the blower motor rotates smoothly.

NOTE
- **The blower motor is damaged in case that the blower motor does not rotate smoothly.**

3. Connect a jumper cable from the battery positive (+) terminal to the blower motor connector terminal 1.



(2) Blower motor
(3) Blower motor connector
(4) Battery

4. Connect a jumper cable from the battery negative (-) terminal to the blower motor connector terminal 4 for a second.

NOTE
- **The blower motor is damaged in case that the blower motor does not rotate.**

3. Repairing

3.1 Heater unit

3.1.1 Removing and installing the heater unit

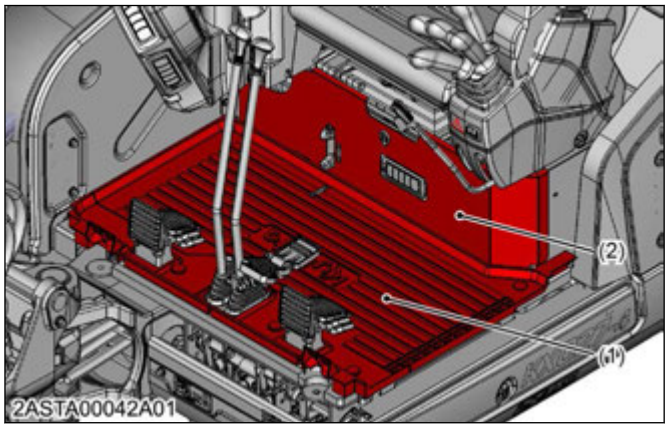
IMPORTANT
- **Work at the clean work space with clean tools.**
- **Install plugs to disconnected hoses.**

Preparing

1. Drain the coolant.

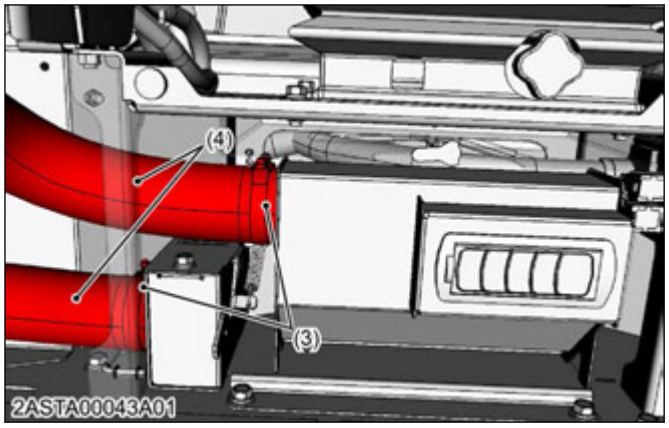
Removing

1. Remove the floor panel and cover.



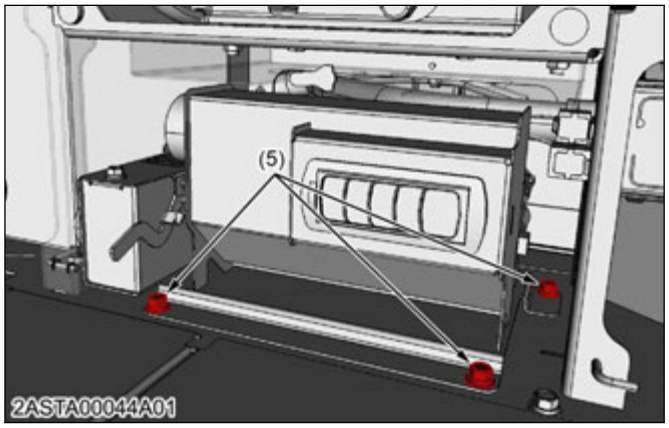
(1) Floor panel (2) Cover

2. Loosen the clamps and disconnect the air ducts.



(3) Clamp (4) Air duct

3. Remove the three bolts.



(5) Bolt (M10 × 20) ×3

4. Disconnect the heater hoses and connector.

(6) Heater hose

■ NOTE

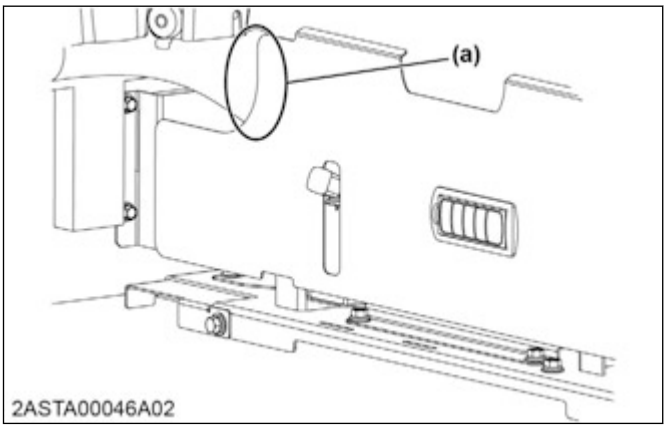
- **Take care of residual coolant in the heater hoses and heating core.**

5. Remove the heater unit.

Installing

■ IMPORTANT

- **Make sure that the hoses are not kinked.**
- **Replenish the coolant into the engine after installing.**



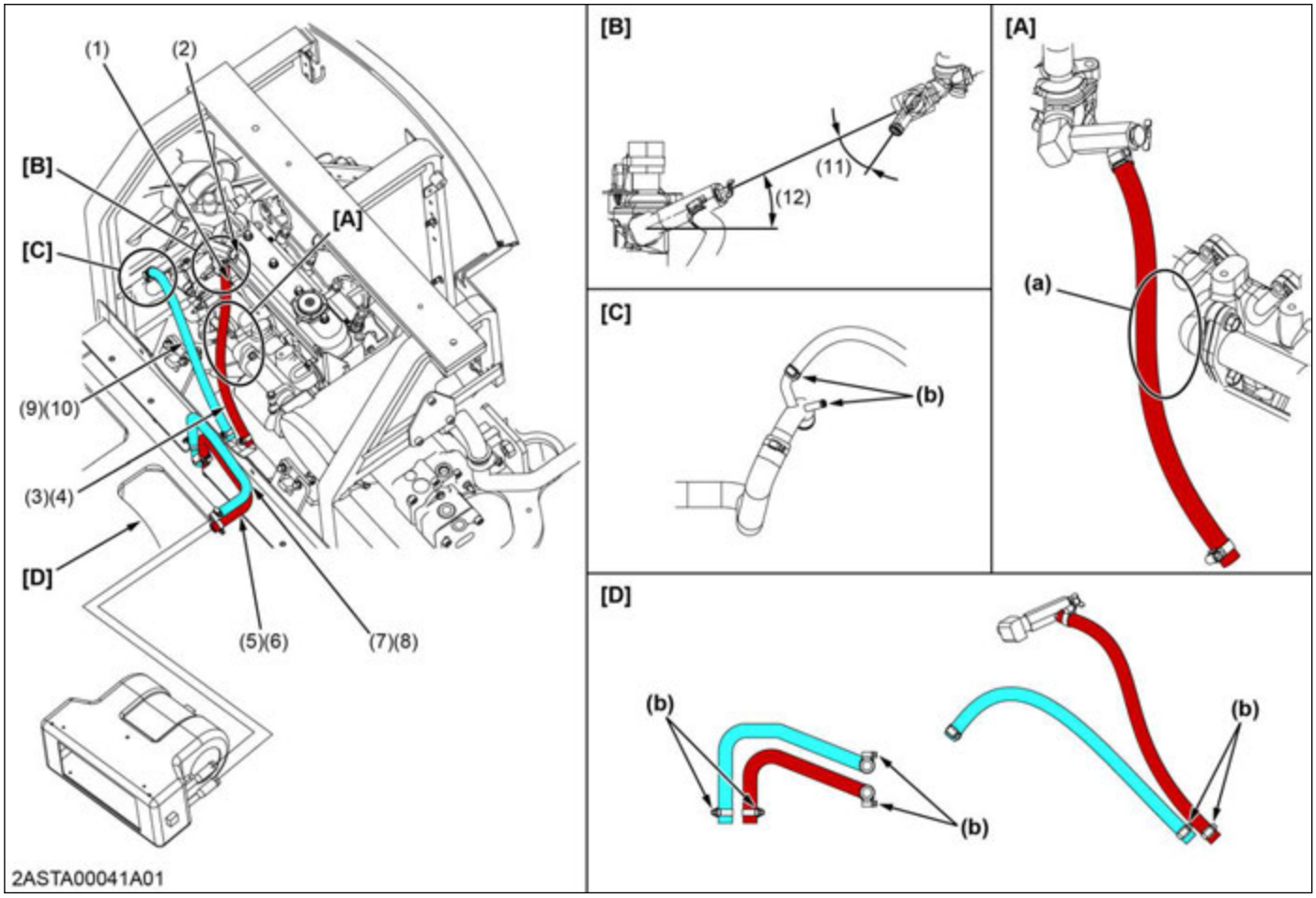
- (a) Do not contact on cover.

3.2 Heater hose

3.2.1 Heater hose routing

IMPORTANT

- **Do not kink the heater hoses.**
- **Insert the heater hoses securely.**



(1) Pipe
(2) Heater valve
(3) Heater hose
(4) Clamp
(5) Heater hose
(6) Clamp
(7) Heater hose
(8) Clamp
(9) Heater hose
(10) Clamp
(11) 30°
(12) 25°

- (a) Keep a clearance of 25 to 35 mm (0.98 to 1.38 in.) between the heater hoses and the exhaust manifold.
- (b) Install the clamp not to contact each other.

No.	Point of use	Inner diameter
(3)	Heater valve - Joint	ϕ13 mm ϕ0.51 in.
(5)	Joint - Heater core	ϕ13 mm ϕ0.51 in.
(7)	Heater core - Joint	ϕ13 mm ϕ0.51 in.
(9)	Joint - Engine	ϕ13 mm ϕ0.51 in.

8. APPENDICES

APPENDICES

1. Servicing information

1.1 Service specifications for machine body

- Standard measurement condition,
  - Hydraulic oil and devices temperature: 50 ℃ (Including motor, pump and cylinders)
  - Engine speed: maximum speed

Items				Units	Service specifications		Service limits
					Value	Tolerance	Value
Wear	Pin			-	-	-	1 mm wear on pin outer diameter.
	Bushing			-	-	-	1 mm wear on bushing inner diameter.
Play	Swivel bearing (vertical play)			mm in.	0.84 0.033	-	1.68 0.066
	Front attachment			mm in.	less than 73 less than 2.8	-	146 5.7
Clearance	Swing bracket (vertical clearance)			mm in.	0.5 0.02	-	-
	Front attachment (each pin)			mm in.	0.5 0.02	-	-
	Front attachment (pins of bucket link 2, 3)			mm in.	1.0 0.04	-	-
Force	Control lever	Pilot control lever (Basic)	Forwards	N kgf	9.6 0.98	±4.9 ±0.50	-
			Backwards	N kgf	9.6 0.98	±4.9 ±0.50	-
			LH and RH	N kgf	9.6 0.98	±4.9 ±0.50	-
		Pilot control lever (Hi-spec)	Forwards	N kgf	11.8 1.2	±4.9 ±0.50	-
			Backwards	N kgf	11.3 1.2	±4.9 ±0.50	-
			LH and RH	N kgf	9.3 0.95	±4.9 ±0.50	-
		Travel control lever	Forwards	N kgf	21.6 2.2	±4.9 ±0.50	-
			Backwards	N kgf	21.6 2.2	±4.9 ±0.50	-
		Blade control lever	Forwards	N kgf	24.0 2.5	±4.9 ±0.50	-
			Backwards	N kgf	24.0 2.5	±4.9 ±0.50	-

(Continued)

Items				Units	Service specifications		Service limits
					Value	Tolerance	Value
Force	Control lever	Lever lock	Raising	N kgf	27 2.8	±9.8 ±1.0	-
			Lowering	N kgf	68 6.9	±9.8 ±1.0	-
		Accelerator lever	Forwards	N kgf	39.2 4.0	±14.7 ±1.5	-
			Backwards	N kgf	34.3 3.5	±14.7 ±1.5	-
		Swing control pedal	LH	N kgf	44.1 4.5	±6.7 ±0.68	-
			RH	N kgf	44.1 4.5	±6.7 ±0.68	-
		AUX control pedal	LH	N kgf	48.0 4.9	±6.7 ±0.68	-
			RH	N kgf	48.0 4.9	±6.7 ±0.68	-
Dimension	Track	Steel track	Width	mm in.	300.0 11.8	-	-
			Link length	mm in.	406.4 16	-	416.4 16.4
			Height	mm in.	90.5 3.56	-	85.5 3.37
			Grouser height	mm in.	16.5 0.65	-	8.0 0.3
			Bushing length	mm in.	55.0 2.2	-	-
			Bushing inner diameter	mm in.	ϕ17.0 ϕ0.67	-	ϕ19.0 ϕ0.75
			Bushing outer diameter	mm in.	ϕ28.0 ϕ1.1	-	ϕ26.5 ϕ1.04
			Master pin length	mm in.	96.5 3.8	-	-
			Master pin outer diameter	mm in.	ϕ16.8 ϕ0.66	±0.05 ±0.0020	ϕ15.5 ϕ0.61
			Pin length	mm in.	97 3.8	-	-
			Pin outer diameter	mm in.	ϕ17 ϕ0.67	-	ϕ15.5 ϕ0.61
			Number of links	-	40	-	-
			Tension dimension	mm in.	75.0 3.0	0 to 5.0 0 to 0.1	-
		Rubber track	Lug height	mm in.	19.5 0.77	-	-
			Link height	mm in.	24.0 0.94	-	-
			Width	mm in.	300 11.81	-	-

(Continued)

Items				Units	Service specifications		Service limits
					Value	Tolerance	Value
Dimension	Track	Rubber track	Height	mm in.	75.5 2.97	-	-
			Tension dimension	mm in.	10.0 0.4	0 to 5 0 0 to 0.2	-
	Carrier roller	Outer diameter		mm in.	ϕ76.3 ϕ3.0	-	ϕ73.3 ϕ2.9
	Front idler	Outer diameter		mm in.	ϕ272.0 ϕ10.7	0 to 2.0 0 to 0.08	ϕ268 ϕ10.6
		Guide width		mm in.	30.0 1.2	-	26 1.0
		Idler width		mm in.	72.0 2.8	-	-
	Sprocket	Outer diameter		mm in.	ϕ361 ϕ14.21	-2.0 to +1.0 -0.08 to 0.04	-
		Inner diameter		mm in.	ϕ190 ϕ7.48	-	-
		Sprocket width		mm in.	30 1.18	±1.0 ±0.04	26 1.02
		Gear height		mm in.	85.5 3.37	-	82.5 3.25
	Tension spring	Steel track	Spring dimension	mm in.	174.3 6.86	±0.5 ±0.020	-
		Rubber track	Spring dimension	mm in.	174.3 6.86	±0.5 ±0.020	-
	Track roller	Guide diameter		mm in.	80.0 3.1	-	65 2.8
		Guide width		mm in.	81.0 3.2	-	91 3.6
		Outer diameter		mm in.	ϕ124.0 ϕ4.88	-	ϕ114 ϕ4.5
		Roller width		mm in.	175.0 6.89	-0.5 -0.020	-

1.2 Service specifications for hydraulic system

■ NOTE

- **Standard measurement condition,**
  - **– Hydraulic oil and devices temperature: 50 ℃ (Including motor, pump and cylinders)**
  - **– Engine speed: Maximum speed**
  - **– Hydraulic cylinder speed not including cushioning.**

Items			Unit	Service specifications		Service limits
				Value	Tolerance	Value
Pressure	Main relief valve	P1 (aP1)	MPa kgf/cm^2 psi	23.5 239.6 3408	-0.5 to 1.0 -5 to 10 -73 to 144	-

(Continued)

Items			Unit	Service specifications		Service limits
				Value	Tolerance	Value
Pressure	Main relief valve	P2 (aP2)	MPa kgf/cm^2 psi	23.5 239.6 3408	-0.5 to 1.0 -5 to 10 -73 to 144	-
		P3 (aP3)	MPa kgf/cm^2 psi	19.6 199.8 2843	-0.5 to 1.0 -5 to 10 -73 to 144	-
	Pilot primary pressure relief valve	Pilot primary (aPP)	MPa kgf/cm^2 psi	4.3 43.8 624	-0.3 to 0.2 -3 to 2 -44 to 29	-
	Overload relief valve	Boom bottom (b1B)	MPa kgf/cm^2 psi	26.9 274.2 3901	±1.0 ±10.0 ±144	-
		Boom rod (b1R)	MPa kgf/cm^2 psi	26.4 268.8 3825	±1.0 ±10.0 ±144	-
		Arm bottom (b2B)	MPa kgf/cm^2 psi	26.3 268.0 3813	±1.0 ±10.0 ±144	-
		Arm rod (b2R)	MPa kgf/cm^2 psi	26.5 269.6 3836	±1.0 ±10.0 ±144	-
		Bucket bottom (b3B)	MPa kgf/cm^2 psi	26.3 267.9 3811	±1.0 ±10.0 ±144	-
		Blade bottom (b4B)	MPa kgf/cm^2 psi	25.9 263.6 3751	±1.0 ±10.0 ±144	-
		Swivel RH (cSR)	MPa kgf/cm^2 psi	17.3 176.4 2509	±1.0 ±10.0 ±144	-
		Swivel LH (cSL)	MPa kgf/cm^2 psi	17.0 173.3 2466	±1.0 ±10.0 ±144	-
Flow rate	Piston pump (P1 + P2) (Engine speed: 2250 rpm, no load, maximum flow rate)		L/min U.S.gals/min	65.6 17.3	-	52.4 13.9
	AUX1 (Engine speed: 2250 rpm, no load, maximum flow rate)		L/min U.S.gals/min	53.1 14.0	-	-
	AUX2 (Engine speed: 2250 rpm, no load, maximum flow rate)		L/min U.S.gals/min	19.3 5.1	-	-
Internal leakage	Hydraulic cylinder	Boom (10 min, engine stop)	mm in.	less than 20 less than 0.79	-	100 3.94
		Arm (10 min, engine stop)	mm in.	less than 11 less than 0.43	-	55 2.17
		Bucket (10 min, engine stop)	mm in.	less than 10 less than 0.39	-	50 1.96

(Continued)

Items			Unit	Service specifications		Service limits
				Value	Tolerance	Value
Internal leakage	Hydraulic cylinder	Blade (10 min, engine stop)	mm in.	less than 25 less than 0.98	-	50 1.97
	Swivel motor	Stopped the engine Activating negative brake	mm in. degrees	0 0 0	-	26 1.02 5
		Running the engine in idle speed Releasing negative brake	mm in. degrees	less than 157 less than 6.18 less than 30	-	157 6.18 30
	Travel motor	(20 degrees slope)	mm in.	less than 300 less than 11.8	-	-
Drain	Swivel motor	RH and LH (Rotating)	L/min U.S.gals/min	0.150 0.04	-	1.0 0.26
		RH and LH (Relief)	L/min U.S.gals/min	0.360 0.10	-	6.0 1.6
	Travel motor	Low speed (Rotating)	L/min U.S.gals/min	0.060 0.016	-	0.4 0.11
		High speed (Rotating)	L/min U.S.gals/min	0.125 0.033	-	-
		Low speed (Relief)	L/min U.S.gals/min	0.720 0.190	-	-
		High speed (Relief)	L/min U.S.gals/min	0.84 0.222	-	-
Speed	Boom cylinder	Lifting (ground to highest)	s	2.6	±0.3	-
		Lowering (highest to ground)	s	2.5	±0.3	-
	Arm cylinder	Crowding	s	2.8	±0.3	-
		Dumping	s	3.0	±0.3	-
	Bucket cylinder	Crowding	s	2.7	±0.3	-
		Dumping	s	1.9	±0.3	-
	Blade cylinder	Lifting (lowest to highest)	s	2.0	±0.3	-
		Lowering (highest to lowest)	s	2.6	±0.3	-
	Swing cylinder	Swing RH	s	5.5	±0.3	-
		Swing LH	s	5.5	±0.3	-
	Swivel motor	RH	rpm s/3 rotation	9.5 18.9	±0.9 -1.6 to +2.0	-
		LH	rpm s/3 rotation	9.5 18.9	±0.9 -1.6 to +2.0	-

(Continued)

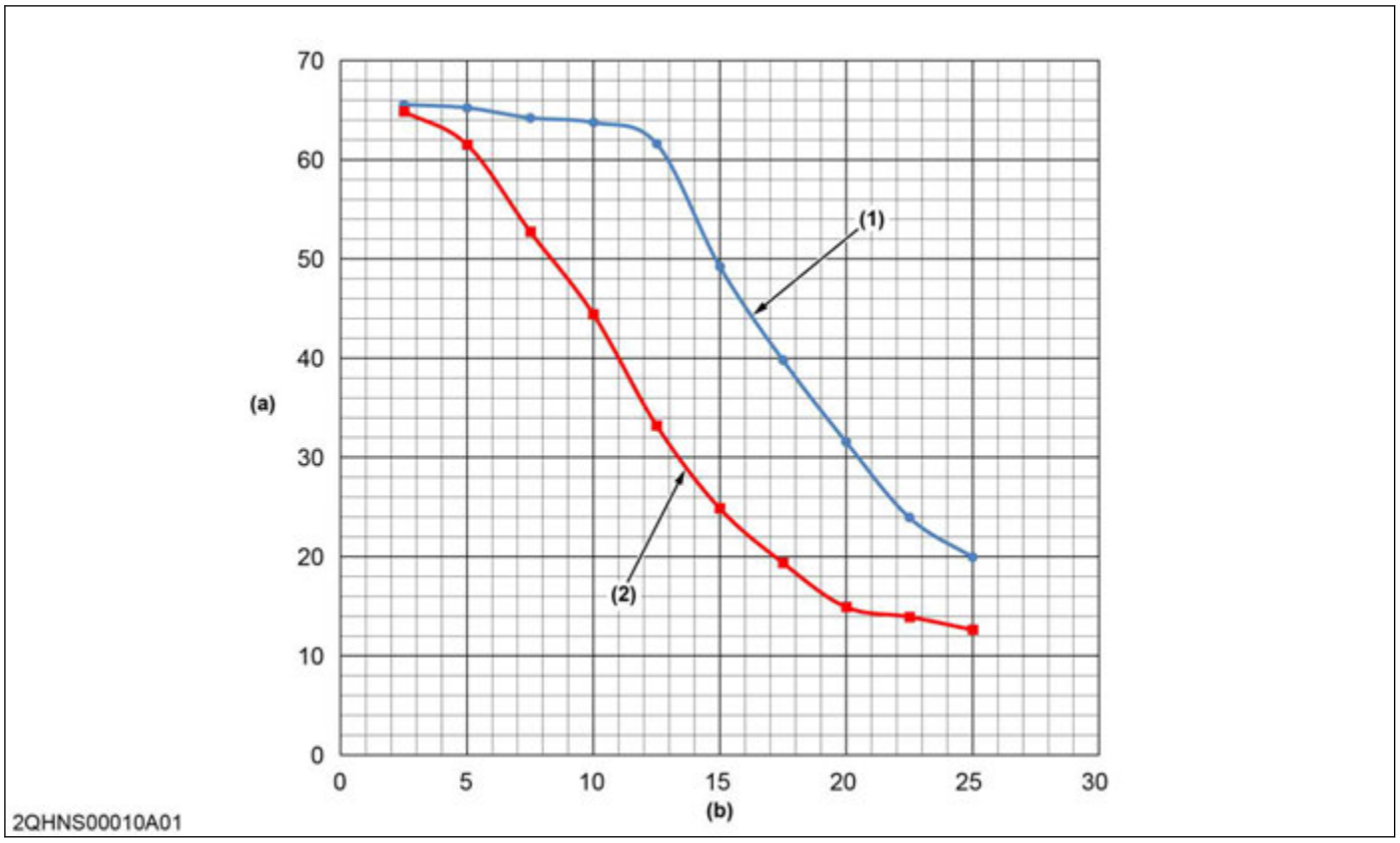
Items			Unit	Service specifications		Service limits
				Value	Tolerance	Value
Speed	Travel motor	High speed with rubber track	km/h mph s/10 m	4.5 2.80 8.00	±0.4 ±0.25 -0.65 to +0.78	-
		Low speed with rubber track	km/h mph s/10 m	2.9 1.80 12.41	±0.3 ±0.19 -1.16 to +1.43	-
		High speed with steel track	km/h mph s/10 m	4.3 2.67 8.37	±0.4 ±0.25 -0.65 to +0.78	-
		Low speed with steel track	km/h mph s/10 m	2.7 1.68 13.33	±0.3 ±0.19 -1.16 to +1.43	-
Travel straightness (10 m, 32.8 ft)			mm in.	-	-	600 23.6

1.2.1 Piston pump P-Q performance

Conditions

- Hydraulic oil and devices temperature: 50.0±5 ℃ (122±9 ℉)
- Engine speed: 2250 rpm

Service specification



(1) P1 + P2 (P3 no load) (2) P1 + P2 (P3 load (relief)) (a) Flow rate (L/min) (b) Pressure (MPa)

Pressure		Flow rate (converted to 2250 rpm)			
		P3 no load		P3 load (relief)	
MPa	psi	L/min	U.S. gals/min	L/min	U.S. gals/min
2.5	363	65.6	17.3	64.9	17.1
5.0	725	65.2	17.2	61.5	16.2
7.5	1088	64.2	16.9	52.8	13.9
10.0	1450	63.7	16.8	44.4	11.7
12.5	1813	61.6	16.3	33.2	8.8
15.0	2175	49.2	13.0	24.9	6.6
17.5	2538	39.8	10.5	19.4	5.1
20.0	2900	31.5	8.3	14.9	3.9
22.5	3263	23.9	6.3	13.9	3.7
25.0	3625	19.9	5.3	12.6	3.3

Service limit

- The service limit is 80% of the service specification.

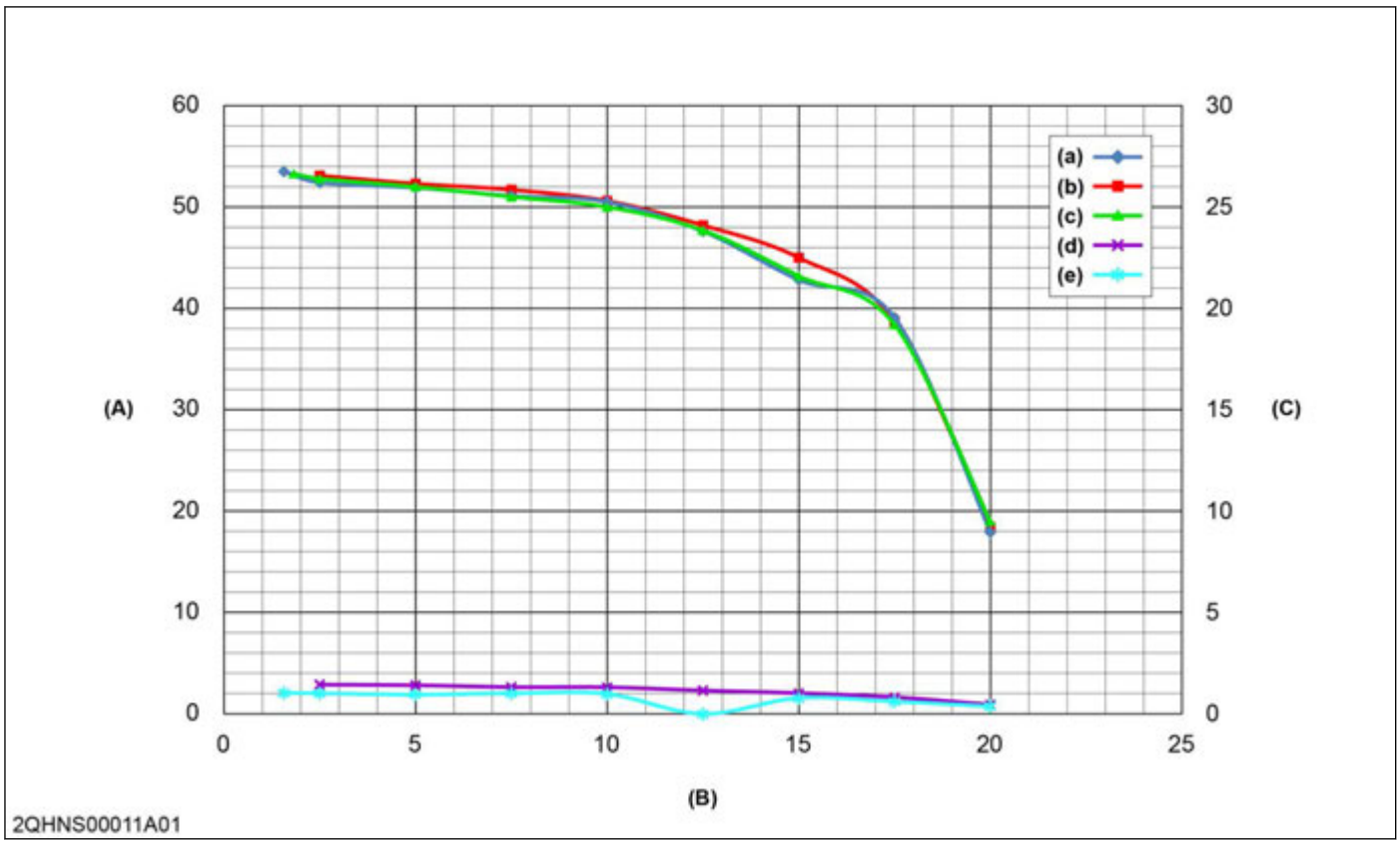
1.2.2 AUX P-Q performance

AUX1 P-Q performance

Conditions

- Hydraulic oil and devices temperature: 50.0±5 ℃ (122±9 ℉)
- Engine speed: 2250 rpm

Service specification



(A) Flow rate (L/min)
(B) Pressure (MPa)
(C) Back pressure (MPa)
(a) AUX1 LH (third line open)
(b) AUX1 LH (third line close)
(c) AUX1 RH (third line close)
(d) Back pressure (third line close)
(e) Back pressure (third line open)

AUX1 LH (third line open)

Pressure		Discharging flow rate (converted to 2250 rpm)		Back pressure	
MPa	psi	L/min	U.S. gals/min	MPa	psi
2.5	363	52.4	13.8	1.01	146
5.0	725	51.9	13.7	0.95	138
7.5	1088	51.1	13.5	1.01	146
10.0	1450	50.5	13.3	0.98	142
12.5	1813	47.6	12.6	0.85	123
15.0	2176	42.8	11.3	0.78	113
17.5	2538	39.1	10.3	0.61	88
20.0	2901	17.9	4.7	0.37	54
22.5	-	-	-	-	-

AUX1 LH (third line close)

Pressure		Discharging flow rate (converted to 2250 rpm)		Back pressure	
MPa	psi	L/min	U.S. gals/min	MPa	psi
2.5	363	53.1	14.0	1.44	209
5.0	725	52.3	13.8	1.41	204
7.5	1088	51.7	13.7	1.32	191
10.0	1450	50.6	13.4	1.31	190
12.5	1813	48.2	12.7	1.15	167
15.0	2176	45.0	11.9	1.02	148
17.5	2538	38.7	10.2	0.82	119
20.0	-	18.4	4.9	0.45	65
22.5	-	-	-	-	-

AUX1 RH (third line close)

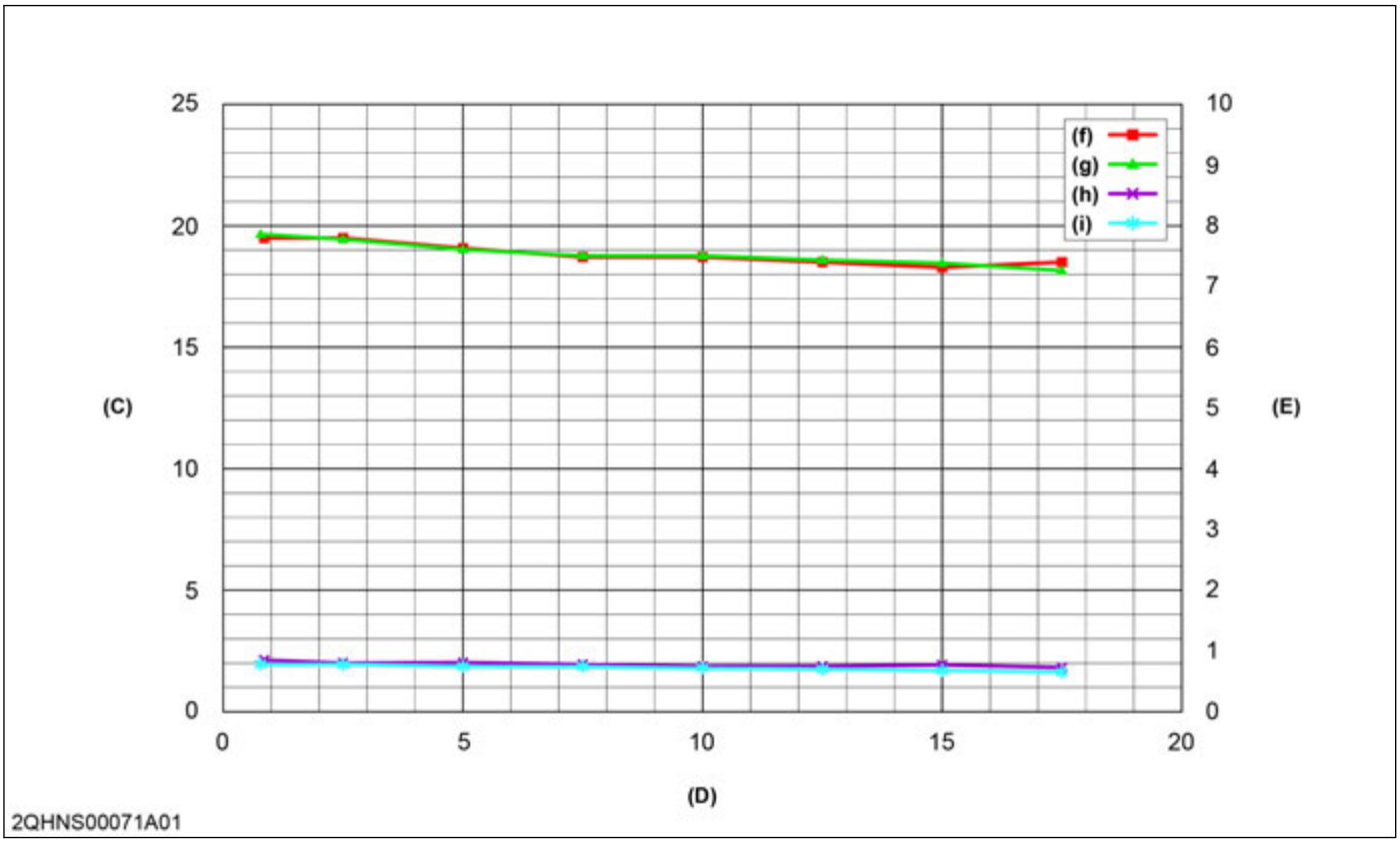
Pressure		Discharging flow rate (converted to 2250 rpm)		Back pressure	
MPa	psi	L/min	U.S. gals/min	MPa	psi
2.5	363	52.8	13.9	1.30	189
5.0	725	52..0	13.7	1.27	184
7.5	1088	51.0	13.5	1.21	175
10.0	1450	50.0	13.2	1.15	167
12.5	1813	47.7	12.6	1.09	158
15.0	2176	43.2	11.4	0.98	142
17.5	2538	38.4	10.1	0.76	110
20.0	-	19.0	5.0	0.44	64
22.5	-	17.5	4.6	0.39	57

AUX2 P-Q performance

Conditions

- Hydraulic oil and devices temperature: 50.0±5 ℃ (122±9 ℉)
- Engine speed: 2250 rpm

Service specification



(C) Flow rate (L/min)
(D) Pressure (MPa)
(E) Back pressure (MPa)
(f) AUX2 LH
(g) AUX2 RH
(h) Back pressure (AUX2 LH)
(i) Back pressure (AUX2 RH)

AUX2 LH

Pressure		Discharging flow rate (converted to 2250 rpm)		Back pressure	
MPa	psi	L/min	U.S.gals/min	MPa	psi
2.5	508	19.3	5.1	0.8	116
5.0	725	19.1	5.0	0.8	116
7.5	1088	18.8	5.0	0.8	116
10.0	1450	18.7	4.9	0.8	116
12.5	1813	18.4	4.9	0.8	116
15.0	2176	18.2	4.8	0.7	102
17.5	2538	18.4	4.9	0.7	102

AUX2 RH

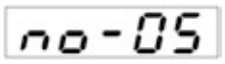
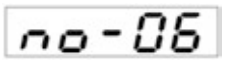
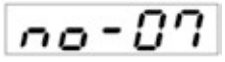
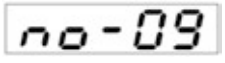
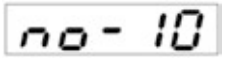
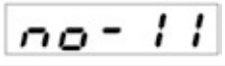
Pressure		Discharging flow rate (converted to 2250 rpm)		Back pressure	
MPa	psi	L/min	U.S.gals/min	MPa	psi
2.5	508	19.4	5.1	0.8	116
5.0	725	19.1	5.0	0.7	102
7.5	1088	18.9	5.0	0.7	102
10.0	1450	18.9	5.0	0.7	102
12.5	1813	18.6	4.9	0.7	102
15.0	2176	18.5	4.9	0.7	102
17.5	2538	18.1	4.8	0.7	102

1.3 Service specifications for engine

Items			Units	Service specifications		Service limits
				Value	Tolerance	Value
Pressure	Compression pressure		MPa kgf/cm^2 psi	3.92 40.0 569	±0.19 ±2.0 ±28	2.26 23.0 327
	Engine oil	Idling	kPa kgf/cm^2 psi	-	-	49 0.5 7.1
		Rated speed	kPa kgf/cm^2 psi	319 3.25 46.25	±122 ±1.25 ±17.75	147 1.5 21.3
Dimension	Fan belt		mm in.	8.0 0.32	±1.0 ±0.04	-

1.4 Service dealer mode

1.4.1 Default settings

Display	Mode	KX030-4	
		Basic	Hi-spec
	Model setting	1: 013 2: 004 3: N	1: 013 2: 004 3: Y
	Clearing periodic check alert	Y (Manual)	
	Informing periodic check alert	N (Inform)	
	Clock setting alert	Y (Inform)	
	Travel buzzer function	N (Deactivation)	
	Travel speed shift switch	N (Hand)	

1.4.2 Tester mode

No.	Items	Display	Reference
1	Engine speed	“oooo” rpm	-
2	Battery voltage	“oo.o” V	12 V
3	Oil SW	“ON” “OFF”	“ON”: lower than 49 kPa “OFF”: higher than 49 kPa

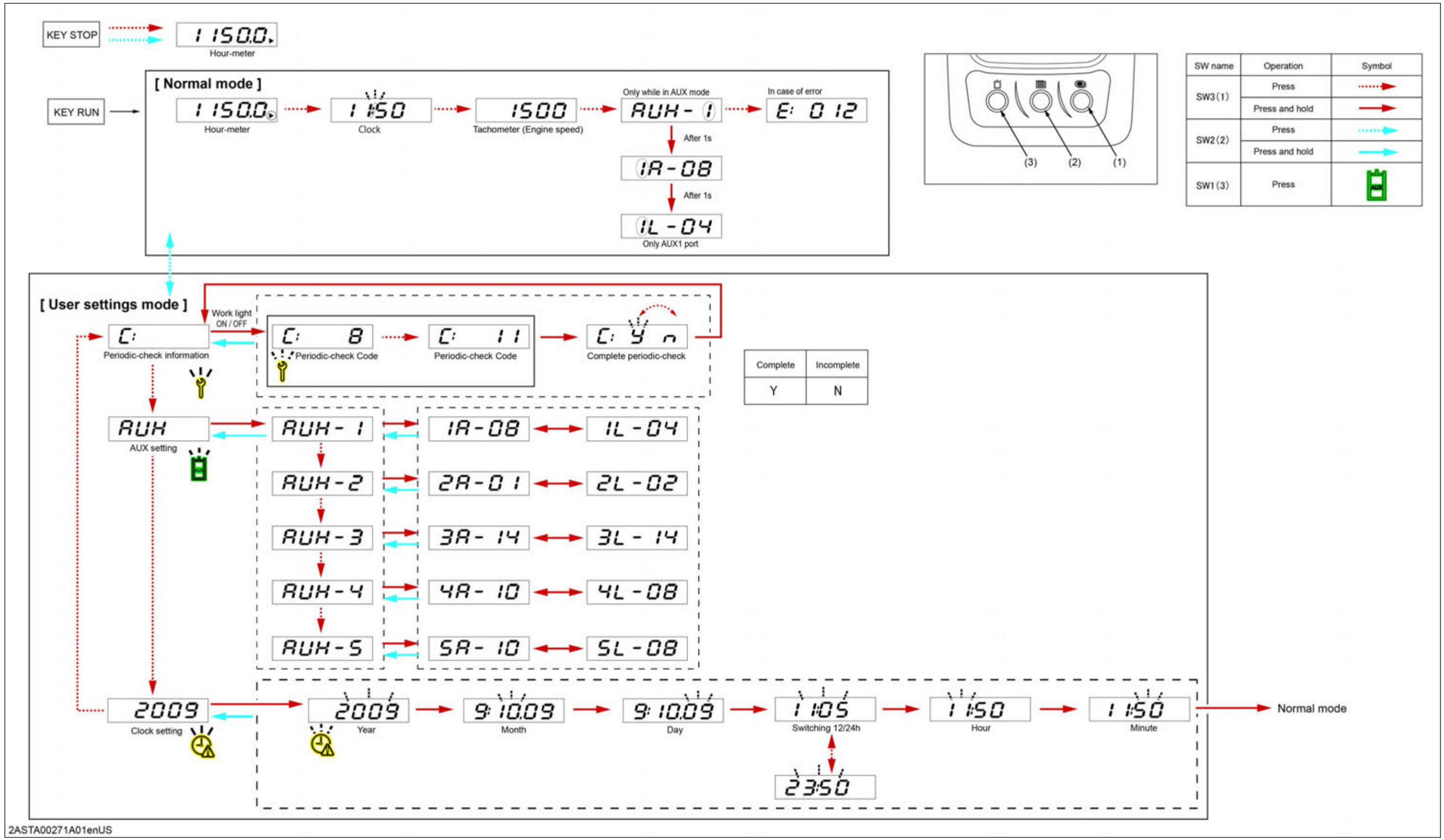
(Continued)

No.	Items	Display	Reference
4	Battery charge SW	"ON" "OFF"	"ON": Engine start "OFF": Engine stop
5	Starter SW	"ON" "OFF"	"ON": key "START" "OFF": key "STOP" or "RUN"
6	Work light SW	"ON" "OFF"	"ON": work light SW is ON "OFF": work light SW is OFF
7	Coolant temperature sensor (voltage)	"o.oo" V	Starter SW "Stop": 0 V Starter SW "RUN": 5 V
8	Coolant temperature sensor (temperature)	"oo" ℃	-49 to 149 ℃
9	Fuel sensor (voltage)	"o.oo" V	Starter SW "Stop": 0 V Starter SW "RUN": 12 V
10	Fuel sensor (resistance)	"ooo" Ω	3±1 to 110±2.5 Ω
11	Fuel feed SW	"ON" "OFF"	"ON": feed SW is ON "OFF": feed SW is OFF
12	Travel speed shift switch	"ON" "OFF"	"ON": travel speed shift SW is ON "OFF": travel speed shift SW is OFF
13	Travel speed shift solenoid	"ON" "OFF"	"ON": travel speed shift SW is ON "OFF": travel speed shift SW is OFF
14	Lever lock SW	"ON" "OFF"	"ON": lowering lever lock "OFF": raising lever lock
15	Lever lock SOL	"ON" "OFF"	"ON": lowering lever lock "OFF": raising lever lock
16	AUX 1 knob SW (voltage) and travel pressure sensor (voltage)	"o.oo" V	0.26 to 4.74 V
17	AUX 1 knob SW (setting voltage left)	"o.oo" V	0.26 to 4.74 V
18	AUX 1 knob SW (setting voltage neutral)	"o.oo" V	0.26 to 4.74 V
19	AUX 1 knob SW (setting voltage right)	"o.oo" V	0.26 to 4.74 V
20	AUX 1 SOL (current)	"o.oo" A	0 to 1.7 A
21	AUX hold SW	"ON" "OFF"	"ON": AUX hold SW is ON "OFF": AUX hold SW is OFF
22	AUX switch	"ON" "OFF"	"ON": AUX SW is ON "OFF": AUX SW is OFF
23	AUX1 RH setting	"oo" × 10 mA	-
24	AUX1 LH setting	"oo" × 10 mA	-
25	Key type	"o"	"0" (Unknown) "1" (Red) "2" (Black) "3" (Yellow) "4" (Green) "5" (Red Yellow) "6" (Red Green)
26	Anti-theft key analysis (registered key)	"ON" "OFF"	"ON": match "OFF": mismatch
27	Anti-theft mode	"ON" "OFF"	"ON": deactivation "OFF": activation

(Continued)

No.	Items	Display	Reference
28	Key	“ON” “OFF”	“ON”: existence “OFF”: non-existence
29	Anti-theft antenna	“ON” “OFF”	“ON”: error “OFF”: normal

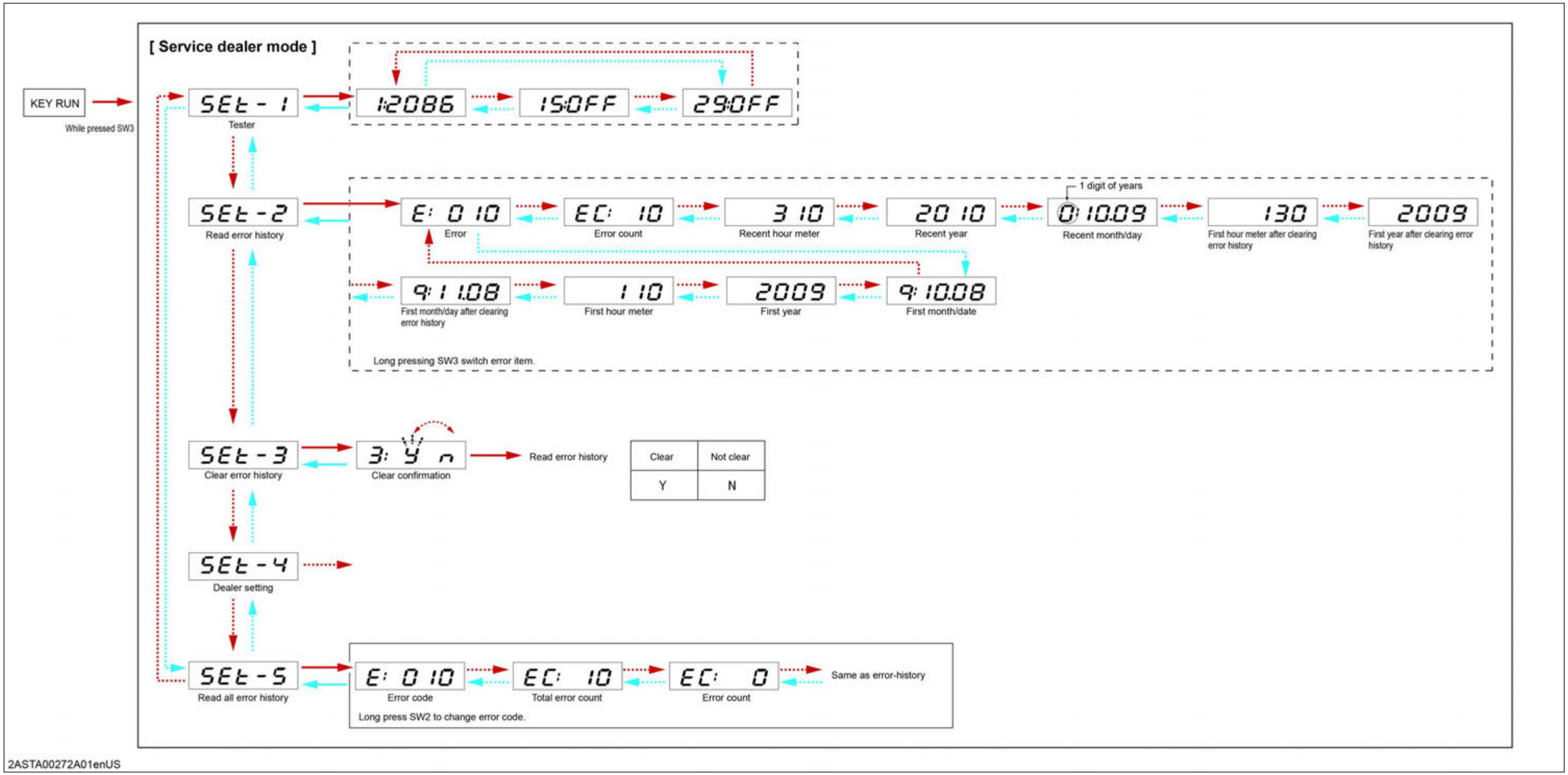
2. Meter flow chart



SW name	Operation	Symbol
SW3(1)	Press	····▶
	Press and hold	——▶
SW2(2)	Press	····▶
	Press and hold	——▶
SW1(3)	Press	

Complete	Incomplete
Y	N

8. APPENDICES



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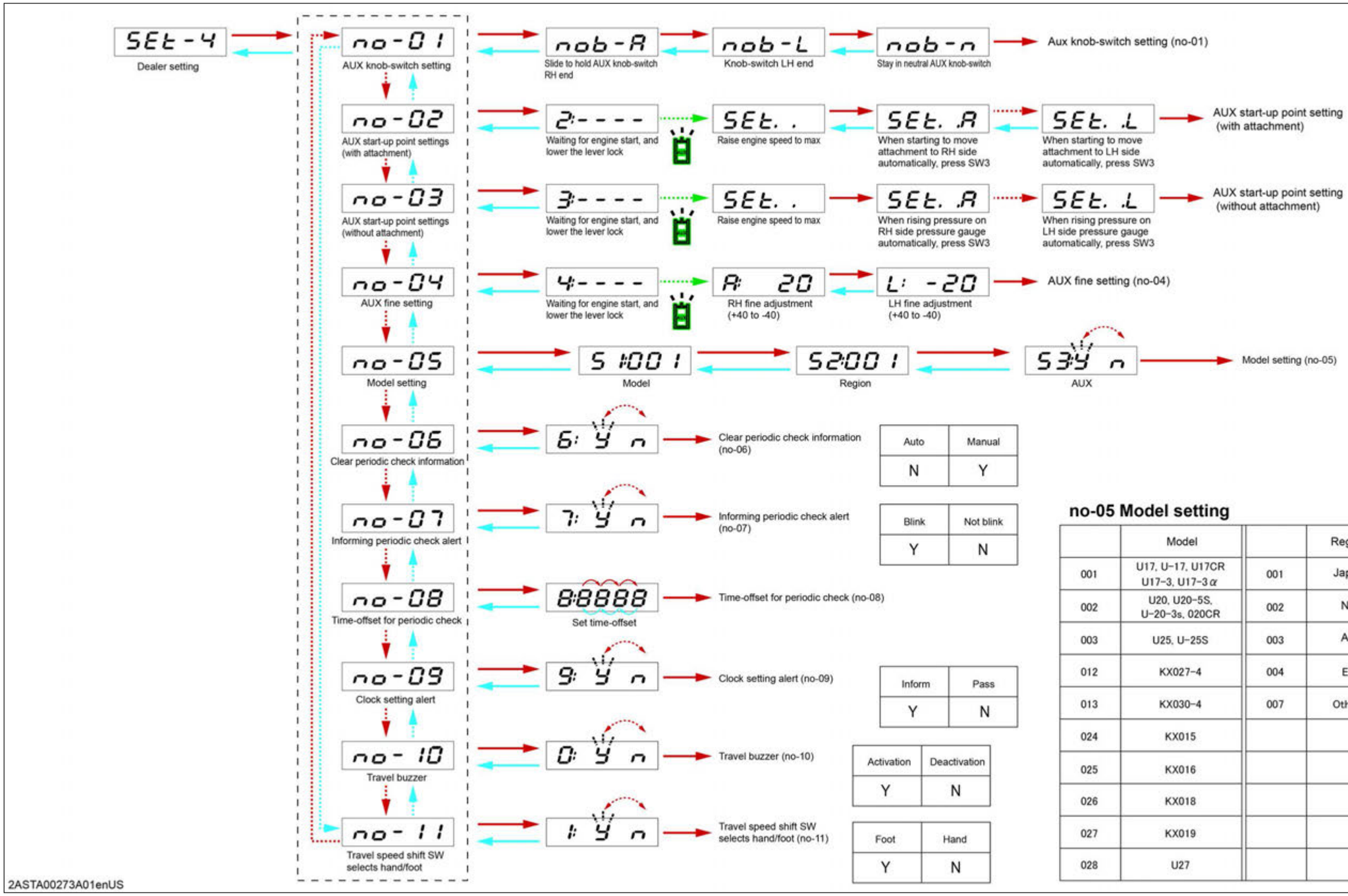
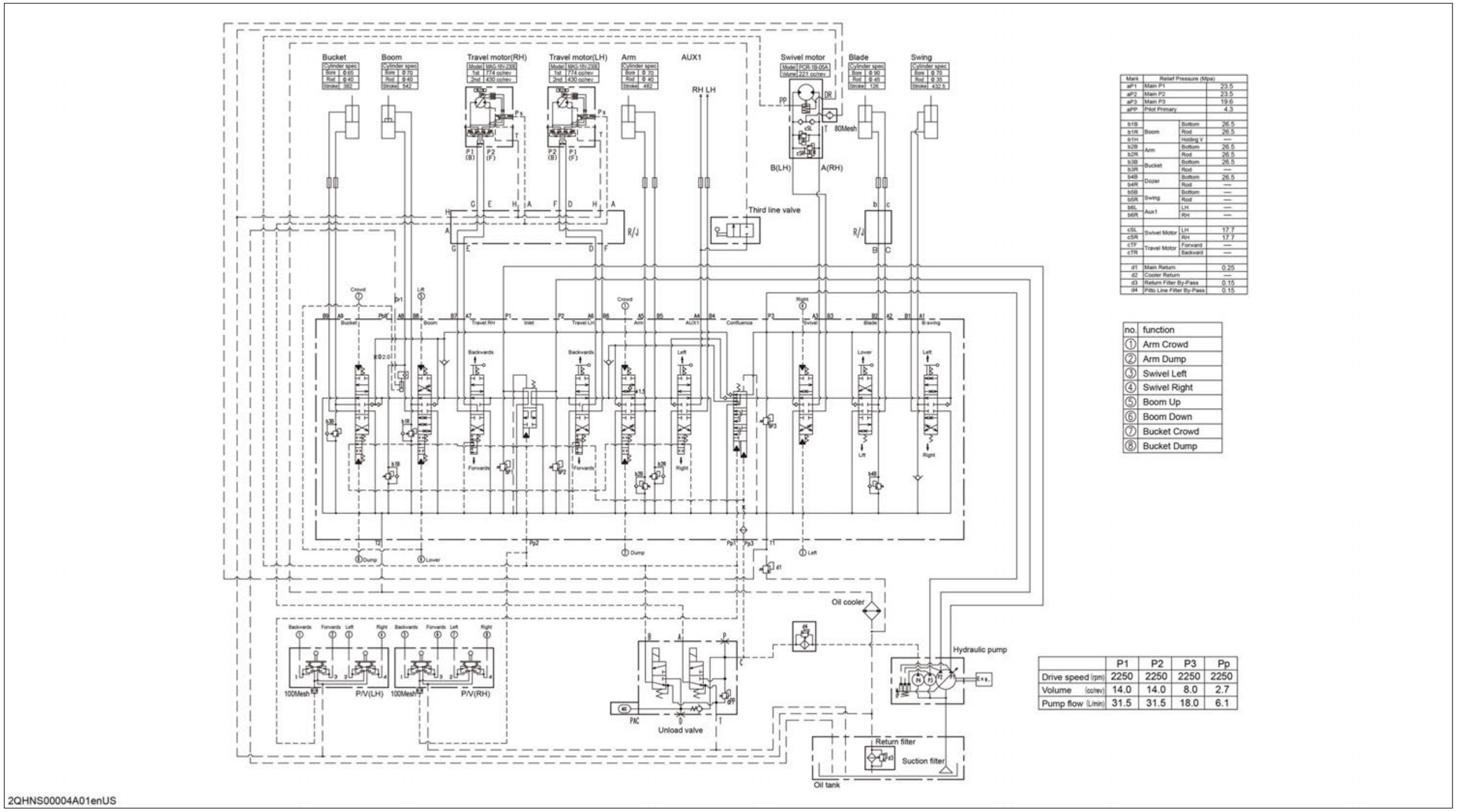


no-05 Model setting

	Model		Region		AUX
001	U17, U-17, U17CR U17-3, U17-3 α	001	Japan	Y	Proportional AUX (Kubota software control)
002	U20, U20-5S, U-20-3s, 020CR	002	NA	N	Other
003	U25, U-25S	003	AU		
012	KX027-4	004	EU		
013	KX030-4	007	Others		
024	KX015				
025	KX016				
026	KX018				
027	KX019				
028	U27				

3. Hydraulic circuit diagram

3.1 Hydraulic circuit diagram for basic specification

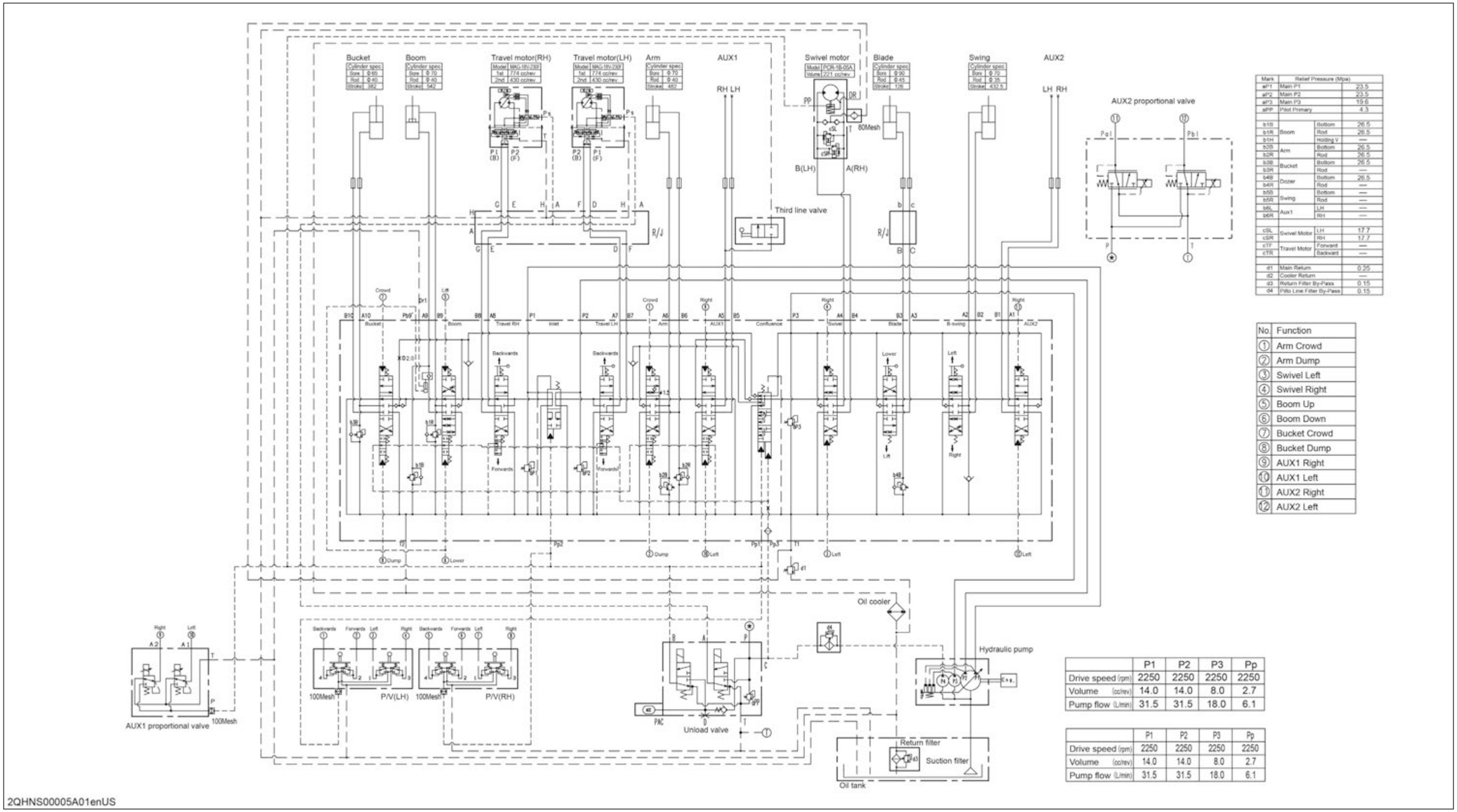


Mark	Relief Pressure (Mpa)		
aP1	Main P1		23.5
aP2	Main P2		23.5
aP3	Main P3		19.6
aPP	Pilot Primary		4.3
b1B	Boom	Bottom	26.5
b1R		Rod	26.5
b1H		Holding V.	—
b2B	Arm	Bottom	26.5
b2R		Rod	26.5
b3B	Bucket	Bottom	26.5
b3R		Rod	—
b4B	Dozer	Bottom	26.5
b4R		Rod	—
b5B	Swing	Bottom	—
b5R		Rod	—
b6L	Aux1	LH	—
b6R		RH	—
cSL	Swivel Motor	LH	17.7
cSR		RH	17.7
cTF	Travel Motor	Forward	—
cTR		Backward	—
d1	Main Return		0.25
d2	Cooler Return		—
d3	Return Filter By-Pass		0.15
d4	Pilto Line Filter By-Pass		0.15

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

	P1	P2	P3	Pp
Drive speed (rpm)	2250	2250	2250	2250
Volume (cc/rev)	14.0	14.0	8.0	2.7
Pump flow (L/min)	31.5	31.5	18.0	6.1

3.2 Hydraulic circuit diagram for Hi spec



Mark	Relief Pressure (Mpa)		
aP1	Main P1		23.5
aP2	Main P2		23.5
aP3	Main P3		19.6
aPP	Pilot Primary		4.3
b1B	Boom	Bottom	26.5
b1R		Rod	26.5
b1H		Holding V	—
b2B	Arm	Bottom	26.5
b2R		Rod	26.5
b3B	Bucket	Bottom	26.5
b3R		Rod	—
b4B	Dozer	Bottom	26.5
b4R		Rod	—
b5B	Swing	Bottom	—
b5R		Rod	—
b6L	Aux1	LH	—
b6R		RH	—
cSL	Swivel Motor	LH	17.7
cSR		RH	17.7
cTF	Travel Motor	Forward	—
cTR		Backward	—
d1	Main Return		0.25
d2	Cooler Return		—
d3	Return Filter By-Pass		0.15
d4	Pilto Line Filter By-Pass		0.15

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

	P1	P2	P3	Pp
Drive speed (rpm)	2250	2250	2250	2250
Volume (cc/rev)	14.0	14.0	8.0	2.7
Pump flow (L/min)	31.5	31.5	18.0	6.1

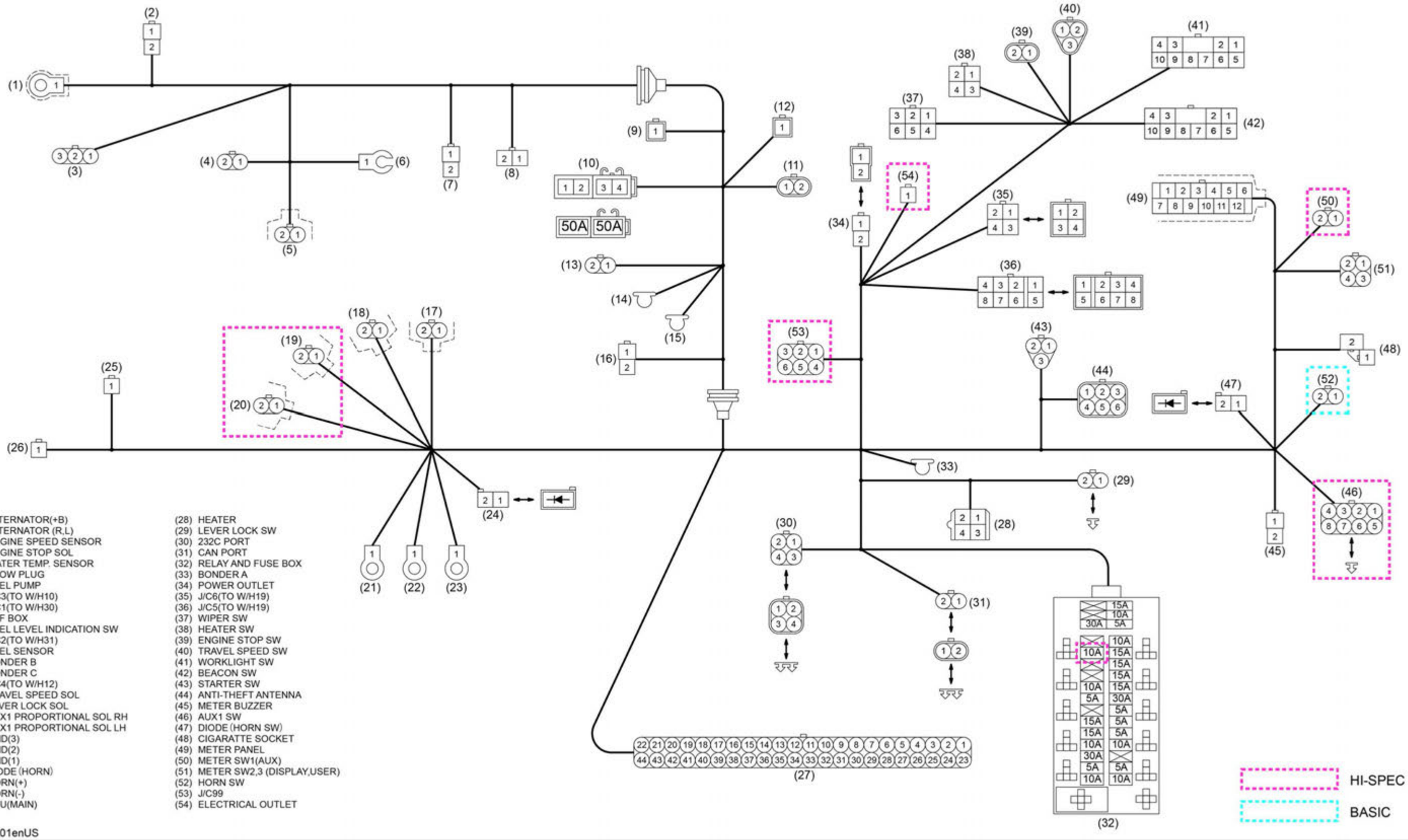
	P1	P2	P3	Pp
Drive speed (rpm)	2250	2250	2250	2250
Volume (cc/rev)	14.0	14.0	8.0	2.7
Pump flow (L/min)	31.5	31.5	18.0	6.1

2QHNS00005A01enUS

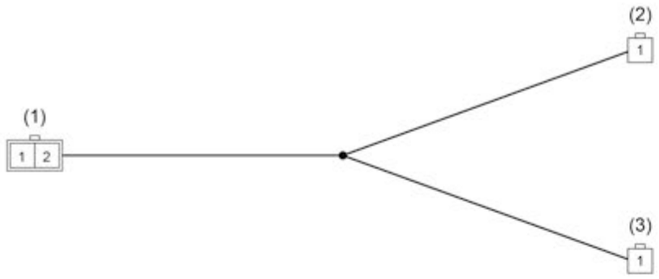
4. Wire harness

4.1 Wire harness

W/H00 (MAIN)

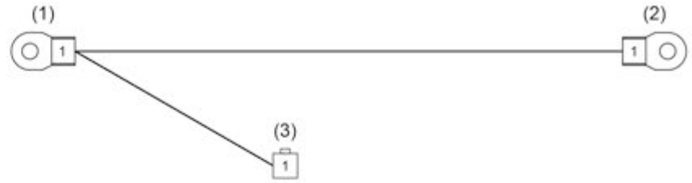


W/H10 (ENGINE)



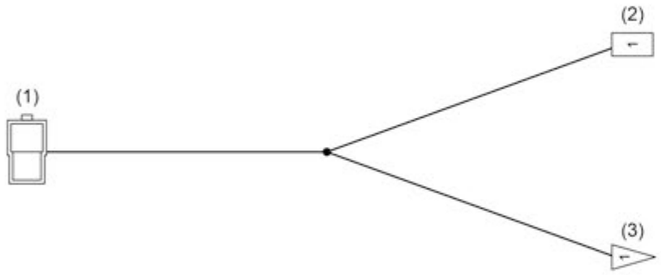
(1) J/C3(TO W/H00)
(2) ENGINE OIL PRESSURE SW
(3) STARTER

W/H31 CORD, BATTERY(2, +)



(1) BATTERY ISOLATER(2+)
(2) STARTER(+B)
(3) J/C2(TO W/H00)

W/H12 (FRONT)

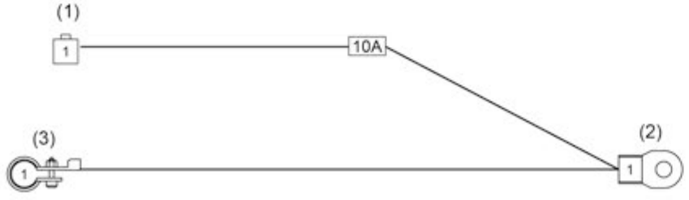


(1) J/C4(TO W/H10)
(2) WORKLIGHT(+)
(3) WORKLIGHT(-)

W/H33 CORD, BATTERY(-)

(1) BATTERY(-)
(2) GND(SWIVEL FRAME)

W/H30 CORD, BATTERY(1,+)



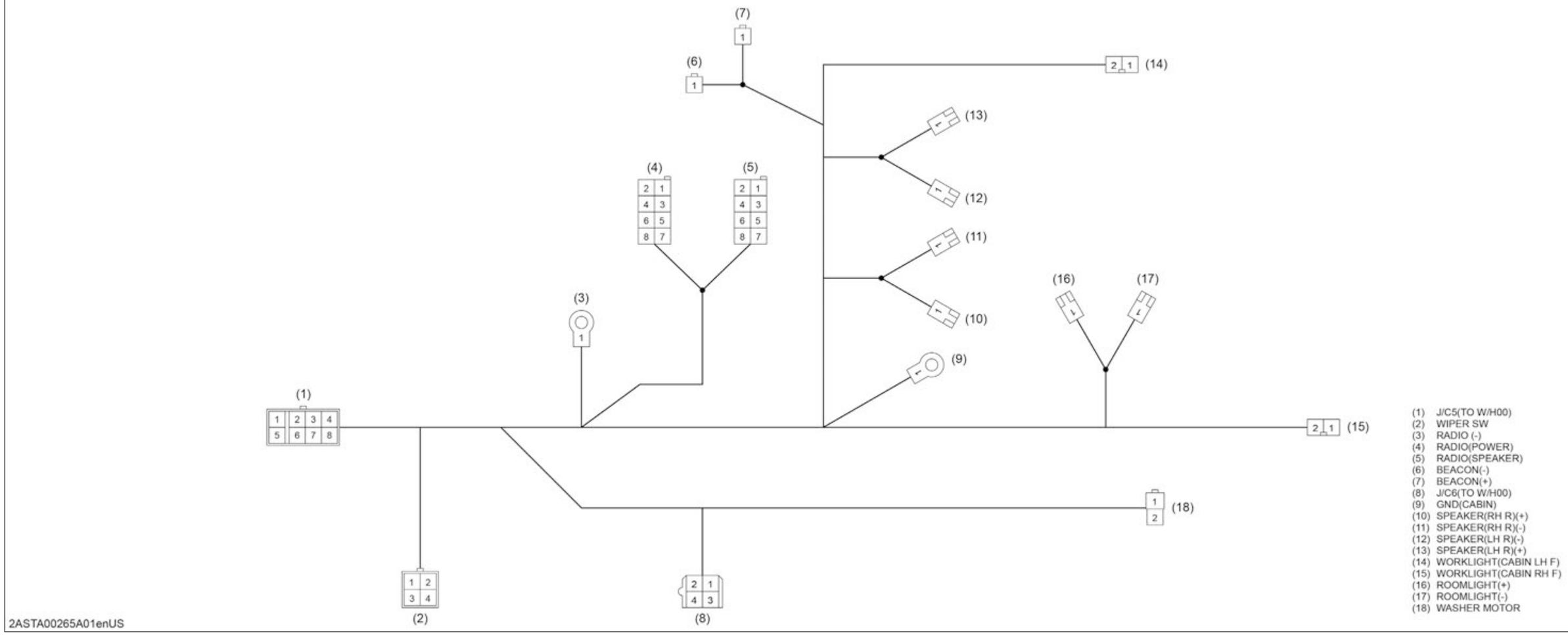
(1) J/C1 (TO W/H00)
(2) BATTERY_1+
(3) BATTERY_ISOLATER

2ASTA00264A01enUS

W/H34 CORD, BODYEARTH

(1) ENGINE(GND)
(2) GND(SWIVEL FRAME)

W/H19 (CABIN)



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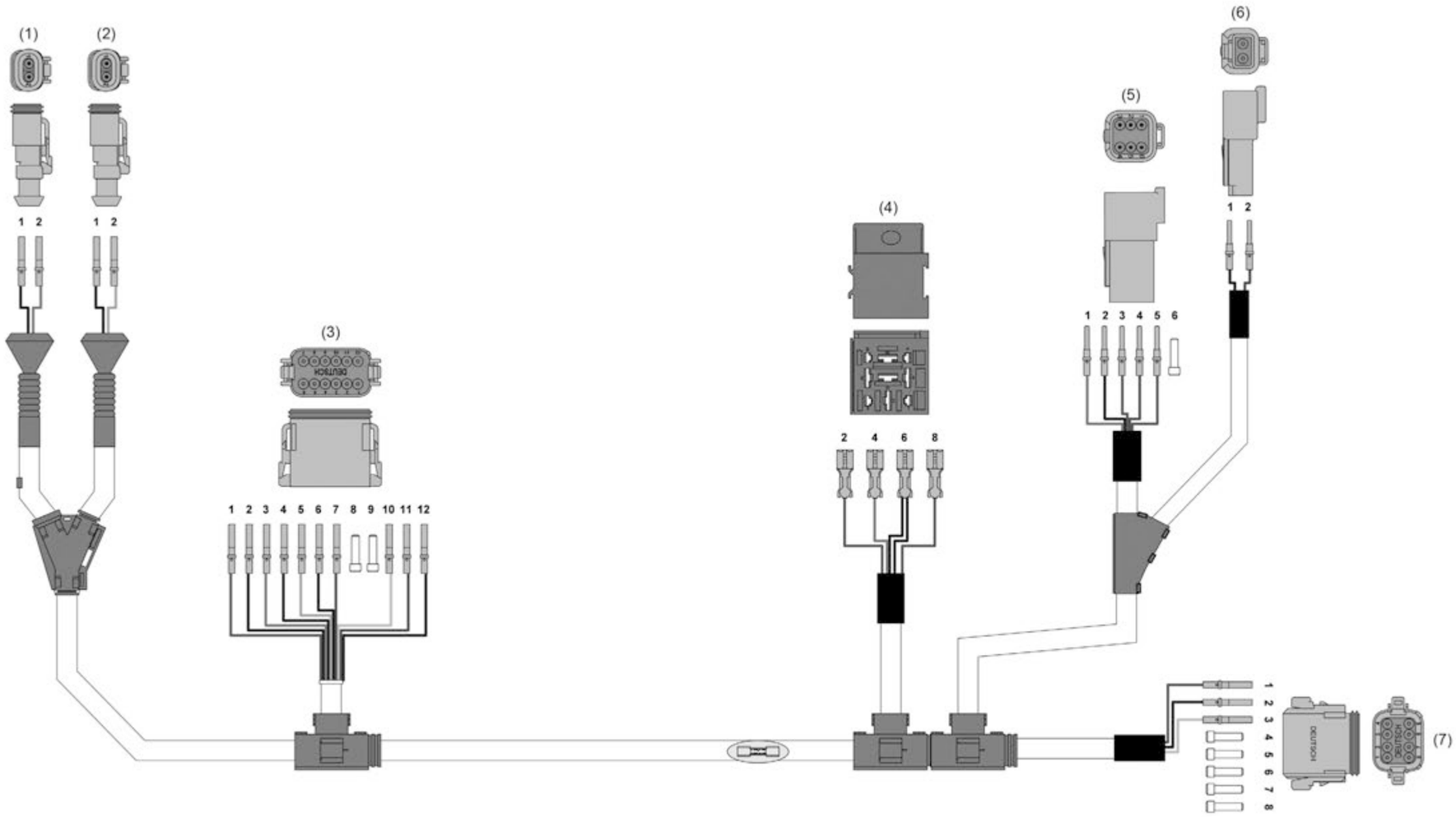
W/H (AUX2)



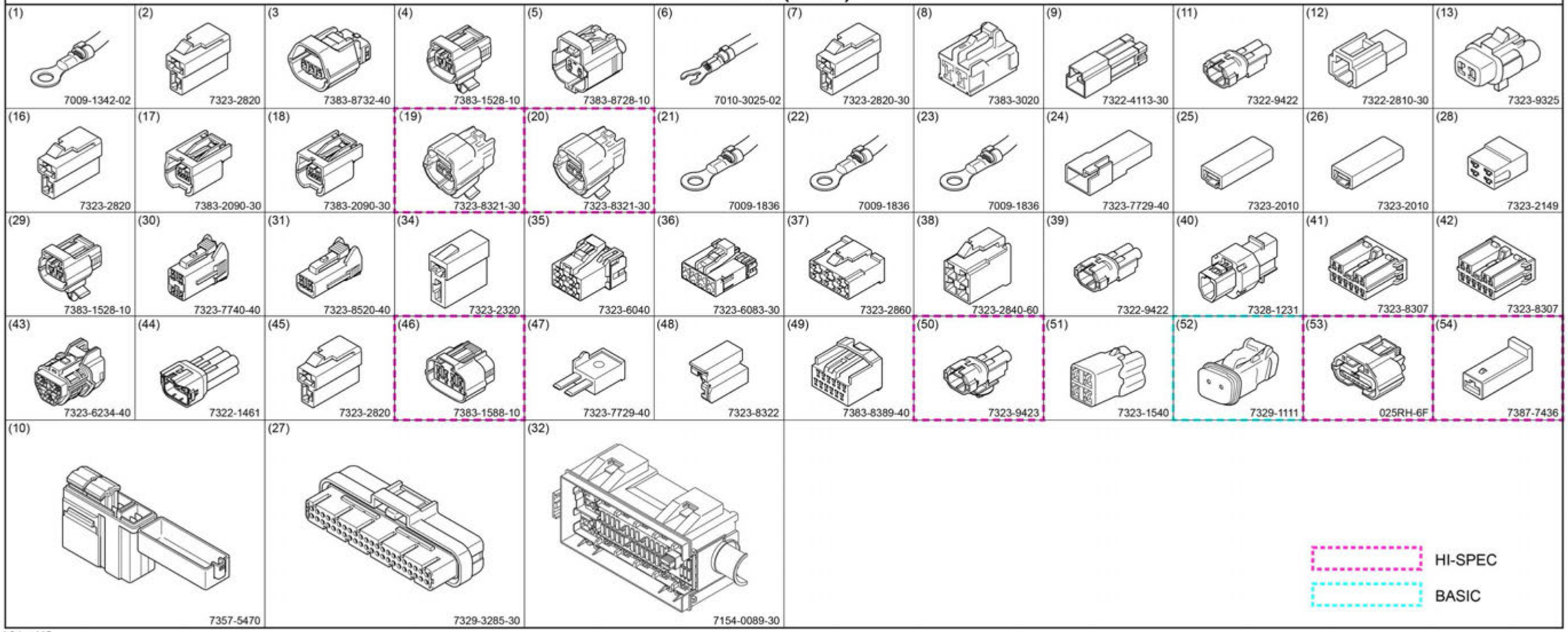
(1) AUX2 PROPOTIONAL SOL RH
(2) AUX2 PROPOTIONAL SOL LH
(3) ECU(AUX2)
(4) RELAY(AUX2)
(5) J/C99
(6) AUX2 DIAL
(7) J/C98

W/H (AUX2 KNOB SWITCH)

(7) J/C98
(8) AUX2 KNOB SWICH

2ASTA00266A01enUS

W/H00 (MAIN)



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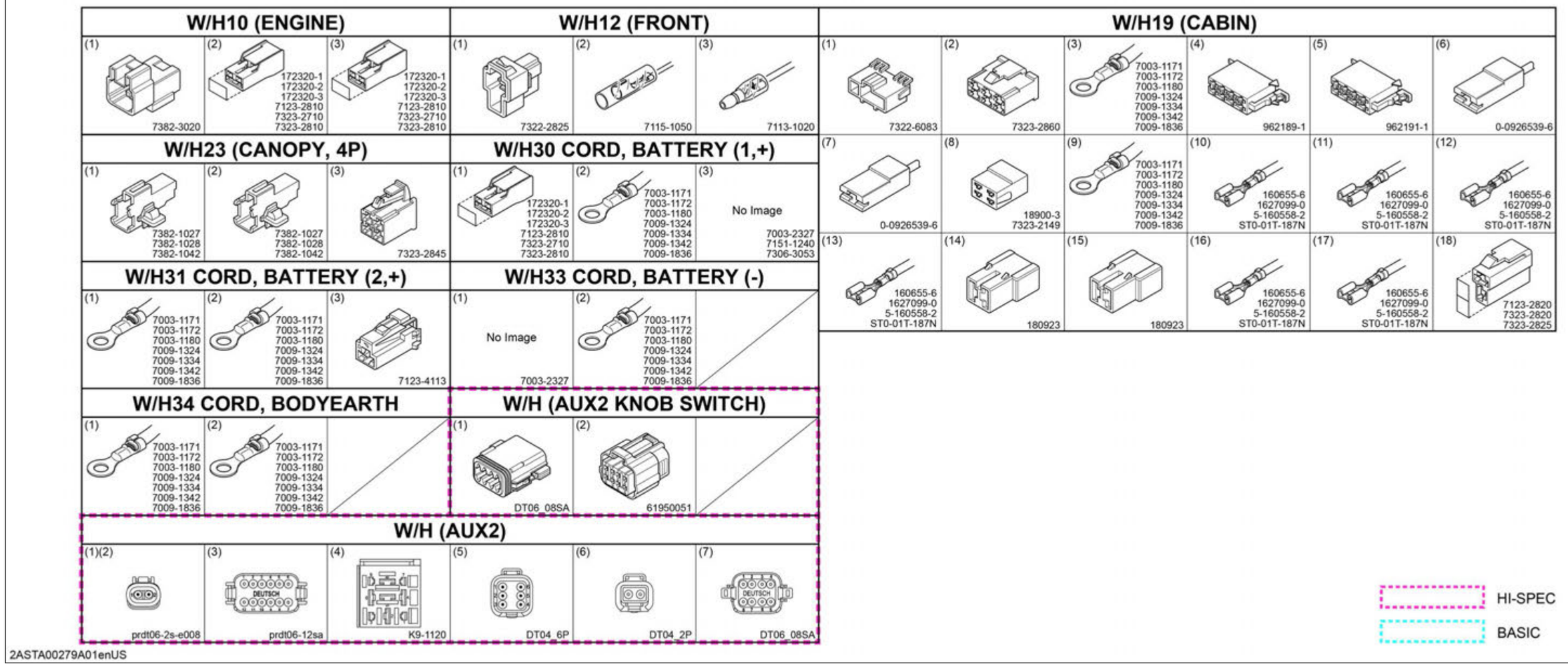
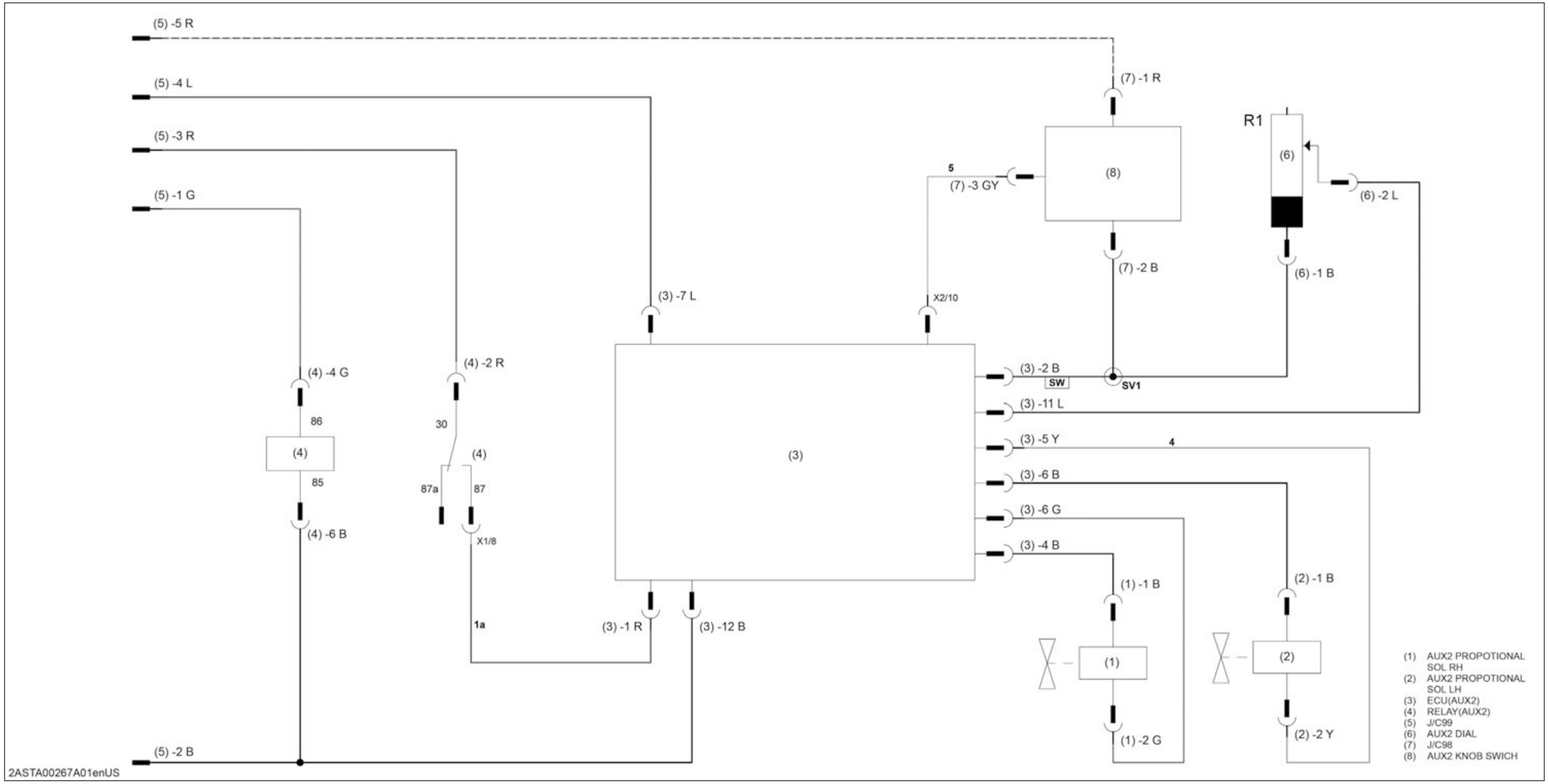

W/H10 (ENGINE)
(1) 7382-3020
(2) 172320-1 172320-2 172320-3 7123-2810 7323-2710 7323-2810
(3) 172320-1 172320-2 172320-3 7123-2810 7323-2710 7323-2810
W/H12 (FRONT)
(1) 7322-2825
(2) 7115-1050
(3) 7113-1020
W/H19 (CABIN)
(1) 7322-6083
(2) 7323-2860
(3) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
(4) 962189-1
(5) 962191-1
(6) 0-0926539-6
(7) 0-0926539-6
(8) 18900-3 7323-2149
(9) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
(10) 160655-6 1627099-0 5-160558-2 ST0-01T-187N
(11) 160655-6 1627099-0 5-160558-2 ST0-01T-187N
(12) 160655-6 1627099-0 5-160558-2 ST0-01T-187N
(13) 160655-6 1627099-0 5-160558-2 ST0-01T-187N
(14) 180923
(15) 180923
(16) 160655-6 1627099-0 5-160558-2 ST0-01T-187N
(17) 160655-6 1627099-0 5-160558-2 ST0-01T-187N
(18) 7123-2820 7323-2820 7323-2825
W/H23 (CANOPY, 4P)
(1) 7382-1027 7382-1028 7382-1042
(2) 7382-1027 7382-1028 7382-1042
(3) 7323-2845
W/H30 CORD, BATTERY (1,+)
(1) 172320-1 172320-2 172320-3 7123-2810 7323-2710 7323-2810
(2) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
(3) No Image 7003-2327 7151-1240 7306-3053
W/H31 CORD, BATTERY (2,+)
(1) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
(2) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
(3) 7123-4113
W/H33 CORD, BATTERY (-)
(1) No Image 7003-2327
(2) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
W/H34 CORD, BODYEARTH
(1) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
(2) 7003-1171 7003-1172 7003-1180 7009-1324 7009-1334 7009-1342 7009-1836
W/H (AUX2 KNOB SWITCH)
(1) DT06_08SA
(2) 61950051
W/H (AUX2)
(1)(2) prdt06-2s-e008
(3) prdt06-12sa
(4) K9-1120
(5) DT04_6P
(6) DT04_2P
(7) DT06_08SA
HI-SPEC
BASIC
2ASTA00279A01enUS

5. Electrical circuit diagram

5.1 Electrical circuit diagram for Hi-spec



W/H00	W/H(MAIN)
W/H10	W/H(ENGINE)
W/H12	W/H(FRONT)
W/H19	W/H(CABIN)
W/H30	BATTERY(1,+)
W/H31	BATTERY(2,+)
W/H33	CORD,BATTERY(-)
W/H34	CORD,BODY EARTH

Composition Specification Code	Notes
BASE	All use
AT	Anti-Theft
BI	Battery isolator
ES	Engine stop SW
BCN	Beacon
HT	Heater
AUX1	AUX1 SW
HS	Horn SW (Right grip)
CAB	Cabin specification
CNP	Canopy specification
N_AB	Not Angle blade
FUV	Fuel sensor-V
NIS	NISHINA SOLENOID
NCRSV	No.CRSV
CANV	CAN(V15)
V15	V1505-E4 Engine
AUX2	AUX2

ELECTRICAL CIRCUIT DIAGRAM (KX030-4)

INDEX

A

abbreviation..... xiii
acid burn
  preventing..... 1-4
air cleaner element
  checking.....2-39
  cleaning.....2-39
  replacing..... 2-46
air filter
  checking.....2-39
  cleaning.....2-39
  replacing..... 2-46
alternator
  checking.....2-49
  installing.....4-21
anti-cavitation function..... 5-27
arm.....3-5,3-23
  dimension.....3-5
  removing..... 3-23
arm cylinder
  component..... 5-131
arm cylinder speed
  measuring..... 5-56
automatic deceleration.....5-25
AUX
  P-Q performance..... 8-8
AUX control on Hi-spec
  general description.....6-17
AUX control pedal
  installing.....3-36
AUX flow rate
  measuring..... 5-65
AUX flow rate setting mode
  operating.....6-21
AUX1 converge circuit..... 5-16
AUX1 proportional valve
  assembling.....5-158
  disassembling..... 5-158
  installing.....5-157
  installing adapter layout..... 5-159
  performance diagram.....5-45
  removing..... 5-157
  specification..... 5-43
AUX2 proportional valve
  assembling.....5-158
  disassembling..... 5-158
  installing.....5-157
  installing adapter layout..... 5-159
  removing..... 5-157
  specification..... 5-45

B

battery
  checking.....2-34
  handling..... 2-4
  removing.....2-10
black key
  registering..... 6-55
blade.....3-9,3-25
  dimension.....3-9
  removing..... 3-25
blade control lever
  installing.....3-33
blade cylinder
  component..... 5-131
blade cylinder speed
  measuring..... 5-56
blower..... 7-2
blower motor
  checking.....7-5
bolt and nut
  tightening..... 2-3
boom.....3-8,3-24
  dimension.....3-8
  removing..... 3-24
boom cylinder
  component..... 5-130
boom cylinder speed
  measuring..... 5-55
boom lock valve..... 5-15
bucket..... 3-3,3-22
  dimension.....3-3
  removing..... 3-22
bucket and bucket linkage
  greasing..... 2-31
bucket cylinder
  component..... 5-131
bucket cylinder speed
  measuring..... 5-56
bus
  description.....6-3

C

cabin..... 3-28
  installing.....3-28
  removing.....3-28
canopy..... 3-27
  installing.....3-27
  removing.....3-27
carrier roller
  dimension.....3-11
  installing.....3-48
  removing.....3-48

circlip
installing 2-2
clock setting mode
operating..... 6-21
communication port
layout..... 6-16
composite terminal..... 6-3
connector..... 6-13
diagram description..... 6-13
handling..... 2-6
handling precaution..... 6-13
control valve..... 5-7,5-88
arm section..... 5-95
assembling..... 5-98
AUX1 section..... 5-94
AUX2 section (hi-spec only)..... 5-91
boom lock section..... 5-97
boom section..... 5-97
bucket section..... 5-98
component..... 5-91
components..... 5-91
confluence valve section..... 5-93
disassembling..... 5-98
function..... 5-12
hydraulic circuit..... 5-10
inlet section..... 5-96
installing..... 5-88
installing adapter layout..... 5-99
removing..... 5-88
specification..... 5-7
spool shift performance..... 5-11
structure..... 5-12
swing section..... 5-92
section..... 5-92
swivel section..... 5-93
travel LH section..... 5-95
travel RH section..... 5-96
coolant
replacing..... 2-53
coolant level
checking..... 2-29
counterbalance valve..... 5-29
counterweight..... 3-26
installing..... 3-26
removing..... 3-26
cylinder internal leakage
measuring..... 5-58

D

default setting..... 8-12
description..... 6-3
display mode..... 6-19
dust valve
cleaning..... 2-29

E

E:001 CAN communication error
handling..... 6-35
E:005 high coolant temperature
handling..... 6-36
E:014 engine oil pressure error
handling..... 6-37
E:015 engine overheating
handling..... 6-38
E:016 battery charging error
handling..... 6-39
E:017 fuel sensor error
handling..... 6-40
E:018 water temperature sensor error
handling..... 6-41
E:020 lever lock solenoid error
handling..... 6-42
E:021 travel speed shift system error
handling..... 6-43
E:022 AUX1 knob switch error
handling..... 6-45
E:023 AUX1 RH solenoid error
handling..... 6-46
E:024 AUX1 LH solenoid error
handling..... 6-47
E:025 battery overcharging
handling..... 6-49
E:026 anti-theft antenna error
handling..... 6-49
E:027 5 V short
handling..... 6-50
E:028 12 V error
handling..... 6-51
elbow with male seat
installing..... 2-3
electrical circuit diagram
accessory -1..... 6-9
accessory -2..... 6-10
cabin..... 6-11
communication..... 6-8
description..... 6-1
engine..... 6-12
Hi-spec..... 8-26
main ECU input -1..... 6-5
main ECU input -2..... 6-6
main ECU output..... 6-7
power supply..... 6-4
unit symbol..... 6-1
electrical device
layout..... 6-14
electrical equipment
checking..... 2-33
electrical wiring
clamp..... 6-2
color coding..... 6-2
handling..... 2-4

engine
dimension....4-5
installing....4-17
performance curve....4-6
removing....4-17
service specification....4-11,8-12
specification....4-3
troubleshooting....4-9
engine compression pressure
measuring....4-11
engine device
layout....4-1
engine mount
installing....4-19
engine oil
replacing....2-42
engine oil filter
replacing....2-42
engine oil level
checking....2-29
engine oil pressure
measuring....4-11
error warning
table....6-27
exhaust system leakage
checking....2-31

F

fan belt
adjusting....2-41
checking....2-30
fan switch
checking....7-4
fire
preventing....1-4
floating seal
replacing....2-2
front attachment horizontal play
measuring....3-19
front idler....3-10,3-41
assembling....3-43
component....3-42
dimension....3-10
disassembling....3-42
removing....3-41
replacing the engine oil....2-48
fuel filter
replacing....2-43
fuel hose....4-12
routing....4-14
fuel injection pump
checking....2-51
fuel level
checking....2-33
fuel line
checking....2-40
replacing....2-53
fuel tank....4-12
draining....2-33
installing....4-12
removing....4-12
fuse
handling....2-6
fuse and relay
layout....6-16

G

general working precaution....2-1
grease cylinder....3-45
removing....3-45

H

heater core....7-2
heater device
layout....7-1
heater hose
routing....7-7
heater system
general description....7-1
heater unit
installing....7-5
removing....7-5
specification....7-1
heater valve....7-2
horsepower control....5-6
hydraulic circuit diagram
basic specification....8-18
Hi spec....8-19
hydraulic cylinder....5-33,5-130
assembling....5-133
bleeding air....2-10
cushioning....5-34
disassembling....5-131
function and structure....5-34
measuring....5-136
specification....5-33
hydraulic cylinder bending
measuring....5-136
hydraulic cylinder rod and head clearance
measuring....5-136
hydraulic cylinder tube and piston wear ring clearance
measuring....5-137
hydraulic device
layout....5-1
hydraulic hose....5-161
connecting....2-3
delivery hose routing (basic)....5-162
delivery hose routing (Hi-spec)....5-164
drain hose routing....5-169
front hose routing....5-166
length description....5-161
metal fitting....5-161
pilot hose routing (basic)....5-171
pilot hose routing (hi-spec)....5-173

replacing..... 2-54
travel and blade hose routing.....5-168
hydraulic oil
replacing..... 2-45
hydraulic oil level
checking.....2-31
hydraulic pump..... 5-2,5-76
component..... 5-78
function and structure..... 5-5
hydraulic circuit..... 5-3
installing.....5-76
installing adapter layout..... 5-86
maintenance standard..... 5-88
removing..... 5-76
specification..... 5-2
hydraulic pump coupling
installing.....5-87
hydraulic system
service specification.....5-53,8-3
hydraulic tank
vacuuming.....2-9
hydraulic troubleshooting
front attachment.....5-49
swivel..... 5-51
traveling..... 5-52

I

identification
engine model..... 2-17
machine model.....2-17
in-line filter
replacing..... 2-44
information
safety labels..... 1-5
injection nozzle
checking.....2-47
intake air line
checking.....2-40
replacing..... 2-53

J

jacking up the machine.....2-11

L

lamp warning
list.....6-28
lever and pedal
measuring..... 3-21
operating force.....3-21
lever lock
installing.....3-29
removing..... 3-29
lubricant quantity.....2-27

M

machine
dimension.....2-21
high pressure washer.....2-7
washing.....2-7
machine body
service specification.....3-17,8-1
machine device
layout..... 3-1
main relief valve pressure
measuring..... 5-70
maintenance
safety label.....1-9
maintenance interval
table..... 2-23
make-up circuit.....5-20
meter flow chart..... 8-15
meter panel.....6-18
function..... 6-18
muffler
installing.....4-20
removing..... 4-20

N

No-01 (AUX knob switch setting)
operating.....6-31
No-02 (AUX start-up point setting (w/ attachment))
operating.....6-31
No-03 (AUX start-up point setting (w/o attachment))
operating.....6-32
No-04 (AUX start-up point fine adjustment)
operating.....6-32
No-06 (clearing periodic check alert)
operating.....6-33
No-07 (informing periodic check alert)
operating.....6-33
No-08 (time offset for periodic check)
operating.....6-33
No-09 (clock setting alert)
operating.....6-34
normal mode
operating.....6-19

O

O-ring
replacing..... 2-1
oil cooler
checking.....2-30
oil seal
replacing..... 2-1
other greasing point
greasing..... 2-32
overload relief valve
measuring..... 5-71

P

periodic check mode
operating....6-19
pilot control valve....5-37,5-137
component....5-139
function and structure....5-39
installing....5-137
installing adapter layout....5-149
performance diagram....5-39
removing....5-137
specification....5-37
pilot control valve (basic)
assembling....5-142
disassembling....5-139
pilot control valve (hi-spec)
assembling....5-146
disassembling....5-144
pilot filter
replacing....2-47
pilot primary pressure
measuring....5-75
pilot secondary pressure
measuring....5-76
pilot valve linkage
greasing....2-41
pin, bushing, and shim
dimension....3-12
piston pump
assembling....5-81
disassembling....5-79
P-Q performance....5-4,8-7
working principle....5-5
piston pump P-Q performance
measuring....5-62
preparing for emergency....1-2
proportional valve....5-43,5-157
function and structure....5-46
working principle....5-46

Q

quick hose coupling
connecting....2-4
disconnecting....2-4

R

radiator
checking....2-30
installing....4-20
radiator hose and clamp
checking....2-40
radiator hose and hose clamp
replacing....2-52
recommended lubricants....2-28
residual pressure of hydraulic circuit
releasing....2-9
return filter
replacing....2-44
revision history....i
rubber track....3-10,3-40
dimension....3-10
installing....3-40
removing....3-40

S

safety first....1-1
safety inspection....2-51
safety label
placement....1-5
service dealer mode
entering....6-29
table....6-23
SET-1 (tester)
operating....6-29
SET-2 (Reading error history)
operating....6-30
SET-3 (Clearing error history)
operating....6-30
SET-4 (dealer setting)
default setting....6-34
No-05 (model setting)....6-32
No-10 (travel buzzer function)....6-34
No-11 (travel speed shift switch)....6-34
operating....6-30-6-34
SET-5 (reading all error history)
operating....6-34
shockless function....5-19
slow blow fuse
layout....6-16
special jig and tool
engine compression pressure measuring kit....4-22
overload relief valve measuring kit....5-176
universal joint tightening jig....5-180
special jigs and tool
travel motor special jigs and tool....5-177
specification....2-19
spring pin
installing....2-2
sprocket
dimension....3-10
starter motor
checking....2-50
starting the machine safely....1-3
steel track....3-9,3-37
dimension....3-9
installing....3-37
removing....3-37
straight traveling circuit....5-12
suction filter
replacing....2-45
swing bracket
greasing....2-32

swing bracket vertical clearance
measuring....3-21
swing control pedal
installing....3-34
swing cylinder
component....5-131
swing cylinder speed
measuring....5-57
swivel bearing....3-37
greasing....2-39
installing....3-37
swivel bearing vertical play
measuring....3-20
swivel gear
greasing....2-36
swivel joint....5-35,5-154
installing....5-154
installing adapter layout....5-156
removing....5-154
specification....5-35
swivel motor....5-17,5-102
assembling....5-106
component....5-103
disassembling....5-103
installing....5-102
installing adapter layout....5-112
parking brake....5-20
removing....5-102
specification....5-17
working principle....5-19
swivel motor drain
measuring....5-73
swivel motor internal leakage
measuring....5-59
swivel motor overload relief valve pressure
measuring....5-72
swivel speed
measuring....5-57

T

tension spring....3-44
installing....3-44
removing....3-44
tester mode....8-12
third line valve....5-47,5-160
component....5-160
installing....5-160
installing adapter layout....5-160
removing....5-160
specification....5-47
thread lock
applying....2-3
thread seal tape
wrapping....2-1
tightening torque
adapter (taper thread)....2-15
bolt and nut....2-13
hose clamp....2-15
hydraulic hose (taper thread)....2-14
hydraulic hose fitting....2-14
locknut of adapter with O-ring (straight thread)..2-14
stud bolt....2-13
to the reader....3
track roller....3-11,3-45
assembling....3-47
component....3-47
dimension....3-11
disassembling....3-47
installing....3-45
removing....3-45
replacing the engine oil....2-48
track tension
adjusting....2-37
checking....2-36
travel control lever....3-31
installing....3-31
travel motor....5-21,5-113
assembling....5-121
component....5-115
decelerator....5-32
disassembling....5-117
function and structure....5-24
installing....5-113
removing....5-113
specification....5-21
working principle....5-24
travel motor drain
measuring....5-74
travel motor gear oil
replacing....2-43
travel motor internal leakage
measuring....5-59
travel speed
measuring....5-57
travel straightness
testing....5-60
troubleshooting
electrical....6-25
heater system....7-3

U

unload valve....5-41,5-151
assembling....5-151
component....5-151
disassembling....5-151
function and structure....5-42
installing adapter layout....5-153
specification....5-41
working principle....5-42
user setting
operating....6-19

W

walk-around inspection....2-29

washer liquid level
checking....2-33
waste fluid
discarding....1-4
water separator
checking....2-31
cleaning....2-38
wire harness....8-20
working caution....1-2
working precaution....1-1

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