INTRODUCTION

- Most accident happens due to the disregard of basic safety rules or precautions. In order to prevent accidents from happening, the factors responsible for accidents must be avoided beforehand.
  For this reason, please read this manual and fully understand the precautions for safety and the proper procedures and directions for inspection and maintenance before starting operation.

  Performing maintenance and repair without adequate knowledge may cause inadvertent accidents.

- It is not possible to cover all the possible cases of accidents in this "WORKSHOP MANUAL". Therefore, attention should be given to precautions other than the ones mentioned in this "WORKSHOP MANUAL". Especially, when repair and maintenance work which are not covered in this "WORKSHOP MANUAL" are carried out, always work under the direction of an instructor who understands the matter.

[Control System Transition]

Model	IGBT Control	FET Control	CAN-BUS Control
FB10P~18P	~221AE1250	221AE1251~	221AE3656~
FB20P~28P	~241AC4968	241AC4969~	241AC6266~
FB30P	~251AC0880	-	251AC0881~

- Please note that the contents of the explanation in this manual are different according to each control system.
  Please refer to the applicable explanations.

■ Using this "WORKSHOP MANUAL"

This manual has information about the layout and names of main components, procedures for disassembly, assembly, inspection, adjustment, maintenance, and hints for troubleshooting which are in effect mainly for the model FB-75 series.

Since the parts used in this machine are subject to change for the sake of better quality, performance enhancement and safety, some portions of the contents and illustrations of this "WORKSHOP MANUAL" may not be identical.

Directions with ⚠ and ☞ marks are very important, must be followed.

	**DANGER**	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. You must follow this instruction.
	WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. You must follow this instruction.
	CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. You must follow this instruction.
	**NOTE**	Indicates suggestions, tips and hints related to the safety of a operator and maintain of truck.

1. Personnel this "WORKSHOP MANUAL" is aimed at:

This "WORKSHOP MANUAL" is directed at personnel who possess sufficient knowledge and technical expertise. If you do not understand any of the contents of this "WORKSHOP MANUAL", perform operation under the guidance of personnel who does.

2. Conditions of a facility

The work conditions described in the "WORKSHOP MANUAL" are written on the assumption that the work is performed at standard work facilities and tools for the maintenance of NICHIYU electric lift trucks are available.

For safe and reliable maintenance, the work should be performed at a shop which is equivalent to these described in this "WORKSHOP MANUAL" with following all instructions strictly.

CONTENTS

SAFETY WORK 1

1. Precautions for safe inspection and maintenance work ····· 1
2. Safety labels ····· 5
3. Model name and serial numbers ····· 9
4. Cautions for maintenance ····· 11
5. Tightening torque for bolts ····· 14
6. Data of LOCTITE and THREEBOND products ····· 15

1. GENERAL 16

1-1. Appearance ····· 16
1-2. Specifications ····· 17

2. FRONT AXLE (DRIVE) 19

2-1. Location and name ····· 19
2-2. Disassembly and reassembly ····· 20
2-2-1. Front axle - removal and installation 20
2-2-2. Front axle - disassembly and reassembly 26
2-3. Inspection and adjustment ····· 34
2-3-1. Gears - Inspection and replacement 34
2-3-2. Wheel hub and hub bolt - Inspection 34
2-4. Troubleshooting ····· 35
2-4-1. Front axle - troubleshooting 35

3. REAR AXLE (STEERING) 36

3-1. Location and name ····· 36
3-2. Disassembly and reassembly ····· 37
3-2-1. Rear axle - removal and installation 37
3-2-2. Rear axle - disassembly and reassembly 39
3-2-3. Rear axle - Reassembling method and attention 41
3-3. Inspection and adjustment ····· 44
3-3-1. Bushing - inspection 44
3-3-2. Center arm - inspection 44
3-3-3. Tie rod Comp. - inspection 44
3-3-4. Knuckle - inspection 44
3-3-5. King pin - inspection 45
3-3-6. Hub and hub bolt - inspection 45
3-3-7. Rear axle Comp. - inspection 45
3-4. Troubleshooting ····· 46
3-4-1. Rear axle - troubleshooting 46

4. TYRE 47

4-1. Location, name and tyre size ····· 47
4-1-1. Tyre - location and name 47
4-1-2. Tyre size 48
4-2. Inspection and adjustment ····· 49
4-2-1. Hub nut - inspection 49
4-2-2. Rim and rim bolt - inspection 49
4-2-3. Air pressure - inspection 50
4-2-4. Tyre - visual inspection and replacement 50
4-3. Troubleshooting ····· 51
4-3-1. Tyre - troubleshooting 51

5. STEERING 52

5-1. Location and name ····· 52
5-2. Disassembly and reassembly ····· 53
5-2-1. Steering linkage - removal and installation 53
5-2-2. Steering linkage - disassembly and reassembly 55
5-3. Inspection and adjustment ····· 57
5-3-1. Joint - inspection and replacement 57
5-3-2. Knob - inspection and replacement 57
5-3-3. Steering wheel - inspection and replacement 57
5-3-4. Torque sensor neutral - check and adjustment 58
5-3-5. Checking by voltage 60
5-3-6. Actuator ass'y - inspection and adjustment 61
5-4. Troubleshooting ····· 62
5-4-1. Steering linkage - troubleshooting 62

6. BRAKE 63

6-1. Location and name ····· 63
- 6-1-1. Foot brake linkage - main part names 63
- 6-1-2. Parking brake linkage - main part names 64

6-2. Disassembly and reassembly ····· 65
- 6-2-1. Wheel brake - removal and installation 65
- 6-2-2. Wheel brake - disassembly and reassembly 68

6-3. Inspection and adjustment ····· 69
- 6-3-1. Brake drum - inspection, repair and replacement 69
- 6-3-2. Shoe & lining - inspection and replacement 69
- 6-3-3. Adjustor ass'y - inspection and replacement 70
- 6-3-4. Wheel cylinder ass'y - inspection and replacement 70
- 6-3-5. Master cylinder ass'y - inspection and replacement 71
- 6-3-6. Brake pedal - inspection 71
- 6-3-7. Parking lever - inspection and adjustment 72
- 6-3-8. Brake linkage - adjustment 72
- 6-3-9. Brake air bleeding 74

6-4. Troubleshooting ····· 76
- 6-4-1. Brake - troubleshooting 76

7. HYDRAULIC SYSTEM 77

7-1. Oil pipimng circuit ····· 77

7a. HYDRAULIC PUMP 78

7a-1. Location and name ····· 78

7a-2. Disassembly and reassembly ····· 79
- 7a-2-1. Hydraulic pump - removal and installation 79

7a-3. Inspection and adjustment ····· 80
- 7a-3-1. Hydraulic pump - inspection 80

7a-4. Troubleshooting ····· 81
- 7a-4-1. Hydraulic pump - troubleshooting 81

7b. OIL TANK AND OIL PIPING 82

7b-1. Location and name ····· 82
- 7b-1-1. Plastic oil tank - main part names 82
- 7b-1-2. Iron oil tank - main part names 82

7b-2. Disassembly and reasembly ····· 83
- 7b-2-1. Oil tank - precautions 83
- 7b-2-2. Oil piping replacement - precautions 83

7b-3. Inspection and adjustment ····· 84
- 7b-3-1. Oil - inspection 84
- 7b-3-2. Recommended oil and quantity 84
- 7b-3-3. Oil tank and filters - cleaning and check 85

7b-4. Troubleshooting ····· 85
- 7b-4-1. Oil tank - troubleshooting 85

7c. CONTROL VALVE 86

7c-1. Location and name ····· 86

7c-2. Disassembly and reassembly ····· 88
- 7c-2-1. Control valve - removal and installation 88
- 7c-2-2. Inner kit of control valve - replacement 91

7c-3. Inspection and adjustment ····· 92
- 7c-3-1. Relief pressure - measurement 92
- 7c-3-2. Microswitch - adjustment 93

7c-4. Troubleshooting ····· 94
- 7c-4-1. Control valve - troubleshooting 94

7d. CYLINDER 95

7d-1. Location and name ····· 95
- 7d-1-1. Lift cylinder - main part names 95
- 7d-1-2. Tilt cylinder - main part names 97

7d-2. Disassembly and reassembly ····· 98
- 7d-2-1. Lift cylinder - removal : P - mast (2 - stage simplex) 98
- 7d-2-2. Lift cylinder - removal : PFL-mast (2-stage duplex), M-mast (3-stage triplex) 100
- 7d-2-3. Tilt cylinder - removal 103
- 7d-2-4. Lift cylinder - installation and adjustment 104
- 7d-2-5. Tilt cylinder - installation 105
- 7d-2-6. Lift cylinder - disassembly and reassembly 106
- 7d-2-7. Tilt cylinder - disassembly and reassembly 116

7d-3. Inspection and adjustment ····· 117
- 7d-3-1. Cylinder comp. - inspection 117
- 7d-3-2. Piston rod - inspection 117
- 7d-3-3. Drift for lift and tilt - inspection 118

7d-4. Variation of the tilt cylinder ····· 119
- 7d-4-1. Tilt angle by masts 119

7d-5. Troubleshooting ····· 120
- 7d-5-1. Cylinder - troubleshooting 120

8. MAST 121

8-1. Location and name ····· 121
8-2. Disassembly and reassembly ····· 123
8-2-1. Lift bracket - removal 123
8-2-2. Mast ass'y - removal 123
8-2-3. Mast - disassembly and reassembly 125
8-3. Inspection and adjustment ····· 128
8-3-1. Mast, lift bracket and roller shaft - inspection 128
8-3-2. Back shoe - inspection 129
8-3-3. Lift chain - inspection and replacement 129
8-3-4. Chain bolt - inspection 130
8-3-5. Chain wheel - inspection 130
8-3-6. Hose pulley - inspection 131
8-3-7. Roller - inspection and replacement 131
8-3-8. Fork - inspection and replacement 132
8-3-9. Lift chain - inspection and adjustment 133
8-3-10. Mast lean- adjustment 134
8-4. Troubleshooting ····· 135
8-4-1. Mast · Lift bracket · Fork - troubleshooting 135

9. MOTOR 136

9-1. Location and name ····· 136
9-1-1. Traction motor - main part names 136
9-1-2. Hydraulic motor - main part names 137
9-1-3. EPS motor - main part names 137
9-1-4. Motors - specifications 138
9-2. Disassembly and reassembly ····· 139
9-2-1. Traction motor - removal and installation 139
9-2-2. Hydraulic motor - removal and installation 140
9-2-3. EPS motor - removal and installation 142
9-2-4. Traction motor - disassembly and reassembly 143
9-2-5. Hydraulic motor - disassembly and reassembly 144
9-2-6. EPS motor - disassembly and reassembly 144
9-3. Inspection and adjustment ····· 145
9-3-1. Rotor comp. - inspection and replacement (Traction and Hydraulic motor) 145
9-3-2. Armature comp. - inspection and replacement 146
9-3-3. Brush, Brush holder and Spring (EPS motor) - inspection and replacement 146
9-3-4. Motor ASS'Y (Traction/Hydraulic motor) - inspection 148
9-3-5. Motor ASS'Y (EPS motor) - inspection 149
9-3-6. Oil seal and permanent magnet (EPS motor) - inspection and replacement 150
9-4. Troubleshooting ····· 150
9-4-1. Motor - troubleshooting 150

10. ELECTRIC PARTS 151

10-1. Location and name ····· 151

10a. CONTROL UNIT 152

10a-1. Location and name ····· 152
10a-2. Disassembly and reassembly ····· 154
10a-2-1. Control unit - removal and installation 154
10a-2-2. Control unit - disassembly and reassembly 156
10a-3. Check and replacement ····· 160
10a-3-1. IGBT module - inspection and replacement 160
10a-3-2. FET module comp. - inspection and replacement 162
10a-3-3. Capacitor - inspection and replacement 163
10a-3-4. EPS controller - specifications 164

10b. DISPLAY PANEL AND DIRECTIONAL SWITCH 165

10b-1. Display panel - Disassembly and reassembly ····· 165
10b-1-1. Display panel - disassembly and reassembly 165
10b-2. Directional switch - Disassembly and reassembly ····· 167
10b-2-1. Display panel - disassembly and name 167
10b-2-2. Wiring of directional switch 168

10c. ACCELERATOR 169

10c-1. Disassembly and reassembly ····· 169
10c-1-1. Accelerator linkage - removal and installation 169
10c-2. Inspection and adjustment ····· 170
10c-2-1. Potentiometer - adjustment 170
10c-2-2. Accelerator linkage - adjustment 171

10d. MAIN CONTACTOR AND FUSE 172

10d-1. Disassembly and reassembly····· 172
10d-1-1. Control unit - removal and installation 172
10d-2. Inspection and replacement ····· 174
10d-2-1. Main contactor - inspection and replacement 174
10d-2-2. Fuse - replacement 174

10e. BUILT-IN CHARGER (OPTION) 175

10e-1. Disassembly and reassembly····· 175
10e-1-1. Charger ass'y - disassembly and reassembly 175
10e-1-2. Transformer - disassembly and reassembly 177
10e-1-3. Built-in charger - specification 178
10e-2. Inspection and replacement ····· 180
10e-2-1. Magnetic contactor - inspection 180
10e-2-2. Plug comp. and receptacle - inspection and replacement 180
10e-2-3. Fuse and fuse base - inspection 180
10e-2-4. Transformer - inspection 181
10e-2-5. Diode - inspection 181
10e-3. Inspection After Assembly ····· 182
10e-3-1. Timer - inspection 182
10e-3-2. Earth - inspection 183
10e-3-3. Reserve function - inspection 183
10e-4. Charging procedure····· 184
10e-4-1. Automatic charge (Daily charge) 184
10e-4-2. Reserve charge 188
10e-4-3. Balancing charge 197
10e-5. Voltage tap ····· 199
10e-5-1. Power supply voltage - check 199
10e-5-2. Voltage tap - selection 199
10e-5-3. Voltage tap - changing 200
10e-5-4. Fuse (three-phase voltage) - replacement 200

10f. BATTERY 201

10f-1. Disassembly and reassembly····· 201
10f-1-1. Battery - removal and installation 201
10f-2. Inspection and adjustment ····· 202
10f-2-1. Battery - inspection 202
10f-2-2. Battery - Cleaning 203

10g. MPU BOARD 204

10g-1. Location and name····· 204
10g-1-1. MPU board 204
10g-1-2. Display board 205
10g-1-3. EPS controller board (EPS / DSP board) 205

11. LASER POINTER (OPTION) 206

11-1. Adjustment····· 206
11-1-1. Fork level - adjustment 206
11-1-2. Laser optical axis - adjustment 206

12. SERVICE DATA 207

12-1. Annual Inspection Service Data ····· 207
12-2. Standard work hours ····· 208

SAFETY WORK

1. Precautions for safe inspection and maintenance work

Maintenance shops

⚠ CAUTION

ADEQUATE SPACE WITH FLAT SURFACE:

- The floor area of the shop (location) where inspection and maintenance are performed must have adequate floor space, and have level surfaces without holes.

➡ If these conditions are not met, unexpected accidents, such as a roll-over of the forklift truck, may result.

⚠ CAUTION

WELL-VENTILATED AREA

- Work such as welding painted components or sanding down coated parts should be carried out in well-ventilated areas.

➡ If this is not observed, harmful toxic gas or dust may be inhaled.

⚠ CAUTION

LOCATION EQUIPPED WITH FIRE EXTINGUISHING EQUIPMENT

- Equipment such as first-aid boxes and fire extinguishers should be nearby when work is performed.

⚠ CAUTION

SAFE AND WELL-LIGHTED AREA

- The work area should be safe and well lighted. When working inside the machine or underneath of it, always use a safety lamp with a shielded light bulb.

➡ If this is not observed, leaked oil may catch fire when a light bulb pops.

⚠ CAUTION

PROPER ARRANGEMENT

- Arrange and clean always at a working place to work safety.
- Especially, arrange disassembled parts well.

Work clothing

⚠ CAUTION

- The worker should wear a safety hat, work clothes, and safety shoes that are suitable for safe work. The work clothes should be close-fitting.

➡ If this is not observed, loose clothing may become caught in a machine, resulting in serious injury.

Tools and gauges

⚠ CAUTION

- Always use tools that are suitable for the work being performed. Use proper size tools when tightening and loosening the parts of the forklift truck.

➡ Failure to observe the above could result in serious injury or damage to machines.

⚠ CAUTION

Prepare tools and gauges before starting to work.

Safety work

⚠ WARNING

- When hoisting a forklift truck or a heavy component, use ropes or cable with correct capacity.
- Do not use ropes or cables which are kinked.

⚠ WARNING

- Do not lift the forklift truck by using other forklift. The bottom of the truck may be damaged by hitting the forks.

⚠ WARNING

After lifting or jacking up a forklift truck, support it with safety blocks or rigid stands.

⚠ WARNING

Apply wheel chocks to tyres to prevent the truck from moving.

⚠ WARNING

When working under a forklift truck, use a pit or proper safety precautions.

Parts

⚠ CAUTION

When replacing any parts, be sure to use NICHIYU genuine parts.

⚠ CAUTION

When replenishing battery electrolyte, be sure to use refined water.

Repair of electrical components

⚠ CAUTION

Be sure to disconnect the battery plug when replacing electrical component.
Do not pull the electric cable when disconnecting the battery plug.
Hold the battery plug and disconnect it.

⚠ CAUTION

Be sure to jack up the drive wheel when trouble shooting electrical operations.

NOTE

Record the places of lead wire connection when disassembling.

⚠ CAUTION

CHARGING BATTERY

- **Batteries produce flammable gas during charging. Do not allow batteries in the vicinity of fire or flames.**

➡ **Failure to observe the above could result in an explosion.**

⚠ CAUTION

- **Diluted sulfuric acid is used as the battery's electrolyte . Keep clothing and skin away from contact with battery fluid.**

➡ **If this is not observed, the fluid may corrode clothing or cause burns.**

Hydraulics

⚠ CAUTION

Before disconnecting hydraulic hoses, release internal oil pressure. To release the pressure, follow next procedures.

1. **Sit on the seat and turn on the key switch.**
2. **Push the lift lever forward to lower the fork on the ground.**
3. **Repeat pushing forward and releasing the lift lever a few times between lowering and neutral positions to release the internal pressure.**
4. **Do not pull the lift lever nor operate any other hydraulic levers. (If the hydraulic motor runs, high pressure is applied to all hydraulic circuits.)**
5. **You must sit on the seat and turn on the key switch to follow above steps 1, 2 and 3. Otherwise, the internal hydraulic pressure is not released because of the OIS. (Operation Interlock System)**

⚠ CAUTION

When removing the hydraulic pipes, cap them to prevent dust from entering into the hydraulic components and pipes.

⚠ CAUTION

When disassembling and assembling the hydraulic components, work at clean place and do not damage the parts.

Tightening torque

⚠ CAUTION

- **Observe tightening torque specified in this manual.**

➡ **If not specified, refer to the table [Tightening torque for bolts] on page 14.**

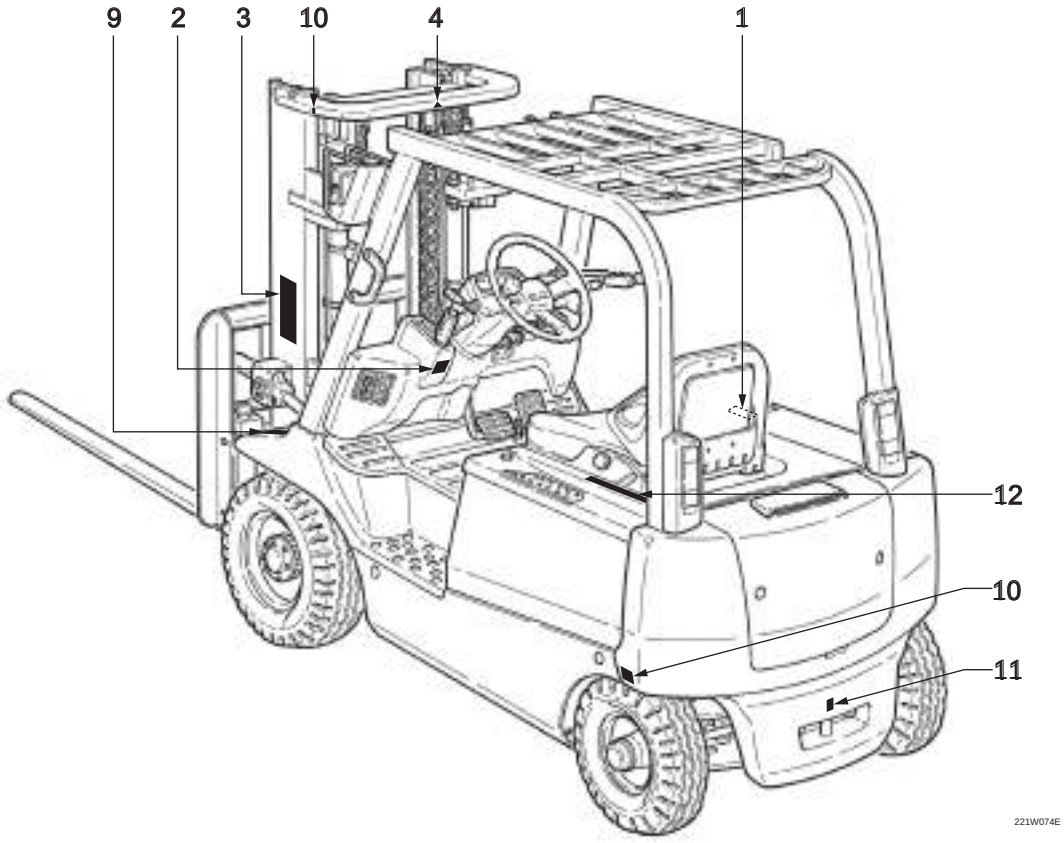
Marks and Symbols

T : Tightening torque
B : Apply THREEBOND product or equivalent
L : Apply LOCTITE product or equivalent
G : Apply grease
MG : Apply molybdenum grease
S : Apply Silicone glue
C : Apply thermal conductive compound
N : Not reusable

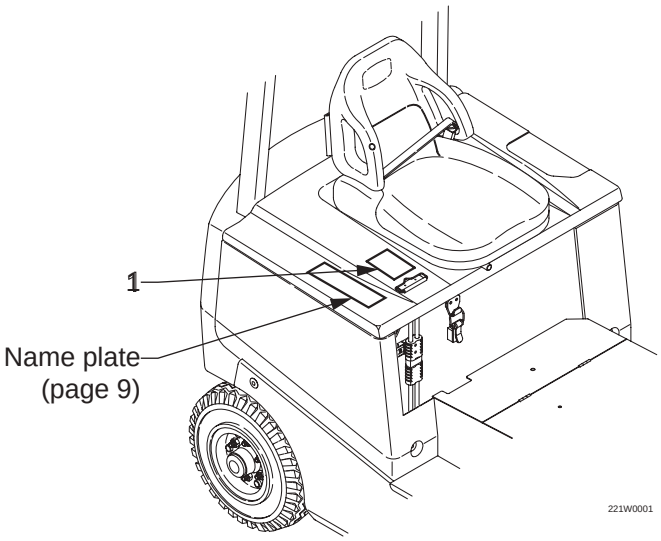
} Refer to the page 15 for details.

2. Safety labels

The illustration below shows the location of safety labels for safe operation.
Always protect the safety labels from contamination and damage.
If they are damaged or lost, replace with new ones.



No.	Parts No.	Parts Name	Q'ty	Notes
1	50004-65160	Plate, caution	1	Safety operation
2	50004-65170	Plate, caution	1	Parking brake
3	50004-65050	Plate, caution	2	No person on / under for
4	50004-65060	Plate, warning	1	Shearing point
5	50004-65180	Plate, caution	1	Battery cover lock
6	24700-13490	Plate, lubrication	1	Lubrication
7	38540-00630	Label, caution	1	w / battery, SHINKOBE
	38540-00520			w / battery, G6E
8	50004-65220	Plate, caution	1	Caution for fingers
9	0902-69954	Label, tyre	1	Air pressure (bar) FB10P-15P
	0902-69964			Air pressure (bar) FB15P-28P
	0902-69944			Air pressure (bar) FB30P
10	0902-69944	Label, tyre	1	Air pressure (bar) FB10P-18P
	0902-69964			Air pressure (bar) FB20P-28P
	0902-69914			Air pressure (bar) FB30P
11	50004-65190	Label, hook	3	Hook position
12	24700-04830	Plate, warning	1	In case of tipover



1

PRECAUTIONS FOR SAFETY OPERATION

1 Do not overload. observe allowable load (blue zone).
2 Prior to operation, check performance of brake or turn quickly.
3 Do not make a sudden start and brake or turn quickly.
4 Do not make a sudden valve lever operation at a high lift.
5 Do not run sideways or handle on an incline.
6 When the red lamp of battery capacity indicator turns on, charge battery.
7 Check electrolyte every week and replenish water.
8 Be sure to use the prescribed fuses.

2

Apply parking brake before leaving truck. Make adjust to provide adequate braking.

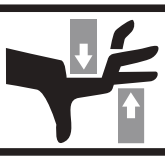
3

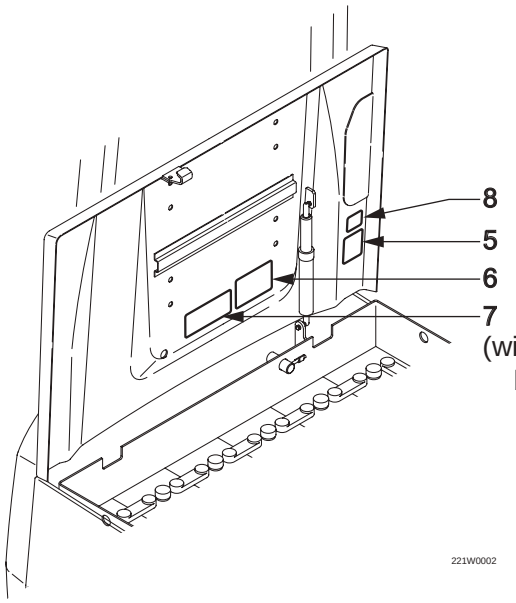
WARNING

50004-65050

4

警 告
WARNING

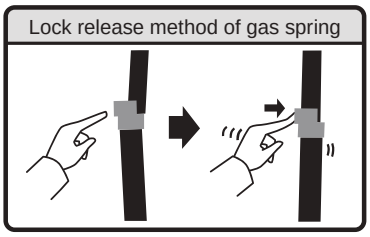




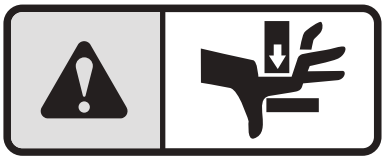
(with Japnese battery only)

5

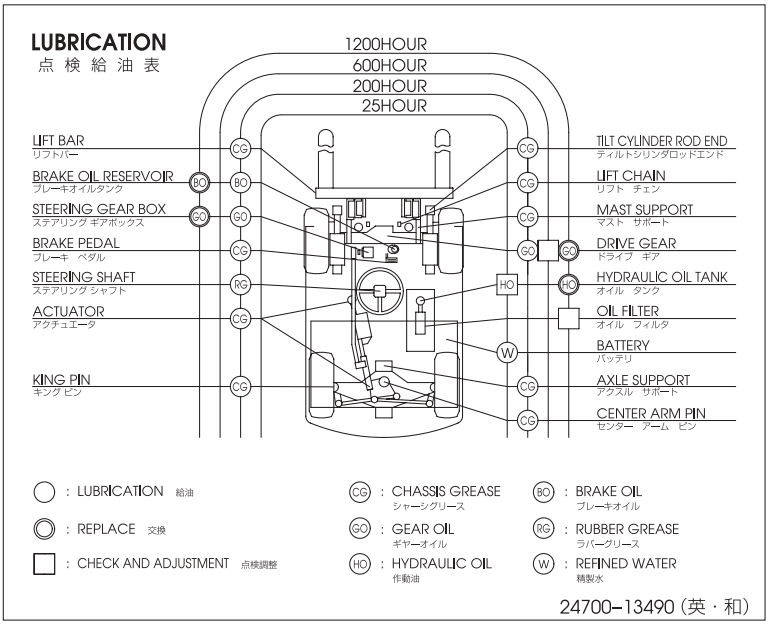
Lock release method of gas spring



8



6



7

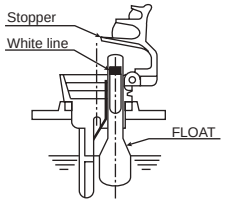
DANGER

- GASES produced by this battery can be explosive.
  Cigarettes, flames or sparks could cause battery to explode.
  Make sure batteries are stored and charged in a well-ventilayed area.
- Batteries contain SULFURIC ACID can cause severe burns.
  Avoid contact with skin, eyes or clothing.
  In event of accident flush with water and call a physician immediately.
- Wear rubber gloves to prevent ELECTRIC SHOCK during checking.
  and maintaining.
- Keep out of reach of children.

IMPORTANT POINT FOR MAINTENANCE

1. Keep the electrolyte level at proper height.
   (When electrolyte decreased, fill purified water
   and stop filling immediately if confirmed the white line of the
   float as shown herein, for over-filling causes overflow.)
2. Always give the battery an adequate charge and
   do not use the battery at overdischarged condition.
3. Keep the surface of battery clean and dry.

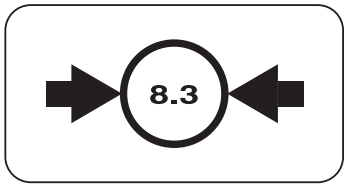
(EX.) VENT PLUG



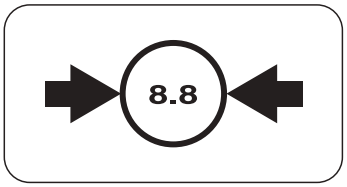
G6E (英文)

9: for Front tyre (only for EEC)

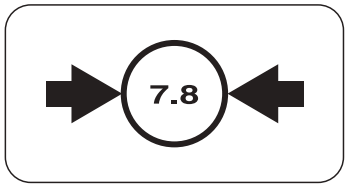
FB10P / 14P



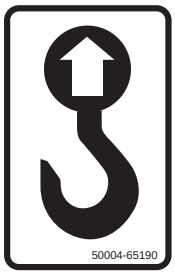
FB15P ~ 28P



FB30P

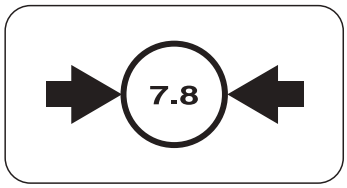


11

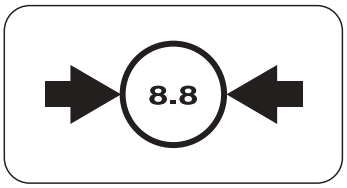


10: for Rear tyre (only for EEC)

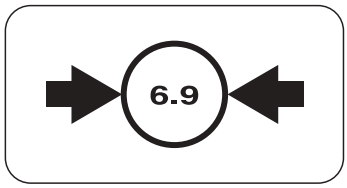
FB10P ~18P



FB20P ~ 28P



FB30P



12

FOR SAFETY NOTICE FOLLOWING WARNINGS

1. Lateral tipover can occur when unloaded if the combination of speed and sharpness of turn produces an overturning moment which exceeds the stability of the truck.
2. Lateral tipover can occur if overloaded or loaded within capacity and the load is elevated and if turning and / or braking when traveling rearward or if turning and / or accelerating when traveling forward produces an overturning moment which exceeds the stability of the truck.
   Rearward tilt and / or off-center positioning of the load and / or uneven ground conditions will further aggravate the above conditions.
3. Longitudinal tipover can occur if overloaded or when loaded within capacity and the load is elevated if forward tilt. braking in forward travel. or commencing rearward travel produces an overturning moment which exceeds the stability of the truck.
4. Serious injury or death can occur to the operator if he / she is trapped between the truck and the ground.

IN CASE OF TIPOVER

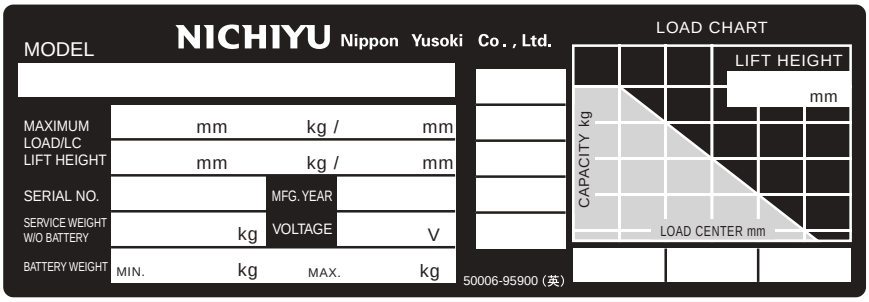
1. The operator should stay with the truck if lateral or longitudinal tipover occurs. The operator should hold on firmiy and lean away from the point of impact.
2. The operator should stay with the truck if it falles off a loading dock or ramp. There are other situations where the environment of the landing area presents a severe hazard. In those incidents. it may be prudent for the operator to leave the truck.

24700-04830

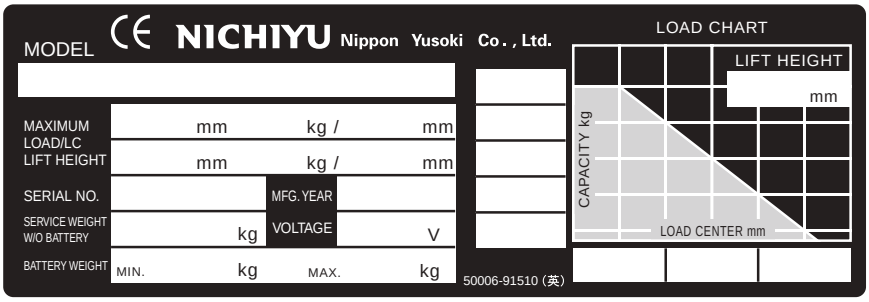
3. Model name and serial numbers

■ Model name

●**Name plate** **(For Standard)**



(For CE)



FB□□ □ − □75 □ − □□□ □ □ □

Capacity code
- 10 : 1000kg
- 14 : 1350kg
- 15 : 1500kg
- 18 : 1750kg
- 20 : 2000kg
- 25 : 2500kg
- 28 : 2750kg
- 30 : 3000kg

Classification of tyre
- P : Pneumatic tyre
- PN : No puncture tyre
- PC : Cushion tyre

□
- U : High speed type

□
- B : Large capacity battery equipped
- C : Stationary charger
- D : Dust resistant

Maximum lifting height [cm]

Mast type
- NO CODE : Two stage full visibility (simplex) mast
- M : Three stage full free lift (triplex) mast (Full visibility mast)
- PFL : Full free lift (duplex) mast (Full visibility mast)

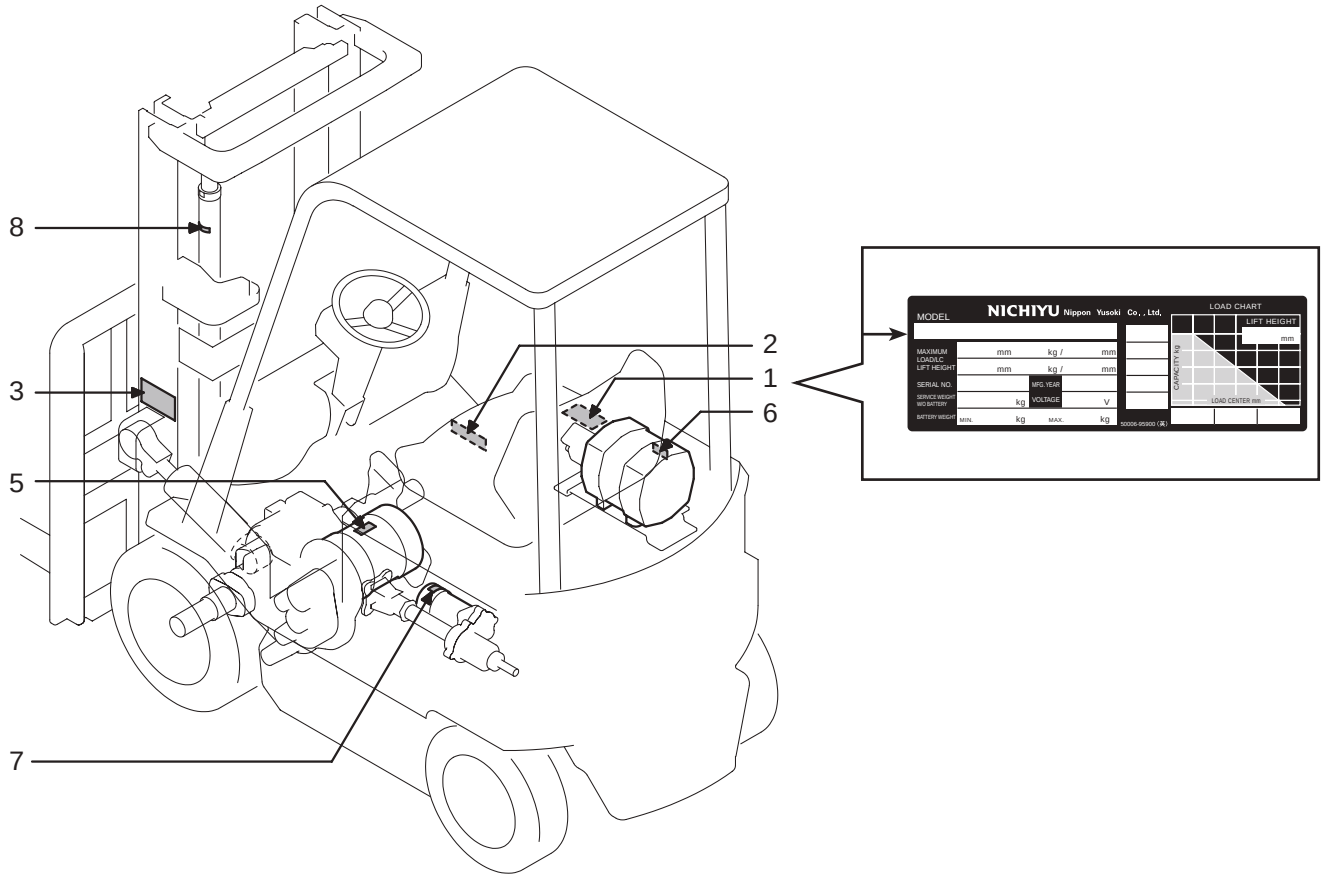
□
- CS : Cold storage use for -35°C
- FCS : Cold storage use for -50°C
- RP : Rust resistant
- Z : Special type

Attachment etc.

Serial numbers

No.	Serial numbers	Stamped position
1	Serial No. of a truck	Stamped on the name plate
2	Serial No. of a chassis	Stamped on the right chassis
3	Serial No. of a mast	Stamped on the mast name plate
4	Serial No. of a front axle	Stamped on the gear case
5	Serial No. of a traction motor	Stamped on the motor name plate
6	Serial No. of a hydraulic motor	Stamped on the motor name plate
7	Serial No. of a EPS motor	Stamped on the motor name plate
8	Serial No. of lift cylinders	Stamped on lift cylinders
9	Serial No. of tilt cylinders	Stamped on tilt cylinders

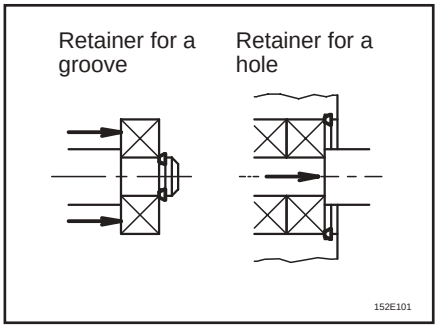
●Location of serial numbers



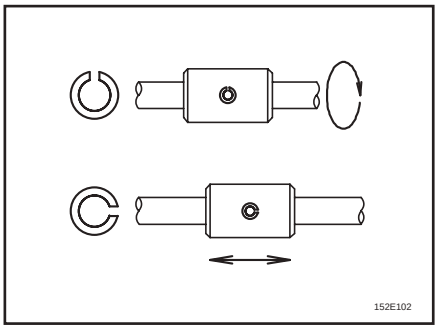
4. Cautions for maintenance

General precautions

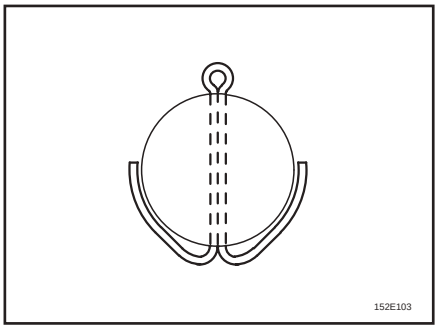
- When replacing any parts, be sure to use genuine NICHIYU parts.
- When parts are assembled, always replace old packing and O-rings with new ones. In addition, be sure to apply a light coat of grease on the O-rings and oil seals before installing them.
- As shown in the illustration, face the flat side of the C-shape retainer in the direction the force is applied when installed.



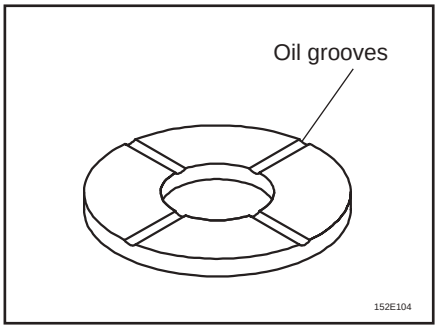
- As shown in the illustration, face the slit side in the direction the force is applied when driving in a spring pin.



- The split pin must be replaced with a new one and split so it will not come out.



- When using a thrust washer with oil grooves cut, observe the direction of installation.

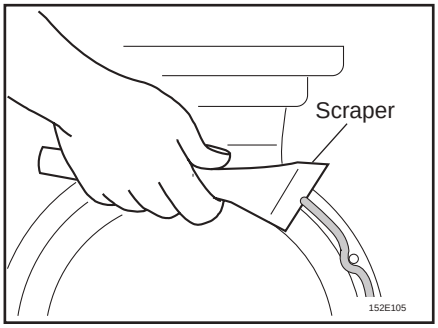


- When connecting and disconnecting couplers of electrical harnesses, always disconnect the battery plug.

■ Using liquid packing

● Scraping before application of seal

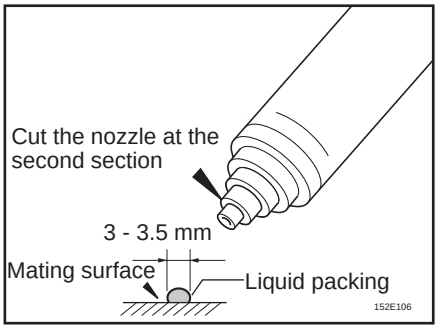
Remove the sealer adhered on the mating surface of the casing by using a scraper or equivalent tool. Be careful not to make scratches of 0.3 mm or deeper. If scratches are made, repair the area by using an oil stone.



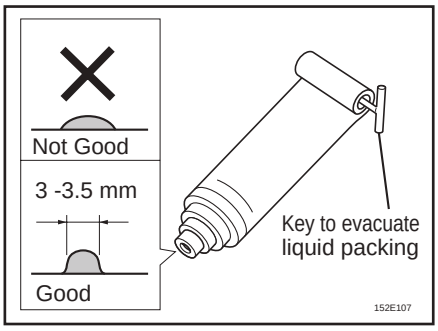
● Applying liquid packing

1. Wipe off the mating surfaces using a cloth soaked in gasoline to remove oil and contamination.
* Do not use kerosene, light oil, or crude oil.

2. Cut the nozzle of the liquid packing tube at about the second section so that the bead width will be 3 to 3.5 mm.



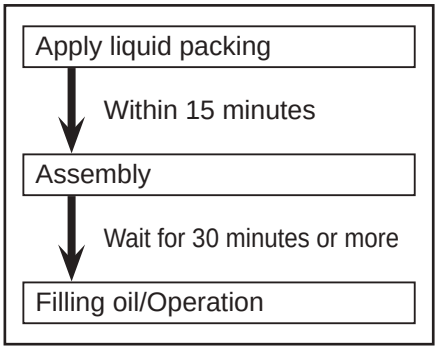
3. Attach a key for rolling up the tube, and apply the liquid packing to the mating surface while rolling up the tube.
* Do not smooth out the bead; doing so may cause leakage.
* When applying the liquid packing to bolt holes, apply it on the internal portion of the mating surface.



4. Close the mating surfaces within 15 minutes after the liquid packing is applied.

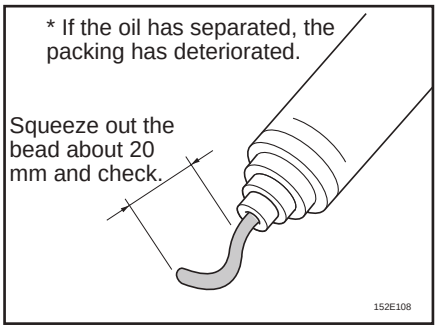
5. When tightening the bolts, always tighten temporarily first, and then tighten them gradually, moving from one to the next in a diagonal pattern.

6. Wait for more than 30 minutes before adding oil or operating the machine.
* Failure to do so may cause oil leakage.



● Deterioration of liquid packing

1. Once the tube has been opened, the liquid packing anchoring the tip part of the nozzle might be cured and deteriorated. Squeeze out that portion and discard it before reusing the packing.



2. If oil (filler) was separated from the liquid packing and the packing appears shiny when it is squeezed out, this indicates that the liquid packing has deteriorated.

* Although the oil may have been separated from a liquid packing opened before its expiration date, this is not an indication of deterioration.

⚠ CAUTION

If the state of the packing is normal, it will be cured within approximately 2 hours. However, a deteriorated packing will not.

5. Tightening torque for bolts

Classification of bolt		4T	8T	Brass	Stainless
Material of bolt		SS400	SCM435 (S55C)	BsBM2S-0	SUS304
Nominal of bolt (mm)	Pitch *1 (mm)	Tightening torque *2 Unit : N· m{kgf·m}			
M 3	0.5	0.6 {0.06}	1.3 {0.14}	0.4 {0.04}	0.5 {0.05}
M 4	0.7	1.4 {0.14}	3.2 {0.33}	1.0 {0.10}	1.0 {0.11}
M 5	0.8	2.7 {0.28}	6.4 {0.66}	1.8 {0.19}	2.0 {0.21}
M 6	1.0	4.7 {0.48}	10 {1.1}	3.1 {0.32}	3.6 {0.37}
M 8	1.25	11 {1.1}	26 {2.7}	7.8 {0.80}	9.0 {0.92}
M 10	1.25	22 {2.3}	55 {5.7}	15 {1.6}	18 {1.9}
M 12	1.25	39 {4.0}	98 {10}	29 {3.0}	33 {3.4}
(M 14)	1.5	62 {6.3}	150 {16}	47 {4.8}	53 {5.4}
M 16	1.5	97 {9.9}	240 {25}	73 {7.5}	81 {8.3}
M 20	1.5	180 {19}	500 {51}	140 {15}	150 {16}
(M 22)	1.5	250 {26}	670 {69}	200 {21}	220 {23}
M 24	2.0	320 {33}	840 {86}	250 {26}	280 {29}
M 30	2.0	640 {66}	1600 {170}	530 {54}	570 {58}

***1. In the table above, the thread pitches of bolt diameters M3 to M8 are for coarse screw threads and those of bolt diameters M10 or larger are for fine threads according to our specifications.**

***2. The tolerance range of tightening torque is to be +/– 10% of the reference values given above. (The tolerance range is determined according to experience, related standards, and records provided by other companies.)**

6. Data of LOCTITE and THREEBOND products

1 LOCTITE product

Product number	Content
#262	Thread-locking material
#542	Thread-sealing material
#648	Retaining compound

Visit: www.henkel.com for details.

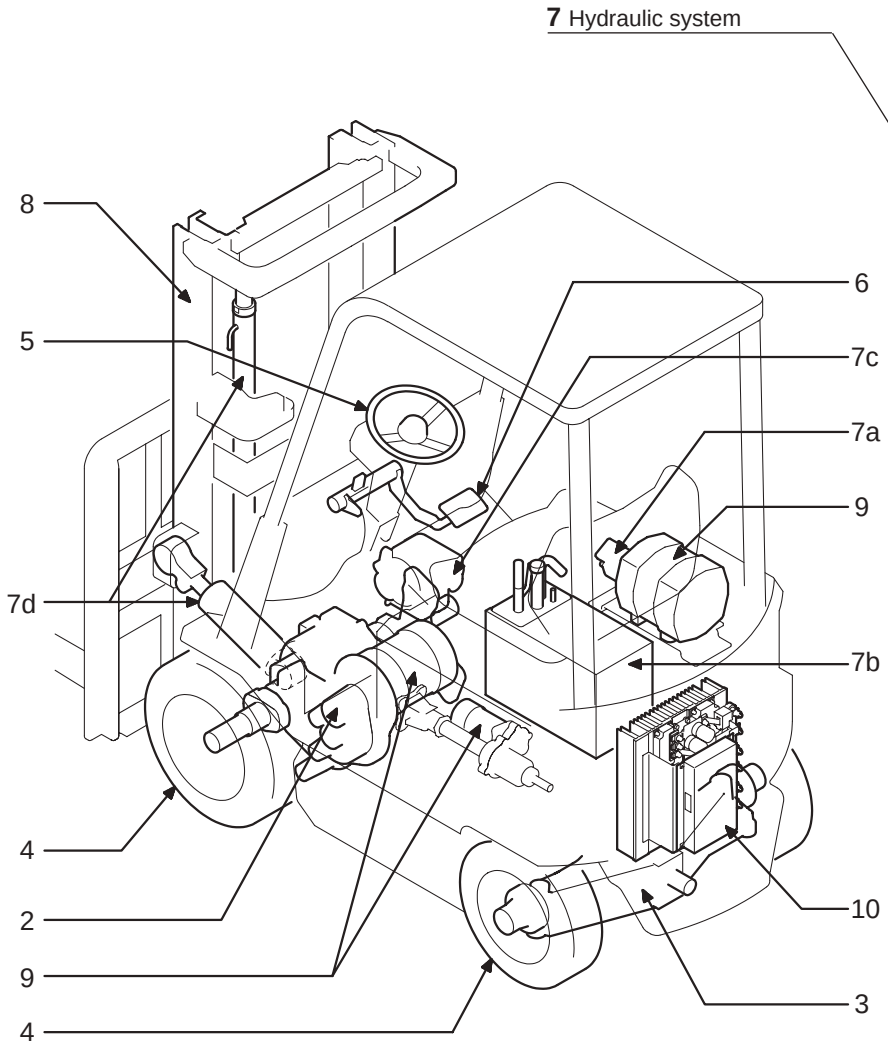
2 THREEBOND product

Product number	Content
#1212 (TB 1212)	Liquid gasket
#1401 (TB 1401)	Plastic thread locker
#1901	Molybdenum disulfide lubricants
#1344 (1344N)	Anaerobic sealant

Visit: www.threebond.co.jp/en/index.html for details.

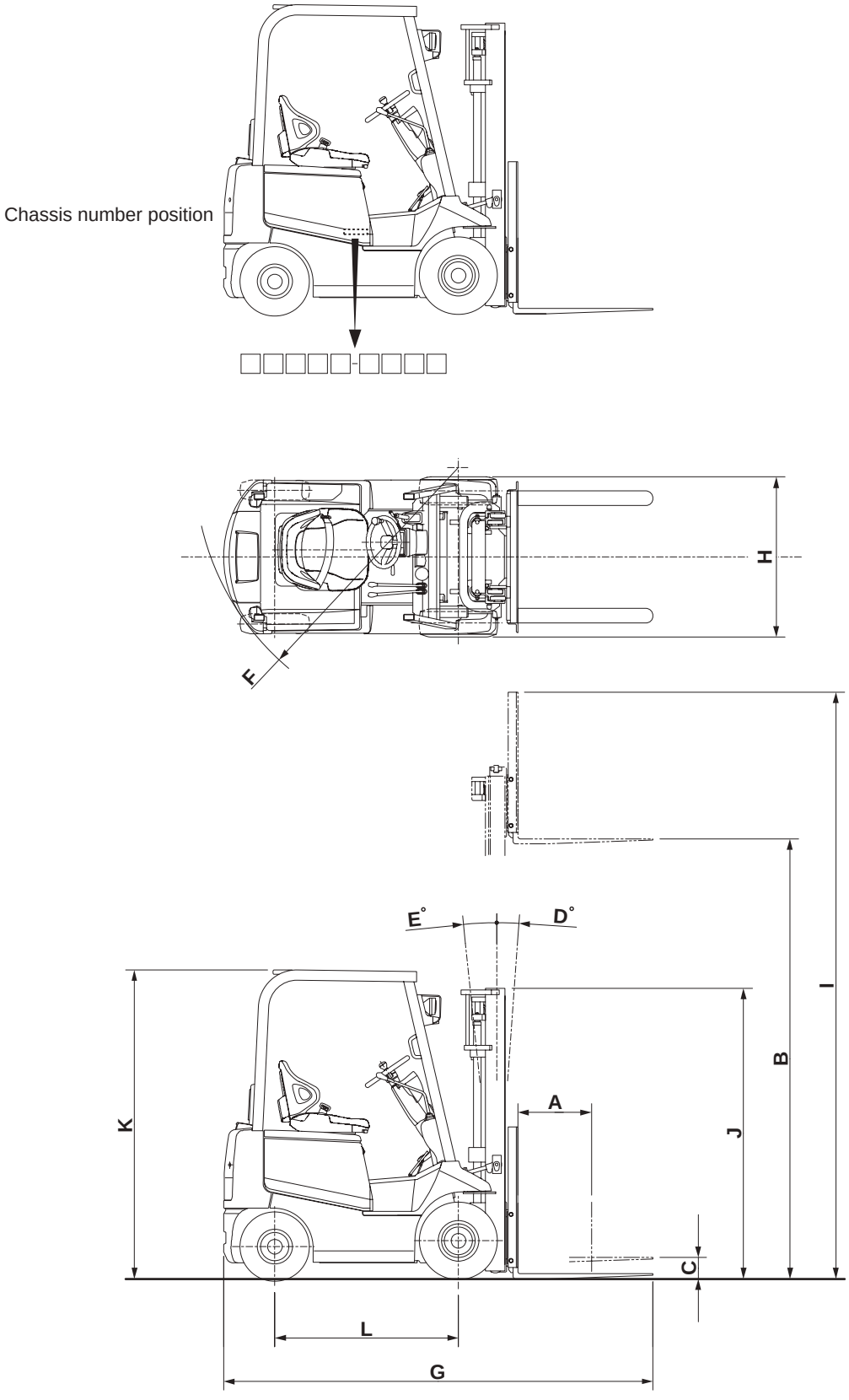
1. GENERAL

1- 1. Appearance



2 FRONT AXLE
3 REAR AXLE
4 TYRE
5 STEERING
6 BRAKE
7a HYDRAULIC PUMP
7b OIL TANK AND OIL PIPING
7c CONTROL VALVE
7d CYLINDER
8 MAST
9 MOTOR
10 ELECTRIC PARTS
11 LASER POINTER
12 SERVICE DATA

1- 2. Specifications



* This illustration shows FB15P.

1) SPECIFICATIONS FOR STANDARD LIFT TRUCKS

MODELS					FB10P	FB14P	FB15P	FB18P	FB20P	FB25P	FB28P	FB30P
Performance	Capacity			kg	1000	1350	1500	1750	2000	2500	2750	3000
	Load center		A	mm	500							
	Lift height		B	mm	3000							
	Free lift		C	mm	145				150		155	
	Lift speed	Loaded		mm/s	370	340	320	310	280	260	250	320
		Unloaded			540				470		410	550
	Tilt angle	Forward	D	i	6							
		Backward	E		12							
	Travel speed	Loaded Pneum. single		km/h	14.0			13.5	14.0	13.5	13.0	13.5
		Loaded Pneum. cushion			13.0			12.5	13.0	12.5	12.0	12.5
		Unloaded Pneum. single			16.0			15.5	16.0	15.5	15.0	15.5
		Unloaded Pneum. cushion			15.0			14.5	15.0	14.5	14.0	14.5
	Min. turning radius		F	mm	1710			1725	1950	2005	2060	2240
	Max. gradeability (Loaded) (5min)			%	22 %	20 %	19 %	17 %	19 %	16 %	14 %	16 %
Dimensions	Overall length		G	mm	3035			3080	3285	3345	3410	3580
	Overall width		H	mm	1050		1090		1175			1180
	Overall height	Mast lifted	I	mm	4000							
		Mast lowered	J		1980							2215
		Overhead guard	K		2110							2225
	Wheel base		L	mm	1250				1400			1600
	Tread	Front wheel		mm	890		900		955			955
		Rear wheel			900		900		945			980
	Road clearance			mm	110							235
	Service weight (w.o./Battery)			kg	2065	2200	2210	2385	2860	3305	3520	3530
	Aisle width with pallet 1100x1100 mm			mm	3205			3225	3475	3530	3605	3815
Tyre	Front	Pneum. single			6.00-9-10PR		21 X 8-9-14PR		23 X 9-10-16PR			28X9-15-12PR
		Pneum. cushion			6.00-9 Solid		21 X 8-9 Solid		23 X 9-10 Solid			28X9-15 Solid
		Pneum. double			ĐĐ		4.50-12-8PR		6.50-10-10PR			6.00-15-10PR
	Rear	Pneum. single			5.00-8-8PR				18 X 7-8-14PR			6.50-10-10PR
		Pneum. cushion			5.00-8 Solid				18 X 7-8 Solid			6.50-10 Solid
Control system (Travel/Hydraulic)					Inverter Control							
Electric motors	For traction			kw	9.0				10.0			
	For hydraulic				9.5					12.0		15.0
	For power steering				0.4				0.5			
Battery		Std.		Ah/5HR	48V 330		48V 400		48V 450	48V 565		72V 450
		Option (1)			48V 400		48V 485		48V 545	48V 600		72V 485
		Option (2)			48V 485		48V 545		48V 565	ĐĐ		72V 545
		Option (3)			48V 545		ĐĐ		48V 600	ĐĐ		72V 600
Charger (3 Phase 200/230V)					Automatic Stationary Charger							

*Subject to change without notice for improvement.
*Figures shown in the above specification table and unit with two stage full visibility mast.

2) SPECIFICATIONS FOR HIGH SPEED LIFT TRUCKS (U-Series)

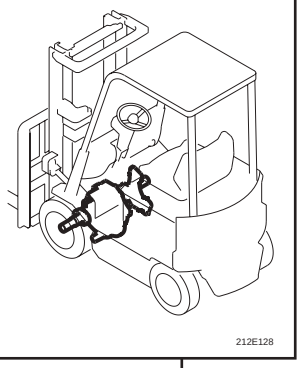
MODELS					FB10P-U	FB14P-U	FB15P-U	FB18P-U	FB20P-U	FB25P-U
Performance	Capacity			kg	1000	1350	1500	1750	2000	2500
	Load center		A	mm	500					
	Lift height		B	mm	3000					
	Free lift		C	mm	145				150	
	Lift speed	Loaded		mm/s	470	440	420	380	360	340
		Unloaded			650				600	
	Tilt angle	Forward	D	i	6					
		Backward	E		12					
	Travel speed	Loaded Pneum. single		km/h	16.0			15.5	15.5	15.0
		Loaded Pneum. cushion			15.0			14.5	14.5	14.0
		Unloaded Pneum. single			18.0			17.5	17.5	17.0
		Unloaded Pneum. cushion			17.0			16.5	16.5	16.0
	Min. turning radius		F	mm	1710			1725	1950	2005
	Max. gradeability (Loaded) (5min)			%	22 %	20 %	19 %	17 %	19 %	16 %
Dimensions	Overall length		G	mm	3035			3080	3285	3345
	Overall width		H	mm	1050		1090		1175	
	Overall height	Mast lifted	I	mm	4000					
		Mast lowered	J		1980					
		Overhead guard	K		2110					
	Wheel base		L	mm	1250				1400	
	Tread	Front wheel		mm	890		900		955	
		Rear wheel			900		900		945	
	Road clearance			mm	110					
	Service weight (w.o./Battery)			kg	2065	2200	2210	2385	2860	3305
	Aisle width with pallet 1100x1100 mm			mm	3205			3225	3475	3530
Tyre	Front	Pneum. single			6.00-9-10PR		21 X 8-9-14PR		23 X 9-10-16PR	
		Pneum. cushion			6.00-9 Solid		21 X 8-9 Solid		23 X 9-10 Solid	
		Pneum. double			ĐĐ		4.50-12-8PR		6.50-10-10PR	
	Rear	Pneum. single			5.00-8-8PR				18 X 7-8-14PR	
		Pneum. cushion			5.00-8 Solid				18 X 7-8 Solid	
Control system (Travel/Hydraulic)					Inverter Control					
Electric motors	For traction			kw	9.0				10.0	
	For hydraulic				12.0				13.5	14.0
	For power steering				0.4				0.5	
Battery		Std.		Ah/5HR	48V 330		48V 400		48V 450	48V 565
		Option (1)			48V 400		48V 485		48V 545	48V 600
		Option (2)			48V 485		48V 545		48V 565	ĐĐ
		Option (3)			48V 545		ĐĐ		48V 600	ĐĐ
Charger (3 Phase 200/230V)					Automatic Stationary Charger					

*Subject to change without notice for improvement.
*Figures shown in the above specification table and unit with two stage full visibility mast.

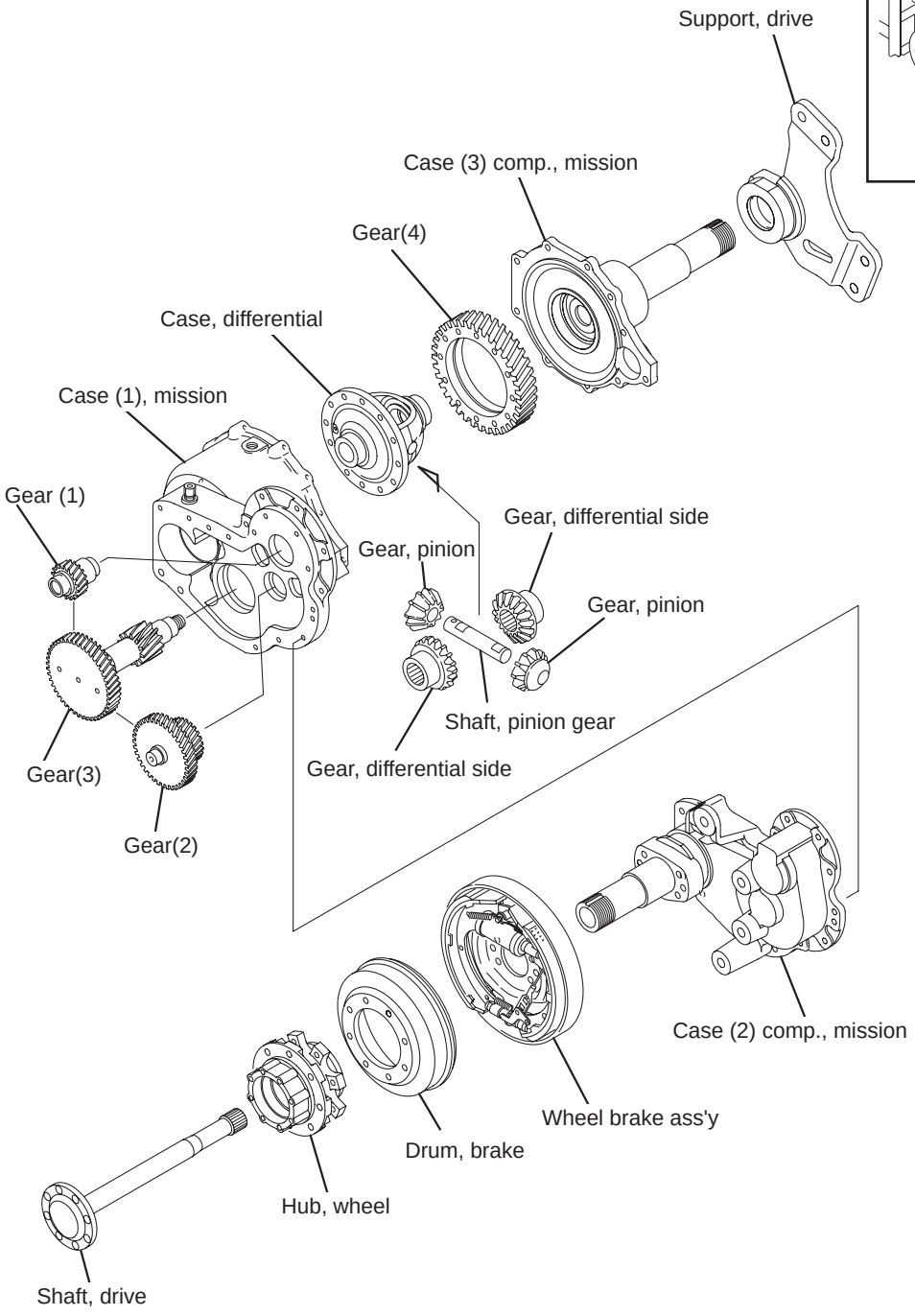
2. FRONT AXLE (DRIVE)

2- 1. Location and name

FRONT AXLE



●**Main parts of front axle**



2- 2. Disassembly and reassembly

⚠ CAUTION

- **Lift or jack up the forklift truck and support it with safety blocks or rigid stands.**
- **Apply wheel chocks to tyres to prevent the truck from moving.**
- **Record places of lead wire connections before disassembling.**
- **When disconnecting hydraulic pipes, cap them to prevent dust from entering into hydraulic components and pipes.**
- **Be sure to disconnect the battery plug.**

2-2-1. Front axle - removal and installation

1. Remove right and left forks.

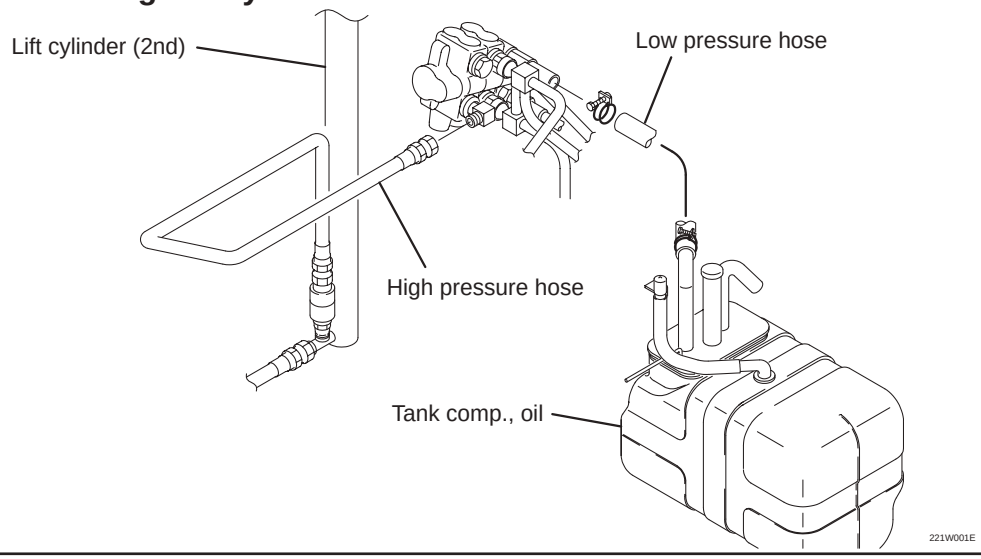
2. Disconnect hydraulic hoses as follows.

⚠ CAUTION

Turn the key switch off and operate hydraulic levers a few times to release high pressure in the hydraulic piping before disconnecting hydraulic hoses or pipes.

1. Disconnect the high pressure hose from the control valve and fix it in place.
2. Loosen the hose clip on the control valve and disconnect the low pressure hose (return hose).

●Disconnecting the hydraulic hose

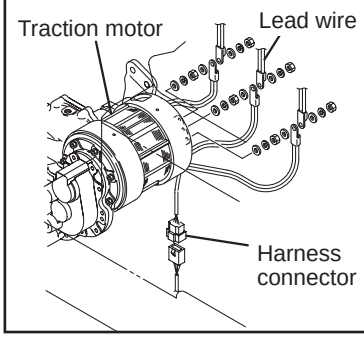


3. Disconnect three lead wires on the traction motor and the harness connector for the bearing sensor.

⚠ CAUTION

- **Be careful not apply too much stress to the cable of the accelerator potentiometer when removing the floor plate.**
- **Record places of lead wire connections before disassembling.**

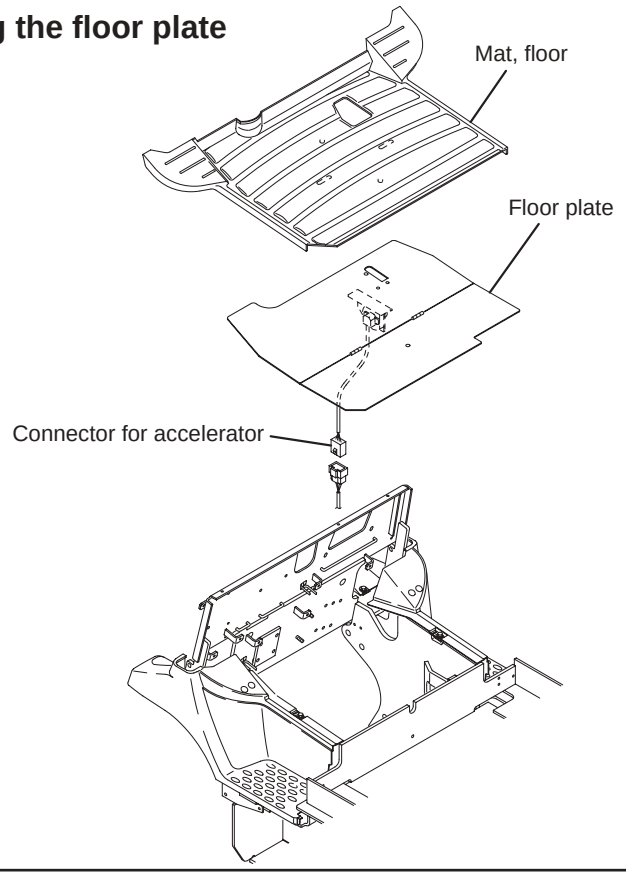
●Disconnecting the motor lead wire



4. Remove the parking linkage ass'y as follows.

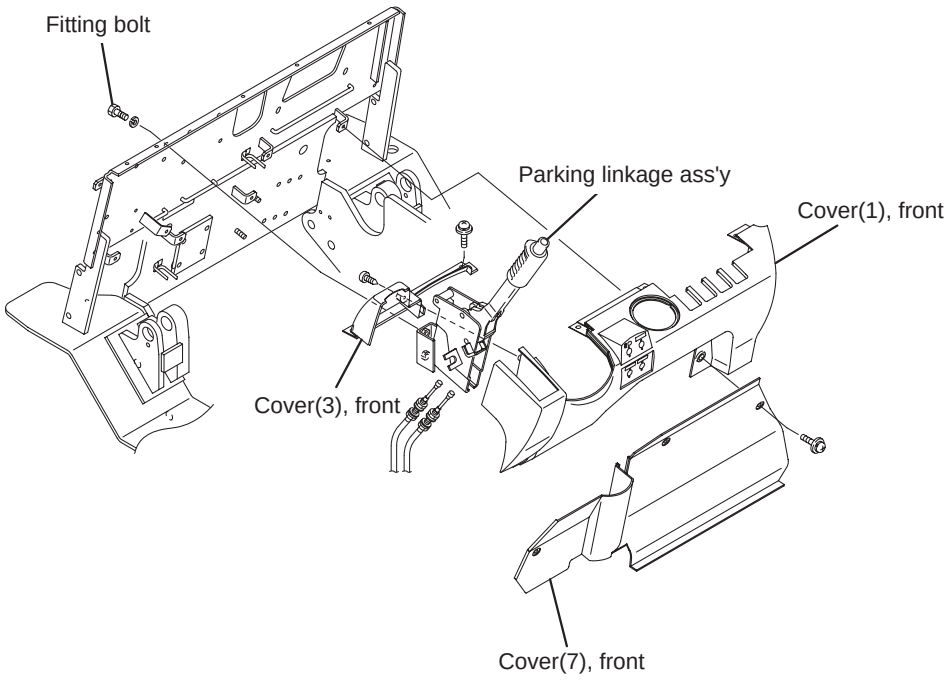
1. Disconnect the harness connector for the accelerator and remove the floor plate.

●Removing the floor plate



2. Remove front covers as shown in the following illustration.
3. Remove fitting bolts to remove the parking linkage ass'y.

●Removing the parking linkage ass'y



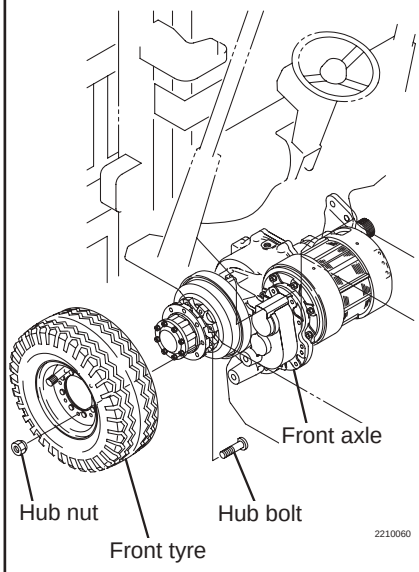
5. Remove front tyres as follows.

1. Apply chocks to both rear tyres.
2. Loosen hub nuts on the front tyres.

NOTE **Do not remove nuts, just loosen.**

3. Hoist the truck at the top of the mast to float the front tyres from the ground.
4. Apply rigid stands or wood blocks (20-30 cm height) under the frame.
5. Remove hub nuts to remove front tyres.

●Removing the front tyre

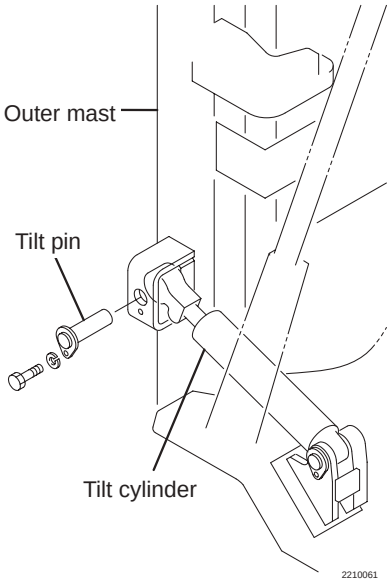


●Hub nut

Tightening torque (M12)	
[FB10P/14P]	89-108 N・m {9-11 kgf・m}
Tightening torque (M16)	
[FB15P/18P]	216-264 N・m {22-27 kgf・m}
Tightening torque (M18)	
[FB20P-30P]	315-385 N・m {32-39 kgf・m}

6. Remove right and left tilt pins that hold tilt cylinders and mast.

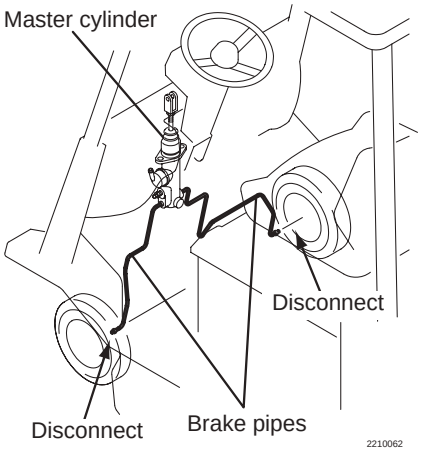
●Removing the tilt pin



7. Disconnect brake pipes as follows.

1. Drain the brake fluid from the brake oil tank.
2. Hoist the mast down and tilt it forward.
3. Disconnect the brake pipes of the wheel brake ass'y.

●**Disconnecting the brake pipe**



8. Replace pivot caps with special ones as follows.

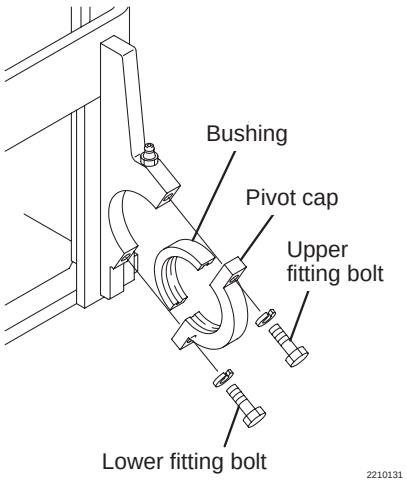
1. Hoist the mast down and tilt it forward.
2. Remove upper fitting bolts for both pivot caps.
3. Hoist the mast to return it to the vertical position.

⚠ CAUTION

Keep the wire rope pulling backward on the chassis to keep the mast vertical.

4. Remove lower fitting bolts for both pivot caps.

●**Replacing the pivot cap**



●Fitting bolt

	Tightening torque
	78-98 N ▪ m
	{8-10 kgf ▪ m}

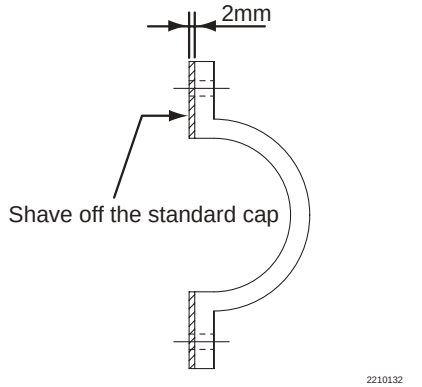
5. Replace pivot caps with special caps.
6. Tighten all fitting bolts by hand.
7. Hoist the mast down and tilt it forward.
8. Use a tool to tighten upper fitting bolts for both special caps.
9. Hoist the mast to return it to the vertical position.

⚠ CAUTION

Keep the wire rope pulling backward on the chassis to keep the mast vertical.

10. Use a tool to tighten lower fitting bolts for both special caps.

●**Special cap details**



9. Remove fitting bolts and nuts for the front axle and frame.

CAUTION

When removing bolts of one side, leave a bolt through the front axle and frame to remove bolts on the other side easily.

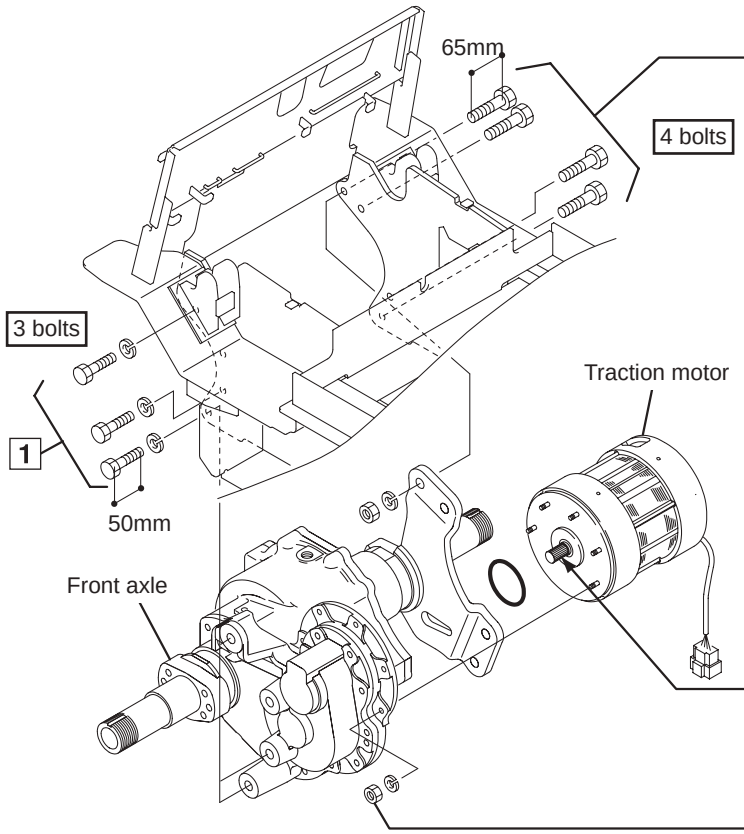
10. Hoist the mast and remove the front axle and traction motor from the frame.

NOTE

Be careful not to catch or damage the brake pipes and parking brake lever when removing the mast and front axle.

●Removing the front axle and traction motor

FB10P



●Fitting bolts (M20x L65)

	Tightening torque
	450-550 N・m
	{46 - 56 kgf・m}

●Fitting bolts (M20x L50)

	Tightening torque
1	450-550 N・m
	{46 - 56 kgf・m}

CAUTION

Pay attention to different bolt lengths, when installing.

	Spline
MG	Apply molybdenum grease on a part of spline.

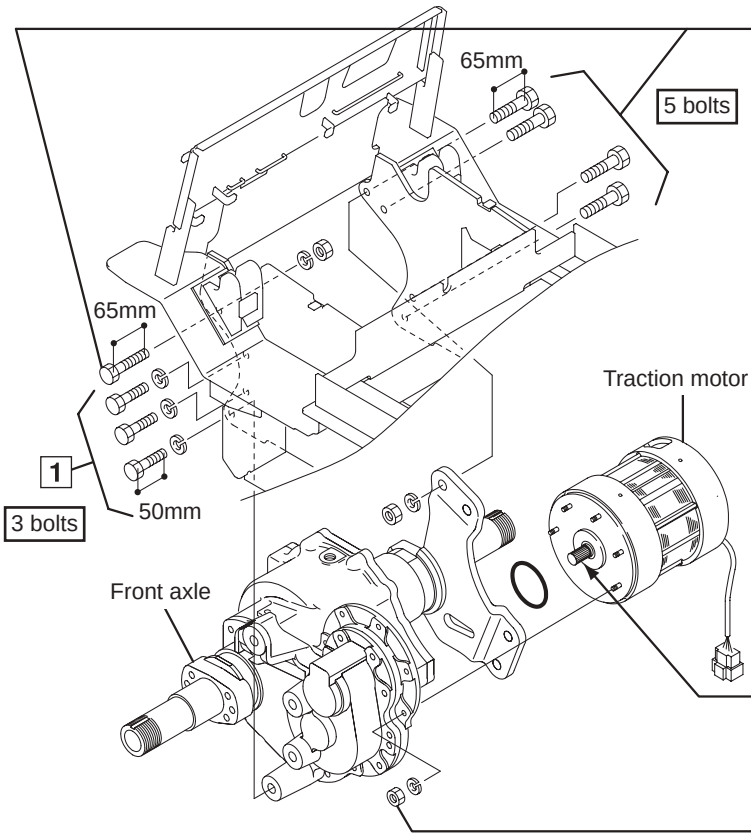
	Tightening torque
	49.5-60.5 N・m
	{5.0 - 6.2 kgf・m}

: Tightening torque
MG : Apply molybdenum grease

2210007

●Removing the front axle and traction motor

FB20P-30P



●Fitting bolts (M20x L65)

Tightening torque
450 - 550 N・m
{46 - 56 kgf・m}

●Fitting bolts (M20x L50)

1	Tightening torque
	450 - 550 N・m
	{46 - 56 kgf・m}

CAUTION

Pay attention to different bolt lengths, when installing.

Spline	MG
Apply molybdenum grease on a part of spline.	

Tightening torque
49.5-60.5 N・m
{5.0 - 6.2 kgf・m}

: Tightening torque
MG : Apply molybdenum grease

2210154

11. Remove the front axle from the mast as follows.

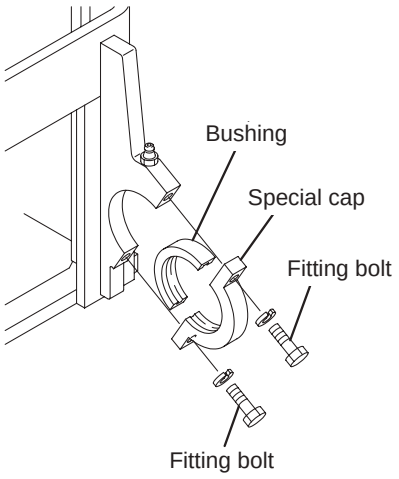
1. Apply wood blocks under the traction motor or front axle.
2. Remove fitting bolts for both special caps.
3. Move the mast back and remove the front axle from the mast.

NOTE **Be careful to not lose the bushings.**

12. Remove the traction motor.

* Install the front axle in reverse order of removal.

●Removing the special cap



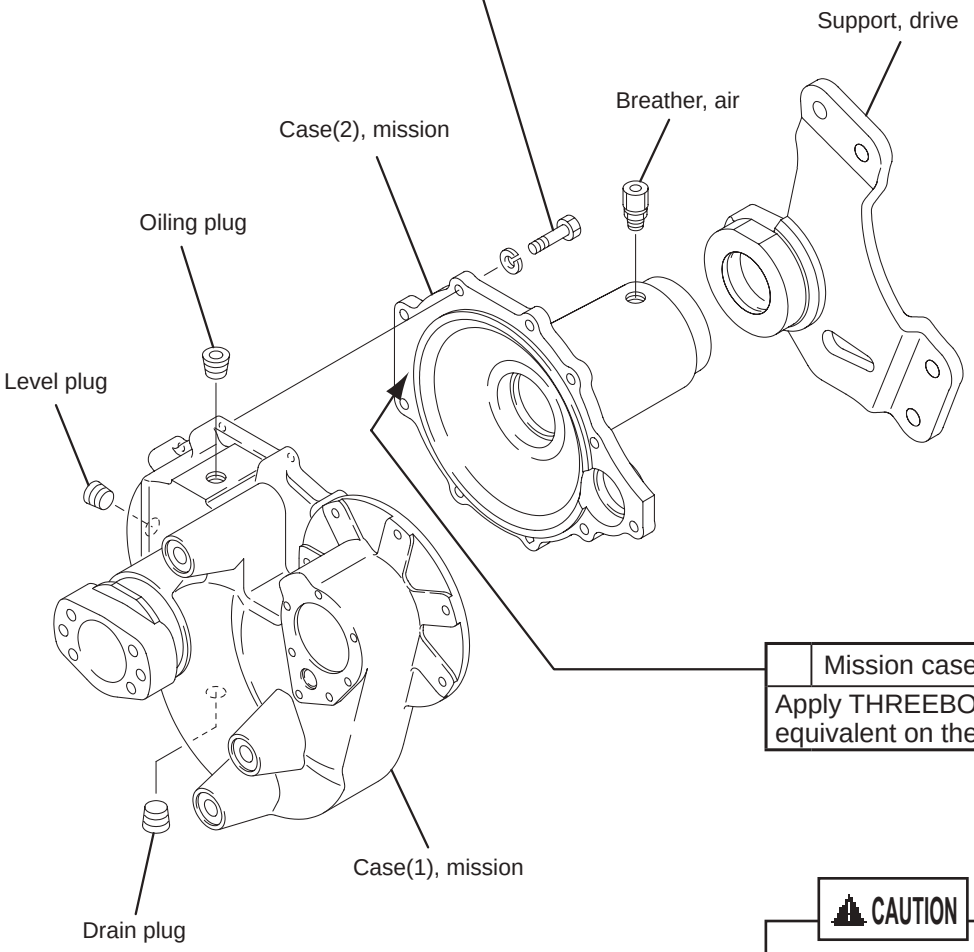
2210131

2-2-2. Front axle - disassembly and reassembly

Transmission case and etc.

●**Disassembling and reassembling the front axle (1)**

FB10P-18P

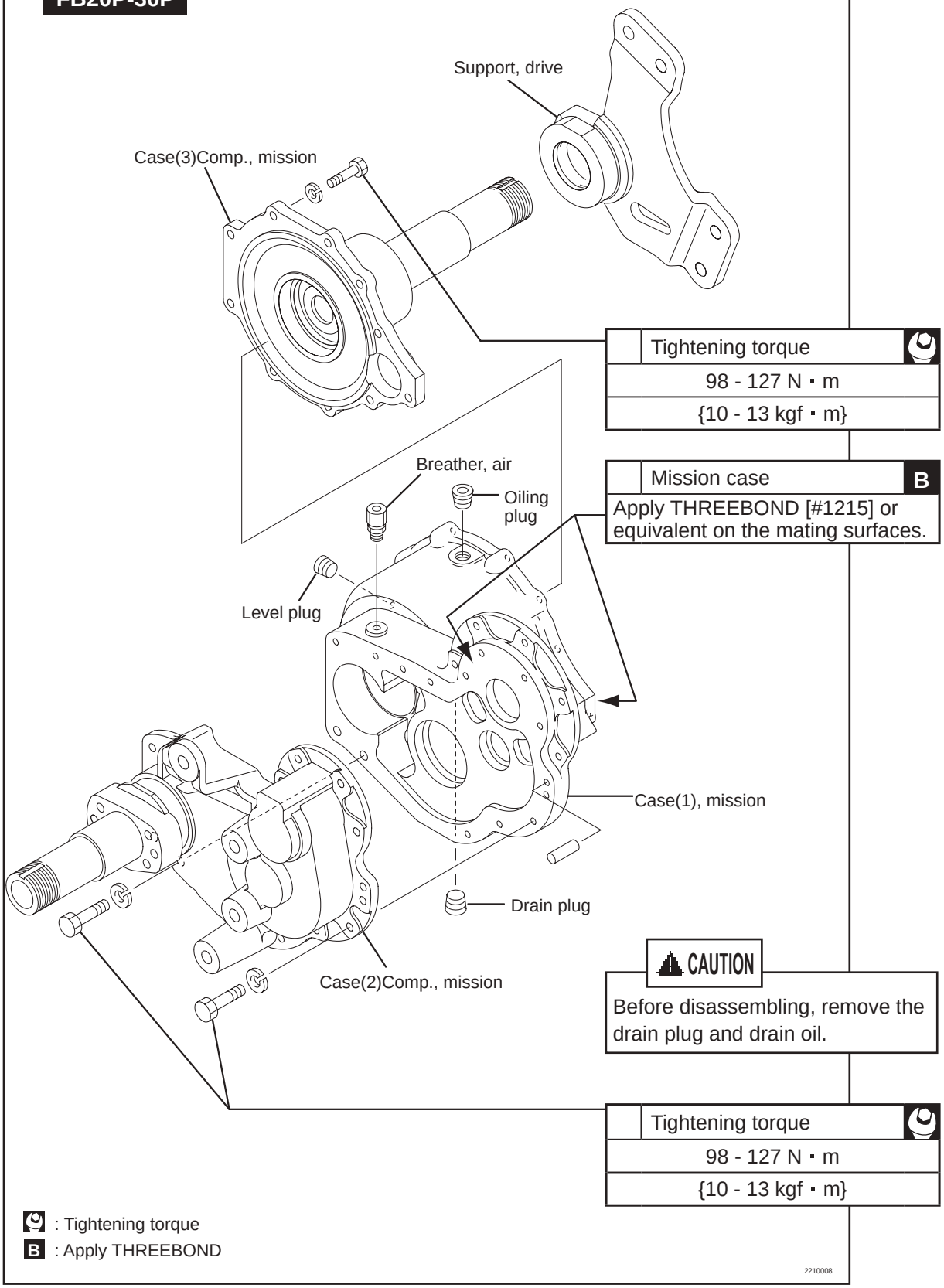


CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

●Disassembling and reassembling the front axle (1)

FB20P-30P



CAUTION

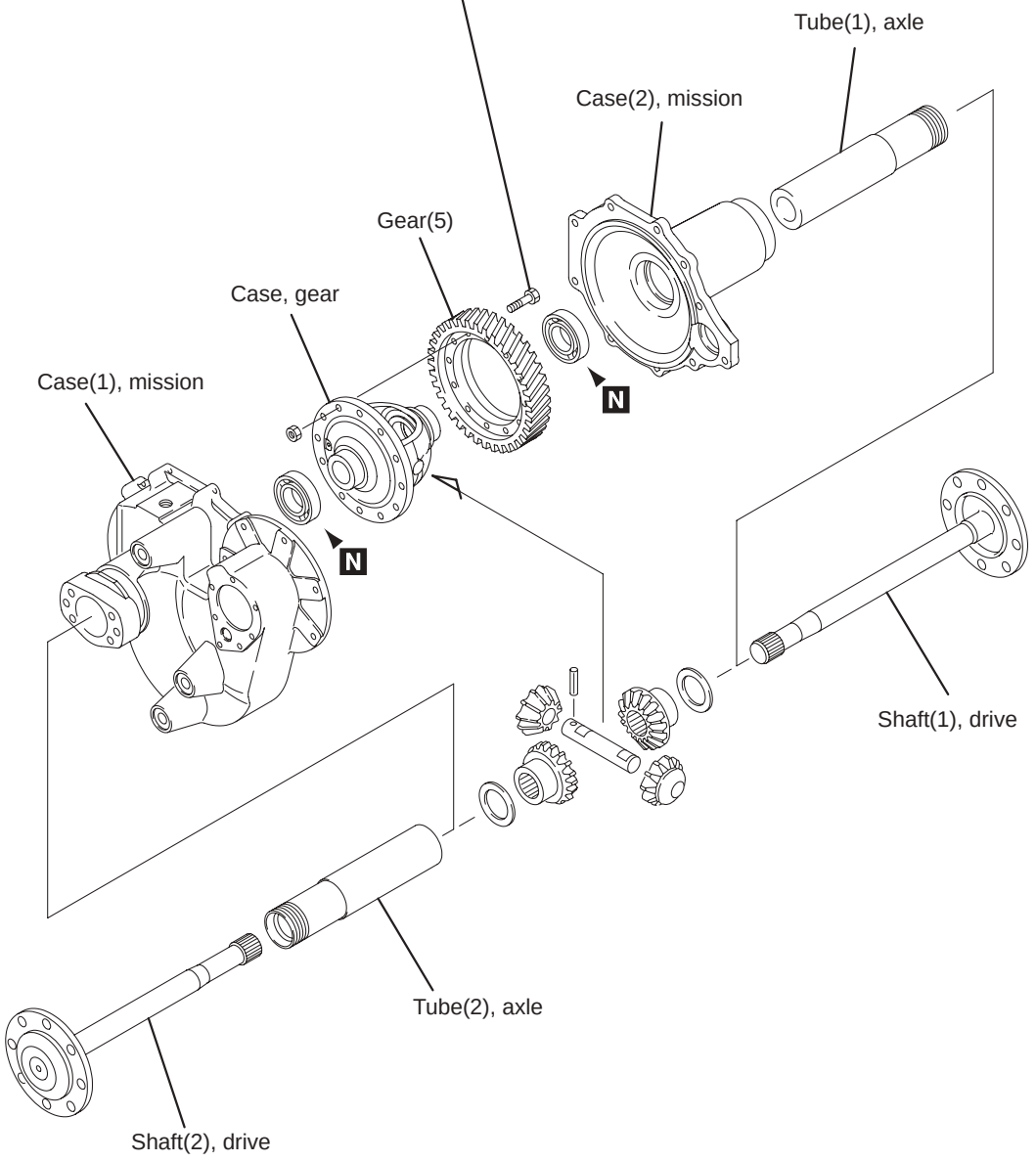
When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

Differential case and etc.

●Disassembling and reassembling the front axle (2)

FB10P-18P

2	Tightening torque	B
Apply THREEBOND [#1360K] or equivalent and then tighten.		
108-147 N ▪ m		
{11-15 kgf ▪ m}		



: Tightening torque
B : Apply THREEBOND
N : Not reusable

221W005E

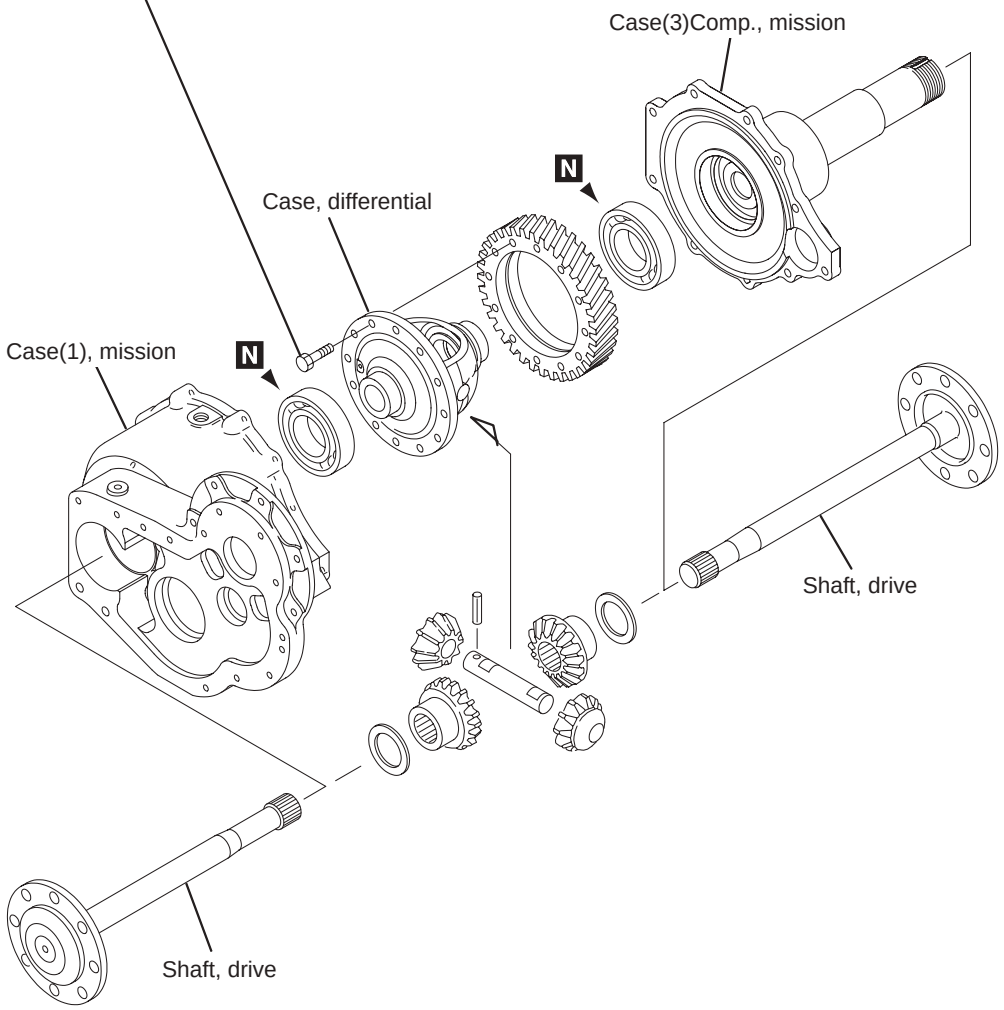
CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

●Disassembling and reassembling the front axle (2)

FB20P-30P

2	Tightening torque	B
Apply THREEBOND [#1360K] or equivalent and then tighten.		
108-147 N ▪ m		
{11-15 kgf ▪ m}		



: Tightening torque
B : Apply THREEBOND
N : Not reusable

2210163

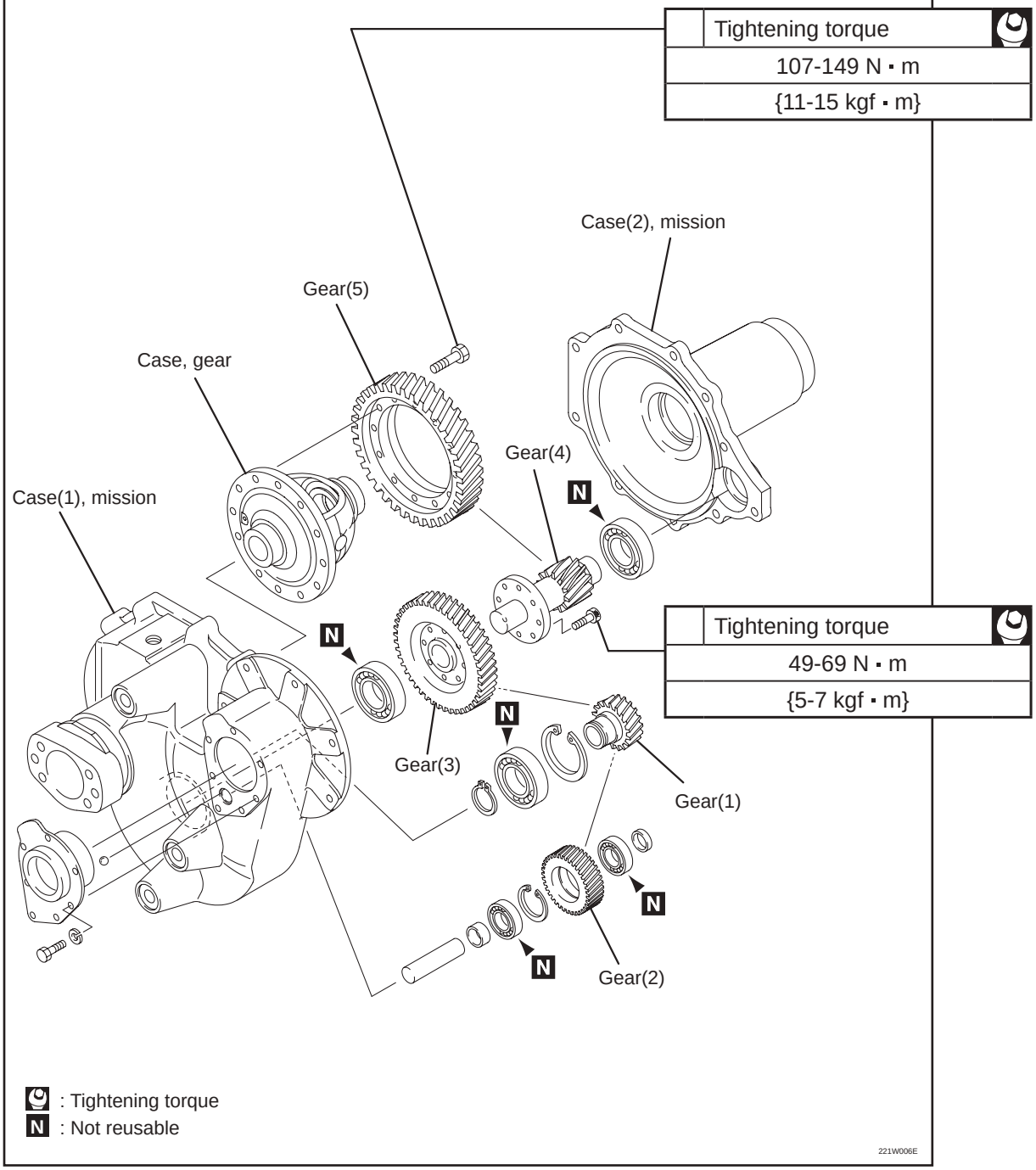
⚠ CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

Gears and etc.

●Disassembling and reassembling the front axle (3)

FB10P-18P

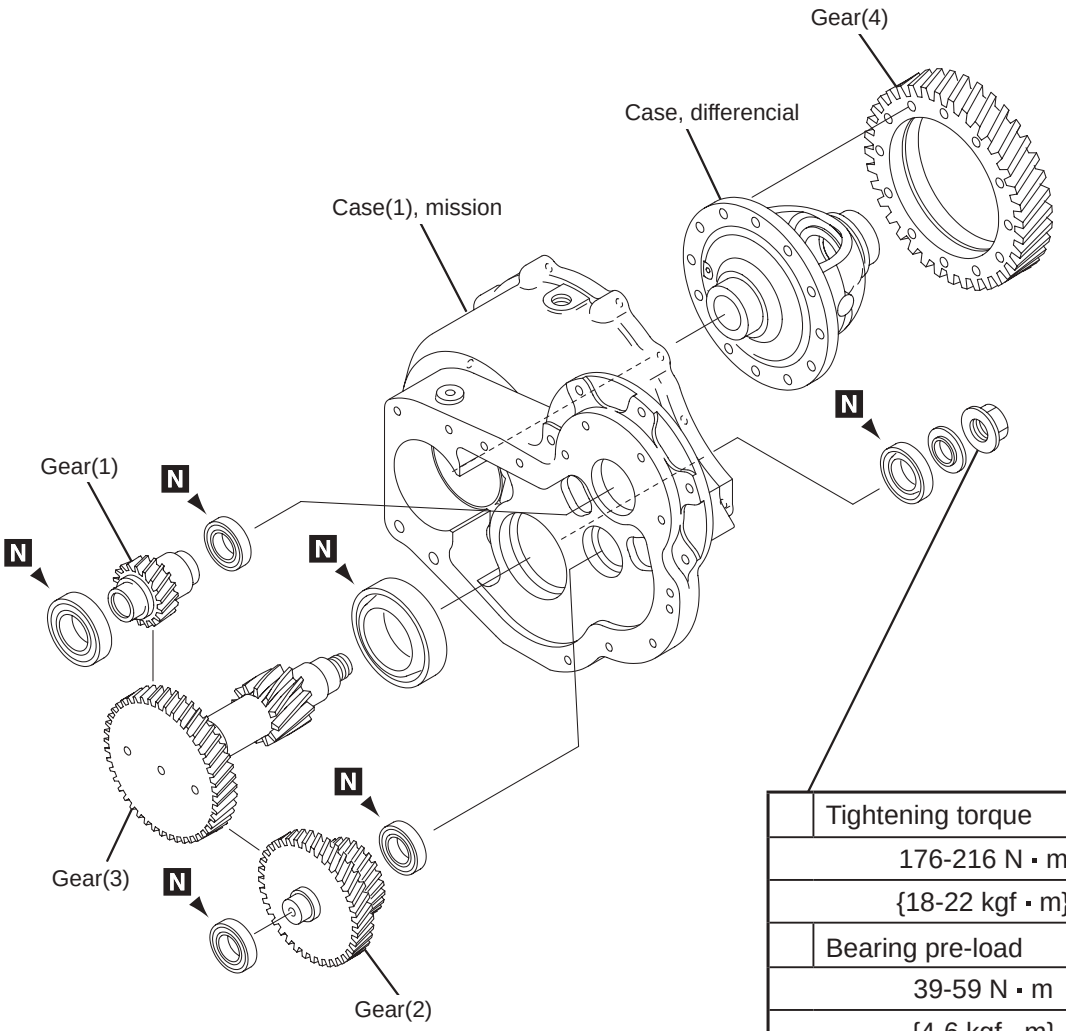


⚠ CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

●Disassembling and reassembling the front axle (3)

FB20P-30P



	Tightening torque
	176-216 N · m
	{18-22 kgf · m}
	Bearing pre-load
	39-59 N · m
	{4-6 kgf · m}

: Tightening torque
N : Not reusable

2210164

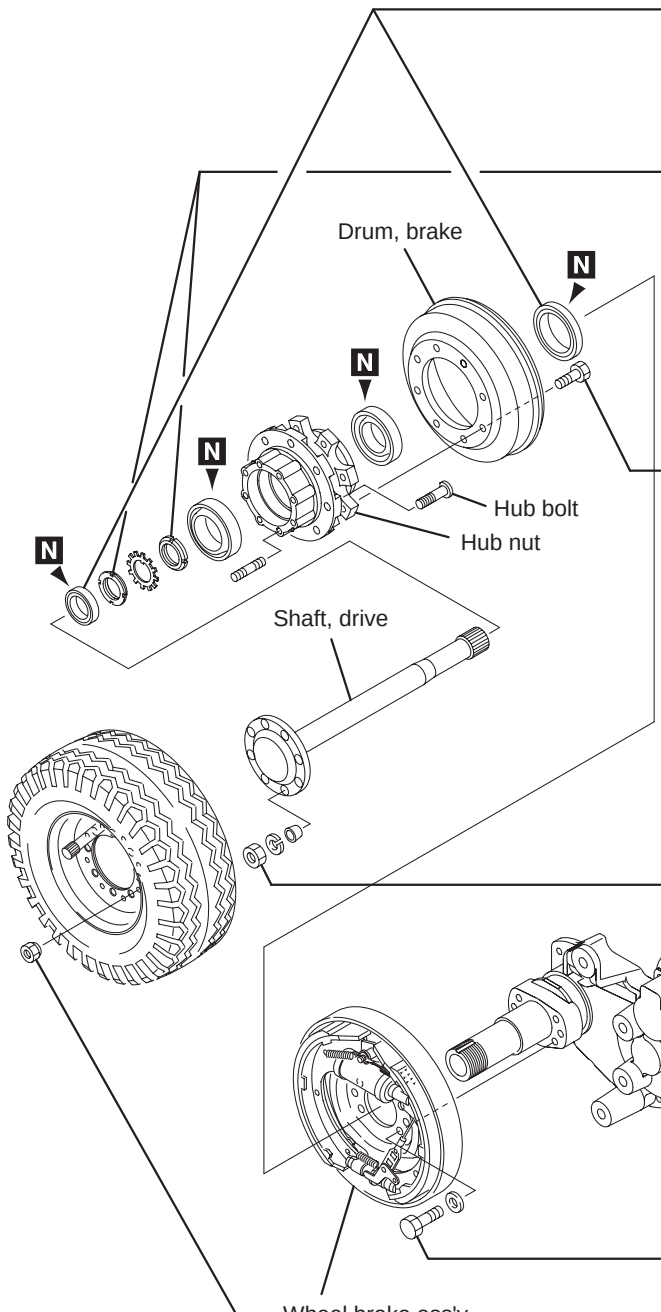
⚠ CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

Wheel hub , drive shaft and etc.

●Disassembling and reassembling the front axle (4)

FB10P/14P



	Oil seal	B	G
Apply grease on the lip of the oil seal, and THREEBOND [#1104] or equivalent			

●Bearing nut

A	Bearing pre-load	
Measure at position A	392-686 N・m	
	{40-70 kgf・m}	

2	Tightening torque	B
Apply THREEBOND[#1360K] or equivalent and tighten.		
[FB10P/14P]	98-127 N・m	
	{10-13 kgf・m}	

	Tightening torque	
[FB10P/14P]	78-108 N・m	
	{8-11 kgf・m}	

	Tightening torque	B
Apply THREEBOND[#1360K] or equivalent and tighten.		
[FB10P/14P]	176-235 N・m	
	{18-24 kgf・m}	

●Hub nut

	Tightening torque (M12)	
[FB10P/14P]	89-108 N・m	
	{9-11 kgf・m}	

: Tightening torque
B : Apply THREEBOND
G : Apply grease
N : Not reusable

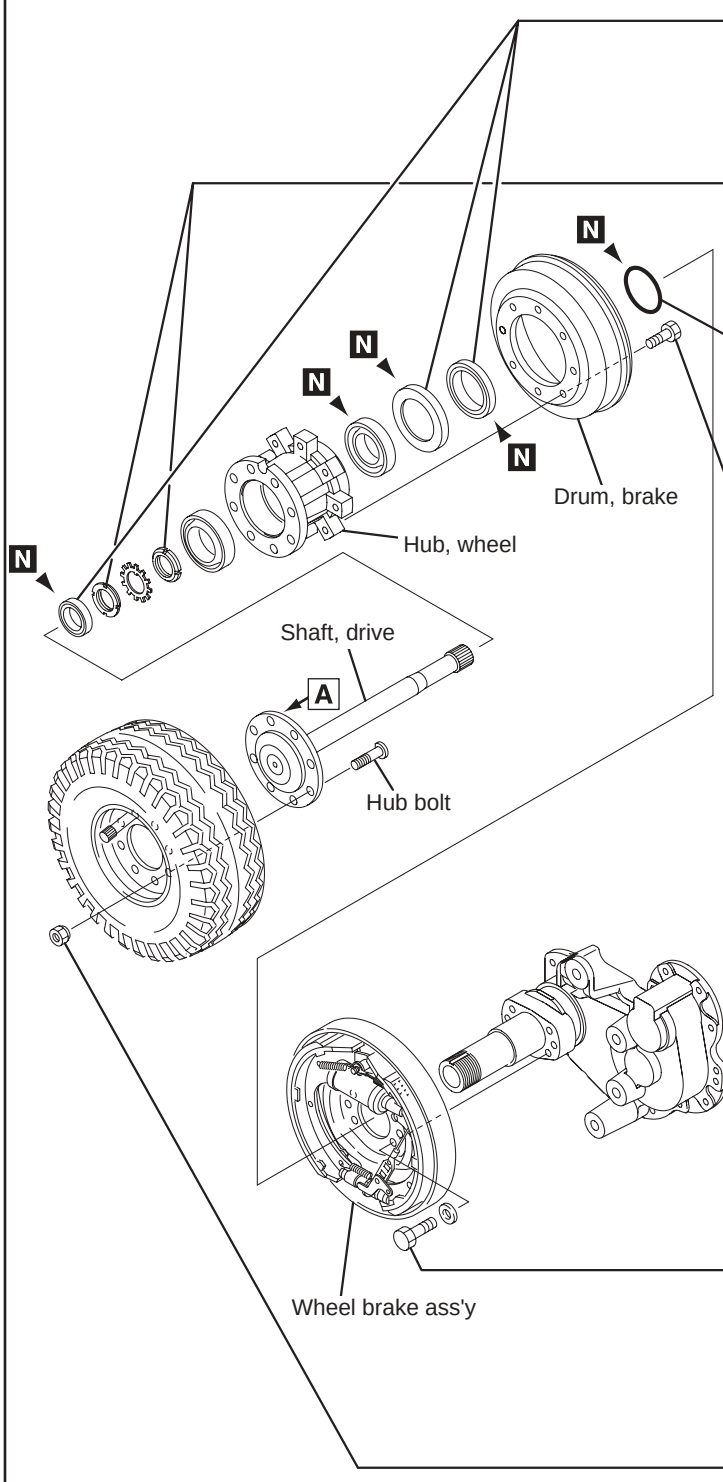
221W007E

⚠ CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

●Disassembling and reassembling the front axle (4)

FB15-30P



	Oil seal	B G
Apply grease on the lip of the oil seal, and THREEBOND [#1104] or equivalent around it.		

●Bearing nut

A	Bearing pre-load	
Measure at position A	392-686 N・m	{40-70 kgf・m}

	O ring	G
Apply grease.		

	Tightening torque	B
Apply THREEBOND[#1360K] or equivalent and tighten.		
[FB15P/18P]	98-127 N・m	{10-13 kgf・m}
[FB20P-30P]	157-206 N・m	{16-21 kgf・m}

	Tightening torque	B
Apply THREEBOND[#1360K] or equivalent and tighten.		
[FB15P/18P]	176-235 N・m	{18-24 kgf・m}
[FB20P-30P]	157-206 N・m	{16-21 kgf・m}

●Hub nut

	Tightening torque (M16)	
[FB15P/18P]	216-264 N・m	{22-27 kgf・m}
	Tightening torque (M18)	
[FB20P-30P]	315-385 N・m	{32-39 kgf・m}

: Tightening torque
B : Apply THREEBOND
G : Apply grease
N : Not reusable

2210155

2- 3. Inspection and adjustment

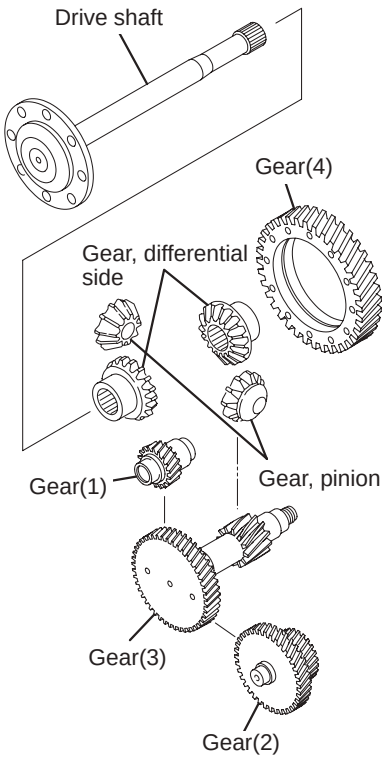
2-3-1. Gears - Inspection and replacement

	Check point
Inspection of gears	Gearing
	Wear
	Scoring
	Pitting
	Damage of Splines

<Measures>

●If beyond repair, replace as a set.

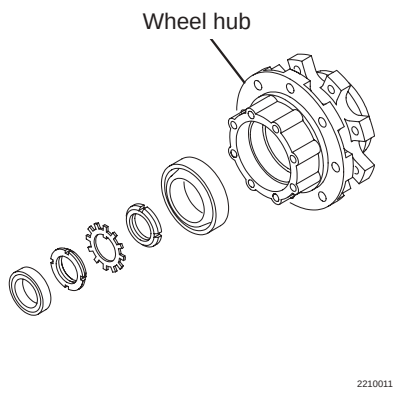
●Inspection of gears



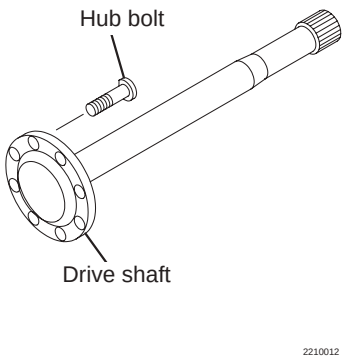
2-3-2. Wheel hub and hub bolt - Inspection

1. Check wheel hubs for damage and crack.
2. Check hub bolts for loosening and damage.

●Inspection of wheel hub



●Inspection of hub bolt



2- 4. Troubleshooting

2-4-1. Front axle - troubleshooting

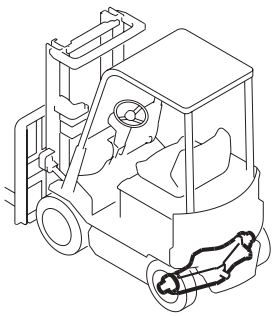
No.	Symptom	Possible cause	Solution
1	Continuous noise while travelling	1. Poor hypoid gear (differential gear) adjustment, or teeth wear	Adjust or replace
		2. Poor hypoid gear (differential gear) bearing adjustment, or teeth wear	Adjust or replace
		3. Loose or out of wheel hub bearings	Adjust or replace
		4. Poor ring gear and shaft (differential gear and beveled pinion) gearing or backlash	Adjust
		5. Not enough gear oil	Replenish
2	Abnormal noise while travelling	1. Out of hypoid gear (differential gear) bearings.	Replace
		2. Out of wheel hub bearings	Replace
		3. Out of backlash due to differential gear wear or thrust washer wear	Replace
		4. Foreign matter in the axle housing	Inspect and clean
		5. Loose drive shaft or carrier ass'y bolts.	Retighten
3	Abnormal noise when turning corners	1. Out of backlash due to differential gear wear or thrust washer wear	Replace
		2. Broken teeth on the differential gear pinion, or pinion shaft wear	Replace
4	Differential heat	1. Out of gear backlash	Adjust
		2. Damaged bearing due to excess bearing preload	Replace
5	Oil leakage from the axle housing	1. Oil surface too high (level plug is at regulated value)	Drain
		2. Oil seal wear or damage	Replace
		3. Poorly installed axle housing	Retighten
		4. Poorly installed plug	Retighten
		5. Air breather clogged	Clean or replace
6	Oil leakage from the wheel hub	1. Oil seal wear or damage	Replace
		2. Off-center rotation due to bearing wear or damage	Replace
7	Oil leakage from the carrier	1. Oil seal wear or damage	Replace

Recommended oil	Model	Qty of oil
Hypoid Gear oil #90 GL-4 / GL-5	FB10P - 18P	5.5 ℓ
	FB20P - 30P	5.0 ℓ

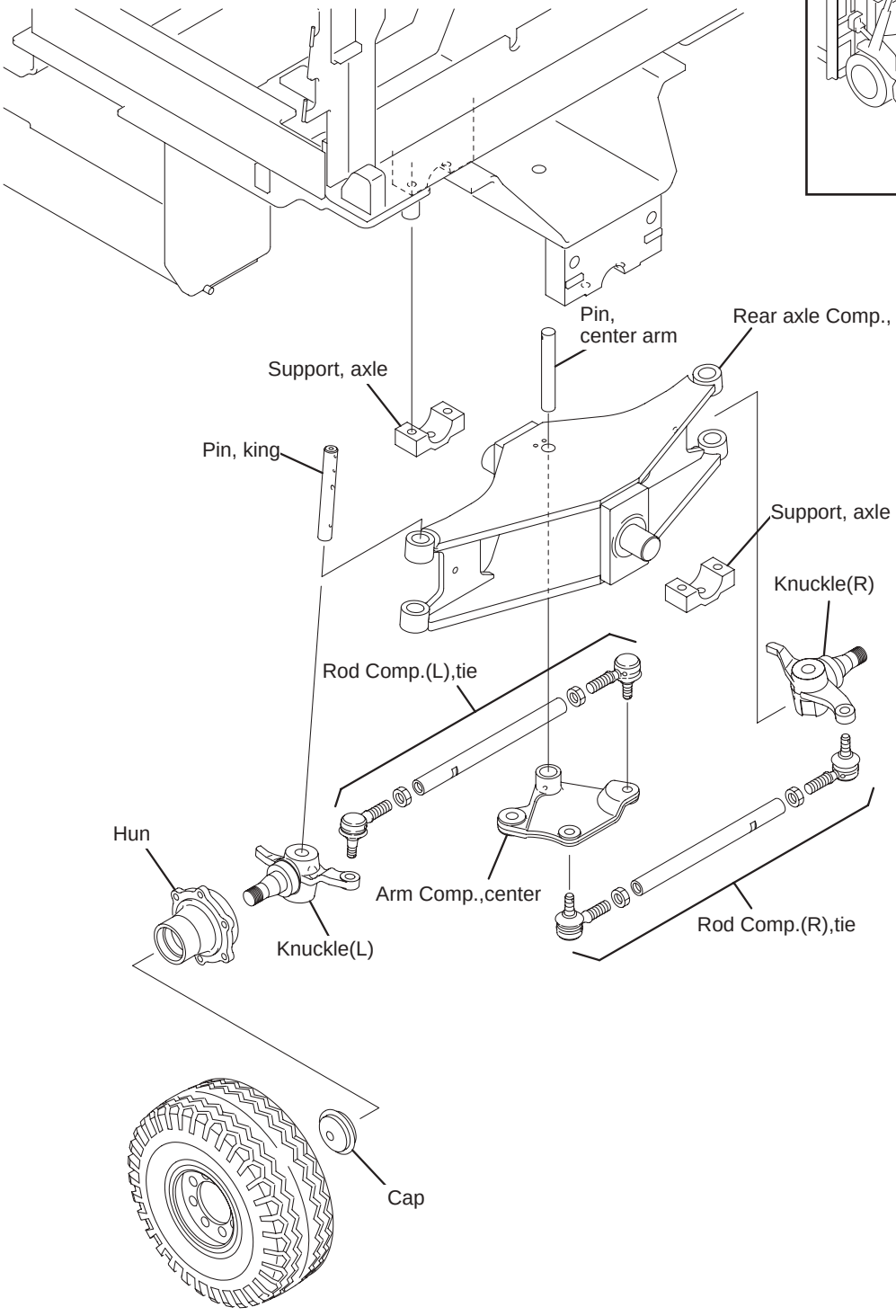
3. REAR AXLE (STEERING)

3- 1. Location and name

Rear axle



●**Main parts of rear axle (Steering)**



3- 2. Disassembly and reassembly

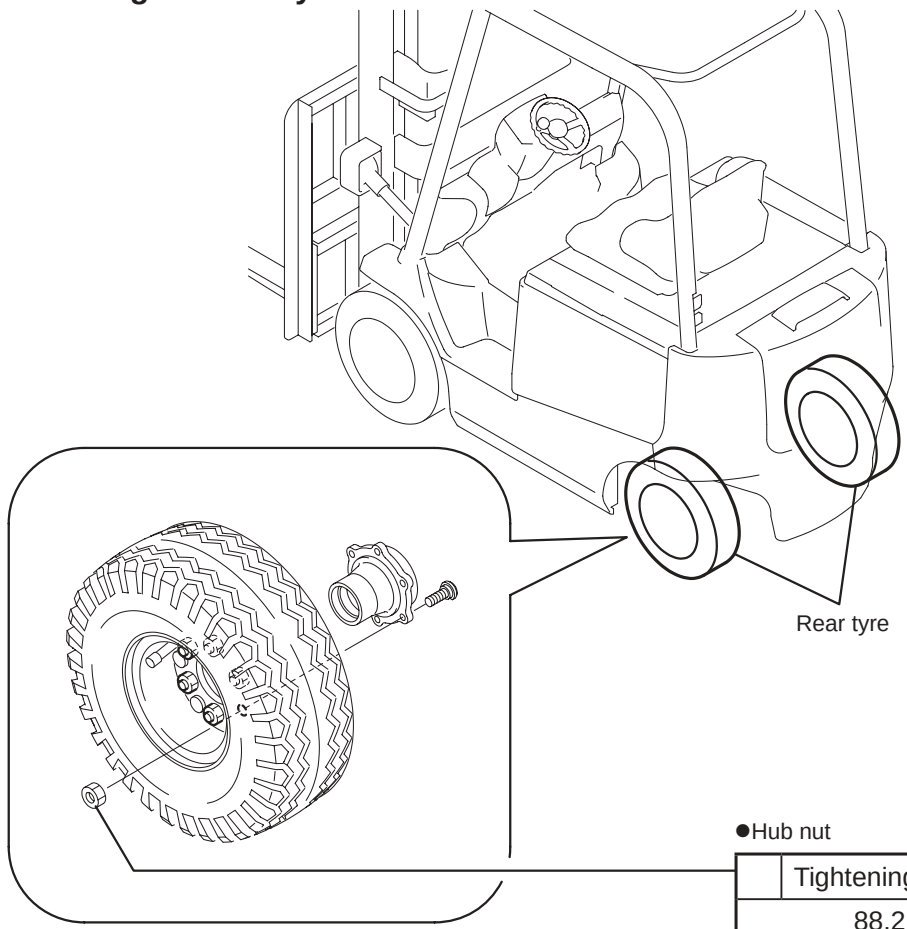
⚠ CAUTION

- **Lift or jack up the forklift truck and support it with safety blocks or rigid stands.**
- **Apply wheel chocks to tyres to prevent the truck from moving.**
- **Record places of lead wire connections before disassembling.**
- **Turn the key switch off and operate hydraulic levers a few times to release high pressure in the hydraulic piping before disconnecting hydraulic hoses or pipes.**
- **When disconnecting hydraulic pipes, cap them to prevent dust from entering into hydraulic components and pipes.**
- **Be sure to disconnect the battery plug.**

3-2-1. Rear axle - removal and installation

1. Rear tyre should be removed before removing the rear axle.

●Removing the rear tyre



●Hub nut

	Tightening torque
	88.2 - 108 N・m
	{9 - 11 kgf・m}

: Tightening torque

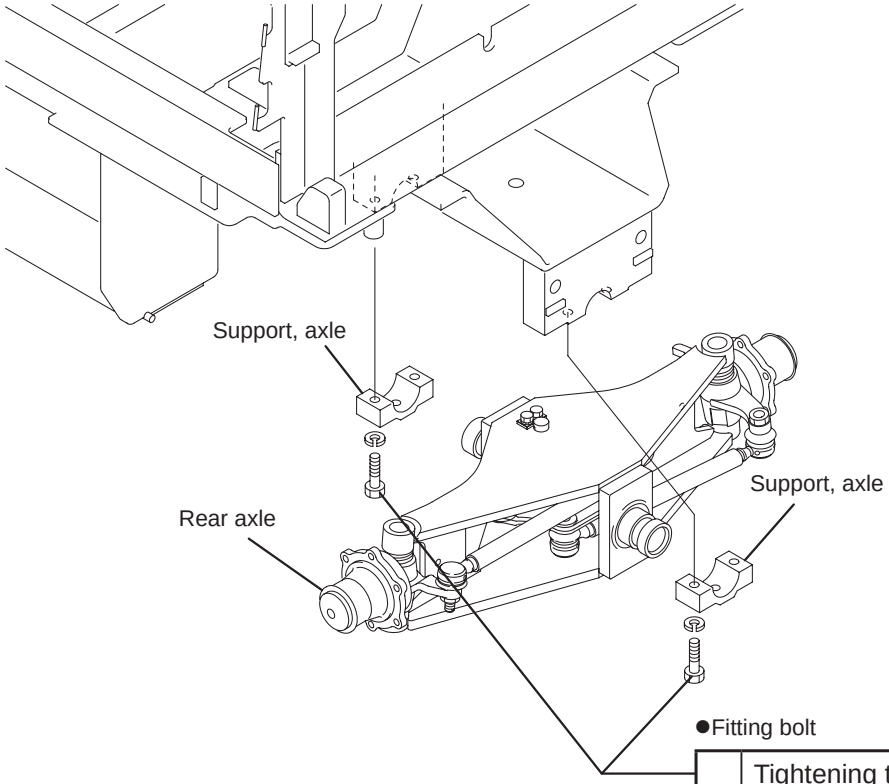
2210014

2. A rear axle should be supported from the lower side with the lift etc.

3. Remove the fitting bolt of "support, axle".

4. Remove the rear axle.

●Removing the rear axle



Tightening torque
87 - 107 N・m
{8.9 - 10.9 kgf・m}

: Tightening torque

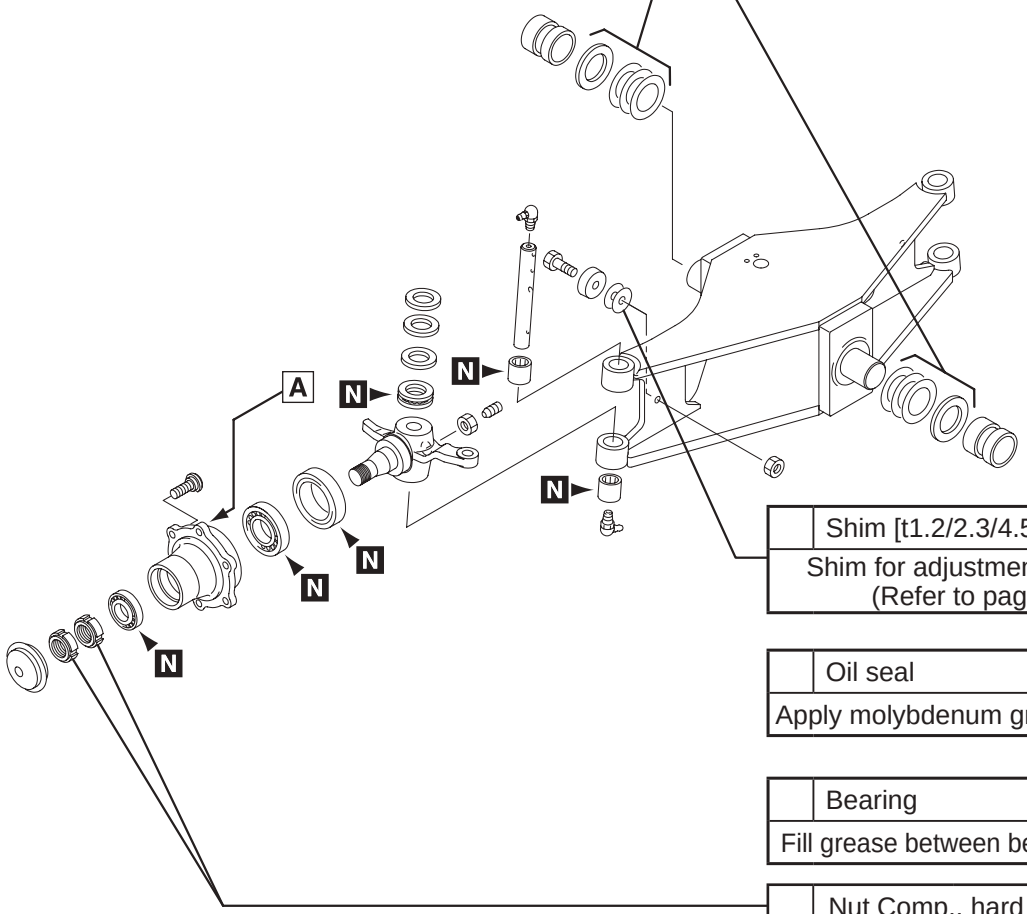
2210015

* Installation the rear axle in reverse order of disassembly.

3-2-2. Rear axle - disassembly and reassembly

Knuckle · hub, etc.

●**Disassembling and reassembling the rear axle (1)**



	Shim [t0.5/1.0/2.3/3.2mm]
	Clearance value : 0.1-0.7mm
	Shim [t1.2/2.3/4.5mm]
	Shim for adjustment the angle (Refer to page 41.)
	Oil seal MG
	Apply molybdenum grease on rip.
	Bearing G
	Fill grease between bearing.
	Nut Comp., hard lock
Tightening torque [Convex side]	21 ~ 31 N · m {2.1 ~ 3.1 kgf · m}
Tightening torque [Concave side]	73-88 N · m {7.4-9 kgf · m}
A	Bearing preload
Measure at A (hub bolt installation position).	44-64 N · m {4.5-6.5 kgf · m}

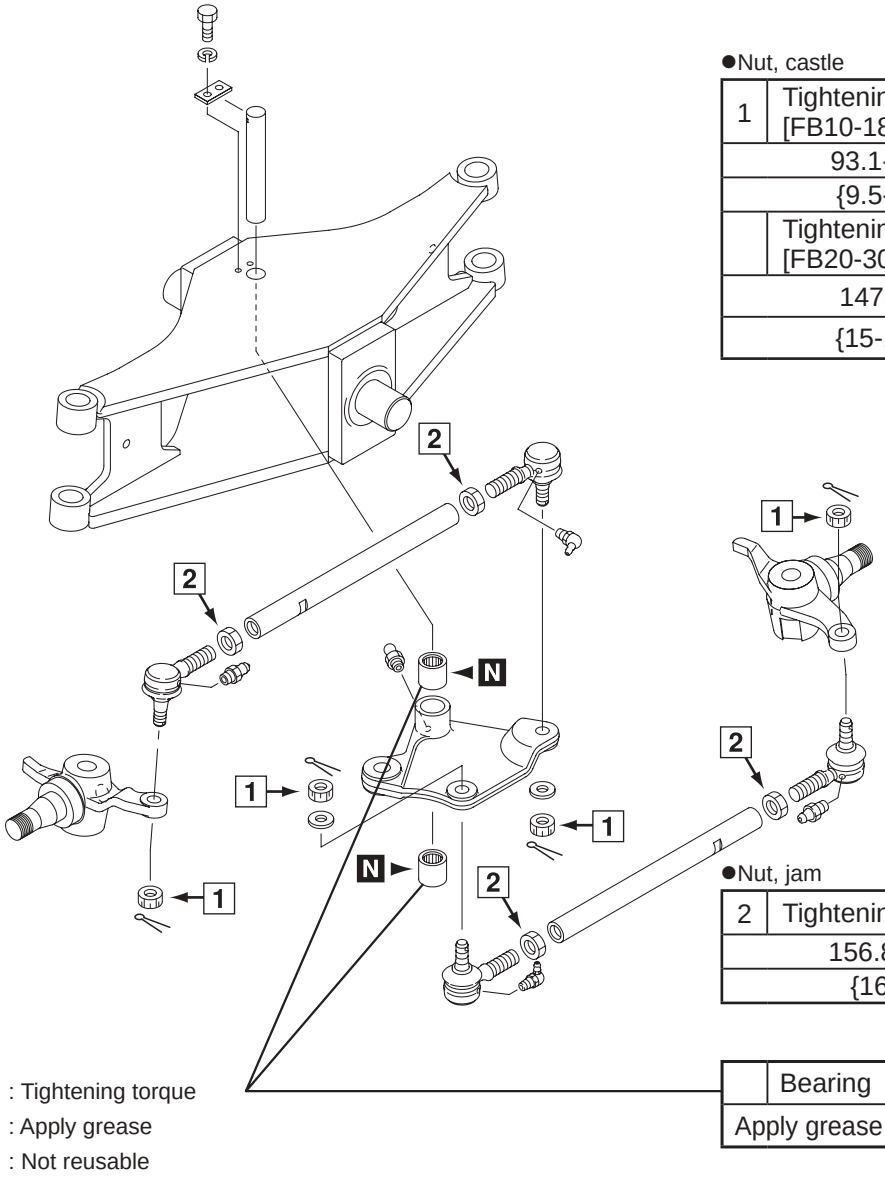
: Tightening torque
G : Apply grease
MG : Apply molybdenum grease
N : Not reusable

CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

Center arm · tie rod, etc.

●Disassembling and reassembling the rear axle (2)



●Nut, castle

1	Tightening torque [FB10-18P]	
	93.1-1112.7 N · m	
	{9.5-11.5 kgf · m}	
	Tightening torque [FB20-30P]	
	147-171.5 N · m	
	{15-17.5 kgf · m}	

●Nut, jam

2	Tightening torque	
	156.8-176.4 N · m	
	{16-18 kgf · m}	

	Bearing	G
Apply grease between bearing.		

⚠ CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

3-2-3. Rear axle - Reassembling method and attention

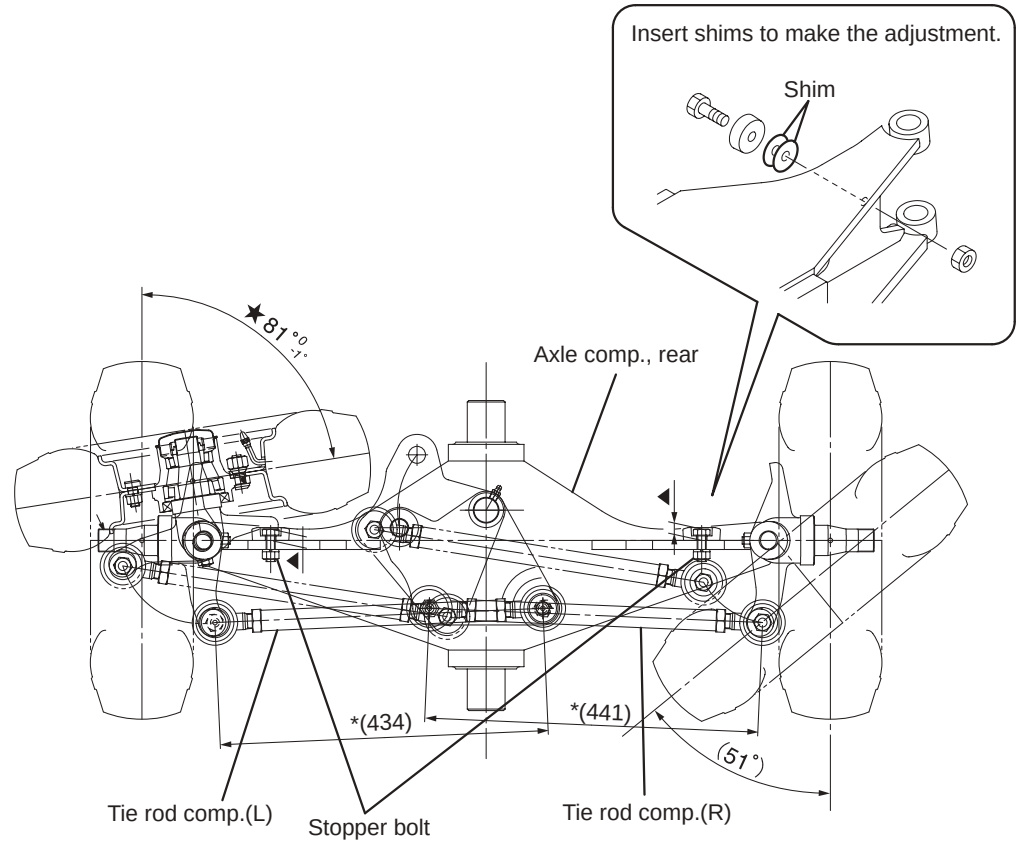
<FB10P/14P/15P/18P>

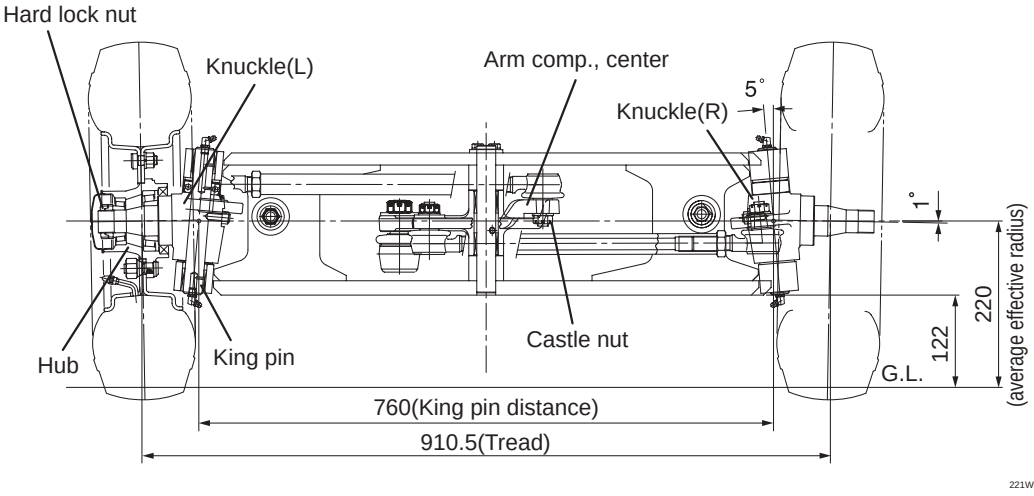
1.Adjust the length of the tie rod comps (L)/(R), and set parts to dimensions indicated by * marks. However, they are the designed dimension, so there may be some differences depending on actual parts. In such a case, adjust to actual dimensions of parts.

(2) Insert and adjust the shim to become the angle of ★ sign to size ▲ of the stopper bolt. (two places)

●Reassembling the rear axle

FB10P-18P





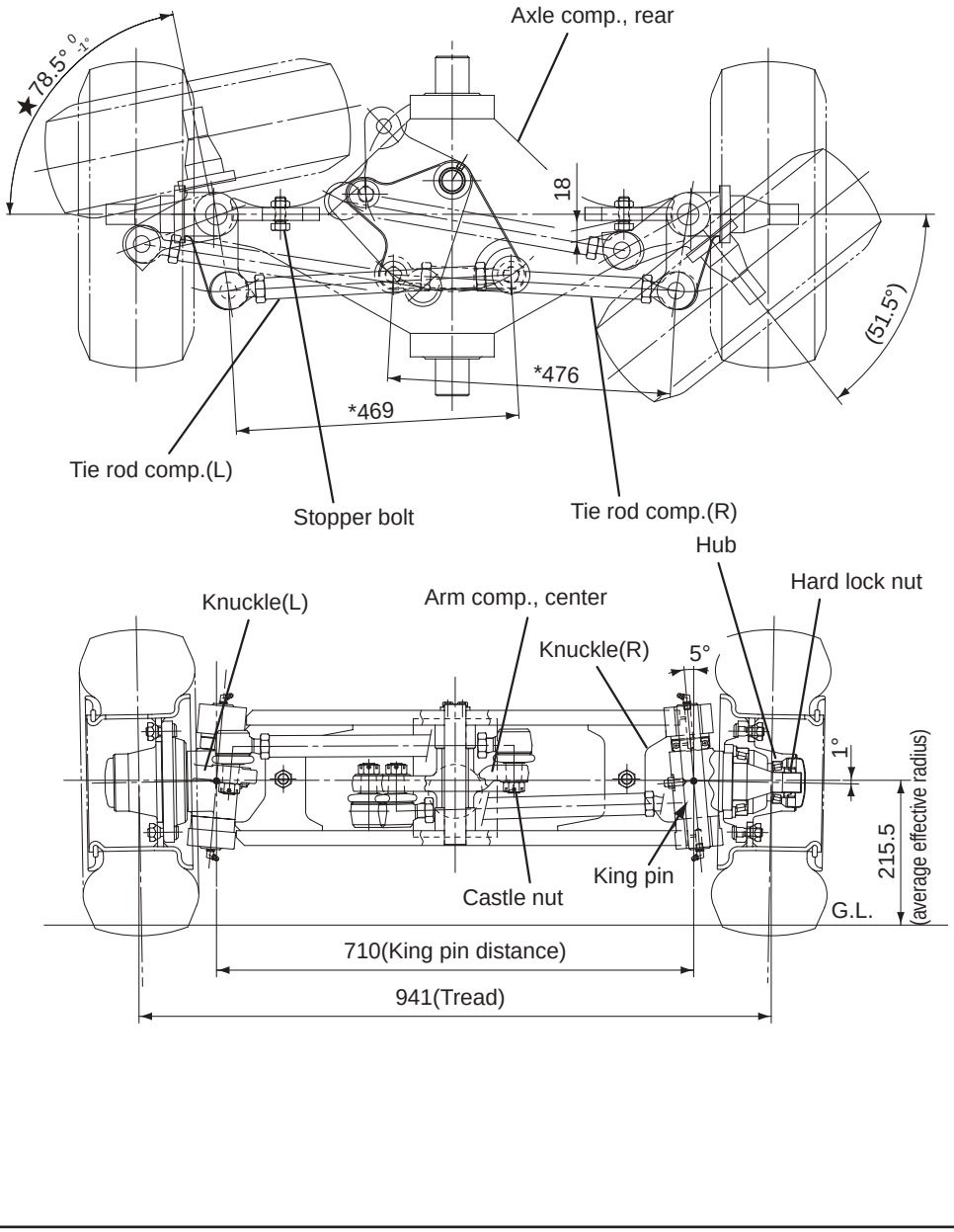
<FB20P/25P/28P>

1.Adjust the length of the tie rod comps (L)/(R), and set parts to dimensions indicated by * marks. However, they are the designed dimension, so there may be some differences depending on actual parts. In such a case, adjust to actual dimensions of parts.

2. Adjust the height of the stopper bolt, and then adjust the maximum rotation angle for the part marked ★ .

●Reassembling the rear axle

FB20P-28P



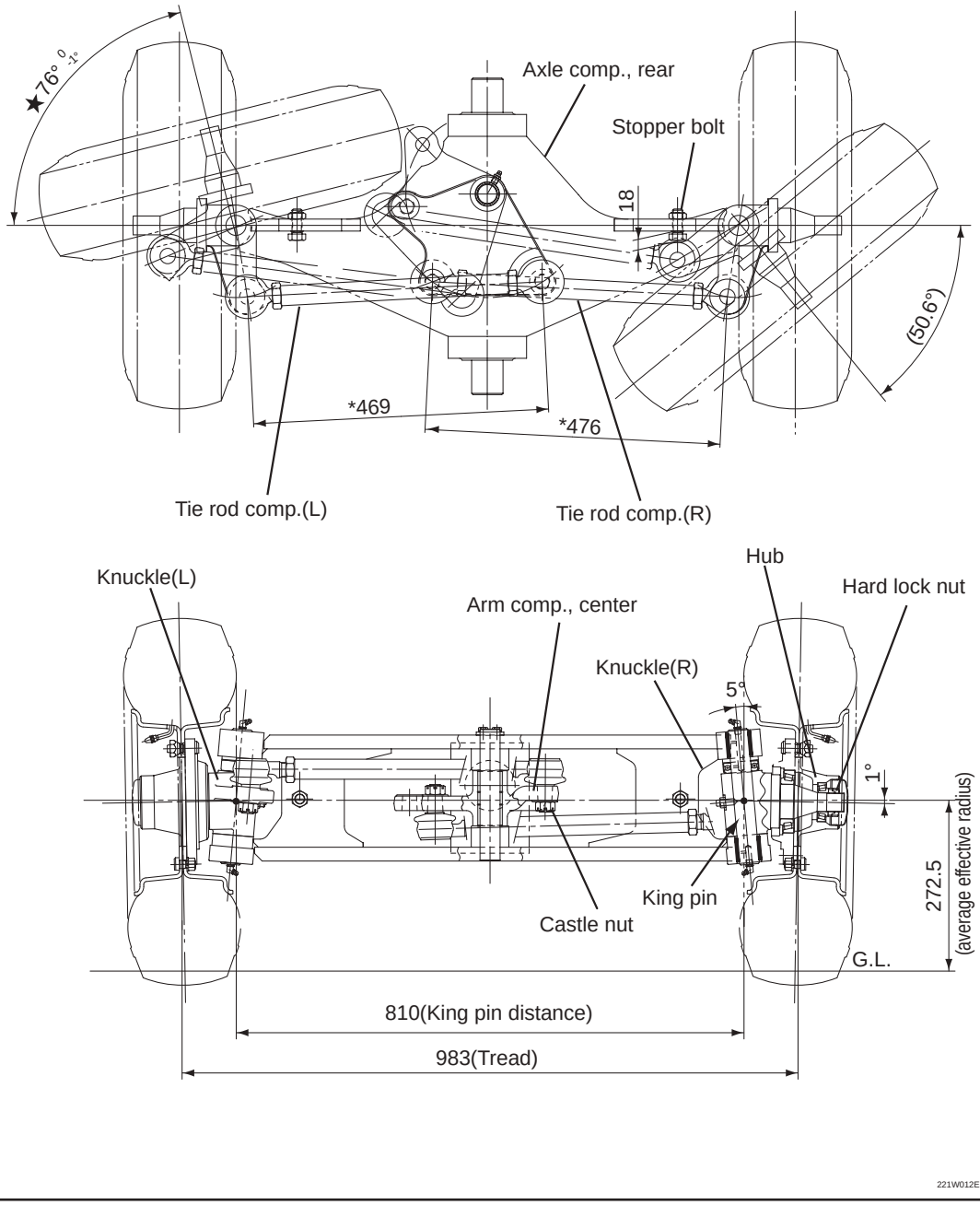
<FB30P>

1.Adjust the length of the tie rod comps (L)/(R), and set parts to dimensions indicated by * marks. However, they are the designed dimension, so there may be some differences depending on actual parts. In such a case, adjust to actual dimensions of parts.

2. Adjust the height of the stopper bolt, and then adjust the maximum rotation angle for the part marked ★ .

●Reassembling the rear axle

FB30P



3- 3. Inspection and adjustment

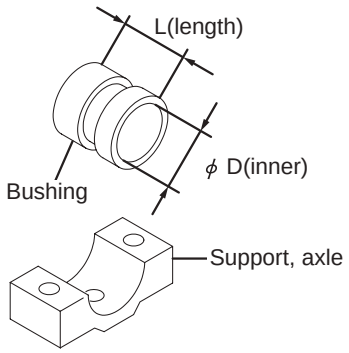
3-3-1. Bushing - inspection

1.Check for wear and damage.

[mm]

Item	Standard value	Wear limit
Bushing	50(ϕ D)×50(L)	50.2(ϕ D)

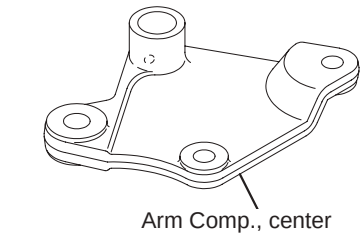
●Inspection of bushing



3-3-2. Center arm - inspection

1.Check for crack.

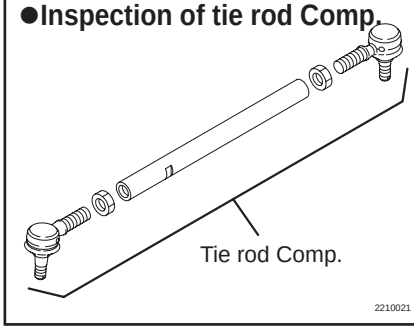
●Inspection of center arm



3-3-3. Tie rod Comp. - inspection

1.Check for straightness.

●Inspection of tie rod Comp.

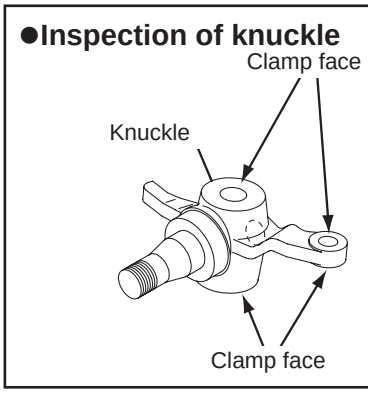


3-3-4. Knuckle - inspection

1.Check for crack.

2. Check for wear on the fitting surfaces of the rear axle comp and the tie rod comp.

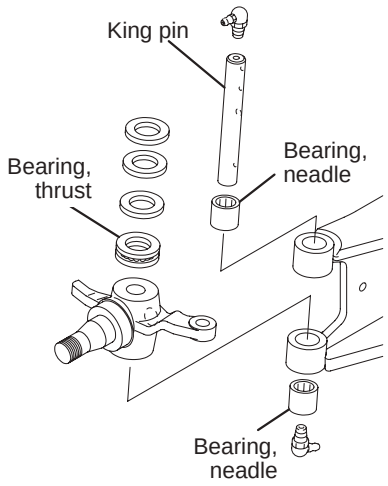
●Inspection of knuckle



3-3-5. King pin - inspection

1.Check for joggling or wear on the surface that contacts the bearing.

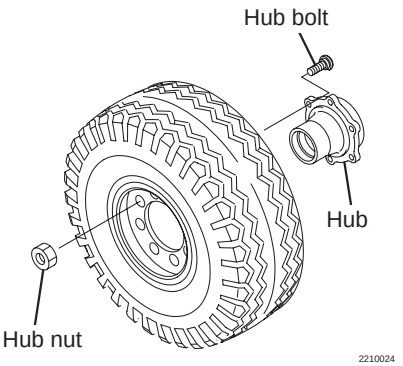
●**Inspection of king pin**



3-3-6. Hub and hub bolt - inspection

1.Check hubs for damage and crack.
2. Check hub bolts for loosening and damage.

●**Inspection of hub and hub bolt**

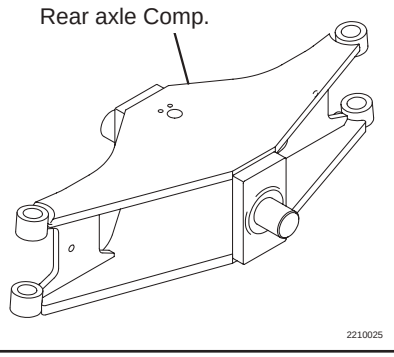


	Tightening torque
	88.2 - 108 N ▪ m
	{9 - 11 kgf ▪ m}

3-3-7. Rear axle Comp. - inspection

1.Check for deformation and damage.

●**Inspection of rear axle Comp.**



3- 4. Troubleshooting

3-4-1. Rear axle - troubleshooting

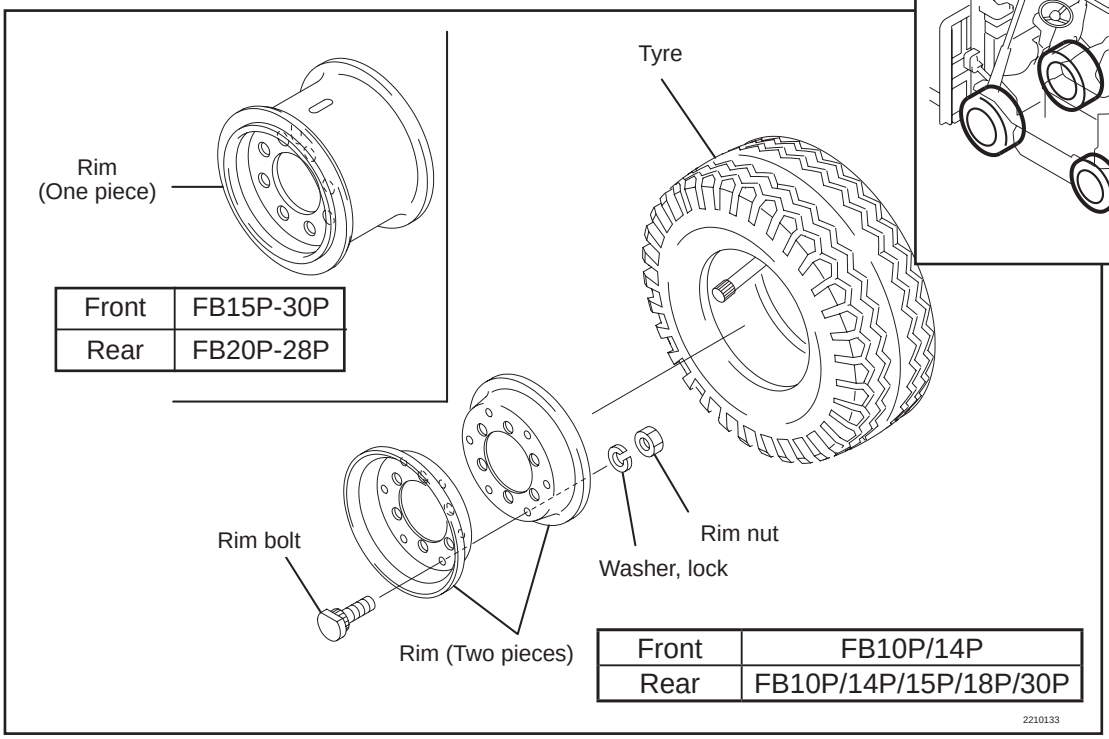
No.	Symptom	Possible cause	Solution
1	Steering is hard.	1. Adjustment of toe-in is not corrent.	Adjust
		2. Bearing for king pin is damaged.	Replace
		3. Low air pressure of wheels	Adjust
		4. Lack of lubrication for rear axle and steering linkage	Lubricate
		5. Connection of linkage is stuck.	Repair or replace
2	Return of steering wheel is bad	1. Steering linkage and each part of rear axle are not adjusted correctly.	Check and adjust
		2. Out of adjustment of wheel alignment	Inspect and adjust
3	Steering wheel is rotated un-expectedly to one side.	1. Incorrect air pressure of wheel	Adjust
		2. Difference of diameter of wheels at L.H. and R.H. sides	Inspect and replace
		3. Out of adjustment wheel alignment (toe-in, camber, king pin and etc.)	Inspect and adjust
		4. Out of adjustment or wear of wheel bearing	Adjust or replace
4	Steering wheel is swung.	1. Large gap between king pin and king pin bearing	Replace
		2. Out of adjustment or wear of wheel bearing	Adjust or replace
		3. Loose hub nuts	Tighten
		4. Heavy wear of ball joint of tie rod socket	Replace
		5. Out of mounting of rear axel	Inspect and adjust
		6. Incorrect air pressure of wheel	Adjust
		7. Out of steering system	Inspect and replace

4. TYRE

⚠ WARNING **Air of the pneumatic tyre shall be discharged completely before disassembling the rim. Failure to observe this instruction can cause serious injury or death by explosion of wheel.**

4- 1. Location, name and tyre size

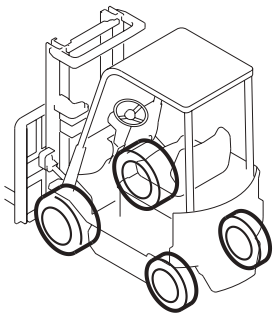
4-1-1. Tyre - location and name



Front	FB15P-30P
Rear	FB20P-28P

Front	FB10P/14P
Rear	FB10P/14P/15P/18P/30P

TYRE



4-1-2. Tyre size

<Pneumatic tyre>

	Applicable model	Size
Front type	FB10P/14P	6.00-9-10PR
	FB15P/18P	21X8-9-14PR
	FB20P-28P	23X9-10-16PR
	FB30P	28X9-15-12PR
Rear type	FB10P-18P	5.00-8-8PR
	FB20P-28P	18X7-8-14PR
	FB30P	6.50-10-10PR

<No puncture tyre>

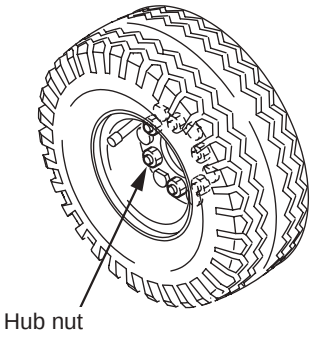
	Applicable model	Size
Front type	FB10P/14P	6.00-9
	FB15P/18P	21X8-9
	FB20P-28P	23X9-10
	FB30P	28X9-15
Rear type	FB10P-18P	5.00-8
	FB20P-28P	18X7-8
	FB30P	6.50-10

4- 2. Inspection and adjustment

4-2-1. Hub nut - inspection

1.Check for damage.
2.Check for loosening.
➡If loose, re-tighten it.

●Inspection of hub nut



▸ Front

Tightening torque (M12)	
[FB10P/14P]	89-108 N・m {9-11 kgf・m}
Tightening torque (M16)	
[FB15P/18P]	216-264 N・m {22-27 kgf・m}
Tightening torque (M18)	
[FB20P-30P]	315-385 N・m {32-39 kgf・m}

▸ Rear

Tightening torque (M18)
88.2-108 N・m {9-11 kgf・m}

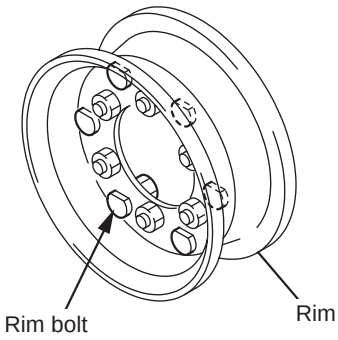
4-2-2. Rim and rim bolt - inspection

1.Check for damage.
2.Check for loosening.
➡If loose, re-tighten it.

NOTE

There are no rim bolts for the following models:
Front : FB15P-30P
Rear : FB20P-28P

●Inspection of rim and rim bolt



▸ Front

Tightening torque (M18)	
[FB10P/14P]	68.5-78.5 N・m {7-8 kgf・m}

▸ Rear

Tightening torque	
[FB10P/14P/ 15P/18P/30P]	68.5-78.5 N・m {7-8 kgf・m}

4-2-3. Air pressure - inspection

<Pneumatic tyre>

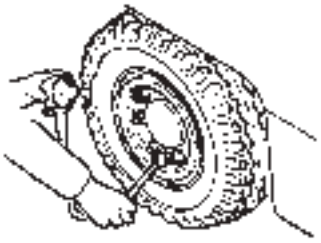
●Front tyre

Applicable model	Type	Air pressure: bar (kgf/cm ^{2})
FB10P/14P	6.00-9-10PR	850kPa(8.5kgf/cm ^{2})
FB15P/18P	21X8-9-14PR	900kPa(9.0kgf/cm ^{2})
FB20P-28P	23X9-10-16PR	900kPa(9.0kgf/cm ^{2})
FB30P	23X9-15-12PR	800kPa(8.0kgf/cm ^{2})

●Rear tyre

Applicable model	Type	Air pressure: bar (kgf/cm ^{2})
FB15P/18P	5.00-8-8PR	850kPa(8.5kgf/cm ^{2})
FB20P-28P	18X7-8-14PR	900kPa(9.0kgf/cm ^{2})
FB30P	6.50-10-10PR	700kPa(7.0kgf/cm ^{2})

●**Inspection of air pressure**



212T001

⚠ CAUTION **Check for the air pressure when the tyres are cool.**

4-2-4. Tyre - visual inspection and replacement

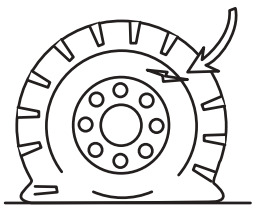
1. Check for cracks, damage, and wear.

➡ Replace the tyre if there are large cracks or damages on the side.

➡ Replace the tyre if there is worn to the bottom of the tread.

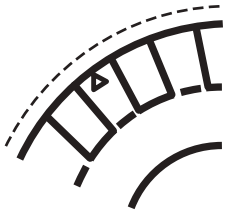
➡ Replace the tyre if there is worn to the wear-limit mark.

●Cracks or damages



●Tyre grooves

● ▲ wearing limit mark



4- 3. Troubleshooting

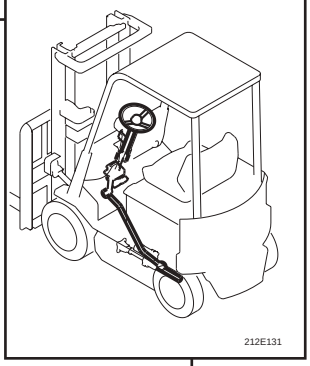
4-3-1. Tyre - troubleshooting

No.	Symptom	Possible cause	Solution
1	Abnormal wear of tyres	1. Incorrect air pressure of tyre	Adjust
		2. Incorrect preload of wheel bearing	Adjust
		3. Different type of wheel or tyre at L.H. and . R.H. sides	Use the same ones.

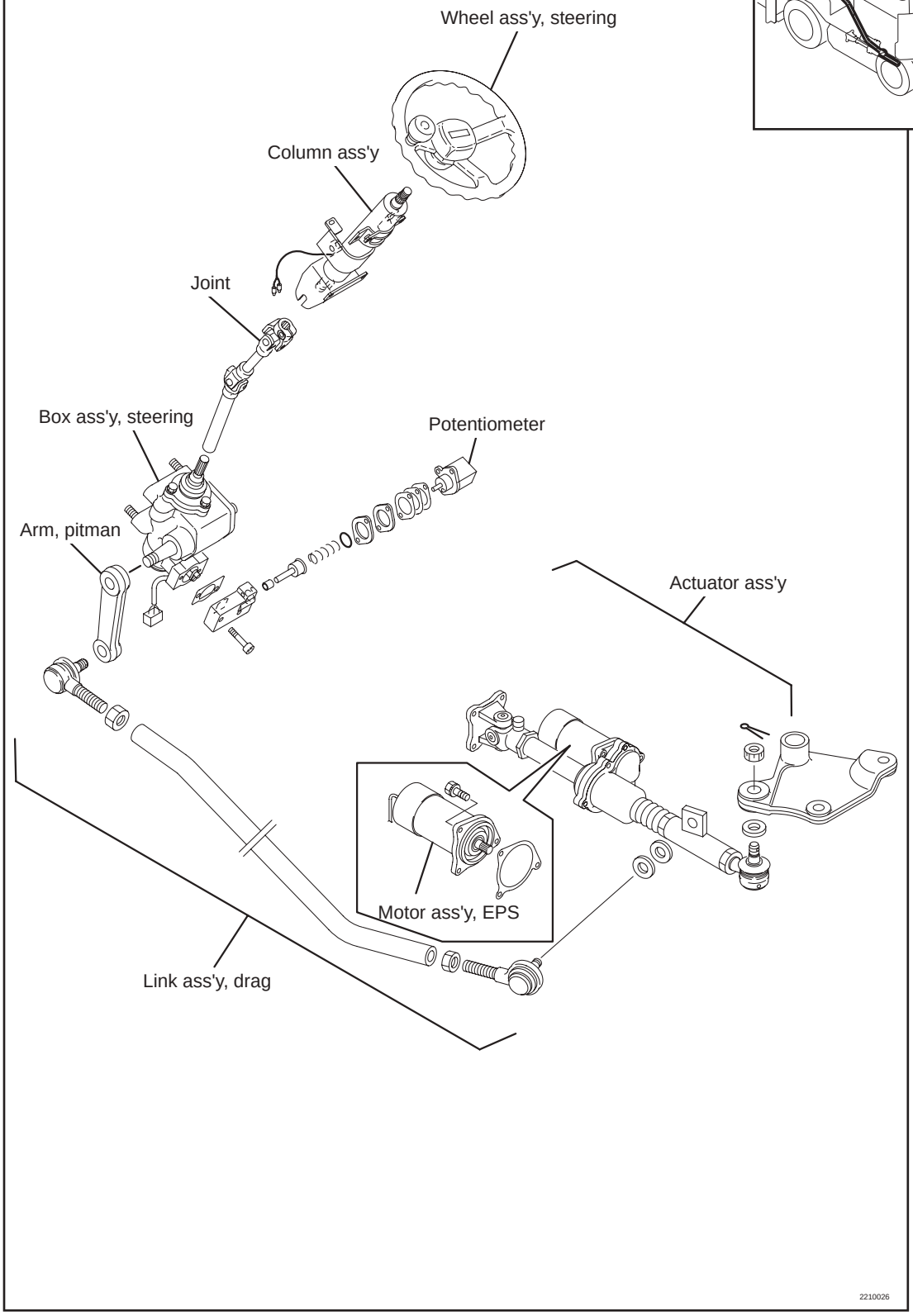
5. STEERING

5- 1. Location and name

STEERING



●**Main parts of steering**



5- 2. Disassembly and reassembly

⚠ CAUTION

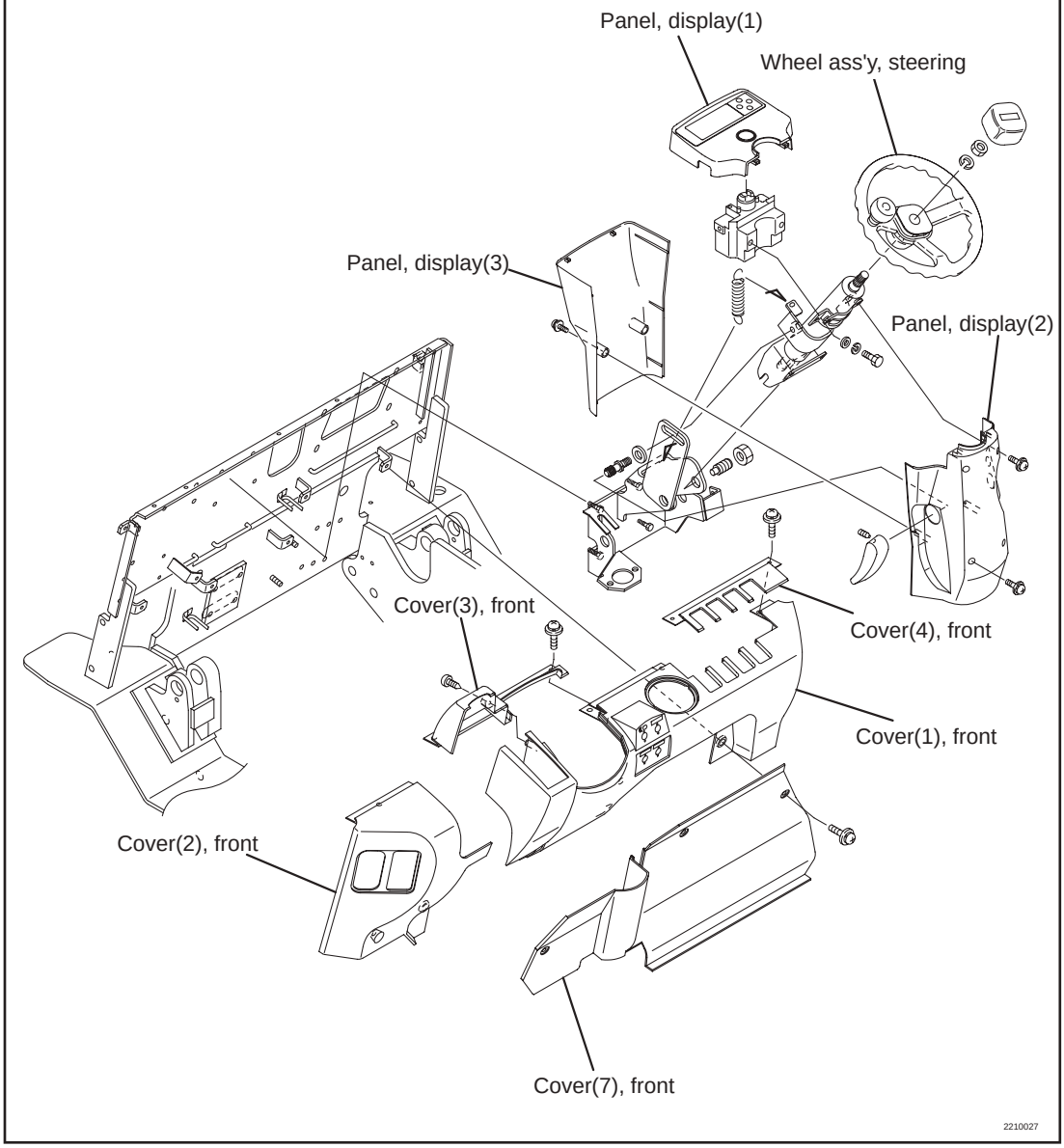
- **Apply wheel chocks to tyres to prevent the truck from moving.**
- **Record places of lead wire connections before disassembling.**
- **Be sure to disconnect the battery plug.**
- **When disconnecting hydraulic pipes, cap them to prevent dust from entering into hydraulic components and pipes.**

5-2-1. Steering linkage - removal and installation

1. The following parts should be removed before removing the steering linkage.

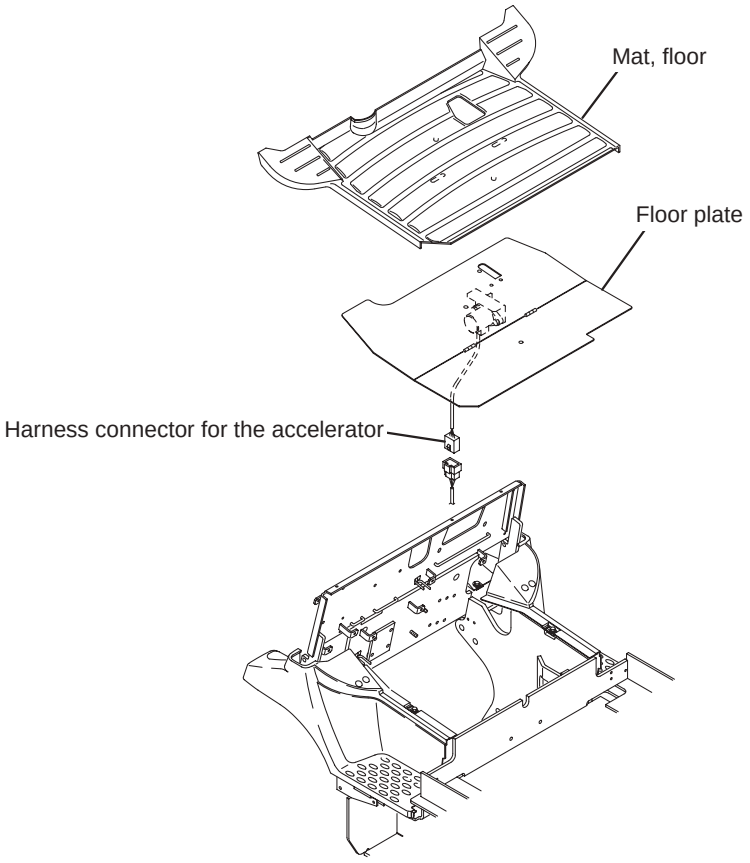
1. Remove the "Wheel ass'y, steering".
2. Remove display panels and front covers as shown in the following illustration.

●Removing the steering wheel ass'y, display panels and front covers



3. Disconnect the harness connector for the accelerator, and remove the floor plate.

●**Removing the floor plate**



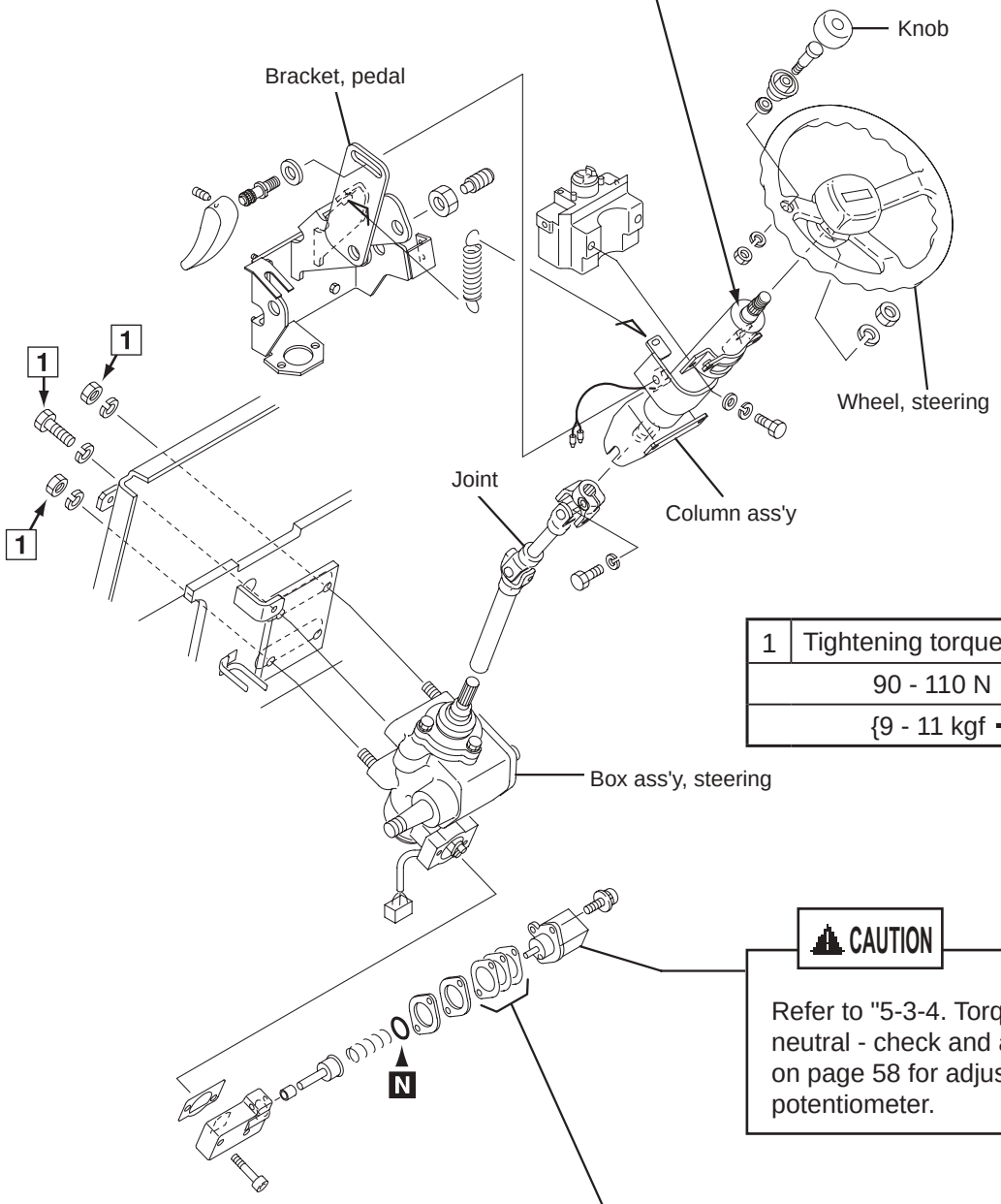
2. Refer to "5-2-2. Steering linkage - disassembly and reassembly" on page 55 for removal of the steering linkage.

* Install the steering linkage in reverse order of removal.

5-2-2. Steering linkage - disassembly and reassembly

Column ass'y, joint, steering box and etc.

●**Disassembling and reassembling the steering linkage (1)**



	Plunger & brush	G
Apply grease on the plunger contact surface and the brush contact surface.		

1	Tightening torque
90 - 110 N ▪ m	
{9 - 11 kgf ▪ m}	

CAUTION

Refer to "5-3-4. Torque sensor neutral - check and adjustment" on page 58 for adjustment of the potentiometer.

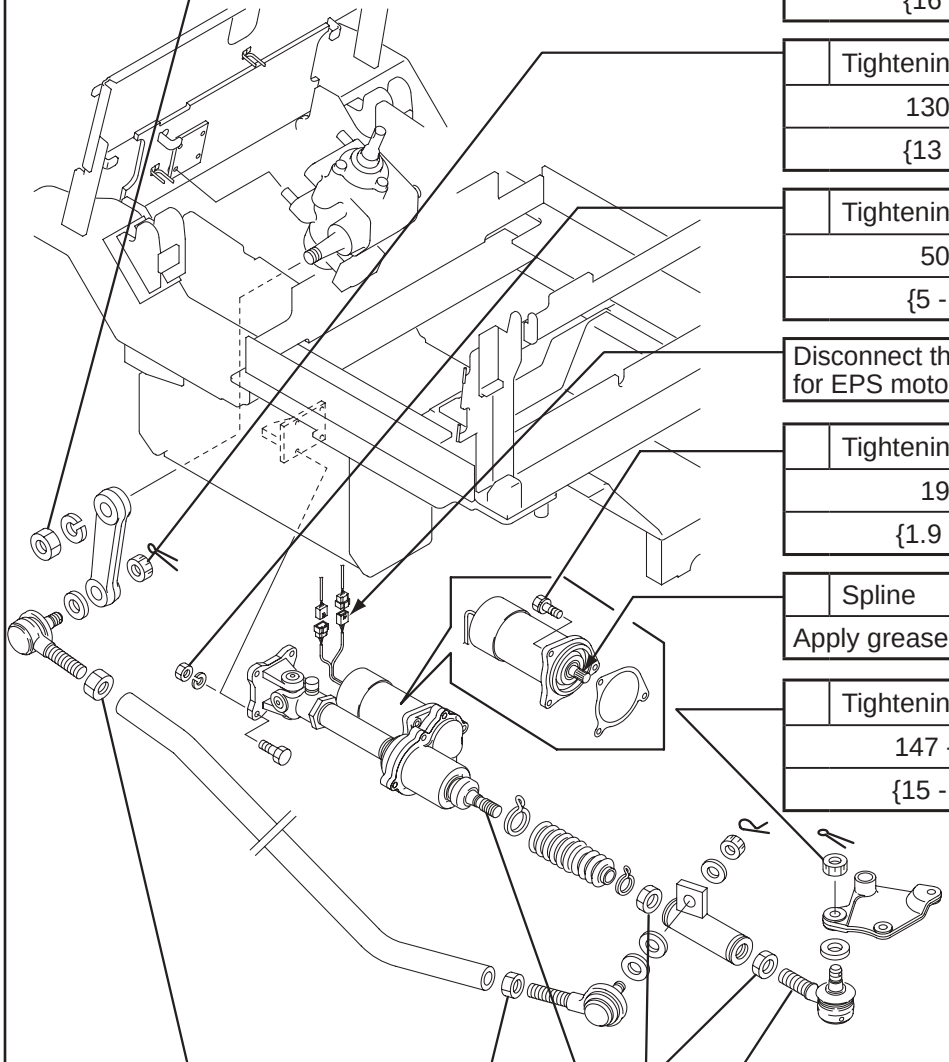
	Shim [t0.2/1.0 mm]
To adjust the potentiometer.	

: Tightening torque
G : Apply grease
N : Not reusable

2210029

Drag link and actuator ass'y

●**Disassembling and reassembling the steering linkage (2)**



Tightening torque	160 - 200 N・m {16 - 20 kgf・m}
Tightening torque	130 - 160 N・m {13 - 16 kgf・m}
Tightening torque	50 - 65 N・m {5 - 6.5 kgf・m}
Disconnect the harness connectors for EPS motor.	
Tightening torque	19 - 30 N・m {1.9 - 3.1 kgf・m}
Spline G	Apply grease on a part of spline.
Tightening torque	147 - 171.5 N・m {15 - 17.5 kgf・m}
Tightening torque	200 N・m {20 kgf・m}
Threads R	After cleaning with grease, apply LOCTITE [#262] or equivalent on threads.
Tightening torque	160 - 200 N・m {16 - 20 kgf・m}
Tightening torque	220 - 260 N・m {22 - 26 kgf・m}

: Tightening torque
G : Apply grease
R : Apply LOCTITE

2210030

5- 3. Inspection and adjustment

5-3-1. Joint - inspection and replacement

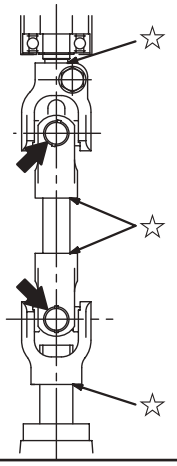
1. Check for abnormal plays at marked parts with arrows.

➡ If abnormal, replace it.

2. Check for crack at marked parts with stars.

➡ If cracked, replace it.

●**Inspection of joint**



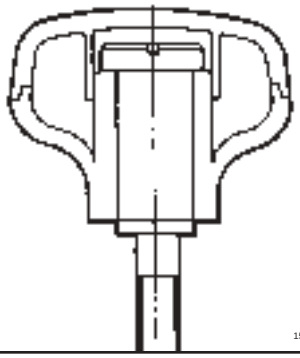
212E044

5-3-2. Knob - inspection and replacement

1. Check for abnormal play and/or crack.

➡ If plays abnormally or cracked, replace it.

●**Inspection of knob**



152T005

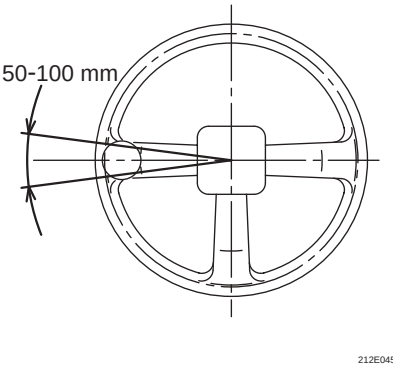
5-3-3. Steering wheel - inspection and replacement

1. Check for crack

➡ If cracked, replace it.

2 After turning off Key switch, measure playing at the steering knob and check if it is within 50 - 100 mm.

●**Inspection of steering wheel**

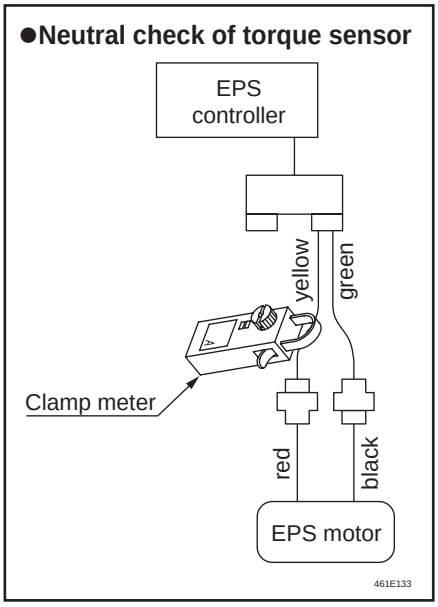


212E045

5-3-4. Torque sensor neutral - check and adjustment

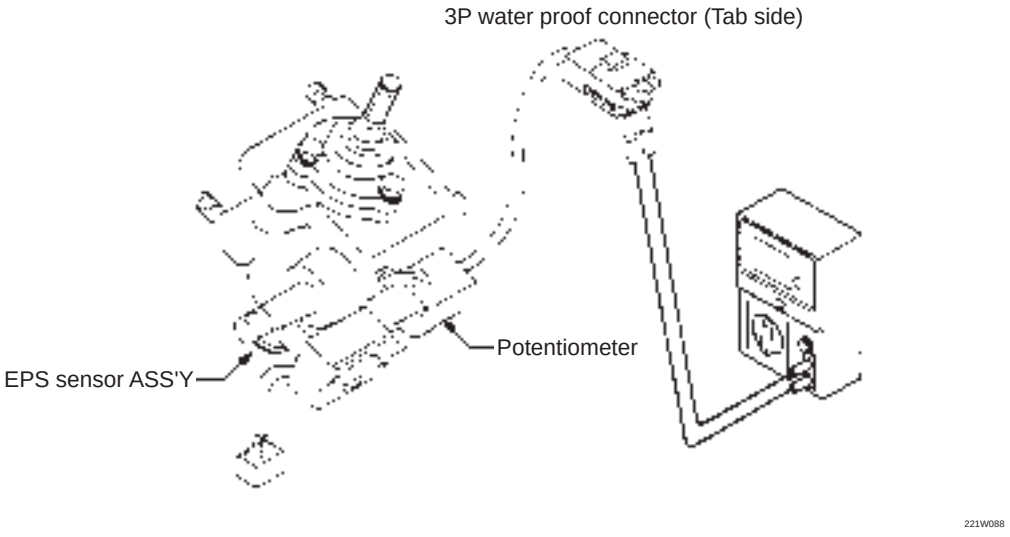
<Checking procedure>

1. Turn the key switch off.
2. Jack up rear wheels from the ground.
3. Remove a rear cover.
   (See "10a-2-1. control unit - removal" on page 154.)
4. Put a clamp meter to a wire [yellow] or [green] between EPS controller and EPS motor [DC range].
5. Turn the key switch on and measure the indication at the clamp meter without steering operation. (= at neutral steer) If the indication shows 0A, it is normal.
6. If any current is flown, adjust the potentiometer by the following procedure.



<Adjusting procedure>

1. Turn the key switch off.
2. Remove the battery plug.
3. Remove the water proof connector.

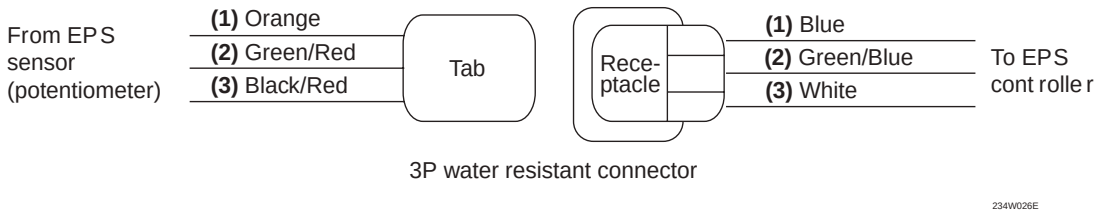


4. Check the resistance between the following pins (tab side).

[Standard value]

- Between (1) pin (orange) and (3) pin (black and red) = Approx. 5kΩ ..... A
- Between (1) pin (orange) and (2) pin (green and red) = Approx. 2.5kΩ ... B
- Between (2) pin (green and red) and (3) pin (black and red) = Approx. 2.5kΩ..... C

Make to the same value.



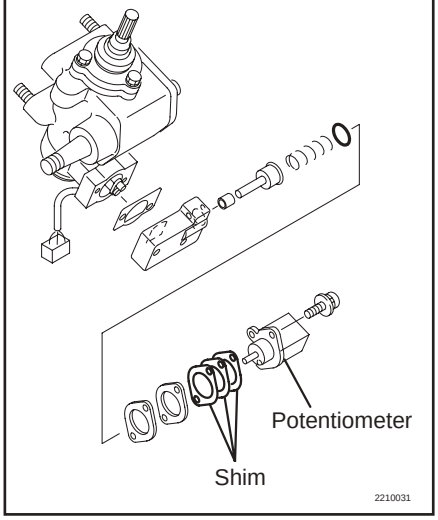
5. Adjust for the resistance of above-mentioned B and C to reach the same value by Shim.

NOTE

Resistance is somewhat different depending on the kind of the tester.

6. Check the current of the EPS motor doesn't flow at a neutral position of the steering according to <Checking procedure> of last page.

● **Adjustment of torque sensor neutral**



5-3-5. Checking by voltage

<Checking by voltage>

Neutral adjustment of the potentiometer can be checked by its output voltage.

<Checking procedure>

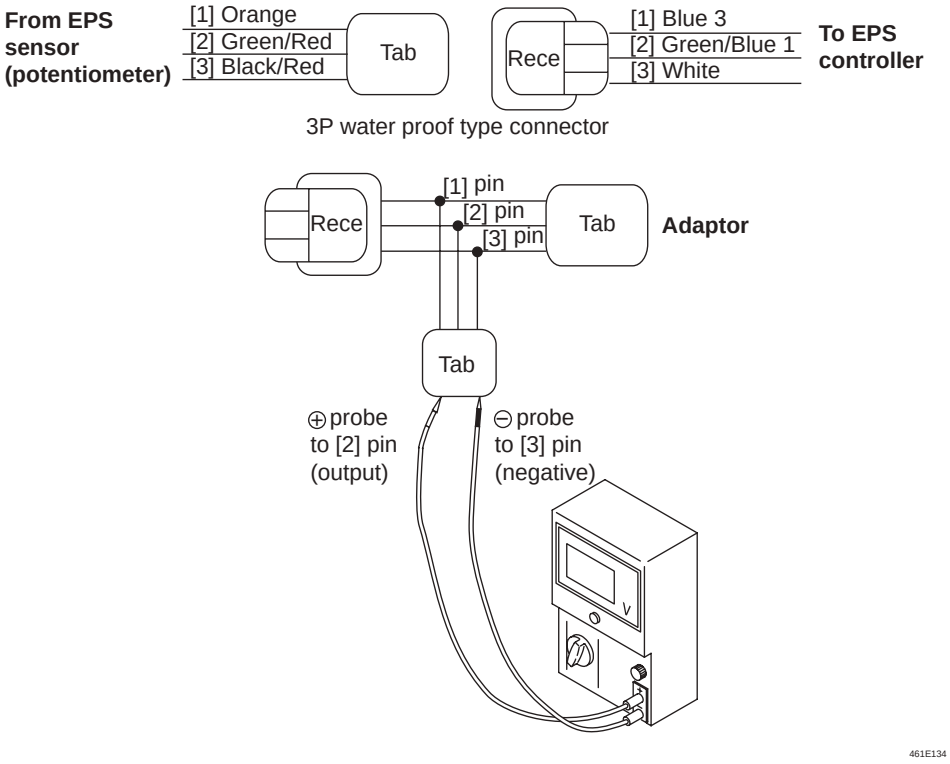
1) Turn the key switch off.
2) Disconnect the connector of the torque sensor and put the adapter for measuring voltage.

NOTE

As the connector of the torque sensor is waterproof type, it is impossible to put the tester probe. Make an adapter by using the same type adapter.

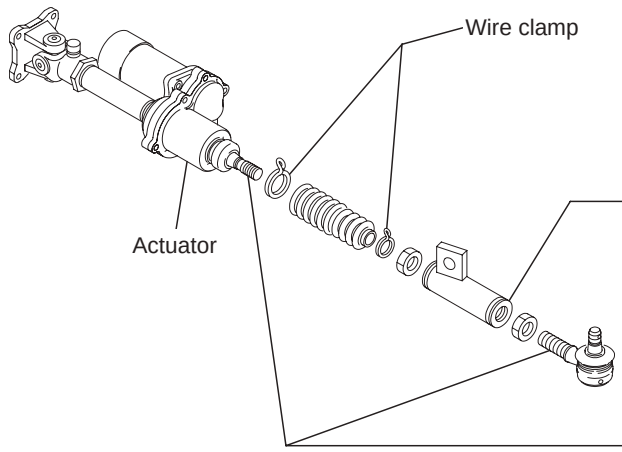
3) Check the voltage at [2] pin [Green/Red or Green/Blue 1] of the adapter.
4) Turn the key switch on and operate the steering wheel from right side end to left side end, then check the voltage. The following values are the standard.

Right side end	0.6 ± 1.8V
Neutral	2.4 ± 2.6V
Left side end	3.2 ± 4.4V



5-3-6. Actuator ass'y - inspection and adjustment

●Inspection of actuator ass'y

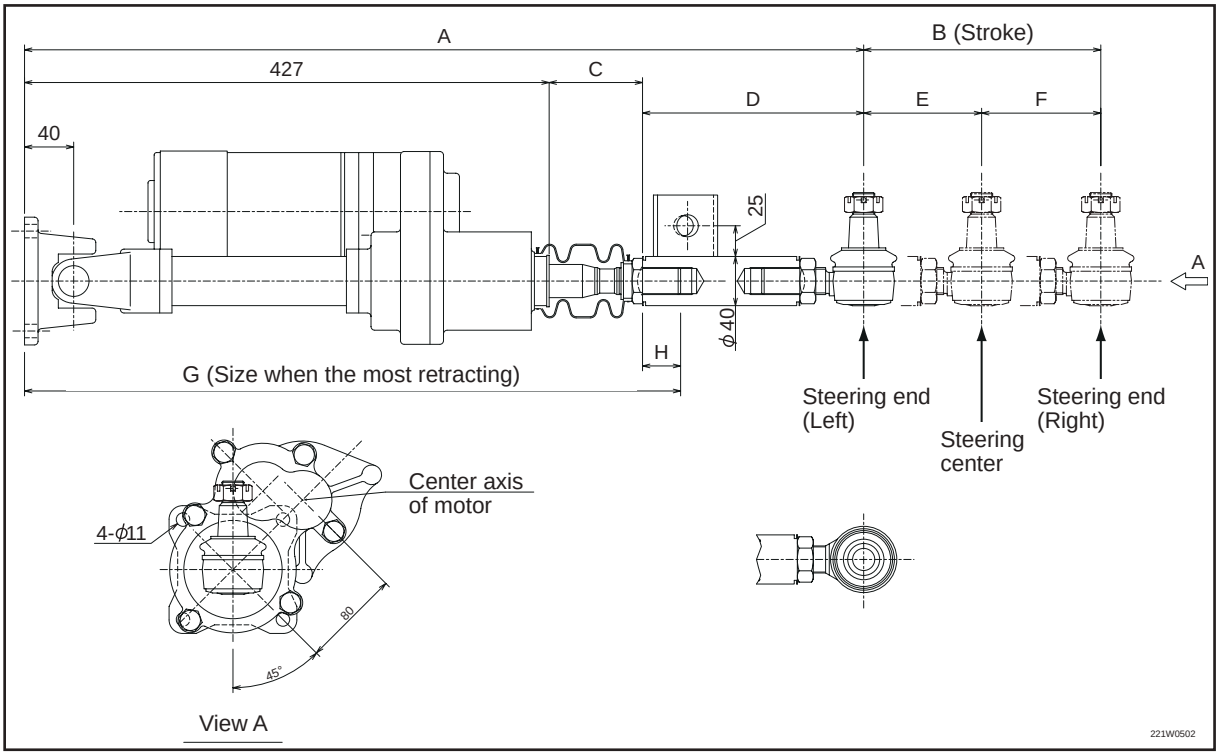


	Socket
Bend the socket edge side along the lock washer after tightening the nut.	

	Threads	L
After cleaning greases, apply LOCTITE [#262] or equivalent on threads.		

L : Apply LOCTITE

221W0501



221W0502

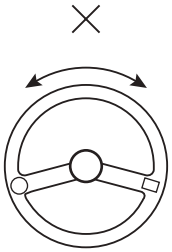
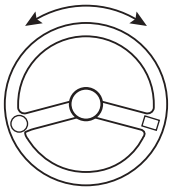
	A	B	C	D	E	F	G	H
FB10P~18P	700	179	91	182	91	88	539	21
FB20P~28P	678	196	73.5	177.5	98	98	532	31.5
FB30P	683	193	76	180	96	97	534	31

⚠ CAUTION

Set the position of the steering center properly when the actuator is replaced. Otherwise the ball screw shaft might bend at the steering end position due to excessive pressure.

5- 4. Troubleshooting

5-4-1. Steering linkage - troubleshooting

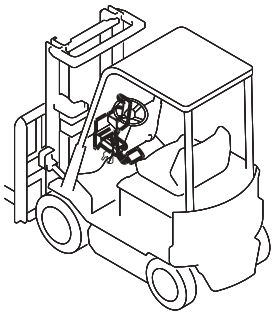
	Symptom		Problem
With the key switch ON and the parking brake is released.	 The steering wheel does not turn!	The main contractor is not turned on.	1 Main contactor 2 EPS controller
		The main contactor trips immediately.	1 EPS controller 2 Torque sensor 3 EPS motor
		The main contactor trips when the steering wheel is turned.	1 EPS controller 2 Torque sensor 3 EPS motor
		The main contactor comes on, but there is no power steering.	1 EPS controller 2 Torque sensor 3 EPS motor
	 The steering wheel turns, but ...	There is power steering, but it is abnormally heavy.	1 Actuator 2 EPS controller 3 EPS motor 4 Torque sensor
		There is power steering, but it feels like it is sticking.	1 EPS motor 2 Actuator 3 EPS controller 4 Torque sensor
		The steering wheel vibrates and can not be controlled.	1 EPS controller 2 Torque sensor 3 Poor connector and/or harness connection in EPS controller, EPS motor, or torque sensor
		Self-steering (The steering wheel operates by itself.)	1 EPS controller 2 Torque sensor
	Other	The motor becomes abnormally hot.	1 EPS controller 2 Torque sensor 3 Actuator 4 EPS motor

6. BRAKE

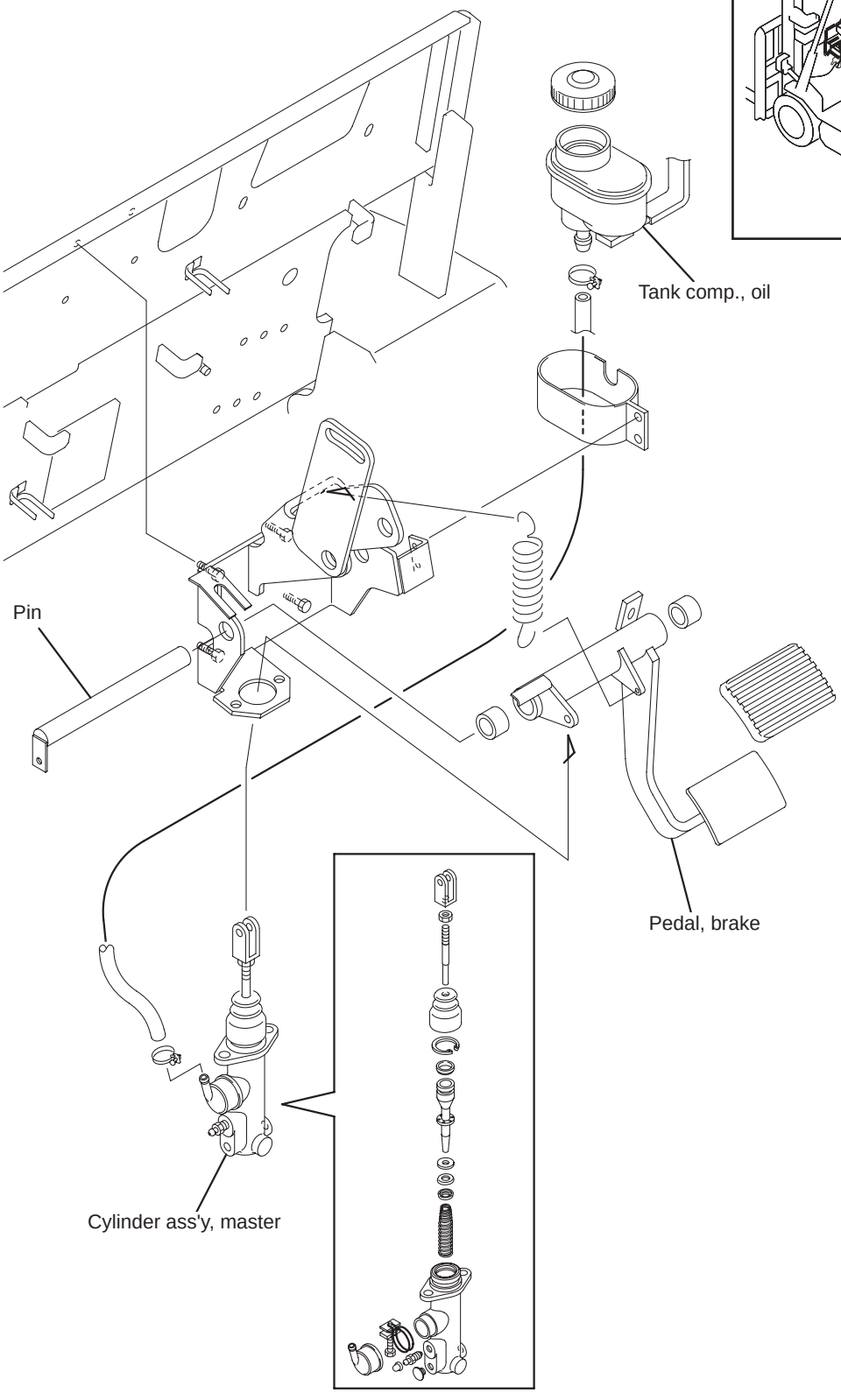
6- 1. Location and name

6-1-1. Foot brake linkage - main part names

FOOT BRAKE LINKAGE

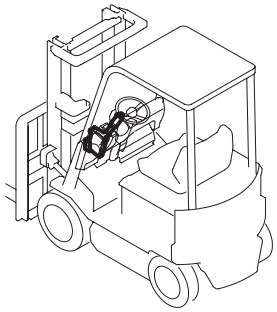


●**Main parts of foot brake linkage**

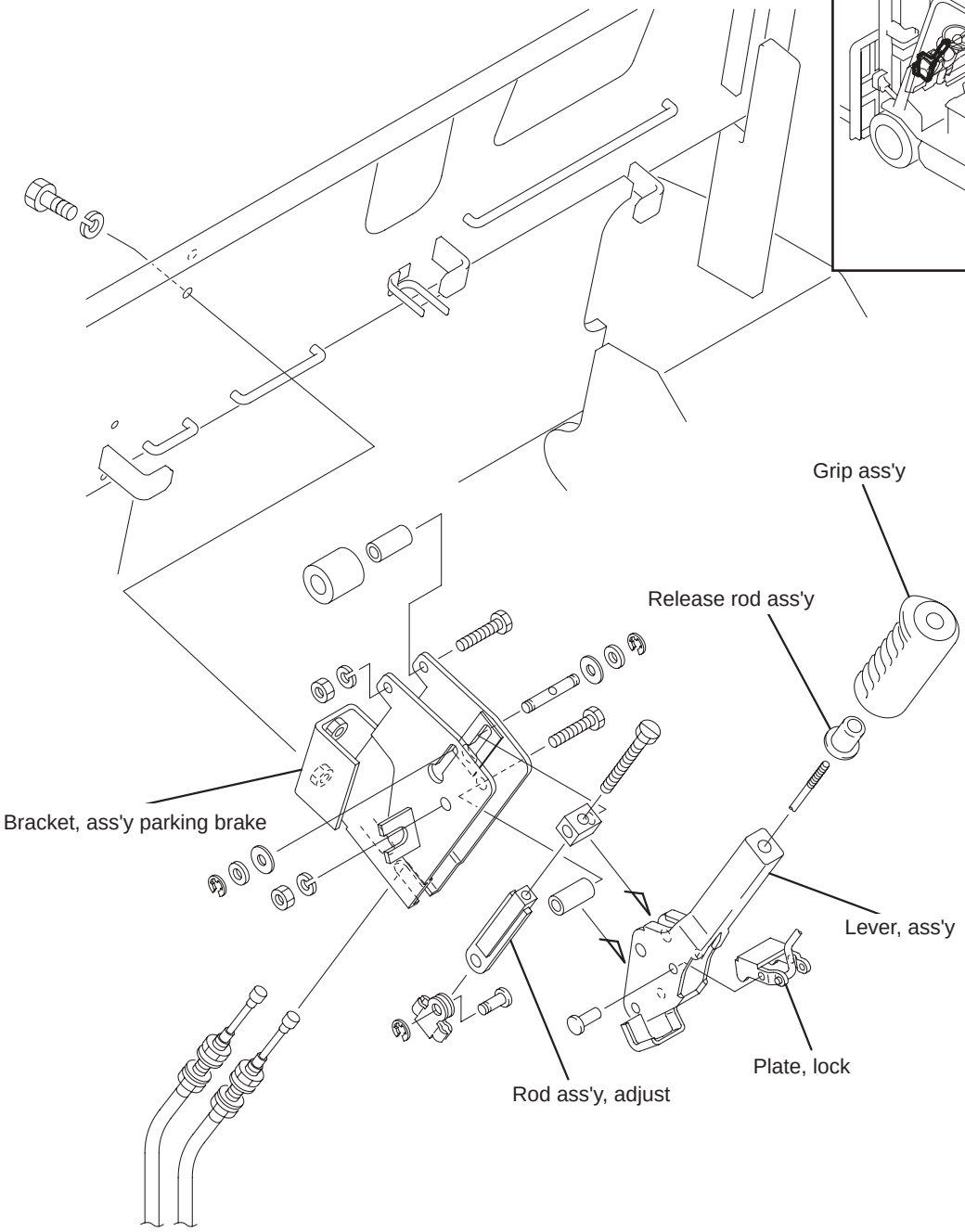


6-1-2. Parking brake linkage - main part names

PARKING BRAKE LINKAGE



●Main parts of parking brake linkage



6- 2. Disassembly and reassembly

⚠ CAUTION

- **Lift or jack up the forklift truck and support it with safety blocks or rigid stands.**
- **Apply wheel chocks to rear tyres to prevent the truck from moving.**
- **Be sure to disconnect the battery plug.**

6-2-1. Wheel brake - removal and installation

1. The following parts should be removed before removing the wheel brake.

1. Remove hub nuts to remove the front tyre.
2. Remove fitting nuts (*1) for the drive shaft.
3. Remove the drive shaft.
4. Remove bearing nuts to remove the wheel hub and brake drum.

2. Remove fitting bolts(*2) to remove the wheel brake ass'y.

* Install the wheel brake in reverse order of removal.

●Removing the wheel brake ass'y

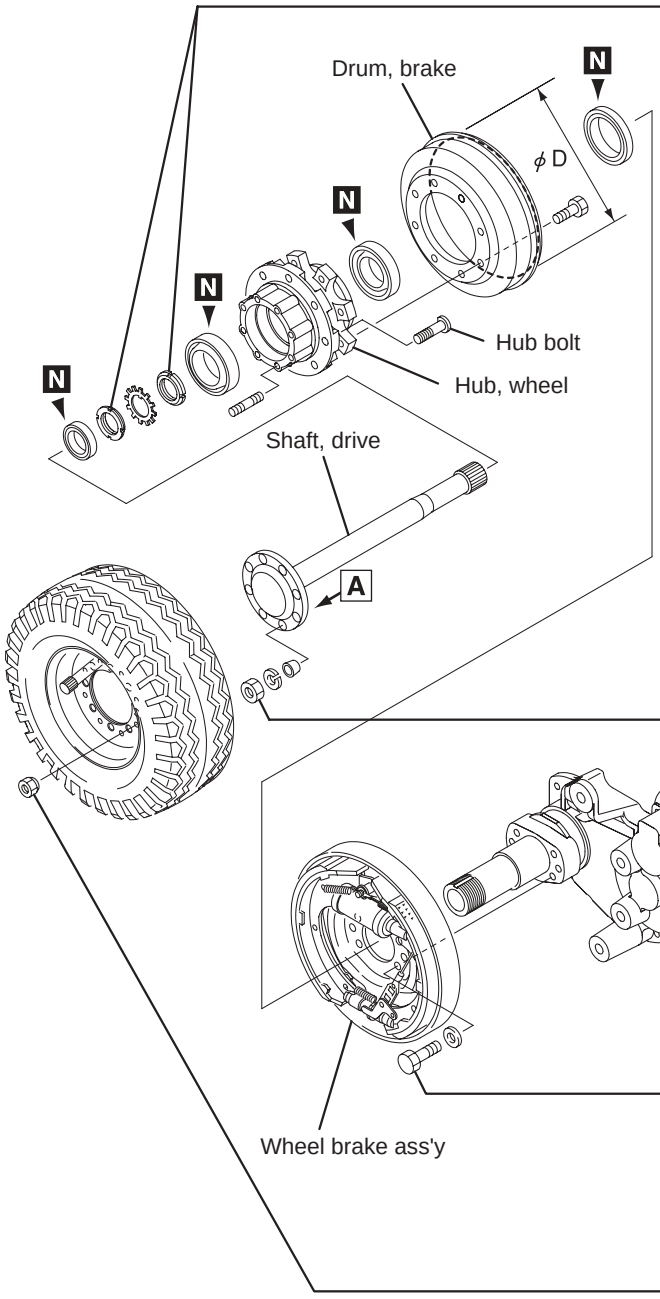
FB10P/14P

●Inner diameter of brake drum

Model	Inner dia (ϕ D)
FB10P/14P	10-inch (254mm)

●Bearing nut

A	Bearing pre-load
Measure at a hub bolt A	392-686 N・m {40-70 kgf・m}



●Fitting nut (*1)

	Tightening torque
[FB10P/14P]	78-108 N・m {8-11 kgf・m}

●Fitting bolt (*2)

	Tightening torque B
Apply THREEBOND [#1360K] or equivalent and tighten.	
[FB10P/14P]	176-235 N・m {18-24 kgf・m}

●Hub nut

	Tightening torque (M12)
[FB10P/14P]	89-108 N・m {9-11 kgf・m}

: Tightening torque
B : Apply THREEBOND
N : Not reusable

221W008E

CAUTION

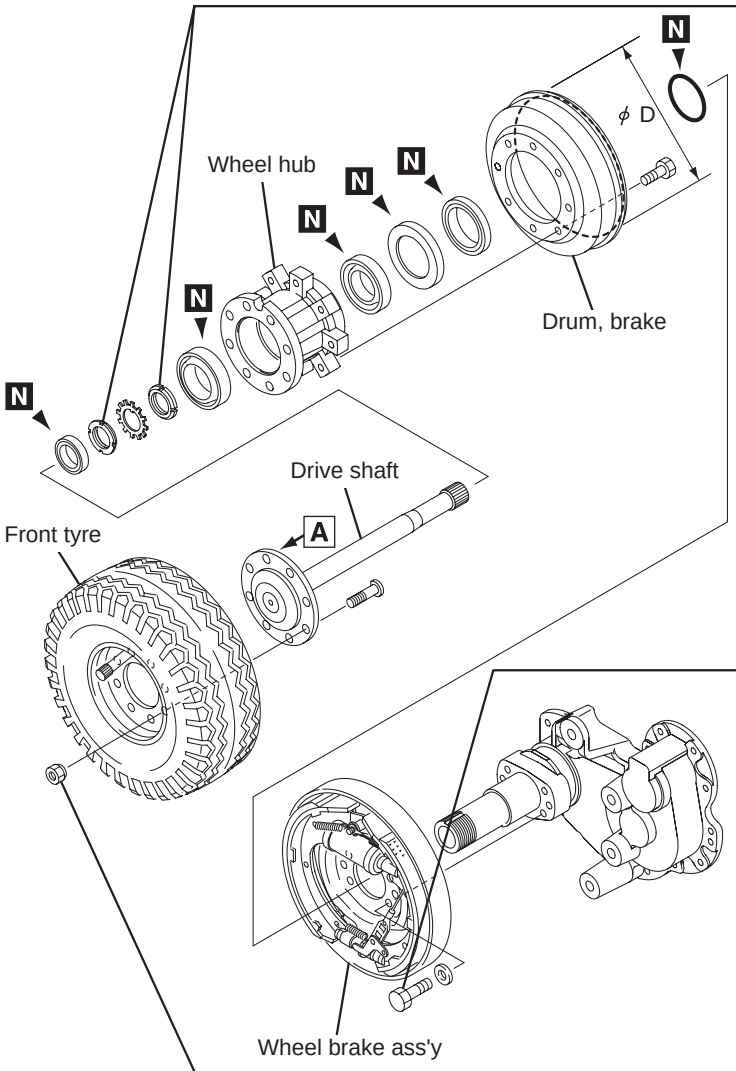
When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

●Removing the wheel brake ass'y

FB15P-30P

●Inner diameter of brake drum

Model	Inner dia. (ϕ D)
FB15P/18P	10-inch (254mm)
FB20P-28P	11-inch (279.4mm)
FB30P	310mm



●Bearing nut

A	Bearing pre-load	
Measure at position A	392-686 N・m	{40-70 kgf・m}

●Fitting bolt (*2)

	Tightening torque B	
Apply THREEBOND [#1360K] or equivalent and tighten.		
[FB15P/18P]	176-235 N・m	{18-24 kgf・m}
[FB20P-30P]	157-206 N・m	{16-21 kgf・m}

●Hub nut

	Tightening torque (M16)	
[FB15P/18P]	216-264 N・m	{22-27 kgf・m}
	Tightening torque (M18)	
[FB20P-30P]	315-385 N・m	{32-39 kgf・m}

: Tightening torque
B : Apply THREEBOND
N : Not reusable

2210156

⚠ CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

6-2-2. Wheel brake - disassembly and reassembly

1. Disassemble the wheel brake ass'y as shown in the following illustration.

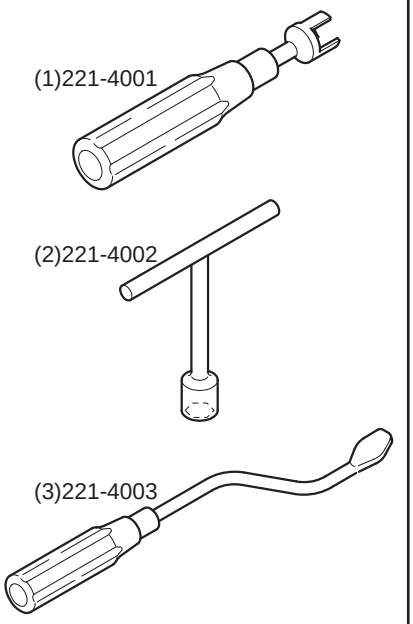
NOTE

When disassembling and assembling the wheel brake, use the special tools for easy work.

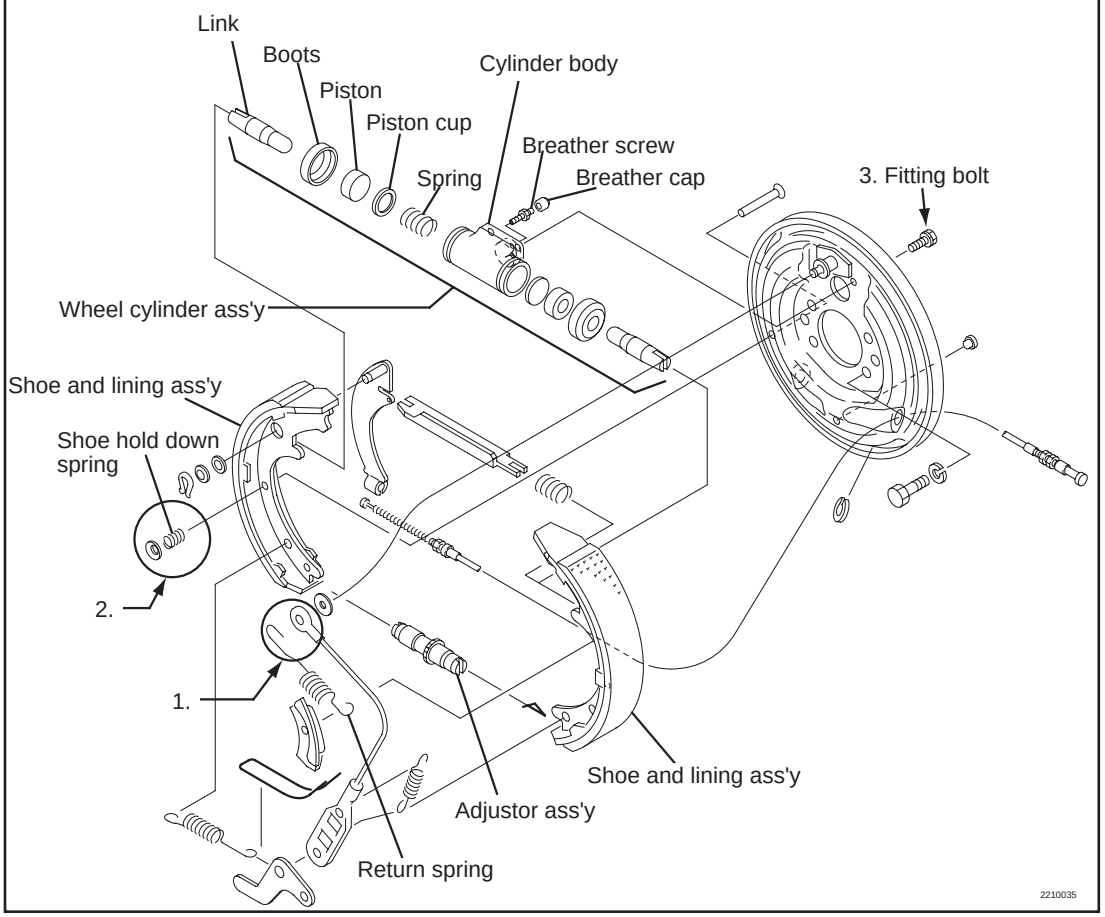
(1)	221-4001	For removing and installing the shoe hold down spring
(2)	221-4002	For removing the return spring
(3)	221-4003	For installing the return spring

1. Remove the return spring with special tool 221-4402.
2. Remove the shoe hold down spring with special tool 221-4001.
   * Use the procedure above to install and remove the shoe and lining ass'y and other parts.
3. Remove fitting bolts for the wheel cylinder ass'y.
4. Remove inner parts.

●Special tools



●Disassembling and reassembling the wheel brake ass'y



* Reassemble the wheel brake in reverse order of disassembly.

6- 3. Inspection and adjustment

⚠ CAUTION **The wheel brake is very important part for safety. It shall be replaced if any damages are found.**

6-3-1. Brake drum - inspection, repair and replacement

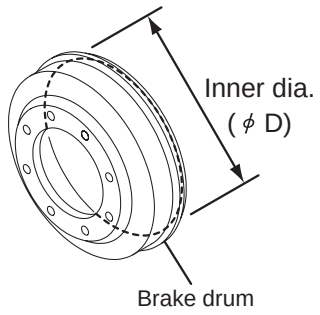
1. Check the inner surface of the brake drum for streaks (damage), wear, and cracks.

⚠ CAUTION **If there are streaks or partial wear, perform repairs or replacement within the limits shown below.**

●Inner diameter of brake drum

Applicable model	Specific dimension(ϕ D)	Repair limit(ϕ D)
FB10P-18P	10-inch(254 mm)	256 mm
FB20P-28P	11-inch(279.4 mm)	281.4 mm
FB30P	(310 mm)	312 mm

●Inspection of brake drum



6-3-2. Shoe & lining - inspection and replacement

1. Measure the thickness of the lining.

➡ If the part is worn to 1.5 mm or less, replace it.

⚠ CAUTION **Measure the area with the most wear.**

2. Check for stains, burning, and deterioration.

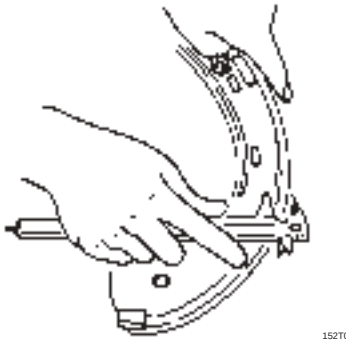
➡ If there are stains, burning, or deterioration, replace the part.

3. Check for cracks and damage.

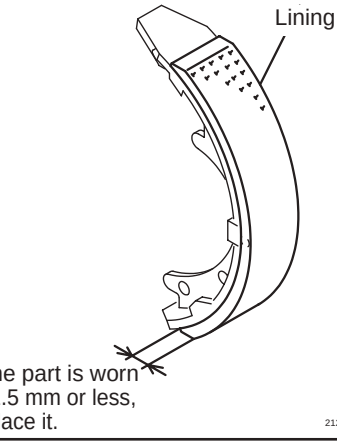
➡ If there is a burn, repair it.

➡ If cracked or damaged, replace it.

●Measuring thickness of lining



●Inspection of shoe & lining



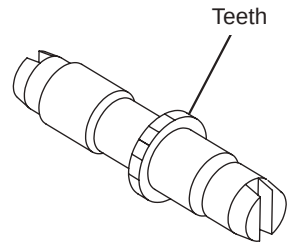
6-3-3. Adjustor ass'y - inspection and replacement

1. Check the teeth of the adjustor ass'y for wear and deformation.

CAUTION

When the adjustor ass'y can not be turned by hand or resistance is felt when turning it, replace it with a new one.

●Inspection of adjustor ass'y



212E053

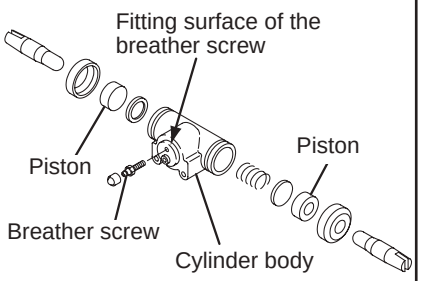
6-3-4. Wheel cylinder ass'y - inspection and replacement

CAUTION

Before performing this inspection, clean the part with a volatile cleaning grease, and then use pressurized air to completely remove the grease.

1. Check the inside of the "Cylinder body" and the fitting surface of the breather screw for damage or rust.
2. Check for damage and deterioration on the inner parts.

●Inspection of wheel cylinder ass'y

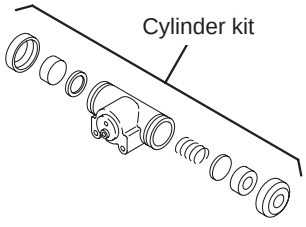


2210056

CAUTION

Replace the cylinder kit at every disassembling or annually.

●Replacing the cylinder kit



2210142

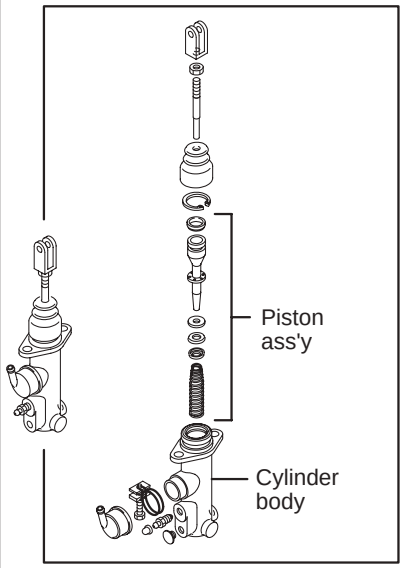
6-3-5. Master cylinder ass'y - inspection and replacement

⚠ CAUTION

Before performing this inspection, clean the part with a volatile cleaning grease, and then use pressurized air to completely remove the grease.

1. Check the inside of the "Cylinder body" for damage or rust.
2. Check for damage and deterioration on the inner parts.

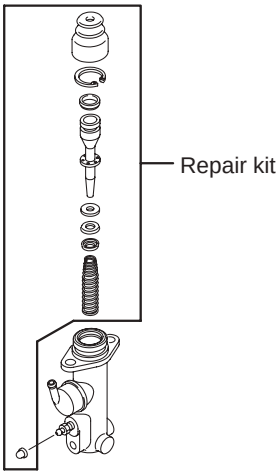
●Inspection of master cylinder ass'y



⚠ CAUTION

Replace the repair kit at every disassembling or annually.

●Replacing the repair kit



6-3-6. Brake pedal - inspection

(1)Check any cracks or damages at welded parts.
(2)Check the bushing for wear.

<Wear limit of bushing>

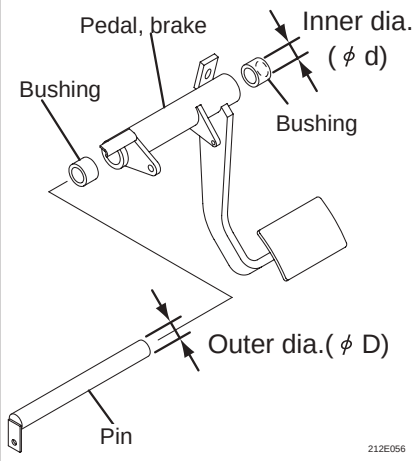
Specific dimension (inner dia ϕ)	Wear limit
20.0 mm	20.15 mm

(3)Check the "Pin, brake" for abnormal wearing.

<Wear limit of pin>

Specific dimension (outer dia ϕ)	Wear limit
20.0 mm	19.9 mm

●Inspection of brake pedal



6-3-7. Parking lever - inspection and adjustment

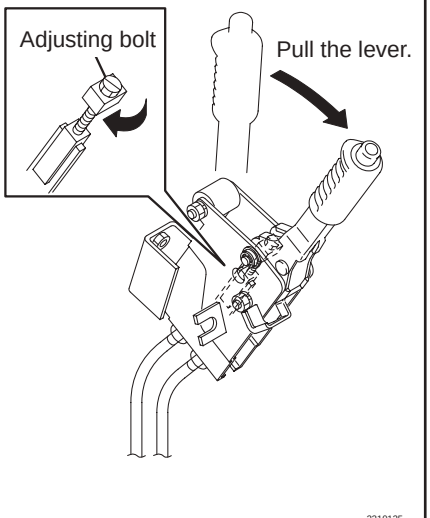
1. Inspect for damage or deformation on the lever.

2. Check if the brake is applied when the lever is pulled.

➡ If the brake is not applied securely, make the following adjustments.

1. Leave the lever in its pulled back position.
2. Tighten the adjusting bolt. (Turn it clockwise.)
3. Push the lever forward to release the brake.
4. Check if the forklift travels without dragging the brake.
5. Perform adjustment again if the brake is not released completely when the parking brake lever is released.

●Inspection of parking lever

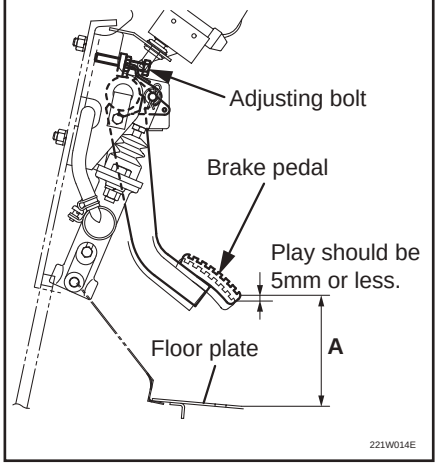


6-3-8. Brake linkage - adjustment

1. Use the adjusting bolt to adjust the height from the floor plate to the brake pedal to within the specific dimension shown below.

Applicable model	Specific dimension(ϕ D)
FB10P-28P	120-130 mm
FB30P	130-140 mm

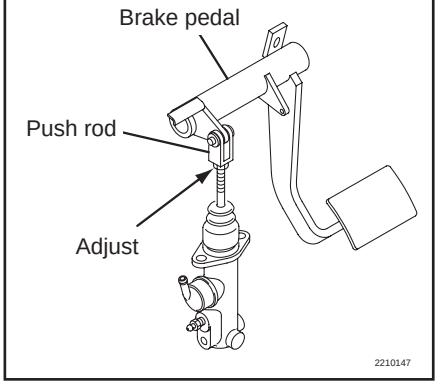
●Adjusting the brake pedal height



2. Use the push rod of the master cylinder to adjust the brake pedal play to the specific dimension shown below, or less.

Specific dimension	About 5 mm

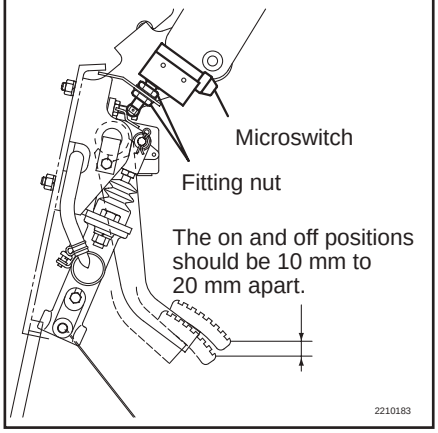
●Adjusting the brake pedal play



3. Use the microswitch fitting nut to adjust the ON/OFF position to within the specific dimension shown below.

Specific dimension	10-20 mm

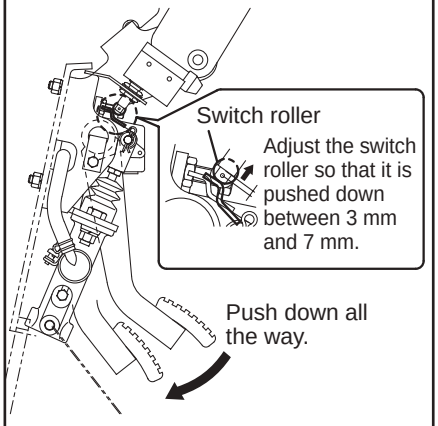
●Adjusting the microswitch position (1)



4. When the brake pedal is pushed down all the way, adjust the switch roller so that it is pushed down by an amount within the specific dimension shown below.

Specific dimension	3mm-7mm

●Adjusting the microswitch position (2)



6-3-9. Brake air bleeding

⚠ CAUTION **After assembling the master cylinder, wheel cylinder, or brake piping, be sure to bleed the air.**

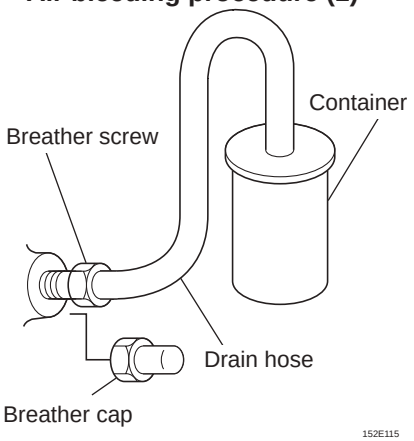
Wheel cylinder air bleeding

<Air bleeding procedure>

1. Remove the breather cap on the wheel cylinder and connect a drain hose to the breather screw. The opposite end of the drain hose should be connected to a container to receive the brake fluid.

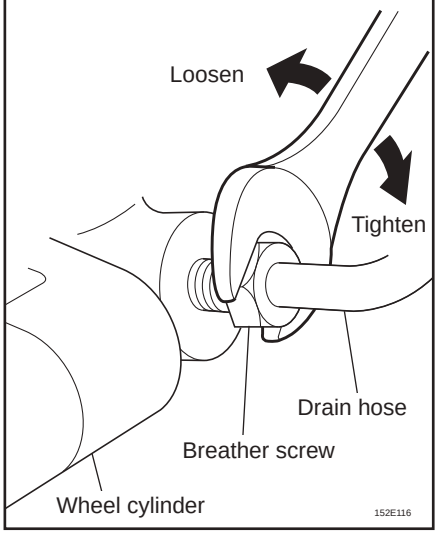
2. Depress and hold the brake pedal several times.

●**Air bleeding procedure (1)**



3. Loosen the breather screw to bleed the brake fluid and air. Tighten the screw again before the flow stops.
4. Repeat steps 2. and 3. until there are no longer any air bubbles in the discharged brake oil.

●**Air bleeding procedure (2)**



⚠ CAUTION **Keep the brake fluid level in the tank by refilling.**

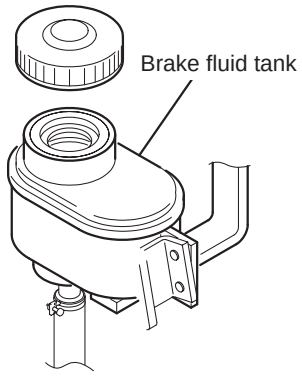
5. After discharging the air, tighten the breather screw securely.

6. Make sure no brake fluid has leaked out.

⚠ CAUTION **Use the specified brake fluid. Do not mix different grades of fluid.**

Recommended brake fluid.
DOT 3 or DOT 4

●**Brake fluid reserve tank**



Master cylinder air bleeding

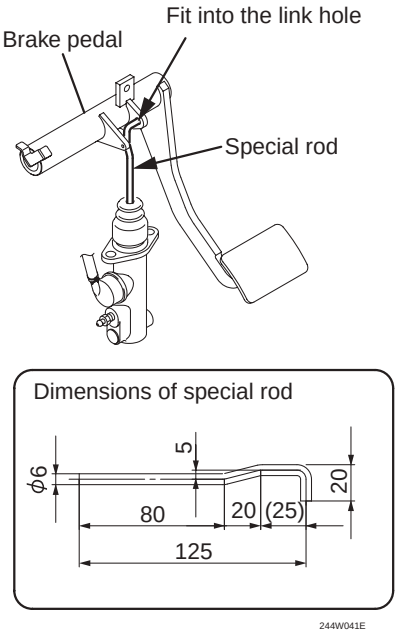
<Preparation for air bleeding>

1. Remove the original push rod from the master cylinder.
2. Loosen the bolt to adjust the height of the pedal.
3. Remove the brake microswitch.
4. Insert a special rod into the master cylinder and hang it on the link hole of the brake pedal.

NOTE

- **If the piston of the master cylinder is not pushed until attaching to the bottom of the cylinder, air in the cylinder cannot be completely discharged.**
  It is not possible to push until attaching to the bottom of the cylinder with a standard push rod, use a special rod longer than the standard.
- **It is also possible to insert a long cross slot screwdriver in the master cylinder instead of a special rod and to move the piston.**
  However, it is necessary to push by considerably strong power.

●Air discharging procedure (1)



<Air discharging procedure>

1. Tighten the air discharging valve of the wheel cylinder.
2. Fill the brake oil in the tank.

CAUTION

- **The brake oil must be recommended oil.**
  Do not mix it with the other articles.
- **Do not feed the brake oil forcefully.**

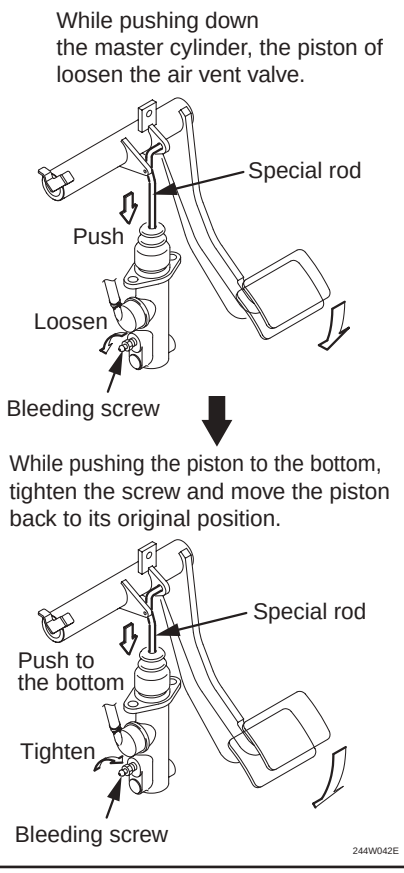
3. Loosen the discharging valve of master cylinder while pushing the piston of the master cylinder.
4. Return the piston completely after tightening the air discharging valve with pistons pushed into interiors most.
5. Air in the master cylinder comes off the air discharging valve completely and repeats the work of 3 and 4 until only the brake oil comes to go out.

CAUTION

Do not make the brake oil in the lubricating oil tank run short during discharging air.

6. Check there is no oil leak.

●Air discharging procedure (2)



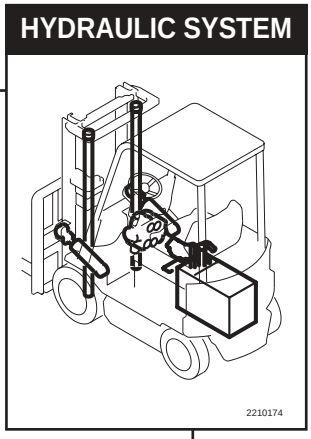
6- 4. Troubleshooting

6-4-1. Brake - troubleshooting

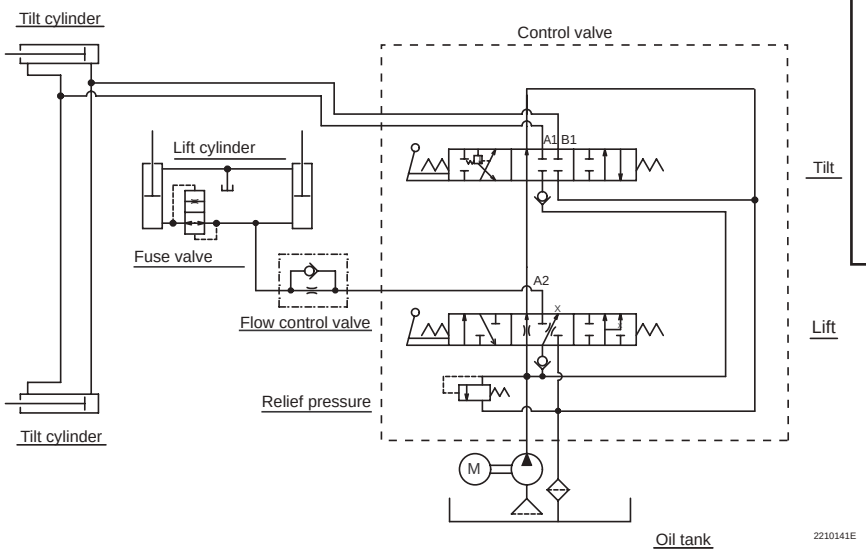
No.	Symptom	Possible cause	Solution
1	Ineffective braking force	1. Oil leakage from piston cup of master cylinder	Replace
		2. Air is mixed into brake oil due to shortage of oil	Refill oil and bleed air
		3. Oil leakage from cup of wheel cylinder	Replace
		4. Air is mixed in brake pipings	Bleed air
		5. Wear of linings or uneven contact with brake drum	Inspect and replace
		6. Adhesion of oil on lining or brake drum	Clean or replace
		7. Out of adjustment of brake	Adjust
2	Brake squeaks	1. Lining is grazed or adhesion of oil on lining	Repair or replace
		2. Backing plate is transformed or fitting bolts are loose	Inspect and retighten
		3. Brake shoe is transformed or badly mounted	Replair or replace
		4. Lining is badly worn	Relpace
		5. Wheel bearing is loosen.	Inspect and retighten
		6. Anchor pin of backing plate is worn or transformed	Replace
3	Braking only at one side	1. Unequal air pressure of tires at R.H and L.H sides	Adjust to appropriate pressure
		2. Out of adjustment of brake	Adjust
		3. Lining is grazed or unequally contacted with brake drum.	Repair or replace
		4. Lining is worn.	Replace
		5. Wheel cylinder is malfunctioned.	Replace
		6. Backing plate is transformed or badly mounted.	Replace or retighten
		7. Brake drum is eccentrically machined or mounted.	Repair or replace
		8. Brake piping is clogged.	Clean or replace
		9. Wheel bearing is loose.	Inspect and adjust
4	Brake drags	1. No play of brake pedal	Adjust
		2. Wheel cylinder is malfunctioned.	Replace
		3. Master cylinder is malfunctioned or hole for oil flow is clogged.	Repair or replace
		4. Return spring in brake ass'y is damaged.	Replace
		5. Parking brake is not fully released or not adjusted correctly	Adjust
		6. Brake piping is clogged.	Clean or replace
		7. Wheel bearing is not mounted correctly.	Adjust
5	Pedal stroke is too large	1. Out of adjustment of brake	Adjust
		2. Air is mixed in brake pipes.	Bleed
		3. Oil leakage from brake pipings or shortage of brake oil.	Fill brake oil and bleed air
		4. Bad adjustment of brake pedal	Adjust
6	Ineffective parking brake	1. Bad installation of parking cable	Adjust
		2. Wear of brake linings	Replace
		3. Out of adjustment of brake	Adjust
		4. Out of adjustment of brake lever	Adjust

7. HYDRAULIC SYSTEM

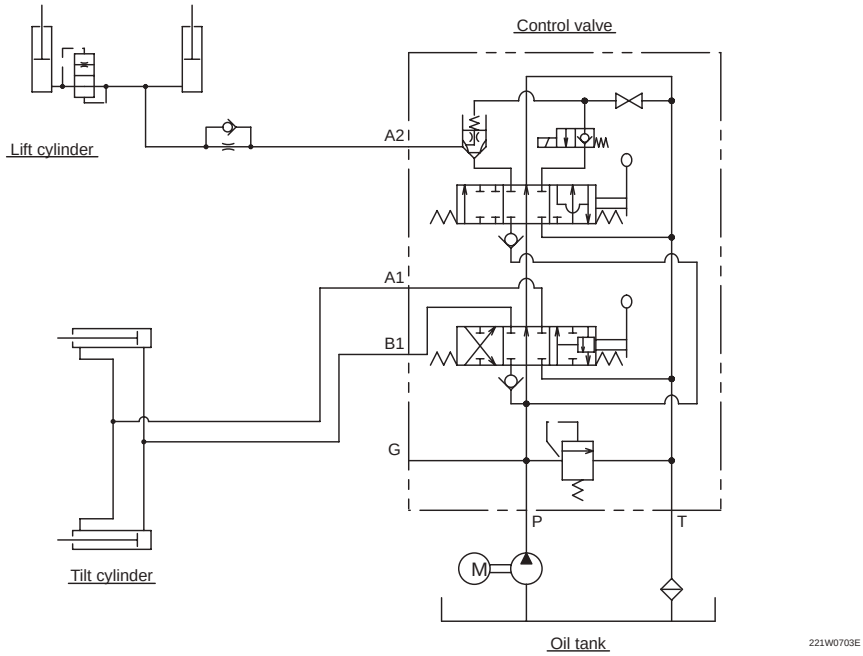
7- 1. Oil pipimng circuit



●IGBT and FET control



●CAN-BUS control



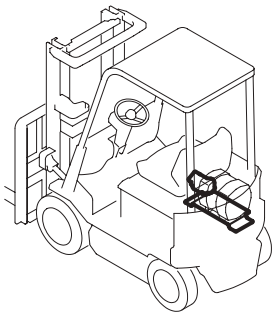
Applicable model	Relief pressure
FB10P/14P/15P	13.7MPa(140kgf/cm^2)
FB18P/20P	15.7MPa(160kgf/cm^2)
FB25P/28P/30P	17.2MPa(175kgf/cm^2)

- 7a. Hydraulic pump 78
- 7b. Oil tank and oil piping 82
- 7c. Control valve 86
- 7d. Cylinder 95

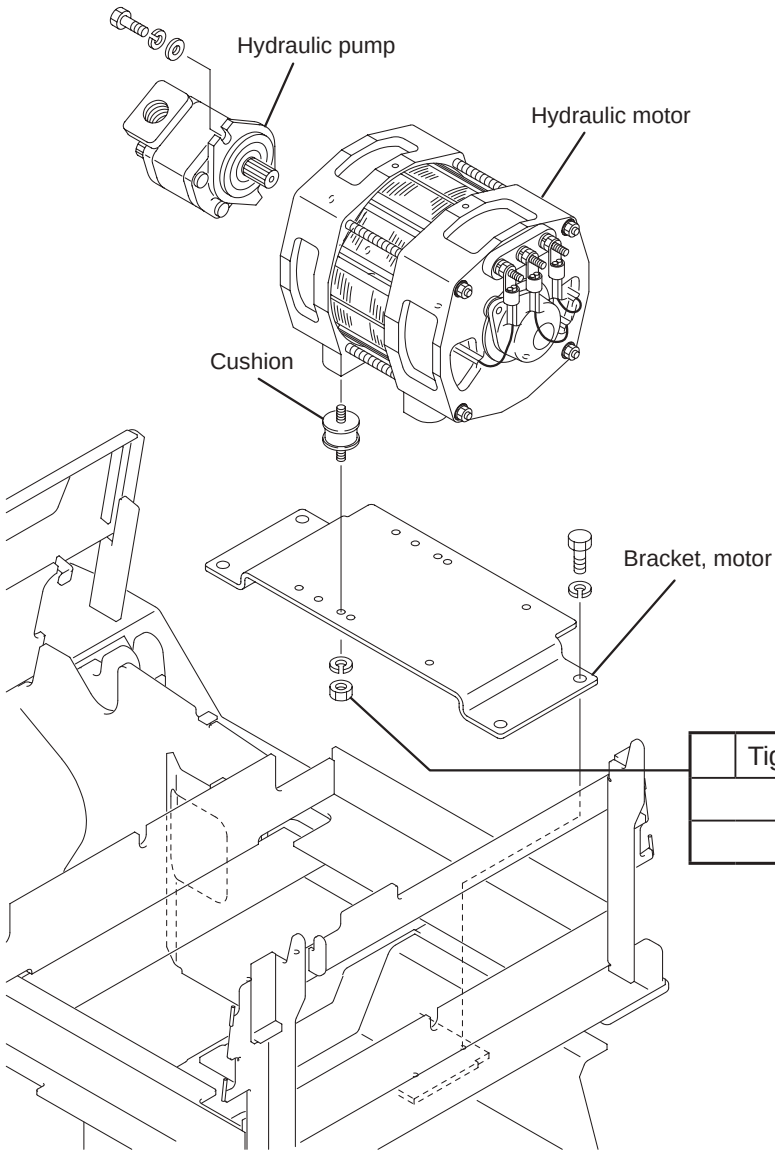
7a. HYDRAULIC PUMP

7a- 1. Location and name

HYDRAULIC PUMP



●**Main parts of hydraulic pump**



Tightening torque
8.8 - 10.8 N・m
{0.9 - 1.1 kgf・m}

: Tightening torque

221W083E

<Hydraulic pump type>

Applicable model	Type	Displacement (cm^3)
FB10P-18P	TMG1-17	18.0
FB20P-18P FB10P-18P-U	TMG1-23	24.5
FB30P FB20P-25P-U	TMG1-27	28.8

7a- 2. Disassembly and reassembly

⚠ CAUTION

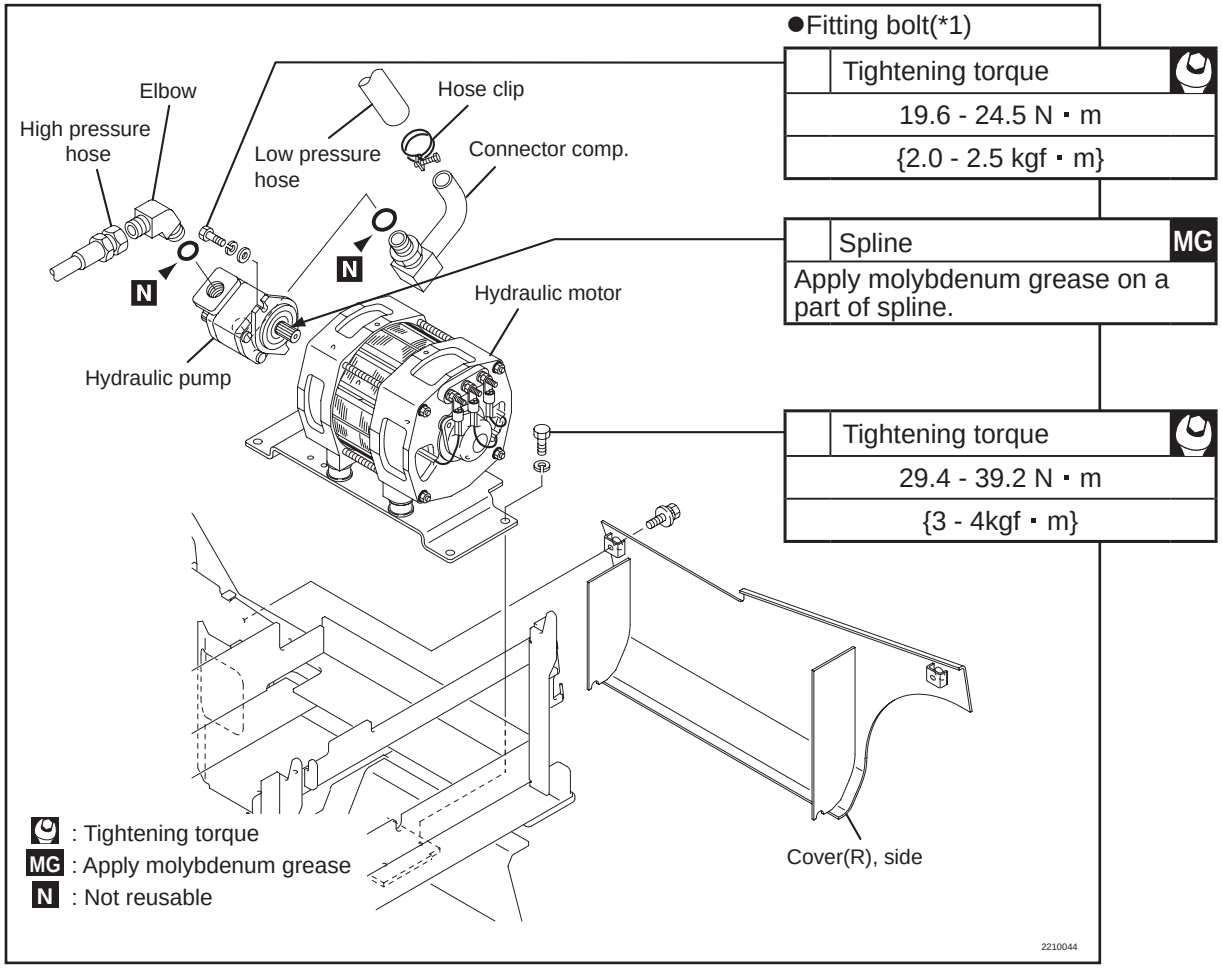
- **Turn the key switch off and operate hydraulic levers a few times to release high pressure in the hydraulic piping before disconnecting hydraulic hoses and pipes.**
- **Before disconnecting hydraulic connections, release internal pressure to prevent from splashing oil.Refer the CAUTION on the page 4 for the procedure.**
- **When disconnecting hydraulic pipes, cap them to prevent dust from entering into hydraulic components and pipes.**
- **Be sure to disconnect the battery plug.**

7a-2-1. Hydraulic pump - removal and installation

1. Remove the "cover(R), side".
2. Remove the high pressure hose and low pressure hose.
3. Remove fitting bolts(*1) to remove the hydraulic pump.
4. Remove the elbow and connector comp.

⚠ CAUTION

Do not disassemble the hydraulic pump.
When damaged, replace the whole pump assembly.



* Install the hydraulic pump in reverse order of removal.

⚠ CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

7a- 3. Inspection and adjustment

7a-3-1. Hydraulic pump - inspection

- Install the hydraulic pump on a truck and check the function by actual lift speed.

⚠ CAUTION **Measure Lift speed after raising the temperature of Hydraulic oil by operating.**

<Specific lift speed>

[mm/sec]

Model	STD (simplex) mast		M (triplex) mast		PFL (duplex) mast	
	Laden	Unladen	Laden	Unladen	Laden	Unladen
FB10P	370	540	360	520	330	470
FB14P	340	540	330	520	300	470
FB15P	320	540	310	520	290	470
FB18P	310	540	300	520	270	470
FB20P	280	540	260	430	240	390
FB25P	260	470	240	430	220	390
FB28P	250	470	230	390	210	390
FB30P	320	410	330	520	300	520
FB10P-U	470	550	450	620	410	560
FB14P-U	440	650	420	620	380	560
FB15P-U	420	650	400	620	370	560
FB18P-U	380	650	360	620	330	560
FB20P-U	360	600	330	550	300	500
FB25P-U	340	600	310	550	280	500

7a- 4. Troubleshooting

7a-4-1. Hydraulic pump - troubleshooting

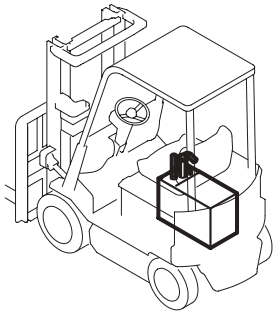
No.	Symptom	Possible cause	Solution
1	No oil is pumped out.	1. Shortage of hydraulic oil	Replenish
		2. Clogging of the suction hose or the suction filter	Inspect and clean
2	Oil leakage	1. Damage of the oil seal	Replace
		2. Damage of the gasket (O-ring)	Replace
		3. No good tightening or damage of the cover and the body, or fitting surface is worn or damaged.	Retighten or replace
3	Pressure is not raised.	1. Wear of the bearing, gear and body	Replace
		2. Mixture of air ● Shortage of hydraulic oil ● Air mixed from the suction hose connection ● Damage of the seal kit (oil seal, O-ring)	Replenish Retighten Replace
		3. No good adjustment of the relief pressure of the control valve	Adjust
4	Abnormal noise	1. Choked in the suction hose	Correct or replace
		2. Clogging of the suction filter	Clean
		3. Air mixed from the suction hose connection	Retighten
		4. Air mixed from the oil seal	Replace
		5. Air in the hydraulic oil	Withdraw air or replace
		6. Shortage of the hydraulic oil	Replenish
		7. High temperature or viscosity of hydraulic oil	Replace
5	High oil temperature	1. Contaminated oil	Replace
		2. High viscosity of hydraulic oil	Replace
		3. Overwork	Observe specification
6	No rotation of hydraulic motor	1. Failure or no good adjustment of the valve microswitch	Replace or Adjust
		2. Blow out of the hydraulic fuse	Replace

7b. OIL TANK AND OIL PIPING

7b- 1. Location and name

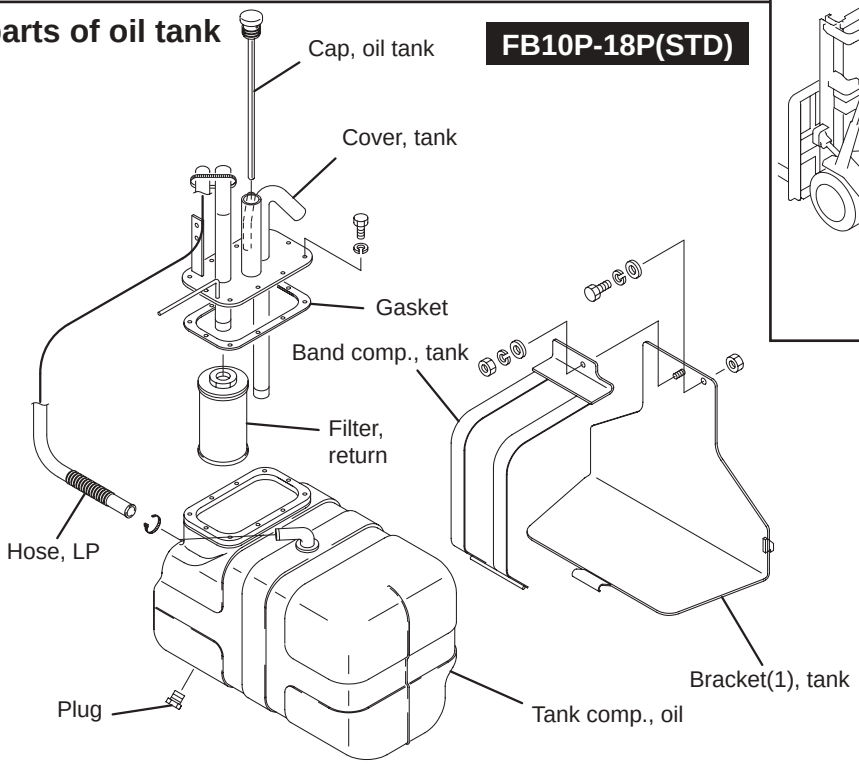
7b-1-1. Plastic oil tank - main part names

OIL TANK



●**Main parts of oil tank**

FB10P-18P(STD)

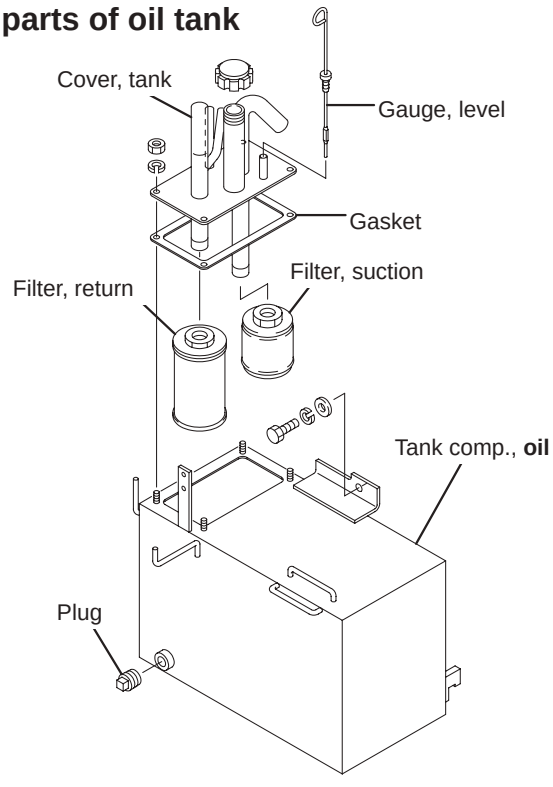


7b-1-2. Iron oil tank - main part names

●**Main parts of oil tank**

FB10P-18P(CS/FCS)

FB20P-30P(STD/CS/FCS)



7b- 2. Disassembly and reasembly

7b-2-1. Oil tank - precautions

●Pay attention to the following when disassembling and/or assembling the oil tank.

⚠ CAUTION

- **Apply wheel chocks to tyres to prevent the truck from moving.**
- **Lower forks to the ground before draining hydraulic oil.**
- **When disconnecting hydraulic pipes, cap them to prevent dust from entering into hydraulic components and pipes.**
- **Wrap the seal tape on the thread of oil filters and the plug. Make sure to tighten them securely when installing.**
- **Be sure to disconnect the battery plug before starting to disassemble.**

7b-2-2. Oil piping replacement - precautions

●Pay attention to the following on replacing and fitting when the hoses are abnormal.

NOTE

Wrap the seal tape on the thread of the connector of hoses before connection.

⚠ CAUTION

- Use required rated hoses to keep enough strength.

Unexpected force may be applied by operating pressure.

152E125

●Do not fit short hoses in the length.

Hose might be damaged due to sharp bending.

152E126

- Do not fit a hose with twisting. Make sure that the hose is not twisted by operation.

Twisting can be found by the line of letters marked on a hose.

152E127

7b- 3. Inspection and adjustment

7b-3-1. Oil - inspection

- Pick some hydraulic oil from the hydraulic tank and compare with new oil to check.

<Specific oil conditions>

Appearance	Smell	Conditions	Countermeasure
Transparent. Color is almost same as new one.	Normal	Normal	No need to change
Transparent but color is thin.	Normal	Different oil may be mixed.	Check viscosity. If normal, it is usable.
Color is changed to milky white.	Normal	Air and/or water are mixed.	Separate water. Then, it is usable.
Color is changed to dark brown.	Bad	Oxidized	Exchange.
Transparent but with small black dusts.	Good	Foreign article is mixed.	Filter it. Then, it is usable.

7b-3-2. Recommended oil and quantity

<Recommended oil>

Specification	Recommended oil
Standard	Shell : Tellus 32 (ISO VG 32)
CS/FCS	Shell : Tellus T15 (ISO VG 15)

<Oil quantity>

CAUTION

- **Keep the oil level within "H" and "L" marks on the level gauge.**
- **Before checking oil level, lower the fork on the flat ground.**

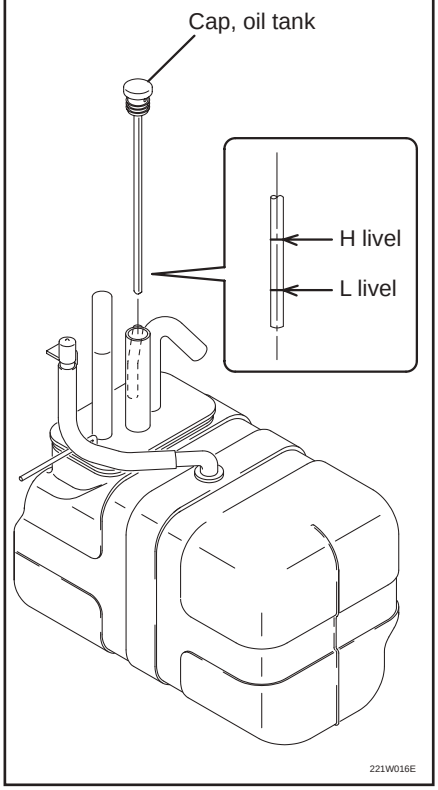
<Oil quantity in oil tank> [L]

Applicable model	Quantity [Check the actual oil level by the gauge.] (Liter)	
	"H" level	"L" level
FB-10P-18P	22.6	19.5
FB20P-28P	26	23
FB30P	29	26

NOTE

Oils in pipings and cylinders (approx. 5-10L) is not included in the quantity which are shown above.

●Checking the oil level



7b-3-3. Oil tank and filters - cleaning and check

1. Clean with compressed air and check the filter for clogging and damage.

➡ If the filter is clogged or damaged, replace it.

2. Remove any dart or foreign material from the bottom of the oil tank.

7b- 4. Troubleshooting

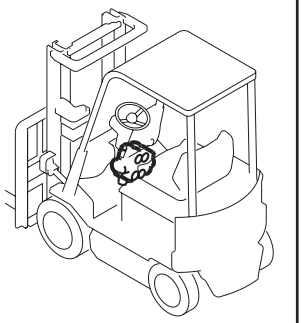
7b-4-1. Oil tank - troubleshooting

No.	Symptom	Problem	Solution
1	Bubbled	Air is mixed.	● Inspect any damages on hoses. ● Re-tighten of the hose clamp.
2	Color of oil is changed.	Air and/or water are mixed.	Change oil
		Oxidized or contaminated with foreign articles.	

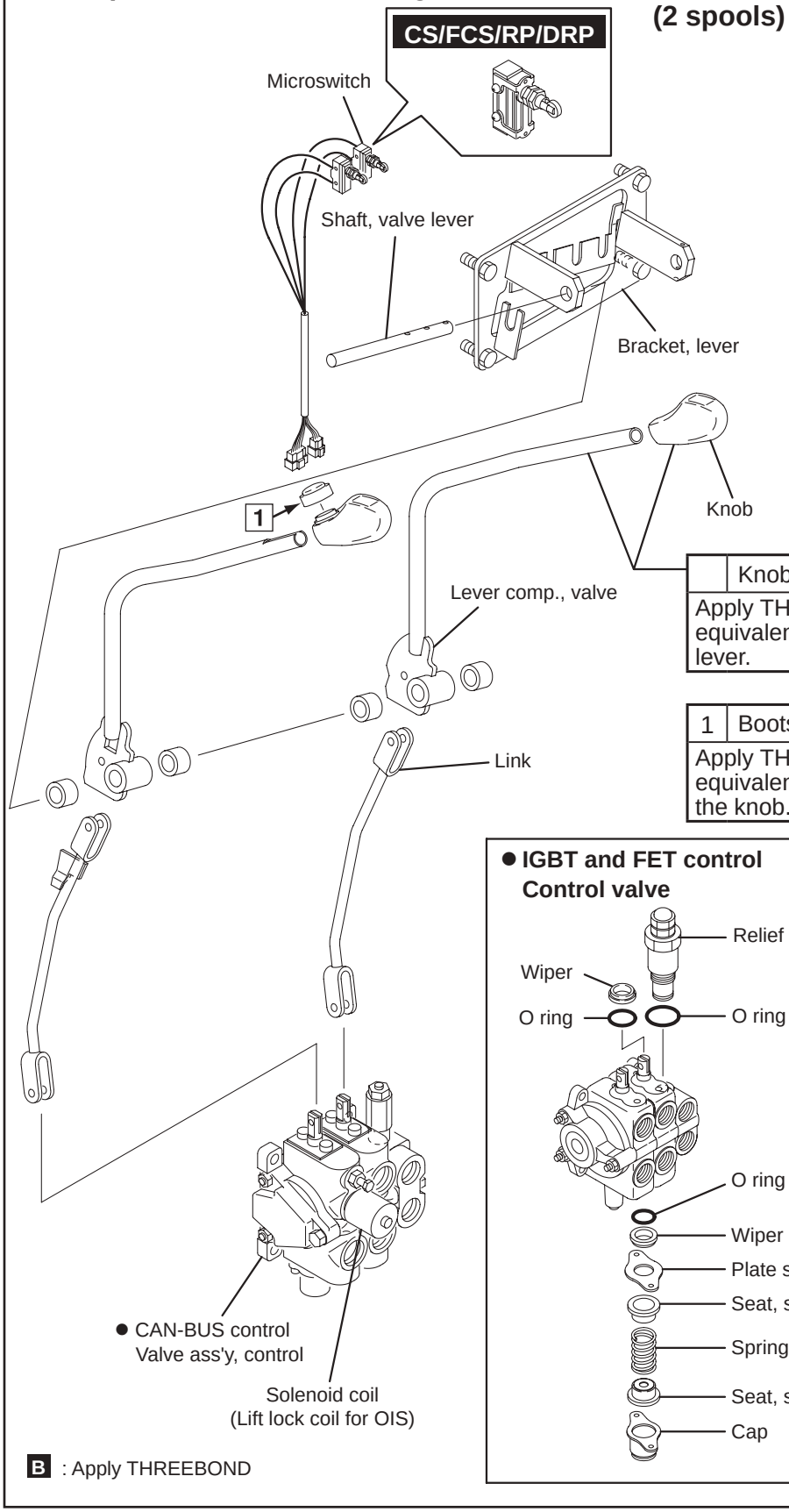
7c. CONTROL VALVE

7c- 1. Location and name

CONTROL VALVE



●Main parts of the valve linkage and control valve (2 spools)



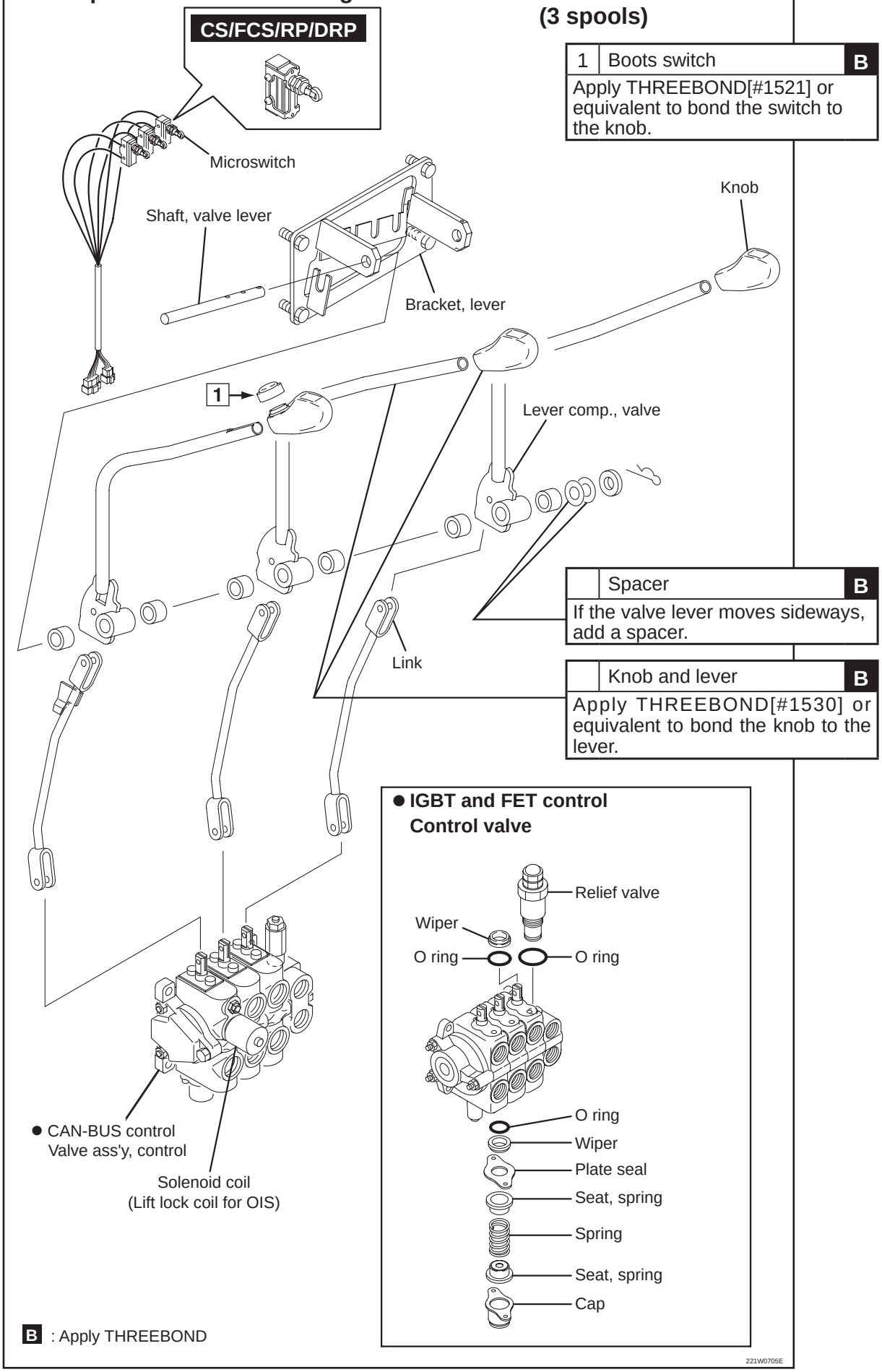
	Knob and lever	B
Apply THREEBOND[#1530] or equivalent to bond the knob to the lever.		

1	Boots switch	B
Apply THREEBOND[#1521] or equivalent to bond the switch to the knob.		

● IGBT and FET control Control valve

7c

●Main parts of the valve linkage and control valve (3 spools)



1	Boots switch	B
Apply THREEBOND[#1521] or equivalent to bond the switch to the knob.		

	Spacer	B
If the valve lever moves sideways, add a spacer.		

	Knob and lever	B
Apply THREEBOND[#1530] or equivalent to bond the knob to the lever.		

● IGBT and FET control Control valve

7c- 2. Disassembly and reassembly

⚠ CAUTION

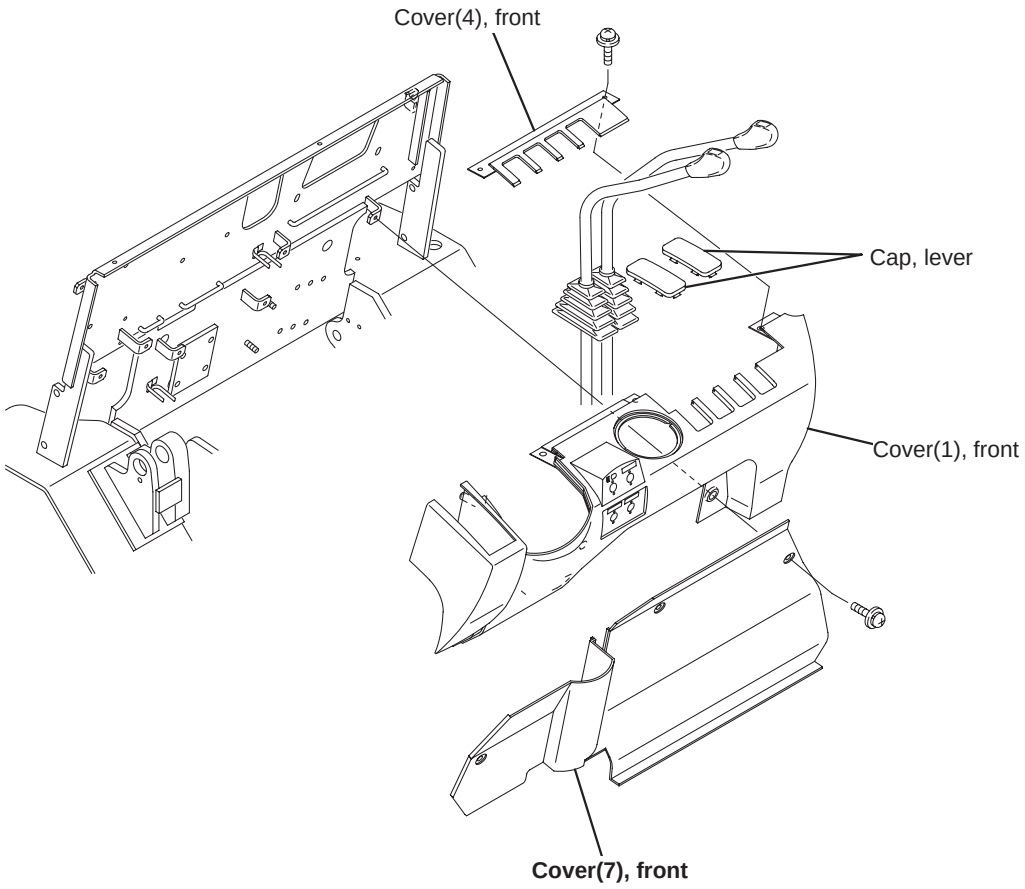
- **Lift or jack up the forklift truck and support it with safety blocks or rigid stands.**
- **Apply wheel chocks to tyres to prevent the truck from moving.**
- **Record places of lead wire connections before disassembling.**
- **Turn the key switch off and operate hydraulic levers a few times to release high pressure in the hydraulic piping before disconnecting hydraulic hoses or pipes.**
- **When disconnecting hydraulic pipes, cap them to prevent dust from entering into hydraulic components and pipes.**
- **Be sure to disconnect the battery plug.**

7c-2-1. Control valve - removal and installation

1. The following parts should be removed before removing the control valve.

1. Remove front covers as shown in the following illustration.

●Removing the front cover



* This illustration shows the control valve for 2 spools.

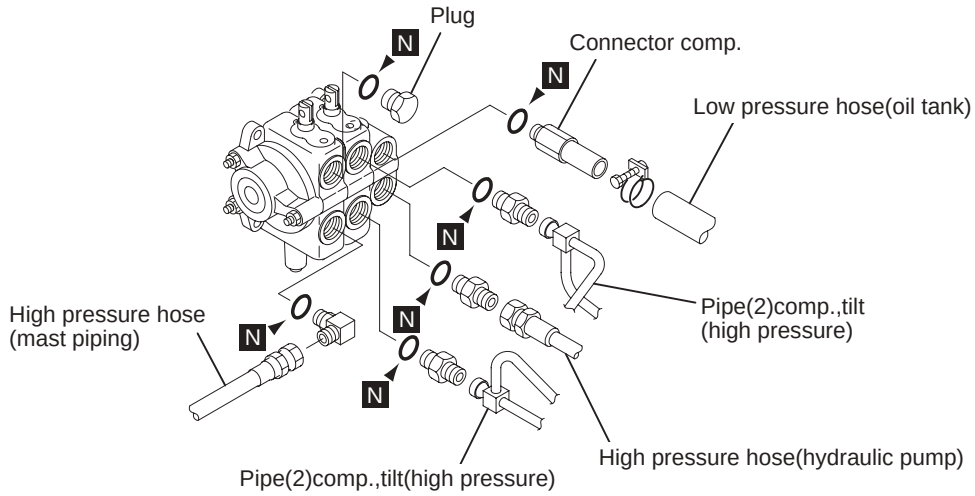
2210050

2. Disconnect hydraulic pipes and hoses as shown in the following illustration.

⚠ CAUTION

Turn the key switch off and operate hydraulic levers a few times to release high pressure in the hydraulic piping before disconnecting hydraulic hoses or pipes.

● IGBT and FET control
Disconnecting the hydraulic pipe and hose



N : Not reusable

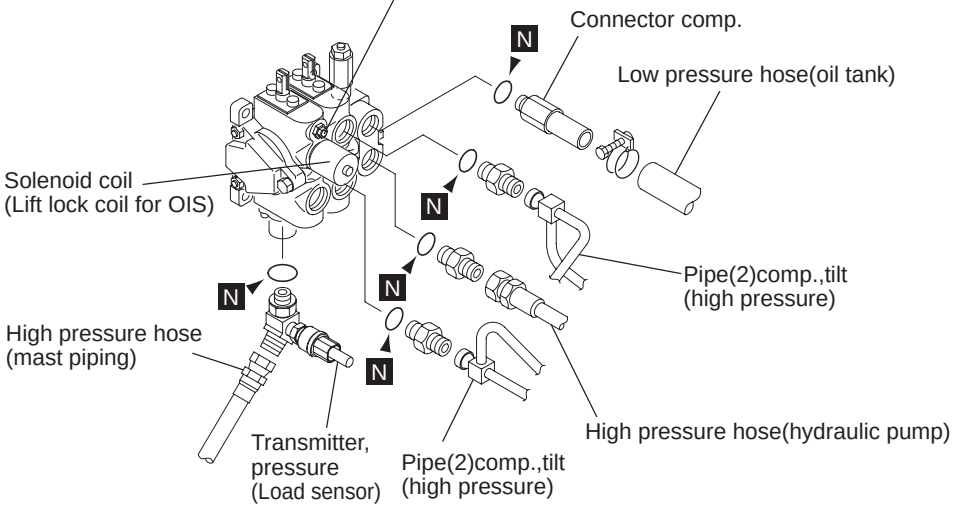
* This illustration shows the control valve for 2 spools.

2210051

● CAN-BUS control
Disconnecting the hydraulic pipe and hose

NOTE

Incase of solenoid coil trouble, loosen the nut and bolt for lowering the mast.



N : Not reusable

* This illustration shows the control valve for 2 spools.

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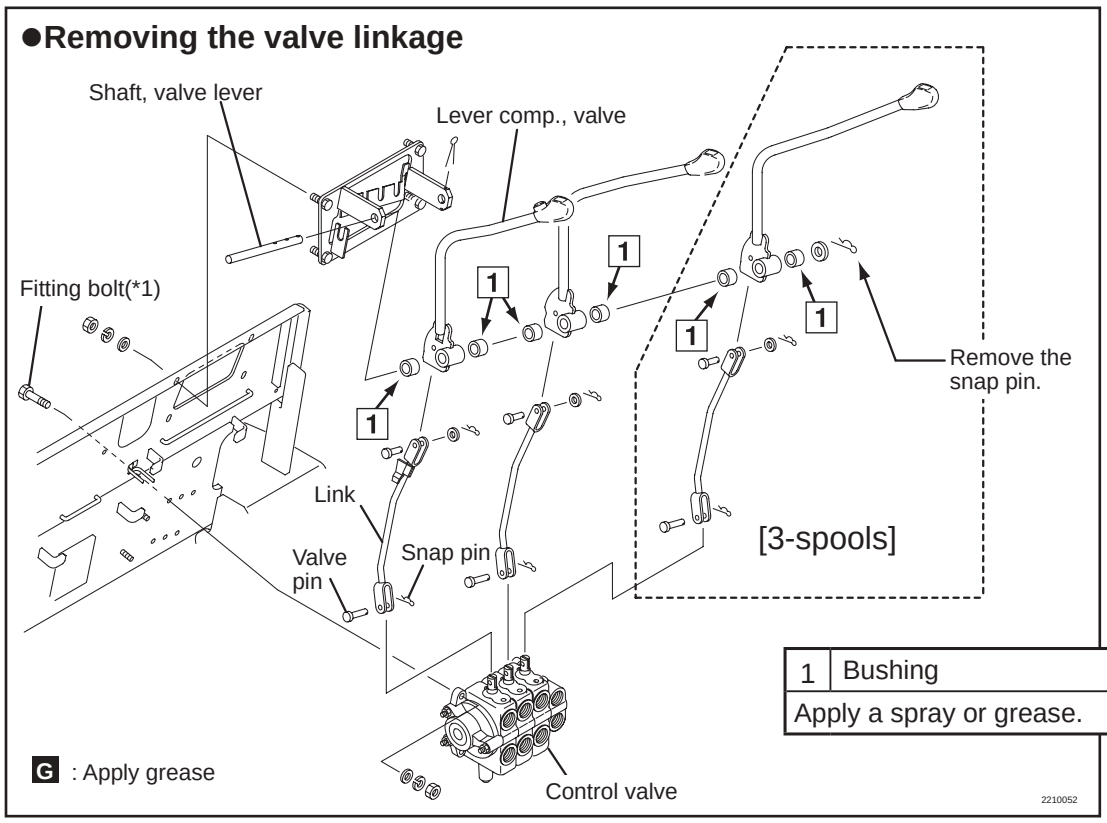
3. Remove snap pins and valve pins to remove the control valve linkage.

NOTE

Do not touch the terminals of the pressure transmitter (load sensor) by dry hand.

2. Remove fitting bolts(*1) remove the control valve.



1	Bushing	G
Apply a spray or grease.		

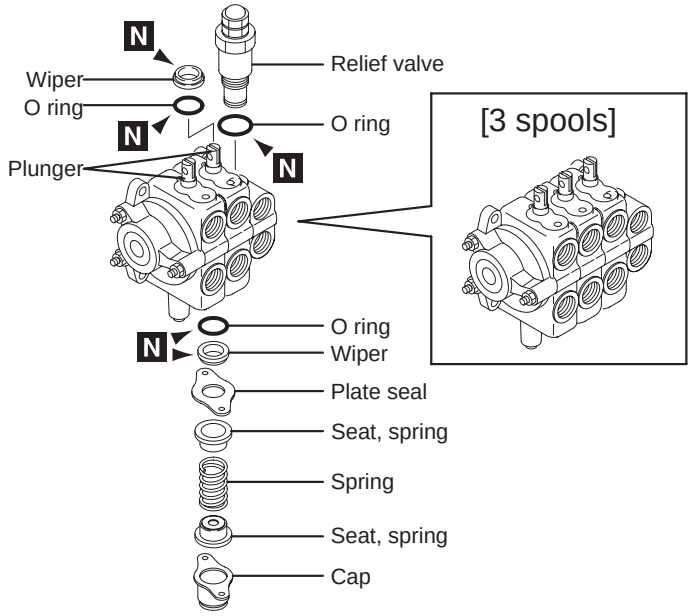
* Install the control valve in reverse order of removal.

7c-2-2. Inner kit of control valve - replacement

1. Replacing the inner kit of Control valve.

1. Remove CAP, WIPER and RELIEF VALVE.
2. Pull out PLUNGER.
3. Replace the inner kit (WIPER and O RING).

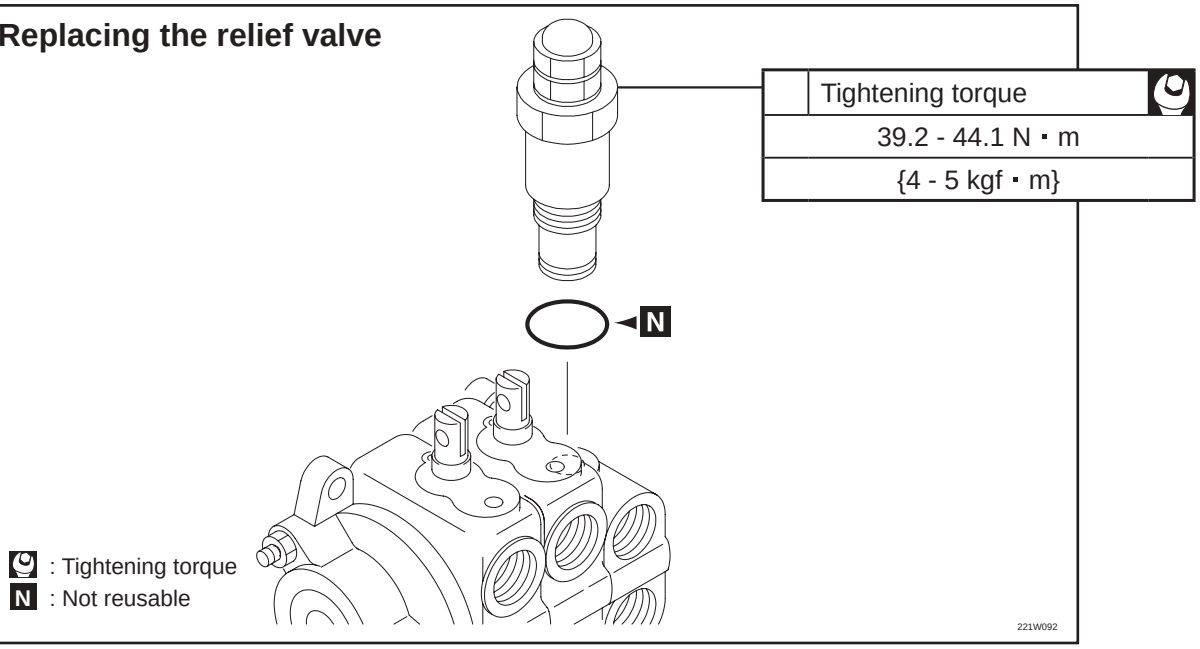
Replacing the inner kit



2. Replacing the Relief valve and O RING as follows.

1. When replacing, tighten it with the following torque.
2. After completing, measure the relief pressure.
   (See the next page for measuring procedure.)

Replacing the relief valve



⚠ CAUTION **When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.**

7c- 3. Inspection and adjustment

7c-3-1. Relief pressure - measurement

⚠ CAUTION **Use 20MPa {200kgf/cm^2} pressure gauge.**

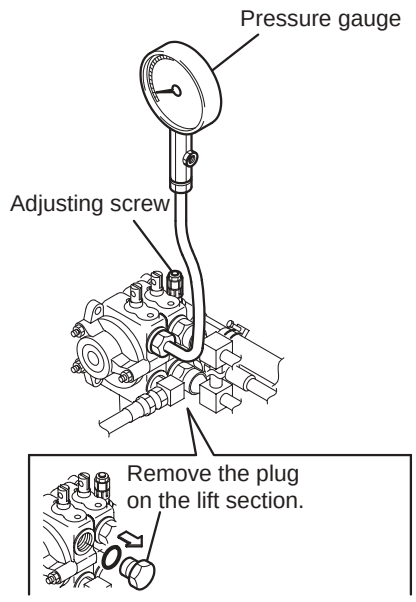
1. Turn off the key switch.
2. Release pressure in the pipings.
   (Refer the CAUTION on the page 4.)
3. Remove the plug of the Lift section, and connect the pressure gauge with the adapter.
4. Turn on the key switch, and pull the Lift lever to the top end.
   Then read the indication of the pressure gauge with pulling the Lift lever.

<Specific relief pressure>

Applicable model	Relief pressure
FB10P/14P/15P	13.7 MPa(140 kgf/cm^2)
FB18P/20P	15.7 MPa(160 kgf/cm^2)
FB25P/28P/30P	17.2 MPa(175 kgf/cm^2)

➡If the relief pressure is out of this specification, adjust the pressure by the adjusting screw.

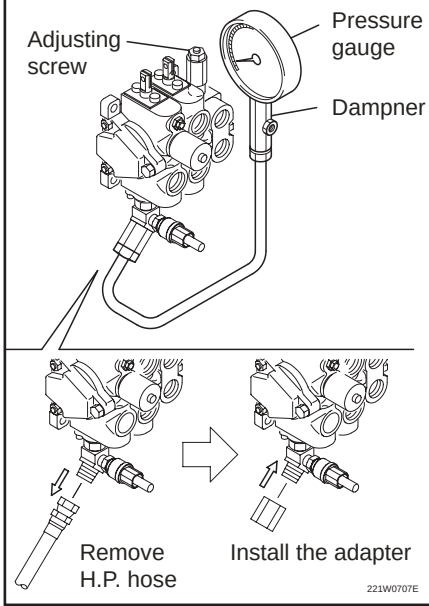
● **IGBT and FET control**
Measurement of relief pressure



⚠ CAUTION **Turn the adjusting screw gradually, because it is very sensitive.**

If operator does not seat the correct position, all hydraulic operation including lift lowering can not work.

● **CAN-BUS control**
Measurement of relief pressure



7c-3-2. Microswitch - adjustment

<Adjusting the microswitch> (Except the lift 1st switch)

1 Adjust the microswitch position to activate the switch when the lever is moved 15 - 25 mm at the top of the lever from the neutral position.

Specified gap when in neutral	0.5 - 1.5 mm

<Adjusting the lift (1st) microswitch>

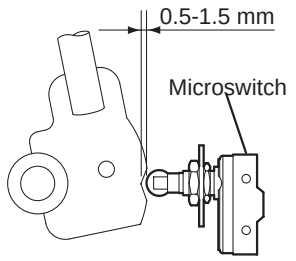
1. Adjust the microswitch position to activate the switch when the spool moves 5 mm.

Specified gap when in neutral	1.0 - 2.0 mm

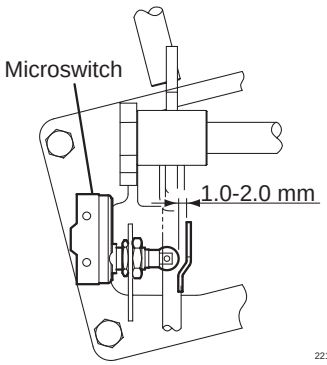
CAUTION

After adjustment of the microswitch, apply THREEBOND[#1401] or equivalent on both fixing nuts of the switch.

●Adjusting the microswitch



●Adjusting the lift (fast) microswitch



7c- 4. Troubleshooting

7c-4-1. Control valve - troubleshooting

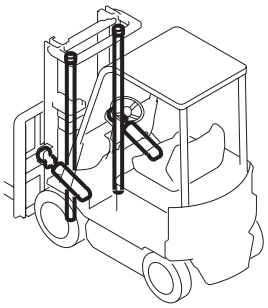
No.	Symptom	Possible cause	Solution
1	Lifting or tilting does not work	1 Failure of the pump or the coupling	Replace
		2 Shortage of oil in the tank	Replenish
		3 Breakage of Plunger spring	Replace
		4 Failure of the hydraulic microswitch	Replace
2	Load with rated capacity can not be lifted	1 Failure of the relief valve or out of adjustment	Replace or adjust
		2 Failure of the pump	Replace
3	Lifting speed is too slow.	1 Over-discharge of the battery	Charge battery
		2 Short stroke of the plunger	Inspect valve linkage
		3 Damage of the packing in the cylinder	Replace
		4 Rilief pressure is too low	Adjust
		5 Damage of the packing of the plunger	Replace
		6 Failure of the pump	Replace
		7 Clogging of the oil filter	Clean/Replace
		8 Hydraulic speed setting in the control unit is not proper.	Adjust
4	Too much drifting for lifting or tilting	1 Damage of the packing of the plunger	Replace
		2 Damage of the Cylinider or the Piston	Replace
		3 Damage of the packing of Piston	Replace
5	Too much shock when starting to lift.	1 Activation timing of lift microswitches is improper.	Adjust
		2 Failure of the relief valve	Replace
6	Oil leakage	1 Damage of O-ring or wiper ring.	Replace
		2 Looseness of tie bolts of the hydraulic valve	Retighten

7d. CYLINDER

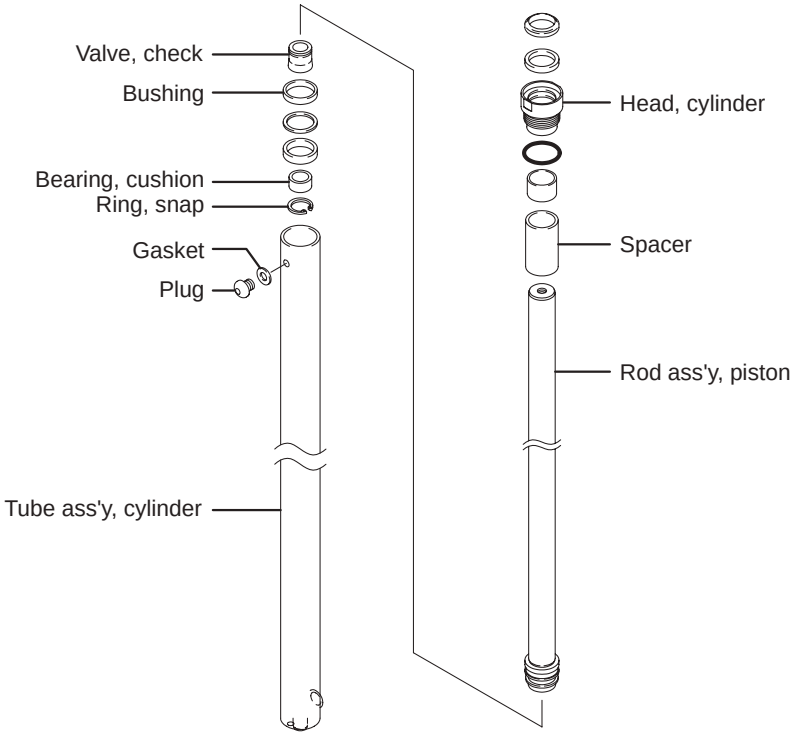
7d- 1. Location and name

7d-1-1. Lift cylinder - main part names

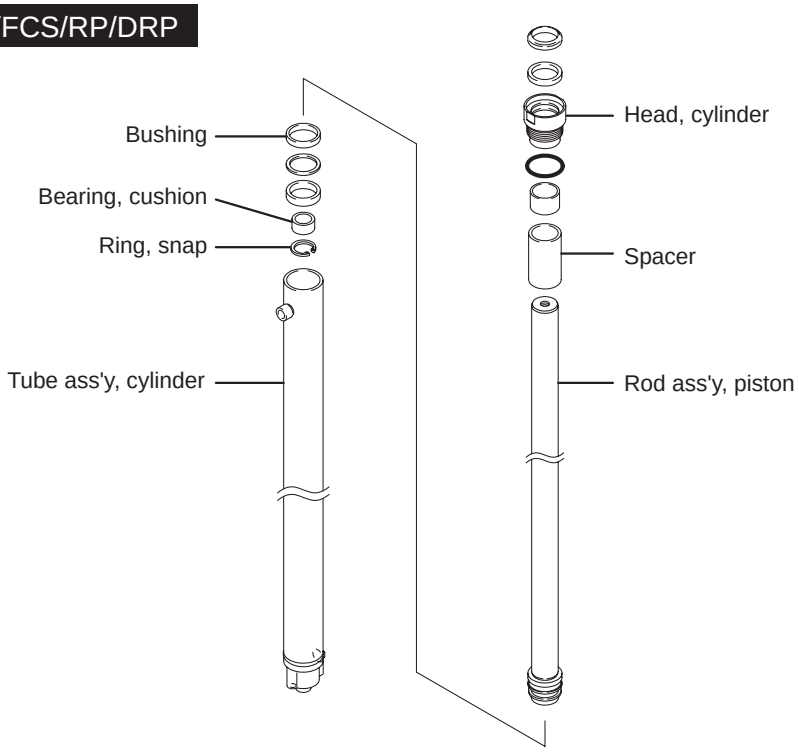
CYLINDER



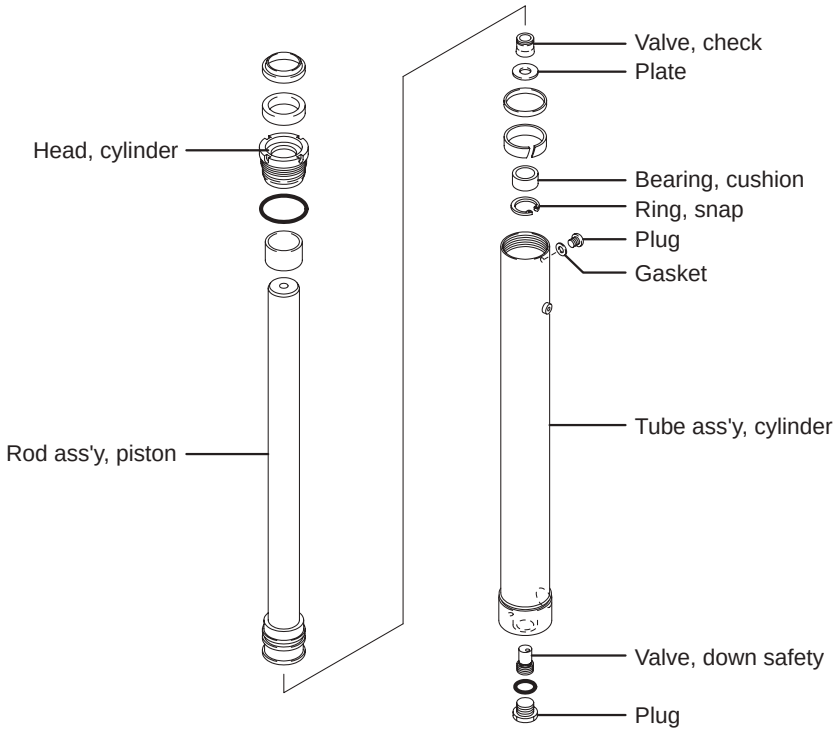
●**Main parts of lift cylinder: P-mast (2-stage simplex)**
M-mast (3-stage triplex)



CS/FCS/RP/DRP



● Main parts of lift cylinder 1st : PFL-mast (2-stage duplex) and M-mast (3-stage triplex)



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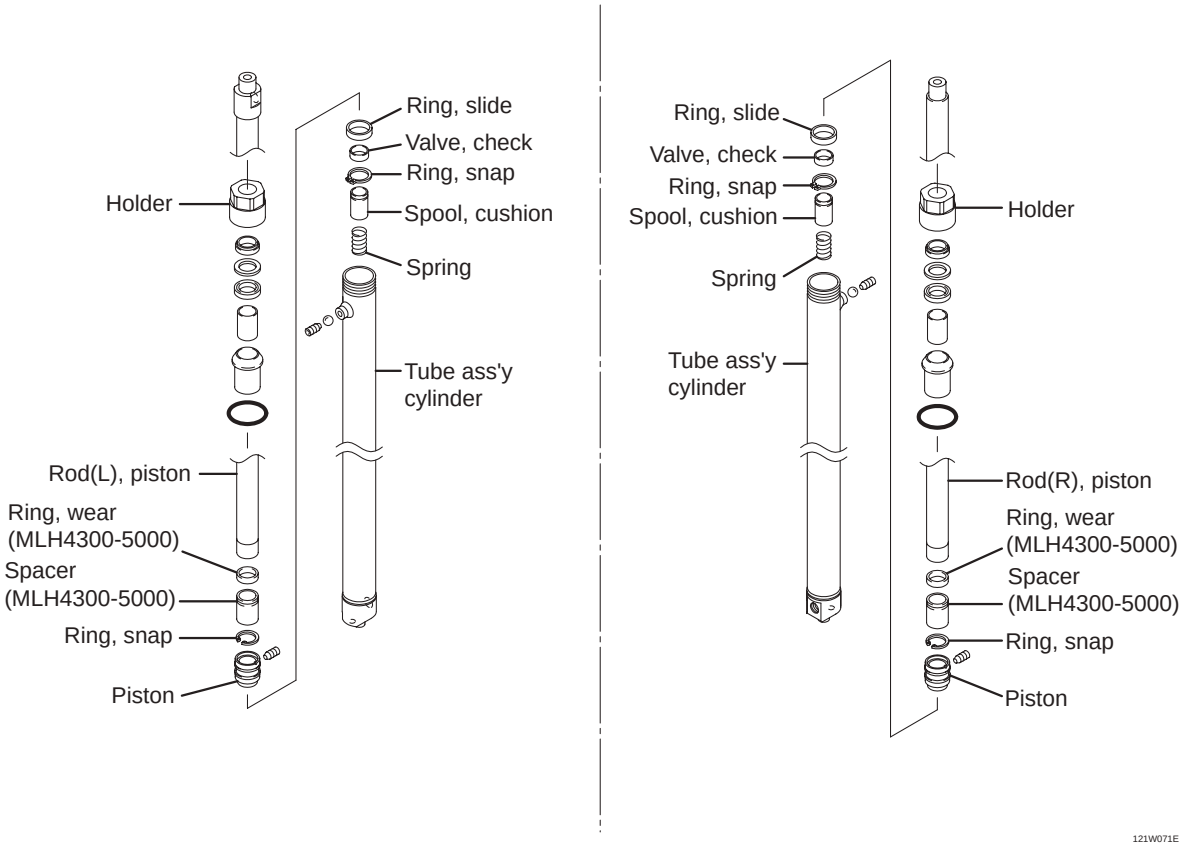
●Main parts of lift cylinder 2nd : PFL-mast (2-stage duplex)



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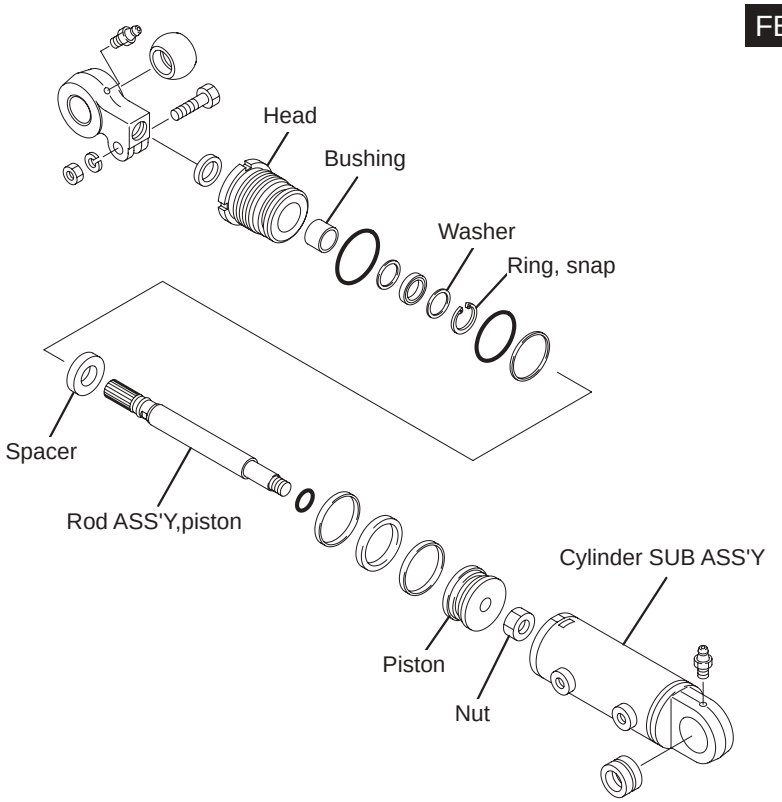
7d-1-2. Tilt cylinder - main part names

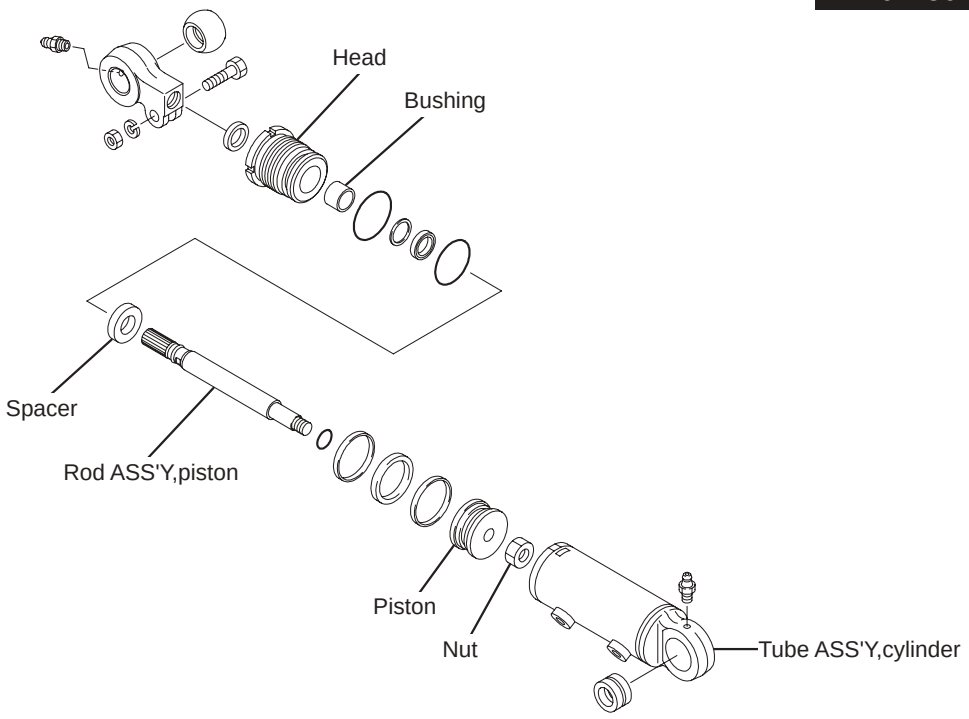
●**Main parts of tift cylinder**

FB10P-18P



221W0701

FB20P-30P



251W013

7d- 2. Disassembly and reassembly

⚠ CAUTION

- **Lift or jack up the forklift truck and support it with safety blocks or rigid stands.**
- **Apply wheel chocks to tyres to prevent the truck from moving.**
- **Before disconnecting hydraulic connections, release internal pressure to prevent from splashing oil.**
  Refer the CAUTION on the page 4 for the procedure.
- **When disconnecting hydraulic pipes, cap them to prevent dust from entering into hydraulic components and pipes.**
- **Be sure to disconnect the battery plug.**

7d-2-1. Lift cylinder - removal : P - mast (2 - stage simplex)

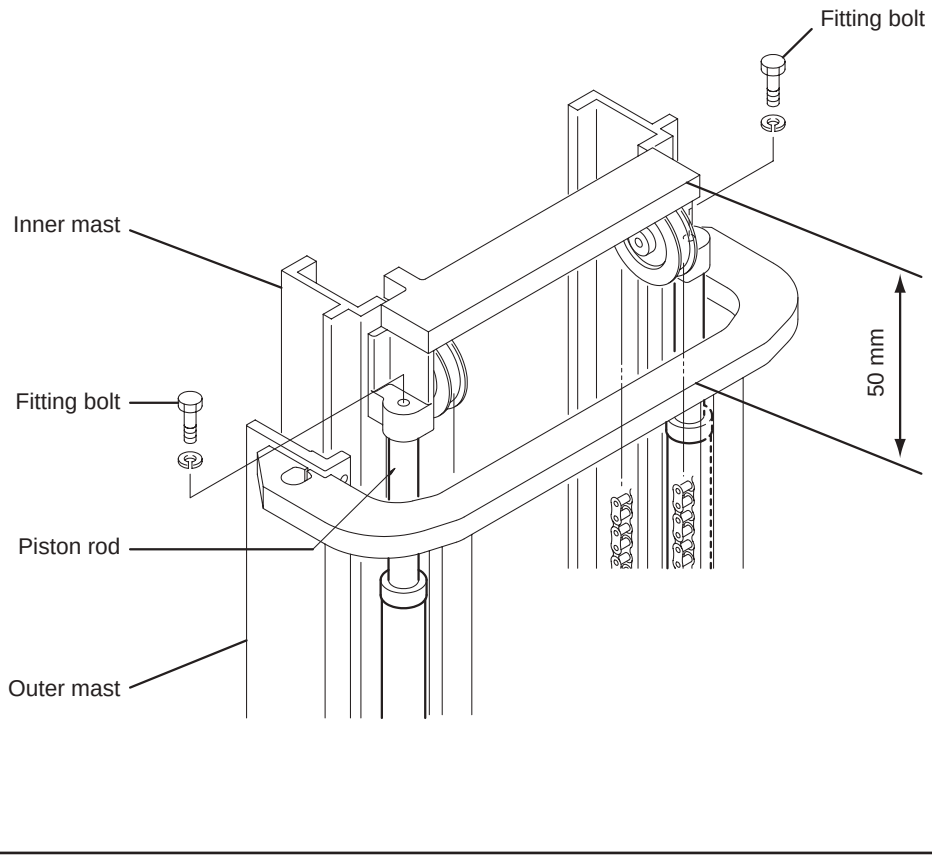
1. Pull the lift lever backward to raise the inner mast about 50mm.(about 100 mm for forks)

2. Support the inner mast with a wire rope or wood block.

3. Remove fitting bolts for piston rod.

●Removing the lift cylinder (1)

P-mast



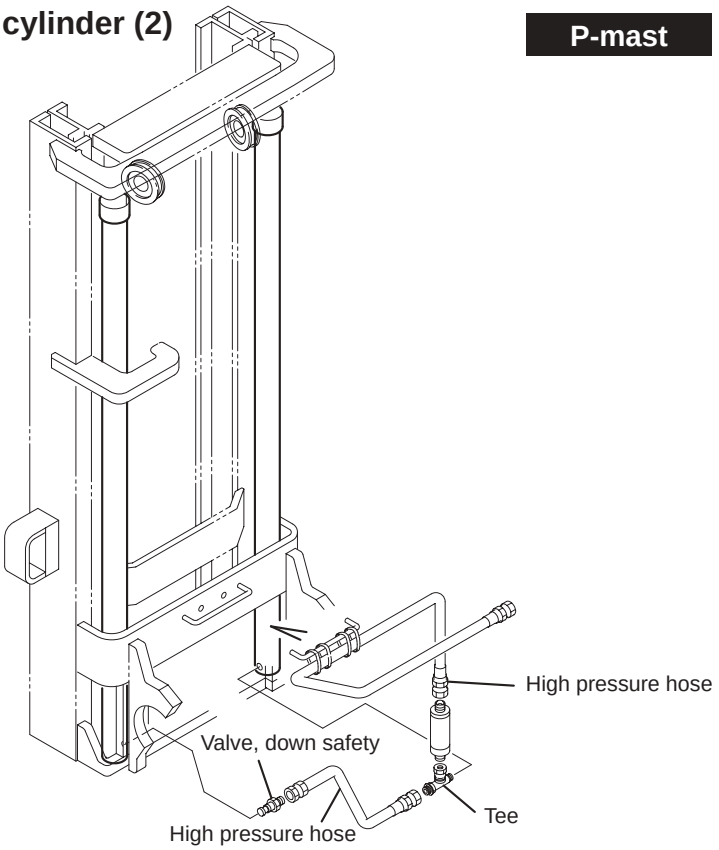
4. Disconnect hydraulic hoses.

⚠ CAUTION

Before disconnecting hydraulic connections, release internal pressure to prevent from splashing oil.
Refer the CAUTION on the page 4 for the procedure.

●Removing the lift cylinder (2)

P-mast



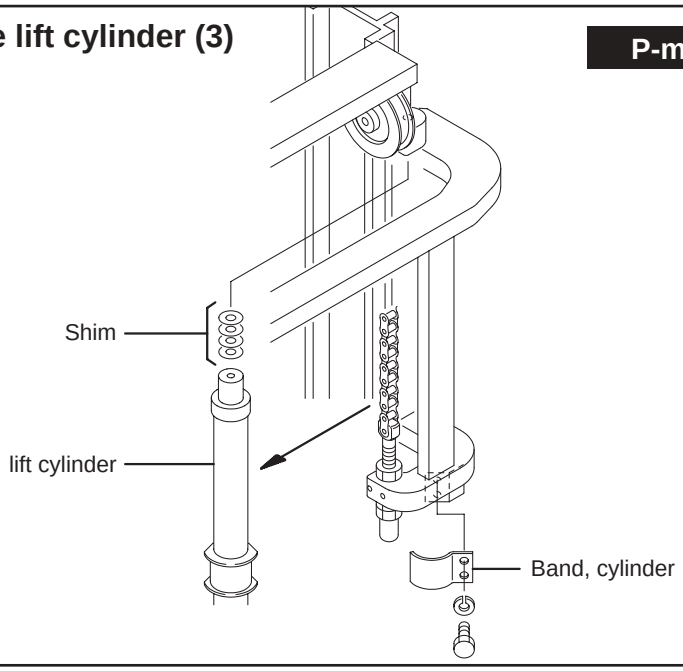
5. Remove cylinder bands to remove lift cylinders.

⚠ CAUTION

Record note the number and thickness of shims when removing them.

●Removing the lift cylinder (3)

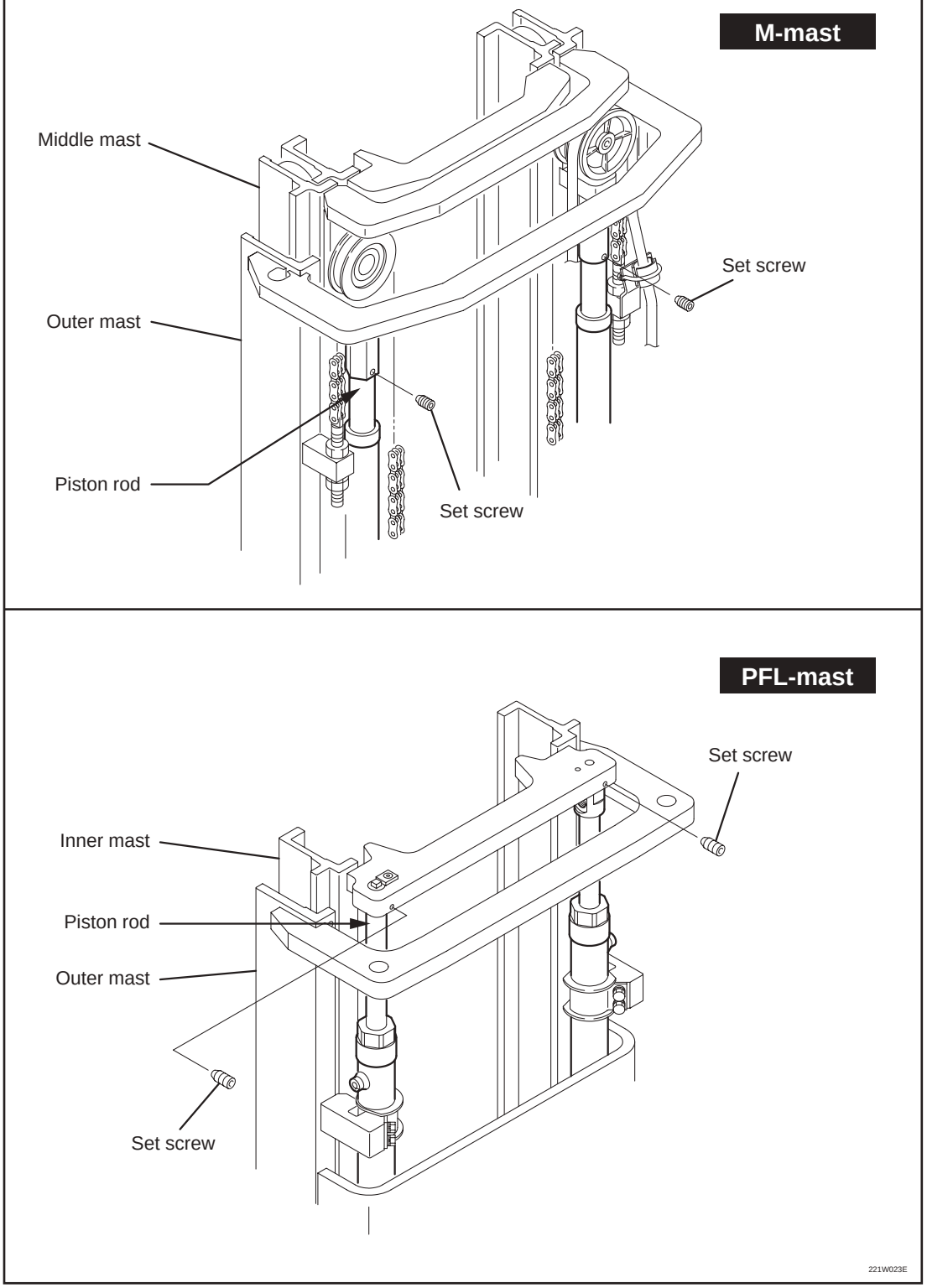
P-mast



7d-2-2. Lift cylinder - removal : PFL-mast (2-stage duplex), M-mast (3-stage triplex)

1. Pull the lift lever backward to raise the middle/inner mast about 50 mm.
2. Support the middle/inner mast with a wire rope or wood block.
3. Remove set screws that fix the piston rod.

●Removing the lift cylinder (1)



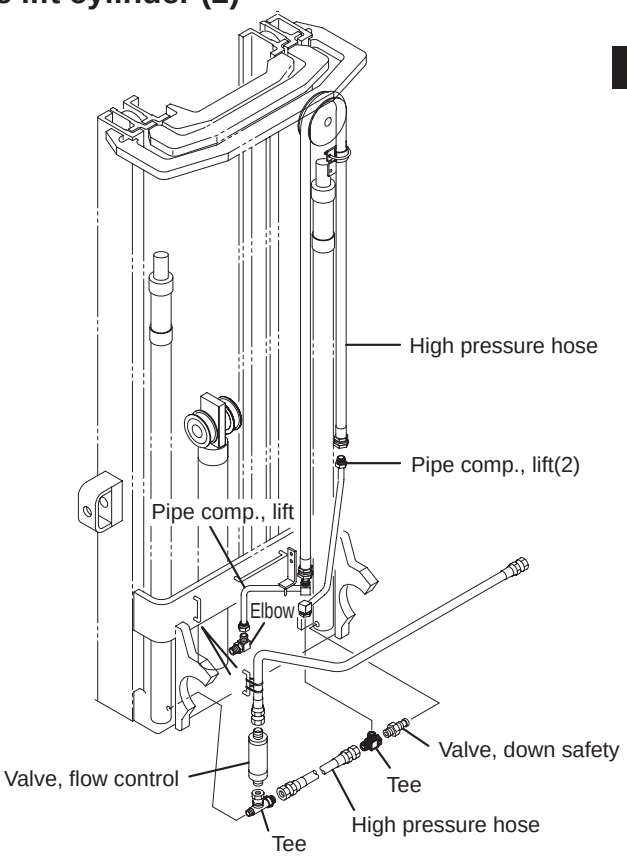
4. Disconnect hydraulic pipes and hoses as shown in the following illustration.

⚠ CAUTION

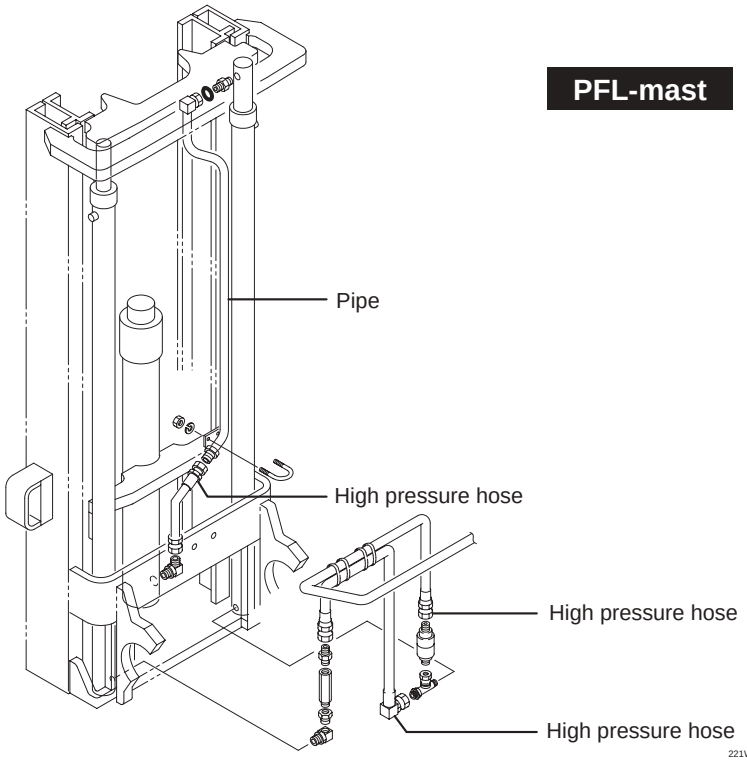
Before disconnecting hydraulic connections, release internal pressure to prevent from splashing oil.
Refer the CAUTION on the page 4 for the procedure.

●Removing the lift cylinder (2)

M-mast

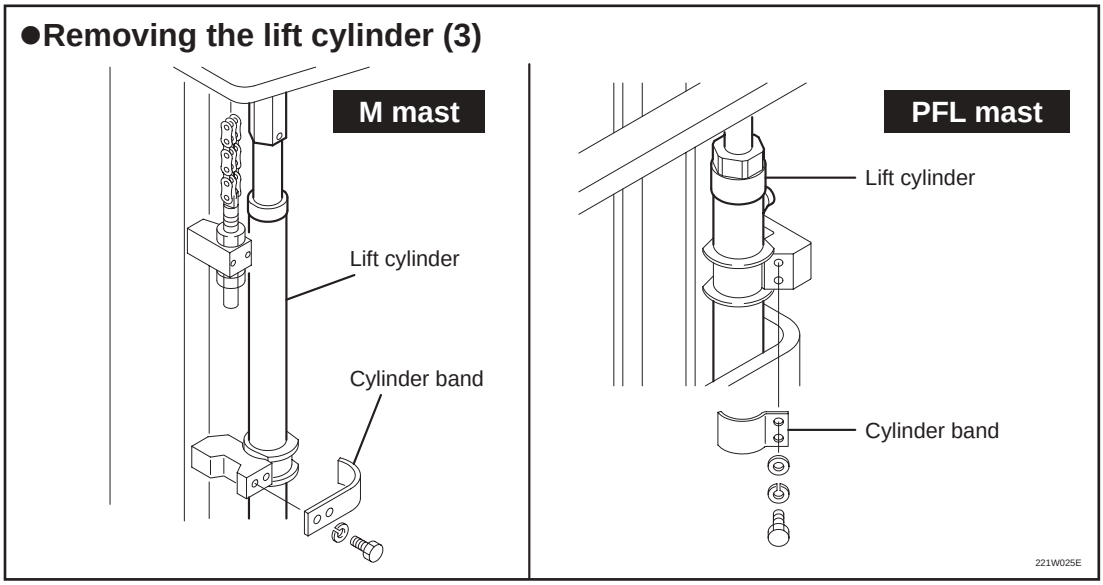


PFL-mast



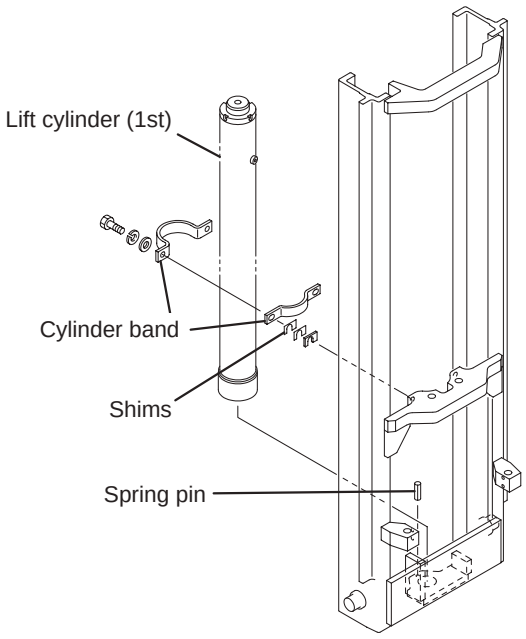
5. Remove cylinder bands to remove outer (2nd) lift cylinders.

●Removing the lift cylinder (3)



⚠ CAUTION **Record note the number and thickness of shims when removing them.**

●Removing the lift cylinder (1)



7d-2-3. Tilt cylinder - removal

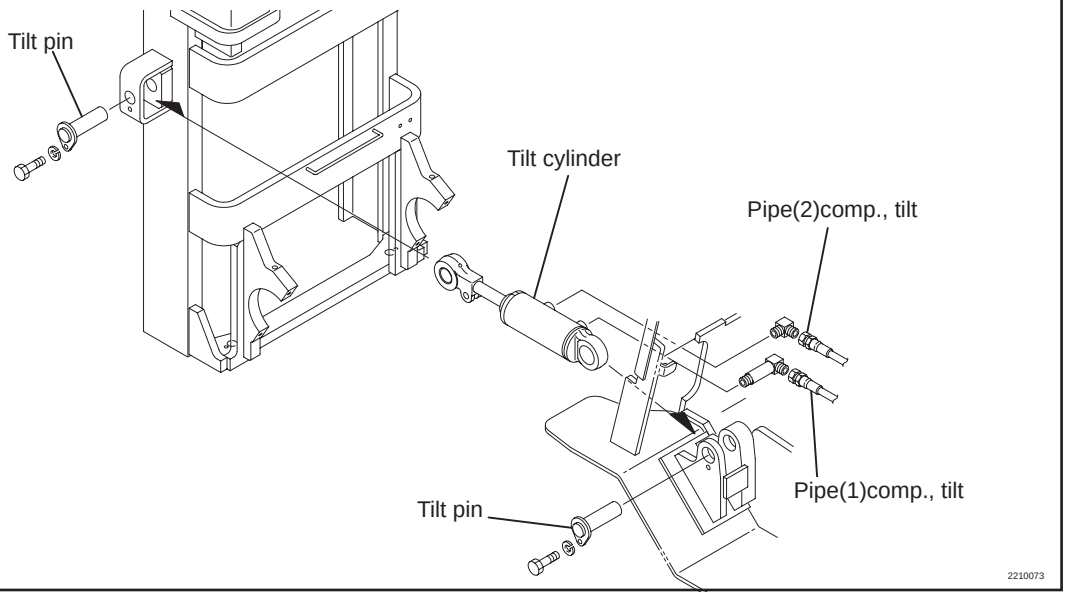
1. Operate the tilt lever to tilt the fork forward.
2. Place a rope on the "top beam" of the outer mast and support the mast by the hoist to prevent from falling down.
3. Remove tilt pipes.

⚠ CAUTION

Before disconnecting hydraulic connections, release internal pressure to prevent from splashing oil.
Refer the CAUTION on the page 4 for the procedure.

4. Remove tilt pins to remove tilt cylinders.

●Removing the tilt cylinder



7d-2-4. Lift cylinder - installation and adjustment

1. Install the lift cylinder in reverse order of removal.

2. After installation of all cylinders and hydraulic pipings, operate the lift lever to raise the mast to the top end.

Make sure if both right and left cylinder rods are extended parallel and have no clearance at the top end.

If clearance found, adjust in the following manner.

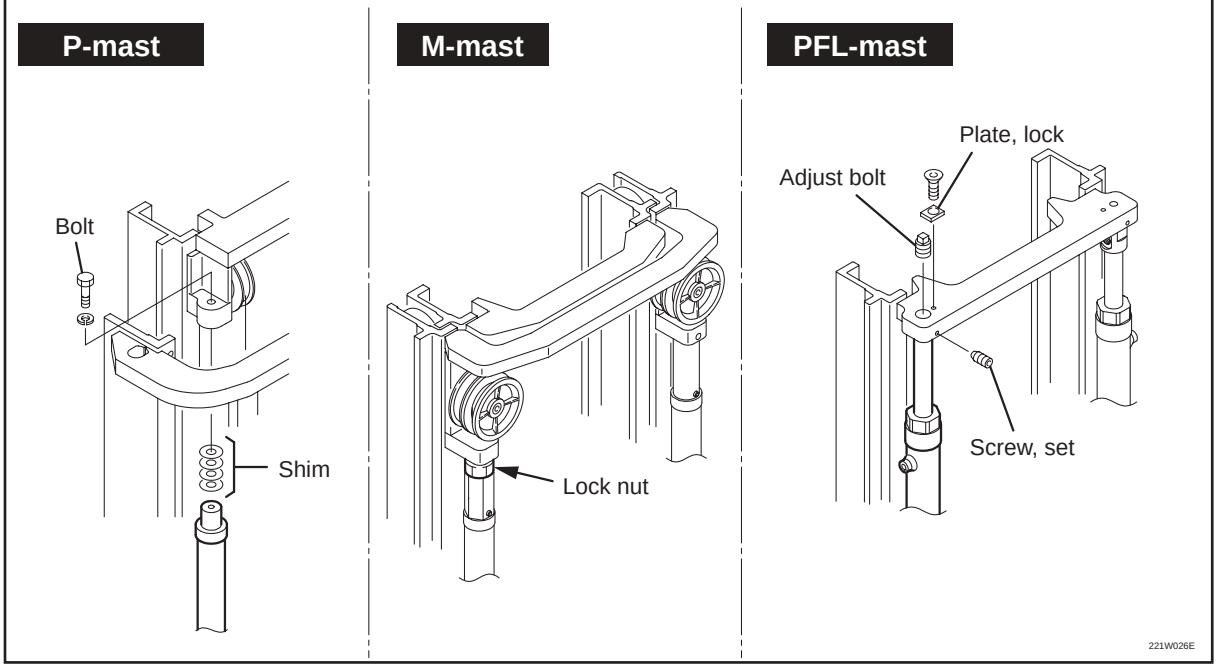
- P-mast : Insert proper thickness and number of shim (t0.2/t0.5/t1.0).
- M-mast : Turn the "Rod, head" at the top of the left cylinder to eliminate the clearance at the top of the cylinder rod, and fix the "Rod, head" with the "Lock nut."

  Tighten the "Screw, set" to fix the cylinder rod.
- PFL-mast : Loosen the "Screw, set" and turn the "Adjust bolt" to eliminate the clearance at the top of the cylinder rod.

  Mount the "Plate, lock" to fix the "Adjust bolt".

  Finally, tighten the "Screw, set" to fix the cylinder rod.

●Adjusting the lift cylinder



3. Make sure that oil is not leaked from anywhere.

7d-2-5. Tilt cylinder - installation

1. Install the tilt cylinder in reverse order of removal.

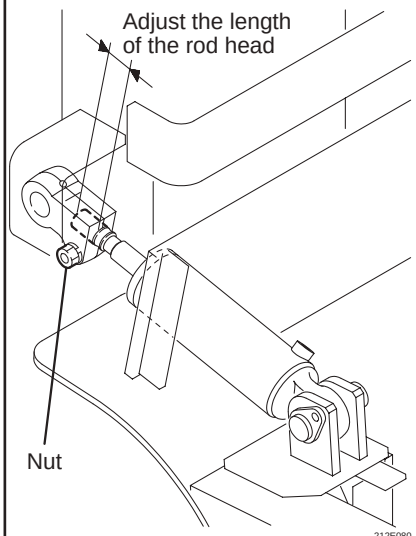
2. Operate the tilt lever and make sure if the mast is not twisted at both forward and backward ends.
If the mast is twisted, adjust the length of the rod by turning the head.
After adjustment, tighten the nut on the head.

3. Make sure that oil is not leaked from anywhere around the tilt cylinder.

NOTE

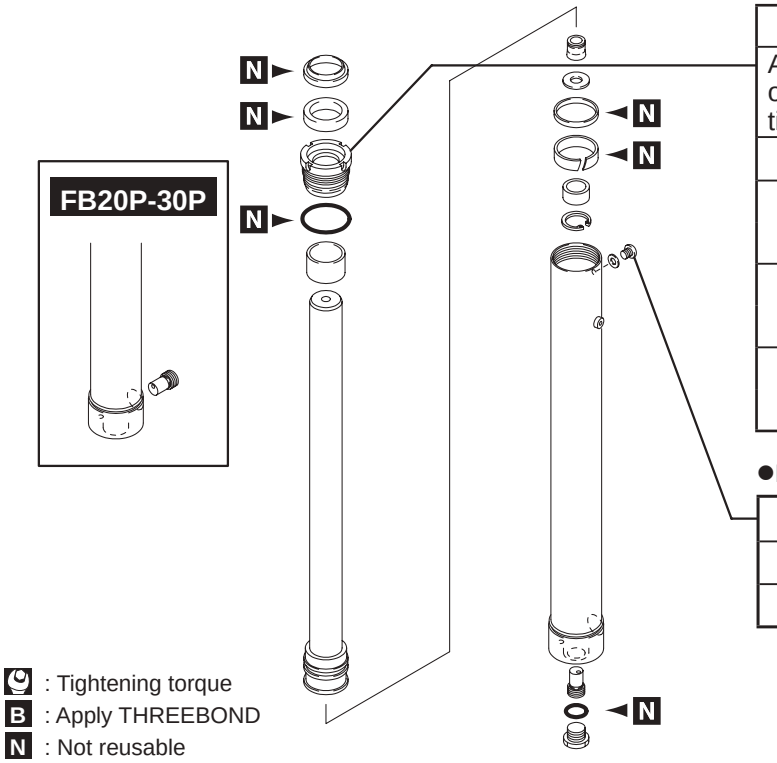
The tilt cylinder may be required to modify or replace if the mast is exchanged for another one with different lifting height.
Refer the section 7d-3 for details.

●Installing the tilt cylinder



7d-2-6. Lift cylinder - disassembly and reassembly

Lift cylinder 1st (M/PFL-mast)



	Head, cylinder	B
Apply THREEBOND[#1901] or equivalent on threads when tightening.		

	Tightening torque
FB10P-18P	343±78.5 N · m {35±8.0 kgf · m}
FB20P/25P	422±96.1 N · m {43±9.8 kgf · m}
FB28P/30P	451±104 N · m {46±10.6 kgf · m}

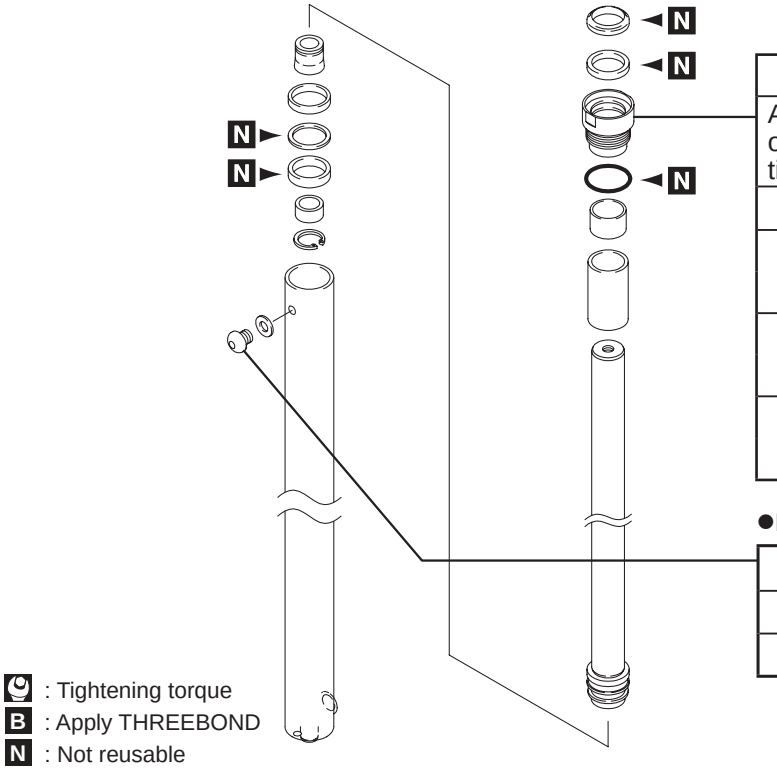
●**Plug**

Tightening torque
3.92±0.98 N · m {0.4±0.1 kgf · m}

: Tightening torque
B : Apply THREEBOND
N : Not reusable

221W093

Lift cylinder (P-mast) / lift cylinder 2nd (M-mast)



	Head, cylinder	B
Apply THREEBOND[#1901] or equivalent on threads when tightening.		

	Tightening torque
FB10P-18P	196±45.1 N · m {20±4.6 kgf · m}
FB20P/25P	235±53.9 N · m {24±5.5 kgf · m}
FB28P/30P	275±61.8 N · m {28±6.3 kgf · m}

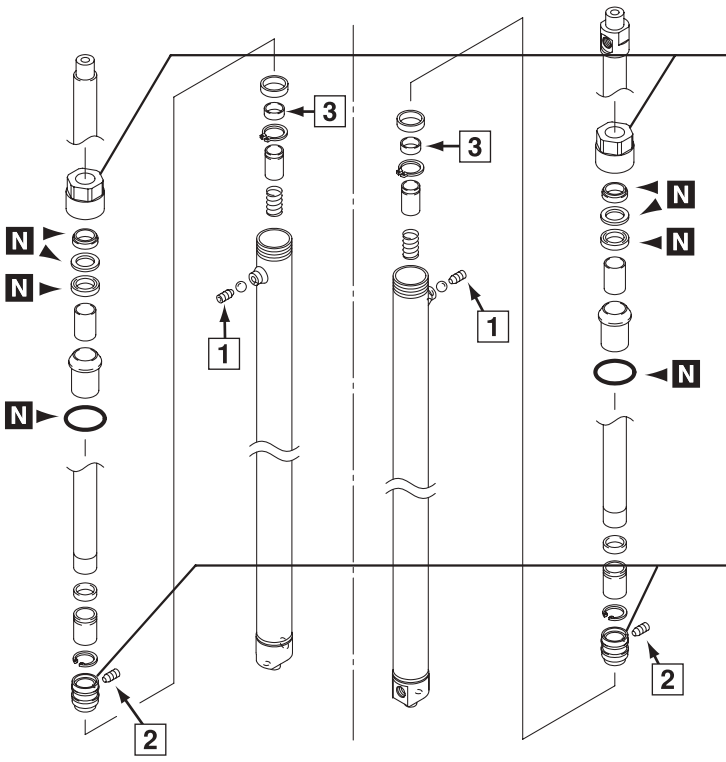
●**Plug**

Tightening torque
3.92±0.98 N · m {0.4±0.1 kgf · m}

: Tightening torque
B : Apply THREEBOND
N : Not reusable

221W027

Lift cylinder 2nd (PFL-mast)



[L.H.] [R.H.]

	Head, cylinder	B
Apply THREEBOND[#1901] or equivalent on threads when tightening.		
	Tightening torque	
FBT10P-18P	206±39 N · m	
	{24±4.0 kgf · m}	
FB20P-30P	235±54 N · m	
	{24±5.5 kgf · m}	

1	Tightening torque
3.92±0.98 N · m	
{0.4±0.1 kgf · m}	

	Tightening torque
196±35 N · m	
{20±3.6 kgf · m}	

3	Check valve
When assembling, be careful of the facing of parts. Face the slit surface toward the spring.	

2	Tightening torque	L
3.92±0.98 N · m		
{0.4±0.1 kgf · m}		
L.H.	After tightening, use a 2 point punch or close.	
R.H.	After tightening, apply LOCTITE.	

: Tightening torque
B : Apply THREEBOND
L : Apply LOCTITE
N : Not reusable

2210078

CAUTION **Replace packings when reassembling.**

NOTE **Apply grease on packings and seals when fitting them.**

1 Preparation for disassembling

Make the preparations shown below before disassembling the cylinder.

●Preparation of the workbench

The workbench should be wide enough to put the parts on. It should be stable and solid so that the parts will not fall off or move during the maintenance.

●Preparation of tools and materials

Prepare proper tools and materials.

2 General precautions for the maintenance

- Before disassembling the cylinder, thoroughly clean any dirt or dust on the outer tube.
- Since these are precision parts, handle them with care. Handle the parts carefully so as not to hit them against each other or allow them to fall.
- Don't tap or pry any parts by force. Such handling may cause burrs or damage parts. As the result, parts may be impossible to reassemble properly and causes oil leaking or degrades the performance.
- If the parts are left halfway while maintenance, they may be rusted or damaged by dusts. They must be covered or protected if the job is required to interrupt.

3 Maintenance standards

Replace the sliding parts and sealing parts according to the following instructions.

- Bushings : When more than 1/4 of circumference is worn out and shows a red copper color.
- Seals : Whenever the cylinder is disassembled, replace them with new ones.
- Piston rod : If curved more than 0.5 mm / 1m.

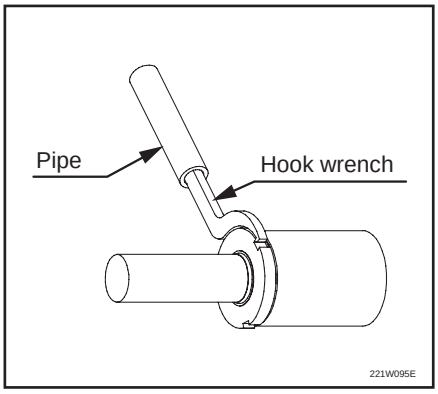
▸4 Disassembly procedure

1. Drain the oil.

2. Put the cylinder horizontal. Remove the plug and the gasket.

⚠ CAUTION

If the plug is not removed before disassembling, piston, piston seal, bushing and/or other internal parts may be damaged.



3. Loosen the cylinder head.
Loosen the cylinder head by using a hook wrench, and then remove the cylinder head from the cylinder tube ASS'Y.
Since the remaining oil may be spilled, put an oil pan to receive.

4. Pull out the cylinder head.
Pull the cylinder head straightly with care.

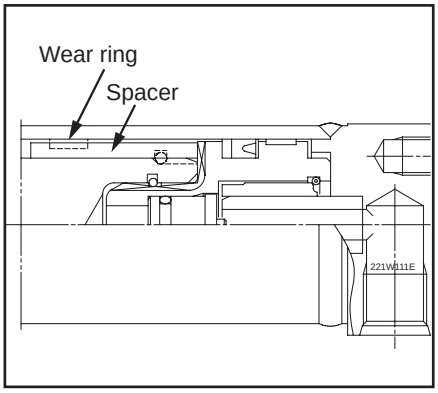
⚠ CAUTION

When removing the cylinder head from the rod, the end of the rod may hit and damage the head if it is pulled out roughtly.

5. Pull out the piston rod ASS'Y.
Pull out the rod carefully with keeping horizontally.
Don't forget to remove the plug before pulling the rod out.

⚠ CAUTION

Be careful not to damage the rod when pulling out from the outer tube especially around the thread part at the end of the tube or if the rod is long.



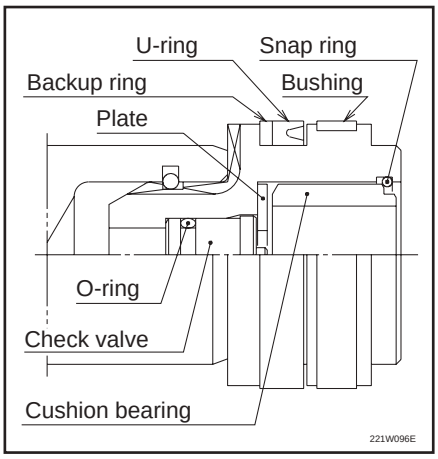
6. Pull out the spacer.
Pull the spacer out from the piston rod ASS'Y.
If the wear ring is fit on the spacer, that spacer cannot be removed from the rod. Only the spacer without wear ring can be removed from the rod.
The wear ring itself can be removed by hand.

7. Disassembly of the piston

Remove the piston seal, the bushing, the cushion bearing, the check valve, and the plate.

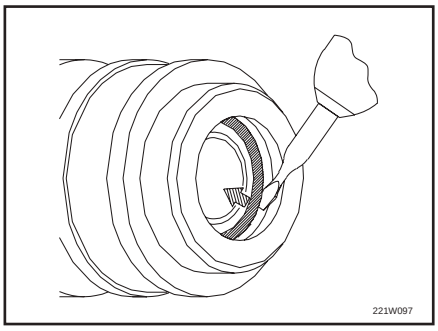
(The plate is installed only in cylinders with an internal diameter of ϕ55 or greater.)

1. Draw out the U-ring and the backup ring by using a spatula or a screwdriver.
2. Remove the bushing with expanding the joint with a screwdriver.



NOTE **All removed seals must be replaced to new ones.**

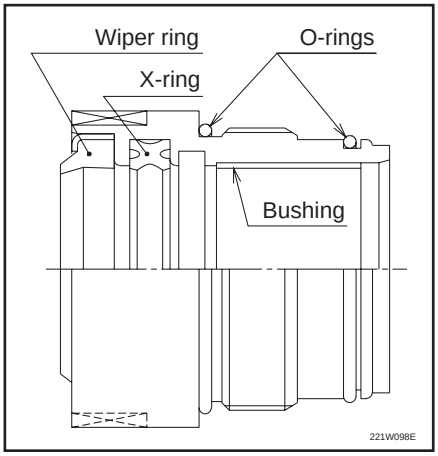
3. Remove the snap ring, and pull out the cushion bearing, the check valve and the plate. Pull the snap ring out of the groove by using a sharp-pointed tool.



8. Disassembly of seals on the cylinder head.

Remove the X-ring, the wiper ring, and the O-ring.

1. Remove rings with extending by using a spatula or a screwdriver.
2. The wiper ring is press-fitted. Stick the ring by a tool like a screwdriver from the bushing side and tap to push the wiper ring out.
3. Remove the O-ring and X-ring with the same manner by using a spatula or a screwdriver.



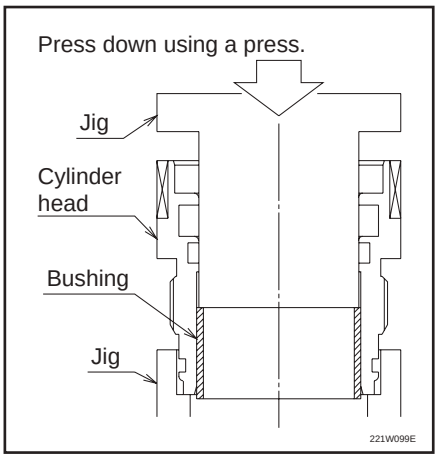
NOTE **Replace all seals and rings to new ones when reassembling.**

9. Disassembly of the bushing in the cylinder head (If required).

Use a jig, as shown in the illustration on the right, and push the bushing out by using a press.

Or, pull out the bushing by the following procedure.

1. Groove the inside face of the bushing by using a tool. (Groove parallel about 10 mm away from the joint.)
2. Stick a flat head screwdriver into the joint of the bushing, and twist along the groove to bend the edge of the bushing.
3. Grab the bent part of the bushing with a plier and pull it out.



NOTE **Replace the bushing to the new one when reassembling.**

10. Cleaning and storage

1. Clean all removed parts with kerosene.
   After wipnig kerosene off, apply the hydraulic oil on them before storage.
2. If removed parts are left without cleaning, they may be rusted or damaged by moisture or dust.

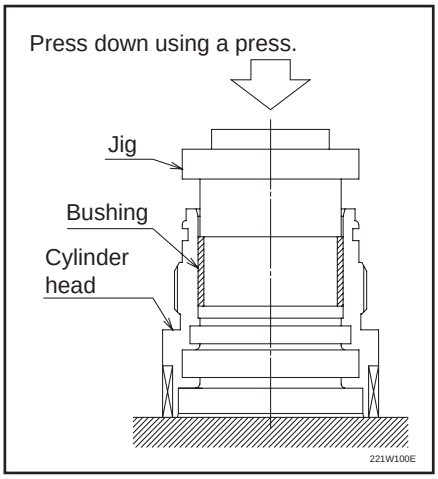
▸5 Reassembly procedure

⚠ CAUTION

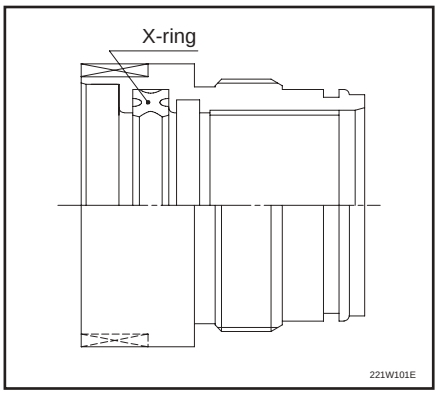
Dust of paints may be peeled off from painted parts (such as the cylinder head) and come into the cylinder which can cause oil leaking.
Pay attention not to come any dusts in the cylinder when reassembling.

1. Reassembly of the cylinder head

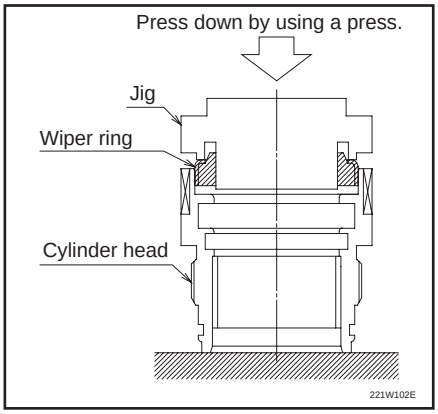
1. Fitting of the bushing
   Press the bushing into the cylinder head by using a press-fitting jig.
   (Apply hydraulic oil to the inner surface of the cylinder head before pressing the bushing in. After press-fitting the bushing, make sure for no gaps or unevenness.)



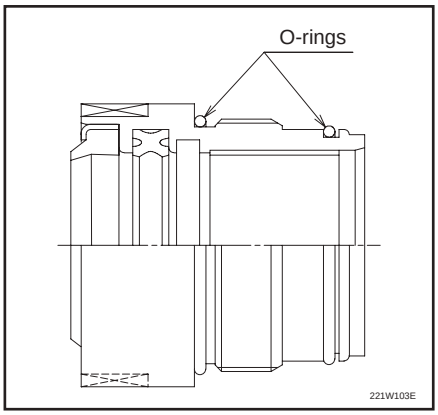
2. Fitting of the X-ring
   Push the X-ring into the X-ring groove in the cylinder head.
   Do not damage the X-ring while installing.
   After fitting the X-ring, make sure there are no damages or transformations.



3. Fitting of the wiper ring
   Fit the wiper ring by using a jig.

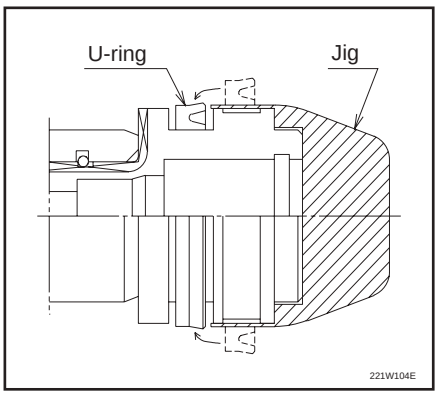


4. Fitting of the O-ring
   Because of using the thinner O-ring than the conventional one, use Nichiyu Genuine part for replacement.
   Be careful not to damage the O-ring because it is stretched when fitting.

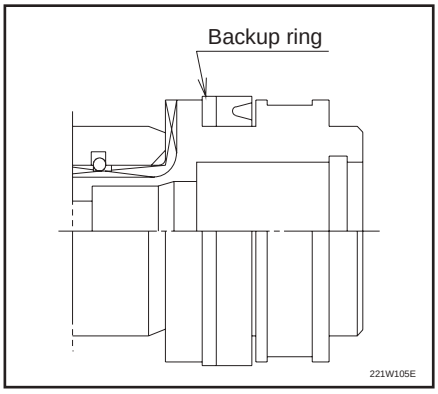


2. Reassembly of the piston

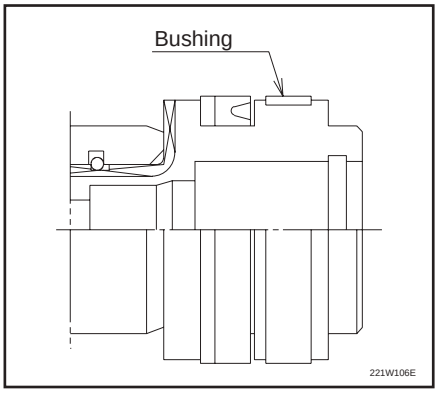
1. Fitting of the U-ring
   Insert the U-ring into the U-ring groove of the piston with stretching.
   Make sure if the direction of the U-ring is correct.
   It might be easier to fit the U-ring if it is heated to about 70℃, or the hydraulic oil is applied on it.
   If an insertion jig as shown in the illustration on the right is used, the U-ring can be fitted easily and safely.



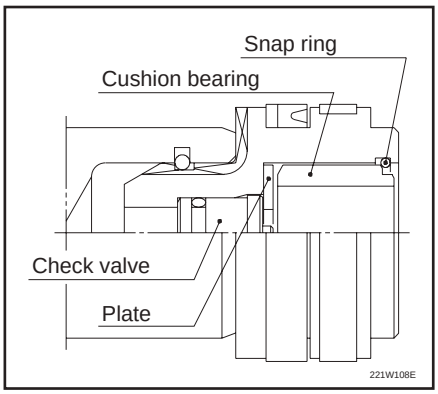
2. Fitting of the backup ring
   Insert the backup ring behind the U-ring.
   (Refer the illustration on the right.)



3. Fitting of the bushing
   Put the bushing on the bushing groove of the piston with expanding at the joint.
   (Refer the illustration on the right.)



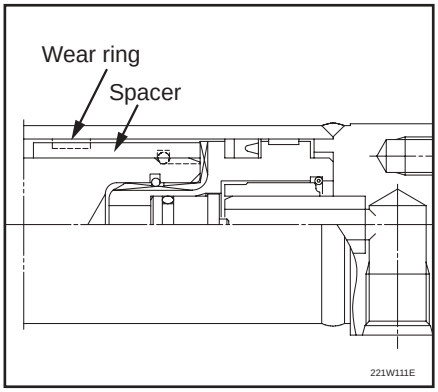
4. Fitting of the check valve, the plate and the cushion bearing.
   Fit the check valve, the plate (only for cylinders with an inner diameter of ϕ55 or greater) and the cushion bearing, the piston with this order.
   Be careful about the direction of the cushion bearing.
   After fitting them, fit the snap ring into the groove in the piston.



3. Reassembling of the cylinder tube ASS'Y, the piston rod ASS'Y and the cylinder head

1. Fixing of the cylinder tube ASS'Y
   Fix the cylinder tube ASS'Y horizontally.

2. Inserting the spacer (Fitting of the wear ring)
   Insert the spacer onto the piston rod ASS'Y. Insert the spacer until it touches the piston.
   If the wear ring was fitted on the spacer originally, fit the new wear ring in the groove on the spacer.

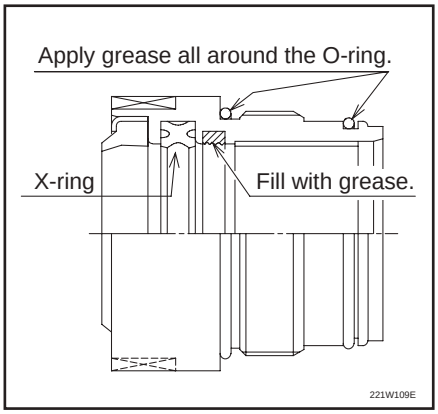


3. Inserting of the piston rod ASS'Y
   Insert the piston rod ASS'Y into the cylinder tube ASS'Y.
   Push the piston rod ASS'Y all the way to the end of the cylinder tube ASS'Y.

⚠ CAUTION

- **Make sure that the plug is removed before inserting the rod into the tube of the cylinder.**
- **Keep the rod horizontally when inserting.**
- **Pay attention not to hit the piston or the rod to the thread of the cylinder tube. Otherwise, parts on the piston or the rod may be damaged.**

4. Lubrication
   Fill the grease in the groove behind of the X-ring in the cylinder head.



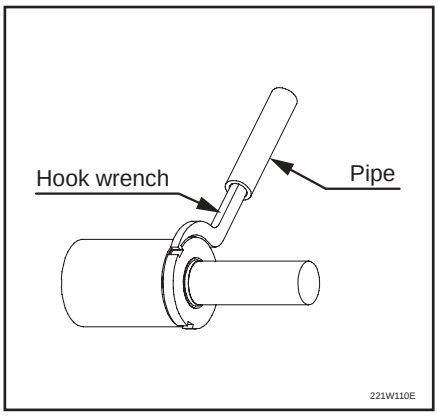
5. Installation of the cylinder head

At first, put the ctlinder head through the piston rod ASS'Y. (Insert the rod from the bottom of the head.)

Next, screw the head in the cylinder tube ASS'Y.

Pay attention not to damage O-rings on the head when screwing.

Then, tighten the head by a hook wrench with the specified torque.



6. Fitting of the plug and the gasket

Fit the plug and the gasket. Tighten them with the specified torque.

4. Operating test

After finishing reassembling, fitting on the mast or chassis, and re-connection of all hydraulic hoses, you can start to test the function.

Move the hydraulic lever slowly to fill the hydraulic oil through the circuit gradually.

Do not move the hydraulic lever quickly for the first 8 or 10 times to fill the oil to the end of the stroke of the cylinder. Otherwise, the oil may be bubbled and the hydraulic pump may be damaged.

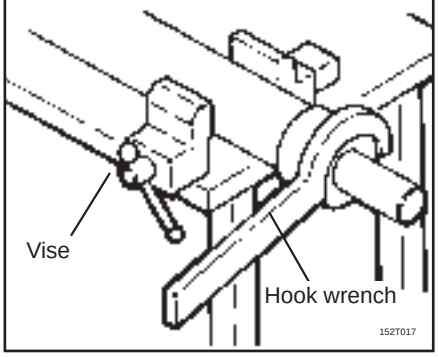
7d-2-7. Tilt cylinder - disassembly and reassembly

1. Fix the cylinder on a vise.

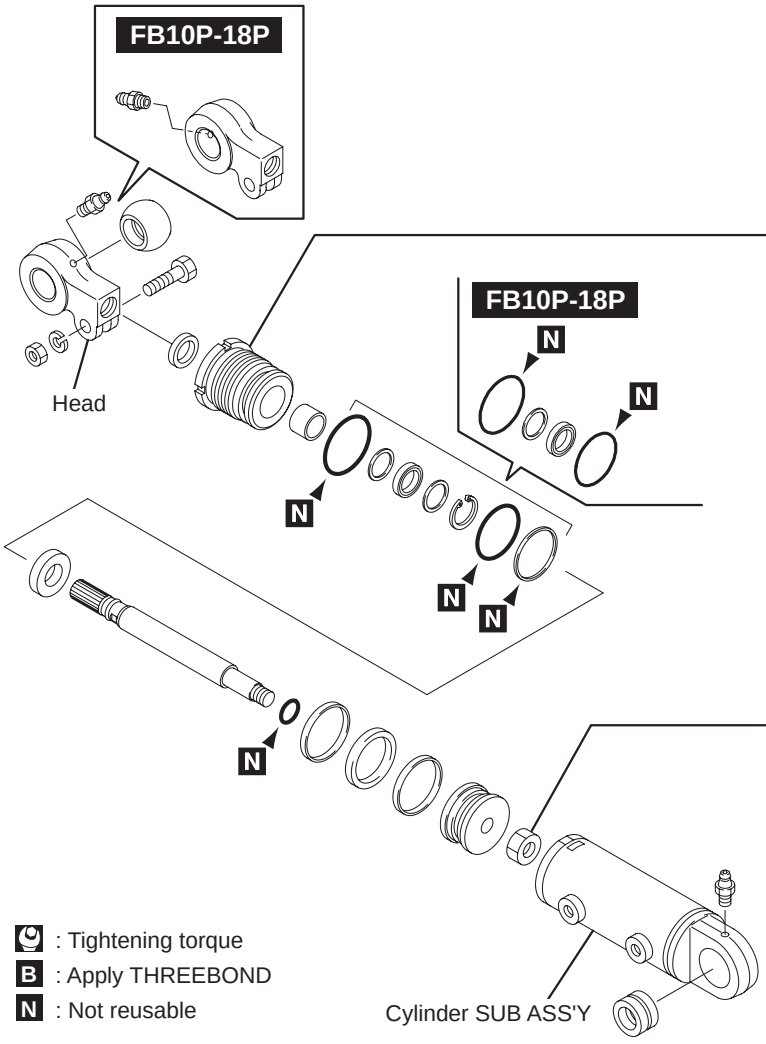
CAUTION **Do not vise around the head.**

2. Remove the cylinder head by a hook wrench.

●**Removing the "head KIT, cylinder"**



●**Disassembling and reassembling the tilt cylinder**



Head, cylinder	B
Apply THREEBOND[#1344] or equivalent on the threads when tightening.	
Tightening torque	
FB10P-18P	343 ± 63.7 N · m {35 ± 6.5 kgf · m}
FB20P-30P	490 ± 49 N · m {50 ± 5 kgf · m}

Tightening torque	
FB10P-18P	343 ± 49 N · m {35 ± 5 kgf · m}
FB20P-30P	735 ± 74 N · m {75 ± 7.5kgf · m}

CAUTION **Replace all seals and packings when reassembling.**

NOTE **Apply grease on all seals and packings when fitting them.**

7d- 3. Inspection and adjustment

7d-3-1. Cylinder comp. - inspection

1. Check inside of the outer tube for rusting and/or damage.

7d-3-2. Piston rod - inspection

1. Check for rusting and/or damage.

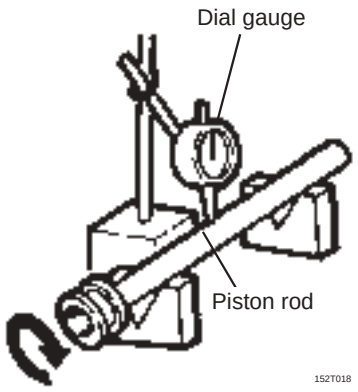
➡ If rusting or damaged, polish them with oil stone till they will not be felt by fingers.

2. Check for deflection.

Deflection limit	1.0 mm

⚠ CAUTION **Measure at least 3 points to check for deflection.**

●**Measuring deflection**



7d-3-3. Drift for lift and tilt - inspection

●After replacing packings or the cylinder ASS'Y, measure the drift of lift and tilt.

➡ If it is out of the specification, it must be maintained again.

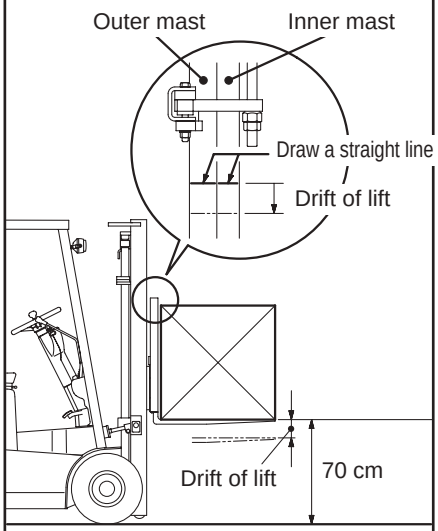
▸1 Measuring drift of lift

1. Load the maximum weight, and then raise the fork about 70 cm from the ground.
2. Tilt the mast vertically to level the fork. (Use the tilt lever.)
3. Draw a straight line over the inner mast and the outer mast.
4. Measure the drift of lift 10 minutes later.

<Specifications>

Applicable model	Drift of lift [mm/10min.] at the line on the Inner mast
FB10P FB10P-18P-U	25-40
FB14P-20P	35-50
FB25P-30P FB20P/25P-U	50-65

●Measuring drift of lift lowering



CAUTION

If the drift of the lift is measured at the top surface of the fork, the specific values should be doubled of the values shown above.

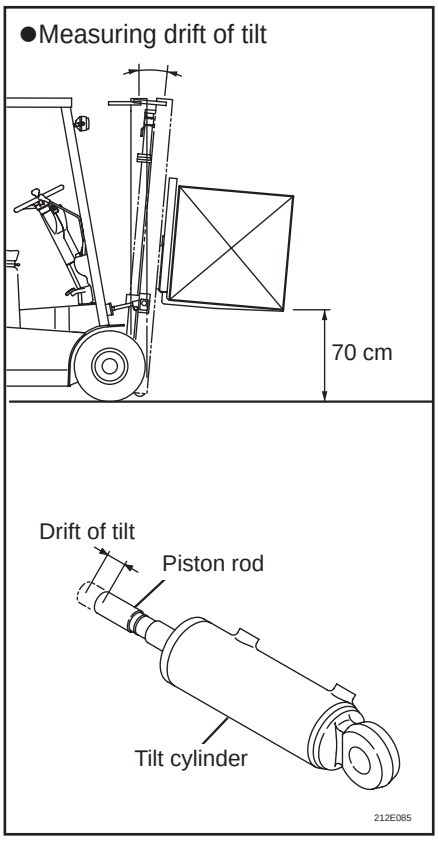
▸2 Measuring drift of tilt

1. Load the maximum weight, and then raise the fork about 70 cm from the ground.
2. Tilt the mast vertically to level the fork. (Use the tilt lever.)
3. Measure the tilt drift of the piston rod of the tilt cylinder 5 minutes later.

<Specifications>

Drift of tilt [mm/5min.]	
Piston rod	5-10

●Measuring drift of tilt



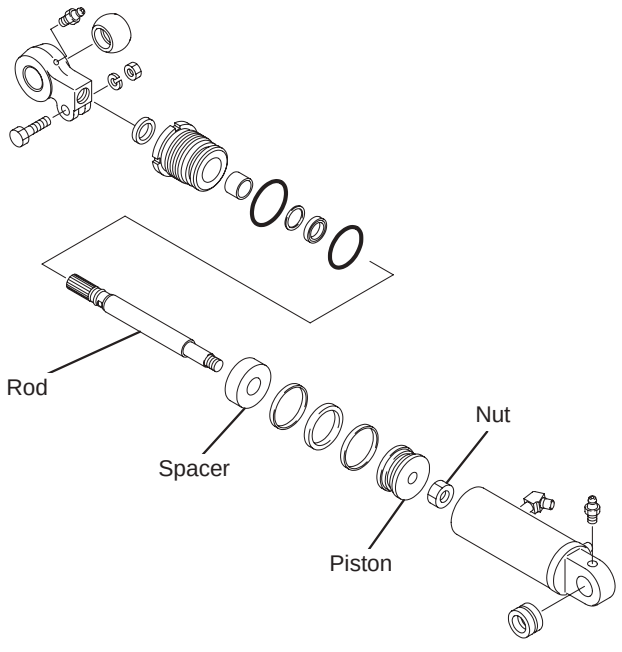
7d- 4. Variation of the tilt cylinder

The tilt angle is decided by the maximum lifting height.
If the mast is exchanged to another one but the different height, the tilt angle must be made sure, and the replacement or modification of the tilt cylinder may be required.

7d-4-1. Tilt angle by masts

Applicable model	Applicable Mast model	Max. lifting height (mm)	Tilt angle (Degrees)		Spacer P / No.	Rod length (mm)	Cylinder I.D.
			Forward	Backward			
FB10 ~ 18P	300P ~ 400P 300PFL ~ 400PFL	3000 ~ 4000	6	12	-	336	L(R)G1
	200P ~ 430P 200PFL ~ 430PFL	2000 ~ 2700 ≧4300	4	6	31851-37500	380	L(R)G4
	330M ~ 550M	3300 ~ 5500	4	6	31851-37500	380	L(R)G4
	570M ~ 700M	5700 ~ 7000	1.5	6	31851-37580	380	L(R)G5
FB20P ~ 28P	300P ~ 400P 300PFL ~ 400PFL	3000 ~ 4000	6	12	-	363	L(R)O1
	200P ~ 430P 200PFL ~ 430PFL	2000 ~ 2700 ≧4300	4	6	31851-37530	412	L(R)O4
	330M ~ 550M	3300 ~ 5500	4	6	31851-37530	412	L(R)O4
	570M ~ 700M	5700 ~ 7000	1.5	6	31851-37610	412	L(R)O5
FB30P	300P ~ 400P 300PFL ~ 400PFL	3000 ~ 4000	6	12	-	397	L(R)R1
	200P ~ 430P 200PFL ~ 430PFL	2000 ~ 2700 ≧4300	4	6	31951-37450	452	L(R)R4
	330M ~ 550M	3300 ~ 5500	4	6	31851-37450	452	L(R)R4
	570M ~ 700M	5700 ~ 7000	1.5	6	31851-37540	452	L(R)R5

●Removing the tift cylinder



7d- 5. Troubleshooting

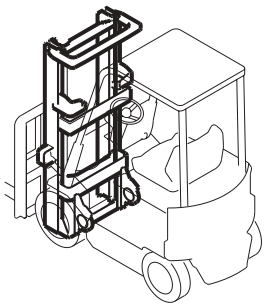
7d-5-1. Cylinder - troubleshooting

No.	Symptom	Possible cause	Solution
1	Oil leakage from Cylinder head	1. Damage of the packing in the cylinder	Replace
		2. Looseness of Cylinder head	Tighten
		3. Damage on the rod	Repair, Replace
2	Oil leakage from Cylinder Comp.	1. Damage of the welded part	Repair
3	Drift is too big	1. Damage of the packing in the cylinder	Replace
		2. Damage inside of the cylinder tube	Repair, Replace
		3. Oil leakage in the Control valve	Replace
4	Cylinder vibrates while operation	1. Bend of the rod	Replace
		2. Shortage of hydraulic oil in the tank	Replace
		3. Sucking air from the fitting of the piping	Tighten
5	Operating speed of the cylinder is slow.	1. Over - discharging of the battery	Charge
		2. Lack of output of the pump	Replace
		3. Plunger of the control valve does not work properly.	Inspect
		4. Clogging of the filter in the tank	Clean or replace
		5. Low relief pressure	Adjust
		6. Damage of the packings of the piston	Replace
		7. Hydraulic speed setting on the control system is not proper.	Adjust
6	Lowering speed is too slow.	1. Stick of the spool in the flow control valve	Replace
		2. Foreign article is caught in the flow control valve.	Clean
		3. The spring in the flow control valve is damaged or weakened.	Replace
		4. Hose of the return circuit from the lift cylinder is choked or bent.	Replace
7	Cylinder does not work.	1. Failure of the micro switch of the control valve	Replace
		2. Failure of the wiring harness to the micro switch of the control valve	Inspect and repair
		3. Failure of the hydraulic contactor or the contact tip.	Inspect and repair
		4. Blow out of the hydraulic main fuse.	Replace

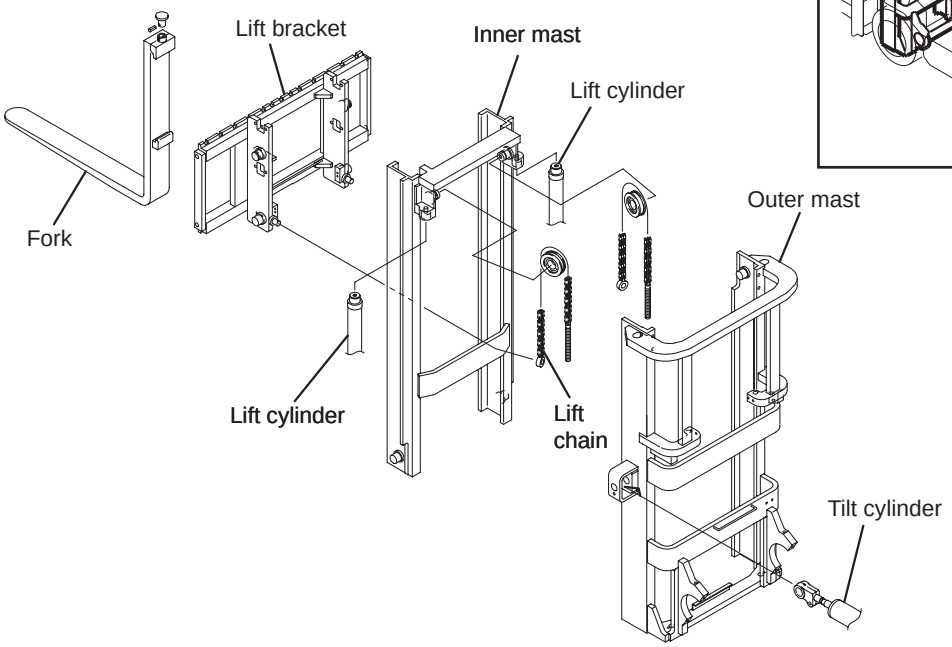
8. MAST

8- 1. Location and name

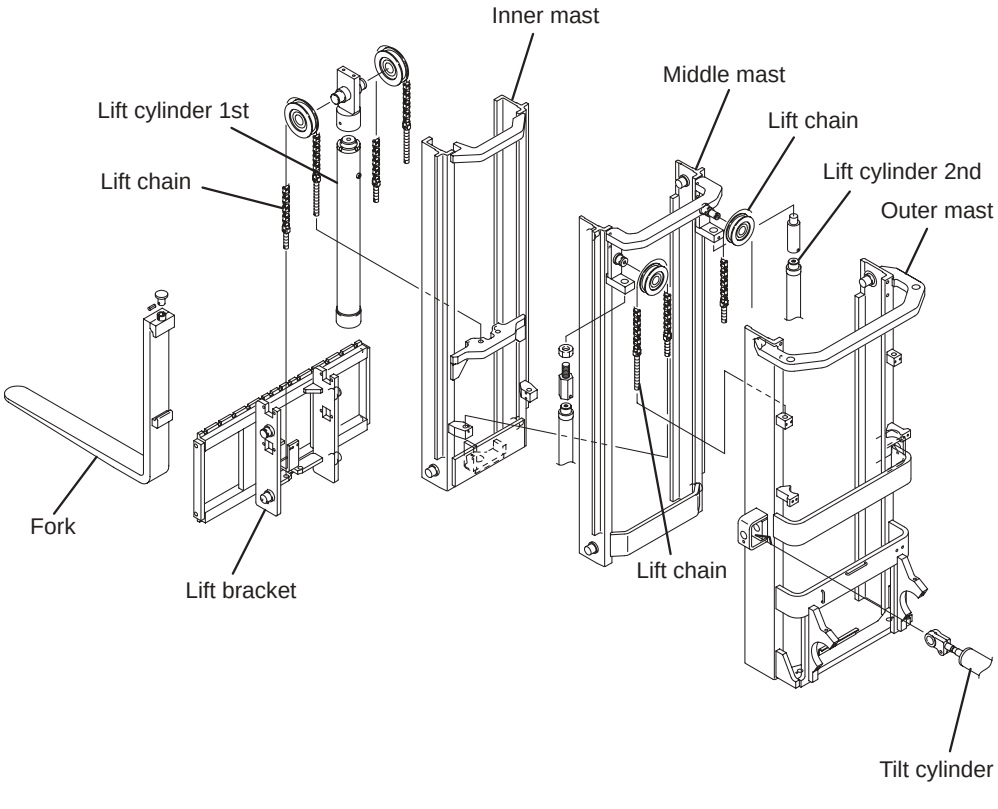
MAST



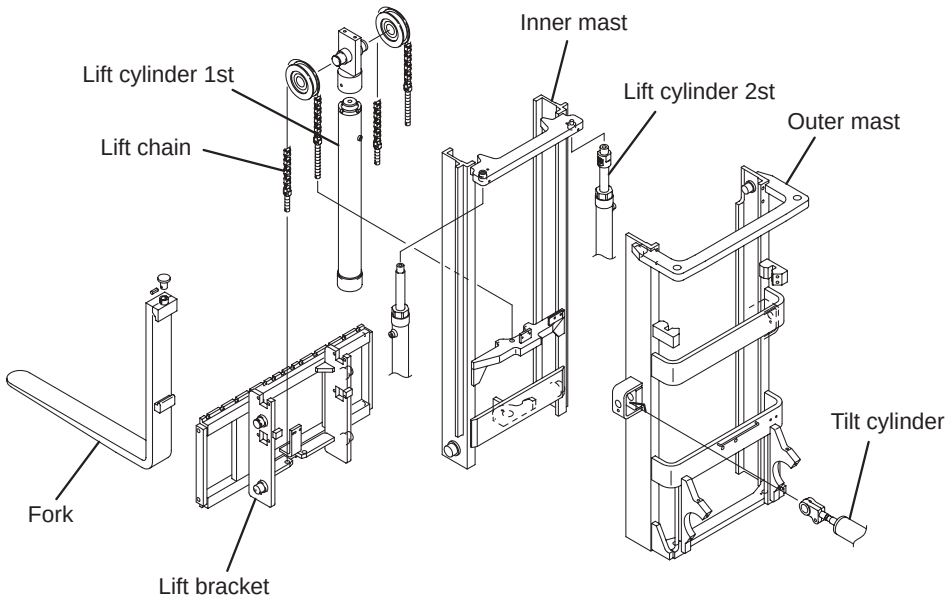
●Main parts of P- mast (simplex)



●Main parts of M- mast (triplex)



●Main parts of PFL-mast (duplex)



8- 2. Disassembly and reassembly

⚠ CAUTION

- **Lift or jack up the forklift truck and support it with safety blocks or rigid stands.**
- **Apply wheel chocks to tyres to prevent the truck from moving.**
- **When disconnecting hydraulic pipes, cap them to prevent dust from entering into hydraulic components and pipes.**
- **Be sure to disconnect the battery plug.**

8-2-1. Lift bracket - removal

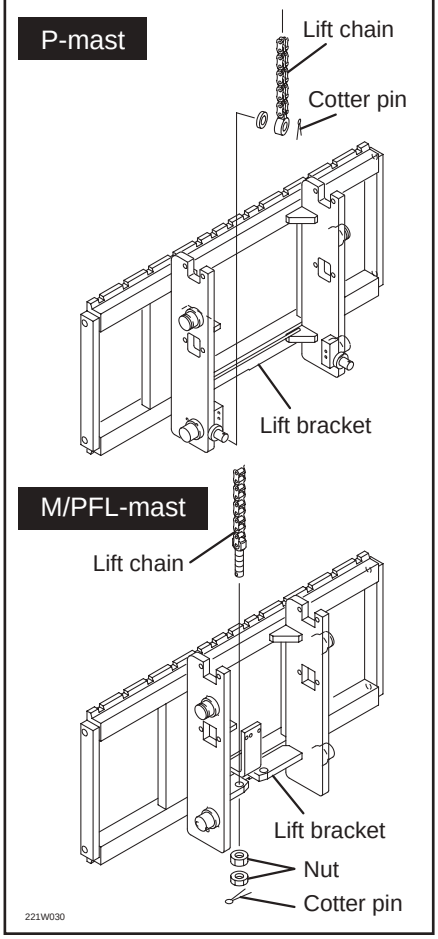
1. Tilt the mast vertically and lower forks to the ground.
2. Remove cotter pins.
3. Slacken lift chains and remove nuts at the chain anchor bolt.
4. Remove lift chains from the front side (fork side).

⚠ CAUTION

Put the nut on the anchor bolt after removing the chain to prevent the thread from damages.

5. Operate the lift lever to raise the inner mast to a height where the lift bracket can be removed.
6. Move the truck backward, or move the lift bracket forward.
7. Lower the inner mast.

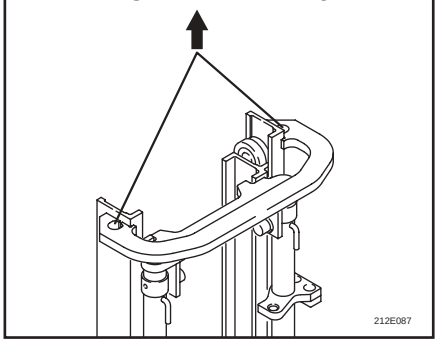
●Removing the lift bracket



8-2-2. Mast ass'y - removal

1. Tilt the mast vertically.
2. Hoist the mast ass'y until the wire ropes are just stretched.

●Hoisting the mast ass'y



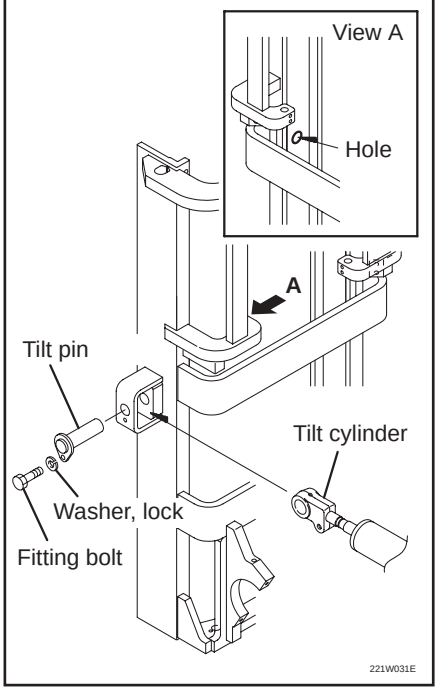
3. Raise the inner mast until its lower end rises to the top of the tilt pin.

4. Remove the fitting bolt for the tilt pin.

5. Use a hammer to strike the tilt pin out from inside of the mast channel through the hole.

6. Lower the inner mast.

●**Removing the tilt pin**



7. Operate the tilt lever to retract the piston rod of the tilt cylinder.

8. Disconnect hydraulic pipes and hoses.

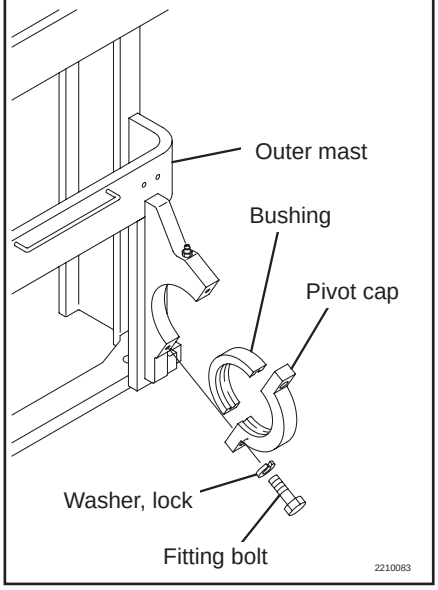
⚠ CAUTION

Turn the key switch off and operate hydraulic levers a few times to release high pressure in the hydraulic piping before disconnecting hydraulic hoses or pipes.

9. Remove fitting bolts for the pivot caps to remove pivot caps and bushings.

10. Hoist the mast ass'y.

●**Removing the pivot cap**



8-2-3. Mast - disassembly and reassembly

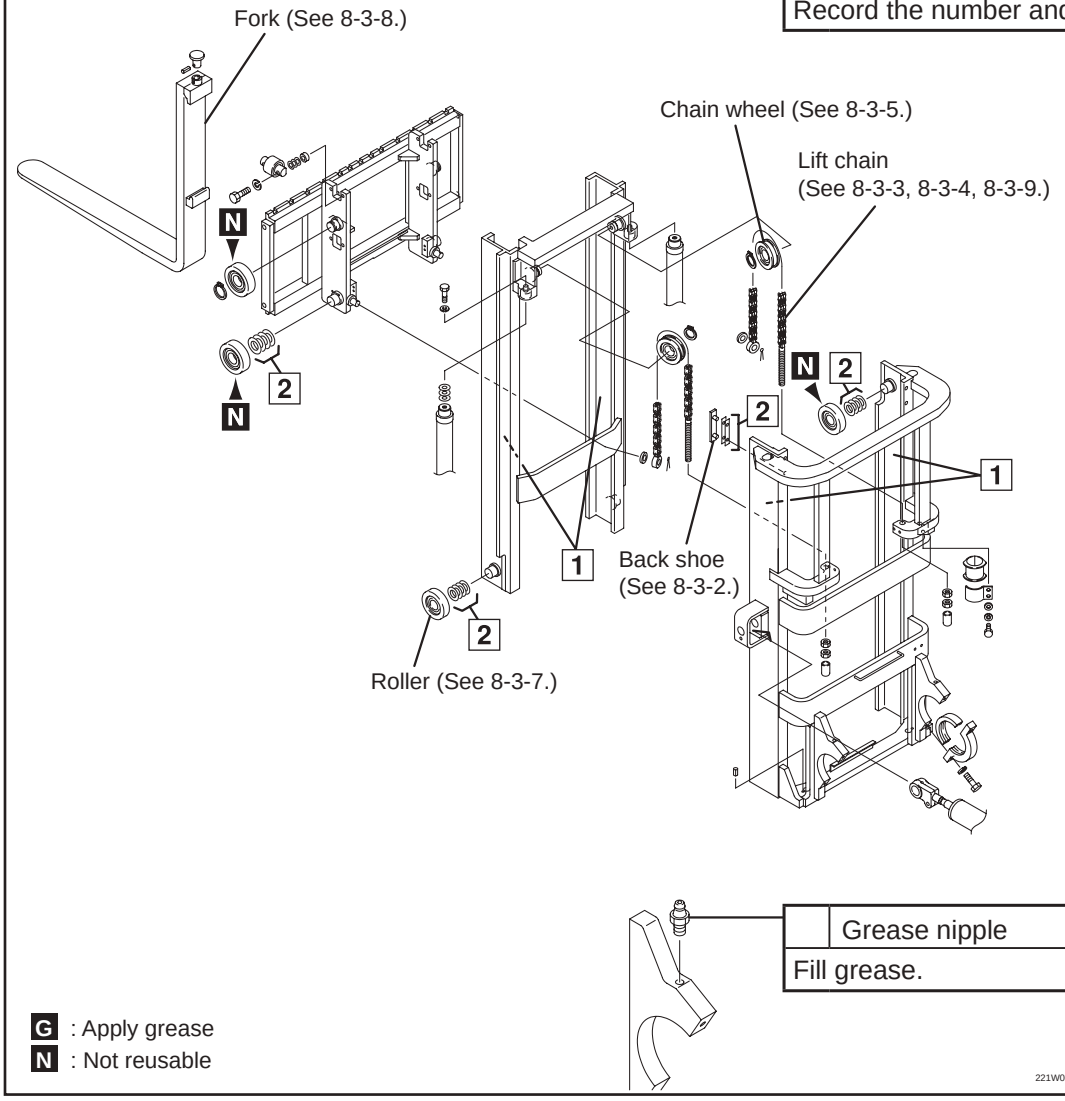
⚠ CAUTION

- **Be sure to record the number and thickness of shims when removing them.**
- **Turn the key switch off and operate hydraulic levers a few times to release high pressure in the hydraulic piping before disconnecting hydraulic hoses or pipes.**
- **When disconnecting hydraulic pipes, cap them to prevent dust from entering into hydraulic components and pipes.**

●Disassembling and reassembling the P-mast

1	Sliding part	G
Apply grease on a sliding part.		

2	Shim
Record the number and thickness.	



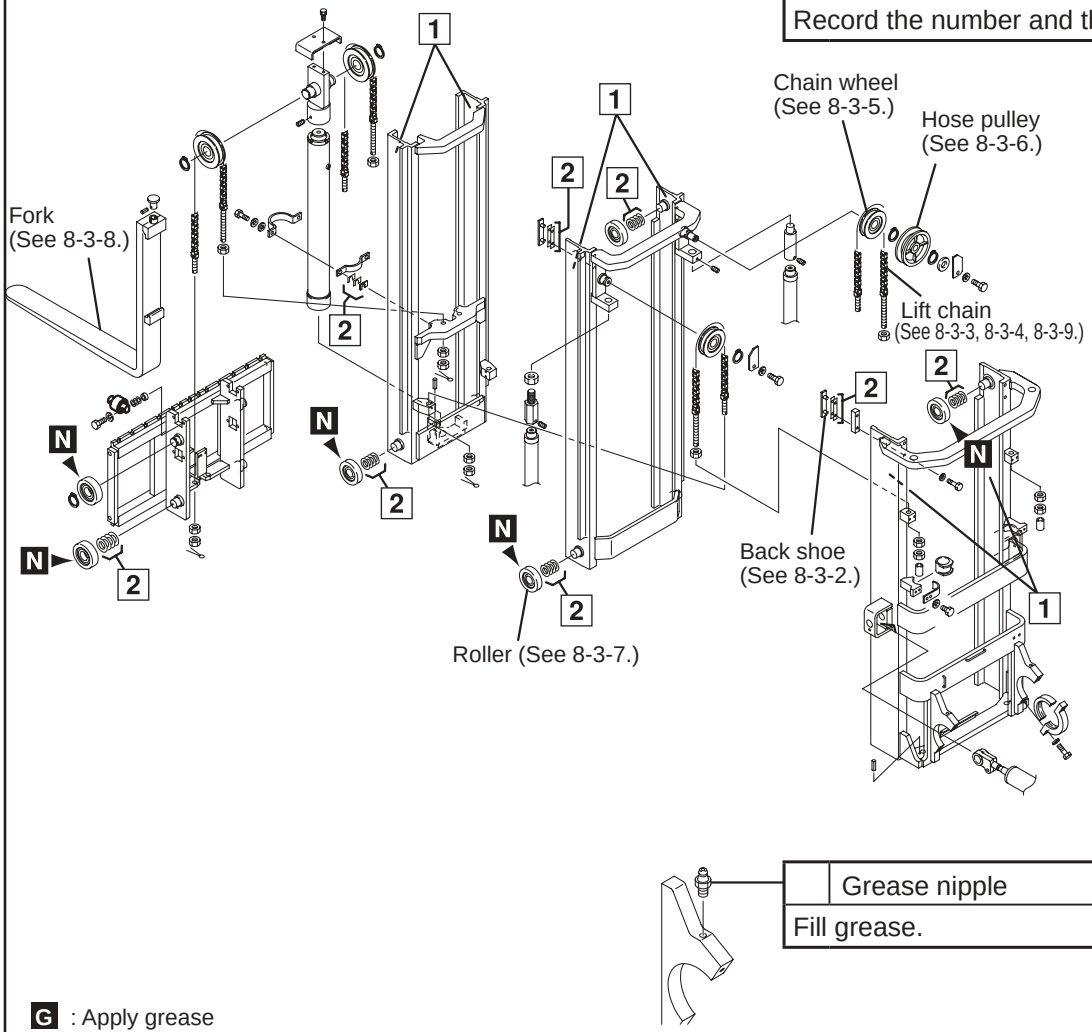
⚠ CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

●Disassembling and reassembling the M mast

1	Sliding part	G
Apply grease on a sliding part.		

2	Shim
Record the number and thickness.	



	Grease nipple	G
Fill grease.		

G : Apply grease
N : Not reusable

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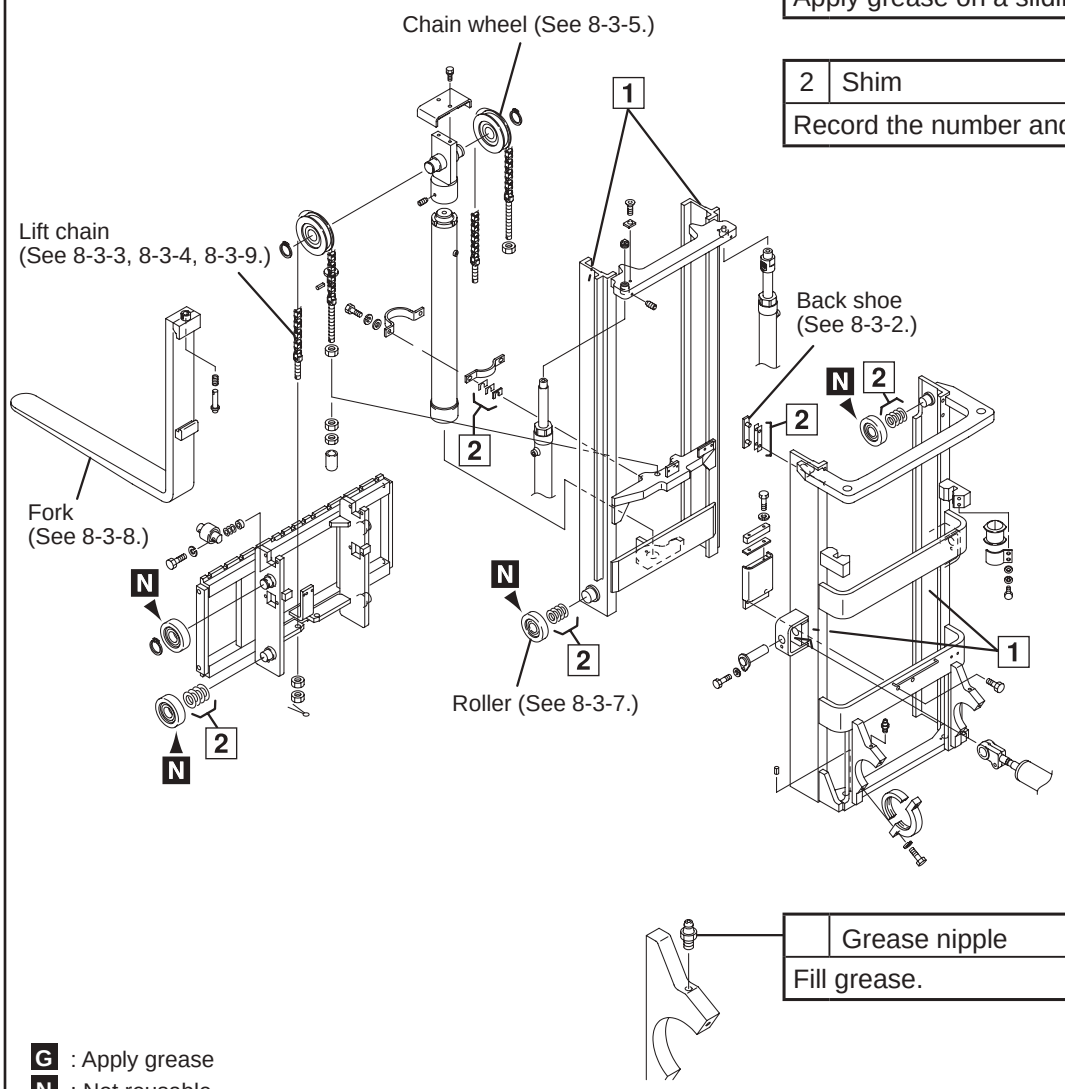
⚠ CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

●Disassembling and reassembling the PFL mast



1	Sliding part	G
Apply grease on a sliding part.		

2	Shim
Record the number and thickness.	

	Grease nipple	G
Fill grease.		

CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

8- 3. Inspection and adjustment

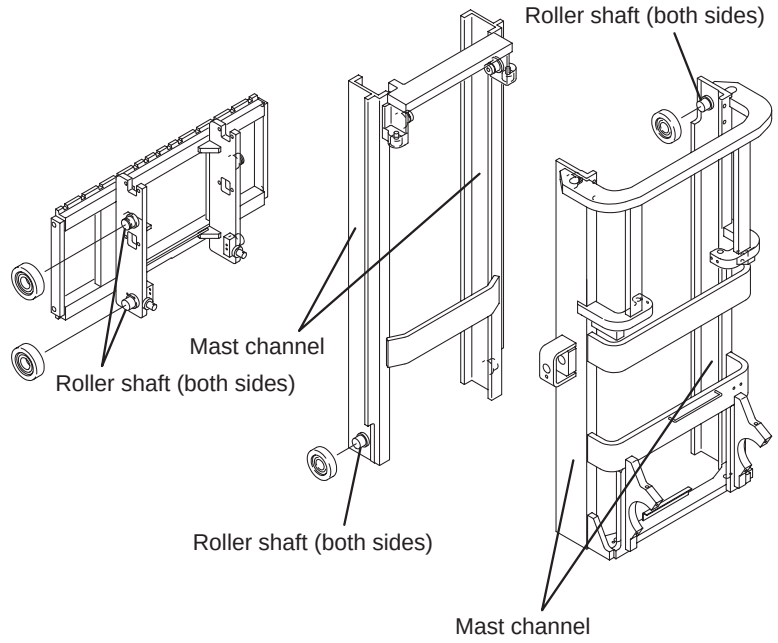
8-3-1. Mast, lift bracket and roller shaft - inspection

1. Check if welded parts are not cracked with color check.

⚠ CAUTION **Use welding rods of low hydrogen type when re-welding on Mast channels and/or Roller shafts.**

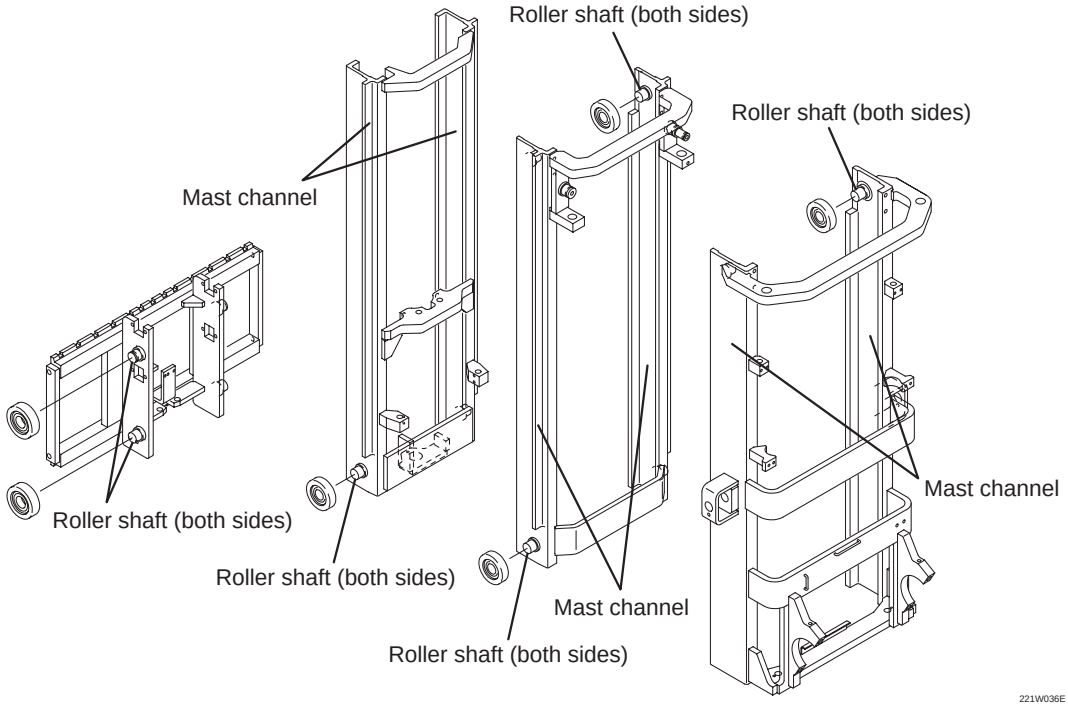
●Inspection of mast, lift bracket and roller shaft

P/PFL-mast



●Inspection of mast, lift bracket and roller shaft

M-mast



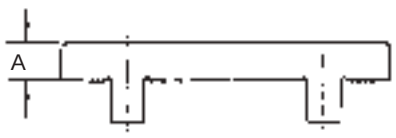
8-3-2. Back shoe - inspection

1. Check the back shoe for wear.

<Specifications> [mm]

Specific thickness [A]	Wear limit
3	2.5

●**Inspection of back shoe**



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8-3-3. Lift chain - inspection and replacement

1. Check lift chains for stretch.
   Measure the length per 20 links at the part which are used frequently.

<Specifications>

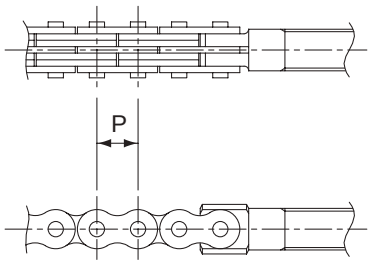
●FB10P-18P (per 20 links) [mm]

Specific dimension	Stretching limit	Pitch [P]	Remarks
317.5	324	15.875	Leaf chain#50 (BL534)

●FB20P-30P (per 20 links) [mm]

Specific dimension	Stretching limit	Pitch [P]	Remarks
381	389	19.5	Leaf chain#60 (BL634)

●**Inspection of lift chain**



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2. Check lift chains for deformation and damage.

➡ If it is twisted, replace it.

3. Check for lubrication.

➡ Apply grease on chains.

8-3-4. Chain bolt - inspection

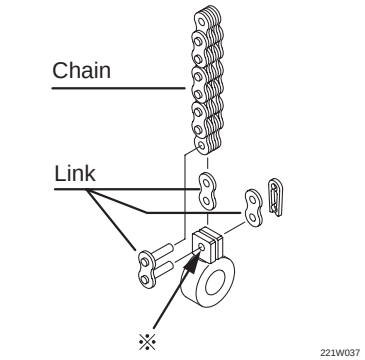
1. Check connecting part (※) for play.
➡ If it is played, replace it.

2. Check for damage on the thread of the anchor bolt.

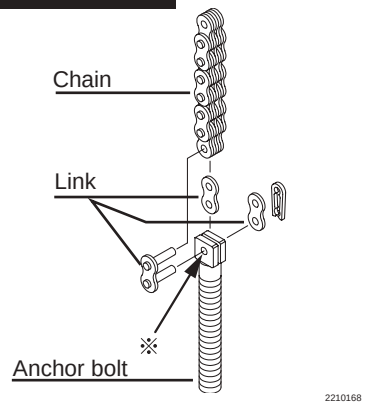
3. Check for damage on the link.

●**Inspection of chain bolt**

P-mast



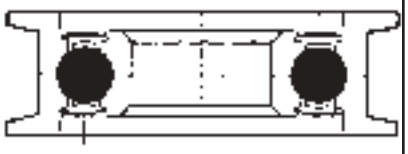
M/PFL-mast



8-3-5. Chain wheel - inspection

1. Check the outer surface for deformation, and the rotation of the bearing.

●**Inspection of chain wheel**



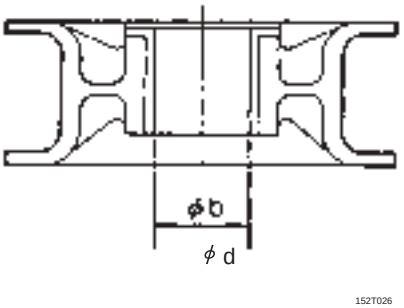
8-3-6. Hose pulley - inspection

1. Check for wear.

<Specifications> [mm]

Item	Specific diameter [d]	Wear limit
Hose pulley	25.0	25.5

●**Inspection of hose pulley**



8-3-7. Roller - inspection and replacement

1. Measure the gap between the mast roller and the mast channel.

➡ If the gap is out of the range of the specification, replace the roller.

<Specifications> [mm]

Item	Allowable gap
Mast roller, Lift roller	1.5

2. Check for play and rotation of the roller.

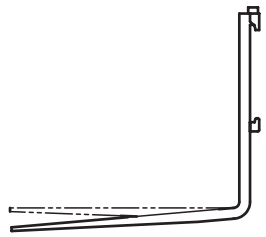
8-3-8. Fork - inspection and replacement

1. Check for transformation and height difference.

<Specifications> [mm]

Item	Allowance dimension
Height difference at the tip of the fork.	10mm or less
Opening of fork tips	15mm or less

●Height difference



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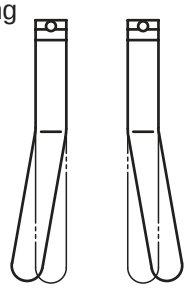
●Opening



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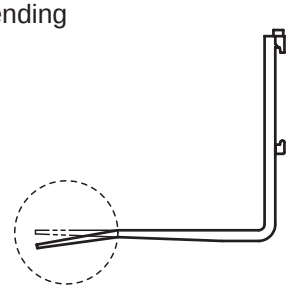
2. Check for wear and cracks.

<Specifications> [mm]

Applicable model	Specific thickness	Wear limit
FB10P/14P/15P/ 18P	35 $^{+3}_{-0}$	32
FB20P	36 $^{+3}_{-0}$	33
FB25P	40 $^{+3}_{-0}$	37
FB28P/30P	47 $^{+3}_{-0}$	44

●Bending



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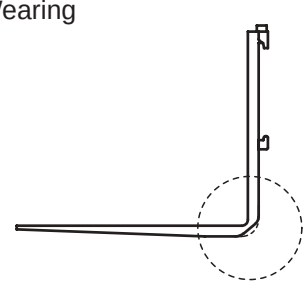
●Wearing



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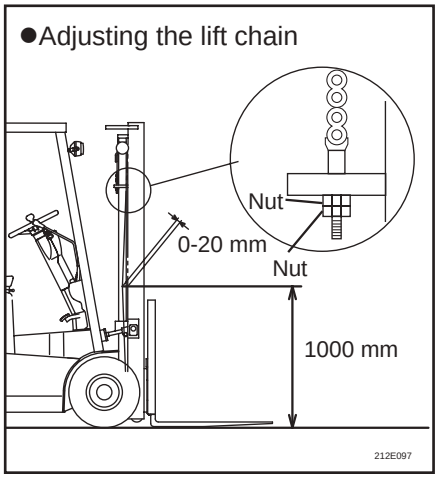
CAUTION

- **If any cracks are found on the fork, replace to the new one immediately. Do not repair.**
- **Check for cracks by using the color check.**

8-3-9. Lift chain - inspection and adjustment

▸1 Adjustment of chain deflection

- Measure the deflection of Lift chains, and adjust it if out of the specification.



<Adjustment>

1. Tilt the mast vertically.
2. Lower forks on the flat floor.
3. Push the chain at approx. 1000 mm high from the floor and measure the deflection.

<Specifications>

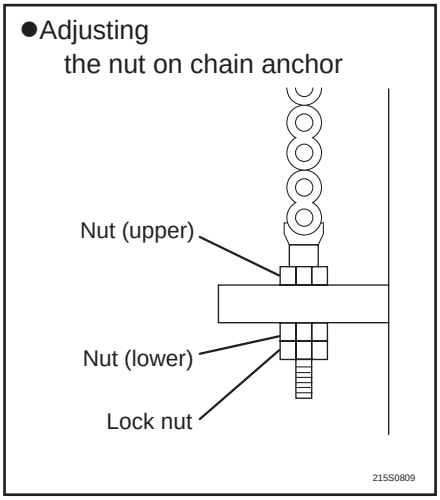
[mm]

Item	Specification
Lift chain deflection	Less than 20 mm

4. If the deflection is out of specification, adjust it with nuts.
5. After making sure if the deflection of both chain (L.H./ R.H.) is equal, tighten nuts.

▸2 Adjustment of nut on chain anchor

1. After adjustment of the chain deflection, tighten the nut (lower) securely with the lock nut.
2. Tighten the nut (upper) on the anchor by hand, and then tighten about 1/4 turn by using a tool.



NOTE

This adjustment can reduce the noise at the anchor.

8-3-10. Mast lean- adjustment

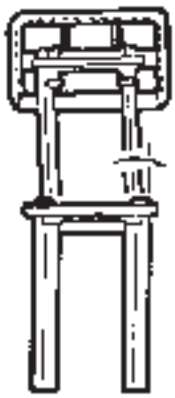
● Check for the following if the inner mast is inclined when lifting forks to the top end.

1. Lift forks a little and check if the tension of both lift chains are the same.

➡ Refer to "8-3-9. Lift chain - inspection and adjustment".

2. Check if both cylinder rods are stopped at the same time when lifting forks to the top end.

●Mast lean



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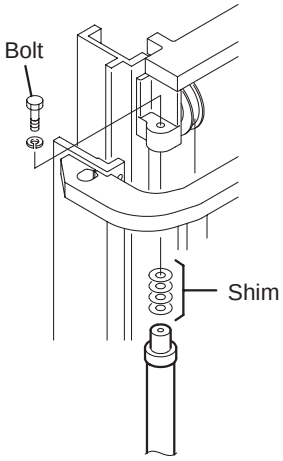
➡ If defects are found, adjust by the following manner.

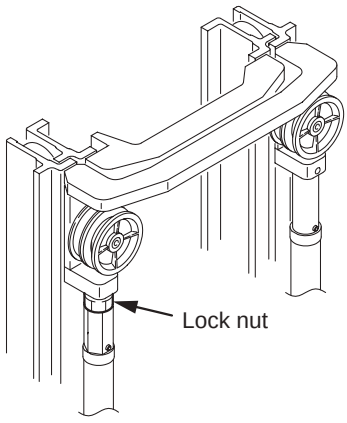
- P-mast :Change numbers or thickness (t0.2/t0.5/t1.0) of shims.
- M-mast :Turn the "Rod, head" to adjust. Then, tighten the lock nut securely.
- PFL-mast :Loosen "screw, set" and turn the adjust bolt.

●Adjusting the lift cylinder

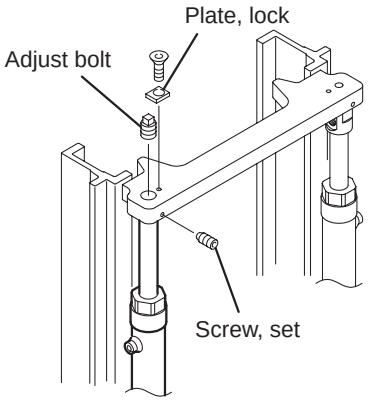
P-mast



M-mast



PFL-mast



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3. Check for deflection in the chains when lowering forks.

8- 4. Troubleshooting

8-4-1. Mast · Lift bracket · Fork - troubleshooting

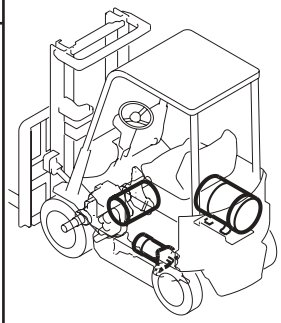
NO.	Symptom	Problem	Solution
1	Inner mast lifts up together with Lift bracket.	1. Improper gap of lift rollers and/or side rollers	Adjust
2	Lifting and lowering of Lift bracket is not smooth.	1. Improper gap of lift rollers and/or side rollers	Adjust
		2. Defect of rollers	Replace
		3. Chain roller does not rotate smoothly.	Repair
3	Lift bracket is inclined	1. Gap of side rollers is too big.	Adjust
		2. Unequal tension of L.H and R.H chains	Adjust
4	Lifting and lowering of inner mast is not smooth.	1. Improper gap between rollers and mast channel	Adjust
		2. Defect of rollers	Replace
5	Inner mast is inclined at extended position	1. Adjustment at the top end of the lift cylinder is not proper.	Adjust
			Adjust
6	Tip of both forks don't have the same height.	1. Bending of forks	Repair, Replace
		2. One-sided load distribution on forks	Proper operation
		3. Bending of the tilt bar	Repair, Replace

9. MOTOR

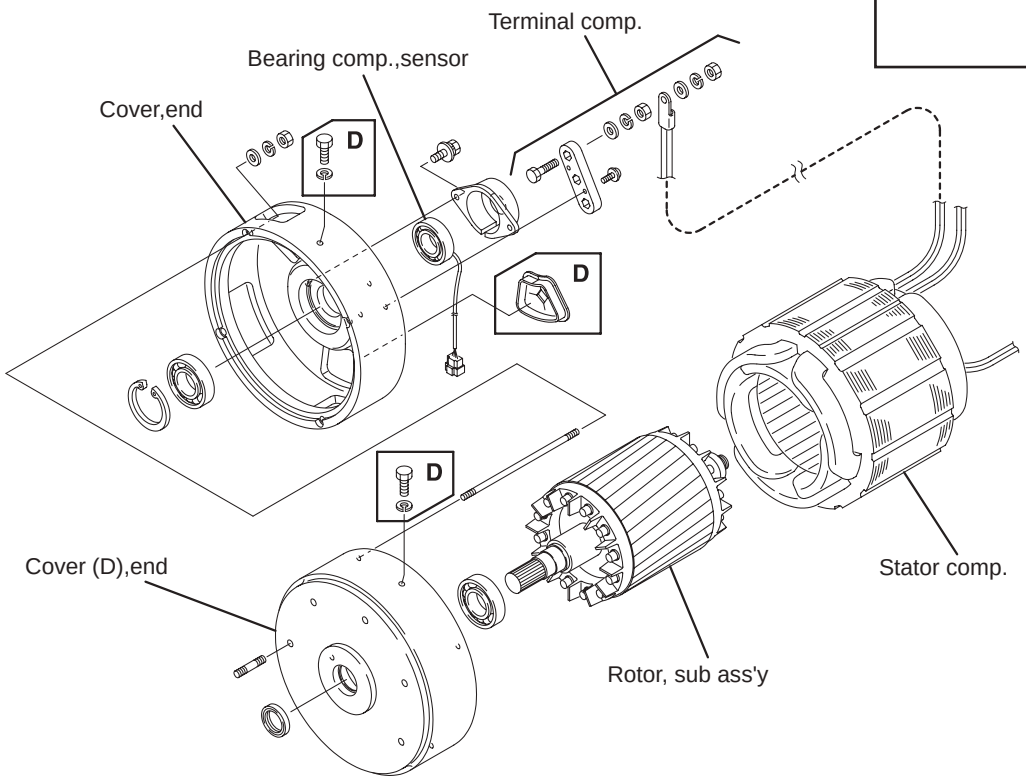
9- 1. Location and name

9-1-1. Traction motor - main part names

MOTOR



●**Main parts of traction motor**



D : Dust resistant

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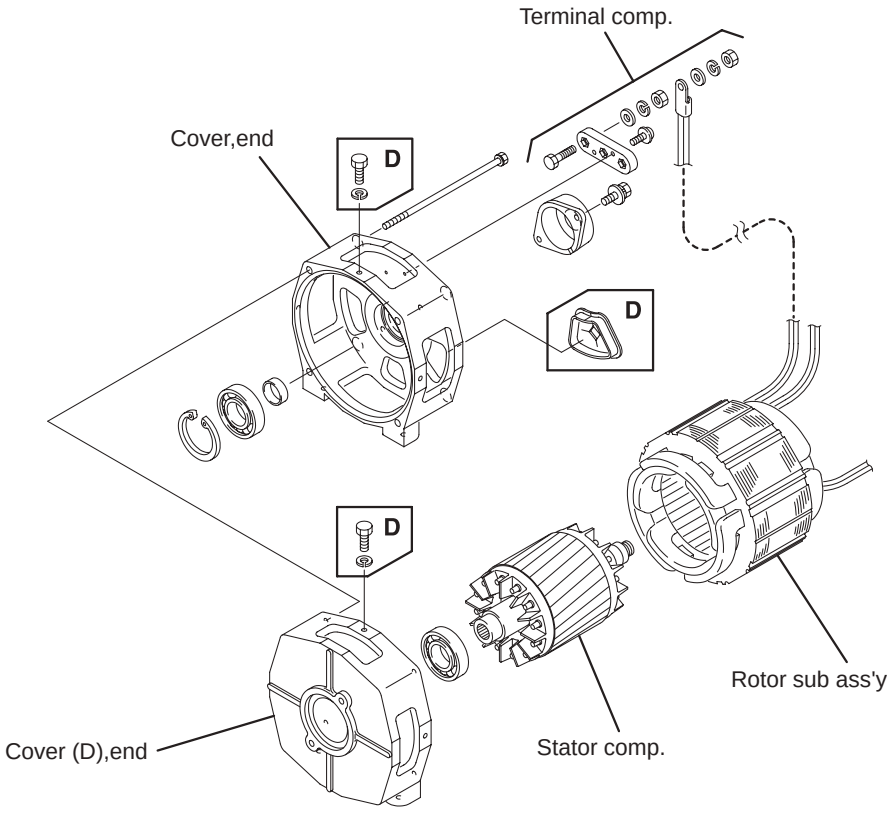
9-1-2. Hydraulic motor - main part names

●**Main parts of hydraulic motor**



D : Dust resistant

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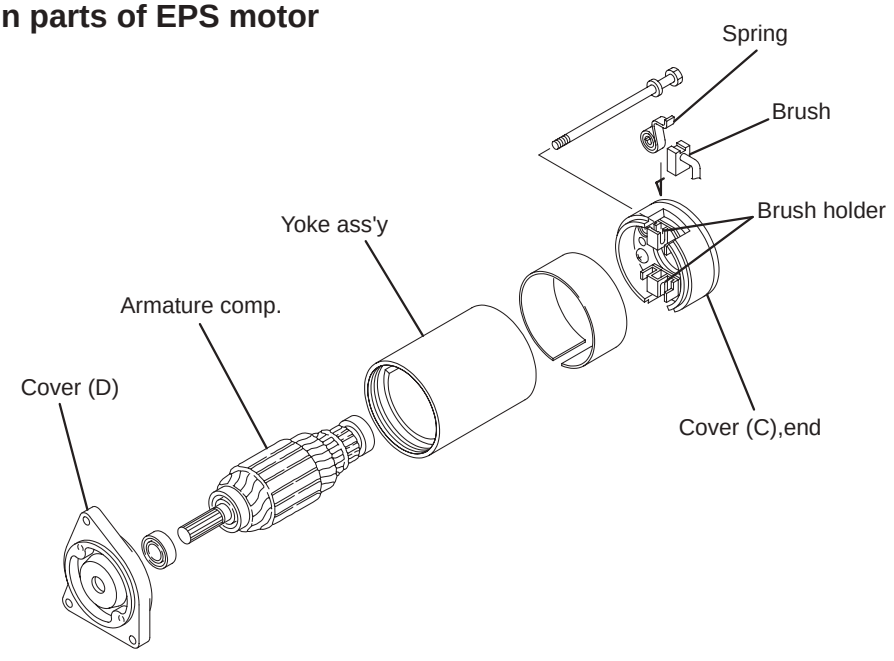
9-1-3. EPS motor - main part names

●**Main parts of EPS motor**



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9-1-4. Motors - specifications

●Traction motor

Applicable model	Type	Rating
FB10P/14P/15P/18P-75	AT90D2	9.0kW, 32V, 1650min-1, 60min
FB10P/14P/15P/18P-75 (Dust resistant)	AT90D2A	9.0kW, 32V, 1650min-1, 30min
FB20P/25P/28P-75, FB20P/25P-U75	AT100E2	10.0kW, 32V, 1500min-1, 60min
FB20P/25P/28P-75, FB20P/25P-U75 (Dust resistant)	AT100E2A	10.0kW, 32V, 1500min-1, 30min
FB30P-75	AT100E3	10.0kW, 48V, 1500min-1, 60min
FB30P-75 (Dust resistant)	AT100E3A	10.0kW, 48V, 1500min-1, 30min

●Hydraulic motor

Applicable model	Type	Rating
FB10P/14P/15P/18P-75 (With sensor)	AH88B2C	9.5kW, 30V, 5min (8.8kW, 10min)
FB10P/14P/15P/18P-75 (With sensor, dust resistant)	AH88B2CA	
FB10P/14P/15P/18P-75 (Without sensor)	AH88B2CD	
FB10P/14P/15P/18P-75 (Without sensor, dust resistant)	AH88B2CDA	
FB10P/14P/15P/18P-U75	AH120C2D	12.0kW, 32V, 1710min-1, 10min
FB10P/14P/15P/18P-U75 (Dust resistant)	AH120C2DA	
FB20P-75	AH95C2D	9.5kW, 32V, 1950min-1, 10min
FB20P-75 (Dust resistant)	AH95C2DA	
FB25P/28P-75	AH120C2D	12.0kW, 32V, 1710min-1, 10min
FB25P/28P-75 (Dust resistant)	AH120C2DA	
FB20P-U75	AH135C2D	13.5kW, 32V, 1800min-1, 10min
FB20P-U75 (Dust resistant)	AH135C2DA	
FB25P-U75	AH140C2D	14.0kW, 32V, 1800min-1, 10min
FB25P-U75 (Dust resistant)	AH140C2DA	
FB30P-75	AH150C3D	15.0kW, 48V, 1800min-1, 10min
FB30P-75 (Dust resistant)	AH150C3DA	

●EPS motor

Applicable model	Type	Rating
FB10P/14P/15P/18P-75	70000-15580	350W, 48V
FB20P/25P/28P-75	70000-15590	550W, 48V
FB30P-75	32911-03290	550W, 72V

9- 2. Disassembly and reassembly

CAUTION

- **Lift or jack up the forklift truck and support it with safety blocks or rigid stands.**
- **Apply wheel chocks to rear tyres to prevent the truck from moving.**
- **Record places of lead wire connections before disassembling.**
- **When disconnecting hydraulic pipes, cap them to prevent dust from entering into hydraulic components and pipes.**
- **Be sure to disconnect the battery plug.**

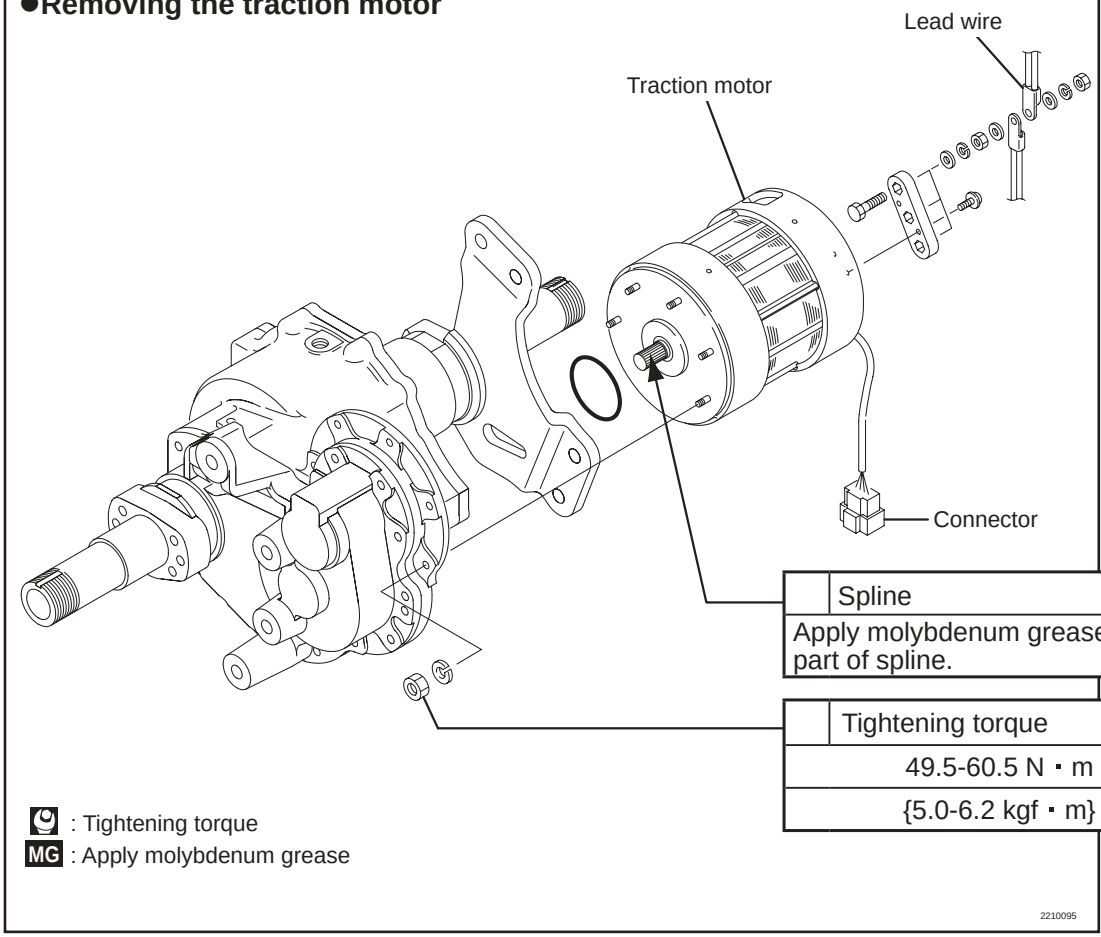
9-2-1. Traction motor - removal and installation

1. Remove the traction motor.
Refer to "2-2-1. Front axle - removal and installation" on page 20.

NOTE

The traction motor can be removed without removing the front axle. However, when doing so, first remove any parts that could be damaged.

●Removing the traction motor



* Install the front axle and traction motor in reverse order of removal.

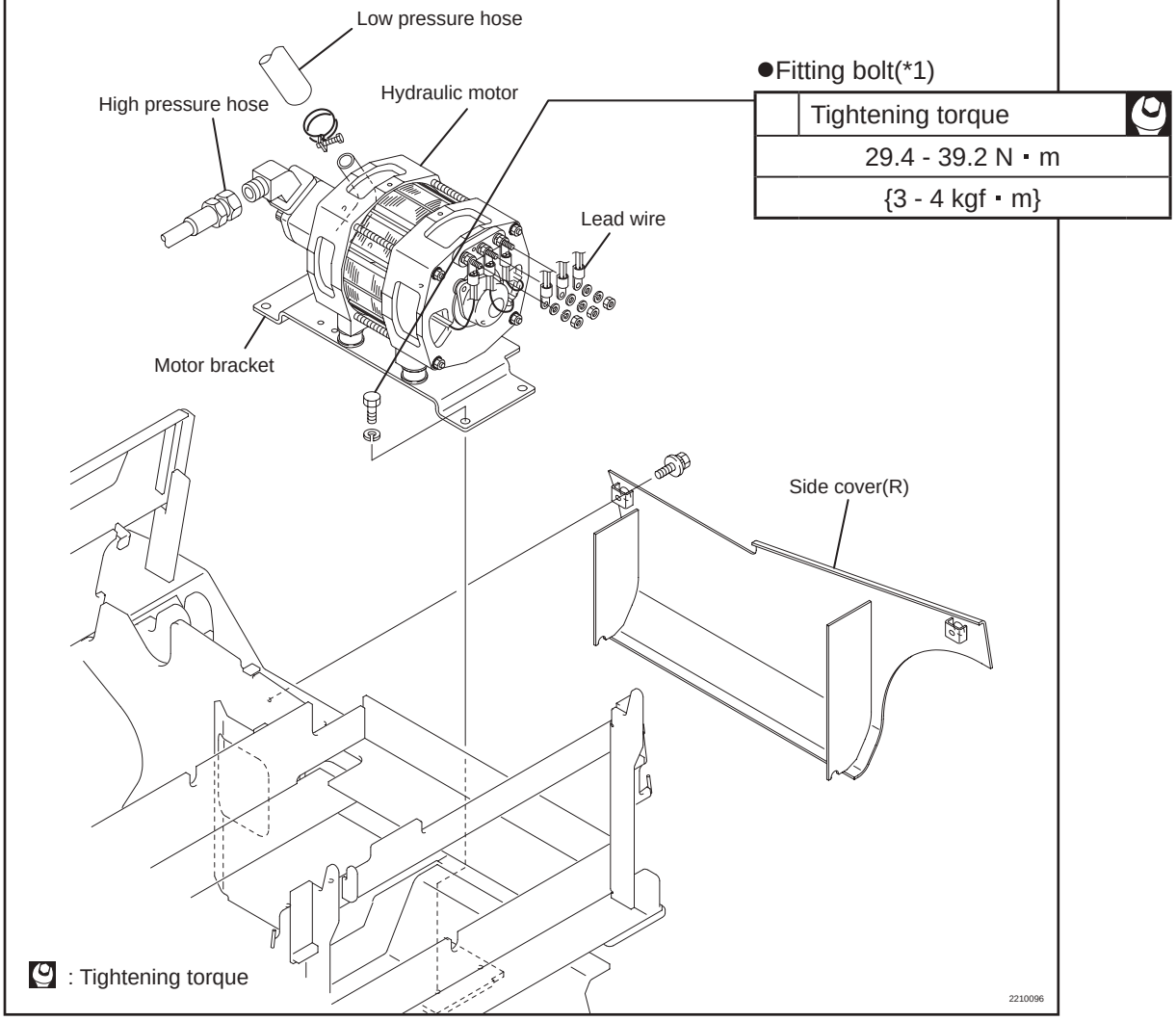
9-2-2. Hydraulic motor - removal and installation

⚠ CAUTION

- **Before disconnecting hydraulic connections, release internal pressure to prevent from splashing oil.**
  Refer the CAUTION on the page 4 for the procedure.
- **When disconnecting hydraulic pipes, cap them to prevent dust from entering into hydraulic components and pipes.**
- **Be sure to disconnect the battery plug.**

1. Remove the cover ASS'Y, battery.
2. Remove the battery ASS'Y
3. Disconnect following hoses from the pump.
   (1) High pressure hose [come from the Control valve]
   (2) Low pressure hose [come from the Oil tank]
4. Disconnect lead wires on the hydraulic motor.
5. Remove fitting bolt for the motor bracket, and hoist the hydraulic motor with the motor bracket.

●Removing the hydraulic motor (1)



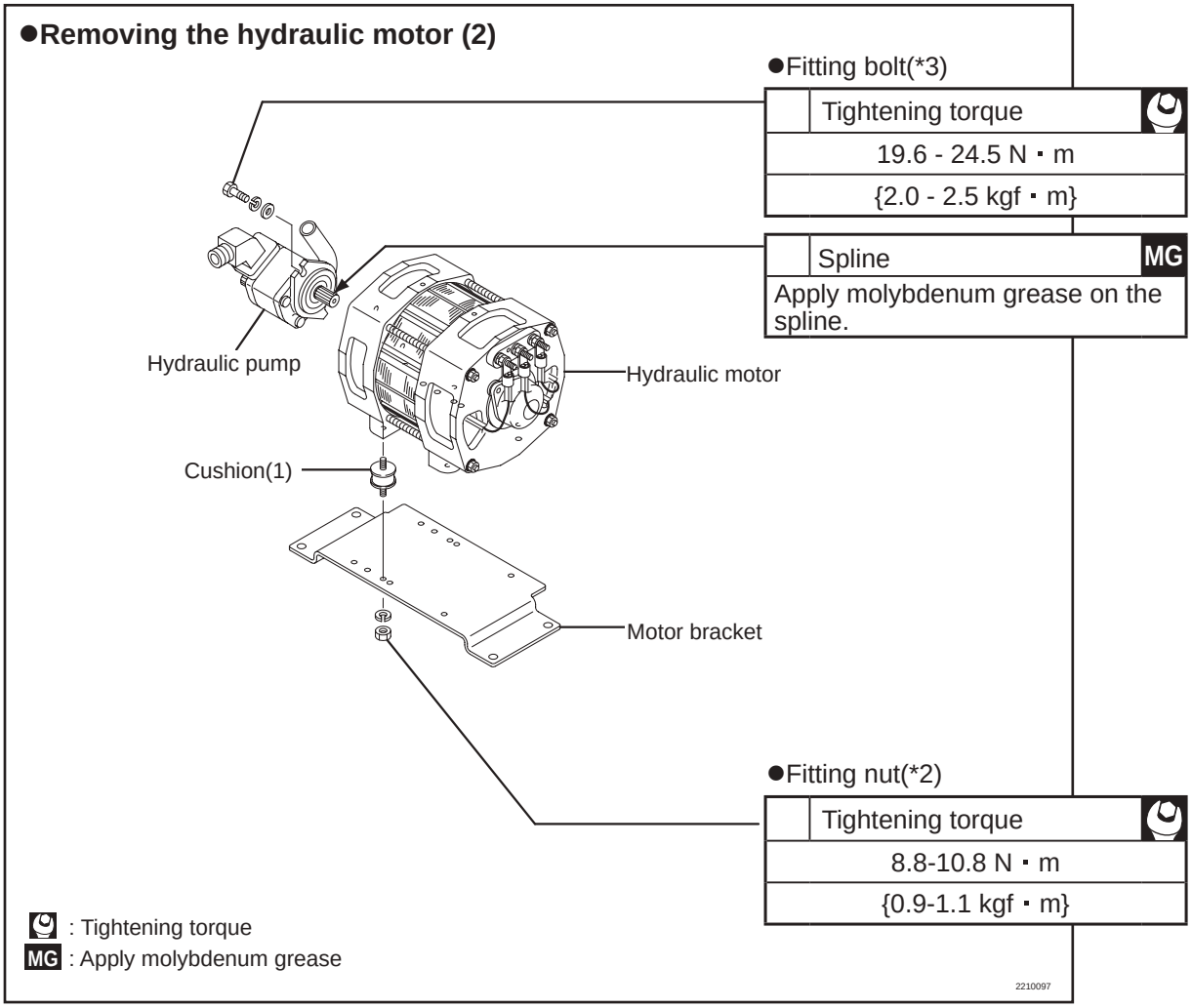
6. Remove fitting nuts(*2) to remove the hydraulic motor from the bracket.

7. Remove fitting bolts(*3) to remove the hydraulic pump from the hydraulic motor.

⚠ CAUTION

Do not disassemble the hydraulic pump.
When damaged, replace the whole pump assembly.

●Removing the hydraulic motor (2)



* Install the hydraulic motor in reverse order of removal.

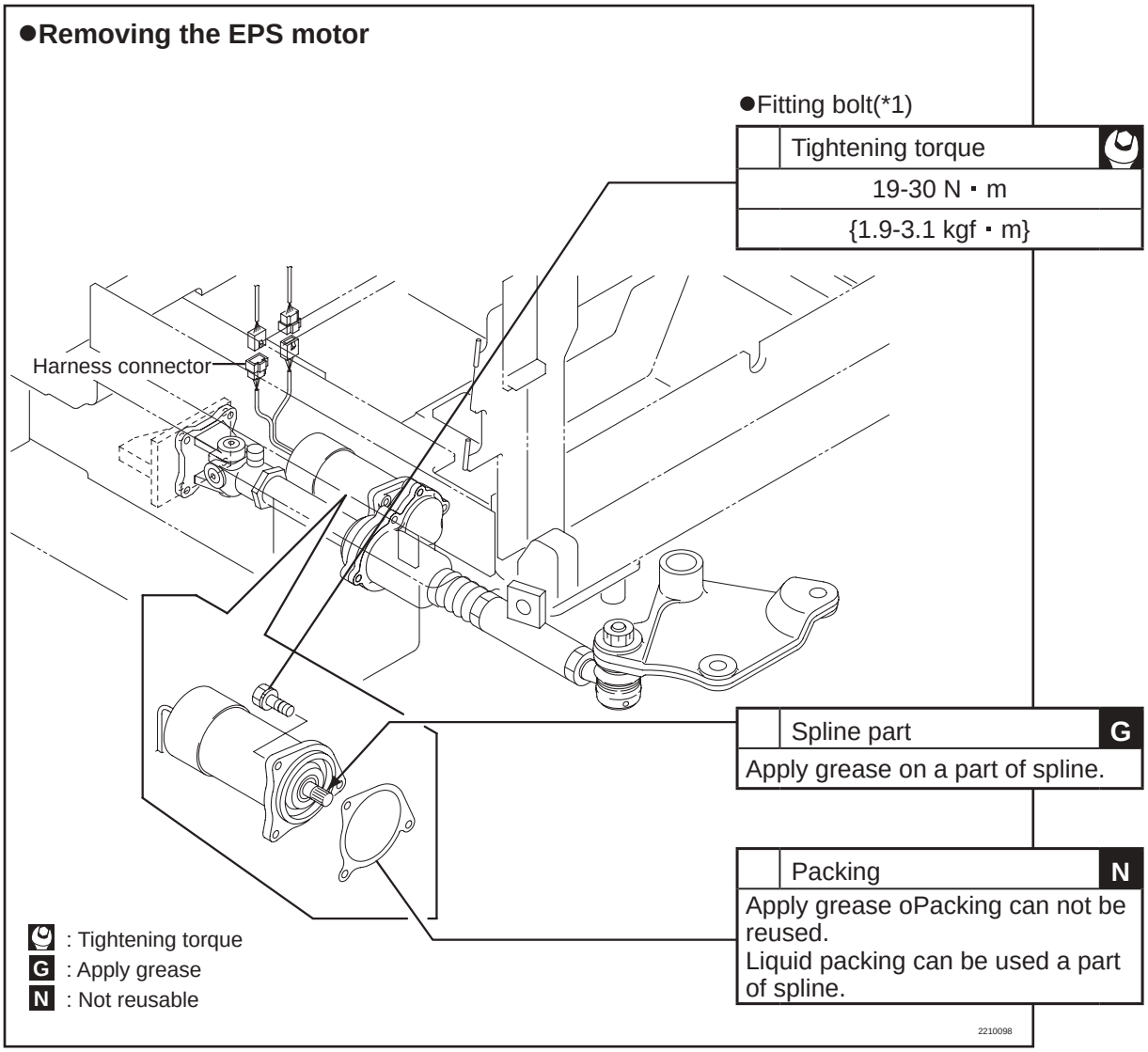
9-2-3. EPS motor - removal and installation

CAUTION

- **Record places of lead wire connections before disassembling.**
- **Be sure to disconnect the battery plug.**

1. Remove the floor plate and disconnect the harness connector for the accelerator.
   Refer to "5-2-1. Steering - removal and installation" on page 53.
2. Remove the battery.
   Refer to "10f-1-1. Battery - removal and installation" on page 201.
3. Disconnect harness connectors for the EPS motor.
4. Remove fitting bolts(*1), and remove the EPS motor from the actuator ass'y.

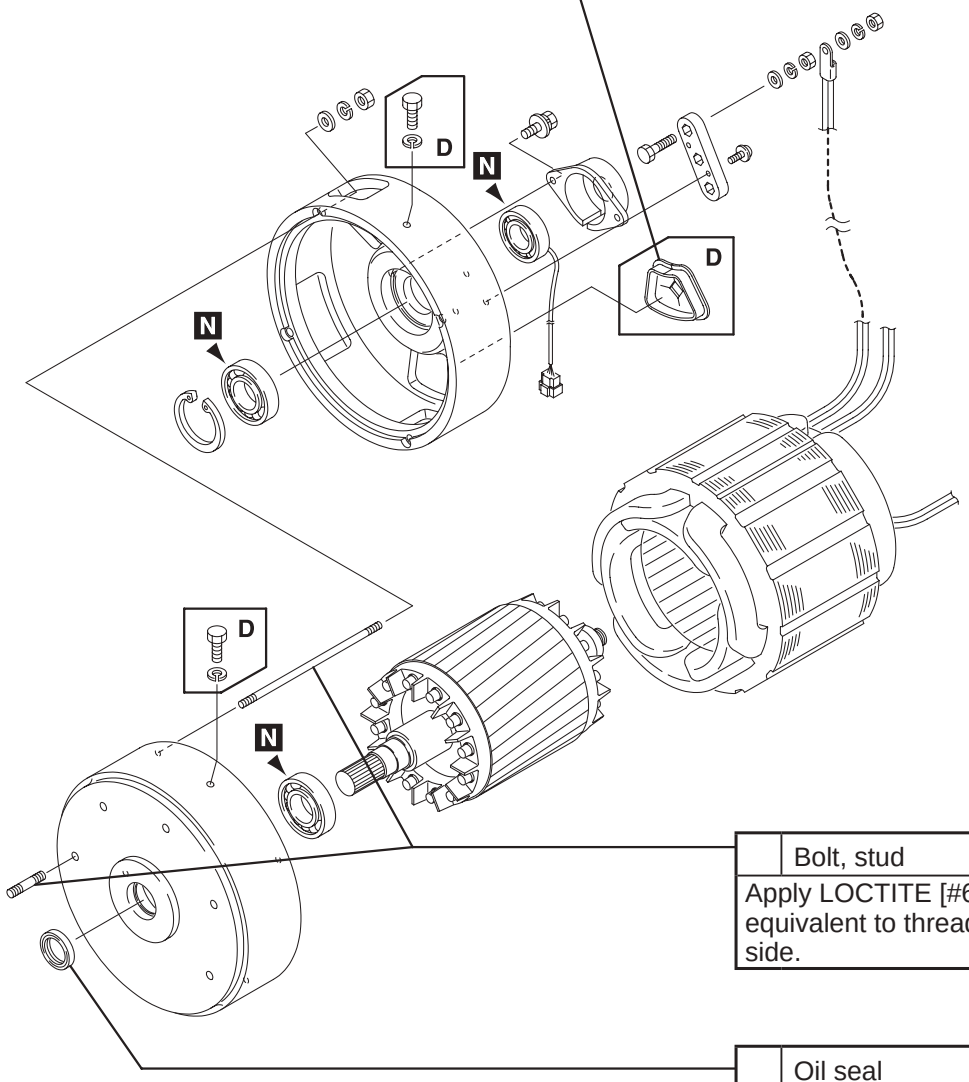
●Removing the EPS motor



* Install the EPS motor in reverse order of removal.

9-2-4. Traction motor - disassembly and reassembly

●**Disassembling and reassembling the traction motor**



	Cap (Dust resistant)	B
Apply THREEBOND[#1527] or equivalent to bond the cap to the "Cover, end".		

	Bolt, stud	L
Apply LOCTITE [#648] or equivalent to threads on the stud side.		

	Oil seal	N	B	G
Apply grease on the lip of the oil seal, and apply the THREEBOND [#1104] or equivalent around the seal.				

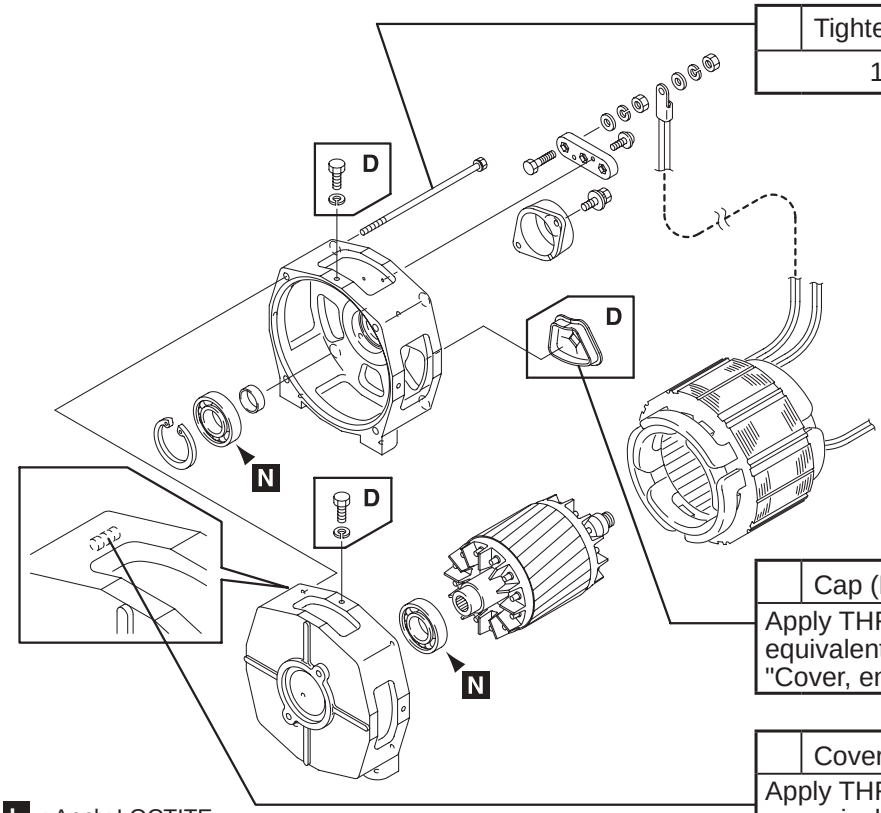
B : Apply THREEBOND
L : Apply LOCTITE
G : Apply grease
N : Not reusable
D : Dust resistant

⚠ CAUTION

When OIL SEALS, O-RINGS and / or BEARINGS were removed, they should be replaced to new ones.

9-2-5. Hydraulic motor - disassembly and reassembly

●Disassembling and reassembling the hydraulic motor



Tightening torque
13.5 N・m±10%

Cap (Dust resistant) B
Apply THREEBOND[#1527] or equivalent to bond the cap to the "Cover, end".

Cover(D), end L
Apply THREEBOND[#648], [#262] or equivalent in M8 tapped holes, and tighten bolts.

L : Apply LOCTITE
N : Not reusable
D : Dust resistant

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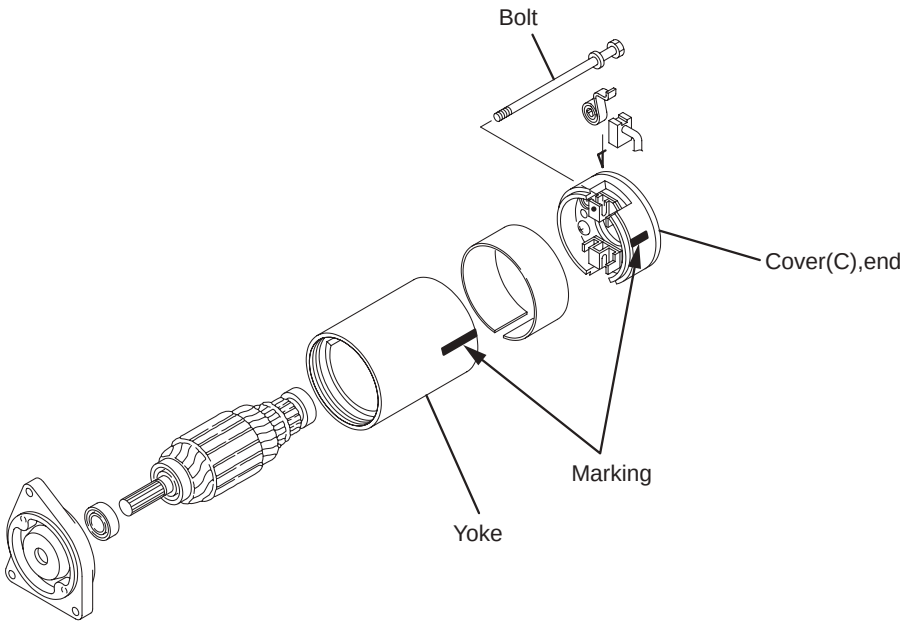
9-2-6. EPS motor - disassembly and reassembly

⚠ CAUTION **Mark the yoke and "cover(C), end" before removing the bolts.**

●Disassembling and reassembling the EPS motor



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9- 3. Inspection and adjustment

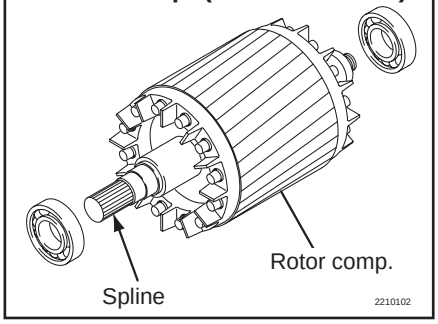
9-3-1. Rotor comp. - inspection and replacement (Traction and Hydraulic motor)

▸1 Inspection for damage

1. Check the rotor comp. for damage, especially by burning.

➡ If it is damaged, replace it.

●Rotor comp. (Traction motor)

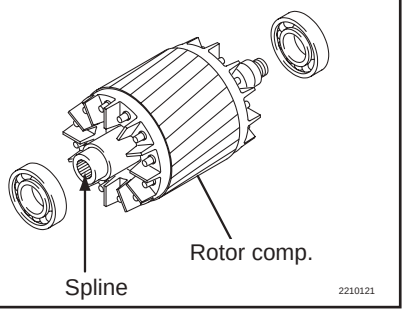


▸2 Inspection of spline

1. Check for wear of spline.

➡ If it is extremely worn, replace it.

●Rotor comp. (Hydraulic motor)

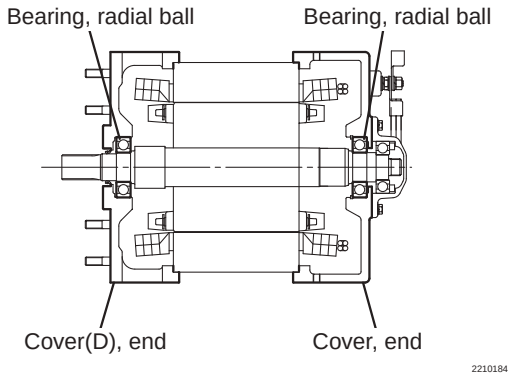


▸3 Inspection of ball bearing

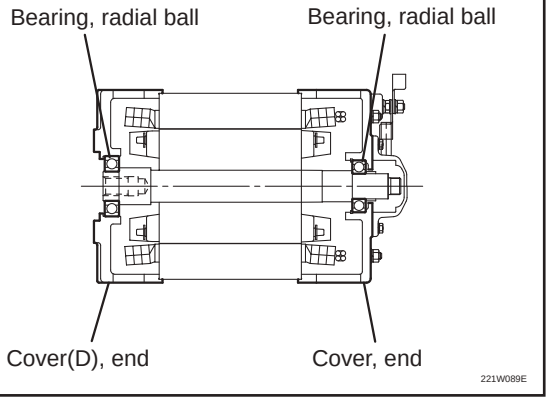
1. Check fitting part of the bearing in the "cover, end" and "cover(D), end".

➡ If loose, replace them.

●Inspection of fitting parts (Traction motor)



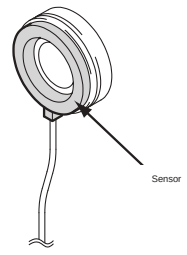
●Inspection of fitting parts (Hydraulic motor)



⚠ CAUTION

- **When replacing the "bearing comp., sensor", be very careful not to damage the sensor. If the sensor is damaged, the motor will not operate correctly.**
- **Because the bearing sensor is very sensitive for the static electricity, do not touch any terminals in the connector directly.**

●Replacing the "Bearing comp., sensor"



9-3-2. Armature comp. - inspection and replacement

1 Inspection for damage

1. Check the armature for damage, especially for burning.

➡ If it is damaged, replace it.

➡ If the surface of Commutator is damaged, repair or replace it.

2 Inspection of spline

1. Check for wear of spline.

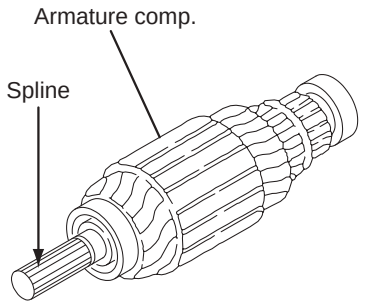
➡ If it is extremely worn, replace it.

3 Inspection of ball bearing

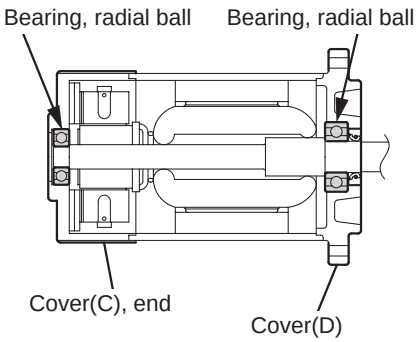
1. Check fitting part of the bearing in the "cover(C), end" and the cover(D).

➡ If loose, replace it.

●Inspection of armature comp.



●Inspection of fitting parts



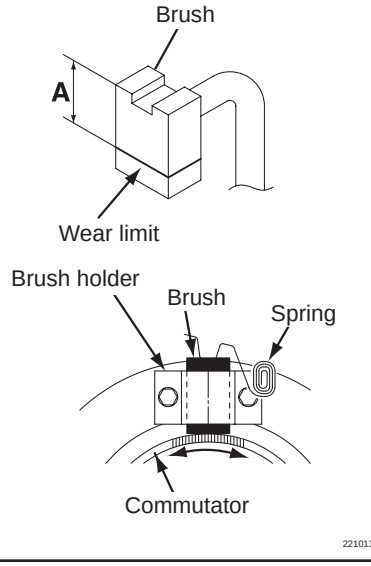
9-3-3. Brush, Brush holder and Spring (EPS motor) - inspection and replacement

1 Inspection of brush wearing

1. Measure dimension (A).
   If it is less than the wear limit, replace it.

Applicable model	Applicable motor	Specification	Wearing limit (A)
FB10P-30P	EPS motor	25mm	15mm

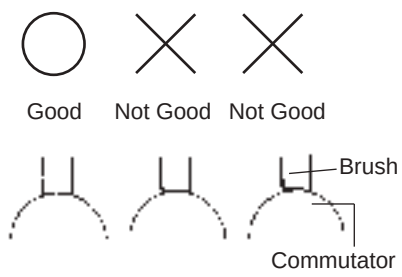
●Inspection of brush wear



▸2 Inspection of contacting surface of brush

- If the contacting surface is not good, repair it as follows.

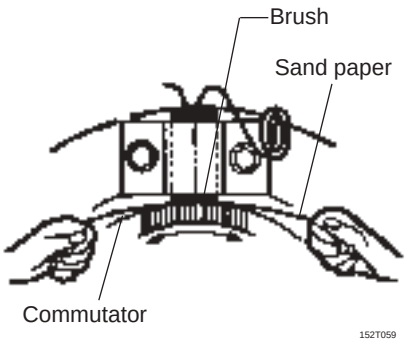
●Inspection of contacting surface of brush



<Repairing procedure>

1. Insert a sand paper [#400] between COMMUTATOR and BRUSH.
   (Face the file side to the brush.)
2. Polish the contacting surface of the brush by moving a sand paper or rotating COMMUTATOR by hand.
3. Blow the dust out with compressed air after repairing.

●Repairing surface of brush



▸3 Inspection of force of spring

- Hook a spring scale to the brush SPRING and check if both springs have the same tension.
  Then make sure of equal force on 2 springs.

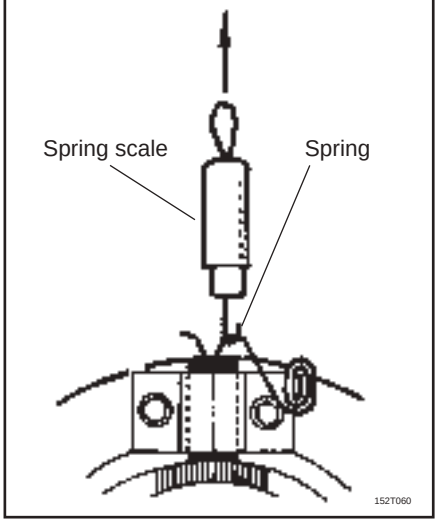
<Specific force of SPRING>

Applicable motor	Reference value	
EPS motor (NIKKO only)	5 N	(0.5 kgf)

⚠ CAUTION

If the SPRING and/or the brush holder were rusted, replace them.

●**Inspection of force of spring**



9-3-4. Motor ASS'Y (Traction/Hydraulic motor) - inspection

- Inspect the the motor with following procedures.

▸1 Abnormal noise check

- Operate the motor. Make sure there is no abnormal noise.

⚠ CAUTION

If the motor is tested by itself, fix the motor on a work bench securely. The motor may move suddenly when starting.
Test the motor with the slow speed.

<Checking procedure>

1. Be sure to secure the motor ASS'Y on a work bench.
2. Use the battery of the forklift truck to carry out testing.
3. Connect wires as follows.

●Traction motor

1) Connect the U1 cable from the chassis to the U1 terminal on the motor.
2) Connect the V1 cable from the chassis to the V1 terminal on the motor.
3) Connect the W1 cable from the chassis to the W1 terminal on the motor.
4) Connect the wire harness from the chassis
(water resistant type 4P) to the connector of the speed sensor in the motor
(water resistant type 4P).

●Hydraulic motor

1) Connect the U2 cable from the chassis to the U2 terminal on the motor.
2) Connect the V2 cable from the chassis to the V2 terminal on the motor.
3) Connect the W2 cable from the chassis to the W2 terminal on the motor.

⚠ CAUTION

If an extension cable is necessary, make them with the following parts:
1) Main cables for motor (3 cables)
1. Cable size : 38 mm^2
2. Terminal : 38-S8
2) Lead wires for speed sensor (4 wires)
1. Wire size : 0.5 mm^2
2. Receptacle : AMP171662-1
3. Tab : AMP173600-1
4. "Housing, cap 4P" : 37010-20940(AMP174259-2)
5. "Housing, plug 4P" : 37010-20890(AMP174257-2)

▸2 Inspection of insulation

● Measure the insulation between terminals and stator comp. with the Megger.

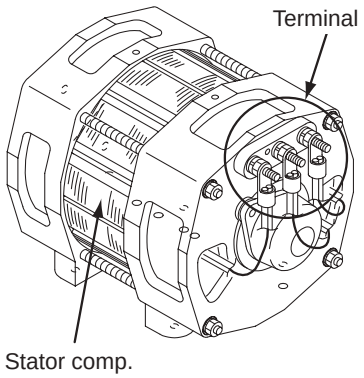
<Resistance>

Tool	Specific resistance
Megger	0.5 MΩ or greater (DC500V)

<Measuring procedure>

1. Apply the earth probe (negative [–]) of the Megger to the stator comp.
2. Apply the line probe (positive [+]) of the Megger to each terminal. (U, V and W)

●Inspection of insulation



9-3-5. Motor ASS'Y (EPS motor) - inspection

●Inspect with the following procedure after assembling.

▸1 Abnormal noise and spark

● Operate the motor. Then make sure that abnormal noise is not heard and sparks of brushes are not seen.

⚠ CAUTION

If the motor is tested by itself, fix the motor on a work bench securely. The motor may move suddenly when starting.
Test the motor with the slow speed.

<Checking procedure>

1. Be sure to secure EPS motor ass'y on a work bench.
2. Apply 1/4 voltage of the battery (about 12V) to carry out testing.
3. Connect wires as follows.
   1) Connect (GREEN or WHITE) wire to the positive (+) terminal of the battery.
   2) Connect (YELLOW or BLACK) wire to the negative (–) terminal of the battery.

▸2 Inspection of insulation

● Measure the insulation between terminals in the connector and the end cover with the Megger.

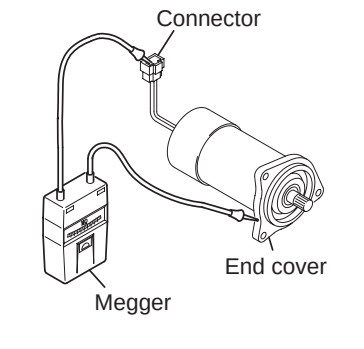
<Resistance>

Tool	Specific resistance
Megger	0.1 MΩ or greater (DC500V)

<Measuring procedure>

1. Apply the earth probe (negative [-]) of the Megger to the yoke.
2. Apply the line probe (positive [+]) of the Megger to each terminal of connector plug.

●Inspection of insulation



9-3-6. Oil seal and permanent magnet(EPS motor) - inspection and replacement

▸1 Oil seal

1. Check Oil seal for wear and damage.

➡ If worn or damaged, replace it.

▸2 Permanent magnet

1. Check permanent magnets in the Yoke for damage and sticking metallic dust.

➡If sticking metallic dust, remove it with compressed air.

➡If damaged, replace the whole motor.

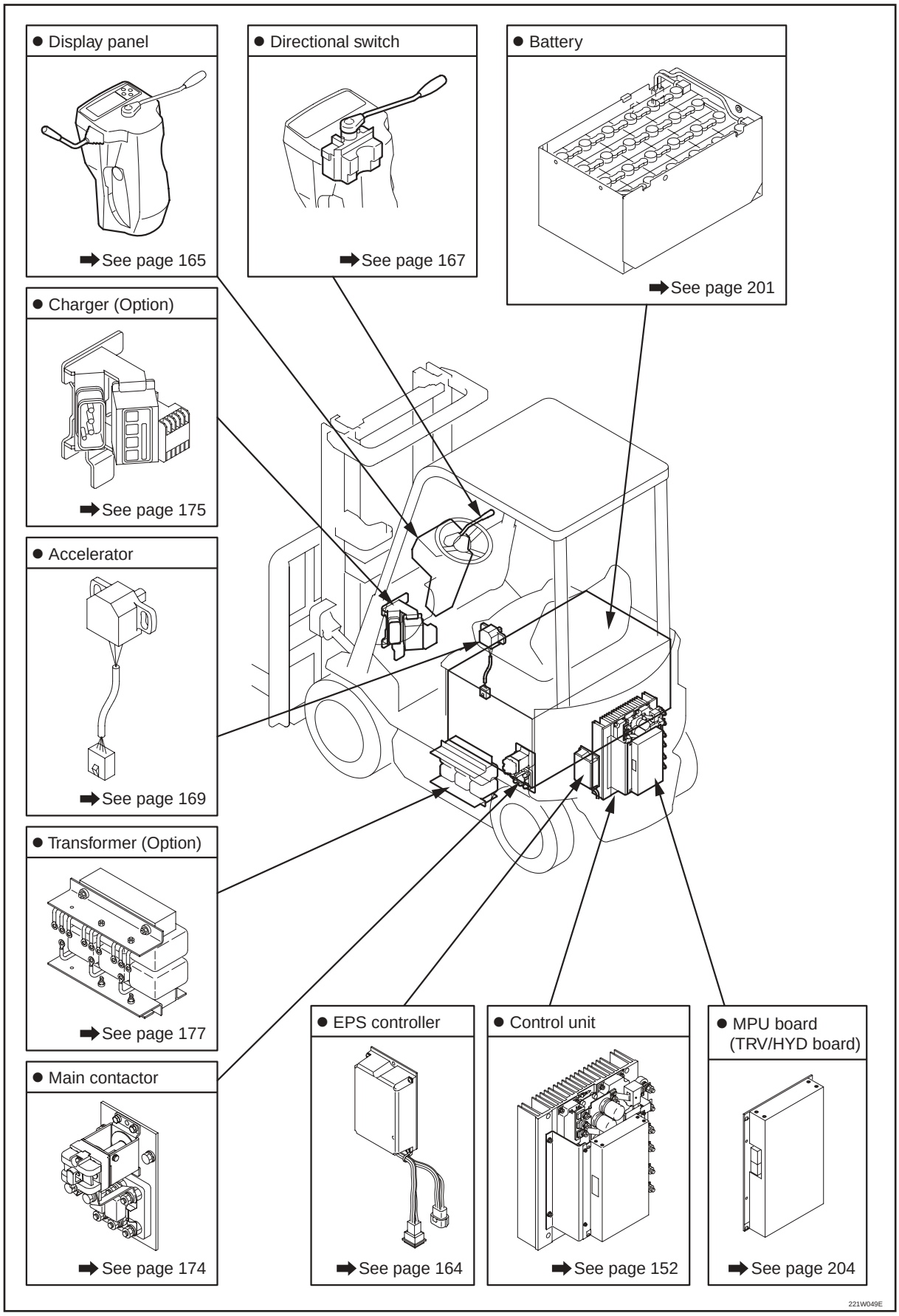
9- 4. Troubleshooting

9-4-1. Motor - troubleshooting

NO.	symptom	Problem	Solution
1	Abnormal noise	1. Damage of bearing	Replace
		2. Armature shaft is not centered	Repair / replace
2	Abnormal temperature rising.	1. Improper rotating	Replace
3	Abnormal noise or temperature rise after installing	1. Wear of serration of Armature shaft or coupling	Replace
		2. Out of adjustment or wear of gears or faulty bearings in Drive unit	Replace
4	The motor does not rotate normally.	1. Damage of sensor bearing	Replace
		2. Poor contact of wires or connectors of the speed sensor.	Repair

10. ELECTRIC PARTS

10- 1. Location and name

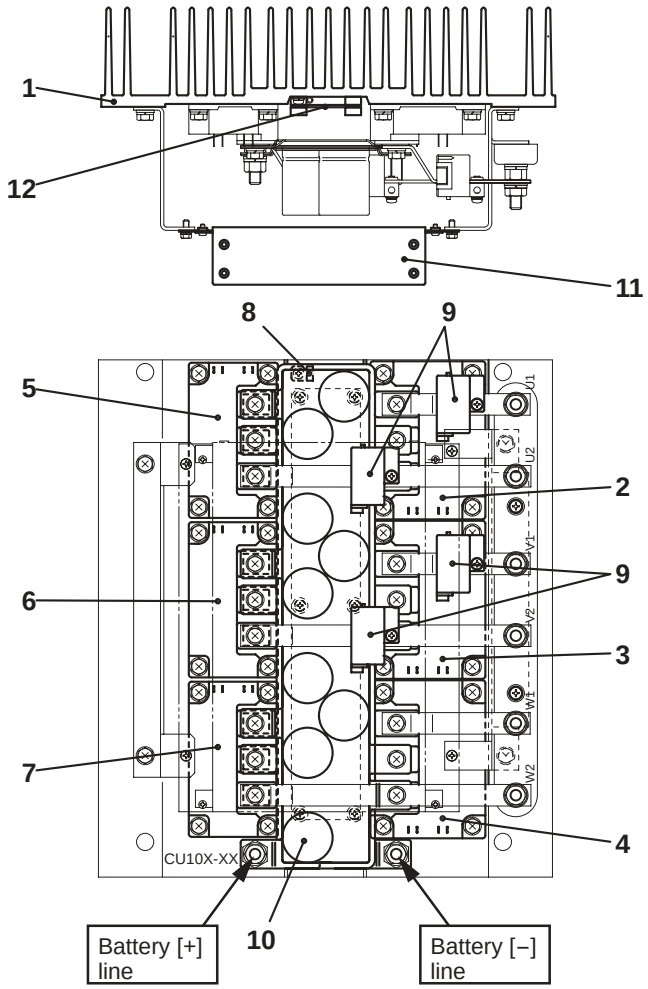


10a. CONTROL UNIT

10a-1. Location and name

IGBT module

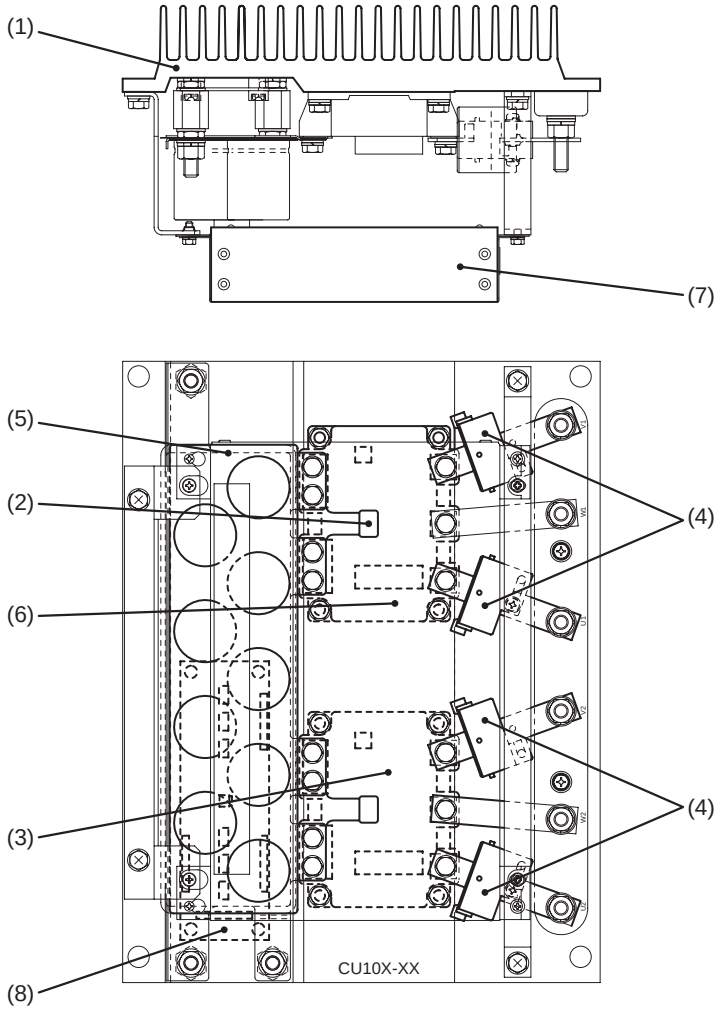
●**Main parts of control unit**



No.	Part name	Q'ty	Remarks
1	Sink, heat	1	
2	IGBT module	1	Travel U phase (U1)
3	IGBT module	1	Travel V phase (V1)
4	IGBT module	1	Travel W phase (W1)
5	IGBT module	1	Travel U phase (U2)
6	IGBT module	1	Travel V phase (V2)
7	IGBT module	1	Travel W phase (W2)
8	Sensor comp., heat	1	
9	Sensor comp., current	4	For the hydraulic U2, V2 For the travel U1, V1
10	Condenser comp.	1	FB10P-28P=80V/5600μF x 9 pieces FB30P=100V/4700μF x 9 pieces
11	Board comp., MPU	1	MPU board
12	Board comp., IGBT	1	Gate signal board

FET module

●Main parts of control unit



No.	Part name	Q'ty	Remarks
1	Sink, heat	1	
2	Module, FET	1	Travel
3	Module, FET	1	Hydraulic
4	Sensoe Comp., current	4	
5	Condenser Comp.	1	FB10P-28P 80V/5600μF×9
			FB30P 100V/4700μF×9
6	Condenser Comp.	2	for EEC
7	Board Comp., MPU	1	MPU board
8	Board Comp., FET	1	Gate signal board

<IGBT module/ FET module・Applicable serial No.>

Applicable model	IGBT module	FET module	CAN-BUS control
FB10P-18P	-221AE1250	221AE1251-	221AE3656-
FB20P-28P	-241AC4968	241AC4969-	241AC6266-
FB30P	-251AC0880	-	251AC0881-

10a-2. Disassembly and reassembly

⚠ CAUTION

- **Apply wheel chocks to tyres to prevent the truck from moving.**
- **Be sure to disconnect the battery plug.**
- **Record places of lead wire connections before disassembling.**

10a-2-1. Control unit - removal and installation

1. Remove "fitting bolts" (*1) to remove the rear cover.

2. Remove "fitting bolts" (*2) to "bracket, cover".

3. Remove the control unit with following procedure.

1. Disconnect wires on the control unit.

☞NOTE

Stamped mark on the ring terminal (at the end of each cable) means followings.

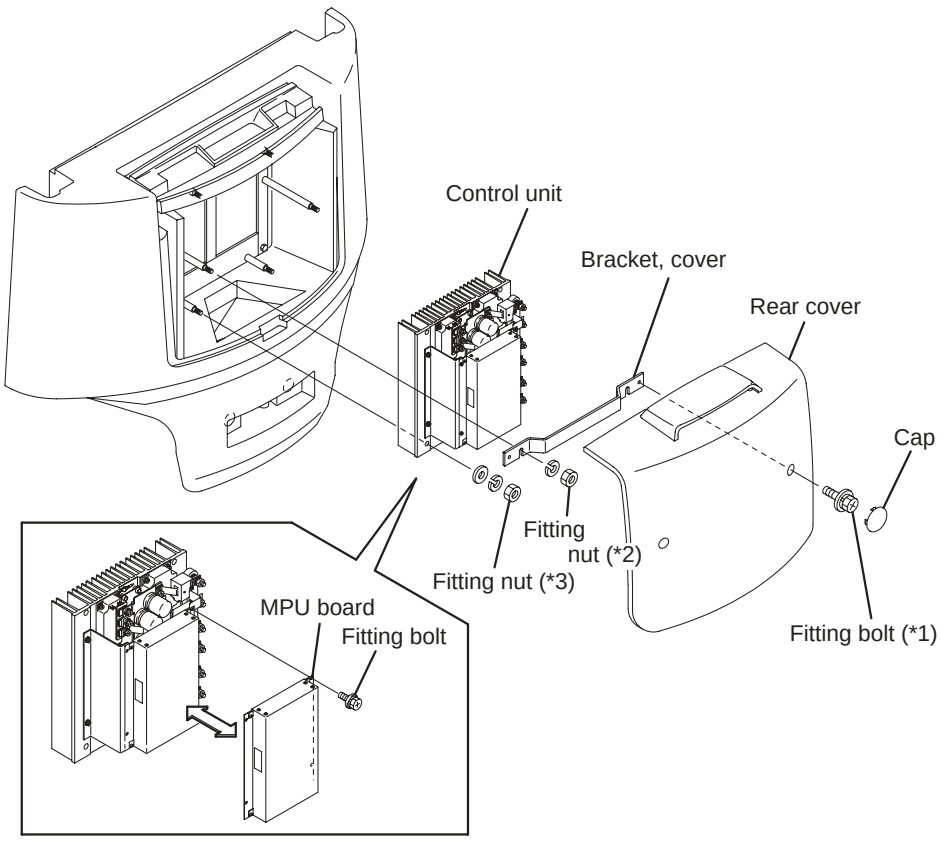
Mark	Connected to
+	Battery (+), Control unit (+)
–	Battery (–), Control unit (–)
T+	Transformer (+)
T-	Transformer (–)
U1,V1,W1	Each phase for Travel control unit and motor
U2,V2,W2	Each phase for Hydraulic control unit and motor
F	Fuse

2. Remove "fitting nuts" (*3) for the control unit to remove the control unit.

4. Remove the MPU board as follows.

1. Disconnect harness connectors from the MPU board.
2. Remove fitting bolts for the MPU board to remove the MPU board.

●Removing the control unit

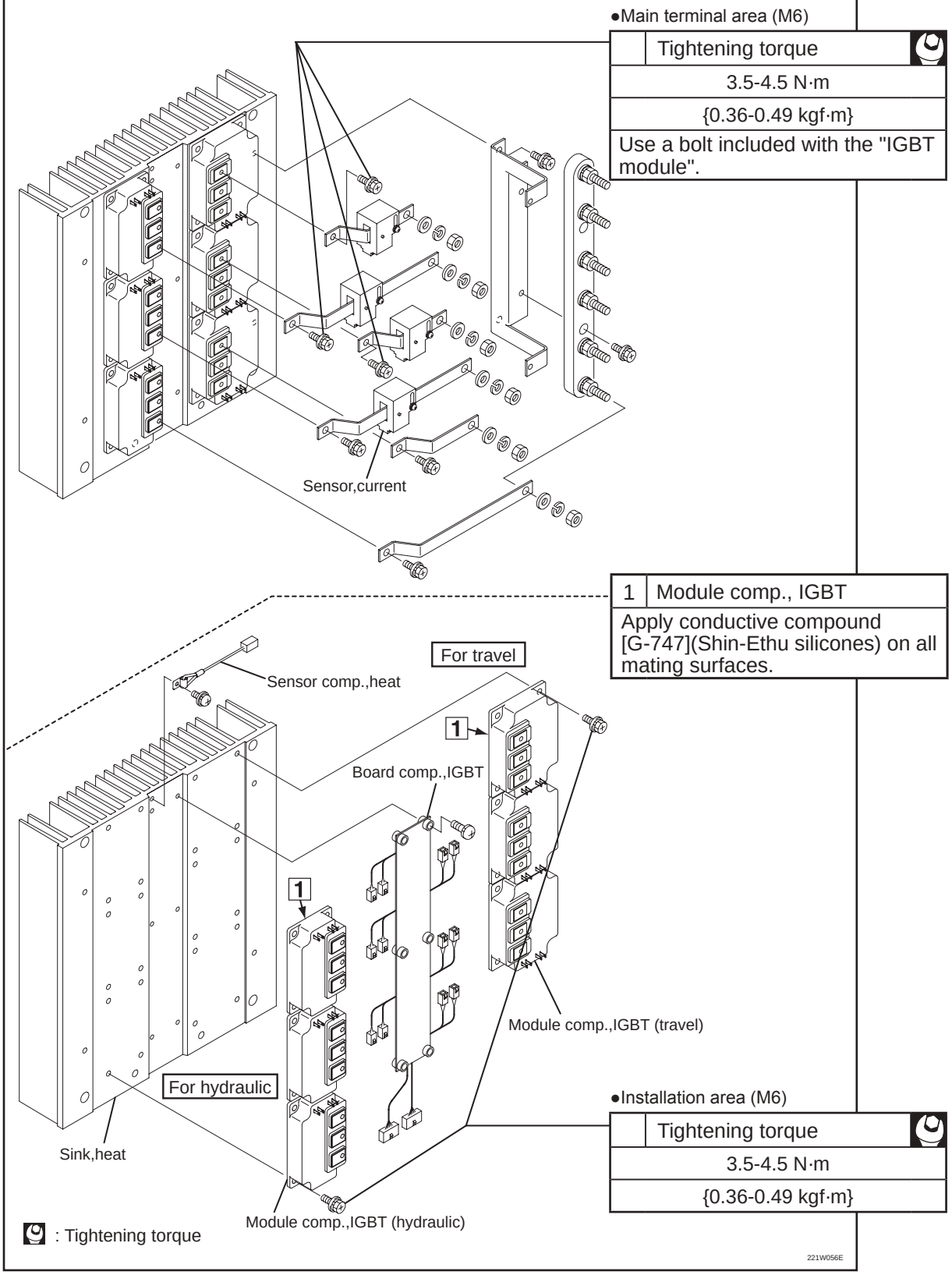


* Installation is in reverse order of removal.

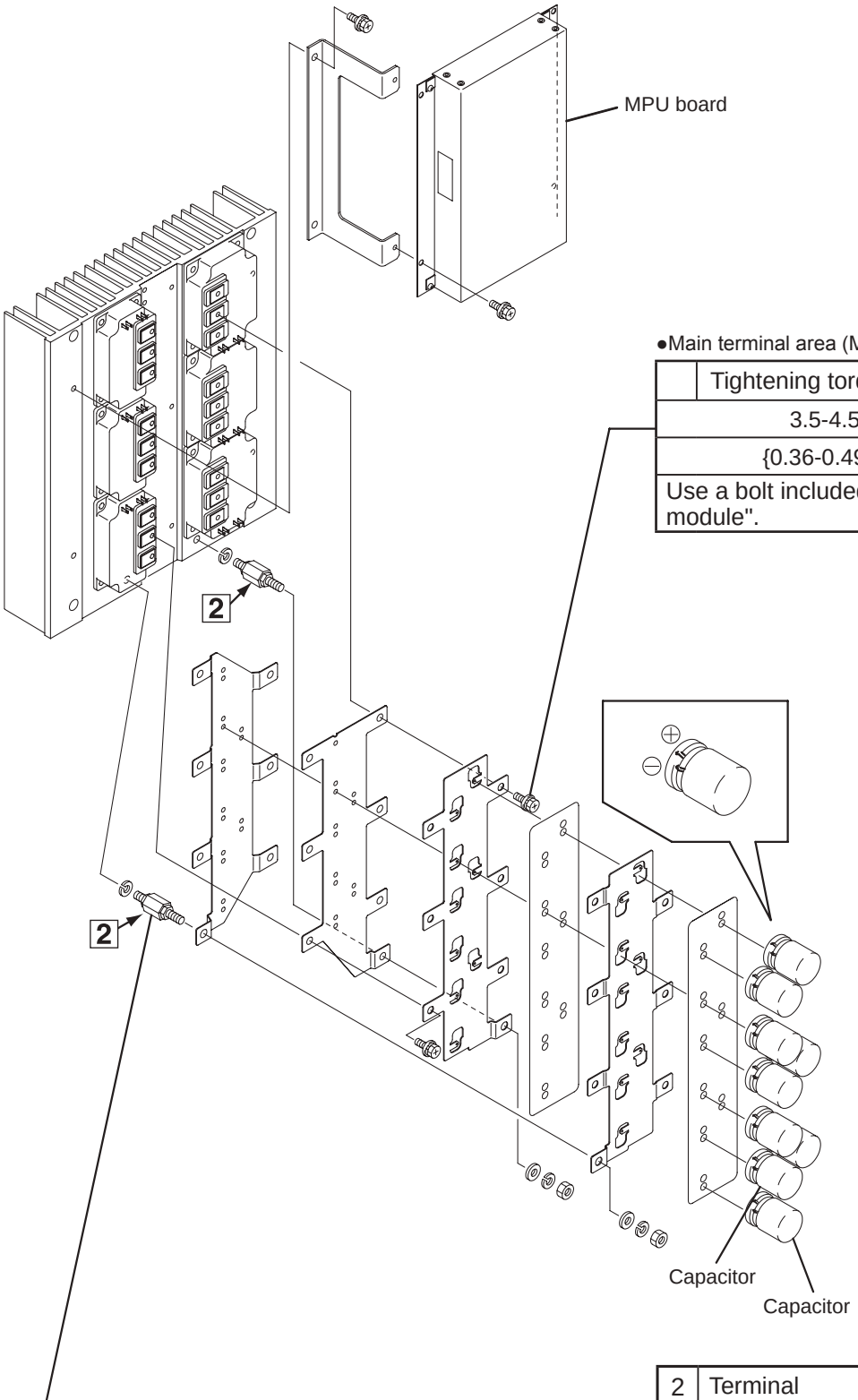
10a-2-2. Control unit - disassembly and reassembly

IGBT module

●Disassembling and reassembling the control unit (1)

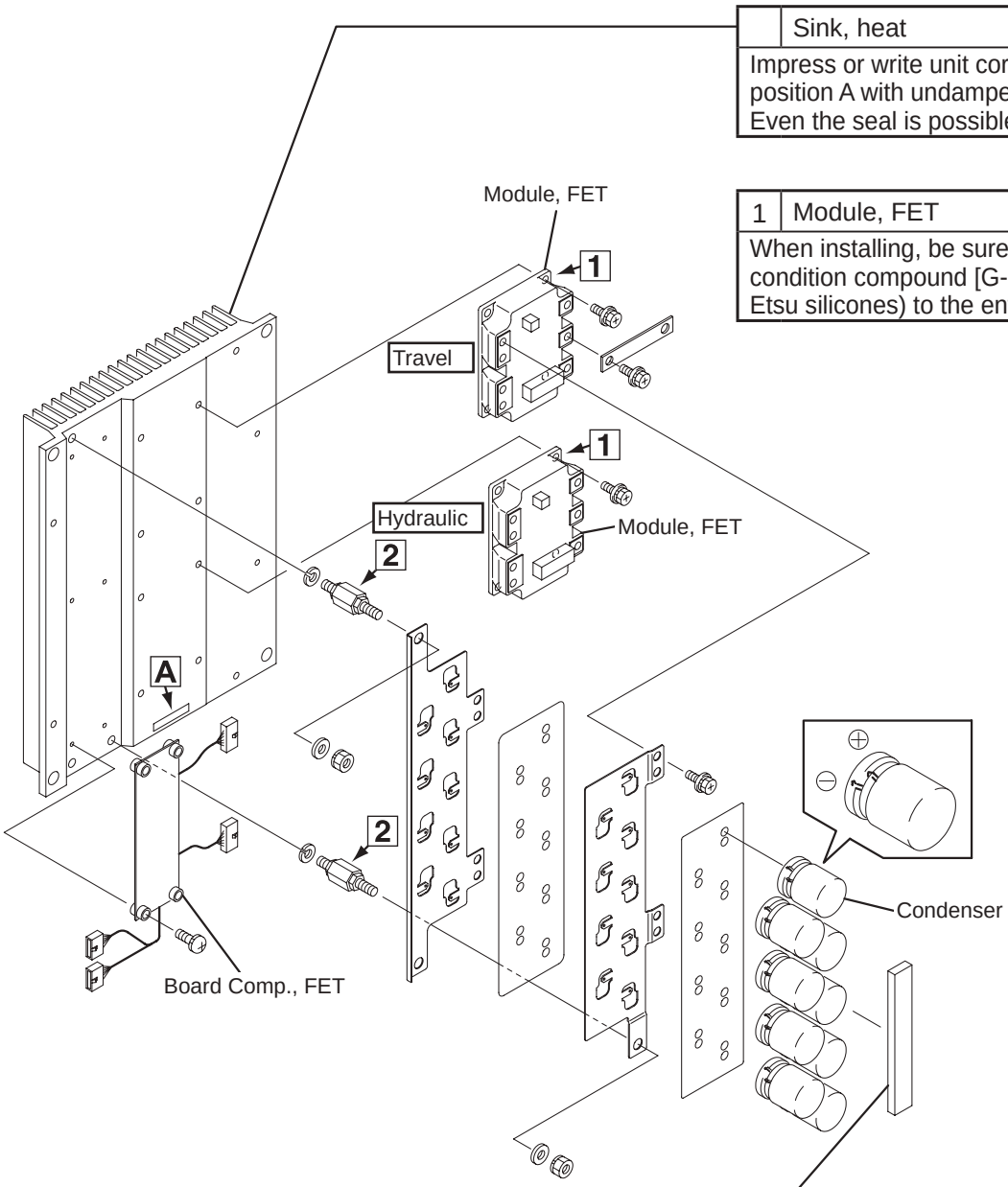


●Disassembling and reassembling the control unit (2)



FET module

●Disassembling and reassembling the control unit (1)

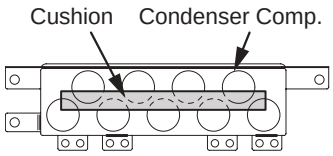


	Sink, heat
Impress or write unit cord No. on position A with undamped ink. Even the seal is possible.	

1	Module, FET	C
When installing, be sure to apply condition compound [G-747] (Shin-Etsu silicones) to the entire surface.		

2	Terminal	L
Apply LOCTITE [#242] or equivalent to the screws to prevent looseness.		
Insert washers as shown in Figure A.		

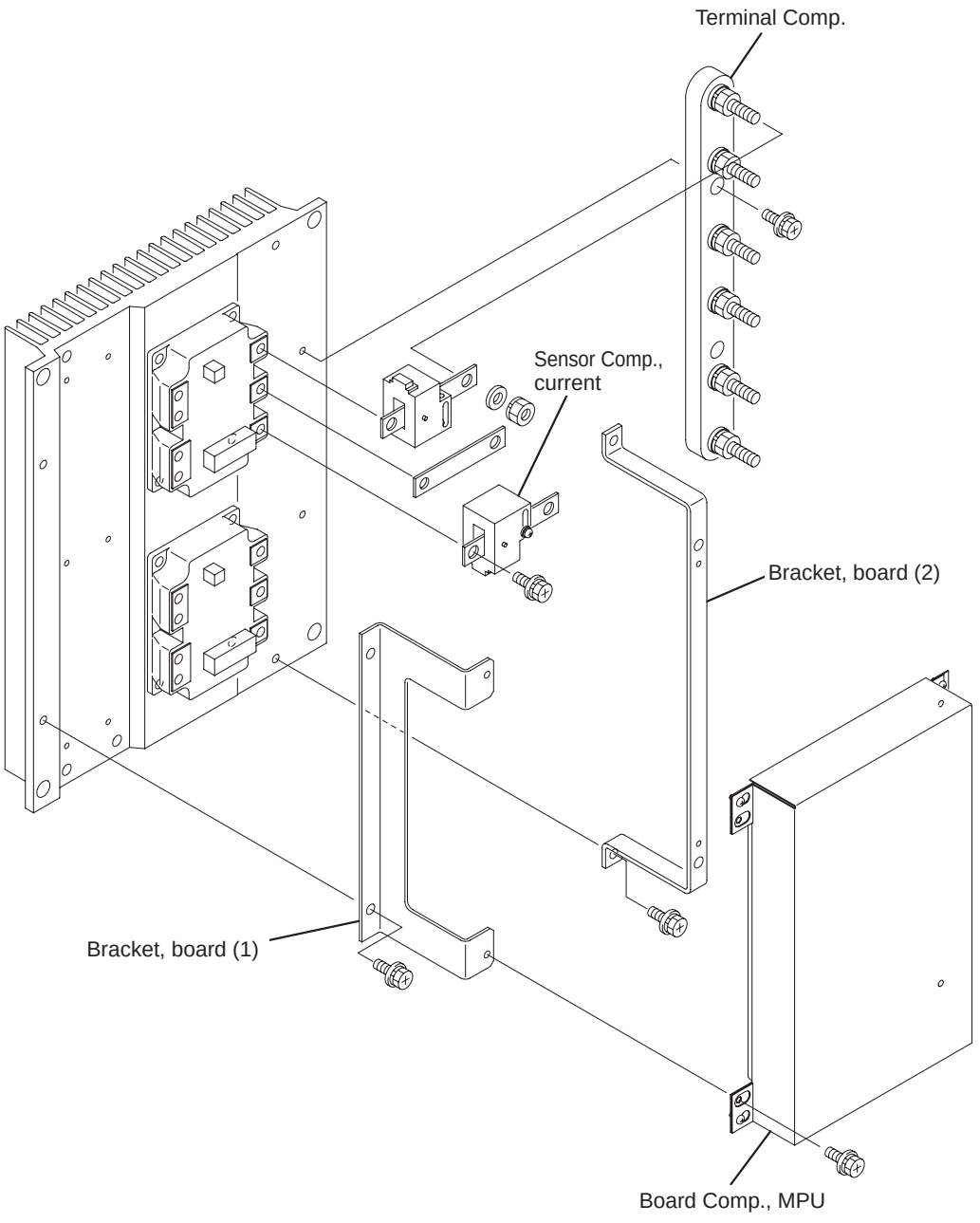
	Cushion
Put it on capacitor Comp side of the position as shown the figure.	



C : Apply compound
L : Apply LOCTITE

221W1003

●Disassembling and reassembling the control unit (2)

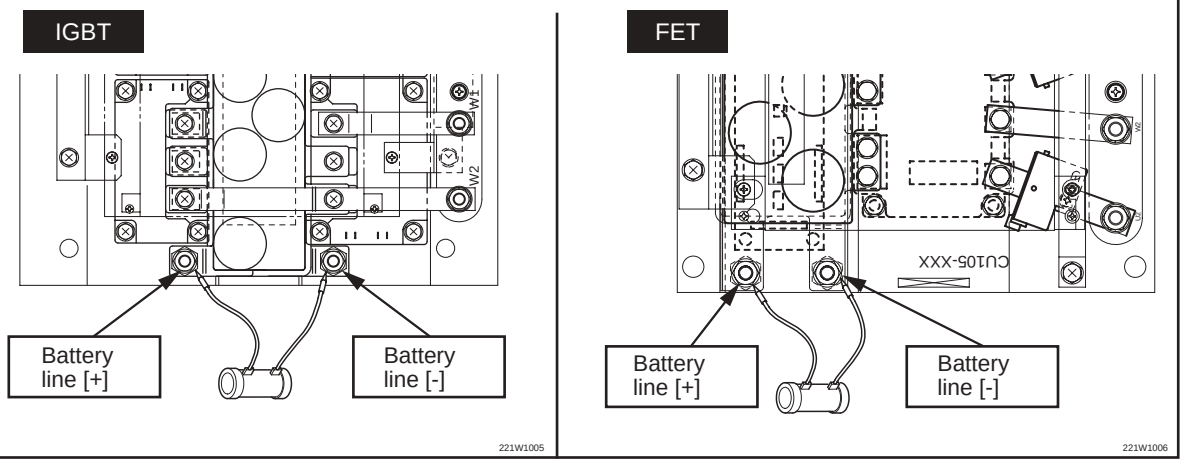


10a- 3. Check and replacement

⚠ CAUTION

- **Apply wheel chocks to tyres to prevent the truck from moving.**
- **Be sure to disconnect the battery plug first.**
- **Discharge Capacitors on the Control Unit. (See next page)**
- **Record places of lead wire connections before disassembling.**

●Electrical discharge of capacitor (control unit)



10a-3-1. IGBT module - inspection and replacement

▸1 Type of IGBT module

●For travel

Applicable model	Type	Element rating	Qty
FB10P-30P FB10P-25P-U	CM600DU-5F	600A(250V)	3

●For hydraulic

Applicable model	Type	Element rating	Qty
FB10P-30P	CM400DU-5F	400A(250V)	3
FB20P-25P-U	CM600DU-5F	600A(250V)	3

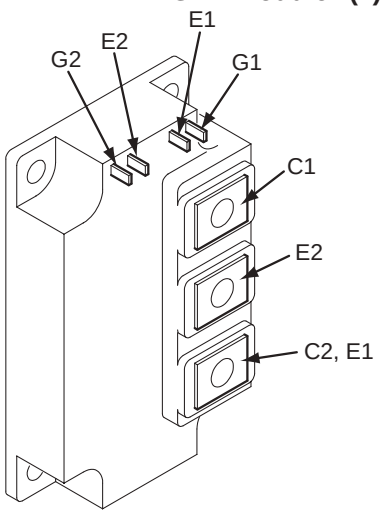
▸2 Checking IGBT module

1. Perform a continuity test at the test points 1 - 6 in the following table by using a digital tester.
   (Use the resistance range with beep function. If you use the diode checking range, you may not able to get the correct result.)
   If continuity is shown at any test points, the tester will beep. Then, replace the module (Travel or Hydraulic) to the new one.
   If any defects are found on the travel IGBT module, both of two modules (for right and left) should be replaced at the same time.
   Replace the set of all nine capacitors at the same time if the module is replaced.

	* Apply the positive (+) prove of the tester to;	* Apply the negative (-) prove of the tester to;
1	G1	C1
2	G1	E2
3	G1	C2, E1
4	G2	C1
5	G2	E2
6	G2	C2, E1

* After inspection, swap the positive and negative prove and carry out the same inspection again.
(Make sure that the beep function of a tester works fine before starting the inspection.)

●**Inspection of "IGBT module" (1)**

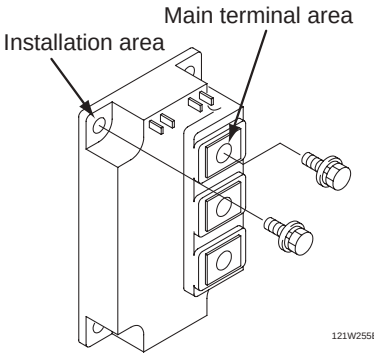


NOTE **This is a simple check, and it is impossible to judge whether it is normal.**

2. When replacing the set of IGBT module, check for burns on the "MPU board".
3. When installing the "IGBT module" to the "sink, heat", be sure to apply conduction compound [G-747] (Shin-Ethu silicones) to the entire contact surface.
4. Apply the tightening torque shown on the right to the main terminal area (M6) and the installation area (M6).

CAUTION **Do not touch each terminal of "IGBT module" directly.**
The element is damaged because of static electricity.
Remove the insulation cap which covers the terminal of "IGBT module" immediately before connecting the connector.

●**Inspection of "IGBT module" (2)**



●Main terminal area (M6)
●Installation area (M6)

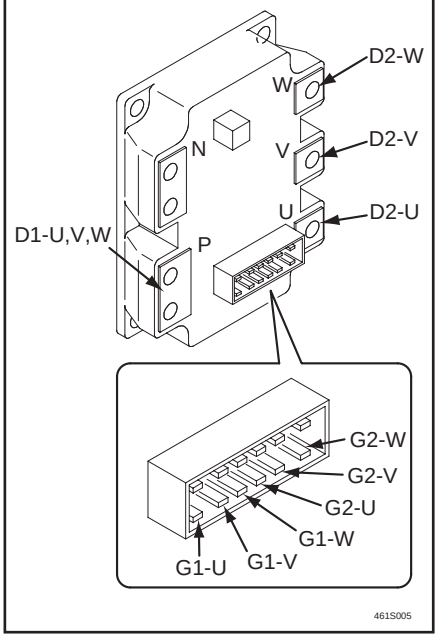
	Tightening torque
	3.5 - 4.5 N ▪ m
	{0.36 - 0.49 kgf ▪ m}

: Tightening torque

10a-3-2. FET module comp. - inspection and replacement

1. Perform a continuity test at the test points 1 - 6 in the following table by using a digital tester.
   (Use the resistance range with beep function. If you use the diode checking range, you may not able to get the correct result.)
   If continuity is shown at any test points, the tester will beep. Then, replace the module (Travel or Hydraulic) to the new one.
   If any defects are found on the travel FET module, both of two modules (for right and left) should be replaced at the same time.
   Replace the set of all nine capacitors at the same time if the module is replaced.

●**Inspection of "FET module (1)**

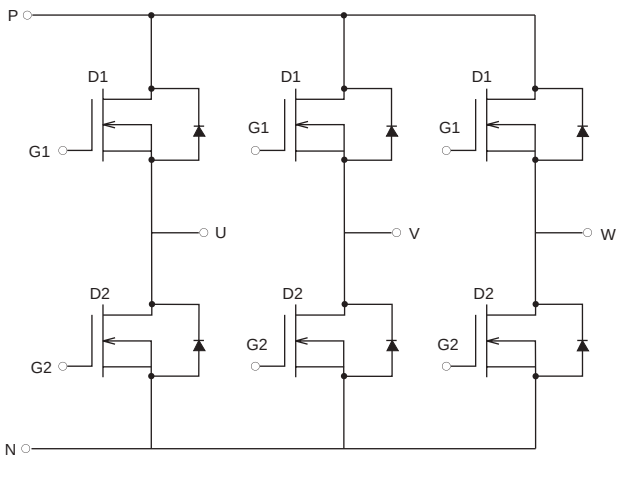


NOTE **Capacitors are replaced every year.**

	"Positive test" lead at	"Negative test" lead at
1	P(Drain1)	G1-(U)
2	P(Drain1)	G1-(V)
3	P(Drain1)	G1-(W)
4	U(D2-U)	G2-(U)
5	V(D2-V)	G2-(V)
6	W(D2-W)	G2-(W)

*Even both plus (+) and minus (-) are acceptable.
Do the continuity checking.

●[FET module] Circuit chart

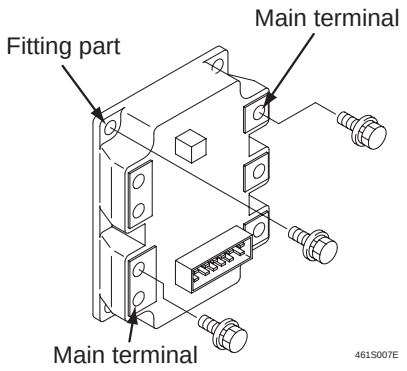


2. If any continuities are shown, check the Board comp. for any burning marks. (Travel or Hydraulic : PBC107). It is probably damaged also by electric surge
3. When installing the "FET module" to the "sink, heat", be sure to apply the thermal conductive compound [G-747] (Shin-Ethu Silicones or equivalent) to the entire contact surface.
4. Apply the tightening torque shown on the right to the main terminal (M6) and the base plate (M6).

⚠ CAUTION

Do not touch each terminal of "FET module" directly.
The element is damaged because of static electricity.
Remove the insulation cap which covers the terminal of "FET module" immediately before connecting the connector.

●Inspection of "FET module" (2)



- Main terminal (M6)
- Fitting part (M6)

	Tightening torque
	3.5 - 4.5 N・m
	{0.36 - 0.49 kgf・m}

: Tightening torque

10a-3-3. Capacitor - inspection and replacement

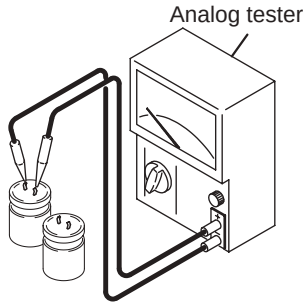
- Check the appearance visually.
  If the appearance looks no problem, check with following procedures.

⚠ CAUTION

Use an analog tester to check the capacitor.

1. Discharge the energy stored in the capacitor with a resistor.
   Refer the next clause "Procedure to discharge capacitor".
2. Set the tester to the resistance range. (kΩ range)
3. Apply the positive (+) prove to the (+) pole of the capacitor, and the negative (-) prove to the (–) pole.
4. First, the tester shows a few kΩ, then increase the resistance and shows "∞" finally if the capacitor is normal.

●Checking the capacitor



⚠ CAUTION

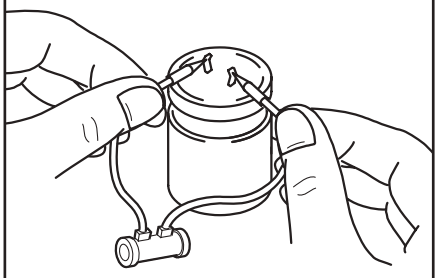
The above checking procedure is only for the basic performance of the capacitor.
If you have any doubts, replace all capacitors.

⚠ CAUTION

If it is found to break down IGBT module / FET module, replace it.

1. Prepare a resistor (20W, 50Ω or 50W, 20Ω).
2. Connect the resistor to the capacitor.
   (See right)
3. Keep connection for 5 seconds. Then, the capacitor can be discharged.

●**Discharging the capacitor**



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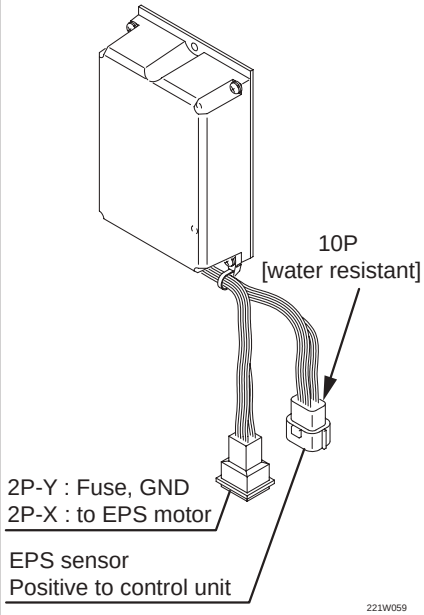
10a-3-4. EPS controller - specifications

IGBT and FET control

Applicable model	Type		Voltage	Current
FB10P-28P	STD	CM103-44	48V	42A
	EEC	*CM103-49		
FB30P	STD	CM103-45	72V	35A

*Only for FET control model

●**EPS controller**



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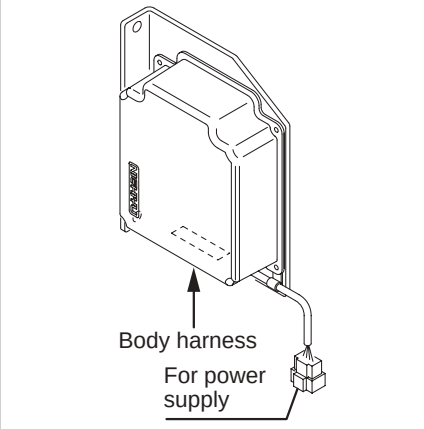
CAN-BUS control

Applicable model	Type		Voltage	Current
FB10P-28P	STD	CU106-41B	48V	42A
	CS	CU108-40A		
FB30P	STD	CU106-43B	72V	35A
	CS	CU108-41A		

●**EPS controller (FET)**



221W1007

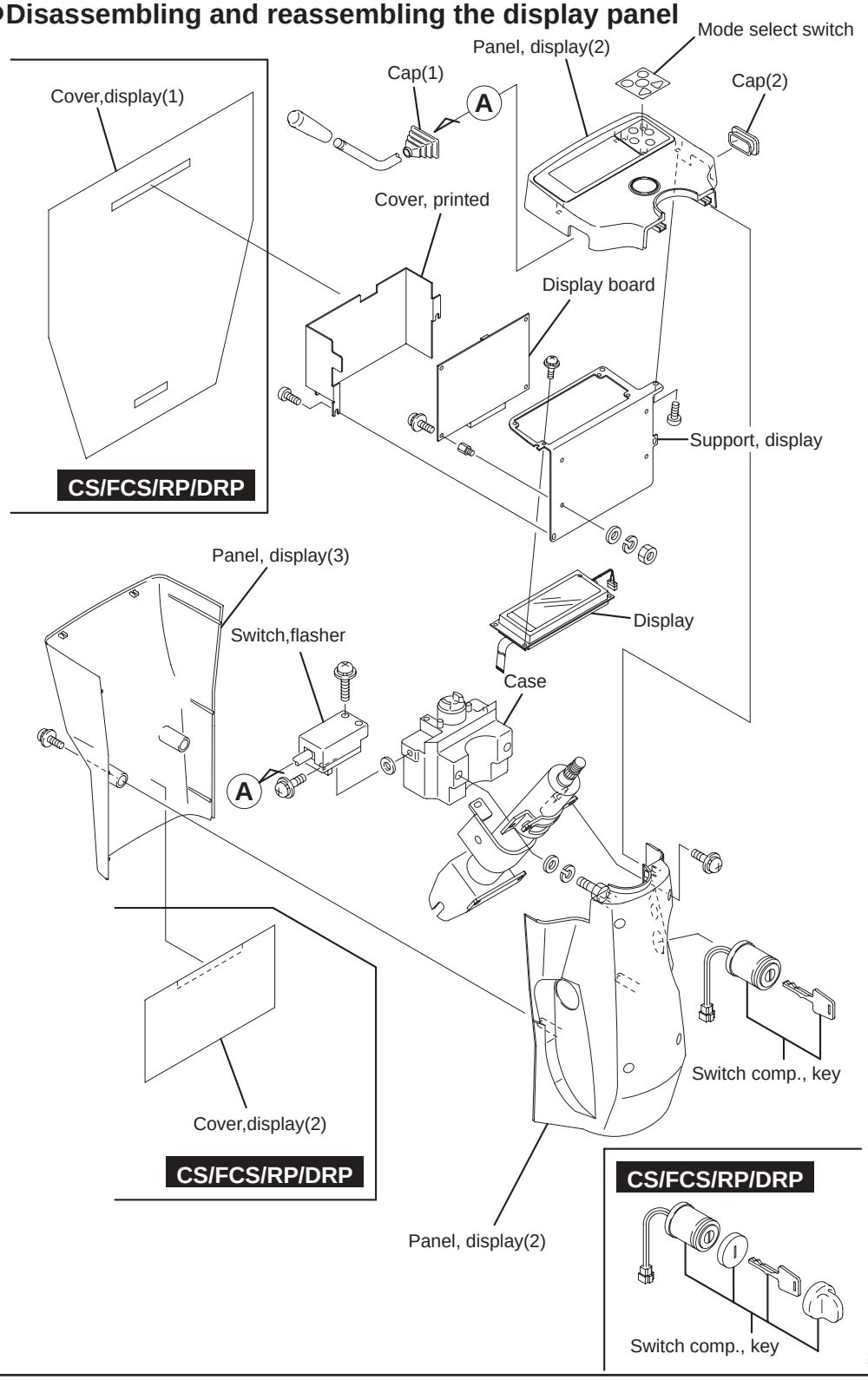
10b. DISPLAY PANEL AND DIRECTIONAL SWITCH

10b-1. Display panel - Disassembly and reassembly

10b-1-1. Display panel - disassembly and reassembly

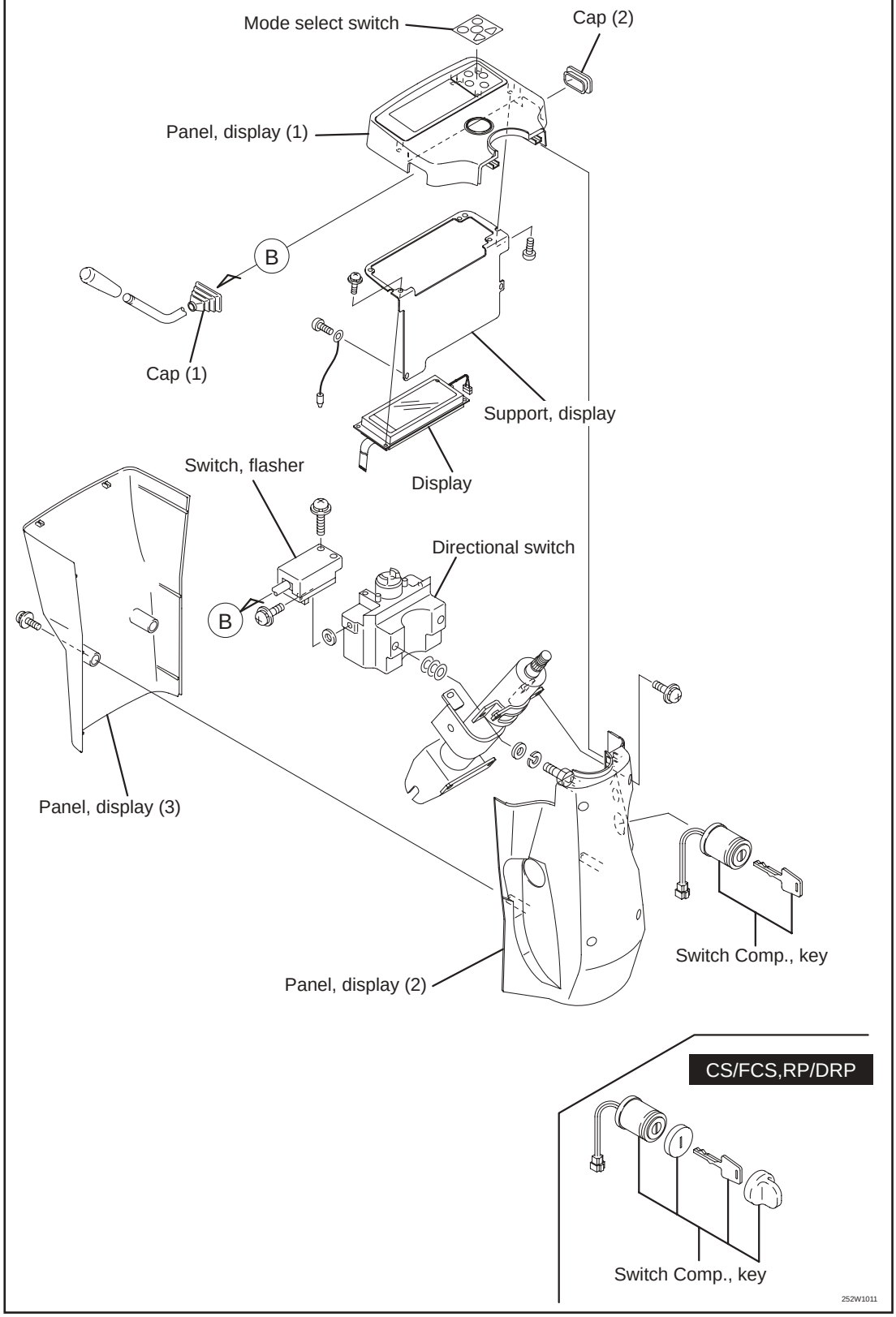
IGBT and FET control

●**Disassembling and reassembling the display panel**



CAN-BUS control

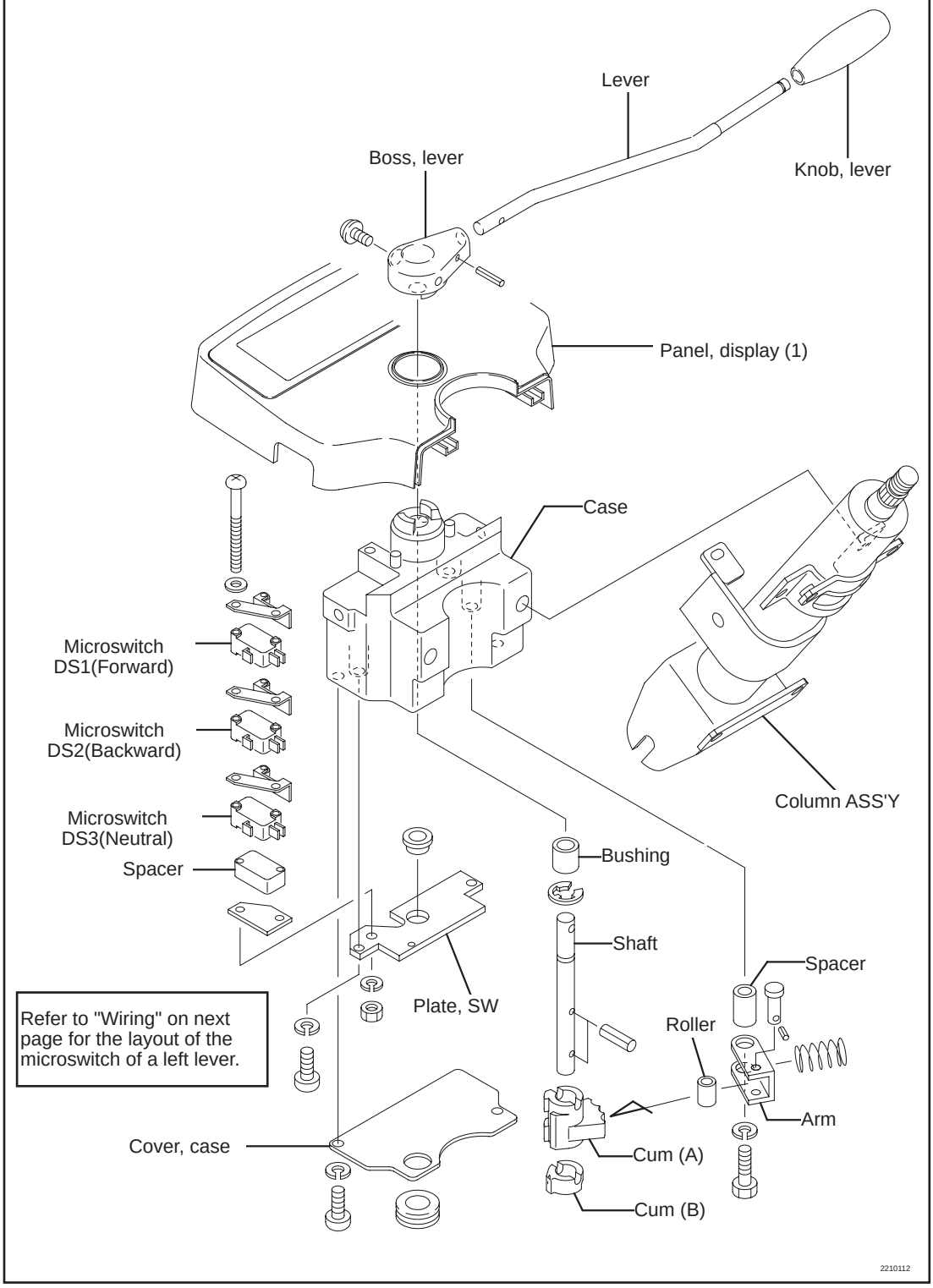
●Disassembling and reassembling the display panel



10b-2. Directional switch - Disassembly and reassembly

10b-2-1. Display panel - disassembly and name

●**Disassembling and reassembling the directional switch**

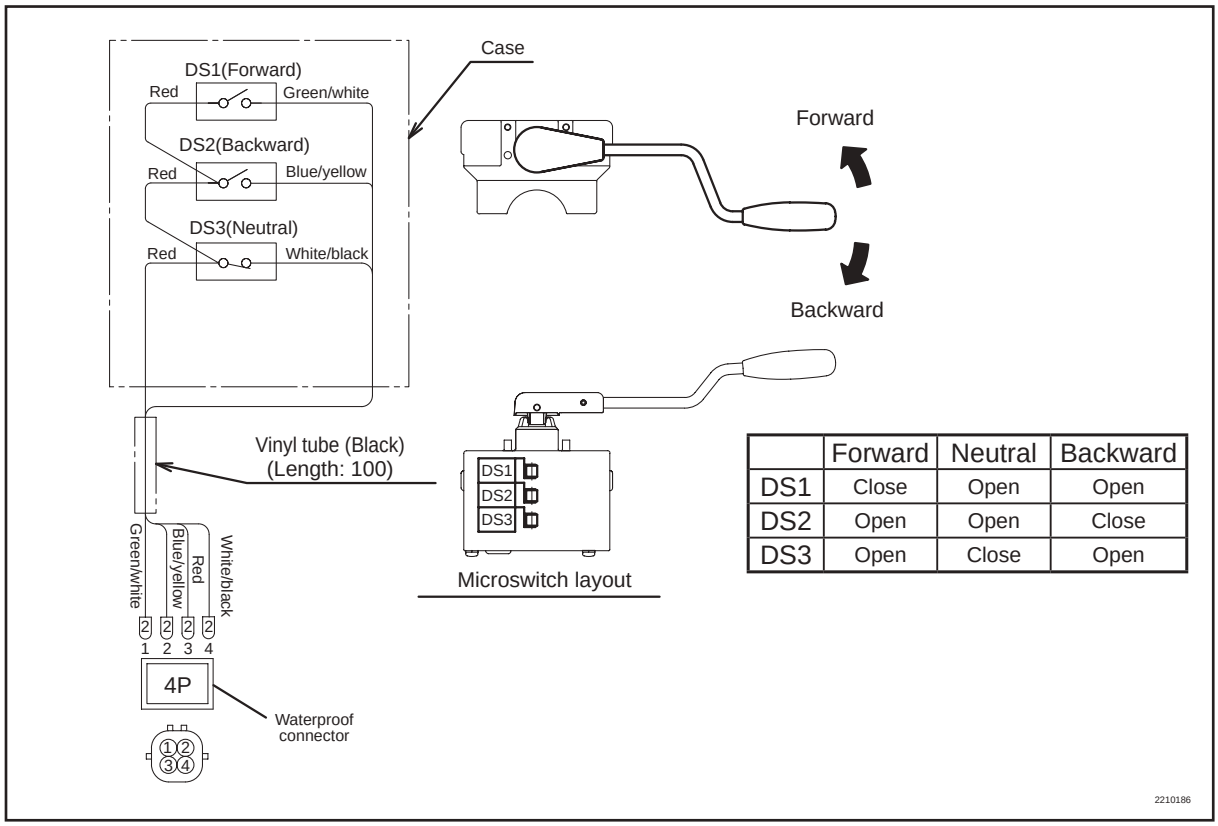


* This illustration shows right lever type. Some trucks may have the left lever type.

➡Refer to "Wiring" on next page for the layout of the microswitch of a left lever.

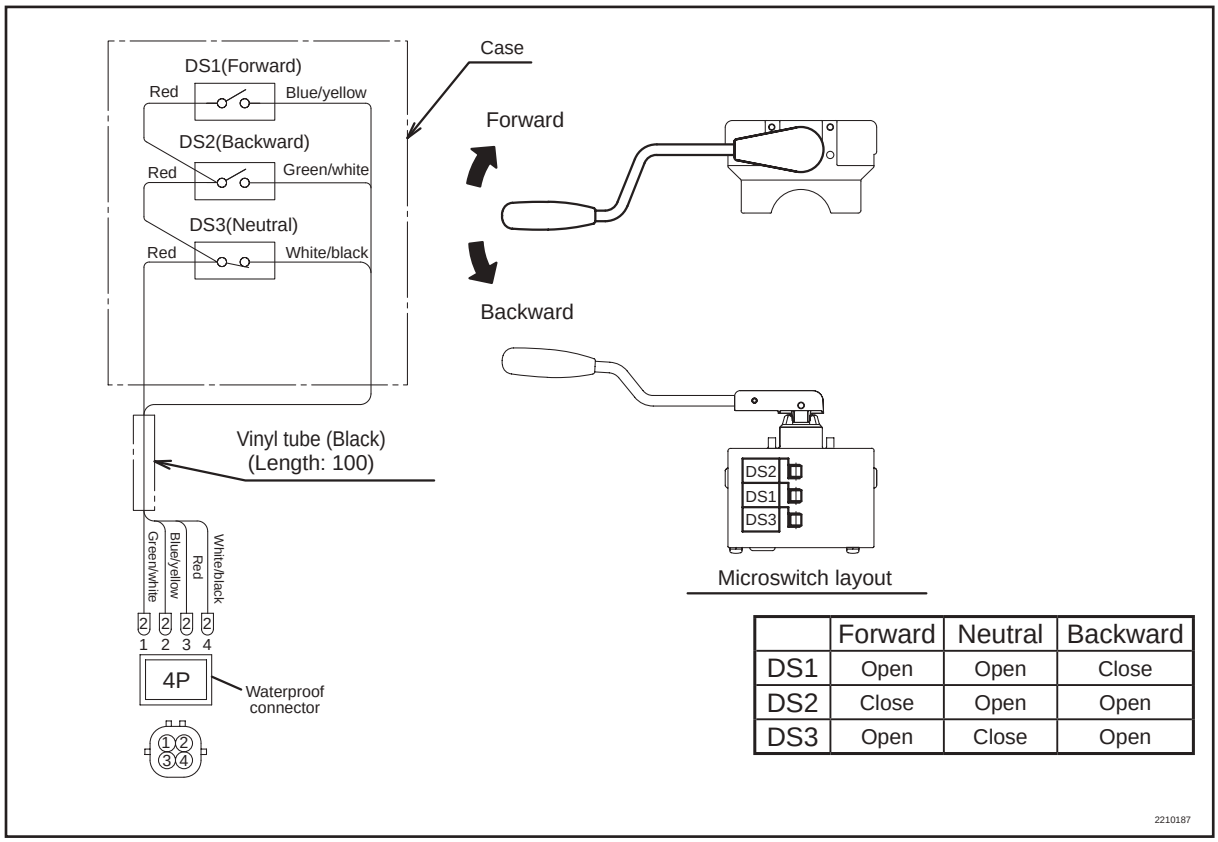
10b-2-2. Wiring of directional switch

<Type: DS100-20 (Right lever)>



	Forward	Neutral	Backward
DS1	Close	Open	Open
DS2	Open	Open	Close
DS3	Open	Close	Open

<Type: DS100-21 (Left lever)>



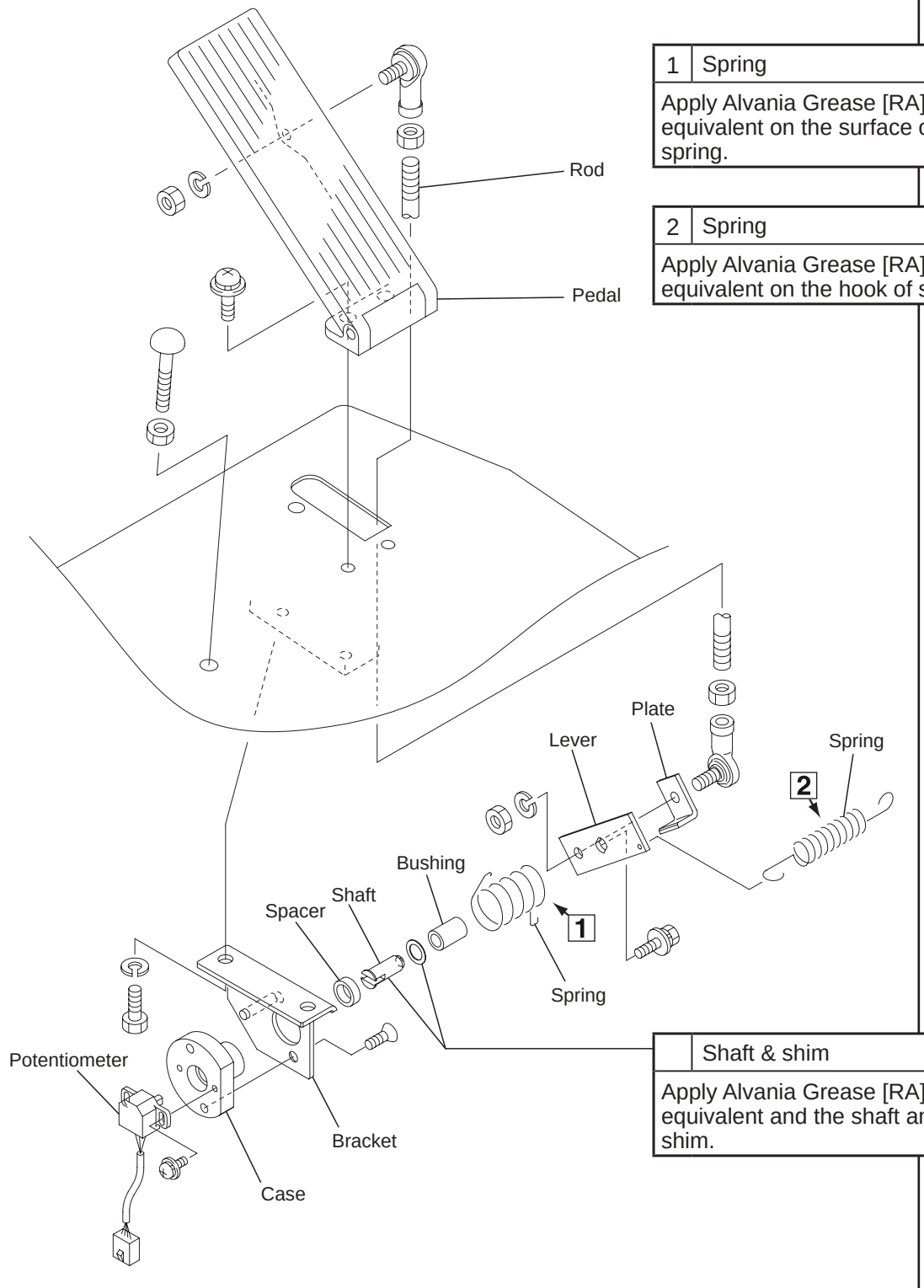
	Forward	Neutral	Backward
DS1	Open	Open	Close
DS2	Close	Open	Open
DS3	Open	Close	Open

10c. ACCELERATOR

10c-1. Disassembly and reassembly

10c-1-1. Accelerator linkage - removal and installation

●Removing and installing the accelerator linkage



1	Spring	G
Apply Alvania Grease [RA] or equivalent on the surface of spring.		

2	Spring	G
Apply Alvania Grease [RA] or equivalent on the hook of spring.		

	Shaft & shim	G
Apply Alvania Grease [RA] or equivalent and the shaft and the shim.		

10c- 2. Inspection and adjustment

10c-2-1. Potentiometer - adjustment

1. Adjust the fixing position of the potentiometer to get the following output voltage.

(1) Apply DC 5 ± 0.5 volts between Red (+) and Black (-).

(2) Measure the voltage between White (output 1) and Black (-), and make sure if the voltage is within the range.

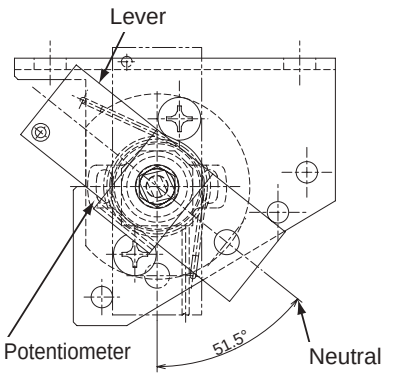
(3) Measure the voltage between Blue (output 2) and Black (-), and make sure if the voltage is within the range.

(4) If you cannot get the correct output voltage, remove the potentiometer once and turn the shaft 180˚ . Then install and test again.

(5) If you cannot get the correct output voltage for both output 1 (white) and output 2 (Blue), replace the potentiometer to the new one.

Lever position	Output voltage
Neutral	0.85 ± 0.1 V
51.5 degree rotated	3.5 V - 4.5 V

●Adjusting the potentiometer

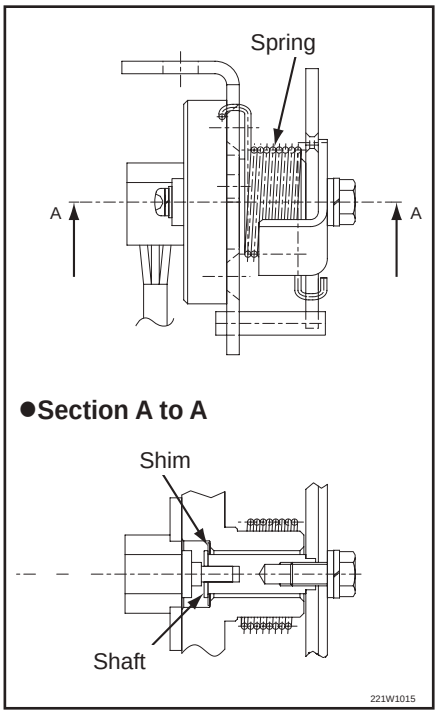


NOTE

This potentiometer is not a variable resistor. So, the shaft does not have the mechanical stopper (can turn 360˚ endless) and cannot measure the resistance by a tester.

NOTE

Apply Alvania Grease or equivalent between the shaft and the shim and also the surface of spring.

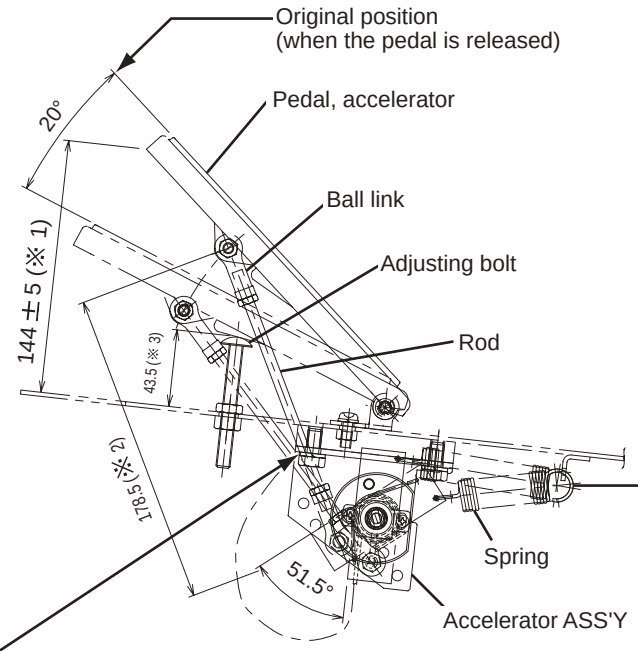


10c-2-2. Accelerator linkage - adjustment

<Adjustment procedure>

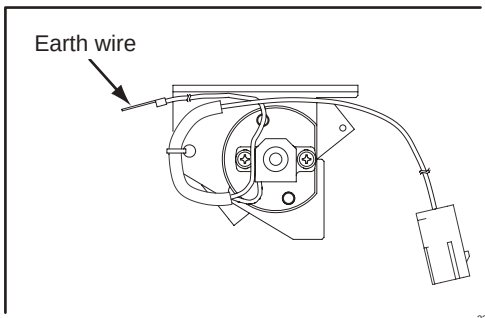
1. Adjust the rod length (※ 2) to 178.5 mm.
   The height of the accelerator pedal (※ 1) should be 144 ± 5 mm when the accelerator pedal is free.
2. Adjust the height of the stopper bolt (※ 3) to 43.5 mm.

●Adjusting the accelator linkage



Spring	G
Apply Alvania Grease {RA} or equivalent on the hook of spring.	

NOTE
Tighten the bolt together with earth wire from potentiometer.



G : Apply grease

221W1014

10d. MAIN CONTACTOR AND FUSE

10d-1. Disassembly and reassembly

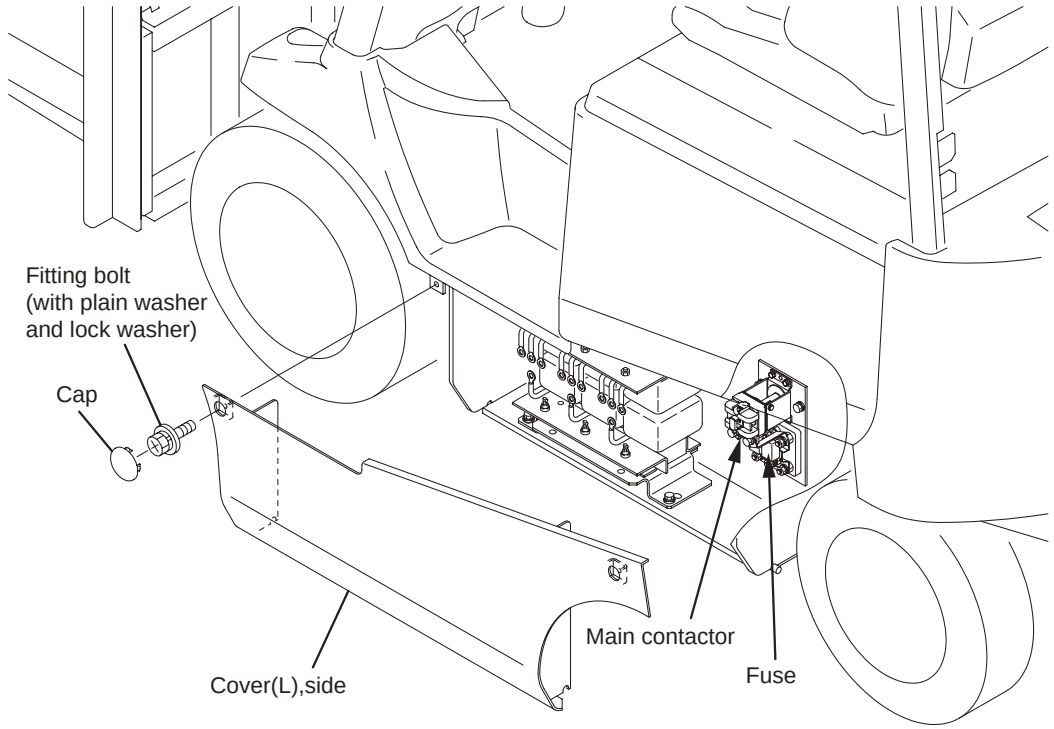
⚠ CAUTION

- **Be sure to disconnect the battery plug.**
- **Apply wheel chocks to tyres to prevent the truck from moving.**
- **Record places of lead wire connections before disassembling.**

10d-1-1. Control unit - removal and installation

1. Remove caps, fitting bolts and the "Cover(L), side".

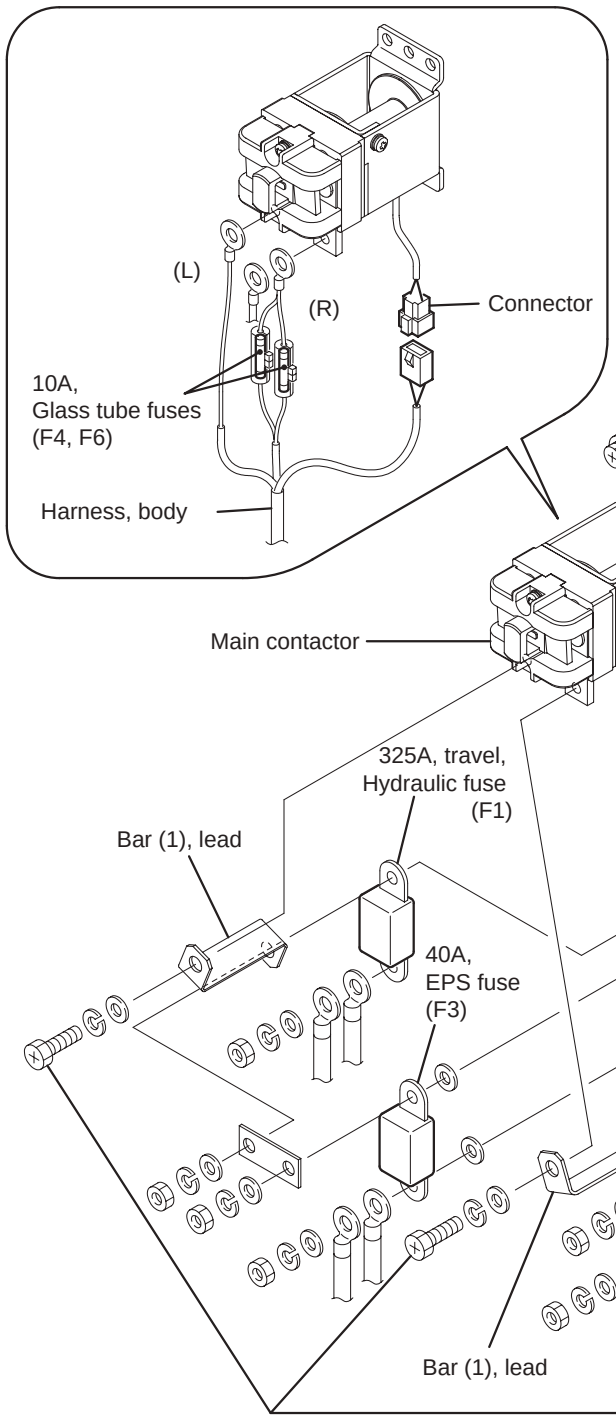
●Removing the front cover



2. Remove the main contactor and all fuses as follows.

1. Disconnect wiring connectors of the main contactor and lead wires.
2. Refer to the diagram below and remove the main contactor and all fuses.

●Removing the main contactor and fuse



●Main terminal area (M8)

Tightening torque(M8)
6.4-7.4 N・m
{0.65-0.75 kgf・m}
Use a bolt included with the main contactor.

: Tightening torque

221W063E

* Install the main contactor and fuse in reverse order of removal.

10d-2. Inspection and replacement

⚠ CAUTION

- **Record places of lead wire connections before disassembling.**
- **Be sure to disconnect the battery plug.**

10d-2-1. Main contactor - inspection and replacement

1. Remove screws, and check for burns or wear in the contact area.

➡ If there is an abnormality in the contact, replace the assembly.

⚠ CAUTION

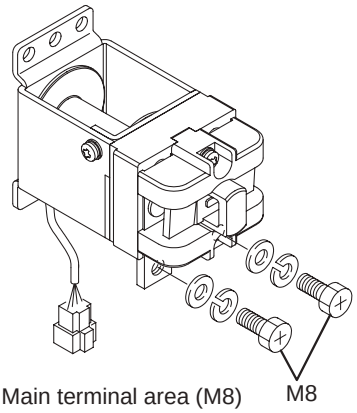
To be safe, the assembly should be replaced every 2 years even if there are no abnormalities.

●Main contactor type

Applicable model	Maker type	Voltage
FB10P-30P	HR-404394	48V

2. Use the tightening torque shown on the right for the main terminal area (M8).

●Inspection of main contactor



●Main terminal area (M8) M8

Tightening torque (M8)
6.4-7.4 N・m
{0.65-0.75 kgf・m}

: Tightening torque

121W226

10d-2-2. Fuse - replacement

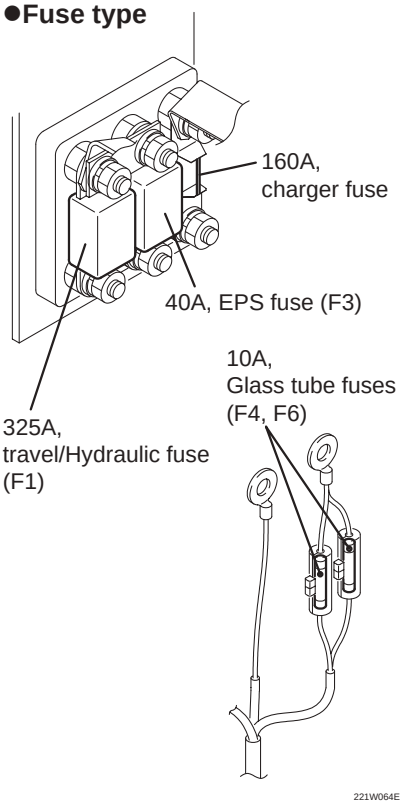
1. Be sure to replace Fuse with the specific capacity one.

●Fuse type

Application	Capacity	
MPU	F1	325A
EPS	F3	40A
Transformer		160A
Control unit	F4	10A
Accessory	F6	10A

2. Be sure to tighten the nuts after replacing it.

●Fuse type



221W064E

10e. BUILT-IN CHARGER (OPTION)

10e-1. Disassembly and reassembly

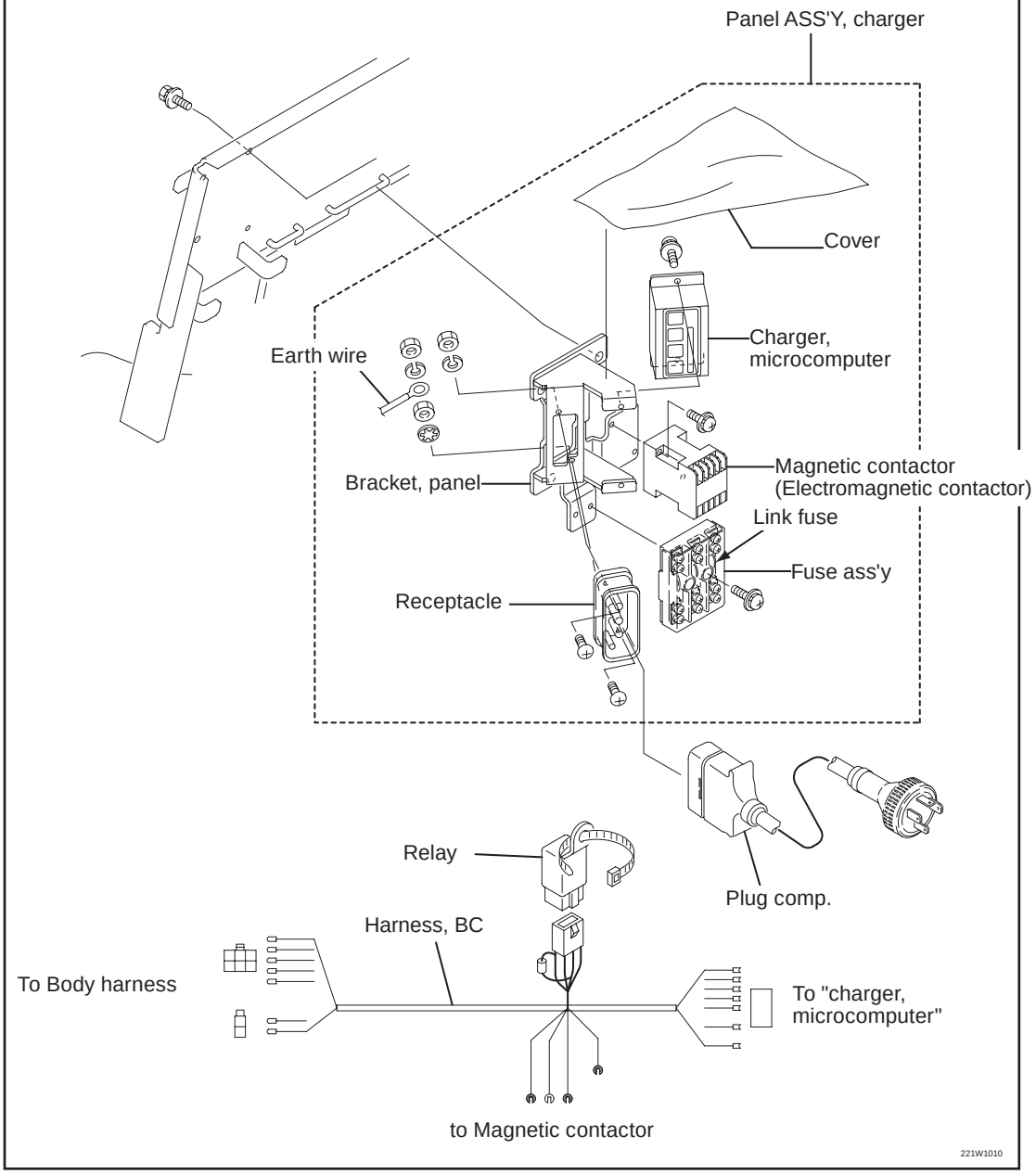
⚠ CAUTION

- **Do not misconnect the earth wire to the normal electric circuit.**
- **Make sure that all wires are connected correctly.**
- **Securely tighten screws or bolts of lead wires.**
- **Insert insulation tubes for the terminals of the transformer in order to keep them away each other and from metal parts.**

10e-1-1. Charger ass'y - disassembly and reassembly

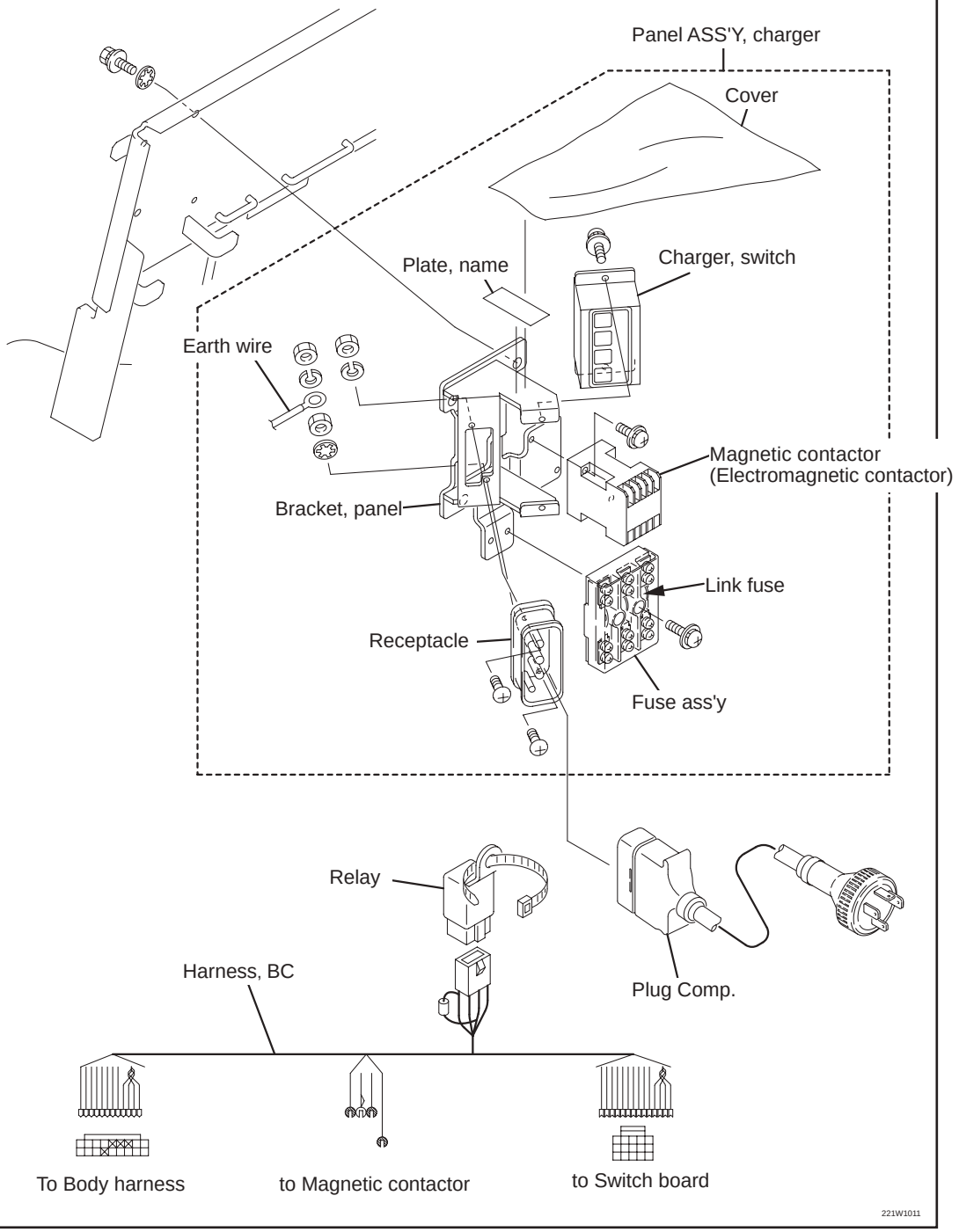
IGBT and FET control

●Disassembling and reassembling the charger ass'y (built-in type)



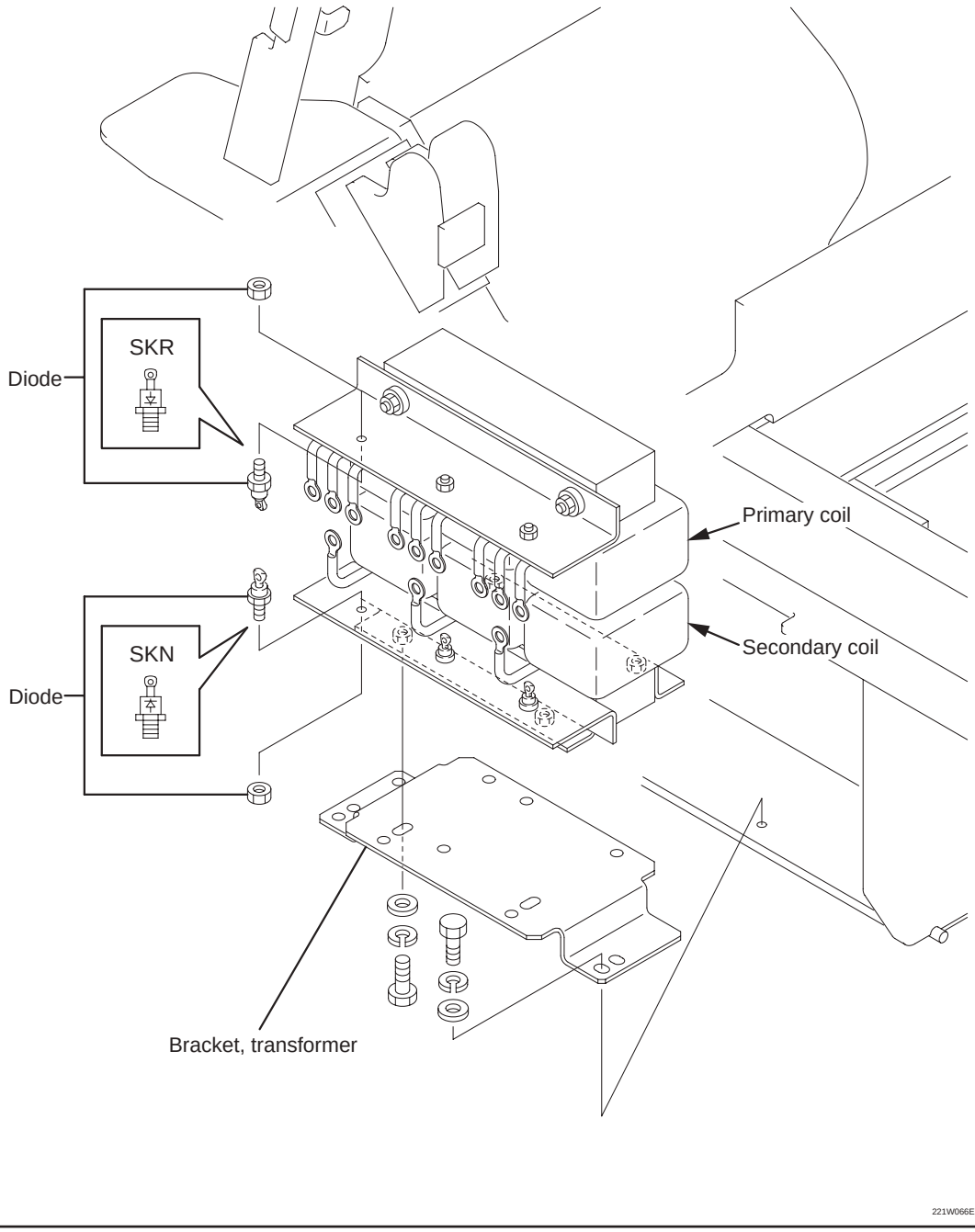
CAN-BUS control

●**Disassembling and reassembling the charger ass'y (built-in type)**



10e-1-2. Transformer - disassembly and reassembly

●**Disassembling and reassembling the transformer (built-in type)**



10e-1-3. Built-in charger - specification

<3 ϕ 200V>

Power supply voltage	Applicable model	Battery capacity	Transformer capacity	Transformer model	Fuse capacity
200V	FB10P/14P	330Ah (Std)	5.2kVA	T1224-2100, T1224-2101	15A
		480-485Ah (Opt)	6.4kVA	T2224-2200, T2224-2201, T2224-2202	20A
		545Ah (Opt)	7.0kVA	T3224-3200, T3224-3201	20A
	FB15P/18P	400Ah (Std) 485Ah (Opt)	6.4kVA	T2224-2200, T2224-2201, T2224-2202	20A
		545Ah (Opt)	7.0kVA	T3224-3200, T3224-3201	20A
	FB20P	485Ah (Std) 545-600Ah (Opt)	6.4kVA	T2224-2200, T2224-2201, T2224-2202	20A
			7.0kVA	T3224-3200, T3224-3201	
		650-730Ah (Opt)	10.0kVA	T4224-0100	30A
	FB25P/28P	565Ah (Std) 600Ah (Opt)	6.4kVA	T2224-2200, T2224-2201, T2224-2202	20A
			7.0kVA	T3224-3200, T3224-3201	
		650-730Ah (Opt)	10.0kVA	T4224-0100	30A
	FB30P	485Ah (Std) 545-600Ah (Opt)	12.0kVA	T3324-1100	30A

<3 ϕ 400V>

Power supply voltage	Applicable model	Battery capacity	Transformer capacity	Transformer model
400V	FB10P/14P	330Ah	5.2kVA	T1224-2100
		480-485Ah	6.4kVA	T2244-1100
		545Ah	7.0kVA	T3244-2100
	FB15P/18P	480-485Ah	6.4kVA	T2244-1100
		545-600Ah	7.0kVA	T3244-2100
	FB20P	400-485Ah	6.4kVA	T2244-1100
		545-600Ah	7.0kVA	T3244-2100
		650-730h	10.0kVA	T4224-0100
	FB25P/28P	565-600Ah	7.0kVA	T3244-0100
		650-730Ah	10.0kVA	T4224-0100
	FB30P	485-600Ah	12.0kVA	T3344-1100

NOTE

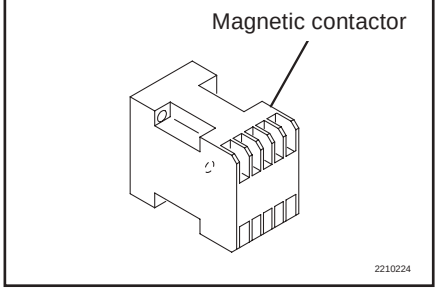
400-volt type charger has the thermal relay instead of the fuse.

10e- 2. Inspection and replacement

10e-2-1. Magnetic contactor - inspection

1. Check for burnings and/or damages on the contacts.

●Inspection of magnetic contactor



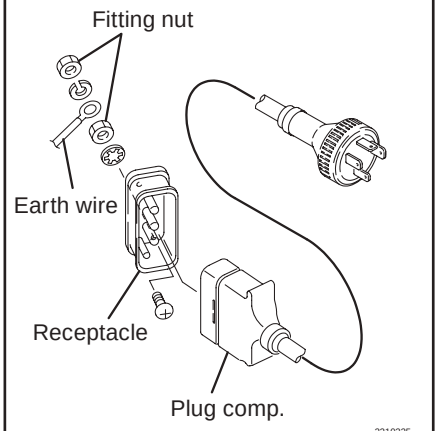
10e-2-2. Plug comp. and receptacle - inspection and replacement

1. Check for burnings and/or discoloration on the receptacle terminal.

➡If there are any burns, discoloration, or abnormal plays on the terminal, replace both the plug comp. and the receptacle.

2. Check the earth wire fitting nuts for loosening.

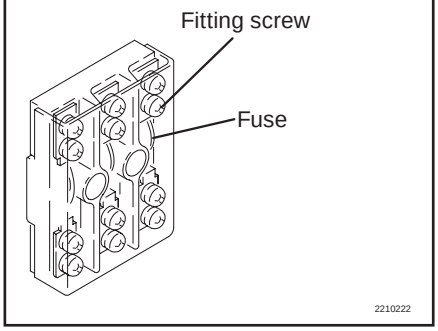
●Inspection of plug comp. and receptacle



10e-2-3. Fuse and fuse base - inspection

1. Check link fuses for blow outs or discoloration.
2. Check fuse fitting screws for loosening.

● Inspection of link fuse and fuse base



10e-2-4. Transformer - inspection

1. Check for damage or dirt.

➡If there is dirty or dusty, clean it away with compressed air.

2. Measure the insulation resistance.

Specific value of insulation resistance	5MΩ or greater

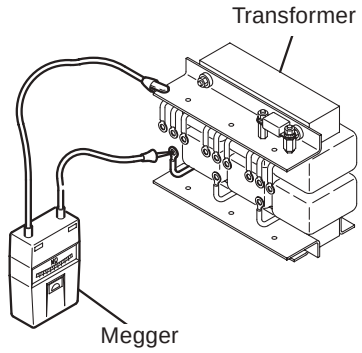
<Measuring procedure>

CAUTION

- **Be sure to disconnect the battery plug before measuring.**
- **If using a megger, do not touch the measuring terminals.**

1. Remove all diodes from the transformer.
2. Use a megger to measure the following locations and check the insulation.
   - Between the primary and secondary coils.
   - Between the primary coil and the steel core of the coil.
   - Between the secondary coil and the steel core of the coil.

●Transformer insulation measurement



10e-2-5. Diode - inspection

1. Measure the resistance to check the diode.

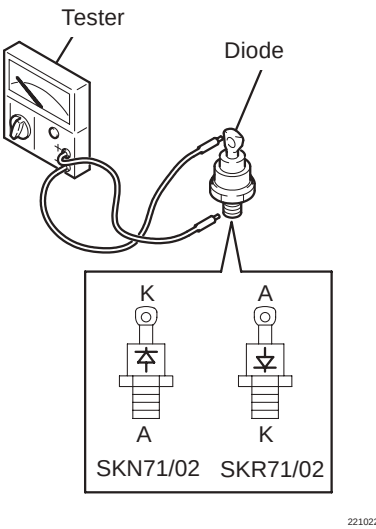
●Specific resistance value

Terminal [+] Positive		Terminal [-] Negative	Resistance Ω
Anode(A)	—	Cathode(K)	∞
Cathode(K)	—	Anode(A)	10 -100 k (Approx. 150KΩ)

NOTE

- **Resistance may vary slightly by the circuit tester.**

●Checking the diode



<Measuring procedure>

1. Set the tester to the resistance (Ω) x 1 range.
2. Apply the positive (+) and negative (-) proves to Anode(A) and Cathode(K) (or vice versa) to check the resistance.

10e- 3. Inspection After Assembly

⚠ CAUTION

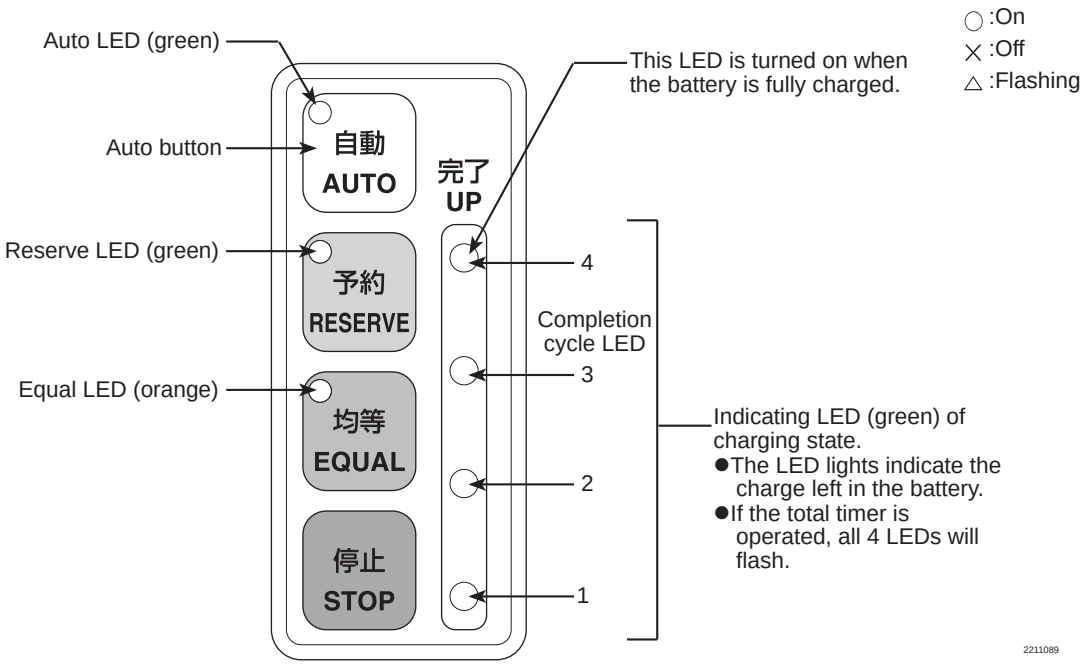
- **Check the continuity between the earth terminal in the receptacle and the chasis. (It must be conducted without resistance.)**
- **Carry out the inspection in well-ventilated area without fire.**

10e-3-1. Timer - inspection

IGBT and FET control

<Total timer>

Checking procedure			Magnetic contactor	Auto LED	Reserve LED	Equal LED	Indicating LED of charging state	
							1–2	3–4
1	Connect the battery plug.		OFF	×	×	×	×	×
2	Connect the AC plug to wall outlet.		OFF	○	○	○	×	×
3	Press and hold the Auto Button for at least 5 seconds.	When pressed	OFF	○	×	×	×	×
		5 seconds later	ON	△	×	×	△	△
4	The check will end approximately 1 minute and 36 seconds after flashing LED.		OFF	△	×	×	△	△



⚠ CAUTION

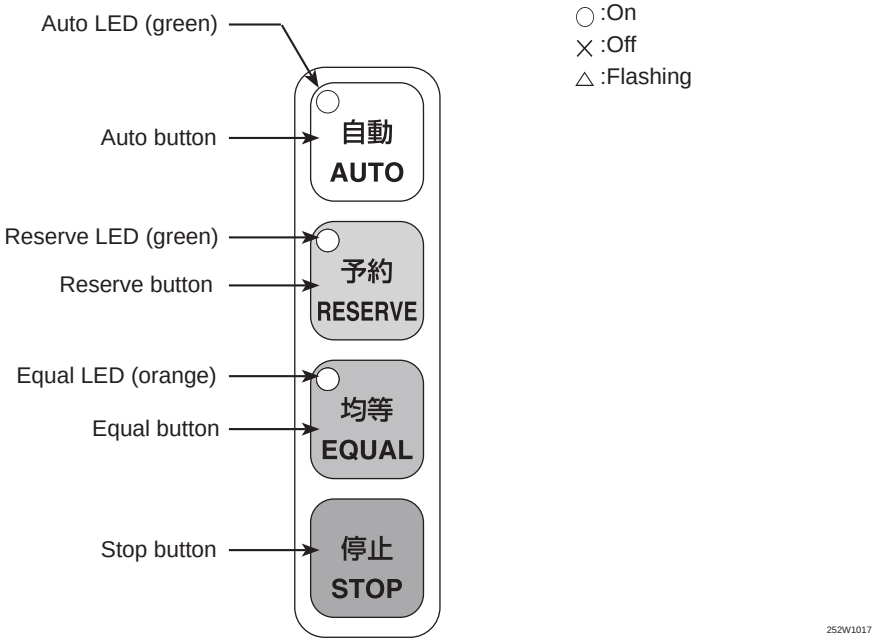
- **If the battery is just finished to charge, operate hydraulic function for 2 or 3 minutes to stabilize the battery voltage before starting to check the total timer.**
- **If you interrupt to charge the battery, push the "STOP" button before disconnecting the battery plug to prevent from sparking.**
- **For a fully charged battery, check after performing approximately 2-3 minutes of hydraulic operation.**
- **If the charging state LEDs are flashed, they will not turn off until the battery plug is unplugged.**

CAN-BUS control

<Checking of Total timer>

Checking procedure			Magnetic contactor	Auto LED	Reserve LED	Equal LED
1	Connect the battery plug.		OFF	×	×	×
2	Connect the AC plug to wall outlet.		OFF	○	○	○
3	Press and hold the Auto Button for at least 5 seconds.	When pressed	OFF	○	×	×
		5 seconds later	ON	△	×	×
4	The check will end approximately 1 minute and 36 seconds after Auto Button begins flashing.		OFF	△	△	△

○ :On
× :Off
△ :Flashing



CAUTION

- **If the battery is just finished to charge, operate hydraulic function for 2 or 3 minutes to stabilize the battery voltage before starting to check the total timer.**
- **If you interrupt to charge the battery, push the "STOP" button before disconnecting the battery plug to prevent from sparking.**
- **For a fully charged battery, check after performing approximately 2-3 minutes of hydraulic operation.**
- **If the charging state LEDs are flashed, they will not turn off until the battery plug is unplugged.**

10e-3-2. Earth - inspection

check the electric connection is done between the earth terminal and the body of the receptacle of the charger panel. (0Ω by ×1 range of the tester)

10e-3-3. Reserve function - inspection

- From " 月日指定 "(month & date), set the timer for 1 to 14 minutes later from the current time. Make sure that the battery charging starts correctly at the set time. (Refer to "10e-4-2. Reserve charge" on page 188 for more information.)

10e- 4. Charging procedure

⚠ WARNING **Do not touch any parts of charger and cable by wet hand.**

⚠ CAUTION

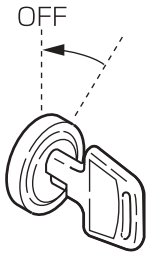
- **Do not disconnect the rectangular plug, AC plug and battery plug while charging.**
- **Push the "STOP" button when discontinue to charge.**
- **The charger operates with high voltage. Touch by wet hand may cause electrical shock.**
- **Do not operate any hydraulic valve levers or accelerator pedal while charging.**

10e-4-1. Automatic charge (Daily charge)

- This charge returns the battery to a full-charged condition after operating the forklift truck.

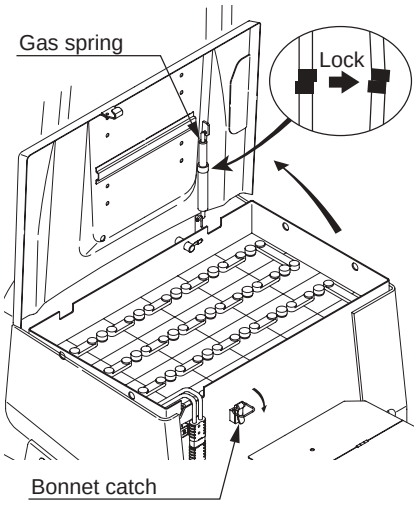
<How to open the battery cover>

1. Move the forklift truck to designated charging area.
2. Turn off the key switch and remove the key.
3. Release the bonnet catch and open the battery cover. Make sure that the battery cover is supported by the gas spring securely.



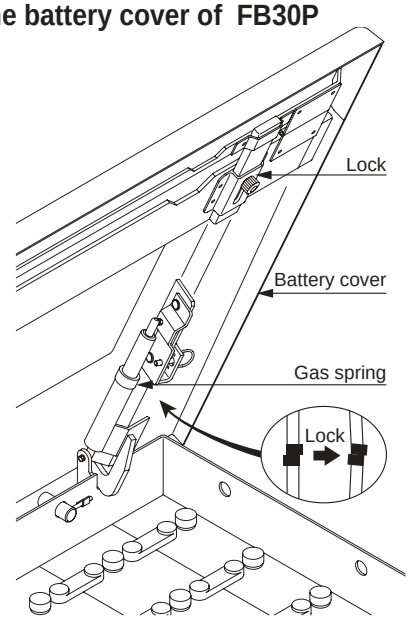
2210200

- **The battery cover of FB10P - 28P**



221W079E

- **The battery cover of FB30P**

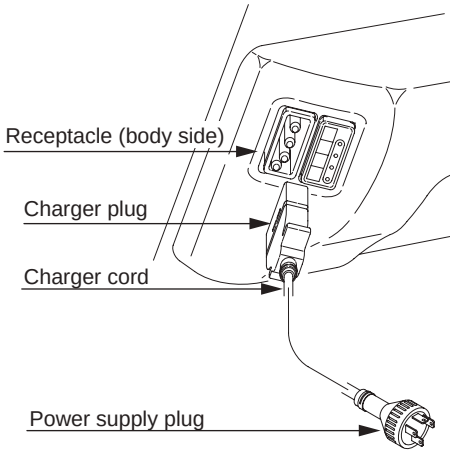


221W080E

⚠ CAUTION **Gas spring (assist damper with self locking) is used at the battery cover.**
Make sure the condition of locking.

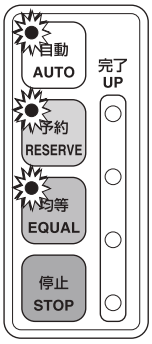
⚠ WARNING **Do not remove the lock of the point part of the battery cover when charging. (For FB30P.)**

4. Connect the rectangular plug of the AC cable to the receptacle on the charger panel.
5. Connect the AC plug to the wall outlet.



2210203E

Then, all "AUTO", "RESERVE" and "EQUAL" lamps are turned on.

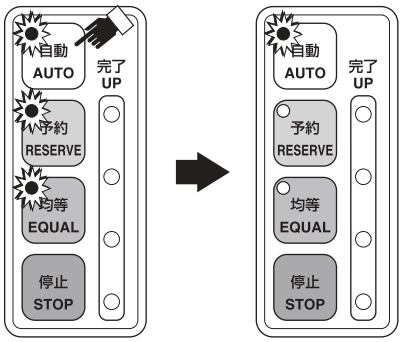


2210204

NOTE **If these lamps are not turned on, make sure the AC cable is connected correctly.**

5. Push "AUTO" button.
   The "AUTO" lamp (green) is lit. Both "RESERVE" and "EQUAL" lamps are turned off.

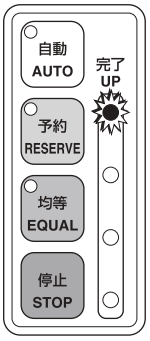
Automatic charge is started.



2210231

IGBT and FET control

6. When charge is completed, the top green lamp of charge status indicator is lit.



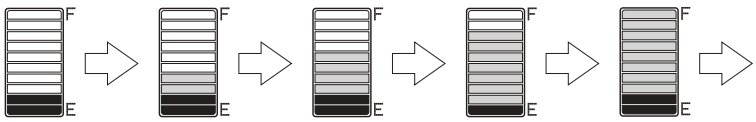
Charge is stopped automatically.

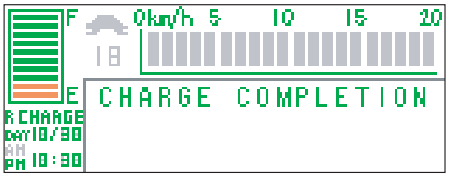
2210232

CAN-BUS control

7. When the charge is begun, the display power is turned on and the charging passage is shown in the indicator.

●Indication of charging passage





221W1012

When the charge is completed, "CHARGE COMPLETION" keeps being displayed.

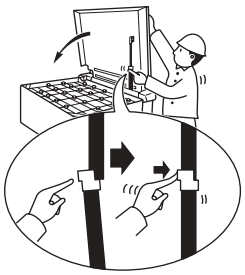
NOTE

- **When the charge is not completed even if 16 hours have passed since it began charging , the end is displayed as a charge error.**
- **If the charge plug is pulled out, the display is turned off.**

8. Disconnect the charger plug and AC plug.

9. Shut the battery cover while pushing a yellow part (resin) in the middle of the gas spring.

Closing battery cover



221W082E

CAUTION

Do not place the finger when pushing a yellow part.
Do not place the finger when closing the battery cover.

10. Fix the bonnet catch surely after shutting the battery cover.

DANGER

Do not touch any parts of charger and cable by wet hand.

⚠ CAUTION

- **Do not disconnect the rectangular plug, AC plug and battery plug while charging.**
- **Push the "STOP" button when discontinue to charge.**
- **The charger operates with high voltage. Touch by wet hand may cause electrical shock.**
- **Do not operate any hydraulic valve levers or accelerator pedal while charging.**

CAN-BUS control

⚠ CAUTION

- **The display is turned off when blacking out while charging.**
  When the power returns within one hour after it blacks out and the power is supplied , the charge is restarted and the charging passage is displayed.
  The charge is not restarted when one hour or more has passed since it blacked out and the charge passage is not displayed.
- **44 hours pass with the charge plug connected after the charge ends, and when outside temperature is less than five degrees, re-charging is done only once.**
  In this case, the charging passage is displayed.

10e-4-2. Reserve charge

●This function is the timer to start charging of the battery. If you want to start charging after a while, or a few days later, for example, this is very convenient function. This function can charge the battery as the "AUTO" mode only.

<Setting of the starting time>

CAUTION

●If any operation of traveling or hydraulics are done while setting the timer, the setting screen is returned to the normal screen immediately.

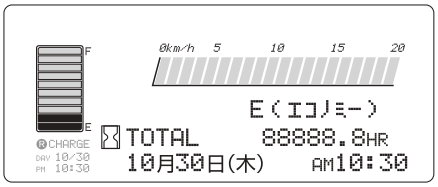
●This setting cannot be activated while traveling and depressing the brake pedal.

1. Move the forklift truck to appropriate area and park.

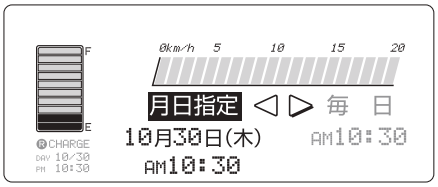
2. Push the "Ⓡ" button of the mode select switch to get the " 充電開始指定 " (reserve charge setting) screen.
   (If pushing "MODE" button, the screen returns to the normal.)
   The " 充電開始指定 " (reserve charge setting) screen appears when the AC cable is connected to the charger panel also.

3. Push "−" or "+" button to select " 月日指定 " (month & date) or " 毎日 " (daily).

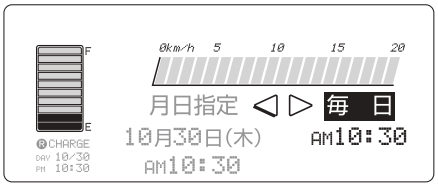
Normal screen



Push Ⓡ button → Push MODE button



Select by pushing ◁ or ▷.



121T319E

NOTE

When selecting " 月日指定 " (month & date)
The reserved time is revised automatically to the same time of seven (7) days later after expiring it.
It is convenient to charge the battery every weekend.

When selecting " 毎日 " (daily)
The reserved time is revised automatically to the same time of the next day after expiring.
It is convenient to charge the battery everyday.

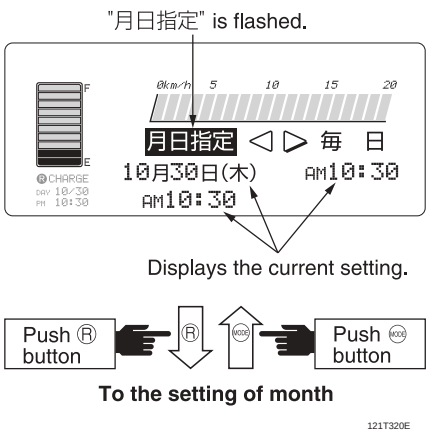
CAUTION

The displayed time is the starting time of charge. It is not the finishing time of charge.

<In case of setting of " 月日 " (month & date)>

●Select " 月日指定 " (month & date) by pushing "⊖" or "⊕".
Screen displays the current setting. (or no date is displayed if not set before.)
Push "Ⓡ" button to move the cursor to the month.
Push "MODE" button to get the normal screen.

"月日指定" (month & date) screen

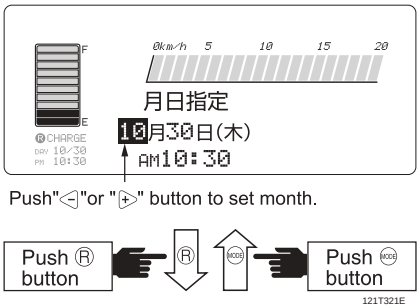


NOTE

When setting the mode of next 1 to 5, each button works as below.
- **" ⊖ " and " ⊕ " buttons : Move the cursor to select the value.**
- **" Ⓡ " button : Move the cursor to the next item.**
- **" MODE " button : Back the cursor to the previous item.**

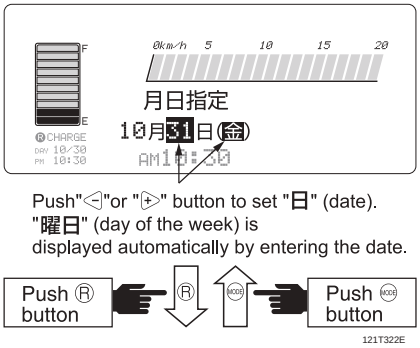
1. **Set the month**

Push "⊖" or "⊕" button to set the month.
After setting of the month, push "Ⓡ" button to select the " 日 " (date).
If pushing "MODE" button, the cursor is returns to the "月日指定 " (month & date) or " 毎日 " (daily) area.



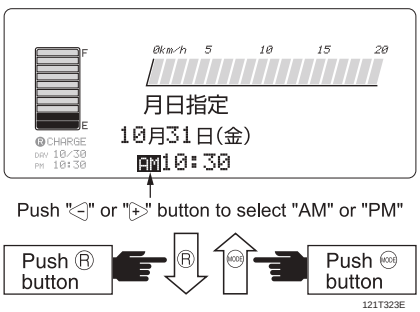
2. **Set the date**

Push "⊖" or "⊕" to select the date. The " 曜日 " (day of the week) is displayed automatically by setting the date.
After setting the date, push "Ⓡ" button to move the cursor to the time (AM or PM).
If pushing "MODE" button, the cursor is returned to the month area.



3. **Set the AM or PM**

Push "⊖" or "⊕" to select "AM" or "PM".
After setting, push "Ⓡ" button to move the cursor to the hour.
If pushing "MODE" button, the cursor is returned to the date area.



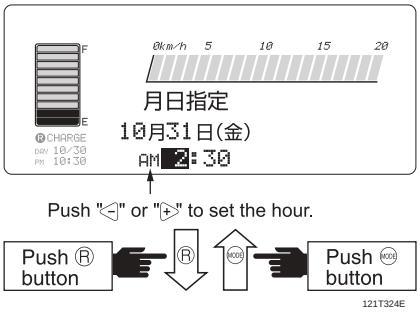
4. **Set the hour**

Push "⊖" or "⊕" to change the hour. Hour can be selected from 1 through 12.

After setting the hour, push "Ⓡ" button to move the cursor to the minute.

If pushing "MODE" button, the cursor is returned to the AM or PM area.

Continued from previous page.

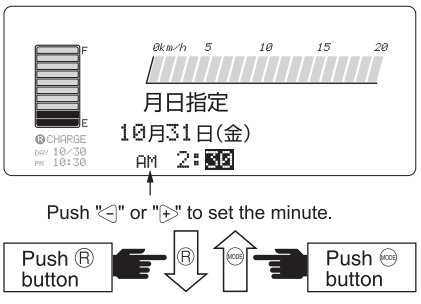


5. **Set the minute**

Push "⊖" or "⊕" to set the minute. The minute can be set to "00", "15", "30" or "45".

After setting, push "Ⓡ" button. Then, "COMPLETE" sign is flashed three times and the display returns to the normal screen.

If pushing "MODE" button, the cursor is returned to the hour area.



⚠ CAUTION

Make sure that the reserved date and time which are displayed at the left lower corner of the screen is correct.

⚠ CAUTION

- **The past date and time cannot be set.**

Example	
Current time	2000年10月30日 PM10:30
⬇	
Input date and time	10月30日 PM10:00
⬇	
Reserved setting	2001年10月30日 PM10:00

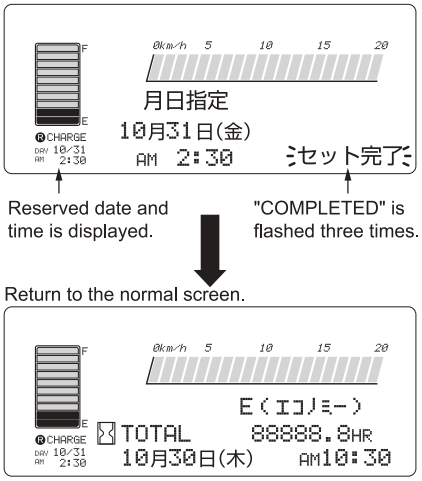
If input the past date and time, it is memorized as the same date and time of the next year.

* If the reserved date and time is become past by setting the current date and time, the same situation is occurred.

- **The reservation is invalid if all required data are not entered.**

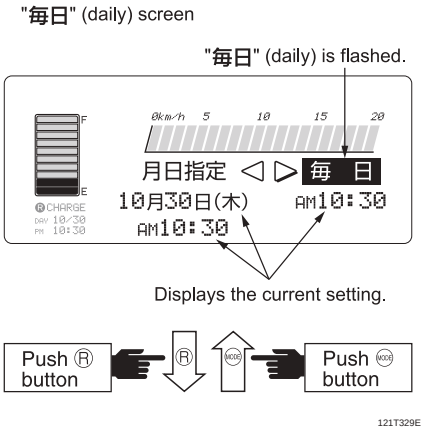
Example : Input data 10月 "blank" 日 PM10:00 → invalid

If any data is not entered (blanked) and move to the next step, all data in that screen will be invalid and deleted.



<In case of setting of "毎日 " (daily)>

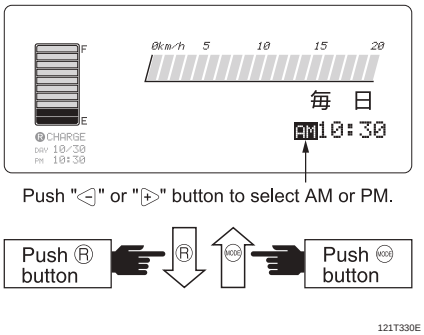
●Push "◁" or "▷" to select " 毎日 " (daily). The screen displays the current setting. If not set before, no data are displayed.
Push " Ⓡ " button to move the cursor to the month.
Push " MODE " button to get the normal screen.



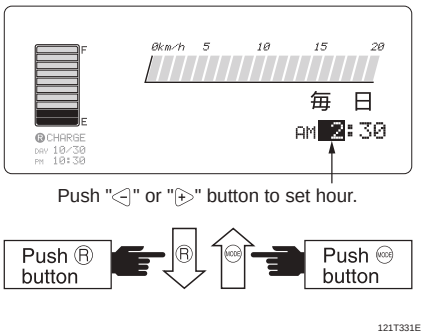
NOTE

When setting the mode of next 1 to 3, each button works as below.
- **" ◁ " and " ▷ " buttons : Move the cursor to select the value.**
- **" Ⓡ " button : Move the cursor to the next item.**
- **" MODE " button : Back the cursor to the previous item.**

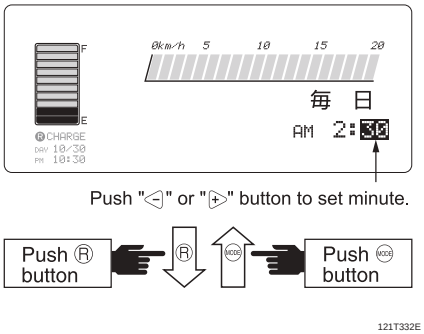
1. **Set the AM or PM**
Push " ◁ " or " ▷ " to select "AM" or PM".
After selecting, push " Ⓡ " button to move the cursor to the hour.
If pushing " MODE " button, the cursor is returned to the " 月日指定 " (month & date) or " 毎日 " (daily) area



2. **Set the hour**
Push " ◁ " or " ▷ " set the hour. The hour can be set from 1 through 12.
After setting, push " Ⓡ " button to move the cursor to the minute.
If pushing " MODE " button, the cursor is returned to the AM or PM area.



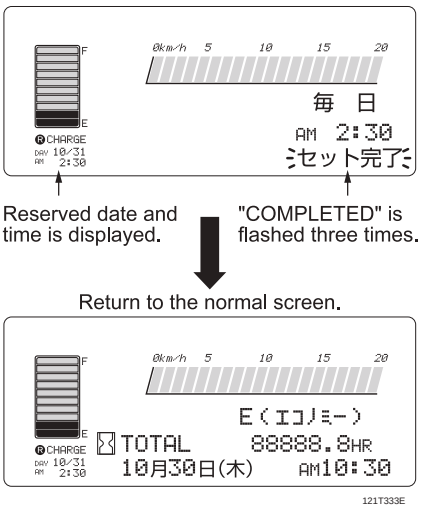
3. **Set the minute**
Push " ◁ " or " ▷ " to set the minute. The minute can be set to "00", "15", "30" or "45".
After setting the minute, push " Ⓡ " button. Then, "COMPLETE" sign is flashed three times and the display returns to the normal screen.
If pushing " MODE " button, the cursor is returned to the hour area.



After setting, push " (R) " button. Then, "COMPLETE" sign is flashed three times and the display returns to the normal screen.

If pushing " (MODE) " button, the cursor is returned to the hour area.

Continued from previous page.



CAUTION

Make sure that the reserved date and time which are displayed at the left lower corner of the screen is correct.

CAUTION

●The past time cannot be set.

Example

Current time	2000年10月30日 PM10:30
⬇	
Input date and time	PM10:00
⬇	
Reserved setting	2000年10月31日 PM10:00

If input the past time, it is memorized as the same time of the next day.

* If the reserved time is become past by setting the current date and time, the same situation is occurred.

●The reservation is invalid if all required data are not entered.

Example : Input data PM "blank" :00 → invalid

If any data is not entered (blanked) and move to the next step, all data in that screen will be invalid and deleted.

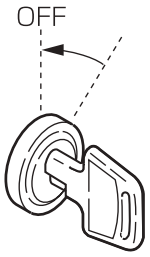
NOTE

After the completion of the reserve setting, its data is renewed automatically after the past of its time.

In case of "毎日" (daily), it is renewed to the same time of the next day.

In case of "月日指定" (month & date), it is renewed to the same time of seven (7) days later.

<Reserve charge>



2210200

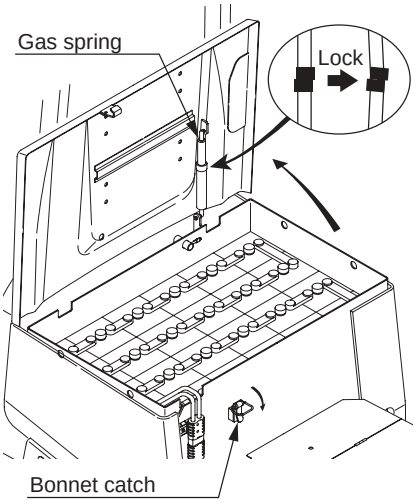
- This mode starts to charge the battery by the preset date and time.

1. Move the forklift truck to designated charging area.
2. Turn off the key switch and remove the key.

<How to open the battery cover>

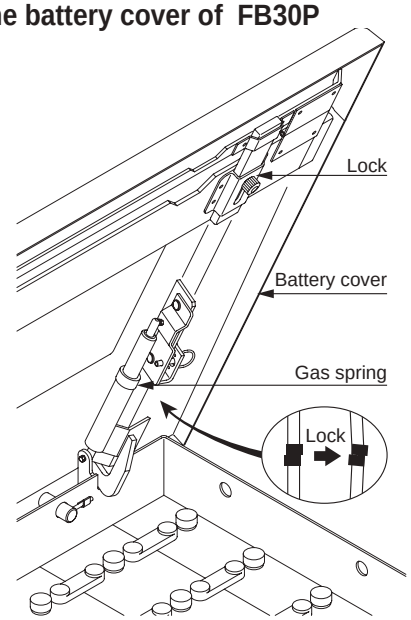
Release the bonnet catch and open the battery cover.

●The battery cover of FB10P - 28P



221W079E

●The battery cover of FB30P



221W080E

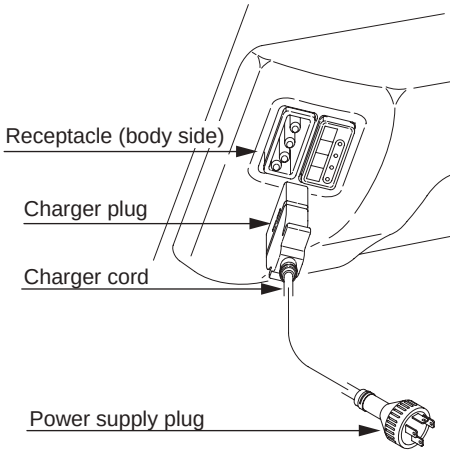
⚠ CAUTION

Gas spring (assist damper with self locking) is used at the battery cover.
Make sure the condition of locking.

⚠ WARNING

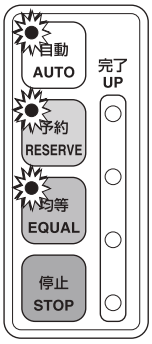
Do not remove the lock of the point part of the battery cover when charging. (For FB30P.)

4. Connect the rectangular plug of the AC cable to the receptacle on the charger panel.
5. Connect the AC plug to wall outlet.



2210203E

Then, all "AUTO", "RESERVE" and "EQUAL" lamps are turned on.

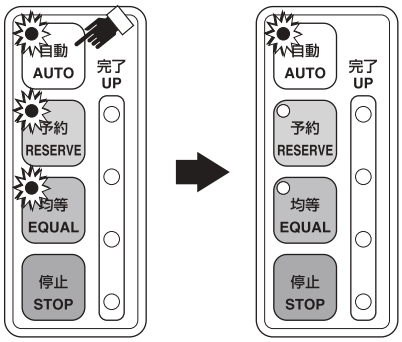


2210204

NOTE **If these lamps are not turned on, make sure the AC cable is connected correctly.**

5. Push "AUTO" button.
   The "AUTO" lamp (green) is lit. Both "RESERVE" and "EQUAL" lamps are turned off.

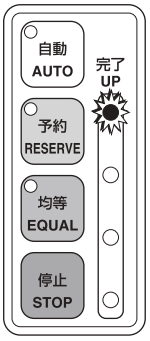
Automatic charge is started.



2210231

IGBT and FET control

6. When charge is completed, the top green lamp of charge status indicator is lit.



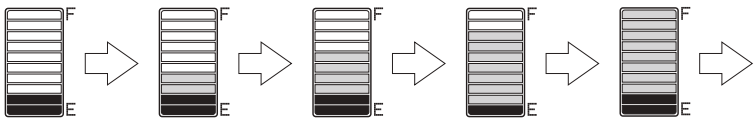
2210232

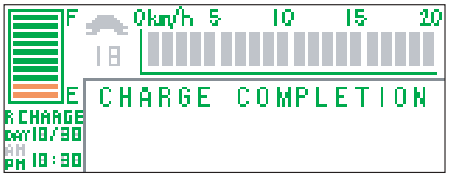
Charge is stopped automatically.

CAN-BUS control

7. When the charge is begun, the display power is turned on and the charging passage is shown in the indicator.

●Indication of charging passage





221W1012

When the charge is completed, "CHARGE COMPLETION" keeps being displayed.

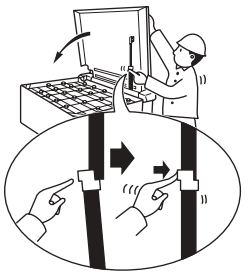
NOTE

- **When the charge is not completed even if 16 hours have passed since it began charging , the end is displayed as a charge error.**
- **If the charge plug is pulled out, the display is turned off.**

8. Disconnect the charger plug and AC plug.

9. Shut the battery cover while pushing a yellow part (resin) in the middle of the gas spring.

Closing battery cover



221W082E

CAUTION

Do not place the finger when pushing a yellow part.
Do not place the finger when closing the battery cover.

10. Fix the bonnet catch surely after shutting the battery cover.

DANGER

Do not touch any parts of charger and cable by wet hand.

⚠ CAUTION

- **Do not disconnect the rectangular plug, AC plug and battery plug while charging.**
- **Push the "STOP" button when discontinue to charge.**
- **The charger operates with high voltage. Touch by wet hand may cause electrical shock.**
- **Do not operate any hydraulic valve levers or accelerator pedal while charging.**

CAN-BUS control

⚠ CAUTION

- **The display is turned off when blacking out while charging.**
  When the power returns within one hour after it blacks out and the power is supplied , the charge is restarted and the charging passage is displayed.
  The charge is not restarted when one hour or more has passed since it blacked out and the charge passage is not displayed.
- **44 hours pass with the charge plug connected after the charge ends, and when outside temperature is less than five degrees, re-charging is done only once.**
  In this case, the charging passage is displayed.

10e-4-3. Balancing charge

- Specific gravity of electrolyte in each cell becomes unbalance after a certain time of charge. In this case, charge the battery for a little bit longer than a normal charge in order to equalize all cells.

<Automatic balancing charge>

In the case of the built-in charger, the controller selects the "EQUAL" mode automatically once of ten charges even pushing the "AUTO" button.

<Manual balancing charge>

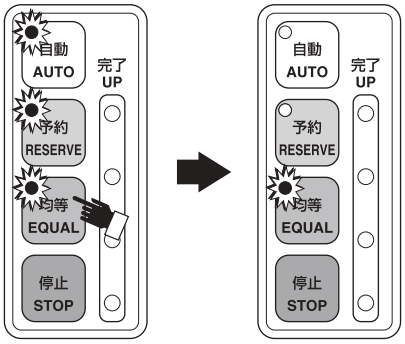
Balancing charge is required for the following cases.

- Every two weeks when the lift truck is operated every day.
- Not charged for a couple of days after discharged.
- Over-discharged.

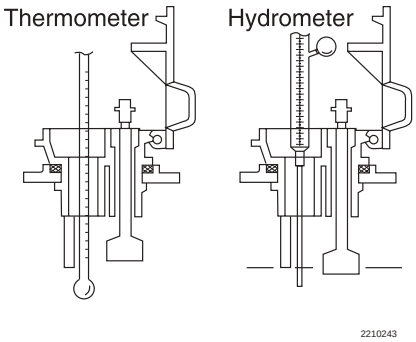
<Charging procedure>

1. Push the "EQUAL" button as the same way as with a normal charge.
   "EQUAL" lamp (orange) will turn on.

To start the Balancing charge.



2. Measure specific gravity of all cells after completion of charge.
   (See "Reading hydrometer" for specific gravity measurement.)



NOTE

When the specific gravity is 1.26-1.28 at 20°C, the battery is fully charged.

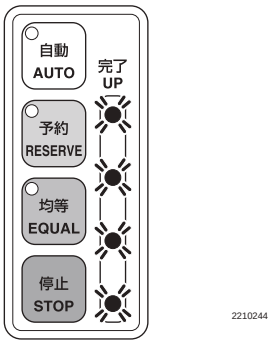
NOTE

- **If the battery plug is disconnected, the memory of time of charging is cleared in the controller and the automatic balancing charge function is not activated properly. In this case, the manual balancing charge is recommended.**
- **If the forklift truck is not used for a long time after completion of charge, the supplement charge function is activated automatically. Then, the "AUTO" lamp is flashed.**

IGBT and FET control

NOTE

If all four (4) lamps of the charging status indicator are flashed, the overtime error is detected.
Check if the volt-age tap selection of the transformer is set to the correct voltage.
If any abnormalities are found, call your local Nichiyu service dealer for inspection or repair.
The error status can be reset by disconnecting the battery plug.



All four (4) lamps of the charging status indicator are flashed

10e- 5. Voltage tap

10e-5-1. Power supply voltage - check

NOTE

- **Measure the power supply voltage at the charging section without running the charger.**
- **Measure the voltage for 1 minute. The highest voltage obtained is the power voltage.**
- **If three-phase input power is used, the average of the highest voltages of each phase (U-V, U-W, and V-W) is the power supply voltage.**

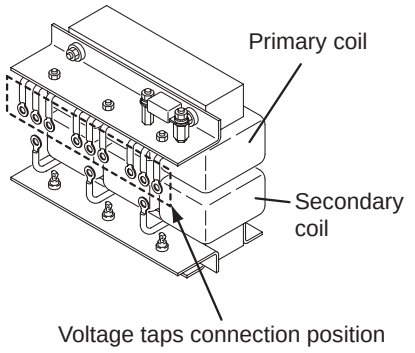
CAUTION

- **The measurement should be made when the peripheral facilities are not used, such as during the lunch time or at night.**

10e-5-2. Voltage tap - selection

●Select a tap to match with the power supply voltage at the charging place.

●Location of the voltage tap

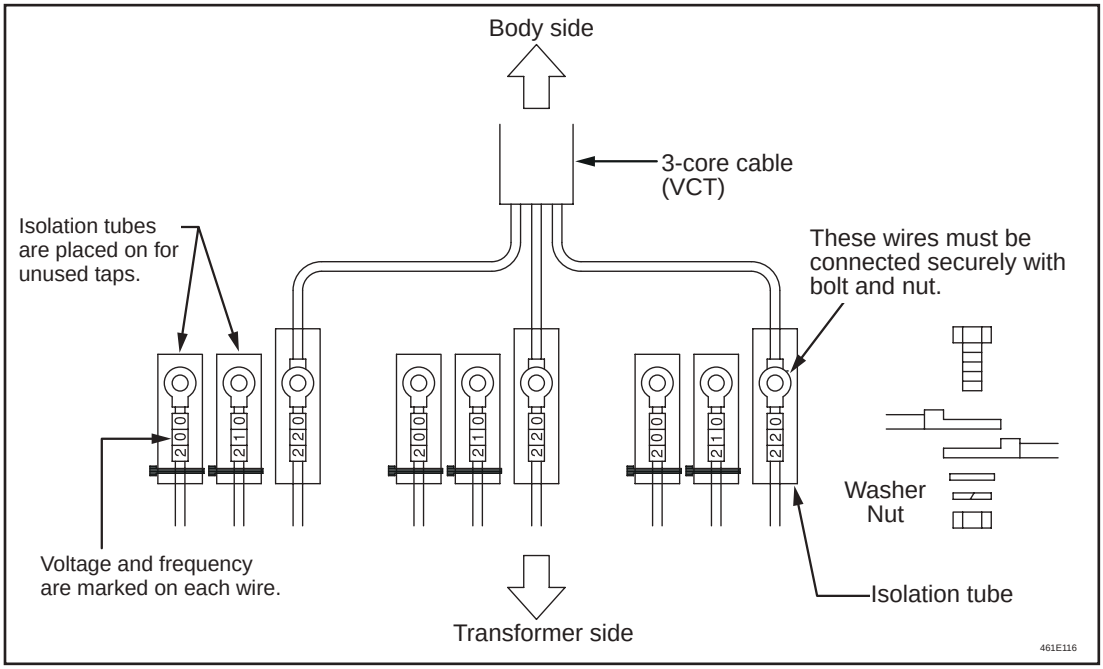


<Input voltage: 200V>

Power voltage (V)	Voltage tap
199 or lower	200V
200 - 209	210V
210 - 219	220V

<Input voltage: 400V>

Power voltage (V)	Voltage tap
379 or lower	380V
380 - 399	400V
400 - 419	420V
420 - 439	440V



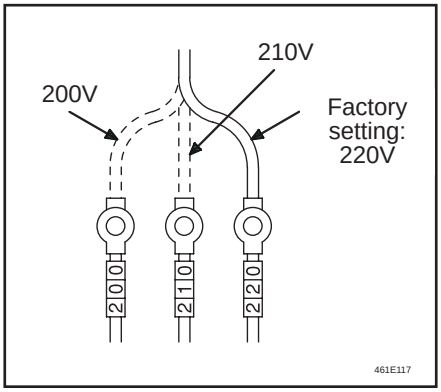
10e-5-3. Voltage tap - changing

⚠ CAUTION

- **Turn off the key switch and disconnect the power supply plug and the battery plug before proceeding the work.**
- **Securely tighten the screw for the ring terminal to prevent from loosening.**

1. Loosen the screw and remove the ring terminal.
2. Reconnect it to the tap fitting to the power supply voltage and secure the ring terminal together with bolts and nuts.
3. Put the isolation tube over the connected part and fix it with a wire tie.

●Factory default setting: 220 Volts

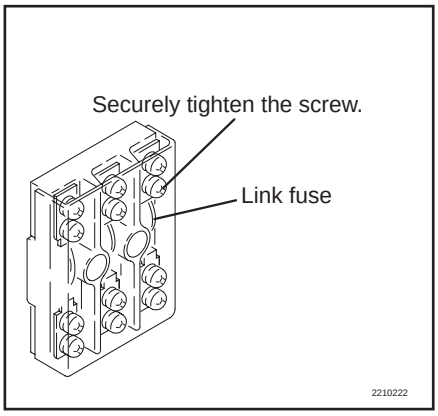


10e-5-4. Fuse (three-phase voltage) - replacement

⚠ CAUTION

- **Disconnect the AC plug of the power supply cable.**
- **Tighten all screws after replacement of fuses.**

1. Loosen the screw to replace the link fuse.



Applicable model	Battery capacity	Power supply voltage
		3 ϕ 200V
FB10P/14P	330Ah(Std)	15A
	480-485Ah(Opt)	20A
	545Ah(Opt)	20A
FB15P/18P	400Ah(Std)/ 485Ah(Opt)	20A
	545Ah(Opt)	20A
FB20P	485Ah(Std)/545-600Ah(Opt)	20A
	650-730Ah(Opt)	20A
FB25P/28P	565Ah(Std)/ 600Ah(Std)	20A
	650-730Ah(Opt)	30A
FB30P	450Ah(Std)/485-600Ah(Opt)	30A

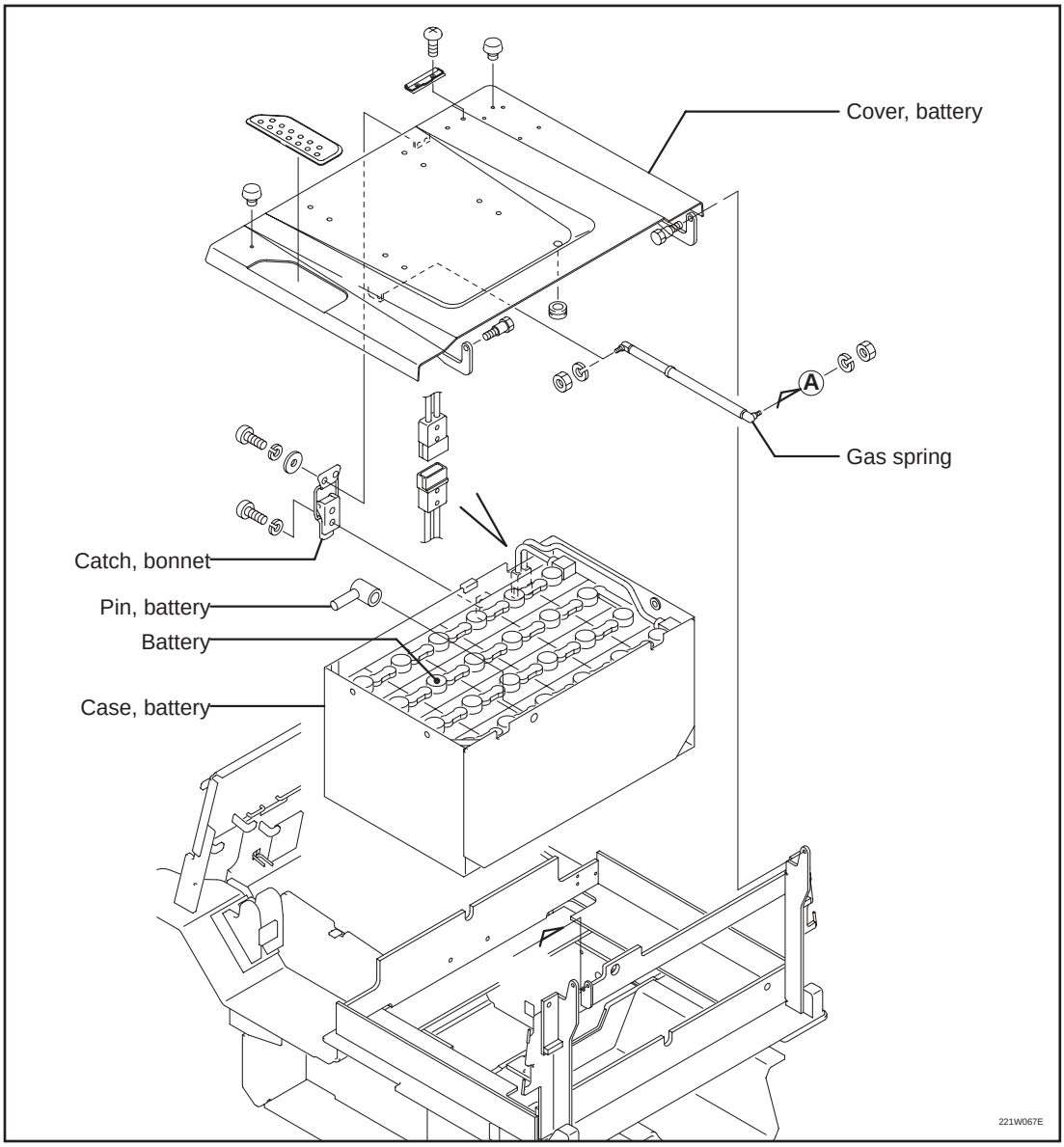
10f. BATTERY

10f-1. Disassembly and reassembly

WARNING

- **Turn off the key switch and disconnect the battery plug.**
- **Apply wheel chocks to tyres to prevent the truck from moving.**
- **Be careful not to touch electrolyte to the body.**
- **If the electrolyte is splashed into eye, wash eye with clean water, and consult a doctor immediately.**
- **The inspecting battery shall be done in a place where is well ventilated and kept away from fire.**
- **Battery is very heavy.**
  Use proper slings or ropes to hang the battery with the hoist to remove or install.

10f-1-1. Battery - removal and installation



10f-2. Inspection and adjustment

10f-2-1. Battery - inspection

▸1 Inspection of quantity of electrolyte and replenishment

<Checking electrolyte level>

1. Disconnect the battery plug.
2. Open the battery cover and set the stopper.

⚠ CAUTION

Since a gas spring (an assistant damper with self-lock function) is used, the locking state should be checked.

3. Check electrolyte level.

<Specification>

- If the red float can seen, electrolyte level is normal. If not, add refined or distilled water to the approproate level.

⚠ CAUTION

Do not add any sulfuric acid in the battery cell. The electrolyte is the dilute sulfuric acid, however, only distilled or refind water can be used to add.

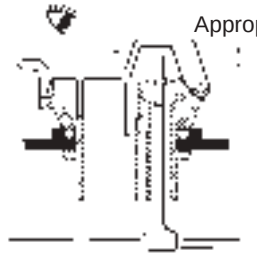
<Adding refined water>

1. Open the cap of the battery cell.
2. Add the distilled or refined water until the top of the red float is touched to the plate of the cap.

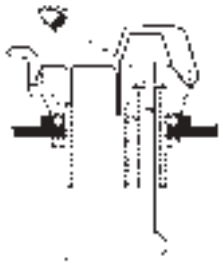
NOTE

The illustration shows the Japanese standard battery and the actual battery on the truck may have the different structure.
Refer the instruction from the battery supplier for details.

●Inspection of electrolyte level



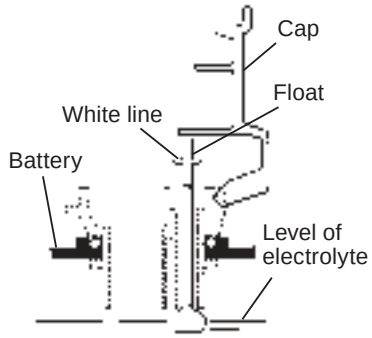
Proper level of electrolyte



Lowest level of electrolyte

Add refined water to the appropriate level.

●Adding water

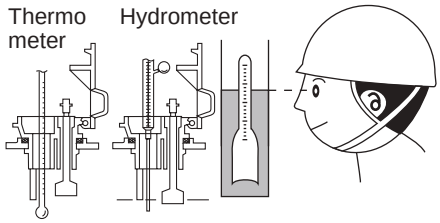


▸ 2 Measurement of specific gravity of electrolyte in each cell

<How to use the hydrometer>

1. Open the cap of the battery cell.
2. Insert the tube of the hydrometer into the cell and suck the electrolyte.
3. Read the scale at the surface of the sucked electrolyte.
4. Read the specific gravity of all cells in turn.
   The difference of the specific gravity of cells should be less than 0.05.
5. If the difference is more than 0.05, carry out the equalizing charge to the battery.
6. After finishing the equalizing charge, check and compare the specific gravity of each cell.
   If the difference is still more than 0.05, consult the battery supplier for inspection.

●MEASUREMENT OF SPECIFIC GRAVITY



<How to convert the specific gravity to the standard value at 20 ℃>

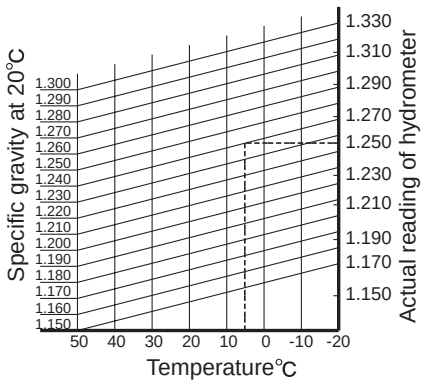
NOTE **The specific gravity should be converted to the value at 20 ℃ when judging the battery condition.**

1. Measure temperature of electrolyte.

CAUTION **●Use thermometer to measure**

2. Measure specific gravity of electrolyte.
3. Measured specific gravity shall be converted to the value at 20 ℃
   [Conversion formula]
   S20=St+0.0007(t-20)
   S20 : Specific gravity converted to 20℃.
   St : Measured specific gravity.
   t : Temperature of electrolyte.

●CONVERSION



10f-2-2. Battery - Cleaning

▸ 1 Cells, connectors and terminals

1. Keep dry. When they get wet, clean with a dry cloth or blow out with compressed air.
2. If they are rusted, clean with a wire brush or a sand paper.

▸ 2 Cleaning vent plug

1. Turn the vent plug counter-clockwise to remove.
2. Clean it with a neutral detergent.
3. Securely fasten the vent plug on the cell after cleaning.

NOTE **If the vent plug is damaged, replace the plug comp. with new one.**

10g. MPU BOARD

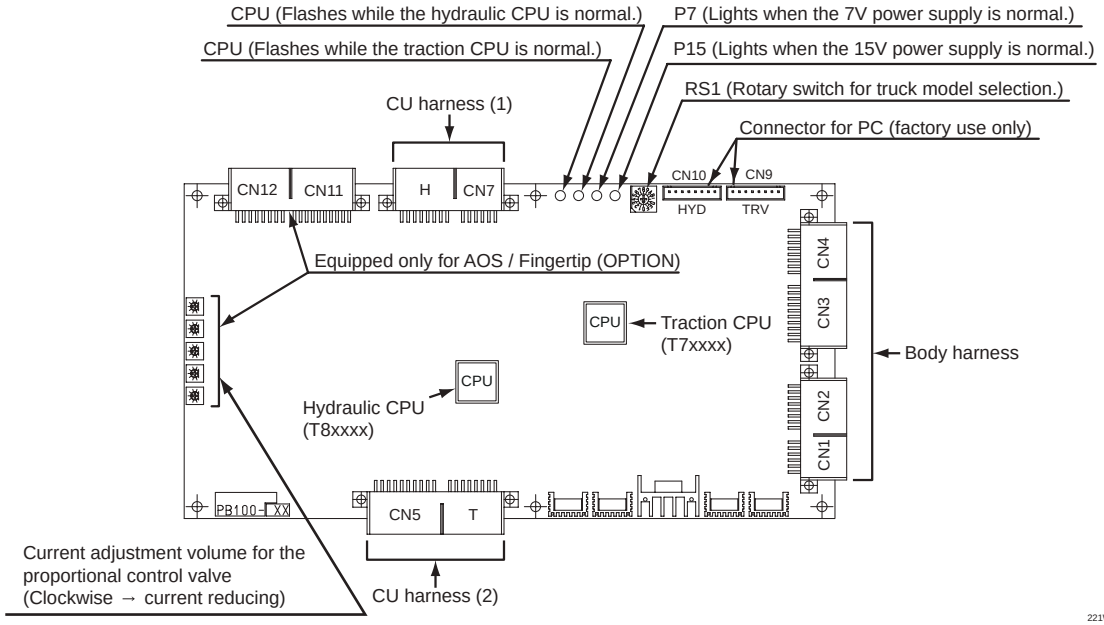
10g- 1. Location and name

10g-1-1. MPU board

●This board controls the traction motor and the hydraulic motor.

IGBT and FET control

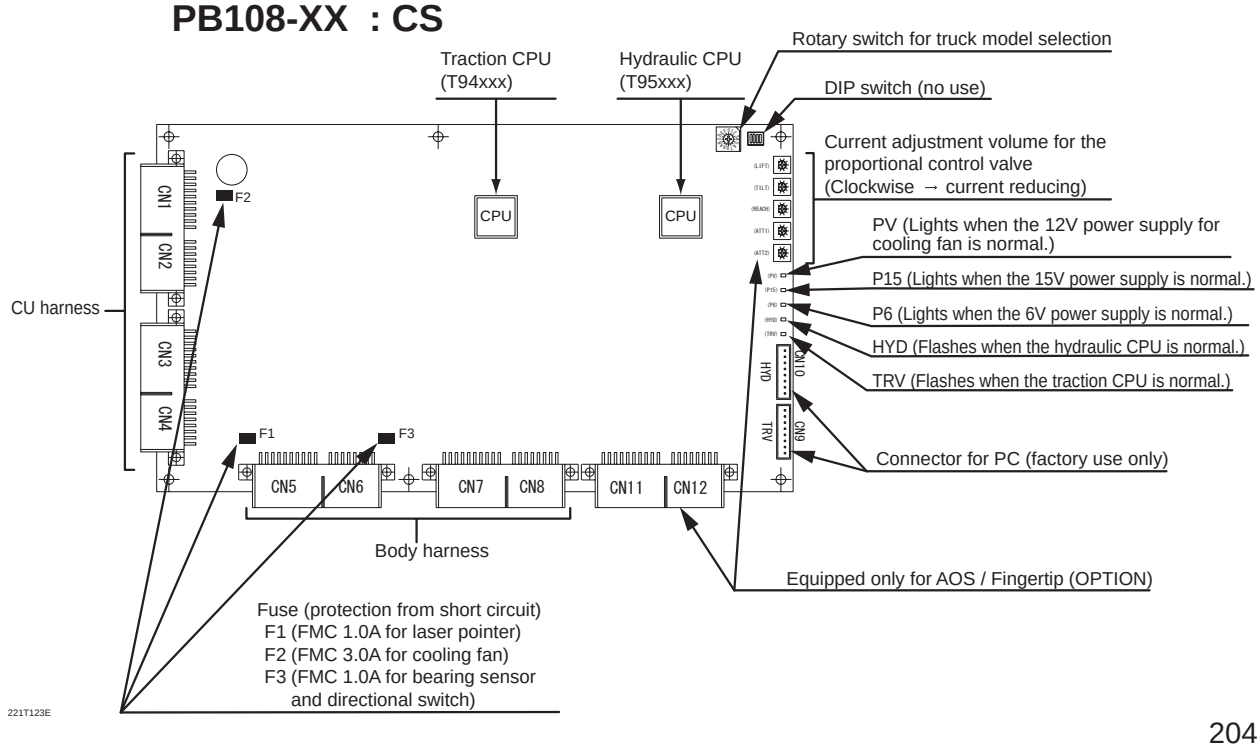
Type : PB104-XX : IGBT control
PB108-XX : FET control



221W119E

CAN-BUS control

Type : PB107-XX : STD
PB108-XX : CS



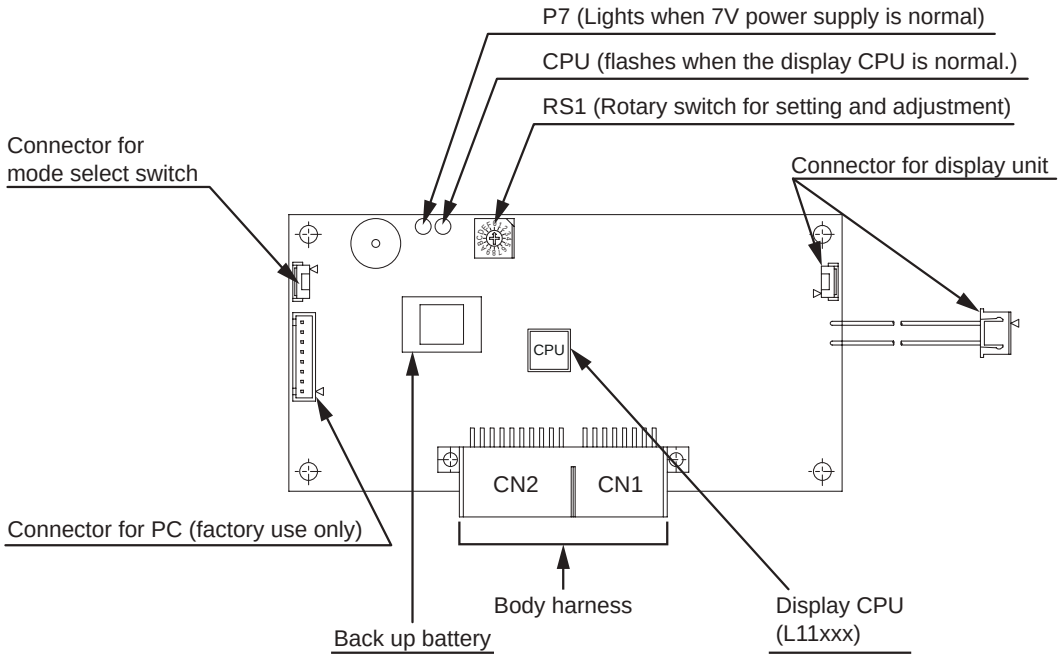
221T123E

10g-1-2. Display board

IGBT and FET control

Type : PB106-XX : Stationary charger
PB103-XX : Built-in charger

- This board controls both the data exchanged between the other boards and the display.

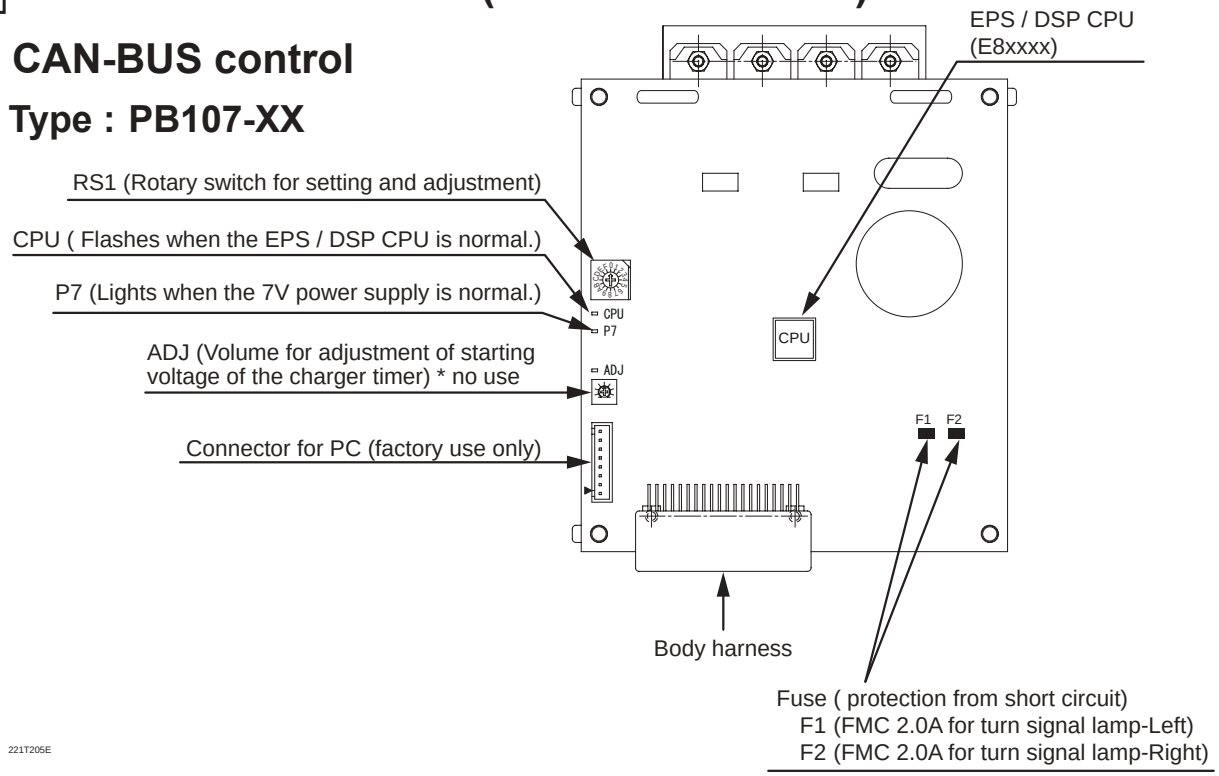


121T243E

10g-1-3. EPS controller board (EPS / DSP board)

CAN-BUS control

Type : PB107-XX



221T205E

⚠ CAUTION

Even when the key is turned off, voltage from the battery is still sent to the display board or EPS controller (EPS / DSP board). Disconnect the battery plug before performing this work.

11. LASER POINTER (OPTION)

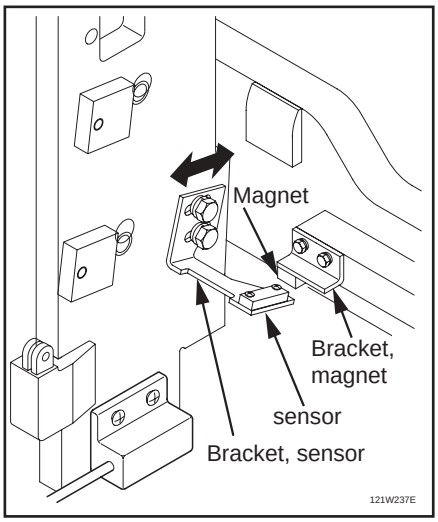
11-1. Adjustment

11-1-1. Fork level - adjustment

1. Raise forks to a height for easy work, and level them.
2. Adjust the positions of the leveling sensor and the magnet to light on the laser beam.

➡When the laser beam light on, the fork leveling indicator is shown on the display.

Adjustment position	Within ± 1.0 degree of the fork leveling position

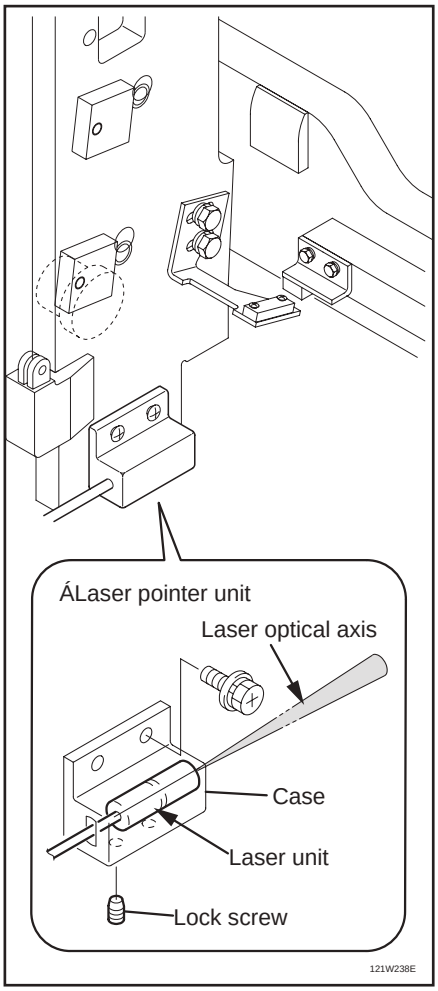


<If the forks are not level>

Either loosen the fixing bolts of the sensor bracket to reposition it, or slightly adjust the magnet so that it is in the center of the sensor sensing element when the forks are level.

11-1-2. Laser optical axis - adjustment

1. Park the forklift truck face to the pallet.
   Distance between the pallet and the tip of the fork should be about 30 to 50 mm.
2. Level the fork horizontally.
3. Turn on the laser pointer.
   Raise the fork to fit to the opening of the pallet.
4. Adjust the angle and height of the laser beam to show the correct position on the side of the pallet.
   If the "LINE" type is used, the laser line should hit the center of the beam of the pallet.
   If the "Dot" type is used, the laser point should hit the upper board of the pallet..
5. Adjust the axis of the laser light by turning the "Screw, set" on the side of the laser unit.
6. Make sure if the fork can be inserted into the pallet normally after indicating the position by the laser pointer.



12. SERVICE DATA

12- 1. Annual Inspection Service Data

Models	No.11 Overcurrent limiter		No.34 Steering wheel		No.71 (Standard load)		No.73 Control valve	
	For travel (A) Current limitation	For hydraulic (A) Relief	Right turn radius (mm)	Left turn radius (mm)	Drift of lift lowering (mm/10min) Top surface of the fork	Drift of lift (mm/5min) Tilt cylinder	Lift relief (MPa)	Tilt relief (MPa)
FB10P	400-500	210-290	1710	←	25-40	5-10	13.7	←
FB14P	400-500	210-290	1710	←	35-50	5-10	13.7	←
FB15P	400-500	210-290	1710	←	35-50	5-10	13.7	←
FB18P	400-500	250-330	1725	←	35-50	5-10	15.7	←
FB20P	400-500	250-330	1950	←	35-50	5-10	15.7	←
FB25P	400-500	250-330	2005	←	50-65	5-10	17.2	←
FB28P	400-500	250-330	2060	←	50-65	5-10	15.7	←
FB30P	400-500	250-330	2240	←	50-65	5-10	17.2	←
FB10P-U	400-500	250-330	1710	←	25-40	5-10	13.7	←
FB14P-U	400-500	250-330	1710	←	25-40	5-10	13.7	←
FB15P-U	400-500	250-330	1710	←	25-40	5-10	13.7	←
FB18P-U	400-500	310-390	1725	←	25-40	5-10	15.7	←
FB20P-U	400-500	310-390	2005	←	50-65	5-10	15.7	←
FB25P-U	400-500	310-390	2060	←	50-65	5-10	17.2	←

12- 2. Standard work hours

<Confirmation procedure>

1. If some different works are required to carry out at the same time, add all working time.
   For example, if you need to remove the cover to replace a part, add both hours for replacing the part and removing the cover.
2. Standard work hour for maintenance represents the inspection (lubricant, charge) job only.

3. For adjustment, replacement/removal/installation (R/R/I), etc, see the respective group pages.

4. Unit of work hours
   "The work hours are based on decimal system."
   "For example, 0.5=30 minutes, 1.0=1 hour"

5. Combined jobs
   For combined jobs, select necessary job items and sum them up.

6. Cost of transportation, sub contractor work, and/or service car charges are not included in the standard work hours.
   Those charge must be charged or claimed separately.

NOTE **R/R/I : Replacement / Removal / Installation**

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
Maintenance	Replace	Drive axle gear oil	0.4	0.4	0.4
		Hydraulic oil	0.4	0.4	0.4
	R/R/I	Lubrication	0.3	0.3	0.3
		Battery electrolyte	0.3	0.3	0.3
Frame	R/R/I	Gas spring	0.3	0.3	0.3
		Floor plate	0.1	0.1	0.1
		Step (L)	0.1	0.1	0.1
		Step (R)	0.1	0.1	0.1
		Cover, battery (with spring)	0.4	0.4	0.4
		Seat	0.2	0.2	0.2
		Battery	0.3	0.3	0.3
		Rear cover	0.1	0.1	0.1
		Battery cover (L)	0.1	0.1	0.1
		Battey cover (R)	0.1	0.1	0.1
		Side cover (L)	0.1	0.1	0.1
		Side cover (R)	0.1	0.1	0.1
Front hood	R/R/I	Front cover (1)	0.2	0.2	0.2
		Front cover (2)	0.1	0.1	0.1
		Front cover (3)	0.1	0.1	0.1
		Front cover (4)	0.1	0.1	0.1
		Front cover (5)	0.1	0.1	0.1
		Front cover (6)	-	0.1	0.1
		Front cover (7)	0.1	0.1	0.1
Counter weight	R/R/I	Control unit	0.5	0.5	0.5
		Counter weight (with Control unit)	0.5	0.5	0.5
	Monthly inspection	Retightening all fitting bolts	0.2	0.2	0.2
Seat	R/R/I	Seat ass'y	0.2	0.2	0.2
	Monthly inspection	Seat damage and Looseness in mounting area	0.1	0.1	0.1
Overhead guard	R/R/I	Head guard (with Turn signal lamp and Head lamp)	0.3	0.3	0.3
		Turn signal lamp	0.2	0.2	0.2
		Head lamp	0.2	0.2	0.2
	Monthly inspection	Looseness in mounting area	0.1	0.1	0.1
		Deformation, crack, and damage	0.1	0.1	0.1
Front axle	R/R/I	Drive Ass'y (with Traction motor, Brake, and Mast)	1.0	1.0	1.0
		Wheel (1 piece)	0.1	0.1	0.1
		Mast ass'y	0.6	0.6	0.6
		Traction motor ass'y	0.7	0.7	0.7
	Monthly inspection	Oil leakage from Drive gear case and unusual noise	0.1	0.1	0.1
	Yearly inspection	Unusual noise, oil level, fouling, oil leakage, and fitting bolt looseness	0.1	0.1	0.1

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
Differential gear	R/R/I	Helical pinion and gear (after removing Drive)	1.2	1.5	1.5
		Differential gear (after removing Drive)	0.8	0.8	0.8
Wheel hub and brake drum	R/R/I	Wheel (1 piece)	0.1	0.1	0.1
		Drive shaft (1 piece) (after removing Wheel)	0.1	0.1	0.1
		Wheel hub (1 piece) (after removing Drive shaft)	0.1	0.1	0.1
		Wheel hub bearing (2 pieces) (after removing Wheel hub)	0.1	0.1	0.1
		Oil seal (Wheel hub) (1 piece) (after removing Wheel hub)	0.1	0.1	0.1
		Stud bolt (1 piece) (after removing Drive shaft)	0.1	0.1	0.1
		Fill grease (Wheel hub bearing) (after removing Bearing)	0.1	0.1	0.1
	Monthly inspection	Retightening all wheel hub nuts	0.1	0.1	0.1
Drive shaft	R/R/I	Drive shaft (1 piece) (after removing Wheel)	0.1	0.1	0.1
		Stud bolt (1 piece) (after removing Drive shaft)	0.1	0.1	0.1
	Monthly inspection	Two pieces rim bolt and hub bolt/nut damage and looseness	0.1	0.1	0.1
		Air pressure, crack, damage, wear and metal chip caught in between	0.1	0.1	0.1
Front wheel	R/R/I	Wheel (1 piece)	0.1	0.1	0.1
		Pneumatic tyre (1 piece)	0.2	0.2	0.3
		No puncture tyre (1 piece)	0.2	0.2	0.3
Rear wheel	R/R/I	Wheel (1 piece)	0.1	0.1	0.1
		Pneumatic tyre (1 piece)	0.2	0.2	0.2
		No puncture tyre (1 piece)	0.2	0.2	0.2
Steering axle (Rear axle)	R/R/I	Wheel (1 piece)	0.1	0.1	0.1
		Steering axle (Rear axle) (after removing Wheel)	1.0	1.0	1.0
		Axle support bushing (For 1 truck) (after removing Rear axle)	0.1	0.1	0.1
	Adjust	Shim (Axle support)	0.1	0.1	0.1
	Monthly inspection	Rear axle joint	0.1	0.1	0.1
	Yearly inspection	Turn radius (Right mm) (Left mm)	0.1	0.1	0.1
		Stopper bolt looseness, if it is not dropped off, and interference with wheel	0.1	0.1	0.1

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
Knuckle	R/R/I	Hub (1 piece) (after removing Wheel)	0.2	0.2	0.2
		King pin and Knuckle (1 piece) (after removing Hub)	0.1	0.1	0.1
		Taper roller bearing (one side) (after removing Hub)	0.2	0.2	0.2
		Needle bearing (king pin) (2 pieces) (after removing King pin)	0.3	0.3	0.3
		Oil seal (Wheel hub) (1 piece) (after removing King pin)	0.1	0.1	0.1
		Bolt (Knuckle stopper) (1 piece)	0.3	0.3	0.3
	Yearly inspection	Wheel bearing and king pin jolt, unusual noise, crack and damage	0.1	0.1	0.1
Wheel hub	R/R/I	Hub (1 piece) (after removing Wheel)	0.2	0.2	0.2
		Taper roller bearing (one side) (after removing Hub)	0.2	0.2	0.2
		Oil seal (wheel hub) (1 piece) (after removing King pin)	0.1	0.1	0.1
		Hub bolt (1 piece) (after removing Hub)	0.1	0.1	0.1
		Fill grease (Hub bearing) (one side) (after removing Bearing)	0.1	0.1	0.1
Center arm	R/R/I	Center arm (after removing Rear axle)	0.4	0.4	0.4
		Needle bearing (center arm) (2 pieces) (after removing Center arm)	0.1	0.1	0.1
	Yearly inspection	Crack, damage, deflection, jolt, fitting bolt looseness and dropped off	0.1	0.1	0.1
Tie rod	R/R/I	Tie rod (1 piece) (after removing Rear axle)	0.4	0.4	0.4
		Rod end(Tie rod end) (1 piece) (after removing Tie rod)	0.1	0.1	0.1
	Yearly inspection	Crack, damage, deflection, jolt, fitting bolt looseness and dropped off	0.1	0.1	0.1

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
Steering box (EPS)	R/R/I	Steering gear box ass'y	0.4	0.4	0.4
		Pitman arm	0.3	0.3	0.3
		Steering column	0.2	0.2	0.2
		Joint (after removing Column)	0.1	0.1	0.1
		Steering wheel	0.2	0.2	0.2
		Horn contact, Horn cup, Spring	0.1	0.1	0.1
		Potentiometer	0.5	0.5	0.5
	Monthly inspection	Measuring Potentiometer voltage	0.1	0.1	0.1
		Steering handle play	0.1	0.1	0.1
		Handle grip damage, looseness in mounting area, and jolt	0.1	0.1	0.1
	Yearly inspection	Gear box oil level, fouling, oil leakage, fitting bolt looseness and dropped off	0.1	0.1	0.1
Steering linkage	R/R/I	Horn contact, Horn cap, Spring	0.1	0.1	0.1
		Pitman arm	0.3	0.3	0.3
		Drag link	0.3	0.3	0.3
		Rod end (1 piece) (after removing Drag link)	0.1	0.1	0.1
		Actuator	0.6	0.6	0.6
	Adjust	Turn radius	0.3	0.3	0.3
Wheel brake	R/R/I	Repair kit (1 set) (after removing Brake drum)	0.2	0.2	0.2
		Parking brake cable (one side)	0.4	0.4	0.4
	Adjustment	Brake (Discharging air)	0.5	0.5	0.5
	Yearly inspection	Space in the shoe Lining peeling, damage and wear Anchor pin corrosion Spring permanent set Drum crack, damage, wear, and fitting bolt looseness Back plate crack, damage, deformation and fitting bolt looseness	0.5	0.5	0.5
	Monthly inspection	Brake test (stopping distance, pull)	0.1	0.1	0.1

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
Foot brake linkage	R/R/I	Pedal	0.3	0.3	0.3
		Pedal bushing (after removing Pedal)	0.1	0.1	0.1
		Pedal pad (after removing Pedal)	0.1	0.1	0.1
		Return spring	0.2	0.2	0.2
	Adjust	Brake pedal play	0.2	0.2	0.2
	Monthly inspection	Height, level and clearance between pedal and floor	0.1	0.1	0.1
		Microswitch timing	0.1	0.1	0.1
	Yearly inspection	"Rod, link" damage, looseness and jolt "Pin, cotter" fracture	0.1	0.1	0.1
Master cylinder	R/R/I	Master cylinder	0.2	0.2	0.2
		Repair kit (after removing Master cylinder)	0.2	0.2	0.2
	Adjust	Brake (discharging air)	0.5	0.5	0.5
	Yearly inspection	Master cylinder and wheel cylinder operation, oil level, fouling and oil leakage	0.1	0.1	0.1
Brake oil piping	R/R/I	Pipe (with tube nut) (1 piece)	0.1	0.1	0.1
	Monthly inspection	Entrained air, oil leakage, damage, aging, bolt looseness, and interference with wheel	0.1	0.1	0.1
Parking brake	R/R/I	Microswitch (parking brake)	0.3	0.3	0.3
		Parking lever comp.	0.5	0.5	0.5
		Parking brake cable (one side)	0.4	0.4	0.4
	Monthly inspection	Lock condition Brake response time Lever stroke and pulling force Feeling, damage, and wear	0.1	0.1	0.1
Oil tank	R/R/I	Gasket	0.1	0.1	0.1
		Suction filter	0.5	0.5	0.5
		Return filter	0.5	0.5	0.5
		LP hose	0.2	0.2	0.2
	Clean	Oil tank	0.5	0.5	0.5
	Monthly inspection	Oil level, any contaminations	0.3	0.3	0.3
	Yearly inspection	Oil level and fouling, if there is any moisture	0.1	0.1	0.1
		Filter, clogging, and damage	0.1	0.1	0.1
Hydraulic pump	R/R/I	Hydraulic pump Connection elbow and nipple Oil piping	0.5	0.5	0.5
		Coupling (after removing Pump)	0.1	0.1	0.1
		Oil seal (after removing Pump)	0.1	0.1	0.1
	Monthly inspection	Oil leakage, Unusual vibration, and unusual noise	0.1	0.1	0.1

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
Control valve	R/R/I	Control valve	0.5	0.5	0.5
		Wiper and O-ring (after removing Control valve)	0.1	0.1	0.1
		Spring or spring seat (after removing Control valve)	0.1	0.1	0.1
		Relief valve	0.2	0.2	0.2
		Linkage	0.6	0.6	0.6
		Oil piping	0.9	0.9	0.9
		Elbow and nipple	0.2	0.2	0.2
	Adjust	Relief valve pressure	0.3	0.3	0.3
	Yearly inspection	Operation, oil leakage, and fitting bolt looseness	0.1	0.1	0.1
Lift cylinder (P-mast)	R/R/I	Lift cylinder (1 piece)	0.3	0.3	0.3
		Chain support comp.	0.2	0.2	0.2
		Oil piping	0.9	0.9	0.9
		Lift bracket	0.4	0.4	0.4
		Seal kit (1 set) (after removing Cylinder)	0.3	0.3	0.3
	Yearly inspection	Operation, oil leakage, dent crack, deflection, scratch, and fitting bolt looseness	0.1	0.1	0.1
		Drift of lowering (mm/10min)	0.2	0.2	0.2
1st lift cylinder (PFL-mast)	R/R/I	1st lift cylinder ass'y	0.9	0.9	0.9
		Seal kit (after removing Cylinder)	0.5	0.5	0.5
	Yearly inspection	Operation, oil leakage, dent, crack, and deflection	0.1	0.1	0.1
		Drift of lowering (mm/10min) Measuring drift of Inner mast lowering	0.2	0.2	0.2
2nd lift cylinder (PFL-mast)	R/R/I	Lift cylinder ass'y (1 piece)	0.3	0.3	0.3
		Seal kit (1 set) (after removing Cylinder) scratch, and fitting bolt looseness	0.3	0.3	0.3
	Yearly inspection	Operation, oil leakage, dent, crack, and deflection	0.1	0.1	0.1
		Drift of lowering (mm/10min)	0.2	0.2	0.2

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
1st lift cylinder (M-mast)	R/R/I	Lift cylinder ass'y	0.8	0.8	0.8
		Seal kit (after removing Cylinder)	0.4	0.4	0.4
	Yearly inspection	Operation, oil leakage, dent, crack, deflection, scratch, and fitting bolt looseness	0.1	0.1	0.1
		Drift of lowering (mm/10min)	0.2	0.2	0.2
2nd lift cylinder (M-mast)	R/R/I	Lift cylinder ass'y (1 piece)	0.3	0.3	0.3
		Seal kit (1 set) (after removing Cylinder)	0.3	0.3	0.3
		Flow control valve	0.2	0.2	0.2
2nd lift cylinder	Yearly inspection	Operation, oil leakage, dent, crack, deflection,scratch, and fitting bolt looseness	0.1	0.1	0.1
		Drift of lowering (mm/10min)	0.2	0.2	0.2
Tilt cylinder	R/R/I	Tilt cylinder ass'y (1 piece)	0.3	0.3	0.3
		Tilt cylinder rod end (after removing Cylinder)	0.1	0.1	0.1
		Rod end bushing (after removing Cylinder)	0.2	0.2	0.2
		Cylinder end cover bushing (after removing Cylinder)	0.1	0.1	0.1
		Tilt pin	0.2	0.2	0.2
		Seal kit (1 piece) (after removing Cylinder)	0.3	0.3	0.3
	Yearly inspection	Operation, oil leakage, dent, crack, deflection, scratch, and fitting bolt looseness	0.1	0.1	0.1
		Drift of lowering (mm/10min)	0.2	0.2	0.2
Piping	R/R/I	Hose (1 piece)	0.2	0.2	0.2
		Connector, elbow, nipple, etc (1 piece)	0.1	0.1	0.1
		Flow control valve or fuse valve	0.2	0.2	0.2
	Monthly inspection	Oil leakage, deformation, damage, jolt, and looseness	0.1	0.1	0.1
	Yearly inspection	Crack, damage, aging, twisting, oil leakage, mounting condition, and bolt/nut looseness	0.1	0.1	0.1

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
Valve lever linkage	R/R/I	Valve lever linkage ass'y (with control valve and microswitch)	0.6	0.6	0.6
		Valve lever (1 piece)	0.2	0.2	0.2
		Link (1 piece)	0.2	0.2	0.2
		Bushing (2 pieces on a lever) (after removing Lever)	0.2	0.2	0.2
		Lever knob (1 piece)	0.1	0.1	0.1
		Microswitch (1 piece)	0.3	0.3	0.3
		Oil piping	0.9	0.9	0.9
Mast	R/R/I	Mast ass'y	0.6	0.6	0.6
		Mast support bushing (For 1 truck)	0.6	0.6	0.6
		Mast roller (after removing Mast) (Outer mast or Inner mast) (1 piece)	0.1	0.1	0.1
		Back shoe (after removing Mast)	0.3	0.3	0.3
		Lift chain (1 piece)	0.3	0.3	0.3
		Lift chain anchor bolt (1 piece)	0.5	0.5	0.5
		Chain wheel (1 piece)	0.2	0.2	0.2
		Chain support	0.5	0.5	0.5
		Stopper cushion rubber	0.1	0.1	0.1
		Stopper bracket	0.1	0.1	0.1
	Adjust	Mast roller adjustment (Outer mast, inner mast)	0.4	0.4	0.4
		Back shoe	0.1	0.1	0.1
Lift bracket	R/R/I	Lift bracket ass'y	0.4	0.4	0.4
		Backrest	0.2	0.2	0.2
		Roller (1 piece) (after removing Lift bracket)	0.8	0.8	0.8
		Side roller (1 piece) (after removing Lift bracket)	0.8	0.8	0.8
		Fork (For 1 truck)	0.2	0.2	0.2
		Fork set pin, spring (1 piece)	0.1	0.1	0.1
	Adjust	Lift bracket adjustment	0.7	0.7	0.
	Monthly inspection	Lift bracket jolt, crack in welded area	0.1	0.1	0.1
	Yearly inspection	Bracket deformation, crack, and damage Roller wear and jolt Pin area crack	0.2	0.2	0.2
Chain wheel and lift chain	Monthly inspection	Chain tension, extension, crack, deformation, damage, and wear, Wheel deformation, damage, and jolt	0.1	0.1	0.1
	Yearly inspection	Chain tension, extension, crack deformation, damage, and wear, Wheel deformation, damage, and jolt	0.1	0.1	0.1

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
Fork	R/R/I	Fork (For 1 truck)	0.2	0.2	0.2
		Fork set pin, spring (1 piece)	0.1	0.1	0.1
		Fork (For 1 truck)	0.2	0.2	0.2
	Monthly inspection	Fork deformation, wear, and crack	0.1	0.1	0.1
	Yearly inspection	Deformation, crack and wear in locking pin area Fork tip opening and leveling Bottom area, upper hock area and under hock area crack and wear	0.1	0.1	0.1
Traction motor	R/R/I	Drive ass'y (with Traction motor, Brake, Mast)	1.0	1.0	1.0
		Wheel (1 piece)	0.1	0.1	0.1
		Mast ass'y	0.6	0.6	0.6
		Traction motor ass'y	0.7	0.7	0.7
		Bearing, sensor	0.3	0.3	0.3
		Cover, end	0.3	0.3	0.3
		Rotor comp./bearing (2 pieces)	0.5	0.5	0.5
		Seal, oil	0.2	0.2	0.2
		Stator comp.	0.5	0.5	0.5
		Cover	0.1	0.1	0.1
	Clean/check	Traction motor ass'y	0.6	0.6	0.6
	Monthly inspection	Unusual sound and unusual smell during motor rotation	0.1	0.1	0.1
	Yearly inspection	Bolt looseness, fitting bolt looseness in main body	0.2	0.2	0.2
		Motor rotation condition - (low speed, inter mediate speed, high speed, acceleration),	0.1	0.1	0.1
		unusual noise, unusual smell	0.1	0.1	0.1
Hydraulic motor	R/R/I	Hydraulic motor ass'y (with pump)	0.3	0.3	0.3
		Pump ass'y	0.4	0.4	0.4
		Cover, end	0.3	0.3	0.3
		Armature / bearing (2 pieces)	0.5	0.5	0.5
		Stator comp.	0.5	0.5	0.5
		Cover	0.1	0.1	0.1
	Clean/check	Motor ass'y	0.5	0.5	0.5
	Monthly inspection	Hydraulic motor unusual noise, unusual smell	0.1	0.1	0.1
	Yearly inspection	Bolt looseness, fitting bolt looseness in main body	0.2	0.2	0.2
		Motor rotation condition -(low speed, inter mediate speed, high speed, acceleration), Unusual noise, unusual smell	0.1	0.1	0.1

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
EPS motor	R/R/I	EPS motor ass'y	0.4	0.4	0.4
		Armature comp./ bearing (2 pieces)	0.4	0.4	0.4
		Carbon brush (all)	0.4	0.4	0.4
	Clean/check	EPS motor ass'y	0.5	0.5	0.5
	Repair	Grinding commutator and under cutting	0.5	0.5	0.5
	Monthly inspection	EPS motor unusual noise, unusual smell	0.1	0.1	0.1
		EPS motor brush wear	0.1	0.1	0.1
	Yearly inspection	Brush wear, contact, commutator burnout commutator burnout	0.2	0.2	0.2

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
Control unit	R/R/I	Control unit ass'y removal / installation	1.5	1.5	1.5
		IGBT module (1 piece) Add 0.2Hrs every time 1 piece is added.	0.7	0.7	0.7
		Sensor comp., current (1 piece) Add 0.3Hrs every time 1 piece is added.	0.6	0.6	0.6
		Capacitor (1 piece) Add 0.2Hrs every time 1 piece is added.	0.8	0.8	0.8
		Resister (1 piece) Add 0.3Hrs every time 1 piece is added.	0.8	0.8	0.8
		Sensor comp., heat (1 piece) Add 0.3Hrs every time 1 piece is added.	0.7	0.7	0.7
		Capacitor (1 piece) Add 0.2Hrs every time 1 piece is added.	0.6	0.6	0.6
		MPU board (travel/hydraulic)	0.4	0.4	0.4
		Fan comp (1 piece) Add 0.3Hrs every time 1 piece is added.	0.5	0.5	0.5
	Confirmation	Travelling speed, lift speed, plugging distance.	0.5	0.5	0.5
	Monthly inspection	Looseness in terminal contact area, looseness in wiring mounting area	0.1	0.1	0.1
		Resistor and capacitor terminal looseness and burnout, fitting bolt looseness	0.1	0.1	0.1
	Yearly inspection	[Overcurrent limiter] (for hydraulic A) Motor lock current value (for travel A)	0.1	0.1	0.1
		[Safety device] Contactor operation (pulling out arc or not)	0.1	0.1	0.1
		Wiring looseness, damage, and clamp condition	0.2	0.2	0.2
Accelerator	R/R/I	Accelerator	0.5	0.5	0.5
	Monthly inspection	Accelerator pedal operating condition	0.1	0.1	0.1
Display panel ass'y	R/R/I	Display panel ass'y	1.0	1.0	1.0

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
Directional switch	R/R/I	Indicator panel cover	0.4	0.4	0.4
		Cam comp.	0.2	0.2	0.2
		Lever comp.	0.3	0.3	0.3
		Microswitch Add 0.1Hrs every time 1 piece is added	0.2	0.2	0.2
	Monthly inspection	Each connected area jolt Lever movement condition Microswitch timing and operating condition Microswitch damage, looseness in mounting area	0.1	0.1	0.1
	Yearly inspection	Adequacy of Microswitch timing,damage, and fitting bolt looseness	0.2	0.2	0.2
Indicator panel	R/R/I	Indicator panel cover	0.4	0.4	0.4
		LCD display unit	0.3	0.3	0.3
		Turn signal lamp switch	0.3	0.3	0.3
		Sheet switch comp.	0.3	0.3	0.3
		Display board	0.3	0.3	0.3
	Monthly inspection	Turn signal lamp damage, operating condition, and mounting condition Instruments operation	0.1	0.1	0.1
Main contactor	R/R/I	Contactor comp.	0.4	0.4	0.4
	Yearly inspection	Contact point looseness, damage, wear, operation, fouling, and fitting bolt looseness	0.1	0.1	0.1
Contactor	Monthly inspection	Contactor timing and operating condition	0.1	0.1	0.1
		Contactor contact point looseness, damage, and wear	0.1	0.1	0.1
		Contactor auxiliary contact point wear, and damage	0.1	0.1	0.1

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
Others (electric parts)	R/R/I	Main fuse (1 piece)	0.2	0.2	0.2
		Turn signal lamp switch ass'y	0.2	0.2	0.2
		Horn	0.2	0.2	0.2
		Battery plug (chassis side)	0.2	0.2	0.2
		Back buzzer	0.1	0.1	0.1
		Head lamp (1 piece)	0.2	0.2	0.2
		Turn signal lamp (1 piece)	0.2	0.2	0.2
		Combination lamp	0.1	0.1	0.1
	Monthly inspection	Fuse fitting bolt looseness, capacity adequacy Warning device damage, operating condition, and mounting condition Rear view mirror and reflecting mirror fouling, damage, and reflecting condition Lightning system operation and mounting condition Direction indicator operation and mounting condition Display board and instruments damage and mounting condition Operation, water infiltration	0.1	0.1	0.1
		Backup alarm operation	0.1	0.1	0.1
Charger (option)	R/R/I	Front panel (left side)	0.3	0.3	0.3
		Transformer ass'y	0.3	0.3	0.3
		Panel ass'y	0.6	0.6	0.6
		Diode (1 piece)	0.1	0.1	0.1
		Adjustment	0.3	0.3	0.3
		Receptacle	0.6	0.6	0.6
		Magnet switch	0.2	0.2	0.2
		Fuse	0.2	0.2	0.2
		AC cable and plug	0.2	0.2	0.2
	Monthly inspection	Timer operation Magnet switch operating condition AC cable damage and looseness Receptacle contact condition	0.1	0.1	0.1
	Yearly inspection	Voltage detection relay operating voltage (V)	0.1	0.1	0.1

Group	Work	Job	Rate (hour)		
			10P-18P	20P-28P	30P
Battery	R/R/I	Battery	0.3	0.3	0.3
		Battery plug	0.4	0.4	0.4
	Adjust	Replenishing water and clean up	0.2	0.2	0.2
	Monthly inspection	Electrolyte level Terminal looseness, damage, and wear Cell damage and electrolyte leakage Temperature and specific gravity after charging (Max. , Min.) Battery plug and cable damage and looseness	0.1	0.1	0.1
	Yearly inspection	Each cell voltage (Max. , Min.)	0.1	0.1	0.1
Electric power steering	R/R/I	EPS controller ass'y	0.4	0.4	0.4
		EPS sensor ass'y	0.4	0.4	0.4
	Monthly inspection	Looseness in gear box mounting area Interference with chassis	0.1	0.1	0.1
		Right and left steering angle	0.1	0.1	0.1

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