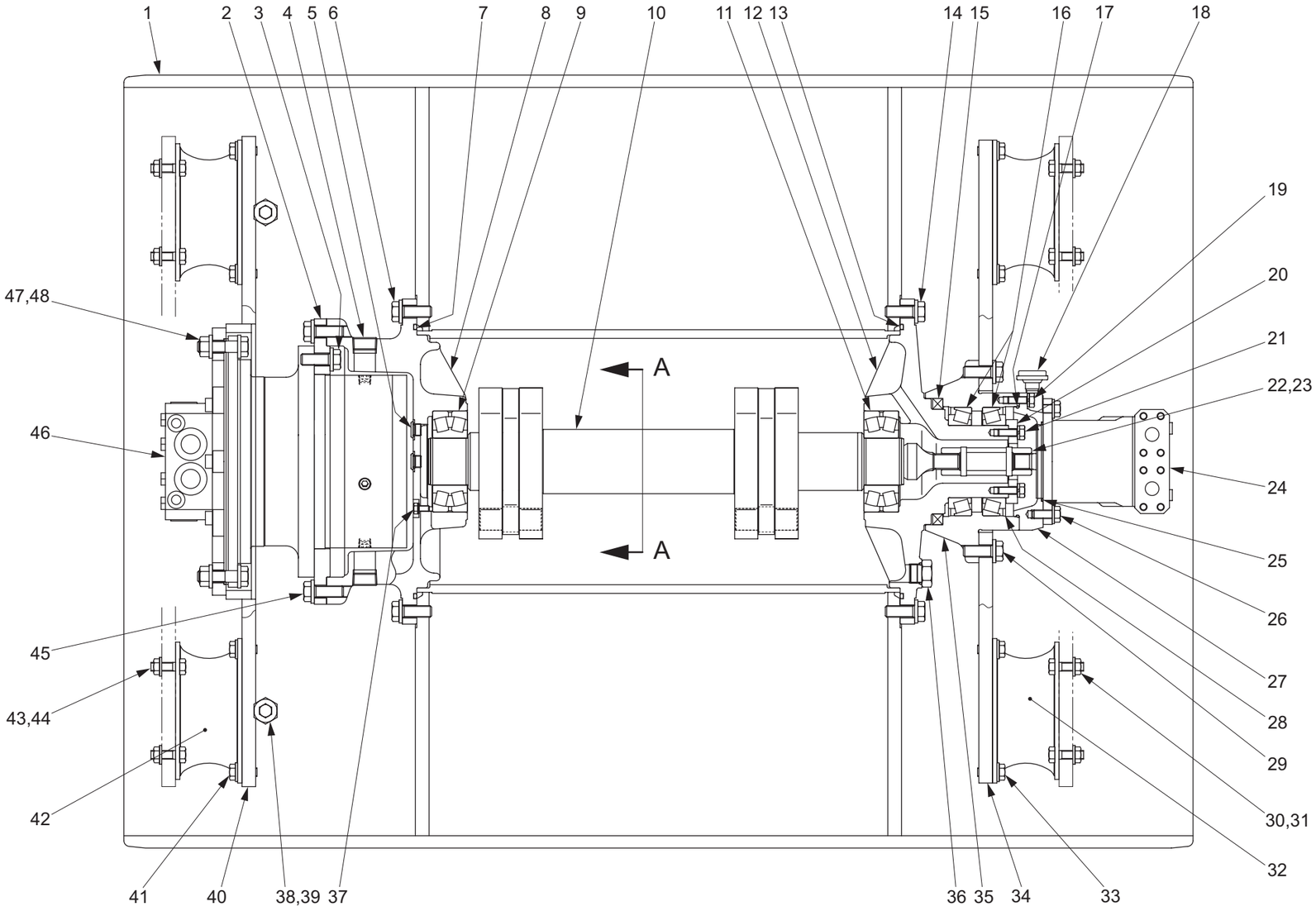
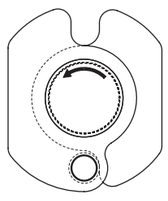
6. VIBRATORY DRUM ASSEMBLY (SW654) (FROM 30143)

6-1. Vibratory Drum Assembly

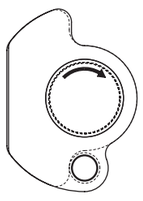


(1) Drum
(2) Ring
(3) Bolt : M16×45
(4) Plug
(5) Plug
(6) Bolt : M16×45
(7) O-ring
(8) Holder
(9) Vibrator bearing
(10) Eccentric shaft
(11) Vibrator bearing
(12) Axle shaft
(13) O-ring
(14) Bolt : M16×45
(15) Oil seal
(16) Roller bearing
(17) O-ring
(18) Breather
(19) Bolt : M10×30
(20) Cover
(21) Bolt : M10×30
(22) Sleeve
(23) Spring pin
(24) Vibrator motor
(25) O-ring
(26) Bolt : M12×30
(27) Flange
(28) Shim
(29) Bolt : M16×45
(30) Bolt : M12×40
(31) Nut : M12
(32) Damper
(33) Bolt : M12×30
(34) Disc
(35) Housing
(36) Plug
(37) Bolt : M 8× 16
(38) Pipe
(39) Bolt : M10×110
(40) Disc
(41) Bolt : M12×30
(42) Damper
(43) Bolt : M12×40
(44) Nut : M12
(45) Bolt : M16×45
(46) Propulsion motor
(47) Bolt : M16×60
(48) Nut : M16

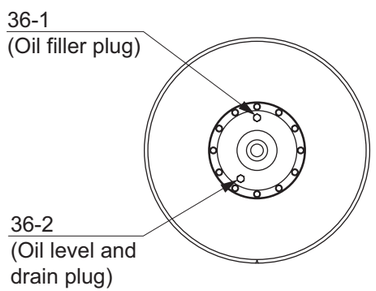


Vibration mode: Low
Counterclockwise rotation

SECTION A-A



Vibration mode: High
Clockwise rotation

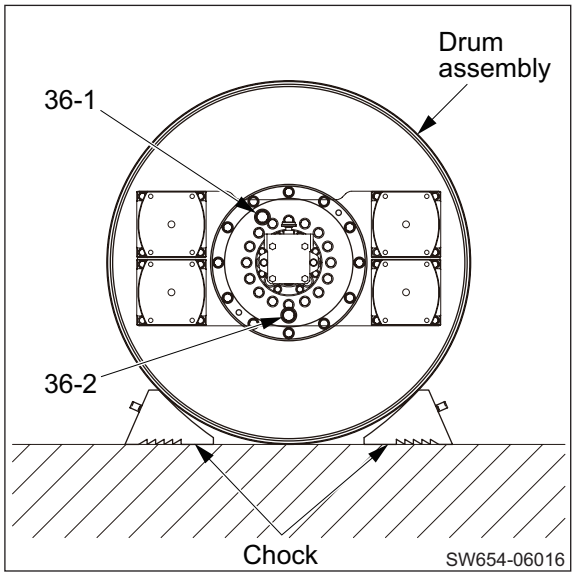


Vibrator motor side

0559-43802-0-10630-A

6-2. Disassembly and Reassembly of Vibratory Drum

- Lead line numbers shown in the illustrations for the following vibratory drum disassembly and reassembly procedures are constant with part numbers of vibratory drum assembly shown on page 6-080.



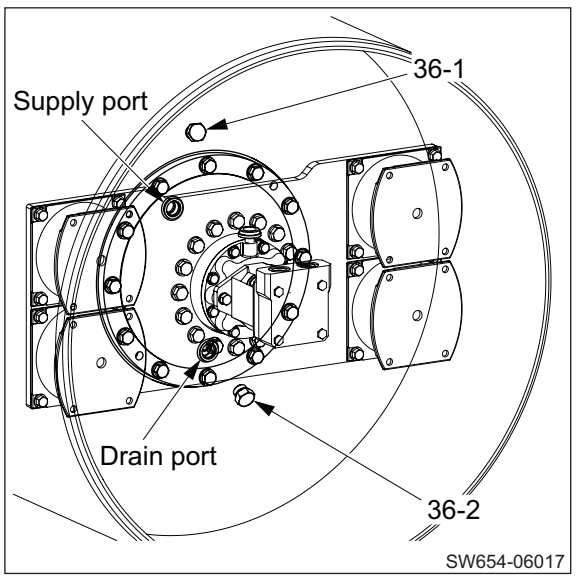
6-2-1. Disassembly of vibratory drum

1) Lay drum assembly with plugs (36-1) and (36-2) positioned as shown on the right.
   - Hold with chocks.

   Drum assembly : 1,485 kg (3,274 lbs.)

2) Remove plugs (36-1) and (36-2).
   - Drain gear oil.

     • Quantity of gear oil : 2.2 L (0.6 gal.)

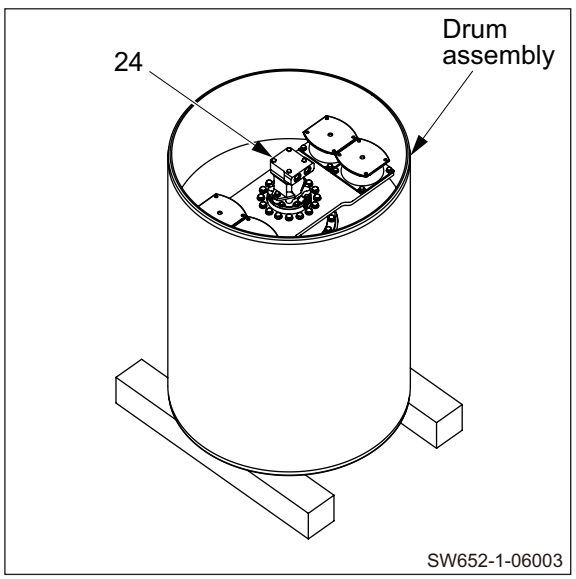


WARNING

- **When standing the vibratory drum, use wooden blocks of sufficient strength to securely support the drum.**
- **Carry out the work in an unstrained posture using a work stool or the like.**

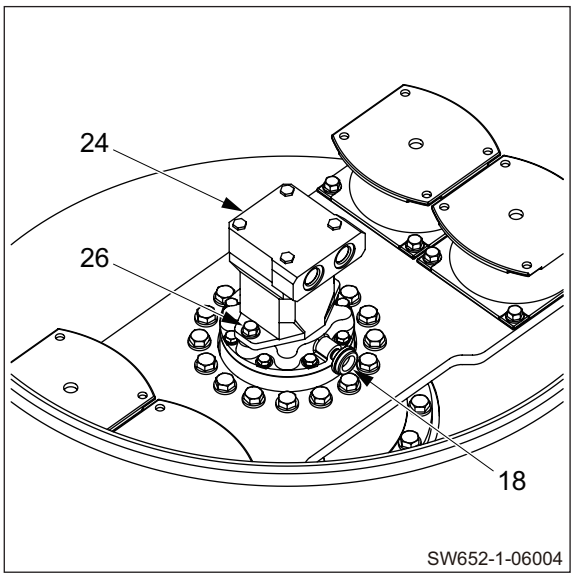
3) Stand drum assembly with its vibrator motor (24) side facing up.

   Drum assembly : 1,485 kg (3,274 lbs.)

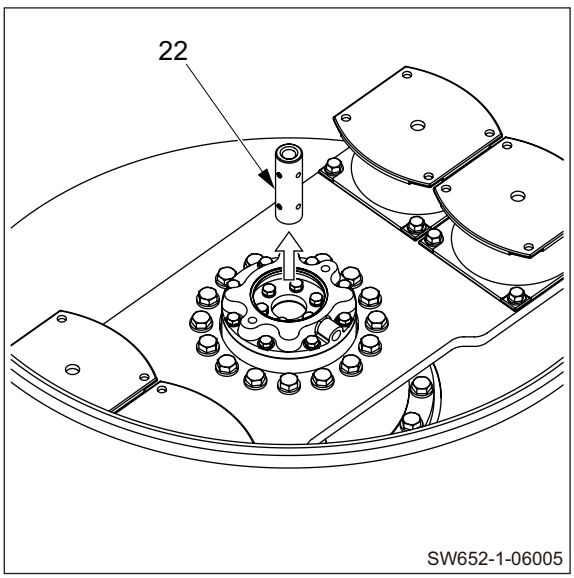


4) Remove breather (18).
   - Remove bolts (26).
   - Remove vibrator motor (24).

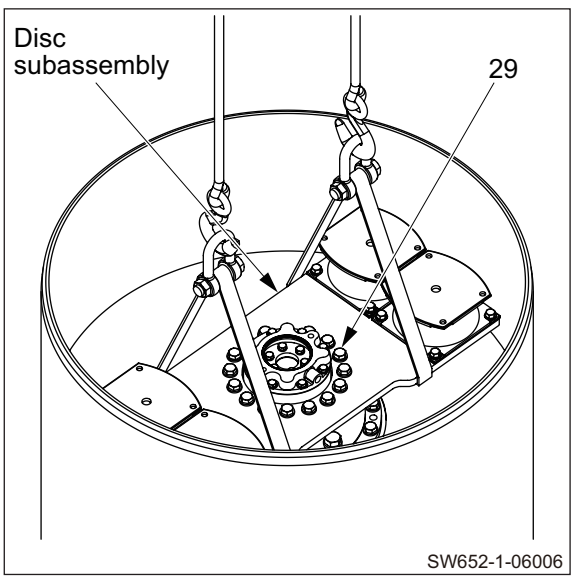
   (24) Vibrator motor : 15 kg (33 lbs.)



5) Remove sleeve (22).

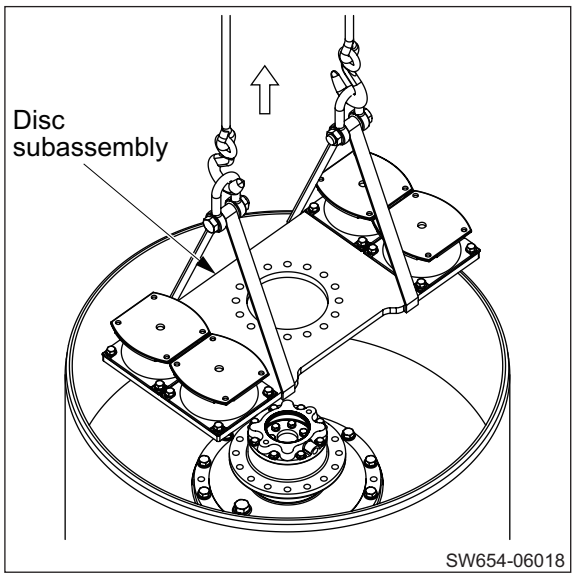


6) Lift disc subassembly.
   - Remove bolts (29).

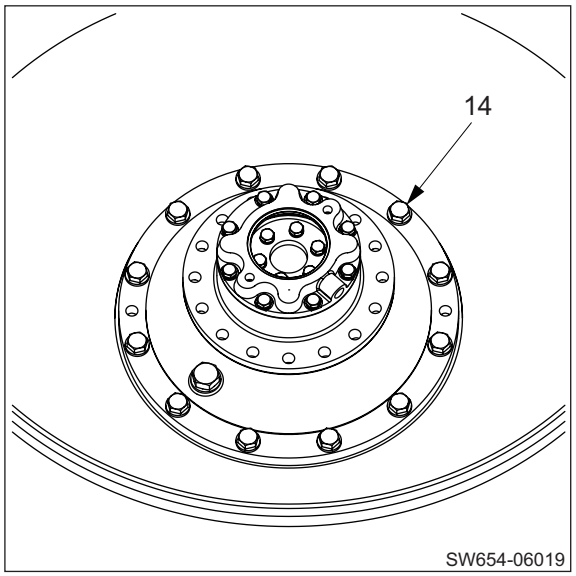


7) Remove disc subassembly.

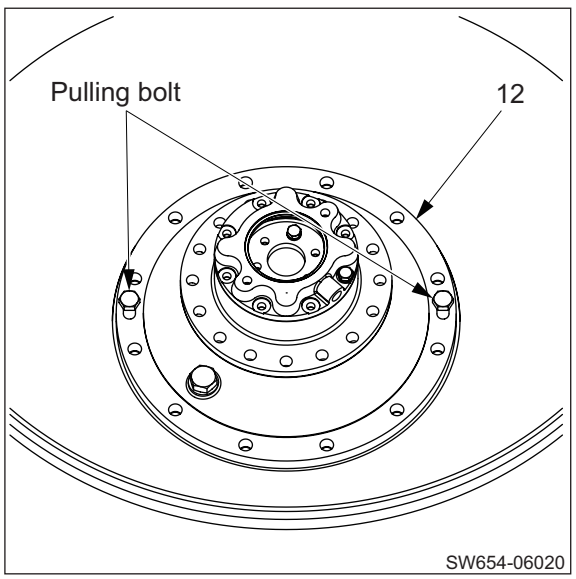
Disc subassembly : 75 kg (165 lbs.)



8) Remove bolts (14).



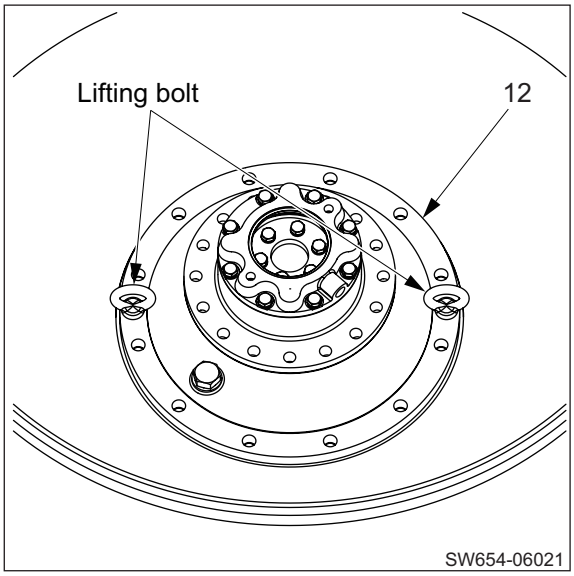
9) Lift axle shaft (12) using two pulling bolts (M16×45).



⚠WARNING

When installing lifting bolts, screw in the threads fully before using.

10) Install lifting bolts (M16) to axle shaft (12).

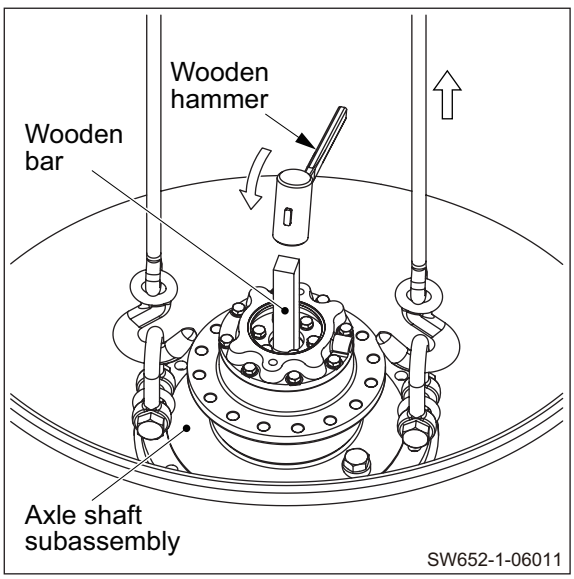


11) Remove axle shaft subassembly.

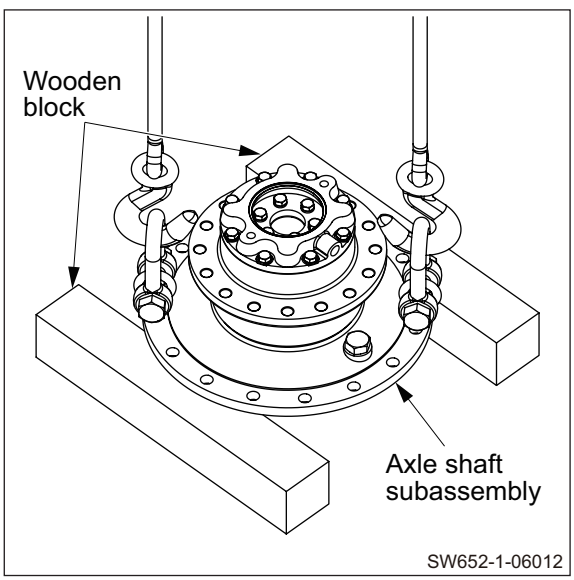
(NOTICE)

- **In order not to lift eccentric shaft together with axle shaft subassembly, tap on the eccentric shaft end with a wooden hammer via a wooden bar during lifting.**

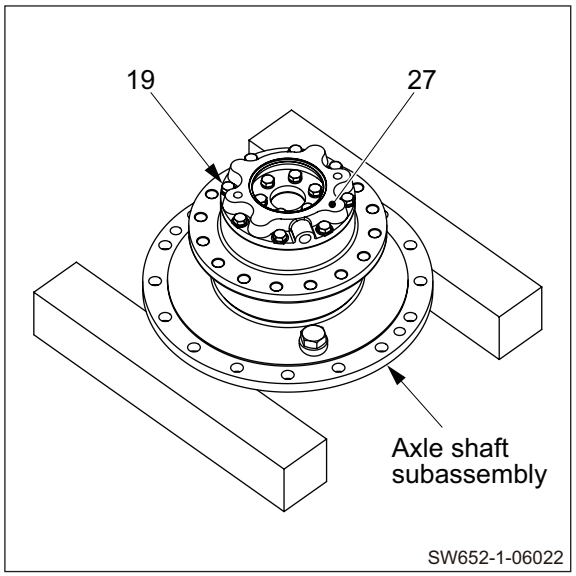
Axle shaft subassembly : 75 kg (165 lbs.)



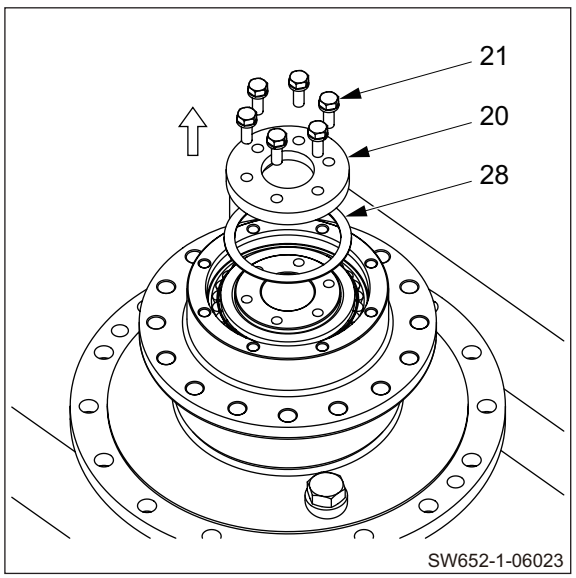
12) Put axle shaft subassembly on wooden blocks.



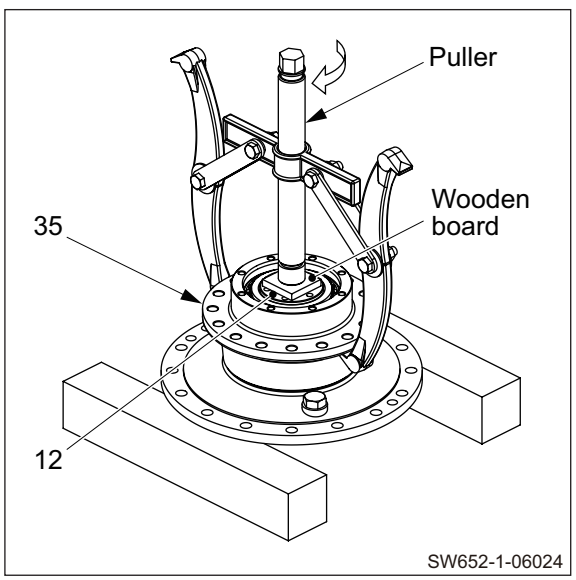
13) Disassembly of axle shaft subassembly.
- Remove bolts (19).
- Remove flange (27).



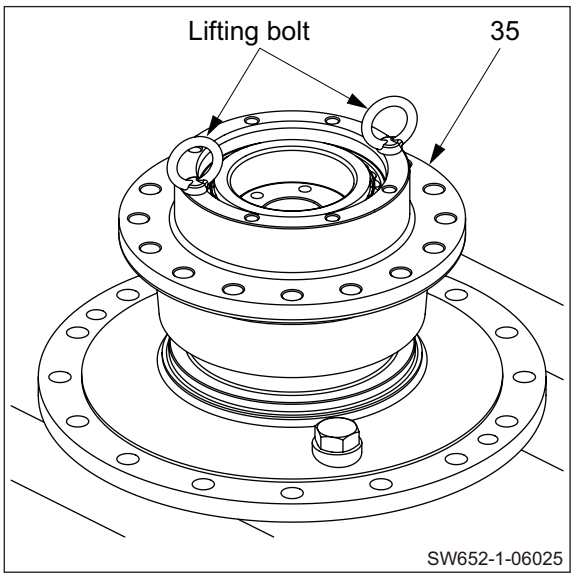
14) Remove bolts (21).
- Remove cover (20).
- Remove shim (28).



15) Put a piece of wooden board on end of axle shaft (12).
- Set a puller on housing (35).
- Remove housing subassembly with roller bearing from axle shaft subassembly.

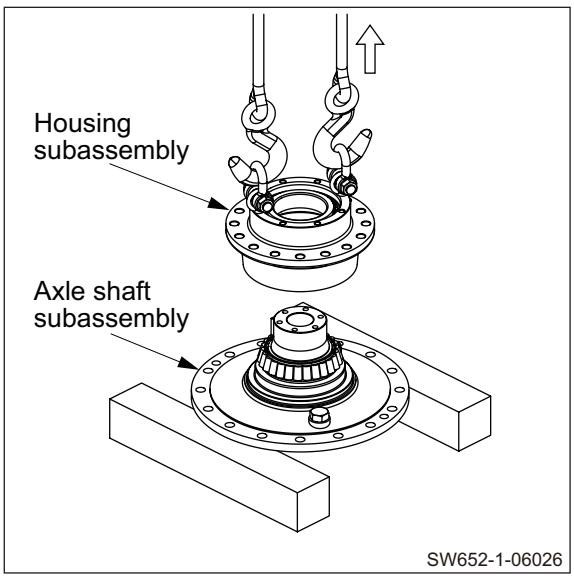


16) Install lifting bolts (M10) to housing (35).

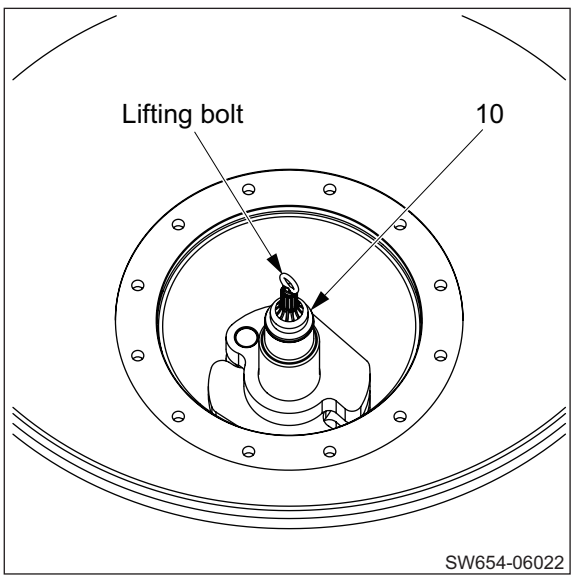


17) Remove housing subassembly from axle shaft subassembly.

Housing subassembly : 20 kg (44 lbs.)



18) Install a lifting bolt (M8) to eccentric shaft (10).



⚠WARNING

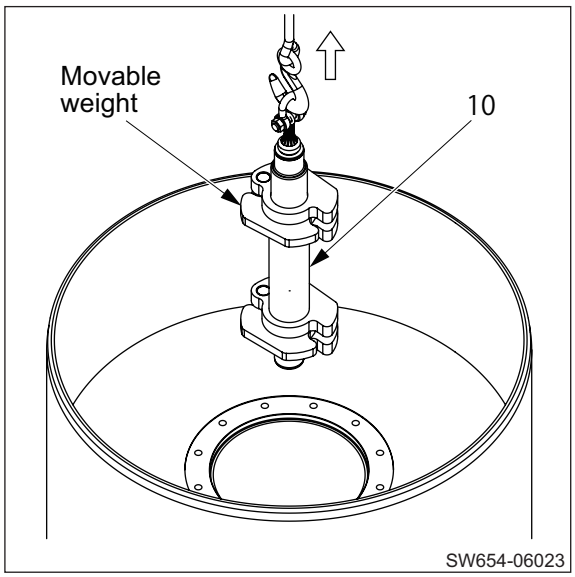
Take care not to get your fingers caught in movable weights.

19) Remove eccentric shaft (10).

ℑkg (10) Eccentric shaft : 55 g (121 lbs.)

(NOTICE)

- **Put the movable weight at its outmost position.**

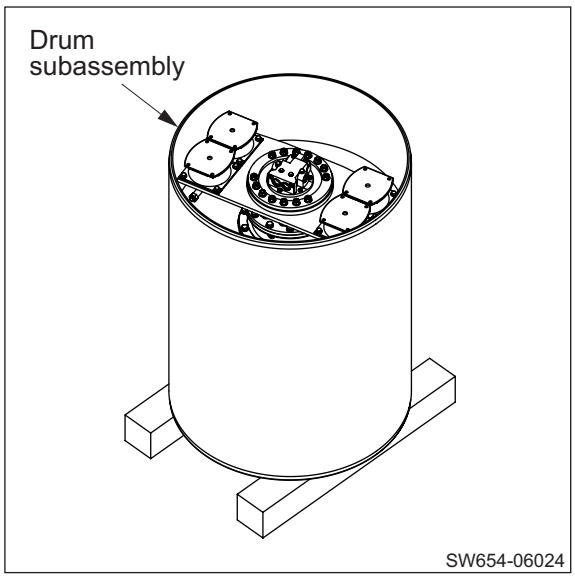


⚠WARNING

Be careful because reversing the vibratory drum involves risk. Confirm that the surrounding area is safe, and work in a natural, unstrained posture.

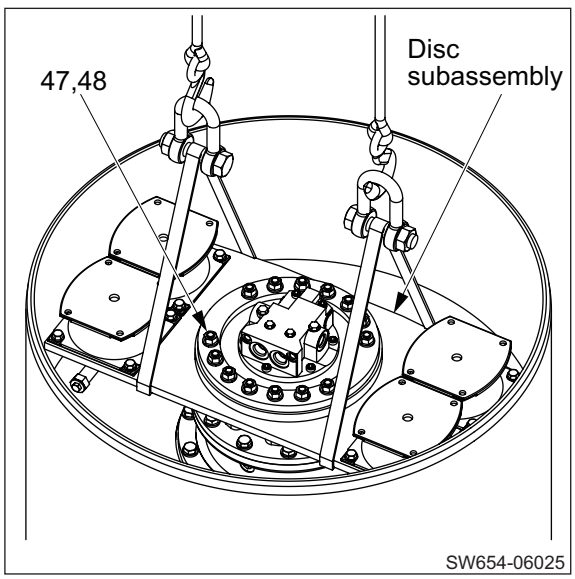
20) Reverse drum subassembly.

ℑkg Drum subassembly : 1,265 kg (2,789 lbs.)



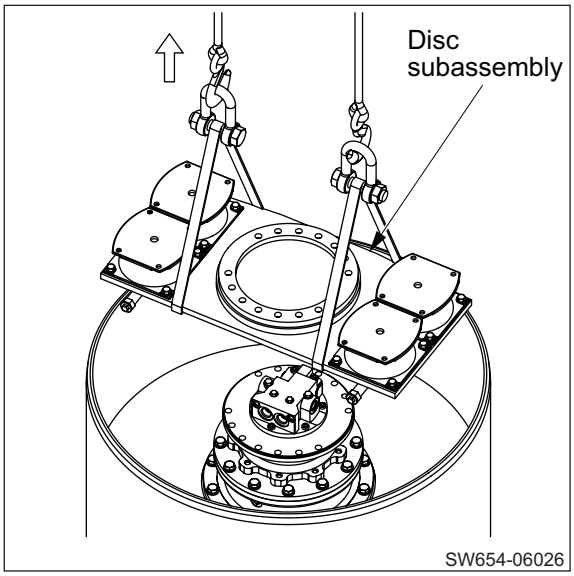
21) Lift disc subassembly.

- Remove nuts (48) and bolts (47).

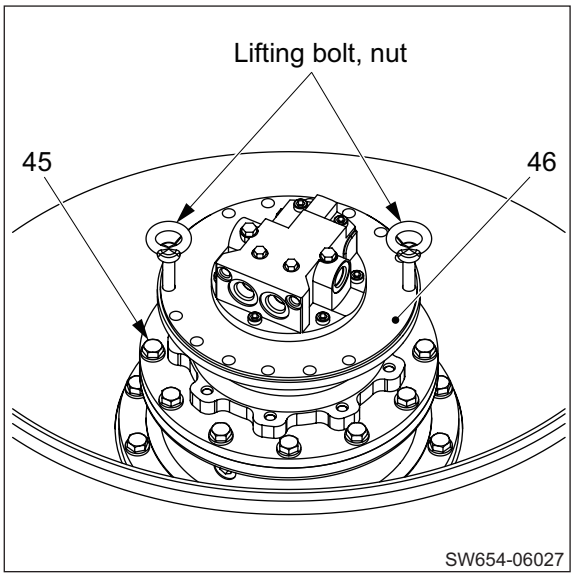


22) Remove disc subassembly.

Disc subassembly : 65 kg (143 lbs.)

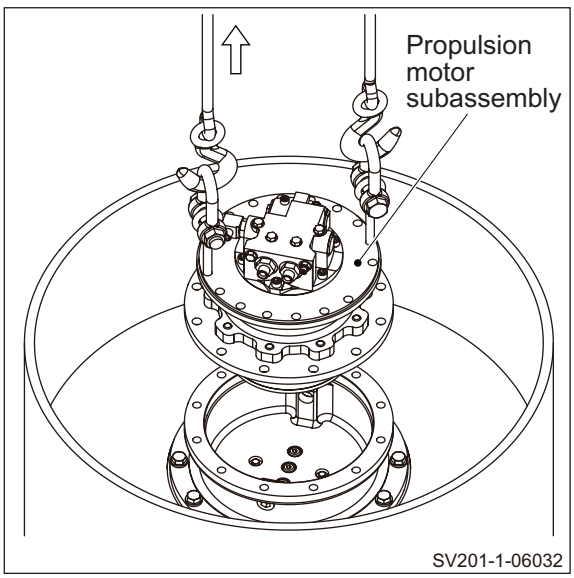


23) Install lifting bolts and nuts (M16) to propulsion motor (46).
- Remove bolts (45).

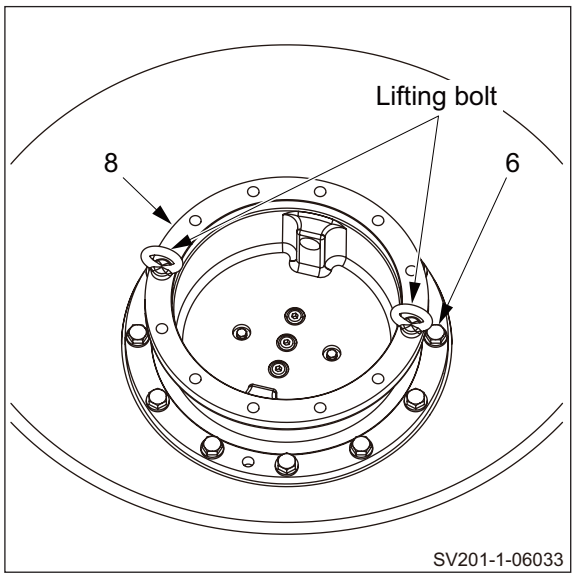


24) Remove propulsion motor subassembly.

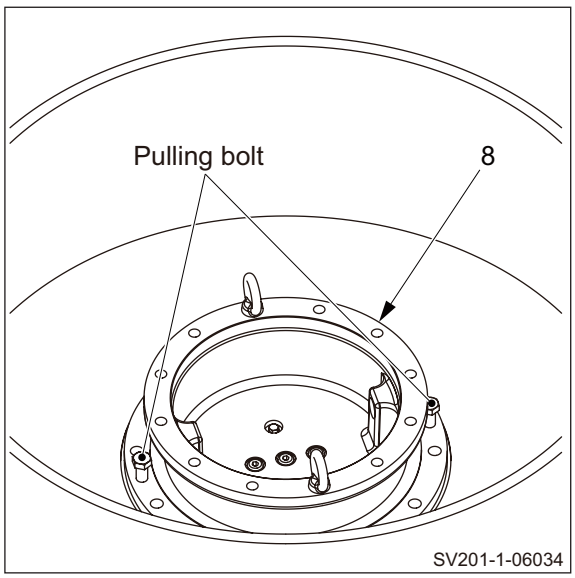
Propulsion motor subassembly : 105 kg (231 lbs.)



25) Install lifting bolts (M16) to holder (8).
- Remove bolts (6).

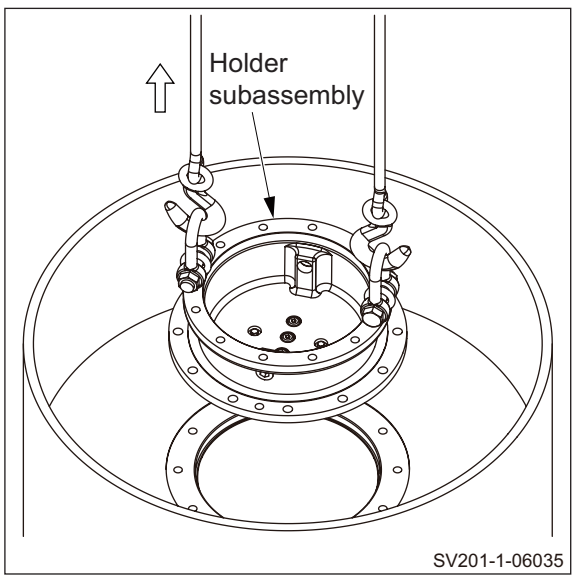


26) Lift holder (8) using two pulling bolts (M16×50).

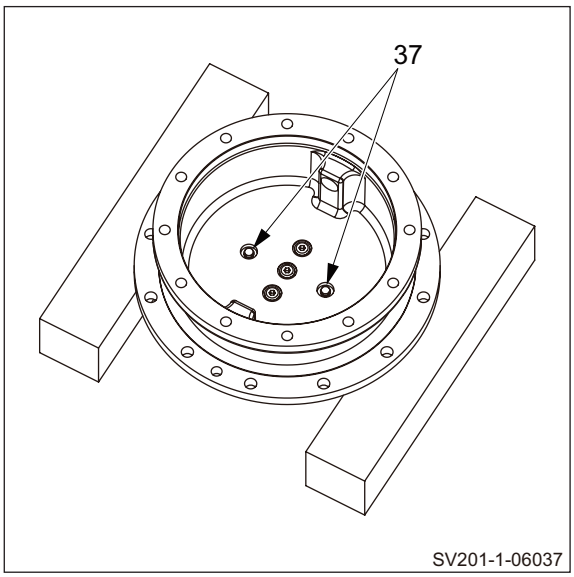


27) Remove holder subassembly.

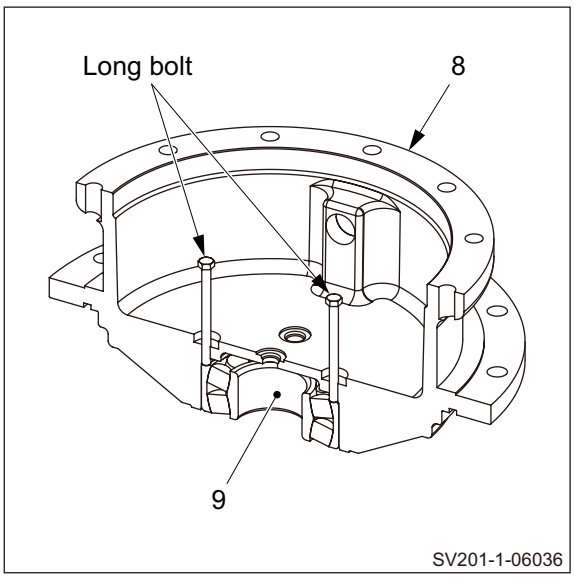
Holder subassembly : 65 kg (143 lbs.)



28) Remove bolts (37).



29) Remove vibrator bearing (9) from holder (8) using long bolts (M8).



6-2-2. Reassembly of vibratory drum

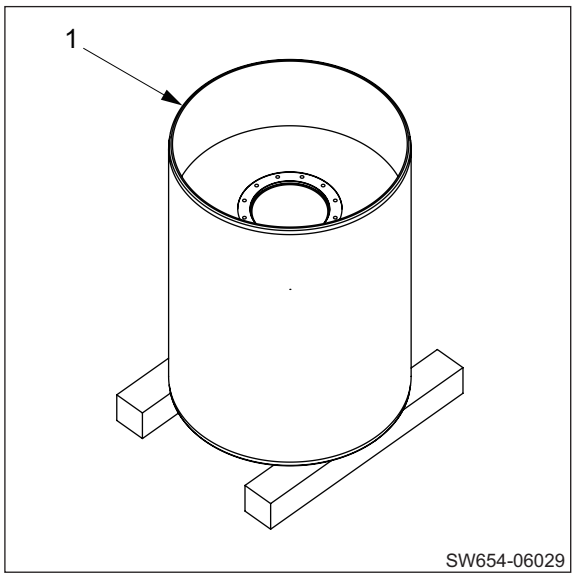
- Before reassembling, clean disassembled parts well and check that there is no abnormality.

⚠WARNING

- **When standing the vibratory drum, use wooden blocks of sufficient strength to securely support the drum.**
- **Carry out the work in an unstrained posture using a work stool or the like.**

1) Stand drum (1) with its propulsion motor side facing up.

kg (1) Drum : 1,025 kg (2,260 lbs.)



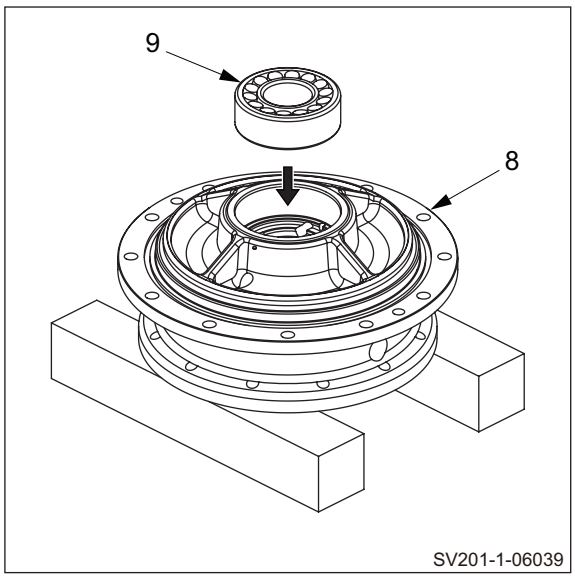
2) Reassembly of holder subassembly

2-1) Apply a coat of gear oil to holder (8) at where bearing will be press-fitted.

- Drive in vibrator bearing (9).

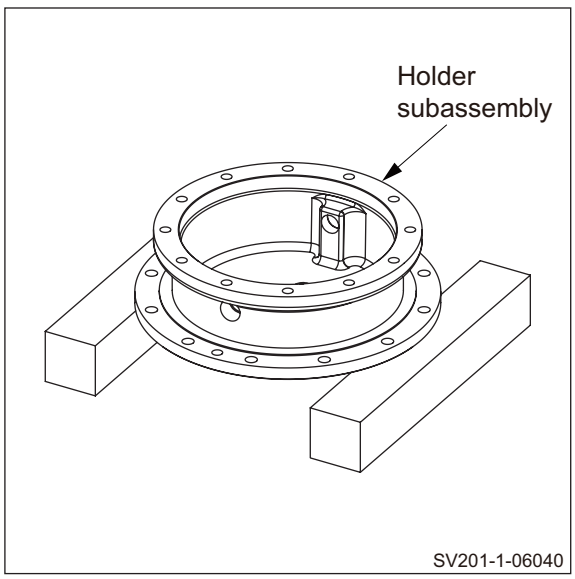
(NOTICE)

- **Take care not to damage the bearing when installing it.**

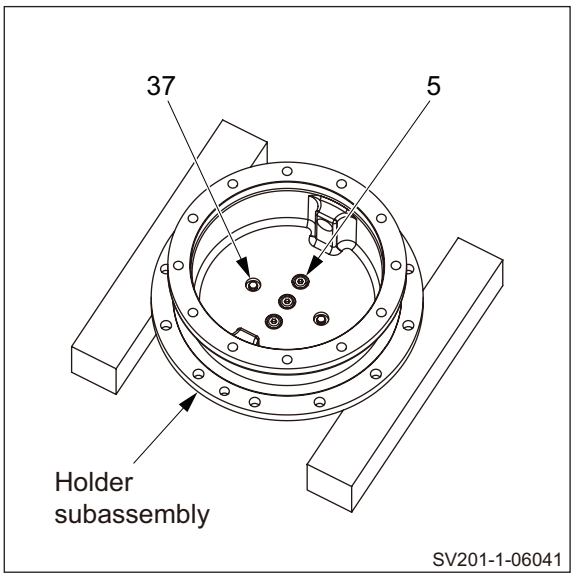


2-2) Reverse holder subassembly.

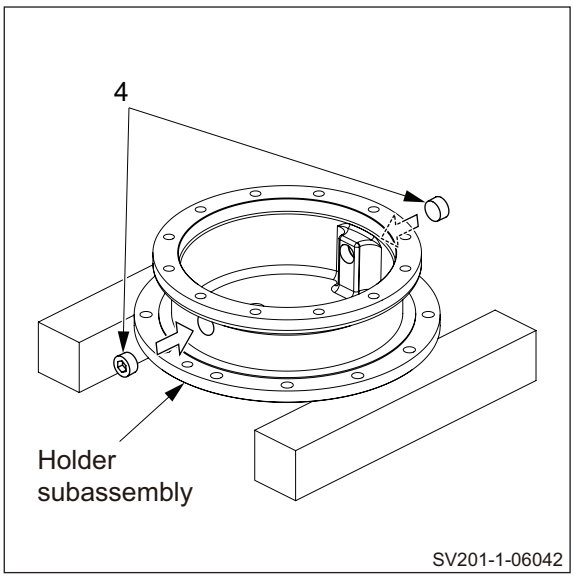
kg Holder subassembly : 65 kg (143 lbs.)



2-3) Apply grease to O-rings for plugs (5).
- Install plugs to holder subassembly.
- Install bolts (37) and seal washers to holder subassembly.



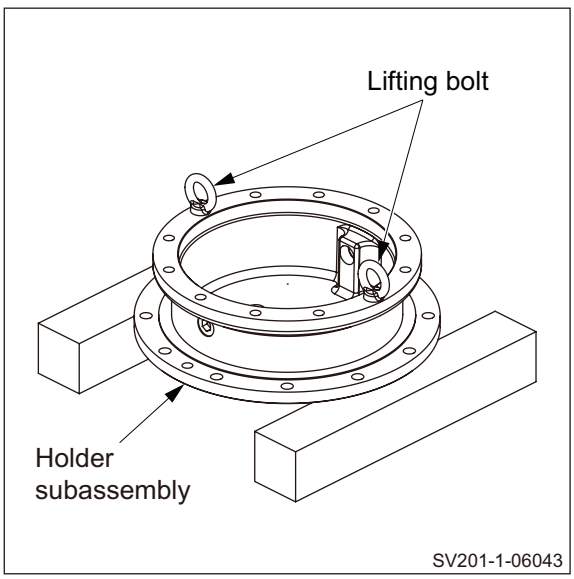
2-4) Apply screw locking agent to plugs (4).
- Install plugs to holder subassembly.



⚠WARNING

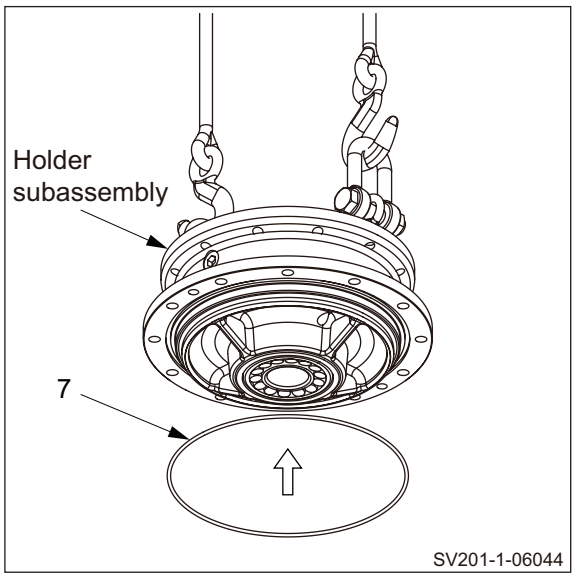
When installing lifting bolts, screw in the threads fully before using.

3) Install lifting bolts (M16) to holder subassembly.



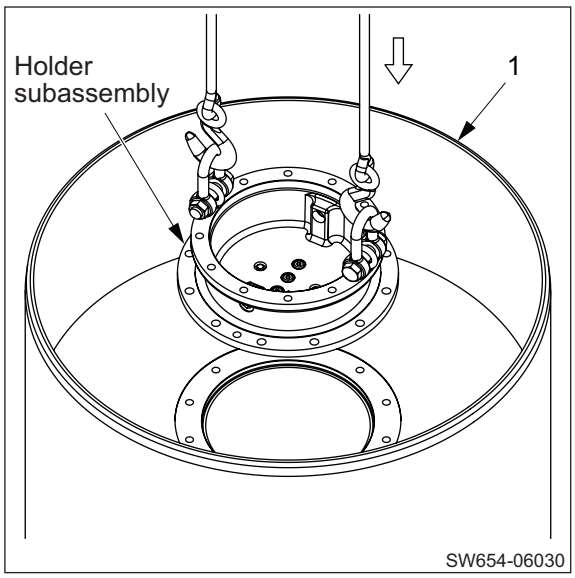
4) Lift holder subassembly.
   - Apply grease to O-ring (7).
   - Install O-ring to holder subassembly.

   Holder subassembly : 65 kg (143 lbs.)



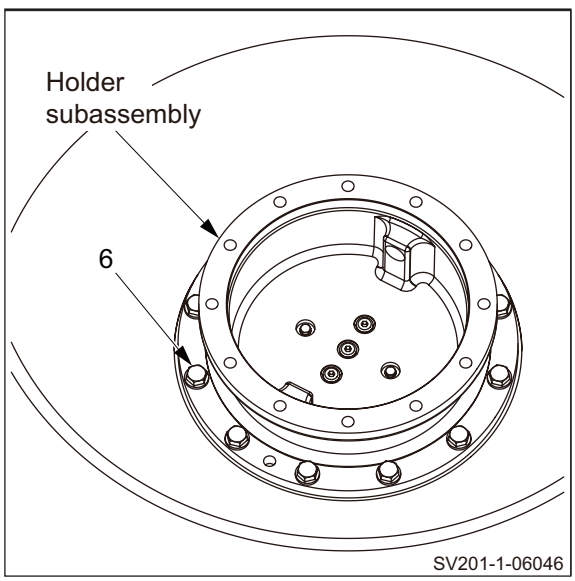
5) Lower holder subassembly on mounting surface of drum (1).

(NOTICE)
- **Take care not to let O-ring to protrude from its groove during installation.**

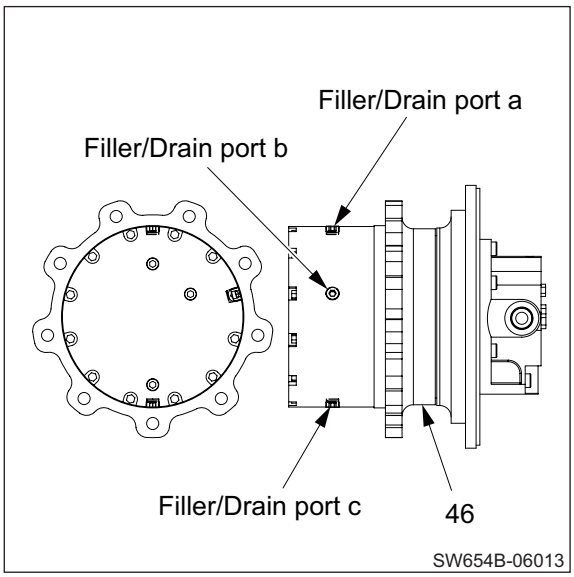


6) Secure holder subassembly to drum (1) with twelve bolts (6) and washers.

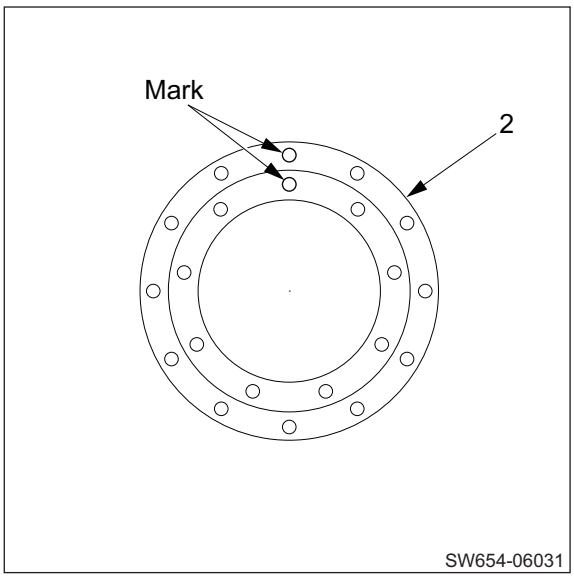
(6) Bolt M16×45 : 265 N·m (195 lbf·ft)



7) Reassembly of propulsion motor subassembly



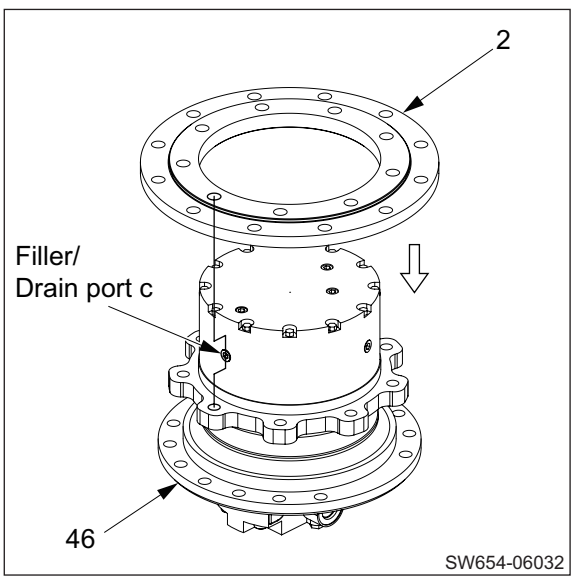
7-1) Making marks on holes of ring (2) as shown.



7-2) Install ring (2) to mounting surface of propulsion motor (46).

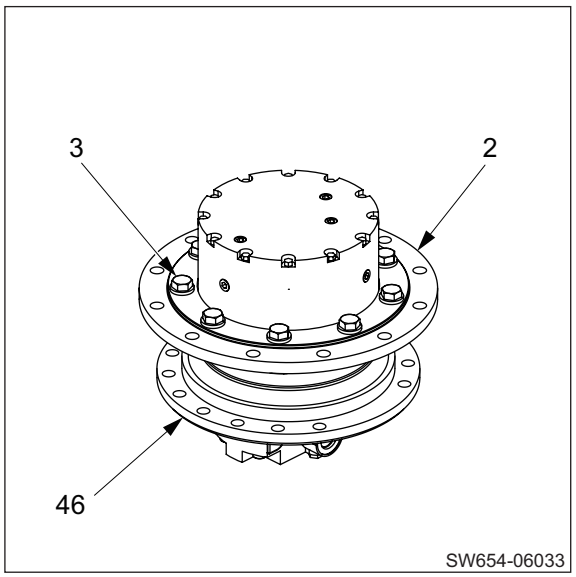
(NOTICE)

- **Align mark of ring with filler/drain port “c” as shown.**



7-3) Secure ring (2) to propulsion motor (46) with nine bolts (3) and washers.

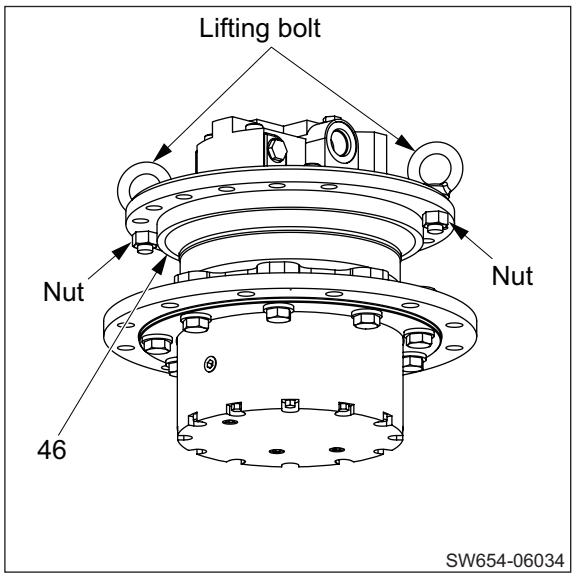
N•m (3) Bolt M16×45 : 265 N·m (195 lbf·ft)



8) Reverse propulsion motor subassembly.

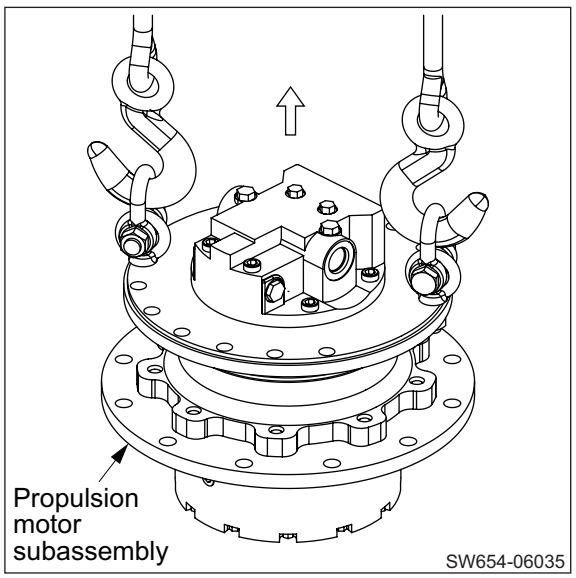
kg Propulsion motor subassembly : 105 kg (231 lbs.)

- Install lifting bolts and nuts (M16) to propulsion motor (46).



9) Lift propulsion motor subassembly.

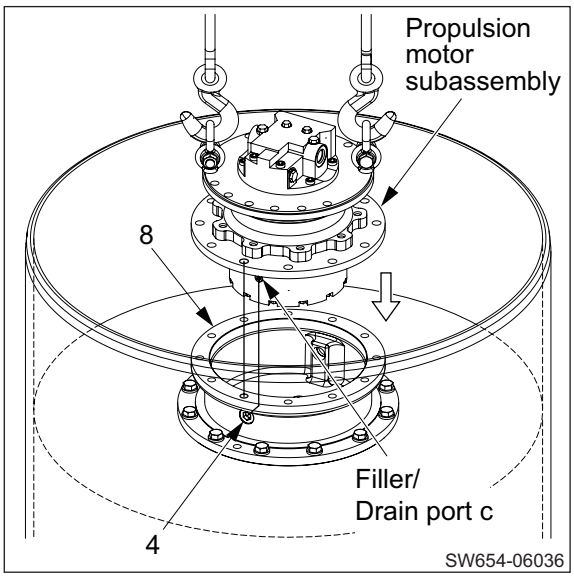
kg Propulsion motor subassembly : 105 kg (231 lbs.)



10) Lower propulsion motor subassembly on mounting surface of holder (8).

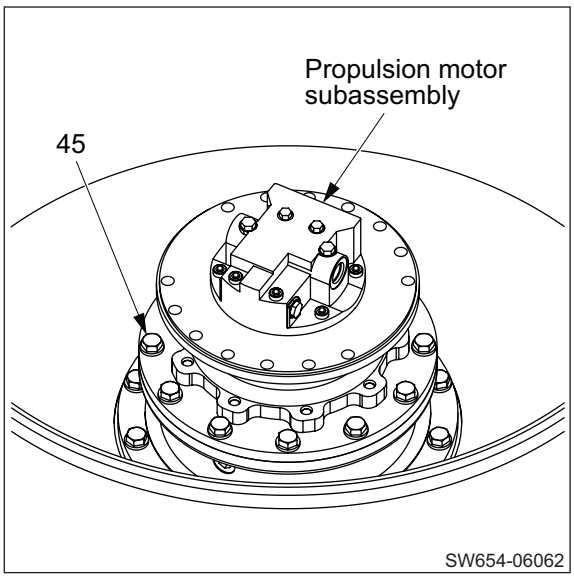
(NOTICE)

- **Align mark of ring with plug (4) as shown.**



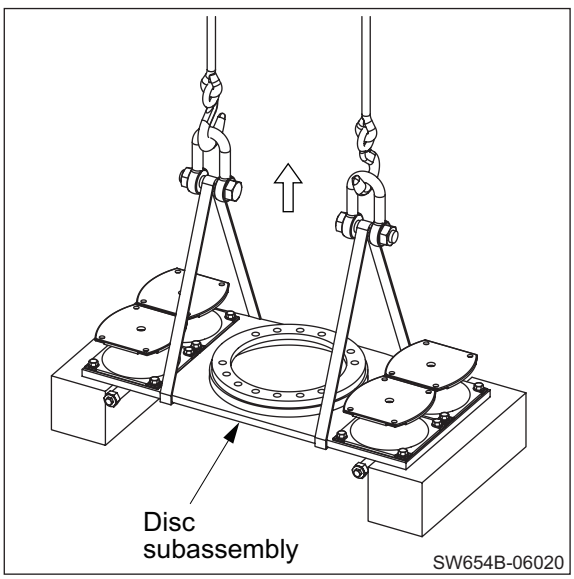
11) Secure propulsion motor subassembly with twelve bolts (45) and washers.

N•m (45) Bolts M16×45 : 265 N·m (195 lbf·ft)

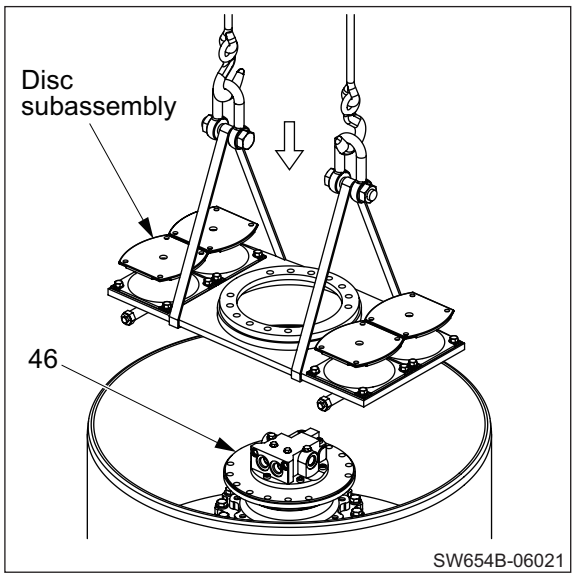


12) Lift disc subassembly.

kg Disc subassembly : 65 kg (143 lbs.)

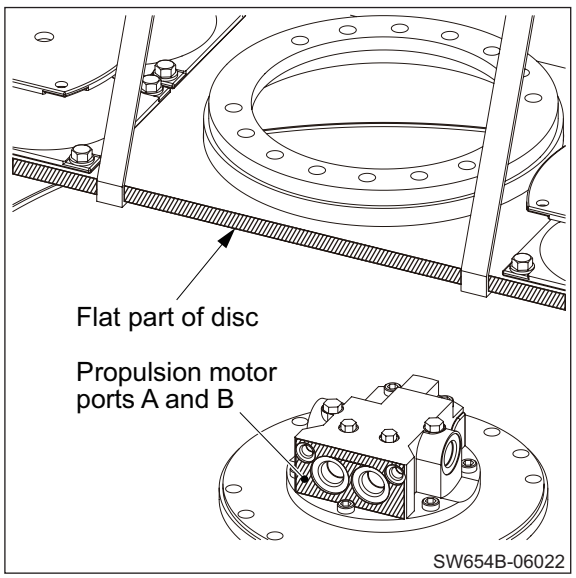


13) Lower disc subassembly on mounting surface of propulsion motor (46).



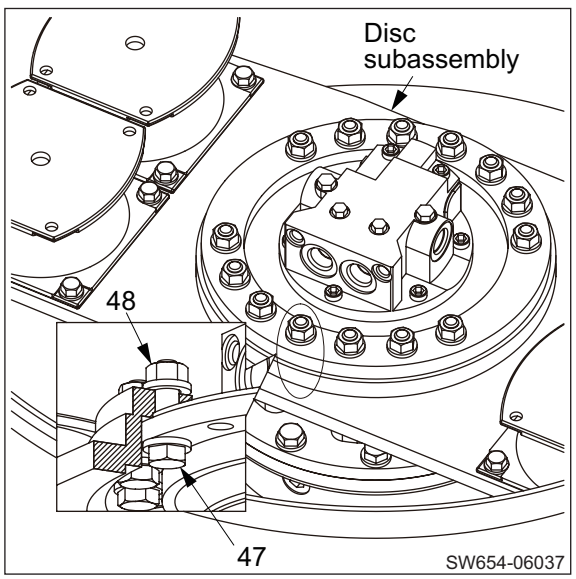
(NOTICE)

- **The flat part of the disc must be parallel with the side of the propulsion motor ports A and B.**



14) Secure disc subassembly with fourteen bolts (47), nuts (48) and washers.

N•m (47) Bolts M16×60 : 265 N·m (195 lbf·ft)

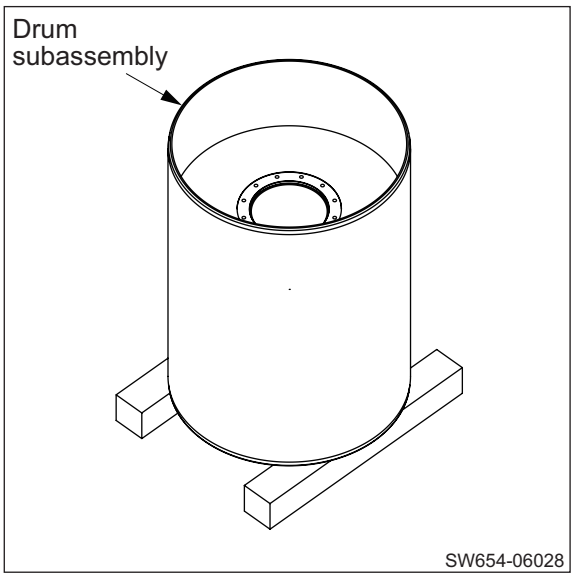


⚠WARNING

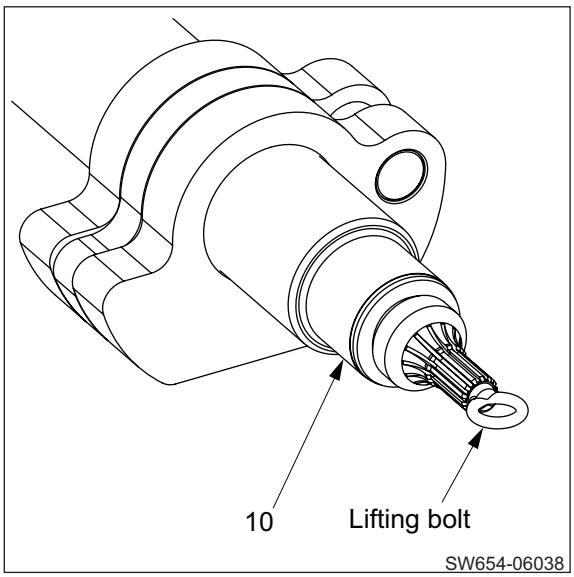
Be careful because reversing the vibratory drum involves risk. Confirm that the surrounding area is safe, and work in a natural, unstrained posture.

15) Reverse drum subassembly.

Drum subassembly : 1,265 kg (2,789 lbs.)



16) Install a lifting bolt (M8) to eccentric shaft (10).



⚠WARNING

Take care not to get your fingers caught in movable weights.

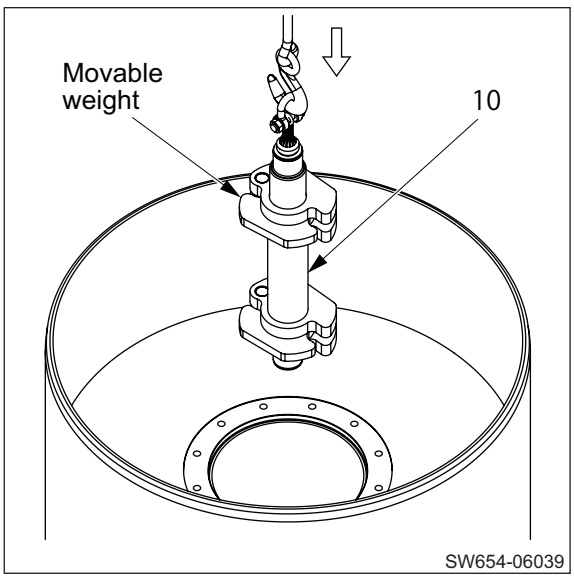
17) Apply a coat of gear oil to eccentric shaft (10) at where bearing will be installed.

- Install eccentric shaft.

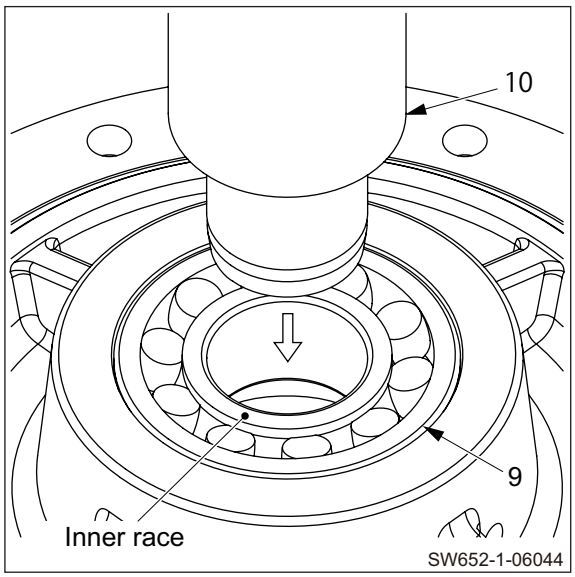
(10) Eccentric shaft : 55 kg (121 lbs.)

(NOTICE)

- **Put the movable weight at its outmost position.**



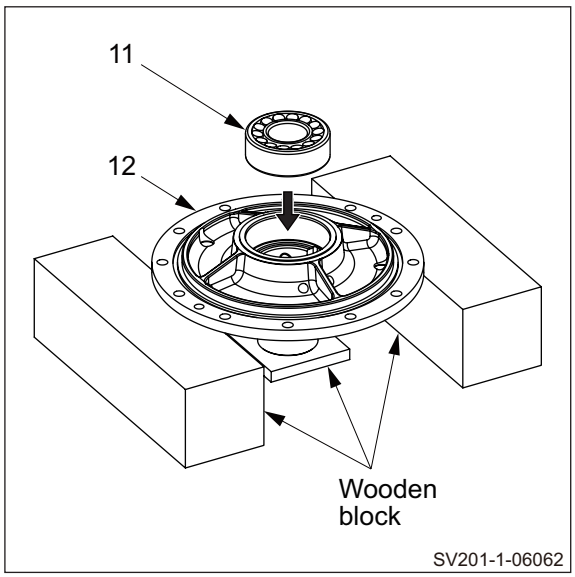
18) Insert eccentric shaft (10) into vibrator bearing (9) while taking care not to tilt vibrator bearing inner race.



19) Reassembly of axle shaft subassembly

19-1) Apply a coat of gear oil to axle shaft (12) at where bearing will be press-fitted.

- Drive in vibrator bearing (11).



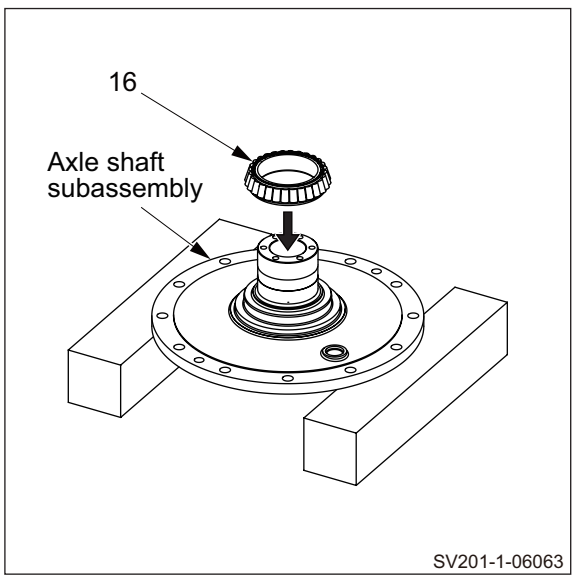
⚠WARNING

Wear heat resistant gloves when handling heated parts to avoid burns.

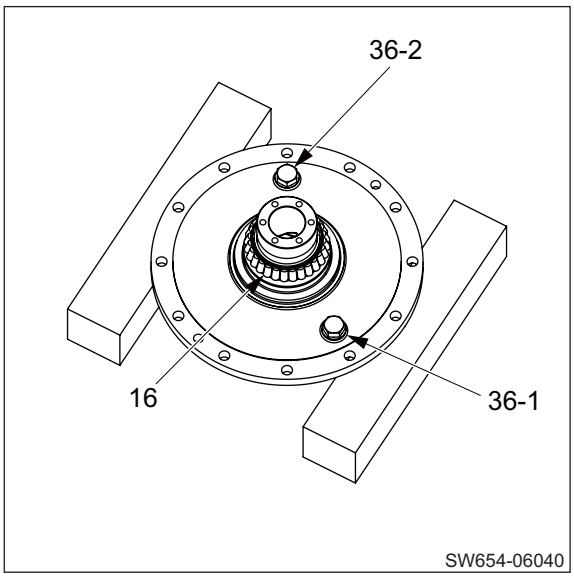
19-2) Reverse axle shaft subassembly.

Axle shaft subassembly : 45 kg (99 lbs.)

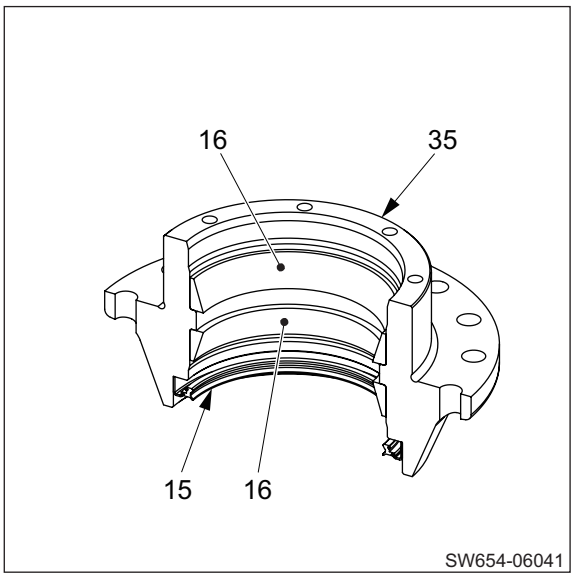
- Heat up roller bearing (16) inner race by using a ring heater or the like.
- Apply a coat of gear oil to axle shaft at where bearing inner race will be press-fitted.
- Drive in heated roller bearing inner race.



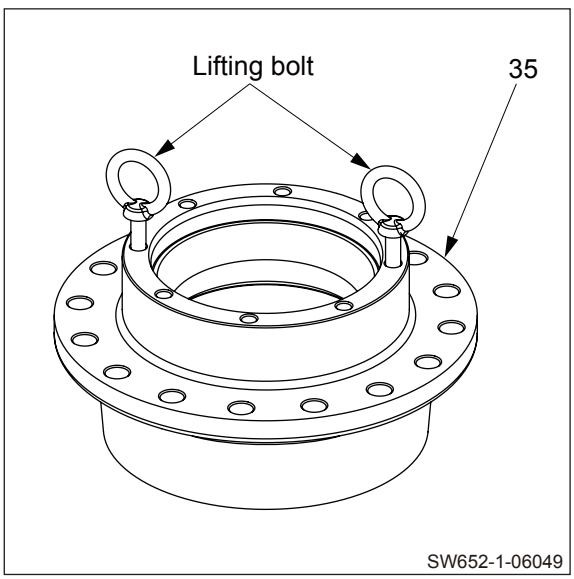
19-3) Apply grease to O-rings for plugs (36-1) and (36-2).
- Install plugs.
- Apply sufficient amount of lithium-based grease to rollers of roller bearing (16) inner race.



19-4) Apply a coat of gear oil to housing (35) at where bearing outer races will be press-fitted.
- Drive roller bearings (16) outer races into housing.
- Apply liquid packing to periphery of oil seal (15).
- Drive in oil seal.
- Apply grease to lip of oil seal.

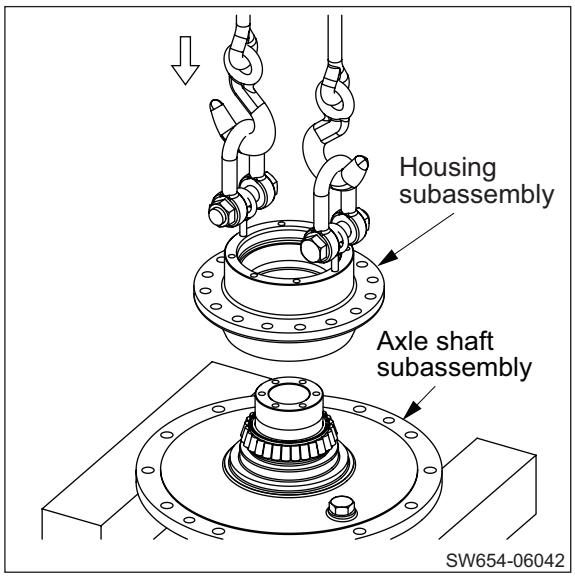


19-5) Install lifting bolts (M10) to housing (35).



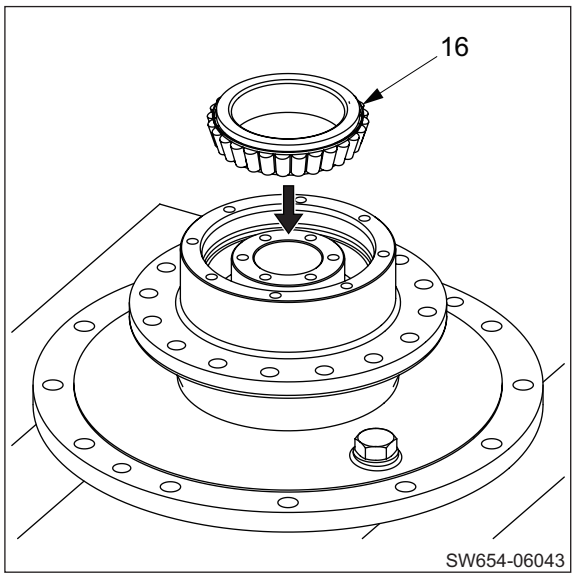
19-6) Install housing subassembly to axle shaft subassembly.

Housing subassembly : 20 kg (44 lbs.)



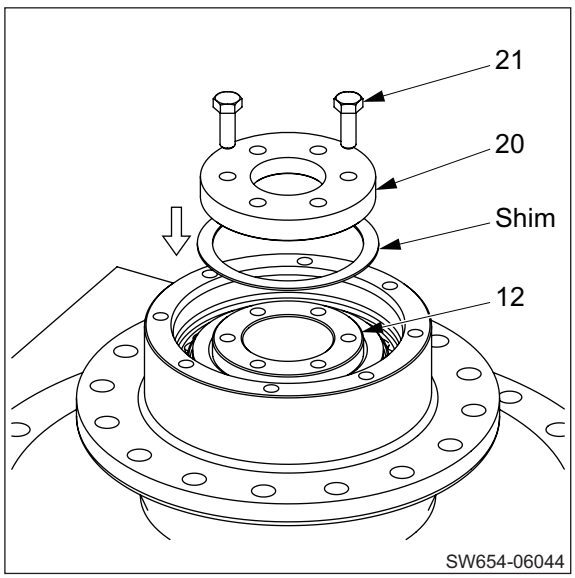
19-7) Apply sufficient amount of lithium-based grease to rollers of roller bearing (16) inner race.

- Drive in roller bearing inner race until rollers come in contact with outer race.

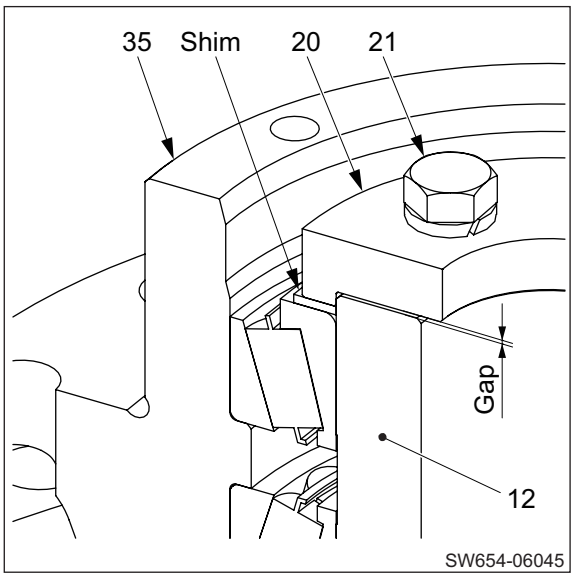


19-8) Preload adjustment of roller bearing

① Install a shim of about 1 mm (0.04 in.) and secure cover (20) to axle shaft (12) with two bolts (21) and spring washers.

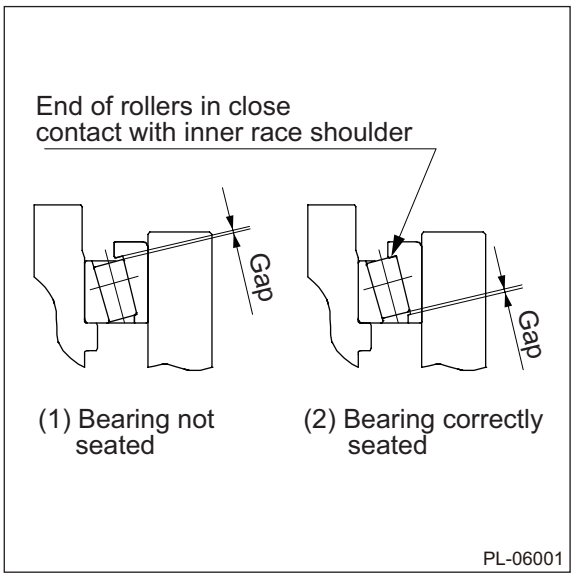


② A gap will remain between end of axle shaft (12) and inside of cover (20).
- Tighten bolts (21) to a torque of 30 N·m (22 lbf·ft).
- Give housing (35) two to three turns.
- Tighten bolts to a torque of 30 N·m (22 lbf·ft) again.
- Repeat this work several times until tightening torque of bolts no longer fluctuates.



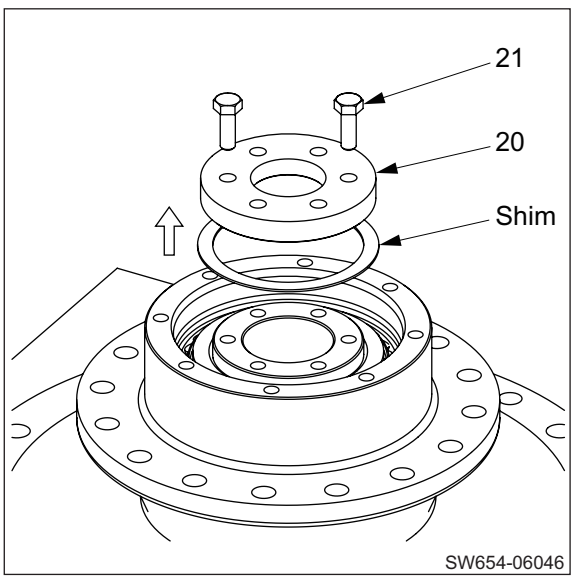
(NOTICE)
- **Tighten the bolts alternately in diagonal directions.**

(NOTICE)
- **Push in the inner race while rotating the bearing. Otherwise, even strongly trying to push the inner race, the bearing rollers will not be pushed up and therefore bearing will not be seated.**

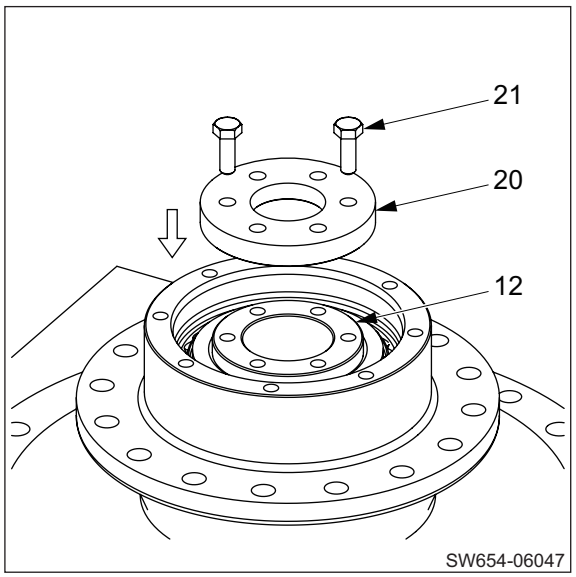


③ Remove bolts (21).
- Remove cover (20).
- Remove shim.

(NOTICE)
- **Do not turn the housing after the cover is removed.**

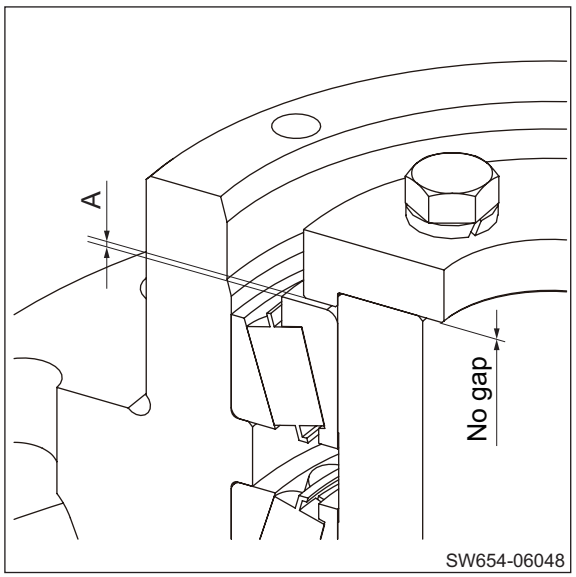


④ Without inserting shim, install cover (20) to axle shaft (12) with two bolts (21) and spring washers.



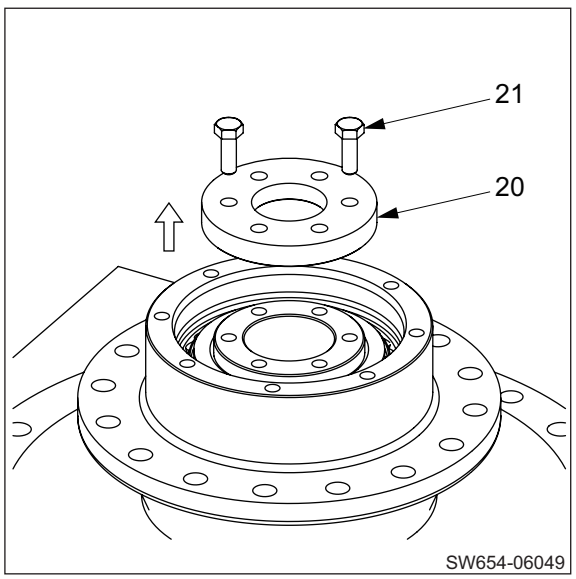
⑤ Using a thickness gauge, measure clearance “A”.

★ **Preload adjusting shim thickness** **= A + 0.1 mm (0.004 in.)**



⑥ Remove bolts (21).

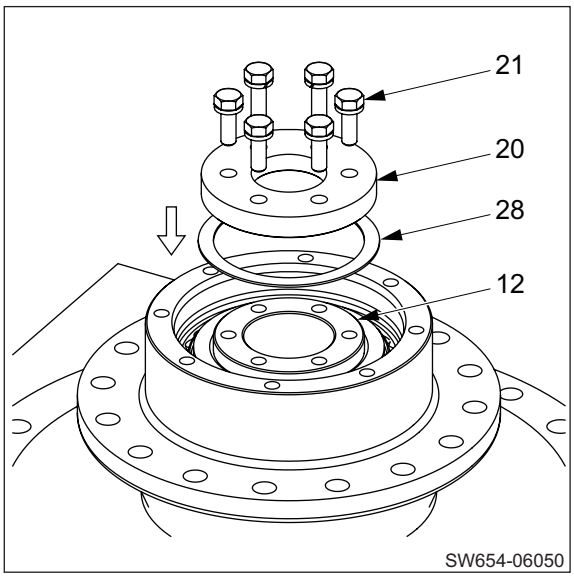
• Remove cover (20).



⑦ Install shim (28) of preload adjusting shim thickness = “A + 0.1 mm (0.004 in.)”.

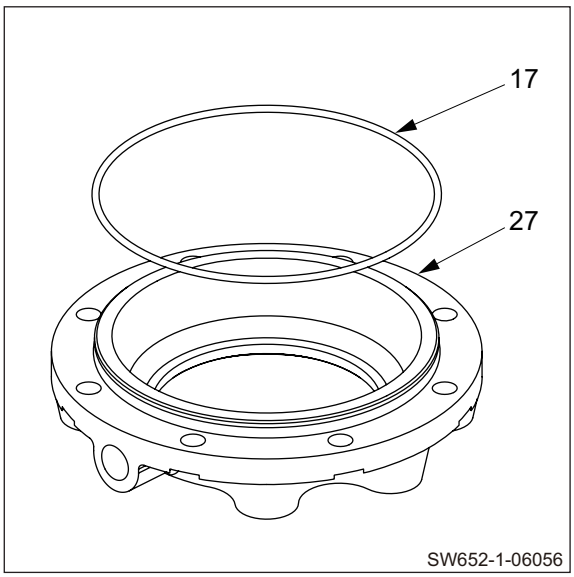
- Secure cover (20) to axle shaft (12) with six bolts (21) and spring washers.

N•m (21) Bolts M10×30 : 59 N·m (43.5 lbf·ft)



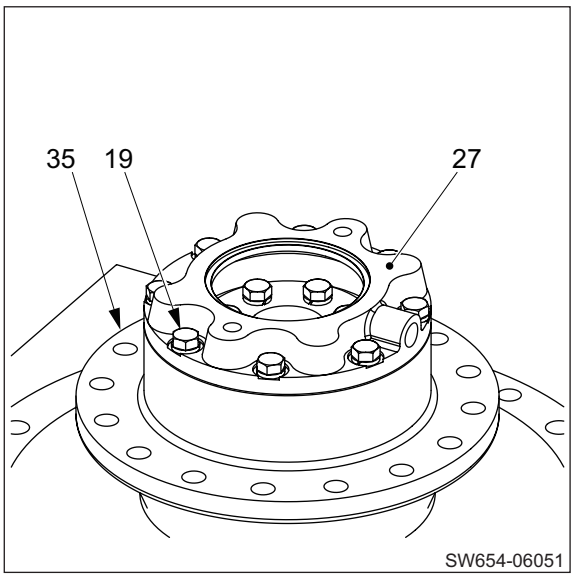
19-9) Apply grease to O-ring (17).

- Install O-ring to flange (27).

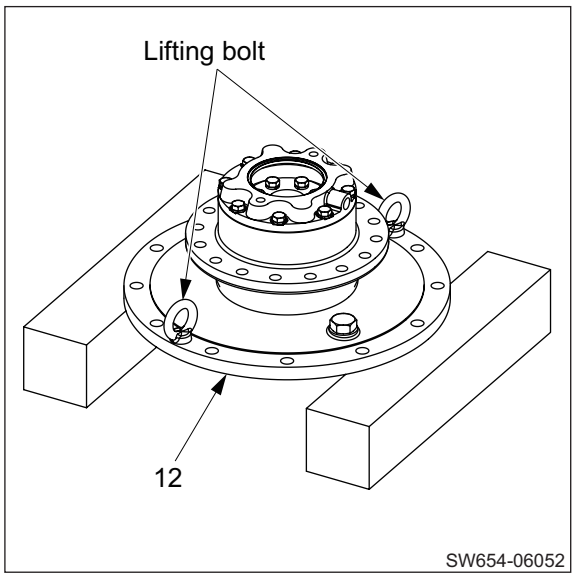


19-10) Secure flange (27) to housing (35) with eight bolts (19) and spring washers.

N•m (19) Bolts M10×30 : 59 N·m (43.5 lbf·ft)



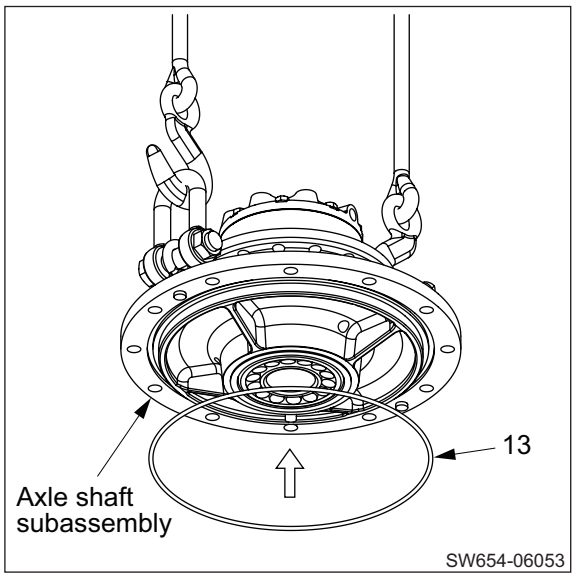
20) Install lifting bolts (M16) to axle shaft (12).



21) Lift axle shaft subassembly.

Axle shaft subassembly : 75 kg (165 lbs.)

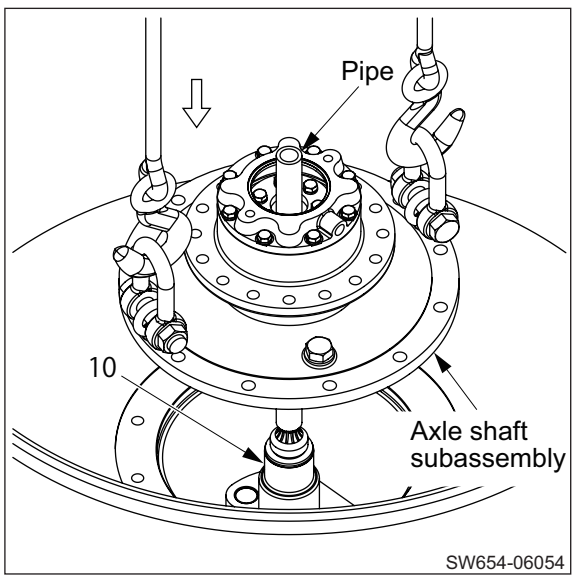
- Apply grease to O-ring (13).
- Install O-ring to axle shaft (12).



22) Lower axle shaft subassembly on mounting surface of drum slowly.

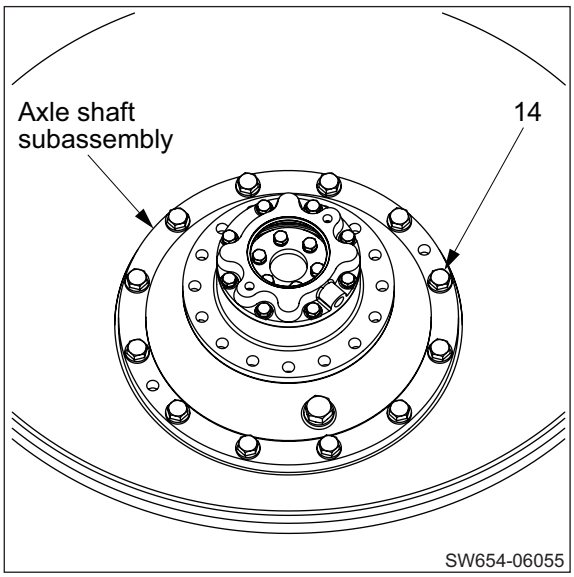
(NOTICE)

- **Support the eccentric shaft (10) with a pipe or the like, to prevent tilting of the vibrator bearing inner race during installation.**

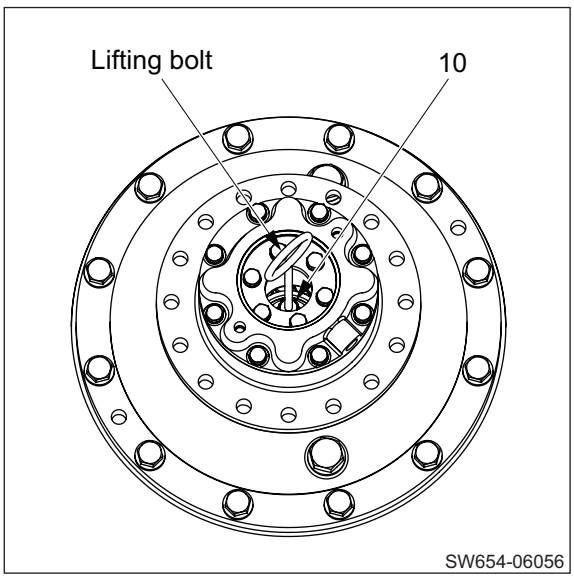


23) Secure axle shaft subassembly with twelve bolts (14) and washers.

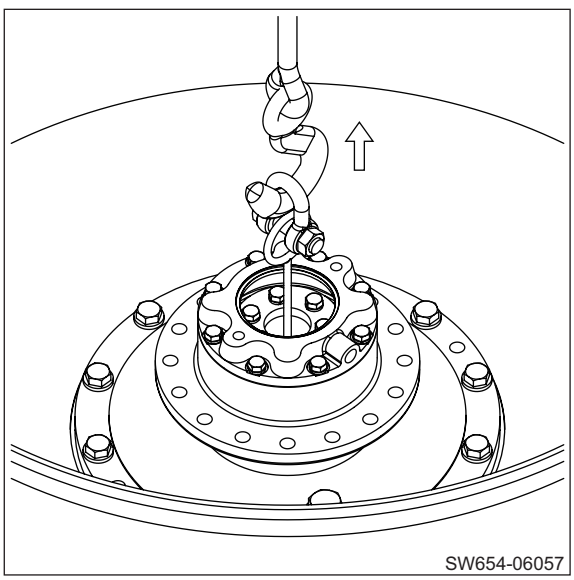
N•m (14) Bolts M16×45 : 265 N·m (195 lbf·ft)



24) Install a lifting bolt (M8) to end of eccentric shaft (10).

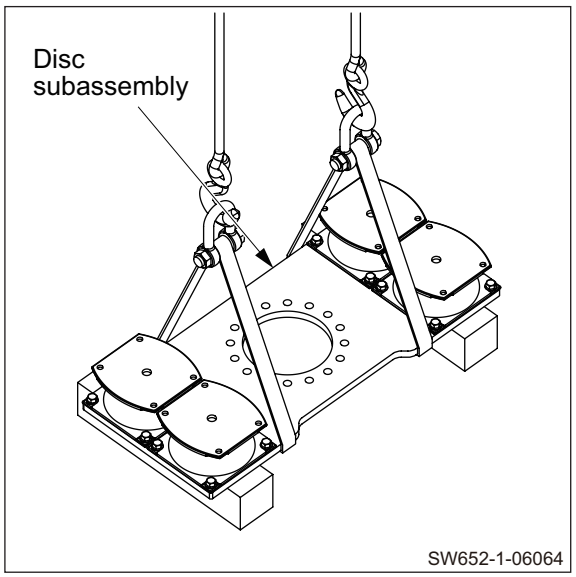


25) Slowly lift eccentric shaft with a crane and check that there is an axial play of 1 to 2.4 mm (0.04 to 0.09 in.).

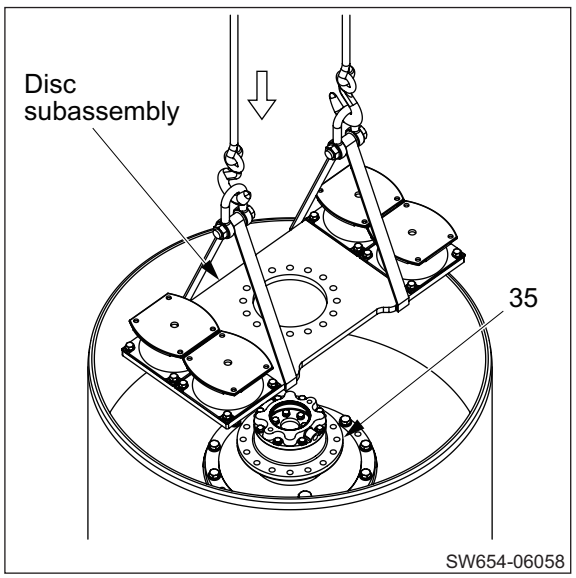


26) Lift disc subassembly.

Disc subassembly : 75 kg (165 lbs.)

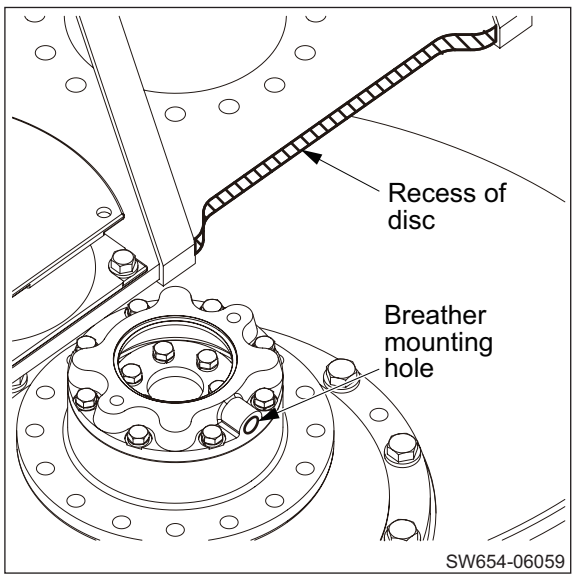


27) Lower disc subassembly on mounting surface of housing (35).



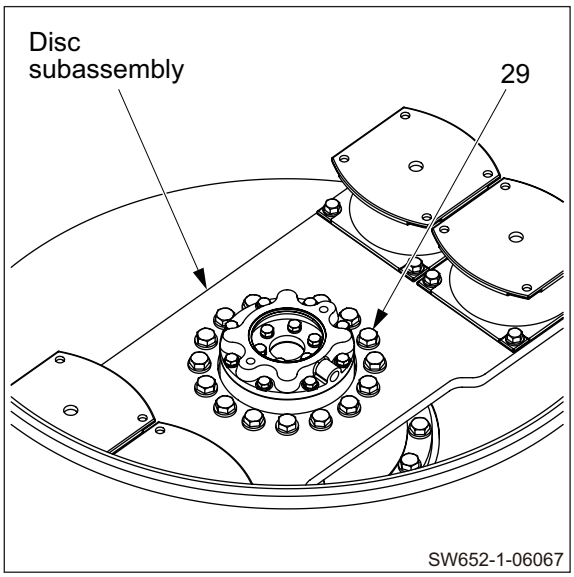
(NOTICE)

- **The recess of the disc must face the same direction as the breather mounting hole in the flange.**

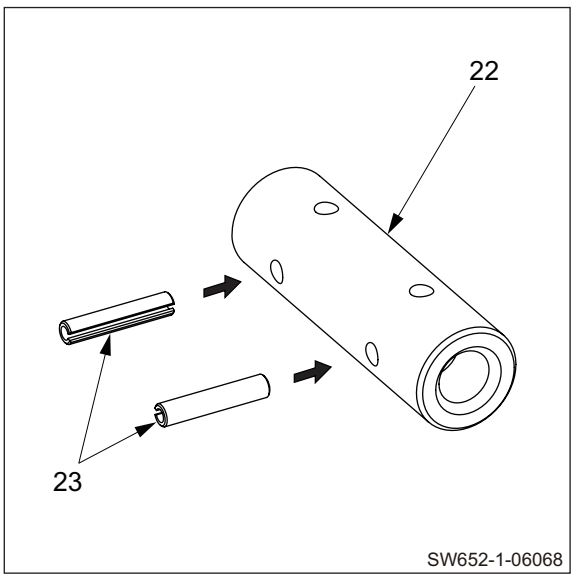


28) Secure disc subassembly with sixteen bolts (29) and washers.

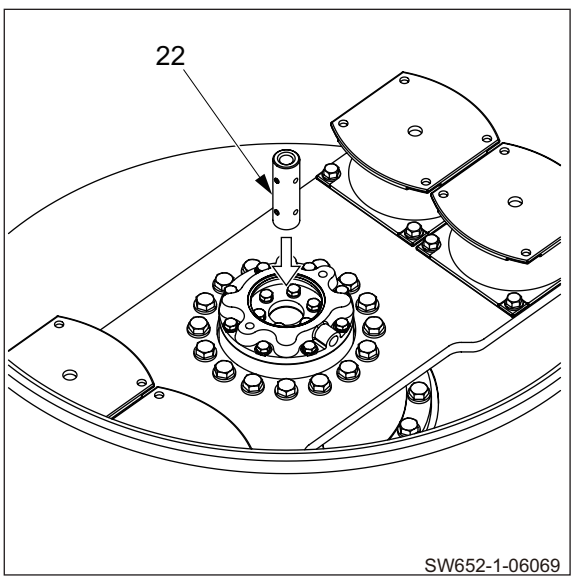
N•m (29) Bolts M16×45 : 265 N·m (195 lbf·ft)



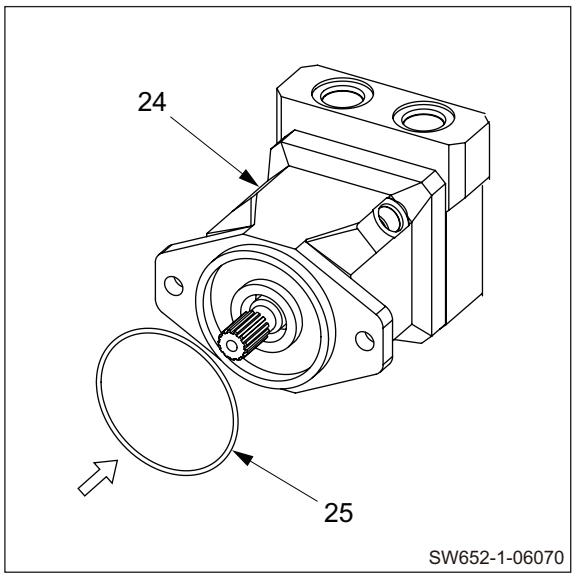
29) Drive two spring pins (23) into sleeve (22).



30) Apply molybdenum-based grease to splined portion of sleeve (22).
- Fit sleeve to splined portion on eccentric shaft end.



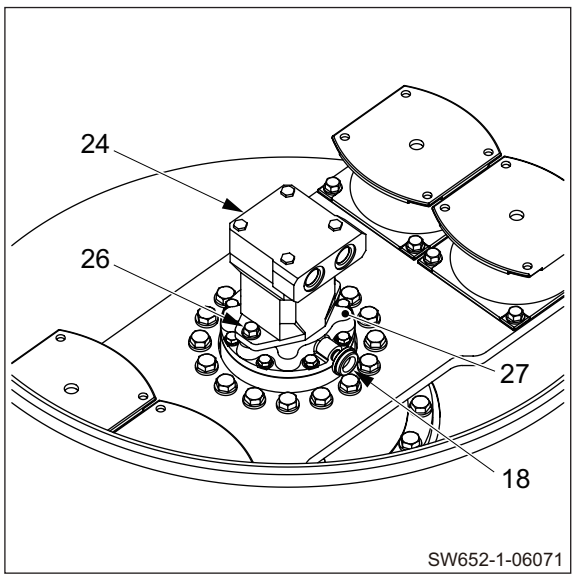
31) Apply grease to O-ring (25).
- Install O-ring to vibrator motor (24).



32) Wind seal tape around threaded portion of breather (18).
- Install breather.
- Secure vibrator motor (24) to flange (27) with two bolts (26) and washers.

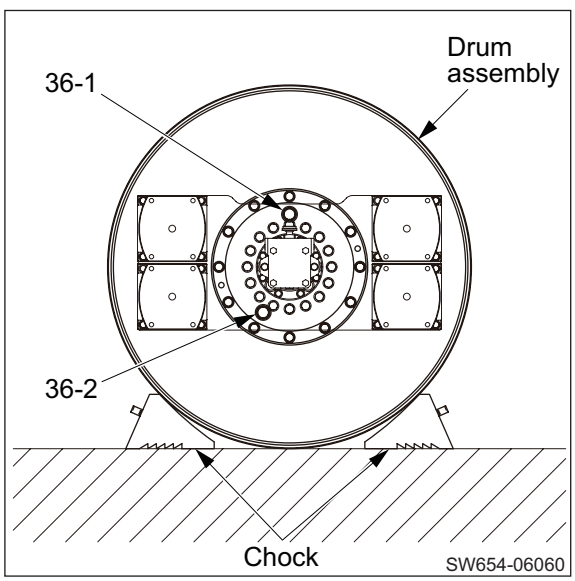
(24) Vibrator motor :15 kg (33 lbs.)

(1267) Bolts M12×30 : 108 N·m (80 lbf·ft)

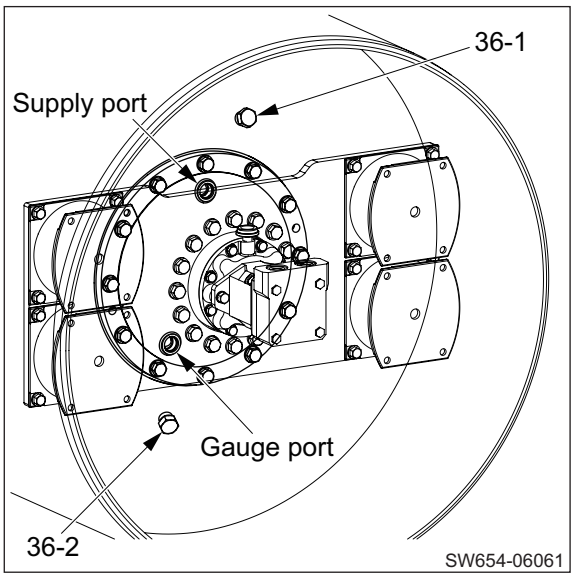


33) Lay drum assembly with plugs (36-1) and (36-2) positioned as shown right.
- Hold with chocks.

Drum assembly : 1,485 kg (3,274 lbs.)

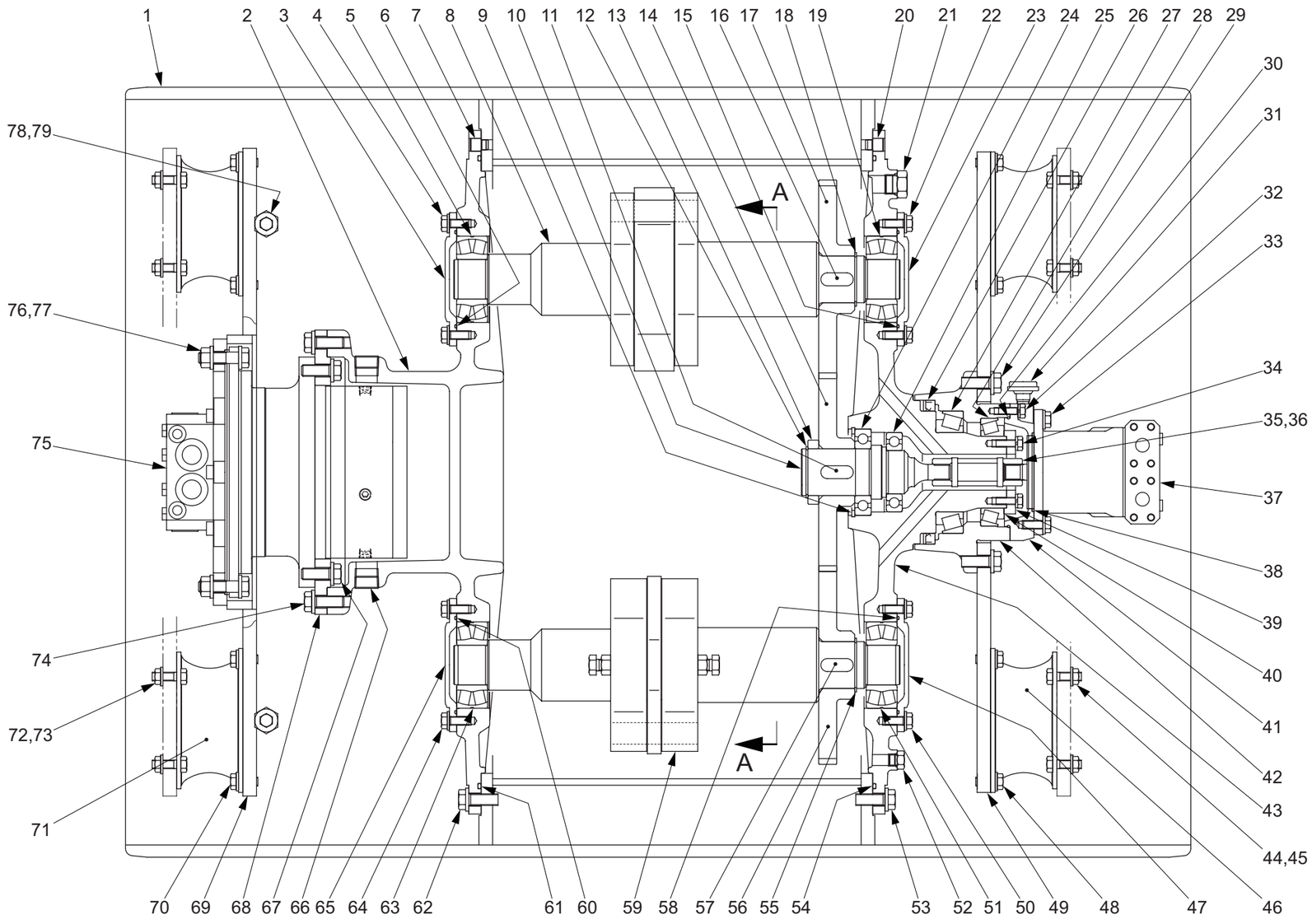


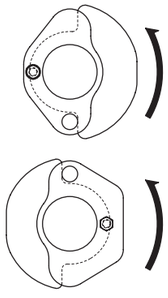
34) Remove plug (36-1) and (36-2).
- Supply gear oil from oil supply port.
- Check that oil drips from gauge port.
  - Quantity of gear oil : 2.2 L (0.6 gal.)
- Reinstall plugs.



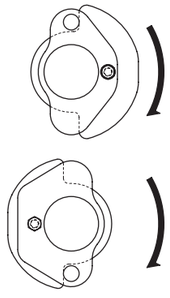
7. VIBRATORY DRUM ASSEMBLY (SW654ND) (FROM 30143)

7-1. Vibratory Drum Assembly



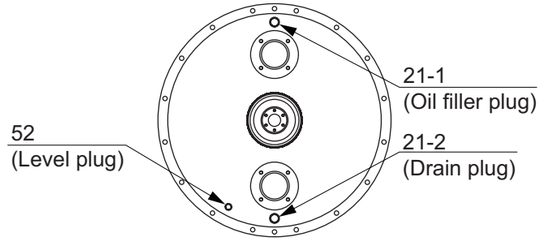


Vibration mode: Normal
Counterclockwise rotation



Vibration mode: Oscillation
Clockwise rotation

SECTION A-A



Vibrator motor side

0559-43805-0-11265-0

(1)	Drum		(51)	Vibrator bearing	
(2)	Housing		(52)	Level plug	
(3)	Cover		(53)	Bolt	: M16×45
(4)	Bolt	: M12×30	(54)	O-ring	
(5)	Vibrator bearing		(55)	Retaining ring	
(6)	O-ring		(56)	Gear	
(7)	Pin		(57)	Sunk key	
(8)	Eccentric shaft		(58)	O-ring	
(9)	Retaining ring		(59)	Eccentric shaft	
(10)	Shaft		(60)	O-ring	
(11)	Sunk key		(61)	O-ring	
(12)	Retaining ring		(62)	Bolt	: M16×45
(13)	Collar		(63)	Vibrator bearing	
(14)	Gear		(64)	Bolt	: M12×30
(15)	O-ring		(65)	Cover	
(16)	Sunk key		(66)	Plug	
(17)	Gear		(67)	Bolt	: M16×45
(18)	Retaining ring		(68)	Ring	
(19)	Vibrator bearing		(69)	Disc	
(20)	Pin		(70)	Bolt	: M12×30
(21)	Plug		(71)	Damper	
(22)	Bolt	: M12×30	(72)	Bolt	: M12×40
(23)	Cover		(73)	Nut	: M12
(24)	Ball bearing		(74)	Bolt	: M16×45
(25)	Ball bearing		(75)	Propulsion motor	
(26)	Oil seal		(76)	Bolt	: M16×60
(27)	Roller bearing		(77)	Nut	: M16
(28)	Roller bearing		(78)	Pipe	
(29)	Bolt	: M16×45	(79)	Bolt	: M10×110
(30)	O-ring				
(31)	Breather				
(32)	Bolt	: M10×30			
(33)	Bolt	: M12×30			
(34)	Bolt	: M10×30			
(35)	Sleeve				
(36)	Spring pin				
(37)	Vibrator motor				
(38)	O-ring				
(39)	Cover				
(40)	Shim				
(41)	Flange				
(42)	Housing				
(43)	Axle shaft				
(44)	Bolt	: M12×40			
(45)	Nut	: M12			
(46)	Damper				
(47)	Cover				
(48)	Bolt	: M12×30			
(49)	Disc				
(50)	Bolt	: M12×30			

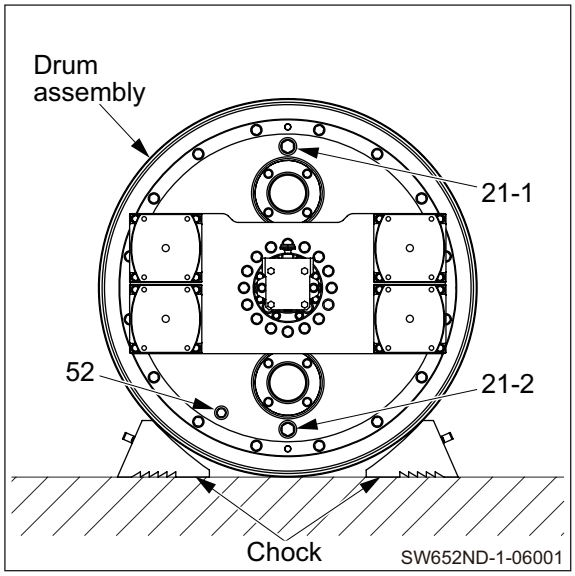
7-2. Disassembly and Reassembly of Vibratory Drum

- Lead line numbers shown in the illustrations for the following vibratory drum disassembly and reassembly procedures are constant with part numbers of vibratory drum assembly shown on page 6-111.

7-2-1. Disassembly of vibratory drum

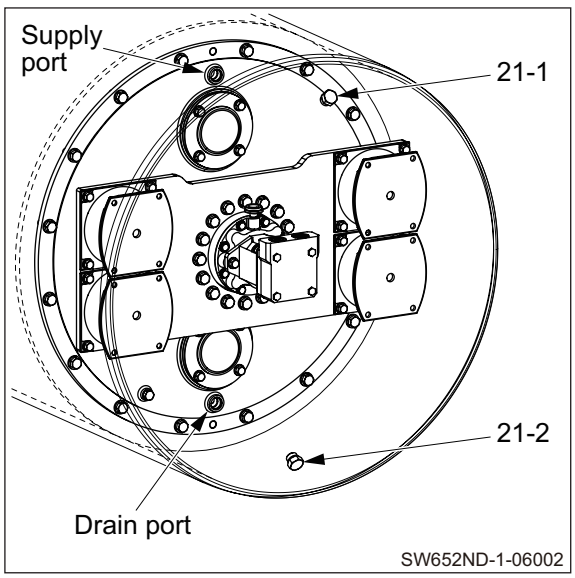
1) Lay drum assembly with plugs (21-1), (21-2), and level plug (52) positioned as shown on the right.
   - Hold with chocks.

   Drum assembly : 1,695 kg (3,737 lbs.)



2) Remove plugs (21-1) and (21-2).
   - Drain gear oil.

   • Quantity of gear oil : 10.4 L (2.7 gal.)

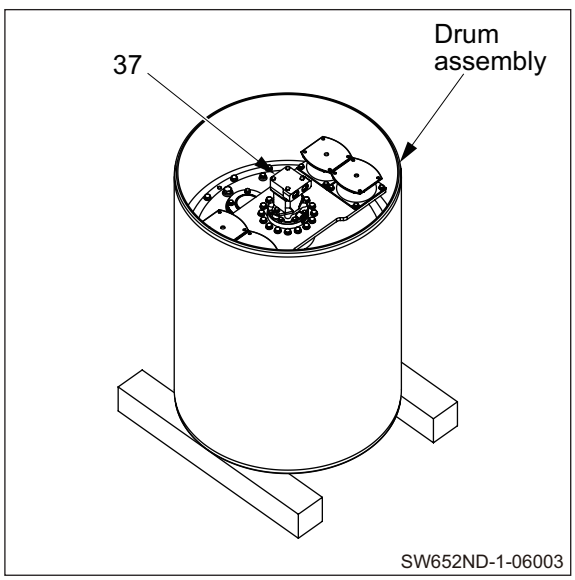


WARNING

- **When standing the vibratory drum, use wooden blocks of sufficient strength to securely support the drum.**
- **Carry out the work in an unstrained posture using a work stool or the like.**

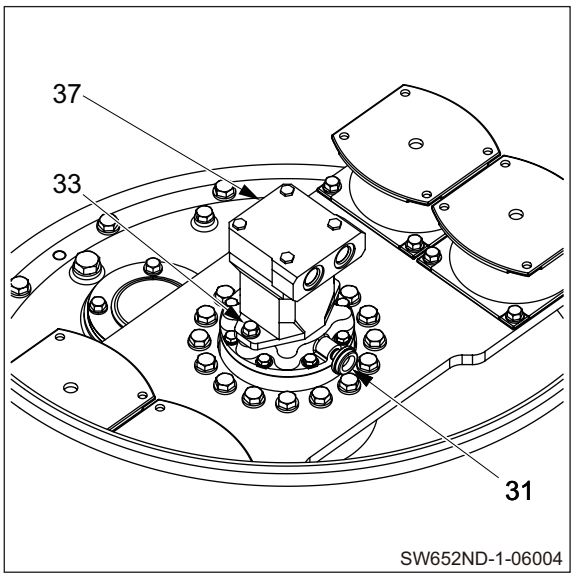
3) Stand drum assembly with its vibrator motor (37) side facing up.

   Drum assembly : 1,685 kg (3,715 lbs.)

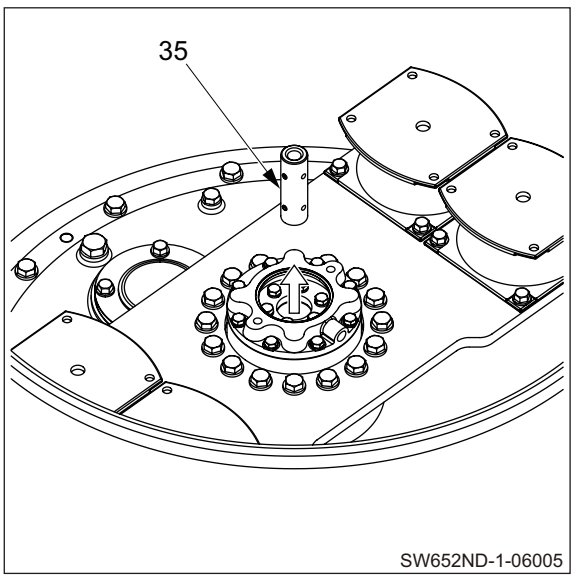


4) Remove breather (31).
   - Remove bolts (33).
   - Remove vibrator motor (37).

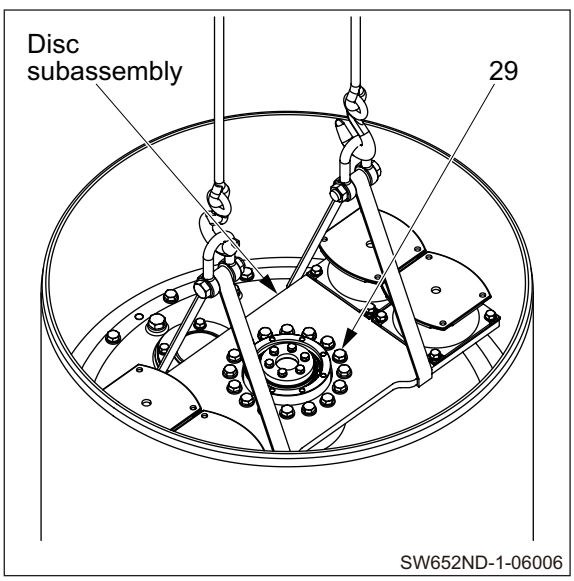
   (37) Vibrator motor : 15 kg (33 lbs.)



5) Remove sleeve (35).

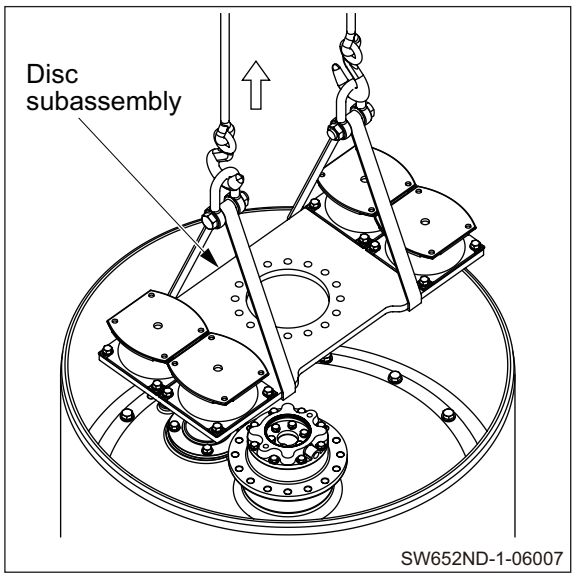


6) Lift disc subassembly.
   - Remove bolts (29).

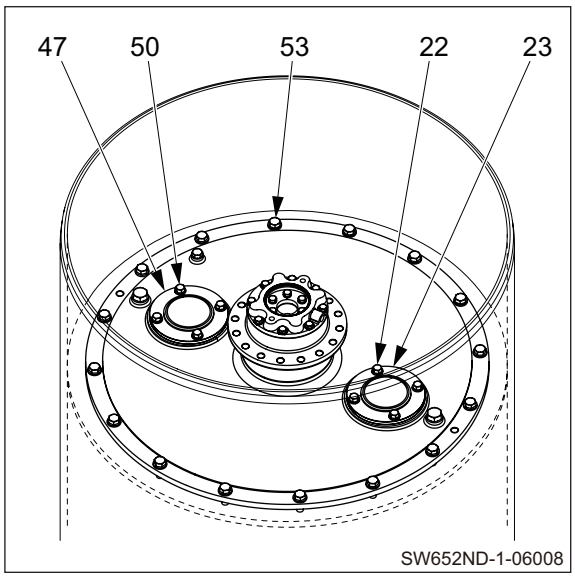


7) Remove disc subassembly.

Disc subassembly : 75 kg (165 lbs.)



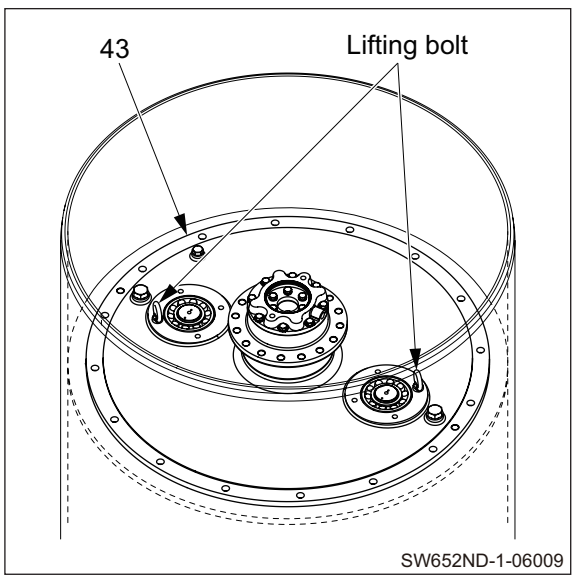
8) Remove bolts (22) and (50).
- Remove covers (23) and (47).
- Remove bolts (53).



WARNING

When installing lifting bolts, screw in the threads fully before using.

9) Install lifting bolts (M12) to axle shaft (43).

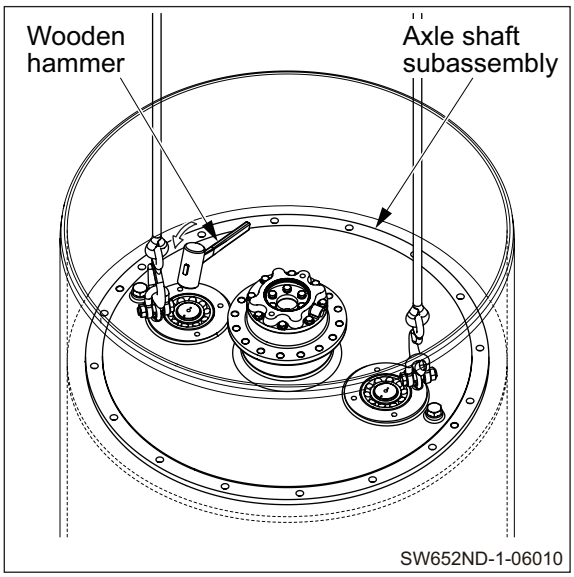


10) Remove axle shaft subassembly.

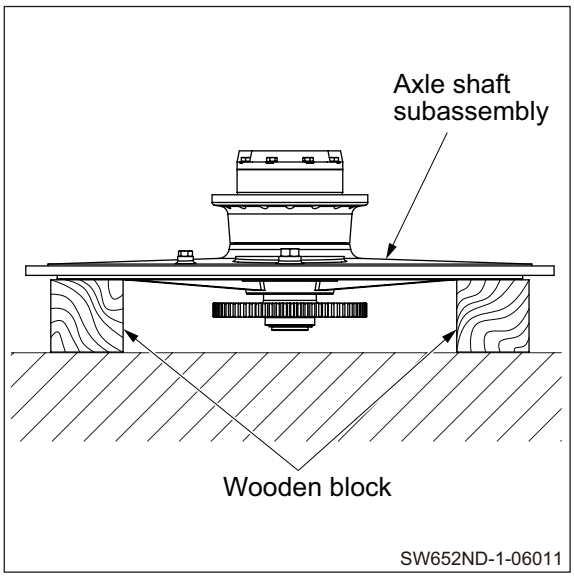
Axle shaft subassembly : 200 kg (441 lbs.)

(NOTICE)

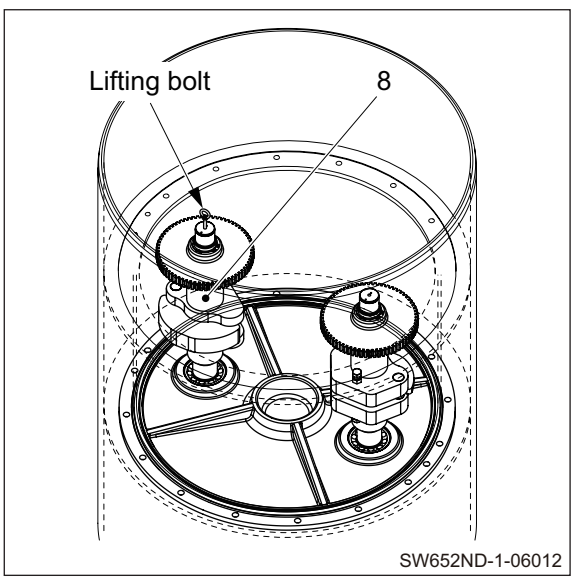
- **In order not to lift eccentric shaft together with axle shaft subassembly, tap on the eccentric shaft ends alternately with a wooden hammer during lifting.**



11) Put axle shaft subassembly on wooden blocks.



12) Install lifting bolts (M8) to eccentric shaft (8).



⚠WARNING

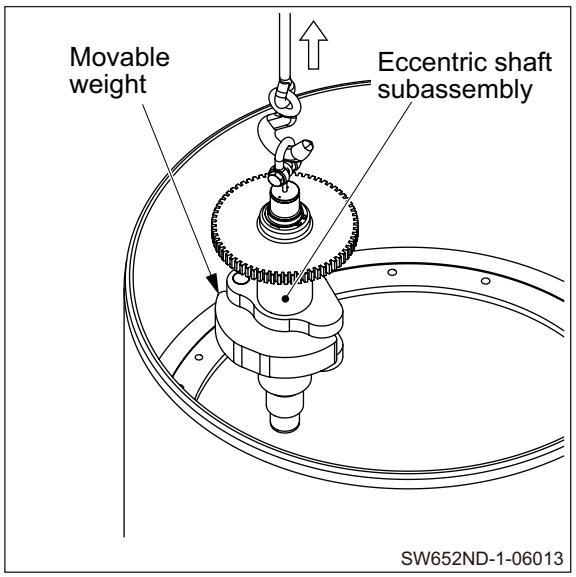
Take care not to get your fingers caught in movable weights.

13) Remove eccentric shaft subassembly.

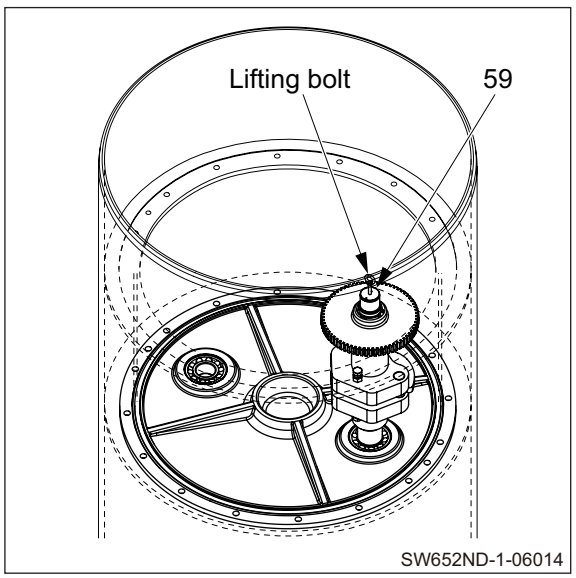
Eccentric shaft subassembly : 70 kg (154 lbs.)

(NOTICE)

- **Put the movable weight at its outmost position.**



14) Install a lifting bolt (M8) to eccentric shaft (59).

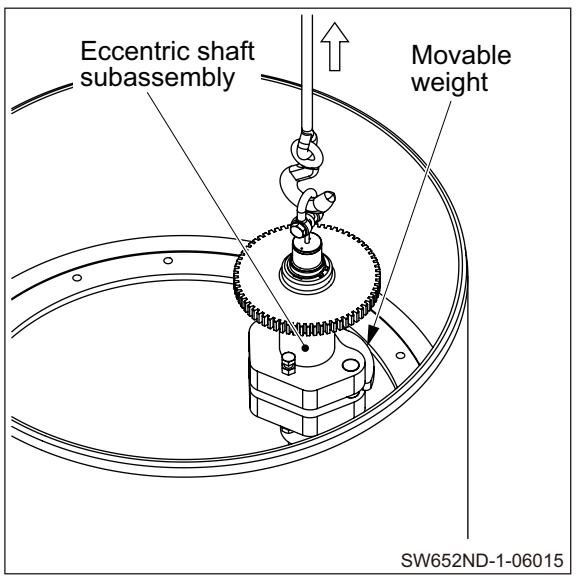


15) Remove eccentric shaft subassembly.

Eccentric shaft subassembly : 70 kg (154 lbs.)

(NOTICE)

- **Put the movable weight at its outmost position.**

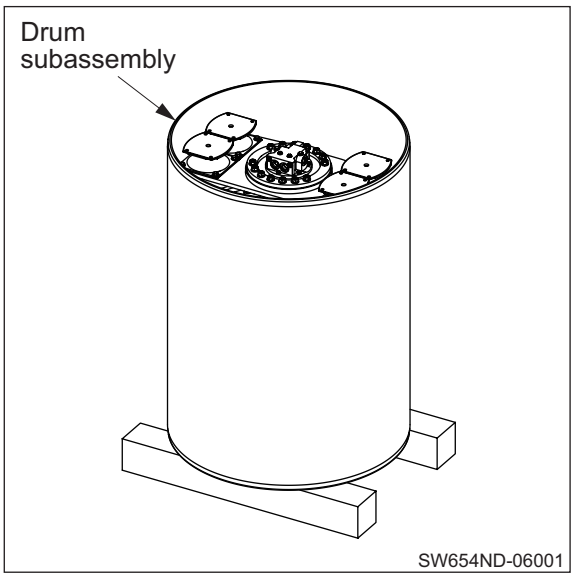


⚠WARNING

Be careful because reversing the vibratory drum involves risk. Confirm that the surrounding area is safe, and work in a natural, unstrained posture.

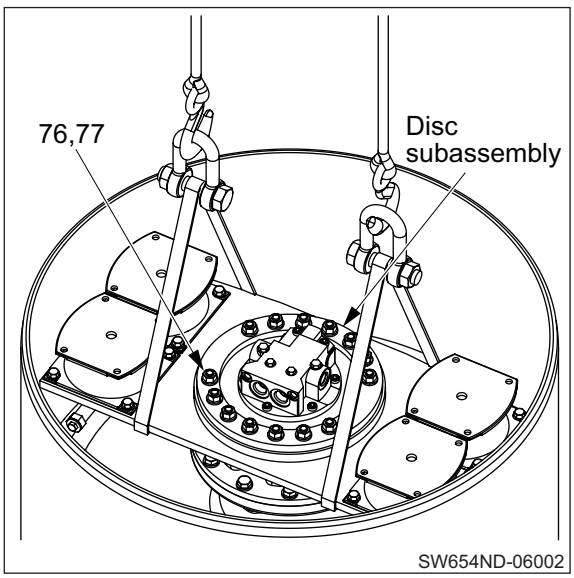
16) Reverse drum subassembly.

Drum subassembly : 1,250 kg (2,756 lbs.)



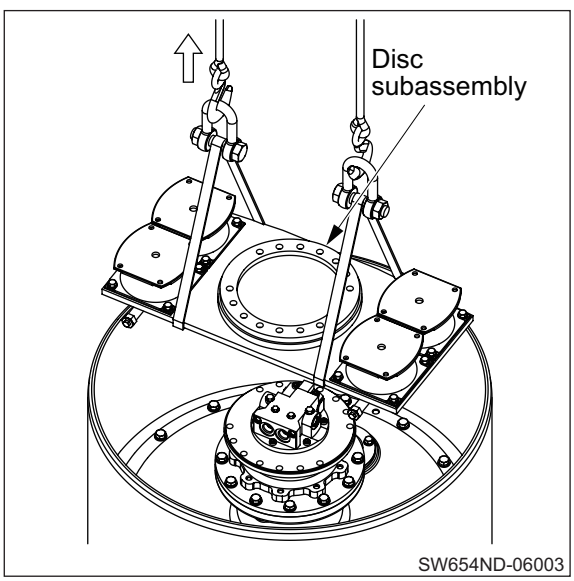
17) Lift disc subassembly.

- Remove nuts (77) and bolts (76).

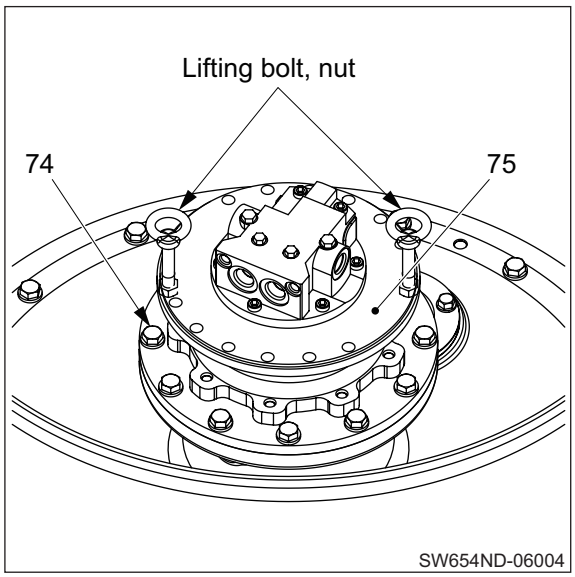


18) Remove disc subassembly.

Disc subassembly : 65 kg (143 lbs.)

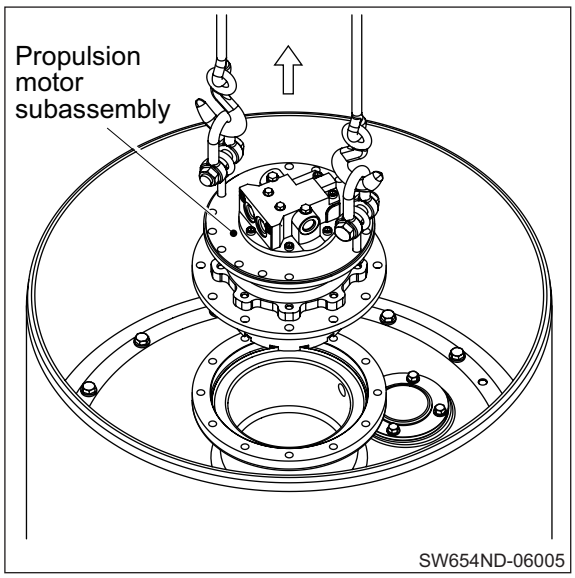


19) Install lifting bolts and nuts (M16) to propulsion motor (75).
- Remove bolts (74).

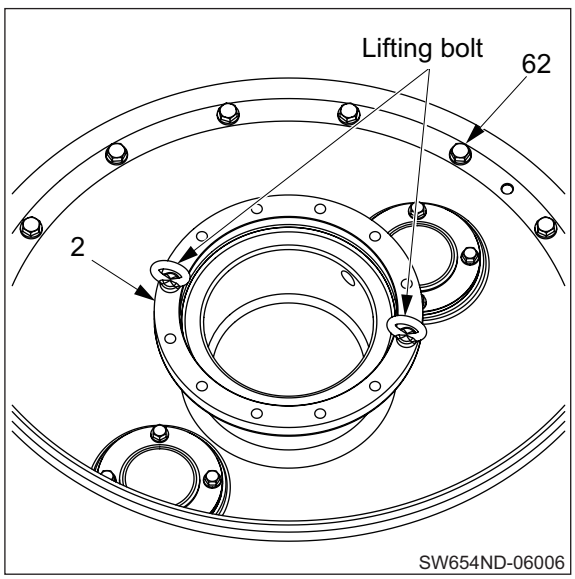


20) Remove propulsion motor subassembly.

Propulsion motor subassembly : 105 kg (231 lbs.)

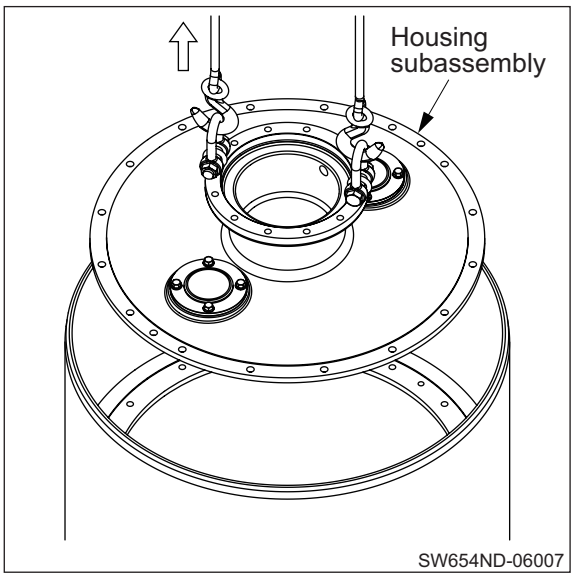


21) Install lifting bolts (M16) to housing (2).
- Remove bolts (62).

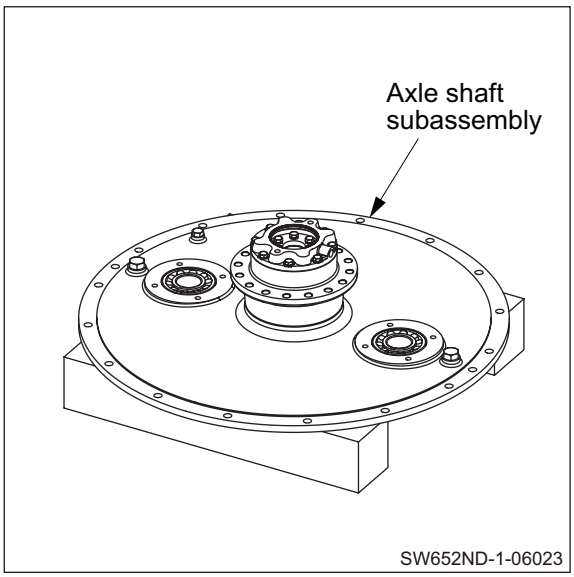


22) Remove housing subassembly.

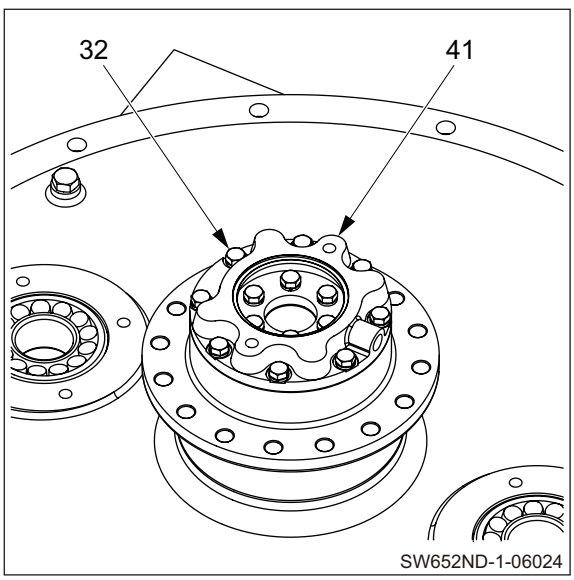
Housing subassembly : 160 kg (353 lbs.)



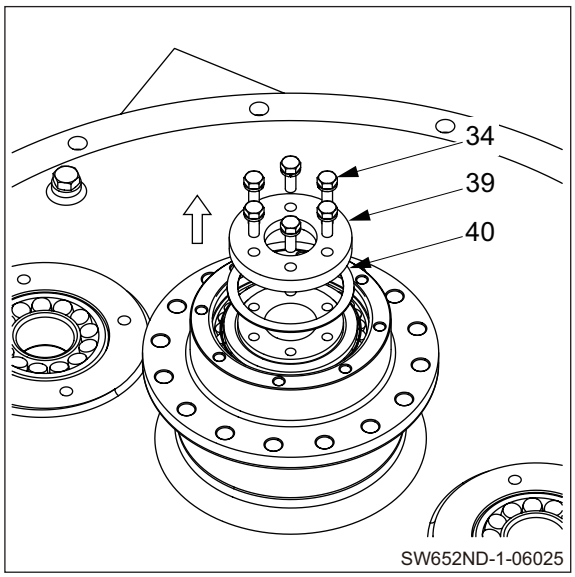
23) Disassembly of axle shaft subassembly



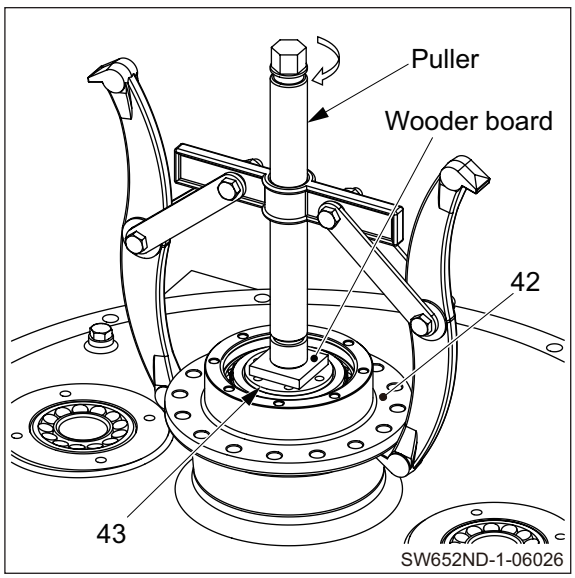
24) Remove bolts (32).
- Remove flange (41).



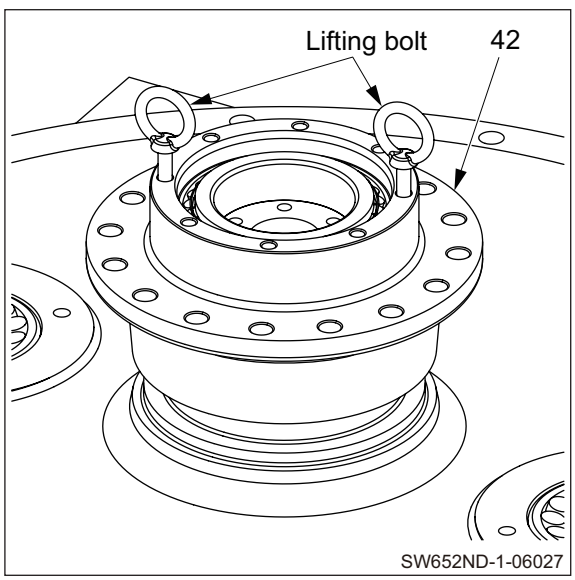
25) Remove bolts (34).
- Remove cover (39).
- Remove shim (40).



26) Put a piece of wooden board on end of axle shaft (43).
- Set a puller on housing (42).
- Remove housing subassembly with roller bearing from axle shaft subassembly.

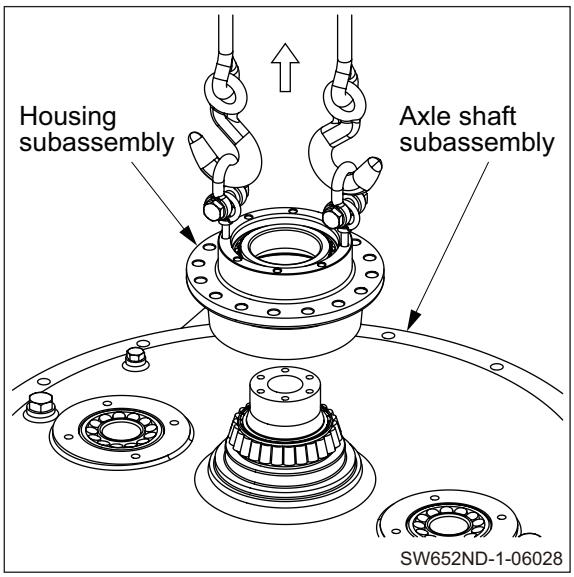


27) Install lifting bolts (M10) to housing (42).

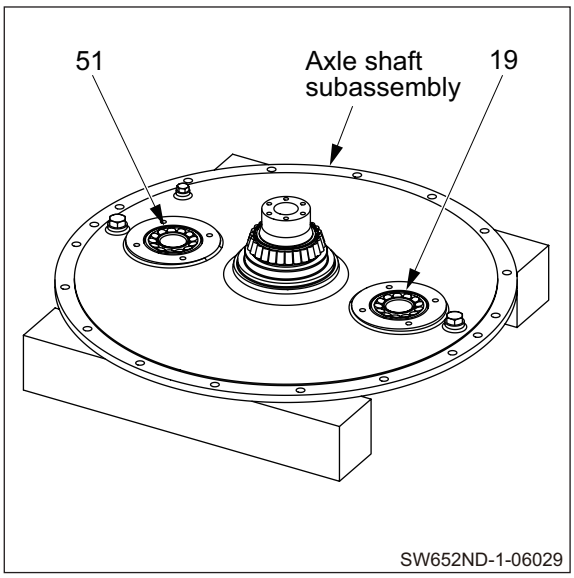


28) Remove housing subassembly from axle shaft subassembly.

Housing subassembly : 20 kg (44 lbs.)



29) Remove vibrator bearings (19) and (51) from axle shaft subassembly.



7-2-2. Reassembly of vibratory drum

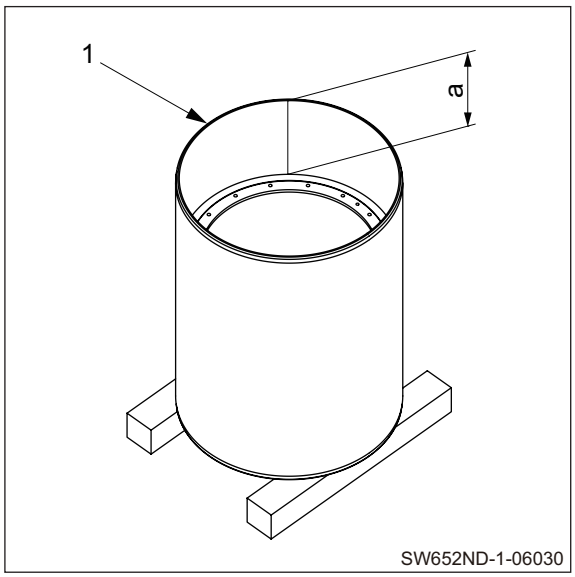
- Before reassembling, clean disassembled parts well and check that there is no abnormality.

⚠WARNING

- **When standing the vibratory drum, use wooden blocks of sufficient strength to securely support the drum.**
- **Carry out the work in an unstrained posture using a work stool or the like.**

1) Stand drum (1) with its propulsion motor side facing up.

(1) Drum : 910 kg (2,006 lbs.)



SW652ND-1-06030

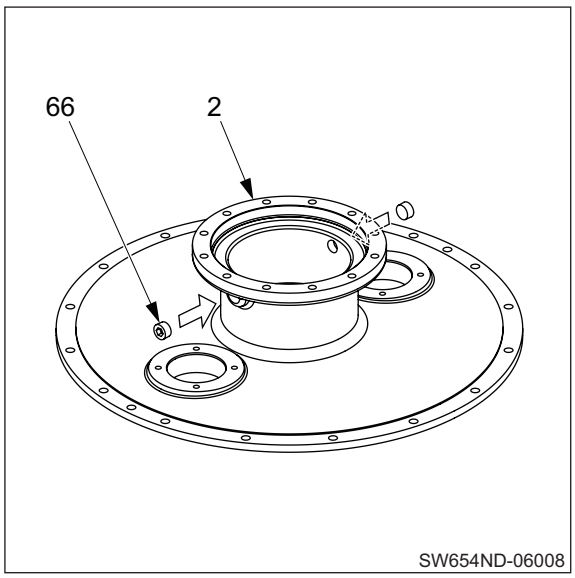
(NOTICE)

- **Propulsion motor side dimension “a” : 491 mm (19 in.)**

2) Reassembly of housing subassembly

2-1) Wind seal tape around threaded portion of plugs (66).

- Install plugs to housing (2).



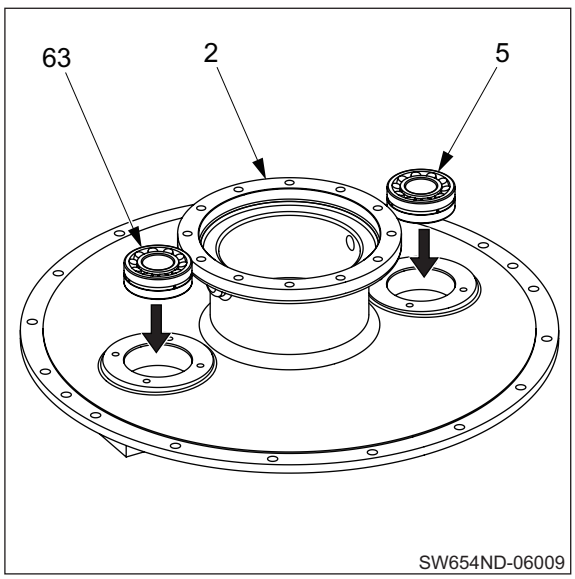
SW654ND-06008

2-2) Apply a coat of gear oil to housing (2) at where bearings will be press-fitted.

- Drive vibrator bearings (5) and (63) into housing.

(NOTICE)

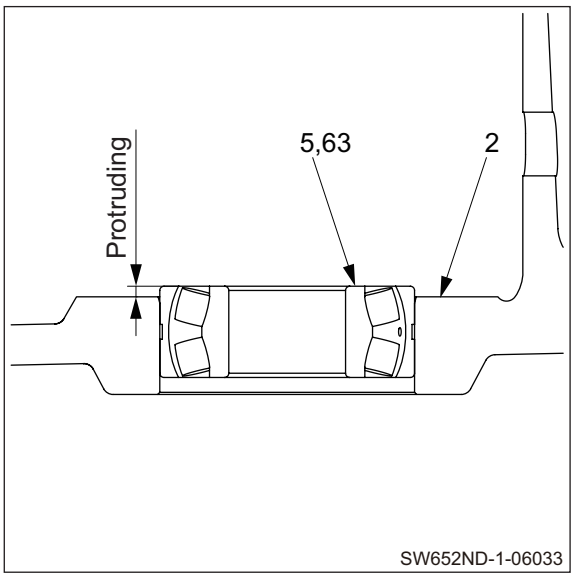
- **Take care not to damage the bearings when installing them.**



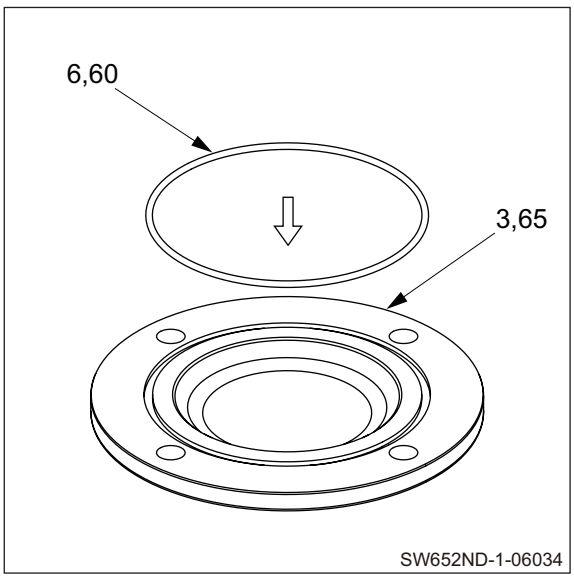
SW654ND-06009

(NOTICE)

- **Stop driving in vibrator bearings (5) and (63) when they come to a position slightly protruding from the boss surface of the housing (2) to avoid driving in too much.**

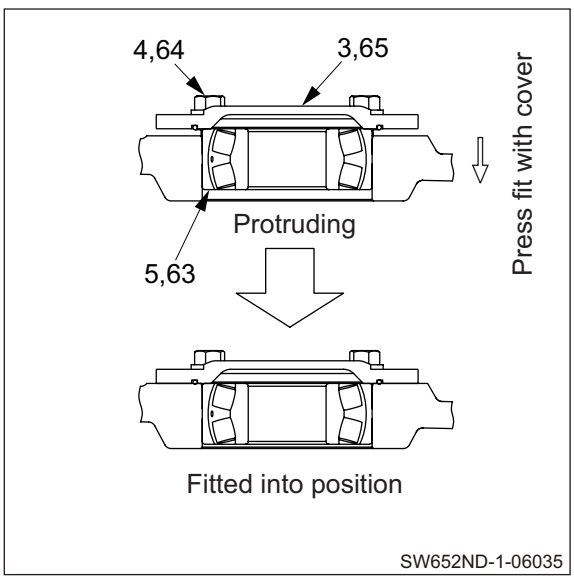


2-3) Apply grease to O-rings (6) and (60).
- Install O-rings to covers (3) and (65).



2-4) Press fit slightly protruding vibrator bearings (5) and (63) into place by securing covers (3) and (65) with four bolts (4), four bolts (64), and washers.

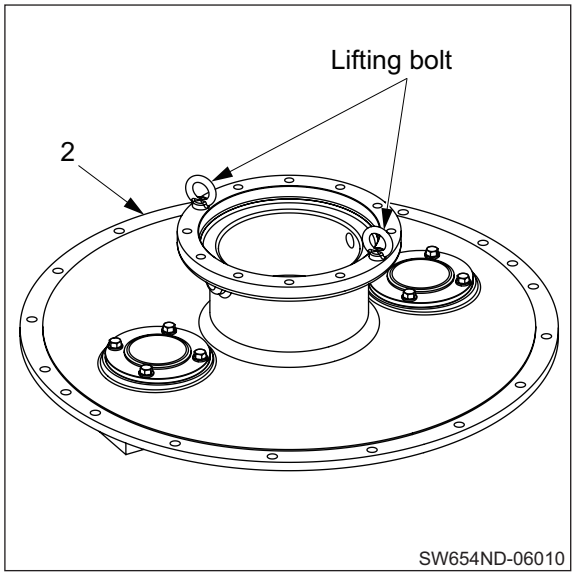
N•m (4) and (64) Bolts M12×30 : 108 N·m (80 lbf·ft)



⚠WARNING

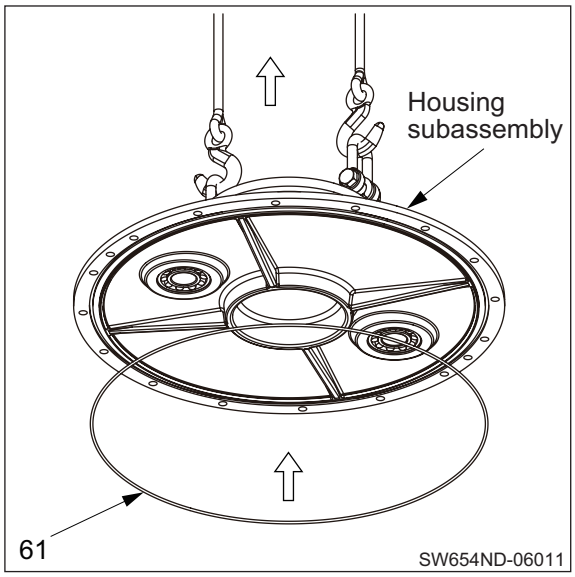
When installing lifting bolts, screw in the threads fully before using.

3) Install lifting bolts (M16) to housing (2).



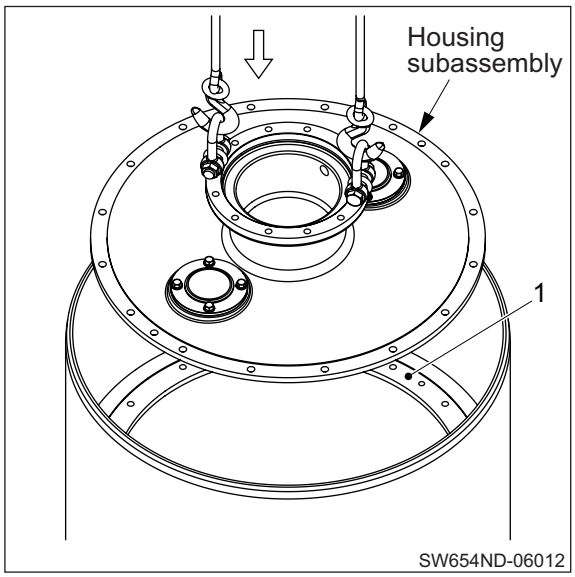
4) Lift housing subassembly.
   - Apply grease to O-ring (61).
   - Install O-ring to housing subassembly.

   5 kg Housing subassembly : 160 kg (353 lbs.)

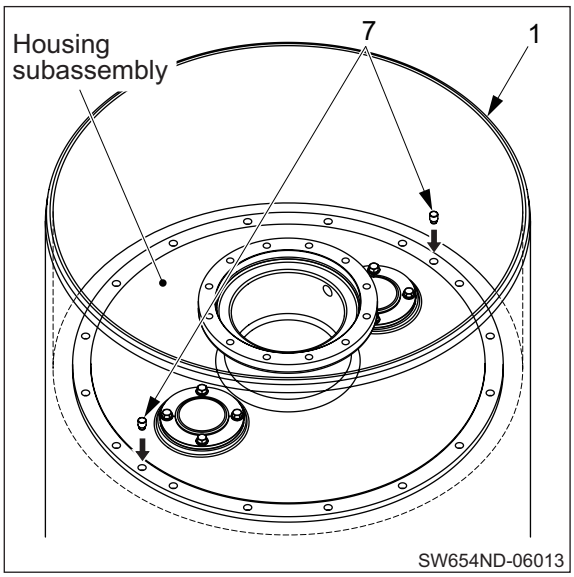


5) Lower housing subassembly on mounting surface of drum (1).

(NOTICE)
- **Take care not to let O-ring to protrude from its groove.**



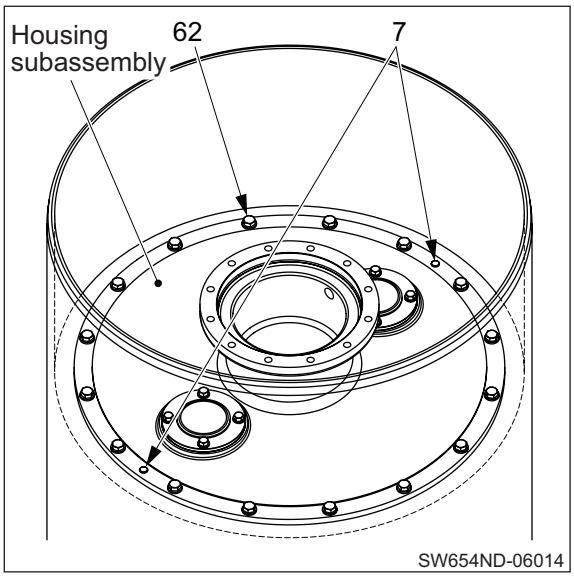
6) Drive in two locating pins (7) for housing subassembly and drum (1) temporarily.



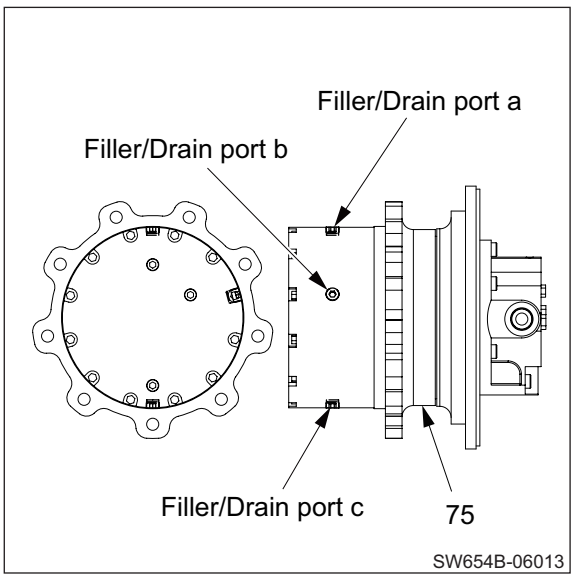
7) Secure housing subassembly with sixteen bolts (62) and washers.

N•m (62) Bolts M16×45 : 265 N·m (195 lbf·ft)

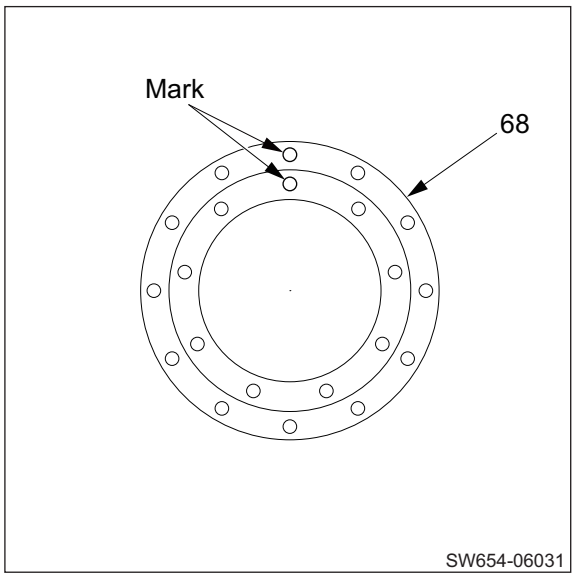
- Drive in locating pins (7) again.



8) Reassembly of propulsion motor subassembly



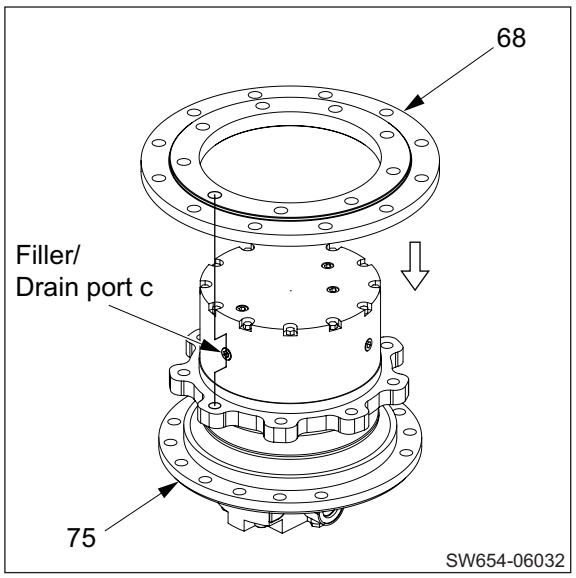
8-1) Making marks on holes of ring (68) as shown.



8-2) Install ring (68) to mounting surface of propulsion motor (75).

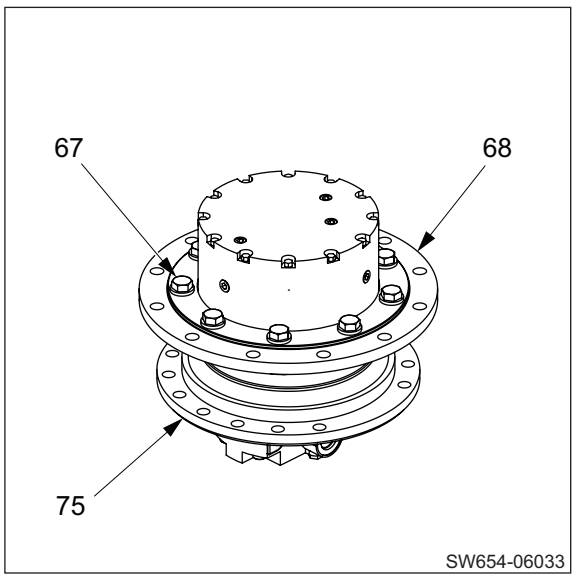
(NOTICE)

- **Align mark of ring with filler/drain port "c" as shown.**



8-3) Secure ring (68) to propulsion motor (75) with nine bolts (67) and washers.

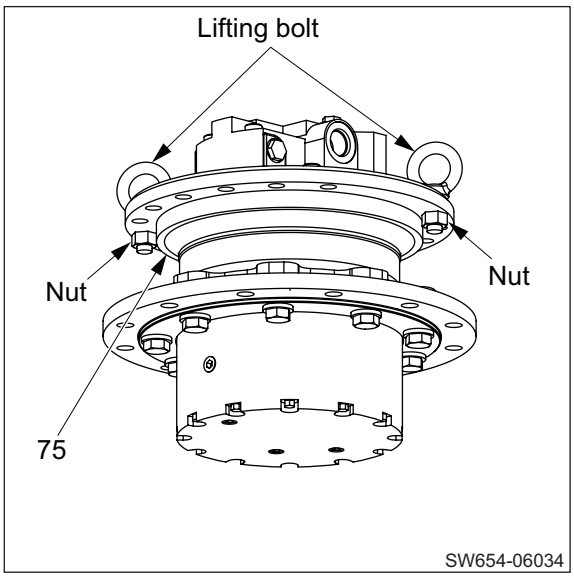
N•m (67) Bolt M16×45 : 265 N·m (195 lbf·ft)



9) Reverse propulsion motor subassembly.

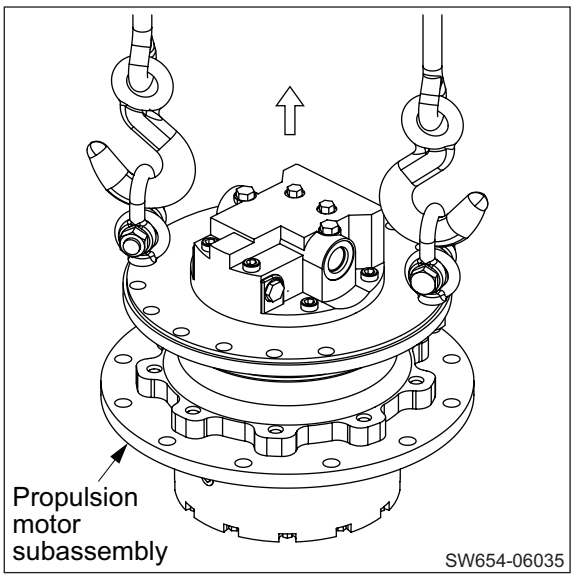
Propulsion motor subassembly : 105 kg (231 lbs.)

- Install lifting bolts and nuts (M16) to propulsion motor (75).



10) Lift propulsion motor subassembly.

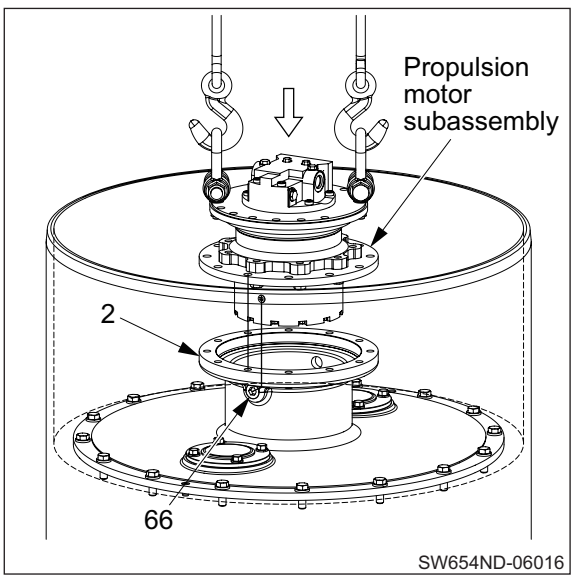
Propulsion motor subassembly : 105 kg (231 lbs.)



11) Lower propulsion motor subassembly on mounting surface of housing (2).

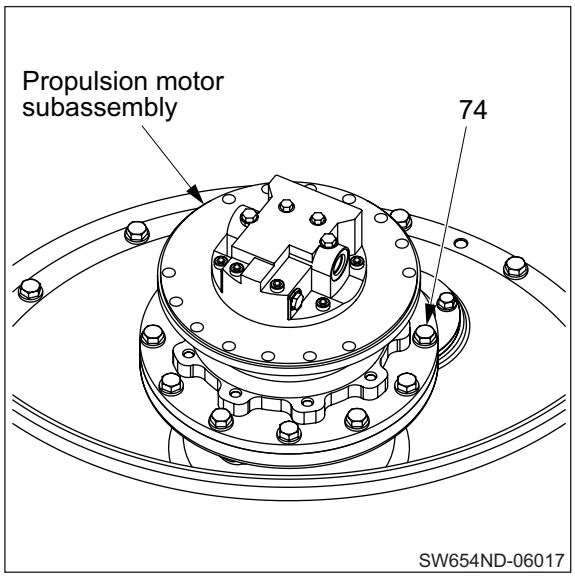
(NOTICE)

- **Align mark of ring with plug (66) as shown.**



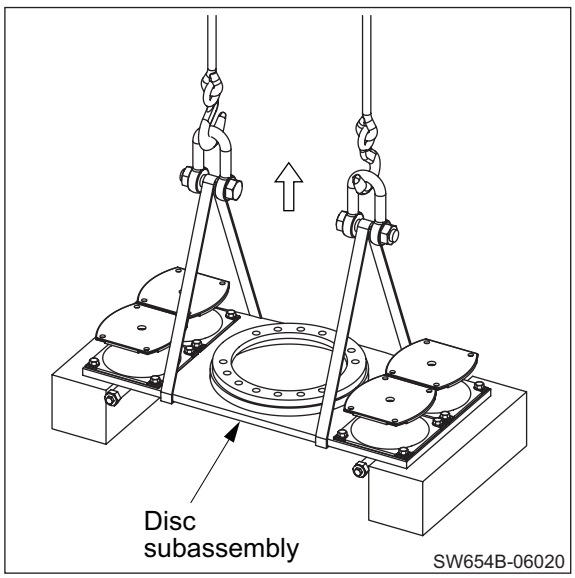
12) Secure propulsion motor subassembly with twelve bolts (74) and washers.

N•m (74) Bolts M16×45 : 265 N·m (195 lbf·ft)

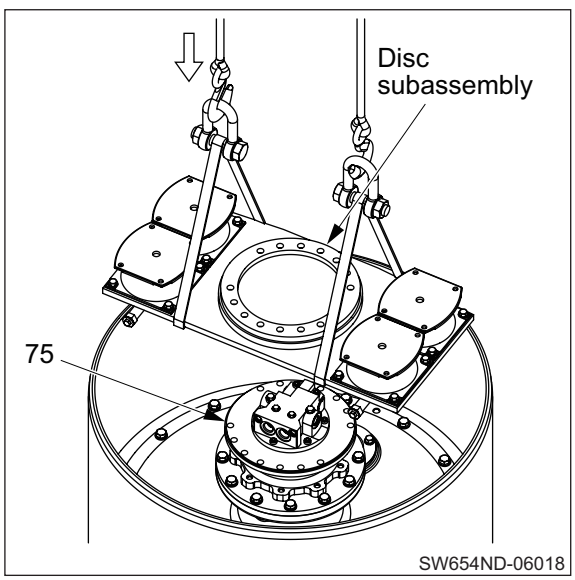


13) Lift disc subassembly.

kg Disc subassembly : 75 kg (165 lbs.)

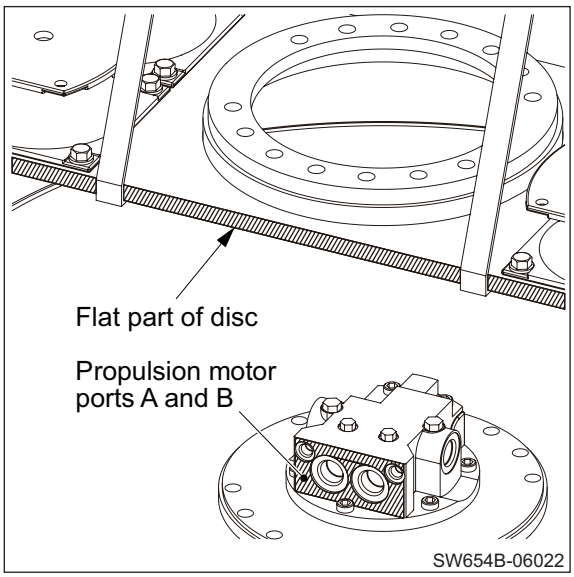


14) Lower disc subassembly on mounting surface of propulsion motor (75).



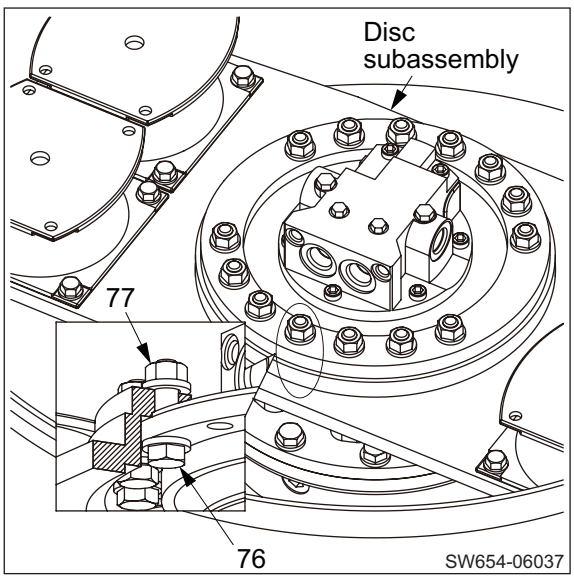
(NOTICE)

- **The flat part of the disc must be parallel with the side of the propulsion motor which have ports A and B.**



15) Secure disc subassembly with fourteen bolts (76), nuts (77) and washers.

N•m (76) Bolts M16×60 : 265 N·m (195 lbf·ft)

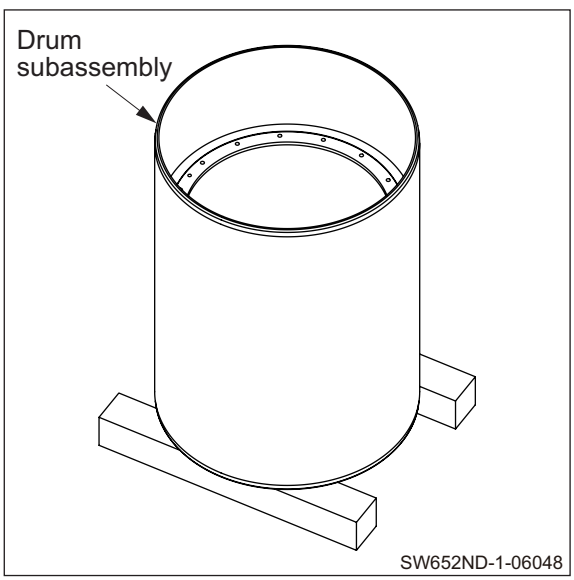


⚠WARNING

Be careful because reversing the vibratory drum involves risk. Confirm that the surrounding area is safe, and work in a natural, unstrained posture.

16) Reverse drum subassembly.

kg Drum subassembly : 1,250 kg (2,756 lbs.)

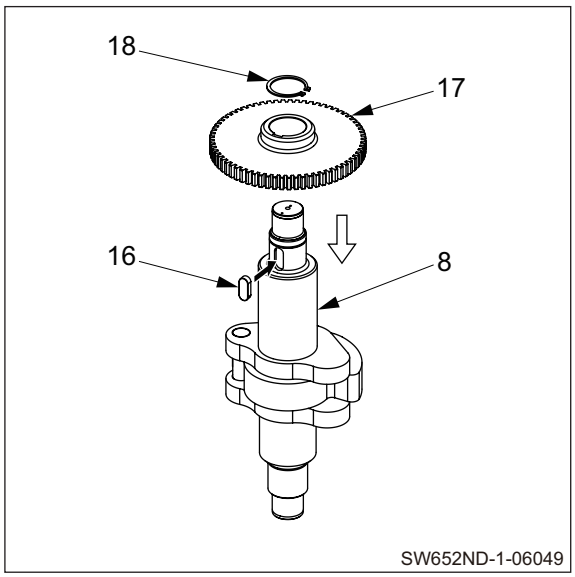


⚠WARNING

Wear heat resistant gloves when handling heated parts to avoid burns.

17) Heat up gear (17) by using a ring heater or the like.
- Drive sunk key (16) into eccentric shaft (8).
- Install heated gear.
- Install retaining ring (18).

(NOTICE)
- **Make sure that the retaining ring is fitted completely in its groove.**

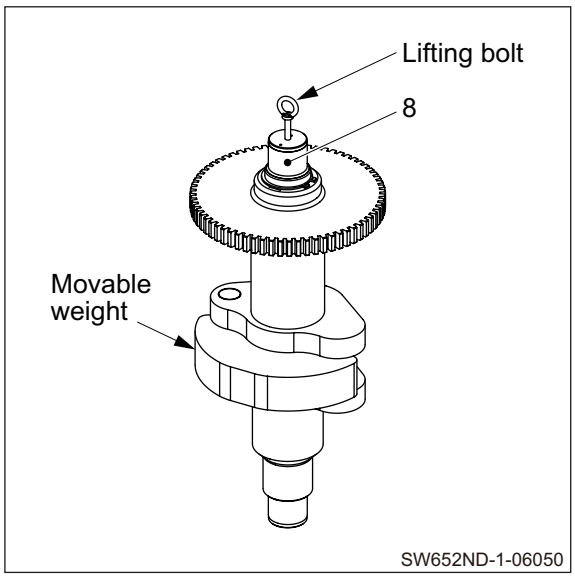


⚠WARNING

Take care not to get your fingers caught in movable weights.

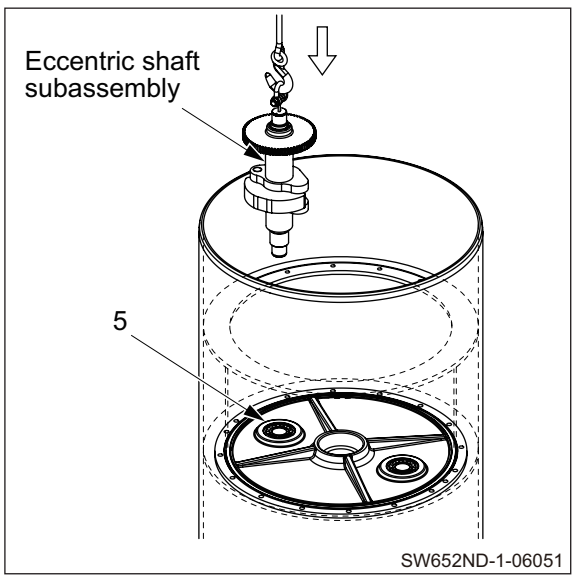
18) Install a lifting bolt (M8) to eccentric shaft (8).

(NOTICE)
- **Put the movable weight at its outmost position.**



19) Apply a coat of gear oil to eccentric shaft subassembly at where vibrator bearing (5) will be installed.
- Install eccentric shaft subassembly.

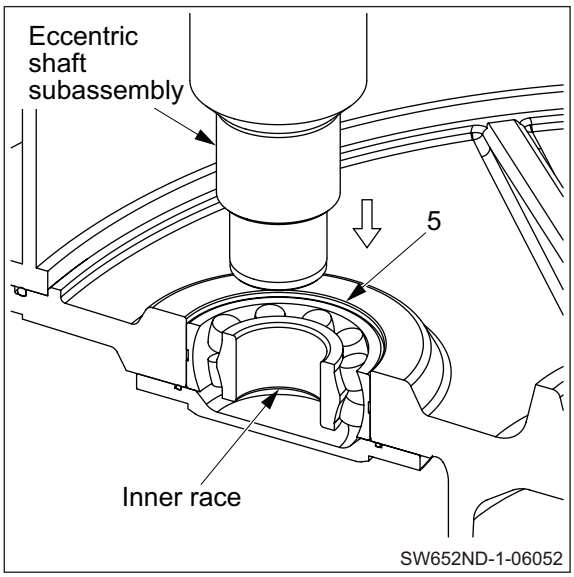
kg Eccentric shaft subassembly : 70 kg (154 lbs.)



20) Insert eccentric shaft subassembly into vibrator bearing (5) while taking care not to tilt vibrator bearing inner race.

(NOTICE)

- **After inserting the eccentric shaft subassembly into the bearing, lay the eccentric shaft subassembly against the inner wall of the drum so that it will not fall down.**

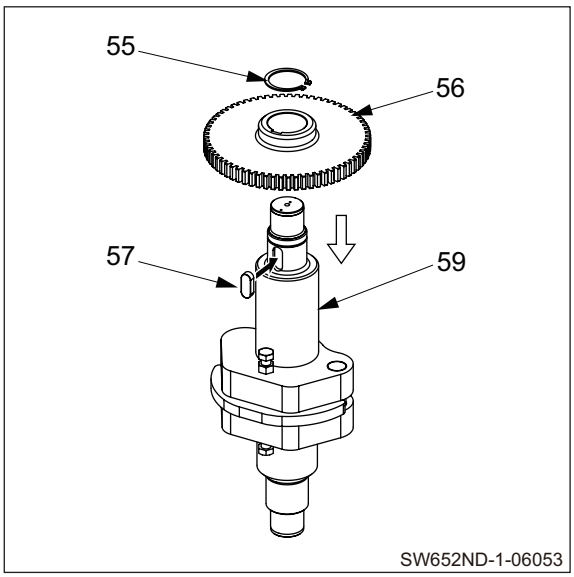


21) Heat up gear (56) by using a ring heater or the like.

- Drive sunk key (57) into eccentric shaft (59).
- Install heated gear.
- Install retaining ring (55).

(NOTICE)

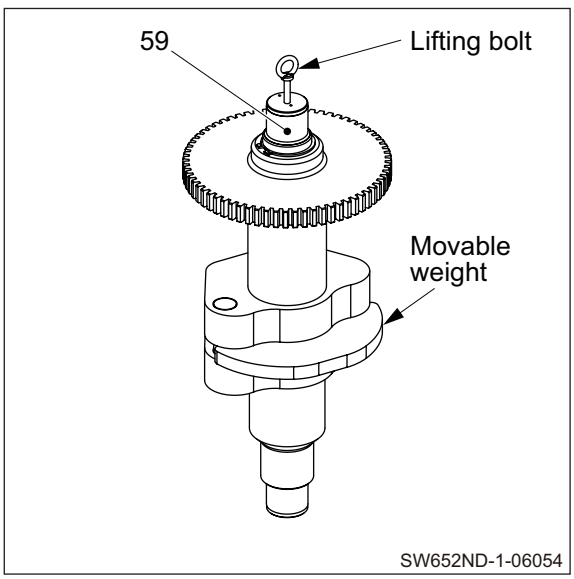
- **Make sure that the retaining ring is fitted completely in its groove.**



22) Install a lifting bolt (M8) to eccentric shaft (59).

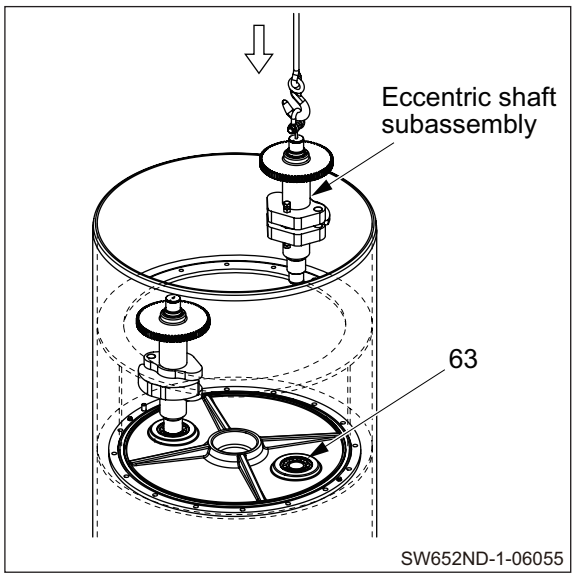
(NOTICE)

- **Put the movable weight at its outmost position.**



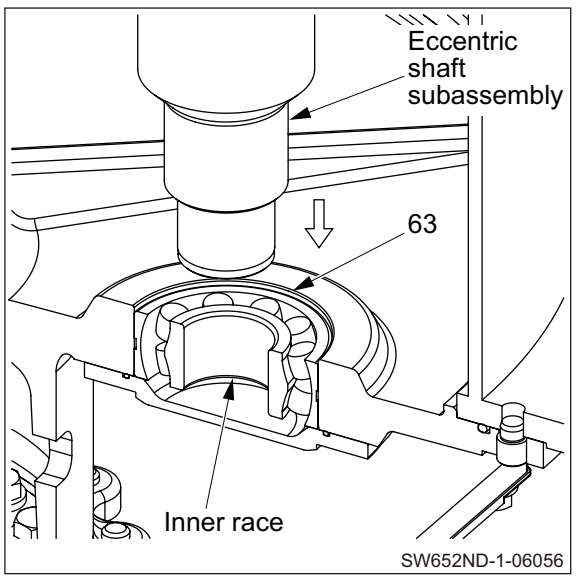
23) Apply a coat of gear oil to eccentric shaft subassembly at where vibrator bearing (63) will be installed.
- Install eccentric shaft subassembly.

Eccentric shaft subassembly : 70 kg (154 lbs.)

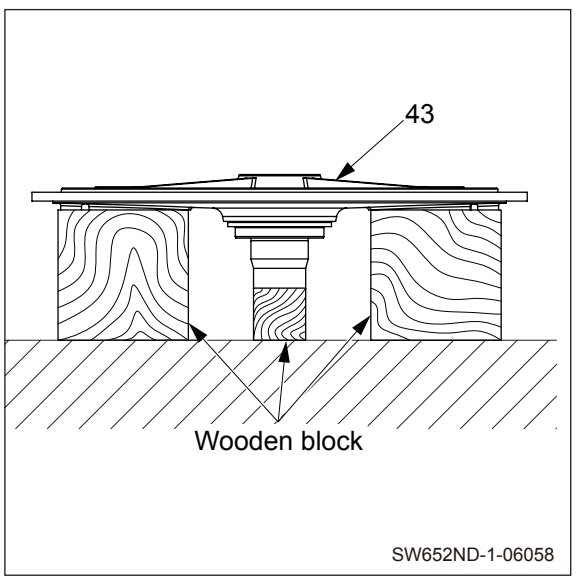


24) Insert eccentric shaft subassembly into vibrator bearing (63) while taking care not to tilt vibrator bearing inner race.

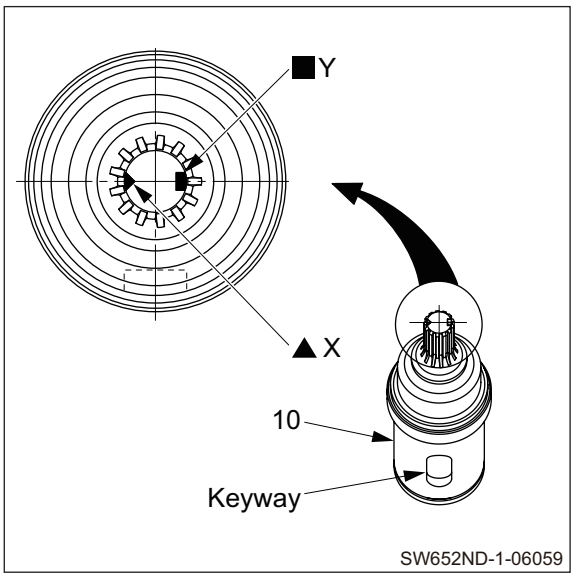
(NOTICE)
- **After inserting the eccentric shaft subassembly into the vibrator bearing, lay the eccentric shaft subassembly against the inner wall of the drum so that it will not fall down.**



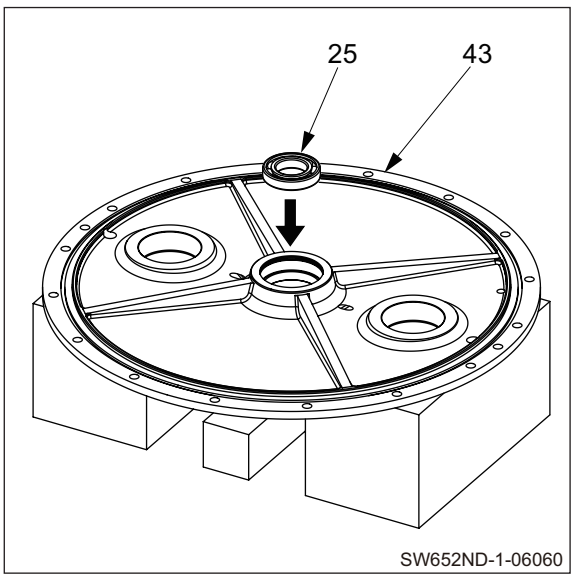
25) Reassembly of axle shaft subassembly
25-1) Fix axle shaft (43) with wooden blocks.



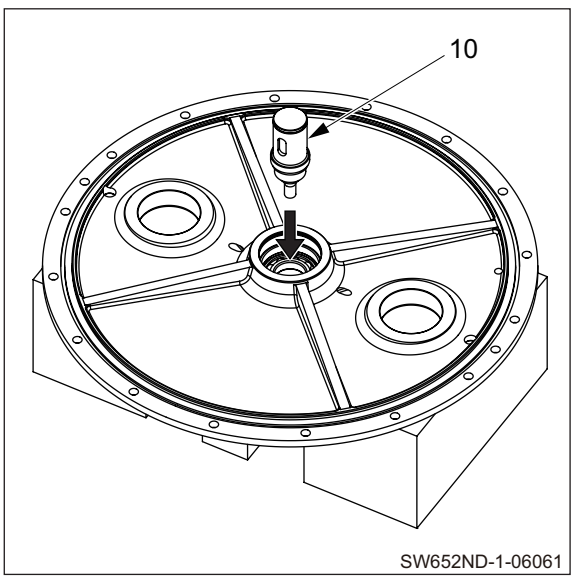
25-2) Making marks on shaft (10).
- Draw a ▲ X on left side with keyway facing down
- Draw a ■ Y on right side with keyway facing down



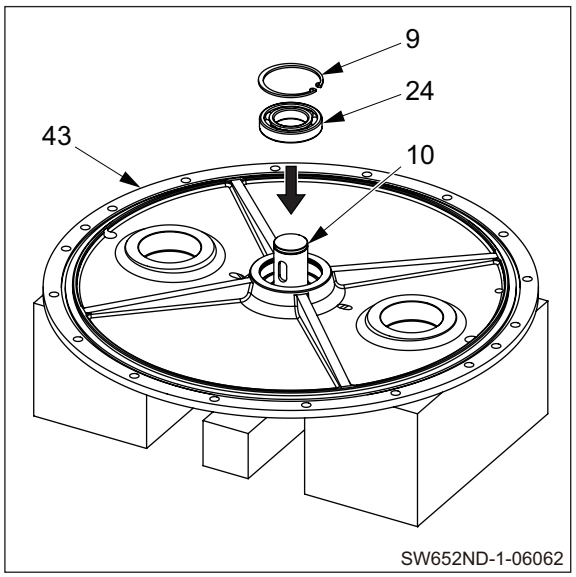
25-3) Apply a coat of gear oil to axle shaft (43) at where bearing will be press-fitted.
- Drive ball bearing (25) into axle shaft.



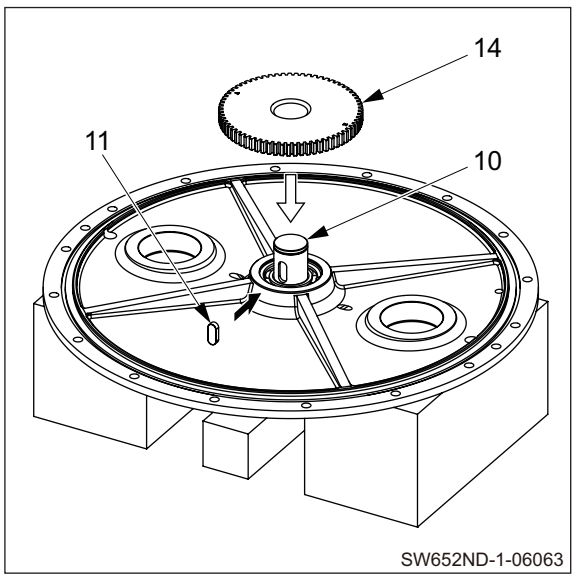
25-4) Apply a coat of gear oil to bearing mounting surface of shaft (10).
- Drive in shaft.



25-5) Apply a coat of gear oil to axle shaft (43) at where bearing will be press-fitted and to drive shaft (10) at where bearing will be installed.
- Drive ball bearing (24) into axle shaft.
- Install retaining ring (9).

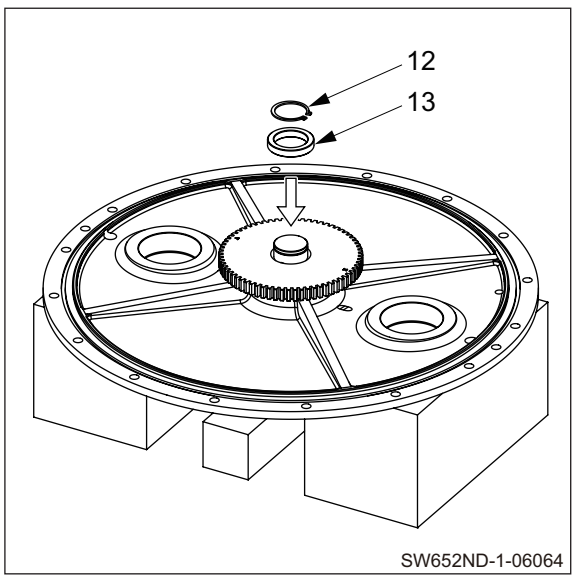


25-6) Heat up gear (14) by using a ring heater or the like.
- Drive sunk key (11) to shaft (10).
- Install heated gear.



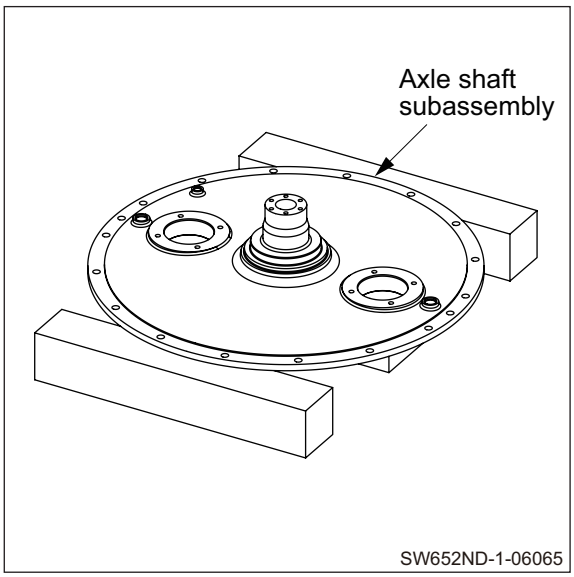
25-7) Install collar (13).
- Install retaining ring (12).

(NOTICE)
- **Make sure that the retaining ring is fitted completely in its groove.**



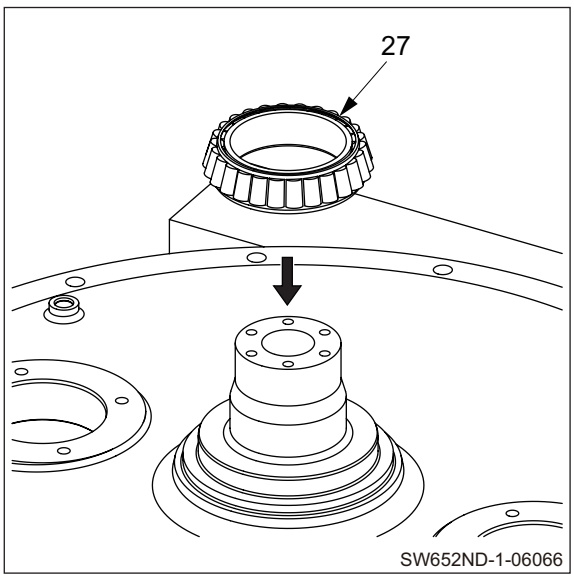
25-8) Reverse axle shaft subassembly.

Axle shaft subassembly : 165 kg (364 lbs.)

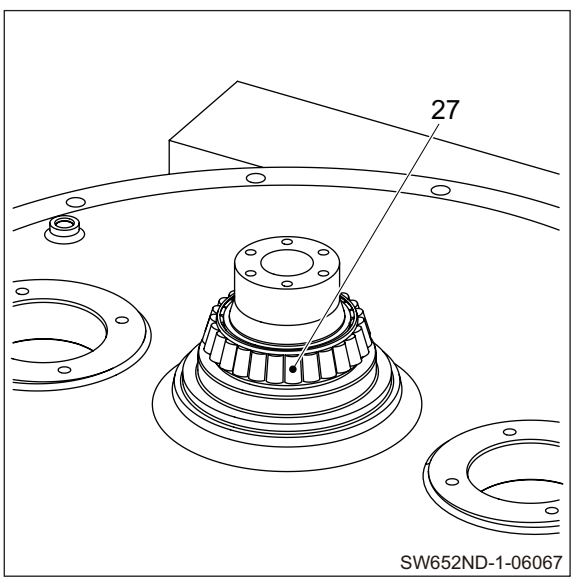


25-9) Heat up roller bearing (27) inner race by using a ring heater or the like.

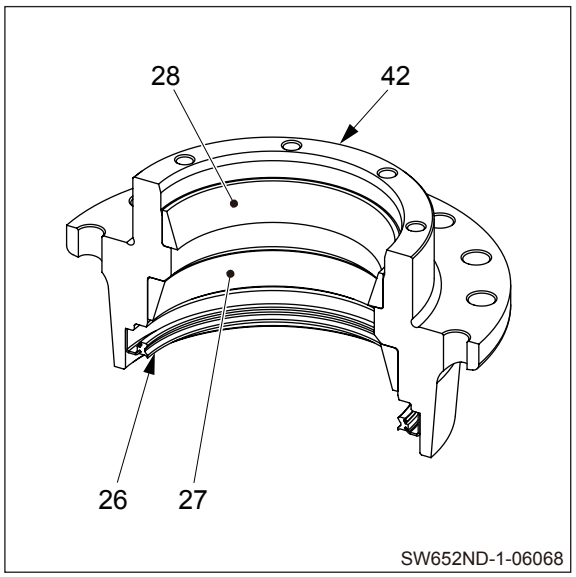
- Apply a coat of gear oil to axle shaft at where bearing inner race will be press-fitted.
- Drive in heated roller bearing inner race.



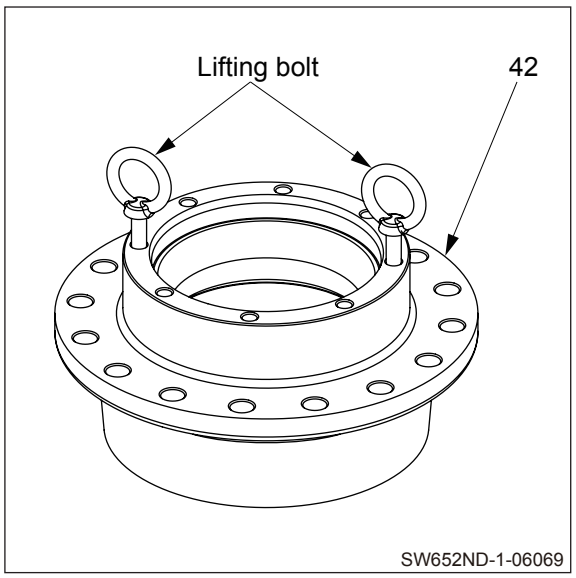
25-10) Apply sufficient amount of lithium-based grease to rollers of roller bearing (27) inner race.



25-11) Apply a coat of gear oil to housing (42) at where bearing outer races will be press-fitted.
- Drive roller bearings (27) and (28) outer races into housing.
- Apply liquid packing to periphery of oil seal (26).
- Drive in oil seal.
- Apply grease to lip of oil seal.

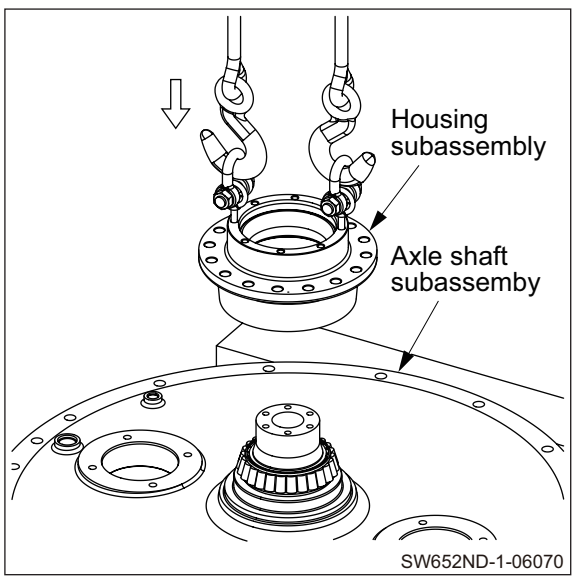


25-12) Install lifting bolts (M10) to housing (42).

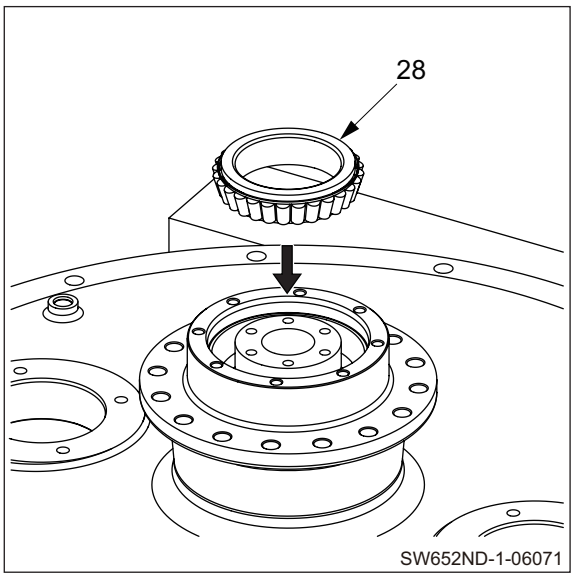


25-13) Install housing subassembly to axle shaft subassembly.

Housing subassembly : 20kg (44 lbs.)

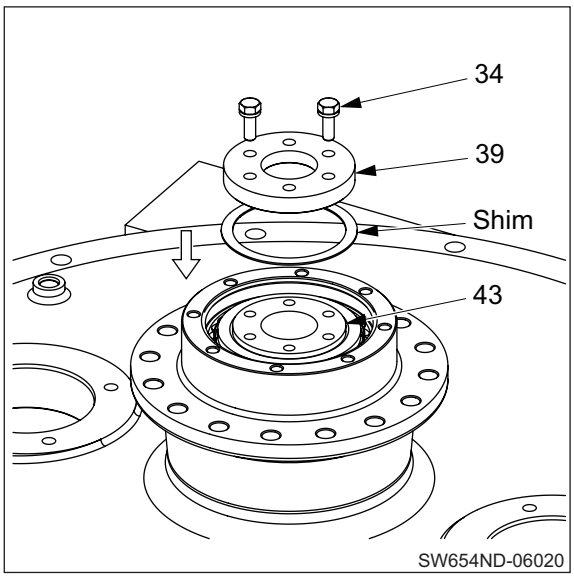


25-14) Apply sufficient amount of lithium-based grease to rollers of roller bearing (28) inner race.
- Drive in roller bearing inner race until rollers come in contact with outer race.



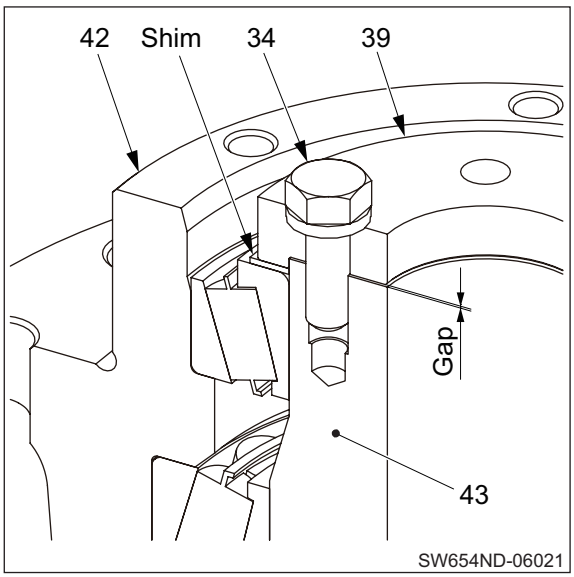
25-15) Preload adjustment of roller bearing

① Install a shim of about 1 mm (0.04 in.) and secure cover (39) to axle shaft (43) with two bolts (34) and spring washers.



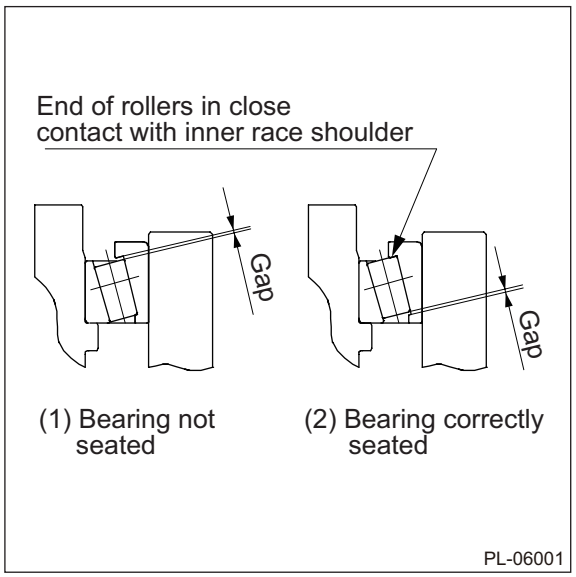
② A gap will remain between end of axle shaft (43) and inside of cover (39).
- Tighten bolts (34) to a torque of 30 N·m (22 lbf·ft).
- Give housing (42) two to three turns.
- Tighten bolts to a torque of 30 N·m (22 lbf·ft) again.
- Repeat this work several times until tightening torque of bolts no longer fluctuates.

(NOTICE)
- **Tighten the bolts alternately in diagonal directions.**



(NOTICE)

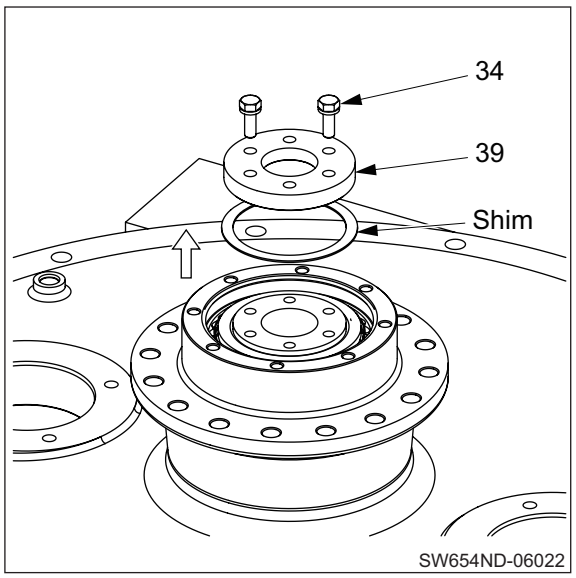
- **Push in the inner race while rotating the bearing. Otherwise, even strongly trying to push the inner race, the bearing rollers will not be pushed up and therefore bearing will not be seated.**



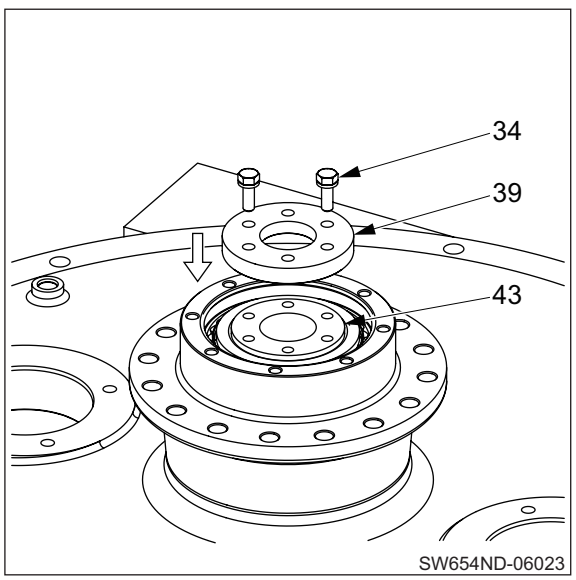
③ Remove bolts (34).
- Remove cover (39).
- Remove shim.

(NOTICE)

- **Do not turn the housing after the cover is removed.**

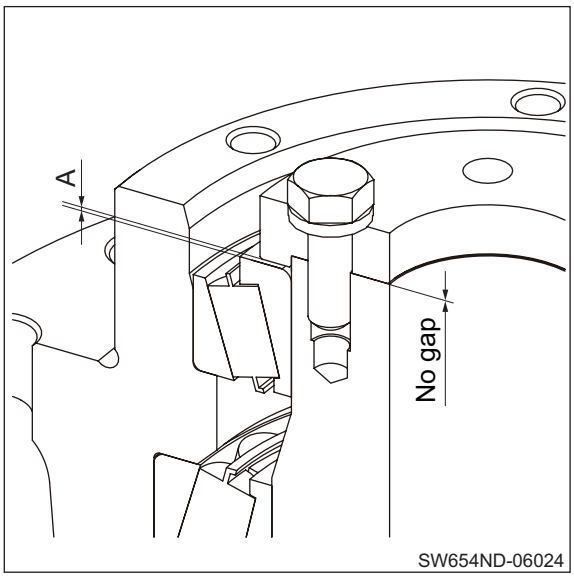


④ Without inserting shim, install cover (39) to axle shaft (43) with two bolts (34) and spring washers.

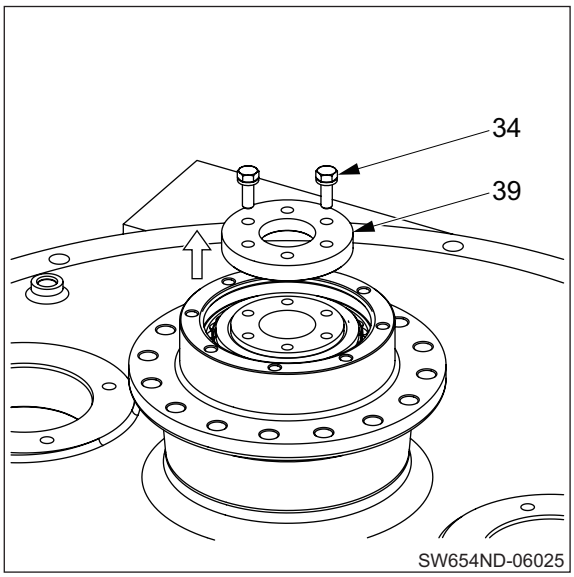


⑤ Using a thickness gauge, measure clearance “A”.

★ **Preload adjusting shim thickness** **= A + 0.1 mm (0.004 in.)**

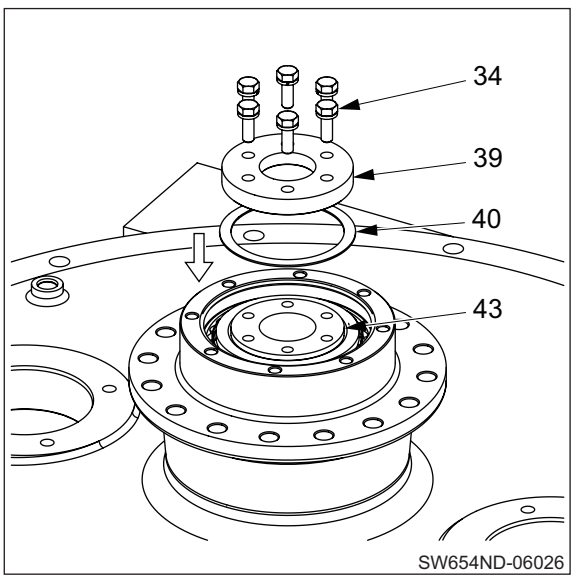


⑥ Remove bolts (34).
- Remove cover (39).

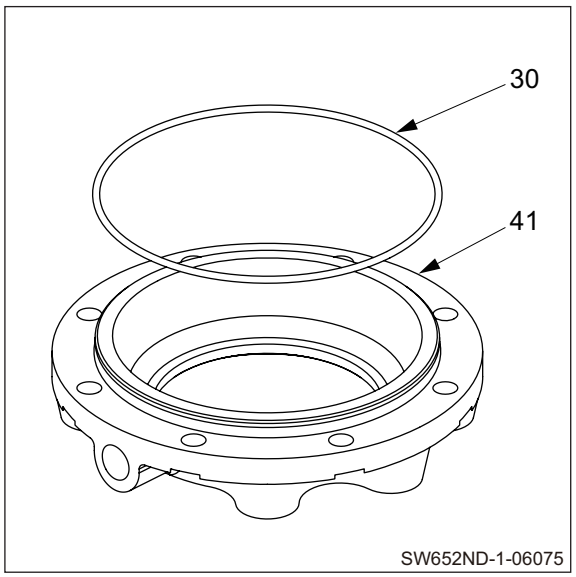


⑦ Install shim (40) of preload adjusting shim thickness = “A + 0.1 mm (0.004 in.)”.
- Secure cover (39) to axle shaft (43) with six bolts (34) and spring washers.

N•m (34) Bolts M10×30 : 59 N·m (43.5 lbf·ft)

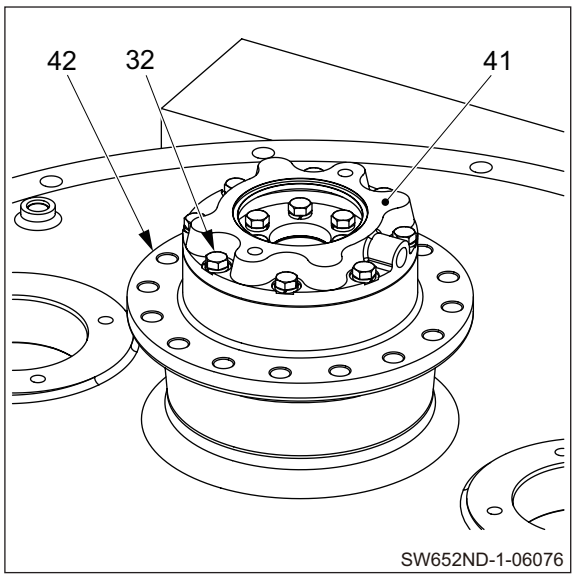


25-16) Apply grease to O-ring (30).
- Install O-ring to flange (41).

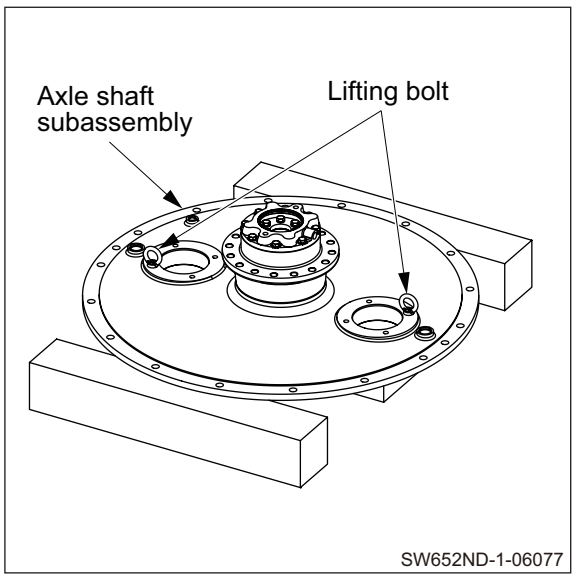


25-17) Secure flange (41) to housing (42) with eight bolts (32) and spring washers.

N•m (32) Bolts M10×30 : 59 N·m (43.5 lbf·ft)



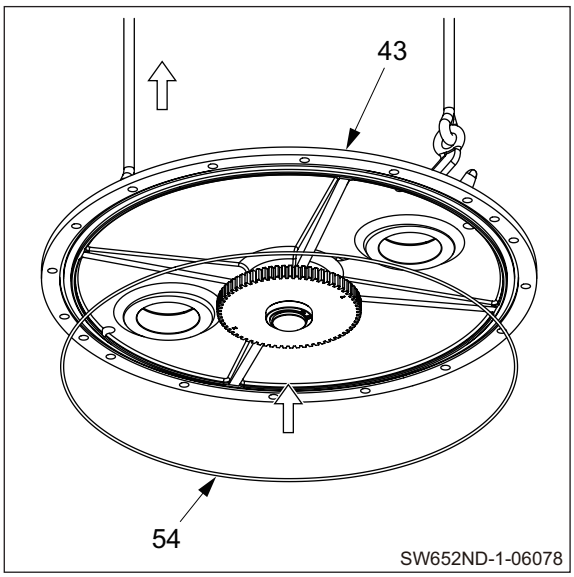
26) Install lifting bolts (M12) to axle shaft subassembly.



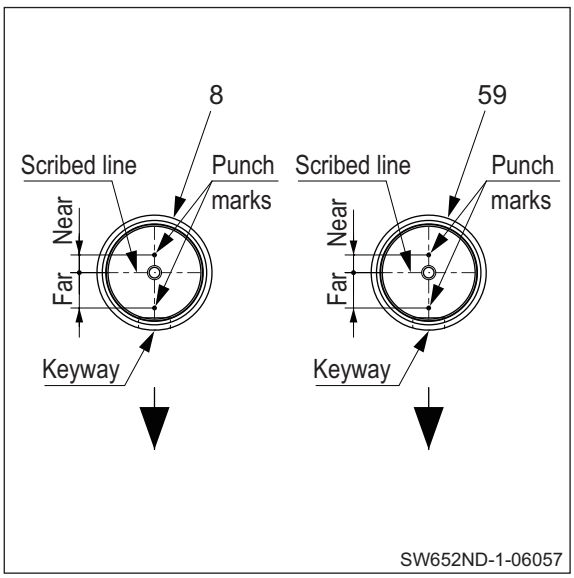
27) Lift axle shaft subassembly.

Axle shaft subassembly : 190 kg (419 lbs.)

- Apply grease to O-ring (54).
- Install O-ring to axle shaft (43).



28) Place punch marks on end of eccentric shafts (8) and (59) as shown right.

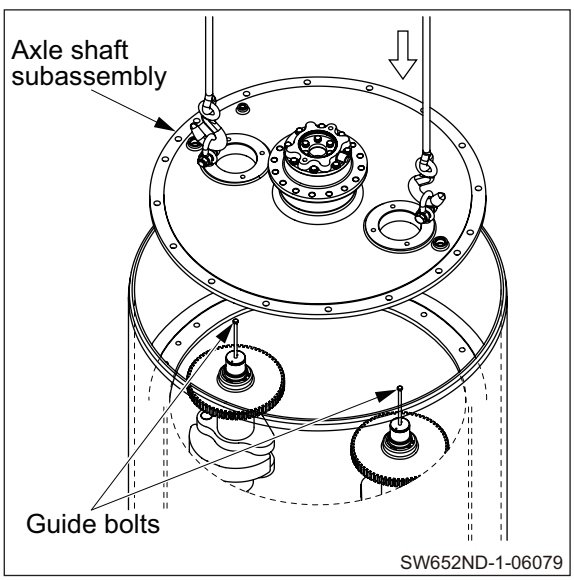


29) Install long guide bolts to end of both eccentric shafts.

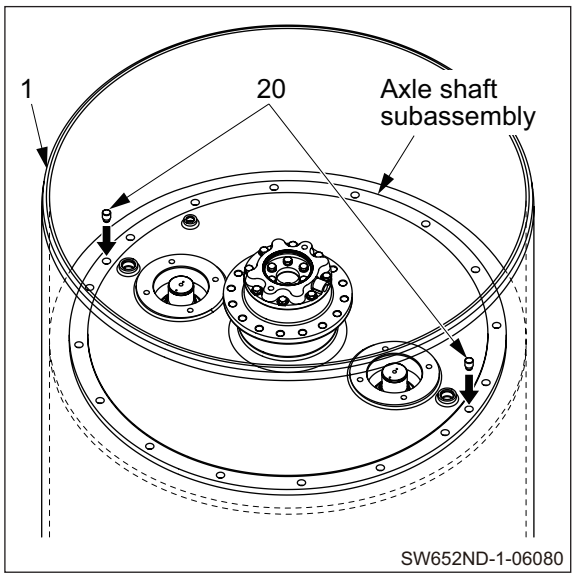
- Lower axle shaft subassembly on mounting surface of drum while taking care not to move punch marks on each eccentric shaft.

(NOTICE)

- **Take care not to let the eccentric shafts fall down.**



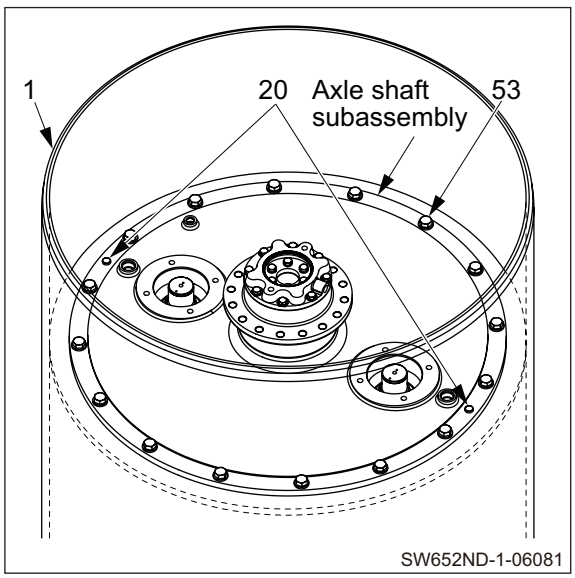
30) Drive in two locating pins (20) for axle shaft subassembly and drum (1) temporarily.



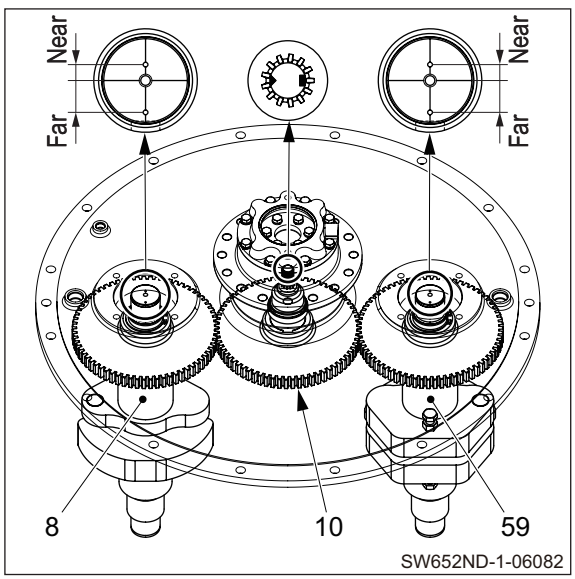
31) Secure axle shaft subassembly to drum (1) with sixteen bolts (53) and washers.

N•m (53) Bolts M16×45 : 265 N·m (195 lbf·ft)

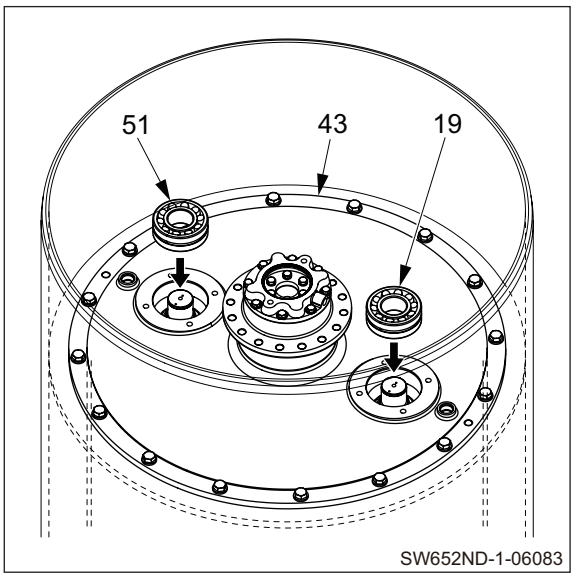
- Drive in locating pins (20) again.



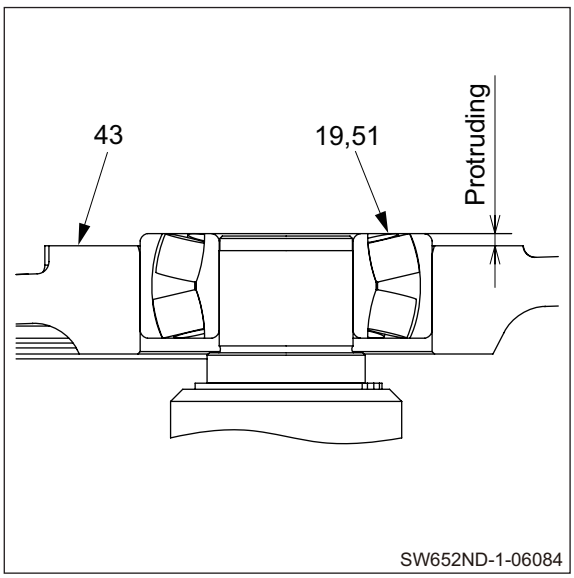
32) Make sure that punch marks on shaft (10) of eccentric shafts (8) and (59) are as shown right.



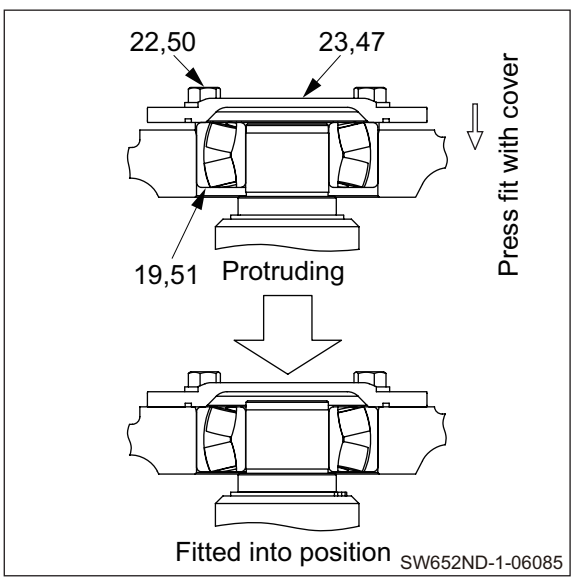
33) Apply a coat of gear oil to axle shaft (43) at where bearings will be press-fitted and to eccentric shafts at where bearings will be installed.
- Drive in vibrator bearings (19) and (51).



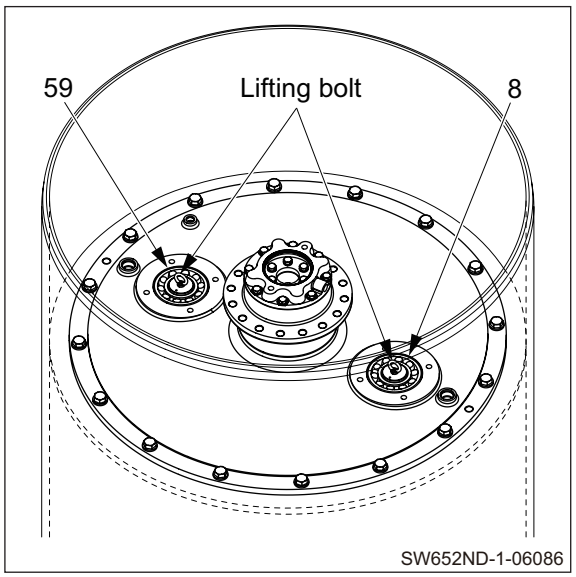
(NOTICE)
- **Stop driving in vibrator bearings (19) and (51) when they come to a position slightly protruding from the boss surface of axle shaft (43) to avoid driving in too much.**



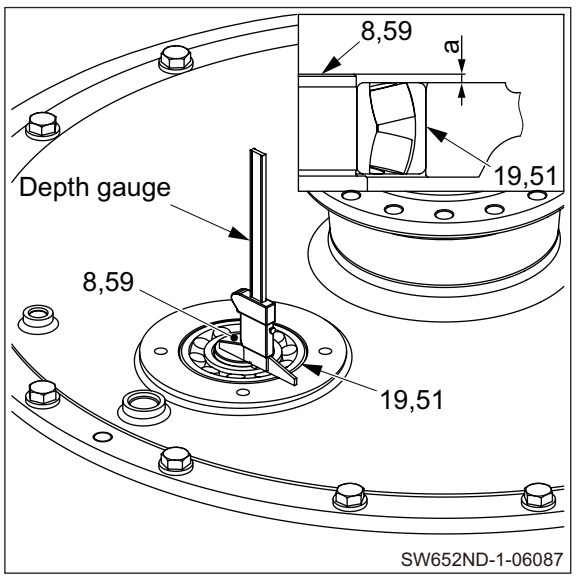
34) Press fit slightly protruding vibrator bearings (19) and (51) into place by installing covers (23) and (47) with four bolts (22), four bolts (50), and washers.
- After press fitting, remove covers to make sure that vibrator bearings are not protruding.



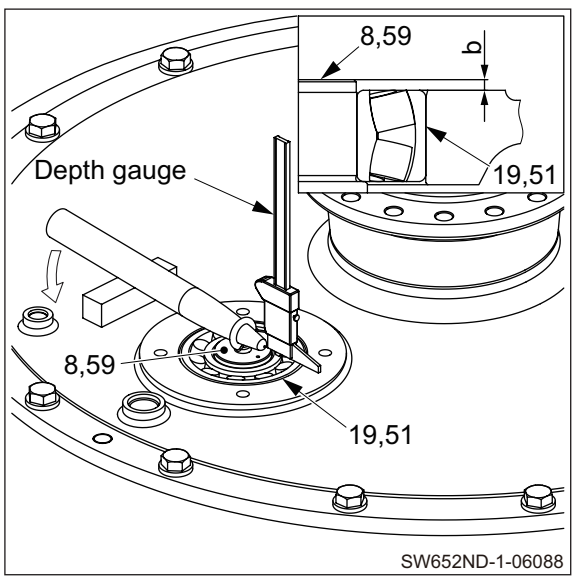
35) Install lifting bolts (M8) to end of eccentric shafts (8) and (59).



36) Measure dimension “a” from end of eccentric shafts (8) and (59) to top of vibrator bearings (19) and (51) by using a depth gauge.



37) Lift eccentric shafts (8) and (59), and measure dimension “b” from end of eccentric shafts to top of vibrator bearings (19) and (51) again by using a depth gauge.

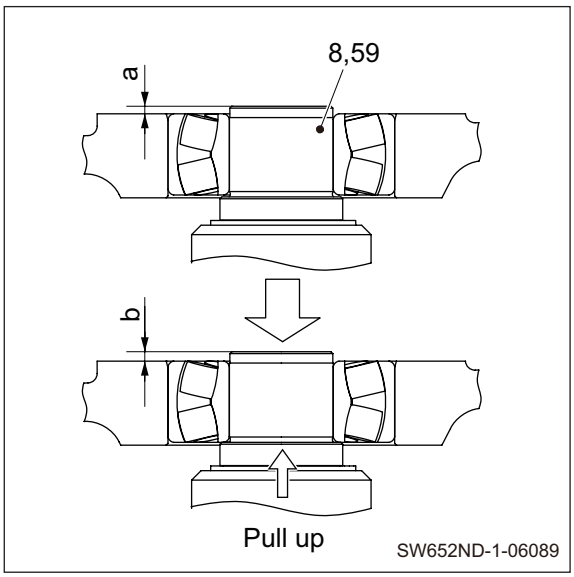


38) Make sure that eccentric shafts (8) and (59) have an axial play of 1 mm (0.04 in.) or more.

b = a + 1 mm (0.04 in.) or more

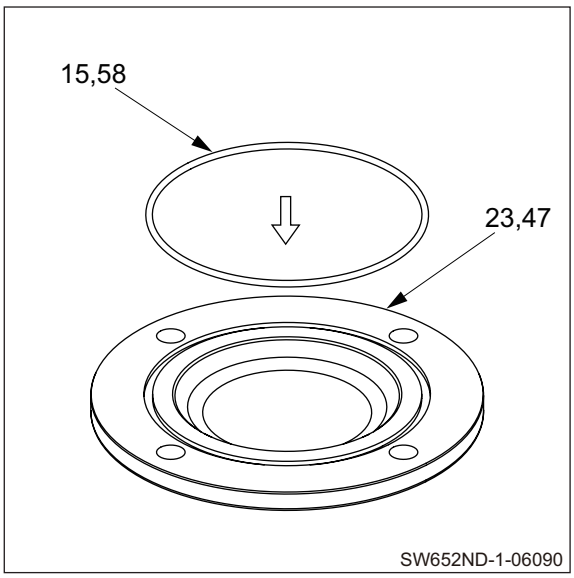
(NOTICE)

- **Two persons are required for taking measurements.**



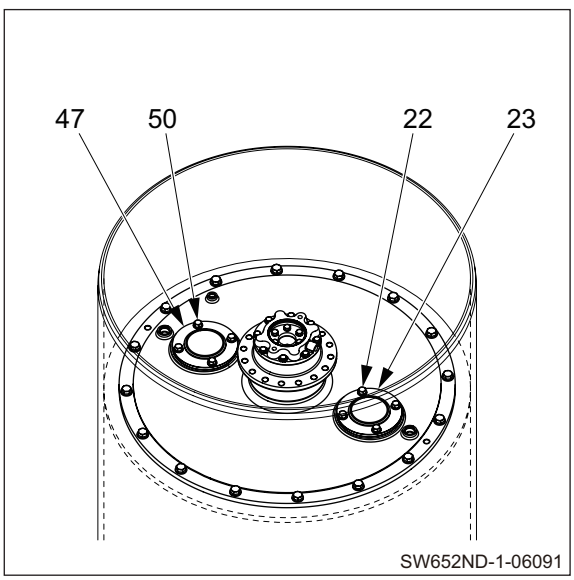
39) Apply grease to O-rings (15) and (58).

- Install O-rings to covers (23) and (47).

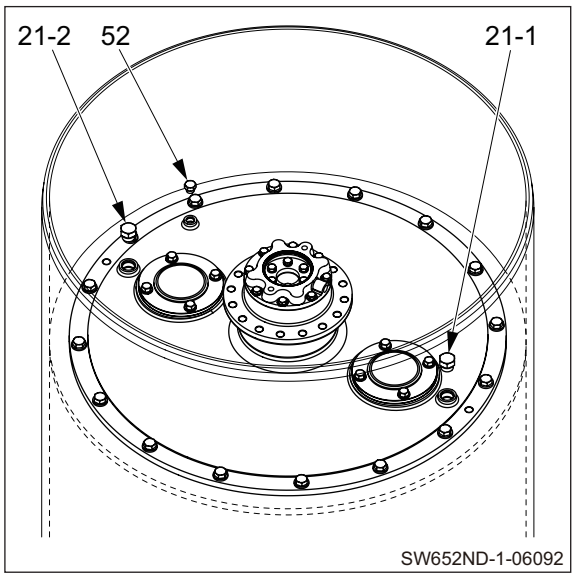


40) Secure covers (23) and (47) to axle shaft subassembly with four bolts (22), four bolts (50), and washers.

N•m (22) and (50) Bolts M12×30 : 110 N·m (81 lbf·ft)

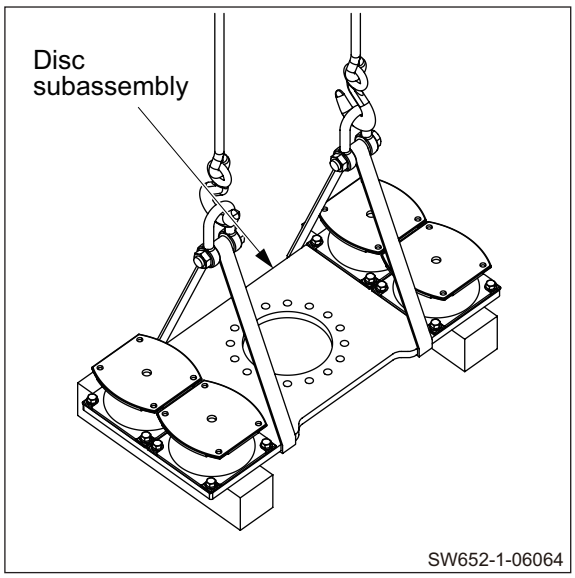


41) Apply grease to O-rings for plugs (21-1), (21-2), and level plug (52).
- Install plugs and level plug.

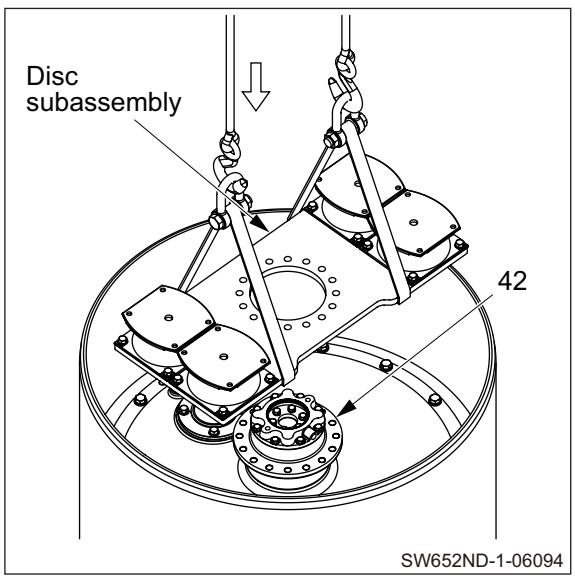


42) Lift disc subassembly.

Disc subassembly : 75kg (165 lbs.)

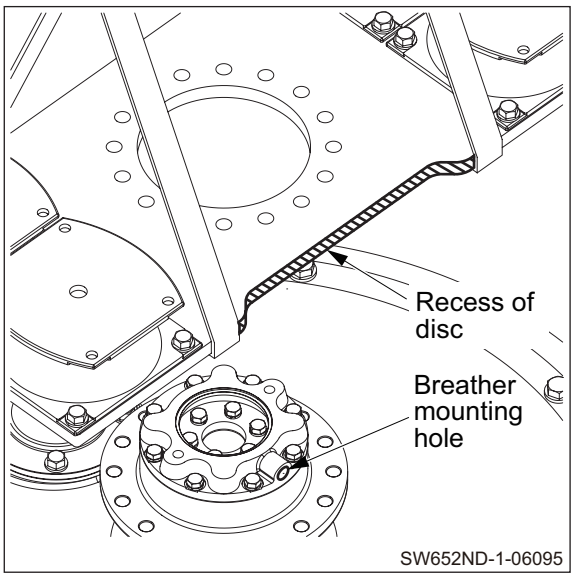


43) Lower disc subassembly on mounting surface of housing (42).



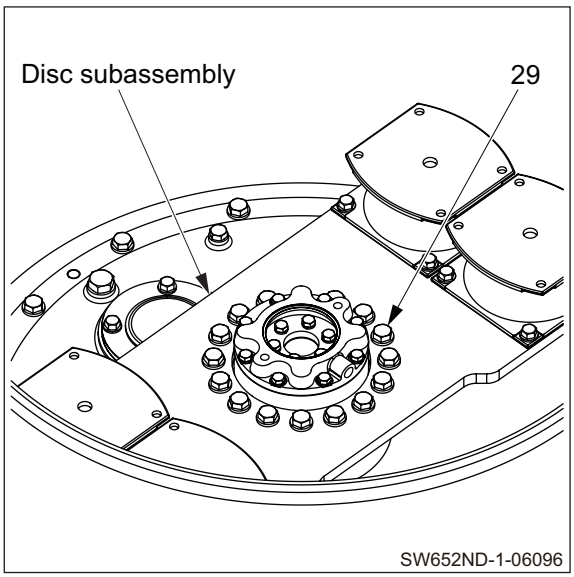
(NOTICE)

- **The recess of the disc must face the same direction as the breather mounting hole in the flange.**

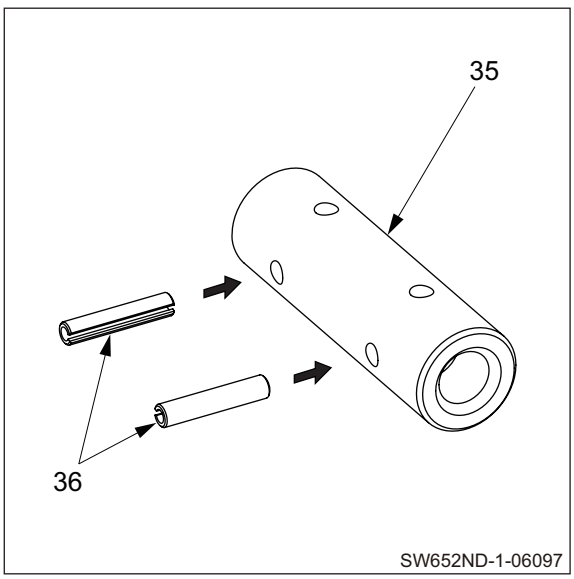


44) Secure disc subassembly with sixteen bolts (29) and washers.

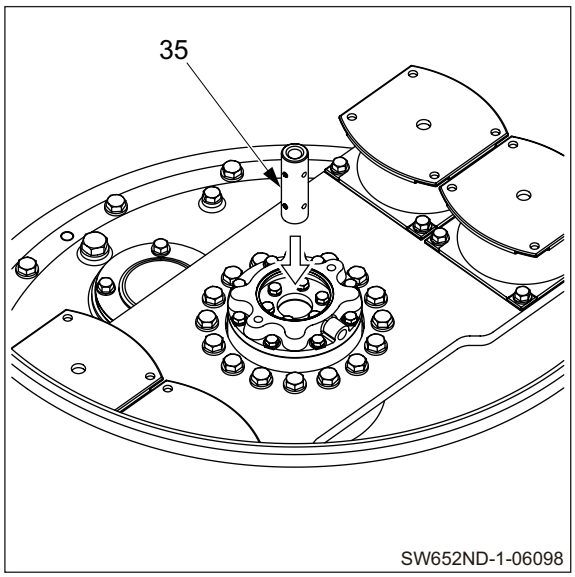
N•m (29) Bolts M16×45 : 265 N·m (195 lbf·ft)



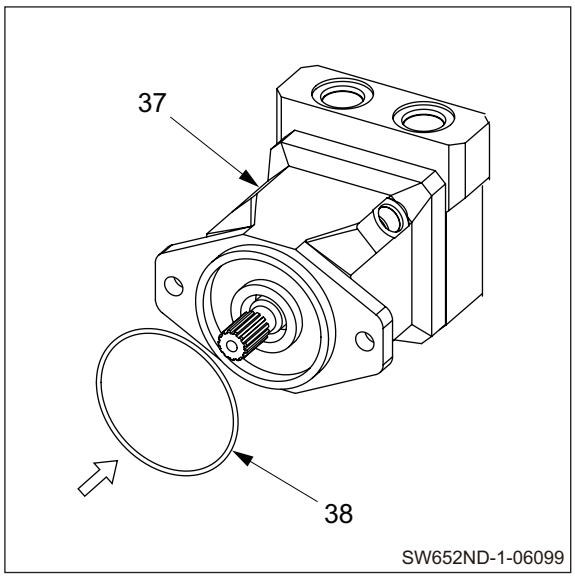
45) Drive two spring pins (36) into sleeve (35).



46) Apply molybdenum-based grease to splined portion of sleeve (35).
- Fit sleeve to splined portion on drive shaft end.



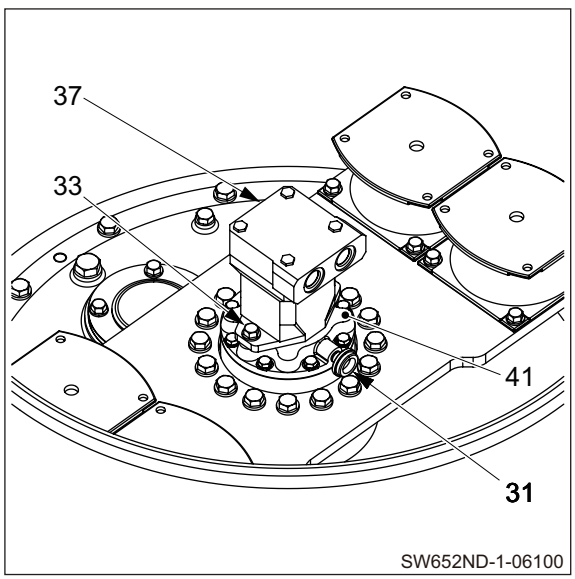
47) Apply grease to O-ring (38).
- Install O-ring to vibrator motor (37).



48) Wind seal tape around threaded portion of breather (31).
- Install breather.
- Secure vibrator motor (37) to flange (41) with two bolts (33) and washers.

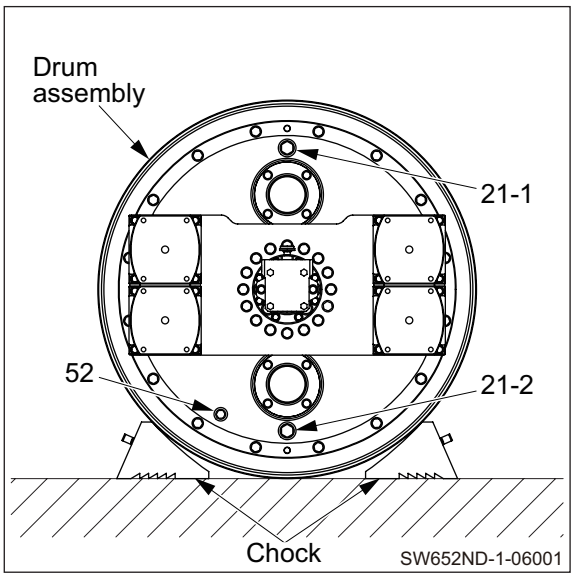
(37) Vibrator motor : 15 kg (33 lbs.)

(33) Bolts M12×30 : 110 N·m (81 lbf·ft)

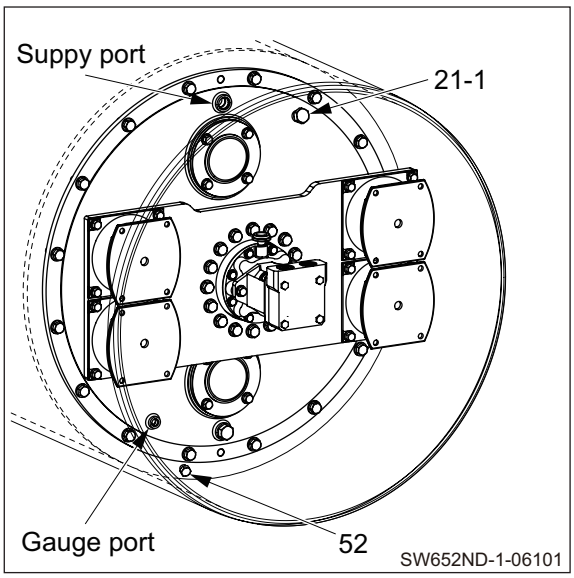


49) Lay drum assembly with plugs (21-1), (21-2), and level plug (52) positioned as shown right.
- Hold with chocks.

Drum assembly : 1,685 kg (3,715 lbs.)

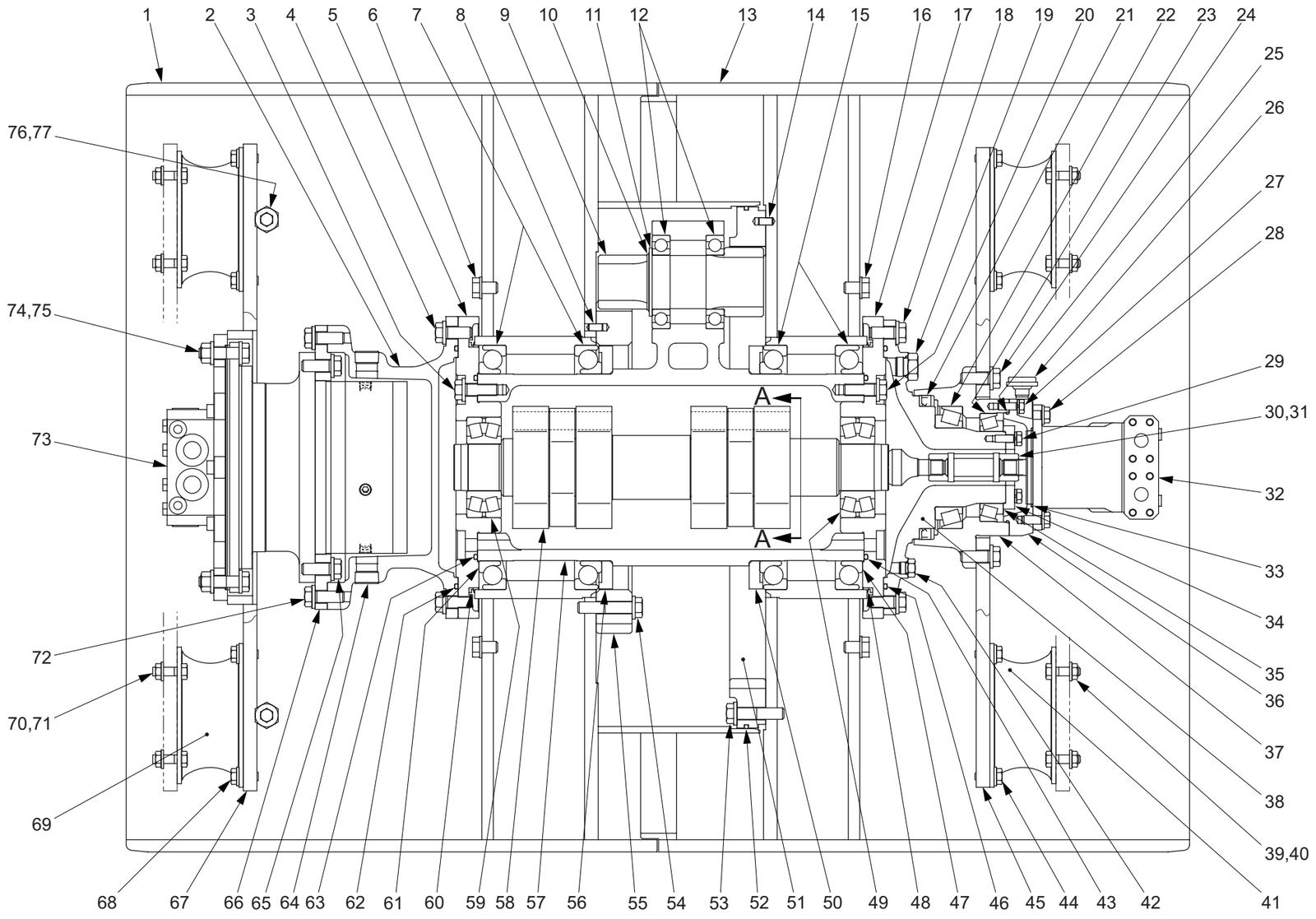


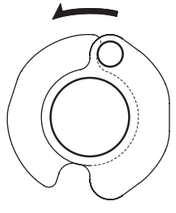
50) Remove plug (21-1) and level plug (52).
- Supply gear oil from oil supply port.
- Check that oil drips from gauge port.
  - Quantity of gear oil : 10.4 L (2.7 gal.)
- Install plug and level plug.



8. VIBRATORY DRUM ASSEMBLY (SW654B) (FROM 30143)

8-1. Vibratory Drum Assembly

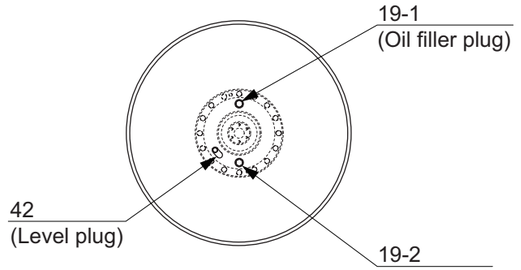




Vibration mode: Low
Counterclockwise rotation

SECTION A-A

Vibration mode: High
Clockwise rotation



Vibrator motor side

0559-43806-0-11266-0

(1) Drum
(2) Housing
(3) Bolt : M16×50
(4) Bolt : M16×40
(5) Disc
(6) Bolt : M16×25
(7) Ball bearing
(8) Pin
(9) Gear
(10) Retaining ring
(11) Washer
(12) Ball bearing
(13) Drum
(14) Pin
(15) Ball bearing
(16) Bolt : M16×25
(17) Disc
(18) Bolt : M16×40
(19) Plug
(20) Bolt : M16×50
(21) Oil seal
(22) Roller bearing
(23) Roller bearing
(24) Bolt : M16×45
(25) O-ring
(26) Breather
(27) Bolt : M10×30
(28) Bolt : M12×30
(29) Bolt : M10×30
(30) Sleeve
(31) Spring pin
(32) Vibrator motor
(33) O-ring
(34) Cover
(35) Shim
(36) Flange
(37) Housing
(38) Axle shaft
(39) Bolt : M12×40
(40) Nut : M12
(41) Damper
(42) Level plug
(43) O-ring
(44) Bolt : M12×30
(45) Disc
(46) O-ring
(47) Shim
(48) V-ring
(49) Vibrator bearing
(50) Collar
(51) Gear
(52) O-ring
(53) Bolt : M16×70
(54) Bolt : M16×80
(55) Gear
(56) Collar
(57) Case
(58) Eccentric shaft
(59) Vibrator bearing
(60) V-ring
(61) Shim
(62) O-ring
(63) O-ring
(64) Plug
(65) Bolt : M16×45
(66) Disc
(67) Disc
(68) Bolt : M12×30
(69) Damper
(70) Bolt : M12×40
(71) Nut : M12
(72) Bolt : M16×45
(73) Propulsion motor
(74) Bolt : M16×60
(75) Nut : M16
(76) Pipe
(77) Bolt : M10×110

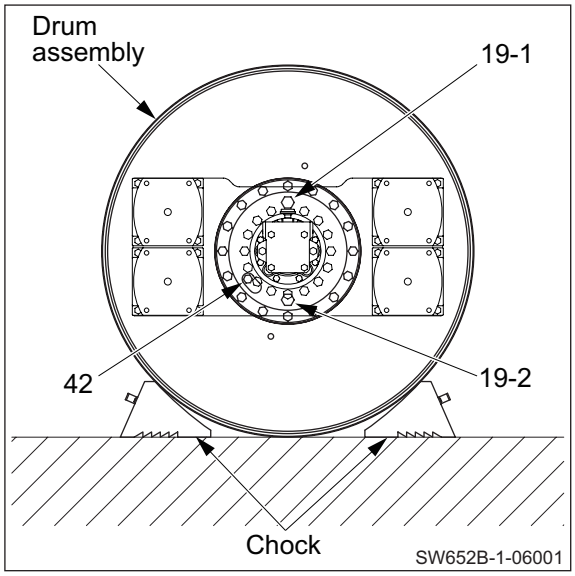
8-2. Disassembly and Reassembly of Vibratory Drum

- Lead line numbers shown in the illustrations for the following vibratory drum disassembly and reassembly procedures are constant with part numbers of vibratory drum assembly shown on page 6-150.

8-2-1. Disassembly of vibratory drum

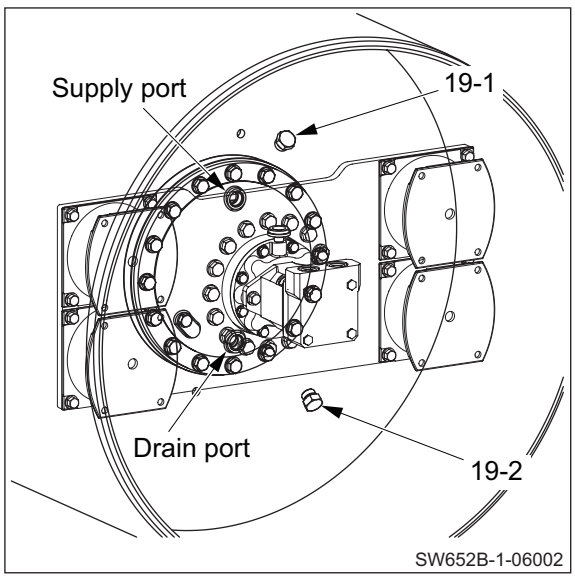
1) Lay drum assembly with plugs (19-1), (19-2), and (42) positioned as shown on the right.
   - Hold with chocks.

   Drum assembly : 1,965 kg (4,332 lbs.)



2) Remove plugs (19-1) and (19-2).
   - Drain gear oil.

     • Quantity of gear oil : 1.7 L (0.4 gal.)

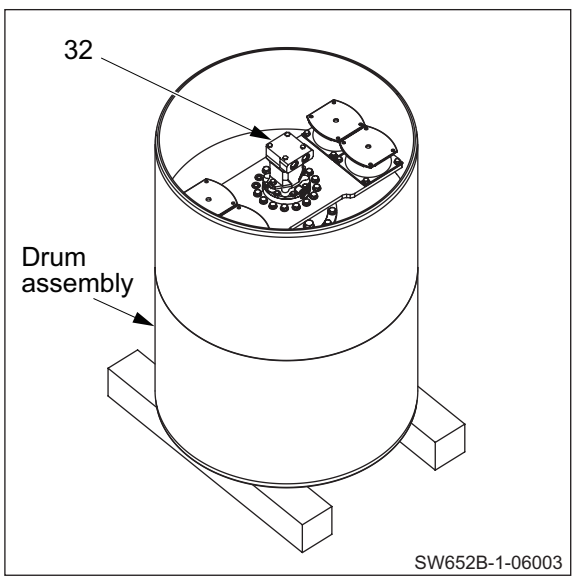


WARNING

- **When standing the vibratory drum, use wooden blocks of sufficient strength to securely support the drum.**
- **Carry out the work in an unstrained posture using a work stool or the like.**

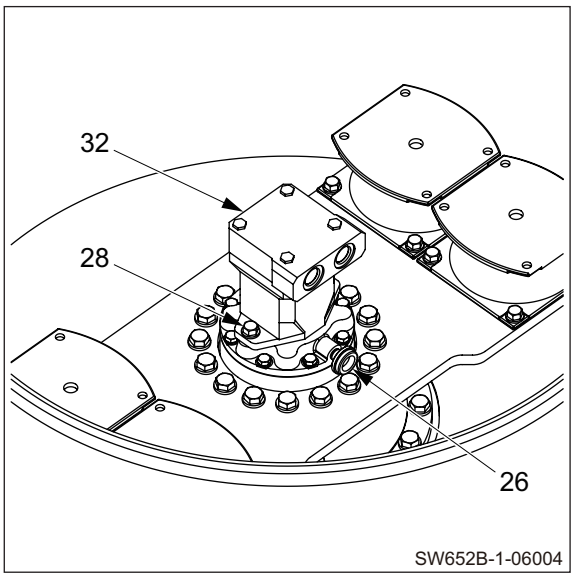
3) Stand drum assembly with its vibrator motor (32) side facing up.

   Drum assembly : 1,960 kg (4,321 lbs.)

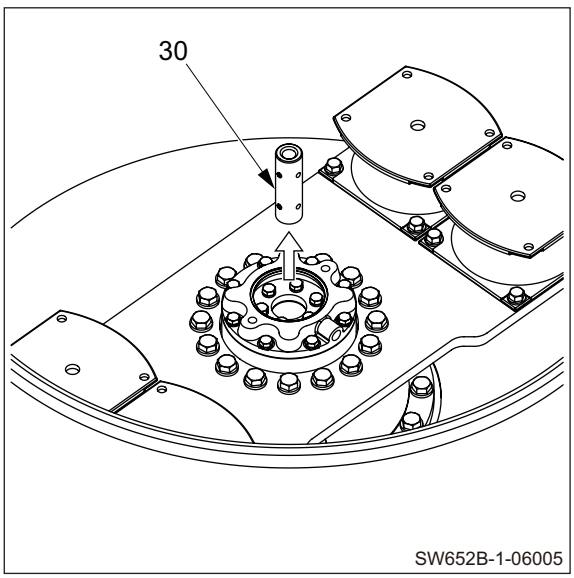


4) Remove breather (26).
   - Remove bolts (28).
   - Remove vibrator motor (32).

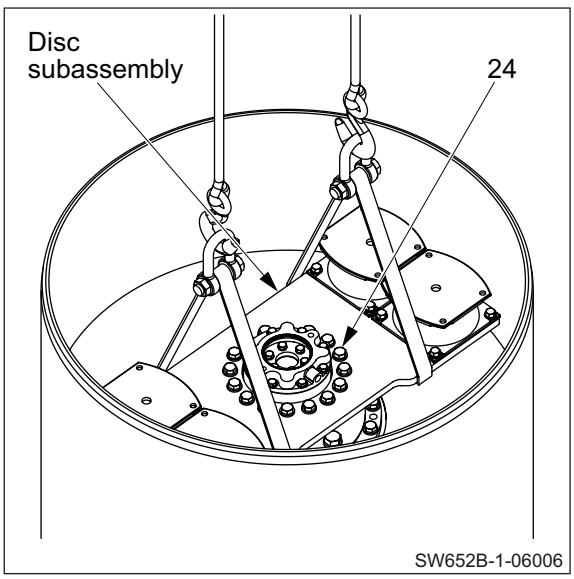
   (32) Vibrator motor : 15 kg (33 lbs.)



5) Remove sleeve (30).

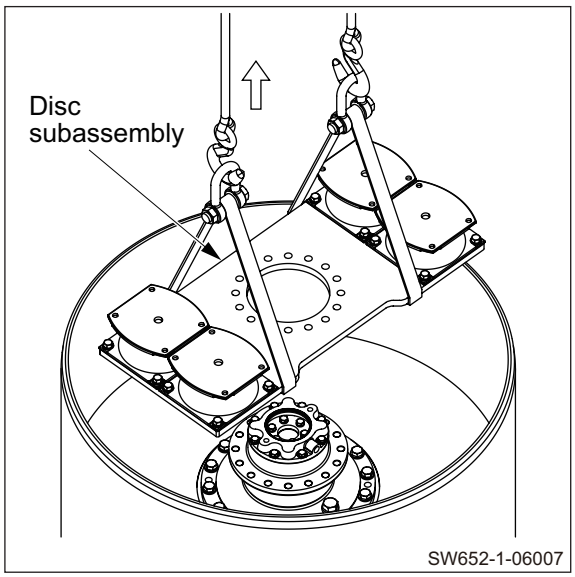


6) Lift disc subassembly.
   - Remove bolts (24).

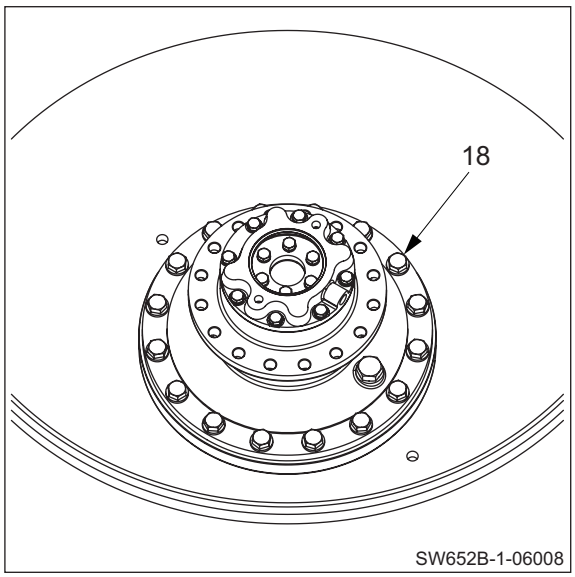


7) Remove disc subassembly.

Disc subassembly : 75 kg (165 lbs.)



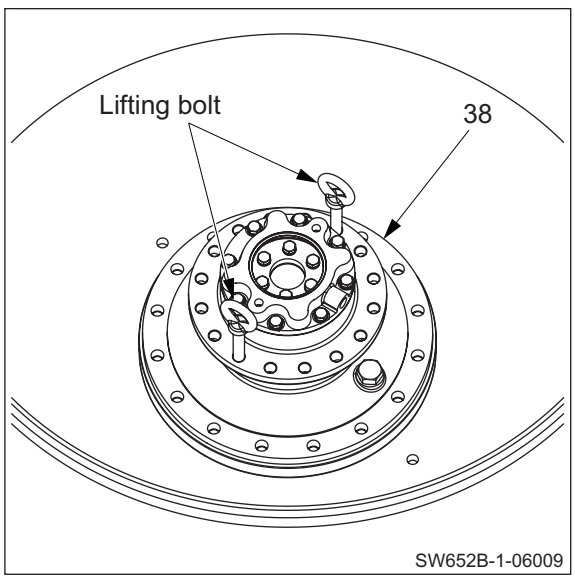
8) Remove bolts (18).



WARNING

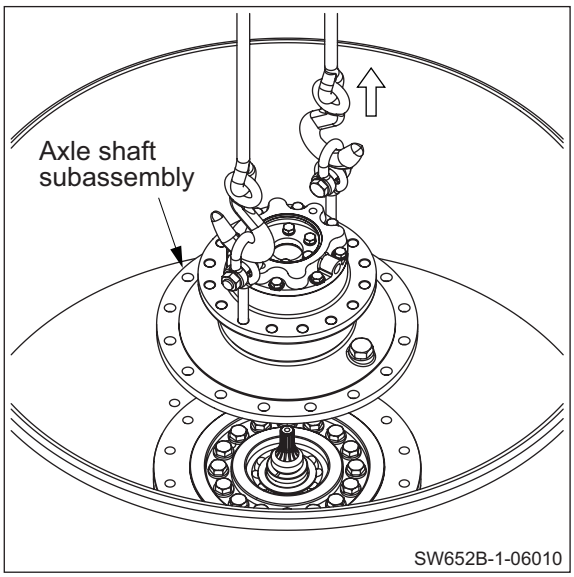
When installing lifting bolts, screw in the threads fully before using.

9) Install lifting bolts (M16) to axle shaft (38).

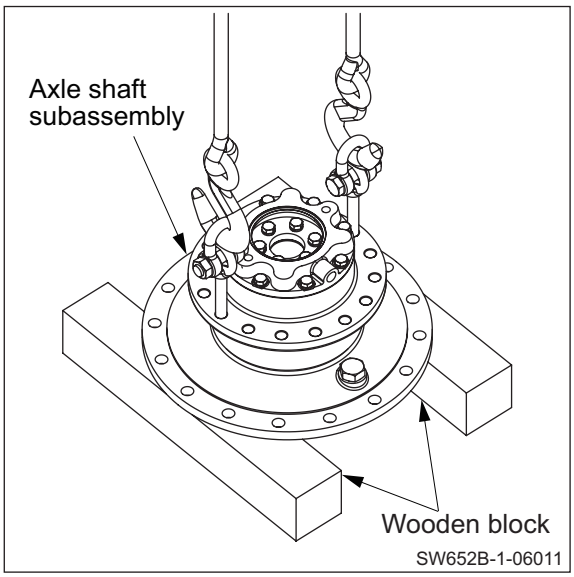


10) Remove axle shaft subassembly.

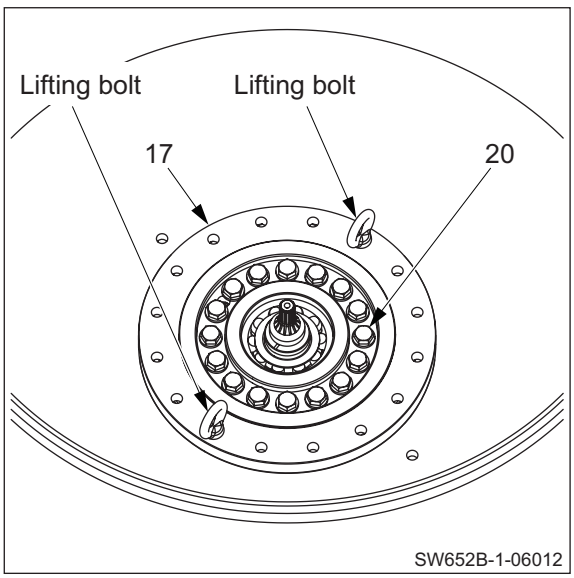
Axle shaft subassembly : 55 kg (121 lbs.)



11) Put axle shaft subassembly on wooden blocks.



12) Install lifting bolts (M16) to disc (17).
- Remove bolts (20).

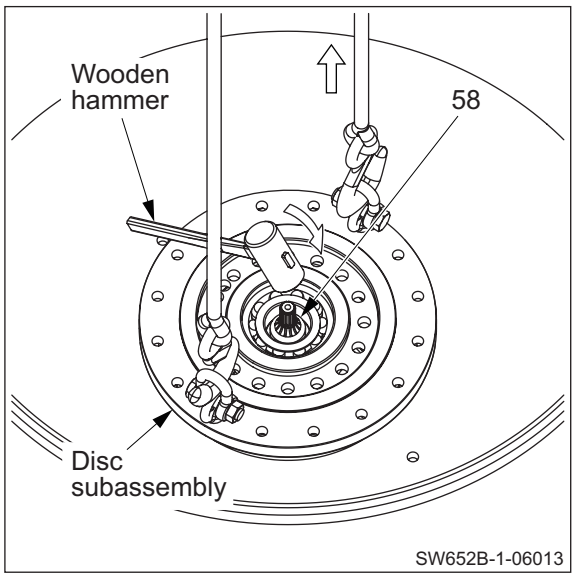


13) Remove disc subassembly.

(NOTICE)

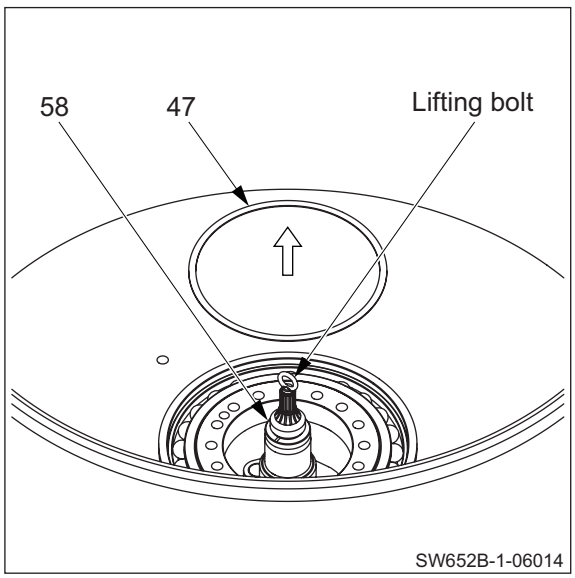
- **In order not to lift eccentric shaft together with disc subassembly, tap on the eccentric shaft end with a wooden hammer during lifting.**

Disc subassembly : 30 kg (66 lbs.)



14) Remove shim (47).

- Install a lifting bolt (M8) to eccentric shaft (58).

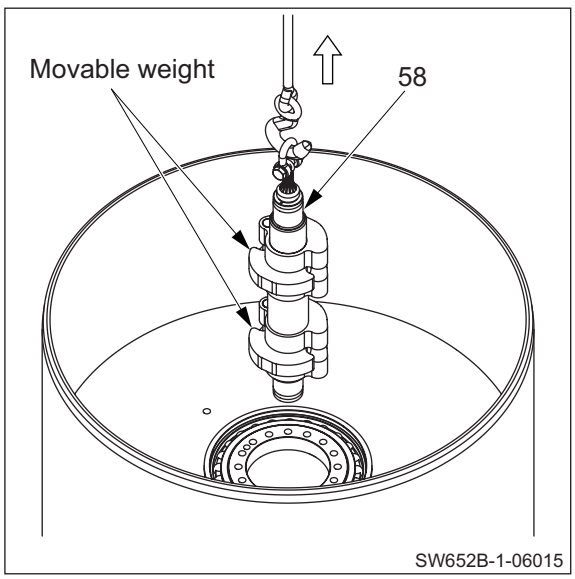


15) Remove eccentric shaft (58).

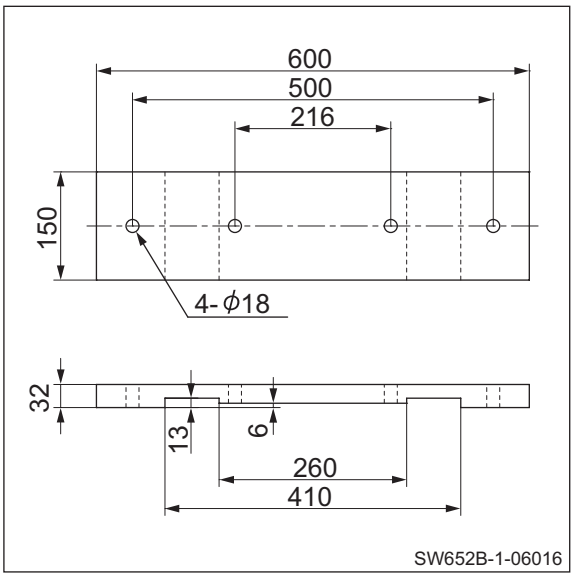
(58) Eccentric shaft : 50 kg (110 lbs.)

(NOTICE)

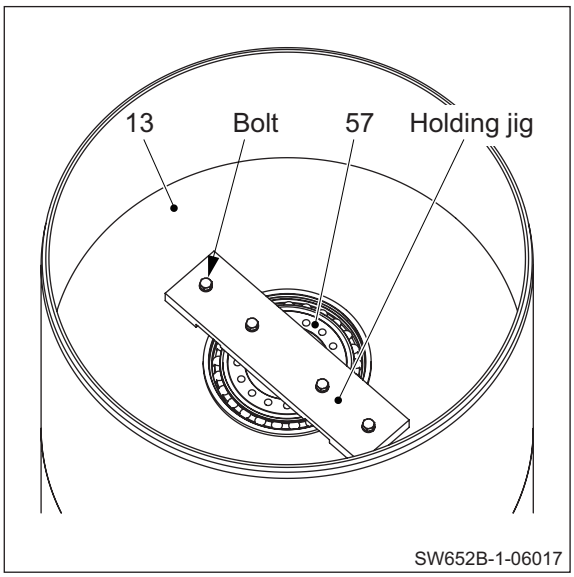
- **Put the movable weights at their outmost position.**



16) Set a holding jig to vibrator motor side drum (13) and case (57), and secure with bolts (M16×50) and spring washer.



SW652B-1-06016



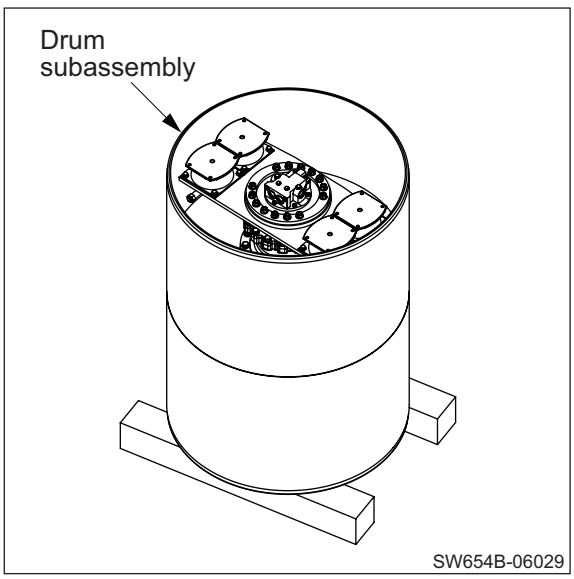
SW652B-1-06017

⚠WARNING

Be careful because reversing the vibratory drum involves risk. Confirm that the surrounding area is safe, and work in a natural, unstrained posture.

17) Reverse drum subassembly.

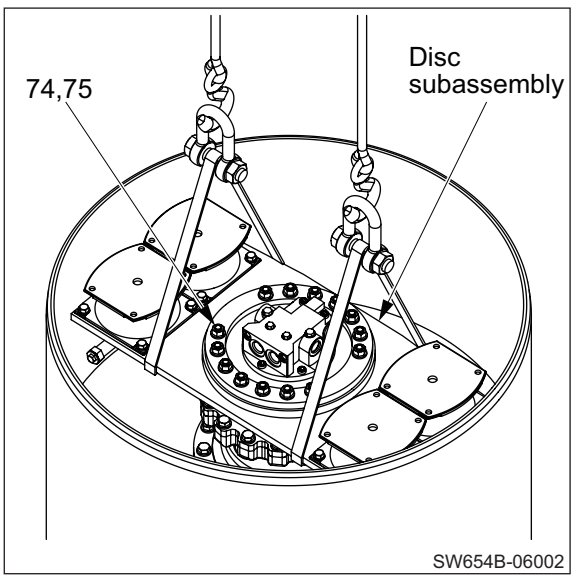
Drum subassembly : 1,755 kg (3,869 lbs.)



SW654B-06029

18) Lift disc subassembly.

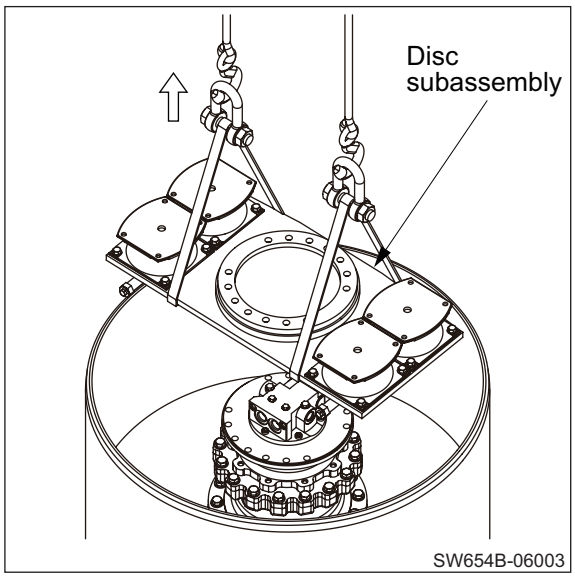
- Remove nuts (75) and bolts (74).



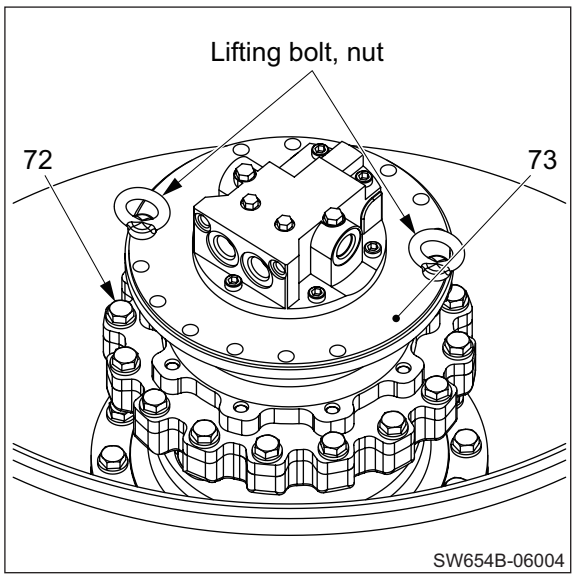
SW654B-06002

19) Remove disc subassembly.

Disc subassembly : 65 kg (143 lbs.)

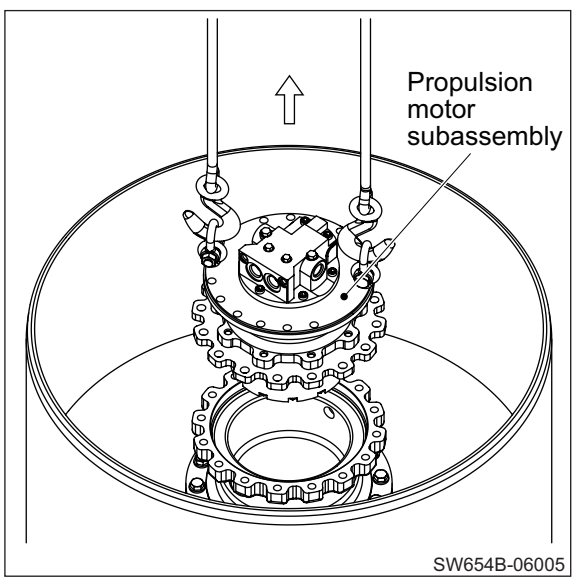


20) Install lifting bolts and nuts (M16) to propulsion motor (73).
- Remove bolts (72).

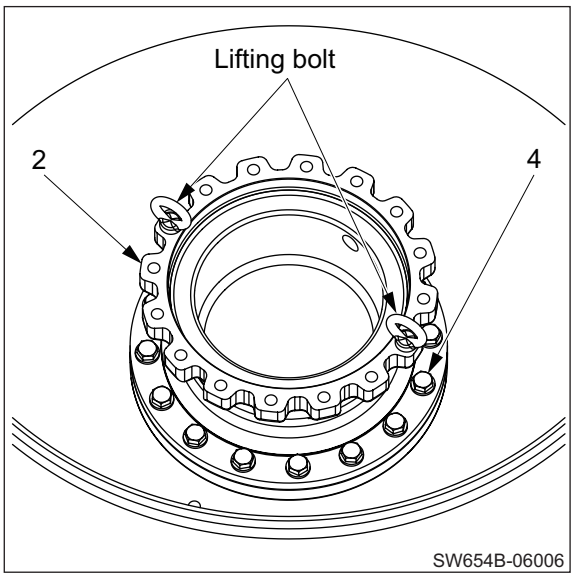


21) Remove propulsion motor subassembly.

Propulsion motor subassembly : 100 kg (220 lbs.)

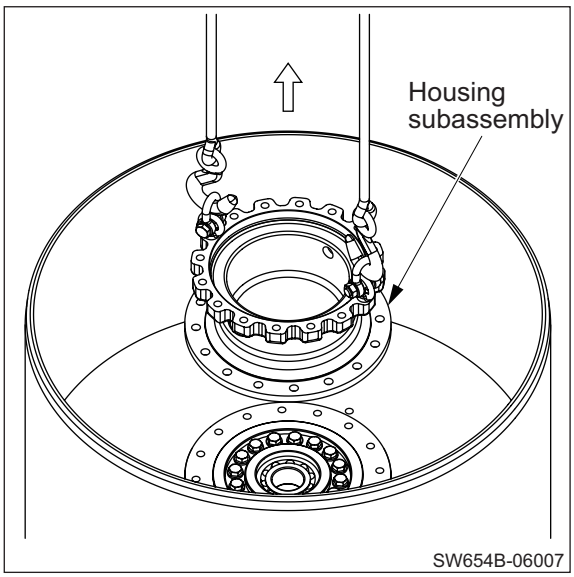


22) Install lifting bolts (M16) to housing (2).
- Remove bolts (4).

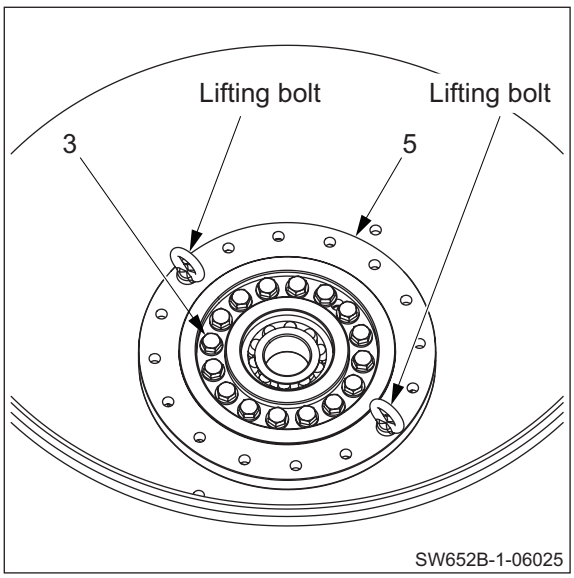


23) Remove housing subassembly.

Housing subassembly : 40 kg (88 lbs.)

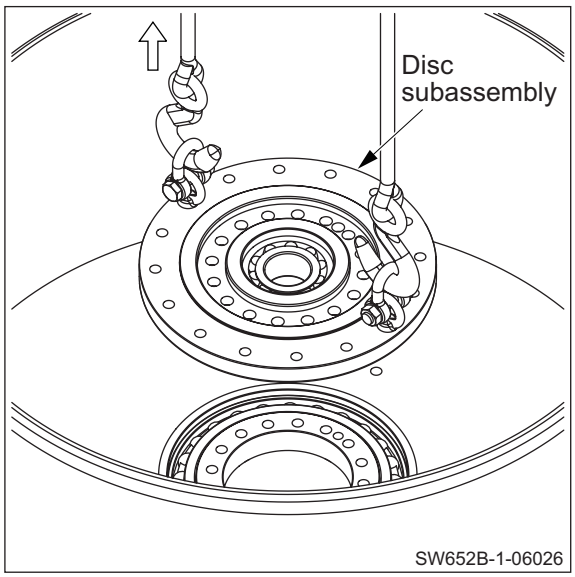


24) Install lifting bolts (M16) to disc (5).
- Remove bolts (3).

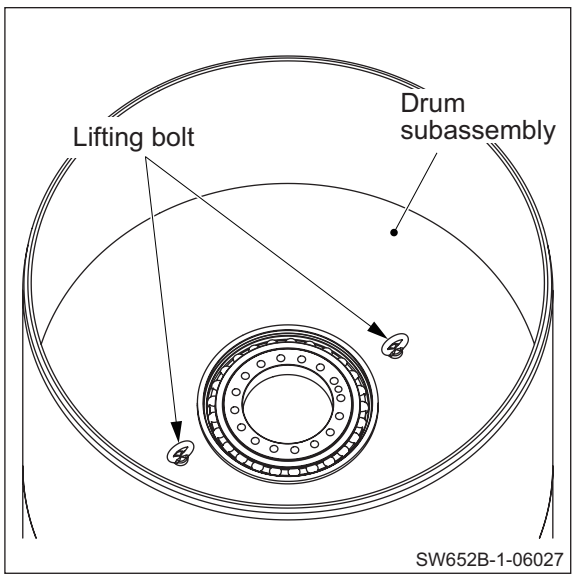


25) Remove disc subassembly.

Disc subassembly : 30 kg (66 lbs.)



26) Install lifting bolts (M16) to propulsion motor side drum subassembly.

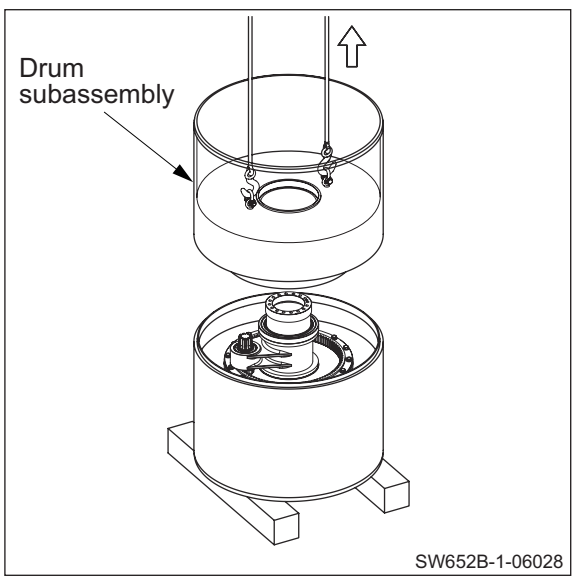


27) Remove propulsion motor side drum subassembly.

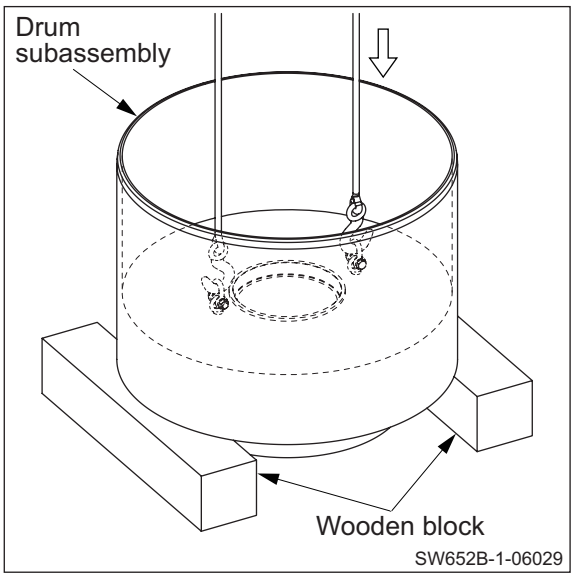
Propulsion motor side drum subassembly
: 710 kg (1,565 lbs.)

(NOTICE)

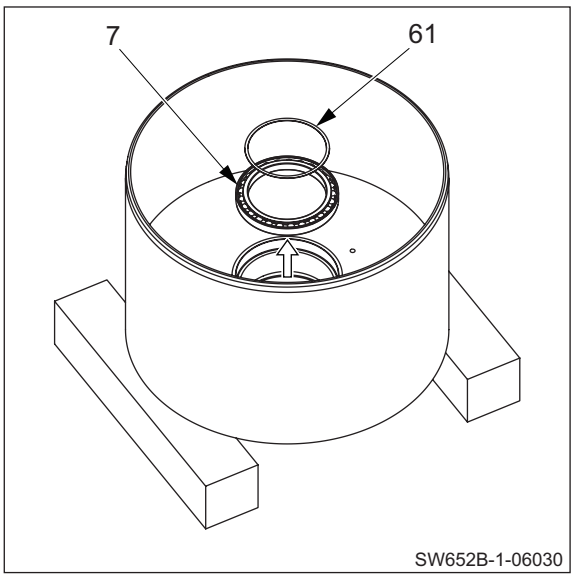
- **Take care not to damage the gear on the case during removal.**



28) Put propulsion motor side drum subassembly on wooden blocks.

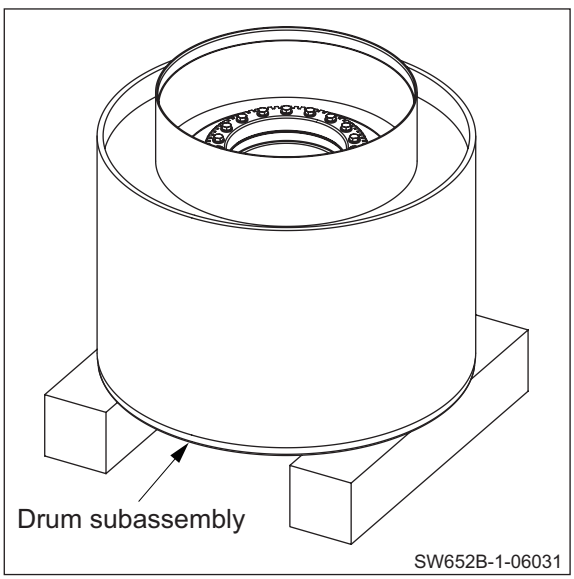


29) Remove shim (61).
- Remove ball bearing (7).

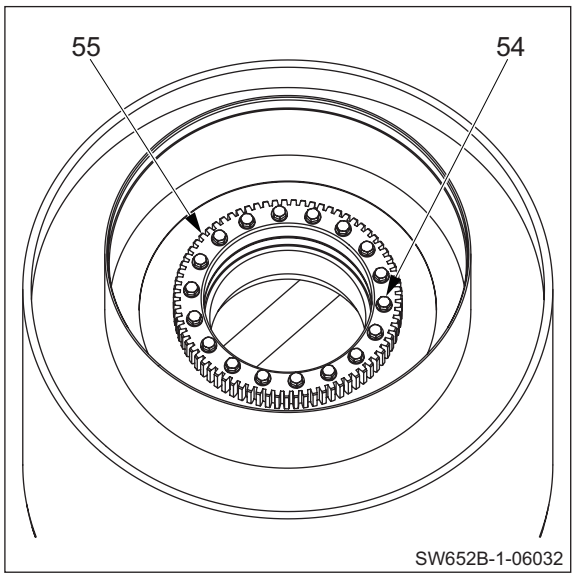


30) Reverse propulsion motor side drum subassembly.

Propulsion motor side drum subassembly
: 700 kg (1,543 lbs.)

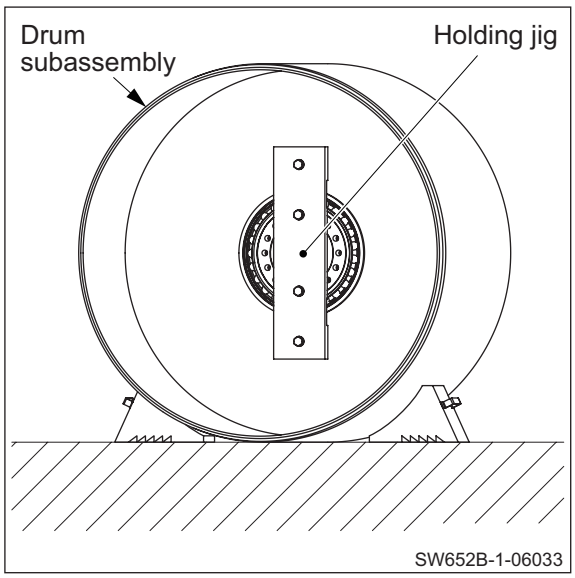


31) Remove bolts (54).
- Remove gear (55).

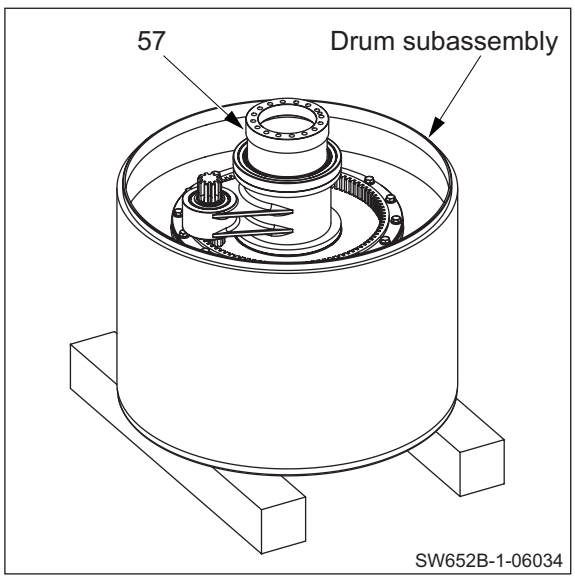


32) Lay vibrator motor side drum subassembly on its side and remove jig.

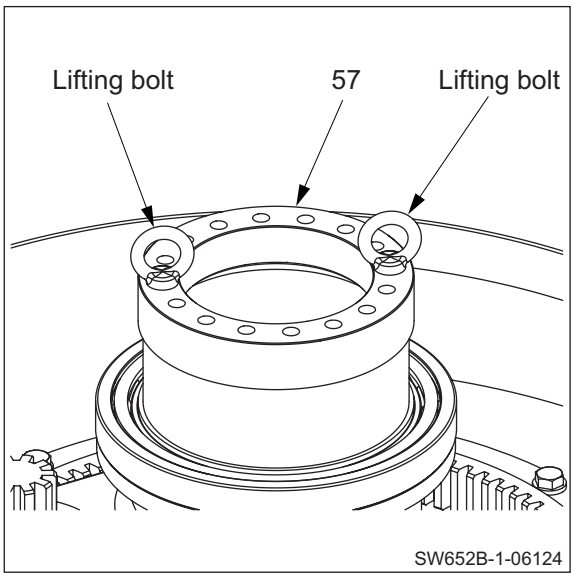
Vibrator motor side drum subassembly
: 795 kg (1,753 lbs.)



33) Stand vibrator motor side drum subassembly again with case (57) facing up.



34) Install lifting bolts (M16) to case (57).

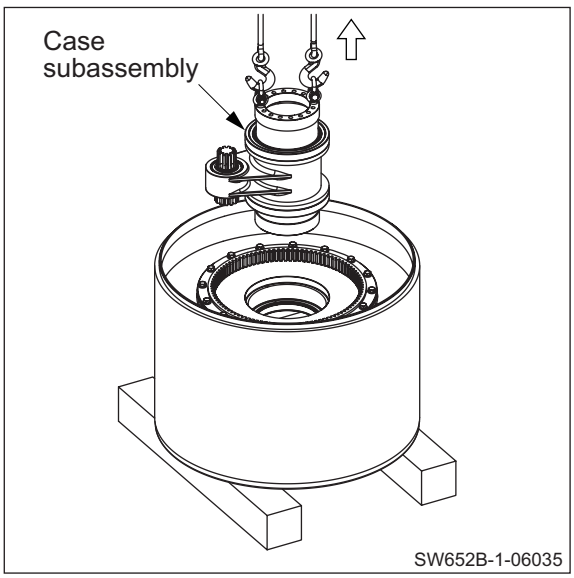


35) Remove case subassembly.

Case subassembly : 125 kg (276 lbs.)

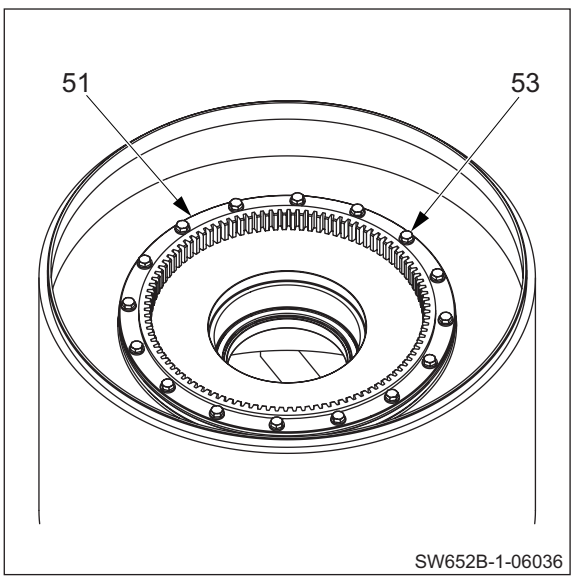
(NOTICE)

- **Take care not to damage the gear on the case during removal.**



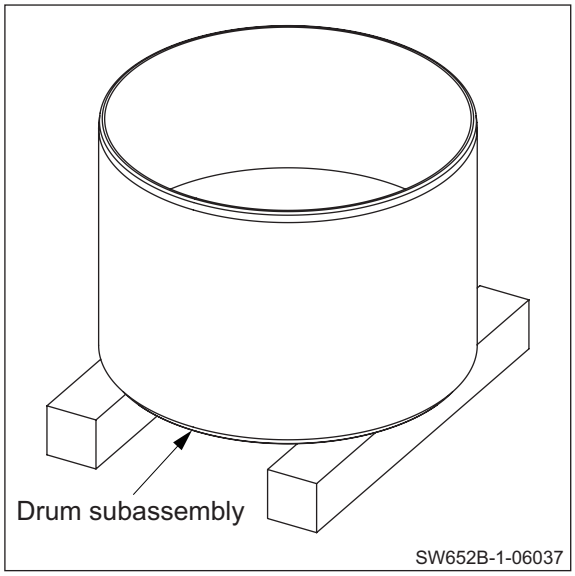
36) Remove bolts (53).

- Remove gear (51).

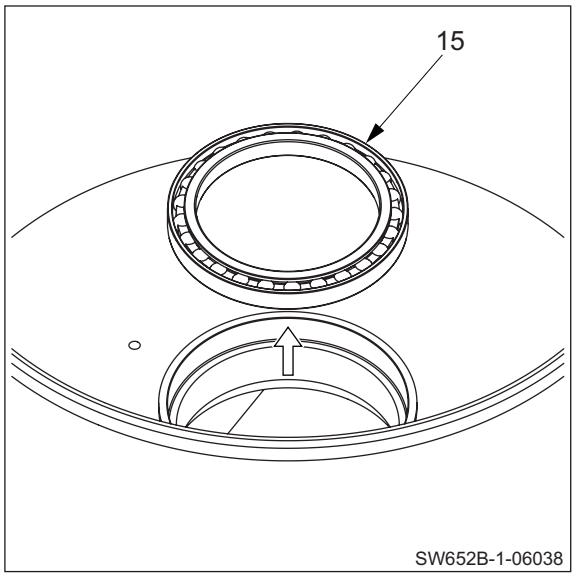


37) Reverse vibrator motor side drum subassembly.

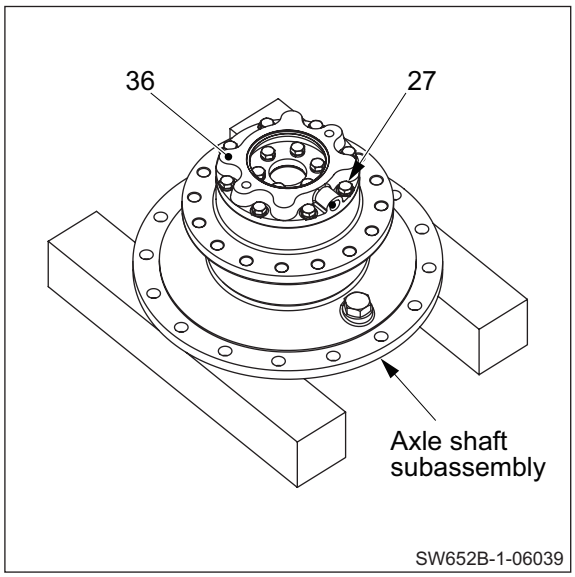
Vibrator motor side drum subassembly
: 605 kg (1,334 lbs.)



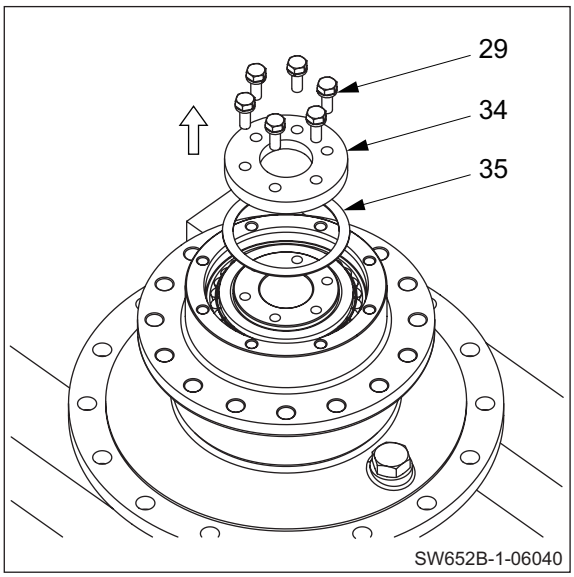
38) Remove ball bearing (15).



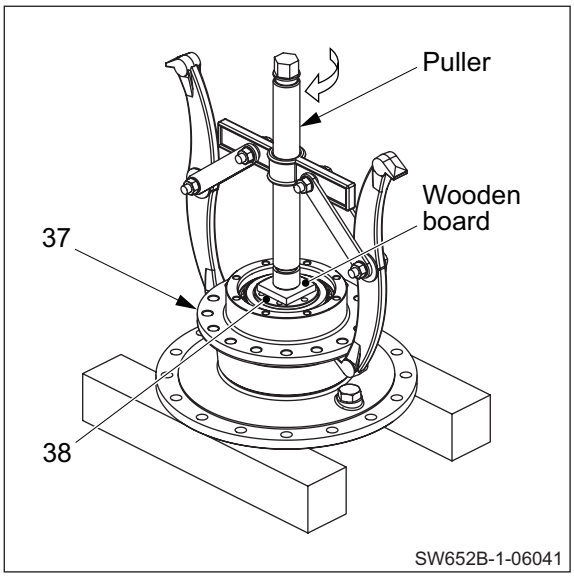
39) Disassembly of axle shaft subassembly
- Remove bolts (27).
- Remove flange (36).



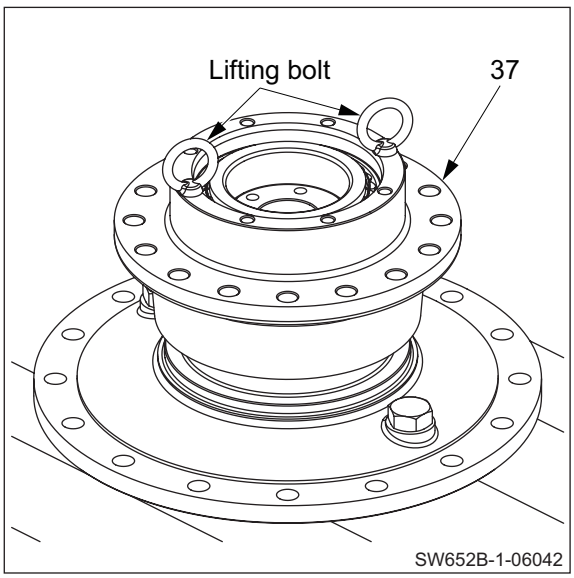
40) Remove bolts (29).
- Remove cover (34).
- Remove shim (35).



41) Put a piece of wooden board on end of axle shaft (38).
- Set a puller on housing (37).
- Remove housing subassembly with roller bearing from axle shaft subassembly.

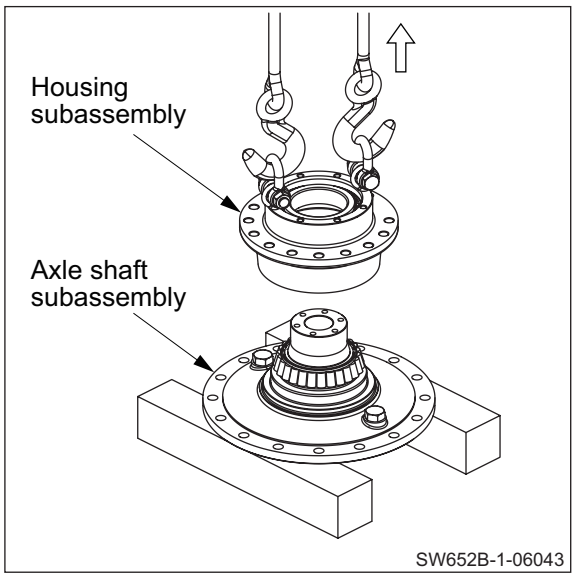


42) Install lifting bolts (M10) to housing (37).



43) Remove housing subassembly from axle shaft subassembly.

Housing subassembly : 20 kg (44 lbs.)



8-2-2. Reassembly of vibratory drum

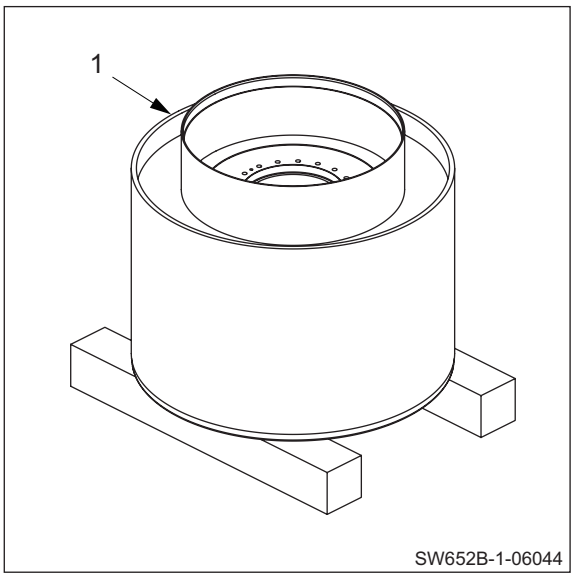
- Before reassembling, clean disassembled parts well and check that there is no abnormality.

⚠WARNING

- **When standing the vibratory drum, use wooden blocks of sufficient strength to securely support the drum.**
- **Carry out the work in an unstrained posture using a work stool or the like.**

1) Stand propulsion motor side drum (1).

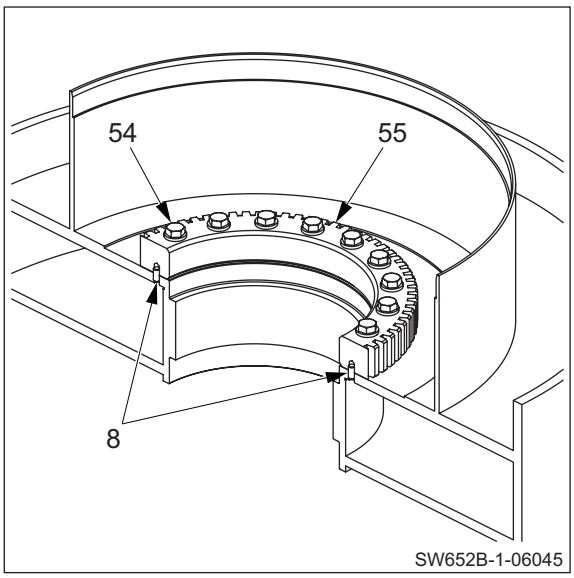
kg (1) Propulsion motor side drum : 655 kg (1,444 lbs.)



2) Position gear (55) by using two locating pins (8).
   - Secure gear with eighteen bolts (54) and washers.

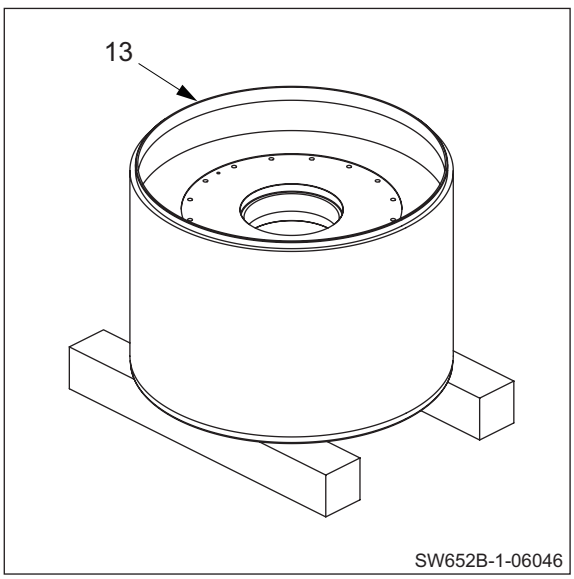
N•m (54) Bolt M16×80 : 265 N·m (195 lbf·ft)

   - Apply lithium-based grease to teeth of gear.



3) Stand vibrator motor side drum (13).

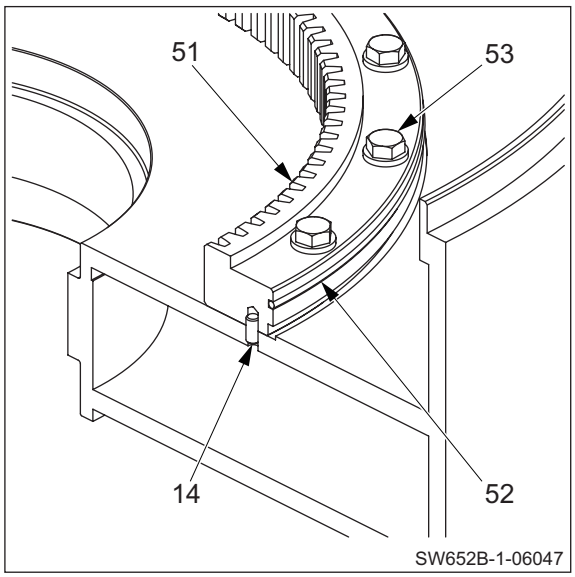
kg (13) Vibrator motor side drum : 595 kg (1,312 lbs.)



4) Apply grease to O-ring (52).
- Install O-ring to gear (51).
- Position gear by using two locating pins (14).
- Secure gear with sixteen bolts (53) and washers.

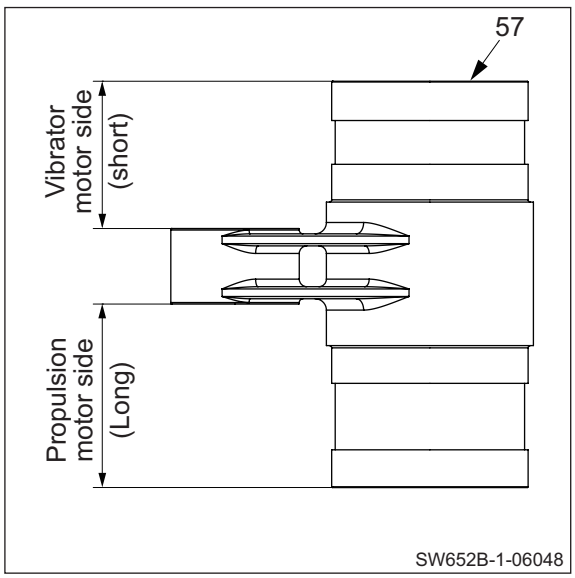
N•m (53) Bolt M16×80 : 265 N·m (195 lbf·ft)

- Apply lithium-based grease to teeth of gear.



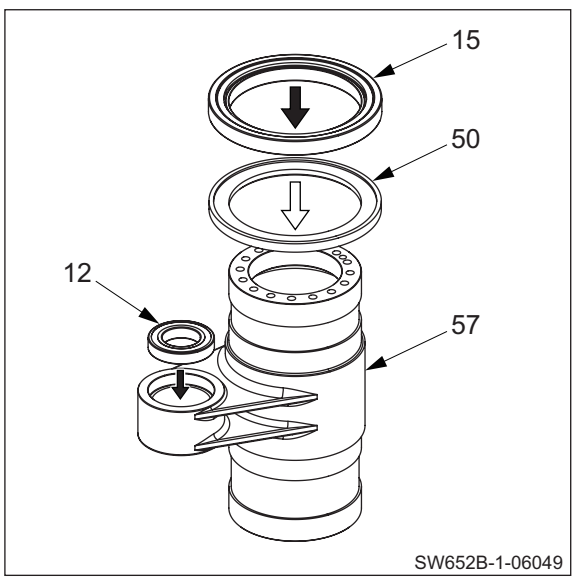
5) Reassembly of case subassembly

5-1) Stand case (57) with its vibrator motor side (short) facing up.

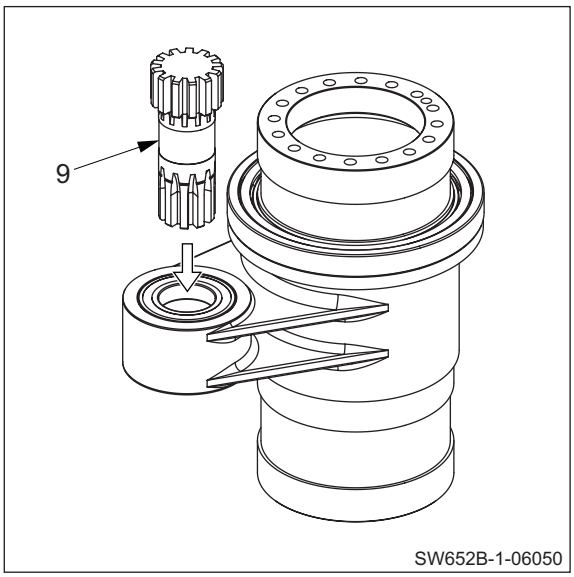


5-2) Apply a coat of gear oil to case (57) at where bearings will be press-fitted.
- Install collar (50).
- Drive vibrator bearings (12) and (15).
- Apply sufficient amount of lithium-based grease to ball bearings.

(NOTICE)
- **Take care not to damage the bearings when installing them.**



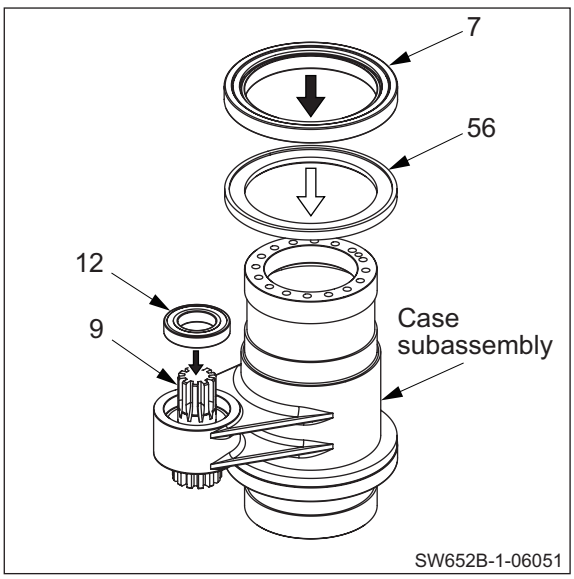
5-3) Apply a coat of gear oil to case at where gear will be installed.
- Install gear (9).



5-4) While supporting gear (9) to prevent it from falling off, reverse case subassembly.

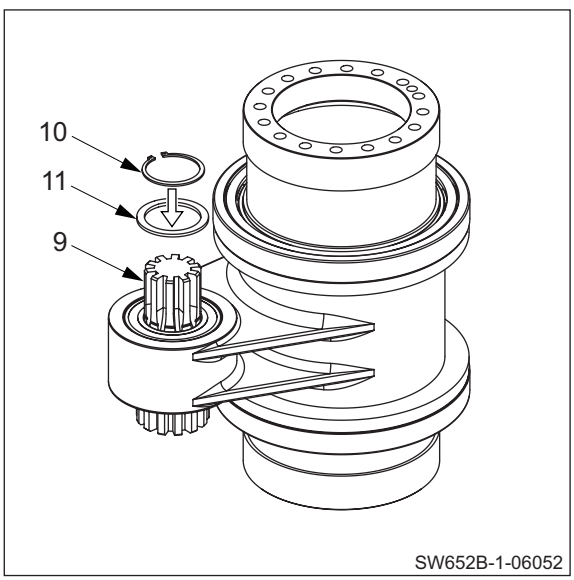
Case subassembly : 110 kg (243 lbs.)

- Apply a coat of gear oil to case at where bearings will be press-fitted.
- Install collar (56).
- Drive in ball bearings (7) and (12).
- Apply sufficient amount of lithium-based grease to ball bearings.



5-5) Hold gear (9) with washer (11) and retaining ring (10).
- Apply sufficient amount of lithium-based grease to teeth of gear.

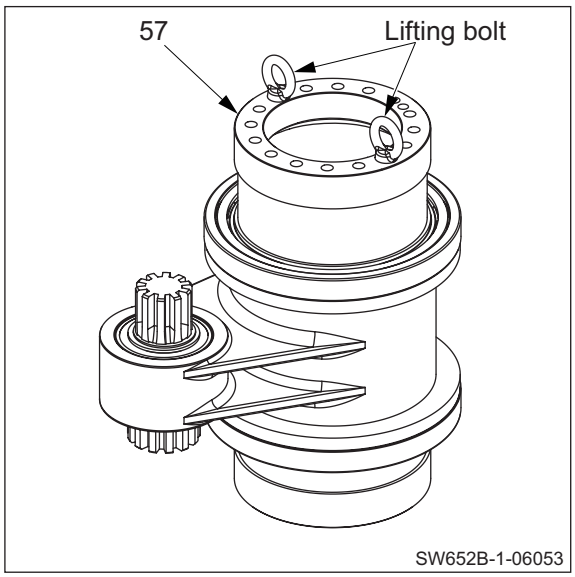
(NOTICE)
- **Make sure that the retaining ring is fitted completely in its groove.**



⚠WARNING

When installing lifting bolts, screw in the threads fully before using.

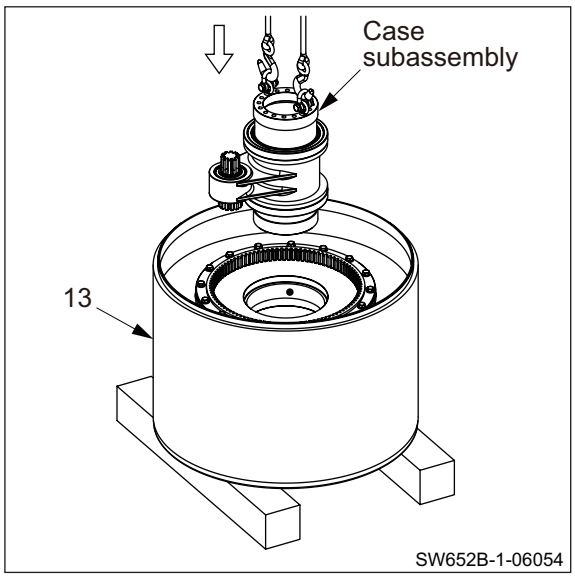
6) Install lifting bolts (M16) to case (57).



7) Apply a coat of gear oil to drum at where bearing will be installed.
   - Install case subassembly to vibrator motor side drum (13).

   Case subassembly : 125 kg (276 lbs.)

(NOTICE)
- **Make sure that the gear on the case subassembly is meshed with the gear on the drum.**



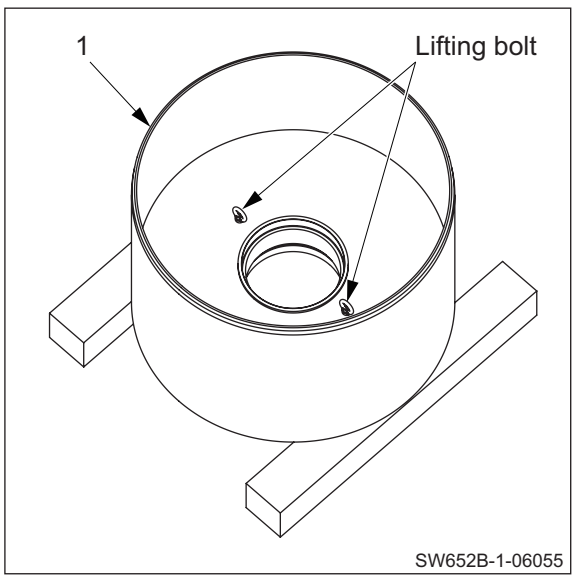
⚠WARNING

Be careful because reversing the vibratory drum involves risk. Confirm that the surrounding area is safe, and work in a natural, unstrained posture.

8) Reverse propulsion motor side drum (1).

   (1) Propulsion motor side drum : 700 kg (1,543 lbs.)

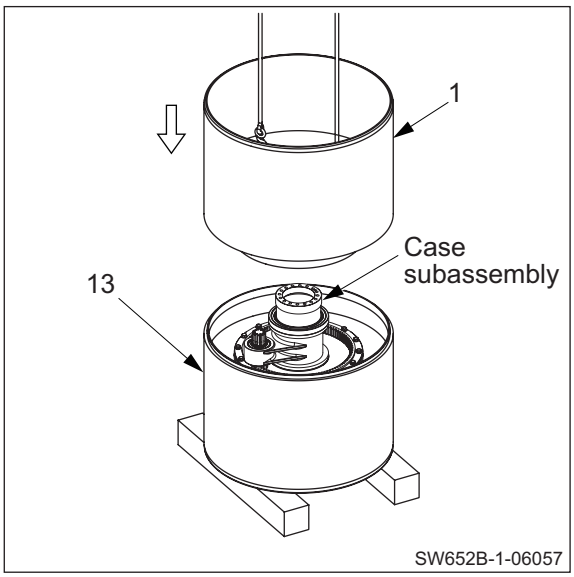
   - Install lifting bolts (M16) to drum.



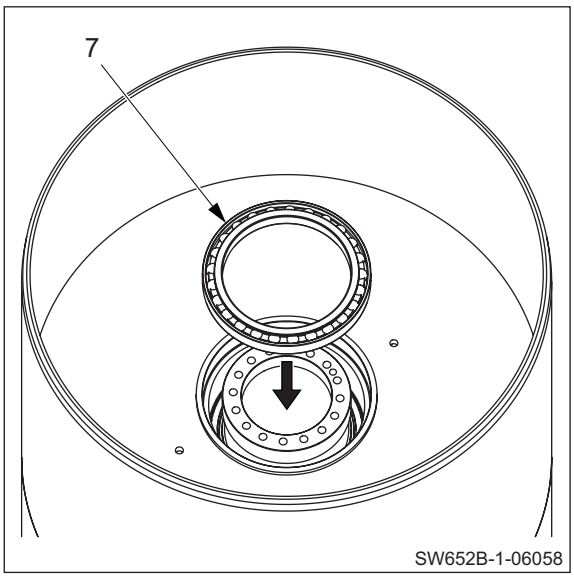
9) Apply a coat of gear oil to drum at where bearing will be installed.
- Install propulsion motor side drum (1) to vibrator motor side drum (13) with case subassembly.

(1) Propulsion motor side drum : 700 kg (1,543 lbs.)

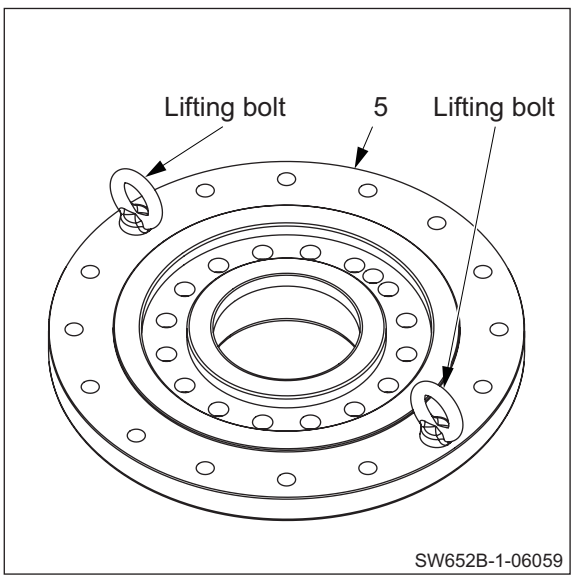
(NOTICE)
- **Make sure that the gear on the case subassembly is meshed with the gear on the drum.**



10) Apply a coat of gear oil to drum at where bearing will be press-fitted.
- Drive in ball bearing (7).
- Apply sufficient amount of lithium-based grease to ball bearing.

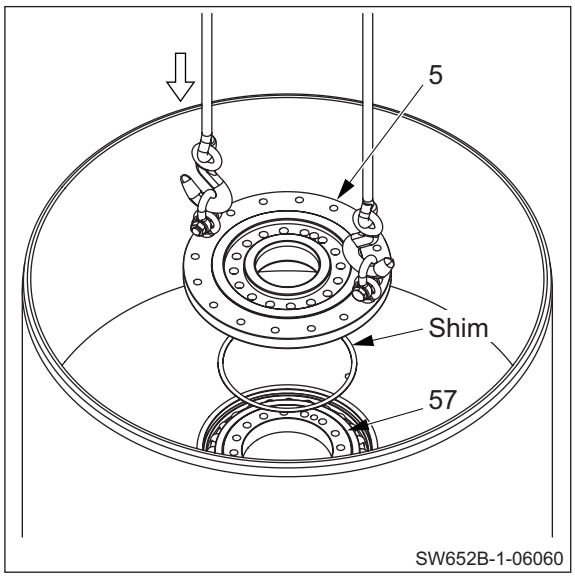


11) Preload adjustment of roller bearing
① Install lifting bolts (M16) to disc (5).



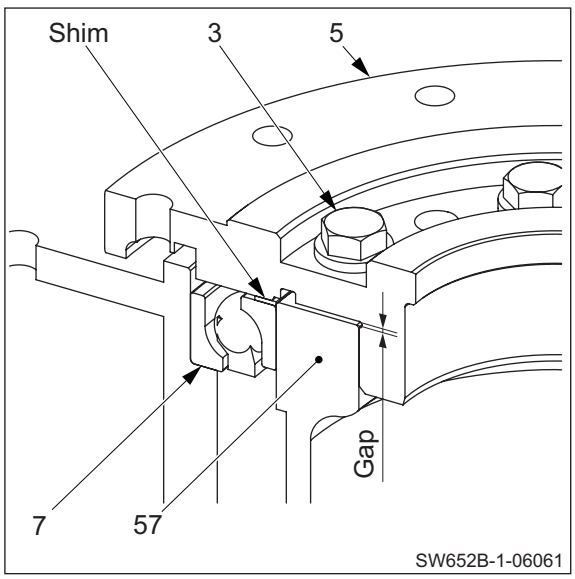
② Insert a shim of about 1.5 mm (0.06 in.) and lower disc (5) on mounting surface of case (57).

(5) Disc : 25 kg (55 lbs.)



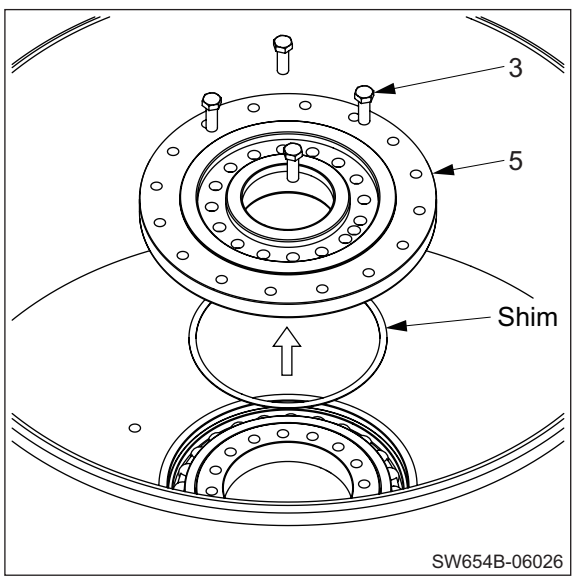
③ A gap will remain between end of case (57) and inside of disc (5).
④ Secure with four bolts (3) and washers to a torque of 30 N·m (22 lbf·ft).
⑤ Rotate propulsion motor side drum subassembly for more than one complete turn in both directions.
⑥ Let ball bearing (7) settle down and tighten bolts to a torque of 30 N·m (22 lbf·ft) again.

(NOTICE)
- **Tighten the bolts alternately in diagonal directions.**

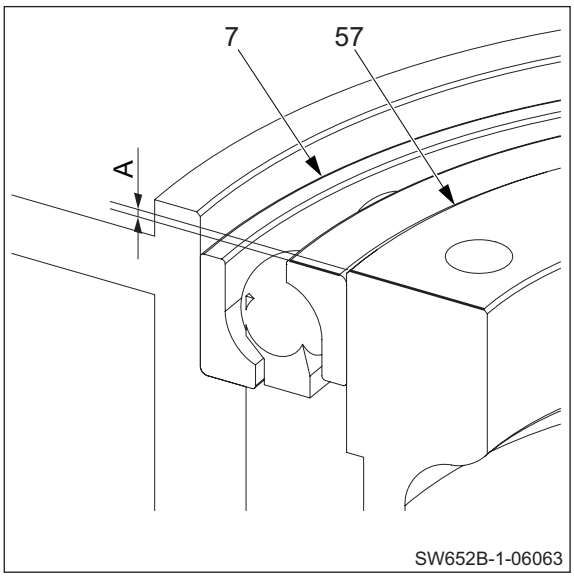


⑦ Remove bolts (3).
- Remove disc (5).
- Remove shim.

(NOTICE)
- **Do not turn the drum after the disc is removed.**

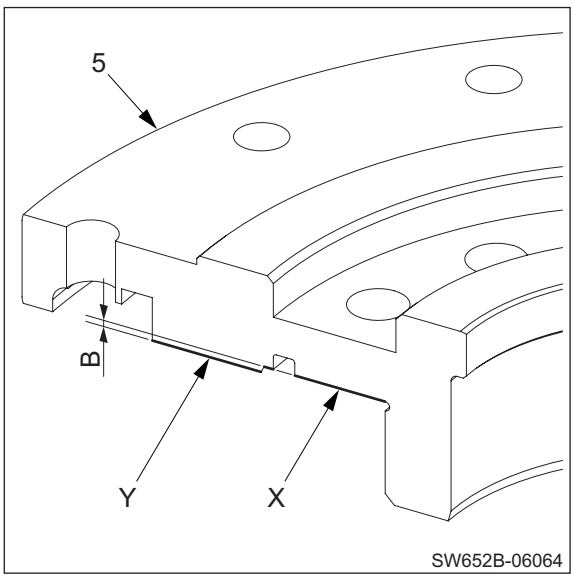


⑧ Measure dimension “A” between end of case (57) and ball bearing (7).



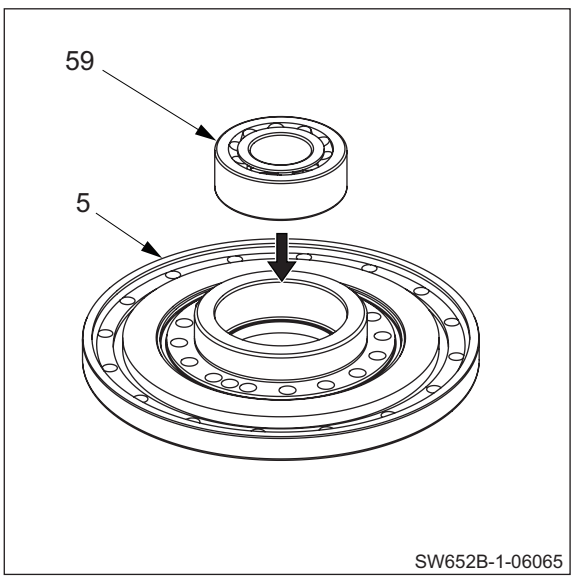
⑨ Measure dimension “B” between X and Y of disc (5).

★ **Preload adjusting shim thickness** **= (A-B) + 0.1 mm (0.004 in.)**

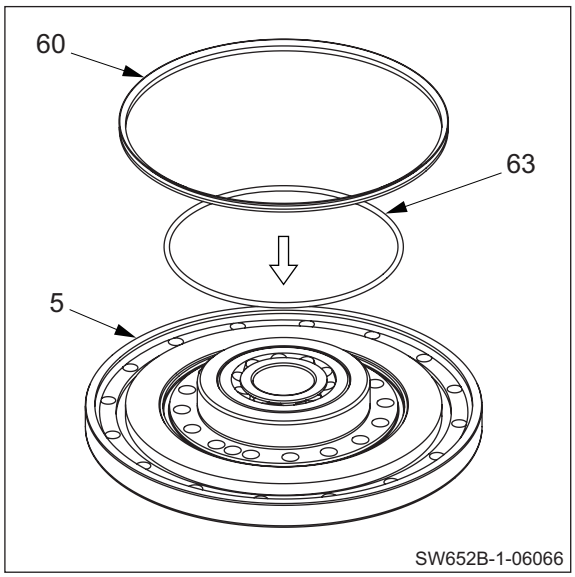


⑩ Reassembly of disc subassembly

- Apply a coat of gear oil to disc (5) at where bearing will be press-fitted.
- Drive vibrator bearing (59) into disc.



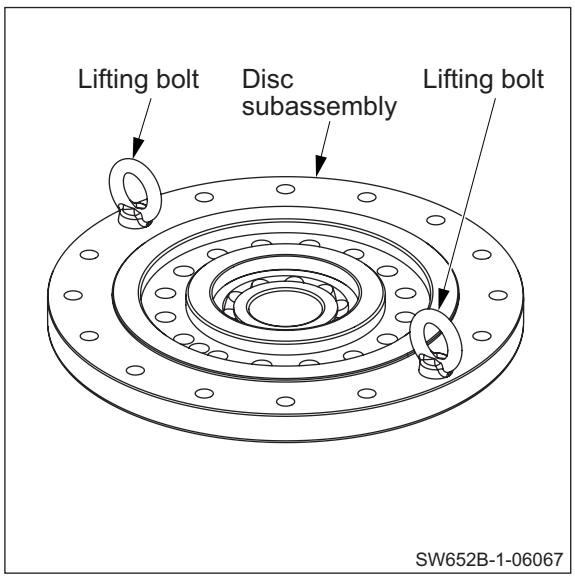
⑪ Apply grease to O-ring (63).
- Install O-ring to disc (5).
- Install V-ring (60) to disc.
- Apply lithium-based grease to lip of V-ring.



⑫ Reverse disc subassembly.

Disc subassembly : 30 kg (66 lbs.)

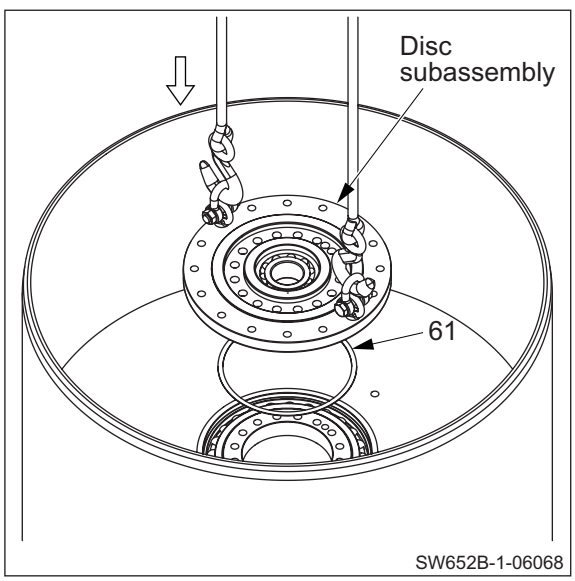
- Install lifting bolts (M16).



⑬ Insert a shim (61) of preload adjusting shim thickness = (A-B) + 0.1 mm (0.004 in.) and lower disc subassembly on mounting surface of case (57).

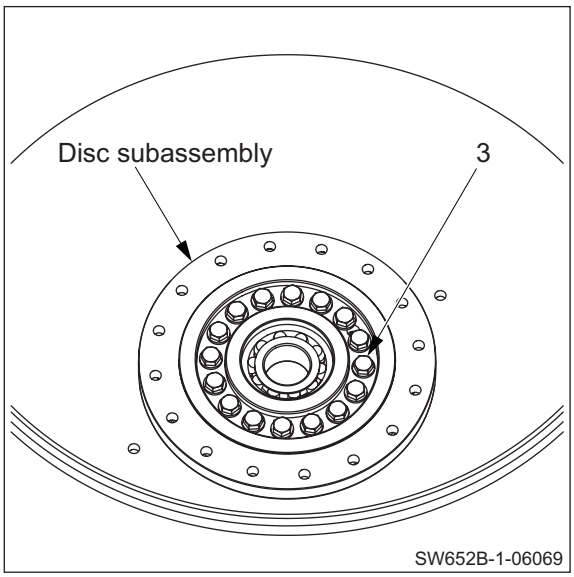
Disc subassembly : 30 kg (66 lbs.)

(NOTICE)
- **Take care not to let O-ring or V-ring to protrude from their grooves.**

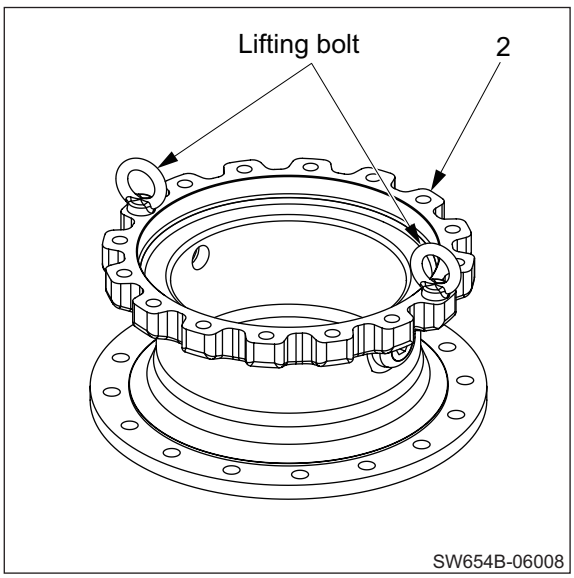


⑭ Secure disc subassembly to case with sixteen bolts (3) and washers.

N•m (3) Bolts M16×50 : 265 N·m (195 lbf·ft)



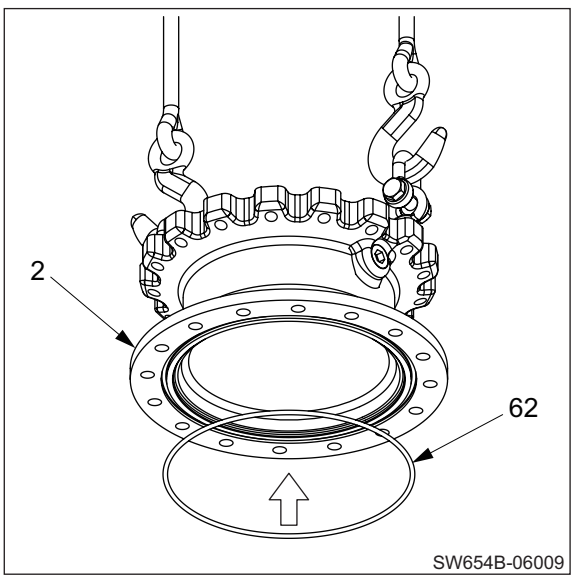
12) Install lifting bolts (M16) to housing (2).



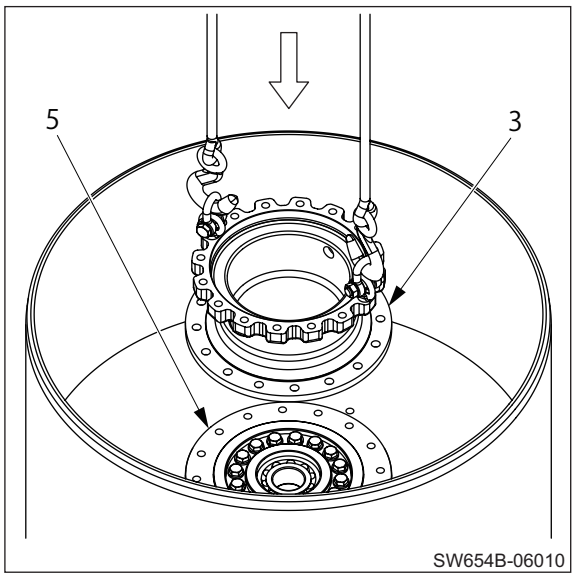
13) Lift housing (2).

- Apply grease to O-ring (62).
- Install O-ring to housing.

kg (2) Housing : 40 kg (88 lbs.)

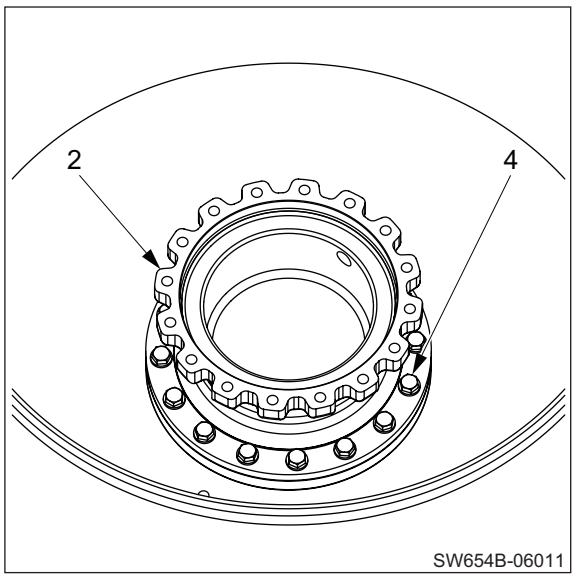


14) Lower housing (2) on mounting surface of disc (5).

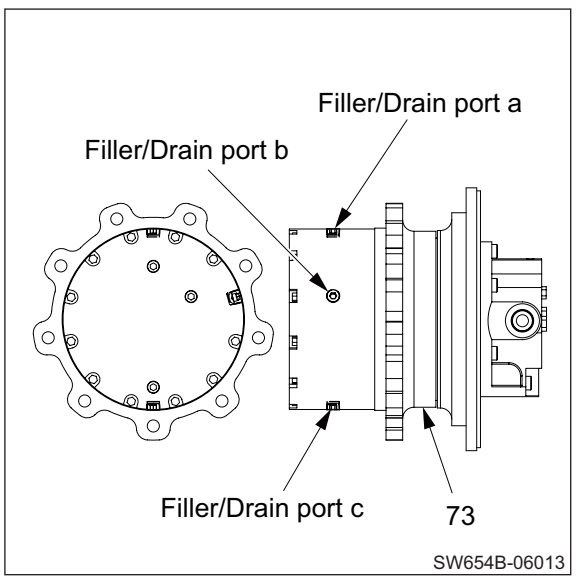


15) Secure housing (2) with sixteen bolts (4) and washers.

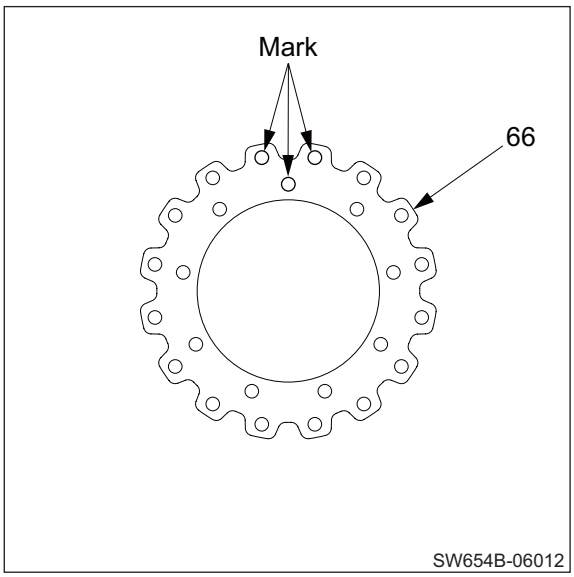
N•m (4) Bolts M16×40 : 265 N·m (195 lbf·ft)



16) Reassembly of propulsion motor subassembly



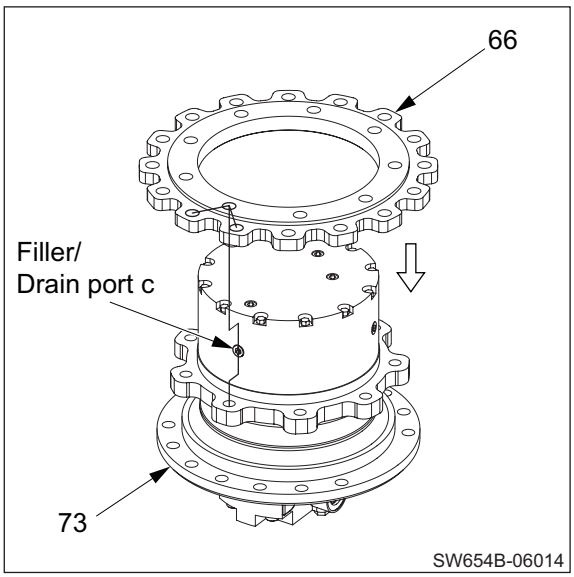
16-1) Making marks on holes of disc (66) as shown.



16-2) Install disc (66) to mounting surface of propulsion motor (73).

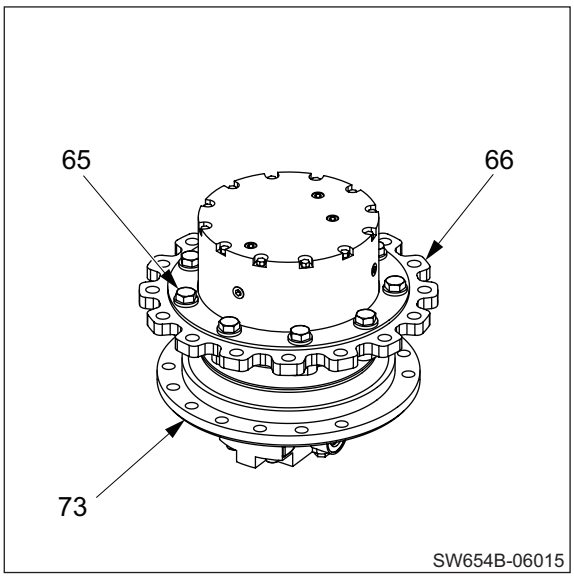
(NOTICE)

- **Align mark of disc with filler/drain port "c" as shown.**



16-3) Secure disc (66) to propulsion motor (73) with nine bolts (65) and washers.

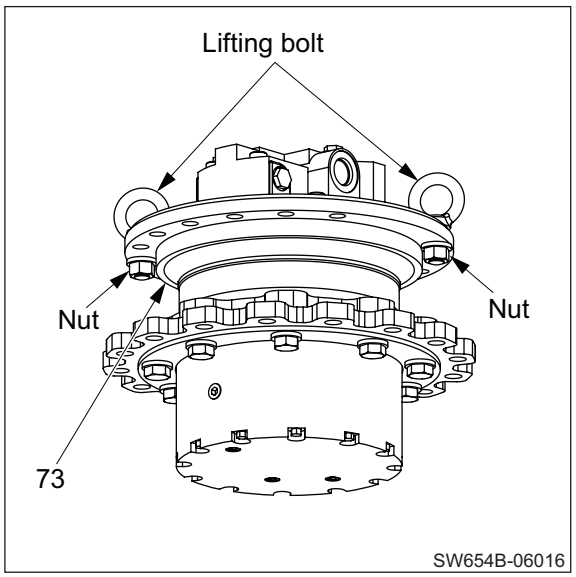
N•m (65) Bolt M16×45 : 265 N·m (195 lbf·ft)



17) Reverse propulsion motor subassembly.

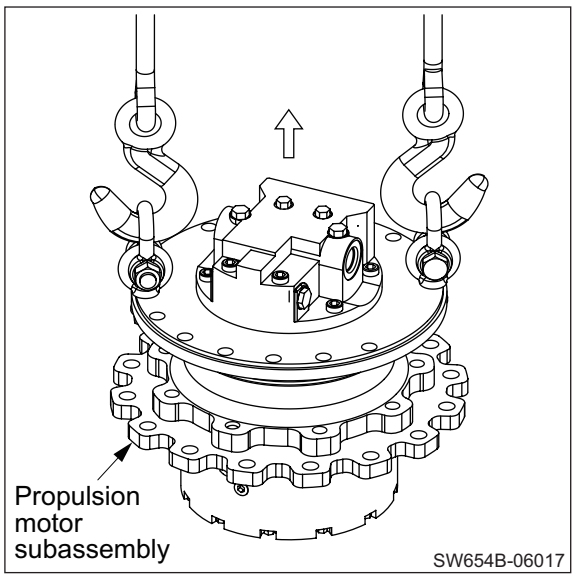
Propulsion motor subassembly : 100 kg (220 lbs.)

- Install lifting bolts and nuts (M16) to propulsion motor (73).



18) Lift propulsion motor subassembly.

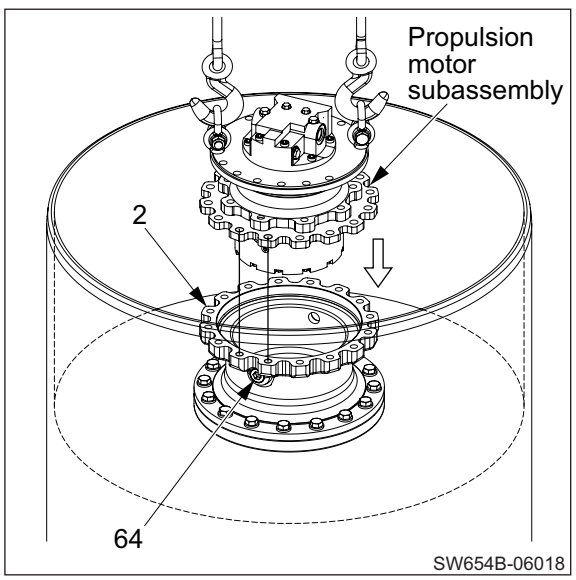
Propulsion motor subassembly : 100 kg (220 lbs.)



19) Lower propulsion motor subassembly on mounting surface of housing (2).

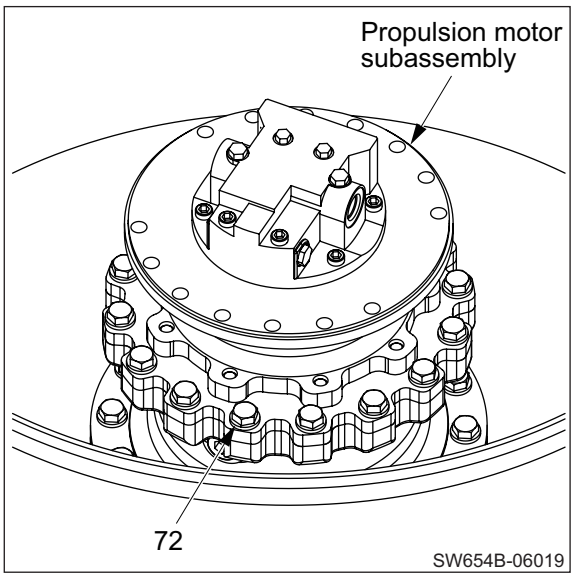
(NOTICE)

- **Align mark of disc with plug (64) as shown.**



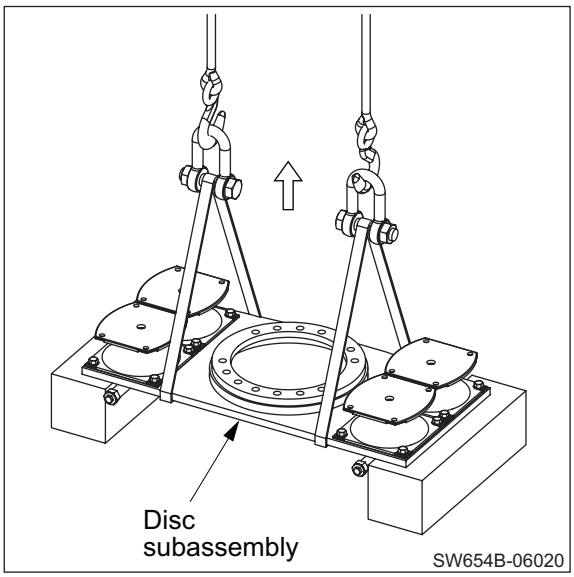
20) Secure propulsion motor subassembly to housing with sixteen bolts (72) and washers.

N•m (72) Bolt M16×45 : 265 N·m (195 lbf·ft)

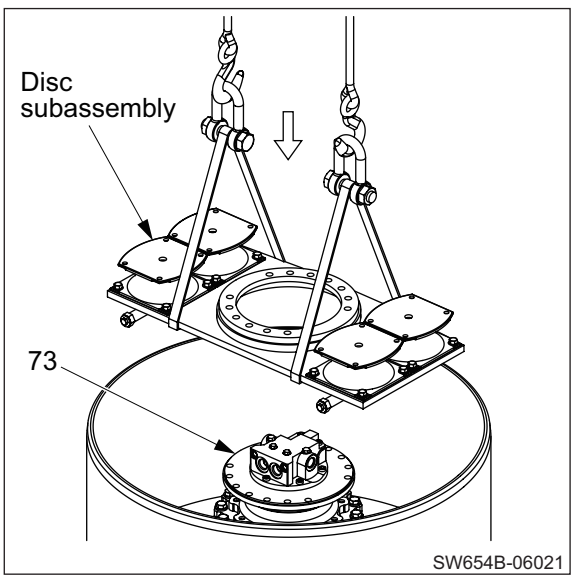


21) Lift disc subassembly.

kg Disc subassembly : 65 kg (143 lbs.)

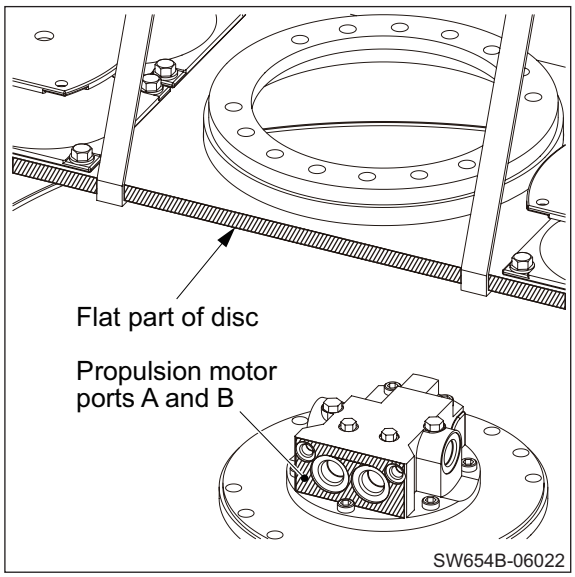


22) Lower disc subassembly on mounting surface of propulsion motor (73).



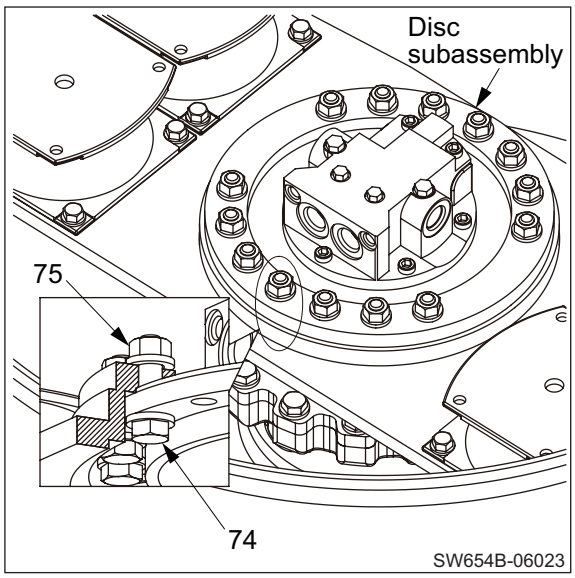
(NOTICE)

- **The flat part of the disc must be parallel with the side of the propulsion motor ports A and B.**



23) Secure disc subassembly with fourteen bolts (74), nuts (75) and washers.

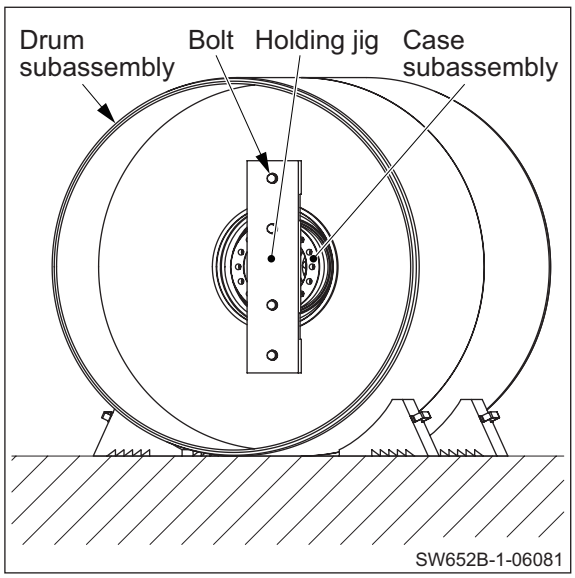
N•m (74) Bolts M16×60 : 265 N·m (195 lbf·ft)



24) Lay vibratory drum subassembly on its side.

kg Drum subassembly : 1,725 kg (3,803 lbs.)

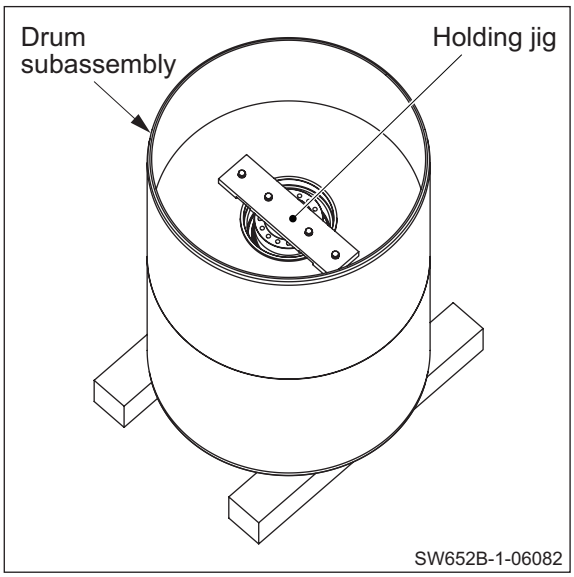
- Set a holding jig to vibrator motor side drum subassembly and case subassembly, and secure with bolts.



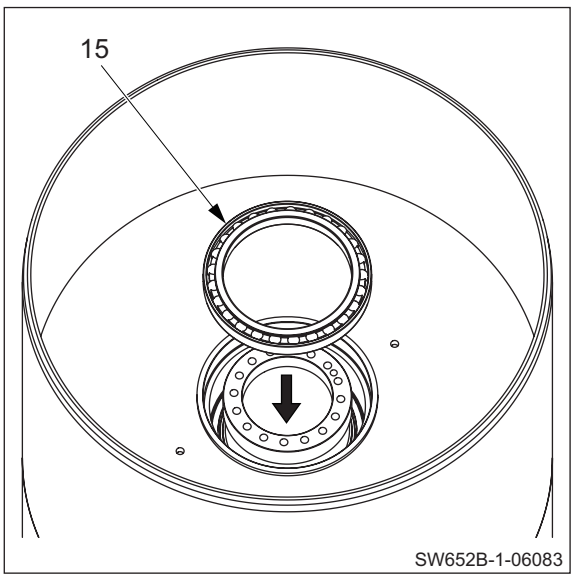
25) Stand drum with its propulsion side facing down.

ℑkg Vibratory drum subassembly : 1,745 kg (3,847 lbs.)

- Remove holding jig.

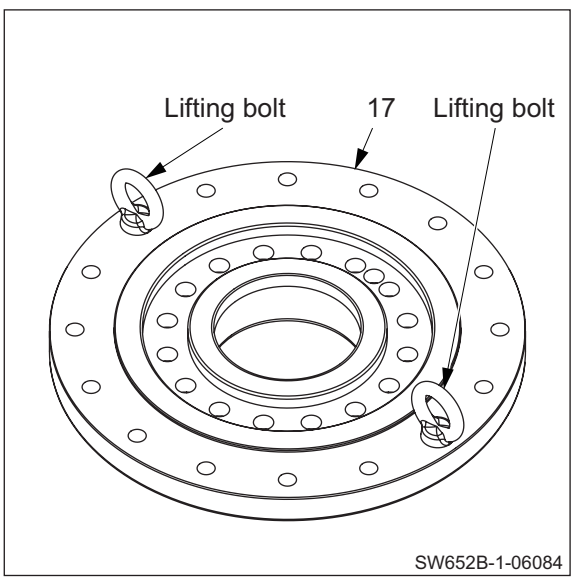


26) Apply a coat of gear oil to drum at where bearing will be press-fitted.
- Drive in ball bearing (15).
- Apply sufficient amount of lithium-based grease to ball bearing.



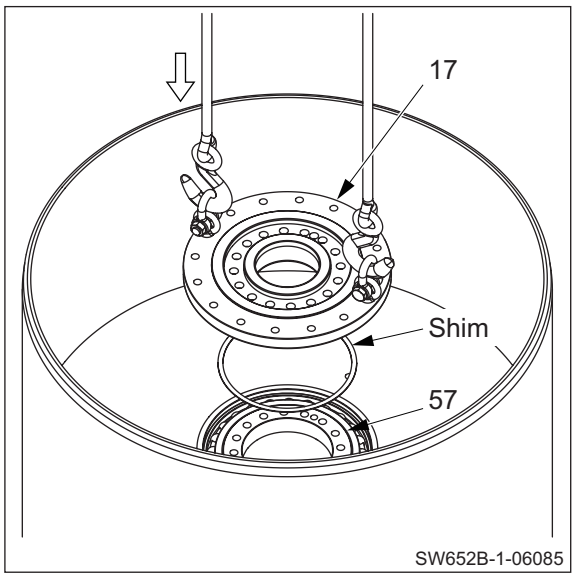
27) Preload adjustment of ball bearing

① Install lifting bolts (M16) to disc (17).



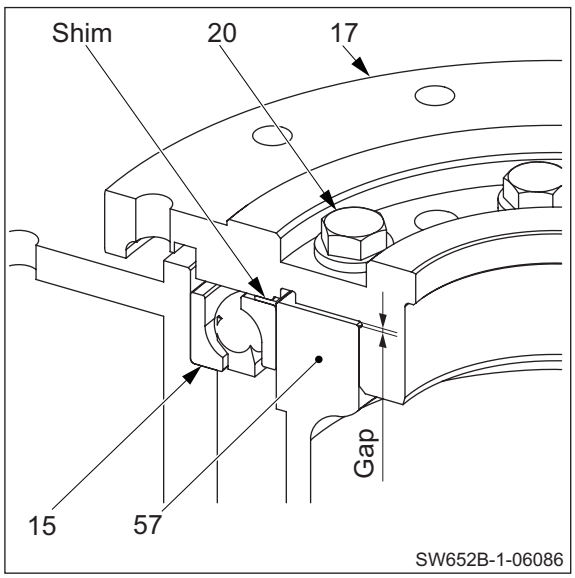
② Insert a shim of about 1.5 mm (0.06 in.) and lower disc (17) on mounting surface of case (57).

(17) Disc : 25 kg (55 lbs.)



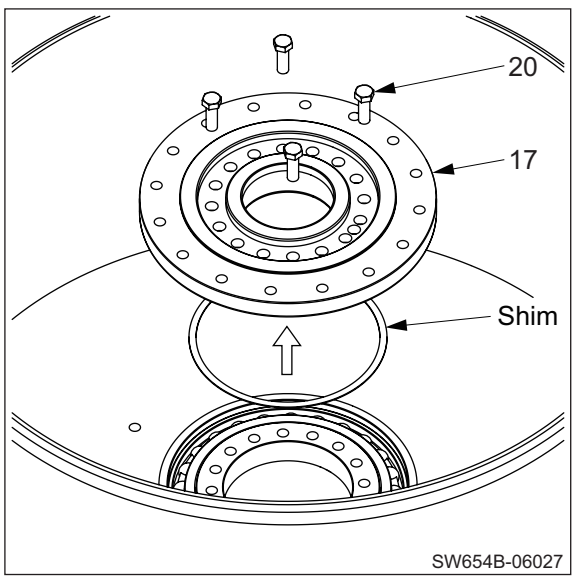
③ A gap will remain between end of case (57) and inside of disc (17).
④ Secure with four bolts (20) and washers to a torque of 30 N·m (22 lbf·ft).
⑤ Rotate vibrator motor side drum subassembly for more than one complete turn in both directions.
⑥ Let ball bearing (15) settle down and tighten bolts to a torque of 30 N·m (22 lbf·ft) again.

(NOTICE)
- **Tighten the bolts alternately in diagonal directions.**

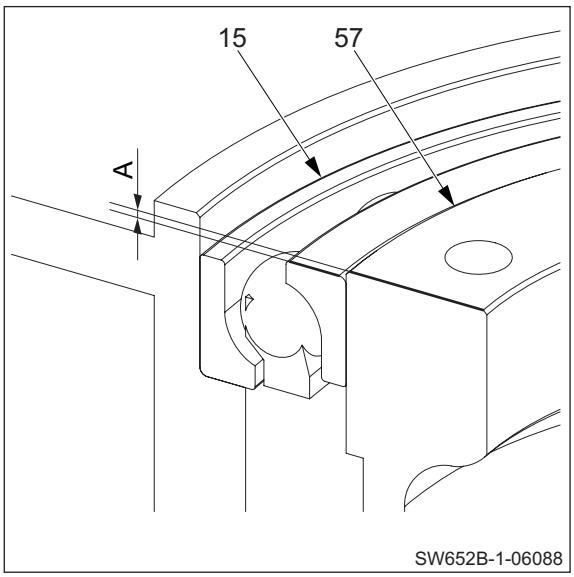


⑦ Remove bolts (20).
- Remove disc (17).
- Remove shim.

(NOTICE)
- **Do not turn the drum after the disc is removed.**

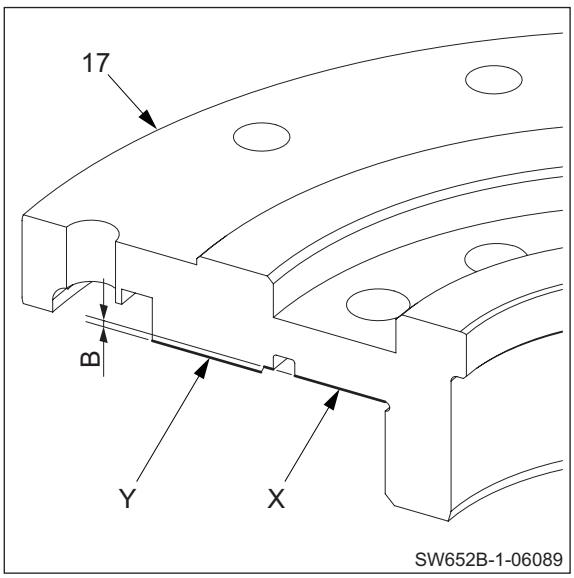


⑧ Measure dimension “A” between end of case (57) and ball bearing (15).



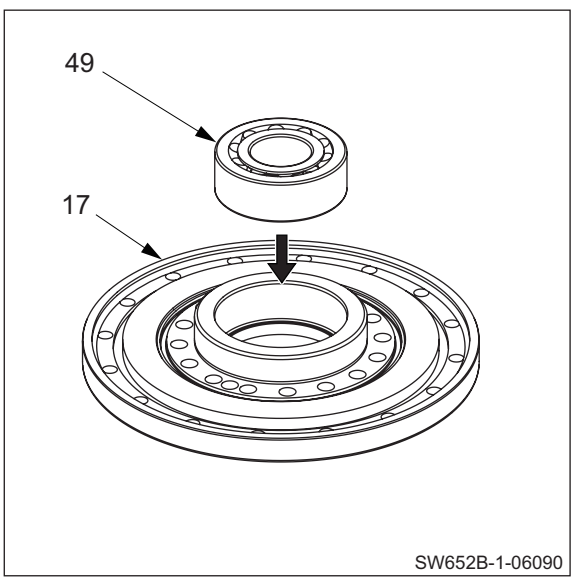
⑨ Measure dimension “B” between X and Y of disc (17).

★ **Preload adjusting shim thickness** **= (A-B) + 0.1 mm (0.004 in.)**

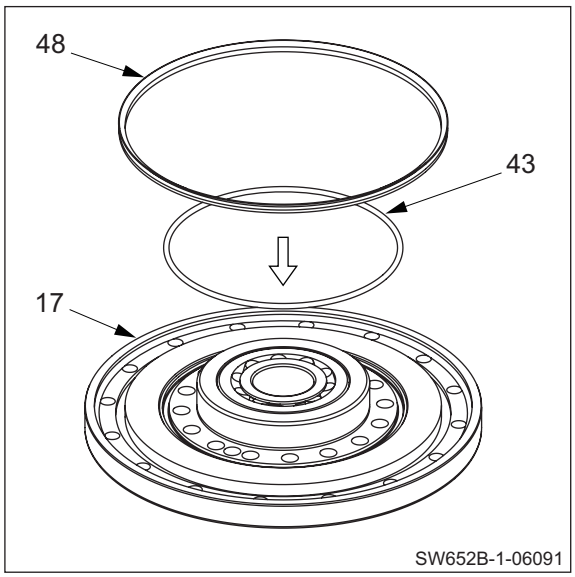


⑩ Reassembly of disc subassembly

- Apply a coat of gear oil to disc (17) at where bearing will be press-fitted.
- Drive vibrator bearing (49) into disc.



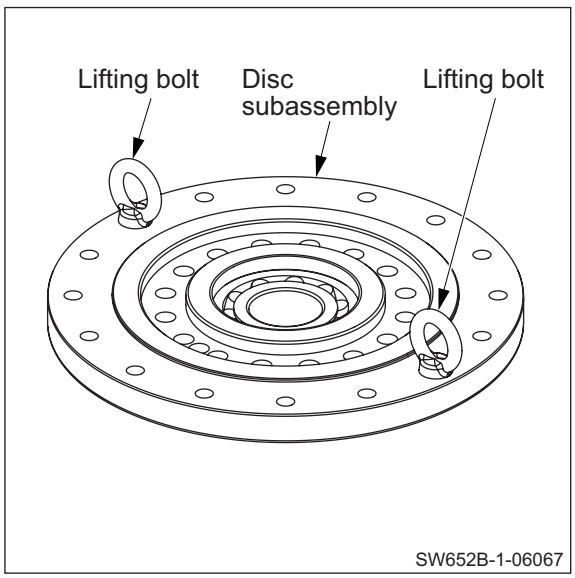
⑪ Apply grease to O-ring (43).
- Install O-ring to disc (17).
- Install V-ring (48) to disc.
- Apply lithium-based grease to lip of V-ring.



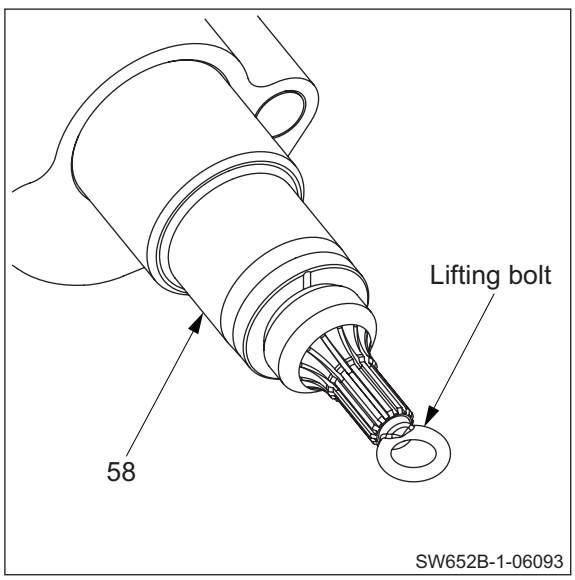
⑫ Reverse disc subassembly.

Disc subassembly : 30 kg (66 lbs.)

- Install lifting bolts (M16).



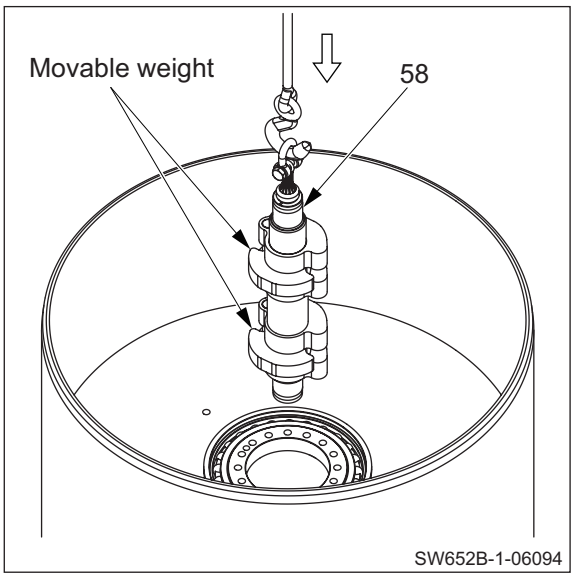
⑬ Install a lifting bolt (M8) to eccentric shaft (58).



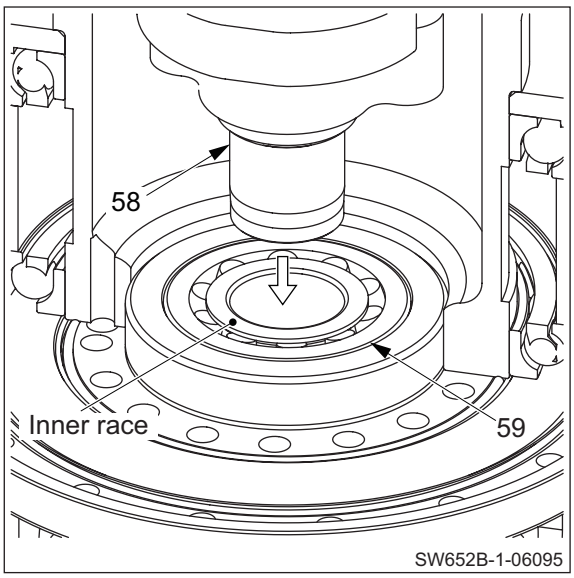
⑭ Apply a coat of gear oil to eccentric shaft (58) at where bearing will be installed.
- Install eccentric shaft.

(58) Eccentric shaft : 50 kg (110 lbs.)

(NOTICE)
- **Put the movable weights at their outmost position.**



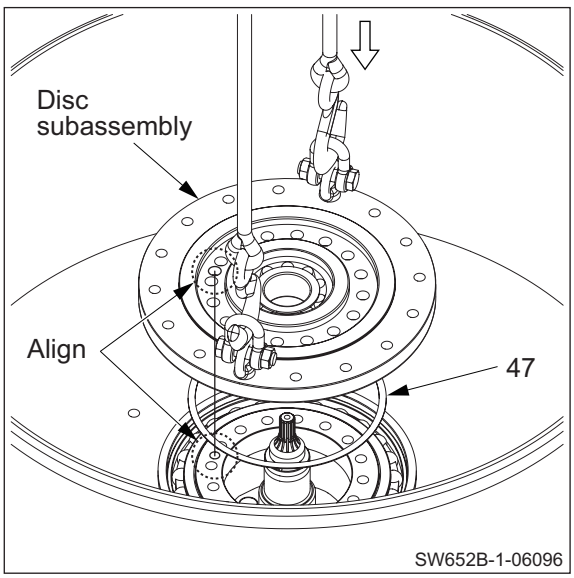
⑮ Insert eccentric shaft (58) into vibrator bearing (59) while taking care not to tilt vibrator bearing inner race.



⑯ Apply a coat of gear oil to inner surface of vibrator bearing (49).
- Insert a shim (47) of preload adjusting shim thickness = (A-B) + 0.1 mm (0.004 in.) and lower disc subassembly on mounting surface of case.

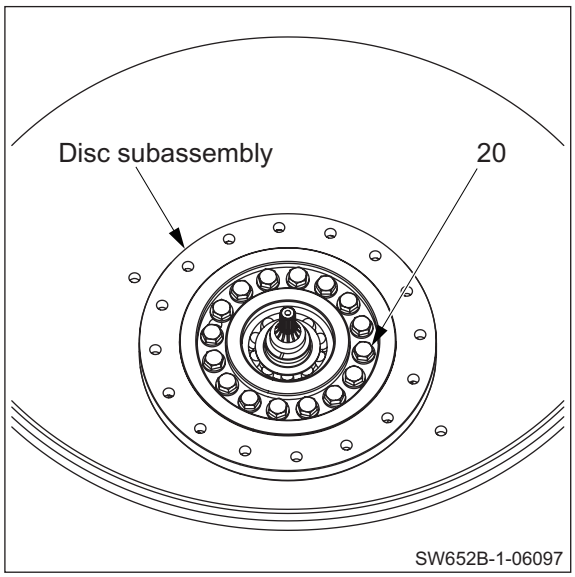
Disc subassembly : 30 kg (66 lbs.)

(NOTICE)
- **Align the 18 mm dia. hole in the disc with the 14 mm dia. hole in the case when installing the disc.**
- **Take care not to let the vibrator bearing inner race tilt during installation.**

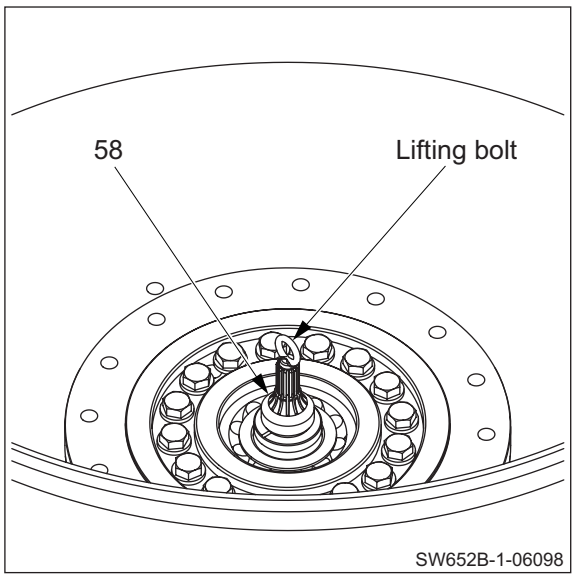


⑰ Secure disc subassembly with sixteen bolts (20) and washers.

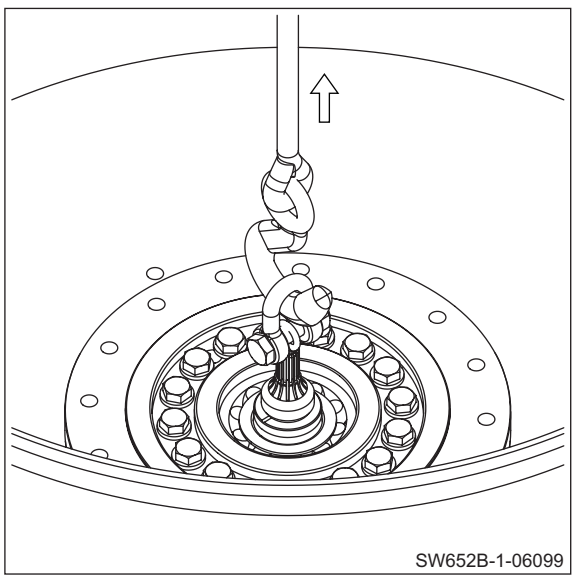
N•m (20) Bolts M16×50 : 265 N·m (195 lbf·ft)



28) Install a lifting bolt (M8) to end of eccentric shaft (58).



29) Slowly lift eccentric shaft with a crane and check that there is an axial play of 1 to 3 mm (0.04 to 0.12 in.).



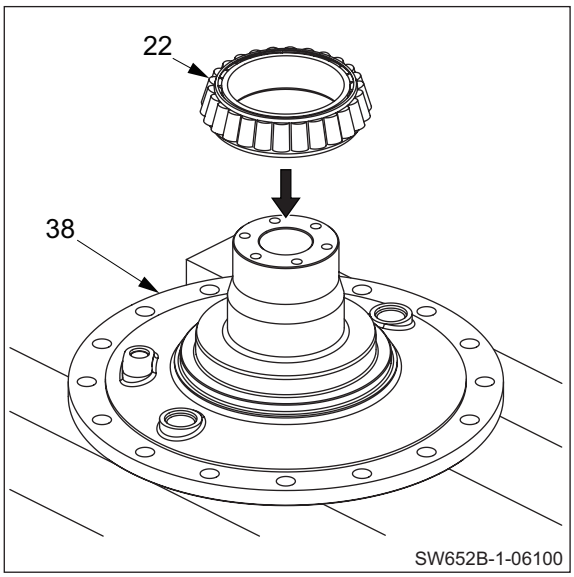
⚠WARNING

Wear heat resistant gloves when handling heated parts to avoid burns.

30) Reassembly of axle shaft subassembly

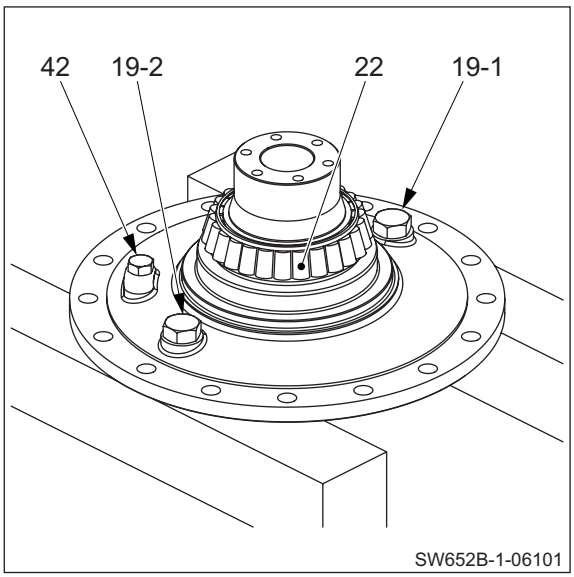
30-1) Heat up roller bearing (22) inner race by using a ring heater or the like.

- Apply a coat of gear oil to axle shaft (38) at where bearing inner race will be press-fitted.
- Drive in heated roller bearing inner race.



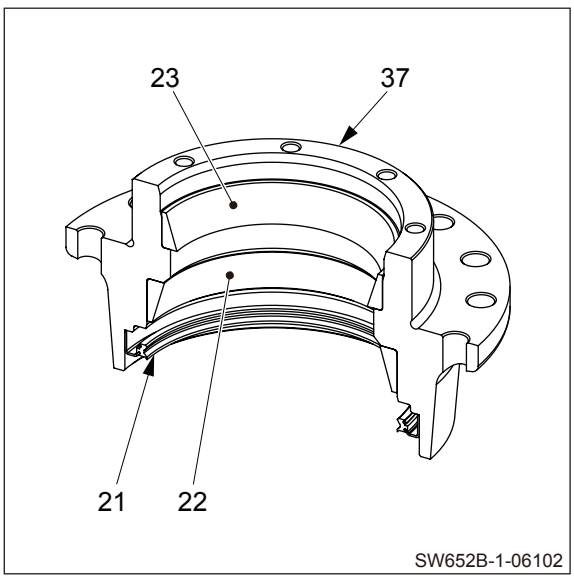
30-2) Apply grease to O-rings for plugs (19-1), (19-2), and level plug (42).

- Install plugs and level plug.
- Apply sufficient amount of lithium-based grease to rollers of roller bearing (22).

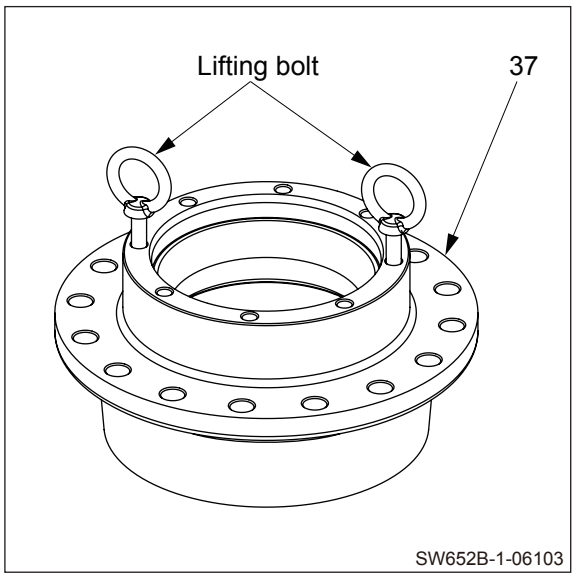


30-3) Apply a coat of gear oil to housing (37) at where bearing outer races will be press-fitted.

- Drive roller bearings (22) and (23) outer races into housing.
- Apply liquid packing to periphery of oil seal (21).
- Drive in oil seal.
- Apply grease to lip of oil seal.

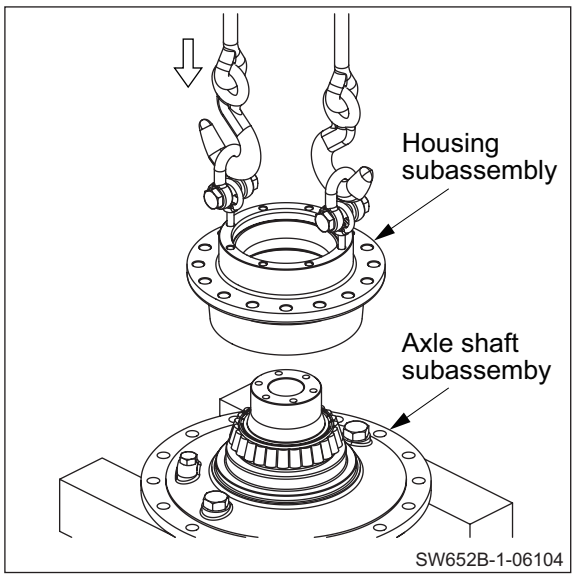


30-4) Install lifting bolts (M10) to housing (37).



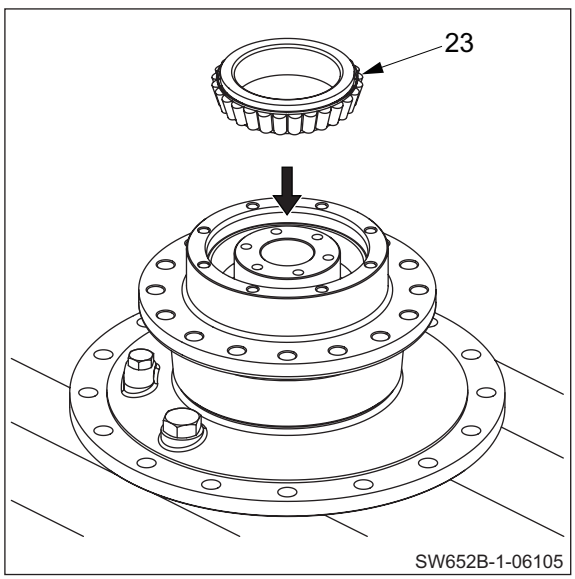
30-5) Install housing subassembly to axle shaft subassembly.

Housing subassembly : 20 kg (44 lbs.)



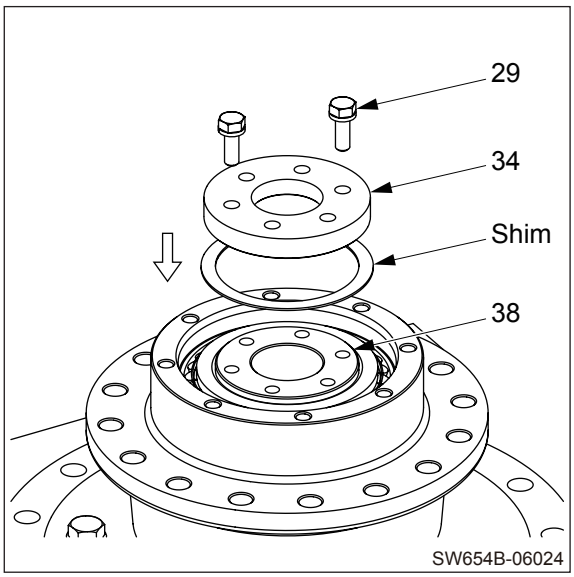
30-6) Apply sufficient amount of lithium-based grease to rollers of roller bearing (23) inner race.

- Drive in roller bearing inner race until rollers come in contact with outer race.



30-7) Preload adjustment of roller bearing

① Install a shim of about 1 mm (0.04 in.) and secure cover (34) to axle shaft (38) with two bolts (29) and spring washers.

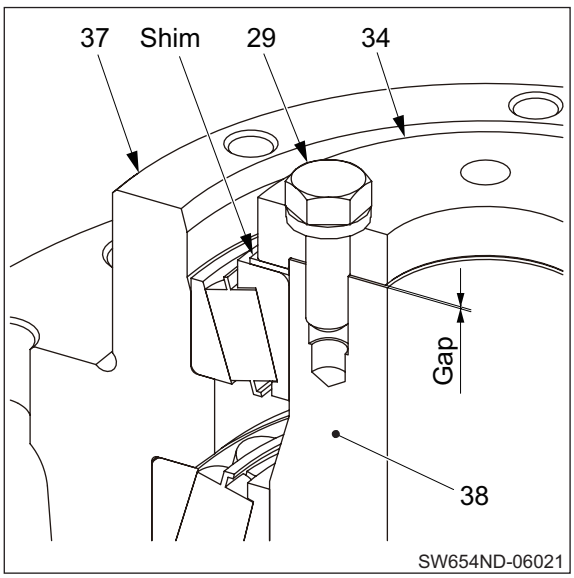


② A gap will remain between end of axle shaft (38) and inside of cover (34).

- Tighten bolts (29) to a torque of 30 N·m (22 lbf·ft).
- Give housing (37) two to three turns.
- Tighten bolts to a torque of 30 N·m (22 lbf·ft) again.
- Repeat this work several times until tightening torque of bolts no longer fluctuates.

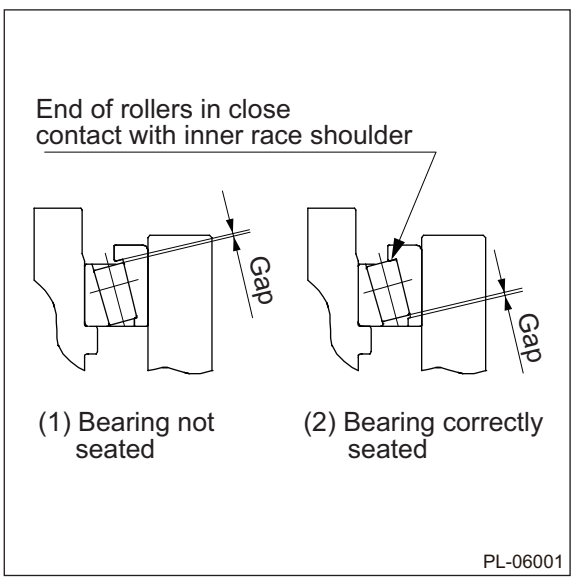
(NOTICE)

- **Tighten the bolts alternately in diagonal directions.**



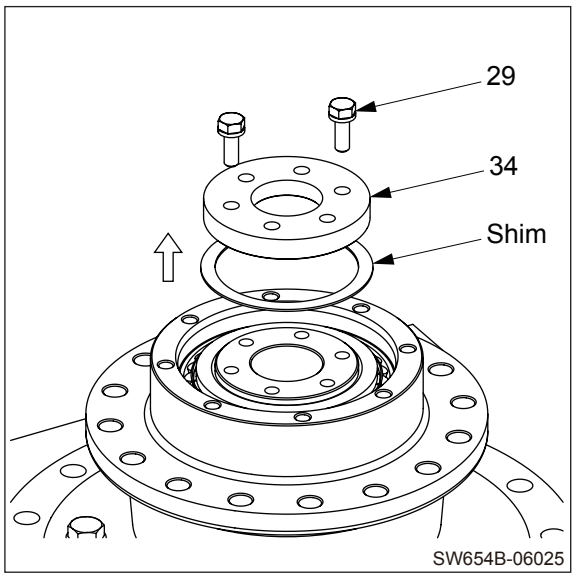
(NOTICE)

- **Push in the inner race while rotating the bearing. Otherwise, even strongly trying to push the inner race, the bearing rollers will not be pushed up and therefore bearing will not be seated.**

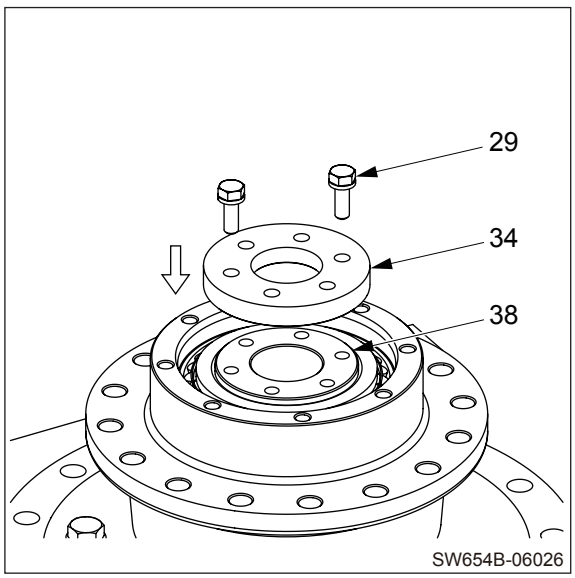


③ Remove bolts (29).
- Remove cover (34).
- Remove shim.

(NOTICE)
- **Do not turn the housing after the cover is removed.**

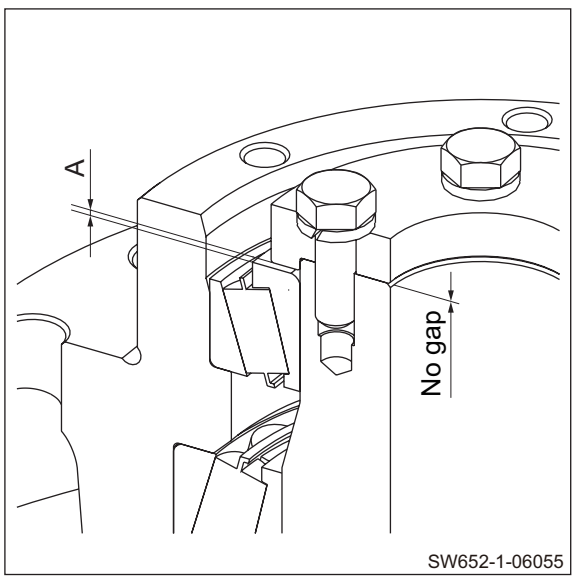


④ Without inserting shim, install cover (34) to axle shaft (38) with two bolts (29) and spring washers.

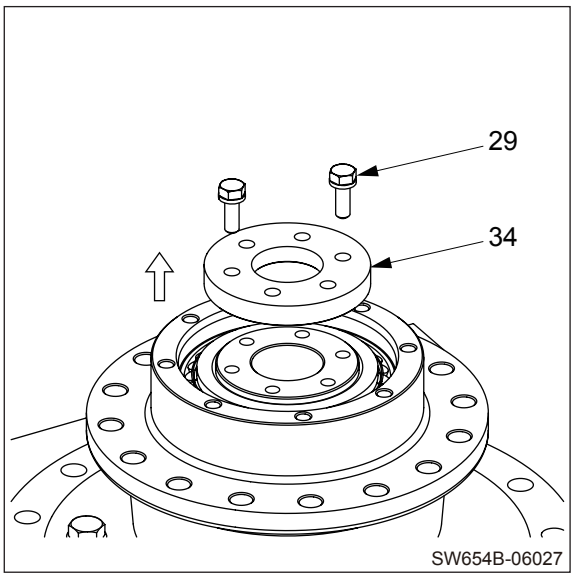


⑤ Using a thickness gauge, measure clearance “A”.

★ **Preload adjusting shim thickness** **= A + 0.1 mm (0.004 in.)**

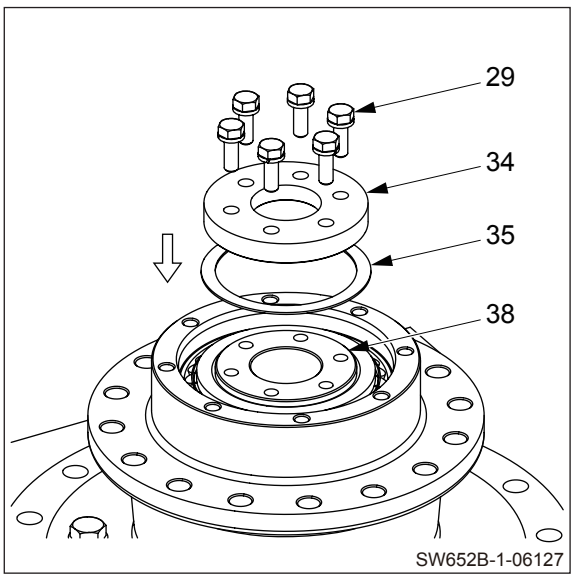


⑥ Remove bolts (29).
• Remove cover (34).

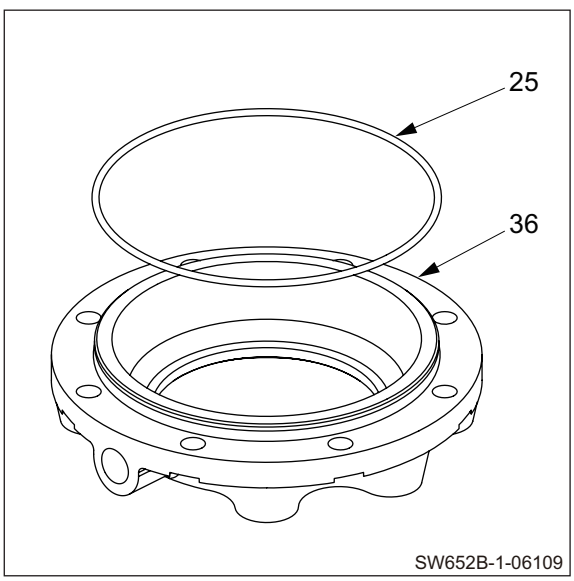


⑦ Install shim (35) of preload adjusting shim thickness = “A + 0.1 mm (0.004 in.)”.
• Secure cover (34) to axle shaft (38) with six bolts (29) and spring washers.

N•m (29) Bolts M10×30 : 59 N·m (44 lbf·ft)

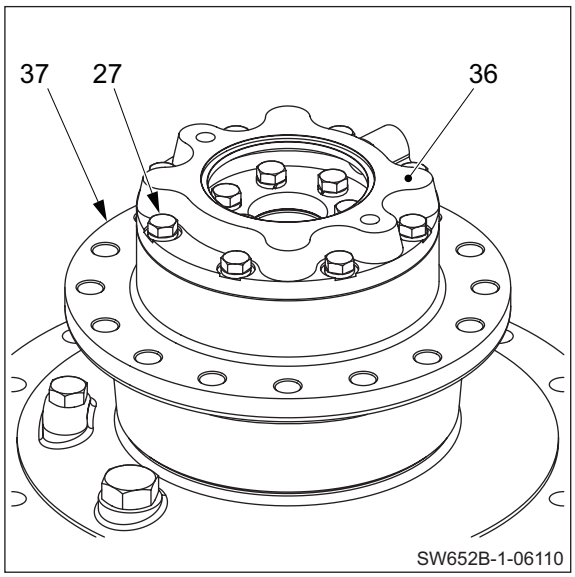


30-8) Apply grease to O-ring (25).
• Install O-ring (25) to flange (36).

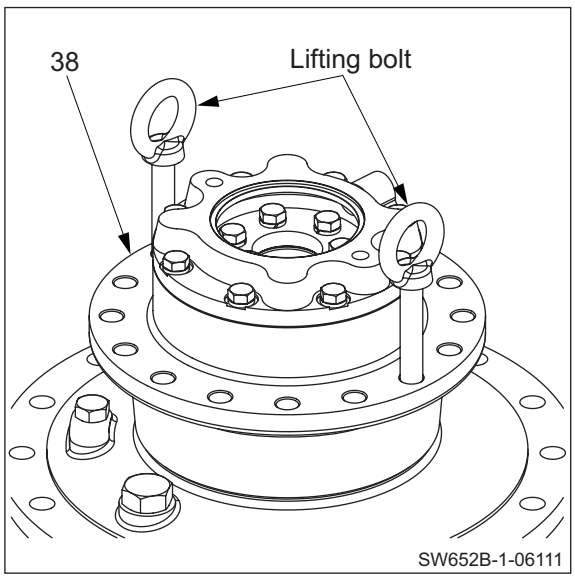


30-9) Secure flange (36) to housing (37) with eight bolts (27) and spring washers.

N•m (27) Bolts M10×30 : 59 N·m (44 lbf·ft)



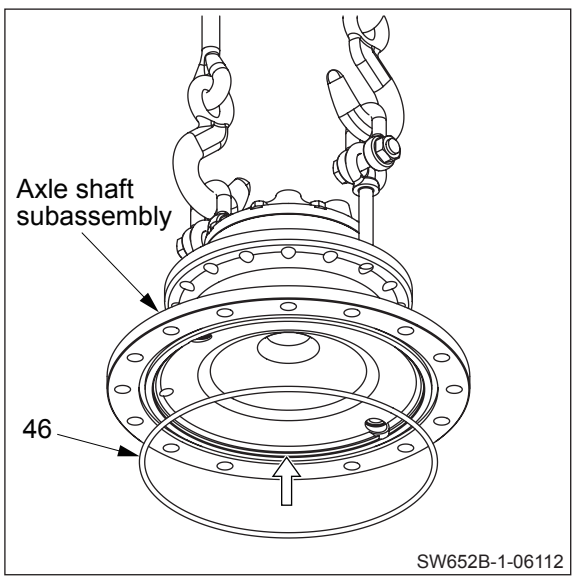
31) Install lifting bolts (M16) to axle shaft (38).



32) Lift axle shaft subassembly.

- Apply grease to O-ring (46).
- Install O-ring to axle shaft subassembly.

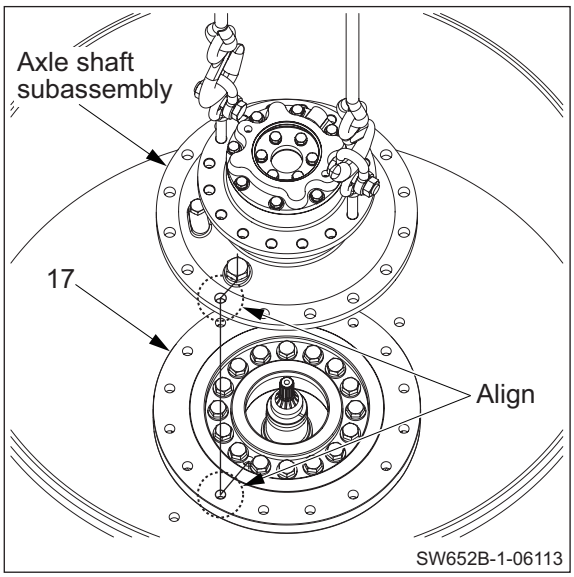
kg Axle shaft subassembly : 55 kg (121 lbs.)



33) Lower axle shaft subassembly on mounting surface of disc (17) slowly.

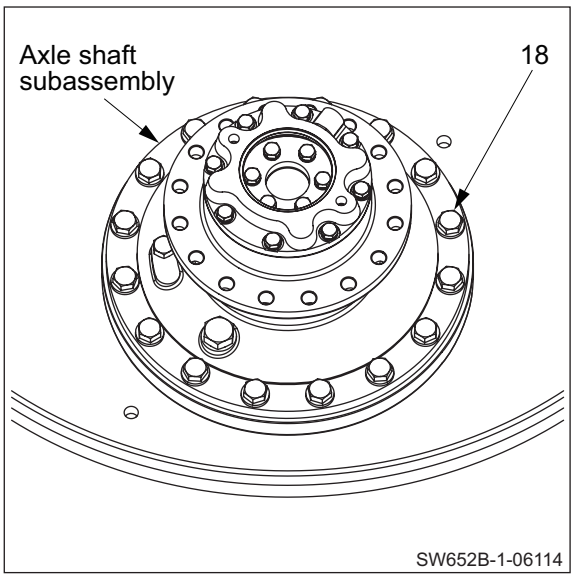
(NOTICE)

- **The drain plug on the axle shaft must be aligned with the 18 mm diameter hole in the disc as shown on the right when installing the axle shaft subassembly.**



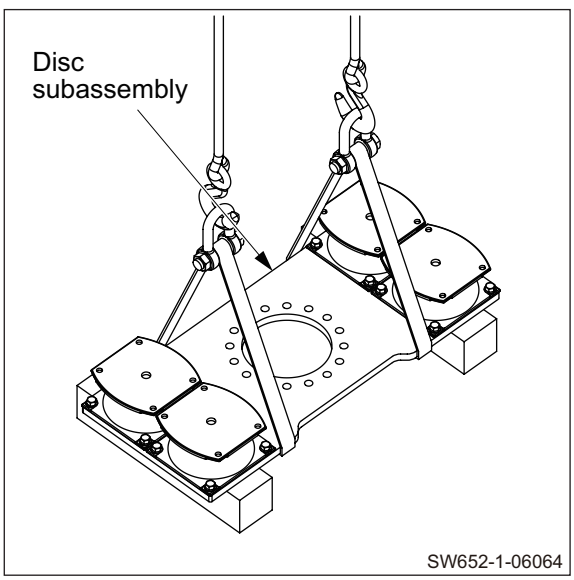
34) Secure axle shaft subassembly with sixteen bolts (18) and washers.

N•m (18) Bolts M16×40 : 265 N·m (195 lbf·ft)

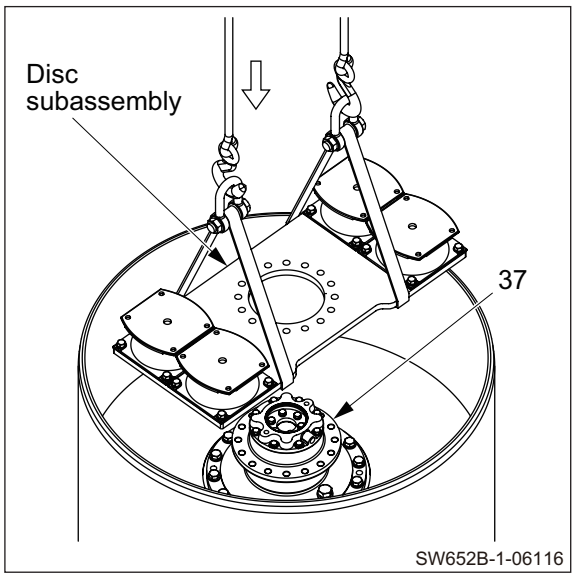


35) Lift disc subassembly.

kg Disc subassembly : 75 kg (165 lbs.)

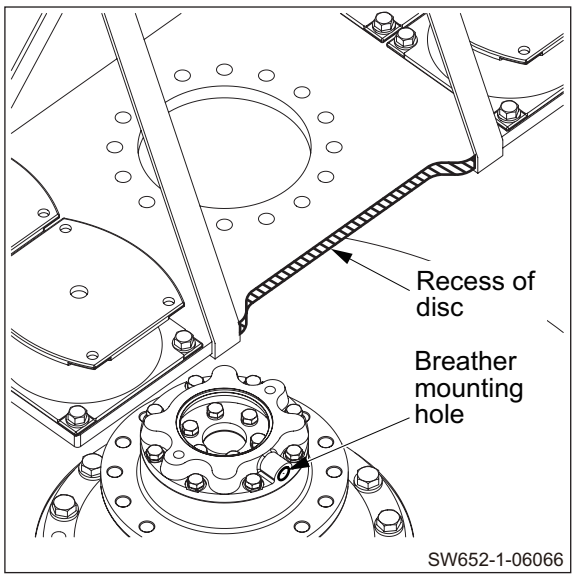


36) Lower disc subassembly on mounting surface of housing (37).



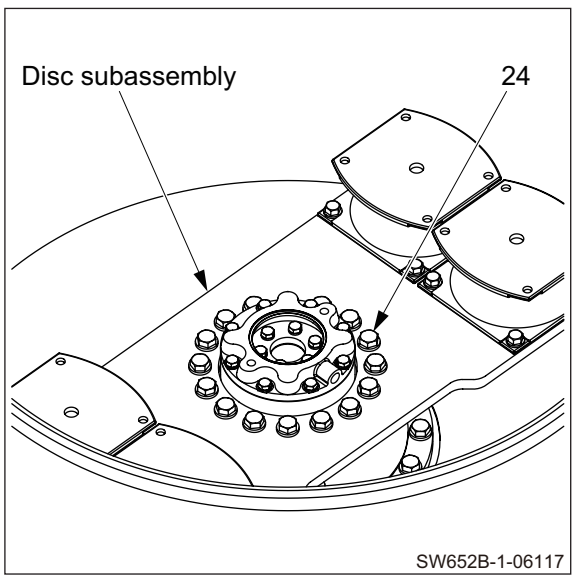
(NOTICE)

- **The recess of the disc must face the same direction as the breather mounting hole in the flange.**

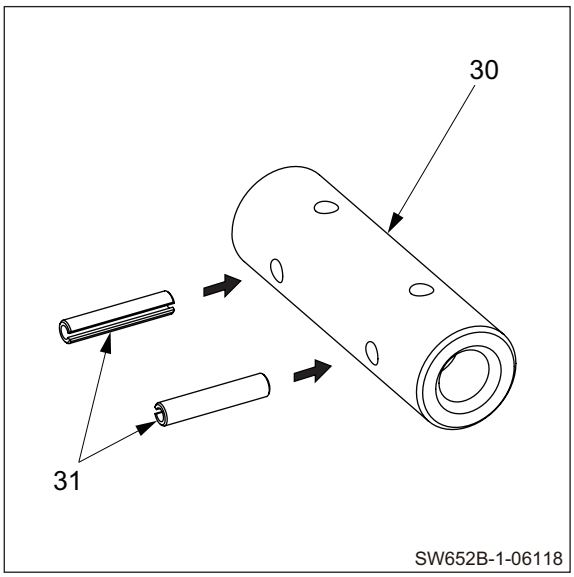


37) Secure disc subassembly with sixteen bolts (24) and washers.

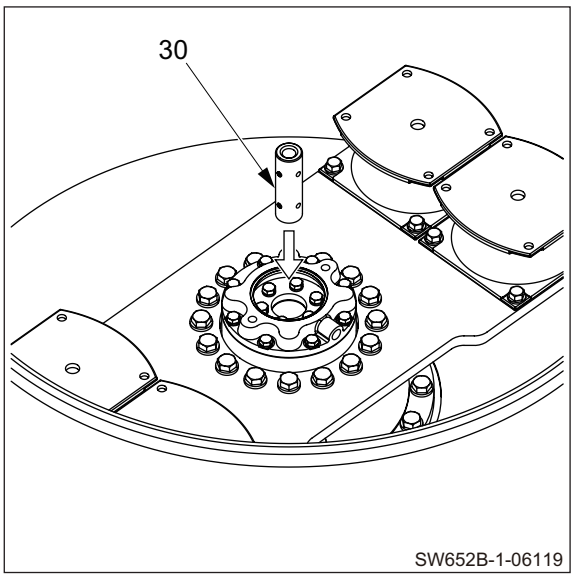
N•m (24) Bolts M16×45 : 265 N·m (195 lbf·ft)



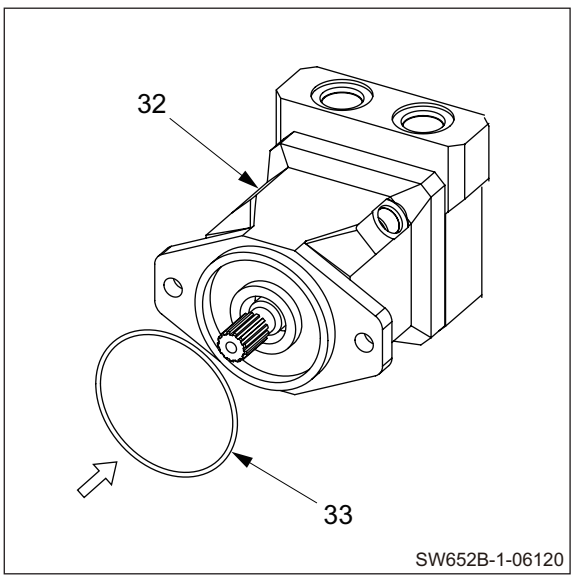
38) Drive two spring pins (31) into sleeve (30).



39) Apply molybdenum-based grease to splined portion of sleeve (30).
- Fit sleeve to splined portion on eccentric shaft end.



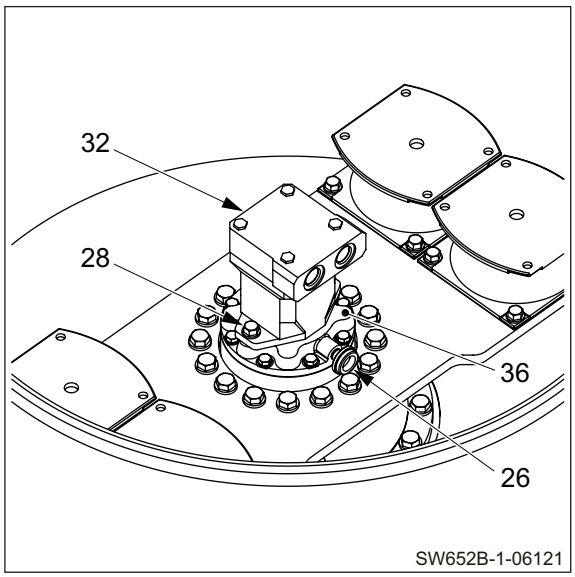
40) Apply grease to O-ring (33).
- Install O-ring to vibrator motor (32).



41) Wind seal tape around threaded portion of breather (26).
- Install breather.
- Secure vibrator motor (32) to flange (36) with two bolts (28) and washers.

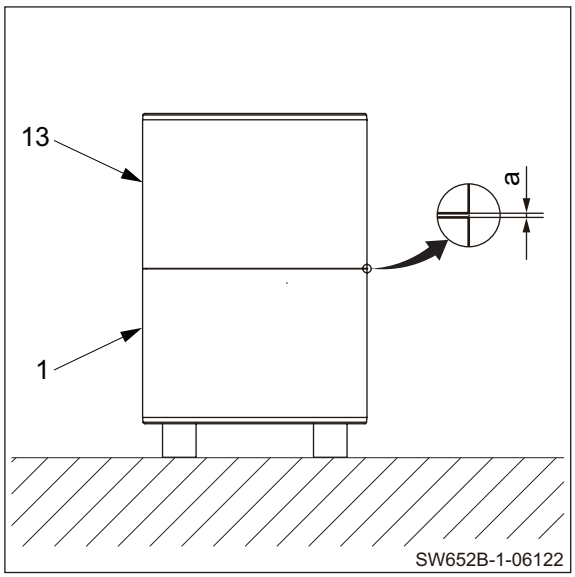
(32) Vibrator motor : 15 kg (33 lbs.)

(28) Bolts M12×30 : 108 N·m (80 lbf·ft)



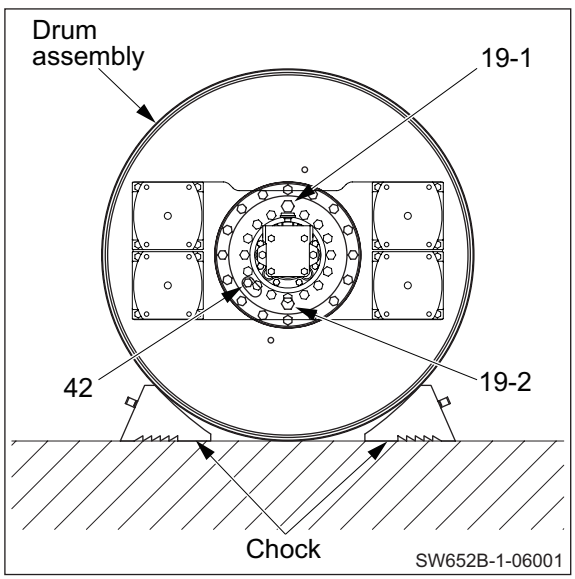
42) Measure clearance “a” between propulsion motor side drum (1) and vibrator motor side drum (13).

★ a = 1.4 to 2.3 mm (0.06 to 0.09 in).

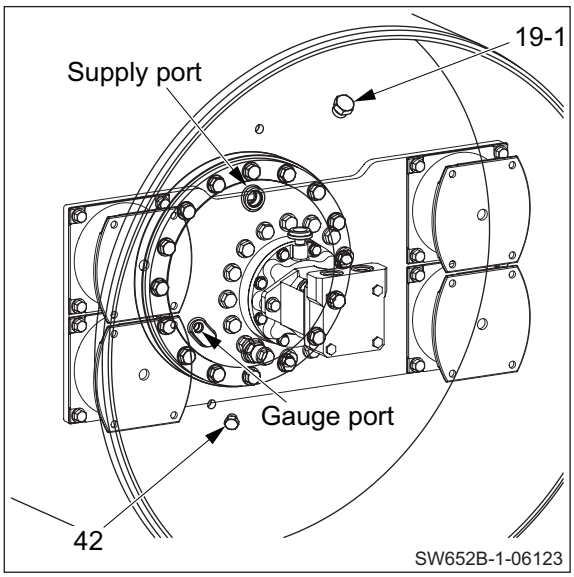


43) Lay vibratory drum assembly with plugs (19-1), (19-2), and (42) positioned as shown right.
- Hold with chocks.

Vibratory drum assembly : 1,960 kg (4,321 lbs.)

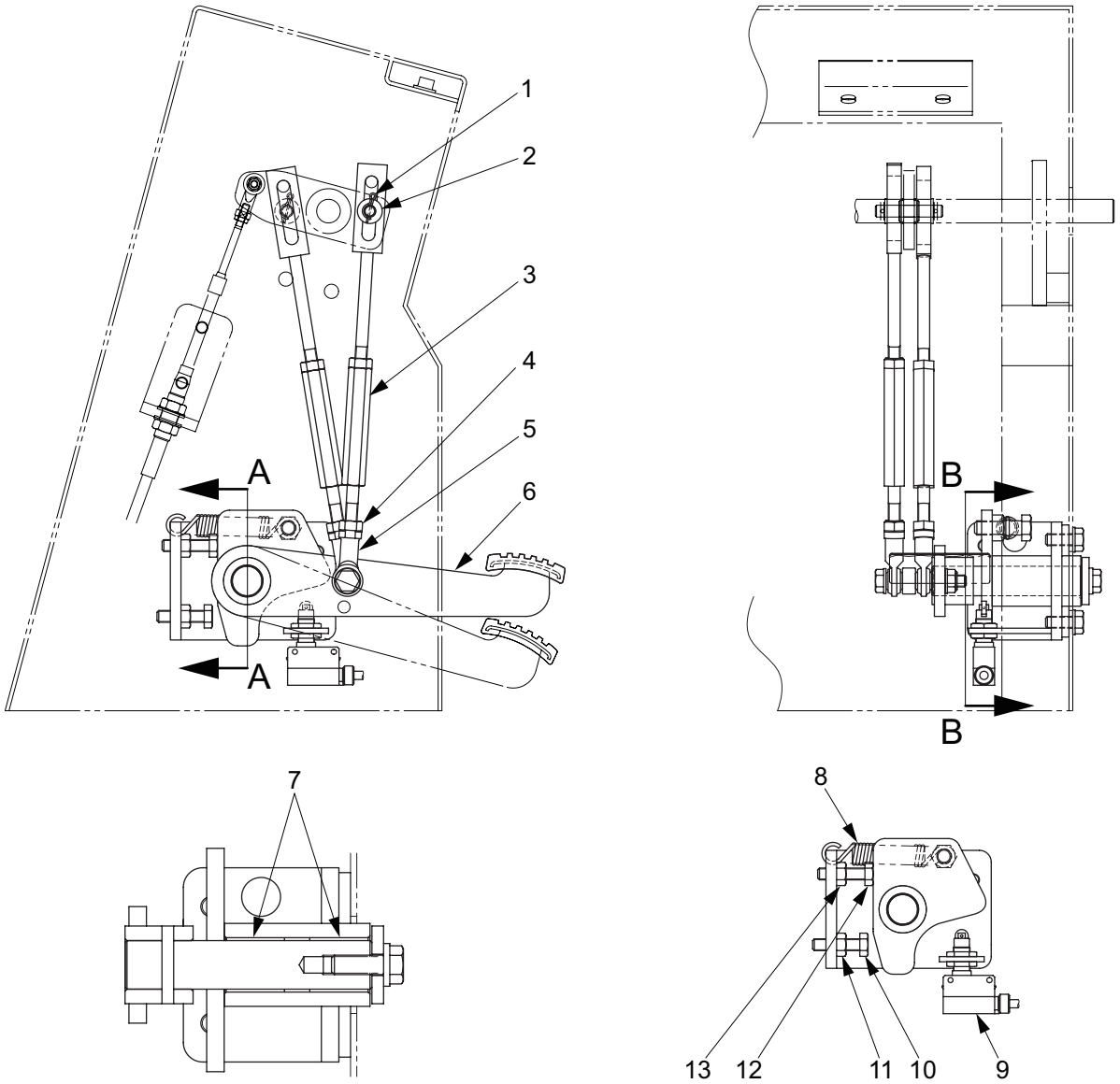


44) Remove plugs (19-1) and (42).
- Supply gear oil from oil supply port.
- Check that oil drips from gauge port.
  - Quantity of gear oil : 1.7 L (0.4 gal.)
- Reinstall plugs.



BRAKE

1. BRAKE PEDAL

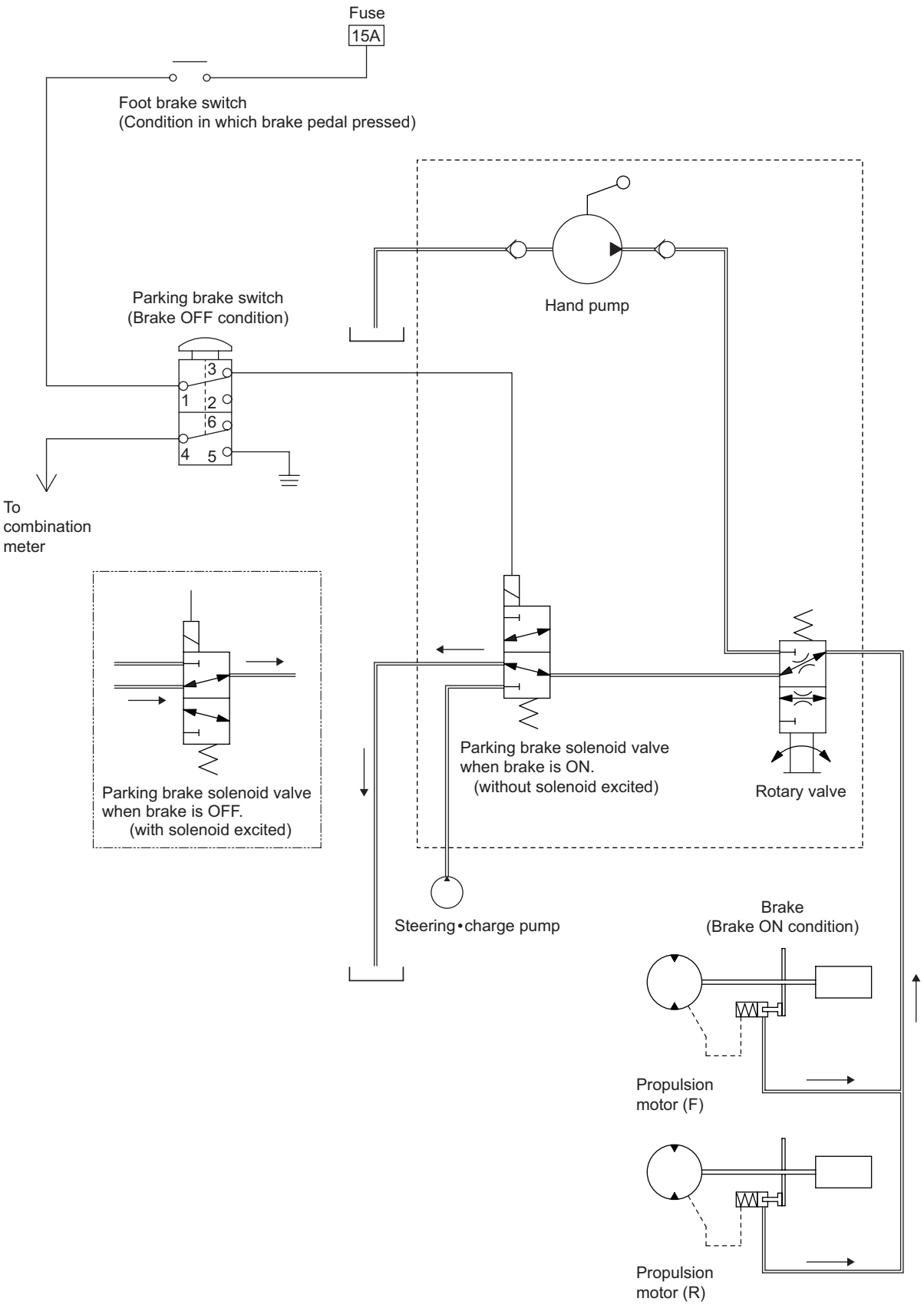


0559-51802-0-10797-A

(1) Split pin
(2) Washer (Apply grease)
(3) Rod
(4) Nut : M10 (Left-hand thread)
(5) Rod end : M10 (Left-hand thread)
(6) Pedal
(7) Bush (Apply grease*)
(8) Spring
(9) Foot brake switch
(10) Stopper bolt : M10×40
(11) Nut : M10
(12) Stopper bolt : M10×40
(13) Nut : M10

* : Lithium-based grease

2. BRAKE SYSTEM



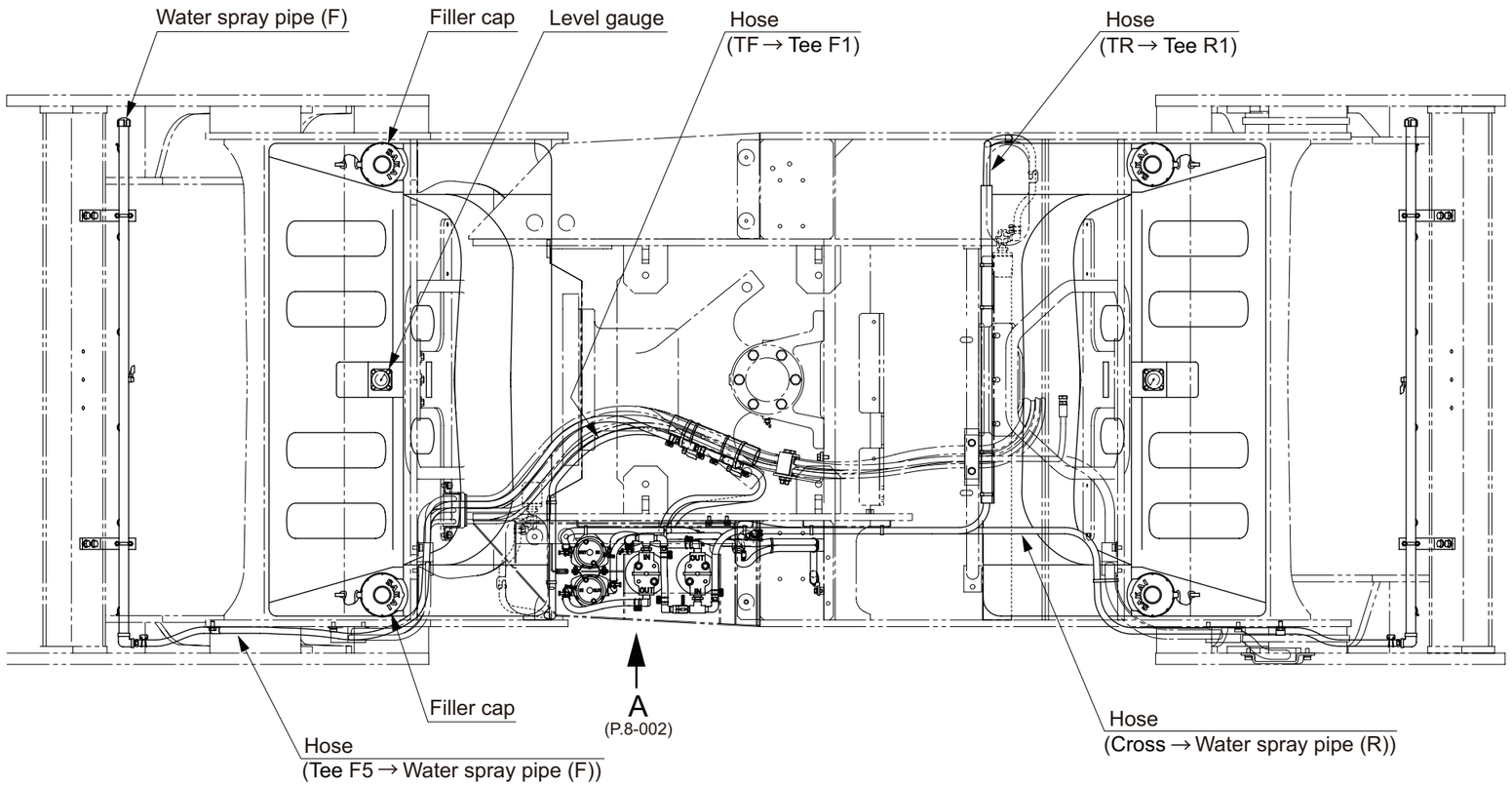
•The arrow (→) symbol shows the direction of the hydraulic oil flow.

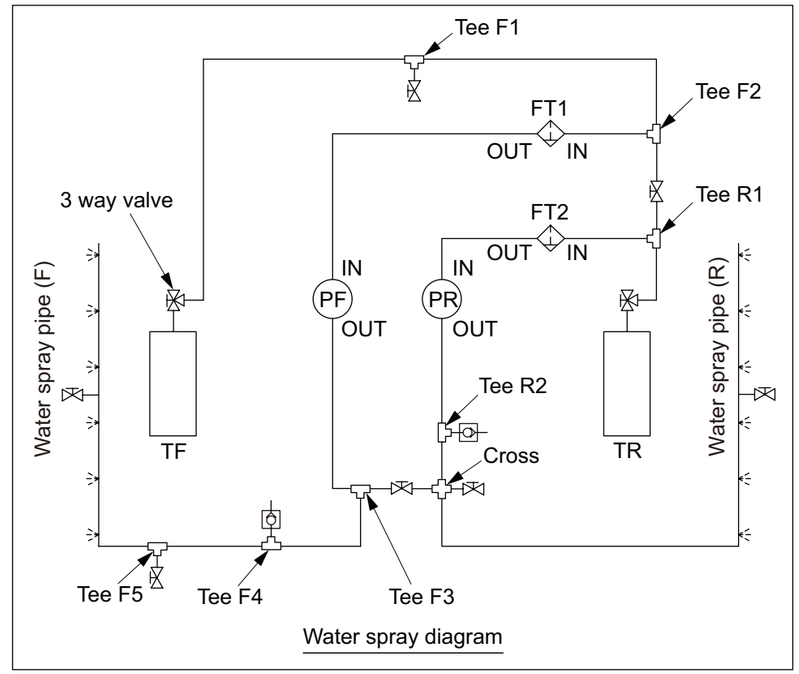
SW654-07001

WATER SPRAY SYSTEM

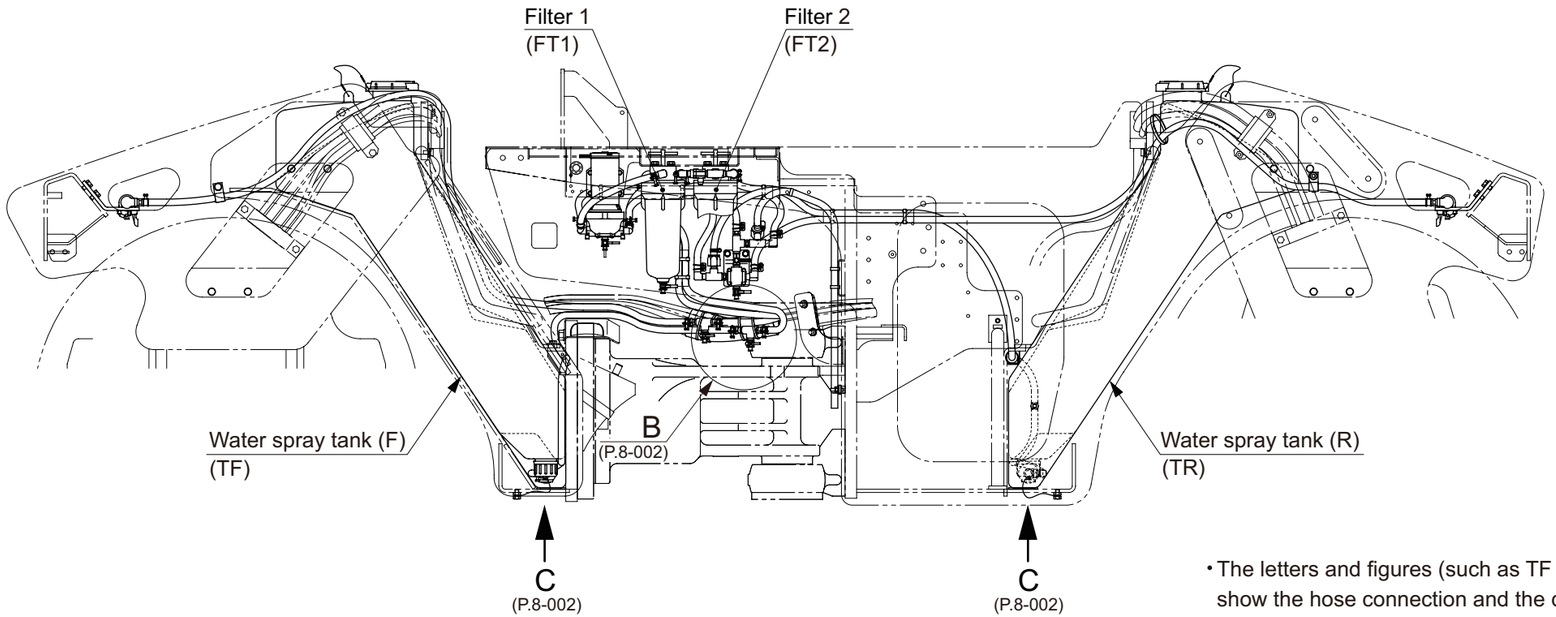
1. WATER SPRAY PIPING

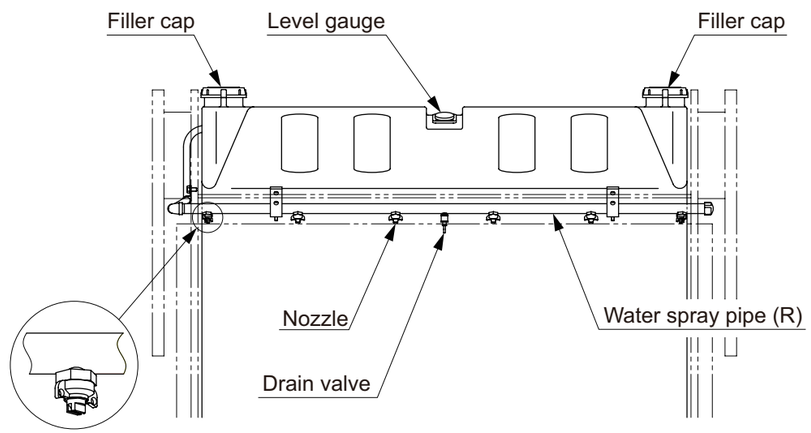
1-1. Water Spray Piping (1)





Water spray diagram

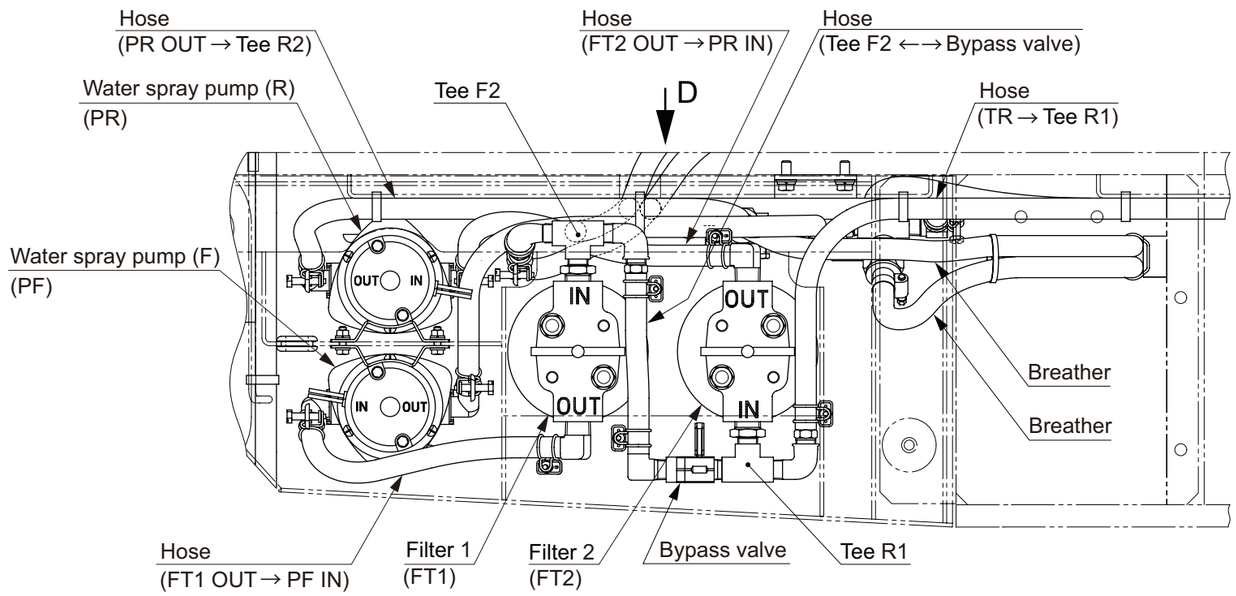


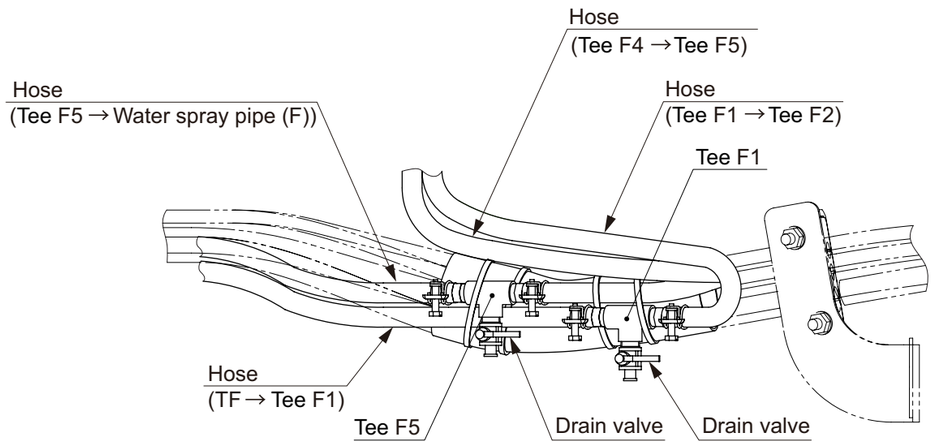


・The letters and figures (such as TF and Tee F1) show each port and the arrow (→) symbols show the hose connection and the direction of the flow of the water.

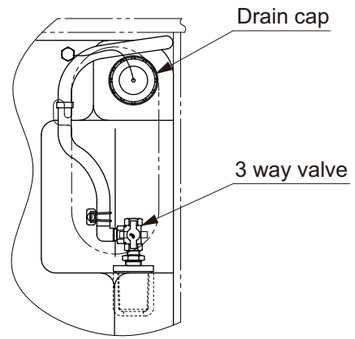
0559-75807-0-10911-B

1-2. Water Spray Piping (2)

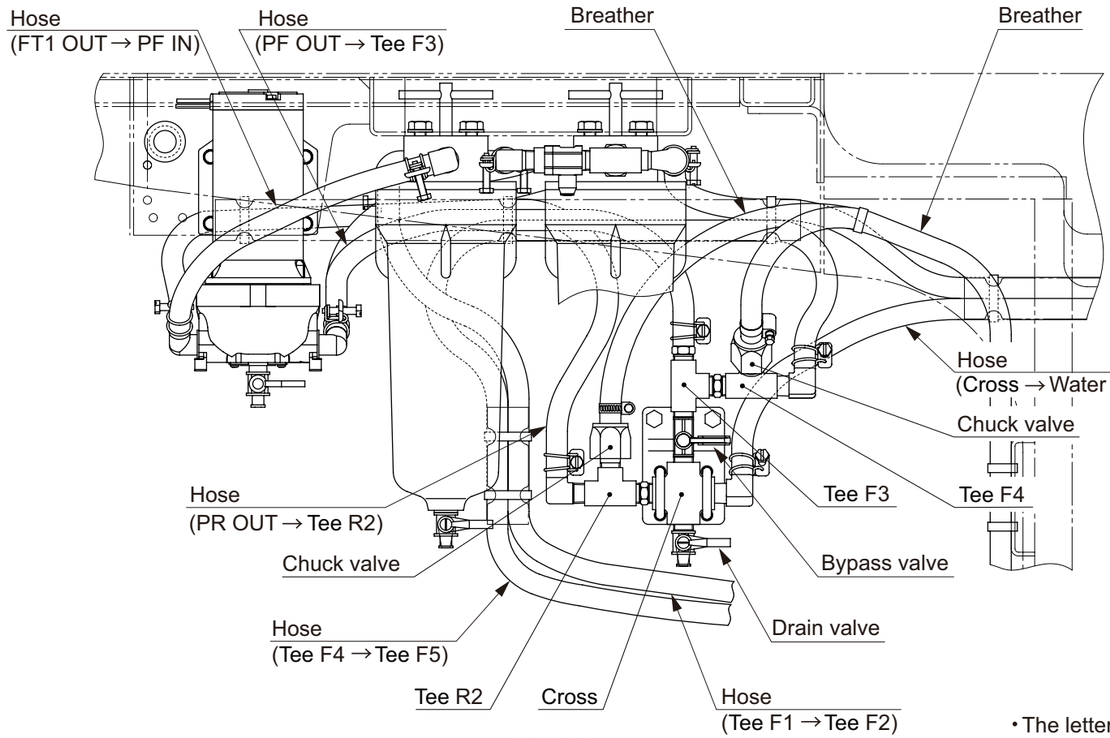




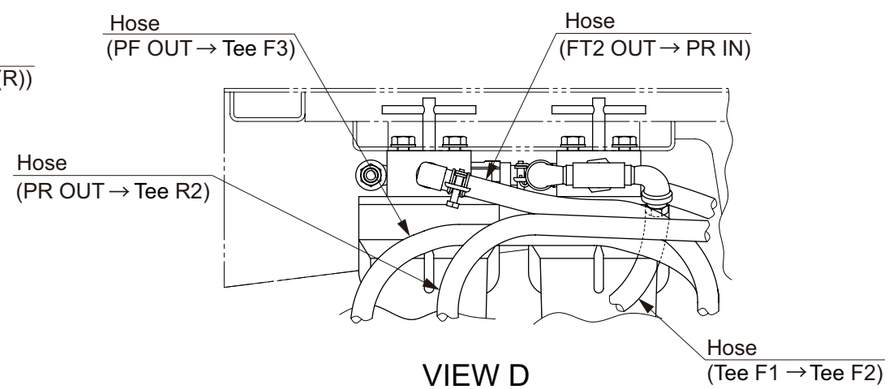
DETAIL B



VIEW C



VIEW A



VIEW D

- The letters and figures (such as TR and Tee R1) show each port and the arrow (→) symbols show the hose connection and the direction of the flow of the water.

0559-75006-1-11011-A
0559-75807-0-10911-B

INSPECTION AND ADJUSTMENT

1. INSPECTION AND ADJUSTMENT

1-1. Safety Precautions for Inspection and Adjustment

⚠ WARNING

Unexpected machine movement may cause a serious accident. When inspecting the machine while the engine is running, always follow the instructions below.

- Park the machine on level, flat ground.
- Apply the parking brake.
- Set chocks in front and behind each drum or tire.
- Make sure that service personnel are given the appropriate information at the appropriate time.
- Make sure that no one can enter any hazardous area.

⚠ CAUTION

Do not work on the hydraulic system while the engine is running and the system is hot and under pressure. Do not disconnect hydraulic hoses or fittings until the system has cooled and pressure has been properly relieved.
Before removing any plugs from the pressure measurement ports, always release any residual pressure from the piping and open the cap of the fluid tank to release and pressure.

⚠ WARNING

Inadvertent starting the engine may cause a serious accident.
When inspecting the engine, make sure to exchange the appropriate cues and hand signal with the person at the operator station to avoid any accidents.

⚠ CAUTION

Before inspecting inside of the engine compartment, always stop the engine.
Contact with the fan, V-belt or exhaust system parts while the engine is running may cause serious injury.

1-2. Preparation for Inspection and Adjustment

- Prepare the necessary measuring instruments. In addition, particularly when measuring pressure values, make sure to prepare the appropriate hoses, adapters and a plug removal tool for the pressure reading port.
- Make sure that the instruments to be used operate normally.
  When handling the instruments, exercise sufficient caution not to drop or apply any impact to them. Doing so may adversely affect the calibration. Another important point is to inspect the instruments regularly. An instrument that does not start from the appropriate zero point may give an inaccurate reading.

1-3. Precautions for Inspection and Adjustment

- When performing inspections and adjustments, pay special attention to safety.
- For each inspection, always take three measurements for each measurement point. If the measurements significantly differ, the measurement method may be incorrect. In such a case, take measurements once again and calculate their average.

1-4. Warm-up

- Machinery will not exhibit their true performance under the cold condition. Before taking measurements, always warm up the engine and make sure that the fluid and engine coolant are warmed to their specified normal operating temperatures.

1-5. Inspection and Adjustment of Engine Related Items

- Refer to shop manual of engine manufacturer for inspection and adjustment of engine itself.

2. MEASUREMENT AND ADJUSTMENT OF PROPULSION CIRCUIT PRESSURE

2-1. Measurement

⚠WARNING

Confirm that the parking brake works properly before measurement.

- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Remove plugs from high pressure gauge port (1-7) and (1-14) of propulsion pump. Attach pressure gauge with adapter ⓨ .
- Adapter ⓨ : 7/16-20UNF
- High pressure gauge port (Forward) : (**1-14**)*
- High pressure gauge port (Reverse) : (**1-7**)*
- Pressure gauge : 0 to 50 MPa (0 to 7,250 psi)

② Confirm that F-R lever is “N”.

③ Apply parking brake by pressing parking brake switch button.

④ Set propulsion speed change switch to “🐢”.

⑤ Set shift lever to “1st”.

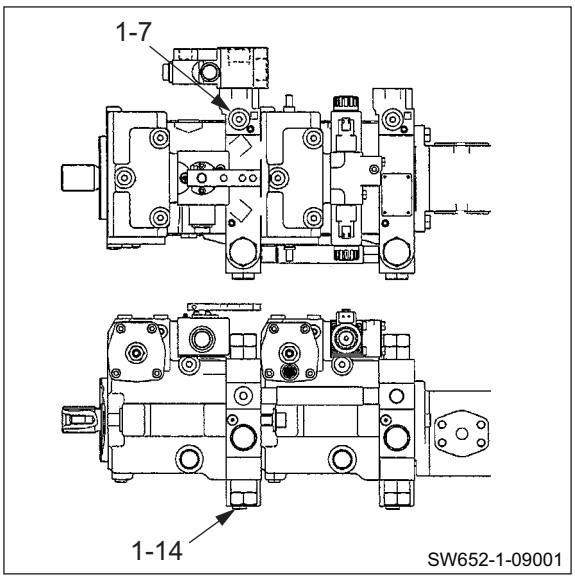
⑥ Start the engine and set throttle lever to “Full”.

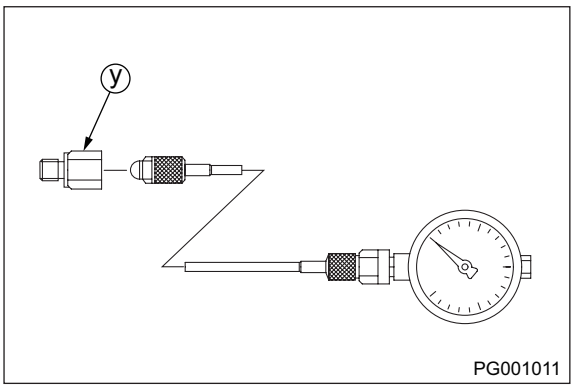
⑦ Establish a condition in which machine propulsion load becomes maximum.
(Pressure does not build up unless propulsion load is applied.)

⑧ With propulsion load at maximum, slowly move F-R lever to the side to be measured.

⑨ Read pressure indicated by pressure gauge.

⑩ After measuring, promptly return F-R lever to “N”.



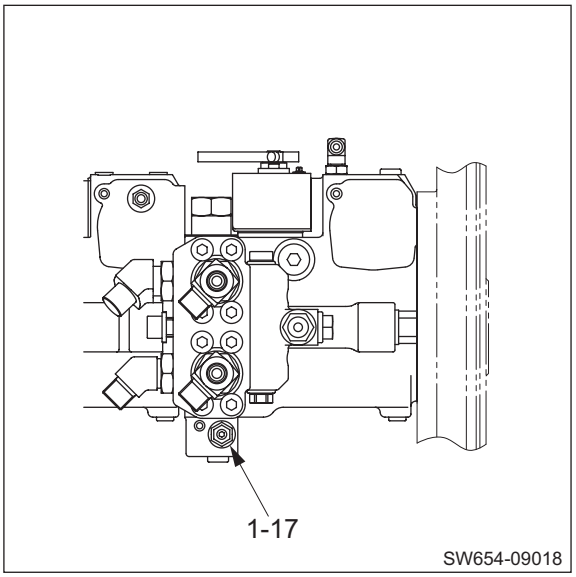


★ Maximum circuit pressure (cut off valve setting)
: 30.0 ± 1.0 MPa (4,350 ± 145 psi)

- The numbers “1-7” and “1-14” appearing in above illustrations are consistent with lead line numbers shown in illustration of hydraulic pump assembly in “2-2. Hydraulic Component Specifications” (P.4-007).

2-2. Adjustment

- If measurement results indicate the pressure deviating from maximum circuit pressure range, make an adjustment in accordance with procedure described below.



2-2-1. If pressures on both forward and reverse sides deviate from maximum circuit pressure range by same value

① Check nut (1) of cut off valve (1-17) for evidence of having loosened.

② If there is evidence of nut having loosened, adjust cut off valve so that pressure becomes within maximum circuit pressure range while watching pressure gauge.

- To adjust pressure, loosen nut and turn adjustment screw (2).

  Adjustment screw turned clockwise
  : Pressure rise
  Adjustment screw turned counterclockwise
  : Pressure drop
  Pressure change rate : 10 MPa/turn (1,450 psi/turn)

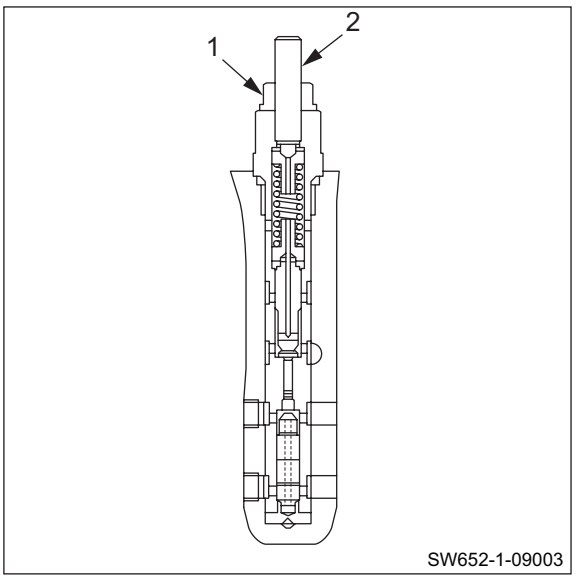
③ If there is no evidence of nut having loosened, remove cut off valve.

④ Check removed cut off valve for trapped dirt and scratches on its seat.

⑤ If trapped dirt is present, disassemble and clean cut off valve.

⑥ If a scratch is found on seat, replace cut off valve.

⑦ After adjustment, measure pressure again and check that pressure reaches maximum circuit pressure range.



N•m (1) Nut : 22 N·m (16 lbf·ft)
(1-17) Cut off valve : 35 N·m (26 lbf·ft)

(NOTICE)

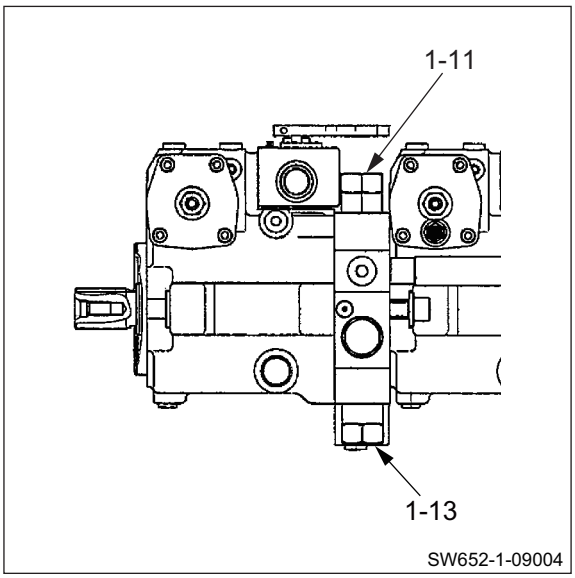
- **Carefully disassemble and reassemble after taking steps to prevent foreign material from getting in.**

- The number “1-17” appearing in above illustrations is consistent with lead line numbers shown in illustration of hydraulic pump assembly in “2-2. Hydraulic Component Specifications” (P.4-007).

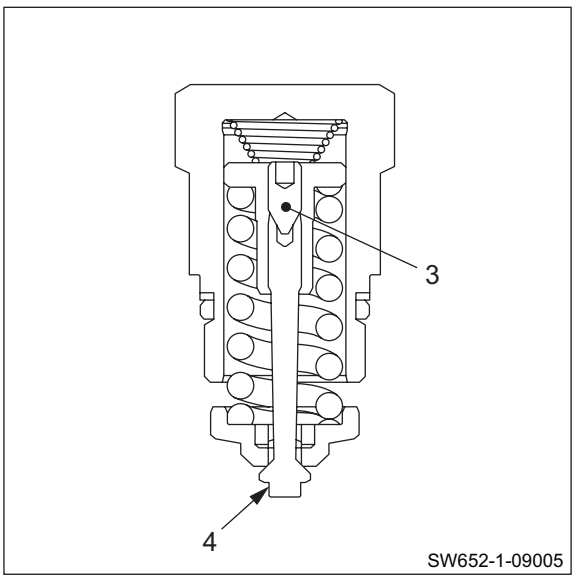
2-2-2. If pressure on either forward or reverse side deviates from maximum circuit pressure range

① Check high pressure relief valve (1-11) or (1-13) for evidence of having loosened.
- High pressure relief valve (Forward) : (**1-13**)*
- High pressure relief valve (Reverse) : (**1-11**)*

② If there is evidence of high pressure relief valve having loosened, adjust it so that pressure becomes within maximum circuit pressure range while watching pressure gauge.
③ Remove high pressure relief valve.
④ Remove lock screw (3).
⑤ Turn adjustment screw (4) to adjust pressure.
Adjustment screw turned clockwise
: Pressure rise
Adjustment screw turned counterclockwise
: Pressure drop
Pressure change rate : 4.5 MPa/turn (653 psi/turn)
⑥ If there is no evidence of high pressure relief valve having loosened, remove it.
⑦ Check removed high pressure relief valve for trapped dirt and scratches on its seat.
⑧ If trapped dirt is present, disassemble and clean high pressure relief valve.
⑨ If a scratch is found on seat, replace high pressure relief valve.
⑩ After adjustment, measure pressure again and check that pressure reaches maximum circuit pressure range.



SW652-1-09004



SW652-1-09005

N•m	(3)	Lock screw	: 6.5 N·m (4.8 lbf·ft)
	(1-11) (1-13)	High pressure relief valve	: 160 N·m (118 lbf·ft)

(NOTICE)
- **Carefully disassemble and reassemble after taking steps to prevent foreign material from getting in.**

- The number “1-11” and “1-13” appearing in above illustrations are consistent with lead line numbers shown in illustration of hydraulic pump assembly in “2-2. Hydraulic Component Specifications” (P.4-007).

3. MEASUREMENT AND ADJUSTMENT OF PROPULSION/ VIBRATOR CHARGE CIRCUIT PRESSURE

- Since oil in charge circuit is supplied from steering circuit, confirm that steering operation is normal before measurement.
- Ensure that neutral positions of F-R lever and hydraulic pump assembly are aligned.

3-1. Measurement

- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Remove plug from coupling (1). Attach pressure gauge with hose ⓢ and connector ⓤ .
- Coupling : 9/16-18UNF×M16
- Adapter for hose ⓢ : M16 P=2.0
- Pressure gauge connector ⓤ : M16×G3/8
- Pressure gauge : 0 to 25 MPa (0 to 3,625 psi)

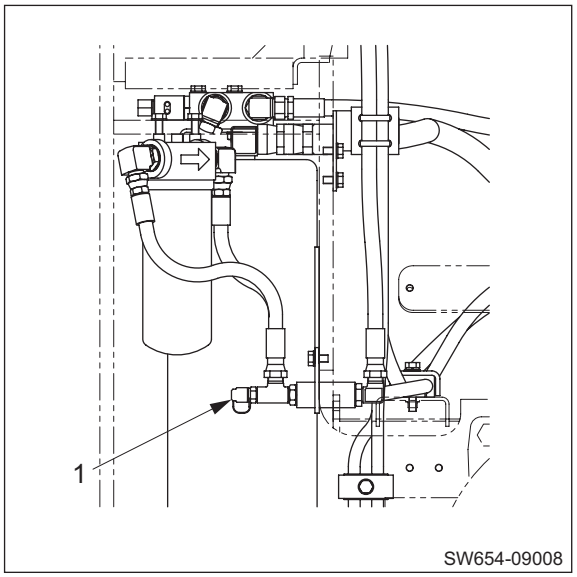
② Confirm that F-R lever is “N”.

③ Apply parking brake by pressing parking brake switch button.

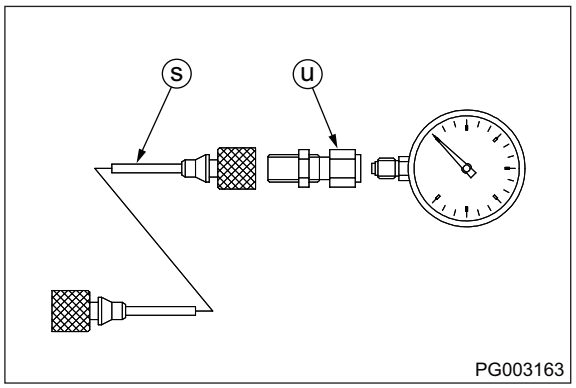
④ Start the engine and set throttle lever to “Full”.

⑤ Read pressure indicated by pressure gauge.

★ Standard charge relief valve setting
: 2.4 ± 0.2 MPa (348 ± 29 psi)



SW654-09008



PG003163

3-2. Adjustment

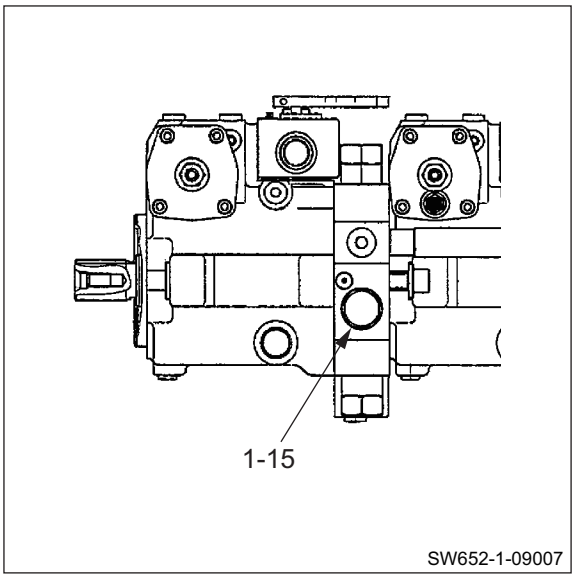
- If measurement results indicate the pressure deviating from standard charge relief pressure setting range, make an adjustment in accordance with procedure described below.

① Check charge relief valve (1-15) for evidence of having loosened.
② If there is evidence of charge relief valve having loosened, adjust it so that pressure becomes within standard charge relief valve pressure setting range while watching pressure gauge.
- To adjust pressure, remove charge relief valve and change thickness of shims (1).
  Pressure change rate : 0.4 MPa/mm (58 psi/mm)

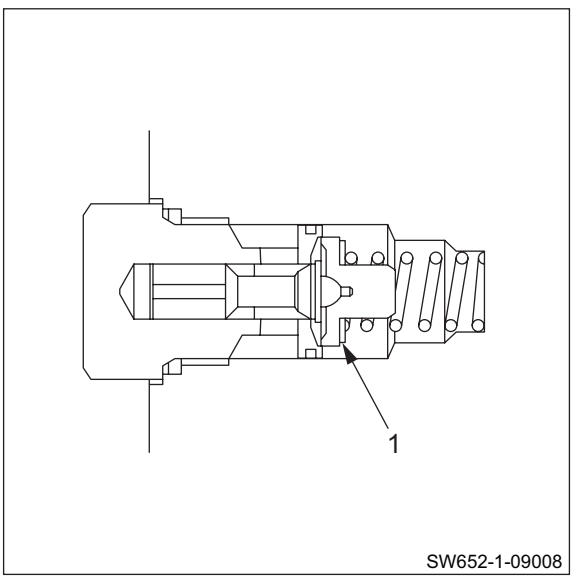
③ If there is no evidence of charge relief valve having loosened, remove it.
④ Check removed charge relief valve for trapped dirt and scratches on its seat.
⑤ If trapped dirt is present, disassemble and clean charge relief valve.
⑥ If a scratch is found on seat, replace charge relief valve.
⑦ After adjustment, measure pressure again and check that pressure reaches standard charge relief valve setting range.

N•m (1-15) Charge relief valve : 70 N·m (52 lbf·ft)

(NOTICE)
- **Carefully disassemble and reassemble after taking steps to prevent foreign material from getting in.**



SW652-1-09007



SW652-1-09008

- The number “1-15” appearing in above illustrations is consistent with lead line numbers shown in illustration of hydraulic pump assembly in “2-2. Hydraulic Component Specifications” (P.4-007).

4. MEASUREMENT OF MACHINE HIGH/LOW SPEED CHANGE CIRCUIT PRESSURE

- Since oil in charge circuit is supplied from steering circuit, confirm that steering operation is normal before measurement.

4-1. Measurement

- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Disconnect hose (1) from propulsion motor. Attach pressure gauge through adapter ⓜ .
- Adapter ⓜ : G1/4
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Confirm that F-R lever is “N”.

③ Apply parking brake by pressing parking brake switch button.

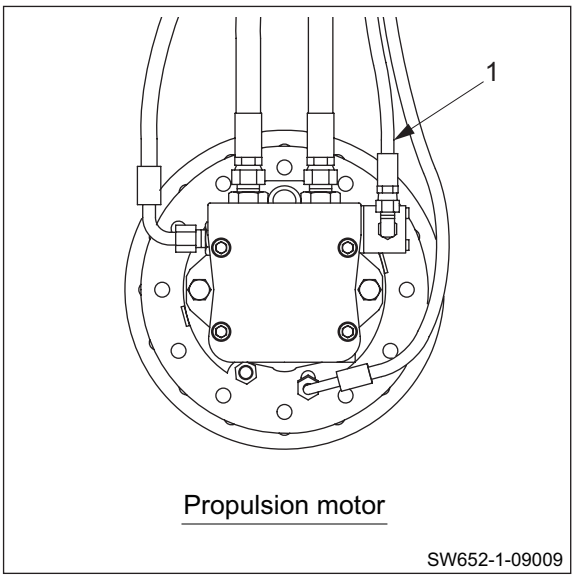
④ Set propulsion speed change switch to “”.

⑤ Start the engine and set throttle lever to “Full”.

⑥ Read pressure indicated by pressure gauge.

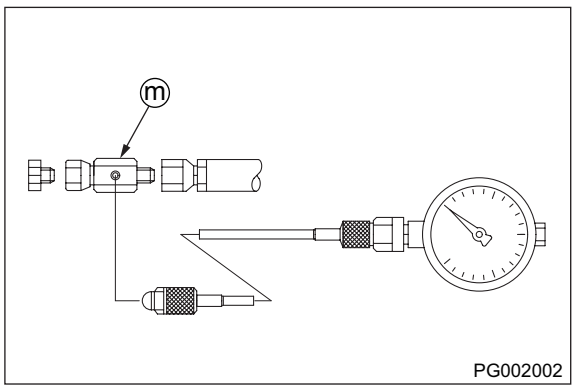
★ Standard charge relief valve setting

: 2.4 ± 0.2 MPa (348 ± 29 psi)



Propulsion motor

SW652-1-09009



PG002002

5. MEASUREMENT OF PROPULSION SERVO CIRCUIT PRESSURE

5-1. Measurement

- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

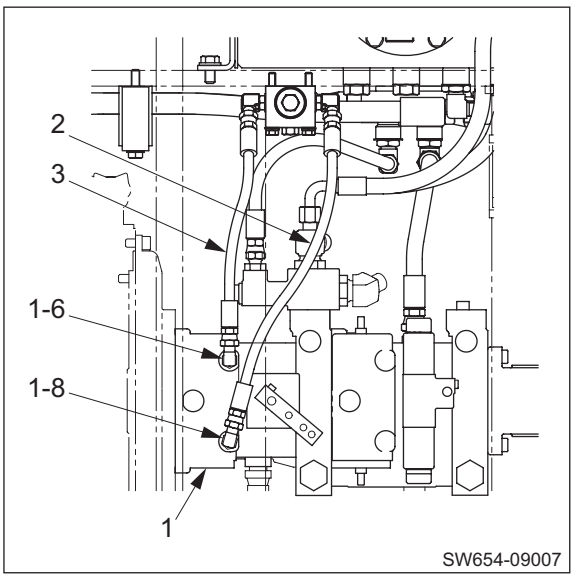
① Disconnect hoses (2) and (3) from propulsion pump (1). Attach pressure gauge through adapter ⓜ .
- Adapter ⓜ : G1/4
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Confirm that F-R lever is “N”.

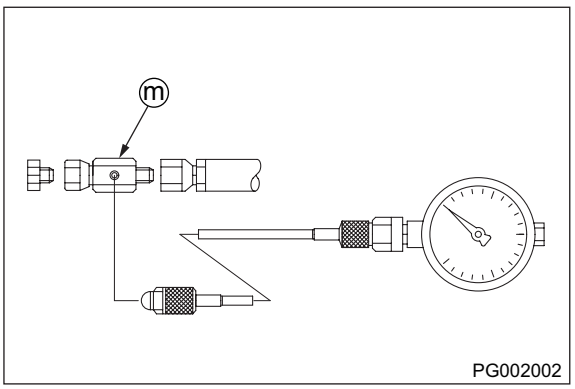
③ Apply parking brake by pressing parking brake switch button.

④ Start the engine and set throttle lever to “Full”.

⑤ Operate F-R lever and then read pressure indicated by pressure gauge.
- With parking brake applied (ON), measured pressures of (1-6) and (1-8) are same.
- With parking brake released (OFF), measured pressures of (1-6) and (1-8) are different.



★ Standard charge relief pressure setting
: 2.4 ± 0.2 MPa (348 ± 29 psi)



- The numbers “1-6” and “1-8” appearing in above illustrations are consistent with lead line numbers shown in illustration of hydraulic pump assembly in “2-2. Hydraulic Component Specifications” (P.4-007).

6. MEASUREMENT OF PARKING BRAKE RELEASE PRESSURE

- Since oil in charge circuit is supplied from steering circuit, confirm that steering operation is normal before measurement.

6-1. Measurement

- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Disconnect hose (1) from propulsion motor. Attach pressure gauge through adapter ⓜ .
- Adapter ⓜ : G1/4
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Confirm that F-R lever is “N”.

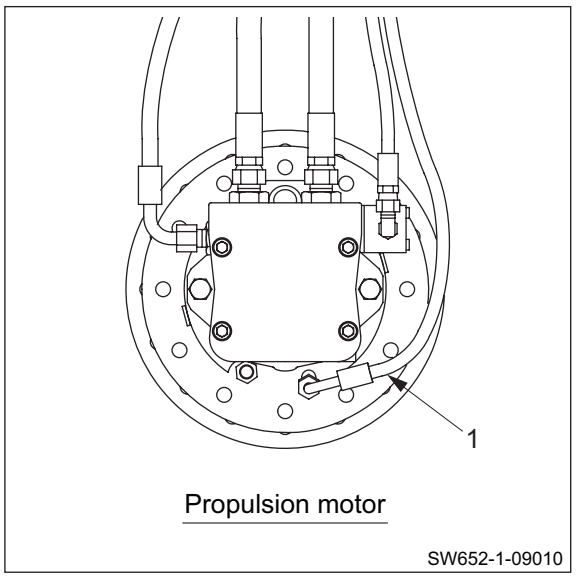
③ Apply parking brake by pressing parking brake switch button.

④ Start the engine and set throttle lever to “Full”.

⑤ Release parking brake by pressing parking brake switch button.

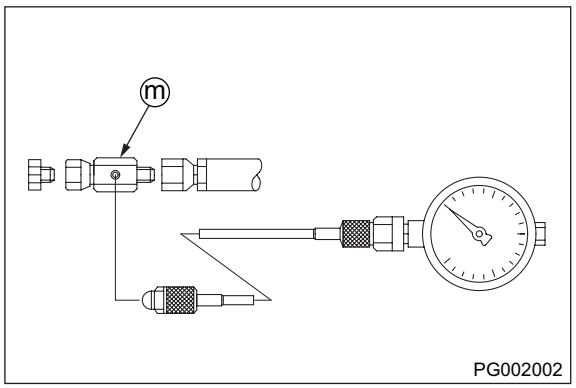
⑥ Read brake release pressure indicated by pressure gauge.

★ Brake release pressure : More than 1.8 MPa (261 psi)



Propulsion motor

SW652-1-09010



PG002002

7. MEASUREMENT AND ADJUSTMENT OF VIBRATOR CIRCUIT PRESSURE

7-1. Measurement

⚠CAUTION

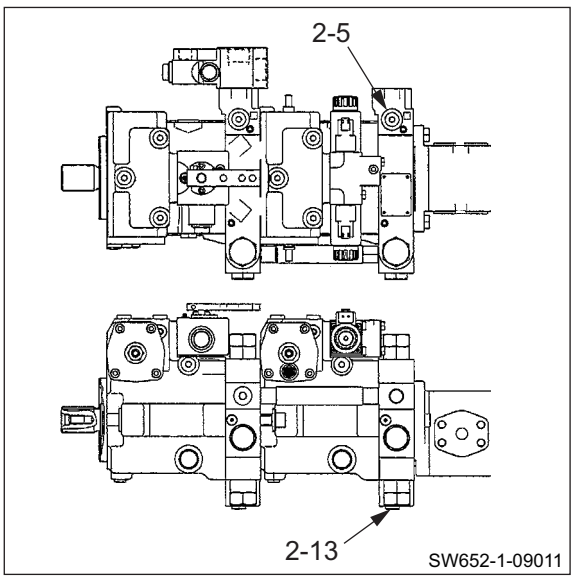
Take care not to operate the vibratory drum for a longer period of time than necessary with the machine stationary. Otherwise, the vibrator bearing could be seized.

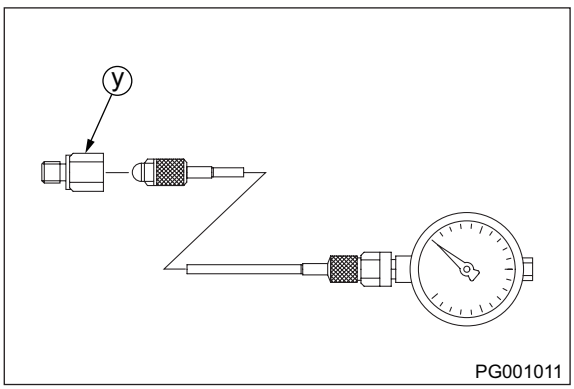
- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Remove plugs from high pressure gauge port (2-5) and (2-13) of vibrator pump. Attach pressure gauge with adapter ⓨ .
- Adapter ⓨ : 7/16-20UNF
- High pressure gauge port : (2-5) (Low amplitude/Oscillation)
- High pressure gauge port : (2-13) (High amplitude/Normal)
- Pressure gauge : 0 to 50 MPa (0 to 7,250 psi)

② Confirm that F-R lever is “N”.
③ Apply parking brake by pressing parking brake switch button.
④ Set shift lever to “1st”.
⑤ Set vibratory drum select switch to “ ⓕⓡ ”.
⑥ Set vibration mode change switch to “ ”.
⑦ Start the engine and set throttle lever to “Full”.
⑧ Press F-R lever vibration switch ON.
⑨ Slowly move F-R lever to forward or reverse side.
⑩ Read pressure gauge for maximum value of vibrator circuit pressure.
⑪ Turn F-R lever vibration switch OFF or move back F-R lever to “N” as soon as measurement is finished.

★ Maximum circuit pressure (cut off valve setting)
: 32.5 ± 1.0 MPa (4,713 ± 145 psi)

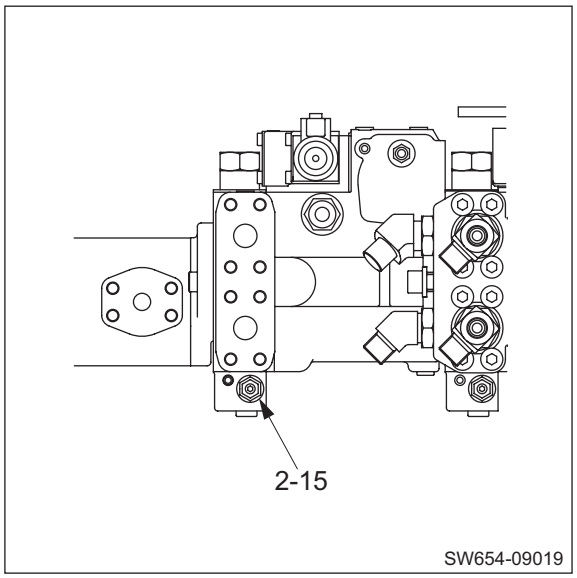




- The numbers “2-5” and “2-13” appearing in above illustrations are consistent with lead line numbers shown in illustration of hydraulic pump assembly in “2-2. Hydraulic Component Specifications” (P.4-007).

7-2. Adjustment

- If measurement results indicate the pressure deviating from maximum circuit pressure range, make an adjustment in accordance with procedure described below.



7-2-1. If pressures on both Low amplitude/Oscillation and High amplitude/Normal sides deviate from maximum circuit pressure range by same value

① Check nut (1) of cut off valve (2-15) for evidence of having loosened.

② If there is evidence of nut having loosened, adjust cut off valve so that pressure becomes within maximum circuit pressure range while watching pressure gauge.

- To adjust pressure, loosen nut and turn adjustment screw (2).

  Adjustment screw turned clockwise
  : Pressure rise
  Adjustment screw turned counterclockwise
  : Pressure drop
  Pressure change rate : 10 MPa/turn (1,450 psi/turn)

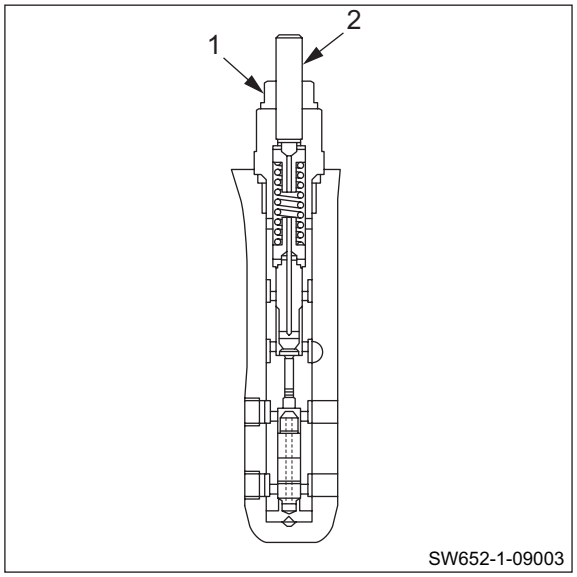
③ If there is no evidence of nut having loosened, remove cut off valve.

④ Check removed cut off valve for trapped dirt and scratches on its seat.

⑤ If trapped dirt is present, disassemble and clean cut off valve.

⑥ If a scratch is found on seat, replace cut off valve.

⑦ After adjustment, measure pressure again and check that pressure reaches maximum circuit pressure range.



N•m (1) Nut : 22 N·m (16 lbf·ft)
(2-15) Cut off valve : 35 N·m (26 lbf·ft)

(NOTICE)

- **Carefully disassemble and reassemble after taking steps to prevent foreign material from getting in.**

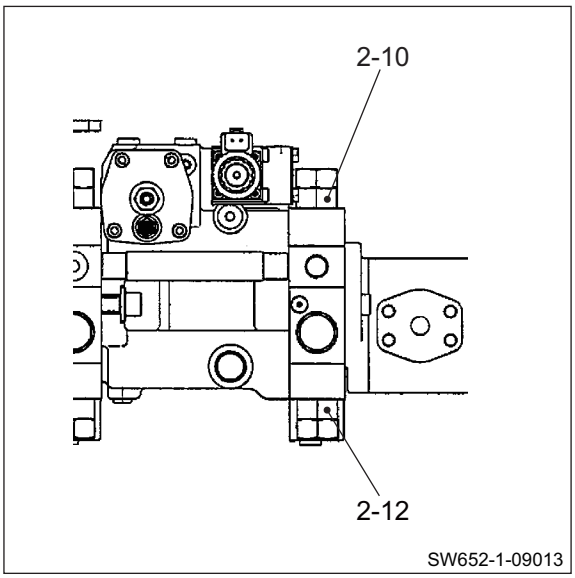
- The number “2-15” appearing in above illustrations is consistent with lead line numbers shown in illustration of hydraulic pump assembly in “2-2. Hydraulic Component Specifications” (P.4-007).

7-2-2. If pressure on either Low amplitude/Oscillation or High amplitude/Normal side deviates from maximum circuit pressure range

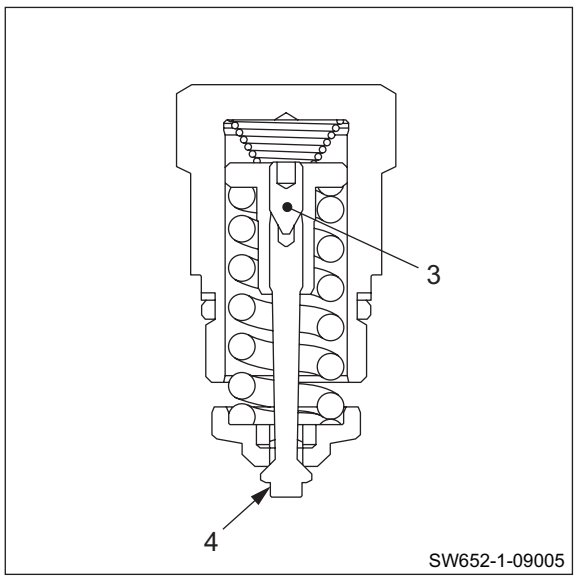
① Check high pressure relief valve (2-10) or (2-12) for evidence of having loosened.
- High pressure relief valve : (2-12)
  (High amplitude/Normal)
- High pressure relief valve : (2-10)
  (Low amplitude/Oscillation)

② If there is evidence of high pressure relief valve having loosened, adjust it so that pressure becomes within maximum circuit pressure range while watching pressure gauge.
③ Remove high pressure relief valve.
④ Remove lock screw (3).
⑤ Turn adjustment screw (4) to adjust pressure.
Adjustment screw turned clockwise
: Pressure rise
Adjustment screw turned counterclockwise
: Pressure drop
Pressure change rate : 4.5 MPa/turn (653 psi/turn)
⑥ If there is no evidence of high pressure relief valve having loosened, remove it.
⑦ Check removed high pressure relief valve for trapped dirt and scratches on its seat.
⑧ If trapped dirt is present, disassemble and clean high pressure relief valve.
⑨ If a scratch is found on seat, replace high pressure relief valve.
⑩ After adjustment, measure pressure again and check that pressure reaches maximum circuit pressure range.

(3) Lock screw : 6.5 N·m (4.8 lbf·ft)
(2-10) (2-12) High pressure relief valve
: 160 N·m (118 lbf·ft)



SW652-1-09013



SW652-1-09005

(NOTICE)
- **Carefully disassemble and reassemble after taking steps to prevent foreign material from getting in.**

- The numbers “2-10” and “2-12” appearing in above illustrations are consistent with lead line numbers shown in illustration of hydraulic pump assembly in “2-2. Hydraulic Component Specifications” (P.4-007).

8. MEASUREMENT AND INSPECTION OF STEERING CIRCUIT PRESSURE

8-1. Measurement

⚠WARNING

Make sure that there is no person around the articulated portion of the machine before operating the steering wheel.

- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Disconnect the hose (1) or (2) from steering cylinder. Attach pressure gauge through adapter ⓝ .
- Adapter ⓝ : G3/8
- Pressure gauge : 0 to 25 MPa (0 to 3,625 psi)

② Confirm that F-R lever is “N”.

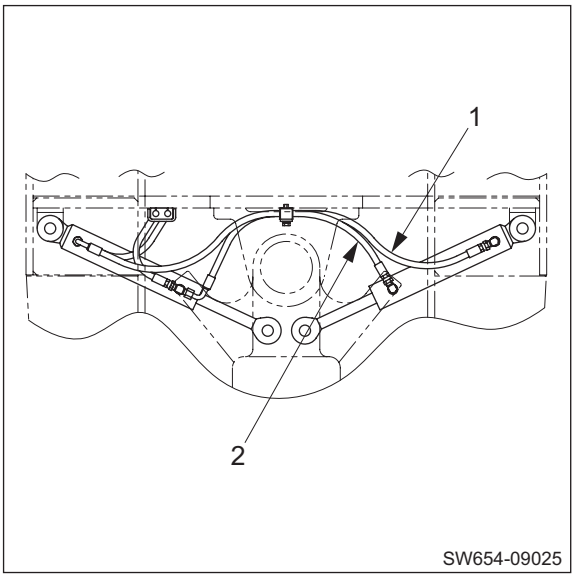
③ Apply parking brake by pressing parking brake switch button.

④ Start the engine and set throttle lever to “Full”.

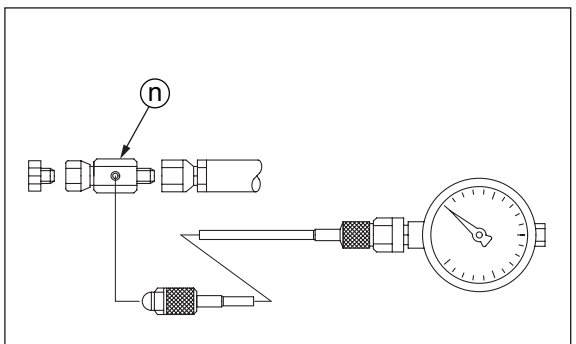
⑤ Turn steering wheel to operate relief valve.

⑥ Read pressure indicated by pressure gauge.

★ Standard maximum circuit pressure
(orbitroll relief pressure + charge relief pressure)
: 18.1 ± 1.0 MPa (2,625 ± 145 psi)



SW654-09025

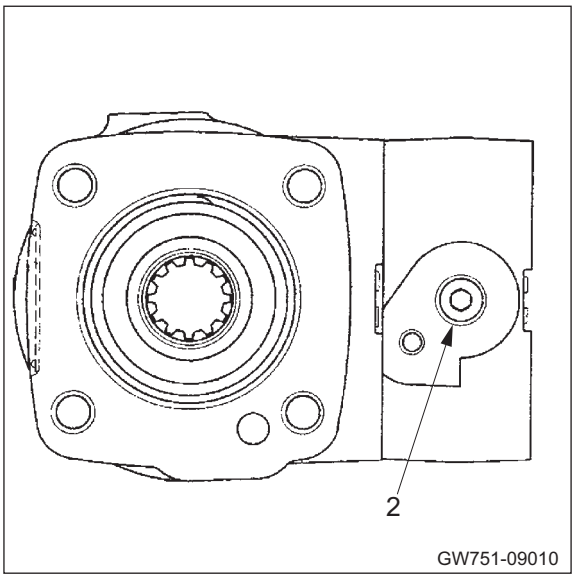


PG002003

8-2. Inspection

- If measurement results indicate the pressure deviating from standard maximum circuit pressure range, make an adjustment in accordance with procedure described below.

① Remove relief valve (2) from orbitrol.
② Check removed relief valve for trapped dirt, scratches on its seat and other abnormalities.
③ If trapped dirt is present, disassemble and clean relief valve.
④ If a scratch or any other abnormality is found on seat, replace relief valve.
⑤ After inspection, measure pressure again and check that pressure reaches standard maximum circuit pressure range.



(NOTICE)

- **Carefully disassemble and reassemble after taking steps to prevent foreign material from getting in.**

9. MEASUREMENT OF HYDRAULIC PUMP CASE PRESSURE

9-1. Measurement of Propulsion Pump Case Pressure

- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Disconnect hose (2) from propulsion pump (1) drain port (1-16). Attach pressure gauge through adapter Ⓟ .
- Adapter Ⓟ : G1/2
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Confirm that F-R lever is “N”.

③ Apply parking brake by pressing parking brake switch button.

④ Set propulsion speed change switch to “🐢”.

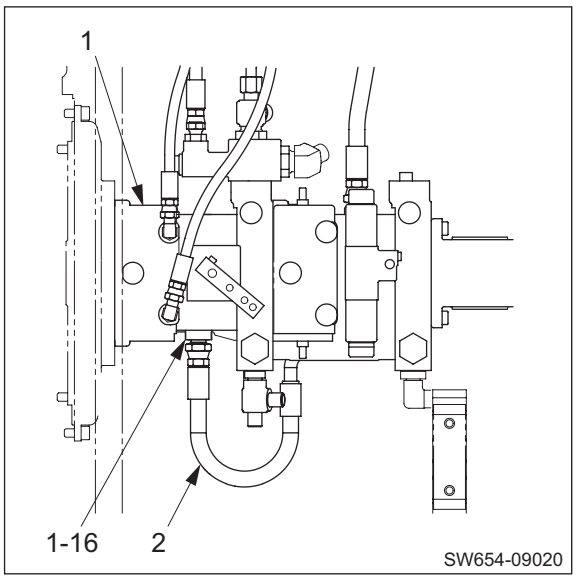
⑤ Set shift lever to “1st”.

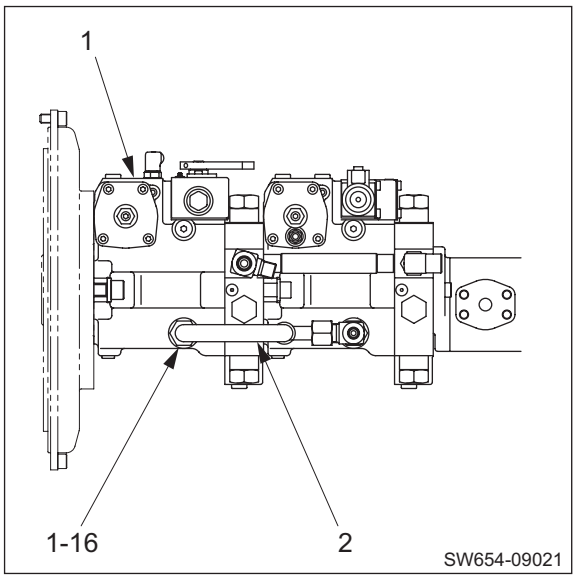
⑥ Start the engine and set throttle lever to “Full”.

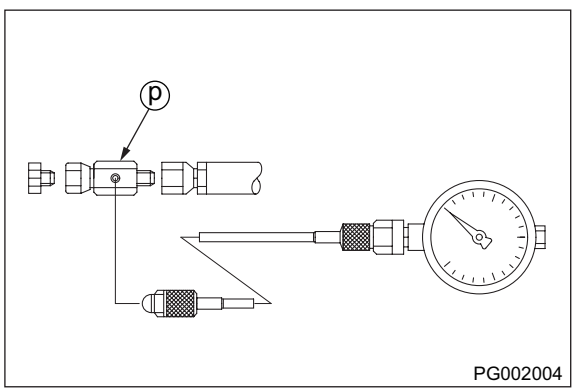
⑦ Establish a condition in which machine propulsion load becomes maximum.
(Pressure does not build up unless propulsion load is applied.)

⑧ With propulsion load at maximum, measure pressure when speed change switch is “🐢” and “🐇” and F-R lever is “N”, “F”, and “R”, respectively.

★ Allowable pump case pressure
: 0.4 MPa (58.0 psi) or less







- The number “1-10” appearing in above illustrations is consistent with lead line numbers shown in illustration of hydraulic pump assembly in “2-2. Hydraulic Component Specifications” (P.4-007).

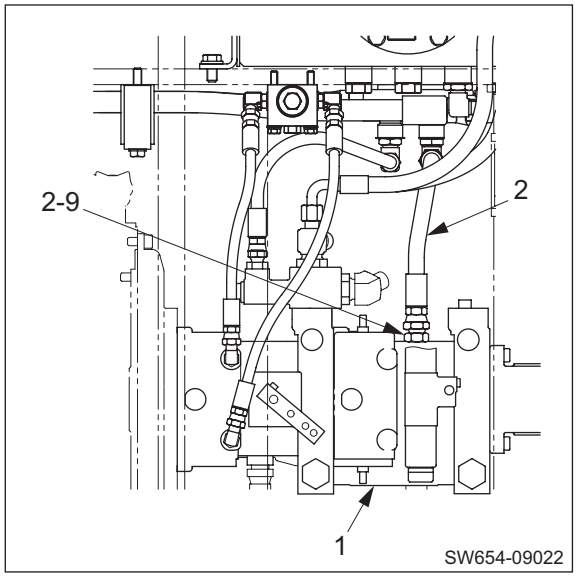
9-2. Measurement of Vibrator Pump Case Pressure

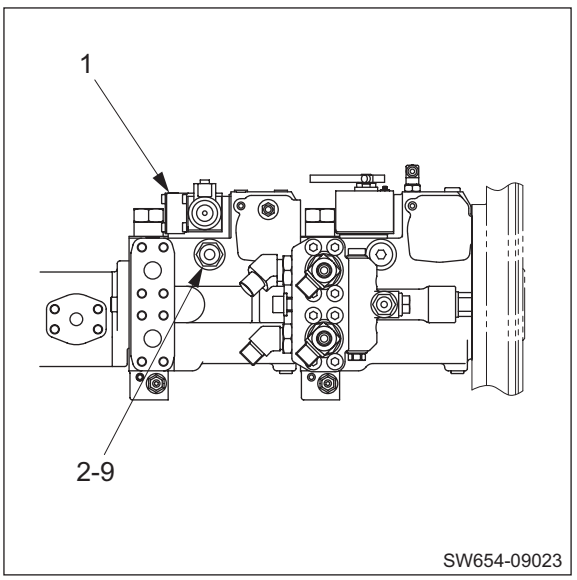
- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

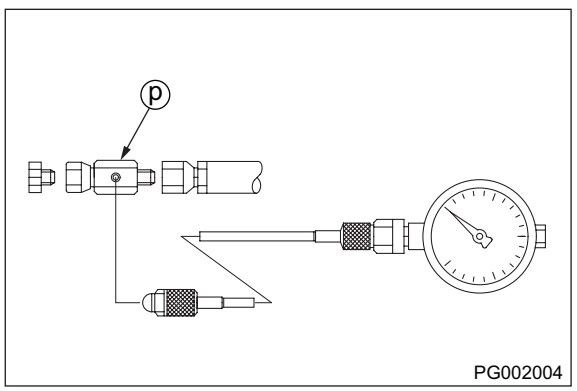
① Disconnect hose (2) from vibrator pump (1) drain port (2-9). Attach pressure gauge through adapter Ⓟ .
- Adapter Ⓟ : G1/2
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Confirm that F-R lever is “N”.
③ Apply parking brake by pressing parking brake switch button.
④ Set shift lever to “1st”.
⑤ Set vibratory drum select switch to “ Ⓕ Ⓡ ”.
⑥ Set vibration mode change switch to “ ”.
⑦ Start the engine and set throttle lever to “Full”.
⑧ Press F-R lever vibration switch ON.
⑨ Slowly move F-R lever to forward or reverse side.
⑩ Measure pressure when vibration switch is “” / “ ”and “” / “ ”, respectively.
⑪ Press F-R lever vibration switch OFF or move back F-R lever to “N” as soon as measurement is finished.

★ Allowable pump case pressure
: 0.4 MPa (58.0 psi) or less







- The number “2-9” appearing in above illustrations is consistent with lead line numbers shown in illustration of hydraulic pump assembly in “2-2. Hydraulic Component Specifications” (P.4-007).

10. MEASUREMENT OF PROPULSION MOTOR CASE PRESSURE

10-1. Measurement

- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Remove plug from drain port (1). Attach pressure gauge with adapter ⓙ .
- Adapter ⓙ : 7/8-14UNF
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Confirm that F-R lever is “N”.

③ Apply parking brake by pressing parking brake switch button.

④ Set propulsion speed change switch to “🐢”.

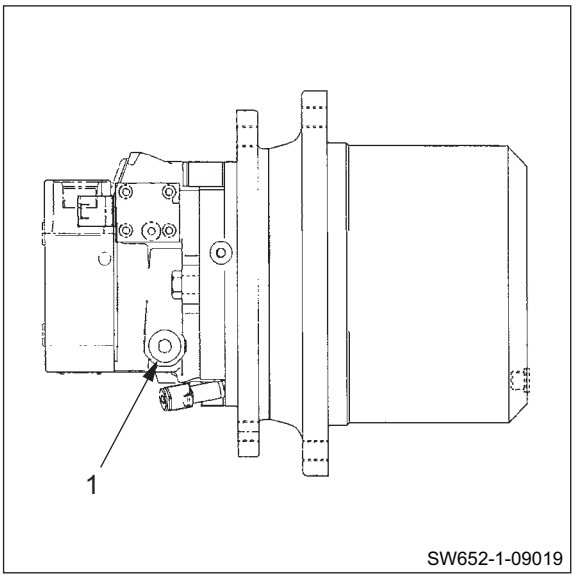
⑤ Set propulsion shift lever to “1st”.

⑥ Start the engine and set throttle lever to “Full”.

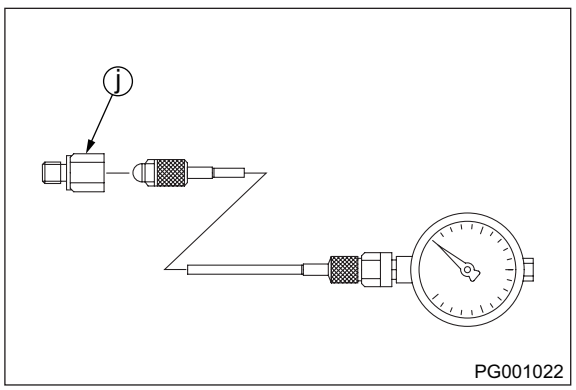
⑦ Establish a condition in which machine propulsion load becomes maximum.
(Pressure does not build up unless propulsion load is applied.)

⑧ With propulsion load at maximum, measure pressure when speed change switch is “🐢” and “🐇” and F-R lever is “N”, “F”, and “R”, respectively.

★ Allowable motor case pressure
: 0.4 MPa (58.0 psi) or less



SW652-1-09019



PG001022

11. MEASUREMENT OF VIBRATOR MOTOR CASE PRESSURE

11-1. Measurement

- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Remove plug from drain port (1). Attach pressure gauge with adapter ⓘ .
- Adapter ⓘ : 3/4-16UNF
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Confirm that F-R lever is “N”.

③ Apply parking brake by pressing parking brake switch button.

④ Set shift lever to “1st”.

⑤ Set vibratory drum select switch to “ Ⓕ Ⓡ ”.

⑥ Set vibration mode change switch to “ ”.

⑦ Start the engine and set throttle lever to “Full”.

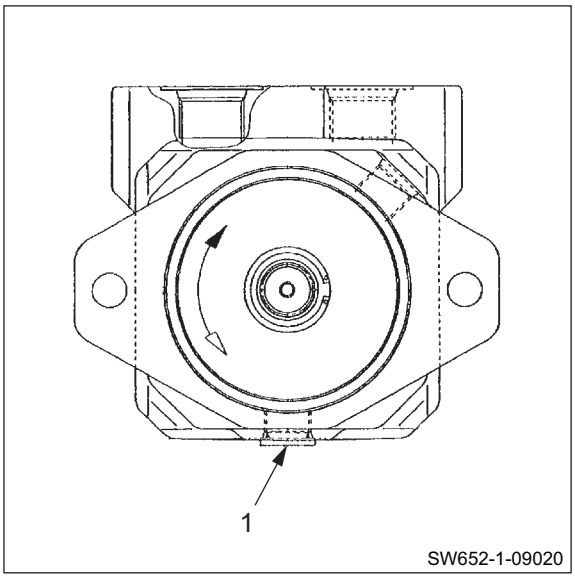
⑧ Press F-R lever vibration switch ON.

⑨ Slowly move F-R lever to forward or reverse side.

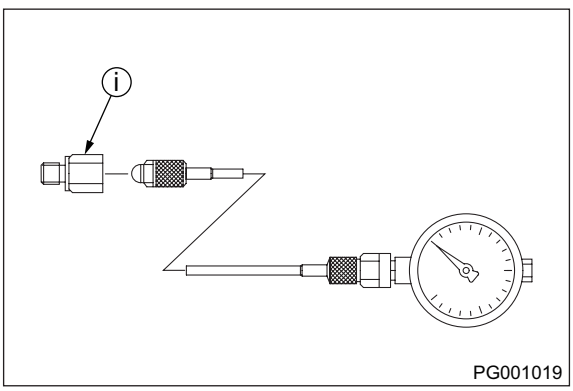
⑩ Measure pressure when vibration switch is “” / “ ”and “” / “ ”, respectively.

⑪ Press F-R lever vibration switch OFF or move back F-R lever to “N” as soon as measurement is finished.

★ Allowable motor case pressure
: 0.2 MPa (29.0 psi) or less



SW652-1-09020



PG001019

12. ADJUSTMENT OF THROTTLE LEVER

12-1. Adjustment of Potentiometer

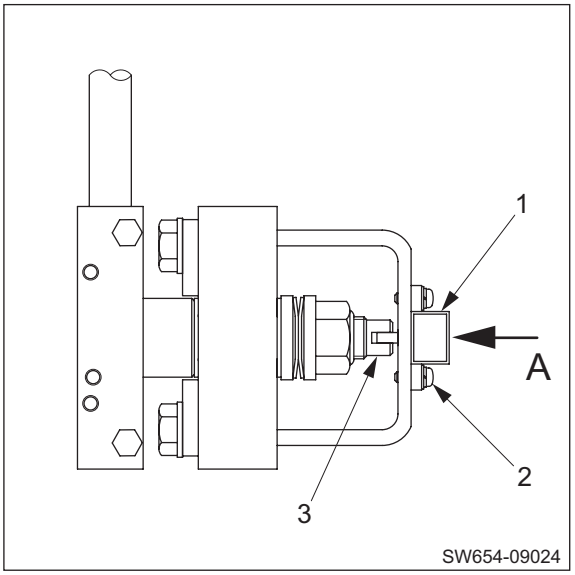
- If potentiometer (1) is replaced, make following adjustments.
- Make adjustments after amply warmed engine.
- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Apply grease to shaft of potentiometer.

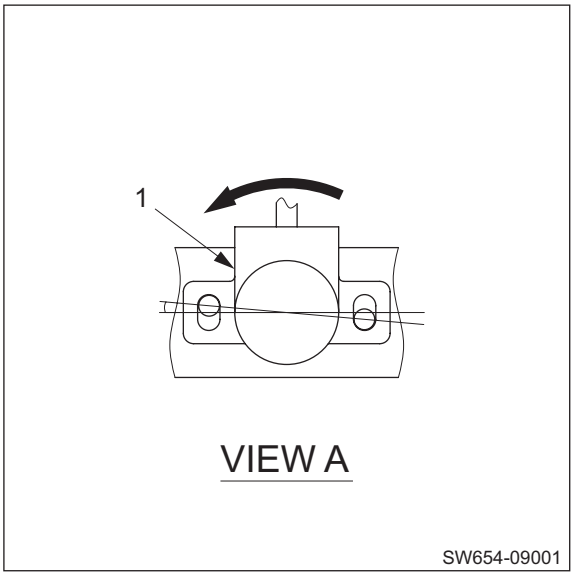
② Insert potentiometer shaft to the groove on throttle lever (3), and fix it with two screws (2).

(NOTICE)

- **When fixing potentiometer (1), turn potentiometer counterclockwise till it is stopped by screws (2) and tighten screws.**
- **Apply thread-locked liquid to screws (2).**



SW654-09024



SW654-09001

③ Set throttle lever (3) to “IDOL”.
④ Loosen lock nut (4), and adjust engine rotational speed to standard value with stopper bolt (5).

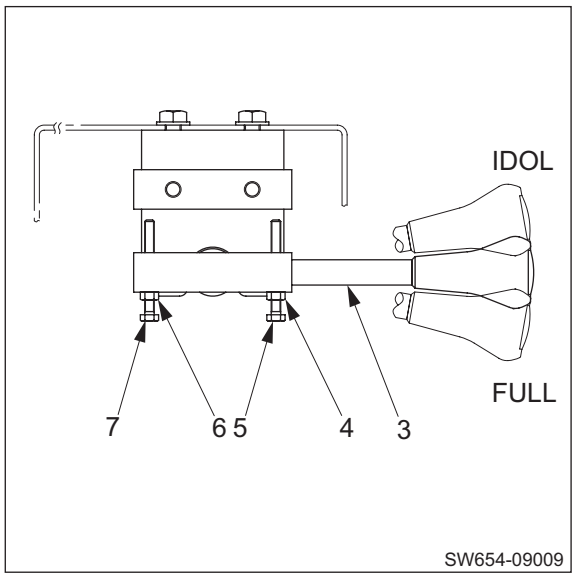
★ Engine rotational speed : 1,000 $^{0}_{-50}$ min^{-1}

- After adjustment, fix stopper bolt (5) with lock nut (4).

⑤ Set throttle lever to “FULL”.
⑥ Loosen lock nut (6), and adjust engine rotational speed to standard value with stopper bolt (7).

★ Engine rotational speed : 2,400 ± 50 min^{-1}

- After adjustment, fix stopper bolt (7) with lock nut (6).



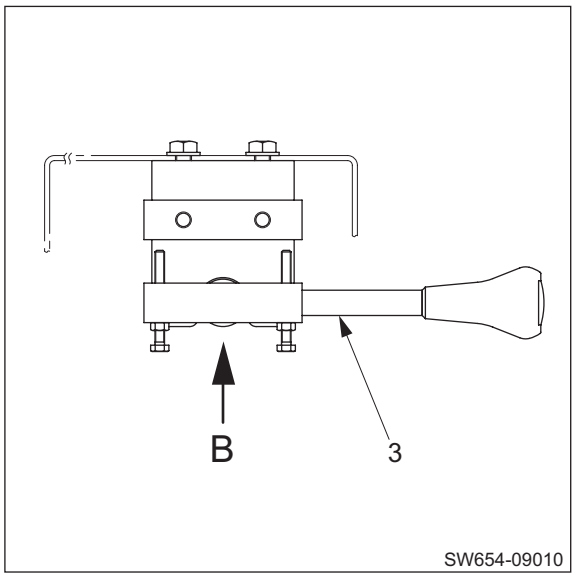
12-2. Adjustment of Operating Force

① Tighten nut (8) and set operating force at center of throttle lever (3) knob to standard operating force. Do not turn nut to the loosening direction.

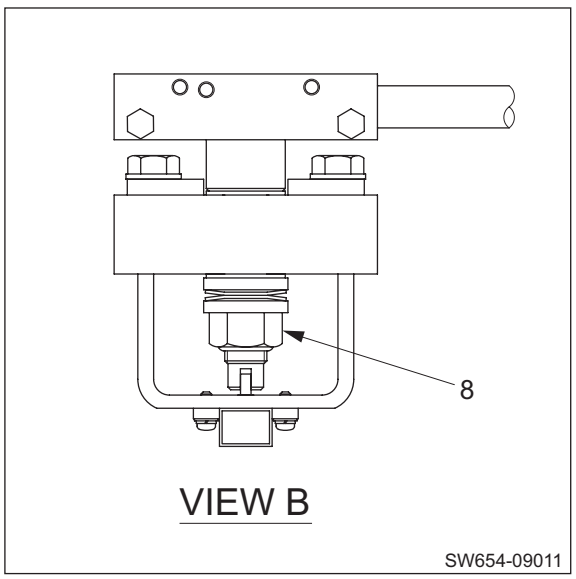
★ Standard operating force : 45 ± 10 N (10 ± 2 lbf)

(NOTICE)

- **In case of loosen nut (8), replace it with a new one.**



SW654-09010

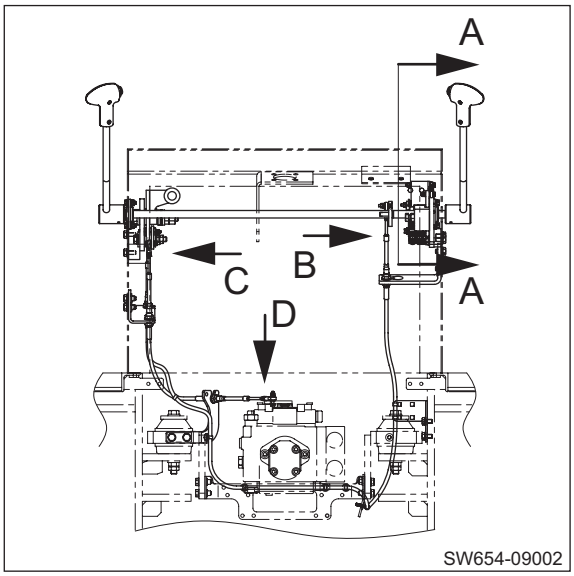


SW654-09011

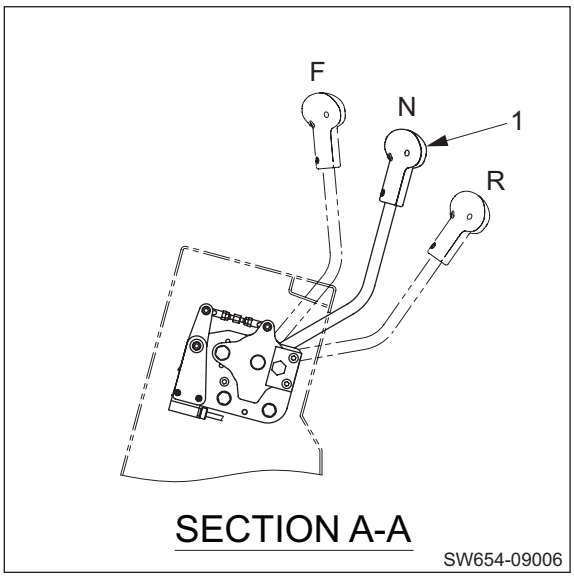
13. ADJUSTMENT OF F-R LEVER AND SHIFT LEVER

13-1. Adjustment of Linkage

- In cases such as propulsion pump is replaced, control cable is replaced, or F-R lever or shift lever does not move smoothly, make following adjustments.
- “N”, maximum “F”, and maximum “R” positions of F-R lever are positioned by notches.

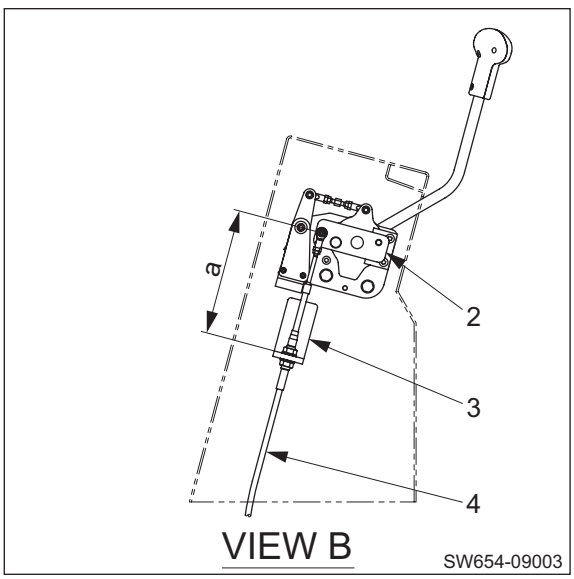


① Set F-R lever (1) to “N”.



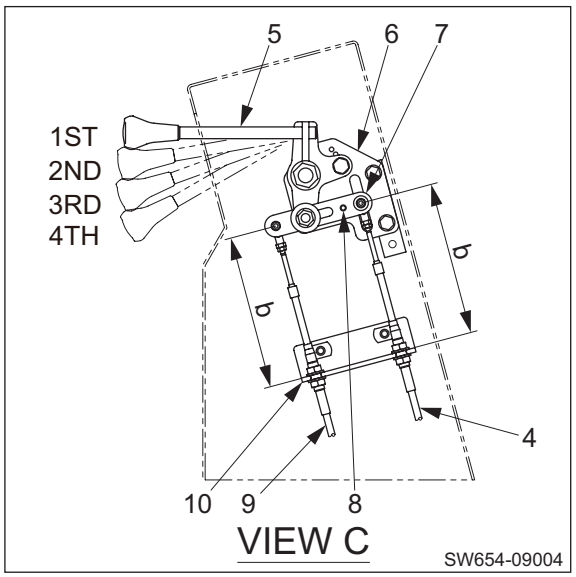
② Attach control cable (4) to shaft subassembly (2) and bracket (3).

★ Specified dimension a: 206 mm (8.1 in.)



• 1st, 2nd, 3rd, and 4th positions of shift lever (7) are positioned by notches.
③ Set shift lever to “1st”.
④ Align hole (8) in plate (7) with hole in base (6), and insert steel bar.
⑤ Attach control cables (4) and (9) to plate.
⑥ Attach control cables to bracket (10).

★ Specified dimension b: 209 mm (8.2 in.)

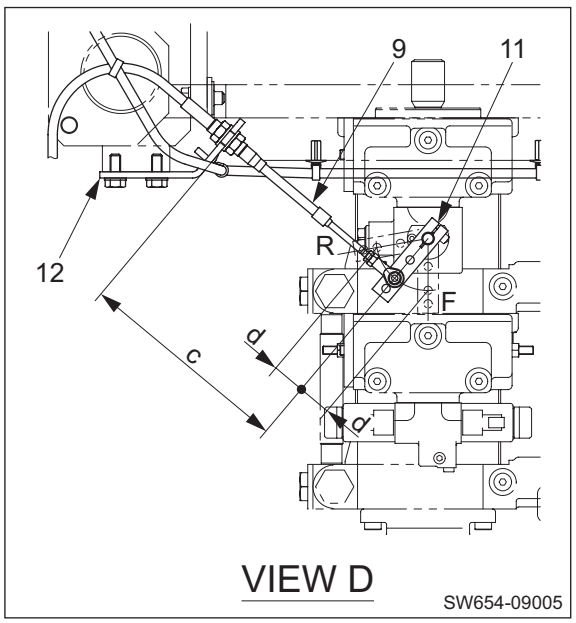


⑦ Fix propulsion pump control lever (11) at neutral position.
⑧ Attach control cable (9) to propulsion pump control lever and bracket (12).

★ Specified dimension c: 207 mm (8.1 in.)

⑨ Confirm the strokes “d” of propulsion pump control lever in each direction.

★ Specified dimension d: 1st 11 mm (0.43 in.)
2nd 16 mm (0.63 in.)
3rd 22 mm (0.87 in.)
4th 31 mm (1.22 in.)



13-2. Adjustment of Operating Force

13-2-1. Adjustment of F-R lever

① Loosen lock nut (15), and adjust bolt (16) so that operating force at center of F-R lever (1) knob matches standard operating force.

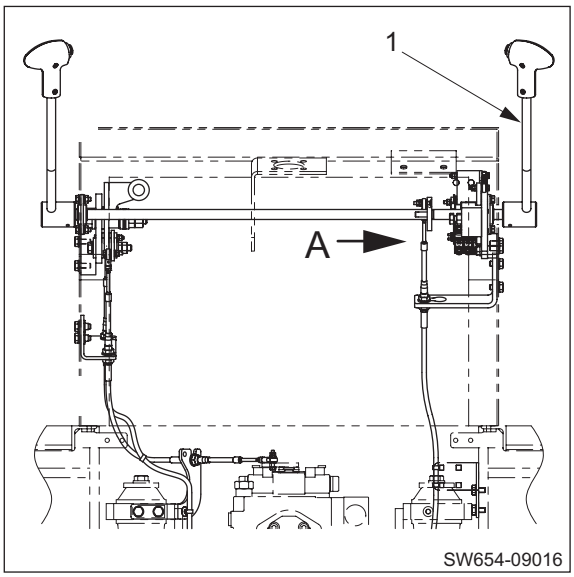
★ Standard operating force : 40 ± 10 N (9 ± 2 lbf)

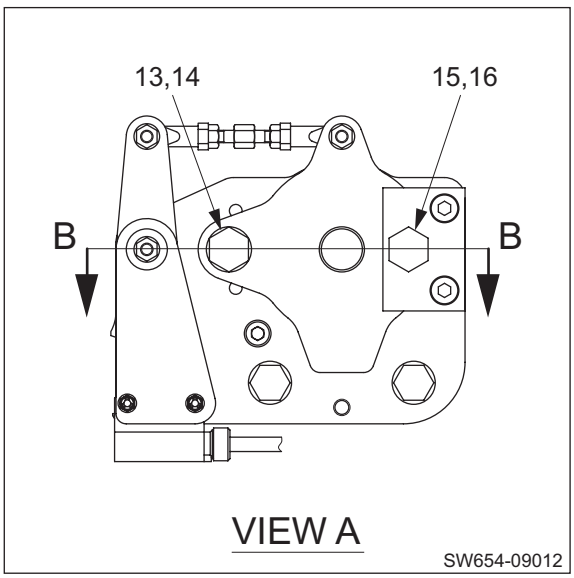
• After adjustment, fix bolt (16) with lock nut (15).

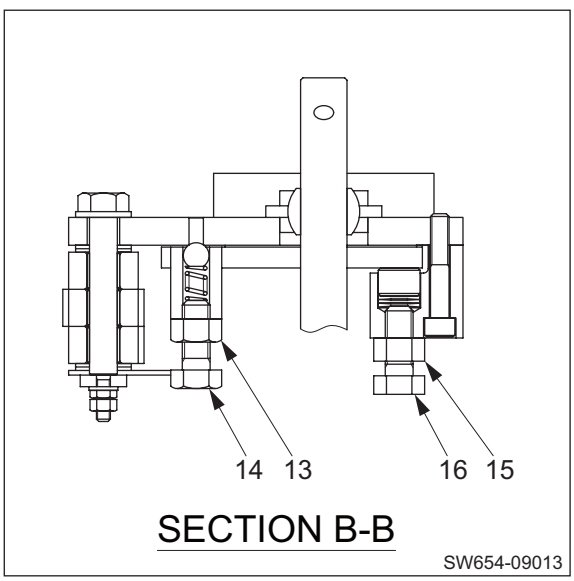
② Loosen lock nut (13), and adjust bolt (14) to match operating force of lever to standard operating force +5N, when getting over notch at center of F-R lever knob.

★ Operating force to move lever over notch
: 45 ± 10 N (10 ± 2 lbf)

• After adjustment, fix bolt (14) with lock nut (13).







13-2-2. Adjustment of shift lever

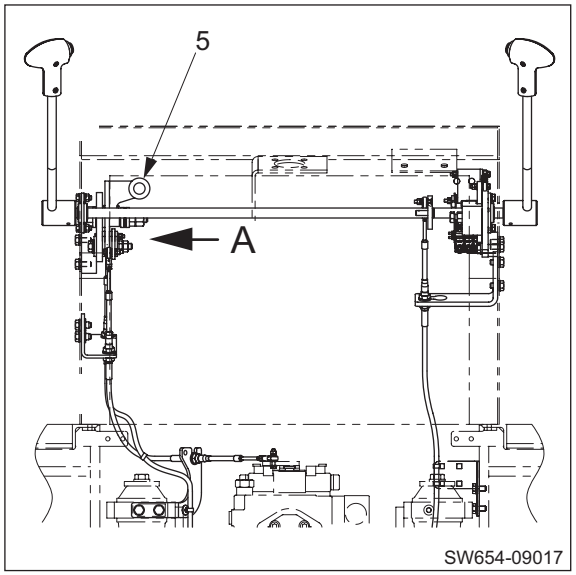
① Adjust nut (17) so that operating force at center of shift lever (5) knob matches standard operating force.

★ Standard operating force : 40 ± 10 N (9 ± 2 lbf)

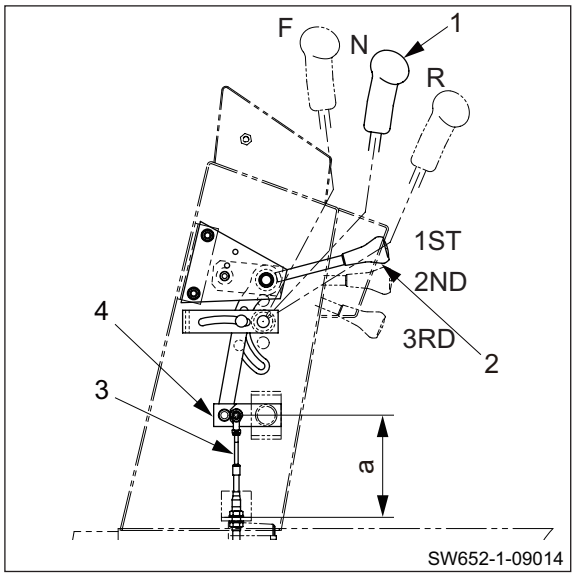
② Loosen lock nut (19), and adjust bolt (18) to match operating force of lever to standard operating force +5N, when getting over notch at center of shift lever knob.

★ Operating force to move lever over notch
: 45 ± 10 N (10 ± 2 lbf)

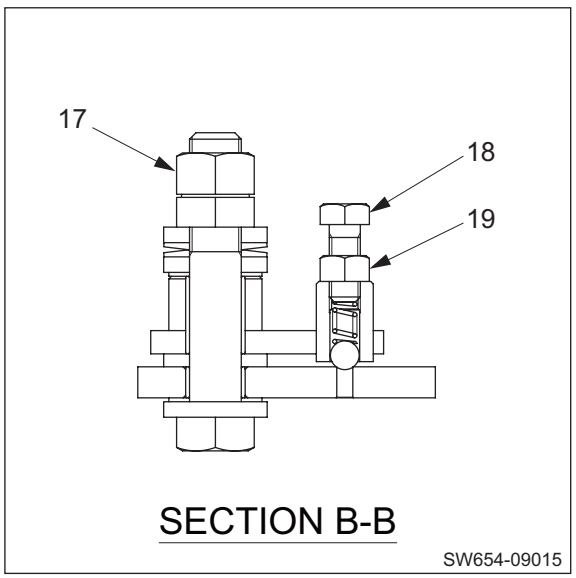
- After adjustment, fix bolt (18) with lock nut (19).



SW654-09017



SW652-1-09014



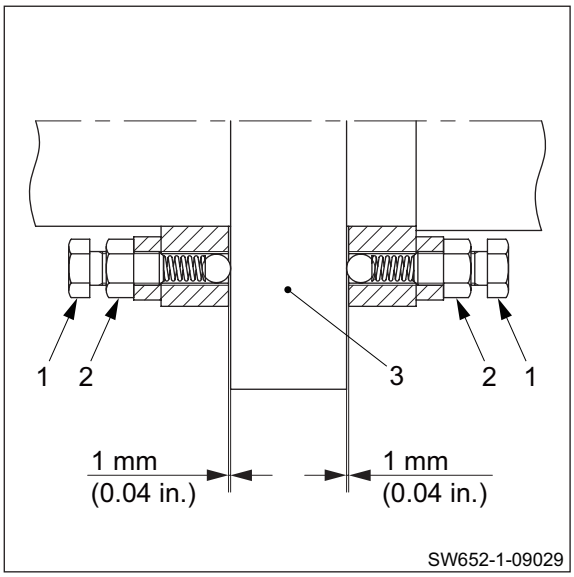
SW654-09015

14. MOVABLE WEIGHT ADJUSTMENT (SW654ND)

- When eccentric shaft is replaced, make adjustment as follows.
- Be sure to replace bolts (1) and nuts (2) with new ones as these are not allowed to reuse.

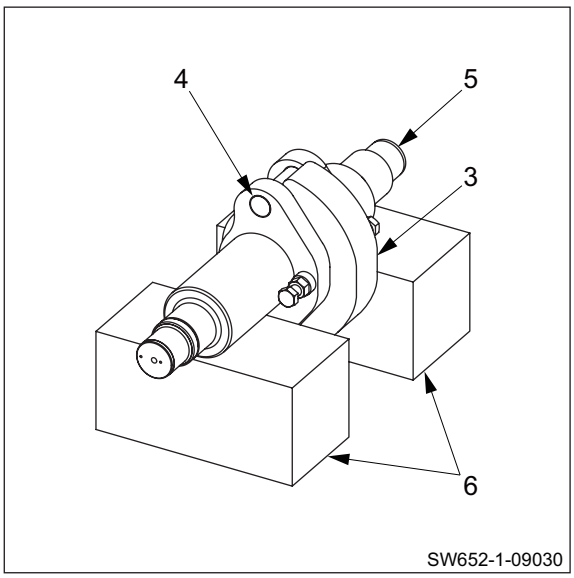
14-1. Adjustment

① Tighten bolts (1) until gaps at both sides of movable weight (3) becomes 1mm (0.04 in.) each.



SW652-1-09029

② Put eccentric shaft (5) on wooden blocks (6) with stopper (4) placed at top.
③ Put movable weight (3) against stopper (4).

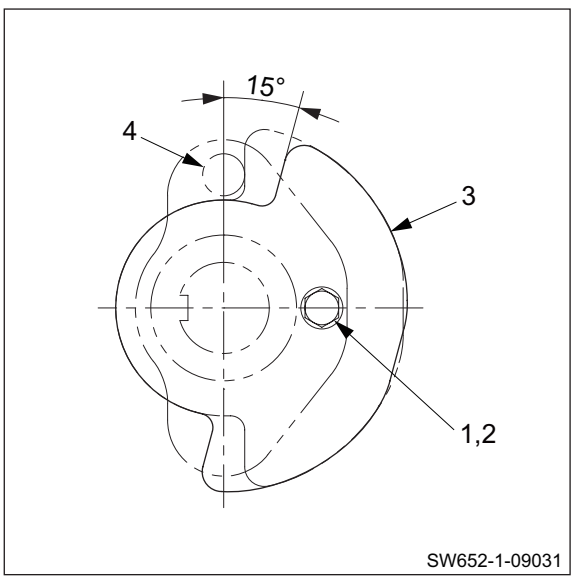


SW652-1-09030

④ Make sure that movable weight (3) starts to swing down by its own weight when movable weight is rotated away from stopper (4) by 15°.
⑤ If swinging does not start at 15°, adjust with bolts (1).
⑥ Securely lock with nuts (2).

(NOTICE)

- **After adjustment is made, be sure to caulk bolts (1) and nuts (2) to prevent turning.**).



SW652-1-09031

15. MEASUREMENT OF MACHINE HIGH/LOW SPEED CHANGE CIRCUIT PRESSURE (FROM 30143)

- Since oil in charge circuit is supplied from steering circuit, confirm that steering operation is normal before measurement.

15-1. Measurement

- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Disconnect hose (1) from propulsion motor. Attach pressure gauge through adapter ⓜ .
- Adapter ⓜ : G1/4
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Confirm that F-R lever is “N”.

③ Apply parking brake by pressing parking brake switch button.

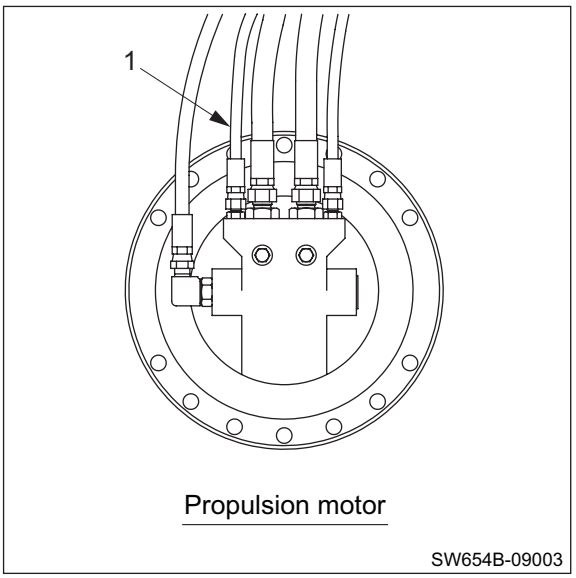
④ Set propulsion speed change switch to “”.

⑤ Start the engine and set throttle lever to “Full”.

⑥ Read pressure indicated by pressure gauge.

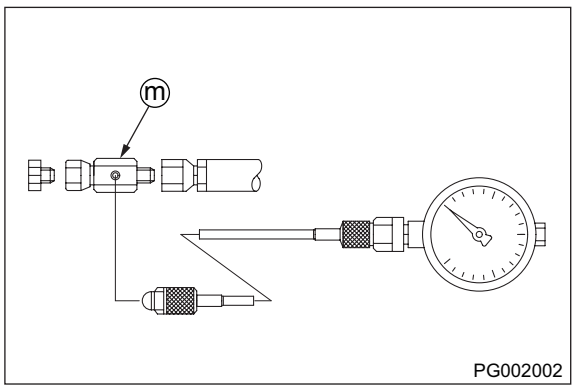
★ Standard charge relief valve setting

: 2.4 ± 0.2 MPa (348 ± 29 psi)



Propulsion motor

SW654B-09003



PG002002

16. MEASUREMENT OF PARKING BRAKE RELEASE PRESSURE (FROM 30143)

- Since oil in charge circuit is supplied from steering circuit, confirm that steering operation is normal before measurement.

16-1. Measurement

- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Disconnect hose (1) from propulsion motor. Attach pressure gauge through adapter ⓜ .
- Adapter ⓜ : G1/4
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Confirm that F-R lever is “N”.

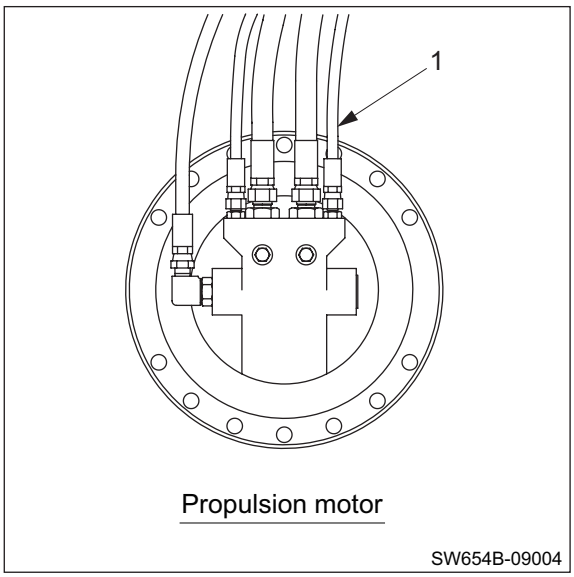
③ Apply parking brake by pressing parking brake switch button.

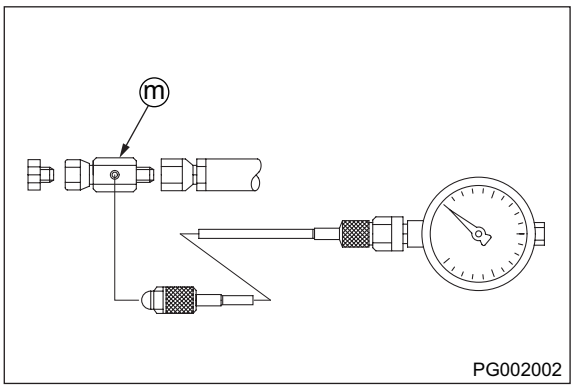
④ Start the engine and set throttle lever to “Full”.

⑤ Release parking brake by pressing parking brake switch button.

⑥ Read brake release pressure indicated by pressure gauge.

★ Brake release pressure : More than 1.5 MPa (218 psi)





17. MEASUREMENT OF PROPULSION MOTOR CASE PRESSURE (FROM 30143)

17-1. Measurement

- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Remove plug from drain port (1). Attach pressure gauge with adapter ⓔ .
- Adapter ⓔ : G3/4
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Confirm that F-R lever is “N”.

③ Apply parking brake by pressing parking brake switch button.

④ Set propulsion speed change switch to “🐢”.

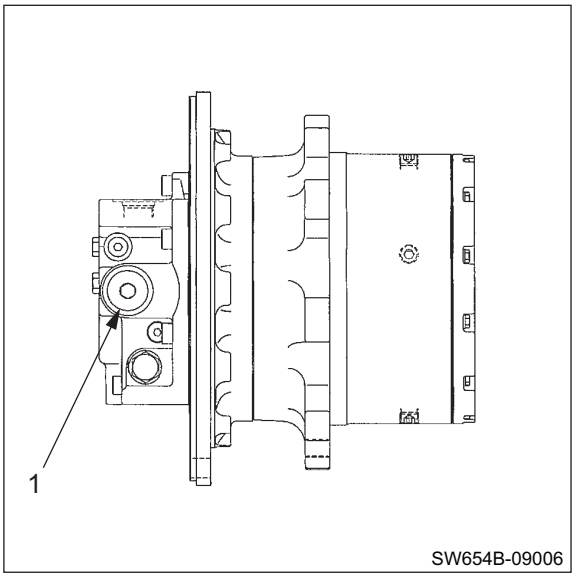
⑤ Set propulsion shift lever to “1st”.

⑥ Start the engine and set throttle lever to “Full”.

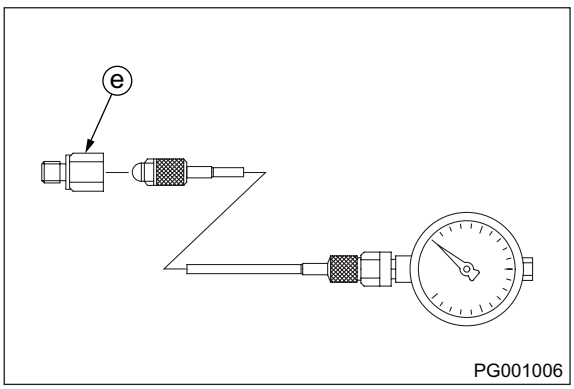
⑦ Establish a condition in which machine propulsion load becomes maximum.
(Pressure does not build up unless propulsion load is applied.)

⑧ With propulsion load at maximum, measure pressure when speed change switch is “🐢” and “🐇” and F-R lever is “N”, “F”, and “R”, respectively.

★ Allowable motor case pressure
: 0.3 MPa (43.5 psi) or less



SW654B-09006



PG001006

TROUBLESHOOTING

1. TROUBLESHOOTING

1-1. Safety Precautions for Troubleshooting

⚠ WARNING

Unexpected machine movement may cause a serious accident. When inspecting the machine while the engine is running, always follow the instructions below.

- **Park the machine on level, flat ground.**
- **Apply the parking brake.**
- **Set chocks in front and behind each drum or tire.**
- **Make sure that service personnel are given the appropriate information at the appropriate time.**
- **Make sure that no one can enter any hazardous area.**

⚠ CAUTION

Do not work on the hydraulic system while the engine is running and the system is hot and under pressure. Do not disconnect hydraulic hoses or fittings until the system has cooled and pressure has been properly relieved.

Before removing any plugs from the pressure measurement ports, always release any residual pressure from the piping and open the cap of the fluid tank to release and pressure.

⚠ WARNING

Inadvertent starting the engine may cause a serious accident.

When inspecting the engine, make sure to exchange the appropriate cues and hand signal with the person at the operator station to avoid any accidents.

⚠ CAUTION

Before inspecting inside of the engine compartment, always stop the engine.

Contact with the fan, V-belt or exhaust system parts while the engine is running may cause serious injury.

1-2. Important Information for Troubleshooting

Before conducting troubleshooting, it is important to carefully read the operation manual and workshop manual and understand the electric circuits for each component as well as the structure and function of each system. Sufficient knowledge of the systems will enable you to identify a possible cause much faster. A fault or problem may seem to be related to many different factors. To identify the true cause, some experience is needed. To perform the appropriate troubleshooting, it is important to learn not only the normal operations of the systems but also the possible symptoms that may occur when an abnormal condition is present.

This chapter explains the possible causes and remedies for likely incidents taken from past experience.

1-3. Before Starting

The information in this section is provided to assist the troubleshooter in understanding the systems and quickly determine the causes when operating abnormalities occur.

The following steps are recommended:

1. If not familiar with the machine, study the Operator's Manual and this Shop Manual.
2. Check with the operator for full details of the trouble, ask questions.
3. Verify the trouble by warming up the machine and operating it. Check the problem yourself.
4. Identify the problem with either a mechanical, hydraulic or electrical system source.
5. Isolate the problem to a particular component or circuit.
6. Eliminate the simplest or easiest to check possibilities first to prevent unnecessary disassembly of components.
7. Following repair or replacement of any parts, perform operational tests to verify that the problem has been eliminated and the performance of all the systems is normal.

2. ELECTRICAL SYSTEM TROUBLESHOOTING

2-1. When Performing Electrical System Fault Diagnosis

⚠ WARNING

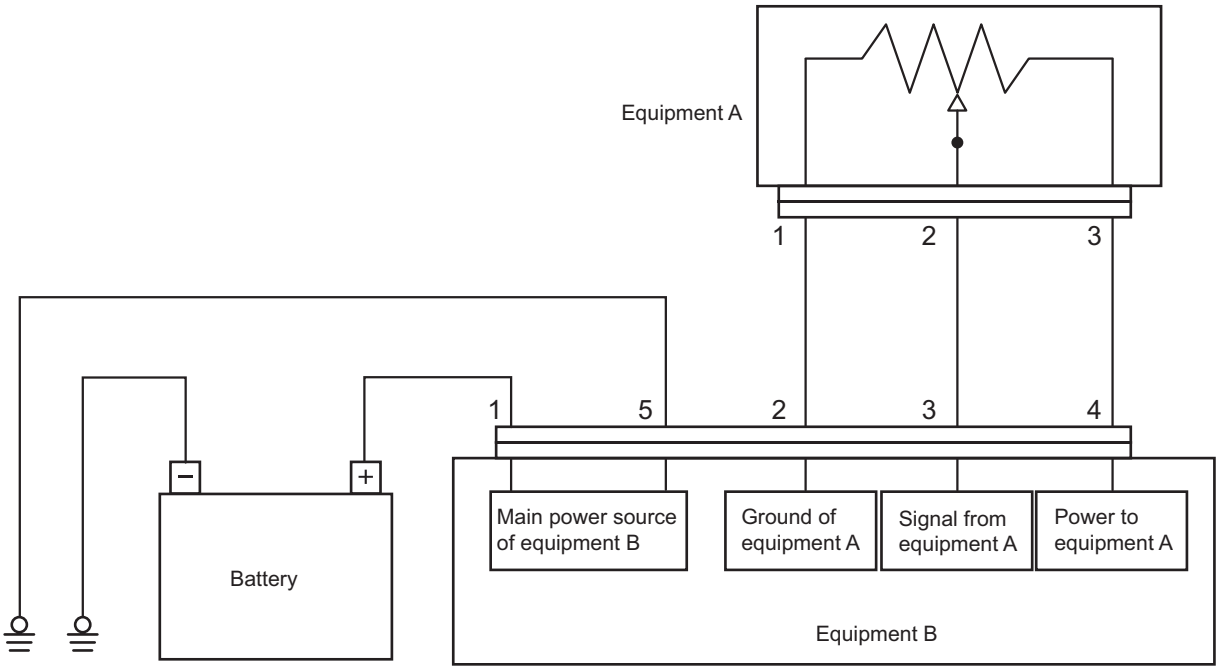
Be very careful because equipment can return to normal during an inspection and suddenly operate properly when a failure occurs due to a faulty contact or other such cause.

2-1-1. Precautions to take during electrical circuit fault diagnosis

- When disconnecting or connecting a connector, be sure to turn the power supply OFF. (Electronic control parts such as the engine control unit, in particular, could be damaged internally.)
- Since connectors are not numbered, be sure to affix alignment marks so that you can restore them to their original condition.
- Before making a diagnosis, check related connectors for faulty connections. (Check by disconnecting and reconnecting related connectors several times.)
- Before proceeding to the next step, be sure to return the disconnected connectors to their original condition.
- When diagnosing a circuit (measuring the voltage, resistance, continuity and current), move related wiring and connectors several times, and check whether the tester’s numerical values change. (If values change, faulty contact in the circuit is possible.)
- Do not ground the circuit of the control unit or apply voltage to it unless otherwise specified.
- For information of wire number, wire size, and wire color used in the sample circuit diagrams, refer to "1-1. Wire Numbers, Wire Sizes, Wire Colors and Connectors Shown in Electrical Circuit Diagram, Wiring Harness Layout and Wiring Harnesses" (P.5-001).

2-1-2. Inspection procedures using a tester

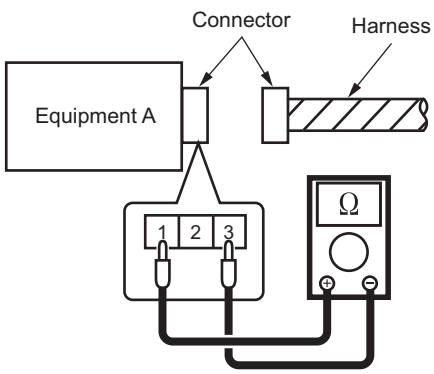
Some of the various inspection procedures are presented here for reference, using a sample circuit below.

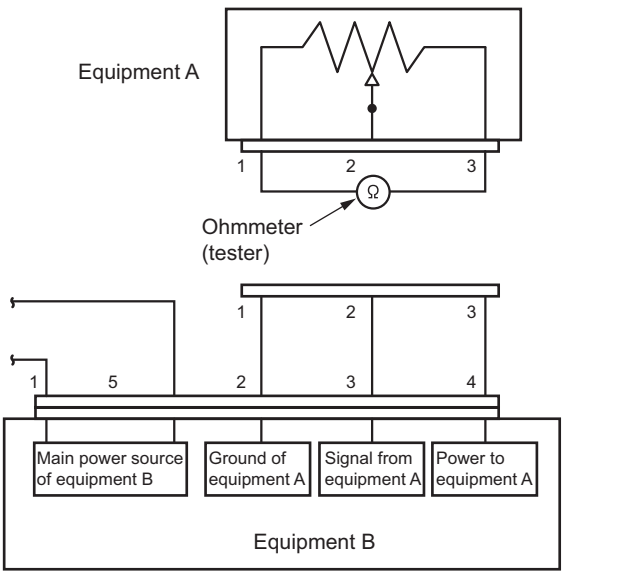


TS-10001

1) Measuring resistance using tester

1-1) Measuring resistance of equipment A (measuring resistance between terminals 1 and 3)





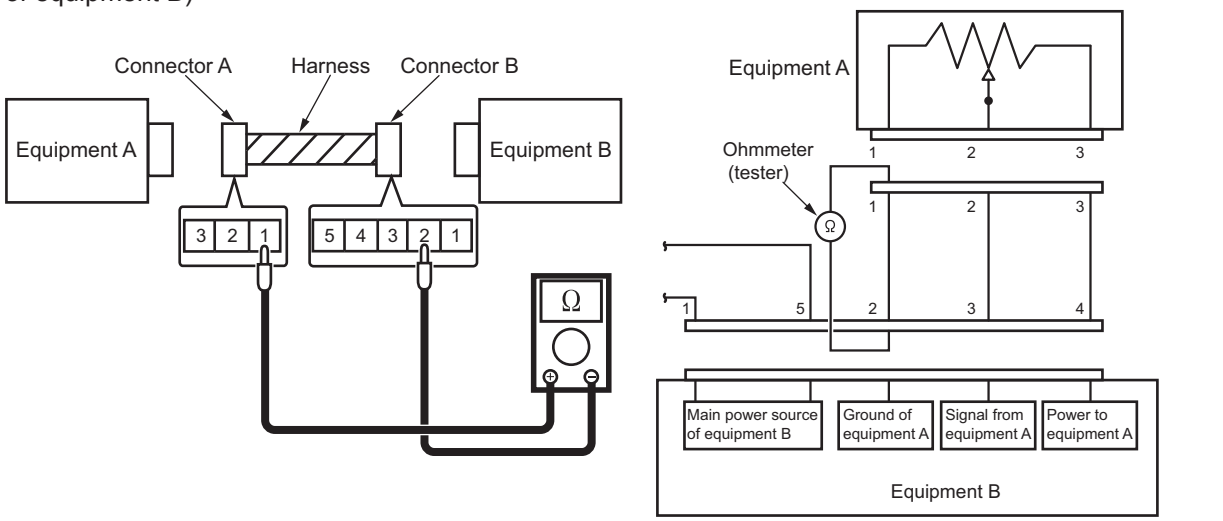
TS-10002

Inspection procedure

① Disconnect the connector of equipment A.

② Connect the test probe (+) to connector terminal 1 of equipment A and the test probe (-) to connector terminal 3 of equipment A and measure the resistance. At this time, reversing the connector terminals between the probes (+) and (-) does not make any difference in the measurement.

1-2) Measuring resistance of harness (measuring resistance between terminal 1 of equipment A and terminal 2 of equipment B)



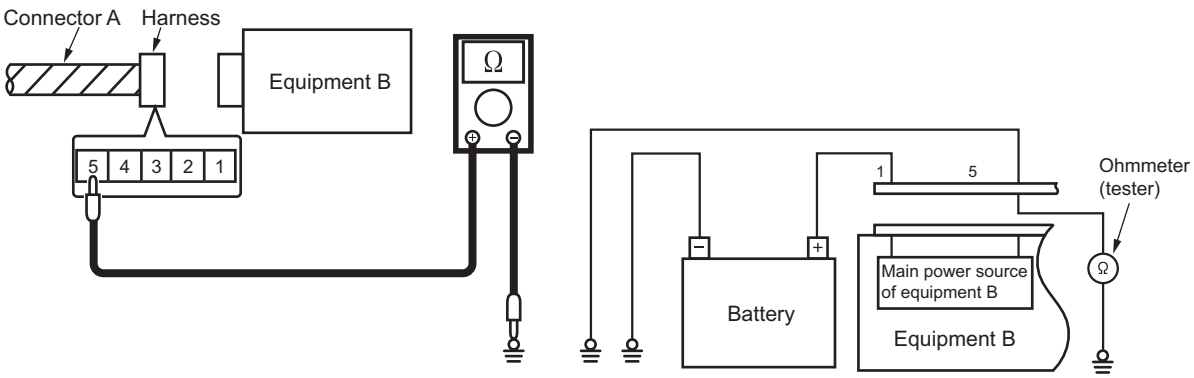
TS-10003

Inspection procedure

① Disconnect the connectors of equipment A and equipment B.
② Connect the test probe (+) to connector terminal 1 of equipment A and the test probe (-) to connector terminal 2 of equipment B and measure the resistance. At this time, reversing the connector terminals between the probes (+) and (-) does not make any difference in the measurement.

Criteria for harness defects
When there is no abnormality in the harness: Less than 10 Ω (measured value)
If there is any abnormality in the harness such as broken wire: 10 Ω or higher (measured value)

1-3) Measuring resistance of grounding wire (measuring resistance between terminal 5 of equipment B and ground)



TS-10004

Inspection procedure

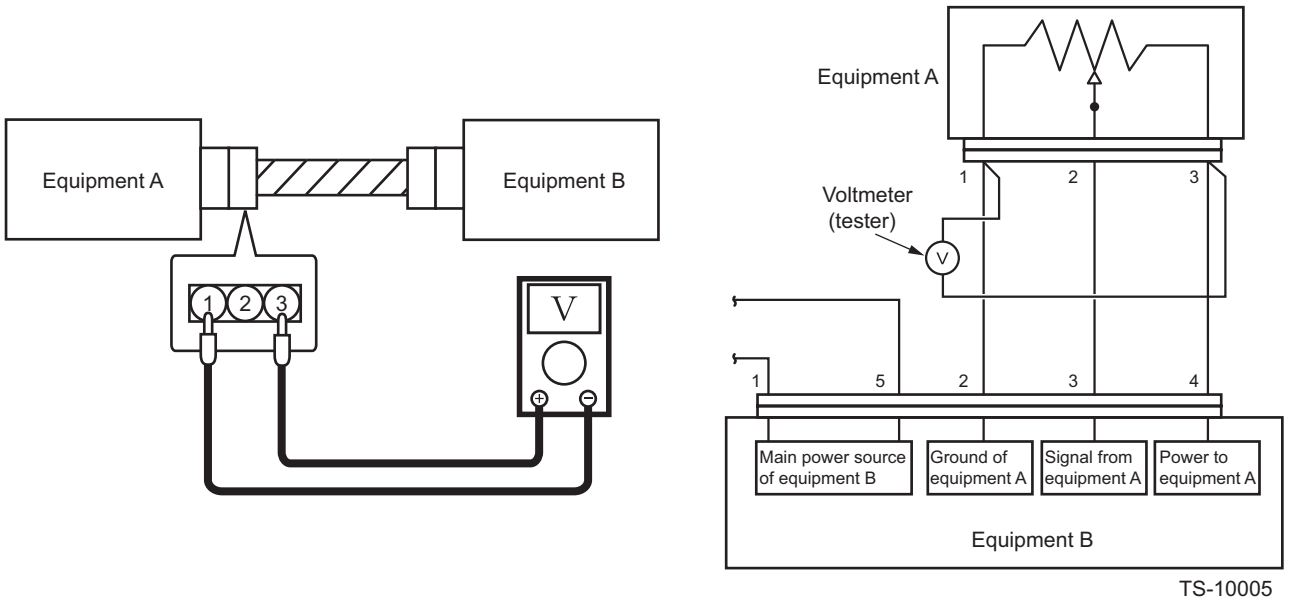
① Disconnect the connector of equipment B.
② Connect the test probe (+) to connector terminal 5 of equipment B and the test probe (-) to a machine ground point (the bolt fastening the ground terminal or an unpainted portion on the body) and measure the resistance. At this time, reversing the connector terminals between the probes (+) and (-) does not make any difference in the measurement.

(NOTICE)

- **When measuring the resistance, connect the test probes to both ends of the portion to be measured. Make also sure that no voltage is applied to the portion to be measured.**
- **When measuring the internal resistance of equipment, be sure first to disconnect all harnesses from the equipment.**
- **When measuring the resistance of a harness, disconnect the equipment connected to both ends of the harness.**

2) Measuring voltage and current flowing using tester

2-1) Measuring voltage of equipment A (measuring voltage between terminals 1 and 3)



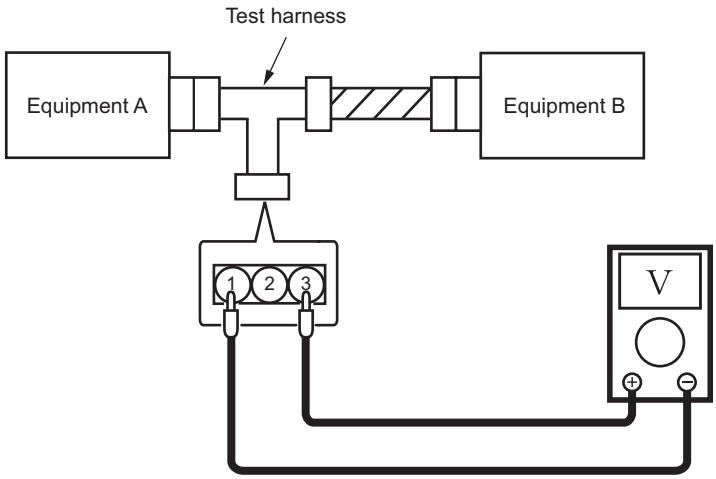
TS-10005

Inspection procedure

① Connect the connectors of equipment A and that of equipment B.

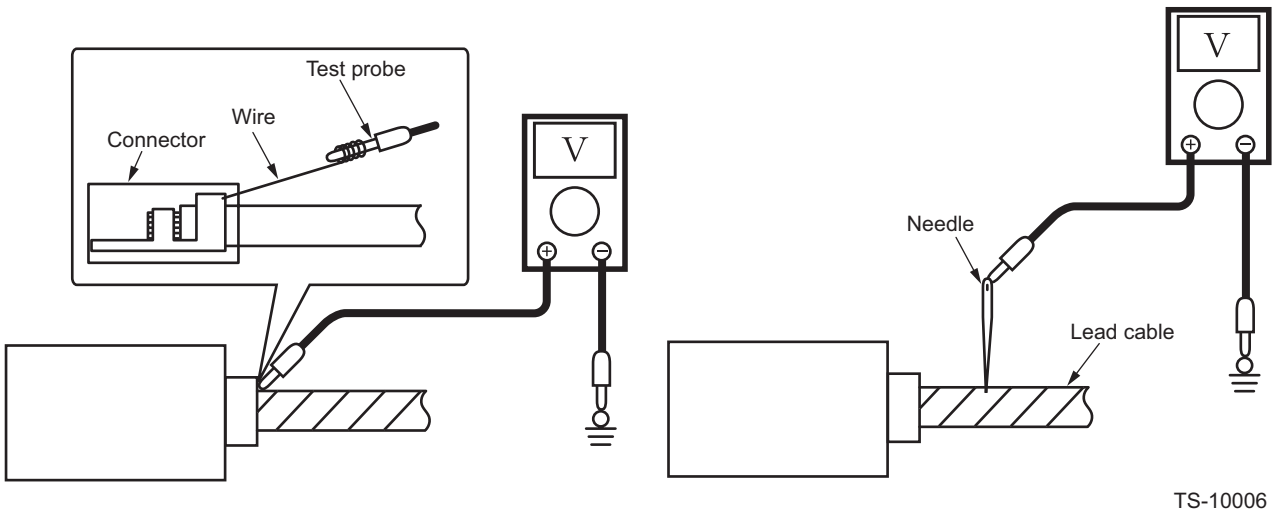
② Connect the test probe (+) to connector terminal 3 of equipment A and the test probe (-) to connector terminal 1 of equipment A and measure the voltage. Note that reversing the connector terminals between the probes (+) and (-) changes the result of the measurement. Be sure to connect the probe (+) to the power source side and the probe (-) to the ground side.

・Measurement using a test harness



・Measurement from the backside of connector

・Measurement on a lead cable



Measurement method

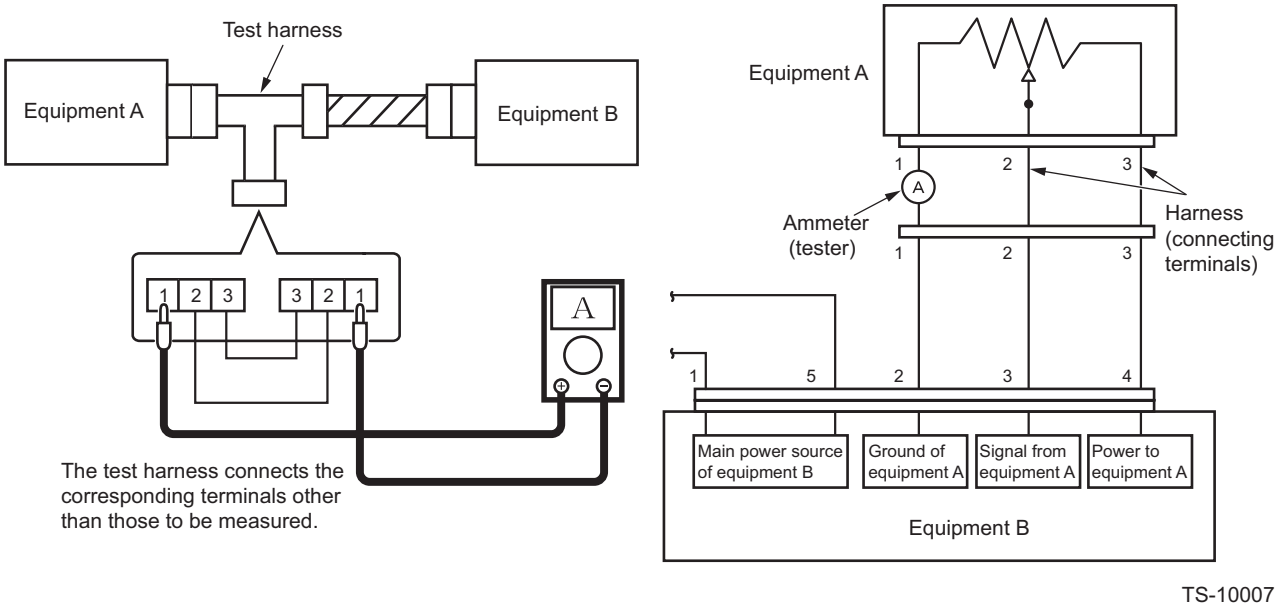
For measurement of voltage, connect the tester probes in parallel to the portion to be measured. Because the voltage can be measured only when the connector is connected in position, contact the tester probes to the terminals without disconnecting the connector. The following methods are available:

- Measurement using a test harness
  Prepare the test harness for the measurement.
- Measurement from the backside of connector
  Insert a wire from the backside of the connector.
- Measurement on a lead cable
  Remove the bundling tape from the harness to separate each cable, and stick the needle into the relevant cable.

(NOTICE)

- **Except for preparing the test harness, proper protection must be made after the measurement to prevent corrosion in the connector terminals or harnesses.**

2-2) Measuring current flowing from equipment B to equipment A
(measuring current between terminal 2 of equipment B and terminal 1 of equipment A)



TS-10007

Inspection procedure

① Disconnect the connector of equipment A and connect the test harness.

② Connect the test probe (+) to connector terminal 1 (harness side) of equipment A and the test probe (-) to connector terminal 1 (equipment side) of equipment A and measure the current. Note that reversing the connector terminals between the probes (+) and (-) changes the result of the measurement. Be sure to connect the probe (+) to the power source side and the probe (-) to the ground side.

Measurement method

When measuring the current, connect the tester in series to the portion to be measured. Because the current cannot be measured when the connector is connected in position, disconnect the connector to allow the test probe to connect between the terminals.

2-1-3. Inspection of electrical system

Operate the applicable switches and turn the relays ON and OFF. Ultimately, if the solenoid valve operates (makes a sound) and the pump runs, the electrical system is OK.
If there is a failure (fault), narrow the range of the inspection to the six broad steps described below.

1) Ground inspection
- Check for disconnected or loose ground. If rust or corrosion is present (which can cause faulty contact), remove the rust.

2) Fuse inspection

2-1) Check for blown fuses, disconnections and corrosion. (A fatigue open circuit cannot be identified visually. Use a tester for checking.)

2-2) If a fuse is blown
Check whether a pump or valve (that is supposed to be protected by a blown fuse) burned, and whether there is a burning odor.
Especially if the pump and valve are not burned, check the harness for signs of burning. If it is burned, replace it.
If a fuse is blown and a relay along the pathway has failed, replace it. And if there is a timer, replace the timer, too. If a switch visually appears to be unsatisfactory (burned, melted, etc.) even though it operates, replace it.
- Simply replacing a fuse may not eliminate the true cause of a problem, and over current may flow again. Also, if over current secondarily causes an electrical path to fail (such as a wiring meltdown inside a solenoid valve), current will not flow. Thus, a fuse may not be blown out, but it also will not operate. If you do not know the location of burning or of an odor, investigate as described follows.

2-3) How to find cause of failure when fuse blown is reproduced
① Turn the starter switch OFF, and remove the connector from the load (valve, pump).
② Referring to the circuit diagram, remove electrical parts that are connected to the circuit, such as relays, timers and diodes.
③ Turn the starter switch ON, and see whether the conditions can be reproduced (fuse is blown).
④ If a fuse is blown, a part such as a relay may have caused a short between the previous harness and ground (vehicle body). (Replace the harness.) If the conditions are not reproduced, check for signs of burning (odor) on the removed electrical parts.
⑤ If there is no problem, turn the starter switch OFF and reattach the parts.
⑥ Turn the starter switch ON and try again.
⑦ If a fuse is blown with this action, the problem was caused by a short between the harness and ground (vehicle body) that followed the attached electrical part. (Replace the harness.)
⑧ If the conditions are not reproduced, turn the starter switch OFF, and connect the loads (valve and pump) one at a time. Turn the starter switch ON and try again to see whether the fuse blown is reproduced.
⑨ If the fuse blown is reproduced, whatever was added at that time (including a harness added electrically) will be the cause of the failure.
- Even if the fuse is not blown and the valve or pump is not burned, the valve or pump may be damaged electrically and may not operate. There may simply be a disconnection in the interior or an abnormal heat-up.
- Even if the fuse is not blown, abnormal heat-up (hot enough to cause burns if touched) may occur if a relay, timer, diode or other semiconductor fails.

3) Connector inspection
- Is a connector disconnected or loose?
- Check that pins are not snapped or corroded.
- If faulty contact is suspected
  Turn the starter switch OFF. Then disconnect and check the connectors (including relay and switch sockets).
  If the terminal has no luster, faulty contact due to oxidation can be suspected. Therefore, polish the terminal by inserting and removing the connector (relay, switch) repeatedly at least five times. (Luster will return.)

4) Relay inspection (Check ON/OFF operation by sound.)
- Conduct without running the engine. (If you run the engine, you cannot hear the sound of operation.)
  Sound heard : A relay failure occurred.
  No sound heard : Using a tester, check the harness.
  Sound heard : A relay failure occurred.
  Still no sound : Using a tester, check the harness.
  Continuity : Turn the starter switch OFF temporarily, disconnect the relay and check for continuity between the harness-side grounding terminal (color: black) and vehicle body ground. (If there is none, replace the harness.)
  Voltage : With the relay disconnected, turn the starter switch ON and turn the operating switch ON. 24 V (or 12 V) (between vehicle body ground) should not reach the relay coil input terminal. Confirm this. Identify the location (section) to which 24 V (or 12 V) reaches. Then replace the harness or take other action.

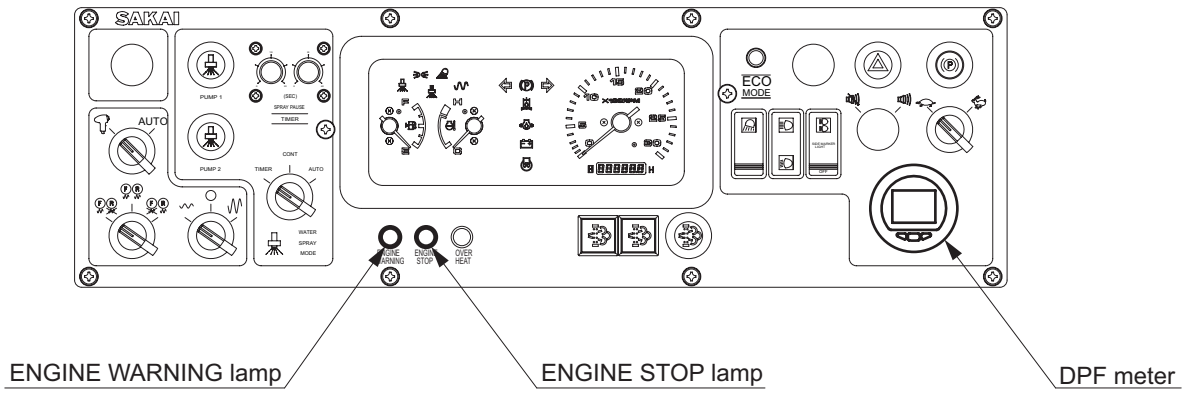
5) Solenoid valve inspection (Check ON/OFF operation by sound.)
- Conduct without running the engine. (If you run the engine, you cannot hear the sound of operation.)
  Sound heard : The electrical system is normal.
  No sound heard : Check with a tester.
  Continuity : ① Turn the starter switch OFF temporarily, disconnect the connector and check for continuity between the harness-side grounding terminal (color: black) and vehicle body ground. (If there is none, replace the harness.)
  : ② Is the solenoid valve coil burnt?
  (Turn the starter switch OFF, disconnect the connector and check the resistance between the solenoid valve terminals.)
  Voltage : With the connector disconnected, turn the starter switch ON and check whether 24 V (or 12 V) exists between the harness-side connector and vehicle body ground.
  If YES : Replace the valve.
  If NO : Investigate and identify the location (section) to which 24 V (or 12 V) reaches. Then replace the harness or take other action.

6) Harness check
- If an incomplete disconnection inside the harness is suspected, wiggle (move) the harness during the relay inspection and solenoid valve inspection to see whether the relay (valve) operates incorrectly.
- Check for burned areas of the harness.
- Turn the starter switch OFF, disconnect the connector and check the continuity, referring to the circuit diagram and wiring coloring.

2-2. Engine Diagnosis Trouble Code

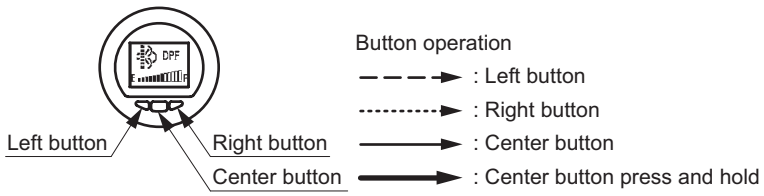
2-2-1. Description of diagnostic trouble code (DTC)

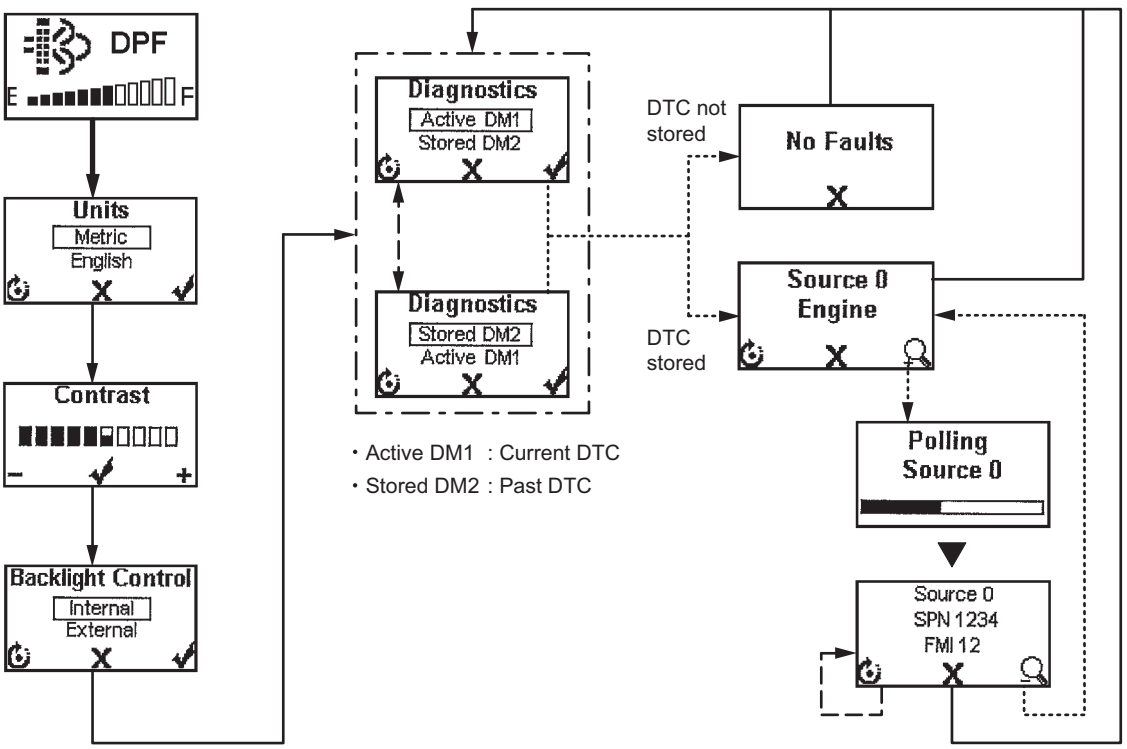
- When the engine warning lamp or engine stop lamp illuminates, the DPF meter is used to display a DTC (diagnostic trouble code).



SW654-10001

1) DTC display procedure using the DPF meter
   - A current or past DTC stored in the engine control unit (ECU) is displayed on the DPF meter by switching its display as described in the diagram below.





DPF-10010

2-2-2. Table of the diagnostic trouble code (DTC)

J1939-73		Description	DTC Description	Diagnosis
SPN	FMI			
29	3	Accelerator pedal or lever position sensor-2 abnormal	Accelerator sensor-2 High	• Short circuit in sensor/harness power supply
	4		Accelerator sensor-2 Low	• Open circuit in sensor/harness, ground fault
91	2	Accelerator pedal or lever position sensor property abnormal	Accelerator pedal sensor property abnormal	• Sensor output of two systems excessively different
	3	Accelerator pedal or lever position sensor-1 abnormal	Accelerator sensor-1 High	• Short circuit in sensor/harness power supply
	4		Accelerator sensor-1 Low	• Open circuit in sensor/harness, ground fault
100	1	Oil pressure decrease	Engine oil pressure decrease	• Engine oil pressure switch activated
102	3	Boost pressure sensor abnormal	Boost pressure sensor High	• Open circuit in sensor/harness, +B short-circuited • Sensor failure
	4		Boost pressure sensor Low	• Short circuit in sensor/harness ground • Sensor failure
108	3	Atmospheric pressure sensor abnormal	Atmospheric pressure sensor High	• Short circuit in sensor/ECU internal circuit +B
	4		Atmospheric pressure sensor Low	• Short circuit in sensor/ECU internal circuit ground
110	0	Overheat	Engine overheat	• Engine water temperature abnormally high
	3	Water temperature sensor abnormal	Water temperature sensor High	• Open circuit in sensor/harness, +B short-circuited
	4		Water temperature sensor Low	• Short circuit in sensor/harness ground
132	1	Intake air shortage (Turbo blower IN hose disconnected)	Intake air shortage (Turbo blower IN hose disconnected)	• Intake air shortage (Turbo blower IN hose disconnected)
	3	Mass air flow (MAF) sensor abnormal	Mass air flow (MAF) sensor High	• Short circuit in sensor/harness +B
	4		Mass air flow (MAF) sensor Low	• Open circuit in sensor/harness, ground fault
	15	Turbo boost increase insufficient (Blow out: Hose between intake flanges disconnected)	Turbo boost increase insufficient (Blow out: Hose between intake flanges disconnected)	• Turbo blow out: Hose between intake flanges disconnected (abnormal)
157	0	Rail pressure abnormally high	Rail pressure abnormally high	• Actual pressure exceeds command pressure. (When detected high pressure exceeding specified pressure range)
	3	Rail pressure sensor abnormal	Rail pressure sensor High	• Open circuit in sensor/harness, +B short-circuited • Sensor failure
	4		Rail pressure sensor Low	• Short circuit in sensor/harness ground • Sensor failure

J1939-73		Description	DTC Description	Diagnosis
SPN	FMI			
168	3	Battery voltage abnormal	Battery voltage High	• Open circuit, short circuit, or breakage in harness • Battery abnormal
	4		Battery voltage Low	• Open circuit, short circuit, or breakage in harness • Battery abnormal
171	3	Intake air temperature sensor (with built-in mass air flow sensor) abnormal	Intake air temperature sensor (with built-in mass air flow sensor) High	• Open circuit in sensor/harness, +B short-circuited
	4		Intake air temperature sensor (with built-in mass air flow sensor) Low	• Short circuit in sensor/harness ground
172	0	Intake air temperature abnormally high (Intercooler model only)	Intake air temperature abnormally high	• Intake air temperature abnormally high
	3	Intake air temperature sensor abnormal	Intake air temperature sensor High	• Open circuit in sensor/harness, +B short-circuited
	4		Intake air temperature sensor Low	• Short circuit in sensor/harness ground
174	0	Fuel temperature abnormally high	Fuel temperature abnormally high	• Fuel temperature abnormally high
	3	Fuel temperature sensor abnormal	Fuel temperature sensor High	• Open circuit in sensor/harness, +B short-circuited
	4		Fuel temperature sensor Low	• Short circuit in sensor/harness ground
190	0	Overrun	Engine overrun	• Engine speed exceeds specified speed
628	2	ECU flash ROM and CPU abnormal	ECU flash ROM abnormal	• Monitoring of unauthorized alteration of internal flash ROM
633	7	Pressure limiter valve opening abnormal	Pressure limiter valve opening abnormal	• Pressure limiter valve opening abnormal
636	2	Crankshaft position sensor (NE sensor) abnormal	NE sensor pulse count abnormal	• Open circuit in sensor/harness, short-circuited • Sensor failure
	7	NE-G phase shift	NE-G phase shift failure	• Phase shift between NE pulse and G pulse excessive
	8	Crankshaft position sensor (NE sensor) abnormal	NE sensor pulse not inputted	• Open circuit in sensor/harness, short-circuited • Sensor failure
651	3	Open circuit in TWV driving system	Injector of 1st engine cylinder (TWV1): Open circuit in harness/coil	• Open circuit in harness • Open circuit in injector coi
652	3		Injector of 2nd engine cylinder (TWV4): Open circuit in harness/coil	
653	3		Injector of 3rd engine cylinder (TWV2): Open circuit in harness/coil	
654	3		Injector of 4th engine cylinder (TWV3): Open circuit in harness/coil	

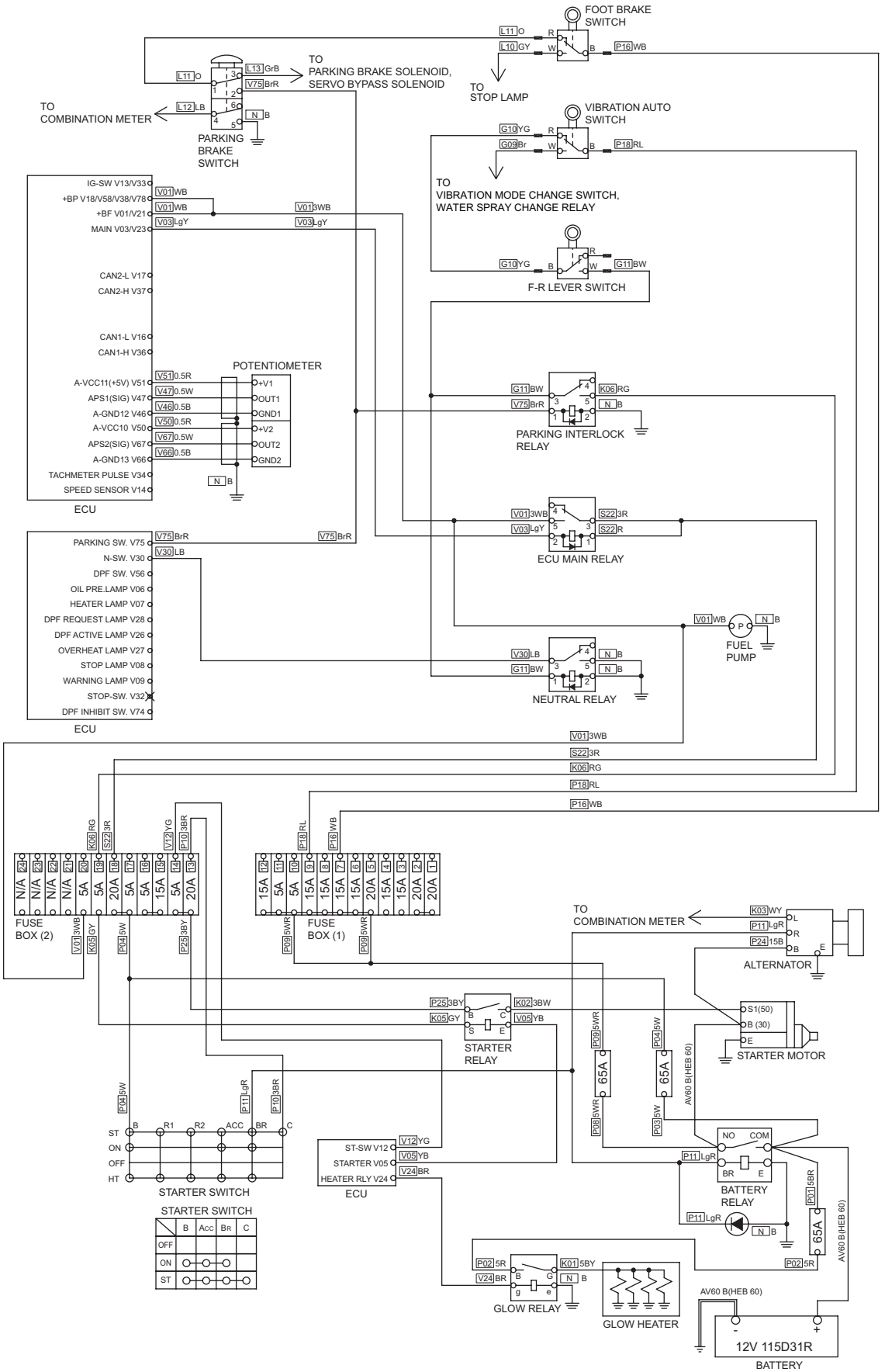
J1939-73		Description	DTC Description	Diagnosis
SPN	FMI			
723	2	Camshaft position sensor (G sensor) abnormal	G sensor pulse count abnormal	• Open circuit in sensor/harness, short-circuited • Sensor failure
	8		G sensor pulse not inputted	
1077	2	ECU flash ROM and CPU abnormal	ECU CPU abnormal (main IC abnormal)	• CPU failure
1239	1	Fuel leakage (high pressure fuel system)	Fuel leakage (high pressure fuel system)	• Fuel leakage from high pressure fuel system (when detected excessive fuel consumption, calculating from difference of fuel rail pressure before and after fuel injection)
1347	3	SCV abnormal	SCV +B short-circuit	• Short circuit in SCV +B
	4		SCV driving system abnormal	• Open circuit in SCV, ground fault
	7	SCV sticking	SCV sticking diagnosis	• SCV sticks while open (when detected condition that actual rail pressure constantly exceeds command rail pressure)
1485	2	Main relay abnormal	Main relay abnormal	• Main relay failure
3242	0	Exhaust temperature rise abnormal T1	Exhaust temperature rise abnormal T1	• DPF inlet temperature (T1) abnormally high
	3	Exhaust temperature sensor 1 (T1: DOC outlet) abnormal	Exhaust temperature sensor 1 (T1: DOC outlet) High	• Open circuit in sensor/harness, +B short-circuited
	4		Exhaust temperature sensor 1 (T1: DOC outlet) Low	• Short circuit in sensor/harness ground
3246	0	Exhaust temperature rise abnormal T2	Exhaust temperature rise abnormal T2	• DPF outlet temperature (T2) abnormally high
	3	Exhaust temperature sensor 2 (T2: DPF outlet) abnormal	Exhaust temperature sensor 2 (T2: DPF outlet) High	• Open circuit in sensor/harness, +B short-circuited
	4		Exhaust temperature sensor 2 (T2: DPF outlet) Low	• Short circuit in sensor/harness ground
3251	3	Differential pressure sensor abnormal	Differential pressure sensor abnormal High	• Open circuit in sensor/harness, +B short-circuited
	4		Differential pressure sensor abnormal Low	• Short circuit in sensor/harness ground
3252	0	DOC reaction abnormal (exhaust gas abnormal)	DOC reaction abnormal (exhaust gas abnormal)	• DOC temperature abnormally high due to unburned gas
3509	3	Sensor voltage 1 abnormal	Sensor supply voltage 1 High	• Sensor supply voltage 1 abnormal or recognition abnormal
	4		Sensor supply voltage 1 Low	
3510	3	Sensor supply voltage 2 abnormal	Sensor supply voltage 2 High	• Sensor supply voltage 2 abnormal or recognition abnormal
	4		Sensor supply voltage 2 Low	
3701	0	PM accumulation abnormal level 5	PM accumulation abnormal level 5	• PM (estimated) accumulation quantity excessive level 5
	15	PM accumulation abnormal level 3	PM accumulation abnormal level 3	• PM (estimated) accumulation quantity excessive level 3
	16	PM accumulation abnormal level 4	PM accumulation abnormal level 4	• PM (estimated) accumulation quantity excessive level 4

J1939-73		Description	DTC Description	Diagnosis
SPN	FMI			
4765	0	Exhaust temperature rise abnormal T0	Exhaust temperature rise abnormal T0	• DOC inlet temperature (T0) abnormally high
	3	Exhaust temperature sensor 0 (T0 : DOC inlet) abnormal	Exhaust temperature sensor 0 (T0 : DOC inlet) High	• Open circuit in sensor/harness, +B short-circuited
	4		Exhaust temperature sensor 0 (T0 : DOC inlet) Low	• Short circuit in sensor/harness ground
523523	2	Open circuit in common 1 system	Open circuit in injector driving circuit: Common 1 system, or TWV 1 and 3 (1st and 4th cylinders) simultaneously	• Open circuit in harness
	3	Short circuit in common 1 TWV driving system	Short circuit in battery: Injector driving circuit at ECU side (Common 1 system), or 1st and 4th cylinders at INJ side simultaneously	• Short circuit in harness +B
	4		Short circuit in GND: Injector driving circuit at ECU side (Common 1 system), or 1st and 4th cylinders at INJ side simultaneously	• Short circuit in harness ground
523524	2	Open circuit in common 2 system	Open circuit in injector driving circuit: Common 2 system, or TWV 2 and 4 (3rd and 2nd cylinders) simultaneously	• Open circuit in harness
	3	Short circuit in common 2 TWV driving system	Short circuit in battery: Injector driving circuit at ECU side (Common 2 system), or 2nd and 3rd cylinders at INJ side simultaneously	• Short circuit in harness +B
	4		Short circuit in GND: Injector driving circuit at ECU side (Common 2 system), or 2nd and 3rd cylinders at INJ side simultaneously	• Short circuit in harness ground
523525	1	Injector charge voltage abnormal	ECU injector charge voltage insufficient	• Injector charge voltage insufficient • ECU charge circuit failure
523527	2	ECU flash ROM and CPU abnormal	ECU CPU abnormal (watching IC abnormal)	• CPU-watching IC failure
523535	0	Overcharge	ECU injector charge voltage excessively high	• ECU injector charge voltage excessively high (ECU charge circuit failure)
523538	2	QR abnormal	QR data abnormal	• QR code correction data abnormal
	7		QR data writing abnormal	• QR code correction data unwritten
523539	2	Pump seizure	Pump seizure 1	• Pressure abnormally high 1
523540	2		Pump seizure 2	• Pressure abnormally high 2
523543	2	Accelerator pedal or lever position sensor abnormal (via CAN)	Accelerator sensor at machine body abnormal	• Abnormal message from machine body received

J1939-73		Description	DTC Description	Diagnosis
SPN	FMI			
523544	3	Air heater relay drive abnormal	Short circuit in air heater relay driving circuit +B	• Short circuit in air heater relay driving circuit +B
	4		Short circuit in air heater relay driving circuit GND	• Open circuit in air heater relay driving circuit, ground fault
523547	2	CAN2 bus off	CAN2 bus off	• Short circuit in CAN2 +B/GND or traffic abnormally high
523548	2	Open circuit in CAN2 frame	Open circuit in CAN_KBT original frame	• Open circuit in CAN_KBT original frame
523572	4	EGR motor abnormal	EGR position sensor abnormal	• EGR position sensor abnormal
523574	3		Open circuit in EGR motor	• Open circuit in EGR motor coil
	4		Short circuit in EGR motor	• Short circuit in EGR motor coil
523575	7	EGR (DC motor) abnormal	EGR valve sticking (FB abnormal)	• EGR valve sticking
523576	2		EGR motor ambient temperature abnormal	• EGR motor temperature abnormally high
523577	2		EGR thermistor sensor with built-in valve abnormal	• EGR motor temperature sensor abnormal
523578	2	Open circuit in CAN_ EGR control line	Disconnection (open circuit) in EGR control line communication	• CAN communication with EGR
523580	2	Intake throttle FB (feed back) abnormal	Intake throttle FB (feed back) abnormal	• Intake throttle DC motor feed back abnormal
523582	3	Intake throttle lift sensor abnormal	Intake throttle lift sensor abnormal (High)	• Intake throttle lift sensor High
	4		Intake throttle lift sensor abnormal (Low)	• Intake throttle lift sensor Low
523589	17	Water temperature rise during manual regeneration insufficient	Water temperature rise during manual regeneration insufficient	• While regenerating, conditions required for warming up the engine not established (Insufficient water temperature rise)
523590	16	Manual regeneration process time-up abnormal	Manual regeneration process time-up abnormal	• Regeneration process not end due to insufficient DPF temperature rise (Regeneration time)
523591	2	Open circuit in CAN2 frame	CAN_CCVS communication disruption	• CAN_CCVS communication disruption
523592	2		CAN_CM1 communication disruption	• CAN_CM1 communication disruption
523593	2		CAN_DDC1 communication disruption	• CAN_DDC1 communication disruption
523594	2		CAN_ETC2 communication disruption	• CAN_ETC2 communication disruption
523595	2		CAN_ETC5 communication disruption	• CAN_ETC5 communication disruption
523596	2		CAN_TSC1 communication disruption	• CAN_TSC1 communication disruption
523598	2		CAN_EBC1 communication disruption	• CAN_EBC1 communication disruption

J1939-73		Description	DTC Description	Diagnosis
SPN	FMI			
523599	0	Simultaneous open circuit in all exhaust temperature sensors	Simultaneous open circuit in all exhaust temperature sensors	• Simultaneous open circuit in all exhaust temperature sensors
523600	0	Warning on incomplete learning of individual difference of pumps	Warning on incomplete learning of individual difference of pumps	• Pump learning history
523601	0	Exhaust temperature continuously abnormal (Starter relay drive prohibit warning)	Exhaust temperature continuously abnormal (Starter relay drive prohibit warning)	• Exhaust temperature when abnormally high temperature generated
523602	0	Regeneration frequency abnormally high	Regeneration frequency abnormally high	• Abnormal interval between end of regeneration process and trigger for next regeneration
523603	15	Warning on High. Temp_AECD operation	Warning on High.Temp_AECD operation	• High Temperature AECD_EGR valve limiting state warning
523604	2	CAN1 bus off	CAN1 bus off	• Short circuit in CAN1 +B/GND or traffic abnormally high
523700	13	EEPROM checksum not coincident	KBT area EEPROM checksum not coincident	• KBT area EEPROM checksum not coincident
523701	13		DST1 area EEPROM checksum not coincident	• DST1 area EEPROM checksum not coincident
523702	13		DST2 area EEPROM checksum not coincident	• DST2 area EEPROM checksum not coincident

Fig.: 2-3-1



SW654-10002

2-3. Engine

Check following items before troubleshooting.

- No blown fuses and power is applied up to fuses.
- Check any ground circuit which belongs to components to be checked.
- Engine warning lamp or engine stop lamp must not be lighting. If engine warning lamp or engine stop lamp lights, refer to troubleshooting of engine manufacturer.

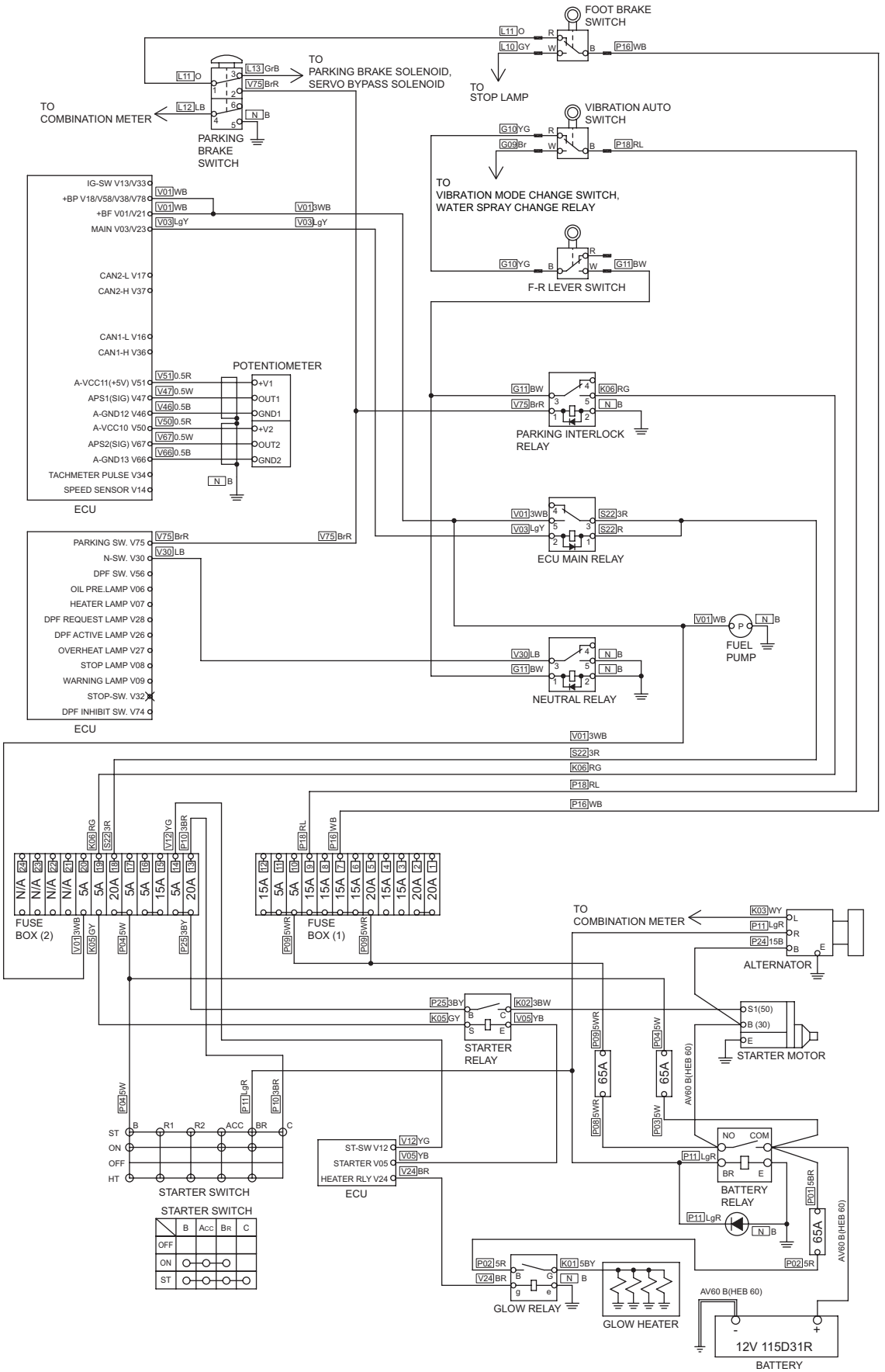
2-3-1. Engine will not start (Starter motor does not run) 1/3

- F-R lever must be in “N”.
- Parking brake switch must be applied.
- Foot brake switch must be OFF (Brake pedal is not depressed).

Reference Fig.: 2-3-1

Check point	Check/Cause	Action
1. Battery	• Measure battery voltage or specific gravity. Standard voltage : 12 V or more Standard gravity : 1.26 or more • If value is below standard, battery capacity is insufficient.	Charge or replace battery.
2. Starter Switch	• Check continuity between O-O according to starter switch connection table. Switch is OK if there is continuity between connection O-O. • If there is no continuity, starter switch is faulty.	Replace starter switch.
3. Starter Motor	(1) When starter switch is ON, measure voltage between starter motor terminal B and chassis ground. Standard voltage : 12 V or more (2) When starter switch is START, measure voltage between starter motor terminal S1 and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and starter motor does not run, starter motor is faulty.	Replace starter motor.
4. Starter Relay	(1) When starter switch is ON, measure voltage between starter relay terminal S inlet wire GY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is START, measure voltage between starter relay terminal B inlet wire BY and chassis ground. Standard voltage : 12 V or more (3) When starter switch is START, measure voltage between starter relay terminal C outlet wire BW and chassis ground Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, starter relay is faulty.	Replace starter relay.

Fig.: 2-3-1



SW654-10002

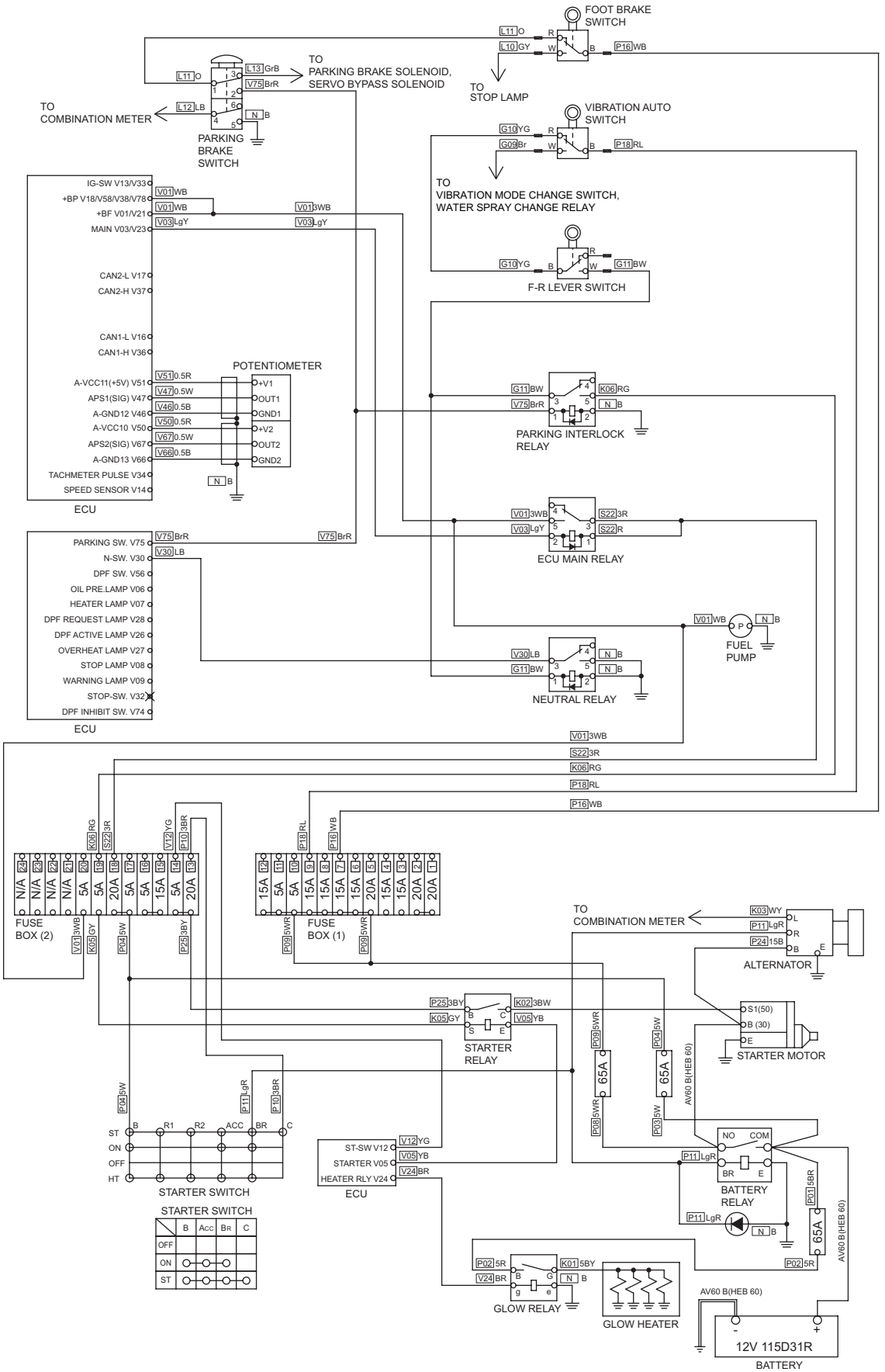
2-3-1. Engine will not start (Starter motor does not run) 2/3

- F-R lever must be in “N”.
- Parking brake switch must be applied.
- Foot brake switch must be OFF (Brake pedal is not depressed).

Reference Fig.: 2-3-1

Check point	Check/Cause	Action
5. Battery Relay	(1) When starter switch is OFF, measure voltage between battery relay primary terminal COM and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between battery relay coil terminal BR inlet wire LgR and coil ground terminal E. Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between battery relay secondary terminal NO and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, battery relay is faulty.	Replace battery relay.
6. Vibration AUTO Switch	(1) When starter switch is ON, measure voltage between vibration AUTO switch terminal inlet wire RL and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between vibration AUTO switch terminal outlet wire YG and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, vibration AUTO switch is faulty.	Replace vibration AUTO switch.
7. F-R Lever Switch	(1) When starter switch is ON, measure voltage between F-R lever switch terminal inlet wire YG and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between F-R lever switch terminal outlet wire BW and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, F-R lever switch is faulty.	Replace F-R lever switch.
8. Parking Interlock Relay	(1) When starter switch is ON, measure voltage between parking interlock relay terminal 1 inlet wire BrR and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between parking interlock relay terminal 3 inlet wire BW and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between parking interlock relay terminal 5 outlet wire RG and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, parking interlock relay is faulty.	Replace parking interlock relay.

Fig.: 2-3-1



SW654-10002

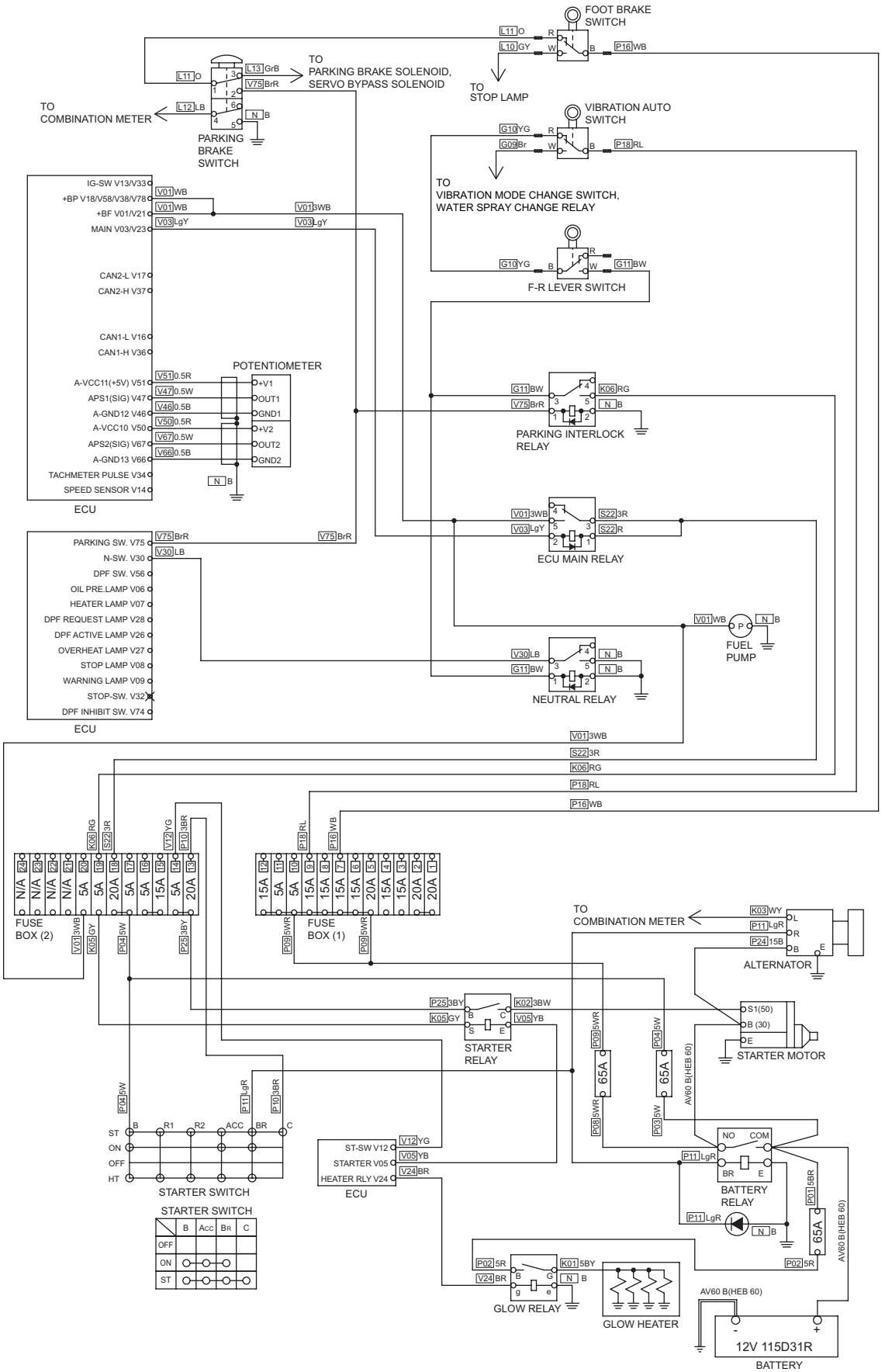
2-3-1. Engine will not start (Starter motor does not run) 3/3

- F-R lever must be in “N”.
- Parking brake switch must be applied.
- Foot brake switch must be OFF (Brake pedal is not depressed).

Reference Fig.: 2-3-1

Check point	Check/Cause	Action
9. Neutral Relay	(1) When starter switch is ON, measure voltage between neutral relay terminal 1 inlet wire BW and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, check continuity between neutral relay terminal 5 outlet wire B and chassis ground. There is continuity in normal condition. (3) When starter switch is ON, check continuity between neutral relay terminal 3 inlet wire LB and chassis ground. There is continuity in normal condition. • If above items (1) and (2) are OK and item (3) is NG, neutral relay is faulty.	Replace neutral relay.
10. Parking Brake Switch	(1) When starter switch is ON, measure voltage between parking brake switch terminal 1 inlet wire O and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between parking brake switch terminal 2 outlet wire BrR and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, parking brake switch is faulty.	Replace parking brake switch.
11. Foot Brake Switch	(1) When starter switch is ON, measure voltage between foot brake switch terminal inlet wire WB and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between foot brake switch terminal outlet wire O and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, foot brake switch is faulty.	Replace foot brake switch.
12. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-3-1



SW654-10002

2-3-2. Engine will not start (But starter motor runs)

- **In case of engine will not start while starter motor runs, generally trouble is caused by that fuel is not supplied, supply amount of fuel is extremely low, or selection of fuel is not appropriate.**
- Check that fuel is supplied to inlet of fuel pump.

Reference Fig.: 2-3-1

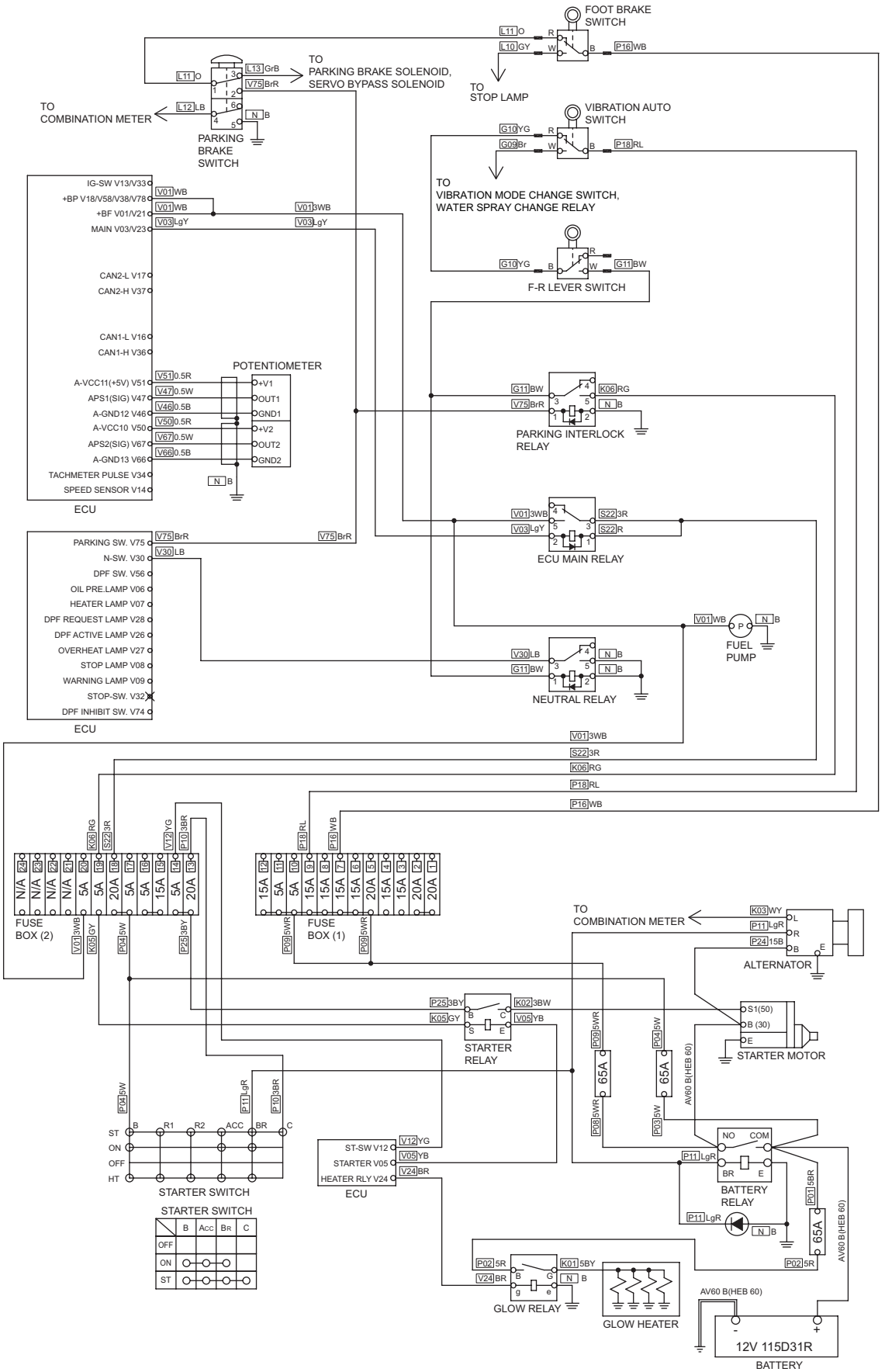
Check point	Check/Cause	Action
1. Fuel Pump	• When starter switch is ON, measure voltage between fuel pump terminal inlet wire WB and chassis ground. Standard voltage : 12 V or more • If above item is OK and fuel pump does not operate, fuel pump is faulty.	Repair or replace fuel pump.
2. ECU Main Relay	(1) Measure voltage between ECU main relay terminal 1 inlet wire R and chassis ground. Standard voltage : 12 V or more (2) Measure voltage between ECU main relay terminal 3 inlet wire R and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between ECU main relay terminal 5 outlet wire WB and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, ECU main relay is faulty.	Replace ECU main relay.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

2-3-3. No charging

Reference Fig.: 2-3-1

Check point	Check/Cause	Action
1. Alternator	• After starting engine, measure voltage between alternator terminal B wire B and chassis ground. Standard voltage : At least intermediate engine speed, 14 V or more • If voltage is lower than standard, alternator is faulty. • If voltage is normal and battery is not charged, battery is faulty.	Replace alternator or battery.

Fig.: 2-3-1



SW654-10002

2-3-4. Glow heater is not heated (Engine starting performance is bad in cold weather)

Reference Fig. : 2-3-1

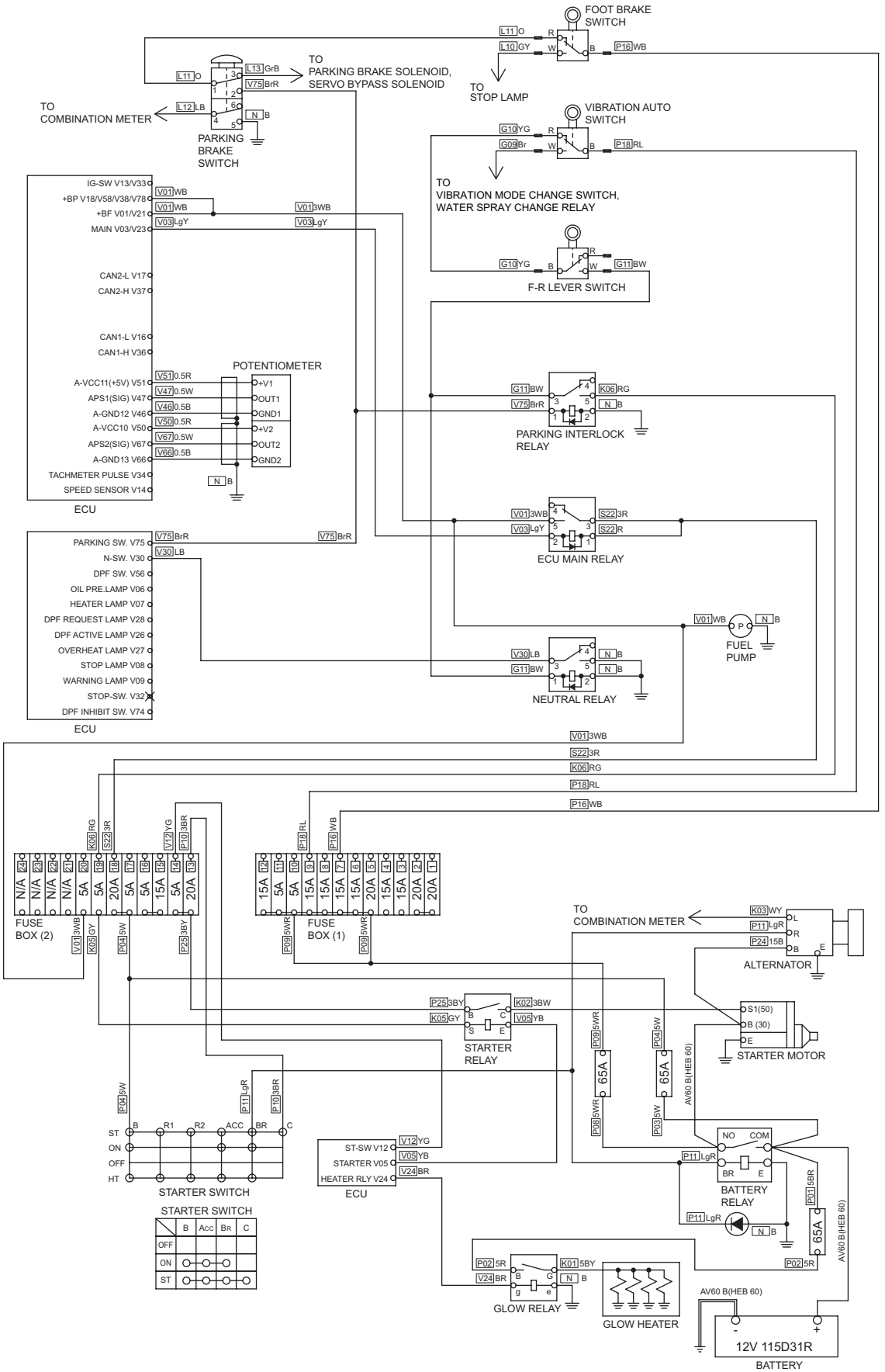
Check point	Check/Cause	Action
1. Glow Heater	• When starter switch is ON, measure voltage between glow heater terminal inlet wire BY and chassis ground. Standard voltage : 12 V or more • If voltage is OK, glow heater is faulty.	Replace glow heater.
2. Glow Relay	(1) When starter switch is ON, measure voltage between glow relay terminal g inlet wire BR and chassis ground. Standard voltage : 12 V or more (2) Measure voltage between glow relay terminal B inlet wire R and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between glow relay terminal G outlet wire BY and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, glow relay is faulty.	Replace glow relay.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

2-3-5. Starter motor runs even when F-R lever is not at “N”

Reference Fig. : 2-3-1

Check point	Check/Cause	Action
1. F-R Lever Switch	• When starter switch is OFF and F-R lever is “F” or “R”, check continuity between F-R lever switch terminal wire YG and terminal wire BW. There is no continuity in normal condition. • If there is continuity, F-R lever switch is faulty.	Replace F-R lever switch.

Fig.: 2-3-1



SW654-10002

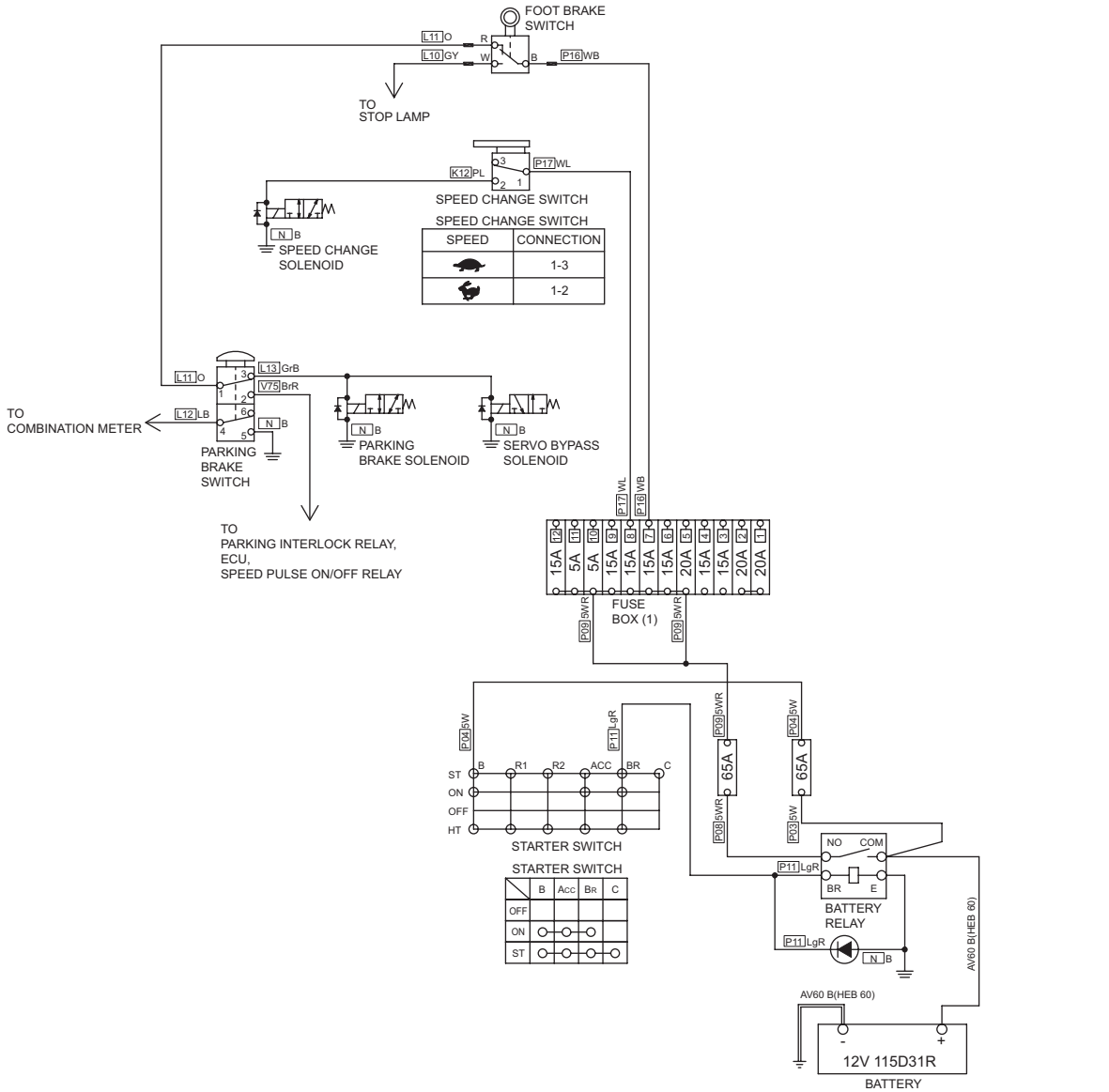
2-3-6. Engine speed does not change when operating throttle lever

- Engine warning lamp must not be lighting.
- Refer to voltage measurement method when voltage is to be measured without disconnecting connector.

Reference Fig. : 2-3-1

Check point	Check/Cause	Action
1. Connector	• Check for corrosion, break, bend, or loosening on potentiometer connector terminals. • If there are any above mentioned abnormalities, the connector is faulty.	Replace connector or terminal.
2. Potentiometer	(1) When starter switch is ON, measure voltage between potentiometer terminal +V1 wire R and potentiometer terminal GND1 wire B. Standard voltage : 5 ± 0.5 V (2) When starter switch is ON, measure voltage between potentiometer terminal +V2 wire R and potentiometer terminal GND2 wire B. Standard voltage : 5 ± 0.5 V (3) When starter switch is ON, measure voltage between potentiometer terminal OUT1 wire W and potentiometer terminal GND1 wire B. When throttle lever is at IDLE position Standard voltage : 0.5 to 1.0 V When throttle lever is at FULL position Standard voltage : 4.0 to 4.5 V (4) When starter switch is ON, measure voltage between potentiometer terminal OUT2 wire W and potentiometer terminal GND2 wire B. When throttle lever is at IDLE position Standard voltage : 4.0 to 4.5 V When throttle lever is at FULL position Standard voltage : 0.5 to 1.0 V • If above items (1) and (2) are OK and item (3) or (4) is NG, potentiometer is faulty.	Replace potentiometer.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty. **(NOTICE)** **• Because three-wire shield cable is used between potentiometer and ECU, it is impossible to repair it. It must be replaced.**	Repair or replace harness.

Fig.: 2-4-1



SW654-10003

2-4. Propulsion System

Check following items before troubleshooting.

- No blown fuses and power is applied up to fuses.
- When measuring voltage and current without disconnecting connectors, refer to “Measuring voltage and current flowing using tester” (P.10-006 to P.10-008).
- Check any ground circuit which belongs to components to be checked.

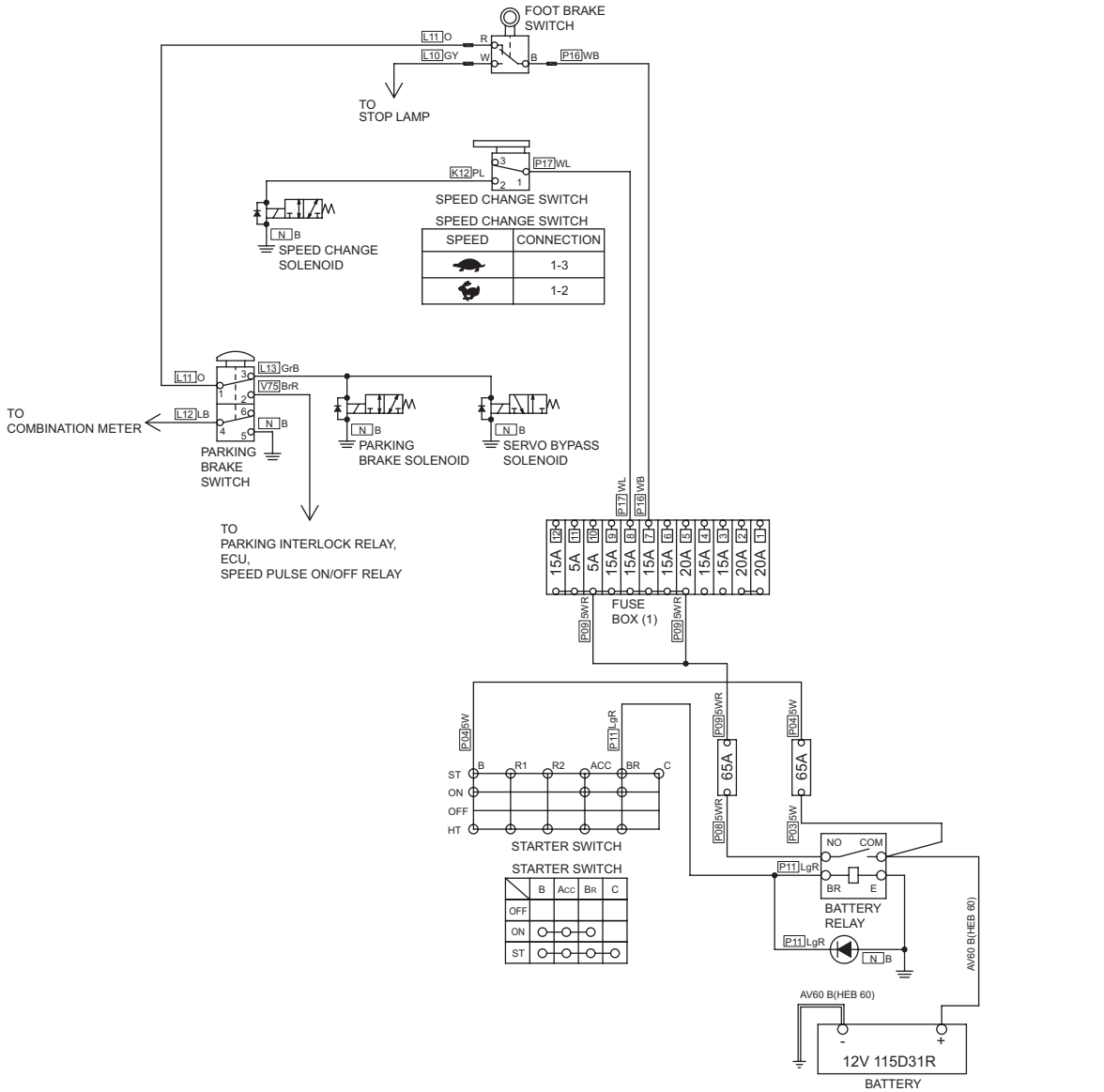
2-4-1. Machine moves neither forward nor backward

- Parking brake switch must be released.
- Foot brake switch must be OFF (Brake pedal is not depressed).

Reference Fig.: 2-4-1

Check point	Check/Cause	Action
1. Parking Brake Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 7.5 Ω • If measured resistance is abnormal, parking brake solenoid is faulty.	Replace parking brake solenoid.
2. Servo Bypass Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 12.3 ± 1.2 Ω • If measured resistance is abnormal, servo bypass solenoid is faulty	Replace servo bypass solenoid.
3. Parking Brake Switch	(1) When starter switch is ON, measure voltage between parking brake switch terminal 1 inlet wire O and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between parking brake switch terminal 3 outlet wire GrB and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, parking brake switch is faulty.	Replace parking brake switch.
4. Foot Brake Switch	(1) When starter switch is ON, measure voltage between foot brake switch terminal inlet wire WB and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between foot brake switch terminal outlet wire O and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, foot brake switch is faulty.	Replace foot brake switch.
5. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-4-1



SW654-10003

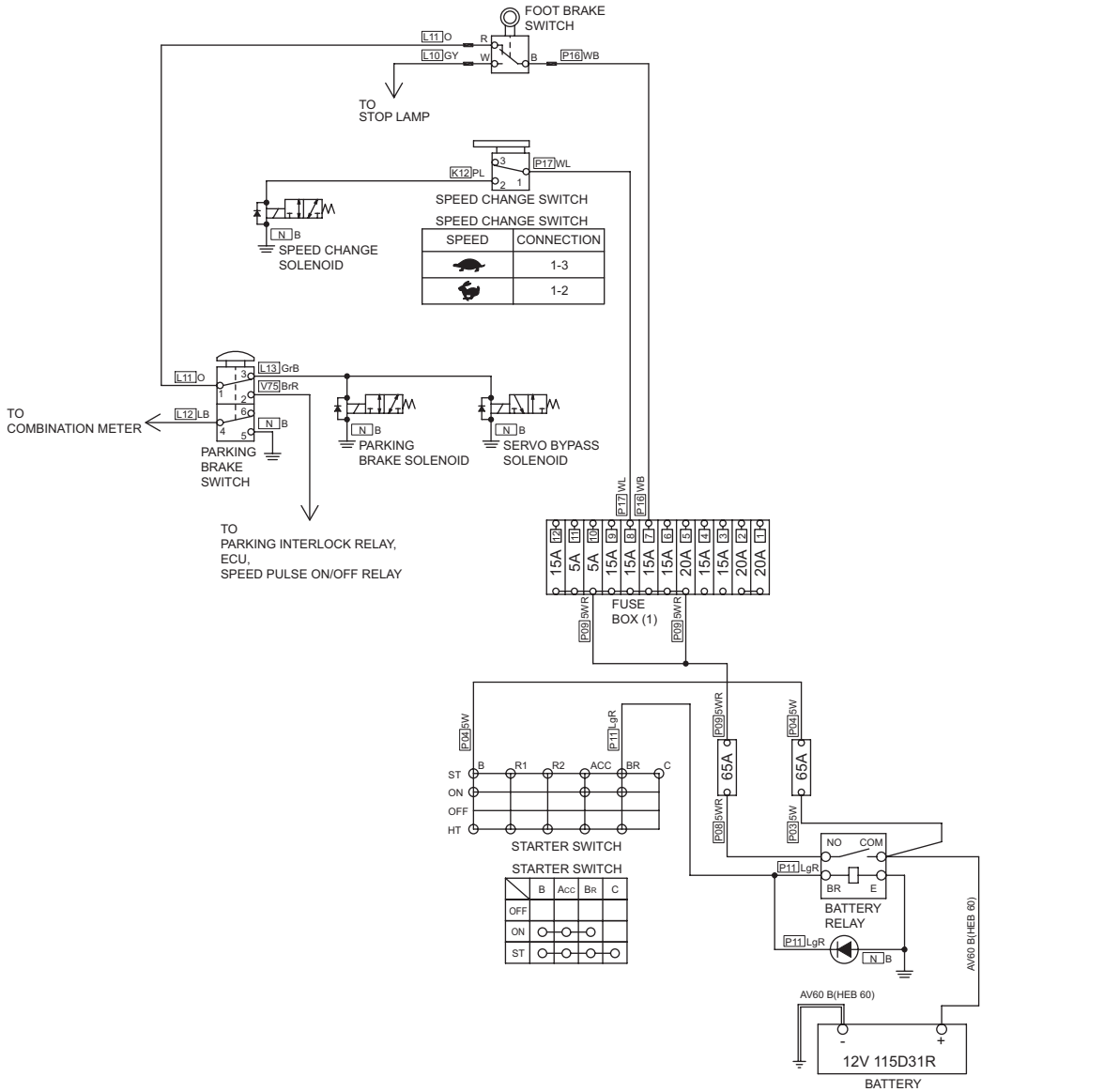
2-4-2. Machine speed cannot be changed

• Speed change switch must be “  ”.

Reference Fig.: 2-4-1

Check point	Check/Cause	Action
1. Speed Change Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 7.5 Ω • If measured resistance is abnormal, speed change solenoid is faulty.	Replace speed change solenoid.
2. Speed Change Switch	(1) When starter switch is ON, measure voltage between speed change switch terminal 1 inlet wire WL and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between speed change switch terminal 2 outlet wire PL and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and (2) is NG, speed change switch is faulty.	Replace speed change switch.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-4-1



SW654-10003

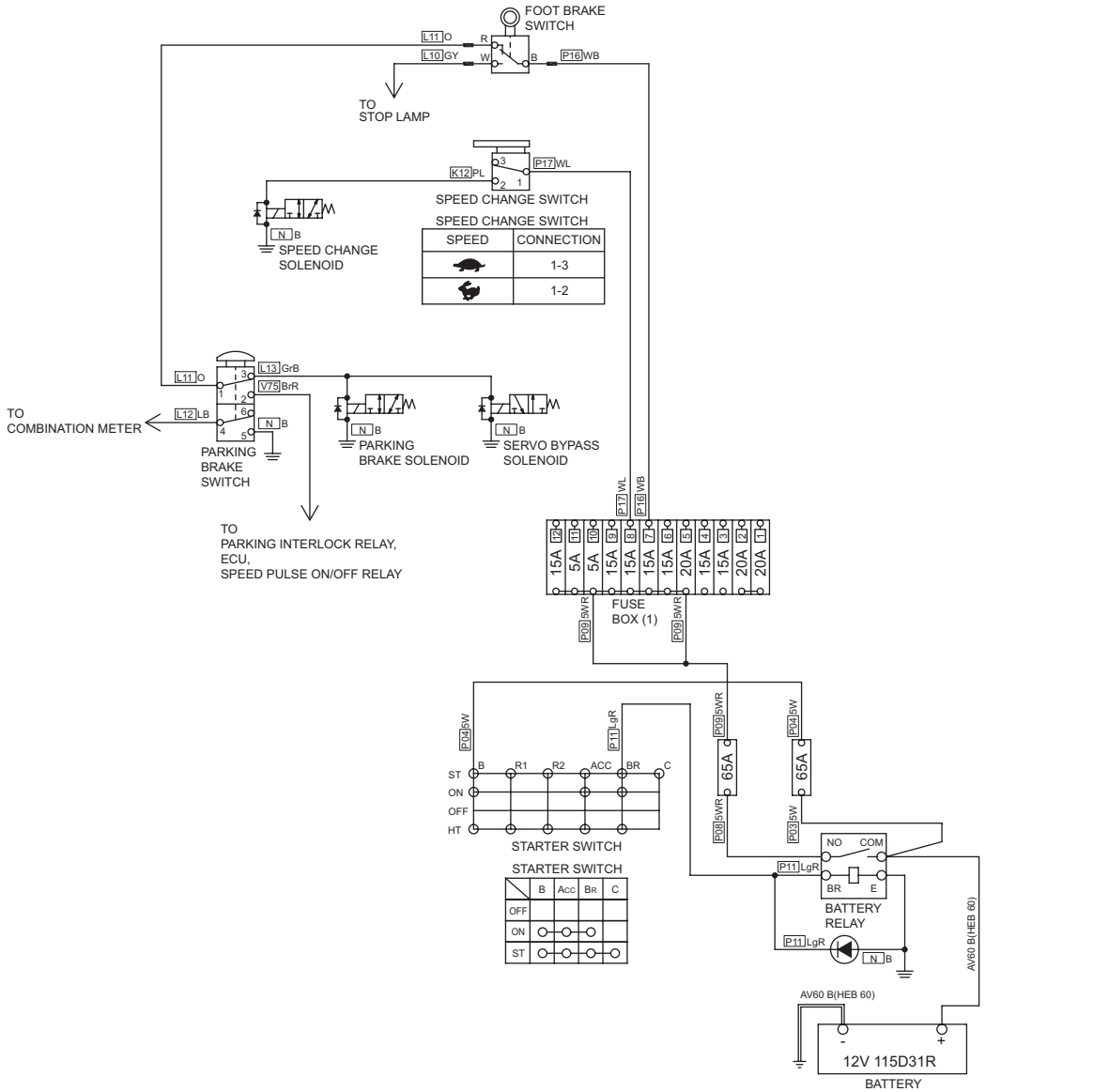
2-4-3. Brake cannot be released

- Parking brake switch must be released.
- Foot brake switch must be OFF (Brake pedal is not depressed).

Reference Fig.: 2-4-1

Check point	Check/Cause	Action
1. Parking Brake Solenoid	• Disconnect harness and measure resistance of coil. Standard voltage : 7.5 Ω • If measured resistance is abnormal, parking brake solenoid is faulty.	Replace parking brake solenoid.
2. Parking Brake Switch	(1) When starter switch is ON, measure voltage between parking brake switch terminal 1 inlet wire O and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between parking brake switch terminal 3 outlet wire GrB and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, parking brake switch is faulty.	Replace parking brake switch.
3. Foot Brake Switch	(1) When starter switch is ON, measure voltage between foot brake switch terminal inlet wire WB and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between foot brake switch terminal outlet wire O and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, foot brake switch is faulty.	Replace foot brake switch.
4. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-4-1



SW654-10003

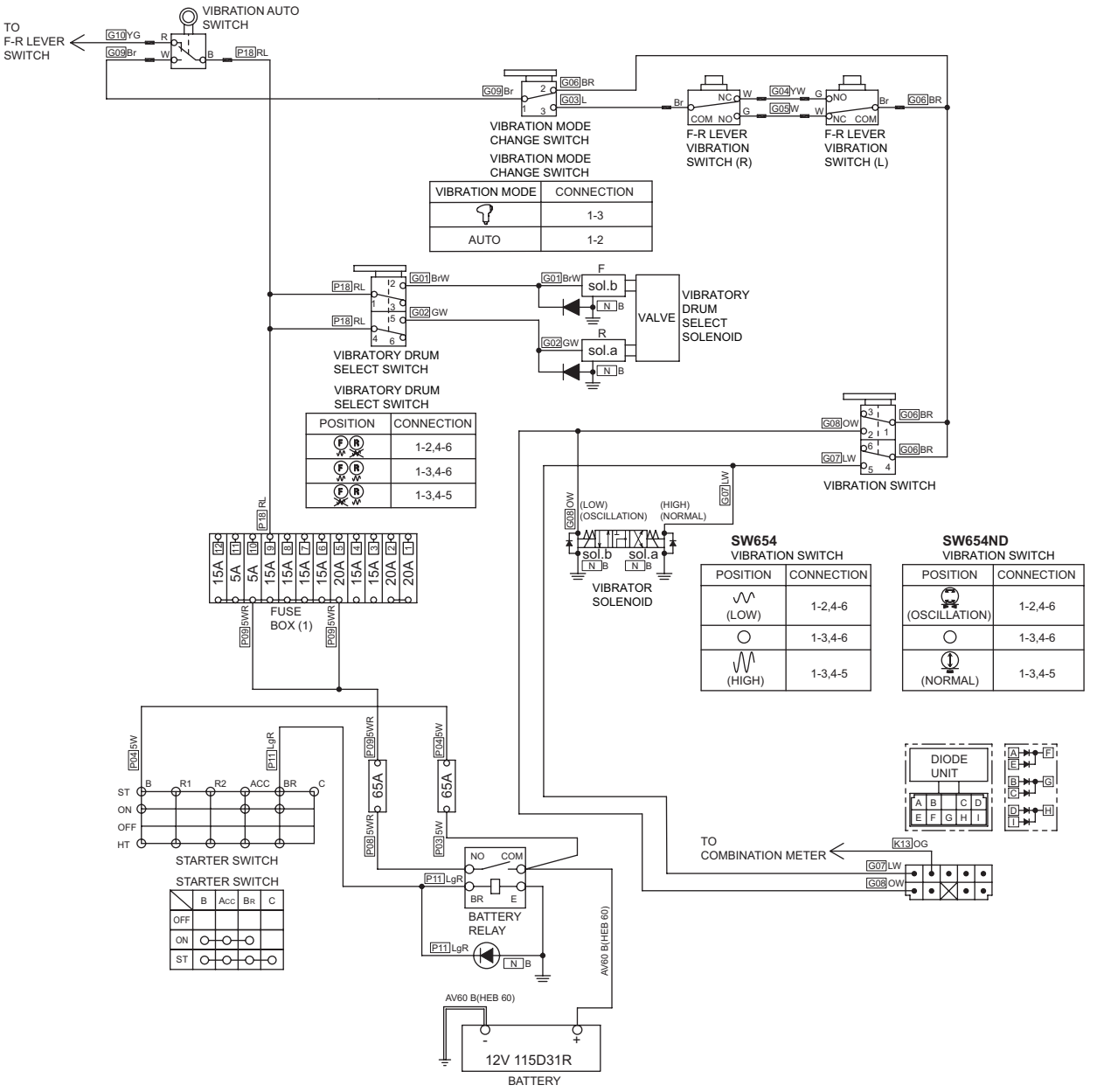
2-4-4. Brake does not work

- Parking brake switch must be applied.
- Foot brake switch must be ON (Brake pedal is depressed).

Reference Fig.: 2-4-1

Check point	Check/Cause	Action
1. Parking Brake Solenoid	• Disconnect harness and measure resistance of coil. Standard voltage : 7.5 Ω • If measured resistance is abnormal, parking brake solenoid is faulty.	Replace parking brake solenoid.
2. Parking Brake Switch	• When starter switch is ON, measure voltage between parking brake switch terminal 3 outlet wire GrB and chassis ground. There is no electricity in normal condition. • If there is electricity, parking brake switch is faulty.	Replace parking brake switch.
3. Foot Brake Switch	• When starter switch is ON, measure voltage between foot brake switch terminal outlet wire O and chassis ground. There is no electricity in normal condition. • If there is electricity, foot brake switch is faulty.	Replace foot brake switch.
4. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-5-1



SW654-10004

2-5. Vibration

Check following items before troubleshooting.

- No blown fuses and power is applied up to fuses.
- Throttle switch must be “FULL”.
- Check any ground circuit which belongs to components to be checked.

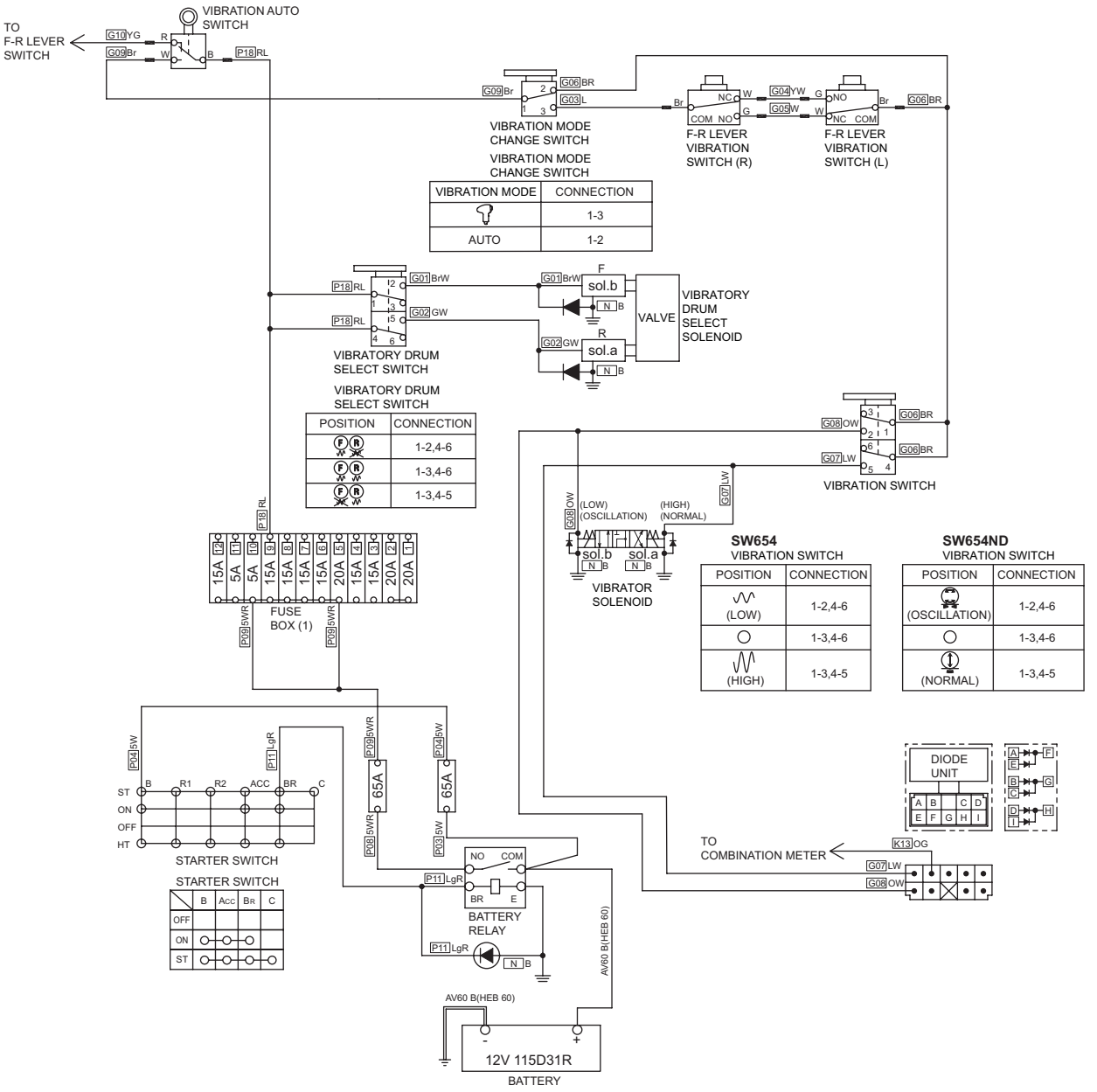
2-5-1. No vibration occurs 1/2

- F-R lever must be “F” or “R”.
- Vibration mode change switch must be “AUTO” (automatic mode).
- Vibration switch must not be “◯”.

Reference Fig.: 2-5-1

Check point	Check/Cause	Action
1. Vibrator Solenoid	• Disconnect harness and measure resistance of coil. Standard voltage : 5.5 Ω • If measured resistance is abnormal, vibrator solenoid is faulty.	Replace vibrator solenoid.
2. Vibration Switch	(1) When starter switch is ON, measure voltage between vibration switch terminal 1 inlet wire BR, terminal 4 inlet wire BR and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and vibration switch is in below position, measure voltage between vibration switch terminal 2 outlet wire OW and chassis ground. SW654 : “ ∿ ” (LOW) SW654ND : “ ⓒ ” (OSCILLATION) Standard voltage : 12 V or more (3) When starter switch is ON and vibration switch is in below position, measure voltage between vibration switch terminal 5 outlet wire LW and chassis ground. SW654 : “ ∿ ” (HIGH) SW654ND : “ ⓘ ” (NORMAL) Standard voltage : 12 V or more • If above item (1) is OK and item (2) or (3) is NG, vibration switch is faulty.	Replace vibration switch.
3. Vibration Mode Change Switch	(1) When starter switch is ON, measure voltage between vibration mode change switch terminal 1 inlet wire Br and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between vibration mode change switch terminal 2 outlet wire BR and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, vibration mode change switch is faulty.	Replace vibration mode change switch.
4. Vibration AUTO Switch	(1) When starter switch is ON, measure voltage between vibration AUTO switch terminal inlet wire RL and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between vibration AUTO switch terminal outlet wire Br and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, vibration AUTO switch is faulty.	Replace vibration AUTO switch.

Fig.: 2-5-1



SW654-10004

2-5-1. No vibration occurs 2/2

- F-R lever must be “F” or “R”.
- Vibration mode change switch must be “AUTO” (automatic mode).
- Vibration switch must not be “◯”.

Reference Fig.: 2-5-1

Check point	Check/Cause	Action
5. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

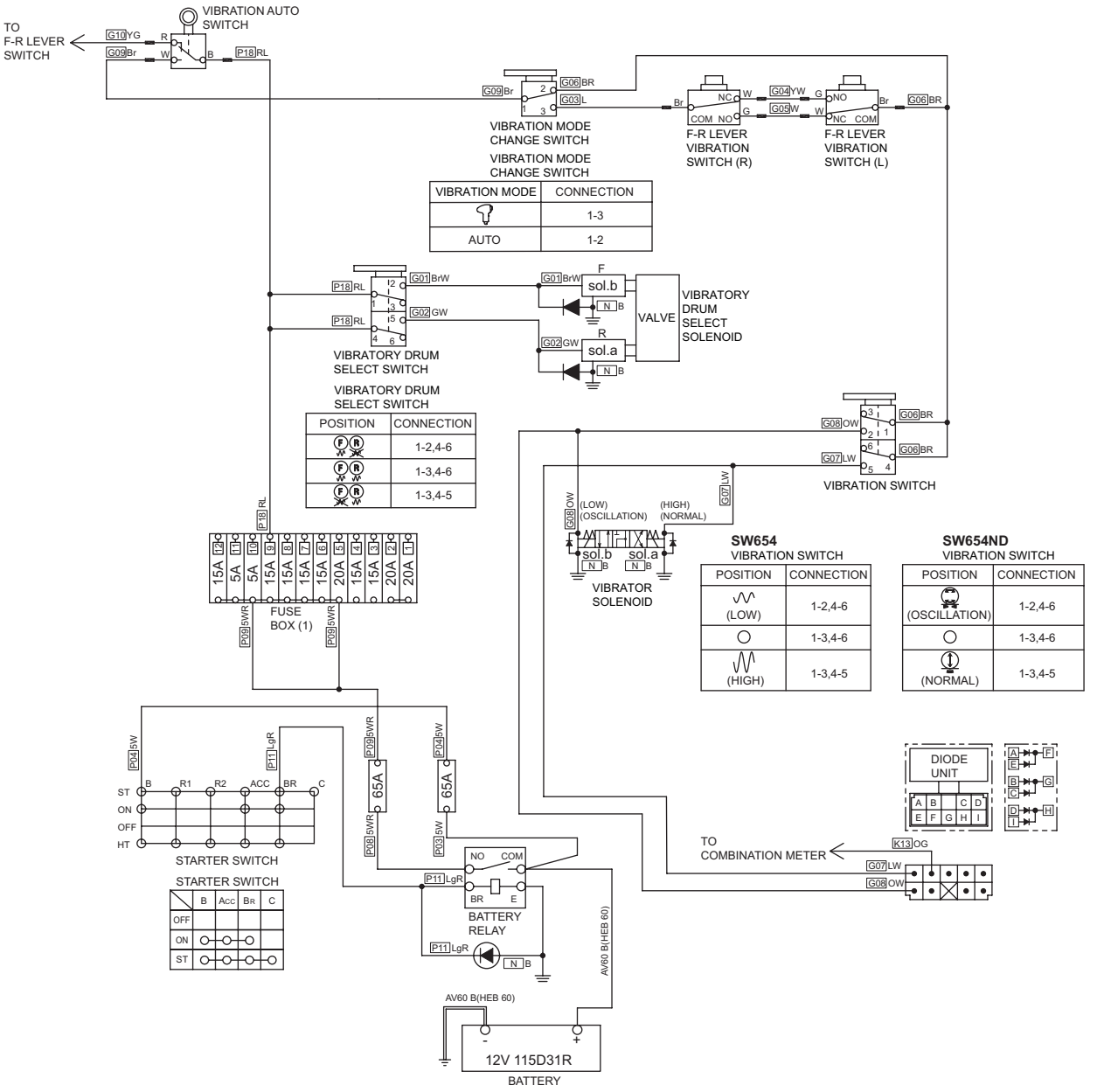
2-5-2. Amplitude does not change (Remains either low or high) : SW654

- Vibration mode change switch must be “AUTO” (automatic mode).

Reference Fig.: 2-5-1

Check point	Check/Cause	Action
1. Vibrator Solenoid	• Disconnect harness and measure resistance of coil. Standard voltage : 5.5 Ω • If measured resistance is abnormal, amplitude cylinder solenoid is faulty.	Replace amplitude cylinder solenoid.
2. Vibration Switch	(1) When starter switch is ON, measure voltage between vibration switch terminal 1 inlet wire BR terminal 4 inlet wire BR and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and vibration switch is “ ◯ ”, measure voltage vibration switch terminal wires and chassis ground. • Vibration switch terminal 2 outlet wire OW and chassis ground. • Vibration switch terminal 5 outlet wire LW and chassis ground. There is no electricity in normal condition. (3) When starter switch is ON and vibration switch is “ ∿∿ ”, measure voltage between vibration switch terminal 2 outlet wire OW and chassis ground. Standard voltage : 12 V or more. (4) When starter switch is ON and vibration switch is “ ∿∿ ”, measure voltage between vibration switch terminal 5 outlet wire LW and chassis ground. Standard voltage : 12 V or more. • If above item (1) is OK and item (2), (3) or (4) is NG, vibration switch is faulty.	Replace vibration switch.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-5-1


VIBRATION AUTO SWITCH
TO F-R LEVER SWITCH
G10 YG
G09 Br
R
W
B
P18 RL
VIBRATION MODE CHANGE SWITCH
G06 BR
G03 L
VIBRATION MODE CHANGE SWITCH
VIBRATION MODE | CONNECTION
1-3
AUTO 1-2
F-R LEVER VIBRATION SWITCH (R)
F-R LEVER VIBRATION SWITCH (L)
G04 YW
G05 W
G
NC
NO
COM
VIBRATORY DRUM SELECT SWITCH
G01 BrW
G02 GW
sol.b
sol.a
VALVE
VIBRATORY DRUM SELECT SOLENOID
POSITION | CONNECTION
1-2,4-6
1-3,4-6
1-3,4-5
VIBRATION SWITCH
G08 OW
G07 LW
(LOW) (OSCILLATION)
(HIGH) (NORMAL)
VIBRATOR SOLENOID
SW654
SW654ND
VIBRATION SWITCH
(OSCILLATION)
(NORMAL)
(LOW)
(HIGH)
FUSE BOX (1)
15A 5A 5A 15A 15A 15A 15A 20A 15A 15A 20A 20A
P09 5WR
P04 5W
P11 LgR
65A
STARTER SWITCH
ST ON OFF HT
B R1 R2 ACC BR C
BATTERY RELAY
P03 5W
AV60 B(HEB 60)
12V 115D31R
BATTERY
DIODE UNIT
TO COMBINATION METER
K13 OG
SW654-10004

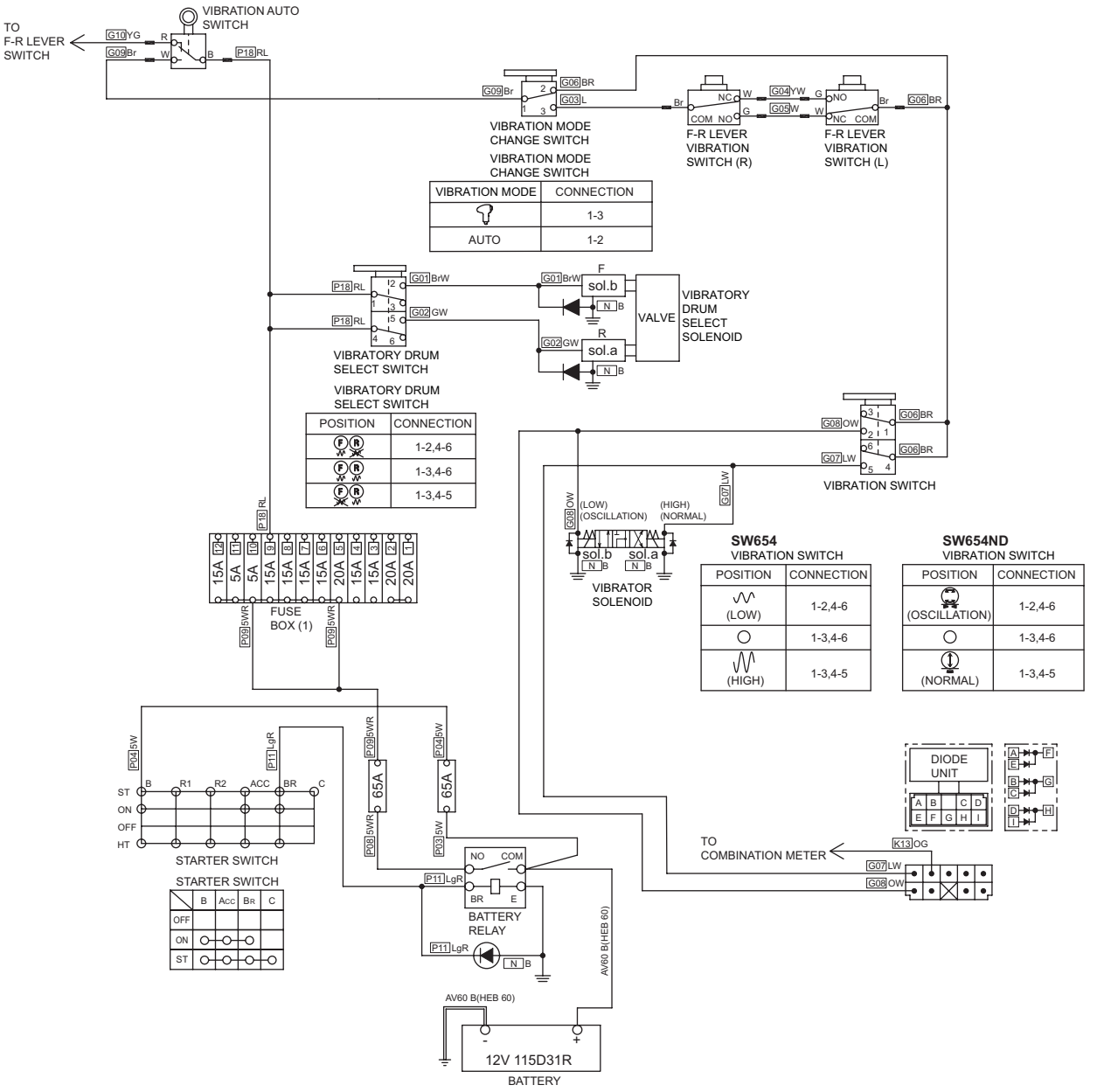
2-5-3. Vibration does not change (Remains normal or oscillation vibration) : SW654ND

• Vibration mode change switch must be “AUTO” (automatic mode).

Reference Fig.: 2-5-1

Check point	Check/Cause	Action
1. Vibrator Solenoid	• Disconnect harness and measure resistance of coil. Standard voltage : 5.5 Ω • If measured resistance is abnormal, amplitude cylinder solenoid is faulty.	Replace amplitude cylinder solenoid.
2. Vibration Switch	(1) When starter switch is ON, measure voltage between vibration switch terminal 1 inlet wire BR, terminal 4 inlet wire BR and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and vibration switch is “ ◯ ”, measure voltage vibration switch terminal wires and chassis ground. • Vibration switch terminal 2 outlet wire OW and chassis ground. • Vibration switch terminal 5 outlet wire LW and chassis ground. There is no electricity in normal condition. (3) When starter switch is ON and vibration switch is “  ”, measure voltage between vibration switch terminal 2 outlet wire OW and chassis ground. Standard voltage : 12 V or more. (4) When starter switch is ON and vibration switch is “  ”, measure voltage between vibration switch terminal 5 outlet wire LW and chassis ground. Standard voltage : 12 V or more. • If above item (1) is OK and item (2), (3) or (4) is NG, vibration switch is faulty.	Replace vibration switch.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-5-1



SW654-10004

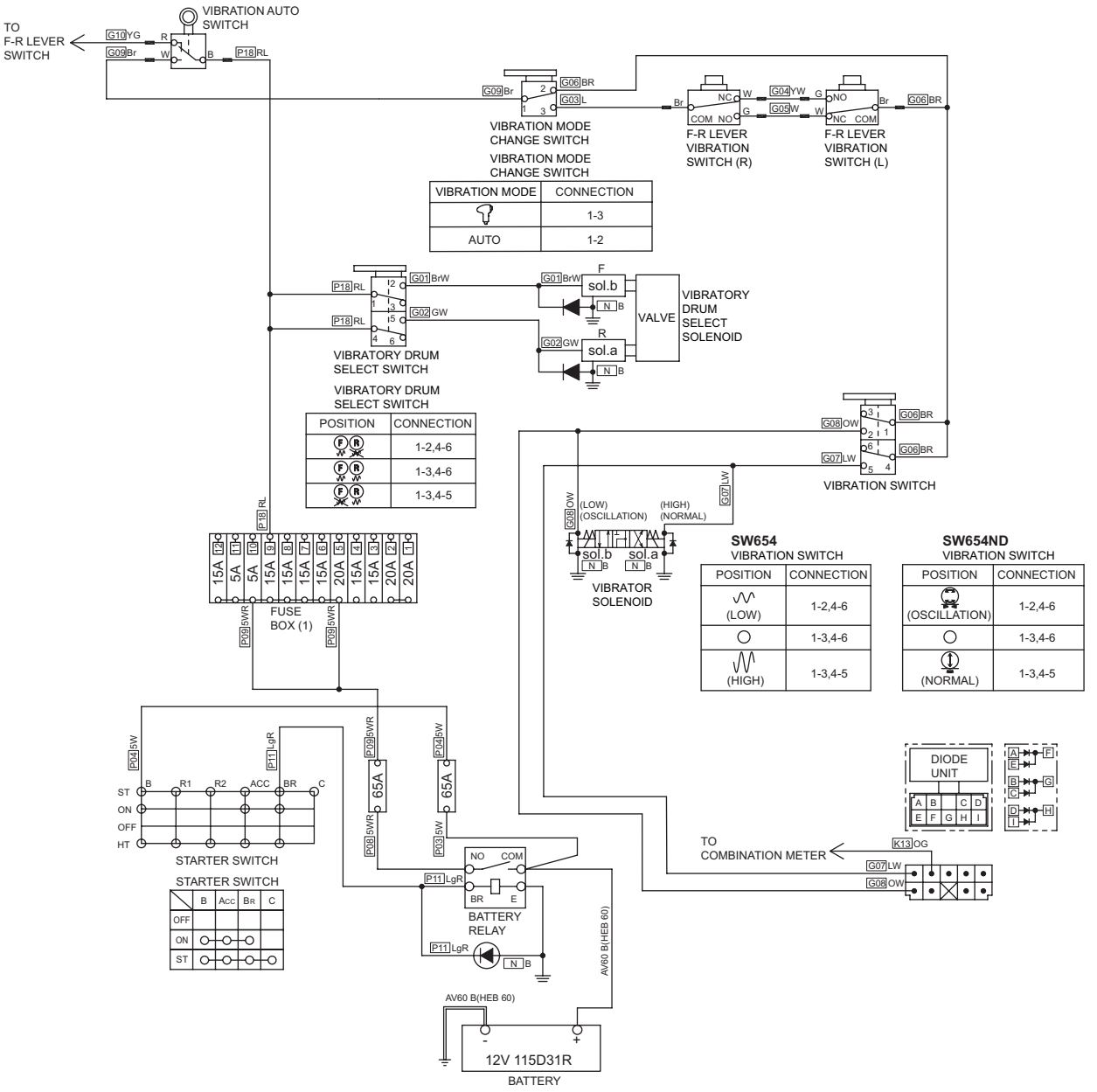
2-5-4. Vibration mode cannot be switched (F-R lever vibration switch does not work)

- Vibration mode change switch must be “  ” (manual mode).
- Vibration switch must not be “OFF”.

Reference Fig.: 2-5-1

Check point	Check/Cause	Action
1. Vibration Mode Change Switch	(1) When starter switch is ON, measure voltage between vibration mode change switch terminal 1 inlet wire Br and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between vibration mode change switch terminal 2 outlet wire BR and chassis ground. There is no electricity in normal condition. • If above item (1) is OK and item (2) is NG, vibration mode change switch is faulty.	Replace vibration mode change switch.
2. F-R Lever Vibration Switch (L)	• Check continuity between F-R lever vibration switch (L) terminals. • Terminal NC and terminal COM • Terminal NO and terminal COM • If continuity is made and broken when switch is operated, it is normal. If not, switch is faulty.	Replace F-R lever vibration switch (L).
3. F-R Lever Vibration Switch (R)	• Check continuity between F-R lever vibration switch (R) terminals. • Terminal NC and terminal COM • Terminal NO and terminal COM • If continuity is made and broken when switch is operated, it is normal. If not, switch is faulty.	Replace F-R lever vibration switch (R).
4. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-5-1

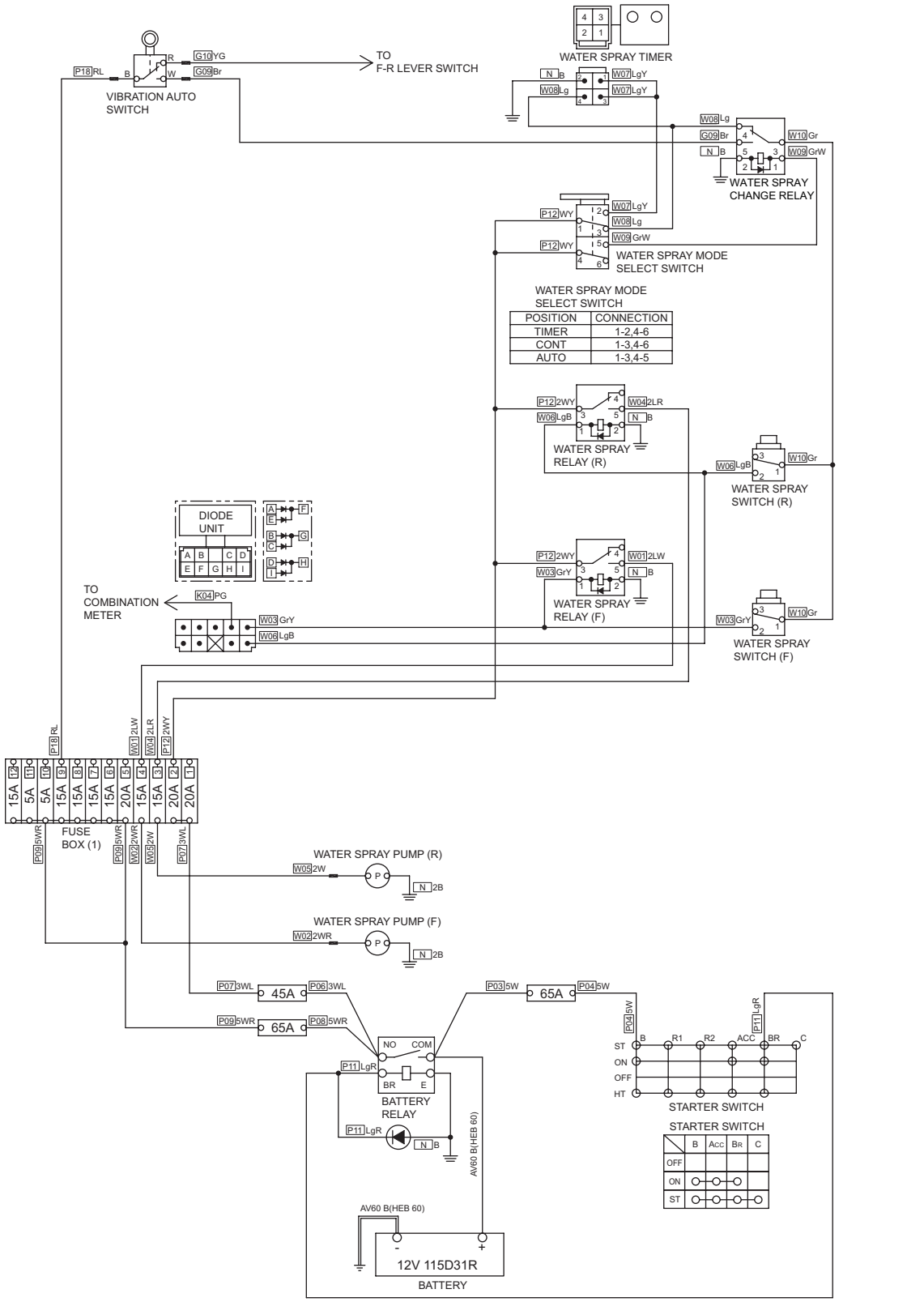

TO F-R LEVER SWITCH
VIBRATION AUTO SWITCH
VIBRATION MODE CHANGE SWITCH
F-R LEVER VIBRATION SWITCH (R)
F-R LEVER VIBRATION SWITCH (L)
VIBRATION MODE CHANGE SWITCH
VIBRATION MODE | CONNECTION
AUTO | 1-2
VIBRATORY DRUM SELECT SWITCH
VALVE
VIBRATORY DRUM SELECT SOLENOID
VIBRATORY DRUM SELECT SWITCH
POSITION | CONNECTION
1-2,4-6
1-3,4-6
1-3,4-5
VIBRATION SWITCH
FUSE BOX (1)
VIBRATOR SOLENOID
SW654
VIBRATION SWITCH
POSITION | CONNECTION
(LOW) 1-2,4-6
1-3,4-6
(HIGH) 1-3,4-5
SW654ND
VIBRATION SWITCH
POSITION | CONNECTION
(OSCILLATION) 1-2,4-6
1-3,4-6
(NORMAL) 1-3,4-5
DIODE UNIT
TO COMBINATION METER
STARTER SWITCH
ST ON OFF HT
B R1 R2 ACC BR C
STARTER SWITCH
B ACC BR C
OFF ON ST
BATTERY RELAY
12V 115D31R
BATTERY
SW654-10004

2-5-5. Vibratory drum cannot be switched

Reference Fig.: 2-5-1

Check point	Check/Cause	Action
1. Vibratory Drum Select Solenoid Valve (a), (b)	• Disconnect harness and measure resistance of coil. Standard voltage : 12.3 ± 1.2 Ω • If measured resistance is abnormal, vibratory drum select solenoid valve is faulty.	Replace vibratory drum select solenoid valve (a) or (b).
2. Vibratory Drum Select Switch	(1) When starter switch is ON, measure voltage between vibratory drum select switch terminal 1 inlet wire RL, terminal 4 inlet wire RL and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and vibratory drum select switch is in " Ⓕ ", measure voltage between vibratory drum select switch terminal 2 outlet wire BrW and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON and vibratory drum select switch is in " Ⓡ ", measure voltage between vibratory drum select switch terminal 2 outlet wire BrW, terminal 5 outlet wire GW and chassis ground. There is no electricity in normal condition. (4) When starter switch is ON and vibratory drum select switch is in " N ", measure voltage between vibratory drum select switch terminal 5 outlet wire GW and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2), (3) or (4) is NG, vibratory drum select switch is faulty.	Replace vibratory drum select switch.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-6-1



SW654-10005

2-6. Water Spray

Check following items before troubleshooting.

- No blown fuses and power is applied up to fuses.
- Water spray switch (F) and (R) must be ON.
- Check any ground circuit which belongs to components to be checked..

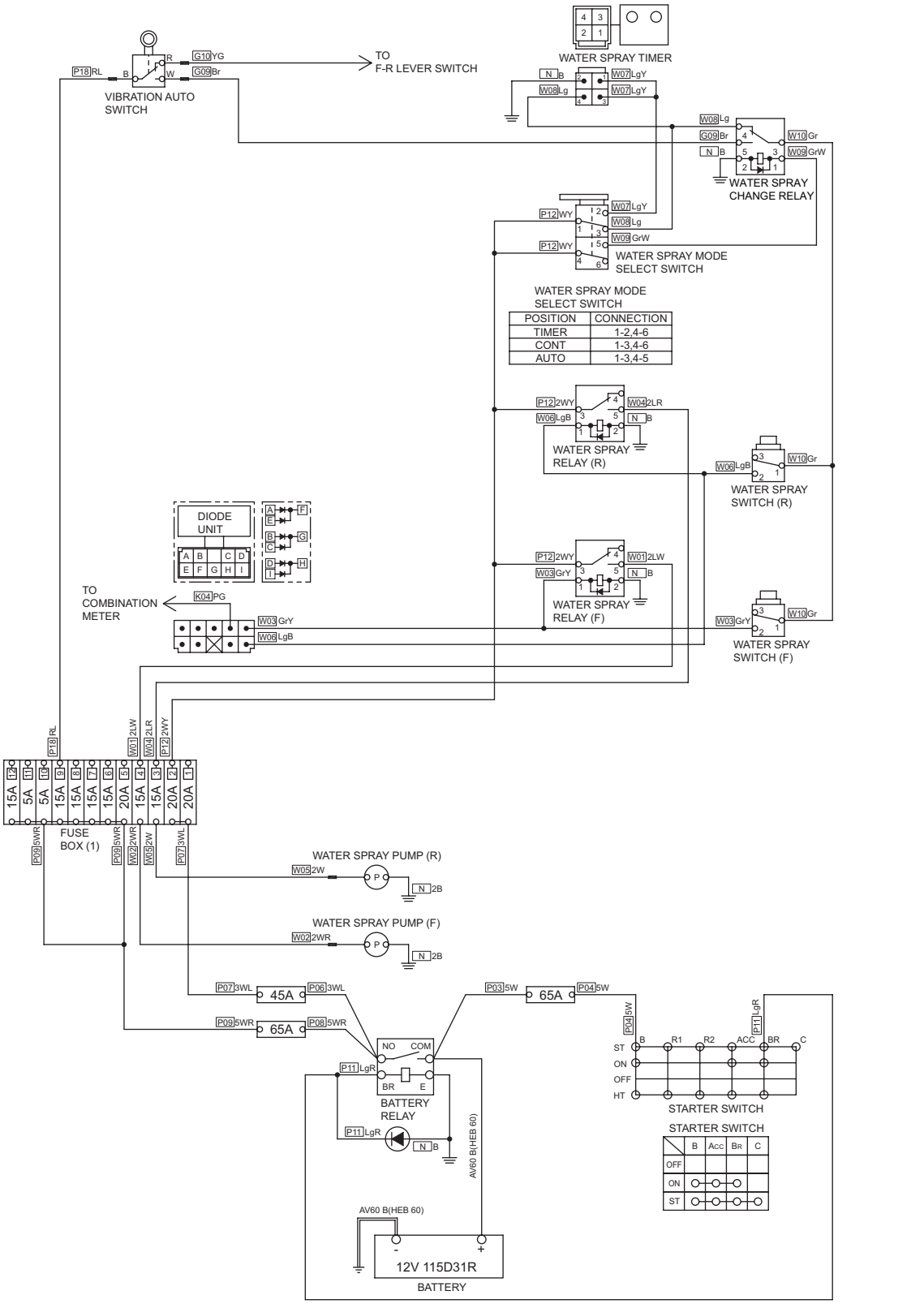
2-6-1. Continuous water spray does not operate 1/2

- Water spray mode select switch must be “CONT”.

Reference Fig.: 2-6-1

Check point	Check/Cause	Action
1. Water Spray Pump (F)	(1) When starter switch is ON, measure voltage between water spray pump (F) terminal inlet wire WR and chassis ground. Standard voltage : 12 V or more (2) Check that no abnormality is found in water spray pump (F) ground terminal. • If above items (1) and (2) are OK and water spray pump (F) does not operate, water spray pump (F) is faulty.	Replace water spray pump (F).
2. Water Spray Pump (R)	(1) When starter switch is ON, measure voltage between water spray pump (R) terminal inlet wire W and chassis ground. Standard voltage : 12 V or more (2) Check that no abnormality is found in water spray pump (R) ground terminal. • If above items (1) and (2) are OK and water spray pump (R) does not operate, water spray pump (R) is faulty.	Replace water spray pump (R).
3. Water Spray Relay (F)	(1) When starter switch is ON, measure voltage between water spray relay (F) terminal 1 inlet wire GrY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between water spray relay (F) terminal 3 inlet wire WY and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between water spray relay (F) terminal 5 outlet wire LW and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, water spray relay (F) is faulty.	Replace water spray relay (F).
4. Water Spray Relay (R)	(1) When starter switch is ON, measure voltage between water spray relay (R) terminal 1 inlet wire LgB and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between water spray relay (R) terminal 3 inlet wire WY and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between water spray relay (R) terminal 5 outlet wire LR and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, water spray relay (R) is faulty.	Replace water spray relay (R).

Fig.: 2-6-1



SW654-10005

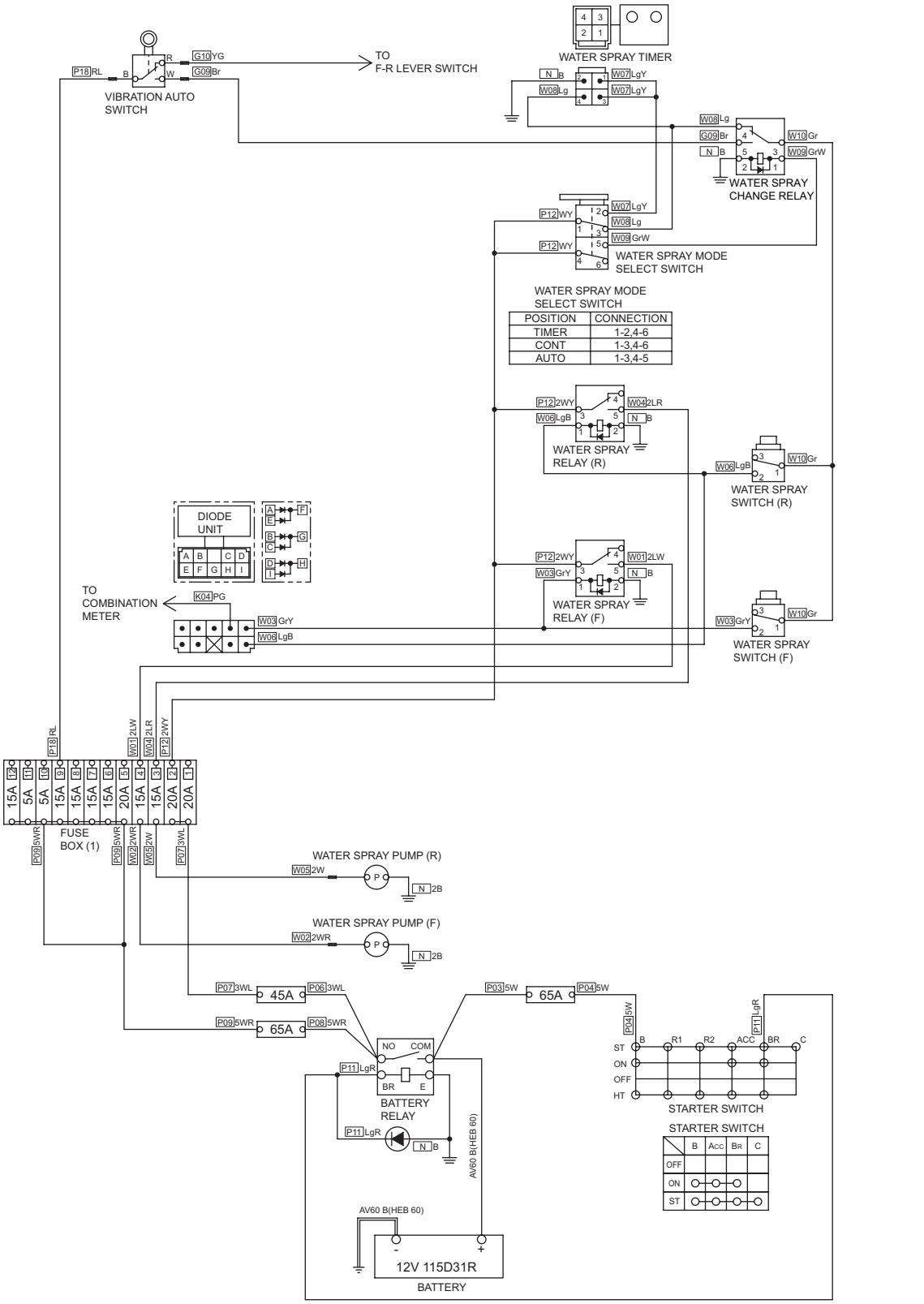
2-6-1. Continuous water spray does not operate 2/2

• Water spray mode select switch must be “CONT”.

Reference Fig.: 2-6-1

Check point	Check/Cause	Action
5. Water Spray Switch (F)	(1) When starter switch is ON, measure voltage between water spray switch (F) terminal 1 inlet wire Gr and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between water spray switch (F) terminal 2 outlet wire GrY and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, water spray switch (F) is faulty.	Replace water spray switch (F).
6. Water Spray Switch (R)	(1) When starter switch is ON, measure voltage between water spray switch (R) terminal 1 inlet wire Gr and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between water spray switch (R) terminal 2 outlet wire LgB and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, water spray switch (R) is faulty.	Replace water spray switch (R).
7. Water Spray Change Relay	(1) When starter switch is ON, measure voltage between water spray change relay terminal 4 inlet wire Lg and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between water spray change relay terminal 3 outlet wire Gr and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, water spray change relay is faulty.	Replace water spray change relay.
8. Water Spray Mode Select Switch	(1) When starter switch is ON, measure voltage between water spray mode select switch terminal 1 inlet wire WY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between water spray mode select switch terminal 3 outlet wire Lg and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, water spray mode select switch is faulty.	Replace water spray mode select switch.
9. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-6-1



SW654-10005

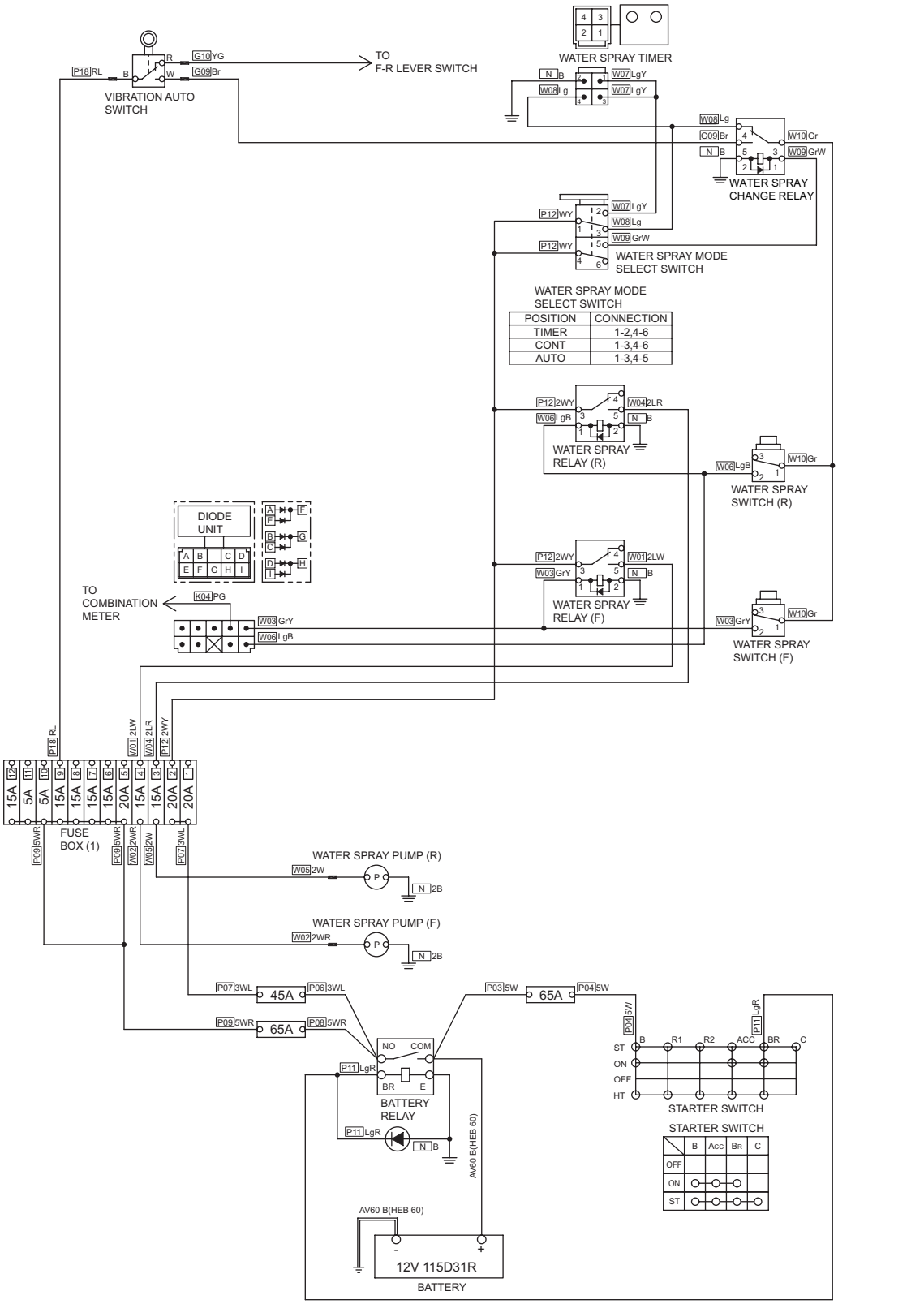
2-6-2. Continuous water spray works, but auto water spray does not operate

- Water spray mode select switch must be “AUTO”.
- F-R lever must be “F” or “R”.

Reference Fig.: 2-6-1

Check point	Check/Cause	Action
1. Water Spray Change Relay	(1) When starter switch is ON, measure voltage between water spray change relay terminal 1 inlet wire GrW and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between water spray change relay terminal 5 inlet wire Br and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between water spray change relay terminal 3 outlet wire Gr and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, water spray change relay is faulty.	Replace water spray change relay.
2. Vibration AUTO Switch	(1) When starter switch is ON, measure voltage between vibration AUTO switch terminal inlet wire RL and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between vibration AUTO switch terminal outlet wire Br and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, vibration AUTO switch is faulty.	Replace vibration AUTO switch.
3. Water Spray Mode Select Switch	(1) When starter switch is ON, measure voltage between water spray mode select switch terminal 4 inlet wire WY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between water spray mode select switch terminal 5 outlet wire GrW and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, water spray mode select switch is faulty.	Replace water spray mode select switch.
4. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-6-1



SW654-10005

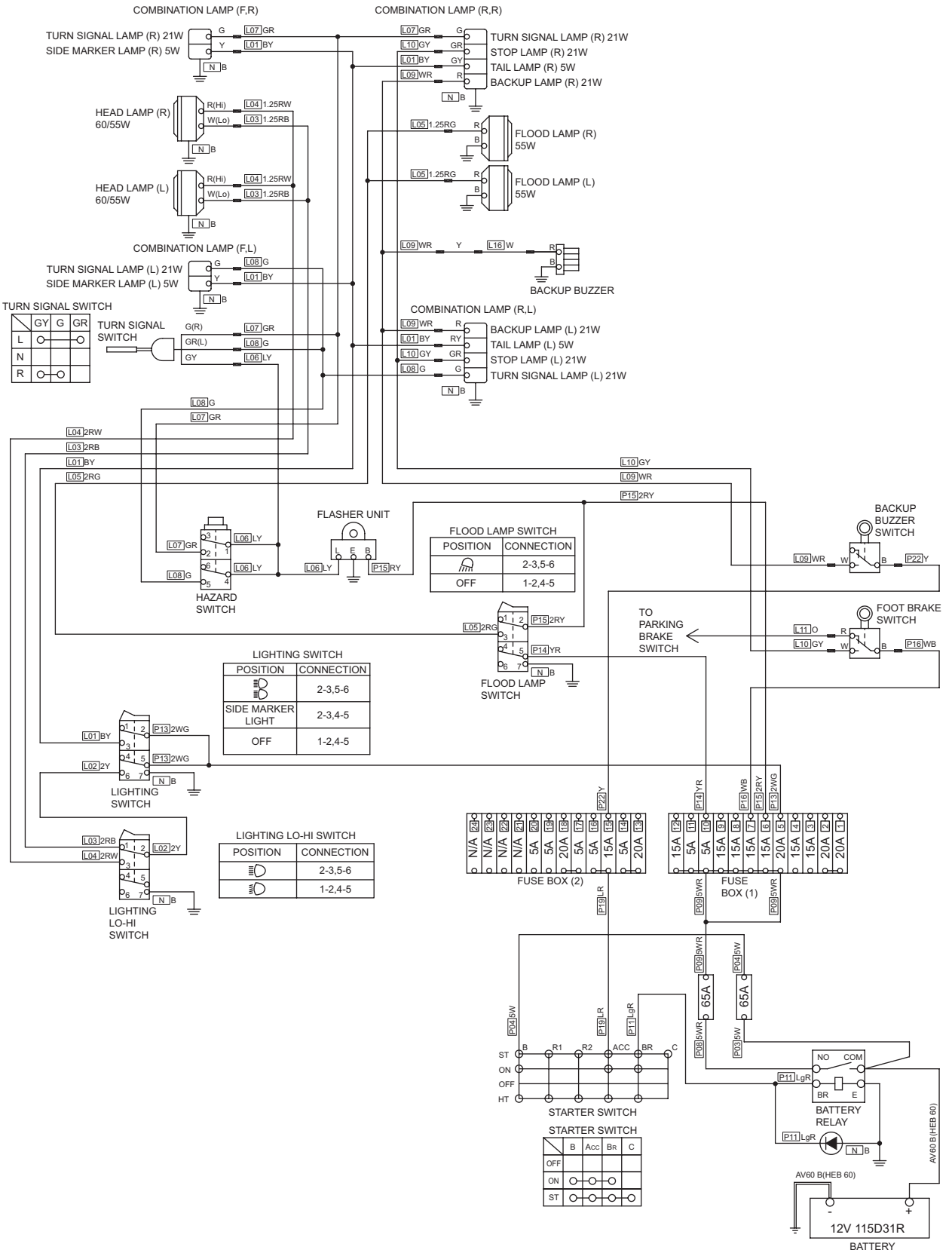
2-6-3. Continuous water spray works, but intermittent water spray does not operate

• Water spray mode select switch must be “TIMER”.

Reference Fig. : 2-6-1

Check point	Check/Cause	Action
1. Water Spray Timer	(1) When starter switch is ON, measure voltage between water spray timer terminal 1 and 3 inlet wire LgY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between water spray timer terminal 4 outlet wire Lg and chassis ground. Standard voltage : 12 V or more (Electricity flows for a definite time.) • If above item (1) is OK and item (2) is NG, water spray timer is faulty.	Replace water spray timer.
2. Water Spray mode Select Switch	(1) When starter switch is ON, measure voltage between water spray mode select switch terminal 1 inlet wire WY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between water spray mode select switch terminal 2 outlet wire LgY and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, water spray mode select switch is faulty.	Replace water spray mode select switch.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-7-1



SW654-10006

2-7. Lighting

Check following items before troubleshooting.

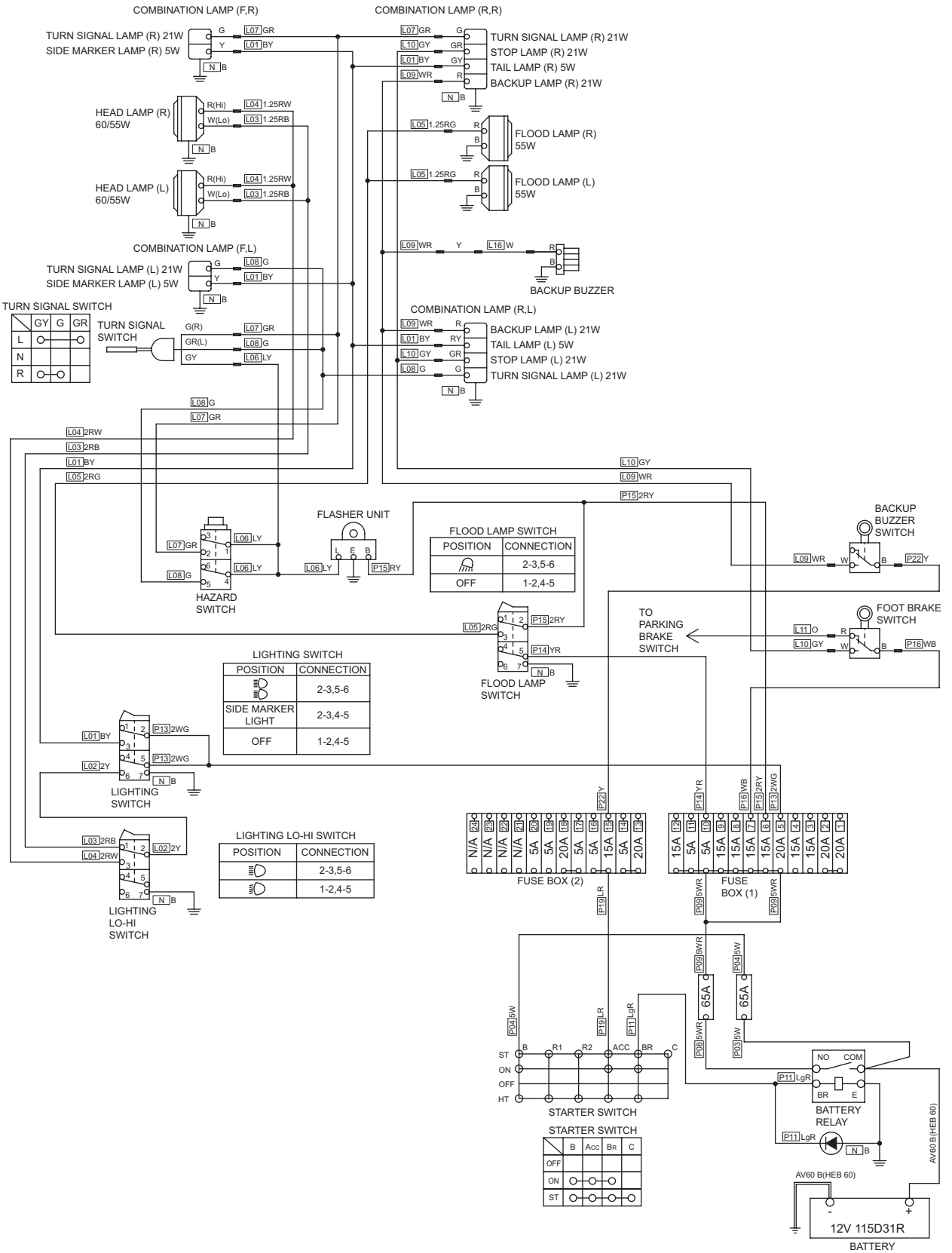
- No blown fuse and power is applied up to fuses.

2-7-1. Head lamp, side marker lamp and tail lamp do not light

Reference Fig. : 2-7-1

Check point	Check/Cause	Action
1. Battery	• Measure battery voltage or specific gravity. Standard voltage : 12 V or more Standard gravity : 1.26 or more • If value is below standard, battery capacity is insufficient.	Charge or replace battery.
2. Each Bulb	• Check that none of lamp bulbs is burned out or has a contact failure. • Bulb is faulty or poorly connected.	Replace each bulb.
3. Lighting Switch	(1) When starter switch is ON, measure voltage between lighting switch terminal 2 and 5 inlet wire WG and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and lighting switch is “SIDE MARKER LIGHT”, measure voltage between lighting switch terminal 3 outlet wire BY and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON and lighting switch is “ ”, measure voltage between lighting switch terminal 6 outlet wire Y and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) or (3) is NG, lighting switch is faulty.	Replace lighting switch.
4. Lighting Lo-Hi Switch	(1) When starter switch is ON and lighting switch is “ ”, measure voltage between ighting Lo-Hi switch terminal 2 inlet wire Y and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, lighting switch is “ ” and lighting Lo-Hi switch is “ ”, measure voltage between lighting Lo-Hi switch terminal 1 outlet wire RB and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, lighting Lo-Hi switch is faulty.	Replace lighting Lo-Hi switch.
5. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-7-1



SW654-10006

2-7-2. Flood lamp does not light

Reference Fig. : 2-7-1

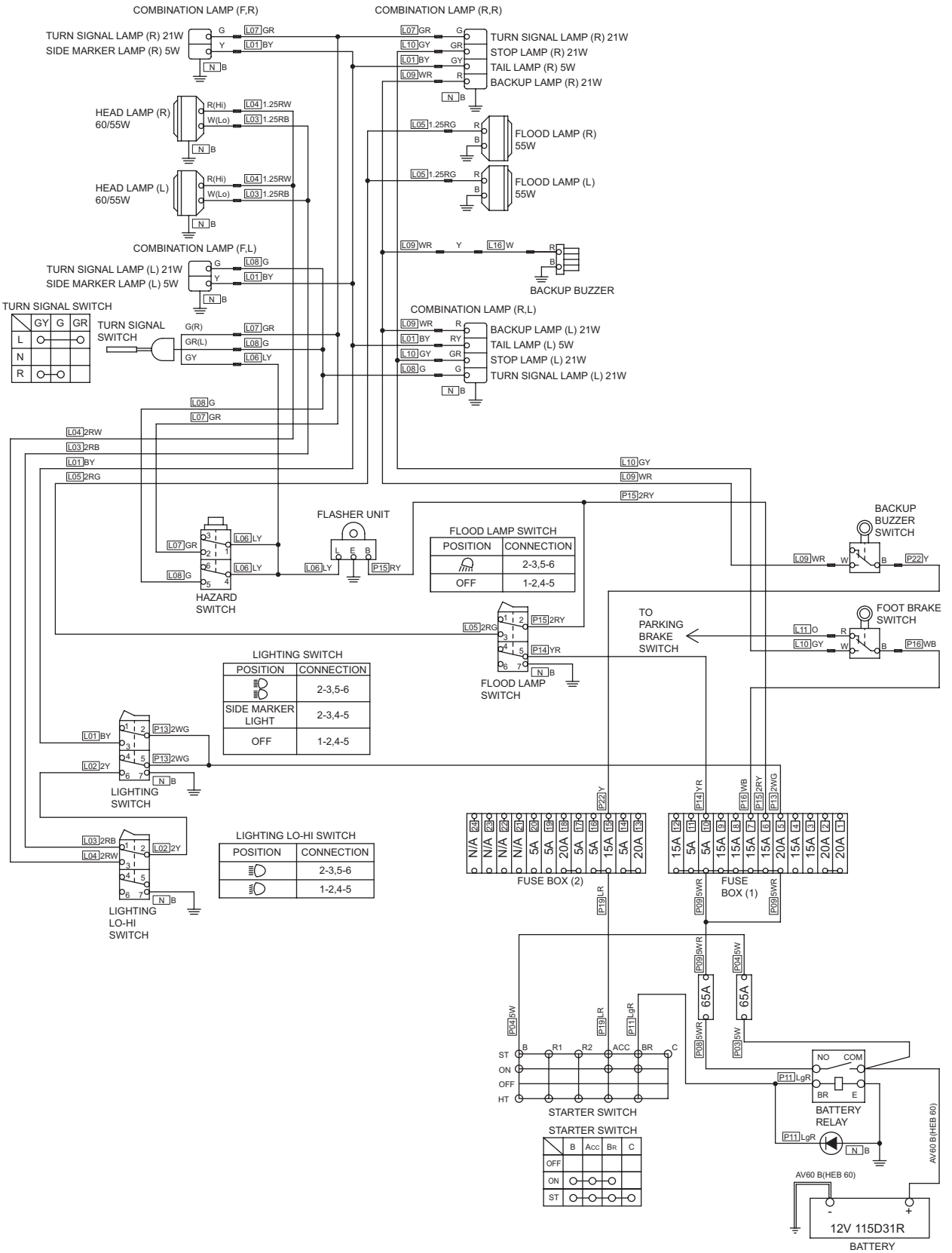
Check point	Check/Cause	Action
1. Each Bulb	• Check that none of lamp bulbs is burned out or has a contact failure. • Bulb is faulty or poorly connected.	Replace each bulb.
2. Flood Lamp Switch	(1) When starter switch is ON, measure voltage between flood lamp switch terminal 2 inlet wire RY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and flood lamp switch is "  ", measure voltage between flood lamp switch terminal 3 outlet wire RG and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, flood lamp switch is faulty.	Replace flood lamp switch.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

2-7-3. High-beam of head lamp does not light

Reference Fig. : 2-7-1

Check point	Check/Cause	Action
1. Each Bulb	• Check that none of lamp bulbs is burned out or has a contact failure. • Bulb is faulty or poorly connected.	Replace each bulb.
2. Lighting Lo-Hi Switch	(1) When starter switch is ON and lighting switch is "  ", measure voltage between lighting Lo-Hi switch terminal 2 inlet wire Y and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, lighting switch is "  " and lighting Lo-Hi switch is "  ", measure voltage between lighting Lo-Hi switch terminal 3 outlet wire RW and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, turn signal switch is faulty.	Replace lighting Lo-Hi switch.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-7-1



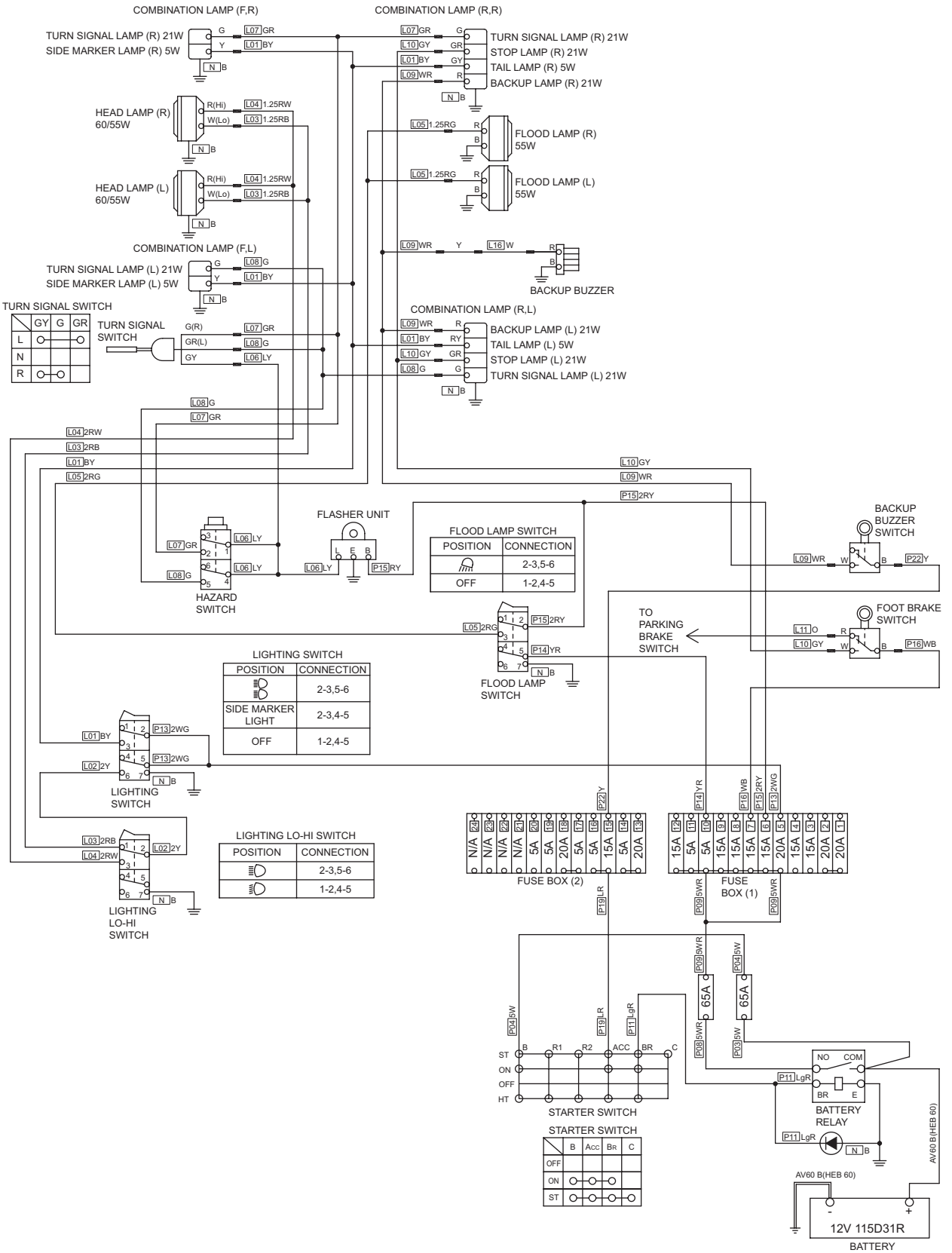
SW654-10006

2-7-4. Turn signal lamp does not blink

Reference Fig. : 2-7-1

Check point	Check/Cause	Action
1. Each Bulb	• Check that none of lamp bulbs is burned out or has a contact failure. • Bulb is faulty or poorly connected.	Replace each bulb.
2. Flasher Unit	(1) When starter switch is ON, measure voltage between flasher unit terminal B inlet wire RY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and turn signal switch lever is moved, measure voltage between flasher unit terminal L outlet wire LY and chassis ground. Standard voltage : 12 V or more with constant intervals • If above item (1) is OK and item (2) is NG, flasher unit is faulty.	Replace flasher unit.
3. Turn Signal Switch	(1) When starter switch is ON and turn signal switch lever is moved, measure voltage between turn signal switch terminal inlet wire LY and chassis ground. Standard voltage : 12 V or more with constant intervals (2) When starter switch is ON and turn signal switch lever is moved, measure voltage between turn signal switch terminals and chassis ground. Turn signal (L) : Wire No.L08 outlet wire G Turn signal (R) : Wire No.L07 outlet wire GR Standard voltage : 12 V or more with constant intervals • If above item (1) is OK and item (2) is NG, turn signal switch is faulty.	Replace turn signal switch.
4. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-7-1



SW654-10006

2-7-5. Hazard lamp does not light (Turn signal blinks)

• Hazard switch must be ON.

Reference Fig. : 2-7-1

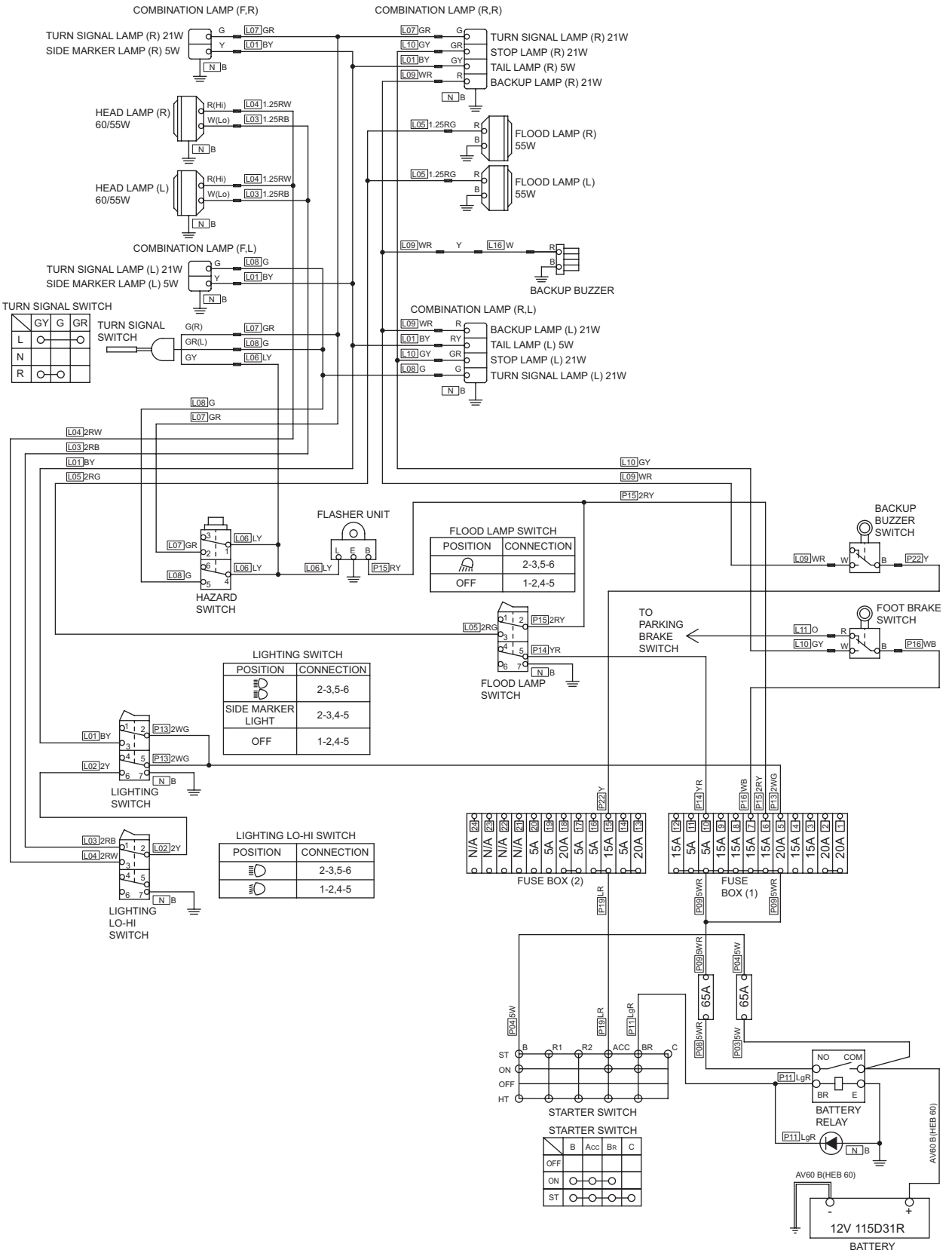
Check point	Check/Cause	Action
1. Each Bulb	• Check that none of lamp bulbs is burned out or has a contact failure. • Bulb is faulty or poorly connected.	Replace each bulb.
2. Hazard Switch	(1) When starter switch is ON, measure voltage between hazard switch terminal 1 and 4 inlet wire LY and chassis ground. Standard voltage : 12 V or more with constant intervals (2) When starter switch is ON, measure voltage between hazard switch terminal 5 outlet wire G and chassis ground. Standard voltage : 12 V or more with constant intervals (3) When starter switch is ON, measure voltage between hazard switch terminal 2 outlet wire GR and chassis ground. Standard voltage : 12 V or more with constant intervals • If above item (1) is OK and item (2) or (3) is NG, hazard switch is faulty.	Replace hazard switch.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

2-7-6. Backup lamp does not light

Reference Fig. : 2-7-1

Check point	Check/Cause	Action
1. Each Bulb	• Check that none of lamp bulbs is burned out or has a contact failure. • Bulb is faulty or poorly connected.	Replace each bulb.
2. Backup Buzzer Switch	(1) When starter switch is ON, measure voltage between backup buzzer switch terminal inlet wire Y and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and F-R lever is “R” , measure voltage between backup buzzer switch terminal outlet wire WR and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, backup buzzer switch is faulty.	Replace backup buzzer switch.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-7-1



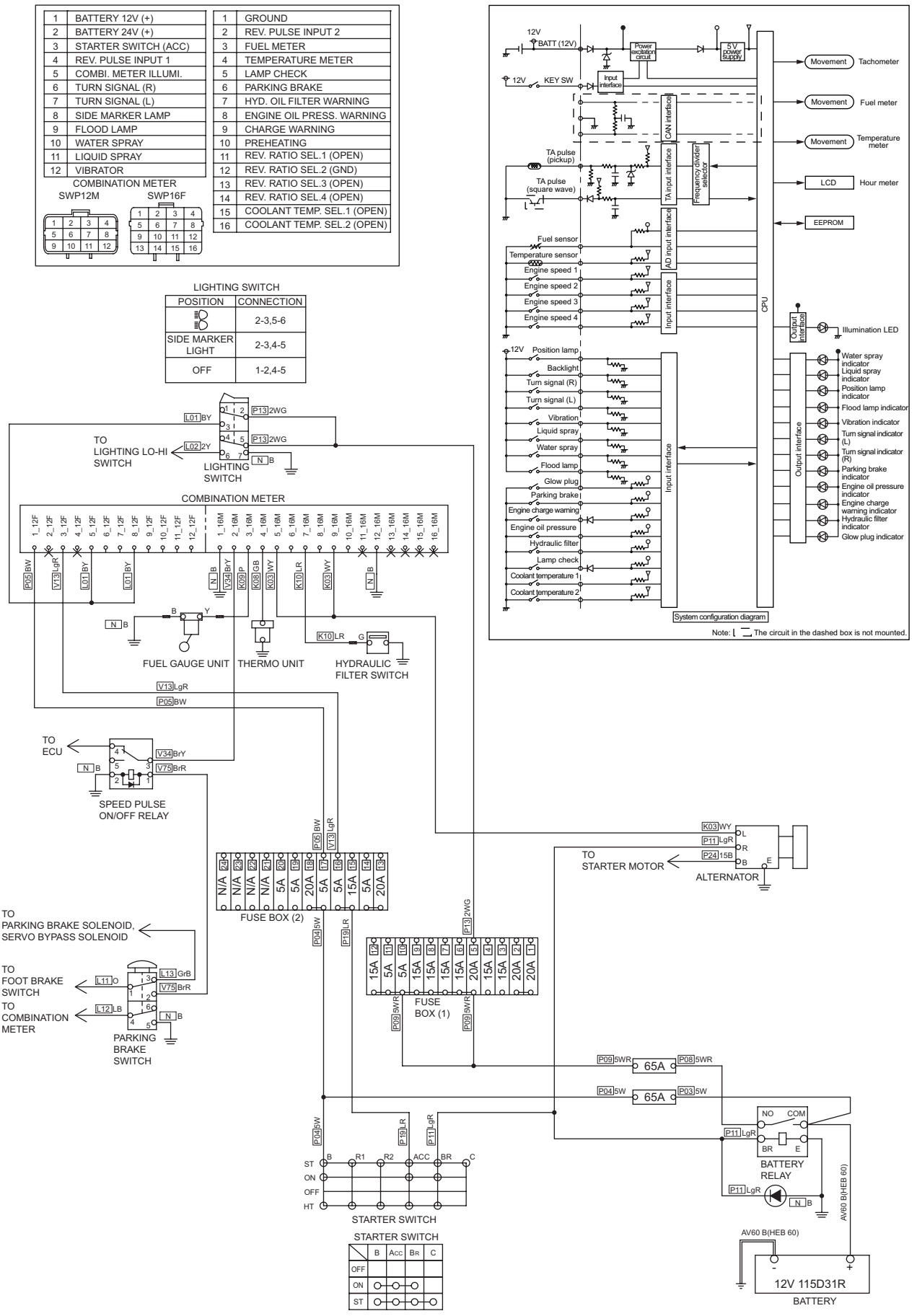
SW654-10006

2-7-7. Stop lamp does not light

Reference Fig. : 2-7-1

Check point	Check/Cause	Action
1. Each Bulb	• Check that none of lamp bulbs is burned out or has a contact failure. • Bulb is faulty or poorly connected.	Replace each bulb.
2. Foot Brake Switch	(1) When starter switch is ON, measure voltage between foot brake switch terminal inlet wire WB and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON while foot brake is depressed, measure voltage between foot brake switch terminal outlet wire GY and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, foot brake switch is faulty.	Replace foot brake switch.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-7-2



SW654-10007

2-7-8. Illumination of combination meter does not light

Reference Fig. : 2-7-2

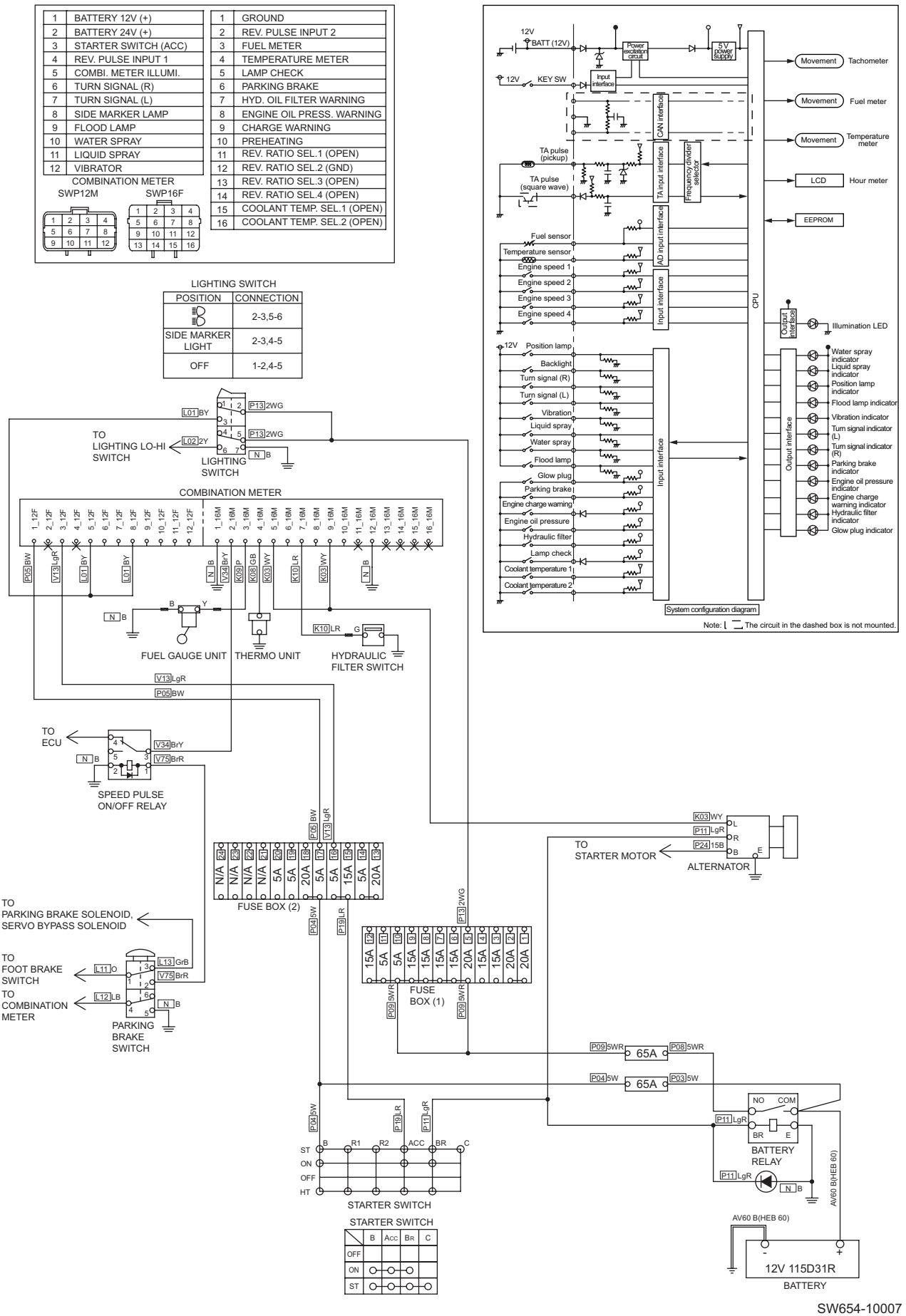
Check point	Check/Cause	Action
1. Harness	• Measure resistance between lighting switch terminal 3 wire BY and combination meter connector terminal wire No.L01 wire BY. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.
2. Combination Meter (Combination meter illumination)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery 12 V (+) terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B • Starter switch (ACC) terminal wire No.V13 inlet wire LgR and ground terminal wire No.N wire B Standard voltage : 12 V or more (2) When starter switch is ON and lighting switch is "SIDE MARKER LIGHT", measure voltage between combination meter illumination terminal wire No.L01 inlet wire BY and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and combination meter does not turn on, combination meter is faulty.	Replace combination meter.

2-7-9. Combination meter warning lamp or indicator lamp is abnormal

Reference Fig. : 2-7-2

Check point	Check/Cause	Action
1. Combination Meter (Lamp check)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery 12 V (+) terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B • Starter switch (ACC) terminal wire No.V13 inlet wire LgR and ground terminal wire No.N wire B Standard voltage : 12 V or more (2) When starter switch is ON, check that parking brake indicator lamp, hydraulic oil filter warning lamp, engine oil pressure warning lamp and charge warning lamp illuminate and then go out after starting engine. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, combination meter is faulty. **(NOTICE)** • **Since engine cannot start unless parking brake switch is applied, parking brake indicator lamp does not go out even after starting engine.**	Replace combination meter.

Fig.: 2-7-2



SW654-10007

2-7-10. Tachometer reading is abnormal

Reference Fig. : 2-7-2

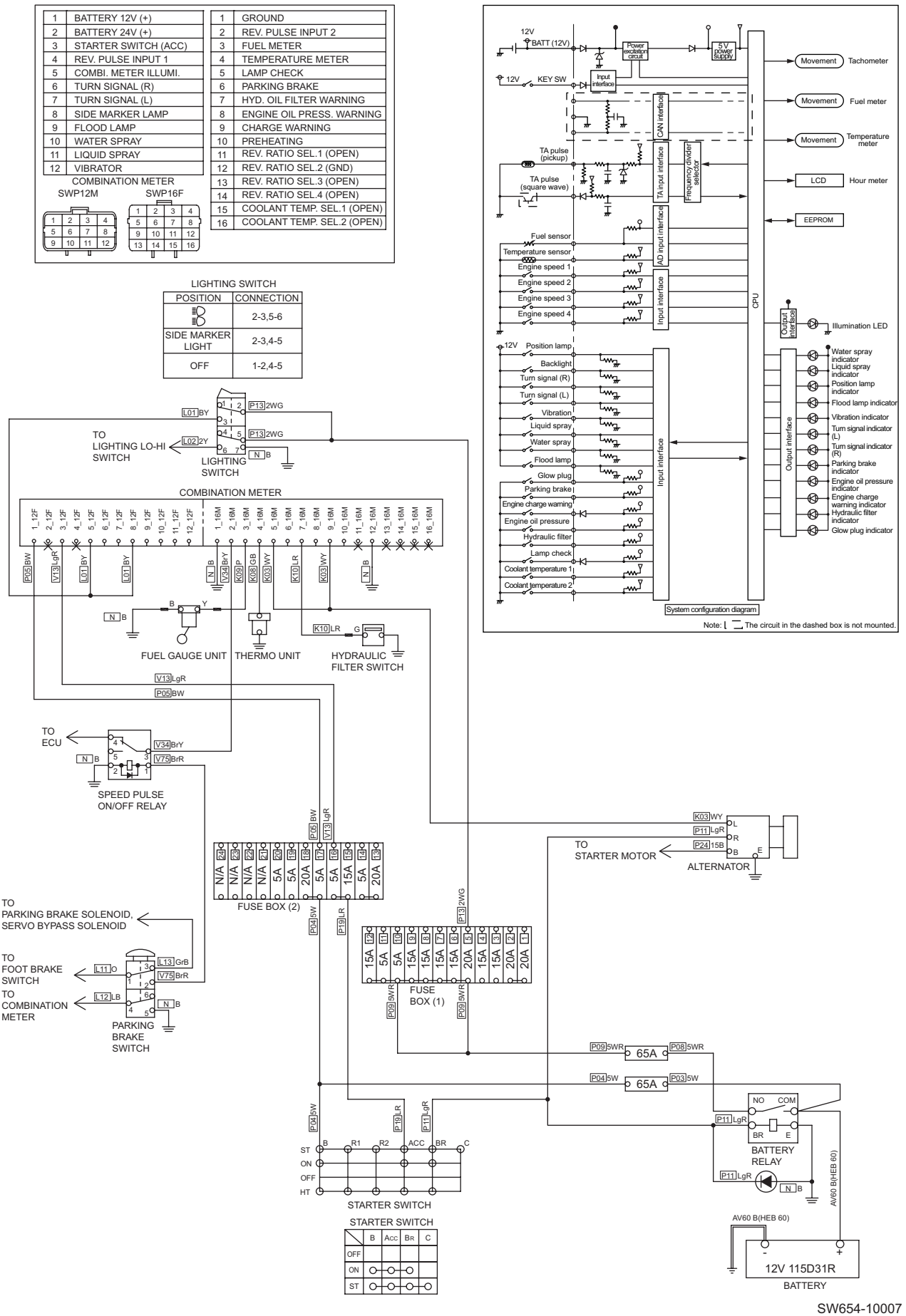
Check point	Check/Cause	Action
1. Combination Meter (Tachometer)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery 12 V (+) terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B • Starter switch (ACC) terminal wire No.V13 inlet wire LgR and ground terminal wire No.N wire B Standard voltage : 12 V or more (2) Check that combination meter REV. ratio SEL.2 terminal wire No.N wire B is grounded. (3) Start engine and measure pulse between combination meter REV. pulse input.2 terminal wire No.V34 wire BrY and chassis ground. Standard pulse : 3 pulses/rotation of engine • If above item is OK and tachometer reading is NG, combination meter is faulty.	Replace combination meter.
2. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

2-7-11. Hour meter is abnormal

Reference Fig. : 2-7-2

Check point	Check/Cause	Action
1. Combination Meter (Hour meter)	• When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery 12 V (+) terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B • Starter switch (ACC) terminal wire No.V13 inlet wire LgR and ground terminal wire No.N wire B Standard voltage : 12 V or more • If no abnormality is found, combination meter is faulty.	Replace combination meter.

Fig.: 2-7-2



SW654-10007

2-7-12. Temperature meter is abnormal

Reference Fig. : 2-7-2

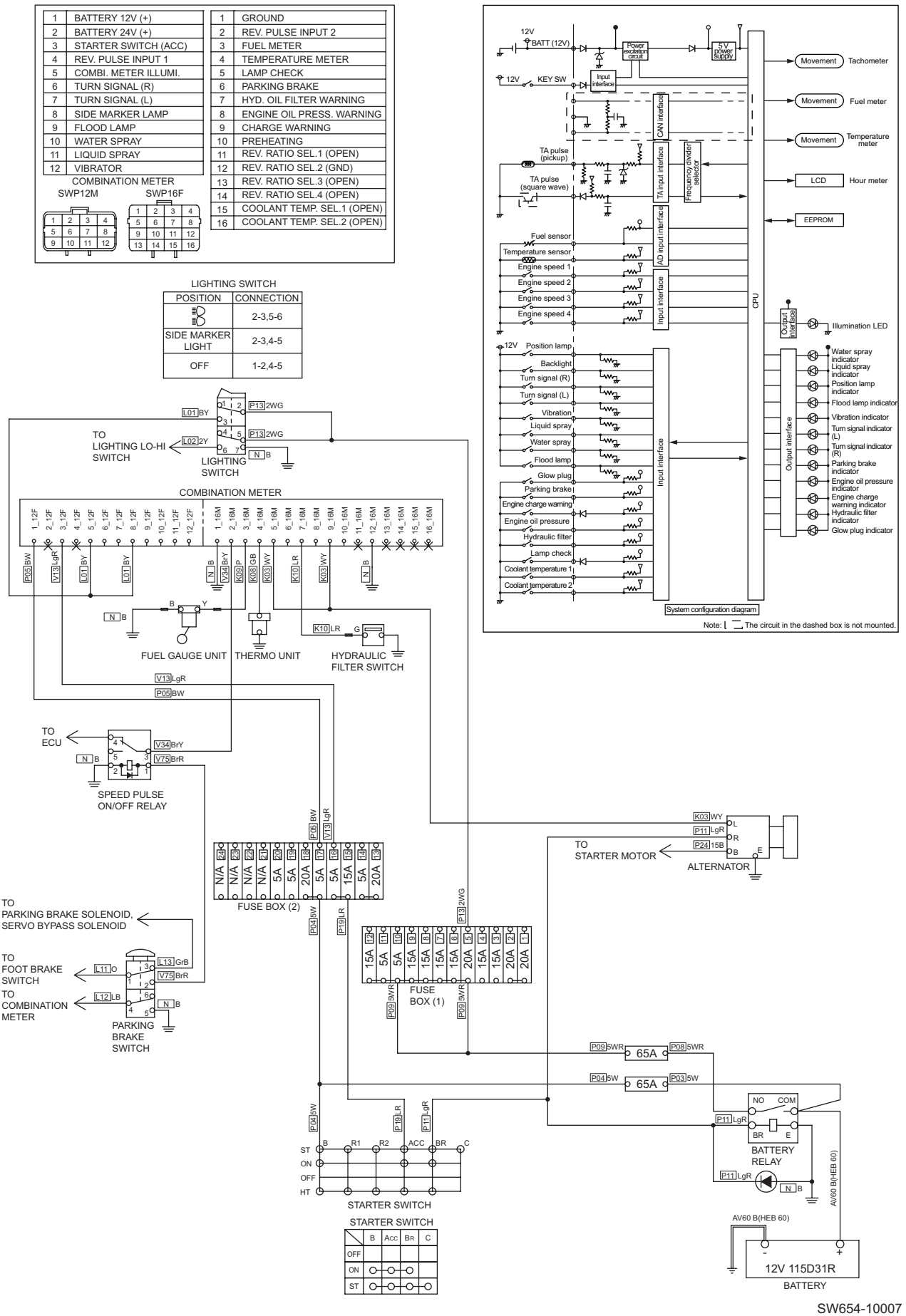
Check point	Check/Cause	Action
1. Thermo Unit	• Disconnect harness and measure resistance of thermo unit. Standard resistance : 164.6 Ω (at unit temperature of 50℃) 26.44 Ω (at unit temperature of 103℃) • If resistance is abnormal, thermo unit is faulty.	Replace thermo unit.
2. Combination Meter (Temperature meter)	• When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery 12 V (+) terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B • Starter switch (ACC) terminal wire No.V13 inlet wire LgR and ground terminal wire No.N wire B Standard voltage : 12 V or more • If no abnormality is found, combination meter is faulty.	Replace combination meter.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

2-7-13. Fuel meter is abnormal

Reference Fig. : 2-7-2

Check point	Check/Cause	Action
1. Fuel Gauge Unit	• Disconnect harness and measure resistance of fuel gauge unit. Standard resistance : 13.5 Ω (with float in “F”) 80.0 Ω (with float in “E”) • If resistance is abnormal, fuel gauge unit is faulty.	Replace fuel gauge unit.
2. Combination Meter (Fuel meter)	• When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery 12 V (+) terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B • Starter switch (ACC) terminal wire No.V13 inlet wire LgR and ground terminal wire No.N wire B Standard voltage : 12 V or more • If no abnormality is found, combination meter is faulty.	Replace combination meter.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-7-2



SW654-10007

2-7-14. Hydraulic oil filter warning lamp remains ON

Reference Fig. : 2-7-2

Check point	Check/Cause	Action

1. Harness	• Disconnect connectors between combination meter and hydraulic oil filter switch.
	• Measure resistance between terminals and chassis ground.
	  • Hydraulic oil filter switch terminal wire LR and chassis ground.
	  • Combination meter connector terminal wire No.K10 wire LR and chassis ground.
	  Standard resistance : 100k Ω or more
	• If resistance is abnormal, harness is faulty.
		Repair or replace harness.

2. Hydraulic Oil Filter Switch	• When starter switch is OFF, check continuity between hydraulic oil filter switch inlet terminal wire LR and chassis ground. There is no continuity in normal condition. • If there is continuity, hydraulic oil filter switch is faulty.	Replace hydraulic oil filter switch.

3. Combination Meter (Hydraulic oil filter warning)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire.
	  • Battery terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B.
	  • Starter switch (ACC) terminal wire No.V13 inlet wire LgR and ground terminal wire No.N wire B.
	  Standard voltage : 12 V or more
	(2) When starter switch is ON, measure voltage between combination meter hydraulic oil filter warning terminal outlet wire No.K10 wire LR and chassis ground.
	  Standard voltage : 12 V or more
	• If above items (1) and (2) are OK but hydraulic oil filter warning lamp remains on after starting engine, combination meter is faulty.
		Replace combination meter.

2-7-15. Charge warning lamp remains ON

• Check with engine running.

Reference Fig. : 2-7-2

Check point	Check/Cause	Action

1. Harness	• Disconnect connectors between combination meter and alternator terminal L.
	• Measure resistance between terminals and chassis ground.
	  • Combination meter connector terminal wire No.K03 wire WY and chassis ground.
	  • Alternator terminal L wire WY and chassis ground
	  Standard resistance : 100k Ω or more
	• If resistance is abnormal, harness is faulty.
		Repair or replace harness.

2. Combination Meter (Charge warning lamp)	• Measure voltage between combination meter charge warning terminal wire No.K03 outlet wire WY and chassis ground. Standard voltage : 12 V or more • If no abnormality is found, combination meter is faulty.	Replace combination meter.

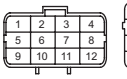
Fig.: 2-7-3

1	BATTERY 12V (+)
2	BATTERY 24V (+)
3	STARTER SWITCH (ACC)
4	REV. PULSE INPUT 1
5	COMBI. METER ILLUMI.
6	TURN SIGNAL (R)
7	TURN SIGNAL (L)
8	SIDE MARKER LAMP
9	FLOOD LAMP
10	WATER SPRAY
11	LIQUID SPRAY
12	VIBRATOR

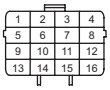
1	GROUND
2	REV. PULSE INPUT 2
3	FUEL METER
4	TEMPERATURE METER
5	LAMP CHECK
6	PARKING BRAKE
7	HYD. OIL FILTER WARNING
8	ENGINE OIL PRESS. WARNING
9	CHARGE WARNING
10	PREHEATING
11	REV. RATIO SEL.1 (OPEN)
12	REV. RATIO SEL.2 (GND)
13	REV. RATIO SEL.3 (OPEN)
14	REV. RATIO SEL.4 (OPEN)
15	COOLANT TEMP. SEL.1 (OPEN)
16	COOLANT TEMP. SEL.2 (OPEN)

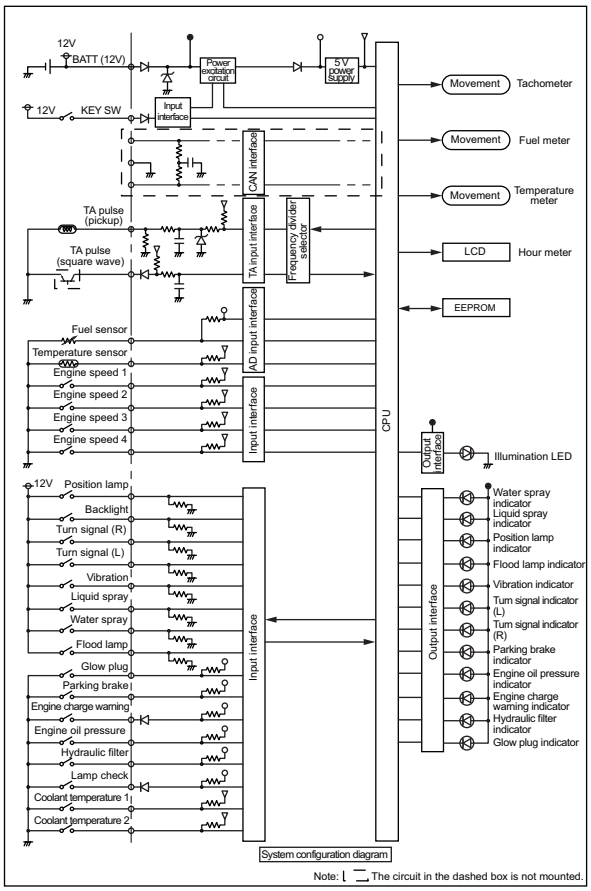
COMBINATION METER

SWP12M



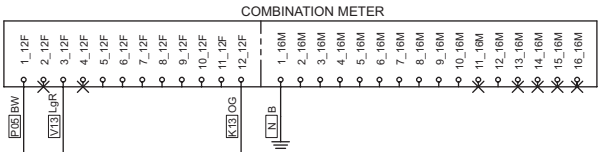
SWP16F

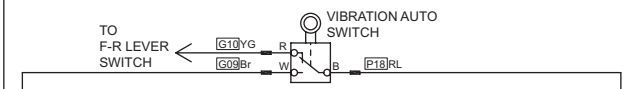


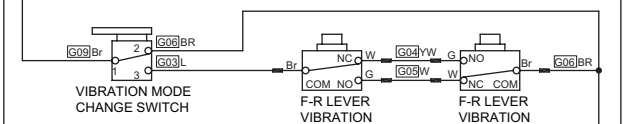


System configuration diagram

Note: The circuit in the dashed box is not mounted.

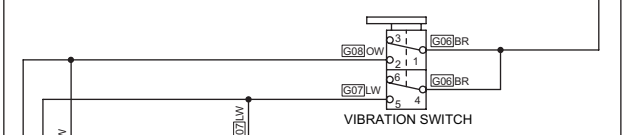


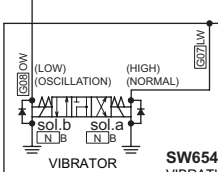




VIBRATION MODE CHANGE SWITCH

VIBRATION MODE	CONNECTION
	1-3
AUTO	1-2



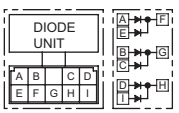


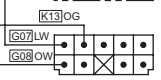
SW654
VIBRATION SWITCH

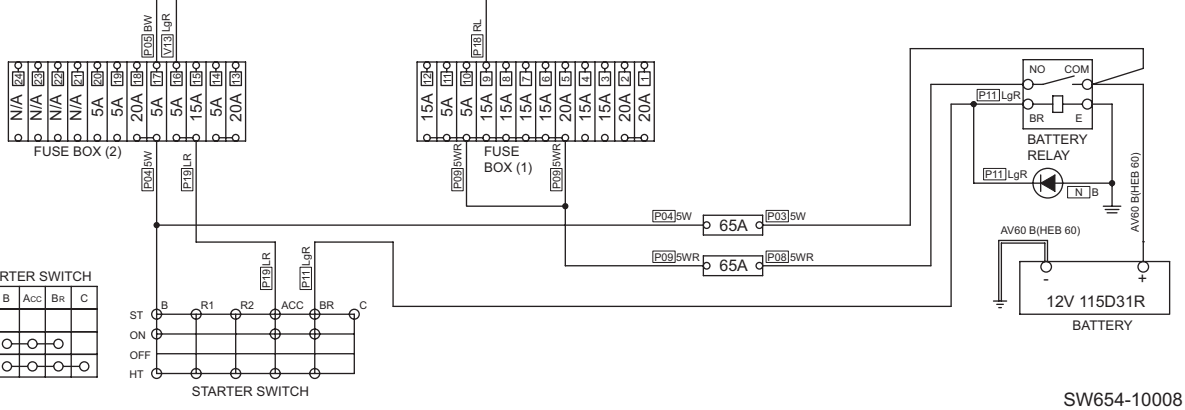
POSITION	CONNECTION
(LOW)	1-2,4-6
	1-3,4-6
(HIGH)	1-3,4-5

SW654ND
VIBRATION SWITCH

POSITION	CONNECTION
(OSCILLATION)	1-2,4-6
	1-3,4-6
(NORMAL)	1-3,4-5







SW654-10008

2-7-16. Vibration indicator lamp does not light

- Check that vibrator can be operated.

Reference Fig. : 2-7-3

Check point	Check/Cause	Action
1. Harness	(1) Measure resistance between vibration switch terminal 5 wire LW and diode unit terminal E wire LW. Standard resistance : 10 Ω or less (2) Measure resistance between vibration switch terminal 2 wire OW and diode unit terminal A wire OW. Standard resistance : 10 Ω or less (3) Measure resistance between diode unit terminal F wire OG and combination meter connector terminal wire No. K13 wire OG. Standard resistance : 10 Ω or less • If above item (1), (2) or (3) is NG, harness is faulty.	Repair or replace harness.
2. Diode Unit	(1) When starter switch is ON and vibration switch is in below position, measure voltage between diode unit terminal A inlet wire OW and chassis ground. SW654 : “ ” (LOW) SW654ND : “ ” (OSCILLATION) Standard voltage : 12 V or more (2) When starter switch is ON and vibration switch is in below position, measure voltage between diode unit terminal E inlet wire LW and chassis ground. SW654 : “ ” (HIGH) SW654ND : “ ” (NORMAL) Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between diode unit terminal F outlet wire OG and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, diode unit is faulty.	Replace diode unit.
3. Combination Meter (Vibration indicator lamp)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery 12 V (+) terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B • Starter switch (ACC) terminal wire No.V13 inlet wire LgR and ground terminal wire No.N wire B Standard voltage : 12 V or more (2) When starter switch is ON, F-R lever and vibration mode change switch and vibration switch in below position, measure voltage between combination meter vibration terminal wire No. K13 inlet wire OG and chassis ground. F-R lever : “F” or “R” Vibration mode change switch : “AUTO” Vibration switch : Must not be “ ◯ ” Standard voltage : 12 V or more • If above items (1) and (2) are OK and vibration indicator lamp does not light, combination meter is faulty.	Replace combination meter.

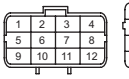
Fig.: 2-7-4

1	BATTERY 12V (+)
2	BATTERY 24V (+)
3	STARTER SWITCH (ACC)
4	REV. PULSE INPUT 1
5	COMBI. METER ILLUMI.
6	TURN SIGNAL (R)
7	TURN SIGNAL (L)
8	SIDE MARKER LAMP
9	FLOOD LAMP
10	WATER SPRAY
11	LIQUID SPRAY
12	VIBRATOR

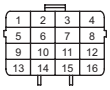
1	GROUND
2	REV. PULSE INPUT 2
3	FUEL METER
4	TEMPERATURE METER
5	LAMP CHECK
6	PARKING BRAKE
7	HYD. OIL FILTER WARNING
8	ENGINE OIL PRESS. WARNING
9	CHARGE WARNING
10	PREHEATING
11	REV. RATIO SEL.1 (OPEN)
12	REV. RATIO SEL.2 (GND)
13	REV. RATIO SEL.3 (OPEN)
14	REV. RATIO SEL.4 (OPEN)
15	COOLANT TEMP. SEL.1 (OPEN)
16	COOLANT TEMP. SEL.2 (OPEN)

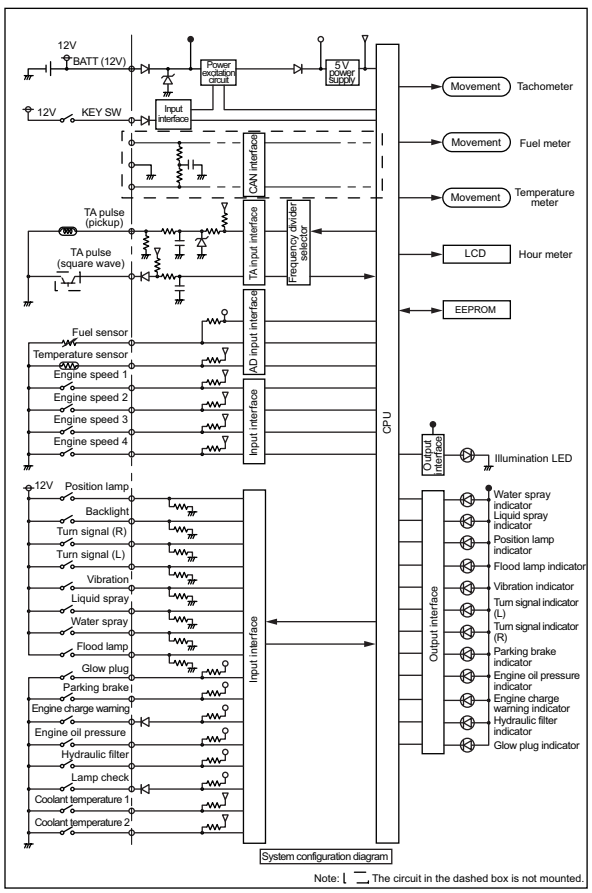
COMBINATION METER

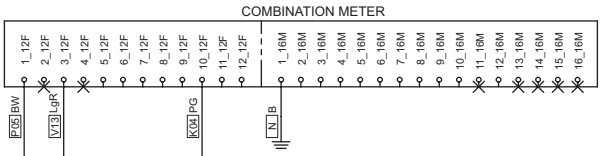
SWP12M

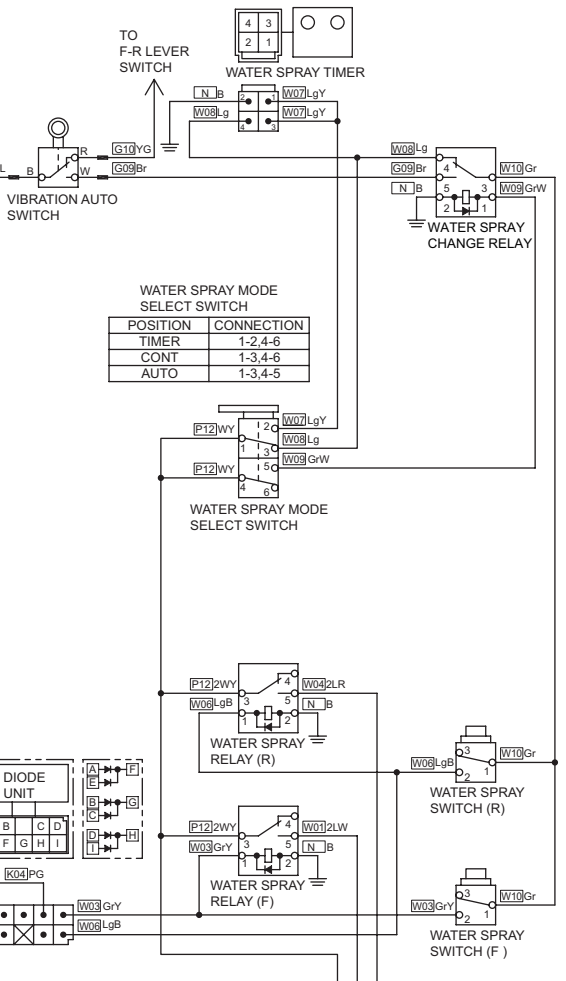


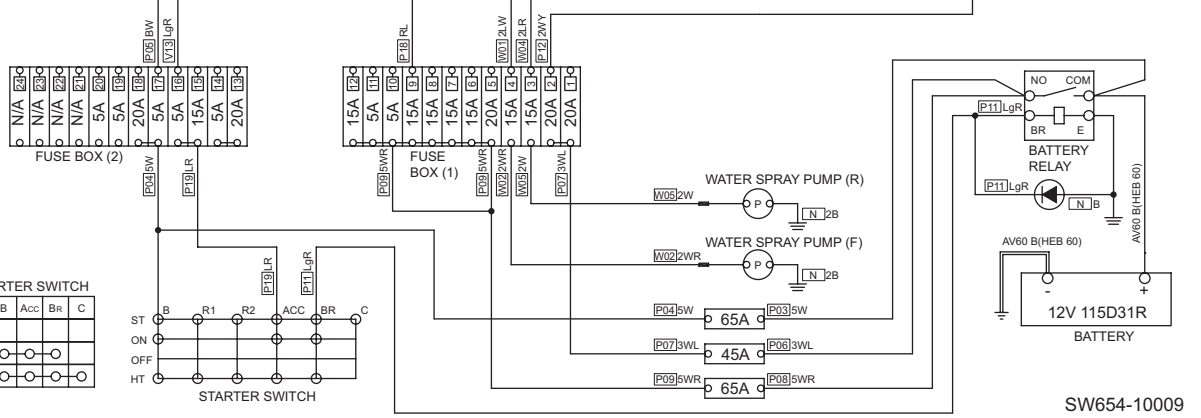
SWP16F











SW654-10009

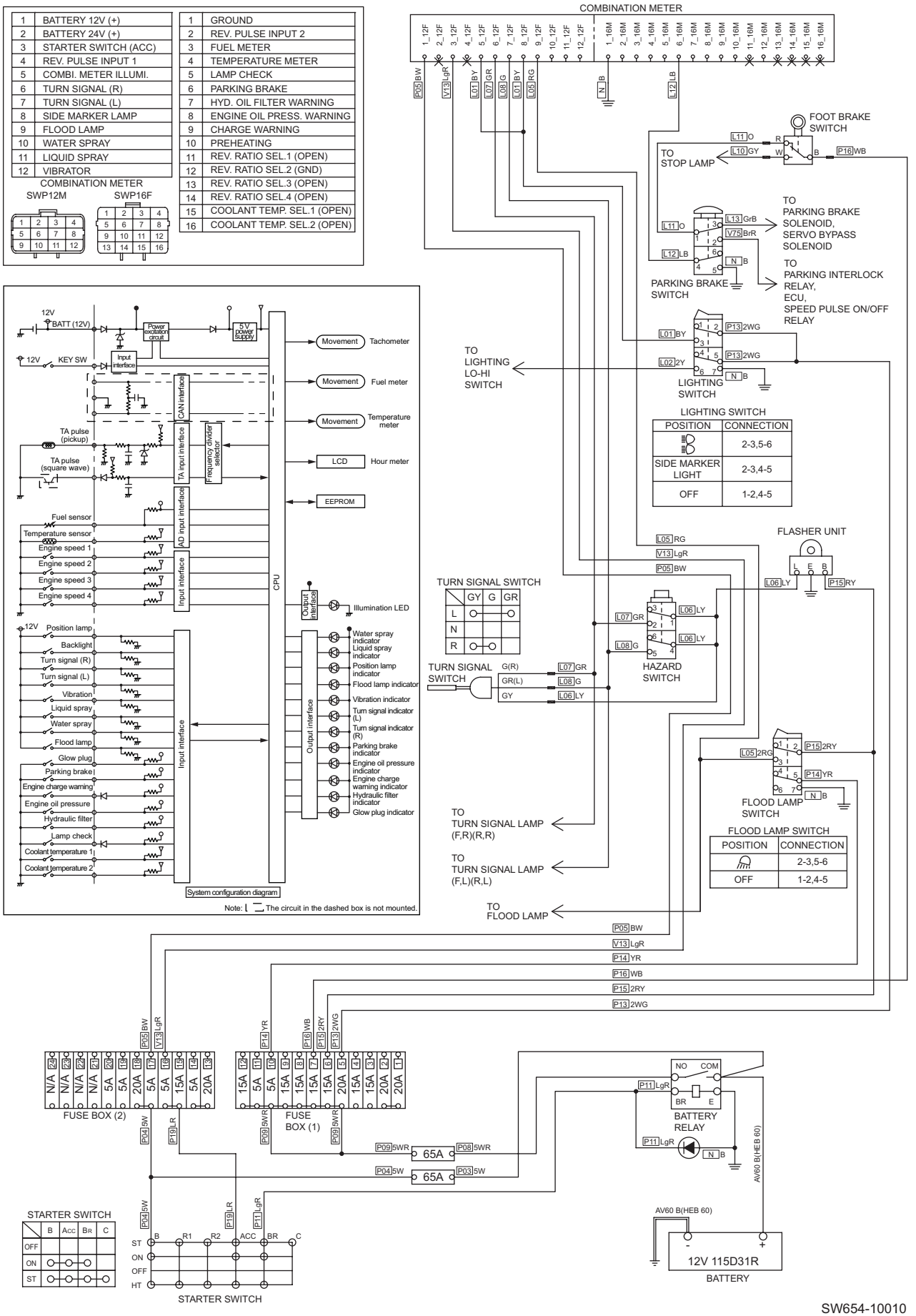
2-7-17. Water spray indicator lamp does not light

• Check that water spray pump can be activated.

Reference Fig. : 2-7-4

Check point	Check/Cause	Action
1. Harness	(1) Measure resistance between water spray switch (F) terminal 2 wire GrY and diode unit terminal I wire GrY. Standard resistance : 10 Ω or less (2) Measure resistance between water spray switch (R) terminal 2 wire LgB and diode unit terminal D wire LgB. Standard resistance : 10 Ω or less (3) Measure resistance between diode unit terminal H wire PG and combination meter connector terminal wire No. K04 wire PG. Standard resistance : 10 Ω or less • If above item (1) , (2) or (3) is NG, harness is faulty.	Repair or replace harness.
2. Diode Unit	(1) When starter switch is ON, water spray switch (F) is ON and water spray mode select switch is “CONT”, measure voltage between diode unit terminal I inlet wire GrY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, water spray switch (R) is ON and water spray mode select switch is “CONT”, measure voltage between diode unit terminal D inlet wire LgB and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON, water spray switch (F) or (R) is ON and water spray mode select switch is “CONT” , measure voltage between diode unit terminal H outlet wire PG and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, diode unit is faulty.	Replace diode unit.
3. Combination Meter (Water spray indicator lamp)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery 12 V (+) terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B • Starter switch (ACC) terminal wire No.V13 inlet wire LgR and ground terminal wire No.N wire B Standard voltage : 12 V or more (2) When starter switch is ON, water spray switch (F) or (R) is ON and water spray mode select switch is “CONT”, measure voltage between combination meter water spray terminal wire No.K04 inlet wire PG and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and water spray indicator lamp does not light, combination meter is faulty.	Replace combination meter.

Fig.: 2-7-5


1 BATTERY 12V (+)
2 BATTERY 24V (+)
3 STARTER SWITCH (ACC)
4 REV. PULSE INPUT 1
5 COMBI. METER ILLUMI.
6 TURN SIGNAL (R)
7 TURN SIGNAL (L)
8 SIDE MARKER LAMP
9 FLOOD LAMP
10 WATER SPRAY
11 LIQUID SPRAY
12 VIBRATOR
COMBINATION METER
SWP12M
SWP16F
1 GROUND
2 REV. PULSE INPUT 2
3 FUEL METER
4 TEMPERATURE METER
5 LAMP CHECK
6 PARKING BRAKE
7 HYD. OIL FILTER WARNING
8 ENGINE OIL PRESS. WARNING
9 CHARGE WARNING
10 PREHEATING
11 REV. RATIO SEL.1 (OPEN)
12 REV. RATIO SEL.2 (GND)
13 REV. RATIO SEL.3 (OPEN)
14 REV. RATIO SEL.4 (OPEN)
15 COOLANT TEMP. SEL.1 (OPEN)
16 COOLANT TEMP. SEL.2 (OPEN)
COMBINATION METER
FOOT BRAKE SWITCH
TO STOP LAMP
TO PARKING BRAKE SOLENOID, SERVO BYPASS SOLENOID
TO PARKING INTERLOCK RELAY, ECU, SPEED PULSE ON/OFF RELAY
PARKING BRAKE SWITCH
TO LIGHTING LO-HI SWITCH
LIGHTING SWITCH
LIGHTING SWITCH
POSITION
CONNECTION
2-3,5-6
SIDE MARKER LIGHT
2-3,4-5
OFF
1-2,4-5
FLASHER UNIT
TURN SIGNAL SWITCH
HAZARD SWITCH
TO TURN SIGNAL LAMP (F,R)(R,R)
TO TURN SIGNAL LAMP (F,L)(R,L)
TO FLOOD LAMP
FLOOD LAMP SWITCH
FLOOD LAMP SWITCH
POSITION
CONNECTION
2-3,5-6
OFF
1-2,4-5
12V
BATT (12V)
KEY SW
Power excitation circuit
5V power supply
Input interface
CAN interface
TA input interface
Frequency divider selector
AD input interface
Input interface
CPU
Output interface
Movement
Tachometer
Movement
Fuel meter
Movement
Temperature meter
LCD
Hour meter
EEPROM
TA pulse (pickup)
TA pulse (square wave)
Fuel sensor
Temperature sensor
Engine speed 1
Engine speed 2
Engine speed 3
Engine speed 4
Position lamp
Backlight
Turn signal (R)
Turn signal (L)
Vibration
Liquid spray
Water spray
Flood lamp
Glow plug
Parking brake
Engine charge warning
Engine oil pressure
Hydraulic filter
Lamp check
Coolant temperature 1
Coolant temperature 2
Illumination LED
Water spray indicator
Liquid spray indicator
Position lamp indicator
Flood lamp indicator
Vibration indicator
Turn signal indicator (L)
Turn signal indicator (R)
Parking brake indicator
Engine oil pressure indicator
Engine charge warning indicator
Hydraulic filter indicator
Glow plug indicator
System configuration diagram
Note: The circuit in the dashed box is not mounted.
FUSE BOX (2)
FUSE BOX (1)
BATTERY RELAY
65A
65A
STARTER SWITCH
STARTER SWITCH
AV60 B(HEB 60)
12V 115D31R
BATTERY
SW654-10010

2-7-18. Flood lamp indicator lamp does not light

• Check that flood lamp lights.

Reference Fig. : 2-7-5

Check point	Check/Cause	Action
1. Harness	• Measure resistance between flood lamp switch terminal 3 wire RG and combination meter connector terminal wire No.L05 wire RG. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.
2. Combination Meter (Flood lamp indicator lamp)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery 12 V (+) terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B • Starter switch (ACC) terminal wire No.V13 inlet wire LgR and ground terminal wire No.N wire B Standard voltage : 12 V or more (2) When starter switch is ON and flood lamp switch is " ", measure voltage between combination meter flood lamp terminal wire No.L05 inlet wire RG and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and flood lamp indicator lamp does not light, combination meter is faulty.	Replace combination meter.

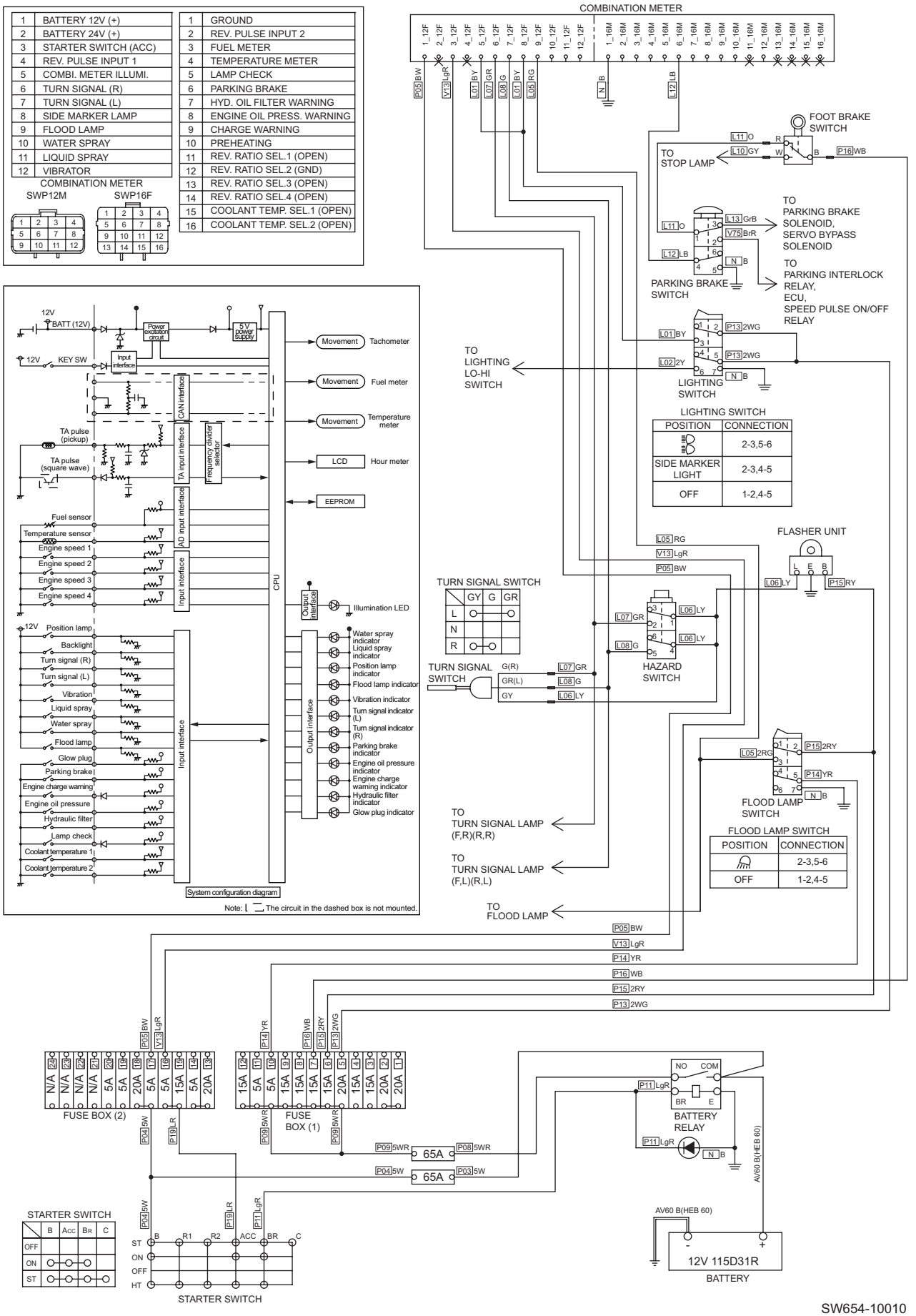
2-7-19. Side marker lamp indicator lamp does not light

• Check that side marker lamp and tail lamp light.

Reference Fig. : 2-7-5

Check point	Check/Cause	Action
1. Harness	• Measure resistance between lighting switch terminal 3 wire BY and combination meter connector terminal wire No.L01 wire BY. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.
2. Combination Meter (Side marker lamp indicator lamp)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery 12 V (+) terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B • Starter switch (ACC) terminal wire No.V13 inlet wire LgR and ground terminal wire No.N wire B Standard voltage : 12 V or more (2) When starter switch is ON and lighting switch is "SIDE MARKER LIGHT", measure voltage between combination meter side marker lamp terminal wire No.L01 inlet wire BY and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and side marker lamp indicator lamp does not light, combination meter is faulty.	Replace combination meter.

Fig.: 2-7-5



1	BATTERY 12V (+)	1	GROUND
2	BATTERY 24V (+)	2	REV. PULSE INPUT 2
3	STARTER SWITCH (ACC)	3	FUEL METER
4	REV. PULSE INPUT 1	4	TEMPERATURE METER
5	COMBI. METER ILLUMI.	5	LAMP CHECK
6	TURN SIGNAL (R)	6	PARKING BRAKE
7	TURN SIGNAL (L)	7	HYD. OIL FILTER WARNING
8	SIDE MARKER LAMP	8	ENGINE OIL PRESS. WARNING
9	FLOOD LAMP	9	CHARGE WARNING
10	WATER SPRAY	10	PREHEATING
11	LIQUID SPRAY	11	REV. RATIO SEL.1 (OPEN)
12	VIBRATOR	12	REV. RATIO SEL.2 (GND)
		13	REV. RATIO SEL.3 (OPEN)
		14	REV. RATIO SEL.4 (OPEN)
		15	COOLANT TEMP. SEL.1 (OPEN)
		16	COOLANT TEMP. SEL.2 (OPEN)

LIGHTING SWITCH	
POSITION	CONNECTION
	2-3,5-6
SIDE MARKER LIGHT	2-3,4-5
OFF	1-2,4-5

FLOOD LAMP SWITCH	
POSITION	CONNECTION
	2-3,5-6
OFF	1-2,4-5

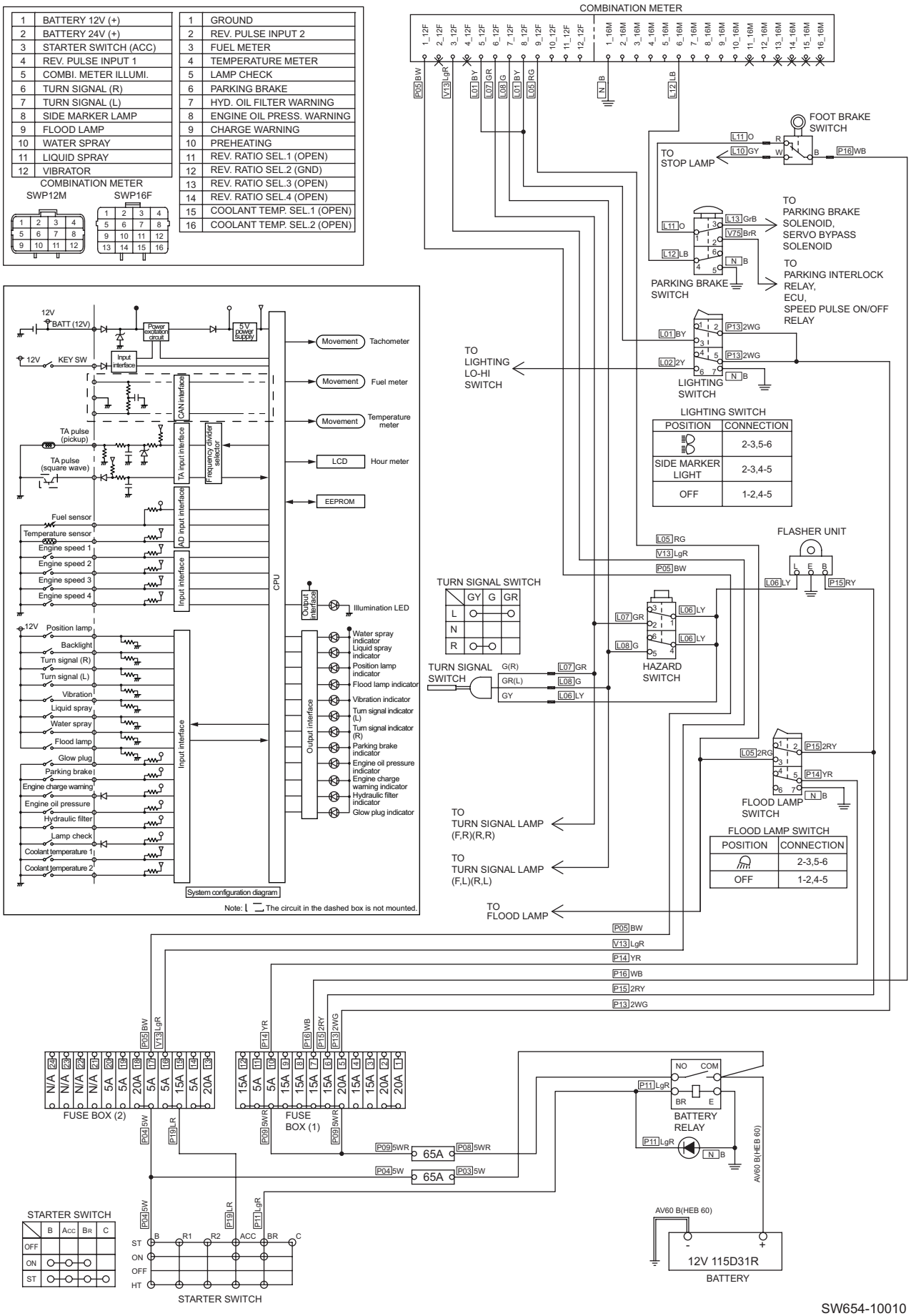
SW654-10010

2-7-20. Parking brake indicator lamp does not light

Reference Fig. : 2-7-5

Check point	Check/Cause	Action
1. Harness	• Measure resistance between parking brake switch terminal 4 wire LB and combination meter connector terminal wire No.L12 wire LB. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.
2. Parking Brake Switch	• When parking brake switch is applied, check continuity between parking brake switch terminal 4 wire LB and terminal 5 wire B. There is continuity in normal condition. • If there is no continuity, parking brake switch is faulty.	Replace parking brake switch.
3. Combination Meter (Parking brake indicator lamp)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery 12 V (+) terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B • Starter switch (ACC) terminal wire No.V13 inlet wire LgR and ground terminal wire No.N wire B Standard voltage : 12 V or more (2) When parking brake switch is applied and starter switch is ON, check continuity between combination meter parking brake terminal wire No.L12 inlet wire LB and chassis ground. There is continuity in normal condition. • If above items (1) and (2) are OK and parking brake indicator lamp does not light, combination meter is faulty.	Replace combination meter.

Fig.: 2-7-5


1 BATTERY 12V (+)
2 BATTERY 24V (+)
3 STARTER SWITCH (ACC)
4 REV. PULSE INPUT 1
5 COMBI. METER ILLUMI.
6 TURN SIGNAL (R)
7 TURN SIGNAL (L)
8 SIDE MARKER LAMP
9 FLOOD LAMP
10 WATER SPRAY
11 LIQUID SPRAY
12 VIBRATOR
COMBINATION METER
SWP12M
SWP16F
1 GROUND
2 REV. PULSE INPUT 2
3 FUEL METER
4 TEMPERATURE METER
5 LAMP CHECK
6 PARKING BRAKE
7 HYD. OIL FILTER WARNING
8 ENGINE OIL PRESS. WARNING
9 CHARGE WARNING
10 PREHEATING
11 REV. RATIO SEL.1 (OPEN)
12 REV. RATIO SEL.2 (GND)
13 REV. RATIO SEL.3 (OPEN)
14 REV. RATIO SEL.4 (OPEN)
15 COOLANT TEMP. SEL.1 (OPEN)
16 COOLANT TEMP. SEL.2 (OPEN)
COMBINATION METER
FOOT BRAKE SWITCH
TO STOP LAMP
TO PARKING BRAKE SOLENOID, SERVO BYPASS SOLENOID
TO PARKING INTERLOCK RELAY, ECU, SPEED PULSE ON/OFF RELAY
PARKING BRAKE SWITCH
TO LIGHTING LO-HI SWITCH
LIGHTING SWITCH
LIGHTING SWITCH
POSITION
CONNECTION
2-3,5-6
SIDE MARKER LIGHT
2-3,4-5
OFF
1-2,4-5
FLASHER UNIT
TURN SIGNAL SWITCH
HAZARD SWITCH
TO TURN SIGNAL LAMP (F,R)(R,R)
TO TURN SIGNAL LAMP (F,L)(R,L)
TO FLOOD LAMP
FLOOD LAMP SWITCH
FLOOD LAMP SWITCH
POSITION
CONNECTION
2-3,5-6
OFF
1-2,4-5
12V
BATT (12V)
KEY SW
Power excitation circuit
5V power supply
Input interface
CAN interface
TA input interface
Frequency divider selector
AD input interface
Input interface
CPU
Output interface
Movement
Tachometer
Movement
Fuel meter
Movement
Temperature meter
LCD
Hour meter
EEPROM
TA pulse (pickup)
TA pulse (square wave)
Fuel sensor
Temperature sensor
Engine speed 1
Engine speed 2
Engine speed 3
Engine speed 4
Position lamp
Backlight
Turn signal (R)
Turn signal (L)
Vibration
Liquid spray
Water spray
Flood lamp
Glow plug
Parking brake
Engine charge warning
Engine oil pressure
Hydraulic filter
Lamp check
Coolant temperature 1
Coolant temperature 2
Illumination LED
Water spray indicator
Liquid spray indicator
Position lamp indicator
Flood lamp indicator
Vibration indicator
Turn signal indicator (L)
Turn signal indicator (R)
Parking brake indicator
Engine oil pressure indicator
Engine charge warning indicator
Hydraulic filter indicator
Glow plug indicator
System configuration diagram
Note: The circuit in the dashed box is not mounted.
FUSE BOX (2)
FUSE BOX (1)
BATTERY RELAY
65A
65A
STARTER SWITCH
STARTER SWITCH
AV60 B(HEB 60)
12V 115D31R
BATTERY
SW654-10010

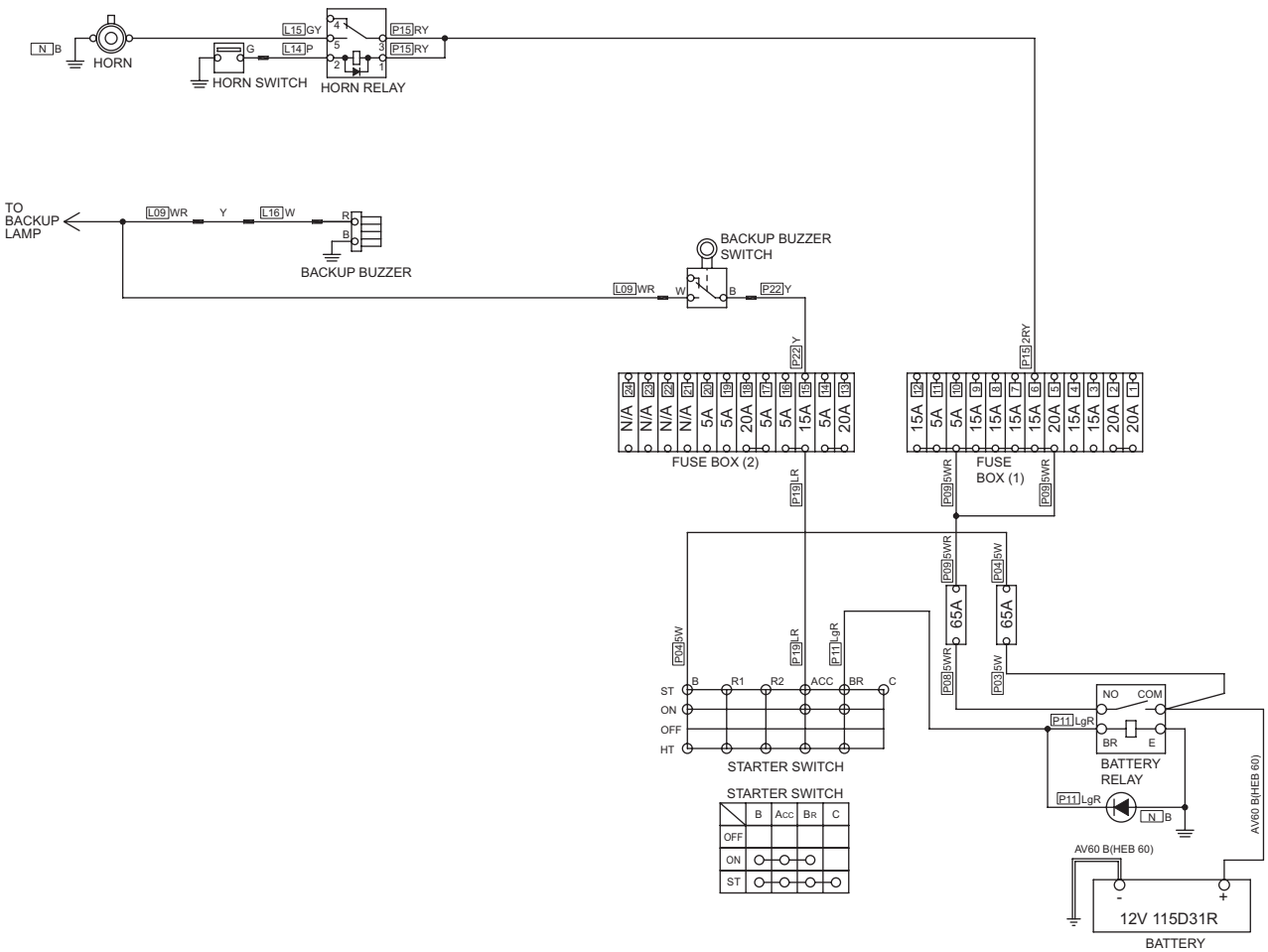
2-7-21. Turn signal indicator lamp does not light

• Check that turn signal lamp blinks.

Reference Fig. : 2-7-5

Check point	Check/Cause	Action
1. Harness	(1) Measure resistance between turn signal switch terminal wire No.L08 wire G and combination meter connector terminal wire No.L08 wire G. Standard resistance : 10 Ω or less (2) Measure resistance between turn signal switch terminal wire No.L07 wire GR and combination meter connector terminal wire No.L07 wire GR. Standard resistance : 10 Ω or less • If above item (1) or (2) is NG, harness is faulty.	Repair or replace harness.
2. Turn Signal Switch	• When turn signal switch lever is moved, check continuity between turn signal switch terminals. Turn signal (L) : Between wire No.L06 wire LY and wire No.L08 wire G Turn signal (R) : Between wire No.L06 wire LY and wire No.L07 wire GR There is continuity in normal condition. • If there is no continuity, turn signal switch is faulty.	Replace turn signal switch.
3. Combination Meter (Turn signal indicator lamp)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery 12 V (+) terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B • Starter switch (ACC) terminal wire No.V13 inlet wire LgR and ground terminal wire No.N wire B Standard voltage : 12 V or more (2) When starter switch is ON and turn signal switch is moved, measure voltage between combination meter terminal wires and chassis ground. • Turn signal (L) terminal wire No.L08 inlet wire G and chassis ground • Turn signal (R) terminal wire No.L07 inlet wire GR and chassis ground Standard voltage : 12 V or more with constant intervals • If above items (1) and (2) are OK and turn signal indicator lamp does not light, combination meter is faulty.	Replace combination meter.

Fig.: 2-7-6



SW654-10011

2-7-22. Horn does not sound

Reference Fig. : 2-7-6

Check point	Check/Cause	Action
1. Horn	• Disconnect horn and directly connect battery positive terminal to horn terminal wire GY side and negative terminal to horn terminal wire B side. • If horn does not sound, horn is faulty.	Replace horn.
2. Horn Relay	(1) When starter switch is ON, measure voltage between horn relay terminal 1 and 3 inlet wire RY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and horn switch pressed, measure voltage between horn relay terminal 5 outlet wire GY and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, horn relay is faulty.	Replace horn relay.
3. Horn Switch	• When horn switch is ON, check continuity between horn switch terminals. There is continuity in normal condition. • If there is no continuity, horn switch is faulty.	Replace horn switch.
4. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

2-7-23. Backup buzzer does not sound

Reference Fig. : 2-7-6

Check point	Check/Cause	Action
1. Backup Buzzer	• Disconnect backup buzzer and directly connect battery positive terminal to backup buzzer terminal wire W side and negative terminal to backup buzzer terminal wire B side. • If backup buzzer does not sound, backup buzzer is faulty.	Replace backup buzzer.
2. Backup Buzzer Switch	(1) When starter switch is ON, measure voltage between backup buzzer switch terminal inlet wire Y and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and F-R lever is “R” , measure voltage between backup buzzer switch terminal outlet wire WR and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, backup buzzer switch is faulty.	Replace backup buzzer switch.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

3. HYDRAULIC SYSTEM TROUBLESHOOTING

3-1. When Performing Hydraulic System Troubleshooting

- The largest factor in the majority of failures of hydraulic devices operating under conditions of higher pressure and greater precision is the entry of dirt (foreign substances) into the hydraulic circuit. Particular caution is required when supplying hydraulic oil or when disassembling and assembling hydraulic devices.

1) Pay attention to the work environment.
As much as possible, avoid performing tasks such as supplying hydraulic oil, replacing filters and repair work on rainy days, when there is strong wind, or in locations where there is much dust.

2) Disassembly and maintenance work in the field
There is the danger of dust entry when disassembly and maintenance work for hydraulic components is performed in the field. In addition, because performance verification after repairs are completed is difficult, replacement of the entire assembly is preferred. Perform disassembly and maintenance of hydraulic components in a special room protected from dust, and use special testers to verify the performance.

3) Sealing of openings
Use caps, tape, plastic bags or other means to seal the openings of removed pipes and components in order to prevent foreign substances from entering. Never leave the openings exposed or put a shop cloth into them. There is the danger of foreign substances entering or of leaking oil causing environmental contamination. Do not dispose of waste oil on-site. Either deliver it to the customer and request disposal or take it back with you and dispose of it.

4) Prevent entry of foreign substances when supplying oil.
Take care that foreign substances do not enter when supplying hydraulic oil. Clean the oil supply port and the area around it, as well as the supply pump, oilcan and other items. A more reliable method is to use oil cleaning equipment, which can filter out the contamination that occurred during storage.

5) Change hydraulic oil while the temperature is still high.
All oils, including hydraulic oil, flow more readily when they are warm. Higher temperatures also make it easier to eject the sludge and other substances outside the circuit together with the oil. For these reasons, oil changes should be performed while the oil temperature is high. When changing the oil, it is necessary to drain out as much of the old hydraulic oil as possible. (In addition to the hydraulic oil tank, also drain the oil from the filter and circuit drain plugs.) If old hydraulic oil remains in the system, the contaminants and sludge in the old oil will mix with the new oil and shorten the hydraulic oil lifetime.

3-2. Propulsion System

If a problem occurs in the propulsion systems such as the propulsion pump, propulsion motor and brakes, determine the cause and carry out action as required, according to the following general troubleshooting items.

(NOTICE)

- **When checking whether or not the pressure is correct, refer to the pressure standard value for each hydraulic circuit.**

3-2-1. Machine moves neither forward nor backward 1/2

Check point	Cause	Check/Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill tank until correct oil level is obtained.
2. Bypass Valve	Bypass valve is open.	Close bypass valve.
3. F-R Lever Linkage	F-R lever linkage is faulty.	Check and adjust F-R lever linkage or replace it if necessary.
4. Charge Circuit Pressure	Propulsion pump does not discharge oil because charge pressure is low.	• Measure charge pressure. • If low, check and adjust charge relief valve or replace it if necessary.
	Charge pressure decreases due to pressure leakage from cut off valve.	Check and adjust cut off valve or replace it if necessary.
	Insufficient steering • charge pump discharge.	Repair steering • charge pump or replace it if necessary.
	Charge pressure decreases due to internal leakage of solenoid valve connecting oil supply circuit with charge circuit. • Parking brake solenoid valve • Speed change solenoid valve	• When solenoid is energized, check if oil flows in return circuit to tank. • If oil is flowing, repair solenoid valve or replace it if necessary.
5. Servo Bypass Solenoid Valve	If spool of servo bypass solenoid valve is stuck, pressure in both sides of servo cylinder chamber is equalized. This causes propulsion pump unable to discharge oil.	• Measure pressure in servo cylinder chambers. • If pressure is equal in both chambers, repair servo bypass solenoid valve or replace it if necessary.
6. Suction Filter for Steering • Charge Pump	Steering • charge pump flow is reduced due to clogged filter.	Clean suction filter or replace it if necessary.
7. Propulsion Circuit Pressure	Pump does not discharge oil because setting pressure of cut off valve is low.	Measure propulsion circuit pressure. If low, check and adjust cut off valve or replace it if necessary.
	Circuit does not obtain required pressure because setting pressure of high pressure relief is low.	• Measure propulsion circuit pressure. • If low, check and adjust high pressure relief valve or replace it if necessary.
8. Propulsion Motor	Propulsion circuit pressure is not held in propulsion motor case.	• Measure propulsion motor case pressure. • If case pressure is not within allowable pressure, repair propulsion motor or replace it if necessary.
	Internal leakage of propulsion motor.	• Measure drain quantity from propulsion motor. • If drain quantity is larger than standard value, repair propulsion motor or replace it if necessary.
	Sticking of disc brakes causes brakes to remain applied.	• Replace disc brakes.

3-2-1. Machine moves neither forward nor backward 2/2

Check point	Cause	Check/Action
9. Propulsion Pump	Discharge flow rate is insufficient due to efficiency degradation of propulsion pump.	• Measure discharge flow rate of propulsion pump with flow meter. • If discharge flow rate is not within specified range, repair propulsion pump or replace it if necessary.
	Discharge flow rate is insufficient due to wear of propulsion pump drive shaft splines.	Replace propulsion pump.
	Propulsion circuit pressure is not held in propulsion pump case.	• Measure propulsion pump case pressure. • If case pressure is not within allowable pressure, repair propulsion pump or replace it if necessary.
10. Parking Brake Solenoid Valve	Brake remains applied because spool of parking brake solenoid valve does not shift.	Repair parking brake solenoid valve or replace it if necessary.
11. Brake Inlet Pressure	Brake cannot be released because brake inlet pressure is low.	• Measure brake release pressure. • If low, repair or replace propulsion motor.
12. Flange	Drive torque is not transmitted to pump due to faulty flange.	Replace flange.

3-2-2. Machine moves in one direction only (forward or backward)

Check point	Cause	Check/Action
1. F-R Lever Linkage	F-R lever linkage is faulty.	Check and adjust F-R lever linkage or replace it if necessary.
2. High Pressure Relief Valve	Low circuit pressure due to incorrect high pressure relief setting or internal leakage of high pressure relief valve.	• Interchange two high pressure relief valves. • If faulty condition is accordingly reversed, check and adjust high pressure relief valve or replace it if necessary.

3-2-3. Slow machine speed or small drive force 1/2

Check point	Cause	Check/Action
1. Bypass Valve	Bypass valve is slightly open.	Close bypass valve completely.
2. F-R Lever Linkage	F-R lever linkage is faulty.	Check and adjust F-R lever linkage or replace it if necessary.
3. Charge Circuit Pressure	Stroke of propulsion pump swash plate is small because charge pressure is low, decreasing discharge rate of propulsion pump.	• Measure charge pressure. • If low, check and adjust charge relief valve or replace it if necessary.
	Insufficient steering • charge pump discharge.	Repair steering • charge pump or replace it if necessary.
	Charge pressure decreases due to internal leakage of solenoid valve connecting oil supply circuit with charge circuit. • Parking brake solenoid valve • Speed change solenoid valve	• When solenoid is energized, check if oil flows in return circuit to tank. • If oil is flowing, repair solenoid valve or replace it if necessary.
4. Suction Filter for Steering • Charge Pump	Flow rate of steering • charge pump decreases as well as charge pressure decreases due to clogged filter.	Clean suction filter or replace it if necessary.

3-2-3. Slow machine speed or small drive force 2/2

Check point	Cause	Check/Action
5. Propulsion Motor	Propulsion motor inlet pressure is low.	• Measure propulsion motor inlet pressure. • If low, check and adjust high pressure relief valve or replace it if necessary.
	Propulsion circuit pressure is not held in propulsion motor case.	• Measure propulsion motor case pressure. • If case pressure is not within allowable pressure, repair propulsion motor or replace it if necessary.
	Output of propulsion motor decreases and number of revolutions decreases due to internal leakage of propulsion motor.	• Measure drain quantity from propulsion motor. • If drain quantity is larger than standard value, repair propulsion motor or replace it if necessary.
6. Propulsion Pump	Discharge flow rate is insufficient due to efficiency degradation of propulsion pump.	• Measure discharge flow rate of propulsion pump with flow meter. • If discharge flow rate is not within specified range, repair propulsion pump or replace it if necessary.
	Discharge flow rate is insufficient due to wear of propulsion pump drive shaft splines.	Replace propulsion pump.
	Propulsion circuit pressure is not held in propulsion pump case.	• Measure propulsion pump case pressure. • If case pressure is not within allowable pressure, repair propulsion pump or replace it if necessary.

3-2-4. Machine speed cannot be switched

Check point	Cause	Check/Action
1. Speed Change Solenoid Valve	Machine speed does not change because spool of speed change solenoid valve does not change.	Repair speed change solenoid valve or replace it if necessary.
2. Propulsion Motor Swash Plate Stroke Cylinder	Faulty propulsion motor swash plate stroke cylinder.	Repair propulsion motor or replace it if necessary.

3-2-5. Machine does not stop completely with F-R lever in “N”

Check point	Cause	Check/Action
1. F-R lever Linkage	F-R lever linkage is faulty.	Check and adjust F-R lever linkage or replace it if necessary.
2. Servo Control Valve	Servo control valve neutral position adjustment failure.	Check and adjust servo control valve or replace it if necessary.
3. Propulsion Pump Servo Cylinder	Faulty propulsion pump servo cylinder or faulty pump swash plate setting.	Repair propulsion pump or replace it if necessary.

3-2-6. Propulsion system is overheating

Check point	Cause	Check/Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill tank until correct oil level is obtained.
2. Oil Cooler	Cooling efficiency is reduced due to clogged oil cooler fins.	Clean oil cooler fins.
3. Flushing Valve	Hydraulic oil in propulsion closed circuit is insufficiently cooled due to flushing valve shuttle spool sticking.	Repair flushing valve or replace it if necessary.
	Hydraulic oil in propulsion closed circuit is insufficiently cooled because flushing valve relief setting pressure is excessively high.	Check dust or damage in flushing relief valve and replace it if necessary.
	Hydraulic oil in propulsion closed circuit is insufficiently cooled due to flushing valve relief valve poppet sticking.	Clean flushing relief valve or replace it if necessary.
4. Propulsion Circuit Pressure	If circuit pressure setting is excessively low, relief valve opens, causing temperature of hydraulic oil in circuit to rise.	• Measure propulsion circuit pressure. • If low, increase relief setting pressure.
	If load is excessively heavy, relief valve opens, causing temperature of hydraulic oil in circuit to rise.	• Measure propulsion circuit pressure. • If high, decrease propulsion load.
5. Suction Filter for Steering • Charge Pump	Load of steering • charge pump increases due to clogged filter, causing temperature of hydraulic oil in circuit to rise.	Clean suction filter or replace it if necessary.
6. Hydraulic Oil Filter	Charge circuit pressure increases due to clogged filter.	Clean hydraulic oil filter or replace it if necessary.

3-2-7. Abnormal noise from propulsion system

Check point	Cause	Check/Action
1. Roller Bearings	Roller bearings supporting front and rear drums are damaged.	Replace roller bearings.
2. Hydraulic Hose Clamp	Vibrator sound of hydraulic hose is generated because clamp securing hydraulic hose is loose.	Tighten bolts of loose hydraulic hose clamp to specified torque.
3. Suction Filter for Steering • Charge Pump	Cavitation is occurring in steering • charge pump due to clogged filter.	Clean suction filter or replace it if necessary.
4. Charge Circuit Pressure	If charge pressure is low, brake cannot be released completely, which causes brake drag.	• Measure charge pressure. • If low, check and adjust charge relief valve or replace it if necessary.
5. Propulsion Motor	Internal bearing of propulsion motor is damaged.	Repair propulsion motor or replace it if necessary.

3-3. Vibrator System

If a problem occurs in the vibrator systems such as the vibrator pump, vibrator motor and vibrator solenoid valve, determine the cause and carry out action as required, according to the following general troubleshooting items.

(NOTICE)

- **When checking whether or not the pressure is correct, refer to the pressure standard value for each hydraulic circuit.**

3-3-1. No vibration 1/2

Check point	Cause	Check/Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill tank until correct oil level is obtained.
2. Charge Circuit Pressure	Vibrator pump does not discharge oil due to low charge pressure.	• Measure charge pressure. • If low, check and adjust charge relief valve or replace it if necessary.
	Charge pressure decreases due to pressure leakage from cut off valve.	Check and adjust cut off valve or replace it if necessary.
	Insufficient steering • charge pump discharge.	Repair steering • charge pump or replace it if necessary.
	Charge pressure decreases due to internal leakage of solenoid valve connecting oil supply circuit with charge circuit. • Parking brake solenoid valve • Speed change solenoid valve	• When solenoid is energized, check if oil flows in return circuit to tank. • If oil is flowing, repair solenoid valve or replace it if necessary.
3. Suction Filter for Steering • Charge Pump	Steering • charge pump flow is reduced due to clogged filler.	Clean suction filter or replace it if necessary.
4. Vibrator Circuit Pressure	Pump does not discharge oil because setting pressure of cut off valve is low.	Measure vibration circuit pressure. If low, check and adjust cut off valve or replace it if necessary.
	Circuit does not obtain required pressure because setting pressure of high pressure relief is low.	• Measure vibrator circuit pressure. • If low, check and adjust high pressure relief valve or replace them if necessary.
5. Vibrator Solenoid Valve	Vibrator pump cannot discharge oil because spool of vibrator solenoid valve does not shift.	Repair vibrator solenoid valve or replace it if necessary.
6. Vibrator Motor	Vibrator circuit pressure is not held in vibrator motor case.	• Measure vibrator motor case pressure. • If case pressure is not within allowable pressure, repair vibrator motor or replace it if necessary.
	Internal leakage of vibrator motor.	• Measure drain quantity from vibrator motor. • If drain quantity is larger than standard value, repair vibrator motor or replace it if necessary.
	Output torque is not transmitted due to worn spline of vibrator motor output shaft.	Replace vibrator motor.

3-3-1. No vibration 2/2

Check point	Cause	Check/Action
7. Vibrator Pump	Insufficient discharge rate from vibrator pump due to reduced efficiency of vibrator pump.	• Measure discharge flow rate of vibrator pump with flow meter. • If discharge flow rate is not within specified range, repair vibrator pump or replace it if necessary.
	Insufficient pump discharge due to wear of vibrator pump drive shaft spline.	Replace vibrator pump.
	Vibrator circuit pressure is not held in vibrator pump case.	• Measure vibrator pump case pressure. • If case pressure is not within allowable pressure, repair vibrator pump or replace it if necessary.

3-3-2. Vibrator frequency is too low

Check point	Cause	Check/Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill tank until correct oil level is obtained.
2. Charge Circuit Pressure	Stroke of vibrator pump swash plate is small because charge pressure is low, decreasing discharge rate of vibrator pump.	• Measure charge pressure. • If low, check and adjust charge relief valve or replace it if necessary.
	Insufficient steering • charge pump discharge.	Repair steering • charge pump or replace it if necessary.
	Charge pressure decreases due to internal leakage of solenoid valve connecting oil supply circuit with charge circuit. • Parking brake solenoid valve • Speed change solenoid valve	• When solenoid is energized, check if oil flows in return circuit to tank. • If oil is flowing, repair solenoid valve or replace it if necessary.
3. Suction Filter for Steering • Charge Pump	Flow rate of steering • charge pump decreases as well as charge pressure decreases due to clogged filter.	Clean suction filter or replace it if necessary.
4. Vibrator Motor	Vibrator motor inlet pressure is low.	• Measure vibrator motor inlet pressure. • If low, check and adjust high pressure relief valve or replace it if necessary.
	Vibrator circuit pressure is not held in vibrator motor case.	• Measure vibrator motor case pressure. • If case pressure is not within allowable pressure, repair vibrator motor or replace it if necessary.
	Decrease in vibrator motor rpm due to internal leakage in vibrator motor.	• Measure drain quantity from vibrator motor. • If drain quantity is larger than standard value, repair vibrator motor or replace it if necessary.
5. Vibrator Pump	Insufficient discharge rate from vibrator pump due to reduced efficiency of vibrator pump.	• Measure discharge flow rate of vibrator pump with flow meter. • If discharge flow rate is not within specified range, repair vibrator pump or replace it if necessary.
	Insufficient pump discharge due to wear of vibrator pump drive shaft spline.	Replace vibrator pump.
	Vibrator circuit pressure is not held in vibrator pump case.	• Measure vibrator pump case pressure. • If case pressure is not within allowable pressure, repair vibrator pump or replace it if necessary.

3-3-3. Vibration mode does not switch

Check point	Cause	Check/Action
1. Vibrator Solenoid Valve	Vibrator solenoid valve spool shifts only in one direction.	Repair vibrator solenoid valve or replace it if necessary.

3-3-4. Vibratory drum does not changeover vibrating

Check point	Cause	Check/Action
1. Vibratory Drum Select Solenoid Valve	Vibratory drum does not changeover vibrating because spool of vibrator solenoid valve does not change.	Repair vibrator solenoid valve or replace it if necessary.

3-3-5. Vibrator does not stop

Check point	Cause	Check/Action
1. Vibrator Solenoid Valve	Vibrator solenoid valve spool does not return to neutral position.	Repair vibrator solenoid valve or replace it if necessary.
2. Vibrator Pump	Vibrator pump swash plate does not return to neutral position.	Repair or replace vibrator pump or replace it if necessary.

3-3-6. Vibrator system is overheating

Check point	Cause	Check/Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill tank until correct oil level is obtained.
2. Oil Cooler	Cooling efficiency is reduced due to clogged oil cooler fins.	Clean oil cooler fins.
3. Flushing Valve	Hydraulic oil in vibrator closed circuit is insufficiently cooled due to flushing valve shuttle spool sticking.	Repair flushing valve or replace it if necessary.
	Hydraulic oil in vibrator closed circuit is insufficiently cooled because flushing valve relief setting pressure is excessively high.	Check dust or damage in flushing relief valve and replace it if necessary.
	Hydraulic oil in vibrator closed circuit is insufficiently cooled due to flushing valve relief valve poppet sticking.	Clean flushing relief valve or replace it if necessary.
4. Vibrator Circuit Pressure	If circuit pressure setting is excessively low, relief valve opens, causing temperature of hydraulic oil in circuit to rise.	• Measure vibrator circuit pressure. • If low, increase relief setting pressure.
	If load is excessively heavy, relief valve opens, causing temperature of hydraulic oil in circuit to rise.	• Measure vibrator circuit pressure. • If high, decrease vibration load.
5. Suction Filter for Steering • Charge Pump	Load of steering • charge pump increases due to clogged filter, causing temperature of hydraulic oil in circuit to rise.	Clean suction filter or replace it if necessary.
6. Hydraulic Oil Filter	Charge circuit pressure increases due to clogged filter.	Clean hydraulic oil filter or replace it if necessary.

3-3-7. Abnormal noise from vibrator system

Check point	Cause	Check/Action
1. Vibrator Bearings	Vibrator bearings supporting eccentric shaft are damaged.	Replace vibrator bearings.
2. Hydraulic Hose Clamp	Vibrator sound of hydraulic hose is generated because clamp securing hydraulic hose is loose.	Tighten bolts of loose hydraulic hose clamp to specified torque.
3. Suction Filter for Steering • Charge Pump	Cavitation is occurring in steering • charge pump due to clogged filter.	Clean suction filter or replace it if necessary.
4. Vibrator Motor	Internal bearing of vibrator motor is damaged.	Repair vibrator motor or replace it if necessary.

3-4. Steering System

If a problem occurs in the steering systems such as the steering • charge pump and orbitrol, determine the cause and carry out action as required, according to the following general troubleshooting items.

(NOTICE)

- **When checking whether or not the pressure is correct, refer to the pressure standard value for each hydraulic circuit.**

3-4-1. Steering wheel is hard to turn

Check point	Cause	Check/Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill tank until correct oil level is obtained.
2. Orbitrol	Relief valve is open or setting pressure is low.	• Measure steering circuit pressure. • If low, check and clean relief valve or replace it if necessary.
	Flow to steering cylinder circuit is insufficient due to leakage from check valve.	Check and clean check valve or replace it if necessary.
	Spool and sleeve of orbitrol are contaminated or clearance is incorrect.	Check and clean orbitrol or replace it if necessary.
3. Steering Circuit Pressure	Pressure in return circuit from orbitrol increases due to clogged charging hydraulic filter.	Clean hydraulic filter or replace it if necessary.
4. Steering Cylinder	Cylinder thrust decreases due to internal leakage of steering cylinder.	Repair steering cylinder or replace it if necessary.
5. Suction Filter for Steering • Charge Pump	Steering • charge pump discharge rate decreases due to clogged filter.	Clean suction filter or replace it if necessary.
6. Steering • Charge Pump	Discharging pressure is insufficient due to efficiency degradation of steering • charge pump.	• Measure steering circuit pressure. • If low, replace steering • charge pump.
7. Steering Column	Column shaft and orbitrol shaft center are misaligned.	Align column shaft with orbitrol shaft center or replace it if necessary.
	Column shaft bearing is worn or damaged.	Repair column shaft or replace it if necessary.

3-4-2. Steering response is slow

Check point	Cause	Check/Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill tank until correct oil level is obtained.
2. Orbitrol	Oil is bypassing because relief valve is open.	• Measure steering circuit pressure. • If low, check and clean relief valve or replace it if necessary.
3. Steering Cylinder	Internal leakage of steering cylinder.	Repair steering cylinder or replace it if necessary.
4. Suction Filter for Steering • Charge Pump	Steering • charge pump discharge rate decreases due to clogged filter.	Clean suction filter or replace it if necessary.
5. Steering • Charge Pump	Discharging pressure is insufficient due to efficiency degradation of steering • charge pump.	• Measure steering circuit pressure. • If low, replace steering • charge pump.

3-4-3. Steering wheel backlash or play is large

Check point	Cause	Check/Action
1. Steering Column	Spline of column shaft or orbitrol is worn.	Replace column shaft or orbitrol.
	Column shaft bearings are worn.	Replace column shaft bearings.
2. Steering Wheel	Serration (spline) of wheel or column shaft is worn.	Replace wheel or column shaft.

3-4-4. Steering system is overheating

Check point	Cause	Check/Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill tank until correct oil level is obtained.
2. Oil Cooler	Cooling efficiency is reduced due to clogged oil cooler fins.	Clean oil cooler fins.
3. Steering Circuit Pressure	If circuit pressure setting is excessively low, relief valve is open, causing temperature of hydraulic oil in circuit to rise.	• Measure steering circuit pressure. • If low, replace relief valve.
	If load is excessively heavy, relief valve is open, causing temperature of hydraulic oil in circuit to rise.	• Measure steering circuit pressure. • If high, decrease steering load.
4. Suction Filter for Steering • Charge Pump	Load of steering • charge pump increases due to clogged filter, causing temperature of hydraulic oil in circuit to rise.	Clean suction filter or replace it if necessary.

3-4-5. Abnormal noise from steering system

Check point	Cause	Check/Action
1. Oil Level of Hydraulic Oil Tank	Pump suction pressure is high because oil level of hydraulic oil tank is low, causing cavitation in steering circuit system.	Fill tank until correct oil level is obtained.
2. Steering Circuit	Cavitation is caused by air in circuit.	Bleed circuit.
3. Hydraulic Hose Clamp	Vibrator sound of hydraulic hose is generated because clamp securing hydraulic hose is loose.	Tighten bolts of loose hydraulic hose clamp to specified torque.
4. Suction Filter for Steering • Charge Pump	Cavitation is occurring in steering • charge pump due to clogged filter.	Clean suction filter or replace it if necessary.

SAKAI HEAVY INDUSTRIES, LTD.

Head office: Seiwa Bldg., 4-8, Shibadaimon 1-chome, Minato-ku, Tokyo, Japan
Telephone: +81-3-3434-3401

Global Service Division: 2500 Takayanagi, Kuki-shi, Saitama, Japan
Telephone: +81-480-52-1111

Printed in Japan 2016.4.50 Ⓞ K.P
0559-99092-0-31205-B

SW654

SHOP MANUAL

SAKAI HEAVY INDUSTRIES, LTD.

Head office: Seiwa Bldg., 4-8, Shibadaimon 1-chome, Minato-ku, Tokyo, Japan

Telephone: +81-3-3434-3401

Global Service Division: 2500 Takayanagi, Kuki-shi, Saitama, Japan

Telephone: +81-480-52-1111

Printed in Japan 2016.4.50 Ⓞ K.P
0559-99092-0-31205-B

Printed in Japan 2017.4.50 ① K.P
0559-99092-0-31205-F