SW654

SHOP MANUAL

SAKAI®

3498-6559A-0

Introduction

This manual provides important information to familiarize you with safe operating and maintenance procedures for your SAKAI roller. Even though you may be familiar with similar equipment you must read and understand this manual before operating or servicing this unit.

Safety is everyone's business and it is one of your primary concerns. Knowing the guidelines presented in this manual will help provide for your safety, for the safety of those around you and for the proper operation and maintenance of the machine. Improper operation is dangerous and can result in injury or death.

Sakai Heavy Industries cannot foresee all possible circumstances or varying conditions to which the operator, serviceman or machine may be exposed to that might lead to a potential hazard. Therefore, the warnings and cautions listed in this manual and those placed on the machine are not intended to be all inclusive and liability for personal injury or damage to equipment or property cannot be assumed.

All information, specifications and illustrations in this publication are based on the product information available at the time that the publication was written. The contents may change without prior notice due to modifications of the model.

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3. HYDRAULIC SYSTEM TROUBLESHOOTING

SAFETY

1. GENERAL SAFETY

1-1. Understanding the Safety Symbols and Words

The words DANGER, WARNING, and CAUTION are used with the safety-alert symbol. DANGER identifies the most serious hazard. When the symbols DANGER, WARNING and CAUTION are displayed, become alert. Your safety or those around you may be involved. NOTICE is used to provide important information that is not hazard related.

⚠DANGER: Indicates an imminently hazardous situation or condition which if not avoided can result in serious personal injury or death.

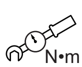
⚠WARNING: Indicates a potentially hazardous situation or condition which if not avoided can result in serious personal injury or death.

⚠CAUTION: Indicates a potentially hazardous situation or condition which if not avoided may result in moderate personal injury or damage to the machine or personal property.

(NOTICE): Indicates important information about operation or maintenance of the machine that may cause damage, breakdown, or shortened service life of the machine if you fail to observe or important point to maintain of quality in maintenance works.

★: Indicates standard value to judge whether measured value is good or not.

Items that indicate the weight of a part or equipment and require attention in wire selection and operating posture for slinging operation.



In the assembly operation, tightening torque in locations that require particular attention.

1-2. General

- Operators and maintenance personnel must be alert to recognize and avoid potential hazards. They should also have comprehensive training, the required skills and necessary tools to perform the job safely.
- The machine was built in accordance to the latest safety standards and recognized safety rules. Nevertheless, misuse of the machine may result in risk to life and limb of the user or nearby personnel and may cause damage to the machine or other property.
- The machine must only be used for its intended purpose as described in the Operator's Manual. It must be operated by safety-conscious persons who are fully aware of the risks involved when operating the machine. Any malfunctions especially those affecting the safety of the machine must be corrected immediately.

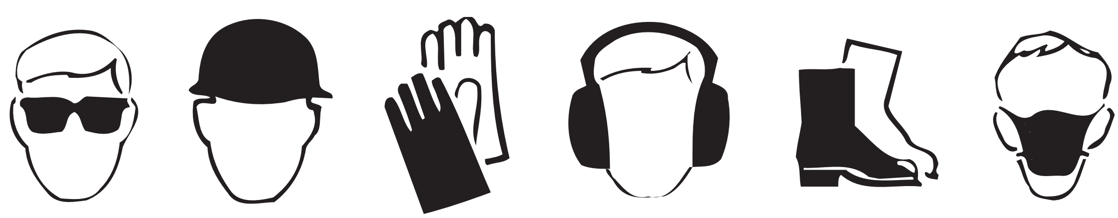
- The machine is designed specifically for the compaction of asphalt or soil road construction materials. Use of the machine for other purposes such as towing other equipment is considered contrary to the designated use. The manufacturer cannot be responsible or held liable for any damage resulting from such use. The risk for such use lies entirely with the user.
- Operating the machine within the limits of its designated use also involves compliance with the inspection and maintenance requirements contained in the Operation and Maintenance Manual.

1-3. Qualifications of Operators and Maintenance Personnel

- Work on the machine must be performed by qualified personnel only. Individual responsibilities of personnel regarding operation, maintenance, repair of the machine must be clearly stated.
- Define the operator's responsibilities; the operator should have authority to refuse instructions that are contrary to safety.
- Do not allow persons being trained to operate or perform maintenance on the machine without constant supervision by an experienced person.
- Work on the electrical system of the machine must be done only by an experienced person or under the guidance of a skilled electrician and according to electrical engineering rules and regulations.
- Work on the frame, brakes, hydraulic and steering systems must be performed by skilled personnel with special knowledge and training for such work.

1-4. Safety Practices and Policies

- Keep the manuals in the container provided on the machine. Manuals must always be available at the site where the machine is being used.
- The operator or user of the machine must be aware of all applicable or legal and mandatory regulations relevant to accident prevention and environmental protection. These regulations may also deal with handling of hazardous substances, the required proper personal safety and protective equipment and traffic or jobsite regulations.
- Machine operating instructions should also be supplemented with detailed instructions pertaining to the specific jobsite or work location.
- Always be sure the persons working on the machine have read the operating instructions and all safety precautions before beginning work. Reading safety instructions after work has already begun is too late.
- Wear close fitting garments and always tie back and secure long hair, also avoid wearing jewelry such as rings. Injury can result from loose clothing, hair or jewelry being caught up in the machinery or rotating parts.
- Use protective equipment as required by the circumstances or by law.



- Observe all safety instructions and warnings attached to the machine.
- Make sure all safety instructions and warnings on the machine are complete and perfectly legible.
- Stop the machine immediately in the event of any malfunction. Report any malfunction immediately to the supervisor or other person of authority.
- Never perform service or maintenance on the machine unless the drums or tires are adequately blocked, articulation lock bar and pin is in the locked position and the parking brake is applied.
- Never make any modifications to the machine which might affect safety without the manufacturer’s approval.
- Always perform the recommended routine inspections and adjustments according to the prescribed intervals.

1-5. Pre Start Inspection

- Inspect your machine daily. Ensure that the routine maintenance and lubrication are properly performed. Repair or replace any malfunctioning, broken or missing parts before using the machine. Refer to the maintenance schedule in the Operator’s Manual.
- Check that all instructions and safety stickers are in place and readable.
- Never fill the fuel tank with the engine running or while near an open flame or while smoking.
- Always clean up any spilled fuel.
- Check for any warning tags placed on the machine, do not operate the machine until all repairs have been made and warning tags have been removed by authorized personnel.
- Check the seat belt for wear or damage; inspect the belt hardware and fabric. Replace if hardware is damaged or the belt is frayed or nicked or stitching is loose. Check that mounting hardware is tight.
- Clean the steps and operating platform of dirt and foreign matter to reduce danger of slipping.
- Know how to shut-down or stop the machine immediately in case of emergency.
- Know the capabilities and limitations of the machine such as speed, gradeability, steering and braking.
- Be aware of the dimensions of the machine such as height, weight especially for transporting.

1-6. Safety Instructions

- Take all necessary precautions to ensure that the machine is used only when in a safe and reliable condition.
- Avoid any operational mode that might compromise safety.
- Operate the machine only if all protective and safety devices are in place and fully functional.
- Always use the hand rails and steps to get on and off your machine maintaining 3-point contact (using both hands).

1-7. Starting

- Start the machine only from the driver's seat and always wear the seat belt.
- Watch that the warning lights and indicators during start-up and shutdown are working in accordance with operating instructions.
- Watch that no one is in danger before starting and when moving the machine.
- Check that braking, steering, signals and lights are fully functional before starting work or traveling with the machine.

1-8. Operating

- Always make sure that there are no obstructions or persons in your line of travel before starting the compactor in motion.
- Never climb on and off the machine while it is in motion.
- Always remain seated with the seat belt fastened when traveling, compacting or loading or unloading the machine.
- Use caution and be very observant when operating in close quarters and congested areas.
- Obey all traffic regulations when working on public roads and make sure machine is compatible with these regulations.
- Never carry passengers.
- Know and use the hand signals for particular jobs and who has the responsibility for signaling.
- Do not work close to edges or in the vicinity of overhanging banks or on grades that could cause the compactor to slide or roll over. Avoid any areas that may be a risk to machine stability.
- Avoid side hill travel. Always operate up and down the slope. Always keep the propulsion (travel control) lever in low speed range when climbing or descending hills or steep grades.
- Make sure there is sufficient clearance when crossing underpasses, bridges and tunnels or when passing under overhead power lines.
- Never allow anyone to stand in the articulation area of the machine when the engine is running.
- Always look in all directions before reversing the direction of travel.
- Always switch on the lighting system (if equipped) during poor visibility conditions and after dark.
- Do not attempt to control the compactor travel speed with the throttle control. Maintain engine speed at the full operating RPM.
- Do not run the engine in a closed building for an extended period of time. Exhaust fumes can kill.

1-9. Stopping

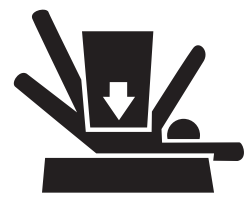
- Always park the machine in a safe area on solid and level ground. If this is not possible, always park at a right angle to the slope and block the drums or tires.
- Do not leave the operator's platform with the engine running. Always move the travel lever to neutral position and apply the parking brake then turn the starter switch to OFF.
- Lock all lockable compartments.
- Park behind a safe barrier, use proper flags, and warning devices, especially when parking in areas of heavy traffic.

1-10. Maintenance

- In any performing any work concerning the operation, adjustment or modification of the machine or it’s safety devices or any work related to maintenance, inspection or repair, always follow the start-up and shut-down procedures in the Operator’s Manual and the Maintenance Manual.
- Ensure that the maintenance area is safe and secure.
- If the machine is shut down for maintenance or repair work it must be secured against inadvertent starting by removing the starter key and attaching a warning sign to the starter switch.

- The machine must be parked on stable and level ground with the drums or tires blocked to prevent inadvertent movement.
- Immediately after the engine has stopped, the exhaust system, engine, radiator coolant, engine oil, hydraulic fluid and other lubricants and components will be very hot. Fluids can be under pressure, removing the radiator cap or draining oil or changing filters can cause serious burns. Wait until the machine has cooled down.

- Use care when attaching and securing lifting tackle to individual parts and large assemblies being removed or repositioned for repair purposes to avoid the risk of accident. Use lifting devices that are in perfect condition and of sufficient lifting capacity. Never stand under suspended loads.

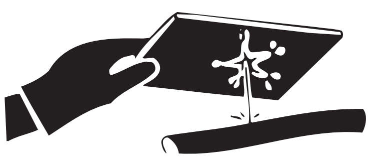


- Always use the proper tools and workshop equipment in good condition when performing maintenance or repairs on the machine.

- Always use specially designed safety ladders and working platforms when working above floor level. Never use machine parts as a climbing aid.
- Keep all steps, handles, handrails, platforms and ladders free from mud, dirt, grease, ice or snow.
- Clean the machine, especially threaded connections of any traces of oil or fuel before carrying out any maintenance or repairs. Never use aggressive detergents. Use lint free cleaning rags.
- Examine all fuel, lubricant and hydraulic fluid lines and connectors for leaks, loose connections chafe marks or damage after cleaning.
- Repair or replace defective parts immediately.
- Whenever possible, avoid servicing or maintenance when the engine is running unless the drums or tires are adequately blocked, the articulation lock bar is in the locked position and the parking brake is applied.
- Never fill the fuel tank with the engine running, while near an open flame or while smoking. Always clean up any spilled fuel.
- Ensure safe operation, optimum performance of the machine and its warranty by using only genuine SAKAI replacement parts.

- Use only the specified fluids and lubricants. Substitute only products known to be equivalent from reputable manufacturers.
- Disconnect the battery cables when working on the electrical system or when welding on the compactor.

- Be sure the battery area is well ventilated (clear of fumes) should it be necessary to connect a jumper cable or battery charger. Fumes can ignite from a spark and may explode.
- Be sure battery charger is OFF when making connections if charging is required.
- Use only original fuses with the specified rating. Switch off the machine immediately if trouble occurs in the electrical system.
- Work on the electrical system may only be carried out by a qualified electrician or by a specially trained person according to electrical engineering principles.
- Inspect the electrical equipment of the machine at regular intervals. Defects such as loose connections or burnt or scorched wires must be repaired or replaced immediately.
- Do not weld, flame cut or perform grinding on the machine unless expressly authorized, as there may be a risk of fire or explosion. Disconnect the battery when welding on the machine.
- Clean the machine and its surrounding from dust or other flammable substances and make sure the area is adequately ventilated before beginning welding, flame cutting or grinding operations.
- Inspect hydraulic hoses at regular intervals and immediately replace if they show signs of chafing, cracking, brittleness, deformation, blistering, fitting separation, leakage, corrosion or other damage which may affect their function or strength.
- Do not work on hydraulic system while the engine is running and the system is under pressure. The hydraulic system remains pressurized even after the engine has stopped.
- Do not disconnect hydraulic hoses or fittings until the pressure has been properly relieved.
- Wait until the systems and fluid have cooled down before disconnecting.
- Never use your hands to check for leaks when inspecting a hydraulic system. Use a piece of cardboard and always wear gloves and safety glasses.



- Get immediate medical attention if fluid has been injected under your skin. Fluid penetration from a pin hole leak can cause severe injury or death.
- Ensure that hydraulic lines and hoses are routed and fitted properly. Ensure that no connections are interchanged. All fittings, lengths and specifications of hoses must comply with the technical requirements.
- Observe all product safety regulations when handling fuel, oils, grease, engine coolant and other chemical substances. Be careful especially when these items are hot as there is a risk of burning or scalding.
- Operate internal combustion engines and fuel operated heating systems only in adequately ventilated premises. Before starting the engine in an enclosed area, make sure there is sufficient ventilation.

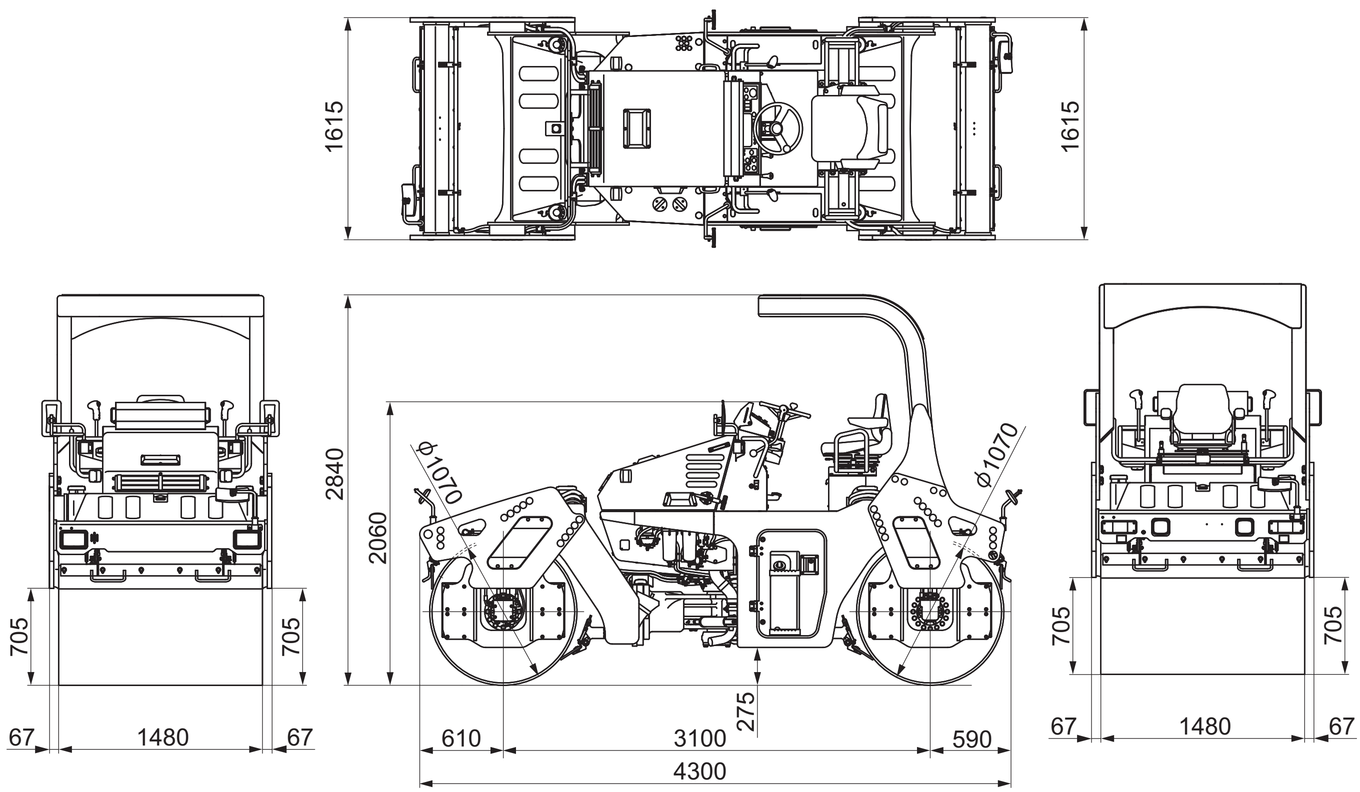
1-11. Transporting the Machine

- Use only suitable and approved trailers and haul vehicles and lifting equipment of sufficient capacity.
- Entrust to experienced personnel the fastening and lifting of loads and instructing of crane operators.
- Only experienced persons familiar with the operation of the machine may load and unload the machine.
- Use ramps or a loading dock when loading or unloading the machine. Ramps must be the proper strength, low angle and the proper height and width.
- Block the drums or tires (front and rear) of the hauling vehicle when loading and unloading the compactor. Ensure that the haul vehicle is on level ground and approach the loading ramps squarely to make sure that the compactor does not slide off the edge of the ramp.
- Keep the deck clear of mud, oil, ice or snow or other materials that can make the deck slippery.
- Position the compactor on the trailer or transport vehicle centered from side to side, and apply the brake. Shut off the engine and lock all lockable compartments.
- Block the drums or tires and lock the articulation lock bar. Chain the machine down properly using the appropriate tackle.
- Know the overall height of the compactor and hauling vehicle. Observe height and weight regulations and be sure you can pass safely at overhead obstructions.
- Obey all traffic regulations and be sure that the proper clearance flags, lights and warning signs including “Slow Moving Vehicle” emblem are displayed when traveling on public roads.
- Know the approximate stopping distance at any given speed.
- Drive Safely. Never turn corners at excessive speeds.

SPECIFICATIONS

1. SPECIFICATION DATA

1-1. SW654



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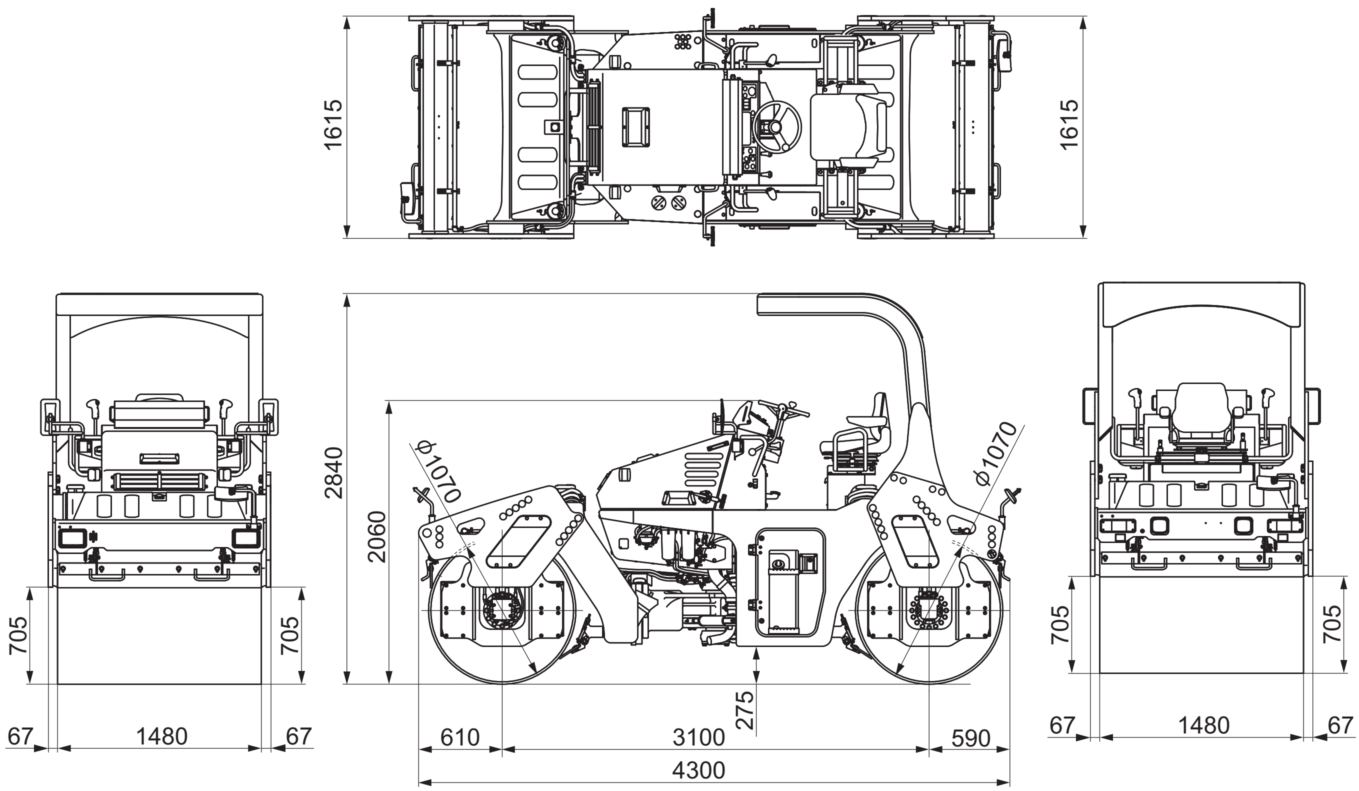
Model & Type	Model		SAKAI SW654 with ROPS
	Type		VIBRATORY TANDEM ROLLER
Weight	Operating weight	without ballast	7,070 kg (15,585 lbs.)
		with ballast	N/A kg (N/A lbs.)
	Maximum weight		7,430 kg (16,380 lbs.)
	Shipping weight	with ROPS	6,600 kg (14,550 lbs.)
		without ROPS	6,320 kg (13,935 lbs.)
	Load on front axle with operating weight		3,360 kg (7,405 lbs.)
	Load on rear axle with operating weight		3,710 kg (8,180 lbs.)
Dimensions	Overall length		4,300 mm (169 in.)
	Overall width		1,615 mm (64 in.)
	Overall height	with ROPS	2,840 mm (112 in.)
		without ROPS	2,060 mm (81 in.)
	Wheelbase		3,100 mm (122 in.)
	Compaction width		1,480 mm (58 in.)
	Front drum	width × dia. × thickness	1,480 mm × 1,070 mm × 17 mm (58 in. × 42 in. × 0.7 in.)
	Rear drum	width × dia. × thickness	1,480 mm × 1,070 mm × 17 mm (58 in. × 42 in. × 0.7 in.)
	Ground clearance		275 mm (11 in.)
	Kerb clearance	Right	705 mm (28 in.)
		Left	705 mm (28 in.)
	Side clearance	Right	67 mm (2.5 in.)
		Left	67 mm (2.5 in.)
	Leveling blade width		N/A mm (N/A in.)

Performance	Vibrator system	Front	Centrifugal force	Low amplitude		62 kN	(13,940 lbf)
				High amplitude		69 kN	(15,510 lbf)
			Frequency	Low amplitude		67 Hz	(4,000 vpm)
				High amplitude		50 Hz	(3,000 vpm)
			Amplitude	Low amplitude		0.27 mm	(0.011 in.)
				High amplitude		0.53 mm	(0.021 in.)
		Rear	Centrifugal force	Low amplitude		62 kN	(13,940 lbf)
				High amplitude		69 kN	(15,510 lbf)
			Frequency	Low amplitude		67 Hz	(4,000 vpm)
				High amplitude		50 Hz	(3,000 vpm)
			Amplitude	Low amplitude		0.27 mm	(0.011 in.)
				High amplitude		0.53 mm	(0.021 in.)
	Linear pressure	Static linear pressure	Front drum	Operating weight		223 N/cm	(125 lbf./in.)
			Rear drum	Operating weight		246 N/cm	(140 lbf./in.)
		Dynamic linear pressure	Front drum	Operating weight	Low amplitude	642 N/cm	(365 lbf./in.)
					High amplitude	689 N/cm	(395 lbf./in.)
			Rear drum	Operating weight	Low amplitude	665 N/cm	(380 lbf./in.)
					High amplitude	712 N/cm	(405 lbf./in.)
	Traveling speed	Number of speed shift				8 speed	
		Speed range	Low	1st		0 to 2 km/h	(0 to 1.2 mile/h)
				2nd		0 to 4 km/h	(0 to 2.5 mile/h)
				3rd		0 to 6 km/h	(0 to 3.7 mile/h)
				4th		0 to 7 km/h	(0 to 4.4 mile/h)
			High	1st		0 to 4 km/h	(0 to 2.5 mile/h)
				2nd		0 to 7 km/h	(0 to 4.4 mile/h)
				3rd		0 to 11 km/h	(0 to 6.8 mile/h)
				4th		0 to 13 km/h	(0 to 8.1 mile/h)
	Gradeability (without vibration)					34 %	(18 °)
	Turning radius	Machine clearance radius inside				3.6 m	(142 in.)
		Machine clearance radius outside				5.5 m	(217 in.)
		Turning radius inside compacted surface				3.7 m	(146 in.)
		Turning radius outside compacted surface				5.2 m	(205 in.)
	Steering / Oscillating angle					± 39 ° / ± 9 °	

1-2. SW654ND



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Model & Type	Model		SAKAI SW654ND with ROPS
	Type		VIBRATORY TANDEM ROLLER
Weight	Operating weight	without ballast	7,370 kg (16,250 lbs.)
		with ballast	N/A kg (N/A lbs.)
	Maximum weight		7,730 kg (17,040 lbs.)
	Shipping weight	with ROPS	6,960 kg (15,345 lbs.)
		without ROPS	6,620 kg (14,595 lbs.)
	Load on front axle with operating weight		3,510 kg (7,740 lbs.)
	Load on rear axle with operating weight		3,860 kg (8,510 lbs.)
Dimensions	Overall length		4,300 mm (169 in.)
	Overall width		1,615 mm (64 in.)
	Overall height	with ROPS	2,840 mm (112 in.)
		without ROPS	2,060 mm (81 in.)
	Wheelbase		3,100 mm (122 in.)
	Compaction width		1,480 mm (58 in.)
	Front drum	width × dia. × thickness	1,480 mm × 1,070 mm × 17 mm (58 in. × 42 in. × 0.7 in.)
	Rear drum	width × dia. × thickness	1,480 mm × 1,070 mm × 17 mm (58 in. × 42 in. × 0.7 in.)
	Ground clearance		275 mm (11 in.)
	Kerb clearance	Right	705 mm (28 in.)
		Left	705 mm (28 in.)
	Side clearance	Right	67 mm (2.5 in.)
		Left	67 mm (2.5 in.)
	Leveling blade width		N/A mm (N/A in.)

Performance	Vibrator system	Front	Centrifugal force	Normal		68 kN (15,285 lbf)
				Oscillation		124 kN (27,875 lbf)
			Frequency	Normal		49 Hz (2,940 vpm)
				Oscillation		49 Hz (2,940 vpm)
			Amplitude	Normal		0.52 mm (0.020 in.)
				Oscillation		0.75 mm (0.030 in.)
		Rear	Centrifugal force	Normal		68 kN (15,285 lbf)
				Oscillation		124 kN (27,875 lbf)
			Frequency	Normal		49 Hz (2,940 vpm)
				Oscillation		49 Hz (2,940 vpm)
			Amplitude	Normal		0.52 mm (0.020 in.)
				Oscillation		0.75 mm (0.030 in.)
	Linear pressure	Static linear pressure	Front drum	Operating weight		233 N/cm (135 lbf./in.)
			Rear drum	Operating weight		256 N/cm (145 lbf./in.)
		Dynamic linear pressure	Front drum	Operating weight	Normal	692 N/cm (395 lbf./in.)
			Rear drum	Operating weight	Normal	715 N/cm (410 lbf./in.)
	Traveling speed	Number of speed shift				8 speed
		Speed range	Low	1st		0 to 2 km/h (0 to 1.2 mile/h)
				2nd		0 to 4 km/h (0 to 2.5 mile/h)
				3rd		0 to 6 km/h (0 to 3.7 mile/h)
				4th		0 to 7 km/h (0 to 4.4 mile/h)
			High	1st		0 to 4 km/h (0 to 2.5 mile/h)
				2nd		0 to 7 km/h (0 to 4.4 mile/h)
				3rd		0 to 11 km/h (0 to 6.8 mile/h)
				4th		0 to 13 km/h (0 to 8.1 mile/h)
	Gradeability (without vibration)					33 % (18 °)
	Turning radius	Machine clearance radius inside				3.6 m (142 in.)
		Machine clearance radius outside				5.5 m (217 in.)
		Turning radius inside compacted surface				3.7 m (146 in.)
		Turning radius outside compacted surface				5.2 m (205 in.)
	Steering / Oscillating angle					± 39 ° / ± 9 °

1-3. Common Specifications

Engine	Model		KUBOTA V3307-CR-T-EF05 (Diesel, EPA-Tier 4)
	Type		4-cycle, water-cooled, 4-cylinder in-line, overhead valve, direct injection type, with turbocharger
	Bore × Stroke		94 mm × 120 mm (3.7 in. × 4.72 in.)
	Displacement		3.331 L (203.3 cu.in.)
	Performance	Rated speed	2,200 min^{-1}
		Rated output	54.6 kW (73 HP)
		Max. torque	261 N·m (193 lbf·ft) at 1,500 min^{-1}
		Fuel consumption rate	227 g/kW·h (0.373 lb/HP·h) at 2,200 min^{-1}
		Fuel consumption	15 L/h with full load (3.9 gal. with full load)
	Fuel system	Fuel	Diesel (ASTM D975-2D)
		Fuel injection pump	High pressure commonrail
		Fuel injection time regulator	Electric speed control
	Lubrication system	Lubrication type	Full forced pressure feed
		Oil filter type	Full flow plastic fiber element
		Oil cooler type	Integrated water cooled
	Air intake system	Air cleaner type	Dry
	Cooling system	Cooling type	Pressurized water forced circulation
		Cooling fan type	Exhale
	Electrical system	Alternator	12 V 90 A
		Starter	12 V 3.0 kW
		Battery	12 V (72 Ah, CCA750A) × 1 pcs. (12 V)
	Dry weight		311 kg (686 lbs.)
Drive system	Transmission	Type	Hydrostatic
		Speeds	8 speed shifts
	Reverser		Switching the direction of flow delivered from the variable pump
	Differential type	Front	N/A
		Rear	N/A
	Final drive	Front	Planetary gear
		Rear	Planetary gear
Vibration system	Power transmission type		Hydraulic
	Vibrator type	SW654	Single eccentric shaft
		SW654ND	Twin eccentric shaft
Brake system	Service brake		Dynamic braking through hydrostatic drive system (F-N-R lever)
	Secondary brake (Emergency brake)		Hydrostatic + spring applied hydraulically released type (Brake pedal)
	Parking brake		Spring applied hydraulically released type (Panel button)
Steering system	Power transmission type		Hydraulic
	Steering type		Articulated
Drum and tyres	Use	Front	Steel drum / Vibrate and drive / 1pc.
		Rear	Steel drum / Vibrate and drive / 1pc.
	Suspension system	Front	Rubber isolation
		Rear	Rubber isolation
Sprinkler system	Water spray type		Pressurized
	Liquid spray type		N/A
Others	ECO mode		Standerd

2. TABLE OF STANDARD VALUES

2-1. Engine

Item		Standard value	Remarks
Engine model		KUBOTA V3307-CR-TE4B	
Rated output		53.8 kW (72 HP)	
Max. rpm under no load		2,400 ± 50 min^{-1}	
Min. rpm under no load		1,000 ± 50 min^{-1}	
Cylinder head tightening torque		187 to 196 N·m (138 to 145 lbf·ft)	
Intake manifold tightening torque		18 to 20 N·m (13 to 15 lbf·ft)	
Exhaust manifold tightening torque		30 to 34 N·m (22 to 25 lbf·ft)	
Fan belt tension		10 to 12 mm (0.39 to 0.47 in.)	When midpoint of belt pressed at 98 N (22 lbf)
Valve clearance (intake)		0.13 to 0.17 mm (0.005 to 0.007 in.)	
Valve clearance (exhaust)		0.13 to 0.17 mm (0.005 to 0.007 in.)	
Compression pressure	Standard value	3.92 MPa (568 psi)	250 min^{-1}
	Allowable limit	2.90 MPa (421 psi)	250 min^{-1}

2-2. Propulsion

Item			Standard value	Remarks
Travel speed (Forward/reverse)	Low	1st	0 to 2 km/h (0 to 1.2 mile/h)	
		2nd	0 to 4 km/h (0 to 2.5 mile/h)	
		3rd	0 to 6 km/h (0 to 3.7 mile/h)	
		4th	0 to 7 km/h (0 to 4.4 mile/h)	
	High	1st	0 to 4 km/h (0 to 2.5 mile/h)	
		2nd	0 to 7 km/h (0 to 4.4 mile/h)	
		3rd	0 to 11 km/h (0 to 6.8 mile/h)	
		4th	0 to 13 km/h (0 to 8.1 mile/h)	

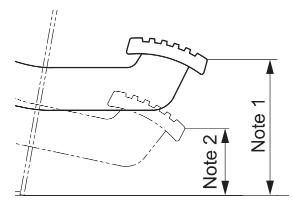
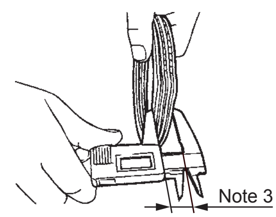
2-3. Hydraulic System

Item			Standard value	Remarks
Propulsion	High pressure relief valve setting		33.0 ± 1.0 MPa (4,785 ± 145 psi)	Differential pressure
	Cut off valve setting		30.0 ± 1.0 MPa (4,350 ± 145 psi)	Differential pressure
	Charge relief valve setting		2.4 ± 0.2 MPa (348 ± 29 psi)	
	Case pressure	Pump	0.4 MPa (58.0 psi) or less	
		Motor (F)	0.4 MPa (58.0 psi) or less	
		Motor (R)	0.4 MPa (58.0 psi) or less	
	Brake release pressure	Motor (F)	More than 1.8 MPa (261 psi)	
		Motor (R)	More than 1.8 MPa (261 psi)	
	Drainage	Motor (F)	5.2 L/min (1.4 gal./min)	, 4th
		Motor (R)	5.2 L/min (1.4 gal./min)	
Vibration	High pressure relief valve setting		34.5 ± 1.0 MPa (5,003 ± 145 psi)	Differential pressure
	Cut off valve setting		32.5 ± 1.0 MPa (4,713 ± 145 psi)	
	Charge relief valve setting		—	
	Case pressure	Pump	0.4 MPa (58.0 psi) or less	
		Motor	0.2 MPa (29.0 psi) or less	
	Drainage	SW654	9.4 L/min (2.5 gal./min)	
		SW654ND	6.9 L/min (1.8 gal./min)	
Steering oil pressure			18.1 ± 1.0 MPa (2,625 ± 145 psi)	(orbitroll relief pressure + charge relief pressure)

2-4. Steering

Item	Standard value	Remarks
Play in steering wheel	5 to 10 mm (0.2 to 0.4 in.)	Steering wheel circumference
	0.5 mm (0.02 in.) or less	Steering column shaft direction

2-5. Brakes

Item	Standard value	Remarks
Clearance between brake pedal and floorboard (as released)	112 mm (4.4 in.) Note 1: See dimensions	 SW652-1-02001
Clearance between brake pedal and floorboard (when pressed down)	52 mm (2.0 in.) Note 2: See dimensions	
Propulsion motor inner brake wear limit Thickness of disc assembly (15 discs)	19.9 mm (0.78 in.) Note 3: See dimensions	 SW652-1-02002

2-6. Capacities

Item		Standard value	Remarks
Engine oil pan		11.2 L (3.0 gal.)	
Fuel tank		120 L (32 gal.)	
Coolant		9 L (2.4 gal.)	
Gear box		1.2 L × 2 (0.3 gal. × 2)	
Hydraulic oil tank		44 L (11.6 gal.)	
Vibrator case	SW654	4.0 L × 2 (1.1 gal. × 2)	
	SW654ND	10.4 L × 2 (2.7 gal. × 2)	
Water spray tank		300 L × 2 (79 gal. × 2)	

3. FUEL AND LUBRICANTS SPECIFICATION

3-1. Rating

Lubricant	Service classification	Ambient temp. and applicable viscosity rating			Applicable Standards
		-15 to 30°C (5 to 86°F) Cold	0 to 40°C (32 to 104°F) Moderate	15 to 55°C (59 to 131°F) Tropical	
Engine oil	API-CH-4 or JASO DH-2	SAE10W-30	SAE10W-30	SAE10W-30	—
Gear oil	API grade GL5	SAE80W-90	SAE90	SAE140	MIL-L-2105
Hydraulic oil	Wear resisting	ISO-VG32 Over VI 140	ISO-VG46 Over VI 140	ISO-VG68 Over VI 110	ISO-3448
Grease	Lithium type extreme-pressure grease				NLGI-2
Fuel	Diesel oil				ASTM-D975-2D

3-2. Recommended Lubricants

Lubricant / Oil company	Engine oil		Gear oil API GL 5	Hydraulic oil ISO-VG 46	Grease (NLGI-2)
	API CJ-4	JASO DH-2			
CHEVRON	DELO 400 LE	DELO 400 LE	RPM Universal Gear Lubricants	Rando HDZ 46	Multifak EP 2
BP	—	—	BP Energear HYPO-U	Bartran HV 46	BP Energrease LS-EP 2
CASTROL	Tection Extra	TECTION J-MAX 2	EXP Gear OILS	Castrol Hyspin AWH 46	Castrol Spheerol EPL 2
EXXON MOBIL	Mobil Delvac 1 ESP	—	Mobilube HD	Mobil DTE 10 Excel 46	Mobilux EP 2
SHELL	Shell Rimula R4 L	Shell Rimula R4 L	Shell Spirax S2 A 90	Shell Tellus S2V 46	Shell Alvania Greases EP 2

4. TIGHTENING TORQUE CHART

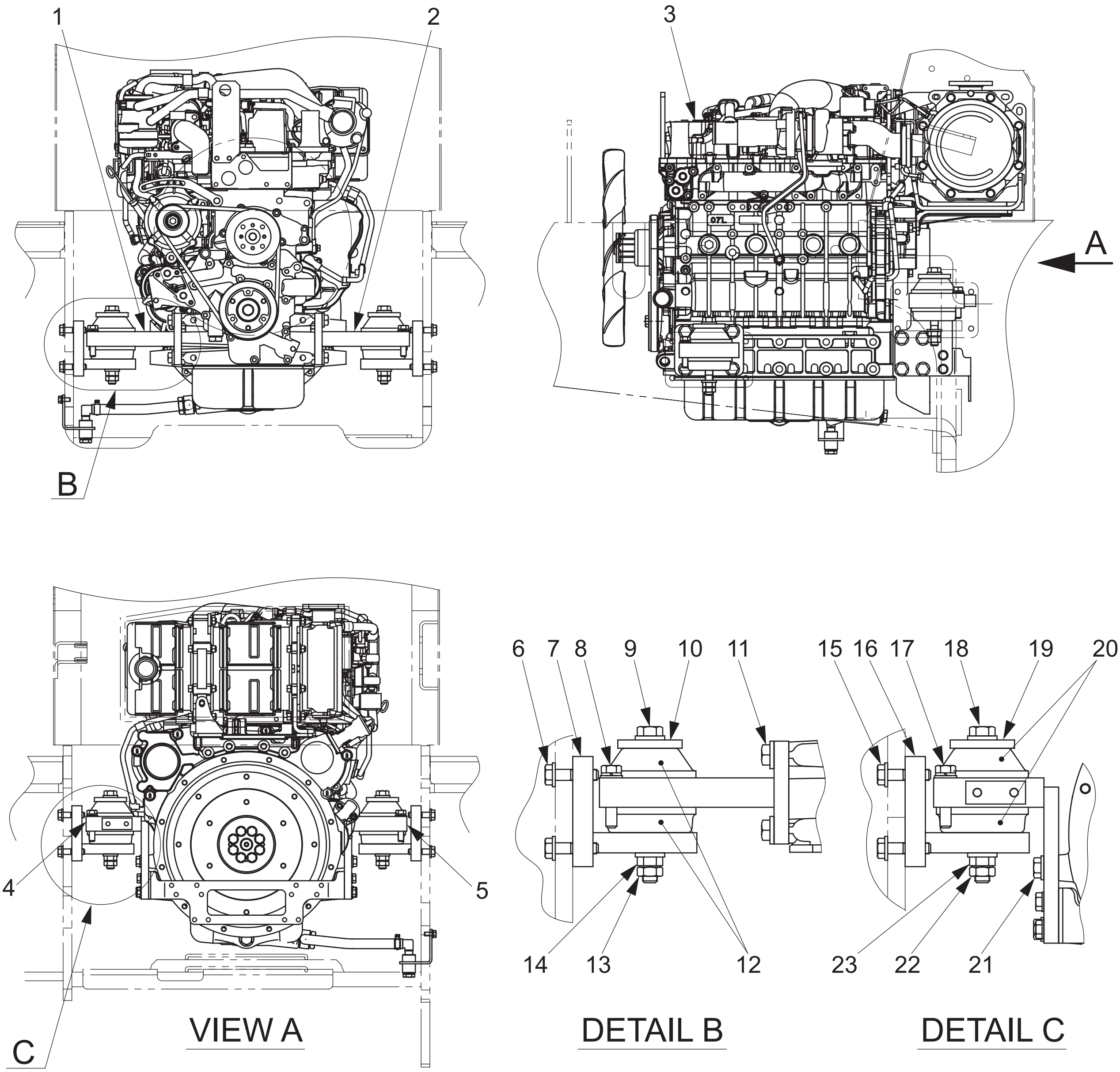
N·m	(lbf·ft)

	Nominal Dia.	Pitch	Strength Classification							
			6.8		8.8		10.9		12.9	
Metric coarse screw	5	0.8	4.9	(3.6)	5.9	(4.4)	7.8	(5.8)	7.8	(5.8)
	6	1.0	7.8	(5.8)	9.8	(7.2)	13	(9.6)	13	(9.6)
	8	1.25	17	(13)	23	(17)	31	(23)	31	(23)
	10	1.5	39	(29)	49	(36)	59	(44)	59	(44)
	12	1.75	69	(51)	78	(58)	108	(80)	108	(80)
	14	2.0	98	(72)	127	(94)	167	(123)	167	(123)
	16	2.0	157	(116)	196	(145)	265	(195)	265	(195)
	18	2.5	196	(145)	245	(181)	343	(253)	343	(253)
	20	2.5	294	(217)	392	(289)	539	(398)	539	(398)
	22	2.5	441	(325)	539	(398)	686	(506)	686	(506)
	24	3.0	539	(398)	637	(470)	883	(651)	883	(651)
	27	3.0	785	(579)	981	(724)	1324	(977)	1324	(977)
	30	3.5	1079	(796)	1324	(977)	1765	(1302)	1765	(1302)
Metric fine screw	10	1.25	39	(29)	49	(36)	69	(51)	69	(51)
	12	1.25	69	(51)	88	(65)	118	(87)	118	(87)
	14	1.5	108	(80)	137	(101)	186	(137)	186	(137)
	16	1.5	167	(123)	206	(152)	284	(209)	284	(209)
	18	1.5	245	(181)	294	(217)	392	(289)	392	(289)
	20	1.5	343	(253)	441	(325)	588	(434)	588	(434)
	22	1.5	490	(361)	588	(434)	785	(579)	785	(579)
	24	2.0	588	(434)	735	(542)	981	(724)	981	(724)
	27	2.0	834	(615)	1030	(760)	1422	(1049)	1422	(1049)
	30	2.0	1177	(868)	1422	(1049)	1961	(1446)	1961	(1446)

ENGINE AND CONTROLS

1. ENGINE

1-1. Engine Mount



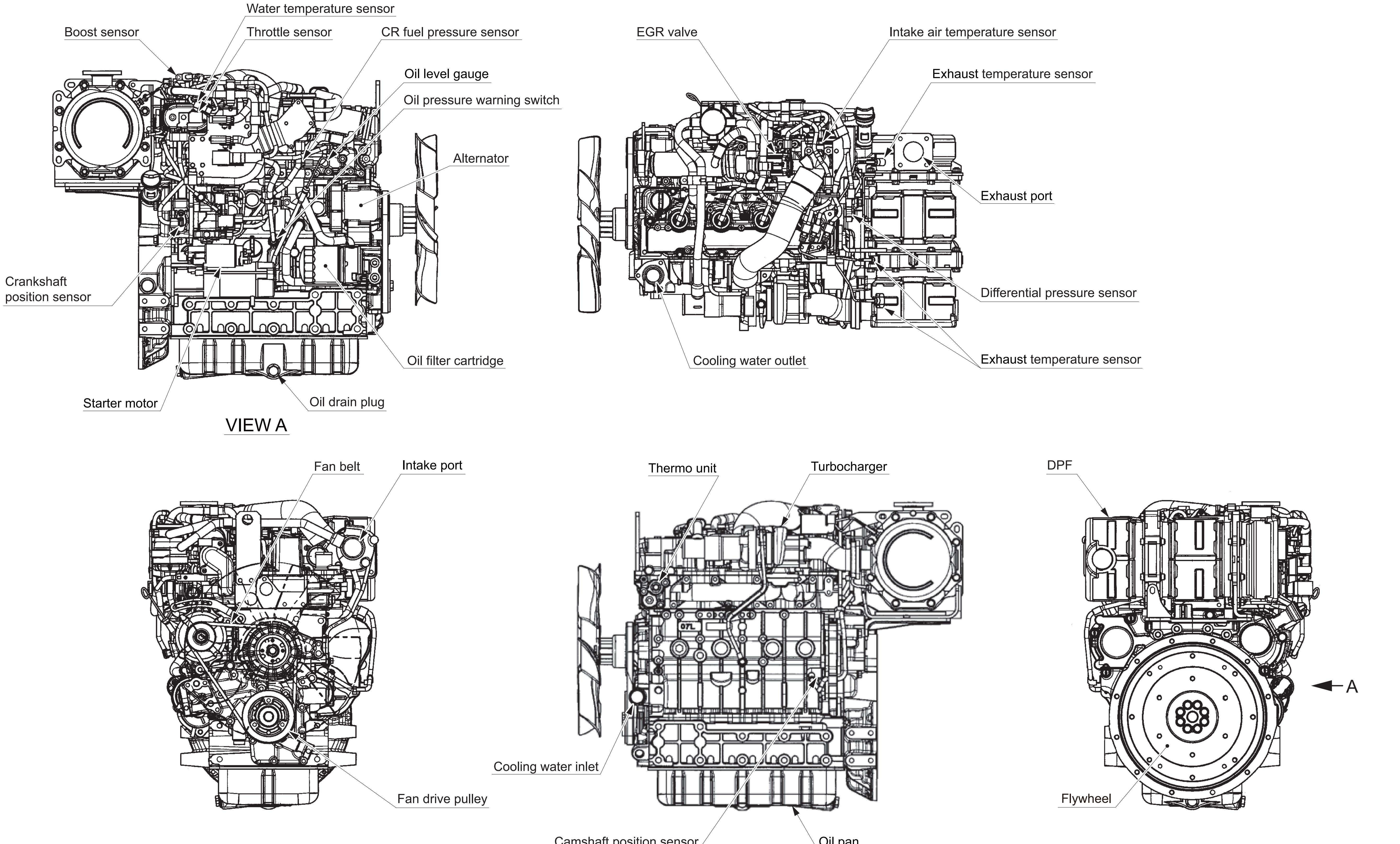
0559-01805-0-10853-A

(1)	Bracket		(9)	Bolt	: M16×160	(17)	Bolt	: M12× 60
(2)	Bracket		(10)	Plate		(18)	Bolt	: M16×160
(3)	Engine		(11)	Bolt	: M14× 40 P=1.5	(19)	Plate	
(4)	Bracket		(12)	Damper		(20)	Damper	
(5)	Bracket		(13)	Nut (upper)	: M16	(21)	Bolt	: M12×35 P=1.25
(6)	Bolt	: M12×50	(14)	Nut (lower)	: M16	(22)	Nut (upper)	: M16
(7)	Bracket		(15)	Bolt	: M12× 50	(23)	Nut (lower)	: M16
(8)	Bolt	: M12×60	(16)	Bracket				

N•m

(6)	Bolt M12×50	: 108 N·m (80 lbf·ft)	(15)	Bolt M12×50	: 108 N·m (80 lbf·ft)
(11)	Bolt M14×45 P=1.5	: 186 N·m (137 lbf·ft)	(21)	Bolt M12×35 P=1.25	: 118 N·m (87 lbf·ft)
(13)	Nut (upper) M16	: 100 N·m (74 lbf·ft)	(22)	Nut (upper) M16	: 100 N·m (74 lbf·ft)
(14)	Nut (lower) M16	: 265 N·m (195 lbf·ft)	(23)	Nut (lower) M16	: 265 N·m (195 lbf·ft)

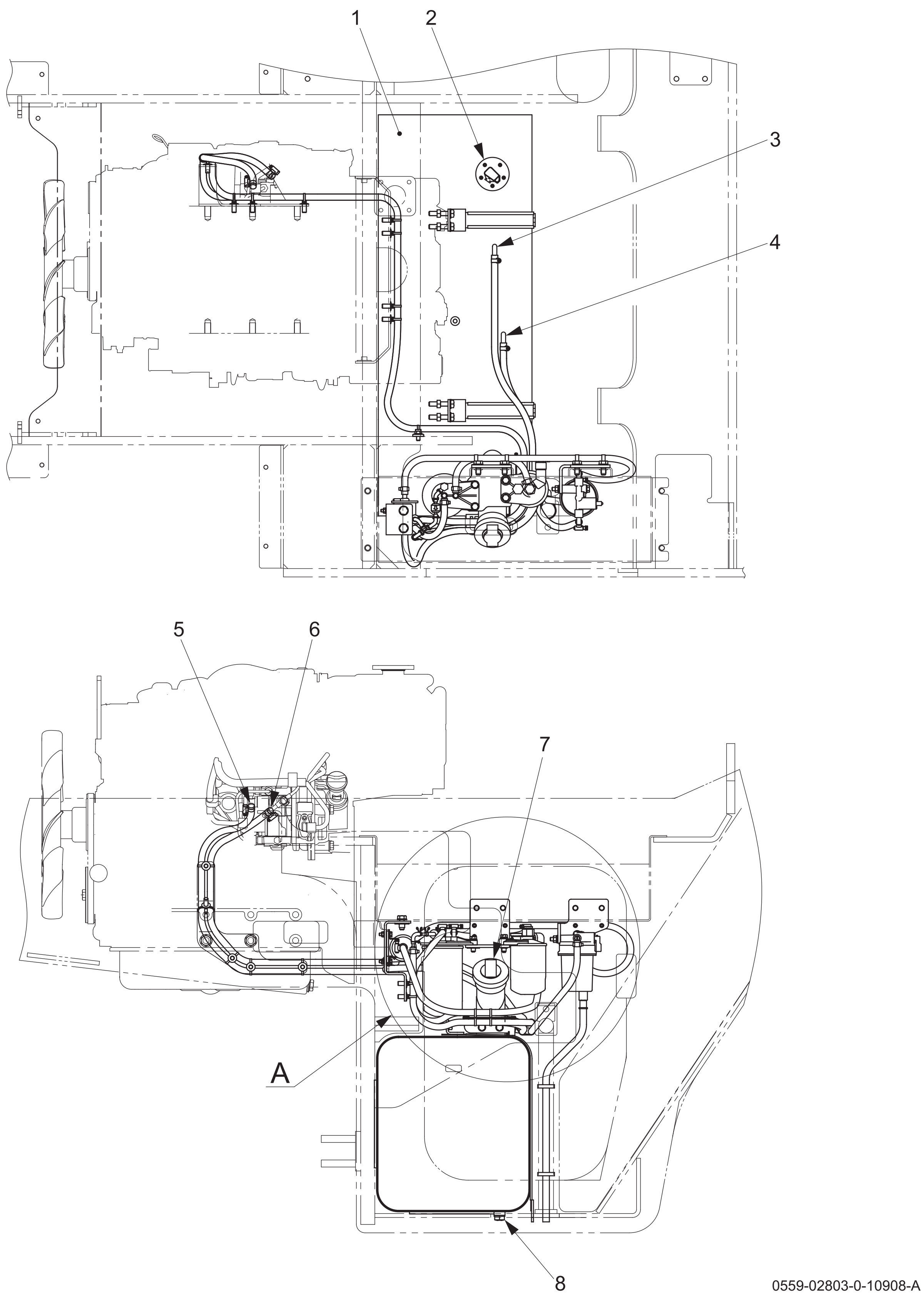
1-2. Engine Exterior

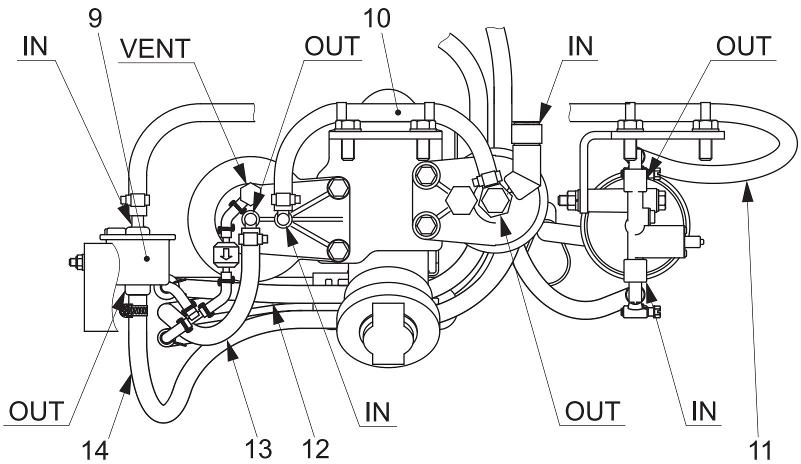


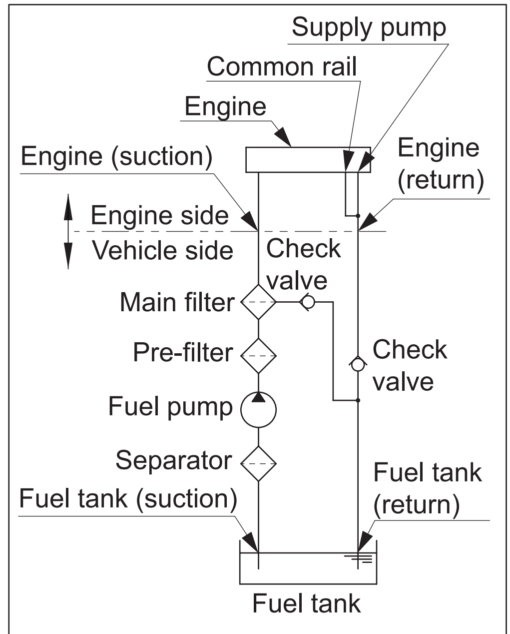
* The actual equipment may differ from that shown above.

SW654-03001

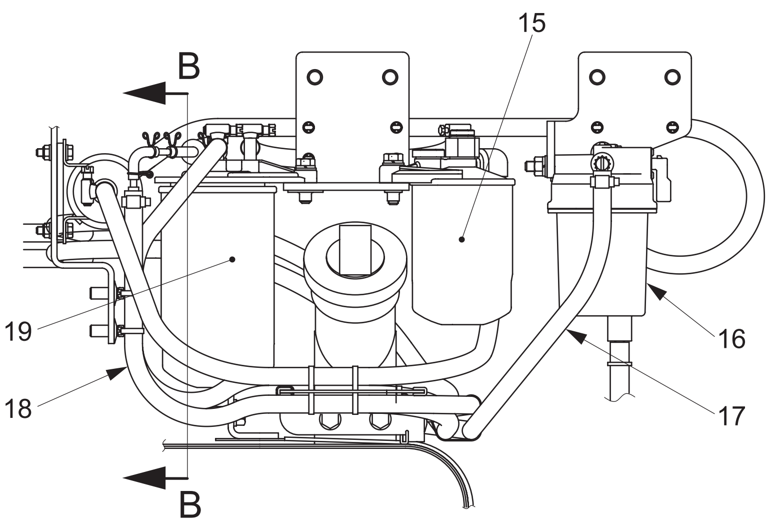
2. FUEL SYSTEM



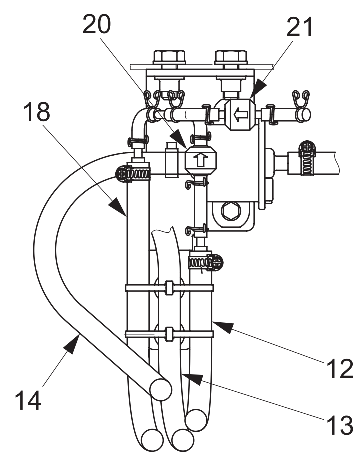




Fuel system diagram



DETAIL A



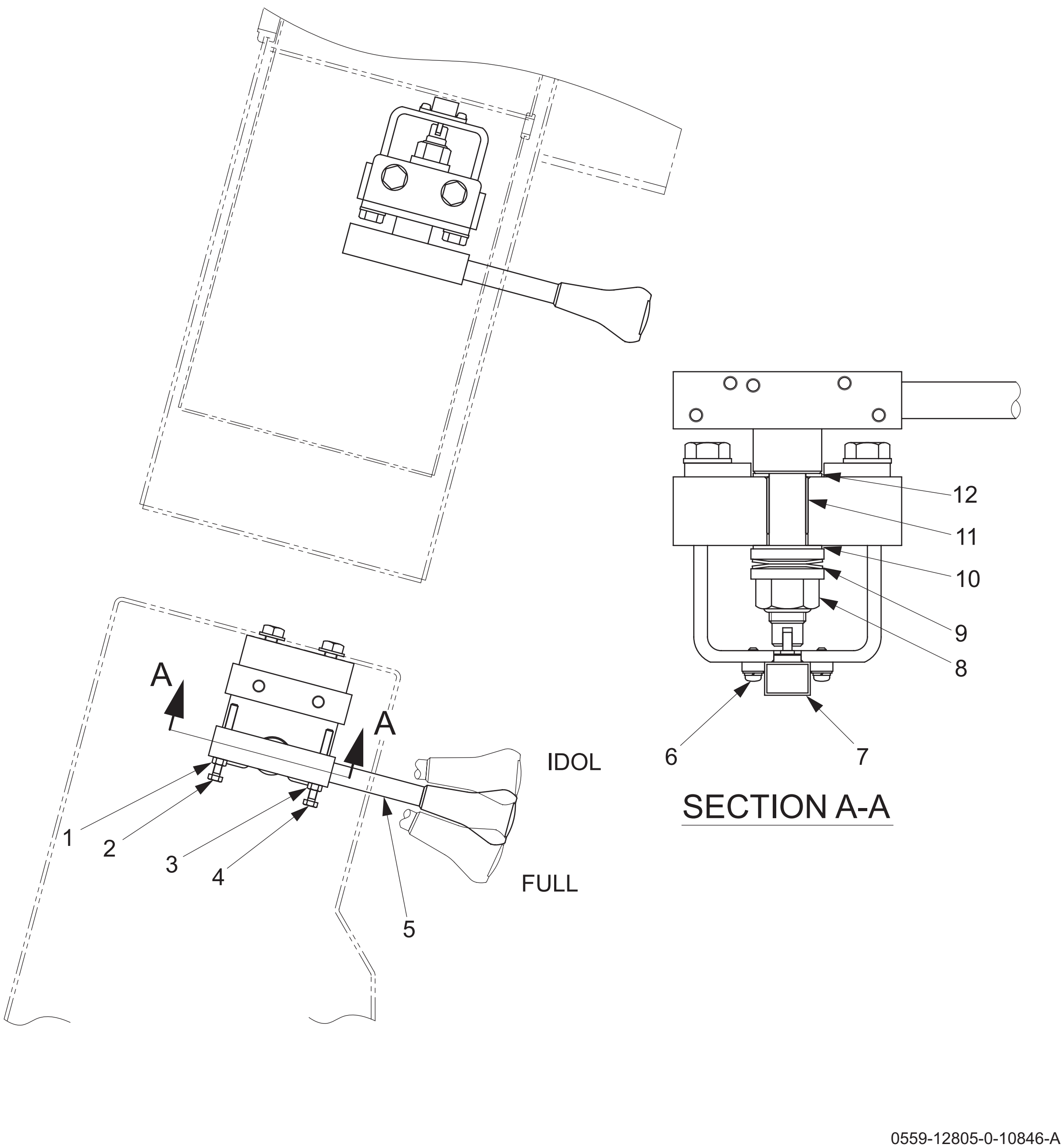
SECTION B-B

0559-02803-0-10908-A

(1) Fuel tank
(2) Fuel gauge unit
(3) Fuel tank (return)
(4) Fuel tank (suction)
(5) Engine (suction)
(6) Engine (return)
(7) Fuel supply port
(8) Drain plug
(9) Fuel pump
(10) Hose (Pre-filter OUT → Main filter IN)
(11) Hose (Separator OUT → Fuel pump IN)
(12) Hose (Engine (return) → Check valve)
(13) Hose (Main filter OUT → Engine (suction))
(14) Hose (Fuel pump OUT → Pre-filter IN)
(15) Pre-filter
(16) Separator
(17) Hose (Fuel tank (suction) → Separator IN)
(18) Hose (Check valve → Fuel tank (return))
(19) Main filter
(20) Check valve
(21) Check valve

3. CONTROL SYSTEM

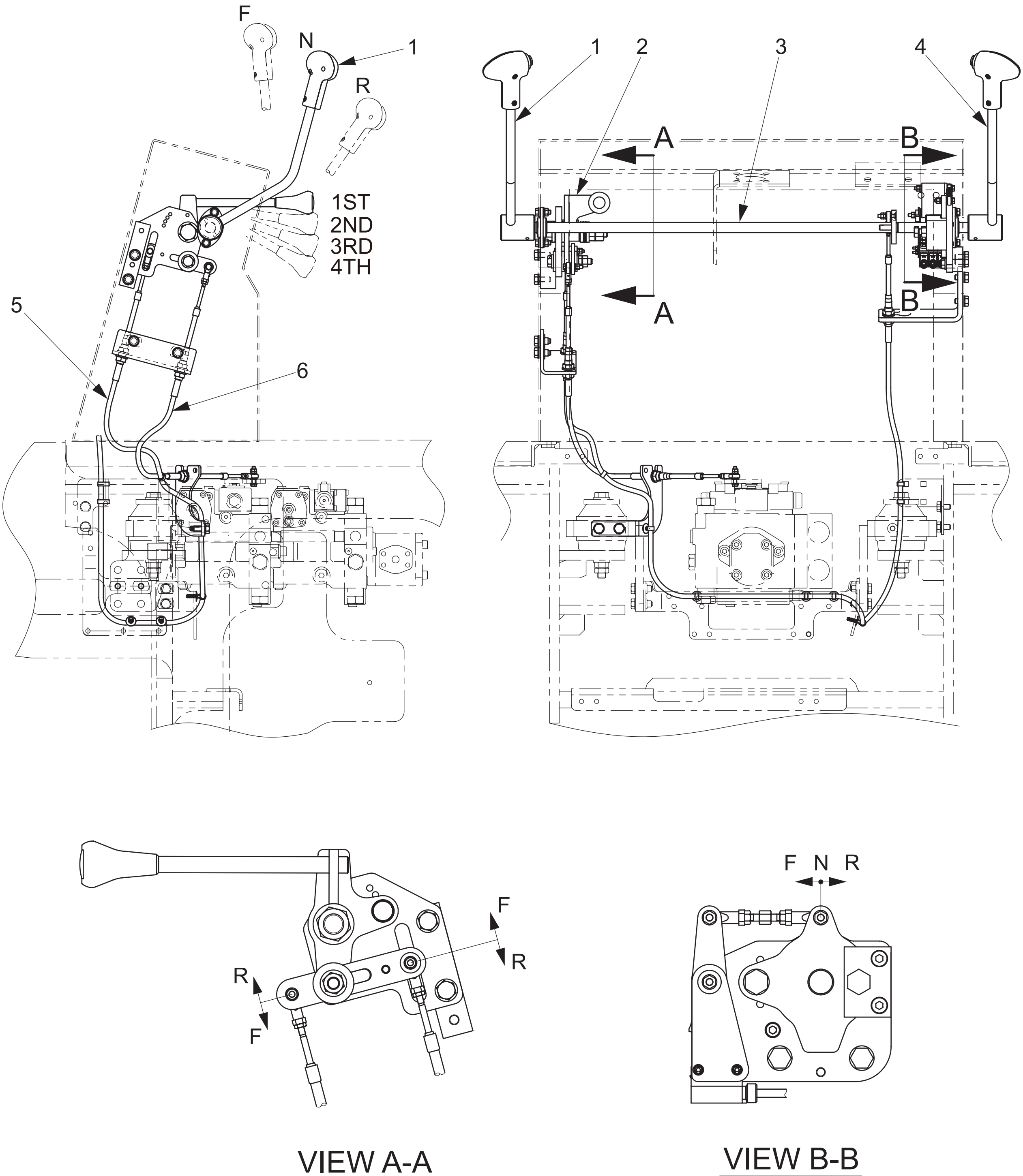
3-1. Throttle Control



(1) Lock nut : M6
(2) Stopper bolt (FULL) : M6×60
(3) Lock nut : M6
(4) Stopper bolt (IDOL) : M6×60
(5) Throttle lever
(6) Screw : M4×12
(7) Potentiometer
(8) Nut : M16
(9) Disc spring (Do not apply grease)
(10) Washer (Apply grease*)
(11) Bush (Apply grease*)
(12) Washer (Apply grease*)

* : Lithium-based grease

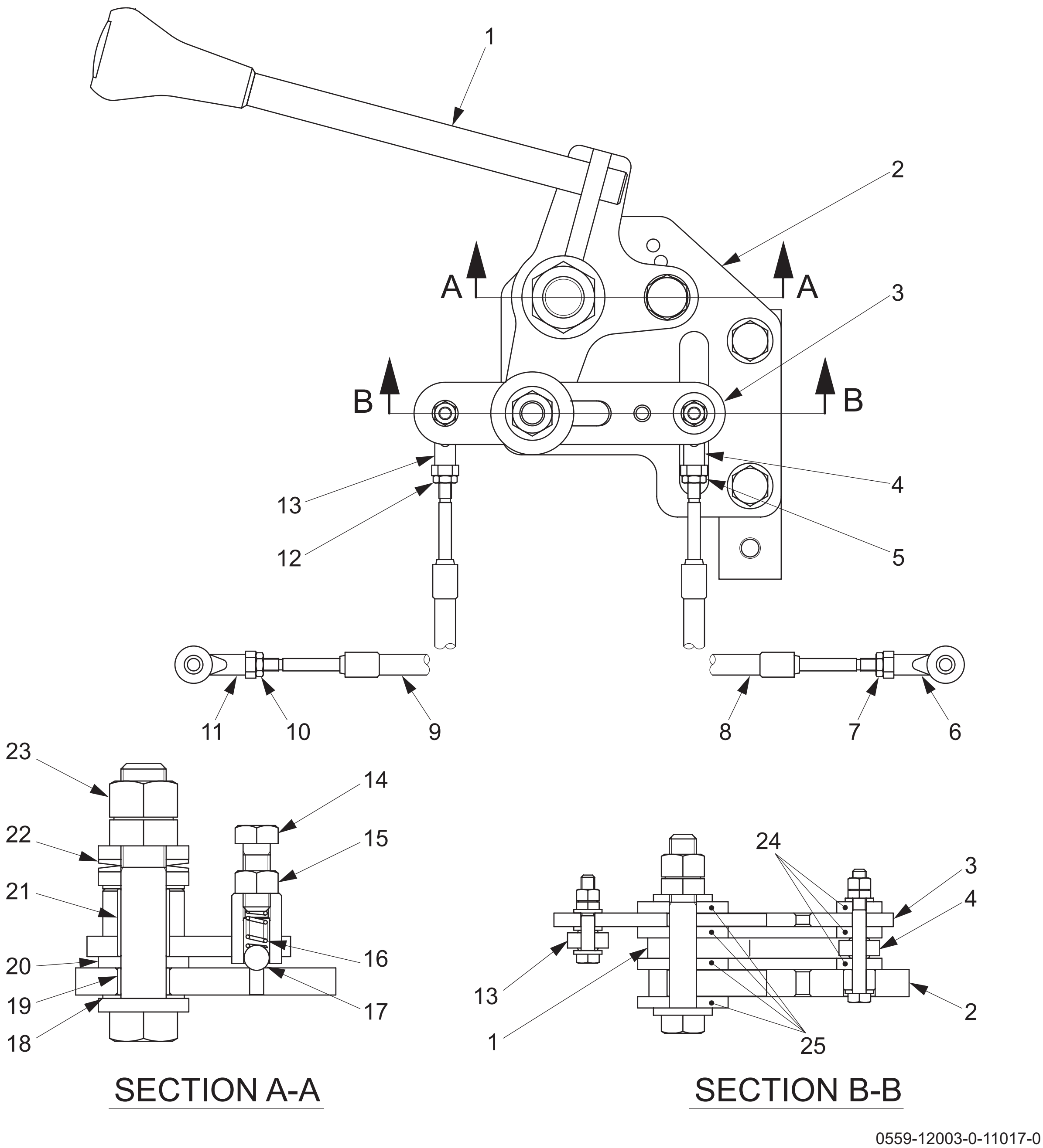
3-2. Forward-reverse Control



0559-12804-0-10827-0

(1) F-R lever (L)
(2) Lever subassembly
(3) Shaft subassembly
(4) F-R lever (R)
(5) Control cable (F-R)
(6) Control cable (shift)

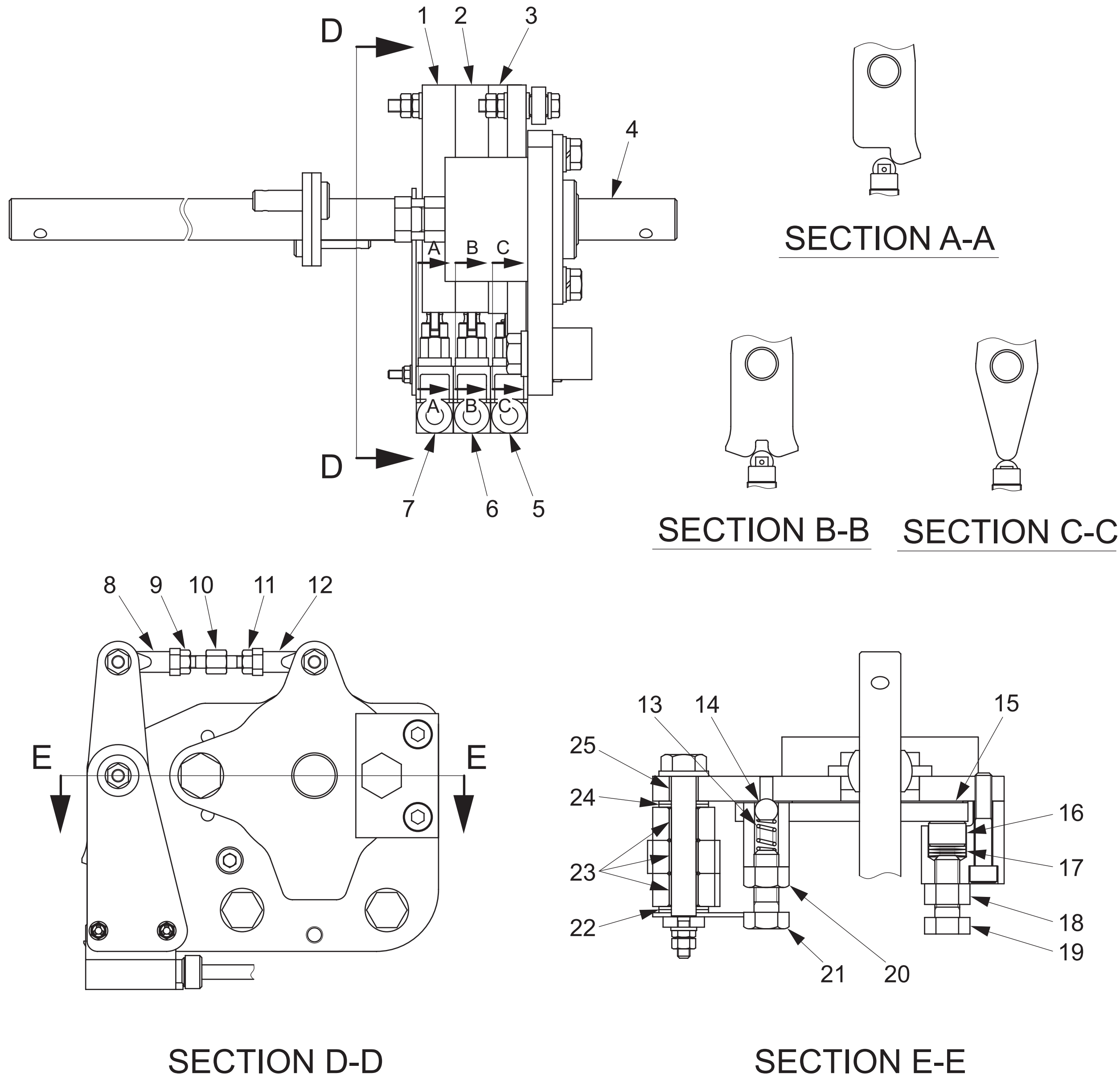
2) Lever subassembly



(1)	Shift lever	
(2)	Base	
(3)	Plate	
(4)	Rod end (Apply grease*)	: M6
(5)	Lock nut	: M6
(6)	Rod end (Apply grease*)	: M6
(7)	Lock nut	: M6
(8)	Control cable (F-R)	
(9)	Control cable (shift)	
(10)	Lock nut	: M6
(11)	Rod end (Apply grease*)	: M6
(12)	Lock nut	: M6
(13)	Rod end (Apply grease*)	: M6
(14)	Bolt	: M12×30
(15)	Lock nut	: M12
(16)	Spring (Fill grease*)	
(17)	Steel ball	
(18)	Washer (Apply grease*)	
(19)	Bush (Apply grease*)	
(20)	Washer (MC nylon)	
(21)	Bush (Apply grease*)	
(22)	Disc spring (Do not apply grease)	
(23)	Nut	: M20
(24)	Washer (MC nylon)	
(25)	Washer (MC nylon)	

* : Lithium-based grease

3) Shaft subassembly



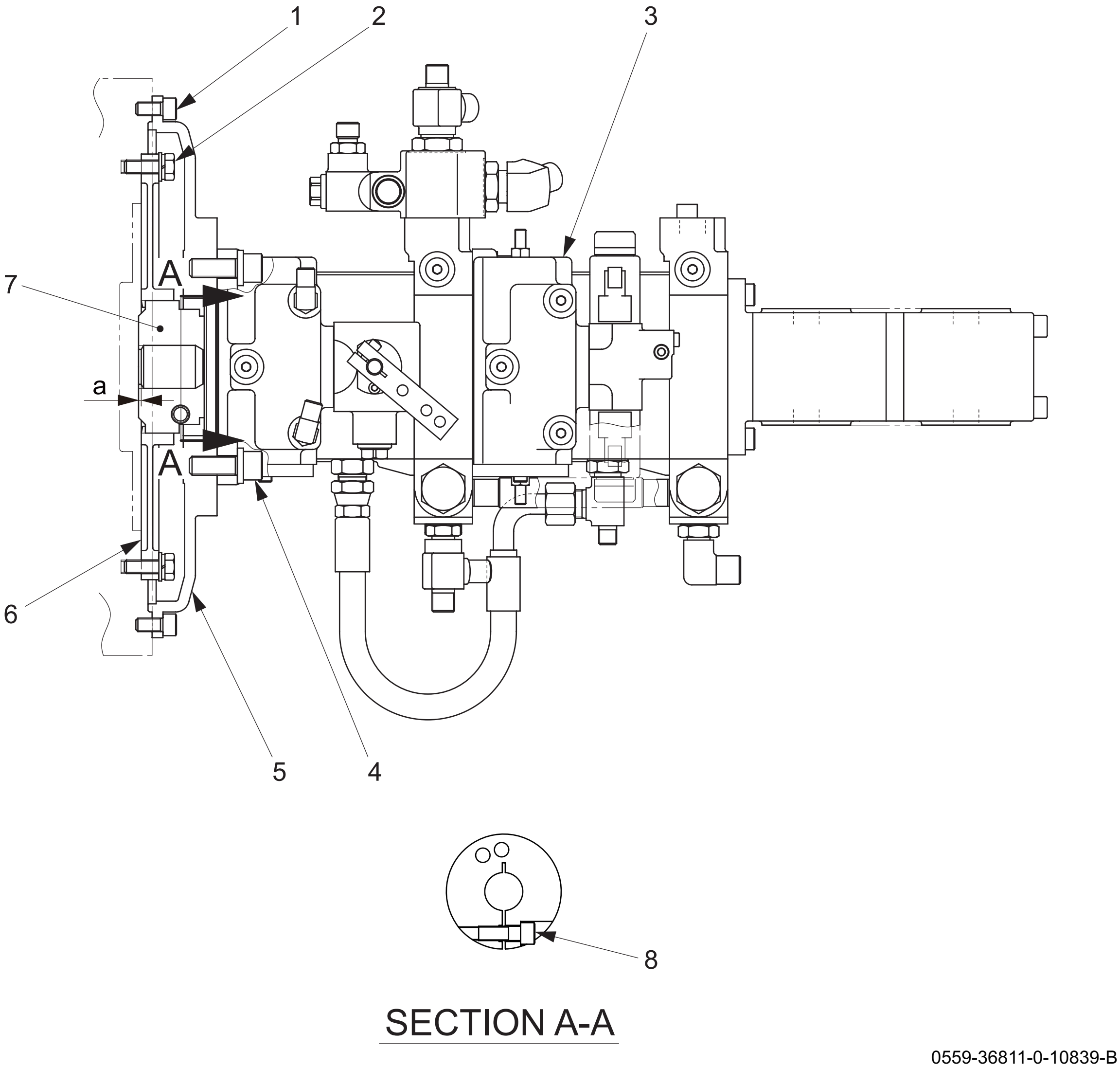
0559-12004-0-11020-A

(1) Arm
(2) Arm
(3) Arm
(4) Shaft
(5) F-R lever switch
(6) Vibration AUTO switch
(7) Backup buzzer switch
(8) Rod end (Apply grease*) : M6 (Left-hand thread)
(9) Nut : M6 (Left-hand thread)
(10) Rod : M6
(11) Nut : M6
(12) Rod end (Apply grease*) : M6
(13) Spring (Fill grease*)
(14) Steel ball
(15) Friction plate
(16) Holder
(17) Disc spring (Fill grease*)
(18) Lock nut : M12
(19) Bolt : M12×30
(20) Lock nut : M12
(21) Bolt : M12×30
(22) Washer (Apply grease*)
(23) Bush (Apply grease*)
(24) Washer (Apply grease*)
(25) Bush (Apply grease*)

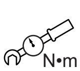
* : Lithium-based grease

4. PUMP MOUNT

4-1. Pump Mount



(1) Bolt : M10×25 P=1.25
(2) Bolt : M10×30 P=1.25
(3) Pump
(4) Bolt : M14×40
(5) Housing
(6) Flange
(7) Hub
(8) Bolt : M12×35



(1) Bolt M10×25 P=1.25 : 69 N·m (51 lbf·ft)
(2) Bolt M10×30 P=1.25 : 49 N·m (36 lbf·ft)
(8) Bolt M12×35 : 86 N·m (63 lbf·ft)

4-1-1. Installation of pump

- When the pump assembly has been removed from the engine for repair or replacement, reinstall it in accordance with the following procedure.

① Apply adequate amount of grease to pump (3) and hub (7) splines.
② Set hub (7) to pump (3) and the specified dimension.

★ **Specified dimension a: 2 mm (0.08 in.)**

③ Secure hub (7) with bolt (8).

N•m (8) Bolt M12×35 : 86 N·m (63 lbf·ft)

④ Secure flange (6) to engine flywheel with eight bolts (2), spring washers and washers.

N•m (2) Bolt M10×30 P=1.25 : 49 N·m (36 lbf·ft)

⑤ Secure housing (5) to flywheel housing with twelve bolts (1).

N•m (1) Bolt M10×25 P=1.25 : 69 N·m (51 lbf·ft)

⑥ Engage hub (7) of pump subassembly with flange (6).
⑦ Secure pump subassembly to housing (5) with two bolts (4) and washers.

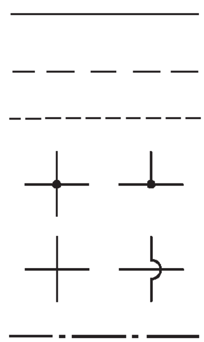
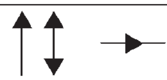
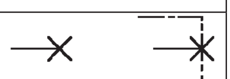
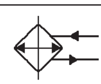
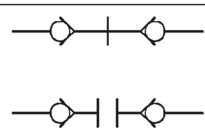
(NOTICE)
- **Bolts (2) is treated with thread-locking fluid. Use new thread-locking fluid treated bolts for installation.**

HYDRAULIC SYSTEMS

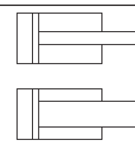
1. SYSTEM CIRCUIT DIAGRAM

1-1. Graphic Symbols for Hydraulic Circuits

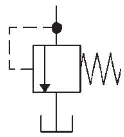
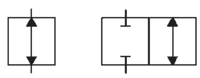
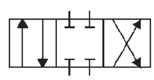
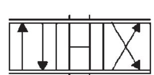
Basic Symbols

DESCRIPTION	SYMBOL
Lines: Main working Pilot control Drain or bleed Lines, joining Not connected Component outline	
Arrow indicates direction of flow.	
Line with fixed restriction (orifice).	
Test port, pressure measurement.	
Temperature measurement gauge	
Pressure measurement gauge	
Reservoir (vented)	
Filter or strainer	
Heat exchanger, lines indicate flow of coolant.	
Quick disconnect: Connected with mechanically opened checks. Disconnected.	
Sloping arrow through a symbol at 45° indicates that a component can be adjusted or varied.	

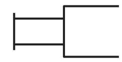
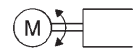
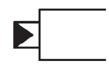
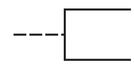
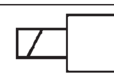
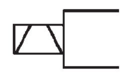
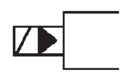
Pump, Motors and Cylinders

DESCRIPTION	SYMBOL
Hydraulic pumps: Fixed displacement Unidirectional Bidirectional Variable displacement Unidirectional Bidirectional Variable displacement pressure compensated Unidirectional	
Hydraulic Motor: Unidirectional Bidirectional	
Double acting hydraulic cylinder Differential cylinder	
Electric motor	

Valves

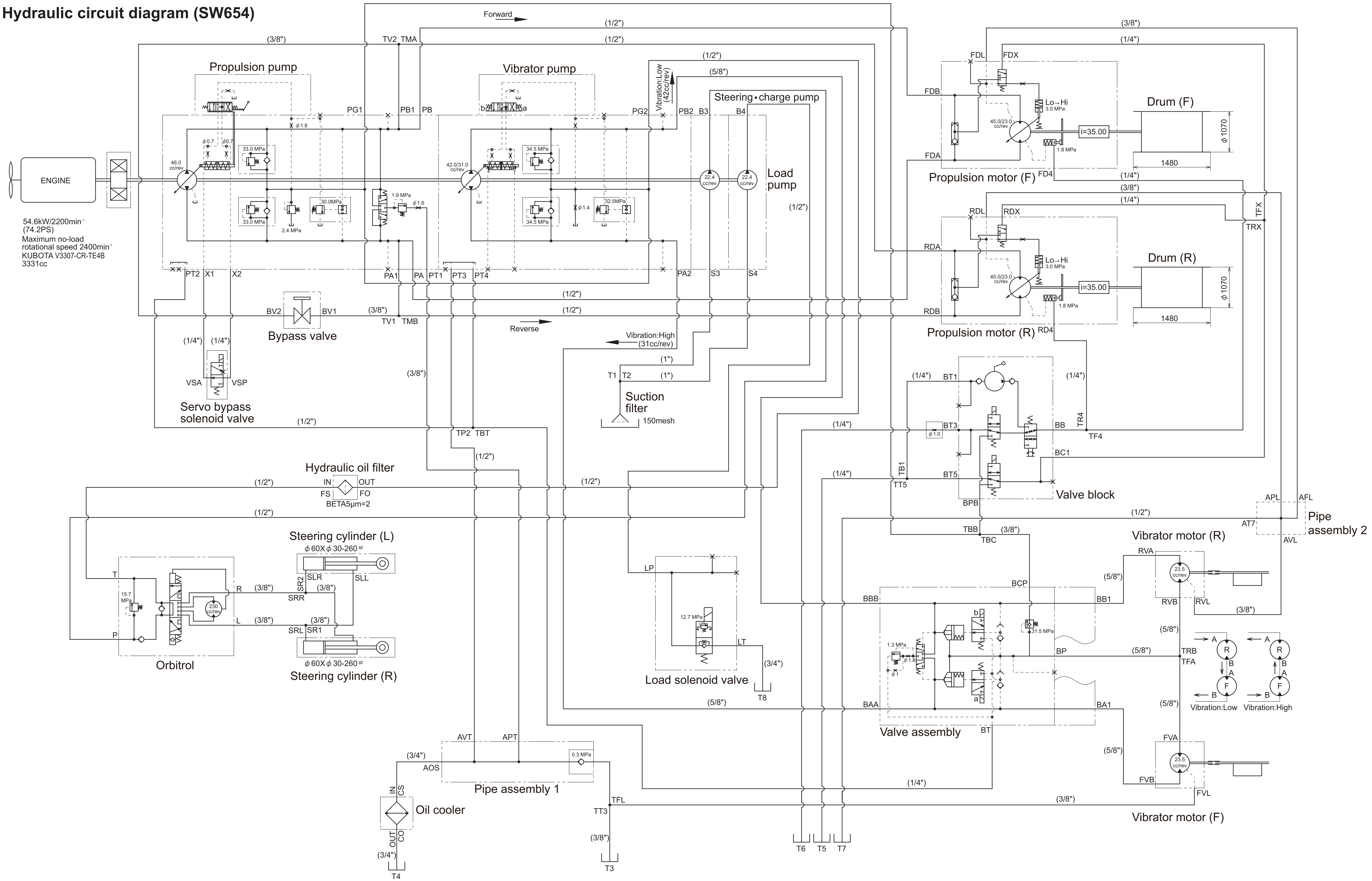
DESCRIPTION	SYMBOL
Check valve	
Manual shut off (On-Off)	
Pressure relief	
Flow control, adjustable	
Valve symbols: The basic valve symbol one or more squares with lines representing flow paths and flow conditions between ports.	
Multiple squares indicate a valve with as many distinct positions there are squares providing various flow path options for the fluid. The multiple square moves to represent how flow paths change when the valving element is shifted within the component.	
Valves with infinite positioning between certain limits are symbolized with lines parallel to the squares.	

Methods of Operation

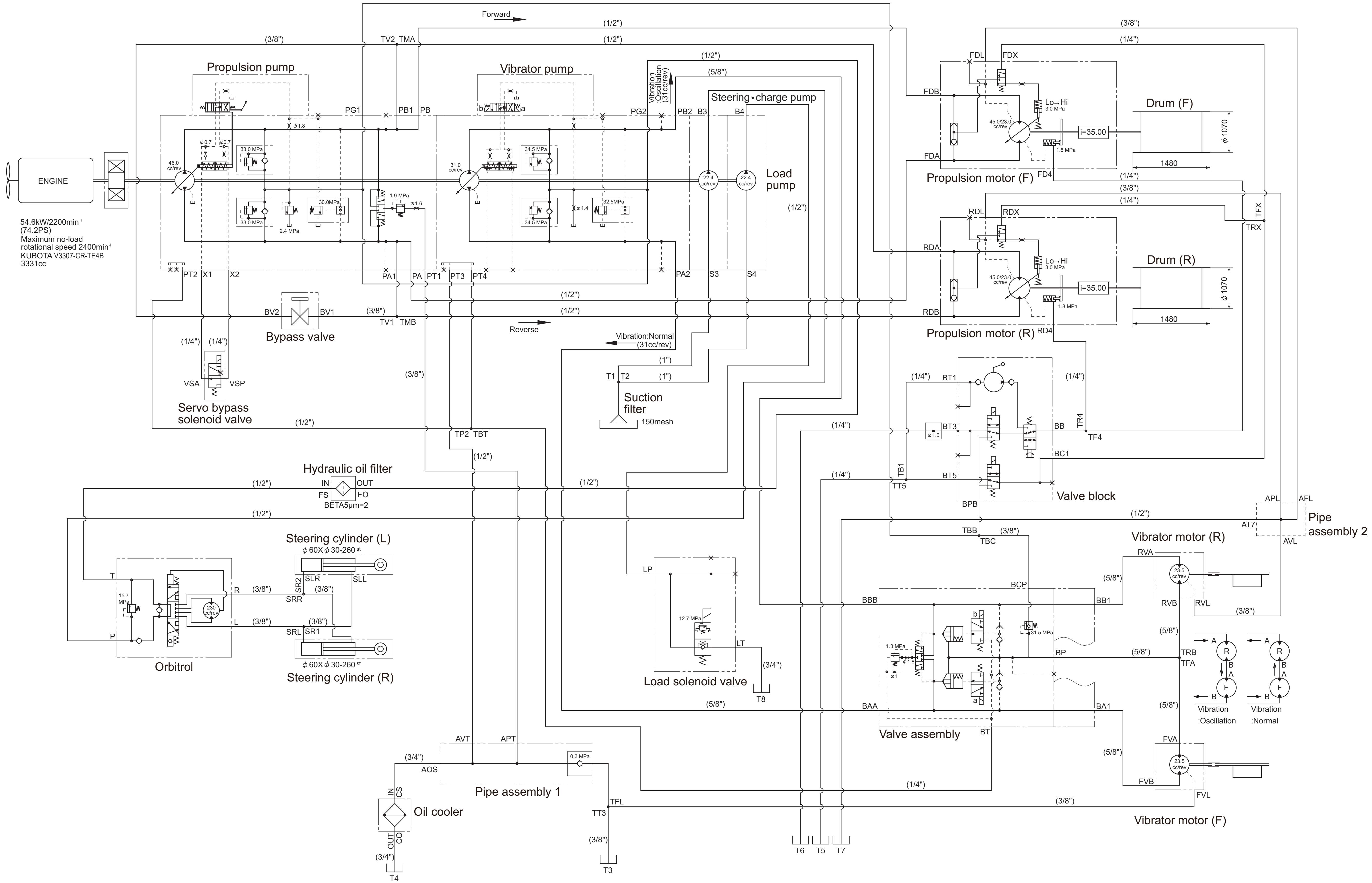
DESCRIPTION	SYMBOL
Spring	
Manual	
Pressure compensated	
Reversing motor	
Pilot pressure: Internal supply Remote supply	 
Solenoid: Single winding Two windings operating in opposite directions. Pilot directional valve is actuated by the solenoid.	  

1-2. Hydraulic Circuit Diagram

1-2-1. Hydraulic circuit diagram (SW654)



1-2-2. Hydraulic circuit diagram (SW654ND)

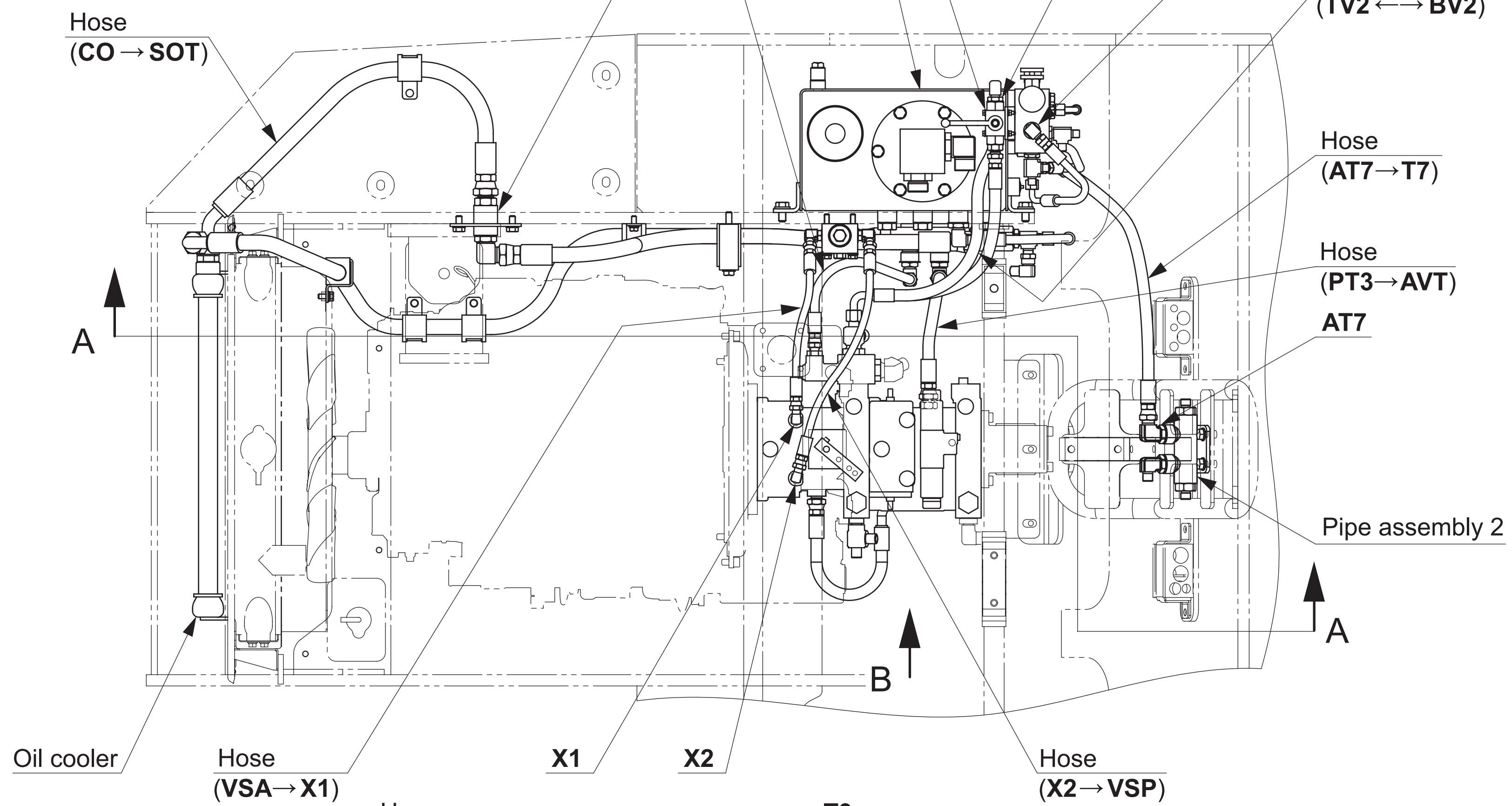


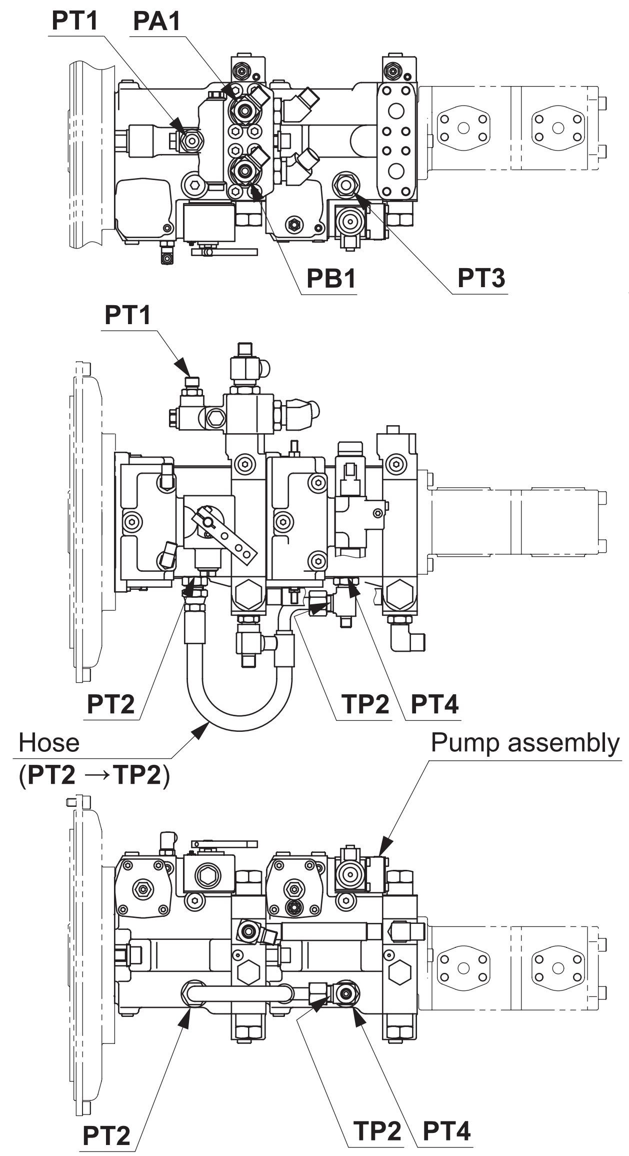
0559-99095-0-11222-0

2. PROPULSION HYDRAULIC SYSTEM

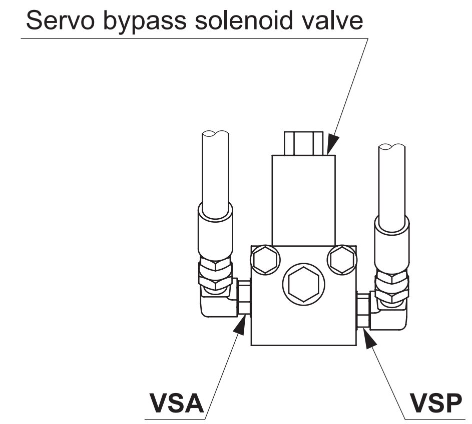
2-1. Propulsion Hydraulic Piping

2-1-1. Propulsion hydraulic piping (1)

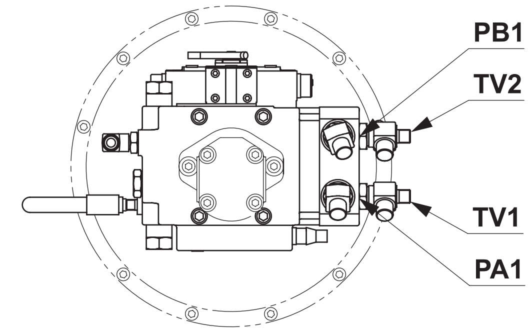


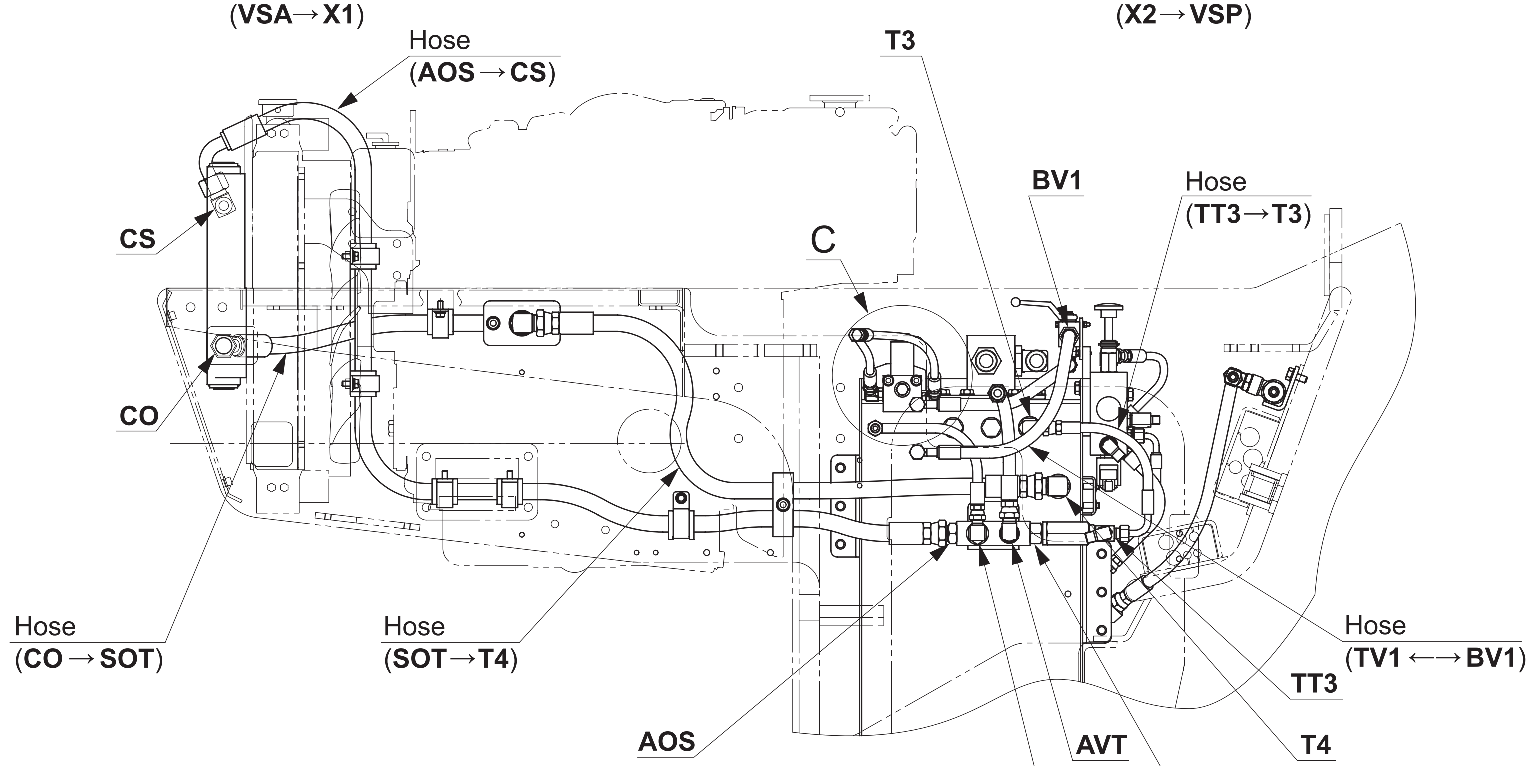


VIEW B

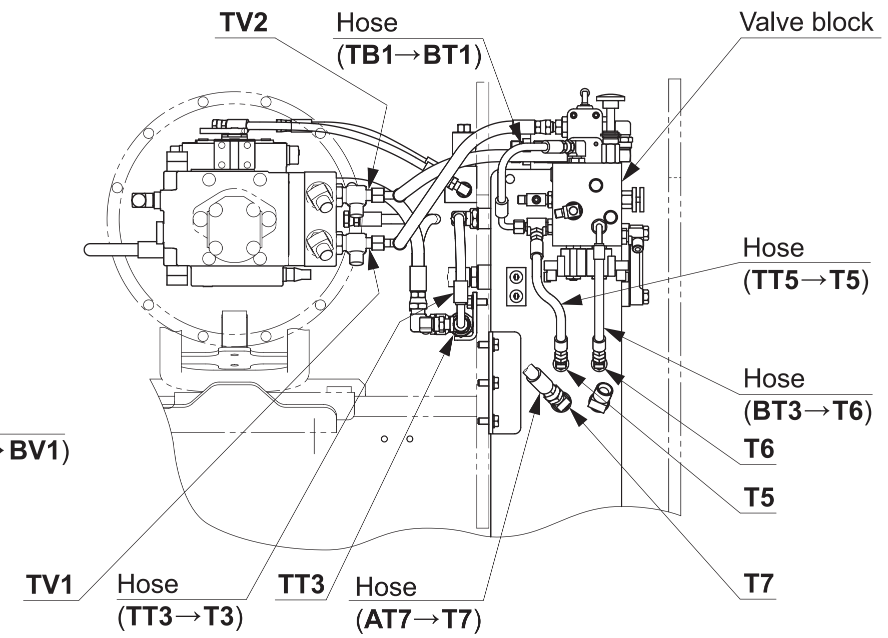


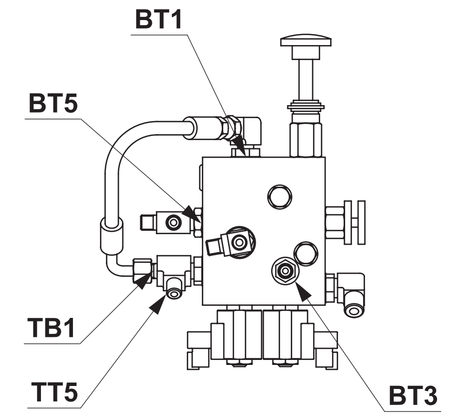
DETAIL C





SECTION A-A



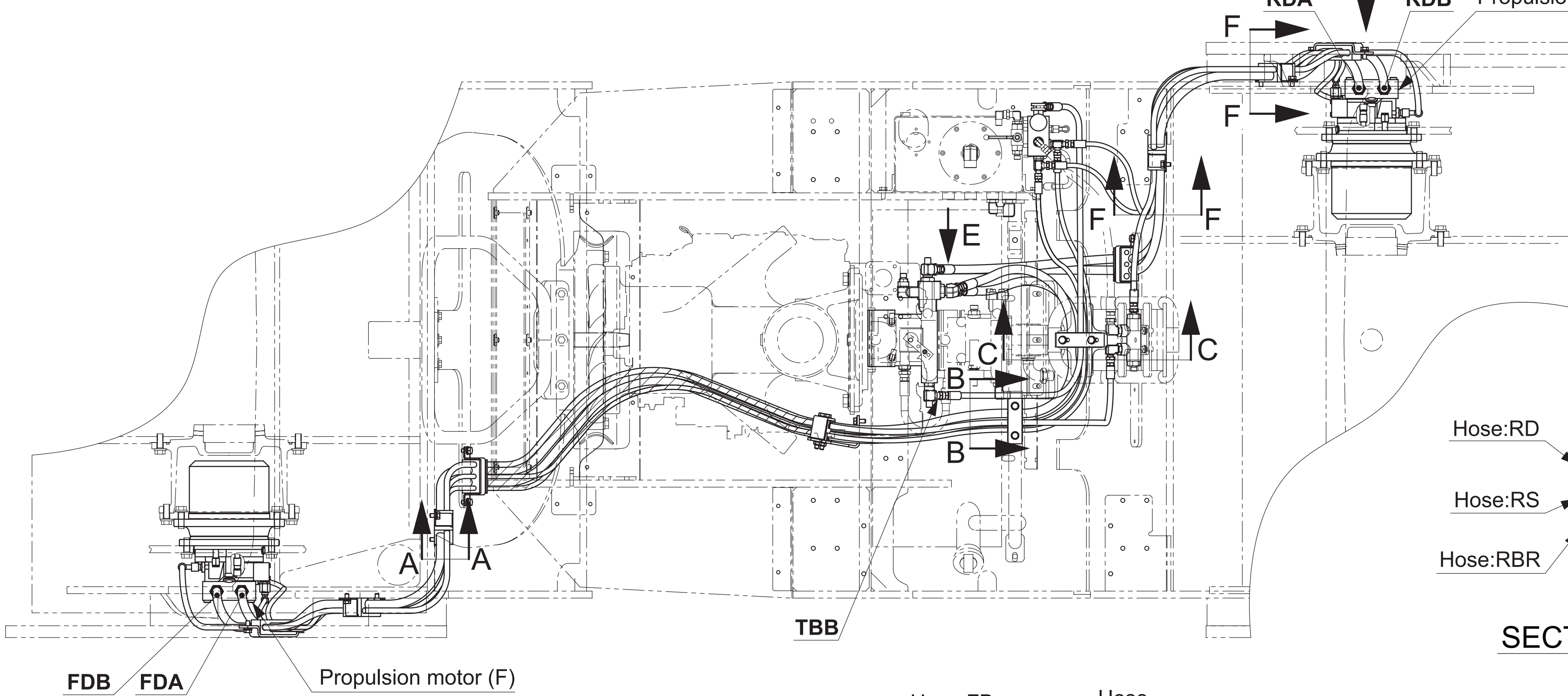


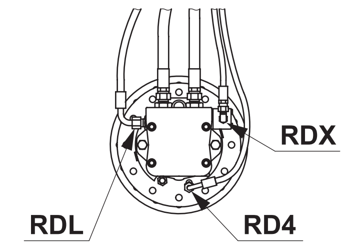
DETAIL VALVE BLOCK

• The letters and numbers in the figure such as "TV1" and "BV1" show each port.
• Arrow " ←→ ; → " symbols show the hose connection and the direction of the flow of the oil.

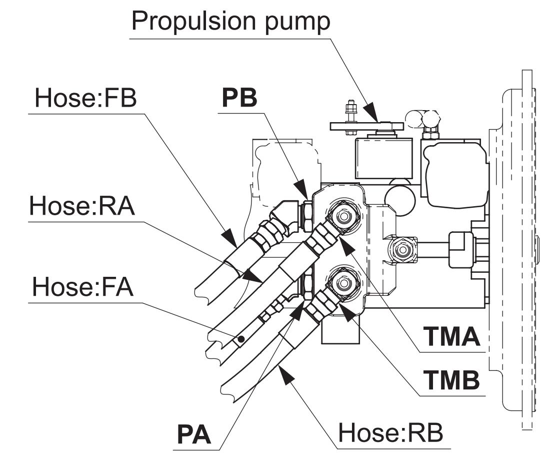
0559-36812-0-10885-B

2-1-2. Propulsion hydraulic piping (2)

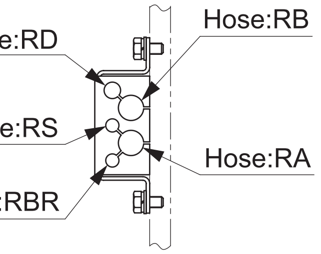




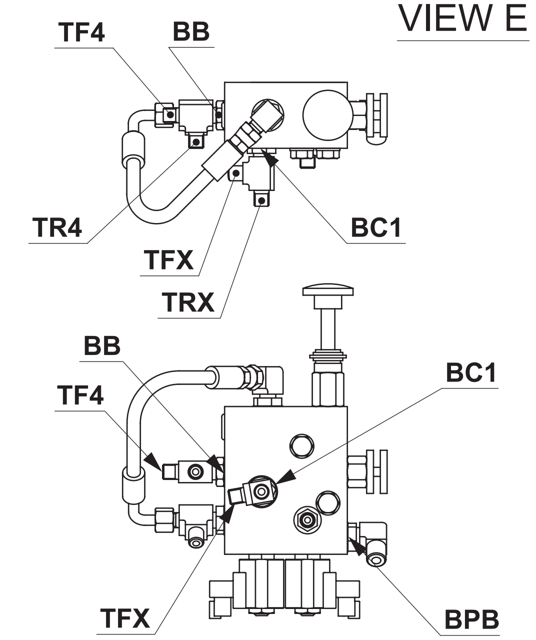
VIEW D



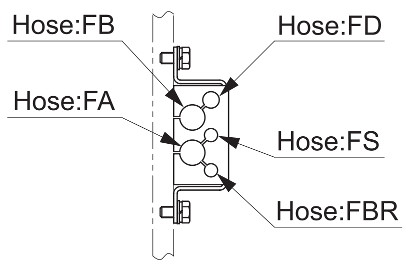
VIEW E



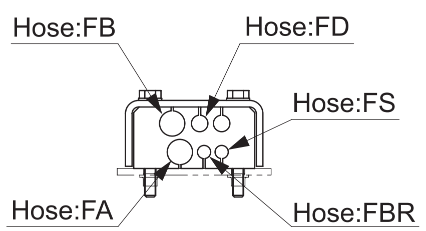
SECTION F-F



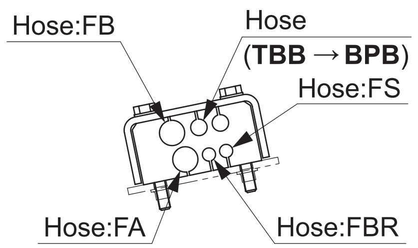
DETAIL VALVE BLOCK



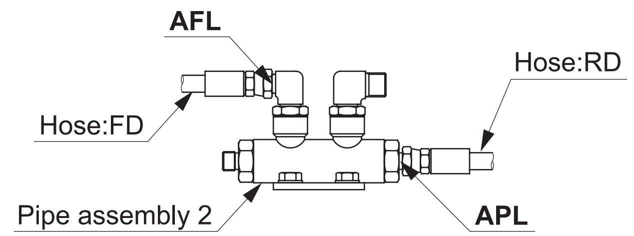
SECTION A-A



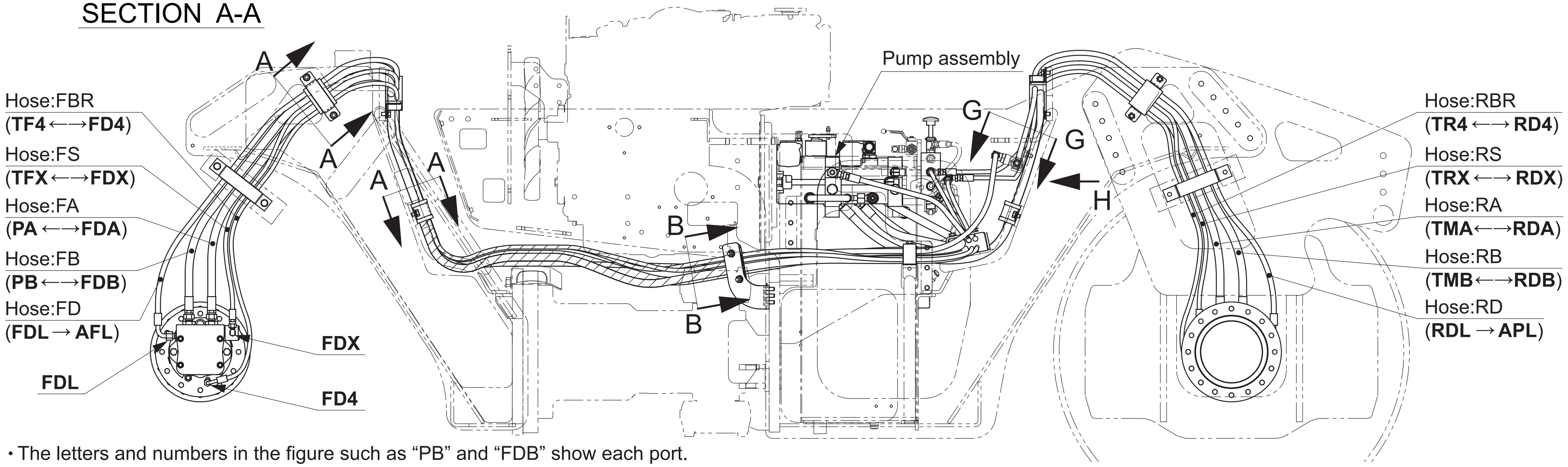
SECTION B-B

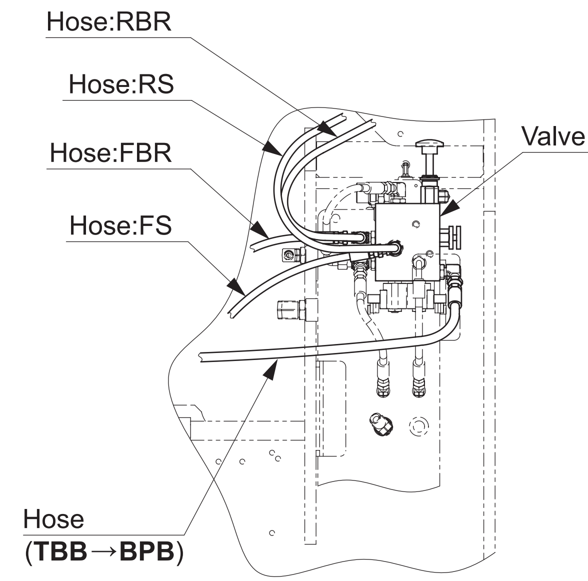


SECTION C-C



SECTION G-G





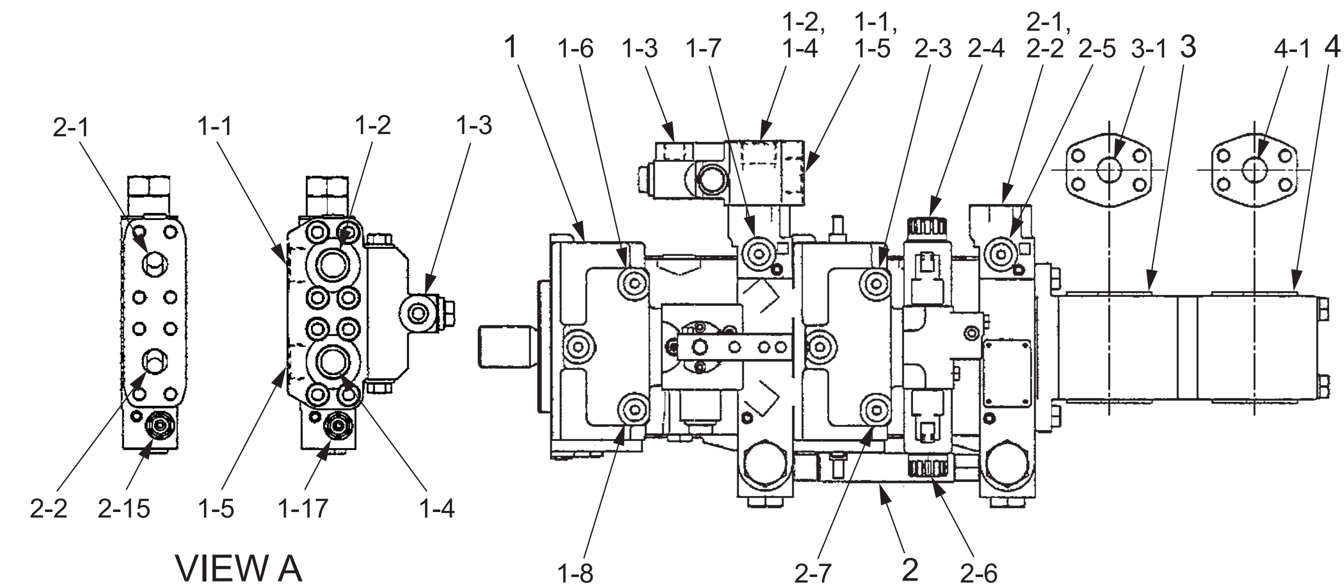
VIEW H

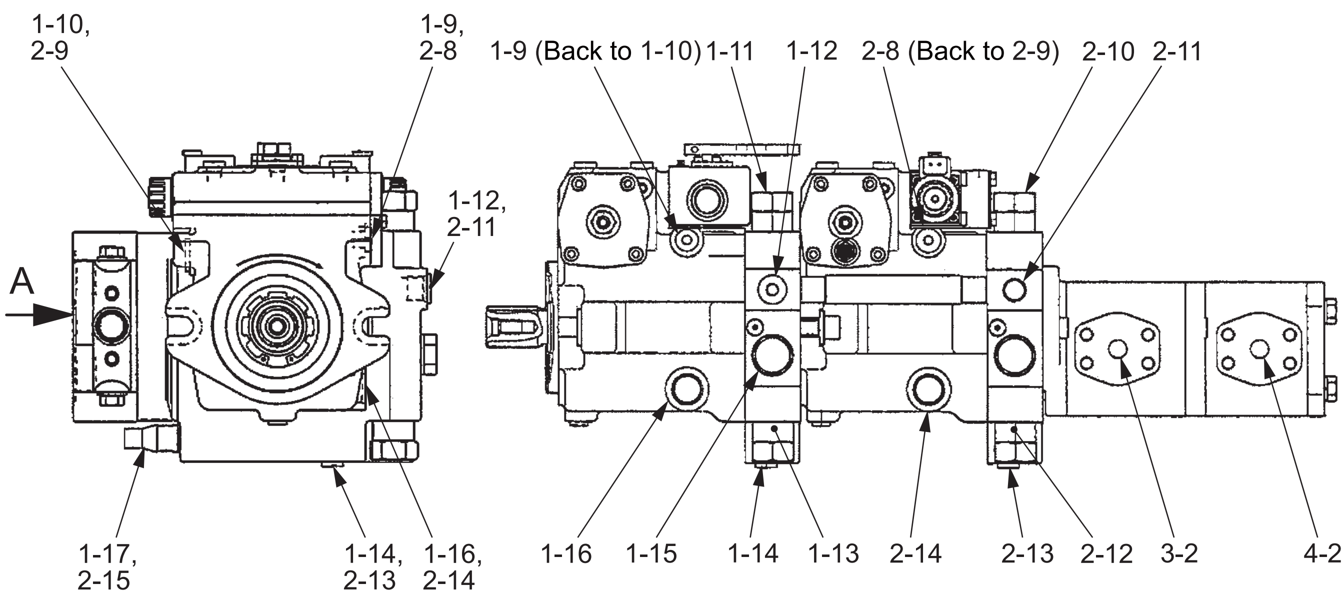
- The letters and numbers in the figure such as "PB" and "FDB" show each port.
- Arrow " ←→ ; → " symbols show the hose connection and the direction of the flow of the oil.

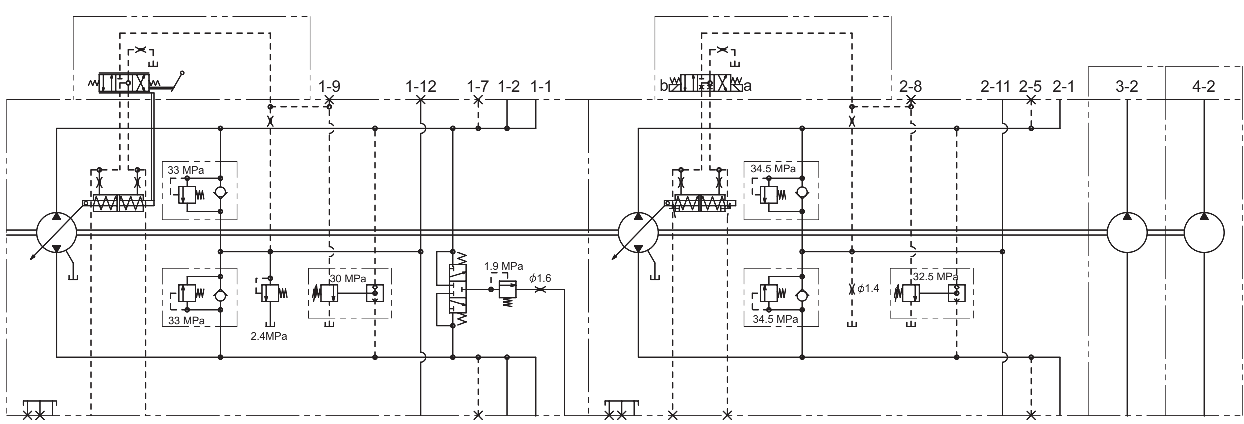
0559-36813-0-10891-B

2-2. Hydraulic Component Specifications

2-2-1. Hydraulic pump assembly (propulsion + vibrator + steering • charge + load)







Hydraulic circuit diagram

SW654-04001

(1) Propulsion pump

(1-1)	Port B (Forward)	**[PB]**	: 1 1/16-12UN
(1-2)	Port B1 (Forward)	**[PB1]**	: 1 1/16-12UN
(1-3)	Drain port	**[PT1]**	: 9/16-18UNF
(1-4)	Port A1 (Reverse)	**[PA1]**	: 1 1/16-12UN
(1-5)	Port A (Reverse)	**[PA]**	: 1 1/16-12UN
(1-6)	Servo pressure gauge port	**[X1]**	: 7/16-20UNF
(1-7)	High pressure gauge port (For port B)		: 7/16-20UNF
(1-8)	Servo pressure gauge port	**[X2]**	: 7/16-20UNF
(1-9)	Control pressure port		: 9/16-18UNF
(1-10)	Drain port or Filler port		: 7/ 8-14UNF
(1-11)	High pressure relief valve (For port B)		
(1-12)	Charge pressure gauge port	**[PG1]**	: 3/ 4-16UNF
(1-13)	High pressure relief valve (For port A)		
(1-14)	High pressure gauge port (For port A)		: 7/16-20UNF
(1-15)	Charge relief valve		
(1-16)	Drain port	**[PT2]**	: 7/ 8-14UNF
(1-17)	Cut off valve		

Specifications

- Displacement : 46 cm^3/rev (2.8 cu.in./rev)
- High pressure relief valve pressure setting : 33.0 MPa (4,785 psi)
- Charge relief valve pressure setting : 2.4 MPa (348 psi)
- Cut off valve pressure setting : 30.0 MPa (4,350 psi)

(2) Vibrator pump

(2-1)	Port B2 (Low amplitude/Oscillation)	**[PB2]**	: SAE 3/4”
(2-2)	Port A2 (High amplitude/Normal)	**[PA2]**	: SAE 3/4”
(2-3)	Servo pressure gauge port		: 7/16-20UNF
(2-4)	Solenoid valve a (High amplitude/Normal)		
(2-5)	High pressure gauge port (For port B)		: 7/16-20UNF
(2-6)	Solenoid valve b (Low amplitude/Oscillation)		
(2-7)	Servo pressure gauge port		: 7/16-20UNF
(2-8)	Control pressure port		: 9/16-18UNF
(2-9)	Drain port or Filler port	**[PT3]**	: 7/ 8-14UNF
(2-10)	High pressure relief valve (For port B)		
(2-11)	Charge pressure gauge port	**[PG2]**	: 3/ 4-16UNF
(2-12)	High pressure relief valve (For port A)		
(2-13)	High pressure gauge port (For port A)		: 7/16-20UNF
(2-14)	Drain port	**[PT4]**	: 7/ 8-14UNF
(2-15)	Cut off valve		

Specifications

- Displacement
  - SW654 (Low amplitude) : 42.0 cm^3/rev (2.6 cu.in./rev)
  - (High amplitude) : 31.0 cm^3/rev (1.9 cu.in./rev)
  - SW654ND : 31.0 cm^3/rev (1.9 cu.in./rev)
- High pressure relief valve pressure setting : 34.5 MPa (5,003 psi)
- Cut off valve pressure setting : 32.5 MPa (4,713 psi)

(3) Steering • charge pump

(3-1)	Suction port	**[S3]**	: SAE 3/4”
(3-2)	Discharge port	**[B3]**	: SAE 3/4”

(4) Load pump

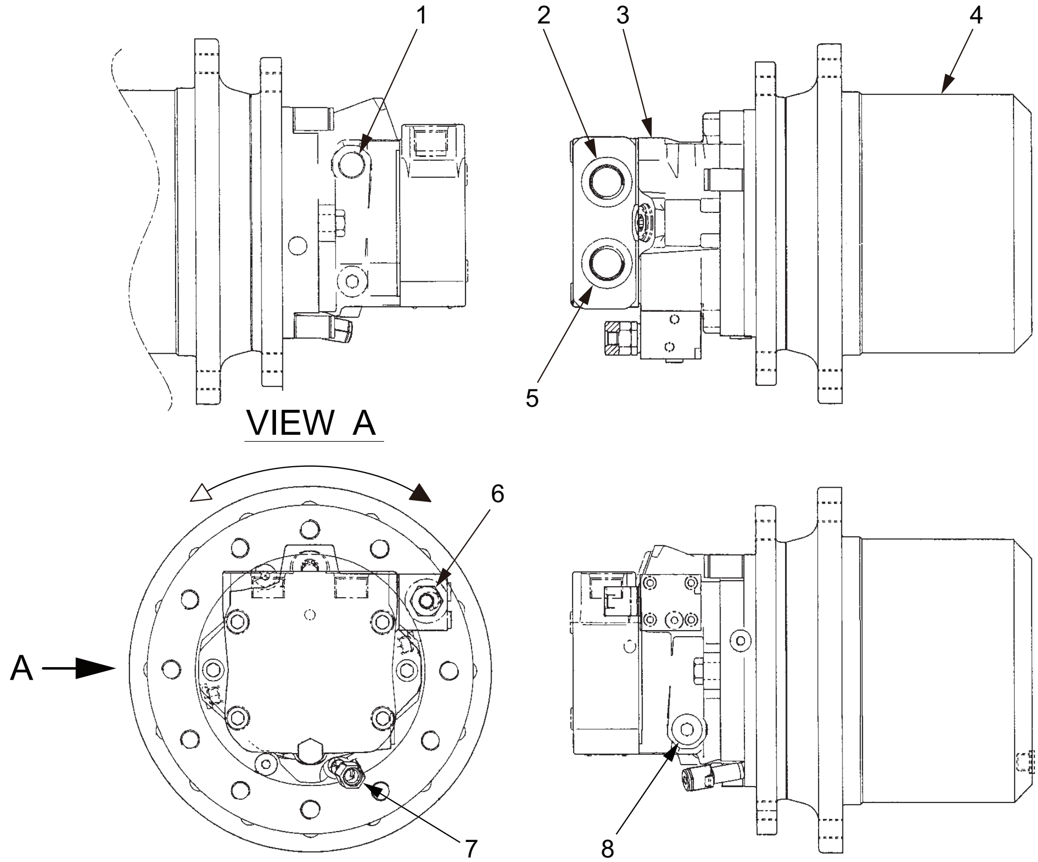
(4-1)	Suction port	**[S4]**	: SAE 3/4”
(4-2)	Discharge port	**[B4]**	: SAE 3/4”

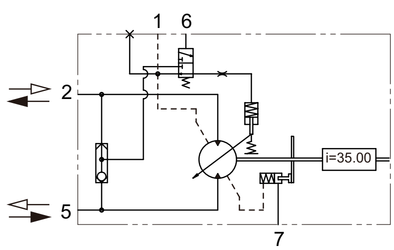
Specifications

- Displacement : 22.4 cm^3/rev (1.4 cu.in./rev)

- Allowable pump case pressure : 0.4 MPa (58.0 psi) or less
- Pump assembly weight : 66 kg (146 lbs.)

2-2-2. Propulsion hydraulic motor





Motor ciruit diagram

Flow of oil

- 2→5 Counterclockwise rotation: Propulsion motor (F) : Forward; Propulsion motor (R) : Reverse
- 5→2 Clockwise rotation: Propulsion motor (F) : Reverse; Propulsion motor (R) : Forward

SW652-1-04002

(1) Drain port **[FDL] [RDL]** : 7/ 8-14UNF
(2) Port B **[FDB] [RDB]** : 1 1/16-12UNF
(3) Motor
(4) Reduction gear
(5) Port A **[FDA] [RDA]** : 1 1/16-12UNF
(6) Pilot pressure port **[FDX] [RDX]** : 7/16-20UNF
(7) Brake release port **[FD4] [RD4]** : G1/4
(8) Drain port : 7/ 8-14UNF

Motor specifications

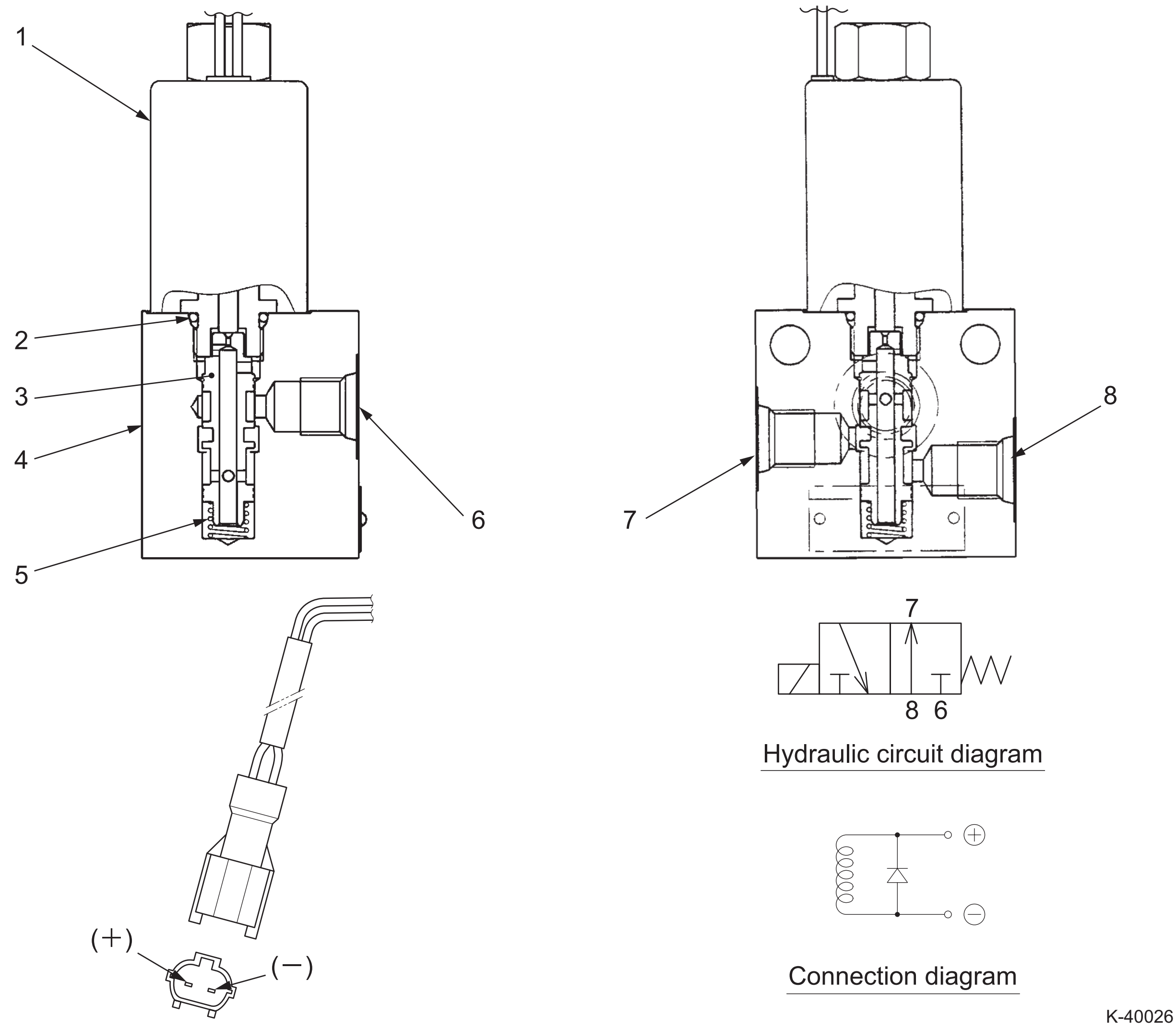
- Displacement (max) : 45.0 cm^3/rev (2.8 cu.in./rev)
  (min) : 23.0 cm^3/rev (1.4 cu.in./rev)
- Maximum working pressure : 30.0 MPa (4,350 psi)
- Allowable motor case pressure : 0.4 MPa (58.0 psi) or less
- Brake release pressure : More than 1.8 MPa (261 psi)
- Speed change pressure : 2.4 MPa (348 psi)

Reduction gear specifications

- Reduction ratio : 1/35.000

- Weight : 60 kg (132 lbs.)

2-2-3. Servo bypass solenoid valve



Hydraulic circuit diagram

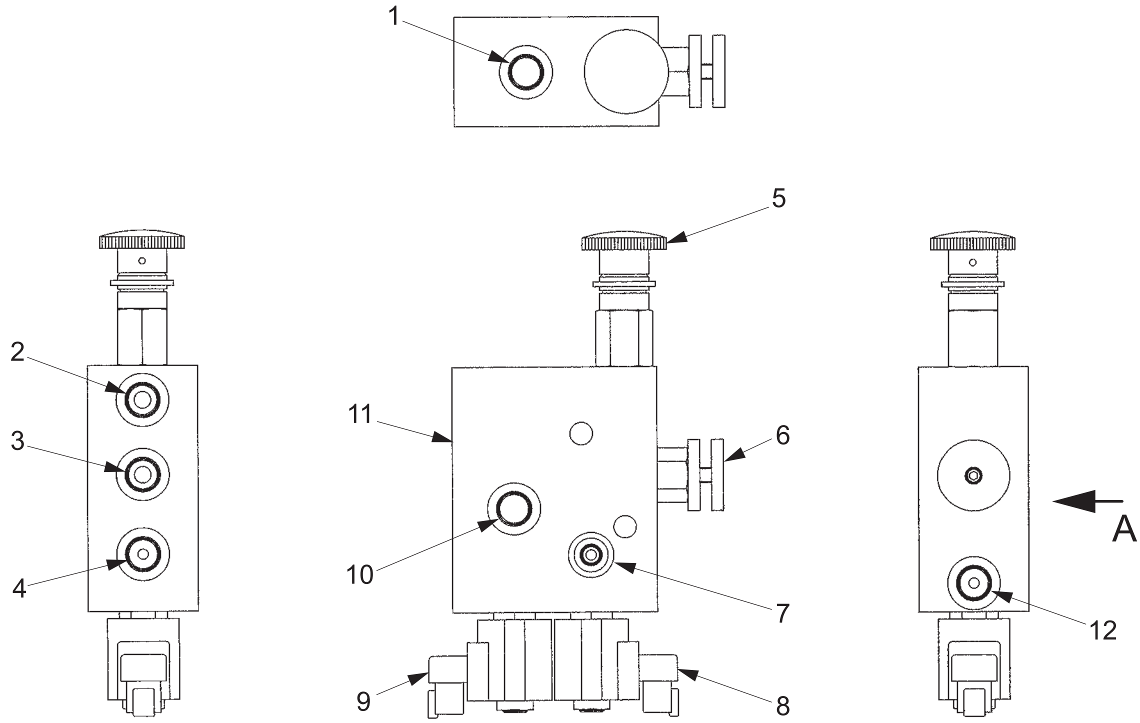
Connection diagram

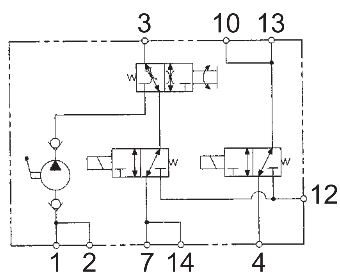
(1) Solenoid
(2) O-ring (1B P14)
(3) Spool (K)
(4) Body
(5) Spring
(6) Port T : G1/4
(7) Port A **[VSA]** : G1/4
(8) Port P **[VSP]** : G1/4

Specifications

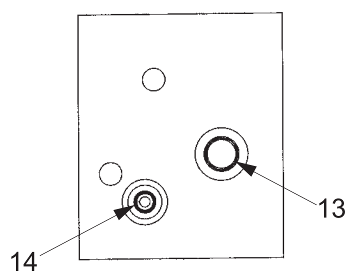
• Rated flow	: 30 L/min	(7.9 gal./min)	
• Rated pressure	: 4.9 MPa	(711 psi)	(7, 8)
	: 0.5 MPa	(72.5 psi)	(6)
• Weight	: 1.5 kg	(3.3 lbs.)	

2-2-4. Valve block





Hydraulic circuit diagram



VIEW A

SW654-04002

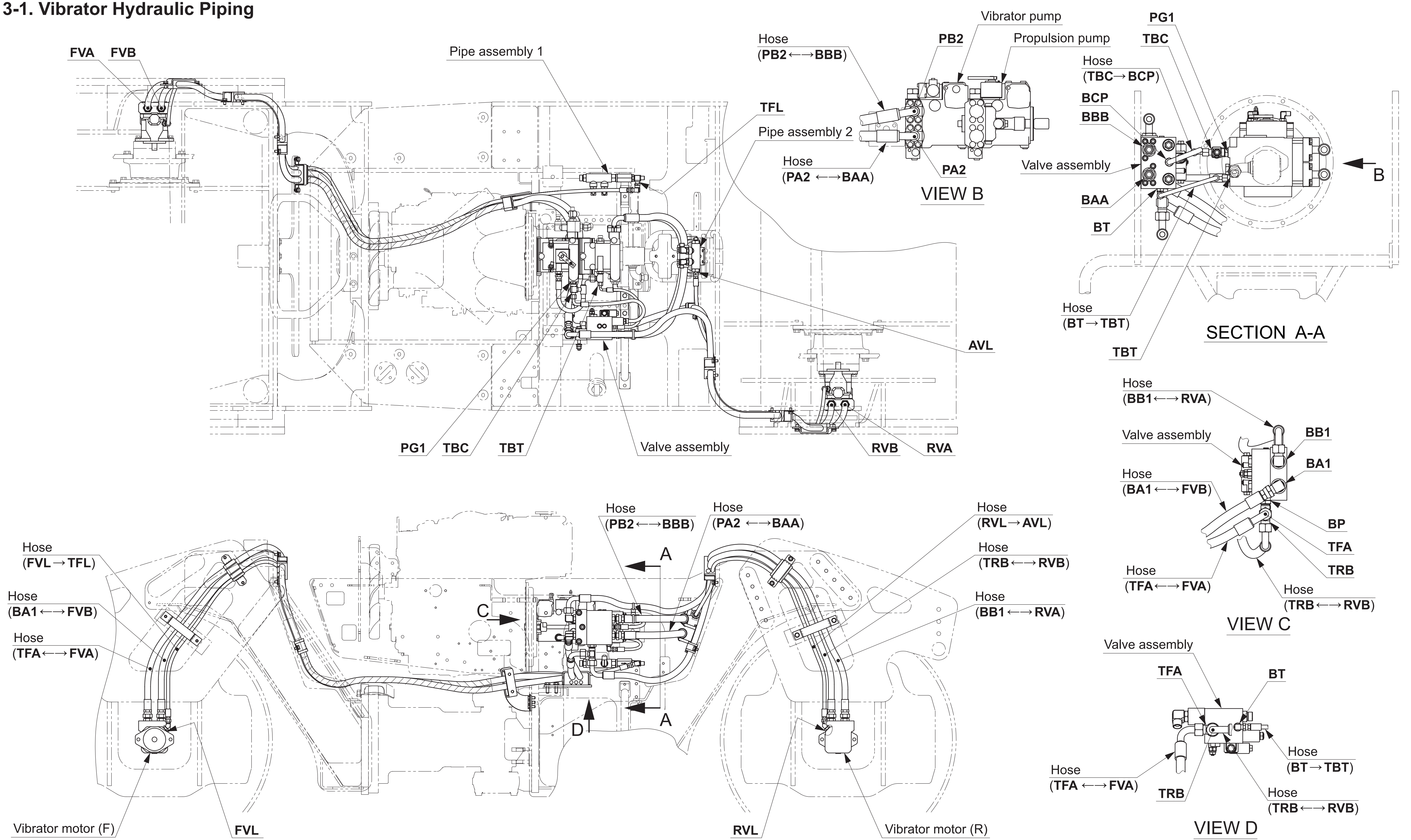
(1)	Port T1	**[BT1]**	:	G3/8
(2)	Port T2		:	G3/8
(3)	Port B	**[BB]**	:	G3/8
(4)	Port T5	**[BT5]**	:	G3/8
(5)	Hand pump			
(6)	Rotary valve			
(7)	Port T3	**[BT3]**	:	G1/8
(8)	Parking brake solenoid valve			
(9)	Speed change solenoid valve			
(10)	Port C1	**[BC1]**	:	G3/8
(11)	Block			
(12)	Port P	**[BPB]**	:	G3/8
(13)	Port C2		:	G3/8
(14)	Port T4		:	G1/8

Specifications

• Maximum flow	:	11 L/min	(2.9 gal./min)
• Maximum working pressure	:	21 MPa	(3,045 psi)
• Hand pump displacement	:	5.7 mL/stroke	(0.0015 gal./stroke)
• Weight	:	4 kg	(8.8 lbs.)

3. VIBRATOR HYDRAULIC SYSTEM

3-1. Vibrator Hydraulic Piping

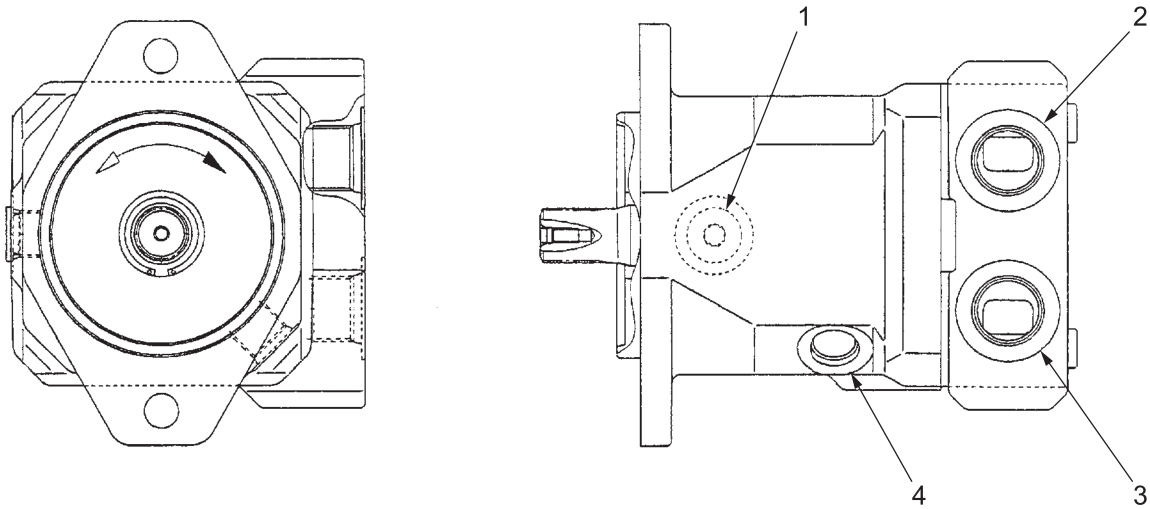


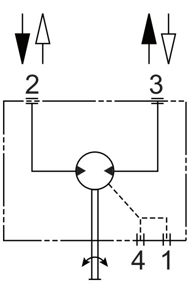
- The letters and numbers in the figure such as “TFA” and “FVA” show each port.
- Arrow “ ←→ ; → ” symbols show the hose connection and the direction of the flow of the oil.

0559-49805-0-10838-B

3-2. Hydraulic Component Specifications

3-2-1. Vibrator hydraulic motor





Hydraulic circuit diagram

Flow of oil
・2→3 Clockwise rotation (Low amplitude/Oscillation)
・3→2 Counterclockwise rotation (High amplitude/Normal)

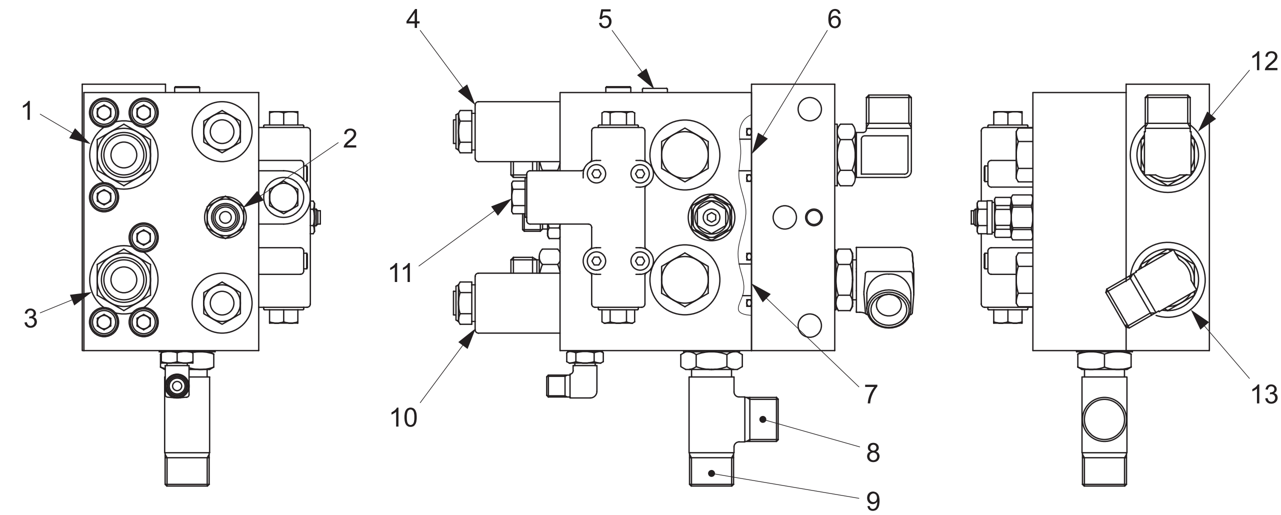
SW652-1-04005

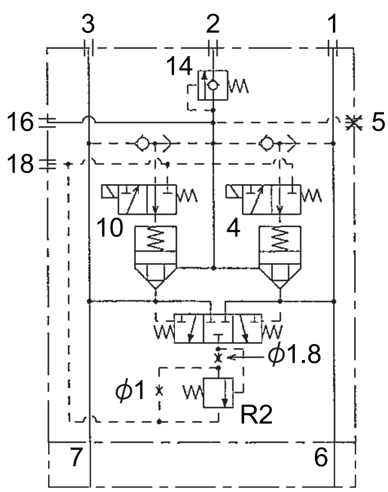
(1) Drain port		:	3/ 4-16UNF
(2) Port A	**[FVA][RVA]**	:	1 1/16-12UN
(3) Port B	**[FVB][RVB]**	:	1 1/16-12UN
(4) Drain port	**[FVL][RVL]**	:	3/ 4-16UNF

Specifications

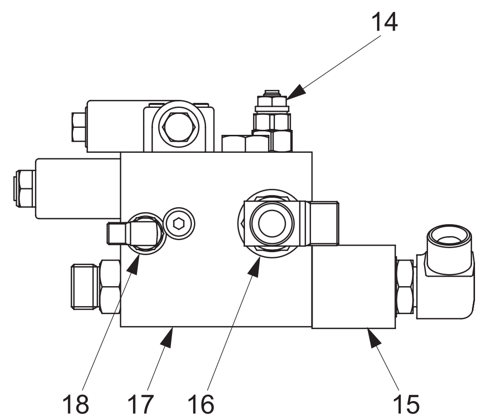
• Displacement	:	23.5 cm^3/rev	(1.43 cu.in./rev)
• Working pressure	:	28 MPa	(4,060 psi)
• Allowable motor case pressure	:	0.2 MPa	(29 psi)
• Weight	:	12 kg	(26 lbs)

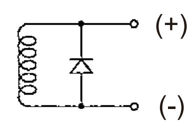
3-2-2. Valve assembly





Hydraulic circuit diagram





Connection diagram

SW654-04004

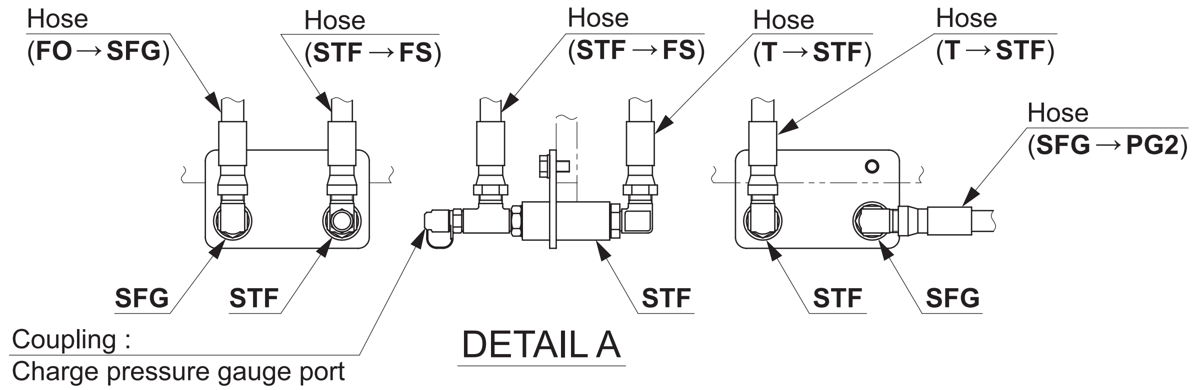
(1)	Port B	**[BBB]**	: 1 1/16-12UN
(2)	Port CP	**[BCP]**	: 9/16-18UNF
(3)	Port A	**[BAA]**	: 1 1/16-12UN
(4)	Solenoid valve b		
(5)	Port MP		: 7/16-20UNF
(6)	Port B1		
(7)	Port A1		
(8)	Port	**[TFA]**	: G3/4
(9)	Port	**[TRB]**	: G3/4
(10)	Solenoid valve a		
(11)	Flushing valve		
(12)	Port	**[BB1]**	: G3/4
(13)	Port	**[BA1]**	: G3/4
(14)	Relief valve (R1)		
(15)	Block		
(16)	Port P	**[BP]**	: 1 1/16-12UN
(17)	Body		
(18)	Port T	**[B3]**	: 9/16-18UNF

Specifications

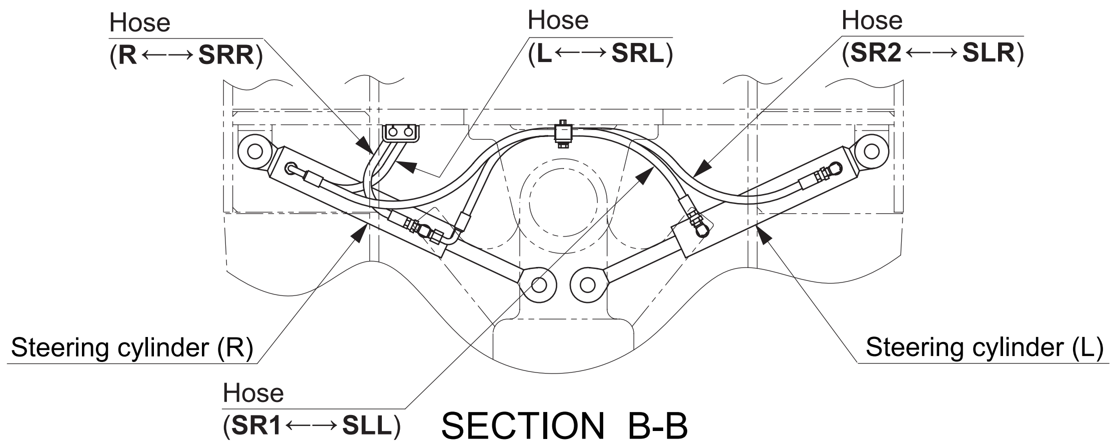
• Rated flow	:	100 L/min	(26.4 gal./min	)	
• Rated pressure	:	35 MPa	(5,075 psi	)	(1 to 3, 5, 16)
	:	0.5 MPa	(72.5 psi	)	(18)
• Relief valve pressure setting	:	31.5 MPa	(4,568 psi	)	(14)
	:	1.3 MPa	(189 psi	)	(R2)
• Weight	:	26 kg	(57.3 lbs.	)	

4. STEERING SYSTEM

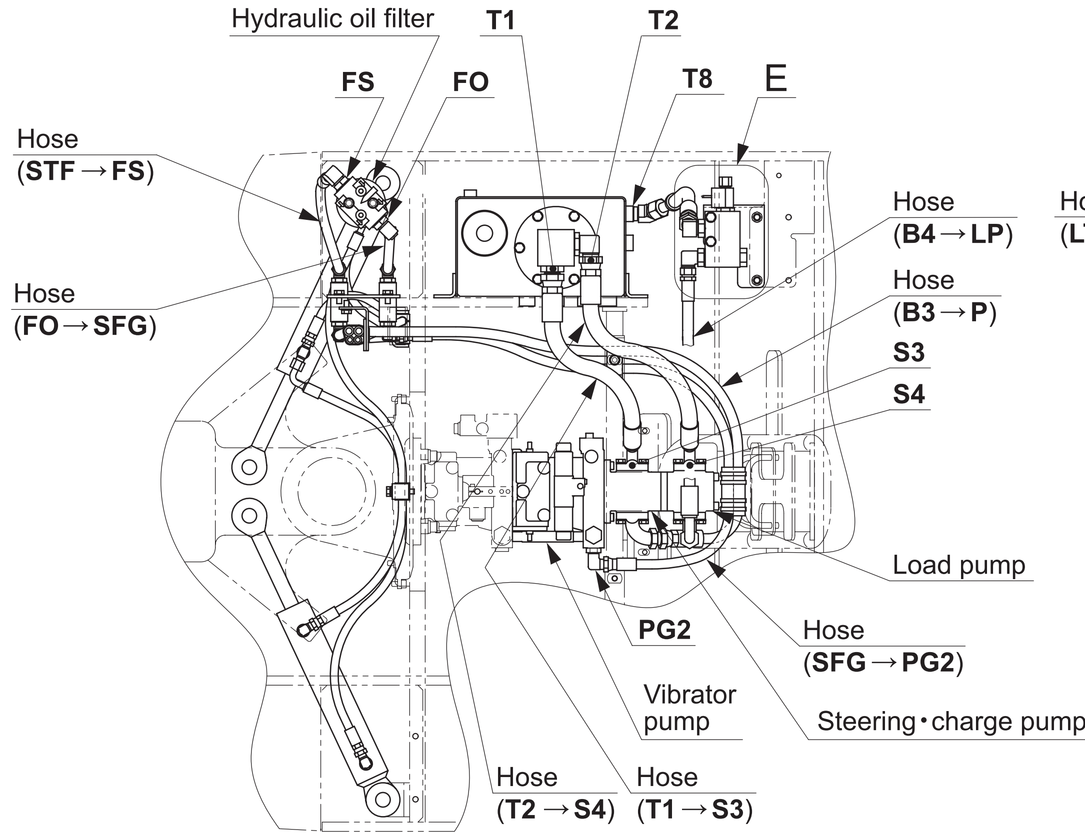
4-1. Steering Hydraulic Piping



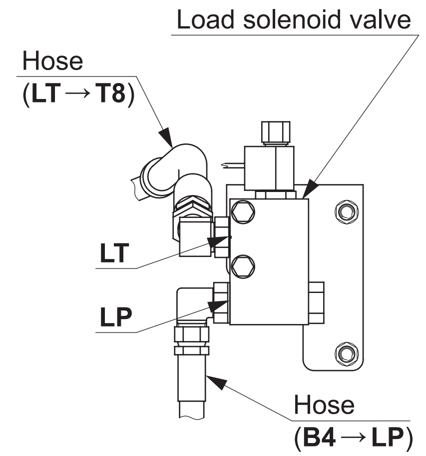
DETAIL A



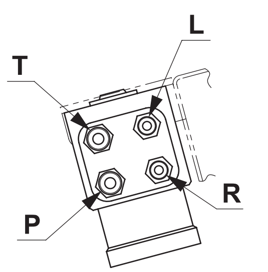
SECTION B-B



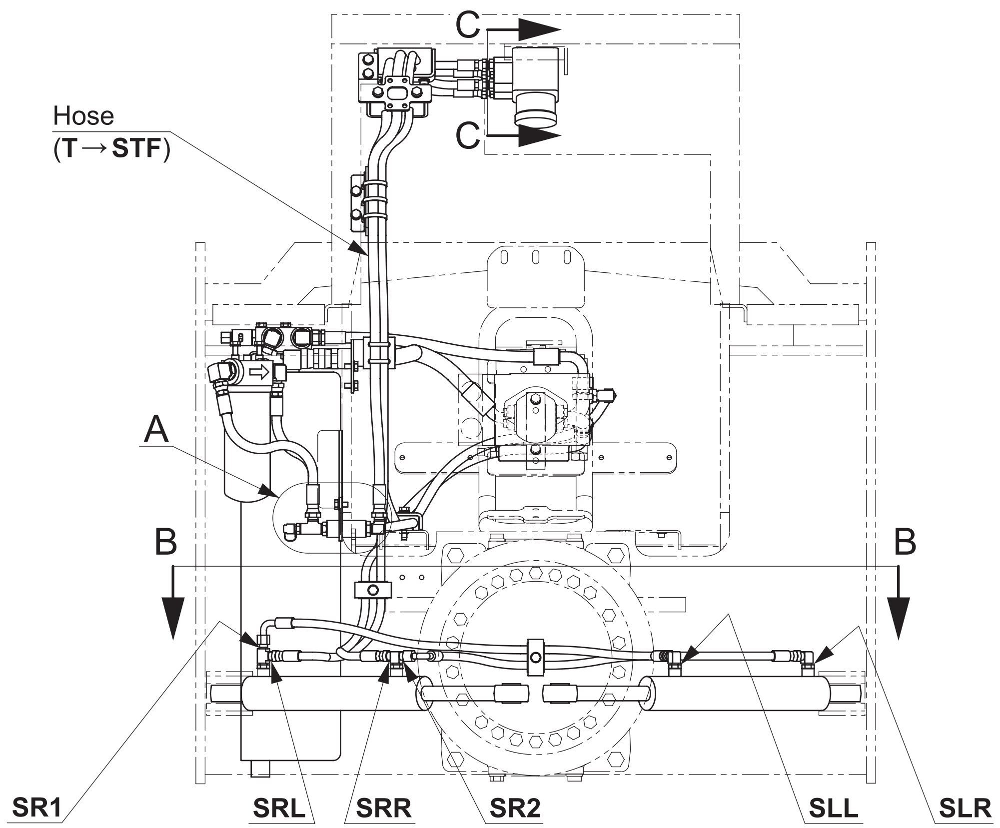
SECTION D-D

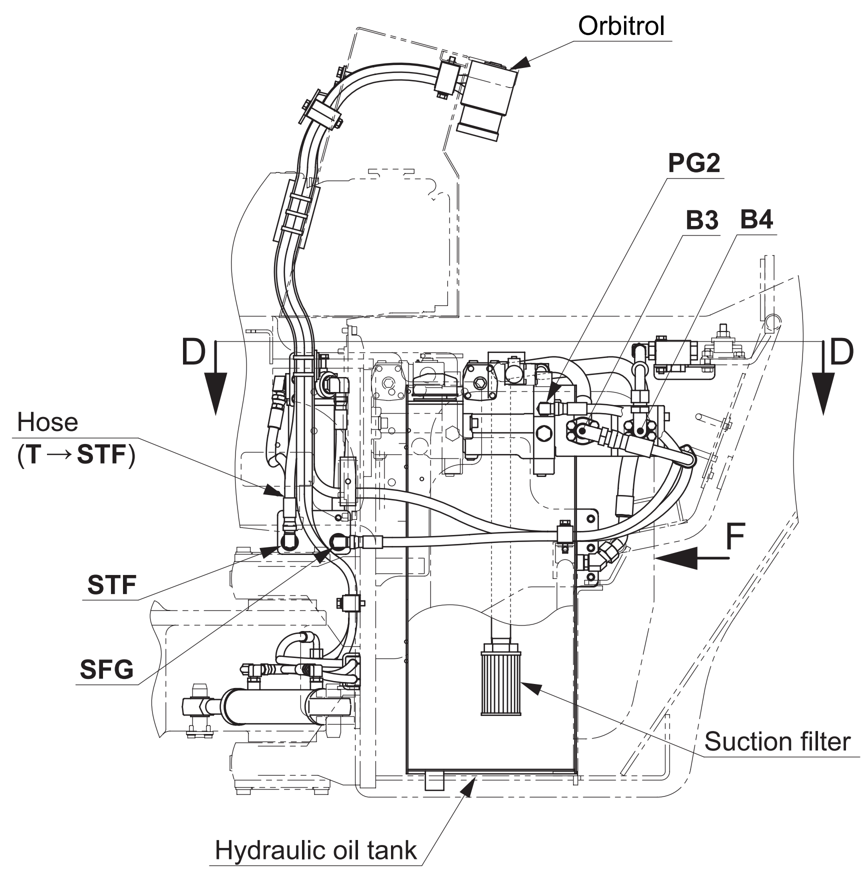


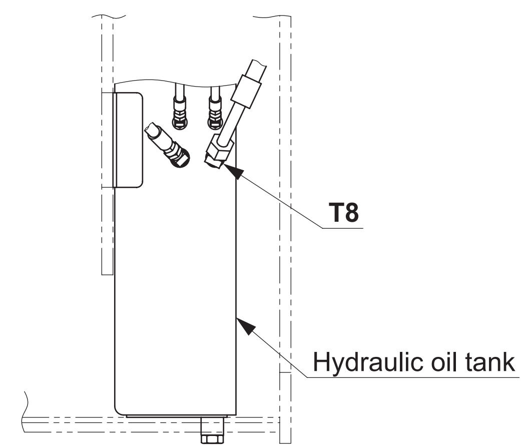
DETAIL E



SECTION C-C





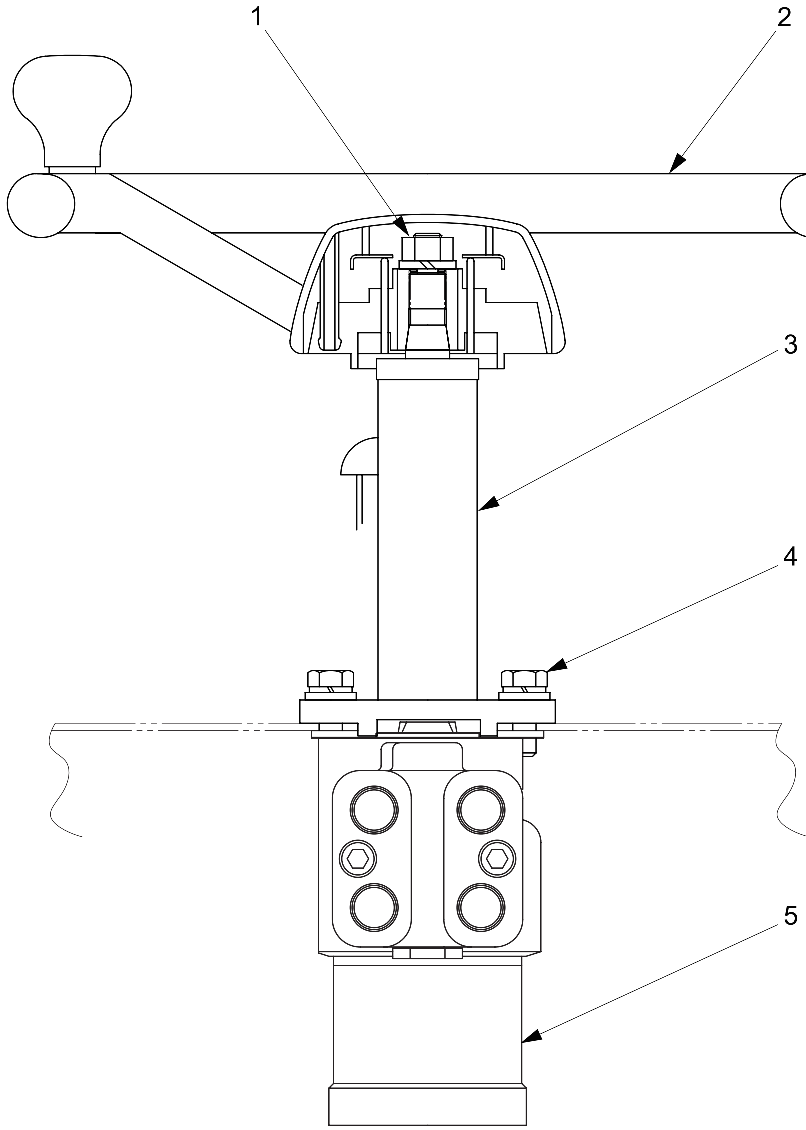


VIEW F

・The letters and numbers in the figure such as "R" and "SRR" show each port.
・Arrow " ←→ ; → " symbols show the hose connection and the direction of the flow of the oil.

0559-32804-0-10870-B

4-2. Steering Wheel



0559-32802-0-20493-0

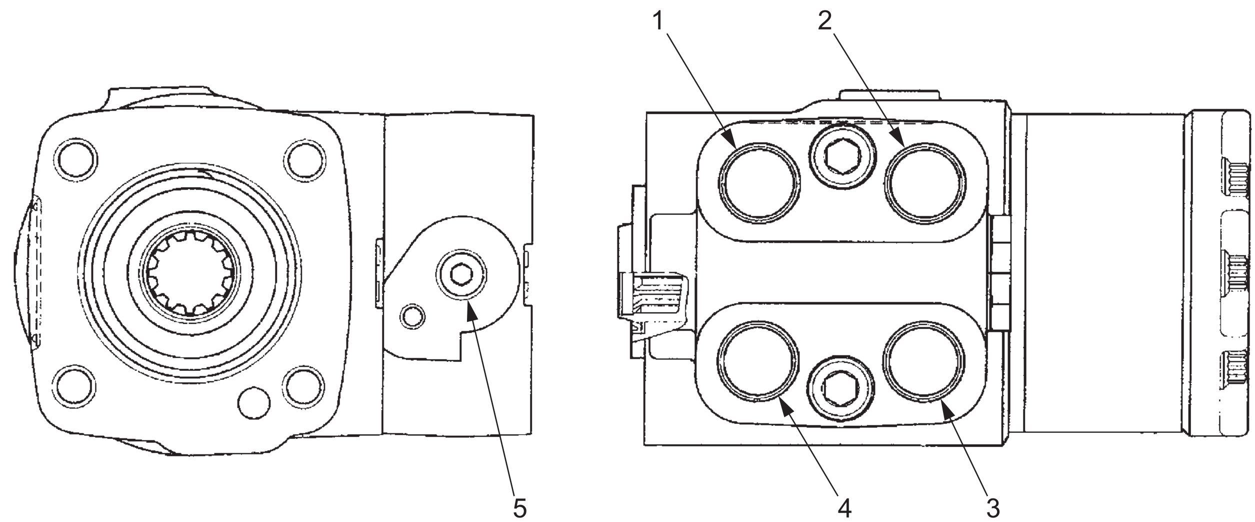
(1) Nut : M12 P=1.25
(2) Steering wheel
(3) Column shaft
(4) Bolt : M10×30
(5) Orbitrol

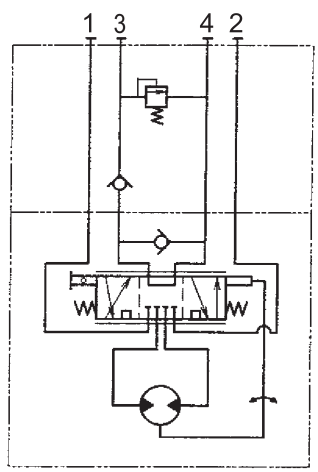
N•m

(1) Nut M12 P=1.25 : 54 to 64 N·m (40 to 47 lbf·ft)
(4) Bolt M10×30 : 49 N·m (36 lbf·ft)

4-3. Hydraulic Component Specifications

4-3-1. Orbitrol





Hydraulic circuit diagram

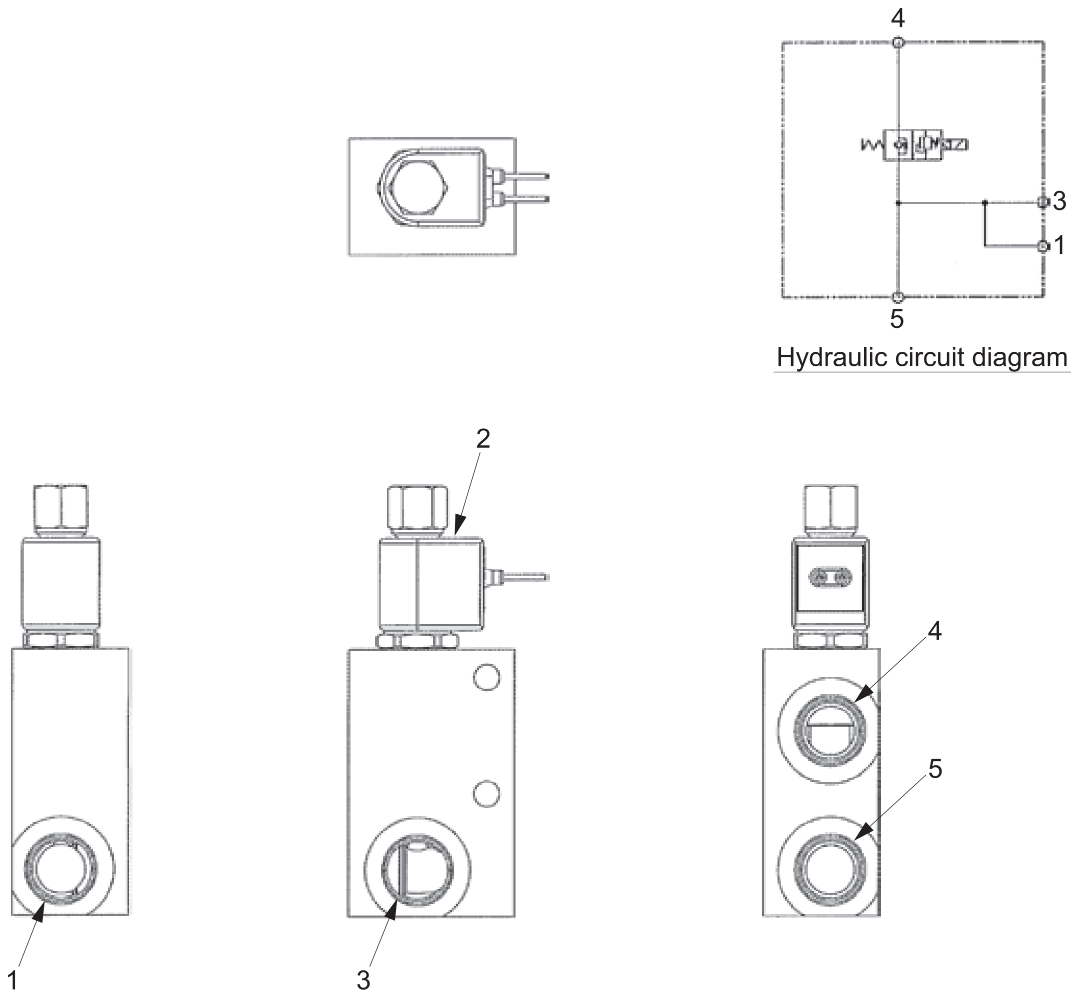
GW751-04016

(1) Port L [L] : 3/4-16UNF
(2) Port R [R] : 3/4-16UNF
(3) Port P [P] : 3/4-16UNF
(4) Port T [T] : 3/4-16UNF
(5) Relief valve

Specifications

- Displacement : 230 cm^3/rev (14.0 cu.in./rev)
- Maximum pressure : 17.2 MPa (2,494 psi)
- Relief valve pressure setting : 15.7 MPa (2,277 psi)
- Weight : 7.7 kg (17.0 lbs.)

4-3-2. Load solenoid valve



SW654-04003

(1) Port B : G3/4
(2) Load solenoid valve
(3) Port A : G3/4
(4) Port T **[LT]** : G3/4
(5) Port P **[LP]** : G3/4

Specifications

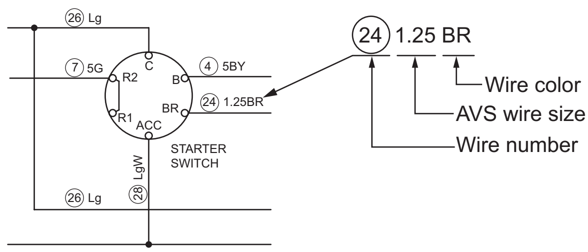
- Maximum flow : 75 L/min (19.8 gal./min)
- Maximum pressure : 21.0 MPa (3,045 psi)
- Relief valve pressure setting : 12.7 MPa (1,842 psi)
- Weight : 1.30 kg (2.9 lbs.)

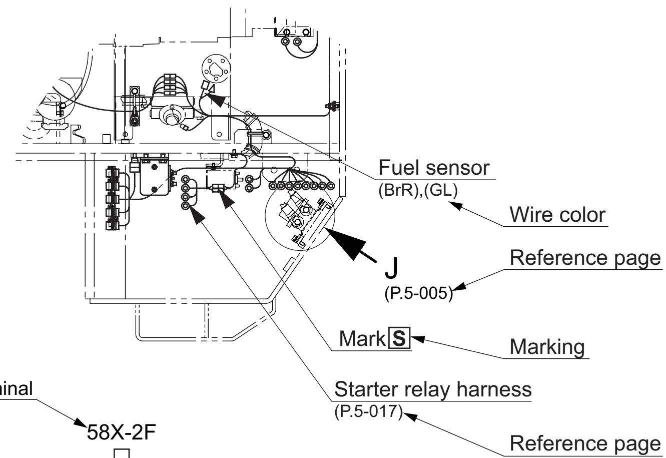
ELECTRICAL SYSTEM

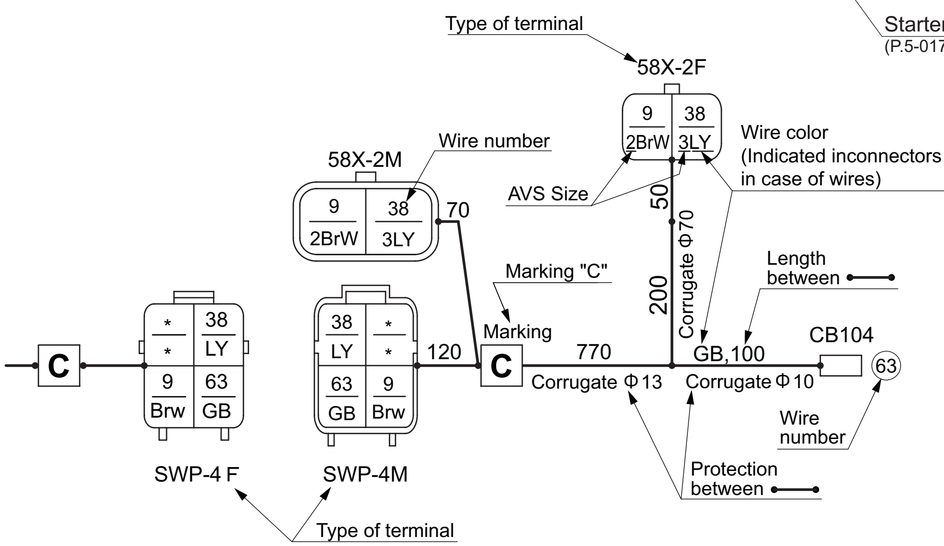
1. PRECAUTIONS FOR WORK

1-1. Wire Numbers, Wire Sizes, Wire Colors and Connectors Shown in Electrical Circuit Diagram, Wiring Harness Layout and Wiring Harnesses

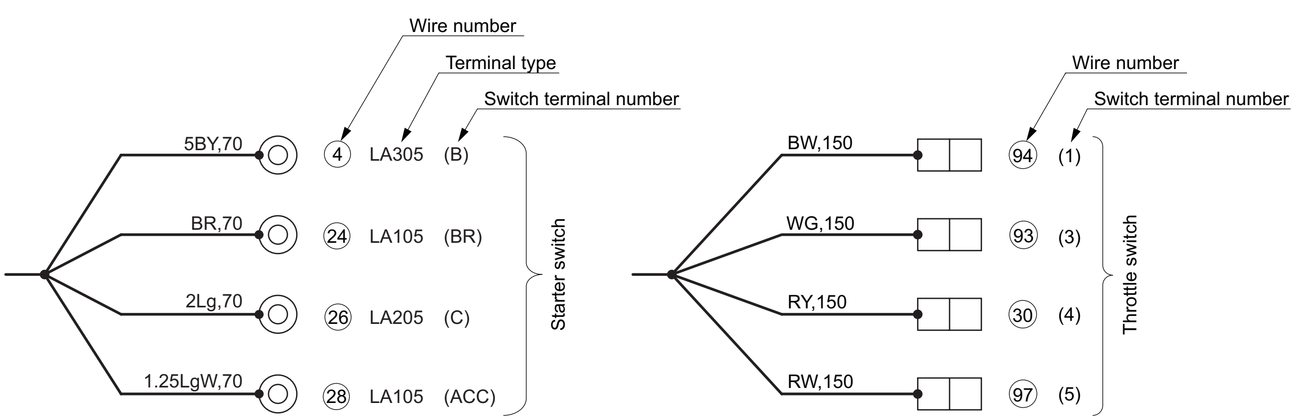
- Codes used in electrical circuit diagrams give the following information.
- The wire size is AVS 0.85 unless otherwise specified.







- The pin or socket layout of mating connectors are symmetrical, either vertically or horizontally. When the connector valves are connected, the pin and socket that have the same number are connected.



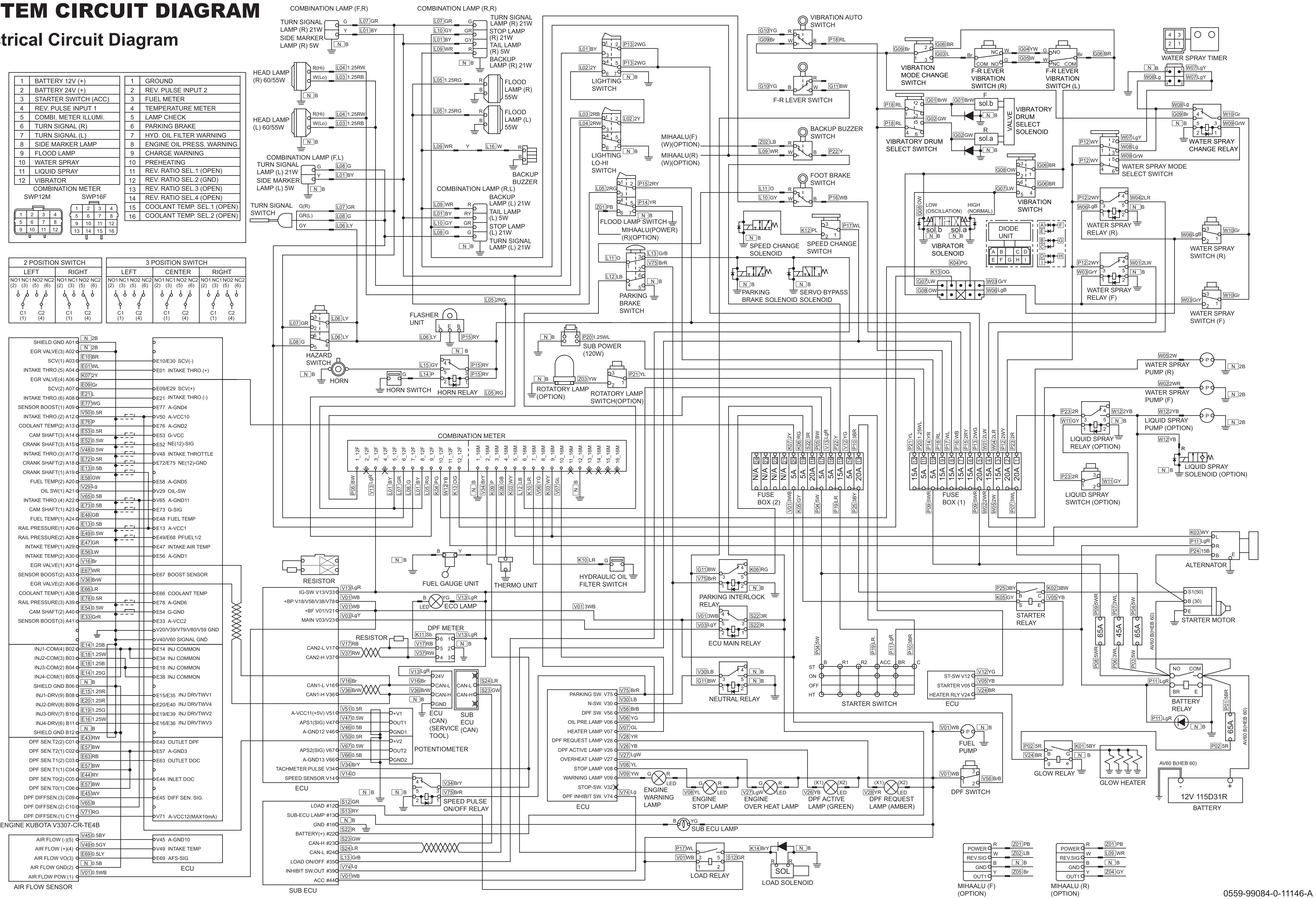
- Wire color code chart

B	Black	BW	Black/ White stripe	BY	Black/ Yellow stripe	BR	Black/ Red stripe	BG	Black/ Green stripe	BL	Black/ Blue stripe		
W	White	WR	White/ Red stripe	WB	White/ Black stripe	WL	White/ Blue stripe	WY	White/ Yellow stripe	WG	White/ Green stripe		
R	Red	RW	Red /White stripe	RB	Red/ Black stripe	RY	Red/ Yellow stripe	RG	Red/ Green stripe	RL	Red/ Blue stripe		
G	Green	GW	Green/ White stripe	GR	Green/ Red stripe	GY	Green/ Yellow stripe	GB	Green/ Black stripe	GL	Green/ Blue stripe		
Y	Yellow	YR	Yellow/ Red stripe	YB	Yellow/ Black stripe	YG	Yellow/ Green stripe	YL	Yellow/ Blue stripe	YW	Yellow/ White stripe		
Br	Brown	BrW	Brown/ White stripe	BrR	Brown/ Red stripe	BrY	Brown/ Yellow stripe	BrB	Brown/ Black stripe	BrG	Brown/ Green stripe	BrL	Brown/ Blue stripe
L	Blue	LW	Blue/ White stripe	LR	Blue/ Red stripe	LY	Blue/ Yellow stripe	LB	Blue/ Black stripe	LG	Blue/ Green stripe		
Lg	Light green	LgR	Light green/ Red stripe	LgY	Light green/ Yellow stripe	LgB	Light green/ Black stripe	LgW	Light green/ White stripe	LgL	Light green/ Blue stripe		

O	Orange	YO	Yellow/ Orange stripe	OW	Orange/ White stripe
		LO	Blue/ Orange stripe	OB	Orange/ Black stripe
		GO	Green/ Orange stripe	OG	Orange/ Green stripe
Gy (Gr)	Gray	GyR	Gray/ Red stripe	GrW	Gray/ White stripe
		GyL	Gray/ Blue stripe	GrY	Gray/ Yellow stripe
Sb	Sky blue			GrB	Gray/ Black stripe
P	Pink	PB	Pink/ Black stripe	PG	Pink/ Green stripe
Pu	Purple			PL	Pink/ Blue stripe

2. SYSTEM CIRCUIT DIAGRAM

2-1. Electrical Circuit Diagram



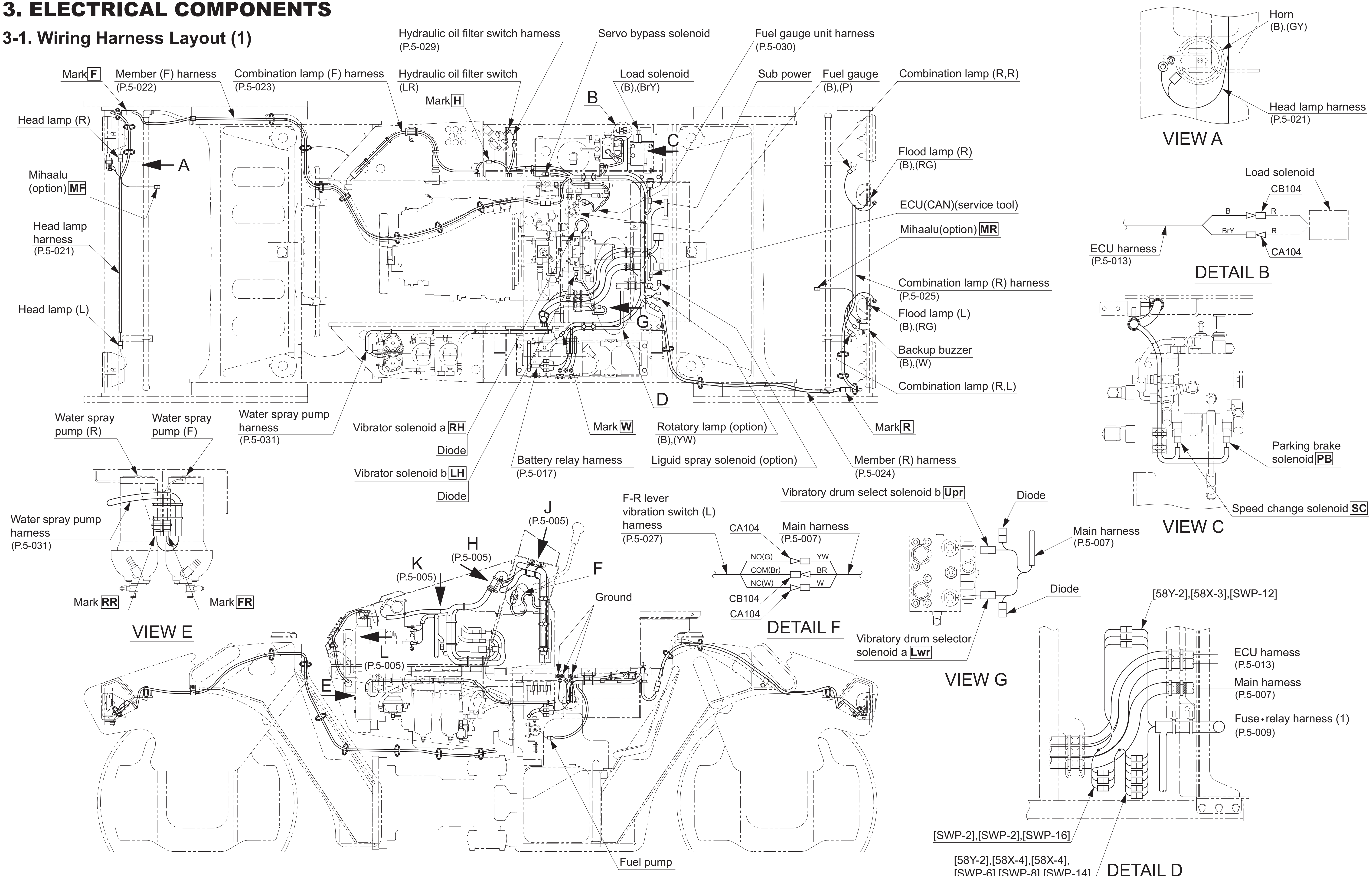
1	BATTERY 12V (+)	1	GROUND
2	BATTERY 24V (+)	2	REV. PULSE INPUT 2
3	STARTER SWITCH (ACC)	3	FUEL METER
4	REV. PULSE INPUT 1	4	TEMPERATURE METER
5	COMBI. METER ILLUMI.	5	LAMP CHECK
6	TURN SIGNAL (R)	6	PARKING BRAKE
7	TURN SIGNAL (L)	7	HYD. OIL FILTER WARNING
8	SIDE MARKER LAMP	8	ENGINE OIL PRESS. WARNING
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)

COMBINATION METER

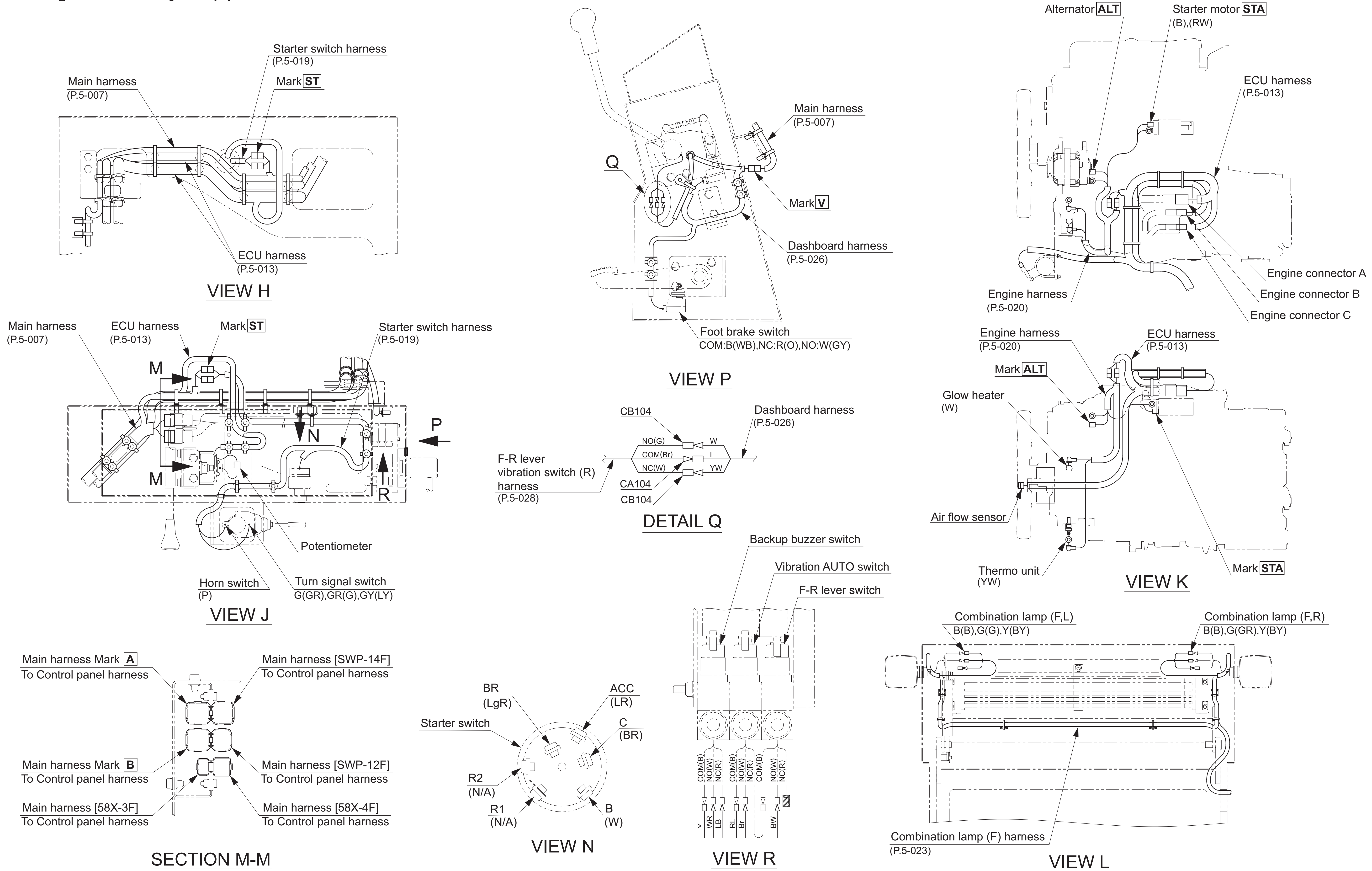
2 POSITION SWITCH		3 POSITION SWITCH		
LEFT	RIGHT	LEFT	CENTER	RIGHT

3. ELECTRICAL COMPONENTS

3-1. Wiring Harness Layout (1)



3-2. Wiring Harness Layout (2)



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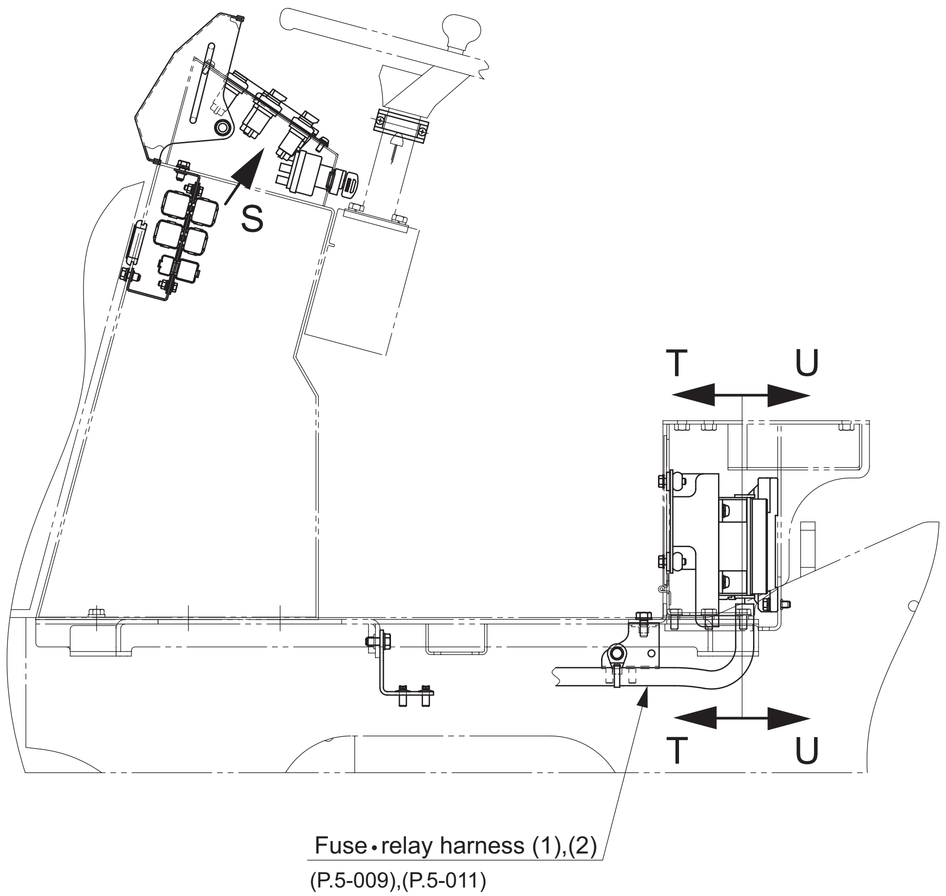
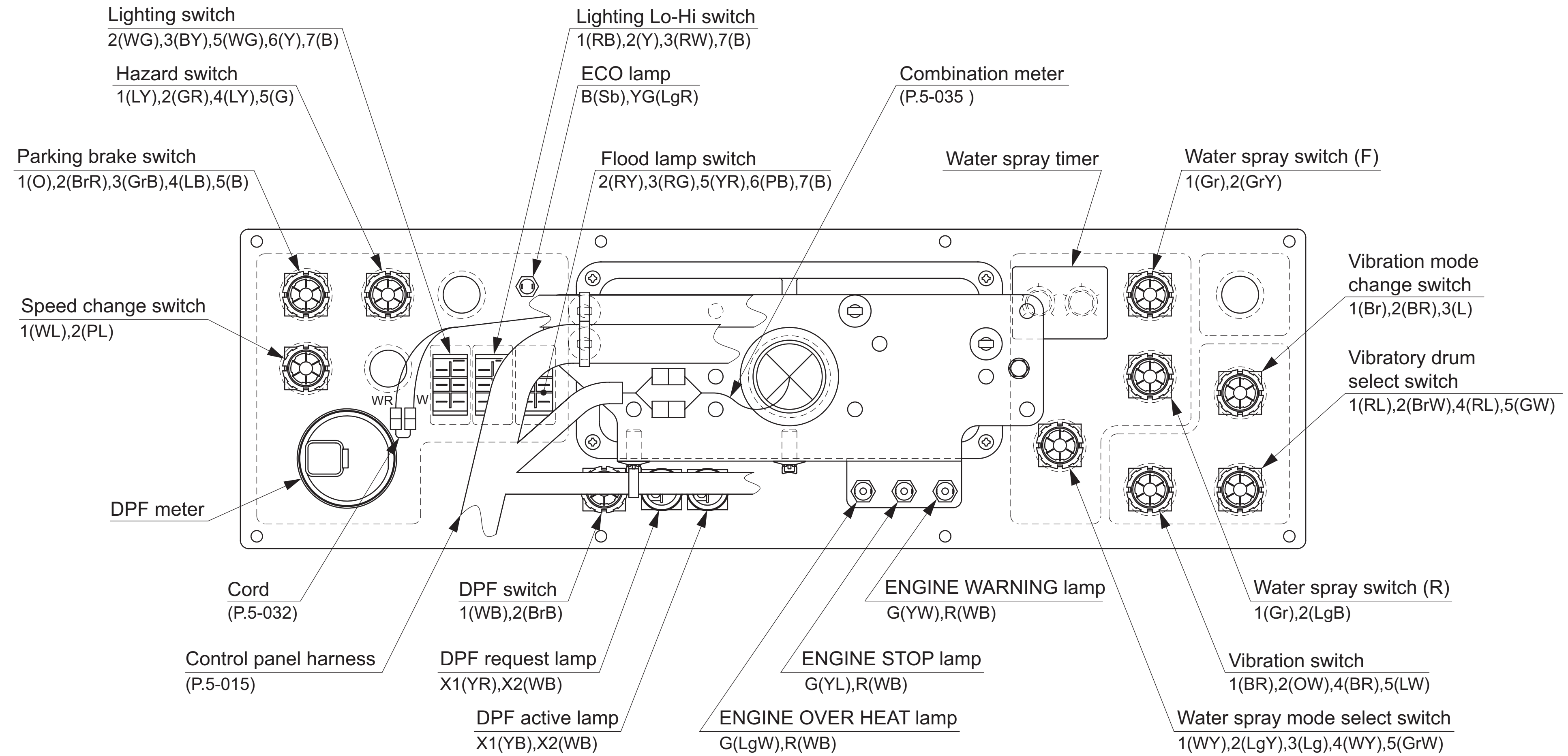
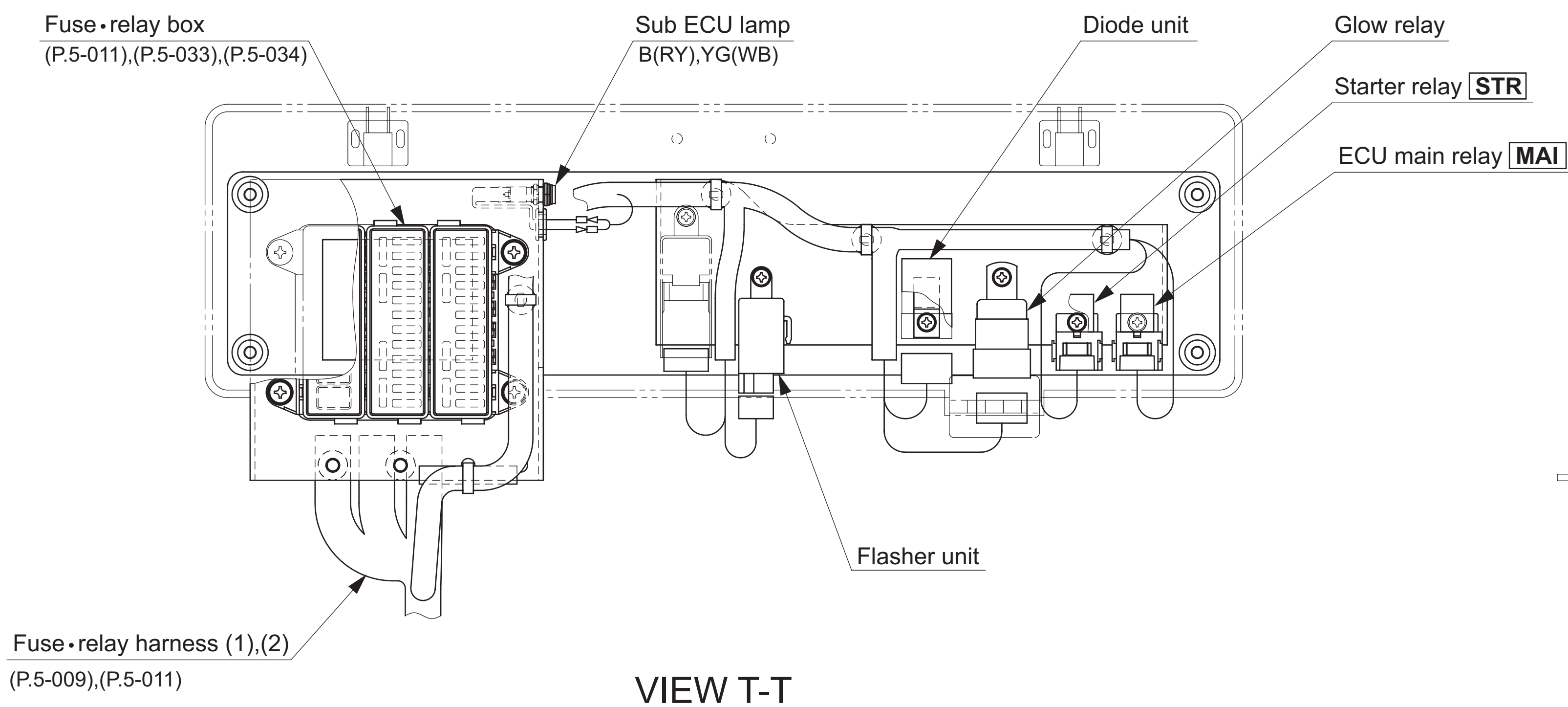
3-3. Wiring Harness Layout (3)

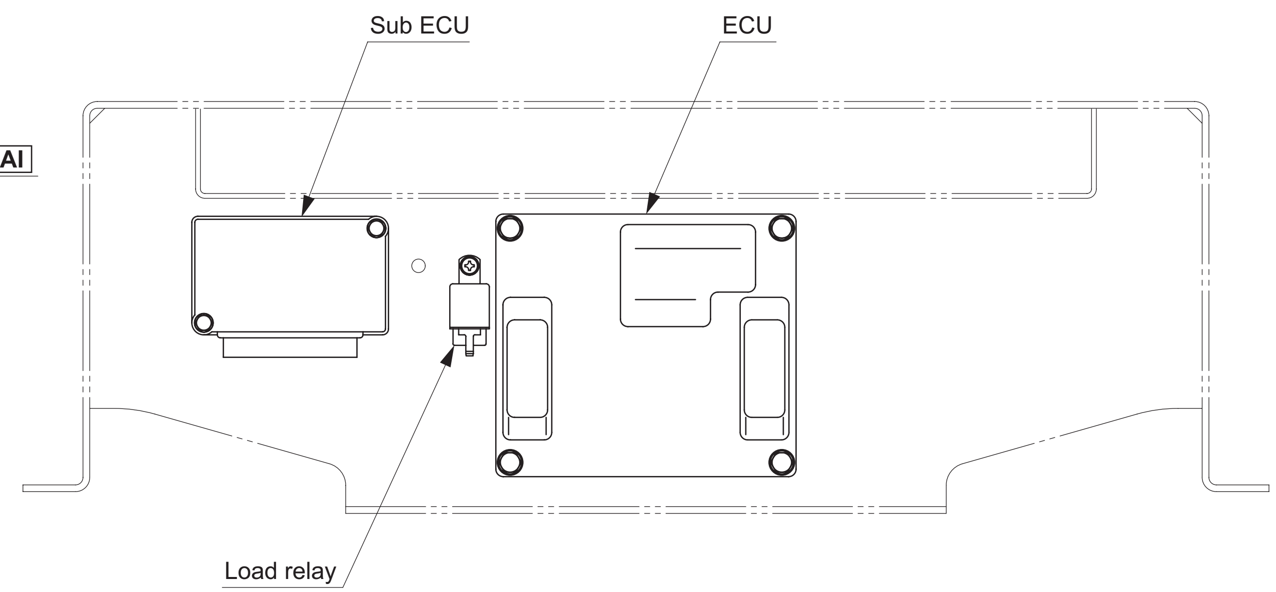




VIEW S



VIEW T-T



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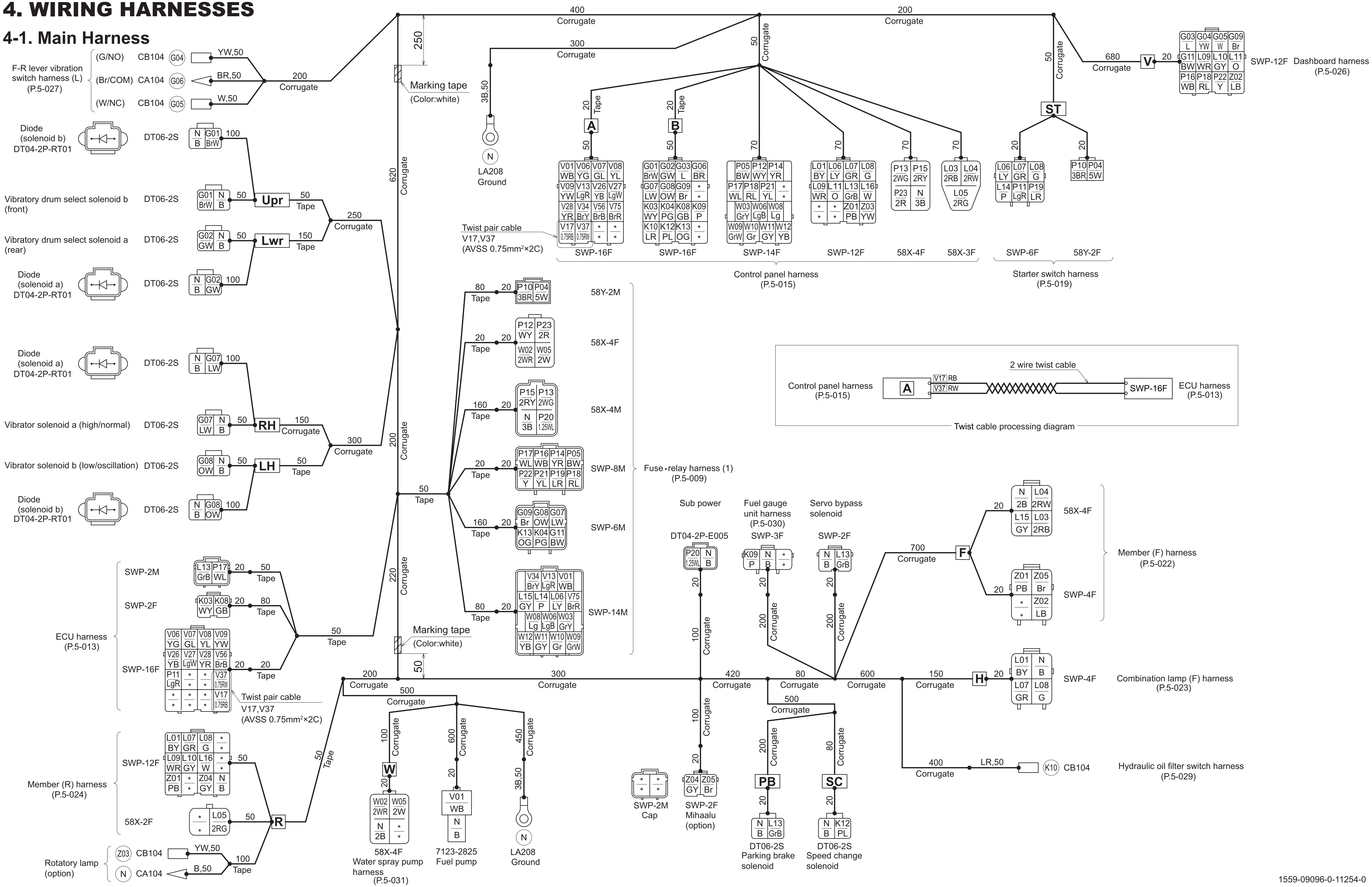
0559-09822-0-11210-A

4. WIRING HARNESSES

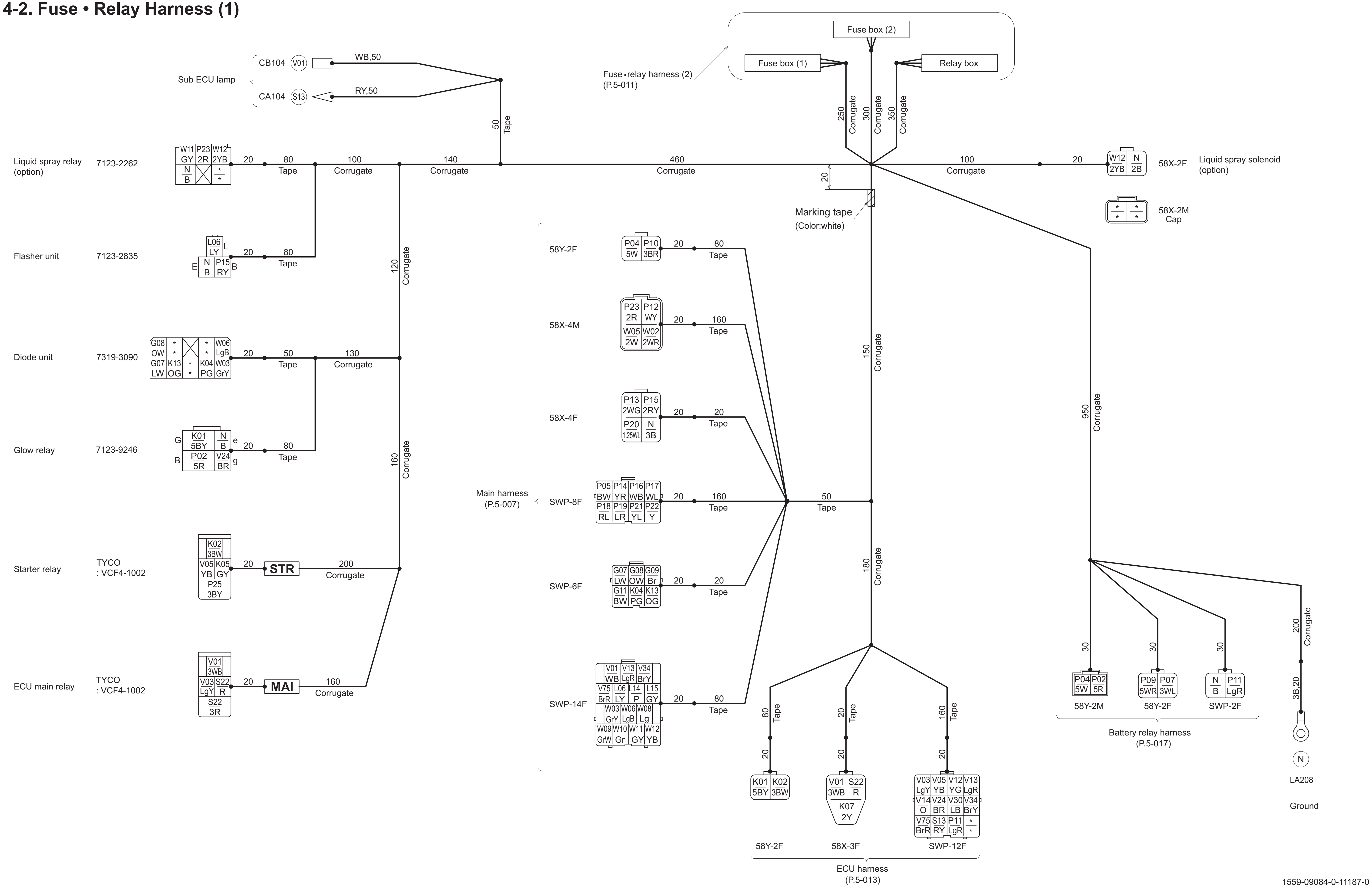
4-1. Main Harness



No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
G01	BrW	3	B, Upr × 2
G02	GW	3	B, Lwr × 2
G03	L	2	B, V
G04	YW	2	V, F-R lever vibration switch (L) harness-G/NO
G05	W	2	V, F-R lever vibration switch (L) harness-W/NC
G06	BR	2	B, F-R lever vibration switch (L) harness-Br/COM
G07	LW	4	B, RH × 2, Fuse • relay harness (1)(6M)
G08	OW	4	B, LH × 2, Fuse • relay harness (1)(6M)
G09	Br	3	B, V, Fuse • relay harness (1)(6M)
G11	BW	2	V, Fuse • relay harness (1)(6M)
K03	WY	2	B, ECU harness
K04	PG	2	B, Fuse • relay harness (1)(6M)
K08	GB	2	B, ECU harness
K09	P	2	B, Fuel gauge unit harness
K10	LR	2	B, Hydraulic oil filter switch harness
K12	PL	2	B, SC
K13	OG	2	B, Fuse • relay harness (1)(6M)
L01	BY	3	H, R, Control panel harness (12F)
L03	2RB	2	F, Control panel harness (3F)
L04	2RW	2	F, Control panel harness (3F)
L05	2RG	2	R, Control panel harness (3F)
L06	LY	3	ST, Control panel harness (12F), Fuse • relay harness (1)(14M)
L07	GR	4	H, R, ST, Control panel harness (12F)
L08	G	4	H, R, ST, Control panel harness (12F)
L09	WR	3	R, V, Control panel harness (12F)
L10	GY	2	R, V
L11	O	2	V, Control panel harness (12F)
L13	GrB	4	PB, Control panel harness (12F), ECU harness, Servo bypass solenoid
L14	P	2	ST, Fuse • relay harness (1)(14M)
L15	GY	2	F, Fuse • relay harness (1)(14M)
L16	W	2	R, Control panel harness (12F)
N	B,2B,3B	23	F, H, LH × 2, Lwr × 2, PB, R × 2, RH × 2, SC, Upr × 2, W, Control panel harness (4F), Ground × 2, Fuel gauge unit harness, Fuel pump, Fuse • relay harness (1)(4M), Servo bypass solenoid, Sub power
P04	5W	2	ST, Fuse • relay harness (1)(2M)
P05	BW	2	Control panel harness (14F), Fuse • relay harness (1)(8M)
P10	3BR	2	ST, Fuse • relay harness (1)(2M)
P11	LgR	2	ST, ECU harness
P12	WY	2	Control panel harness (14F), Fuse • relay harness (1)(4F)

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
P13	2WG	2	Control panel harness (4F), Fuse • relay harness (1)(4M)
P14	YR	2	Control panel harness (14F), Fuse • relay harness (1)(8M)
P15	2RY	2	Control panel harness (4F), Fuse • relay harness (1)(4M)
P16	WB	2	V, Fuse • relay harness (1)(8M)
P17	WL	3	Control panel harness (14F), ECU harness, Fuse • relay harness (1)(8M)
P18	RL	3	V, Control panel harness (14F), Fuse • relay harness (1)(8M)
P19	LR	2	ST, Fuse • relay harness (1)(8M)
P20	1.25WL	2	Fuse • relay harness (1)(4M), Sub power
P21	YL	2	Control panel harness (14F), Fuse • relay harness (1)(8M)
P22	Y	2	V, Fuse • relay harness (1)(8M)
P23	2R	2	Control panel harness (4F), Fuse • relay harness (1)(4F)
V01	WB	3	A, Fuel pump, Fuse • relay harness (1)(14M)
V06	YG	2	A, ECU harness
V07	GL	2	A, ECU harness
V08	YL	2	A, ECU harness
V09	YW	2	A, ECU harness
V13	LgR	2	A, Fuse • relay harness (1)(14M)
V17	0.75RB	2	A, ECU harness
V26	YB	2	A, ECU harness
V27	LgW	2	A, ECU harness
V28	YR	2	A, ECU harness
V34	BrY	2	A, Fuse • relay harness (1)(14M)
V37	0.75RW	2	A, ECU harness
V56	BrB	2	A, ECU harness
V75	BrR	2	A, Fuse • relay harness (1)(14M)
W02	2WR	2	W, Fuse • relay harness (1)(4F)
W03	GrY	2	Control panel harness (14F), Fuse • relay harness (1)(14M)
W05	2W	2	W, Fuse • relay harness (1)(4F)
W06	LgB	2	Control panel harness (14F), Fuse • relay harness (1)(14M)
W08	Lg	2	Control panel harness (14F), Fuse • relay harness (1)(14M)
W09	GrW	2	Control panel harness (14F), Fuse • relay harness (1)(14M)
W10	Gr	2	Control panel harness (14F), Fuse • relay harness (1)(14M)
W11	GY	2	Control panel harness (14F), Fuse • relay harness (1)(14M)
W12	YB	2	Control panel harness (14F), Fuse • relay harness (1)(14M)
Z01	PB	3	F, R, Control panel harness (12F)
Z02	LB	2	F, V
Z03	YW	2	R, Control panel harness (12F)
Z04	GY	2	R, Mihaalu (option)
Z05	Br	2	F, Mihaalu (option)

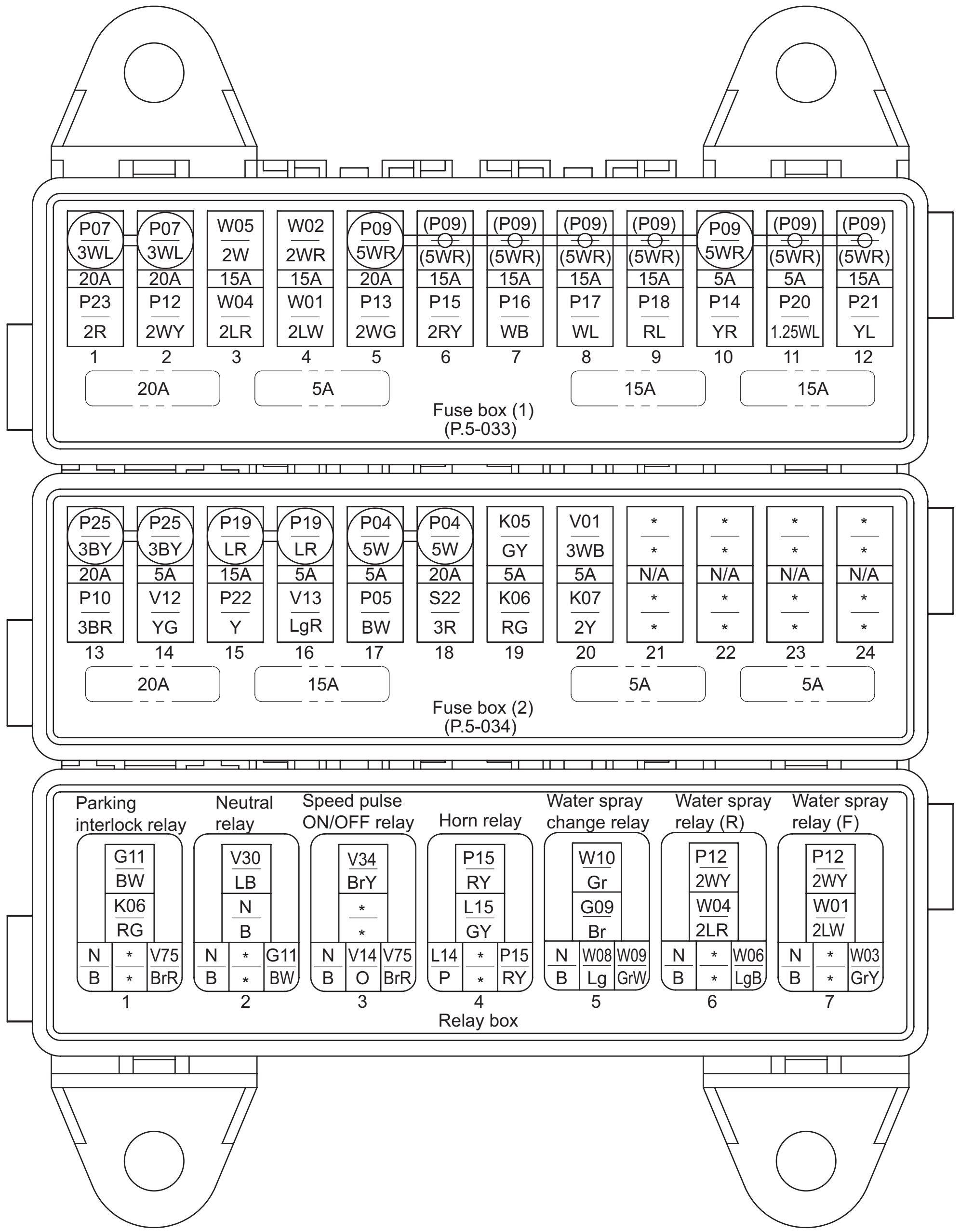
4-2. Fuse • Relay Harness (1)

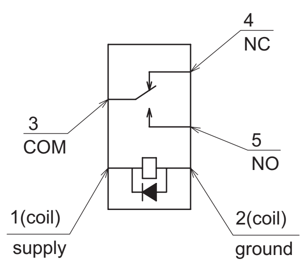


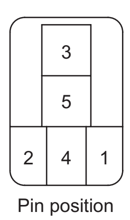
No.	SIZE, COLOR	CONTACT POINTS	CONNECTION (1)	CONNECTION (2)
G07	LW	2	Diode unit, Main harness (6F)	
G08	OW	2	Diode unit, Main harness (6F)	
G09	Br	2	Main harness (6F)	Relay 5-5
G11	BW	3	Main harness (6F)	Relay 1-3, 2-1
K01	5BY	2	ECU harness, Glow relay	
K02	3BW	2	**STR**, ECU harness	
K04	PG	2	Diode unit, Main harness (6F)	
K05	GY	2	**STR**	Fuse 19
K06	RG	2		Fuse 19, Relay 1-5
K07	2Y	2	ECU harness	Fuse 20
K13	OG	2	Diode unit, Main harness (6F)	
L06	LY	2	Flasher unit, Main harness (14F)	
L14	P	2	Main harness (14F)	Relay 4-2
L15	GY	2	Main harness (14F)	Relay 4-5
N	B,2B,3B	14	Battery relay harness, Flasher unit, Glow relay, Ground, Main harness (4F), Liguid spray relay (option), Liguid spray solenoid (option)	Relay 1-2, 2-2, 2-5, 3-2, 5-2, 6-2, 7-2
P02	5R	2	Battery relay harness, Glow relay	
P04	5W	3	Battery relay harness, Main harness (2F)	Fuse 17
P05	BW	2	Main harness (8F)	Fuse 17
P07	3WL	2	Battery relay harness	Fuse 1
P09	5WR	3	Battery relay harness	Fuse 5, 10
P10	3BR	2	Main harness (2F)	Fuse 13
P11	LgR	2	Battery relay harness, ECU harness	
P12	WY,2WY	4	Main harness (4M)	Fuse 2, Relay 6-3, 7-3
P13	2WG	2	Main harness (4F)	Fuse 5
P14	YR	2	Main harness (8F)	Fuse 10
P15	RY,2RY	5	Flasher unit, Main harness (4F)	Fuse 6, Relay 4-1, 4-3
P16	WB	2	Main harness (8F)	Fuse 7
P17	WL	2	Main harness (8F)	Fuse 8

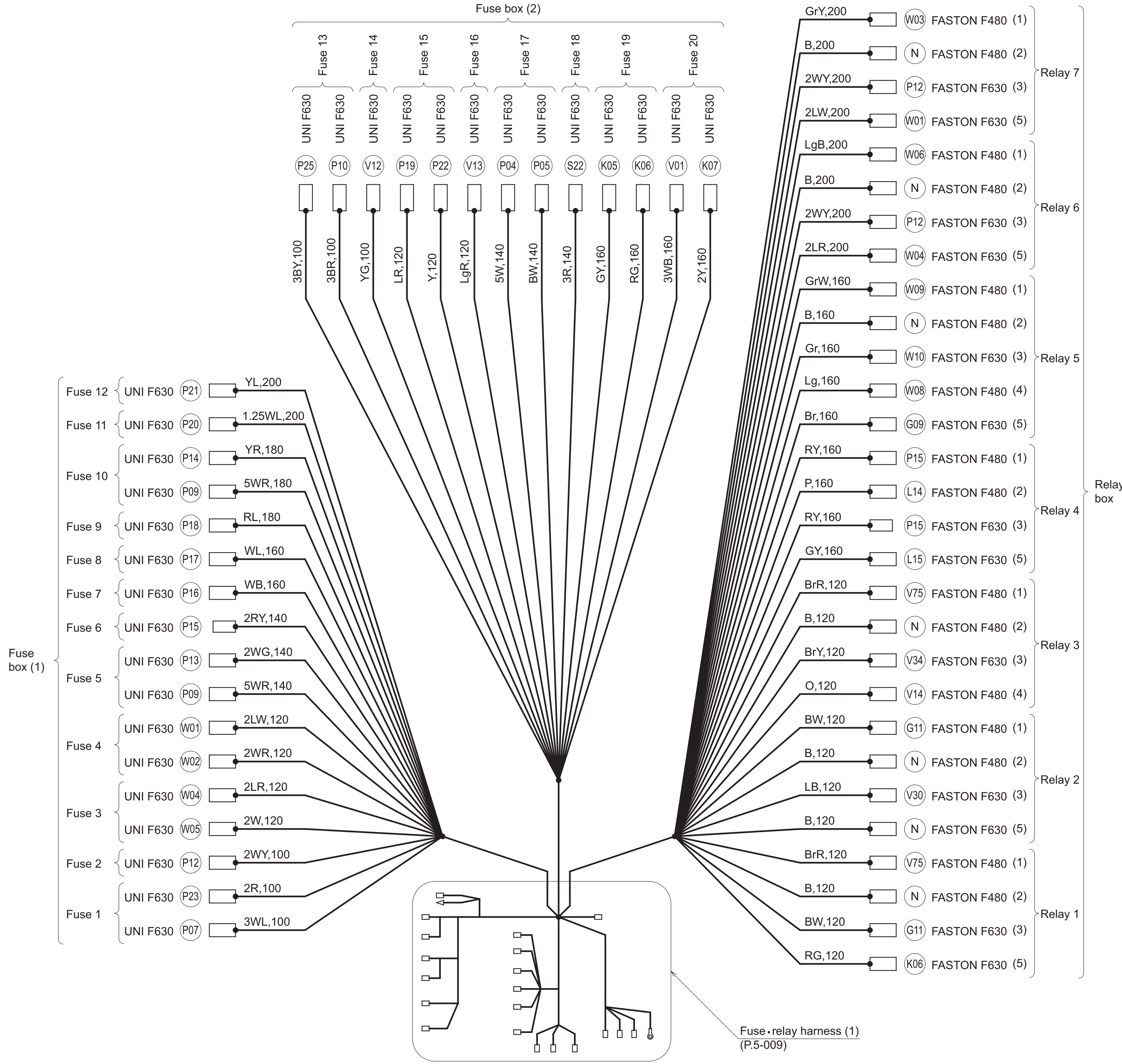
No.	SIZE, COLOR	CONTACT POINTS	CONNECTION (1)	CONNECTION (2)
P18	RL	2	Main harness (8F)	Fuse 9
P19	LR	2	Main harness (8F)	Fuse 15
P20	1.25WL	2	Main harness (4F)	Fuse 11
P21	YL	2	Main harness (8F)	Fuse 12
P22	Y	2	Main harness (8F)	Fuse 15
P23	2R	3	Main harness (4M), Liguid spray relay (option)	Fuse 1
P25	3BY	2	**STR**	Fuse 13
S13	RY	2	ECU harness, Sub ECU lamp	
S22	R,3R	4	**MAI** × 2, ECU harness	Fuse 18
V01	WB,3WB	5	**MAI**, ECU harness, Main harness (14F), Sub ECU lamp	Fuse 20
V03	LgY	2	**MAI**, ECU harness	
V05	YB	2	**STR**, ECU harness	
V12	YG	2	ECU harness	Fuse 14
V13	LgR	3	ECU harness, Main harness (14F)	Fuse 16
V14	O	2	ECU harness	Relay 3-4
V24	BR	2	ECU harness, Glow relay	
V30	LB	2	ECU harness	Relay 2-3
V34	BrY	3	ECU harness, Main harness (14F)	Relay 3-3
V75	BrR	4	ECU harness, Main harness (14F)	Relay 1-1, 3-1
W01	2LW	2		Fuse 4, Relay 7-5
W02	2WR	2	Main harness (4M)	Fuse 4
W03	GrY	3	Diode unit, Main harness (14F)	Relay 7-1
W04	2LR	2		Fuse 3, Relay 6-5
W05	2W	2	Main harness (4M)	Fuse 3
W06	LgB	3	Diode unit, Main harness (14F)	Relay 6-1
W08	Lg	2	Main harness (14F)	Relay 5-4
W09	GrW	2	Main harness (14F)	Relay 5-1
W10	Gr	2	Main harness (14F)	Relay 5-3
W11	GY	2	Main harness (14F), Liguid spray relay (option)	
W12	YB,2YB	3	Main harness (14F), Liguid spray relay (option), Liguid spray solenoid (option)	

4-3. Fuse • Relay Harness (2)









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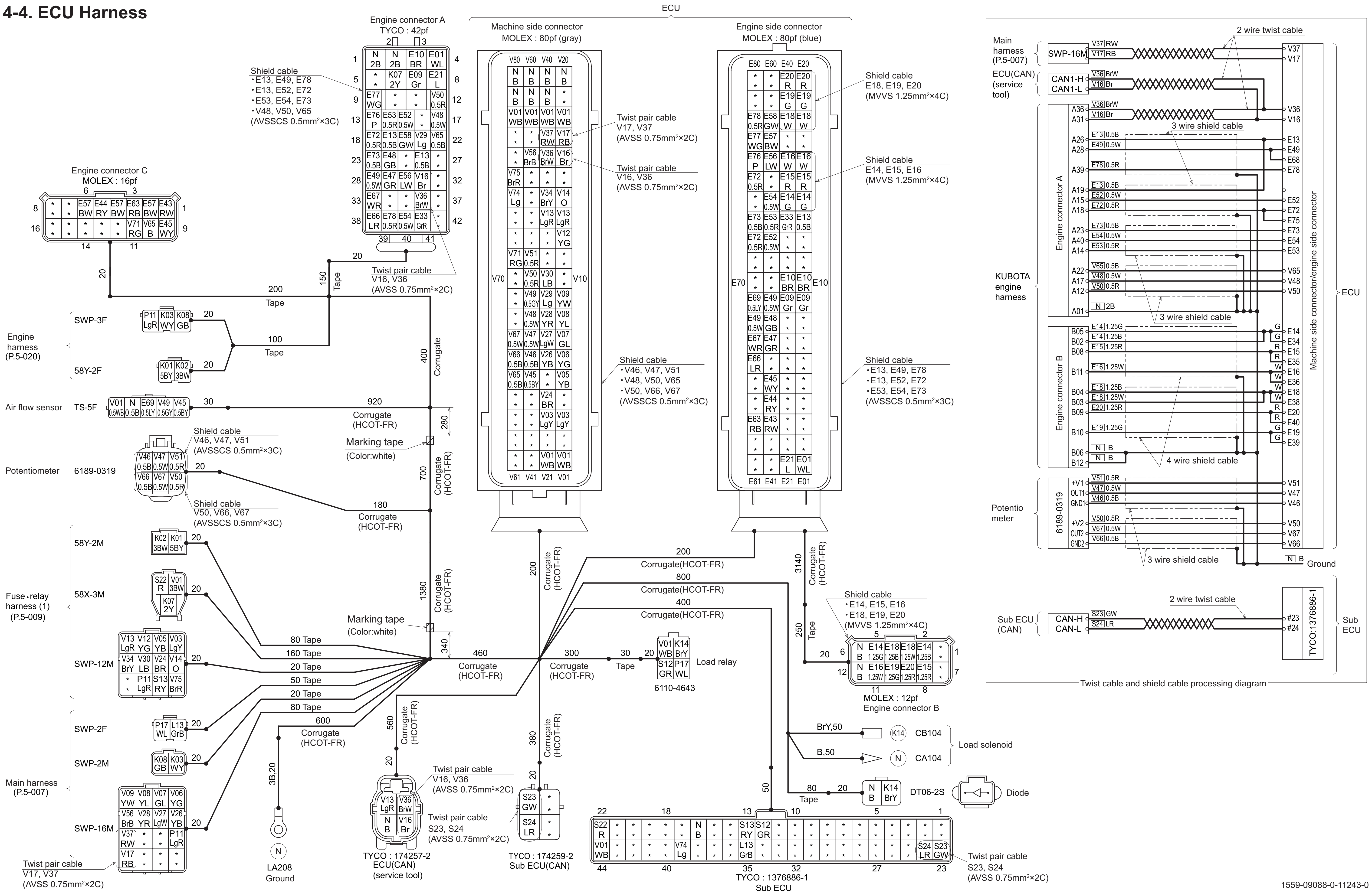
No.	SIZE, COLOR	CONTACT POINTS	CONNECTION	
			(1)	(2)
G07	LW	2	Diode unit, Main harness (6F)	
G08	OW	2	Diode unit, Main harness (6F)	
G09	Br	2	Main harness (6F)	Relay 5-5
G11	BW	3	Main harness (6F)	Relay 1-3, 2-1
K01	5BY	2	ECU harness, Glow relay	
K02	3BW	2	**STR**, ECU harness	
K04	PG	2	Diode unit, Main harness (6F)	
K05	GY	2	**STR**	Fuse 19
K06	RG	2		Fuse 19, Relay 1-5
K07	2Y	2	ECU harness	Fuse 20
K13	OG	2	Diode unit, Main harness (6F)	
L06	LY	2	Flasher unit, Main harness (14F)	
L14	P	2	Main harness (14F)	Relay 4-2
L15	GY	2	Main harness (14F)	Relay 4-5
N	B,2B,3B	14	Battery relay harness, Flasher unit, Glow relay, Ground, Main harness (4F), Liguid spray relay (option), Liguid spray solenoid (option)	Relay 1-2, 2-2, 2-5, 3-2, 5-2, 6-2, 7-2
P02	5R	2	Battery relay harness, Glow relay	
P04	5W	3	Battery relay harness, Main harness (2F)	Fuse 17
P05	BW	2	Main harness (8F)	Fuse 17
P07	3WL	2	Battery relay harness	Fuse 1
P09	5WR	3	Battery relay harness	Fuse 5, 10
P10	3BR	2	Main harness (2F)	Fuse 13
P11	LgR	2	Battery relay harness, ECU harness	
P12	WY,2WY	4	Main harness (4M)	Fuse 2, Relay 6-3, 7-3
P13	2WG	2	Main harness (4F)	Fuse 5
P14	YR	2	Main harness (8F)	Fuse 10
P15	RY,2RY	5	Flasher unit, Main harness (4F)	Fuse 6, Relay 4-1, 4-3
P16	WB	2	Main harness (8F)	Fuse 7
P17	WL	2	Main harness (8F)	Fuse 8

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION	
			(1)	(2)
P18	RL	2	Main harness (8F)	Fuse 9
P19	LR	2	Main harness (8F)	Fuse 15
P20	1.25WL	2	Main harness (4F)	Fuse 11
P21	YL	2	Main harness (8F)	Fuse 12
P22	Y	2	Main harness (8F)	Fuse 15
P23	2R	3	Main harness (4M), Liguid spray relay (option)	Fuse 1
P25	3BY	2	**STR**	Fuse 13
S13	RY	2	ECU harness, Sub ECU lamp	
S22	R,3R	4	**MAI** × 2, ECU harness	Fuse 18
V01	WB,3WB	5	**MAI**, ECU harness, Main harness (14F), Sub ECU lamp	Fuse 20
V03	LgY	2	**MAI**, ECU harness	
V05	YB	2	**STR**, ECU harness	
V12	YG	2	ECU harness	Fuse 14
V13	LgR	3	ECU harness, Main harness (14F)	Fuse 16
V14	O	2	ECU harness	Relay 3-4
V24	BR	2	ECU harness, Glow relay	
V30	LB	2	ECU harness	Relay 2-3
V34	BrY	3	ECU harness, Main harness (14F)	Relay 3-3
V75	BrR	4	ECU harness, Main harness (14F)	Relay 1-1, 3-1
W01	2LW	2		Fuse 4, Relay 7-5
W02	2WR	2	Main harness (4M)	Fuse 4
W03	GrY	3	Diode unit, Main harness (14F)	Relay 7-1
W04	2LR	2		Fuse 3, Relay 6-5
W05	2W	2	Main harness (4M)	Fuse 3
W06	LgB	3	Diode unit, Main harness (14F)	Relay 6-1
W08	Lg	2	Main harness (14F)	Relay 5-4
W09	GrW	2	Main harness (14F)	Relay 5-1
W10	Gr	2	Main harness (14F)	Relay 5-3
W11	GY	2	Main harness (14F), Liguid spray relay (option)	
W12	YB,2YB	3	Main harness (14F), Liguid spray relay (option), Liguid spray solenoid (option)	

4-4. ECU Harness

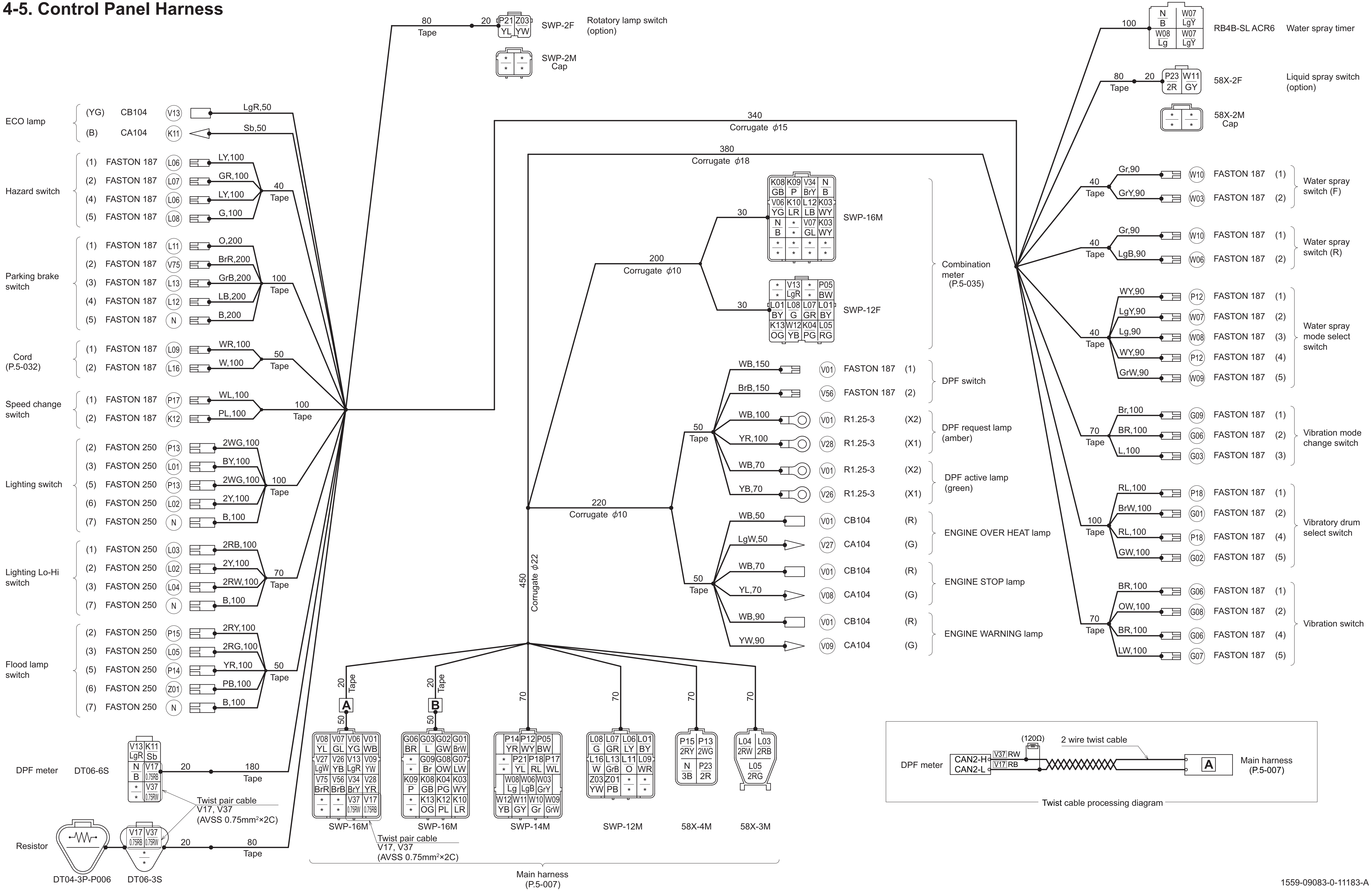


No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
E01	WL	2	ECU-E01, Engine connector A-4
E09	Gr	3	ECU-E09, -E29, Engine connector A-7
E10	BR	3	ECU-E10, -E30, Engine connector A-3
E13	0.5B	3	ECU-E13, Engine connector A-19, -26
E14	G,1.25G	4	ECU-E14, -E34, Engine connector B-2, -5
E15	R,1.25R	3	ECU-E15, -E35, Engine connector B-8
E16	W,1.25W	3	ECU-E16, -E36, Engine connector B-11
E18	W,1.25W	4	ECU-E18, -E38, Engine connector B-3, -4
E19	G,1.25G	3	ECU-E19, -E39, Engine connector B-10
E20	R,1.25R	3	ECU-E20, -E40, Engine connector B-9
E21	L	2	ECU-E21, Engine connector A-8
E33	GrR	2	ECU-E33, Engine connector A-41
E43	RW	2	ECU-E43, Engine connector C-1
E44	RY	2	ECU-E44, Engine connector C-5
E45	WY	2	ECU-E45, Engine connector C-9
E47	GR	2	ECU-E47, Engine connector A-29
E48	GB	2	ECU-E48, Engine connector A-24
E49	0.5W	3	ECU-E49, -E68, Engine connector A-28
E52	0.5W	2	ECU-E52, Engine connector A-15
E53	0.5R	2	ECU-E53, Engine connector A-14
E54	0.5W	2	ECU-E54, Engine connector A-40
E56	LW	2	ECU-E56, Engine connector A-30
E57	BW	4	ECU-E57, Engine connector C-2, -4, -6
E58	GW	2	ECU-E58, Engine connector A-20
E63	RB	2	ECU-E63, Engine connector C-3
E66	LR	2	ECU-E66, Engine connector A-38
E67	WR	2	ECU-E67, Engine connector A-33
E69	0.5LY	2	ECU-E69, Air flow sensor
E72	0.5R	3	ECU-E72, -E75, Engine connector A-18
E73	0.5B	2	ECU-E73, Engine connector A-23

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
E76	P	2	ECU-E76, Engine connector A-13
E77	WG	2	ECU-E77, Engine connector A-9
E78	0.5R	2	ECU-E78, Engine connector A-39
K01	5BY	2	Engine harness, Fuse • relay harness (1)
K02	3BW	2	Engine harness, Fuse • relay harness (1)
K03	WY	2	Engine harness, Main harness
K07	2Y	2	Engine connector A-6, Fuse • relay harness (1)
K08	GB	2	Engine harness, Main harness
K14	BrY	3	Diode, Load relay, Load solenoid
L13	GrB	2	Main harness, Sub ECU-35
N	0.5B,B, 2B,3B	17	ECU-V20, -V39, -V40, -V59, -V60, -V79, -V80, Air flow sensor, ECU(CAN)(service tool), Engine connector A-1, -2, B-6, -12, Diode, Ground, Load solenoid, Sub ECU-16
P11	LgR	3	Engine harness, Fuse • relay harness (1), Main harness
P17	WL	2	Main harness, Load relay
S12	GR	2	Load relay, Sub ECU-12
S13	RY	2	Fuse • relay harness (1), Sub ECU-13
S22	R	2	Fuse • relay harness (1), Sub ECU-22
S23	GW	2	Sub ECU(CAN), Sub ECU-23
S24	LR	2	Sub ECU(CAN), Sub ECU-24
V01	0.5WB, WB,3WB	10	ECU-V01, -V18, -V21, -V38, -V58, -V78, Air flow sensor, Fuse • relay harness (1), Load relay, Sub ECU-44
V03	LgY	3	ECU-V03, -V23, Fuse • relay harness (1)
V05	YB	2	ECU-V05, Fuse • relay harness (1)
V06	YG	2	ECU-V06, Main harness
V07	GL	2	ECU-V07, Main harness
V08	YL	2	ECU-V08, Main harness
V09	YW	2	ECU-V09, Main harness
V12	YG	2	ECU-V12, Fuse • relay harness (1)

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
V13	LgR	4	ECU(CAN)(service tool), ECU-V13, -V33, Fuse • relay harness (1)
V14	O	2	ECU-V14, Fuse • relay harness (1)
V16	Br	3	ECU(CAN)(service tool), ECU-V16, Engine connector A-31
V17	RB	2	ECU-V17, Main harness
V24	BR	2	ECU-V24, Fuse • relay harness (1)
V26	YB	2	ECU-V26, Main harness
V27	LgW	2	ECU-V27, Main harness
V28	YR	2	ECU-V28, Main harness
V29	Lg	2	ECU-V29, Engine connector A-21
V30	LB	2	ECU-V30, Fuse • relay harness (1)
V34	BrY	2	ECU-V34, Fuse • relay harness (1)
V36	BrW	3	ECU(CAN)(service tool), ECU-V36, Engine connector A-36
V37	RW	2	ECU-V37, Main harness
V45	0.5BY	2	ECU-V45, Air flow sensor
V46	0.5B	2	ECU-V46, Potentiometer
V47	0.5W	2	ECU-V47, Potentiometer
V48	0.5W	2	ECU-V48, Engine connector A-17
V49	0.5GY	2	ECU-V49, Air flow sensor
V50	0.5R	3	ECU-V50, Engine connector A-12, Potentiometer
V51	0.5R	2	ECU-V51, Potentiometer
V56	BrB	2	ECU-V56, Main harness
V65	0.5B,B	3	ECU-V65, Engine connector A-22, C-10
V66	0.5B	2	ECU-V66, Potentiometer
V67	0.5W	2	ECU-V67, Potentiometer
V71	RG	2	ECU-V71, Engine connector C-11
V74	Lg	2	ECU-V74, Sub ECU-39
V75	BrR	2	ECU-V75, Fuse • relay harness (1)

4-5. Control Panel Harness



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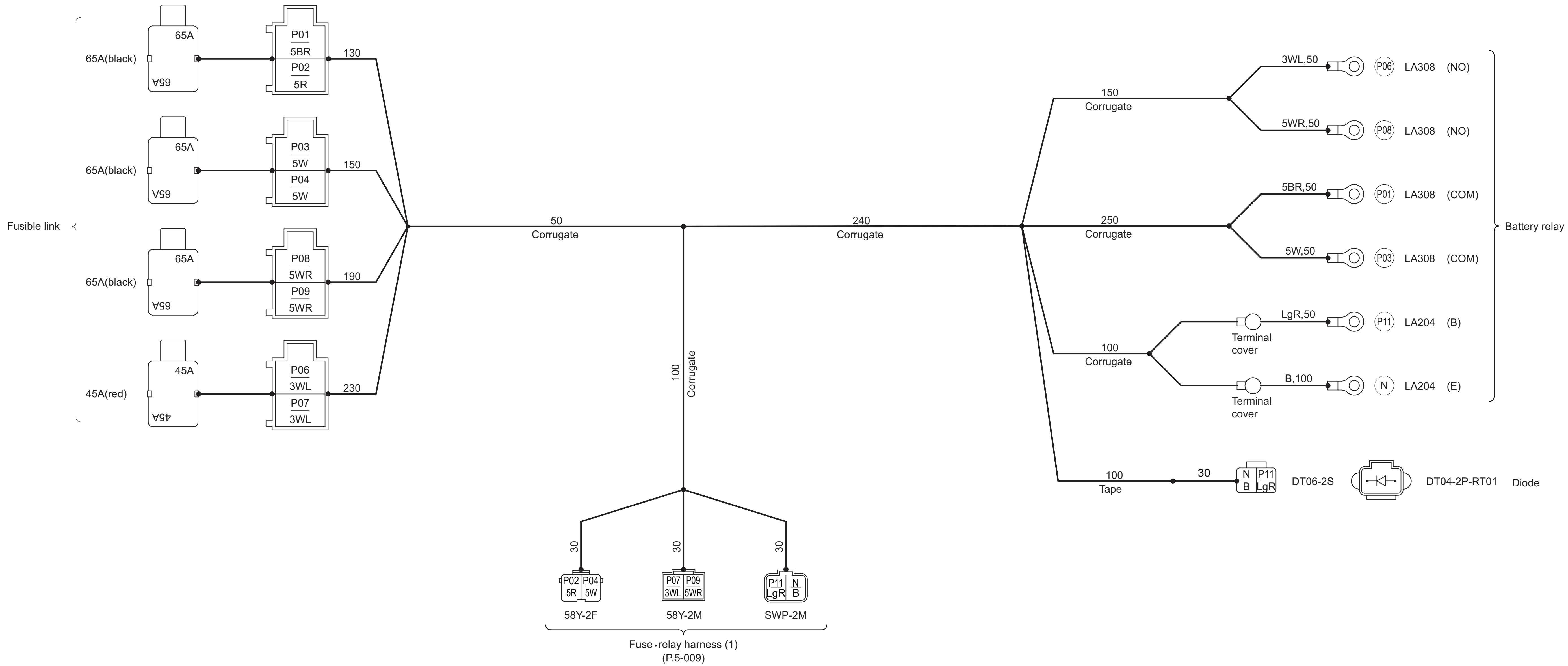
No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
G01	BrW	2	B, Vibratory drum select switch -2
G02	GW	2	B, Vibratory drum select switch -5
G03	L	2	B, Vibration mode change switch -3
G06	BR	4	B, Vibration mode change switch -2, Vibration switch -1, -4
G07	LW	2	B, Vibration switch -5
G08	OW	2	B, Vibration switch -2
G09	Br	2	B, Vibration mode change switch -1
K03	WY	3	B, Combination meter (16M) × 2
K04	PG	2	B, Combination meter (12F)
K08	GB	2	B, Combination meter (16M)
K09	P	2	B, Combination meter (16M)
K10	LR	2	B, Combination meter (16M)
K11	Sb	2	DPF meter, ECO lamp -B
K12	PL	2	B, Speed change switch -2
K13	OG	2	B, Combination meter (12F)
L01	BY	4	Combination meter (12F) × 2, Lighting switch -3, Main harness (12M)
L02	2Y	2	Lighting Lo-Hi switch -2, Lighting switch -6
L03	2RB	2	Lighting Lo-Hi switch -1, Main harness (3M)
L04	2RW	2	Lighting Lo-Hi switch -3, Main harness (3M)
L05	RG,2RG	3	Combination meter (12F), Flood lamp switch -3, Main harness (3M)
L06	LY	3	Hazard switch -1, -4, Main harness (12M)
L07	GR	3	Combination meter (12F), Hazard switch -2, Main harness (12M)
L08	G	3	Combination meter (12F), Hazard switch -5, Main harness (12M)
L09	WR	2	Cord, Main harness (12M)
L11	O	2	Parking brake switch -1, Main harness (12M)
L12	LB	2	Combination meter (16M), Parking brake switch -4
L13	GrB	2	Parking brake switch -3, Main harness (12M)
L16	W	2	Cord, Main harness (12M)
N	B,3B	9	Combination meter (16M) × 2, DPF meter, Flood lamp switch -7, Lighting Lo-Hi switch -7, Lighting switch -7, Main harness (4M), Parking brake switch -5, Water spray timer
P05	BW	2	Combination meter (12F), Main harness (14M)
P12	WY	3	Main harness (14M), Water spray mode select switch -1, -4

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
P13	2WG	3	Lighting switch -2, -5, Main harness (4M)
P14	YR	2	Flood lamp switch -5, Main harness (14M)
P15	2RY	2	Flood lamp switch -2, Main harness (4M)
P17	WL	2	Main harness (14M), Speed change switch -1
P18	RL	3	Main harness (14M), Vibratory drum select switch -1, -4
P21	YL	2	Main harness (14M), Rotatory lamp (option)
P23	2R	2	Main harness (4M), Liguid spray switch (option)
V01	WB	7	A, DPF active lamp -X2, DPF request lamp -X2, DPF switch -1, ENGINE OVER HEAT lamp -R, ENGINE STOP lamp -R, ENGINE WARNING lamp -R
V06	YG	2	A, Combination meter (16M)
V07	GL	2	A, Combination meter (16M)
V08	YL	2	A, ENGINE STOP lamp -G
V09	YW	2	A, ENGINE WARNING lamp -G
V13	LgR	4	A, Combination meter (12F), DPF meter, ECO lamp -YG
V17	0.75RB	3	A, DPF meter, Resistor
V26	YB	2	A, DPF active lamp -X1
V27	LgW	2	A, ENGINE OVER HEAT lamp -G
V28	YR	2	A, DPF request lamp -X1
V34	BrY	2	A, Combination meter (16M)
V37	0.75RW	3	A, DPF meter, Resistor
V56	BrB	2	A, DPF switch -2
V75	BrR	2	A, Parking brake switch -2
W03	GrY	2	Main harness (14M), Water spray switch (F)-2
W06	LgB	2	Main harness (14M), Water spray switch (R)-2
W07	LgY	3	Water spray mode select switch -2, Water spray timer × 2
W08	Lg	3	Main harness (14M), Water spray mode select switch -3, Water spray timer
W09	GrW	2	Main harness (14M), Water spray mode select switch -5
W10	Gr	3	Main harness (14M), Water spray switch (F)-1, Water spray switch (R)-1
W11	GY	2	Main harness (14M), Liguid spray switch (option)
W12	YB	2	Combination meter (12F), Main harness (14M)
Z01	PB	2	Flood lamp switch -6, Main harness (12M)
Z03	YW	2	Main harness (12M), Rotatory lamp (option)

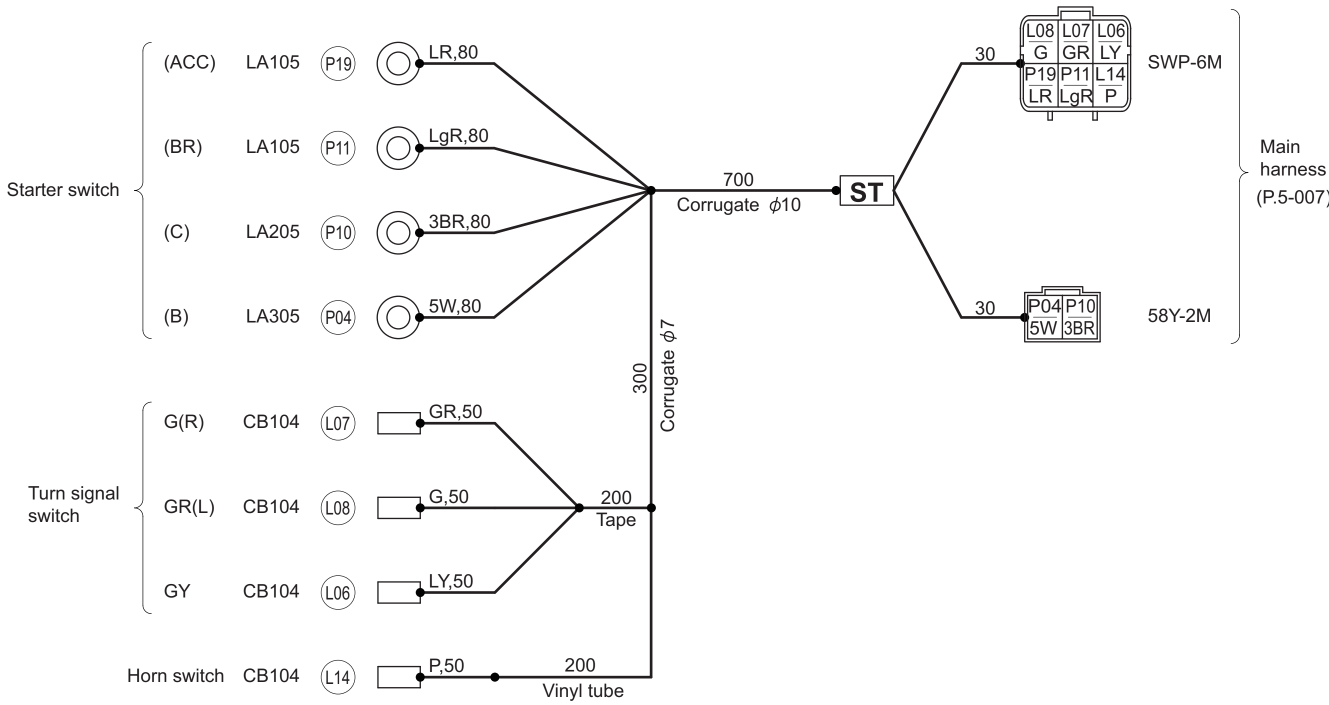
4-6. Battery Relay Harness



1559-09075-0-11155-A

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
N	B	3	Battery relay -E, Diode, Fuse • relay harness (1)
P01	5BR	2	Fusible link 65A, Battery relay -COM
P02	5R	2	Fusible link 65A, Fuse • relay harness (1)
P03	5W	2	Fusible link 65A, Battery relay -COM
P04	5W	2	Fusible link 65A, Fuse • relay harness (1)
P06	3WL	2	Fusible link 45A, Battery relay -NO
P07	3WL	2	Fusible link 45A, Fuse • relay harness (1)
P08	5WR	2	Fusible link 65A, Battery relay -NO
P09	5WR	2	Fusible link 65A, Fuse • relay harness (1)
P11	LgR	3	Battery relay -B, Diode, Fuse • relay harness (1)

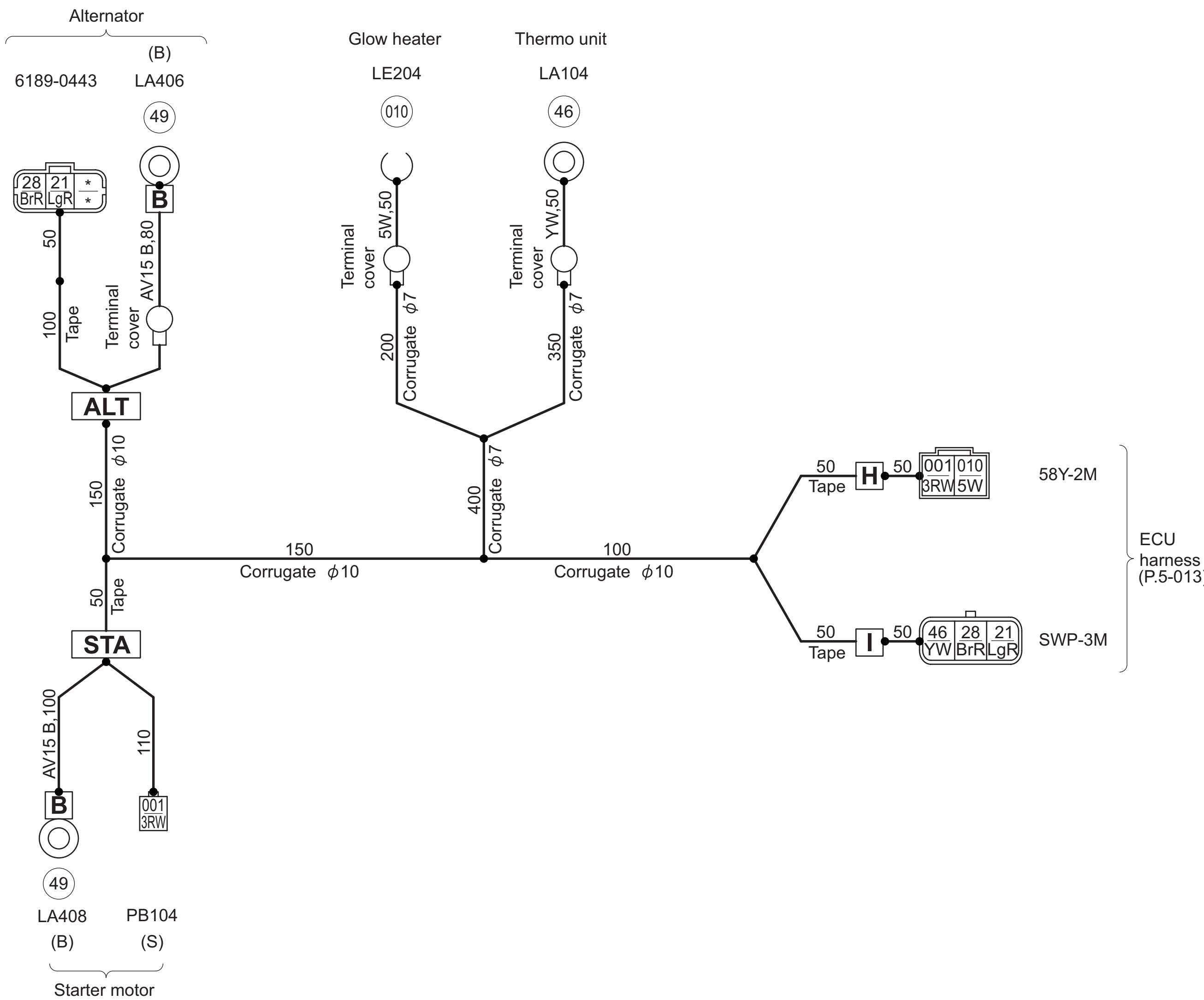
4-7. Stater Switch Harness



1559-09076-0-21156-0

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
P06	LY	2	ST, Turn signal switch (GY)
P07	GR	2	ST, Turn signal switch -R(G)
P08	G	2	ST, Turn signal switch -L(GR)
L14	P	2	ST, Horn switch
P04	5W	2	ST, Starter switch -B
P10	3BR	2	ST, Starter switch -C
P11	LgR	2	ST, Starter switch -BR
P19	LR	2	ST, Starter switch -ACC

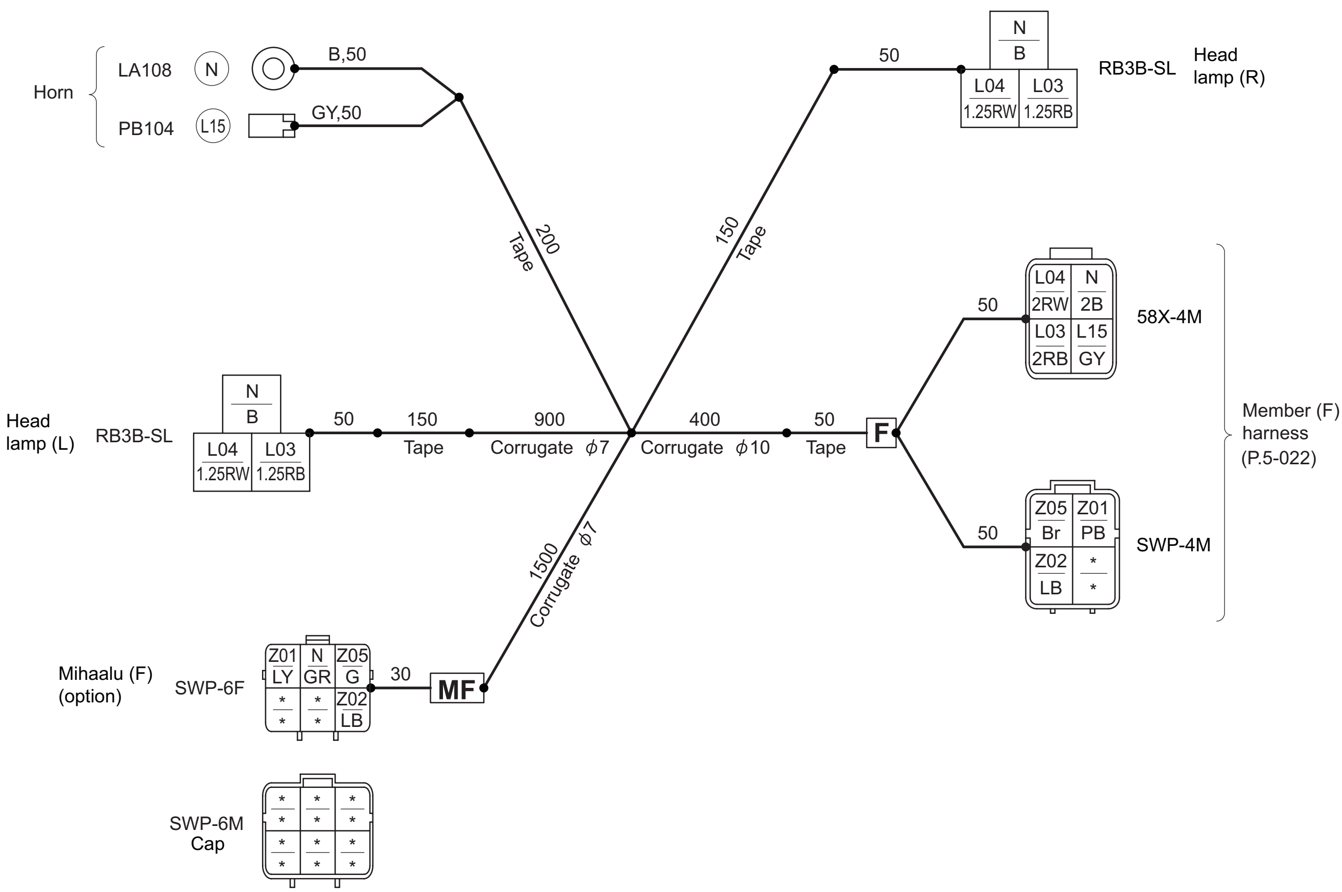
4-8. Engine Harness



1634-09119-0-21489-0

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
001	3RW	2	H, STA
010	5W	2	H, Glow heater
21	LgR	2	ALT, I
28	BrR	2	ALT, I
46	YW	2	I, Thermo unit
49	B	2	ALT-B, STA-B

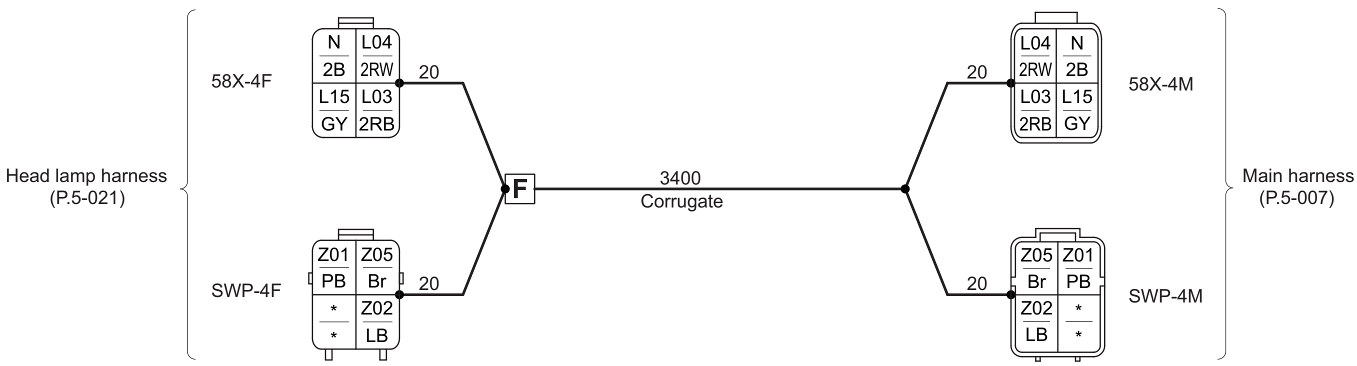
4-9. Head Lamp Harness



1559-09093-0-31249-0

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
L03	1.25RB,2RB	3	F, Head lamp (L), (R)
L04	1.25RW,2RW	3	F, Head lamp (L), (R)
L15	GY	2	F, Horn
N	B,2B	5	F, MF, Head lamp (L), (R), Horn
Z01	PB	2	F, MF
Z02	LB	2	F, MF
Z05	Br	2	F, MF

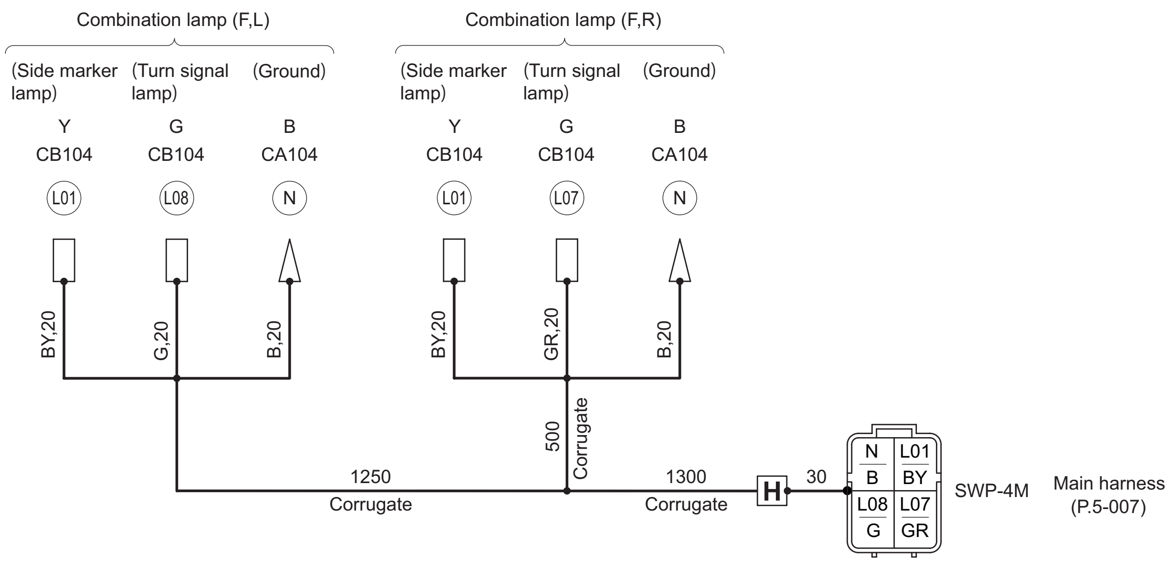
4-10. Member (F) Harness



1559-09094-0-31250-0

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
L03	2RB	2	F, Main harness
L04	2RW	2	F, Main harness
L15	GY	2	F, Main harness
N	2B	2	F, Main harness
Z01	PB	2	F, Main harness
Z02	LB	2	F, Main harness
Z05	Br	2	F, Main harness

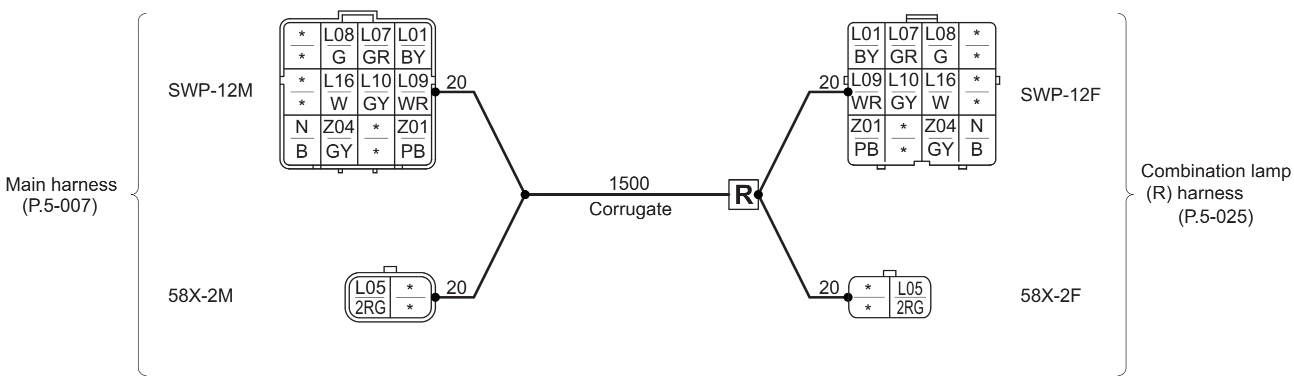
4-11. Combination Lamp (F) Harness



1559-09086-0-21196-0

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
L01	BY	3	H, Combination lamp (F,L), (F,R)
L07	GR	2	H, Combination lamp (F,R)
L08	G	2	H, Combination lamp (F,L)
N	B	3	H, Combination lamp (F,L), (F,R)

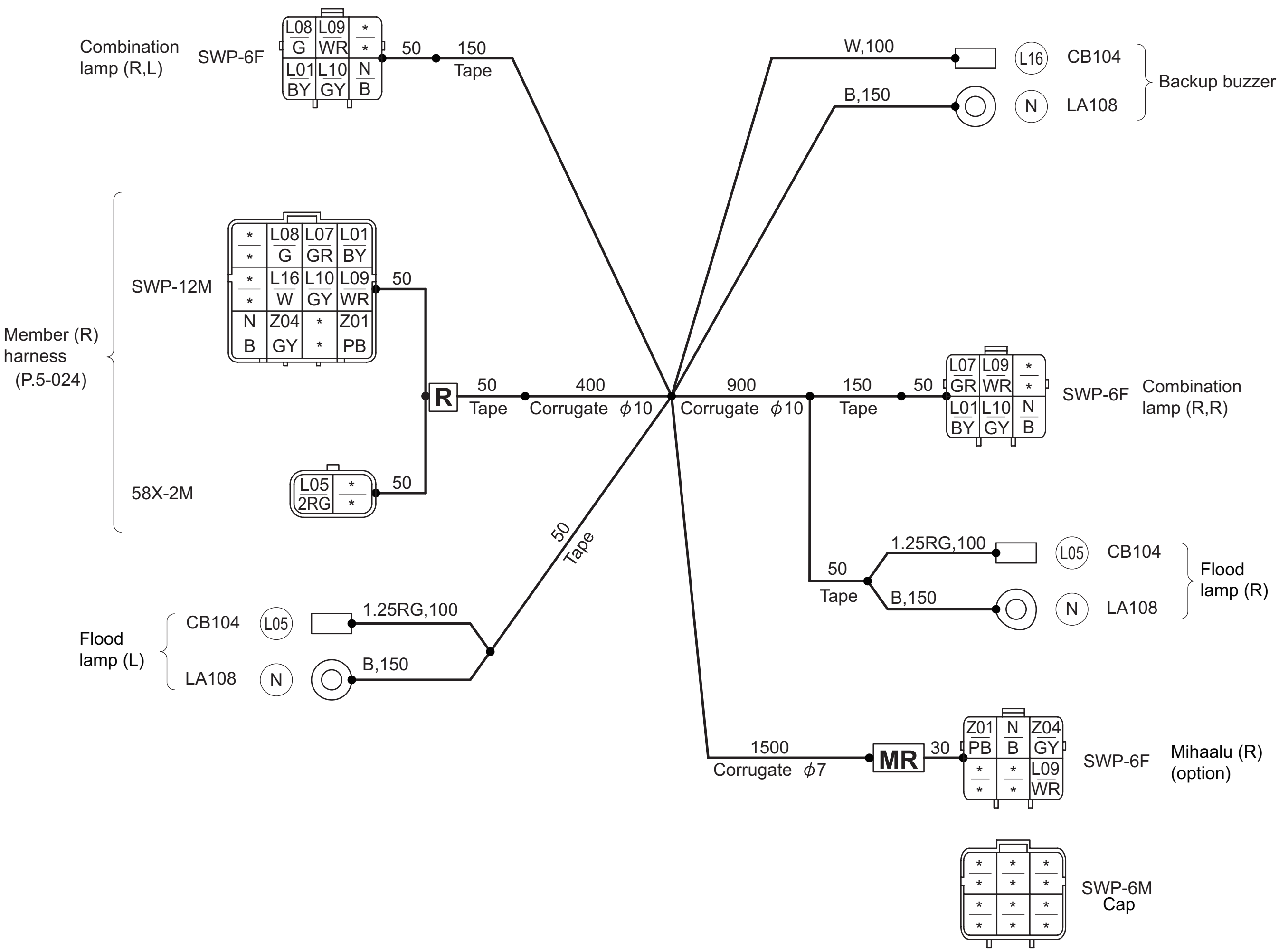
4-12. Member (R) Harness



1559-09095-0-21251-0

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
L01	BY	2	R, Main harness
L05	2RG	2	R, Main harness
L07	GR	2	R, Main harness
L08	G	2	R, Main harness
L09	WR	2	R, Main harness
L10	GY	2	R, Main harness
L16	W	2	R, Main harness
N	B	2	R, Main harness
Z01	PB	2	R, Main harness
Z04	GY	2	R, Main harness

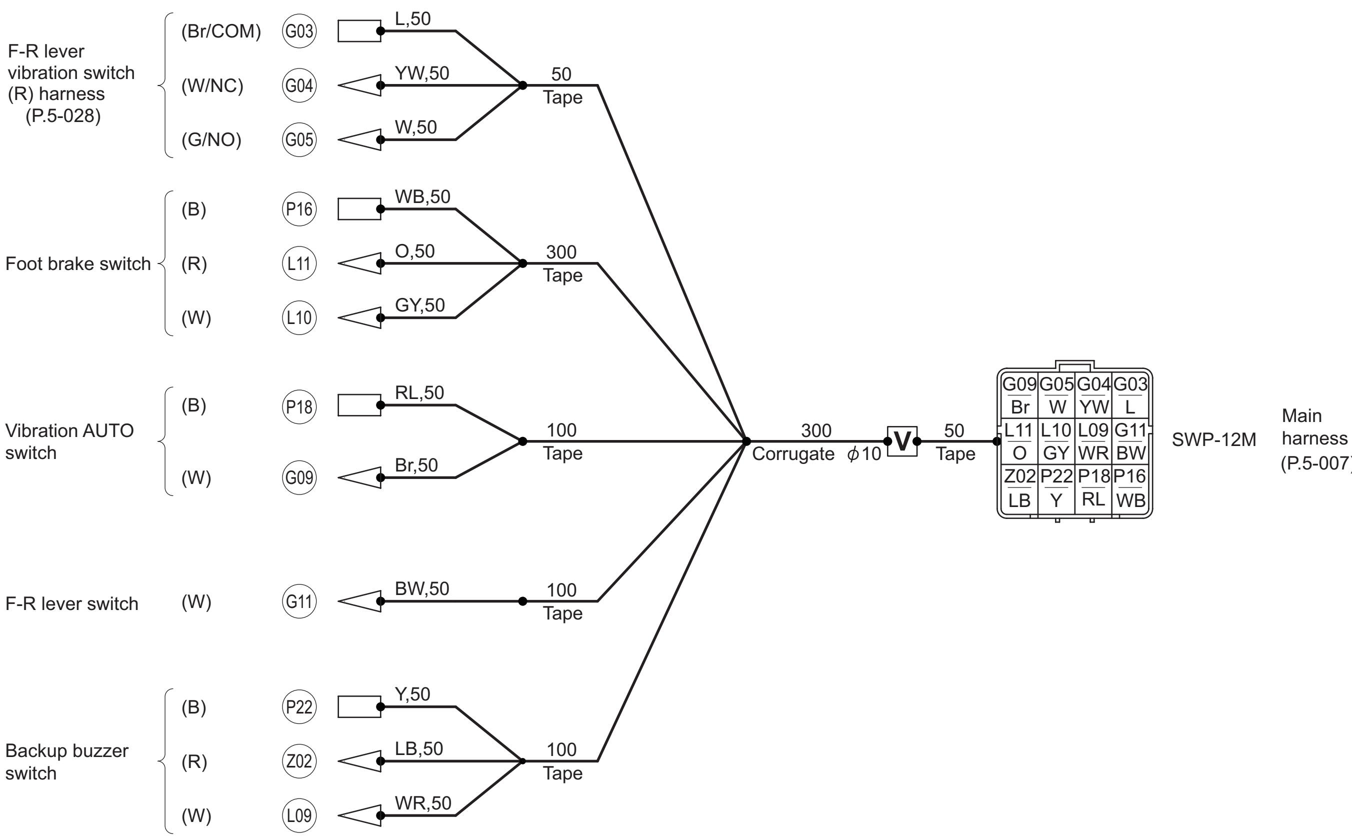
4-13. Combination Lamp (R) Harness



1559-09092-0-21248-0

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
L01	BY	3	R, Combination lamp (R,L), (R,R)
L05	1.25RG,2RG	3	R, Flood lamp (L), (R)
L07	GR	2	R, Combination lamp (R,R)
L08	G	2	R, Combination lamp (R,L)
L09	WR	4	R, Combination lamp (R,L), (R,R), MR (option)
L10	GY	3	R, Combination lamp (R,L), (R,R)
L16	W	2	R, Backup buzzer
N	B	7	R, Backup buzzer, Combination lamp (R,L), (R,R), Flood lamp (L), (R), MR (option)
Z01	PB	2	R, MR (option)
Z04	GY	2	R, MR (option)

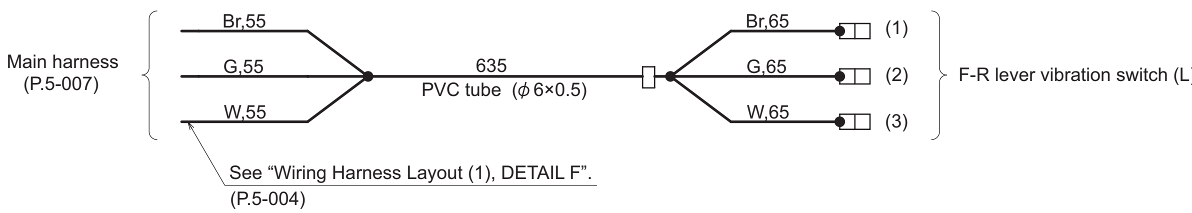
4-14. Dashboard Harness



1559-09078-0-21161-0

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
G03	L	2	V, F-R lever vibration switch (R) harness -Br/COM
G04	YW	2	V, F-R lever vibration switch (R) harness -W/NC
G05	W	2	V, F-R lever vibration switch (R) harness -G/NO
G09	Br	2	V, Vibration AUTO switch -W
G11	BW	2	V, F-R lever switch -W
L09	WR	2	V, Backup buzzer switch -W
L10	GY	2	V, Foot brake switch -W
L11	O	2	V, Foot brake switch -R
P16	WB	2	V, Foot brake switch -B
P18	RL	2	V, Vibration AUTO switch -B
P22	Y	2	V, Backup buzzer switch -B
Z04	LB	2	V, Backup buzzer switch -R

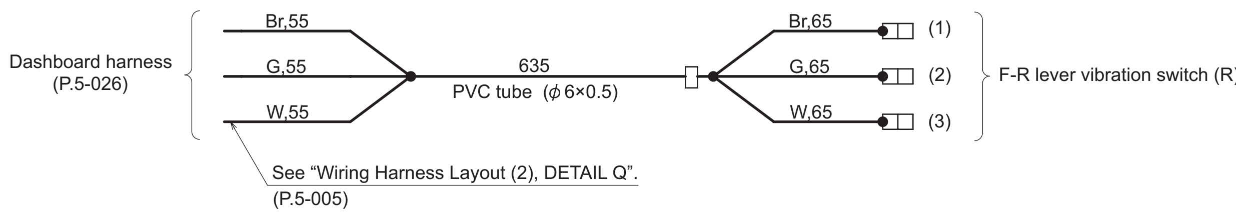
4-15. F-R Lever Vibration Switch (L) Harness



1539-12013-0-30226-0

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
–	Br	2	Main harness, F-R lever vibration switch (L)-1
–	G	2	Main harness, F-R lever vibration switch (L)-2
–	W	2	Main harness, F-R lever vibration switch (L)-3

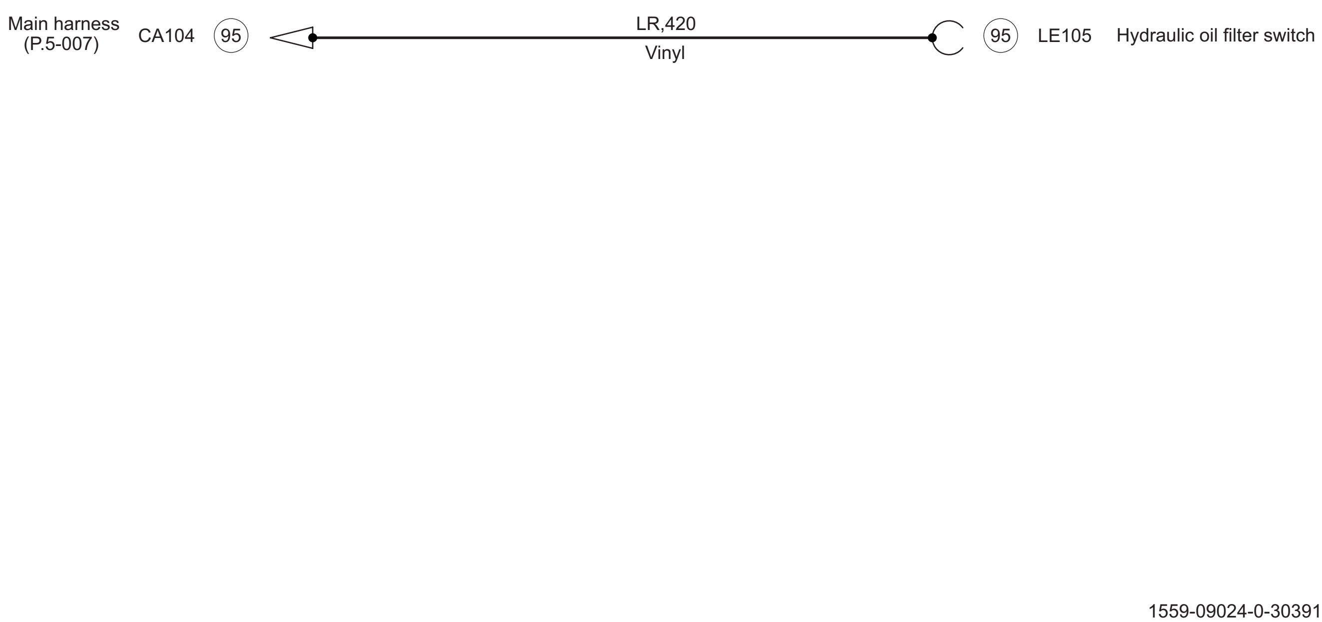
4-16. F-R Lever Vibration Switch (R) Harness



1539-12013-0-30226-0

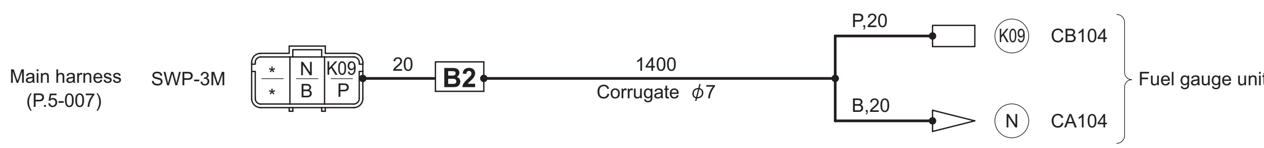
No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
–	Br	2	Dashboard harness, F-R lever vibration switch (R)-1
–	G	2	Dashboard harness, F-R lever vibration switch (R)-2
–	W	2	Dashboard harness, F-R lever vibration switch (R)-3

4-17. Hydraulic Oil Filter Switch Harness



No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
95	LR	2	Main harness, Hydraulic oil filter switch

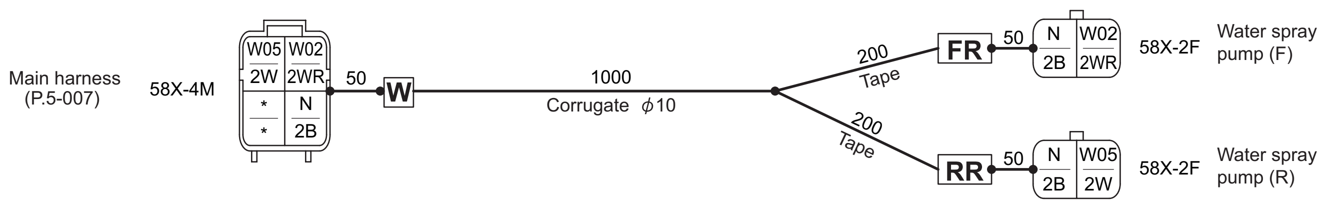
4-18. Fuel Gauge Unit Harness



1539-09113-0-20885-A

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
K09	P	2	**B2**, Fuel gauge unit
N	B	2	**B2**, Fuel gauge unit

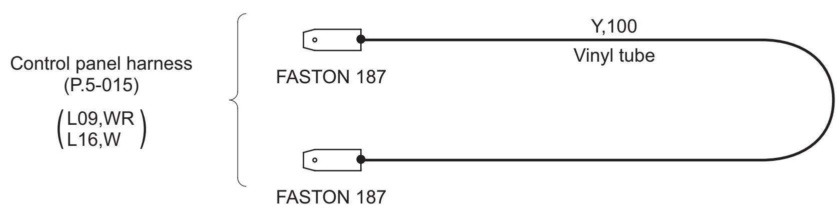
4-19. Water Spray Pump Harness



1559-09072-0-31152-0

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
N	2B	3	W, FR, RR
W02	2WR	2	W, FR
W05	2W	2	W, RR

4-20. Cord

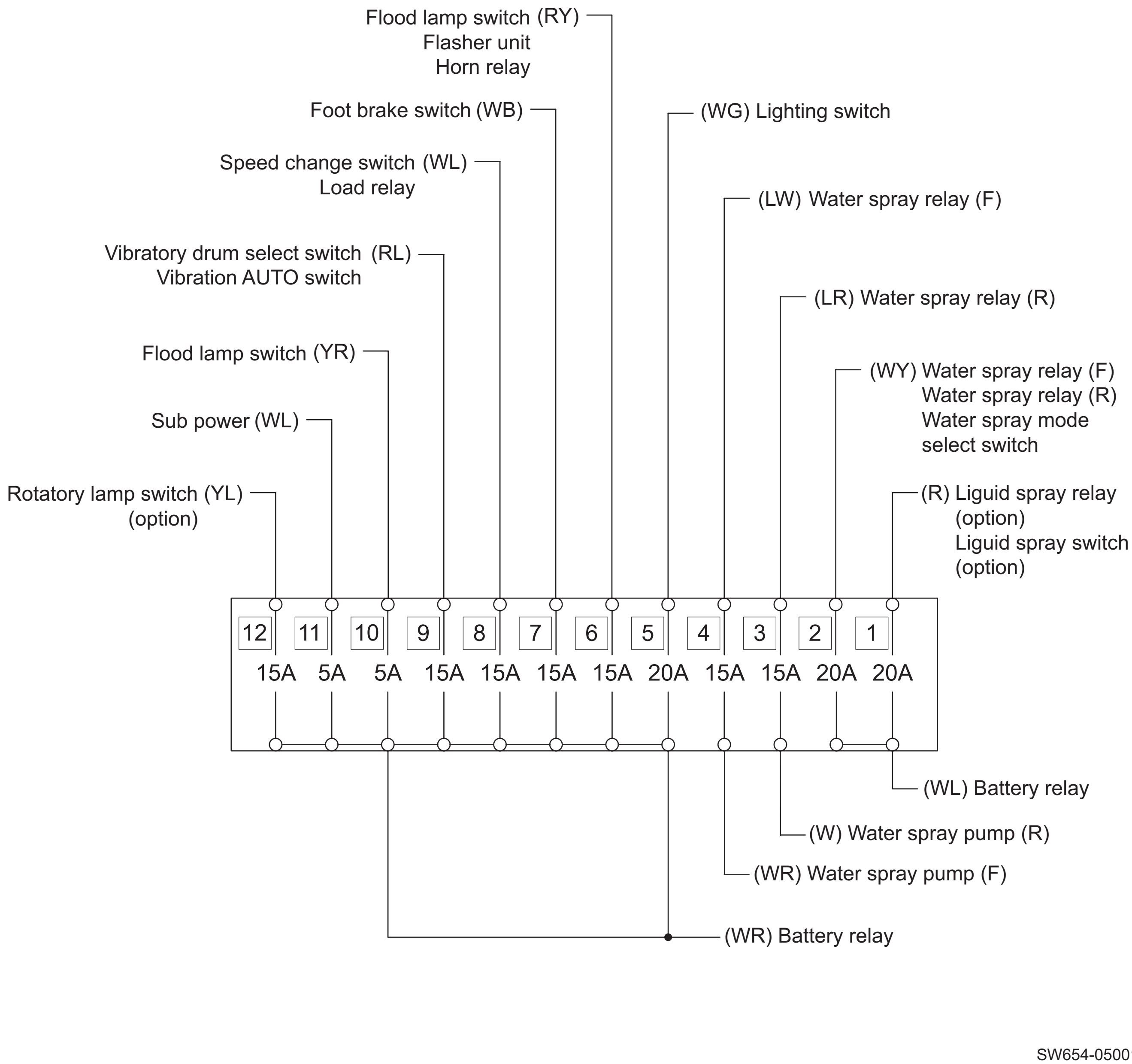


1559-09087-0-41208-0

No.	SIZE, COLOR	CONTACT POINTS	CONNECTION
–	Y	2	Control panel harness ×2

5. ELECTRICAL COMPONENT SPECIFICATIONS

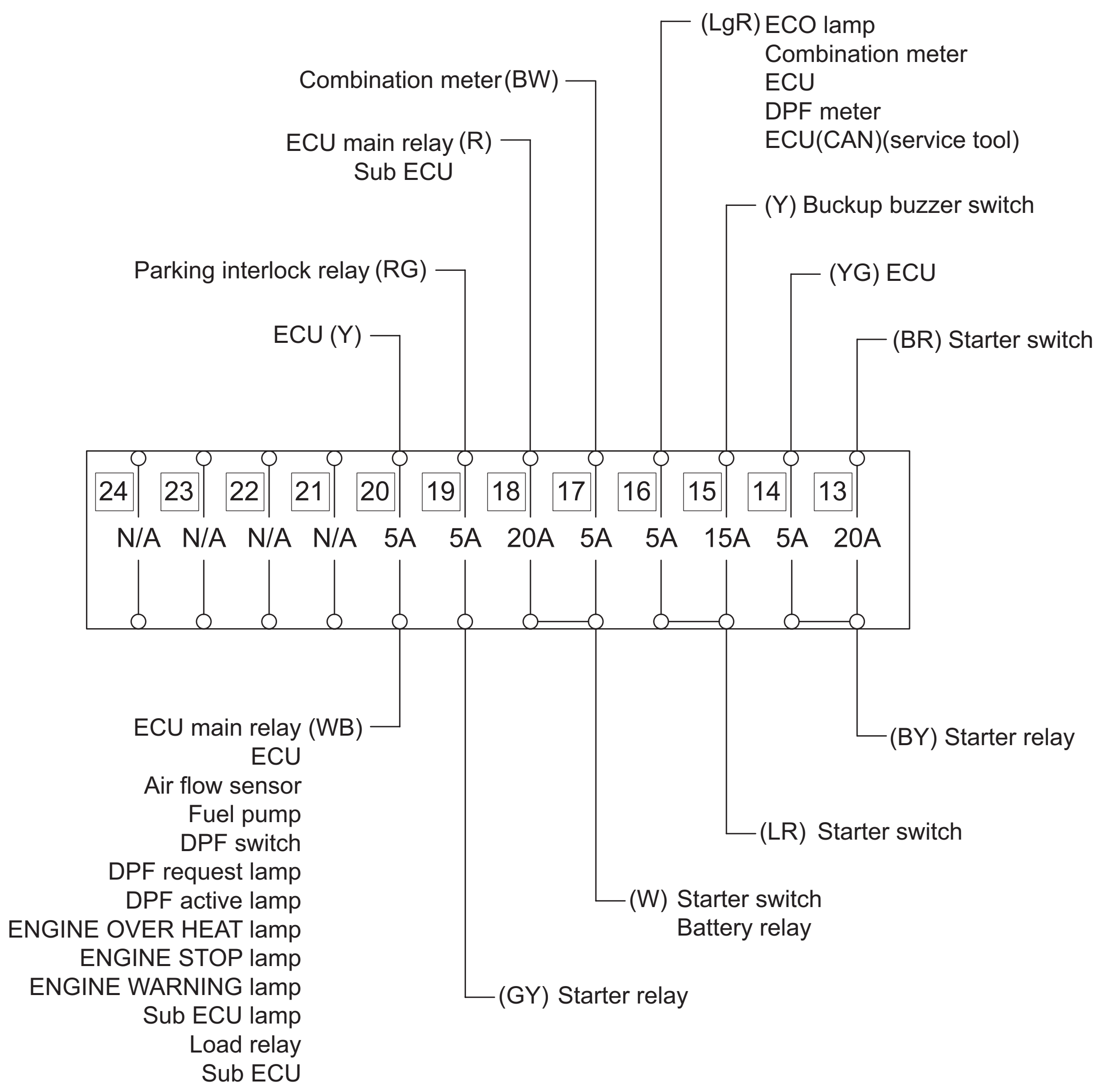
5-1. Fuse Box (1)



Harness color codes

W	: White	RY	: Red/Yellow stripe
R	: Red	RL	: Red/Blue stripe
WR	: White/Red stripe	YR	: Yellow/Red stripe
WB	: White/Black stripe	YL	: Yellow/Blue stripe
WL	: White/Blue stripe	LW	: Blue/White stripe
WY	: White/Yellow stripe	LR	: Blue/Red stripe
WG	: White/Green stripe		

5-2. Fuse Box (2)

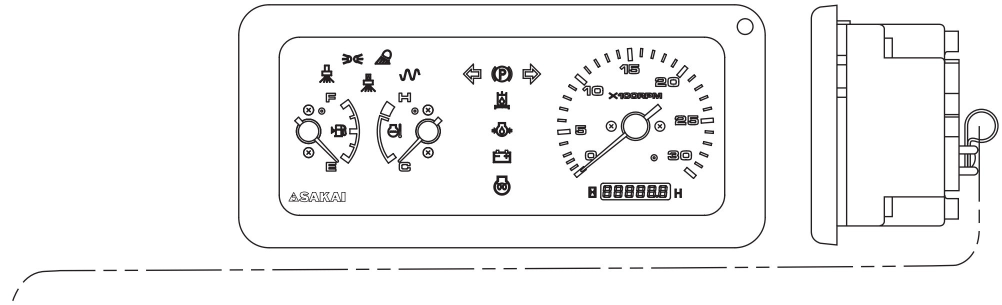


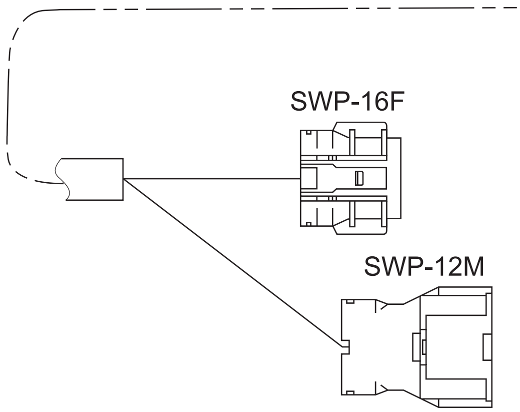
SW654-05002

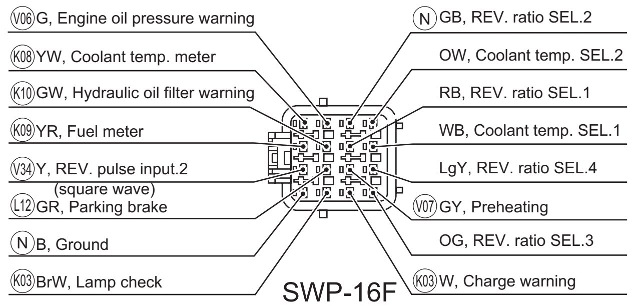
Harness color codes

W	: White	WB	: White/Black stripe
R	: Red	RG	: Red/Green stripe
Y	: Yellow	GY	: Green/Yellow stripe
BW	: Black/White stripe	YG	: Yellow/Green stripe
BY	: Black/Yellow stripe	LR	: Blue/Red stripe
BR	: Black/Red stripe	LgR	: Light green/Red stripe

5-3. Combination Meter



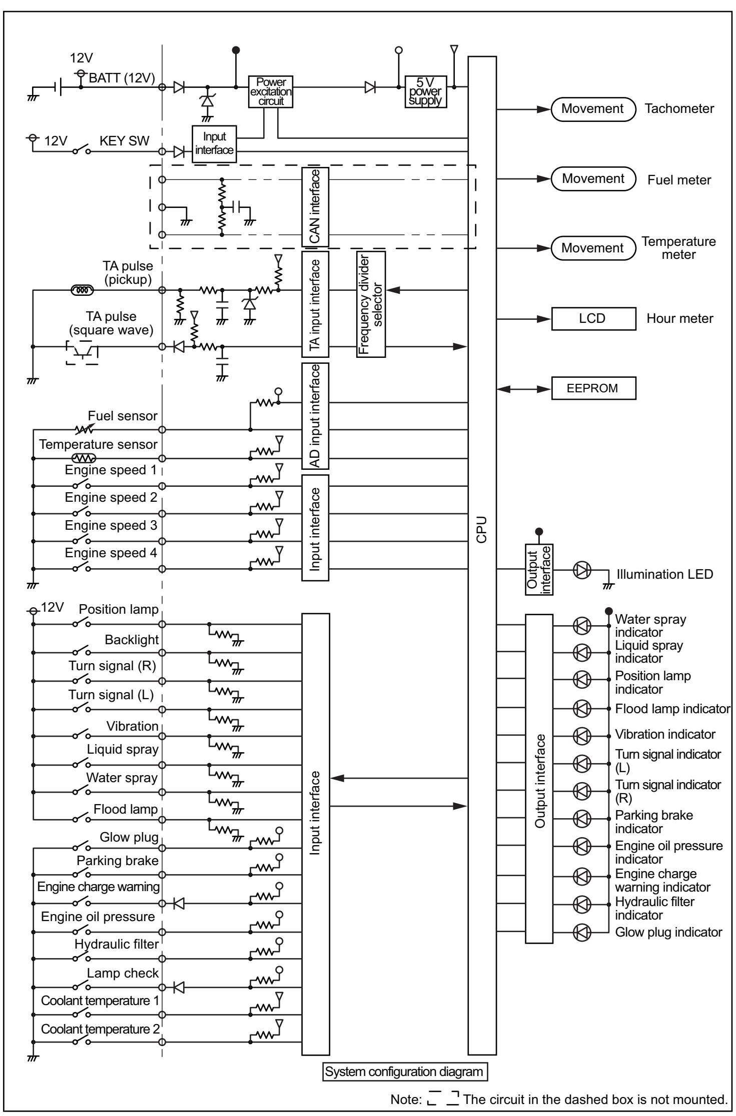


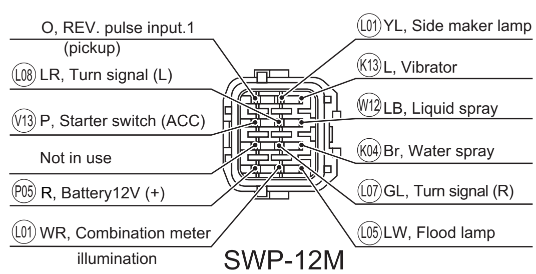


Harness side

N B	K03 WY	K03 WY	* *
V34 BrY	L12 LB	V07 GL	* *
K09 P	K10 LR	* *	* *
K08 GB	V06 YG	N B	* *

SWP-16M





Harness side

P05 BW	L01 BY	L05 RG
* *	L07 GR	K04 PG
V13 LgR	L08 G	W12 YB
* *	L01 BY	K13 OG

SWP-12F

SW654-05003

VIBRATORY DRUM

1. PRECAUTIONS FOR DISASSEMBLY AND REASSEMBLY

- When removing, installing, disassembling or reassembling the unit, observe the general precautions described below.

1) Precautions for removal work

- Coolant that contains antifreeze should be treated as a chemical, and must not be drained carelessly on the ground.
- To prevent dust from getting into disconnected hoses and tubes, cover them with a plug or similar means.
- When draining oil, use a receptacle with sufficient capacity to receive it.
- Before proceeding with the work, look for matchmarks that show the installation location. For reassembly, place matchmarks in the required locations to prevent errors. Then remove.
- When disconnecting wiring connectors, hold the connector components so that unreasonable force is not applied to the wires.
- Label wires and hoses to ensure correct installation location.
- Confirm the number and thickness of shims prior to storage.
- When lifting parts, use lifting equipment of sufficient capacity.
- When separating parts by using pull bolts, tighten the bolts alternately.
- Before removing a unit, clean its surrounding area. Then after removal, cover it to prevent dust and other substances from getting in.
- Before removing piping for hydraulic oil or coolant, or removing related parts, satisfactorily release internal pressure.

2) Precautions for installation work

- Tighten bolts and nuts (sleeve nuts) to the specified torque (screw tightening torque table).
- When installing hoses, do not twist them or allow them to interfere with other parts.
- Replace gaskets, O-rings, split pins, and lock plates with new parts.
- Properly bend split pins and lock plates.
- When applying an adhesive, first clean and remove oil/grease from the surfaces properly. Then apply two or three drops to the threaded areas.
- When applying a liquid gasket, first clean and remove oil/grease from the application surface properly, and confirm that the surface is free of dust and damage. Then apply the product evenly.
- Clean parts well. Repair scratches, dents, burrs, rust, etc.
- Apply grease to rotating and sliding components.
- Apply gear oil to the surfaces of press-fit parts.
- After installing snap rings, confirm that they are properly seated in the grooves.
- Connect wiring connectors securely after cleaning off adhering oil, dust and water.
- Use lifting bolts that are not fatigued or deformed. Screw them in fully.
- When tightening a split flange, tighten screws alternately to prevent uneven tightening.
- Before installing hydraulic parts, confirm that they are free of damage and dust, etc.

3) Precautions when work is completed

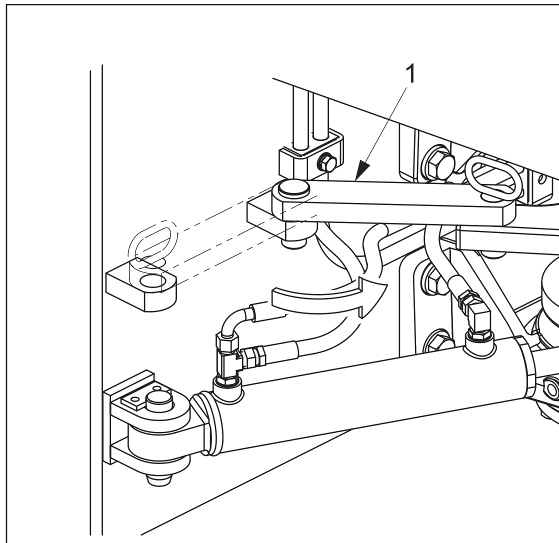
- If coolant has been drained, securely retighten the drain valve and fill with coolant (mixing in long-life coolant) to the specified level. Start the engine and allow the coolant to circulate through the piping. Then add coolant again to the specified level.
- If hydraulic equipment has been removed and reinstalled, fill with hydraulic oil to the specified level. Start the engine and allow the oil to circulate through the piping. Then add oil again to the specified level.

2. VIBRATORY DRUM

2-1. Removal and Installation of Vibratory Drum

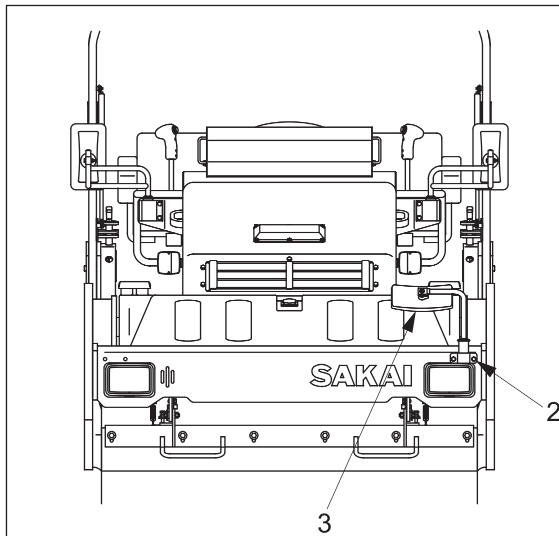
2-1-1. Removal of vibratory drum

1) Securing machine
   - Hold drum with chocks.
   - Lock front and rear frames with steering lock bar (1).



SW654-06001

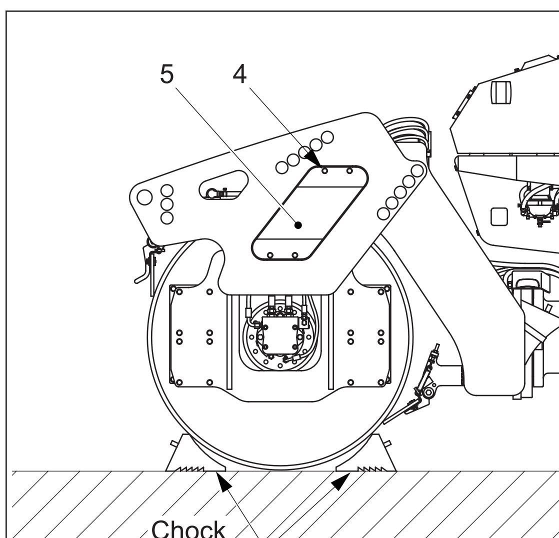
2) Removal of mirror assembly
   - Remove bolts (2).
   - Remove mirror assembly (3).



SW654-06011

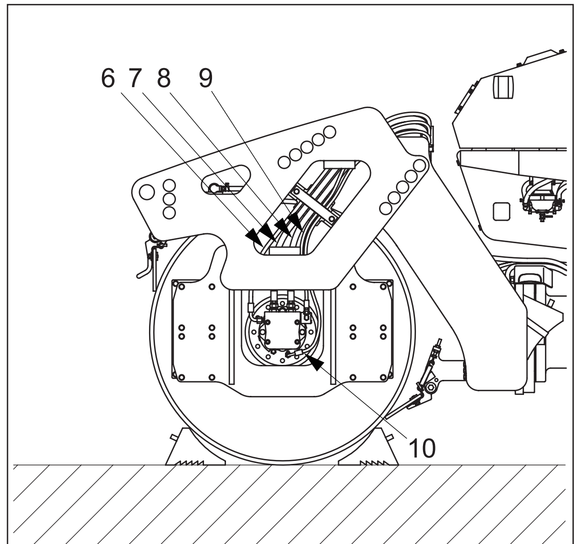
> **⚠WARNING**
>
> **The hydraulic oil in the machine is hot and compressed immediately after the machine is stopped. Disconnecting the hydraulic hoses in this condition can cause burns. Wait for the hydraulic oil to cool down before starting the work.**

3) Disconnecting piping
   3-1) Disconnecting propulsion motor piping
   - Remove bolts (4).
   - Remove cover (5).



SW654-06012

- Disconnect hydraulic hoses (6), (7), (8), (9) and (10) connecting to propulsion motor.



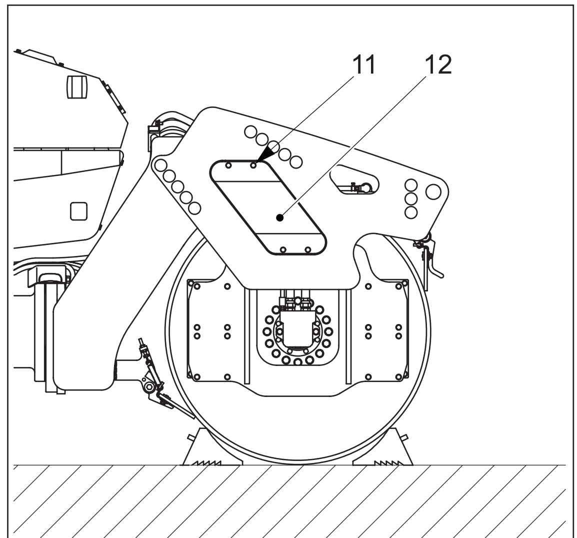
SW654-06013

(NOTICE)

- **Plug both ends of the disconnected hoses or implement other actions to prevent entry of foreign matter.**

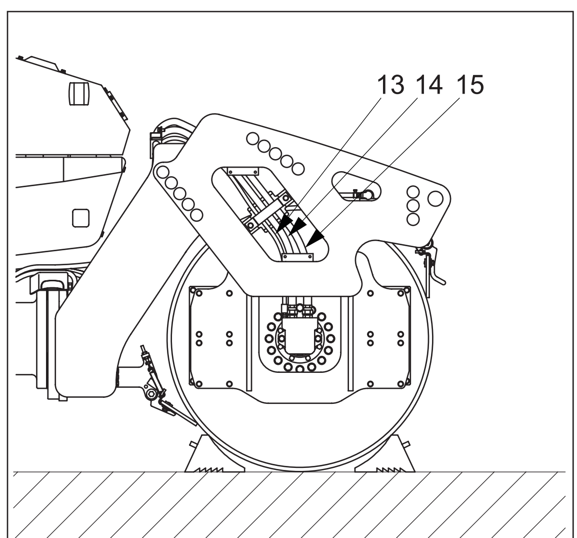
2-2) Disconnecting vibrator motor piping

- Remove bolts (11).
- Remove cover (12).



SW654-06014

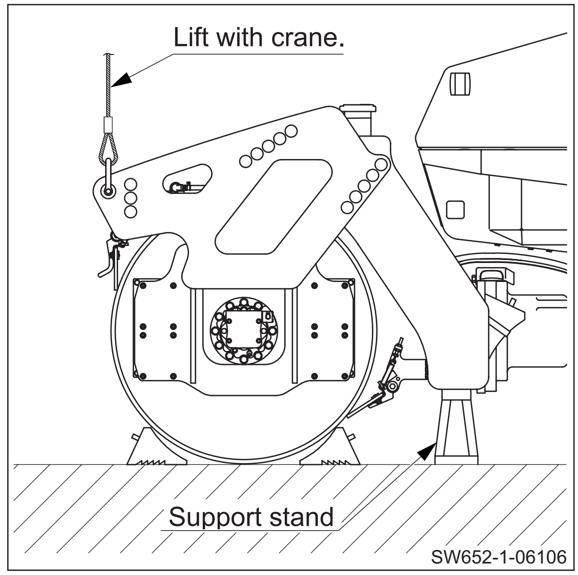
- Disconnect hydraulic hoses (13), (14), and (15) connecting to vibrator motor.



SW654-06015

DANGER

When lifting the machine body, use an appropriate hoist of sufficient strength. Confirm that the surrounding area is safe, and work in a natural, unstrained posture.
Also, to firmly secure the machine body, use a support stand of sufficient strength.



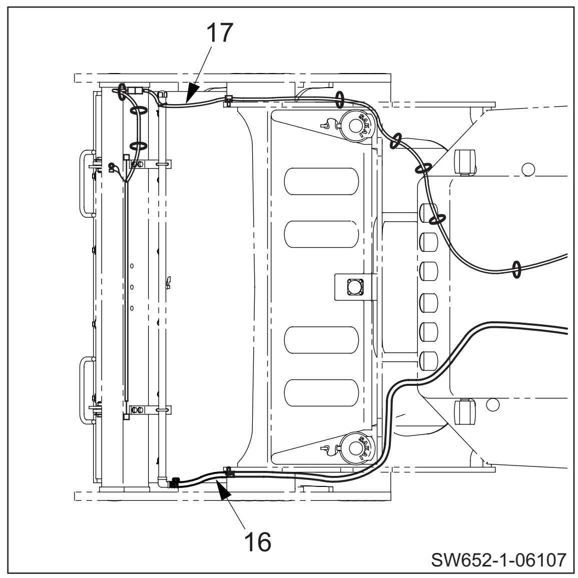
4) Supporting frame
- Lift frame with a crane.
- Place support stands under frame when drum is slightly off ground to support machine body.

kg

	Front axle	Rear axle
SW654	: 3,360 kg (7,405 lbs.)	3,710 kg (8,180 lbs.)
SW654ND	: 3,510 kg (7,740 lbs.)	3,860 kg (8,510 lbs.)

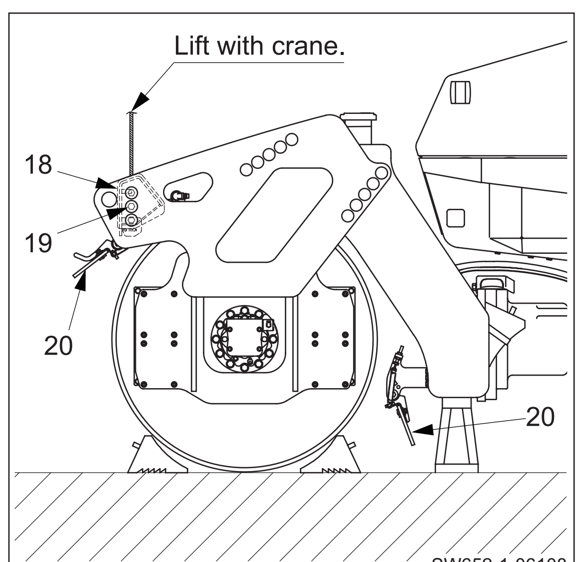
5) Removal of cross member

5-1) Remove water spray pipe (16) and electrical harness (17).

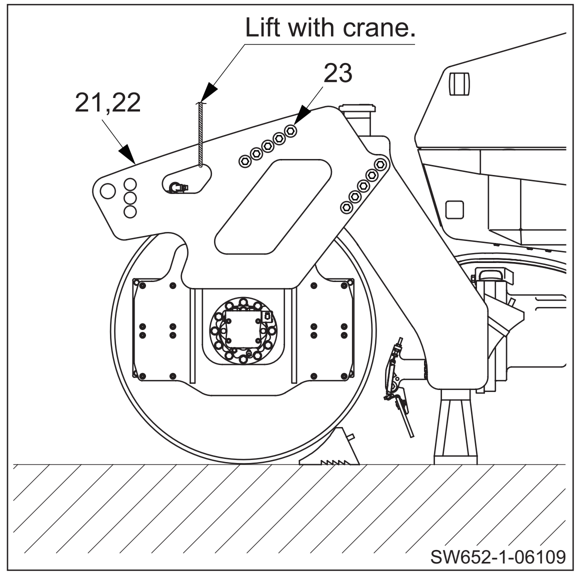


5-2) Flip up scraper blade (20).
- Lift cross member (18) with a crane and hold it.
- Remove bolts (19) (left and right sides).
- Remove cross member (18).

kg (18) Cross member
Front : 90 kg (198 lbs.)
Rear : 90 kg (198 lbs.)



6) Removal of drum assembly
- Lift left plate (21), right plate (22) and hold them.
- Remove bolts (23) (left and right sides).
- Remove drum assembly together with plates (21), (22) from frame.
- Remove rear drum assembly in same way.

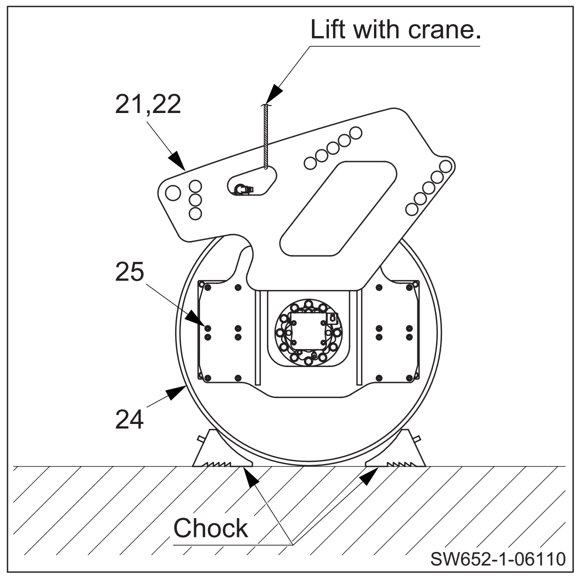


(NOTICE)
- **Damper mounting bolts and nuts must not be stressed during the removal.**

kg

	Front drum assembly	Rear drum assembly
SW654	: 1,825 kg (4,023 lbs.)	1,820 kg (4,012 lbs.)
SW654ND	: 2,030 kg (4,475 lbs.)	2,025 kg (4,464 lbs.)

7) Removal of plates
- Hold drum (24) with chocks.
- Remove nuts and bolts (25) (left and right sides).
- Remove plate (21), (22).



kg

(21) Front left plate	: 175 kg (386 lbs.)
(22) Front right plate	: 190 kg (419 lbs.)

- Remove rear drum assembly in same way.

kg

Rear left plate	: 185 kg (408 lbs.)
Rear right plate	: 175 kg (386 lbs.)

2-1-2. Installation of vibratory drum

1) Install vibratory drum in reverse order in which it was removed.
   - Tightening torque for bolts where particular care is required when installing vibratory drum.

     (19) Bolt M16×50 : 265 N·m (195 lbf·ft)
     (23) Bolt M16×50 : 265 N·m (195 lbf·ft)
     (25) Nut M12 : 110 N·m (81 lbf·ft)

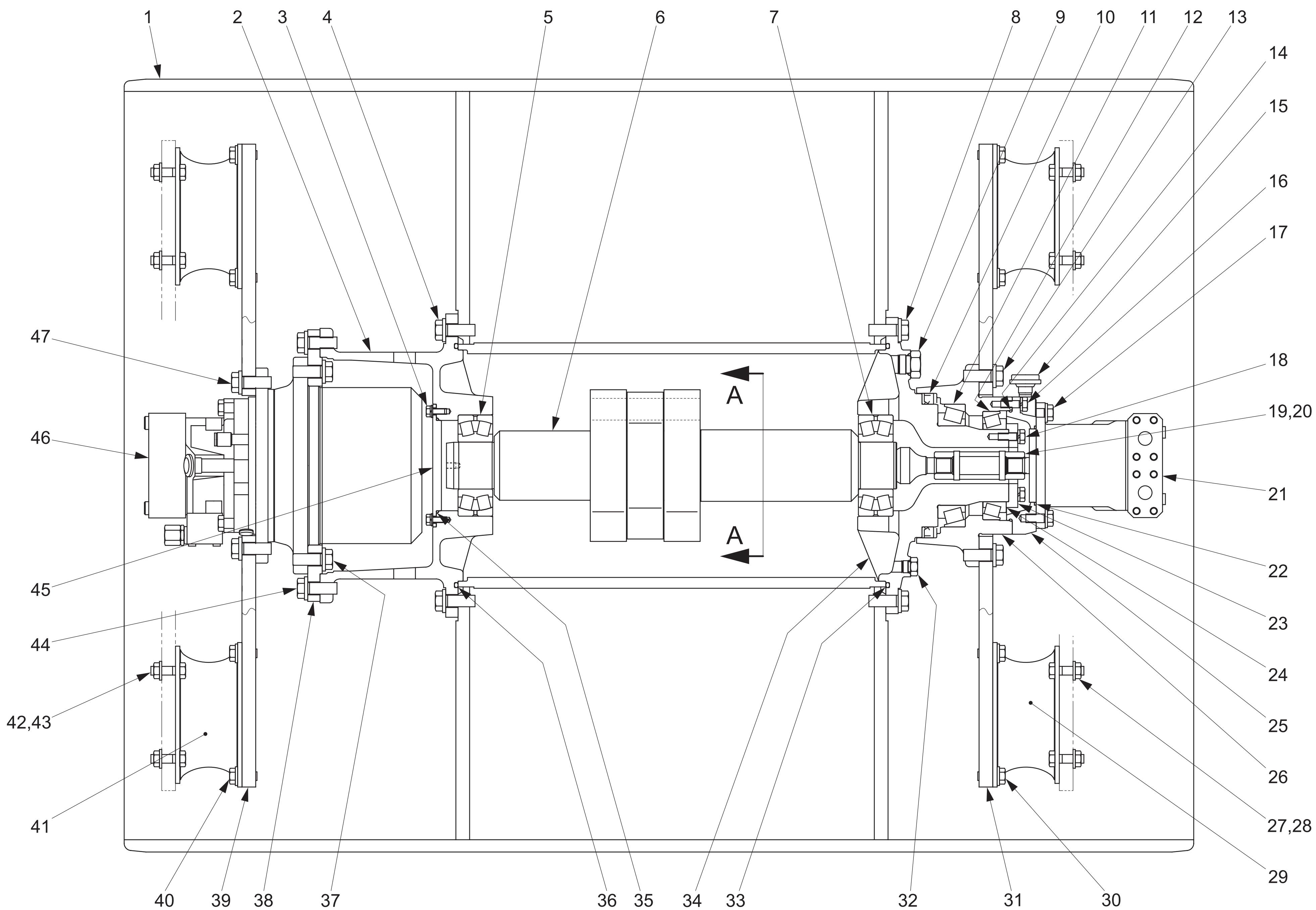
2) Upon installing vibratory drum, pay particular attention to items mentioned below.
   - Fill hydraulic oil tank to specified level to make up for any oil leakage.
   - Start engine and circulate oil through piping. Then check oil level again, ensuring that oil is at specified level.

(NOTICE)

- **If the engine is run at high speed or the cylinder is operated to full stroke when the engine is started for the first time after the work is completed, the piston packing or other items may be damaged by air entering into the cylinder.**

3. VIBRATORY DRUM ASSEMBLY (SW654)

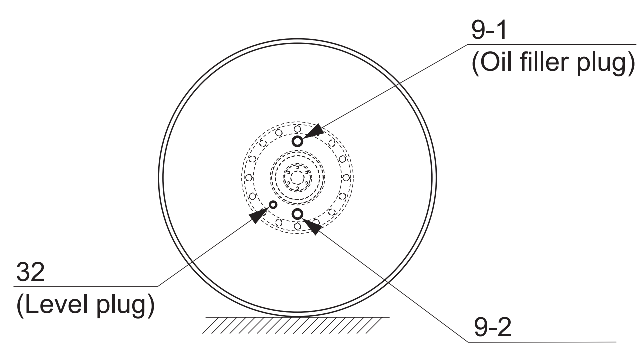
3-1. Vibratory Drum Assembly



Vibration mode: Low
Counterclockwise rotation

SECTION A-A

Vibration mode: High
Clockwise rotation



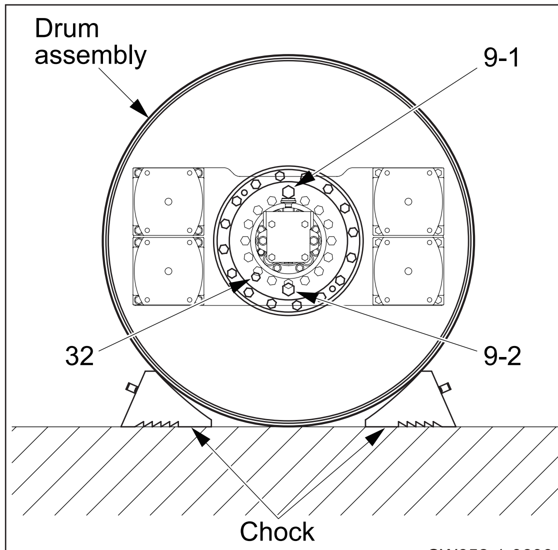
Vibrator motor side

0558-43801-0-10013-H

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

3-2. 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 6-008.



SW652-1-06001

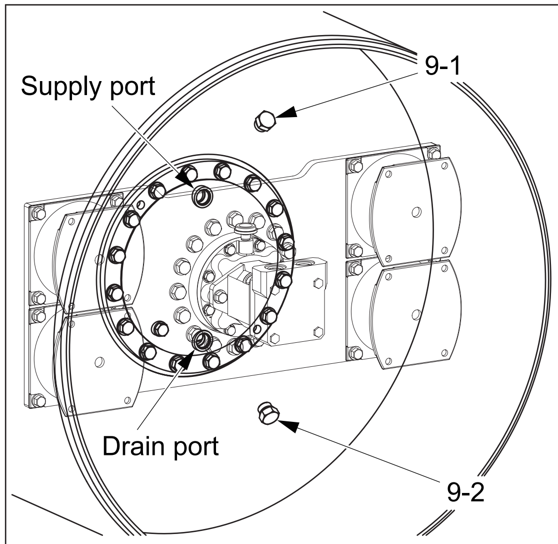
3-2-1. Disassembly of vibratory drum

1) Lay drum assembly with plugs (9-1), (9-2), and level plug (32) positioned as shown on the right.
   - Hold with chocks.

   kg Drum assembly : 1,460 kg (3,219 lbs.)

2) Remove plugs (9-1) and (9-2).
   - Drain gear oil.

   • Quantity of gear oil : 4.0 L (1.1 gal.)



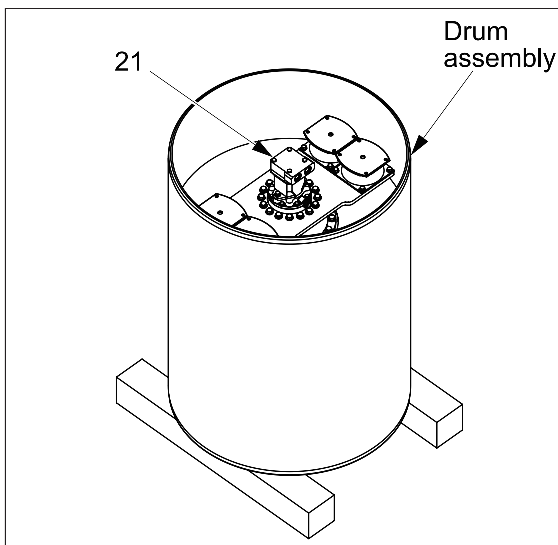
SW652-1-06002

⚠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 (21) side facing up.

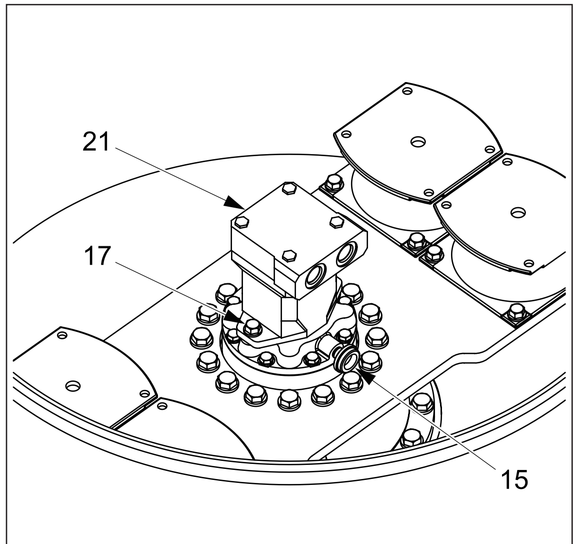
   kg Drum assembly : 1,455 kg (3,208 lbs.)



SW652-1-06003

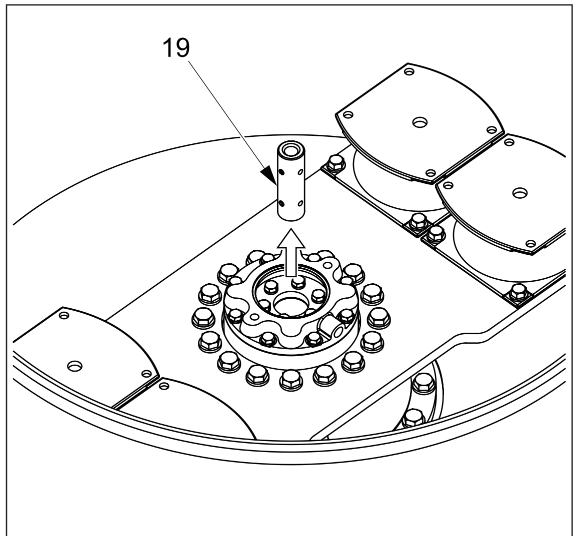
4) Remove breather (15).
- Remove bolts (17).
- Remove vibrator motor (21).

kg (21) Vibrator motor : 15 kg (33 lbs.)



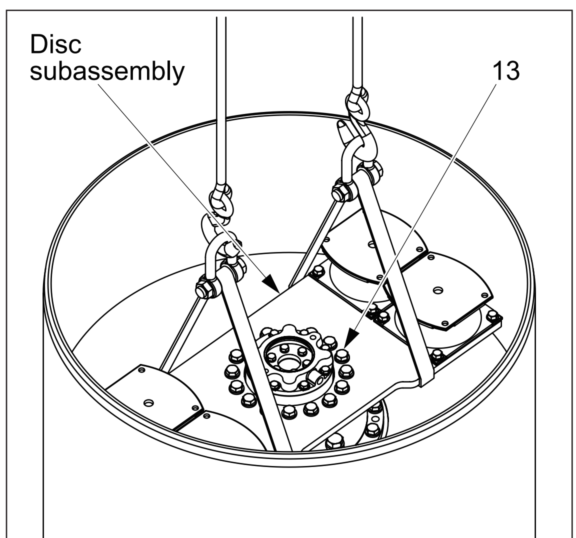
SW652-1-06004

5) Remove sleeve (19).



SW652-1-06005

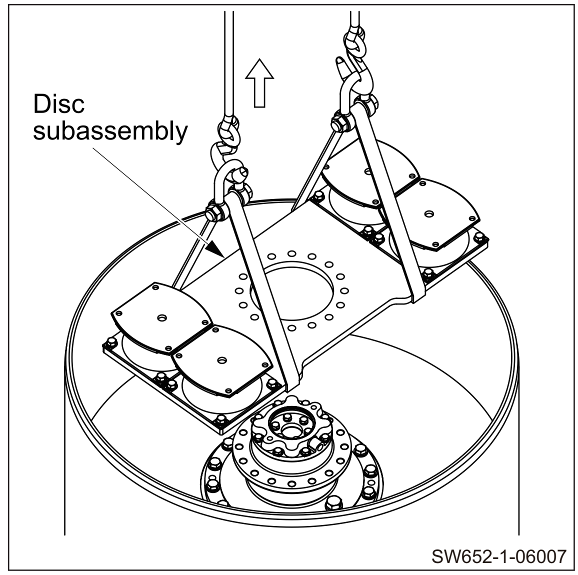
6) Lift disc subassembly.
- Remove bolts (13).



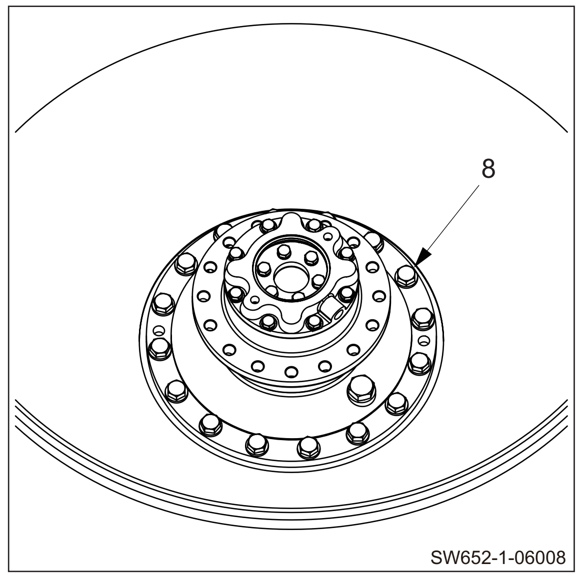
SW652-1-06006

7) Remove disc subassembly.

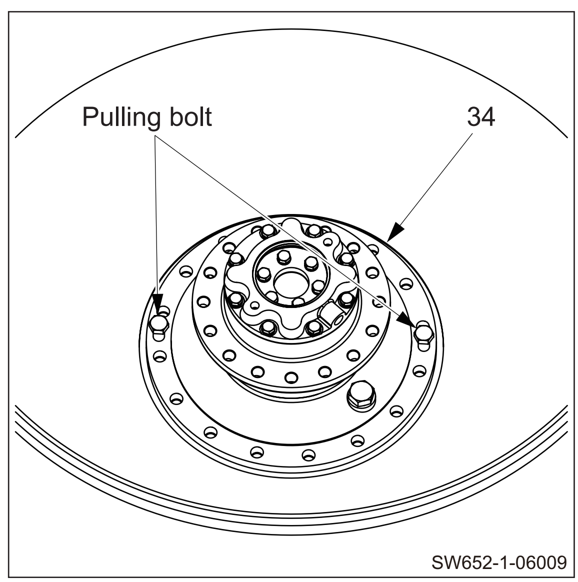
Disc subassembly : 75 kg (165 lbs.)



8) Remove bolts (8).



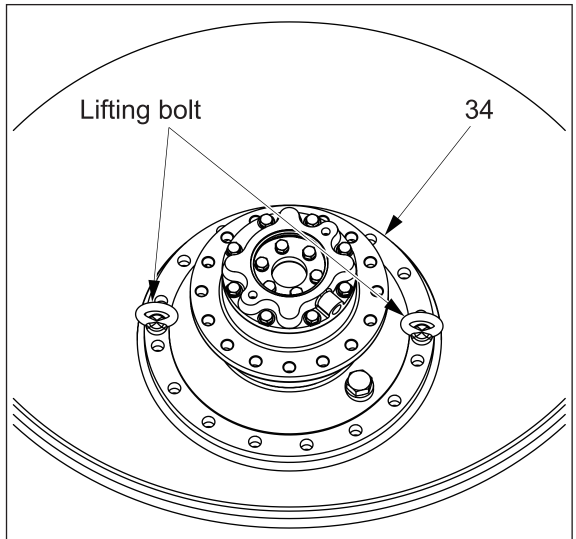
9) Lift axle shaft (34) using two pulling bolts (M16×45).



⚠ WARNING

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

10) Install lifting bolts (M16) to axle shaft (34).

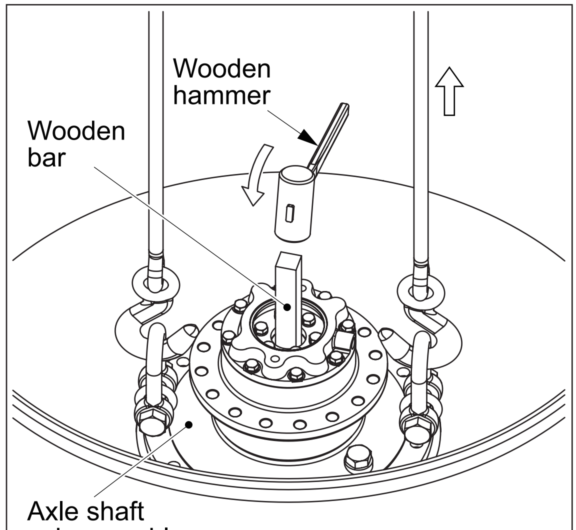


SW652-1-06010

11) Remove axle shaft subassembly.

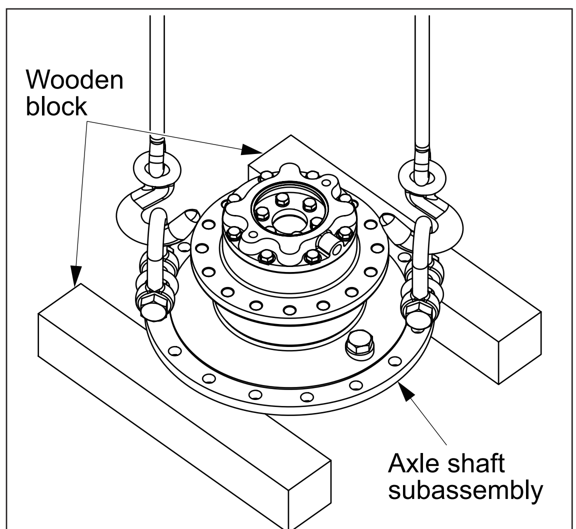
(NOTICE)
- **In order not to lift eccentric shaft together with axle shaft subassembly, tap on the eccentric shaft end with a wooden hammer via a wooden bar during lifting.**

Axle shaft subassembly : 65 kg (143 lbs.)



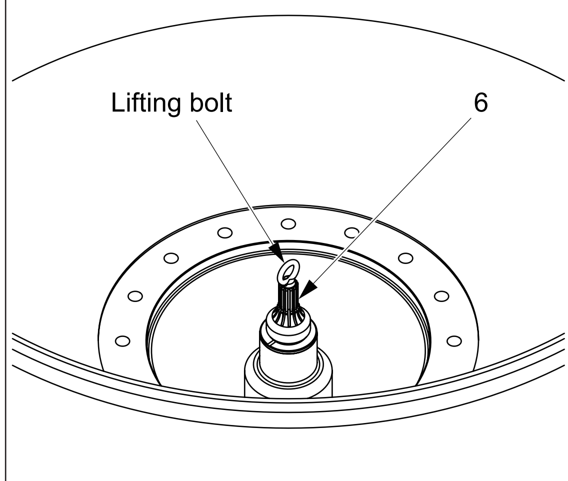
SW652-1-06011

12) Put axle shaft subassembly on wooden blocks.



SW652-1-06012

13) Install a lifting bolt (M8) to eccentric shaft (6).



SW652-1-06013

⚠WARNING

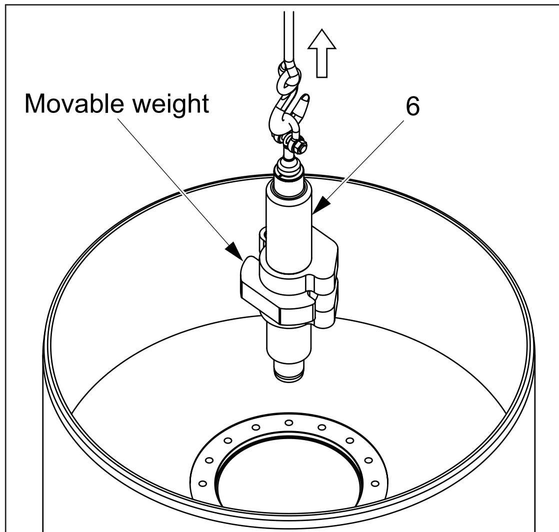
Take care not to get your fingers caught in movable weights.

14) Remove eccentric shaft (6).

(6) Eccentric shaft : 60 g (132 lbs.)

(NOTICE)

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



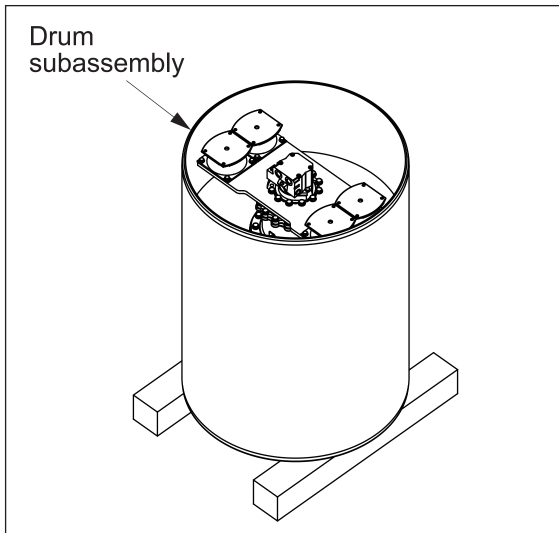
SW652-1-06014

⚠WARNING

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

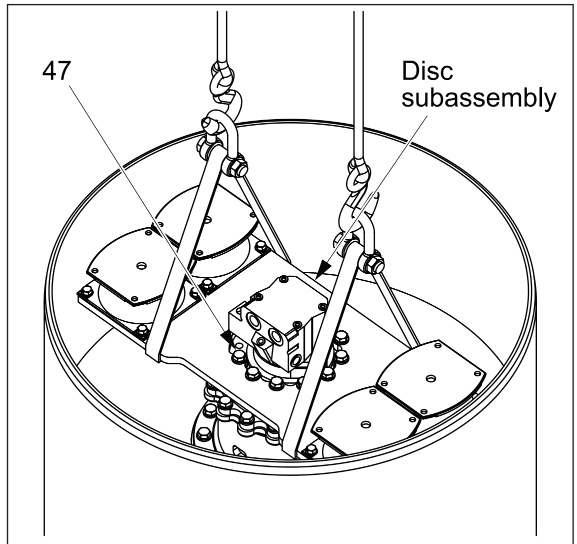
15) Reverse drum subassembly.

Drum subassembly : 1,240 kg (2,734 lbs.)



SW652-1-06015

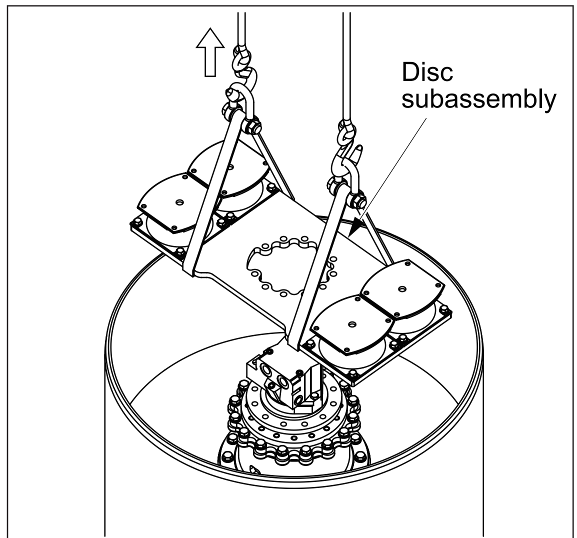
16) Lift disc subassembly.
 • Remove bolts (47).



SW652-1-06016

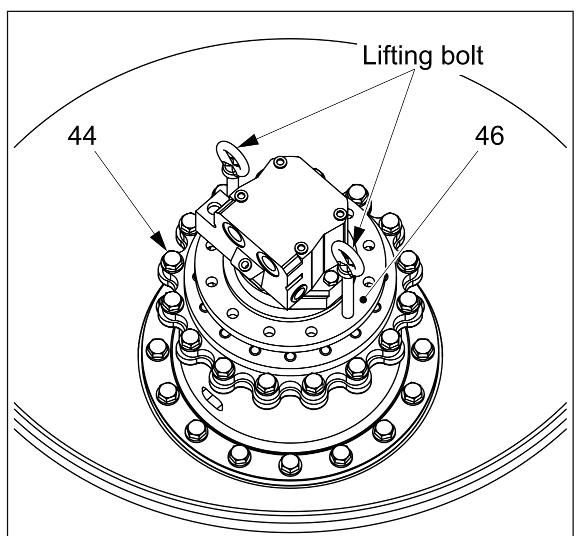
17) Remove disc subassembly.

Disc subassembly : 75 kg (165 lbs.)



SW652-1-06017

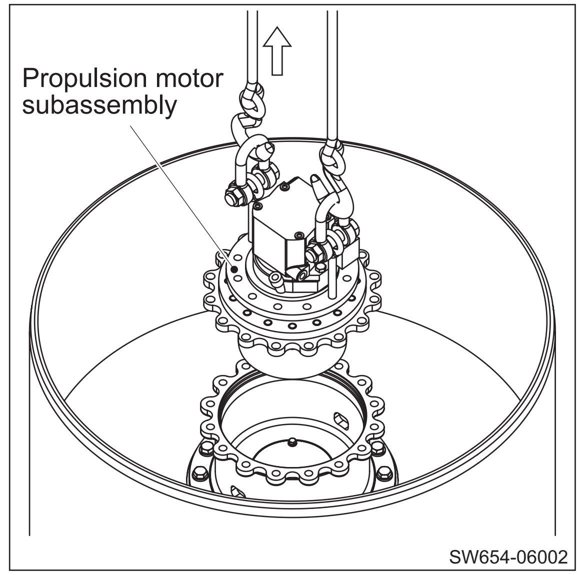
18) Install lifting bolts (M16) to propulsion motor (46).
 • Remove bolts (44).



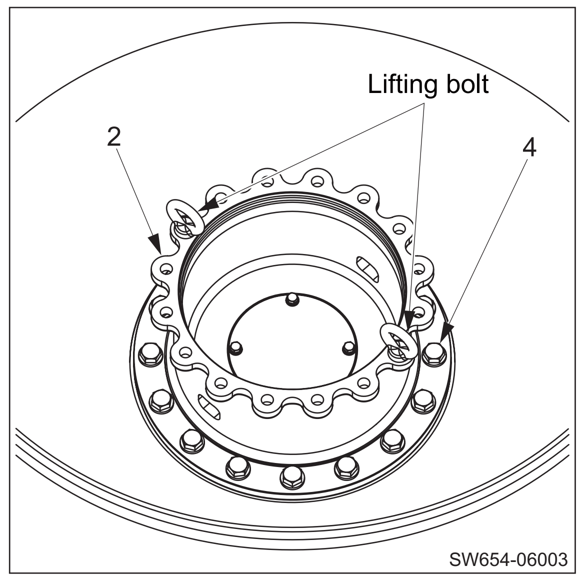
SW652-1-06018

19) Remove propulsion motor subassembly.

Propulsion motor subassembly : 80 kg (176s lbs.)

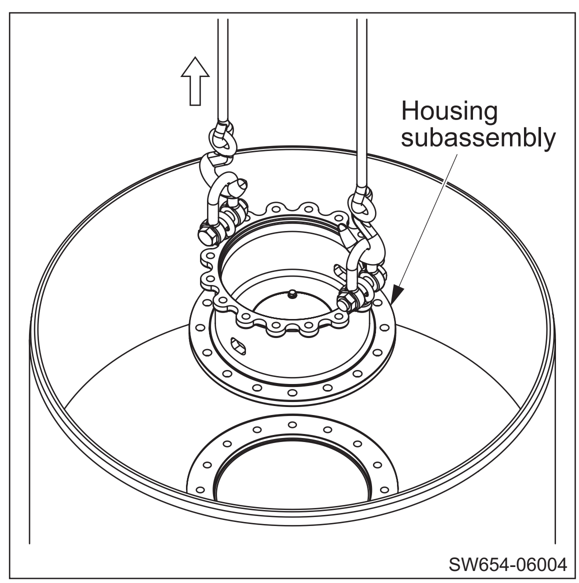


20) Install lifting bolts (M16) to housing (2).
- Remove bolts (4).

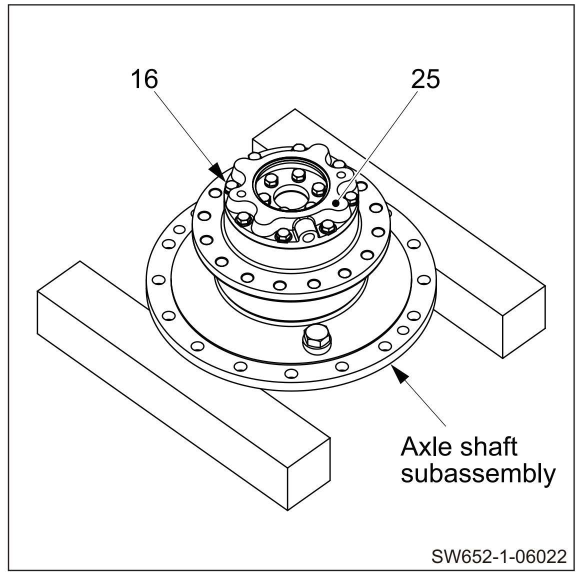


21) Remove housing subassembly.

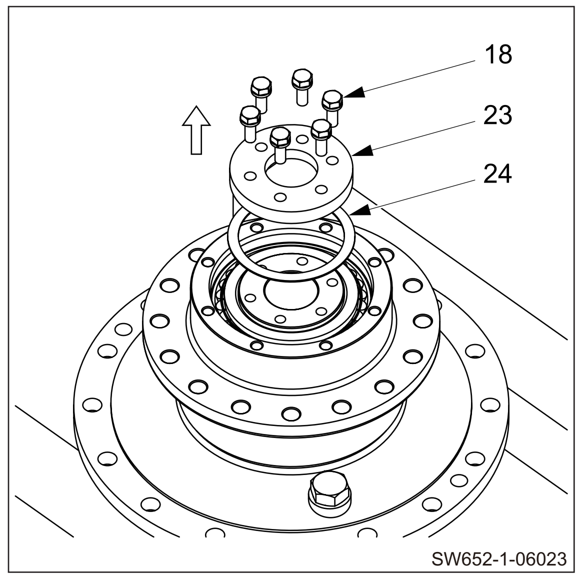
Housing subassembly : 50 kg (110 lbs.)



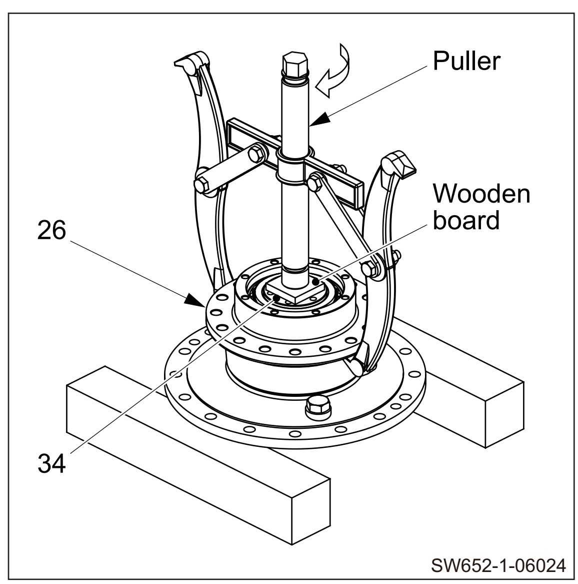
22) Disassembly of axle shaft subassembly.
- Remove bolts (16).
- Remove flange (25).



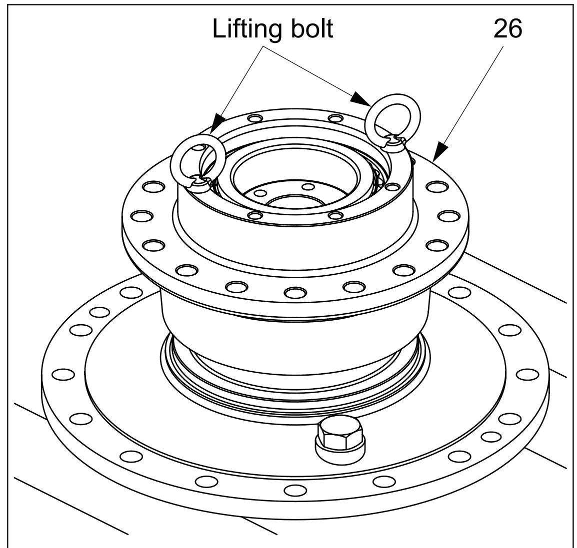
23) Remove bolts (18).
- Remove cover (23).
- Remove shim (24).



24) Put a piece of wooden board on end of axle shaft (34).
- Set a puller on housing (26).
- Remove housing subassembly with roller bearing from axle shaft subassembly.



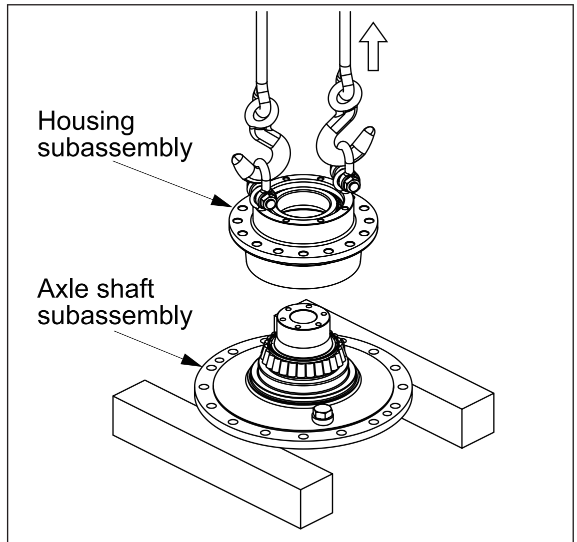
25) Install lifting bolts (M10) to housing (26).



SW652-1-06025

26) Remove housing subassembly from axle shaft subassembly.

kg Housing subassembly : 20 kg (44 lbs.)



SW652-1-06026

3-2-2. Reassembly of vibratory drum

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

⚠WARNING

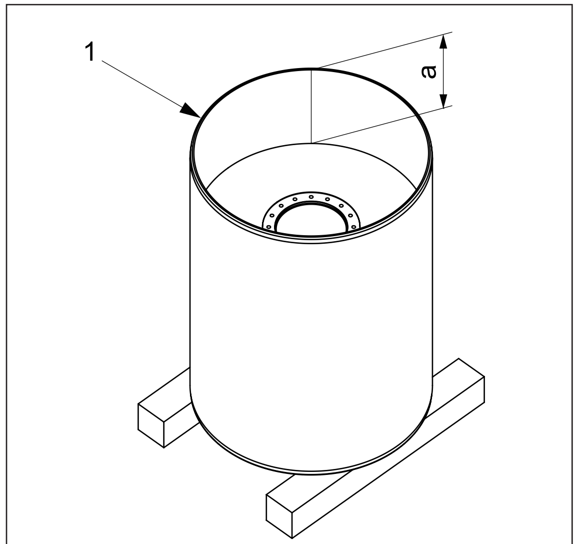
- **When standing the vibratory drum, use wooden blocks of sufficient strength to securely support the drum.**
- **Carry out the work in an unstrained posture using a work stool or the like.**

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

kg (1) Drum : 1,035 kg (2,282 lbs.)

(NOTICE)

- **Propulsion motor side dimension "a" : 459 mm (18 in.)**



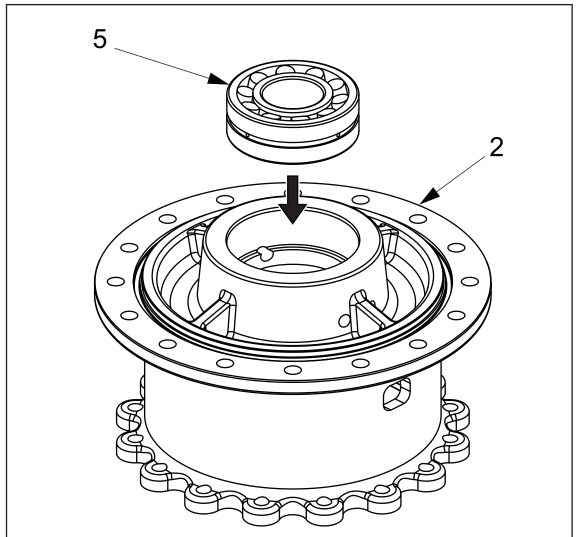
SW652-1-06027

2) Reassembly of housing subassembly

2-1) Apply a coat of gear oil to housing (2) at where bearing will be press-fitted.
- Drive in vibrator bearing (5).

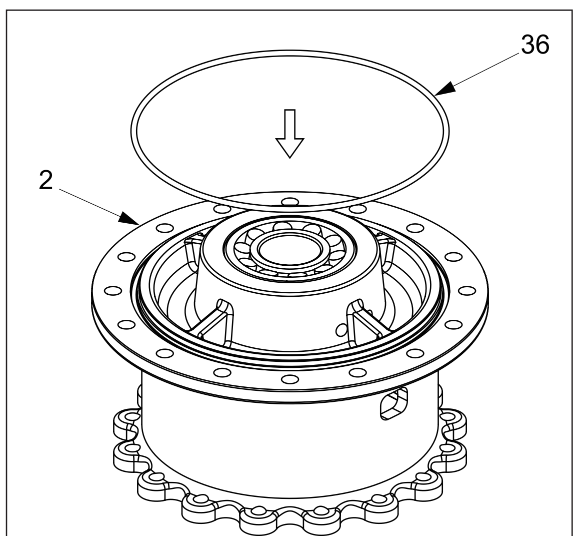
(NOTICE)

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



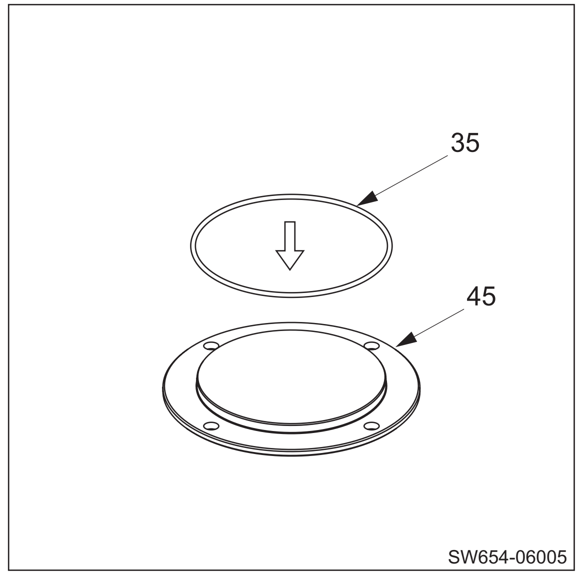
SW652-1-06028

2-2) Apply grease to O-ring (36).
- Install O-ring to housing (2).



SW652-1-06029

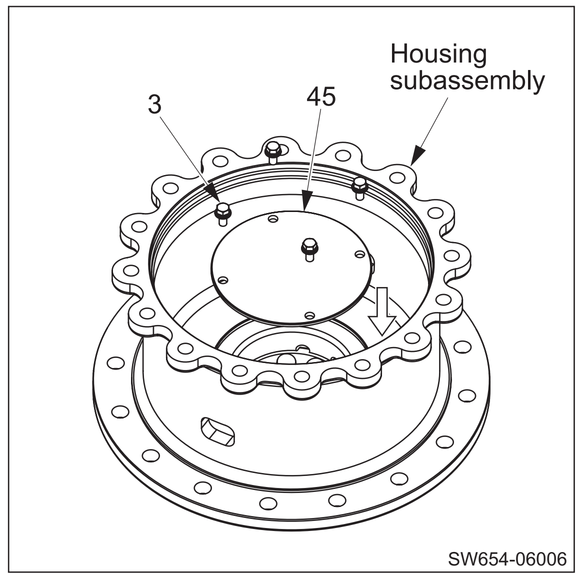
2-3) Apply grease to O-ring (35).
- Install O-ring to cover (45).



2-4) Reverse housing subassembly.

kg Housing subassembly : 50 kg (110 lbs.)

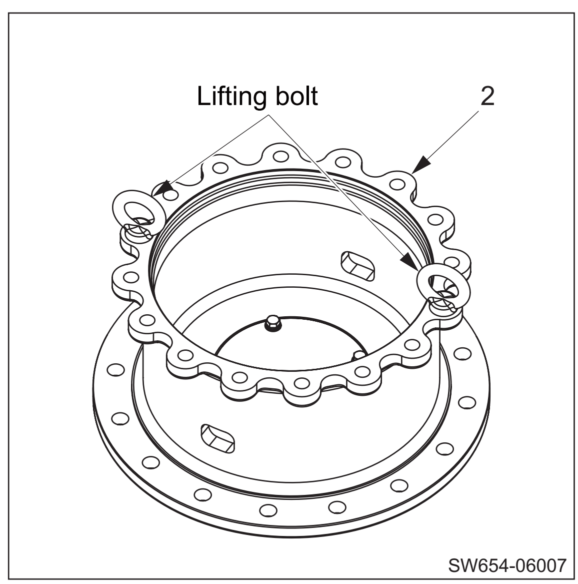
- Install cover (45) to housing subassembly with four bolts (3), spring washers and washers.



WARNING

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

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

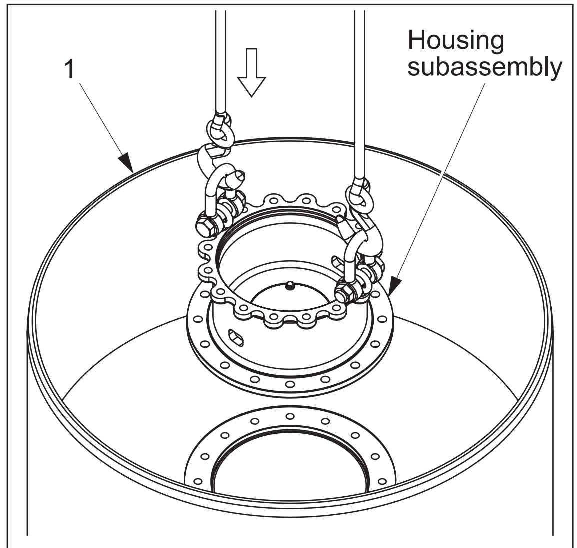


4) Lower housing subassembly on mounting surface of drum (1).

Housing subassembly : 50 kg (110 lbs.)

(NOTICE)

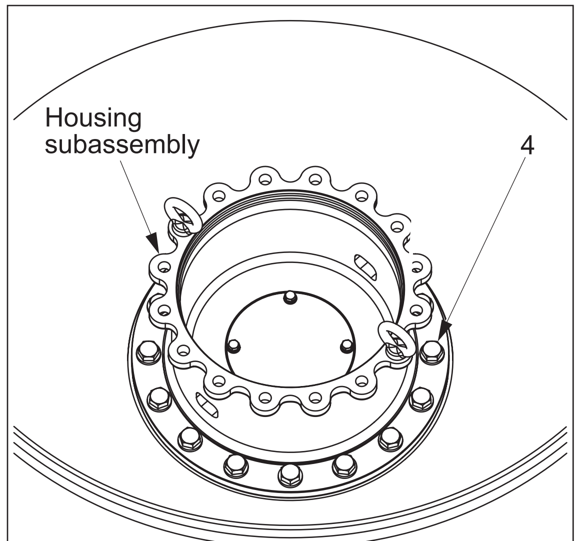
- **Take care not to let O-ring to protrude from its groove.**



SW654-06008

5) Secure housing subassembly with sixteen bolts (4) and washers.

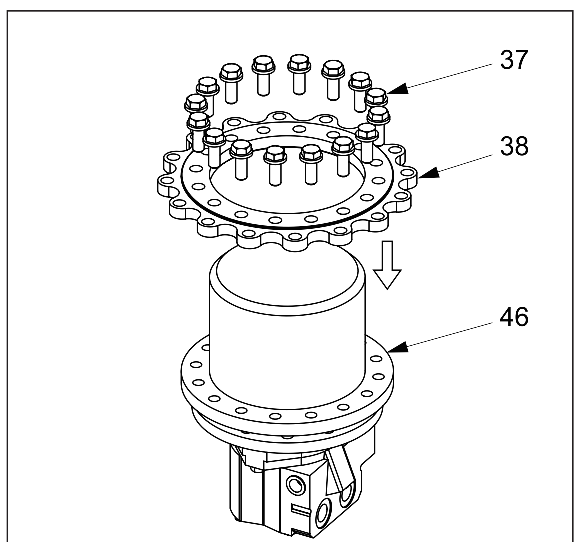
(4) Bolts M16×45 : 265 N·m (195 lbf·ft)



SW654-06009

6) Reassembly of propulsion motor subassembly
- Secure disc (38) to propulsion motor (46) with sixteen bolts (37) and washers.

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

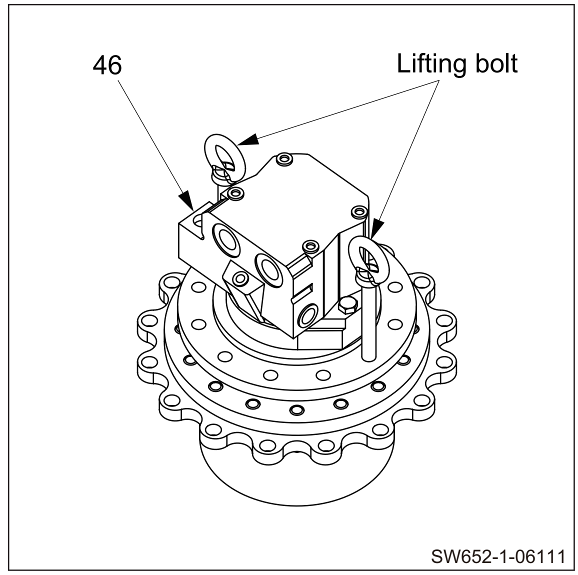


SW652-1-06034

7) Reverse propulsion motor subassembly.

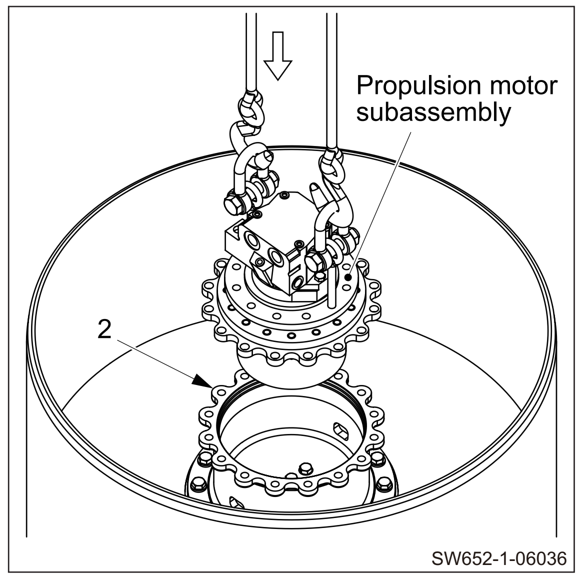
kg Propulsion motor subassembly : 80 kg (176 lbs.)

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



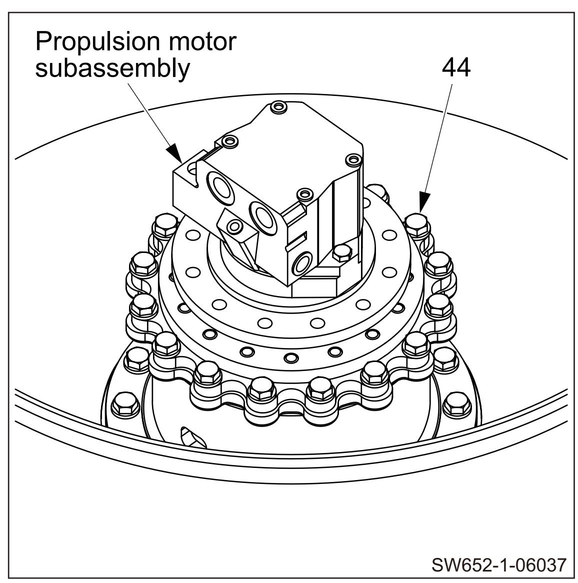
8) Lower propulsion motor subassembly on mounting surface of housing (2).

kg Propulsion motor subassembly : 80 kg (176 lbs.)



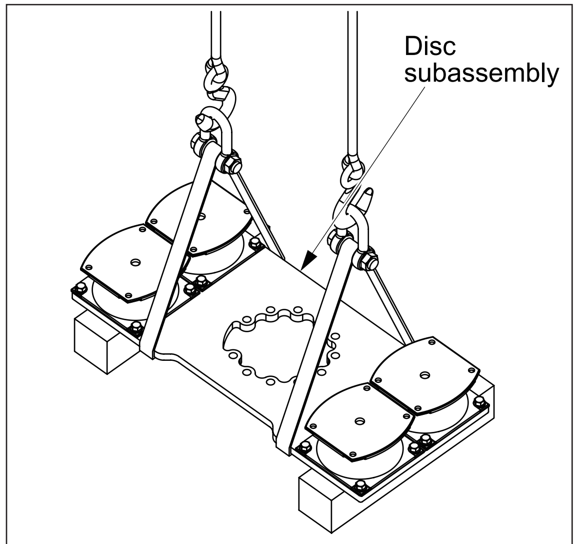
9) Secure propulsion motor subassembly with sixteen bolts (44) and washers.

N•m (44) Bolts M16×45 : 265 N·m (195 lbf·ft)



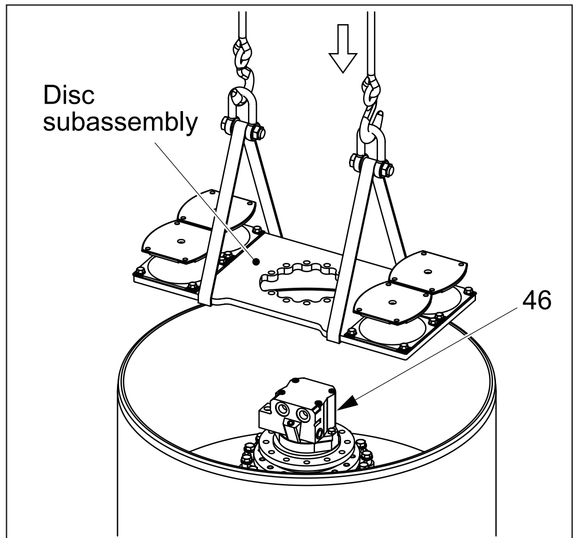
10) Lift disc subassembly.

Disc subassembly : 75 kg (165 lbs.)



SW652-1-06038

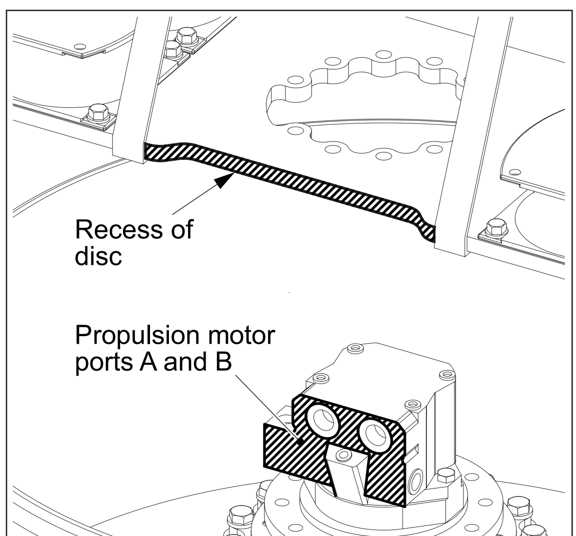
11) Lower disc subassembly on mounting surface of propulsion motor (46).



SW652-1-06039

(NOTICE)

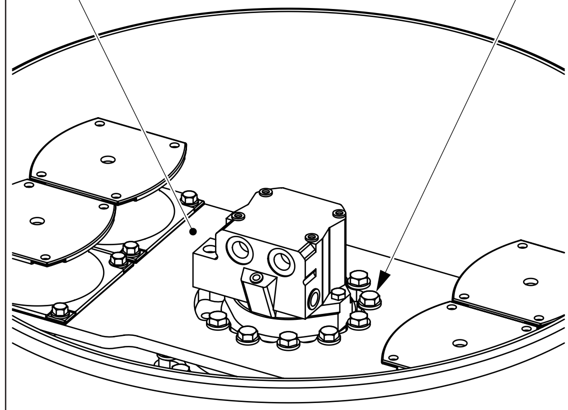
- **The recess of the disc must be parallel with the side of the propulsion motor ports A and B.**



SW652-1-06073

12) Secure disc subassembly with eleven bolts (47) and washers.

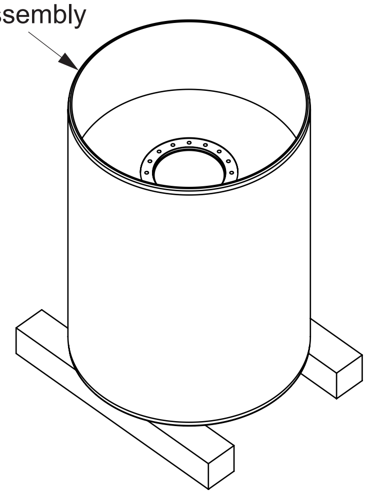
(47) Bolts M16×45 : 265 N·m (195 lbf·ft)



SW652-1-06040

⚠WARNING

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

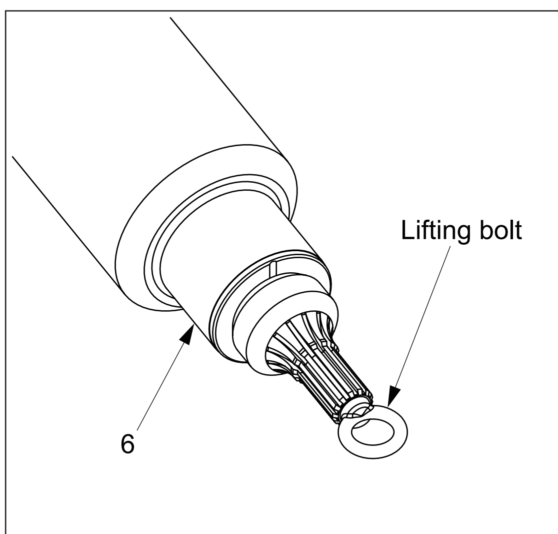


SW652-1-06041

13) Reverse drum subassembly.

Drum subassembly : 1,240 kg (2,734 lbs.)

14) Install a lifting bolt (M8) to eccentric shaft (6).



SW652-1-06042

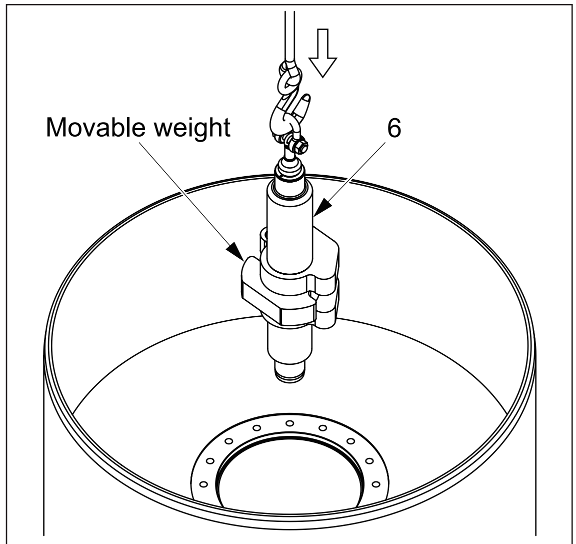
⚠WARNING

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

15) Apply a coat of gear oil to eccentric shaft (6) at where bearing will be installed.
- Install eccentric shaft.

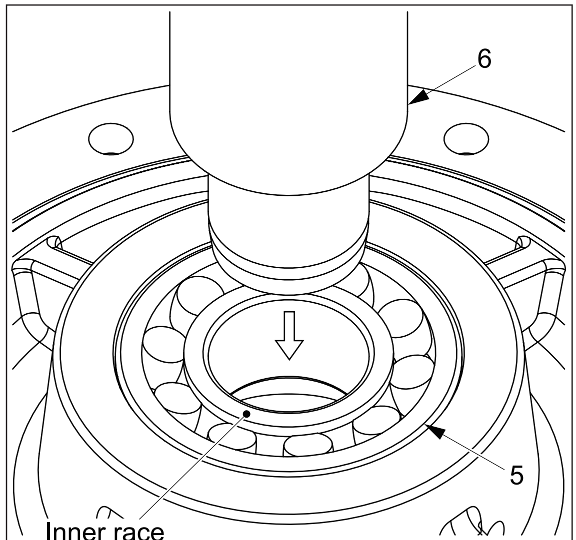
kg (6) Eccentric shaft : 60 kg (132 lbs.)

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



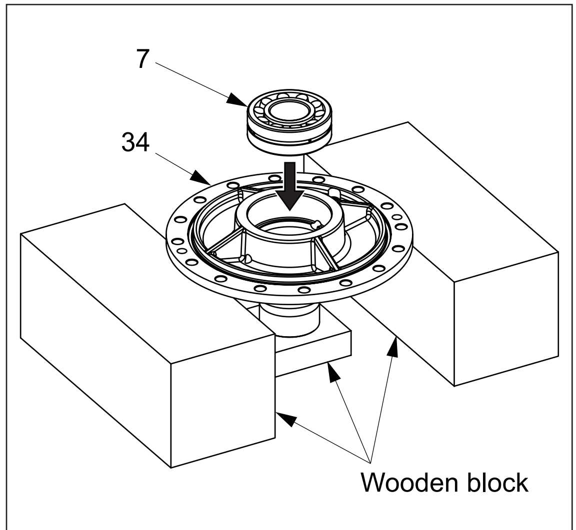
SW652-1-06043

16) Insert eccentric shaft (6) into vibrator bearing (5) while taking care not to tilt vibrator bearing inner race.



SW652-1-06044

17) Reassembly of axle shaft subassembly
17-1) Apply a coat of gear oil to axle shaft (34) at where bearing will be press-fitted.
- Drive in vibrator bearing (7).



SW652-1-06045

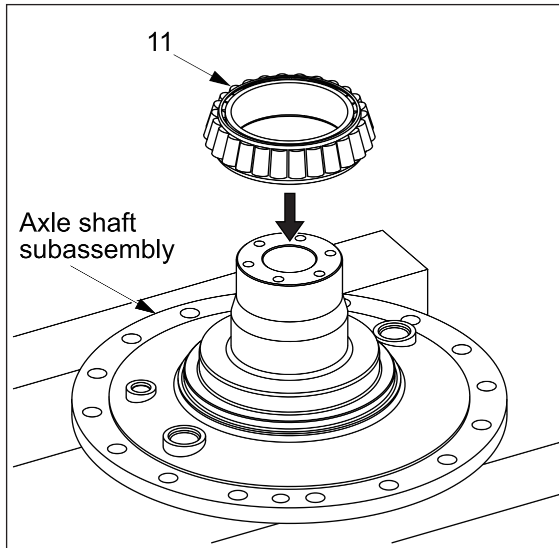
⚠ WARNING

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

17-2) Reverse axle shaft subassembly.

kg Axle shaft subassembly : 40 kg (88 lbs.)

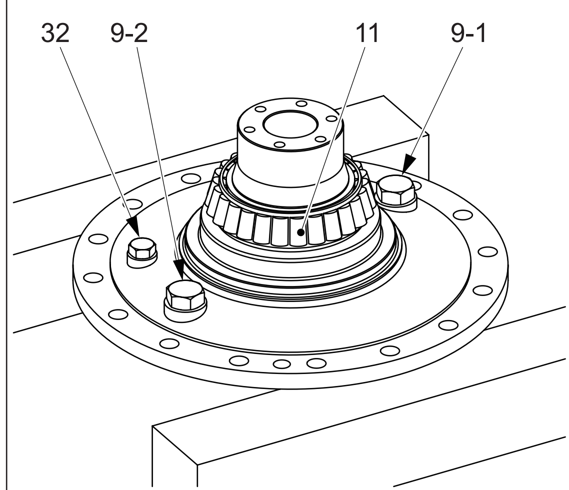
- Heat up roller bearing (11) inner race by using a ring heater or the like.
- Apply a coat of gear oil to axle shaft at where bearing inner race will be press-fitted.
- Drive in heated roller bearing inner race.



SW652-1-06046

17-3) Apply grease to O-rings for plugs (9-1), (9-2) and level plug (32).

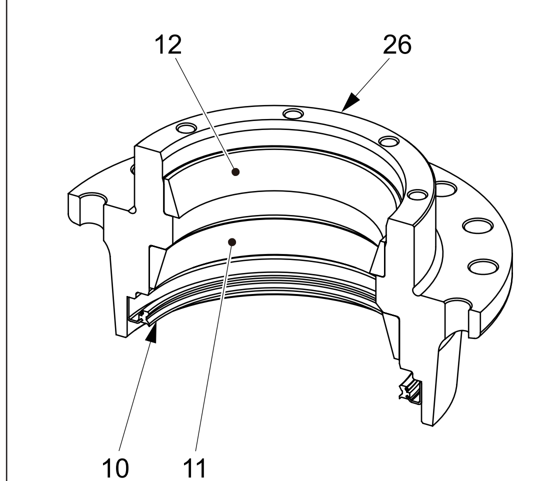
- Install plugs and level plug.
- Apply sufficient amount of lithium-based grease to rollers of roller bearing (11) inner race.



SW652-1-06047

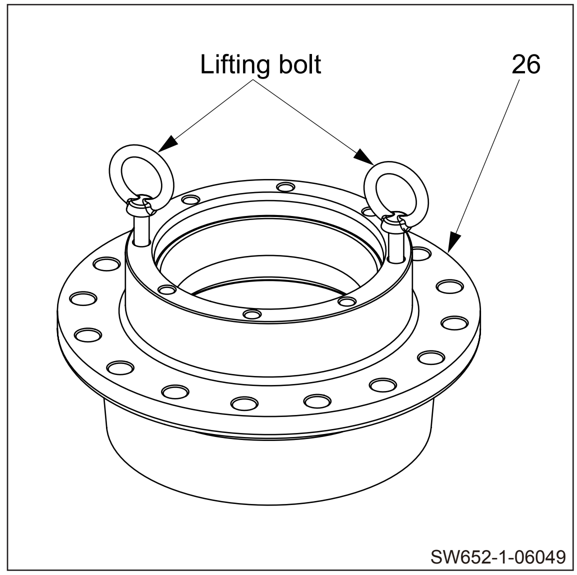
17-4) Apply a coat of gear oil to housing (26) at where bearing outer races will be press-fitted.

- Drive roller bearings (11) and (12) outer races into housing.
- Apply liquid packing to periphery of oil seal (10).
- Drive in oil seal.
- Apply grease to lip of oil seal.



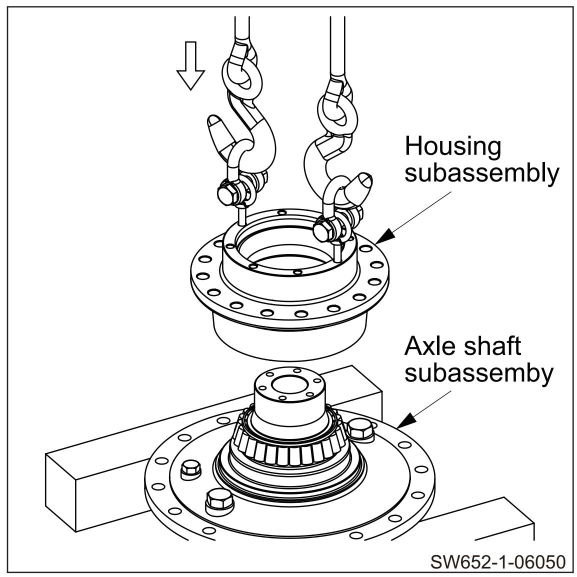
SW652-1-06048

17-5) Install lifting bolts (M10) to housing (26).



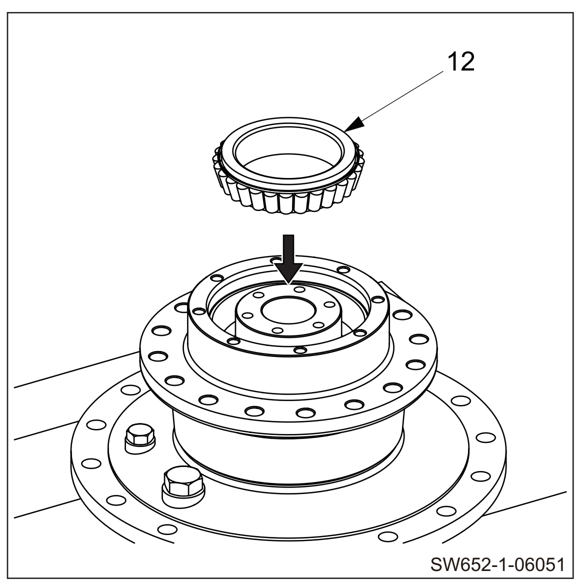
17-6) Install housing subassembly to axle shaft subassembly.

Housing subassembly : 20 kg (44 lbs.)



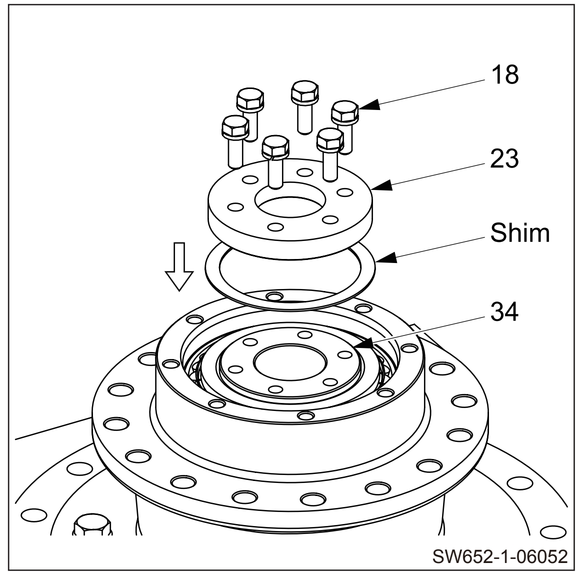
17-7) Apply sufficient amount of lithium-based grease to rollers of roller bearing (12) inner race.

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



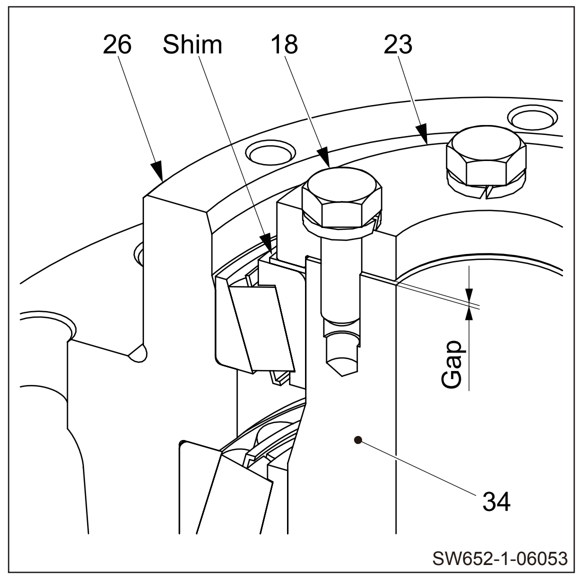
17-8) Preload adjustment of roller bearing

① Install a shim of about 1 mm (0.04 in.) and secure cover (23) to axle shaft (34) with six bolts (18) and spring washers.



② A gap will remain between end of axle shaft (34) and inside of cover (23).

- Tighten bolts (18) to a torque of 60 N·m (44 lbf·ft).
- Give housing (26) two to three turns.
- Tighten bolts to a torque of 60 N·m (44 lbf·ft) again.
- Repeat this work several times until tightening torque of bolts no longer fluctuates.

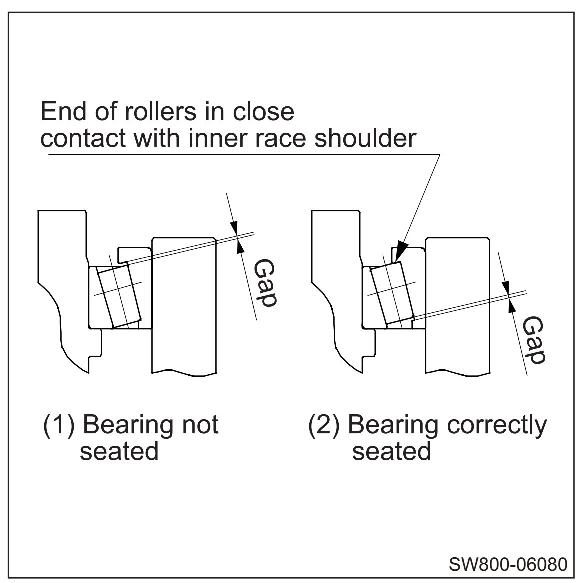


(NOTICE)

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

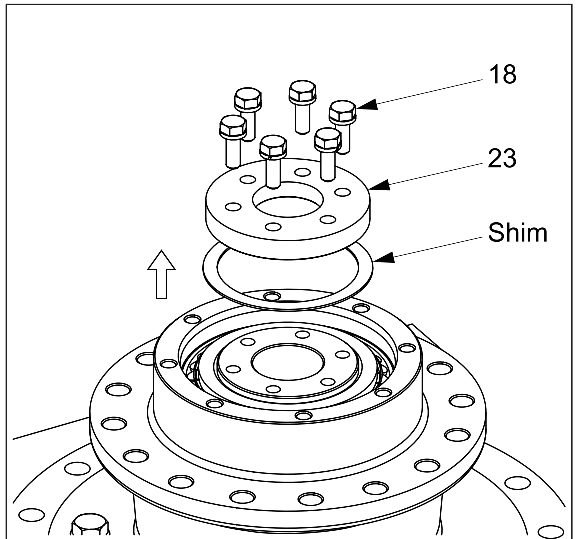
(NOTICE)

- **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.**



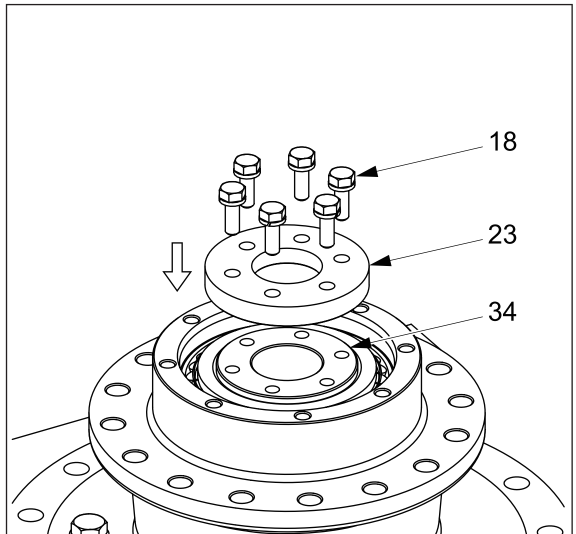
③ Remove bolts (18).
- Remove cover (23).
- Remove shim.

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



SW652-1-06075

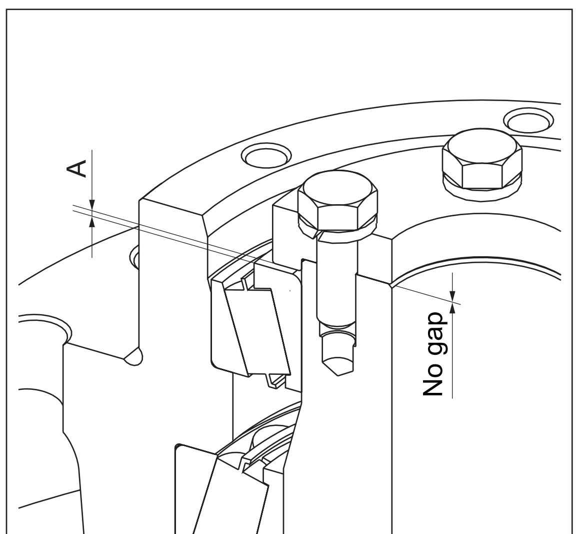
④ Without inserting shim, install cover (23) to axle shaft (34) with six bolts (18) and spring washers.



SW652-1-06054

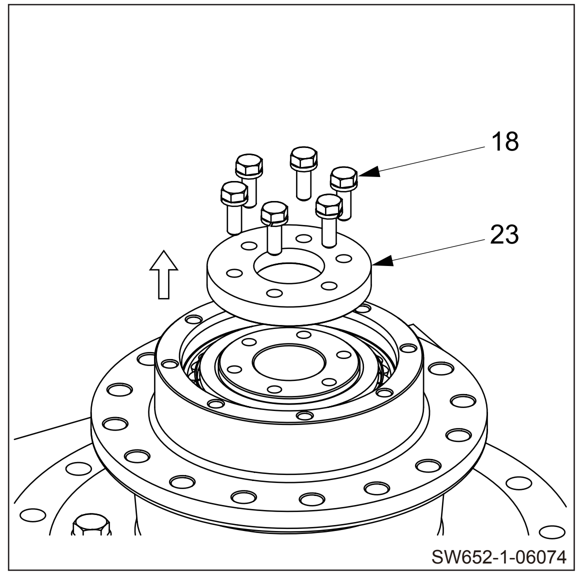
⑤ Using a thickness gauge, measure clearance “A”.

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



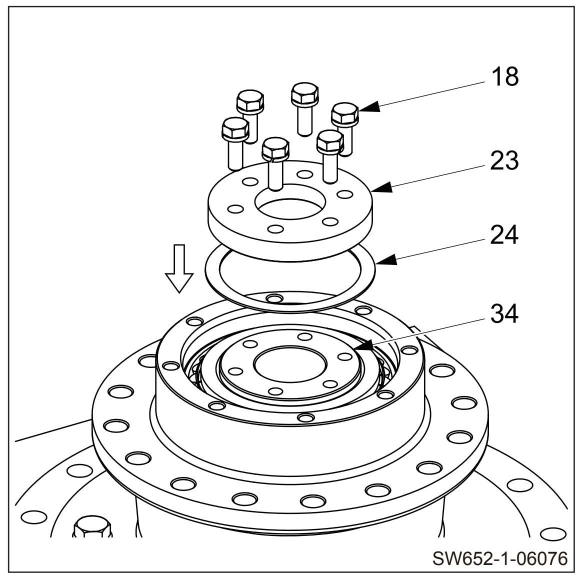
SW652-1-06055

⑥ Remove bolts (18).
- Remove cover (23).

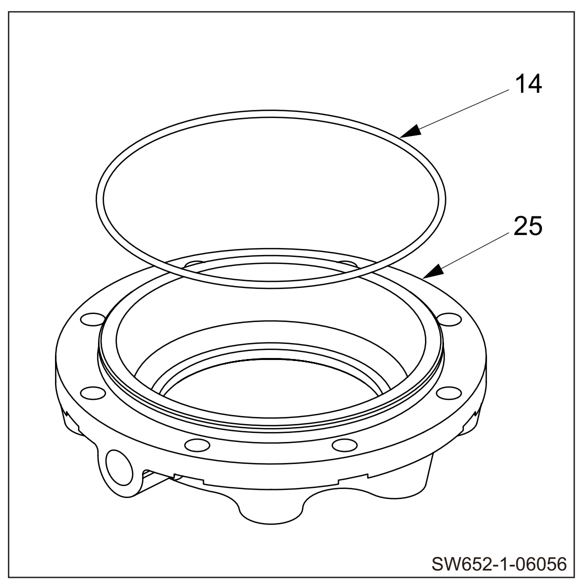


⑦ Install shim (24) of preload adjusting shim thickness = "A + 0.1 mm (0.004 in.)".
- Secure cover (23) to axle shaft (34) with six bolts (18) and spring washers.

N•m (18) Bolts M10×30 : 60 N·m (44 lbf·ft)

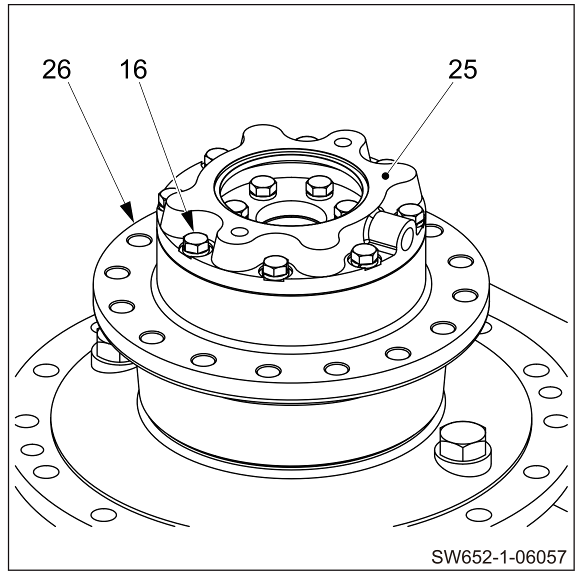


17-9) Apply grease to O-ring (14).
- Install O-ring to flange (25).

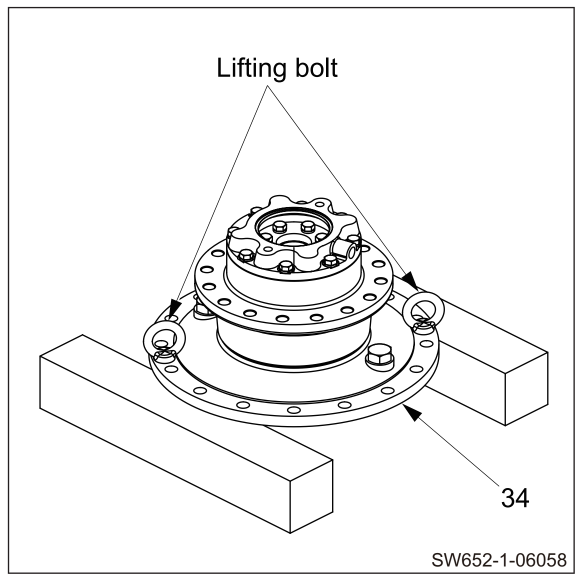


17-10) Secure flange (25) to housing (26) with eight bolts (16) and spring washers.

N•m (16) Bolts M10×30 : 60 N·m (44 lbf·ft)



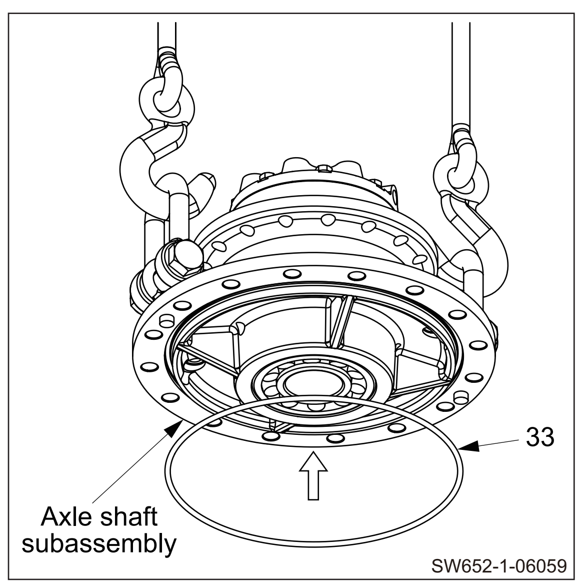
18) Install lifting bolts to axle shaft (34).



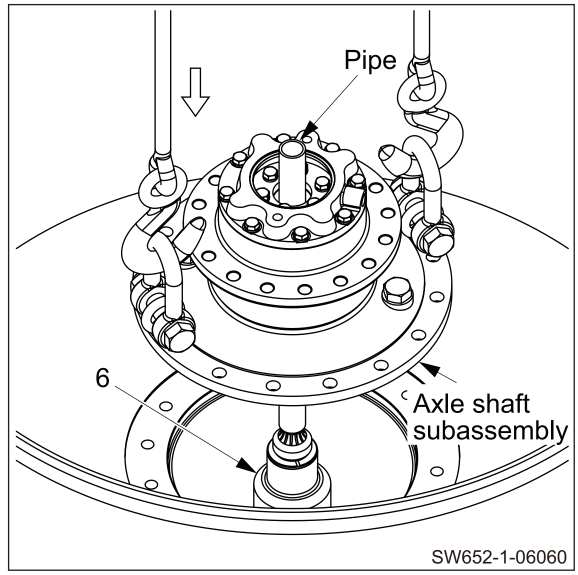
19) Lift axle shaft subassembly.

kg Axle shaft subassembly : 65 kg (143 lbs.)

- Apply grease to O-ring (33).
- Install O-ring to axle shaft (34).



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

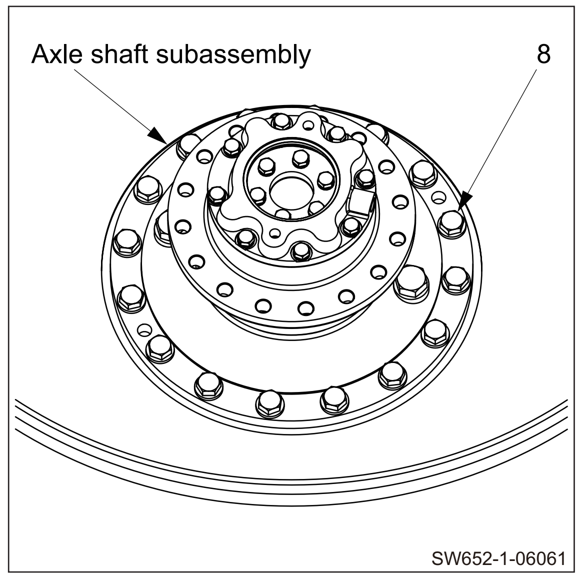


(NOTICE)

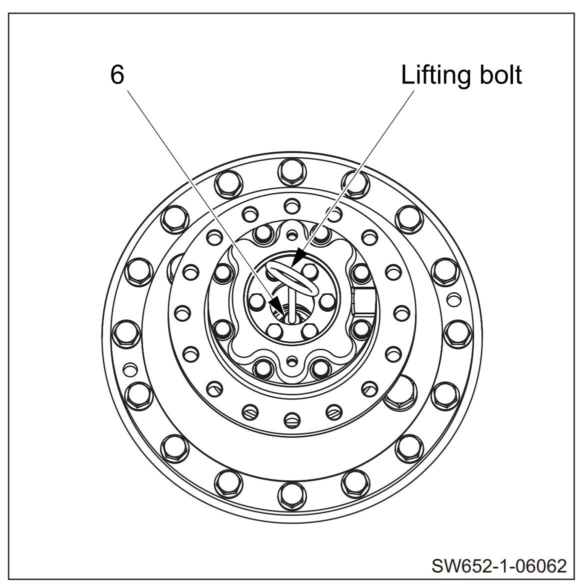
- **Support the eccentric shaft (6) with a pipe or the like, to prevent tilting of the vibrator bearing inner race during installation.**

21) Secure axle shaft subassembly with sixteen bolts (8) and washers.

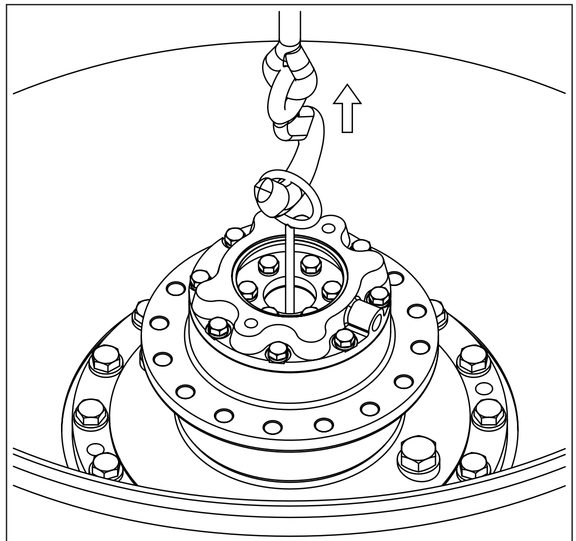
N•m (8) Bolts M16×45 : 265 N·m (195 lbf·ft)



22) Install a lifting bolt (M8) to end of eccentric shaft (6).



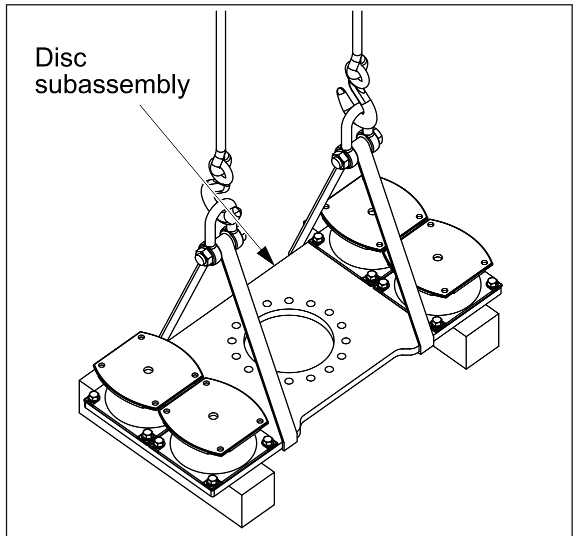
23) Slowly lift eccentric shaft with a crane and check that there is an axial play of 1 to 3 mm (0.04 to 0.12 in.).



SW652-1-06063

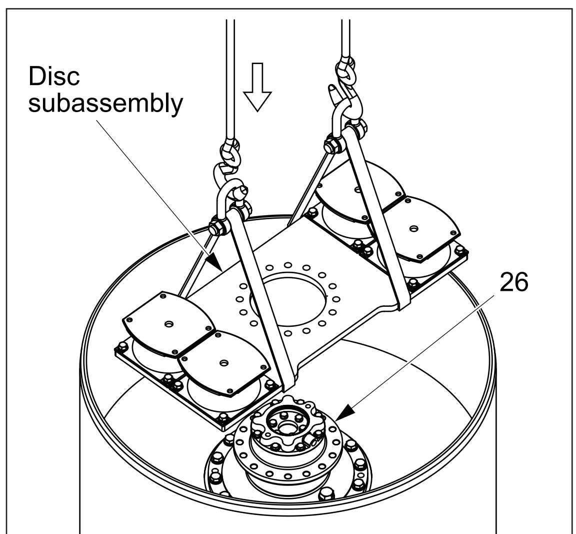
24) Lift disc subassembly.

Disc subassembly : 75 kg (165 lbs.)



SW652-1-06064

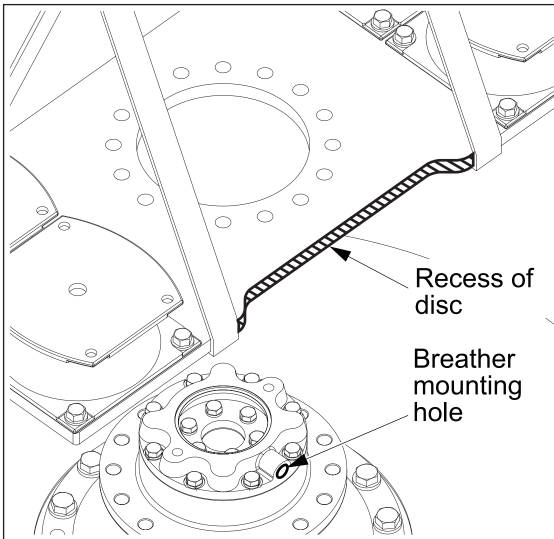
25) Lower disc subassembly on mounting surface of housing (26).



SW652-1-06065

(NOTICE)

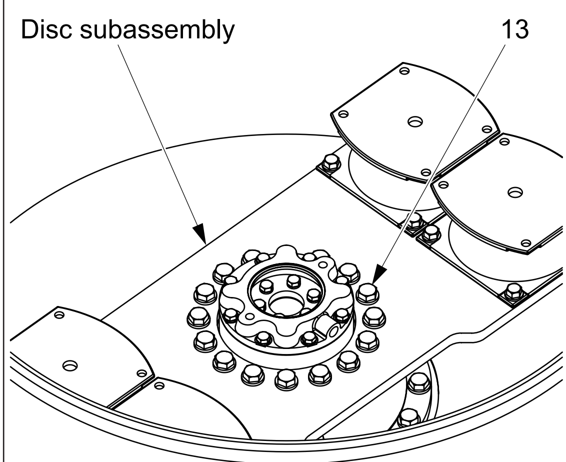
- **The recess of the disc must face the same direction as the breather mounting hole in the flange.**



SW652-1-06066

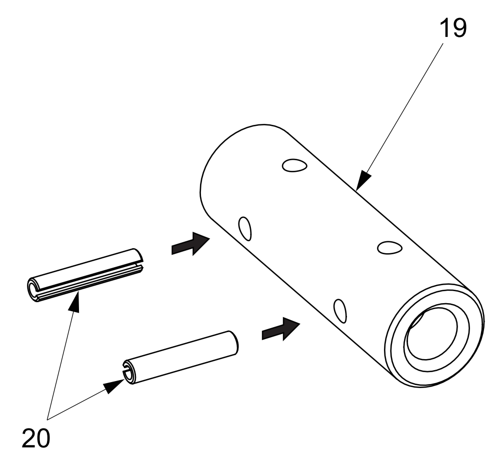
26) Secure disc subassembly with sixteen bolts (13) and washers.

N•m (13) Bolts M16×45 : 265 N·m (195 lbf·ft)



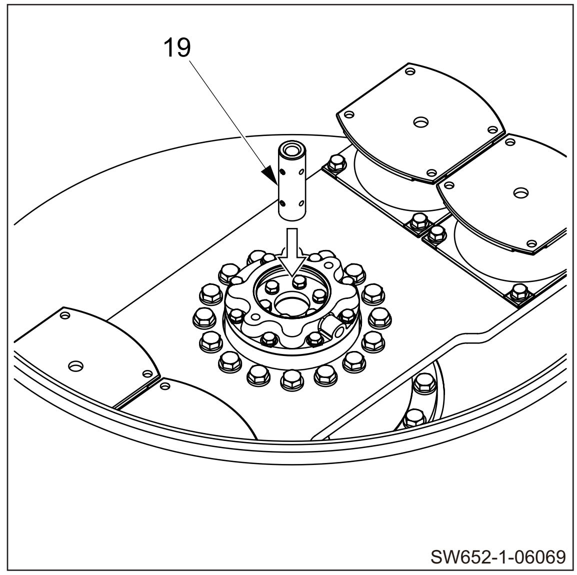
SW652-1-06067

27) Drive two spring pins (20) into sleeve (19).

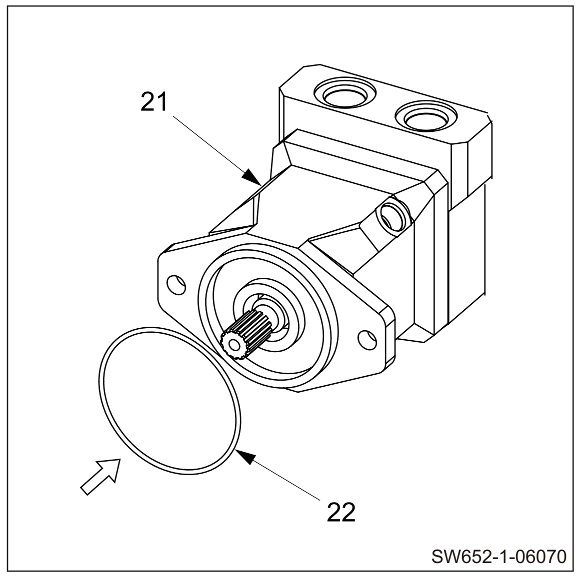


SW652-1-06068

28) Apply molybdenum-based grease to splined portion of sleeve (19).
   - Fit sleeve to splined portion on eccentric shaft end.



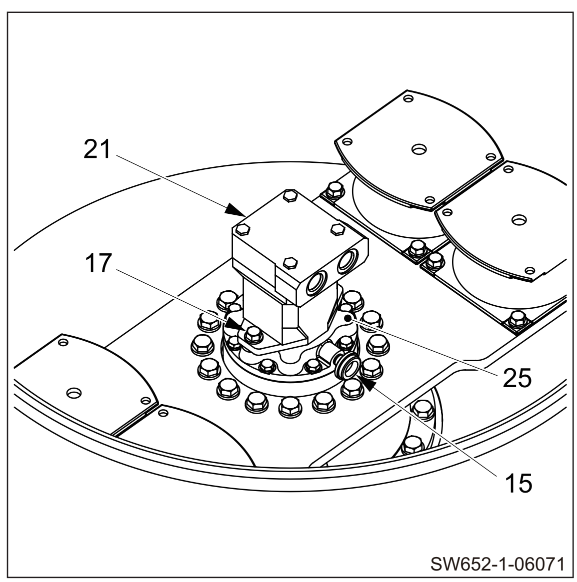
29) Apply grease to O-ring (22).
   - Install O-ring to vibrator motor (21).



30) Wind seal tape around threaded portion of breather (15).
   - Install breather.
   - Secure vibrator motor (21) to flange (25) with two bolts (17) and washers.

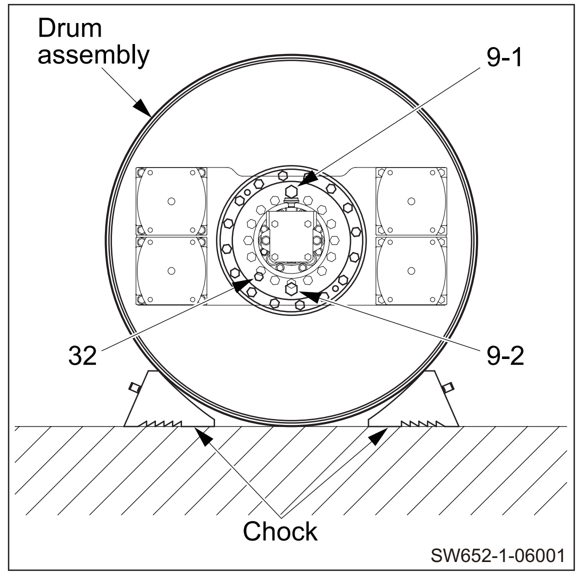
kg (21) Vibrator motor :15 kg (33 lbs.)

N•m (17) Bolts M12×30 : 110 N·m (81 lbf·ft)



31) Lay drum assembly with plugs (9-1), (9-2), and level plug (32) positioned as shown right.
- Hold with chocks.

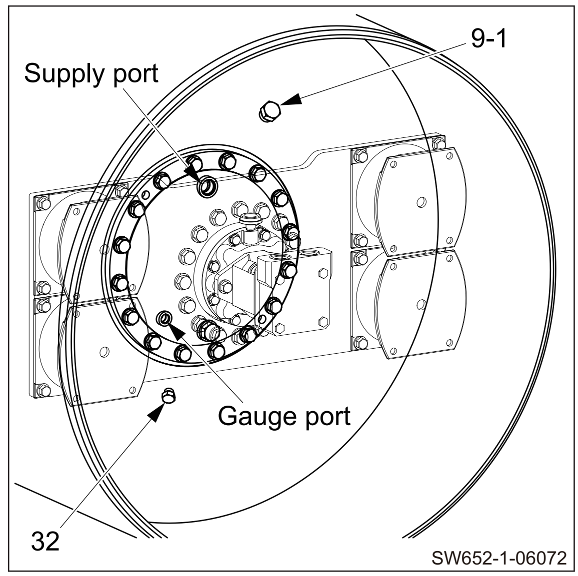
Drum assembly : 1,455 kg (3,208 lbs.)



32) Remove plug (9-1) and level plug (32).
- Supply gear oil from oil supply port.
- Check that oil drips from gauge port.

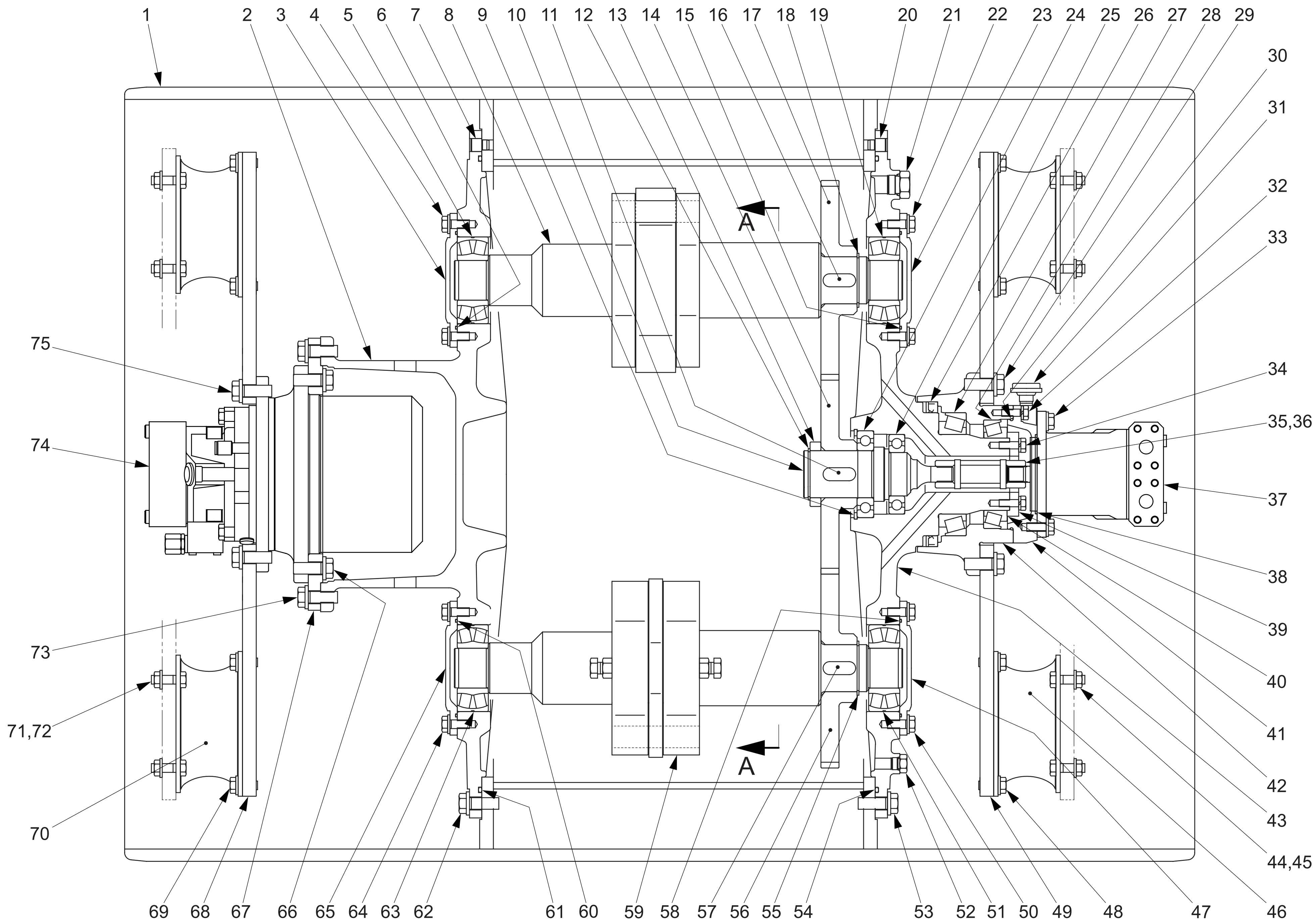
• Quantity of gear oil : 4.0 L (1.1 gal.)

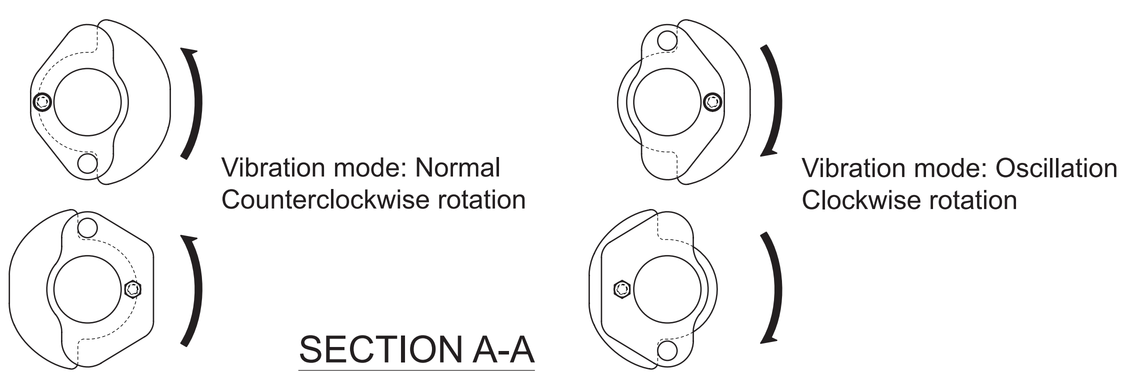
- Reinstall plug and level plug.

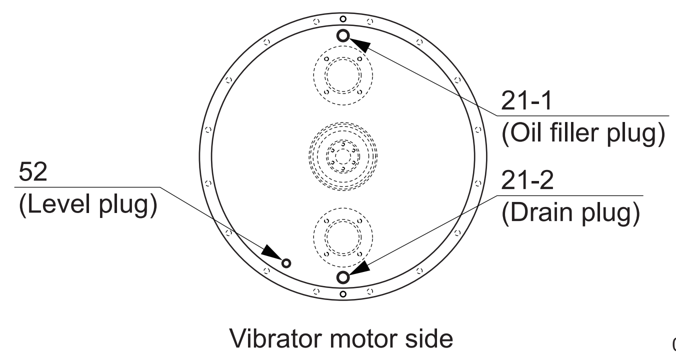


4. VIBRATORY DRUM ASSEMBLY (SW654ND)

4-1. Vibratory Drum Assembly







0559-43802-0-10060-0

(1)	Drum	
(2)	Housing	
(3)	Cover	
(4)	Bolt	: M12×30
(5)	Vibrator bearing	
(6)	O-ring	
(7)	Pin	
(8)	Eccentric shaft	
(9)	Retaining ring	
(10)	Shaft	
(11)	Sunk key	
(12)	Retaining ring	
(13)	Collar	
(14)	Gear	
(15)	O-ring	
(16)	Sunk key	
(17)	Gear	
(18)	Retaining ring	
(19)	Vibrator bearing	
(20)	Pin	
(21)	Plug	
(22)	Bolt	: M12×30
(23)	Cover	
(24)	Ball bearing	
(25)	Ball bearing	
(26)	Oil seal	
(27)	Roller bearing	
(28)	Roller bearing	
(29)	Bolt	: M16×45
(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
(51)	Vibrator bearing	
(52)	Level plug	
(53)	Bolt	: M16×45
(54)	O-ring	
(55)	Retaining ring	
(56)	Gear	
(57)	Sunk key	
(58)	O-ring	
(59)	Eccentric shaft	
(60)	O-ring	
(61)	O-ring	
(62)	Bolt	: M16×45
(63)	Vibrator bearing	
(64)	Bolt	: M12×30
(65)	Cover	
(66)	Bolt	: M16×45
(67)	Disc	
(68)	Disc	
(69)	Bolt	: M12×30
(70)	Damper	
(71)	Bolt	: M12×40
(72)	Nut	: M12
(73)	Bolt	: M16×45
(74)	Propulsion motor	
(75)	Bolt	: M16×45

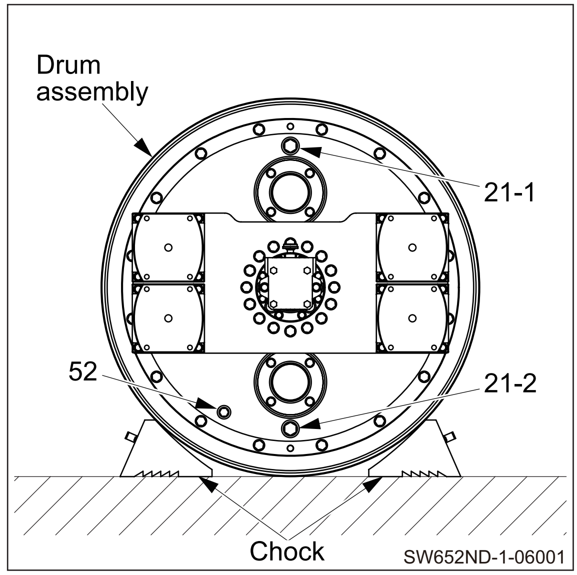
4-2. Disassembly and Reassembly of Vibratory Drum

- 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 6-036.

4-2-1. Disassembly of vibratory drum

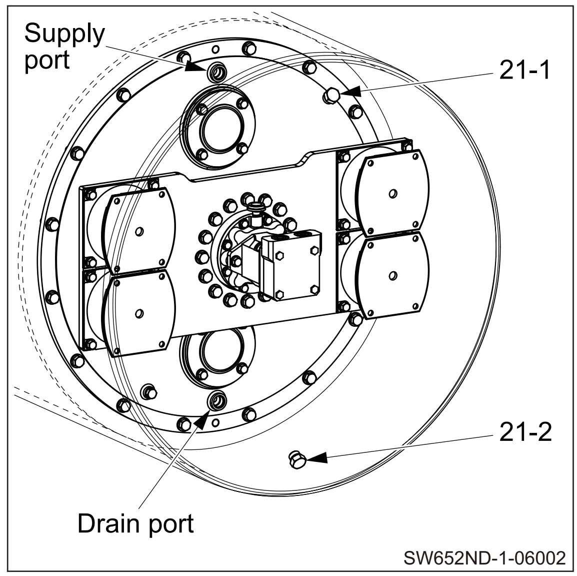
1) Lay drum assembly with plugs (21-1), (21-2), and level plug (52) positioned as shown on the right.
   - Hold with chocks.

   kg Drum assembly : 1,675 kg (3,693 lbs.)



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

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

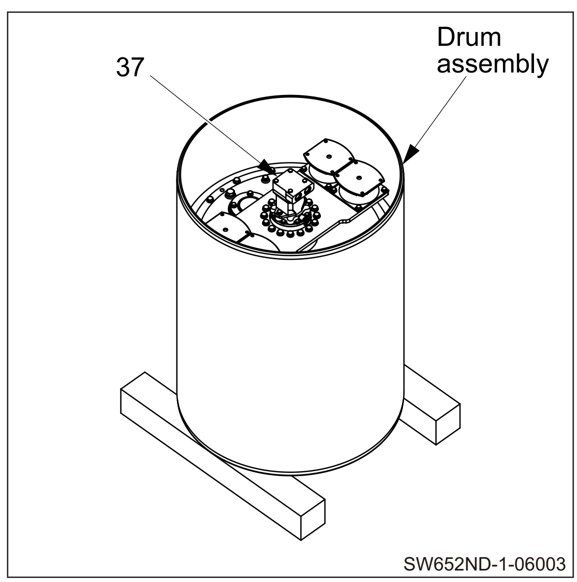


⚠WARNING

- **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.**

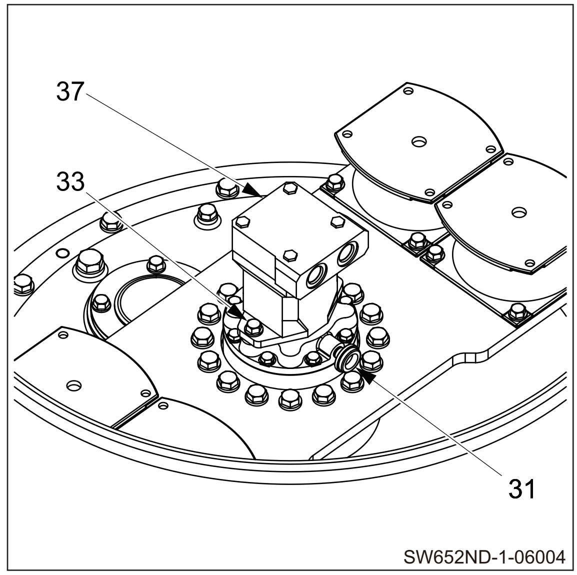
3) Stand drum assembly with its vibrator motor (37) side facing up.

   kg Drum assembly : 1,665 kg (3,671 lbs.)

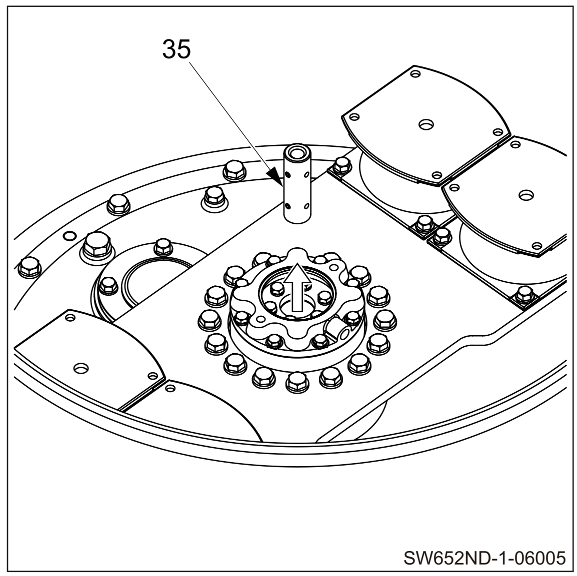


4) Remove breather (31).
   - Remove bolts (33).
   - Remove vibrator motor (37).

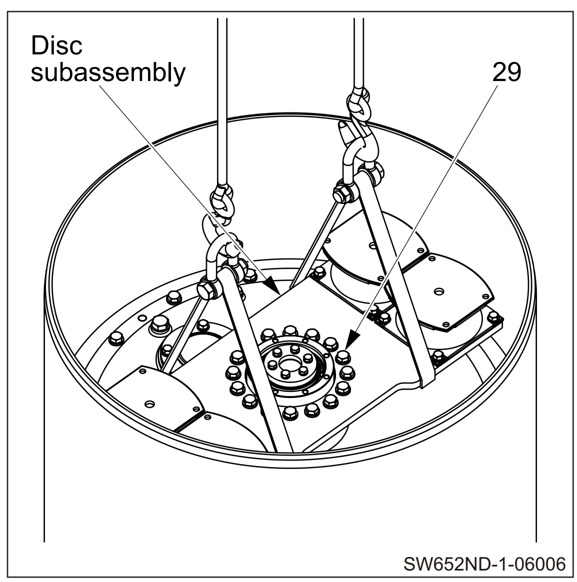
     kg (37) Vibrator motor : 15 kg (33 lbs.)



5) Remove sleeve (35).

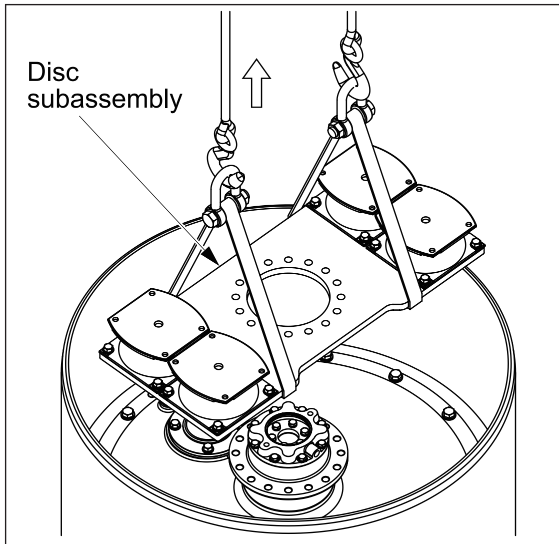


6) Lift disc subassembly.
   - Remove bolts (29).



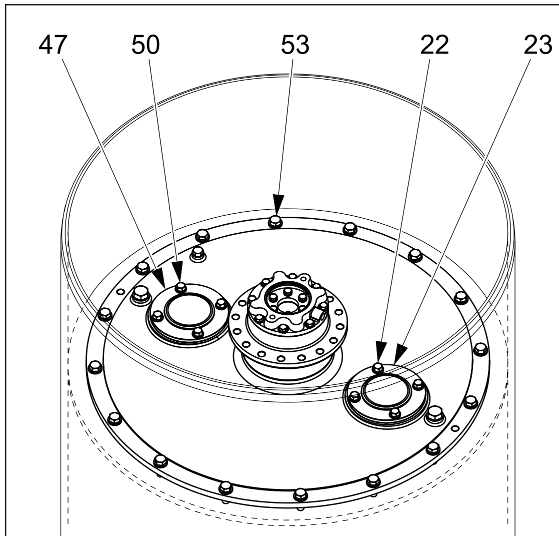
7) Remove disc subassembly.

kg Disc subassembly : 75 kg (165 lbs.)



SW652ND-1-06007

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

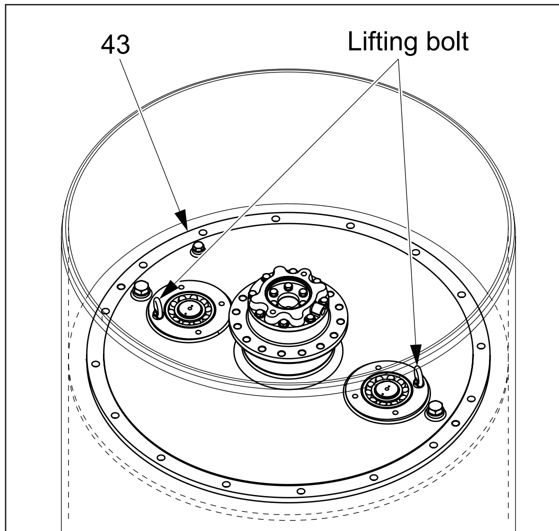


SW652ND-1-06008

WARNING

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

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



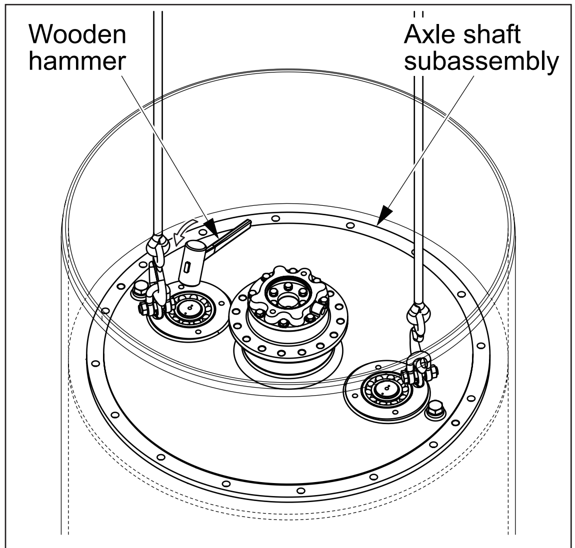
SW652ND-1-06009

10) Remove axle shaft subassembly.

Axle shaft subassembly : 205 kg (452 lbs.)

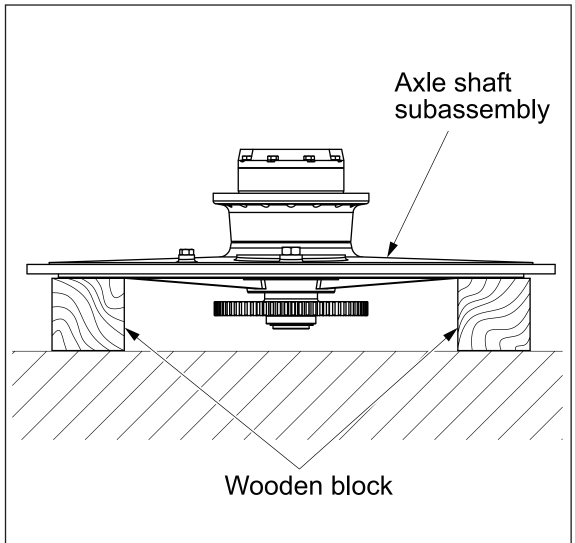
(NOTICE)

- **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.**



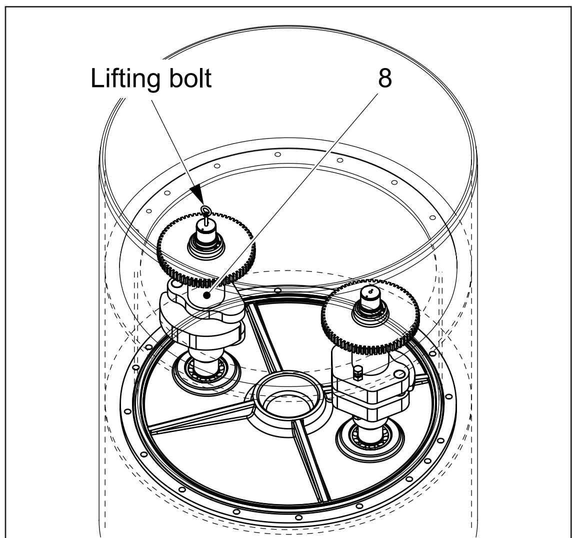
SW652ND-1-06010

11) Put axle shaft subassembly on wooden blocks.



SW652ND-1-06011

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



SW652ND-1-06012

⚠WARNING

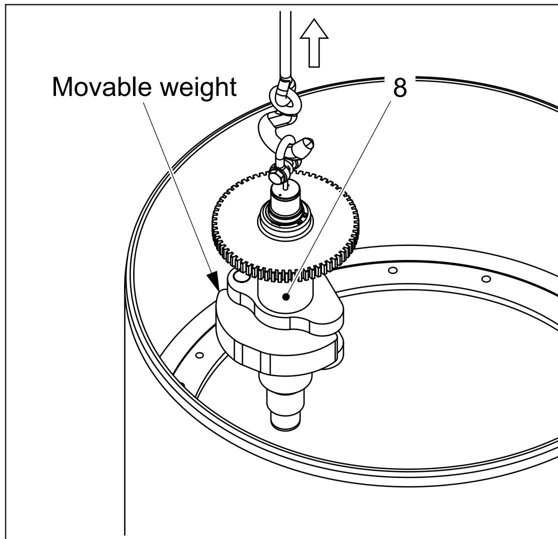
Take care not to get your fingers caught in movable weights.

13) Remove eccentric shaft (8).

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

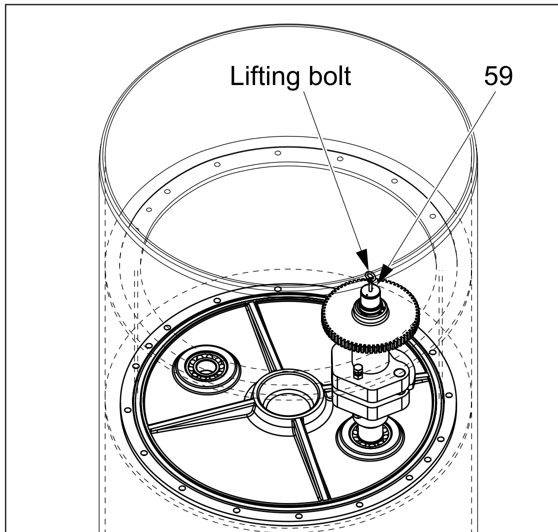
(NOTICE)

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



SW652ND-1-06013

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



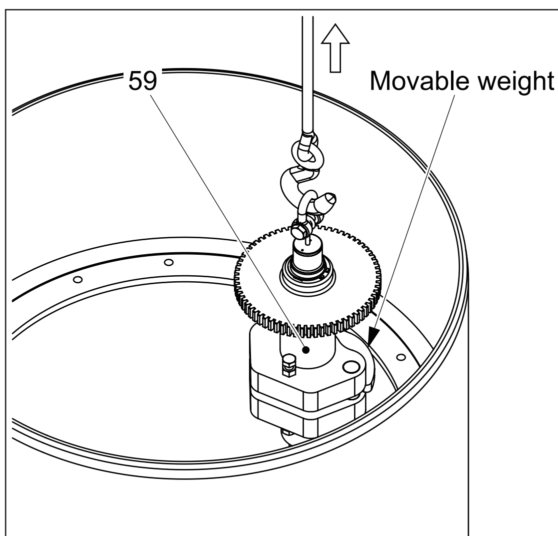
SW652ND-1-06014

15) Remove eccentric shaft (59).

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

(NOTICE)

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



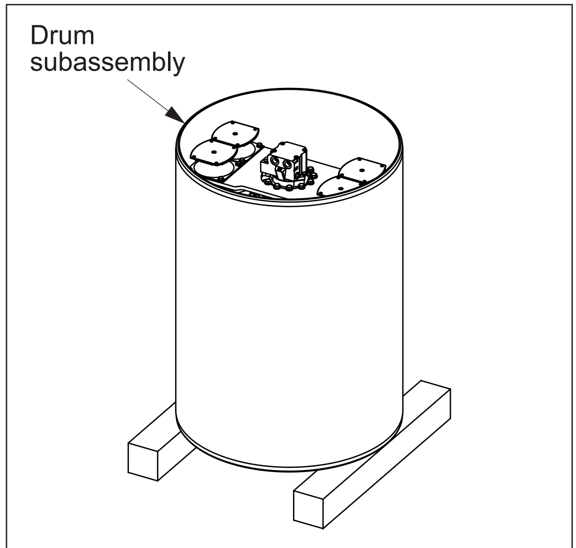
SW652ND-1-06015

⚠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.

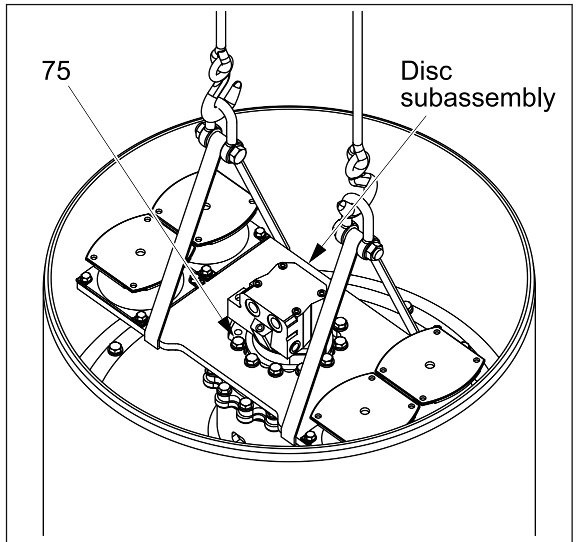
Drum subassembly : 1,230 kg (2,712 lbs.)



SW652ND-1-06016

17) Lift disc subassembly.

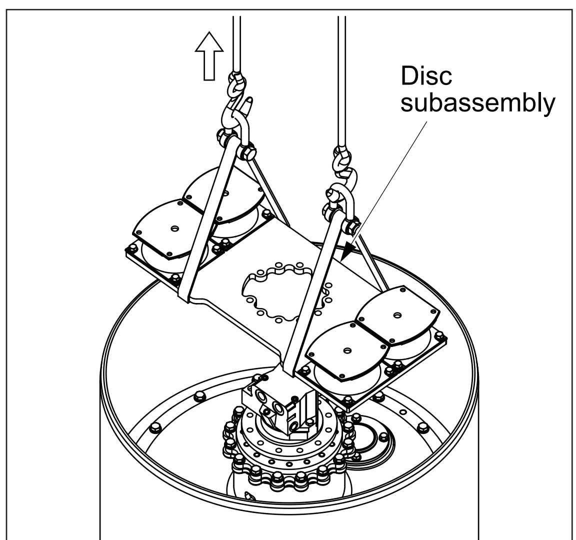
- Remove bolts (75).



SW652ND-1-06017

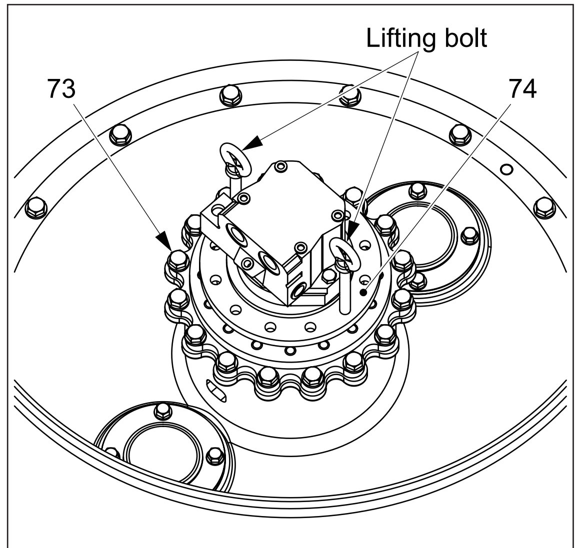
18) Remove disc subassembly.

Disc subassembly : 75 kg (165 lbs.)



SW652ND-1-06018

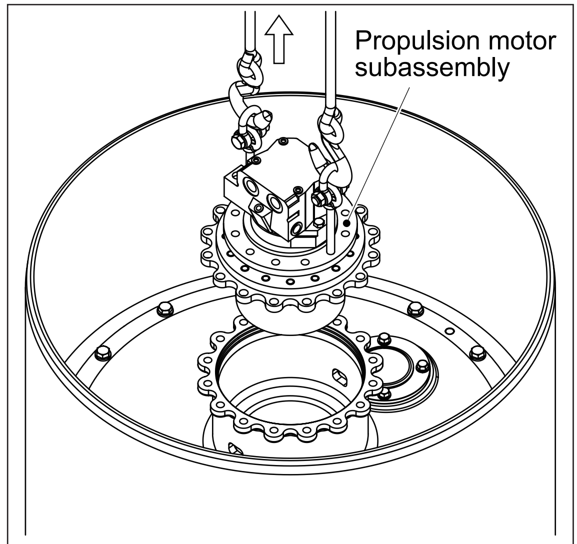
19) Install lifting bolts (M16) to propulsion motor (74).
- Remove bolts (73).



SW652ND-1-06019

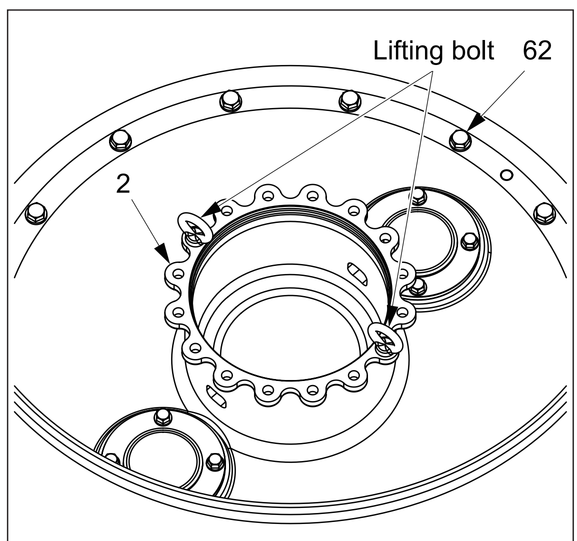
20) Remove propulsion motor subassembly.

Propulsion motor subassembly : 80 kg (176 lbs.)



SW652ND-1-06020

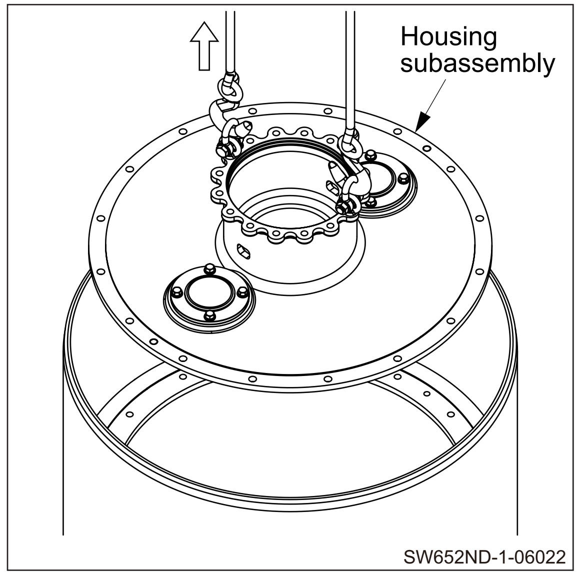
21) Install lifting bolts (M16) to housing (2).
- Remove bolts (62).



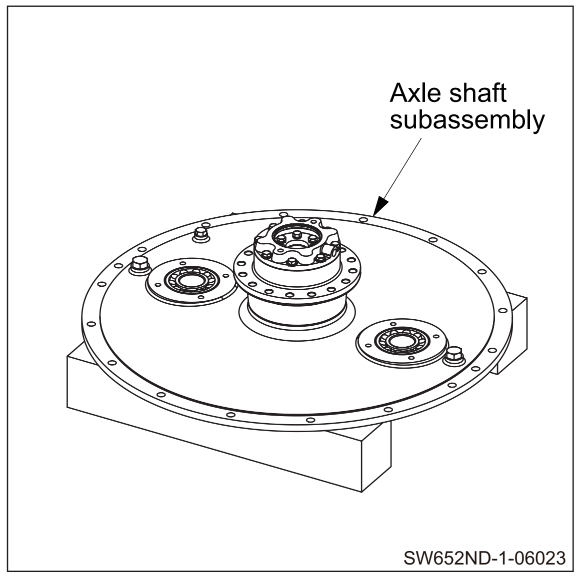
SW652ND-1-06021

22) Remove housing subassembly.

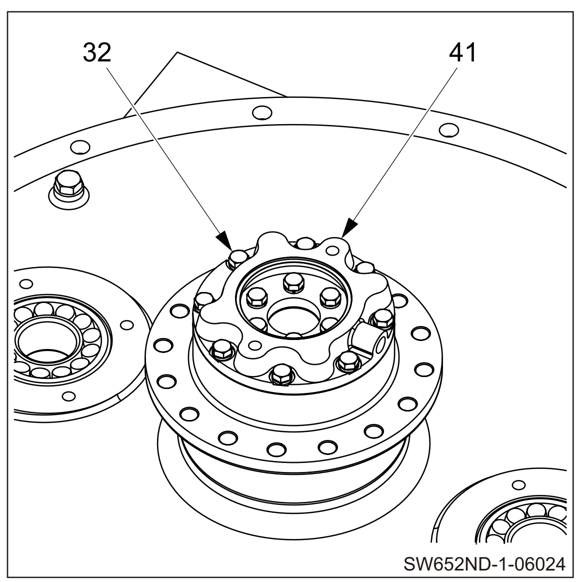
Housing subassembly : 160 kg (353 lbs.)



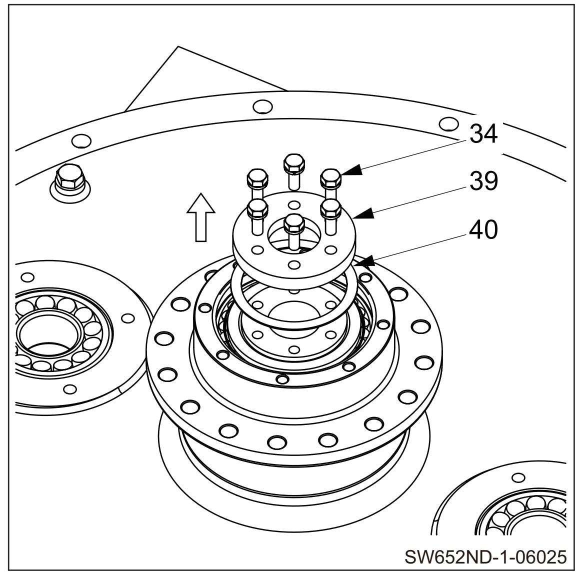
23) Disassembly of axle shaft subassembly



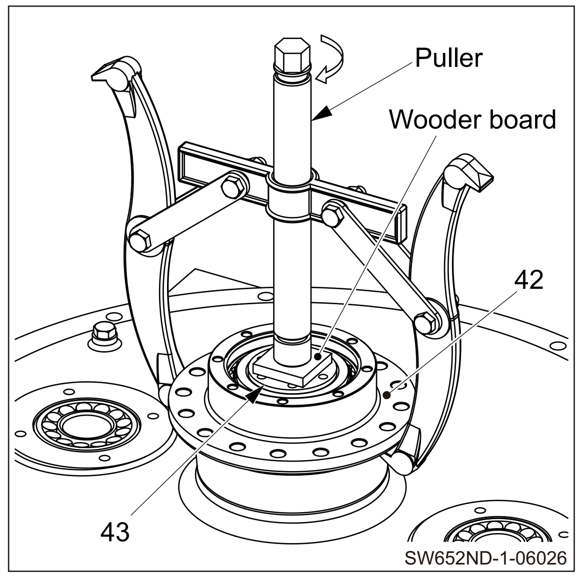
24) Remove bolts (32).
- Remove flange (41).



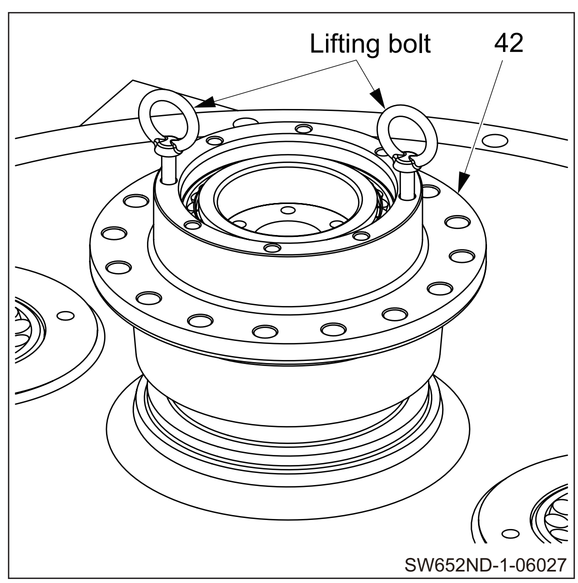
25) Remove bolts (34).
- Remove cover (39).
- Remove shim (40).



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.

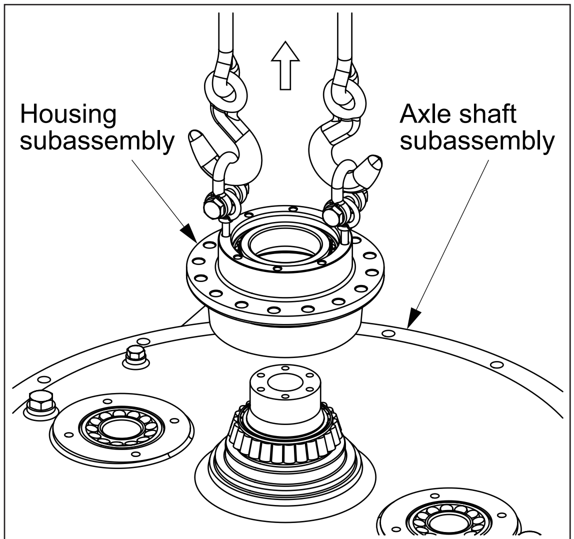


27) Install lifting bolts (M10) to housing (42).



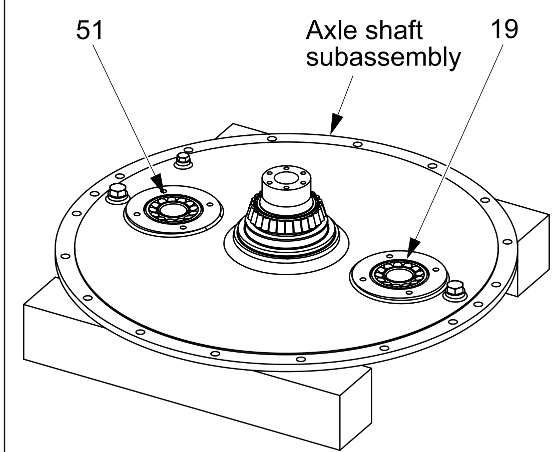
28) Remove housing subassembly from axle shaft subassembly.

Housing subassembly : 20 kg (44 lbs.)



SW652ND-1-06028

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



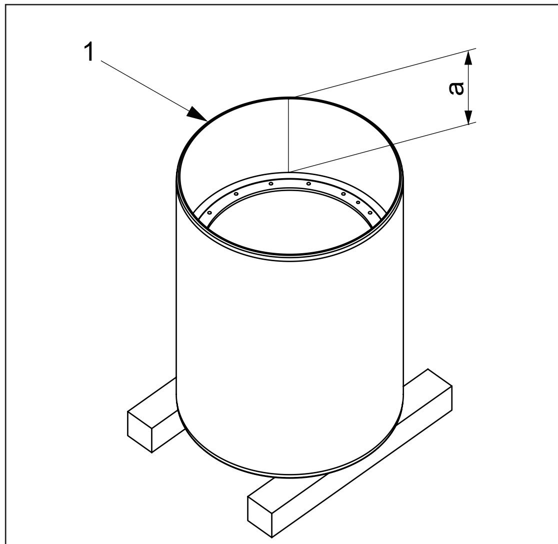
SW652ND-1-06029

4-2-2. 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.**



SW652ND-1-06030

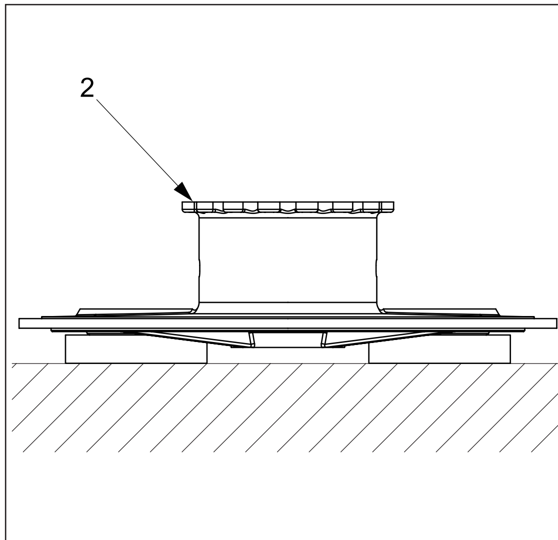
1) Stand drum (1) with its propulsion motor side facing up.

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

(NOTICE)

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

2) Reassembly of housing subassembly
   - Fix housing (2) with wooden blocks.

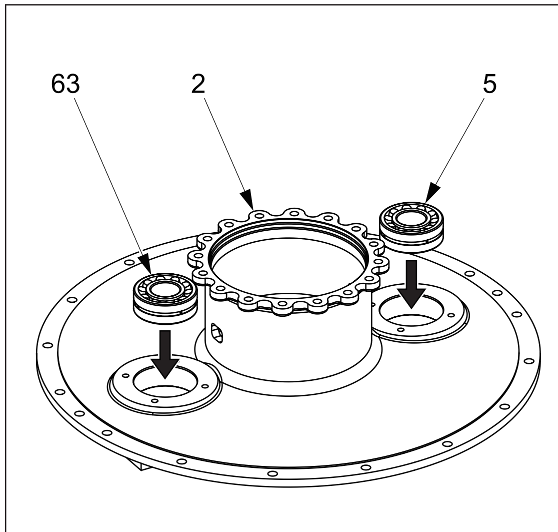


SW652ND-1-06031

2-1) 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)

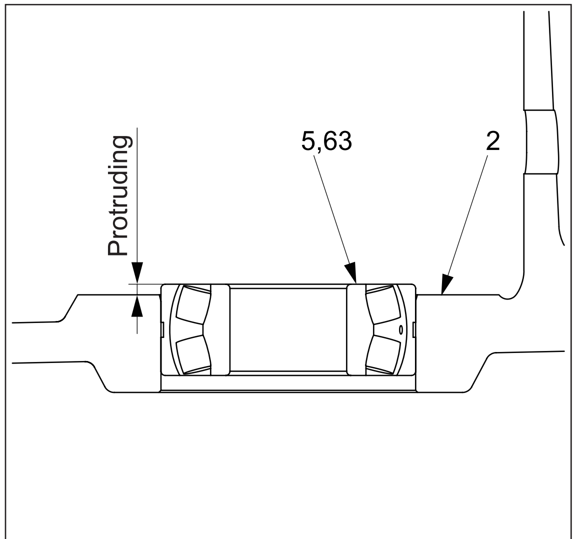
- **Take care not to damage the bearings when installing them.**



SW652ND-1-06032

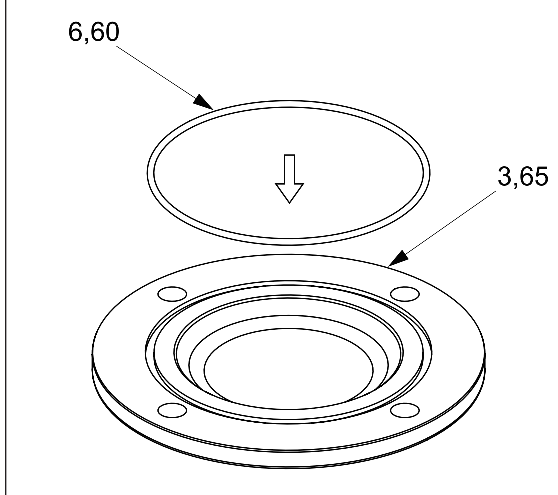
(NOTICE)

- **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.**



SW652ND-1-06033

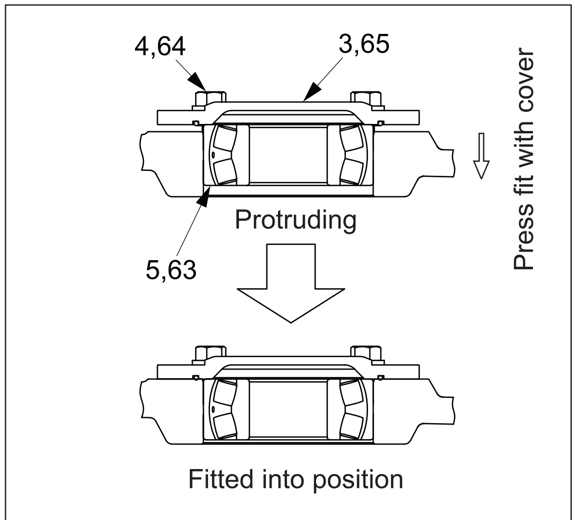
2-2) Apply grease to O-rings (6) and (60).
- Install O-rings to covers (3) and (65).



SW652ND-1-06034

2-3) 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 : 110 N·m (81 lbf·ft)

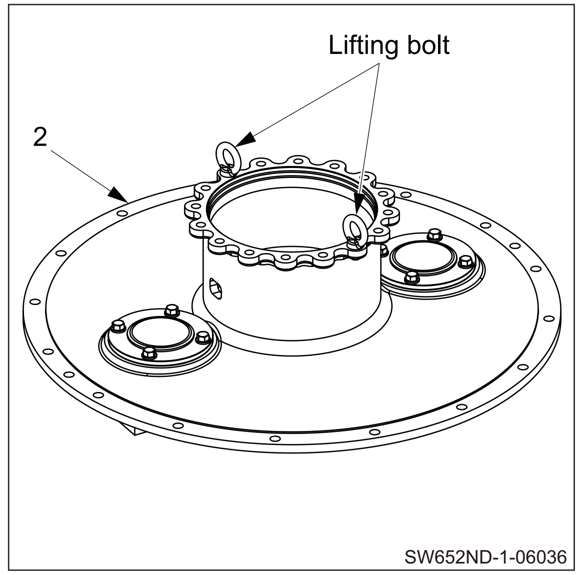


SW652ND-1-06035

⚠WARNING

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

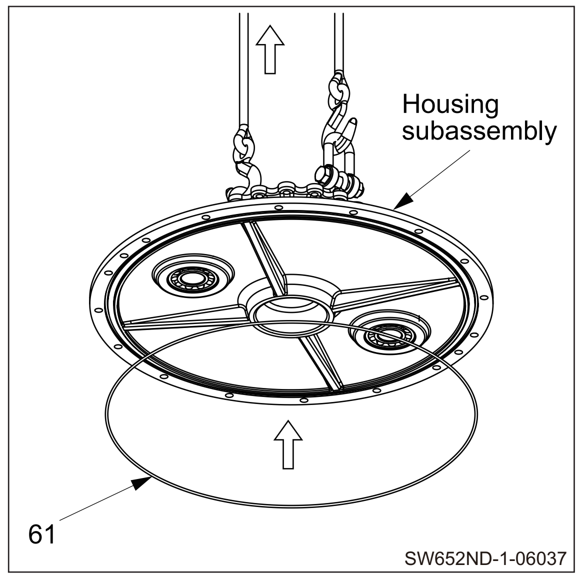
3) Install lifting bolts (M16) to housing (2).



4) Lift housing subassembly.

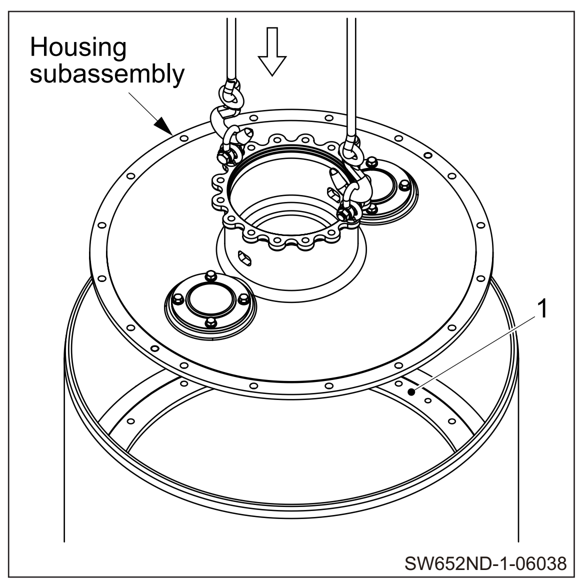
kg Housing subassembly : 160 kg (353 lbs.)

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

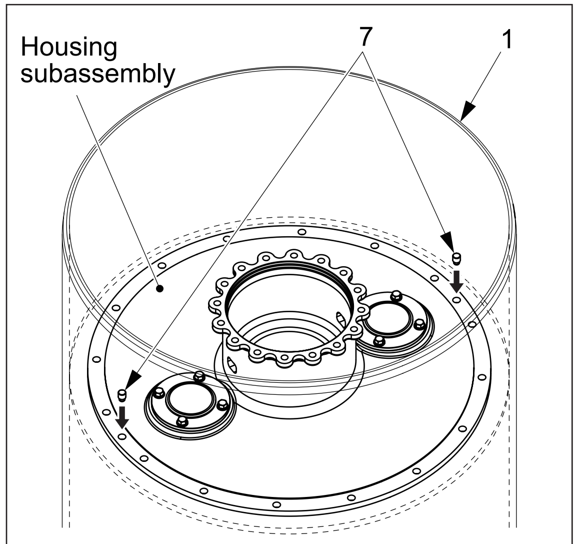


5) Lower housing subassembly on mounting surface of drum (1).

(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.

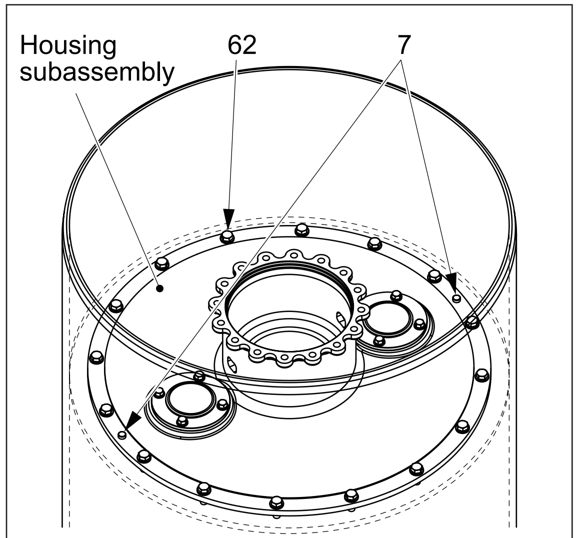


SW652ND-1-06039

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

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

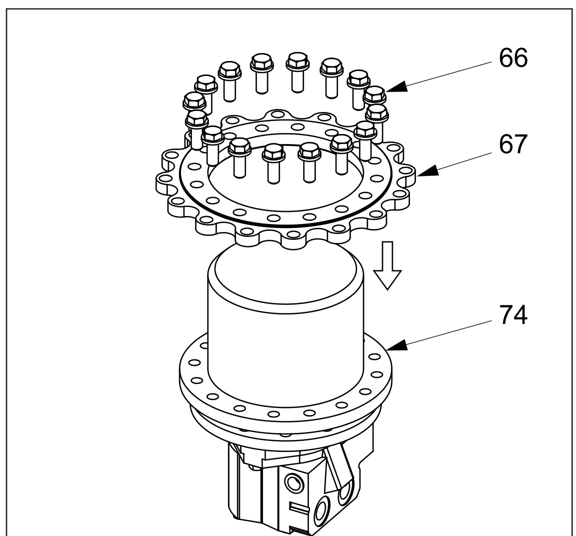
- Drive in locating pins (7) again.



SW652ND-1-06040

8) Reassembly of propulsion motor subassembly
- Secure disc (67) to propulsion motor (74) with sixteen bolts (66) and washers.

N•m (66) Bolts M16×45 : 265 N·m (195 lbf·ft)

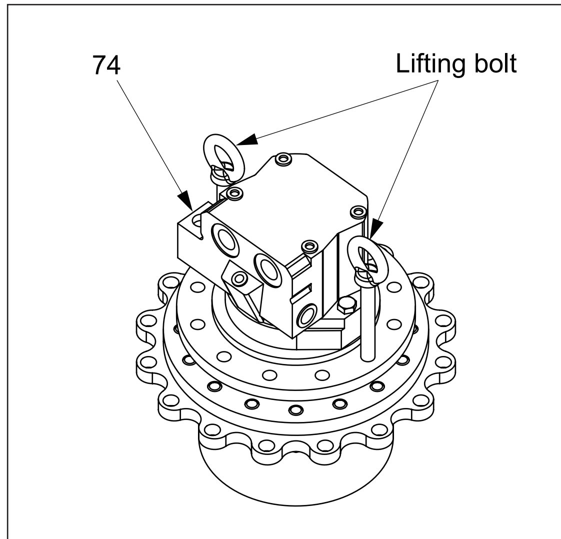


SW652ND-1-06041

9) Reverse propulsion motor subassembly.

kg Propulsion motor subassembly : 80 kg (176 lbs.)

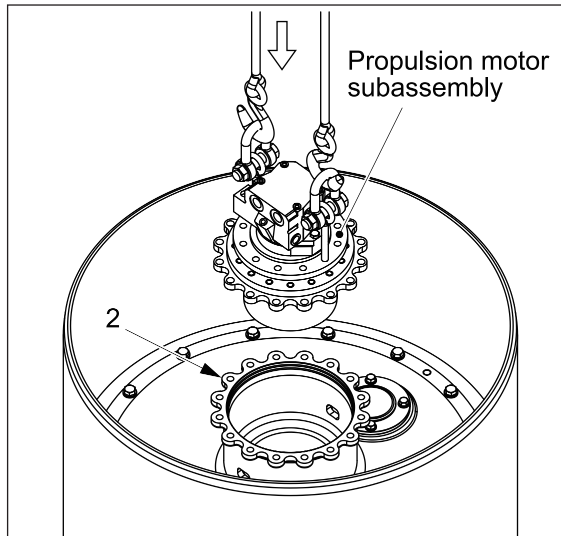
- Install lifting bolts (M16) to propulsion motor (74).



SW652-1-06112

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

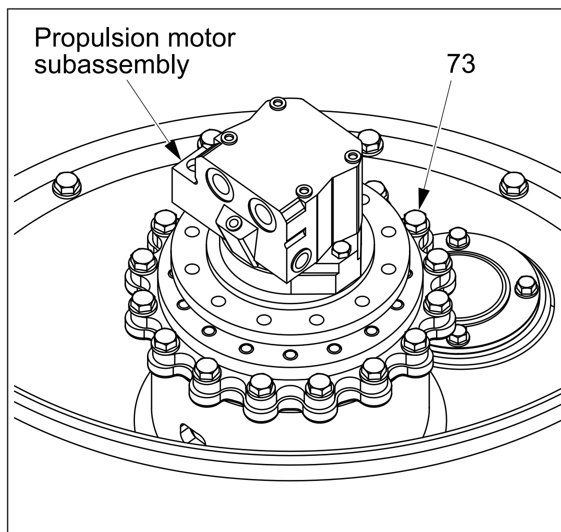
kg Propulsion motor subassembly : 80 kg (176 lbs.)



SW652ND-1-06043

11) Secure propulsion motor subassembly with sixteen bolts (73) and washers.

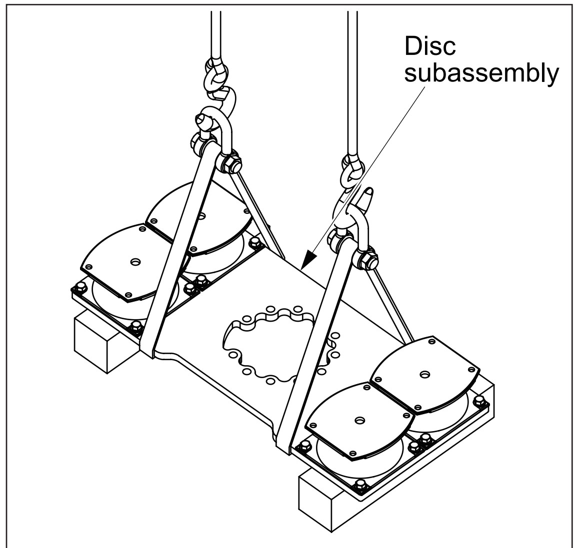
N•m (73) Bolts M16×45 : 265 N·m (195 lbf·ft)



SW652ND-1-06044

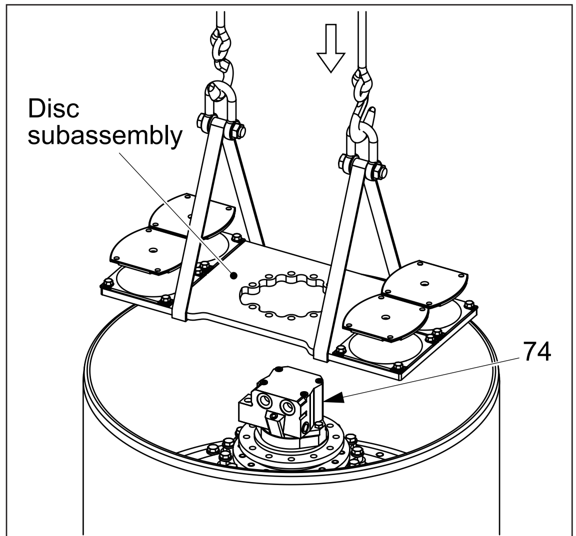
12) Lift disc subassembly.

Disc subassembly : 75 kg (165 lbs.)



SW652-1-06038

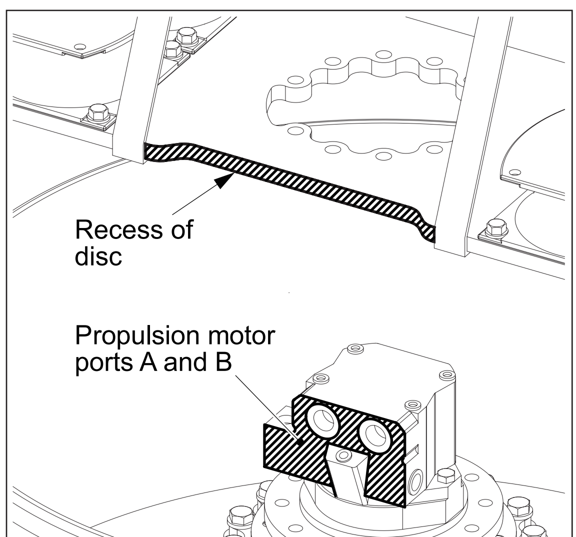
13) Lower disc subassembly on mounting surface of propulsion motor (74).



SW652ND-1-06046

(NOTICE)

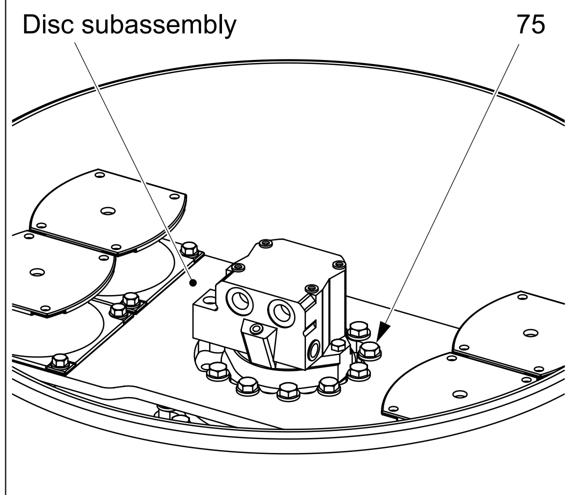
- **The recess of the disc must be parallel with the side of the propulsion motor which have ports A and B.**



SW652-1-06073

14) Secure disc subassembly with eleven bolts (75) and washers.

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



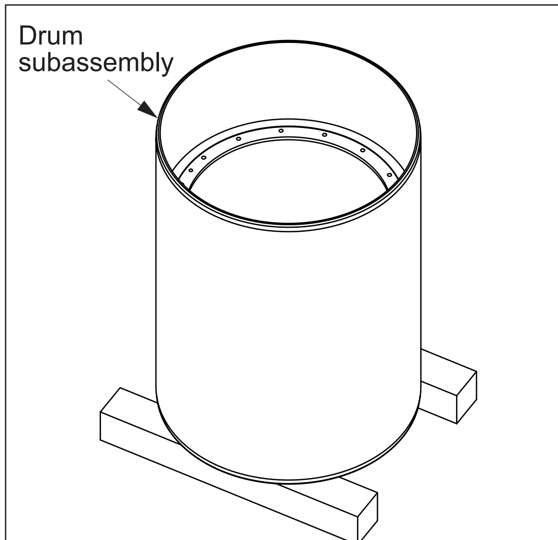
SW652ND-1-06047

⚠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 : 1,230 kg (2,712 lbs.)



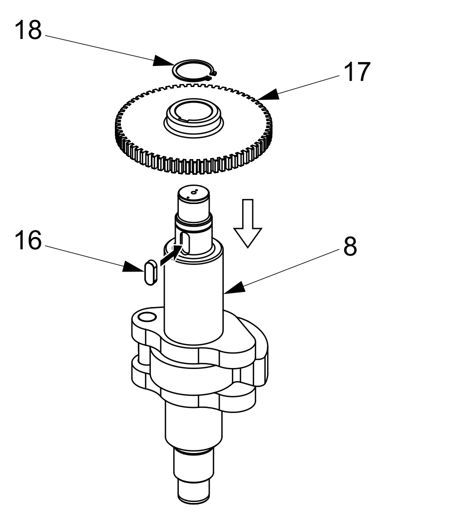
SW652ND-1-06048

⚠WARNING

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

16) 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.**



SW652ND-1-06049

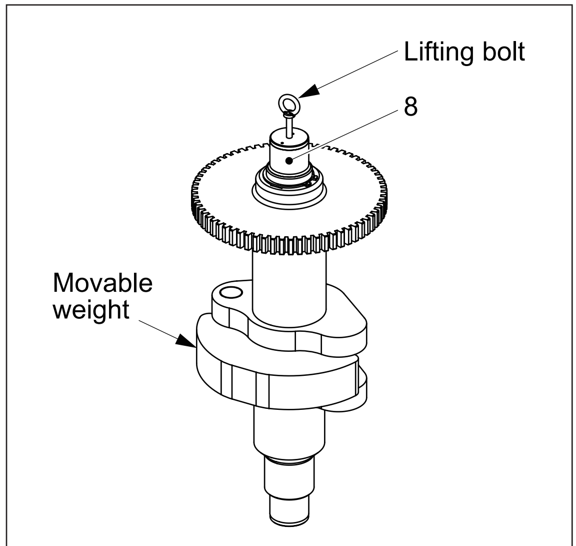
⚠WARNING

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

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

(NOTICE)

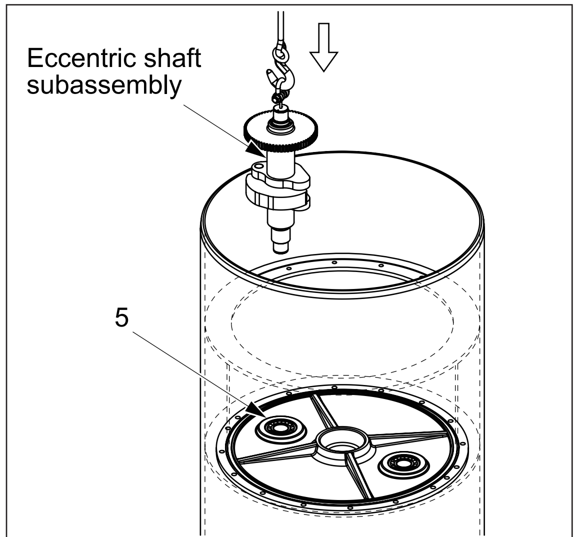
- **Put the movable weight at its outmost position.**



SW652ND-1-06050

18) 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.)

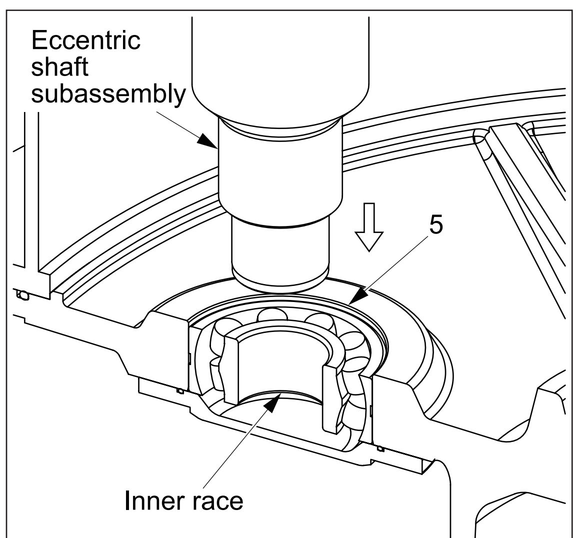


SW652ND-1-06051

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

(NOTICE)

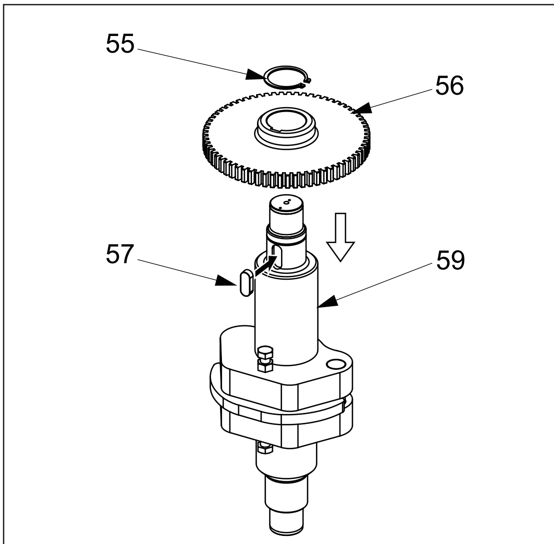
- **After inserting the eccentric shaft subassembly into the bearing, lay the eccentric shaft subassembly against the inner wall of the drum so that it will not fall down.**



SW652ND-1-06052

20) 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).

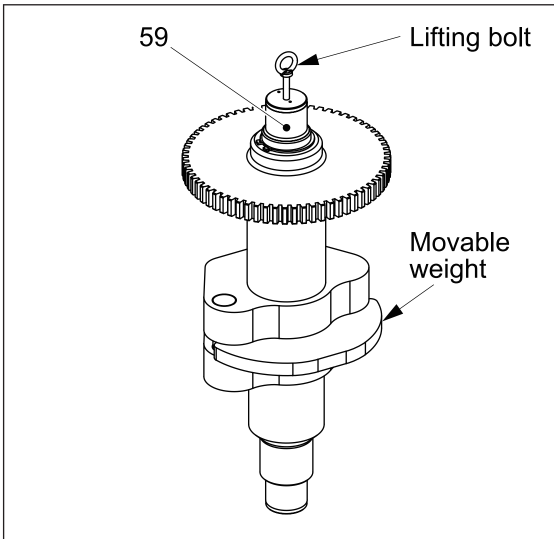
(NOTICE)
- **Make sure that the retaining ring is fitted completely in its groove.**



SW652ND-1-06053

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

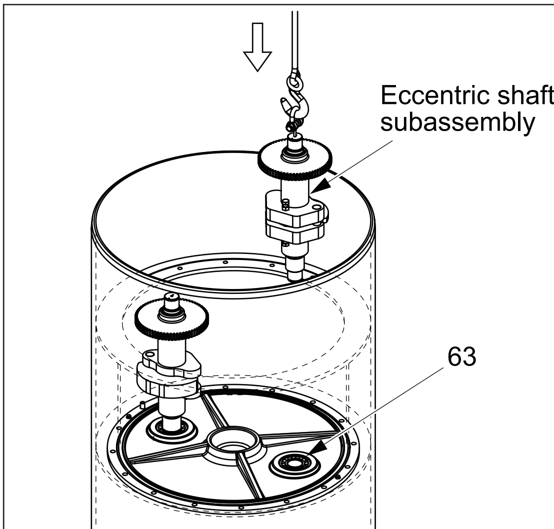
(NOTICE)
- **Put the movable weight at its outmost position.**



SW652ND-1-06054

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

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

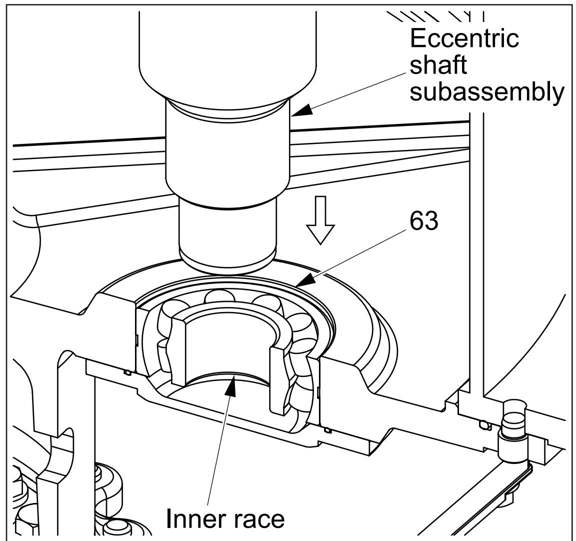


SW652ND-1-06055

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

(NOTICE)

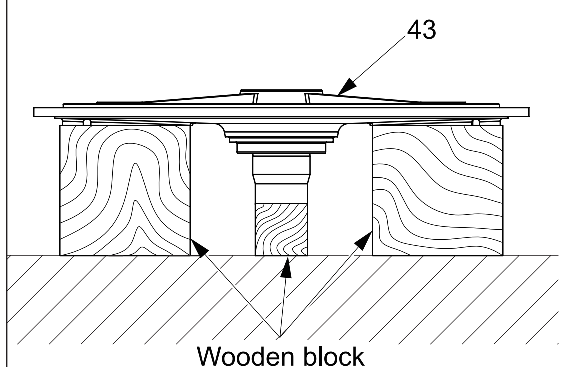
- **After inserting the eccentric shaft subassembly into the vibrator bearing, lay the eccentric shaft subassembly against the inner wall of the drum so that it will not fall down.**



SW652ND-1-06056

24) Reassembly of axle shaft subassembly

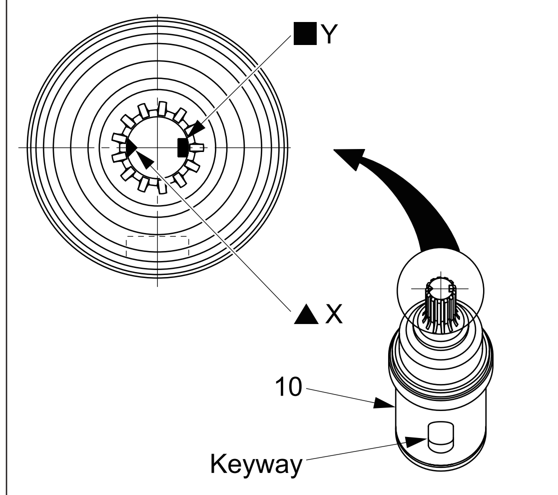
24-1) Fix axle shaft (43) with wooden blocks.



SW652ND-1-06058

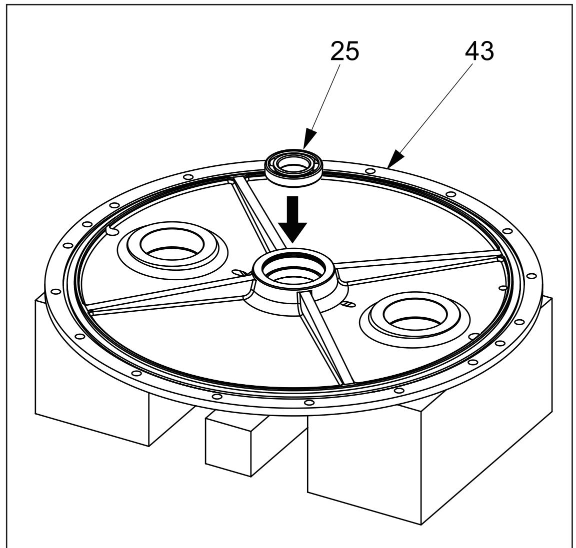
24-2) Making marks on shaft (10)

- Draw a ▲ X on left side with keyway facing down
- Draw a ■ Y on right side with keyway facing down



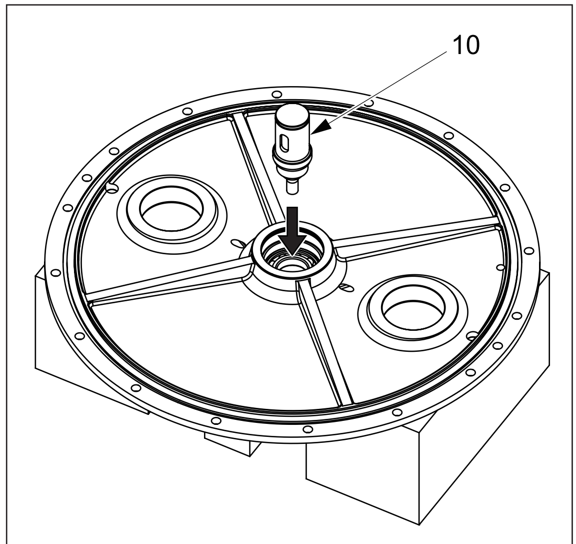
SW652ND-1-06059

24-3) Apply a coat of gear oil to axle shaft (43) at where bearing will be press-fitted.
- Drive ball bearing (25) into axle shaft.



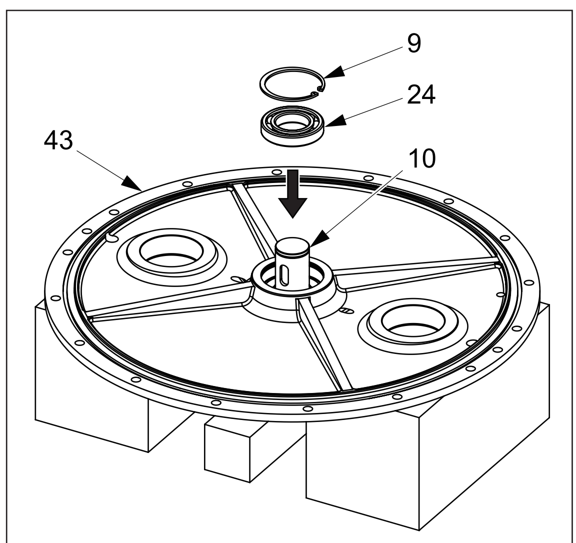
SW652ND-1-06060

24-4) Apply a coat of gear oil to bearing mounting surface of shaft (10).
- Drive in shaft.



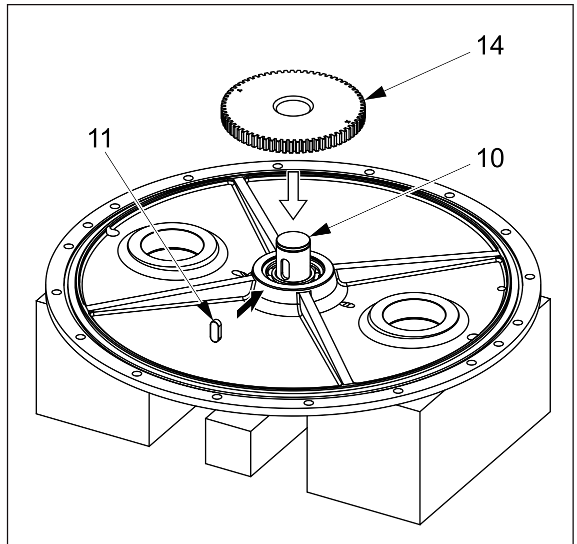
SW652ND-1-06061

24-5) 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).



SW652ND-1-06062

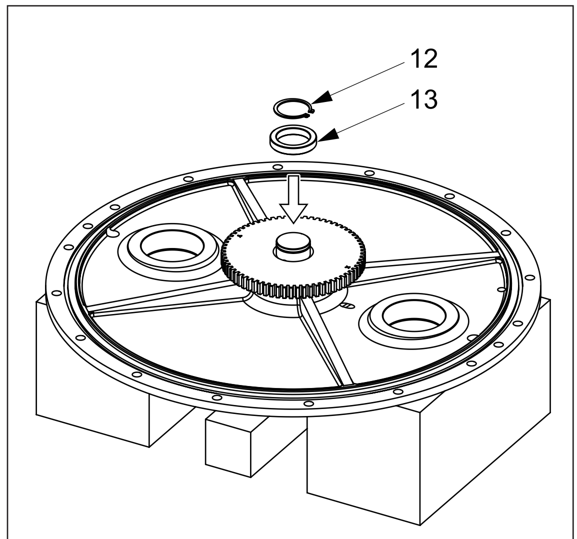
24-6) Heat up gear (14) by using a ring heater or the like.
- Drive sunk key (11) to shaft (10).
- Install heated gear.



SW652ND-1-06063

24-7) Install collar (13).
- Install retaining ring (12).

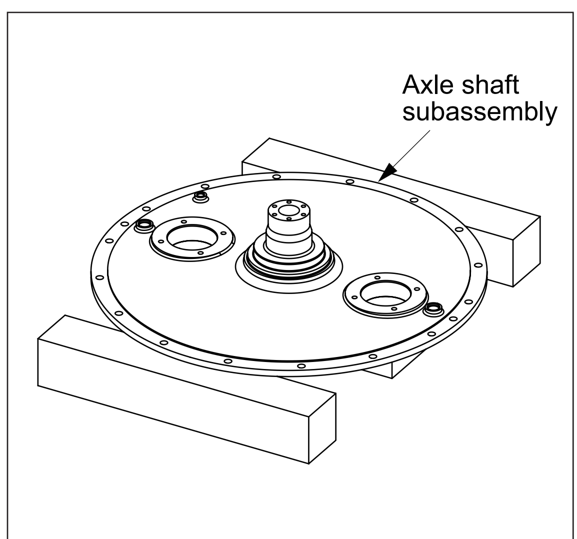
(NOTICE)
- **Make sure that the retaining ring is fitted completely in its groove.**



SW652ND-1-06064

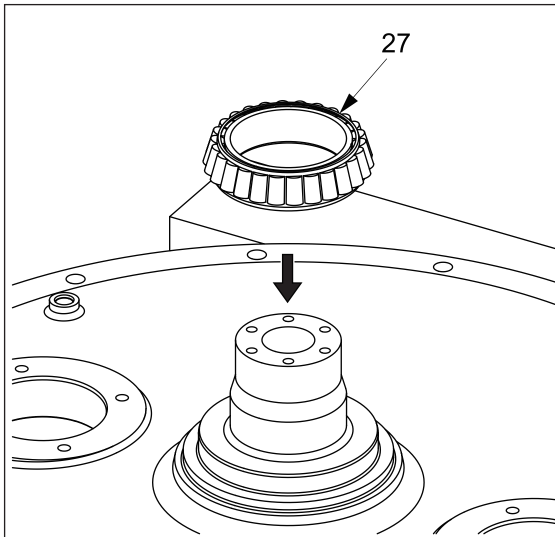
24-8) Reverse axle shaft subassembly.

kg Axle shaft subassembly : 165 kg (364 lbs.)



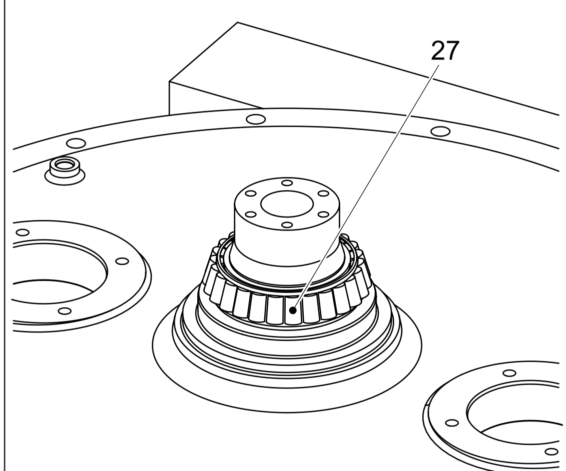
SW652ND-1-06065

24-9) 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.



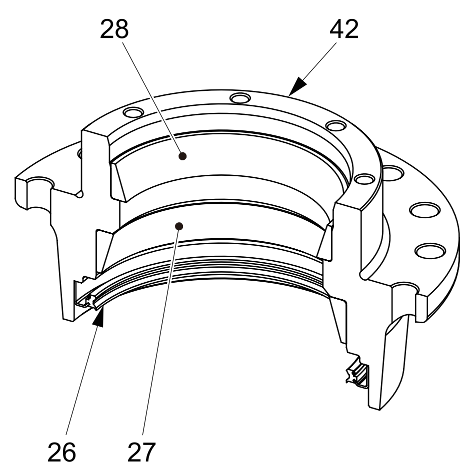
SW652ND-1-06066

24-10) Apply sufficient amount of lithium-based grease to rollers of roller bearing (27) inner race.



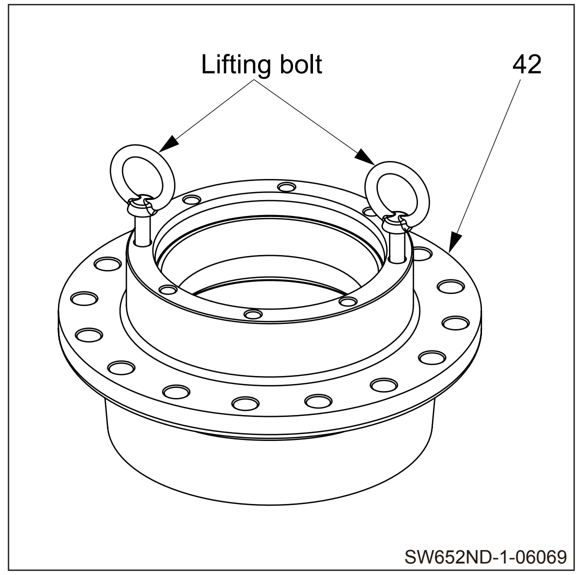
SW652ND-1-06067

24-11) 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.



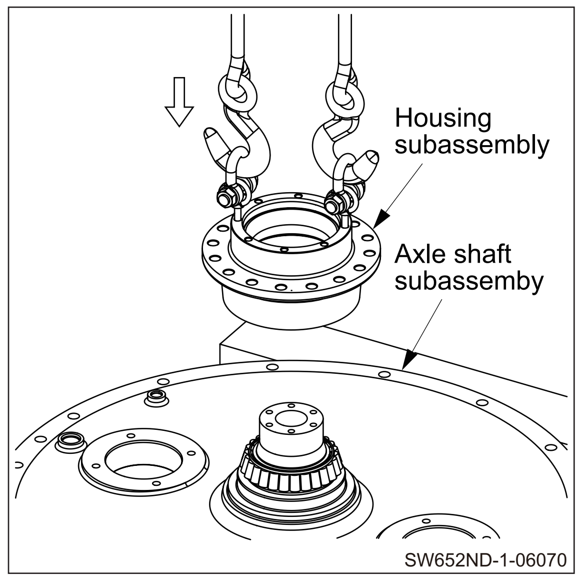
SW652ND-1-06068

24-12) Install lifting bolts (M10) to housing (42).



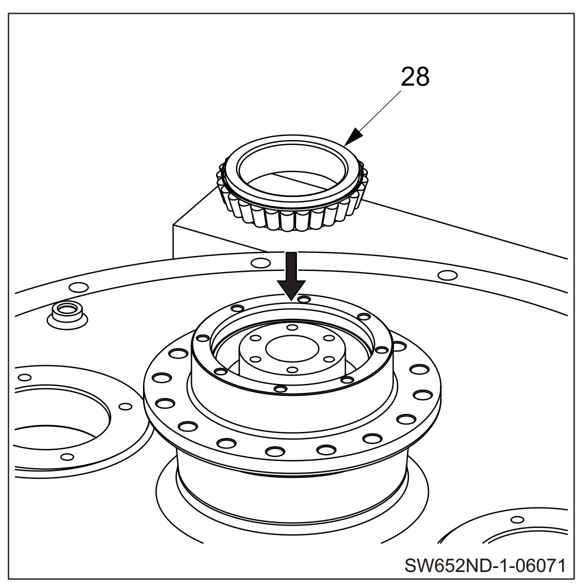
24-13) Install housing subassembly to axle shaft subassembly.

kg Housing subassembly : 20kg (44 lbs.)



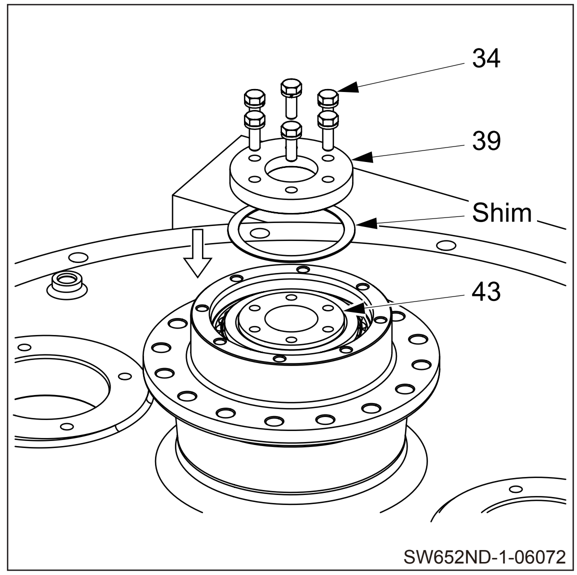
24-14) Apply sufficient amount of lithium-based grease to rollers of roller bearing (28) inner race.

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



24-15) 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 six bolts (34) and spring washers.

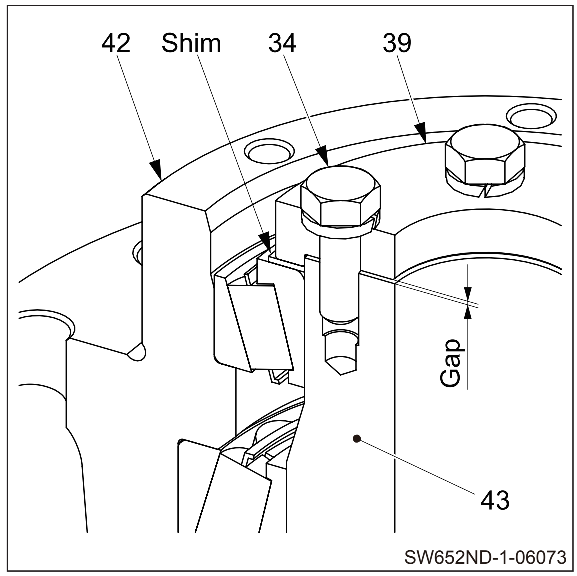


② A gap will remain between end of axle shaft (43) and inside of cover (39).

- Tighten bolts (34) to a torque of 60 N·m (44 lbf·ft).
- Give housing (42) two to three turns.
- Tighten bolts to a torque of 60 N·m (44 lbf·ft) again.
- Repeat this work several times until tightening torque of bolts no longer fluctuates.

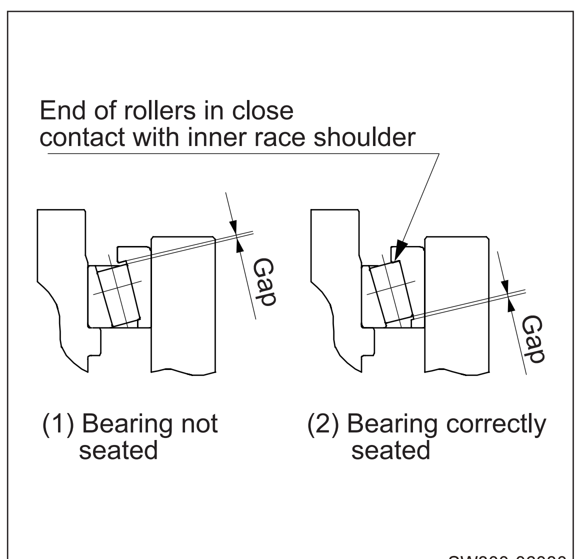
(NOTICE)

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



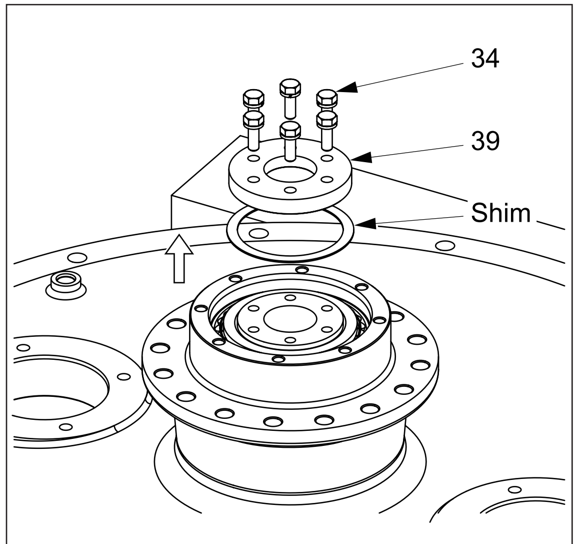
(NOTICE)

- **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.**



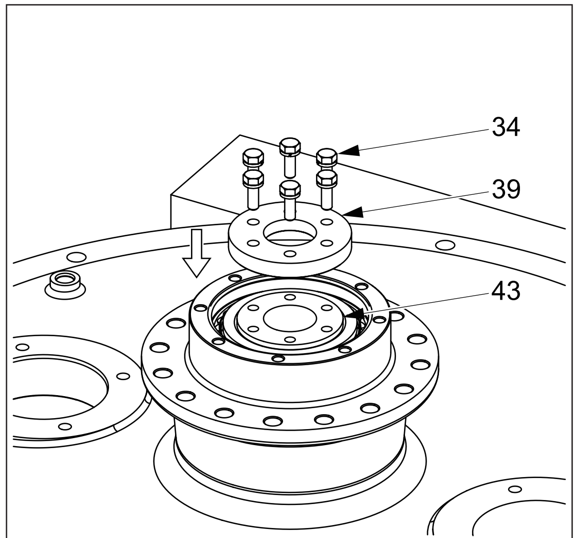
③ Remove bolts (34).
- Remove cover (39).
- Remove shim.

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



SW652ND-1-06103

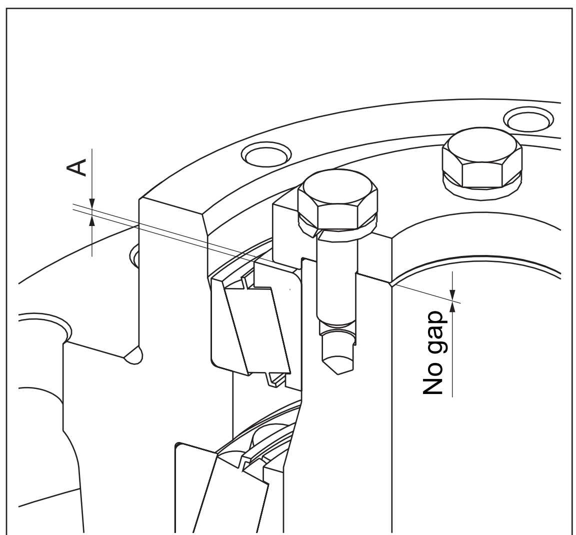
④ Without inserting shim, install cover (39) to axle shaft (43) with six bolts (34) and spring washers.



SW652ND-1-06074

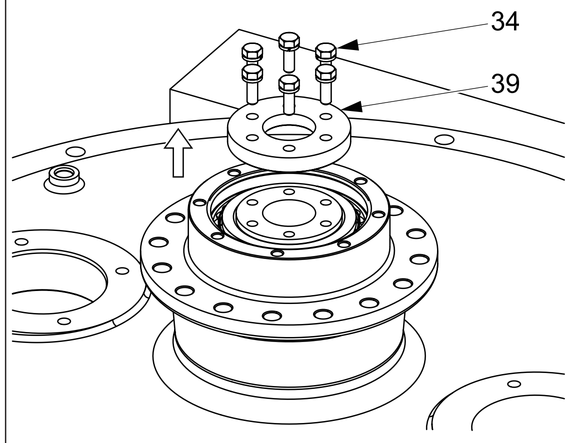
⑤ Using a thickness gauge, measure clearance “A”.

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



SW652-1-06055

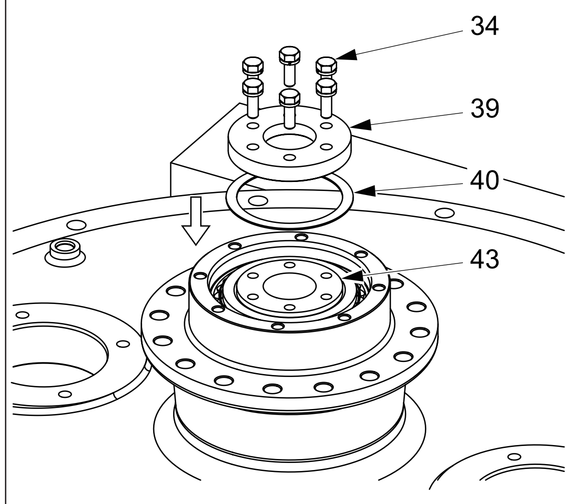
⑥ Remove bolts (34).
- Remove cover (39).



SW652ND-1-06102

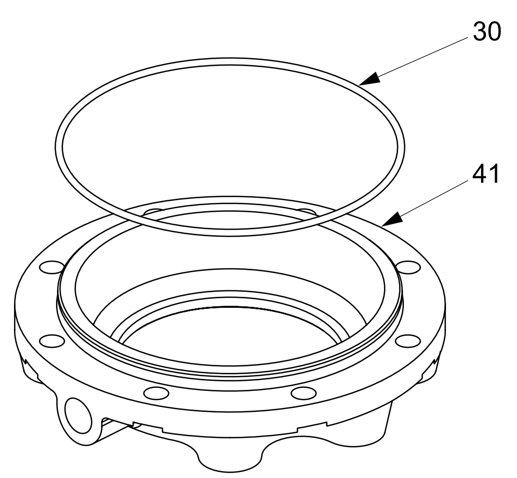
⑦ Install shim (40) of preload adjusting shim thickness = “A + 0.1 mm (0.004 in.)”.
- Secure cover (39) to axle shaft (43) with six bolts (34) and spring washers.

N•m (34) Bolts M10×30 : 60 N·m (44 lbf·ft)



SW652ND-1-06104

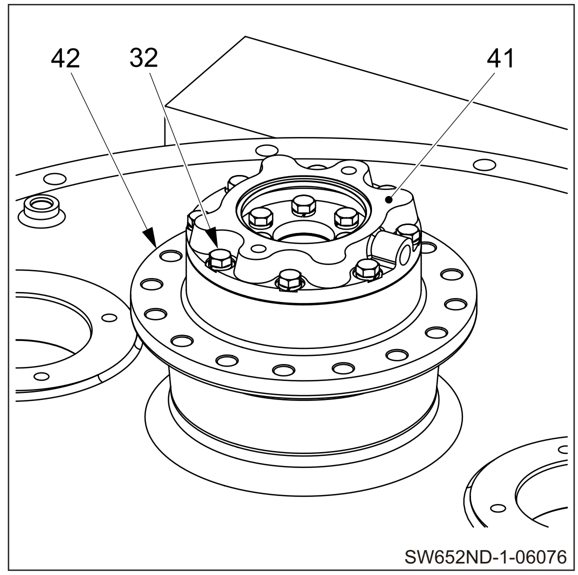
24-16) Apply grease to O-ring (30).
- Install O-ring to flange (41).



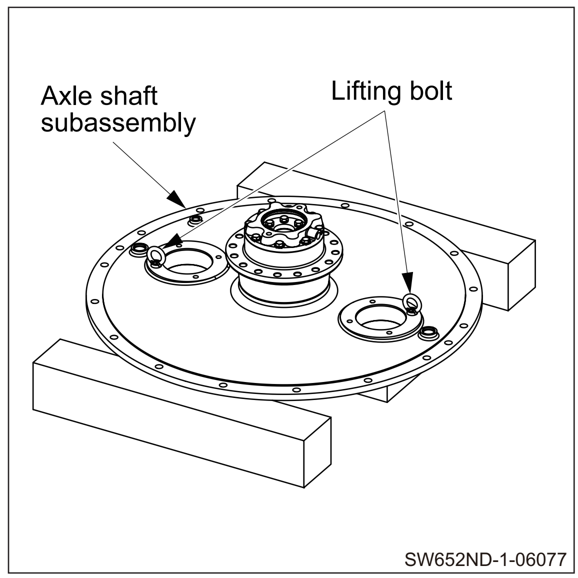
SW652ND-1-06075

24-17) Secure flange (41) to housing (42) with eight bolts (32) and spring washers.

N•m (32) Bolts M10×30 : 60 N·m (44 lbf·ft)



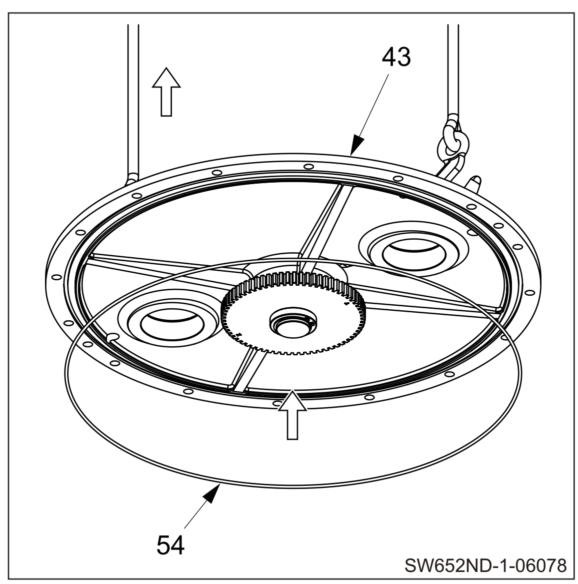
25) Install lifting bolts (M12) to axle shaft subassembly.



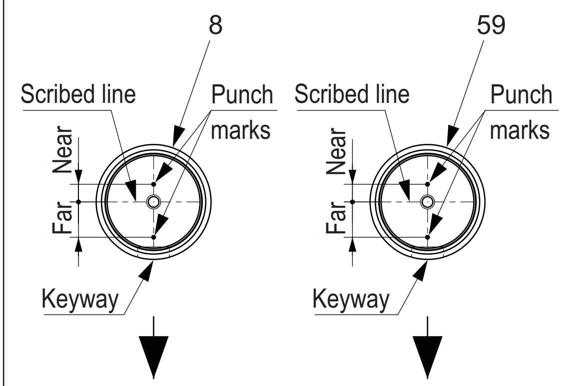
26) Lift axle shaft subassembly.

kg Axle shaft subassembly : 195 kg (430 lbs.)

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



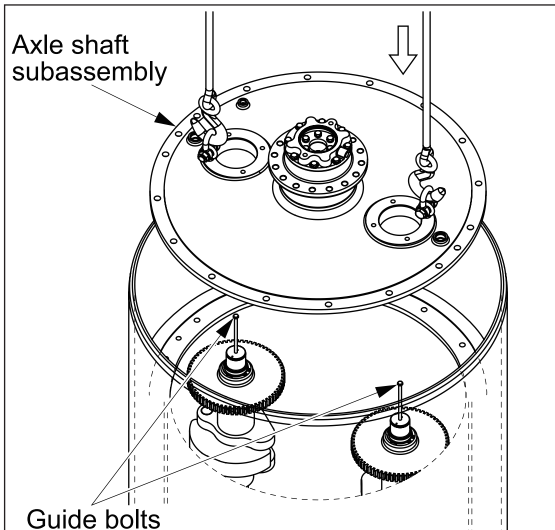
27) Place punch marks on end of eccentric shafts (8) and (59) as shown right.



SW652ND-1-06057

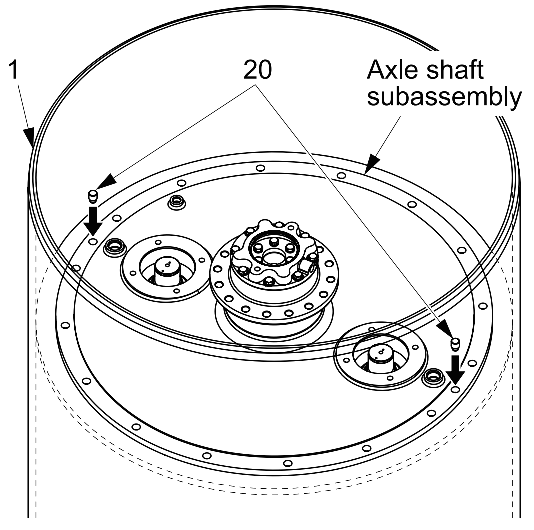
28) Install long guide bolts to end of both eccentric shafts.
- Lower axle shaft subassembly on mounting surface of drum while taking care not to move punch marks on each eccentric shaft.

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



SW652ND-1-06079

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

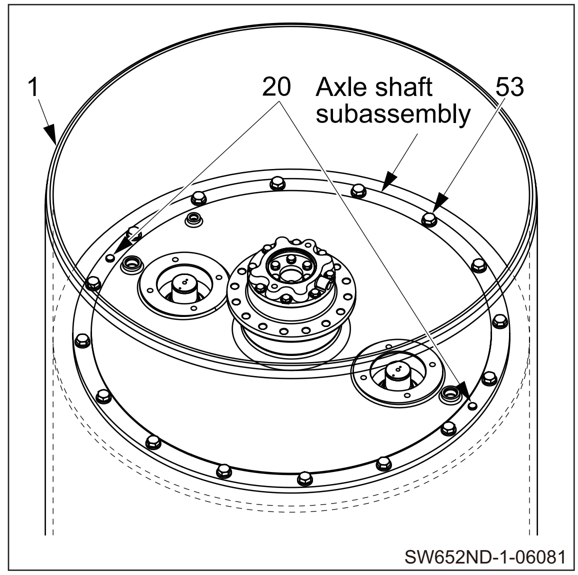


SW652ND-1-06080

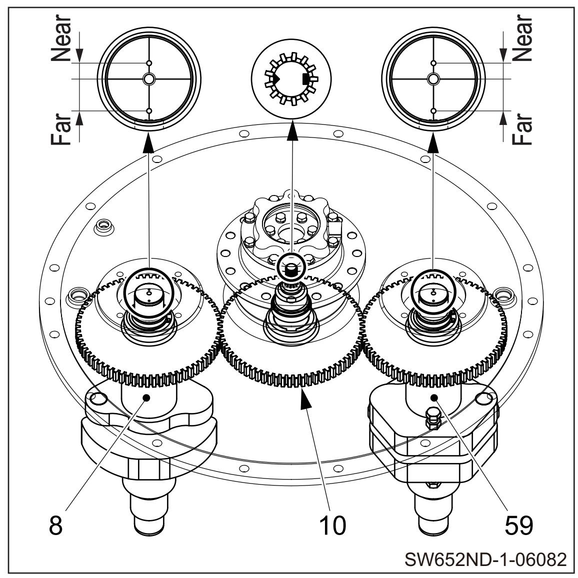
30) Secure axle shaft subassembly to drum (1) with sixteen bolts (53) and washers.

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

- Drive in locating pins (20) again.

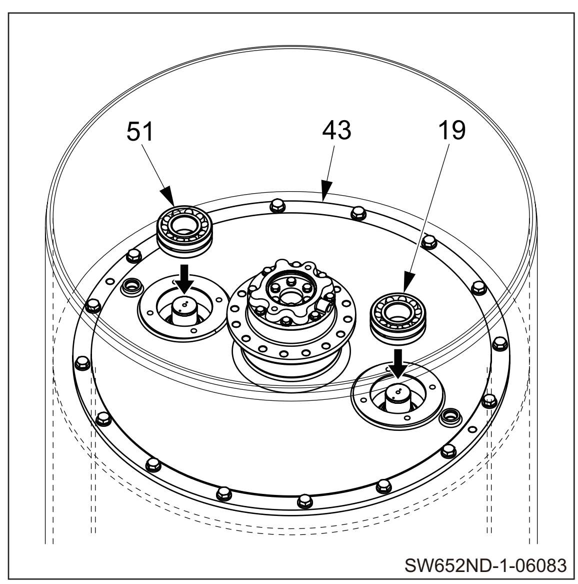


31) Make sure that punch marks on shaft (10) of eccentric shafts (8) and (59) are as shown right.



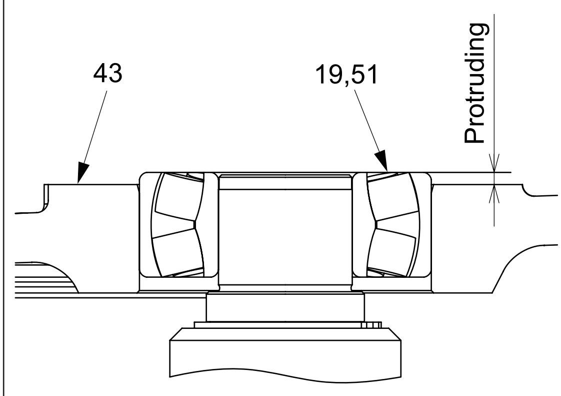
32) Apply a coat of gear oil to axle shaft (43) at where bearings will be press-fitted and to eccentric shafts at where bearings will be installed.

- Drive in vibrator bearings (19) and (51).



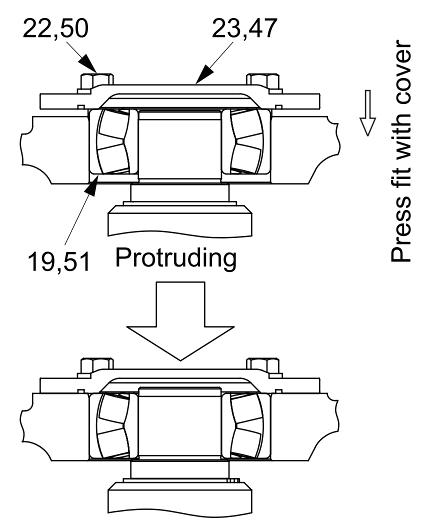
(NOTICE)

- **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.**



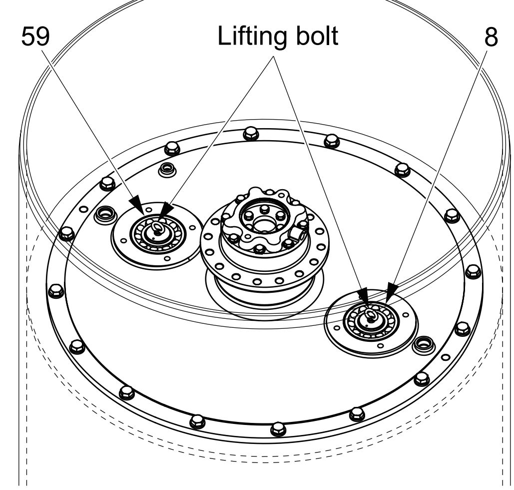
SW652ND-1-06084

33) 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.



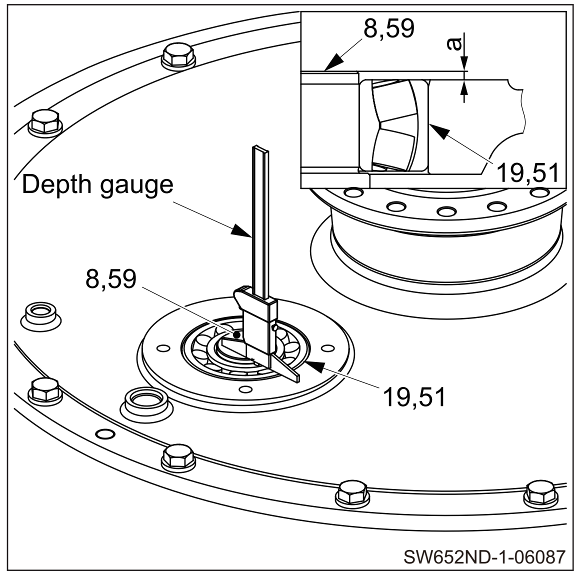
SW652ND-1-06085

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

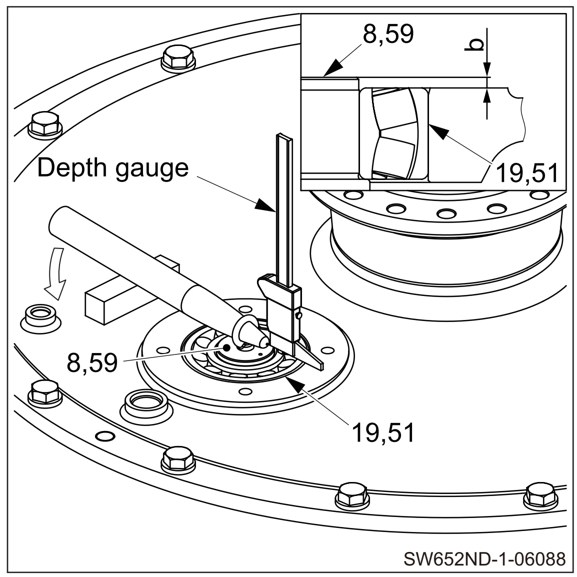


SW652ND-1-06086

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



36) 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.

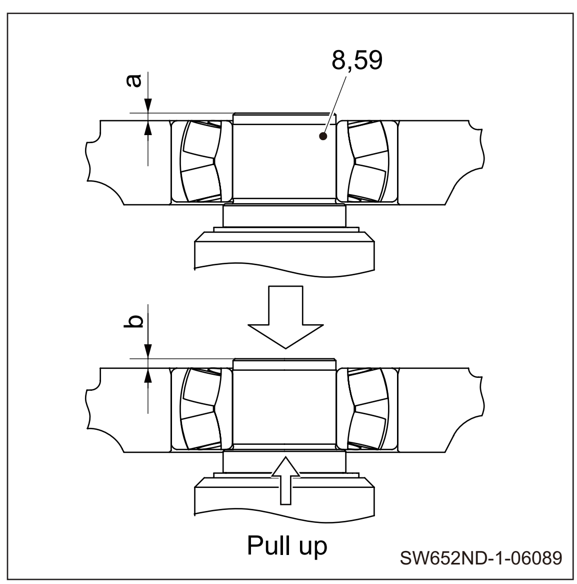


37) Make sure that eccentric shafts (8) and (59) have an axial play of 1 mm (0.04 in.) or more.

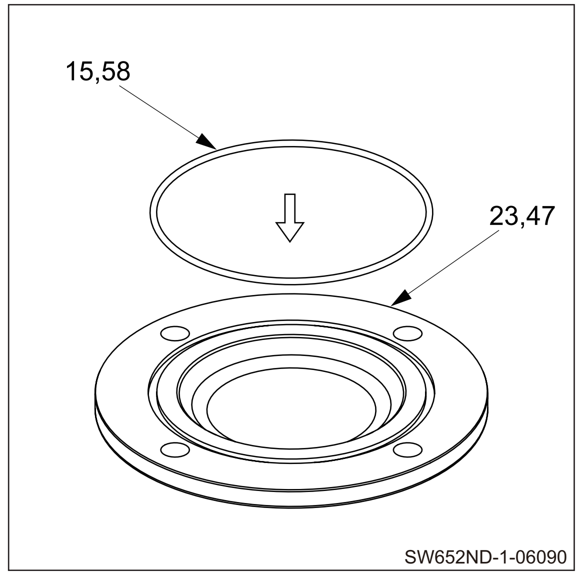
b = a + 1 mm (0.04 in.) or more

(NOTICE)

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

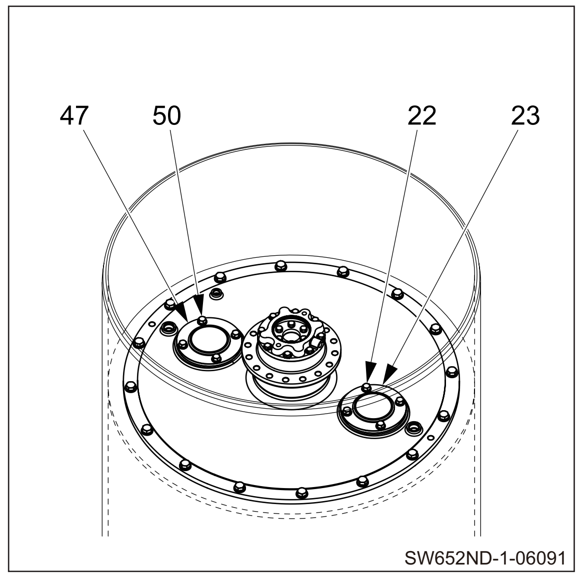


38) Apply grease to O-rings (15) and (58).
- Install O-rings to covers (23) and (47).

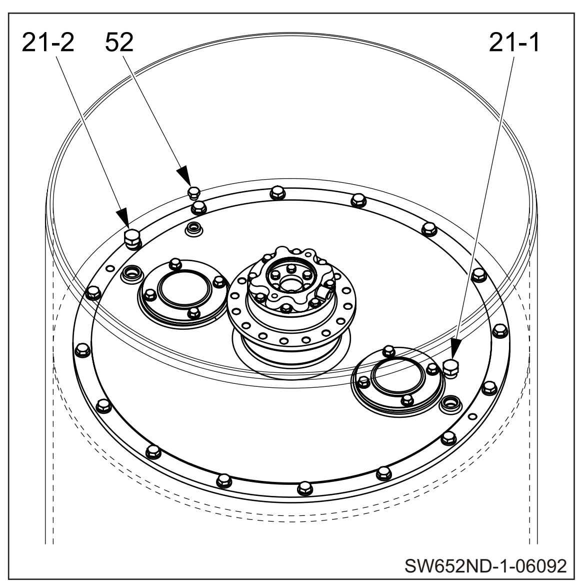


39) Secure covers (23) and (47) to axle shaft subassembly with four bolts (22), four bolts (50), and washers.

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

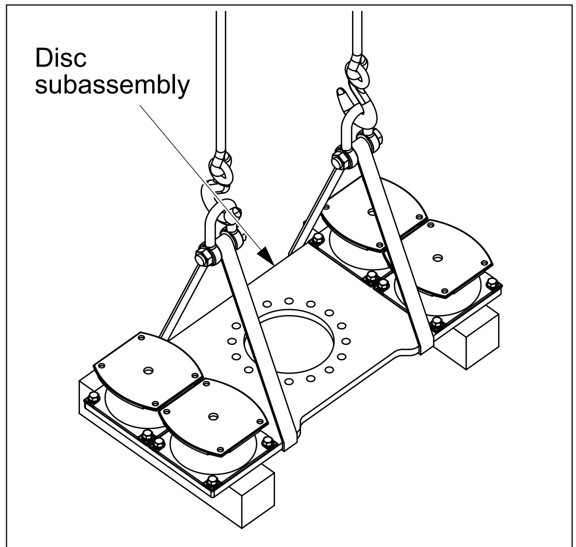


40) Apply grease to O-rings for plugs (21-1), (21-2), and level plug (52).
- Install plugs and level plug.



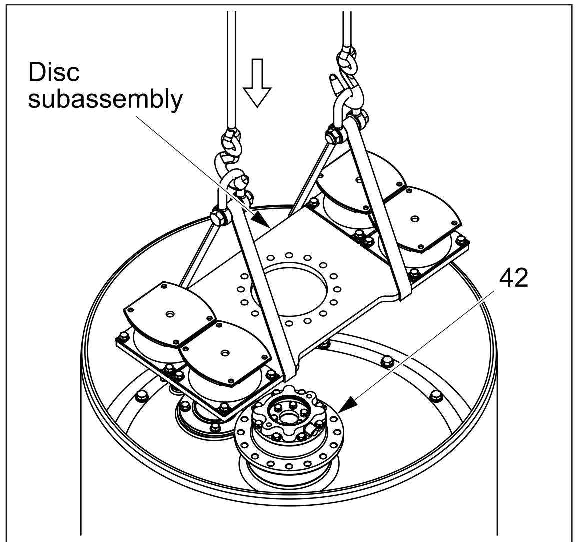
41) Lift disc subassembly.

Disc subassembly : 75kg (165 lbs.)



SW652-1-06064

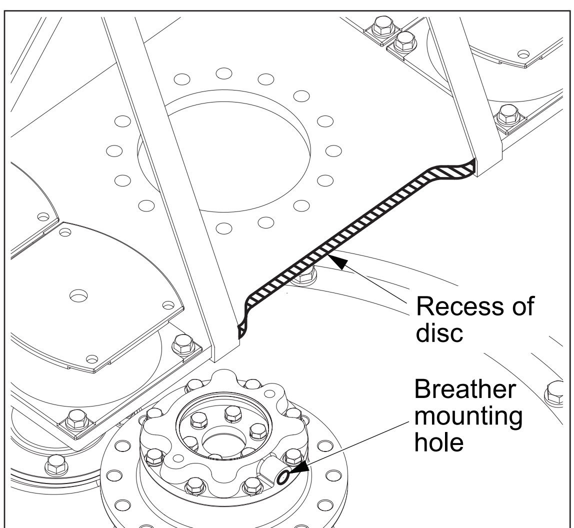
42) Lower disc subassembly on mounting surface of housing (42).



SW652ND-1-06094

(NOTICE)

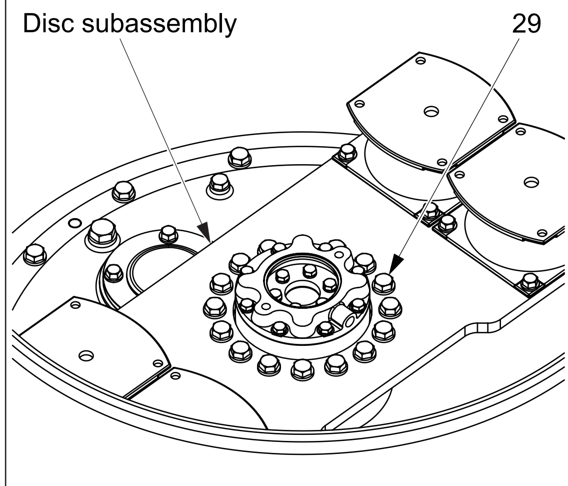
- **The recess of the disc must face the same direction as the breather mounting hole in the flange.**



SW652ND-1-06095

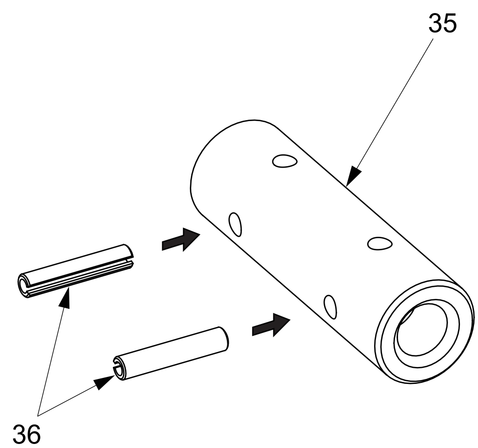
43) Secure disc subassembly with sixteen bolts (29) and washers.

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



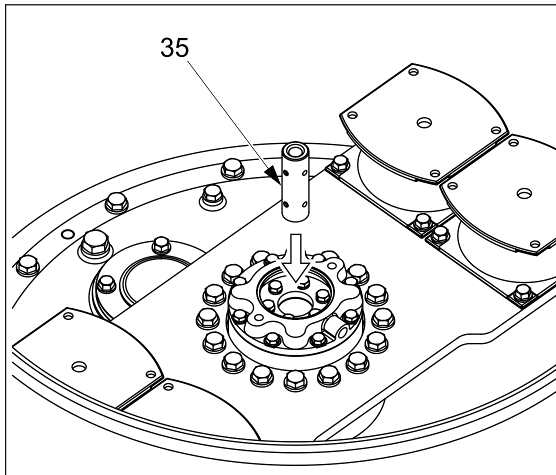
SW652ND-1-06096

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



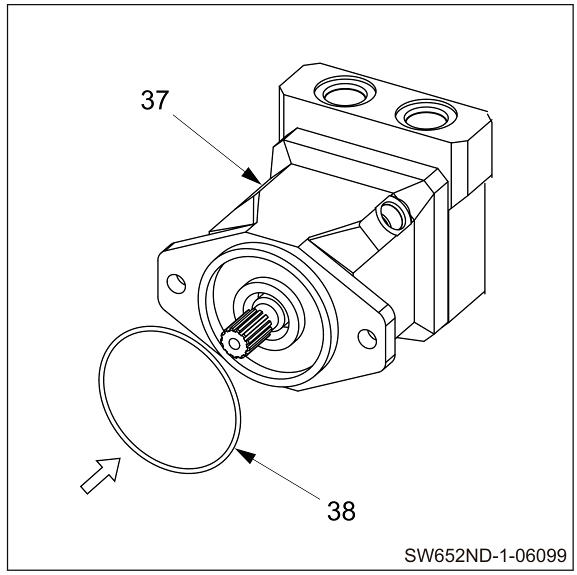
SW652ND-1-06097

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



SW652ND-1-06098

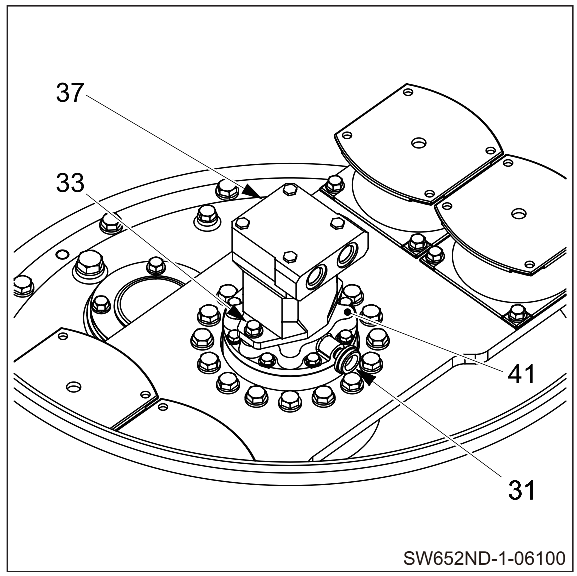
46) Apply grease to O-ring (38).
- Install O-ring to vibrator motor (37).



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

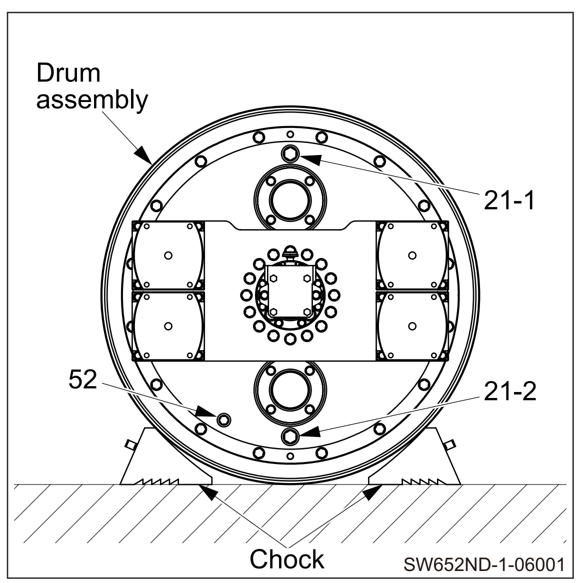
kg (37) Vibrator motor : 15 kg (33 lbs.)

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



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

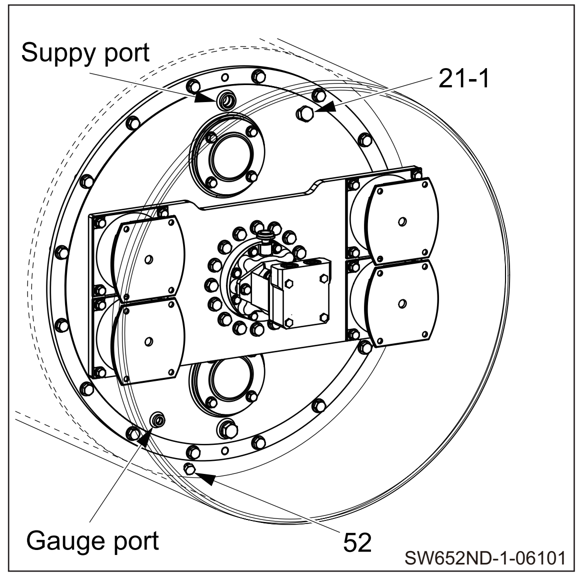
kg Drum assembly : 1,665 kg (3,671 lbs.)



49) Remove plug (21-1) and level plug (52).
- Supply gear oil from oil supply port.
- Check that oil drips from gauge port.

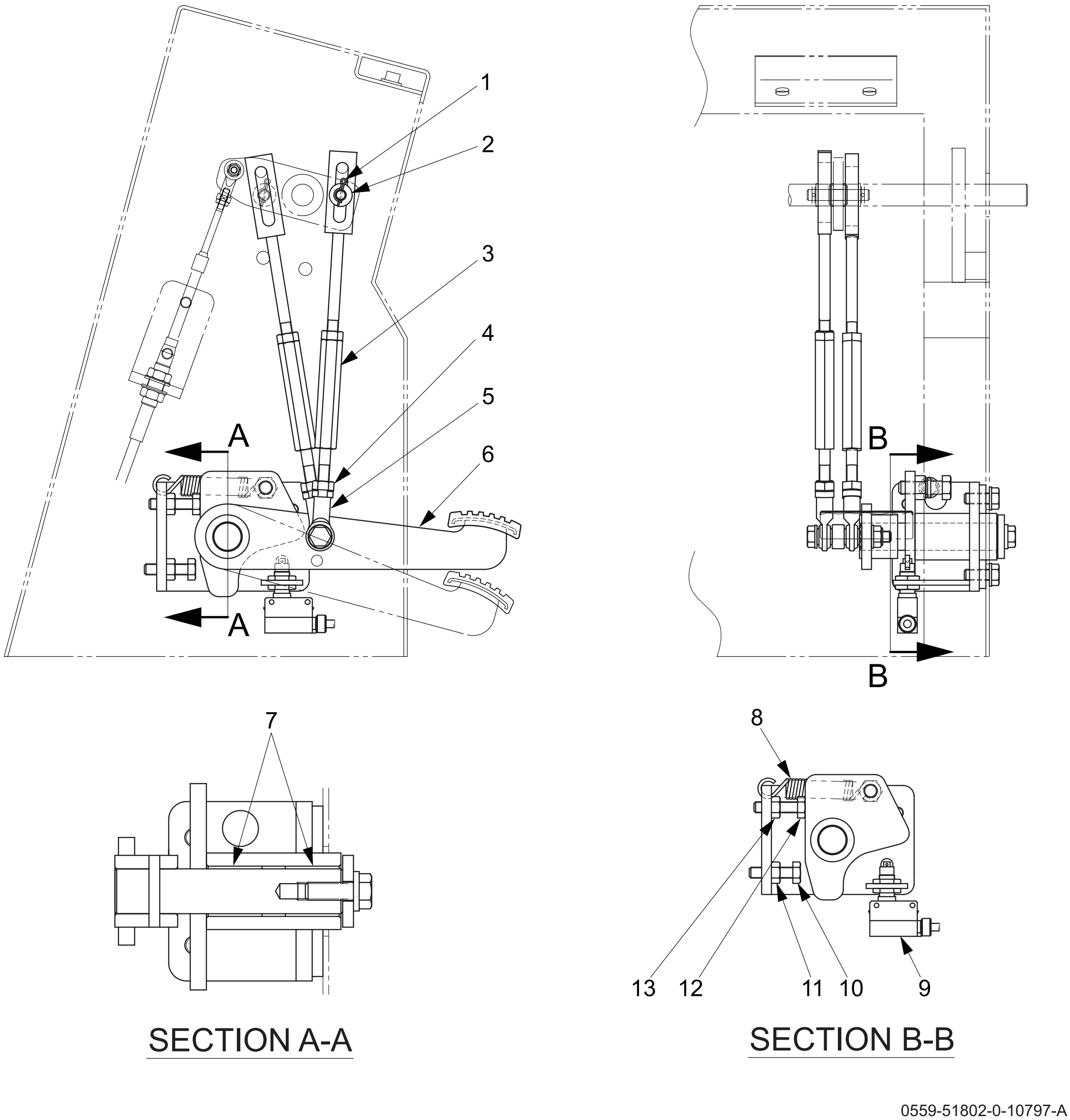
  • Quantity of gear oil : 10.4 L (2.7 gal.)

- Install plug and level plug.



BRAKE

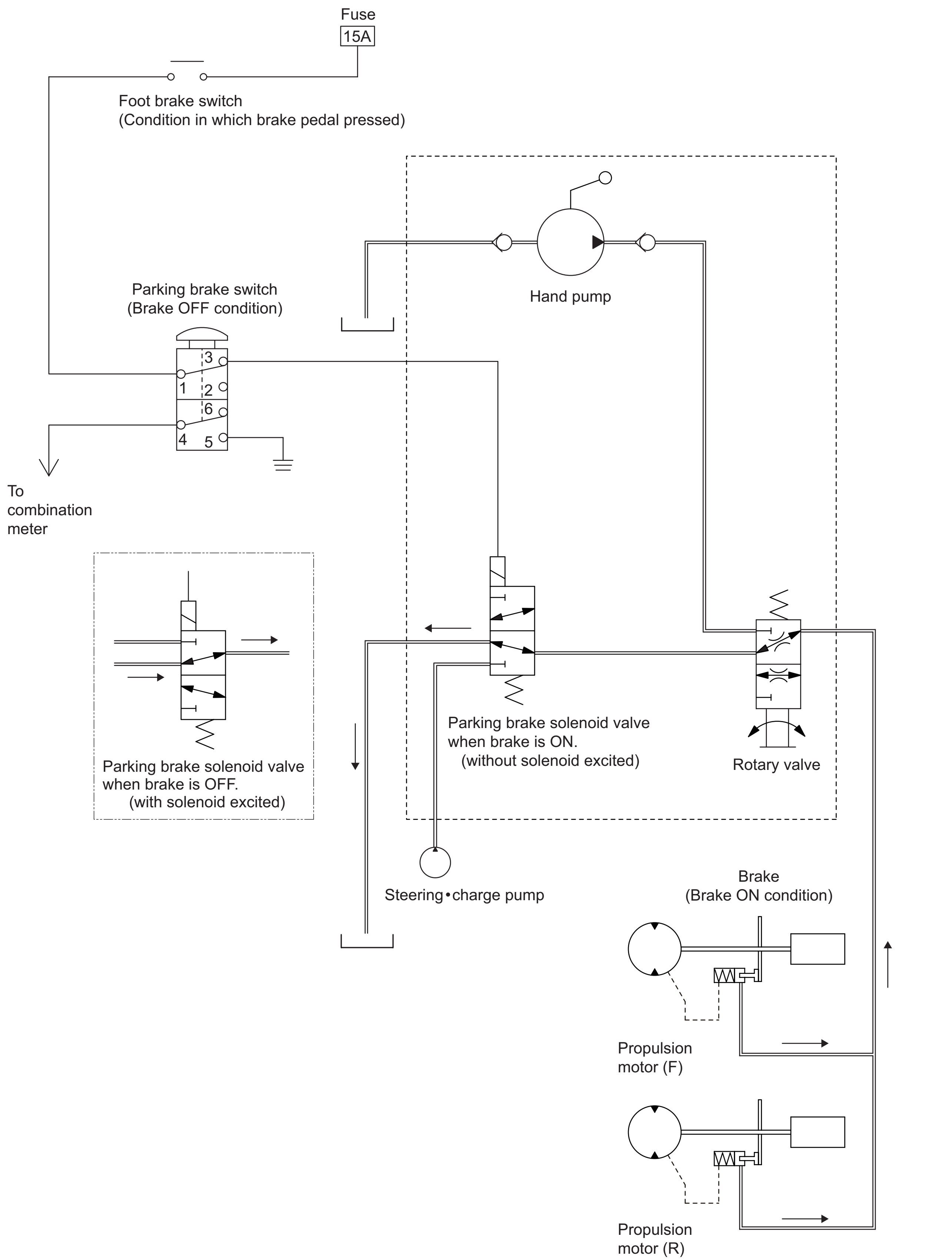
1. BRAKE PEDAL



(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



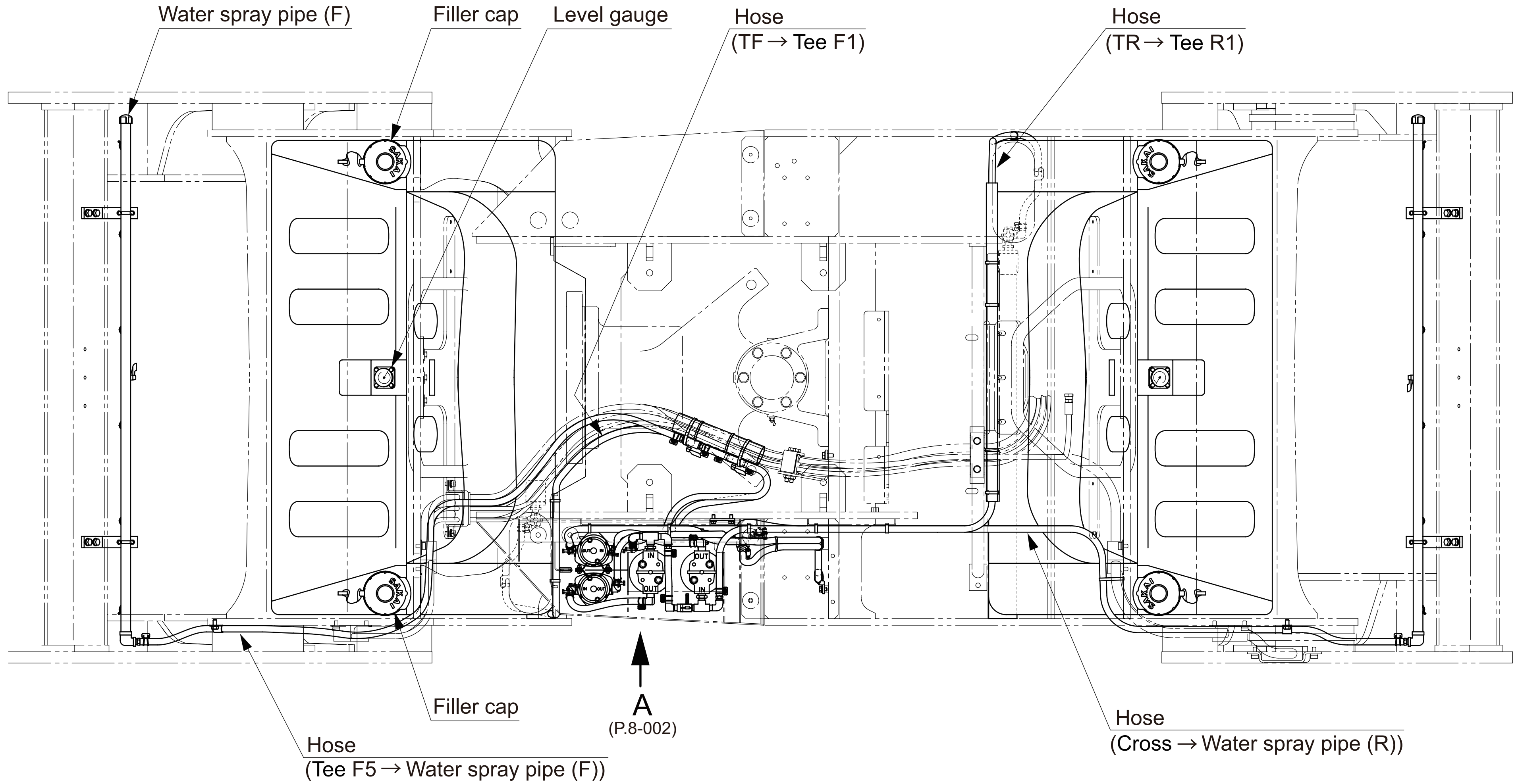
・The arrow (→) symbol shows the direction of the hydraulic oil flow.

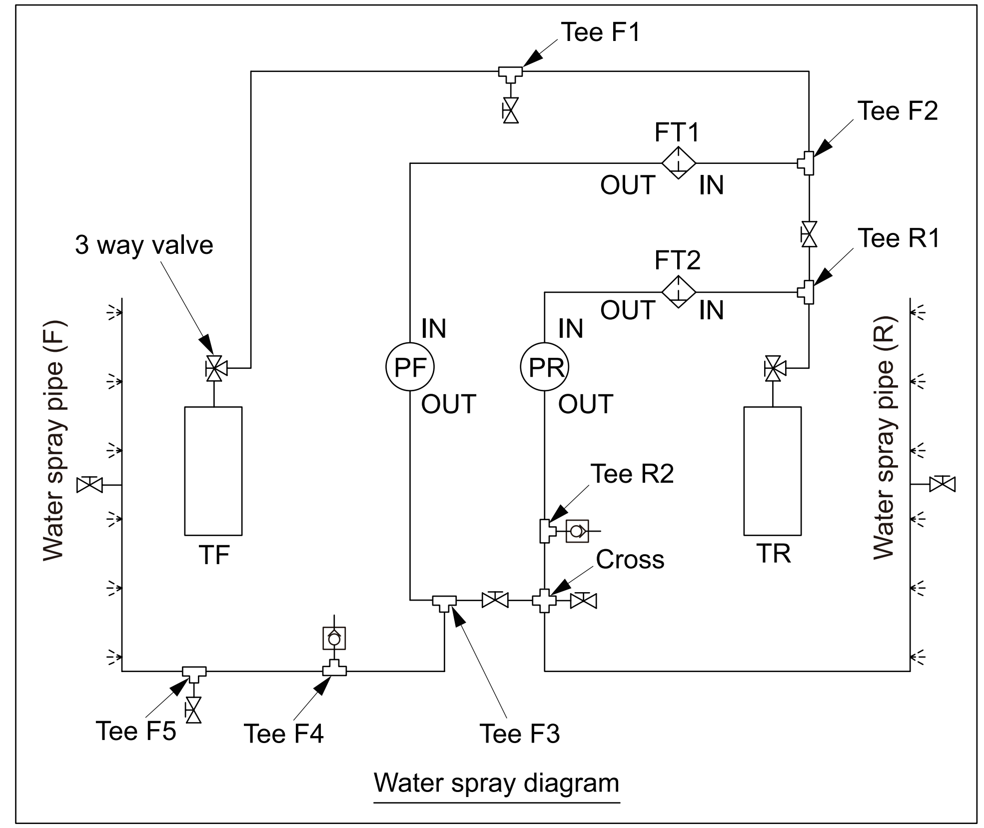
SW654-07001

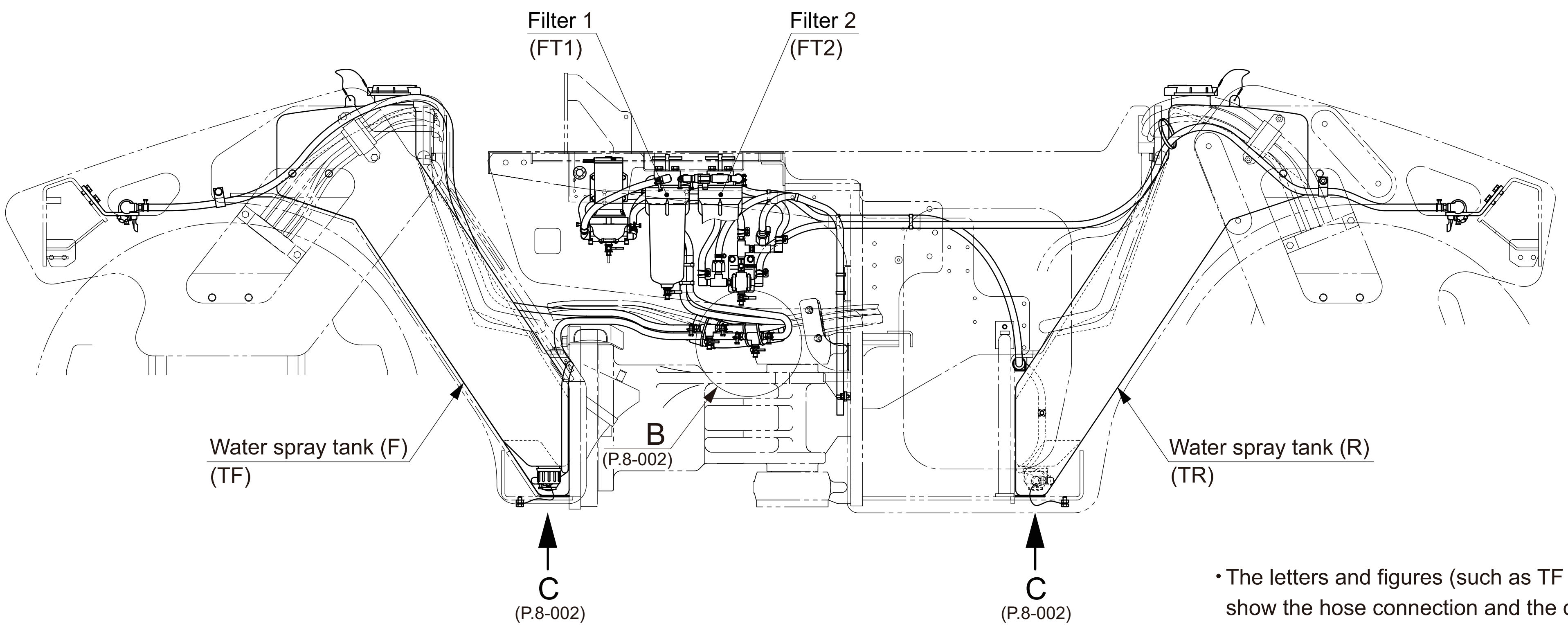
WATER SPRAY SYSTEM

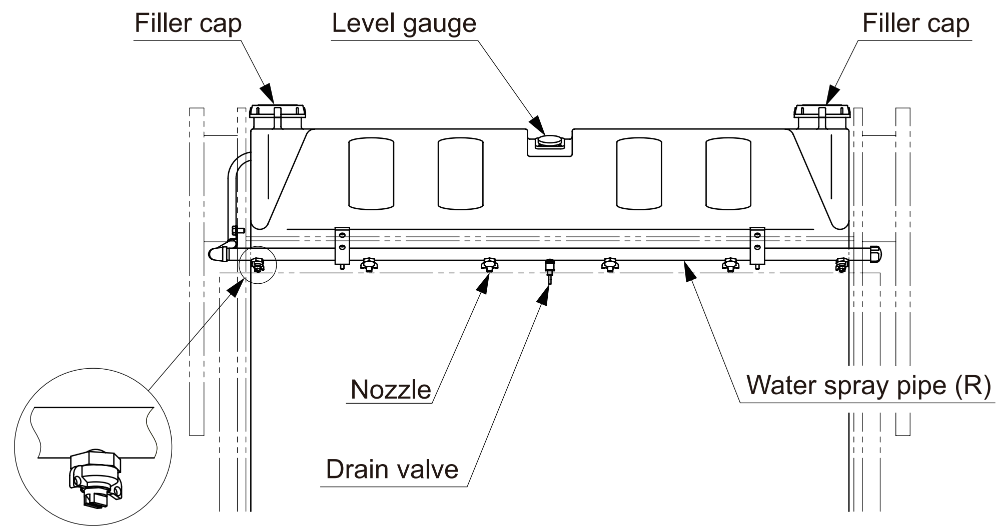
1. WATER SPRAY PIPING

1-1. Water Spray Piping (1)





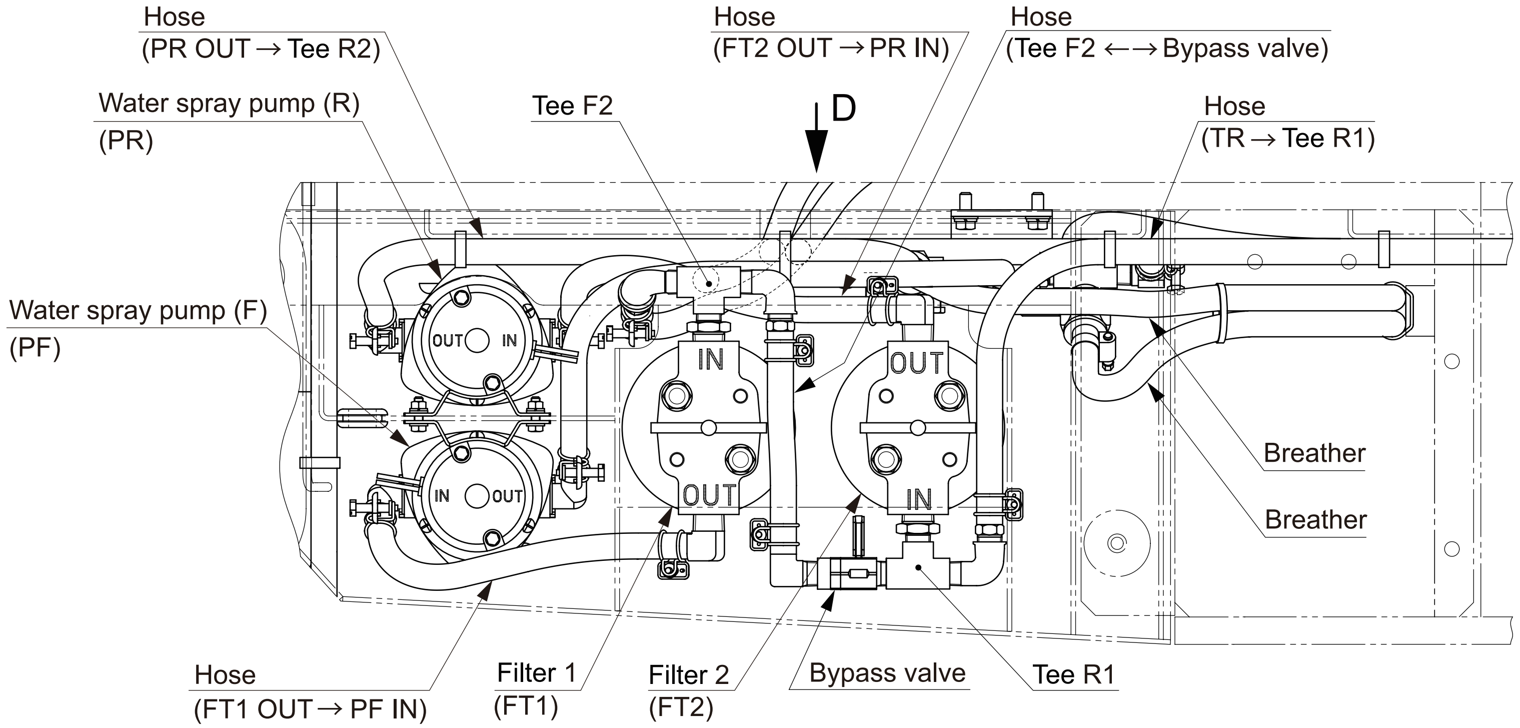


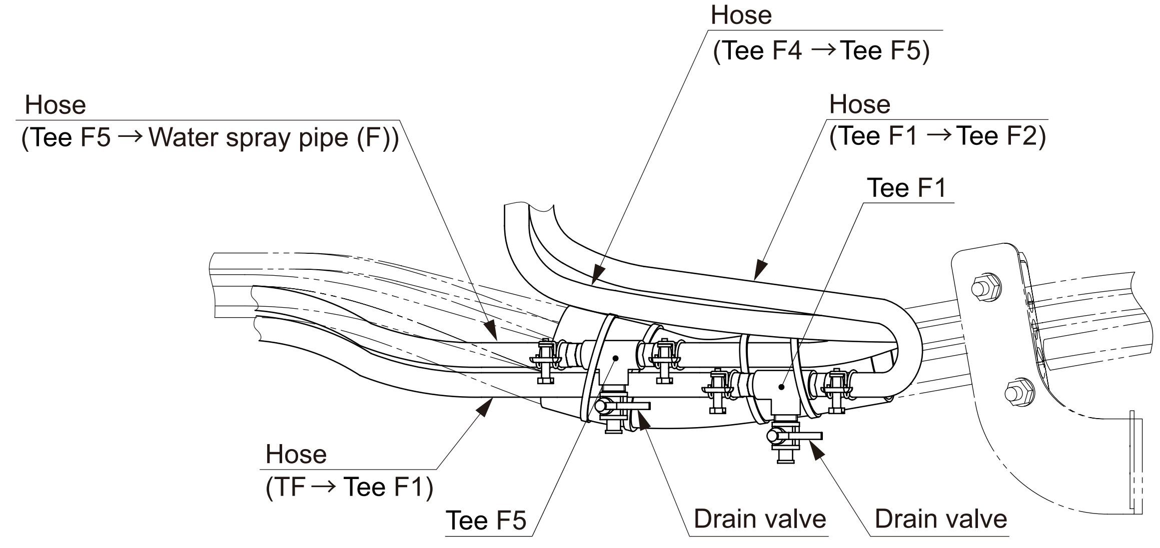


・The letters and figures (such as TF and Tee F1) show each port and the arrow (→) symbols show the hose connection and the direction of the flow of the water.

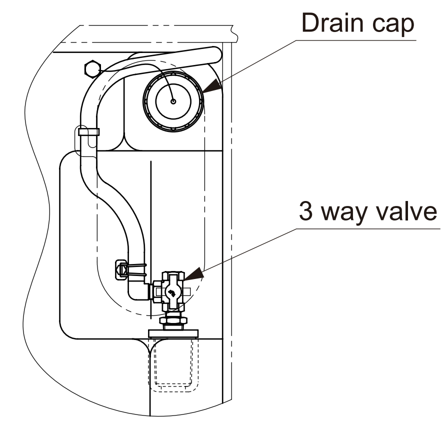
0559-75807-0-10911-B

1-2. Water Spray Piping (2)

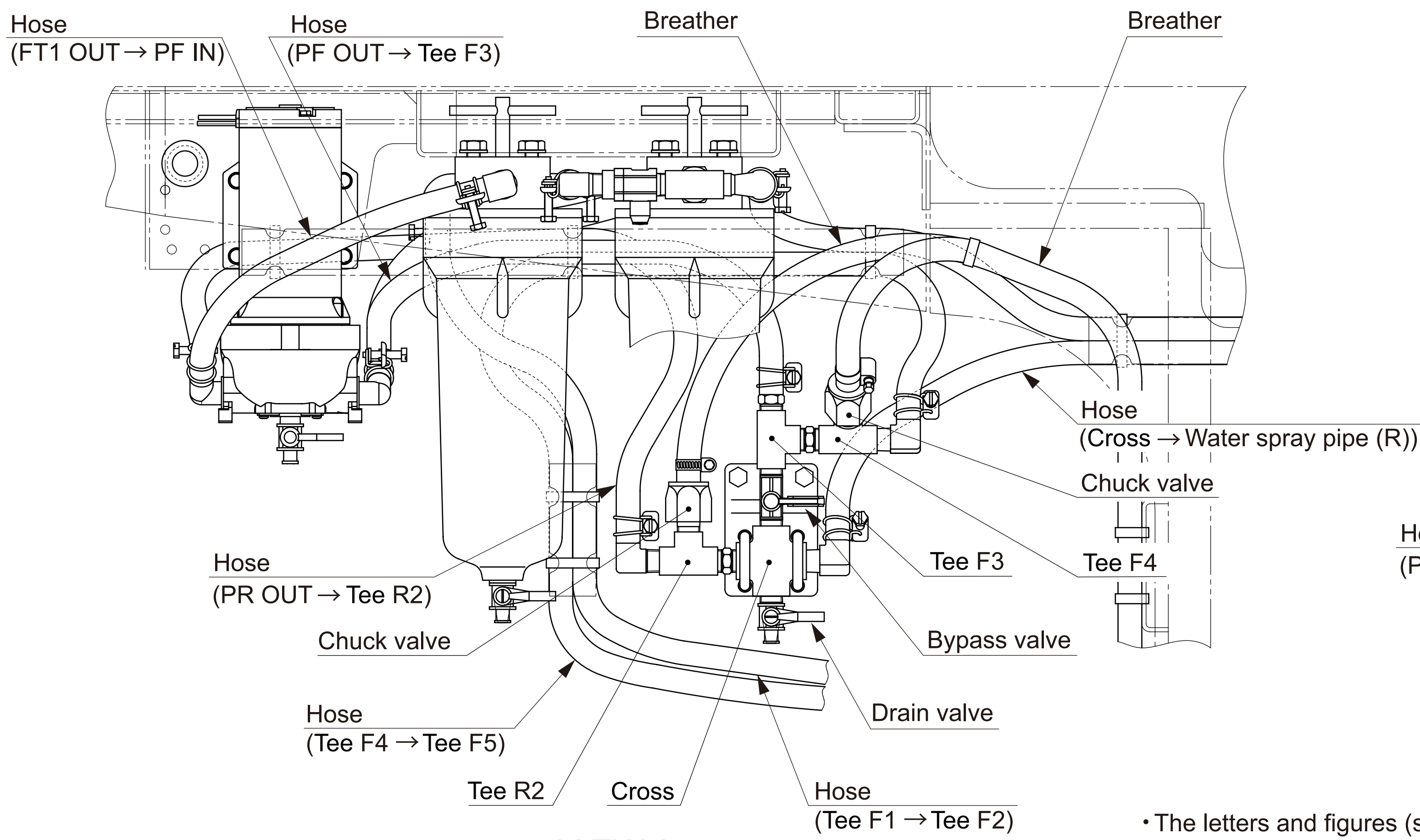




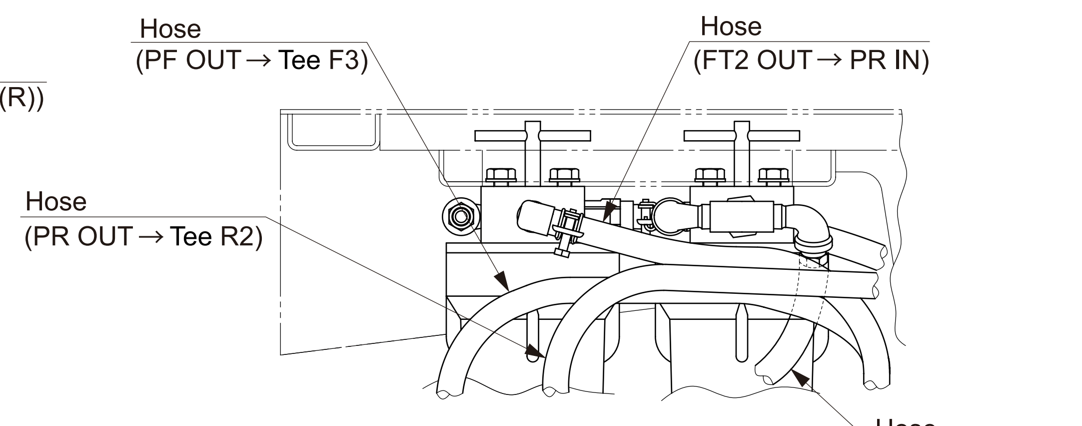
DETAIL B



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

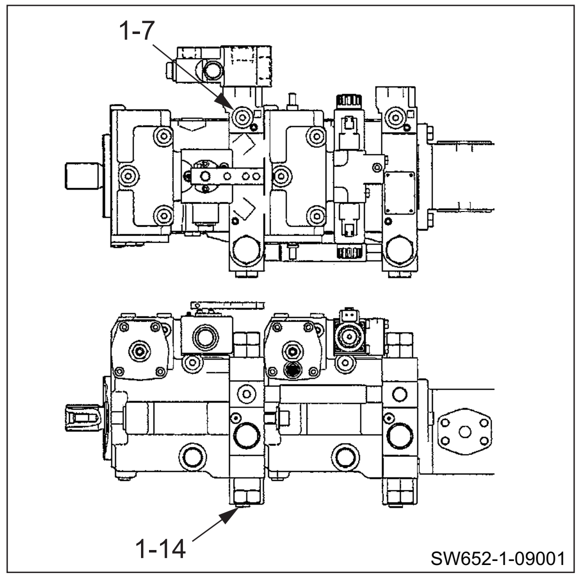
> **⚠WARNING**
>
> **Confirm that the parking brake works properly before measurement.**

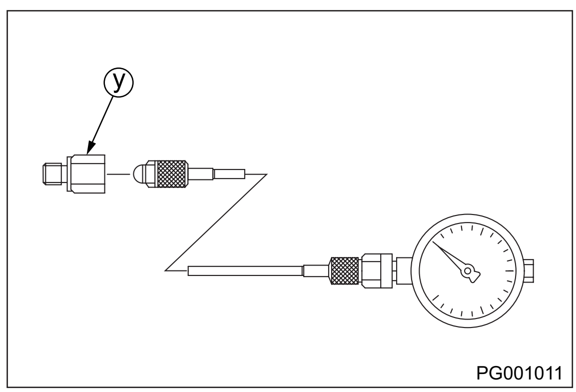
- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

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) : (1-7)
  - High pressure gauge port (Reverse) : (1-14)
  - 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)

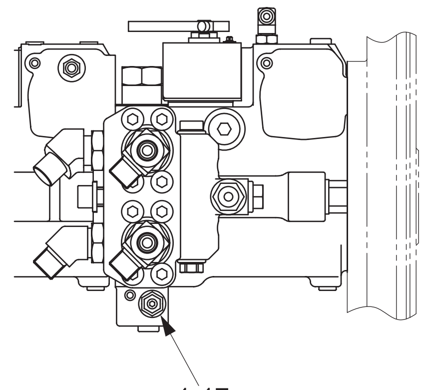




- The numbers “1-7” and “1-14” appearing in above illustrations are consistent with lead line numbers shown in illustration of hydraulic pump assembly in “2-2. Hydraulic Component Specifications” (P.4-007).

2-2. Adjustment

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



SW654-09018

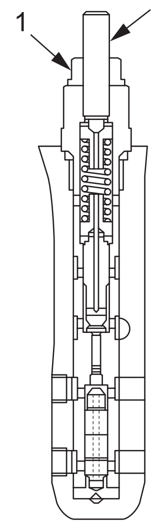
2-2-1. If pressures on both forward and reverse sides deviate from maximum circuit pressure range by same value

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)



SW652-1-09003

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) : (1-11)
- High pressure relief valve (Reverse) : (1-13)

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.

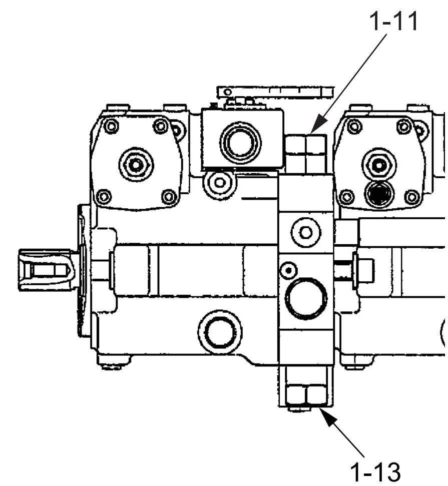
⑧ If trapped dirt is present, disassemble and clean high pressure relief valve.

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.

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)



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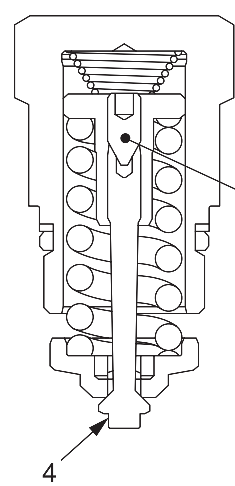


SW652-1-09005

(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)

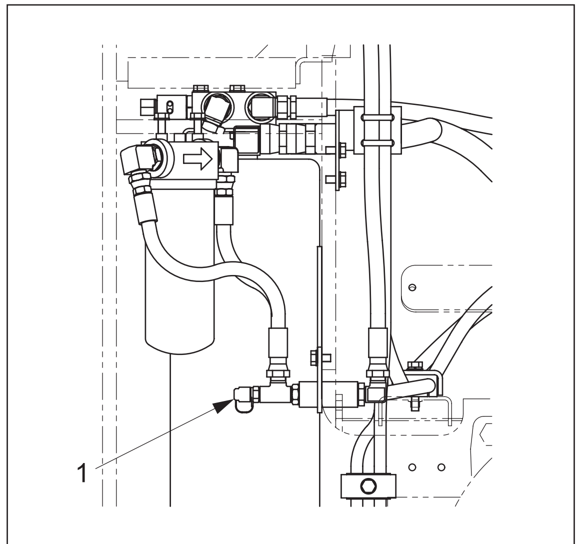
② Confirm that F-R lever is “N”.

③ Apply parking brake by pressing parking brake switch button.

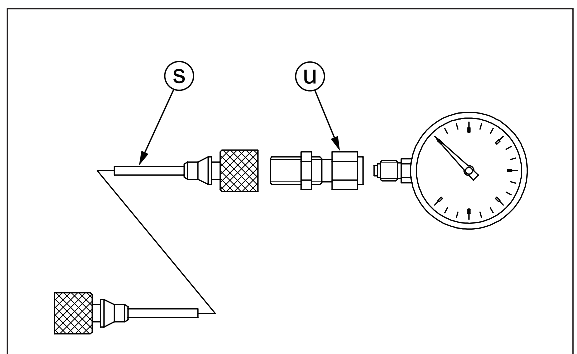
④ Start the engine and set throttle lever to “Full”.

⑤ Read pressure indicated by pressure gauge.

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



SW654-09008



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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.

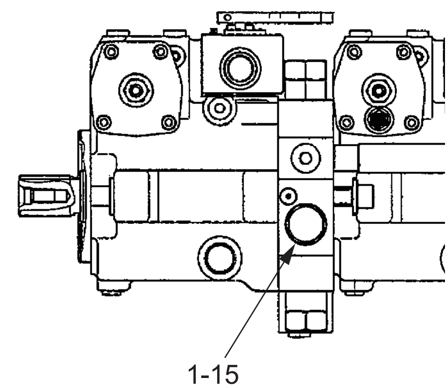
⑥ If a scratch is found on seat, replace charge relief valve.

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.**



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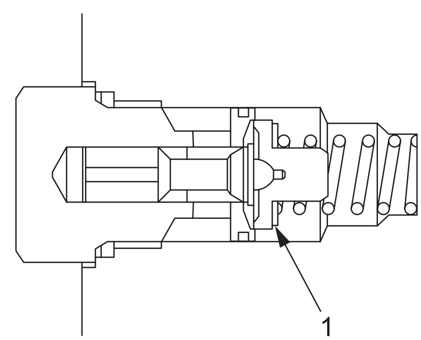


SW652-1-09008

- 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

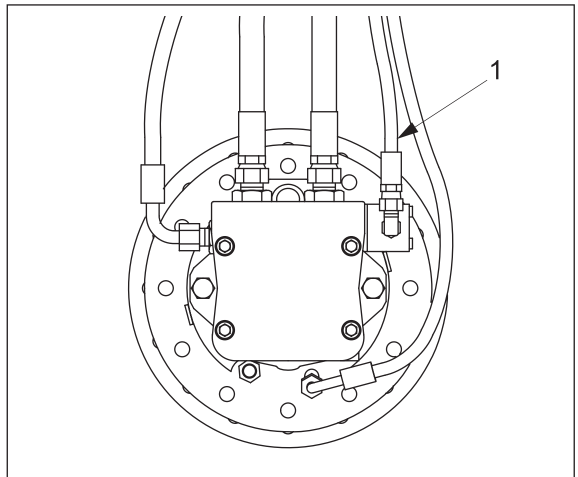
- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

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.

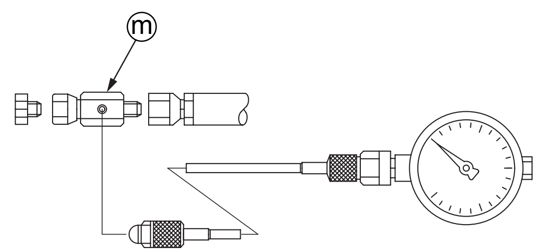
★ **Standard charge relief valve setting**

: 2.4 ± 0.2 MPa (348 ± 29 psi)



Propulsion motor

SW652-1-09009



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5. MEASUREMENT OF PROPULSION SERVO CIRCUIT PRESSURE

5-1. Measurement

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

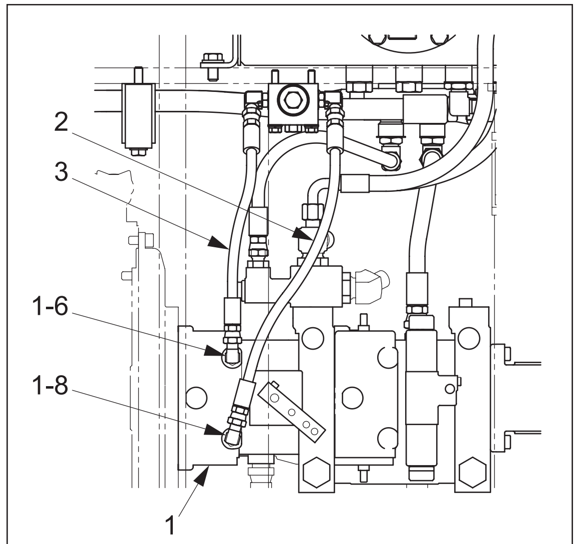
① Disconnect hoses (2) and (3) from propulsion pump (1). Attach pressure gauge through adapter ⓜ .
  - Adapter ⓜ : G1/4
  - Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Confirm that F-R lever is “N”.

③ Apply parking brake by pressing parking brake switch button.

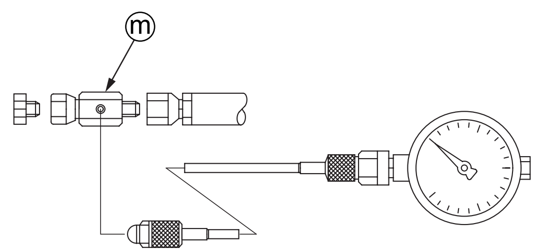
④ Start the engine and set throttle lever to “Full”.

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.



SW654-09007

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



PG002002

- 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 $\pm$ 5°C (122 $\pm$ 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".

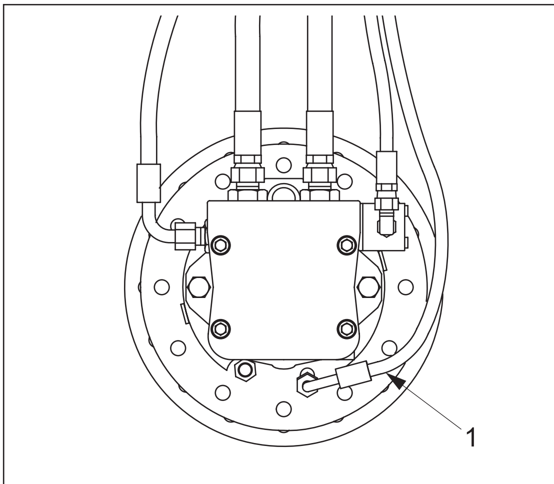
③ Apply parking brake by pressing parking brake switch button.

④ Start the engine and set throttle lever to "Full".

⑤ Release parking brake by pressing parking brake switch button.

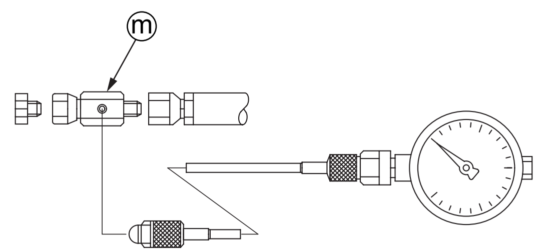
⑥ Read brake release pressure indicated by pressure gauge.

★ **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

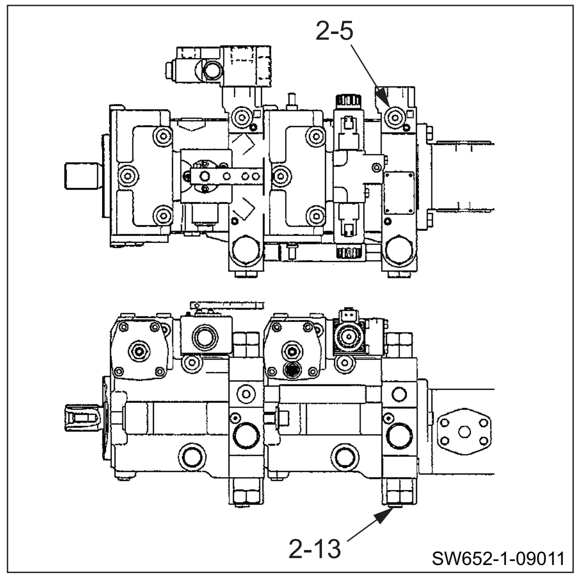
Take care not to operate the vibratory drum for a longer period of time than necessary with the machine stationary. Otherwise, the vibrator bearing could be seized.

- 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)**



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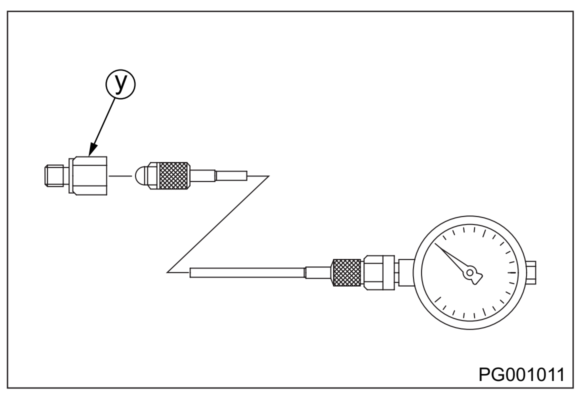
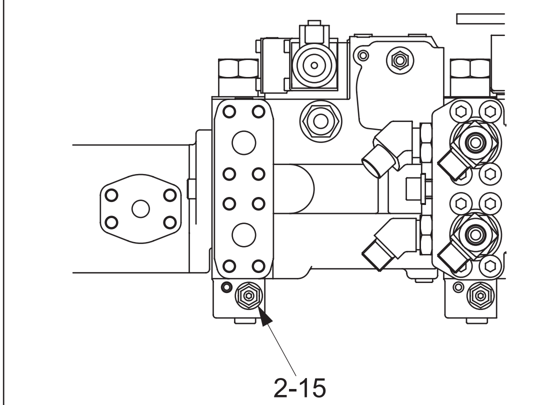


PG001011

- 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.



SW654-09019

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)

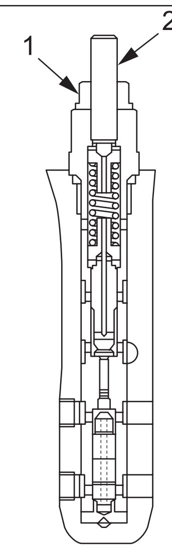
③ If there is no evidence of nut having loosened, remove cut off valve.

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.



SW652-1-09003

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)

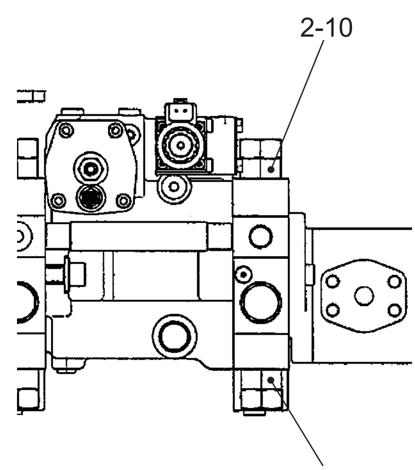
⑥ If there is no evidence of high pressure relief valve having loosened, remove it.

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.



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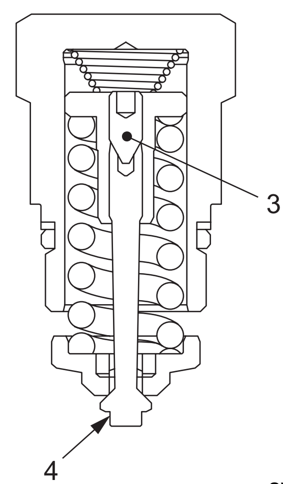


SW652-1-09005

N·m		
(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)

(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

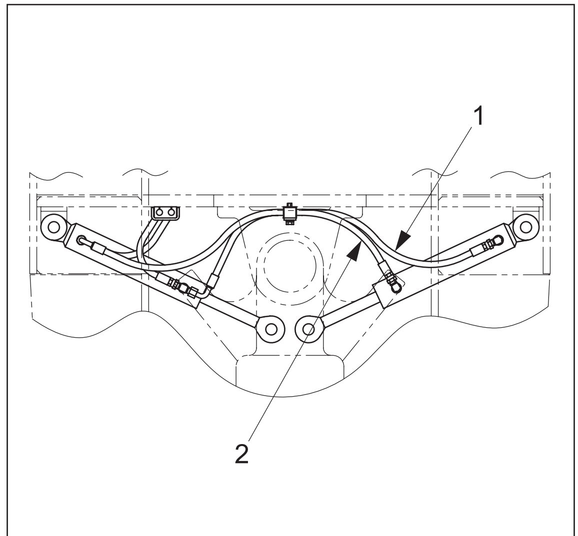
Make sure that there is no person around the articulated portion of the machine before operating the steering wheel.

- 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)**



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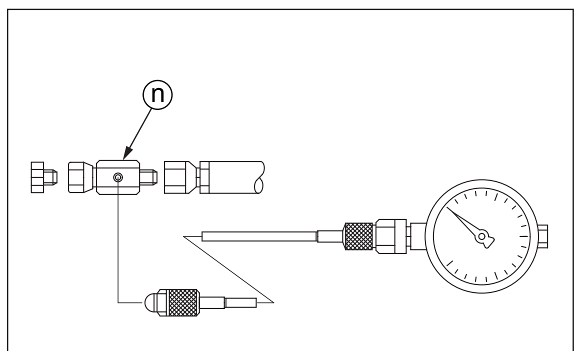
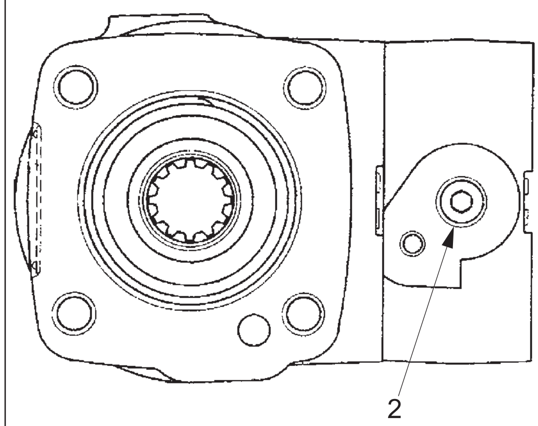


PG002003

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.



GW751-09010

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 $\pm$ 5°C (122 $\pm$ 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 “ ”.

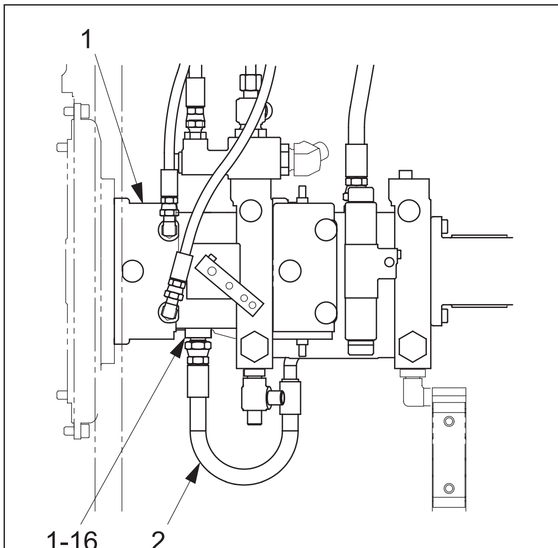
⑤ Set shift lever to “1st”.

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



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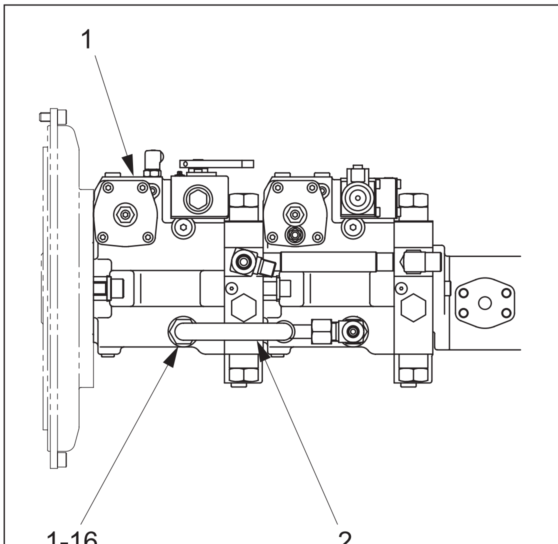

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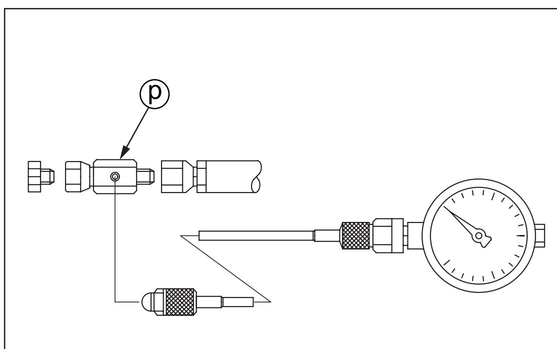


PG002004

- 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).

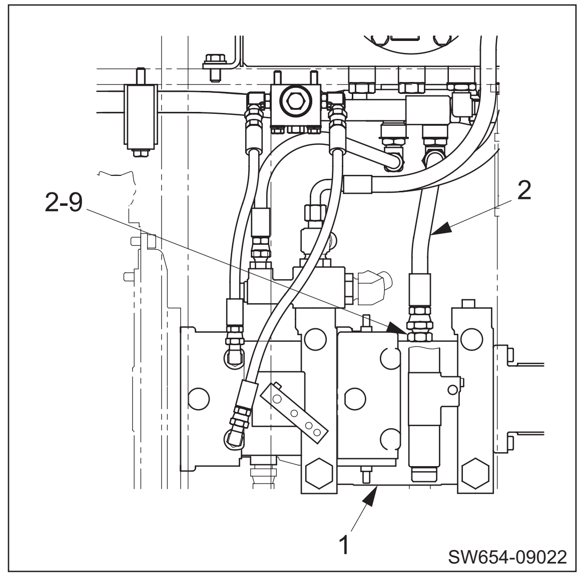
9-2. Measurement of Vibrator Pump Case Pressure

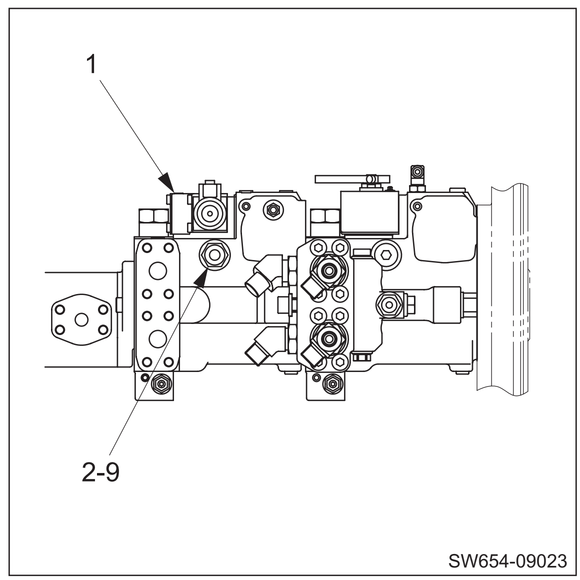
- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

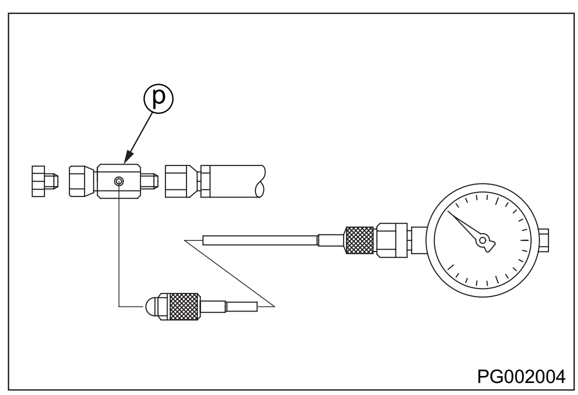
① Disconnect hose (2) from vibrator pump (1) drain port (2-9). Attach pressure gauge through adapter ⓟ .
  - Adapter ⓟ : G1/2
  - Pressure gauge : 0 to 5 MPa (0 to 725 psi)

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 “ F R ”.
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 “ ”.

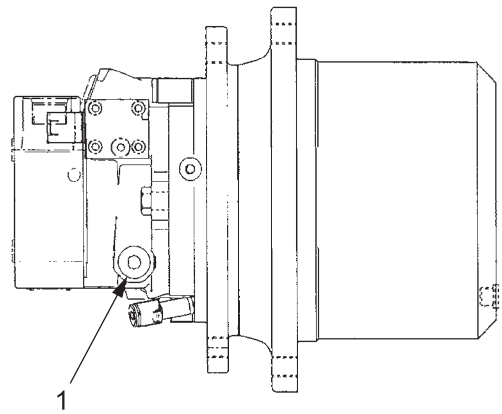
⑤ Set propulsion shift lever to “1st”.

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



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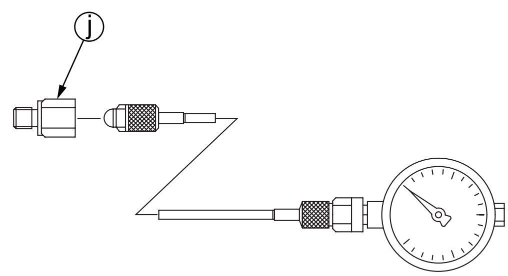


PG001022

11. MEASUREMENT OF VIBRATOR MOTOR CASE PRESSURE

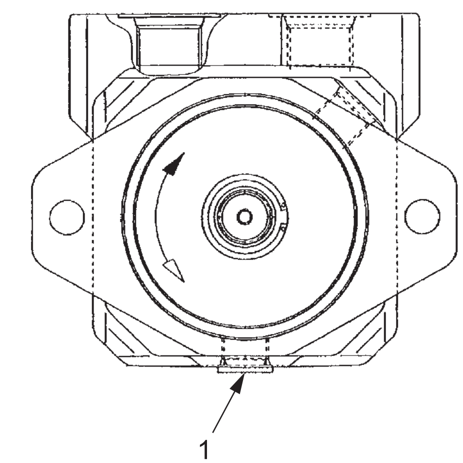
11-1. Measurement

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

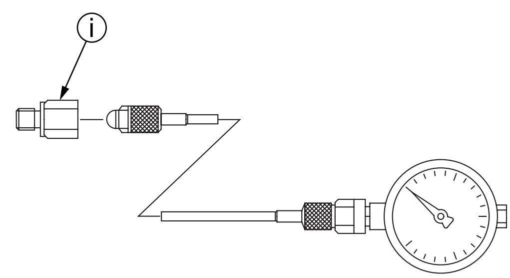
① Remove plug from drain port (1). Attach pressure gauge with adapter ⓘ .
  - Adapter ⓘ : 3/4-16UNF
  - Pressure gauge : 0 to 5 MPa (0 to 725 psi)

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

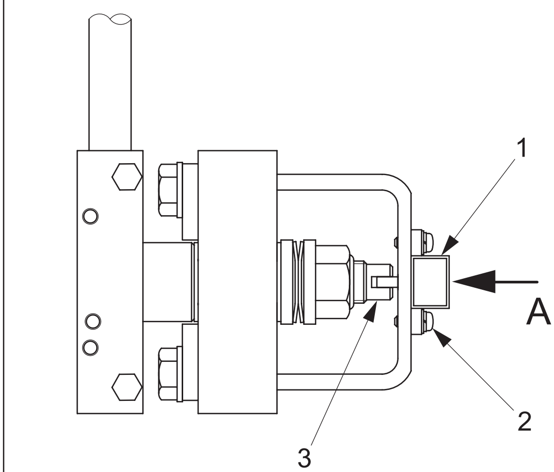
12. ADJUSTMENT OF THROTTLE LEVER

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.

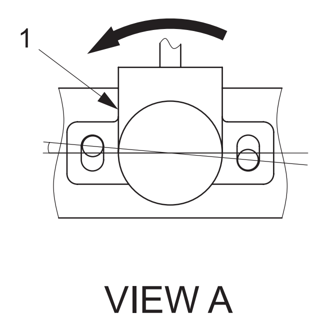
② Insert potentiometer shaft to the groove on throttle lever (3), and fix it with two screws (2).



SW654-09024

(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).**



SW654-09001

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

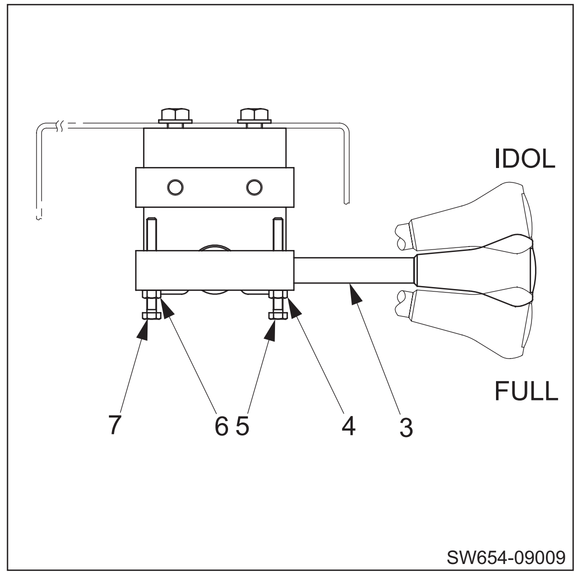
★ **Engine rotational speed : 1,000 $^{0}_{-50}$ min^{-1}**

- 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).



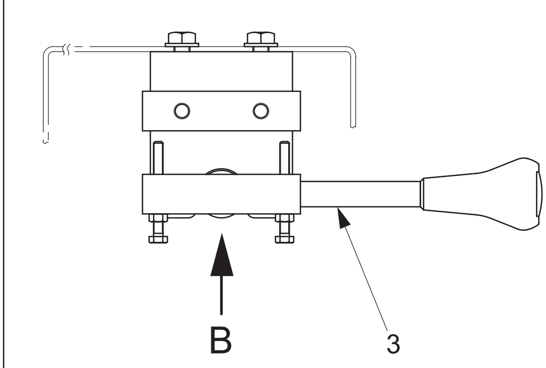
12-2. Adjustment of Operating Force

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.

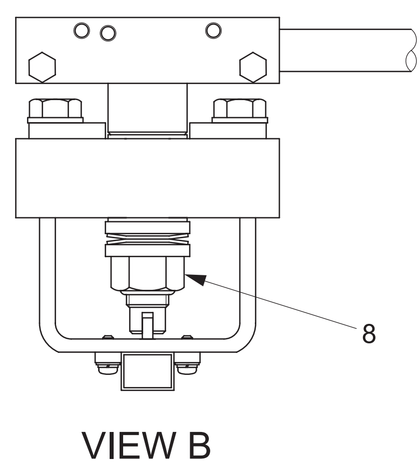
★ Standard operating force : 45 ± 10 N (10 ± 2 lbf)

(NOTICE)

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



SW654-09010

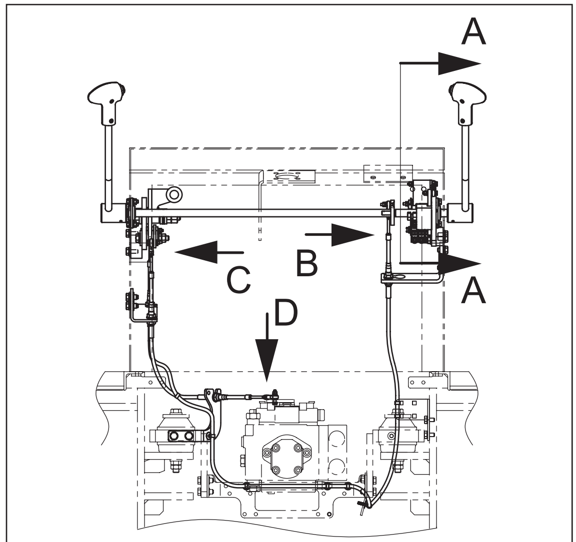


SW654-09011

13. ADJUSTMENT OF F-R LEVER AND SHIFT LEVER

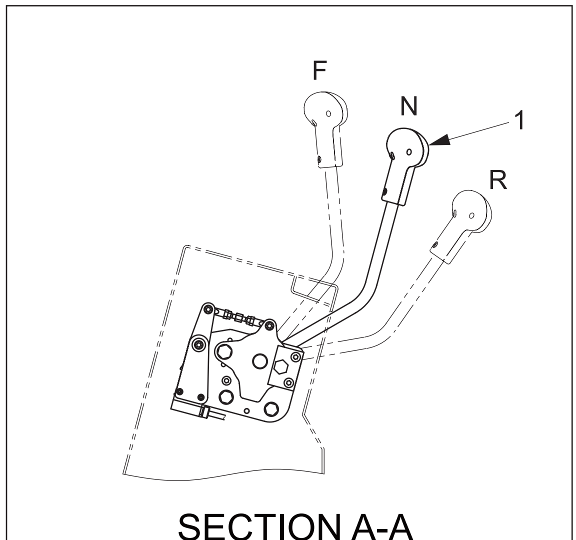
13-1. Adjustment of Linkage

- 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.



SW654-09002

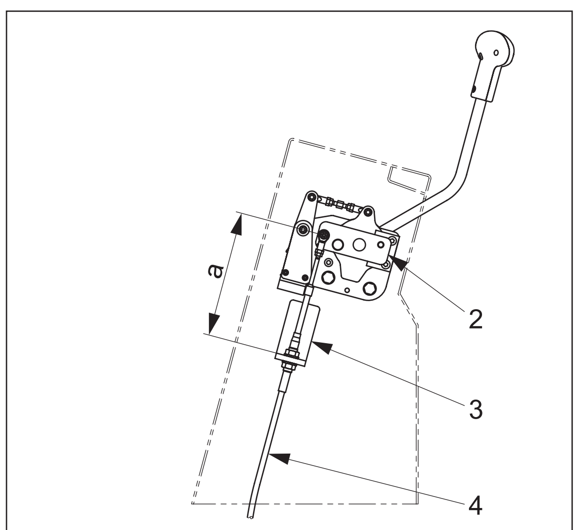
① Set F-R lever (1) to "N".



SW654-09006

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

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

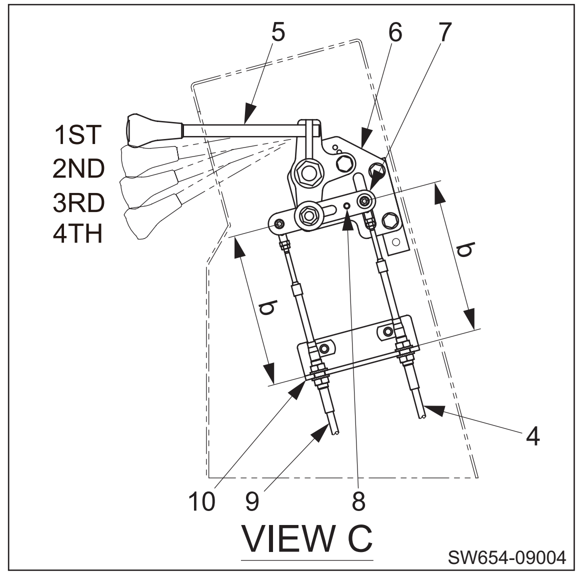


SW654-09003

- 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.)

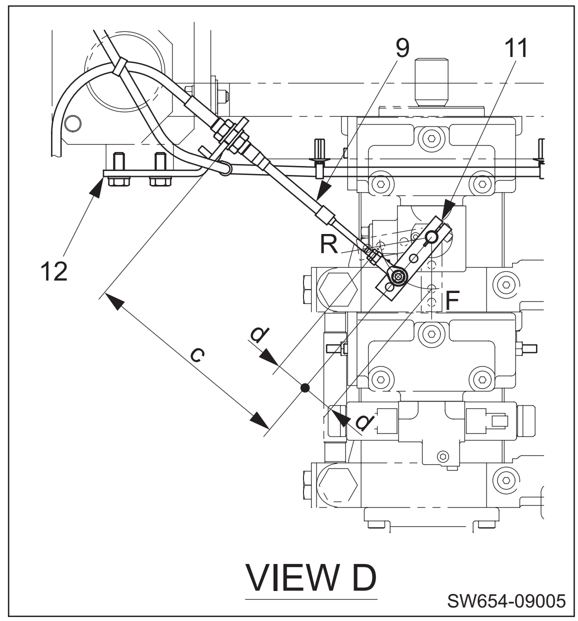


⑦ Fix propulsion pump control lever (11) at neutral position.
⑧ Attach control cable (9) to propulsion pump control lever and bracket (12).

★ 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.

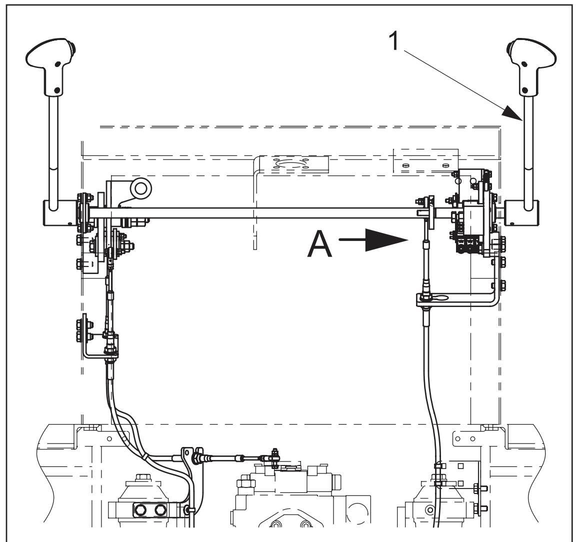
★ **Standard operating force : 40 ± 10 N (9 ± 2 lbf)**

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

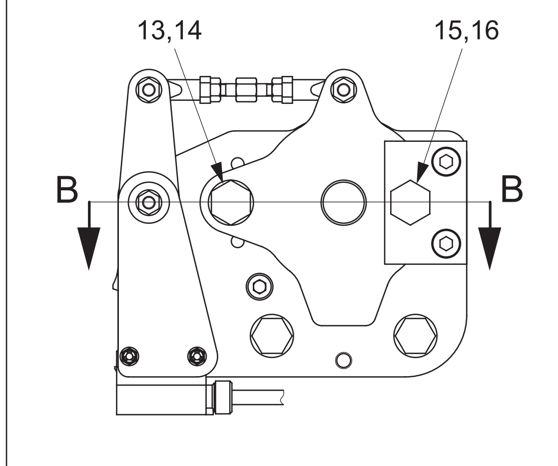
② Loosen lock nut (13), and adjust bolt (14) to match operating force of lever to standard operating force +5N, when getting over notch at center of F-R lever knob.

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

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

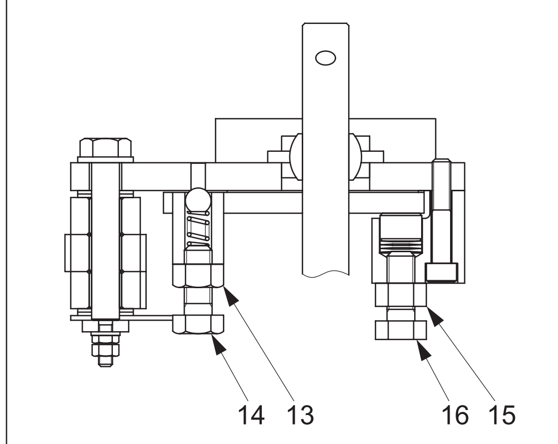


SW654-09016



VIEW A

SW654-09012



SECTION B-B

SW654-09013

13-2-2. Adjustment of shift lever

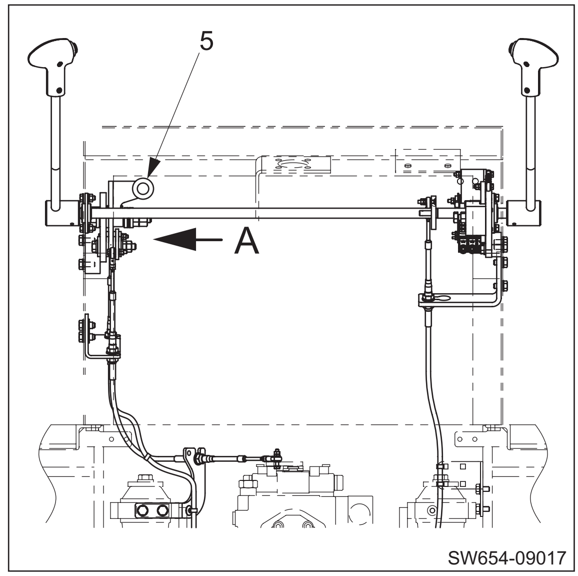
① Adjust nut (17) so that operating force at center of shift lever (5) knob matches standard operating force.

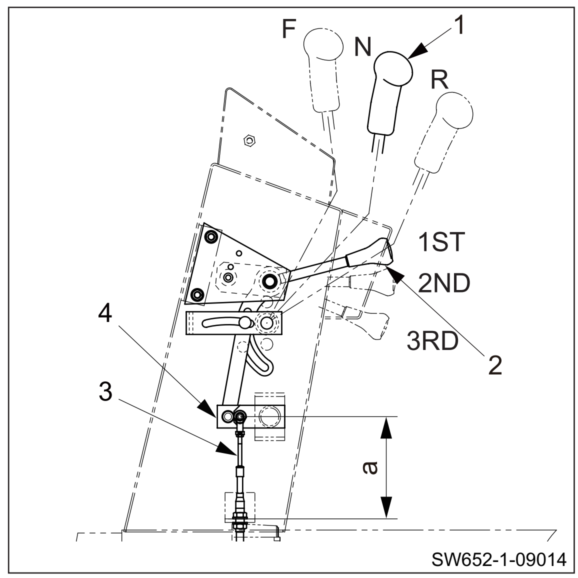
★ **Standard operating force : 40 ± 10 N (9 ± 2 lbf)**

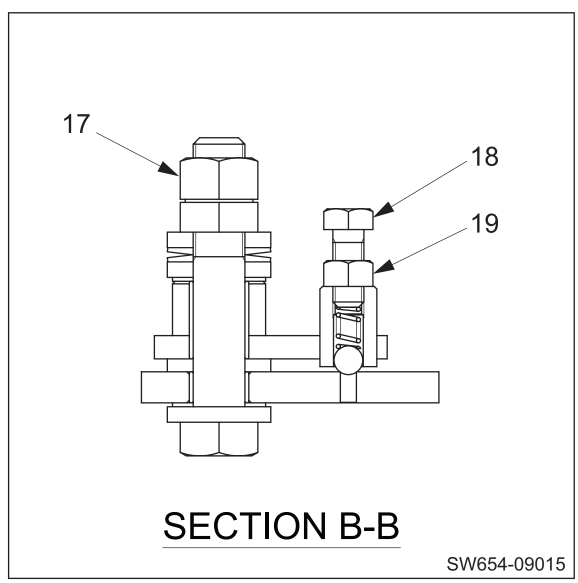
② Loosen lock nut (19), and adjust bolt (18) to match operating force of lever to standard operating force +5N, when getting over notch at center of shift lever knob.

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

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





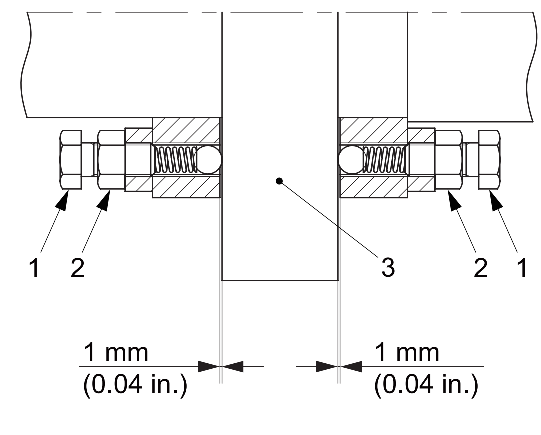


14. MOVABLE WEIGHT ADJUSTMENT (SW654ND)

- 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

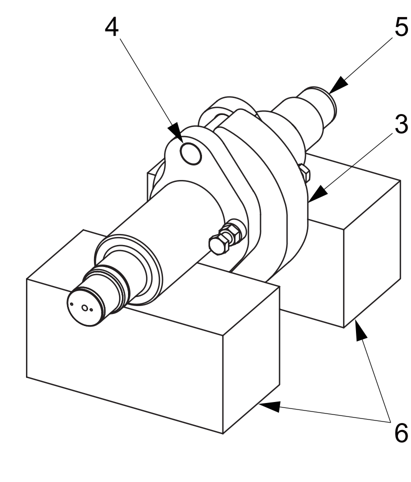
① Tighten bolts (1) until gaps at both sides of movable weight (3) becomes 1mm (0.04 in.) each.



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

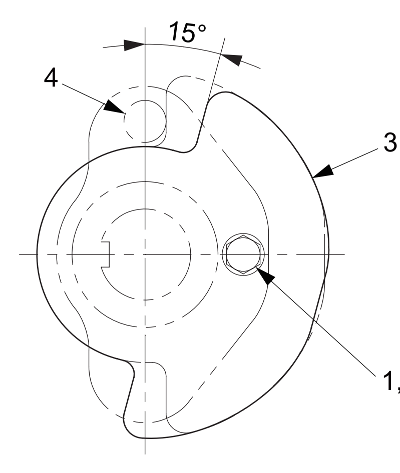
④ Make sure that movable weight (3) starts to swing down by its own weight when movable weight is rotated away from stopper (4) by 15°.

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

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

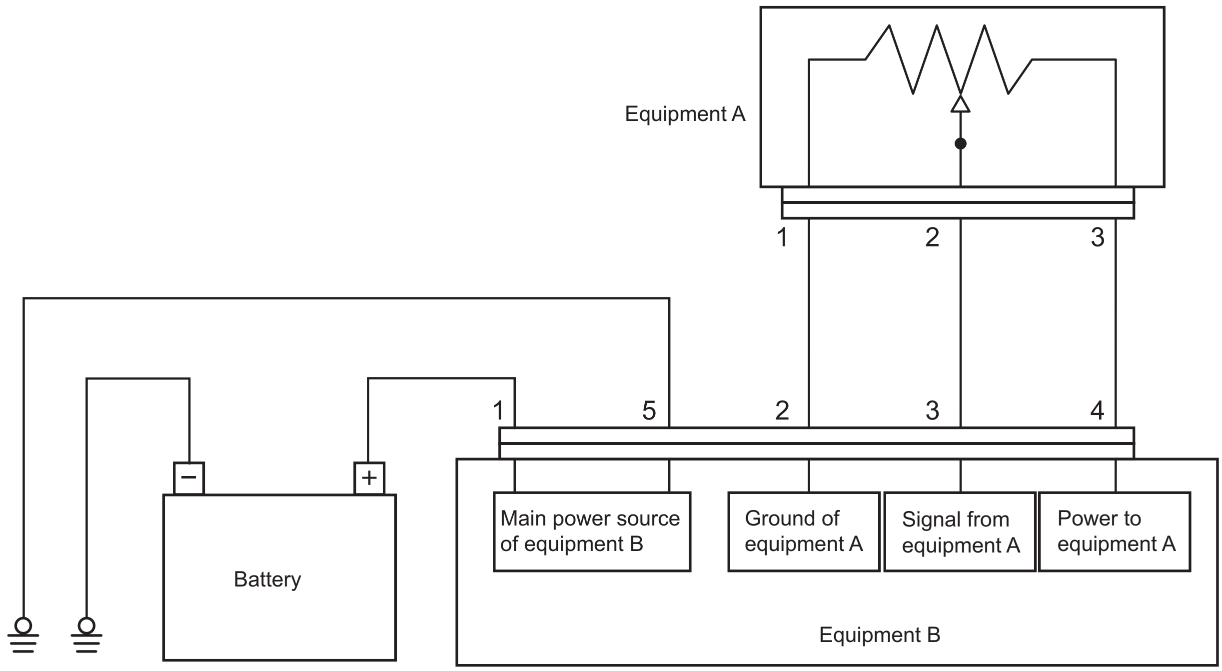
Be very careful because equipment can return to normal during an inspection and suddenly operate properly when a failure occurs due to a faulty contact or other such cause.

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

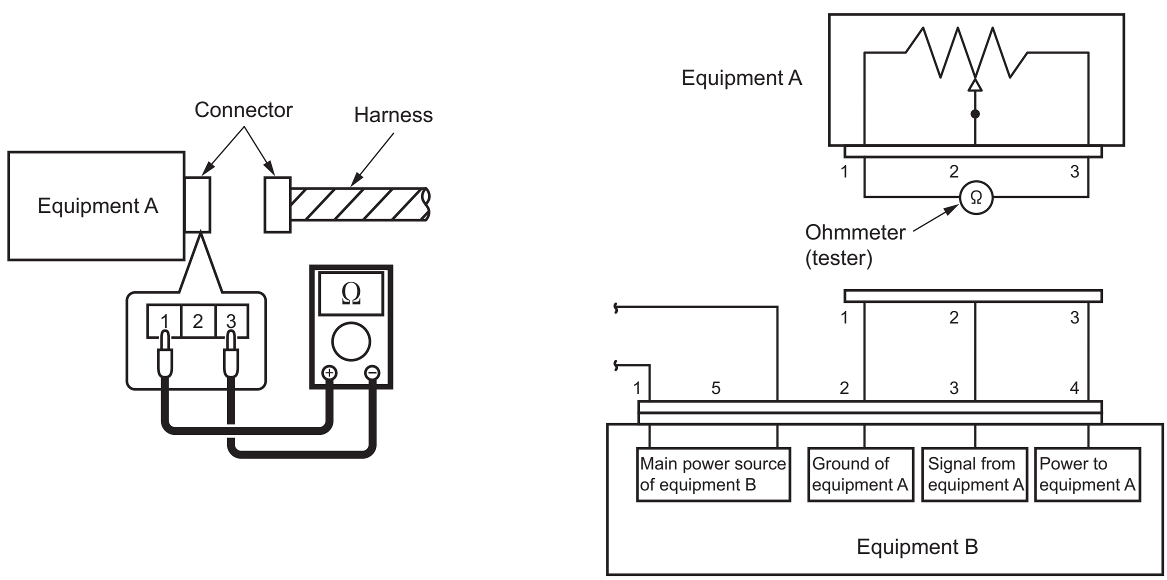
Some of the various inspection procedures are presented here for reference, using a sample circuit below.



TS-10001

1) Measuring resistance using tester

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



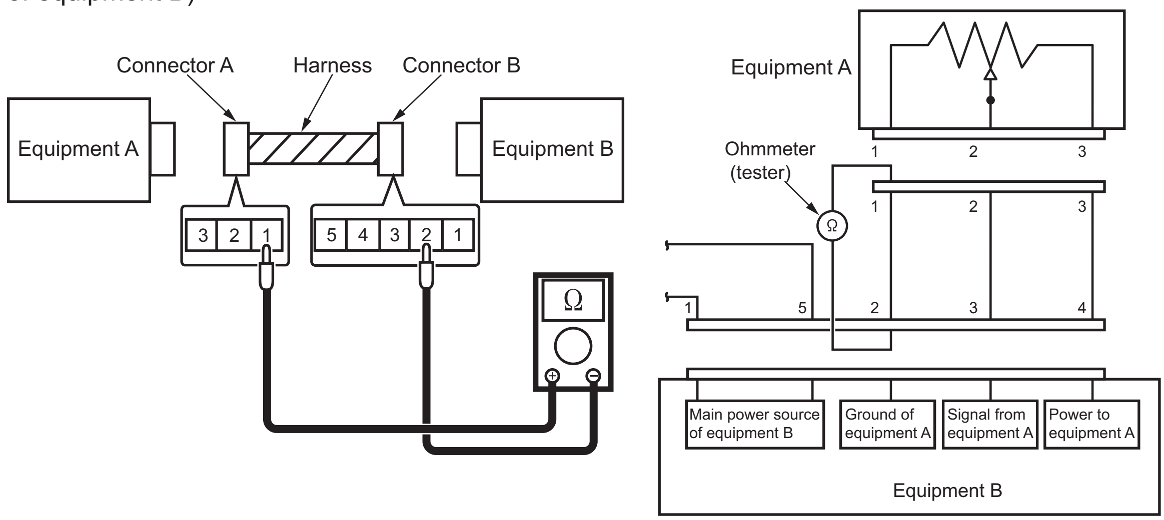
TS-10002

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)



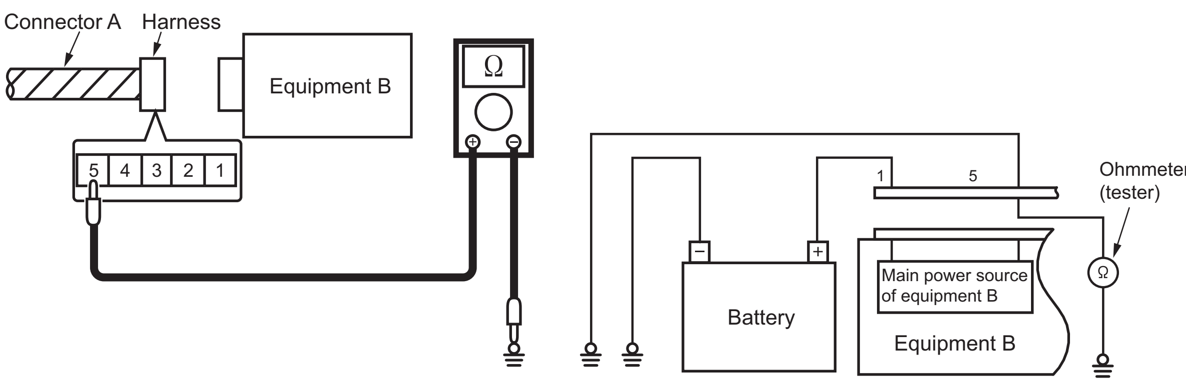
TS-10003

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)



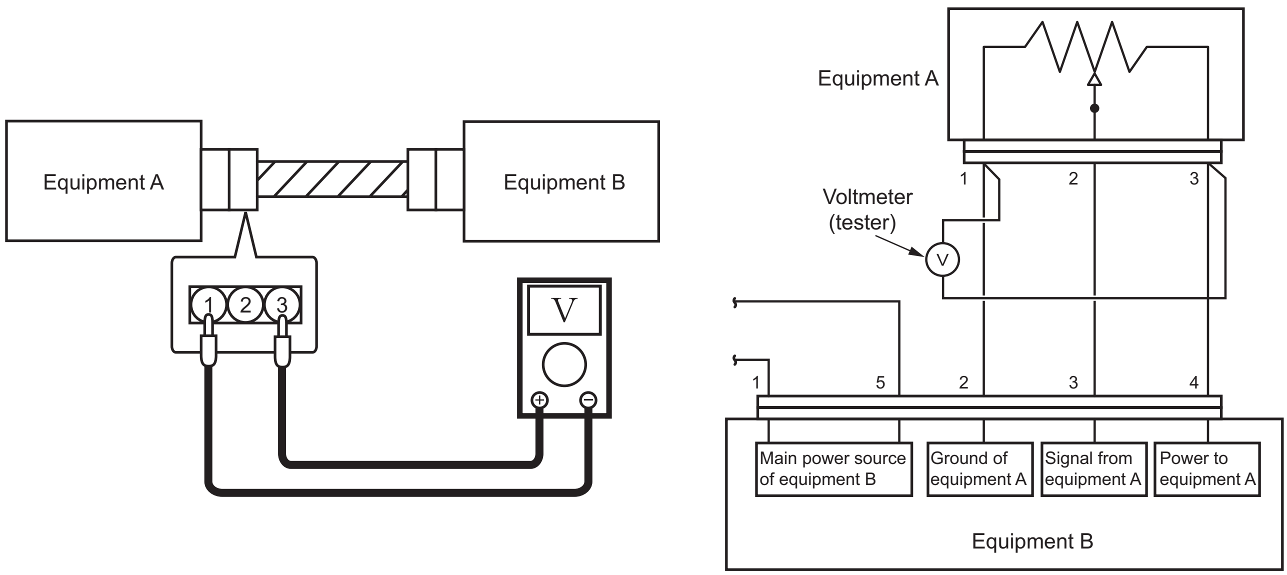
TS-10004

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)



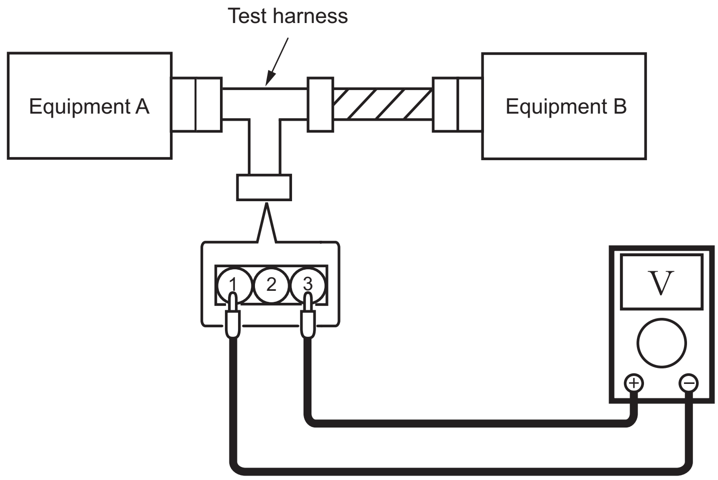
TS-10005

Inspection procedure

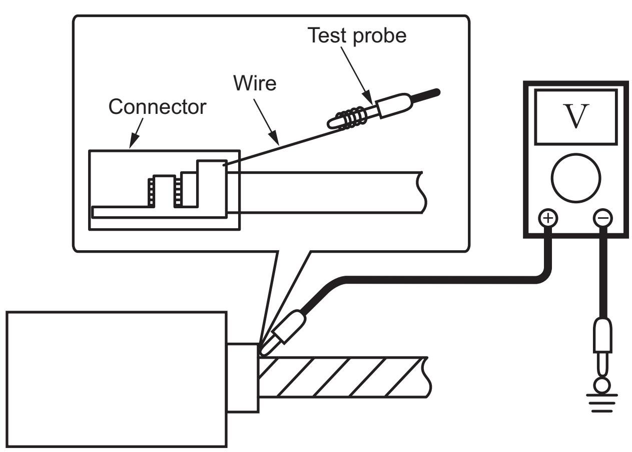
① Connect the connectors of equipment A and that of equipment B.

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.

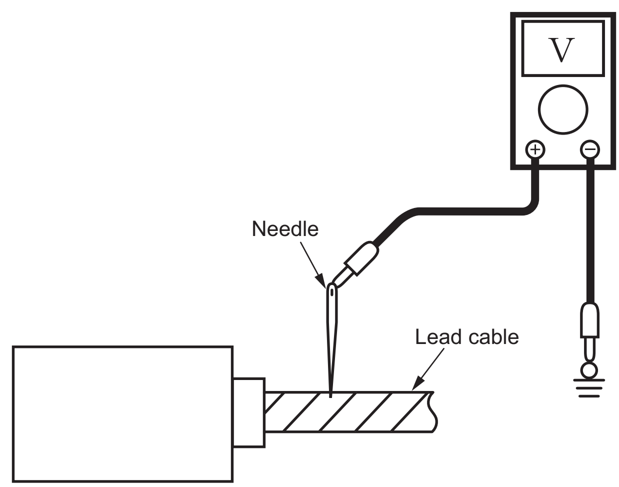
• Measurement using a test harness



• Measurement from the backside of connector



• Measurement on a lead cable



TS-10006

Measurement method

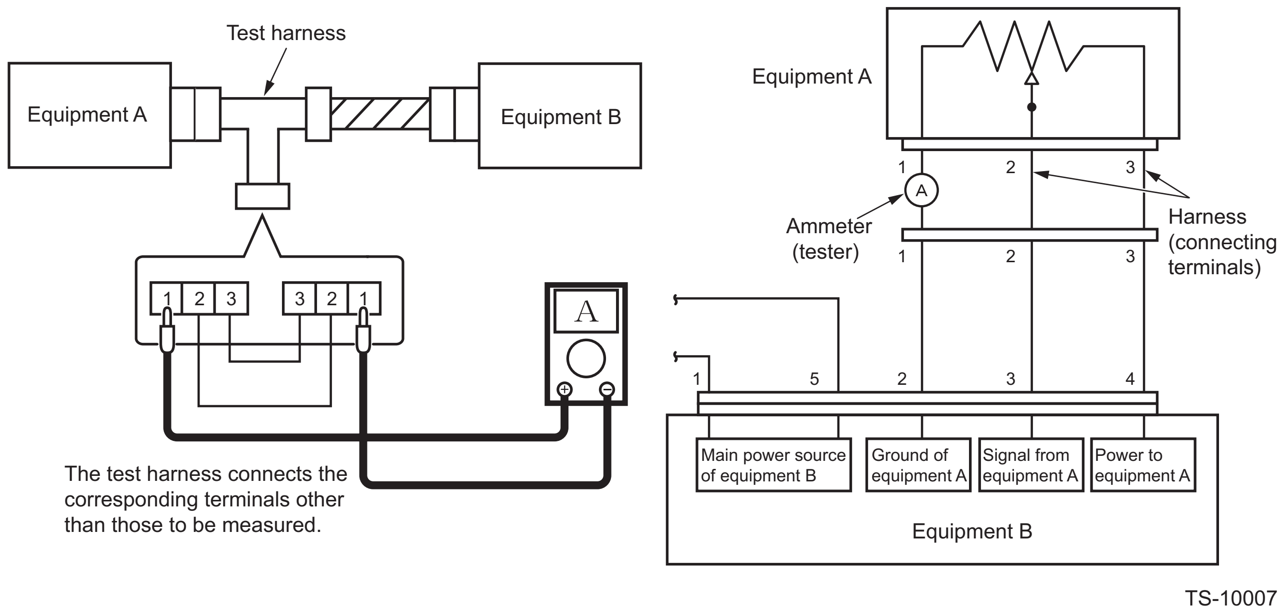
For measurement of voltage, connect the tester probes in parallel to the portion to be measured. Because the voltage can be measured only when the connector is connected in position, contact the tester probes to the terminals without disconnecting the connector. The following methods are available:

- 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)



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.

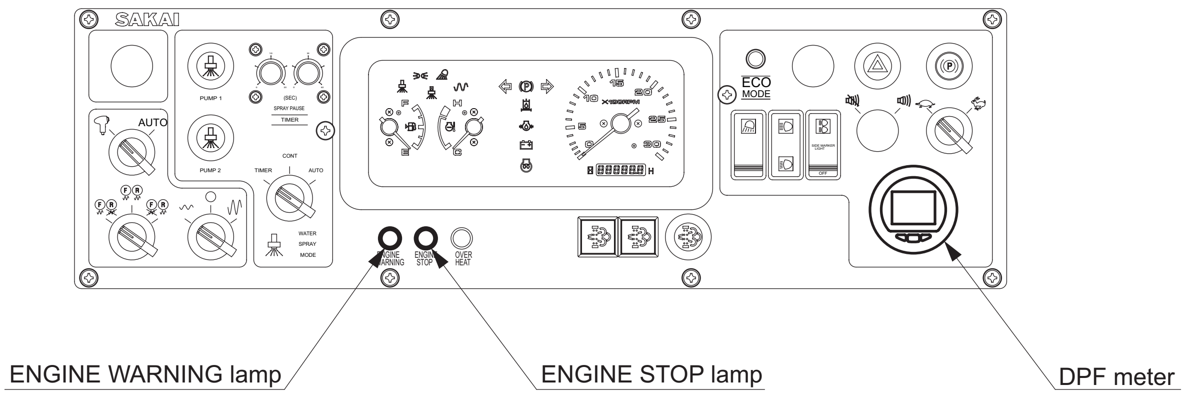
5) Solenoid valve inspection (Check ON/OFF operation by sound.)
- Conduct without running the engine. (If you run the engine, you cannot hear the sound of operation.)
  Sound heard : The electrical system is normal.
  No sound heard : Check with a tester.
    Continuity : ① Turn the starter switch OFF 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

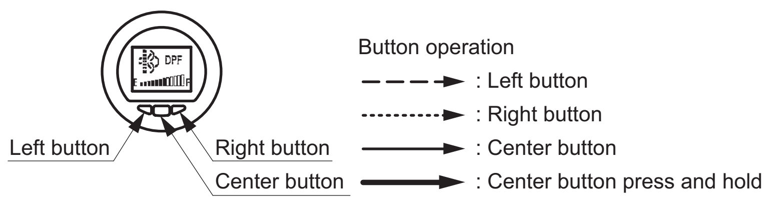
2-2-1. Description of diagnostic trouble code (DTC)

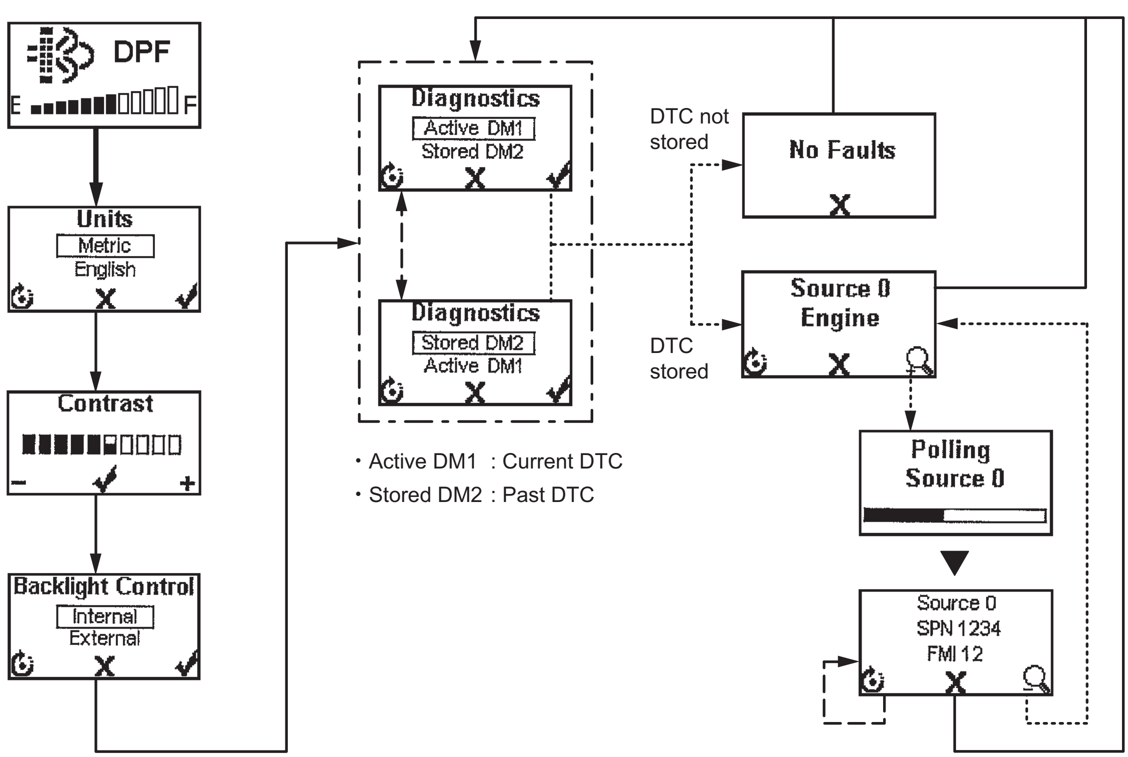
- When the engine warning lamp or engine stop lamp illuminates, the DPF meter is used to display a DTC (diagnostic trouble code).



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.





*Pressing and holding the center button returns any display back to the DPF meter.

DPF-10010

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

J1939-73 SPN	J1939-73 FMI	Description	DTC Description	Diagnosis
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 SPN	FMI	Description	DTC Description	Diagnosis
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	

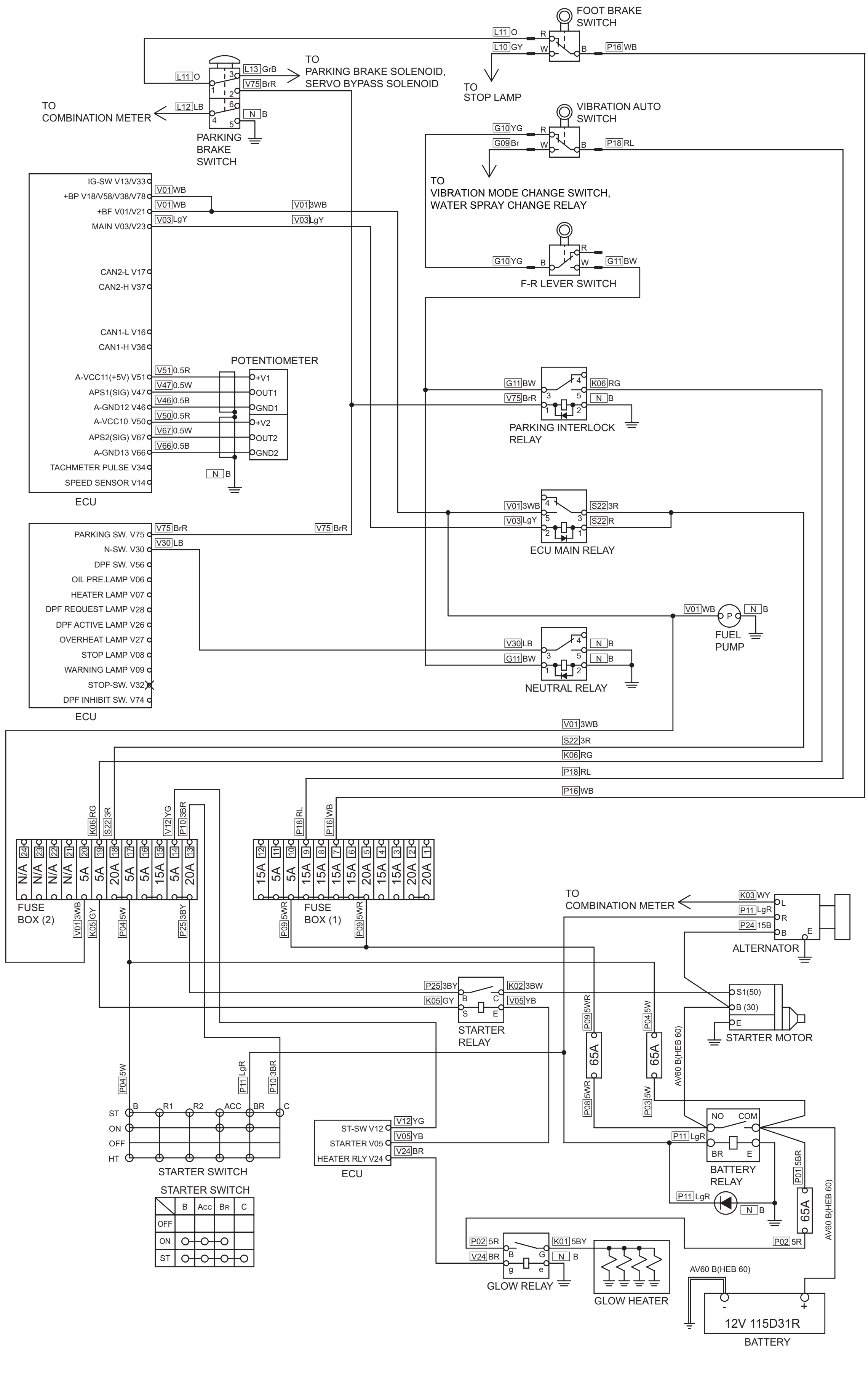
J1939-73 SPN	FMI	Description	DTC Description	Diagnosis
723	2	Camshaft position sensor (G sensor) abnormal	G sensor pulse count abnormal	• Open circuit in sensor/harness, short-circuited • Sensor failure
	8		G sensor pulse not inputted	
1077	2	ECU flash ROM and CPU abnormal	ECU CPU abnormal (main IC abnormal)	• 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 SPN	J1939-73 FMI	Description	DTC Description	Diagnosis
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



STARTER SWITCH

	B	ACC	BR	C
OFF				
ON	O	O	O	
ST	O	O	O	O

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.

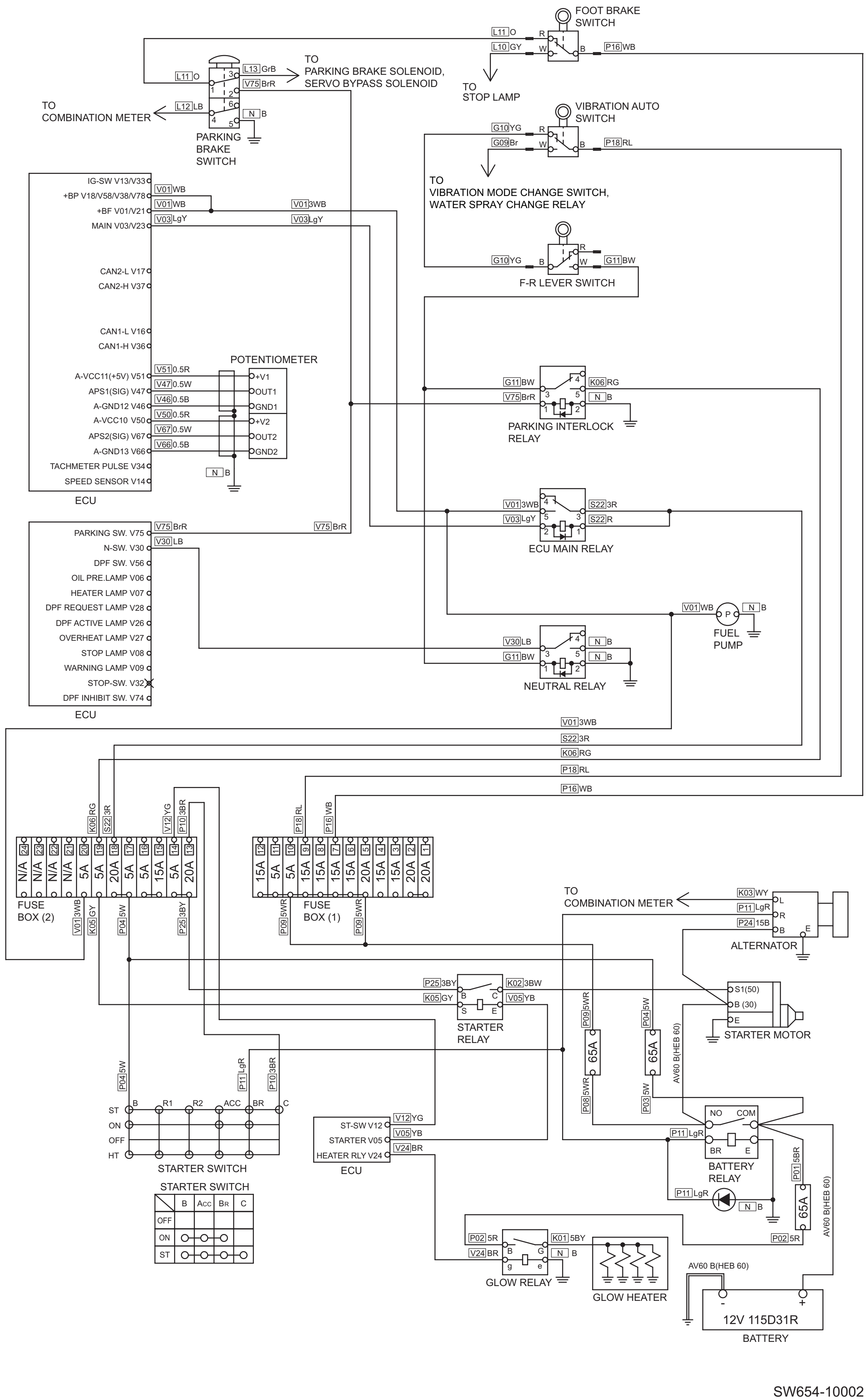
2-3-1. Engine will not start (Starter motor does not run) 1/3

- 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


FOOT BRAKE SWITCH
L11 O
L10 GY
P16 WB
TO STOP LAMP
L13 GrB
V75 BrR
TO PARKING BRAKE SOLENOID, SERVO BYPASS SOLENOID
L11 O
L12 LB
TO COMBINATION METER
N B
PARKING BRAKE SWITCH
VIBRATION AUTO SWITCH
G10 YG
G09 Br
P18 RL
TO VIBRATION MODE CHANGE SWITCH, WATER SPRAY CHANGE RELAY
G10 YG
G11 BW
F-R LEVER SWITCH
IG-SW V13/V33
+BP V18/V58/V38/V78
+BF V01/V21
MAIN V03/V23
V01 WB
V01 WB
V03 LgY
V01 3WB
V03 LgY
CAN2-L V17
CAN2-H V37
CAN1-L V16
CAN1-H V36
POTENTIOMETER
A-VCC11(+5V) V51
APS1(SIG) V47
A-GND12 V46
A-VCC10 V50
APS2(SIG) V67
A-GND13 V66
TACHMETER PULSE V34
SPEED SENSOR V14
V51 0.5R
V47 0.5W
V46 0.5B
V50 0.5R
V67 0.5W
V66 0.5B
+V1
OUT1
GND1
+V2
OUT2
GND2
N B
ECU
G11 BW
V75 BrR
K06 RG
N B
PARKING INTERLOCK RELAY
V01 3WB
V03 LgY
S22 3R
S22 R
ECU MAIN RELAY
PARKING SW. V75
N-SW. V30
DPF SW. V56
OIL PRE.LAMP V06
HEATER LAMP V07
DPF REQUEST LAMP V28
DPF ACTIVE LAMP V26
OVERHEAT LAMP V27
STOP LAMP V08
WARNING LAMP V09
STOP-SW. V32
DPF INHIBIT SW. V74
V75 BrR
V30 LB
V75 BrR
ECU
V01 WB
N B
FUEL PUMP
V30 LB
G11 BW
N B
N B
NEUTRAL RELAY
V01 3WB
S22 3R
K06 RG
P18 RL
P16 WB
K06 RG
S22 3R
V12 YG
P10 3BR
P18 RL
P16 WB
N/A N/A N/A N/A 5A 5A 20A 5A 5A 15A 5A 20A
FUSE BOX (2)
15A 5A 5A 15A 15A 15A 20A 15A 15A 20A 20A
FUSE BOX (1)
V01 3WB
K05 GY
P04 5W
P25 3BY
P09 5WR
P09 5WR
TO COMBINATION METER
K03 WY
P11 LgR
P24 15B
ALTERNATOR
P25 3BY
K05 GY
K02 3BW
V05 YB
STARTER RELAY
S1(50)
B (30)
STARTER MOTOR
P09 5WR
P04 5W
65A
65A
AV60 B(HEB 60)
P08 5WR
P03 5W
P04 5W
P11 LgR
P10 3BR
ST
ON
OFF
HT
B R1 R2 ACC BR C
STARTER SWITCH
ST-SW V12
STARTER V05
HEATER RLY V24
V12 YG
V05 YB
V24 BR
ECU
NO
COM
P11 LgR
BR
BATTERY RELAY
P11 LgR
N B
P01 5BR
65A
AV60 B(HEB 60)
P02 5R
P02 5R
K01 5BY
V24 BR
N B
GLOW RELAY
GLOW HEATER
AV60 B(HEB 60)
12V 115D31R
BATTERY
STARTER SWITCH
B
ACC
BR
C
OFF
ON
ST
SW654-10002

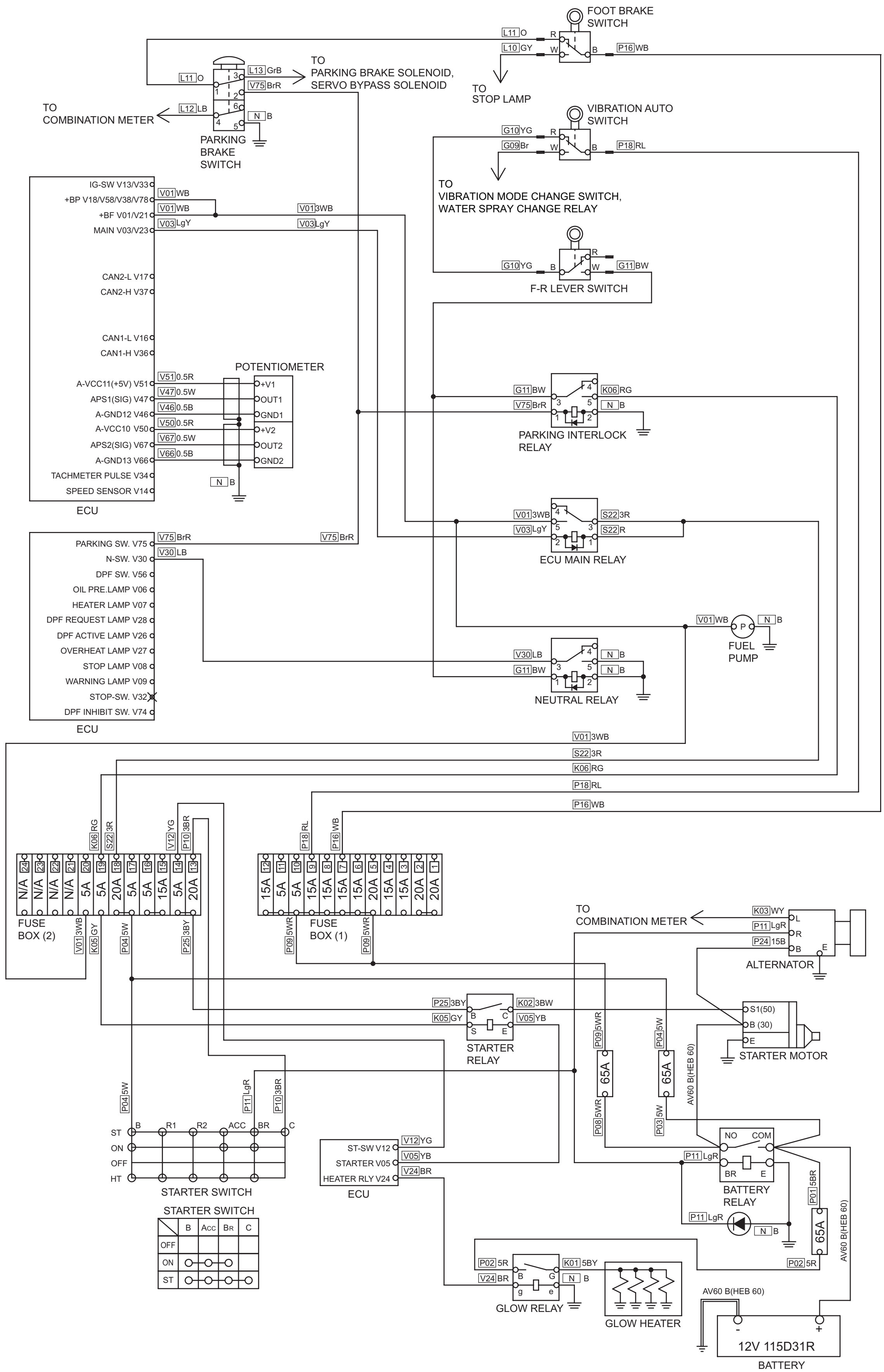
2-3-1. Engine will not start (Starter motor does not run) 2/3

- 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



STARTER SWITCH

	B	Acc	Br	C
OFF				
ON	O	O	O	
ST	O	O	O	O

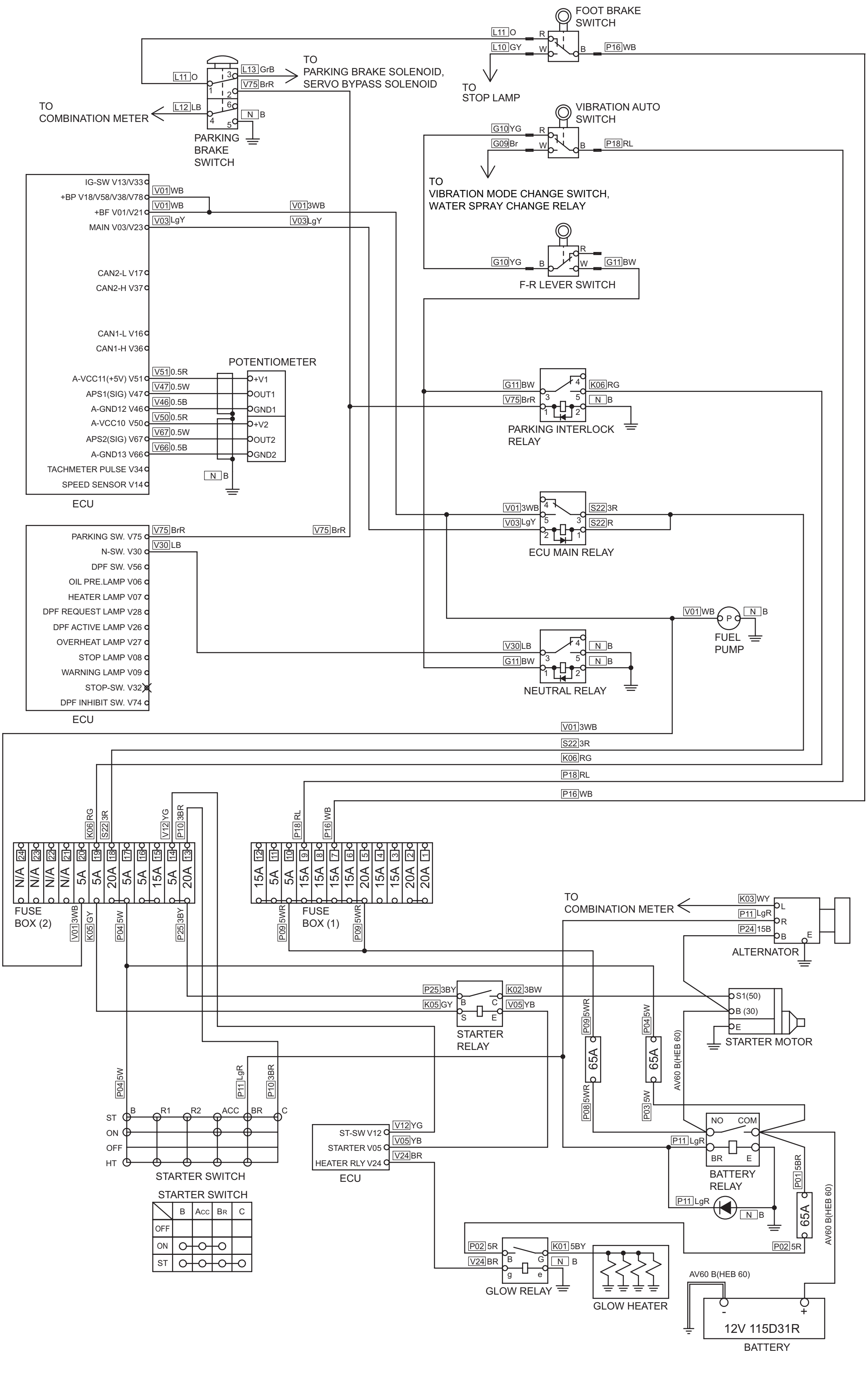
2-3-1. Engine will not start (Starter motor does not run) 3/3

- 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



STARTER SWITCH	B	Acc	Br	C
OFF				
ON	○	○	○	
ST	○	○	○	○

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

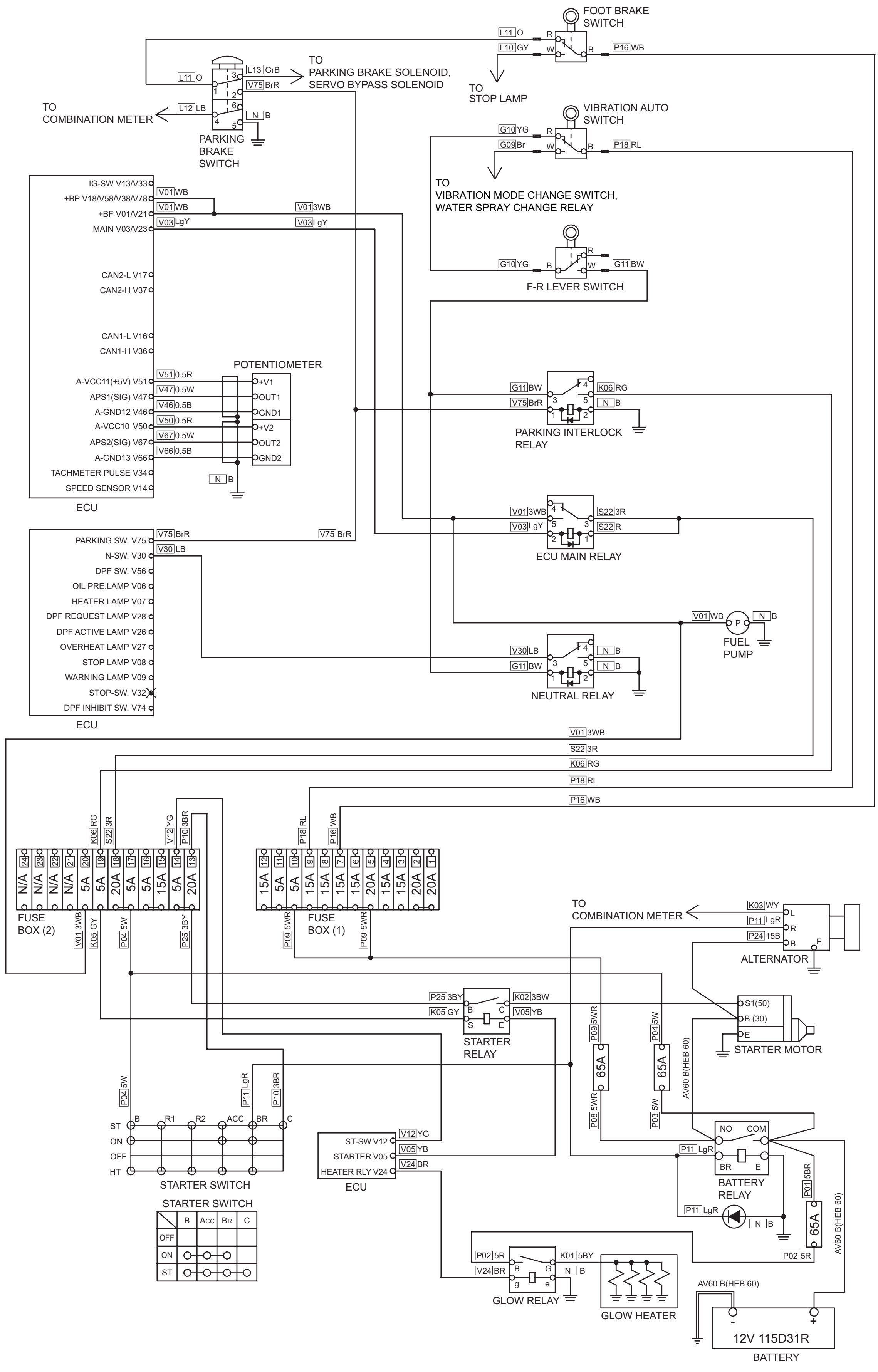
Check point	Check/Cause	Action
1. Fuel Pump	• When starter switch is ON, measure voltage between fuel pump terminal inlet wire WB and chassis ground. Standard voltage : 12 V or more • If above item is OK and fuel pump does not operate, fuel pump is faulty.	Repair or replace fuel pump.
2. ECU Main Relay	(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



STARTER SWITCH	B	ACC	BR	C
OFF				
ON	○	○	○	
ST	○	○	○	○

SW654-10002

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

Reference Fig. : 2-3-1

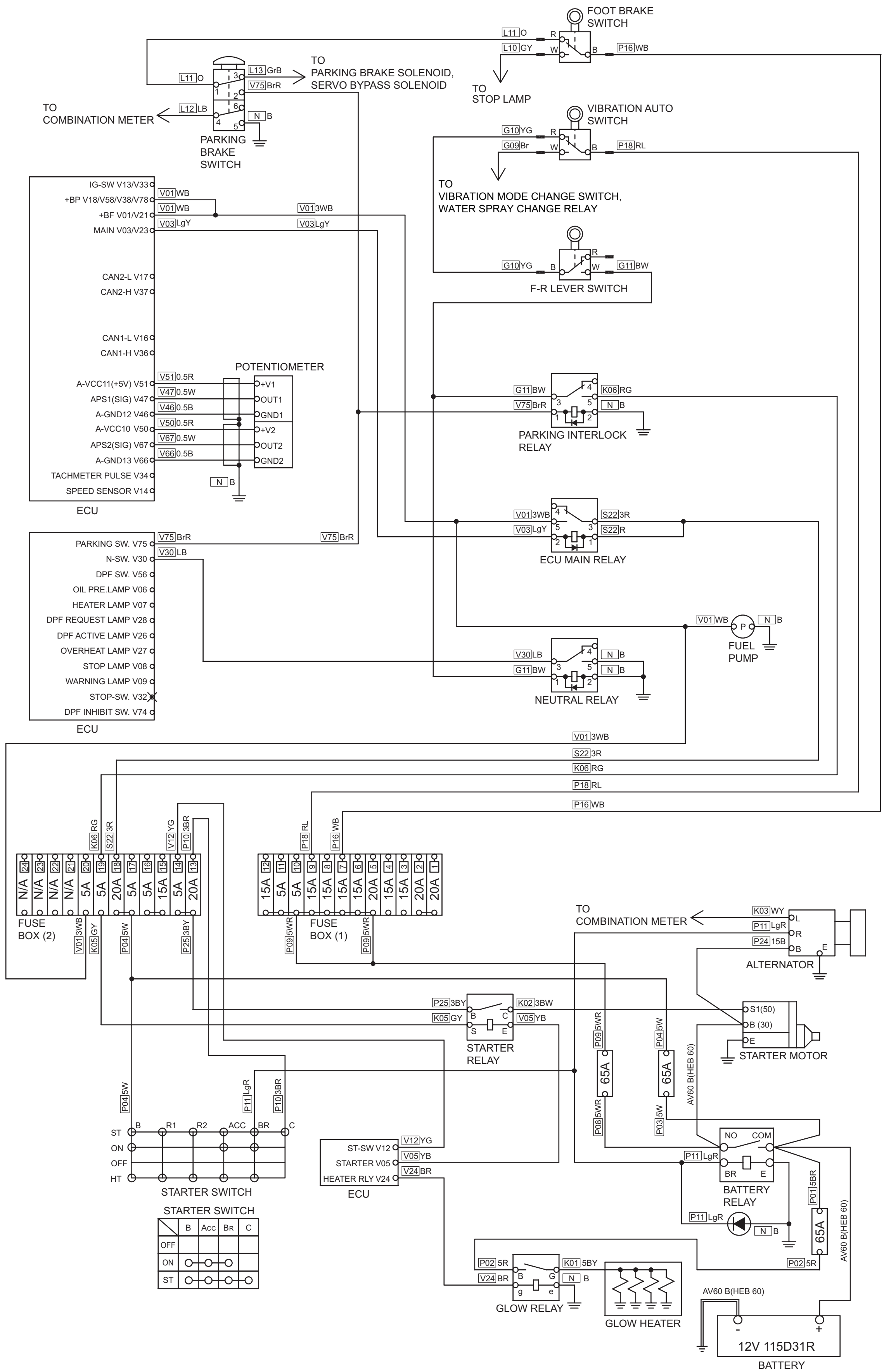
Check point	Check/Cause	Action
1. Glow Heater	• When starter switch is ON, measure voltage between glow heater terminal inlet wire BY and chassis ground. Standard voltage : 12 V or more • If voltage is OK, glow heater is faulty.	Replace glow heater.
2. Glow Relay	(1) When starter switch is ON, measure 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



STARTER SWITCH	B	Acc	Br	C
OFF				
ON	O	O	O	
ST	O	O	O	O

SW654-10002

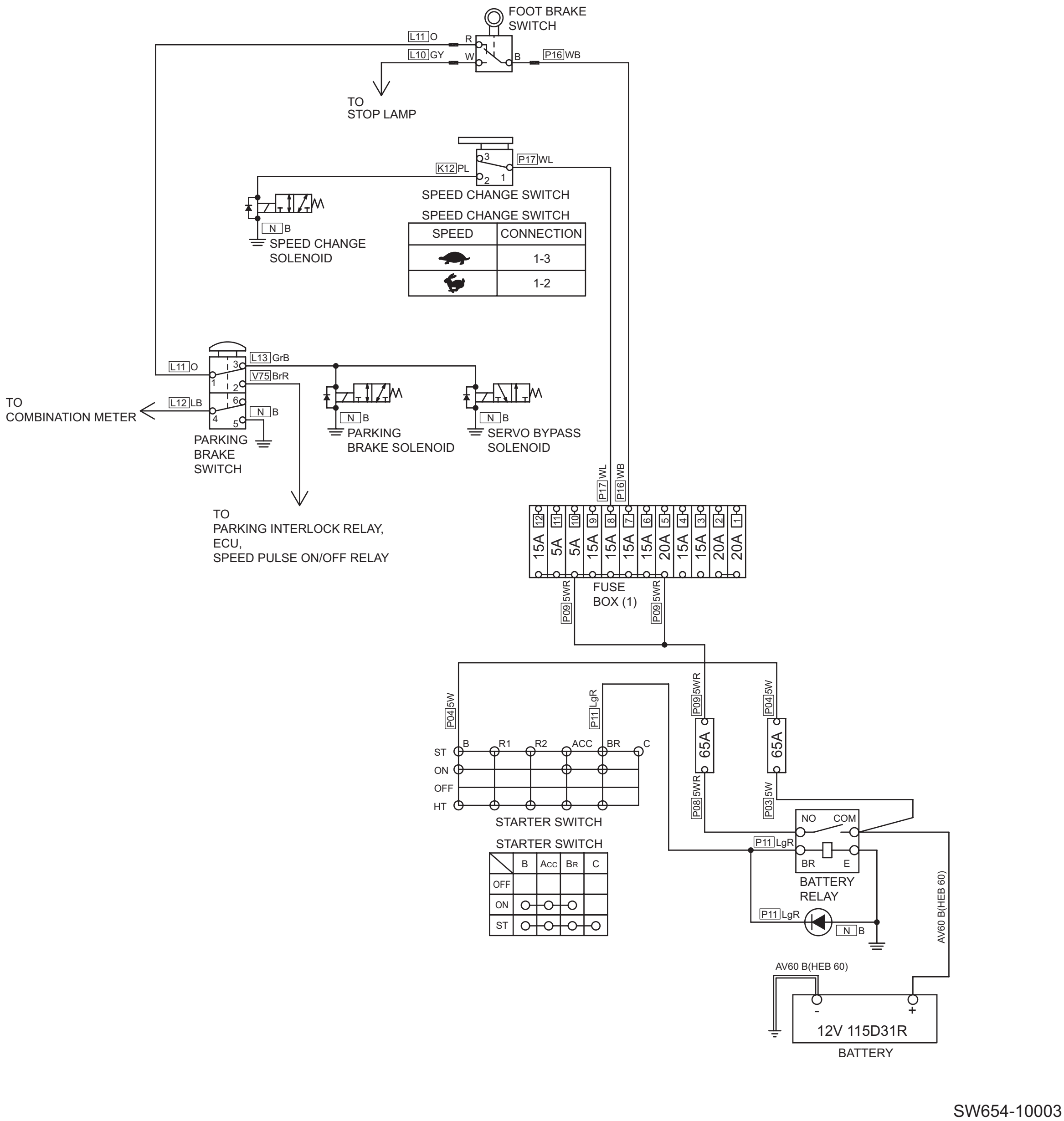
2-3-6. Engine speed does not change when operating throttle lever

- 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


FOOT BRAKE SWITCH
L11 O
L10 GY
R
W
B
P16 WB
TO STOP LAMP
K12 PL
P17 WL
SPEED CHANGE SWITCH
N B
SPEED CHANGE SOLENOID
SPEED CHANGE SWITCH
SPEED
CONNECTION
1-3
1-2
L11 O
L13 GrB
V75 BrR
L12 LB
N B
TO COMBINATION METER
PARKING BRAKE SWITCH
PARKING BRAKE SOLENOID
SERVO BYPASS SOLENOID
TO PARKING INTERLOCK RELAY, ECU, SPEED PULSE ON/OFF RELAY
P17 WL
P16 WB
15A 5A 5A 15A 15A 15A 15A 20A 15A 15A 20A 20A
FUSE BOX (1)
P09 5WR
P04 5W
P11 LgR
P09 5WR
P04 5W
65A
65A
P08 5WR
P03 5W
ST
ON
OFF
HT
B
R1
R2
ACC
BR
C
STARTER SWITCH
STARTER SWITCH
B
Acc
Br
C
OFF
ON
ST
NO
COM
P11 LgR
BR
E
BATTERY RELAY
P11 LgR
N B
AV60 B(HEB 60)
AV60 B(HEB 60)
12V 115D31R
BATTERY
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.

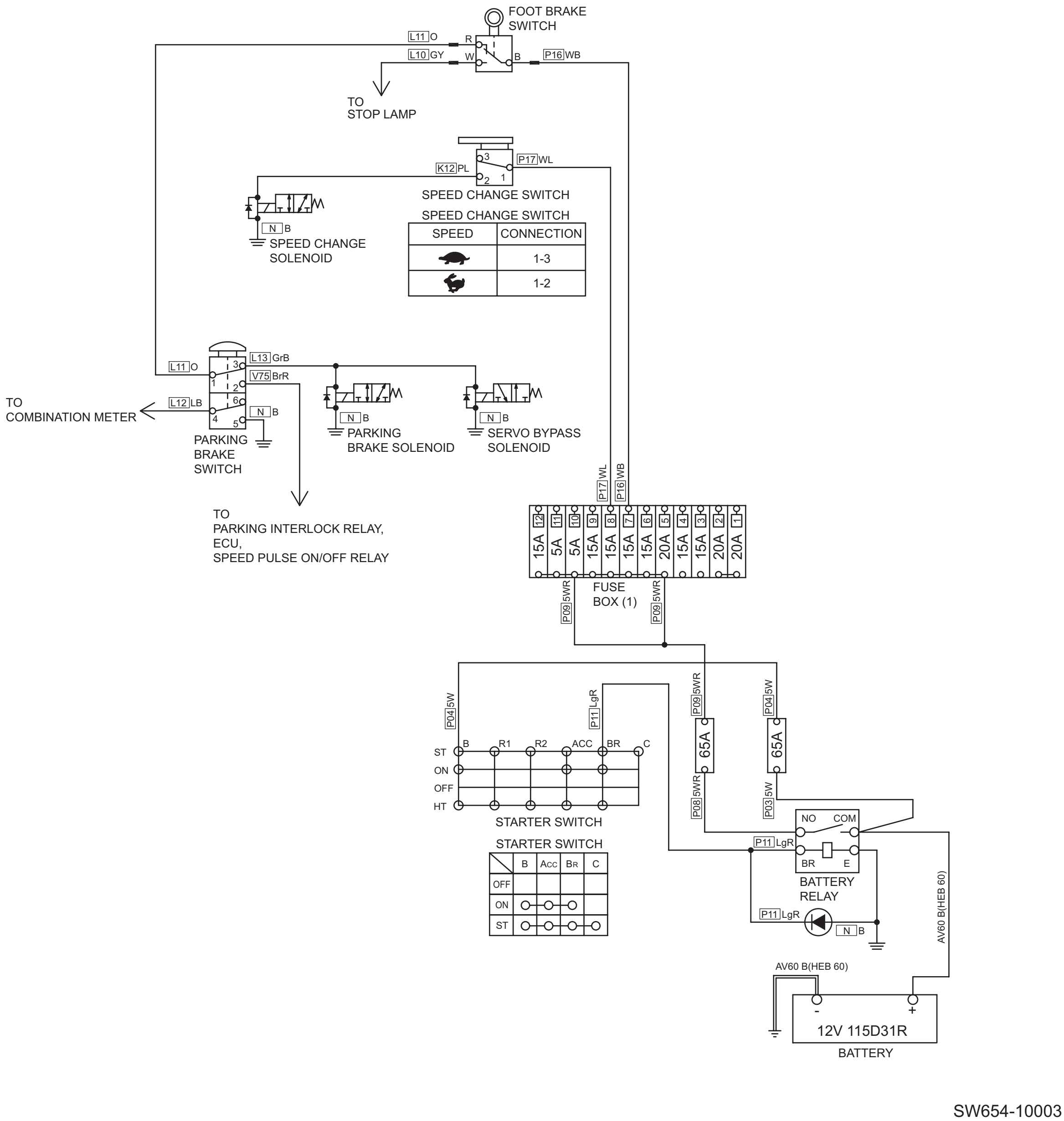
2-4-1. Machine moves neither forward nor backward

- 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 $\pm$ 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


FOOT BRAKE SWITCH
TO STOP LAMP
SPEED CHANGE SWITCH
SPEED CHANGE SOLENOID
SPEED
CONNECTION
1-3
1-2
TO COMBINATION METER
PARKING BRAKE SWITCH
PARKING BRAKE SOLENOID
SERVO BYPASS SOLENOID
TO PARKING INTERLOCK RELAY, ECU, SPEED PULSE ON/OFF RELAY
FUSE BOX (1)
STARTER SWITCH
BATTERY RELAY
12V 115D31R
BATTERY
SW654-10003

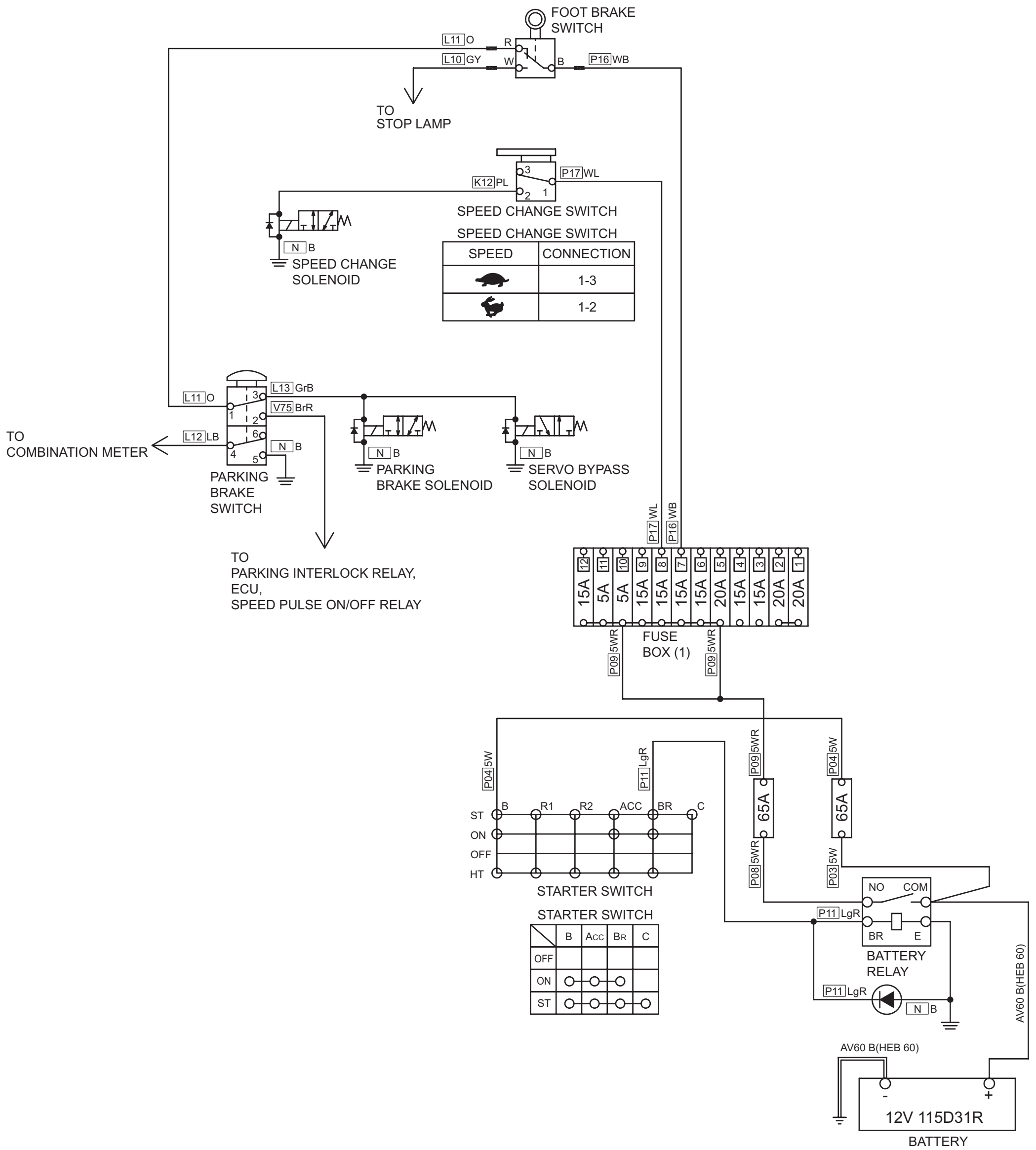
2-4-2. Machine speed cannot be changed

- 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

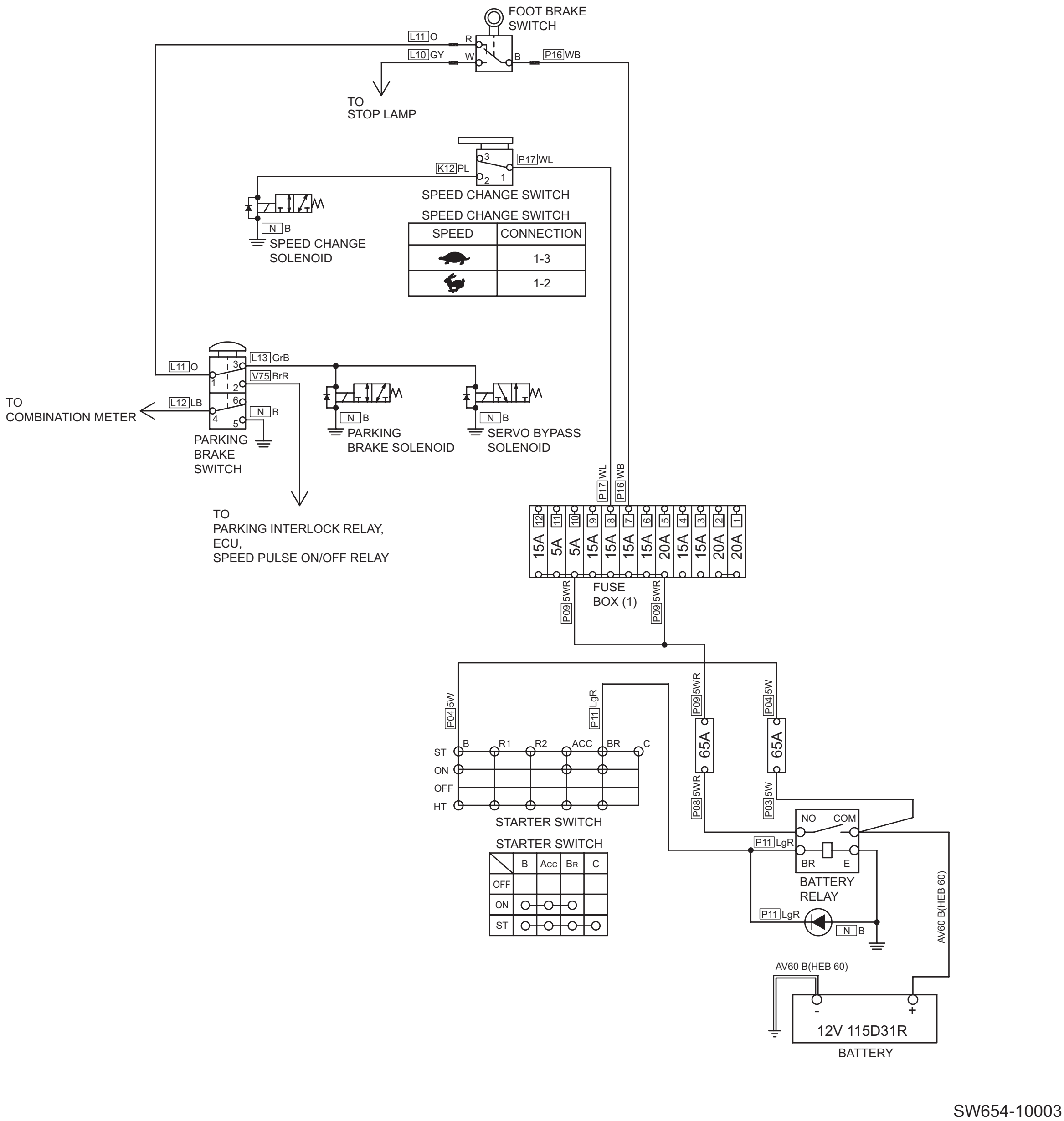
2-4-3. Brake cannot be released

- 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


FOOT BRAKE SWITCH
L11 O
L10 GY
R
W
B
P16 WB
TO STOP LAMP
K12 PL
3
2
1
P17 WL
SPEED CHANGE SWITCH
N B
SPEED CHANGE SOLENOID
SPEED CHANGE SWITCH
SPEED
CONNECTION
1-3
1-2
L11 O
L13 GrB
V75 BrR
L12 LB
N B
TO COMBINATION METER
PARKING BRAKE SWITCH
N B
PARKING BRAKE SOLENOID
N B
SERVO BYPASS SOLENOID
TO PARKING INTERLOCK RELAY, ECU, SPEED PULSE ON/OFF RELAY
P17 WL
P16 WB
15A 12
5A 11
5A 10
15A 9
15A 8
15A 7
15A 6
20A 5
15A 4
15A 3
20A 2
20A 1
FUSE BOX (1)
P09 5WR
P09 5WR
P04 5W
P11 LgR
P09 5WR
P04 5W
65A
65A
P08 5WR
P03 5W
ST
ON
OFF
HT
B
R1
R2
ACC
BR
C
STARTER SWITCH
STARTER SWITCH
B
ACC
BR
C
OFF
ON
ST
NO
COM
BR
E
P11 LgR
BATTERY RELAY
P11 LgR
N B
AV60 B(HEB 60)
AV60 B(HEB 60)
12V 115D31R
BATTERY
SW654-10003

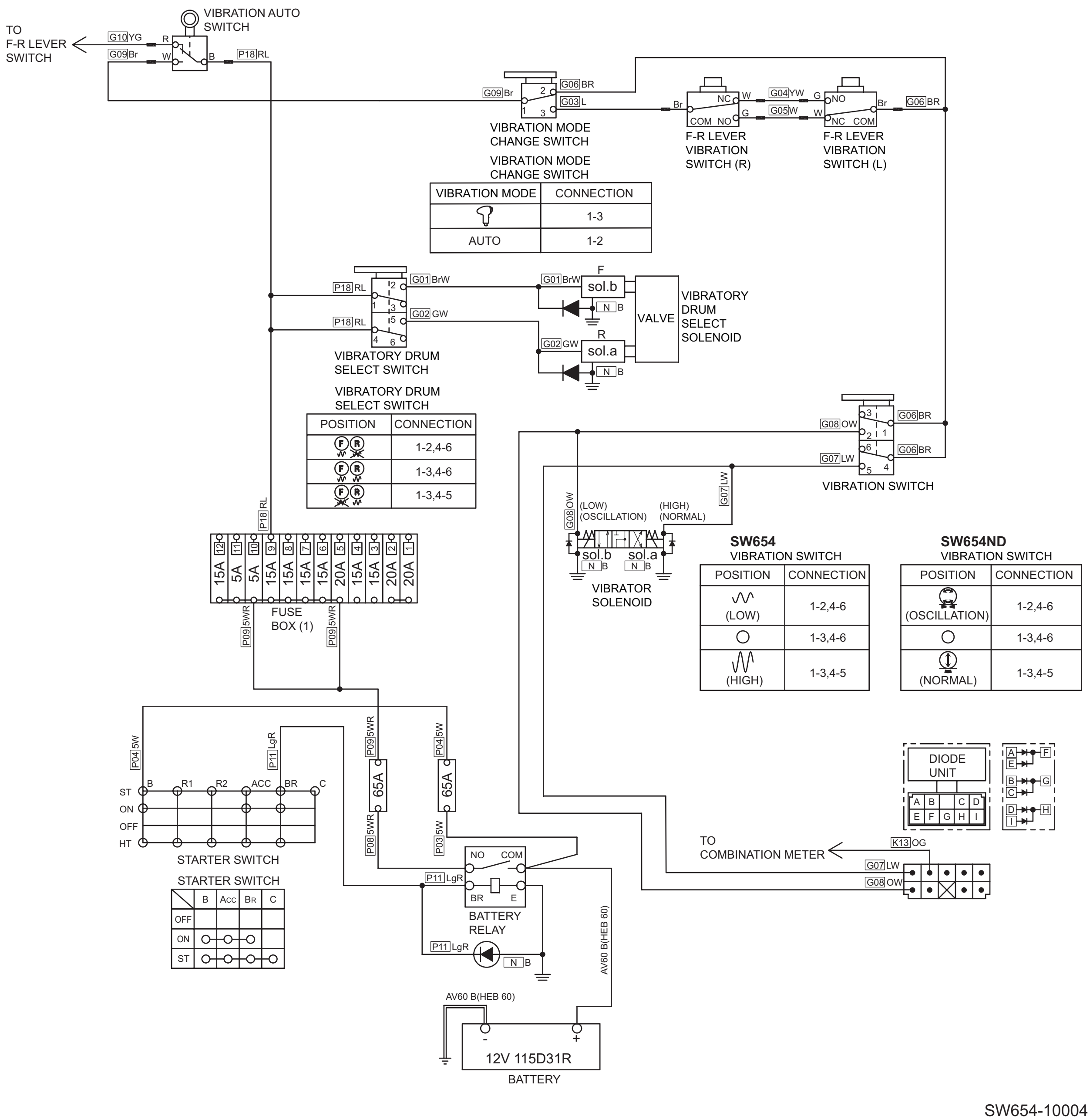
2-4-4. Brake does not work

- 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


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

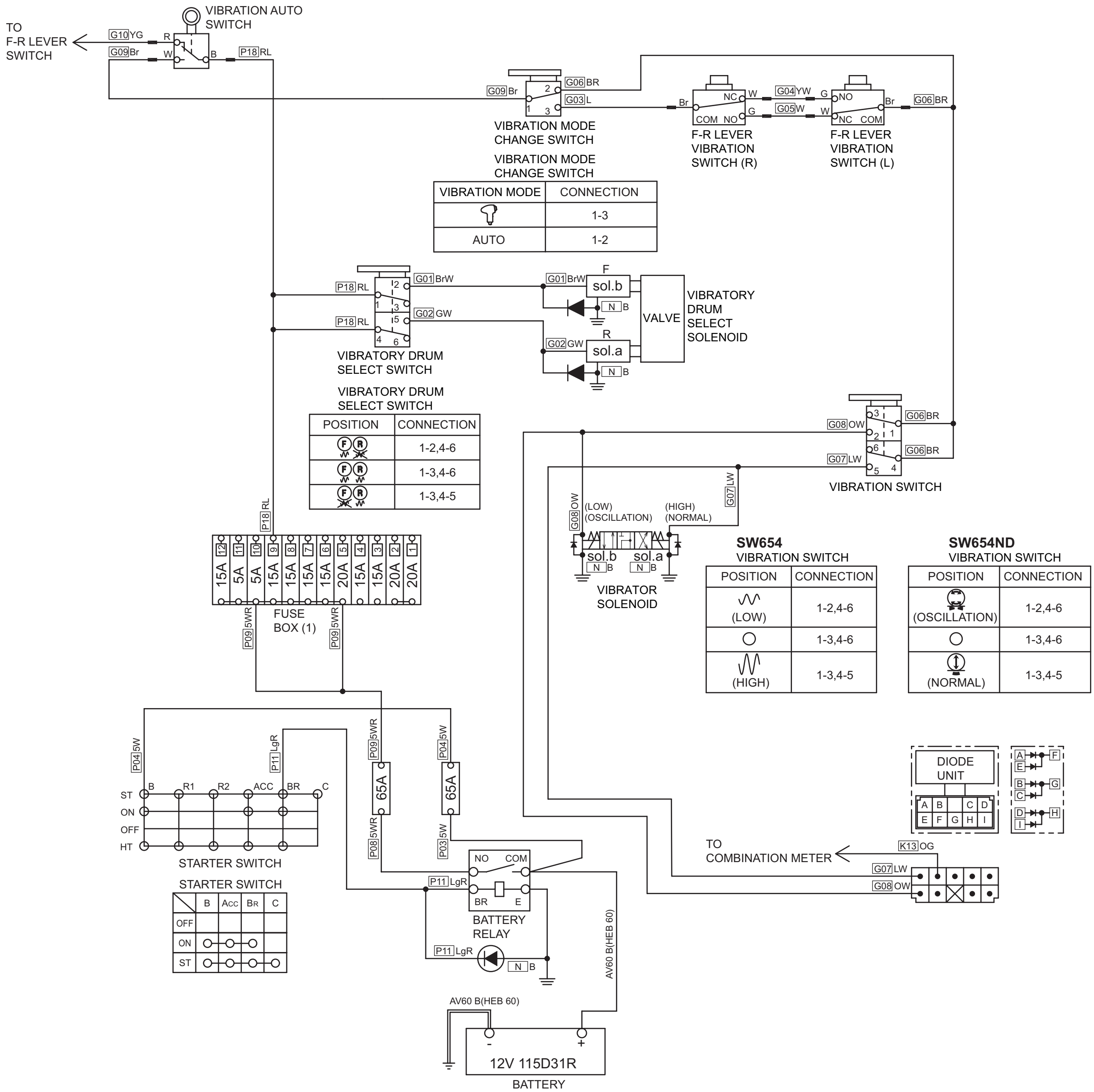
2-5-1. No vibration occurs 1/2

- 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.

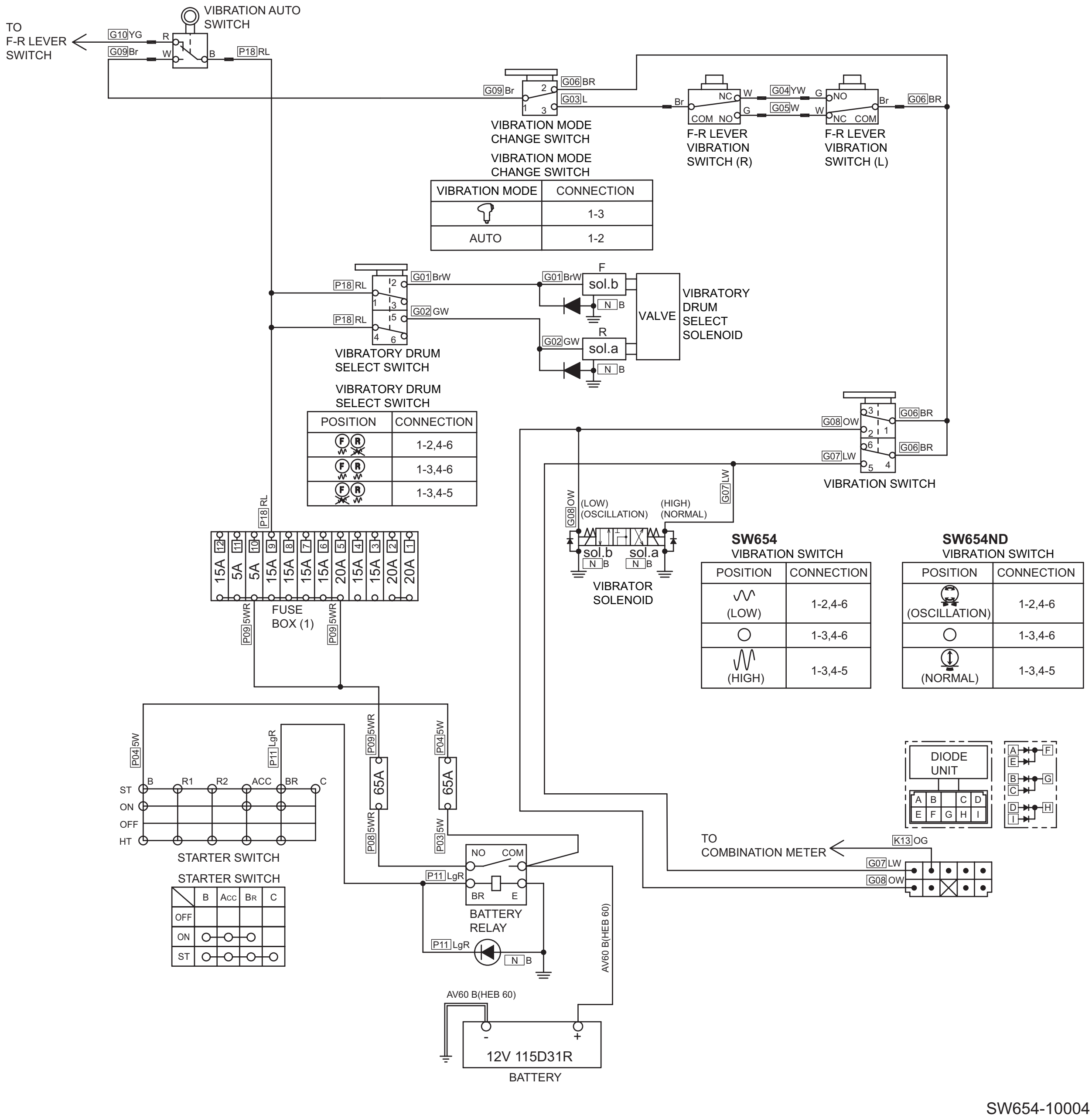
2-5-2. Amplitude does not change (Remains either low or high) : SW654

- 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 MODE CHANGE SWITCH

VIBRATION MODE	CONNECTION
	1-3
AUTO	1-2

VIBRATORY DRUM SELECT SWITCH

POSITION	CONNECTION
	1-2,4-6
	1-3,4-6
	1-3,4-5

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

STARTER SWITCH

	B	ACC	BR	C
OFF				
ON	O	O	O	
ST	O	O	O	O

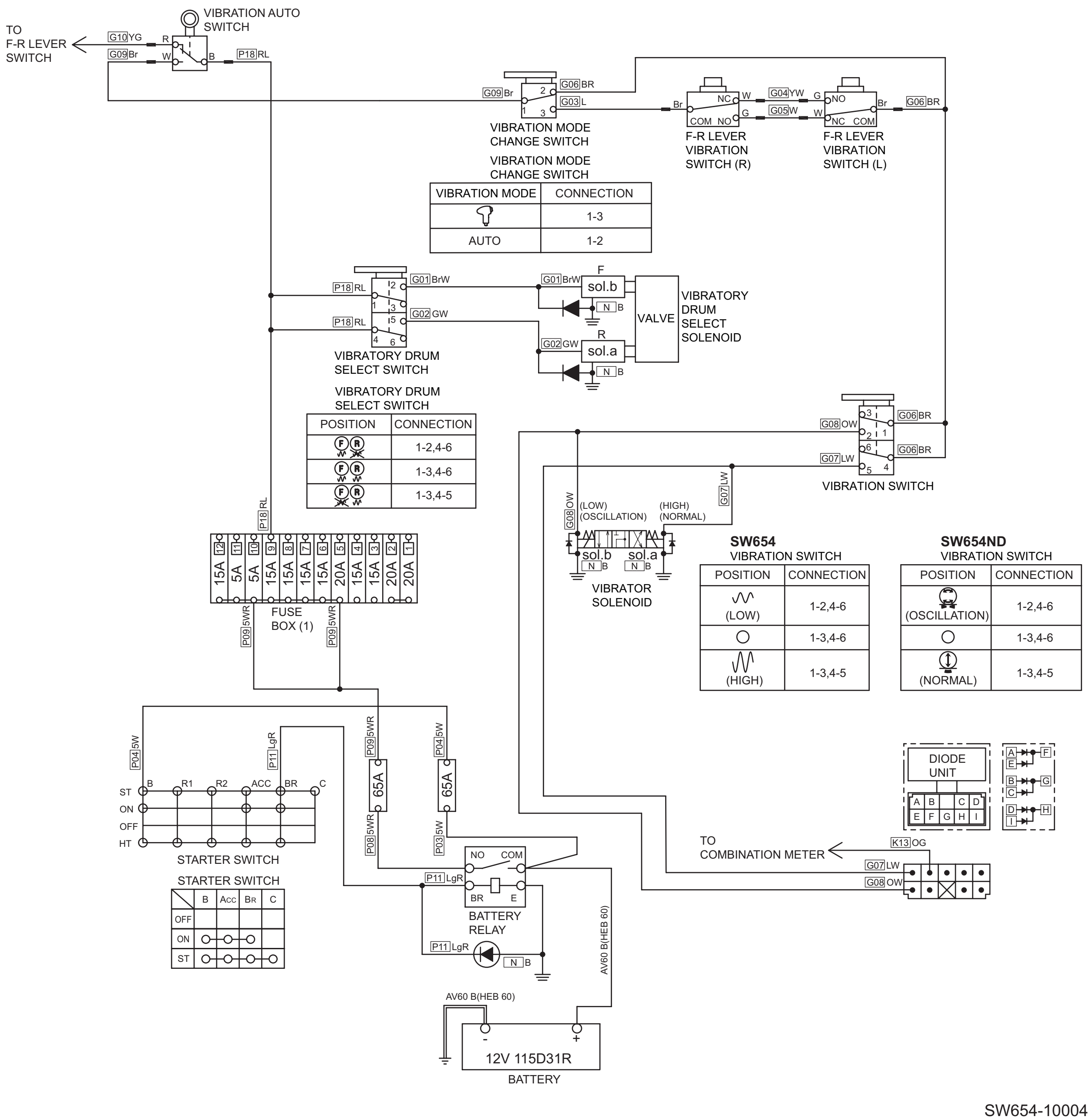
2-5-3. Vibration does not change (Remains normal or oscillation vibration) : SW654ND

- 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


VIBRATION AUTO SWITCH
TO F-R LEVER SWITCH
VIBRATION MODE CHANGE SWITCH
F-R LEVER VIBRATION SWITCH (R)
F-R LEVER VIBRATION SWITCH (L)
VIBRATION MODE CHANGE SWITCH
VIBRATION MODE | CONNECTION
1-3
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
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
FUSE BOX (1)
DIODE UNIT
TO COMBINATION METER
STARTER SWITCH
BATTERY RELAY
12V 115D31R
BATTERY
SW654-10004

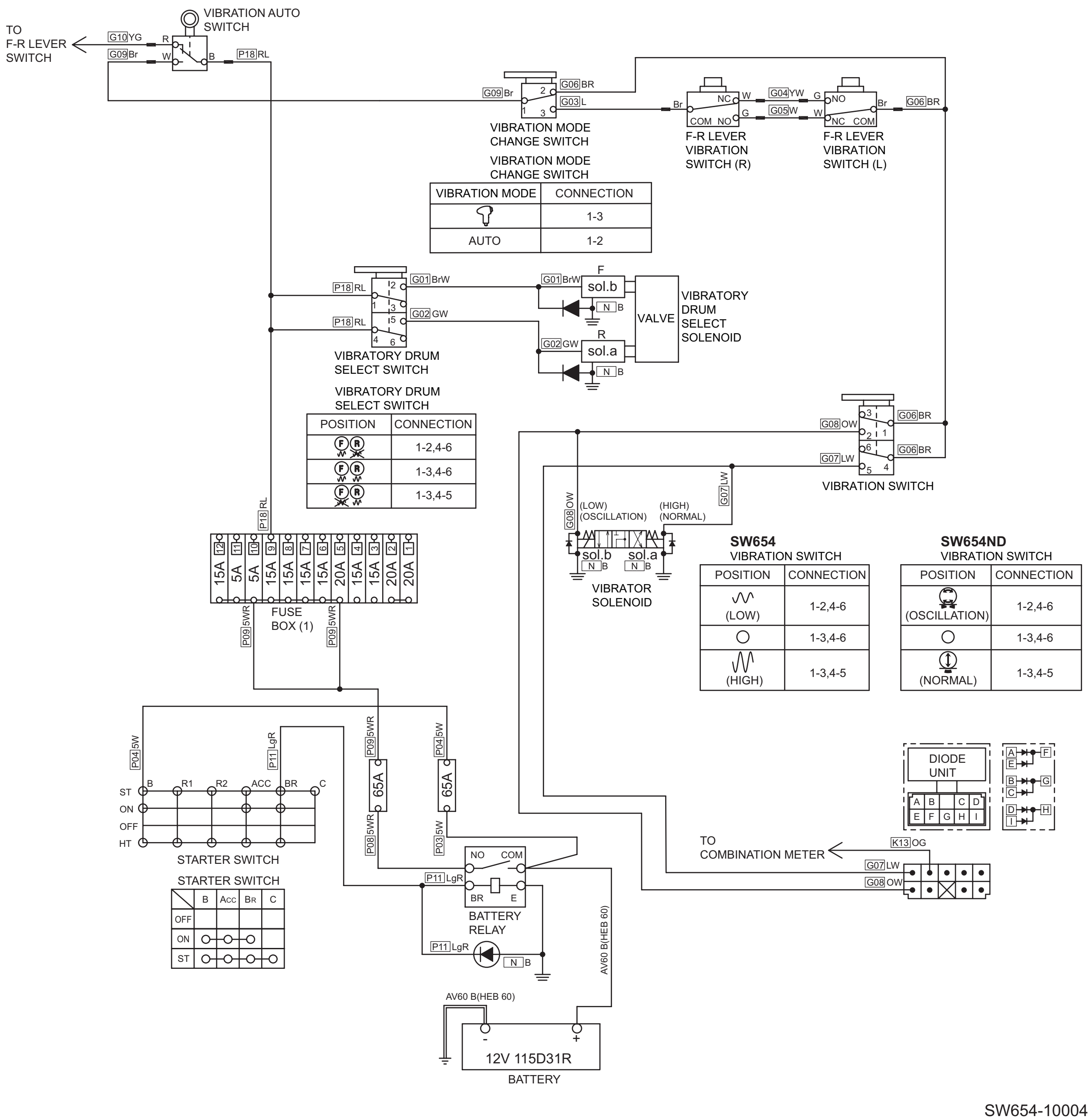
2-5-4. Vibration mode cannot be switched (F-R lever vibration switch does not work)

- 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



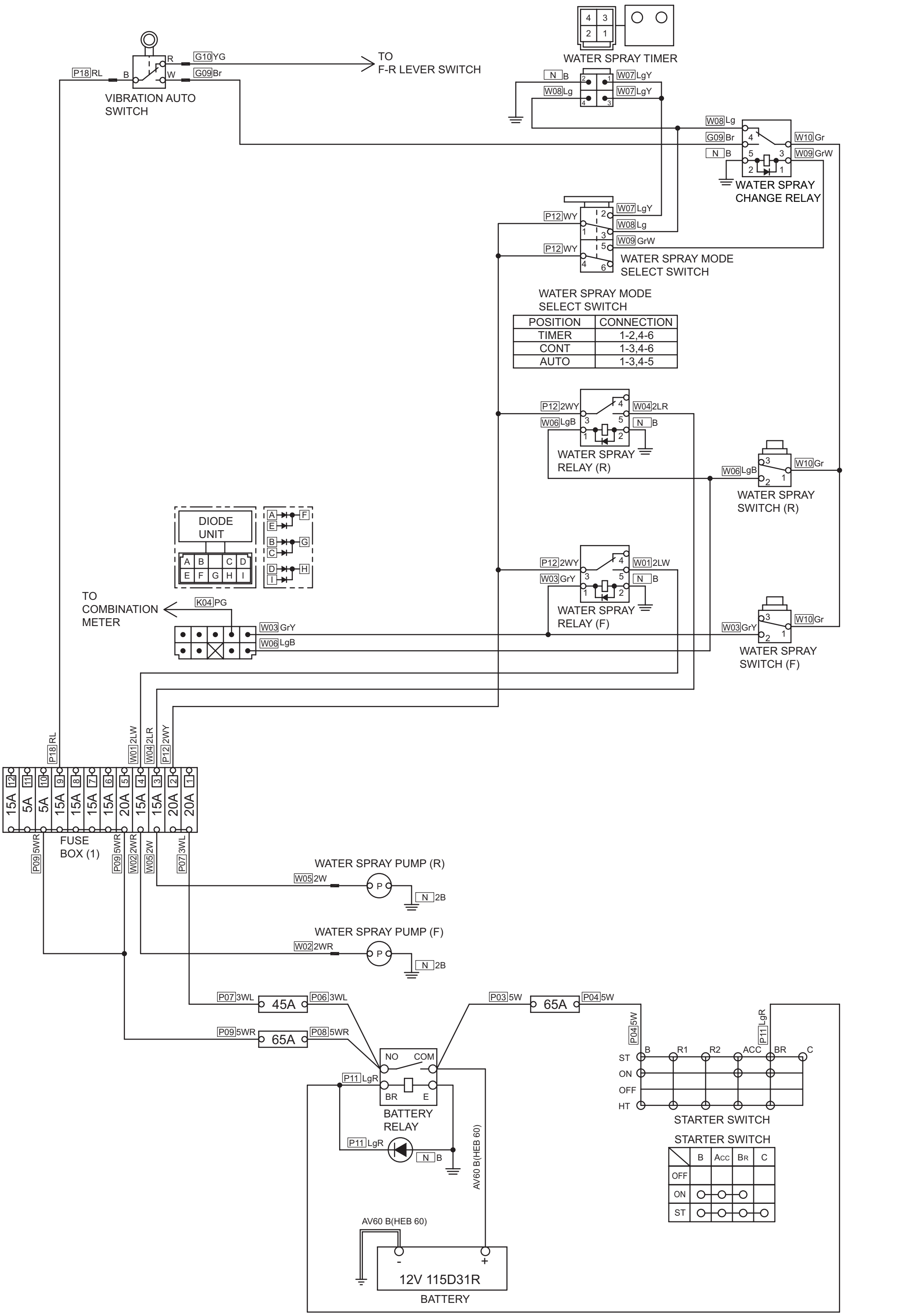
TO F-R LEVER SWITCH
VIBRATION AUTO SWITCH
VIBRATION MODE CHANGE SWITCH
F-R LEVER VIBRATION SWITCH (R)
F-R LEVER VIBRATION SWITCH (L)
VIBRATION MODE CHANGE SWITCH
VIBRATION MODE | CONNECTION
1-3
AUTO | 1-2
VIBRATORY DRUM SELECT SWITCH
VALVE
VIBRATORY DRUM SELECT SOLENOID
VIBRATORY DRUM SELECT SWITCH
POSITION | CONNECTION
1-2,4-6
1-3,4-6
1-3,4-5
VIBRATION SWITCH
(LOW) (OSCILLATION)
(HIGH) (NORMAL)
VIBRATOR SOLENOID
FUSE BOX (1)
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
STARTER SWITCH
BATTERY RELAY
AV60 B(HEB 60)
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 " ⒻⓇ ", 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..

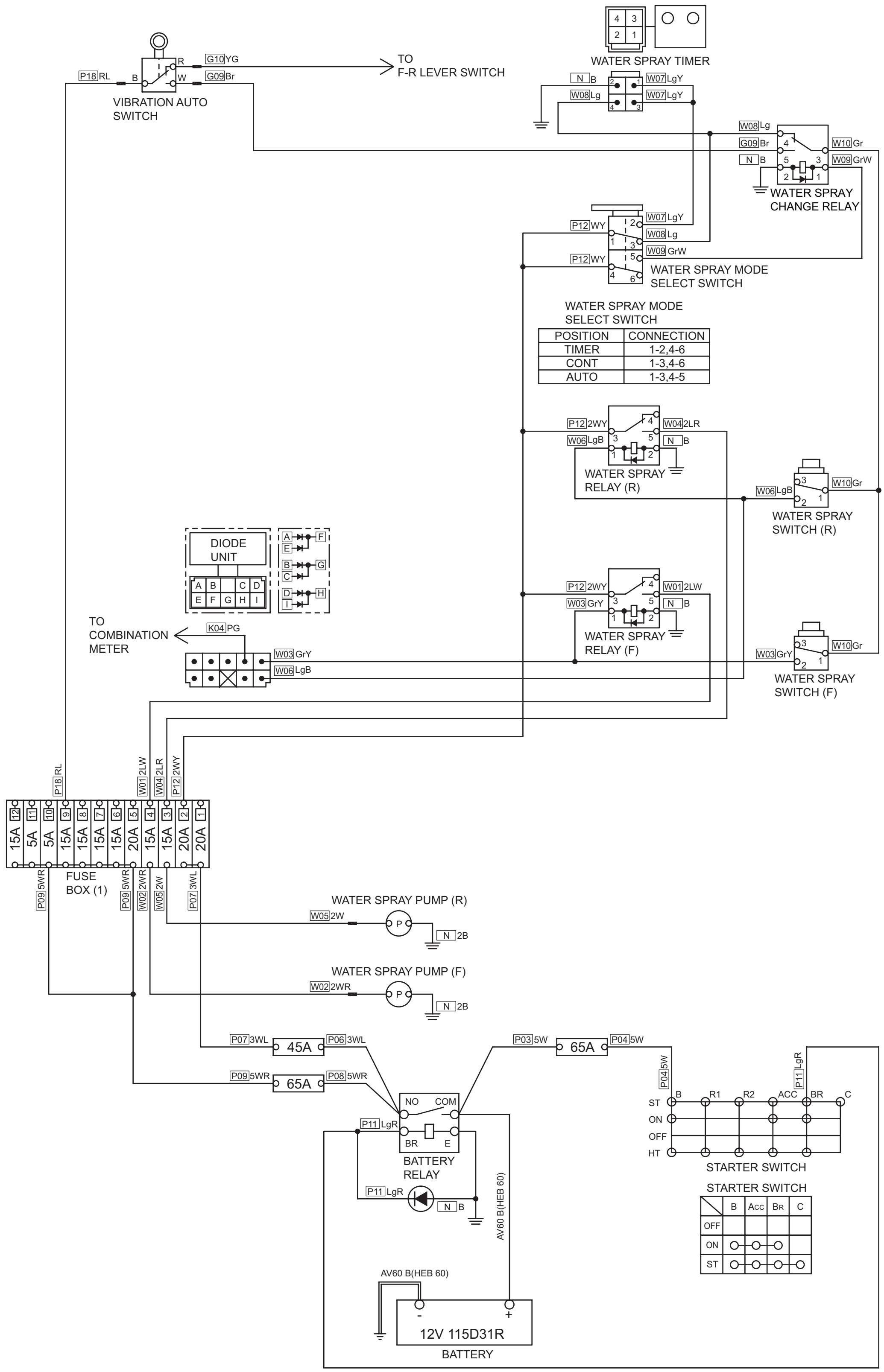
2-6-1. Continuous water spray does not operate 1/2

- 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

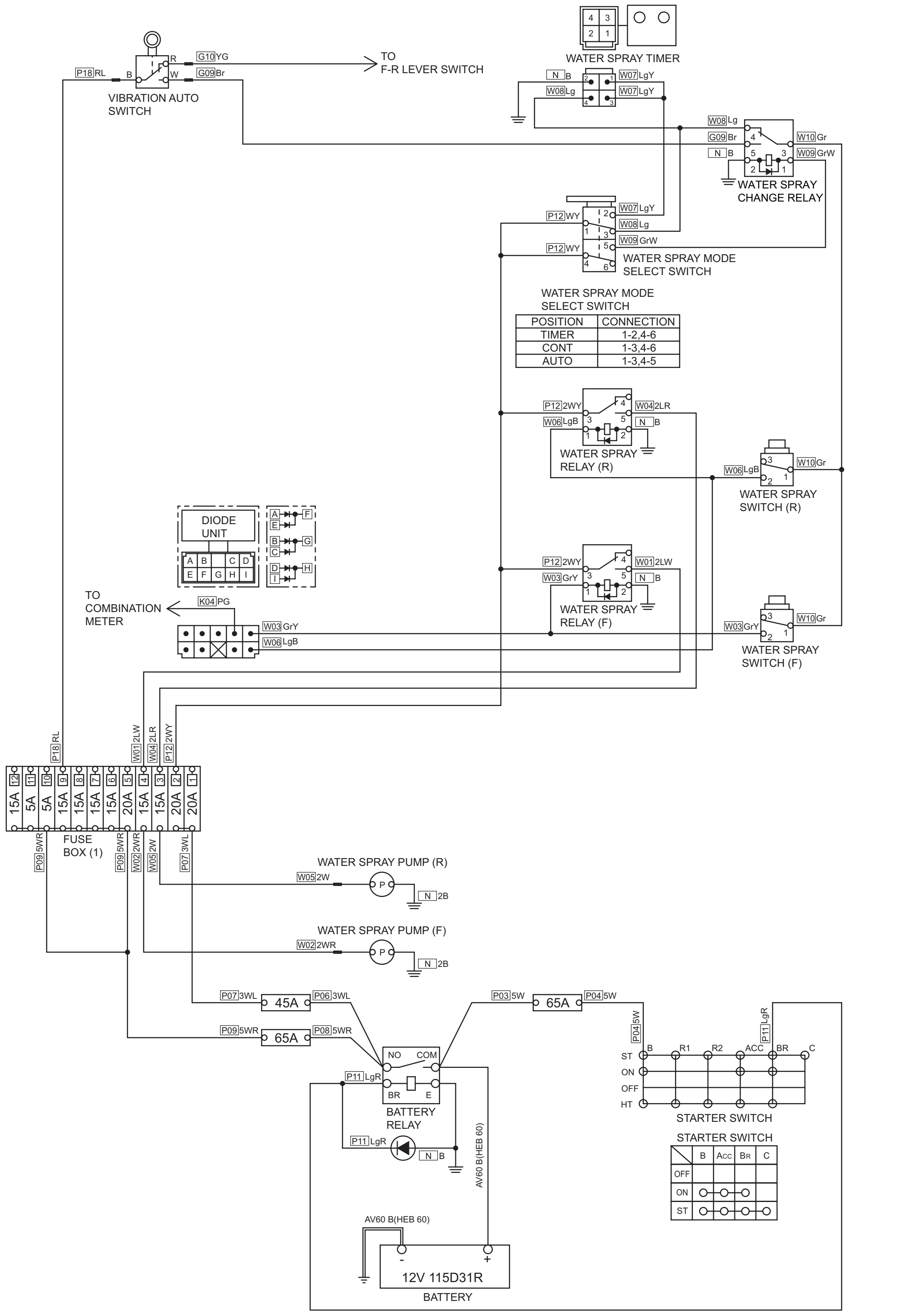
2-6-1. Continuous water spray does not operate 2/2

- 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

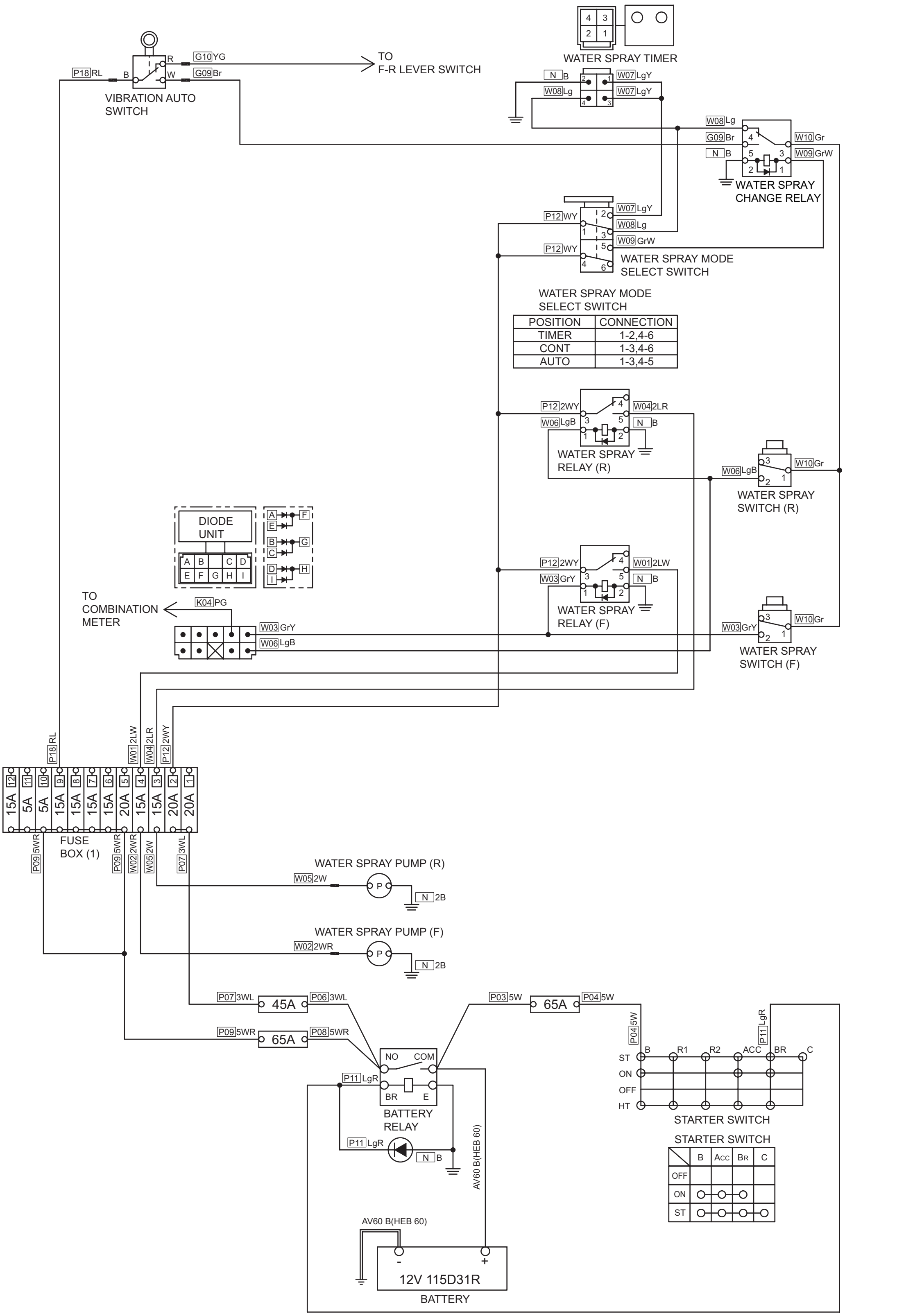
2-6-2. Continuous water spray works, but auto water spray does not operate

- 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



WATER SPRAY MODE SELECT SWITCH

POSITION	CONNECTION
TIMER	1-2,4-6
CONT	1-3,4-6
AUTO	1-3,4-5

STARTER SWITCH

	B	ACC	BR	C
OFF				
ON	O	O	O	
ST	O	O	O	O

SW654-10005

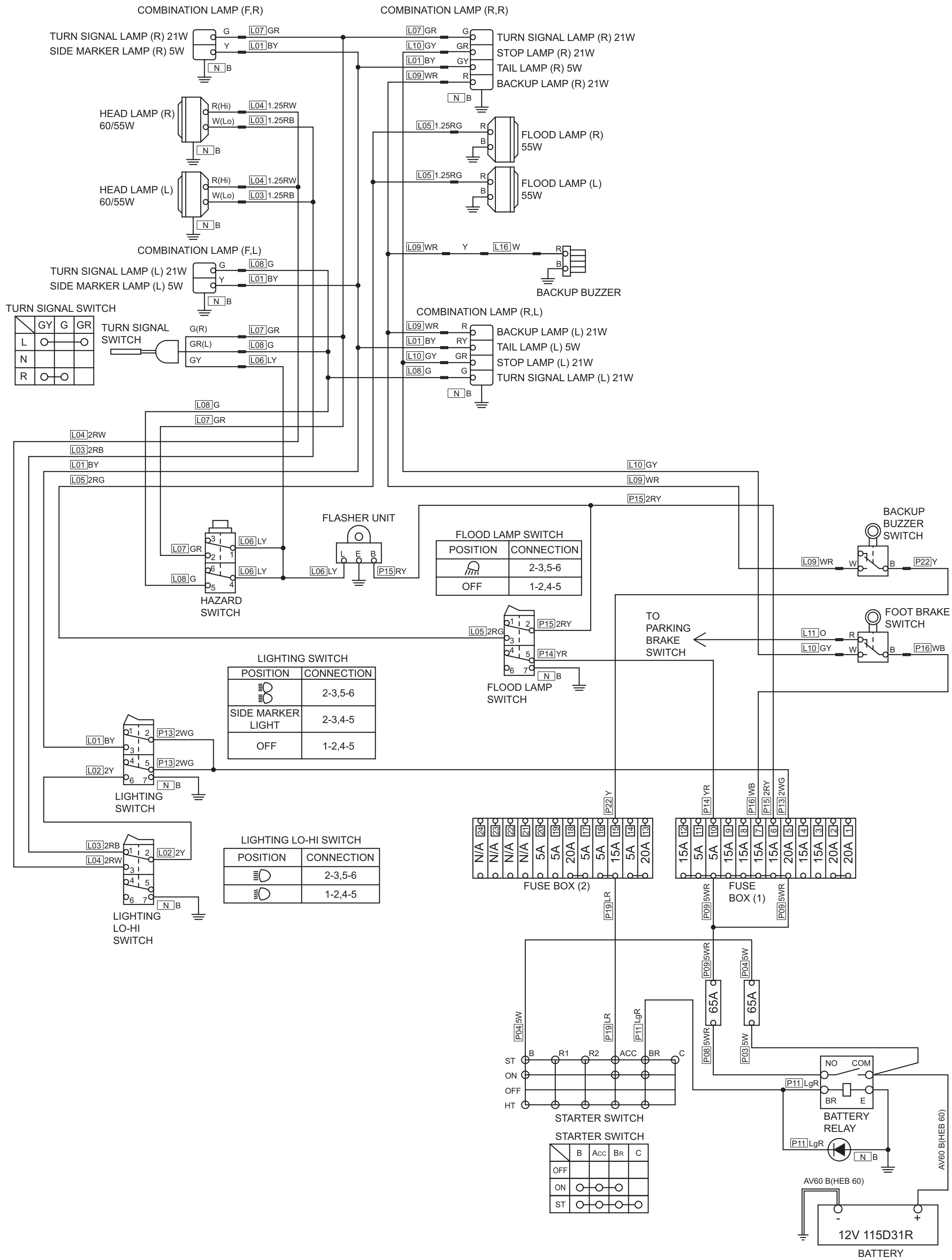
2-6-3. Continuous water spray works, but intermittent water spray does not operate

- 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



TURN SIGNAL SWITCH

	GY	G	GR
L	O—		—O
N			
R	O—O		

FLOOD LAMP SWITCH

POSITION	CONNECTION
(flood lamp symbol)	2-3,5-6
OFF	1-2,4-5

LIGHTING SWITCH

POSITION	CONNECTION
(head lamp symbol)	2-3,5-6
SIDE MARKER LIGHT	2-3,4-5
OFF	1-2,4-5

LIGHTING LO-HI SWITCH

POSITION	CONNECTION
(high beam symbol)	2-3,5-6
(low beam symbol)	1-2,4-5

STARTER SWITCH

	B	ACC	BR	C
OFF				
ON	O—	—O—	—O	
ST	O—	—O—	—O—	—O

SW654-10006

2-7. Lighting

Check following items before troubleshooting.

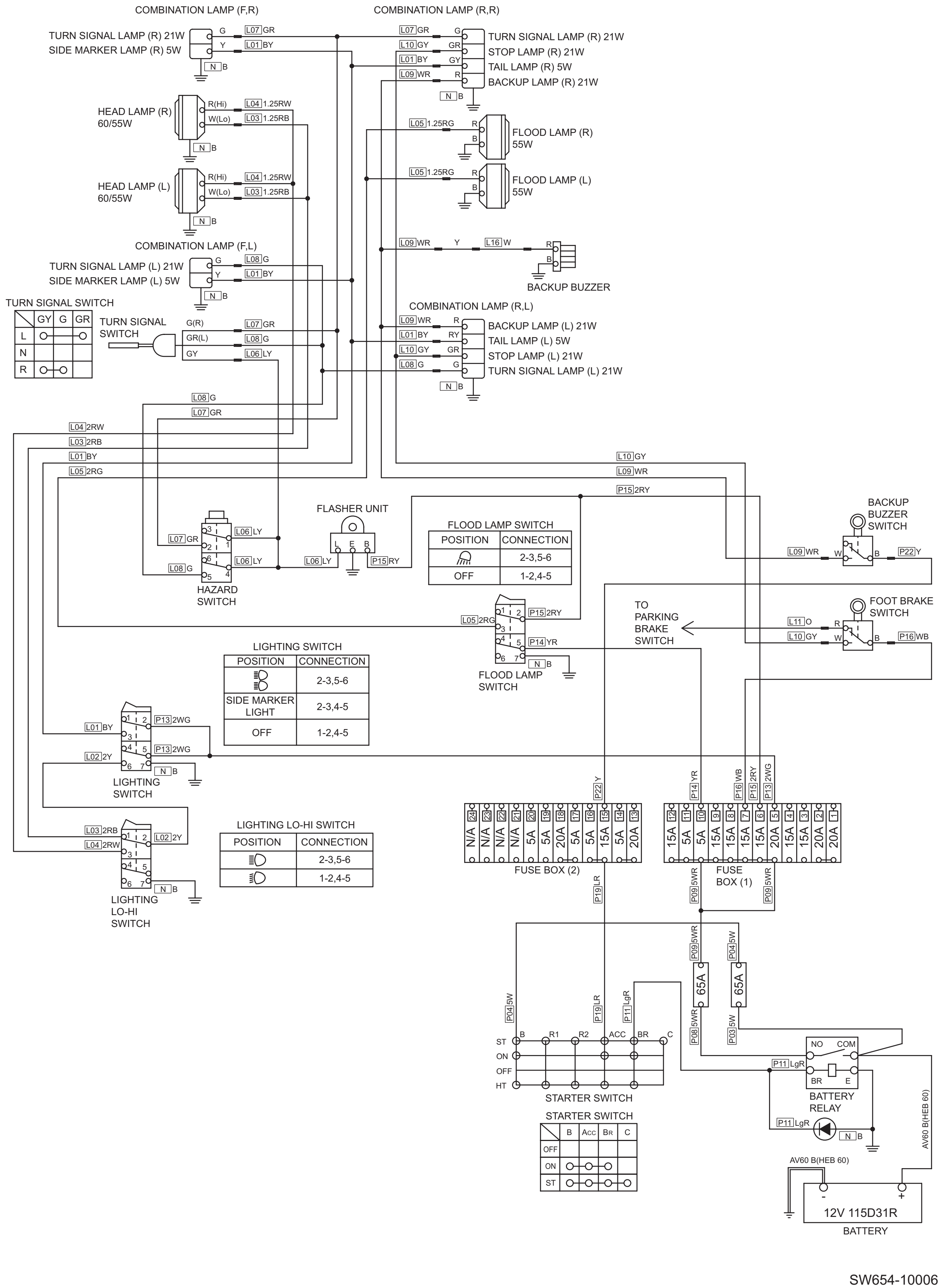
- No blown fuse and power is applied up to fuses.

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


COMBINATION LAMP (F,R)
TURN SIGNAL LAMP (R) 21W
SIDE MARKER LAMP (R) 5W
COMBINATION LAMP (R,R)
TURN SIGNAL LAMP (R) 21W
STOP LAMP (R) 21W
TAIL LAMP (R) 5W
BACKUP LAMP (R) 21W
HEAD LAMP (R) 60/55W
FLOOD LAMP (R) 55W
HEAD LAMP (L) 60/55W
FLOOD LAMP (L) 55W
COMBINATION LAMP (F,L)
TURN SIGNAL LAMP (L) 21W
SIDE MARKER LAMP (L) 5W
BACKUP BUZZER
TURN SIGNAL SWITCH
COMBINATION LAMP (R,L)
BACKUP LAMP (L) 21W
TAIL LAMP (L) 5W
STOP LAMP (L) 21W
TURN SIGNAL LAMP (L) 21W
FLASHER UNIT
FLOOD LAMP SWITCH
POSITION CONNECTION
2-3,5-6
OFF 1-2,4-5
HAZARD SWITCH
BACKUP BUZZER SWITCH
TO PARKING BRAKE SWITCH
FOOT BRAKE SWITCH
LIGHTING SWITCH
POSITION CONNECTION
2-3,5-6
SIDE MARKER LIGHT 2-3,4-5
OFF 1-2,4-5
LIGHTING SWITCH
LIGHTING LO-HI SWITCH
POSITION CONNECTION
2-3,5-6
1-2,4-5
LIGHTING LO-HI SWITCH
FUSE BOX (2)
FUSE BOX (1)
STARTER SWITCH
BATTERY RELAY
12V 115D31R
BATTERY
AV60 B(HEB 60)
SW654-10006

2-7-2. Flood lamp does not light

Reference Fig. : 2-7-1

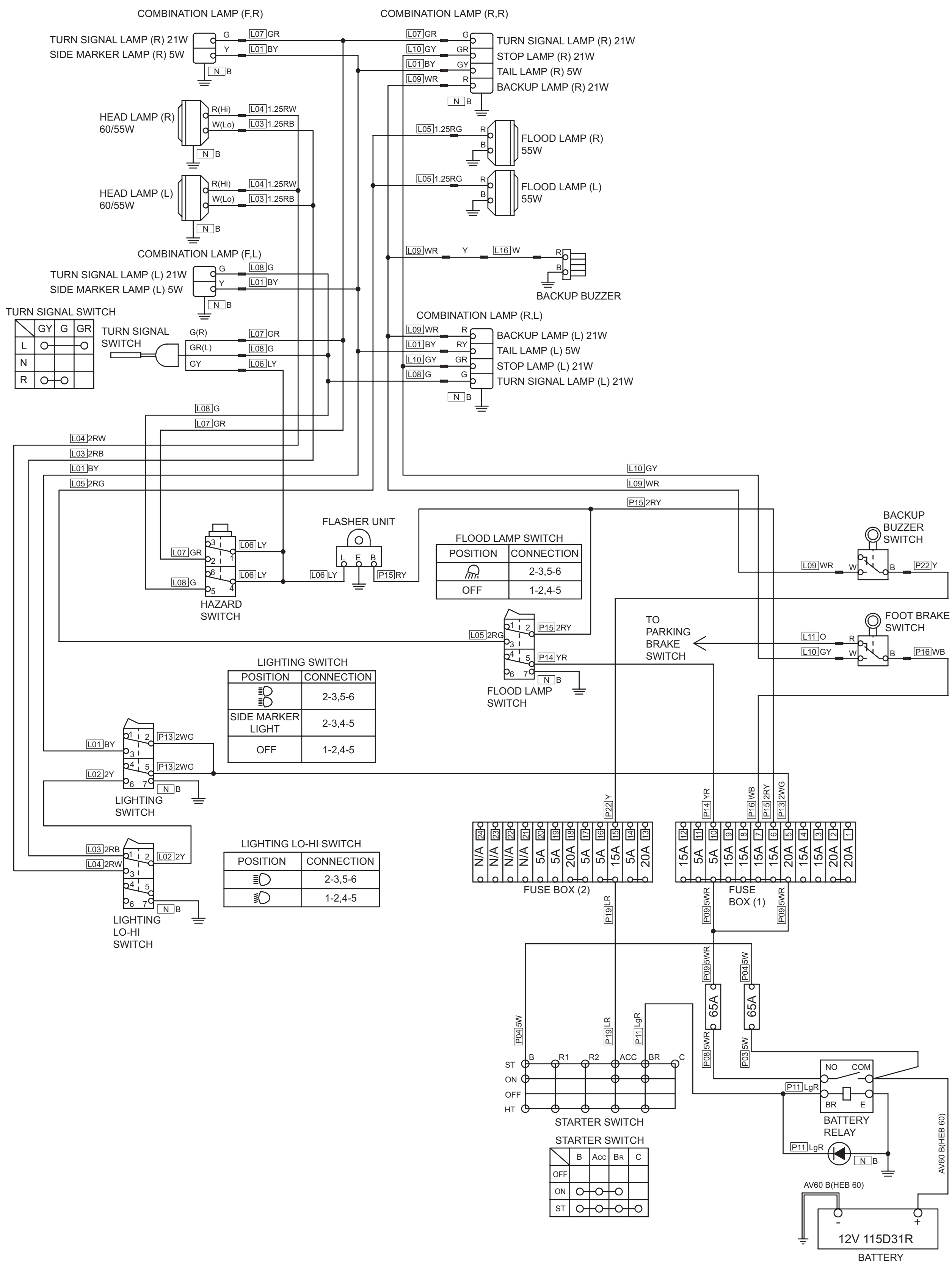
Check point	Check/Cause	Action
1. Each Bulb	• Check that none of lamp bulbs is burned out or has a contact failure. • Bulb is faulty or poorly connected.	Replace each bulb.
2. Flood Lamp Switch	(1) When starter switch is ON, measure voltage between flood lamp switch terminal 2 inlet wire RY and chassis 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

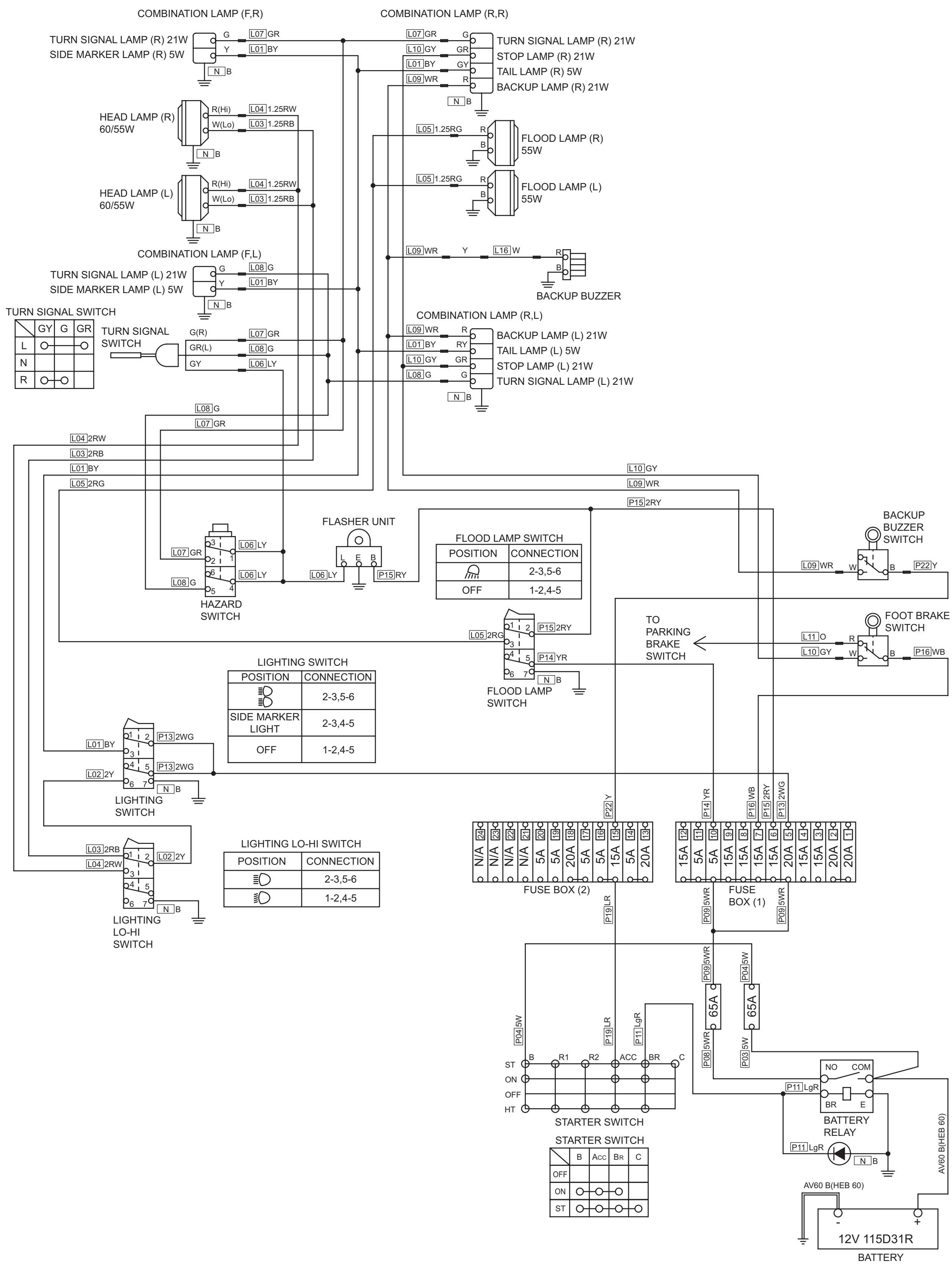

COMBINATION LAMP (F,R)
COMBINATION LAMP (R,R)
TURN SIGNAL LAMP (R) 21W
SIDE MARKER LAMP (R) 5W
STOP LAMP (R) 21W
TAIL LAMP (R) 5W
BACKUP LAMP (R) 21W
HEAD LAMP (R) 60/55W
FLOOD LAMP (R) 55W
HEAD LAMP (L) 60/55W
FLOOD LAMP (L) 55W
COMBINATION LAMP (F,L)
TURN SIGNAL LAMP (L) 21W
SIDE MARKER LAMP (L) 5W
BACKUP BUZZER
TURN SIGNAL SWITCH
COMBINATION LAMP (R,L)
BACKUP LAMP (L) 21W
TAIL LAMP (L) 5W
STOP LAMP (L) 21W
TURN SIGNAL LAMP (L) 21W
FLASHER UNIT
FLOOD LAMP SWITCH
POSITION CONNECTION
2-3,5-6
OFF 1-2,4-5
HAZARD SWITCH
BACKUP BUZZER SWITCH
FOOT BRAKE SWITCH
TO PARKING BRAKE SWITCH
LIGHTING SWITCH
POSITION CONNECTION
2-3,5-6
SIDE MARKER LIGHT 2-3,4-5
OFF 1-2,4-5
FLOOD LAMP SWITCH
LIGHTING SWITCH
LIGHTING LO-HI SWITCH
POSITION CONNECTION
2-3,5-6
1-2,4-5
LIGHTING LO-HI SWITCH
FUSE BOX (2)
FUSE BOX (1)
65A
65A
STARTER SWITCH
STARTER SWITCH
B ACC BR C
OFF
ON
ST
BATTERY RELAY
NO COM
BR E
AV60 B(HEB 60)
12V 115D31R
BATTERY
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



COMBINATION LAMP (F,R)
COMBINATION LAMP (R,R)
TURN SIGNAL LAMP (R) 21W
SIDE MARKER LAMP (R) 5W
STOP LAMP (R) 21W
TAIL LAMP (R) 5W
BACKUP LAMP (R) 21W
HEAD LAMP (R) 60/55W
HEAD LAMP (L) 60/55W
FLOOD LAMP (R) 55W
FLOOD LAMP (L) 55W
COMBINATION LAMP (F,L)
TURN SIGNAL LAMP (L) 21W
SIDE MARKER LAMP (L) 5W
BACKUP BUZZER
TURN SIGNAL SWITCH
COMBINATION LAMP (R,L)
BACKUP LAMP (L) 21W
TAIL LAMP (L) 5W
STOP LAMP (L) 21W
TURN SIGNAL LAMP (L) 21W
FLASHER UNIT
HAZARD SWITCH
FLOOD LAMP SWITCH
POSITION CONNECTION
2-3,5-6
OFF 1-2,4-5
BACKUP BUZZER SWITCH
TO PARKING BRAKE SWITCH
FOOT BRAKE SWITCH
FLOOD LAMP SWITCH
LIGHTING SWITCH
POSITION CONNECTION
2-3,5-6
SIDE MARKER LIGHT 2-3,4-5
OFF 1-2,4-5
LIGHTING LO-HI SWITCH
POSITION CONNECTION
2-3,5-6
1-2,4-5
FUSE BOX (2)
FUSE BOX (1)
STARTER SWITCH
BATTERY RELAY
12V 115D31R
BATTERY
SW654-10006

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

- Hazard switch must be ON.

Reference Fig. : 2-7-1

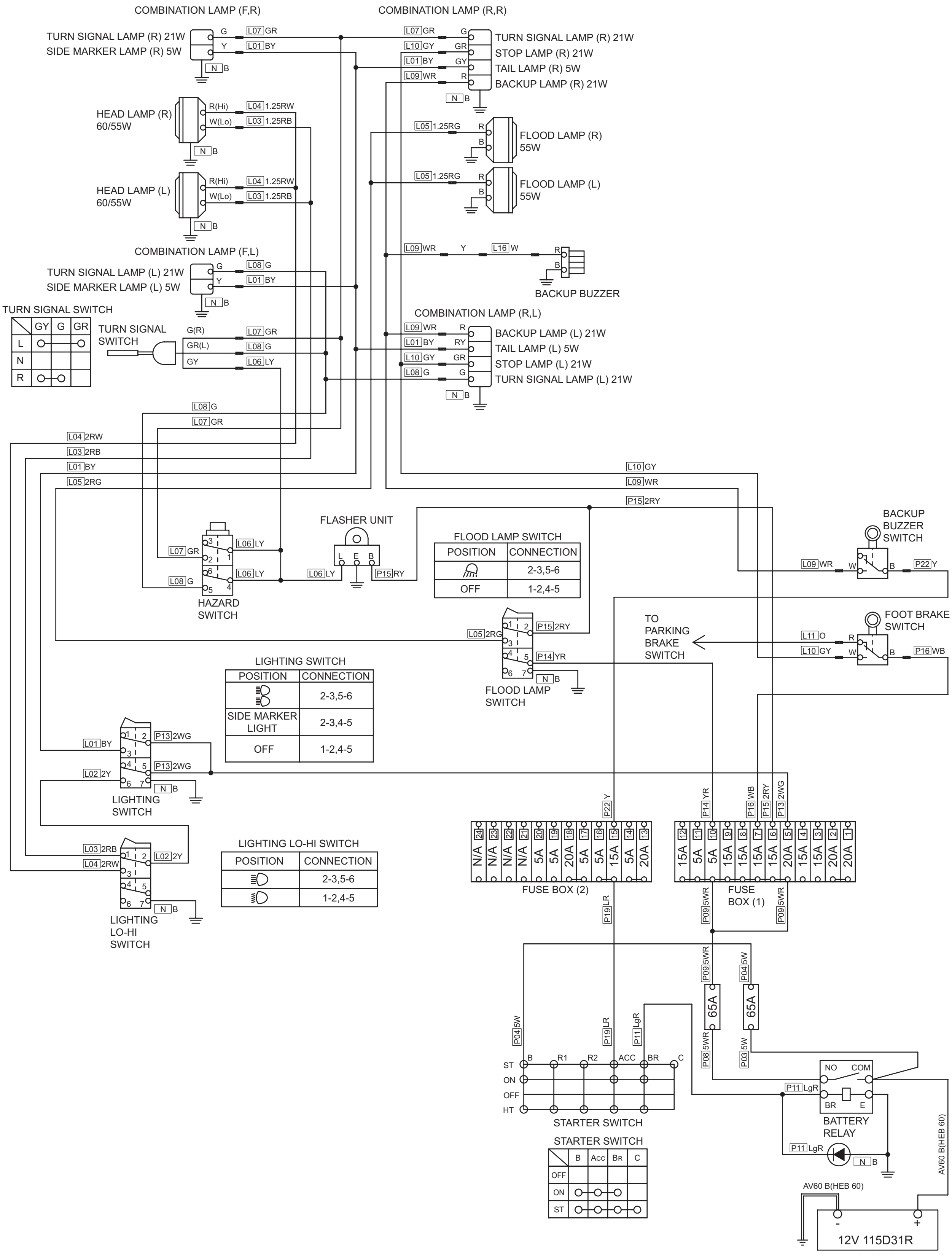
Check point	Check/Cause	Action
1. Each Bulb	• Check that none of lamp bulbs is burned out or has a contact failure. • Bulb is faulty or poorly connected.	Replace each bulb.
2. Hazard Switch	(1) When starter switch is ON, measure voltage between hazard switch terminal 1 and 4 inlet wire LY and chassis 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



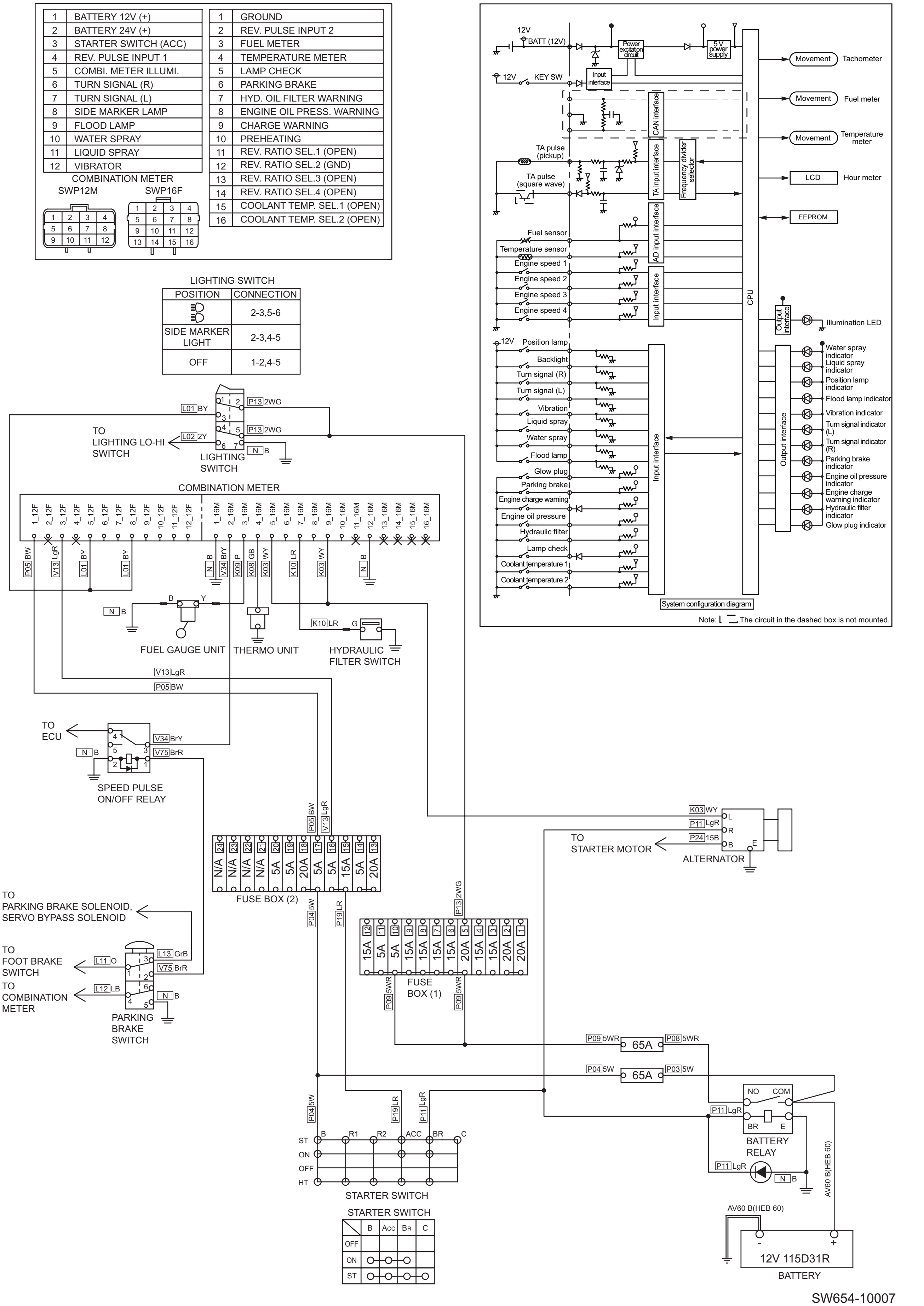
SW654-10006

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



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
LIGHTING SWITCH
POSITION
CONNECTION
2-3,5-6
SIDE MARKER LIGHT
2-3,4-5
OFF
1-2,4-5
TO LIGHTING LO-HI SWITCH
LIGHTING SWITCH
COMBINATION METER
FUEL GAUGE UNIT
THERMO UNIT
HYDRAULIC FILTER SWITCH
TO ECU
SPEED PULSE ON/OFF RELAY
FUSE BOX (2)
TO PARKING BRAKE SOLENOID, SERVO BYPASS SOLENOID
TO FOOT BRAKE SWITCH
TO COMBINATION METER
PARKING BRAKE SWITCH
FUSE BOX (1)
TO STARTER MOTOR
ALTERNATOR
65A
BATTERY RELAY
STARTER SWITCH
B
ACC
BR
C
OFF
ON
ST
HT
AV60 B(HEB 60)
12V 115D31R
BATTERY
12V
BATT (12V)
Power excitation circuit
5V power supply
KEY SW
Input interface
CAN interface
TA pulse (pickup)
TA pulse (square wave)
TA input interface
Frequency divider selector
Fuel sensor
Temperature sensor
Engine speed 1
Engine speed 2
Engine speed 3
Engine speed 4
AD input interface
Input interface
CPU
Movement
Tachometer
Fuel meter
Temperature meter
LCD
Hour meter
EEPROM
Output interface
Illumination LED
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
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.
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.

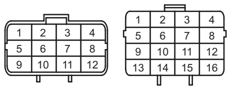
Fig.: 2-7-2

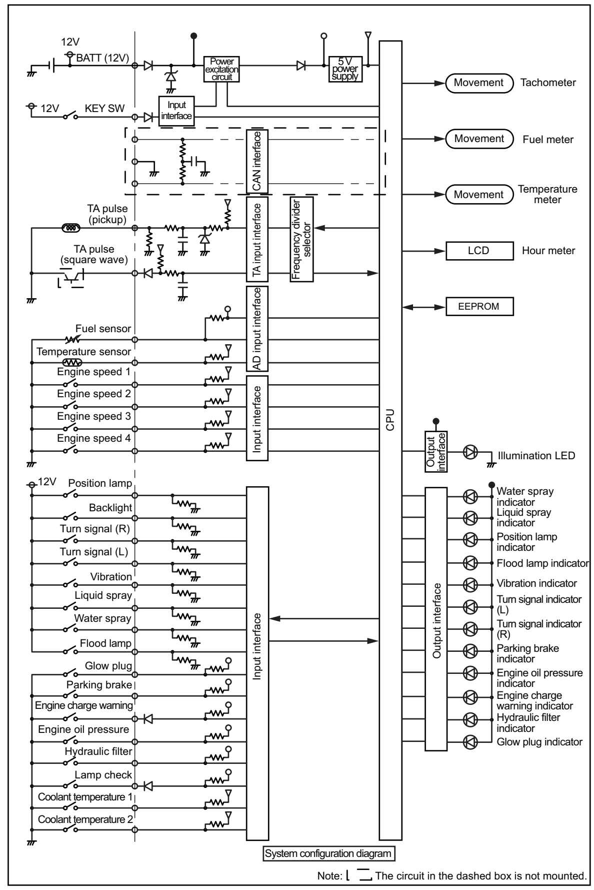
1	BATTERY 12V (+)
2	BATTERY 24V (+)
3	STARTER SWITCH (ACC)
4	REV. PULSE INPUT 1
5	COMBI. METER ILLUMI.
6	TURN SIGNAL (R)
7	TURN SIGNAL (L)
8	SIDE MARKER LAMP
9	FLOOD LAMP
10	WATER SPRAY
11	LIQUID SPRAY
12	VIBRATOR

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

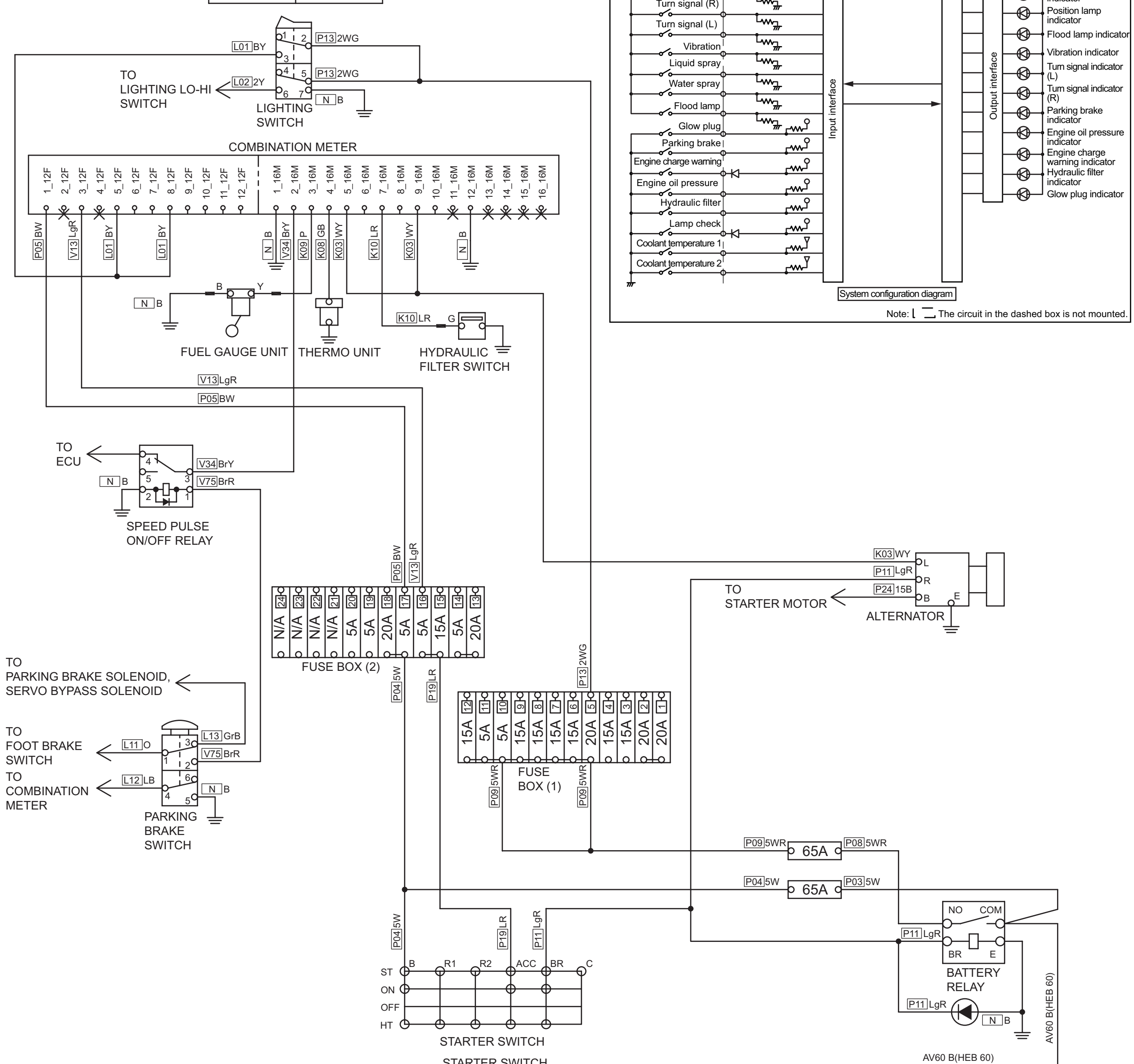
SWP12M SWP16F





LIGHTING SWITCH

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



STARTER SWITCH

	B	ACC	BR	C
OFF				
ON	O	O	O	
ST	O	O	O	O

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

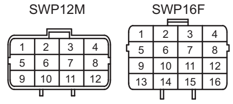
Check point	Check/Cause	Action
1. Combination Meter (Hour meter)	• When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery 12 V (+) terminal wire No.P05 inlet wire BW and ground terminal wire No.N wire B • Starter switch (ACC) terminal wire 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.

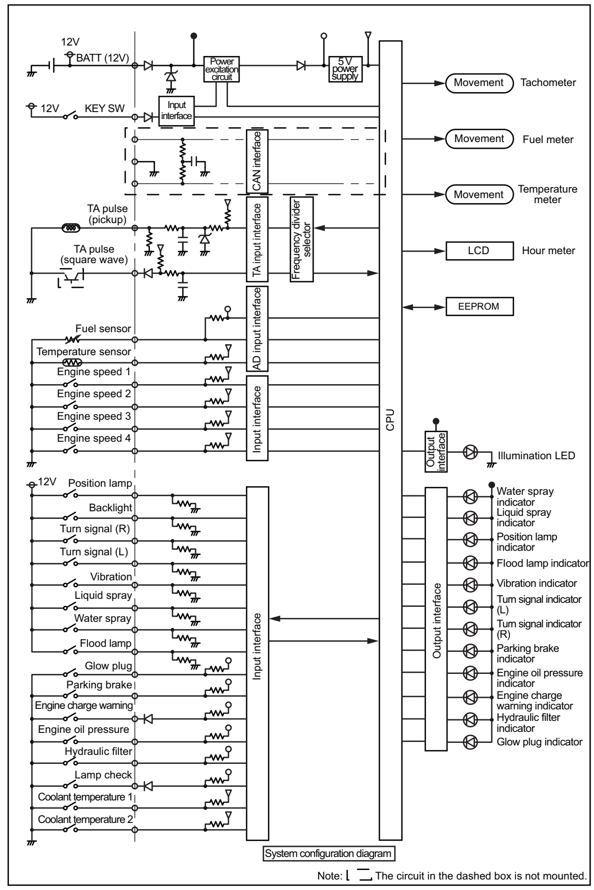
Fig.: 2-7-2

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)

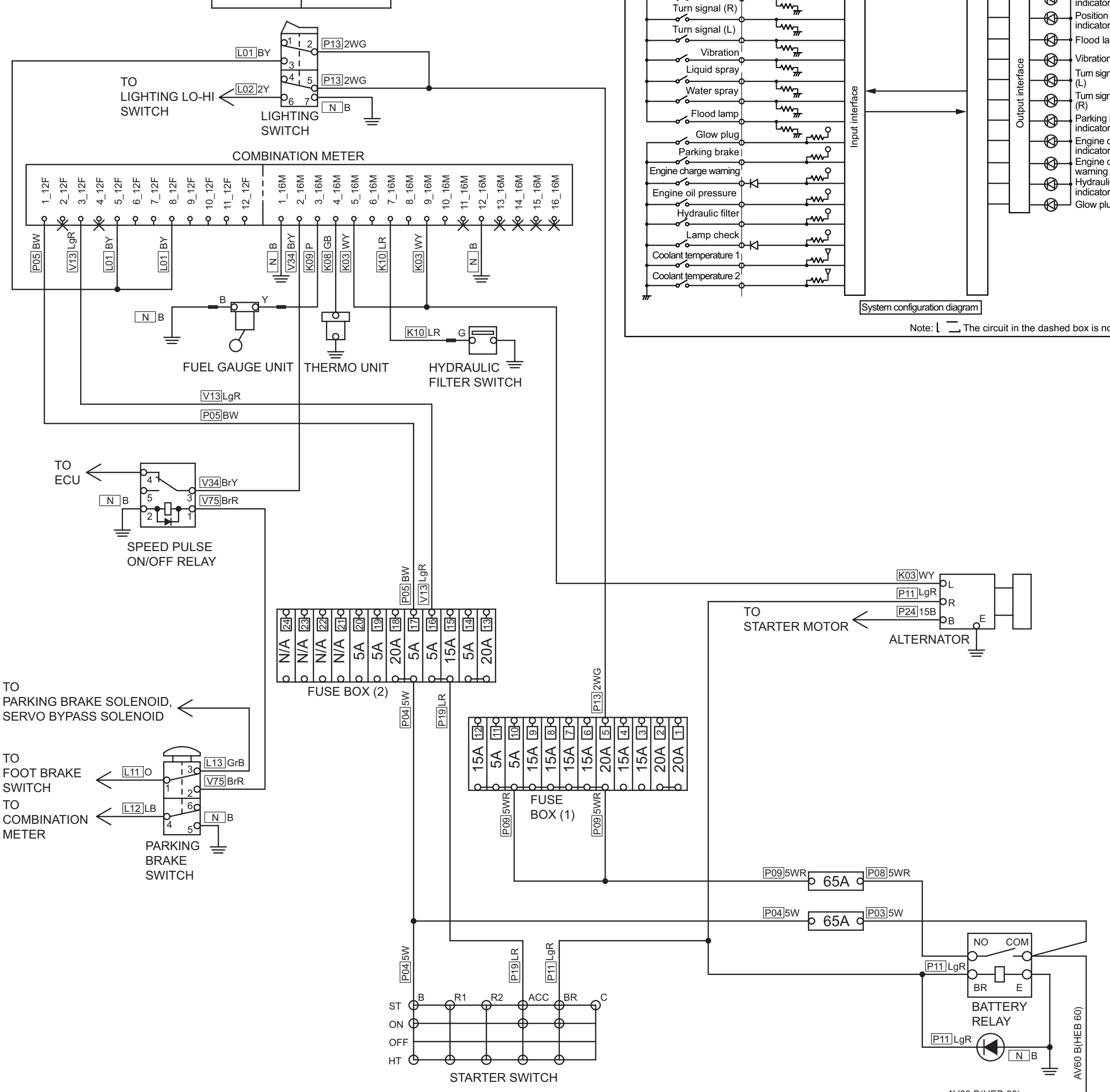
COMBINATION METER





LIGHTING SWITCH

POSITION	CONNECTION
(lamp symbol)	2-3,5-6
SIDE MARKER LIGHT	2-3,4-5
OFF	1-2,4-5



STARTER SWITCH

	B	ACC	BR	C
OFF				
ON	O	O	O	
ST	O	O	O	O

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.

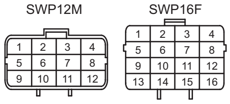
Fig.: 2-7-2

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)

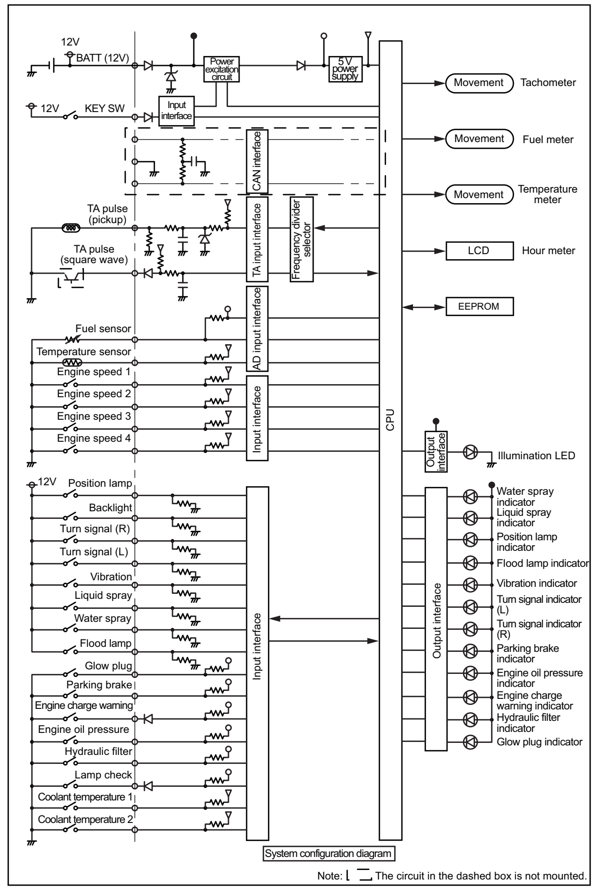
COMBINATION METER

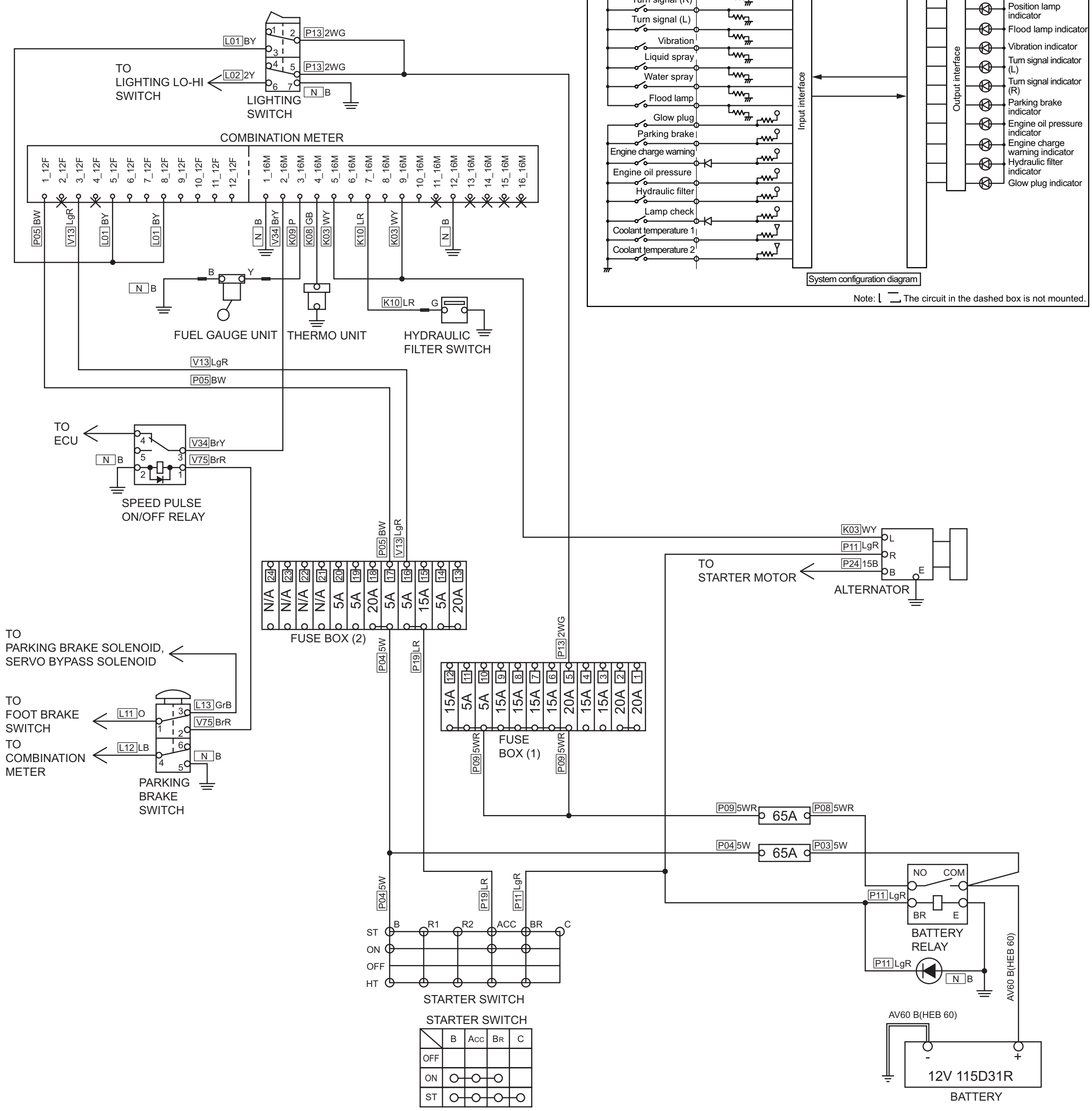
SWP12M SWP16F



LIGHTING SWITCH

POSITION	CONNECTION
(lamp symbol)	2-3,5-6
SIDE MARKER LIGHT	2-3,4-5
OFF	1-2,4-5





STARTER SWITCH

	B	ACC	BR	C
OFF				
ON	O	O	O	
ST	O	O	O	O

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.

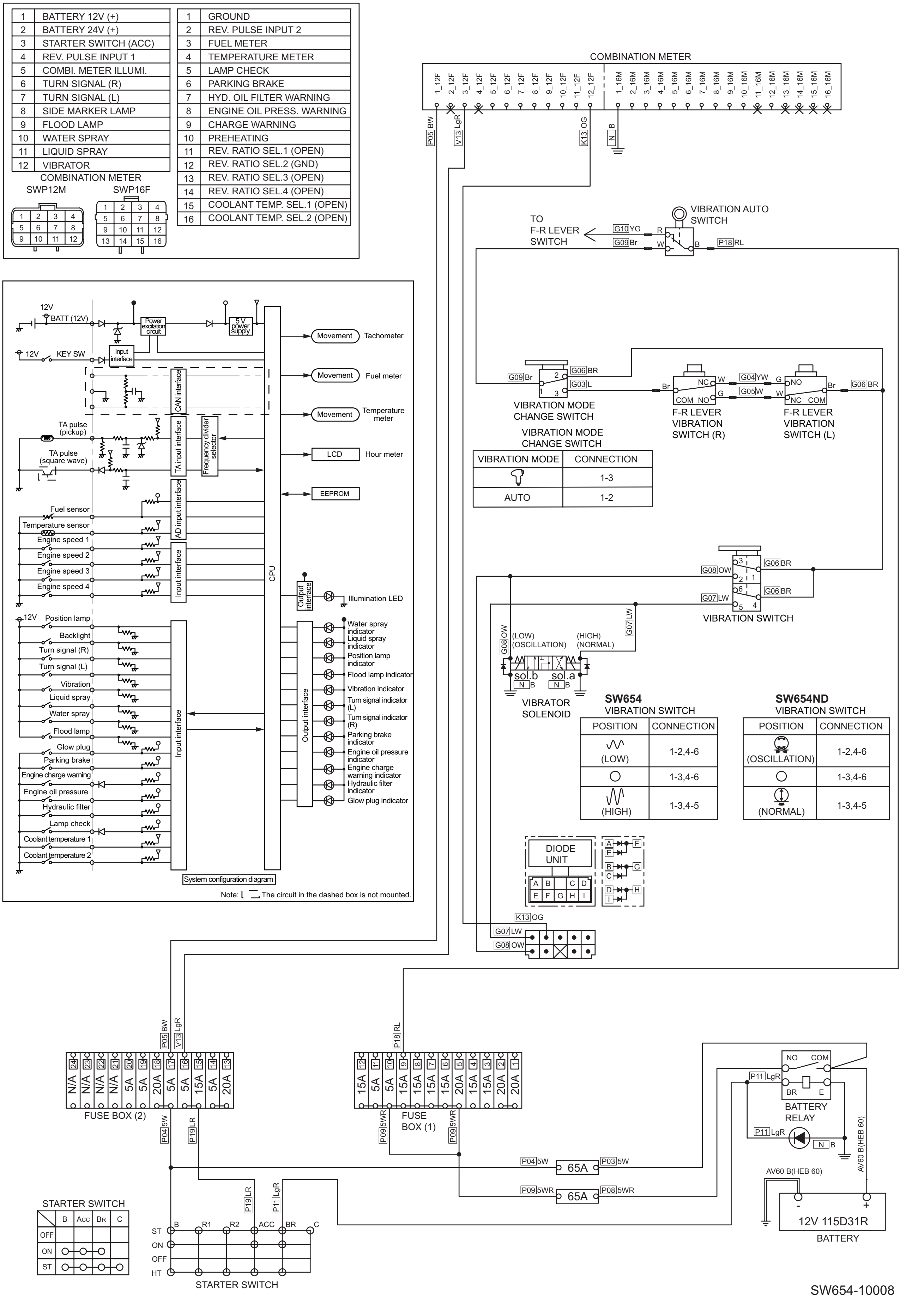
Reference Fig. : 2-7-2

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)

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

STARTER SWITCH

	B	ACC	BR	C
OFF				
ON	○	○	○	
ST	○	○	○	○

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.

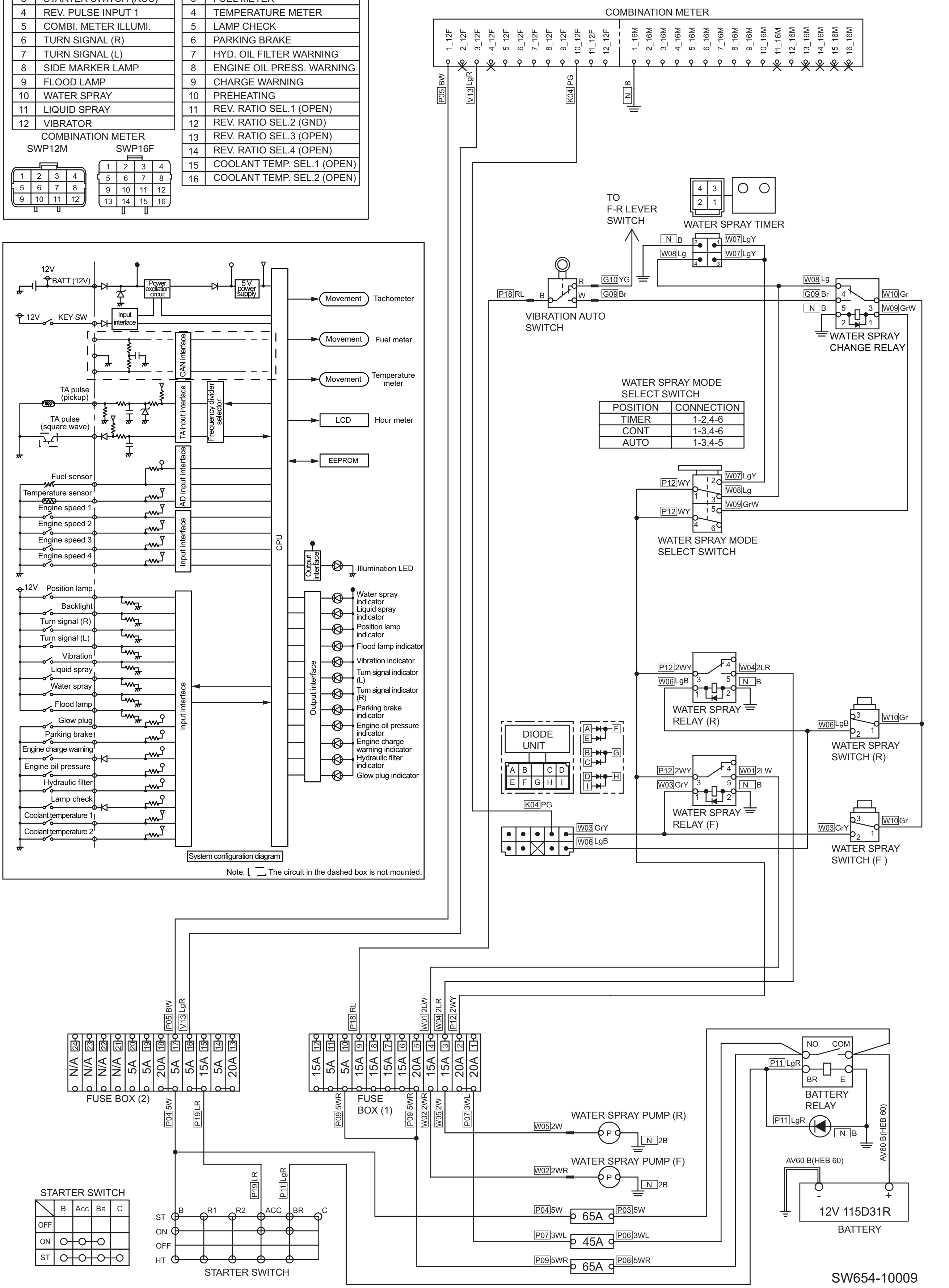
Fig.: 2-7-4

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



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

• Check that water spray pump can be activated.

Reference Fig. : 2-7-4

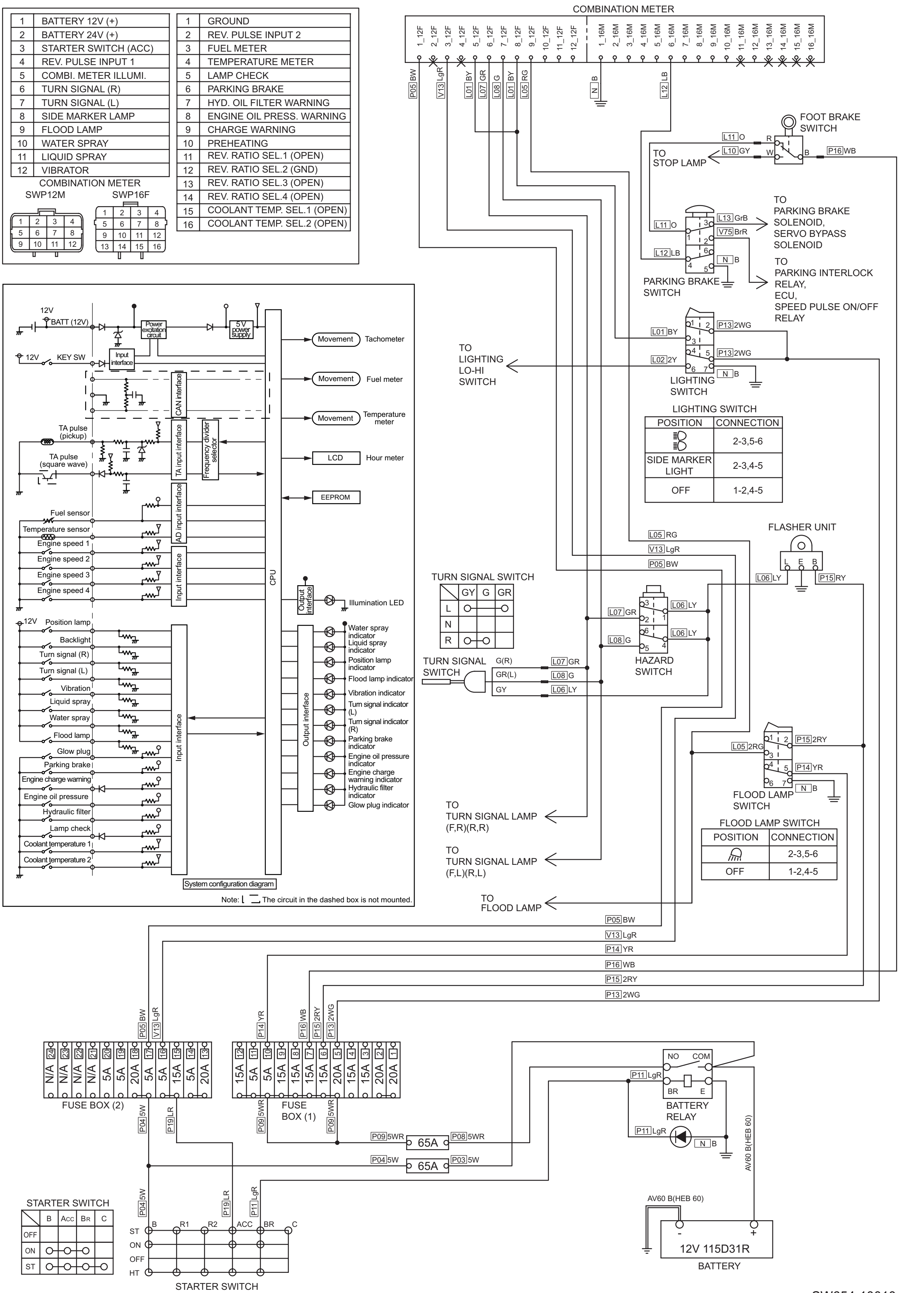
Check point	Check/Cause	Action
1. Harness	(1) Measure resistance between water spray switch (F) terminal 2 wire GrY and diode unit terminal I wire GrY. Standard resistance : 10 Ω or less (2) Measure resistance between water spray switch (R) terminal 2 wire LgB and diode unit terminal D wire LgB. Standard 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

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



LIGHTING SWITCH

POSITION	CONNECTION
(headlamp symbol)	2-3,5-6
SIDE MARKER LIGHT	2-3,4-5
OFF	1-2,4-5

TURN SIGNAL SWITCH

	GY	G	GR
L		O—O	O
N			
R	O—O		

FLOOD LAMP SWITCH

POSITION	CONNECTION
(flood lamp symbol)	2-3,5-6
OFF	1-2,4-5

STARTER SWITCH

	B	ACC	BR	C
OFF				
ON	O	O	O	
ST	O	O	O	O

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.

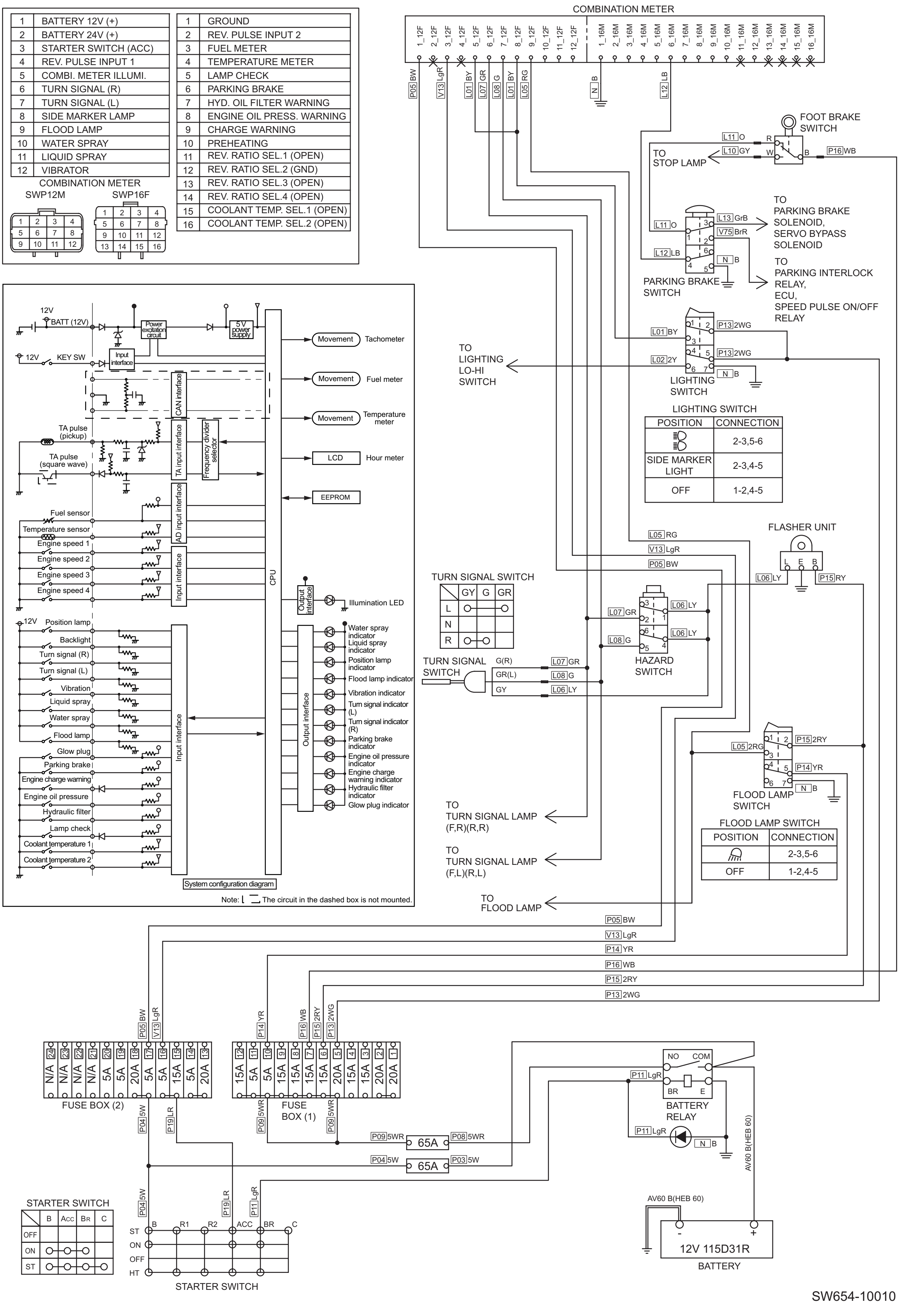
2-7-19. Side marker lamp indicator lamp does not light

- 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

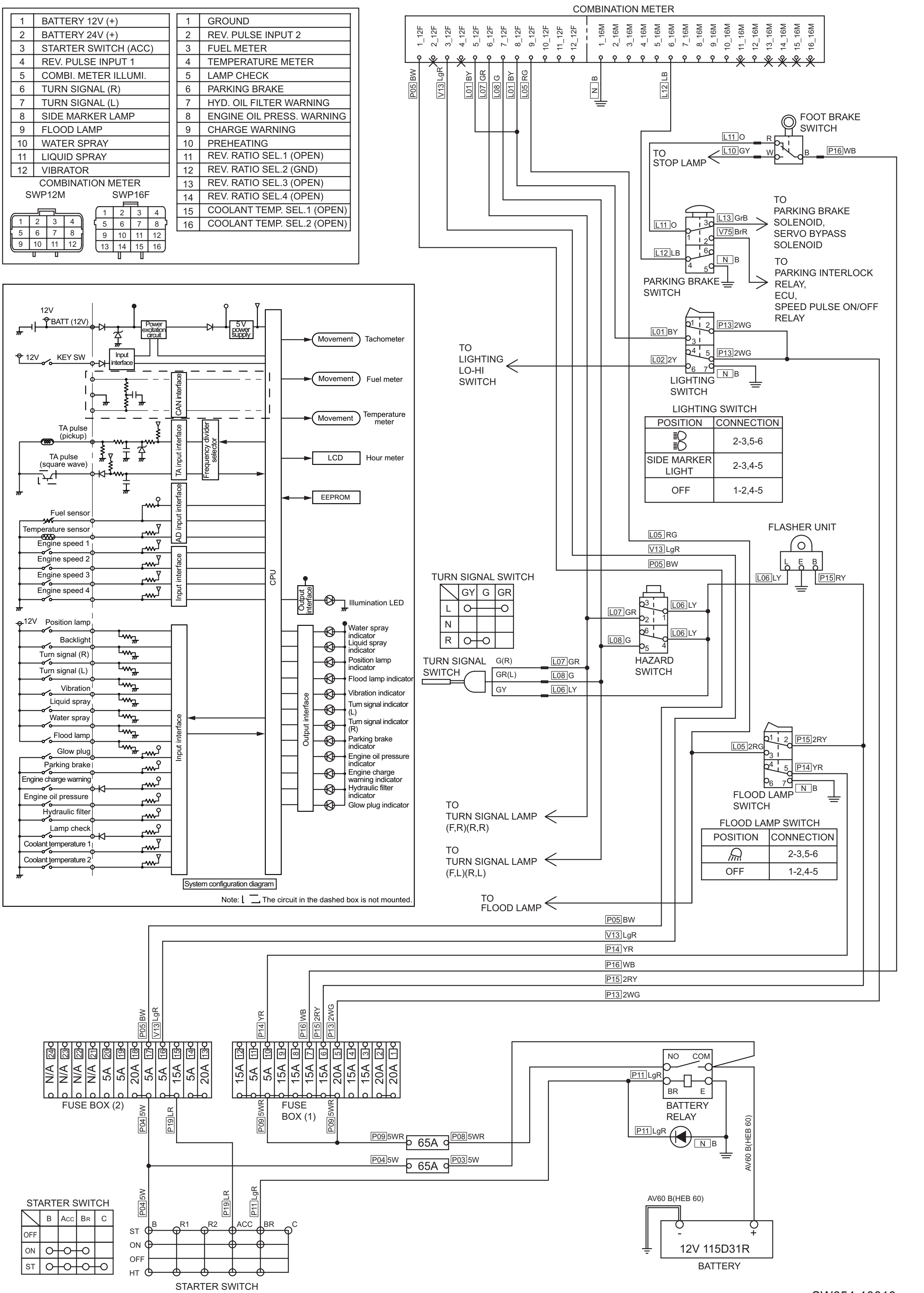

1 BATTERY 12V (+)
2 BATTERY 24V (+)
3 STARTER SWITCH (ACC)
4 REV. PULSE INPUT 1
5 COMBI. METER ILLUMI.
6 TURN SIGNAL (R)
7 TURN SIGNAL (L)
8 SIDE MARKER LAMP
9 FLOOD LAMP
10 WATER SPRAY
11 LIQUID SPRAY
12 VIBRATOR
1 GROUND
2 REV. PULSE INPUT 2
3 FUEL METER
4 TEMPERATURE METER
5 LAMP CHECK
6 PARKING BRAKE
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
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
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
FLOOD LAMP SWITCH
2-3,5-6
1-2,4-5
TO TURN SIGNAL LAMP (F,R)(R,R)
TO TURN SIGNAL LAMP (F,L)(R,L)
TO FLOOD LAMP
CPU
Tachometer
Fuel meter
Temperature meter
Hour meter
LCD
EEPROM
Illumination LED
System configuration diagram
Note: The circuit in the dashed box is not mounted.
FUSE BOX (2)
FUSE BOX (1)
BATTERY RELAY
12V 115D31R
BATTERY
STARTER SWITCH
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



SWP12M		SWP16F	
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)

COMBINATION METER

SW654-10010

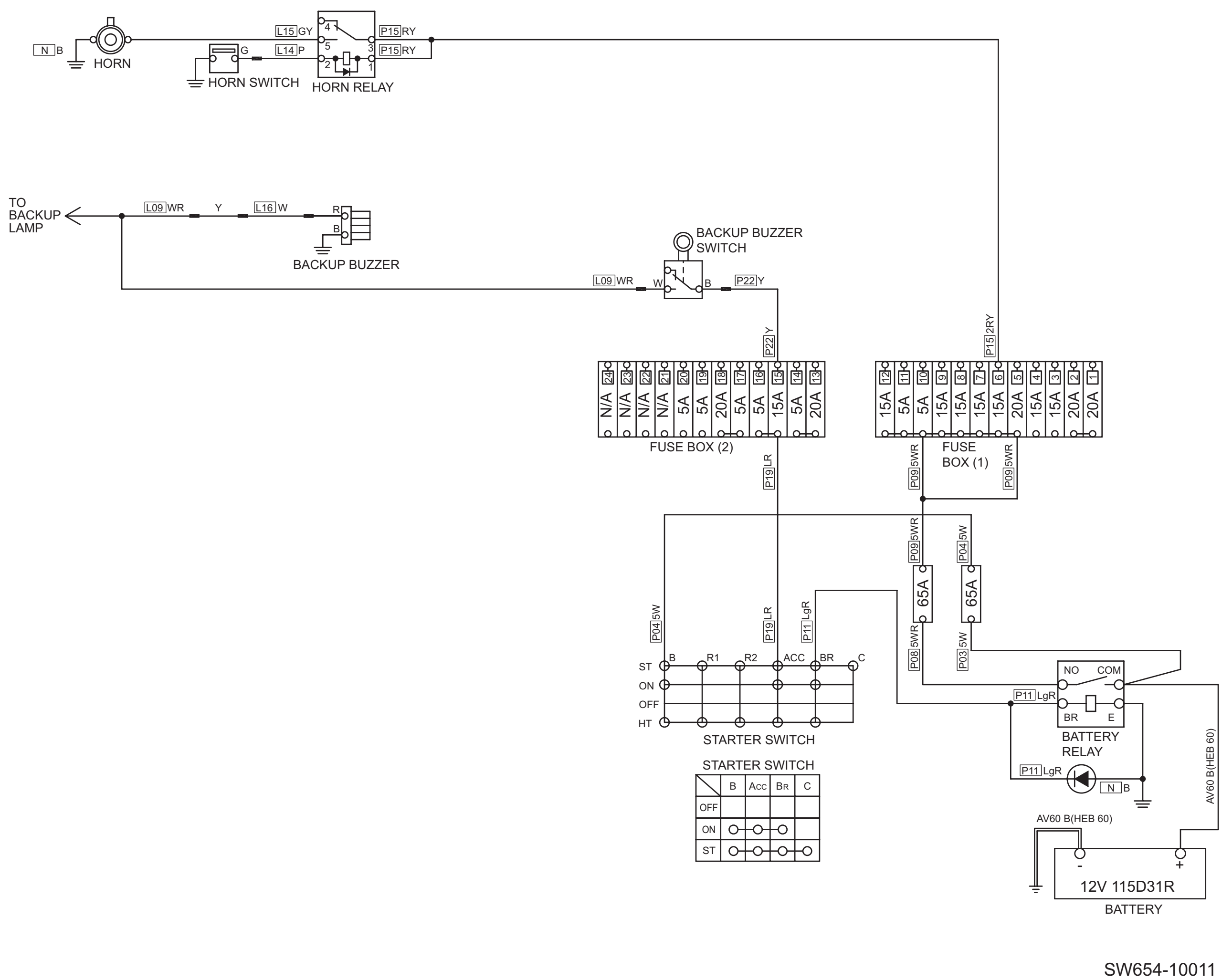
2-7-21. Turn signal indicator lamp does not light

- 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


HORN
HORN SWITCH
HORN RELAY
TO BACKUP LAMP
BACKUP BUZZER
BACKUP BUZZER SWITCH
FUSE BOX (2)
FUSE BOX (1)
STARTER SWITCH
BATTERY RELAY
12V 115D31R
BATTERY
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.

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Printed in Japan 2016.4.50 Ⓞ K.P
0559-99092-0-31205-B