SV510-Ⅲ
SHOP MANUAL

SAKAI®

3498-6412A-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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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.

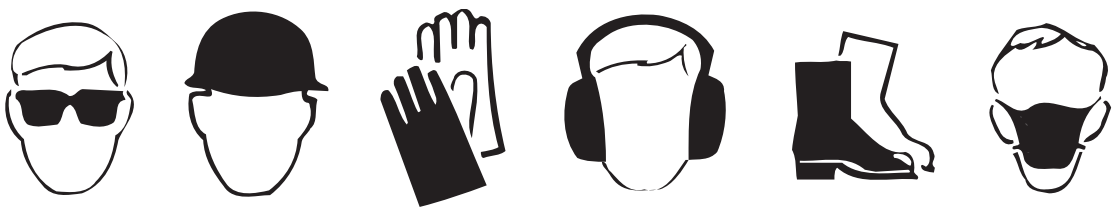
- The machine is designed specifically for the compaction of asphalt or soil road construction materials. Use of the machine for other purposes such as towing other equipment is considered contrary to the designated use. The manufacturer cannot be responsible or held liable for any damage resulting from 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.

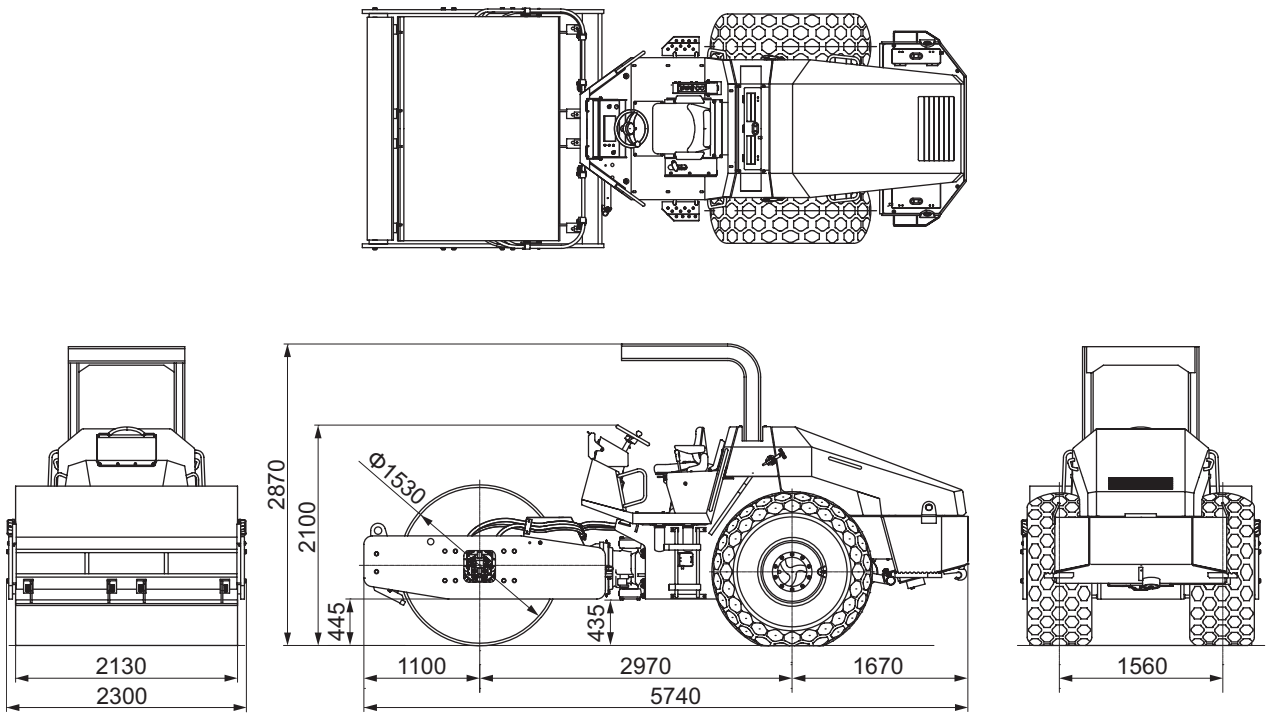
1-11. Transporting the Machine

- 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. SV510D-Ⅲ



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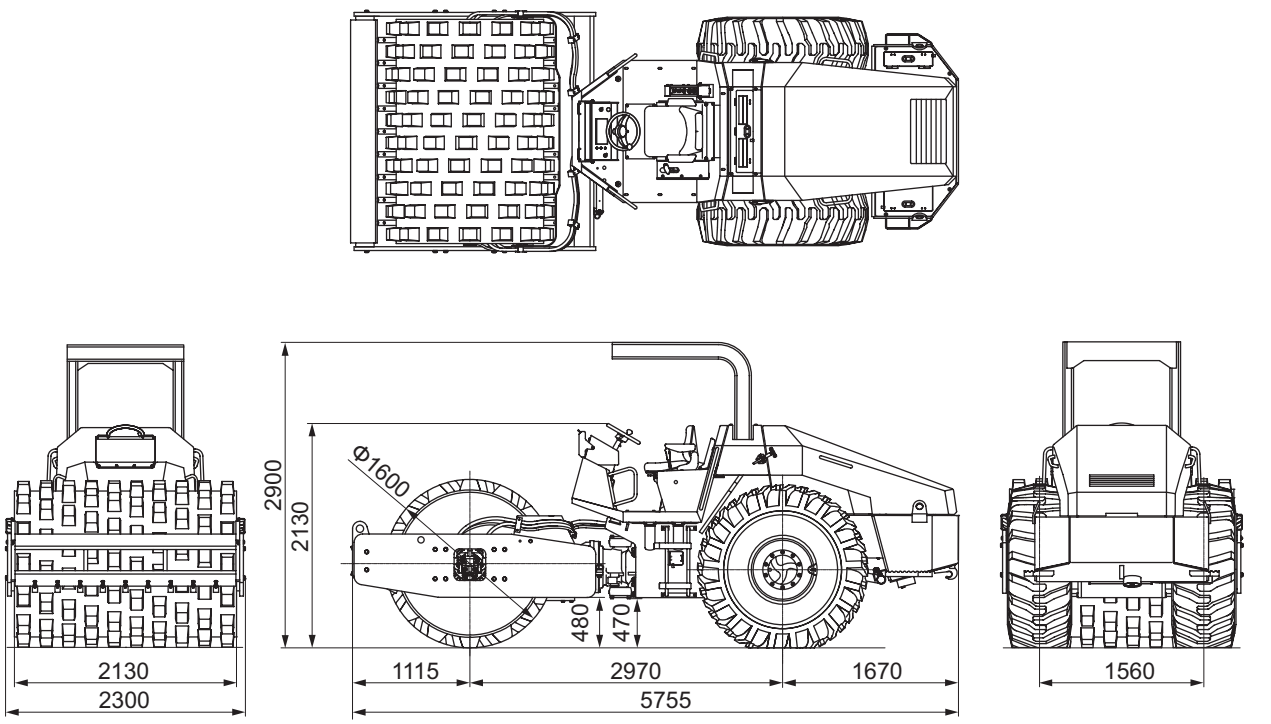
Model			SV510D-Ⅲ
Weight	Operating weight		10,670 kg (23,525 lbs.)
	Front axle		5,760 kg (12,700 lbs.)
	Rear axle		4,910 kg (10,825 lbs.)
Dimensions	Overall length		5,740 mm (226 in.)
	Overall width		2,300 mm (91 in.)
	Overall height	Steering wheel	2,100 mm (83 in.)
		ROPS	2,870 mm (113 in.)
	Wheelbase		2,970 mm (117 in.)
	Compaction width		2,130 mm (84 in.)
	Minimum height above ground		435 mm (17 in.)
	Curb clearance		445 mm (18 in.)
Speed	1st		0 to 6 km/h (0 to 3.7 mph)
	2nd		0 to 10 km/h (0 to 6.2 mph)
Vibration performance	Frequency	Low amplitude	36.7 Hz (2,200 vpm)
		High amplitude	27.5 Hz (1,650 vpm)
	Centrifugal force	Low amplitude	171.5 kN (38,553 lbs.)
		High amplitude	225.4 kN (50,670 lbs.)
	Amplitude	Low amplitude	1.01 mm (0.04 in.)
		High amplitude	1.81 mm (0.08 in.)
Minimum turning radius			5.6 m (221 in.)
Gradability *1			62 % (32 °)

*1: The gradability is the calculated value. It may vary based on the ground surface conditions.

Engine	Name			CUMMINS QSB4.5 Tier 3 Diesel Engine with turbocharger
	Model			Water-cooled, 4-cycle, 4-cylinder, in-line, direct-injection, with turbocharger
	Number of cylinders - Bore × Stroke			4-107 mm × 124 mm (4-4.213 in. × 4.882 in.)
	Displacement			4.5 L (274.6 cu.in)
	Performance	Rated speed		2,300 min^{-1} (2,300 rpm)
		Rated output		110 kW (148 HP)
				at 2,300 min^{-1}
		Max. torque		598 N·m (441 lbf·ft)
				at 1,500 min^{-1}
		Fuel consumption		234 g/kW·h (0.385 lb/HP·h)
				at 1,200 min^{-1}
	Governor			Electrical all-speed type
	Lubrication system			Forced circulation
	Oil filter			Strata Pore™/Spin-on type
	Air cleaner			Dry type
	Cooling system			Centrifugal pump forced feeding system (pressure type)
	Cooling fan			Suction type
	Electrical system	Alternator		12 V 160 A
		Starter		12 V 4.8 kW
		Battery		12 V 100 Ah × 2 pcs. (12 V)
Power line	Transmission	Type		Hydrostatic transmission
		Speeds		2 speed shifts
	Reverser			Switching the direction of flow delivered from the variable pump
	Differential			Auto lock type
	Final drive			Planetary gear
Vibrating system	Transmission			Hydrostatic transmission
	Vibrator			Eccentric shaft type
Braking device	Service brake			Hydrostatic and mechanical type
	Parking brake			Mechanical type
Steering system	Steering control type			Hydraulic type (Articulated type)
	Steering control angle			± 37 °
	Oscillation angle			± 7 °
Drum and wheels	Use	Front drum		Vibration and driving
		Rear tires		Drive
	Dimension	Dimension	width × diameter	2,130 mm × 1,530 mm (84 in. × 60 in.)
		Rear tires	size	23.1-26-8 PR (OR)
	Suspension system	Front		Rubber damper type
		Rear		Rigid
Others	Ropes			Iron
	Electrical components and instruments			1 set

1-2. SV510T-Ⅲ



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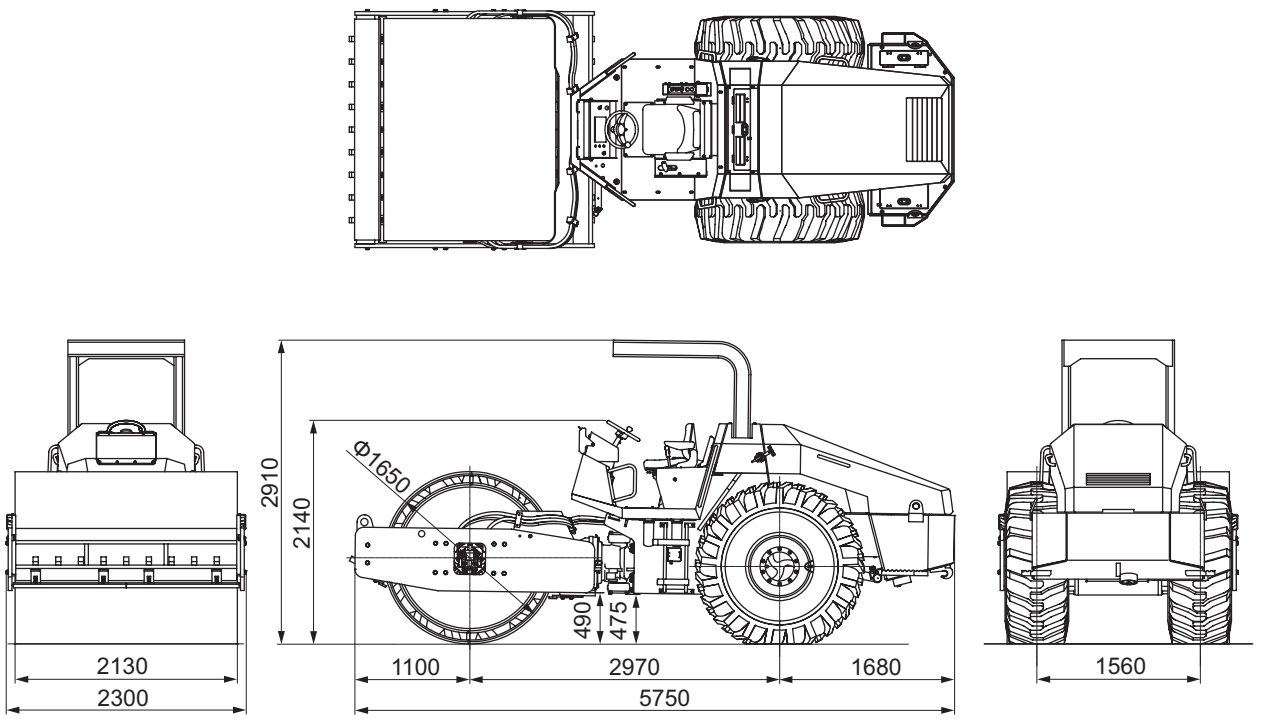
Model			SV510T-Ⅲ
Weight	Operating weight		11,030 kg (24,320 lbs.)
	Front axle		6,110 kg (13,470 lbs.)
	Rear axle		4,920 kg (10,850 lbs.)
Dimensions	Overall length		5,755 mm (227 in.)
	Overall width		2,300 mm (91 in.)
	Overall height	Steering wheel	2,130 mm (84 in.)
		ROPS	2,900 mm (114 in.)
	Wheelbase		2,970 mm (117 in.)
	Compaction width		2,130 mm (84 in.)
	Minimum height above ground		470 mm (19 in.)
	Curb clearance		480 mm (19 in.)
Speed	1st		0 to 6 km/h (0 to 3.7 mph)
	2nd		0 to 10 km/h (0 to 6.2 mph)
Vibration performance	Frequency	Low amplitude	36.7 Hz (2,200 vpm)
		High amplitude	27.5 Hz (1,650 vpm)
	Centrifugal force	Low amplitude	186.2 kN (41,858 lbs.)
		High amplitude	245.0 kN (55,076 lbs.)
	Amplitude	Low amplitude	1.01 mm (0.04 in.)
		High amplitude	1.81 mm (0.08 in.)
Minimum turning radius			5.6 m (221 in.)
Gradability *1			62 % (32 °)

*1: The gradability is the calculated value. It may vary based on the ground surface conditions.

Engine	Name			CUMMINS QSB4.5 Tier 3 Diesel Engine with turbocharger
	Model			Water-cooled, 4-cycle, 4-cylinder, in-line, direct-injection, with turbocharger
	Number of cylinders - Bore × Stroke			4-107 mm × 124 mm (4-4.213 in. × 4.882 in.)
	Displacement			4.5 L (274.6 cu.in)
	Performance	Rated speed		2,300 min^{-1} (2,300 rpm)
		Rated output		110 kW (148 HP)
				at 2,300 min^{-1}
		Max. torque		598 N·m (441 lbf·ft)
				at 1,500 min^{-1}
		Fuel consumption		234 g/kW·h (0.385 lb/HP·h)
				at 1,200 min^{-1}
	Governor			Electrical all-speed type
	Lubrication system			Forced circulation
	Oil filter			Strata Pore™/Spin-on type
	Air cleaner			Dry type
	Cooling system			Centrifugal pump forced feeding system (pressure type)
	Cooling fan			Suction type
	Electrical system	Alternator		12 V 160 A
		Starter		12 V 4.8 kW
		Battery		12 V 100 Ah × 2 pcs. (12 V)
Power line	Transmission	Type		Hydrostatic transmission
		Speeds		2 speed shifts
	Reverser			Switching the direction of flow delivered from the variable pump
	Differential			Auto lock type
	Final drive			Planetary gear
Vibrating system	Transmission			Hydrostatic transmission
	Vibrator			Eccentric shaft type
Braking device	Service brake			Hydrostatic and mechanical type
	Parking brake			Mechanical type
Steering system	Steering control type			Hydraulic type (Articulated type)
	Steering control angle			± 37 °
	Oscillation angle			± 7 °
Drum and wheels	Use	Front drum		Vibration and driving
		Rear tires		Drive
	Dimension	Front drum	width × diameter	2,130 mm × 1,600 mm (84 in. × 63 in.)
			Number of pads	140
			Pad height	100 mm (3.9 in.)
			Pad area	130 cm^2 (20 sq.in.)
		Rear tires	size	23.1-26-10 PR (OR)
	Suspension system	Front		Rubber damper type
		Rear		Rigid
Others	Ropes			Iron
	Electrical components and instruments			1 set

1-3. SV510TF-Ⅲ



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Model			SV510TF-Ⅲ
Weight	Operating weight		13,270 kg (29,255 lbs.)
	Front axle		8,380 kg (18,475 lbs.)
	Rear axle		4,890 kg (10,780 lbs.)
Dimensions	Overall length		5,750 mm (226 in.)
	Overall width		2,300 mm (91 in.)
	Overall height	Steering wheel	2,140 mm (84 in.)
		ROPS	2,910 mm (115 in.)
	Wheelbase		2,970 mm (117 in.)
	Compaction width		2,130 mm (84 in.)
	Minimum height above ground		475 mm (19 in.)
	Curb clearance		490 mm (19 in.)
Speed	1st		0 to 6 km/h (0 to 3.7 mph)
	2nd		0 to 10 km/h (0 to 6.2 mph)
Vibration performance	Frequency	Low amplitude	36.7 Hz (2,200 vpm)
		High amplitude	27.5 Hz (1,650 vpm)
	Centrifugal force	Low amplitude	186.2 kN (41,858 lbs.)
		High amplitude	245.0 kN (55,076 lbs.)
	Amplitude	Low amplitude	0.76 mm (0.03 in.)
		High amplitude	1.78 mm (0.07 in.)
Minimum turning radius			5.6 m (221 in.)
Gradability *1			62 % (32 °)

*1: The gradability is the calculated value. It may vary based on the ground surface conditions.

Engine	Name				CUMMINS QSB4.5 Tier 3 Diesel Engine with turbocharger
	Model				Water-cooled, 4-cycle, 4-cylinder, in-line, direct-injection, with turbocharger
	Number of cylinders - Bore × Stroke				4-107 mm × 124 mm (4-4.213 in. × 4.882 in.)
	Displacement				4.5 L (274.6 cu.in)
	Performance	Rated speed			2,300 min^{-1} (2,300 rpm)
		Rated output			110 kW (148 HP)
					at 2,300 min^{-1}
		Max. torque			598 N·m (441 lbf·ft)
					at 1,500 min^{-1}
		Fuel consumption			234 g/kW·h (0.385 lb/HP·h)
					at 1,200 min^{-1}
	Governor				Electrical all-speed type
	Lubrication system				Forced circulation
	Oil filter				Strata Pore™/Spin-on type
	Air cleaner				Dry type
	Cooling system				Centrifugal pump forced feeding system (pressure type)
	Cooling fan				Suction type
	Electrical system	Alternator			12 V 160 A
		Starter			12 V 4.8 kW
		Battery			12 V 100 Ah × 2 pcs. (12 V)
Power line	Transmission	Type			Hydrostatic transmission
		Speeds			2 speed shifts
	Reverser				Switching the direction of flow delivered from the variable pump
	Differential				Auto lock type
	Final drive				Planetary gear
Vibrating system	Transmission				Hydrostatic transmission
	Vibrator				Eccentric shaft type
Braking device	Service brake				Hydrostatic and mechanical type
	Parking brake				Mechanical type
Steering system	Steering control type				Hydraulic type (Articulated type)
	Steering control angle				± 37 °
	Oscillation angle				± 7 °
Drum and wheels	Use	Front drum			Vibration and driving
		Rear tires			Drive
	Dimension	Front drum	Smooth	width × diameter	2,130 mm × 1,650 mm (84 in. × 65 in.)
			Pad	width × diameter	2,130 mm × 1,600 mm (84 in. × 63 in.)
				Number of pads	140
				Pad height	100 mm (3.9 in.)
				Pad area	130 cm^2 (20 sq.in.)
		Rear tires		size	23.1-26-10PR (OR)
	Suspension system	Front			Rubber damper type
		Rear			Rigid
Others	Ropes				Iron
	Electrical components and instruments				1 set

2. TABLE OF STANDARD VALUES

2-1. Engine

Item		Standard value	Remarks
Engine model		CUMMINS QSB4.5 Tier 3 Diesel Engine with turbocharger	
Rated output		110/2,300 kW/ min^{-1} (148/2,300 HP/rpm)	
Max. rpm under no load		2,300 ± 30 rpm	
Min. rpm under no load		900 ± 20 rpm	
Cylinder head tightening torque	1st	90 N·m (66 lbf·ft)	
	2nd	90 N·m (66 lbf·ft)	
	3rd	Tighten additional 90°	
Intake manifold tightening torque		24 N·m (18 lbf·ft)	
Exhaust manifold tightening torque		43 N·m (32 lbf·ft)	
Valve clearance (intake)		0.254 mm (0.01 in.)	
Valve clearance (exhaust)		0.508 mm (0.02 in.)	
Crankcase blowby		101.6 mm of H_2O (4.0 in. of H_2O) 58 L/min (2.048 cfm/min)	Use mano meter
Fuel consumption rate		234 g/kW·h (0.385 lb/HP·h)	
Engine dry mass		375 kg (827 lbs.)	

2-2. Propulsion

Item		Standard value	Remarks
Travel speed (Forward/reverse)	1st	0 to 6 km/h (0 to 3.7 mph)	
	2nd	0 to 10 km/h (0 to 6.2 mph)	
Rear wheel/hub nut		785 N·m (579 lbf·ft)	
Tire inflation pressure		137 kPa (20 psi)	

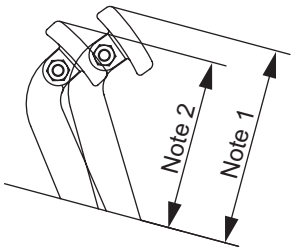
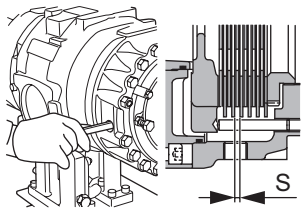
2-3. Hydraulic System

Item		Standard value	Remarks
Propulsion oil pressure	High pressure relief valve setting	41.8 ± 1.0 MPa (6,061 ± 145 psi)	At 1,800 min^{-1}
	Charge relief valve setting	1.89 ± 0.2 MPa (274 ± 29 psi)	
	Motor relief valve setting	2.45 ± 0.2 MPa (355 ± 29 psi)	
	Motor drainage (front)	17.8 L/min (4.7 gal./min)	
	Motor drainage (rear)	18.4 L/min (4.9 gal./min)	
	Allowable pump case pressure	0.3 MPa (43.5 psi) or less	
	Allowable motor case pressure	0.3 MPa (43.5 psi) or less	
Rear axle brake release pressure		1.5 to 3.0 MPa (218 to 435 psi)	
Vibration oil pressure	High pressure relief valve setting	25.0 ± 1.0 MPa (3,625 ± 145 psi)	
	Charge relief valve setting	2.34 ± 0.2 MPa (339 ± 29 psi)	
	Motor drainage	9.8 L/min (2.6 gal./min)	Allowable maximum value (at maximum rotation)
	Allowable pump case pressure	0.3 MPa (43.5 psi) or less	
	Allowable motor case pressure	0.3 MPa (43.5 psi) or less	
Steering oil pressure (orbitroll relief pressure + charge relief pressure)		16.9 ± 1.0 MPa (2,451 ± 145 psi)	

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)	169 mm (6.7 in.) Note 1: See dimensions	 SV700-02001
Clearance between brake pedal and floorboard (when pressed down)	145 mm (5.7 in.) Note 2: See dimensions	
Brake disc wear limit	4.5 mm (0.18 in.) (S)	 SV700-02003

2-6. Capacities

Item	Standard value	Remarks
Engine oil pan	11.6 L (3.1 gal.)	
Fuel tank	250 L (66 gal.)	
Coolant	17 L (4.5 gal.)	
Gear box (front)	4.7 L (1.24 gal.)	
Gear box (rear)	2.0 L (0.53 gal.)	
Center housing (rear) type 1	9.5 L (2.51 gal.)	
Center housing (rear) type 2	11 L (2.9 gal.)	
Hub reduction gear case (rear left and right)	1.75 L ×2 (0.46 gal. ×2)	
Hydraulic oil tank	50 L (13.2 gal.)	
Vibrator case (front)	34 L (9.0 gal.)	

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 grade CH-4	SAE10W-30	SAE15W-40	SAE15W-40	MIL-L-2104B
Gear oil	API grade GL4	SAE80W-90	SAE90	SAE140	MIL-L-2105
Hydraulic oil	Anti wear	ISO-VG32 Over VI 140	ISO-VG46 Over VI 140	ISO-VG68 Over VI 110	ISO-3448
Grease	Lithium type extreme pressure				NLGI-2
Fuel	Diesel oil				ASTM D975-2D

3-2. Recommended Lubricants

Lubricant / Oil company	Engine oil API CH-4	Gear oil API GL 4	Hydraulic oil VG 46	Grease (NLGI-II)
CALTEX	N/A	Universal Thuban 90	Rando Oil HD 46	Martifack EP 2
BP	Vanellus C Extra	BP Gear Oil EP 90	BP Energol HLP 46	BP Energrease LS-EP 2
ESSO	N/A	Esso Gear Oil GP 90	Nuto H 46	Beacon EP 2
MOBIL	Delvac MX	Mobil Pegasus Gear oil 90	Nuto Oil 25	Beacon EP 25
SHELL	Rimula X	Shell Spirax 90 EP	Shell Tellus Oil 46	Shell Alvania EP Grease 2
CASTROL	Castrol GTX Diesel	Castrol Hypoy 90	Hyspin AWS 46	Spherrol ELP 2

4. TIGHTENING TORQUE CHART

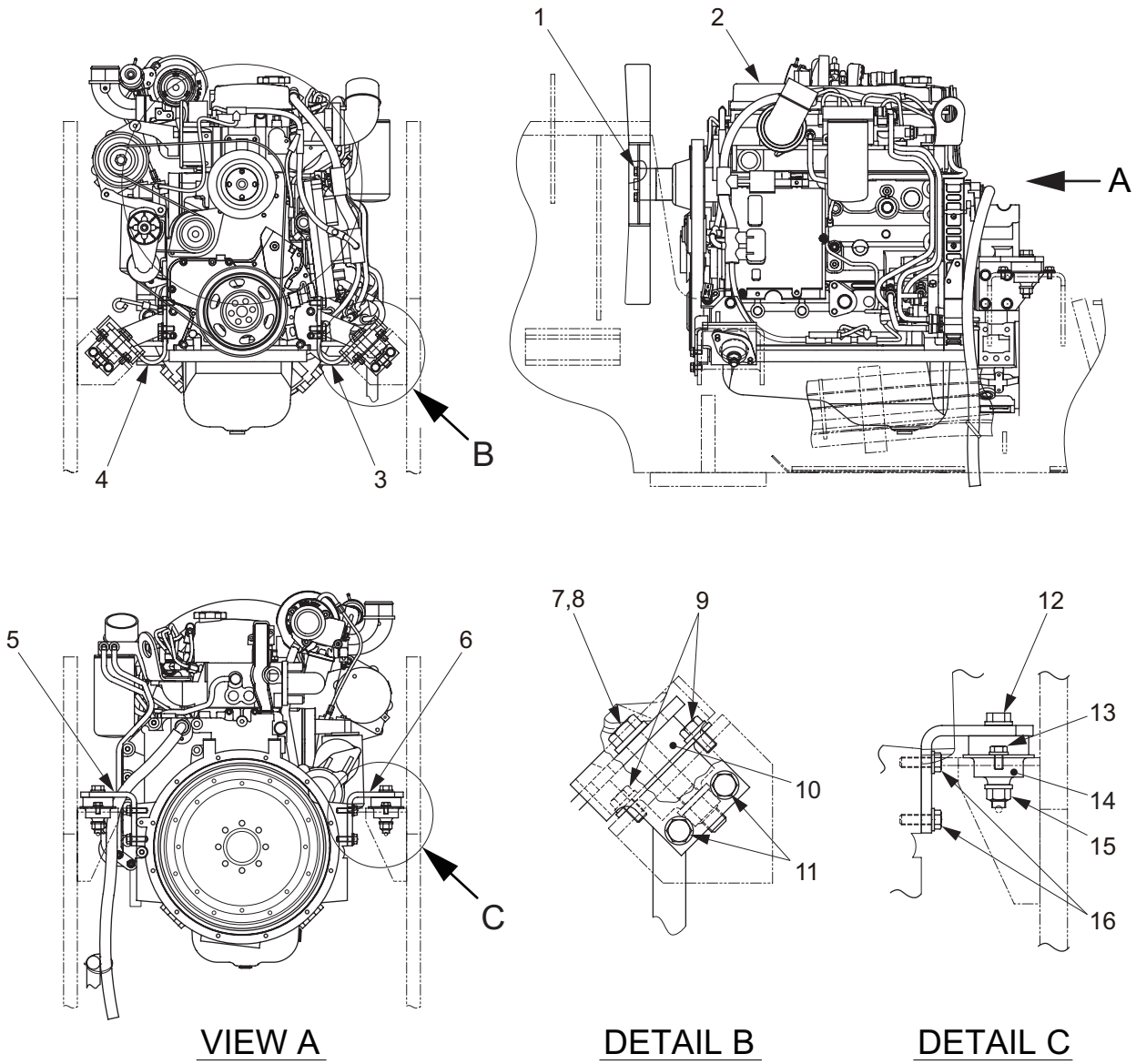
N·m	(lbf·ft)

	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



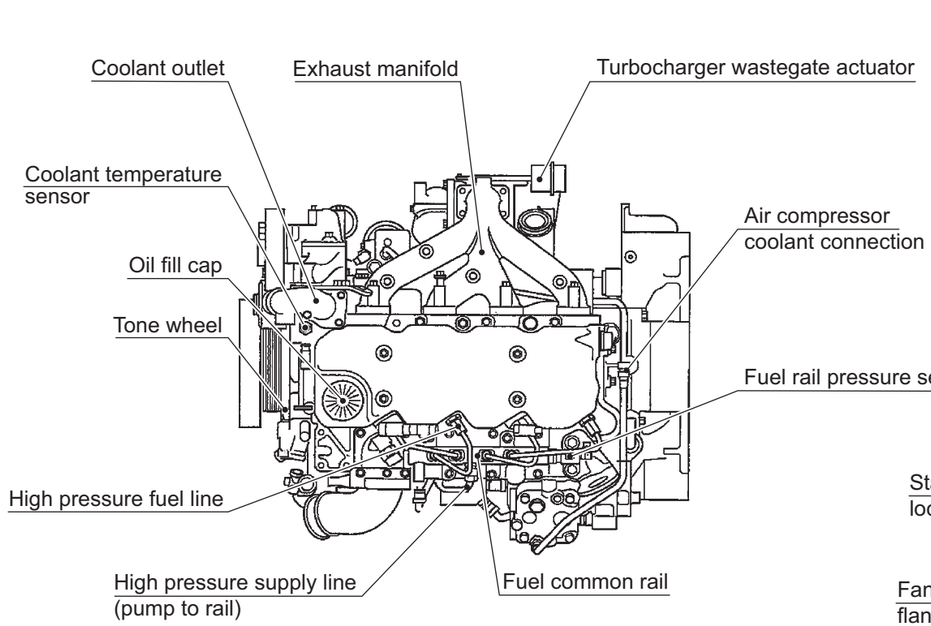
0412-01804-0-10471-0

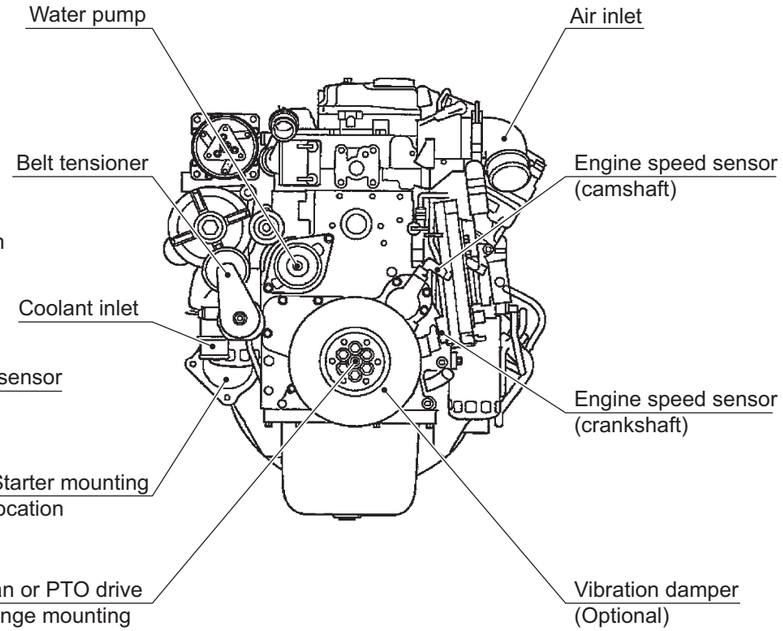
(1) Bolt : M10×100
(2) Engine
(3) Bracket
(4) Bracket
(5) Bracket
(6) Bracket
(7) Bolt : M16×100
(8) Nut : M16
(9) Bolt : M10×20
(10) Damper
(11) Bolt : M10×20
(12) Bolt : M16×100
(13) Bolt : M10×20
(14) Damper
(15) Nut : M16
(16) Bolt : M12×40

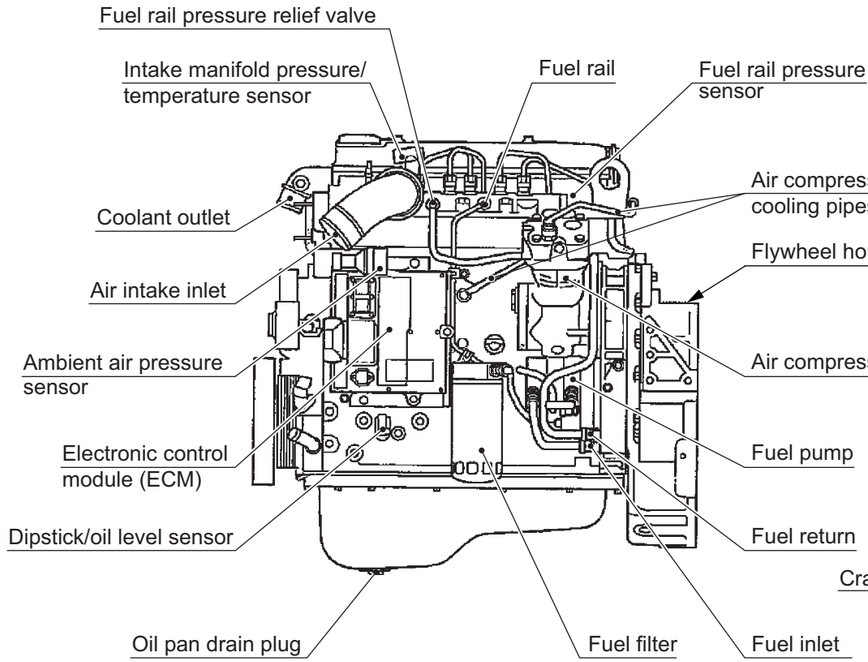
N•m

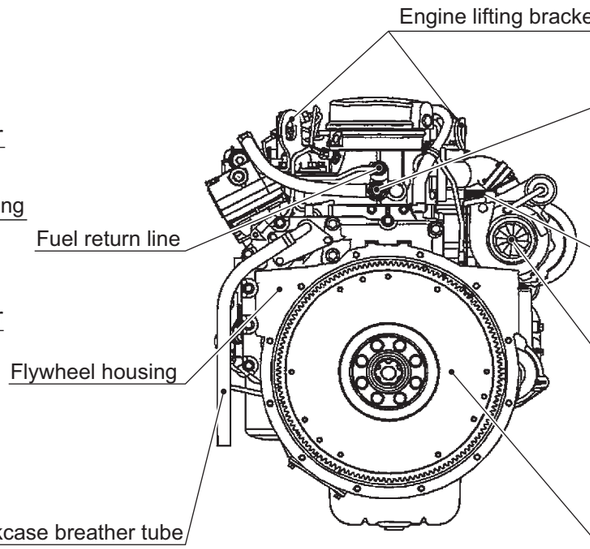
(1) Bolt M10×100 : 43 N·m (32 lbf·ft)
(7) Bolt M16×100 : 265 N·m (195 lbf·ft)
(9) Bolt M10×20 : 59 N·m (44 lbf·ft)
(11) Bolt M10×20 : 59 N·m (44 lbf·ft)
(12) Bolt M16×100 : 265 N·m (195 lbf·ft)
(13) Bolt M10×20 : 59 N·m (44 lbf·ft)
(16) Bolt M12×40 : 108 N·m (80 lbf·ft)

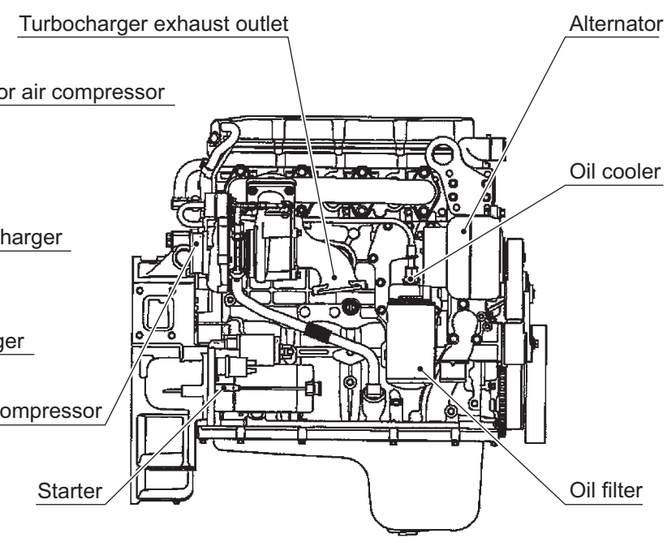
1-2. Engine Exterior









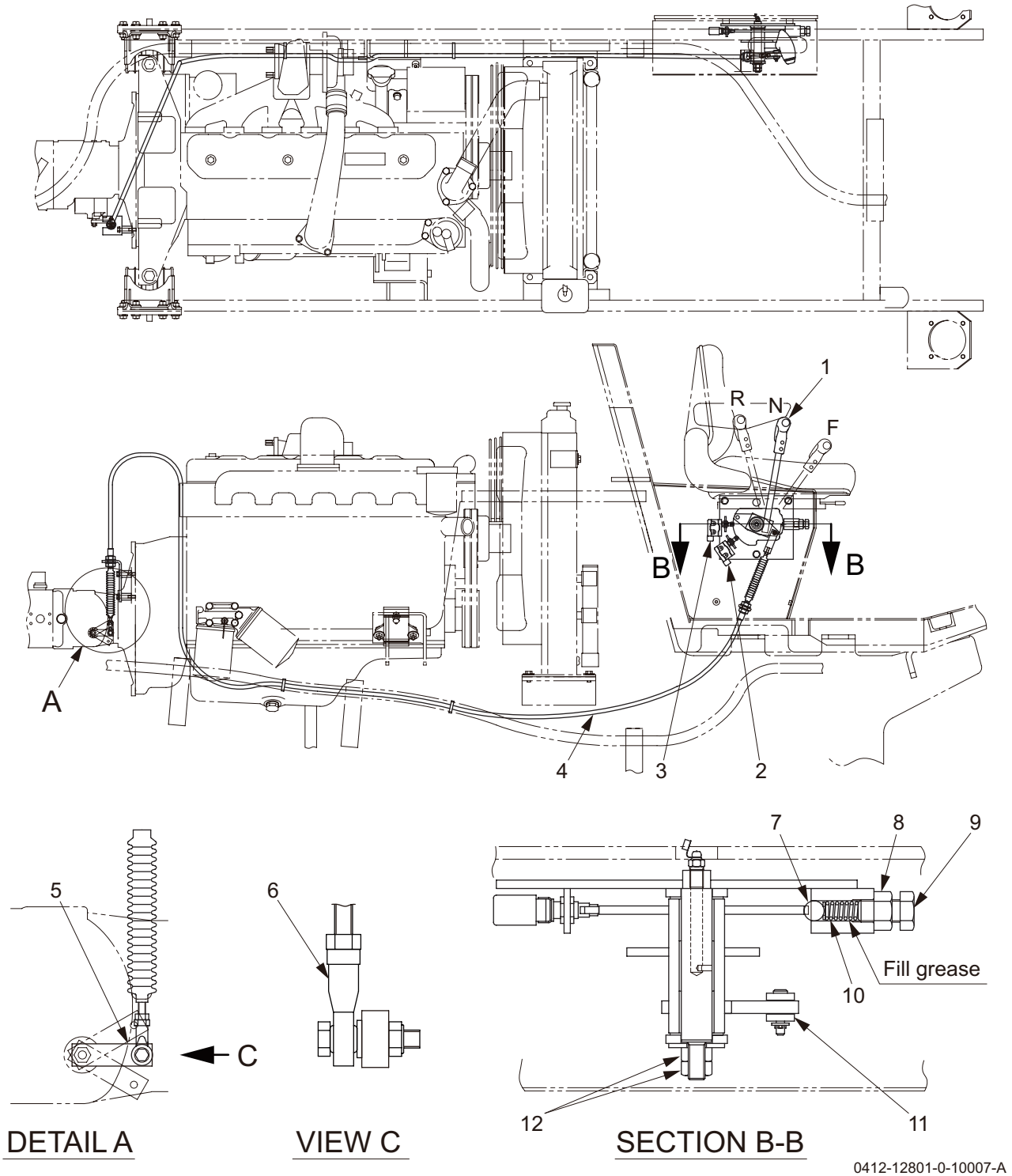


* The actual equipment may differ from that shown above.

SV510-Ⅲ-03001

2. CONTROL SYSTEM

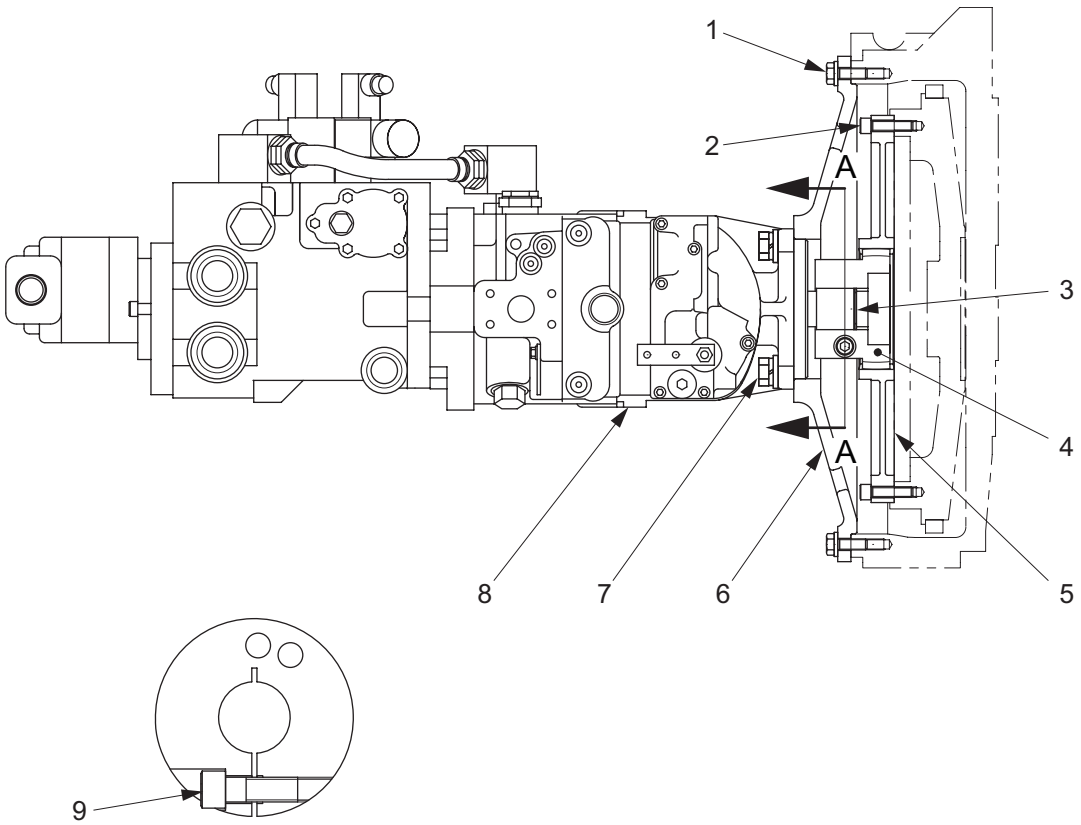
2-1. Forward-reverse Control



(1) F-R lever
(2) Backup buzzer switch
(3) F-R lever switch
(4) Control cable
(5) Pump lever
(6) Rod end
(7) Steel ball
(8) Nut : M16
(9) Bolt : M16×30
(10) Spring
(11) Clevis
(12) Nut : M12

3. PUMP MOUNT

3-1. Pump Mount



SECTION A-A

0412-36814-0-20312-0

(1) Bolt : M10×30
(2) Bolt : M10×38
(3) Retaining ring
(4) Hub
(5) Flange
(6) Housing
(7) Bolt : M14×45
(8) Pump
(9) Bolt : M12×35

N•m

(1) Bolt M10×30 : 59 N·m (44 lbf·ft)
(2) Bolt M10×38 : 49 N·m (36 lbf·ft)
(7) Bolt M14×45 : 167 N·m (123 lbf·ft)
(9) Bolt M12×35 : 120 N·m (89 lbf·ft)

3-1-1. 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 lithium-based grease to pump (8) and hub (4) splines.
② Install retaining ring (3) of hub (4) to pump (8) and set to the specified dimension.

★ Specified dimension a: 32 mm (1.26 in.)

③ Tighten bolt (9) to hub.

N•m (9) Bolt M12×35 : 120 N·m (89 lbf·ft)

④ Install housing (6) to pump (8) and tighten with four bolts (7) and spring washers, and washers.

N•m (7) Bolt M14×45 : 167 N·m (123 lbf·ft)

⑤ Install flange (5) on engine flywheel and tighten eight bolts (2).

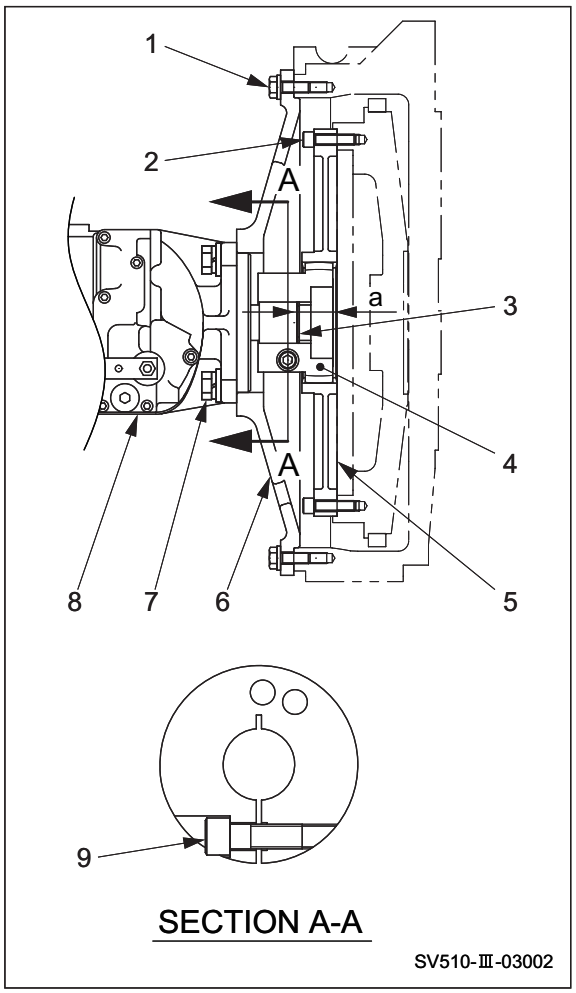
N•m (2) Bolt M10×38 : 49 N·m (36 lbf·ft)

⑥ Ensure engagement of flange (5) with hub (4) and install pump (8) in engine.
⑦ Tighten twelve bolts (1) and washers.

N•m (1) Bolt M10×30 : 59 N·m (44 lbf·ft)

(NOTICE)

- **Bolts (2) and (9) are treated with thread-locking fluid. When removed, replace with new bolts.**

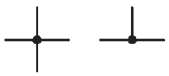
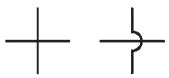
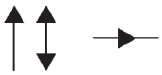
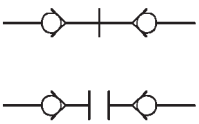


HYDRAULIC SYSTEMS

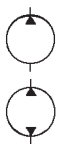
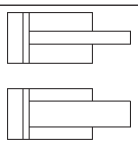
1. SYSTEM CIRCUIT DIAGRAM

1-1. Graphic Symbols for Hydraulic Circuits

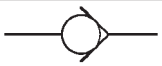
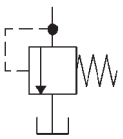
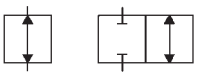
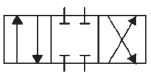
Basic Symbols

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.	

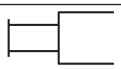
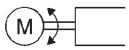
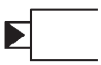
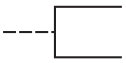
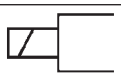
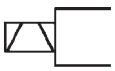
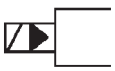
Pump, Motors and Cylinders

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	

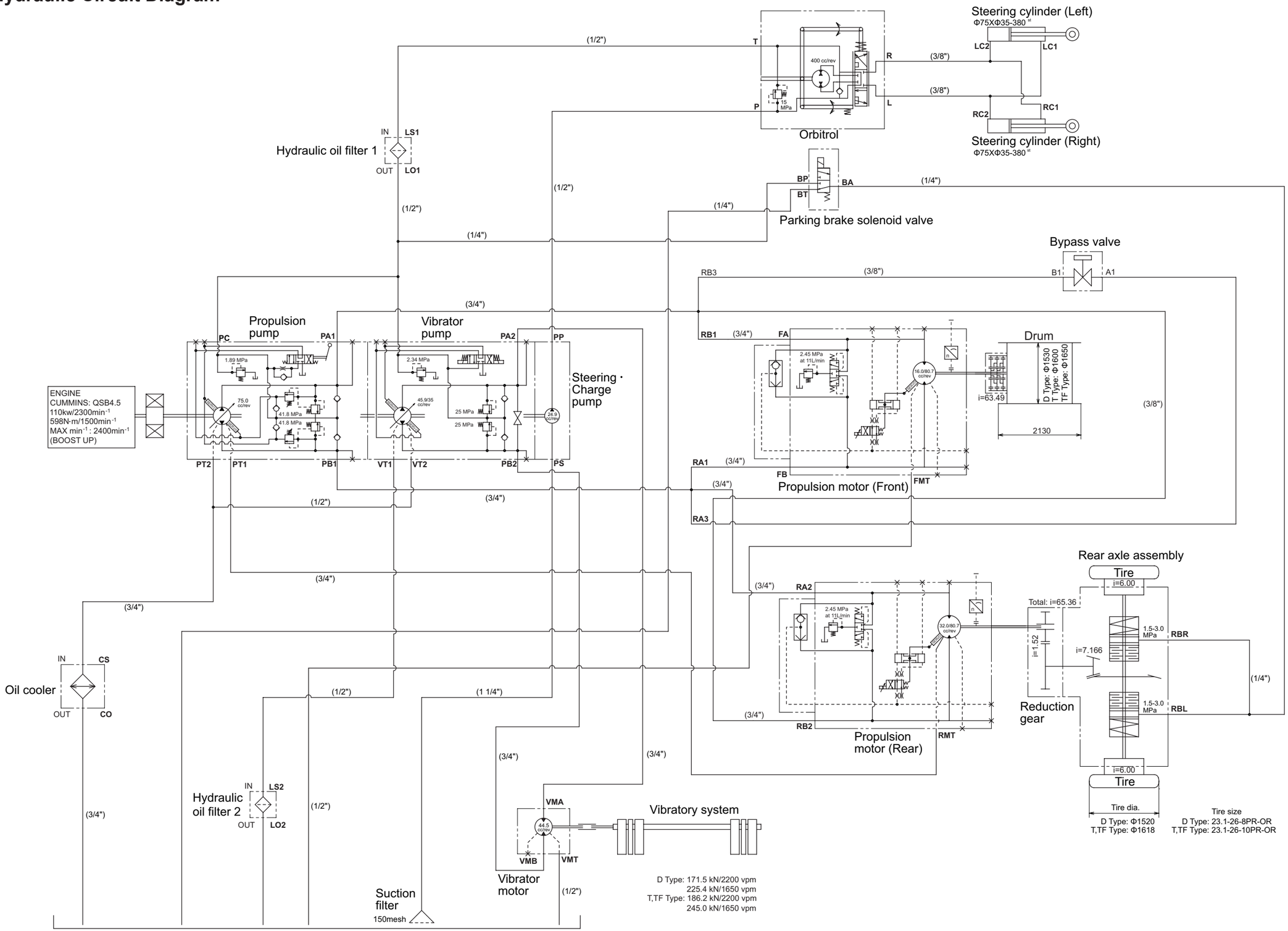
Valves

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

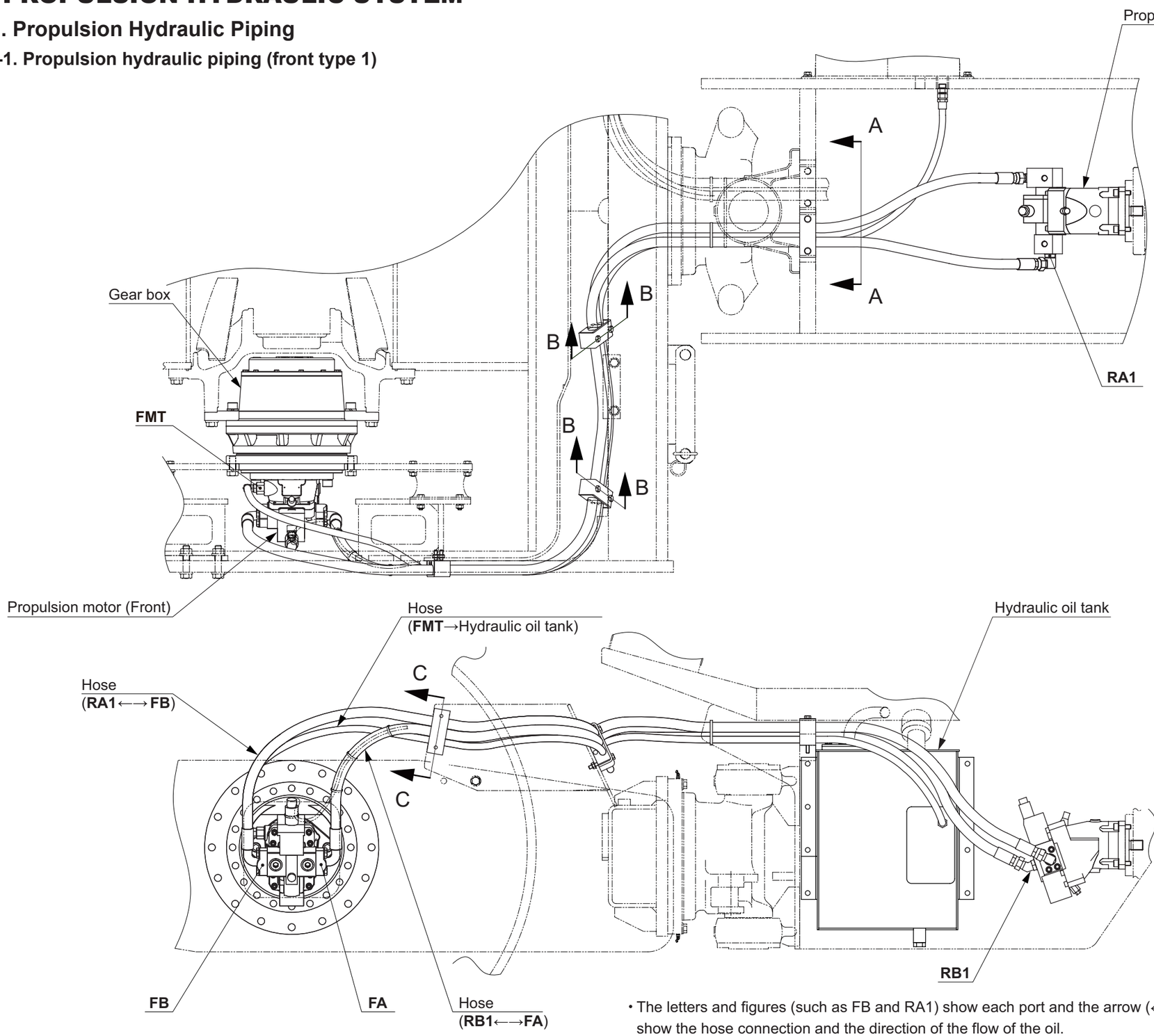


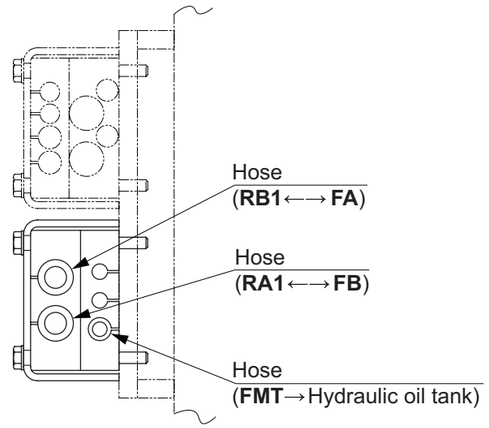
0412-99034-0-10466-0

2. PROPULSION HYDRAULIC SYSTEM

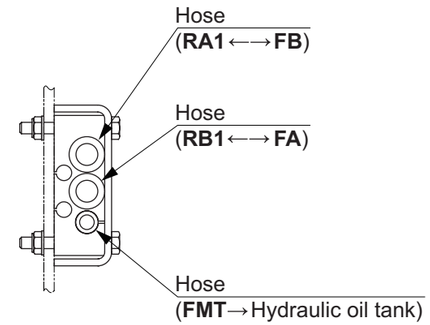
2-1. Propulsion Hydraulic Piping

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

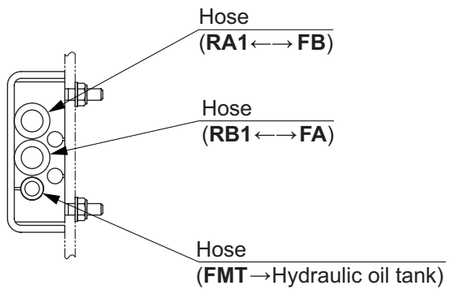




SECTION A-A



SECTION B-B

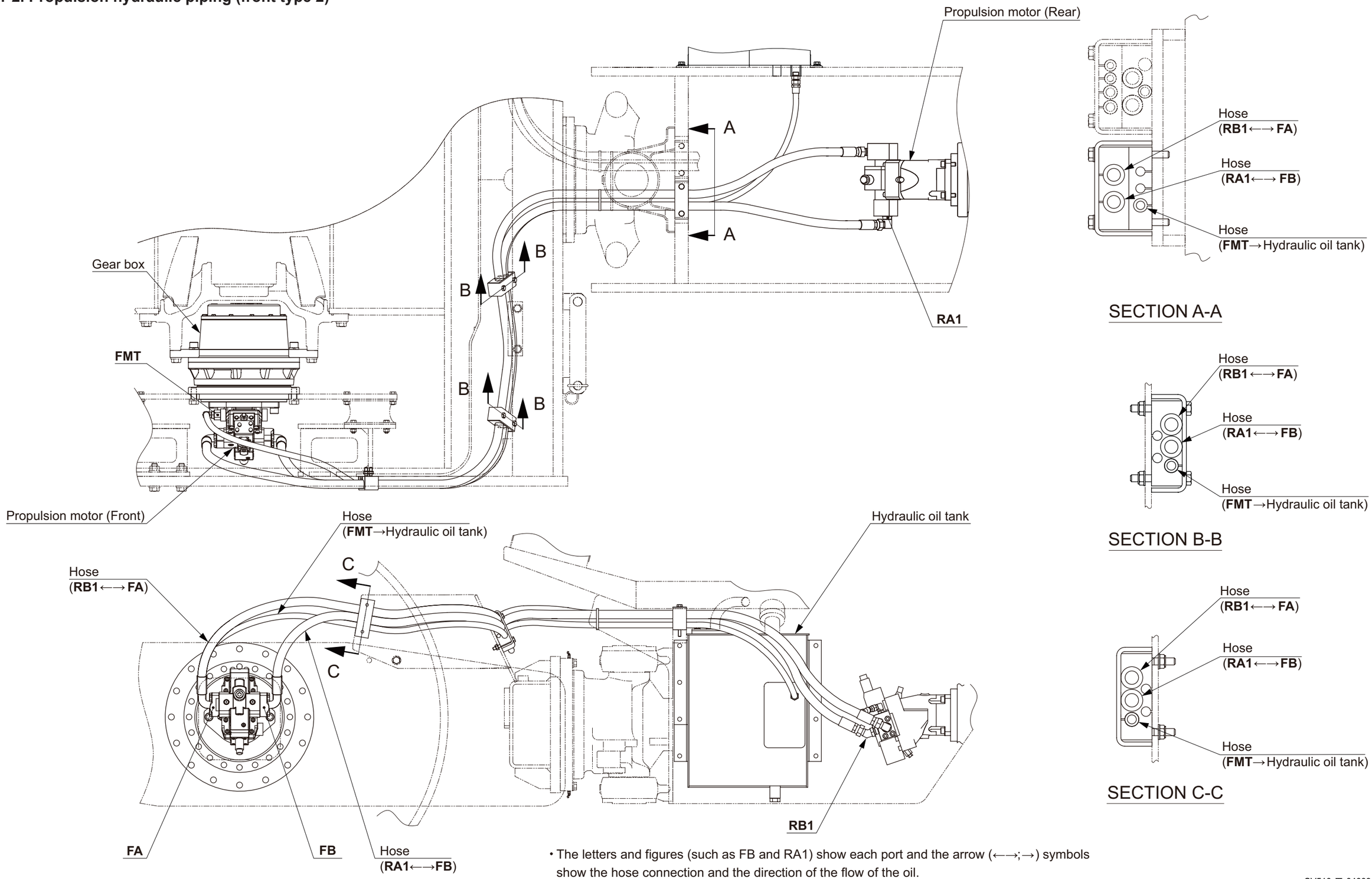


SECTION C-C

• The letters and figures (such as FB and RA1) show each port and the arrow (←→;→) symbols show the hose connection and the direction of the flow of the oil.

0412-36820-0-10442-0

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



SECTION A-A

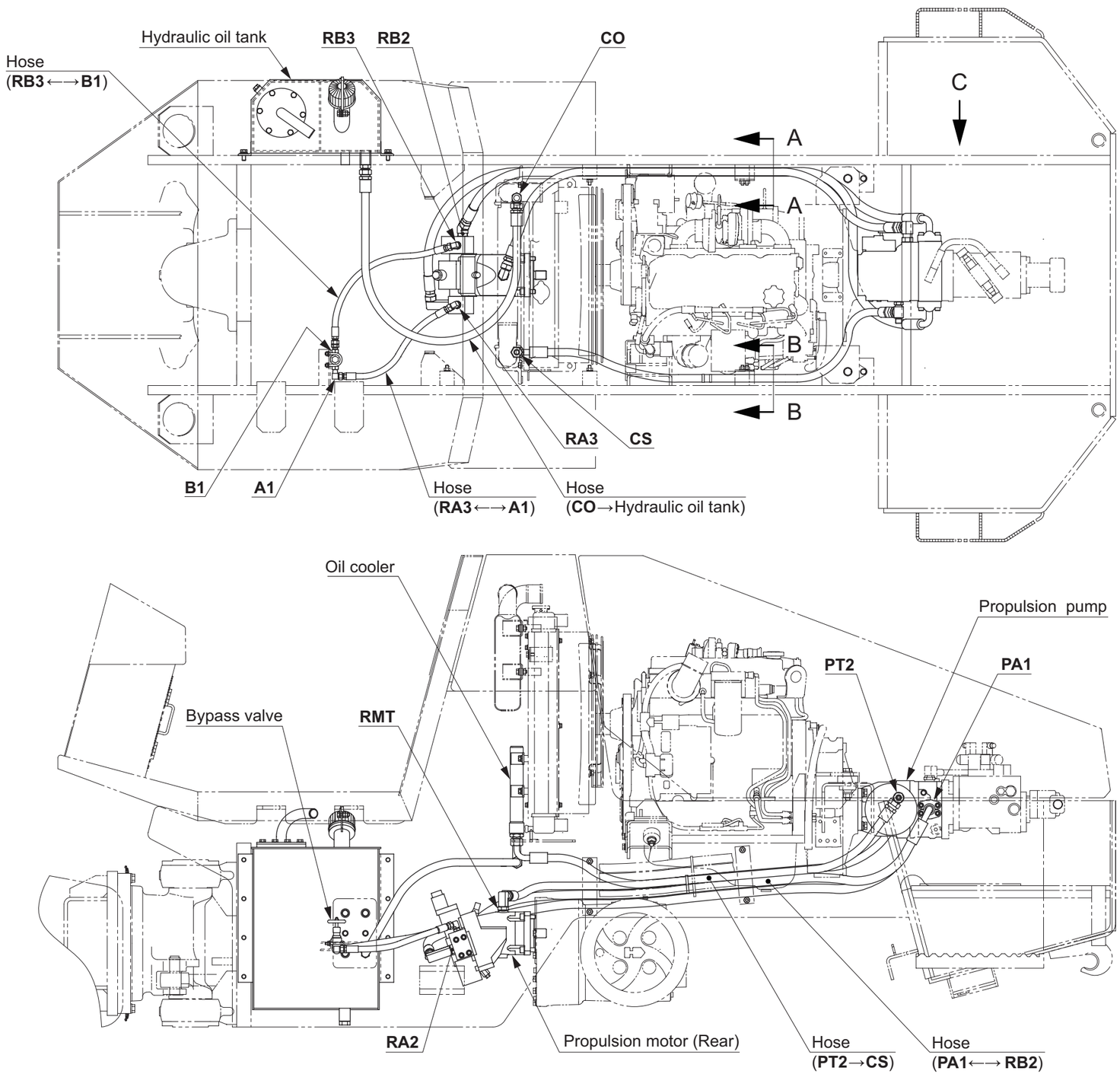
SECTION B-B

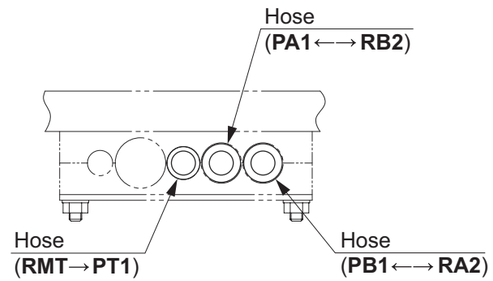
SECTION C-C

• The letters and figures (such as FB and RA1) show each port and the arrow (←→;→) symbols show the hose connection and the direction of the flow of the oil.

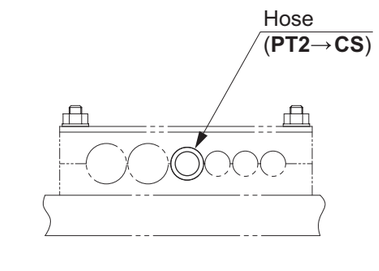
SV510-Ⅲ-04009

2-1-3. Propulsion hydraulic piping (rear)

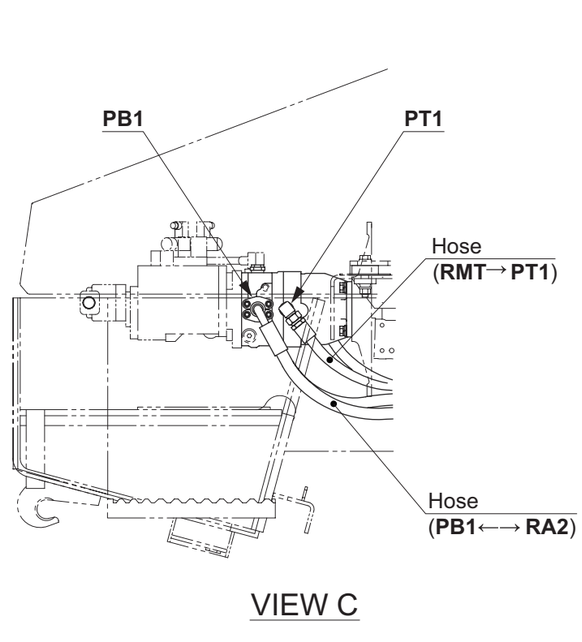




SECTION A-A



SECTION B-B



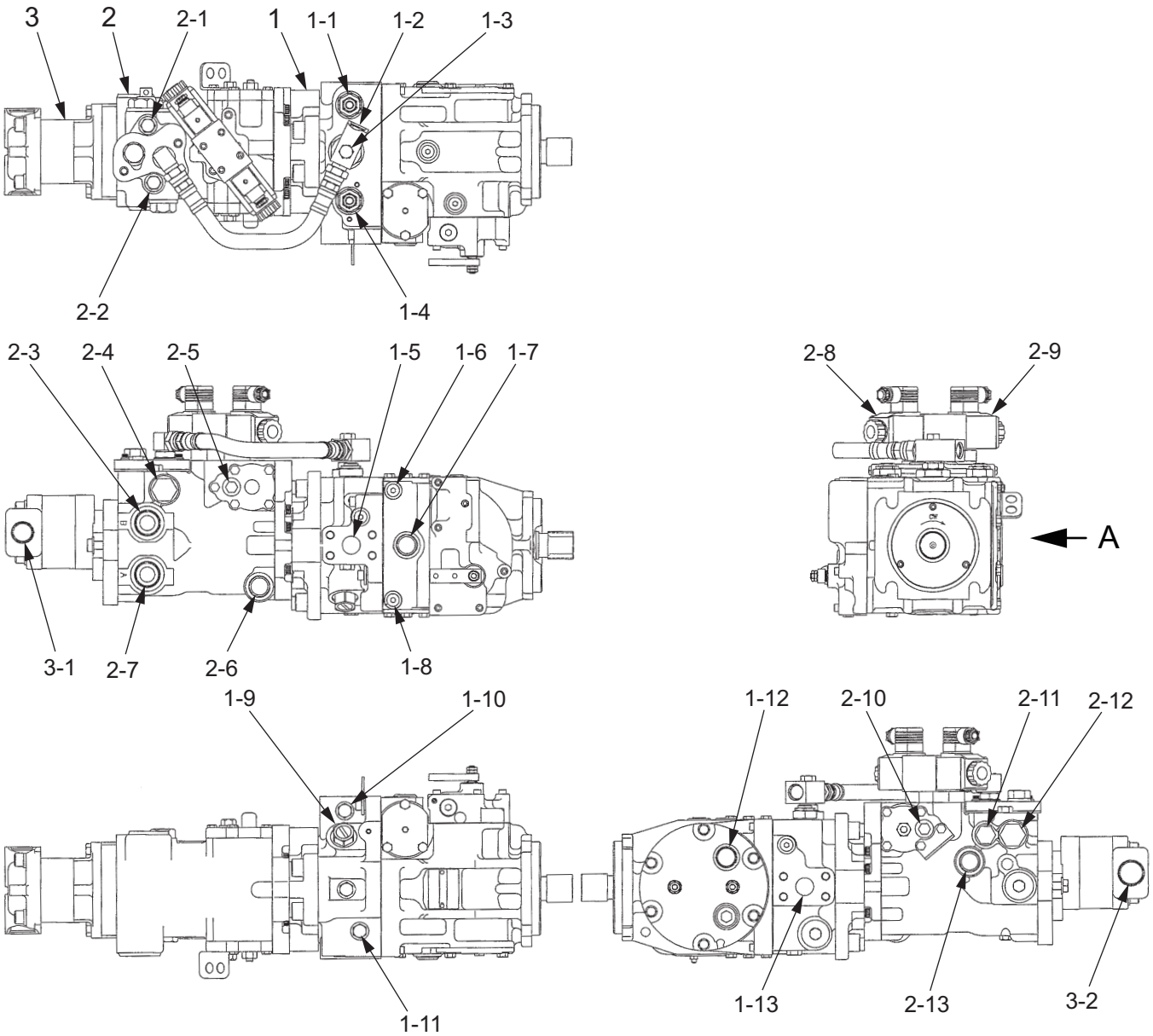
VIEW C

• The letters and figures (such as PT2 and CS) show each port and the arrow (←→; →) symbols show the hose connection and the direction of the flow of the oil.

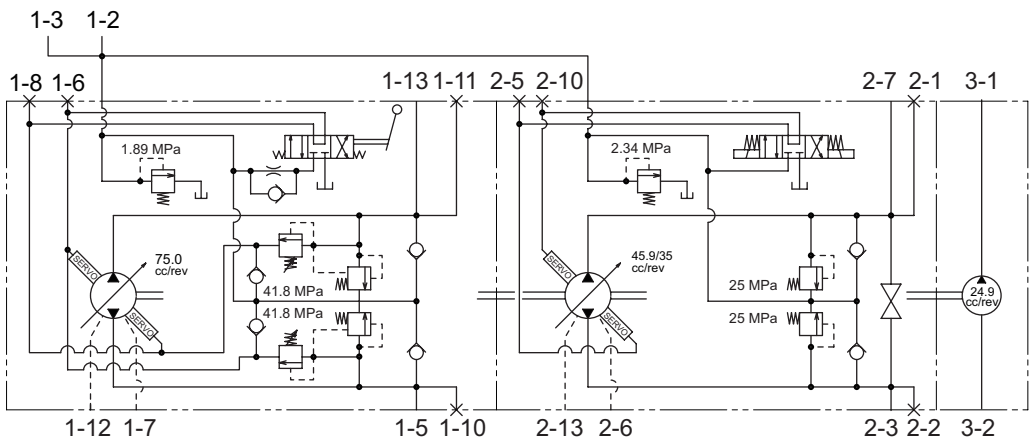
0412-36821-0-10451-0

2-2. Hydraulic Component Specifications

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



VIEW A



Pump circuit diagram

SV510-Ⅲ-04001

(1) Propulsion pump

(1-1)	Multifunction valve (Port A1)		
(1-2)	Charge supply port	**[PC]**	: G1/2
(1-3)	Charge pressure gauge port		: 9/16-18UNF
(1-4)	Multifunction valve (Port B1)		
(1-5)	Port B1 (Forward)	**[PB1]**	: SAE 1”
(1-6)	Servo pressure gauge port		: 9/16-18UNF
(1-7)	Drain port	**[PT1]**	: 1 1/16-12UN
(1-8)	Servo pressure gauge port		: 9/16-18UNF
(1-9)	Charge relief valve		
(1-10)	High pressure gauge port (For Port B)		: 9/16-18UNF
(1-11)	High pressure gauge port (For Port A)		: 9/16-18UNF
(1-12)	Drain port	**[PT2]**	: 1 1/16-12UN
(1-13)	Port A1 (Reverse)	**[PA1]**	: SAE 1”

Specifications

- Displacement : 75 cm^3/rev (4.58 cu.in./rev)
- Pressure limit pressure setting : 41.8 MPa (6,061 psi) (at 1,800 min^{-1})
- Charge relief valve pressure setting : 1.89 MPa (274 psi) (at 40 L/min)

(2) Vibrator pump

(2-1)	High pressure gauge port (For Port A2)		: 9/16-18UNF
(2-2)	High pressure gauge port (For Port B2)		: 9/16-18UNF
(2-3)	Port B2 (High amplitude)	**[PB2]**	: 1 5/16-12UN
(2-4)	High pressure relief valve (For Port B2)		
(2-5)	Servo pressure gauge port		: 9/16-18UNF
(2-6)	Drain port	**[VT2]**	: 1 1/16-12UN
(2-7)	Port A2 (Low amplitude)	**[PA2]**	: 1 5/16-12UN
(2-8)	Solenoid valve a (Low amplitude)		
(2-9)	Solenoid valve b (High amplitude)		
(2-10)	Servo pressure gauge port		: 9/16-18UNF
(2-11)	Charge relief valve		
(2-12)	High pressure relief valve (For Port A2)		
(2-13)	Drain port	**[VT1]**	: 1 1/16-12UN

Specifications

- Displacement (Low amplitude) : 45.9 cm^3/rev (2.8 cu.in./rev)
  (High amplitude) : 35.0 cm^3/rev (2.1 cu.in./rev)
- High pressure relief valve pressure setting : 25.0 MPa (3,625 psi)
- Charge relief valve pressure setting : 2.34 MPa (339 psi) (at 20 L/min)

(3) Steering pump

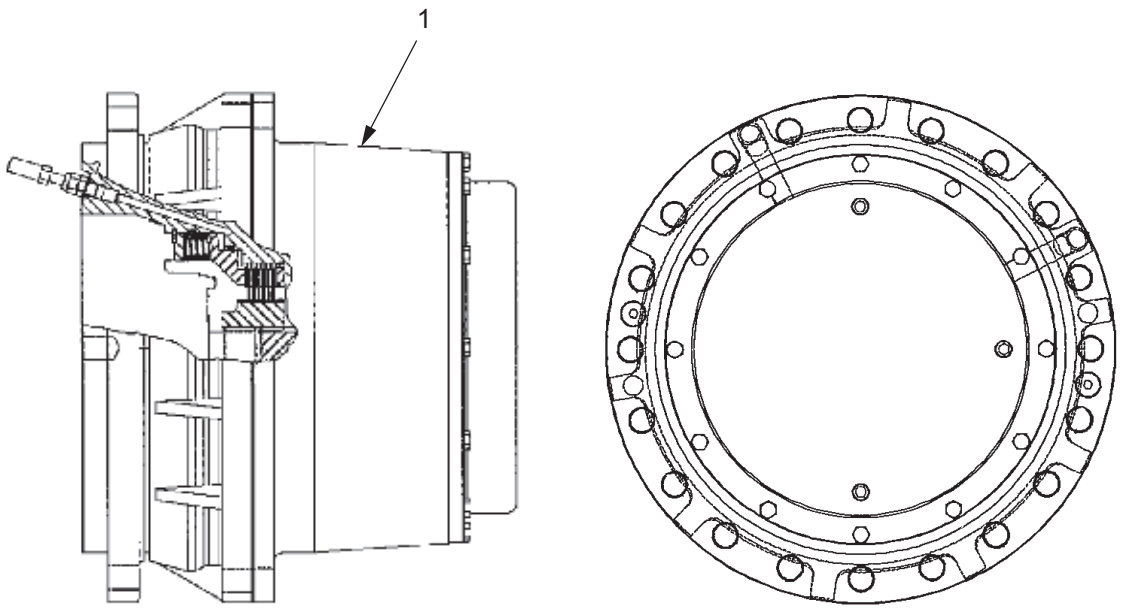
(3-1)	Discharge port	**[PP]**	: G3/4
(3-2)	Suction port	**[PS]**	: G1

Specifications

- Displacement : 24.9 cm^3/rev (1.52 cu.in./rev)

- Allowable pump case pressure : 0.3 MPa (43.5 psi) or less
- Pump assembly weight : 94.5 kg (208 lbs.)

2-2-2. Gear box

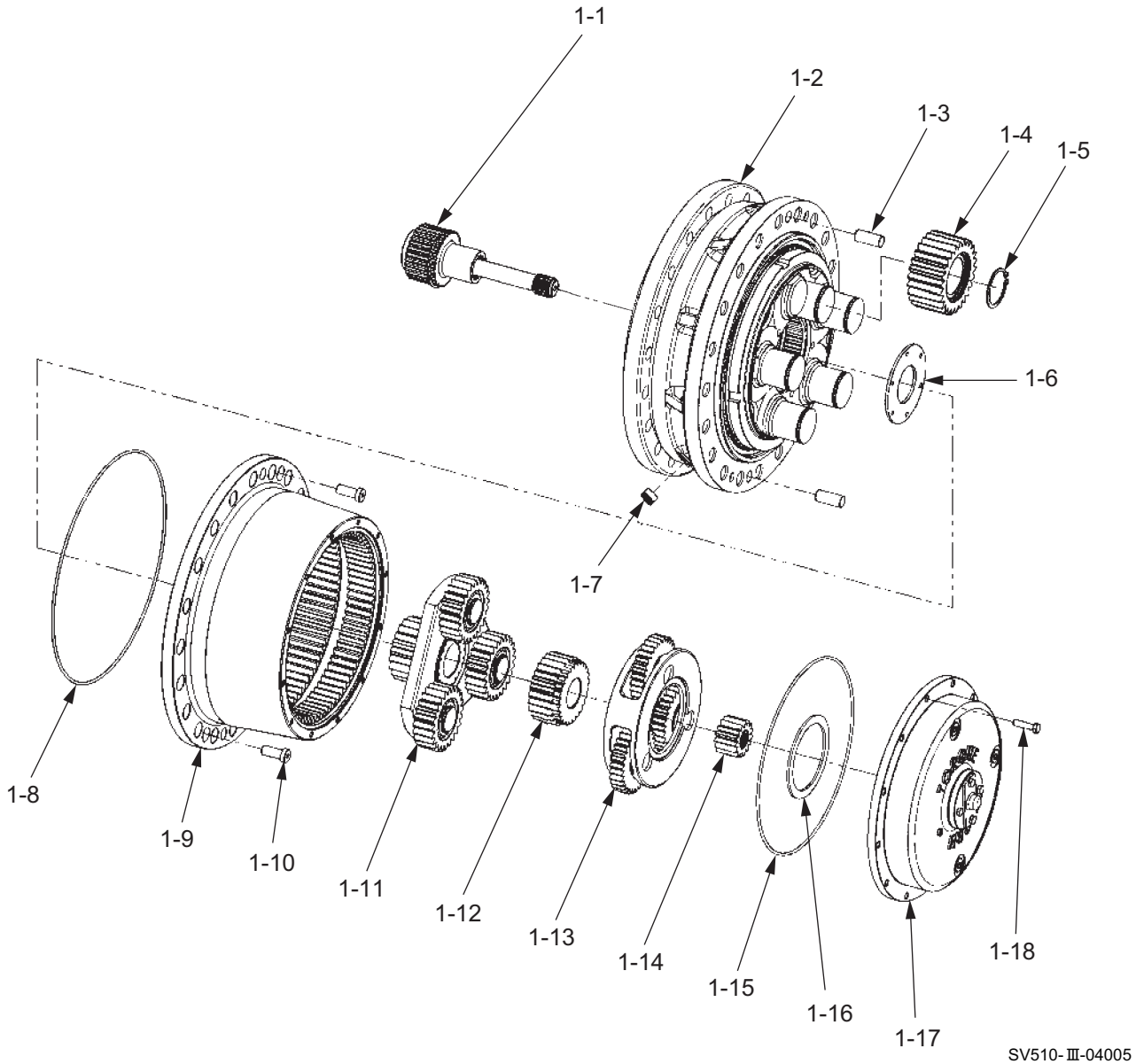


SV510-Ⅲ-04004

(1) Gear box

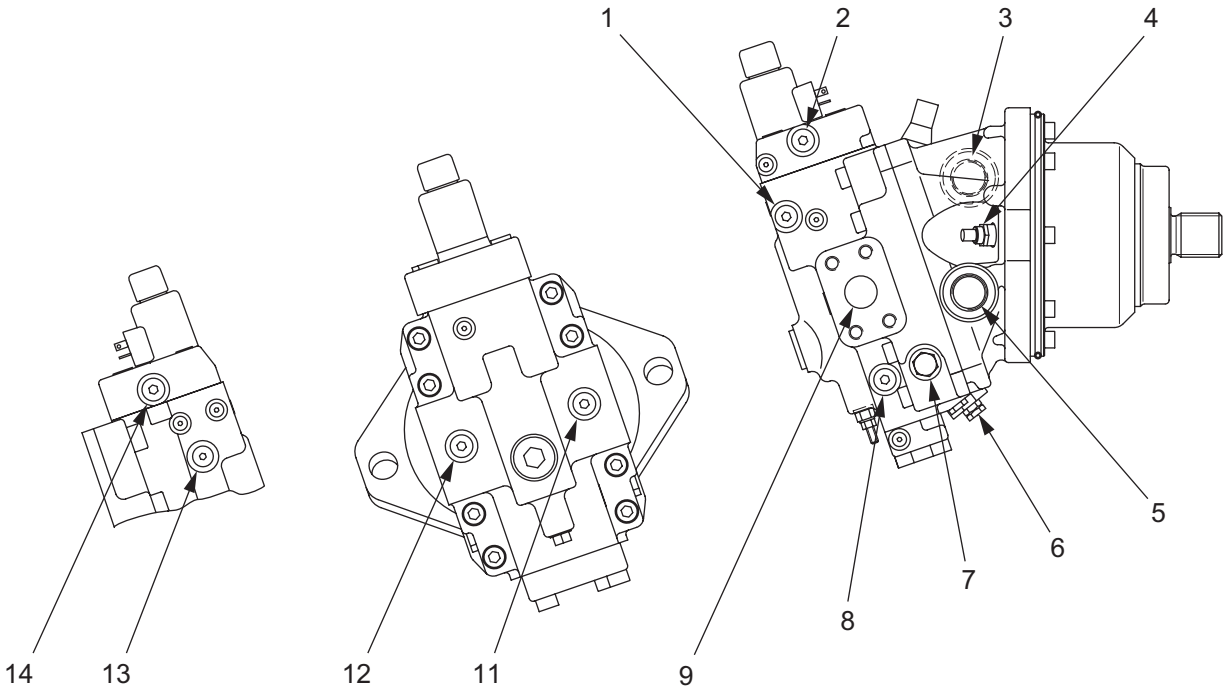
Specifications
- Reduction ratio : 1/63.49
- Weight : 168 kg (370 lbs.)

1) Structure of gear box

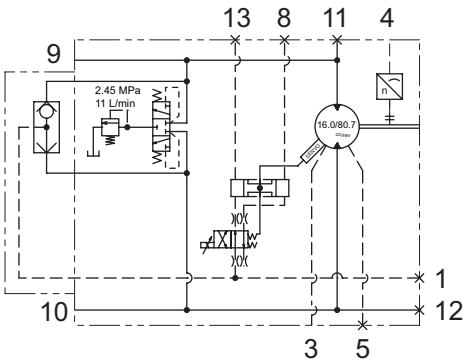


(1) Gear box
- (1-1) Input shaft/coupling subassembly
- (1-2) Hub/spindle subassembly
- (1-3) Dowel pin
- (1-4) Output planetary subassembly
- (1-5) External retaining ring
- (1-6) Thrust spacer
- (1-7) Magnetic pipe plug
- (1-8) O-ring
- (1-9) Ring gear
- (1-10) Bolt
- (1-11) Intermediate carrier subassembly
- (1-12) Sun gear
- (1-13) Input carrier subassembly
- (1-14) Sun gear
- (1-15) O-ring
- (1-16) Thrust washer
- (1-17) Cover subassembly
- (1-18) Bolt

2-2-3. Propulsion hydraulic motor (front)



SV510-Ⅲ-04002



Motor circuit diagram

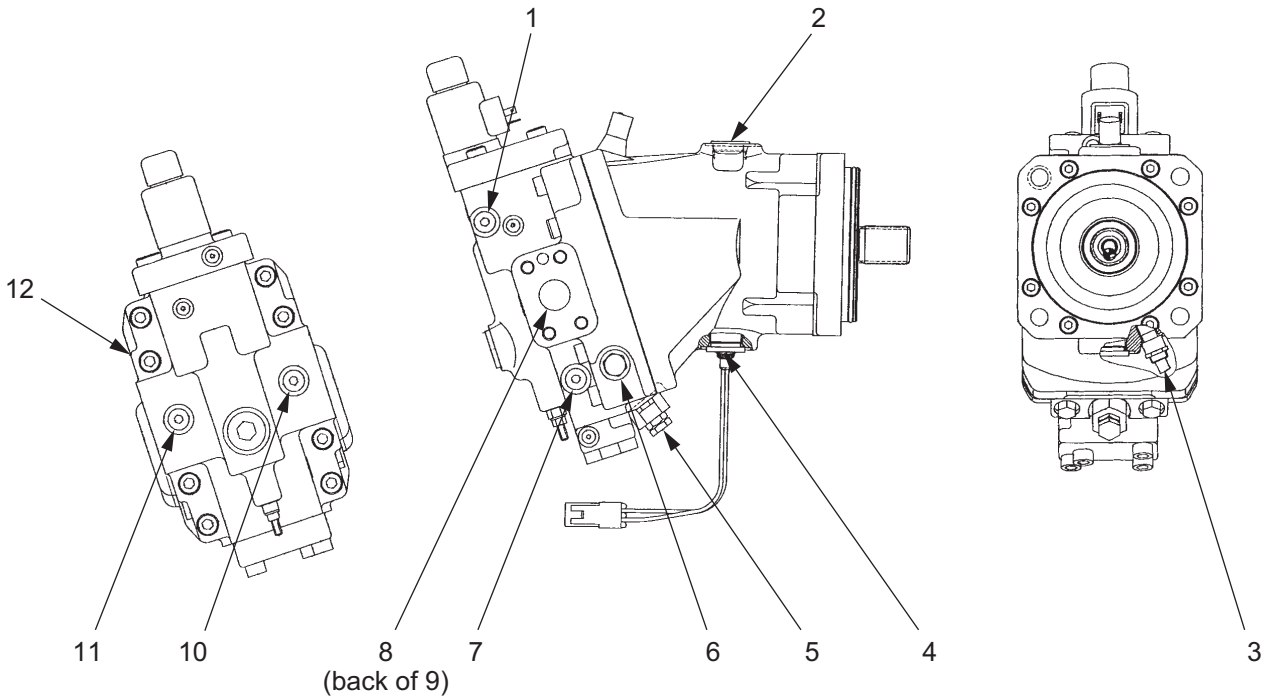
SV510-Ⅲ-04003

(1) Servo pressure gauge port	: 9/16-18UNF	(8) Servo pressure min. angle gauge port	: 9/16-18UNF
(2) Control pressure gauge port	: 9/16-18UNF	(9) Port A (Reverse) **[FA]**	: SAE 1”
(3) Drain port **[FMT]**	: 1 1/16-12UN	(10) Port B (Forward) **[FB]**	: SAE 1”
(4) Speed pickup		(11) High pressure gauge port (For Port A)	: 9/16-18UNF
(5) Drain port	: 1 1/16-12UN	(12) High pressure gauge port (For Port B)	: 9/16-18UNF
(6) Charge pressure relief valve		(13) Servo pressure max. angle gauge port	: 9/16-18UNF
(7) Loop flushing shuttle valve		(14) Supply pressure shuttle valve	: 9/16-18UNF

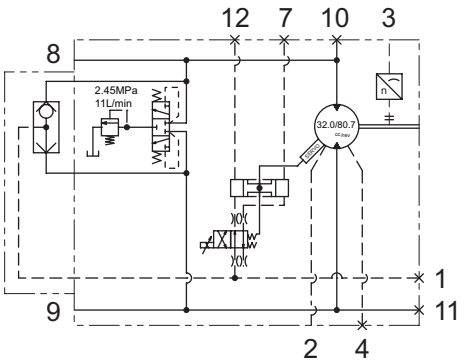
Motor specifications

• Displacement (max.)	:	80.7 cm^3/rev	(4.92 cu.in./rev)	
(min.)	:	16.1 cm^3/rev	(0.98 cu.in./rev)	
• Charge relief valve pressure setting	:	2.45 MPa	(355 psi)	(at 11 L/min)
• Allowable motor case pressure	:	0.3 MPa	(43.5 psi)	or less
• Weight	:	32 kg	(71 lbs.)	

2-2-4. Propulsion hydraulic motor (rear)



SV510-Ⅲ-04006



Motor circuit diagram

SV510-Ⅲ-04007

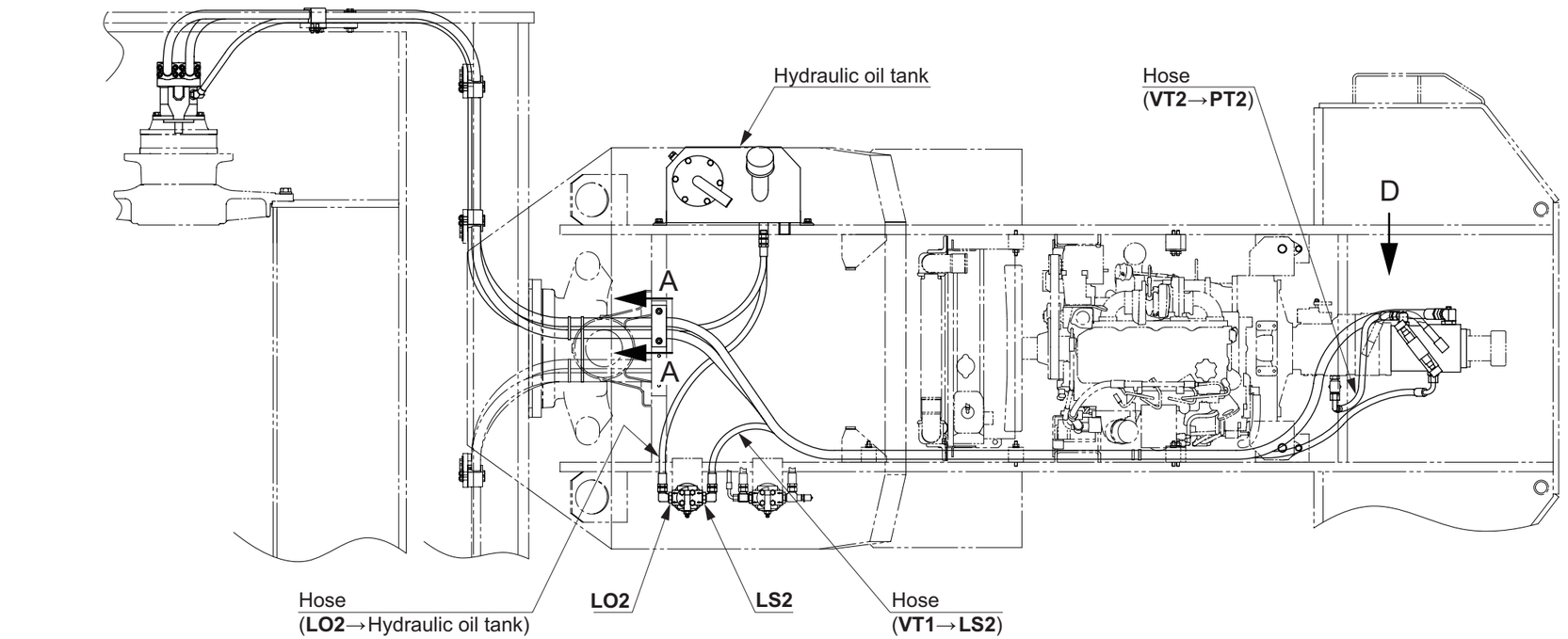
(1) Servo pressure gauge port : 9/16-18UNF
(2) Drain port **[RMT]** : 1 1/16-12UN
(3) Speed pickup
(4) Drain port : 1 1/16-12UN
(5) Charge pressure relief valve
(6) Loop flushing shuttle valve
(7) Servo pressure min. angle gauge port : 9/16-18UNF
(8) Port A (Forward) **[RA]** : SAE 1”
(9) Port B (Reverse) **[RB]** : SAE 1”
(10) High pressure gauge port (For Port A) : 9/16-18UNF
(11) High pressure gauge port (For Port B) : 9/16-18UNF
(12) Servo pressure max. angle gauge port : 9/16-18UNF

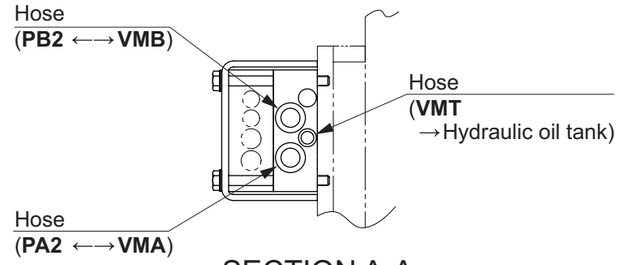
Motor specifications

- Displacement (max.) : 80.7 cm^3/rev (4.92 cu.in./rev)
  (min.) : 32.0 cm^3/rev (1.95 cu.in./rev)
- Charge relief valve pressure setting : 2.45 MPa (355 psi) (at 11 L/min)
- Allowable motor case pressure : 0.3 MPa (43.5 psi) or less
- Weight : 32 kg (71 lbs.)

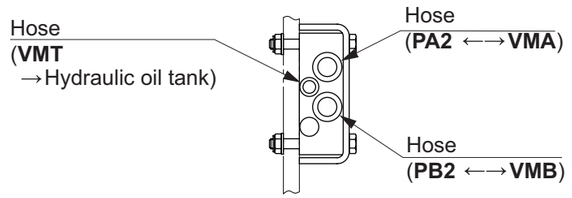
3. VIBRATOR HYDRAULIC SYSTEM

3-1. Vibrator Hydraulic Piping

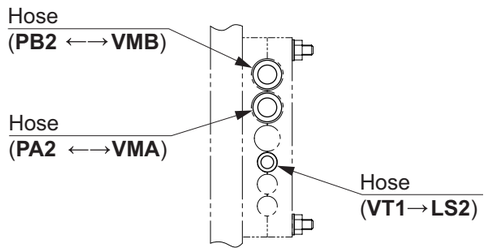




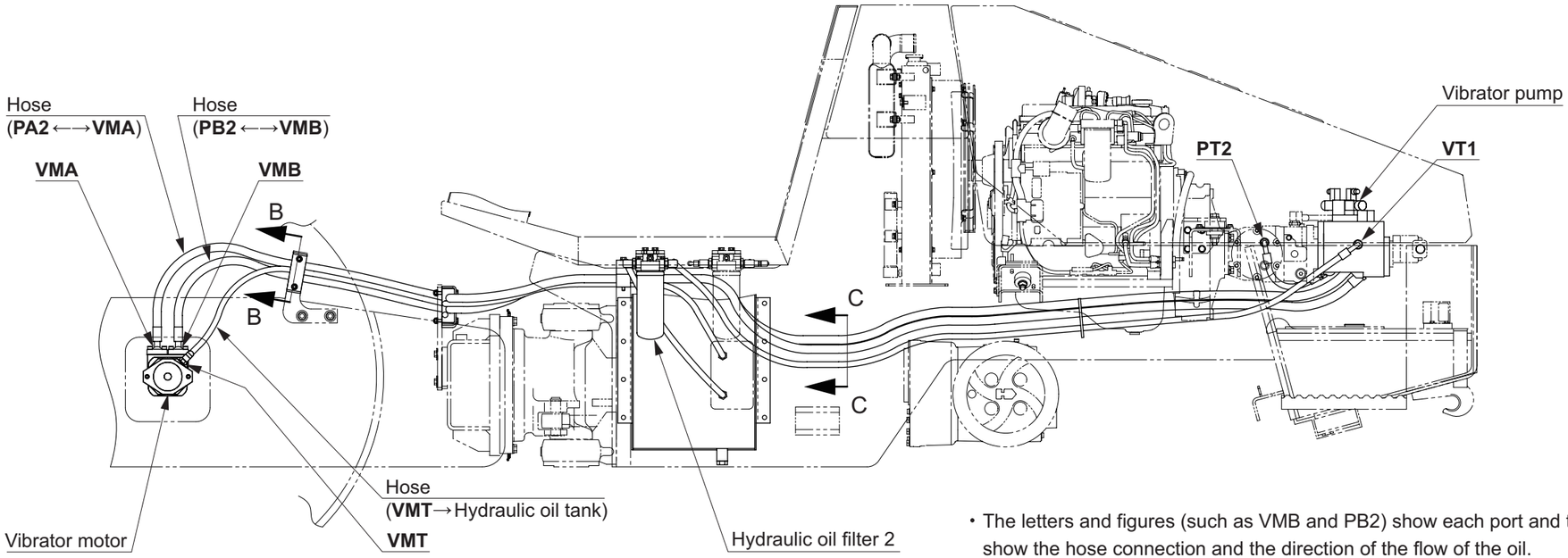
SECTION A-A

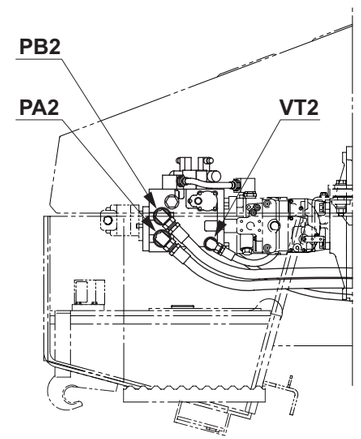


SECTION B-B



SECTION C-C





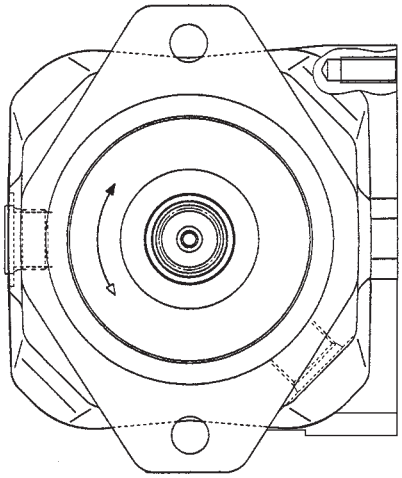
VIEW D

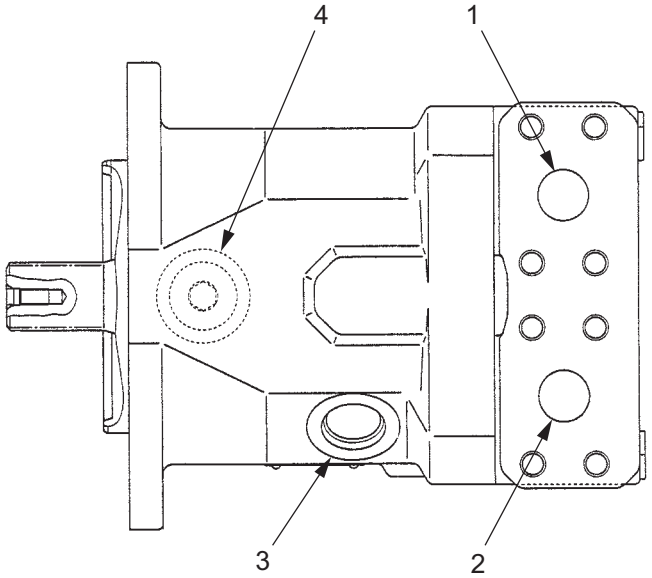
- The letters and figures (such as VMB and PB2) show each port and the arrow (⟷;→) symbols show the hose connection and the direction of the flow of the oil.

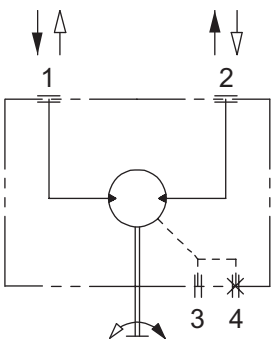
0412-49803-0-10273-0

3-2. Hydraulic Component Specifications

3-2-1. Vibrator hydraulic motor







Hydraulic circuit diagram

Flow of oil
- 1→2 Clockwise rotation
- 2→1 Counterclockwise rotation

SV510-Ⅲ-04008

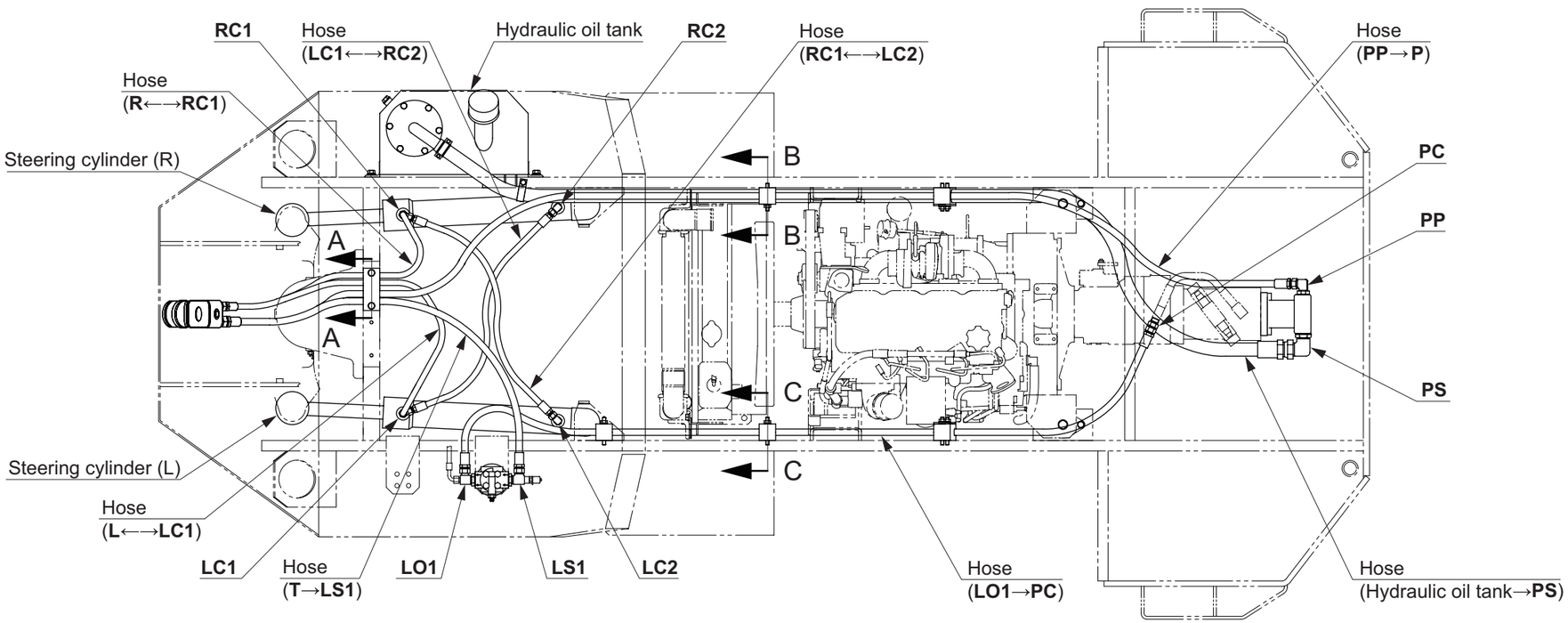
(1) Port A	**[VMA]**	:	SAE 3/4”
(2) Port B	**[VMB]**	:	SAE 3/4”
(3) Drain port (L)	**[VMT]**	:	7/8-14UNF
(4) Drain port (L1)		:	7/8-14UNF

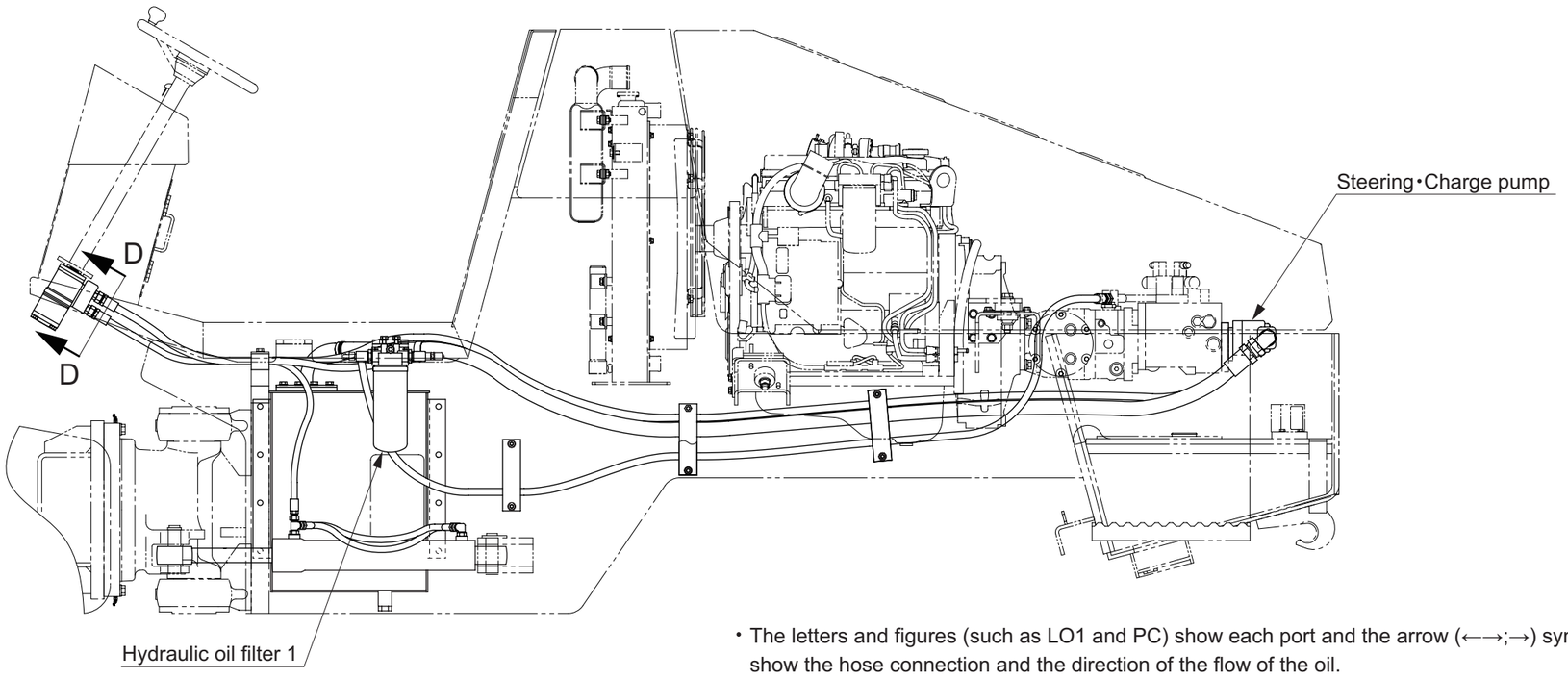
Specifications

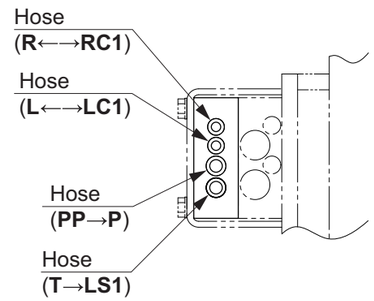
• Displacement	:	44.5 cm^3/rev	(2.72 cu.in./rev	)
• Working pressure	:	28 MPa	(4,060 psi	)
• Allowable pump case pressure	:	0.3 MPa	(43.5 psi	)
• Weight	:	17 kg	(37 lbs.	)

4. STEERING SYSTEM

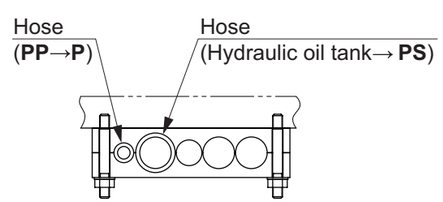
4-1. Steering Hydraulic Piping



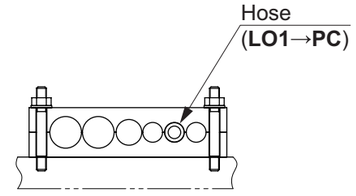




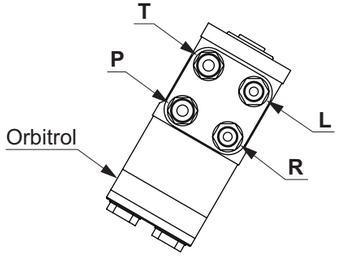
SECTION A-A



SECTION B-B



SECTION C-C

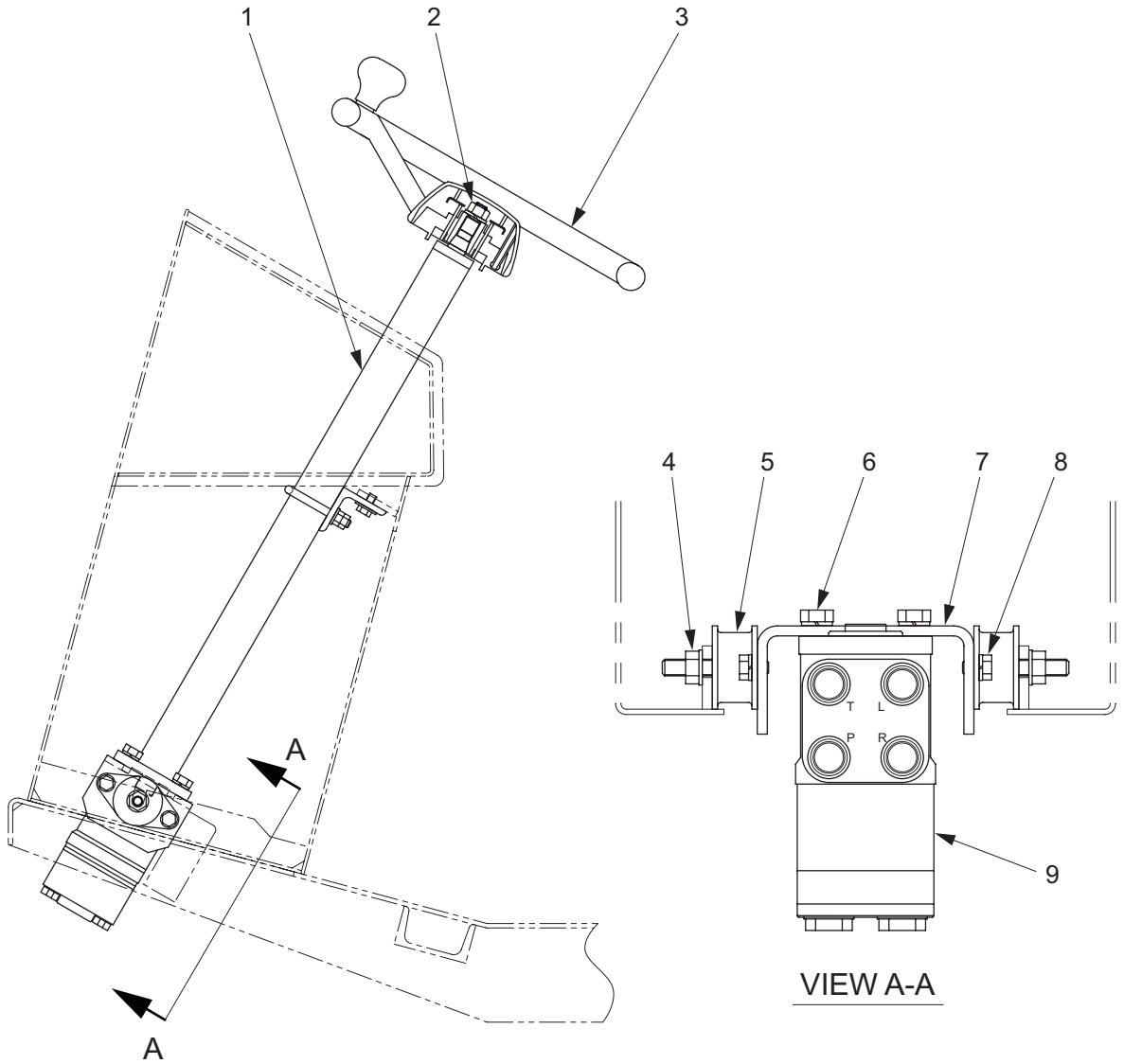


SECTION D-D

• The letters and figures (such as LO1 and PC) show each port and the arrow (←→;→) symbols show the hose connection and the direction of the flow of the oil.

0412-32804-0-10271-0

4-2. Steering Wheel



0404-32804-021754-A

(1) Column shaft
(2) Nut : M12 P=1.25
(3) Steering wheel
(4) Nut : M10
(5) Damper
(6) Bolt : M10×30
(7) Bracket
(8) Bolt : M8×12
(9) Orbitrol

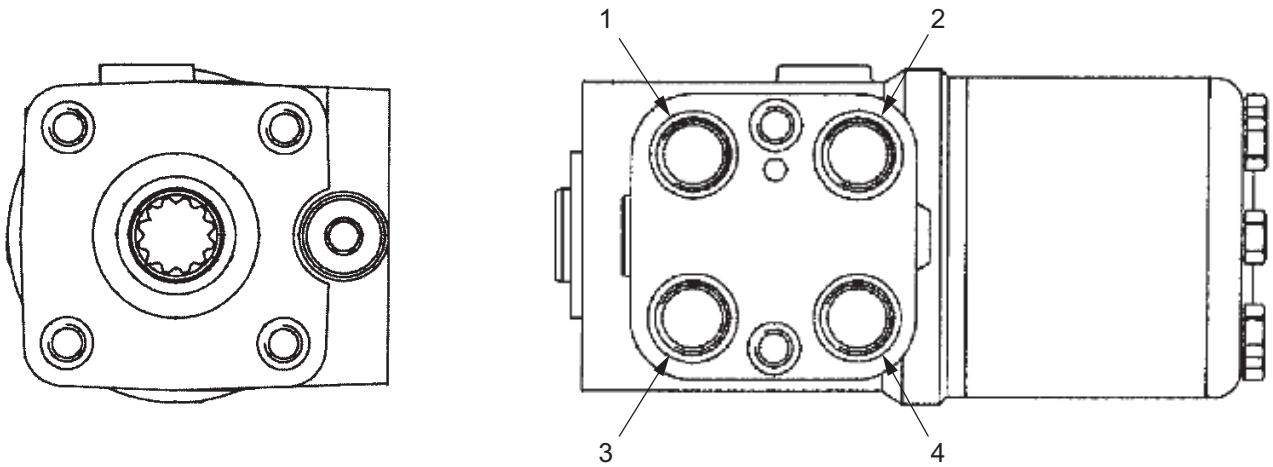
N•m

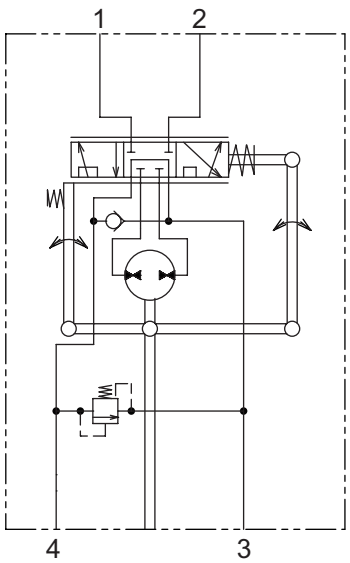
(2) Nut M12 P=1.25 : 35 N·m (26 lbf·ft)
(4) Nut M10 : 49 N·m (36 lbf·ft)
(6) Bolt M10×30 : 49 N·m (36 lbf·ft)
(8) Bolt M8×12 : 23 N·m (17 lbf·ft)

• Steering wheel assembly weight : 17 kg (37 lbf·ft)

4-3. Hydraulic Component Specifications

4-3-1. Orbitrol





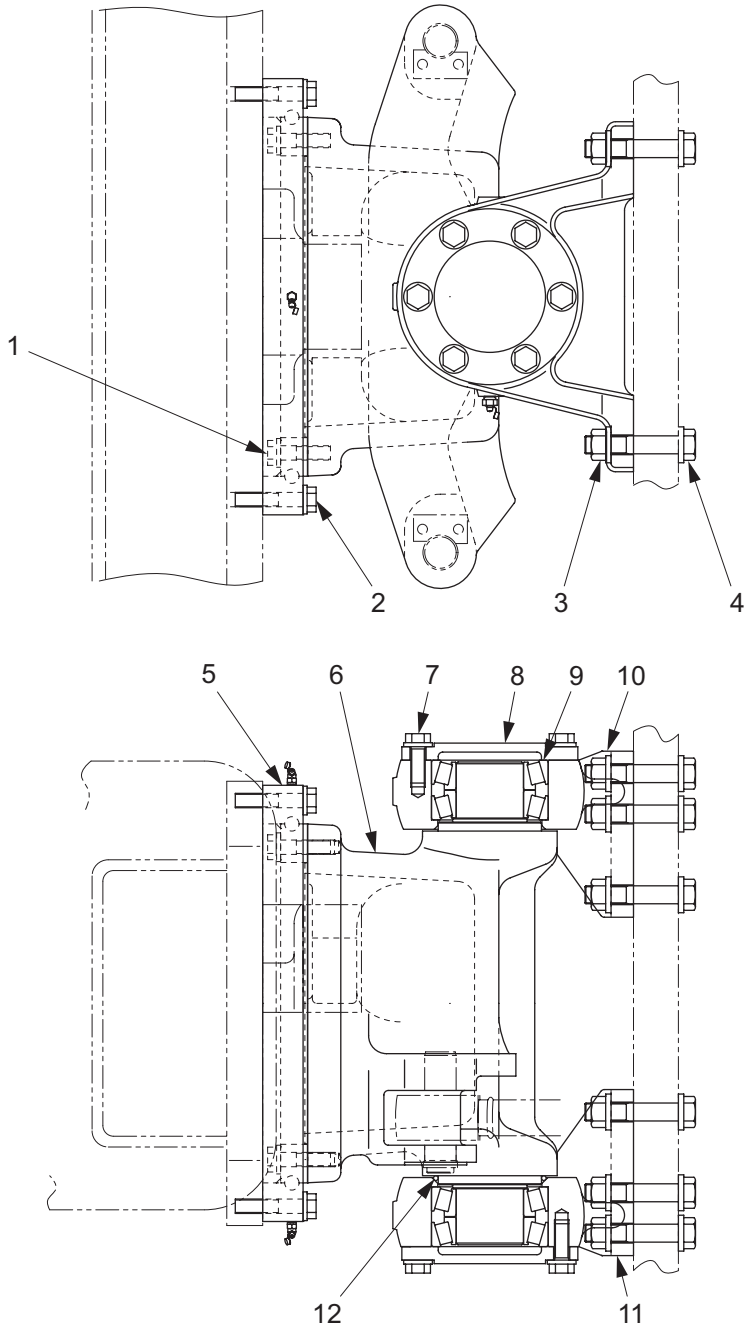
Hydraulic circuit diagram

SV510-Ⅲ-04010

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

Specifications
- Displacement : 400 cm^3/rev (24.4 cu.in./rev)
- Relief valve pressure setting : 15.0 MPa (2,175 psi)
- Weight : 7 kg (15 lbs.)

4-4. Frame (Center Pin)



0402-61802-0-10059-G

(1) Bolt : M16×60
(2) Bolt : M16×80
(3) Nut : M20
(4) Bolt : M20×110
(5) Swing bearing
(6) Yoke
(7) Bolt : M16×45
(8) Cover
(9) Roller bearing
(10) Bracket (upper)
(11) Bracket (lower)
(12) O-ring

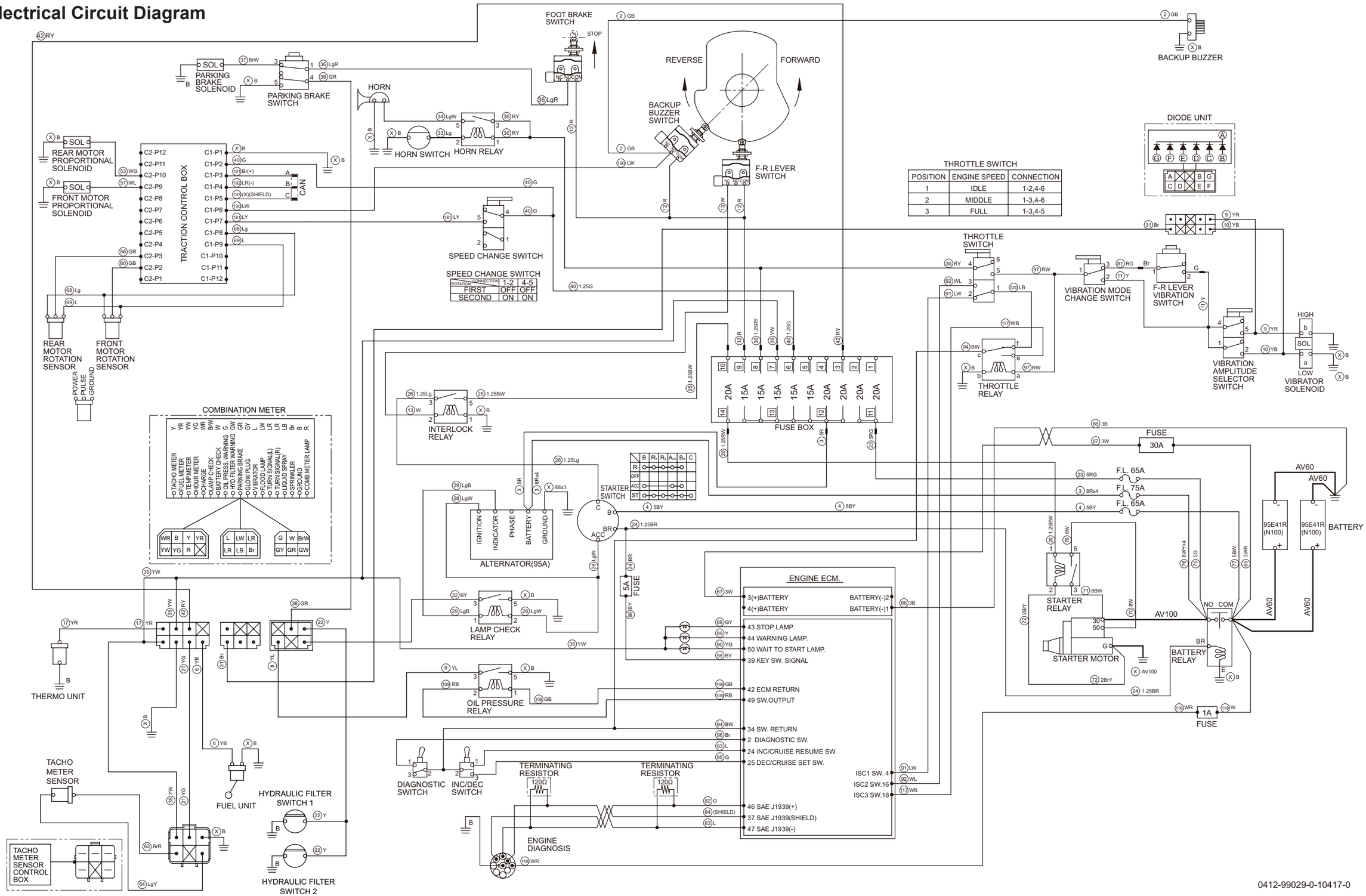
N•m

(1) Bolt M16×60 : 265 N·m (196 lbf·ft)
(2) Bolt M16×80 : 265 N·m (196 lbf·ft)
(3) Nut M20 : 539 N·m (398 lbf·ft)
(7) Bolt M16×45 : 265 N·m (196 lbf·ft)

ELECTRICAL SYSTEM

1. SYSTEM CIRCUIT DIAGRAM

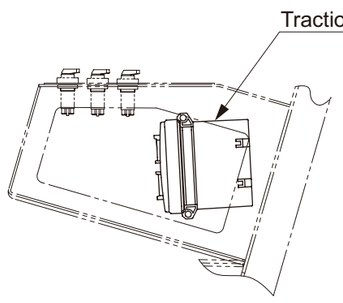
1-1. Electrical Circuit Diagram



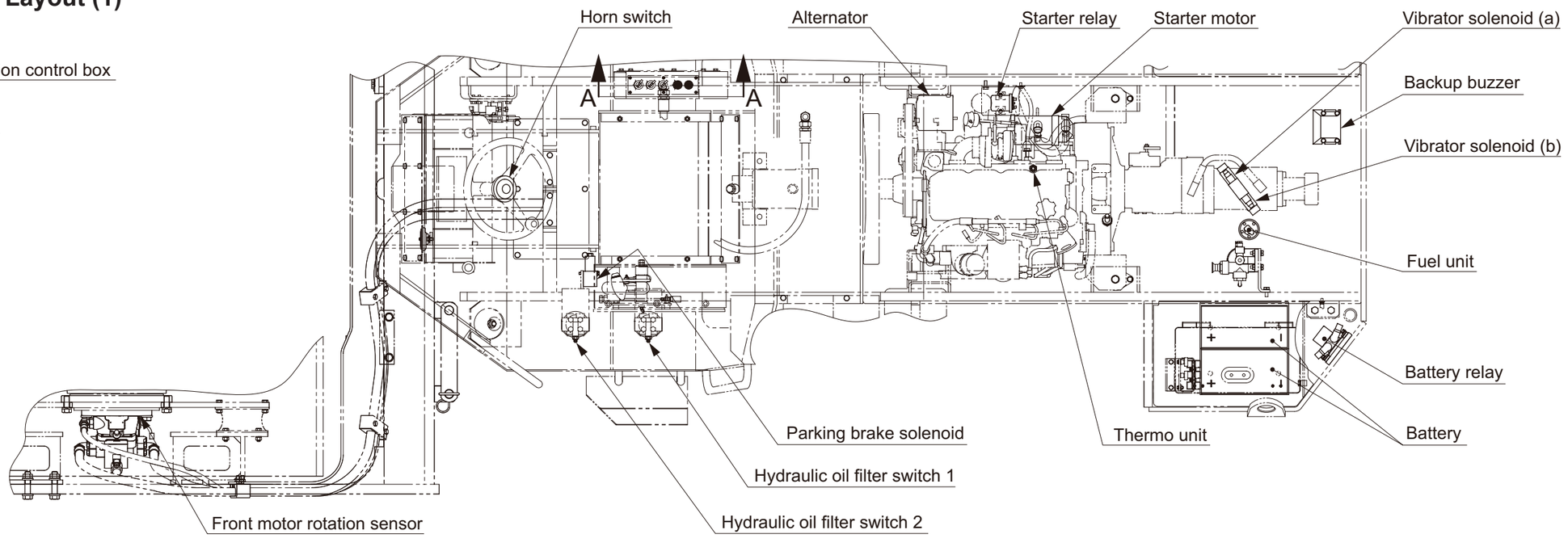
0412-99029-0-10417-0

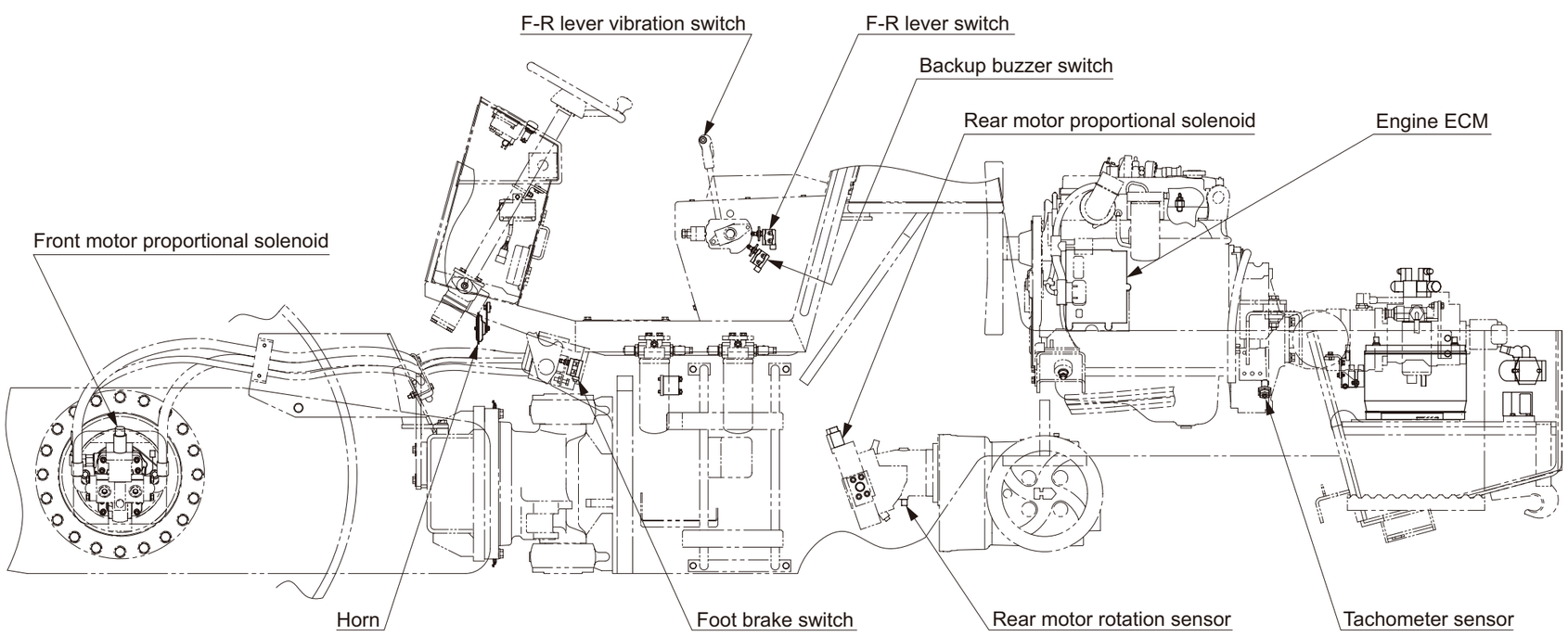
2. ELECTRICAL COMPONENTS

2-1. Electrical Component Layout (1)



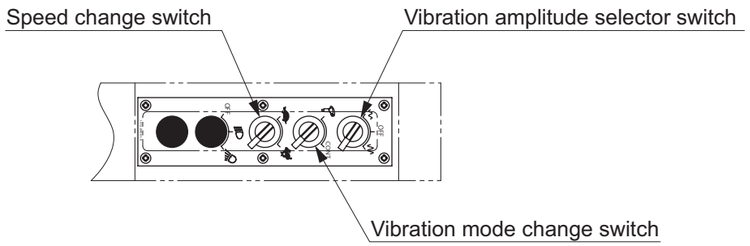
SECTION A-A



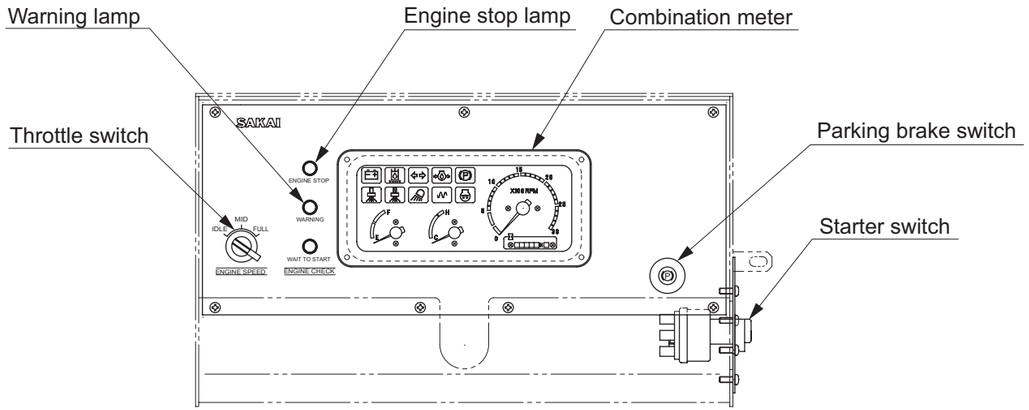


0412-09821-0-10463-0
0412-09815-0-10286-B

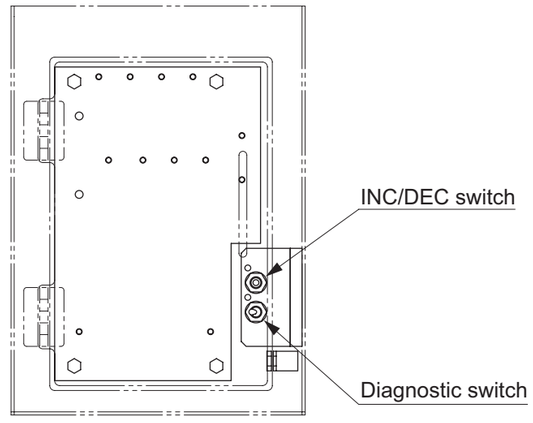
2-2. Electrical Component Layout (2)



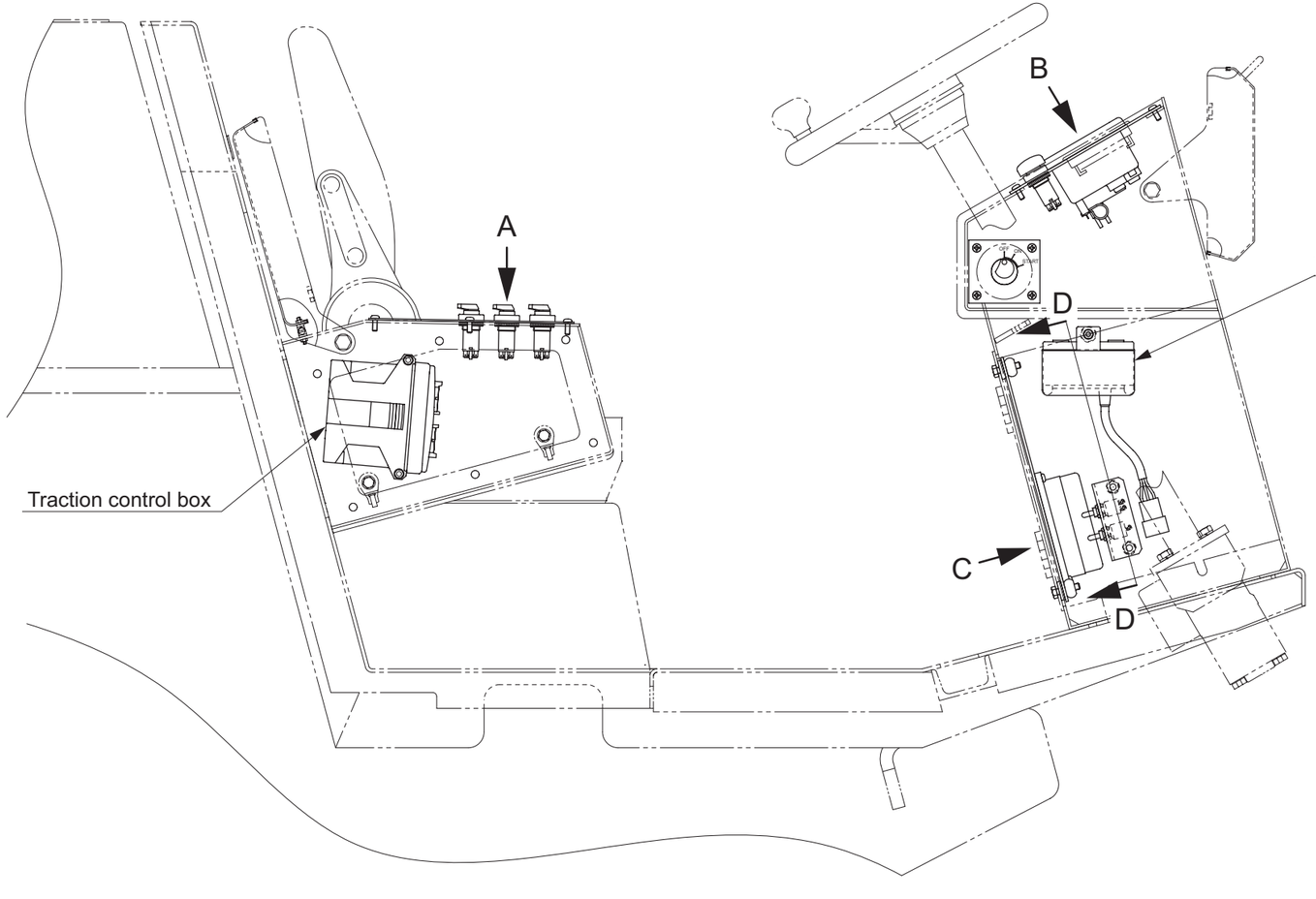
VIEW A

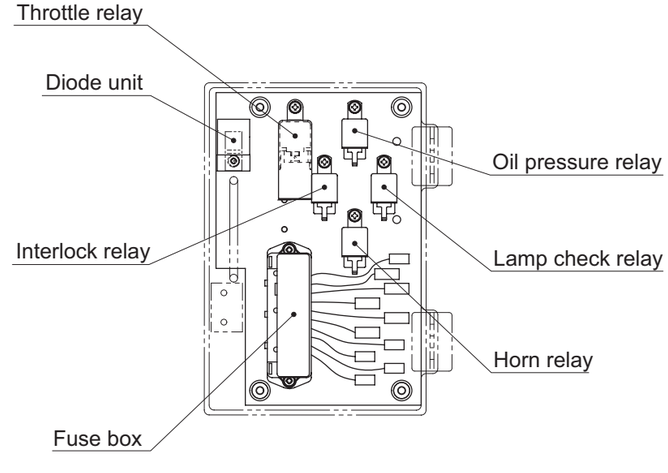


VIEW B



VIEW C



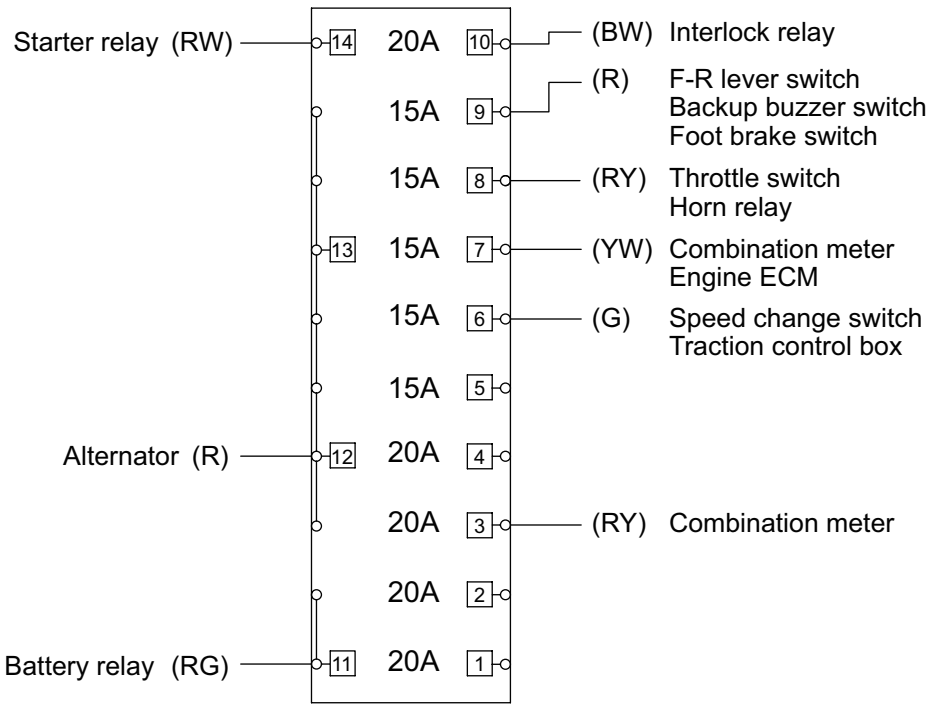


SECTION D-D

0412-09822-0-10464-0

3. ELECTRICAL COMPONENT SPECIFICATIONS

3-1. Fuse Box



Fuse box

SV510-Ⅲ-05001

Harness color codes

RG	: Red/Green stripe	BW	: Black/White stripe
RW	: Red/White stripe	YW	: Yellow/White stripe
RY	: Red/Yellow stripe	G	: Green
R	: Red		

VIBRATORY DRUM • REAR AXLE

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 cotter pins, and lock plates with new parts.
- Properly bend split cotter 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 gear oil to rotating and sliding components.
- Apply grease 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

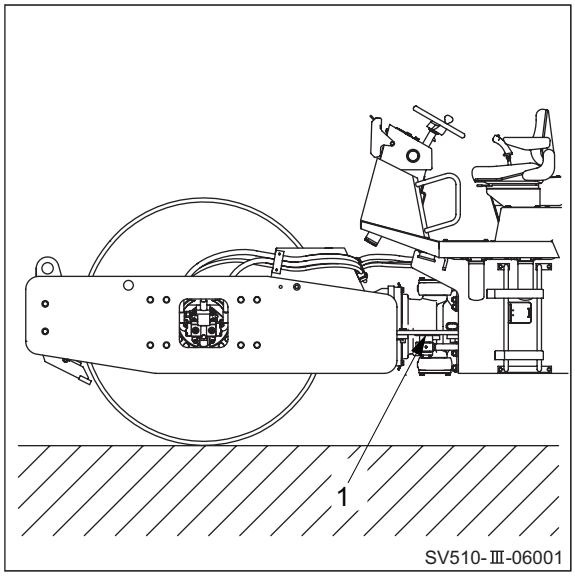
- If coolant has been drained, securely retighten the drain cock and fill with coolant (mixing in long-life coolant) to the specified level. Start the engine and allow the coolant to circulate through the piping. Then add coolant again to the specified level.
- If hydraulic equipment has been removed 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) Joint front frame and rear frame with steering lock bar (1).

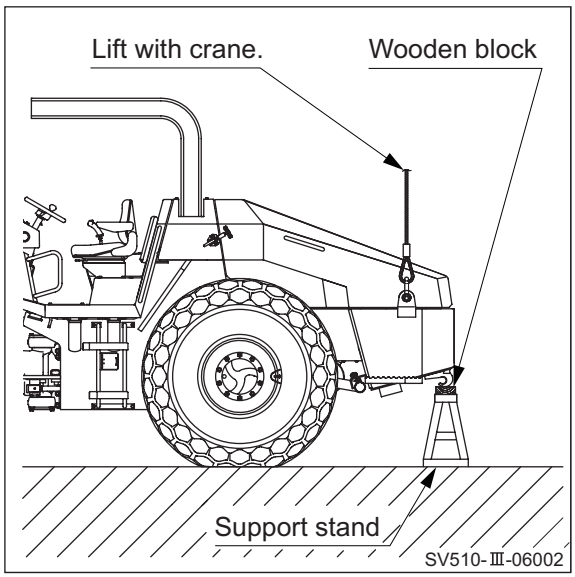


⚠WARNING

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.

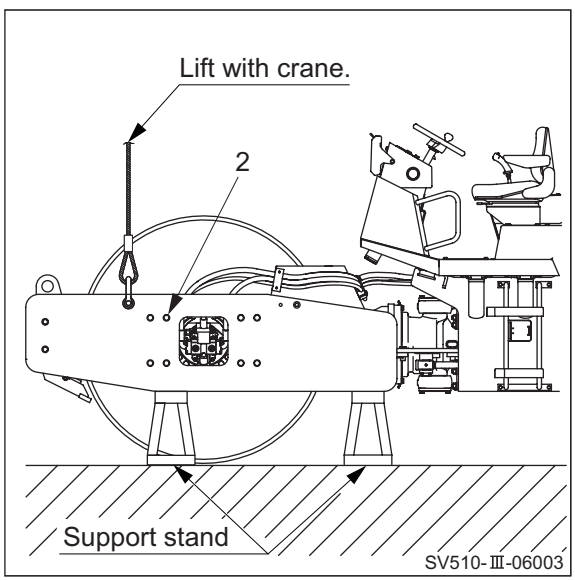
2) Lift rear frame with a crane.
   - Firmly secure machine body by placing support stands and/or wooden blocks at rear end of rear frame.

(NOTICE)
- **Do not allow rear wheel tires to leave the ground. (The tires must support the machine's body weight, too.)**



Rear axle weight
SV510D-Ⅲ : 4,910 kg (10,825 lbs.)
SV510T-Ⅲ : 4,920 kg (10,850 lbs.)
SV510TF-Ⅲ : 4,890 kg (10,780 lbs.)

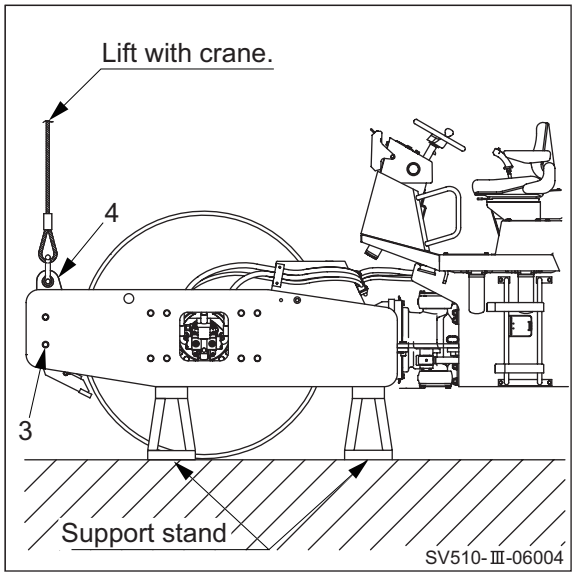
3) Lift front frame with a crane.
   - Ensuring that no load is applied to eight bolts (2) (left and right sides), place support stands at right and left sides of front frame. Firmly secure machine body.



Front axle weight
SV510D-Ⅲ : 5,760 kg (12,700 lbs.)
SV510T-Ⅲ : 6,110 kg (13,470 lbs.)
SV510TF-Ⅲ : 8,380 kg (18,475 lbs.)

4) Lift cross member (4) with a crane and hold it.
- Remove two bolts (3) (left and right sides).
- Lift cross member (4) and remove it from frame.

Cross member
SV510D-Ⅲ : 460 kg (1,014 lbs.)
SV510T-Ⅲ : 470 kg (1,036 lbs.)
SV510TF-Ⅲ : 500 kg (1,102 lbs.)



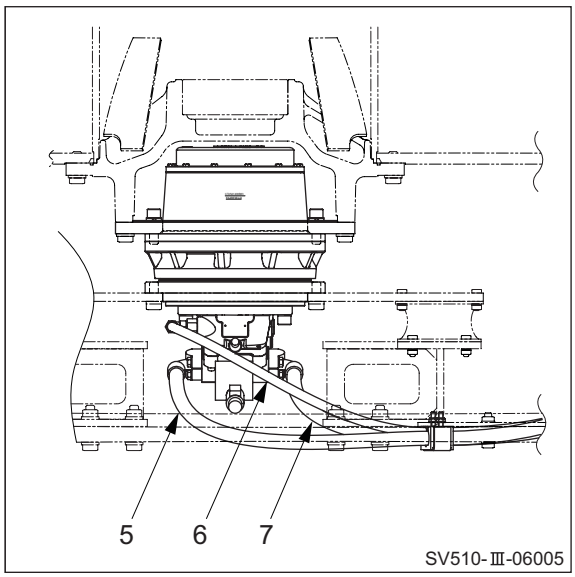
⚠WARNING

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.

5) Disconnecting piping

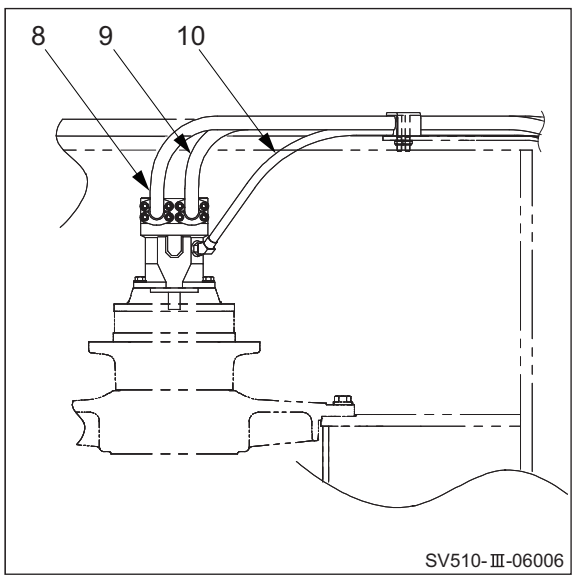
5-1) Propulsion motor piping
- Disconnect hydraulic hoses (5), (6) and (7) connecting to propulsion motor.

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



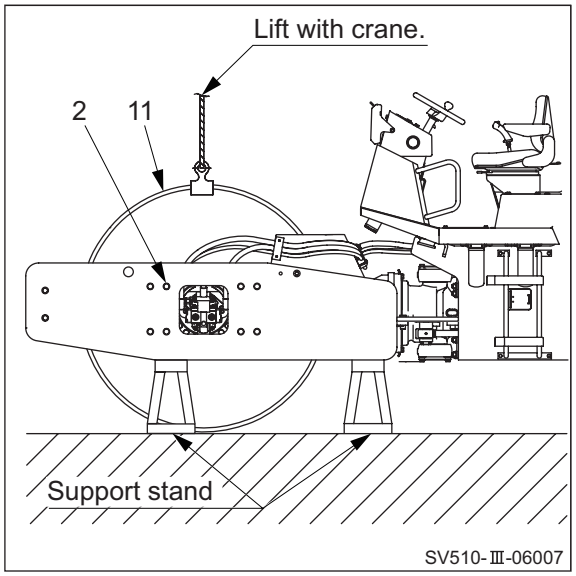
5-2) Vibrator motor piping
- Disconnect hydraulic hoses (8), (9) and (10) connecting to vibrator motor.

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

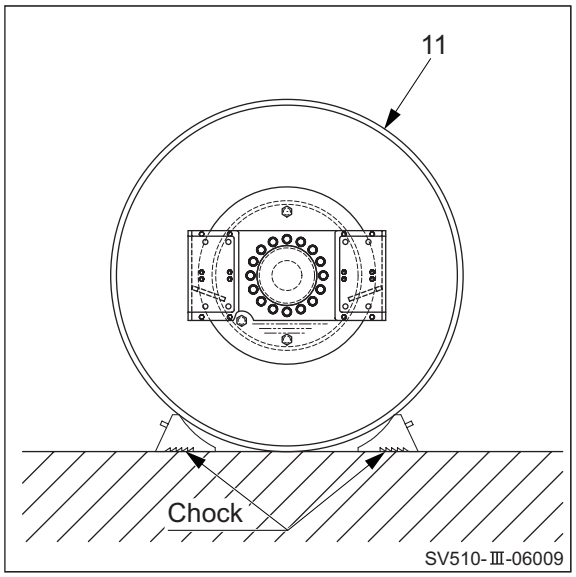


6) Remove eight bolts (2) (left and right sides).
   • Lift off vibratory drum (11) from frame.

   Vibratory drum assembly
   SV510D-Ⅲ : 4,470 kg (9,855 lbs.)
   SV510T-Ⅲ : 4,810 kg (10,604 lbs.)
   SV510TF-Ⅲ : 7,180 kg (15,829 lbs.)



7) Put chocks or the like under removed drum (11) to prevent it from moving.



2-1-2. Installation of vibratory drum

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

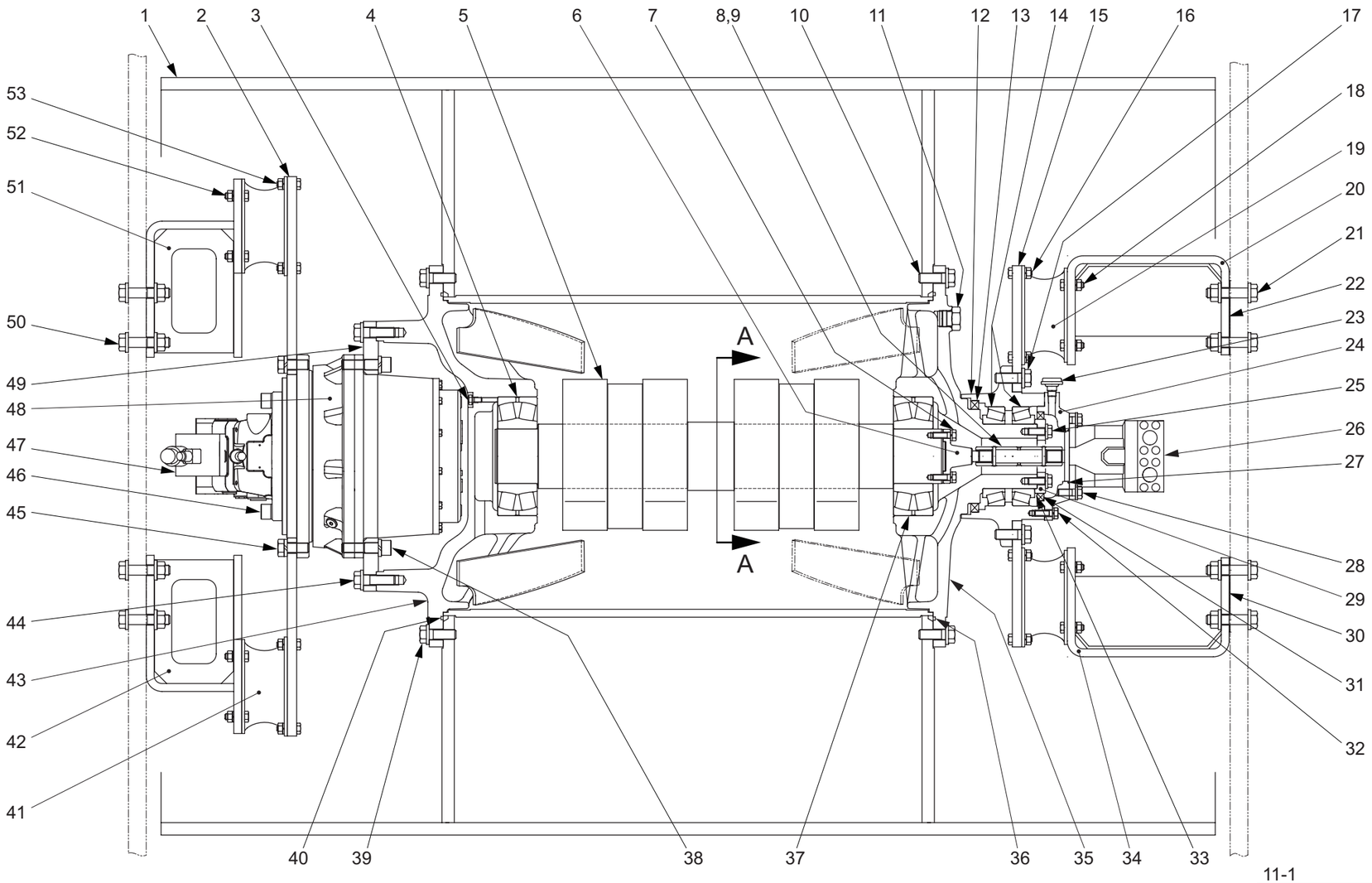
(3) Bolts M20×110 : 539 N·m (398 lbf·ft)
(Cross member)
(2) Bolts M20×90 : 539 N·m (398 lbf·ft)
(Vibratory drum)

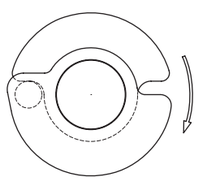
2) Upon installing vibratory drum, pay particular attention to items mentioned below.
   • Fill hydraulic oil tank to specified level to make up for any oil leakage.
   • Start engine and circulate oil through piping. Then check oil level again, ensuring that the oil is at specified level.

(NOTICE)

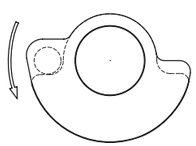
- **If the engine is run at high speed or the cylinder is operated to full stroke when the engine is started for the first time after the work is completed, the piston packing or other items may be damaged by air entering into the cylinder.**

2-2. Vibratory Drum Assembly



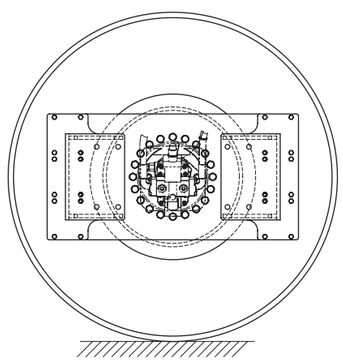


Vibration mode: Low
Motor clockwise rotation

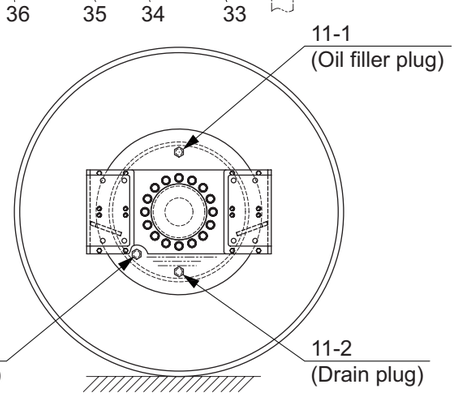


Vibration mode: High
Motor counterclockwise rotation

SECTION A-A



Propulsion motor side



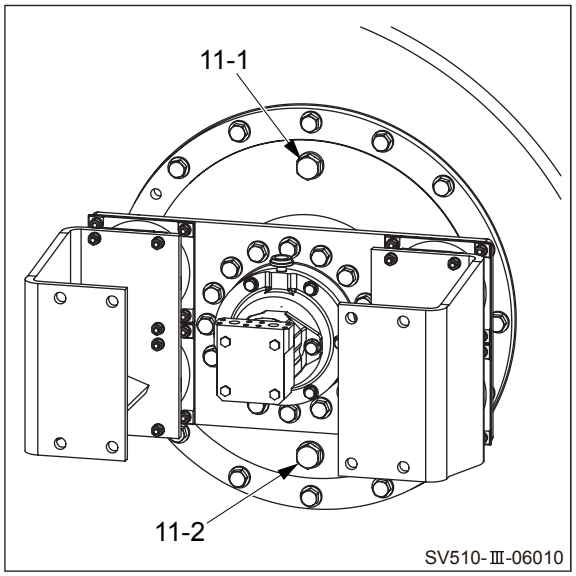
Vibrator motor side

0412-43801-0-10456-A

(1) Drum
(2) Disc
(3) Bolt : M10×20
(4) Vibrator bearing
(5) Eccentric shaft
(6) Shaft
(7) Bolt : M12×40
(8) Sleeve
(9) Spring pin
(10) Bolt : M20×60
(11) Plug
(12) Housing
(13) Oil seal
(14) Roller bearing
(15) Disc
(16) Bolt : M12×40
(17) Bolt : M20×60
(18) Bolt : M12×40
(19) Damper
(20) Holder
(21) Bolt : M20×90
(22) Plate
(23) Breather
(24) Cover
(25) Bolt : M14×40
(26) Vibrator motor
(27) O-ring
(28) Bolt : M14×40
(29) Cover
(30) Plate
(31) Oil seal
(32) Bolt : M12×40
(33) Shim
(34) Holder
(35) Axle shaft
(36) O-ring
(37) Vibrator bearing
(38) Bolt : M20×80 P=1.5
(39) Bolt : M20×60
(40) O-ring
(41) Damper
(42) Holder
(43) Axle shaft
(44) Bolt : M20×70
(45) Bolt : M20×50 P=1.5
(46) Bolt : M20×40 P=1.5
(47) Propulsion motor
(48) Gear box
(49) Ring
(50) Bolt : M20×90
(51) Holder
(52) Bolt : M12×40
(53) Bolt : M12×40

2-3. 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 6-007.

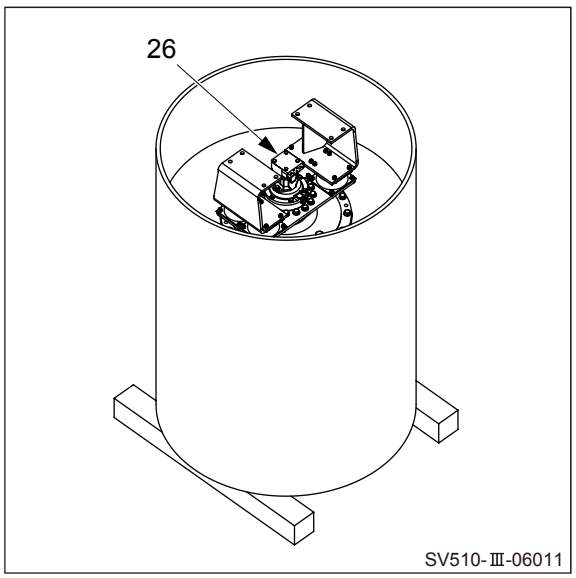


2-3-1. Disassembly of vibratory drum

1) Remove plugs (11-1) and (11-2).
   - Drain gear oil in vibrator case.
     - Quantity of gear oil : 34 L (9.0 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.**

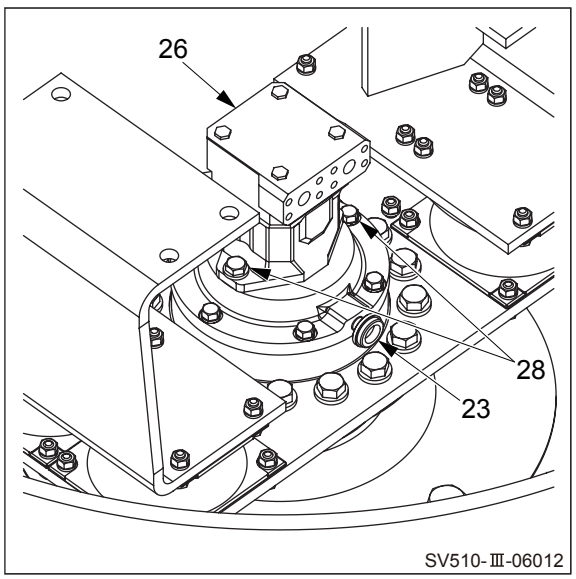


2) Lift vibratory drum with a crane and stand it with its vibrator motor (26) side facing up as shown on the right.

   Vibratory drum assembly
   SV510D-Ⅲ : 4,470 kg (9,855 lbs.)
   SV510T-Ⅲ : 4,810 kg (10,604 lbs.)
   SV510TF-Ⅲ : 7,180 kg (15,829 lbs.)

3) Remove two bolts (28).
   - Remove vibrator motor (26).
   - Remove breather (23).

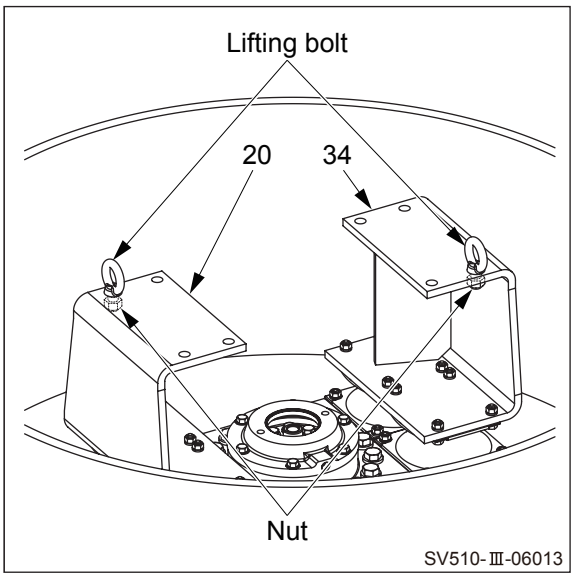
   (26) Vibrator motor: 20 kg (44 lbs.)



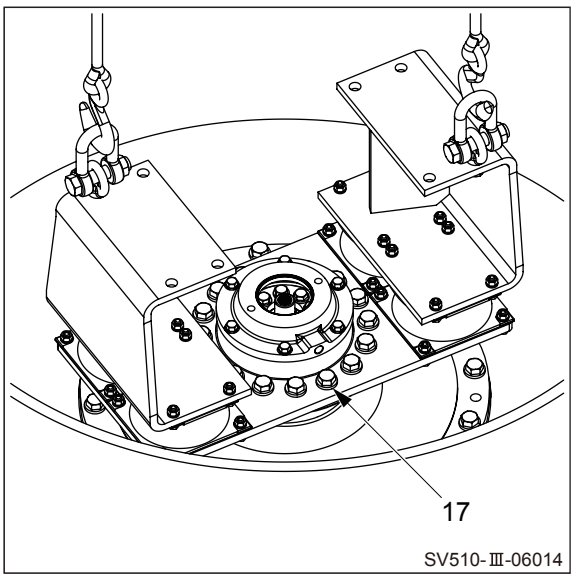
⚠WARNING

When installing lifting bolts, secure them with nuts.

4) Install lifting bolts and nuts (M20) to holders (20) and (34).

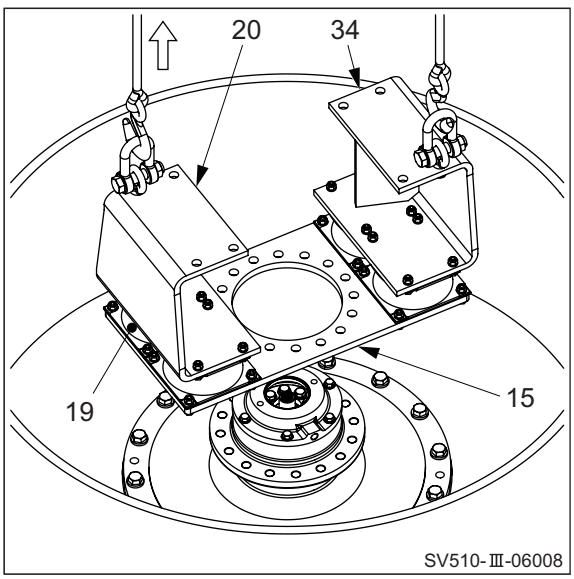


5) Remove sixteen bolts (17).

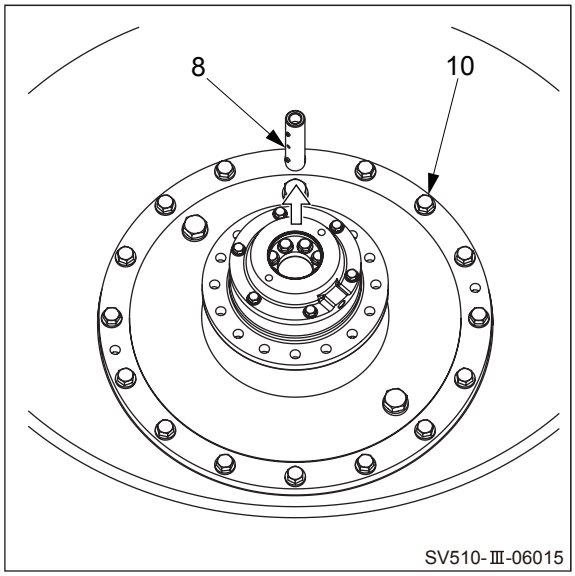


6) Lift holders (20), (34), dampers (19) and disc (15) together with a crane and remove them.

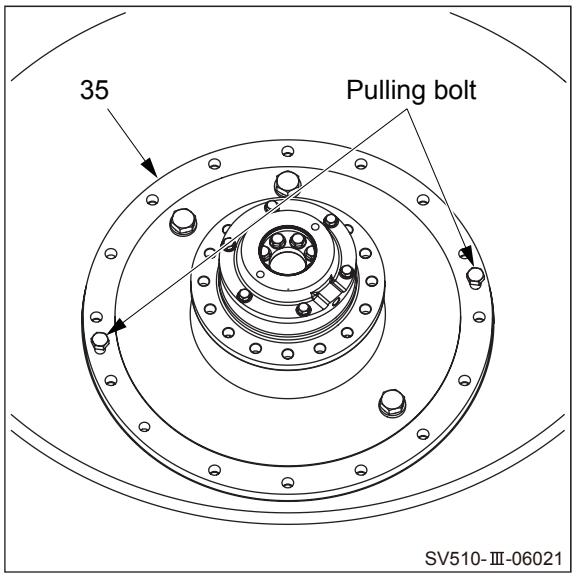
Ⓙ kg Total weight of parts to be lifted : 150 kg (331 lbs.)



7) Pull out sleeve (8).
   • Remove sixteen bolts (10).



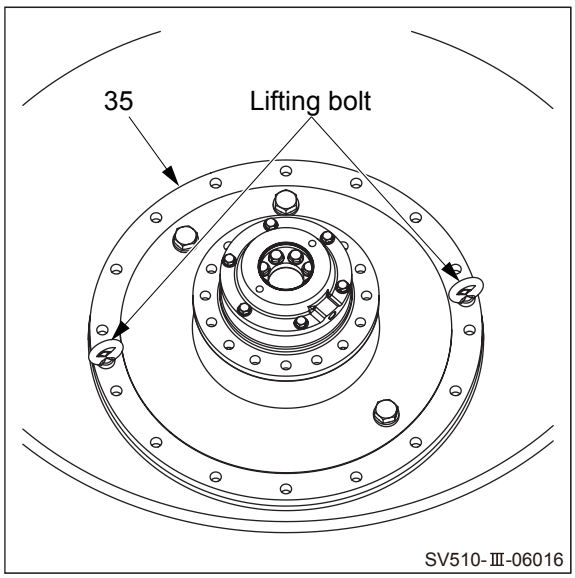
8) Lift axle shaft (35) using two pulling bolts (M20×60).



⚠WARNING

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

9) Install lifting bolts (M20) to axle shaft subassembly (35).

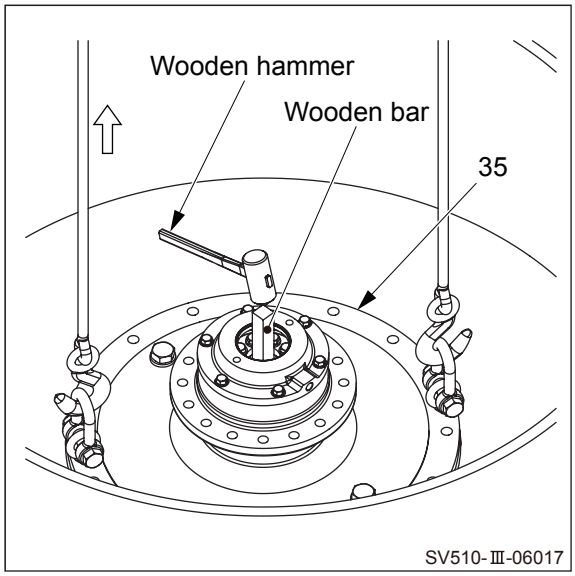


10) Slowly lift axle shaft subassembly (35) with a crane and remove it.

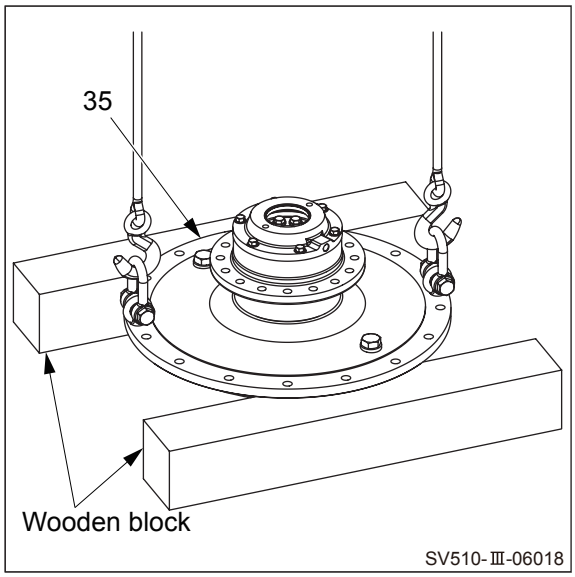
(NOTICE)

- **In order not to lift eccentric shaft (5) together with axle shaft subassembly (35), tap on the eccentric shaft end with a wooden hammer via a wooden bar during lifting.**

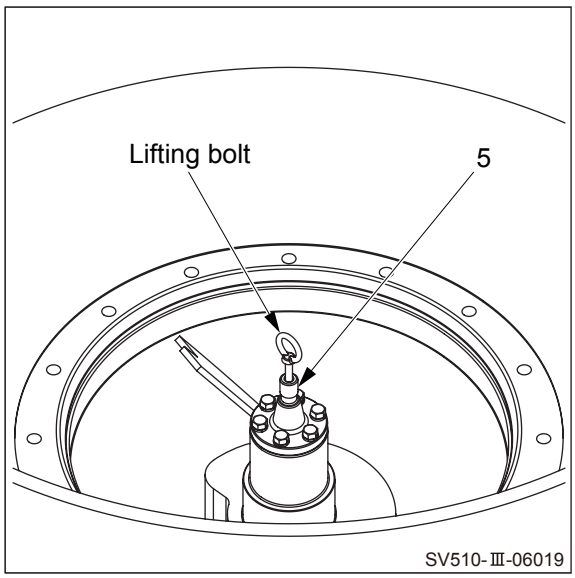
(35) Axle shaft subassembly : 240 kg (529 lbs.)



11) Put removed axle shaft subassembly (35) on wooden blocks.



12) Install a lifting bolt (M10) to the end of eccentric shaft subassembly (5).

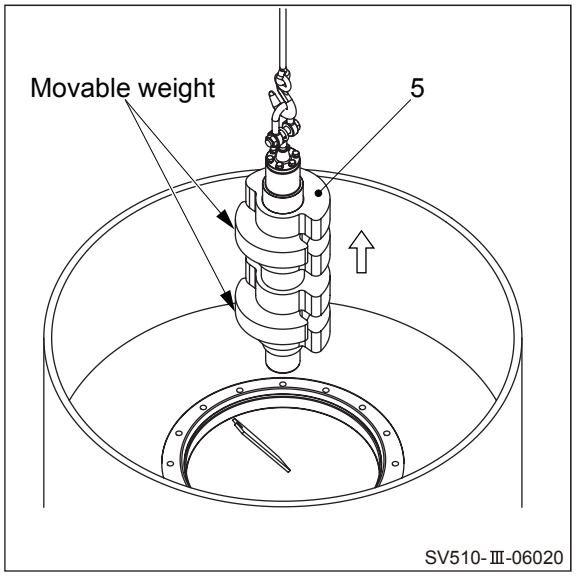


13) Lift eccentric shaft subassembly (5) with a crane and remove it.

(NOTICE)

- **When lifting the eccentric shaft, put the movable weights at their outmost position.**

(5) Eccentric shaft subassembly : 260 kg (573 lbs.)



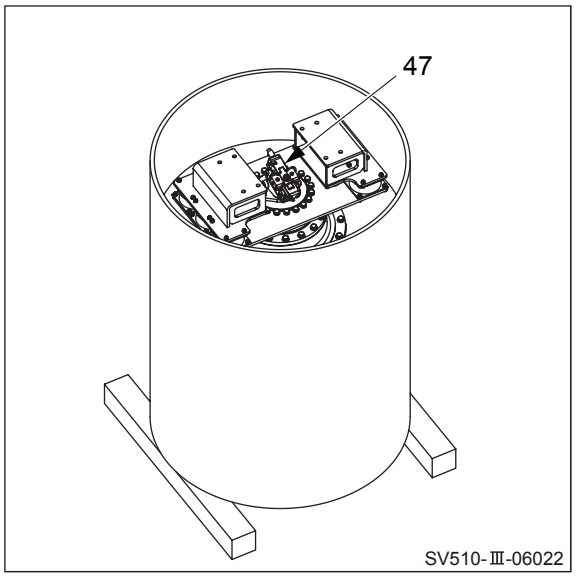
WARNING

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

14) Lift vibratory drum with a crane and reverse it. Then, stand drum with its propulsion motor (47) side facing up.

Total weight of parts to be lifted

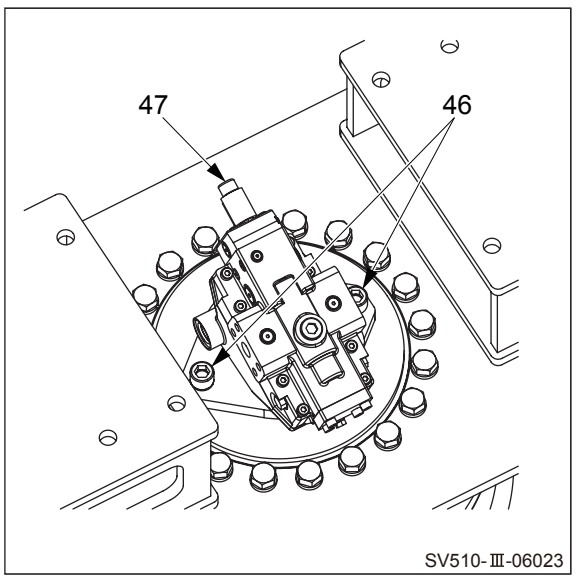
SV510D-Ⅲ : 3,790 kg (8,355 lbs.)
SV510T-Ⅲ : 4,120 kg (9,083 lbs.)
SV510TF-Ⅲ : 6,255 kg (13,790 lbs.)



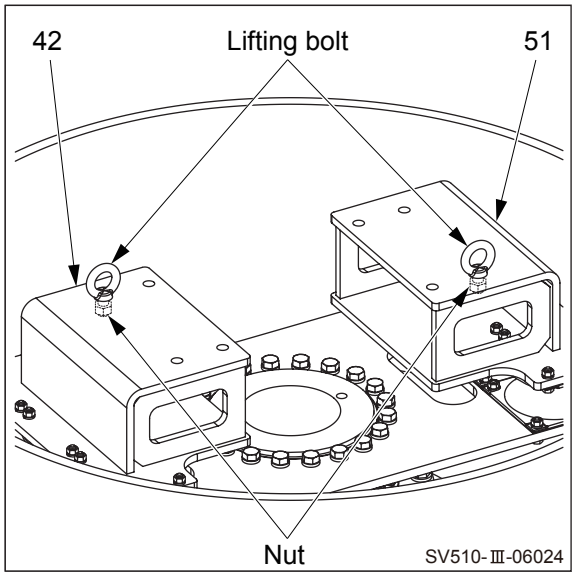
15) Remove two bolts (46).

- Remove propulsion motor (47).

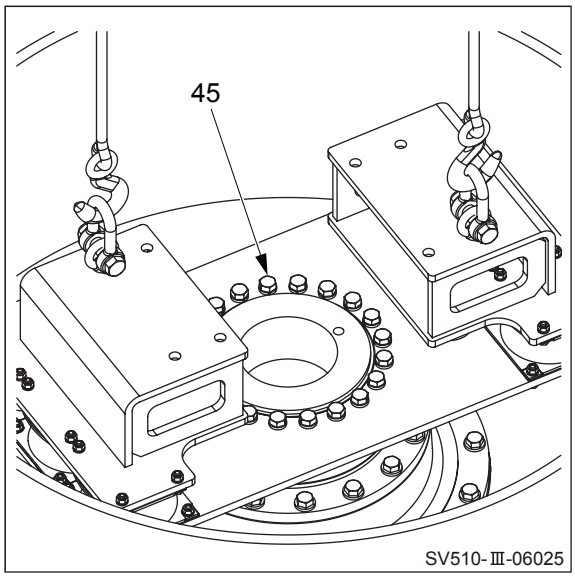
(47) Propulsion motor : 35 kg (77 lbs.)



16) Install lifting bolts and nuts (M20) to holders (42) and (51).

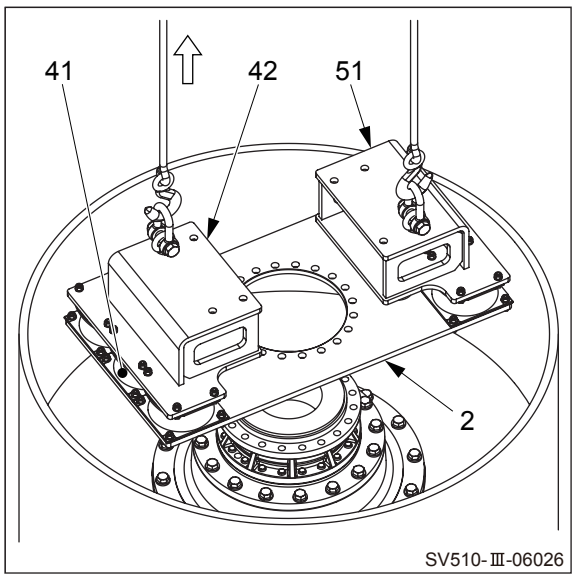


17) Remove twenty bolts (45).

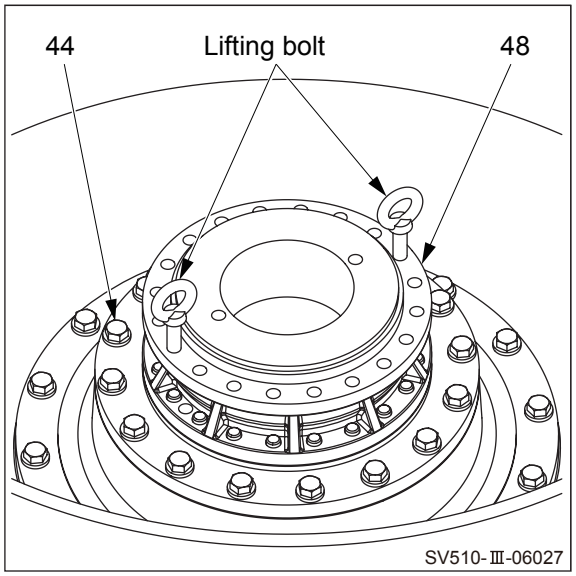


18) Lift holders (42), (51), dampers (41) and disc (2) together with a crane and remove them.

ℑkg Total weight of parts to be lifted : 230 kg (507 lbs.)

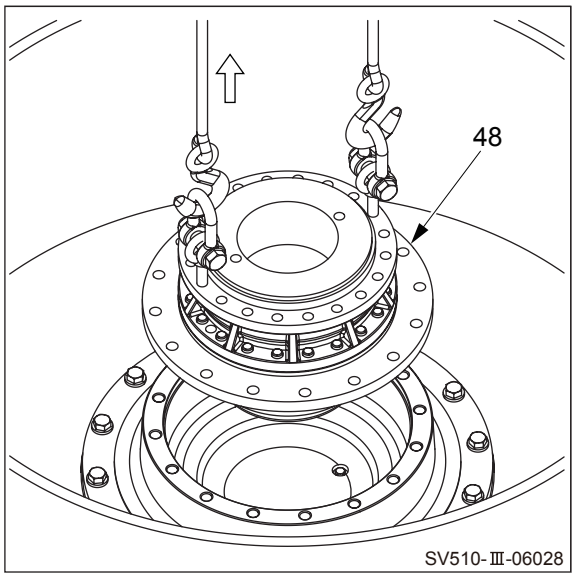


19) Install lifting bolts (M20, P=1.5) to gearbox (48).
- Remove sixteen bolts (44).

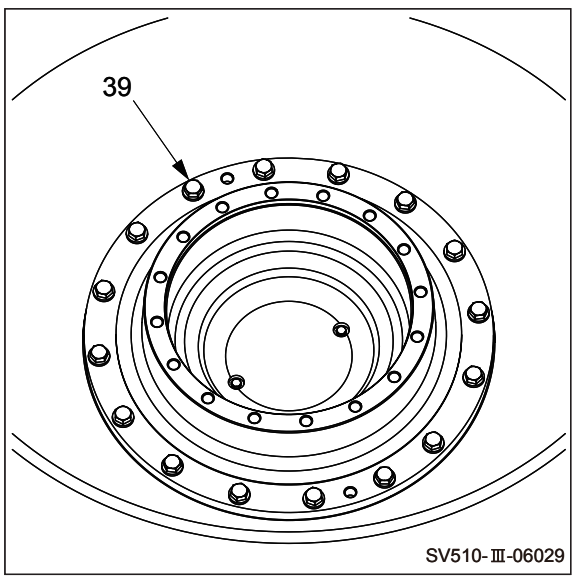


20) Lift gearbox subassembly (48) with a crane and remove it.

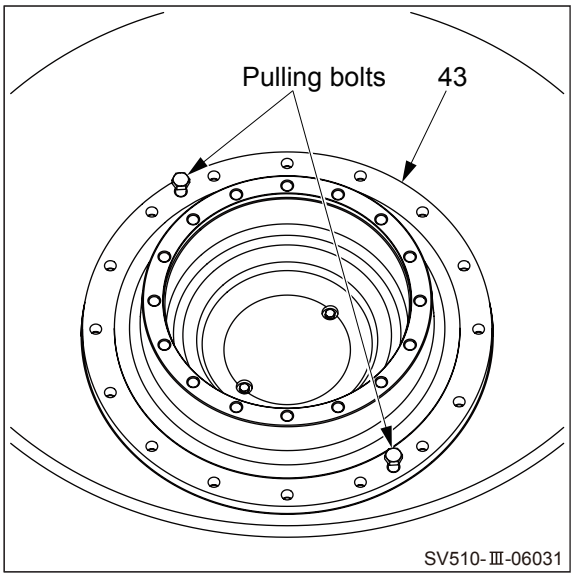
Total weight of parts to be lifted : 220 kg (485 lbs.)



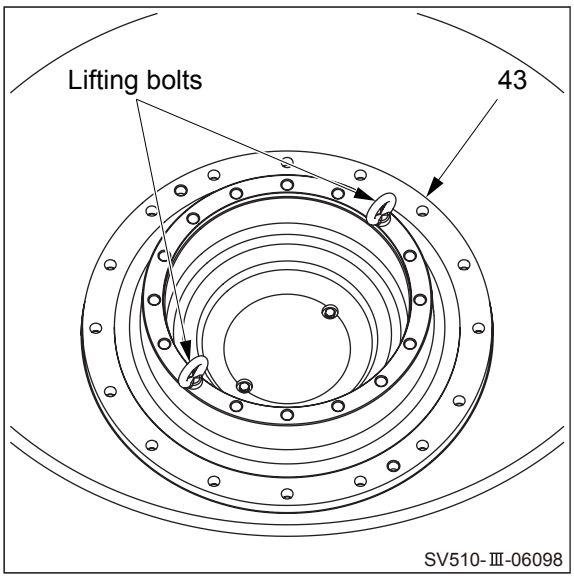
21) Remove sixteen bolts (39).



22) Lift axle shaft (43) using two pulling bolts (M20×60).

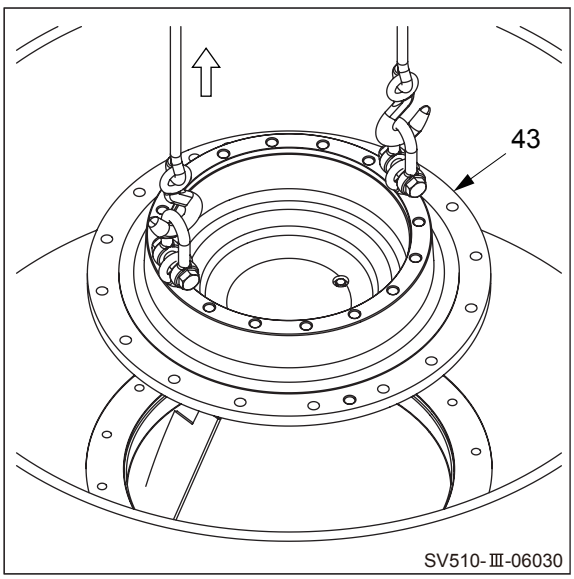


23) Install lifting bolts (M20) on axle shaft (43).

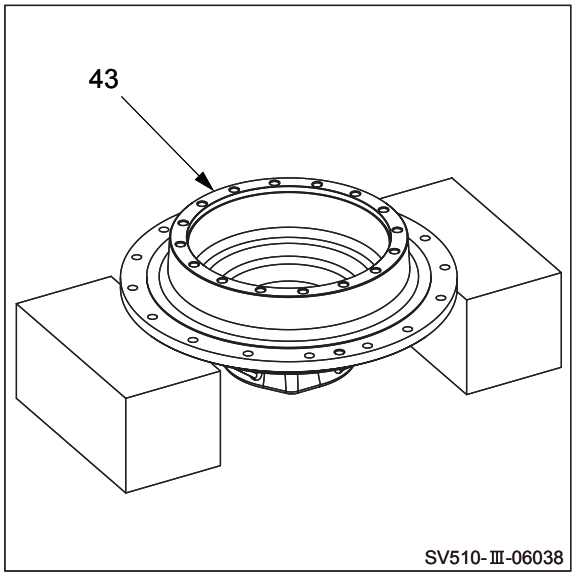


24) Lift axle shaft (43) with a crane and remove it.

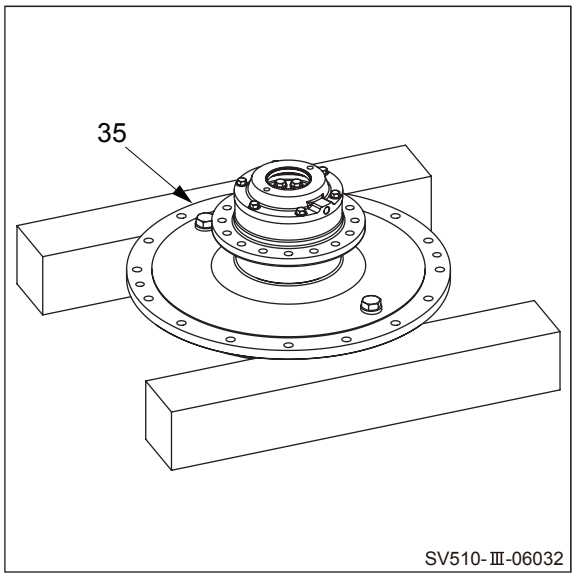
(43) Axle shaft : 235 kg (518 lbs.)



25) Put removed axle shaft (43) on wooden blocks.

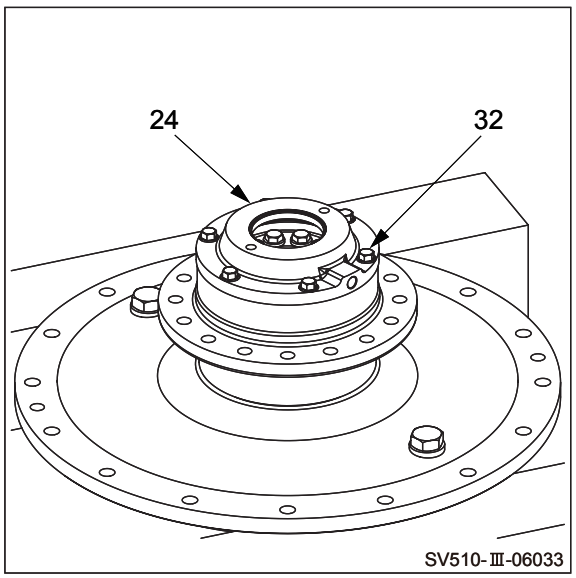


26) The right illustration shows axle shaft subassembly (35) removed from vibratory drum.

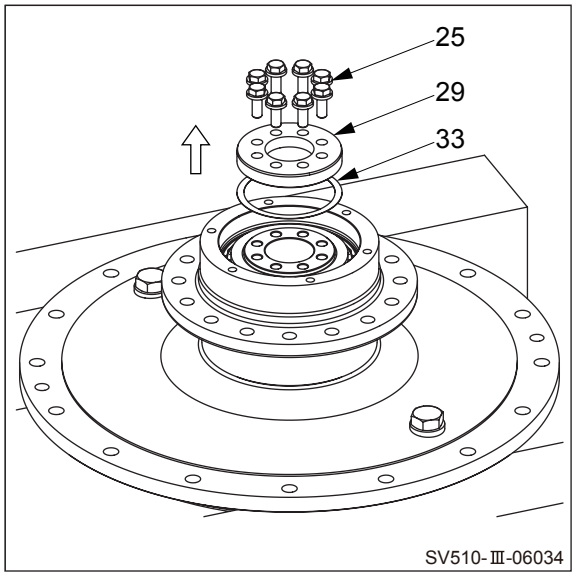


27) Remove six bolts (32).
- Remove cover (24).

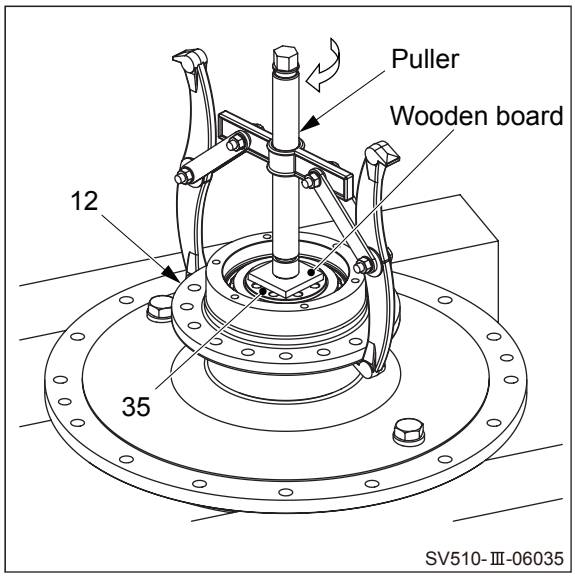
(24) Cover : 10 kg (22 lbs.)



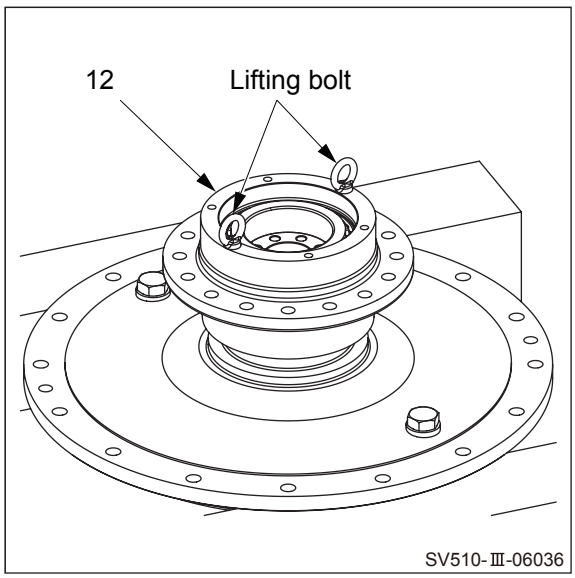
28) Remove eight bolts (25).
- Remove cover (29).
- Remove shim (33).



29) Put a piece of wooden board on the end of axle shaft (35) and set a puller on housing (12).
- Separate housing (12) together with roller bearing from axle shaft (35).

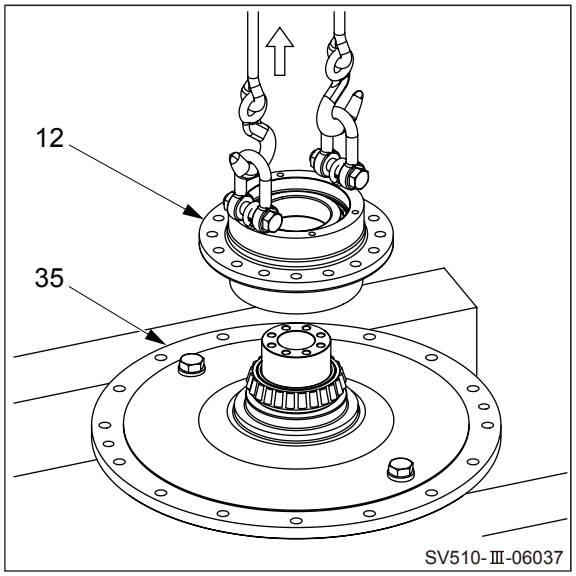


30) Install lifting bolts (M12) to housing (12).

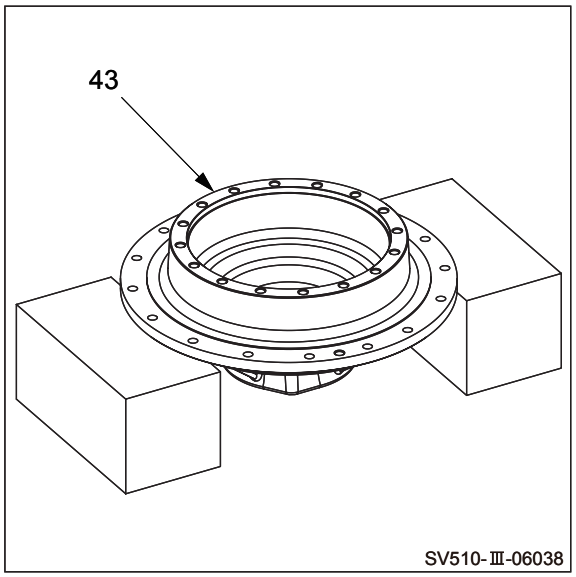


31) Lift housing subassembly (12) with a crane and separate it from axle shaft (35).

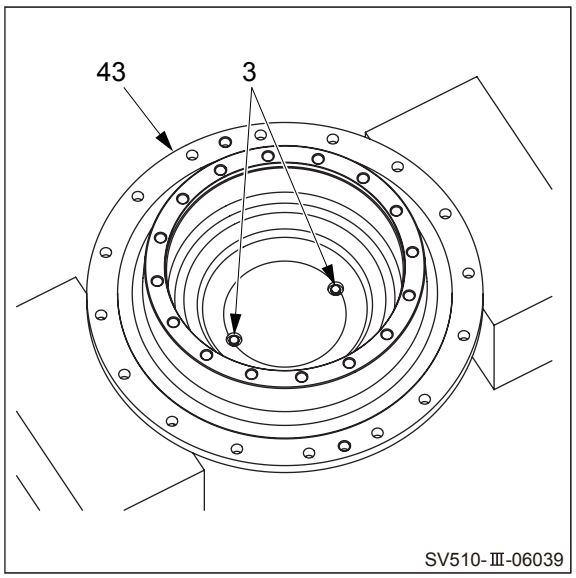
ⓚg (12) Housing subassembly : 45 kg (99 lbs.)



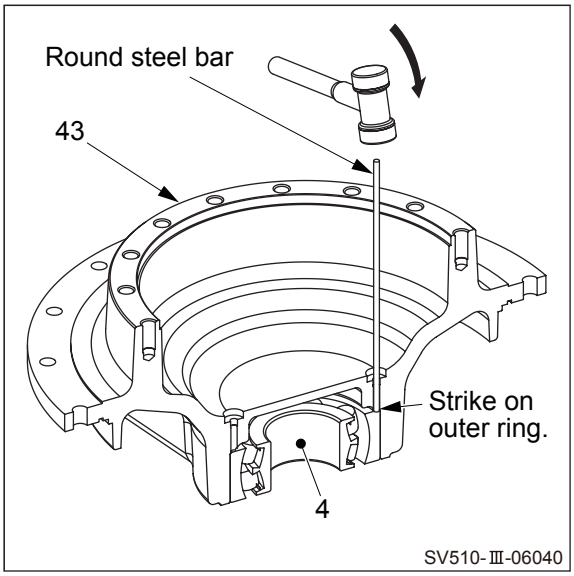
32) The right illustration shows axle shaft (43) removed from vibratory drum.



33) Remove bolts (3) from axle shaft (43).



34) Insert a round steel bar through bolt holes and alternately strike each side on outer race of vibrator bearing (4).
- Remove vibrator bearing (4) from axle shaft (43).



2-3-2. Reassembly of vibratory drum

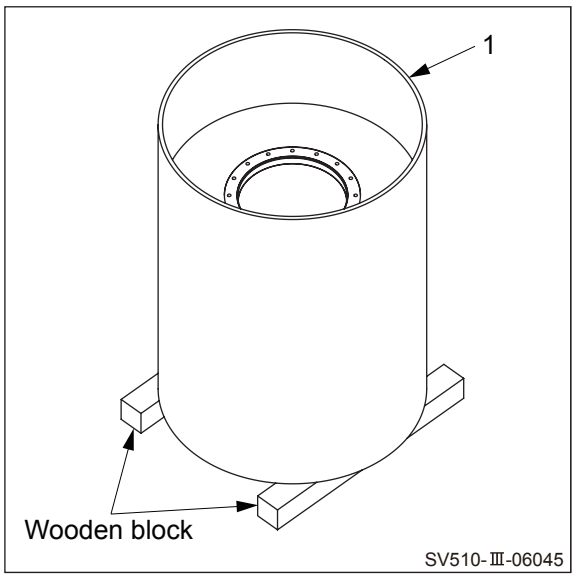
- Before reassembling, clean disassembled parts well and check that there is no abnormality.
- When removed bolts threaded with thread sealant, replace new bolts.

⚠WARNING

When standing the vibratory drum, use wooden blocks of sufficient strength to securely support the drum.

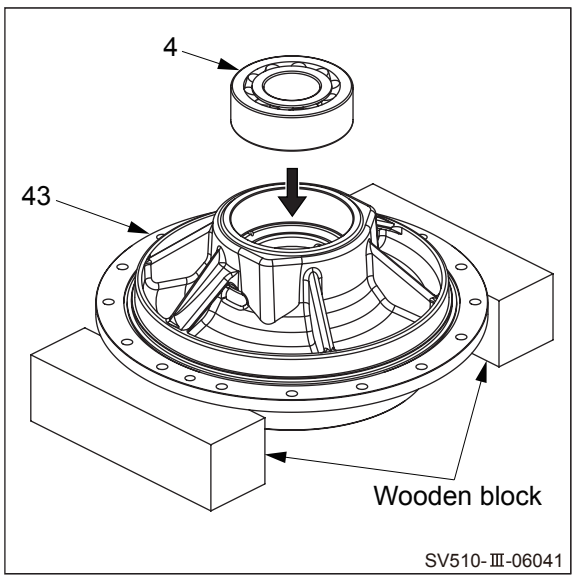
1) Lift vibratory drum (1) with a crane and put it in an upright position.

   ⅁kg (1) Vibratory drum
   SV510D-Ⅲ : 3,060 kg (6,746 lbs.)
   SV510T-Ⅲ : 3,385 kg (7,463 lbs.)
   SV510TF-Ⅲ : 5,755 kg (12,687 lbs.)

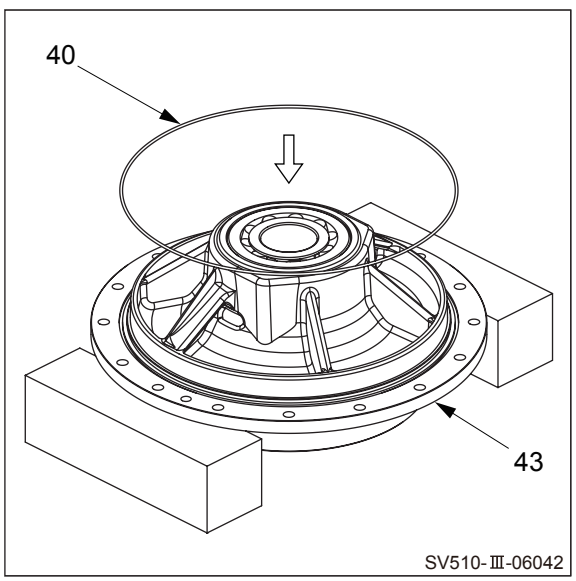


2) Apply a thin coat of gear oil to axle shaft (43) on its surface where vibrator bearing (4) will be press-fitted.
   - Drive in vibrator bearing (4).

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



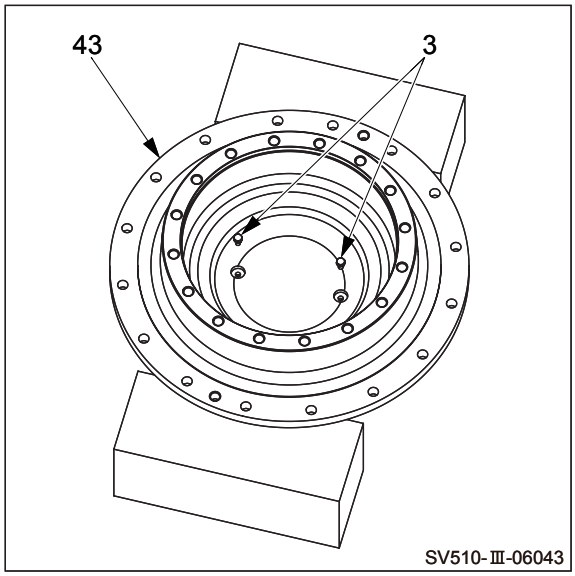
3) Apply grease to entire periphery of O-ring (40).
   - Install O-ring (40) on axle shaft subassembly (43).



4) Lift axle shaft (43) with a crane and reverse it.

(43) Axle shaft : 235 kg (518 lbs.)

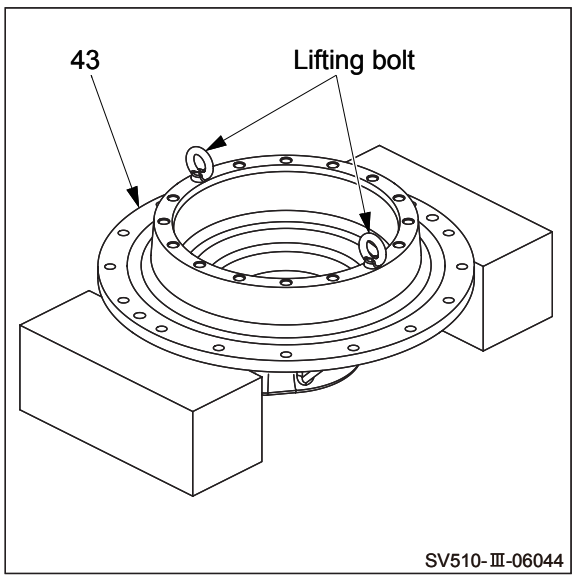
- Install two bolts (3) and seal washers.



WARNING

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

5) Install lifting bolts (M20) to axle shaft (43).

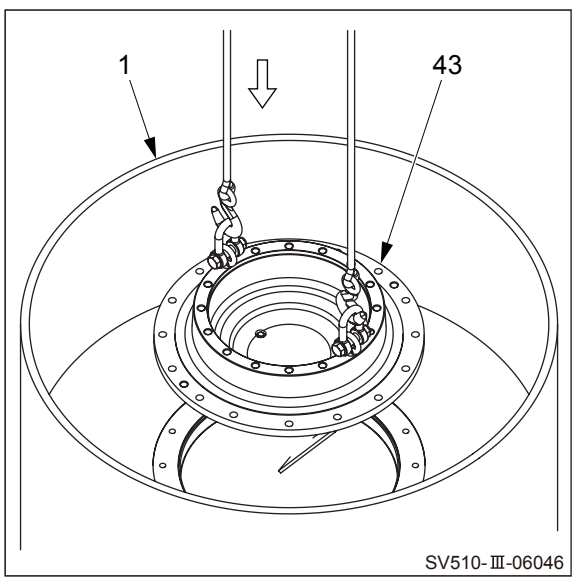


6) Lift axle shaft (43) with a crane and lower it on mounting surface of vibratory drum (1).

(43) Axle shaft : 235 kg (518 lbs.)

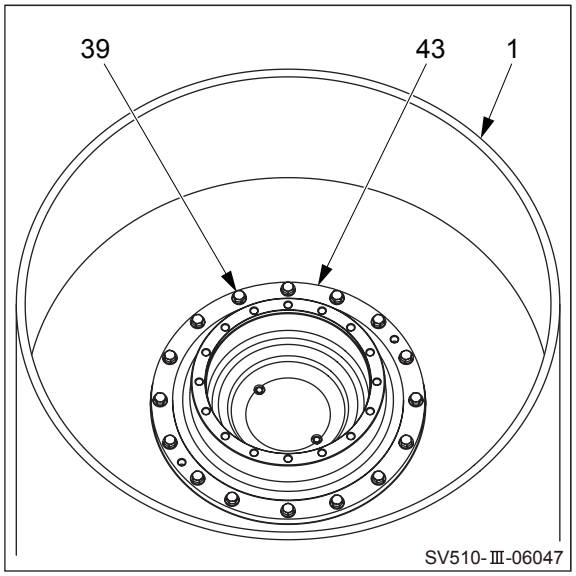
(NOTICE)

- **When installing axle shaft, take care not to allow the O-ring to protrude from the fitting groove.**



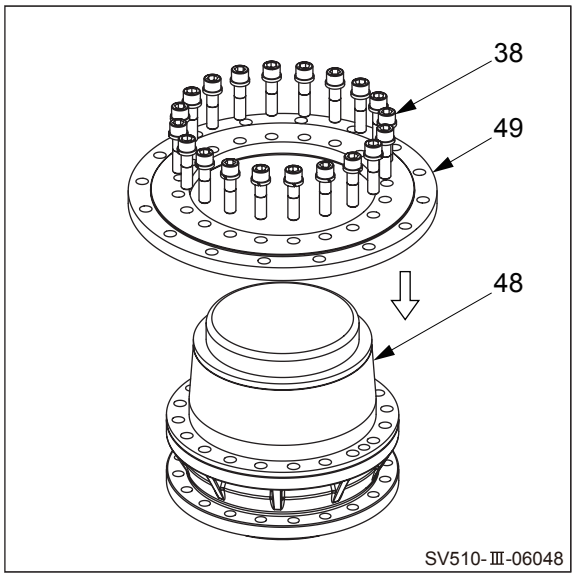
7) Secure axle shaft (43) to vibratory drum (1) with sixteen bolts (39) and washers.

N•m (39) Bolts M20×60 : 539 N·m (398 lbf·ft)



8) Secure ring (49) to gearbox (48) with twenty bolts (38) and spring washers.

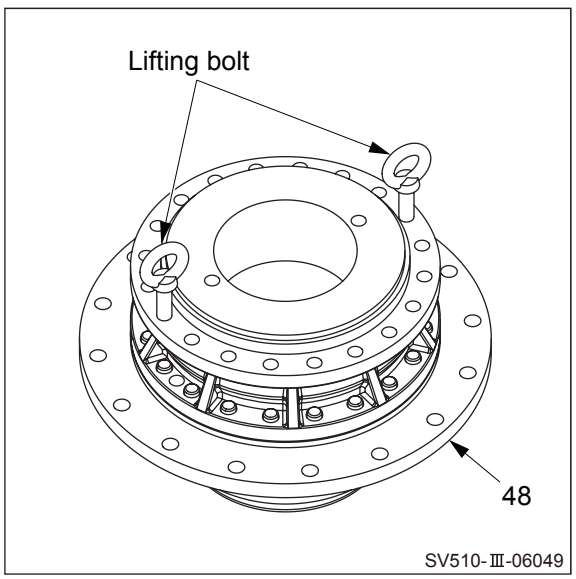
N•m (38) Bolts M20×80 P=1.5 : 588 N·m (434 lbf·ft)



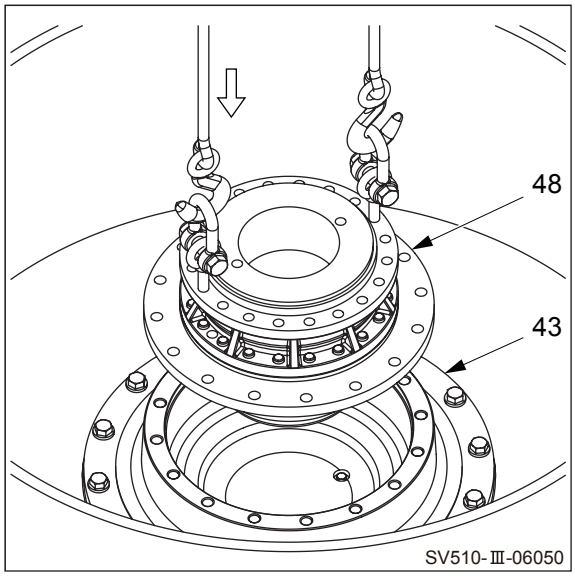
9) Lift gearbox subassembly (48) with a crane and reverse it.

kg (48) Gearbox subassembly : 220 kg (485 lbs.)

- Install lifting bolts (M20, P=1.5) to gearbox subassembly (48).

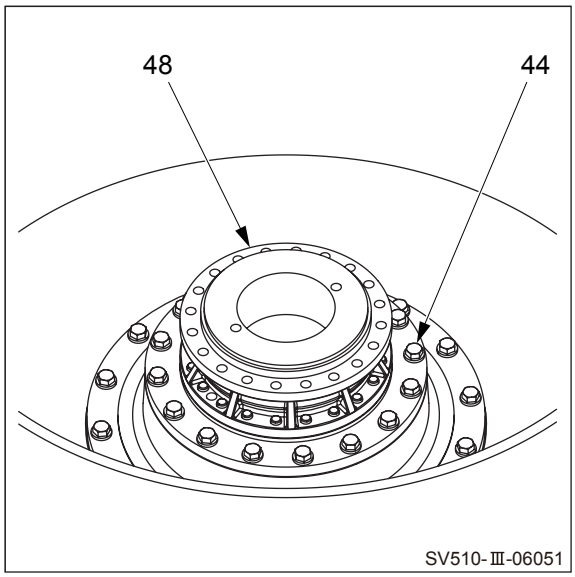


10) Lift gearbox subassembly (48) with a crane and lower it on the mounting surface of axle shaft (43).



11) Secure gearbox subassembly (48) with sixteen bolts (44) and washers.

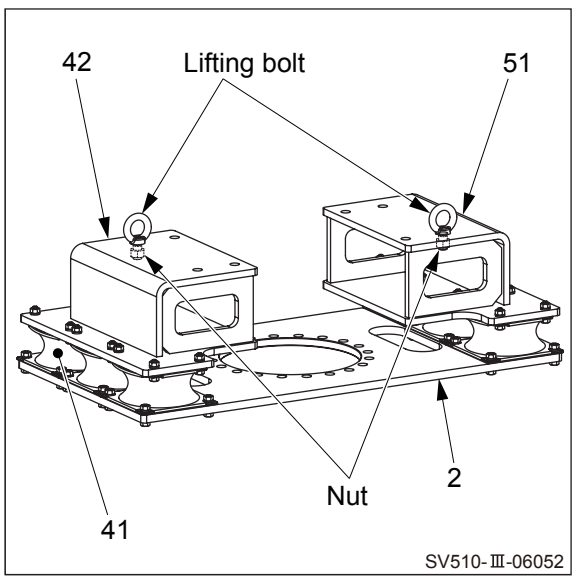
N•m (44) Bolts M20×70 : 539 N·m (398 lbf·ft)



⚠WARNING

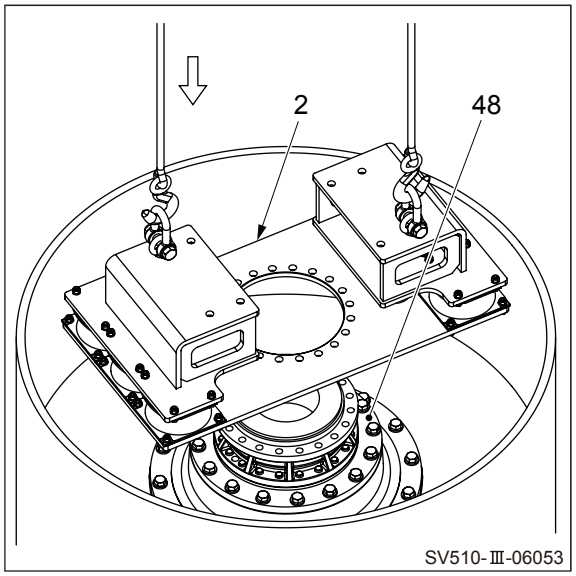
When installing lifting bolts, secure them with nuts.

12) Install lifting bolts and nuts (M20) on a subassembly of holders (42), (51), dampers (41) and disc (2) as shown on the right.



13) Lift disc subassembly (2) with a crane and lower it on mounting surface of gearbox (48).

(2) Disc subassembly : 230 kg (507 lbs.)

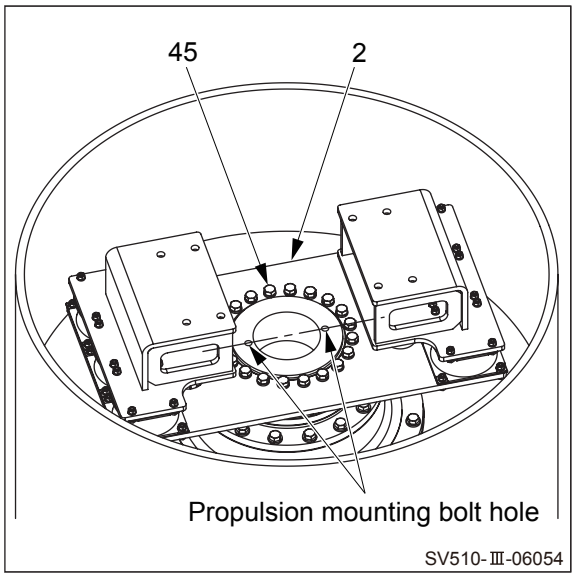


14) Secure disc subassembly (2) with twenty bolts (45) and spring washers.

(45) Bolts M20×50 P=1.5 : 588 N·m (434 lbf·ft)

(NOTICE)

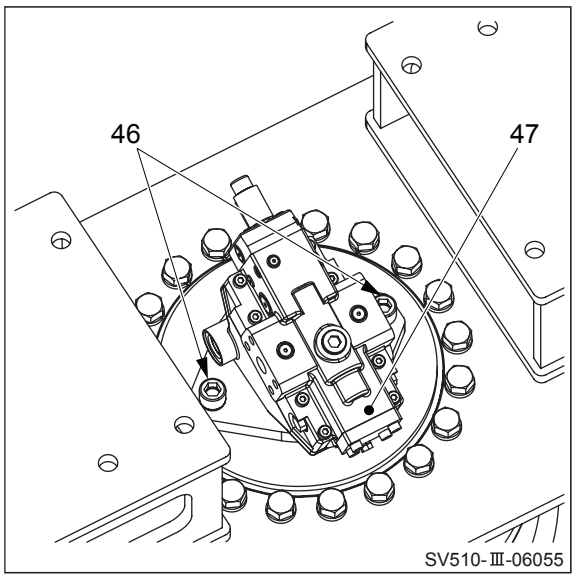
- **When installing the disc subassembly, the imaginary line passing through both propulsion motor mounting bolt hole centers must be parallel to the longer edge of the disc.**



15) Secure propulsion motor (47) with two bolts (46) and washers.

(47) Propulsion motor : 35 kg (77 lbs.)

(46) Bolts M20×40 P=1.5 : 588 N·m (434 lbf·ft)

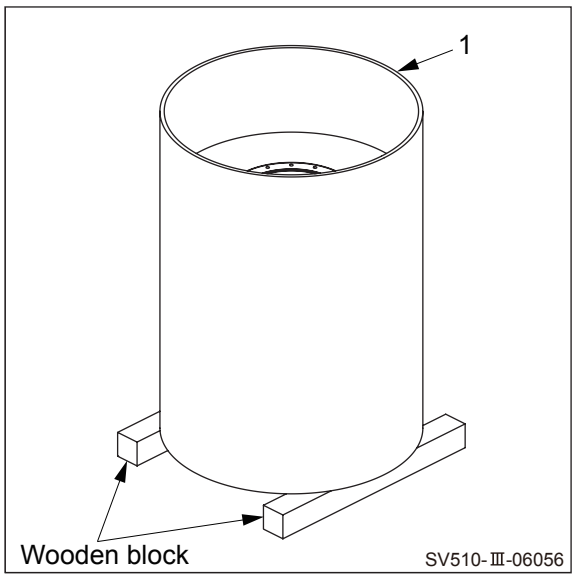


⚠WARNING

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

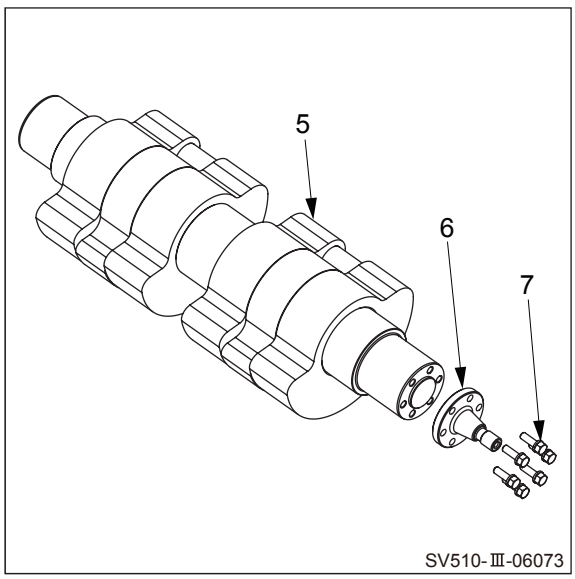
16) Lift vibratory drum subassembly (1) with a crane and reverse it. Then, stand drum with its propulsion motor side facing down.

(1) Vibratory drum
SV510D-Ⅲ : 3,790 kg (8,355 lbs.)
SV510T-Ⅲ : 4,120 kg (9,083 lbs.)
SV510TF-Ⅲ : 6,255 kg (13,790 lbs.)

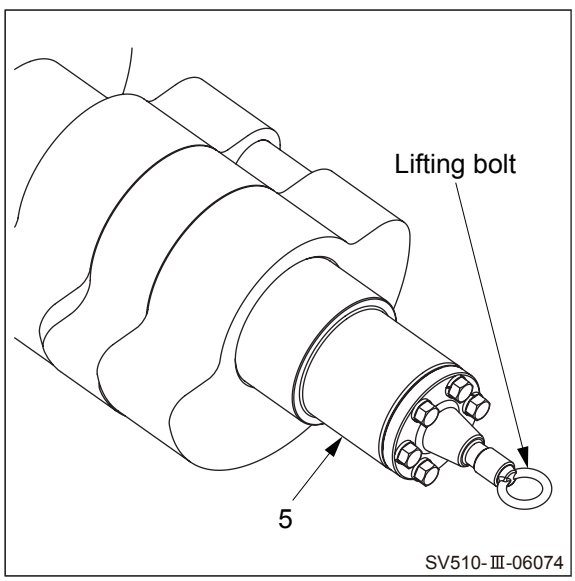


17) Secure shaft (6) to eccentric shaft (5) with six bolts (7) and spring washers.

(7) Bolts M12×40 : 108 N·m (80 lbf·ft)



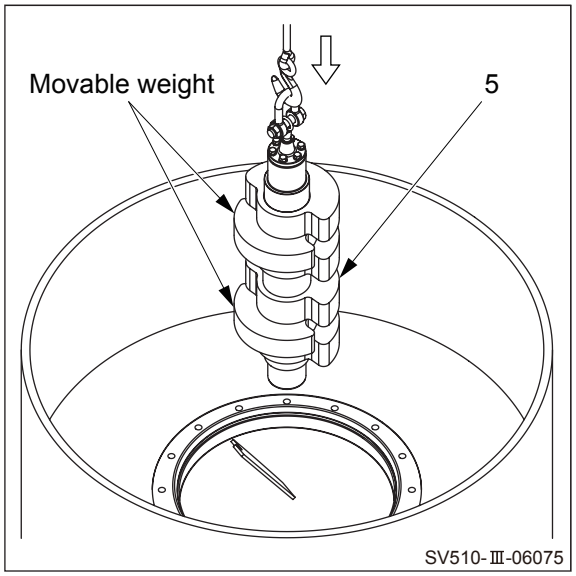
18) Install a lifting bolt (M10) to the end of eccentric shaft subassembly (5).



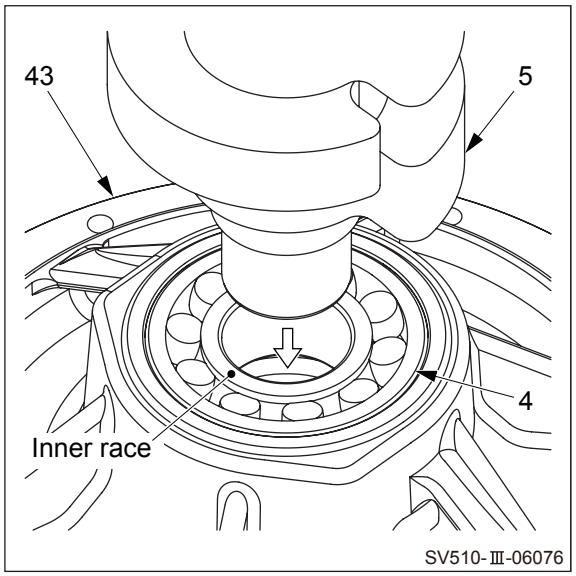
19) Apply a coat of gear oil to eccentric shaft subassembly (5) at where bearing will be installed.
- Lift eccentric shaft subassembly (5) with a crane and install it on vibratory drum slowly.

$\mathfrak{Z}_{kg}$ (5) Eccentric shaft subassembly : 260 kg (573 lbs.)

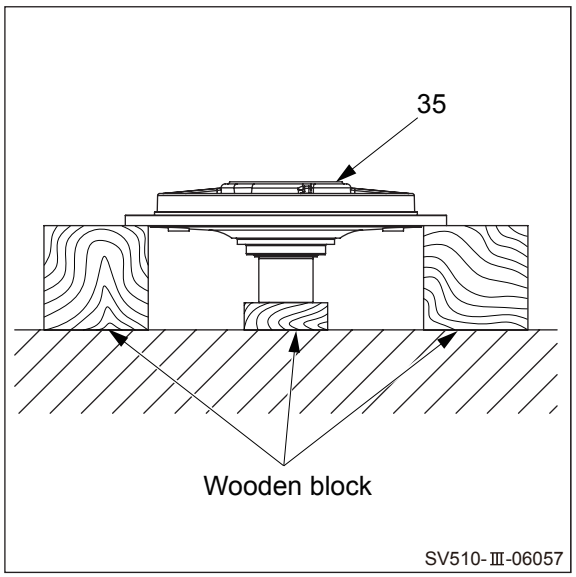
(NOTICE)
- **When lifting the eccentric shaft, put the movable weights at their outmost position.**



20) Insert eccentric shaft subassembly (5) into vibrator bearing (4) while taking care not to tilt vibrator bearing inner race installed on axle shaft (43).

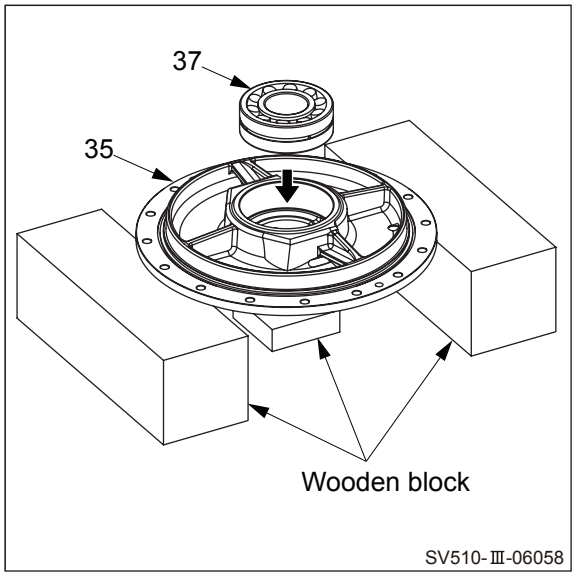


21) Reassembly of axle shaft subassembly (35)
21-1) Fix axle shaft (35) with wooden blocks.



21-2) Apply a thin coat of gear oil to axle shaft (35) on its surface where vibrator bearing (37) will be press-fitted.
- Drive in vibrator bearing (37).

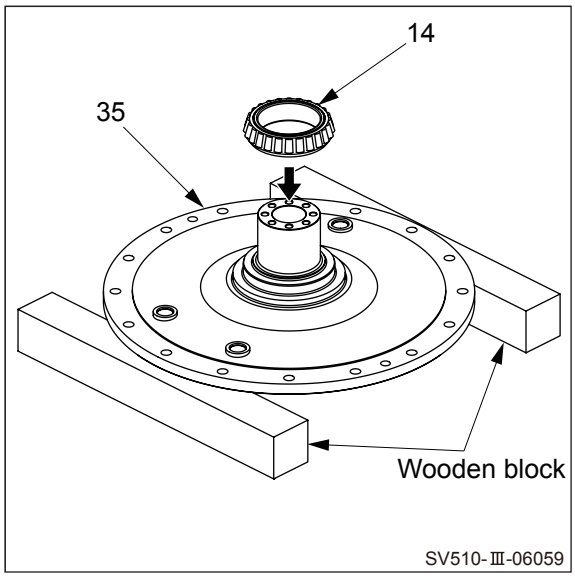
(NOTICE)
- **Take care not to damage the bearing when installing it.**



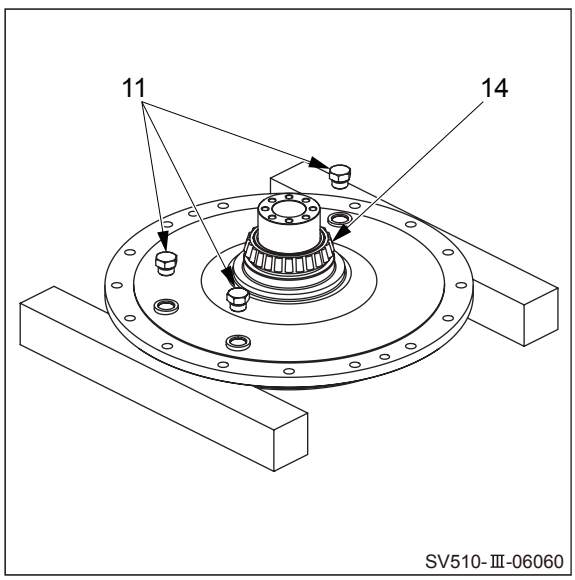
21-3) Lift axle shaft (35) with a crane and reverse it.

(35) Axle shaft : 180 kg (397 lbs.)

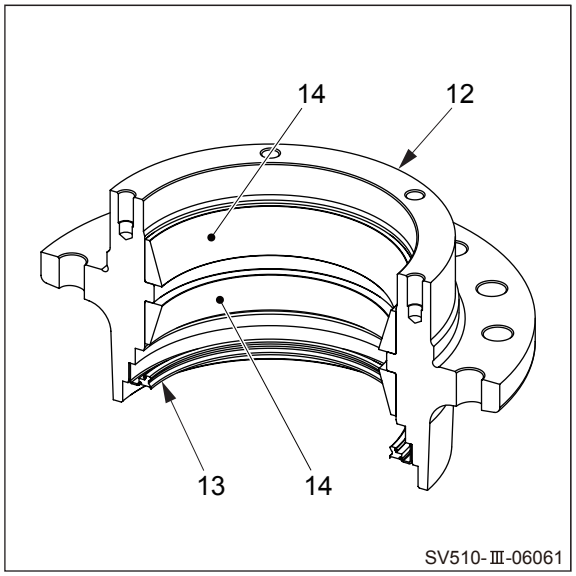
- Apply a thin coat of gear oil to roller bearing (14) inner race on its surface to be press-fitted.
- Press fit roller bearing (14) inner race.



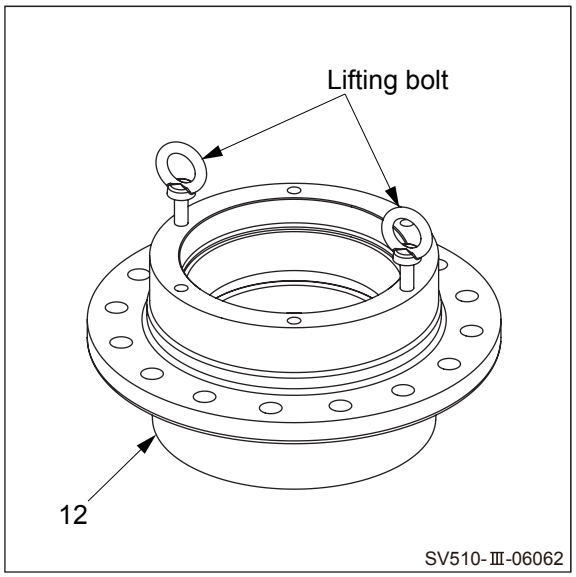
21-4) Apply grease to O-rings for plugs (11).
- Install three plugs (11).
- Apply sufficient amount of lithium-based grease to rollers of roller bearing (14) inner race.



21-5) Apply a thin coat of gear oil to roller bearing (14) outer race on its surface to be press-fitted.
- Drive outer race of roller bearing (14) into housing (12).
- Install oil seal (13).
- Apply a thin coat of grease to lip of oil seal (13).

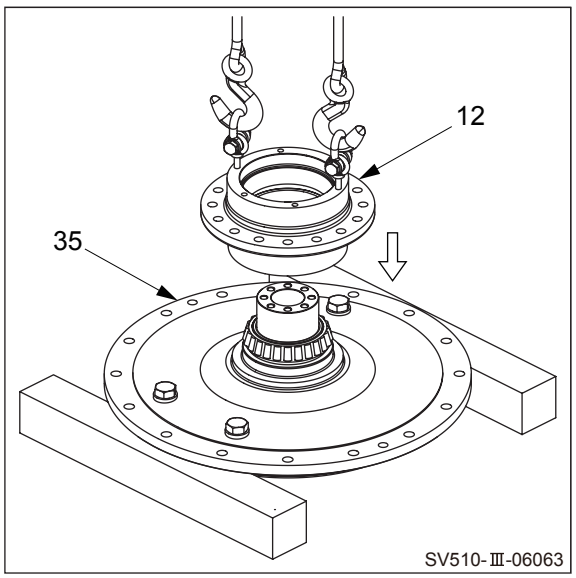


21-6) Install lifting bolts (M12) to housing subassembly (12).

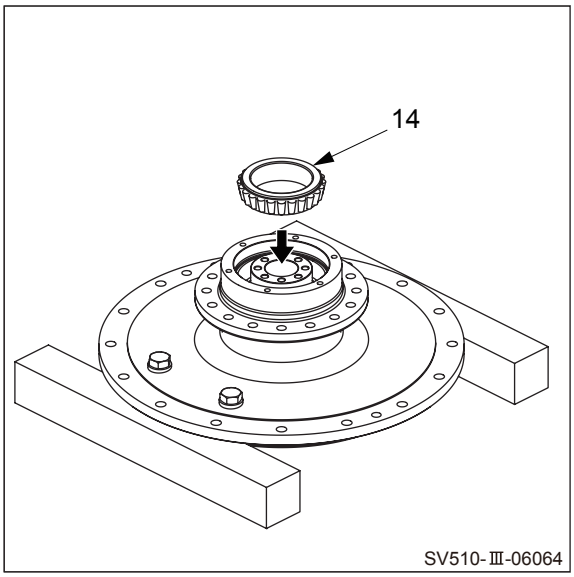


21-7) Lift housing subassembly (12) with a crane and install it on axle shaft subassembly (35).

(12) Housing subassembly : 40 kg (88 lbs.)

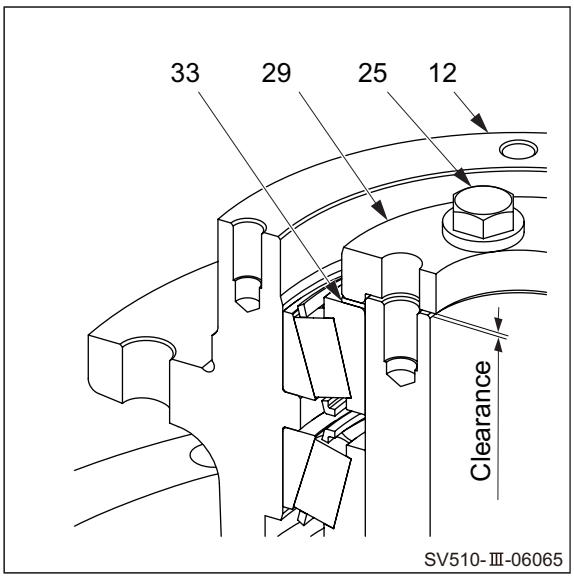


21-8) Apply sufficient amount of lithium-based grease to rollers of roller bearing (14) inner race.
- Drive in roller bearing (14) inner race until rollers come in contact with outer race.



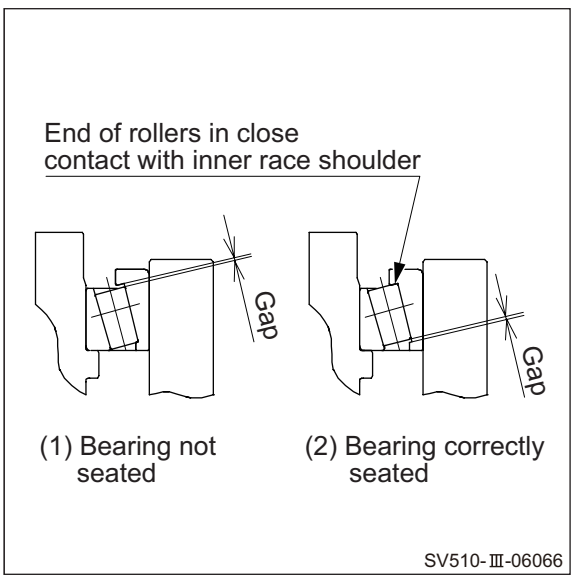
21-9) Preload adjustment of roller bearing

① Install a shim (33) of about 1 mm (0.08 in.) on axle shaft and install cover (29). The shim provides a clearance between end face of axle shaft and inner surface of cover (29).
- Tighten four bolts (25) with washers to a torque of 108 N·m (80 lbf·ft).
- Give housing (12) two to three turns and tighten bolts to a torque of 108 N·m (80 lbf·ft) again.
- Repeat this work several times until tightening torque of bolts no longer fluctuates.

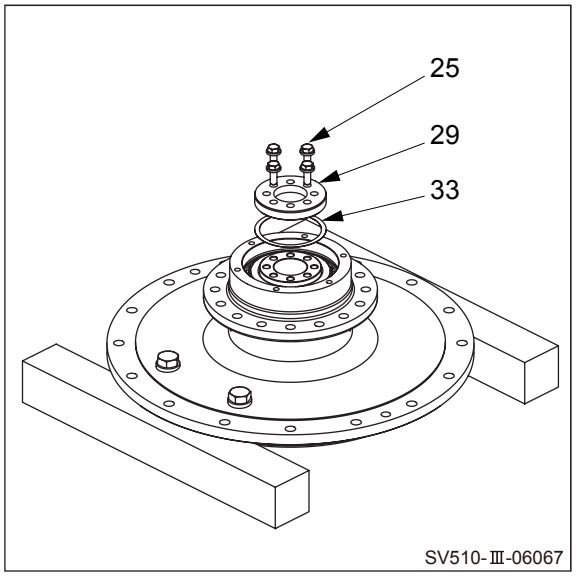


(NOTICE)
- **Tighten four of the eight bolts (25) alternately in the diagonal directions.**

(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.**

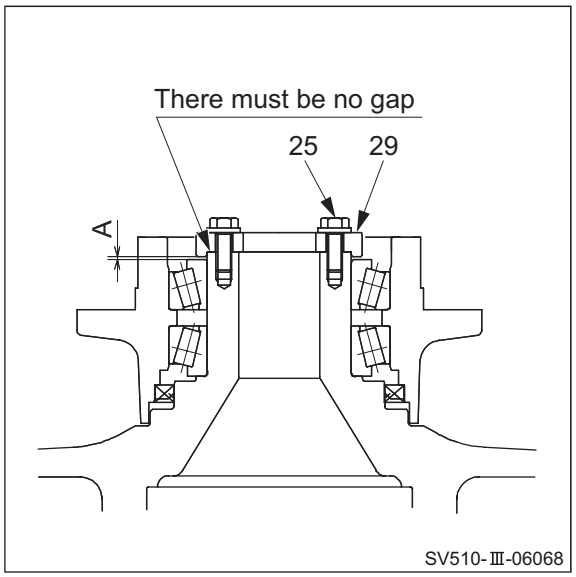


② Remove four bolts (25).
- Remove cover (29).
- Remove shim (33).



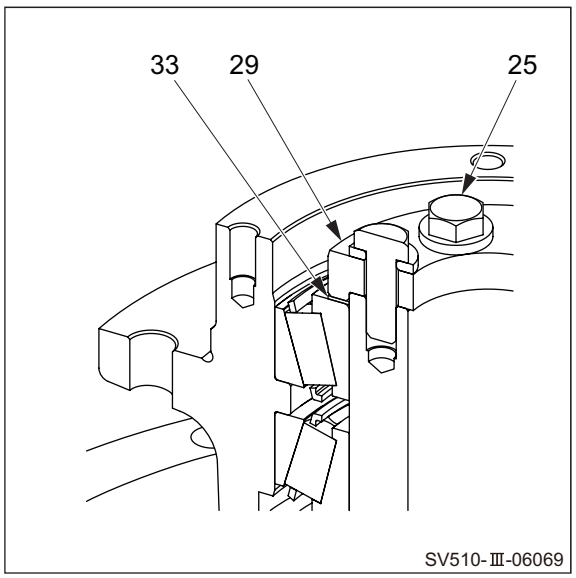
③ Without inserting shim, install cover (29).
- Install washers to four bolts (25) and tighten.
- Using a thickness gauge, measure the gap at dimension “A”.

★ **Preload adjusting shim thickness** **= A + 0.1 mm (0.04 in.)**

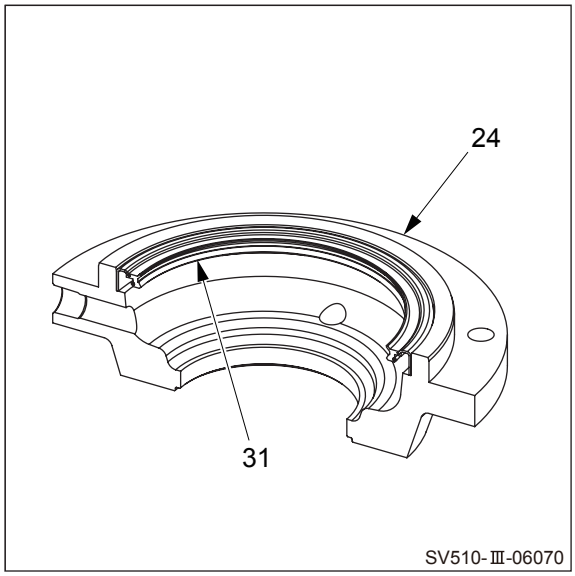


④ Remove four bolts (25).
- Remove cover (29).
- Install a shim of preload adjusting shim (33) thickness “A + 0.1 mm” and reinstall cover (29). Then, secure cover with eight bolts (25) and washers.

N•m (25) Bolts M14×40 : 170 N·m (125 lbf·ft)

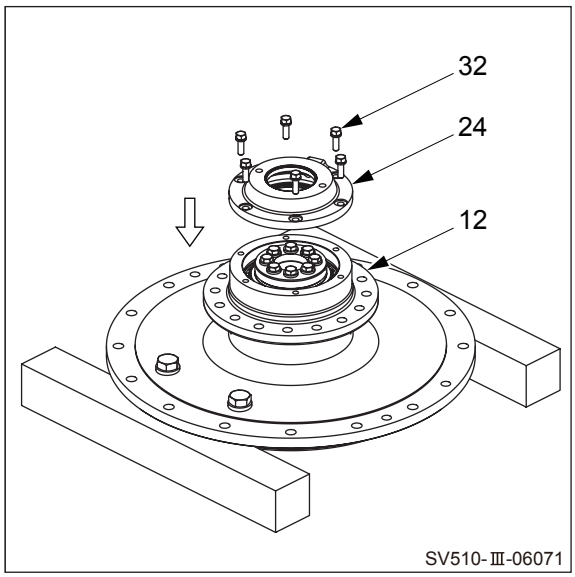


⑤ Install oil seal (31) on cover (24).
- Apply a thin coat of grease to lip of oil seal (31).
- Apply liquid packing to mounting surface.

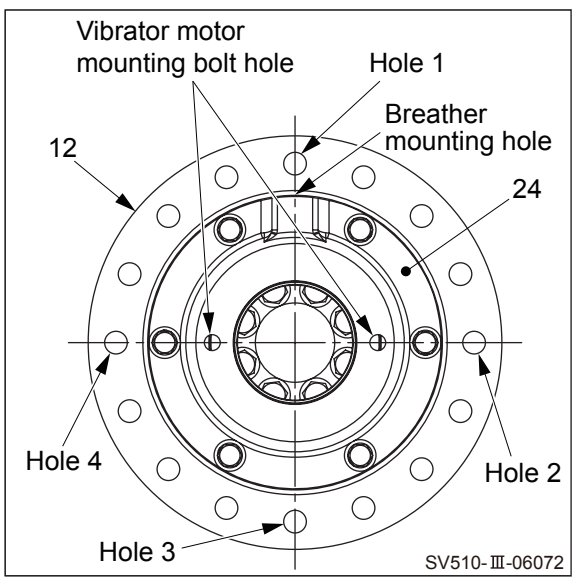


⑥ Secure cover (24) to housing subassembly (12) with six bolts (32) and spring washers.

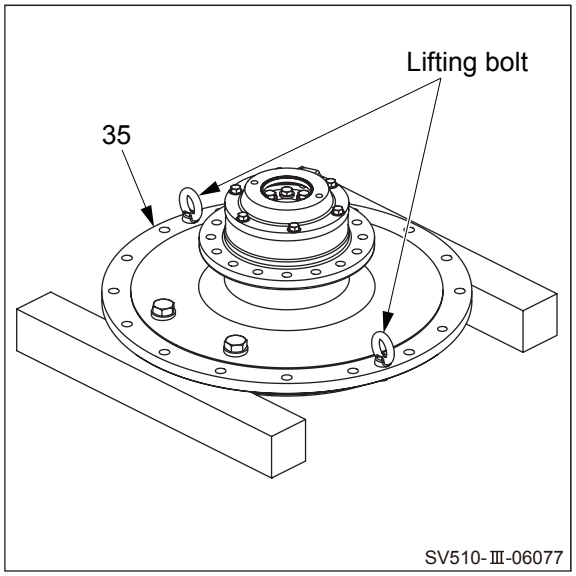
N•m (32) Bolts M12×40 : 108 N·m (80 lbf·ft)



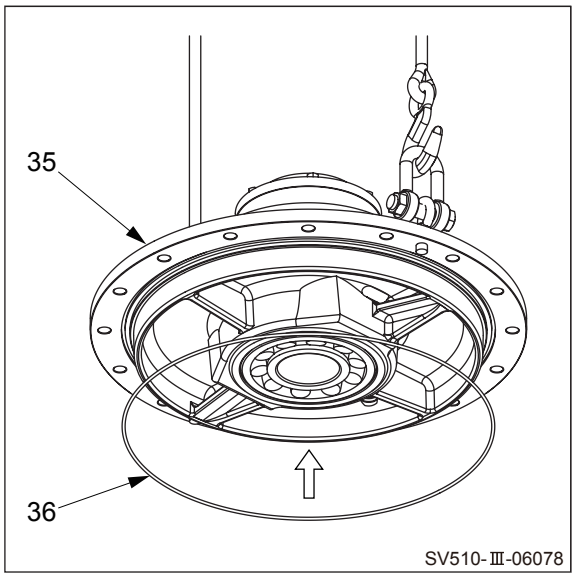
(NOTICE)
- **The four holes in housing (12), breather mounting hole in cover (24), and vibrator motor mounting bolt holes must be arranged as shown on the right.**



22) Install lifting bolts (M20) to axle shaft subassembly (35).



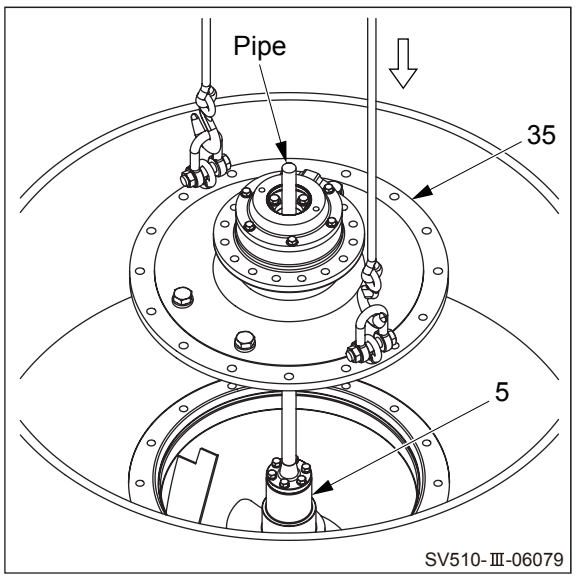
23) Apply grease to entire periphery of O-ring (36).
- Install O-ring (36) on axle shaft subassembly (35).



24) Lift axle shaft subassembly (35) with a crane and lower it slowly.
- Supporting eccentric shaft subassembly (5) with a pipe or the like, align center of vibrator bearing inner race to that of shaft.

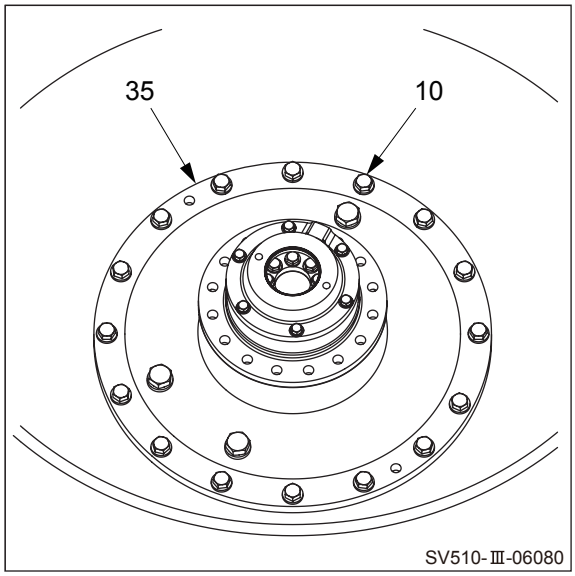
$\mathfrak{Z}_{kg}$ (35) Axle shaft subassembly : 240 kg (529 lbs.)

(NOTICE)
- **Install the axle shaft taking care not to tilt the vibrator bearing.**
- **When installing the axle shaft, take care not to allow the O-ring to protrude from the fitting groove.**

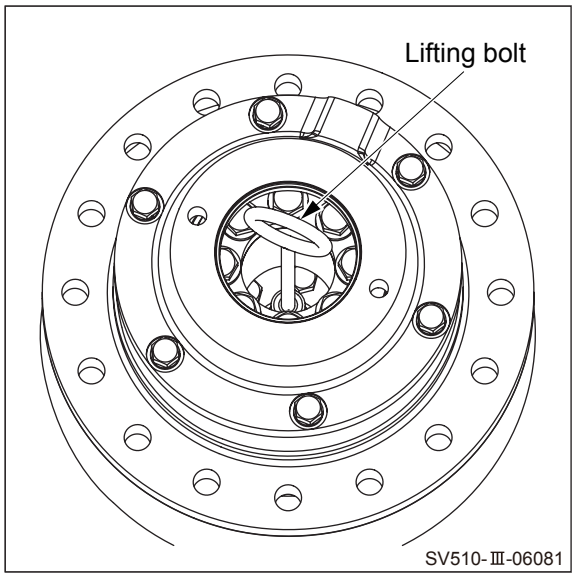


25) Secure axle shaft subassembly (35) to drum with sixteen bolts (10).

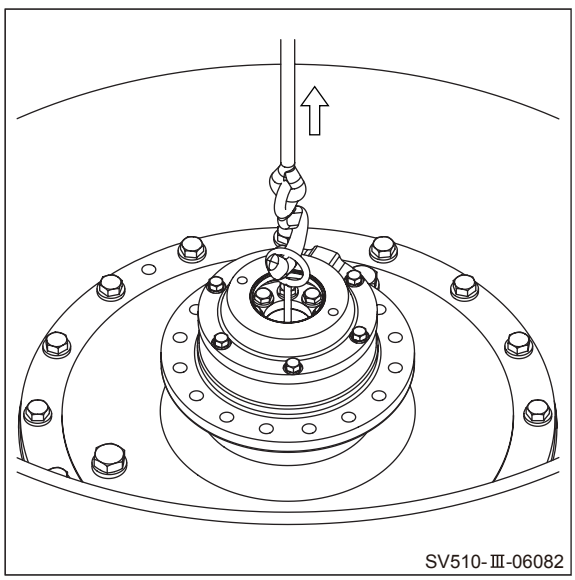
N•m (10) Bolts M20×60 : 539 N·m (398 lbf·ft)



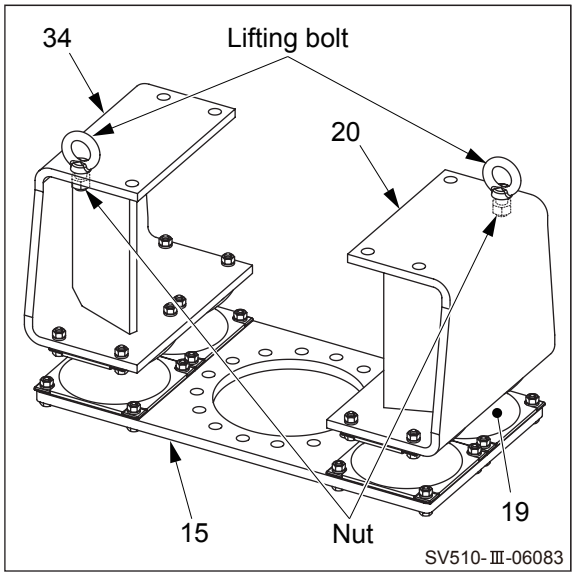
26) Install a lifting bolt (M8) on shaft end of eccentric shaft (5).



27) 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.).

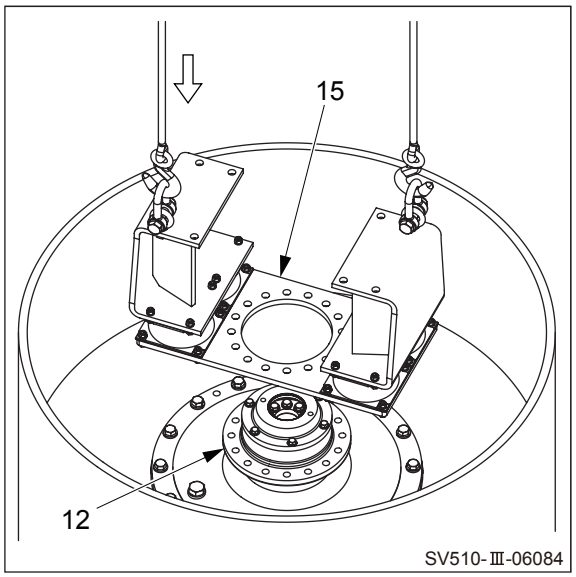


28) Install lifting bolts and nuts (M20) on a subassembly of holders (20), (34), dampers (19) and disc (15) as shown on the right.



29) Lift disc subassembly (15) with a crane and lower it on mounting surface of housing (12).

(15) Disc subassembly : 150 kg (331 lbs.)

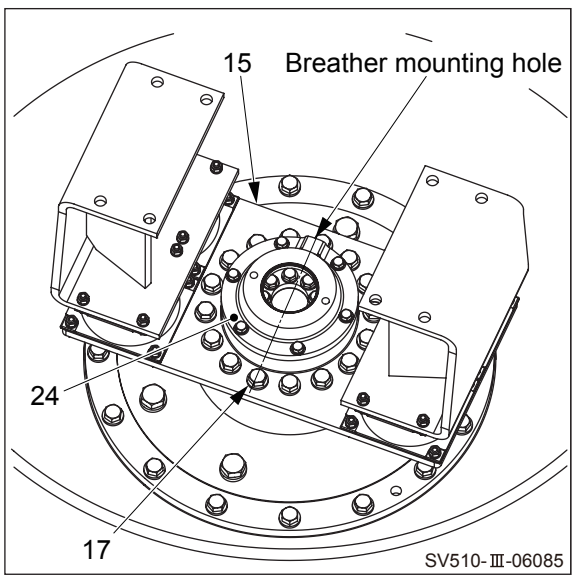


30) Secure disc subassembly (15) with sixteen bolts (17) and washers.

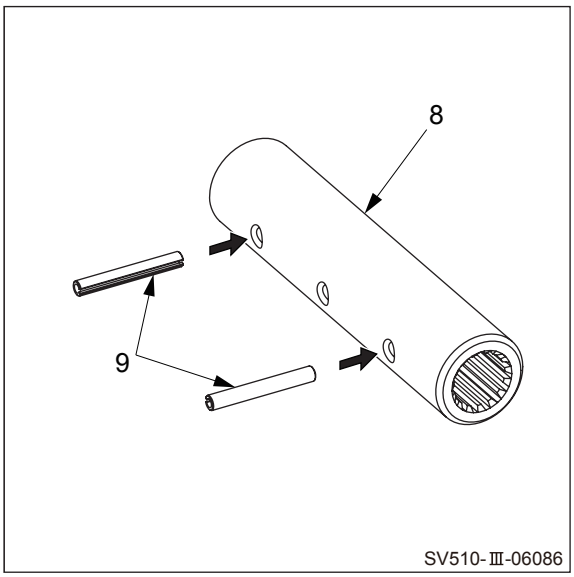
(17) Bolts M20×60 : 539 N·m (398 lbf·ft)

(NOTICE)

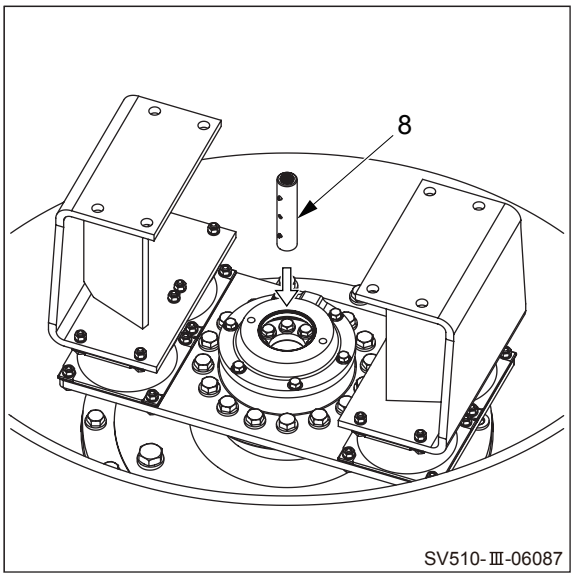
- **When installing the disc subassembly, the breather mounting hole in cover (24) must be perpendicular to the longer edge of the disc.**



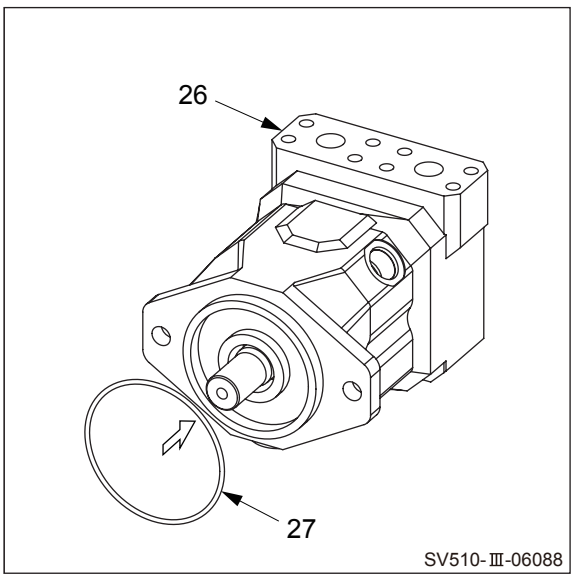
31) Drive two spring pins (9) into sleeve (8).



32) Apply molybdenum-based grease to splined portion of sleeve (8).
- Fit sleeve (8) to splined shaft on eccentric shaft end.



33) Apply grease to O-ring (27).
- Install O-ring (27) to vibrator motor (26).



34) Secure vibrator motor (26) to cover (24) with two new thread sealant bolts (28) and washers.

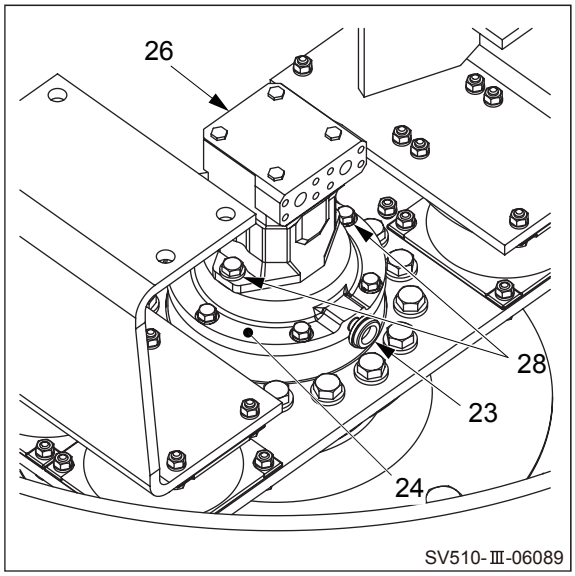
(26) Vibrator motor : 20 kg (44 lbs.)

(28) Bolts M14×40 : 170 N·m (80 lbf·ft)

- Wind seal tape around the threaded portion of breather (23).
- Install breather (23).

(NOTICE)

- **When installing the vibrator motor, take care not to allow the O-ring to protrude from the fitting groove.**



35) Lift vibratory drum assembly with a crane and lay it with plugs positioned as shown on the right.

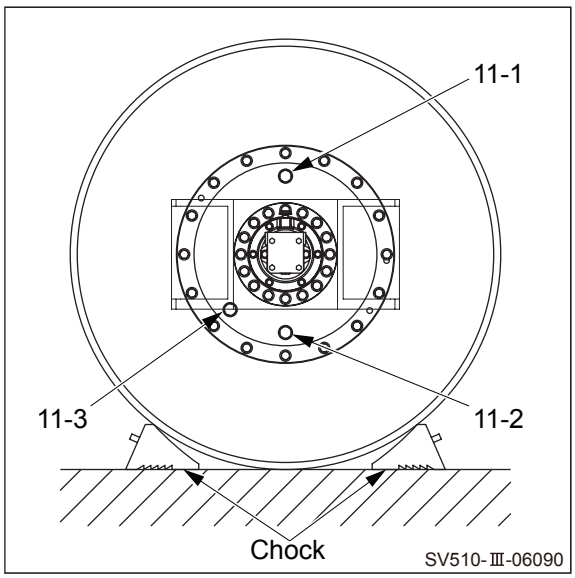
- Hold with chocks.

Vibratory drum assembly

SV510D-Ⅲ : 4,470 kg (9,855 lbs.)
SV510T-Ⅲ : 4,810 kg (10,604 lbs.)
SV510TF-Ⅲ : 7,180 kg (15,829 lbs.)

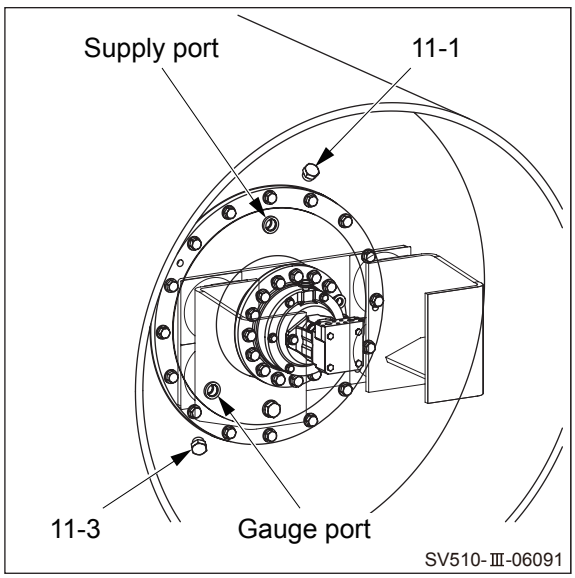
(NOTICE)

- **Make sure that the drum is placed on level ground.**



36) Remove plugs (11-1) and (11-3).

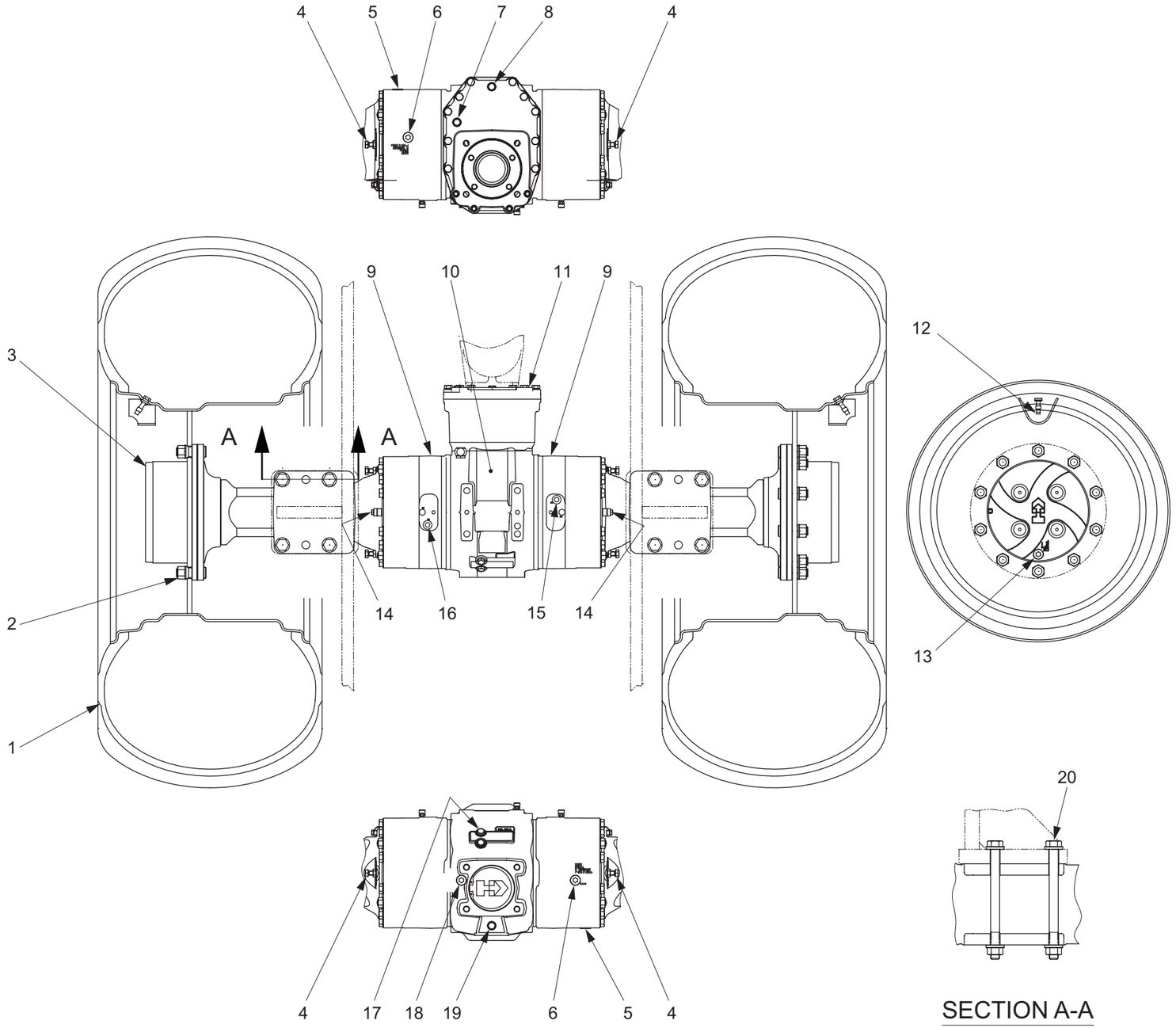
- Supply gear oil from oil supply port.
- Check that oil drips from gauge port.
  - Quantity of gear oil : 34 L (9.0 gal.)
- Reinstall plugs (11-1) and (11-3).



3. REAR AXLE

3-1. Rear Axle Assembly

3-1-1. Rear axle assembly (type 1)



SECTION A-A

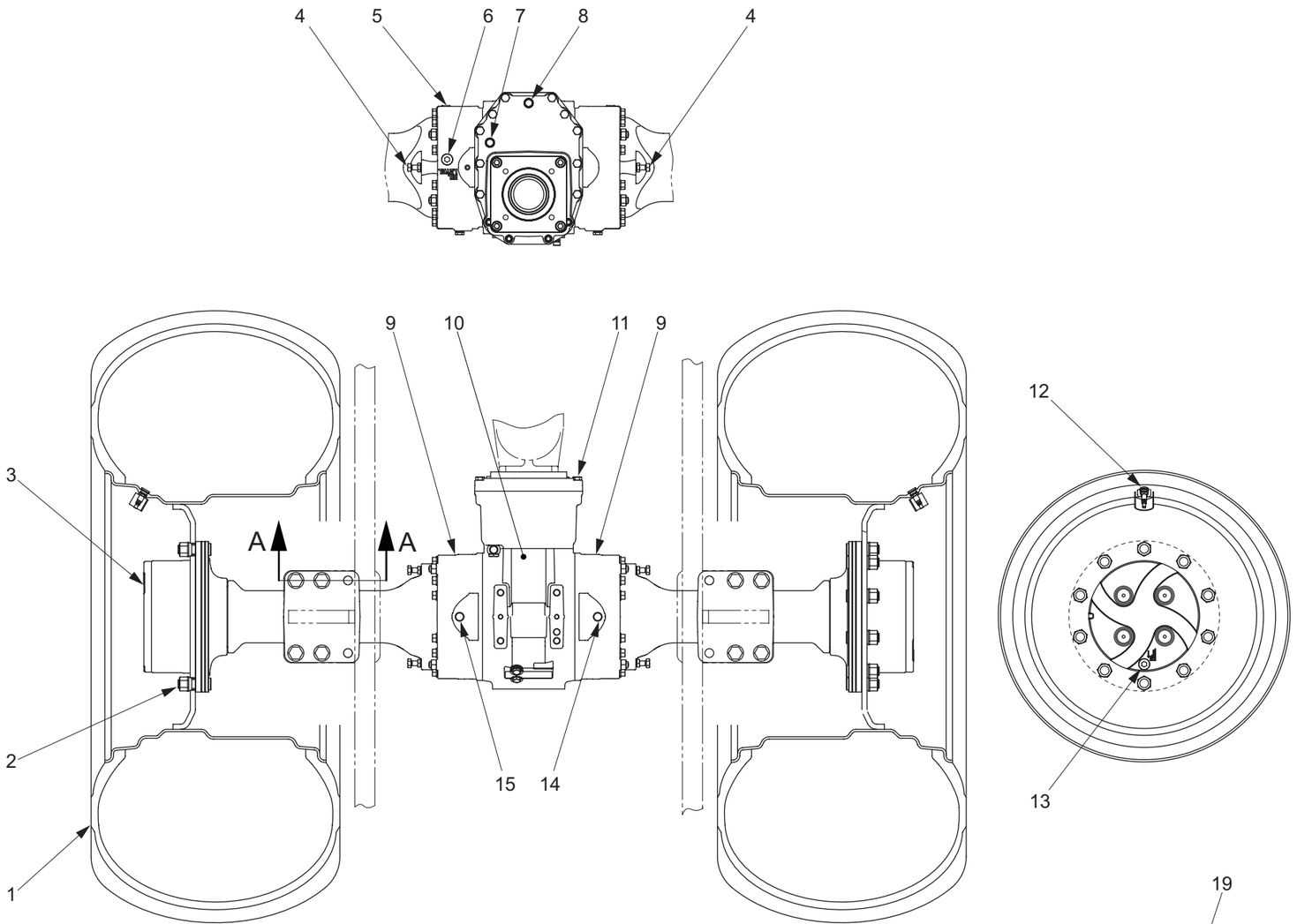
(1) Tire
(2) Nut : M22 P=1.5
(3) Hub reduction gear
(4) Bolt (brake release)
(5) Plug (brake drain)
(6) Plug (brake filler and level gauge)
(7) Plug (gearbox filler and level gauge)
(8) Plug (gearbox drain)
(9) Brake
(10) Differential
(11) Gearbox
(12) Valve
(13) Plug (hub reduction gear filler, level gauge and drain)
(14) Bolt (brake adjustment)
(15) Parking brake release port **[RBL]** : G1/4
(16) Parking brake release port **[RBR]** : G1/4
(17) Plug (differential filler)
(18) Plug (differential filler and level gauge)
(19) Plug (differential drain)
(20) Bolt : M20×250

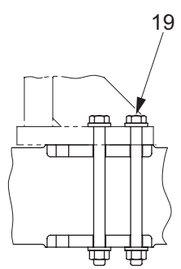
N·m
(2) Nut M22 P=1.5 : 785 N·m (579 lbf·ft)
(19) Bolt M20×250 : 540 N·m (398 lbf·ft)

Specifications
- Tire inflation pressure : 137.5 kPa (20 psi)
- Tire assembly weight : 220 kg (485 lbs.)
- Rear axle assembly weight : 1,020 kg (2,249 lbs.)

0411-27802-0-10066-0

3-1-2. Rear axle assembly (type 2)





SECTION A-A

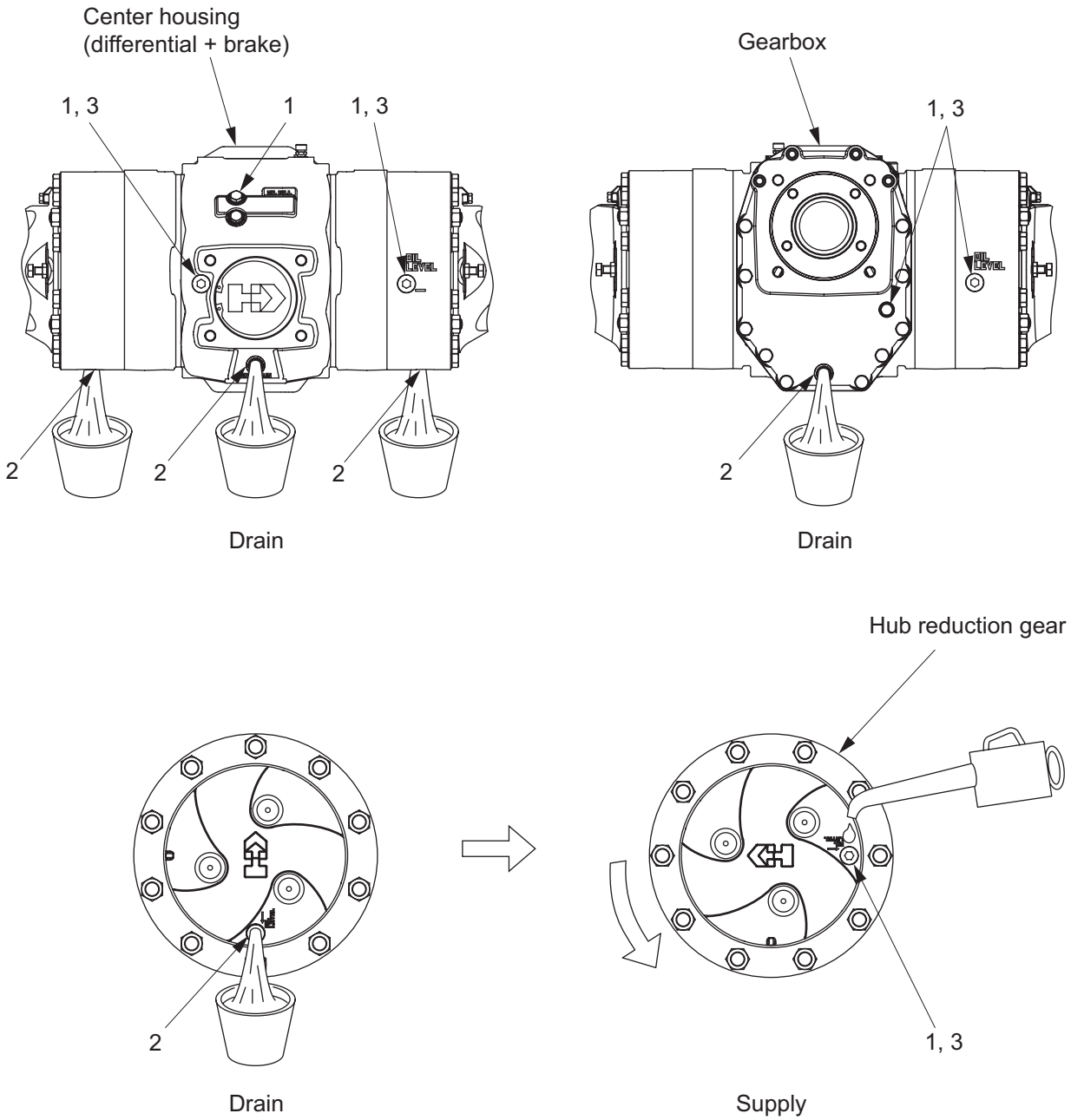
(1) Tire
(2) Nut : M22 P=1.5
(3) Hub reduction gear
(4) Bolt (brake release)
(5) Plug (brake drain)
(6) Plug (brake filler and level gauge)
(7) Plug (gearbox filler and level gauge)
(8) Plug (gearbox drain)
(9) Brake
(10) Differential
(11) Gearbox
(12) Valve
(13) Plug (hub reduction gear component filler, level gauge and drain)
(14) Parking brake release port **[RBL]** : G1/4
(15) Parking brake release port **[RBR]** : G1/4
(16) Plug (differential filler)
(17) Plug (differential filler and level gauge)
(18) Plug (differential drain)
(19) Bolt : M20×250

N•m
(2) Nut M22 P=1.5 : 785 N·m (579 lbf·ft)
(19) Bolt M20×250 : 540 N·m (398 lbf·ft)

Specifications
- Tire inflation pressure : 170 kPa (25 psi)
- Tire assembly weight : 220 kg (485 lbs.)
- Rear axle assembly weight : 1,020 kg (2,249 lbs.)

0414-27801-0-10008-B

3-2. Rear Axle Lubrication



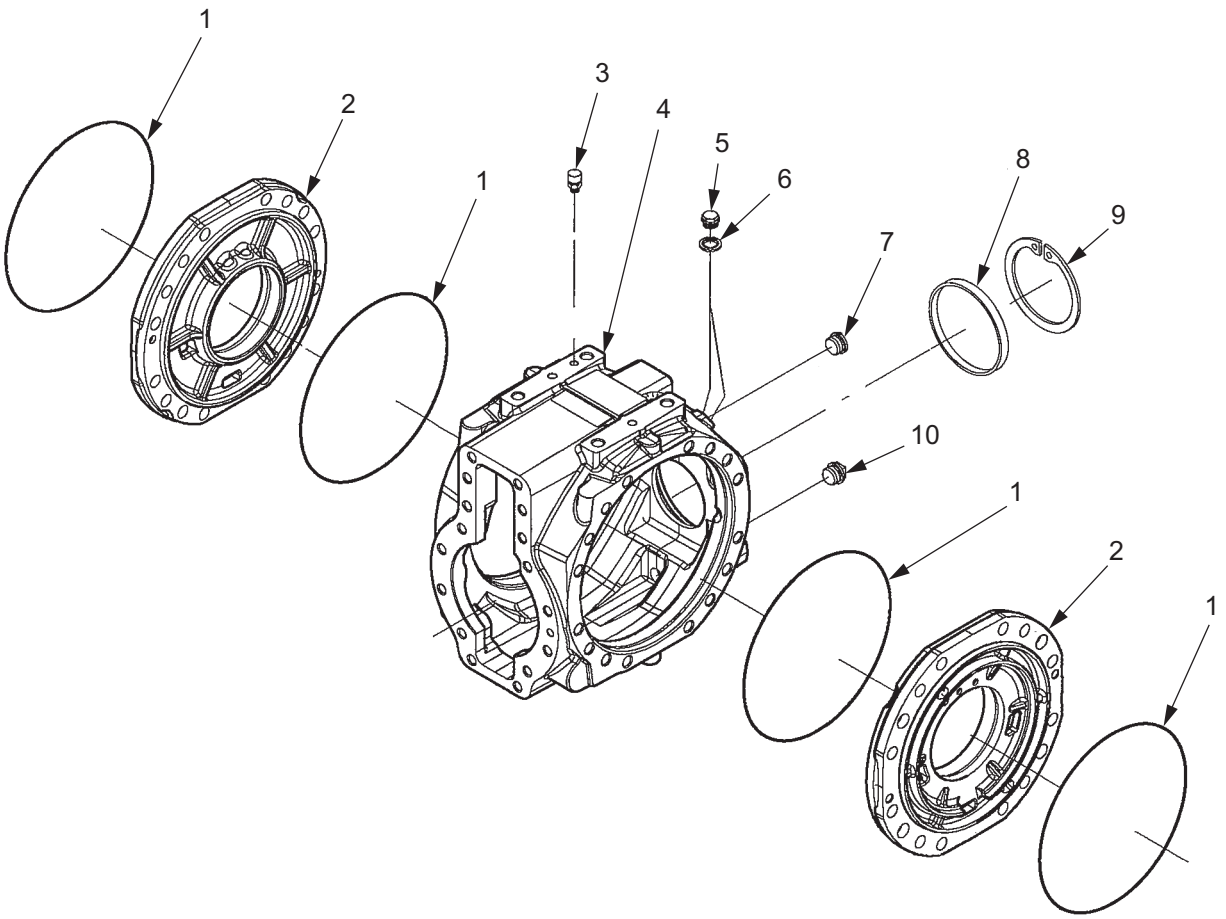
(1) Filler port
(2) Drain port
(3) Level gauge

- Change oil : Gear oil API-grade GL4 SAE90 (See recommended lubrication.)
- Change oil quantity

Gearbox	:	2.0 L	(0.53 gal.)
Center housing (type 1)	:	9.5 L	(2.51 gal.)
(type 2)	:	11.0 L	(2.90 gal.)
Hub reduction gear	:	1.75 L×2	(0.46 gal.×2)

3-3. Rear Axle Structure

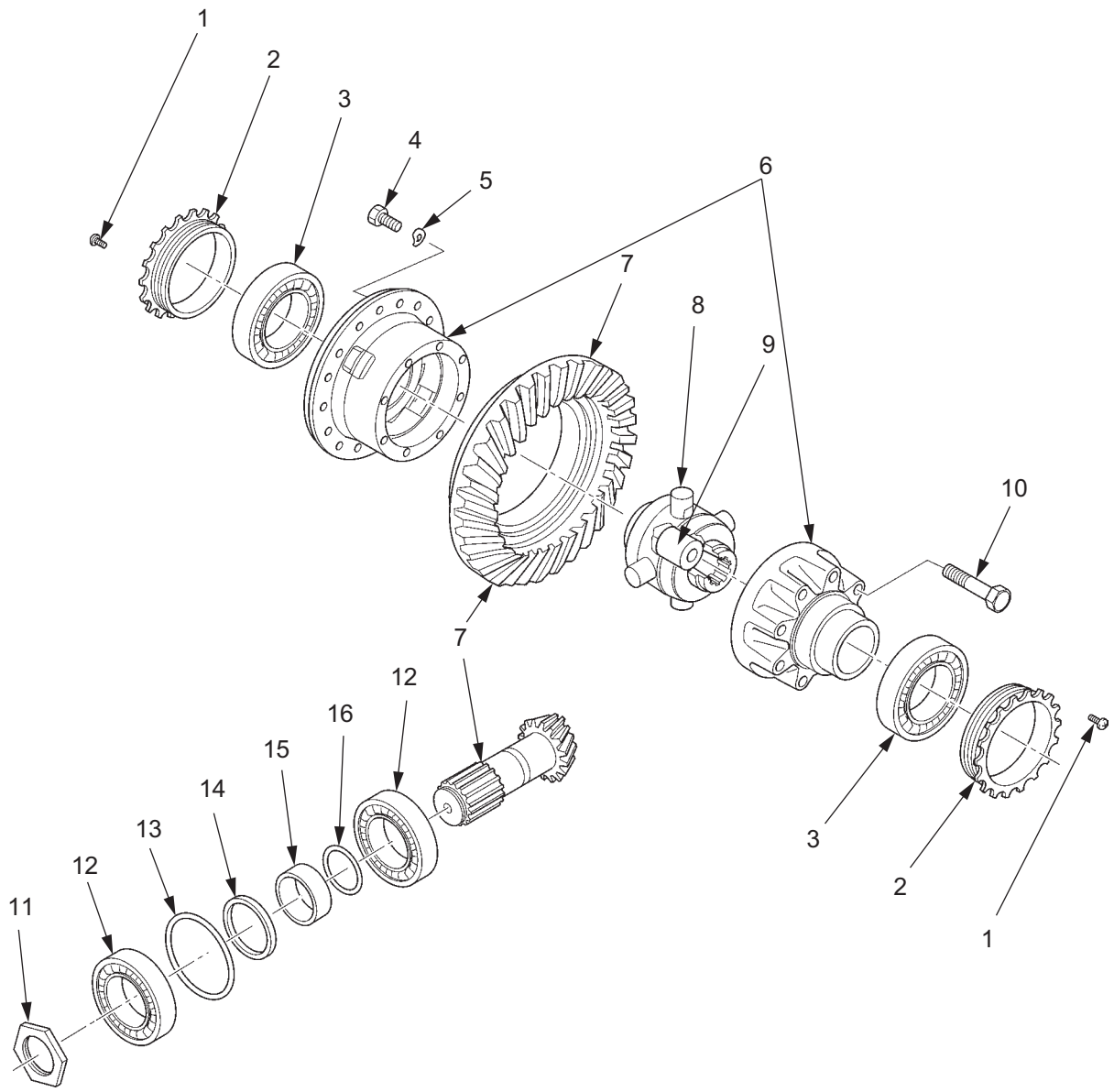
3-3-1. Center housing



SV510-Ⅲ-06093

(1) O-ring
(2) Cover
(3) Vent
(4) Housing
(5) Bolt
(6) Seal washer
(7) Plug
(8) Cover
(9) Snap ring
(10) Magnet plug

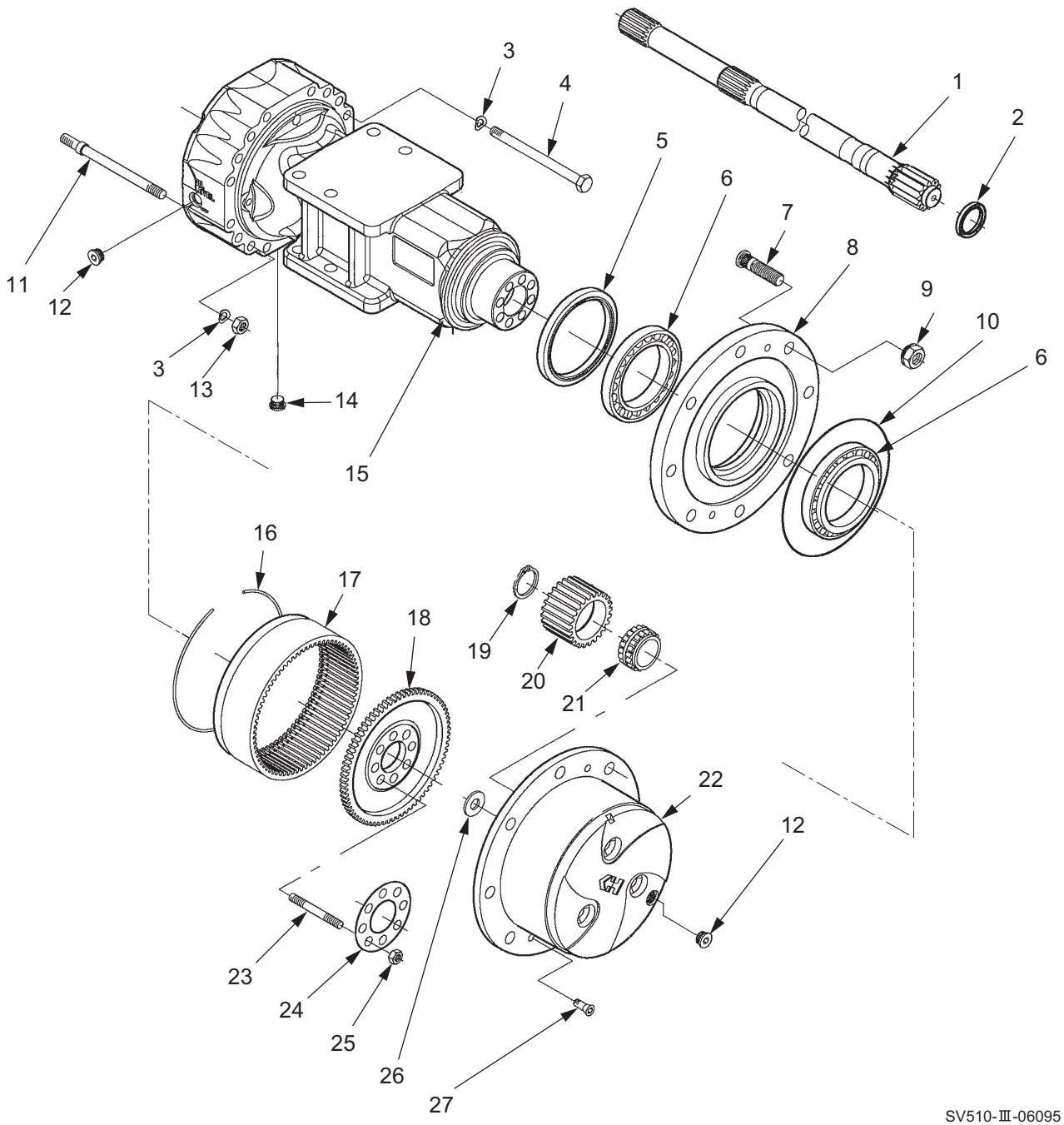
3-3-2. Differential



SV510-Ⅲ-06101

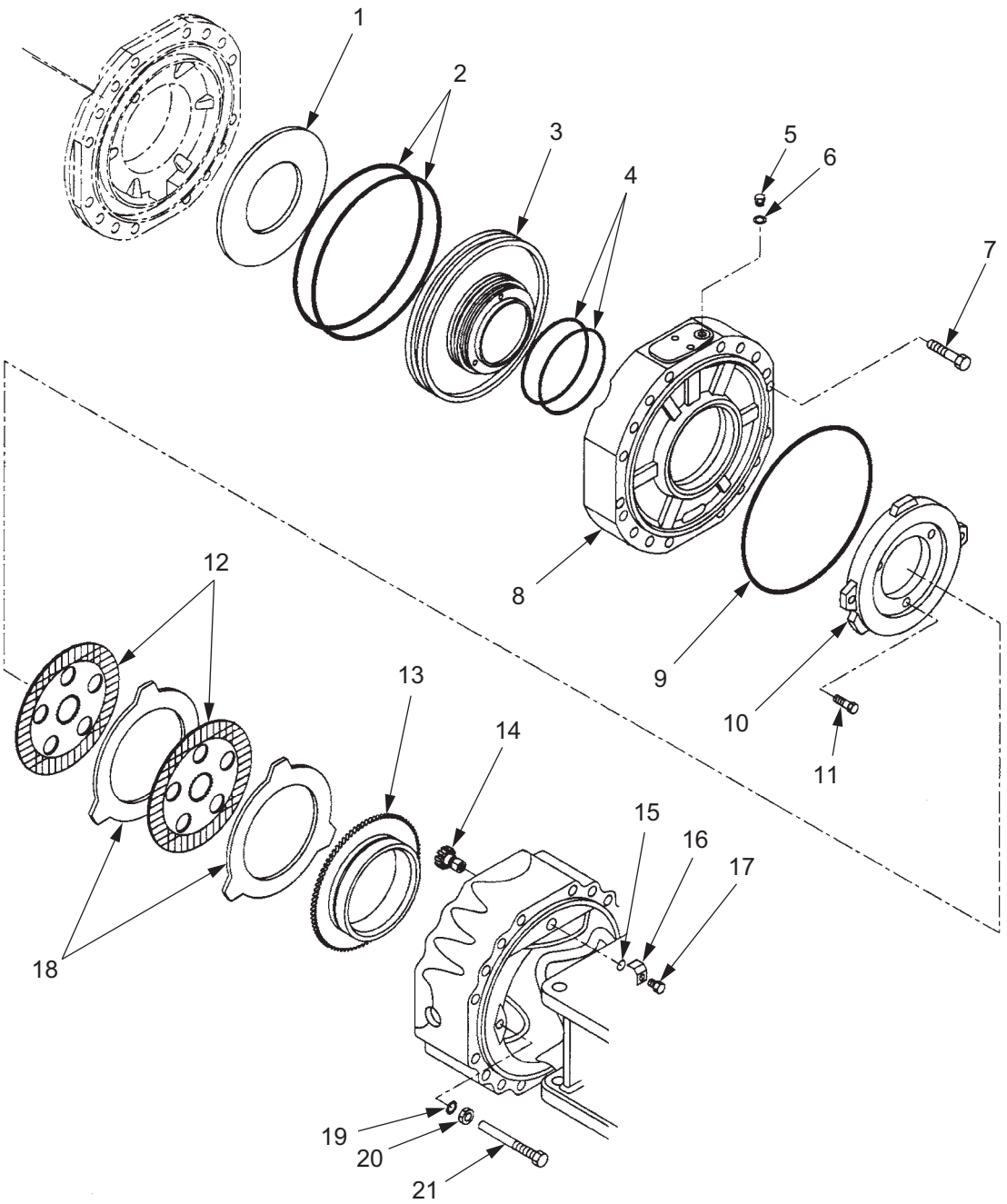
(1) Bolt
(2) Ring nut
(3) Taper roller bearing
(4) Bolt
(5) Spring washer
(6) Differential carrier
(7) Bevel gear set
(8) Nospin differential
(9) Spacer
(10) Bolt
(11) Ring nut
(12) Taper roller bearing
(13) Shim
(14) Seal
(15) Spacer
(16) Shim

3-3-3. Hub reduction gear



(1) Half shaft
(2) Seal
(3) Spring washer
(4) Bolt
(5) Seal
(6) Bearing
(7) Wheel stud
(8) Wheel hub
(9) Wheel nut
(10) O-ring
(11) Stud
(12) Plug
(13) Nut
(14) Magnet plug
(15) Axle case
(16) Circlip
(17) Ring gear
(18) Ring gear support
(19) Snap ring
(20) Planet gear
(21) Bearing
(22) Planet gear carrier
(23) Stud
(24) Locking plate
(25) Nut
(26) Friction washer
(27) Countersunk bolt

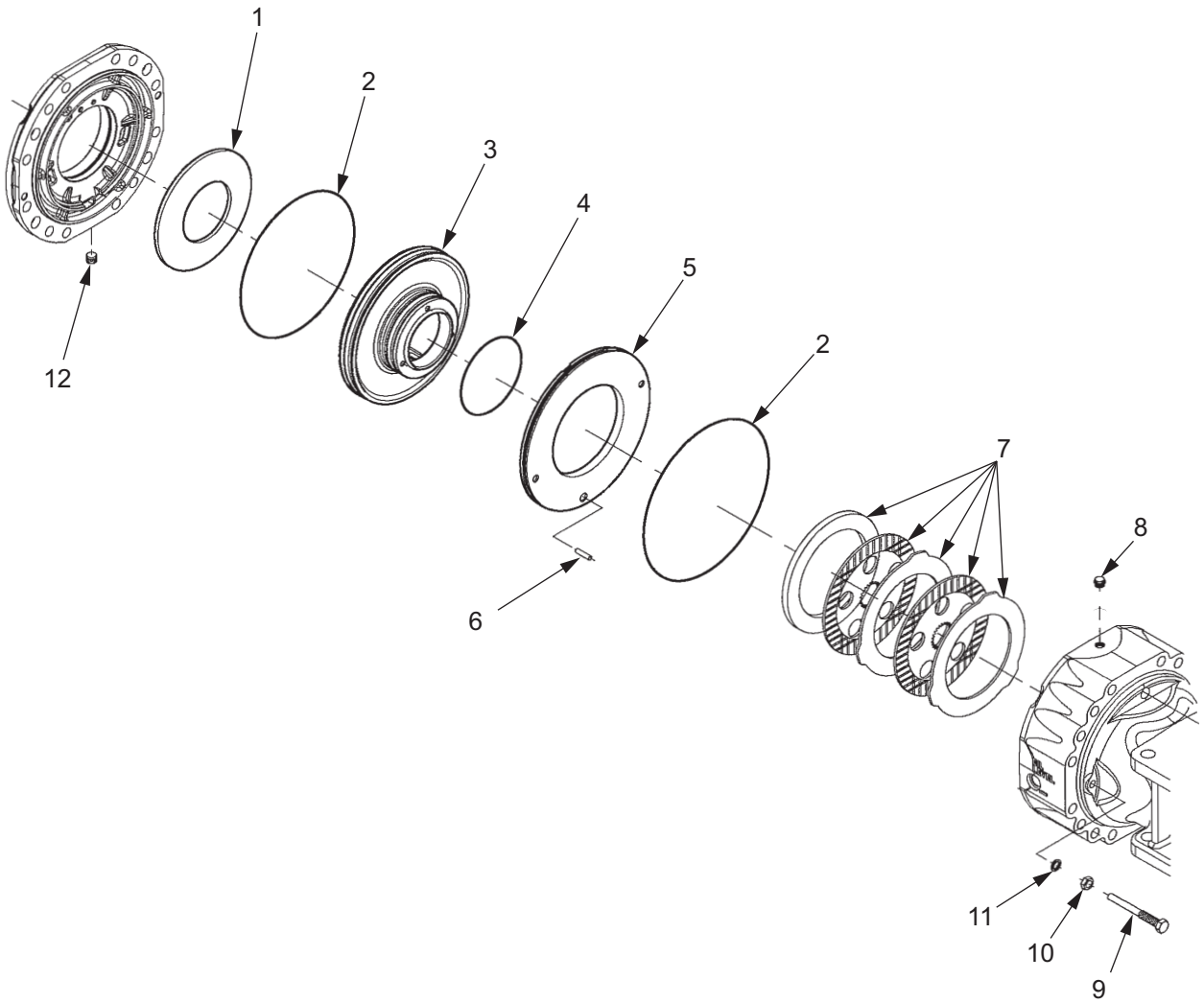
3-3-4. Brake (type 1)



SV510-Ⅲ-06096

(1) Spring
(2) O-ring
(3) Piston
(4) O-ring
(5) Bolt
(6) Seal washer
(7) Bolt
(8) Cover
(9) O-ring
(10) Disc
(11) Cylinder bolt
(12) Brake disc
(13) Ring
(14) Pinion
(15) O-ring
(16) Lock plate
(17) Bolt
(18) Plate
(19) Lock washer
(20) Nut
(21) Bolt

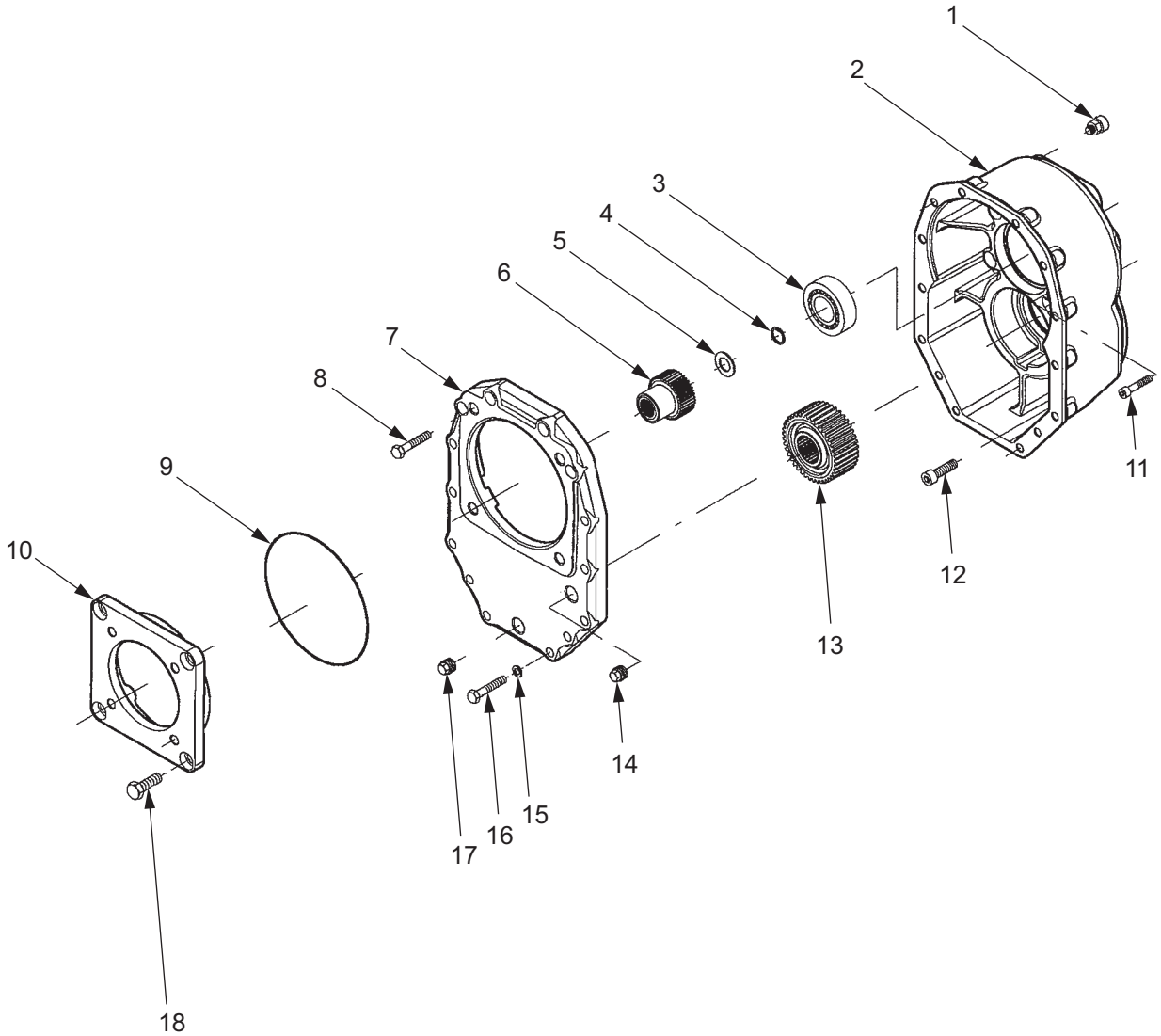
3-3-5. Brake (type 2)



SV700-06094

(1) Spring
(2) O-ring
(3) Piston
(4) O-ring
(5) Ring
(6) Dowel
(7) Brake disc
(8) Plug
(9) Bolt
(10) Nut
(11) Lock washer
(12) Plug

3-3-6. Gearbox

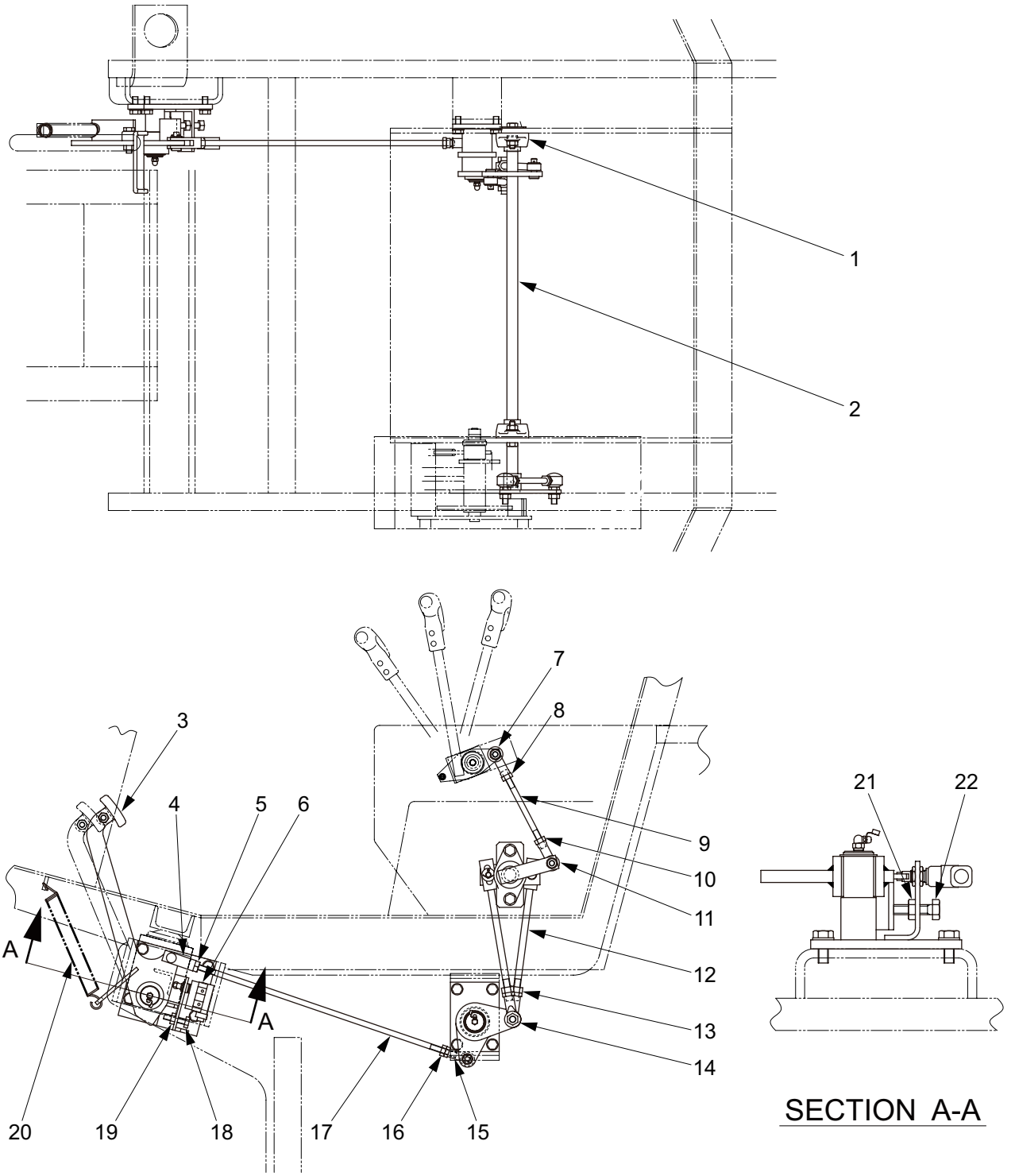


SV510-Ⅲ-06097

(1) Vent
(2) Housing
(3) Ball bearing
(4) Circlip
(5) Spacer
(6) Gear
(7) Cover
(8) Cylinder bolt
(9) O-ring
(10) Intermediate cover
(11) Cylinder bolt
(12) Bolt
(13) Gear
(14) Plug
(15) Spring washer
(16) Bolt
(17) Magnet plug
(18) Cylinder bolt

BRAKE

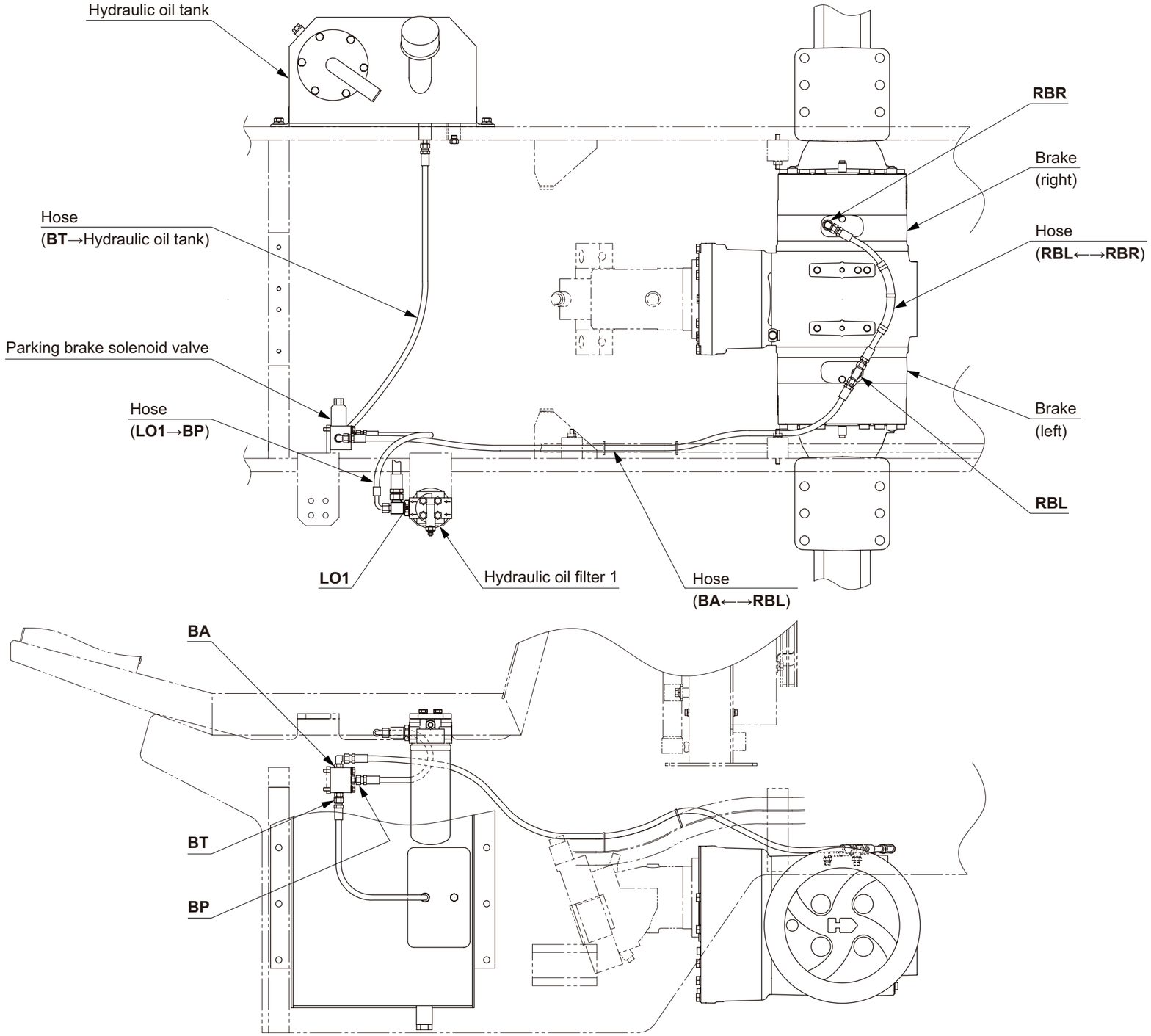
1. BRAKE PEDAL



0411-51801-0-10045-B

(1) Bearing unit
(2) Shaft
(3) Brake pedal
(4) Clevis
(5) Nut : M10
(6) Foot brake switch
(7) Ball joint
(8) Nut : M10
(9) Rod
(10) Nut : M10 (Left-hand thread)
(11) Ball joint (Left-hand thread)
(12) Rod
(13) Nut : M12
(14) Rod end
(15) Ball joint (Left-hand thread)
(16) Nut : M10 (Left-hand thread)
(17) Rod
(18) Stopper bolt : M10×40
(19) Nut : M10
(20) Return spring
(21) Nut : M10
(22) Stopper bolt : M10×40

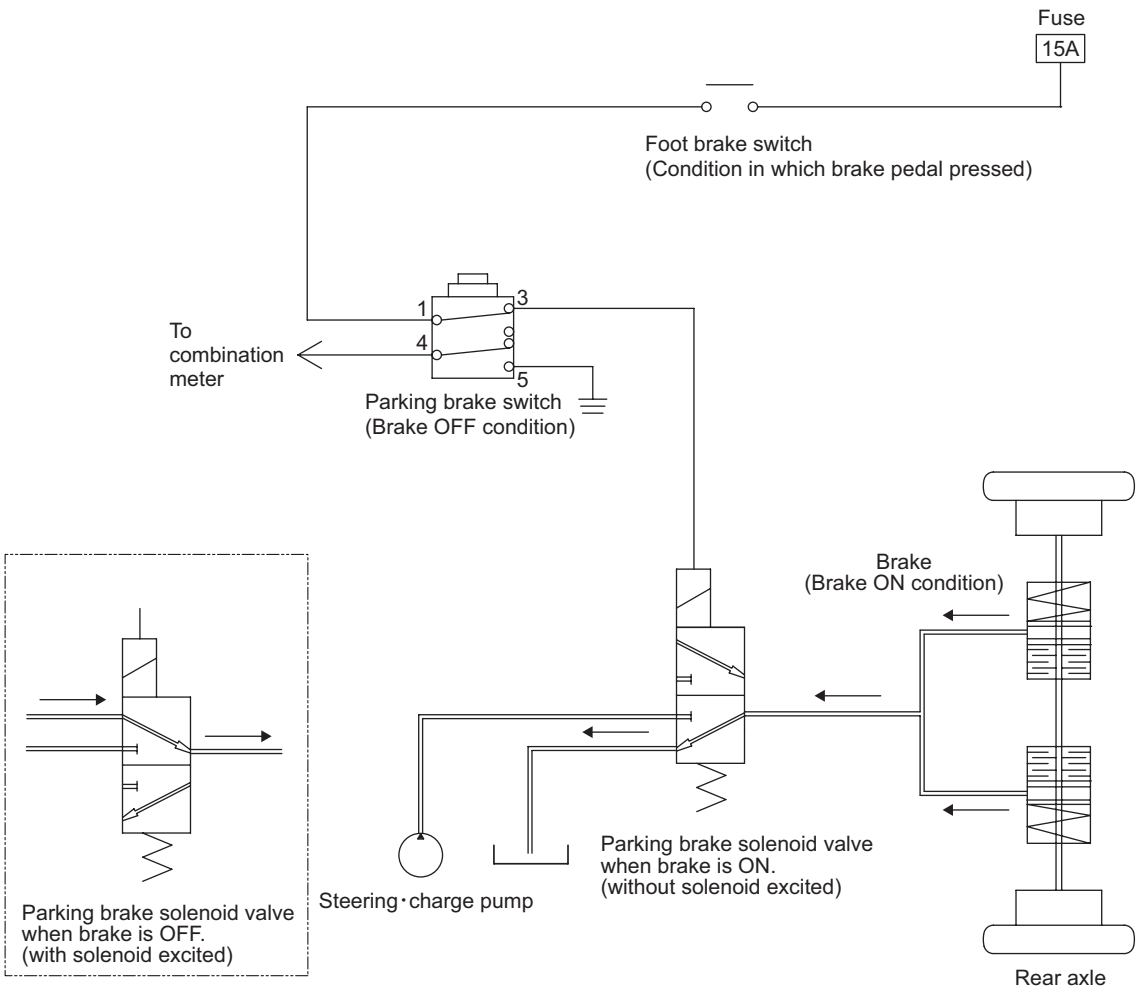
2. BRAKE HYDRAULIC PIPING



• The letters and figures (such as BA and RBL) show each port and the arrow (←→;→) symbols show the hose connection and the direction of the flow of the oil.

0412-36822-0-10452-0

3. BRAKE SYSTEM

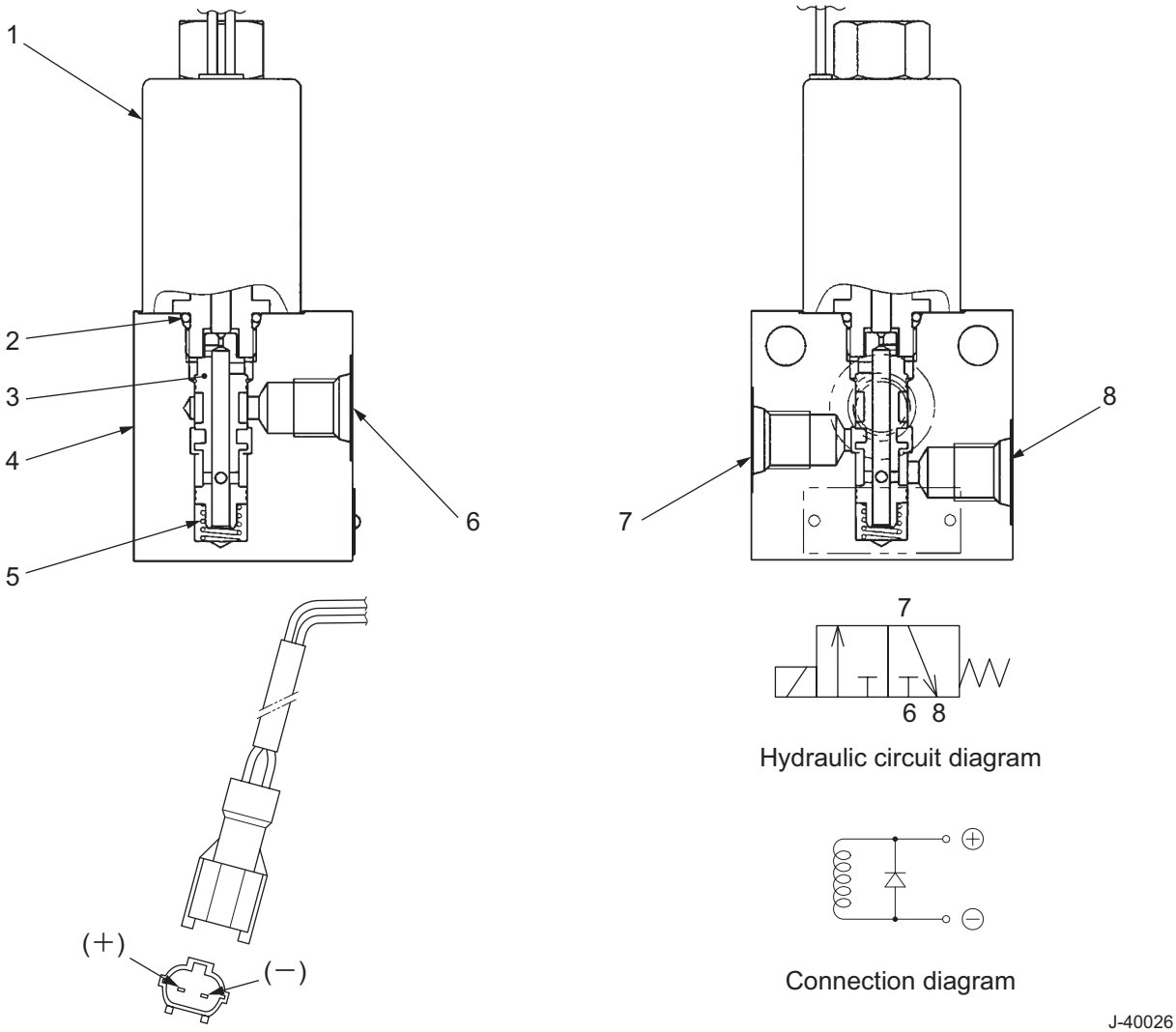


・ The arrow (→) symbol shows the direction of the hydraulic oil flow.

SV510-Ⅲ-07001

4. HYDRAULIC COMPONENT SPECIFICATIONS

4-1. Brake Solenoid Valve



Hydraulic circuit diagram

Connection diagram

J-40026

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

Specifications

- Rated pressure : 4.9 MPa (710 psi) (6, 7)
  : 0.5 MPa (72.5 psi) (8)
- Rated flow : 30 L/min (7.9 gal./min)
- Weight : 1.5 kg (3.3 lbs.)

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 ± 41°F)

① Remove plugs from couplings (1-10) and (1-11) of propulsion pump. 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
- High pressure gauge port (Forward) : (1-10)
- High pressure gauge port (Reverse) : (1-11)
- Pressure gauge : 0 to 50 MPa (0 to 7,250 psi)

② Apply parking brake by pressing parking brake switch button.

③ Set propulsion speed change switch to "🐢" position.

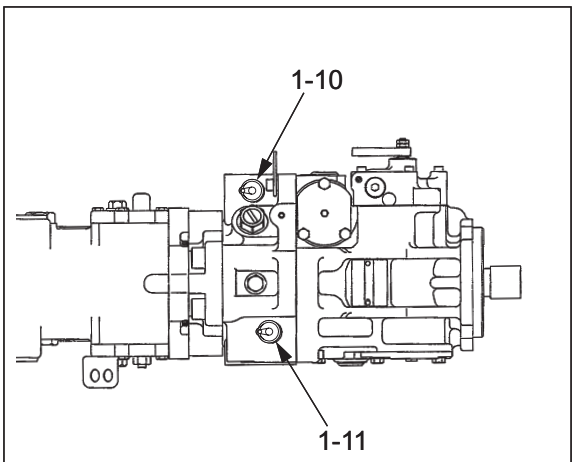
④ Start the engine and set throttle switch to "Full" position.

⑤ Slowly move F-R lever to the side to be measured.

- Then, read pressure indicated by pressure gauge.

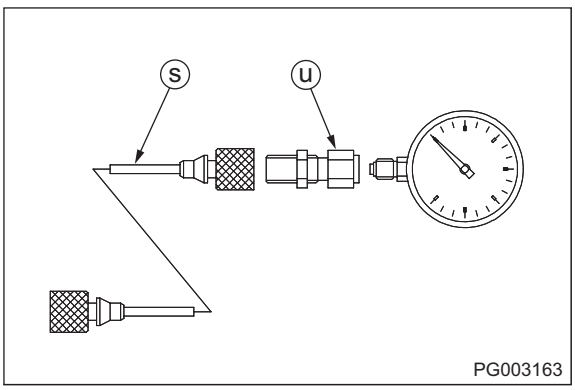
⑥ After measuring, promptly return F-R lever to "Neutral" position.

★ Maximum circuit pressure
(high pressure relief valve setting)
: 41.8 ± 1.0 MPa (6,061 ± 145 psi)



Propulsion pump

SV510-Ⅲ-08001



PG003163

- The numbers "1-10" and "1-11" appearing in above illustrations are consistent with lead line numbers shown in illustration of propulsion pump in "2-2. Hydraulic Component Specifications" (page 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.

① Check nut (2) of multifunction valve (1-1) or (1-4) for evidence of having loosened.
- Multifunction valve (Forward) : (1-4)
- Multifunction valve (Reverse) : (1-1)

② If there is evidence of nut having loosened, adjust multifunction valve so that pressure becomes within maximum circuit pressure range while watching pressure gauge.
- To adjust pressure, loosen nut and turn adjustment screw (3).

Adjustment screw turned clockwise
: Pressure rise
Adjustment screw turned counterclockwise
: Pressure drop
Pressure change rate : 9 MPa/turn (1,305 psi/turn)

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

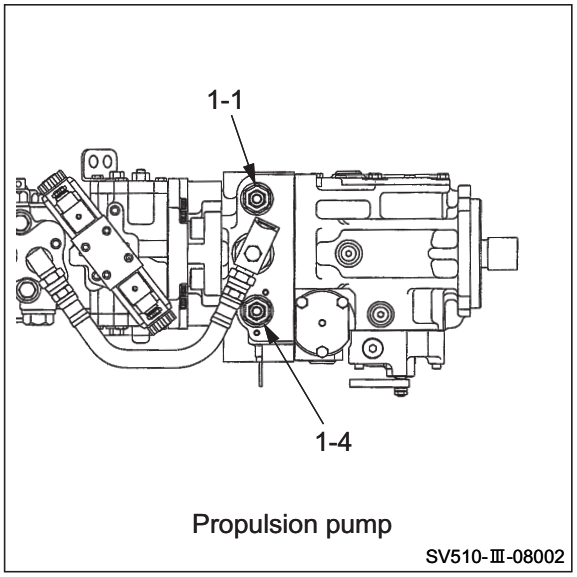
④ Check removed multifunction valve for trapped dirt and scratches on its seat.

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

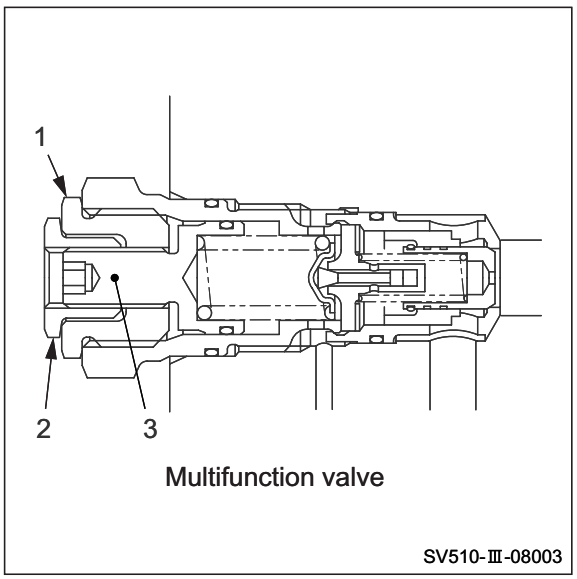
⑥ If a scratch is found on seat, replace multifunction valve.

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

(1)	Nut	: 41 N·m (30 lbf·ft)
(2)	Nut	: 20 N·m (16 lbf·ft)
(1-1) and (1-4)	Multifunction valve	: 89 N·m (66 lbf·ft)



Propulsion pump
SV510-Ⅲ-08002



Multifunction valve
SV510-Ⅲ-08003

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

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

3. MEASUREMENT AND ADJUSTMENT OF PROPULSION CHARGE CIRCUIT PRESSURE

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

3-1. Measurement

• Oil temperature during measurement : 50 ± 5°C (122 ± 41°F)

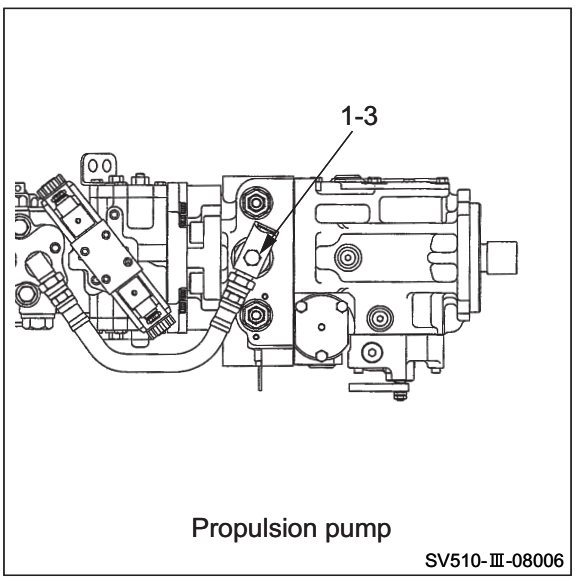
① Remove plug from charge pressure gauge port (1-3). Attach pressure gauge with adapter ⓗ .
  • Adapter ⓗ : 9/16-18UNF
  • Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Apply parking brake by pressing parking brake switch button.

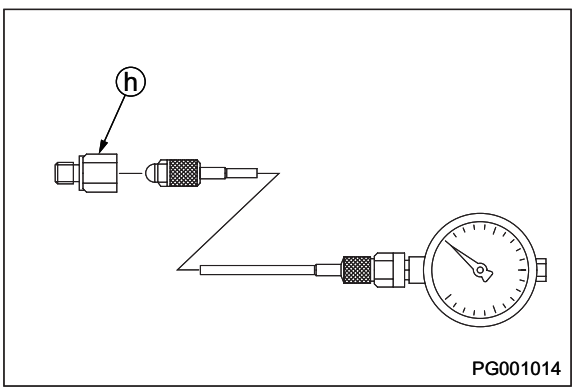
③ Start the engine and set throttle switch to “Full” position.

• Then, read pressure indicated by pressure gauge.

★ Standard charge relief valve setting
: 1.89 ± 0.2 MPa (274 ± 29 psi)



Propulsion pump
SV510-Ⅲ-08006



PG001014

• The number “1-3” appearing in above illustrations is consistent with lead line numbers shown in illustration of propulsion pump in “2-2. Hydraulic Component Specifications” (page 4-007).

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.

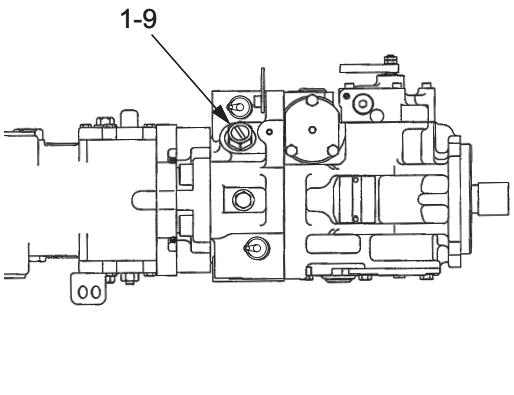
① Check nut (2) of charge relief valve (1-9) for evidence of having loosened.
② If there is evidence of nut having loosened, adjust charge relief valve so that pressure becomes within standard charge relief valve pressure setting range while watching pressure gauge.
- To adjust pressure, loosen nut and turn adjustment screw (3).

Adjustment screw turned clockwise
: Pressure rise
Adjustment screw turned counterclockwise
: Pressure drop
Pressure change rate : 0.39 MPa/turn (57 psi/turn)

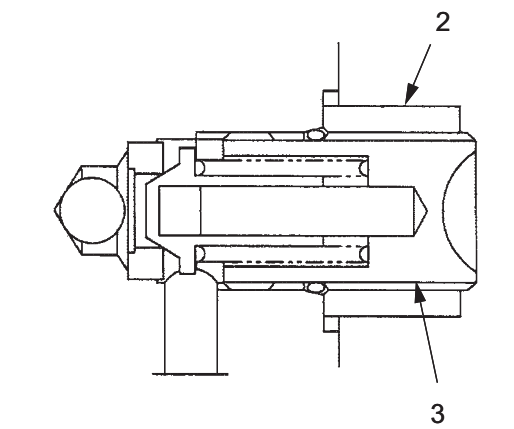
③ If there is no evidence of nut having loosened, remove charge relief valve.
④ Check removed charge relief valve for trapped dirt and scratches on its seat.
⑤ If trapped dirt is present, disassemble and clean charge relief valve.
⑥ If a scratch is found on seat, replace charge relief valve.
⑦ After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

N•m
(2) Nut : 52 N·m (38 lbf·ft)

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



Propulsion pump
SV510-Ⅲ-08007



Charge relief valve
SV510-Ⅲ-08008

- The number “1-9” appearing in above illustrations is consistent with lead line numbers shown in illustration of propulsion pump in “2-2. Hydraulic Component Specifications” (page 4-007).

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

4-1. Measurement

- Oil temperature during measurement : 50 ± 5°C (122 ± 41°F)

① Remove plugs from propulsion motor's gauge ports (1), (2), (3) and (4). Attach pressure gauge with the adapter ⓗ .
- Adapter ⓗ : 9/16-18UNF
- Servo pressure max. angle gauge port : (1), (3) (1st speed)
- Servo pressure min. angle gauge port : (2), (4) (2nd speed)
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

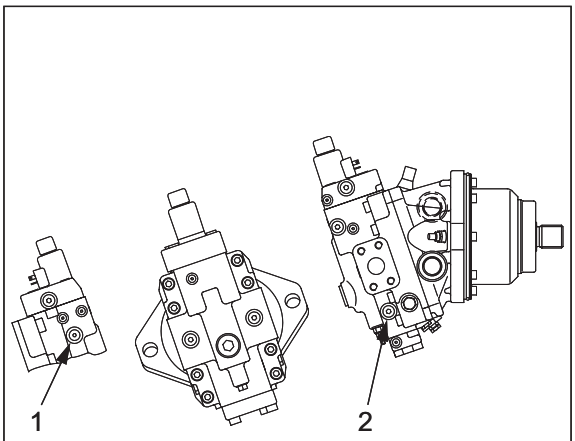
② Apply parking brake by pressing parking brake switch button.

③ Set propulsion speed change switch to " " or " " position.

④ Start the engine and set throttle switch to "Full" position.

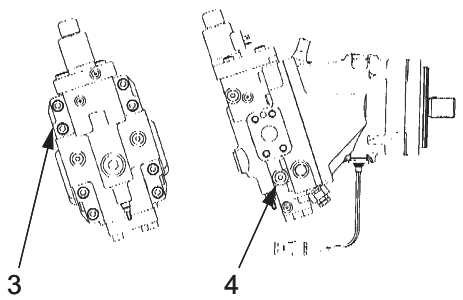
- Then, read pressure indicated by pressure gauge.

★ Standard motor relief valve setting
: 2.45 ± 0.2 MPa (355 ± 29 psi)



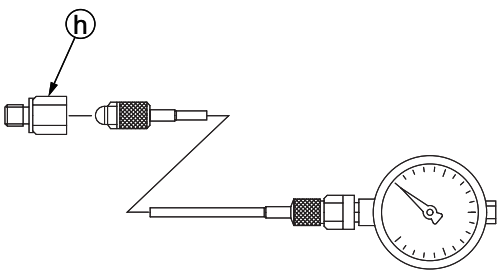
Propulsion motor (Front)

SV510-Ⅲ-08024



Propulsion motor (Rear)

SV510-Ⅲ-08009



PG001014

5. MEASUREMENT OF PARKING BRAKE RELEASE PRESSURE

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

5-1. Measurement

• Oil temperature during measurement : 50 ± 5°C (122 ± 41°F)

① Disconnect brake release hose (1) from brake solenoid valve. Attach pressure gauge through adapter ⓜ .
  • Adapter ⓜ : G 1/4
  • Pressure gauge : 0 to 5 MPa (0 to 725 psi)

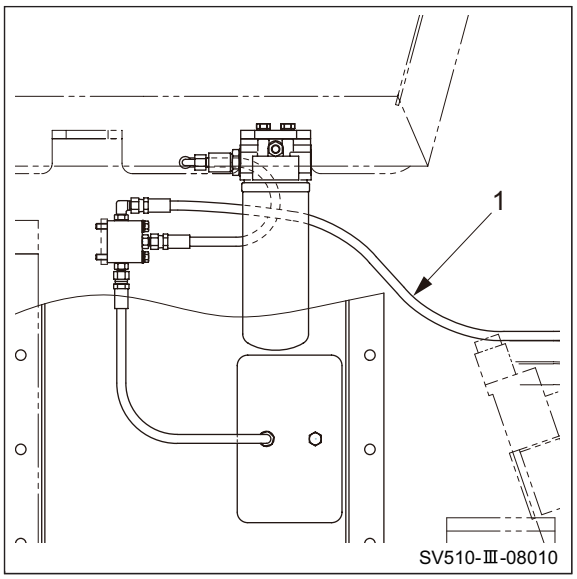
② Confirm that F-R lever is in “Neutral” position.

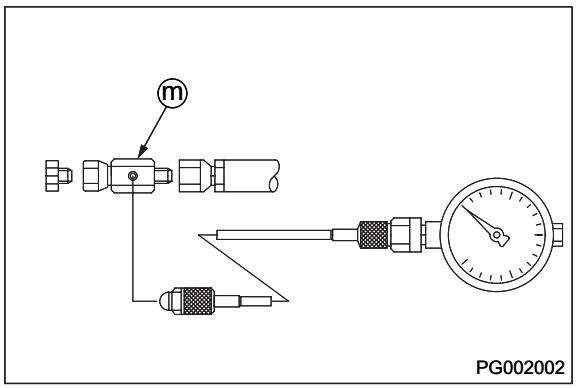
③ Apply parking brake by pressing parking brake switch button.

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

⑤ Release parking brake by pressing parking brake switch button.
  • Then, read brake release pressure indicated by pressure gauge.

★ Brake release pressure : 1.5 to 3.0 MPa (218 to 435 psi)





6. MEASUREMENT AND INSPECTION OF VIBRATOR CIRCUIT PRESSURE

6-1. 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 ± 41°F)

① Remove plugs from coupling (2-1) and (2-2) of vibrator pump. 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
- High pressure gauge port (Low amplitude) : (2-1)
- High pressure gauge port (High amplitude) : (2-2)
- Pressure gauge : 0 to 50 MPa (0 to 7,250 psi)

② Apply parking brake by pressing parking brake switch button.

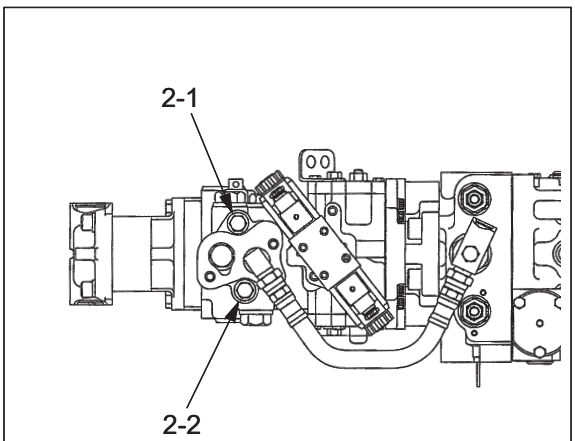
③ Set vibration mode change switch to " " position.

④ Start the engine and set throttle switch to "Full" position.

⑤ Press F-R lever vibration switch "ON".
- Then, read pressure gauge for maximum value of vibrator circuit pressure.

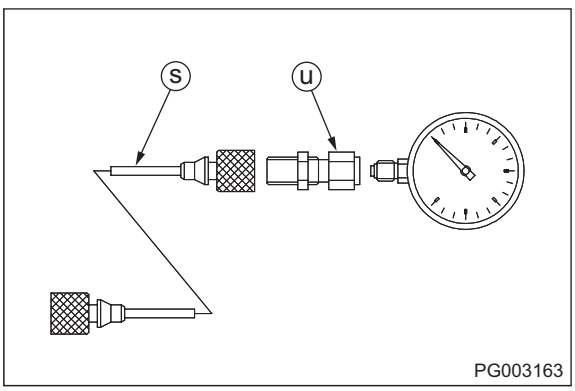
⑥ Turn F-R lever vibration switch "OFF" as soon as measurement is finished.

★ Maximum circuit pressure (high pressure relief valve setting)
: 25.0 ± 1.0 MPa (3,625 ± 145 psi)



Vibrator pump

SV510-Ⅲ-08011



PG003163

- The numbers "2-1" and "2-2" appearing in above illustrations are consistent with lead line numbers shown in illustration of vibrator pump in "2-2. Hydraulic Component Specifications" (page 4-007).

6-2. Inspection

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

① Remove high pressure relief valve (2-4) or (2-12) responsible for vibrator whose circuit pressure is abnormal.
- High pressure relief valve (Low amplitude) : (2-12)
- High pressure relief valve (High amplitude) : (2-4)

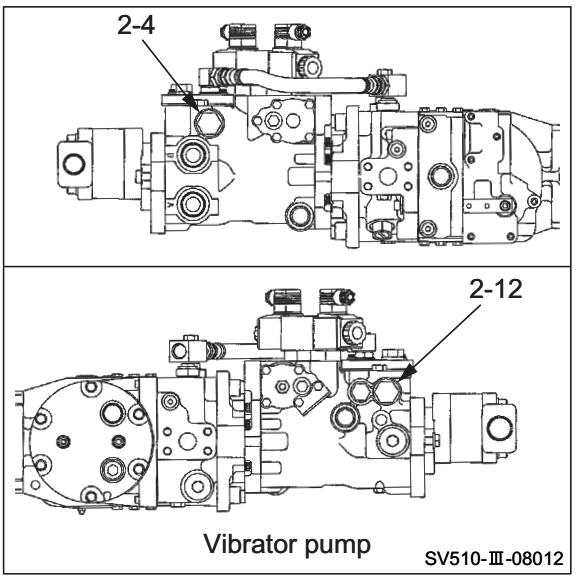
② Check removed high pressure relief valve for trapped dirt and other abnormalities.

③ If trapped dirt is present, disassemble and clean high pressure relief valve.

④ If pressure still deviates from maximum circuit pressure range after valve is disassembled and cle aned, replace high pressure relief valve.

⑤ After inspection, measure pressure again and check that pressure reaches maximum circuit pressure range.

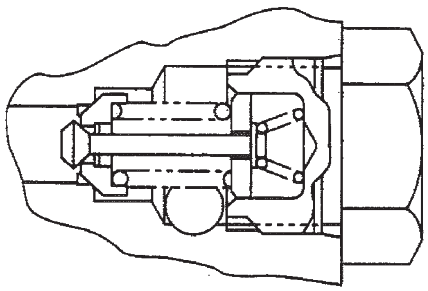
N•m (2-4) to (2-12) High pressure relief valve
: 176 N·m (130 lbf·ft)



Vibrator pump
SV510-Ⅲ-08012

(NOTICE)

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

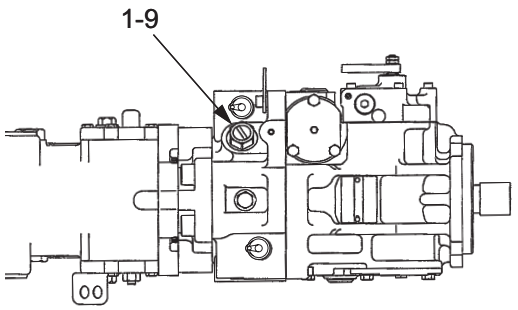

High pressure relief valve
SV510-Ⅲ-08013

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

7. MEASUREMENT AND INSPECTION OF VIBRATOR CHARGE CIRCUIT PRESSURE

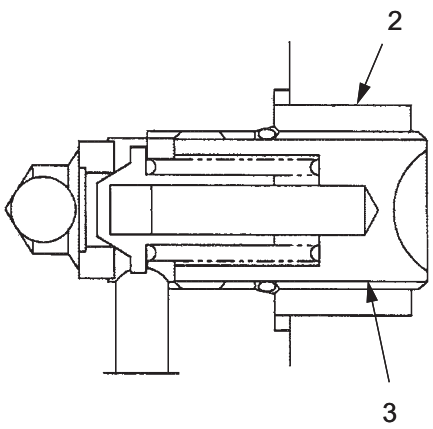
- Since oil in charge circuit is supplied from steering circuit, confirm that steering operation is normal before measurement.
- Propulsion charge circuits and vibration charge circuits consist of parallel circuits. Thus, in order to measure whether vibrator charge circuit pressure is within standard value, use following operation to ensure that oil does not escape to the charge relief valve on propulsion pump side.

① Loosen nut (2) from charge relief valve (1-9) on propulsion pump side.
② Tighten adjustment screw (3) by two complete turns.
  - Pressure change rate: 0.39 MPa/turn (57 psi/turn)



Propulsion pump

SV510-Ⅲ-08007



Charge relief valve

SV510-Ⅲ-08008

- The number “1-9” appearing in above illustrations is consistent with lead line numbers shown in illustration of vibrator pump in “2-2. Hydraulic Component Specifications” (page 4-007).

7-1. Measurement

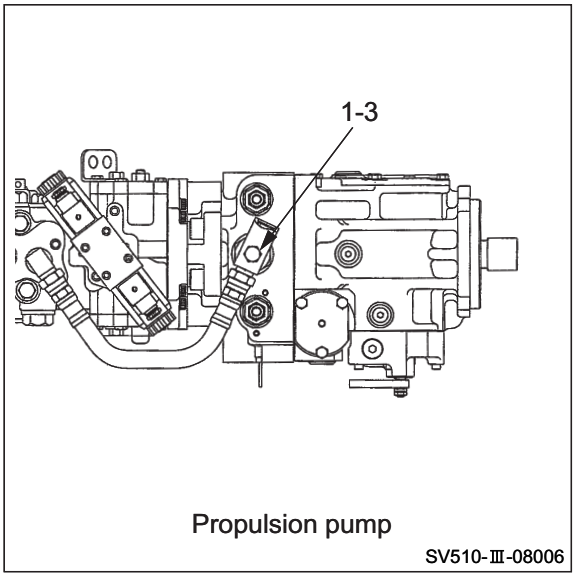
- Oil temperature during measurement : 50 ± 5°C (122 ± 41°F)

① Remove plug from charge pressure gauge port (1-3). Attach pressure gauge with adapter ⓗ .
- Adapter ⓗ : 9/1 6-18UNF
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

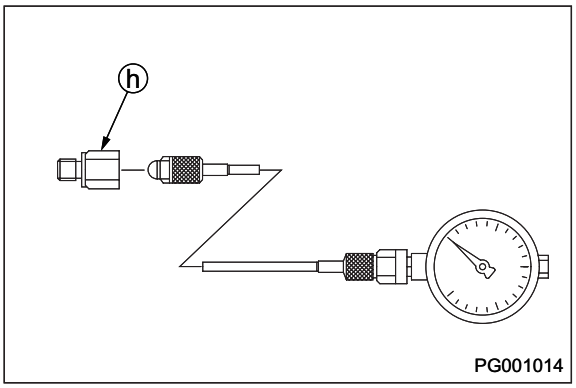
② Apply parking brake by pressing parking brake switch button.

③ Start the engine and set throttle switch to “Full” position.
- Then, read pressure indicated by pressure gauge.

★ Standard charge relief valve setting
: 2.34 ± 0.2 MPa (339 ± 29 psi)



Propulsion pump
SV510-Ⅲ-08006



PG001014

- The number “1-3” appearing in above illustrations is consistent with lead line numbers shown in illustration of vibrator pump in “2-2. Hydraulic Component Specifications” (page 4-007).

7-2. Inspection

- If measurement results indicate the pressure deviating from standard charge relief pressure setting range, make an adjustment in accordance with procedure described below.
- Since charge relief valve is a fixed type, adjustment of the pressure setting is not possible.

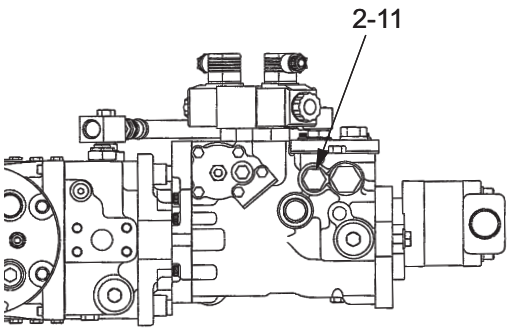
① Remove charge relief valve (2-11).
② Check removed charge relief valve for trapped dirt and other abnormalities.
③ If trapped dirt is present, disassemble and clean charge relief valve.
④ If pressure still deviates from standard charge pressure setting range after valve is disassembled and cleaned, replace charge relief valve.
⑤ After inspection, measure pressure again and check that pressure reaches standard charge relief pressure setting range.

N•m

(2-11) Charge relief valve : 108 N·m (80 lbf·ft)

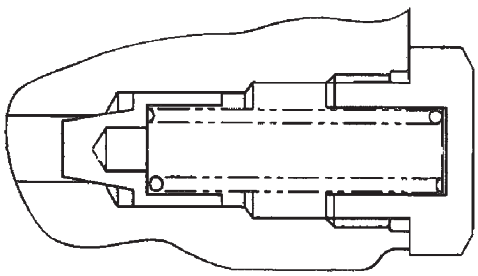
(NOTICE)

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



Vibrator pump

SV510-Ⅲ-08004



Charge relief valve

SV510-Ⅲ-08015

- The number “2-11” appearing in above illustrations is consistent with lead line numbers shown in illustration of vibrator pump in “2-2. Hydraulic Component Specifications” (page 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.

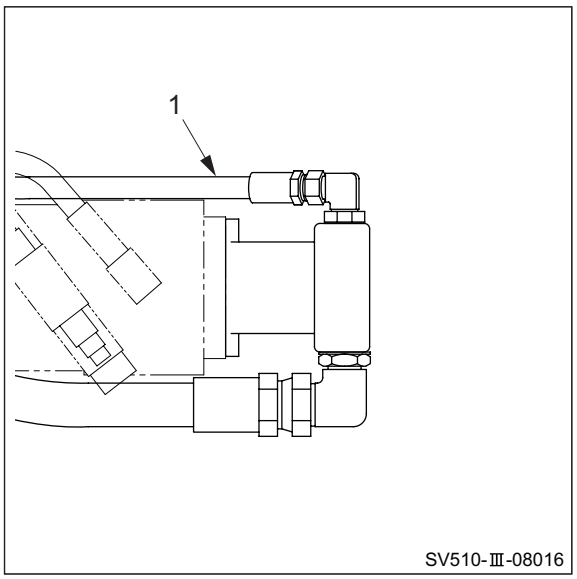
- Oil temperature during measurement : 50 ± 5°C (122 ± 41°F)

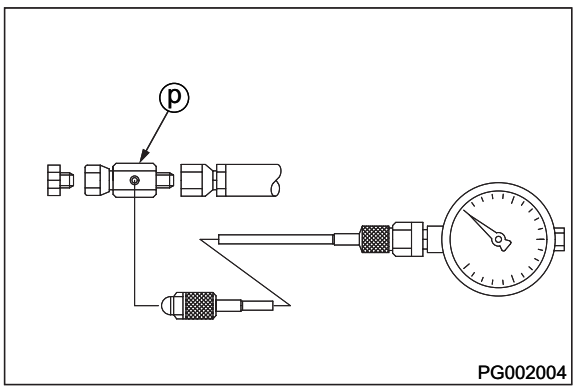
① Disconnect the hose (1) from steering·charge pump. Attach the pressure gauge through the adapter Ⓟ .
- Adapter Ⓟ : G1/2
- Pressure gauge : 0 to 25 MPa (0 to 3,625 psi)

② Confirm that F-R lever is in “Neutral” positio n properly.

③ Start the engine and set throttle switch to “Full” position.
- Turn steering wheel to operate relief valve.
- Then, read pressure indicated by pressure gauge.

★ Standard maximum circuit pressure
(orbitroll relief pressure + charge relief pressure)
: 16.9 ± 1.0 MPa (2,451 ± 145 psi)

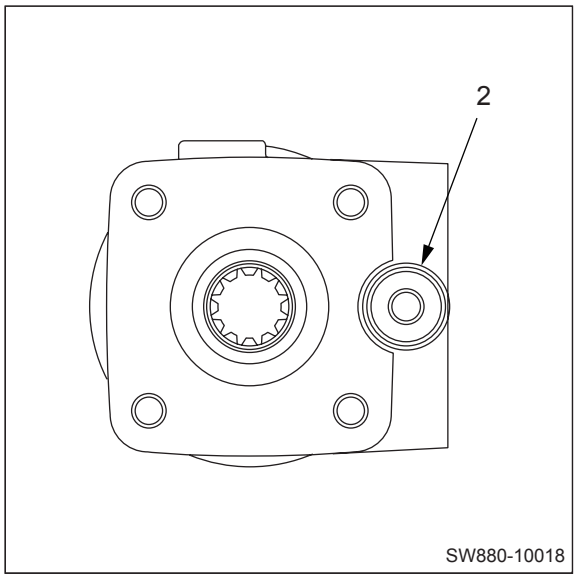




8-2. Inspection

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

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



(NOTICE)

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

9. MEASUREMENT OF HYDRAULIC PUMP CASE PRESSURE

9-1. Measurement of Propulsion Pump Case Pressure

- Oil temperature during measurement : 50 ± 5°C (122 ± 41°F)

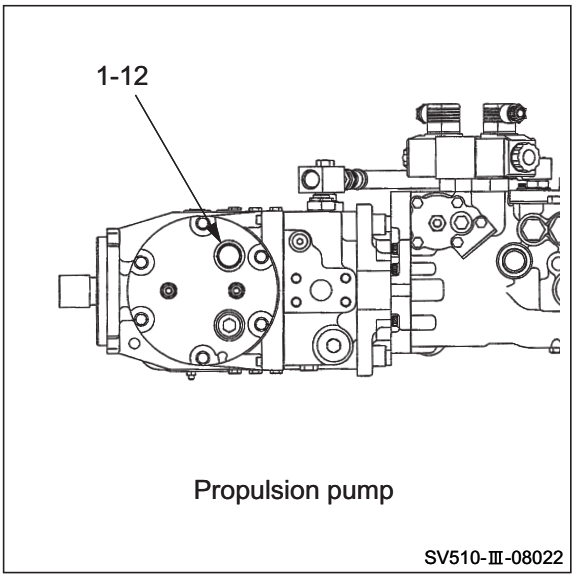
① Remove plug from drain port (1-12). Attach pressure gauge with adapter ⓩ .
- Adapter ⓩ : 1 1/16-20UN
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Apply parking brake by pressing parking brake switch button.

③ Start the engine and set throttle switch to “Full” position.

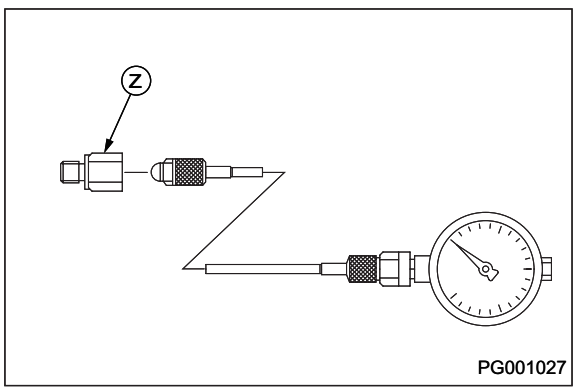
④ Measure pressure when speed change switch is in “🐢” and “🐇” positions and F-R lever in “neutral”, “forward”, and “reverse” positions, respectively.

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



Propulsion pump

SV510-Ⅲ-08022



PG001027

- The number such as “1-12” appearing in above illustrations is consistent with lead line numbers shown in illustration of propulsion pump in “2-2. Hydraulic Component Specifications” (page 4-007).

9-2. Measurement of Vibrator Pump Case Pressure

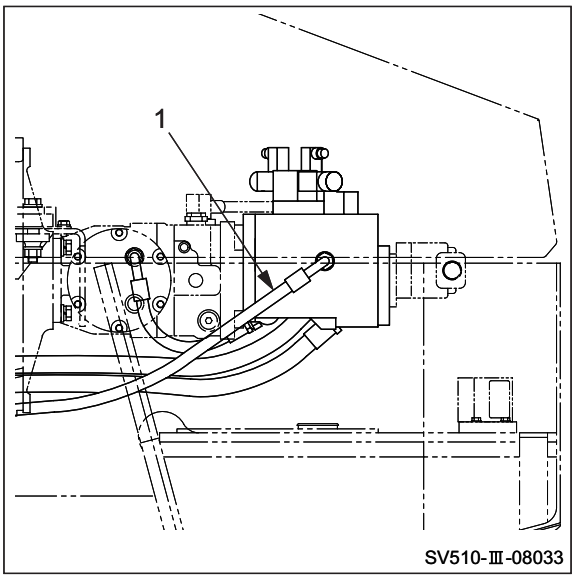
⚠CAUTION

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.

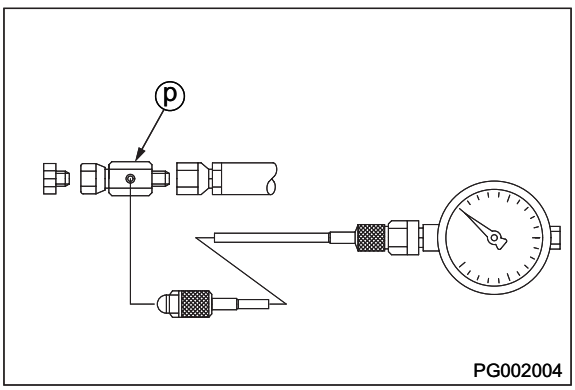
- Oil temperature during measurement : 50 ± 5°C (122 ± 41°F)

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

② Apply parking brake by pressing parking brake switch button.
③ Set vibration mode change switch to " " position.
④ Start the engine and set throttle switch to "Full" position.
⑤ Press F-R lever vibration switch "ON".
⑥ Measure pressure when vibration amplitude selector switch is in "" and "" positions, respectively.
⑦ Turn F-R lever vibration switch "OFF" as soon as measurement is finished.



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



10. MEASUREMENT OF PROPULSION MOTOR CASE PRESSURE

10-1. Measurement

• Oil temperature during measurement : 50 ± 5°C (122 ± 41°F)

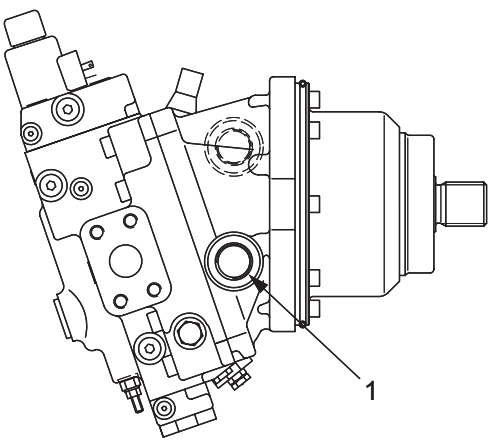
① Remove plug from drain port (1) and (2). Attach pressure gauge and adapter ⓩ .
- Adapter ⓩ : 1 1/16-12UN
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Apply parking brake by pressing parking brake switch button.

③ Start the engine and set throttle switch to “Full” position.

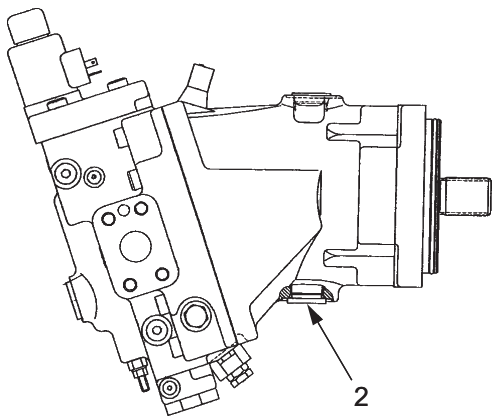
④ Measure pressure when speed change switch is in “🐢” and “🐇” positions and F-R lever in “neutral”, “forward”, and “reverse” positions, respectively.

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



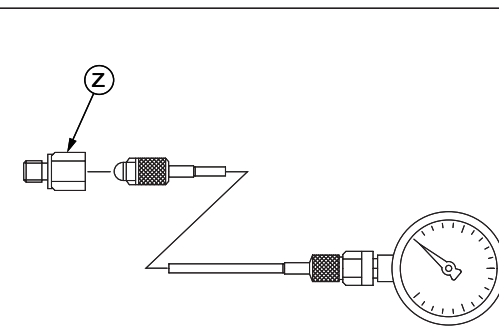
Propulsion motor (front)

SV510-Ⅲ-08020



Propulsion motor (rear)

SV510-Ⅲ-08021



PG001027

11. MEASUREMENT OF VIBRATOR MOTOR CASE PRESSURE

11-1. Measurement

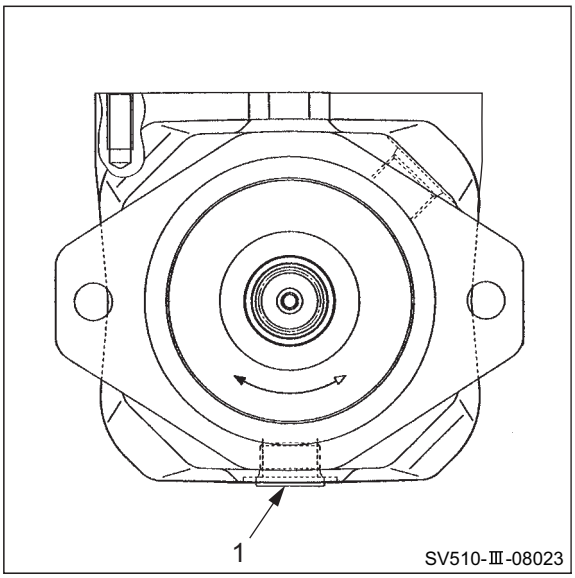
⚠CAUTION

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.

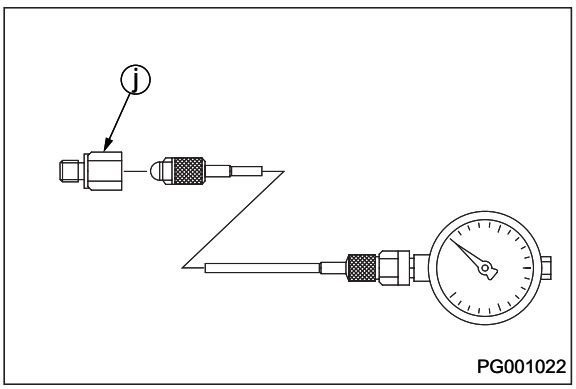
- Oil temperature during measurement : 50 ± 5°C (122 ± 41°F)

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 Apply parking brake by pressing parking brake switch button.
③ Set vibration mode change switch to " " position.
④ Start the engine and set throttle switch to "Full" position.
⑤ Press F-R lever vibration switch "ON".
⑥ Measure pressure when vibration amplitude selector switch is in "" and "" positions, respectively.
⑦ Turn F-R lever vibration switch "OFF" as soon as measurement is finished.



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



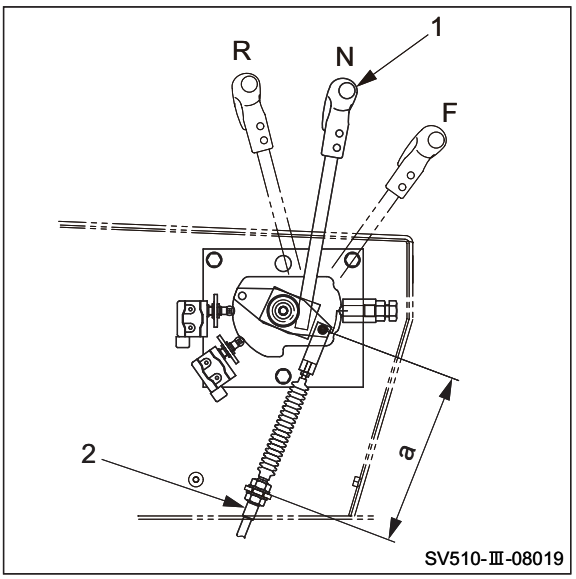
12. ADJUSTMENT OF F-R LEVER LINKAGE

12-1. Adjustment

- If F-R lever linkage was replaced, make an adjustment in accordance with procedure described below.
- Neutral position of F-R lever (1) and maximum stroke on forward-reverse side are positioned by notches.

① Firmly secure the F-R lever in neutral position.
② Firmly secure both ends of control cable (2).

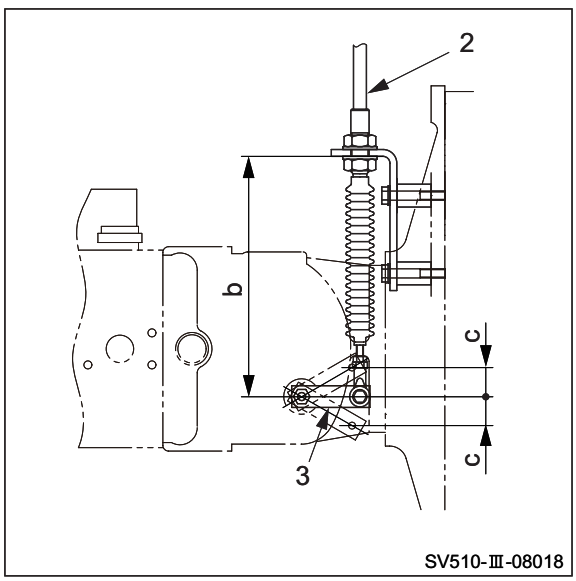
★ Specified dimension of control cable ends
a: 238 mm (9.37 in.)



★ Specified dimension of control cable ends
b: 210 mm (8.27 in.)

③ Confirm the stroke of control lever (3) on propulsion pump side.

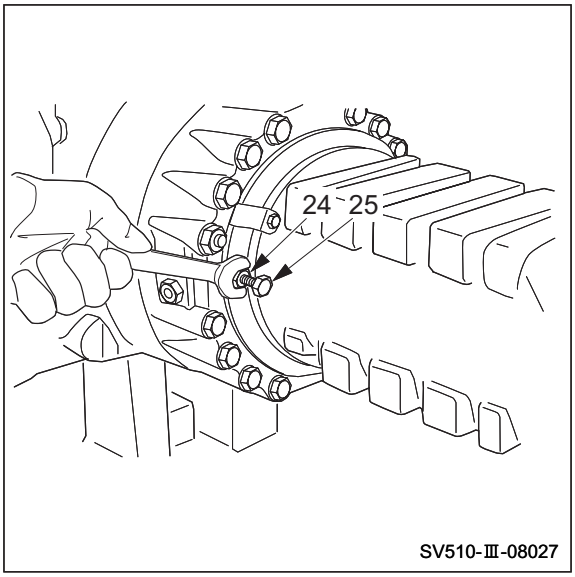
★ Specified dimension of control lever
c: 25 mm (1.0 in.)



13. BRAKE ADJUSTMENT

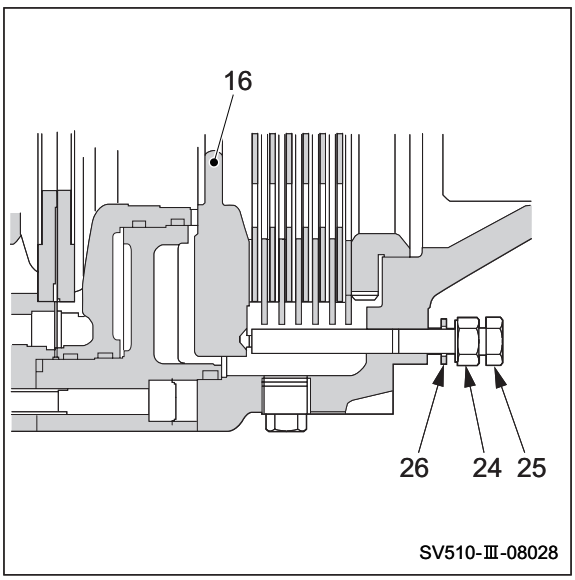
13-1. Manually Releasing the Brake

1) Loosen nut (24) of bolt (25).
   • Loosen nut on the opposite side.



SV510-Ⅲ-08027

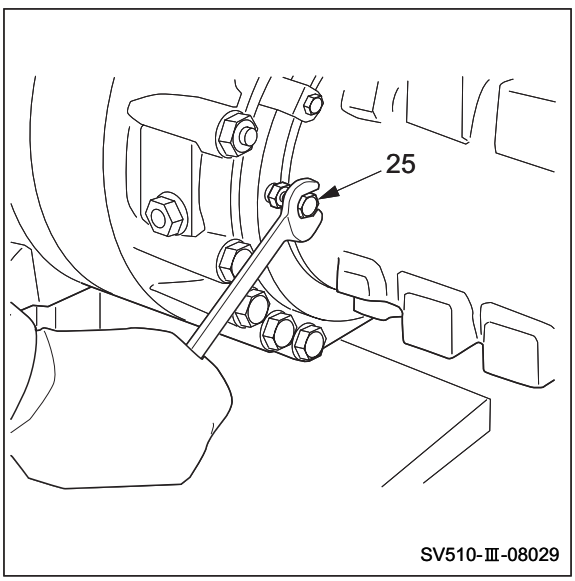
2) Tighten bolt (25), and press it into disc (16).
   • Do the same with bolt on the opposite side.



SV510-Ⅲ-08028

3) Alternately tighten bolts (25) 1/4 turn each, and release brake disc.

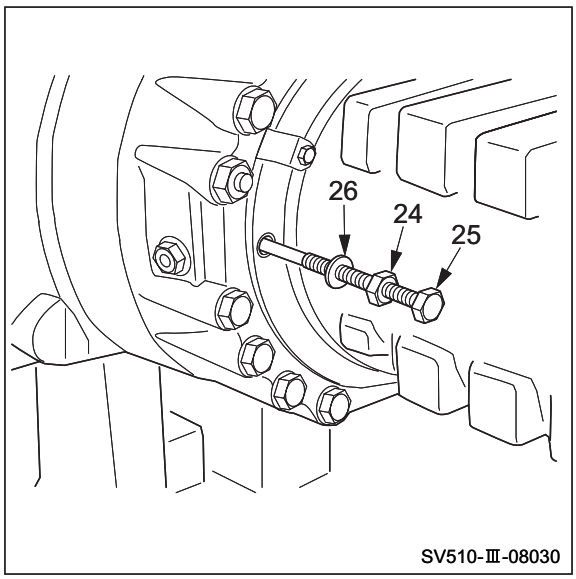
★ After bolt end makes contact with disc (16), strictly observe not tightening bolt (25) more than one complete turn.



SV510-Ⅲ-08029

13-2. Adjustment after Manual Release of Brake

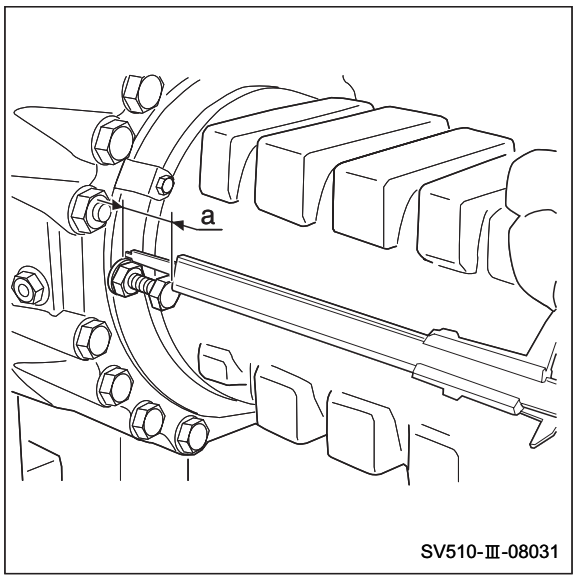
① Remove bolt (25), nut (24), and seal washer (26).
② Replace seal washer (26) with a new one.
③ Apply grease to bolt (25) threads.
④ As shown on the right, install bolt (25), nut (24), and seal washer (26).



SV510-Ⅲ-08030

⑤ Adjust bolt (25) to the dimensions as shown on the right.
• Similarly, adjust the bolt on the opposite side.

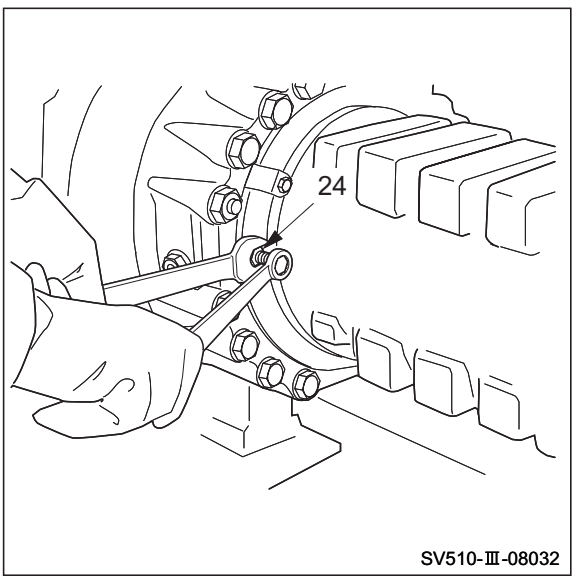
★ Specified dimension a: $34\ ^{+0.5}_{0}$ mm ($1.34\ ^{+0.02}_{0}$ in.)



SV510-Ⅲ-08031

⑥ Tighten nut (24), and firmly secure bolt (25).

★ When tightening nut (24), make sure that bolt (25) does not move. After securing bolt, check the dimensions of bolt again.

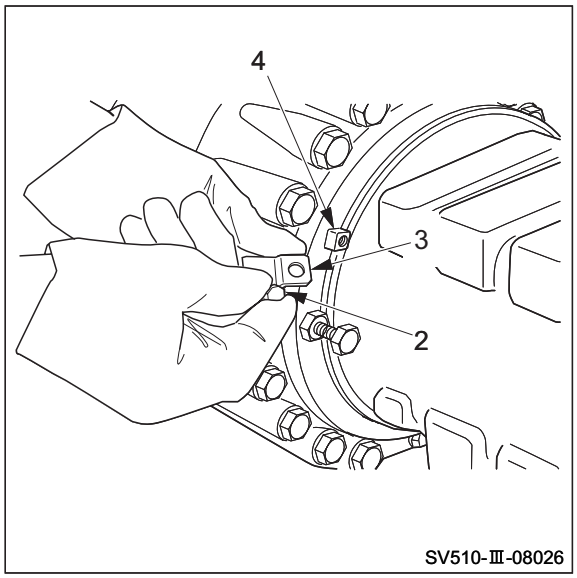


SV510-Ⅲ-08032

13-3. Brake Clearance Adjustment (Type 1 only)

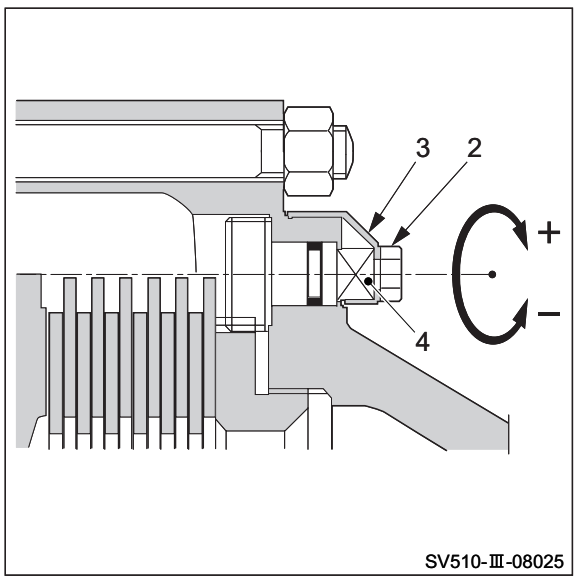
- Remove bolt (2) and lock plate (3).
- Rotate adjustment pinion (4) counterclockwise to eliminate all existing clearance between braking discs.

N•m Rotate up to a torque of 8 to 10 N·m (5.9 to 7.4 lbf·ft)



- Rotate pinion (4) clockwise to determine the required clearance of 1 mm (0.04 in.).
  - Clearance change rate : 0.25 mm/turn (0.010 in./turn)
- Install lock plate (3) and lock with bolt (2).

N•m (2) Bolt : 10 to 11 N·m (7.4 to 8.1 lbf·ft)



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.

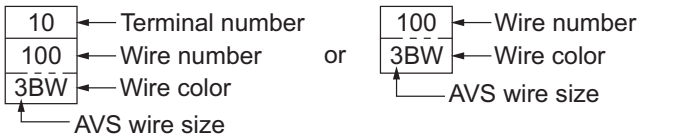
1-3. Before Starting

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:

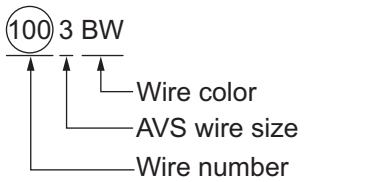
1. If not familiar with the machine, study the Operator's Manual and this Shop Manual.
2. Check with the operator for full details of the trouble, ask questions.
3. Verify the trouble by warming up the machine and operating it. Check the problem yourself.
4. Identify the problem with either a mechanical, 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.

1-4. Wire Color Code and Number



GW750-2-10001

- The arrangement of connector terminals shown above is that of connecting surfaces on the connector side.



SW880-11020

- Wire number, wire size and wire color are shown as above in electrical circuit diagrams.

B	Black	BW	Black/ White stripe	BY	Black/ Yellow stripe	BR	Black/ Red stripe	BG	Black/ Green stripe	BL	Black/ Blue stripe			O	Orange	YO	Yellow/ Orange stripe
W	White	WR	White/ Red stripe	WB	White/ Black stripe	WL	White/ Blue stripe	WY	White/ Yellow stripe	WG	White/ Green stripe					LO	Blue/ Orange stripe
R	Red	RW	Red/ White stripe	RB	Red/ Black stripe	RY	Red/ Yellow stripe	RG	Red/ Green stripe	RL	Red/ Blue stripe					GO	Green/ Orange stripe
G	Green	GW	Green/ White stripe	GR	Green/ Red stripe	GY	Green/ Yellow stripe	GB	Green/ Black stripe	GL	Green/ Blue stripe			Gy	Gray	GyR	Gray/ Red stripe
Y	Yellow	YR	Yellow/ Red stripe	YB	Yellow/ Black stripe	YG	Yellow/ Green stripe	YL	Yellow/ Blue stripe	YW	Yellow/ White stripe					GyL	Gray/ Blue 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	Sb	Sky blue		
L	Blue	LW	Blue/ White stripe	LR	Blue/ Red stripe	LY	Blue/ Yellow stripe	LB	Blue/ Black stripe	LG	Blue/ Green stripe			P	Pink	PB	Pink/ Black 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			Pu	Purple		

2. ELECTRICAL SYSTEM TROUBLESHOOTING

2-1. When Performing Electrical System Fault Diagnosis

⚠ WARNING

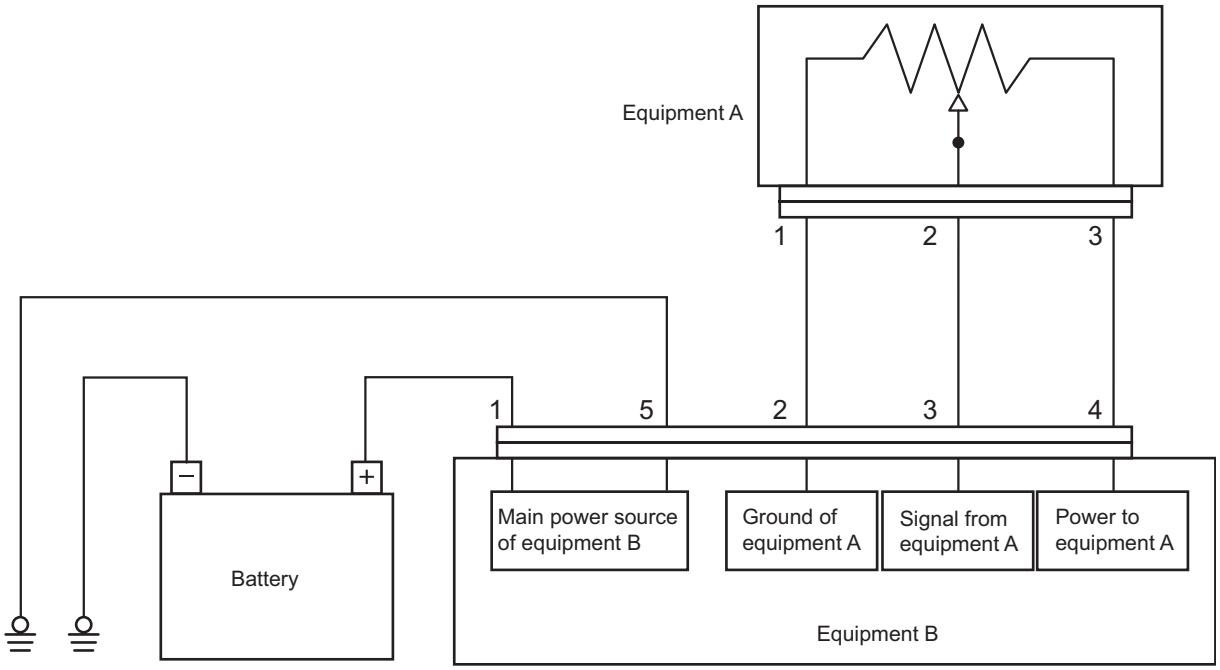
Be very careful because equipment can return to normal during an inspection and suddenly operate properly when a failure occurs due to a faulty contact or other such cause.

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.

2-1-2. Inspection procedures using a tester

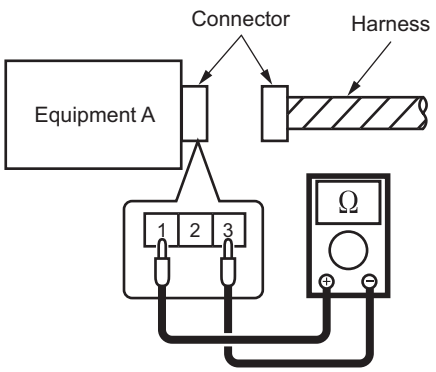
Some of the various inspection procedures are presented here for reference, using a sample circuit below.

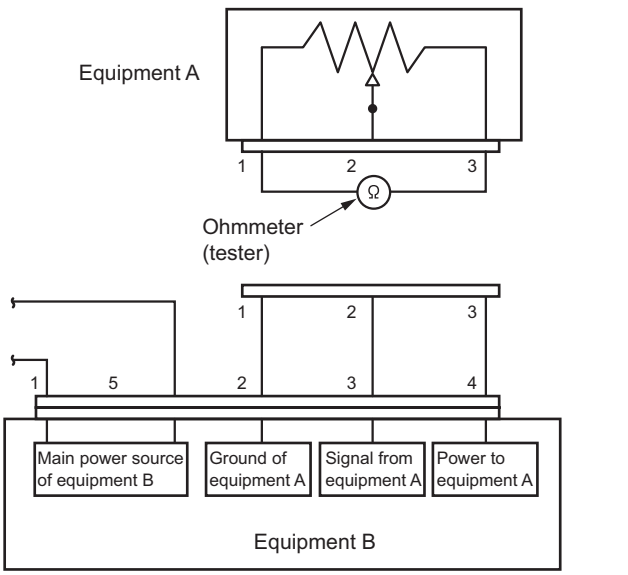


GW750-2-10003

1) Measuring resistance using tester

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





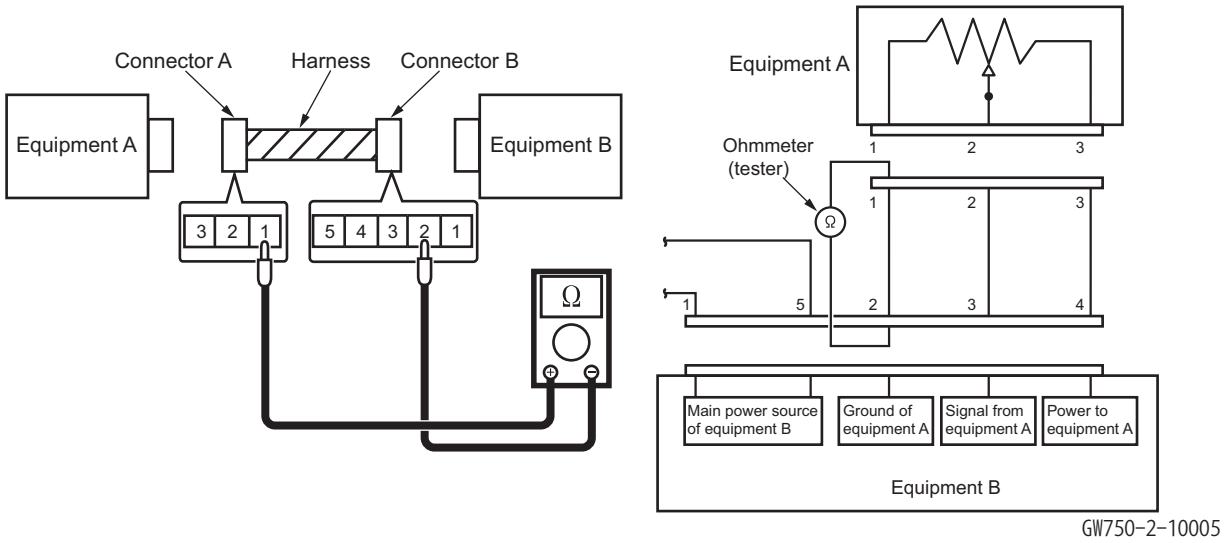
GW750-2-10004

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)



GW750-2-10005

Inspection procedure

① Disconnect the connectors of equipment A and equipment B.

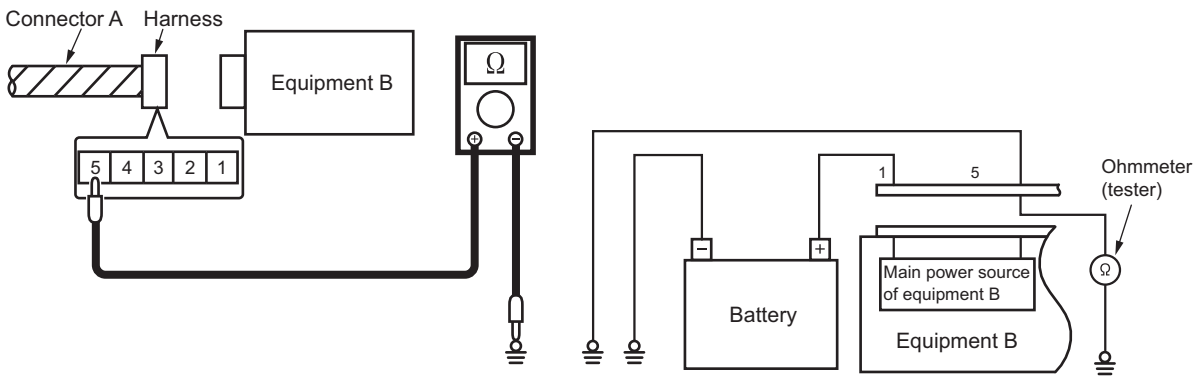
② Connect the test probe (+) to connector terminal 1 of equipment A and the test probe (-) to connector terminal 2 of equipment B and measure the resistance. At this time, reversing the connector terminals between the probes (+) and (-) does not make any difference in the measurement.

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)



GW750-2-10006

Inspection procedure

① Disconnect the connector of equipment B.

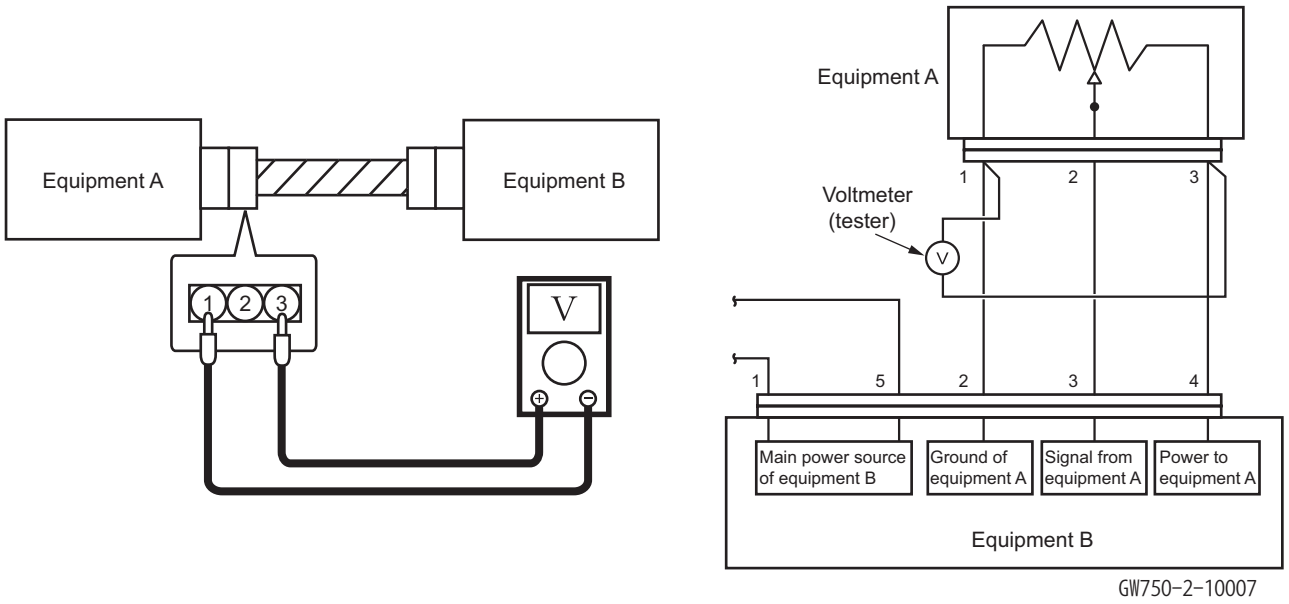
② Connect the test probe (+) to connector terminal 5 of equipment B and the test probe (-) to a machine ground point (the bolt fastening the ground terminal or an unpainted portion on the body) and measure the resistance. At this time, reversing the connector terminals between the probes (+) and (-) 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)

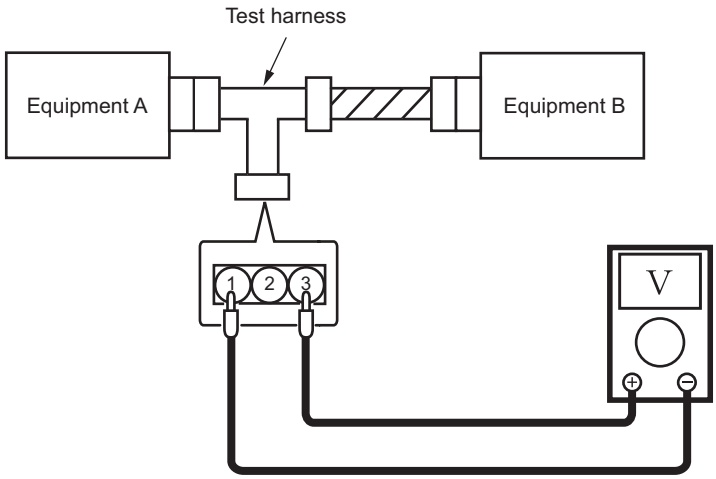


Inspection procedure

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

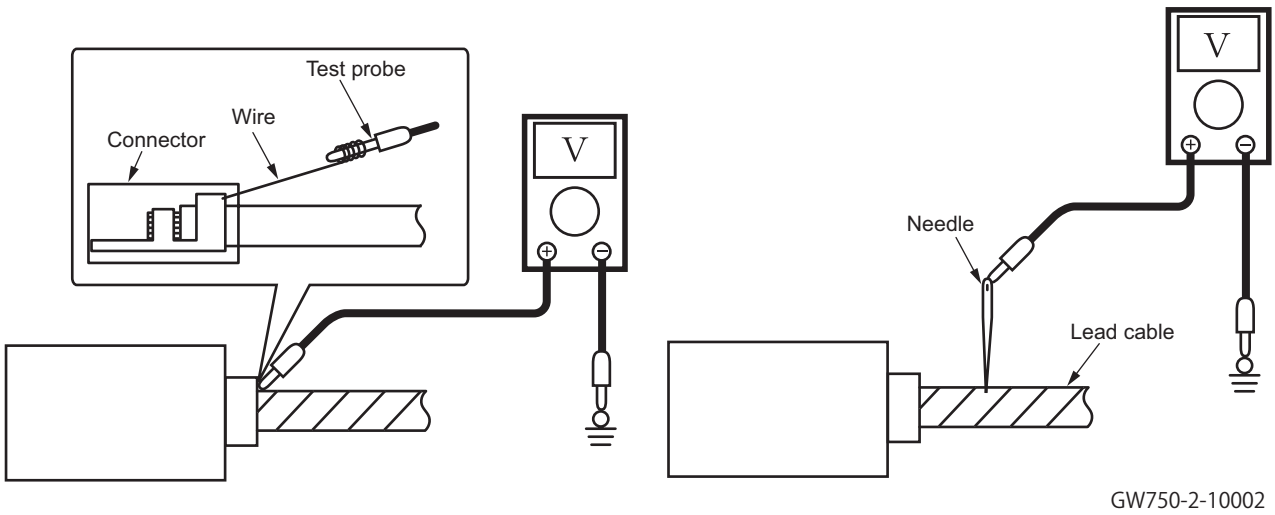
② Connect the test probe (+) to connector terminal 3 of equipment A and the test probe (-) to connector terminal 1 of equipment A and measure the voltage. Note that reversing the connector terminals between the probes (+) and (-) changes the result of the measurement. Be sure to connect the probe (+)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

・Measurement using a test harness



・Measurement from the backside of connector

・Measurement on a lead cable



Measurement method

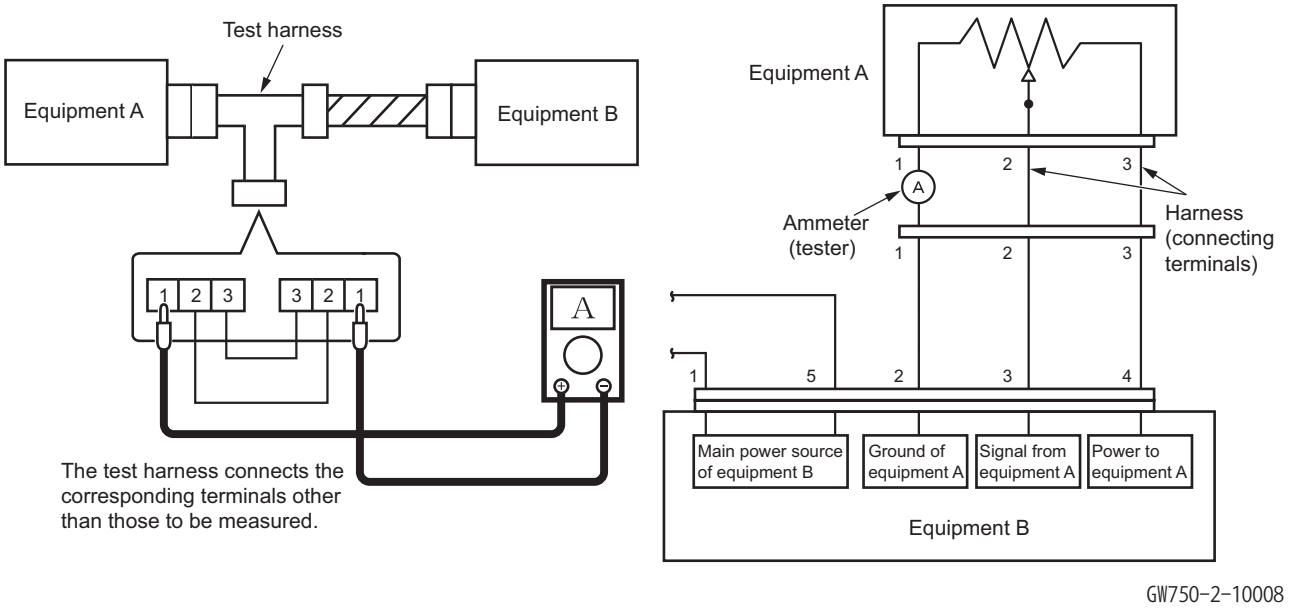
For measurement of voltage, connect the tester probes in parallel to the portion to be measured. Because the voltage can be measured only when the connector is connected in position, contact the tester probes to the terminals without disconnecting the connector. The following methods are available:

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

(NOTICE)

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

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



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. Fault Codes

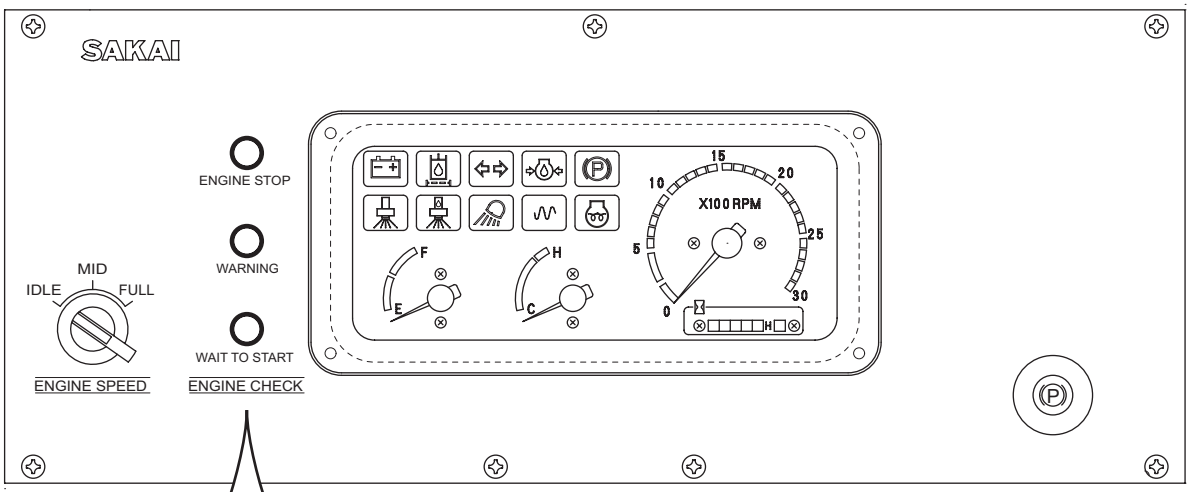
2-2-1. Description of fault codes

The electronic engine control system can display and record certain detectable fault conditions. These failures are displayed as fault codes, which make troubleshooting easier. The fault codes are retained in the ECM.

There are two types of diagnostic codes:

- Engine electronic control system fault codes are to inform the operator that there is a problem with the control system that will require troubleshooting.
- Information and engine protection fault codes are to inform the operator that the control system has detected an engine condition outside the normal operating range.

- All fault codes recorded will either be active (fault code is currently active on the engine) or inactive (fault code was active at some time, but is not currently active).
- The “ENGINE STOP” light is red and indicates the need to stop the engine as soon as it can be safely done. The engine must remain shutdown until the fault can be repaired.
- The “WARNING” light is orange and indicates the need to repair the fault at the first available opportunity.
- Maintenance type fault codes will flash the orange warning light for 30 seconds after the starter switch is turned to the “ON” position when one of the following occurs: maintenance is required (if maintenance monitor is turned on) or if water-in-fuel is detected.
  If the warning light flashes for 30 seconds at starter switch is “ON” position and water is drained from the primary, fuel sedimenter, then the secondary filter must be replaced.



ENGINE STOP (RED)	ENGINE STOP
WARNING	WARNING (ORANGE)
*Engine is not functioning normally pull over and stop	*May loose some feature *Proceed and repair as soon as convenient

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2-2-2. Reading procedures of fault codes

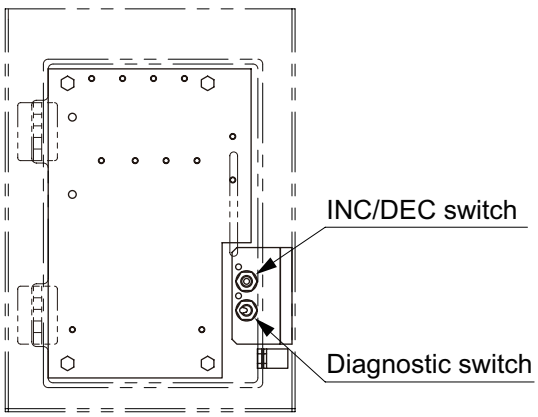
- Fault codes can be accessed in at least two different ways; using the electronic service tool, or fault code flash out.
- To check for active engine electronic fuel system and engine protection system fault codes, turn the starter switch OFF and move the diagnostic switch to the ON position.

1) Turn the starter switch to the ON position.
   - If no active fault codes are recorded, both “ENGINE STOP” and “WARNING” lights will come on and stay on.
   - If active fault codes are recorded, both “ENGINE STOP” and “WARNING” lights will come on momentarily then begin to flash the code of the recorded faults.

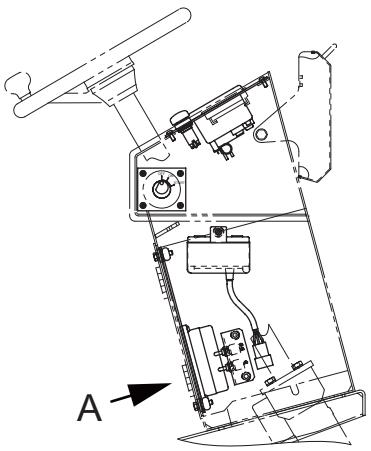
2) The fault code will flash in the following sequence:
   ① First, a “WARNING” (orange) light will flash.
   ② Then there will be a short one or two seconds pause after which the number of the recorded fault code will flash in “ENGINE STOP” (red).
   ③ There will be a one or two second pause between each number.
   ④ When the number has finished flashing in red, an orange light will appear again.

3) The lights flash each fault code out three times before advancing to the next code. To skip to the next fault code, move the INC/DEC switch momentarily to the increment (+) position. You can go back to the previous fault code by momentarily moving the INC/DEC switch to the decrement (-) position. If only one active fault is recorded, the same fault code will continuously be displayed when either (+) or (-) switch is depressed. The explanation of the fault codes is in 2-2-3. Fault code list.

4) When not using the diagnostic system, turn off the diagnostic switch.



VIEW A



Example Fault Code Sequence

Fault Code 235 :

○ ENGINE STOP	1～2 seconds Pause	☼ ☼ ENGINE STOP 2 Blink	1～2 seconds Pause	☼ ☼ ☼ ENGINE STOP 3 Blink	1～2 seconds Pause	☼☼☼☼☼ ENGINE STOP 5 Blink	1～2 seconds Pause	○ ENGINE STOP
☼ WARNING 1 Blink		○ WARNING		○ WARNING		○ WARNING		☼ WARNING 1 Blink

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2-2-3. Fault code list

Fault code (Lamp)	Reason	Effect
115 (Red)	Engine magnetic crankshaft speed/position lost both of two signals • Data erratic, intermittent, or incorrect. The ECM has detected that the primary engine speed sensor and the backup engine speed sensor signals are reversed.	Fueling to the injectors is disabled and the engine cannot be started.
122 (Orange)	Intake manifold 1 pressure sensor circuit • Voltage above normal or shorted to high source. High signal voltage detected at the intake manifold pressure circuit.	Derate in power output of the engine.
123 (Orange)	Intake manifold 1 pressure sensor circuit • Voltage below normal or shorted to low source. Low signal voltage detected at the intake manifold pressure circuit.	Derate in power output of the engine.
135 (Orange)	Engine oil rifle pressure 1 sensor circuit • Voltage above normal or shorted to high source. High signal voltage detected at the engine oil pressure circuit.	None on performance. No engine protection for oil pressure.
141 (Orange)	Engine oil rifle pressure 1 sensor circuit • Voltage below normal or shorted to low source. Low signal voltage detected at engine oil pressure circuit.	None on performance. No engine protection for oil pressure.
143 (Orange)	Engine oil rifle pressure • Data valid but below normal operation range. • Moderately severe level. Engine oil pressure signal indicates engine oil pressure is below the engine protection warning limit.	None on performance.
144 (Orange)	Engine coolant temperature 1 sensor circuit • Voltage above normal or shorted to high source. High signal voltage or open circuit detected at engine coolant temperature circuit.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for engine coolant temperature.
145 (Orange)	Engine coolant temperature 1 sensor circuit • Voltage below normal or shorted to low source. Low signal voltage detected at engine coolant temperature circuit.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for engine coolant temperature.
146 (Orange)	Engine coolant temperature • Data valid but above normal operation range. • Moderately severe level. Engine coolant temperature signal indicates engine coolant temperature is above engine protection warning limit.	Progressive power derate increasing in severity from time of alert.
151 (Red)	Engine coolant temperature • Data valid but above normal operation range. • Most severe level. Engine coolant temperature signal indicates engine coolant temperature above engine protection critical limit.	Progressive power derate increasing in severity from time of alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red stop lamp starts flashing.
153 (Orange)	Intake manifold 1 temperature sensor circuit • Voltage above normal or shorted to high source. High signal voltage detected at intake manifold air temperature circuit.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for intake manifold air temperature.

Fault code (Lamp)	Reason	Effect
154 (Orange)	Intake manifold 1 temperature sensor circuit • Voltage below normal or shorted to low source. Low signal voltage detected at intake manifold air temperature circuit.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for intake manifold air temperature.
155 (Red)	Intake manifold 1 temperature • Data valid but above normal operation range. • Most severe level. Intake manifold air temperature signal indicates intake manifold air temperature above engine protection critical limit.	Progressive power derate increasing in severity from time of alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red stop lamp starts flashing.
187 (Orange)	Sensor supply 2 circuit • Voltage below normal or shorted to low source. Low voltage detected at the sensor supply Number 2 circuit.	Engine power derate.
195 (Orange)	Coolant level sensor 1 circuit • Voltage above normal or shorted to high source. High signal voltage detected at engine coolant level circuit.	None on performance.
196 (Orange)	Coolant level sensor 1 circuit • Voltage below normal or shorted to low source. Low signal voltage detected at engine coolant level circuit.	None on performance.
197 (Orange)	Coolant level • Data valid but below normal operation range. • Moderately severe level. Low engine coolant level detected.	None on performance.
221 (Orange)	Barometric pressure sensor circuit • Voltage above normal or shorted to high source. High signal voltage detected at barometric pressure circuit.	Engine power derate.
222 (Orange)	Barometric pressure sensor circuit • Voltage below normal or shorted to low source. Low signal voltage detected at barometric pressure circuit.	Engine power derate.
227 (Orange)	Sensor supply 2 circuit • Voltage above normal or shorted to high source. High voltage detected at sensor supply number 2 circuit.	Engine power derate.
234 (Red)	Engine Crankshaft speed/position • Data valid but above normal operation range. • Most severe level. Engine speed signal indicates engine speed above engine protection limit.	Fuel injection disabled until engine speed falls below the overspeed limit.
235 (Red)	Coolant level • Data valid but below normal operation range. • Most severe level. Low engine coolant level detected.	Progressive power derate increasing in severity from time of alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red stop lamp starts flashing.
238 (Orange)	Sensor supply 3 circuit • Voltage below normal or shorted to low source. Low voltage detected on the +5 VDC sensor supply circuit to the engine speed sensor.	Possible hard starting and rough running.

Fault code (Lamp)	Reason	Effect
239 (Orange)	Engine position sensor main supply • Out of range high. • Error.	—
261 (Orange)	Engine Fuel Temperature • Data valid but above normal operation range. • Moderately severe level. Engine fuel temperature 1 signal indicates engine fuel temperature is above engine protection warning limit.	Calibration dependent progressive power and speed derate and engine shutdown with increasing time after alert.
271 (Orange)	Fuel pump pressurizing assembly 1 circuit • Voltage below normal or shorted to low source. Low signal voltage detected at the fuel pump pressurizing assembly 1 circuit.	Engine will run poorly at idle. Engine will have low power. Fuel pressure will be higher than commanded.
272 (Orange)	Fuel pump pressurizing assembly 1 circuit • Voltage above normal or shorted to high source. High signal voltage or open circuit detected at the fuel pump pressurizing assembly 1 circuit.	Engine will not run or engine will run poorly.
281 (Orange)	APC diesel cylinder pressure imbalance error • A pumping imbalance between the front and rear pumping plungers has been detected.	Engine will not run or possible low power.
285 (Orange)	SAE J1939 multiplexing PGN timeout error • Abnormal update rate. The ECM did not receive a multiplexed message from vehicle electronic control unit within the time limit or did not receive it at all.	One or more multiplexed devices will not operate properly. One or more symptoms will occur.
286 (Orange)	SAE J1939 multiplexing configuration error • Out of calibration. The ECM expected information from a multiplexed device but only received a portion of the necessary information.	At least one multiplexed device will not operate properly.
287 (Orange)	SAE J1939 multiplexed accelerator pedal or lever sensor system • Received network data in error. The vehicle electronic control unit detected a fault with its accelerator pedal.	Engine may only idle or engine will not accelerate to full speed.
288 (Red)	SAE J1939 multiplexing remote accelerator pedal or lever position sensor circuit • Received network data in error. The vehicle electronic control unit detected a fault with remote accelerator.	The engine will not respond to the remote throttle. Engine may only idle. The primary or cab accelerator may be able to be used.
295 (Orange)	Ambient air pressure sensor • Error detected at initial start. The ambient air pressure sensor is reading an erratic value when starter switch is turned to ON position.	Engine power derate.
322 (Orange)	Injector solenoid driver cylinder 1 circuit • Current below normal or open circuit. High resistance or no current detected at Number 1 injector driver or return pin.	Engine can misfire or possibly run rough.
323 (Orange)	Injector solenoid driver cylinder 5 circuit • Current below normal or open circuit. High resistance or no current detected at number 5 injector driver or return pin.	Engine can misfire or possibly run rough.

Fault code (Lamp)	Reason	Effect
324 (Orange)	Injector solenoid driver cylinder 3 circuit • Current below normal or open circuit. High resistance or no current detected at number 3 injector driver or return pin.	Engine can misfire or possibly run rough.
325 (Orange)	Injector solenoid driver cylinder 6 circuit • Current below normal or open circuit. High resistance or no current detected at number 6 injector driver or return pin.	Engine can misfire or possibly run rough.
331 (Orange)	Injector solenoid driver cylinder 2 circuit • Current below normal or open circuit. High resistance or no current detected in number 2 injector driver or return pin.	Engine can misfire or possibly run rough.
332 (Orange)	Injector solenoid driver cylinder 4 circuit • Current below normal or open circuit. High resistance or no current detected in number 4 injector driver or return pin.	Engine can misfire or possibly run rough.
334 (Orange)	Engine coolant temperature • In-range error. The engine coolant temperature reading is not changing with engine operation conditions.	The ECM will estimate engine coolant temperature.
342 (Red)	Electronic calibration code incompatibility • Out of calibration. An incompatible calibration between the primary and secondary installed ECM's has been detected.	None on performance.
343 (Orange)	Electronic control module warning internal hardware failure • Bad intelligent device or component.	No performance effects or possible severe power derate.
351 (Orange)	Injector power supply • Bad intelligent device or component. The ECM measured injector boost voltage is low.	Possible smoke, low power, engine misfire, and/or engine will not start.
352 (Orange)	Sensor supply 1 circuit • Voltage below normal or shorted to low source. Low voltage detected at sensor supply number 1 circuit.	Engine power derate.
386 (Orange)	Sensor supply 1 circuit • Voltage above normal or shorted to high source. High voltage detected at sensor supply number 1 circuit.	Engine power derate.
415 (Red)	Engine oil rifle pressure • Data valid but below normal operation range. • Most severe level. Oil pressure signal indicates oil pressure below the engine protection critical limit.	Progressive power derate increasing in severity, from time if alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red stop lamp starts flashing.
418 (Maintenance)	Water in fuel indicator • Data valid but above normal operation range. • Least severe level. Water has been detected in the fuel filter.	Possible white smoke, loss of power, or hard starting.
421 (Orange)	Engine oil temperature • Data valid but above normal operation range. • Moderately severe level. Engine oil temperature 1 signal indicates engine oil temperature is above engine protection warning limit.	Severity based torque derate.

Fault code (Lamp)	Reason	Effect
422 (Orange)	Coolant level reading incorrect.	No action taken by the ECM.
425 (Orange)	Oil temperature in-range error.	No action taken by the ECM.
426 (None)	SAE J1939 datalink • Data erratic, intermittent, or incorrect. Communication between the ECM and another device on the SAE J1939 datalink has been lost.	None on performance. J1939 devices possibly do not operate.
435 (Orange)	Engine oil pressure switch error. An error in the engine oil pressure switch signal was detected by the ECM.	None on performance. No engine protection for oil pressure.
441 (Orange)	Battery 1 voltage • Data valid but below normal operation range. • Moderately Severe Level. ECM supply voltage is below the minimum system voltage level.	Engine may stop running or be difficult to start.
442 (Orange)	Battery 1 Voltage • Data valid but above normal operation range. • Moderately severe level. ECM supply voltage is above the maximum system voltage level.	Possible electrical damage to all electrical components.
449 (Red)	Injector metering rail 1 pressure • Data valid but above normal operation range. • Most severe level.	None or possible engine noise associated with higher injection pressures (especially at idle or light load). Engine power is reduced.
451 (Orange)	Injector metering rail 1 pressure sensor circuit • Voltage above normal or shorted to high source. High signal voltage detected at the rail fuel pressure sensor circuit.	Power and/or speed derate.
452 (Orange)	Injector metering rail 1 pressure sensor circuit • Voltage below normal or shorted to low source. Low signal voltage detected at the rail fuel pressure sensor circuit.	Power and/or speed derate.
488 (Orange)	Intake manifold 1 temperature • Data valid but above normal operation range. • Moderately severe level. Intake manifold air temperature signal indicates intake manifold air temperature is above the engine protection warning limit.	Progressive power derate increasing in severity from time of alert.
546 (Orange)	Fuel delivery pressure sensor circuit • Voltage above formal or shorted to high source.	No action taken by the ECM.
547 (Orange)	Fuel delivery pressure sensor circuit • Voltage below normal or shorted to low source.	No action taken by the ECM.
553 (Orange)	Injector metering rail 1 pressure • Data valid but above normal operation range. • Moderately severe level. The ECM has detected that fuel pressure is higher than commanded pressure.	None or possible engine noise associated with higher injection pressures (especially at idle or light load). Engine power is reduced.
554 (Orange)	Injector metering rail 1 pressure • Data erratic, intermittent, or incorrect. The ECM has detected that the fuel pressure signal is not changing.	The ECM will estimate fuel pressure and power is reduced.

Fault code (Lamp)	Reason	Effect
559 (Orange)	Injector metering rail 1 pressure • Data valid but below normal operation range. • Moderately severe level. The ECM has detected that fuel pressure is lower than commanded pressure.	Possibly hard to start, low power or engine smoke.
689 (Orange)	Engine crankshaft speed/position • Data erratic, intermittent, or incorrect. Loss of signal from crankshaft sensor.	Engine can run rough. Possibly poor starting capability. Engine runs using backup speed sensor. Engine power is reduced.
731 (Orange)	Engine speed/position camshaft and crankshaft misalignment • Mechanical system not responding properly or out of adjustment. Mechanical misalignment between the crankshaft and camshaft engine speed sensors.	Engine will run derated. Excessive black smoke, hard start, and rough idle possible.
951 (None)	Cylinder power imbalance between cylinders. A power imbalance between cylinders was detected by the ECM.	Possible low power, rough idle, or misfire.
1117 (None)	Power supply lost with ignition on • Data erratic, intermittent, or incorrect. Supply voltage to the ECM fell below 6.2 VDC momentarily, or the ECM was not allowed to power down correctly (retain battery voltage for 30 seconds after starter switch OFF).	Possible no noticeable performance effects or engine dying or hard starting. Fault information, trip information, and maintenance monitor data may be inaccurate.
1376 (Maintenance)	Engine camshaft speed/position sensor • Data erratic, intermittent, or incorrect. The ECM has detected an error in the engine camshaft speed/position signal.	Possible poor starting. Engine power derate.
1383 (Orange)	Intake manifold 1 pressure sensor circuit • Voltage above normal or shorted to high source. High signal voltage detected at the intake manifold 1 pressure circuit.	Engine power derate to no air setting.
1384 (Orange)	Intake manifold 1 pressure sensor circuit • Voltage below normal or shorted to low source. Low signal voltage detected at the intake manifold 1 pressure circuit.	Engine power derate to no air setting.
1411 (Orange)	Generator output frequency adjust potentiometer circuit • Voltage above normal or shorted to high source.	No action taken by the ECM.
1412 (Orange)	Droop adjust potentiometer circuit • Voltage above normal or shorted to high source.	No action taken by the ECM.
1418 (Orange)	Gain adjust potentiometer circuit • Voltage above normal or shorted to high source.	No action taken by the ECM.
1597 (Maintenance)	Electronic control module critical internal failure • Bad intelligent device or component.	No action taken by the ECM.
1695 (Orange)	Sensor supply 5 • Voltage high error.	No action taken by the ECM.
1696 (Orange)	Sensor Supply 5 • Voltage low error.	No action taken by the ECM.

Fault code (Lamp)	Reason	Effect
1845 (Maintenance)	Water in fuel indicator sensor circuit • Voltage above normal or shorted to high source.	No action taken by the ECM.
1846 (Maintenance)	Water in fuel indicator sensor circuit • Voltage below normal or shorted to low source.	No action taken by the ECM.
1911 (Orange)	Injector metering rail 1 pressure • Data valid but above normal operation range • Most severe level.	No action taken by the ECM.
1978 (Orange)	Generator speed/load governing bias circuit • Voltage above normal or shorted to high source.	No action taken by the ECM.
1979 (Orange)	Generator speed/load governing bias circuit • Voltage below normal or shorted to low source.	No action taken by the ECM.
1992 (Red)	Engine crankshaft speed/position • Data valid but above normal operation range. • Moderately severe level.	No action taken by the ECM.
2215 (Orange)	Fuel pump delivery pressure • Data valid but below normal operation range. • Moderately severe level. The ECM has detected that fuel pressure is lower than commanded pressure.	Possible hard to start, low power, or engine smoke.
2249 (Orange)	Injector metering rail 1 pressure • Data valid but below normal operation range. • Most severe level. The ECM has detected that fuel pressure is lower than commanded pressure.	Possibly hard to start, low power, or engine smoke.
2261 (Maintenance)	Fuel pump delivery pressure • Data valid but above normal operation range. • Least severe level. Fuel pump supply pressure high.	Low power or engine smoke.
2262 (Maintenance)	Fuel pump delivery pressure • Data valid but below normal operation range. • Least severe level. Fuel pump supply pressure low.	Low power.
2265 (Orange)	Electric lift pump for engine fuel supply circuit • Voltage above normal or shorted to high source. High voltage or open detected at the fuel lift pump signal circuit.	Engine may be difficult to start.
2266 (Orange)	Electric lift pump for engine fuel supply circuit • Voltage below normal or shorted to low source. Low signal voltage detected at the fuel lift pump circuit.	Engine may be difficult to start.
2292 (Orange)	Fuel inlet meter device • Data valid but above normal operation range. • Moderately severe level. The flow demand is higher than expected.	Possibly hard to start, low power, and possible engine smoke. Engine power is derated.
2293 (Orange)	Fuel inlet meter device flow demand lower than expected • Data valid but below normal operation range • Moderately severe level. The flow demand is lower than expected.	None or possible engine noise associated with higher injection pressures (especially at idle or light load). Engine power is derated.

Fault code (Lamp)	Reason	Effect
2311 (Orange)	Electronic fuel injection control valve circuit • Condition exists. Fuel pump actuator circuit resistance too high or too low.	Possible low power.
2321 (None)	Engine crankshaft speed/position sensor • Data erratic, intermittent, or incorrect. Crankshaft engine speed sensor intermittent synchronization.	Engine may exhibit misfire as control switches from the primary to the backup speed sensor. Engine power is reduced while the engine operates on the backup speed sensor.
2322 (None)	Engine camshaft speed/position sensor • Data erratic, intermittent, or incorrect. Camshaft engine speed sensor intermittent synchronization.	Possible low power.
2377 (Orange)	Fan control circuit • Voltage above normal or shorted to high source.	No action taken by the ECM.
2555 (Orange)	Intake air heater 1 circuit • Voltage above normal or shorted to high source. High voltage detected at the intake air heater signal circuit.	The intake air heater may be ON or OFF all the time.
2556 (Orange)	Intake air heater 1 circuit • Voltage below normal or shorted to low source. Low voltage detected at the intake air heater signal circuit.	The intake air heater may be ON or OFF all the time.
2973 (Orange)	Intake manifold 1 pressure • Data erratic, intermittent, or incorrect. The ECM has detected an intake manifold pressure signal that is too high or low for current engine operating conditions.	Engine power derate.

(NOTICE)

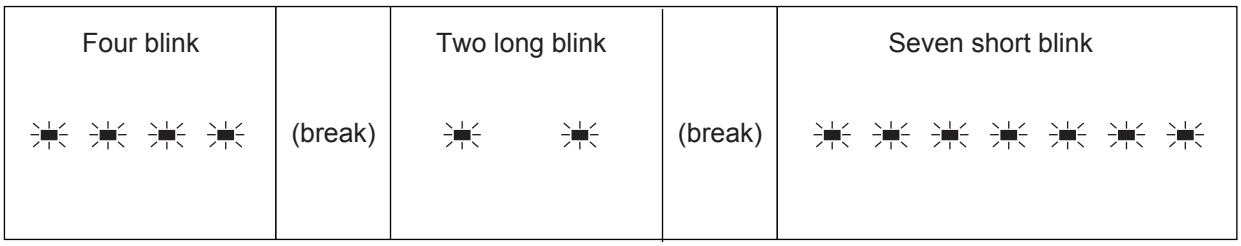
- **For details, refer to “Troubleshooting” in Shop Manual of engine manufacturer.**

2-3. Error Codes

2-3-1. Description of error codes

- The traction control system is comprised of traction control box, motor rotation sensors and motor proportional solenoids. The traction control box receives signals from motor rotation sensors. When the sensor signal indicates that the drum or drive wheels are spinning, the traction control box sends an output signal to the motor proportional solenoid of the spinning drum or drive wheels to reduce the flow to the motor. The flow is then routed to the drum or drive wheel that is not spinning.
- While operating the compactor both the drive wheels and drum begin to spin, the compactor will automatically go to the low travel speed. As the compactor moves out of the area of slippage, it will remain the low travel speed mode regardless of the switch position. The compactor must be placed in neutral to and then returned to the desired position to reset the traction control box.
- The traction control box has two LEDs on the front panel. The green LED illuminates when the traction control box is powered. The red LED is for displaying error codes by number of flashes. The error codes are displayed in a numerical order. A flash code cannot be cleared until the error is corrected. After the error has been corrected the traction control box will indicate the next error code if one is present. The traction control system will not operate properly with active error codes.
- The error codes are assigned a number ranging from 1 to 99. The error codes show up with a four blink “burst” to indicate the start of an error code. This is followed by “long” blinks representing the “tens” value of the error number followed by “short” blinks representing the “one” value.

Example : Error code 27



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2-3-2. Error code list

Rear motor rotation sensor

Error code	Description
1 to 4	Bad speed sensor
5	Frequency voltage too low
6	Frequency voltage too high
7	Broken wire, signal
8	Broken wire, ground
9	Broken wire, power

Front motor rotation sensor

Error code	Description
11 to 14	Bad speed sensor
15	Frequency voltage too low
16	Frequency voltage too high
17	Broken wire, signal
18	Broken wire, ground
19	Broken wire, power

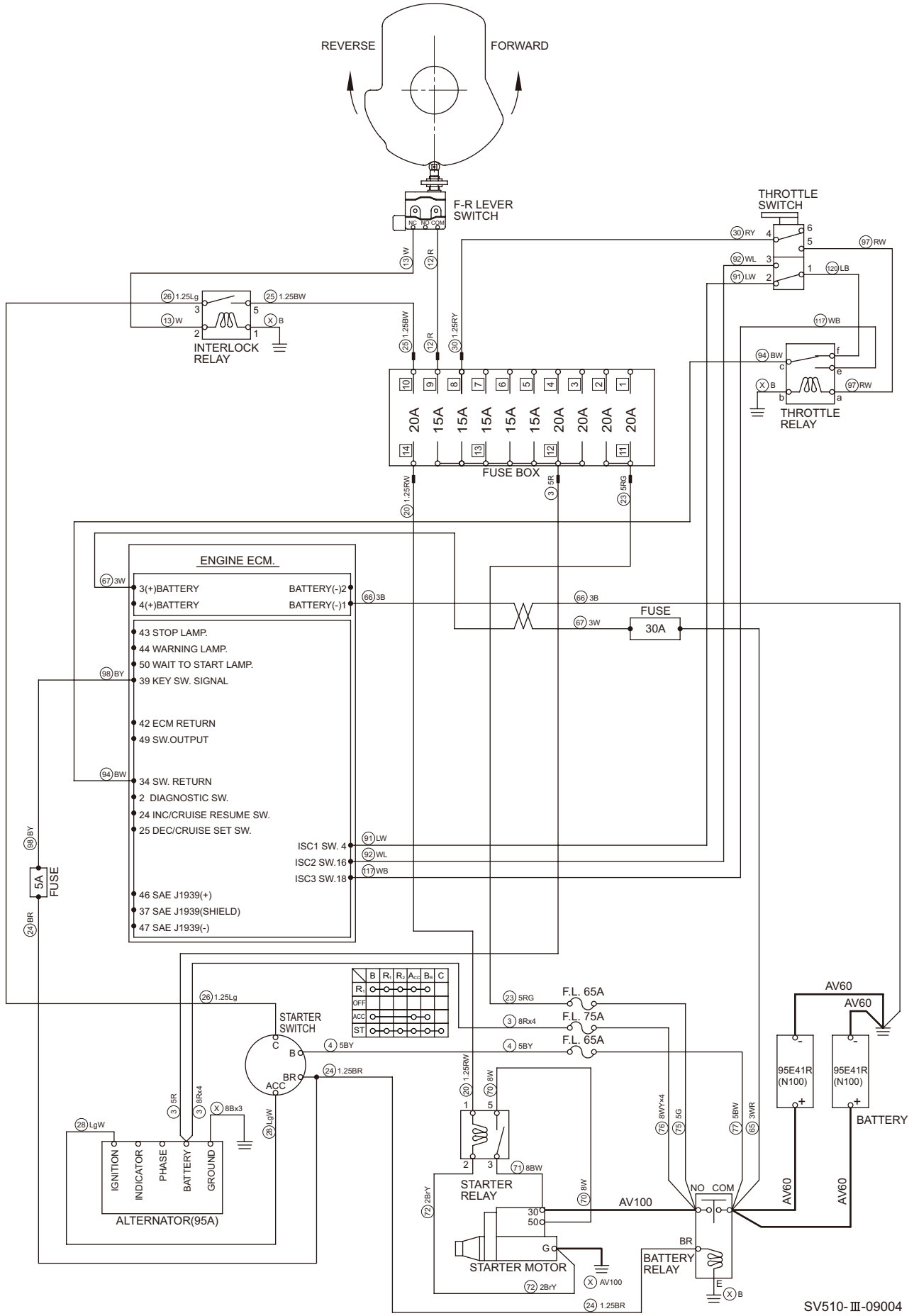
Rear motor proportional solenoid

Error code	Description
21	Current too high or low based on plus 1 pre-sets
22	Current too high or low based on plus 1 pre-sets
23	Open circuit
24	Dead short to coil
25	Bad coil, amps too high

Front motor proportional solenoid

Error code	Description
31	Current too high or low based on plus 1 pre-sets
32	Current too high or low based on plus 1 pre-sets
33	Open circuit
34	Dead short to coil
35	Bad coil, amps too high

Fig.: 2-4-1


REVERSE
FORWARD
F-R LEVER SWITCH
N/C NO COM
THROTTLE SWITCH
INTERLOCK RELAY
THROTTLE RELAY
FUSE BOX
20A 15A 15A 15A 15A 20A 20A 20A 20A
ENGINE ECM.
3(+)BATTERY
4(+)BATTERY
BATTERY(-)2
BATTERY(-)1
43 STOP LAMP.
44 WARNING LAMP.
50 WAIT TO START LAMP.
39 KEY SW. SIGNAL
42 ECM RETURN
49 SW.OUTPUT
34 SW. RETURN
2 DIAGNOSTIC SW.
24 INC/CRUISE RESUME SW.
25 DEC/CRUISE SET SW.
ISC1 SW. 4
ISC2 SW.16
ISC3 SW.18
46 SAE J1939(+)
37 SAE J1939(SHIELD)
47 SAE J1939(-)
FUSE 30A
5A FUSE
STARTER SWITCH
F.L. 65A
F.L. 75A
F.L. 65A
STARTER RELAY
STARTER MOTOR
BATTERY RELAY
IGNITION
INDICATOR
PHASE
BATTERY
GROUND
ALTERNATOR(95A)
AV60
AV60
95E41R (N100)
95E41R (N100)
BATTERY
AV100
AV60
AV60
SV510-Ⅲ-09004

2-4. Engine

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 following using tester” (P.9-006 to P.9-008).
- Check any ground circuit which belongs to components to be checked.
- Engine check lamp must not be lighting. If engine check lamp lights, refer to “Troubleshooting” in shop manual of engine manufacturer.

(NOTICE)

- **If any abnormality is found in shielded twisted wires, repair is not approved. Be sure to replace them.**

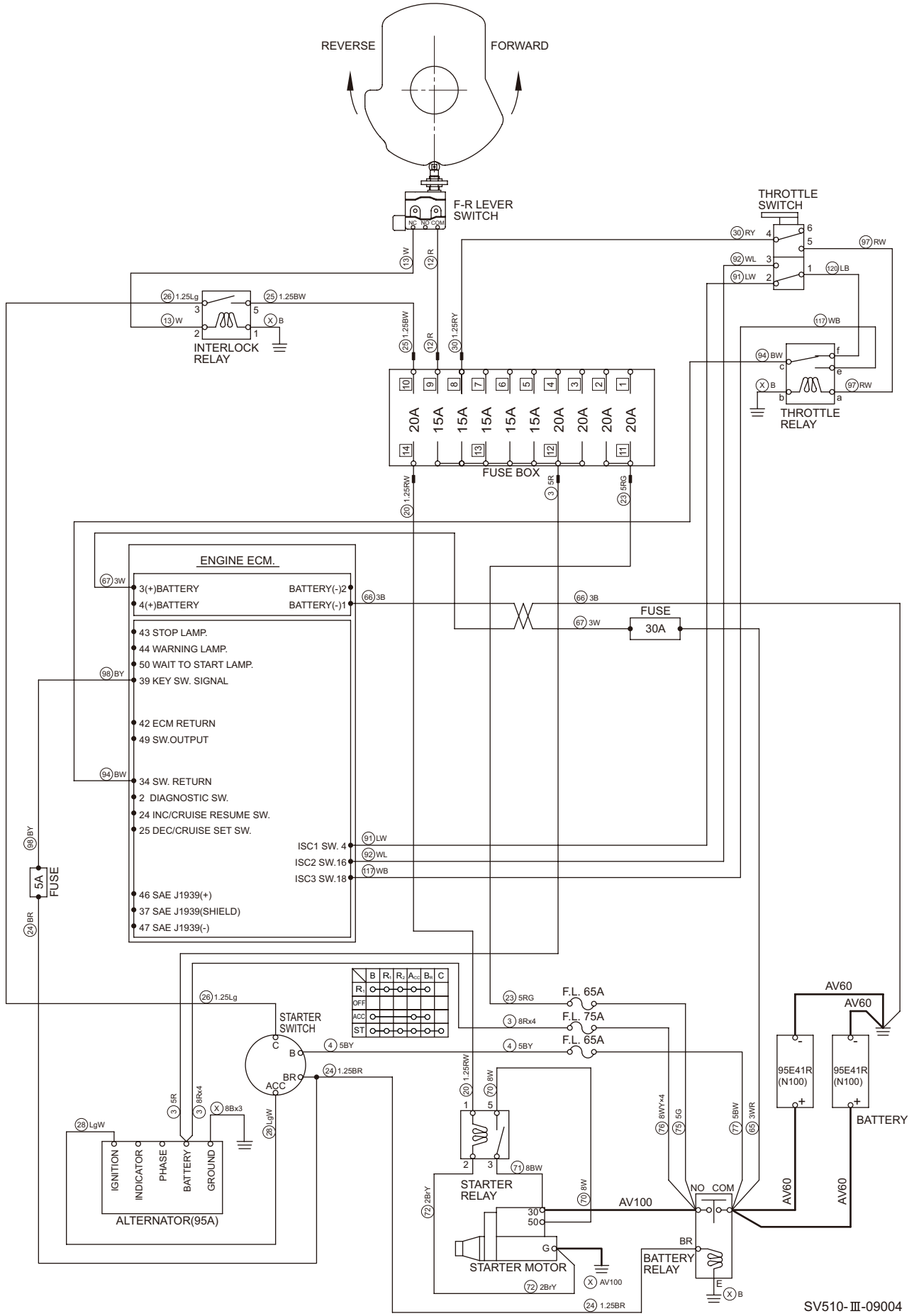
2-4-1. Engine will not start (Starter motor does not run) 1/2

- F-R lever must be in neutral position.

Reference Fig.: 2-4-1

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 30 and chassis ground. Standard voltage : 12 V or more (2) When starter switch is START, measure voltage between starter motor terminal 50 and chassis ground. Standard voltage : 12 V or more • If starter motor does not run even though above items (1) and (2) are OK, starter motor is faulty.	Replace starter motor.
4. 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 BR 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.

Fig.: 2-4-1


REVERSE
FORWARD
F-R LEVER SWITCH
N/C NO COM
THROTTLE SWITCH
INTERLOCK RELAY
THROTTLE RELAY
FUSE BOX
20A 15A 15A 15A 15A 20A 20A 20A 20A
ENGINE ECM.
3(+)BATTERY
4(+)BATTERY
BATTERY(-)2
BATTERY(-)1
43 STOP LAMP.
44 WARNING LAMP.
50 WAIT TO START LAMP.
39 KEY SW. SIGNAL
42 ECM RETURN
49 SW.OUTPUT
34 SW. RETURN
2 DIAGNOSTIC SW.
24 INC/CRUISE RESUME SW.
25 DEC/CRUISE SET SW.
ISC1 SW. 4
ISC2 SW.16
ISC3 SW.18
46 SAE J1939(+)
37 SAE J1939(SHIELD)
47 SAE J1939(-)
FUSE 30A
5A FUSE
STARTER SWITCH
F.L. 65A
F.L. 75A
F.L. 65A
STARTER RELAY
STARTER MOTOR
BATTERY RELAY
AV100
AV60
AV60
95E41R (N100)
95E41R (N100)
BATTERY
IGNITION
INDICATOR
PHASE
BATTERY
GROUND
ALTERNATOR(95A)
SV510-Ⅲ-09004

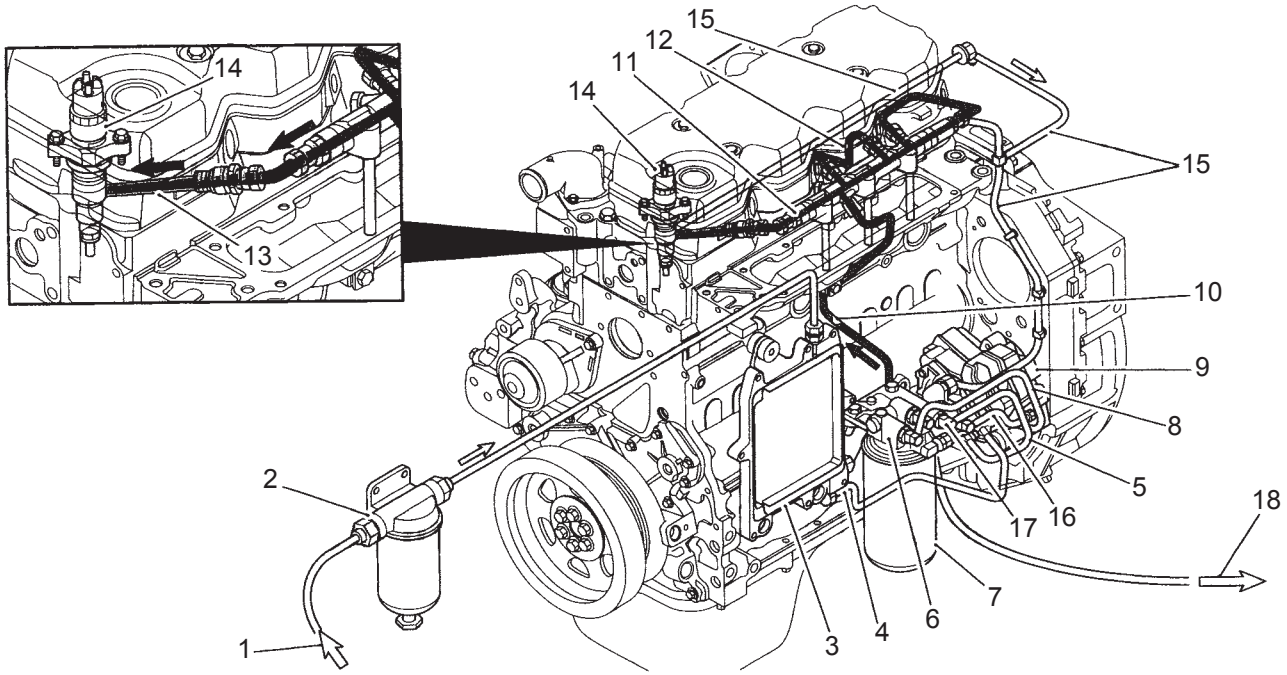
2-4-1. Engine will not start (Starter motor does not run) 2/2

• F-R lever must be in neutral position.

Reference Fig.: 2-4-1

Check point	Check/Cause	Action
5. Starter Relay	(1) When starter switch is START, measure voltage between starter relay terminal 1 inlet wire RW and chassis ground. Standard voltage : 12 V or more (2) When starter switch is START, measure voltage between starter relay terminal 3 inlet wire BW and chassis ground. Standard voltage : 12 V or more (3) When starter switch is START, measure voltage between starter relay terminal 5 outlet wire W 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.
6. F-R Lever Switch	(1) When starter switch is ON, measure voltage between F-R lever switch terminal COM inlet wire R and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between F-R lever switch terminal NC outlet wire W 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.
7. Interlock Relay	(1) When starter switch is ON, measure voltage between interlock relay terminal 2 inlet wire W and chassis ground. Standard voltage : 12 V or more (2) When starter switch is START, measure voltage between interlock relay terminal 3 inlet wire Lg and chassis ground. Standard voltage : 12 V or more (3) When starter switch is START, measure voltage between interlock relay terminal 5 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, interlock relay is faulty.	Replace interlock relay.
8. 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.: 2-4-2



* The actual equipment may differ from that shown above.

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Fuel schematic

1 From fuel tank
2 Fuel pre-filter (not mounted on engine)
3 ECM cooling plate
4 To fuel supply pump
5 To fuel filter
6 Fuel filter head
7 Fuel filter
8 To high pressure pump
9 High pressure pump
10 To fuel rail
11 Fuel rail
12 To injectors
13 High pressure connector
14 Injector
15 Fuel return from injectors and fuel rail to fuel filter head
16 Fuel return from high pressure pump to fuel filter head
17 Fuel return manifold
18 To fuel tank

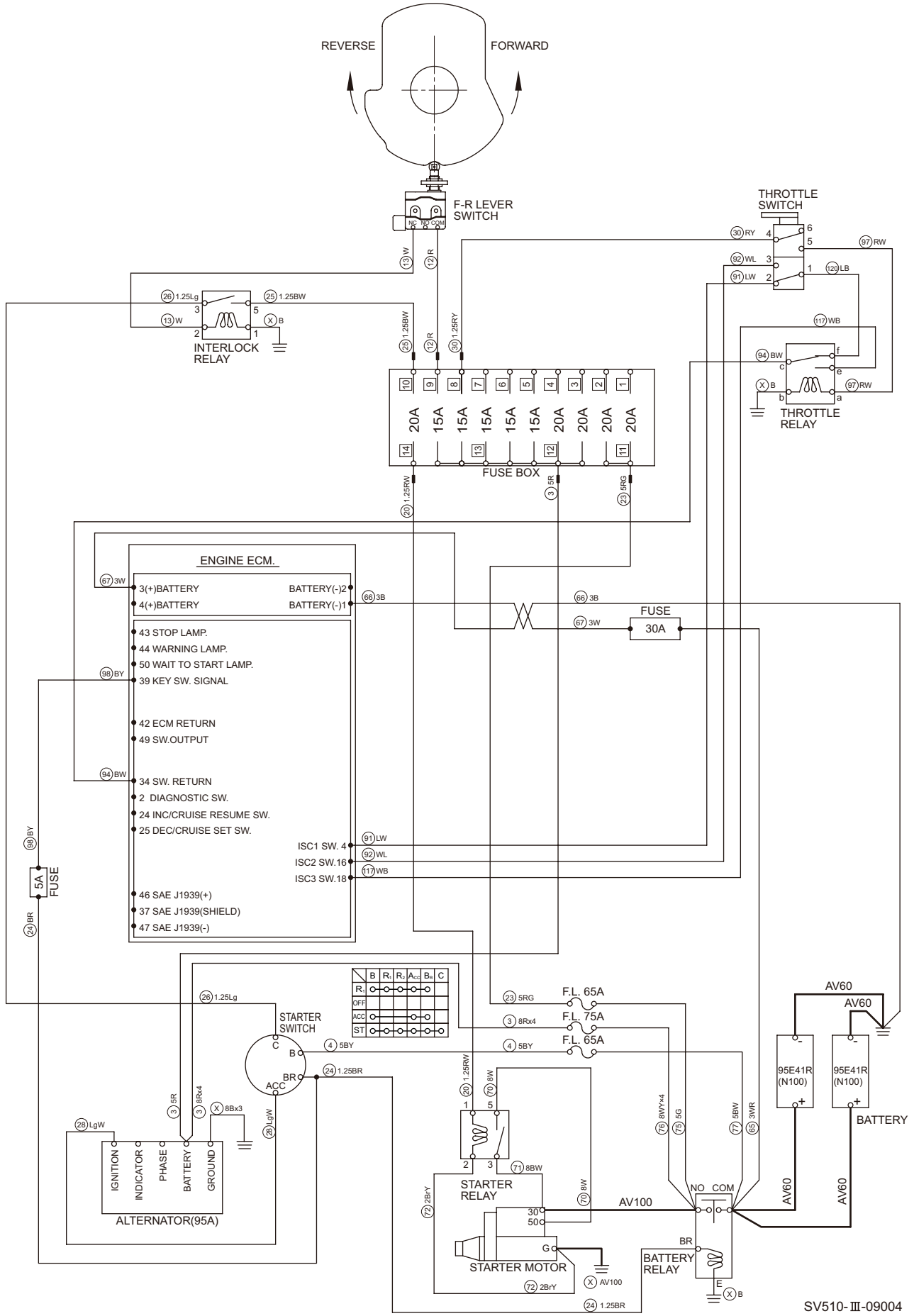
2-4-2. Engine will not start (But starter motor runs)

- **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.: 2-4-2

Check point	Check/Cause	Action
1. Fuel Tank	• Check that fuel tank is filled with diesel oil. • If quantity is low, fuel is not delivered to fuel system.	Fill tank with fuel.
	• Check that there is no water has entered fuel tank. • If water has entered tank, engine does not start.	Drain water from tank.
	• Check that quality of diesel oil is sufficient. • If oil does not meet standard, engine may fail.	Replace fuel in tank with an appropriate one.
2. Fuel Prefilter (with sedimenter), Fuel Filter	• Check that water in sedimenter is not above upper limit. • If amount of water exceeds limit, engine does not start.	Drain water.
	• Check filter for clogging. • Insufficient supply of proper fuel due to clogging of filter. **(NOTICE)** **• Priming should be performed whenever filter is replaced.**	• Replace filter. • Bleed filter.
3. Fuel Supply Pump	• Disconnect hoses and pipes connecting to fuel supply pump and check that fuel flows out of pump. • If fuel does not flow out of pump, it is not delivered to fuel system. **(NOTICE)** **• Air bleeding should be performed whenever fuel supply pump is replaced.**	• Replace fuel supply pump. • Bleed pump.
4. Hoses Connecting Between Parts	• Check hoses and pipes between fuel tank and fuel filter for fuel leakage and clogging. • Hose failure due to deterioration **(NOTICE)** **• Air bleeding should be performed whenever fuel hoses and pipes are replaced.**	Replace hose or pipe.

Fig.: 2-4-1


REVERSE
FORWARD
F-R LEVER SWITCH
N/C NO COM
THROTTLE SWITCH
INTERLOCK RELAY
THROTTLE RELAY
FUSE BOX
20A 15A 15A 15A 15A 20A 20A 20A 20A
ENGINE ECM.
3(+)BATTERY
4(+)BATTERY
BATTERY(-)2
BATTERY(-)1
43 STOP LAMP.
44 WARNING LAMP.
50 WAIT TO START LAMP.
39 KEY SW. SIGNAL
42 ECM RETURN
49 SW.OUTPUT
34 SW. RETURN
2 DIAGNOSTIC SW.
24 INC/CRUISE RESUME SW.
25 DEC/CRUISE SET SW.
ISC1 SW. 4
ISC2 SW.16
ISC3 SW.18
46 SAE J1939(+)
37 SAE J1939(SHIELD)
47 SAE J1939(-)
FUSE 30A
5A FUSE
STARTER SWITCH
F.L. 65A
F.L. 75A
F.L. 65A
AV60
AV60
95E41R (N100)
95E41R (N100)
BATTERY
IGNITION
INDICATOR
PHASE
BATTERY
GROUND
ALTERNATOR(95A)
STARTER RELAY
STARTER MOTOR
AV100
NO COM
BATTERY RELAY
AV60
AV60
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2-4-3. No charging

Reference Fig.: 2-4-1

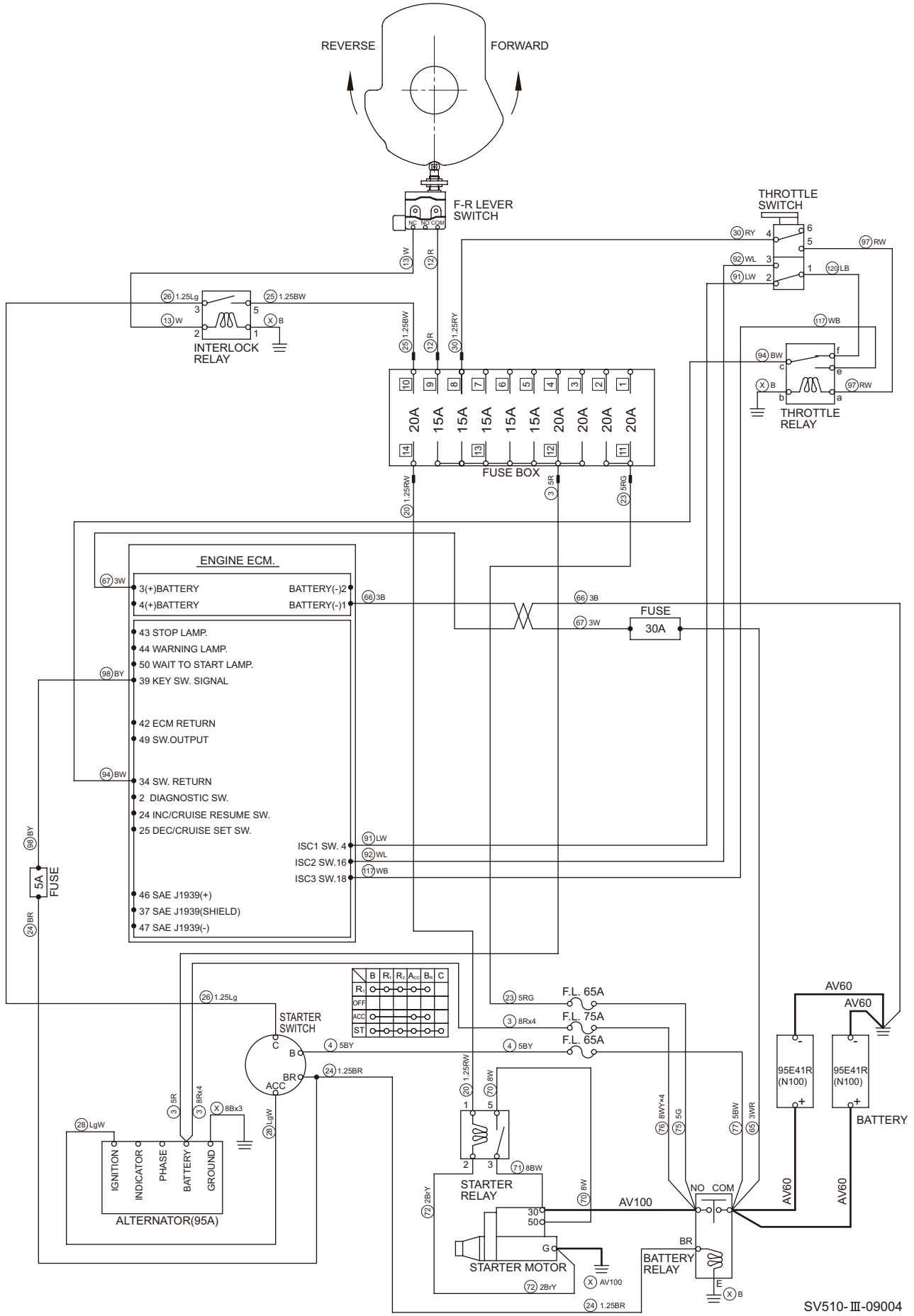
Check point	Check/Cause	Action
1. Alternator	• After starting engine, measure voltage between alternator terminal BATTERY wire R and chassis ground. Standard voltage: At least intermediate engine speed, 14 V or more • If voltage is lower than standard, alternator is faulty. • If voltage is higher than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

2-4-4. Engine speed cannot be switched

Reference Fig. : 2-4-1

Check point	Check/Cause	Action
1. Throttle Switch	(1) When throttle switch is in “IDLE” position, check continuity between throttle switch terminals 1 and 2, 4 and 6. There is continuity in normal condition. (2) When throttle switch is in “MID” position, check continuity between throttle switch terminals 1 and 3, 4 and 6. There is continuity in normal condition. (3) When throttle switch is in “FULL” position, check continuity between throttle switch terminals 1 and 3, 4 and 5. There is continuity in normal condition. • If above item (1), (2) or (3) is NG, throttle switch is faulty.	Replace throttle switch.
2. Throttle Relay	(1) When starter switch is ON and throttle switch is in “FULL” position, measure voltage between throttle relay terminal a inlet wire RW and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and throttle switch is in “FULL” position, measure voltage between throttle relay terminal e outlet wire WB and chassis ground. There is electricity in normal condition. (3) When starter switch is ON and throttle switch is in “IDLE” or “MID” position, measure voltage between throttle relay terminal f outlet wire LB and chassis ground. There is electricity in normal condition. • If above item (1) is OK and item (2) or (3) is NG, throttle relay is faulty.	Replace throttle 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.

Fig.: 2-4-1

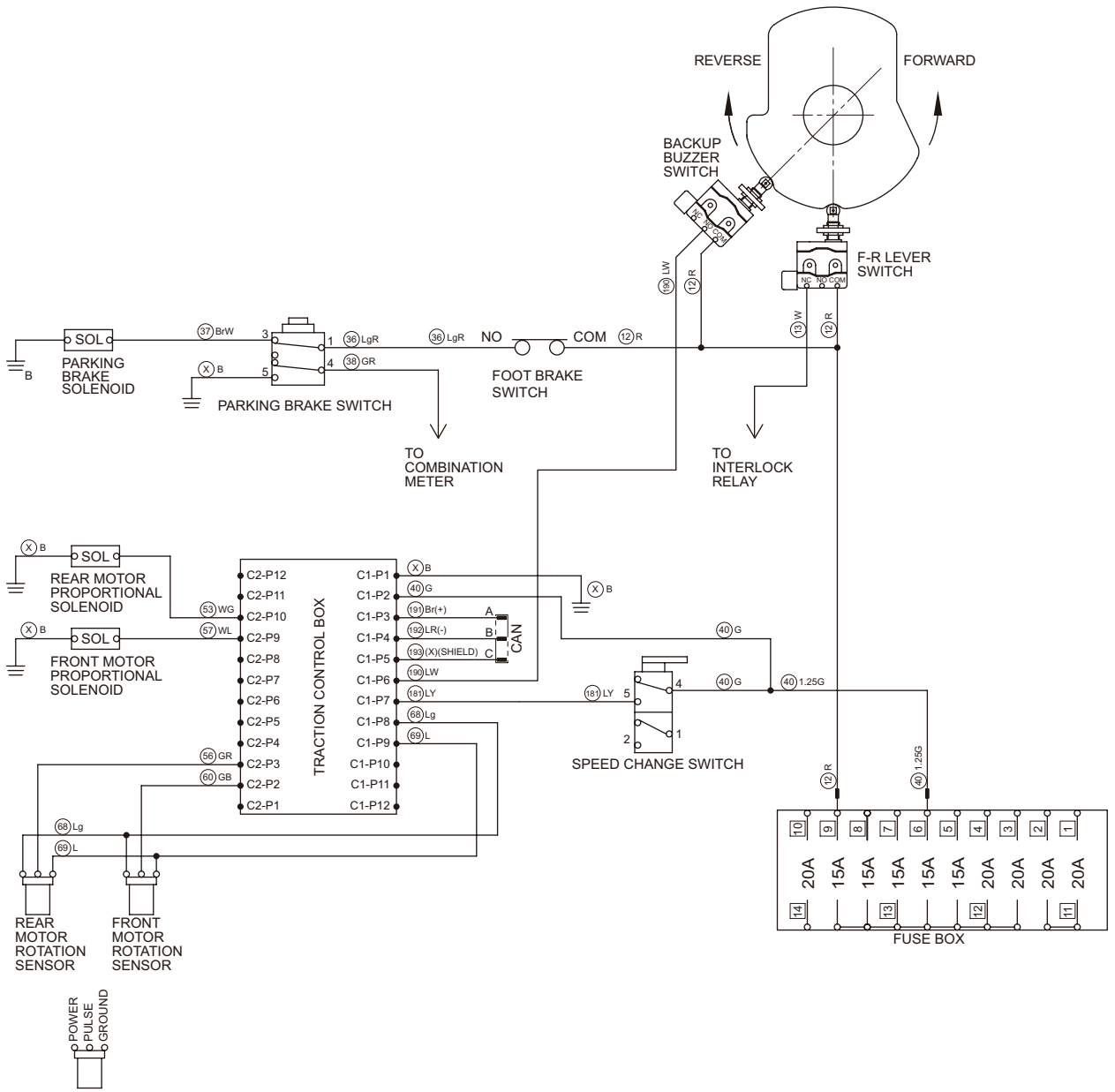

REVERSE
FORWARD
F-R LEVER SWITCH
N/C NO COM
THROTTLE SWITCH
INTERLOCK RELAY
THROTTLE RELAY
FUSE BOX
20A 15A 15A 15A 15A 20A 20A 20A 20A
ENGINE ECM.
3(+)BATTERY
4(+)BATTERY
BATTERY(-)2
BATTERY(-)1
43 STOP LAMP.
44 WARNING LAMP.
50 WAIT TO START LAMP.
39 KEY SW. SIGNAL
42 ECM RETURN
49 SW.OUTPUT
34 SW. RETURN
2 DIAGNOSTIC SW.
24 INC/CRUISE RESUME SW.
25 DEC/CRUISE SET SW.
ISC1 SW. 4
ISC2 SW.16
ISC3 SW.18
46 SAE J1939(+)
37 SAE J1939(SHIELD)
47 SAE J1939(-)
FUSE 30A
5A FUSE
STARTER SWITCH
B R1 R2 Acc Bm C
R1
OFF
ACC
ST
F.L. 65A
F.L. 75A
F.L. 65A
AV60
AV60
95E41R (N100)
95E41R (N100)
BATTERY
IGNITION
INDICATOR
PHASE
BATTERY
GROUND
ALTERNATOR(95A)
STARTER RELAY
STARTER MOTOR
AV100
NO COM
BATTERY RELAY
SV510-Ⅲ-09004

2-4-5. Starter motor runs even when F-R lever is not at neutral position

Reference Fig.: 2-4-1

Check point	Check/Cause	Action
1. F-R Lever Switch	• When starter switch is OFF and F-R lever is in forward or reverse position, check continuity between F-R lever switch terminal COM and terminal NC. There is no continuity in normal condition. • If there is continuity, F-R lever switch is faulty.	Replace F-R lever switch.

Fig.: 2-5-1



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2-5. Propulsion

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.9-006 to P.9-008).
- Check any ground circuit which belongs to components to be checked.

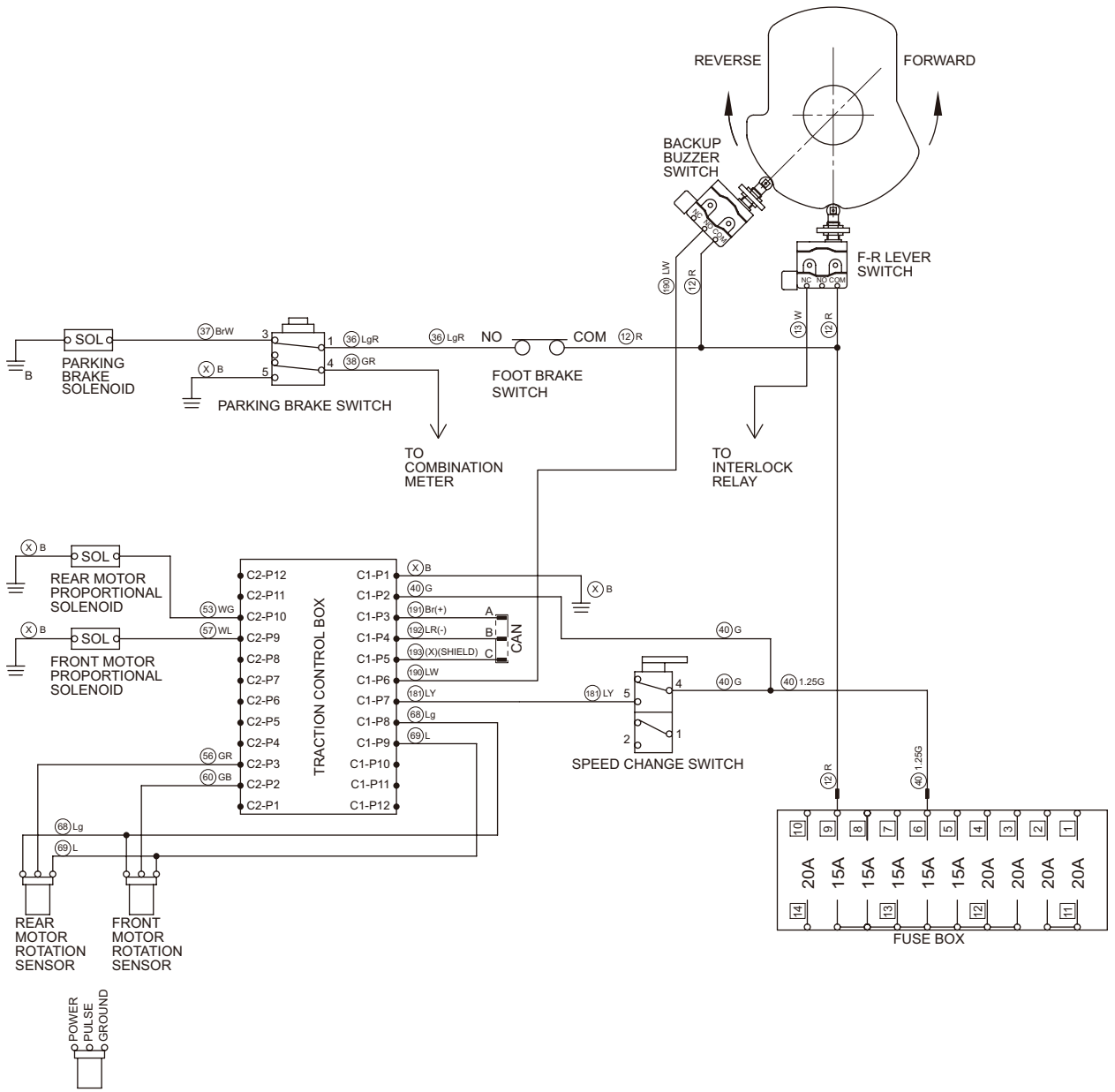
2-5-1. Machine moves neither forward nor backward

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

Reference Fig.: 2-5-1

Check point	Check/Cause	Action
1. Parking Brake Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 12.3 ± 1.2 Ω • If measured resistance is abnormal, parking brake solenoid is faulty.	Replace parking brake solenoid.
2. Foot Brake Switch	(1) When starter switch is ON, measure voltage between foot brake switch terminal COM inlet wire R and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between foot brake switch terminal NO outlet wire LgR 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. Parking Brake Switch	(1) When starter switch is ON, measure voltage between parking brake switch terminal 1 inlet wire LgR 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 BrW 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. 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



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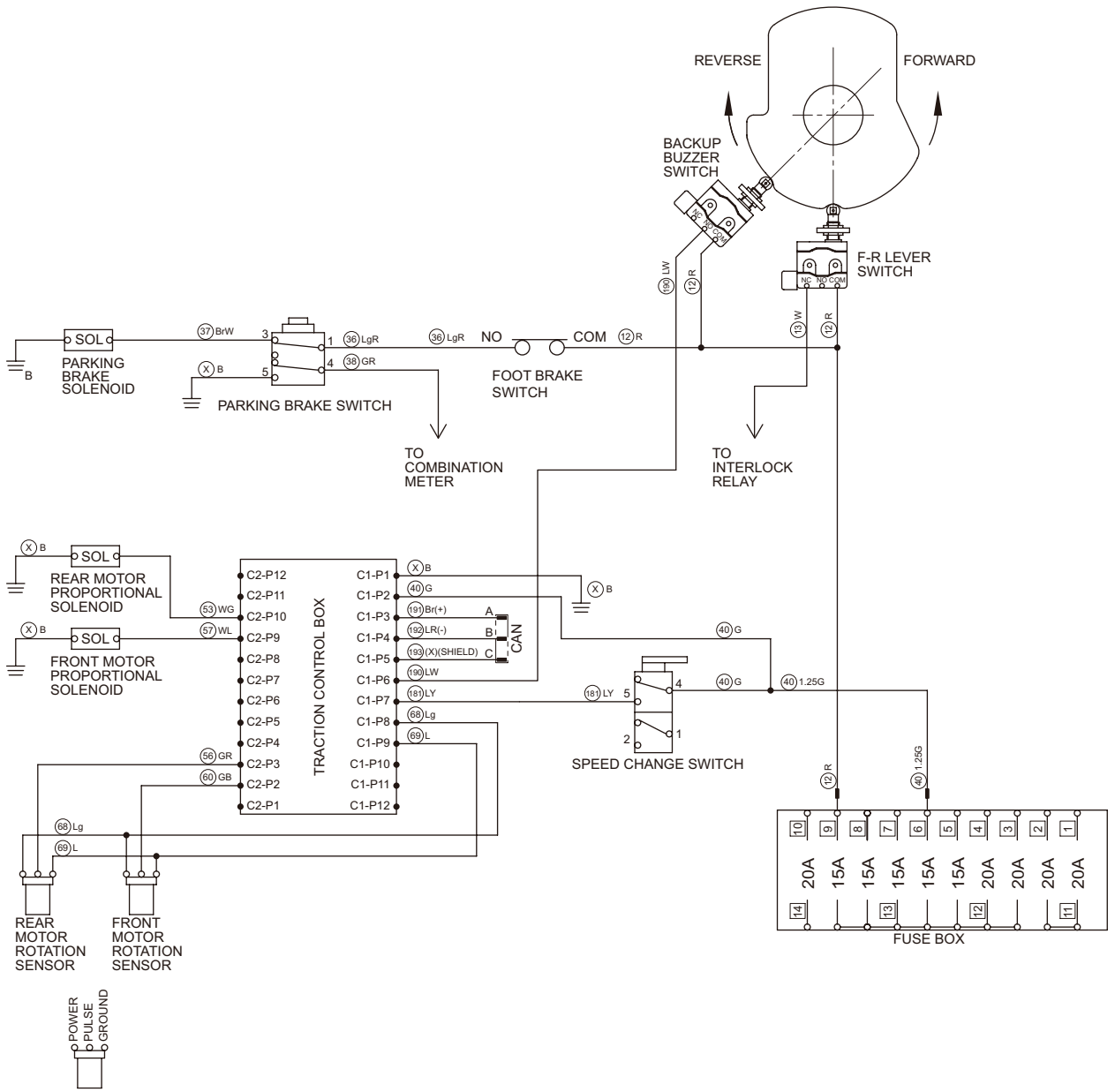
2-5-2. Machine speed cannot be changed

• Check whether traction control box LED shows no error code.

Reference Fig.: 2-5-1

Check point	Check/Cause	Action
1. Speed Change Switch	(1) When starter switch is ON, measure voltage between speed change switch terminal 4 inlet wire G and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and speed change switch is in " 🐢 " position, measure voltage between speed change switch terminal 5 outlet wire LY and chassis ground. There is no electricity in normal condition. (3) When starter switch is ON and speed change switch is in " 🐇 " position, measure voltage between speed change switch terminal 5 outlet wire LY and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and (2) or (3) is NG, speed change switch is faulty.	Replace speed change switch.
2. Traction Control Box	(1) When starter switch is ON, measure voltage between traction control box terminal C1-P2 inlet wire G and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and speed change switch is in " 🐇 " position, measure voltage between traction control box terminal C1-P7 inlet wire LY and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK but machine speed does not change, traction control box is faulty.	Replace traction control box.
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



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2-5-3. Traction control does not work 1/3

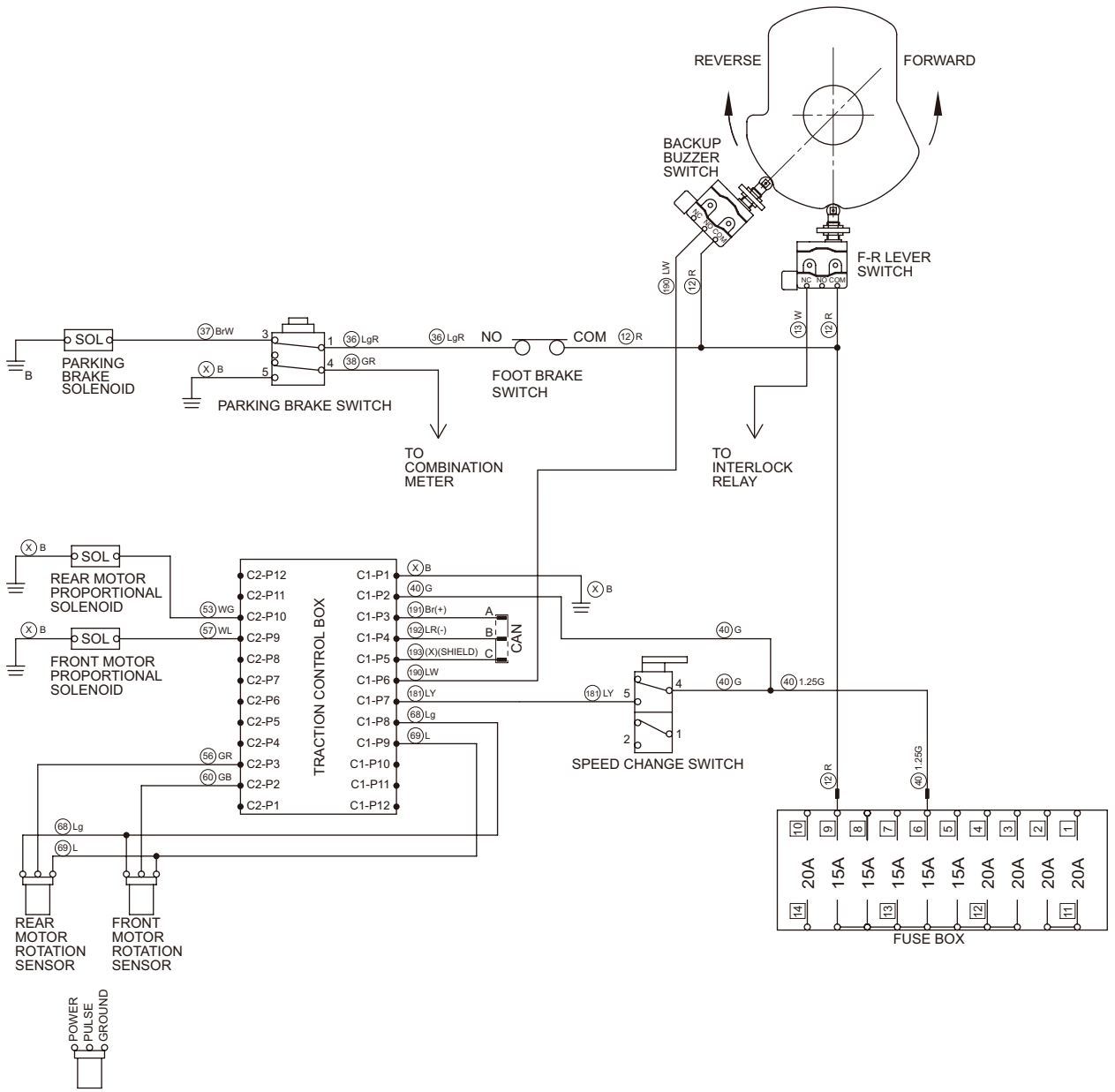
• Check whether traction control box LED shows any error code.

1) When LED shows any error code

Reference Fig.: 2-5-1

Error code	Check point	Check/Cause	Action
1 to 9	1. Connector	• Check rear motor rotation sensor connector and traction control box (terminal C1-P8, C1-P9 and C2-P3) for corrosion, breakage, bending and looseness. • If any abnormality is found, connector is faulty.	Replace connector or terminal.
	2. Harness	• Measure resistances between rear motor rotation sensor and traction control box terminal wires. • Rear motor rotation sensor terminal POWER wire Lg and traction control box terminal C1-P8 wire Lg. • Rear motor rotation sensor terminal PULSE wire GR and traction control box terminal C2-P3 wire GR. • Rear motor rotation sensor terminal GROUND wire L and traction control box terminal C1-P9 wire L. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.
	3. Rear Motor Rotation Sensor	(1) When starter switch is ON, measure voltage between rear motor rotation sensor terminal POWER inlet wire Lg and chassis ground. Standard voltage : 6.5 ± 2.0 V (2) Check that rear motor rotation sensor terminal GROUND wire L is grounded. (3) Start engine and rotate wheels. Measure pulse between rear motor rotation sensor terminal PULSE outlet wire GR and chassis ground. Standard pulse : 49 pulses/rotation • If above items (1) and (2) are OK and item (3) is NG, rear motor rotation sensor is faulty.	Replace rear motor rotation sensor.
11 to 19	1. Connector	• Check front motor rotation sensor connector and traction control box (terminal C1-P8, C1-P9 and C2-P2) for corrosion, breakage, bending and looseness. • If any abnormality is found, connector is faulty.	Replace connector or terminal.
	2. Harness	• Measure resistances between front motor rotation sensor and traction control box terminal wires. • Front motor rotation sensor terminal POWER wire Lg and traction control box terminal C1-P8 wire Lg. • Front motor rotation sensor terminal PULSE wire GB and traction control box terminal C2-P2 wire GB. • Front motor rotation sensor terminal GROUND wire L and traction control box terminal C1-P9 wire L. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.
	3. Front Motor Rotation Sensor	(1) When starter switch is ON, measure voltage between front motor rotation sensor terminal POWER inlet wire Lg and chassis ground. Standard voltage : 6.5 ± 2.0 V (2) Check that front motor rotation sensor terminal GROUND wire L is grounded. (3) Start engine and rotate drum. Measure pulse between front motor rotation sensor terminal PULSE outlet wire GB and chassis ground. Standard pulse : 49 pulses/rotation • If above items (1) and (2) are OK and item (3) is NG, front motor rotation sensor is faulty.	Replace front motor rotation sensor.

Fig.: 2-5-1



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2-5-3. Traction control does not work 2/3

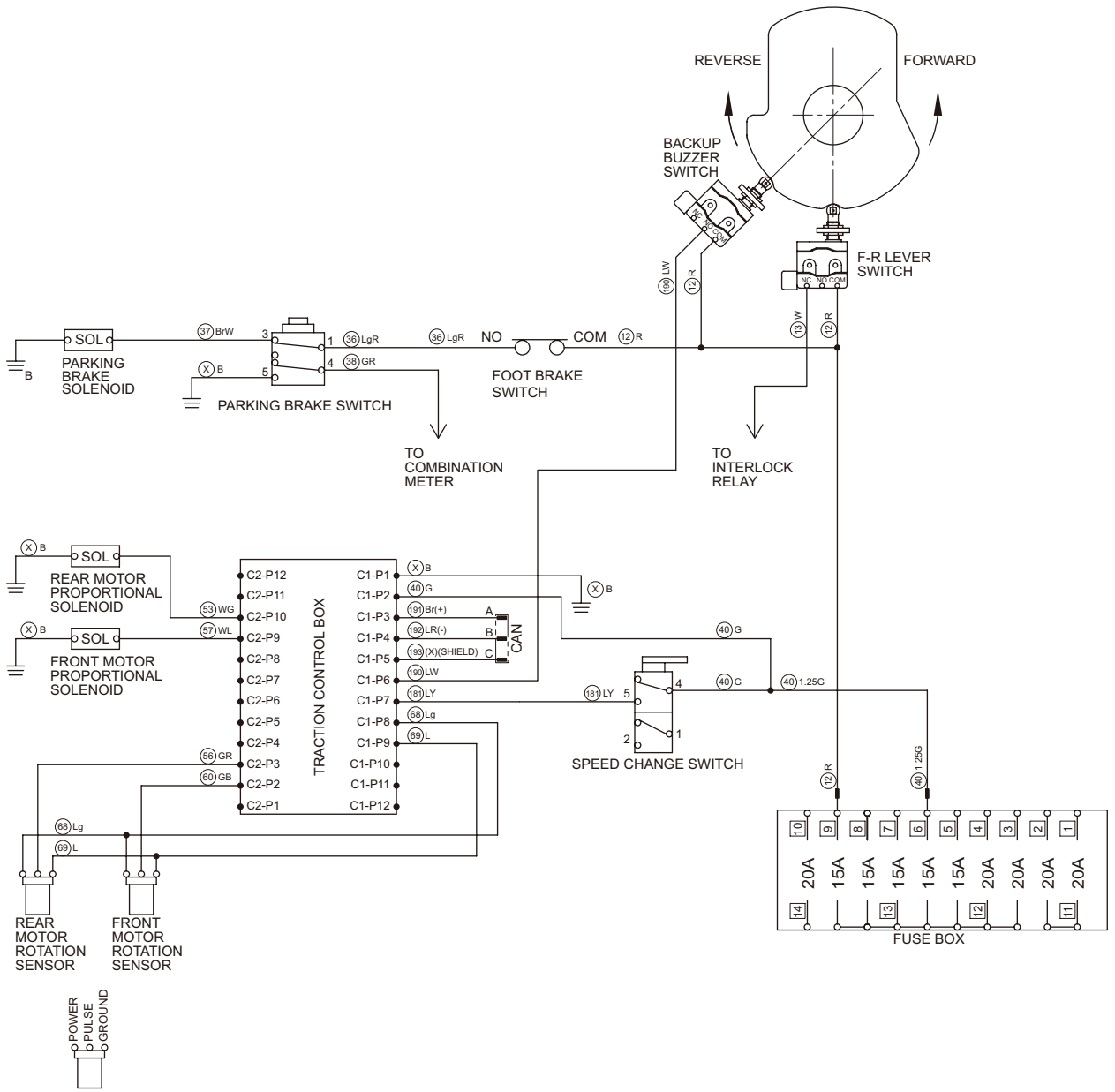
• Check whether traction control box LED shows any error code.

1) When LED shows any error code

Reference Fig.: 2-5-1

Error code	Check point	Check/Cause	Action
21 to 25	1. Connector	• Check rear motor proportional solenoid connector and traction control box (terminal C2-P10) for corrosion, breakage, bending and looseness. • If any abnormality is found, connector is faulty.	Replace connector or terminal.
	2. Harness	• Measure resistances between rear motor proportional solenoid terminal wire WG and traction control box terminal C2-P10 wire WG. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.
	3. Rear Motor Proportional Solenoid	• Disconnect harness and measure resistances of coil. Standard resistance : 5.7 Ω • If resistance is abnormal, rear motor proportional solenoid is faulty. • If resistance is normal, traction control box is faulty.	Replace rear motor proportional solenoid or traction control box.
31 to 35	1. Connector	• Check front motor proportional solenoid connector and traction control box (terminal C2-P9) for corrosion, breakage, bending and looseness. • If any abnormality is found, connector is faulty.	Replace connector or terminal.
	2. Harness	• Measure resistances between front motor proportional solenoid terminal wire WL and traction control box terminal C2-P9 wire WL. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.
	3. Front Motor Proportional Solenoid	• Disconnect harness and measure resistances of coil. Standard resistance : 5.7 Ω • If resistance is abnormal, front motor proportional solenoid is faulty. • If resistance is normal, traction control box is faulty.	Replace front motor proportional solenoid or traction control box.

Fig.: 2-5-1



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2-5-3. Traction control does not work 3/3

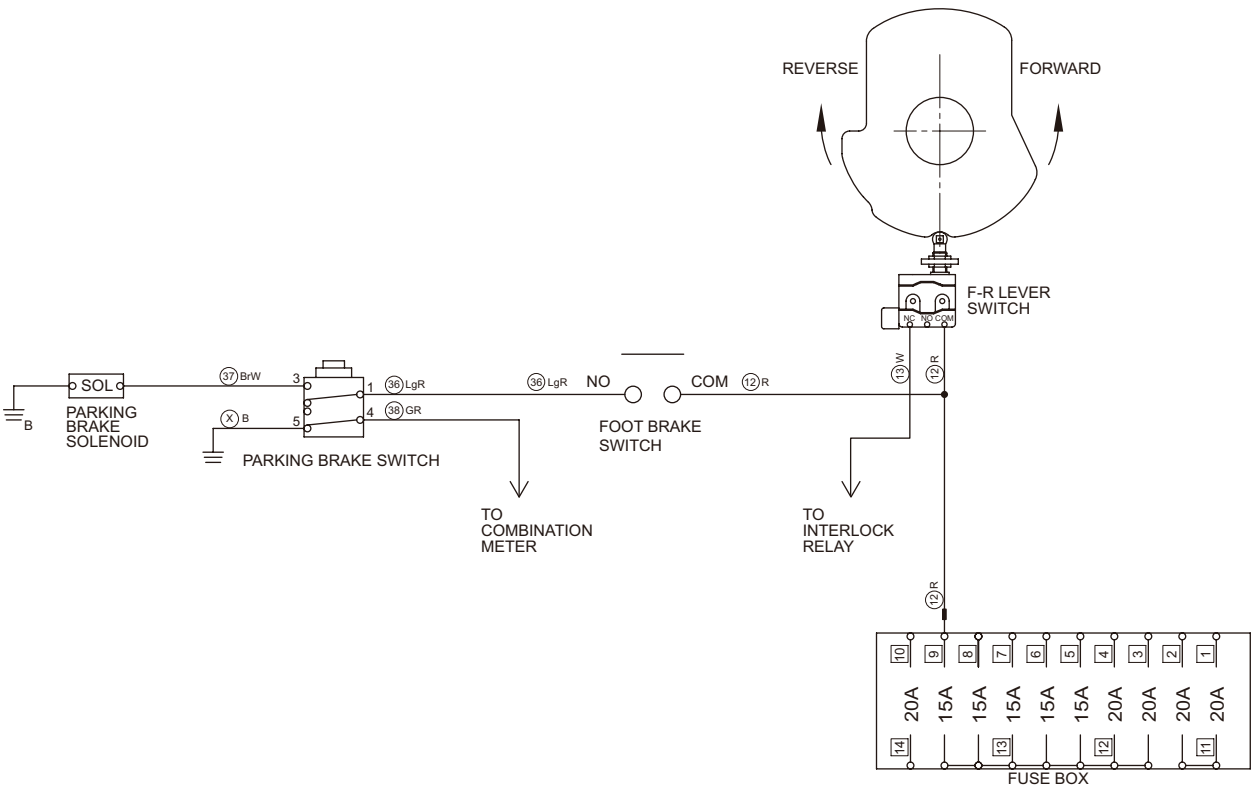
• Check whether traction control box LED shows any error code.

2) When LED shows no error code

Reference Fig.: 2-5-1

Check point	Check/Cause	Action
1. Harness	(1) Measure resistance between traction control box terminal C1-P2 wire G and fuse box terminal 6 wire G. Standard resistance : 10 Ω or less (2) Measure resistance between traction control box terminal C1-P6 wire LW and backup buzzer switch terminal NO wire LW. Standard resistance : 10 Ω or less (3) Measure resistance between traction control box terminal C1-P1 wire B and chassis ground wire B. Standard resistance : 10 Ω or less • If above item (1), (2) or (3) is NG, harness is faulty.	Repair or replace harness.
2. Backup Buzzer Switch	(1) When starter switch is ON, measure voltage between backup buzzer switch terminal COM inlet wire R and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and F-R lever is in reverse position, measure voltage between backup buzzer switch terminal NO outlet wire LW 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. Traction Control Box	(1) When starter switch is ON, measure voltage between traction control box terminal C1-P2 inlet wire G and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and F-R lever is in reverse position, measure voltage between traction control box terminal C1-P6 inlet wire LW and chassis ground. Standard voltage : 12 V or more (3) Check traction control box terminal C1-P1 wire B is grounded. • If above item (1), (2) or (3) is NG, traction control box is faulty.	Replace traction control box.

Fig.: 2-5-2



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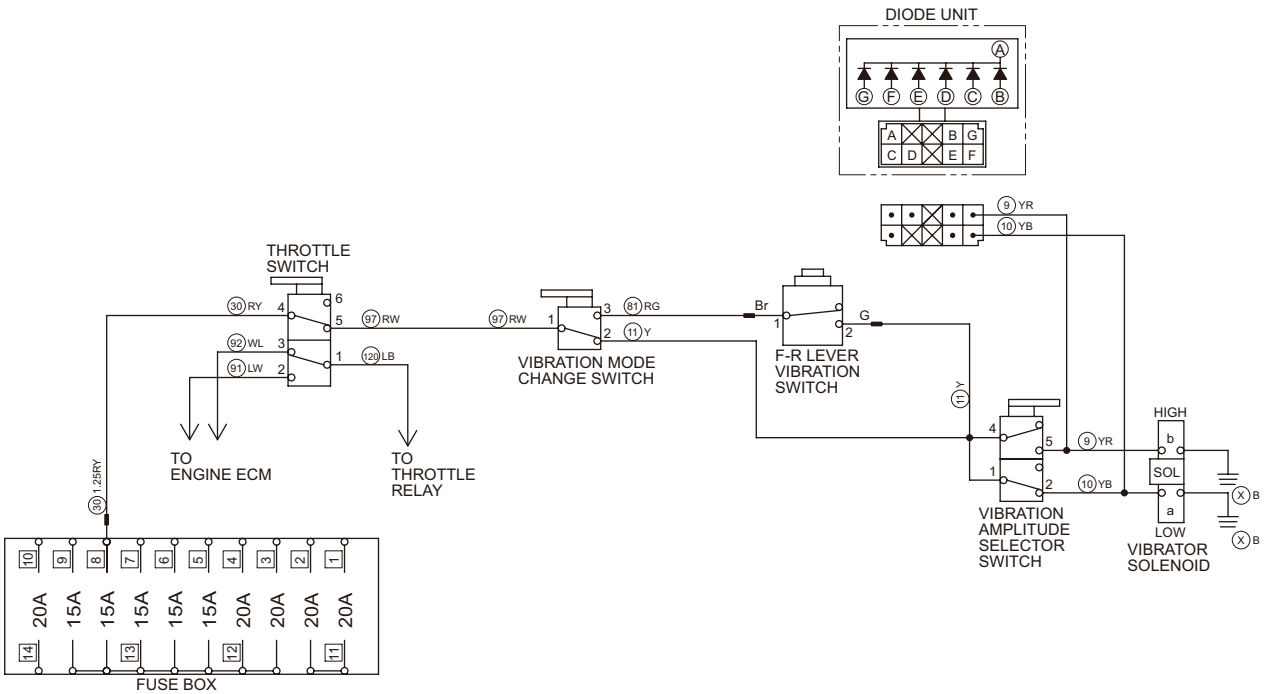
2-5-4. Brake does not work

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

Reference Fig.: 2-5-2

Check point	Check/Cause	Action
1. Parking Brake Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 12.3 ± 1.2 Ω • If measured resistance is abnormal, parking brake solenoid is faulty.	Replace parking brake solenoid.
2. Foot Brake Switch	• When starter switch is ON, measure voltage between foot brake switch terminal NO outlet wire LgR and chassis ground. There is no electricity in normal condition. • If electricity flows, foot brake switch is faulty.	Replace foot brake switch.
3. Parking Brake Switch	• When starter switch is ON, measure voltage between parking brake switch terminal 3 outlet wire BrW and chassis ground. There is no electricity in normal condition. • If electricity flows, parking brake switch is faulty.	Replace parking 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.: 2-6-1



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2-6. Vibration

Check following items before troubleshooting.

- No blown fuses and power is applied up to fuses.
- Throttle switch must be “FULL” position.

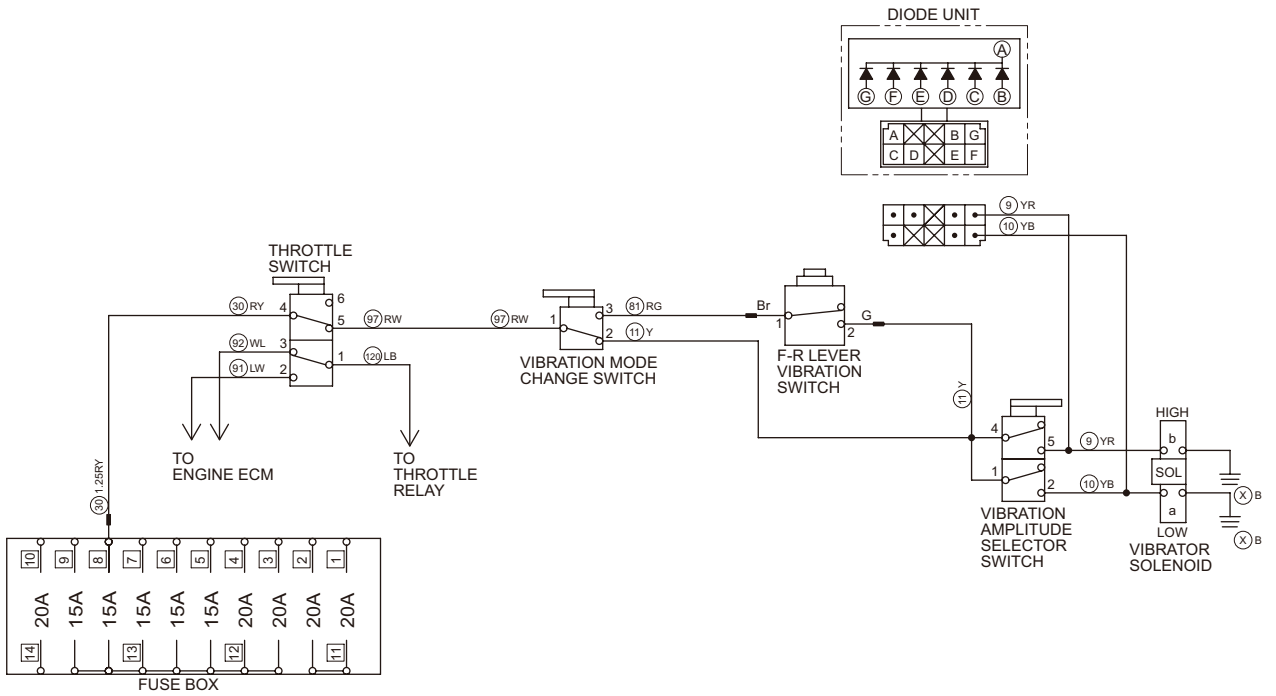
2-6-1. No vibration occurs

- Vibration mode change switch must be “CONT” position (continuous mode).
- Vibration amplitude selector switch must not be OFF.

Reference Fig.: 2-6-1

Check point	Check/Cause	Action
1. Vibrator Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 4.8 Ω • If resistance is abnormal, vibrator solenoid is faulty.	Replace vibrator solenoid.
2. Vibration Amplitude Selector Switch	(1) When starter switch is ON, measure voltage between vibration amplitude selector switch terminal 1 inlet wire Y, terminal 4 inlet wire Y and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and vibration amplitude selector switch is in “ ⩘ ” position, measure voltage between vibration amplitude selector switch terminal 2 outlet wire YB and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON and vibration amplitude selector switch is in “ ⩘ ” position, measure voltage between vibration amplitude selector switch terminal 5 outlet wire YR and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) or (3) is NG, vibration amplitude selector switch is faulty.	Replace vibration amplitude selector switch.
3. Vibration Mode Change Switch	(1) When starter switch is ON, measure voltage between vibration mode change switch terminal 1 inlet wire RW 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 Y 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. Throttle Switch	(1) When starter switch is ON, measure voltage between throttle switch terminal 4 inlet wire RY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between throttle switch terminal 5 outlet wire RW and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, throttle switch is faulty.	Replace throttle 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.: 2-6-2



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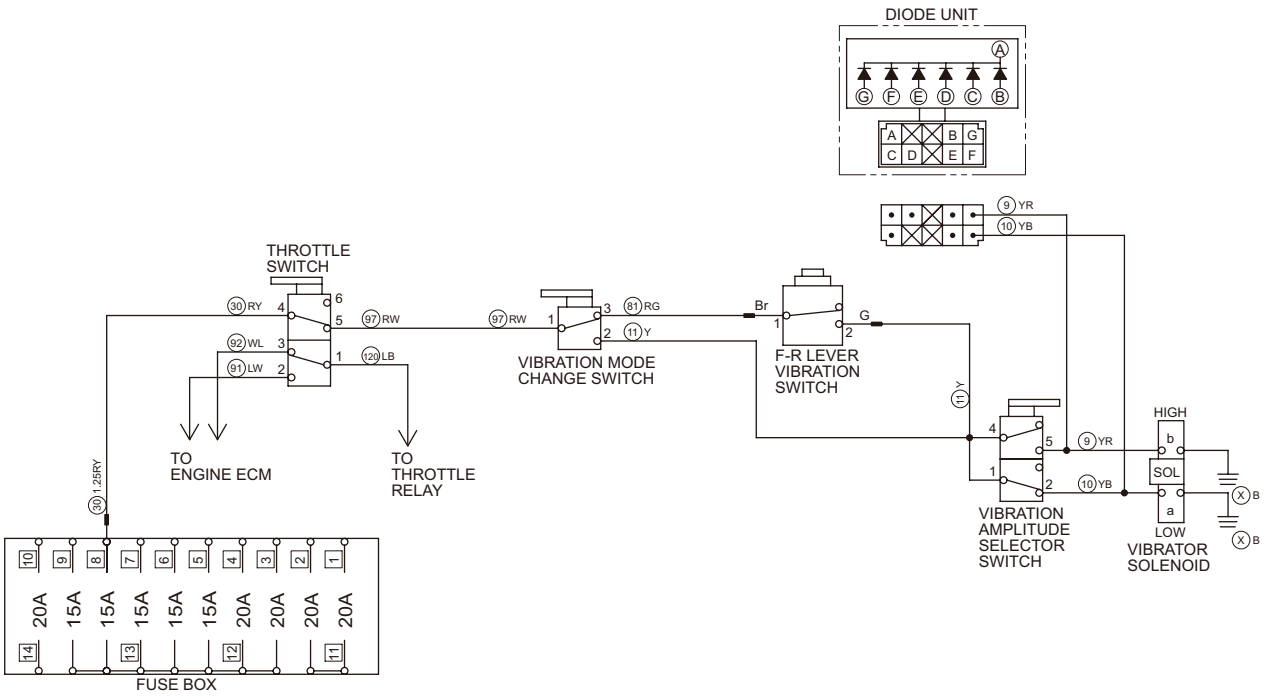
2-6-2. Amplitude does not change (Remains either Low or High)

- Vibration mode change switch must be “CONT” position (continuous mode).
- Vibration amplitude selector switch must be OFF.

Reference Fig. : 2-6-2

Check point	Check/Cause	Action
1. Vibrator Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 4.8 Ω • If resistance is abnormal, vibrator solenoid is faulty.	Replace vibrator solenoid.
2. Vibration Amplitude Selector Switch	(1) When starter switch is ON, measure voltage between vibration amplitude selector switch terminal 1 inlet wire Y, terminal 4 inlet wire Y and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and vibration amplitude selector switch is in “ ⋀⋀ ” position, measure voltage between vibration amplitude selector switch terminal 2 outlet wire YB and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON and vibration amplitude selector switch is in “ ⋀⋀ ” position, measure voltage between vibration amplitude selector switch terminal 5 outlet wire YR and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) or (3) is NG, vibration amplitude selector switch is faulty.	Replace vibration amplitude selector 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.: 2-6-3



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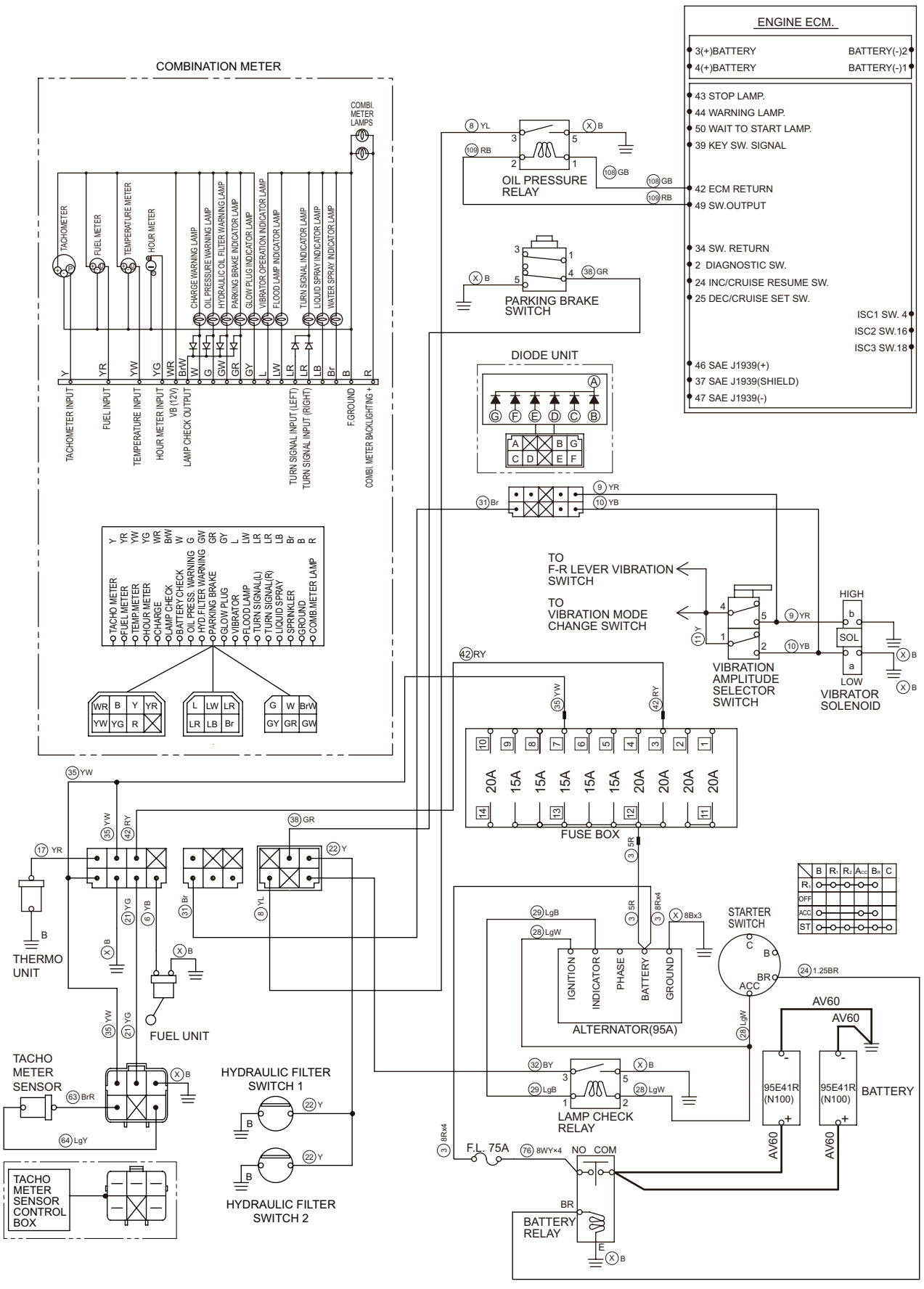
2-6-3. Vibration mode cannot be switched (F-R lever vibration switch does not work)

- Vibration mode change switch to “  ” position (manual mode).
- Vibration amplitude selector switch must not be OFF.

Reference Fig. : 2-6-3

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 RW and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between vibration mode change 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, vibration mode change switch is faulty.	Replace vibration mode change switch.
2. F-R Lever Vibration Switch	(1) When starter switch is ON, measure voltage between F-R lever vibration switch terminal 1 inlet wire Br and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and F-R lever vibration switch is pressed once, measure voltage between F-R lever vibration switch terminal 2 outlet wire G and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, F-R lever vibration switch is faulty.	Replace F-R lever 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.: 2-7-1



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2-7. Lighting

Check following item before troubleshooting.

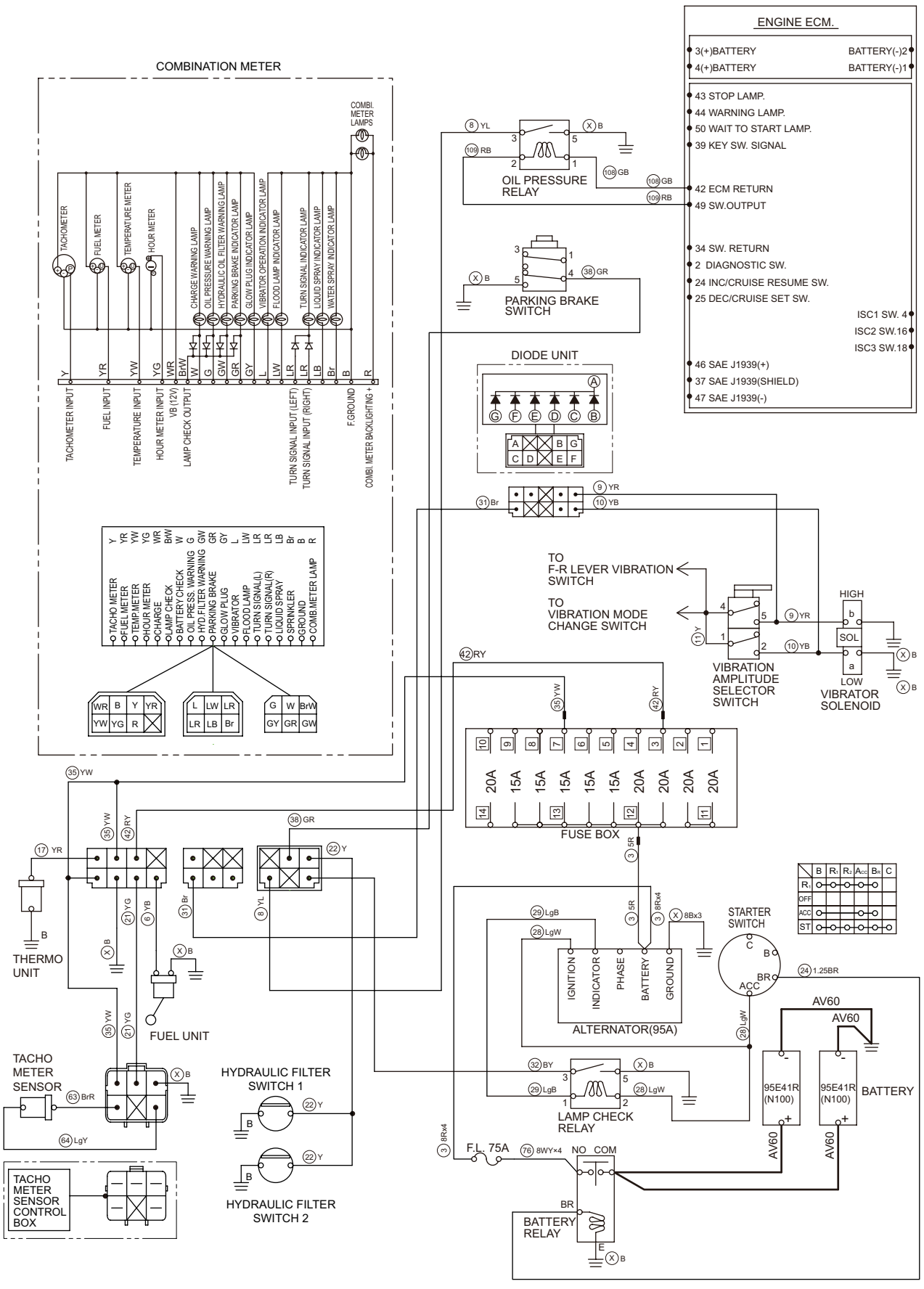
- No blown fuse and power is applied up to fuses.
- When measuring voltage and current without disconnecting connectors, refer to “measuring voltage and current following using tester” (P.9-006 to P.9-008).
- Check any ground circuit which belongs to components to be checked.

2-7-1. Illumination of combination meter does not turn on

Reference Fig. : 2-7-1

Check point	Check/Cause	Action
1. Bulbs	• Check if bulbs have burned out or are poorly contacted. • Bulbs are faulty or poorly connected.	Replace bulbs.
2. Combination Meter (Backlighting)	• When starter switch is ON, measure voltage between combination meter backlighting terminal inlet wire No. 42 RY and ground terminal wire B. Standard voltage : 12 V or more • If above item is OK and combination meter does not turn on, 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.: 2-7-1



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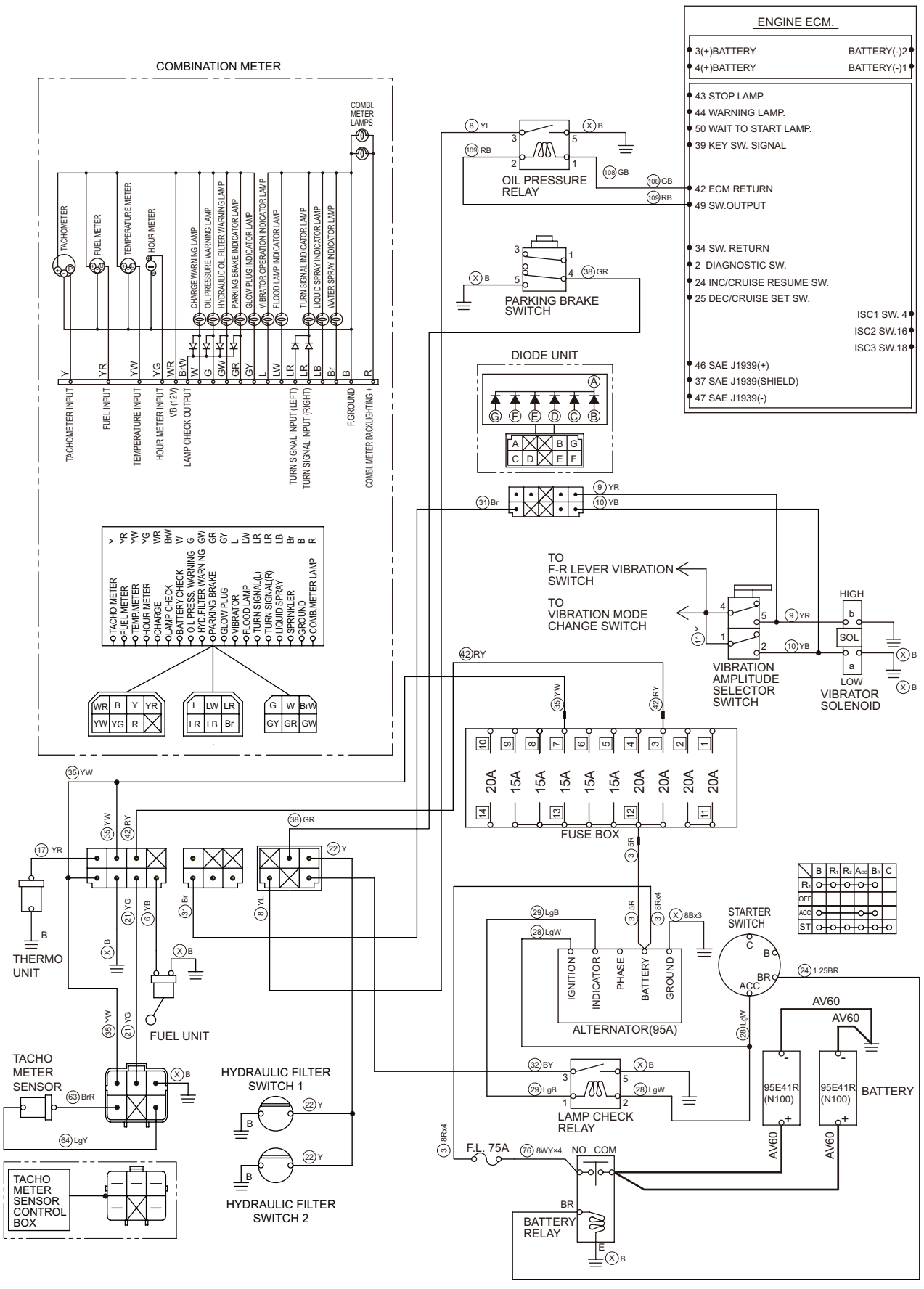
2-7-2. Combination meter warning lamp or indicator lamp is abnormal

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 (charge warning lamp, oil pressure warning lamp, hydraulic oil filter warining lamp and parking brake indicator lamp). • Bulb is faulty or poorly connected.	Replace each bulb.
2. Lamp Check Relay	(1) When starter switch is ON, measure voltage between lamp check relay terminal 1 outlet wire LgB and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between lamp check relay terminal 5 outlet wire B and chassis ground. Standard voltage : 12 V or more (3) After starting engine, measure voltage between lamp check relay terminal wires and chassis ground. • Lamp check relay terminal 1 inlet wire LgB and chassis ground. • Lamp check relay terminal 5 outlet wire B and chassis ground. There is no electricity in normal condition. • If above item (1) is OK and item (2) is NG, lamp check relay is faulty. • If above items (1) and (2) is OK and item (3) is NG, alternator is faulty.	Repair or replace lamp check relay or alternator.
3. Combination Meter (Lamp check)	(1) When starter switch is ON, measure voltage between combination meter battery terminal inlet wire No. 35 YW and ground terminal wire B. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between combination meter lamp check terminal outlet wire No. 32 BY and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and no abnormality is found in lamp check relay, combination meter is faulty.	Replace combination meter.
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


ENGINE ECM.
3(+)BATTERY
4(+)BATTERY
BATTERY(-)2
BATTERY(-)1
43 STOP LAMP.
44 WARNING LAMP.
50 WAIT TO START LAMP.
39 KEY SW. SIGNAL
42 ECM RETURN
49 SW.OUTPUT
34 SW. RETURN
2 DIAGNOSTIC SW.
24 INC/CRUISE RESUME SW.
25 DEC/CRUISE SET SW.
ISC1 SW. 4
ISC2 SW.16
ISC3 SW.18
46 SAE J1939(+)
37 SAE J1939(SHIELD)
47 SAE J1939(-)
COMBINATION METER
COMBI METER LAMPS
TACHOMETER
FUEL METER
TEMPERATURE METER
HOUR METER
CHARGE WARNING LAMP
OIL PRESSURE WARNING LAMP
HYDRAULIC OIL FILTER WARNING LAMP
PARKING BRAKE INDICATOR LAMP
GLOW PLUG INDICATOR LAMP
VIBRATOR OPERATION INDICATOR LAMP
FLOOD LAMP INDICATOR LAMP
TURN SIGNAL INDICATOR LAMP
LIQUID SPRAY INDICATOR LAMP
WATER SPRAY INDICATOR LAMP
TACHOMETER INPUT
FUEL INPUT
TEMPERATURE INPUT
HOUR METER INPUT
VB (12V)
LAMP CHECK OUTPUT
TURN SIGNAL INPUT (LEFT)
TURN SIGNAL INPUT (RIGHT)
F.GROUND
COMBI METER BACKLIGHTING +
TACHO METER
FUEL METER
TEMP METER
HOUR METER
CHARGE
LAMP CHECK
BATTERY CHECK
OIL PRESS. WARNING
HYD FILTER WARNING
PARKING BRAKE
GLOW PLUG
VIBRATOR
FLOOD LAMP
TURN SIGNAL(L)
TURN SIGNAL(R)
LIQUID SPRAY
SPRINKLER
GROUND
COMB.METER LAMP
OIL PRESSURE RELAY
PARKING BRAKE SWITCH
DIODE UNIT
TO F-R LEVER VIBRATION SWITCH
TO VIBRATION MODE CHANGE SWITCH
VIBRATION AMPLITUDE SELECTOR SWITCH
HIGH
LOW
SOL
VIBRATOR SOLENOID
FUSE BOX
20A
15A
THERMO UNIT
FUEL UNIT
TACHO METER SENSOR
TACHO METER SENSOR CONTROL BOX
HYDRAULIC FILTER SWITCH 1
HYDRAULIC FILTER SWITCH 2
IGNITION
INDICATOR
PHASE
BATTERY
GROUND
ALTERNATOR(95A)
STARTER SWITCH
LAMP CHECK RELAY
F.L. 75A
BATTERY RELAY
95E41R (N100)
BATTERY
AV60
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2-7-3. Tachometer reading is abnormal

Reference Fig. : 2-7-1

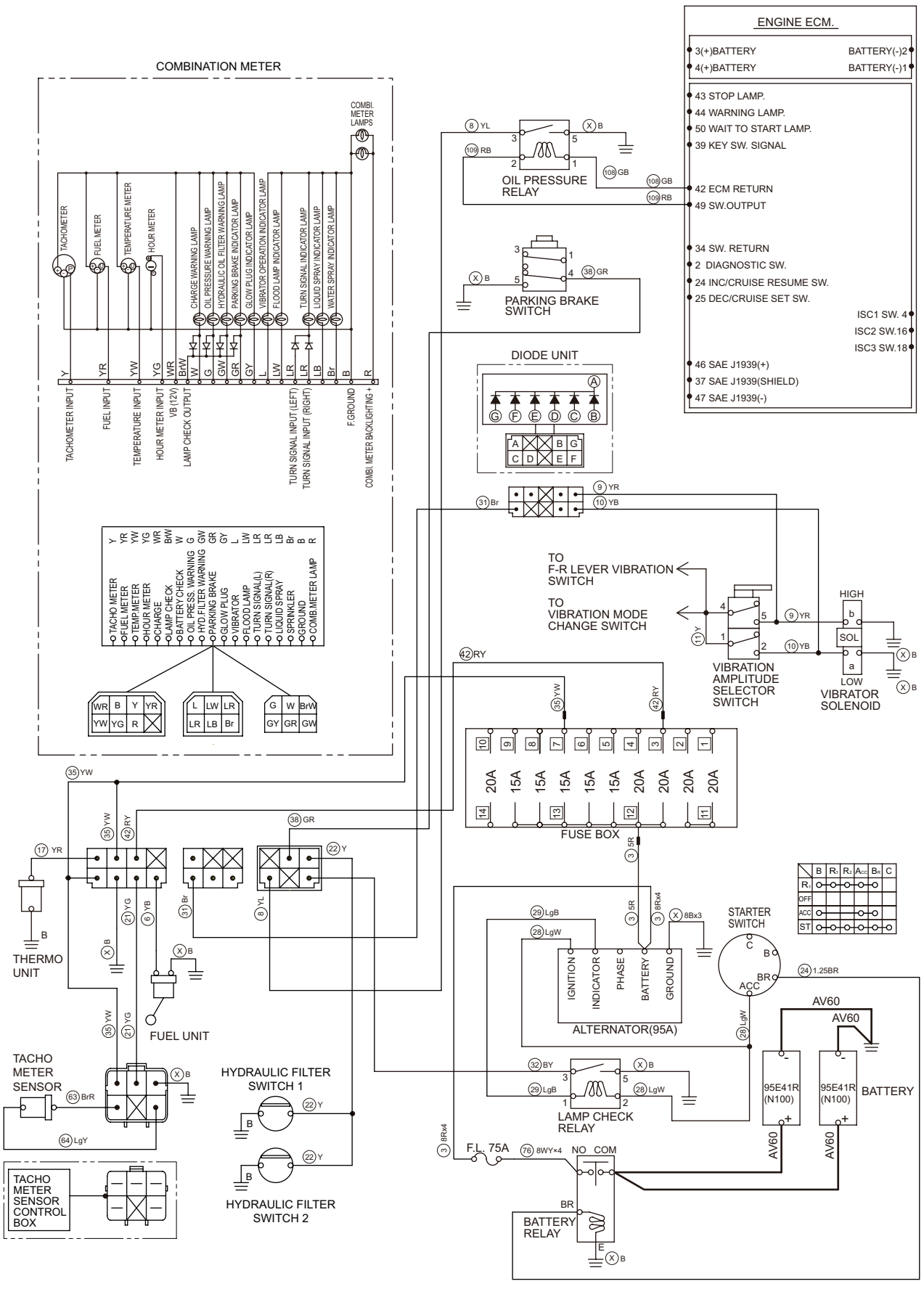
Check point	Check/Cause	Action
1. Tachometer Sensor	• Start engine and fix engine speed at 1,000 rpm. Measure pulse between tachometer sensor terminal outlet wire BrR and ground terminal wire LgY. Standard pulse : 126,023/min. • If measured pulse is abnormal, tachometer sensor is faulty.	Replace tachometer sensor.
2. Control Box	• Start engine and fix engine speed at 1,000 rpm. Measure pulse between control box terminal outlet wire YG and ground terminal wire B. Standard pulse : 2,000/min. • If measured pulse is abnormal, control box is faulty.	Replace control box.
3. Combination Meter (Tachometer)	• When starter switch is ON, measure voltage between combination meter battery terminal inlet wire No. 35 YW and ground terminal wire B. Standard voltage : 12 V or more • If above item is OK and no abnormality found in tachometer sensor or control box, combination meter is faulty.	Replace combination meter.
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.

2-7-4. Hour meter is abnormal

Reference Fig. : 2-7-1

Check point	Check/Cause	Action
1. Combination Meter (Hour meter)	• When starter switch is ON, measure voltage between combination meter hour meter terminal inlet wire No. 35 YW and ground terminal wire B. Standard voltage : 12 V or more • If no abnormality is found, 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.

Fig.: 2-7-1



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2-7-5. Temperature meter is abnormal

Reference Fig. : 2-7-1

Check point	Check/Cause	Action
1. Thermo Unit	• Disconnect harness and measure resistance of thermo unit. Standard resistance: 153.9 Ω [(at unit temperature of 50°C (122°F)] 24.9 Ω [(at unit temperature of 103°C (217°F)] • 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 battery terminal inlet wire No. 35 YW and ground terminal wire B. Standard voltage : 12 V or more • If above item is OK and no abnormality is found in thermo unit, 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.

2-7-6. Fuel meter is abnormal

Reference Fig. : 2-7-1

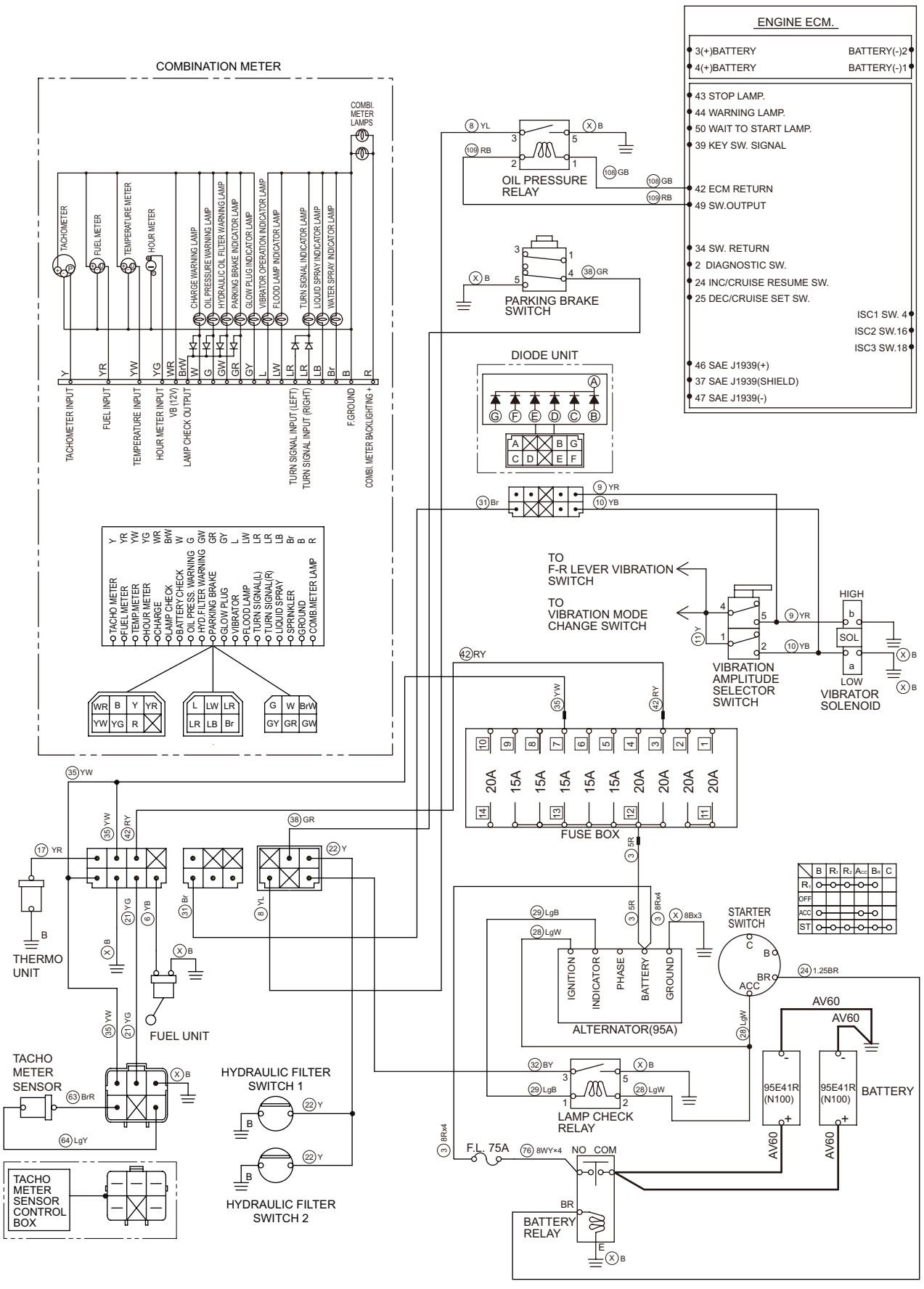
Check point	Check/Cause	Action
1. Fuel Unit	• Disconnect harness and measure resistance of fuel unit. Standard resistance: 10 Ω (with float in Full position) 90 Ω (with float in Empty position) • If resistance is abnormal, fuel unit is faulty.	Replace fuel unit.
2. Combination Meter (Fuel meter)	• When starter switch is ON, measure voltage between combination meter battery terminal inlet wire No. 35 YW and ground terminal wire B. Standard voltage : 12 V or more • If above item is OK and no abnormality is found in fuel unit, 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.

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

Reference Fig. : 2-7-1

Check point	Check/Cause	Action
1. Hydraulic Oil Filter Switch	• When engine is not running, check continuity between hydraulic oil filter switch inlet terminal 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.

Fig.: 2-7-1


ENGINE ECM.
3(+)BATTERY
4(+)BATTERY
BATTERY(-)2
BATTERY(-)1
43 STOP LAMP.
44 WARNING LAMP.
50 WAIT TO START LAMP.
39 KEY SW. SIGNAL
42 ECM RETURN
49 SW.OUTPUT
34 SW. RETURN
2 DIAGNOSTIC SW.
24 INC/CRUISE RESUME SW.
25 DEC/CRUISE SET SW.
ISC1 SW. 4
ISC2 SW.16
ISC3 SW.18
46 SAE J1939(+)
37 SAE J1939(SHIELD)
47 SAE J1939(-)
COMBINATION METER
COMBI METER LAMPS
TACHOMETER
FUEL METER
TEMPERATURE METER
HOUR METER
CHARGE WARNING LAMP
OIL PRESSURE WARNING LAMP
HYDRAULIC OIL FILTER WARNING LAMP
PARKING BRAKE INDICATOR LAMP
GLOW PLUG INDICATOR LAMP
VIBRATOR OPERATION INDICATOR LAMP
FLOOD LAMP INDICATOR LAMP
TURN SIGNAL INDICATOR LAMP
LIQUID SPRAY INDICATOR LAMP
WATER SPRAY INDICATOR LAMP
TACHOMETER INPUT
FUEL INPUT
TEMPERATURE INPUT
HOUR METER INPUT
VB (12V)
LAMP CHECK OUTPUT
TURN SIGNAL INPUT (LEFT)
TURN SIGNAL INPUT (RIGHT)
F.GROUND
COMBI METER BACKLIGHTING +
TACHO METER
FUEL METER
TEMP METER
HOUR METER
CHARGE
LAMP CHECK
BATTERY CHECK
OIL PRESS. WARNING
HYD FILTER WARNING
PARKING BRAKE
GLOW PLUG
VIBRATOR
FLOOD LAMP
TURN SIGNAL(L)
TURN SIGNAL(R)
LIQUID SPRAY
SPRINKLER
GROUND
COMB.METER LAMP
OIL PRESSURE RELAY
PARKING BRAKE SWITCH
DIODE UNIT
TO F-R LEVER VIBRATION SWITCH
TO VIBRATION MODE CHANGE SWITCH
VIBRATION AMPLITUDE SELECTOR SWITCH
HIGH
LOW
SOL
VIBRATOR SOLENOID
FUSE BOX
20A
15A
THERMO UNIT
FUEL UNIT
TACHO METER SENSOR
TACHO METER SENSOR CONTROL BOX
HYDRAULIC FILTER SWITCH 1
HYDRAULIC FILTER SWITCH 2
IGNITION
INDICATOR
PHASE
BATTERY
GROUND
ALTERNATOR(95A)
STARTER SWITCH
LAMP CHECK RELAY
F.L. 75A
BATTERY RELAY
95E41R (N100)
BATTERY
AV60
SV510-Ⅲ-09008

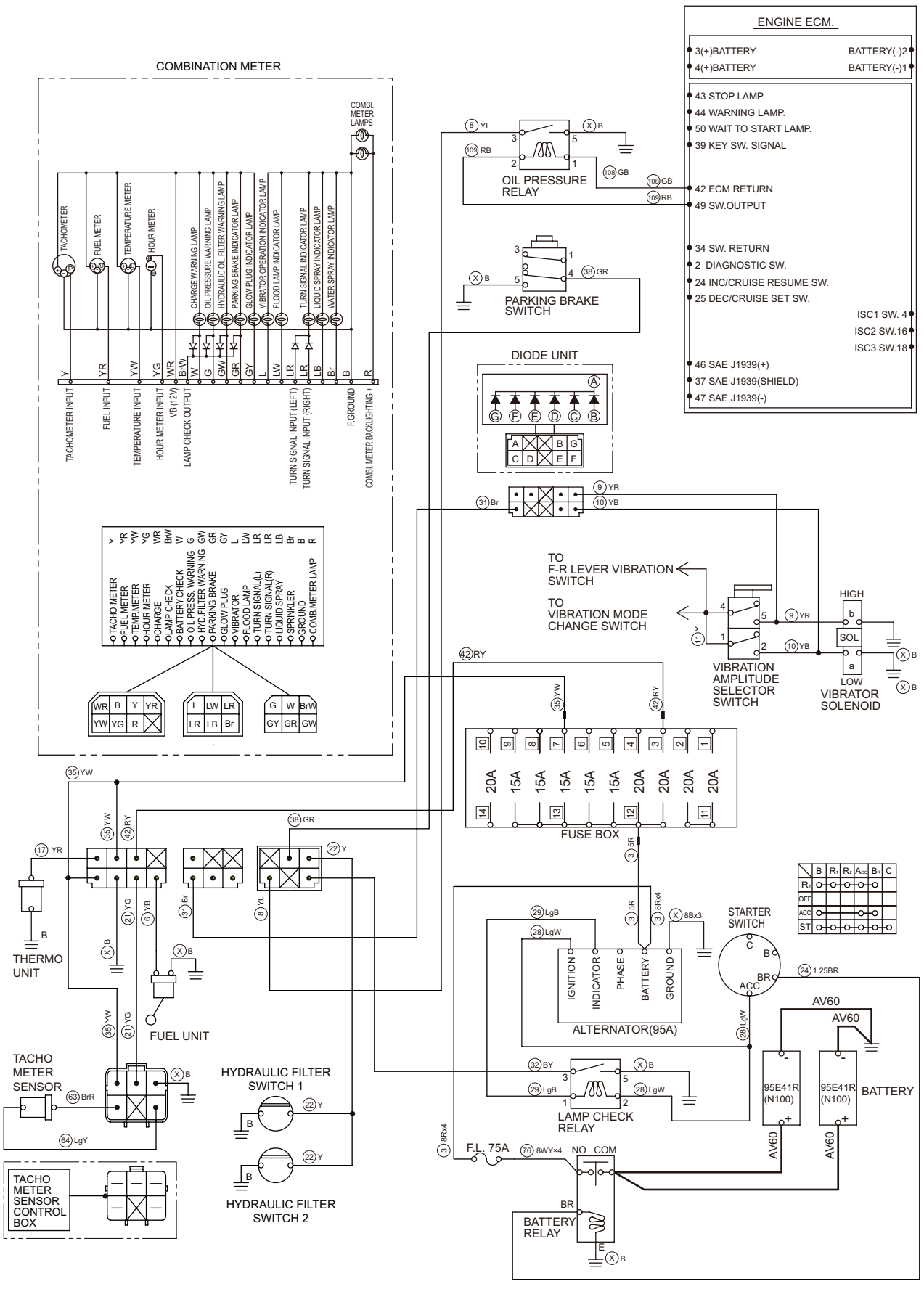
2-7-8. Oil pressure warning lamp remains ON

• Check whether engine check lamps show no fault code.

Reference Fig. : 2-7-1

Check point	Check/Cause	Action
1. Oil Pressure Relay	(1) When starter switch is ON, measure voltage between oil pressure relay terminal 1 outlet wire GB and chassis ground. There is no electricity in normal condition. (2) When starter switch is ON, measure voltage between oil pressure relay terminal 5 outlet wire B and chassis ground. There is no electricity in normal condition. • If above item (1) is OK and item (2) is NG, oil pressure relay is faulty.	Replace oil pressure relay.
2. Combination Meter (Oil pressure warning lamp)	(1) When starter switch is ON, measure voltage between combination meter battery terminal inlet wire No. 35 YW and ground terminal wire B. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between combination meter oil pressure terminal outlet wire No. 8 YL and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and no abnormality is found in oil pressure relay, 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.: 2-7-1



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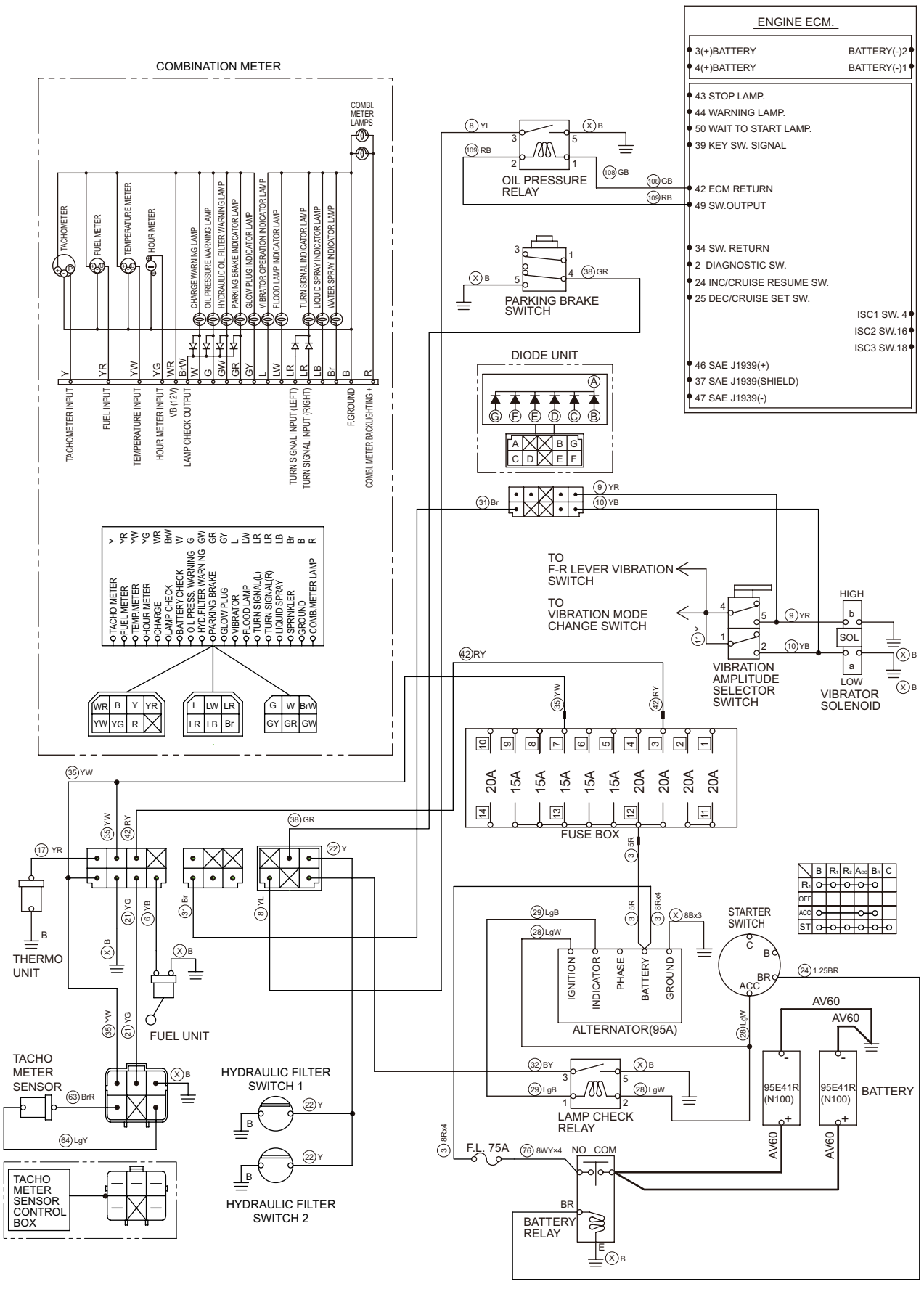
2-7-9. Vibration indicator lamp does not light

• Check that vibrator can be activated.

Reference Fig. : 2-7-1

Check point	Check/Cause	Action
1. Bulb	• Check if bulb has burned out or is poorly contacted. • Bulb is faulty or poorly connected.	Replace bulb.
2. Diode Unit	(1) When starter switch is ON and vibration amplitude selector switch is in " ∿ " position, measure voltage between diode unit terminal G and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and vibration amplitude selector switch is in " ⩘ " position, measure voltage between diode unit terminal F and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between diode unit terminal A 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)	• When starter switch is ON and vibration amplitude selector switch is " ∿ " or " ⩘ " position, measure voltage between combination meter vibration indicator lamp terminal inlet wire No. 31 Br and ground terminal wire B. Standard voltage : 12 V or more • If above item is OK and vibration indicator lamp does not light, combination meter is faulty.	Replace combination meter.
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



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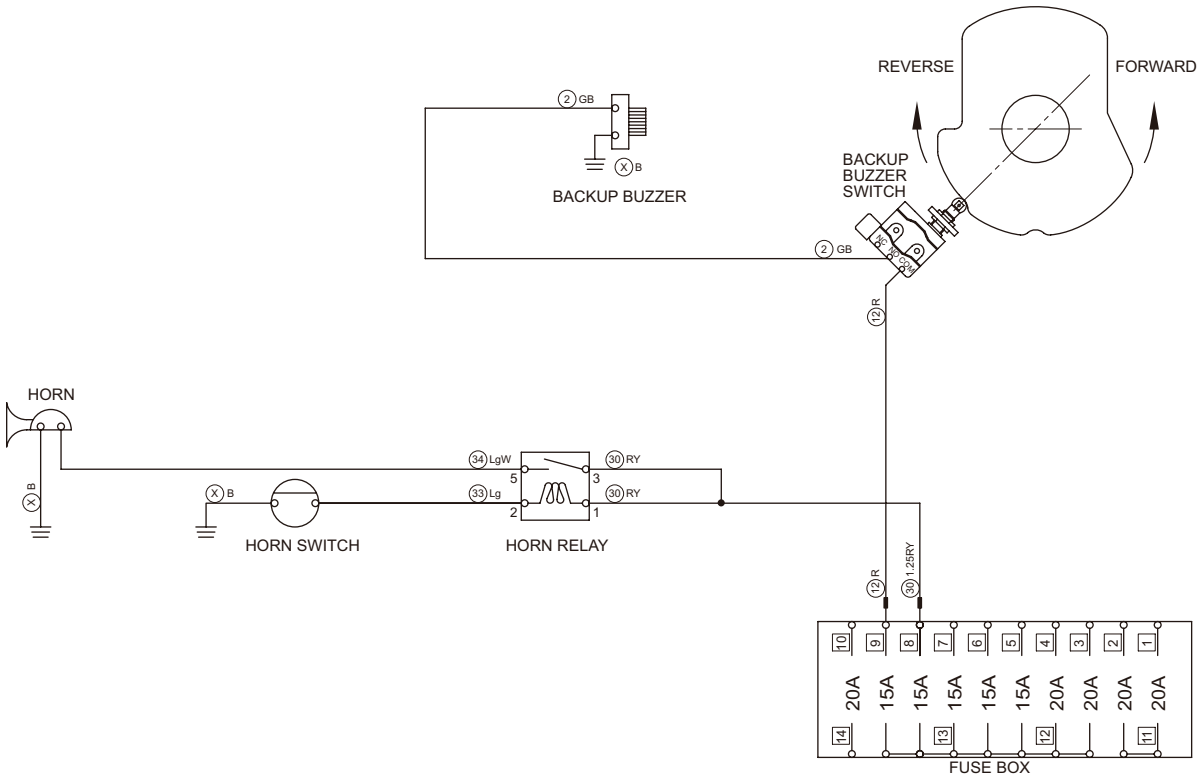
2-7-10. Parking brake indicator lamp does not light

Reference Fig. : 2-7-1

Check point	Check/Cause	Action
1. Bulb	• Check if bulb has burned out or is poorly contacted. • Bulb is faulty or poorly connected.	Replace bulb.
2. Parking Brake Switch	• When parking brake is applied, check continuity between parking brake switch terminal 4 and 5. 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)	(1) When starter switch is ON, measure voltage between combination meter battery terminal inlet wire No. 35 YW and ground terminal wire B. Standard voltage: 12 V or more (2) When starter switch is ON and parking brake is applied, measure voltage between combination meter parking brake terminal outlet wire No. 38 GR and chassis ground. Standard voltage: 12 V or more • If above item (1) is OK and item (2) is NG, combination meter is faulty.	Replace combination meter.
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. : 2-7-2



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2-7-11. Horn does not sound

Reference Fig. : 2-7-2

Check point	Check/Cause	Action
1. Horn	• Disconnect horn and directly connect battery positive terminal to horn terminal wire LgW 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 and horn switch is pressed, measure voltage between horn relay terminal 2 outlet wire Lg and chassis ground. Standard voltage: 12 V or more (2) When starter switch is ON and horn switch is pressed, measure voltage between horn relay terminal 5 outlet wire LgW 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 OFF, measure resistance between horn switch terminals. Standard resistance: 100 kΩ or more • If resistance is abnormal, 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.

2-7-12. Backup buzzer does not sound

Reference Fig. : 2-7-2

Check point	Check/Cause	Action
1. Backup Buzzer	• Disconnect backup buzzer and directly connect battery positive terminal to backup buzzer terminal wire GB 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 COM inlet wire R and chassis ground. Standard voltage: 12 V or more (2) When starter switch is ON and F-R lever is in reverse position, measure voltage between reverse switch terminal NO outlet wire GB 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.
	Insufficient charge pump discharge.	Repair 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	• 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. Suction Filter for Charge Pump	Charge pump flow is reduced due to clogged filter.	Clean suction filter or replace it if necessary.
6. Propulsion Circuit Pressure	Circuit does not obtain required pressure because setting pressure of high pressure relief is low.	• Measure propulsion circuit pressure. • If low, check and adjust multifunction valve or replace it if necessary.
7. Propulsion Motor	Propulsion circuit pressure is not held in propulsion motor case.	If pressure in propulsion motor case is not within allowable range, 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.
8. 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.	If pressure in propulsion pump case is not within allowable range, repair propulsion pump or replace it if necessary.

3-2-1. Machine moves neither forward nor backward 2/2

Check point	Cause	Check/Action
9. Brake Solenoid Valve	Brake remains applied because spool of brake solenoid valve does not shift.	Repair brake solenoid valve or replace it if necessary.
10. Brake Inlet Pressure	Brake cannot be released because brake inlet pressure is low.	• Measure brake release pressure. • If low, replace rear axle.
11. Rear Axle	Sticking of disc brakes causes brakes to remain applied.	Replace disc brakes.
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. Multifunction Valve	Low circuit pressure due to incorrect high pressure relief setting or internal leakage of multifunction valve.	• Interchange two multifunction valves. • If faulty condition is accordingly reversed, check and adjust multifunction 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 charge pump discharge.	Repair 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	• 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 Charge Pump	Flow rate of charge pump decreases as well as charge pressure decreases due to clogged filter.	Clean suction filter or replace it if necessary.
5. Propulsion Motor	Propulsion motor inlet pressure is low.	• Measure propulsion motor inlet pressure. • If low, check and adjust multifunction valve or replace it if necessary.
	Propulsion circuit pressure is not held in propulsion motor case.	If pressure in propulsion motor case is not within allowable range, 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.

3-2-3. Slow machine speed or small drive force 2/2

Check point	Cause	Check/Action
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.	If pressure in propulsion pump case is not within allowable range, repair propulsion pump or replace it if necessary.

3-2-4. Machine speed cannot be switched

Check point	Cause	Check/Action
1. Front or Rear Motor Proportional Solenoid Valve	Vehicle speed is not switched because front or rear motor proportional solenoid valve spool does not move.	Repair front or rear motor proportional solenoid valve or replace it if necessary.
2. Front or Rear Propulsion Motor Swash Plate Stroke Cylinder	Faulty front or rear propulsion motor swash plate stroke cylinder.	Repair front or rear propulsion motor or replace it if necessary.

3-2-5. Machine does not stop completely with F-R lever in neutral position

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 Charge Pump	Load of 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 1	Charge circuit pressure increases due to clogged filter.	Clean hydraulic oil filter 1 or replace it if necessary.

3-2-7. Abnormal noise from propulsion system

Check point	Cause	Check/Action
1. Axle Bearings	Axle bearings supporting front drum and rear tire are damaged.	Replace axle bearings.
2. Gear Box	Reduction gear of gear box is damaged.	Replace reduction gear.
3. Rear Axle	Rear axle gear is damaged.	Replace rear axle gear.
4. 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.
5. Suction Filter for Charge Pump	Cavitation is occurring in charge pump due to clogged filter.	Clean suction filter or replace it if necessary.
6. 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.
7. 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

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.
	Insufficient charge pump discharge.	Repair 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	• 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 Charge Pump	Flow rate of vibrator charge pump decreases due to clogged filter.	Clean suction filter or replace it if necessary.
4. Vibrator Circuit Pressure	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	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.
	Vibrator circuit pressure is not held in vibrator motor case.	If pressure in vibrator motor case is not within allowable range, repair vibrator motor or replace it if necessary.
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.	If pressure in vibrator pump case is not within allowable range, 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 charge pump discharge.	Repair 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	• 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 Charge Pump	Flow rate of 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.	If pressure in vibrator motor case is not within allowable range, 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.	If pressure in vibrator pump case is not within allowable range, repair vibrator pump or replace it if necessary.

3-3-3. Amplitude does not switch between high and low

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. 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.

3-3-5. 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. 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.
4. Suction Filter for Charge Pump	Load of charge pump increases due to clogged filter, causing temperature of hydraulic oil in circuit to rise.	Clean suction filter or replace it if necessary.
5. Hydraulic Oil Filter 2	Charge circuit pressure increases due to clogged filter.	Clean hydraulic oil filter 2 or replace it if necessary.

3-3-6. 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 Charge Pump	Cavitation is occurring in 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 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 1.	Clean hydraulic filter 1 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 Charge Pump	Charge pump discharge rate decreases due to clogged filter.	Clean suction filter or replace it if necessary.
6. Charge Pump	Discharging pressure is insufficient due to efficiency degradation of charge pump.	• Measure steering circuit pressure. • If low, replace 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 adjust 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 Charge Pump	Charge pump discharge rate decreases due to clogged filter.	Clean suction filter or replace it if necessary.
5. Charge Pump	Discharging pressure is insufficient due to efficiency degradation of charge pump.	• Measure steering circuit pressure. • If low, replace 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 Charge Pump	Load of steering 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. Air in 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 Charge Pump	Cavitation is occurring in charge pump due to clogged filter.	Clean suction filter or replace it if necessary.

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