SV412

SHOP MANUAL

SAKAI®

3498-64047-0

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.

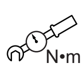
⚠WARNING: Indicates a potentially hazardous situation or condition which if not avoided can result in serious personal injury or death.

⚠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.

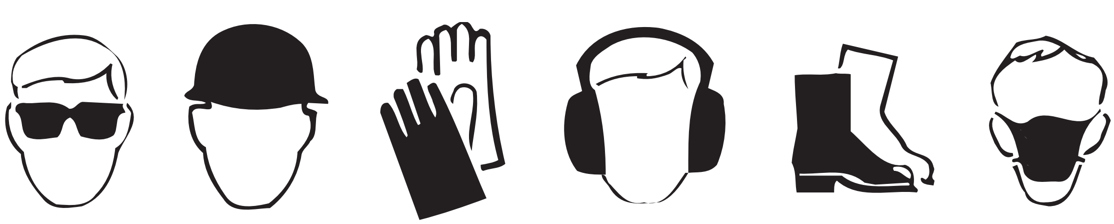
- The machine is designed specifically for the compaction of asphalt or soil road construction materials. Use of the machine for other purposes such as towing other equipment is considered contrary to the designated use. The manufacturer cannot be responsible or held liable for any damage resulting from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

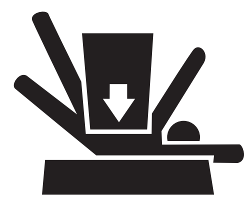
- Always park the machine in a safe area on solid and level ground. If this is not possible, always park at a right angle to the slope and block the drums or tires.
- Do not leave the operator's platform with the engine running. Always move the travel lever to neutral position and apply the parking brake 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.

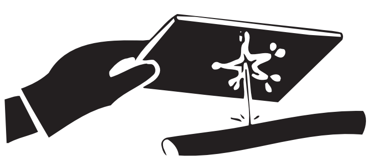


- Always use the proper tools and workshop equipment in good condition when performing maintenance or repairs on the machine.

- 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.

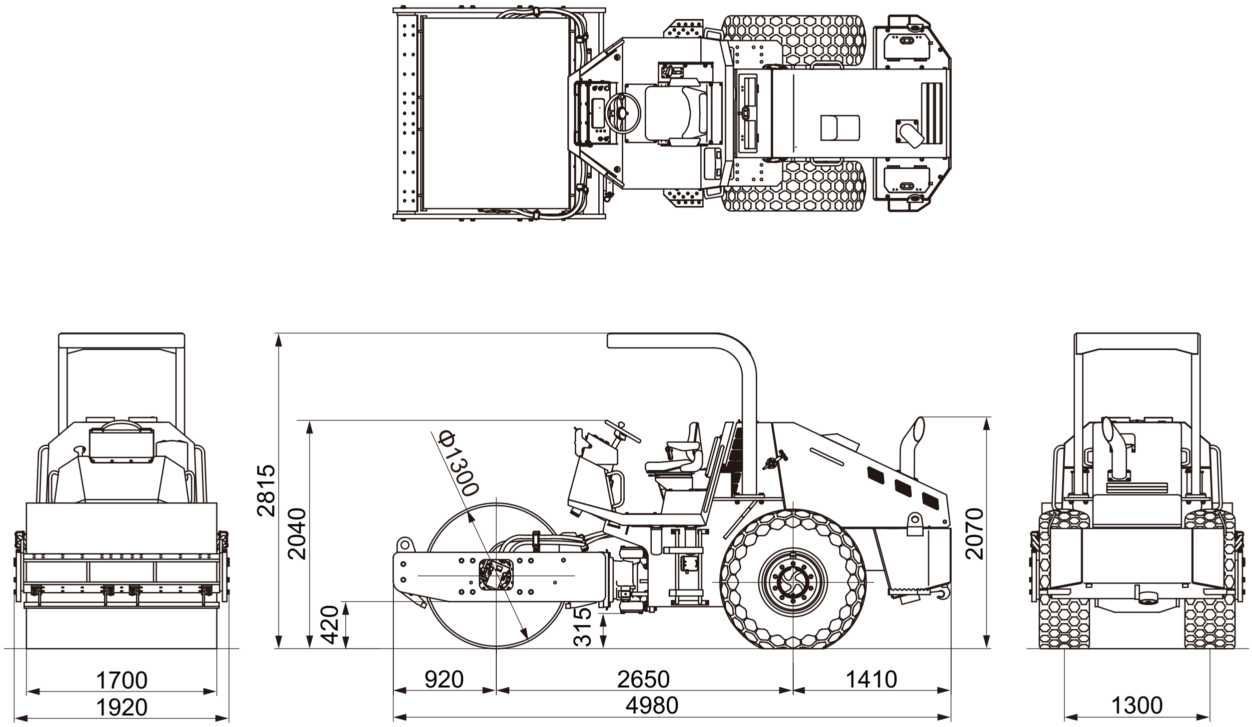
1-11. Transporting the Machine

- 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. SV412D



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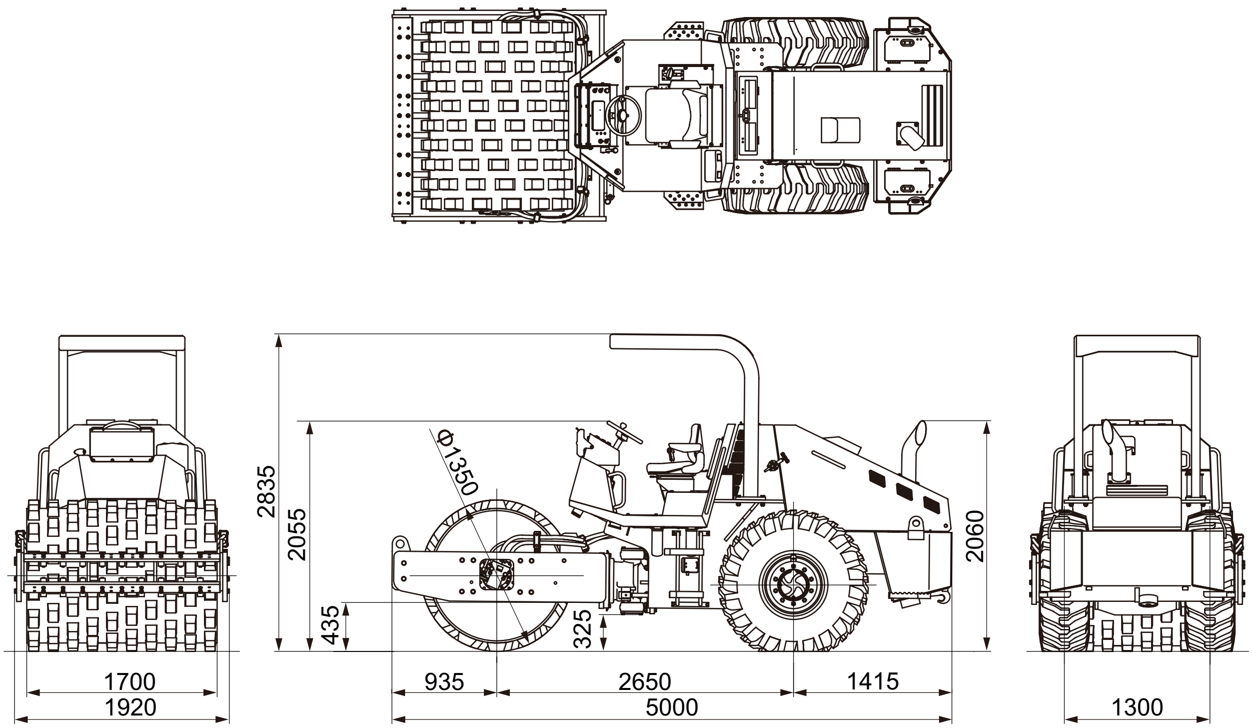
Model			SV412D
Weight	Operating weight		7,540 kg (16,620 lbs.)
	Front axle		3,600 kg (7,935 lbs.)
	Rear axle		3,940 kg (8,685 lbs.)
Dimensions	Overall length		4,980 mm (196 in.)
	Overall width		1,920 mm (76 in.)
	Overall height	Steering wheel	2,040 mm (80 in.)
		ROPS	2,815 mm (111 in.)
	Wheelbase		2,650 mm (104 in.)
	Compaction width		1,700 mm (67 in.)
	Minimum height above ground		315 mm (12.0 in.)
	Curb clearance		420 mm (16.5 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	38 Hz
		High amplitude	30 Hz
	Centrifugal force	Low amplitude	93 kN (20,905 lbs.)
		High amplitude	118 kN (26,525 lbs.)
	Amplitude	Low amplitude	0.70 mm (0.028 in.)
		High amplitude	1.40 mm (0.055 in.)
Minimum turning radius			4.9 m (193 in.)
Gradability *1			61 % (32 °)

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

Engine	Name			CUMMINS QSB3.3 Diesel Engine with turbocharger (EPA Interim Tier 4)
	Model			Water-cooled, 4-cycle, 4-cylinder, in-line, vertical mounted, overhead valve, direct injection type
	Bore × Stroke			95 mm × 115 mm (3.740 in. × 4.528 in.)
	Displacement			3.262 L (199 cu.in)
	Performance	Rated speed		2,400 min^{-1} (2,400 rpm)
		Rated output		82 kW (110 HP) at 2,400 min^{-1}
		Max. torque		415 N·m (306 lbf·ft) at 1,600 min^{-1}
		Fuel consumption		233 g/kW·h (0.383 lb/HP·h) at rated speed
	Governor			Full electronic control
	Lubrication system			Pressure lubrication by gear pump
	Oil filter			Full-flow: stratapore (synthetic)
	Air cleaner			Dry type
	Cooling system			Centrifugal pump forced feeding system (pressure type)
	Cooling fan			Inhaling type
	Electrical system	Alternator		12 V 60 A
		Starter		12 V 2.7 kW
		Battery		12 V CCA 620 × 1 pcs. (12 V)
	Dry weight			361 kg (795 lbs.)
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		Vibrate & drive × 1
		Rear tires		Drive × 2
	Dimension	Front drum	width × diameter	1,700 mm × 1,300 mm (67 in. × 51 in.)
		Rear tires	size	16.9-24 6PR (A)
	Suspension system	Front		Rubber damper type
		Rear		Rigid
Others	Rops			Steel frame

1-2. SV412T



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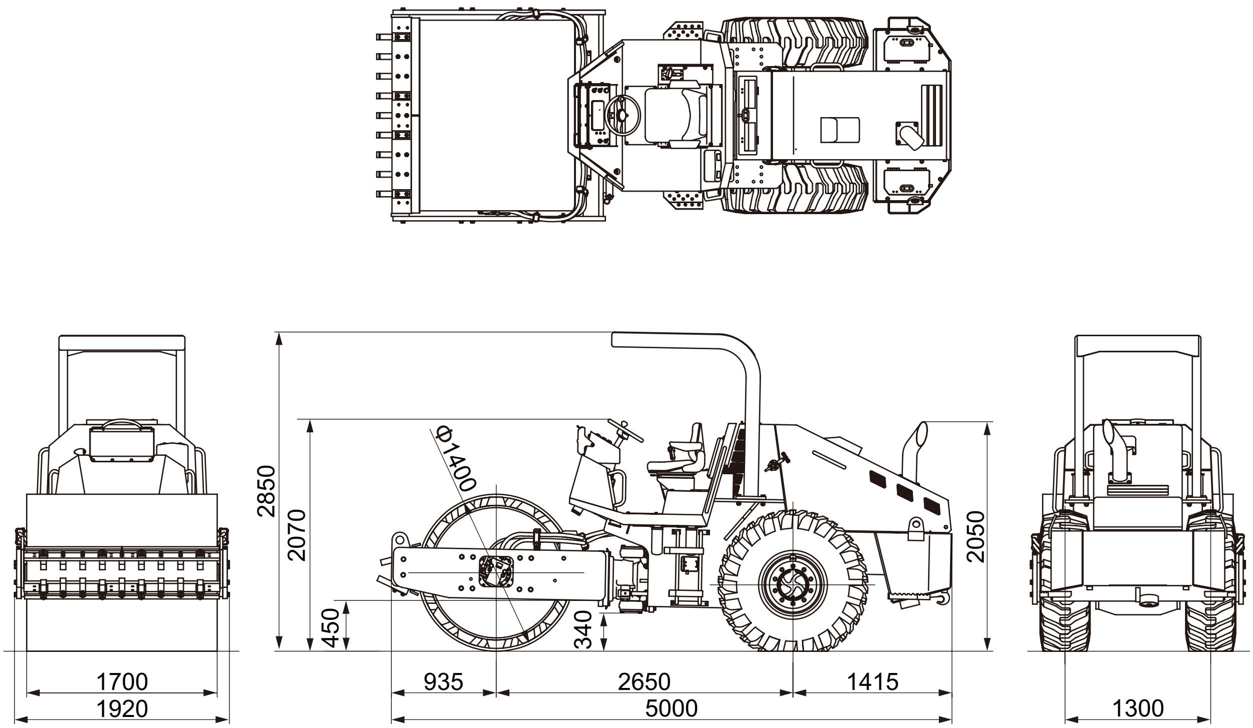
Model			SV412T	
Weight	Operating weight		7,780 kg	(17,150 lbs.)
	Front axle		3,820 kg	(8,420 lbs.)
	Rear axle		3,960 kg	(8,730 lbs.)
Dimensions	Overall length		5,000 mm	(197 in.)
	Overall width		1,920 mm	(76 in.)
	Overall height	Steering wheel	2,055 mm	(81 in.)
		ROPS	2,835 mm	(112 in.)
	Wheelbase		2,650 mm	(104 in.)
	Compaction width		1,700 mm	(67 in.)
	Minimum height above ground		325 mm	(12.5 in.)
	Curb clearance		435 mm	(17 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	38 Hz	
		High amplitude	30 Hz	
	Centrifugal force	Low amplitude	103 kN	(23,155 lbs.)
		High amplitude	127 kN	(28,550 lbs.)
	Amplitude	Low amplitude	0.70 mm	(0.028 in.)
		High amplitude	1.40 mm	(0.055 in.)
Minimum turning radius			4.9 m	(193 in.)
Gradability *1			60 %	(31 °)

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

Engine	Name				CUMMINS QSB3.3 Diesel Engine with turbocharger (EPA Interim Tier 4)
	Model				Water-cooled, 4-cycle, 4-cylinder, in-line, vertical mounted, overhead valve, direct injection type
	Bore × Stroke				95 mm × 115 mm (3.740 in. × 4.528 in.)
	Displacement				3.262 L (199 cu.in)
	Performance	Rated speed			2,400 min^{-1} (2,400 rpm)
		Rated output			82 kW (110 HP)
					at 2,400 min^{-1}
		Max. torque			415 N·m (306 lbf·ft)
					at 1,600 min^{-1}
		Fuel consumption			233 g/kW·h (0.383 lb/HP·h)
					at rated speed
	Governor				Full electronic control
	Lubrication system				Pressure lubrication by gear pump
	Oil filter				Full-flow: stratapore (synthetic)
	Air cleaner				Dry type
	Cooling system				Centrifugal pump forced feeding system (pressure type)
	Cooling fan				Inhaling type
	Electrical system	Alternator			12 V 60 A
		Starter			12 V 2.7 kW
		Battery			12 V CCA 620 × 1 pcs. (12 V)
	Dry weight				361 kg (795 lbs.)
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			Vibrate & drive × 1
		Rear tires			Drive × 2
	Dimension	Front drum	Pad	width × diameter	1,700 mm × 1,350 mm (67 in. × 53 in.)
				Number of pads	140
				Pad height	75 mm (3.0 in.)
				Pad area	102 cm^2 (16 sq.in.)
		Rear tires	size		16.9-24 6PR (A)
	Suspension system	Front			Rubber damper type
		Rear			Rigid
Others	Rops				Steel frame

1-3. SV412TF



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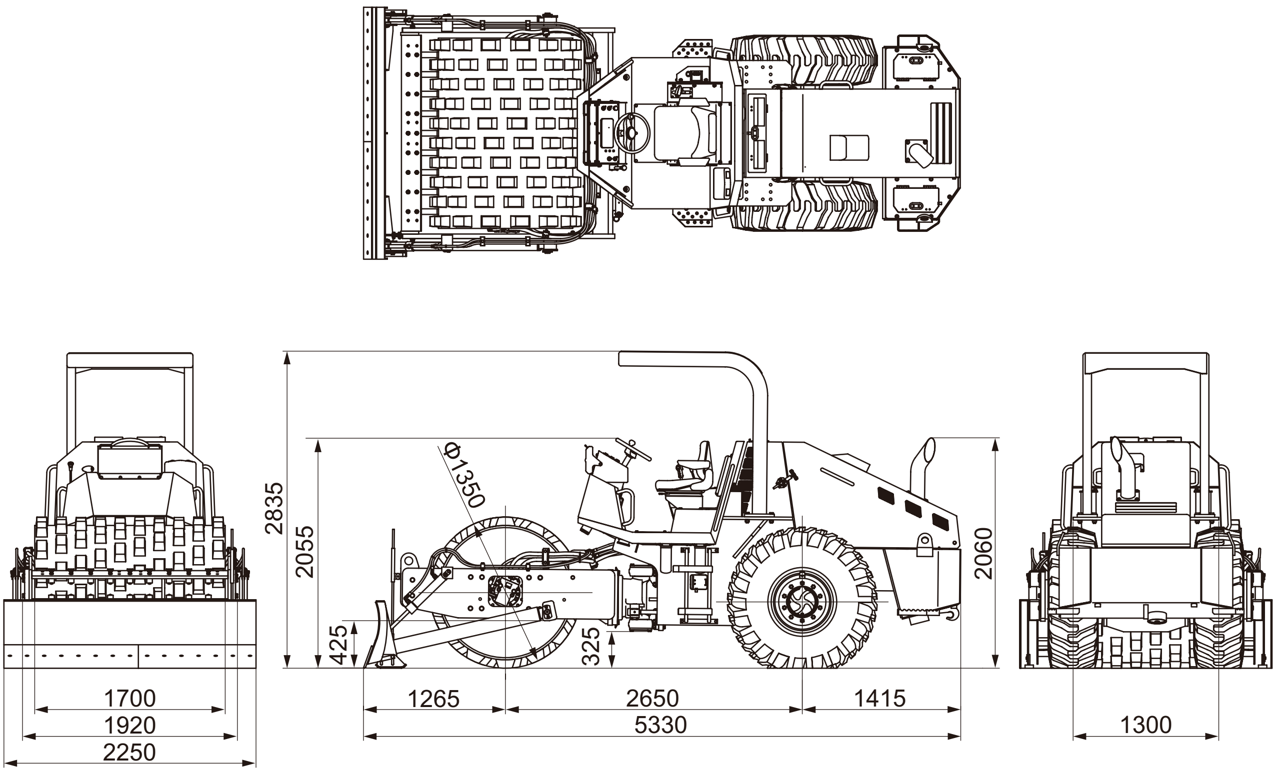
Model			SV412TF	
Weight	Operating weight		9,050 kg	(19,950 lbs.)
	Front axle		5,110 kg	(11,265 lbs.)
	Rear axle		3,940 kg	(8,685 lbs.)
Dimensions	Overall length		5,000 mm	(197 in.)
	Overall width		1,920 mm	(76 in.)
	Overall height	Steering wheel	2,070 mm	(81 in.)
		ROPS	2,850 mm	(112 in.)
	Wheelbase		2,650 mm	(104 in.)
	Compaction width		1,700 mm	(67 in.)
	Minimum height above ground		340 mm	(13.0 in.)
	Curb clearance		450 mm	(17.5 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	38 Hz	
		High amplitude	30 Hz	
	Centrifugal force	Low amplitude	103 kN	(23,155 lbs.)
		High amplitude	127 kN	(28,550 lbs.)
	Amplitude	Low amplitude	0.50 mm	(0.020 in.)
		High amplitude	0.90 mm	(0.035 in.)
Minimum turning radius			4.9 m	(193 in.)
Gradability *1			46 %	(25 °)

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

Engine	Name				CUMMINS QSB3.3 Diesel Engine with turbocharger (EPA Interim Tier 4)
Engine	Model				Water-cooled, 4-cycle, 4-cylinder, in-line, vertical mounted, overhead valve, direct injection type
Engine	Bore × Stroke				95 mm × 115 mm (3.740 in. × 4.528 in.)
Engine	Displacement				3.262 L (199 cu.in)
Engine	Performance	Rated speed			2,400 min^{-1} (2,400 rpm)
Engine	Performance	Rated output			82 kW (110 HP) at 2,400 min^{-1}
Engine	Performance	Max. torque			415 N·m (306 lbf·ft) at 1,600 min^{-1}
Engine	Performance	Fuel consumption			233 g/kW·h (0.383 lb/HP·h) at rated speed
Engine	Governor				Full electronic control
Engine	Lubrication system				Pressure lubrication by gear pump
Engine	Oil filter				Full-flow: stratapore (synthetic)
Engine	Air cleaner				Dry type
Engine	Cooling system				Centrifugal pump forced feeding system (pressure type)
Engine	Cooling fan				Inhaling type
Engine	Electrical system	Alternator			12 V 60 A
Engine	Electrical system	Starter			12 V 2.7 kW
Engine	Electrical system	Battery			12 V CCA 620 × 1 pcs. (12 V)
Engine	Dry weight				361 kg (795 lbs.)
Power line	Transmission	Type			Hydrostatic transmission
Power line	Transmission	Speeds			2 speed shifts
Power line	Reverser				Switching the direction of flow delivered from the variable pump
Power line	Differential				Auto lock type
Power line	Final drive				Planetary gear
Vibrating system	Transmission				Hydrostatic transmission
Vibrating system	Vibrator				Eccentric shaft type
Braking device	Service brake				Hydrostatic and mechanical type
Braking device	Parking brake				Mechanical type
Steering system	Steering control type				Hydraulic type (Articulated type)
Steering system	Steering control angle				± 37 °
Steering system	Oscillation angle				± 7 °
Drum and wheels	Use	Front drum			Vibrate & drive × 1
Drum and wheels	Use	Rear tires			Drive × 2
Drum and wheels	Dimension	Front drum	Smooth	width × diameter	1,700 mm × 1,400 mm (67 in. × 55 in.)
Drum and wheels	Dimension	Front drum	Pad	width × diameter	1,700 mm × 1,350 mm (67 in. × 53 in.)
Drum and wheels	Dimension	Front drum	Pad	Number of pads	140
Drum and wheels	Dimension	Front drum	Pad	Pad height	75 mm (3.0 in.)
Drum and wheels	Dimension	Front drum	Pad	Pad area	102 cm^2 (16 sq.in.)
Drum and wheels	Dimension	Rear tires	size		16.9-24 6PR (A)
Drum and wheels	Suspension system	Front			Rubber damper type
Drum and wheels	Suspension system	Rear			Rigid
Others	Rops				Steel frame

1-4. SV412TB



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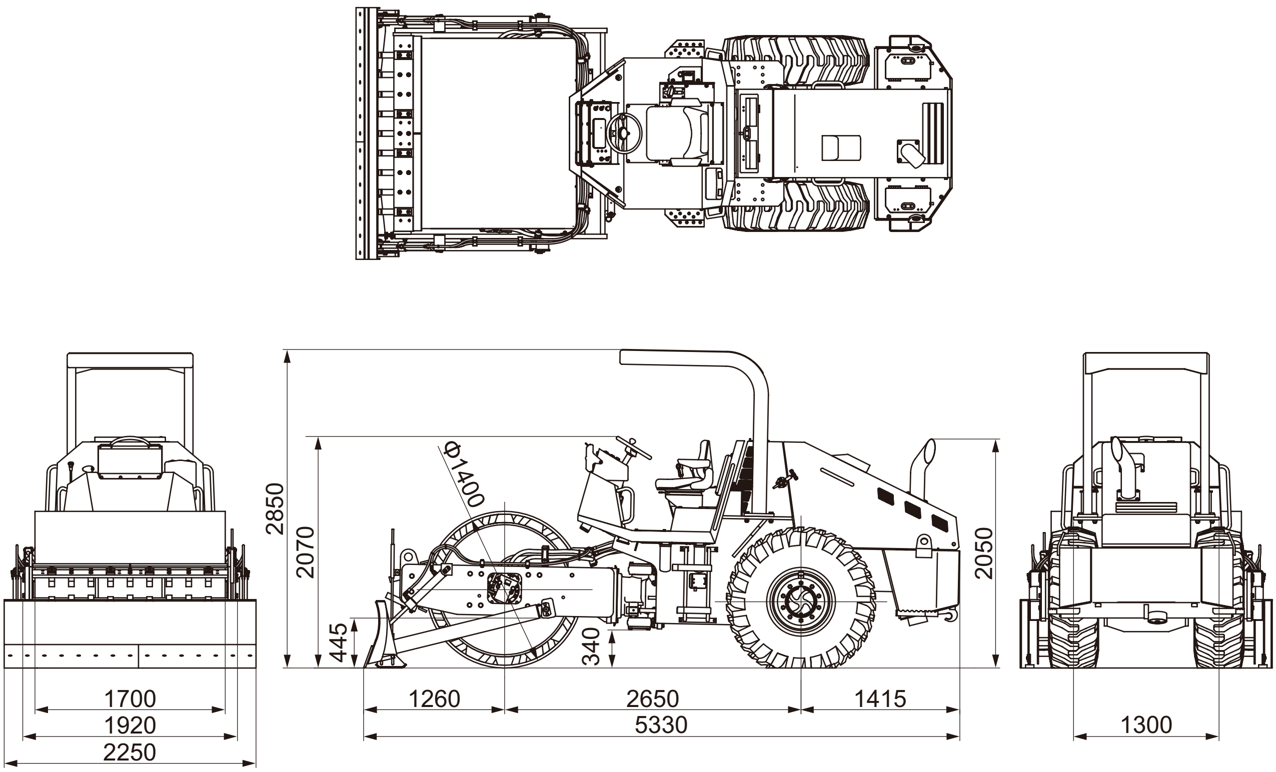
Model			SV412TB	
Weight	Operating weight		8,200 kg	(18,080 lbs.)
	Front axle		4,340 kg	(9,570 lbs.)
	Rear axle		3,860 kg	(8,510 lbs.)
Dimensions	Overall length		5,330 mm	(210 in.)
	Overall width		2,250 mm	(89 in.)
	Overall height	Steering wheel	2,055 mm	(81 in.)
		ROPS	2,835 mm	(112 in.)
	Wheelbase		2,650 mm	(104 in.)
	Compaction width		1,700 mm	(67 in.)
	Minimum height above ground		325 mm	(12.5 in.)
	Curb clearance		425 mm	(16.5 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	38 Hz	
		High amplitude	30 Hz	
	Centrifugal force	Low amplitude	103 kN	(23,155 lbs.)
		High amplitude	127 kN	(28,550 lbs.)
	Amplitude	Low amplitude	0.70 mm	(0.028 in.)
		High amplitude	1.40 mm	(0.055 in.)
Minimum turning radius			4.9 m	(193 in.)
Gradability *1			55 %	(29 °)

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

Engine	Name			CUMMINS QSB3.3 Diesel Engine with turbocharger (EPA Interim Tier 4)
	Model			Water-cooled, 4-cycle, 4-cylinder, in-line, vertical mounted, overhead valve, direct injection type
	Bore × Stroke			95 mm × 115 mm (3.740 in. × 4.528 in.)
	Displacement			3.262 L (199 cu.in)
	Performance	Rated speed		2,400 min^{-1} (2,400 rpm)
		Rated output		82 kW (110 HP) at 2,400 min^{-1}
		Max. torque		415 N·m (306 lbf·ft) at 1,600 min^{-1}
		Fuel consumption		233 g/kW·h (0.383 lb/HP·h) at rated speed
	Governor			Full electronic control
	Lubrication system			Pressure lubrication by gear pump
	Oil filter			Full-flow: stratapore (synthetic)
	Air cleaner			Dry type
	Cooling system			Centrifugal pump forced feeding system (pressure type)
	Cooling fan			Inhaling type
	Electrical system	Alternator		12 V 60 A
		Starter		12 V 2.7 kW
		Battery		12 V CCA 620 × 1 pcs. (12 V)
	Dry weight			361 kg (795 lbs.)
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		Vibrate & drive × 1
		Rear tires		Drive × 2
	Dimension	Front drum	width × diameter	1,700 mm × 1,350 mm (67 in. × 53 in.)
		Front drum Pad	Number of pads	140
		Front drum Pad	Pad height	75 mm (3.0 in.)
		Front drum Pad	Pad area	102 cm^2 (16 sq.in.)
		Rear tires	size	16.9-24 6PR (A)
	Suspension system	Front		Rubber damper type
		Rear		Rigid
Others	Rops			Steel frame

1-5. SV412FB



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Model			SV412FB	
Weight	Operating weight		9,460 kg	(20,855 lbs.)
	Front axle		5,630 kg	(12,410 lbs.)
	Rear axle		3,830 kg	(8,445 lbs.)
Dimensions	Overall length		5,330 mm	(210 in.)
	Overall width		2,250 mm	(89 in.)
	Overall height	Steering wheel	2,070 mm	(81 in.)
		ROPS	2,850 mm	(112 in.)
	Wheelbase		2,650 mm	(104 in.)
	Compaction width		1,700 mm	(67 in.)
	Minimum height above ground		340 mm	(13.0 in.)
	Curb clearance		445 mm	(17.5 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	38 Hz	
		High amplitude	30 Hz	
	Centrifugal force	Low amplitude	103 kN	(23,155 lbs.)
		High amplitude	127 kN	(28,550 lbs.)
	Amplitude	Low amplitude	0.50 mm	(0.020 in.)
		High amplitude	0.90 mm	(0.035 in.)
Minimum turning radius			4.9 m	(193 in.)
Gradability *1			44 %	(24 °)

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

Engine	Name				CUMMINS QSB3.3 Diesel Engine with turbocharger (EPA Interim Tier 4)
	Model				Water-cooled, 4-cycle, 4-cylinder, in-line, vertical mounted, overhead valve, direct injection type
	Bore × Stroke				95 mm × 115 mm (3.740 in. × 4.528 in.)
	Displacement				3.262 L (199 cu.in)
	Performance	Rated speed			2,400 min^{-1} (2,400 rpm)
		Rated output			82 kW (110 HP)
					at 2,400 min^{-1}
		Max. torque			415 N·m (306 lbf·ft)
					at 1,600 min^{-1}
		Fuel consumption			233 g/kW·h (0.383 lb/HP·h)
					at rated speed
	Governor				Full electronic control
	Lubrication system				Pressure lubrication by gear pump
	Oil filter				Full-flow: stratapore (synthetic)
	Air cleaner				Dry type
	Cooling system				Centrifugal pump forced feeding system (pressure type)
	Cooling fan				Inhaling type
	Electrical system	Alternator			12 V 60 A
		Starter			12 V 2.7 kW
		Battery			12 V CCA 620 × 1 pcs. (12 V)
	Dry weight				361 kg (795 lbs.)
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			Vibrate & drive × 1
		Rear tires			Drive × 2
	Dimension	Front drum	Smooth	width × diameter	1,700 mm × 1,400 mm (67 in. × 55 in.)
			Pad	width × diameter	1,700 mm × 1,350 mm (67 in. × 53 in.)
				Number of pads	140
				Pad height	75 mm (3.0 in.)
				Pad area	102 cm^2 (16 sq.in.)
		Rear tires		size	16.9-24 6PR (A)
	Suspension system	Front			Rubber damper type
		Rear			Rigid
Others	Rops				Steel frame

2. TABLE OF STANDARD VALUES

2-1. Engine

Item		Standard value	Remarks
Engine model		CUMMINS QSB3.3 T4i Diesel Engine with turbocharger	
Rated output		82/2,400 kW/ min^{-1} (110/2,400 HP/rpm)	
Max. rpm under no load		2,400 rpm	
Min. rpm under no load		750 rpm	
Cylinder head tightening torque	1st	69 N·m (51 lbf·ft)	
	2nd	108 N·m (80 lbf·ft)	
	3rd	Tighten additional 90°	
Intake manifold tightening torque		65 N·m (48 lbf·ft)	
Exhaust manifold tightening torque		45 N·m (33 lbf·ft)	
Valve clearance (intake)		0.35 mm (0.014 in.)	
Valve clearance (exhaust)		0.50 mm (0.020 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

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)	

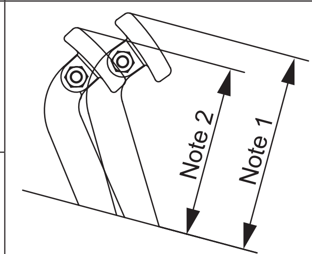
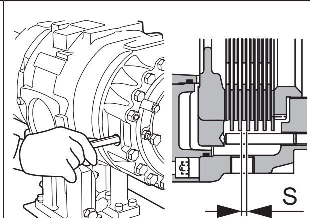
2-3. Hydraulic Systems

Item			Standard value	Remarks
Propulsion	High pressure relief valve setting		41.8 ± 1.0 MPa (6,061 ± 145 psi)	at 1,800 min^{-1}
	Charge relief valve setting		2.5 ± 0.2 MPa (363 ± 29 psi)	
	Charge relief valve setting (Rear motor)		2.67 MPa (387 psi)	at 19 L/min
	Case pressure	Pump	0.3 MPa (43.5 psi) or less	
		Front motor	0.3 MPa (43.5 psi) or less	
		Rear motor	0.3 MPa (43.5 psi) or less	
	Brake release pressure	Front motor	—	
		Rear motor	—	
		Rear axle	1.5 to 3.0 MPa (218 to 435 psi)	
	Motor drainage	Front motor	5.5 L/min (1.5 gal./min)	
		Rear motor	5.0 L/min (1.3 gal./min)	
Vibration	High pressure relief valve setting		25.0 ± 1.0 MPa (3,625 ± 145 psi)	
	Charge relief valve setting		2.5 ± 0.2 MPa (363 ± 29 psi)	
	Case pressure	Pump	0.3 MPa (43.5 psi) or less	
		Motor	0.17 MPa (24.7 psi) or less	
	Motor drainage		6.3 L/min (1.7 gal./min)	
Steering oil pressure			17.5 ± 1.0 MPa (2,538 ± 145 psi)	(orbitroll relief pressure + charge relief pressure)

2-4. Steering

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

2-5. Brakes

Item	Standard value	Remarks
Clearance between brake pedal and floorboard (as released)	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	7 L (1.8 gal.)	
Fuel tank	172 L (45 gal.)	
Coolant	20 L (5.3 gal.)	
Reduction gear (front motor)	3.2 L (0.8 gal.)	
Center housing (rear axle)	7.3 L (1.9 gal.)	
Hub reduction gear case (rear left and right)	1.25 L ×2 (0.3 gal. ×2)	
Hydraulic oil tank	50 L (13 gal.)	
Vibrator case (front)	21 L (5.5 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

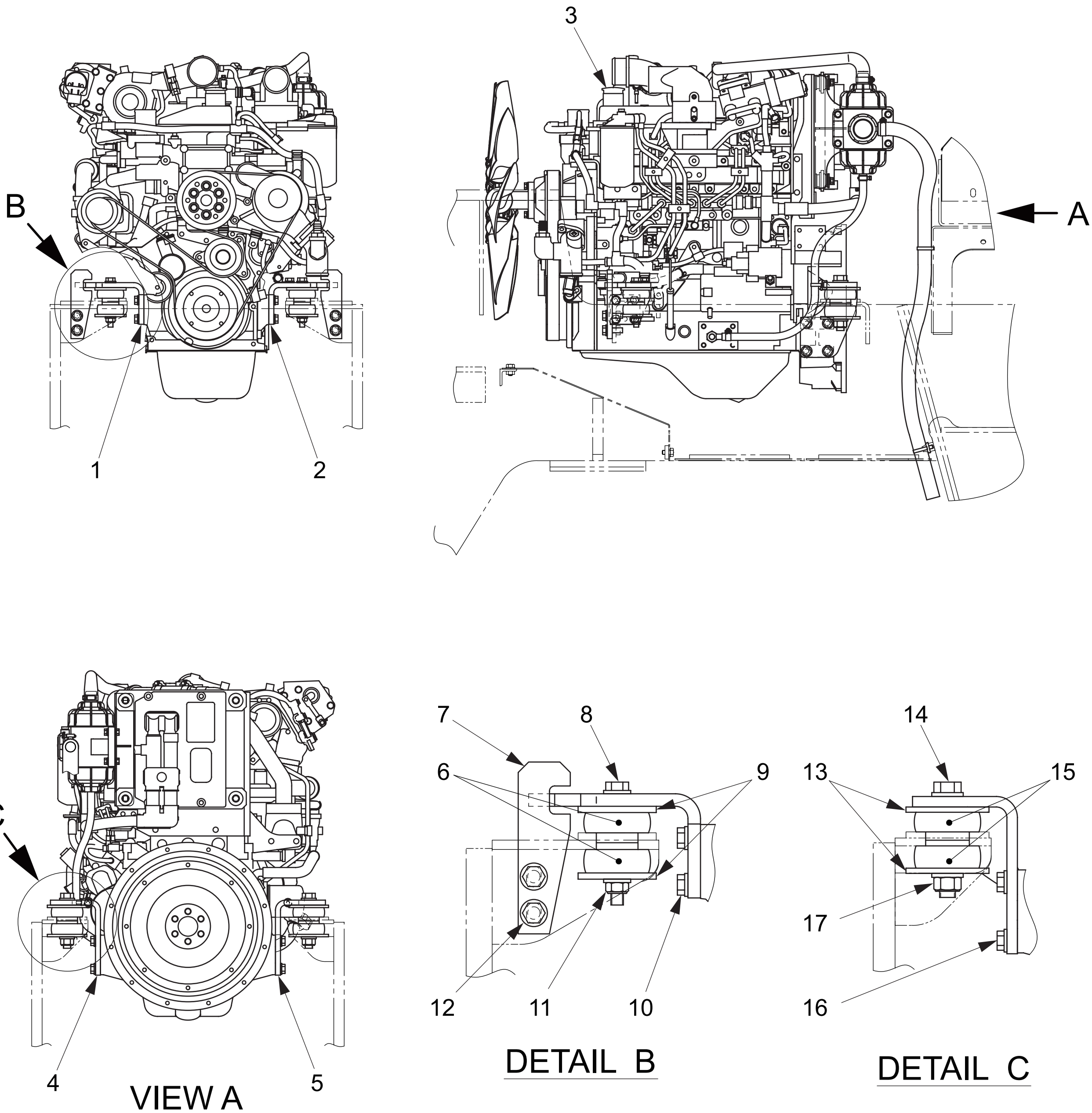
N·m	(lbf·ft)

	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



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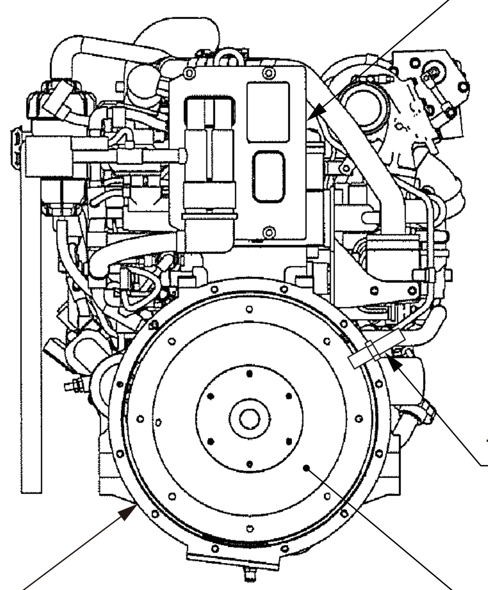
(1) Bracket
(2) Bracket
(3) Engine
(4) Bracket
(5) Bracket
(6) Damper
(7) Stopper
(8) Bolt : M12×110
(9) Plate
(10) Bolt : M10× 30
(11) Nut : M12
(12) Bolt : M12× 40
(13) Plate
(14) Bolt : M18×120
(15) Damper
(16) Bolt : M12× 35
(17) Nut : M18

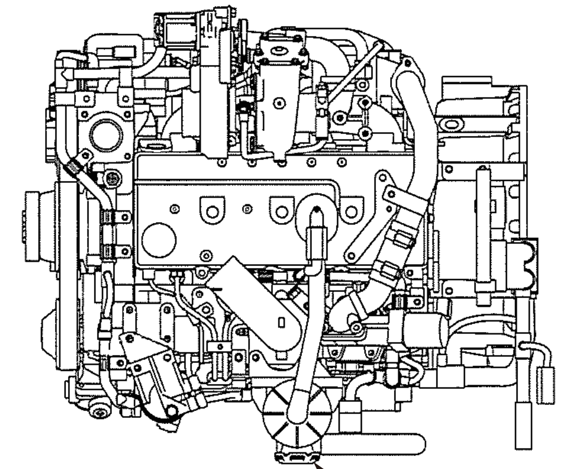
N•m

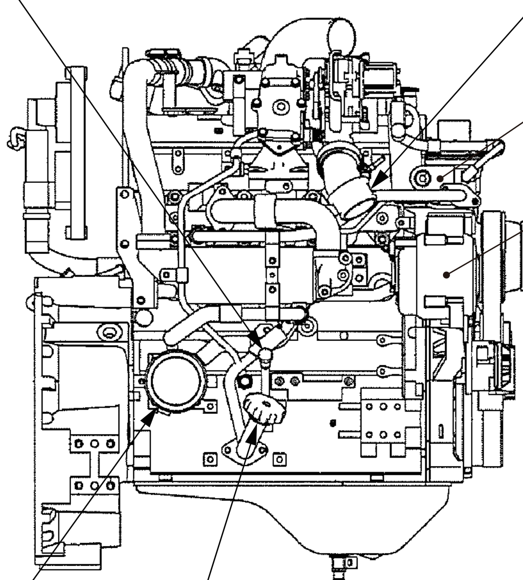
(8) Bolt M12×110 : 113 N·m (83 lbf·ft)
(10) Bolt M10× 30 : 59 N·m (44 lbf·ft)
(12) Bolt M12× 40 : 78 N·m (58 lbf·ft)
(14) Bolt M18×120 : 382 N·m (282 lbf·ft)
(16) Bolt M12× 35 : 108 N·m (80 lbf·ft)

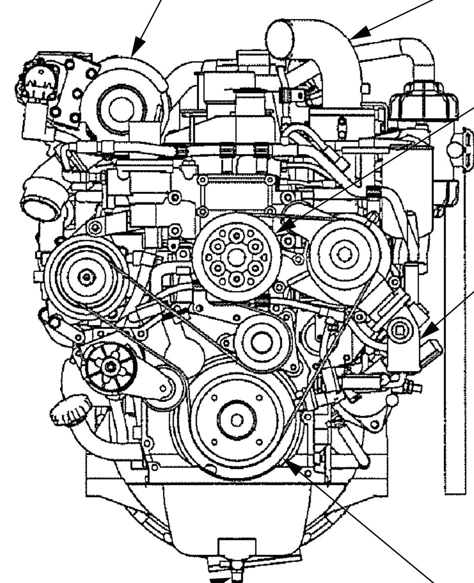
1-2. Engine Exterior

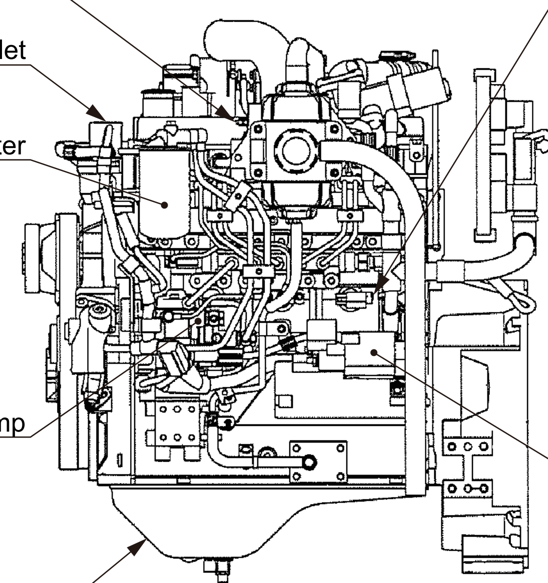


VIEW A







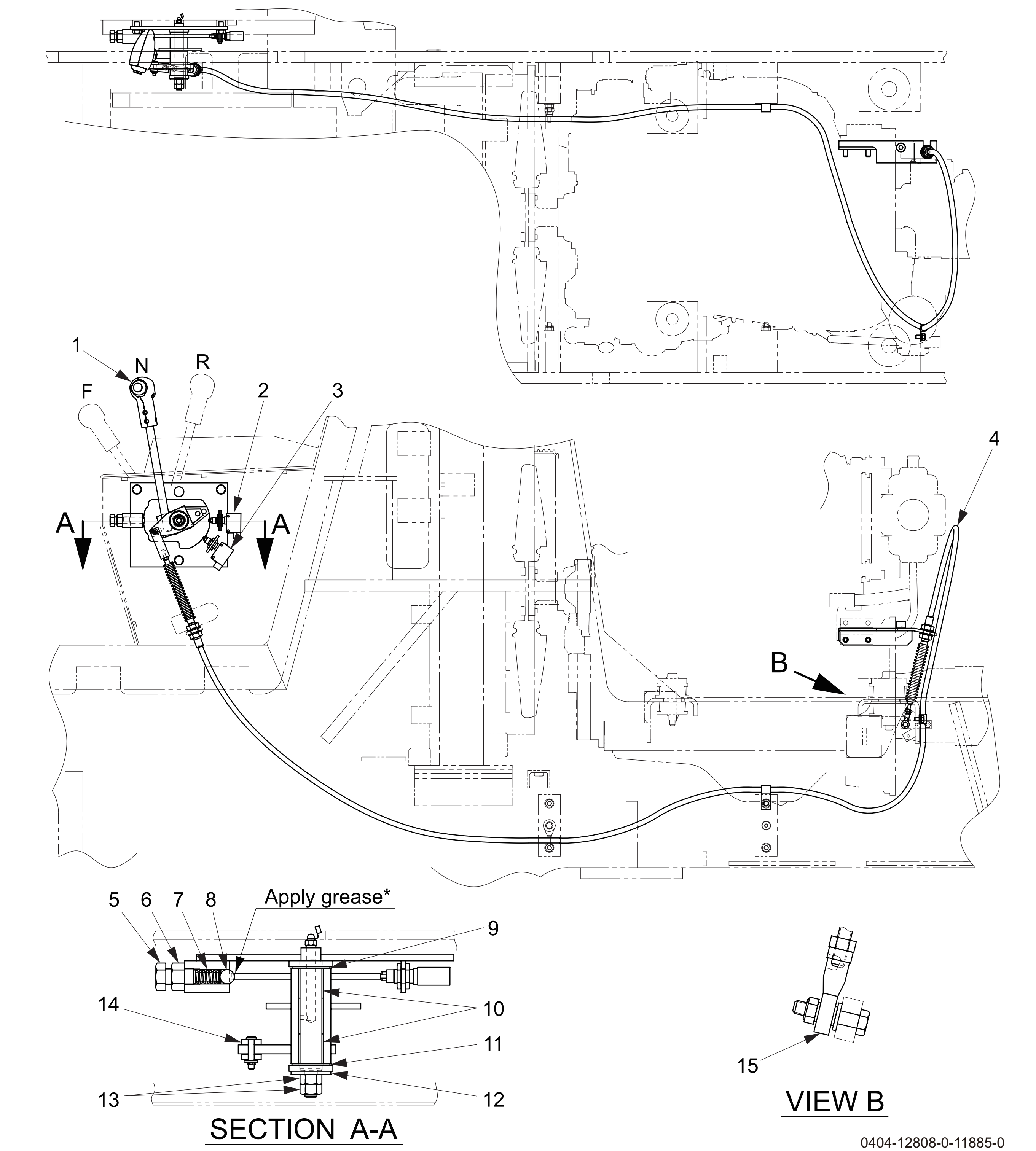


* The actual equipment may differ from that shown above.

SV412-03001

2. CONTROL SYSTEM

2-1. Forward-reverse Control

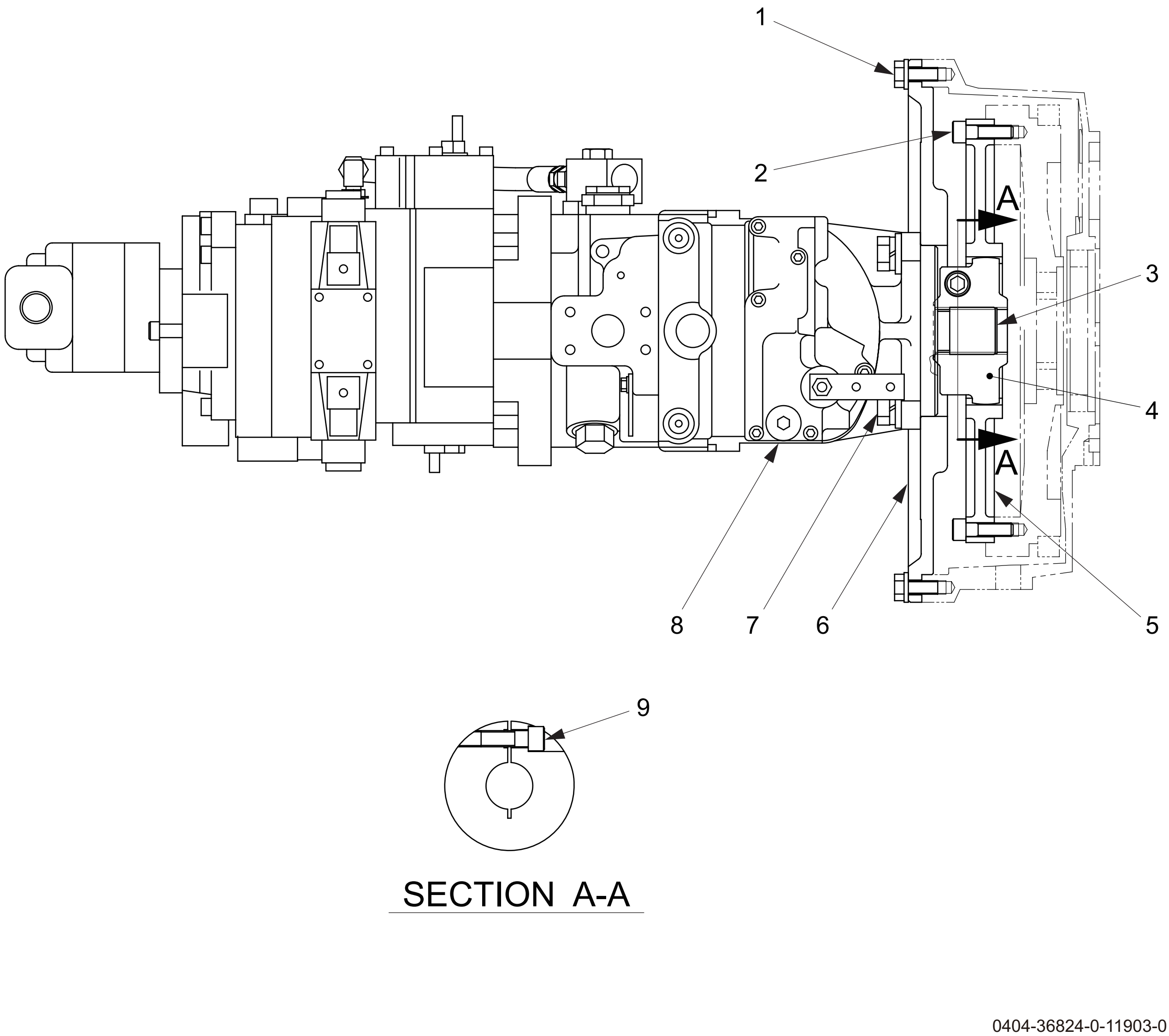


(1) F-R lever
(2) F-R lever switch
(3) Backup buzzer switch
(4) Control cable
(5) Bolt : M16× 30
(6) Nut : M16
(7) Spring (Fill grease)
(8) Steel ball
(9) Washer (Apply grease*)
(10) Bush (Apply grease*)
(11) Washer (Apply grease*)
(12) Washer
(13) Nut
(14) Clevis
(15) Rod end (Apply grease*)

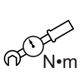
* Lithium-based grease

3. PUMP MOUNT

3-1. Pump Mount



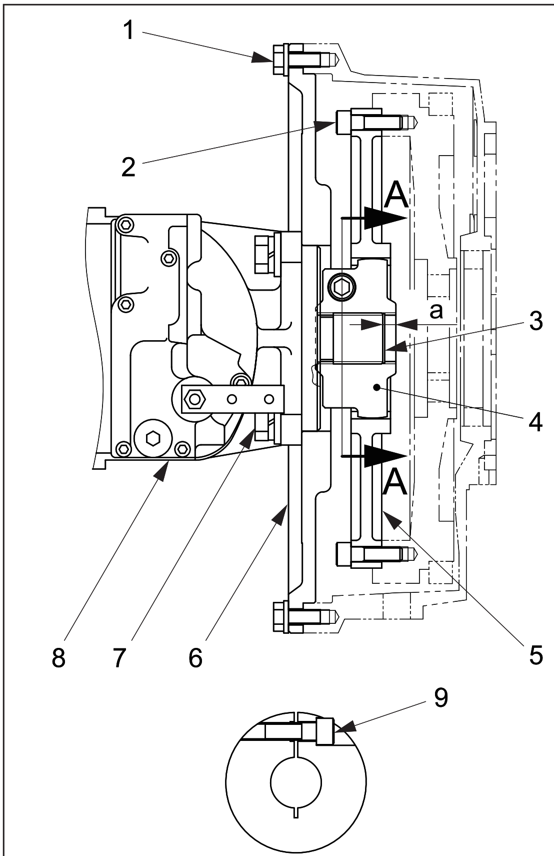
(1) Bolt : M10× 25
(2) Bolt : M10× 35
(3) Retaining ring
(4) Hub
(5) Flange
(6) Housing
(7) Bolt : M14× 45
(8) Pump
(9) Bolt : M12× 35



(1) Bolt M10× 25 : 59 N·m (44 lbf·ft)
(2) Bolt M10× 35 : 49 N·m (36 lbf·ft)
(7) Bolt M14× 45 : 167 N·m (123 lbf·ft)
(9) Bolt M12× 35 : 86 N·m (63 lbf·ft)

3-1-1. Installation of pump

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



SECTION A-A

SV412-03002

① Apply adequate amount of 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: 9 mm (0.35 in.)

③ Secure hub (4) with bolts (9).

N•m (9) Bolt M12×35 : 86 N·m (63 lbf·ft)

④ Secure flange (5) to engine flywheel with eight bolts (2).

N•m (2) Bolt M10×35 : 49 N·m (36 lbf·ft)

⑤ Secure housing (6) to engine flywheel housing with twelve bolts (1) and washers.

N•m (1) Bolt M10×25 : 59 N·m (44 lbf·ft)

⑥ Engage hub (4) with flange (5).
⑦ Secure pump (8) to housing (6) with four bolts (7), spring washers and washers.

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

(NOTICE)

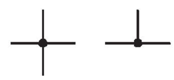
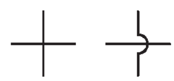
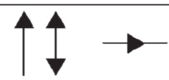
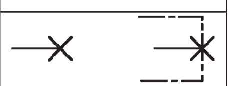
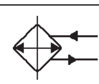
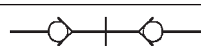
- **Bolt (2) is treated with thread-locking fluid. Use new thread-locking fluid treated bolt for installation.**

HYDRAULIC SYSTEMS

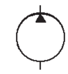
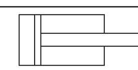
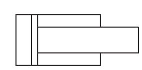
1. SYSTEM CIRCUIT DIAGRAM

1-1. Graphic Symbols for Hydraulic Circuits

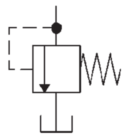
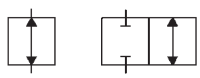
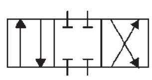
Basic Symbols

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

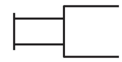
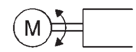
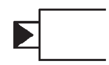
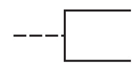
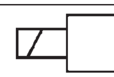
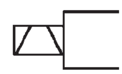
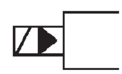
Pump, Motors and Cylinders

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

Valves

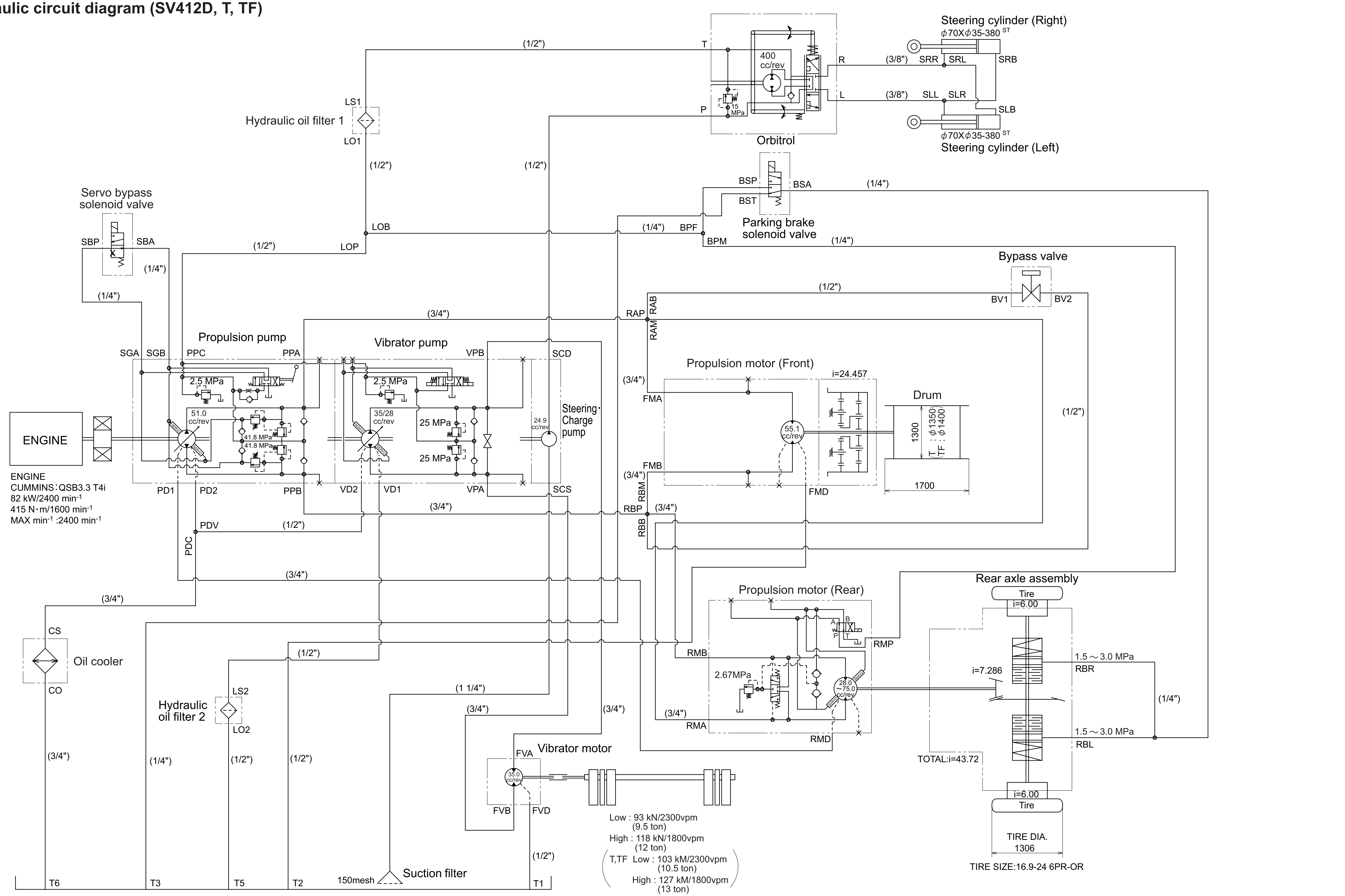
DESCRIPTION	SYMBOL
Check valve	
Manual shut off (On-Off)	
Pressure relief	
Flow control, adjustable	
Valve symbols: The basic valve symbol one or more squares with lines representing flow paths and flow conditions between ports.	
Multiple squares indicate a valve with as many distinct positions there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

Methods of Operation

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

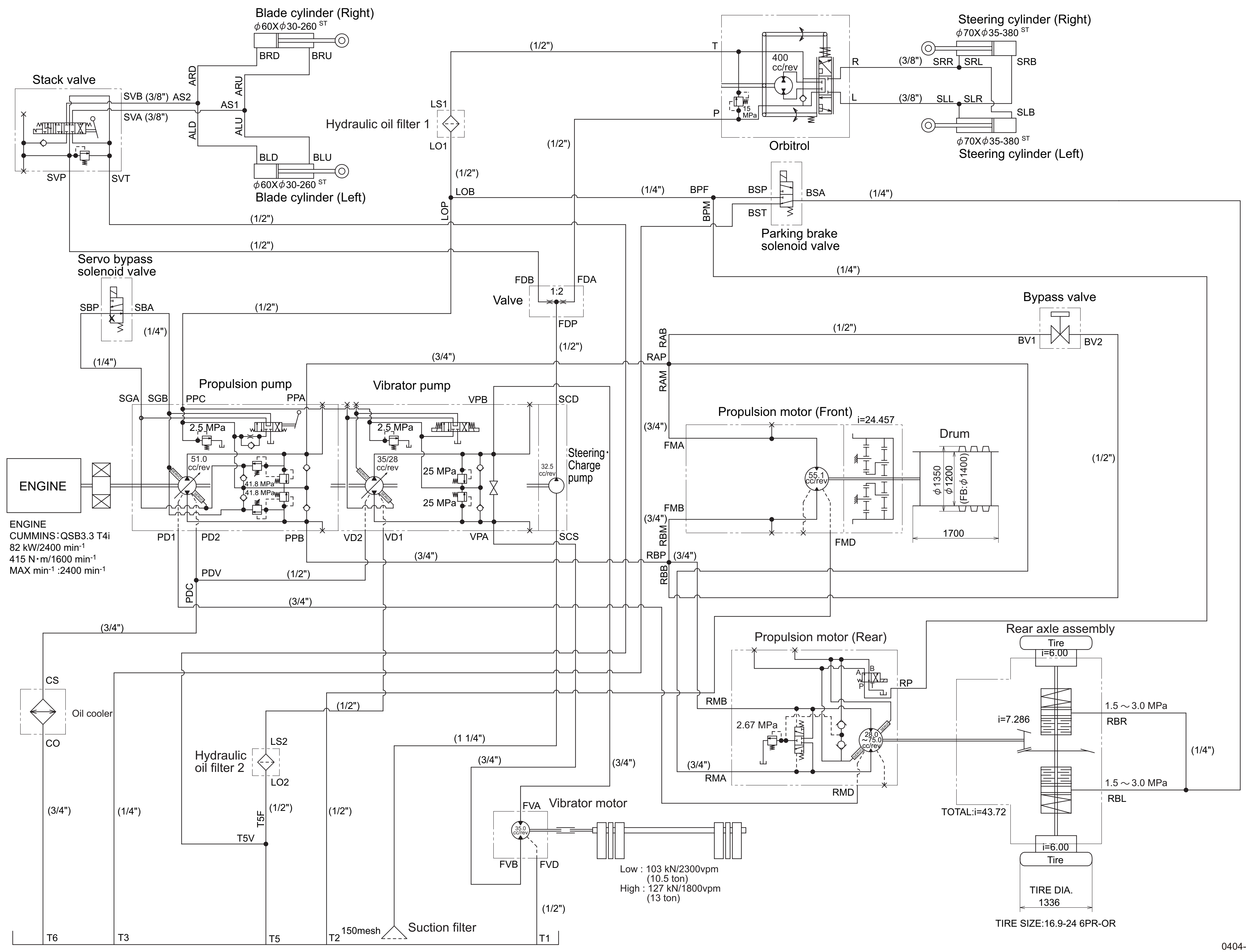
1-2. Hydraulic Circuit Diagram

1-2-1. Hydraulic circuit diagram (SV412D, T, TF)



0404-99042-0-11939-0

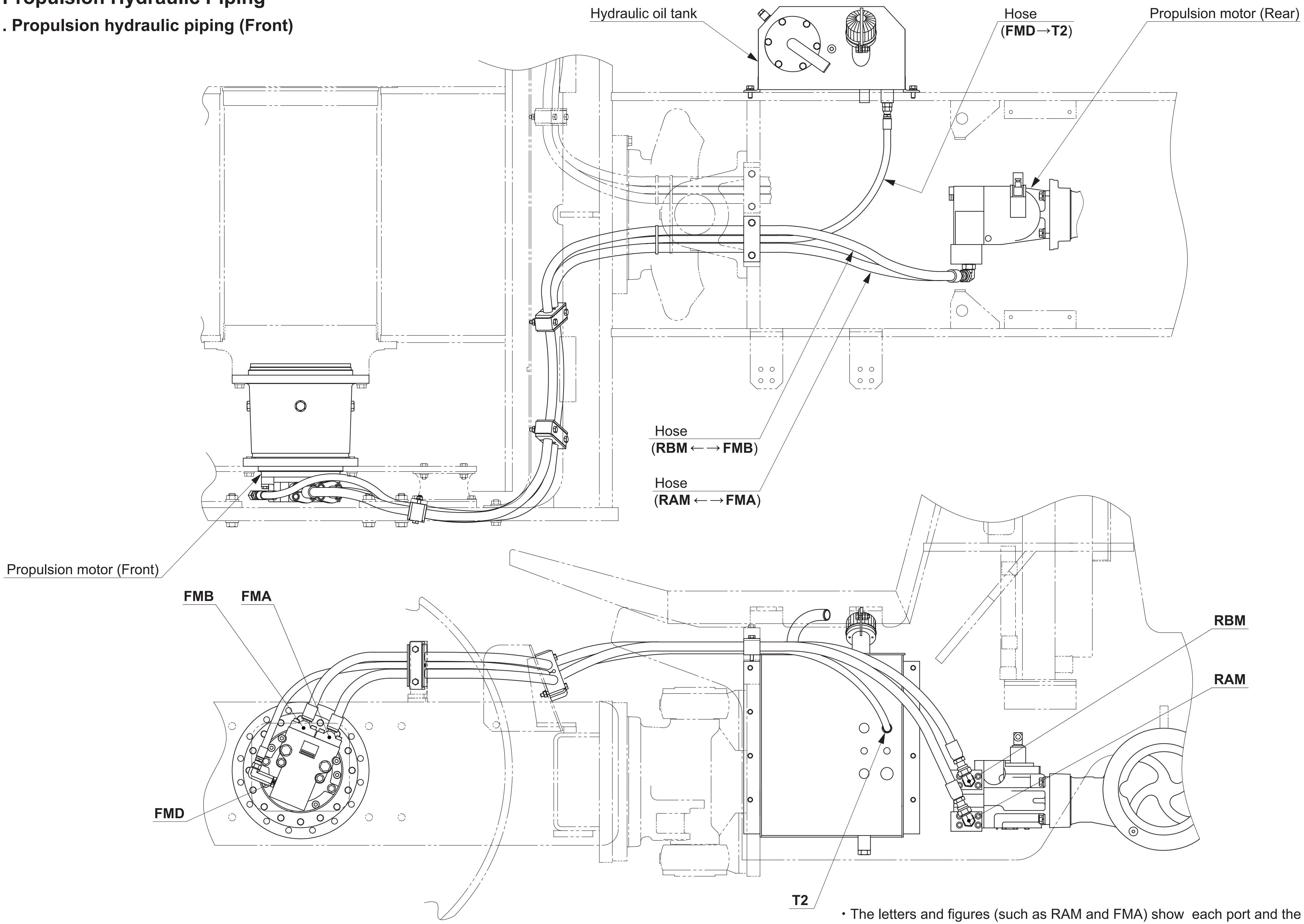
1-2-2. Hydraulic circuit diagram (SV412TB, FB)



2. PROPULSION HYDRAULIC SYSTEM

2-1. Propulsion Hydraulic Piping

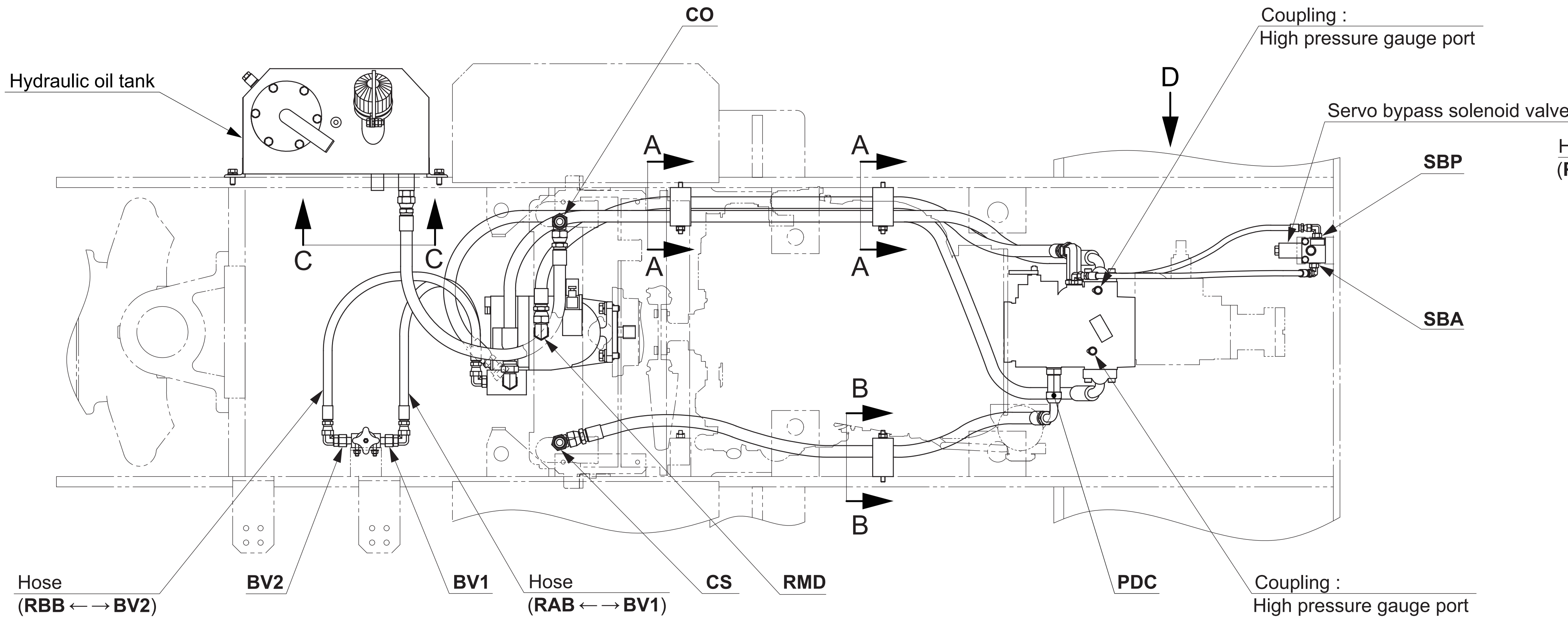
2-1-1. Propulsion hydraulic piping (Front)

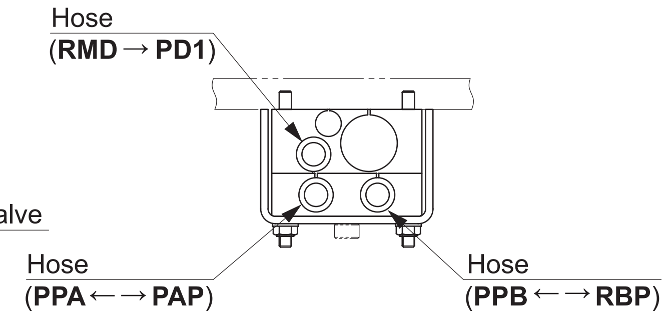


・The letters and figures (such as RAM and FMA) show each port and the arrow (←→ ; →) symbols show the hose connection and the direction of the flow of the oil.

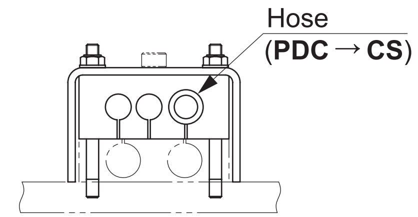
0404-36825-0-11904-0

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

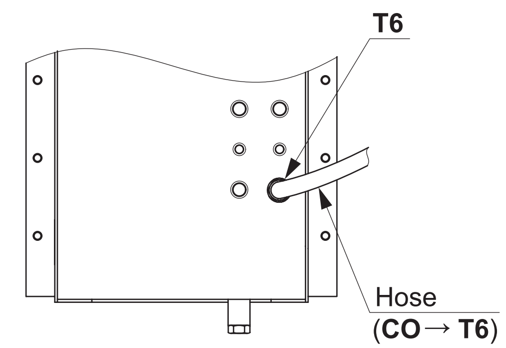




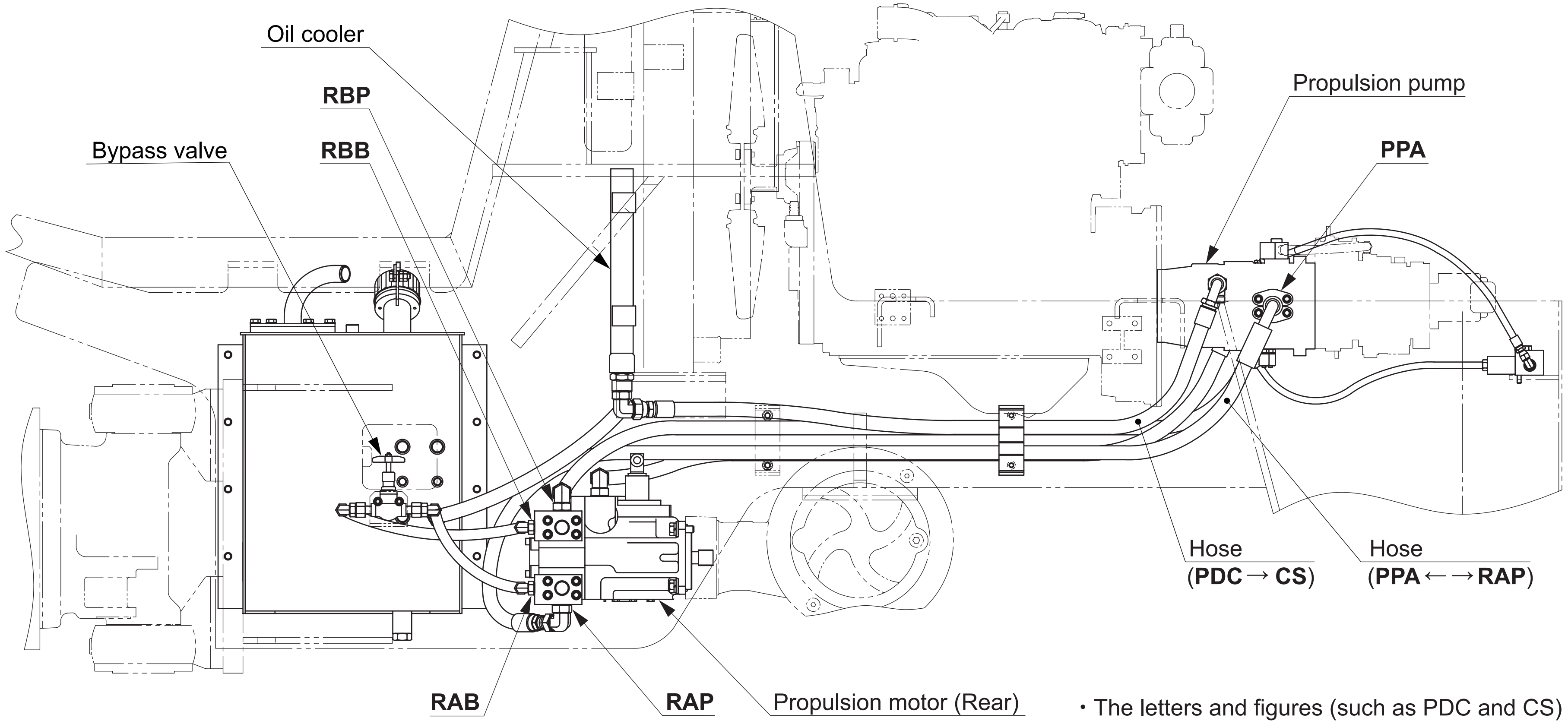
SECTION A-A

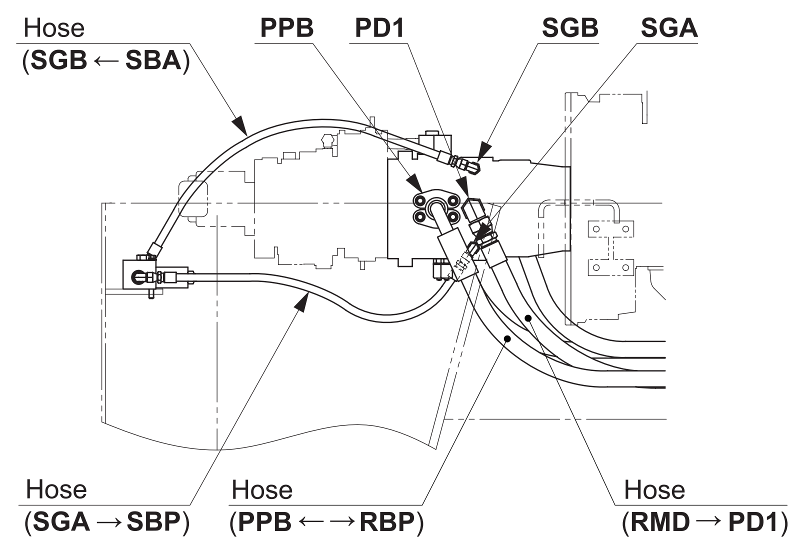


SECTION B-B



SECTION C-C





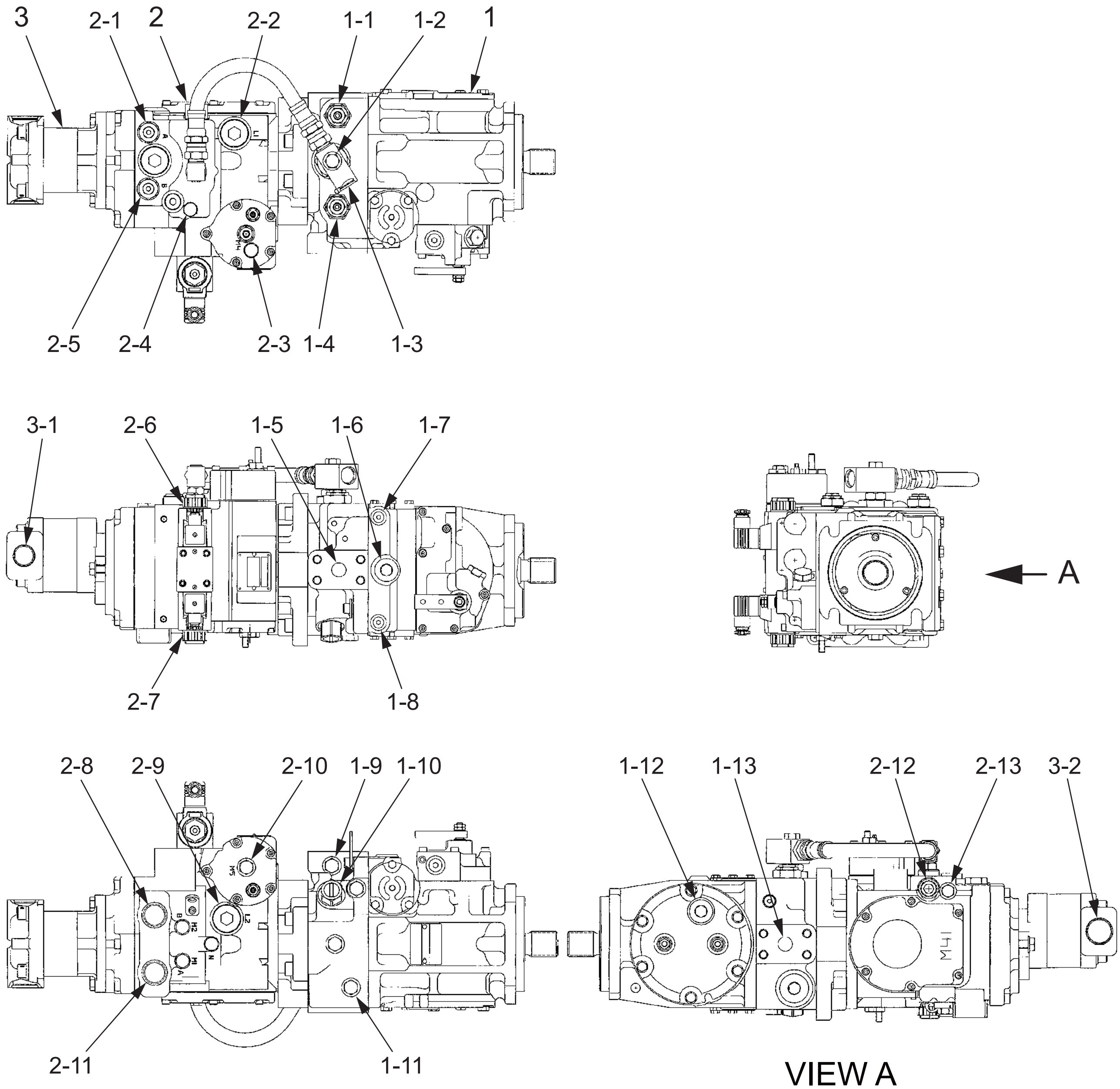
VIEW D

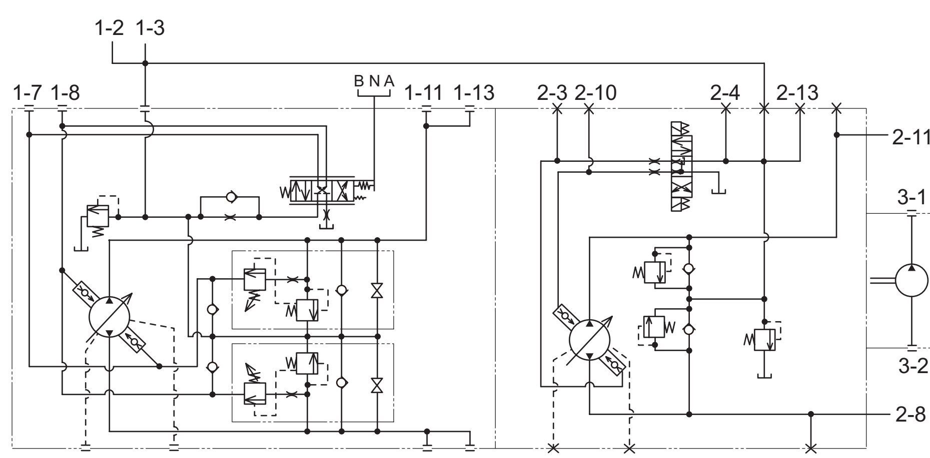
- The letters and figures (such as PDC and CS) show each port and the arrow (←→ ; →) symbols show the hose connection and the direction of the flow of the oil.

0404-36826-0-11905-0

2-2. Hydraulic Component Specifications

2-2-1. Hydraulic pump assembly (propulsion + vibrator • steering) (SV412D, T, TF)





Pump circuit diagram

SV412-04001

(1) Propulsion pump

(1-1)	Multifunction valve (For port A1)		
(1-2)	Charge pressure gauge port		: 9/16-18UNF
(1-3)	Charge supply port	**[PPC]**	: 7/ 8-14UNF
(1-4)	Multifunction valve (For port B1)		
(1-5)	Port B1 (Forward)	**[PPB]**	: SAE 1”
(1-6)	Drain port	**[PD1]**	: 1 1/16-12UN
(1-7)	Servo pressure gauge port	**[SGA]**	: 7/16-20UNF
(1-8)	Servo pressure gauge port	**[SGB]**	: 7/16-20UNF
(1-9)	High pressure gauge port (For port B1)		: 9/16-18UNF
(1-10)	Charge relief valve		
(1-11)	High pressure gauge port (For port A1)		: 9/16-18UNF
(1-12)	Drain port	**[PD2]**	: 1 1/16-12UN
(1-13)	Port A1 (Reverse)	**[PPA]**	: SAE 1”

Specifications

- Displacement : 51 cm^3/rev (3.1 cu.in./rev)
- High pressure relief valve pressure setting : 41.8 MPa (6,061 psi)
- Charge relief valve pressure setting : 2.5 MPa (363 psi)

(2) Vibrator pump

(2-1)	High pressure relief valve (For port A2)		
(2-2)	Drain port	**[VD1]**	: 1 5/16-12UN
(2-3)	Servo pressure gauge port		: 9/16-18UNF
(2-4)	Charge pressure gauge port		: 9/16-18UNF
(2-5)	High pressure relief valve (For port B2)		
(2-6)	Solenoid valve b (Low amplitude)		
(2-7)	Solenoid valve a (High amplitude)		
(2-8)	Port B2	**[VPB]**	: 1 1/16-12UN
(2-9)	Drain port	**[VD2]**	: 1 5/16-12UN
(2-10)	Servo pressure gauge port		: 9/16-18UNF
(2-11)	Port A2	**[VPA]**	: 1 1/16-12UN
(2-12)	Charge relief valve		
(2-13)	Charge pressure gauge port		: 1/ 2-20UNF

Specifications

- Displacement (Low amplitude) : 35.0 cm^3/rev (2.1 cu.in./rev)
  (High amplitude) : 28.0 cm^3/rev (1.7 cu.in./rev)
- High pressure relief valve pressure setting : 25.0 MPa (3,625 psi)
- Charge relief valve pressure setting : 2.5 MPa (363 psi)

(3) Steering pump

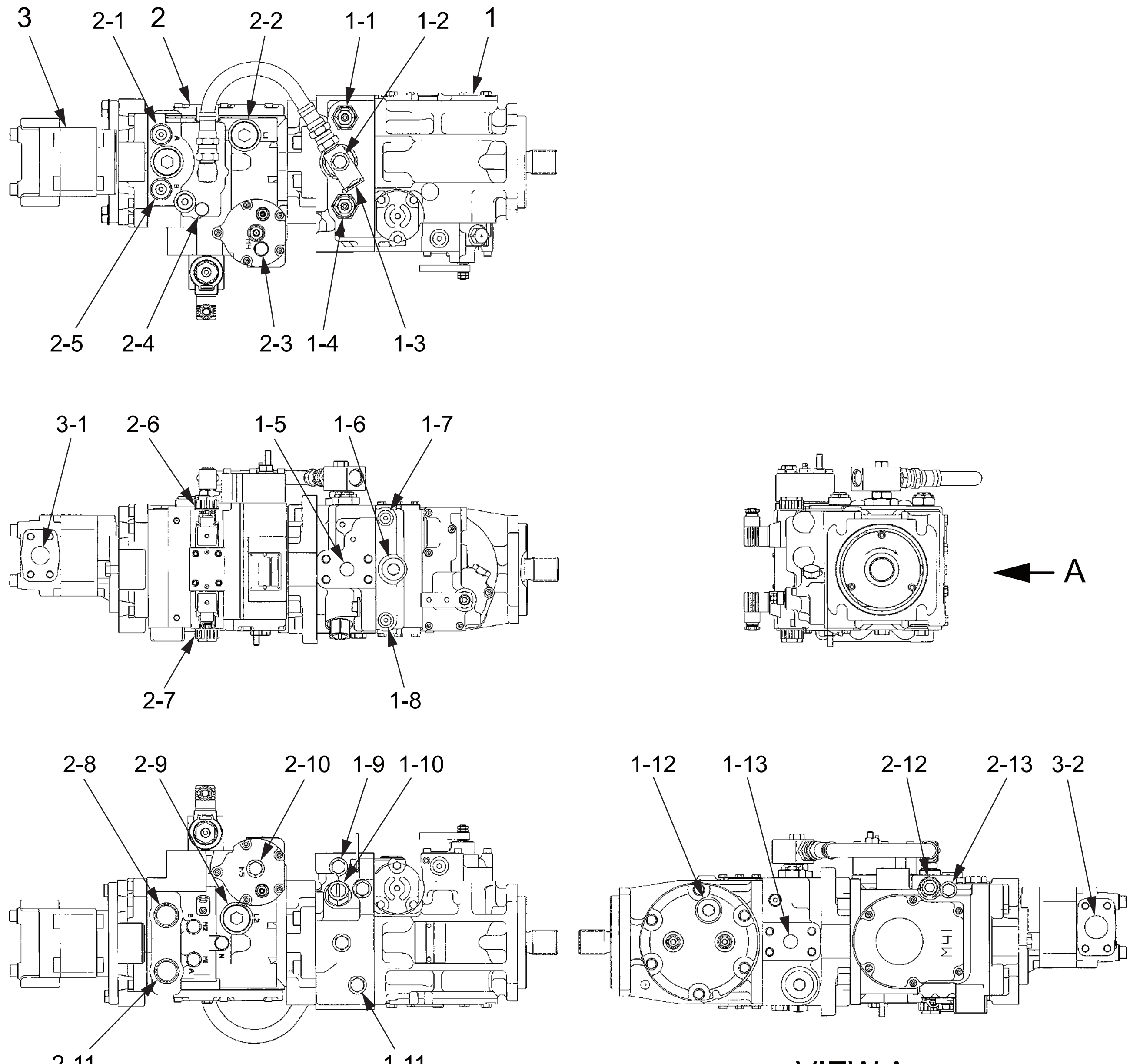
(3-1)	Discharge port	**[SCD]**	: 1 1/16-12UN
(3-2)	Suction port	**[SCS]**	: 1 5/16-12UN

Specifications

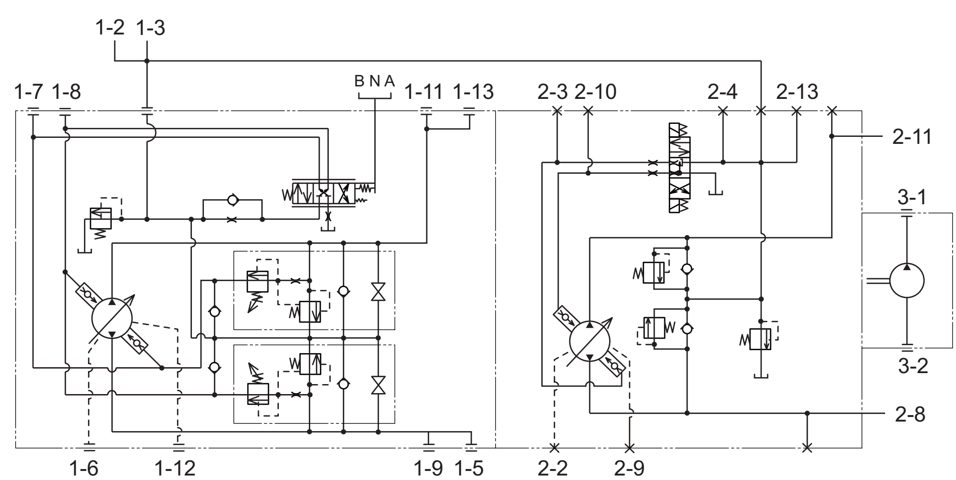
- Displacement : 24.9 cm^3/rev (1.5 cu.in./rev)

- Allowable pump case pressure : 0.3 MPa (43.5 psi) or less
- Pump assembly weight : 95 kg (209 lbs.)

2-2-2. Hydraulic pump assembly (propulsion + vibrator • steering) (SV412TB, TF)



VIEW A



Pump circuit diagram

SV412-04002

(1) Propulsion pump

(1-1)	Multifunction valve (For port A1)		
(1-2)	Charge pressure gauge port		: 9/16-18UNF
(1-3)	Charge supply port	**[PPC]**	: 7/ 8-14UNF
(1-4)	Multifunction valve (For port B1)		
(1-5)	Port B1 (Forward)	**[PPB]**	: SAE 1”
(1-6)	Drain port	**[PD1]**	: 1 1/16-12UN
(1-7)	Servo pressure gauge port	**[SGA]**	: 7/16-20UNF
(1-8)	Servo pressure gauge port	**[SGB]**	: 7/16-20UNF
(1-9)	High pressure gauge port (For port B1)		: 9/16-18UNF
(1-10)	Charge relief valve		
(1-11)	High pressure gauge port (For port A1)		: 9/16-18UNF
(1-12)	Drain port	**[PD2]**	: 1 1/16-12UN
(1-13)	Port A1 (Reverse)	**[PPA]**	: SAE 1”

Specifications

- Displacement : 51 cm^3/rev (3.1 cu.in./rev)
- High pressure relief valve pressure setting : 41.8 MPa (6,061 psi)
- Charge relief valve pressure setting : 2.5 MPa (363 psi)

(2) Vibrator pump

(2-1)	High pressure relief valve (For port A2)		
(2-2)	Drain port	**[VD1]**	: 1 5/16-12UN
(2-3)	Servo pressure gauge port		: 9/16-18UNF
(2-4)	Charge pressure gauge port		: 9/16-18UNF
(2-5)	High pressure relief valve (For port B2)		
(2-6)	Solenoid valve b (Low amplitude)		
(2-7)	Solenoid valve a (High amplitude)		
(2-8)	Port B2	**[VPB]**	: 1 1/16-12UN
(2-9)	Drain port	**[VD2]**	: 1 5/16-12UN
(2-10)	Servo pressure gauge port		: 9/16-18UNF
(2-11)	Port A2	**[VPA]**	: 1 1/16-12UN
(2-12)	Charge relief valve		
(2-13)	Charge pressure gauge port		: 1/ 2-20UNF

Specifications

- Displacement (Low amplitude) : 35.0 cm^3/rev (2.1 cu.in./rev)
  (High amplitude) : 28.0 cm^3/rev (1.7 cu.in./rev)
- High pressure relief valve pressure setting : 25.0 MPa (3,625 psi)
- Charge relief valve pressure setting 2.5 MPa (363 psi)

(3) Steering pump

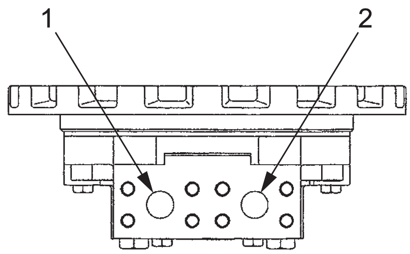
(3-1)	Discharge port	**[SCD]**	: Φ25
(3-2)	Suction port	**[SCS]**	: Φ32

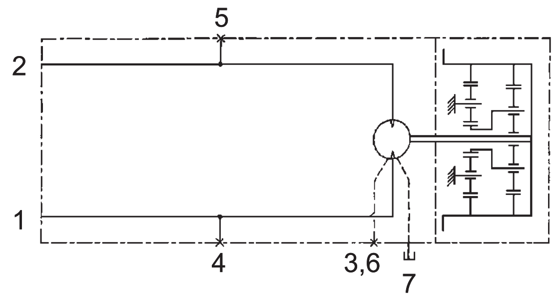
Specifications

- Displacement : 32.5 cm^3/rev (2.0 cu.in./rev)

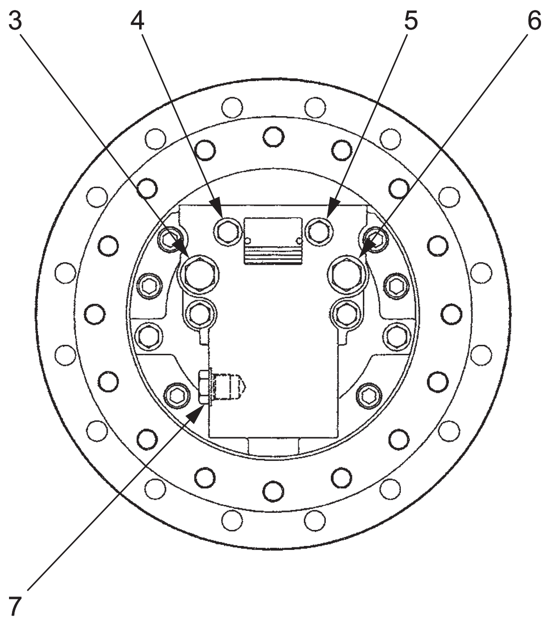
- Allowable pump case pressure : 0.3 MPa (43.5 psi) or less
- Pump assembly weight : 95 kg (209 lbs.)

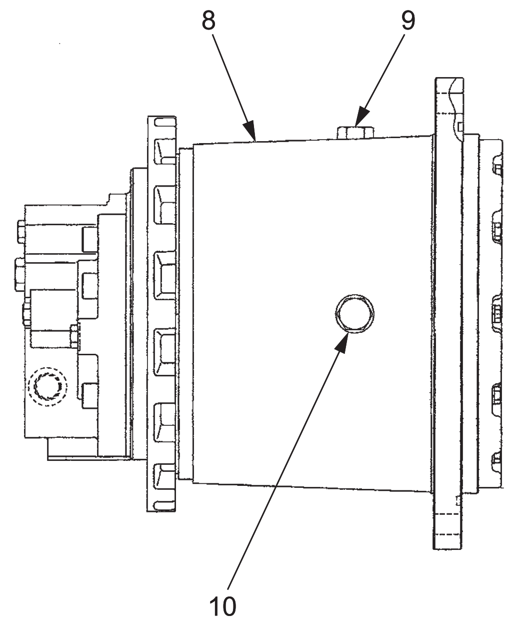
2-2-3. Propulsion hydraulic motor (Front)





Motor circuit diagram





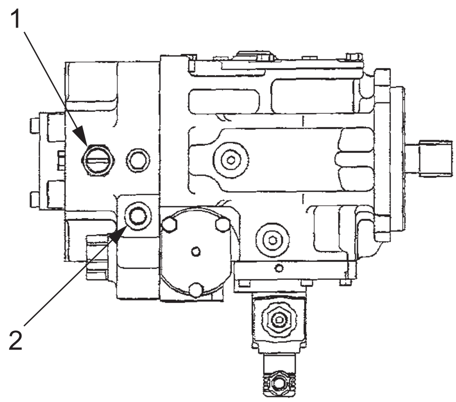
SV400-2-04007

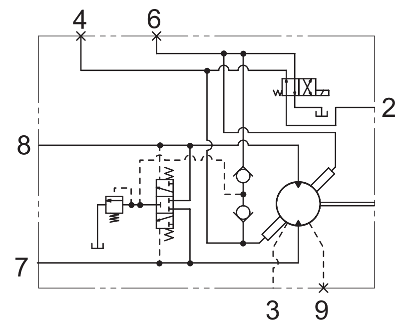
(1) Port B	**[FMB]**	: SAE 1”	(6)	Drain port		:	7/8-14UNF
(2) Port A	**[FMA]**	: SAE 1”	(7)	Drain port	**[FMD]**	:	7/8-14UNF
(3) Drain port		: 7/ 8-14UNF	(8)	Reduction gear			
(4) High pressure gauge port (For port B)		: 9/16-18UNF	(9)	Filler cap		:	7/8-14UNF
(5) High pressure gauge port (For port A)		: 9/16-18UNF	(10)	Filler cap		:	7/8-14UNF

Motor specifications
- Displacement : 55.1 cm^3/rev (3.4 cu.in./rev)
- Maximum working pressure : 41.8 MPa (6,061 psi)
- Allowable motor case pressure : 0.3 MPa (43.5 psi) or less

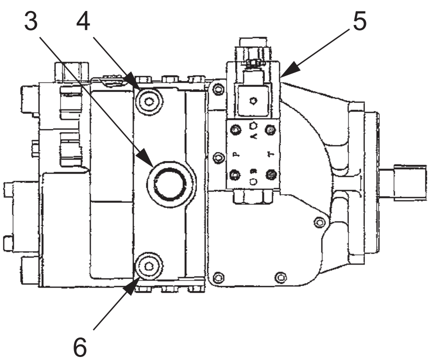
Reduction gear specifications
- Reduction ratio : 1/24.457
- Weight : 167 kg (368 lbs.)

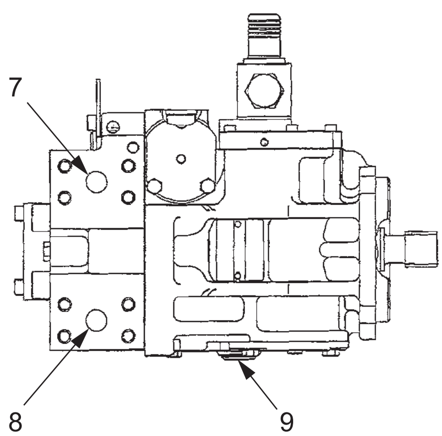
2-2-4. Propulsion hydraulic motor (Rear)

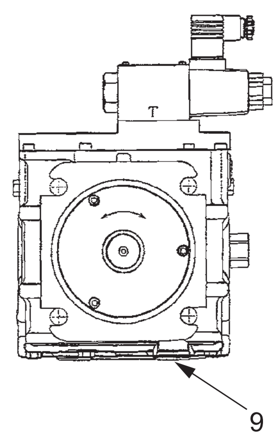




Motor ciruit diagram







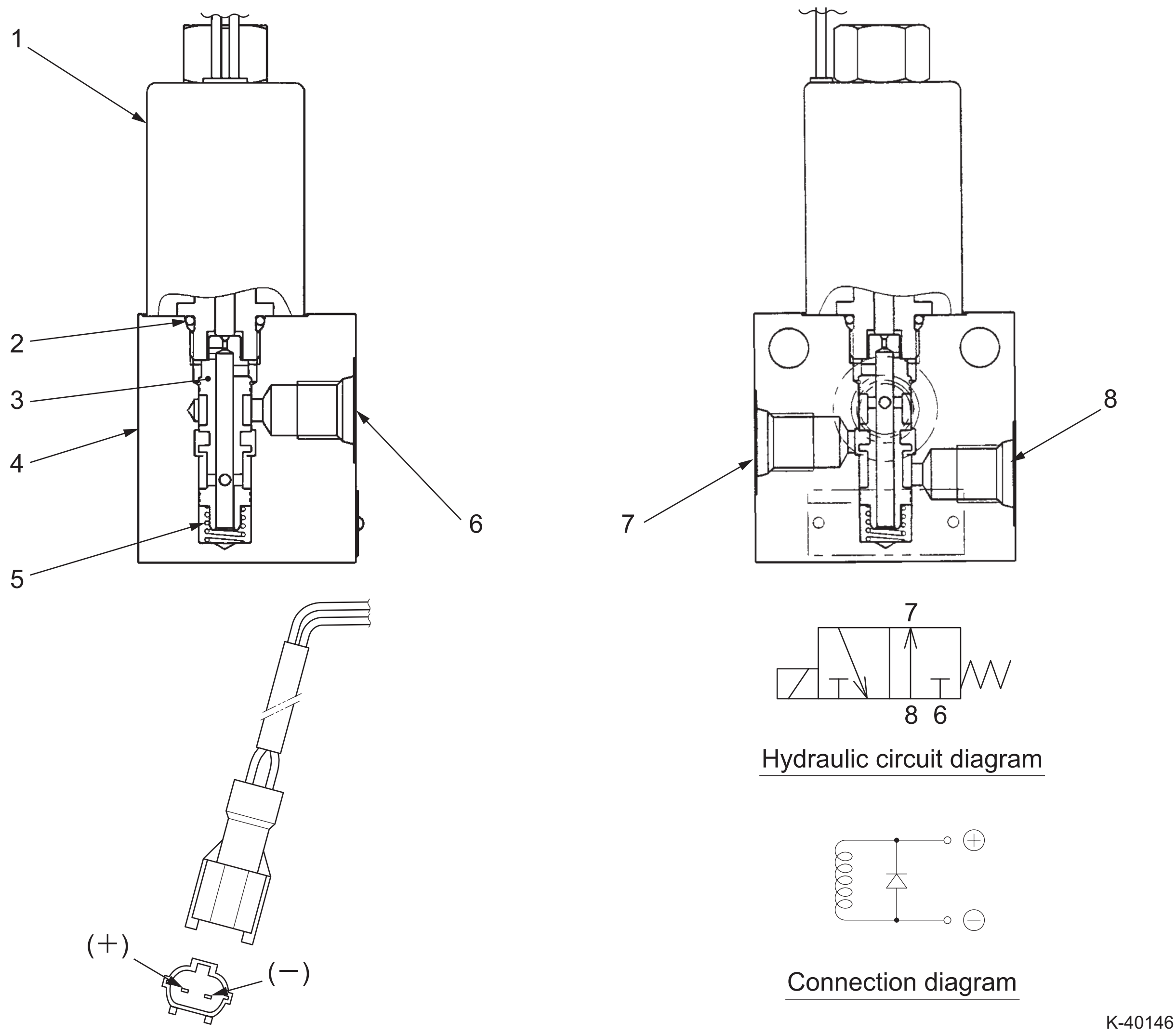
SV505- I -04003

(1) Charge pressure relief valve
(2) Pilot supply port **[RMP]** : 9/16-18UNF
(3) Drain port **[RMD]** : 1 1/16-12UN
(4) Servo pressure gauge port : 9/16-18UNF
(5) Speed change solenoid valve
(6) Servo pressure gauge port : 9/16-18UNF
(7) Port B (Reverse) **[RMB]** : SAE 1”
(8) Port A (Forward) **[RMA]** : SAE 1”
(9) Drain port : 1 1/16-12UN

Motor specifications

- Displacement (max.) : 75 cm^3/rev (4.58 cu.in./rev)
  (min.) : 28 cm^3/rev (1.71 cu.in./rev)
- Charge relief valve pressure setting : 2.67 MPa (387 psi) (at 19 L/min)
- Allowable motor case pressure : 0.3 MPa (43.5 psi) or less
- Weight : 48 kg (106 lbs.)

2-2-5. Servo bypass solenoid valve



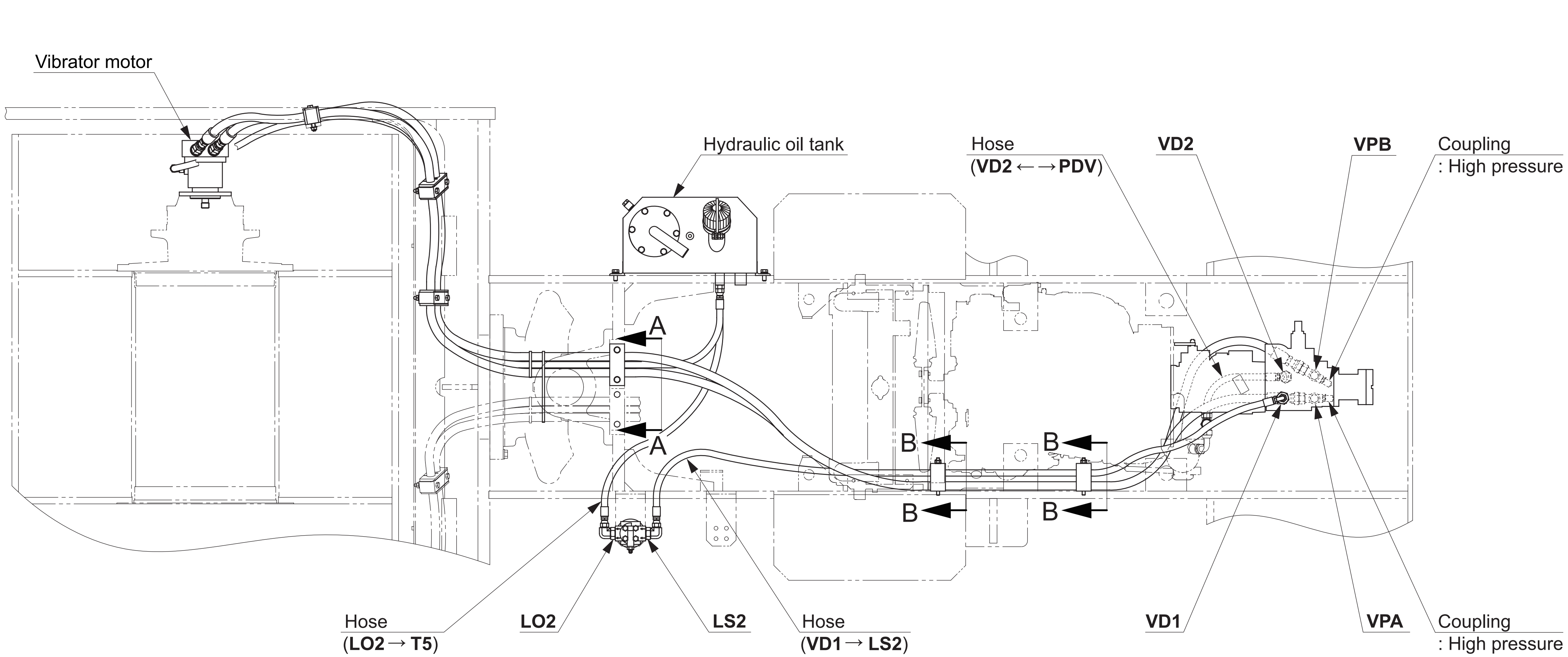
(1) Solenoid
(2) O-ring (1B P14)
(3) Spool (J)
(4) Body
(5) Spring
(6) Port P **[SBP]** : 9/16-18UNF-2B
(7) Port A **[SBA]** : 9/16-18UNF-2B
(8) Port T : 9/16-18UNF-2B

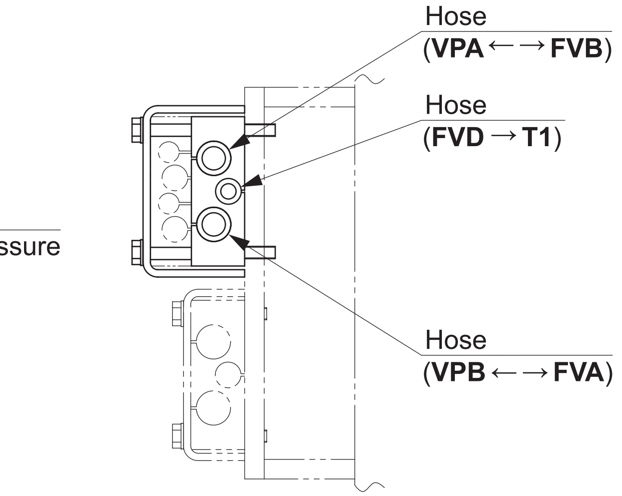
Specifications

• 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.	)	

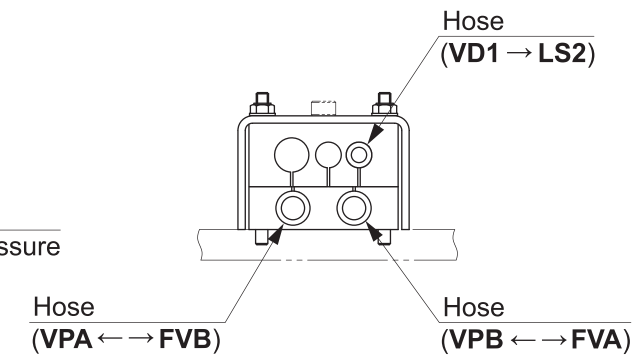
3. VIBRATOR HYDRAULIC SYSTEM

3-1. Vibrator Hydraulic Piping

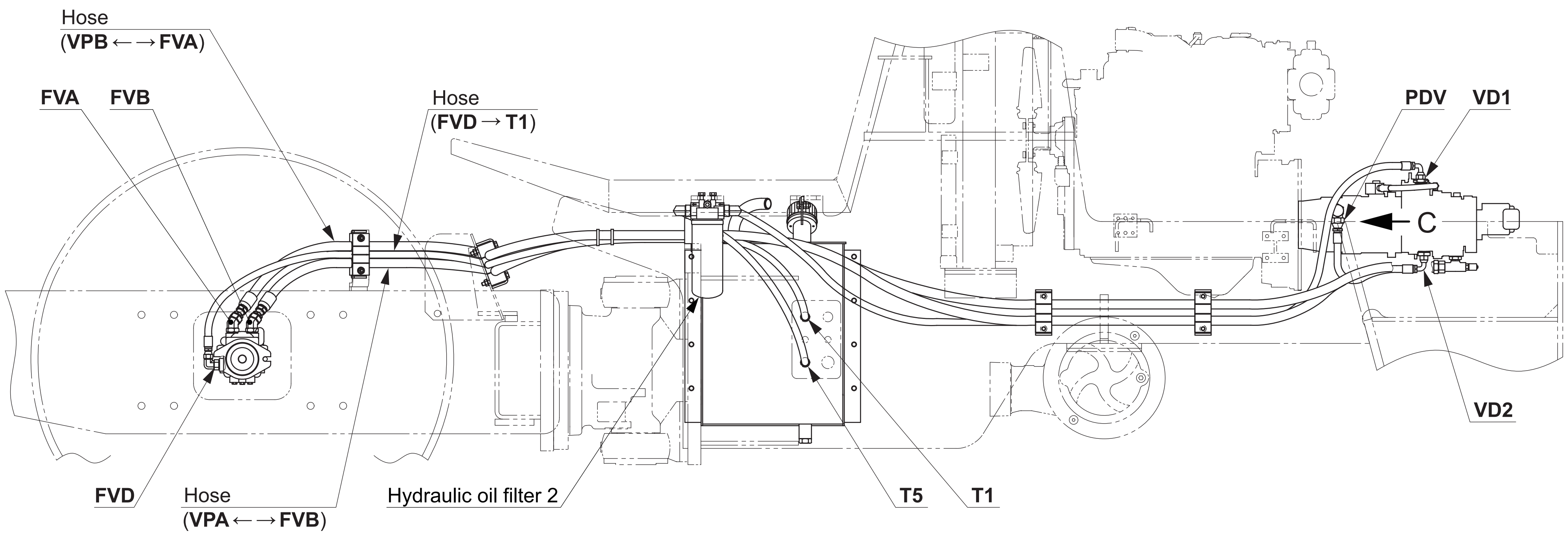


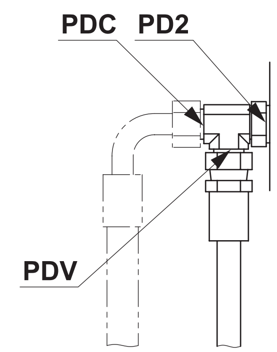


SECTION A-A



SECTION B-B





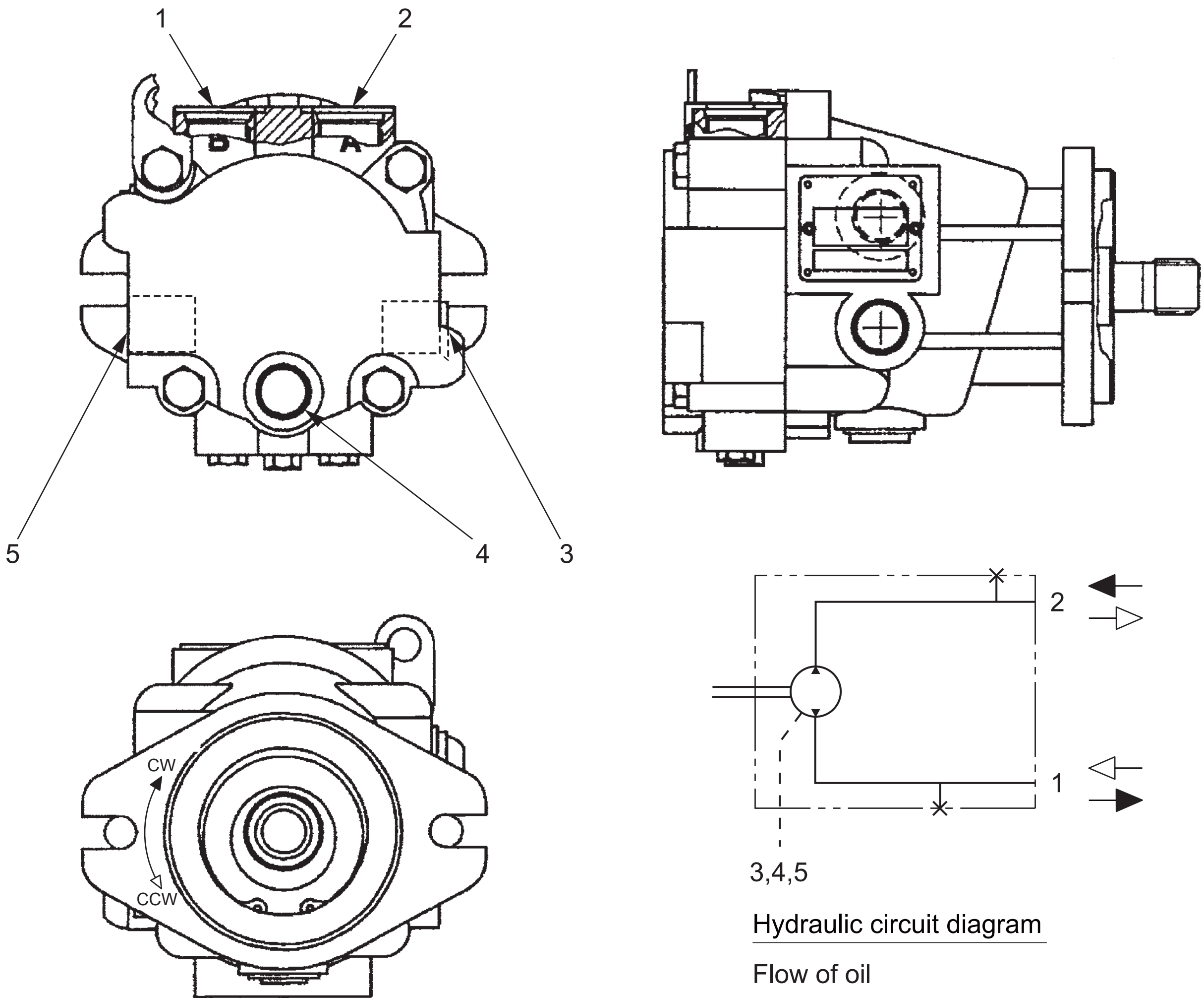
VIEW C

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

0404-49804-0-11907-0

3-2. Hydraulic Component Specification

3-2-1. Vibrator hydraulic motor



Hydraulic circuit diagram

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

SV400-2-04012

(1)	Port B	**[FVB]**	:	1 1/16-12UN
(2)	Port A	**[FVA]**	:	1 1/16-12UN
(3)	Drain port	**[FVD]**	:	7/ 8-14UNF
(4)	Drain port		:	7/ 8-14UNF
(5)	Drain port		:	7/ 8-14UNF

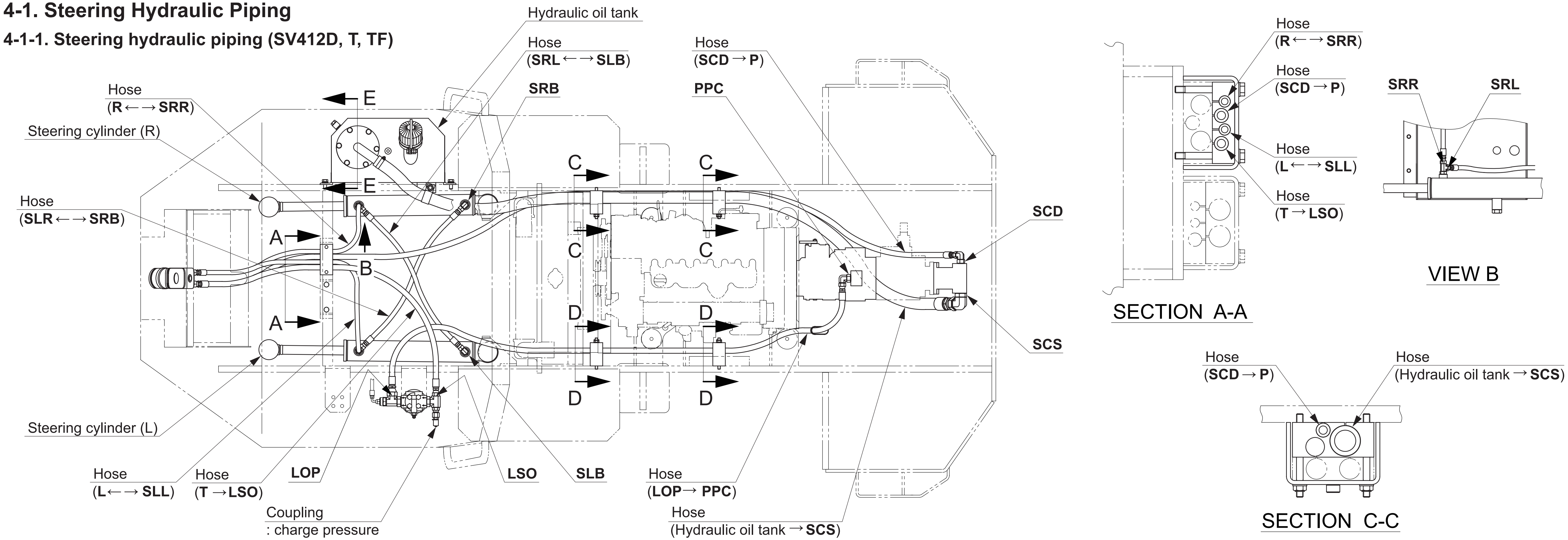
Specifications

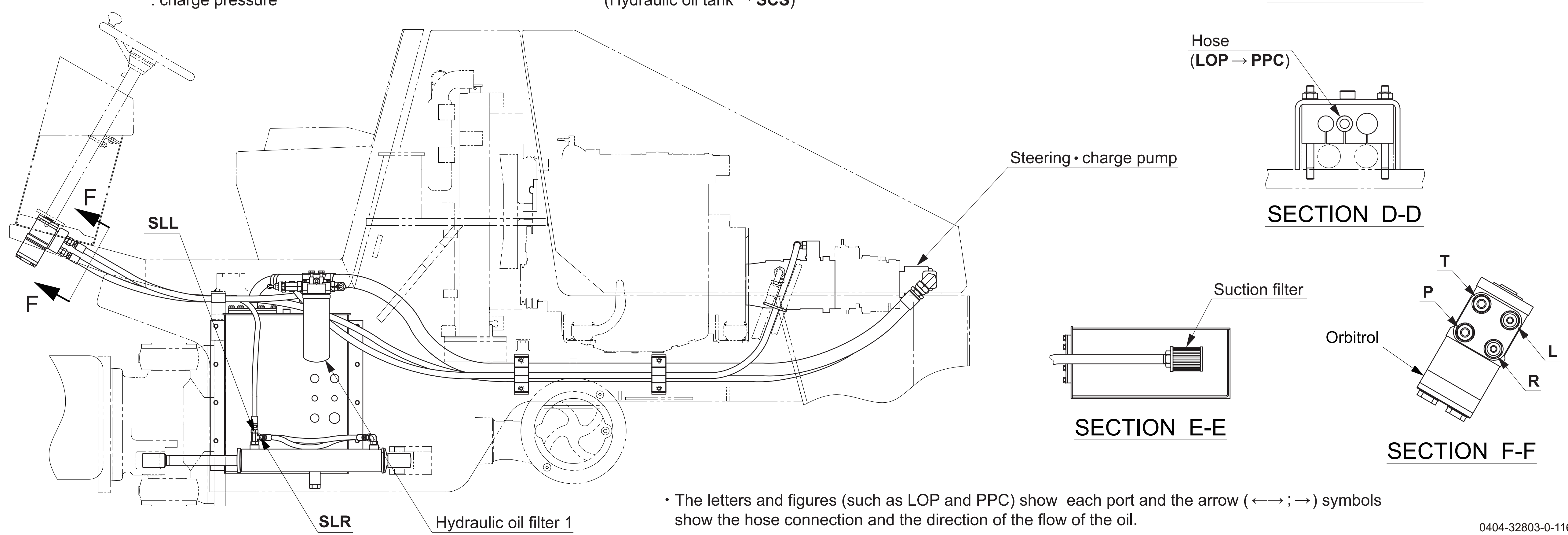
• Displacement	:	35.0 cm^3/rev	(2.1 cu.in.)
• Working pressure	:	34.5 MPa	(5,003 psi)
• Allowable motor case pressure	:	0.17 MPa	(24.7 psi)
• Weight	:	11 kg	(24.3 lbs.)

4. STEERING SYSTEM

4-1. Steering Hydraulic Piping

4-1-1. Steering hydraulic piping (SV412D, T, TF)

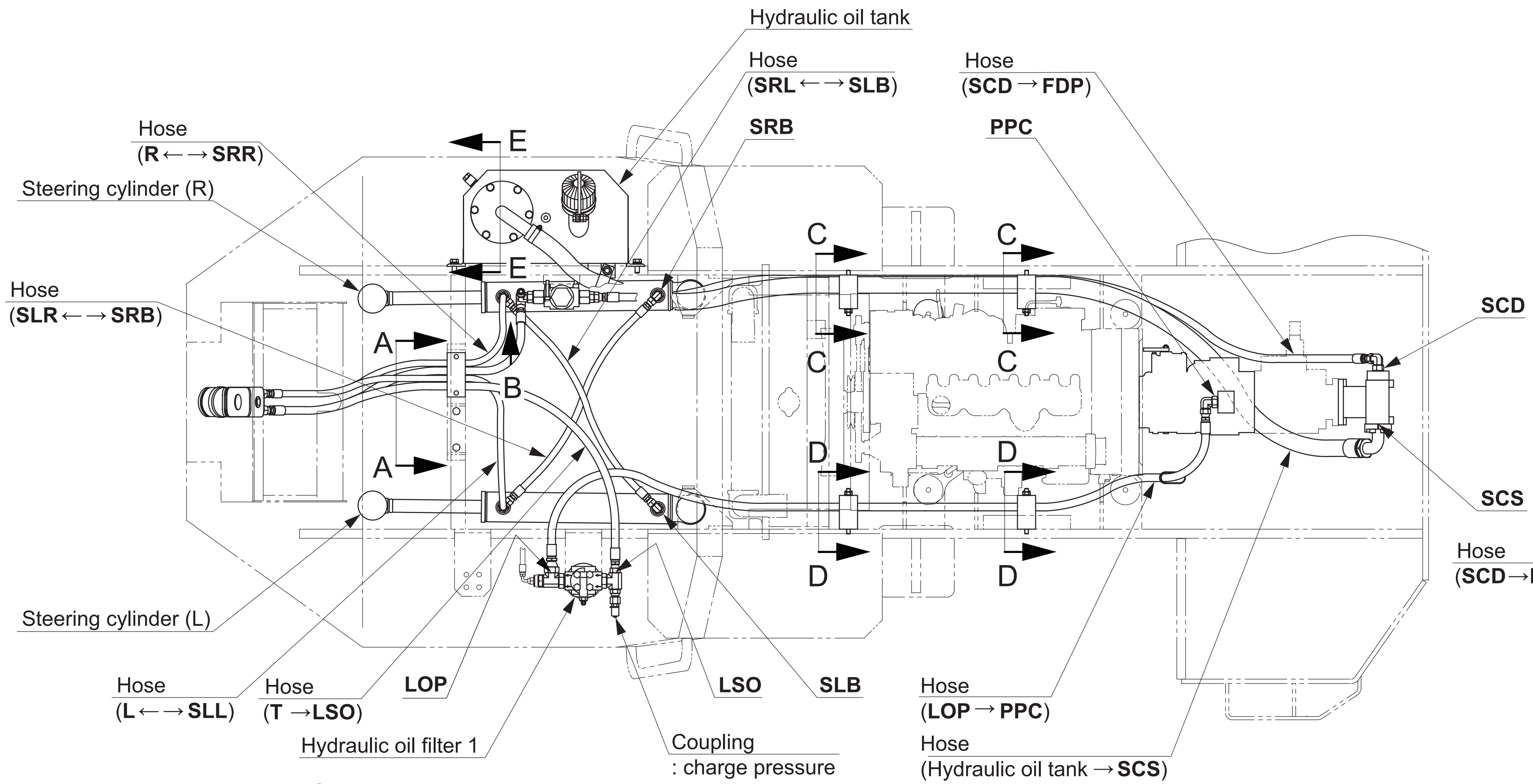


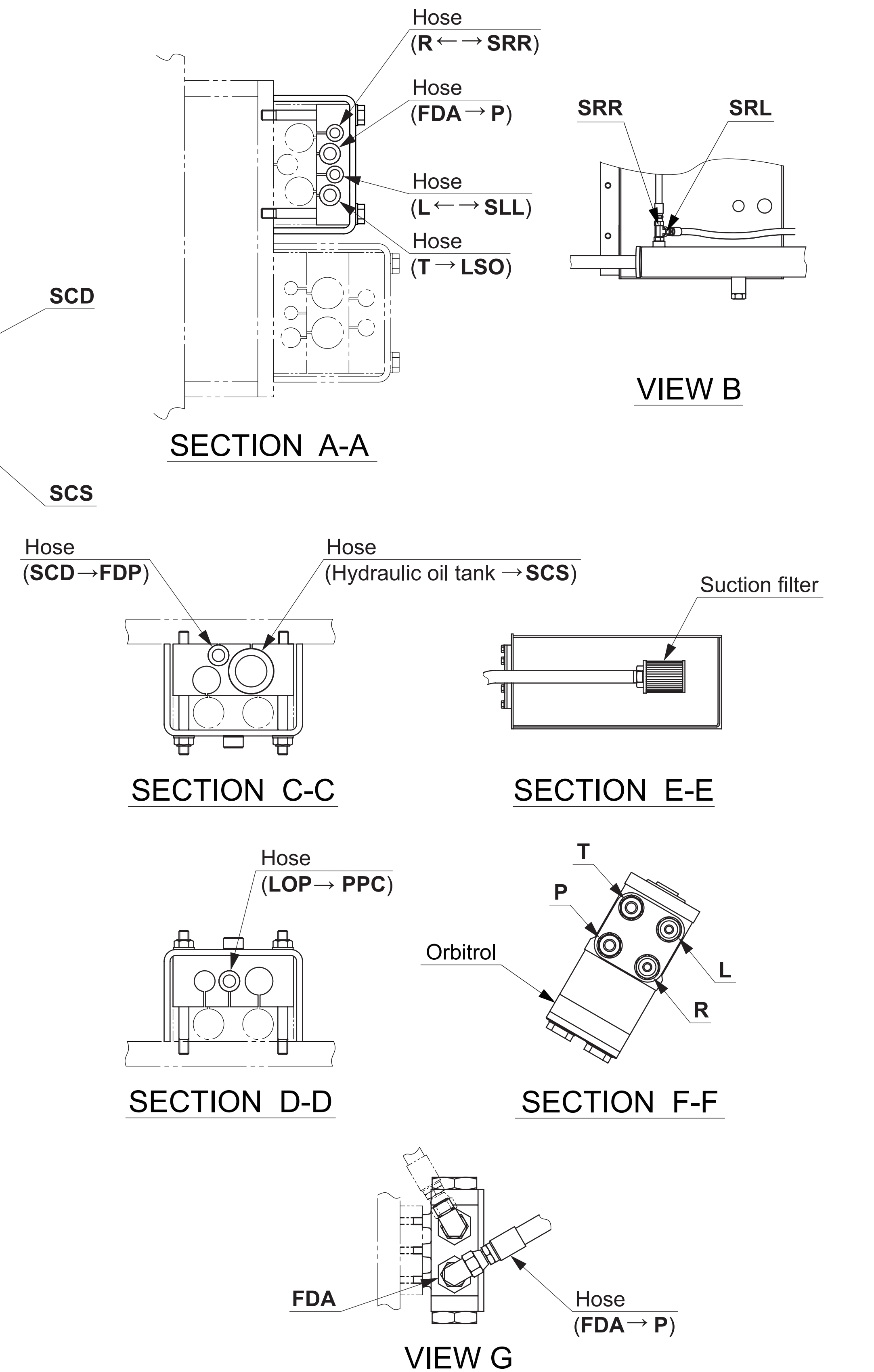


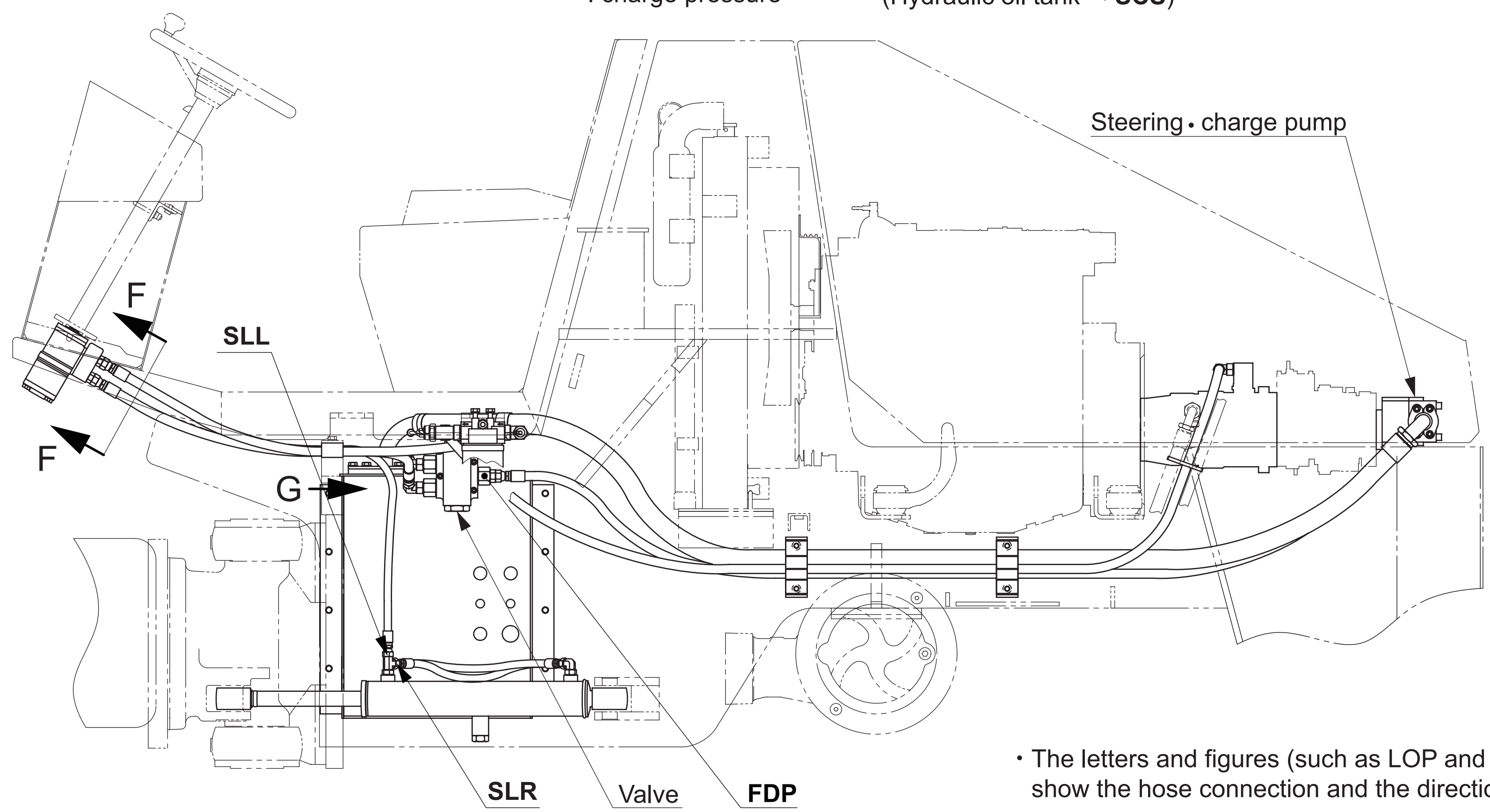
・The letters and figures (such as LOP and PPC) show each port and the arrow (←→ ; →) symbols show the hose connection and the direction of the flow of the oil.

0404-32803-0-11655-A

4-1-2. Steering hydraulic piping (SV412TB, FB)



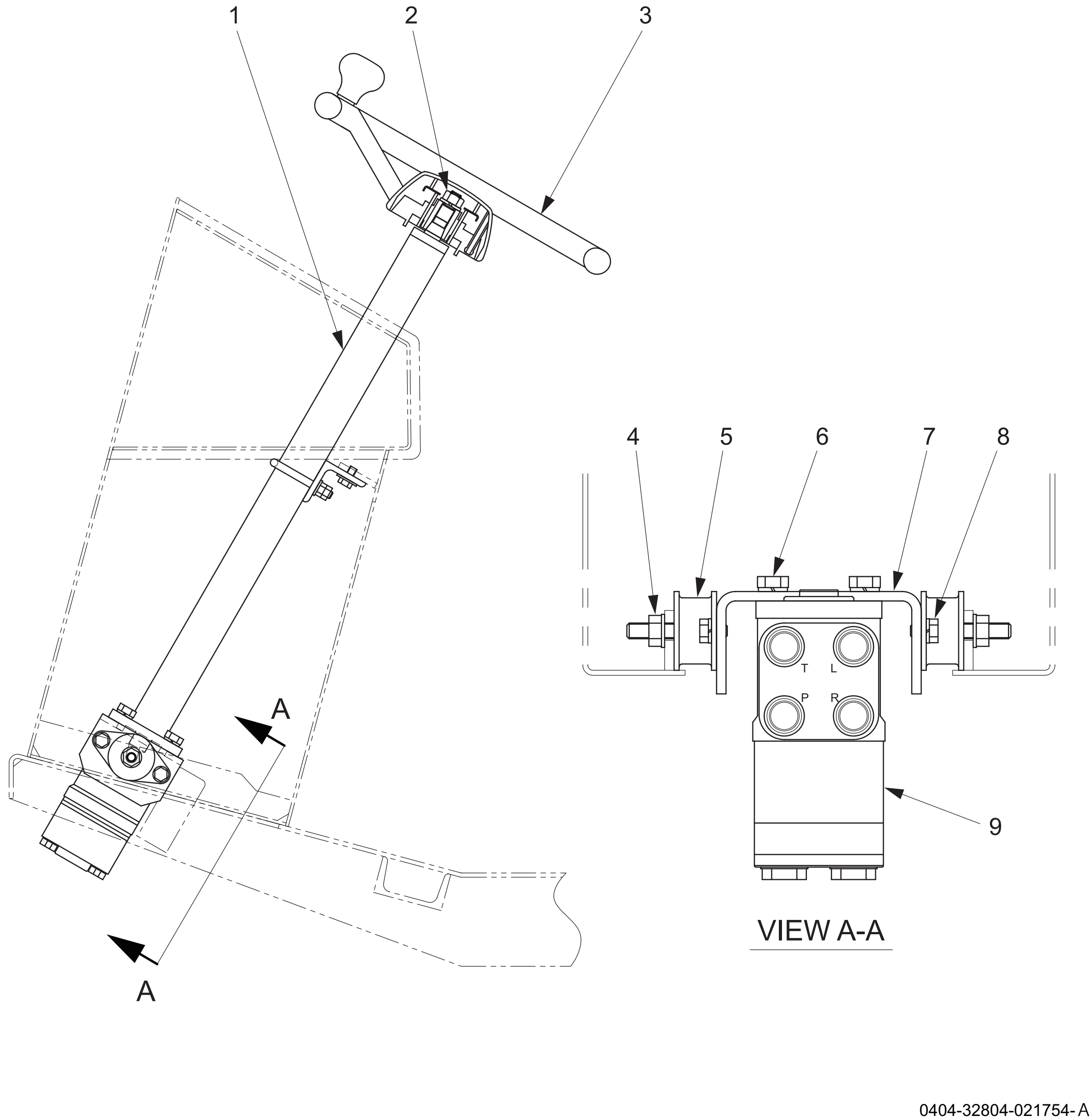




• The letters and figures (such as LOP and PPC) show each port and the arrow (←→ ; →) symbols show the hose connection and the direction of the flow of the oil.

0404-32805-0-11816-0

4-2. Steering Wheel



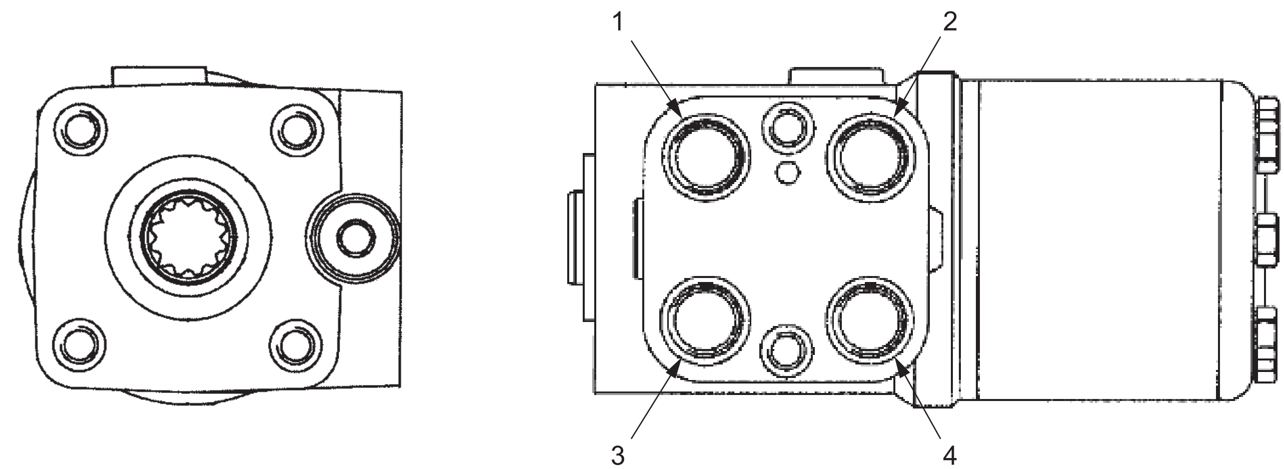
(1) Column shaft
(2) Nut : M12 P=1.25
(3) Steering wheel
(4) Nut : M10
(5) Damper
(6) Bolt : M10×30
(7) Bracket
(8) Bolt : M 8×12
(9) Orbitrol

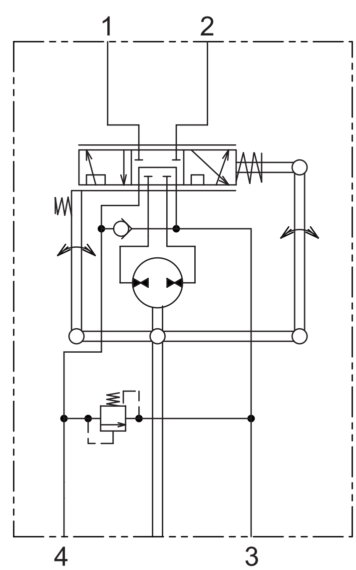
N•m

(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 M 8×12 : 23 N·m (17 lbf·ft)

4-3. Hydraulic Component Specifications

4-3-1. Orbitrol





Hydraulic circuit diagram

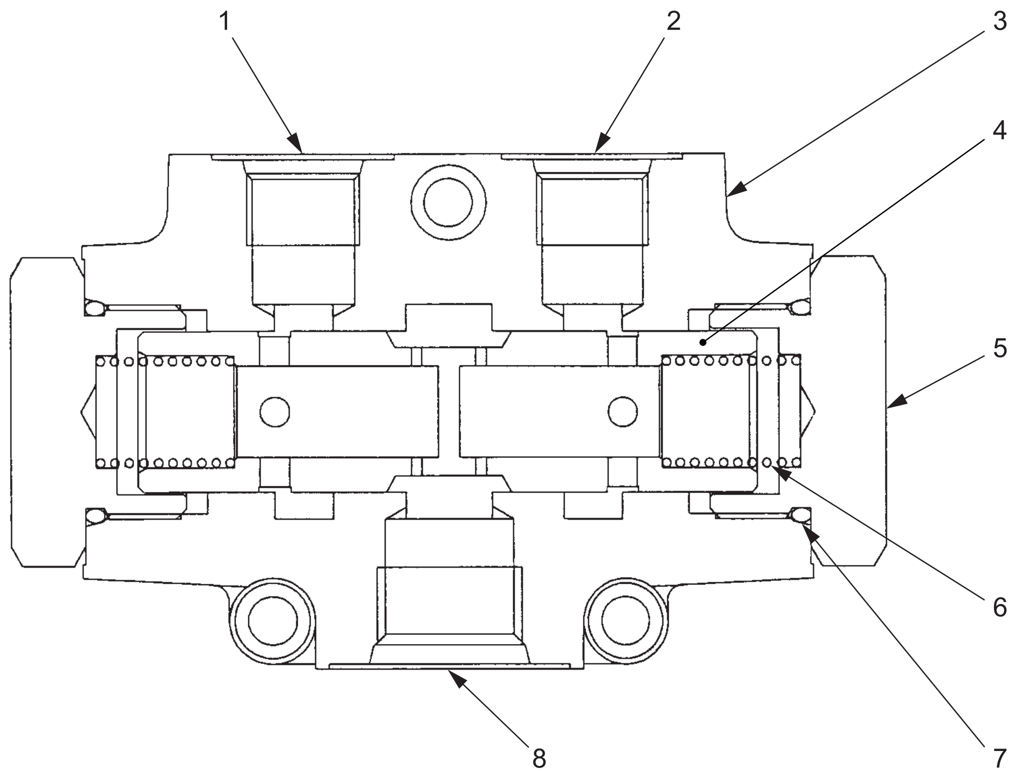
SV510-Ⅲ-04010

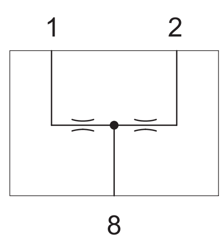
(1) Port L **[L]** : 3/4-16UNF
(2) Port R **[R]** : 3/4-16UNF
(3) Port T **[T]** : 3/4-16UNF
(4) Port P **[P]** : 3/4-16UNF

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.)

4-3-2. Valve (SV412TB, FB)





Hydraulic circuit diagram

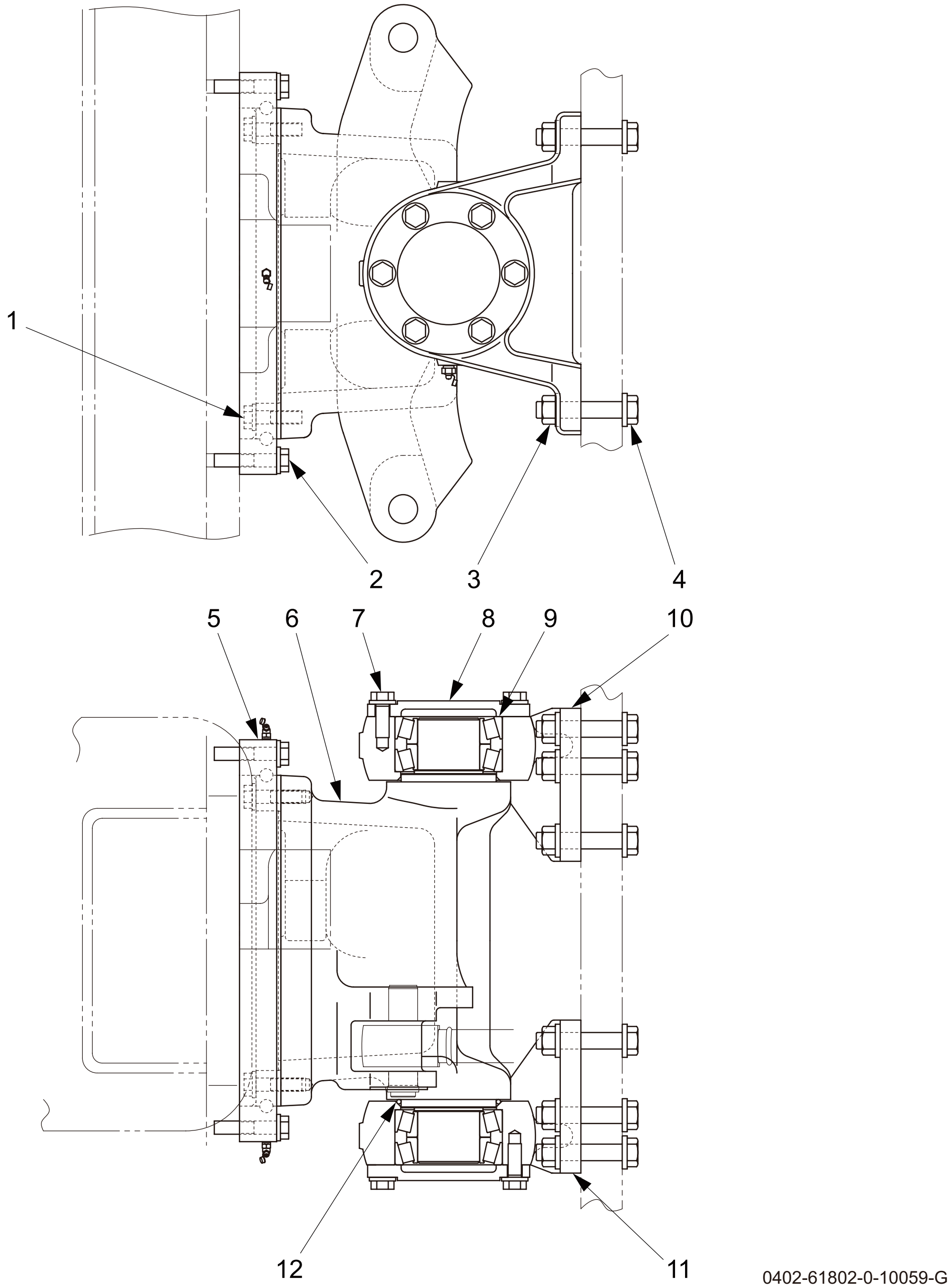
SV412-04003

(1) Port A **[FDA]** : G1/2”
(2) Port B **[FDB]** : G1/2”
(3) Body
(4) Spool
(5) Cover
(6) Spring
(7) O-ring
(8) Port P **[FDP]** : G3/4”

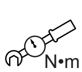
Specifications

- Rated pressure : 29.4 MPa (4,263 psi)
- Standard flow : 60 L/min (16 gal./min)
- Flow division ratio (A : B) : 2 : 1
- Weight : 5 kg (11 lbs.)

4-4. Frame (Center Pin)



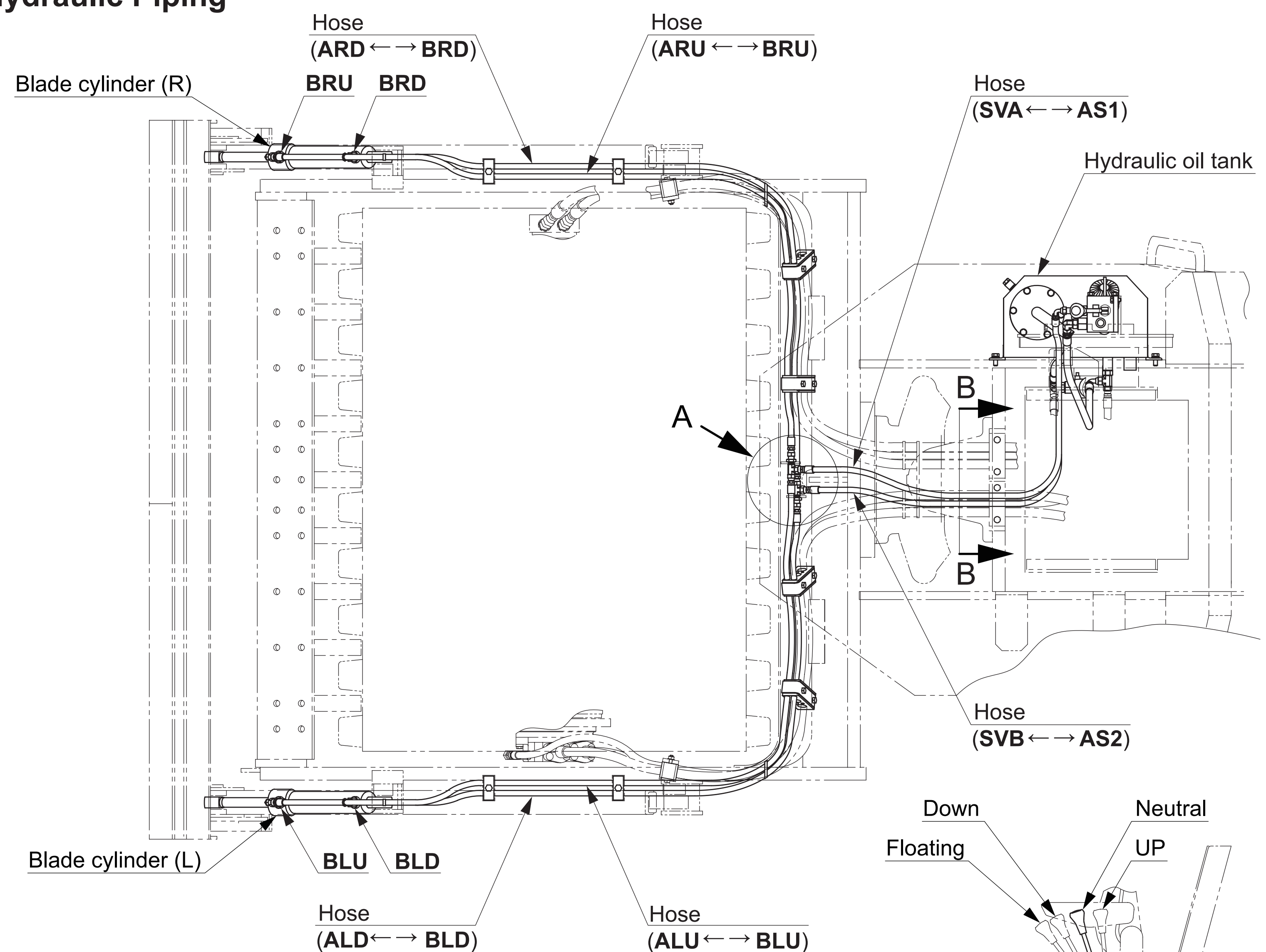
(1) Bolt : M16×60	(5) Swing bearing	(9) Roller bearing
(2) Bolt : M16×80	(6) Yoke	(10) Bracket (upper)
(3) Nut : M20	(7) Bolt : M16×45	(11) Bracket (lower)
(4) Bolt : M20×100	(8) Cover	(12) O-ring

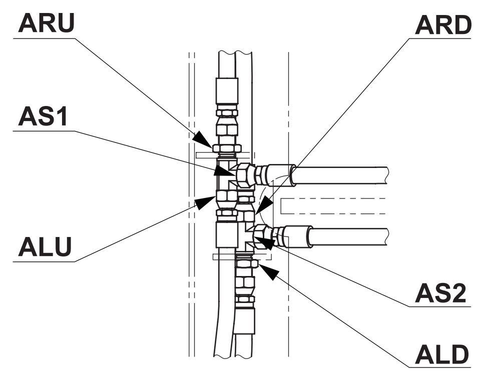


(1) Bolt	M16×60	:	265 N·m	(195 lbf·ft)
(2) Bolt	M16×80	:	265 N·m	(195 lbf·ft)
(3) Nut	M20	:	539 N·m	(398 lbf·ft)
(7) Bolt	M16×45	:	265 N·m	(195 lbf·ft)

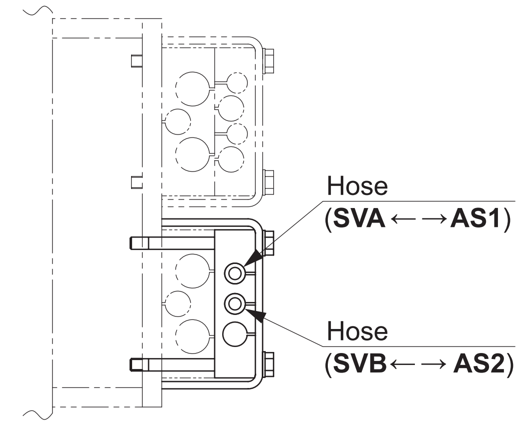
5. BLADE SYSTEM (SV412TB, FB)

5-1. Blade Hydraulic Piping

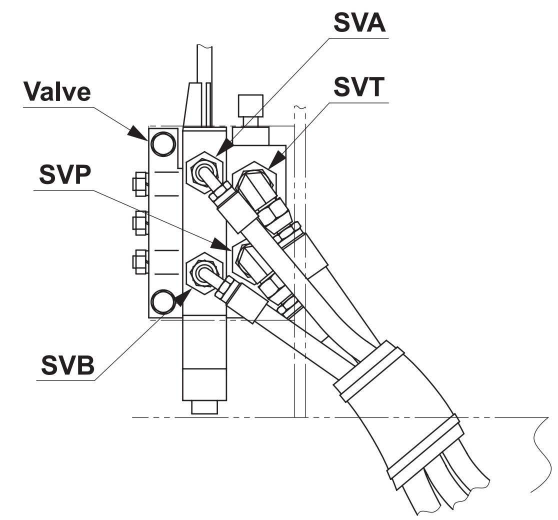




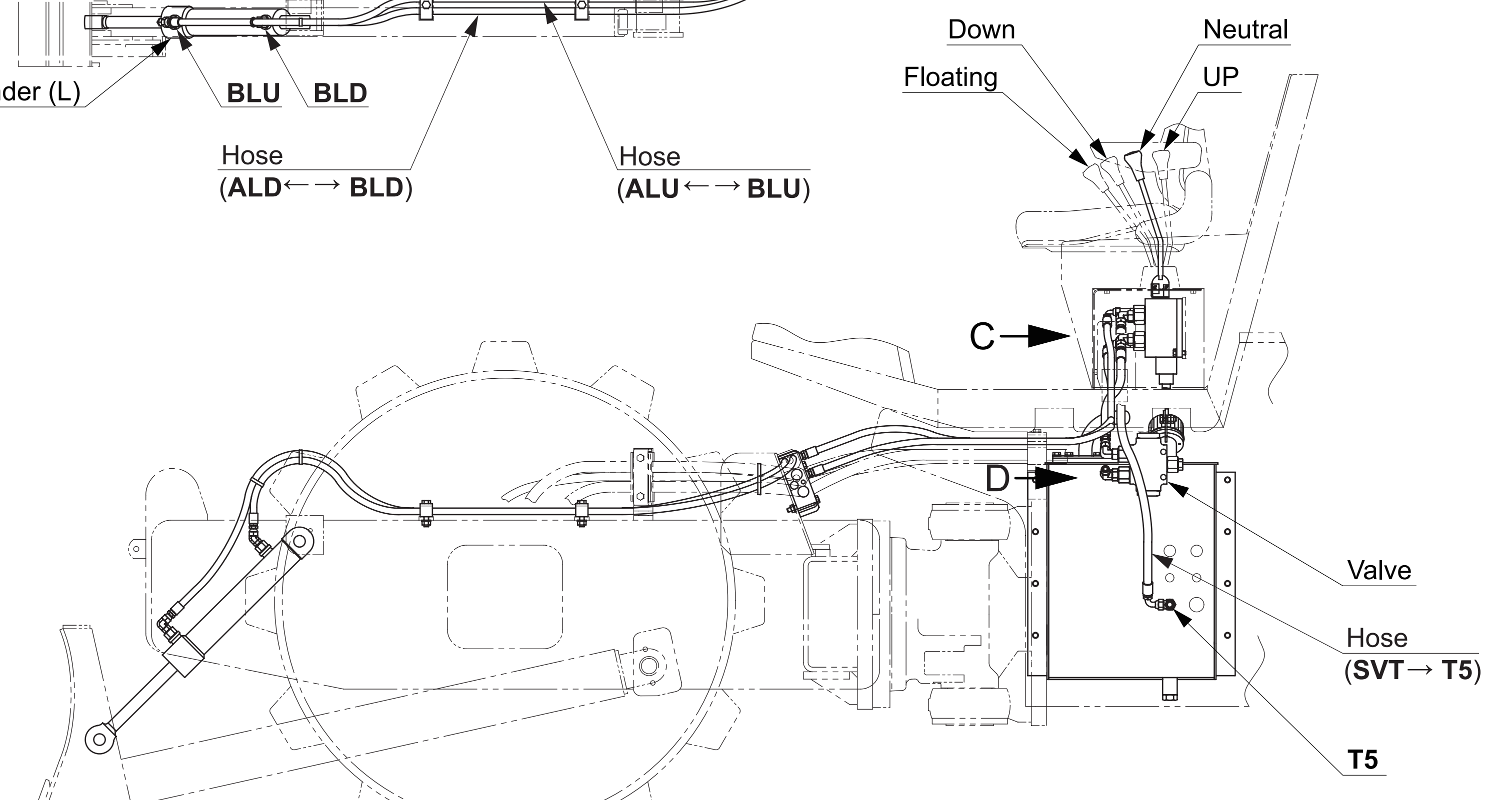
DETAIL A

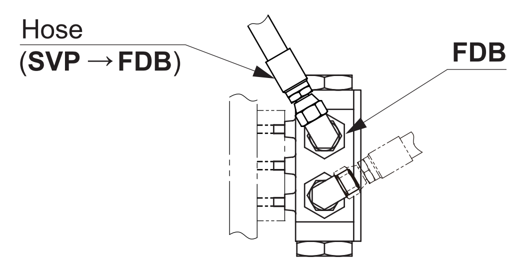


SECTION B-B



VIEW C





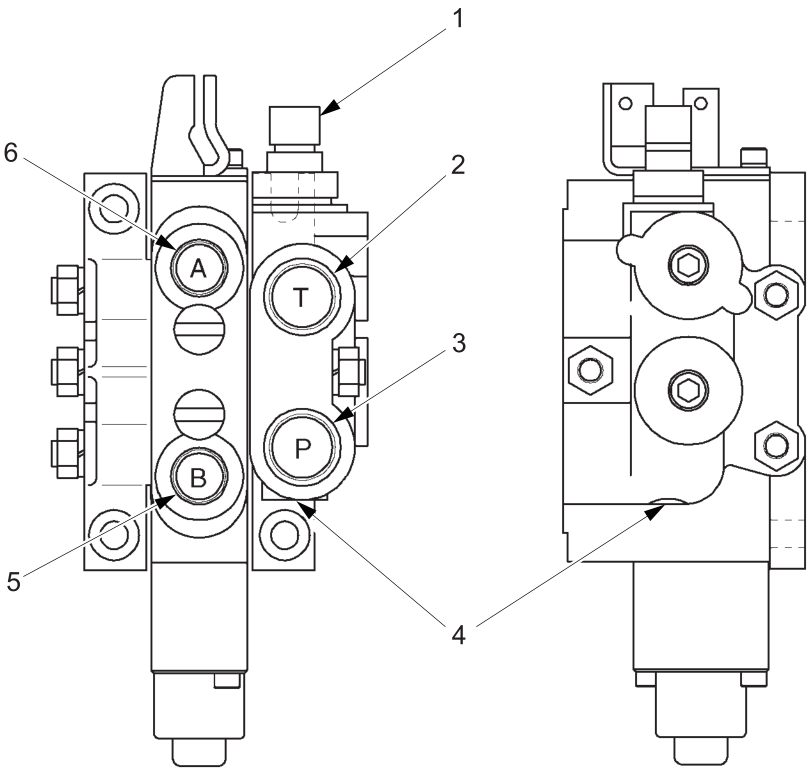
VIEW D

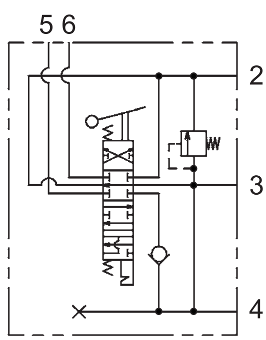
- The letters and figures (such as SVT and T5) show each port and the arrow (←→ ; →) symbols show the hose connection and the direction of the flow of the oil.

0404-49805-0-11910-0

5-2. Hydraulic Component Specification

5-2-1. Valve





Hydraulic circuit diagram

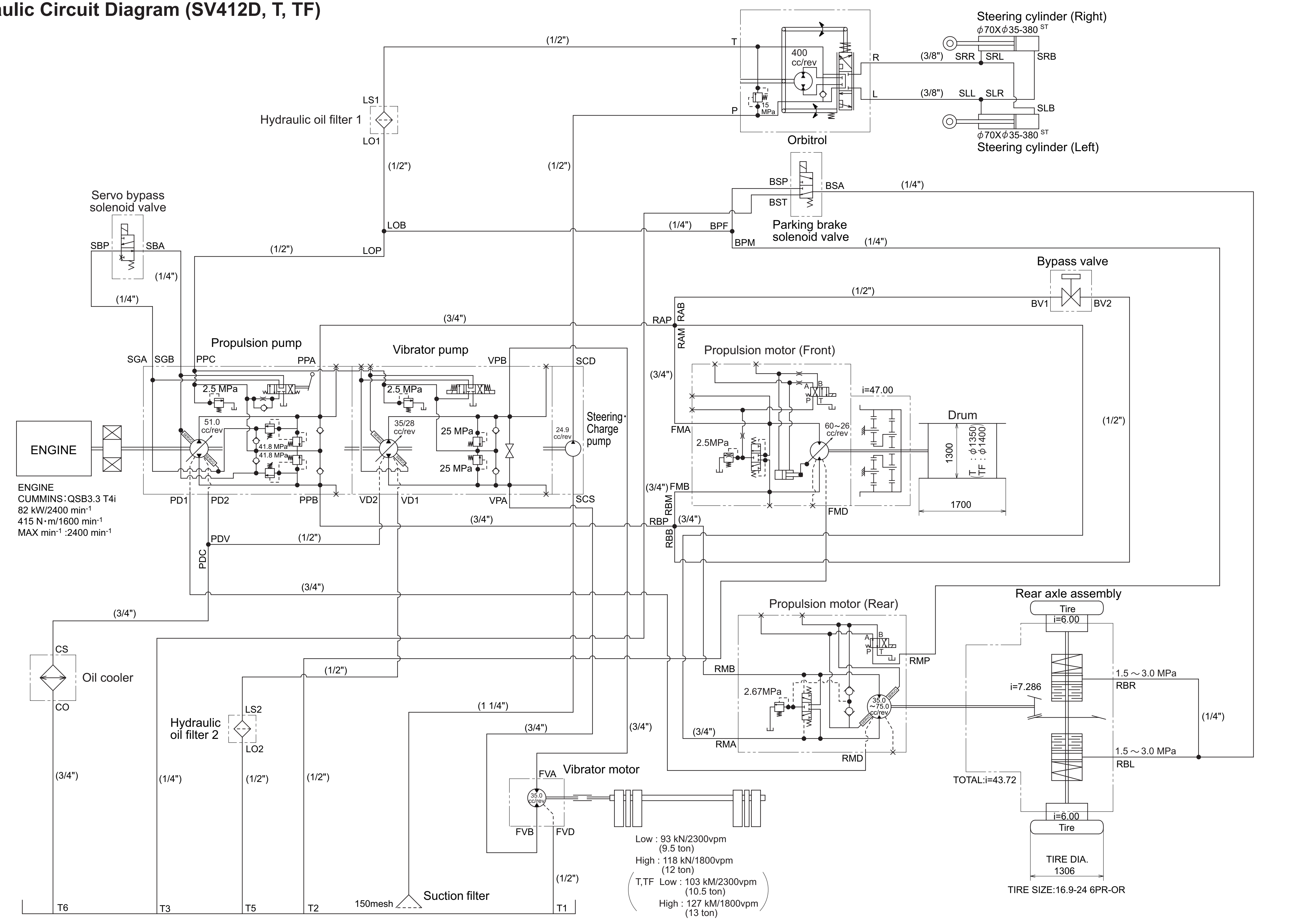
SV201-1-04010

(1) Relief valve
(2) Port T **[SVT]** : G3/4
(3) Port P **[SVP]** : G3/4
(4) Pressure gauge port : Rc 1/4
(5) Port B **[SVB]** : G1/2
(6) Port A **[SVA]** : G1/2

Specifications
- Rated flow : 70 L/min (18 gal./min)
- Maximum working pressure : 20.6 MPa (2,987 psi)
- Relief valve pressure setting : 13.7 MPa (1,987 psi) at 30 L/min (7.9 gal./min)
- Weight : 7.1 kg (15.7 lbs.)

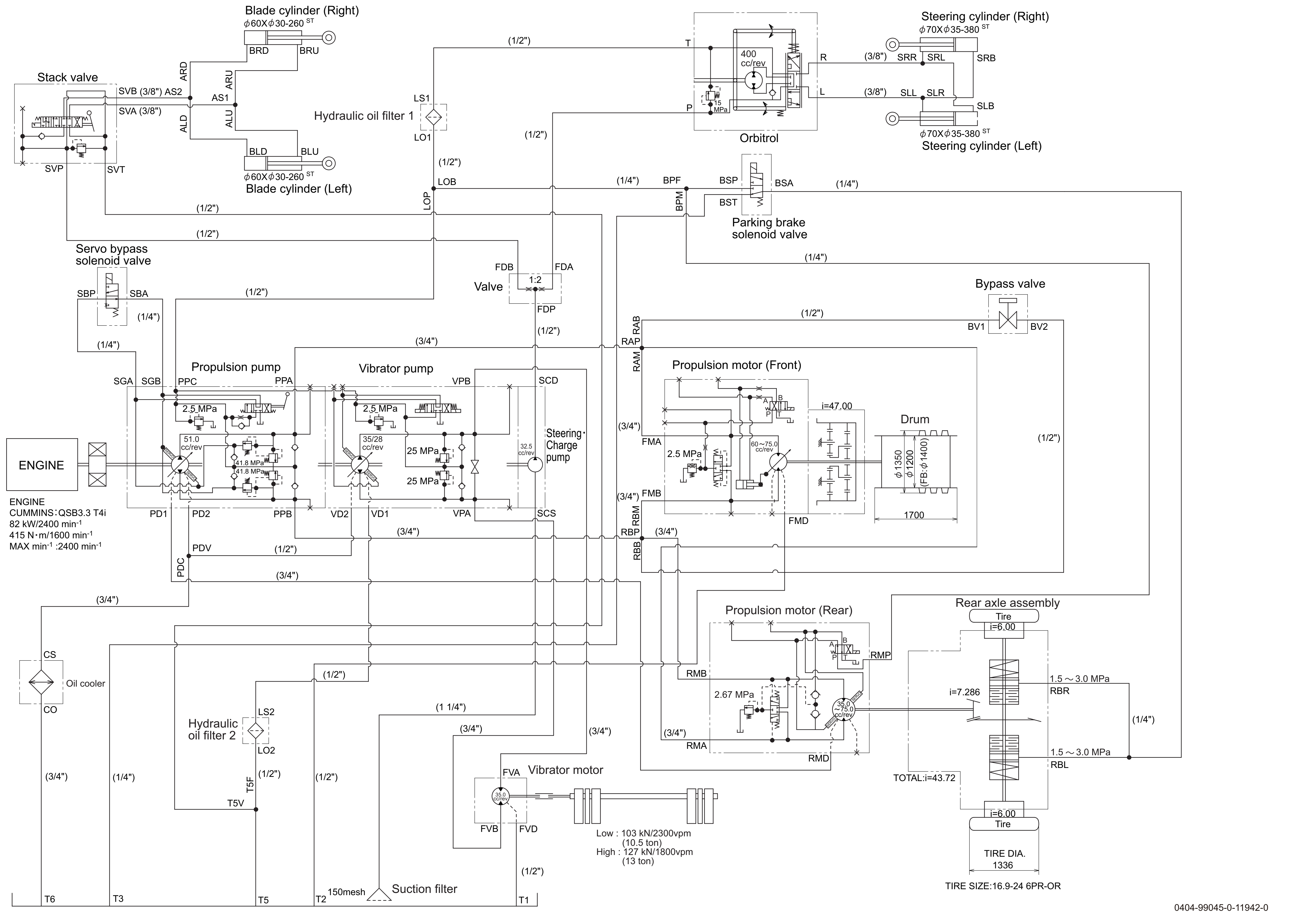
6. HIGH TORQUE TYPE ONLY

6-1. Hydraulic Circuit Diagram (SV412D, T, TF)

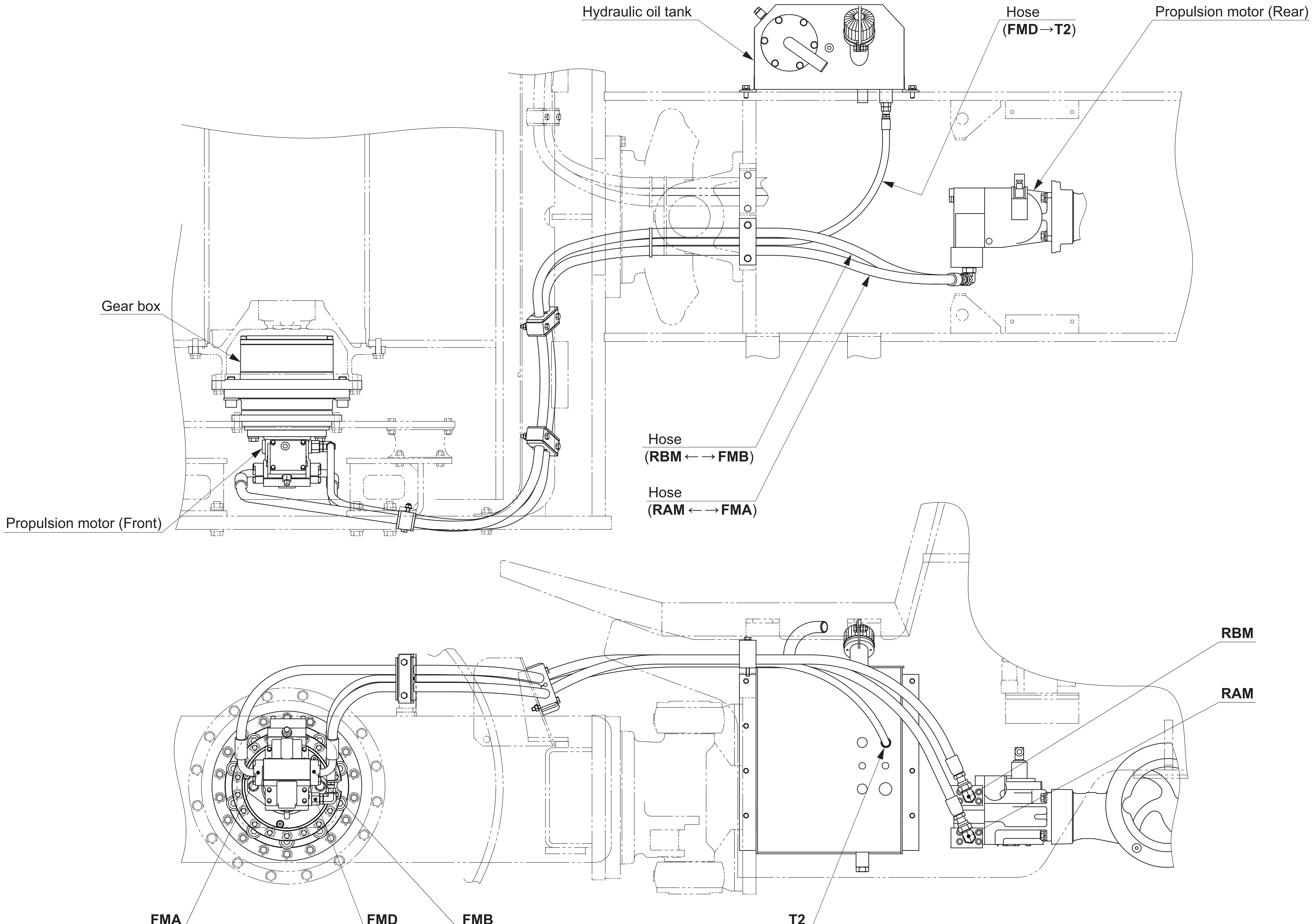


0404-99044-0-11941-0

6-2. Hydraulic Circuit Diagram (SV412TB, FB)



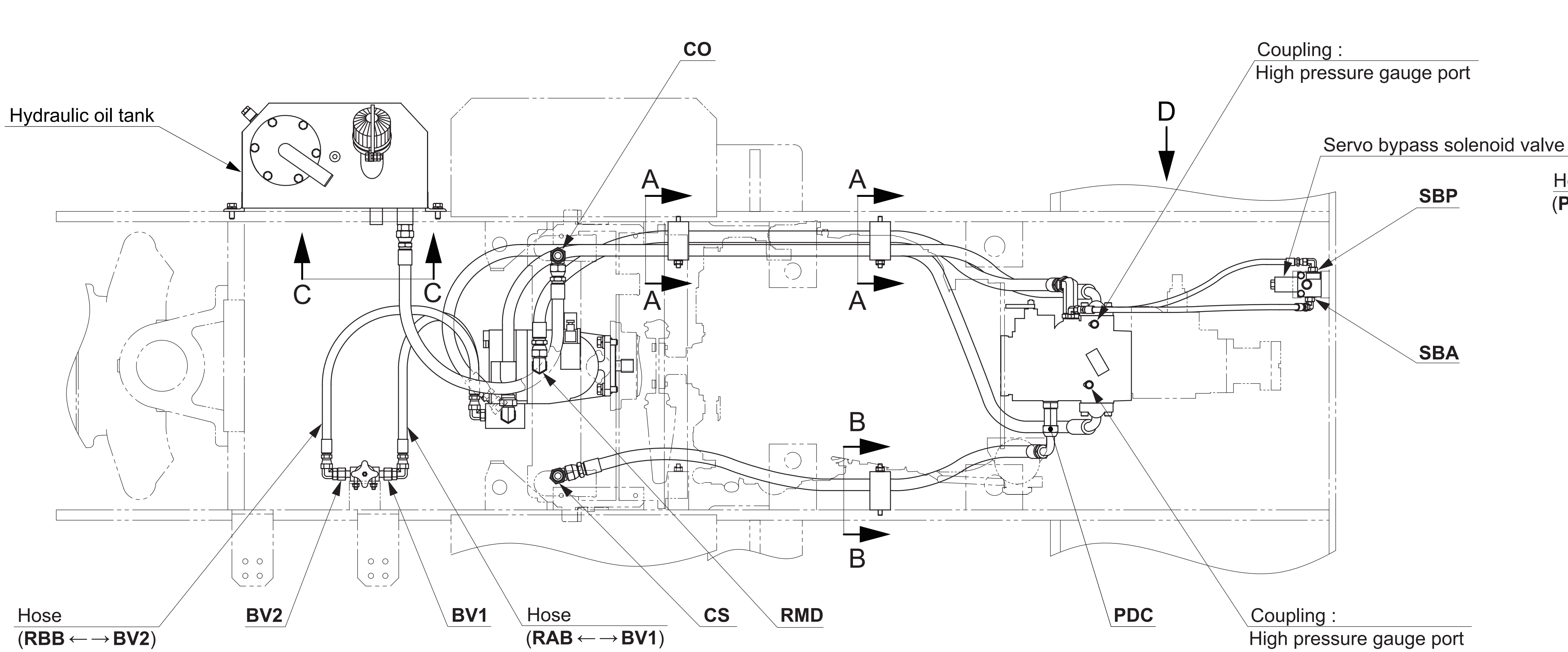
6-3. Propulsion Hydraulic Piping (Front)

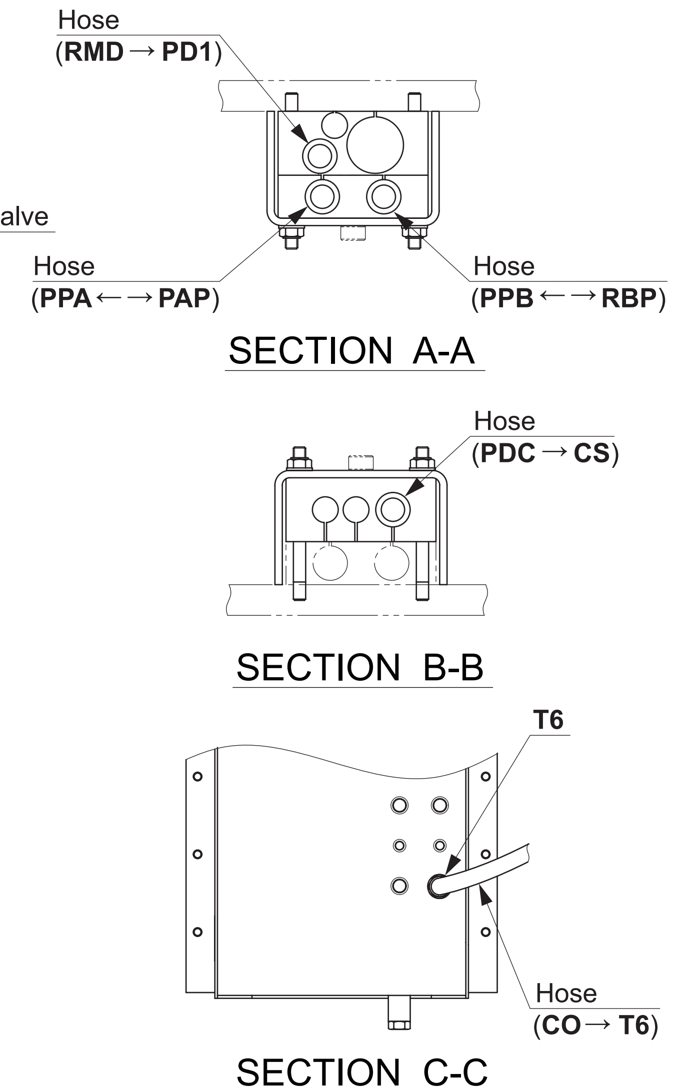


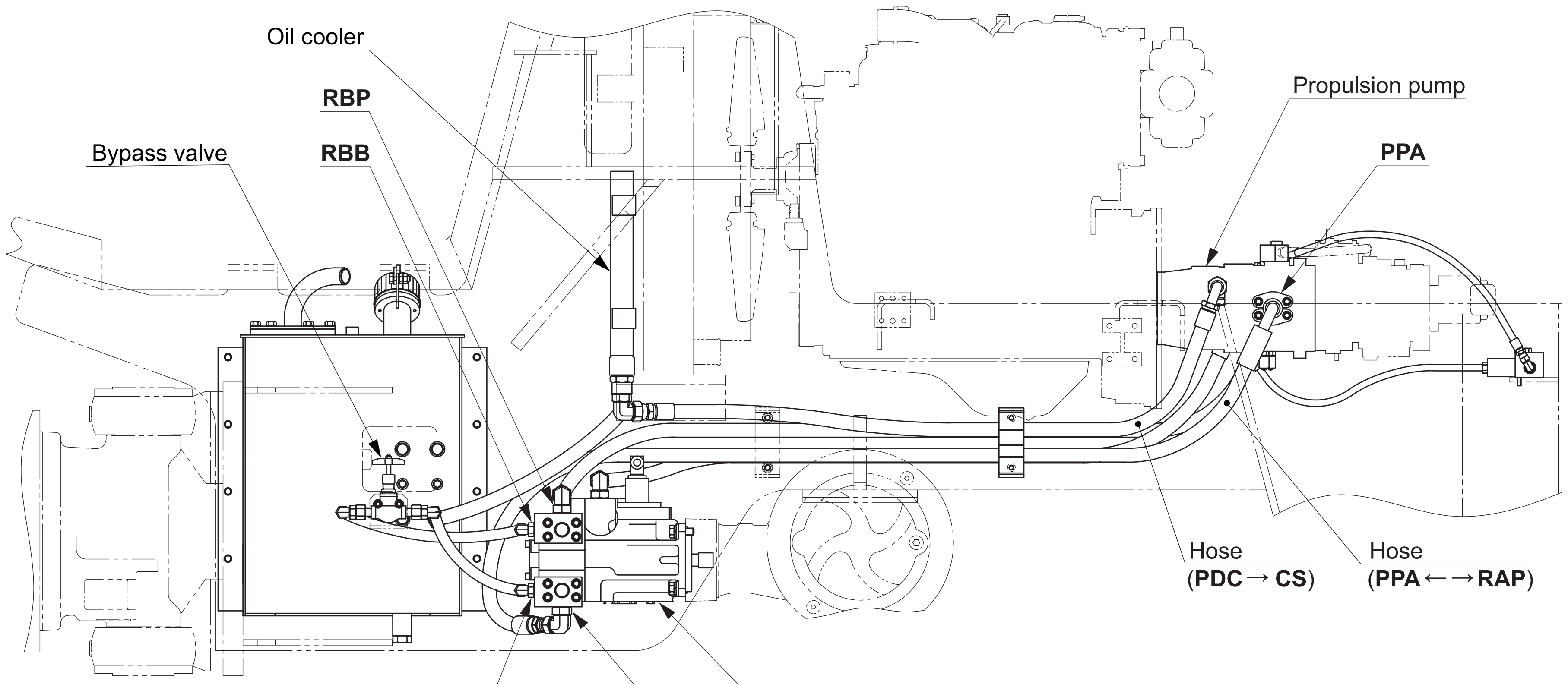
・The letters and figures (such as RAM and FMA) show each port and the arrow (←→ ; →) symbols show the hose connection and the direction of the flow of the oil.

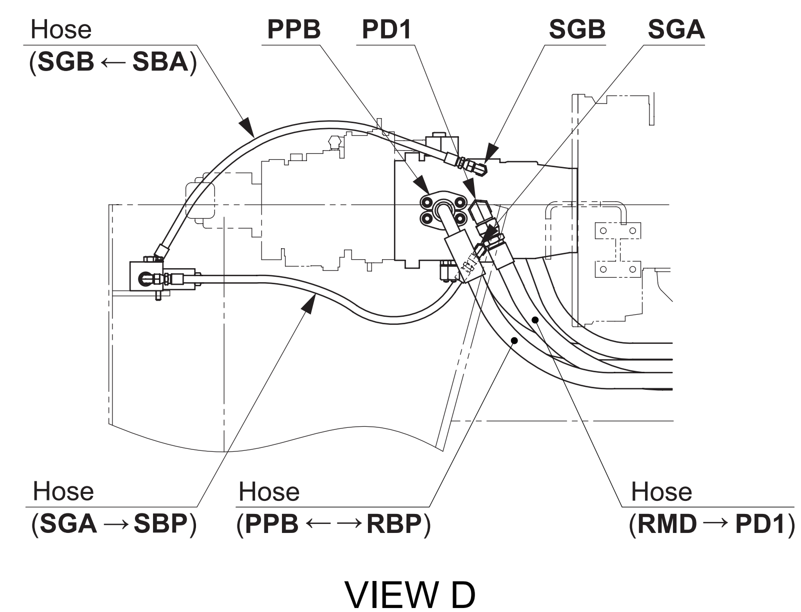
0404-36829-0-11911-0

6-4. Propulsion Hydraulic Piping (Rear)





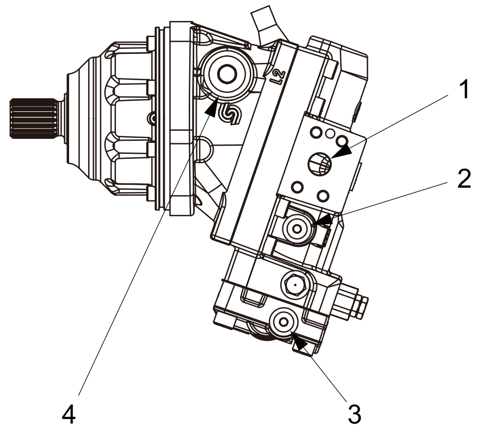


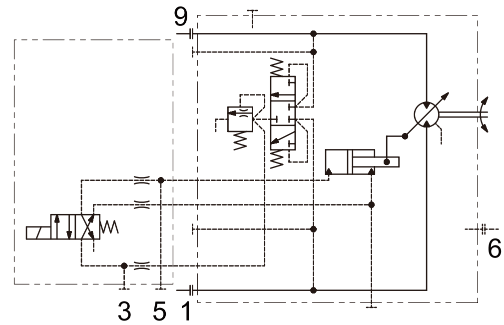


・The letters and figures (such as PDC and CS) show each port and the arrow (←→ ; →) symbols show the hose connection and the direction of the flow of the oil.

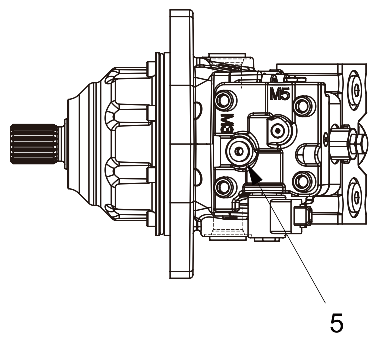
0404-36830-0-11912-0

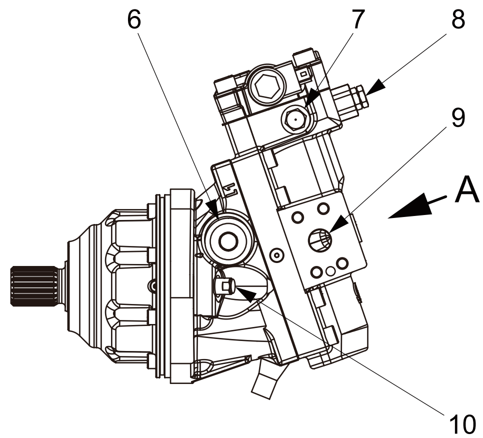
6-5. Propulsion Hydraulic Motor (Front)

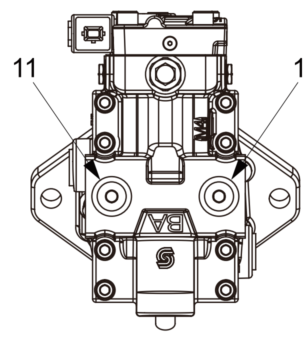




Motor circuit diagram







VIEW A

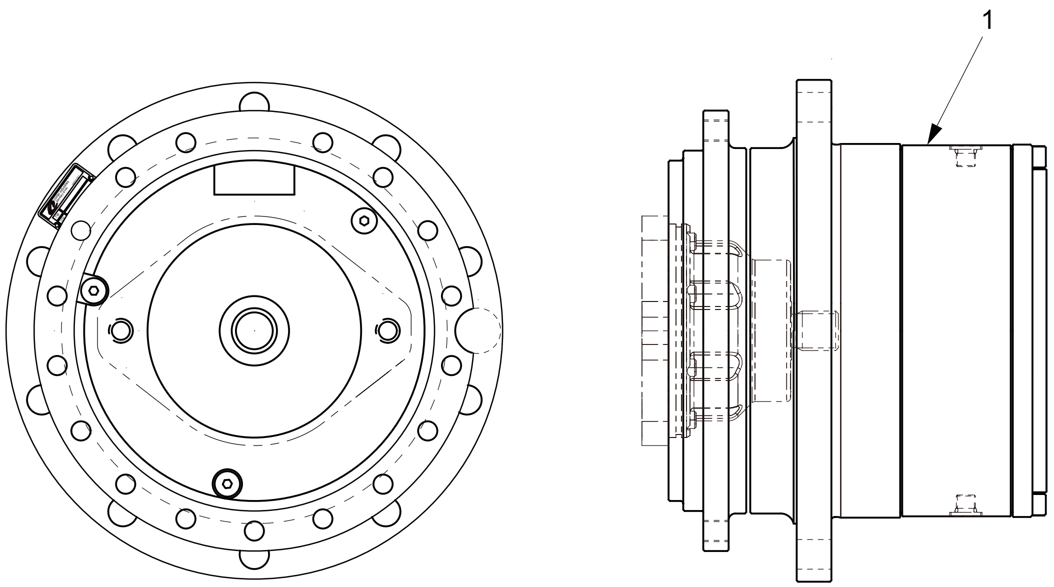
SV410-2-04001

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

Motor specifications

- Displacement (max.) : 60.0 cm^3/rev (3.66 cu.in./rev)
  (min.) : 26.0 cm^3/rev (1.59 cu.in./rev)
- Charge relief valve pressure setting : 2.5 MPa (363 psi)
- Allowable motor case pressure : 0.3 MPa (43.5 psi) or less
- Weight : 28 kg (62 lbs.)

6-6. Gear Box



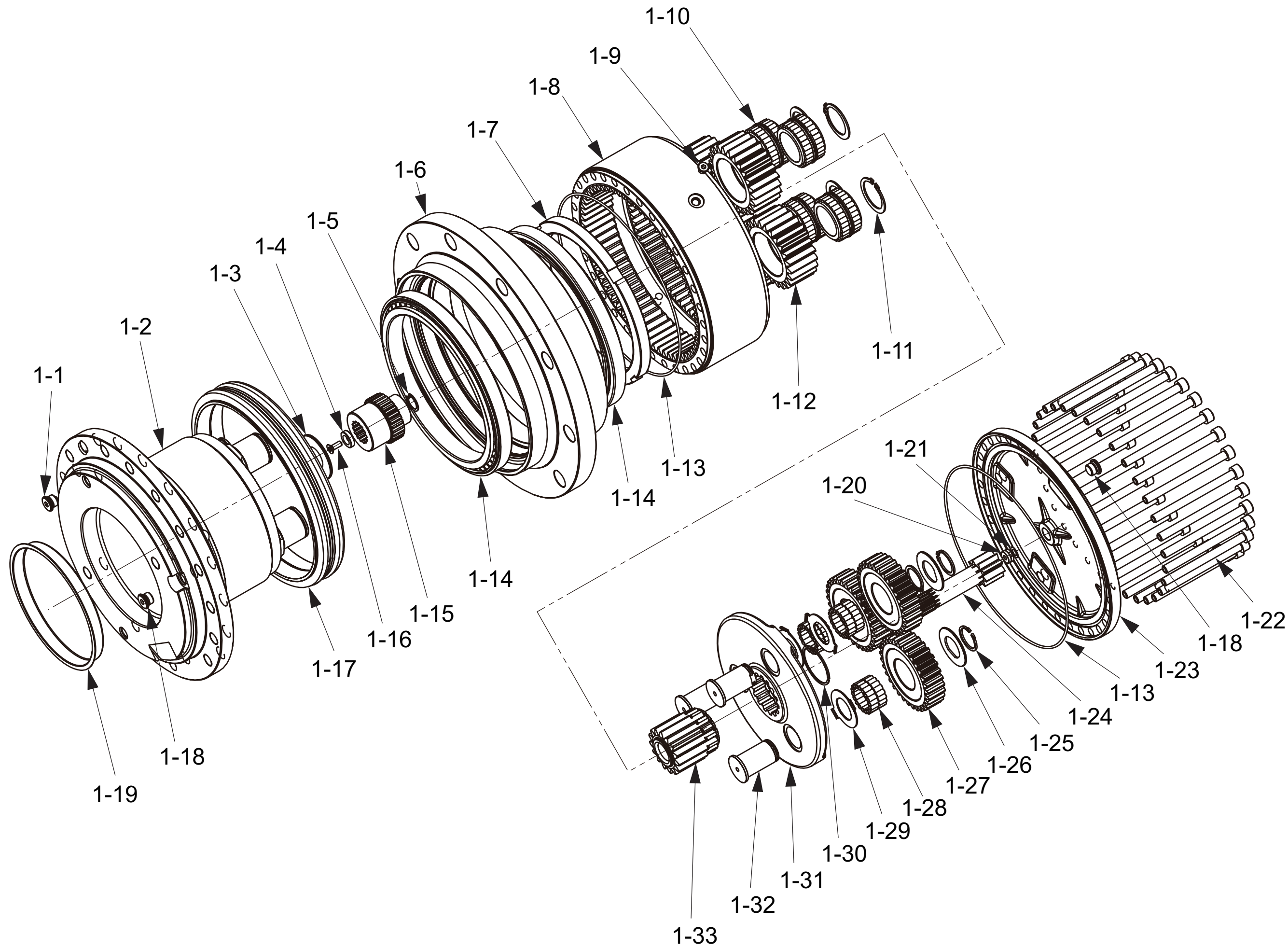
SV410-2-04002

(1) Gear box

Specifications

- Reduction ratio : 1/47.00
- Weight : 90 kg (198 lbs.)

1) Structure of gear box

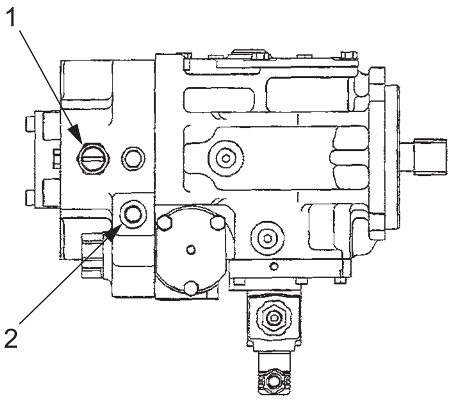


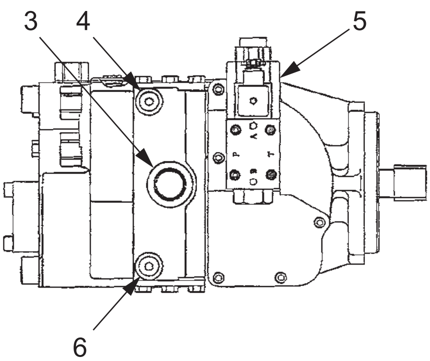
SV410-2-04003

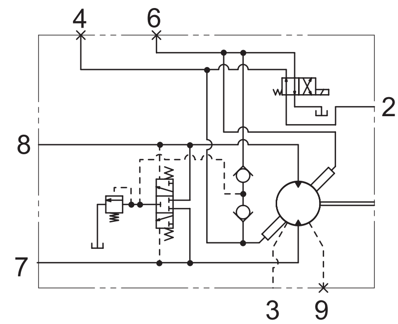
(1) Gear box

(1-1)	Plug	: 9/16-18UNF	(1-18)	Plug	: 9/16-18UNF
(1-2)	Hub		(1-19)	Cover	
(1-3)	Spacer		(1-20)	Pad	
(1-4)	Plate		(1-21)	Shim	
(1-5)	Snap ring		(1-22)	Bolt	: M10×120
(1-6)	Housing		(1-23)	Cover	
(1-7)	Bearing nut	: M190	(1-24)	Sun gear	
(1-8)	Ring gear		(1-25)	Snap ring	
(1-9)	Plug		(1-26)	Bearing washer	
(1-10)	Needle bearing		(1-27)	Planetary gear	
(1-11)	Snap ring		(1-28)	Needle	
(1-12)	Planetary gear		(1-29)	Bearing washer	
(1-13)	O-ring		(1-30)	Snap ring	
(1-14)	Taper bearing		(1-31)	Carrier	
(1-15)	Coupling		(1-32)	Gear pin	
(1-16)	Bolt	: M6×16	(1-33)	Sun gear	
(1-17)	Floating seal kit				

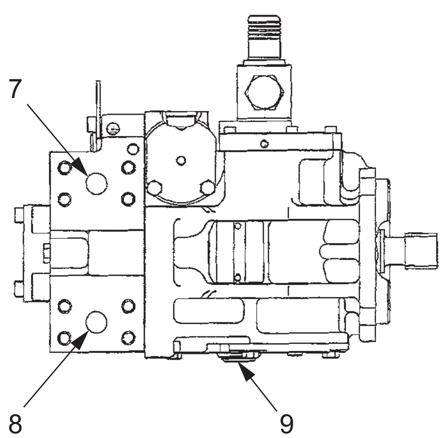
6-7. Propulsion Hydraulic Motor (Rear)

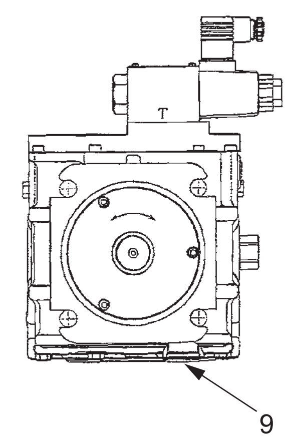






Motor ciruit diagram





SV505- I -04003

(1) Charge pressure relief valve
(2) Pilot supply port **[RMP]** : 9/16-18UNF
(3) Drain port **[RMD]** : 1 1/16-12UN
(4) Servo pressure gauge port : 9/16-18UNF
(5) Speed change solenoid valve
(6) Servo pressure gauge port : 9/16-18UNF
(7) Port B (Reverse) **[RMB]** : SAE 1”
(8) Port A (Forward) **[RMA]** : SAE 1”
(9) Drain port : 1 1/16-12UN

Motor specifications

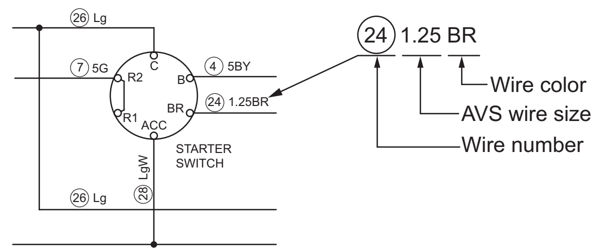
• Displacement (max.)	:	75	cm^3/rev	(4.58 cu.in./rev)	
(min.)	:	35	cm^3/rev	(2.14 cu.in./rev)	
• Charge relief valve pressure setting	:	2.67	MPa	(387 psi)	(at 19 L/min)
• Allowable motor case pressure	:	0.3	MPa	(43.5 psi)	or less
• Weight	:	55	kg	(121 lbs.)	

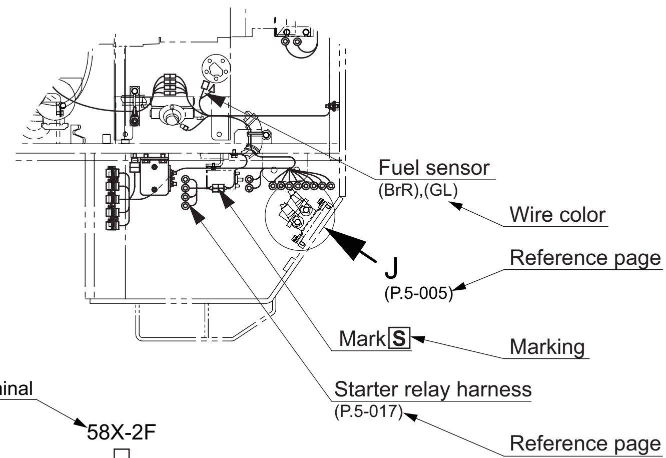
ELECTRICAL SYSTEM

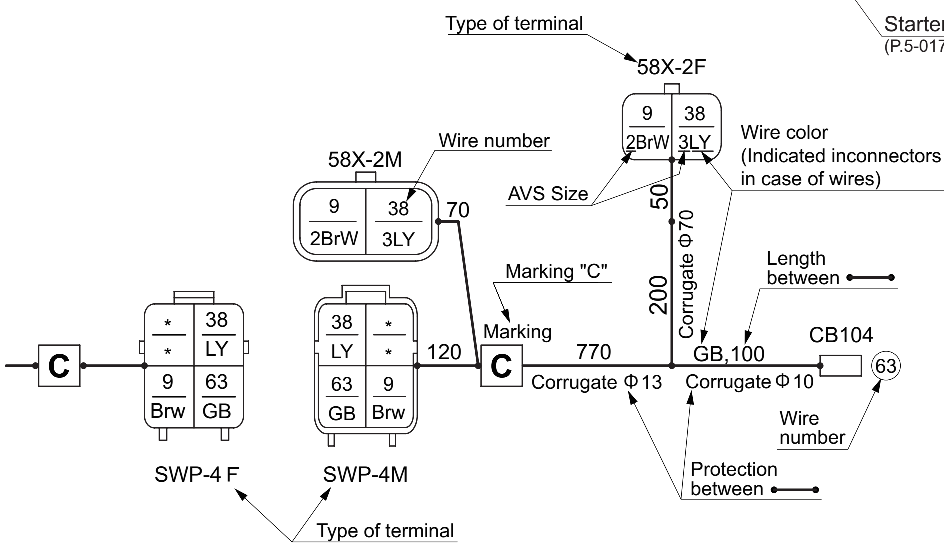
1. PRECAUTIONS FOR WORK

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

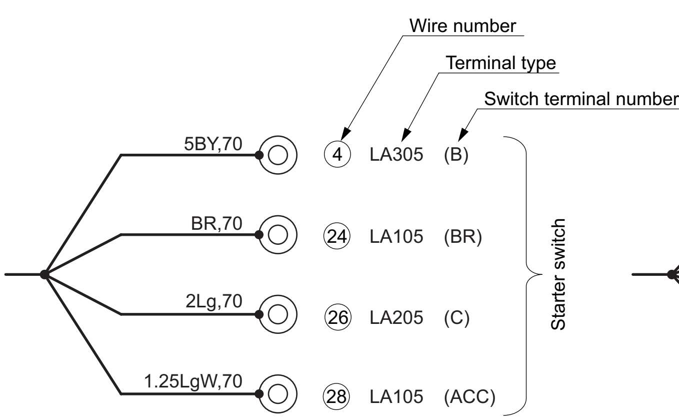
- Codes used in electrical circuit diagrams give the following information.
- The wire size is AVS 0.85 unless otherwise specified.

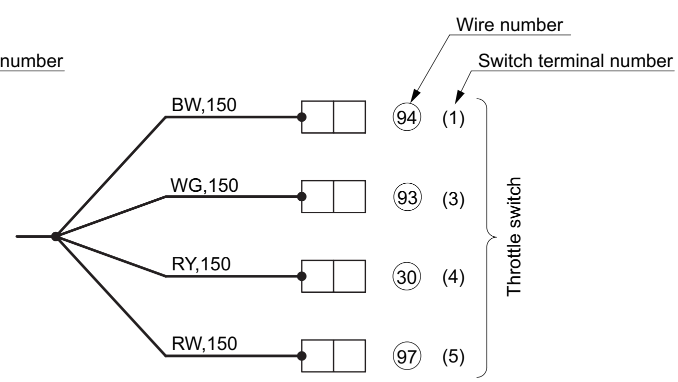






- The pin or socket layout of mating connectors are symmetrical, either vertically or horizontally. When the connector valves are connected, the pin and socket that have the same number are connected.



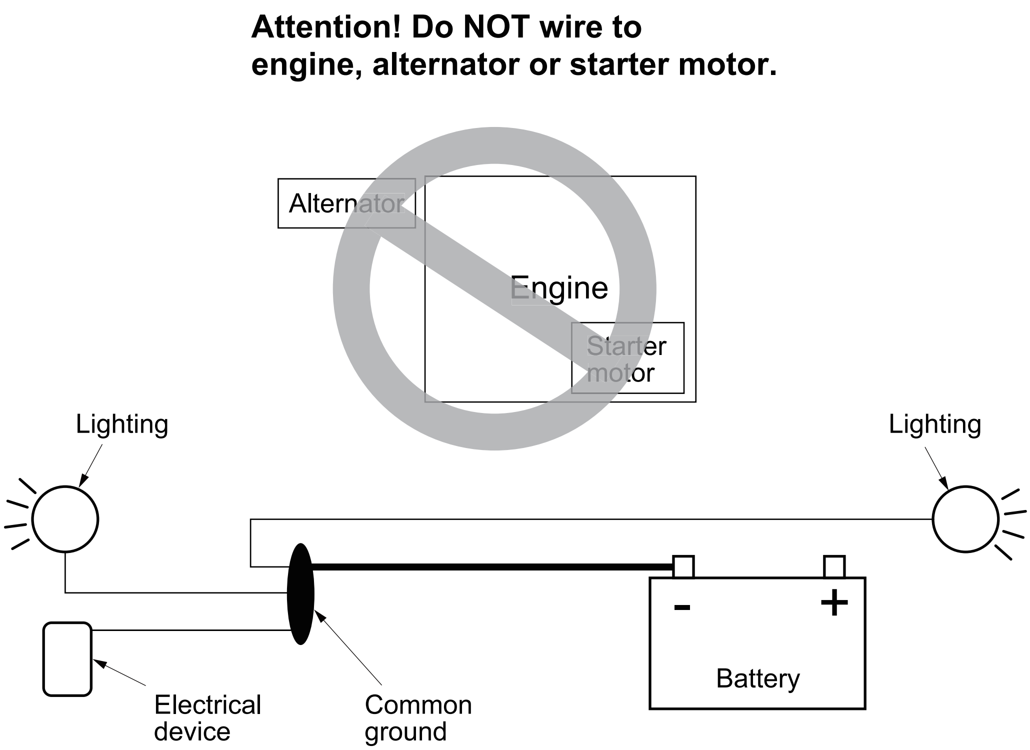


- Wire color code chart

B	Black	BW	Black/ White stripe	BY	Black/ Yellow stripe	BR	Black/ Red stripe	BG	Black/ Green stripe	BL	Black/ Blue stripe			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		

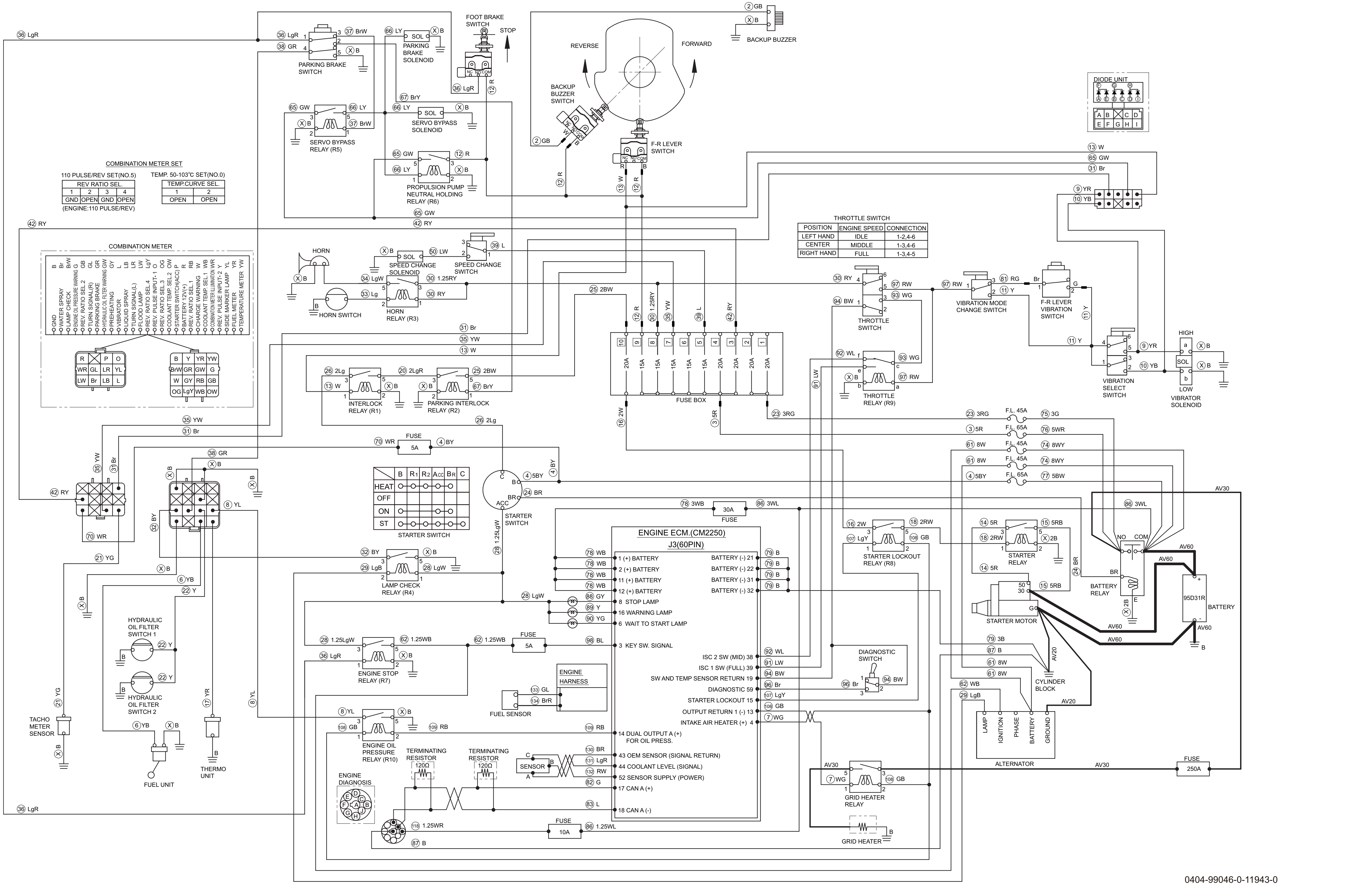
1-2. Electrical Equipment Installation

When wiring electrical components to this machine (for example, additional lighting or electrical devices), connect all grounds to a common ground location and then return to the negative side of the battery. Do not wire to the engine block, starter or alternator terminals. Reference picture is below.



2. SYSTEM CIRCUIT DIAGRAM

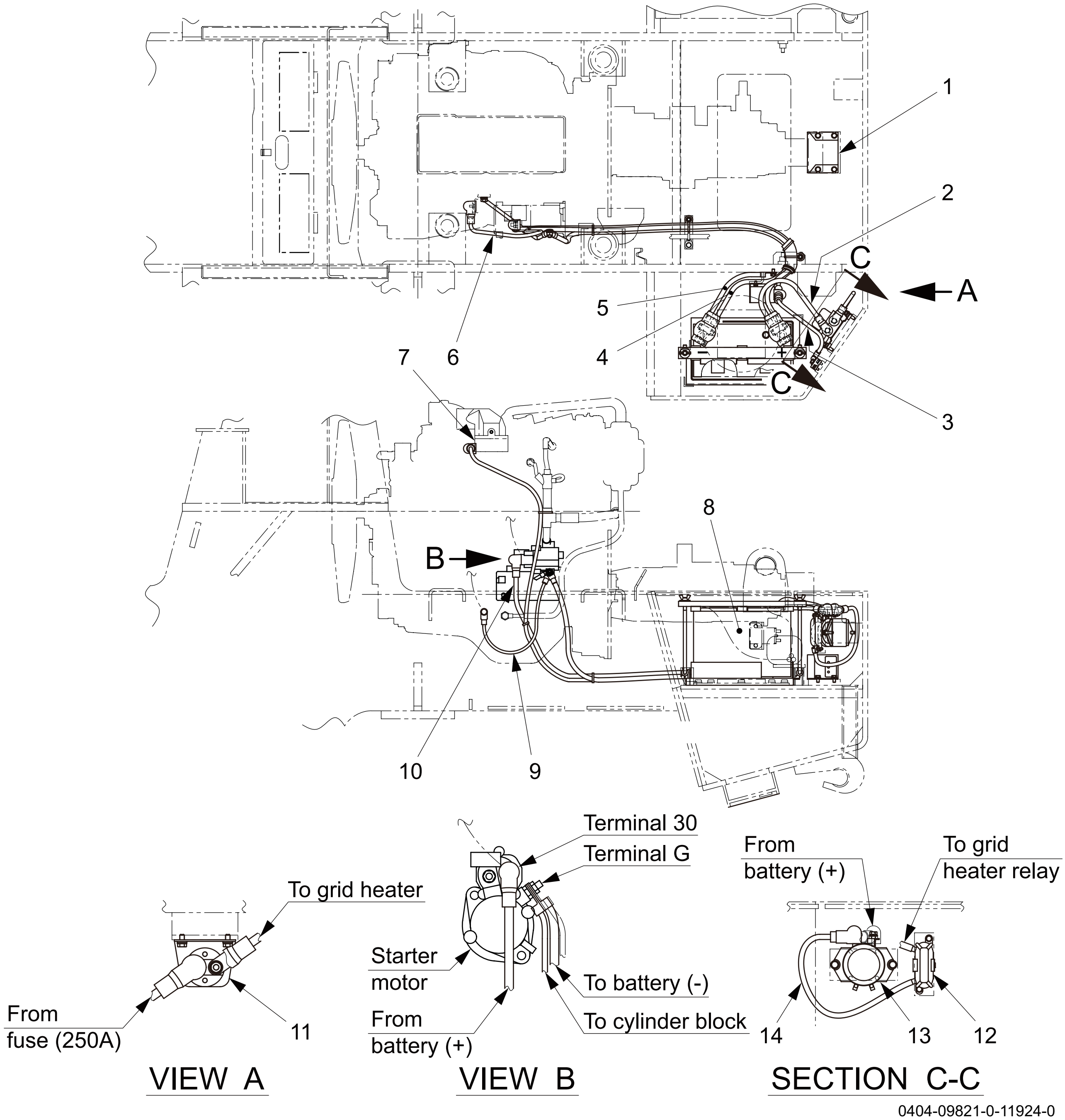
2-1. Electrical Circuit Diagram



0404-99046-0-11943-0

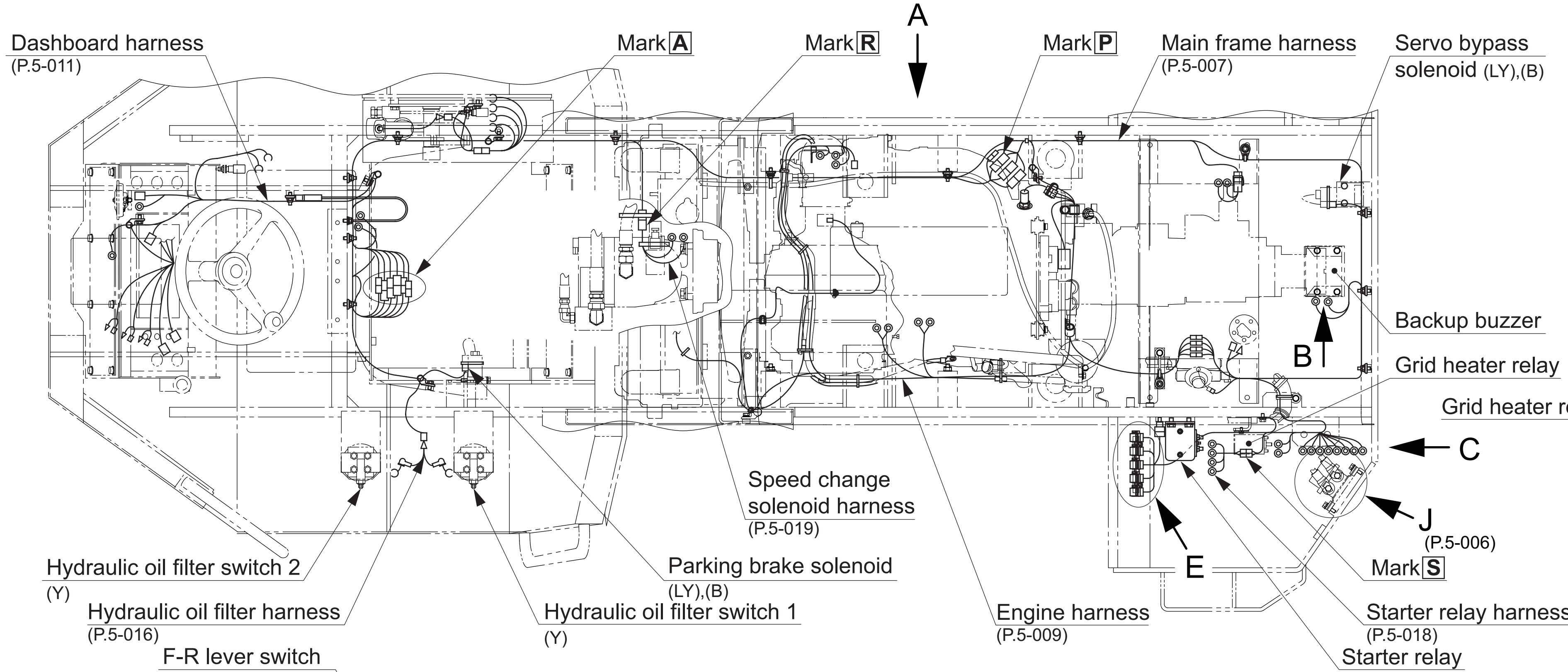
3. ELECTRICAL COMPONENTS

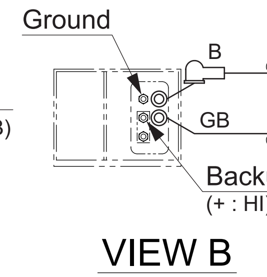
3-1. Battery Layout

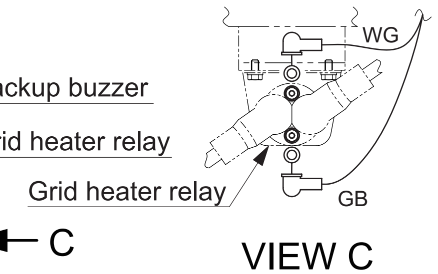


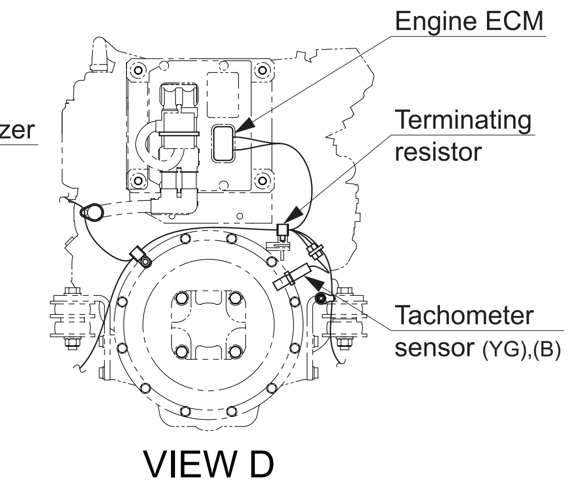
(1) Backup buzzer
(2) Cord (Battery – Battery relay)
(3) Cord (Fuse – Grid heater relay)
(4) Cord (Battery (-) – Starter motor (terminal G))
(5) Cord (Battery (-) – Ground)
(6) Cord (Grid heater relay – Grid heater)
(7) Grid heater (Air heater)
(8) Battery
(9) Cord (Starter motor – Ground)
(10) Cord (Battery (+) – Starter motor (terminal 30))
(11) Grid heater relay
(12) Fuse (250A)
(13) Battery relay
(14) Cord (Battery relay – Fuse)

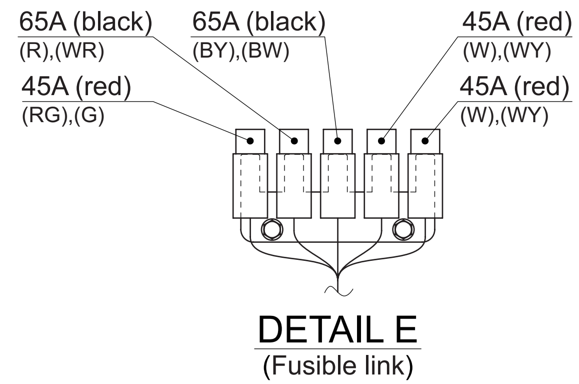
3-2. Wiring Harness Layout (1)

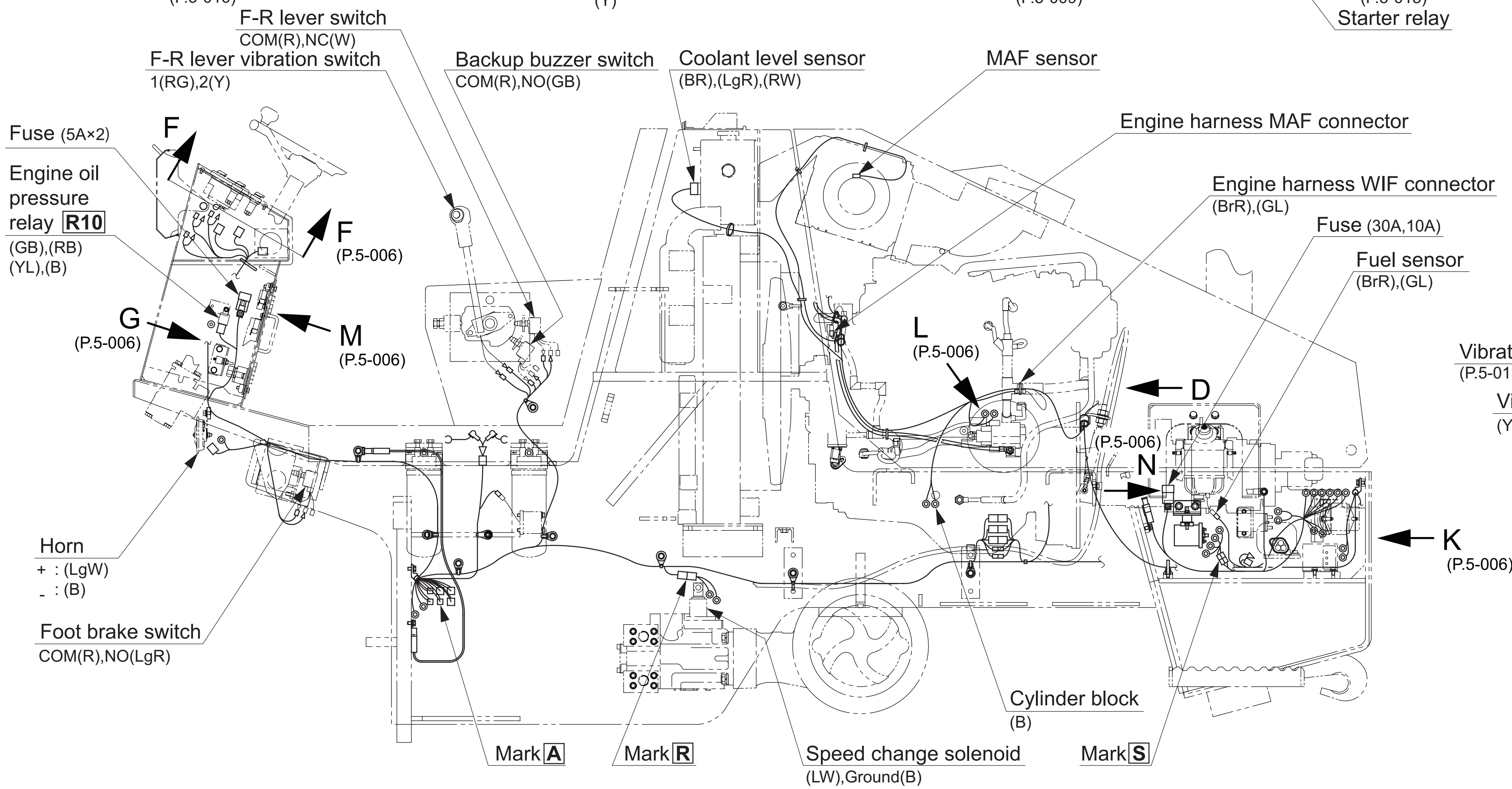


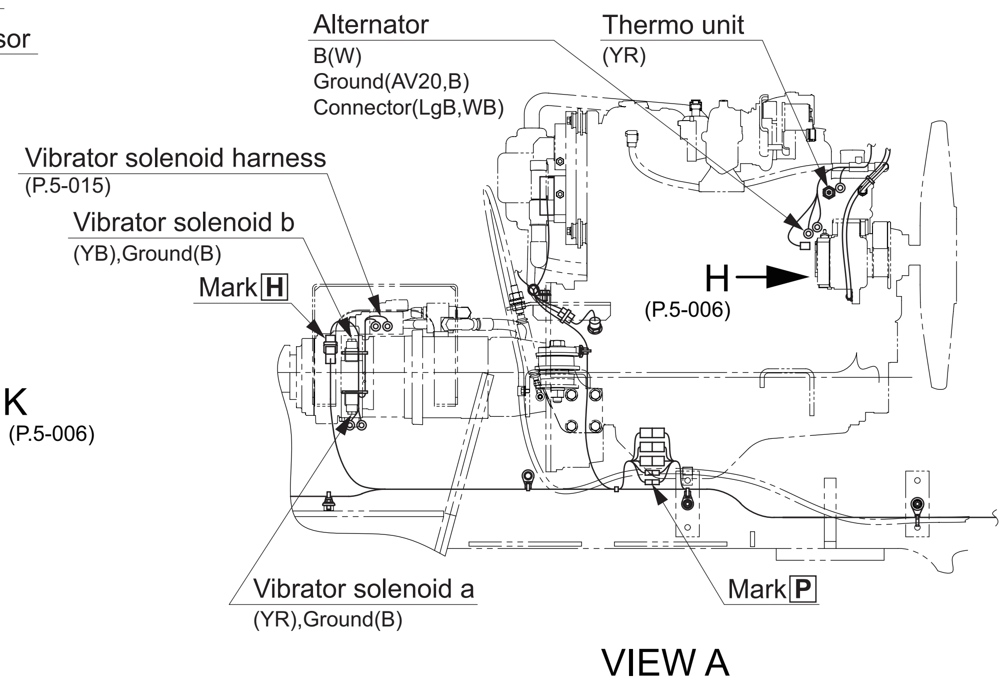












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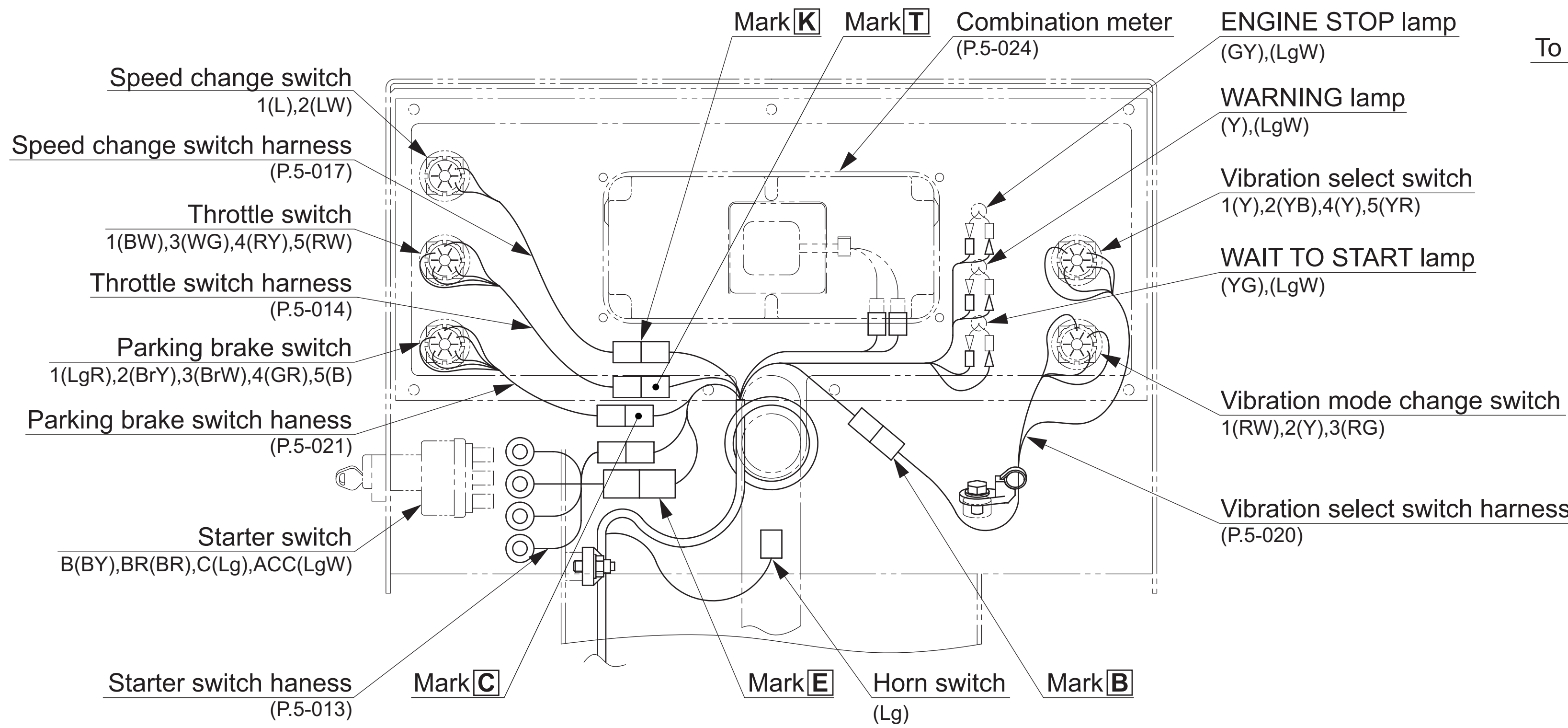
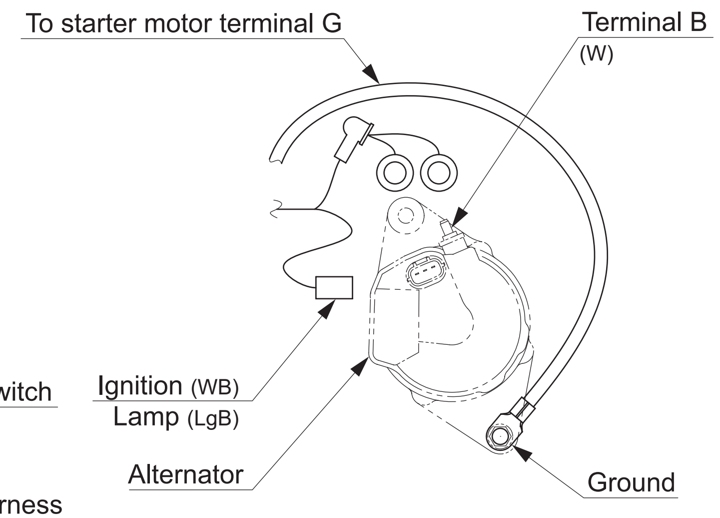
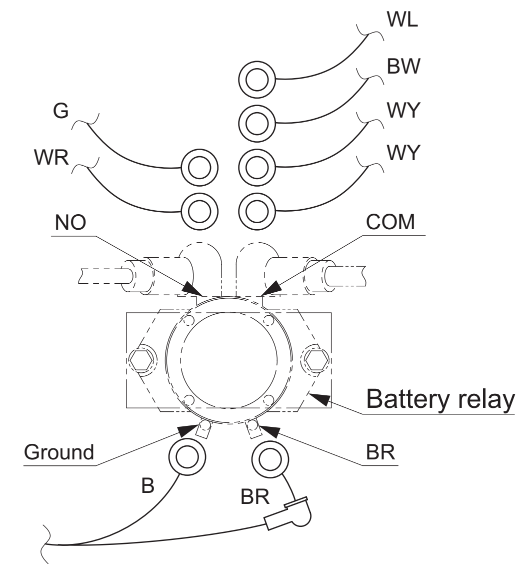
3-3. Wiring Harness Layout (2)



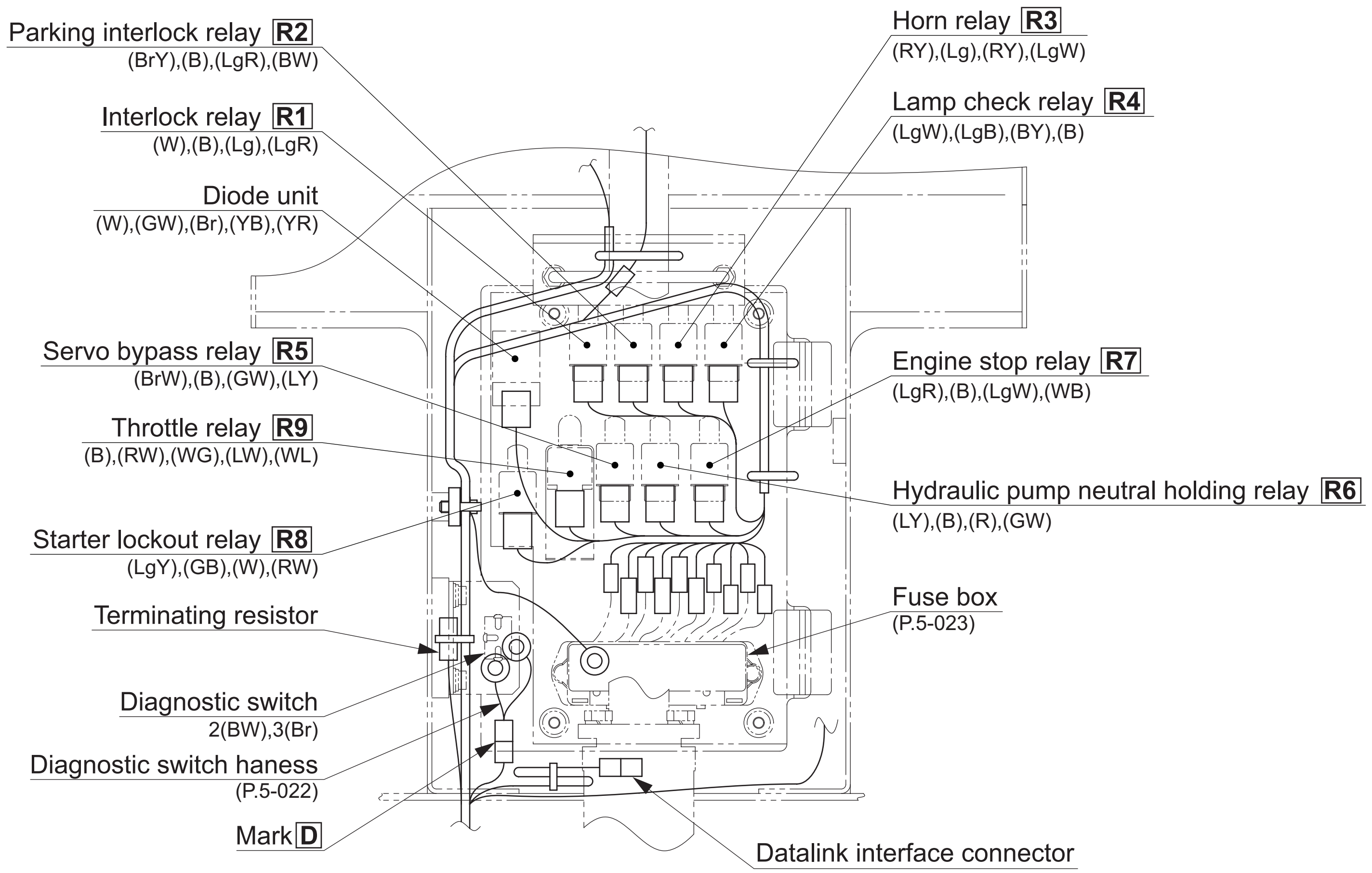
VIEW F-F



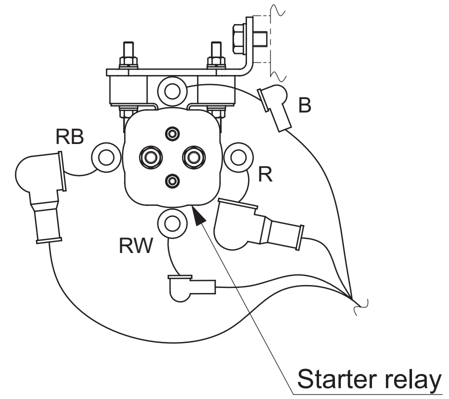
VIEW H



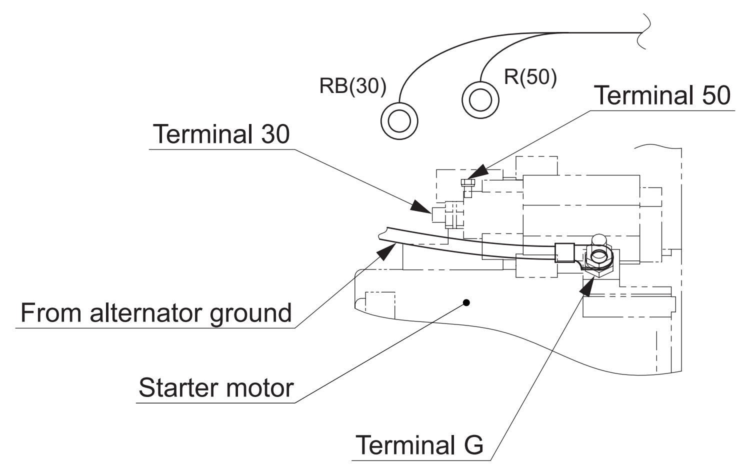
DETAIL J



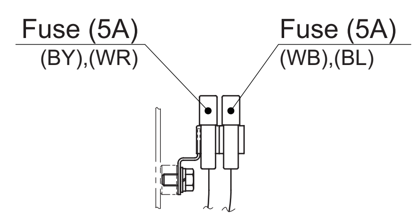
VIEW G



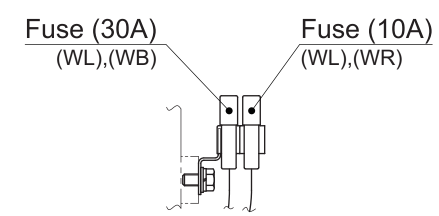
VIEW K



DETAIL L



VIEW M

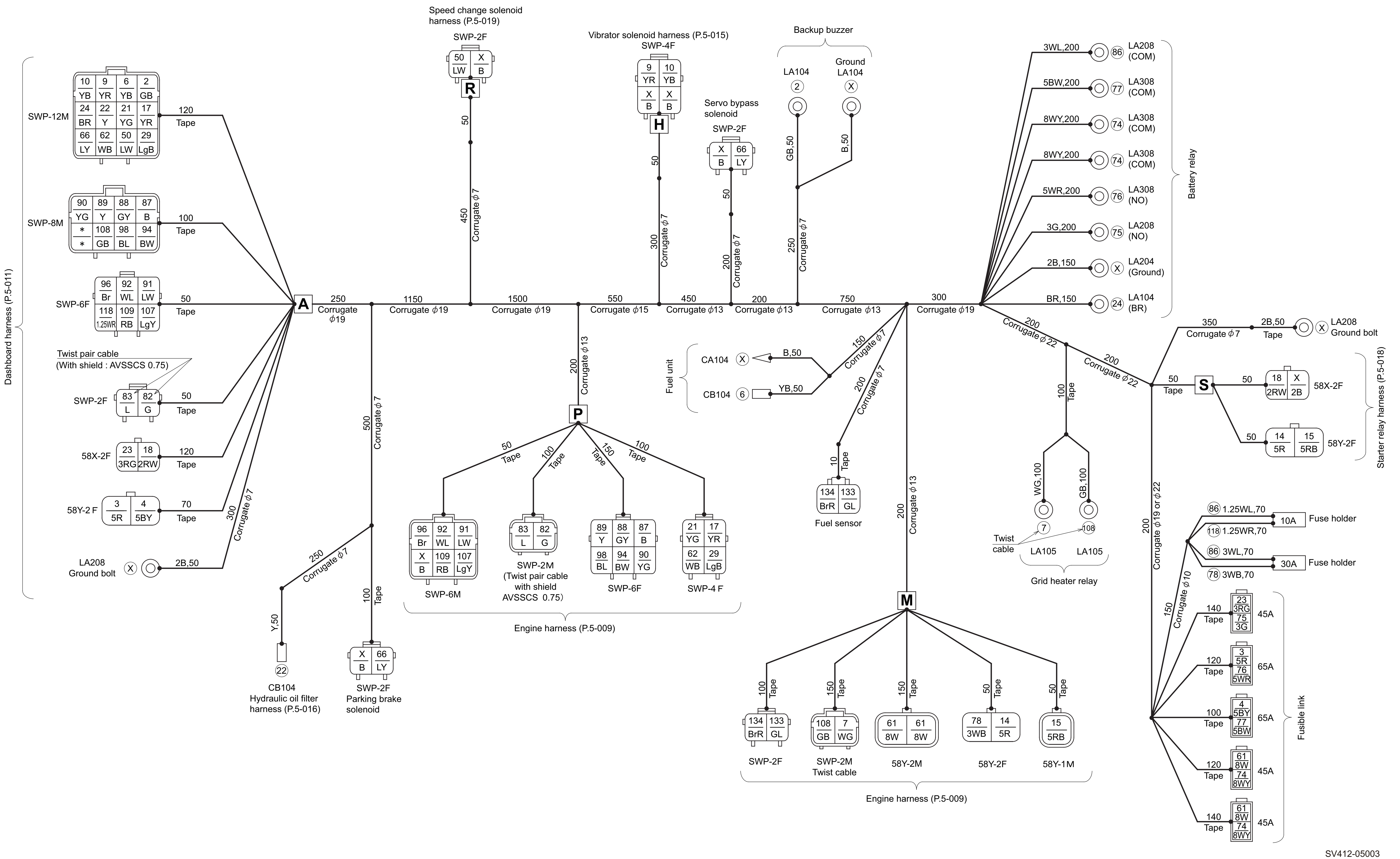


VIEW N

0404-09822-0-11977-0

4. WIRING HARNESSES

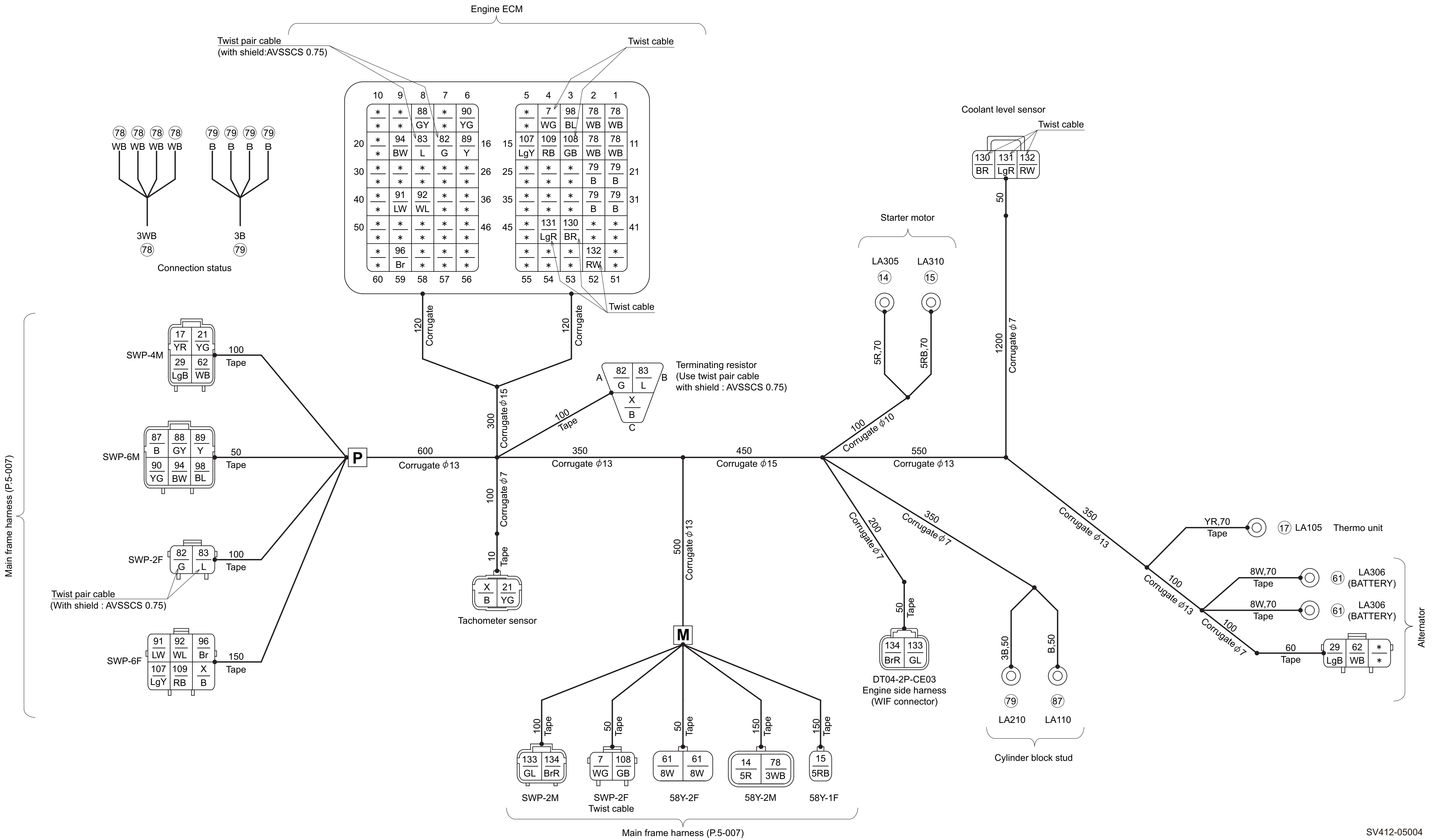
4-1. Main Frame Harness



NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
X	B, 2B	12	Fuel unit, Battery relay-coil, Backup buzzer, Parking brake solenoid, Servo bypass solenoid, Ground bolt × 2, S, R, P, H × 2
2	GB	2	A, Backup buzzer
3	5R	2	A, Fusible link 65A
4	5BY	2	A, Fusible link 65A
6	YB	2	A, Fuel unit
7	WG	2	Grid heater relay, M
9	YR	2	A, H
10	YB	2	A, H
14	5R	2	M, S
15	5RB	2	M, S
17	YR	2	A, P
18	2RW	2	A, S
21	YG	2	A, P
22	Y	2	A, Hydraulic oil filter switch harness
23	3RG	2	A, Fusible link 45A
24	BR	2	A, Battery relay-BR
29	LgB	2	A, P
50	LW	2	A, R
61	8W	4	Fusible link 45A × 2, M × 2
62	WB	2	A, P
66	LY	3	A, Parking brake solenoid, Servo bypass solenoid

NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
74	8WY	4	Fusible link 45A × 2, Battery relay-COM × 2
75	3G	2	Fusible link 45A, Battery relay-NO
76	5WR	2	Fusible link 65A, Battery relay-NO
77	5BW	2	Fusible link 65A, Battery relay-COM
78	3WB	2	Fuse 30A, M
82	G	2	A, P
83	L	2	A, P
86	1.25WL, 3WL	3	Fuse 10A, Fuse 30A, Battery relay-COM
87	B	2	A, P
88	GY	2	A, P
89	Y	2	A, P
90	YG	2	A, P
91	LW	2	A, P
92	WL	2	A, P
94	BW	2	A, P
96	Br	2	A, P
98	BL	2	A, P
107	LgY	2	A, P
108	GB	3	A, Grid heater relay, M
109	RB	2	A, P
118	1.25WR	2	A, Fuse 10A
133	GL	2	Fuel sensor, M
134	BrR	2	Fuel sensor, M

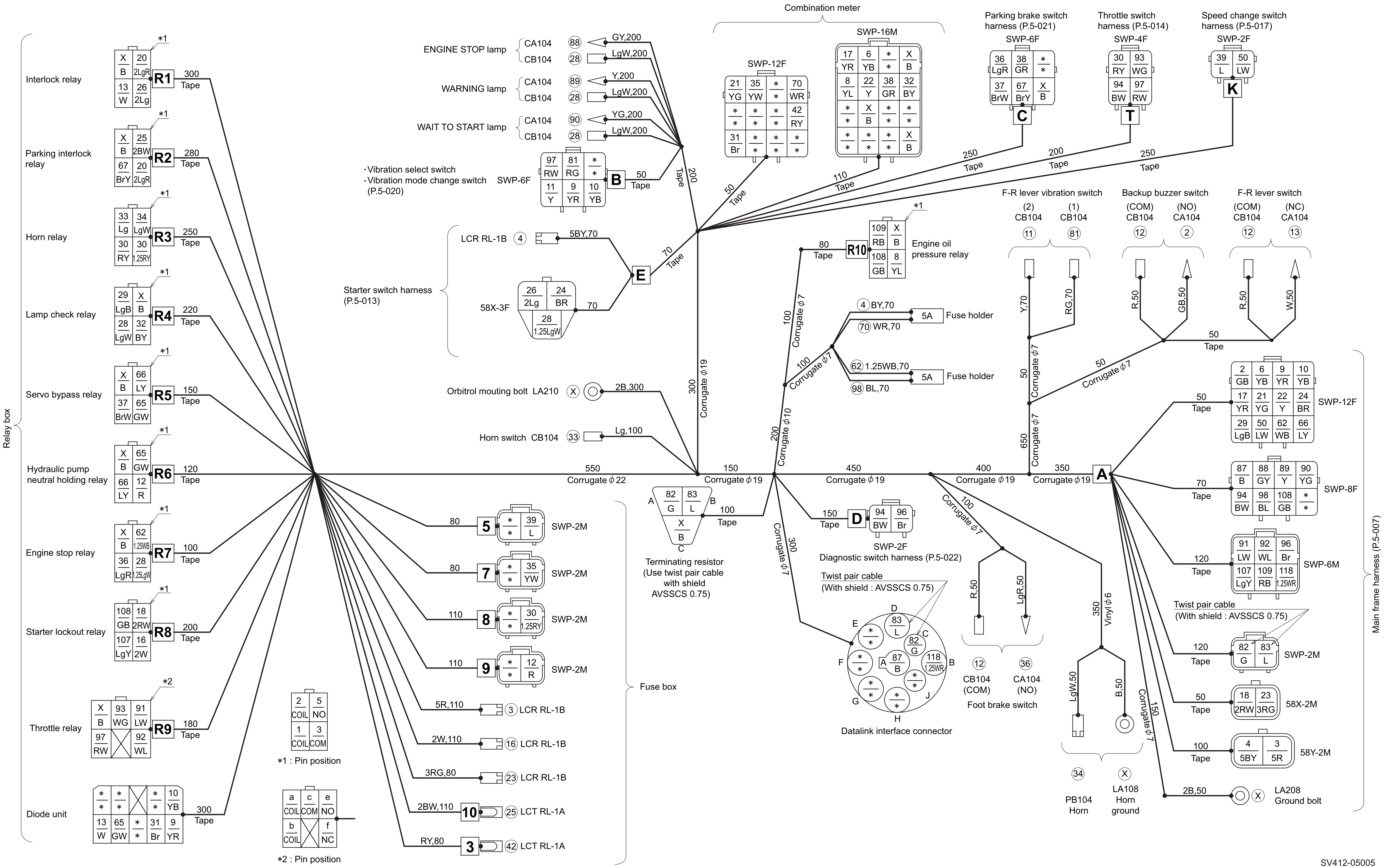
4-2. Engine Harness



NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
X	B	3	P, Terminating-C, Tachometer sensor
7	WG	2	Engine ECM-4, M
14	5R	2	Starter motor-50, M
15	5RB	2	Starter motor-30, M
17	YR	2	P, Thermo unit
21	YG	2	P, Tachometer sensor
29	LgB	2	P, Alternator-LAMP
61	8W	4	Alternator-BATTERY × 2, M × 2
62	WB	2	P, Alternator-IGNITION
78	WB, 3WB	5	Engine ECM-1, 2, 11, 12, M
79	B, 3B	5	Engine ECM-21, 22, 31, 32, Cylinder block stud
82	G	3	P, Engine ECM-17, Terminating resistor-A
83	L	3	P, Engine ECM-18, Terminating resistor-B
87	B	2	P, Cylinder block stud
88	GY	2	P, Engine ECM-8

NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
89	Y	2	P, Engine ECM-16
90	YG	2	P, Engine ECM-6
91	LW	2	P, Engine ECM-39
92	WL	2	P, Engine ECM-38
94	BW	2	P, Engine ECM-19
96	Br	2	P, Engine ECM-59
98	BL	2	P, Engine ECM-3
107	LgY	2	P, Engine ECM-15
108	GB	2	Engine ECM-13, M
109	RB	2	P, Engine ECM-14
130	BR	2	Engine ECM-43, Coolant level sensor-C
132	LgR	2	Engine ECM-44, Coolant level sensor-B
132	RW	2	Engine ECM-52, Coolant level sensor-A
133	GL	2	Engine side harness (WIF connector), M
134	BrR	2	Engine side harness (WIF connector), M

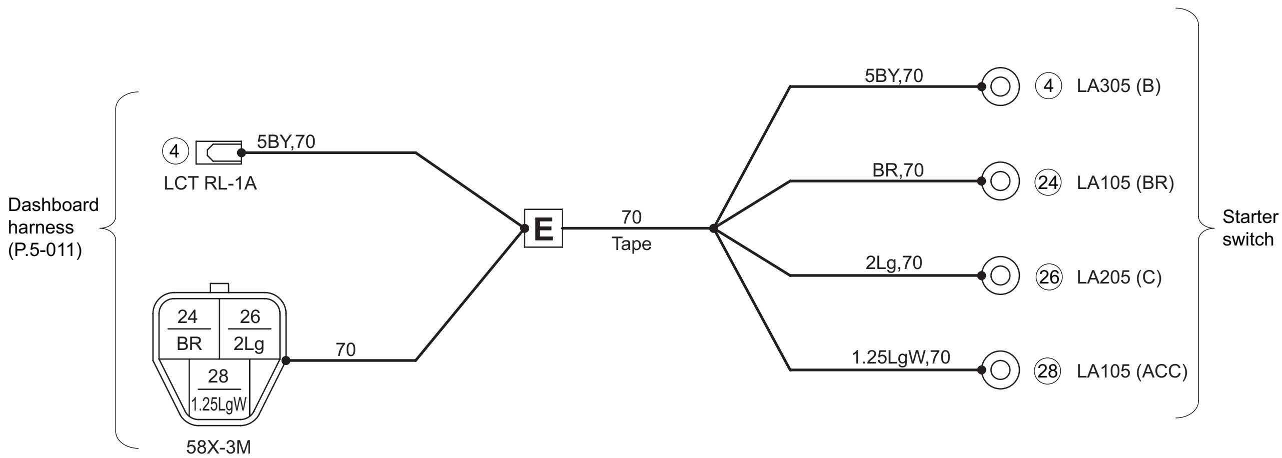
4-3. Dashboard Harness



NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
Ⓧ	B, 2B	16	C, Relay box-R1, R2, R4, R5, R6, R7, R9, Relay-R10, Combination meter × 3, Horn ground, Orbitrol mount, Ground bolt, Terminating resistor-C
②	GB	2	A, Backup buzzer switch-NO
③	5R	2	A, Fuse box
④	BY, 5BY	3	A, E, Fuse 5A
⑥	YB	2	A, Combination meter
⑧	YL	2	Relay-R10, Combination meter
⑨	YR	3	A, B, Diode unit-E
⑩	YB	3	A, B, Diode unit-A
⑪	Y	2	B, F-R lever vibration switch-2
⑫	R	5	Fuse box-9, Relay box-R6, Foot brake switch-COM, Backup buzzer switch-COM, F-R lever switch-COM
⑬	W	3	F-R lever switch-NC, Relay box-R1, Diode unit
⑯	2W	2	Relay box-R8, Fuse box
⑰	YR	2	A, Combination meter
⑱	2RW	2	A, Relay box-R8
⑳	2LgR	2	Relay box-R1, R2
㉑	YG	2	A, Combination meter
㉒	Y	2	A, Combination meter
㉓	3RG	2	A, Fuse box
㉔	BR	2	A, E
㉕	2BW	2	Fuse box-10, Relay box-R2
㉖	2Lg	2	E, Relay box-R1
㉘	LgW, 1.25LgW	6	E, Relay box-R4, R7, ENGINE STOP lamp, WARNING lamp, WAIT TO START lamp
㉙	LgB	2	A, Relay box-R4
㉚	RY, 1.25RY	4	T, Fuse box-8, Relay box-R3 × 2
㉛	Br	2	Relay box-Diode unit, Combination meter
㉜	BY	2	Relay box-R4, Combination meter
㉝	Lg	2	Relay box-R3, Horn switch
㉞	LgW	2	Relay box-R3, Horn

NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
㉟	YW	2	Combination meter, Fuse box-7
㊱	LgR	3	C, Relay box-R7, Foot brake switch-NO
㊲	BrW	2	C, Relay box-R5
㊳	GR	2	C, Combination meter
㊴	L	2	K, Fuse box-5
㊷	RY	2	Combination meter, Fuse box-3
㊿	LW	2	A, K
62	WB, 1.25WB	3	A, Fuse holder 5A, Relay box-R5
65	GW	3	Relay box-R5, R6, Diode unit
66	LY	3	A, Relay box-R5, R6
67	BrY	2	C, Relay box-R2
70	WR	2	Combination meter, Fuse 5A
81	RG	2	F-R lever vibration switch-1, B
82	G	3	A, Datalink interface connector-C, Terminating resistor-A
83	L	3	A, Datalink interface connector-D, Terminating resistor-B
87	B	2	A, Datalink interface connector-A
88	GY	2	A, ENGINE STOP lamp
89	Y	2	A, WARNING lamp
90	YG	2	A, WAIT TO START lamp
91	LW	2	A, Relay box-R9
92	WL	2	A, Relay box-R9
93	WG	2	T, Relay box-R9
94	BW	3	A, D, T
96	Br	2	A, D
97	RW	3	T, B, Relay box-R9
98	BL	2	A, Fuse 5A
107	LgY	2	A, Relay box-R8
108	GB	3	A, Relay box-R8, Relay-R10
109	RB	2	A, Relay-R10
118	1.25WR	2	A, Datalink interface connector-B

4-4. Starter Switch Harness



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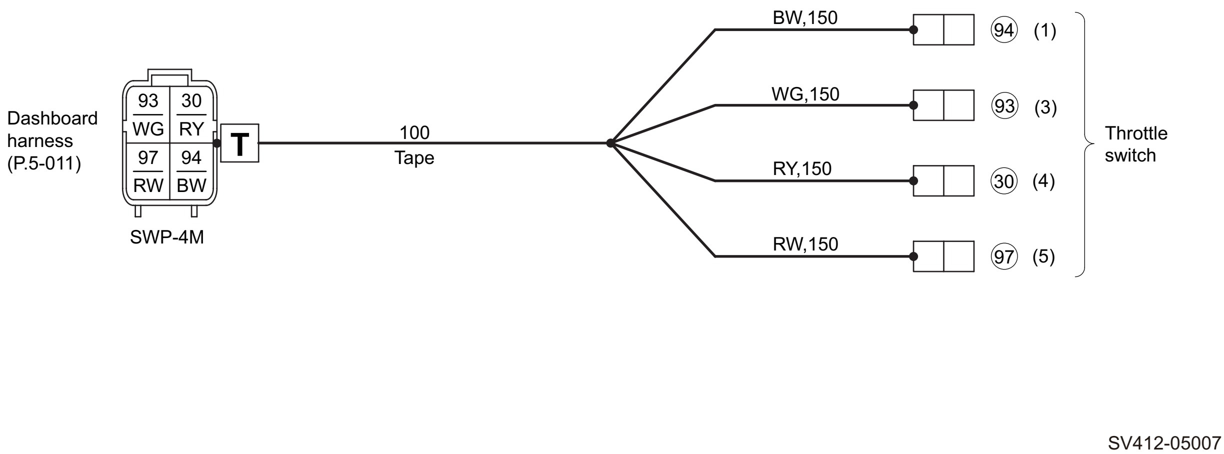
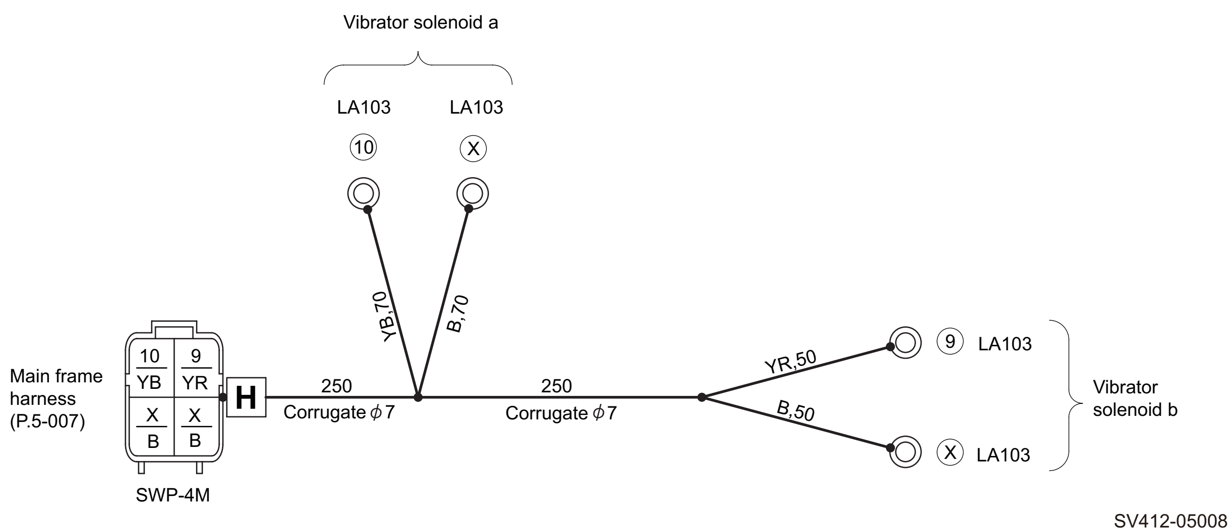
NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
4	5BY	2	E, Starter switch-B
24	BR	2	E, Starter switch-BR
26	2Lg	2	E, Starter switch-C
28	2LgW	2	E, Starter switch-ACC

4-5. Throttle Switch Harness



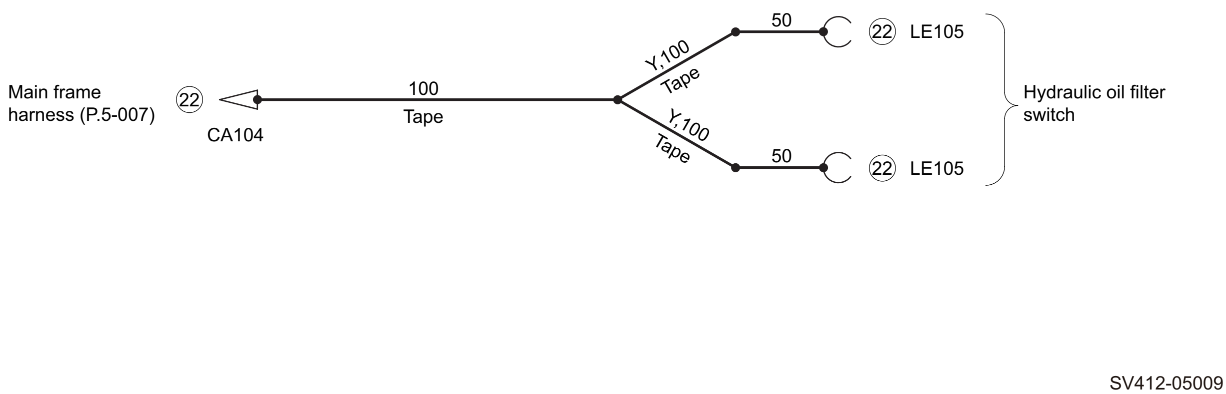
NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
30	RY	2	T, Throttle switch-4
93	WG	2	T, Throttle switch-3
94	BW	2	T, Throttle switch-1
97	RW	2	T, Throttle switch-5

4-6. Vibrator Solenoid Harness



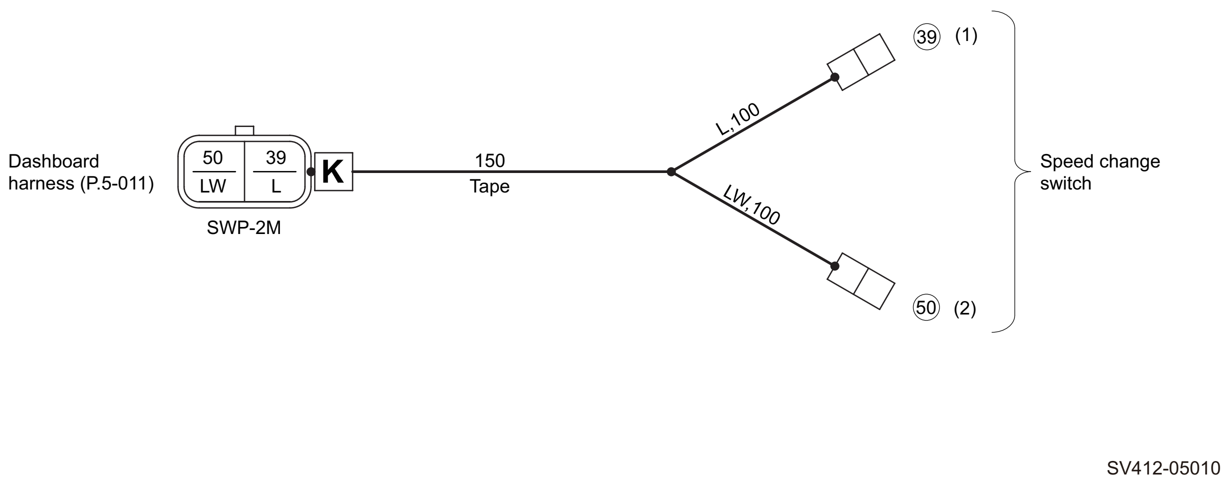
NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
X	B	4	H × 2, Vibrator solenoid-a,b
9	YR	2	H, Vibrator solenoid-b (VIB. Hi)
10	YB	2	H, Vibrator solenoid-a (VIB. Lo)

4-7. Hydraulic Oil Filter Harness



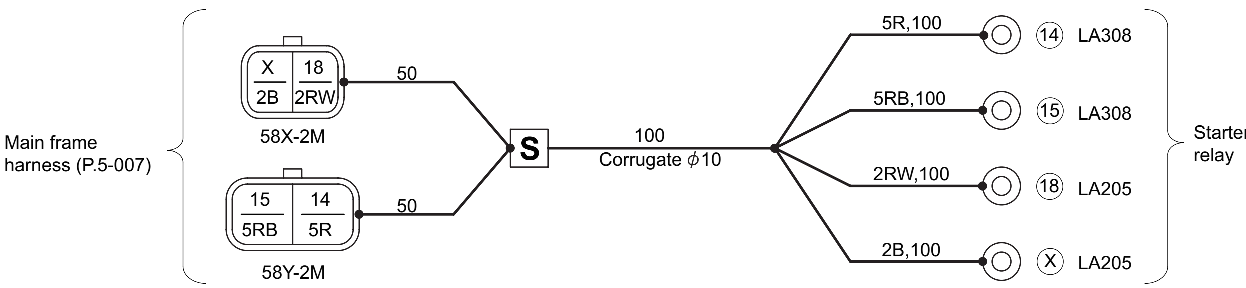
NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
22	Y	3	Hydraulic oil filter switch × 2

4-8. Speed Change Switch Harness



NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
39	L	2	K, Speed change switch-1
50	LW	2	K, Speed change switch-2

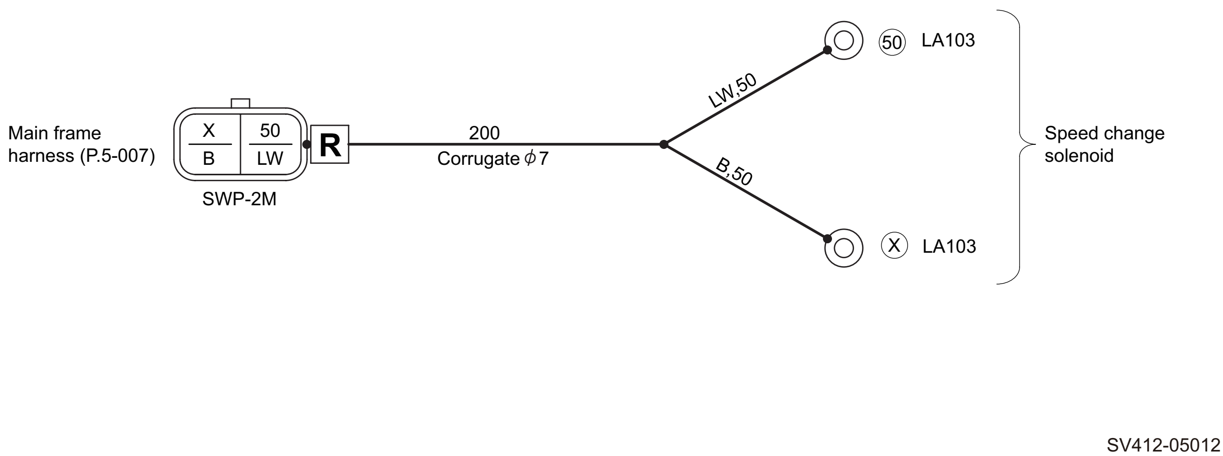
4-9. Starter Relay Harness



SV412-05011

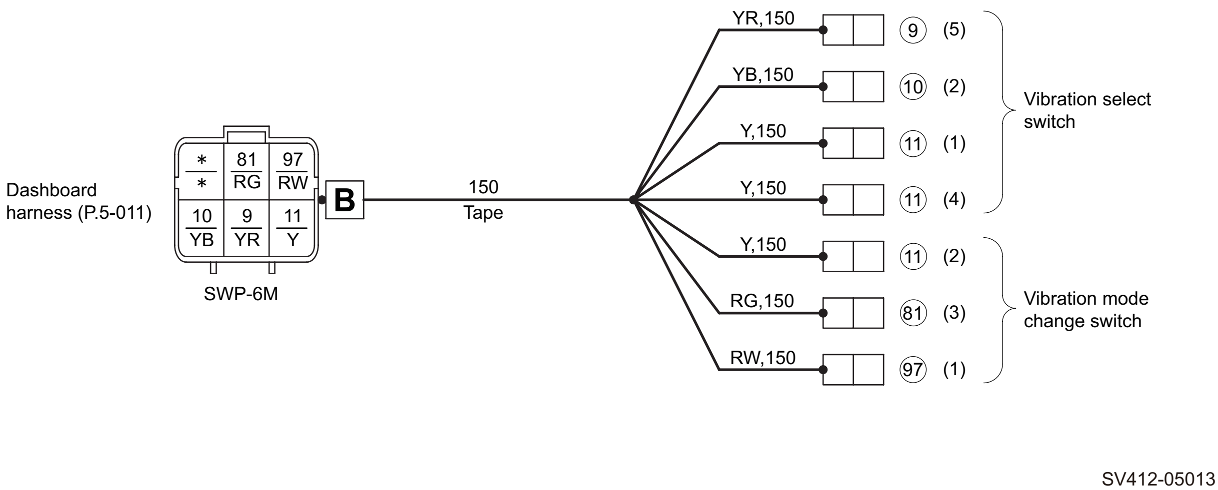
NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
X	2B	2	S, Starter relay
14	5R	2	S, Starter relay
15	5RB	2	S, Starter relay
18	2RW	2	S, Starter relay

4-10. Speed Change Solenoid Harness



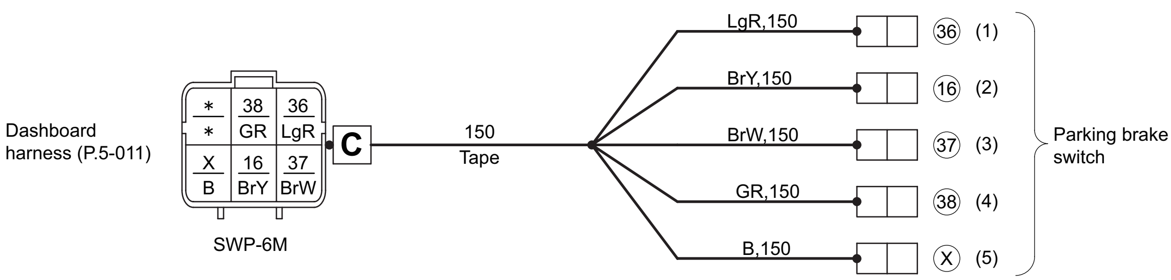
NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
X	B	2	R, Speed change solenoid
50	LW	2	R, Speed change solenoid

4-11. Vibration Select Switch Harness



NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
9	YR	2	B, Vibration select switch-5
10	YB	2	B, Vibration select switch-2
11	Y	4	B, Vibration select switch-1, 4, Vibration mode change switch-2
81	RG	2	B, Vibration mode change switch-3
97	RW	2	B, Vibration mode change switch-1

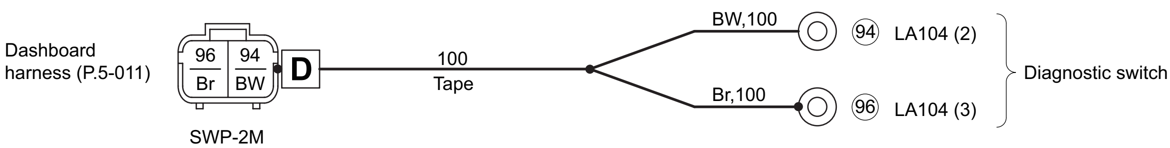
4-12. Parking Brake Switch Harness



SV412-05014

NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
X	B	2	C, Parking brake switch-5
16	BrY	2	C, Parking brake switch-2
36	LgR	2	C, Parking brake switch-1
37	BrW	2	C, Parking brake switch-3
38	GR	2	C, Parking brake switch-4

4-13. Diagnostic Switch Harness

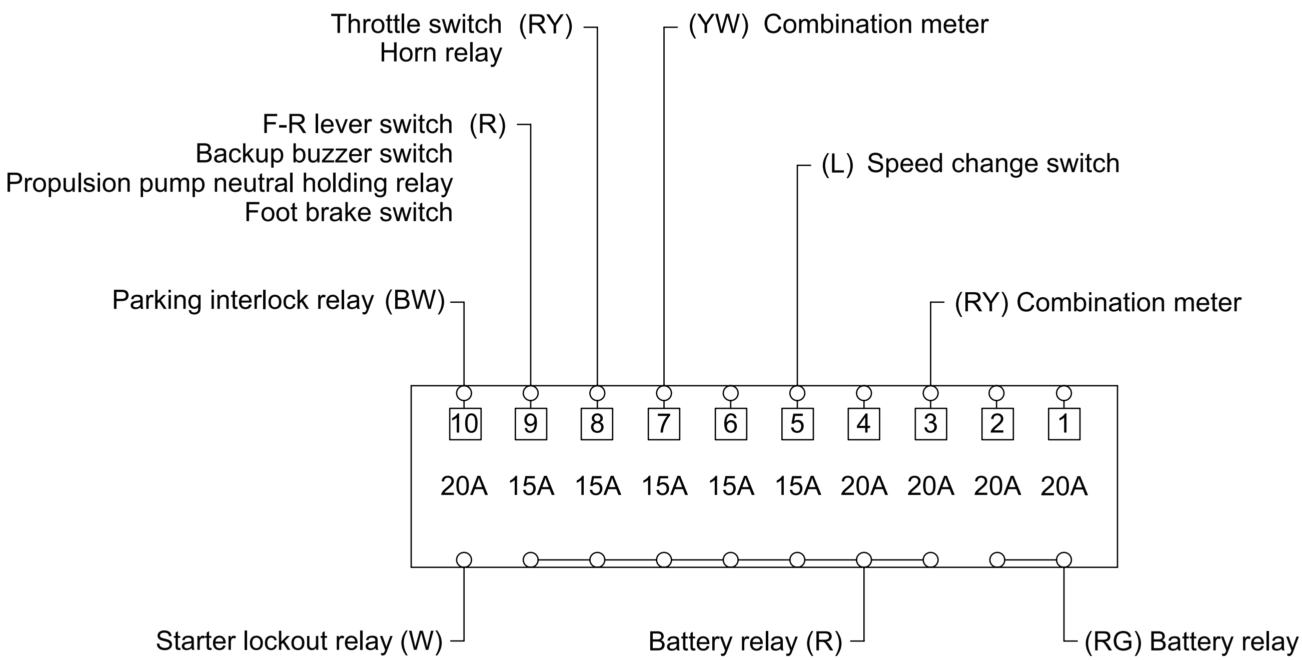


SV412-05015

NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
94	BW	2	D, Diagnostic switch-2
96	Br	2	D, Diagnostic switch-3

5. ELECTRICAL COMPONENT SPECIFICATIONS

5-1. Fuse Box

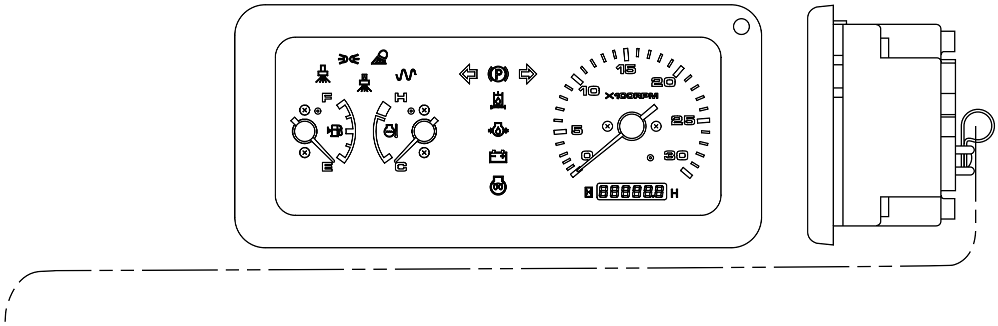


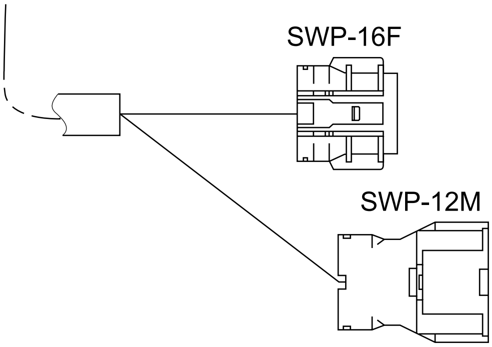
SV412-05001

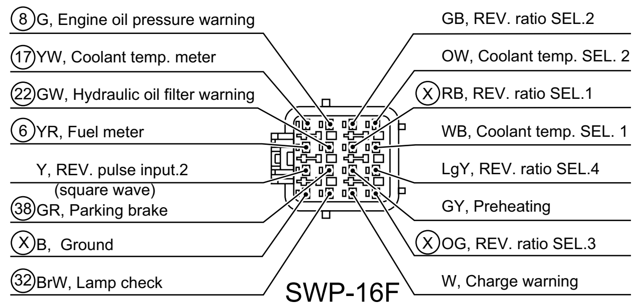
Harness color codes

W	: White	RY	: Red/Yellow stripe
R	: Red	RG	: Red/Green stripe
L	: Blue	YW	: Yellow/White stripe
BW	: Black/White stripe		

5-2. Combination Meter



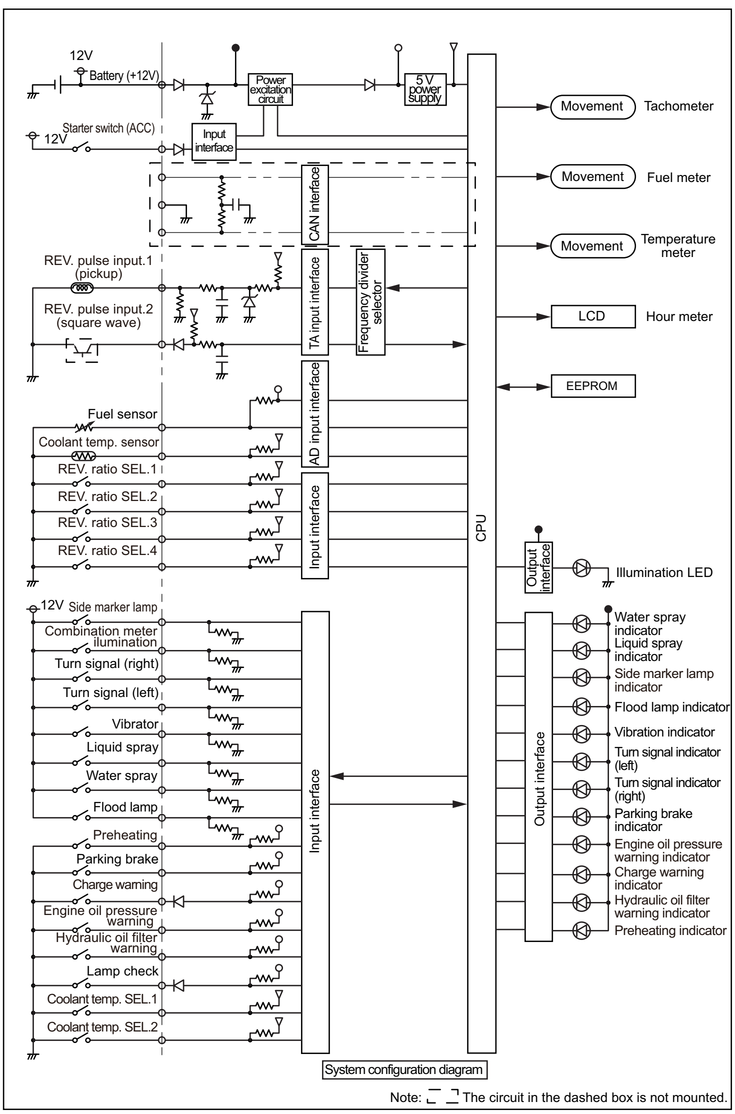


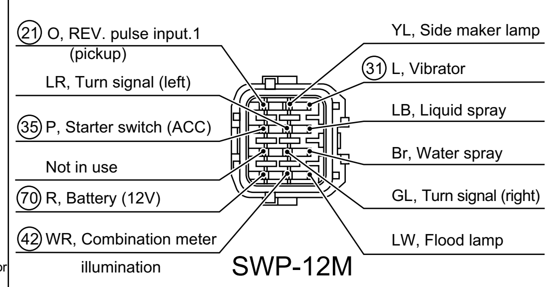


Harness side

X / B	32 / BY	* / *	X / B
* / *	38 / GR	* / *	* / *
6 / YB	22 / Y	X / B	* / *
17 / YR	8 / YL	* / *	* / *

SWP-16M





Harness side

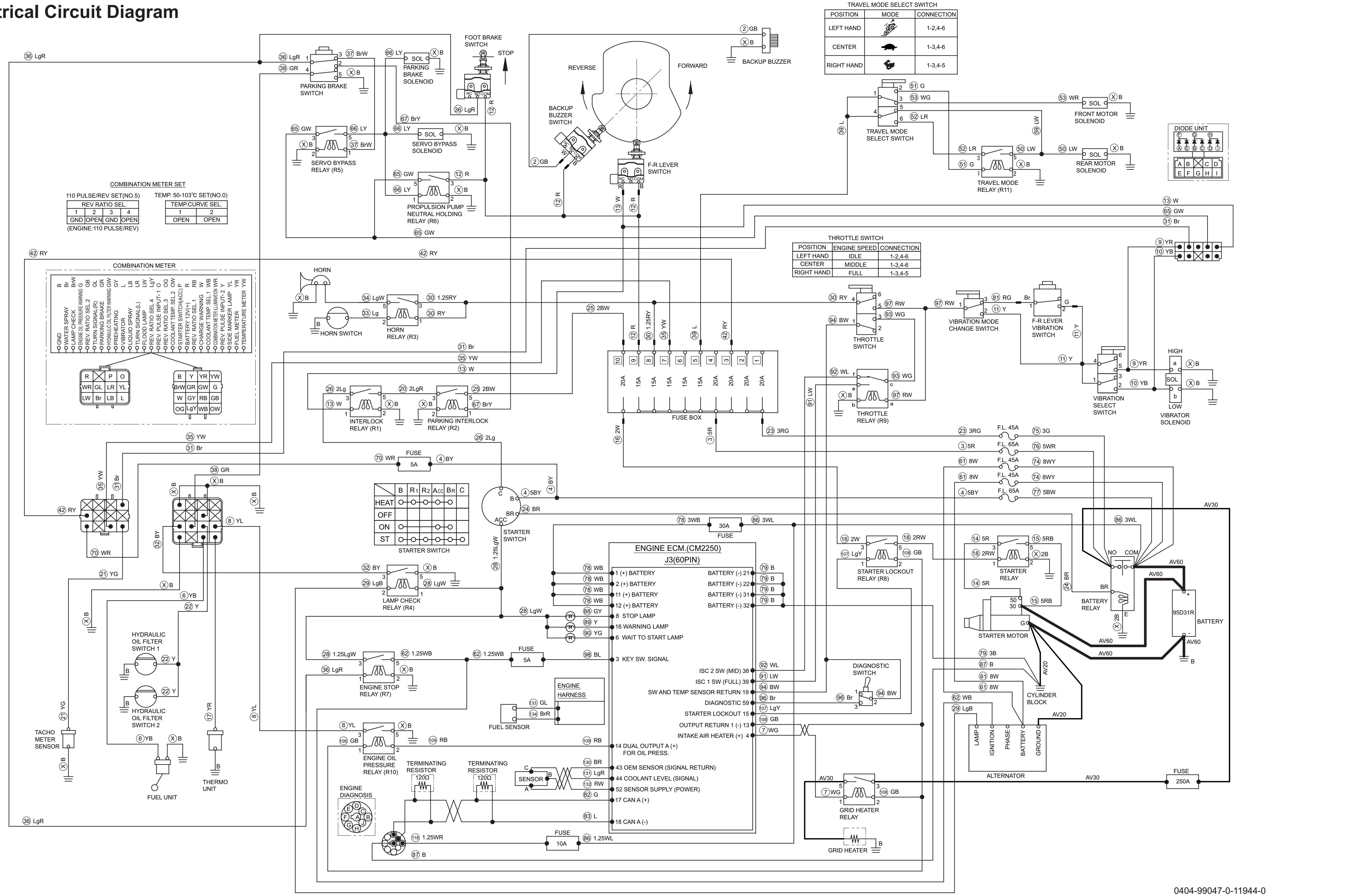
70 / WR	42 / RY	* / *
* / *	* / *	* / *
35 / YW	* / *	* / *
21 / YG	* / *	31 / Br

SWP-12F

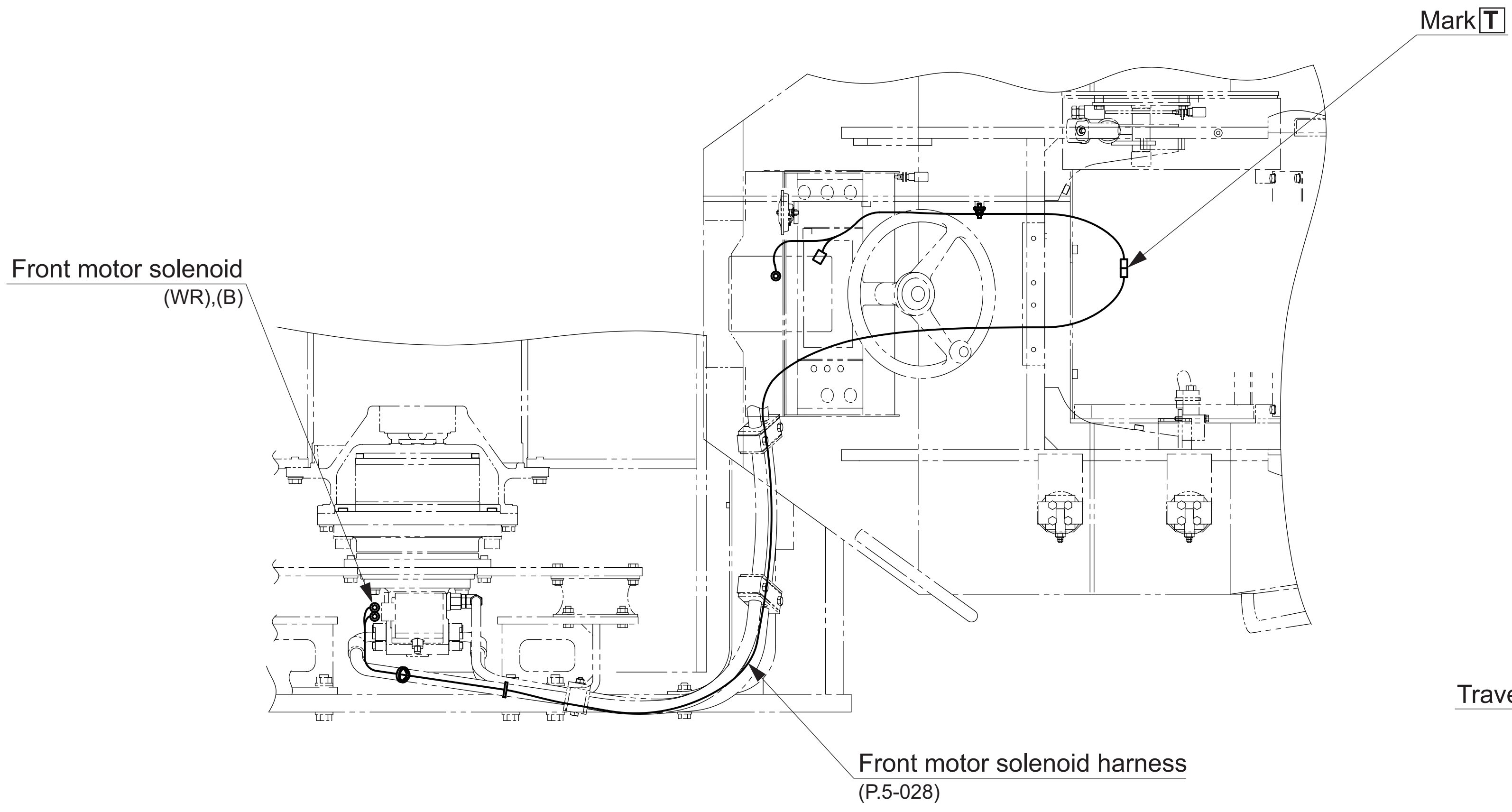
SV412-05002

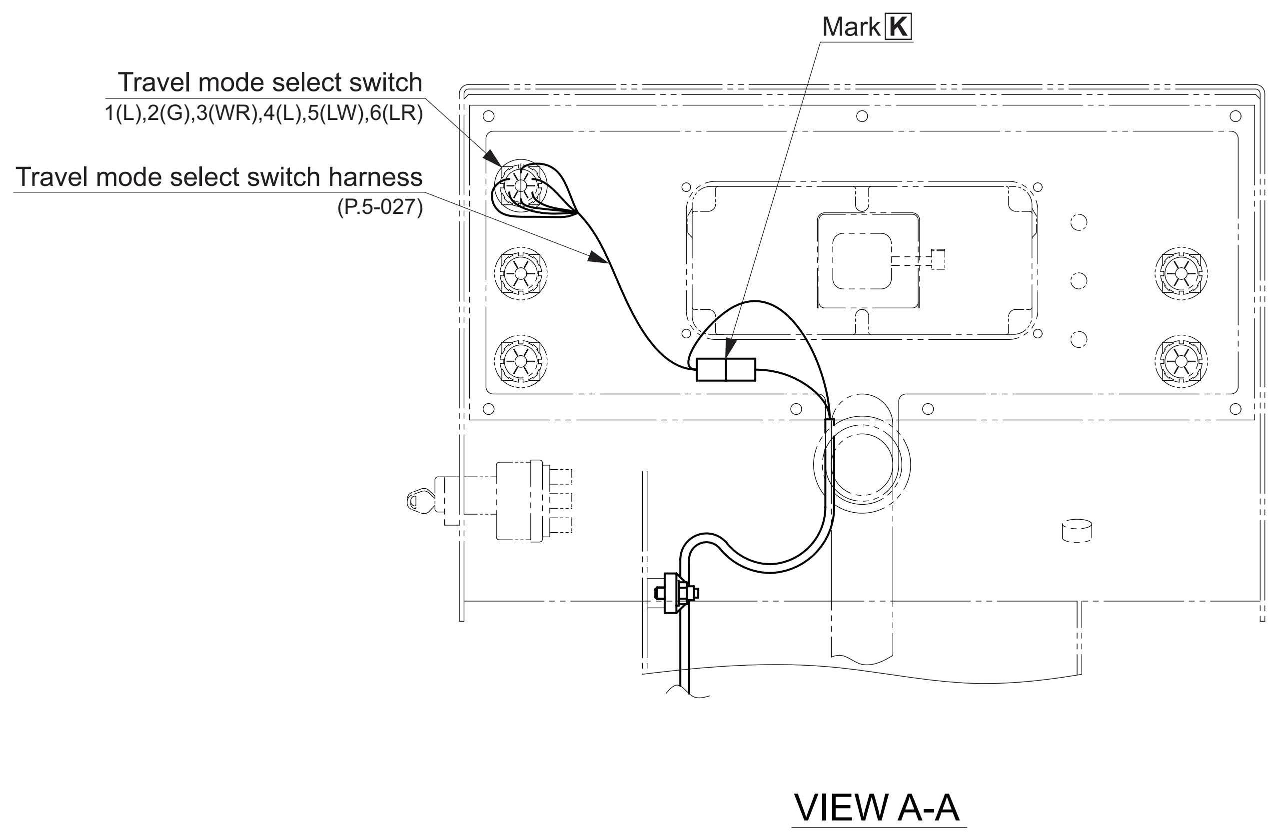
6. HIGH TORQUE TYPE ONLY

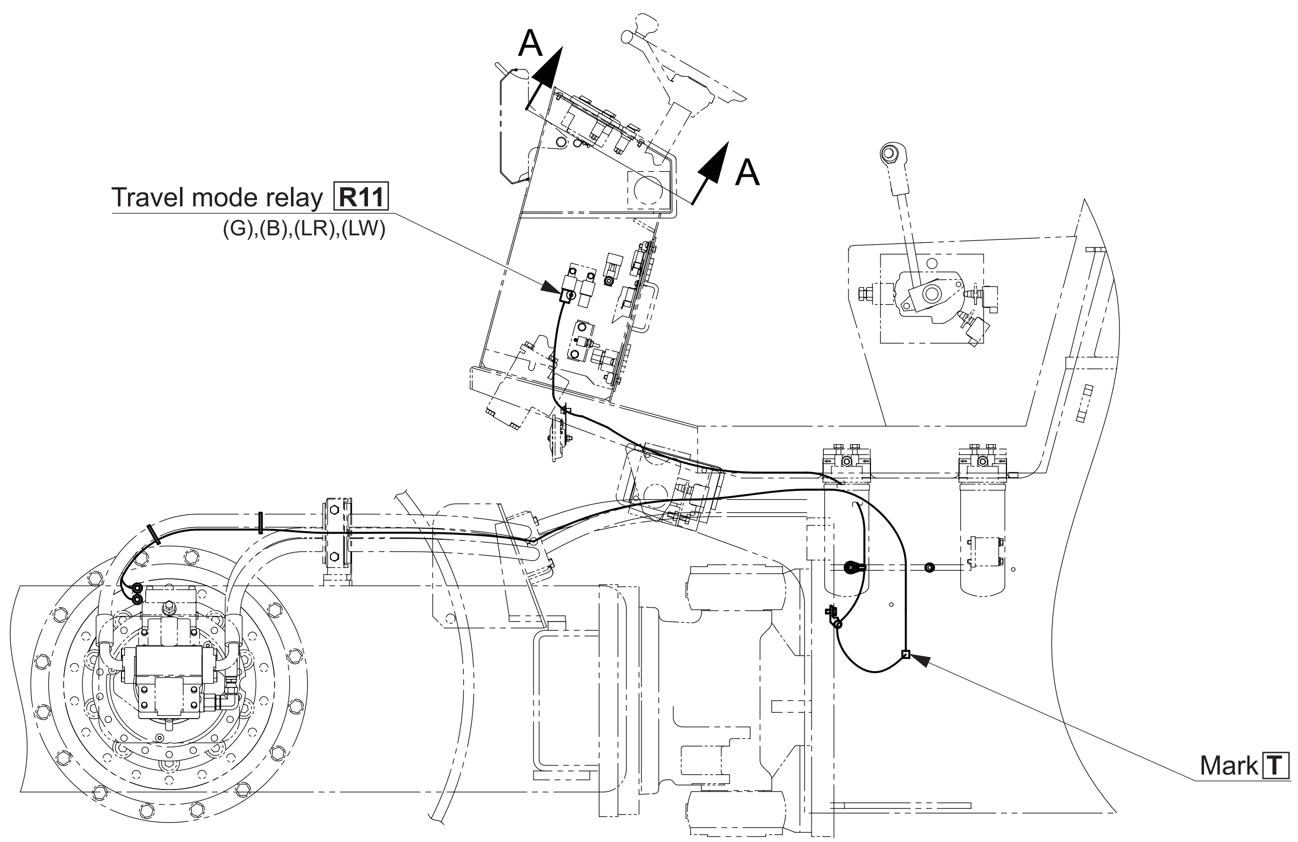
6-1. Electrical Circuit Diagram



6-2. Wiring Harness Layout







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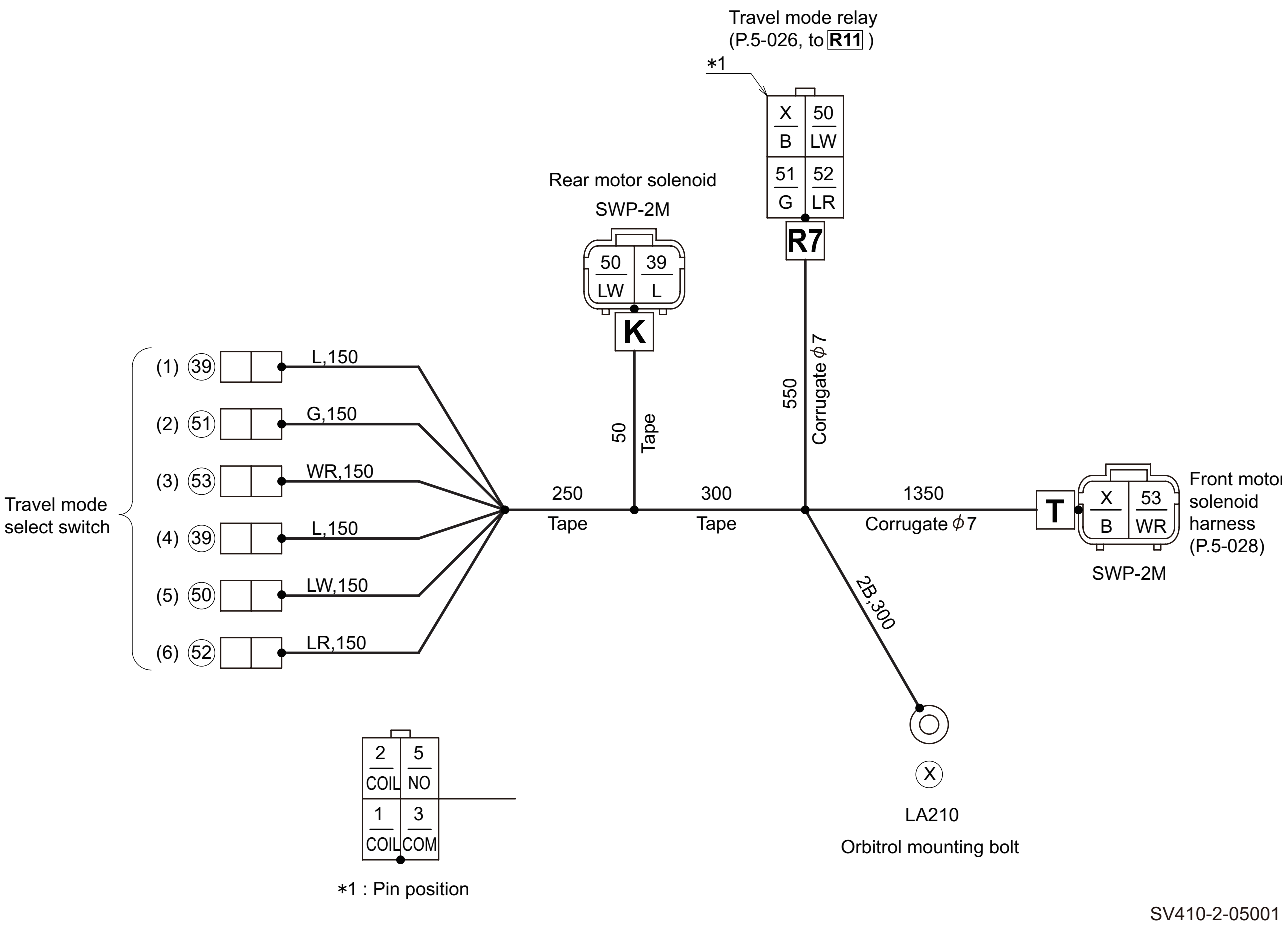
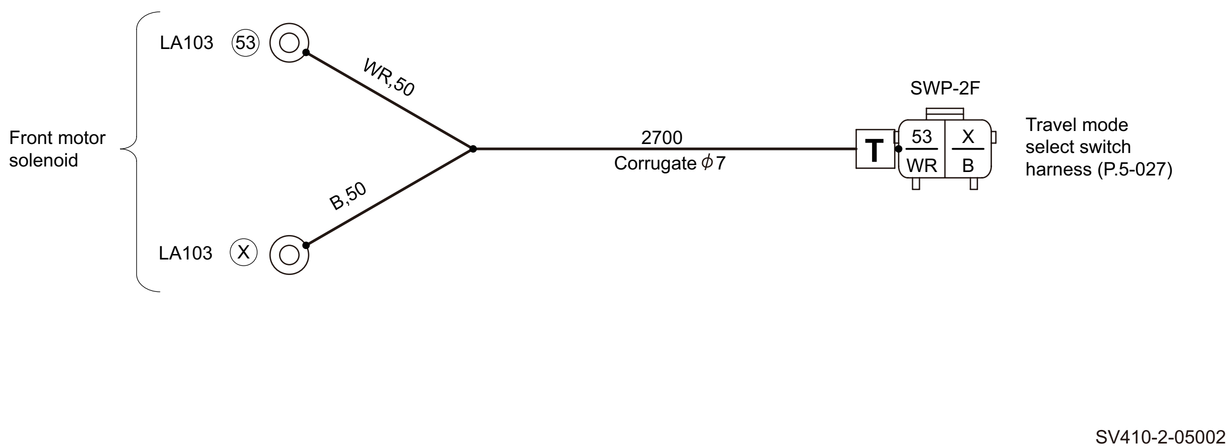
0404-09824-0-12020-0

6-3. Travel Mode Select Switch Harness



NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
X	B	3	T, R7, Orbitrol mounting bolt
39	L	3	K, Travel mode select switch-1,4
50	LW	3	K, R7, Travel mode select switch-5
51	G	2	R7, Travel mode select switch-2
52	LR	2	R7, Travel mode select switch-6
53	WR	2	T, Travel mode select switch-3

6-4. Front Motor Solenoid Harness



NO.	SIZE, COLOR	CONTACT POINTS	CONNECTION
X	B	2	T, Front motor solenoid (-)
53	BR	2	T, Front motor solenoid (+)

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

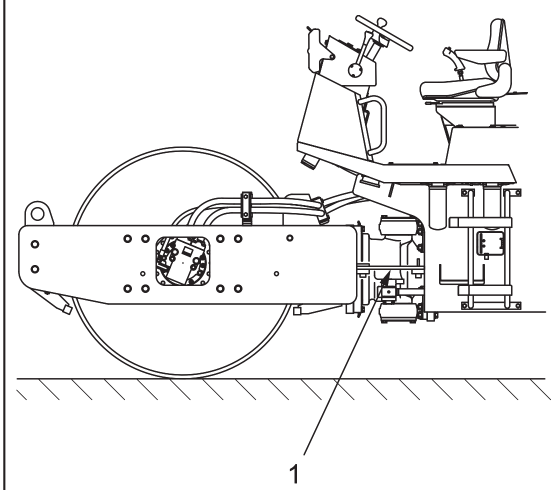
- If coolant has been drained, securely retighten the drain cock and fill with coolant (mixing in long-life coolant) to the specified level. Start the engine and allow the coolant to circulate through the piping. Then add coolant again to the specified level.
- If hydraulic equipment has been removed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

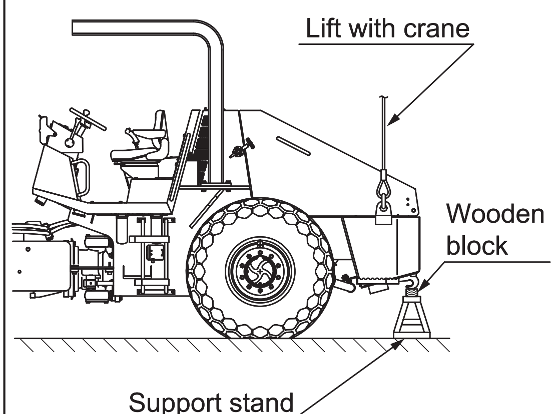
2-1-1. Removal of vibratory drum

1) Using the steering lock bar (1), connect the front and rear frames. Firmly secure it so that the front and rear frames do not move.



SV400-2-06001

2) As shown in the figure on the right, lift the rear frame with a crane. Firmly secure the vehicle body by placing support stands and/or wooden blocks at the rear end of the rear frame.
★ **Do not allow the rear wheel tires to leave the ground. (The tires must support the vehicle's body weight, too.)**



SV400-2-06002

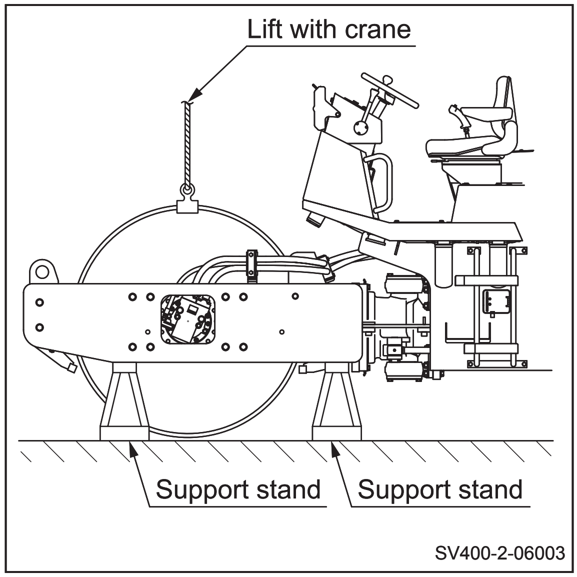
kg Rear lift weight

SV412D : 3,940 kg (8,685 lbs.)
SV412T : 3,960 kg (8,730 lbs.)
SV412TF : 3,940 kg (8,685 lbs.)
SV412TB : 3,860 kg (8,510 lbs.)
SV412FB : 3,830 kg (8,445 lbs.)

⚠ WARNING

When lifting the vehicle, 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 vehicle body, use a support stand of sufficient strength.

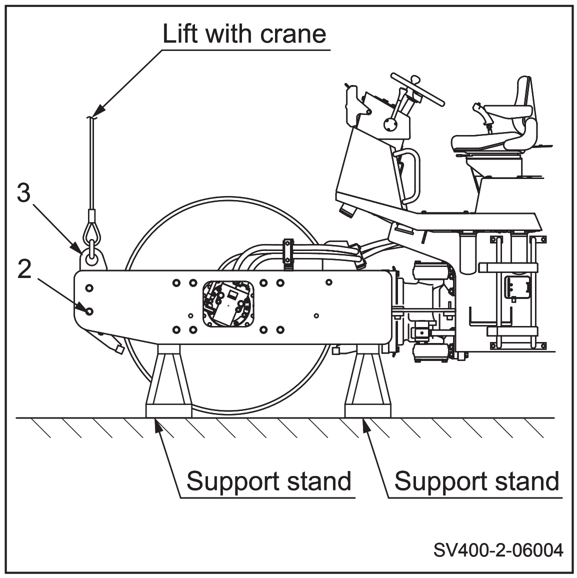
3) Lift the front frame with a crane. With the drum slightly above the ground surface, place support stands at the right and left sides of the front frame. Firmly secure the vehicle body.



kg Front axle weight

SV412D : 3,600 kg (7,935 lbs.)
SV412T : 3,820 kg (8,420 lbs.)
SV412TF : 5,110 kg (11,265 lbs.)
SV412TB : 4,340 kg (9,570 lbs.)
SV412FB : 5,630 kg (12,410 lbs.)

4) With the crossmember (3) lifted by the crane, loosen the two bolts (2) (both right and left). Then remove the crossmember from the front frame.



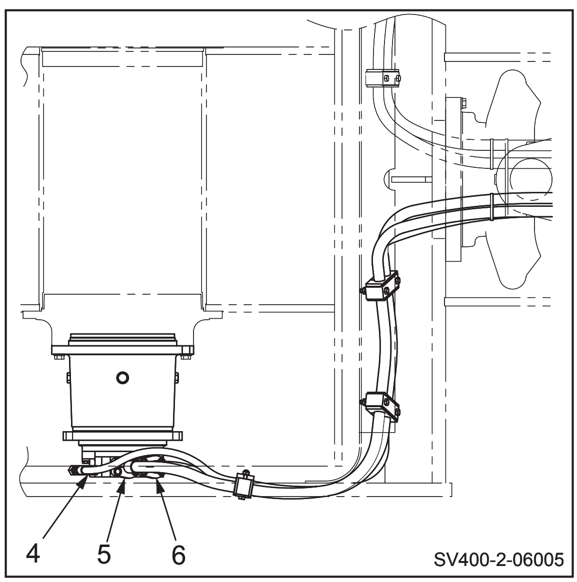
kg Crossmember

SV412D : 210 kg (463 lbs.)
SV412T : 285 kg (628 lbs.)
SV412TF : 340 kg (750 lbs.)
SV412TB : 285 kg (628 lbs.)
SV412FB : 340 kg (750 lbs.)

• When installing

N·m (2) M20×100: 540 N·m (398 lbf·ft)

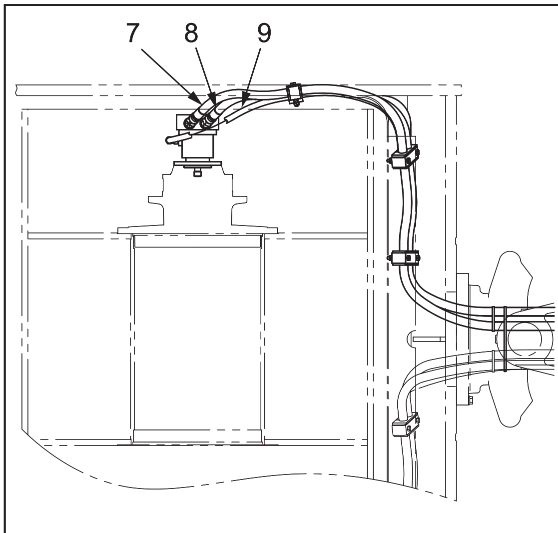
5) Disconnecting piping
① Propulsion motor piping
Disconnect the hydraulic hoses (4, 5 and 6) that are connected to the propulsion motor.
★ **Either plug both sides of disconnected connections or take other steps to prevent dust from getting inside.**



WARNING

Immediately after the vehicle has stopped, the hydraulic oil will be hot and under builtup pressure. If, under these conditions, you try to disconnect the piping, you may get burned. Therefore, wait until the oil has cooled before engaging in this task.

② Vibrator motor piping
Disconnect the hydraulic hoses (7, 8 and 9) that are connected to the vibrator motor.
★ **Either plug both sides of disconnected connections or take other steps to prevent dust from getting inside.**

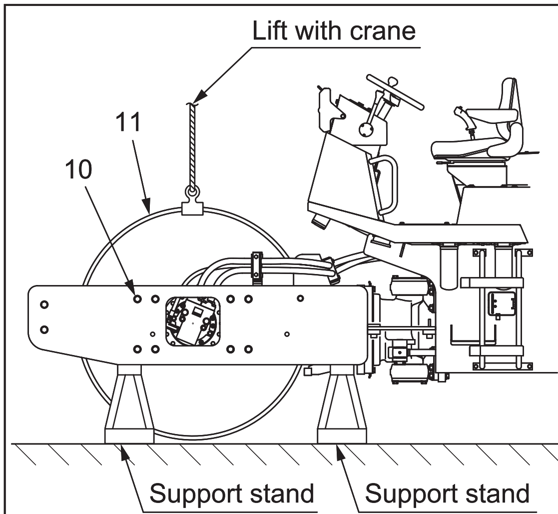


SV400-2-06006

6) Lift the drum (11) with a crane. Ensuring that no load is applied to the eight bolts (10), loosen and remove the bolts (10). (Similarly, remove the bolts from the opposite side, too.) Separate the drum assembly and front frame.

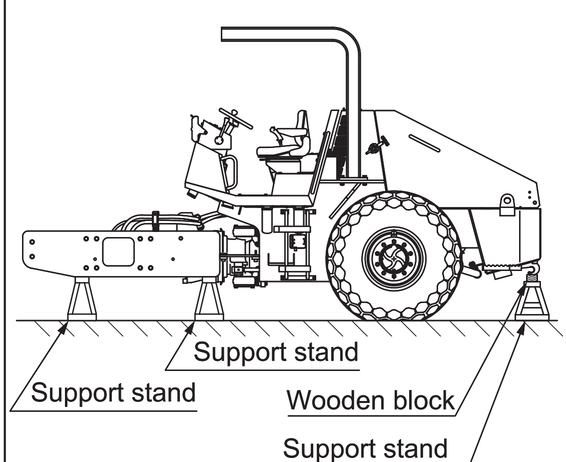
• When installing

N·m (10) M20×90: 540 N·m (398 lbf·ft)



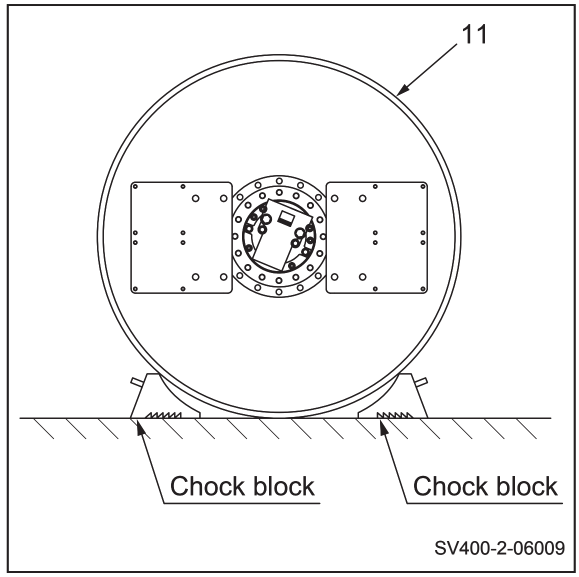
SV400-2-06007

7) As shown in the figure on the right, use support stands or other means to firmly secure the side of the vehicle body on which the drum was removed. Ensure that the vehicle body does not move.



SV400-2-06008

8) Place chock blocks at the front and rear of the removed drum assembly (11) to prevent the drum assembly from moving.



2-1-2. Installation of vibratory drum

1) Install the vibratory drum in the reverse order in which it was removed.
   - Tightening torque for bolts in locations requiring particular attention during reinstallation of the vibratory drum:

     (10) M20×90: 540 N·m (398 lbf·ft)

     (2) M20×100: 540 N·m (398 lbf·ft)

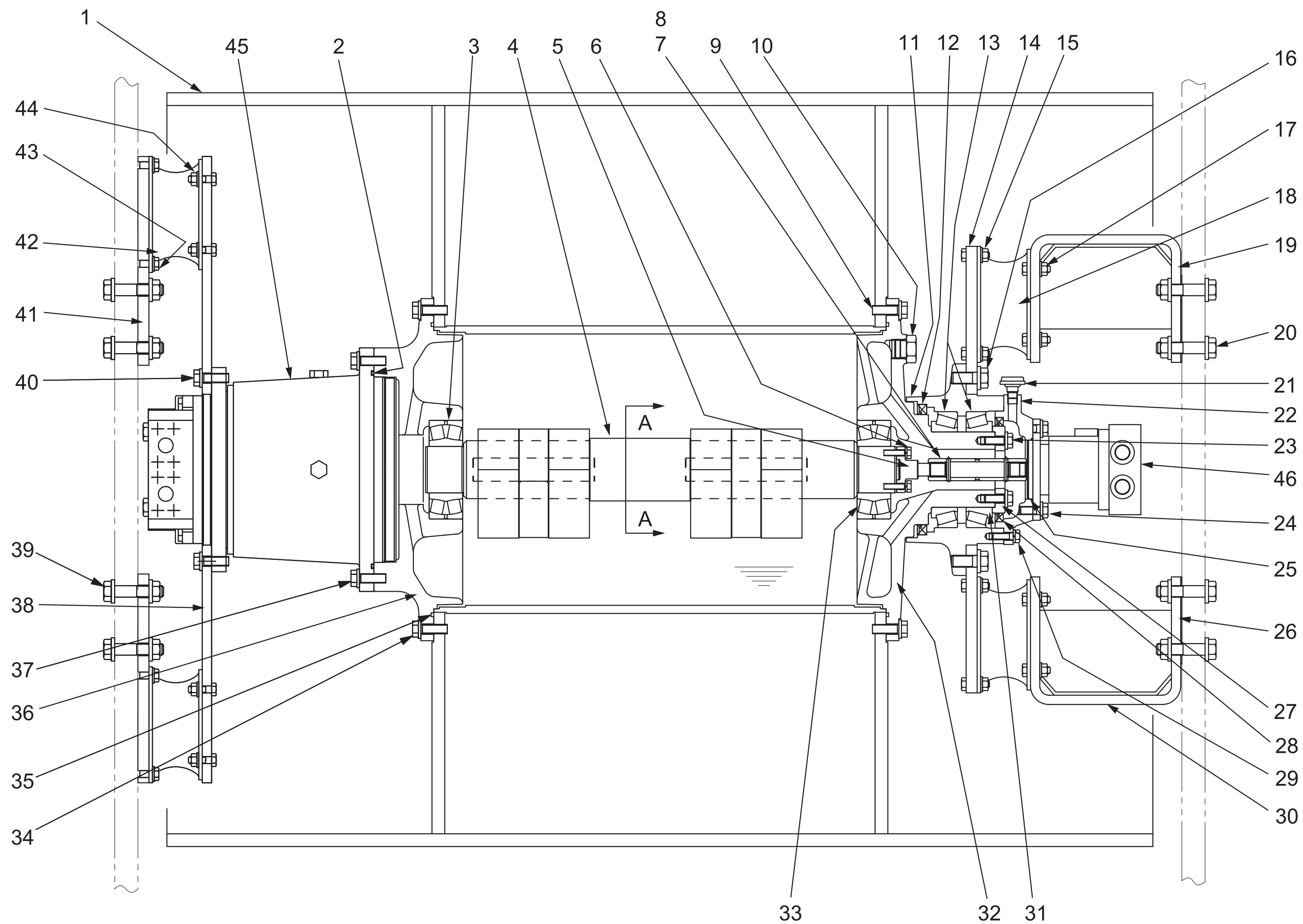
2) When installing the vibratory drum, pay particular attention to the items mentioned below.

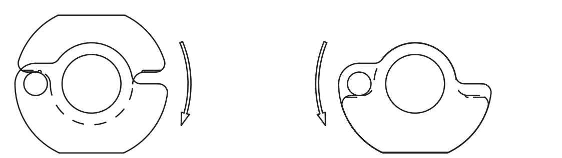
> **⚠ CAUTION**
>
> **If the engine is run at high speed or the cylinder is operated to full stroke when the engine is started for the first time after work is completed, the piston packing or other items may be damaged by air entering into the cylinder.**

★ **Fill the hydraulic oil tank to the specified level to make up for any oil leakage.**

★ **Start the engine and circulate the oil through the piping. Then check the oil level again, ensuring that the oil is at the specified level.**

2-2. Vibratory Drum Assembly

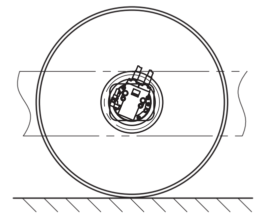




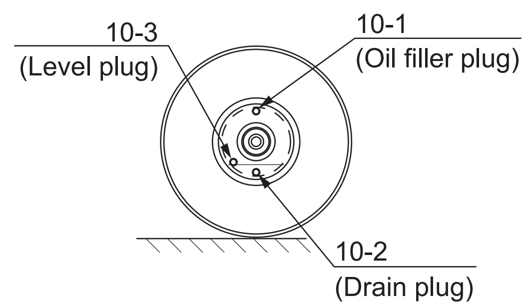
Vibrator mode is Low with motor rotating clockwise

Vibrator mode is High with motor rotating counterclockwise

SECTION A-A



Propulsion motor side



Vibrator motor side

0404-43801-0-10002-H

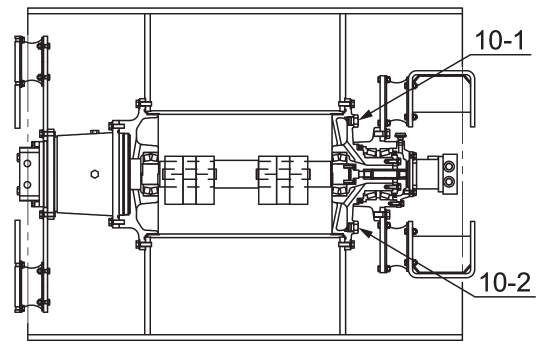
(1) Drum
(2) O-ring
(3) Vibrator bearing
(4) Eccentric shaft
(5) Shaft
(6) Bolt (M10×40)
(7) Sleeve
(8) Spring pin
(9) Bolt (M16×50)
(10) Plug
(11) Housing
(12) Oil seal
(13) Roller bearing
(14) Disc
(15) Bolt (M12×40)
(16) Bolt (M20×50)
(17) Bolt (M12×40)
(18) Damper
(19) Holder
(20) Bolt (M20×90)
(21) Breather
(22) Cover
(23) Bolt (M14×40)
(24) Bolt (M14×40)
(25) O-ring
(26) Shim
(27) Cover
(28) Oil seal
(29) Bolt (M12×40)
(30) Holder
(31) Shim
(32) Axle shaft
(33) Vibrator bearing
(34) Bolt (M16×50)
(35) O-ring
(36) Axle shaft
(37) Bolt (M16×50)
(38) Disc
(39) Bolt (M20×90)
(40) Bolt (M16×50)
(41) Holder
(42) Damper
(43) Bolt (M12×25)
(44) Bolt (M12×40)
(45) Propulsion motor
(46) Vibrator motor

2-3. Disassembly and Reassembly of Vibratory Drum

- Leader numbers appearing in the vibratory drum disassembly and reassembly procedure illustrations shown below correspond to the numbers indicating the parts of the vibratory drum assembly (page 6-008).

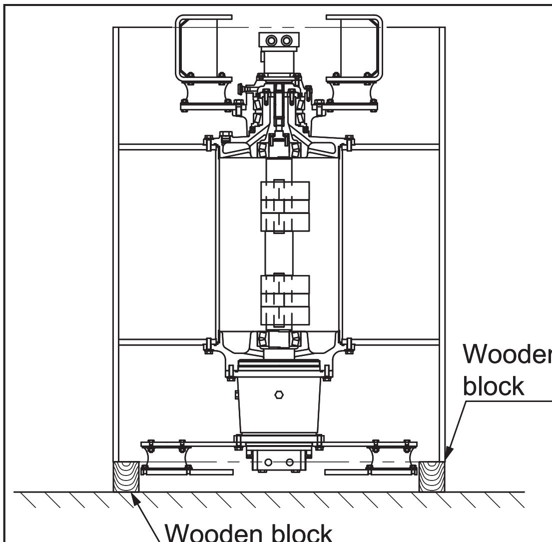
2-3-1. Disassembly of vibratory drum

1) Remove the plugs (10-1 and 10-2).
   - Drain the gear oil from the vibrator case.
   - Gear oil quantity: 21 L (5.5 gal.)



SV400-2-06012

2) Lift the vibratory drum with a crane. As shown in the figure on the right, stand it up with the propulsion motor side facing downward.



SV400-2-06013

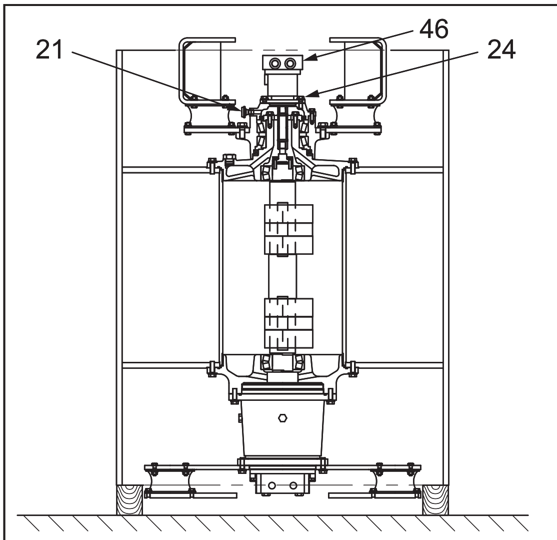
WARNING

After standing up the drum, place wooden blocks that have sufficient strength underneath. Stabilize the drum so that it is not unsteady.

kg Vibratory drum assembly

SV412D : 2,685 kg (5,919 lbs.)
SV412T : 2,890 kg (6,371 lbs.)
SV412TF : 4,230 kg (9,325 lbs.)
SV412TB : 2,890 kg (6,371 lbs.)
SV412FB : 4,230 kg (9,325 lbs.)

3) Remove the two bolts (24).
   - Remove the vibrator motor (46).
   - Remove the breather (21).



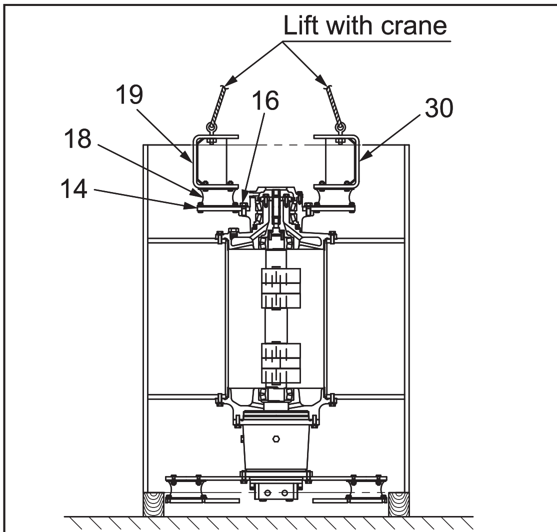
SV400-2-06014

⚠ WARNING

Use aids such as work stepladders when working, and work with a natural, unstrained posture.

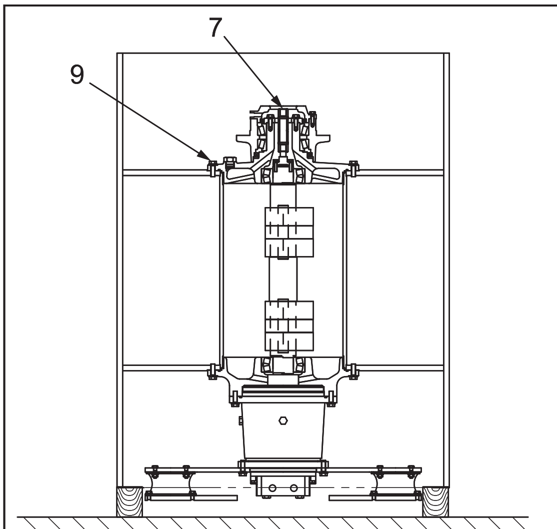
4) Remove the sixteen bolts (16).
   - Attach the lifting bolts/nuts (M20×2.5) as shown in the figure on the right.
   - Using a crane, lift and remove the holder (19), damper (18) and disc (14) together.

Total of lifted parts (19, 30, 18 and 14)
: 135 kg (298 lbs.)



SV400-2-06015

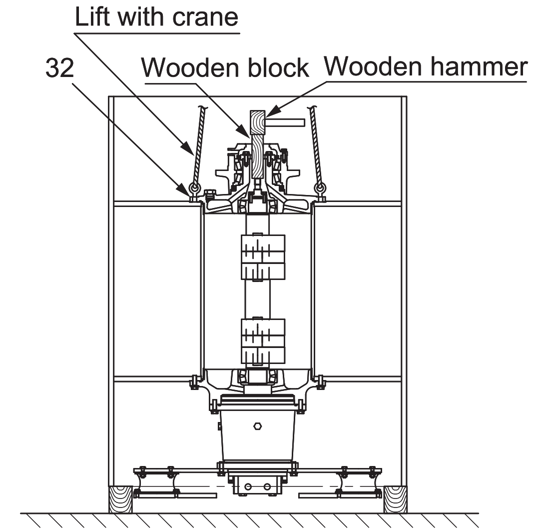
5) Remove the sixteen bolts (9).
   - Remove the sleeve (7).



SV400-2-00016

6) Attach the lifting bolts (M16×2.0) as shown in the figure on the right.
   • Using a crane, slowly lift and remove the axle shaft (32).
     ★ **At this time, to ensure that the vibrator shaft does not follow along with the axle shaft (32), lift the end of the vibrator shaft while lightly tapping with a wooden hammer through a wood block.**

Axle shaft: 150 kg (331 lbs.)



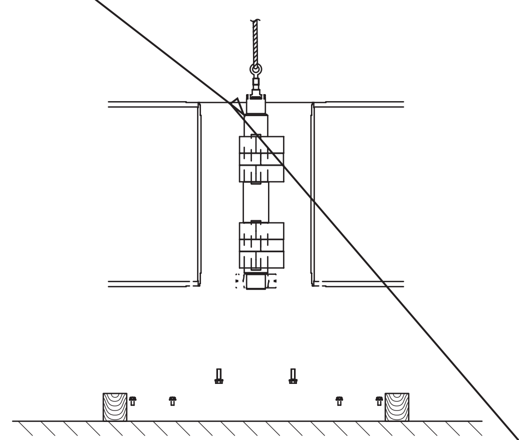
SV400-2-06017

⚠ CAUTION

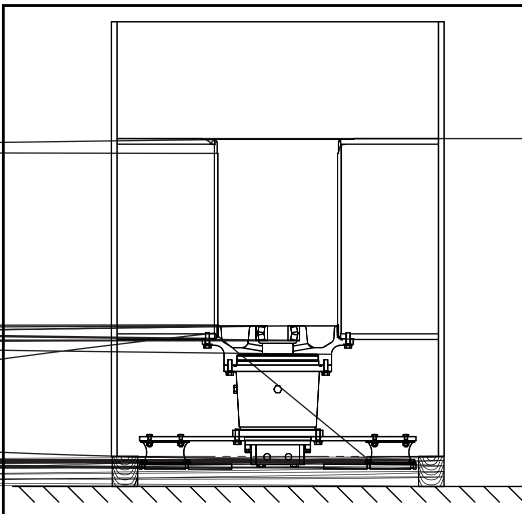
When attaching the lifting bolts, screw in the threads fully before using.

7) Attach a lifting bolt (M10×1.5) to the end of the vibrator shaft (4). Then lift with a crane and remove.

Vibrator Shaft: 140 kg (309 lbs.)


SV400-2-06018

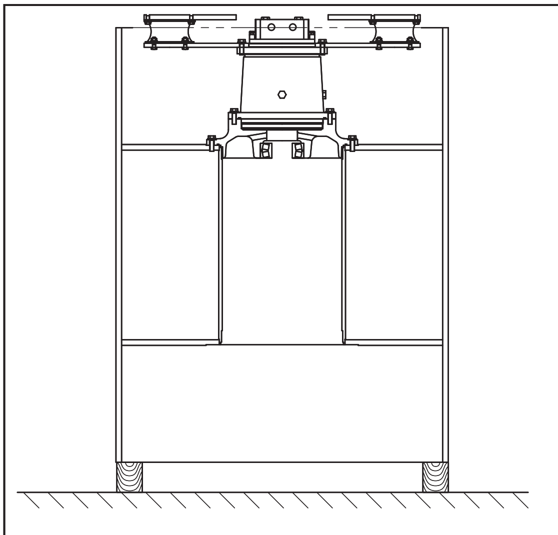
8) In the figure on the right, the vibrator motor side is up. From the top, the figure shows the condition with the part removed.


SV400-2-06019

9) Lift and invert the drum with a crane. Stand it up with the propulsion motor side upward.

Lifted weight in figure on the right

SV412D : 2,240 kg (4,938 lbs.)
SV412T : 2,440 kg (5,379 lbs.)
SV412TF : 3,780 kg (8,333 lbs.)
SV412TB : 2,440 kg (5,379 lbs.)
SV412FB : 3,780 kg (8,333 lbs.)



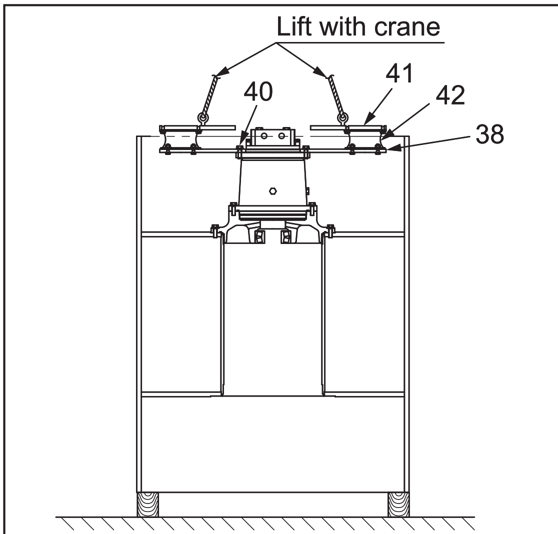
SV400-2-06020

⚠ WARNING

Inverting the drum can be dangerous work. Therefore, be very careful, confirm that the surrounding area is safe and work in a natural, unstrained posture.

10) Remove the sixteen bolts (40).
- As shown in the figure on the right, attach the lifting bolt (M20×2.5) to the holder (41) and slowly lift. Remove together with the damper (42) and disc (38).

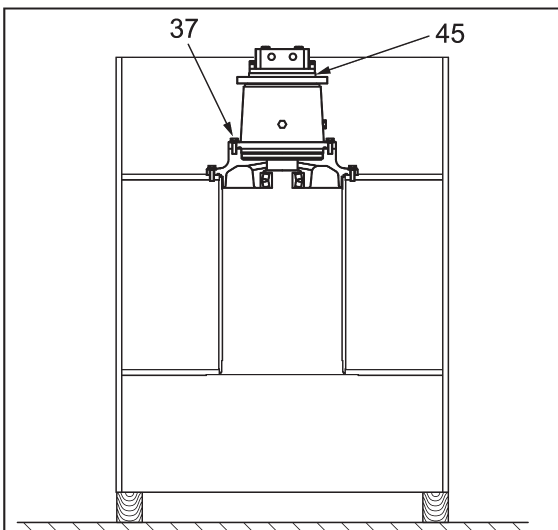
Total of lifted parts (41, 42 and 38)
: 115 kg (255 lbs.)



SV400-2-06021

11) Remove the sixteen bolts (37).
- Remove the propulsion motor (45).

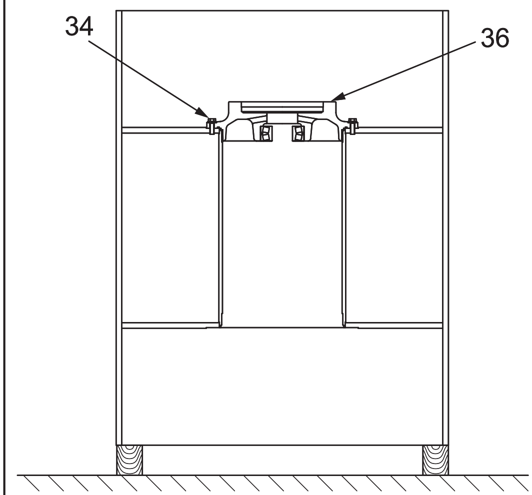
Propulsion motor: 185 kg (408 lbs.)



SV400-2-06022

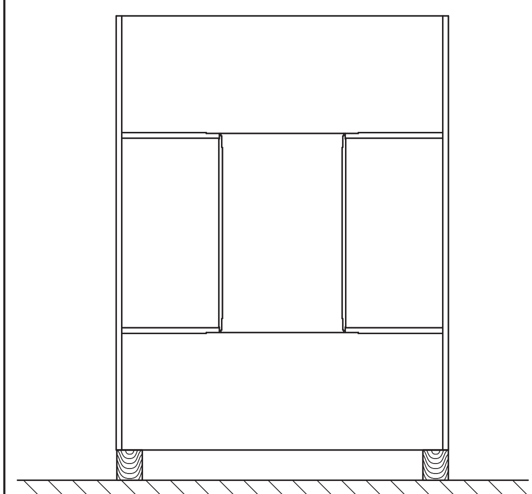
12) Remove the sixteen bolts (34).
- Remove the axle shaft (36).

Axle shaft: 105 kg (231 lbs.)

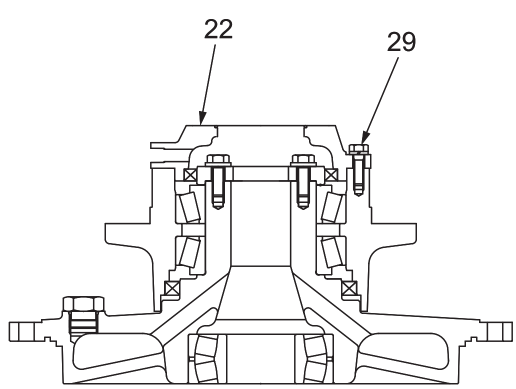


SV400-2-06023

13) The figure on the right shows the condition in which all parts have been removed from the vibratory drum assembly.

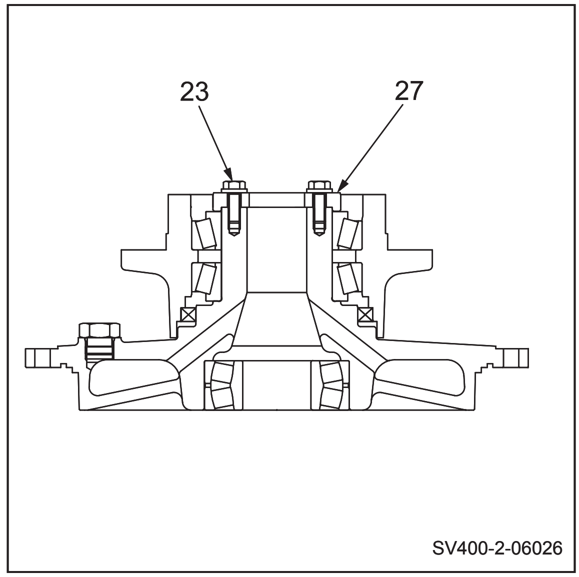

SV400-2-06024

14) The figure on the right shows the axle shaft subassembly removed from the vibratory drum.
- Remove the six bolts (29).
- Remove the cover (22).

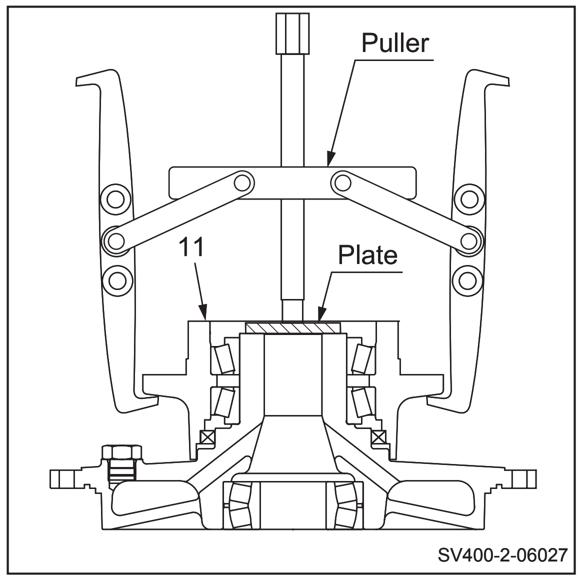


SV400-2-06025

15) Remove the eight bolts (23).
  • Remove the cover (27).



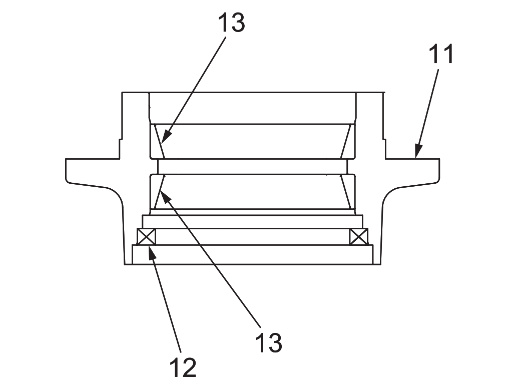
16) Place the plate at the end of the axle shaft. With the puller against the housing (11), separate the housing, including the roller bearing, from the axle shaft.



2-3-2. Reassembly of vibratory drum

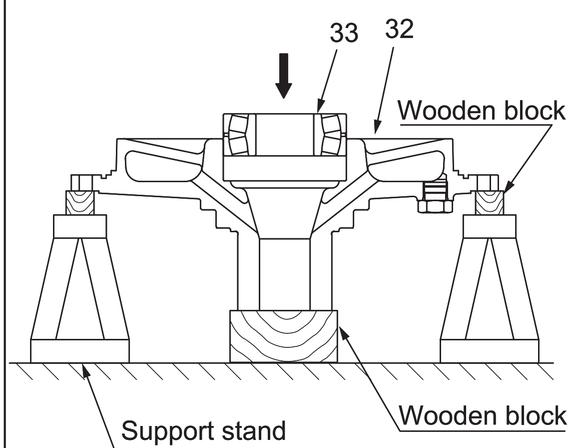
★ **Before reassembling, confirm that each part that was disassembled has been well cleaned and is free of any abnormality.**

1) Lightly apply gear oil to the press-fitting surface of the roller bearing (13) outer race.
   - Drive the outer race of the roller bearing (13) into the housing (11).
   - Attach the oil seal (12).



SV400-2-06028

2) As shown in the figure on the right, firmly secure the axle shaft (32) with support stands and/or wooden blocks.
   - Lightly apply gear oil to the press-fitting surface of the vibrator bearing (33).
   - Drive in the vibrator bearing (33).

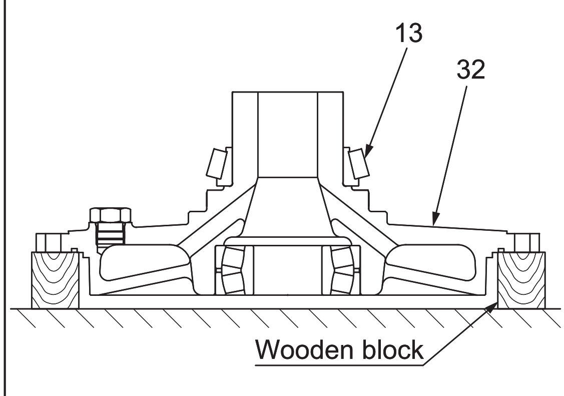


SV400-2-06029

3) Using a crane, lift and invert the axle shaft (32) subassembly.

   Axle shaft subassembly: 90 kg (198 lbs.)

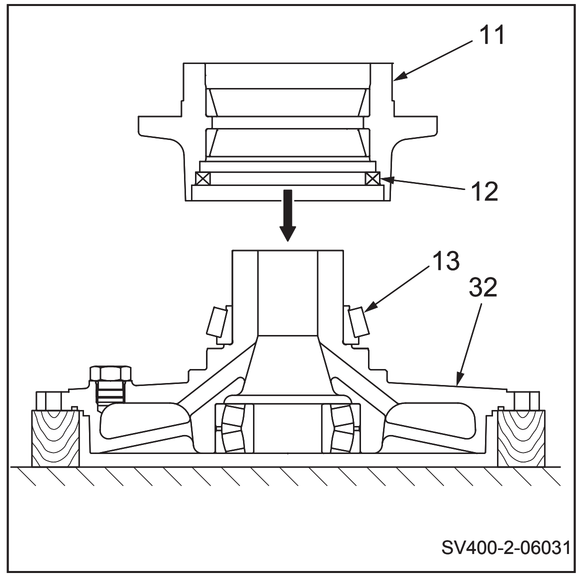
   - Lightly apply gear oil to the press-fitting surface of the roller bearing.
   - Attach the inner race of the roller bearing (13).



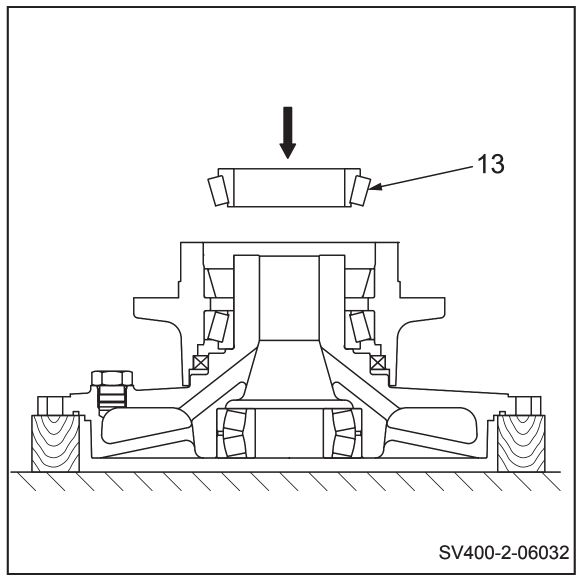
SV400-2-06030

4) Apply an ample amount of lithium-based grease to the rolling surfaces of the roller bearing (13).
- Lightly apply the same grease to the lip surfaces of the oil seal (12).
- Join the axle shaft (32) subassembly and housing (11).

kg Housing: 40 kg (88 lbs.)

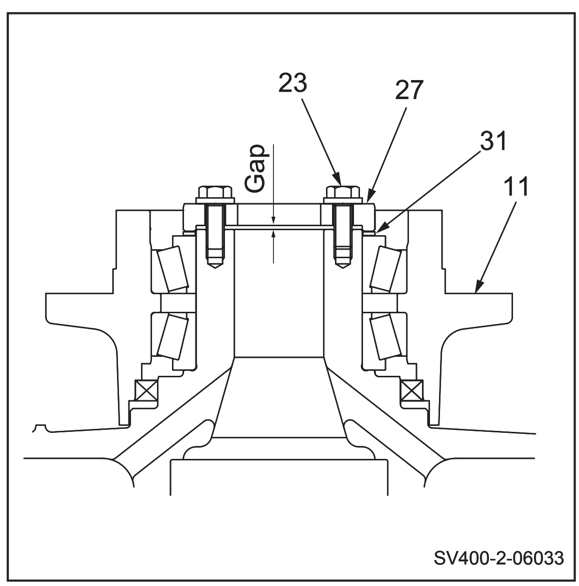


5) After applying an ample amount of lithium-based grease to the inner race of the roller bearing (13), drive it in until the inner race's rolling surface makes contact with the outer race.



6) As shown in the figure on the right, insert shims (31) approximately 1 mm to create a gap between the axle shaft end face and cover (27) interior surface. Then install the cover (27).
- Install washers to the four bolts (23), and tighten to a tightening torque of 108 N·m (80 lbf·ft).
- Rotate the housing (11) two or three times. Then tighten the same bolts again to a tightening torque of 108 N·m (80 lbf·ft).
- Repeat this procedure two or three times until the bolt tightening torque no longer varies.

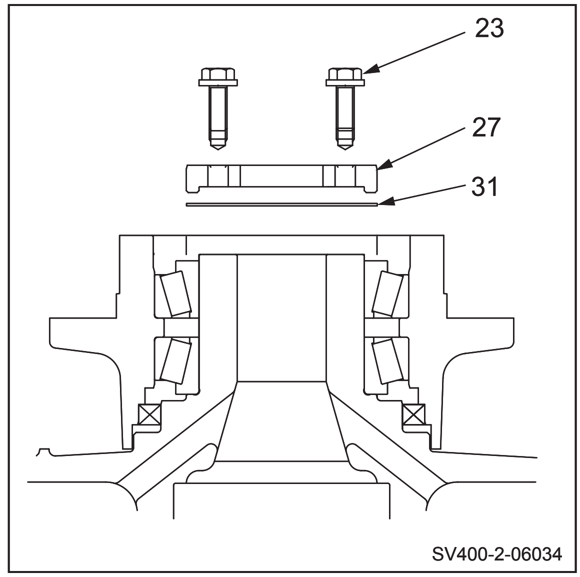
★ **When tightening the bolts (23), alternately tighten by using four of the eight bolts positioned diagonally from each other.**



7) Roller bearing preload adjustment

① Remove the four bolts (23).

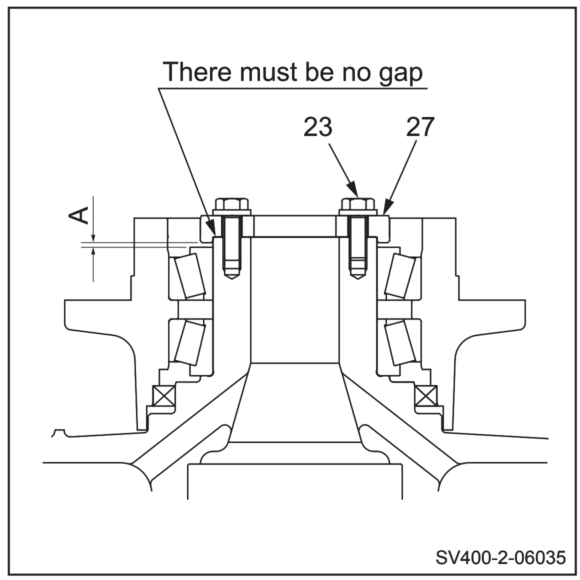
- Remove the cover (27) and shim (31).



② Without inserting shims, install the cover (27). Then install washers to the four bolts (23) and tighten.

- Using a thickness gauge, measure the gap at dimension A.

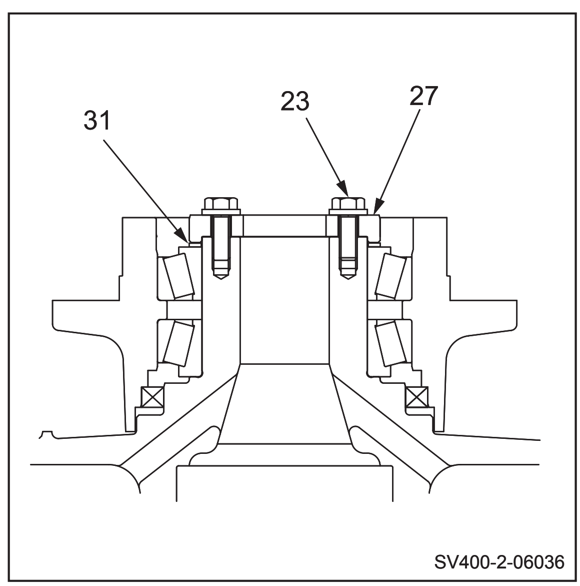
★ **Preload adjustment shim thickness = (A+0.1) mm**



③ Remove the bolts (23).

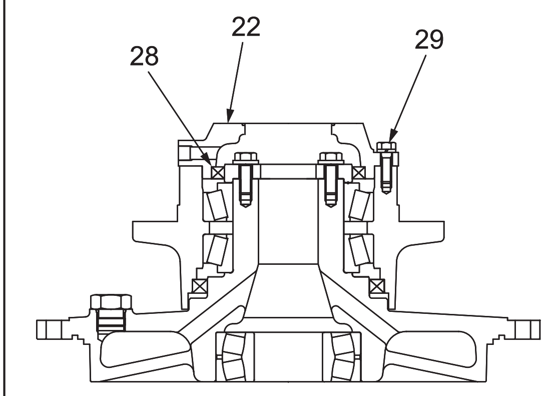
- Remove the cover (27).
- Insert the shim (31) whose preload adjustment shim thickness equal to (A+0.1) mm. Then firmly secure the cover (27) again by installing washers to the eight bolts (23).

N·m (23) M14×40: 170 N·m (125 lbf·ft)



8) Install the oil seal (28) to the cover (22).
 • Lightly apply grease to the lip surfaces of the oil seal (28).
 • Using the six bolts (29) and spring washers, firmly secure the cover (22) to the housing.

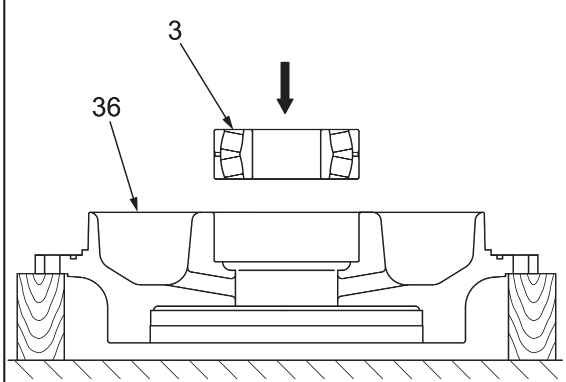
(29) M12×40: 108 N·m (80 lbf·ft)



SV400-2-06037

9) Lightly apply gear oil to the press-fitting surface of the vibrator bearing (3).
 • Drive the vibrator bearing (3) into the axle shaft (36).

Axle shaft : 100 kg (220 lbs.)
Vibrator bearing : 10 kg (22 lbs.)

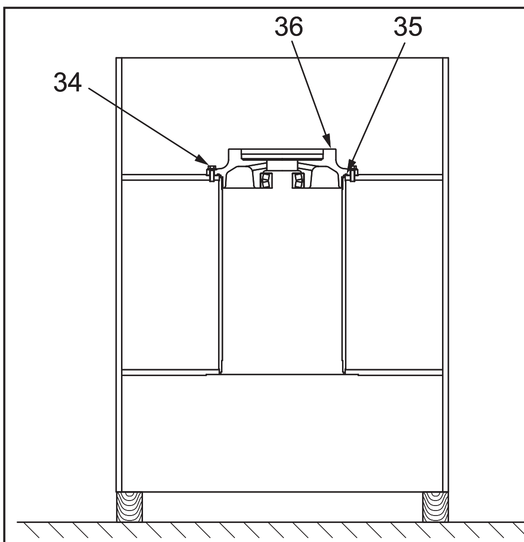


SV400-2-06038

10) Install the O-ring (35) to the axle shaft (36).
 • Lightly apply grease to the entire circumference of the O-ring (35).
 • Using the sixteen bolts (34) and washers, firmly secure the axle shaft (36) to the drum.

(34) M16×50: 270 N·m (199 lbf·ft)

NOTE : When installing, make sure that the O-ring does not protrude from the groove.



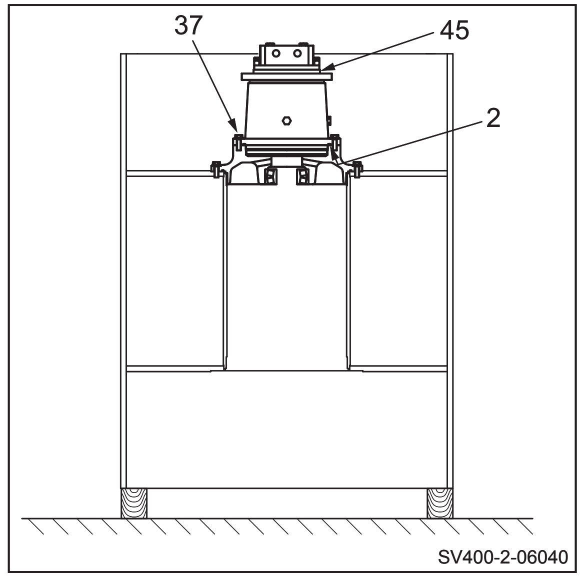
SV400-2-06039

WARNING

Use aids such as work stepladders when working, and work with a natural, unstrained posture.

11) Attach the O-ring (2) to the propulsion motor (45).
- Lightly apply grease to the entire circumference of the O-ring (2).
- Using the sixteen bolts (37) and washers, firmly secure the propulsion motor (45) to the axle shaft.

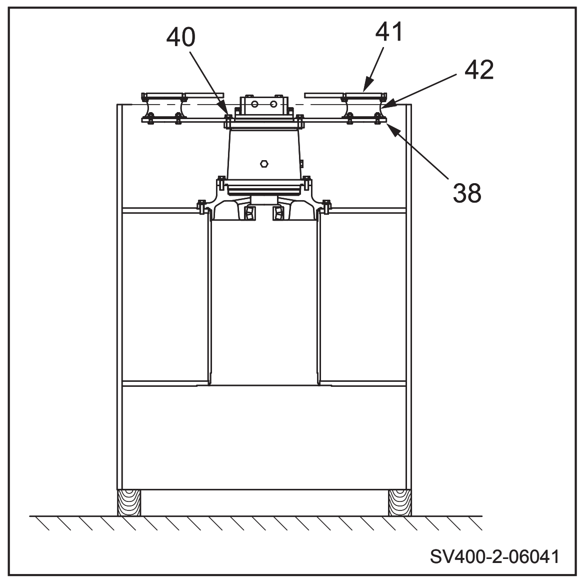
NOTE: When attaching, make sure that the O-ring does not protrude from the groove.



Propulsion motor: 185 kg (408 lbs.)

(37) M16×50: 270 N·m (199 lbf·ft)

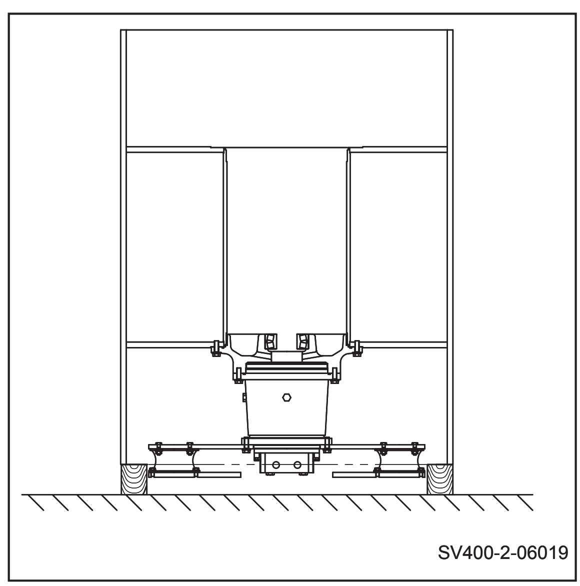
12) Using the sixteen bolts (40) and washers, firmly secure the subassembly of the holder (41), damper (42) and disc (38) to the propulsion motor.



Total of lifted parts (41, 42 and 38)
: 115 kg (255 lbs.)

(40) M16×50: 270 N·m (199 lbf·ft)

13) Lifting with a crane, invert the drum as shown in the figure on the right.



Lifted weight in figure on the right

SV412D : 2,240 kg (4,938 lbs.)
SV412T : 2,440 kg (5,379 lbs.)
SV412TF : 3,780 kg (8,333 lbs.)
SV412TB : 2,440 kg (5,379 lbs.)
SV412FB : 3,780 kg (8,333 lbs.)

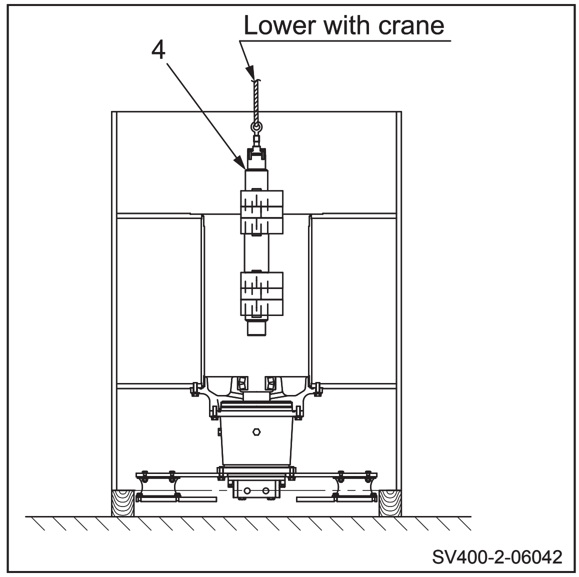
⚠ WARNING

Inverting the drum can be dangerous work. Therefore, be very careful, confirm that the surrounding area is safe and work in a natural, unstrained posture.

14) Attach a lifting bolt (M10×1.5) to the end of the vibrator shaft (4). Then lift with a crane, slowly lower and attach.

★ **When inserting the vibrator shaft into the vibrator bearing for attachment, be careful not to allow the inner race of the vibrator bearing to lean.**

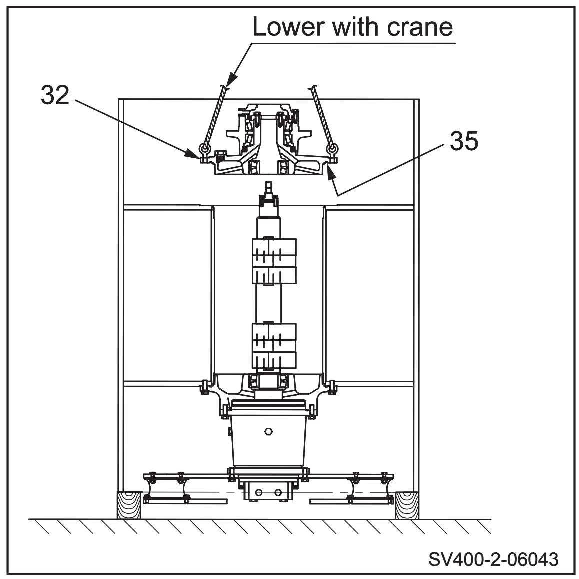
kg Vibrator Shaft: 140 kg (309 lbs.)



15) Attach the O-ring (35) to the axle shaft (32) subassembly.
- Lightly apply grease to the entire circumference of the O-ring (35).
- Lift and slowly lower the axle shaft (32) subassembly with a crane.

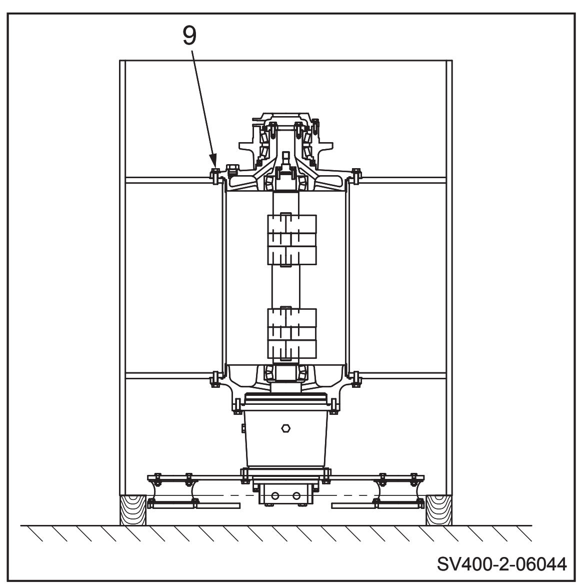
★ **When attaching the axle shaft, move the vibrator shaft until the center of the vibrator bearing inner race is aligned with the center of the shaft. Be careful not to allow the vibrator bearing to lean.**

kg Axle shaft (32) subassembly
: 150 kg (331 lbs.)

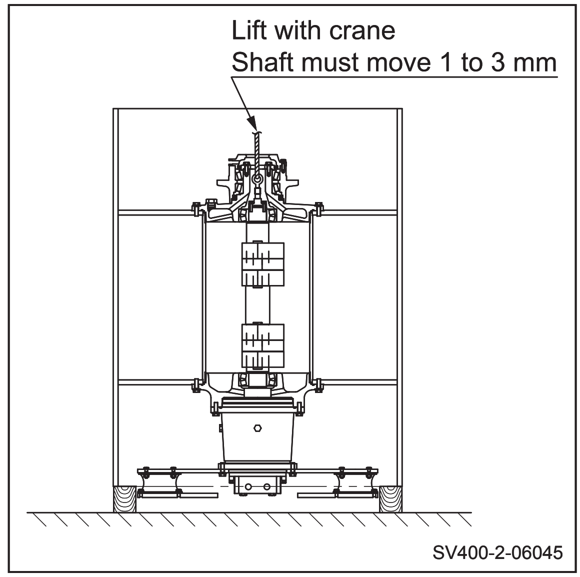


16) Using the sixteen bolts (9) and washers, firmly secure the axle shaft subassembly to the drum.
NOTE: When attaching, make sure that the O-ring does not protrude from the groove.

N·m (21) M16×50: 270 N·m (199 lbf·ft)

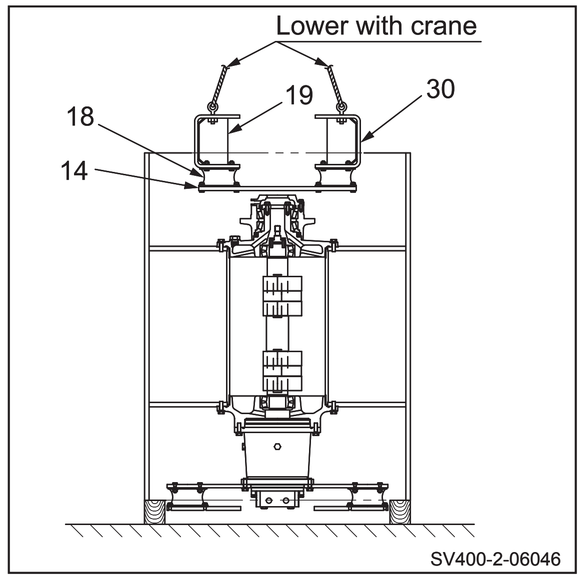


17)Attach a lifting bolt (M10×1.5) to the vibrator shaft end. Then slowly lift with a crane. Confirm that 1 to 3 mm (0.04 to 0.12 in.) of play exists in the axial direction.



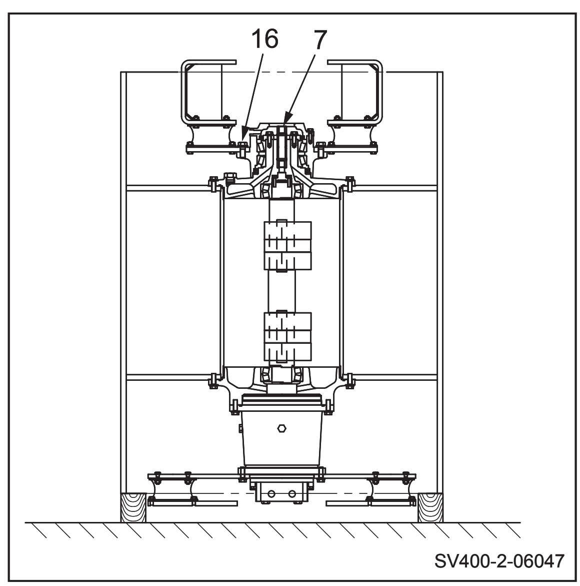
18)Using a crane, lift and slowly lower the subassembly of the holder (19 and 30), damper (18) and disc (14).

Total of lifted parts (19, 30, 18 and 14)
: 135 kg (298 lbs.)



19)Using the sixteen bolts (16) and washers, firmly secure the holder subassembly to the housing.
- Apply a molybdenum-based grease to the spline surface of the sleeve (7), and attach it to the spline shaft at the end of the vibrator shaft.

(16) M20×50: 540 N·m (398 lbf·ft)

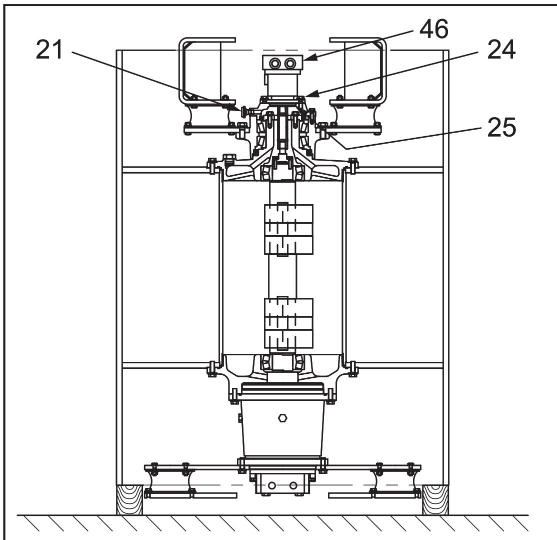


20) Attach the breather (21).

- Attach the O-ring (25) to the vibrator motor (46). Using the two bolts (24) and washers, firmly secure it to the cover.

  ★ **Attach by aligning the top side of the vibrator motor (46) and breather (21) with the top side of the propulsion motor.**

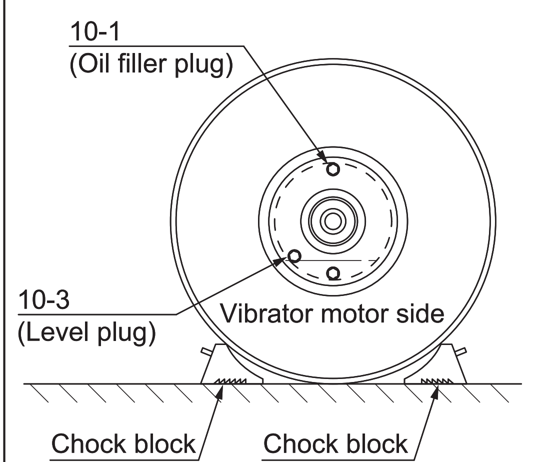
N·m (24) M14×40: 170 N·m (125 lbf·ft)



SV400-2-06048

21) Lift the vibratory drum assembly with a crane, and set it sideways at the position of the plug shown in the figure on the right.

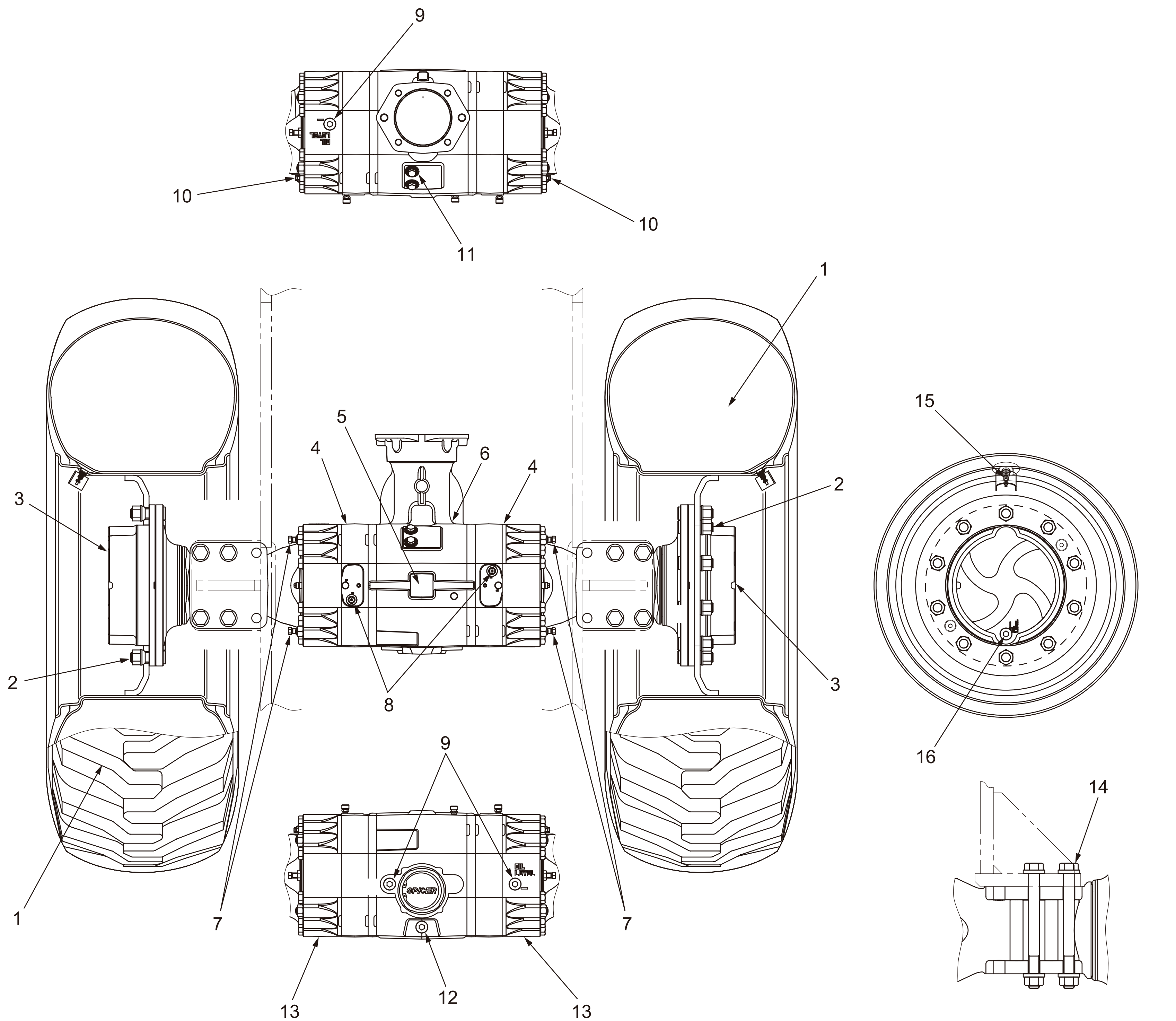
- Remove the oil filler plug and level plug.
- From the oil filler plug hole, add approximately 21 L (5.5 gal.) of gear oil until gear oil drips from the level plug hole.
- Attach the oil filler plug and level plug.



SV400-2-06049

3. AXLE

3-1. Rear Axle (SV412D)

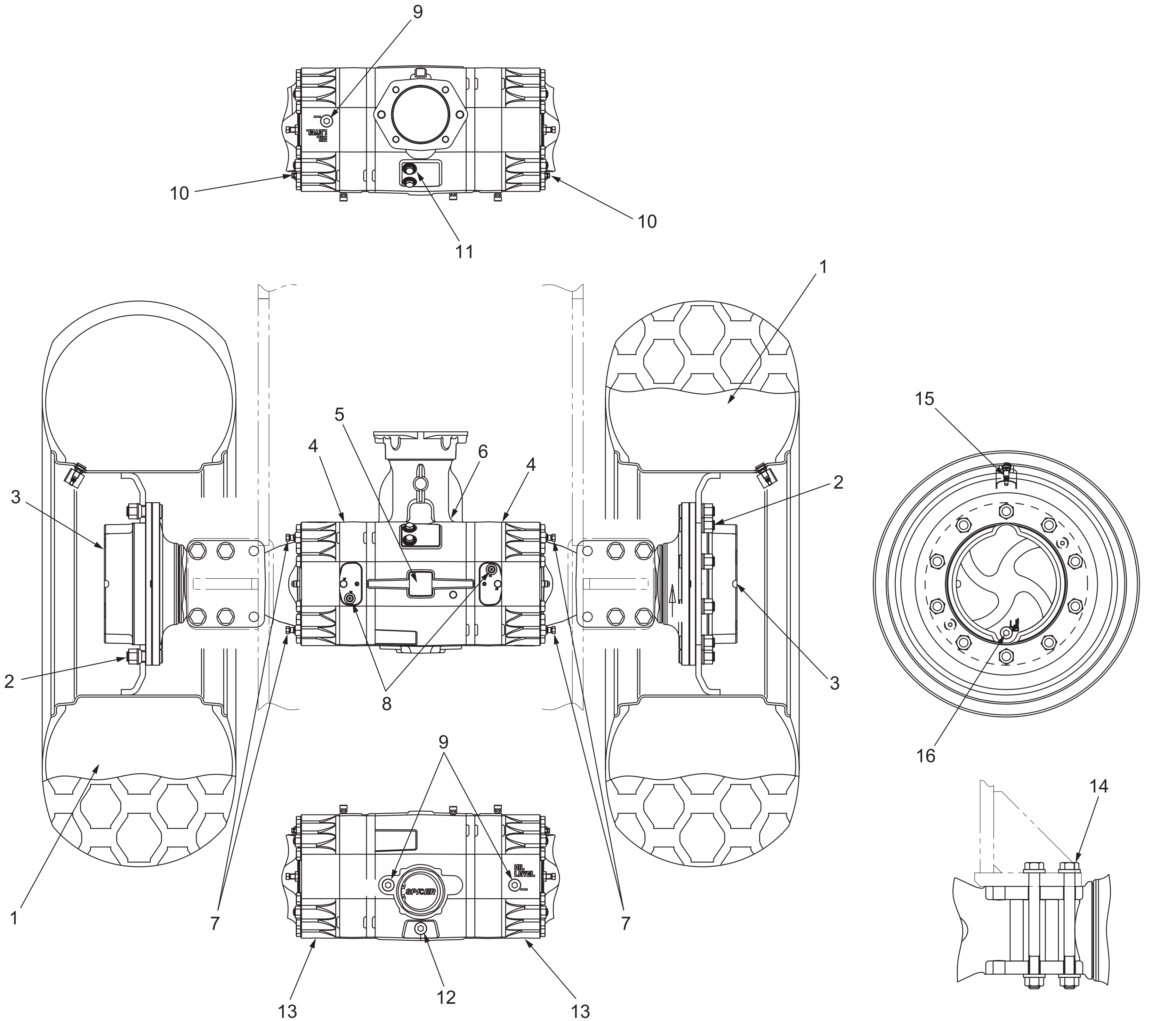


0404-27804-0-11494-A

(1) Tire {Tire inflation pressure: 137.34 kPa (20 psi)}
(2) Nut (M22 p=1.5)
N · m 785 N·m (579 lbf·ft)
(3) Hub reduction gear
(4) Brake
(5) Differential
(6) Center housing
(7) Bolt (for brake release)
(8) Plug (for brake component lubrication)
(9) Plug (for brake and differential component lubrication and level gauge)
(10) Bolt (for brake adjustment)
(11) Plug (for differential component lubrication)
(12) Plug (for differential component drain)
(13) Plug (for brake component drain)
(14) Bolt (M20×220)
N · m 540 N·m (398 lbf·ft)
(15) Valve
(16) Plug (for hub reduction gear component lubrication, level gauge and drain)

- Rear axle assembly weight : 660 kg (1,455 lbs.)
- Tire assembly weight : 145 kg (320 lbs.)

3-2. Rear Axle (SV412T, TF, TB, FB)

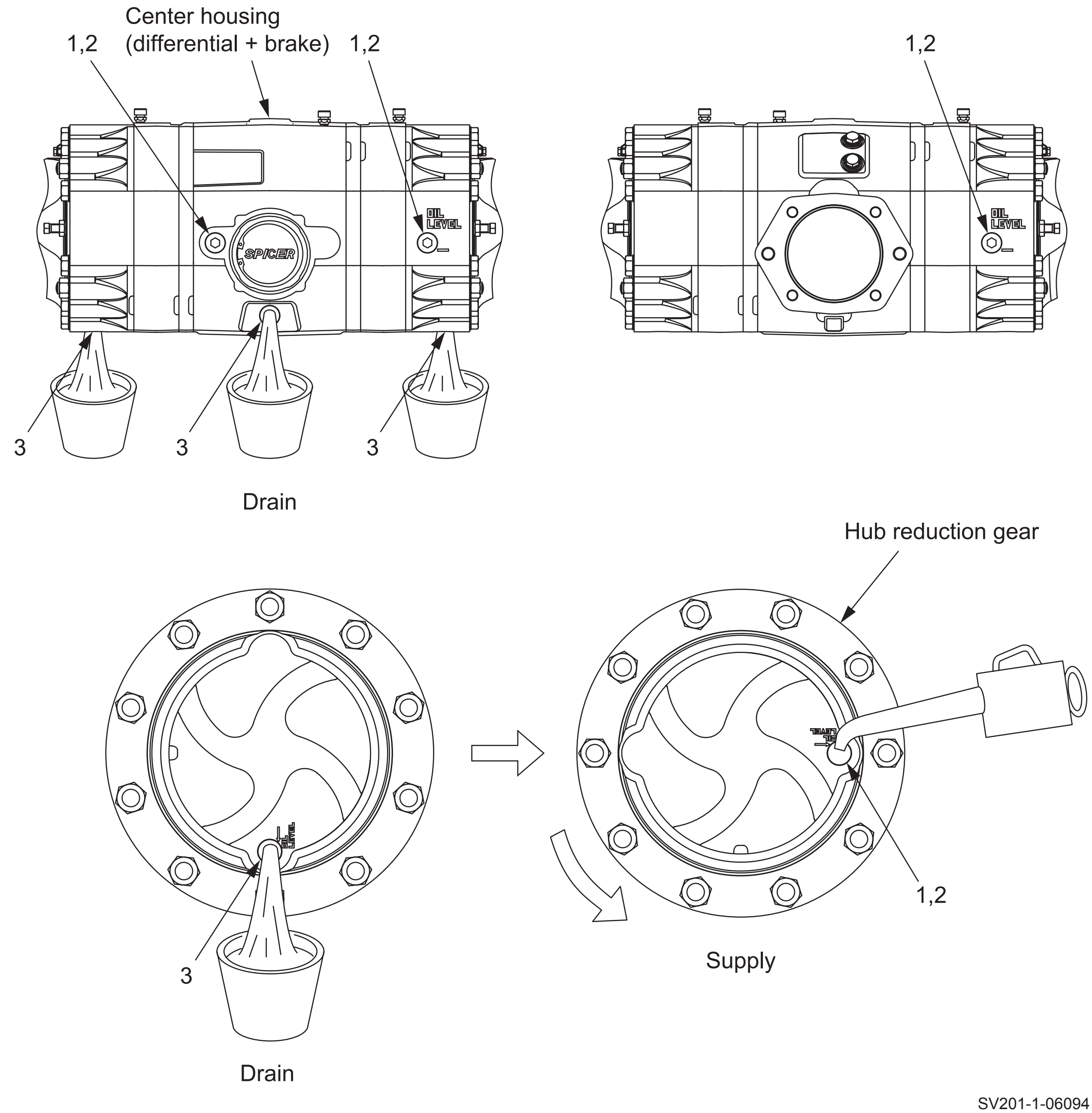


0404-27805-0-11495-0

(1) Tire {Tire inflation pressure: 137.34 kPa (20 psi)}
(2) Nut (M22 p=1.5)
785 N·m (579 lbf·ft)
(3) Hub reduction gear
(4) Brake
(5) Differential
(6) Center housing
(7) Bolt (for brake release)
(8) Plug (for brake component lubrication)
(9) Plug (for brake and differential component lubrication and level gauge)
(10) Bolt (for brake adjustment)
(11) Plug (for differential component lubrication)
(12) Plug (for differential component drain)
(13) Plug (for brake component drain)
(14) Bolt (M20×220)
540 N·m (398 lbf·ft)
(15) Valve
(16) Plug (for hub reduction gear component lubrication, level gauge and drain)

- Rear axle assembly weight : 630 kg (1,389 lbs.)
- Tire assembly weight : 130 kg (287 lbs.)

3-3. Rear Axle Lubrication



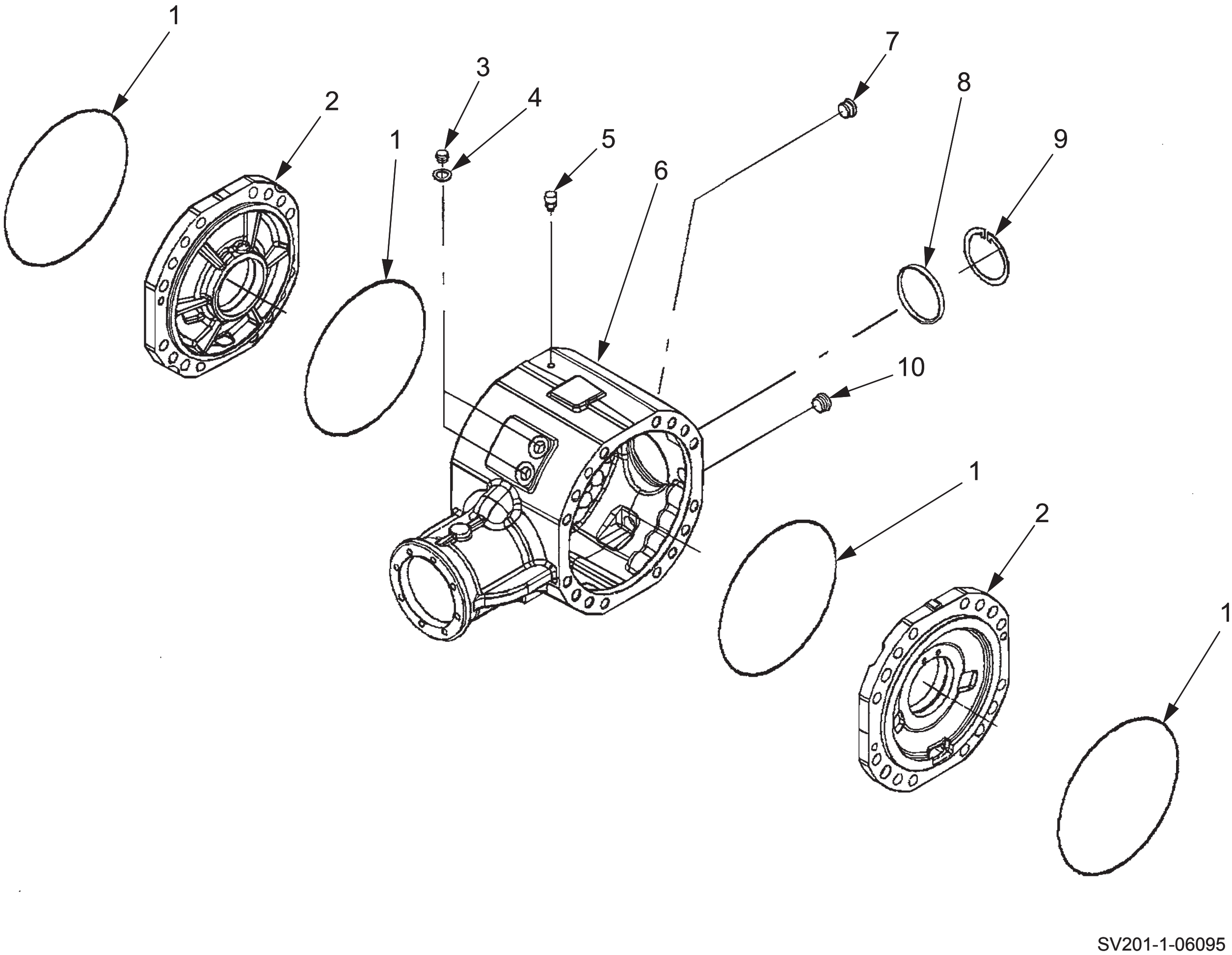
(1) Filler port
(2) Level gauge
(3) Drain port

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

Center housing	:	6.8 L	(1.8 gal.)
Hub reduction gear	:	0.75 L×2	(0.2 gal.×2)

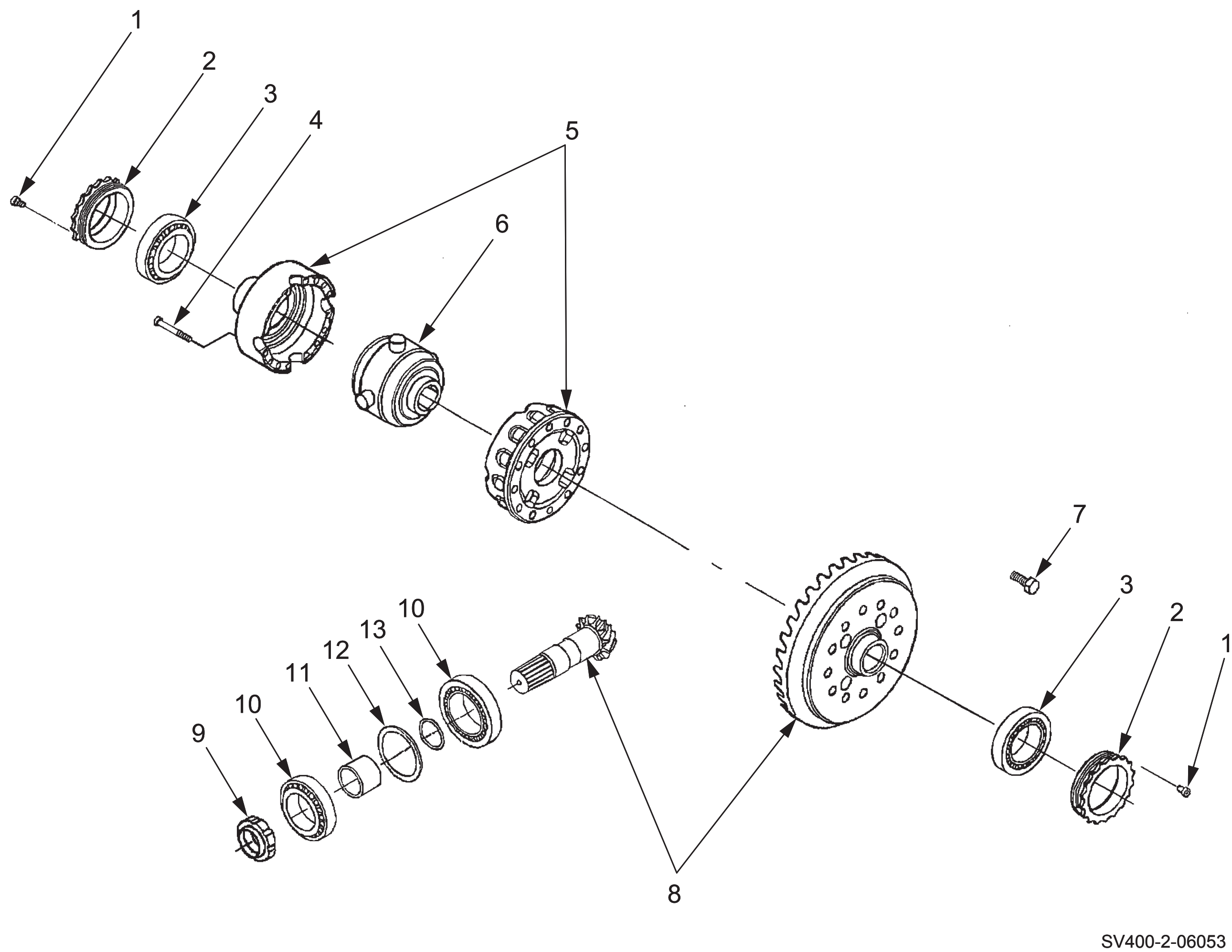
3-4. Rear Axle Structure

3-4-1. Center housing



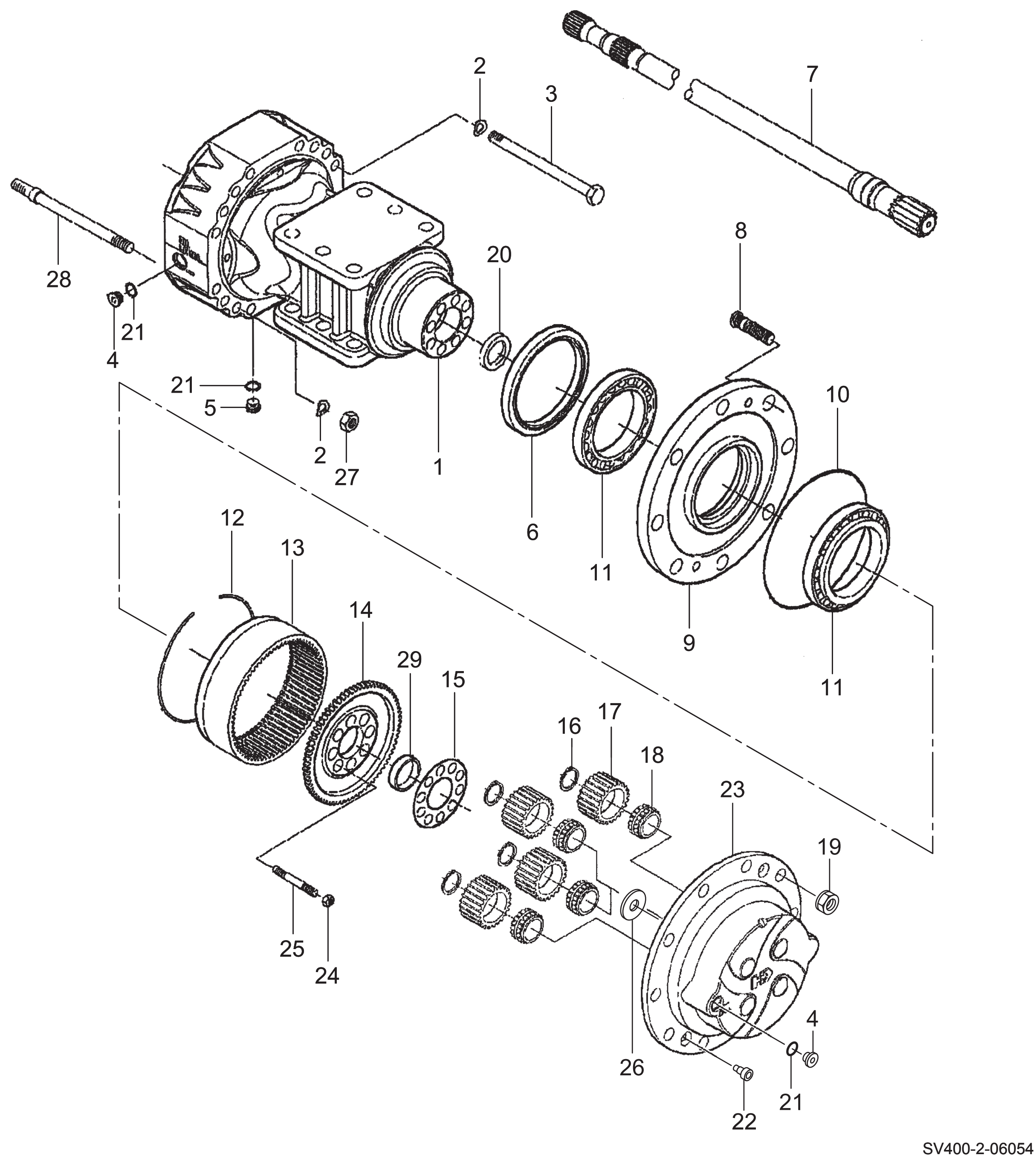
(1) O-ring	(5) Vent	(9) Snap ring
(2) Cover	(6) Housing	(10) Magnet plug
(3) Bolt	(7) Plug	
(4) Seal washer	(8) Plug	

3-4-2. Differential



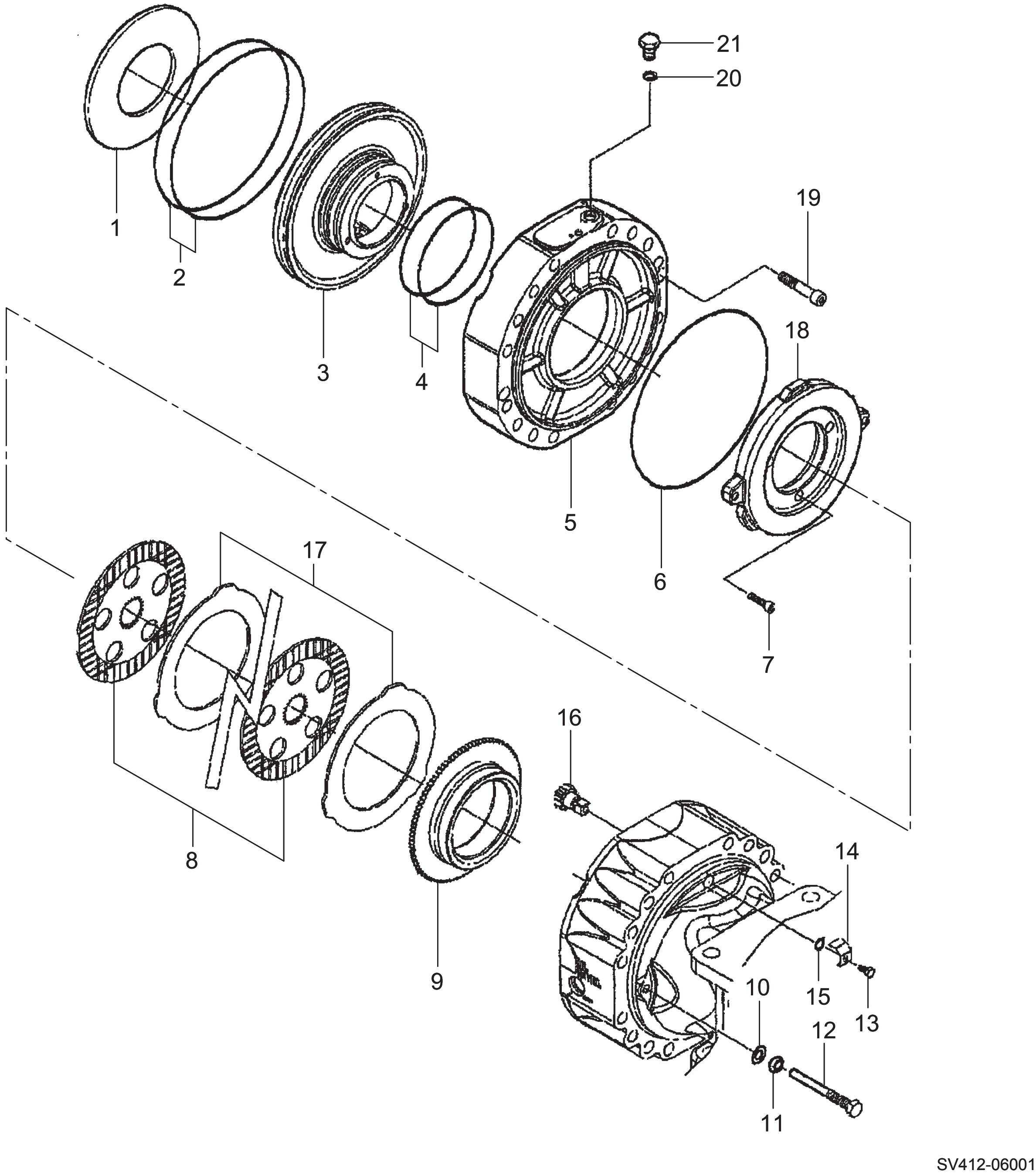
(1) Cylinder bolt	(6) No spin differential	(11) Spacer
(2) Ring nut	(7) Bolt	(12) Shim
(3) Taper roller bearing	(8) Bevel gear set	(13) Shim
(4) Cylinder bolt	(9) Ring nut	
(5) Differential carrier	(10) Taper roller bearing	

3-4-3. Hub reduction gear



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

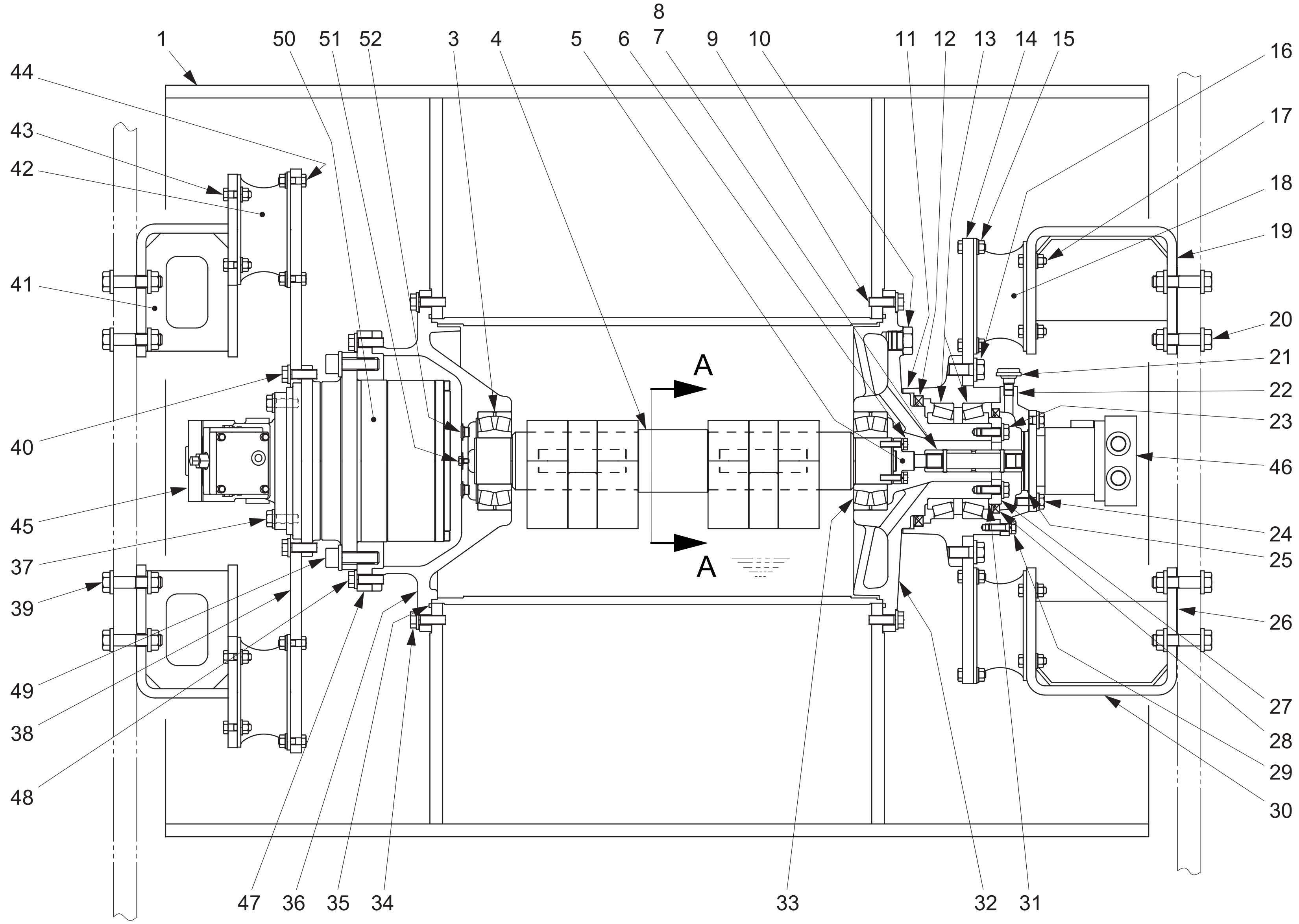
3-4-4. Brake

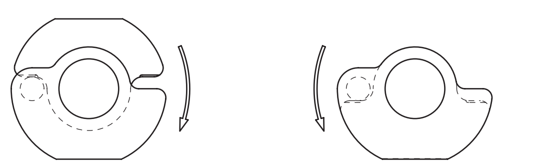


(1) Spring	(8) Brake disc	(15) O-ring
(2) O-ring	(9) Ring	(16) Pinion
(3) Piston	(10) Lock washer	(17) Intermediate brake disc
(4) O-ring	(11) Nut	(18) Disc
(5) Cover	(12) Adjustment bolt	(19) Bolt
(6) O-ring	(13) Hexagon bolt	(20) Seal washer
(7) Cylinder bolt	(14) Sheet	(21) Bolt

4. HIGH TORQUE TYPE ONLY

4-1. Vibratory Drum Assembly

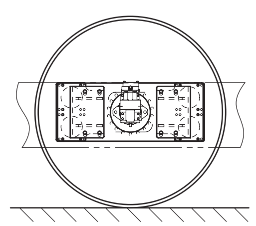




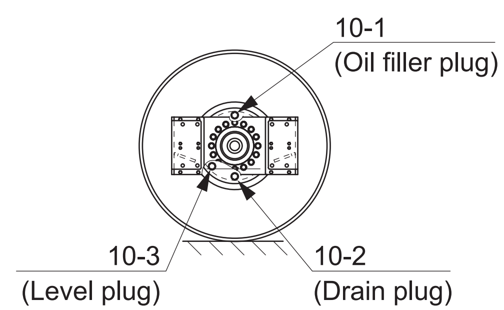
Vibrator mode is Low with motor rotating clockwise

Vibrator mode is High with motor rotating counterclockwise

SECTION A-A



Propulsion motor side



Vibrator motor side

0404-43802-0-11846-0

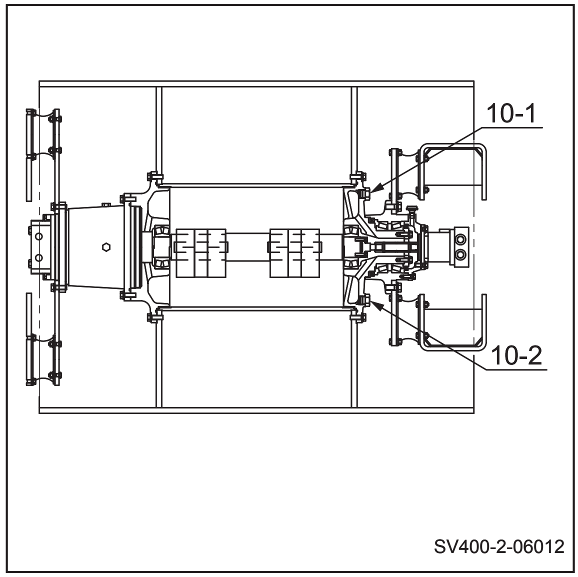
(1) Drum
(3) Vibrator bearing
(4) Eccentric shaft
(5) Shaft
(6) Bolt (M10×40)
(7) Sleeve
(8) Spring pin
(9) Bolt (M16×50)
(10) Plug
(11) Housing
(12) Oil seal
(13) Roller bearing
(14) Disc
(15) Bolt (M12×40)
(16) Bolt (M20×50)
(17) Bolt (M12×40)
(18) Damper
(19) Holder
(20) Bolt (M20×90)
(21) Breather
(22) Cover
(23) Bolt (M14×40)
(24) Bolt (M14×40)
(25) O-ring
(26) Shim
(27) Cover
(28) Oil seal
(29) Bolt (M12×40)
(30) Holder
(31) Shim
(32) Axle shaft
(33) Vibrator bearing
(34) Bolt (M16×50)
(35) O-ring
(36) Housing
(37) Bolt (M16×50)
(38) Disc
(39) Bolt (M20×90)
(40) Bolt (M16×50)
(41) Holder
(42) Damper
(43) Bolt (M12×40)
(44) Bolt (M12×40)
(45) Propulsion motor
(46) Vibrator motor
(47) Ring
(48) Bolt (M16×50)
(49) Bolt (M22×70)
(50) Gear box
(51) Bolt (M8×16)
(52) Plug

4-2. Disassembly and Reassembly of Vibratory Drum

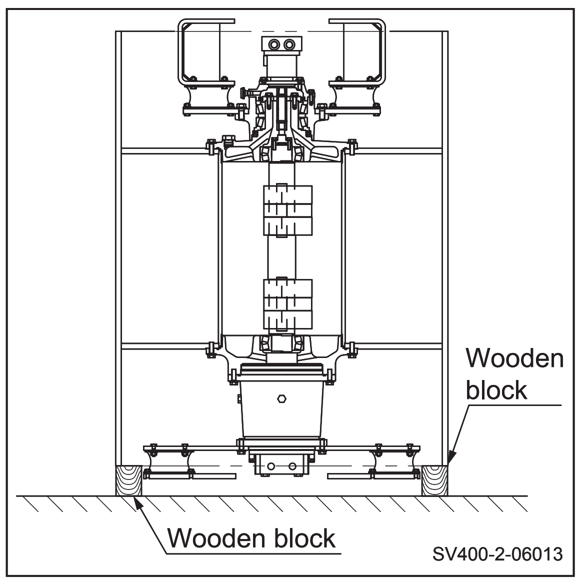
- Leader numbers appearing in the vibratory drum disassembly and reassembly procedure illustrations shown below correspond to the numbers indicating the parts of the vibratory drum assembly (page 6-030).

4-2-1. Disassembly of vibratory drum

1) Remove the plugs (10-1 and 10-2).
   - Drain the gear oil from the vibrator case.
   - Gear oil quantity: 21 L (5.5 gal.)



2) Lift the vibratory drum with a crane. As shown in the figure on the right, stand it up with the propulsion motor side facing downward.



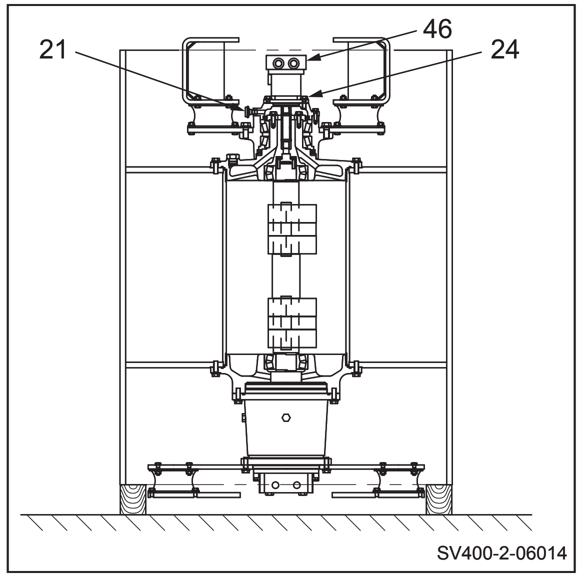
⚠ WARNING

After standing up the drum, place wooden blocks that have sufficient strength underneath. Stabilize the drum so that it is not unsteady.

kg Vibratory drum assembly

SV412D : 2,665 kg (5,875 lbs.)
SV412T : 2,865 kg (6,316 lbs.)
SV412TF : 4,205 kg (9,270 lbs.)
SV412TB : 2,865 kg (6,316 lbs.)
SV412FB : 4,205 kg (9,270 lbs.)

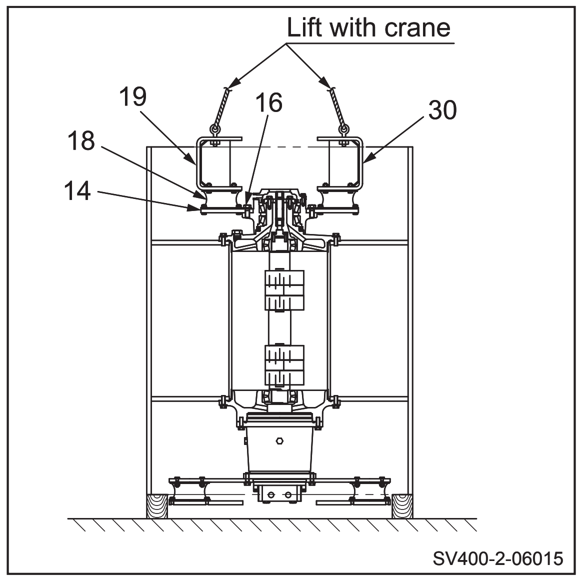
3) Remove the two bolts (24).
   - Remove the vibrator motor (46).
   - Remove the breather (21).



⚠ WARNING

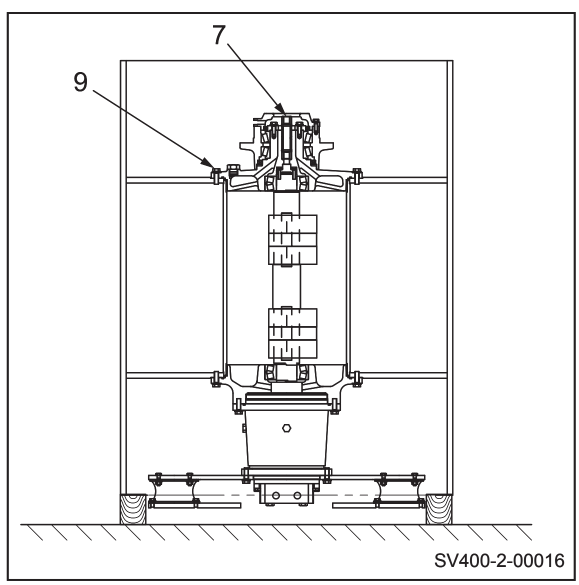
Use aids such as work stepladders when working, and work with a natural, unstrained posture.

4) Remove the sixteen bolts (16).
   - Attach the lifting bolts/nuts (M20×2.5) as shown in the figure on the right.
   - Using a crane, lift and remove the holder (19), damper (18) and disc (14) together.



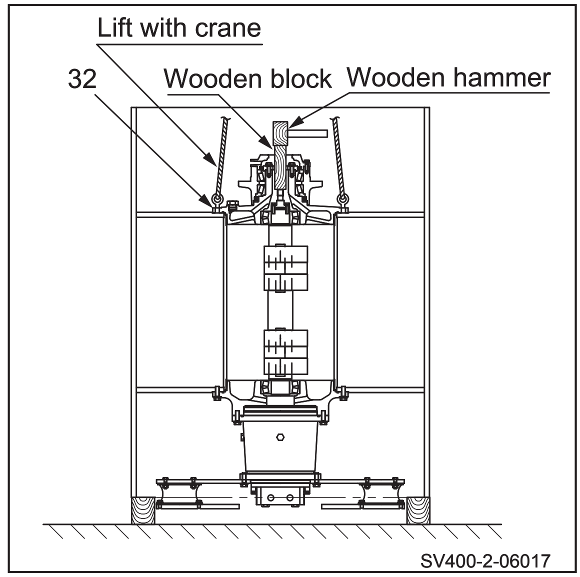
Total of lifted parts (19, 30, 18 and 14)
: 135 kg (298 lbs.)

5) Remove the sixteen bolts (9).
   - Remove the sleeve (7).



6) Attach the lifting bolts (M16×2.0) as shown in the figure on the right.
   • Using a crane, slowly lift and remove the axle shaft (32).
     ★ **At this time, to ensure that the vibrator shaft does not follow along with the axle shaft (32), lift the end of the vibrator shaft while lightly tapping with a wooden hammer through a wood block.**

kg Axle shaft: 150 kg (331 lbs.)

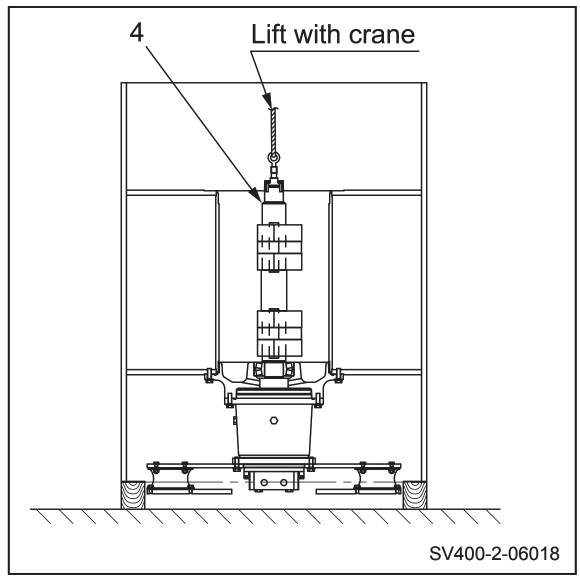


CAUTION

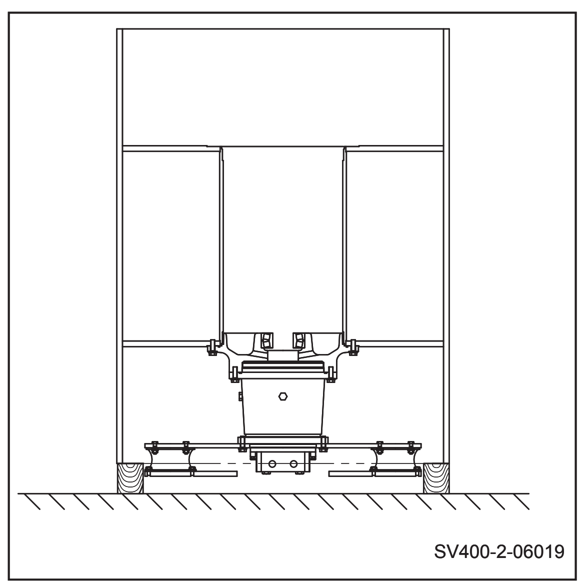
When attaching the lifting bolts, screw in the threads fully before using.

7) Attach a lifting bolt (M10×1.5) to the end of the eccentric shaft (4). Then lift with a crane and remove.

kg Eccentric shaft: 135 kg (298 lbs.)



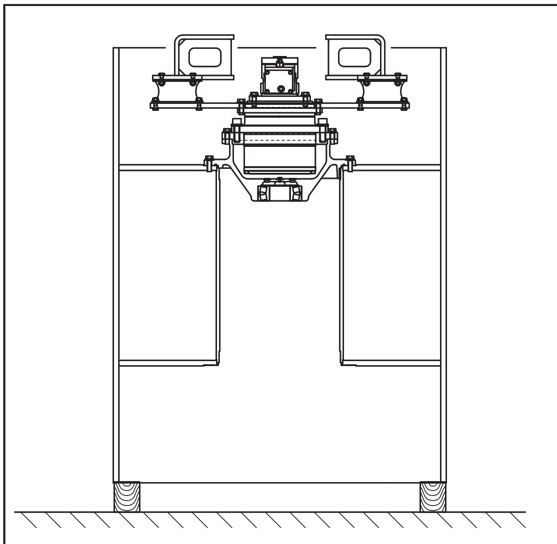
8) In the figure on the right, the vibrator motor side is up. From the top, the figure shows the condition with the part removed.



9) Lift and invert the drum with a crane. Stand it up with the propulsion motor side upward.

Lifted weight in figure on the right

SV412D : 2,225 kg (4,905 lbs.)
SV412T : 2,425 kg (5,346 lbs.)
SV412TF : 3,765 kg (8,300 lbs.)
SV412TB : 2,425 kg (5,346 lbs.)
SV412FB : 3,765 kg (8,300 lbs.)

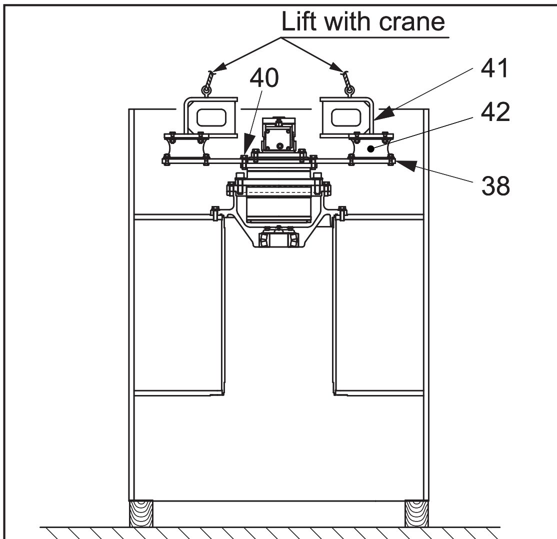

SV410-2-06001

WARNING

Inverting the drum can be dangerous work. Therefore, be very careful, confirm that the surrounding area is safe and work in a natural, unstrained posture.

10) Remove the seventeen bolts (40).
- As shown in the figure on the right, attach the lifting bolt/nut (M20×2.5) to the holder (41) and slowly lift. Remove together with the damper (42) and disc (38).

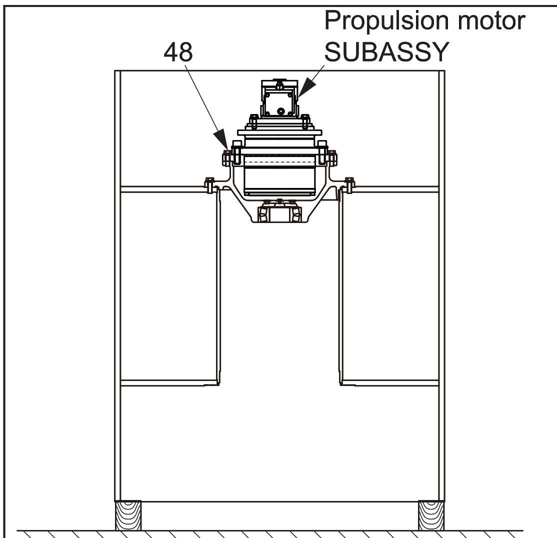
Total of lifted parts (41, 42 and 38)
: 145 kg (320 lbs.)



SV410-2-06002

11) Remove the eighteen bolts (48).
- Remove the propulsion motor SUBASSY.

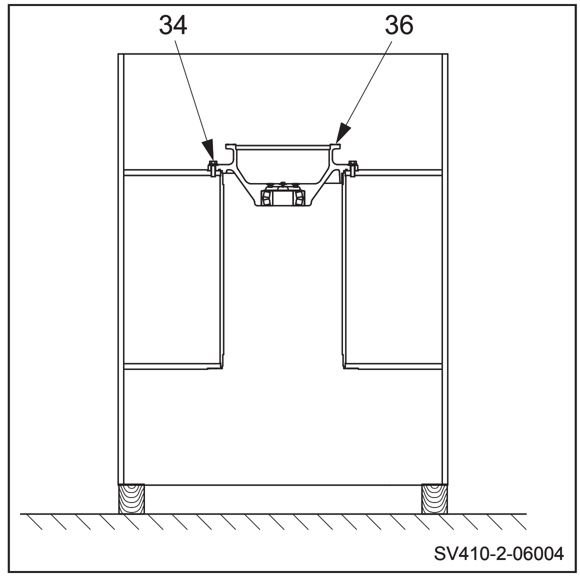
Propulsion motor SUBASSY
: 145 kg (320 lbs.)



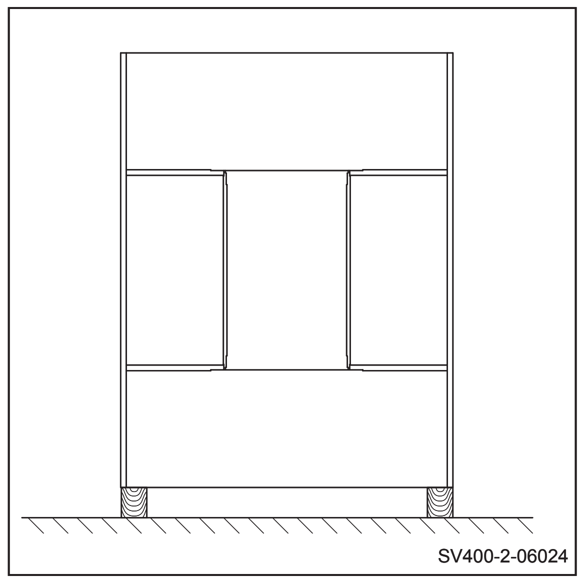
SV410-2-06003

12) Remove the sixteen bolts (34).
- Remove the housing (36).

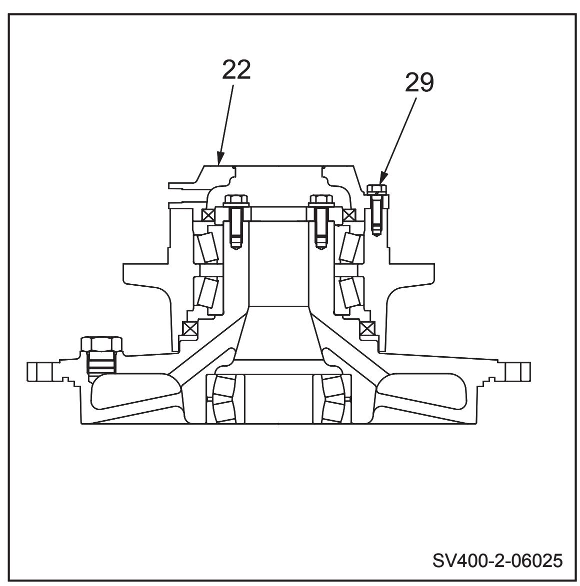
Axle shaft: 100 kg (220 lbs.)



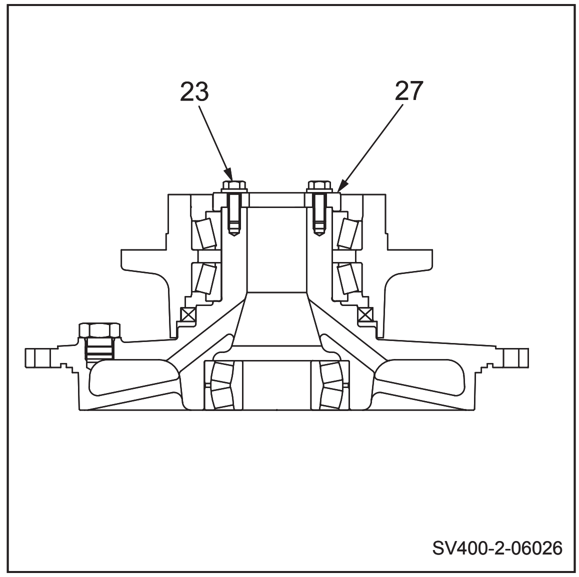
13) The figure on the right shows the condition in which all parts have been removed from the vibratory drum assembly.



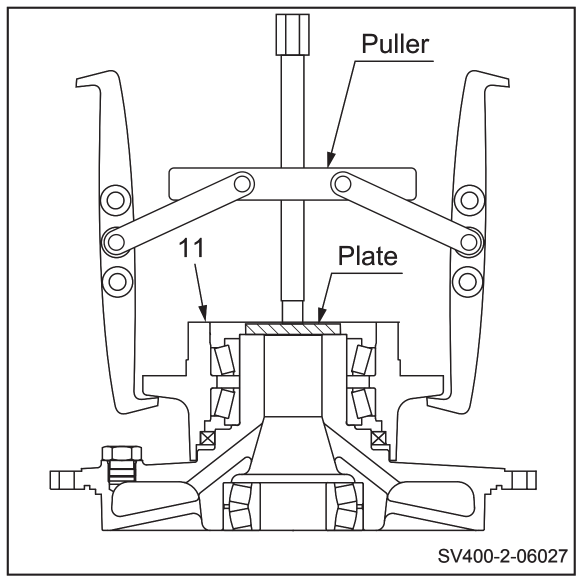
14) The figure on the right shows the axle shaft subassembly removed from the vibratory drum.
- Remove the six bolts (29).
- Remove the cover (22).



15) Remove the eight bolts (23).
- Remove the cover (27).



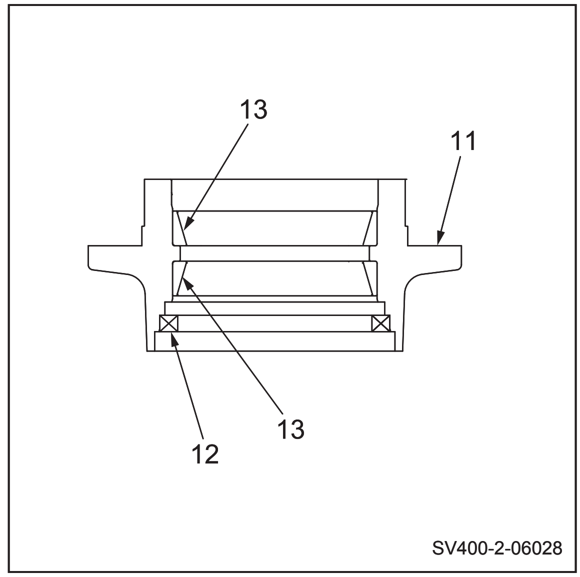
16) Place the plate at the end of the axle shaft. With the puller against the housing (11), separate the housing, including the roller bearing, from the axle shaft.



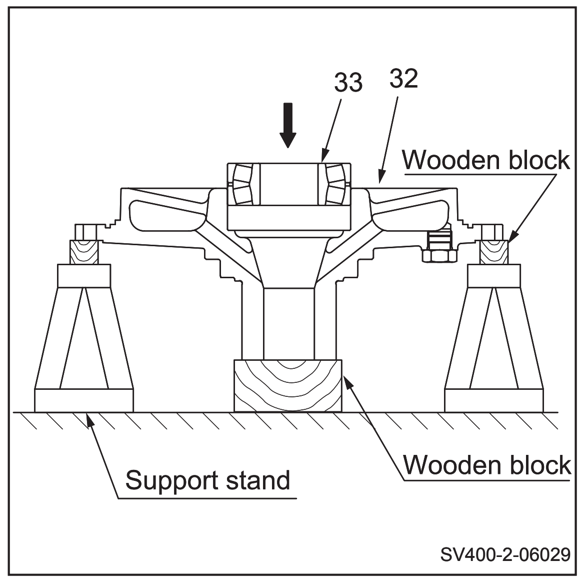
4-2-2. Reassembly of vibratory drum

★ **Before reassembling, confirm that each part that was disassembled has been well cleaned and is free of any abnormality.**

1) Lightly apply gear oil to the press-fitting surface of the roller bearing (13) outer race.
   - Drive the outer race of the roller bearing (13) into the housing (11).
   - Attach the oil seal (12).



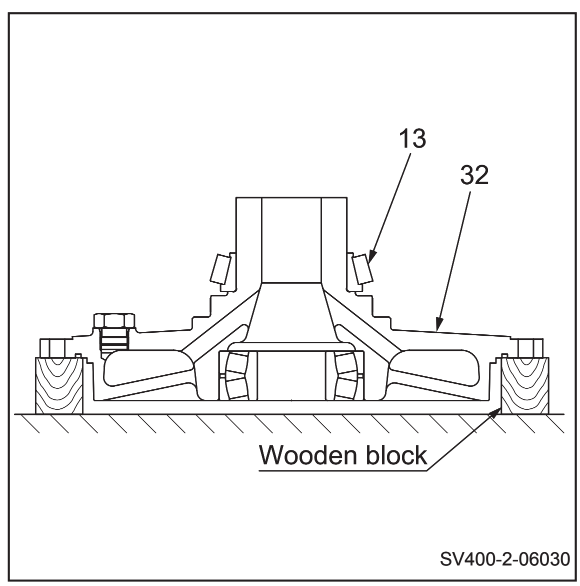
2) As shown in the figure on the right, firmly secure the axle shaft (32) with support stands and/or wooden blocks.
   - Lightly apply gear oil to the press-fitting surface of the vibrator bearing (33).
   - Drive in the vibrator bearing (33).



3) Using a crane, lift and invert the axle shaft (32) subassembly.

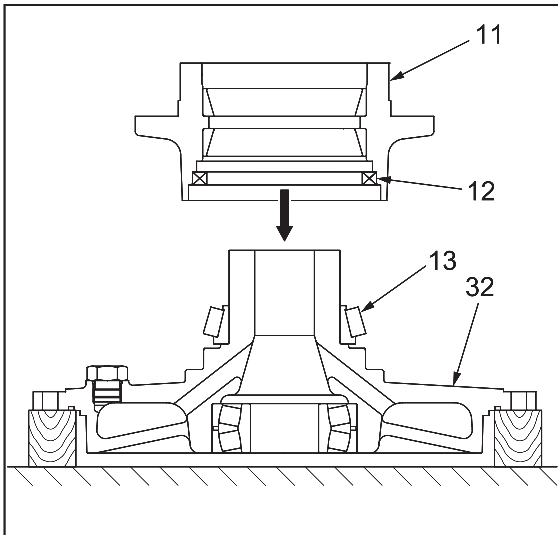
   Axle shaft subassembly: 90 kg (198 lbs.)

   - Lightly apply gear oil to the press-fitting surface of the roller bearing.
   - Attach the inner race of the roller bearing (13).



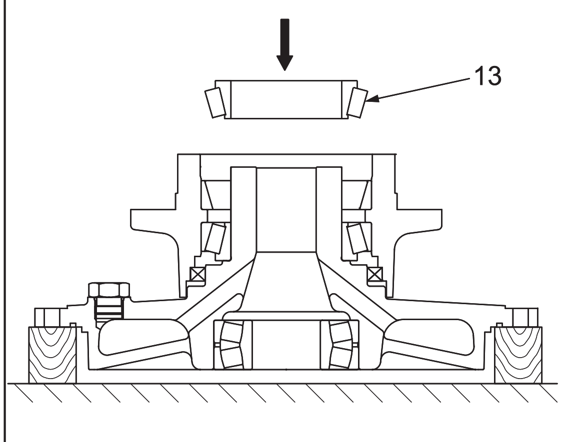
4) Apply an ample amount of lithium-based grease to the rolling surfaces of the roller bearing (13).
- Lightly apply the same grease to the lip surfaces of the oil seal (12).
- Join the axle shaft (32) subassembly and housing (11).

Housing: 40 kg (88 lbs.)



SV400-2-06031

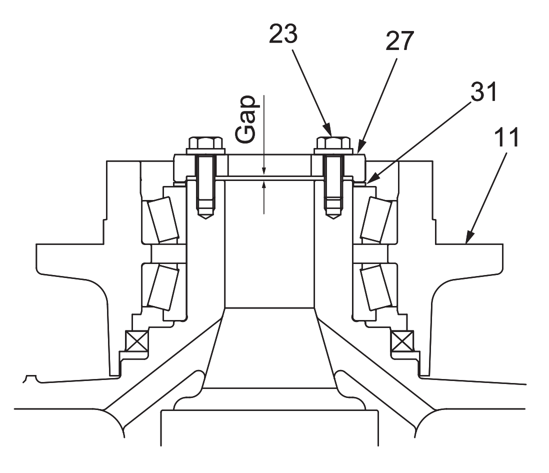
5) After applying an ample amount of lithium-based grease to the inner race of the roller bearing (13), drive it in until the inner race's rolling surface makes contact with the outer race.



SV400-2-06032

6) As shown in the figure on the right, insert shims (31) approximately 1 mm to create a gap between the axle shaft end face and cover (27) interior surface. Then install the cover (27).
- Install washers to the four bolts (23), and tighten to a tightening torque of 108 N·m (80 lbf·ft).
- Rotate the housing (11) two or three times. Then tighten the same bolts again to a tightening torque of 108 N·m (80 lbf·ft).
- Repeat this procedure two or three times until the bolt tightening torque no longer varies.

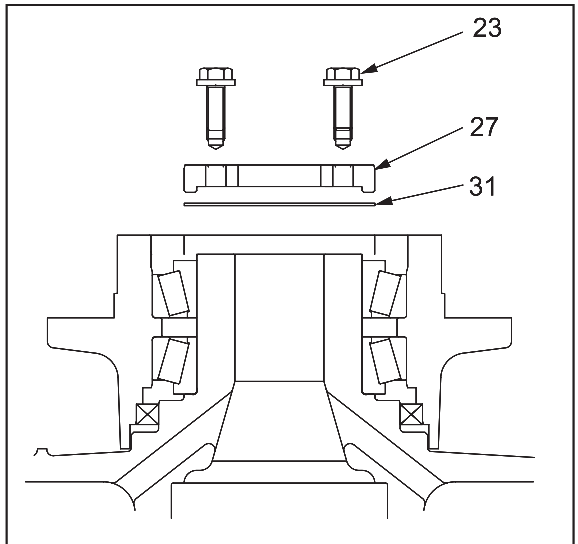
★ **When tightening the bolts (23), alternately tighten by using four of the eight bolts positioned diagonally from each other.**



SV400-2-06033

7) Roller bearing preload adjustment

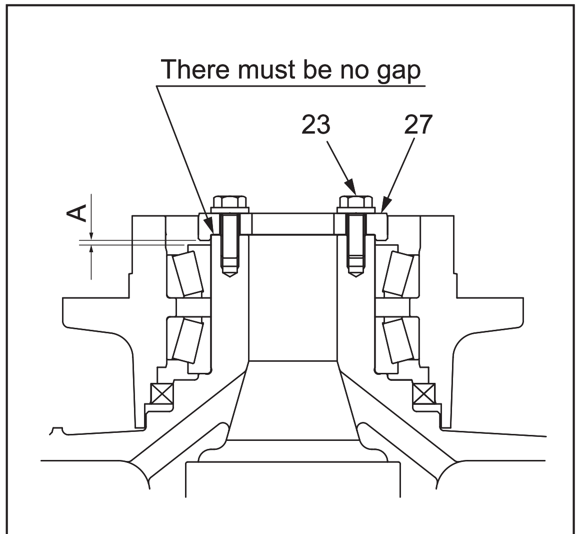
① Remove the four bolts (23).
- Remove the cover (27) and shim (31).



SV400-2-06034

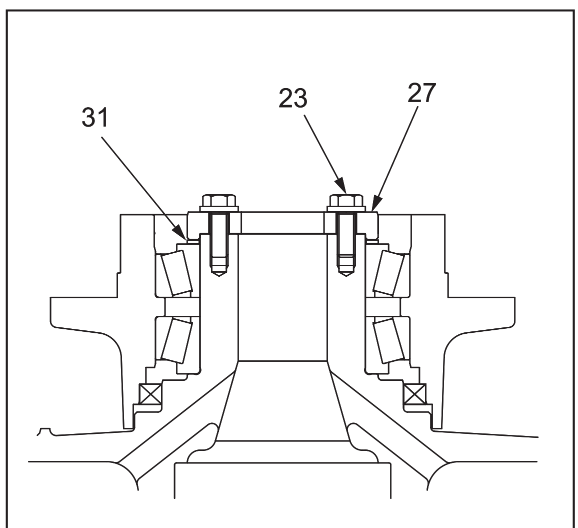
② Without inserting shims, install the cover (27). Then install washers to the four bolts (23) and tighten.
- Using a thickness gauge, measure the gap at dimension A.

★ **Preload adjustment shim thickness = (A+0.1) mm**



SV400-2-06035

③ Remove the bolts (23).
- Remove the cover (27).
- Insert the shim (31) whose preload adjustment shim thickness equal to (A+0.1) mm. Then firmly secure the cover (27) again by installing washers to the eight bolts (23).

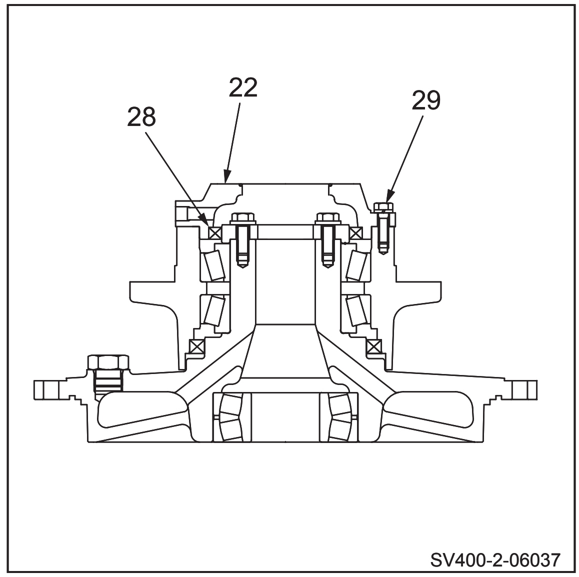


SV400-2-06036

N·m (23) M14×40: 170 N·m (125 lbf·ft)

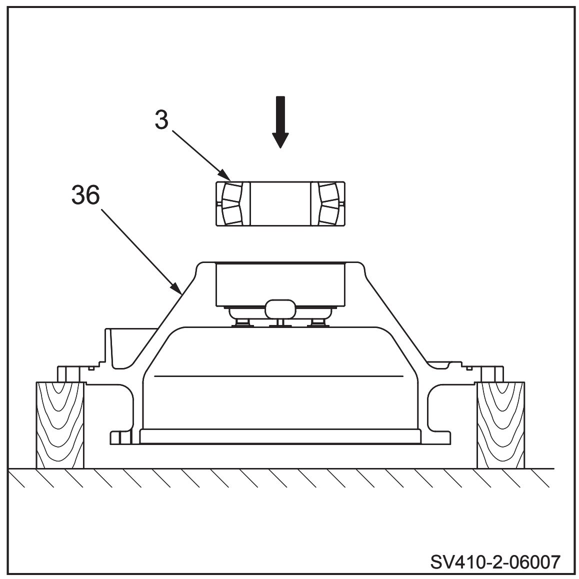
8) Install the oil seal (28) to the cover (22).
   - Lightly apply grease to the lip surfaces of the oil seal (28).
   - Using the six bolts (29) and spring washers, firmly secure the cover (22) to the housing.

N·m (29) M12×40: 108 N·m (80 lbf·ft)



9) Lightly apply gear oil to the press-fitting surface of the vibrator bearing (3).
   - Drive the vibrator bearing (3) into the axle shaft (36).

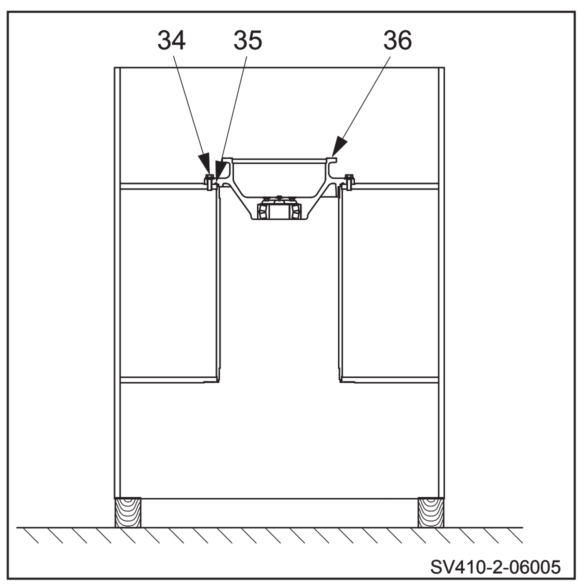
kg Axle shaft : 100 kg (220 lbs.)
Vibrator bearing : 10 kg (22 lbs.)



10) Install the O-ring (35) to the housing (36).
   - Lightly apply grease to the entire circumference of the O-ring (35).
   - Using the sixteen bolts (34) and washers, firmly secure the housing (36) to the drum.

N·m (34) M16×50: 270 N·m (199 lbf·ft)

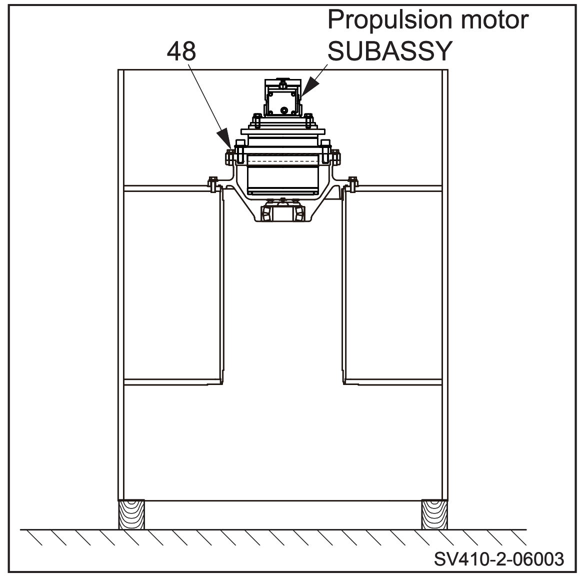
NOTE : When installing, make sure that the O-ring does not protrude from the groove.



⚠ WARNING

Use aids such as work stepladders when working, and work with a natural, unstrained posture.

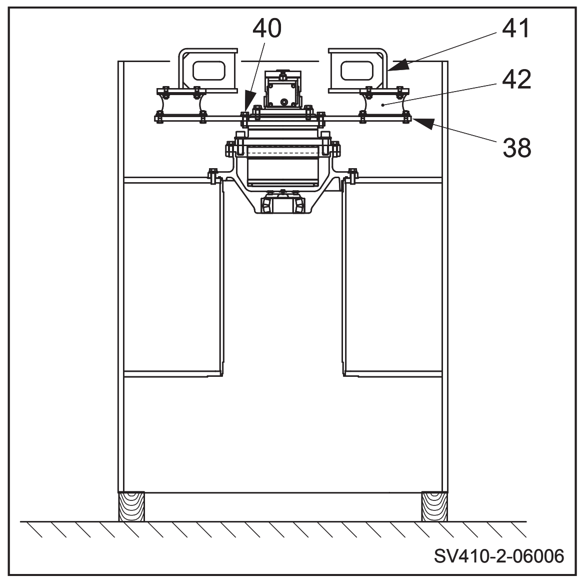
11) Using the eighteen bolts (48) and washers, firmly secure the propulsion motor SUBASSY to the axle shaft.
NOTE: When attaching, make sure that the O-ring does not protrude from the groove.



Propulsion motor SUBASSY
: 145 kg (320 lbs.)

(48) M16×50: 270 N·m (199 lbf·ft)

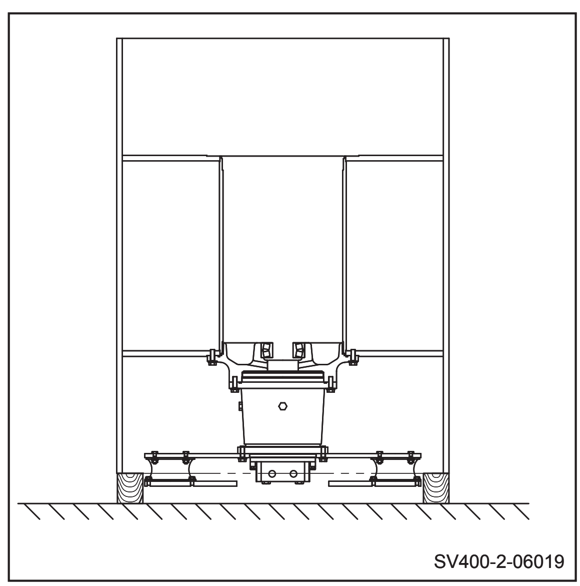
12) Using the seventeen bolts (40) and washers, firmly secure the subassembly of the holder (41), damper (42) and disc (38) to the propulsion motor.



Total of lifted parts (41, 42 and 38)
: 145 kg (320 lbs.)

(40) M16×50: 270 N·m (199 lbf·ft)

13) Lifting with a crane, invert the drum as shown in the figure on the right.



Lifted weight in figure on the right
SV412D : 2,225 kg (4,905 lbs.)
SV412T : 2,425 kg (5,346 lbs.)
SV412TF : 3,765 kg (8,300 lbs.)
SV412TB : 2,425 kg (5,346 lbs.)
SV412FB : 3,765 kg (8,300 lbs.)

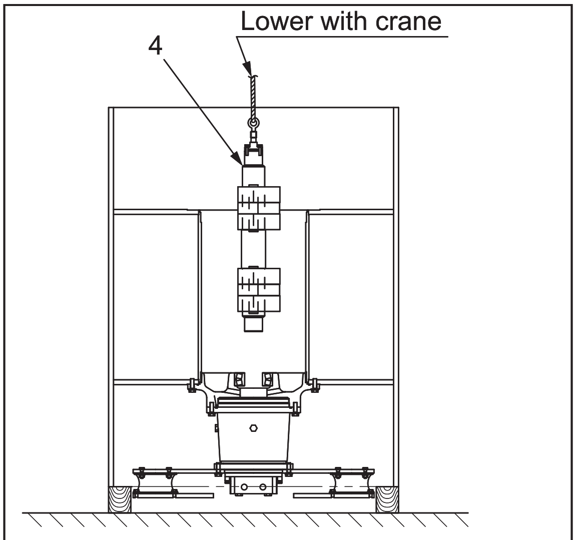
⚠ WARNING

Inverting the drum can be dangerous work. Therefore, be very careful, confirm that the surrounding area is safe and work in a natural, unstrained posture.

14)Attach a lifting bolt (M10×1.5) to the end of the vibrator shaft (4). Then lift with a crane, slowly lower and attach.

★ **When inserting the vibrator shaft into the vibrator bearing for attachment, be careful not to allow the inner race of the vibrator bearing to lean.**

kg Vibrator shaft: 135 kg (298 lbs.)

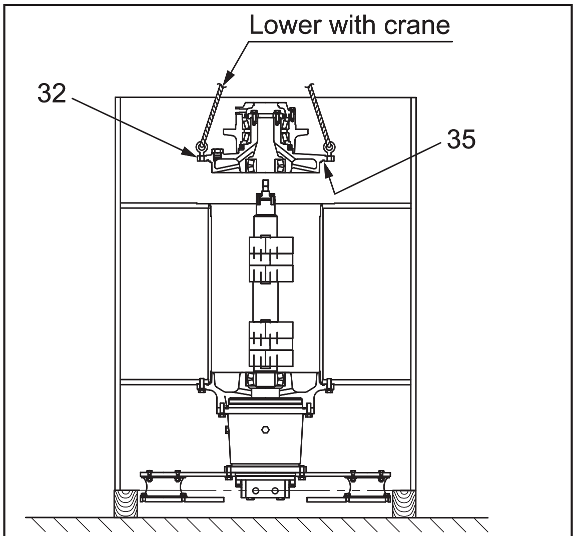


SV400-2-06042

15)Attach the O-ring (35) to the axle shaft (32) subassembly.
- Lightly apply grease to the entire circumference of the O-ring (35).
- Lift and slowly lower the axle shaft (32) subassembly with a crane.

★ **When attaching the axle shaft, move the vibrator shaft until the center of the vibrator bearing inner race is aligned with the center of the shaft. Be careful not to allow the vibrator bearing to lean.**

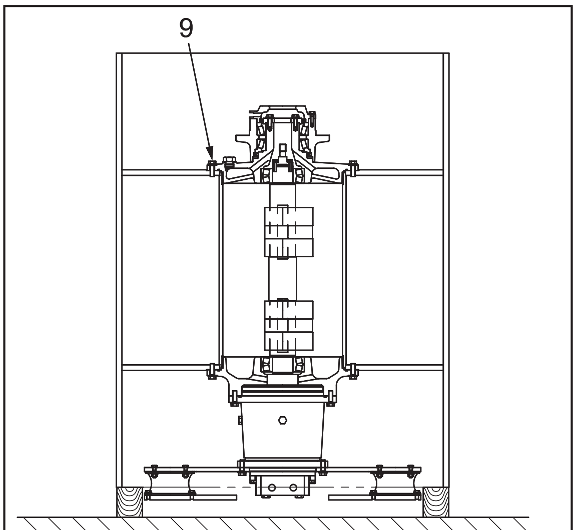
kg Axle shaft (32) subassembly
: 150 kg (331 lbs.)



SV400-2-06043

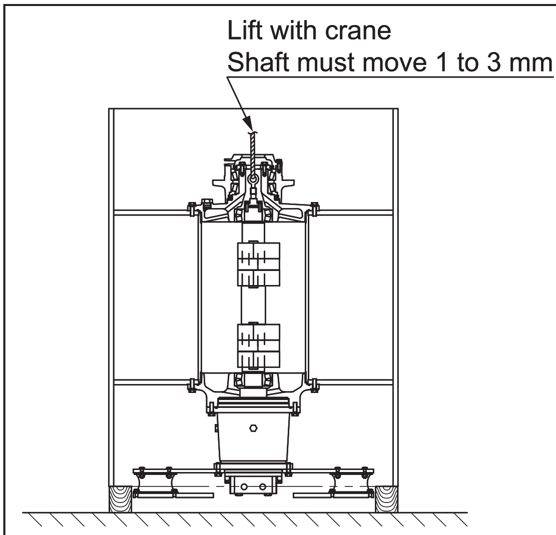
16)Using the sixteen bolts (9) and washers, firmly secure the axle shaft subassembly to the drum.
NOTE: When attaching, make sure that the O-ring does not protrude from the groove.

N·m (21) M16×50: 270 N·m (199 lbf·ft)



SV400-2-06044

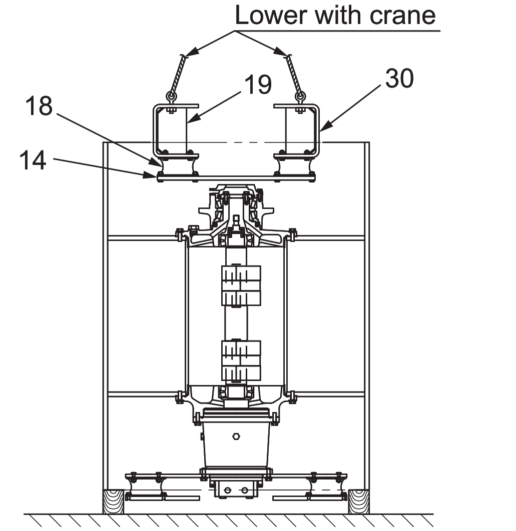
17)Attach a lifting bolt (M10×1.5) to the vibrator shaft end. Then slowly lift with a crane. Confirm that 1 to 3 mm (0.04 to 0.12 in.) of play exists in the axial direction.



SV400-2-06045

18)Using a crane, lift and slowly lower the subassembly of the holder (19 and 30), damper (18) and disc (14).

Total of lifted parts (19, 30, 18 and 14)
: 135 kg (298 lbs.)

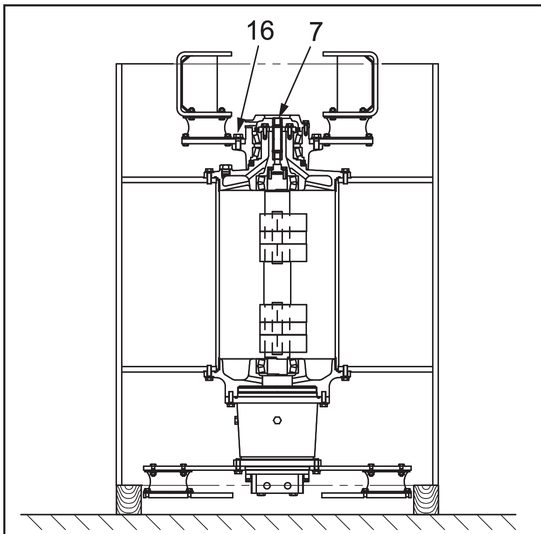


SV400-2-06046

19)Using the sixteen bolts (16) and washers, firmly secure the holder subassembly to the housing.

- Apply a molybdenum-based grease to the spline surface of the sleeve (7), and attach it to the spline shaft at the end of the vibrator shaft.

(16) M20×50: 540 N·m (398 lbf·ft)

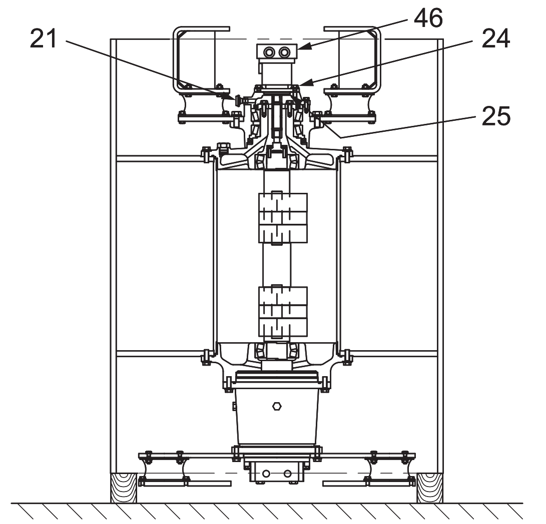


SV400-2-06047

20)Attach the breather (21).
- Attach the O-ring (25) to the vibrator motor (46). Using the two bolts (24) and washers, firmly secure it to the cover.

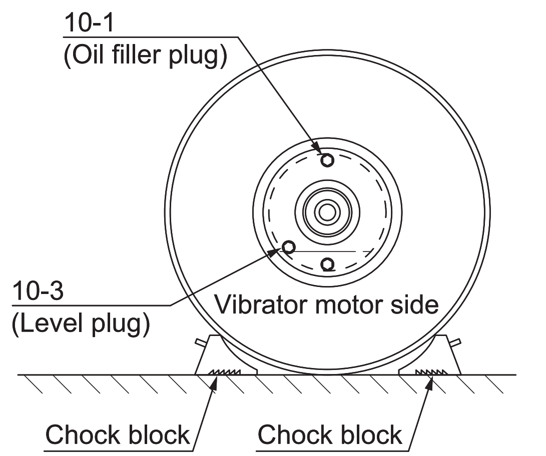
★ **Attach by aligning the top side of the vibrator motor (46) and breather (21) with the top side of the propulsion motor.**

N·m (24) M14×40: 170 N·m (125 lbf·ft)



SV400-2-06048

21)Lift the vibratory drum assembly with a crane, and set it sideways at the position of the plug shown in the figure on the right.
- Remove the oil filler plug and level plug.
- From the oil filler plug hole, add approximately 21 L (5.5 gal.) of gear oil until gear oil drips from the level plug hole.
- Attach the oil filler plug and level plug.

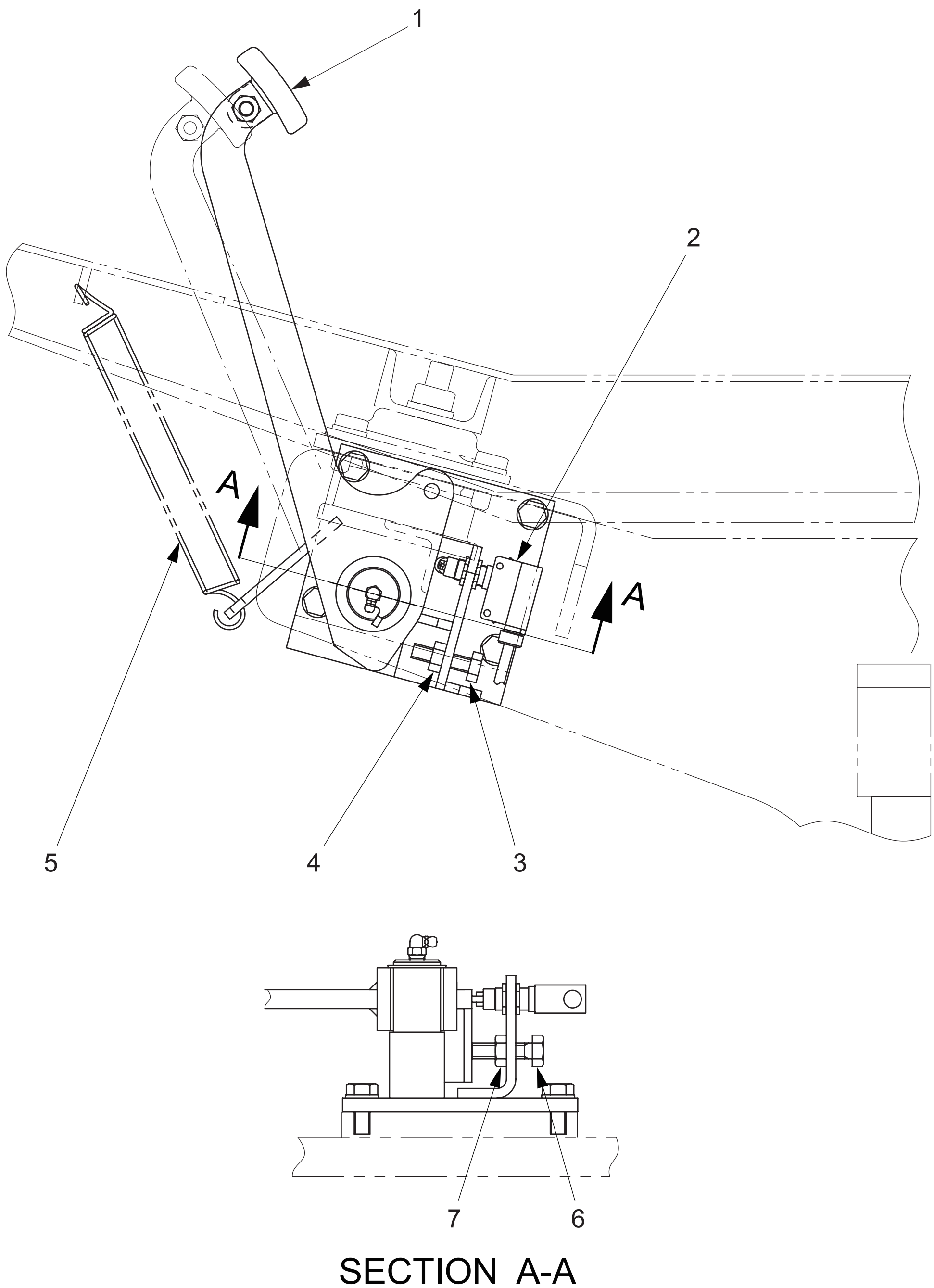


SV400-2-06049

BRAKE

1. BRAKE SYSTEM

1-1. Brake Pedal



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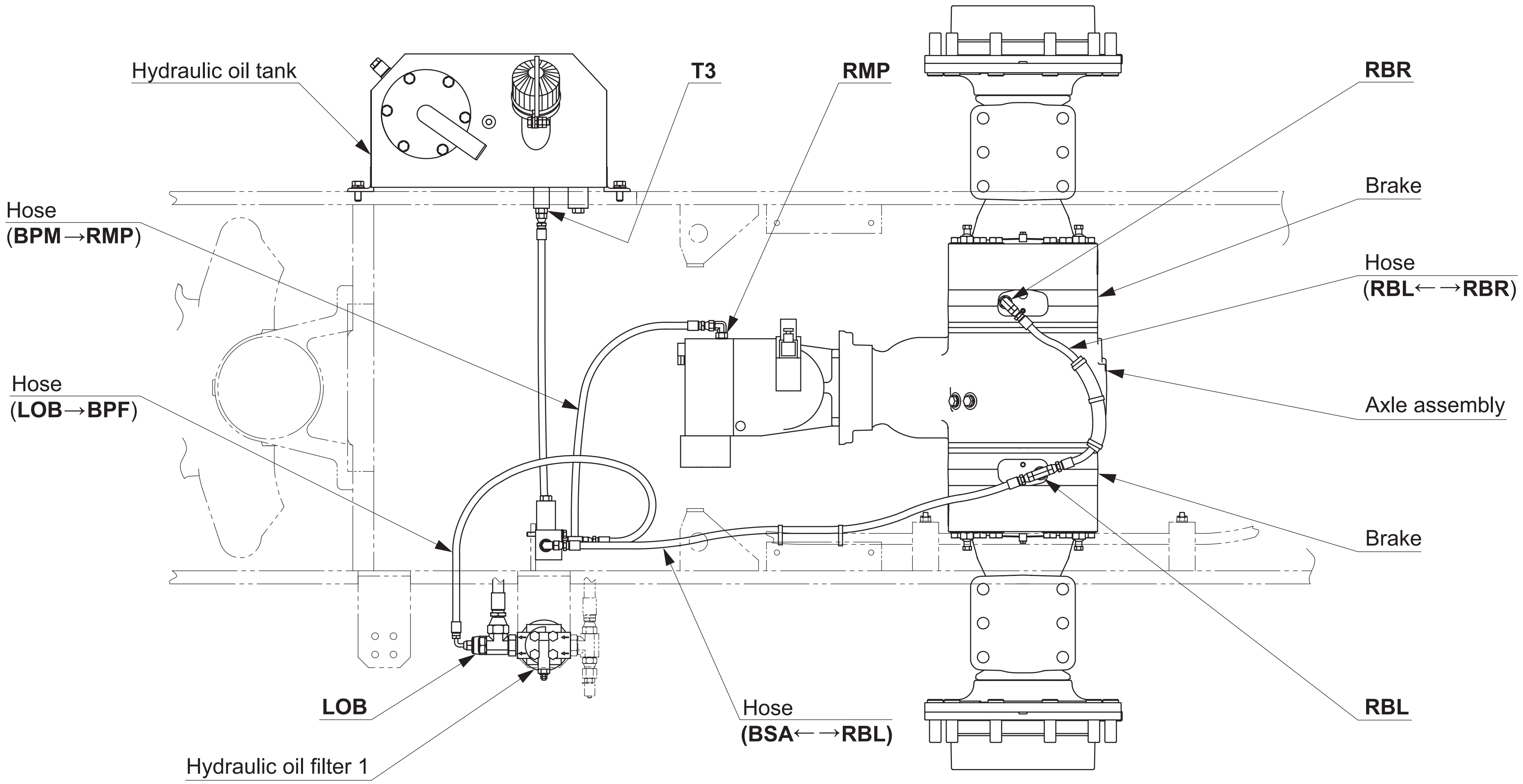
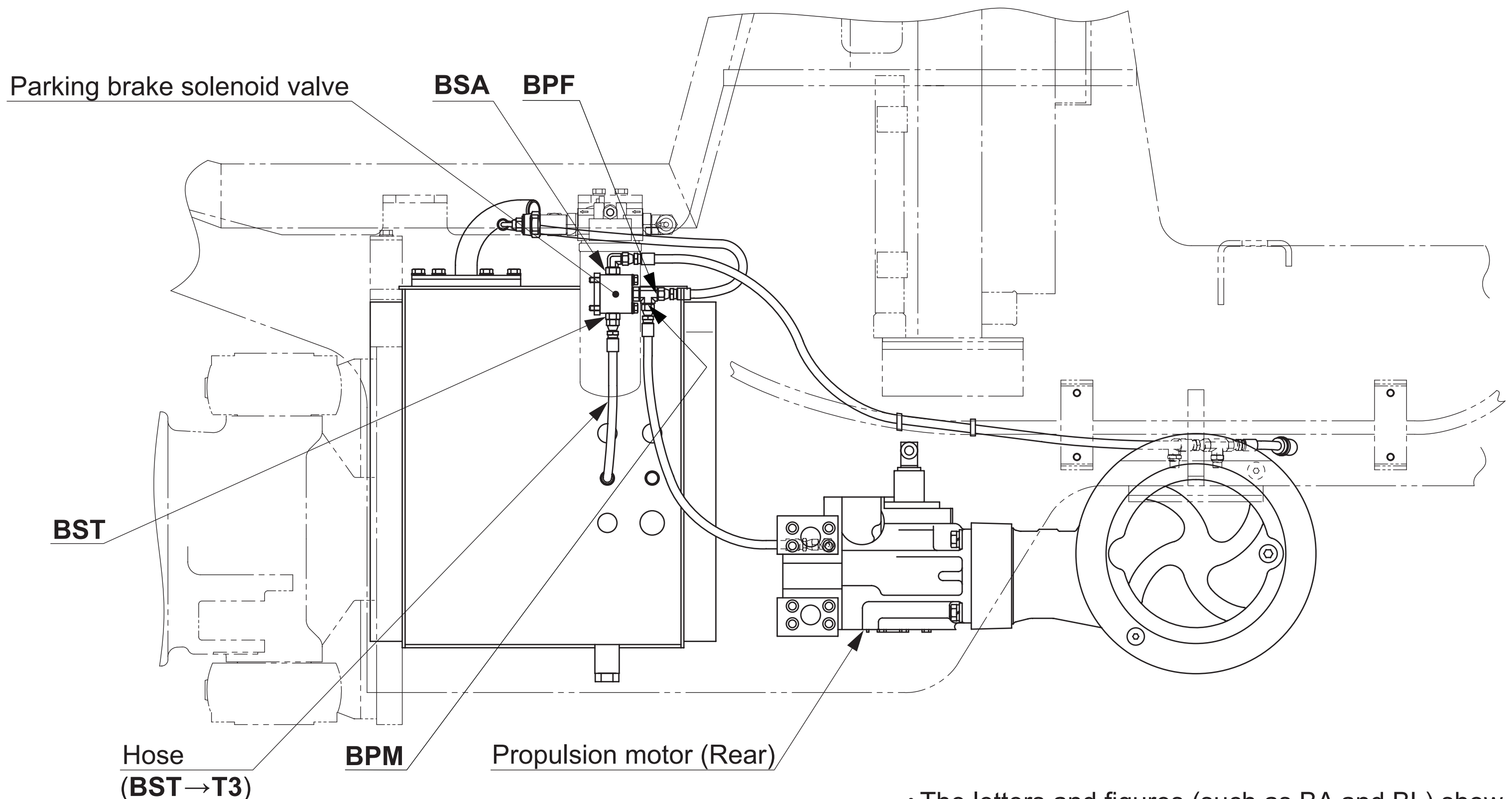
(1) Brake pedal
(2) Foot brake switch
(3) Stopper bolt : M10× 40
(4) Nut : M10
(5) Return spring
(6) Stopper bolt : M10× 40
(7) Nut : M10

2. BRAKE HYDRAULIC PIPING

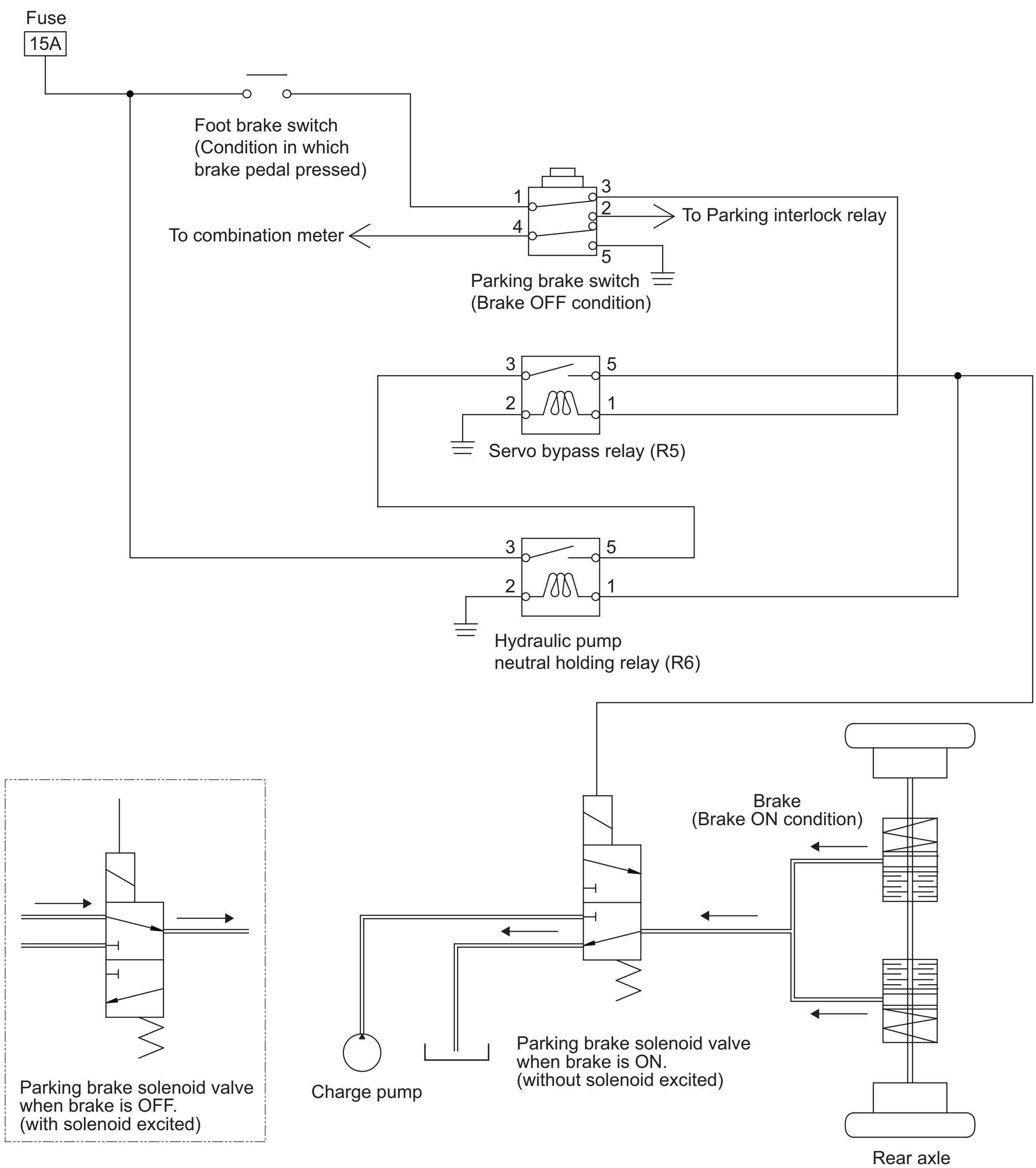




• The letters and figures (such as BA and BL) show each port and the arrow (←→;→) symbols show the hose connection and the direction of the flow of the oil.

0404-36827-0-11906-0

3. BRAKE SYSTEM

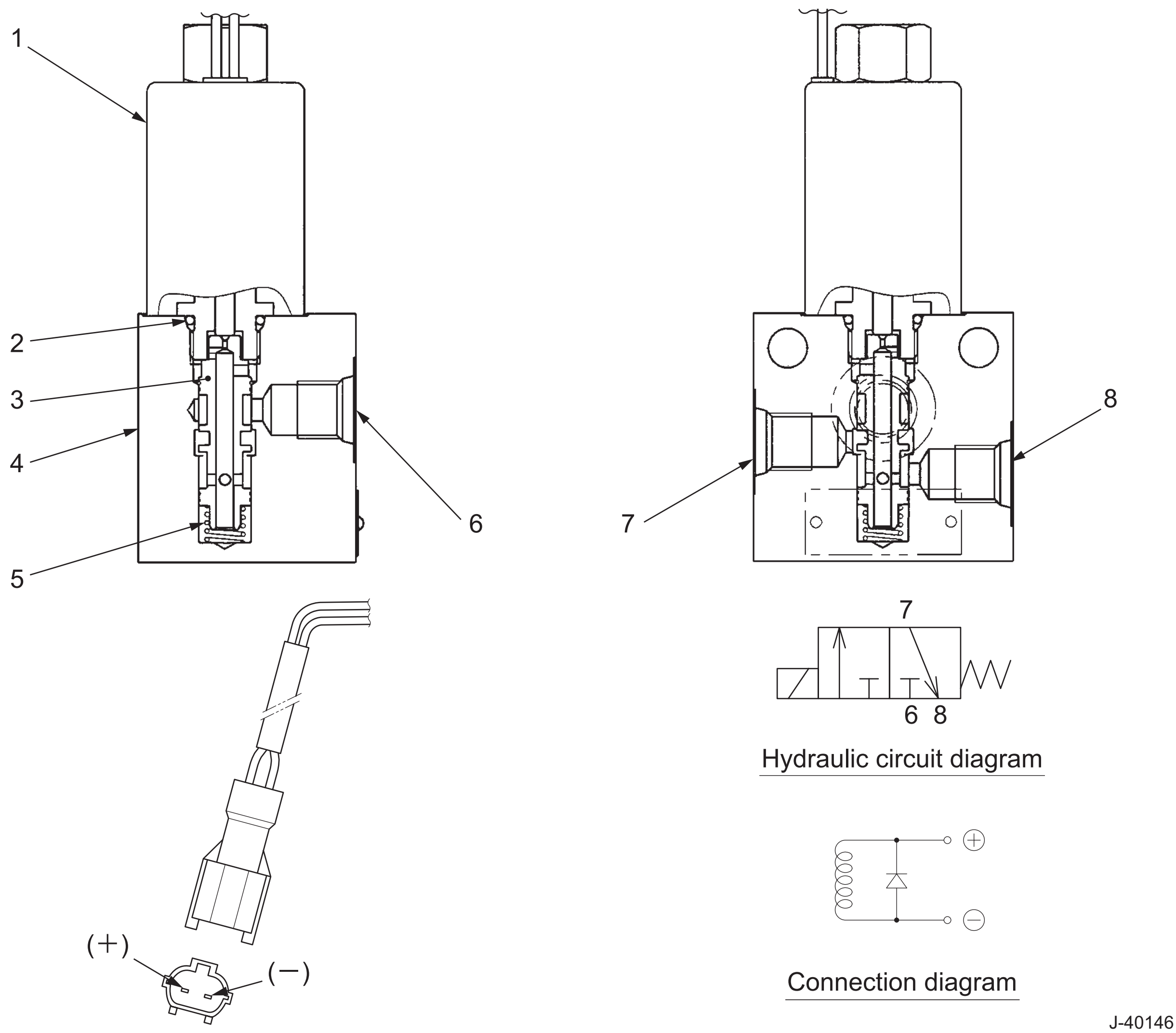


· The arrow (⟶) symbol shows the direction of the hydraulic oil flow.

SV412-07001

4. HYDRAULIC COMPONENT SPECIFICATION

4-1. Brake Solenoid Valve



(1) Solenoid
(2) O-ring (1B P14)
(3) Spool (J)
(4) Body
(5) Spring
(6) Port P **[BSP]** : 9/16-18UNF-2B
(7) Port A **[BSA]** : 9/16-18UNF-2B
(8) Port T **[BST]** : 9/16-18UNF-2B

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

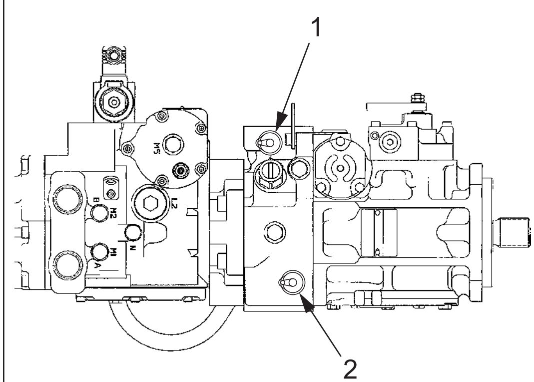
⚠WARNING

Confirm that the parking brake works properly before measurement.

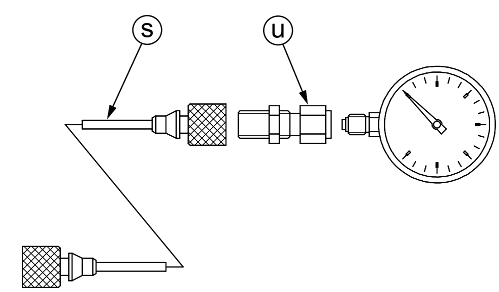
- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

① Remove plugs from couplings (1) and (2) 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)
- High pressure gauge port (Reverse) : (2)
- Pressure gauge : 0 to 50 MPa (0 to 7,250 psi)



SV412-08001



PG003163

② Set propulsion speed change switch to “ ”.

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

④ Establish a condition in which machine propulsion load becomes maximum.
(Pressure does not build up unless propulsion load is applied.)

⑤ With propulsion load at maximum, slowly move F-R lever to the side to be measured.

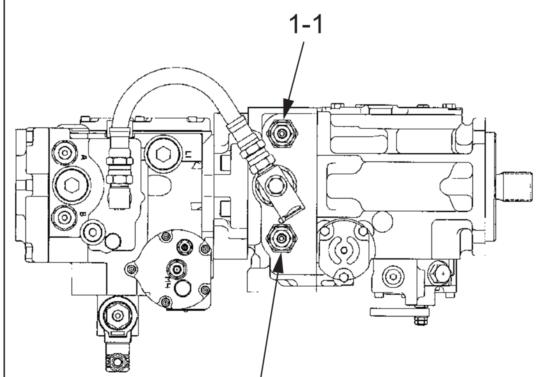
- Then, read pressure indicated by pressure gauge.

⑥ After measuring, promptly return F-R lever to “N”.

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

2-2. Adjustment

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



SV412-08002

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)

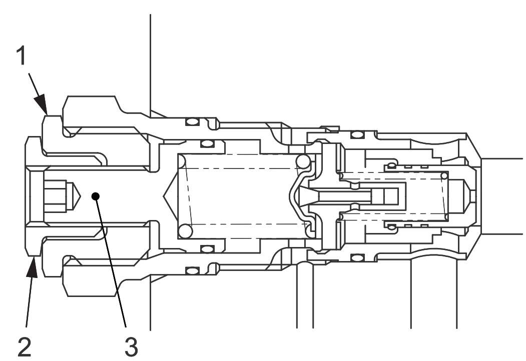
③ If there is no evidence of nut having loosened, remove multifunction valve.

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.



Multifunction valve
SV510-Ⅲ-08003

N•m

(1)	Nut	: 41 N·m (30 lbf·ft)
(2)	Nut	: 20 N·m (16 lbf·ft)
(1-10) (1-11)	Multifunction valve	: 89 N·m (66 lbf·ft)

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

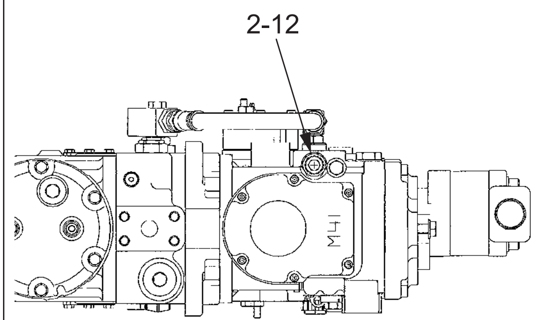
① Loosen nut (1) from charge relief valve (2-12) on vibrator pump side.

② Tighten adjustment screw (2) by 1/2 complete turns.

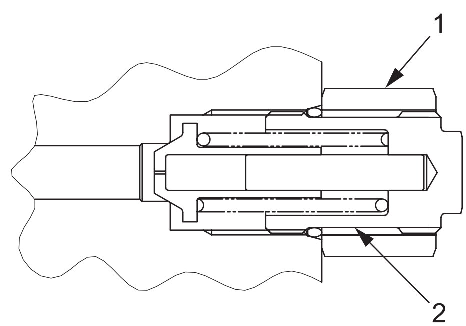
Adjustment screw turned clockwise
: Pressure rise

Adjustment screw turned counterclockwise
: Pressure drop

Pressure change rate
: 0.54 MPa/ 1/2 turn (78.3 psi/ 1/2 turn)



SV412-08003



SV520-08004

- The number “2-12” 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).

3-1. Measurement

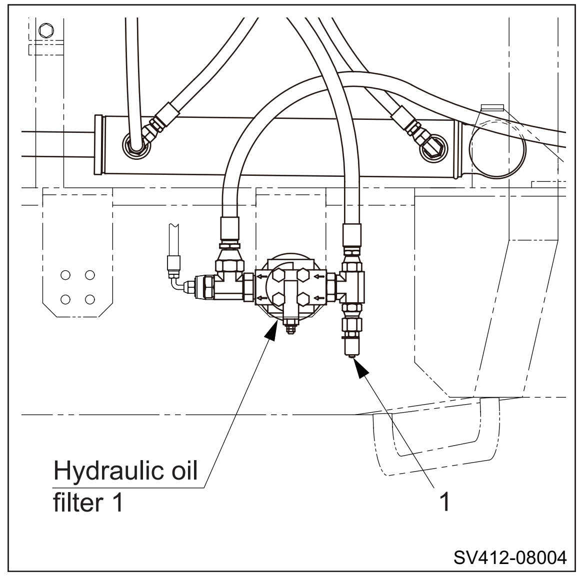
- Oil temperature during measurement : 50 ± 5°C (122 ± 9°F)

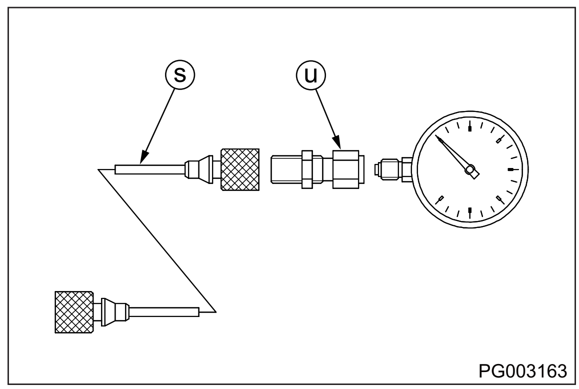
① Remove plug from coupling (1) of hydraulic oil filter 1.
Attach pressure gauge with hose ⓢ and connector ⓤ .
- Coupling : 9/16-18UNF×M16
- Adapter for hose ⓢ : M16 P=2.0
- Pressure gauge connector ⓤ : M16×G3/8

② Apply parking brake by pressing parking brake switch button.

③ Start the engine and set throttle switch to "FULL".
- Then, read pressure indicated by pressure gauge.

★ **Standard charge relief valve setting**
: 2.5 ± 0.2 MPa (363 ± 29 psi)





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 (1-10) 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.

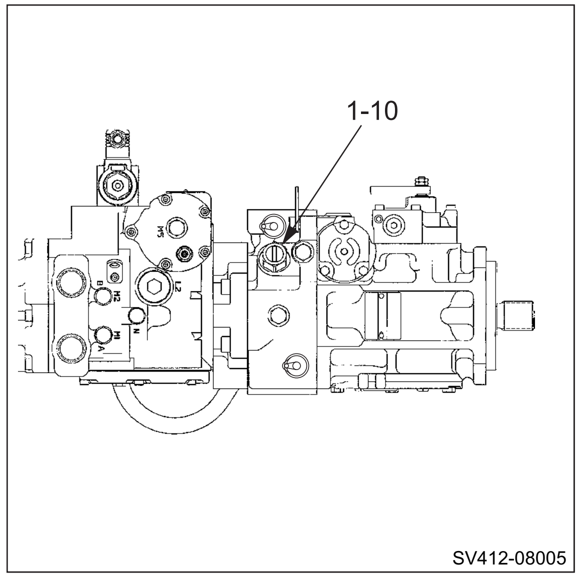
⑥ If a scratch is found on seat, replace charge relief valve.

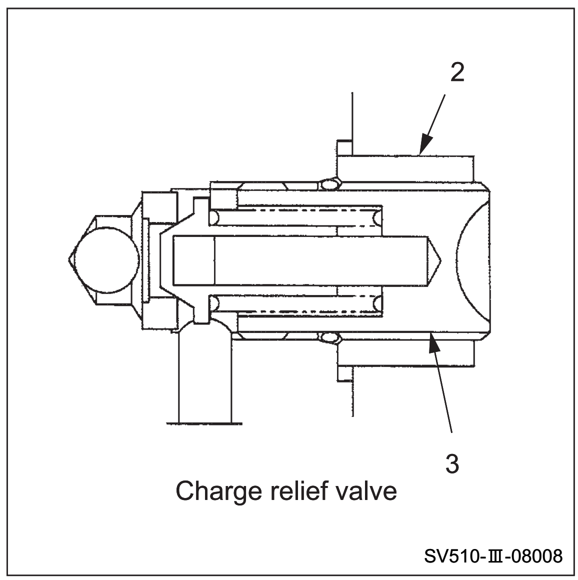
⑦ After adjustment, measure pressure again and check that pressure reaches standard charge relief valve setting range.

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.**





Charge relief valve

- The number “1-10” 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 PROPULSION SERVO CIRCUIT PRESSURE

4-1. Measurement

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

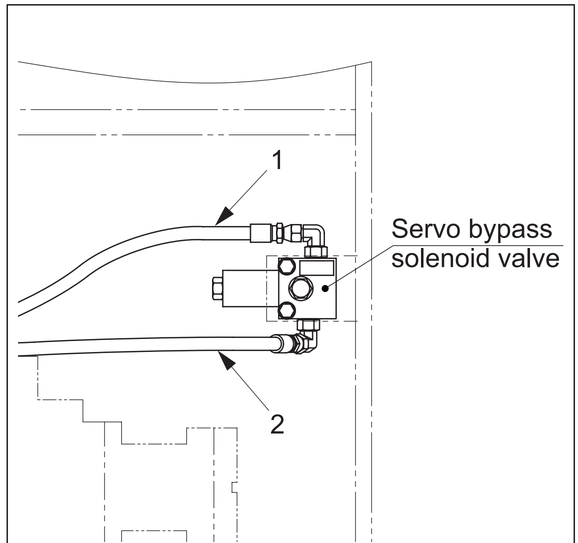
① Disconnect the hoses (1) and (2) from servo bypass solenoid valve. Attach pressure gauge through adapter ⓦ.
- Adapter ⓦ : 4-4LOHL6G5TP (Parker part number)
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Apply parking brake by pressing parking brake switch button.

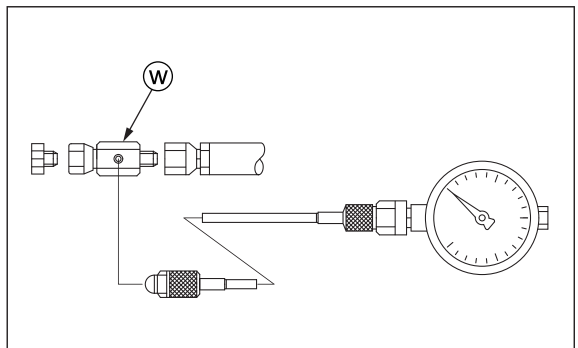
③ Start the engine and set throttle switch to “FULL”.

④ Operate F-R lever and then read pressure indicated by pressure gauge.
- With parking brake “ON”, measured pressures of (1) and (2) are the same.
- With parking brake “OFF”, measured pressures of (1) and (2) are different.

★ Standard charge relief pressure setting
: 2.5 ± 0.2 MPa (363 ± 29 psi)



SV412-08023



PG002060

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

5-1. Measurement

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

① Remove plugs from rear propulsion motor gauge ports (1) and (2). Attach pressure gauge with the adapter ⓗ .

- Adapter ⓗ : 9/16-18UNF
- Servo pressure gauge port (Low) : (1)
- Servo pressure gauge port (High) : (2)
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Apply parking brake by pressing parking brake switch button.

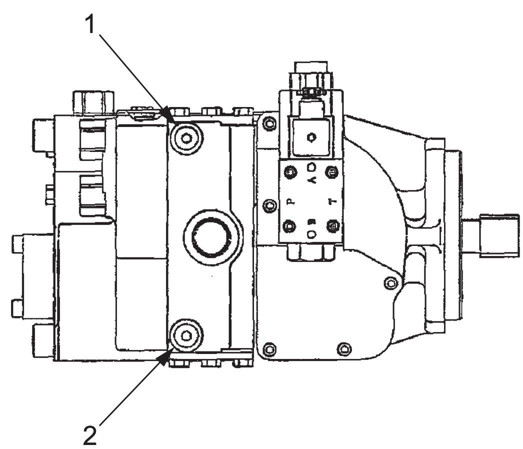
③ Set propulsion speed change switch to "  " or "  ".

④ Start the engine and set throttle switch to "FULL".

- Then, read pressure indicated by pressure gauge.

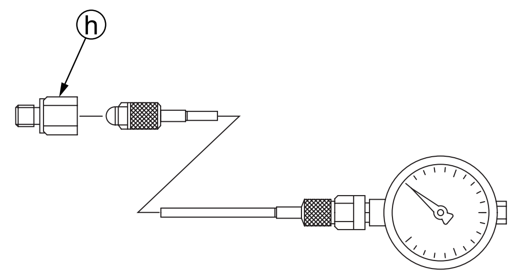
★ **Standard charge relief valve setting**

: 2.67 ± 0.2 MPa (387 ± 29 psi)



Propulsion motor (Rear)

SV505- I -08001



PG001014

6. MEASUREMENT OF PARKING BRAKE RELEASE PRESSURE

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

6-1. Measurement

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

① Disconnect hose (1) from brake solenoid valve. Attach pressure gauge through adapter ⓦ .
  - Adapter ⓦ : 4-4LOHL6G5TP (Parker part number)
  - Pressure gauge : 0 to 5 MPa (0 to 725 psi)

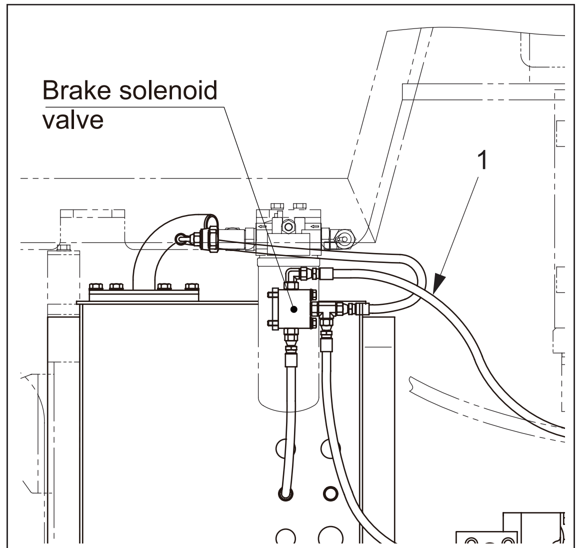
② Confirm that F-R lever is in “N”.

③ Apply parking brake by pressing parking brake switch button.

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

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)**



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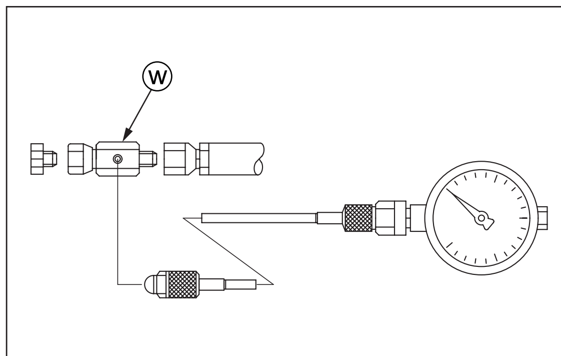


PG002060

7. MEASUREMENT AND INSPECTION OF VIBRATOR CIRCUIT PRESSURE

7-1. Measurement

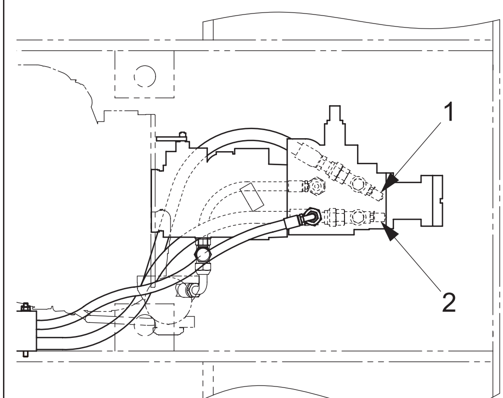
CAUTION

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

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

① Remove plugs from couplings (1) and (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) : (1)
- High pressure gauge port (High amplitude) : (2)
- Pressure gauge : 0 to 50 MPa (0 to 7,250 psi)



SV412-08007

② Apply parking brake by pressing parking brake switch button.

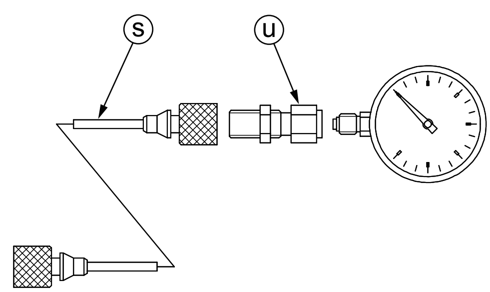
③ Set vibration mode change switch to “ ”.

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

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.



PG003163

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

7-2. Inspection

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

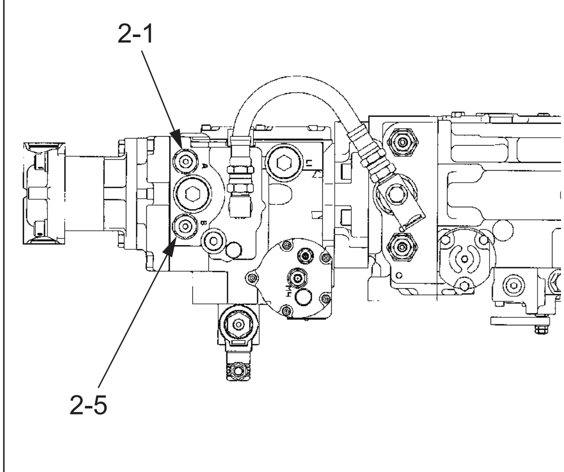
① Remove plug and valve from high pressure relief valve port (2-1) or (2-5) of vibrator pump.
  - High pressure relief valve port : (2-5) (Low amplitude)
  - High pressure relief valve port : (2-1) (High amplitude)

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 cleaned, replace high pressure relief valve.

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

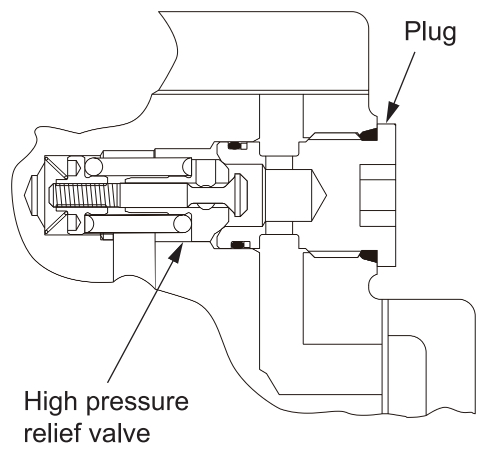


SV412-08008

N•m Plug : 40 N·m (30 lbf·ft)

(NOTICE)

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



SV412-08024

- The numbers “2-1” and “2-5” 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).

8. MEASUREMENT AND ADJUSTMENT 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.

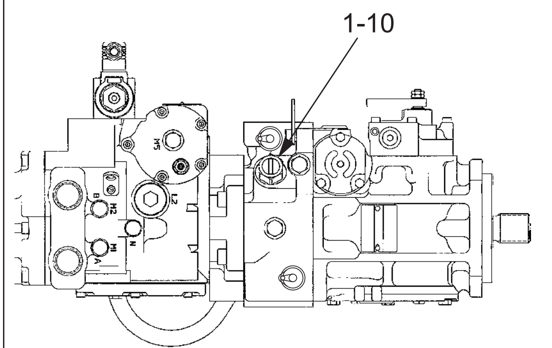
① Loosen nut (2) from charge relief valve (1-10) on propulsion pump side.

② Tighten adjustment screw (3) by two complete turns.

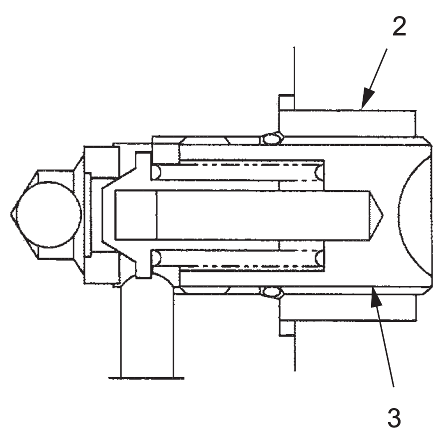
Adjustment screw turned clockwise
: Pressure rise

Adjustment screw turned counterclockwise
: Pressure drop

Pressure change rate
: 0.78 MPa/ 2 turns (113 psi/ 2 turns)



SV412-08005



Charge relief valve

SV510-Ⅲ-08008

- The number “1-10” 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).

8-1. Measurement

- Oil temperature during measurement : 50 $\pm$ 5°C (122 $\pm$ 9°F)

① Remove plug from coupling (1) of hydraulic oil filter 1.
Attach pressure gauge with hose ⓢ and connector ⓤ.

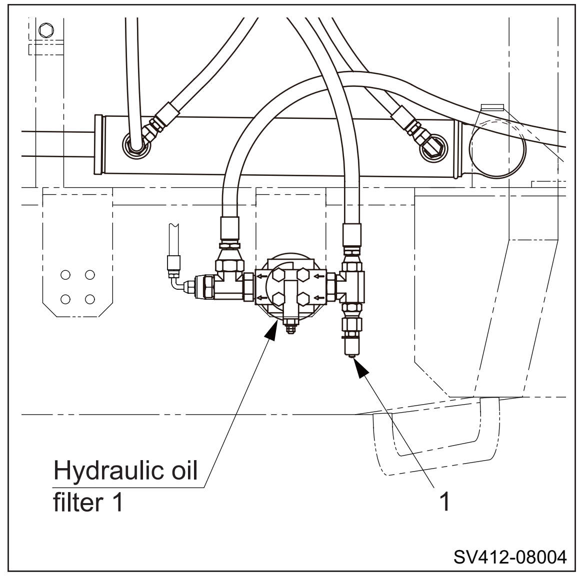
- Coupling : 9/16-18UNF×M16
- Adapter for hose ⓢ : M16 P=2.0
- Pressure gauge connector ⓤ : M16×G3/8
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

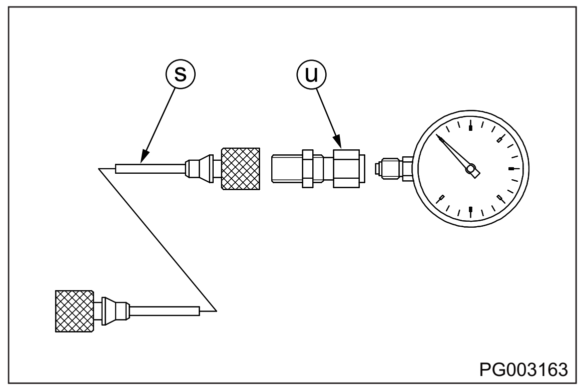
② Apply parking brake by pressing parking brake switch button.

③ Start the engine and set throttle switch to "FULL".

- Then, read pressure indicated by pressure gauge.

★ **Standard charge relief valve setting**
: 2.5 $\pm$ 0.2 MPa (363 $\pm$ 29 psi)





8-2. 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 (1) of charge relief valve (2-12) 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 (2).

  Adjustment screw turned clockwise
  : Pressure rise
  Adjustment screw turned counterclockwise
  : Pressure drop
  Pressure change rate
  : 0.27 MPa/ 1/4 turn (39.2 psi/ 1/4 turn)

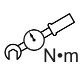
③ If there is no evidence of nut having loosened, remove charge relief valve.

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.

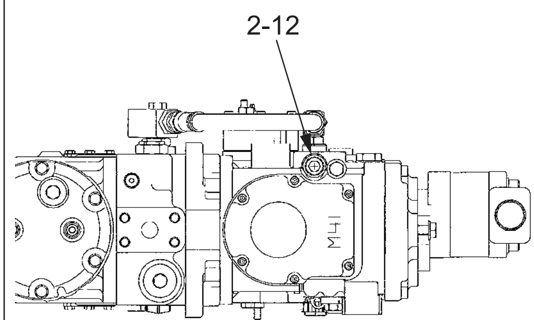
⑦ After adjustment, measure pressure again and check that pressure reaches standard charge relief valve setting range.



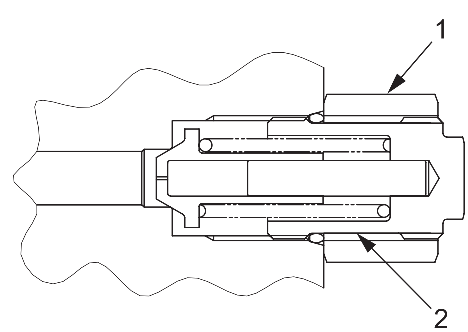
(1) Nut : 40 N·m (30 lbf·ft)

(NOTICE)

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



SV412-08003



SV520-08004

- The number “2-12” 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. MEASUREMENT OF VIBRATOR HIGH/LOW CHANGE CIRCUIT PRESSURE

9-1. Measurement

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

① Remove plugs from servo pressure gauge ports (2-3) and (2-10). Attach pressure gauge with the adapter ⓗ .

- Adapter ⓗ : 9/16-18UNF
- Servo pressure gauge port (Low) : (2-10)
- Servo pressure gauge port (High) : (2-3)
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Apply parking brake by pressing parking brake switch button.

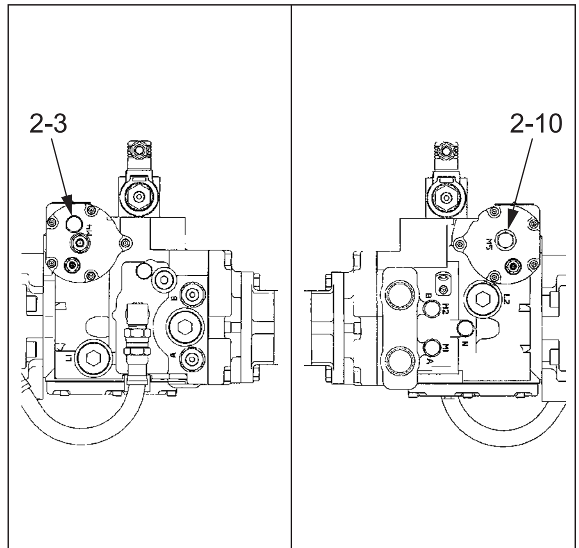
③ Start the engine and set throttle switch to “FULL”.

④ Set vibration select switch and then read pressure indicated by pressure gauge.

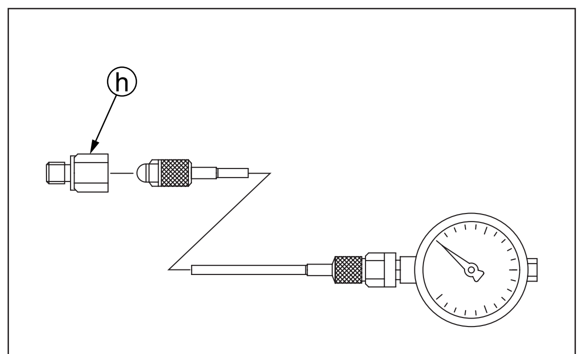
- With vibration select switch is in “○”, measured pressures of (2-3) and (2-10) are same.
- With vibration select switch is in “ ” or “ ”, measured pressures of (2-3) and (2-10) are different.

★ Standard charge relief valve setting

: 2.5 ± 0.2 MPa (363 ± 29 psi)



SV412-08009



PG001014

10. MEASUREMENT AND INSPECTION OF STEERING CIRCUIT PRESSURE

10-1. Measurement

⚠WARNING

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

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

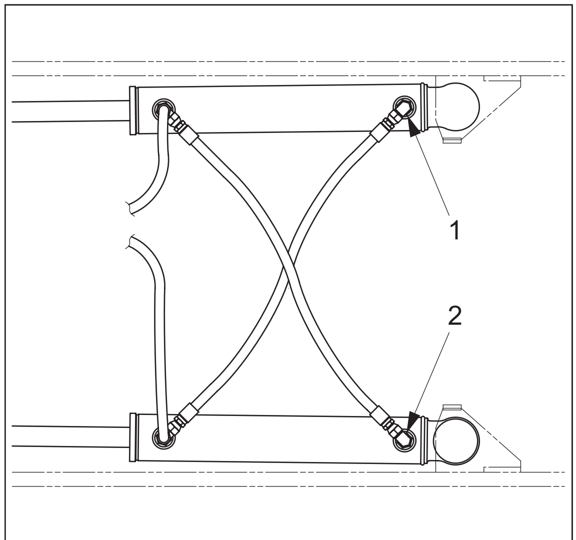
① Disconnect the hose (1) or (2) from steering cylinder.
Attach pressure gauge through adapter ⓧ .
- Adapter ⓧ : 6-4LOHL6G5TP (Parker part number)
- Pressure gauge : 0 to 25 MPa (0 to 3,625 psi)

② Confirm that F-R lever is in "N" properly.

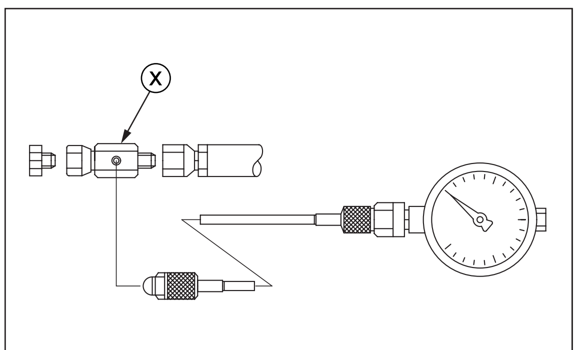
③ Start the engine and set throttle switch to "FULL".

④ Turn steering wheel to operate relief valve.
- Then, read pressure indicated by pressure gauge.

★ **Standard maximum circuit pressure (orbitroll relief pressure + charge relief pressure) : 17.5 ± 1.0 MPa (2,538 ± 145 psi)**



SV412-08025

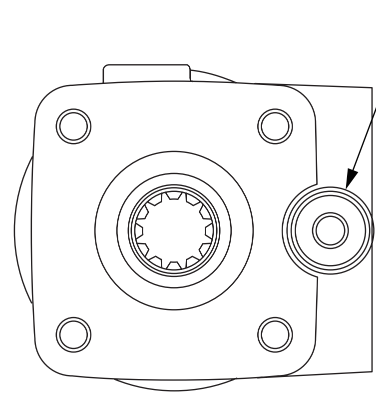


PG002090

10-2. Inspection

- If measurement results indicate the pressure deviating from standard maximum circuit pressure range, make an inspection 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.



SW880-10018

(NOTICE)

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

11. MEASUREMENT AND INSPECTION OF BLADE CIRCUIT PRESSURE (SV412TB, FB)

11-1. Measurement

WARNING

Make sure that there is no person around the blade portion of the machine before operating the blade control lever.

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

① Disconnect hose (1) or (2) from blade cylinder. Attach pressure gauge through the adapter ⓧ .
- Adapter ⓧ : 6-4LOHL6G5TP (Parker part number)
- Pressure gauge : 0 to 25 MPa (0 to 3,625 psi)

② Confirm that F-R lever is in “N” properly.

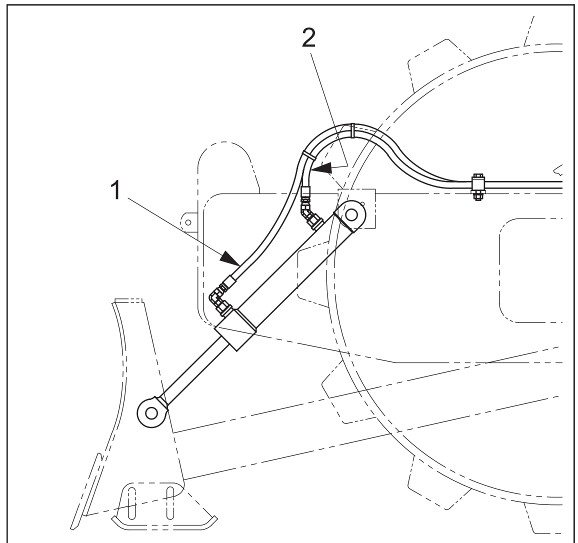
③ Set steering wheel to a position where vibratory drum faces straight forward.

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

⑤ Move blade control lever to operate relief valve.
- Then, read pressure indicated by pressure gauge.

★ **Standard maximum circuit pressure (stack valve relief pressure)**

: 13.7 ± 1.0 MPa (1,987 ± 145 psi)



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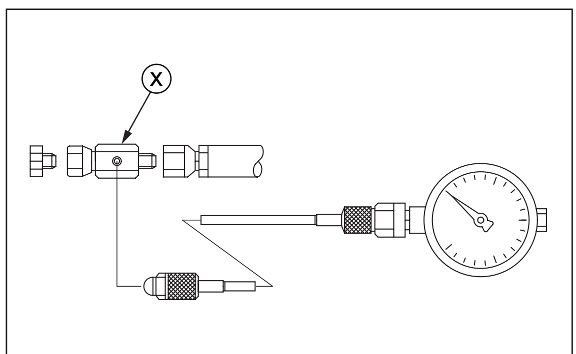


PG002090

11-2. Inspection

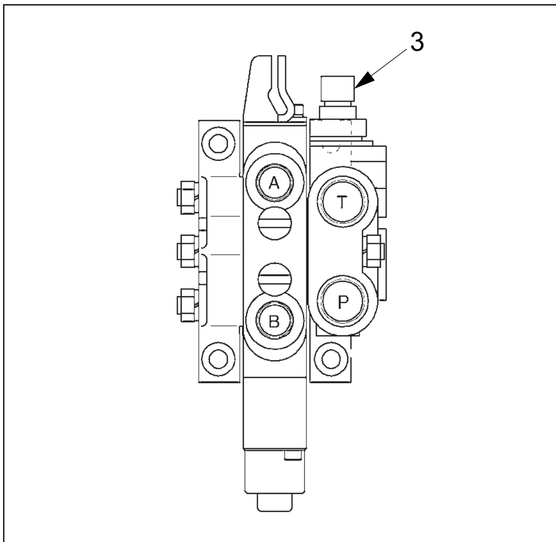
- If measurement results indicate the pressure deviating from standard maximum circuit pressure range, make an inspection in accordance with procedure described below.

① Remove relief valve (3) from stack valve.
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.

N•m (3) Relief valve : 39.2 ± 4 N·m (28.9 ± 3 lbf·ft)

(NOTICE)

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



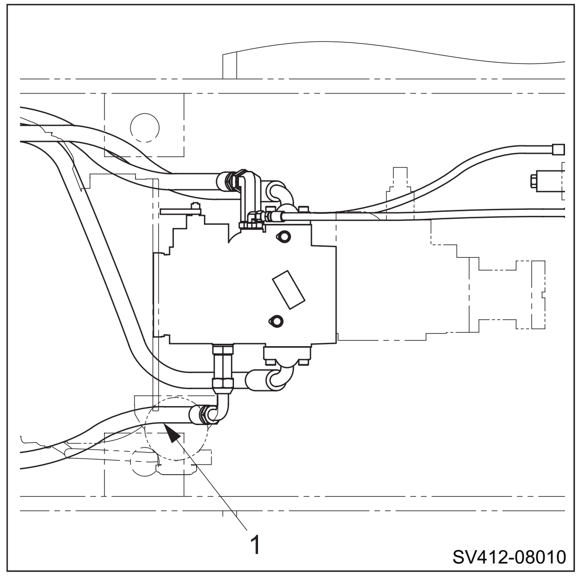
SV201-1-08009

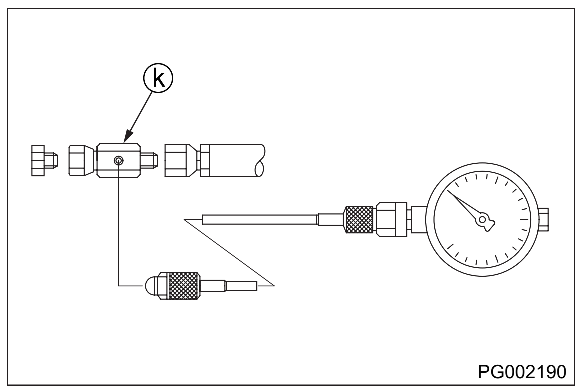
12. MEASUREMENT OF HYDRAULIC PUMP CASE PRESSURE

12-1. Measurement

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

① Disconnect hose (1) from propulsion pump. Attach pressure gauge through adapter ⓚ .
- Adapter ⓚ : 12-4LOHL6G5TP (Parker part number)
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)





② Set propulsion speed change switch to “ ”.
③ Start the engine and set throttle switch to “FULL”.
④ Establish a condition in which machine propulsion load becomes maximum.
(Pressure does not build up unless propulsion load is applied.)
⑤ With propulsion load at maximum, measure pressure when speed change switch is in “ ” and “ ” and F-R lever is in “N”, “F”, and “R”, respectively.

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

13. MEASUREMENT OF PROPULSION MOTOR CASE PRESSURE

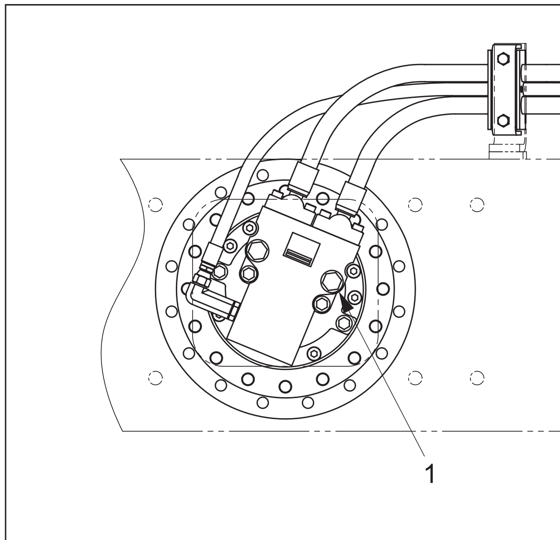
13-1. Measurement of Front Propulsion Motor

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

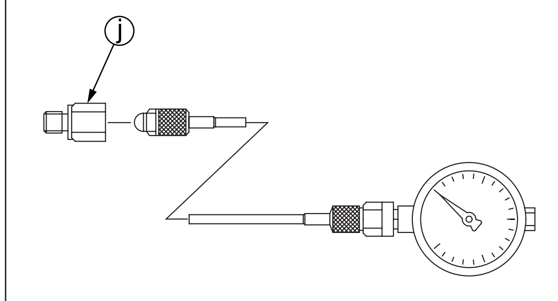
① Remove plug from drain port (1). Attach pressure gauge and adapter ⓙ.
  - Adapter ⓙ : 7/8-14UNF
  - Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Set propulsion speed change switch to “ ”.
③ Start the engine and set throttle switch to “FULL”.
④ Establish a condition in which machine propulsion load becomes maximum.
(Pressure does not build up unless propulsion load is applied.)
⑤ With propulsion load at maximum, measure pressure when speed change switch is in “ ” and “ ” and F-R lever is in “N”, “F”, and “R”, respectively.

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



SV412-08012



PG001022

13-2. Measurement of Rear Propulsion Motor

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

① Remove plug from drain port (1). Attach pressure gauge and adapter ⓩ .

- Adapter ⓩ : 1 1/16-12UN
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

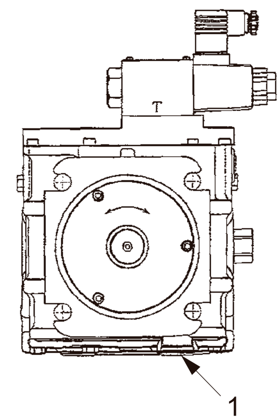
② Set propulsion speed change switch to " ".

③ Start the engine and set throttle switch to "FULL".

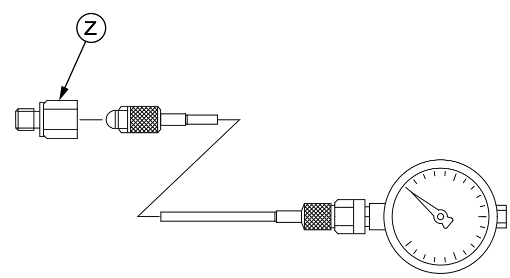
④ Establish a condition in which machine propulsion load becomes maximum.
(Pressure does not build up unless propulsion load is applied.)

⑤ With propulsion load at maximum, measure pressure when speed change switch is in " " and " " and F-R lever is in "N", "F", and "R", respectively.

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



Propulsion motor (rear)
SV505- I -08005



PG001027

14. MEASUREMENT OF VIBRATOR MOTOR CASE PRESSURE

14-1. Measurement

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

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

① Remove 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 “ ”.

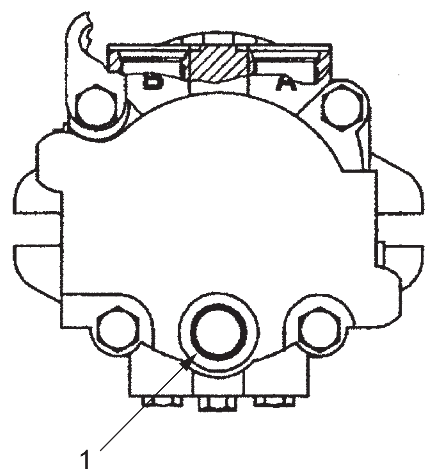
④ Start the engine and set throttle switch to “FULL”.

⑤ Press F-R lever vibration switch ON.

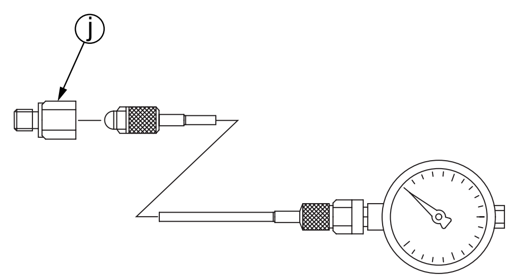
⑥ Measure pressure when vibration select switch is in “ ” and “ ”, respectively.

⑦ Turn F-R lever vibration switch OFF as soon as measurement is finished.

★ Allowable motor case pressure
: 0.17 MPa (24.7 psi) or less



SV412-08013



PG001022

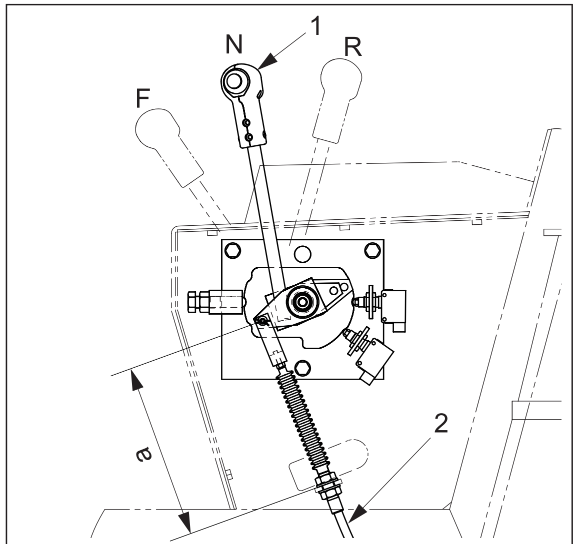
15. ADJUSTMENT OF F-R LEVER LINKAGE

15-1. Adjustment

- In cases such as propulsion hydraulic pump is replaced, control cable is replaced or F-R lever does not move smoothly, make an adjustment in accordance with procedure described below.
- “N”, maximum “F”, and maximum “R” positions of F-R lever (1) are positioned by notches.

① Set F-R lever in “N”.
② Attach both ends of control cable (2).

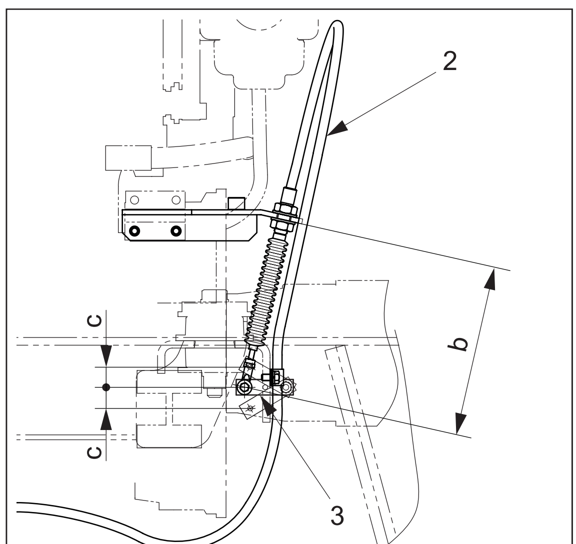
★ **Specified dimension a : 239 mm (9.41 in.)**



SV412-08015

③ Confirm the strokes of propulsion pump control lever (3).

★ **Specified dimension b : 211 mm (8.31 in.)**
c : 26 mm (1.0 in.)

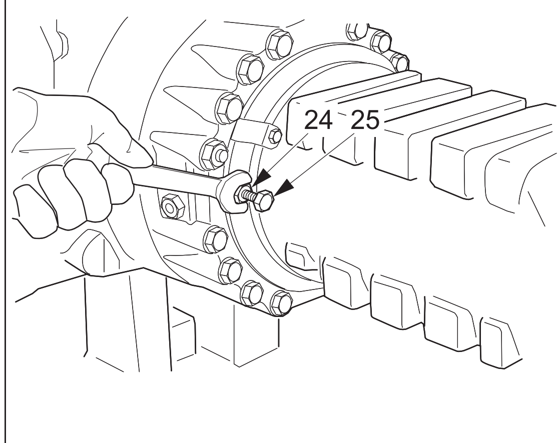


SV412-08016

16. BRAKE ADJUSTMENT

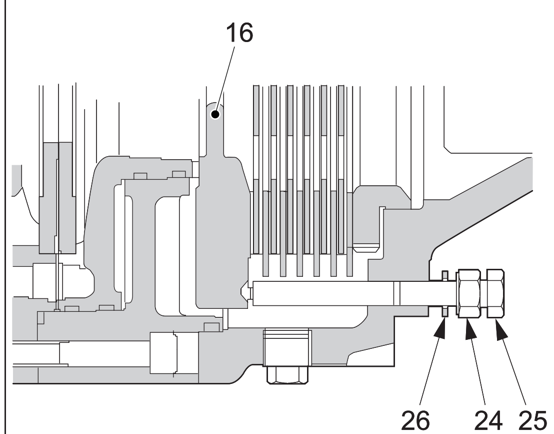
16-1. Manually Releasing the Brake

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



SV510-Ⅲ-08027

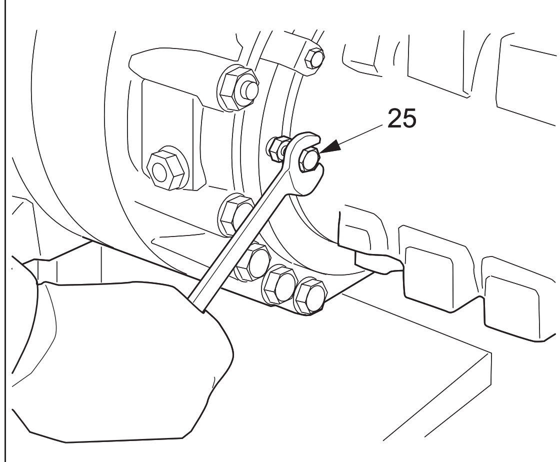
2) Tighten bolt (25), and press it into disc (16).
   - Do the same with bolt on the opposite side.



SV510-Ⅲ-08028

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

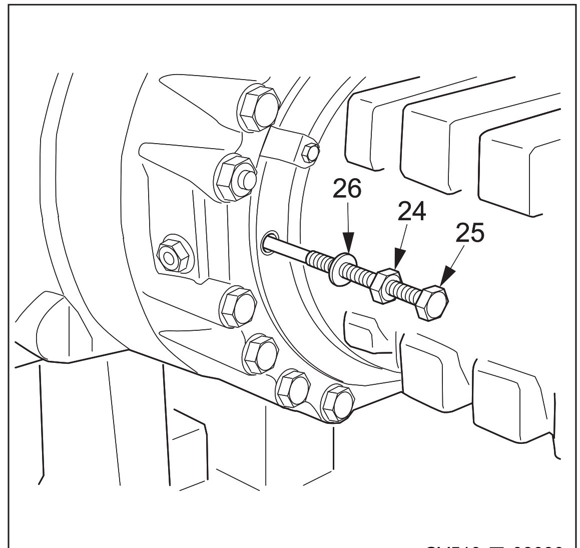
★ **After bolt end makes contact with disc (16), strictly observe not tightening bolt (25) more than one complete turn.**



SV510-Ⅲ-08029

16-2. Adjustment after Manual Release of Brake

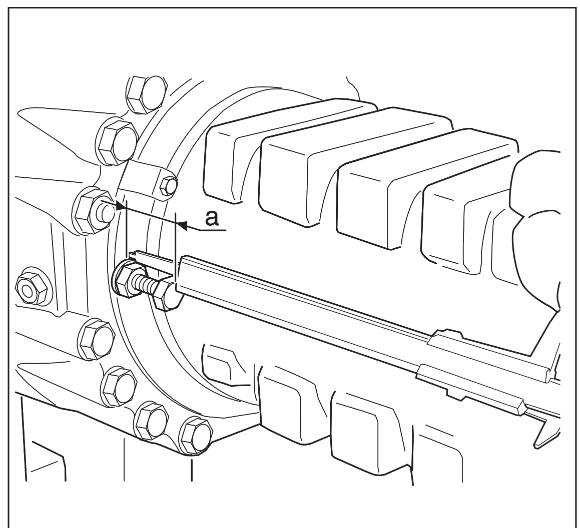
① Remove bolt (25), nut (24), and seal washer (26).
② Replace seal washer (26) with a new one.
③ Apply grease to bolt (25) threads.
④ As shown on the right, install bolt (25), nut (24), and seal washer (26).



SV510-Ⅲ-08030

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

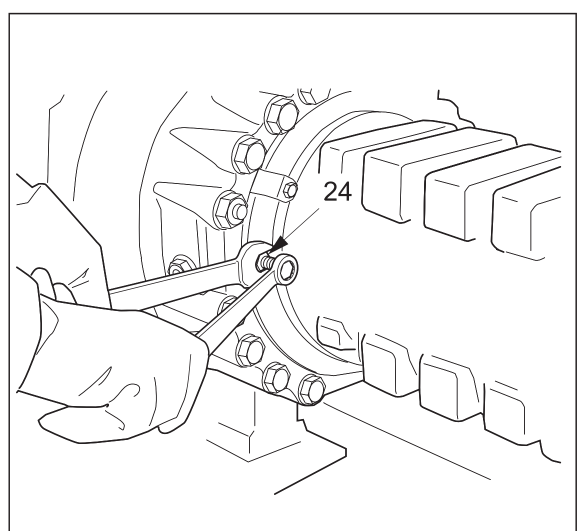
★ **Specified dimension a: 30 $^{+0.5}_{0}$ mm (1.34 $^{+0.02}_{0}$ in.)**



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.**

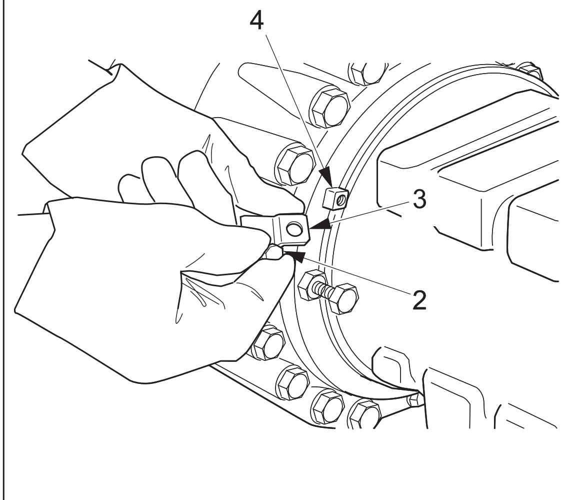


SV510-Ⅲ-08032

16-3. Brake Clearance Adjustment

- 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)

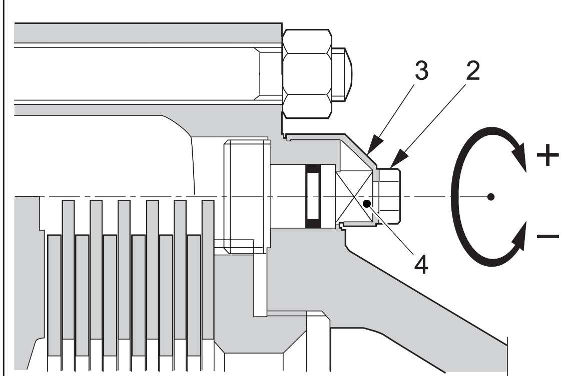


SV510-Ⅲ-08026

- 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)



SV510-Ⅲ-08025

17. HIGH TORQUE TYPE ONLY

17-1. Measurement of Propulsion Motor Case Pressure

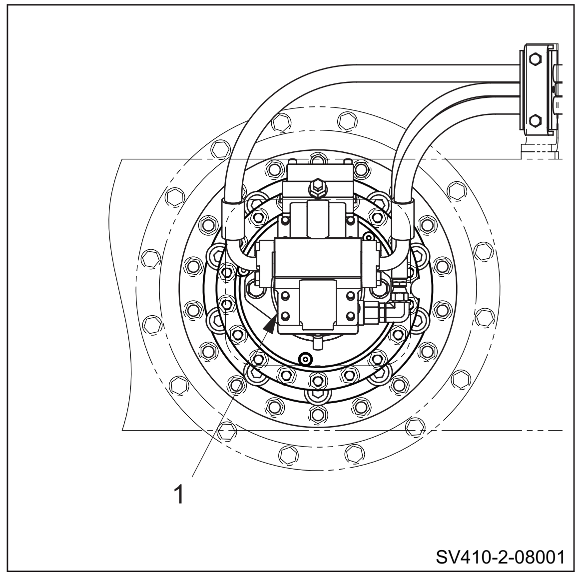
17-1-1. Measurement of front propulsion motor

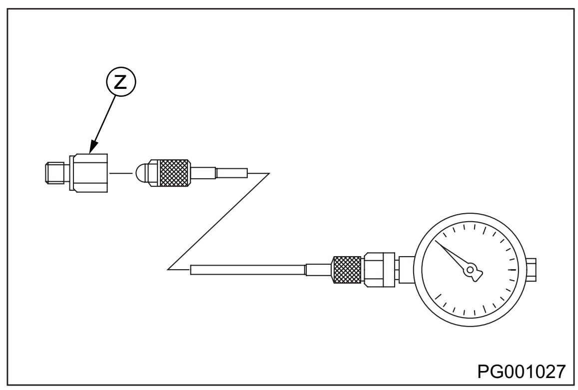
- Oil temperature during measurement : $50_{\pm 5}$°C ($122_{\pm 9}$°F)

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

② Set propulsion speed change switch to “ ”.
③ Start the engine and set throttle switch to “FULL”.
④ Establish a condition in which machine propulsion load becomes maximum.
(Pressure does not build up unless propulsion load is applied.)
⑤ With propulsion load at maximum, measure pressure when speed change switch is in “ ”, “ ” and “ ” and F-R lever is in “N”, “F”, and “R”, respectively.

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





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 Number and Color Code

Refer to "1-1. Wire Numbers, Wire Sizes, Wire Colors and Connectors Shown in Electrical Circuit Diagram, Wiring Harness Layout and Wiring Harnesses" of ELECTRICAL SYSTEM.

2. ELECTRICAL SYSTEM TROUBLESHOOTING

2-1. When Performing Electrical System Fault Diagnosis

WARNING

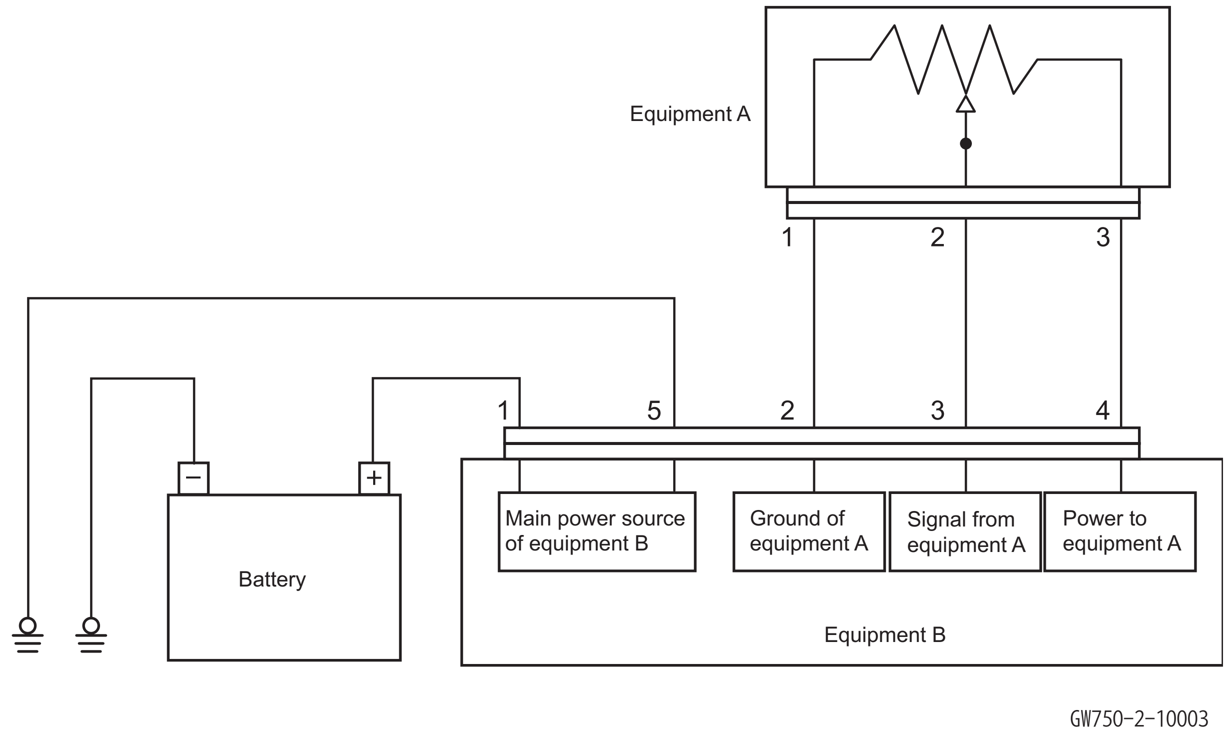
Be very careful because equipment can return to normal during an inspection and suddenly operate properly when a failure occurs due to a faulty contact or other such cause.

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.

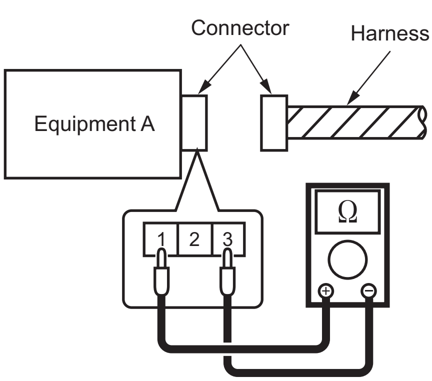
2-1-2. Inspection procedures using a tester

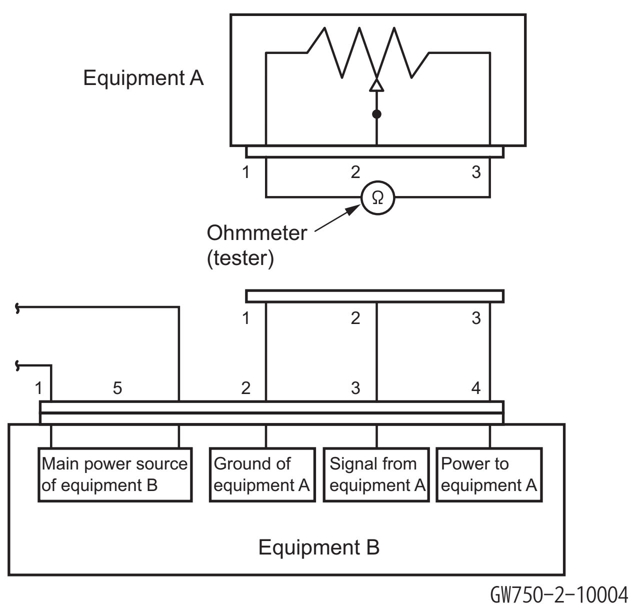
Some of the various inspection procedures are presented here for reference, using a sample circuit below.



1) Measuring resistance using tester

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



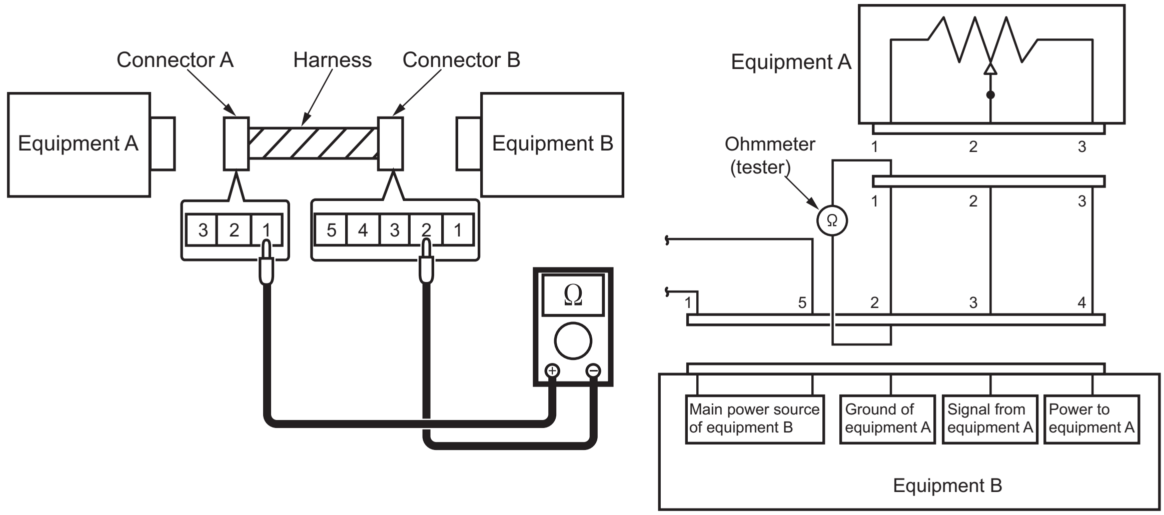


Inspection procedure

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.

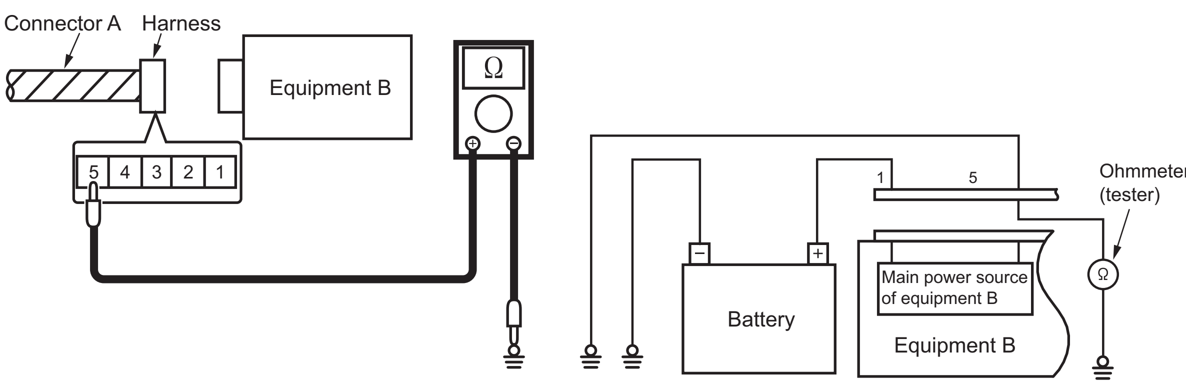
② Connect the test probe (+) to connector terminal 1 of equipment A and the test probe (-) to connector terminal 2 of equipment B and measure the resistance. At this time, reversing the connector terminals between the probes (+) and (-) does not make any difference in the measurement.

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.

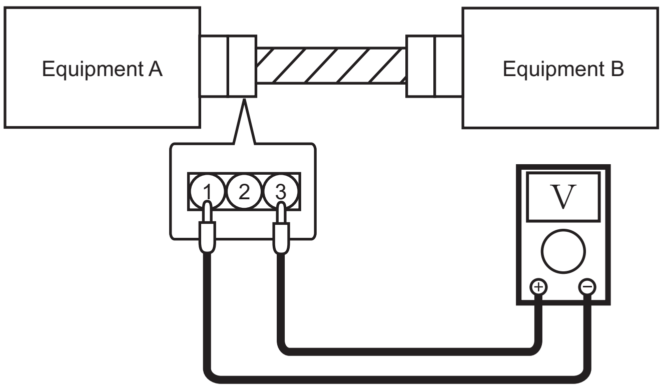
② Connect the test probe (+) to connector terminal 5 of equipment B and the test probe (-) to a machine ground point (the bolt fastening the ground terminal or an unpainted portion on the body) and measure the resistance. At this time, reversing the connector terminals between the probes (+) and (-)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

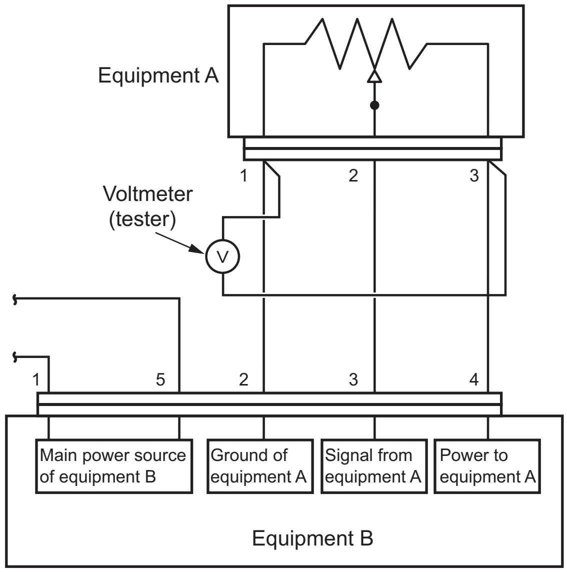
(NOTICE)

- **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)





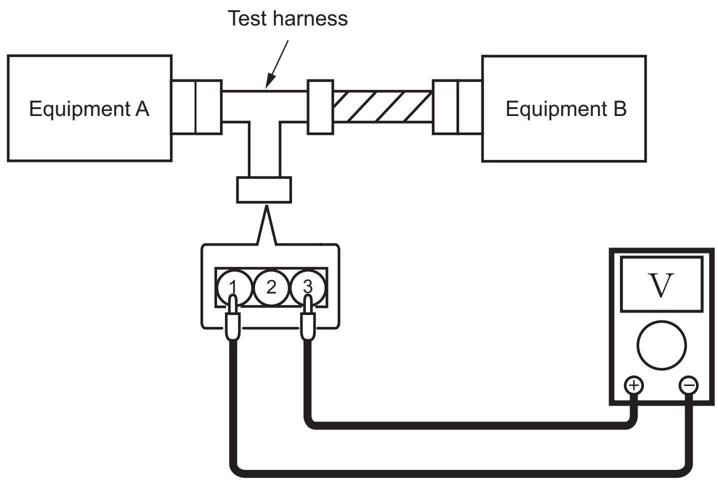
GW750-2-10007

Inspection procedure

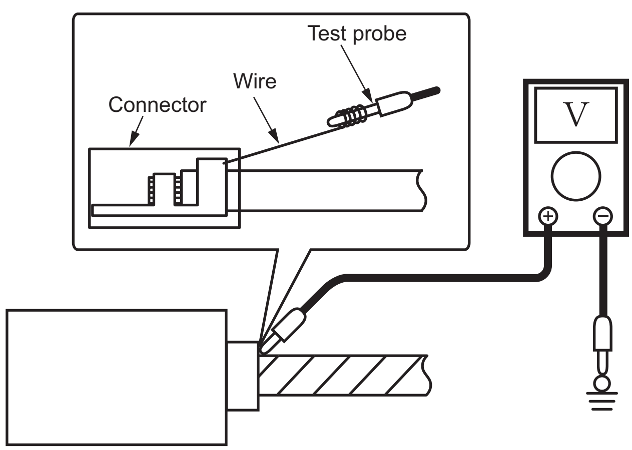
① Connect the connectors of equipment A and that of equipment B.

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.

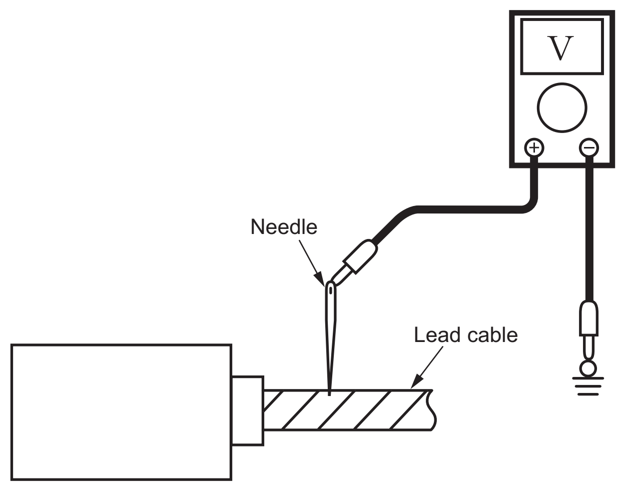
• Measurement using a test harness



• Measurement from the backside of connector



• Measurement on a lead cable



GW750-2-10002

Measurement method

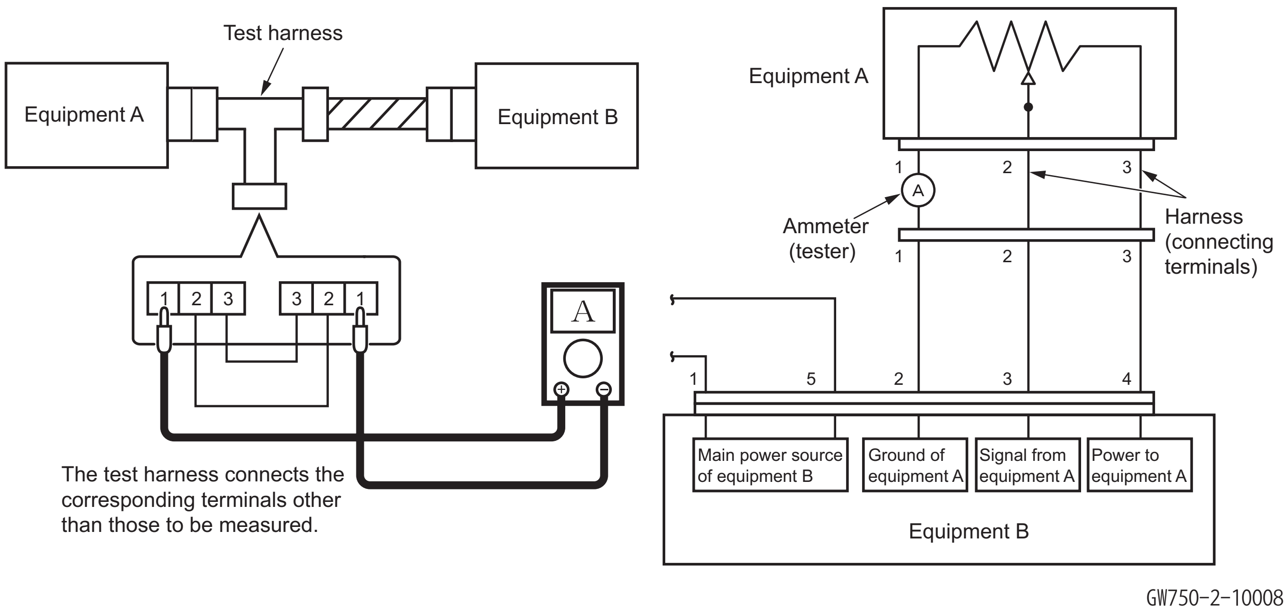
For measurement of voltage, connect the tester probes in parallel to the portion to be measured. Because the voltage can be measured only when the connector is connected in position, contact the tester probes to the terminals without disconnecting the connector. The following methods are available:

- 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

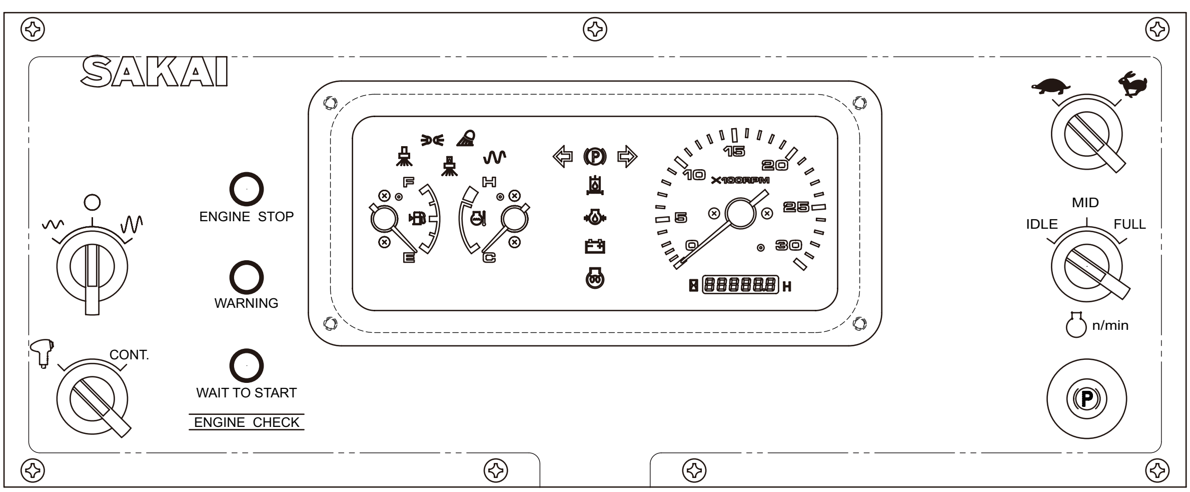
2-2-1. Fault detection

- Faults are detected while the starter switch is on, during the operation of the machine itself. If a fault becomes active (currently detected) at this time, a fault is logged in memory and a snapshot of engine parameters is logged. In addition, certain faults may illuminate the warning lamp (orange) or the stop lamp (red).

2-2-2. Fault lamps

- The CM2250 controller systems use 3 indicator lamps: the “ENGINE STOP”, “WARNING” and “WAIT TO START”. If the starter switch is turned on but the diagnostic switch remains off, the indicator lamps will illuminate for approximately two seconds and then go off, one after the other, to verify they are working and wired correctly. They all go on and then go off one at a time, at an interval of approximately 0.5 seconds each.

  - “ENGINE STOP” Lamp - The “ENGINE STOP” lamp provides critical operator messages. These messages require immediate and decisive operator response. The “ENGINE STOP” lamp is also used to flash out diagnostic fault codes.
  - “WARNING” Lamp - The “WARNING” lamp provides important operator messages. These messages require timely operator attention. The “WARNING” lamp is also used to delineate diagnostics fault codes.
  - “WAIT TO START” Lamp - The “WAIT TO START” lamp indicates that the pre-start intake manifold heater warm-up sequence is active. A Cummins supplied grid heater will automatically heat the intake manifold based on the Intake Manifold Temperature when needed prior to engine starting. Intake manifold heating improves engine starting in cold temperatures and reduces white smoke.



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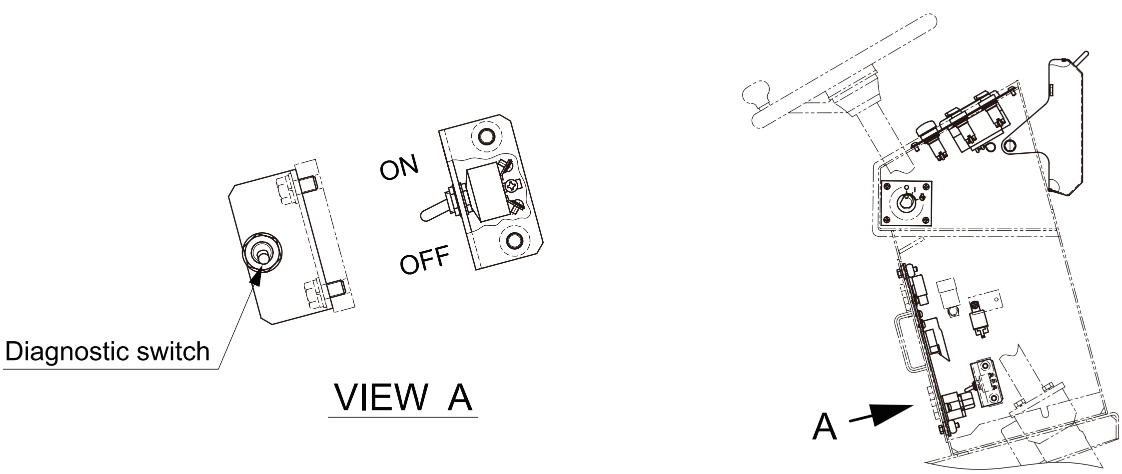
2-2-3. Flash out of fault codes

- Fault codes can be accessed in at least two different ways; using the electronic service tool or fault code flash out.
- Fault flash out mode can be entered through the use of a diagnostic switch. The diagnostic switch may also be multiplexed on the J1939 datalink.

  Entering diagnostic mode:
  1) To enter the fault flash out, the starter switch must be ON with the engine not running.
  2) When a diagnostic switch is used to enter the mode, the ECM will automatically flash the first fault code after the switch is turned on. Each active fault shall flash out twice, wrapping around to the first fault code at the end.

  Flashing of fault codes:
  - The diagram below depicts the pattern of the fault code flash out scheme as indicated by the "ENGINE STOP" lamp. A blink is equivalent to the "ENGINE STOP" lamp being on for 0.5 seconds, and off for 0.5 seconds. A pause between fault code digits has duration of 2 seconds.



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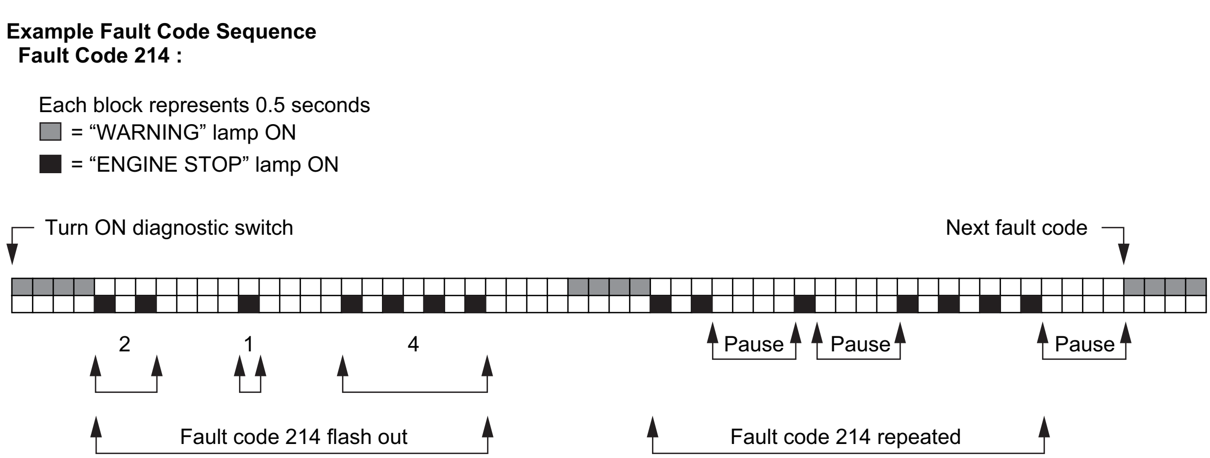

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2-2-4. Fault code list

Fault code (Lamp)	Reason	Effect
111 (Red)	Engine control module critical internal failure • Bad intelligent device or component.	Engine may not start.
115 (Red)	Engine magnetic crankshaft speed/position lost both of two signals • Data erratic, intermittent, or incorrect.	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.	Derate in power output of the engine.
123 (Orange)	Intake manifold 1 pressure sensor circuit • Voltage below normal or shorted to low source.	Derate in power output of the engine.
131 (Red)	Accelerator pedal or lever position sensor 1 circuit • Voltage above normal or shorted to high source.	Severe derate in power output of the engine. Limp home power only.
132 (Red)	Accelerator pedal or lever position sensor 1 circuit • Voltage below normal or shorted to low source.	Severe derate in power output of the engine. Limp home power only.
133 (Red)	Remote accelerator pedal or lever position sensor circuit • Voltage above normal or shorted to high source.	Remote accelerator will not operate. Remote accelerator position will be set to zero percent.
134 (Red)	Remote accelerator pedal or lever position sensor circuit • Voltage below normal or shorted to low source.	Remote accelerator will not operate. Remote accelerator position will be set to zero percent.
135 (Orange)	Engine oil rifle pressure 1 sensor circuit • Voltage above normal or shorted to high source.	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.	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.	None on performance.
144 (Orange)	Engine coolant temperature 1 sensor circuit • Voltage above normal or shorted to high source.	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.	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.	Progressive power derate increasing in severity from time of alert.
147 (Red)	Accelerator pedal or lever position 1 sensor circuit frequency • Data valid but below normal operational range. • Most severe level.	Severe derate in power output of the engine. Limp home power only.

Fault code (Lamp)	Reason	Effect
148 (Red)	Accelerator pedal or lever position sensor 1 • Data valid but above normal operational range. • Most severe level.	Severe derate in power output of the engine. Limp home power only.
151 (Red)	Engine coolant temperature • Data valid but above normal operation range. • Most severe level.	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.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for intake manifold air temperature.
154 (Orange)	Intake manifold 1 temperature sensor circuit • Voltage below normal or shorted to low source.	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.	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.	Engine power derate.
195 (Orange)	Coolant level sensor 1 circuit • Voltage above normal or shorted to high source.	None on performance.
196 (Orange)	Coolant level sensor 1 circuit • Voltage below normal or shorted to low source.	None on performance.
197 (Orange)	Coolant level • Data valid but below normal operation range. • Moderately severe level.	None on performance.
221 (Orange)	Barometric pressure sensor circuit • Voltage above normal or shorted to high source.	Engine power derate.
222 (Orange)	Barometric pressure sensor circuit • Voltage below normal or shorted to low source.	Engine power derate.
227 (Orange)	Sensor supply 2 circuit • Voltage above normal or shorted to high source.	Engine power derate.
234 (Red)	Engine Crankshaft speed/position • Data valid but above normal operation range. • Most severe level.	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.	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.
237 (Orange)	External speed input (Multiple unit synchronization) • Data erratic, intermittent or incorrect.	Primary or secondary engine may stop running.
238 (Orange)	Sensor supply 3 circuit • Voltage below normal or shorted to low source.	Possible hard starting and rough running.

Fault code (Lamp)	Reason	Effect
239 (Orange)	Sensor supply 3 circuit • Voltage above normal or shorted to high source.	Possible hard starting and rough running.
241 (Orange)	Wheel based machine speed • Data erratic, intermittent or incorrect.	Engine speed limited to maximum engine speed without VSS parameter value. Cruise control, gear down protection and road speed governor will not work.
245 (Orange)	Fan control circuit • Voltage below normal or shorted to low source.	The fan can possibly stay on continuously or not run at all.
271 (Orange)	Fuel pump pressurizing assembly 1 circuit • Voltage below normal or shorted to low source.	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.	Engine will not run or engine will run poorly.
285 (Orange)	SAE J1939 multiplexing PGN timeout error • Abnormal update rate.	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.	At least one multiplexed device will not operate properly.
288 (Red)	SAE J1939 multiplexing remote accelerator pedal or lever position sensor circuit • Received network data in error.	The engine will not respond to the remote throttle. Engine may only idle. The primary or cab accelerator may be able to be used.
292 (Red)	Auxiliary temperature sensor input 1 • Special instructions.	Possible engine derate.
293 (Orange)	Auxiliary temperature sensor input #1 circuit • Voltage above normal or shorted to high source.	None on performance.
294 (Orange)	Auxiliary temperature sensor input #1 circuit • Voltage below normal or shorted to low source.	None on performance.
295 (Orange)	Barometric pressure • Data erratic, intermittent or incorrect.	Engine power derate.
296 (Red)	Auxiliary pressure sensor input 1 • Special instructions	Possible engine power derate.
297 (Orange)	Auxiliary pressure sensor input #2 circuit • Voltage above normal or shorted to high source.	None on performance.
298 (Orange)	Auxiliary pressure sensor input #2 circuit • Voltage below normal or shorted to low source.	None on performance.
322 (Orange)	Injector solenoid driver cylinder 1 circuit • Current below normal or open circuit.	Engine can misfire or possibly run rough.
324 (Orange)	Injector solenoid driver cylinder 3 circuit • Current below normal or open circuit.	Engine can misfire or possibly run rough.
331 (Orange)	Injector solenoid driver cylinder 2 circuit • Current below normal or open circuit.	Engine can misfire or possibly run rough.
332 (Orange)	Injector solenoid driver cylinder 4 circuit • Current below normal or open circuit.	Engine can misfire or possibly run rough.

Fault code (Lamp)	Reason	Effect
343 (Orange)	Electronic control module warning internal hardware failure • Bad intelligent device or component.	Possible no noticeable performance effects, engine dying or hard starting. Fault information, trip information and maintenance monitor data can be inaccurate.
349 (Orange)	Transmission output shaft speed • Data valid but above normal operational range. • Moderately severe level.	Engine will run off of a default auxiliary speed.
351 (Orange)	Injector power supply • Bad intelligent device or component.	Possible low power, engine misfire and/or engine will not start.
352 (Orange)	Sensor supply 1 circuit • Voltage below normal or shorted to low source.	Engine power derate.
386 (Orange)	Sensor supply 1 circuit • Voltage above normal or shorted to high source.	Engine power derate.
415 (Red)	Engine oil rifle pressure • Data valid but below normal operation range. • Most severe level.	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 engine stop lamp starts flashing.
418 (Orange/ Blinking)	Water in fuel indicator • Data valid but above normal operation range. • Least severe level.	Possible white smoke, loss of power, or hard starting.
428 (Orange)	Water in fuel indicator sensor circuit • Voltage above normal or shorted to high source.	None on performance. No water in fuel warning available.
429 (Orange)	Water in fuel indicator sensor circuit • Voltage below normal or shorted to low source.	None on performance. No water in fuel warning available.
431 (Orange)	Accelerator pedal or lever idle validation switch • Data erratic, intermittent or incorrect.	Engine will only idle.
432 (Red)	Accelerator pedal or lever idle validation switch circuit • Out of calibration.	Engine will only idle.
435 (Orange)	Engine oil rifle pressure • Data erratic, intermittent or incorrect.	None on performance. No engine protection for oil pressure.
441 (Orange)	Battery 1 voltage • Data valid but below normal operation range. • Moderately severe 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.	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.	Power and/or speed derate.
452 (Orange)	Injector metering rail 1 pressure sensor circuit • Voltage below normal or shorted to low source.	Power and/or speed derate.

Fault code (Lamp)	Reason	Effect
488 (Orange)	Intake manifold 1 temperature • Data valid but above normal operation range. • Moderately severe level.	Progressive power derate increasing in severity from time of alert.
489 (Orange)	Transmission output shaft speed • Data valid but below normal operational range. • Moderately severe level.	ECM changes engine speed to a calibration dependent set point.
497 (Orange)	Multiple unit synchronization switch circuit • Data erratic, intermittent or incorrect.	Synchronization function of multiple unit is disabled.
515 (Orange)	Sensor supply 6 circuit • Voltage above normal or shorted to high source.	Possible reduced performance.
516 (Orange)	Sensor supply 6 circuit • Voltage below normal or shorted to low source.	Possible reduced performance.
523 (Orange)	Intermediate (P.T.O) speed switch validation • Data erratic, intermittent or incorrect.	Intermediate speed control switch may not operate correctly.
527 (Orange)	Auxiliary input/output 2 circuit • Voltage above normal or shorted to high source.	None on performance.
528 (Orange)	Auxiliary alternate torque validation switch • Data erratic, intermittent or incorrect.	Torque curve setting defaults to default curve.
529 (Orange)	Auxiliary input/output 3 circuit • Voltage above normal or shorted to high source.	None on performance.
553 (Orange)	Injector metering rail 1 pressure • Data valid but above normal operation range. • Moderately severe level.	None or possible engine noise associated with higher injection pressures (especially at idle or light load). Engine power is reduced.
555 (Orange)	Crankcase pressure • Data valid but above normal operating range. • Moderately severe level.	None on performance.
556 (Red)	Crankcase pressure • Data valid but above normal operational range. • Most severe level.	Engine power derate.
559 (Orange)	Injector metering rail 1 pressure • Data valid but below normal operation range. • Moderately severe level.	Possibly hard to start, low power or engine smoke. Engine could possibly not start.
584 (Orange)	Starter relay driver circuit • Voltage above normal or shorted to high source.	Either the engine will not start or the engine will not have starter lockout protection.
585 (Orange)	Starter relay driver circuit • Voltage below normal or shorted to low source.	The engine will not have starter lockout protection.
595 (Orange)	Turbocharger 1 speed • Data valid but above normal operating range. • Moderately severe level.	No effect on engine performance.
599 (Red)	Auxiliary commanded dual output shutdown • Special instructions.	Engine will shutdown.
649 (Orange/ Blinking)	Change lubricating oil and filter • Condition exists.	Maintenance reminder only.

Fault code (Lamp)	Reason	Effect
687 (Orange)	Turbocharger 1 speed • Data valid but below normal operating range. • Moderately severe level.	Engine power derate. The ECM uses an estimated turbocharger speed.
689 (Orange)	Engine crankshaft speed/position • Data erratic, intermittent or incorrect.	Engine power derate.
691 (Orange)	Turbocharger 1 compression intake temperature circuit • Voltage above normal or shorted to high source.	Engine power derate.
692 (Orange)	Turbocharger 1 compression intake temperature circuit • Voltage below normal or shorted to low source.	Engine power derate.
731 (Orange)	Engine speed/position camshaft and crankshaft misalignment • Mechanical system not responding or out of adjustment.	Engine will run derated. Hard start and rough idle possible.
778 (Orange)	Engine camshaft speed/position sensor • Data erratic, intermittent or incorrect.	Engine can run rough. Possibly poor starting capability. Engine runs using primary engine position sensor.
1117 (None)	Power supply lost with starter switch ON • Data erratic, intermittent or incorrect.	Possible no noticeable performance effects, engine dying or hard starting. Fault information, trip information and maintenance monitor data can be inaccurate.
1239 (Orange)	Accelerator pedal or lever position sensor 2 circuit • Voltage above normal or shorted to high source.	Severe derate in power output of the engine. Limp home power only.
1241 (Orange)	Accelerator pedal or lever position sensor 2 circuit • Voltage below normal or shorted to low source.	Severe derate in power output of the engine. Limp home power only.
1242 (Red)	Accelerator pedal or lever position sensor 1 • Data erratic, intermittent or incorrect.	The engine will only idle.
1515 (Red)	SAE J1939 multiplexed accelerator pedal or lever sensor system • Received network data in error.	The engine will only idle.
1539 (Orange)	Auxiliary pressure sensor input 1 circuit • Voltage above normal or shorted to high source.	None on performance.
1621 (Orange)	Auxiliary pressure sensor input 1 circuit • Voltage below normal or shorted to low source.	None on performance.
1695 (Orange)	Sensor supply 5 • Voltage above normal or shorted to high source.	Severe derate in power output of the engine. Limp home power only.
1696 (Orange)	Sensor supply 5 • Voltage below normal or shorted to low source.	Severe derate in power output of the engine. Limp home power only.
1843 (Orange)	Crankcase pressure circuit • Voltage above normal or shorted to high source.	No engine protection for high crankcase pressure.

Fault code (Lamp)	Reason	Effect
1844 (Orange)	Crankcase pressure circuit • Voltage below normal or shorted to low source.	No engine protection for high crankcase pressure.
1896 (Orange)	EGR valve controller • Out of calibration	EGR valve actuation will be disabled.
1898 (Orange)	VGT actuator controller • Out of calibration	Low intake manifold pressure. The VGT will be in the open position.
1911 (Orange)	Injector metering rail 1 pressure • Data valid but above normal operation range • Most severe level.	None or possible engine noise associated with higher injection pressure (especially at idle or light load) or possible power interruption associated with dump valve reset.
1938 (Orange)	ECU power output supply voltage 1 • Data valid but below normal operating range. • Moderately severe level.	None on performance.
1942 (Orange)	Crankcase pressure • Data erratic, intermittent or incorrect.	None on performance.
1961 (Orange)	EGR valve control circuit over temperature • Data valid but above normal operating range. • Least severe level.	EGR valve operation will be disabled.
1974 (Orange/ Blinking)	Crankcase pressure • Data valid but above normal operating range. • Least severe level.	None on performance.
2182 (Orange)	Engine brake actuator driver 1 circuit • Voltage above normal or shorted to high source.	Engine brake on cylinders 1, 2 and 3 can not be activated.
2183 (Orange)	Engine brake actuator driver 1 circuit • Voltage below normal or shorted to low source.	Engine brake on cylinders 1, 2 and 3 can not be activated.
2185 (Orange)	Sensor supply 4 circuit • Voltage above normal or shorted to high source.	Engine will only idle.
2186 (Orange)	Sensor supply 4 circuit • Voltage below normal or shorted to low source.	Engine will only idle.
2195 (Red)	Auxiliary equipment sensor input 3 engine protection critical • Special instructions.	Engine may shutdown.
2272 (Orange)	EGR valve position circuit • Voltage below normal or shorted to low source.	EGR valve actuation will be disabled.
2288 (None)	Turbocharger 1 speed • Data valid but above normal operating range. • Least severe level.	Engine power derate to lower the turbocharger speed.
2311 (Orange)	Electronic fuel injection control valve circuit • Condition exists.	Possible low power.
2321 (None)	Engine crankshaft speed/position • Data erratic, intermittent or incorrect.	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.	None on performance.

Fault code (Lamp)	Reason	Effect
2349 (Orange)	EGR valve control circuit • Current below normal or open circuit.	EGR valve actuation will be disabled.
2353 (Orange)	EGR valve control circuit • Current above normal or grounded circuit.	EGR valve actuation will be disabled.
2357 (Orange)	EGR valve control circuit • Mechanical system not responding or out of adjustment.	EGR valve actuation will be disabled.
2363 (Orange)	Engine brake actuator driver output 2 circuit • Voltage below normal or shorted to low source.	Engine brake on cylinders 4, 5 and 6 can not be activated.
2367 (Orange)	Engine brake actuator driver output 2 circuit • Voltage above normal or shorted to high source.	Engine brake on cylinders 4, 5 and 6 can not be activated.
2372 (Orange)	Fuel filter differential pressure • Data valid but above normal operating range. • Moderately severe level.	Engine can possibly have low power.
2373 (Orange)	Exhaust gas pressure sensor circuit • Voltage above normal or shorted to high source.	None on performance.
2374 (Orange)	Exhaust gas pressure sensor circuit • Voltage below normal or shorted to low source.	None on performance.
2375 (Orange)	Exhaust gas recirculation temperature sensor circuit • Voltage above normal or shorted to high source.	EGR valve actuation will be disabled.
2376 (Orange)	Exhaust gas recirculation temperature sensor circuit • Voltage below normal or shorted to low source.	EGR valve actuation will be disabled.
2377 (Orange)	Fan control circuit • Voltage above normal or shorted to high source.	The fan may stay on continuously or not run at all.
2448 (Orange/ Blinking)	Coolant level • Data valid but below normal operating range. • Least severe level.	None on performance.
2554 (Orange)	Exhaust gas pressure • Data erratic, intermittent or incorrect.	The ECM will estimate the exhaust gas pressure.
2555 (Orange)	Engine intake air heater 1 circuit • Voltage above normal or shorted to high source.	The intake air heats may be ON or OFF at all the time.
2556 (Orange)	Engine intake air heater 1 circuit • Voltage below normal or shorted to low source.	The intake air heats may be ON or OFF at all the time.
2557 (Orange)	Auxiliary PWM driver #1 • Voltage above normal or shorted to high source.	Can not control transmission.
2558 (Orange)	Auxiliary PWM driver #1 • Voltage below normal or shorted to low source.	Can not control transmission.

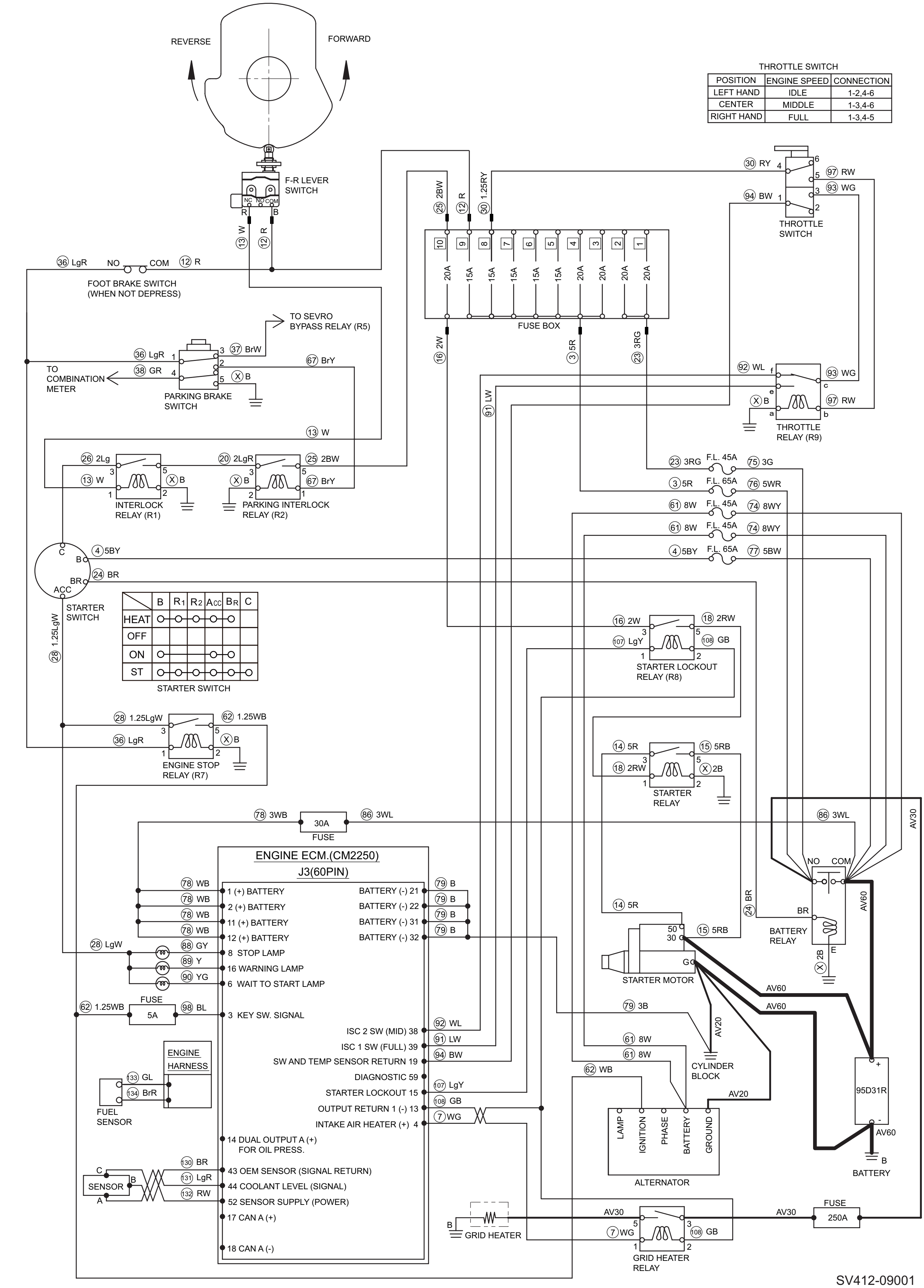
Fault code (Lamp)	Reason	Effect
2646 (Orange)	Engine coolant temperature • Condition exists.	EGR valve actuation will be disabled.
2765 (None)	Engine injector bank 1 barcodes • Out of calibration.	None on performance.
2961 (None)	Exhaust gas recirculation temperature • Data valid but above normal operating range. • Least severe level.	Slight fueling derate to bring EGR temperature under the maximum limit.
2973 (Orange)	Intake manifold 1 pressure • Data erratic, intermittent or incorrect.	Engine power derate.
3186 (Orange)	Tachograph output shaft speed • Abnormal update rate.	None on performance.
3213 (Orange)	Tachograph output shaft speed • Received network data in error.	None on performance.
3326 (Red)	SAE J1939 multiplexed accelerator pedal or lever sensor system • Abnormal update rate.	Engine will only idle.
3328 (Orange)	Transmission output shaft speed • Abnormal update rate.	None on performance.
3418 (Orange)	Transmission output shaft speed • Received network data in error.	None on performance.
3525 (Orange)	Wheel-based vehicle speed • Received network data in error.	None on performance.
3526 (Orange)	Wheel-based vehicle speed • Abnormal update rate.	None on performance.
3527 (Red)	Accelerator pedal or lever idle validation switch • Received network data in error.	Engine will only idle.
3528 (Red)	Accelerator pedal or lever idle validation switch • Abnormal update rate.	Engine will only idle.
3616 (None)	Engine VGT nozzle position • Mechanical system not responding or out of adjustment.	Engine power may be derated.
3697 (Red)	Engine control module calibration memory • Bad intelligent device or component.	Engine may not start.
3724 (Orange)	Battery 1 voltage • Data valid but below normal operating range. • Least severe level.	EGR valve actuation will be disabled.
3727 (None)	High pressure common rail fuel pressure relief valve • Mechanical system not responding or out of adjustment.	Possible low power or power interruption associated with relief valve reset.
3737 (None)	Engine starter mode overcrank protection • Condition exists.	Starter operation is prohibited until the starter motor has adequately cooled.
3741 (Orange)	High pressure common rail fuel pressure relief valve • Data valid but above normal operational range. • Most severe level.	Engine may run rough, may stop running, may not start or may be difficult to start.
3765 (Orange)	Auxiliary temperature sensor input 2 circuit • Voltage above normal or shorted to high source.	None on performance.

Fault code (Lamp)	Reason	Effect
3766 (Orange)	Auxiliary temperature sensor input 2 circuit • Voltage below normal or shorted to low source.	None on performance.

(NOTICE)

- **For details, refer to “Service information” of engine manufacturer.**

Fig.: 2-3-1



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2-3. Engine

Check following items before troubleshooting.

- No blown fuses and power is applied up to fuses.
- Check any ground circuit which belongs to components to be checked.
- Engine check lamp must not be lighting. If engine check lamp lights, refer to “Service information” of engine manufacturer.

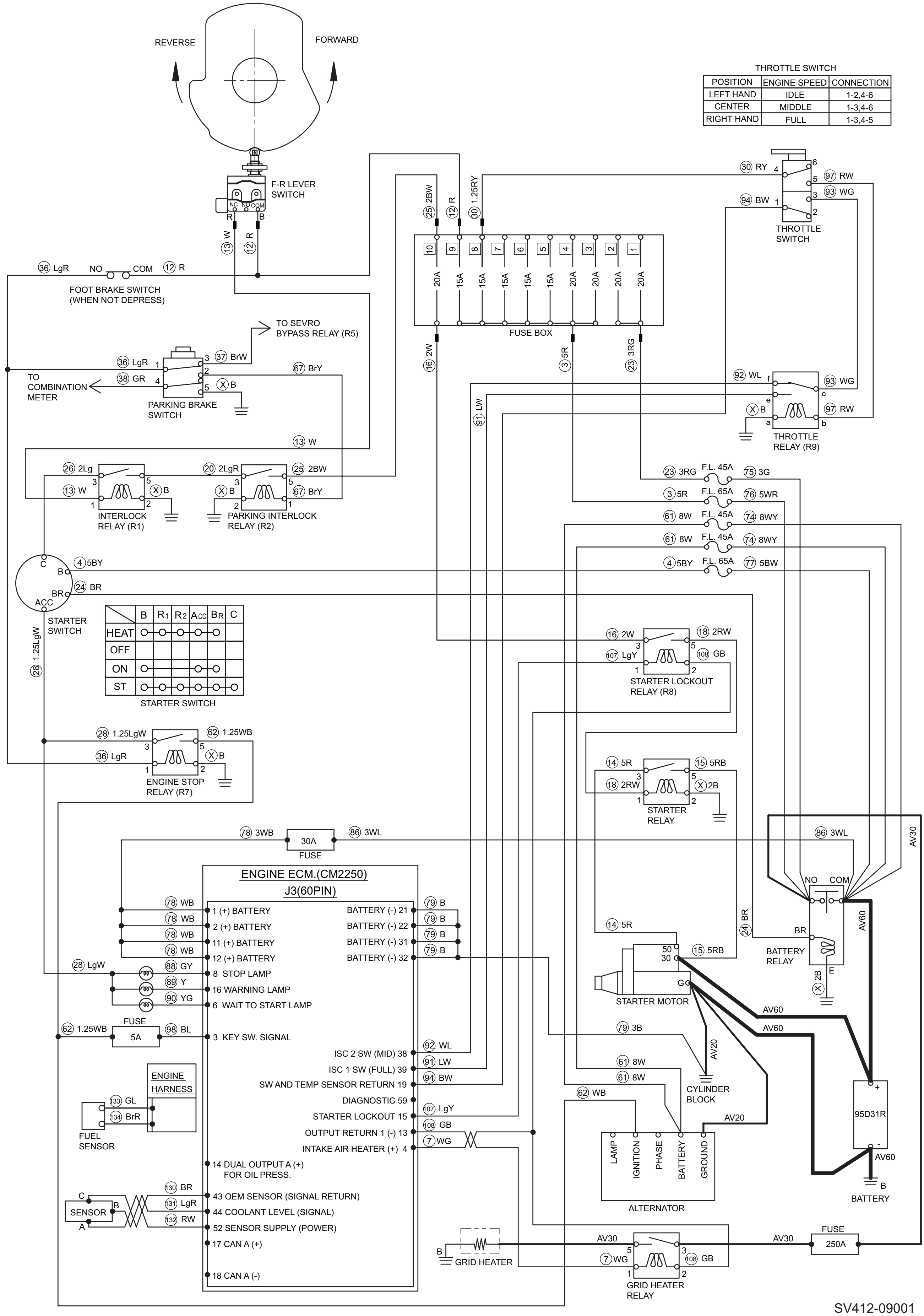
2-3-1. Engine will not start (Starter motor does not run) 1/3

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

Reference Fig.: 2-3-1

Check point	Check/Cause	Action
1. Battery	• Measure battery voltage or specific gravity. Standard voltage : 12 V or more Standard gravity : 1.26 or more • If value is below standard, battery capacity is insufficient.	Charge or replace battery.
2. Starter Switch	• Check continuity between O-O according to starter switch connection table. Switch is OK if there is continuity between connection O-O. • If there is no continuity, starter switch is faulty.	Replace starter switch.
3. Starter Motor	(1) When starter switch is ON, measure voltage between starter motor terminal 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.
5. Starter Lockout Relay (R8)	(1) When starter switch is ON, measure voltage between starter lockout relay terminal 1 inlet wire LgY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is START, measure voltage between starter lockout relay terminal 3 inlet wire W and chassis ground. Standard voltage : 12 V or more (3) When starter switch is START, measure voltage between starter lockout relay terminal 5 outlet wire RW and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, starter lockout relay is faulty.	Replace starter lockout relay (R8).

Fig.: 2-3-1


REVERSE
FORWARD
F-R LEVER SWITCH
NC NO COM
THROTTLE SWITCH
POSITION | ENGINE SPEED | CONNECTION
LEFT HAND | IDLE | 1-2,4-6
CENTER | MIDDLE | 1-3,4-6
RIGHT HAND | FULL | 1-3,4-5
THROTTLE SWITCH
THROTTLE RELAY (R9)
FOOT BRAKE SWITCH (WHEN NOT DEPRESS)
TO SEVRO BYPASS RELAY (R5)
TO COMBINATION METER
PARKING BRAKE SWITCH
FUSE BOX
20A 15A 15A 15A 15A 15A 20A 20A 20A 20A
INTERLOCK RELAY (R1)
PARKING INTERLOCK RELAY (R2)
STARTER SWITCH
B R1 R2 ACC BR C
HEAT
OFF
ON
ST
STARTER SWITCH
F.L. 45A
F.L. 65A
F.L. 45A
F.L. 45A
F.L. 65A
STARTER LOCKOUT RELAY (R8)
STARTER RELAY
ENGINE STOP RELAY (R7)
30A FUSE
ENGINE ECM.(CM2250) J3(60PIN)
1 (+) BATTERY
2 (+) BATTERY
11 (+) BATTERY
12 (+) BATTERY
8 STOP LAMP
16 WARNING LAMP
6 WAIT TO START LAMP
3 KEY SW. SIGNAL
14 DUAL OUTPUT A (+) FOR OIL PRESS.
43 OEM SENSOR (SIGNAL RETURN)
44 COOLANT LEVEL (SIGNAL)
52 SENSOR SUPPLY (POWER)
17 CAN A (+)
18 CAN A (-)
BATTERY (-) 21
BATTERY (-) 22
BATTERY (-) 31
BATTERY (-) 32
ISC 2 SW (MID) 38
ISC 1 SW (FULL) 39
SW AND TEMP SENSOR RETURN 19
DIAGNOSTIC 59
STARTER LOCKOUT 15
OUTPUT RETURN 1 (-) 13
INTAKE AIR HEATER (+) 4
FUSE 5A
ENGINE HARNESS
FUEL SENSOR
SENSOR
BATTERY RELAY
STARTER MOTOR
CYLINDER BLOCK
LAMP IGNITION PHASE BATTERY GROUND
ALTERNATOR
95D31R
BATTERY
GRID HEATER
GRID HEATER RELAY
FUSE 250A
SV412-09001

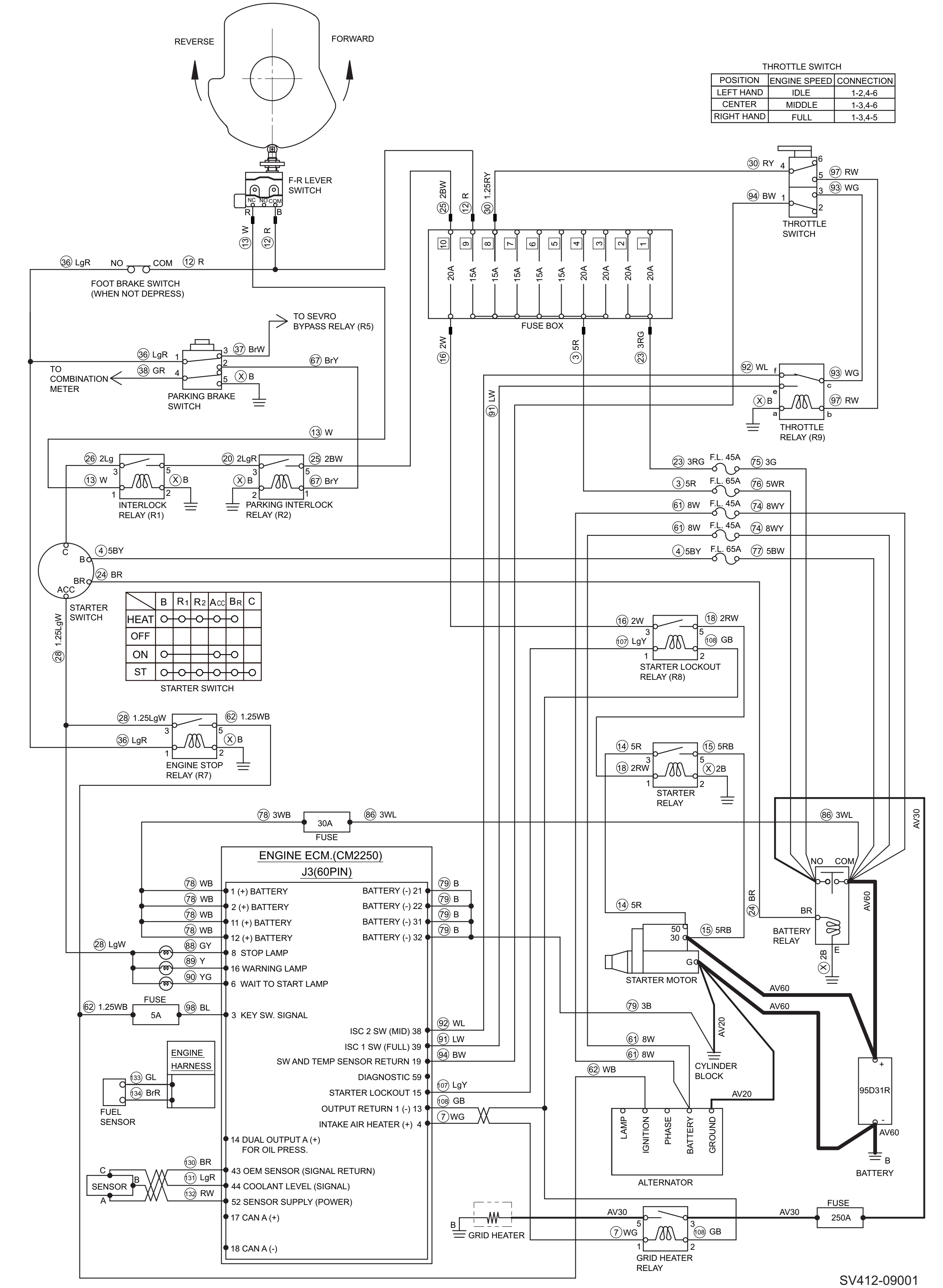
2-3-1. Engine will not start (Starter motor does not run) 2/3

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

Reference Fig.: 2-3-1

Check point	Check/Cause	Action
6. 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 ON, measure voltage between starter relay terminal 5 inlet wire RB and chassis ground. Standard voltage : 12 V or more (3) When starter switch is START, measure voltage between starter relay terminal 3 outlet wire R 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.
7. 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.
8. 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.
9. 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 2 outlet wire BrY 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.

Fig.: 2-3-1



THROTTLE SWITCH

POSITION	ENGINE SPEED	CONNECTION
LEFT HAND	IDLE	1-2,4-6
CENTER	MIDDLE	1-3,4-6
RIGHT HAND	FULL	1-3,4-5

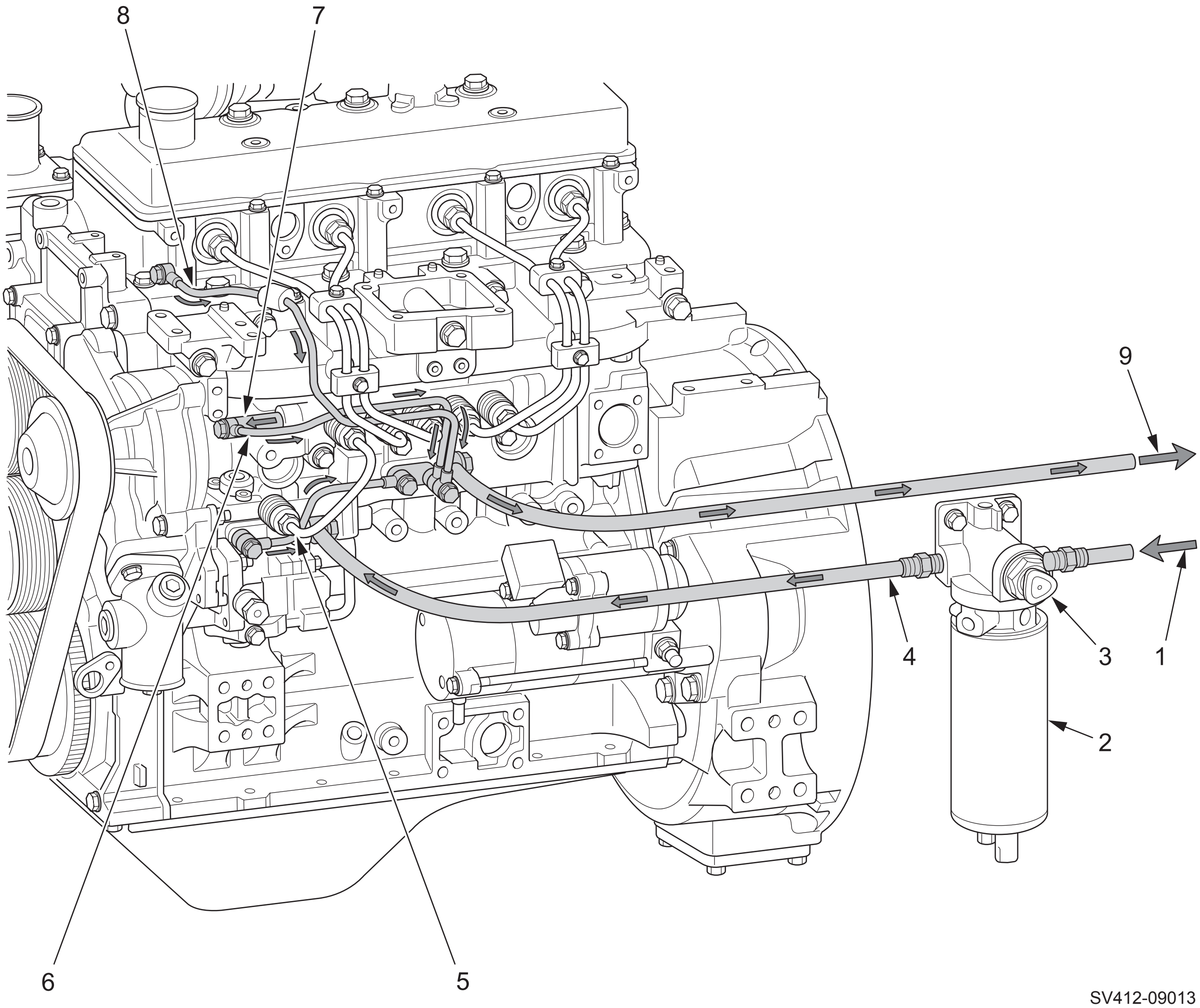
2-3-1. Engine will not start (Starter motor does not run) 3/3

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

Reference Fig.: 2-3-1

Check point	Check/Cause	Action
10. Interlock Relay (R1)	(1) When starter switch is ON, measure voltage between interlock relay terminal 1 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 LgR 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 (R1).
11. Parking Interlock Relay (R2)	(1) When starter switch is ON, measure voltage between parking interlock relay terminal 1 inlet wire BrY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is START, measure voltage between parking interlock relay terminal 3 inlet wire LgR and chassis ground. Standard voltage : 12 V or more (3) When starter switch is START, measure voltage between parking 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, parking interlock relay is faulty.	Replace parking interlock relay (R2).
12. Engine Stop Relay (R7)	(1) When starter switch is ON, measure voltage between engine stop relay terminal 1 inlet wire LgR and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between engine stop relay terminal 3 inlet wire LgW and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between engine stop relay terminal 5 outlet wire WB and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, engine stop relay is faulty.	Replace engine stop relay (R7).
13. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-3-2



(1) Fuel from supply tank
(2) Water/fuel separator filter (remote or engine mounted)
(3) Priming pump (remote or engine mounted)
(4) Fuel supply to gear pump
(5) Fuel pump fuel return
(6) Common rail fuel return
(7) Fuel rail pressure relief valve
(8) Fuel return from injectors
(9) Fuel return to tank

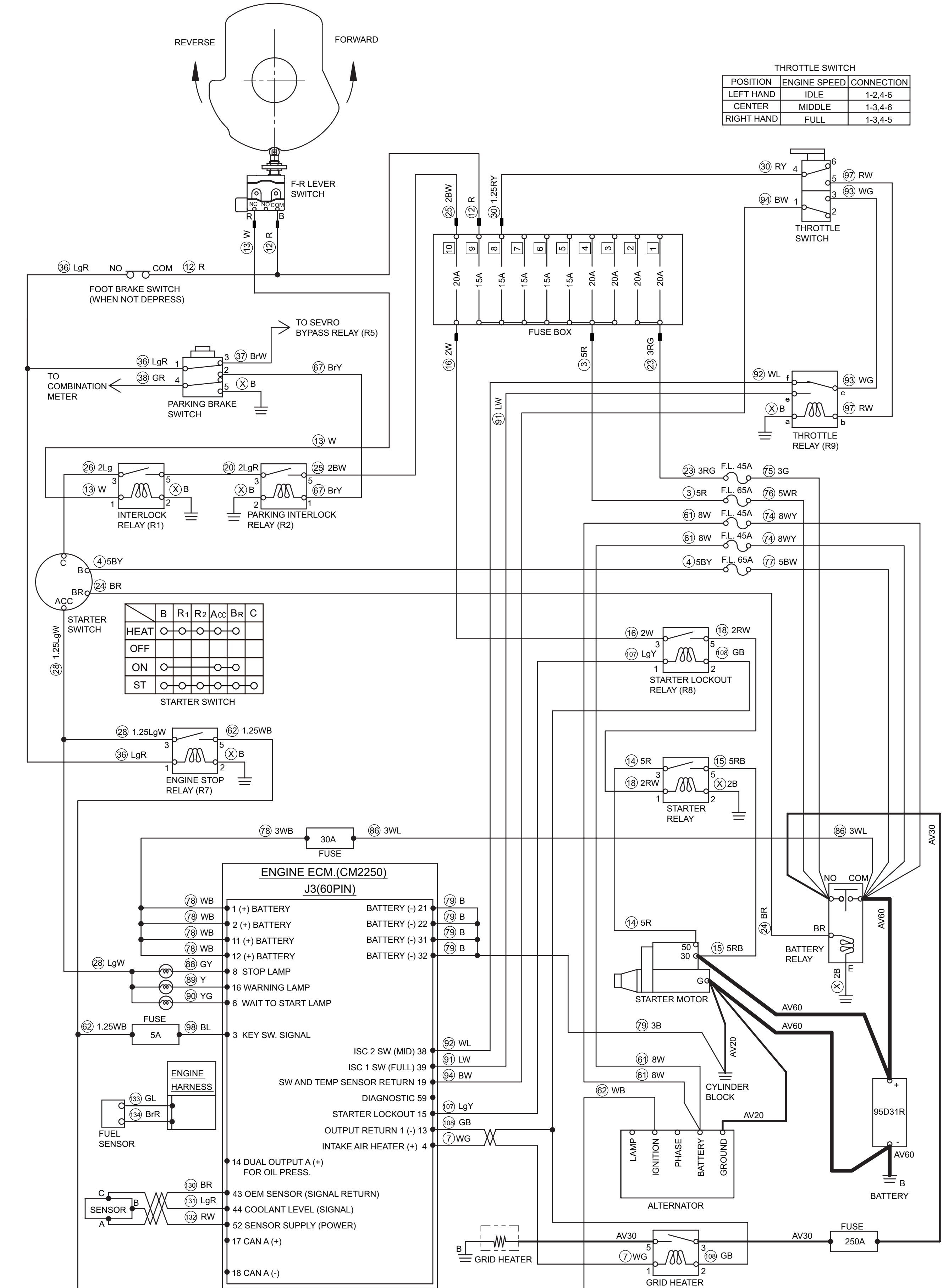
2-3-2. Engine will not start (But starter motor runs)

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

Reference Fig.: 2-3-2

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. Water/ Fuel Separator Filter/ Fuel Filter (Pressure Side)	• Check that water does not cover water-in-fuel (WIF) sensor in contaminant collection bowl. • If water covers the sensor, engine may not start.	Drain water.
	• Check filter for clogging. • Insufficient supply of proper fuel due to clogging of filter. **(NOTICE)** **• Air bleeding should be performed whenever filter is replaced.**	• Replace filter. • Bleed filter.
3. Fuel Gear Pump	• Disconnect hose connecting to fuel gear 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 gear pump is replaced.**	• Replace fuel gear pump. • Bleed pump.
4. Hoses Connecting Between Parts	• Check hoses for fuel leakage and clogging. • Hose failure due to deterioration. **(NOTICE)** **• Air bleeding should be performed whenever fuel hose is replaced.**	Replace hose.

Fig.: 2-3-1



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2-3-3. No charging

Reference Fig.: 2-3-1

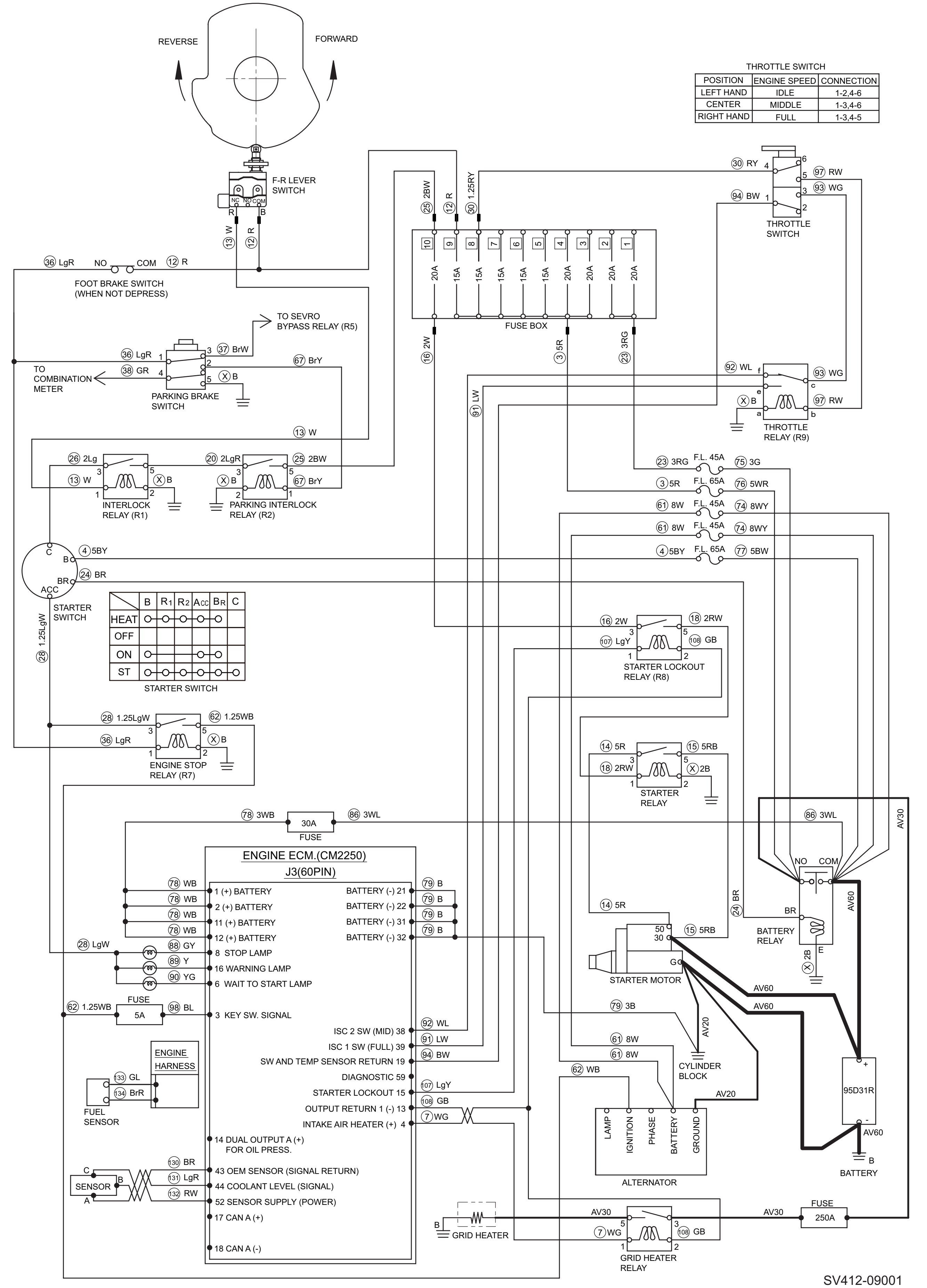
Check point	Check/Cause	Action
1. Alternator	• After starting engine, measure voltage between alternator terminal BATTERY wire W and chassis ground. Standard voltage : At least intermediate engine speed, 14 V or more • If voltage is lower than standard, alternator is faulty. • If voltage is normal and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

2-3-4. Grid heater does not work (Engine starting performance is bad in cold weather)

Reference Fig. : 2-3-1

Check point	Check/Cause	Action
1. Grid Heater	• When starter switch is ON, measure voltage between grid heater inlet wire and chassis ground. Standard voltage : 12 V or more • If voltage is normal, grid heater is faulty.	Replace grid heater.
2. Grid Heater Relay	(1) When starter switch is ON, measure voltage between grid heater relay terminal 2 inlet wire GB and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between grid heater relay terminal 3 inlet wire and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between grid heater relay terminal 5 outlet wire and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, grid heater relay is faulty.	Replace grid heater 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. **(NOTICE)** **• If any abnormality is found in shielded twisted wires, repair is not approved. Be sure to replace them.**	Repair or replace harness.

Fig.: 2-3-1



THROTTLE SWITCH

POSITION	ENGINE SPEED	CONNECTION
LEFT HAND	IDLE	1-2,4-6
CENTER	MIDDLE	1-3,4-6
RIGHT HAND	FULL	1-3,4-5

STARTER SWITCH

	B	R1	R2	ACC	BR	C
HEAT	O	O	O	O	O	
OFF						
ON	O			O	O	
ST	O	O	O	O	O	O

2-3-5. Starter motor runs even when F-R lever is not at "N" and parking brake is not applied

Reference Fig.: 2-3-1

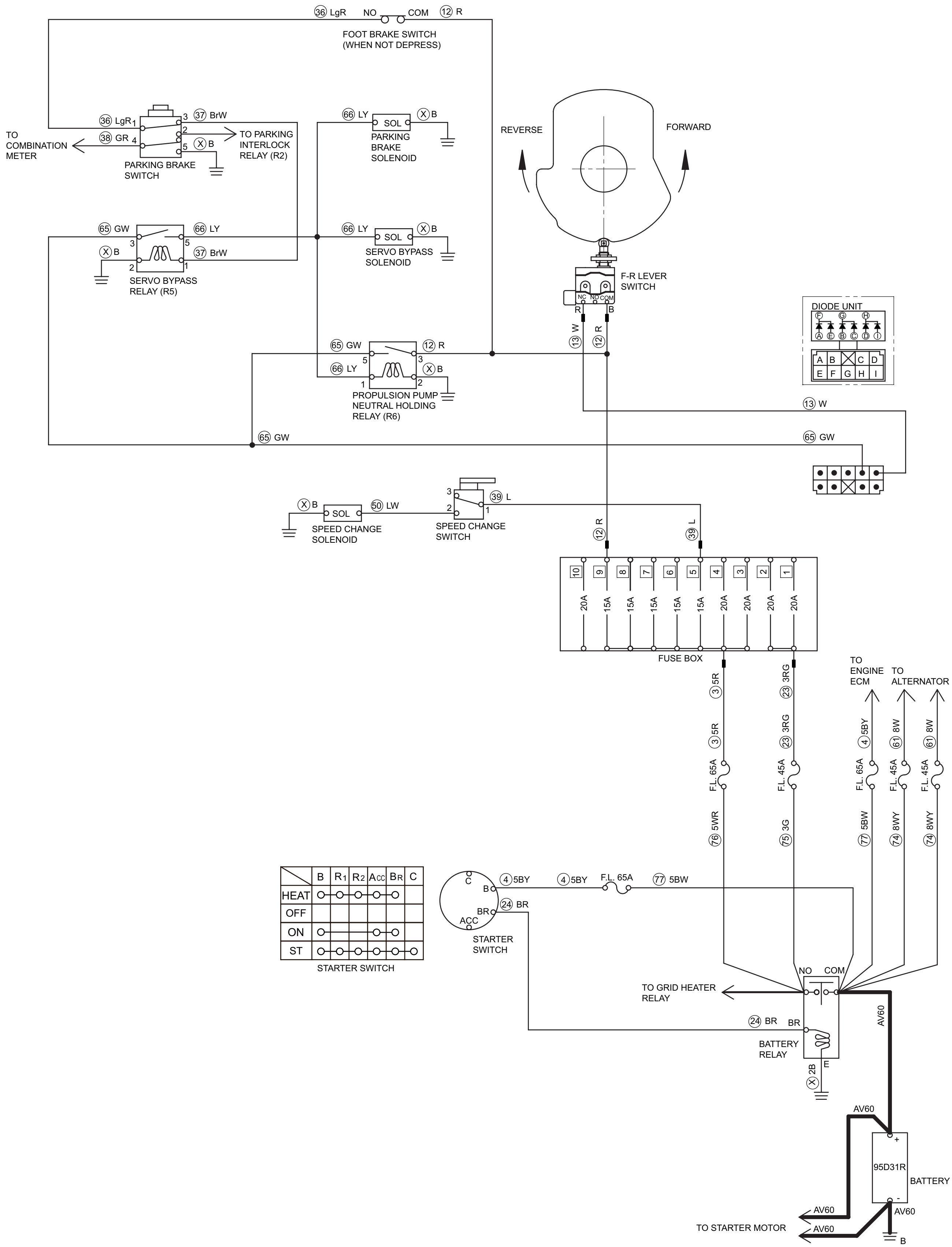
Check point	Check/Cause	Action
1. F-R Lever Switch	• When starter switch is OFF and F-R lever is "F" or "R", check continuity between F-R lever switch terminal COM and terminal NC. There is no continuity in normal condition. • If there is continuity, F-R lever switch is faulty.	Replace F-R lever switch.
2. Parking Brake Switch	• When starter switch is OFF and parking brake switch is released position, check continuity between parking brake switch terminal 1 and 2. There is no continuity in normal condition. • If there is continuity, parking brake switch is faulty.	Replace parking brake switch.

2-3-6. Engine speed cannot be switched

Reference Fig. : 2-3-1

Check point	Check/Cause	Action
1. Throttle Switch	(1) When throttle switch is "IDLE", check continuity between throttle switch terminals 1 and 2, 4 and 6. There is continuity in normal condition. (2) When throttle switch is "MID", check continuity between throttle switch terminals 1 and 3, 4 and 6. There is continuity in normal condition. (3) When throttle switch is "FULL", 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 (R9)	(1) When starter switch is ON and throttle switch is "FULL", measure voltage between throttle relay terminal b inlet wire RW and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and throttle switch is "FULL", measure voltage between throttle relay terminal e outlet wire LW and chassis ground. There is electricity in normal condition. (3) When starter switch is ON and throttle switch is "MID", measure voltage between throttle relay terminal f outlet wire WL 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 (R9).
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



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2-4. Propulsion

Check following items before troubleshooting.

- No blown fuses and power is applied up to fuses.
- Check any ground circuit which belongs to components to be checked.

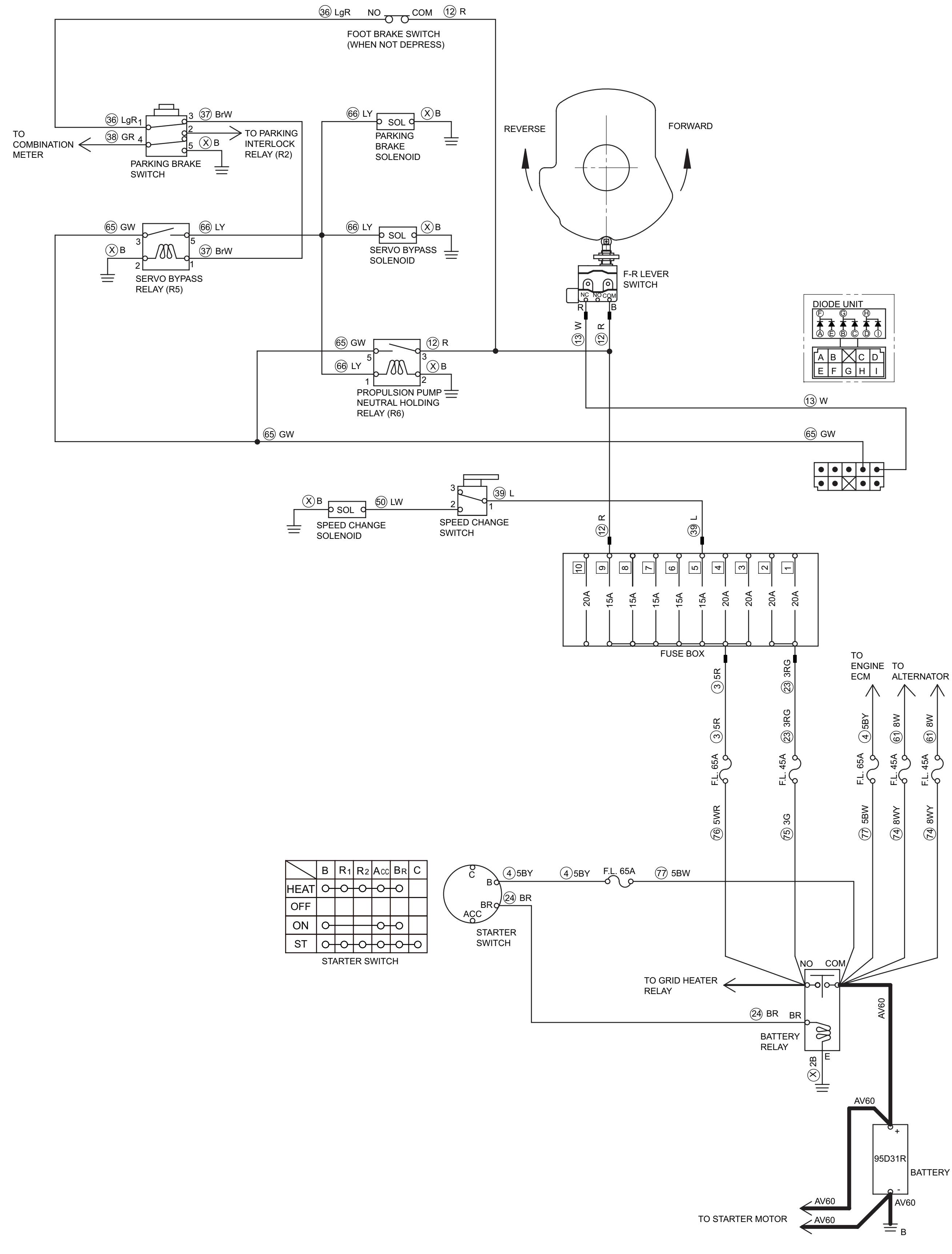
2-4-1. Machine moves neither forward nor backward 1/2

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

Reference Fig.: 2-4-1

Check point	Check/Cause	Action
1. Servo Bypass Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 12.3 ± 1.2 Ω • If measured resistance is abnormal, servo bypass solenoid is faulty.	Replace servo bypass solenoid.
2. 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.
3.Servo Bypass Relay (R5)	(1) When starter switch is ON, measure voltage between servo bypass relay terminal 1 inlet wire BrW and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between servo bypass terminal 3 inlet wire GW and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between servo bypass relay terminal 5 outlet wire LY and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, servo bypass is faulty.	Replace servo bypass relay (R5).
4.Propulsion Pump Neutral Holding Relay (R6)	(1) When starter switch is ON and F-R lever is “F” or “R”, measure voltage between propulsion pump neutral holding relay terminal 1 inlet wire LY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and F-R lever is “F” or “R”, measure voltage between propulsion pump neutral holding relay terminal 3 inlet wire R and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON and F-R lever is “F” or “R”, measure voltage between propulsion pump neutral holding relay terminal 5 outlet wire GW and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, propulsion pump neutral holding relay is faulty.	Replace propulsion pump neutral holding relay (R6).

Fig.: 2-4-1



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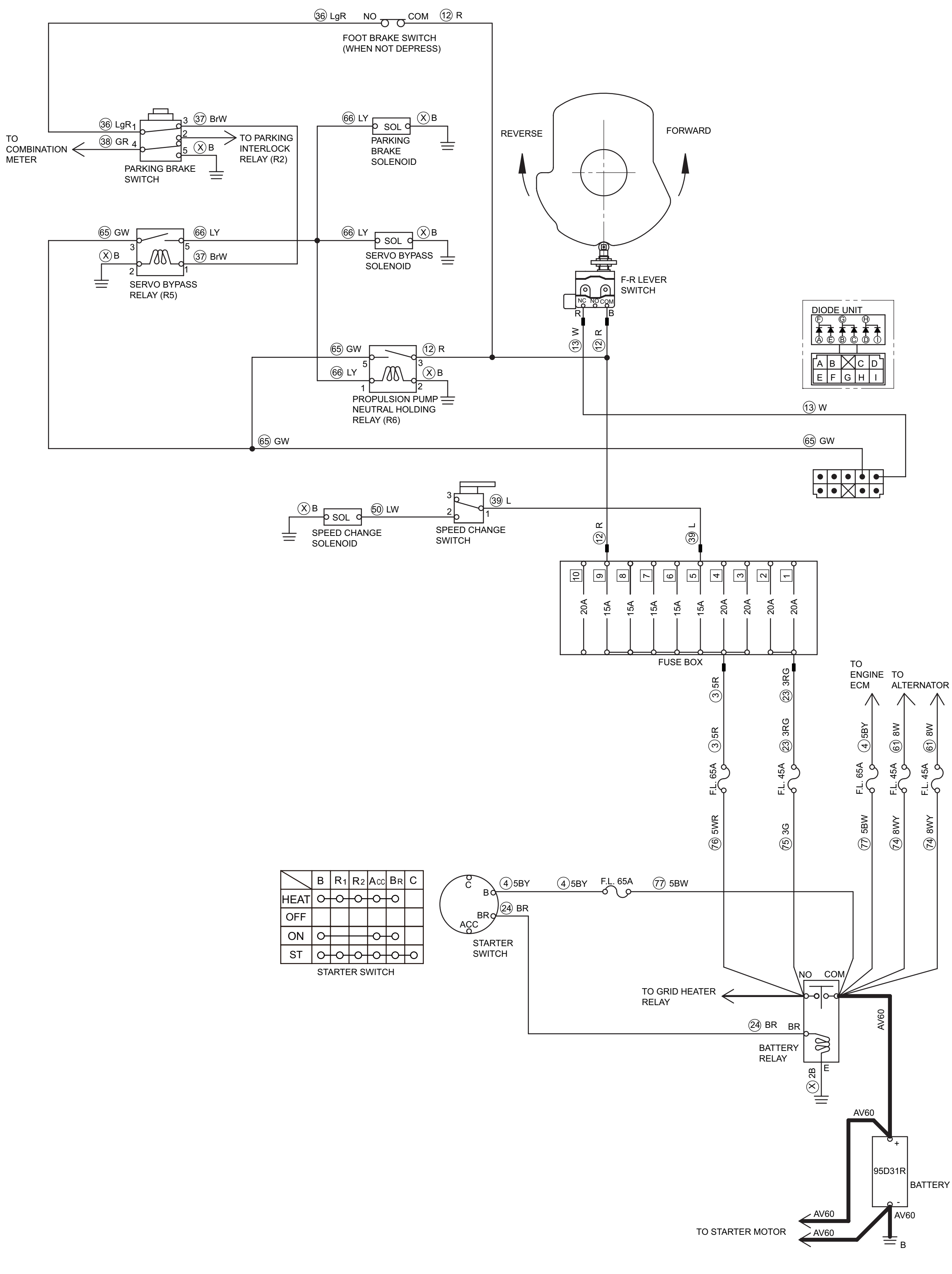
2-4-1. Machine moves neither forward nor backward 2/2

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

Reference Fig.: 2-4-1

Check point	Check/Cause	Action
5. Diode Unit	(1) When starter switch is ON and F-R lever is “N”, measure voltage between diode unit terminal I inlet wire W and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and F-R lever is “N”, measure voltage between diode unit terminal H outlet wire GW and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2) is NG, diode unit is faulty.	Replace diode unit.
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 and F-R lever is “N”, 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. 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.
8. 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.
9. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-4-1


36 LgR
NO
COM
12 R
FOOT BRAKE SWITCH (WHEN NOT DEPRESS)
TO COMBINATION METER
36 LgR
38 GR
37 BrW
X B
TO PARKING INTERLOCK RELAY (R2)
PARKING BRAKE SWITCH
66 LY
SOL
PARKING BRAKE SOLENOID
REVERSE
FORWARD
65 GW
66 LY
37 BrW
SERVO BYPASS RELAY (R5)
SERVO BYPASS SOLENOID
F-R LEVER SWITCH
NC NO COM
DIODE UNIT
13 W
12 R
65 GW
PROPULSION PUMP NEUTRAL HOLDING RELAY (R6)
50 LW
39 L
SPEED CHANGE SOLENOID
SPEED CHANGE SWITCH
39 L
20A 15A 15A 15A 15A 15A 20A 20A 20A 20A
FUSE BOX
3 5R
23 3RG
TO ENGINE ECM
TO ALTERNATOR
4 5BY
61 8W
F.L. 65A
F.L. 45A
76 5WR
75 3G
77 5BW
74 8WY
B R1 R2 ACC BR C
HEAT
OFF
ON
ST
STARTER SWITCH
4 5BY
24 BR
STARTER SWITCH
TO GRID HEATER RELAY
BATTERY RELAY
X 2B
AV60
95D31R
BATTERY
TO STARTER MOTOR
SV412-09002

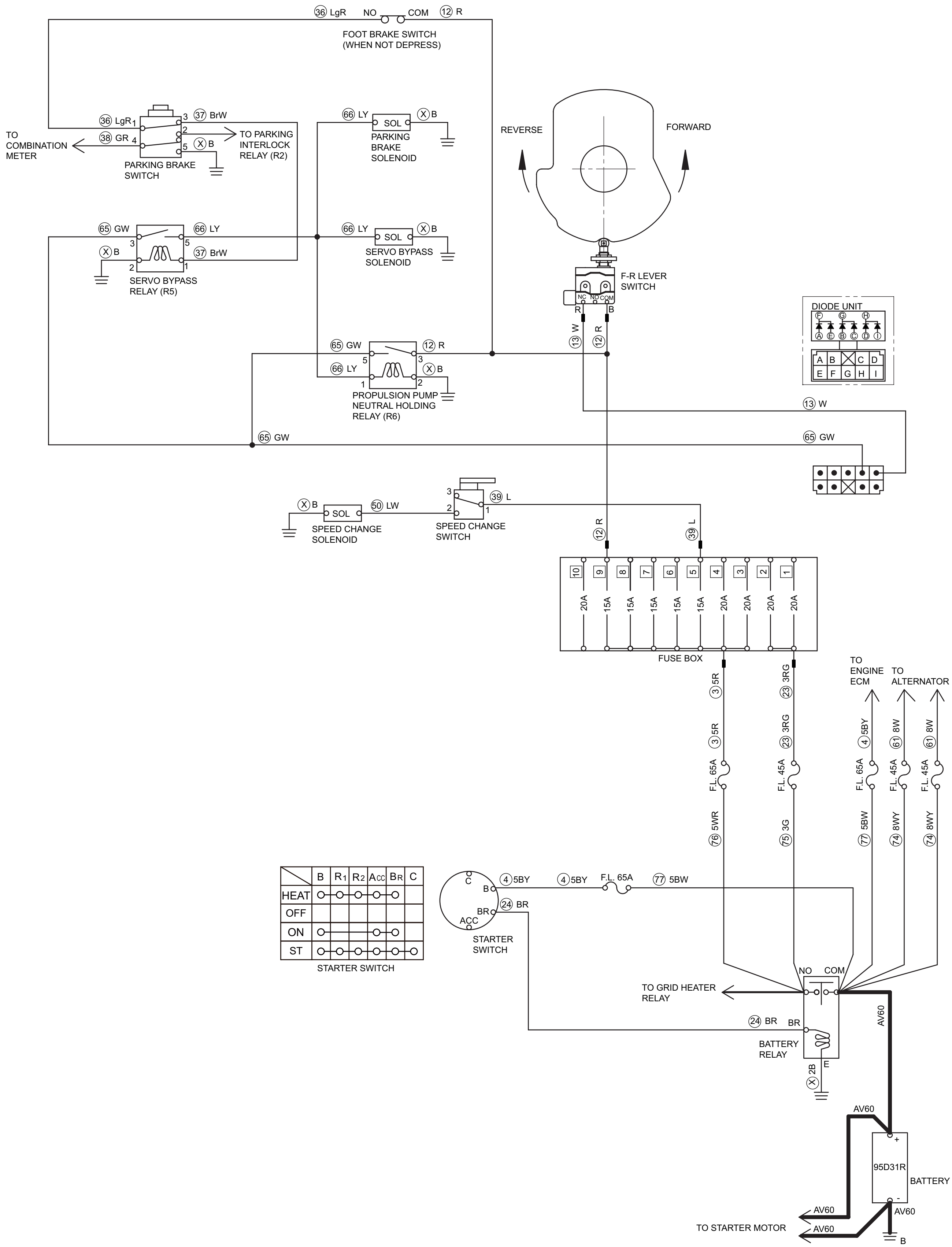
2-4-2. Machine speed cannot be changed

- Speed change switch must be “ ”.

Reference Fig.: 2-4-1

Check point	Check/Cause	Action
1. Speed Change Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 5.1 Ω • If measured resistance is abnormal, speed change solenoid is faulty.	Replace speed change solenoid.
2. Speed Change Switch	(1) When starter switch is ON, measure voltage between speed change switch terminal 1 inlet wire L and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between speed change switch terminal 2 outlet wire LW and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and (2) is NG, speed change switch is faulty.	Replace speed change switch.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-4-1



	B	R1	R2	Acc	BR	C
HEAT	o	o	o	o	o	
OFF						
ON	o			o	o	
ST	o	o	o	o	o	o

STARTER SWITCH

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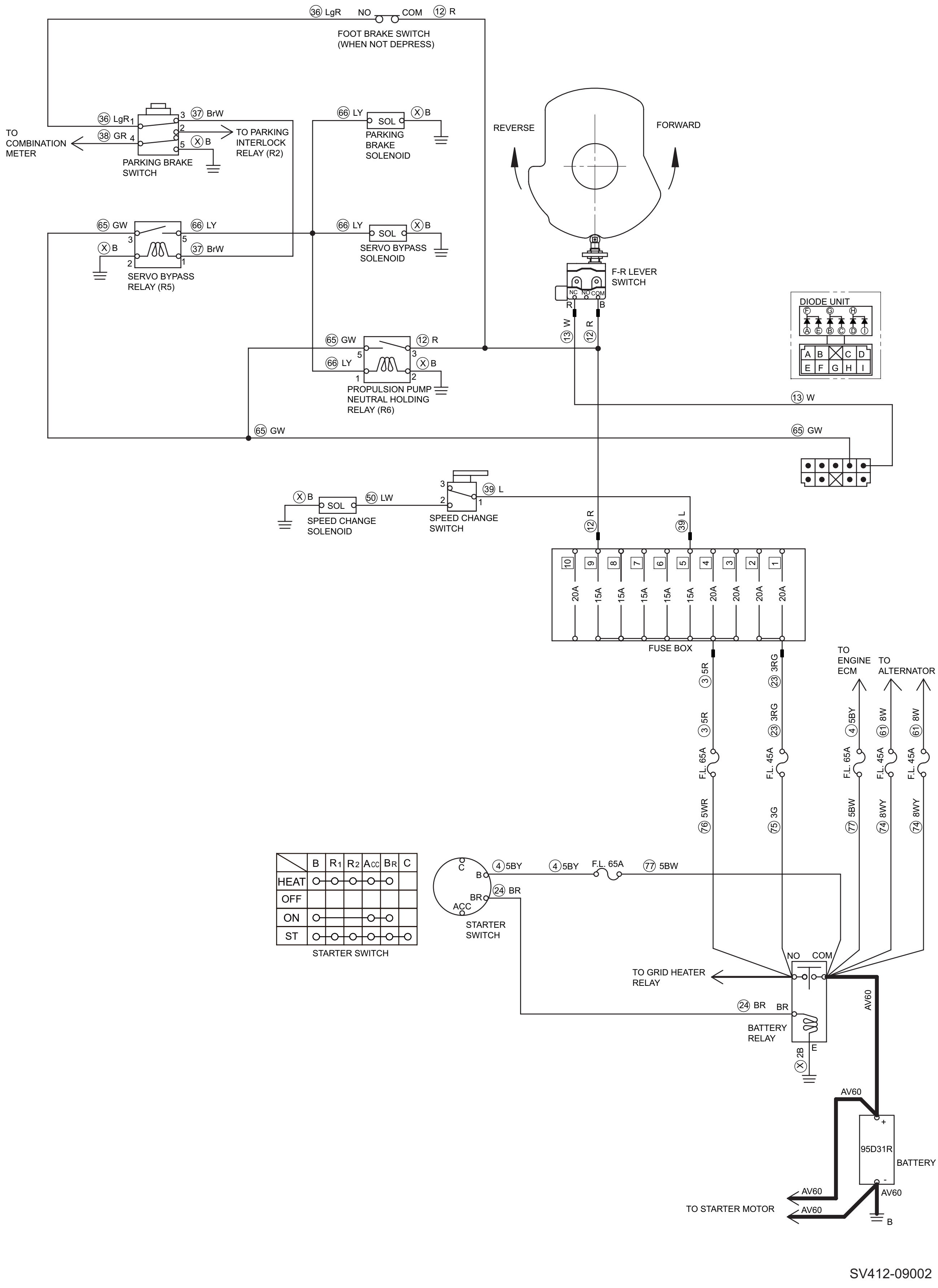
2-4-3. Brake cannot be released 1/2

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

Reference Fig.: 2-4-1

Check point	Check/Cause	Action
1. Parking Brake Solenoid	• Disconnect harness and measure resistance of coil. Standard voltage : 12.3 $\pm$ 1.2 Ω • If measured resistance is abnormal, parking brake solenoid is faulty.	Replace parking brake solenoid.
2. Servo Bypass Relay (R5)	(1) When starter switch is ON, measure voltage between servo bypass relay terminal 1 inlet wire BrW and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between servo bypass terminal 3 inlet wire GW and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between servo bypass relay terminal 5 outlet wire LY and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, servo bypass is faulty.	Replace servo bypass relay (R5).
3. Propulsion Pump Neutral Holding Relay (R6)	(1) When starter switch is ON, measure voltage between propulsion pump neutral holding relay terminal 1 inlet wire LY and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and F-R lever is “F” or “R”, measure voltage between propulsion pump neutral holding relay terminal 3 inlet wire R and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON and F-R lever is “F” or “R”, measure voltage between propulsion pump neutral holding relay terminal 5 outlet wire GW and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, propulsion pump neutral holding relay is faulty.	Replace propulsion pump neutral holding relay (R6).
4. 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.

Fig.: 2-4-1



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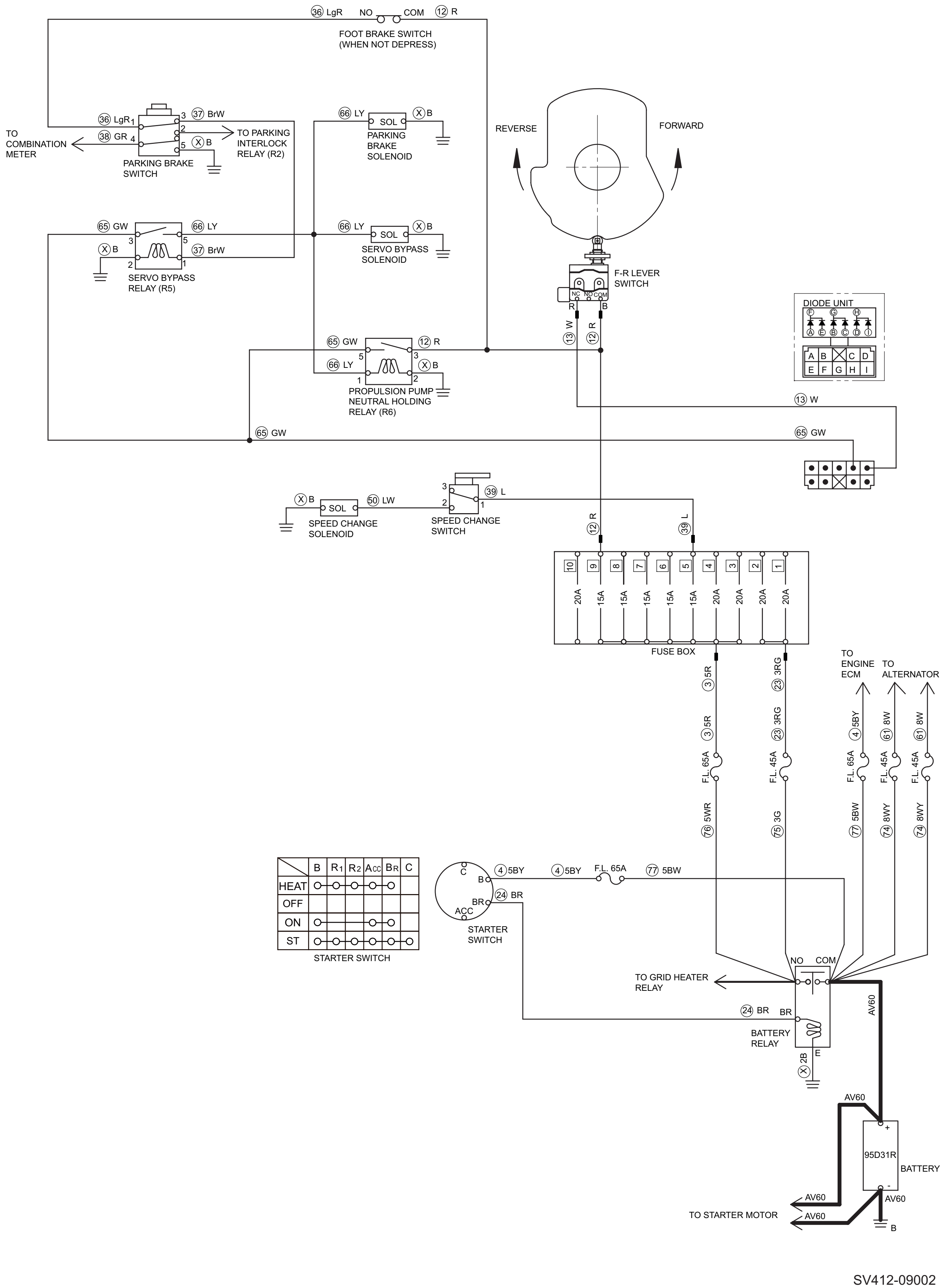
2-4-3. Brake cannot be released 2/2

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

Reference Fig.: 2-4-1

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

Fig.: 2-4-1


FOOT BRAKE SWITCH (WHEN NOT DEPRESS)
PARKING BRAKE SWITCH
TO COMBINATION METER
TO PARKING INTERLOCK RELAY (R2)
PARKING BRAKE SOLENOID
SERVO BYPASS SOLENOID
SERVO BYPASS RELAY (R5)
REVERSE
FORWARD
F-R LEVER SWITCH
DIODE UNIT
PROPULSION PUMP NEUTRAL HOLDING RELAY (R6)
SPEED CHANGE SOLENOID
SPEED CHANGE SWITCH
FUSE BOX
TO ENGINE ECM
TO ALTERNATOR
STARTER SWITCH
TO GRID HEATER RELAY
BATTERY RELAY
BATTERY
95D31R
TO STARTER MOTOR
SV412-09002

2-4-4. Brake does not work

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

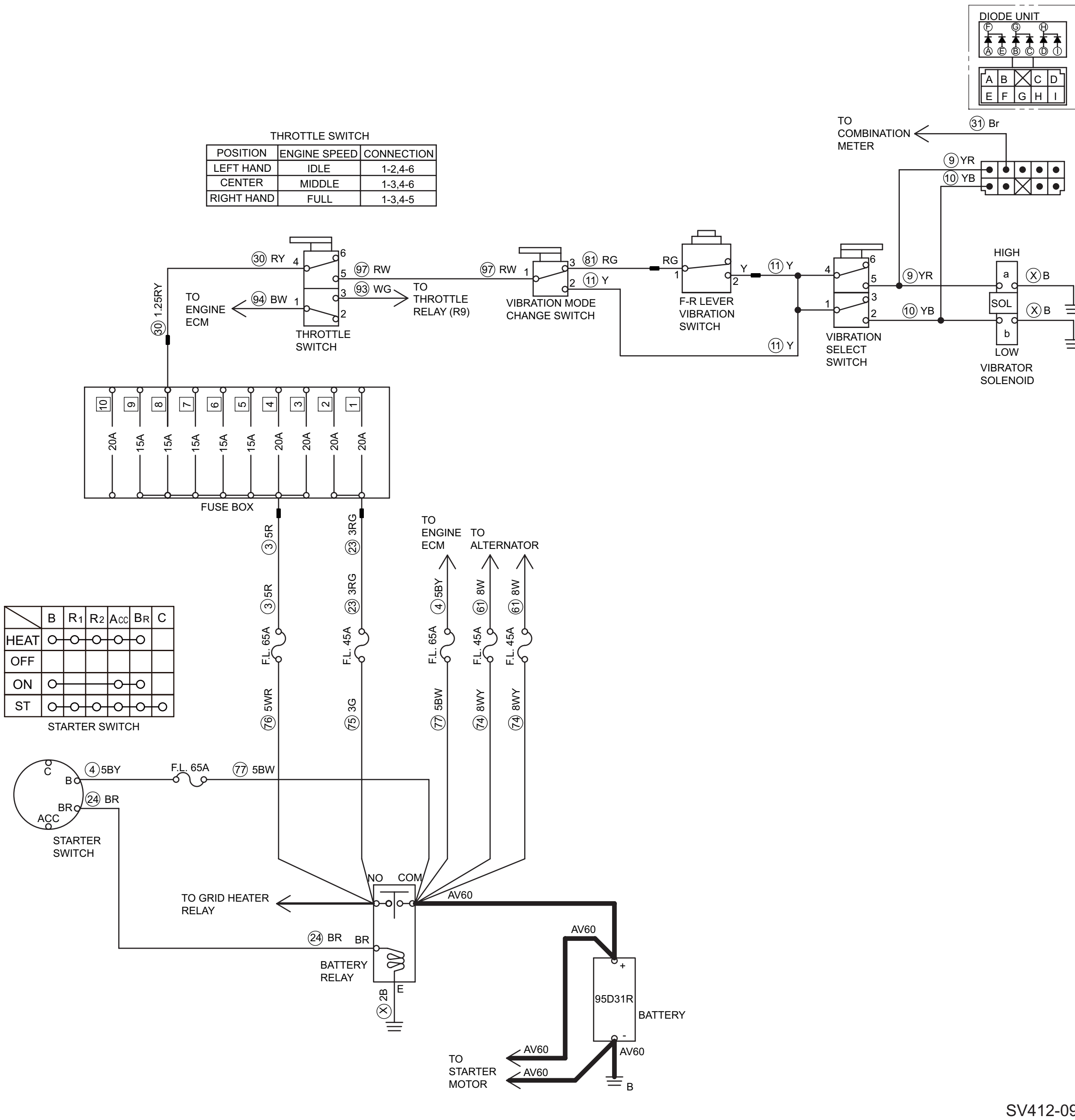
Reference Fig.: 2-4-1

Check point	Check/Cause	Action
1. Parking Brake Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 12.3 ± 1.2 Ω • If measured resistance is abnormal, parking brake solenoid is faulty.	Replace parking brake solenoid.
2. Parking Brake Switch	• When starter switch is ON, measure voltage between parking brake switch terminal 3 outlet wire BrW and chassis ground. There is no electricity in normal condition. • If electricity flows, parking brake switch is faulty.	Replace parking brake switch.
3. Foot Brake Switch	• When starter switch is ON, measure voltage between foot brake switch terminal 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.
4. Servo Bypass Relay (R5)	(1) When starter switch is ON, measure voltage between servo bypass relay terminal 1 inlet wire BrW and chassis ground. There is no electricity in normal condition. (2) When starter switch is ON, measure voltage between servo bypass terminal 5 outlet wire LY and chassis ground. There is no electricity in normal condition. • If above item (1) is OK and item (2) is NG, servo bypass is faulty.	Replace servo bypass relay (R5).
5. Propulsion Pump Neutral Holding Relay (R6)	(1) When starter switch is ON, measure voltage between propulsion pump neutral holding relay terminal 1 inlet wire LY and chassis ground. There is no electricity in normal condition. (2) When starter switch is ON and F-R lever is “F” or “R”, measure voltage between propulsion pump neutral holding relay terminal 5 outlet wire GW and chassis ground. There is no electricity in normal condition. • If above item (1) is OK and item (2) is NG, propulsion pump neutral holding relay is faulty.	Replace propulsion pump neutral holding relay (R6).
6. 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

THROTTLE SWITCH

POSITION	ENGINE SPEED	CONNECTION
LEFT HAND	IDLE	1-2,4-6
CENTER	MIDDLE	1-3,4-6
RIGHT HAND	FULL	1-3,4-5



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2-5. Vibration

Check following items before troubleshooting.

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

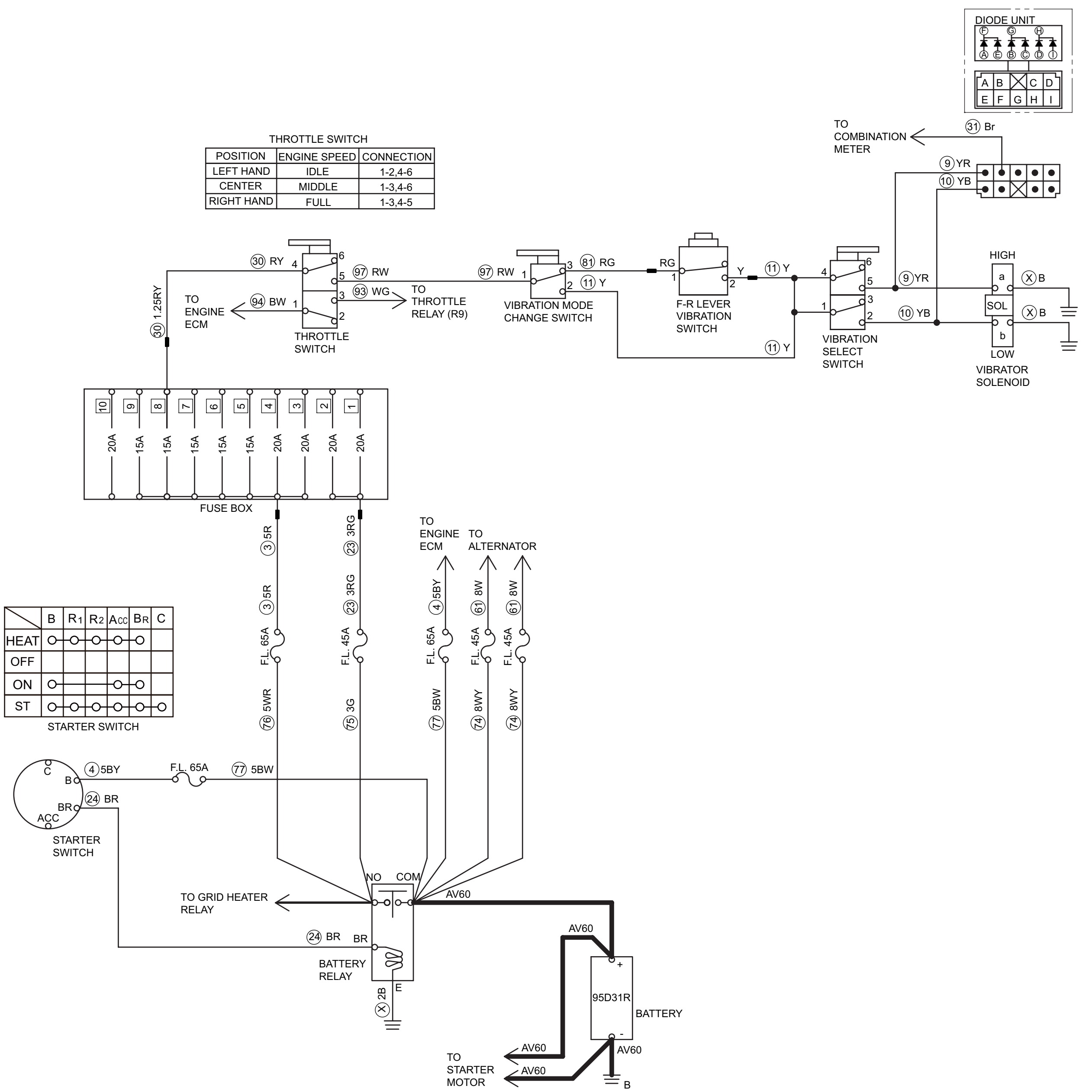
2-5-1. No vibration occurs

- Vibration mode change switch must be “CONT” (continuous mode).
- Vibration select switch must not be “ ◯ ”.

Reference Fig.: 2-5-1

Check point	Check/Cause	Action
1. Vibrator Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 5.1 Ω • If resistance is abnormal, vibrator solenoid is faulty.	Replace vibrator solenoid.
2. Vibration Select Switch	(1) When starter switch is ON, measure voltage between vibration select 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 select switch is “ ”, measure voltage between vibration select switch terminal 2 outlet wire YB and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON and vibration select switch is “ ”, measure voltage between vibration select 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 select switch is faulty.	Replace vibration select switch.
3. 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.
4. 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.
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.: 2-5-1



SV412-09003

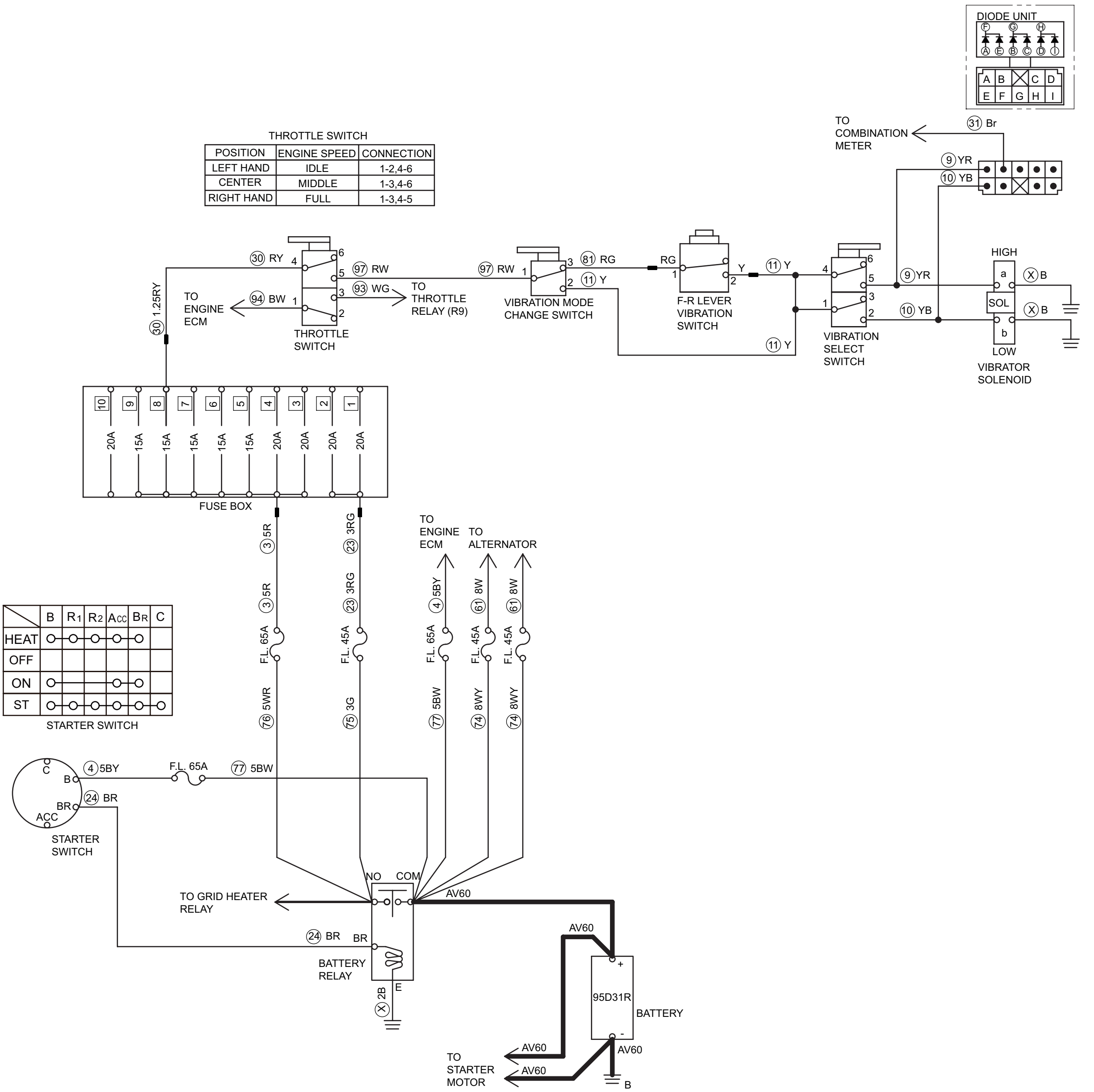
2-5-2. Amplitude does not change (Remains either Low or High)

- Vibration mode change switch must be “CONT” (continuous mode).

Reference Fig. : 2-5-1

Check point	Check/Cause	Action
1. Vibrator Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 5.1 Ω • If resistance is abnormal, vibrator solenoid is faulty.	Replace vibrator solenoid.
2. Vibration Select Switch	(1) When starter switch is ON, measure voltage between vibration select 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 select switch is “ ”, measure voltage between vibration select switch terminal 2 outlet wire YB and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON and vibration select switch is “ ”, measure voltage between vibration select 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 select switch is faulty.	Replace vibration select switch.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-5-1



DIODE UNIT
TO COMBINATION METER
31 Br
9 YR
10 YB
THROTTLE SWITCH
POSITION | ENGINE SPEED | CONNECTION
LEFT HAND | IDLE | 1-2,4-6
CENTER | MIDDLE | 1-3,4-6
RIGHT HAND | FULL | 1-3,4-5
30 RY
97 RW
93 WG
94 BW
TO ENGINE ECM
TO THROTTLE RELAY (R9)
THROTTLE SWITCH
VIBRATION MODE CHANGE SWITCH
81 RG
11 Y
F-R LEVER VIBRATION SWITCH
VIBRATION SELECT SWITCH
HIGH
SOL
LOW
VIBRATOR SOLENOID
X B
30 1.25RY
FUSE BOX
20A 15A 15A 15A 15A 15A 20A 20A 20A 20A
3 5R
23 3RG
TO ENGINE ECM
TO ALTERNATOR
4 5BY
61 8W
F.L. 65A
F.L. 45A
76 5WR
75 3G
77 5BW
74 8WY
STARTER SWITCH
B R1 R2 ACC BR C
HEAT
OFF
ON
ST
24 BR
TO GRID HEATER RELAY
NO COM
AV60
BATTERY RELAY
X 2B
E
95D31R
BATTERY
TO STARTER MOTOR
SV412-09003

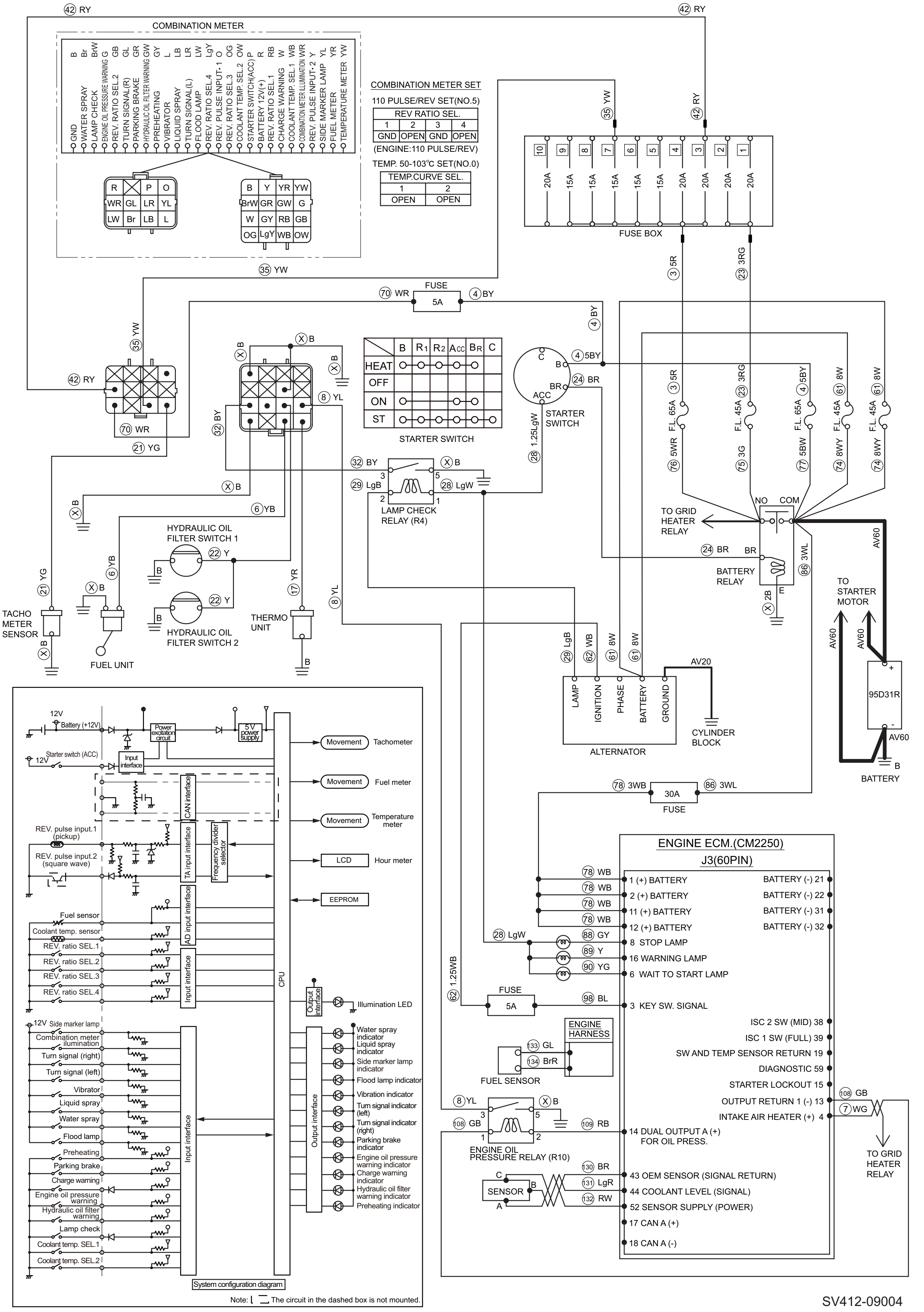
2-5-3. Vibration mode cannot be switched (F-R lever vibration switch does not work)

- Vibration mode change switch to “ ” (manual mode).
- Vibration select switch must not be “ ○ ”.

Reference Fig. : 2-5-1

Check point	Check/Cause	Action
1. F-R Lever Vibration Switch	(1) When starter switch is ON, measure voltage between F-R lever vibration switch terminal 1 inlet wire RG 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 Y 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.
2. 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.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-6-1


COMBINATION METER
COMBINATION METER SET
110 PULSE/REV SET(NO.5)
REV RATIO SEL.
GND OPEN GND OPEN
(ENGINE:110 PULSE/REV)
TEMP. 50-103°C SET(NO.0)
TEMP.CURVE SEL.
OPEN OPEN
FUSE BOX
STARTER SWITCH
HEAT
OFF
ON
ST
LAMP CHECK RELAY (R4)
TO GRID HEATER RELAY
BATTERY RELAY
TO STARTER MOTOR
HYDRAULIC OIL FILTER SWITCH 1
HYDRAULIC OIL FILTER SWITCH 2
TACHO METER SENSOR
FUEL UNIT
THERMO UNIT
ALTERNATOR
CYLINDER BLOCK
95D31R
BATTERY
FUSE
30A
ENGINE ECM.(CM2250)
J3(60PIN)
1 (+) BATTERY
2 (+) BATTERY
11 (+) BATTERY
12 (+) BATTERY
8 STOP LAMP
16 WARNING LAMP
6 WAIT TO START LAMP
3 KEY SW. SIGNAL
BATTERY (-) 21
BATTERY (-) 22
BATTERY (-) 31
BATTERY (-) 32
ISC 2 SW (MID) 38
ISC 1 SW (FULL) 39
SW AND TEMP SENSOR RETURN 19
DIAGNOSTIC 59
STARTER LOCKOUT 15
OUTPUT RETURN 1 (-) 13
INTAKE AIR HEATER (+) 4
14 DUAL OUTPUT A (+) FOR OIL PRESS.
43 OEM SENSOR (SIGNAL RETURN)
44 COOLANT LEVEL (SIGNAL)
52 SENSOR SUPPLY (POWER)
17 CAN A (+)
18 CAN A (-)
ENGINE HARNESS
FUEL SENSOR
ENGINE OIL PRESSURE RELAY (R10)
SENSOR
System configuration diagram
Note: The circuit in the dashed box is not mounted.
SV412-09004

2-6. Lighting

Check following items before troubleshooting.

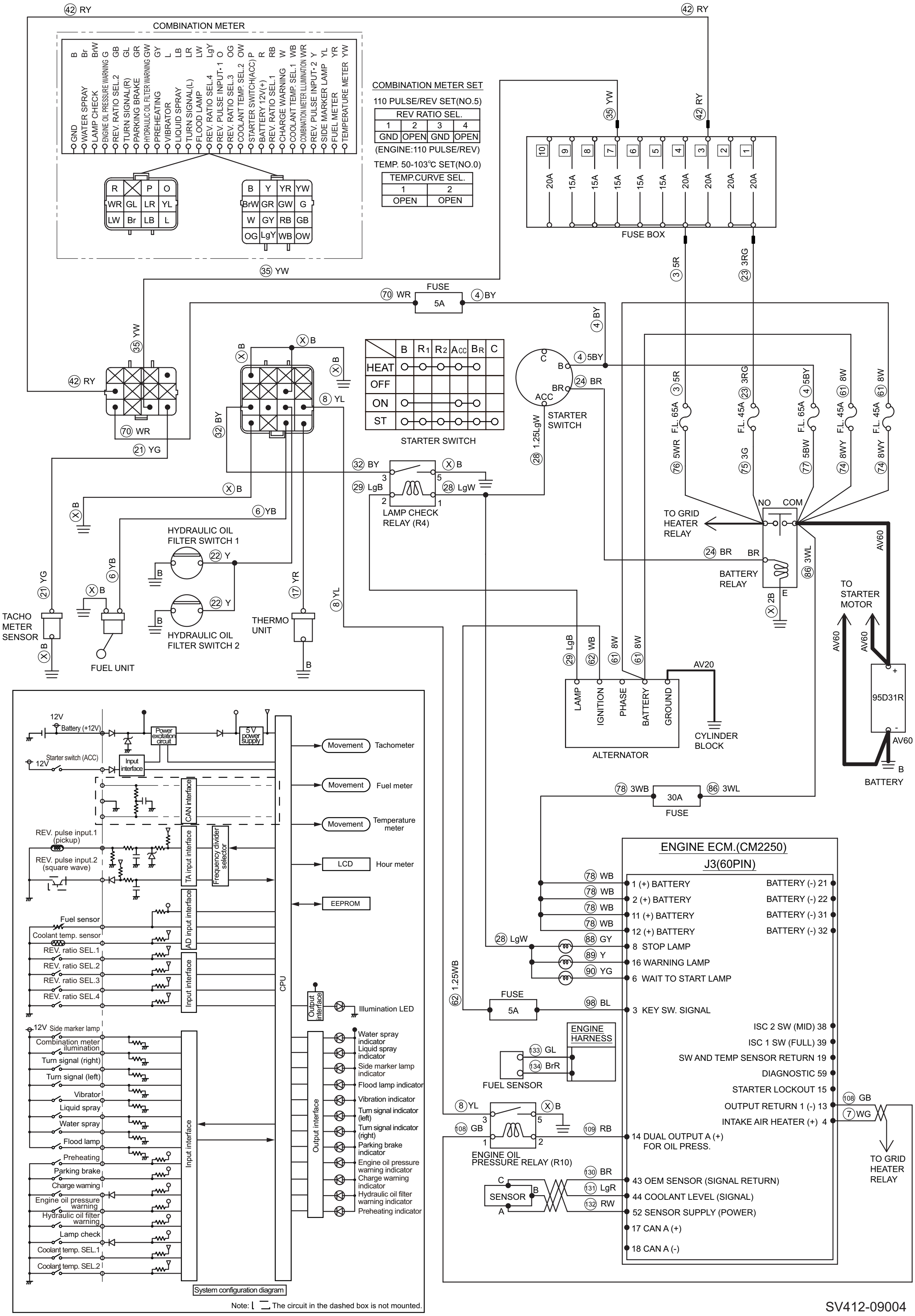
- No blown fuse and power is applied up to fuses.
- When measuring voltage and current without disconnecting connectors, refer to “measuring voltage and current following using tester” (P. 9-006 to P. 9-008).
- Check any ground circuit which belongs to components to be checked.

2-6-1. Illumination of combination meter does not turn on

Reference Fig. : 2-6-1

Check point	Check/Cause	Action
1. Harness	• Measure resistance between fuse box terminal 3 wire RY and combination meter connector terminal wire No. 42 wire RY. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.
2. Combination Meter (Combination meter illumination)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery terminal wire No. 70 inlet wire WR and ground terminal wire B • Starter switch terminal wire No. 35 inlet wire YW and ground terminal wire B Standard voltage : 12 V or more (2) When starter switch is ON, measure voltage between combination meter illumination terminal wire No. 42 inlet wire RY and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and combination meter illumination does not turn on, combination meter is faulty.	Replace combination meter.

Fig.: 2-6-1



SV412-09004

2-6-2. Combination meter warning lamp or indicator lamp is abnormal

Reference Fig. : 2-6-1

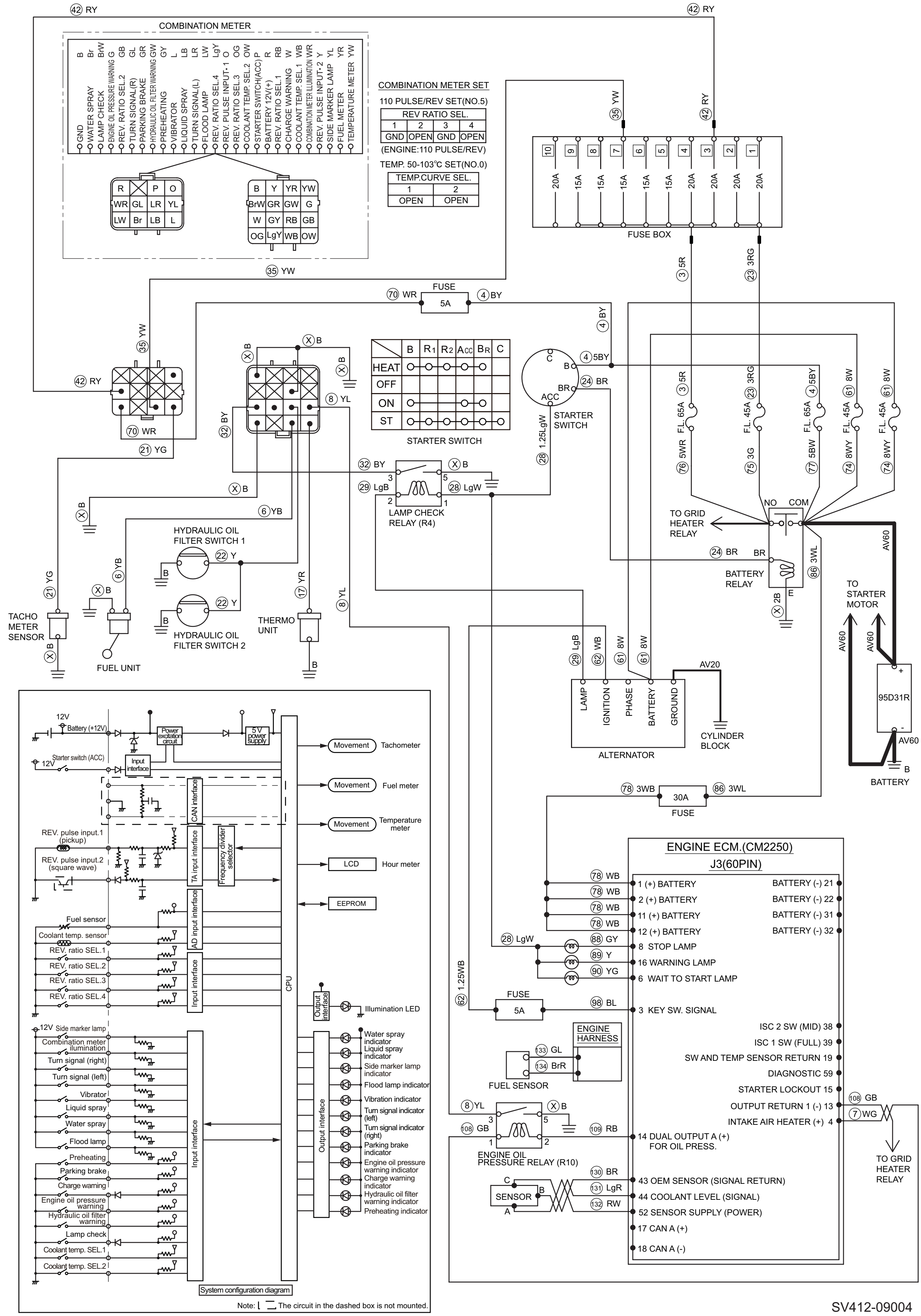
Check point	Check/Cause	Action

1. Harness	• Disconnect connectors between combination meter and lamp check relay.
	• Measure resistance between terminals and chassis ground.
	  • Combination meter connector terminal wire No. 32 wire BY and chassis ground
	  • Lamp check relay terminal 3 wire BY and chassis ground
	    Standard resistance: 100 kΩ or more
	• If resistance is abnormal, harness is faulty.
		Repair or replace harness.

2. Lamp Check Relay (R4)	(1) When starter switch is ON, measure voltage between lamp check relay terminal 2 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 2 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) are OK and item (3) is NG, alternator is faulty.
		Repair or replace lamp check relay (R4) or alternator.

3. Combination Meter (Lamp check)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire.
	  • Battery terminal wire No. 70 inlet wire WR and ground terminal wire B
	  • Starter switch terminal wire No. 35 inlet wire YW and ground terminal wire B
	  Standard voltage : 12 V or more
	(2) When starter switch is ON, check that parking brake indicator lamp, hydraulic oil filter warning lamp, engine oil pressure warning lamp and electrical charge warning lamp illuminate and then go out after starting engine.
	• If above item (1) is OK and the item (2) is NG, combination meter is faulty.
	
	(NOTICE)
	• Since engine cannot start unless parking brake switch is applied and F-R lever is "N", parking brake indicator lamp does not go out even after starting engine.
		Replace combination meter.

Fig.: 2-6-1


COMBINATION METER
GND
WATER SPRAY
LAMP CHECK
ENGINE OIL PRESSURE WARNING
REV. RATIO SEL.2
TURN SIGNAL(R)
PARKING BRAKE
HYDRAULIC OIL FILTER WARNING
PREHEATING
VIBRATOR
LIQUID SPRAY
TURN SIGNAL(L)
FLOOD LAMP
REV. RATIO SEL.4
REV. PULSE INPUT-1
REV. RATIO SEL.3
COOLANT TEMP. SEL.2
STARTER SWITCH(ACC)
BATTERY 12V(+)
REV. RATIO SEL.1
CHARGE WARNING
COOLANT TEMP. SEL.1
COMBINATION METER ILLUMINATION
REV. PULSE INPUT-2
SIDE MARKER LAMP
FUEL METER
TEMPERATURE METER
COMBINATION METER SET
110 PULSE/REV SET(NO.5)
REV RATIO SEL.
1 2 3 4
GND OPEN GND OPEN
(ENGINE:110 PULSE/REV)
TEMP. 50-103°C SET(NO.0)
TEMP.CURVE SEL.
1 2
OPEN OPEN
FUSE BOX
FUSE
5A
STARTER SWITCH
HEAT
OFF
ON
ST
LAMP CHECK RELAY (R4)
HYDRAULIC OIL FILTER SWITCH 1
HYDRAULIC OIL FILTER SWITCH 2
TACHO METER SENSOR
FUEL UNIT
THERMO UNIT
TO GRID HEATER RELAY
BATTERY RELAY
TO STARTER MOTOR
ALTERNATOR
LAMP
IGNITION
PHASE
BATTERY
GROUND
CYLINDER BLOCK
95D31R
BATTERY
30A
ENGINE ECM.(CM2250)
J3(60PIN)
1 (+) BATTERY
2 (+) BATTERY
11 (+) BATTERY
12 (+) BATTERY
8 STOP LAMP
16 WARNING LAMP
6 WAIT TO START LAMP
3 KEY SW. SIGNAL
BATTERY (-) 21
BATTERY (-) 22
BATTERY (-) 31
BATTERY (-) 32
ISC 2 SW (MID) 38
ISC 1 SW (FULL) 39
SW AND TEMP SENSOR RETURN 19
DIAGNOSTIC 59
STARTER LOCKOUT 15
OUTPUT RETURN 1 (-) 13
INTAKE AIR HEATER (+) 4
14 DUAL OUTPUT A (+) FOR OIL PRESS.
43 OEM SENSOR (SIGNAL RETURN)
44 COOLANT LEVEL (SIGNAL)
52 SENSOR SUPPLY (POWER)
17 CAN A (+)
18 CAN A (-)
ENGINE HARNESS
FUEL SENSOR
ENGINE OIL PRESSURE RELAY (R10)
SENSOR
TO GRID HEATER RELAY
Battery (+12V)
Starter switch (ACC)
Power excitation circuit
5 V power supply
Input interface
CAN interface
TA input interface
Frequency divider selector
AD input interface
Output interface
CPU
Movement
Tachometer
Fuel meter
Temperature meter
LCD
Hour meter
EEPROM
REV. pulse input.1 (pickup)
REV. pulse input.2 (square wave)
Fuel sensor
Coolant temp. sensor
REV. ratio SEL.1
REV. ratio SEL.2
REV. ratio SEL.3
REV. ratio SEL.4
Illumination LED
Side marker lamp
Combination meter illumination
Turn signal (right)
Turn signal (left)
Vibrator
Liquid spray
Water spray
Flood lamp
Preheating
Parking brake
Charge warning
Engine oil pressure warning
Hydraulic oil filter warning
Lamp check
Coolant temp. SEL.1
Coolant temp. SEL.2
Water spray indicator
Liquid spray indicator
Side marker lamp indicator
Flood lamp indicator
Vibration indicator
Turn signal indicator (left)
Turn signal indicator (right)
Parking brake indicator
Engine oil pressure warning indicator
Charge warning indicator
Hydraulic oil filter warning indicator
Preheating indicator
System configuration diagram
Note: The circuit in the dashed box is not mounted.
SV412-09004

2-6-3. Tachometer reading is abnormal

Reference Fig. : 2-6-1

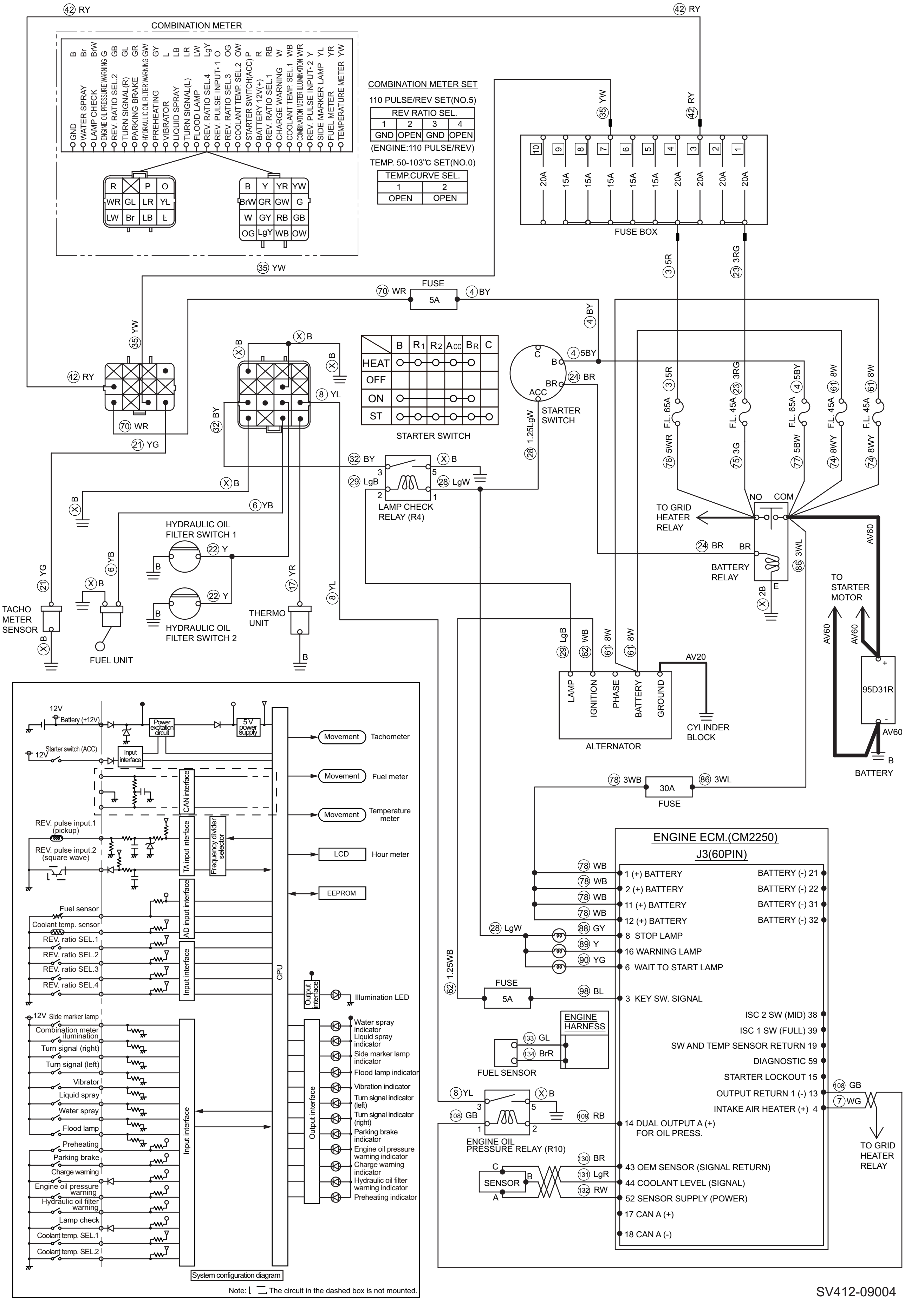
Check point	Check/Cause	Action
1. Combination Meter (Tachometer)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery terminal wire No. 70 inlet wire WR and ground terminal wire B • Starter switch terminal wire No. 35 inlet wire YW and ground terminal wire B Standard voltage : 12 V or more (2) Check that combination meter terminal B wires (rev. ratio 1 and 3) are grounded. (3) Start engine and measure pulse between combination meter rev. pulse input. 1 terminal wire No. 21 inlet wire YG and chassis ground. Standard pulse : 110 pulses/rotation of engine • If above items (1) and (2) are OK and pulse is NG in item (3), tachometer sensor is faulty. • If above items (1) and (2) are OK and tachometer reading is NG in item (3), combination meter is faulty.	Replace tachometer sensor or combination meter.
2. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

2-6-4. Hour meter is abnormal

Reference Fig. : 2-6-1

Check point	Check/Cause	Action
1. Combination Meter (Hour meter)	• When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery terminal wire No. 70 inlet wire WR and ground terminal wire B • Starter switch terminal wire No. 35 inlet wire YW and ground terminal wire B Standard voltage : 12 V or more • If no abnormality is found, combination meter is faulty.	Replace combination meter.

Fig.: 2-6-1


COMBINATION METER
COMBINATION METER SET
110 PULSE/REV SET(NO.5)
REV RATIO SEL.
GND OPEN GND OPEN
(ENGINE:110 PULSE/REV)
TEMP. 50-103°C SET(NO.0)
TEMP.CURVE SEL.
OPEN OPEN
FUSE BOX
STARTER SWITCH
HEAT OFF ON ST
LAMP CHECK RELAY (R4)
HYDRAULIC OIL FILTER SWITCH 1
HYDRAULIC OIL FILTER SWITCH 2
TACHO METER SENSOR
FUEL UNIT
THERMO UNIT
TO GRID HEATER RELAY
BATTERY RELAY
TO STARTER MOTOR
ALTERNATOR
CYLINDER BLOCK
95D31R
BATTERY
FUSE
ENGINE ECM.(CM2250)
J3(60PIN)
ENGINE HARNESS
FUEL SENSOR
ENGINE OIL PRESSURE RELAY (R10)
SENSOR
System configuration diagram
Note: The circuit in the dashed box is not mounted.
SV412-09004

2-6-5. Temperature meter is abnormal

Reference Fig. : 2-6-1

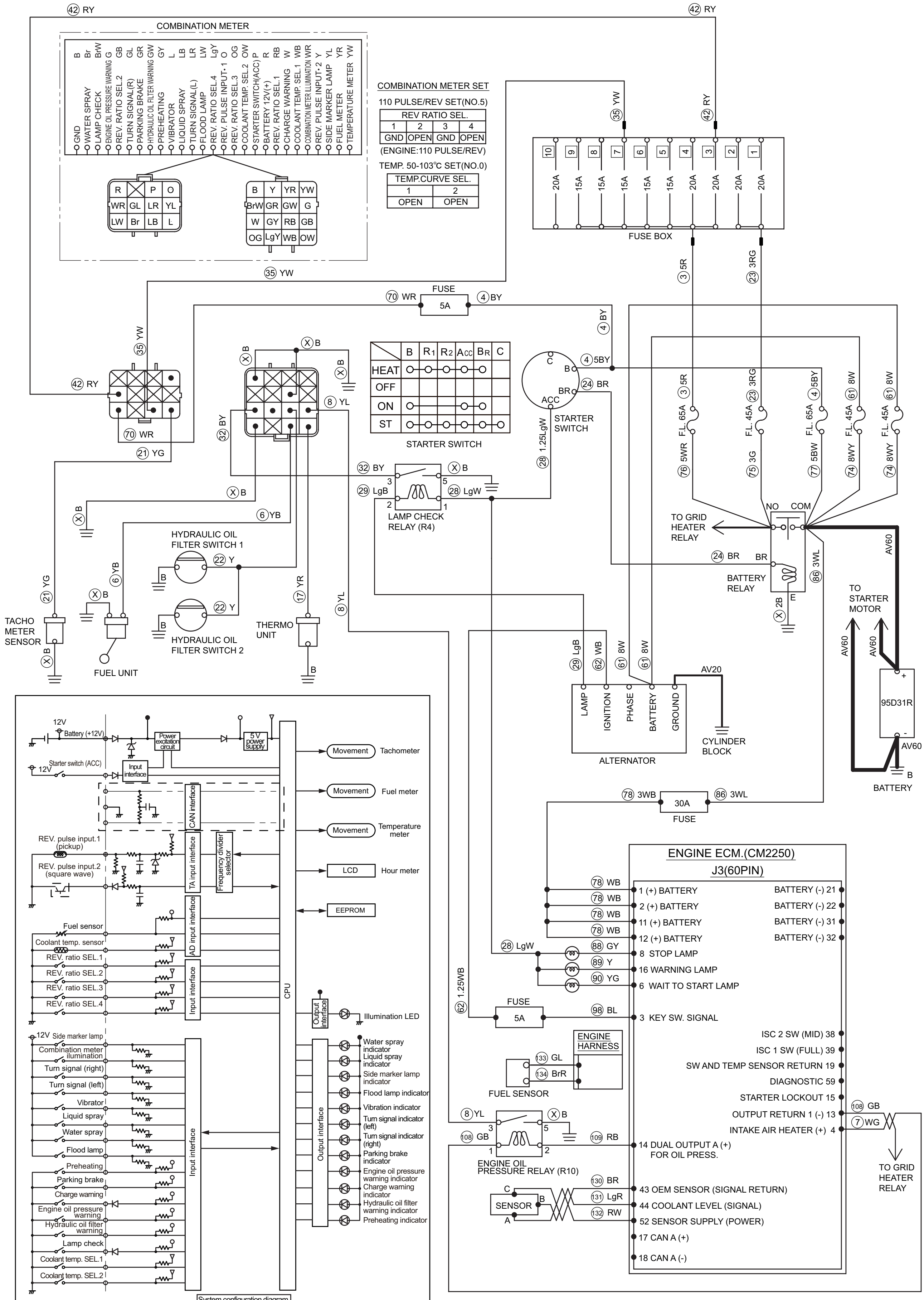
Check point	Check/Cause	Action
1. Thermo Unit	• Disconnect harness and measure resistance of thermo unit. Standard resistance : 164.6 Ω [(at unit temperature of 50°C (122°F)] 26.44 Ω [(at unit temperature of 103°C (217°F)] • If resistance is abnormal, thermo unit is faulty.	Replace thermo unit.
2. Combination Meter (Temperature meter)	• When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery terminal wire No. 70 inlet wire WR and ground terminal wire B • Starter switch terminal wire No. 35 inlet wire YW and ground terminal wire B Standard voltage : 12 V or more • If no abnormality is found, combination meter is faulty.	Replace combination meter.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

2-6-6. Fuel meter is abnormal

Reference Fig. : 2-6-1

Check point	Check/Cause	Action
1. Fuel Unit	• Disconnect harness and measure resistance of fuel unit. Standard resistance : 13.5 Ω (with float in “F”) 80.0 Ω (with float in “E”) • 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 terminal wires and ground terminal wire. • Battery terminal wire No. 70 inlet wire WR and ground terminal wire B • Starter switch terminal wire No. 35 inlet wire YW and ground terminal wire B Standard voltage : 12 V or more • If no abnormality is found, combination meter is faulty.	Replace combination meter.
3. Harness Connecting Between Terminals	• Measure resistance of harness connecting between terminals. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.

Fig.: 2-6-1



SV412-09004

2-6-7. Hydraulic oil filter warning lamp remains ON

Reference Fig. : 2-6-1

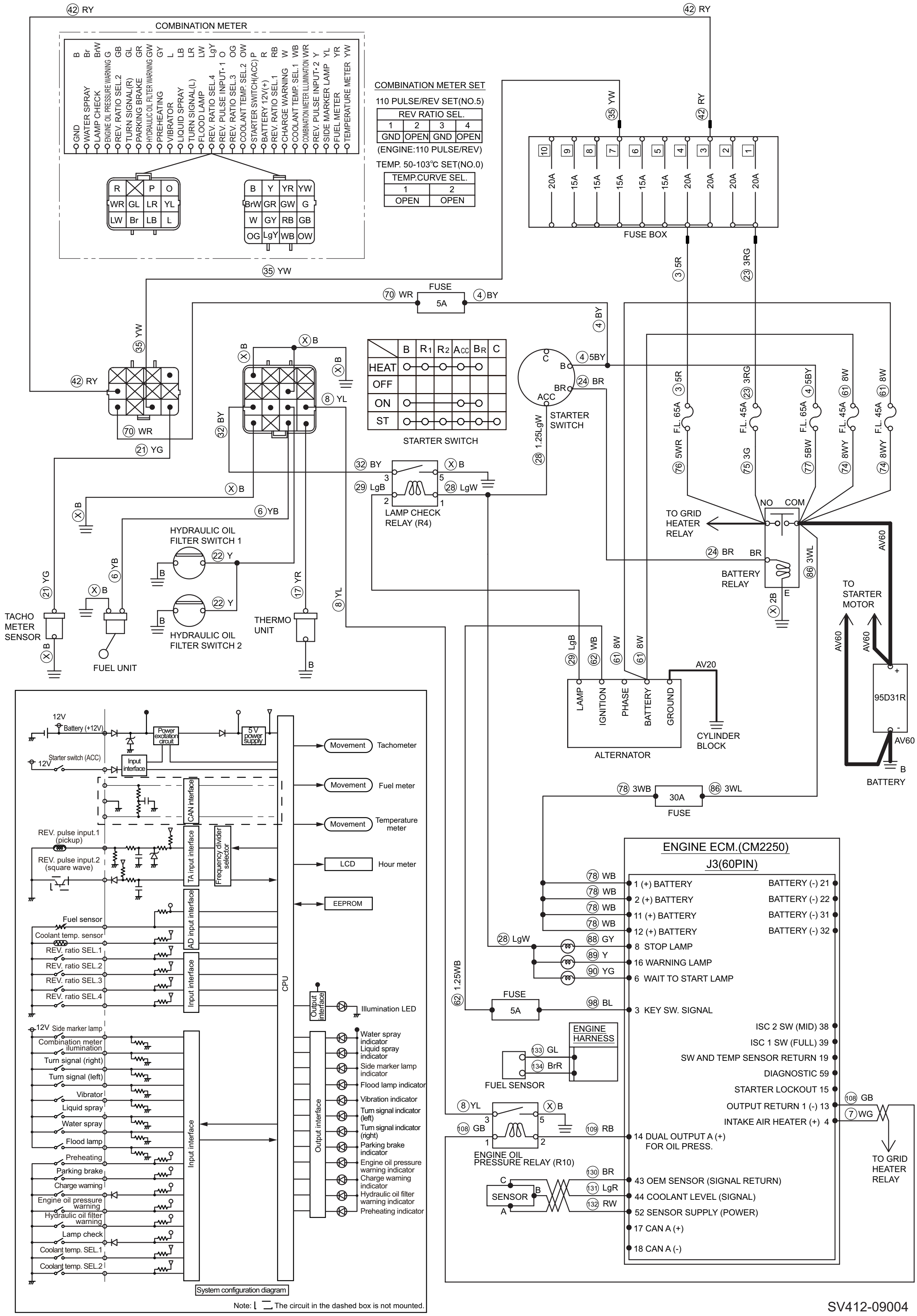
Check point	Check/Cause	Action

1. Harness	• Disconnect connectors between hydraulic oil filter switch 1, 2 and combination meter.
	• Measure resistance between terminal and chassis ground.
	  • Hydraulic oil filter switch 1 or 2 terminal wire Y and chassis ground.
	  • Combination meter connector terminal wire No. 22 wire Y and chassis ground.
	    Standard resistance : 100 kΩ or more
	• If resistance is abnormal, harness is faulty.
		Repair or replace harness.

2. Hydraulic Oil Filter Switch 1 or 2	• When starter switch is OFF, check continuity between hydraulic oil filter switch 1 or 2 inlet terminal and chassis ground. There is no continuity in normal condition. • If there is continuity, hydraulic oil filter switch 1 or 2 is faulty.	Replace hydraulic oil filter switch 1 or 2.

3. Combination Meter (Hydraulic oil filter warning indicator lamp)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire.
	  • Battery terminal inlet wire No. 70 inlet wire WR and ground terminal wire B.
	  • Starter switch terminal inlet wire No. 35 inlet wire YW and ground terminal wire B.
	    Standard voltage : 12 V or more
	(2) When starter switch is ON, measure voltage between combination meter hydraulic oil filter warning terminal outlet wire Y and chassis ground.
	    There is no electricity in normal condition.
	• If above items (1) and (2) are OK and no abnormality is found in hydraulic oil filter switch 1 or 2 but hydraulic oil filter warning lamp remains on after starting engine, combination meter is faulty.
		Replace combination meter.

Fig.: 2-6-1


COMBINATION METER
GND
WATER SPRAY
LAMP CHECK
ENGINE OIL PRESSURE WARNING
REV. RATIO SEL.2
TURN SIGNAL(R)
PARKING BRAKE
HYDRAULIC OIL FILTER WARNING
PREHEATING
VIBRATOR
LIQUID SPRAY
TURN SIGNAL(L)
FLOOD LAMP
REV. RATIO SEL.4
REV. PULSE INPUT-1
REV. RATIO SEL.3
COOLANT TEMP. SEL.2
STARTER SWITCH(ACC)
BATTERY 12V(+)
REV. RATIO SEL.1
CHARGE WARNING
COOLANT TEMP. SEL.1
COMBINATION METER ILLUMINATION
REV. PULSE INPUT-2
SIDE MARKER LAMP
FUEL METER
TEMPERATURE METER
COMBINATION METER SET
110 PULSE/REV SET(NO.5)
REV RATIO SEL.
1 2 3 4
GND OPEN GND OPEN
(ENGINE:110 PULSE/REV)
TEMP. 50-103°C SET(NO.0)
TEMP.CURVE SEL.
1 2
OPEN OPEN
FUSE BOX
FUSE
5A
STARTER SWITCH
HEAT
OFF
ON
ST
LAMP CHECK RELAY (R4)
HYDRAULIC OIL FILTER SWITCH 1
HYDRAULIC OIL FILTER SWITCH 2
TACHO METER SENSOR
FUEL UNIT
THERMO UNIT
TO GRID HEATER RELAY
BATTERY RELAY
TO STARTER MOTOR
95D31R
BATTERY
ALTERNATOR
LAMP
IGNITION
PHASE
BATTERY
GROUND
CYLINDER BLOCK
30A
ENGINE ECM.(CM2250)
J3(60PIN)
1 (+) BATTERY
2 (+) BATTERY
11 (+) BATTERY
12 (+) BATTERY
8 STOP LAMP
16 WARNING LAMP
6 WAIT TO START LAMP
3 KEY SW. SIGNAL
BATTERY (-) 21
BATTERY (-) 22
BATTERY (-) 31
BATTERY (-) 32
ISC 2 SW (MID) 38
ISC 1 SW (FULL) 39
SW AND TEMP SENSOR RETURN 19
DIAGNOSTIC 59
STARTER LOCKOUT 15
OUTPUT RETURN 1 (-) 13
INTAKE AIR HEATER (+) 4
14 DUAL OUTPUT A (+) FOR OIL PRESS.
43 OEM SENSOR (SIGNAL RETURN)
44 COOLANT LEVEL (SIGNAL)
52 SENSOR SUPPLY (POWER)
17 CAN A (+)
18 CAN A (-)
ENGINE HARNESS
FUEL SENSOR
ENGINE OIL PRESSURE RELAY (R10)
SENSOR
Tachometer
Fuel meter
Temperature meter
Hour meter
EEPROM
LCD
CPU
Illumination LED
System configuration diagram
Note: The circuit in the dashed box is not mounted.
SV412-09004

2-6-8. Engine oil pressure warning lamp remains ON

- Check whether engine check lamps show no fault code.

Reference Fig. : 2-6-1

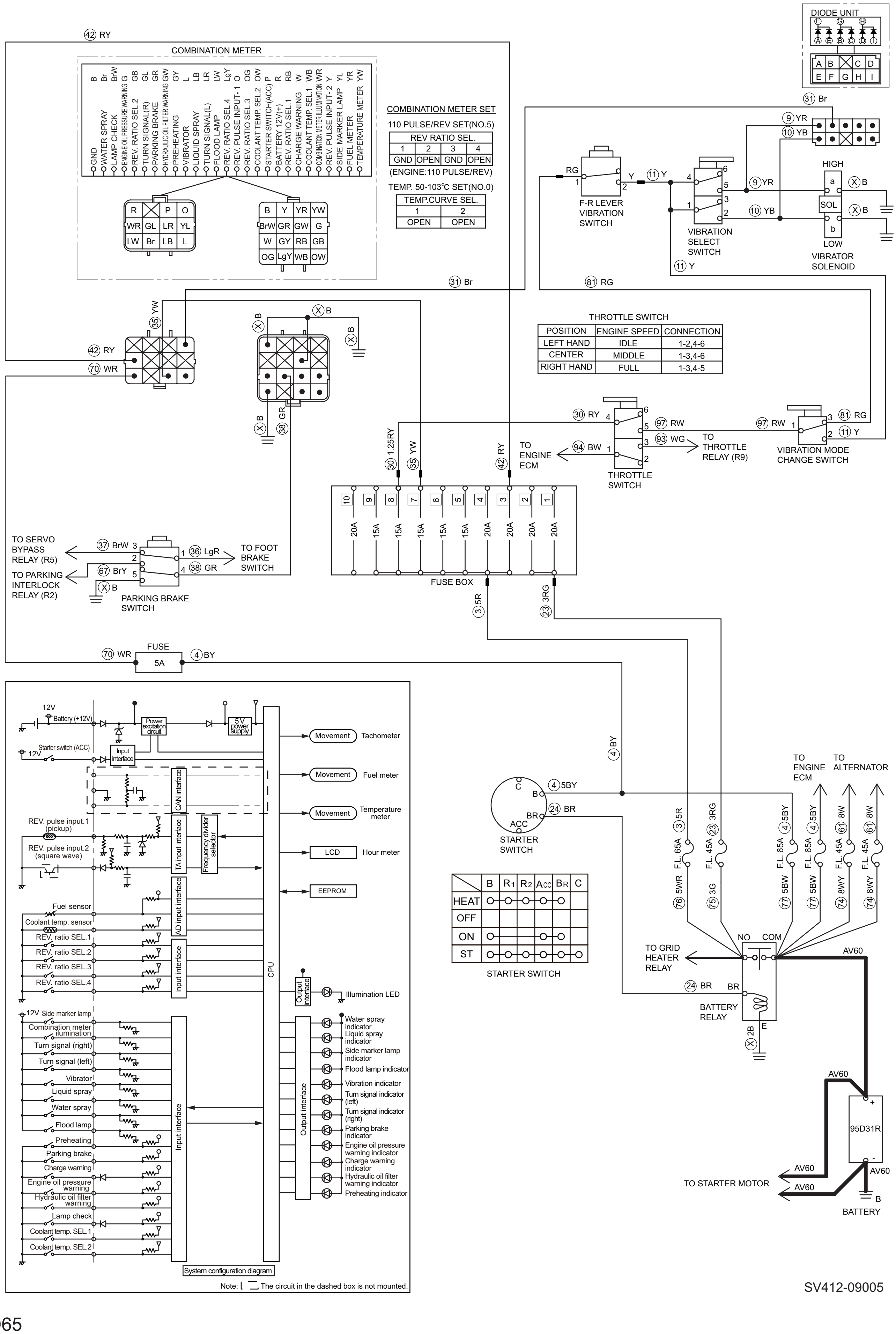
Check point	Check/Cause	Action

1. Harness	• Disconnect connectors between engine ECM, engine oil pressure relay (R10) and combination meter.
	• Measure resistance between terminals and chassis ground.
	  • Engine ECM output return (-) terminal 13 wire GB and chassis ground.
	  • Engine oil pressure relay (R10) terminal 1 wire GB and chassis ground.
	  • Engine ECM dual output A (+) for oil press terminal 14 wire RB and chassis ground.
	  • Engine oil pressure relay (R10) terminal 2 wire RB and chassis ground.
	  • Combination meter connector terminal wire No. 8 wire YL and chassis ground.
	  • Engine oil pressure relay (R10) terminal 3 wire YL and chassis ground.
	    Standard resistance : 100 kΩ or more
	• If resistance is abnormal, harness is faulty.
	
	(NOTICE)
	• If any abnormality is found in shielded twisted wires, repair is not approved. Be sure to replace them.
		Repair or replace harness.

2. Engine Oil Pressure Relay (R10)	(1) When starter switch is ON, measure voltage between engine oil pressure relay (R10) terminal 2 outlet wire RB and chassis ground.
	    There is no electricity in normal condition.
	(2) When starter switch is ON, measure voltage between engine oil pressure relay (R10) 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, engine oil pressure relay (R10) is faulty.
		Replace engine oil pressure relay (R10).

3. Combination Meter (Engine oil pressure warning indicator lamp)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire.
	  • Battery terminal inlet wire No. 70 inlet wire WR and ground terminal wire B.
	  • Starter switch terminal inlet wire No. 35 inlet wire YW and ground terminal wire B.
	    Standard voltage : 12 V or more
	(2) When starter switch is ON, measure voltage between combination meter engine oil pressure warning terminal outlet wire No. 8 wire YL and chassis ground.
	    There is no electricity in normal condition.
	• If above items (1) and (2) are OK and no fault code is shown but engine oil pressure warning lamp remains on after starting engine, combination meter is faulty.
		Replace combination meter.

Fig.: 2-6-2


COMBINATION METER
COMBINATION METER SET
110 PULSE/REV SET(NO.5)
REV RATIO SEL.
1 2 3 4
GND OPEN GND OPEN
(ENGINE:110 PULSE/REV)
TEMP. 50-103℃ SET(NO.0)
TEMP.CURVE SEL.
1 2
OPEN OPEN
DIODE UNIT
F-R LEVER VIBRATION SWITCH
VIBRATION SELECT SWITCH
HIGH
LOW
VIBRATOR SOLENOID
THROTTLE SWITCH
POSITION ENGINE SPEED CONNECTION
LEFT HAND IDLE 1-2,4-6
CENTER MIDDLE 1-3,4-6
RIGHT HAND FULL 1-3,4-5
TO ENGINE ECM
TO THROTTLE RELAY (R9)
VIBRATION MODE CHANGE SWITCH
TO SERVO BYPASS RELAY (R5)
TO PARKING INTERLOCK RELAY (R2)
TO FOOT BRAKE SWITCH
PARKING BRAKE SWITCH
FUSE BOX
FUSE 5A
STARTER SWITCH
B R1 R2 ACC BR C
HEAT
OFF
ON
ST
TO ENGINE ECM
TO ALTERNATOR
TO GRID HEATER RELAY
BATTERY RELAY
TO STARTER MOTOR
95D31R
BATTERY
System configuration diagram
Note: The circuit in the dashed box is not mounted.
SV412-09005

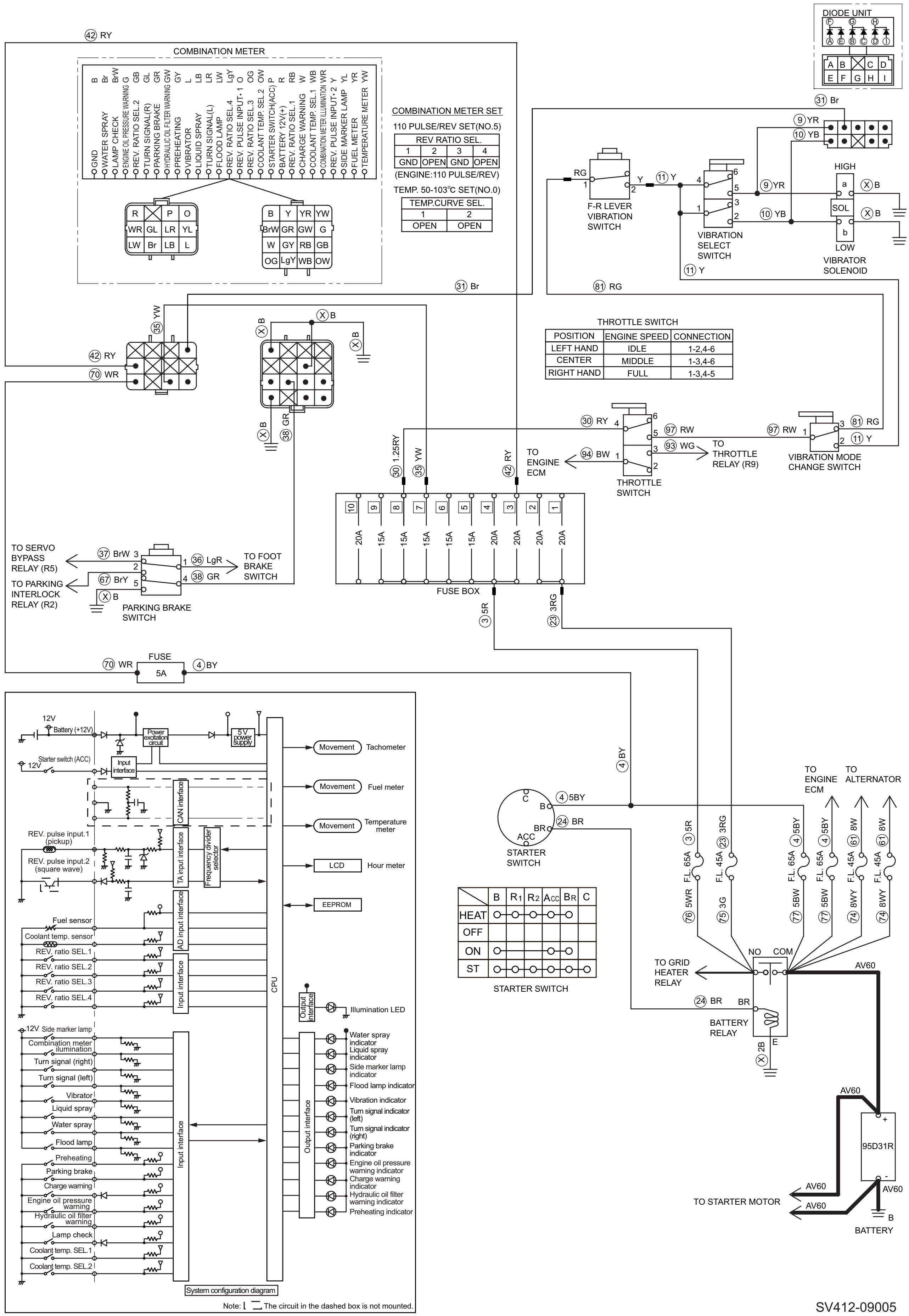
2-6-9. Vibration indicator lamp does not light

- Check that vibrator can be operated.

Reference Fig. : 2-6-2

Check point	Check/Cause	Action
1. Harness	(1) Measure resistance between vibration select switch terminal 5 wire YR and diode unit terminal E wire YR. Standard resistance : 10 Ω or less (2) Measure resistance between vibration select switch terminal 2 wire YB and diode unit terminal A wire YB. Standard resistance : 10 Ω or less (3) Measure resistance between diode unit terminal F wire Br and combination meter connector terminal wire No. 31 wire Br. Standard resistance : 10 Ω or less • If above item (1), (2) or (3) is NG, harness is faulty.	Repair or replace harness.
2. Diode Unit	(1) When starter switch is ON and vibration select switch is “ ”, measure voltage between diode unit terminal A inlet wire YB and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and vibration select switch is “ ”, measure voltage between diode unit terminal E inlet wire YR and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON, measure voltage between diode unit terminal F outlet wire Br and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, diode unit is faulty.	Replace diode unit.
3. Combination Meter (Vibration indicator lamp)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery terminal wire No. 70 inlet wire WR and ground terminal wire B • Starter switch terminal wire No. 35 inlet wire YW and ground terminal wire B Standard voltage : 12 V or more (2) When starter switch is ON, vibration mode change switch is “CONT” and vibration select switch is “ ” or “ ”, measure voltage between combination meter vibration terminal wire No. 31 inlet wire Br and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and vibration indicator lamp does not light, combination meter is faulty.	Replace combination meter.

Fig.: 2-6-2

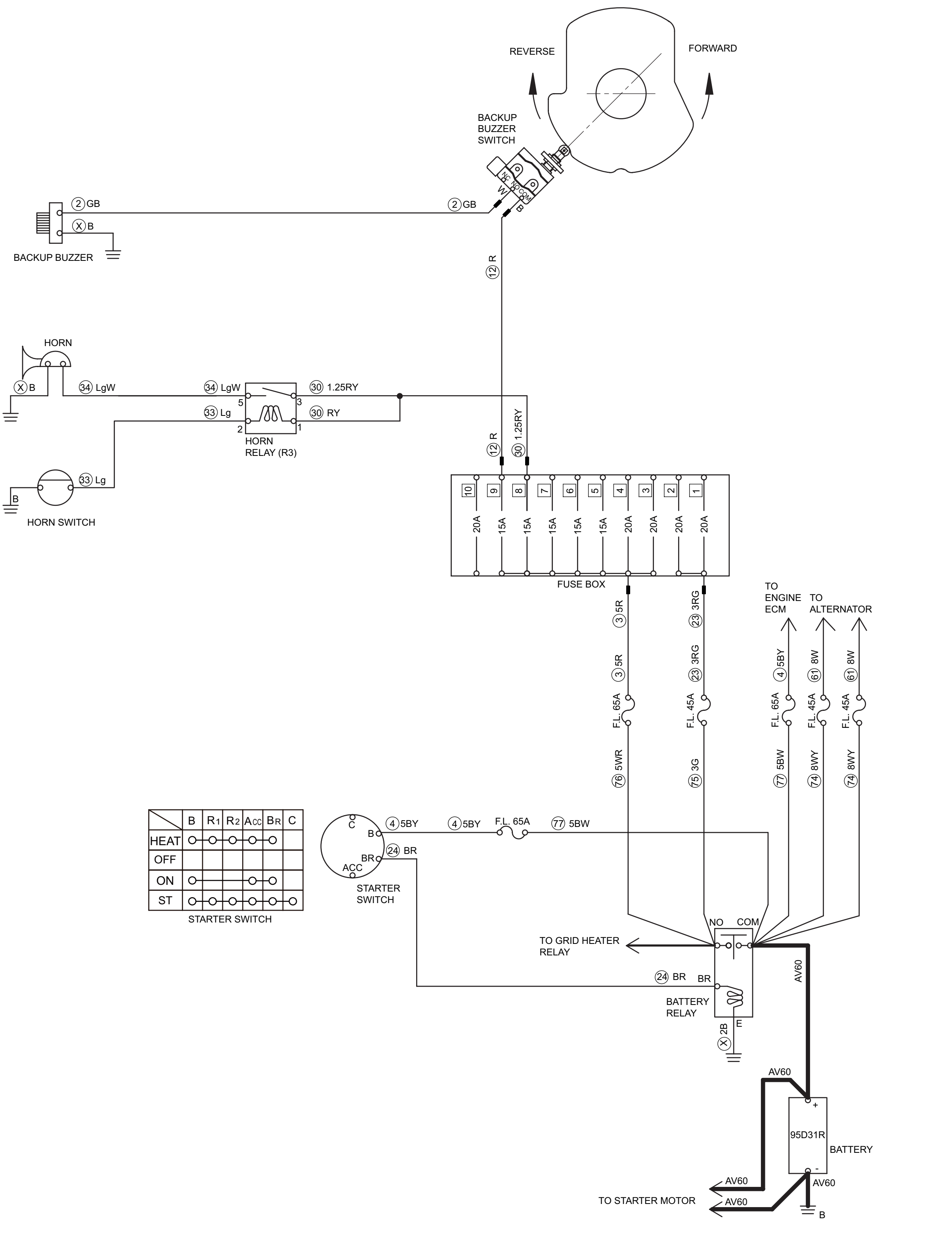

COMBINATION METER
GND B
WATER SPRAY Br
LAMP CHECK BrW
ENGINE OIL PRESSURE WARNING G
REV. RATIO SEL.2 GB
TURN SIGNAL(R) GL
PARKING BRAKE GR
HYDRAULIC OIL FILTER WARNING GW
PREHEATING GY
VIBRATOR L
LIQUID SPRAY LB
TURN SIGNAL(L) LR
FLOOD LAMP LW
REV. RATIO SEL.4 LgY
REV. PULSE INPUT- 1 O
COOLANT TEMP. SEL.3 OG
COOLANT TEMP. SEL.2 OW
STARTER SWITCH(ACC) P
BATTERY 12V(+) R
REV. RATIO SEL.1 RB
CHARGE WARNING W
COOLANT TEMP. SEL.1 WB
COMBINATION METER ILLUMINATION WR
REV. PULSE INPUT- 2 Y
SIDE MARKER LAMP YL
FUEL METER YR
TEMPERATURE METER YW
COMBINATION METER SET
110 PULSE/REV SET(NO.5)
REV RATIO SEL.
1 2 3 4
GND OPEN GND OPEN
(ENGINE:110 PULSE/REV)
TEMP. 50-103℃ SET(NO.0)
TEMP.CURVE SEL.
1 2
OPEN OPEN
DIODE UNIT
F-R LEVER VIBRATION SWITCH
VIBRATION SELECT SWITCH
HIGH
LOW
VIBRATOR SOLENOID
SOL
THROTTLE SWITCH
POSITION | ENGINE SPEED | CONNECTION
LEFT HAND | IDLE | 1-2,4-6
CENTER | MIDDLE | 1-3,4-6
RIGHT HAND | FULL | 1-3,4-5
TO ENGINE ECM
TO THROTTLE RELAY (R9)
VIBRATION MODE CHANGE SWITCH
FUSE BOX
TO SERVO BYPASS RELAY (R5)
TO PARKING INTERLOCK RELAY (R2)
TO FOOT BRAKE SWITCH
PARKING BRAKE SWITCH
FUSE 5A
STARTER SWITCH
B R1 R2 ACC BR C
HEAT
OFF
ON
ST
TO ENGINE ECM
TO ALTERNATOR
TO GRID HEATER RELAY
BATTERY RELAY
TO STARTER MOTOR
95D31R
BATTERY
Battery (+12V)
Starter switch (ACC)
Power excitation circuit
5V power supply
Input interface
CAN interface
TA input interface
Frequency divider selector
AD input interface
Output interface
CPU
Movement Tachometer
Movement Fuel meter
Movement Temperature meter
LCD Hour meter
EEPROM
REV. pulse input.1 (pickup)
REV. pulse input.2 (square wave)
Fuel sensor
Coolant temp. sensor
REV. ratio SEL.1
REV. ratio SEL.2
REV. ratio SEL.3
REV. ratio SEL.4
Illumination LED
Side marker lamp
Combination meter illumination
Turn signal (right)
Turn signal (left)
Vibrator
Liquid spray
Water spray
Flood lamp
Preheating
Parking brake
Charge warning
Engine oil pressure warning
Hydraulic oil filter warning
Lamp check
Coolant temp. SEL.1
Coolant temp. SEL.2
Water spray indicator
Liquid spray indicator
Side marker lamp indicator
Flood lamp indicator
Vibration indicator
Turn signal indicator (left)
Turn signal indicator (right)
Parking brake indicator
Engine oil pressure warning indicator
Charge warning indicator
Hydraulic oil filter warning indicator
Preheating indicator
System configuration diagram
Note: The circuit in the dashed box is not mounted.
SV412-09005

2-6-10. Parking brake indicator lamp does not light

Reference Fig. : 2-6-2

Check point	Check/Cause	Action
1. Harness	• Measure resistance between parking brake switch terminal 4 wire GR and combination meter connector terminal wire No. 38 wire GR. Standard resistance : 10 Ω or less • If resistance is abnormal, harness is faulty.	Repair or replace harness.
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 lamp)	(1) When starter switch is ON, measure voltage between combination meter terminal wires and ground terminal wire. • Battery terminal wire No. 70 inlet wire WR and ground terminal wire B • Starter switch terminal wire No. 35 inlet wire 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 wire No. 38 outlet wire GR and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and parking brake indicator lamp does not light, combination meter is faulty.	Replace combination meter.

Fig.: 2-6-3



SV412-09006

2-6-11. Horn does not sound

Reference Fig. : 2-6-3

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 (R3)	(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 (R3).
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.

2-6-12. Backup buzzer does not sound

Reference Fig. : 2-6-3

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 “R”, measure voltage between backup buzzer 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 • Speed change solenoid valve	• When solenoid is energized, check if oil flows in return circuit to tank. • If oil is flowing, repair solenoid valve or replace it if necessary.
5. Servo Bypass Solenoid Valve	If spool of servo bypass solenoid valve is stuck, pressure in both sides of servo cylinder chamber is equalized. This causes propulsion pump unable to discharge oil.	• Measure pressure in servo cylinder chambers. • If pressure is equal in both chambers, repair servo bypass solenoid valve or replace it if necessary.
6. Suction Filter for Charge Pump	Charge pump flow is reduced due to clogged filter.	Clean suction filter or replace it if necessary.
7. 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.
8. 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.

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

Check point	Cause	Check/Action
9. Propulsion Pump	Discharge flow rate is insufficient due to efficiency degradation of propulsion pump.	• Measure discharge flow rate of propulsion pump with flow meter. • If discharge flow rate is not within specified range, repair propulsion pump or replace it if necessary.
	Discharge flow rate is insufficient due to wear of propulsion pump drive shaft splines.	Replace propulsion pump.
	Propulsion circuit pressure is not held in propulsion pump case.	If pressure in propulsion pump case is not within allowable range, repair propulsion pump or replace it if necessary.
10. Parking Brake Solenoid Valve	Brake remains applied because spool of parking brake solenoid valve does not shift.	Repair parking brake solenoid valve or replace it if necessary.
11. Brake Inlet Pressure	Brake cannot be released because brake inlet pressure is low.	• Measure brake release pressure. • If low, repair or replace propulsion motor.
12. Rear Axle	Sticking of disc brakes causes brakes to remain applied.	• Replace disc brakes.
13. 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 • Speed change solenoid valve	• When solenoid is energized, check if oil flows in return circuit to tank. • If oil is flowing, repair solenoid valve or replace it if necessary.
4. Suction Filter for 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.

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

Check point	Cause	Check/Action
5. Propulsion Motor	Propulsion motor inlet pressure is low.	• Measure propulsion motor inlet pressure. • If low, check and adjust 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.
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. Speed Change Solenoid Valve	Machine speed does not change because spool of speed change solenoid valve does not change.	Repair speed change solenoid valve or replace it if necessary.
2. Rear Propulsion Motor Swash Plate Stroke Cylinder	Faulty rear propulsion motor swash plate stroke cylinder.	Repair propulsion motor or replace it if necessary.

3-2-5. Machine does not stop completely with F-R lever in “N”

Check point	Cause	Check/Action
1. F-R lever Linkage	F-R lever linkage is faulty.	Check and adjust F-R lever linkage or replace it if necessary.
2. Servo Control Valve	Servo control valve neutral position adjustment failure.	Check and adjust servo control valve or replace it if necessary.
3. Servo Cylinder	Faulty 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 (only rear propulsion motor)	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 and rear drums are damaged.	Replace axle bearings.
2. Reduction gear (front motor)	Reduction gear of front motor 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 • Speed change solenoid valve	• When solenoid is energized, check if oil flows in return circuit to tank. • If oil is flowing, repair solenoid valve or replace it if necessary.
3. Vibrator Solenoid Valve	Vibrator pump cannot discharge oil because spool of vibrator solenoid valve does not shift.	Repair vibrator solenoid valve or replace them if necessary.
4. Suction Filter for Charge Pump	Charge pump flow is reduced due to clogged filler.	Clean suction filter or replace it if necessary.
5. Vibrator Circuit Pressure	Circuit does not obtain required pressure because setting pressure of high pressure check relief is low.	• Measure vibrator circuit pressure. • If low, check and clean high pressure relief valve or replace it if necessary.
6. 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.
	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.
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 • Speed change solenoid valve	• When solenoid is energized, check if oil flows in return circuit to tank. • If oil is flowing, repair solenoid valve or replace it if necessary.
3. Suction Filter for 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 clean 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 place does not return to neutral position.	Repair 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, check and clean relief valve or replace it if necessary.
	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 oil filter 1.	Clean hydraulic oil 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 Steering • Charge Pump	Charge pump discharge rate decreases due to clogged filter.	Clean suction filter or replace it if necessary.
6. Steering • Charge Pump	Discharging pressure is insufficient due to efficiency degradation of 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 clean relief valve or replace it if necessary.
3. Steering Cylinder	Internal leakage of steering cylinder.	Repair steering cylinder or replace it if necessary.
4. Suction Filter for Steering • Charge Pump	Charge pump discharge rate decreases due to clogged filter.	Clean suction filter or replace it if necessary.
5. Steering • Charge Pump	Discharging pressure is insufficient due to efficiency degradation of 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 Steering • 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. Steering Circuit	Cavitation is caused by air in circuit.	Bleed circuit.
3. Hydraulic Hose Clamp	Vibrator sound of hydraulic hose is generated because clamp securing hydraulic hose is loose.	Tighten bolts of loose hydraulic hose clamp to specified torque.
4. Suction Filter for Steering • Charge Pump	Cavitation is occurring in charge pump due to clogged filter.	Clean suction filter or replace it if necessary.

3-5. Blade (SV412TB, FB)

If a problem occurs in the blade control system, 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.**

3-5-1. Blade up/down operation not possible

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. Flow Dividing Valve (Steering Blade) for Separation	Oil flow is not divided because spool is stuck on one side, interrupting hydraulic circuit.	Clean spool or replace it if necessary.
3. Blade Circuit Pressure	Circuit does not obtain required pressure because setting pressure of stack valve relief valve is low.	• Measure blade circuit pressure. • If low, inspect stack valve relief valve or replace it if necessary.
4. Stack Valve	Blade cylinder does not operate because stack valve spool does not change.	If stack valve lever does not move, check and clean spool, or replace stack valve.
5. Blade Cylinder	Cylinder thrust decreases due to internal leakage of blade cylinder.	Repair blade cylinder or replace it if necessary.
6. Suction Filter for Steering • Charge Pump	Steering pump discharge rate decreases due to clogged filter.	Clean suction filter or replace it if necessary.
7. Steering • Charge Pump	Discharging pressure is insufficient due to efficiency degradation of steering pump.	• Measure the steering circuit pressure. • If low, replace steering pump.

3-5-2. Blade movement is slow or force is small

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. Stack Valve	Oil bypassing because relief valve is open.	• Measure blade circuit pressure. • If low, inspect relief valve or replace it if necessary.
3. Blade Cylinder	Internal leakage of blade cylinder	Repair blade cylinder or replace it if necessary.
4. Suction Filter for Steering • Charge Pump	Steering pump discharge rate decreases due to clogged filter.	Clean suction filter or replace it if necessary.
5. Steering • Charge Pump	Discharge rate is insufficient due to efficiency degradation of steering pump.	• Measure the steering circuit pressure. • If low, replace steering pump.

3-5-3. Blade floating operation not possible

Check point	Cause	Check/Action
Stack Valve	Blade floating operation is not possible because stack valve spool does not change.	If stack valve lever does not move, check and clean spool, or replace stack valve.

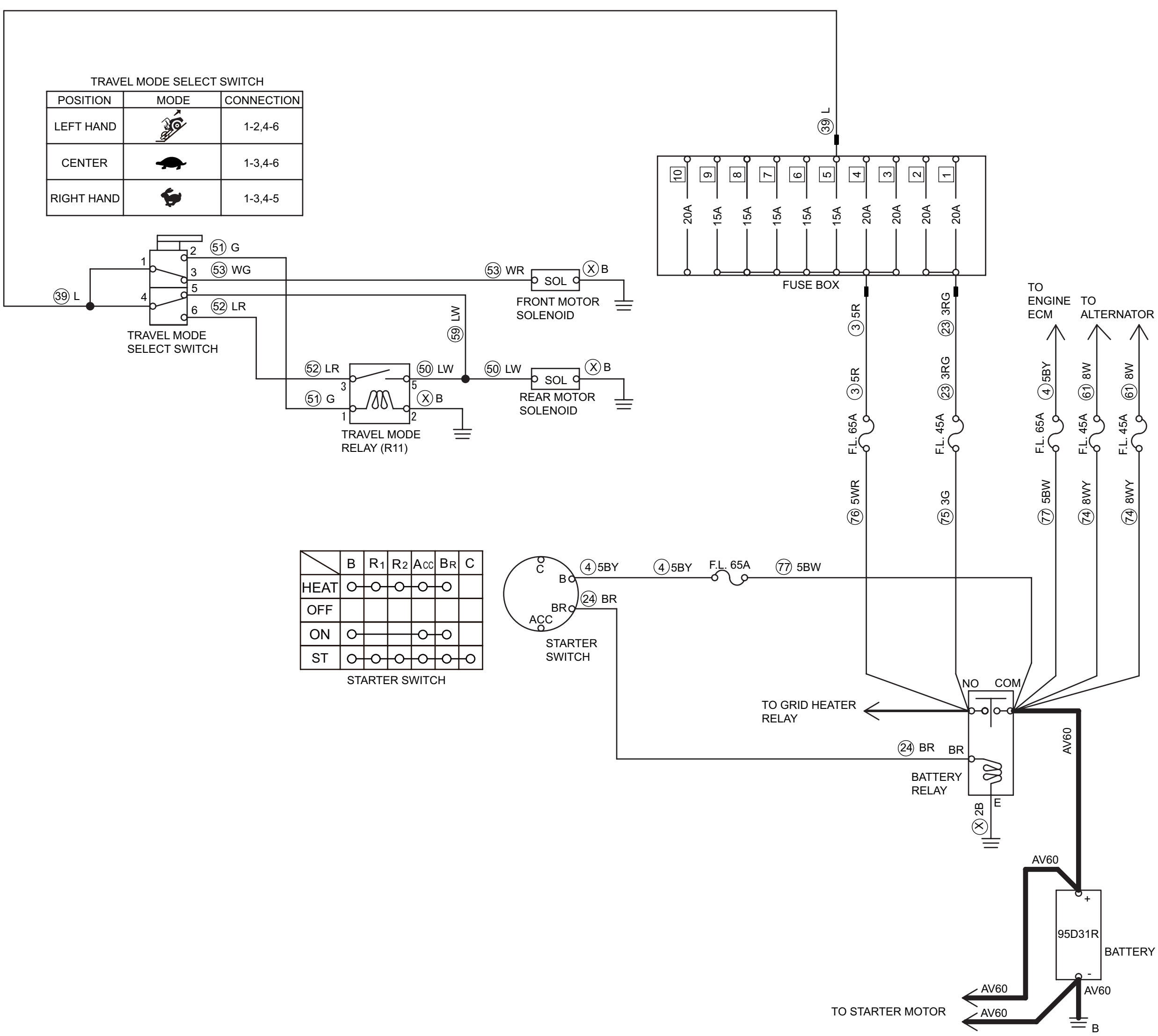
3-5-4. Blade hydraulic system is overheating

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. Blade Circuit Setting Pressure	If circuit pressure setting is excessively low, relief valve is open, causing temperature of hydraulic oil in circuit to rise.	• Measure blade 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 blade circuit pressure. • If high, decrease blade load.
3. Suction Filter for Steering • 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.

3-5-5. Abnormal noise from blade hydraulic 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 the blade system circuit.	Fill tank until the correct oil level is obtained.
2. Blade Circuit	Cavitation is caused by air in circuit.	Bleed circuit.
3. Hydraulic Hose Clamp	Vibrator sound of hydraulic hose is generated because clamp securing hydraulic hose is loose.	Tighten bolts of loose hydraulic hose clamp to specified torque.
4. Suction Filter for Steering • Charge Pump	Cavitation results at steering pump due to clogged filter.	Clean suction filter or replace it if necessary.

Fig.: 4-1-1



SV412-09014

4. HIGH TORQUE TYPE ONLY

4-1. Electrical System Troubleshooting (Propulsion)

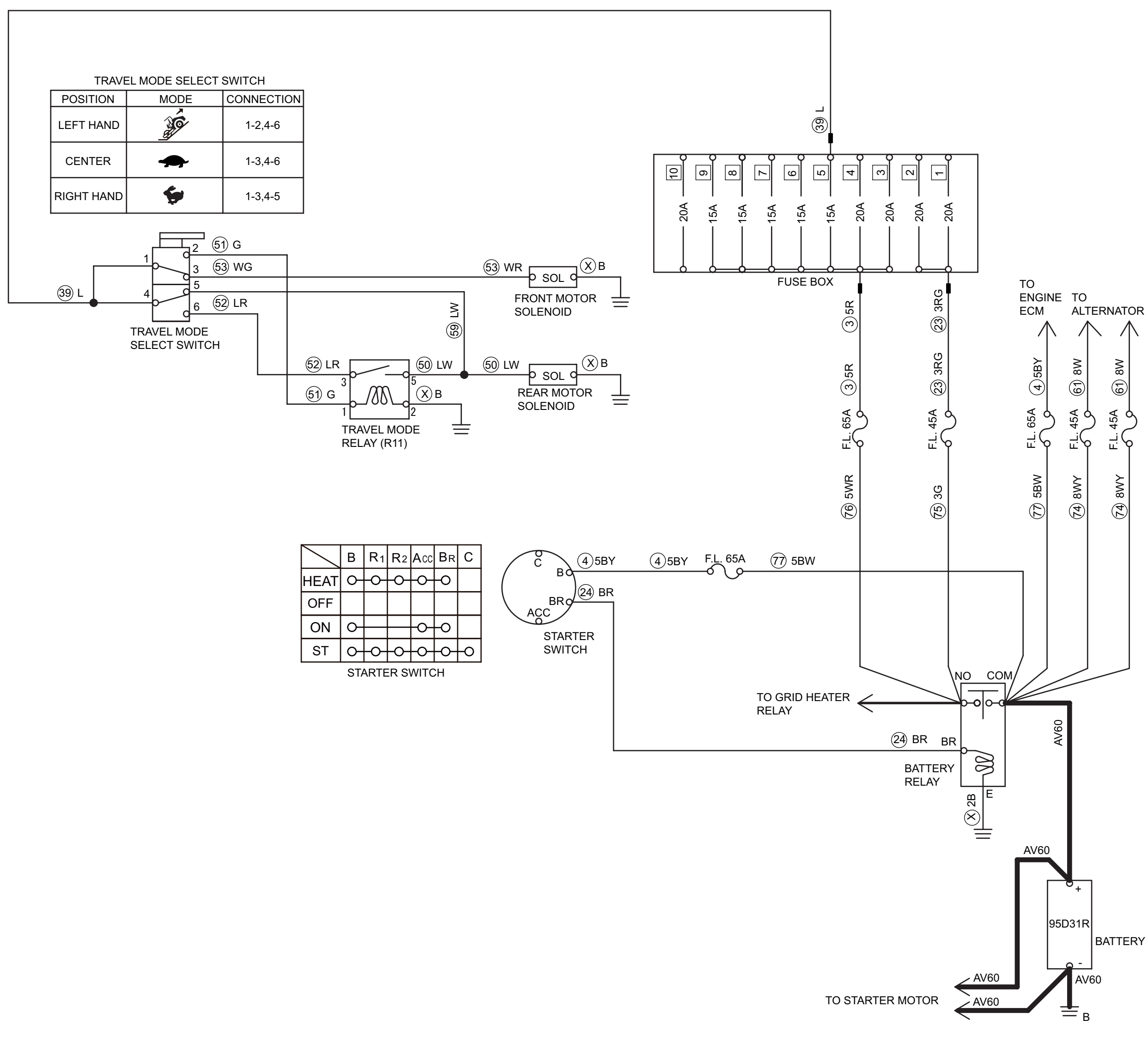
4-1-1. Travel mode cannot be changed 1/2

- No blown fuses and power is applied up to fuses.
- Check any ground circuit which belongs to components to be checked.

Reference Fig.: 4-1-1

Check point	Check/Cause	Action
1. Front Motor Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 9.8 Ω • If measured resistance is abnormal, front motor solenoid is faulty.	Replace front motor solenoid.
2. Rear Motor Solenoid	• Disconnect harness and measure resistance of coil. Standard resistance : 5.1 Ω • If measured resistance is abnormal, rear motor solenoid is faulty.	Replace rear motor solenoid.
3. Travel Mode Relay (R11)	(1) When starter switch is ON and travel mode select switch is "  ", measure voltage between travel mode relay terminal 1 inlet wire G and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and travel mode select switch is "  ", measure voltage between travel mode relay terminal 3 inlet wire LR and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON and travel mode select switch is "  ", measure voltage between travel mode relay terminal 5 outlet wire LW and chassis ground. Standard voltage : 12 V or more • If above items (1) and (2) are OK and item (3) is NG, travel mode relay is faulty.	Replace travel mode relay (R11).

Fig.: 4-1-1


TRAVEL MODE SELECT SWITCH
POSITION
MODE
CONNECTION
LEFT HAND
1-2,4-6
CENTER
1-3,4-6
RIGHT HAND
1-3,4-5
39 L
FUSE BOX
20A
15A
51 G
53 WG
52 LR
53 WR
SOL
X B
FRONT MOTOR SOLENOID
59 LW
TRAVEL MODE SELECT SWITCH
52 LR
50 LW
51 G
TRAVEL MODE RELAY (R11)
REAR MOTOR SOLENOID
3 5R
23 3RG
TO ENGINE ECM
TO ALTERNATOR
4 5BY
61 8W
F.L. 65A
F.L. 45A
76 5WR
75 3G
77 5BW
74 8WY
B
R1
R2
ACC
BR
C
HEAT
OFF
ON
ST
STARTER SWITCH
F.L. 65A
24 BR
NO
COM
TO GRID HEATER RELAY
AV60
BATTERY RELAY
X 2B
E
95D31R
BATTERY
TO STARTER MOTOR
SV412-09014

4-1-1. Travel mode cannot be changed 2/2

- No blown fuses and power is applied up to fuses.
- Check any ground circuit which belongs to components to be checked.

Reference Fig.: 4-1-1

Check point	Check/Cause	Action
4. Travel Mode Select Switch	(1) When starter switch is ON, measure voltage between travel mode select switch terminal 1, 4 inlet wire L and chassis ground. Standard voltage : 12 V or more (2) When starter switch is ON and travel mode select switch is "  ", measure voltage between travel mode select switch terminal wires and chassis ground. • Travel mode select switch terminal 2 outlet wire G and chassis ground. • Travel mode select switch terminal 6 outlet wire LR and chassis ground. Standard voltage : 12 V or more (3) When starter switch is ON and travel mode select switch is "  ", measure voltage between travel mode select switch terminal wires and chassis ground. • Travel mode select switch terminal 3 outlet wire WG and chassis ground. • Travel mode select switch terminal 6 outlet wire LR and chassis ground. Standard voltage : 12 V or more (4) When starter switch is ON and travel mode select switch is "  ", measure voltage between travel mode select switch terminal wires and chassis ground. • Travel mode select switch terminal 3 outlet wire WG and chassis ground. • Travel mode select switch terminal 5 outlet wire LW and chassis ground. Standard voltage : 12 V or more • If above item (1) is OK and item (2), (3) or (4) is NG, travel mode select switch is faulty.	Replace travel mode select 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.

4-2. Hydraulic System Troubleshooting (Propulsion)

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.**

4-2-1. 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 • Rear motor solenoid valve	• When solenoid is energized, check if oil flows in return circuit to tank. • If oil is flowing, repair solenoid valve or replace it if necessary.
5. Servo Bypass Solenoid Valve	If spool of servo bypass solenoid valve is stuck, pressure in both sides of servo cylinder chamber is equalized. This causes propulsion pump unable to discharge oil.	• Measure pressure in servo cylinder chambers. • If pressure is equal in both chambers, repair servo bypass solenoid valve or replace it if necessary.
6. Suction Filter for Charge Pump	Charge pump flow is reduced due to clogged filter.	Clean suction filter or replace it if necessary.
7. 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.
8. 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.

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

Check point	Cause	Check/Action
9. Propulsion Pump	Discharge flow rate is insufficient due to efficiency degradation of propulsion pump.	• Measure discharge flow rate of propulsion pump with flow meter. • If discharge flow rate is not within specified range, repair propulsion pump or replace it if necessary.
	Discharge flow rate is insufficient due to wear of propulsion pump drive shaft splines.	Replace propulsion pump.
	Propulsion circuit pressure is not held in propulsion pump case.	If pressure in propulsion pump case is not within allowable range, repair propulsion pump or replace it if necessary.
10. Parking Brake Solenoid Valve	Brake remains applied because spool of parking brake solenoid valve does not shift.	Repair parking brake solenoid valve or replace it if necessary.
11. Brake Inlet Pressure	Brake cannot be released because brake inlet pressure is low.	• Measure brake release pressure. • If low, repair or replace propulsion motor.
12. Rear Axle	Sticking of disc brakes causes brakes to remain applied.	• Replace disc brakes.
13. Flange	Drive torque is not transmitted to pump due to faulty flange.	Replace flange.

4-2-2. Travel mode cannot be switched

Check point	Cause	Check/Action
1. Front Motor Solenoid Valve	Travel mode does not change because spool of front motor solenoid valve does not change.	Repair front motor solenoid valve or replace it if necessary.
2. Rear Motor Solenoid Valve	Travel mode does not change because spool of rear motor solenoid valve does not change.	Repair rear motor solenoid valve or replace it if necessary.
3. Propulsion Motor Swash Plate Stroke Cylinder	Faulty propulsion motor swash plate stroke cylinder.	Repair propulsion motor or replace it if necessary.

4-2-3. 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.

4-2-4. Abnormal noise from propulsion system

Check point	Cause	Check/Action
1. Axle Bearings	Axle bearings supporting front and rear drums are damaged.	Replace axle bearings.
2. Gear Box (Front motor)	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.

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