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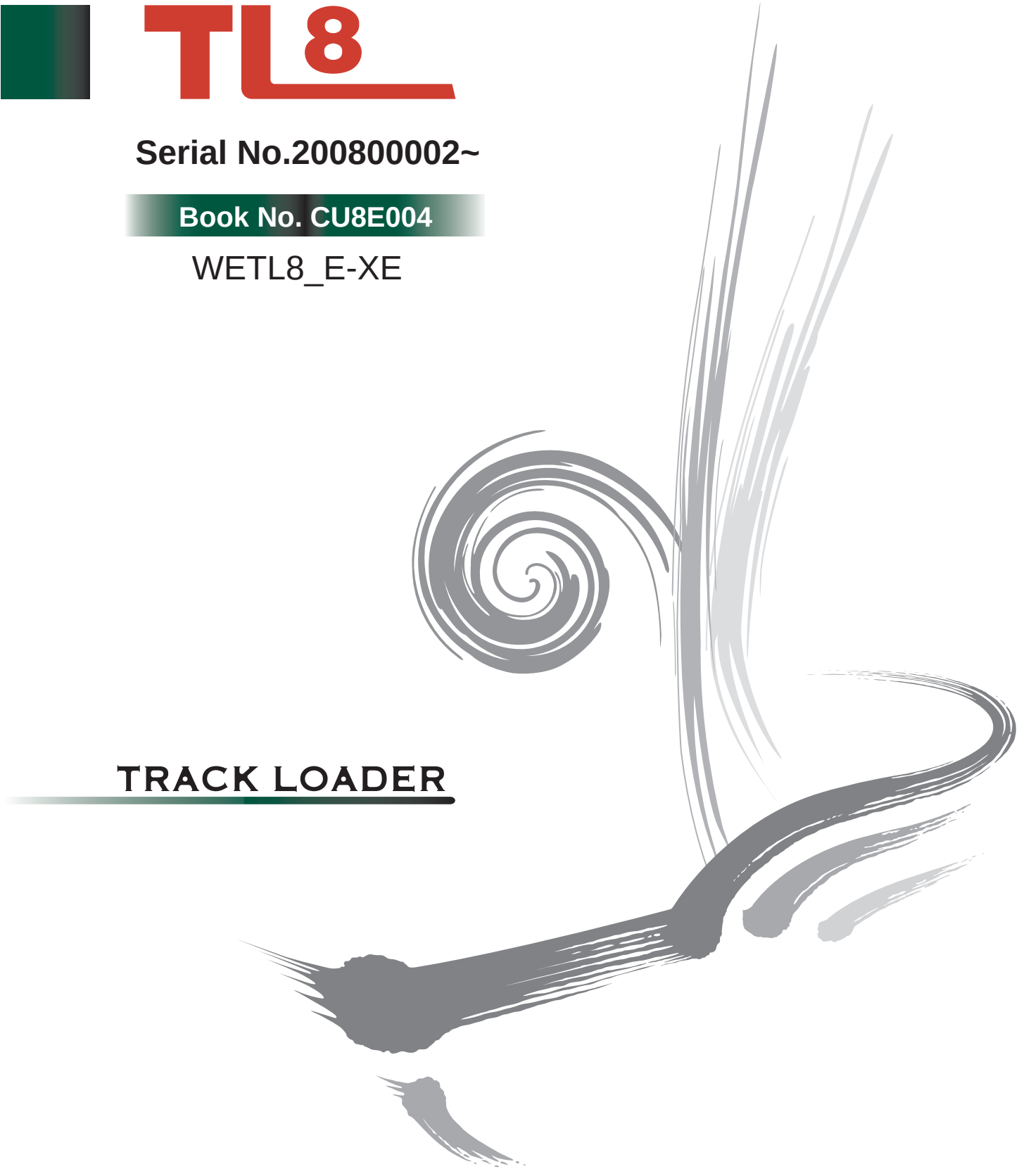
WORKSHOP MANUAL

TL8

Serial No.200800002~

Book No. CU8E004

WETL8_E-XE



TRACK LOADER

TAKEUCHI

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FOREWORD

This manual, which is written for engineers who service the machine, describes procedures for disassembly and assembly, inspection and maintenance, and troubleshooting, as well as maintenance reference values and an outline of the specifications. Refer to this manual during daily work to improve your services. Note that the information is subject to change without notice due to design modifications made to the machine from time to time by the manufacturer.

Directional terms: front, rear, left, right

In this manual, the “front” refers to the end of the machine where the bucket is mounted, while the “rear” refers to the other end where the travel motor is mounted. The “right” or “left” refers to the side viewed by a person sitting in the operator’s seat.

Machine serial number

The machine serial number is stamped on the identification plate. Be sure to include this number when sending a report or inquiry or when ordering parts.

Control of manual

Appoint a person in charge of keeping the manuals up to date in your company and inform us of the person’s name for our records. Any revisions or additions to this manual will be sent to the person.

Symbols used in this manual

The symbols used in this manual have the following meanings.

S/N Indicates the machine serial number.
Means “Refer to the section quoted.”
Indicates the mass of the equipment or machine.
Means “Tighten to the torque specified here.”
Indicates the use of thread-locking compound.
Indicates the use of grease.

Manual structure

This manual consists of the following parts.

1. Safety
2. Service data
3. Function
4. Disassembly and assembly
5. Troubleshooting
6. Other

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SAFETY 1

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SAFETY ALERT SYMBOL



This symbol represents the safety alert. The message that follows the symbol contains important information regarding human safety.
Read and understand the message to avoid personal injury or death.

Safety label

Safety labels are used to alert operators or other people exposed to the risks of injury or damage. There are the following three types of labels.
Read the labels carefully as they are important for your safety.

⚠ DANGER

The word "DANGER" indicates an imminently hazardous situation which, if not avoided, is likely to result in serious injury or death.

⚠ WARNING

The word "WARNING" indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death.

⚠ CAUTION

The word "CAUTION" indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

IMPORTANT: The word "IMPORTANT" is used to alert operators and maintenance personnel about situations which could result in damage to the machine and its components.

This manual is intended for trained and qualified personnel only. Warnings or cautions described in this manual do not necessarily cover all safety measures. It is also impossible to cover all hazards and risks which may be associated with the maintenance of the machine in every environment. For maintenance work, each person must take adequate safety precautions against possible hazards in the respective working environment.

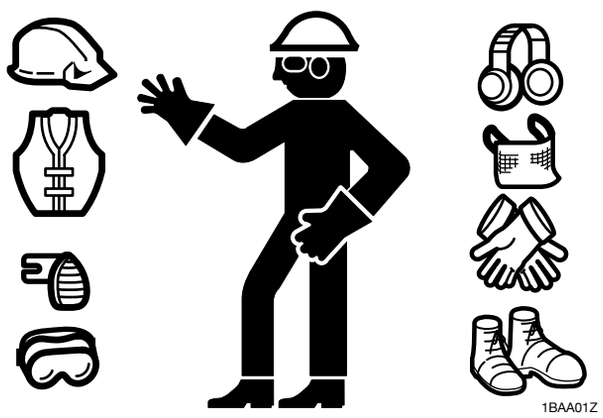
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SAFETY PRECAUTIONS

Observe all safety rules

- Operation, inspection and maintenance of this machine must be performed only by a trained and qualified person.
- All rules, regulations, precautions and safety procedures must be understood and followed when performing operation, inspection and maintenance of this machine.
- Do not perform any operation, inspection or maintenance of this machine when under the influence of alcohol, drugs, medication, fatigue or insufficient sleep.

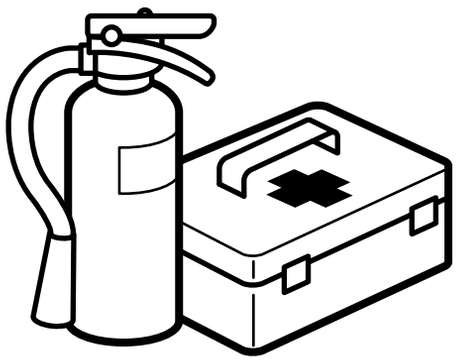
Wear safe clothing and protective gear



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- Do not wear loose clothing or any accessory that can catch on the controls or the moving parts of the machine.
- Do not wear clothing stained with oil or grease that can easily catch fire.
- Wear protective gear such as helmet, safety shoes, protective goggles, respirator, gloves and earmuffs, as appropriate, depending on the work involved. Especially make sure to wear protective eye-wear and mask when working with a grinding/polishing/sanding machine, hammer or compressed air, as metal fragments or other objects could scatter in such an environment.
- Wear hearing protectors when operating the machine. Loud and prolonged noise can damage or destroy your hearing.

Install an extinguisher and a first aid kit



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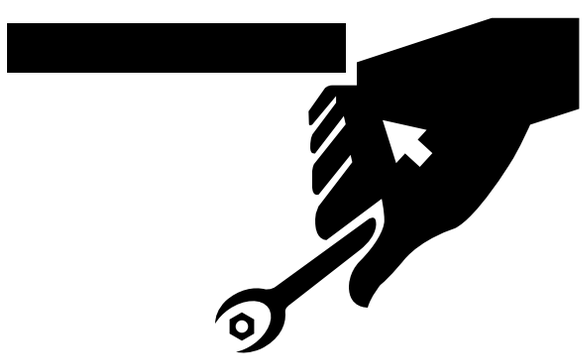
- Install an extinguisher to fight a fire, and learn how to use it.
- Prepare a first aid kit and keep it at a designated place.
- Decide on the procedures to be used in case of fire or other hazards.
- Decide on and take note of the contact(s) in case of emergency.

Place a “Do not operate” alert sign

Serious injury or death may result if an unauthorized person starts the engine or touches the controls during inspection or maintenance.

- Before performing maintenance, stop the engine, remove the key and store it in a safe place.
- Prominently display a “Do not operate” alert sign on places such as the starter switch and the control lever. Place another sign outside of the machine as necessary.

Use the correct tools



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Do not use damaged or weakened tools or tools designed for other purposes. Use only the correct tools for the work involved.

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Regularly replace the safety-critical parts

- Regularly replace fuel hoses to prevent a fire hazard. Hoses wear out over time, even if they do not show any symptom of wear.
- Regardless of the replacement schedule, replace immediately if a symptom of wear is found.

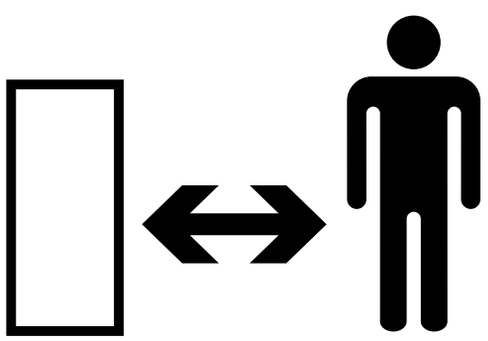
Explosionproof lighting



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To prevent an ignition or explosion, use explosion-proof lights when inspecting fuel, oil, coolant or battery fluid.

Prohibit access by unauthorized persons



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Do not allow unauthorized personnel in the work area while working.
Take particular care that no unauthorized person is present when grinding, welding or using a hammer.

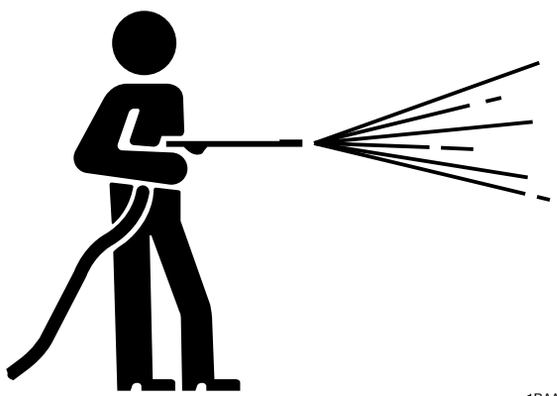
Prepare the work area

- Select a level and firm ground on which to perform maintenance work. Make sure that the work area is light enough and well ventilated.
- Straighten any obstacle or dangerous object, remove any spill of oil or grease and clean the work area.

When the canopy is tilted up

- If the canopy is raised or lowered while the engine is moving, the machine may accidentally start moving, resulting in severe injury to the maintenance personnel. Make sure that the working equipment has been lowered to the ground and the engine has been turned off before raising/lowering the canopy.
- When the canopy is tilted up, firmly secure the canopy with a stopper to prevent it from falling.

Keep the machine clean



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- Clean the machine before performing maintenance and try to keep it clean.
- Before washing, cover the electrical parts with vinyl to prevent water from entering, as this could cause a short-circuit or malfunction. Do not use water or steam to wash the battery, sensors, connectors or the operator's seat area.

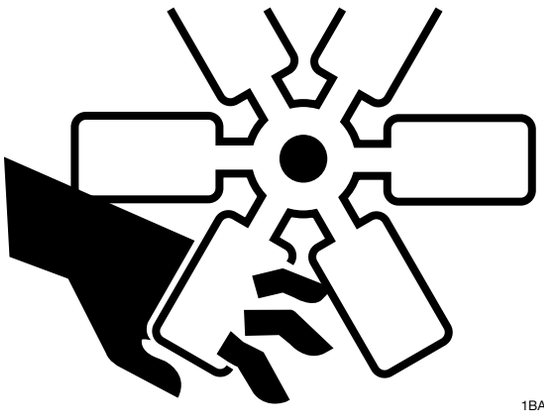
Stop the engine before performing maintenance

Make sure the engine is stopped before starting inspection or maintenance. If maintenance must be performed with the engine running, always work as a 2-person team, communicating with each other.

- One of them must sit at the operator's seat and stop the engine whenever necessary. He/she must take care not to touch the lever or pedal unless necessary.
- The one who performs maintenance must make sure to keep his/her body or clothing away from the moving part of the machine.

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Keep clear of the moving fan and belt



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- Any object that can be easily caught in moving parts must be kept away.
- If a hand or tool becomes trapped in the fan or fan belt, you could lose your finger. Do not touch the fan or belt while they are moving.

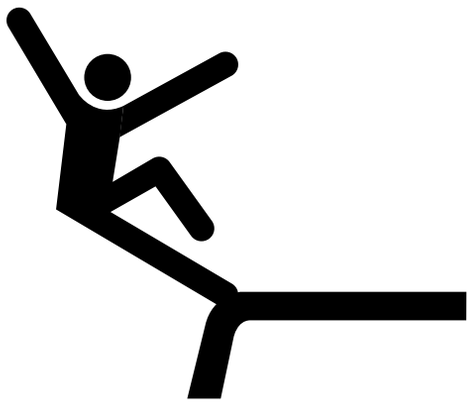
When working under the machine



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- Before performing maintenance or repairs under the machine, set all movable equipment against the ground or in the lowermost position.
- Place chocks under the crawler tracks to secure the machine.
- If it is unavoidably necessary to work under the raised machine or working equipment, be sure to firmly support it by using an arm stopper, wooden block, stand or safety brace. Never go under the raised machine or working equipment without such protection measures.

When working on the machine



1BAA09Z

- To prevent slipping/falling from machine, clear the footing and observe the following:
  a. Do not spill oil or grease on the machine.
  b. Keep the machine tidy and clean.
  c. Be careful when walking around the machine.
- Never jump down from the machine. Climb up/down the ladder (steps) holding the handrail to support your weight in a three point secure stance (hand and feet).
- Wear protective gear according to the work involved.

Securing the working equipment

When replacing/repairing the bucket teeth or side cutter, secure the relevant equipment to prevent any accidental movement.

Secure the engine hood and guard when they are open

Firmly secure the machine when the engine hood or guard is left open. Do not keep the hood or guard open on a windy day or if the machine is parked on a slope.

Place heavy components in a stable position



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When it is necessary to temporally place a heavy component, such as the hoe attachment, on the ground during removal or installation, be sure to place it in a stable position.

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Caution when filling with fuel or oil



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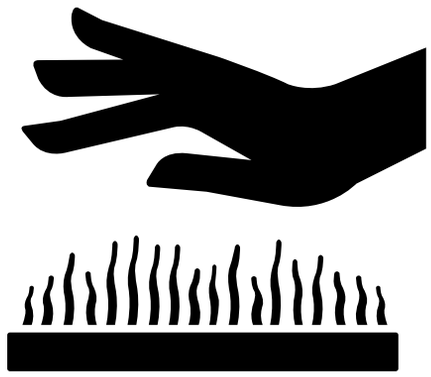
- Keep away from heat, sparks and flame while filling with fuel or oil.
- Never remove the fuel cap or try to fuel when the engine is running or still hot.
- Maintain control of the fuel filler nozzle when filling the tank.
- Refill with fuel or oil outdoors or in a well ventilated place, with the engine turned off.
- Clean up spilled fuel or oil immediately.
- Do not overfill the tank.
- Firmly tighten the fuel cap or oil cap. If the fuel cap is lost, replace it only with the original manufacturer's approved cap. Use of a non-approved cap without proper venting may result in pressurization of the tank.
- Never use fuel for cleaning.
- Use the correct grade of fuel for the operating season.

Handling of hoses

Oil leak or fuel leak can cause a fire.

- Do not twist, bend or hit the hoses.
- Never use twisted, bent or cracked pipes, tubes or hoses; otherwise, they may burst.
- Retighten loose connections.

Be careful with hot and pressurized components

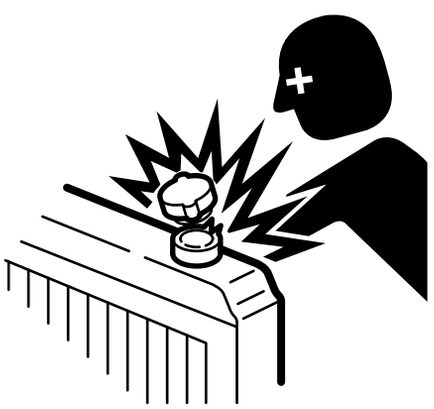


1BAA12Z

Before performing inspection and maintenance, stop the engine and allow the machine to cool down.

- The engine, muffler, radiator, hydraulic lines, sliding parts and many other parts of the machine are hot immediately after the engine is stopped. Wait until it cools before making any inspection or adjustments.
- The engine coolant, hydraulic oil and other oils are also hot and under high pressure. Touching these liquids will cause burns.

Handling of radiator

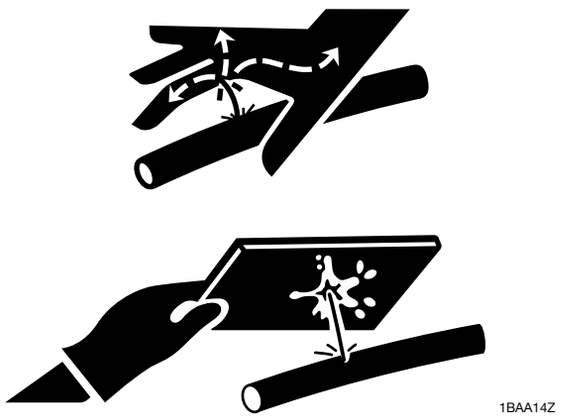


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Do not remove the radiator cap when the coolant is hot. Wait until it cools down, and then remove the radiator cap by loosening it slowly to release the internal pressure.

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Be careful with oils under pressure



1BAA14Z

Pressure is maintained in the hydraulic circuit long after the engine has been shut down.

- Do not fill with, dispose of fuel/oil, or perform the inspection and maintenance until the internal pressure is completely released.
- The hydraulic oil escaping from a small hole can be hazardous if contacted. It is under high enough pressure to penetrate the skin or eyes and cause serious injury. If leak is suspected, protect your eyes and skin by wearing protective glasses and thick gloves to search for a leak. Also use a paperboard or plywood to keep your skin from oil spurting. If oil penetrates the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury.

Release internal pressure before working on the hydraulic system

Oil may spurt out if caps or filters are removed or pipes are disconnected before releasing the pressure in the hydraulic system.

- Gradually loosen the vent plug to release the internal pressure of the hydraulic oil tank.
- Move all the control levers and pedals several times in all directions to release the pressure from the circuit of the working equipment (for link type controls).
- When removing plugs or screws, or when disconnecting hoses, stand to the side and loosen them slowly to gradually release the internal pressure before removing.

Be careful with grease under pressure



1BAA15Z

In the track adjuster, the grease has been injected under high pressure. If the tension is adjusted without following the prescribed procedure, the grease discharge valve may fly off, resulting in injury.

- Loosen the grease discharge valve slowly.
- Do not put your face, arms, legs or body in front of the grease discharge valve.

Handling of the accumulator



1BAA16Z

Be sure to handle the high-pressure nitrogen gas enclosed in the accumulator with care according to procedure. If handled incorrectly, it could explode and cause serious injury. Strictly observe the following precautions:

- Do not disassemble.
- Do not allow flame near it or throw it into a fire.
- Do not drill, weld or fuse.
- Do not subject it to physical shock such as hitting, rolling or dropping.
- Before disposing of the unit, the sealed gas must be drained. Contact your sales or service dealer for help with this.

Disconnect the battery

Disconnect the wiring from the both terminals (+ and -) on the battery before working on the electrical system or doing electric welding. Otherwise, short-circuit and explosion of the battery can result.

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Use caution when handling batteries



1BAA17Z

- Batteries contain sulfuric acid which will damage eyes or skin if contacted.
  - If eye contact occurs, flush immediately with clean water and get prompt medical attention.
  - If accidentally swallowed, drink large quantities of water or milk and call a physician immediately.
  - If acid contacts skin or clothing, wash off immediately with a lot of water.
- Wear protective glasses and gloves when working with batteries.
- Batteries generate flammable hydrogen gas which may explode. Keep away from flame and sparks.
- Do not use or charge the battery when the electrolyte level is lower than the lower limit: otherwise, it could cause an explosion.
- Be sure to stop the engine by turning off the starter switch before inspecting or handling the battery.
- Be careful not to let metal tools (or any metal objects) such as a hammer or spanner come into contact with the battery terminals.
- When disconnecting the battery wiring, always disconnect it from the earth side (-). When connecting, connect the earth side last.
- Loose battery terminals may result in sparks. Be sure to fasten terminals tightly.
- Make sure the battery caps are tightened securely.
- Do not charge a battery or jump-start the engine if the battery is frozen; otherwise it may explode.
  Warm the frozen battery to 15°C (60°F) before use.

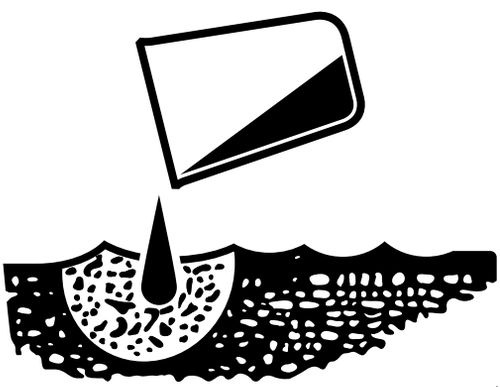
Have a service agent repair welding cracks or other damage

Ask a service agent to make any repairs that require welding. If the agent is unavailable, make sure the welding is done by a qualified person in a properly equipped workplace.

Checks after maintenance

- Gradually raise the engine speed from low idle to maximum and check that no oil or water is leaking from the parts serviced.
- Move the controls and check that the machine is operating properly.

Disposing of wastes



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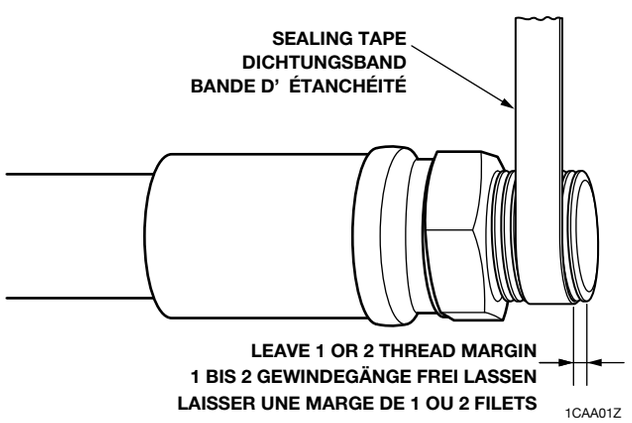
- Always collect oil that is drained from the machine in containers. Improperly disposed waste oil can cause environmental harm.
- Follow appropriate laws and regulations when disposing of harmful objects such as oil, fuel, coolant, solvent, filters and batteries.

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CAUTIONS WHEN WORKING

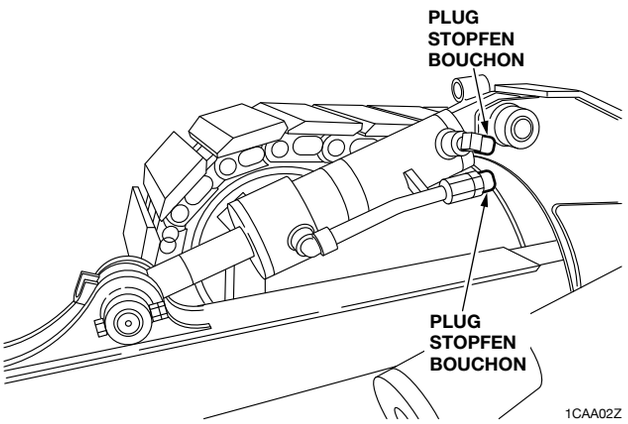
When disassembling or assembling

- Clean the machine before disassembly.
- Check the following items and record the results:
  a. Model, machine serial number, hour meter.
  b. Reason for repair, repair history.
  c. Are the filters dirty?
  d. The conditions of the fuel and oil.
  e. Any damage or looseness to any part?
- Where necessary, draw alignment indicators to avoid assembly errors. To avoid misconnection, place indicators such as reference tags on pipes.
- Clean all disassembled parts and new parts, arrange them neatly, and place indicators as necessary.
- Be sure to replace all seals and cotter pins with new ones.
- Keep those parts that should not come in contact with water or oil away from those with oil on the surface.
- When installing bearings, bushings and oil seals, a press tool should be used. If a hammer is used, use a cushioning material to avoid damage.
- Wipe all joining surfaces clean until there is no dirt or dust adhering to them.
- Wrap the thread tight with seal tape starting 1 or 2 threads away from the thread end. The tape should be overlapped by about 10 mm (0.39 in).



When removing/installing the hydraulic unit

- Make sure that the temperature of the hydraulic oil has dropped and is cool enough to work with.
- To prevent the hydraulic oil from escaping under pressure, release the residual pressure in the piping.
- Be sure to install caps or plugs on all openings in the hydraulic unit to prevent dirt from getting into the unit through them.

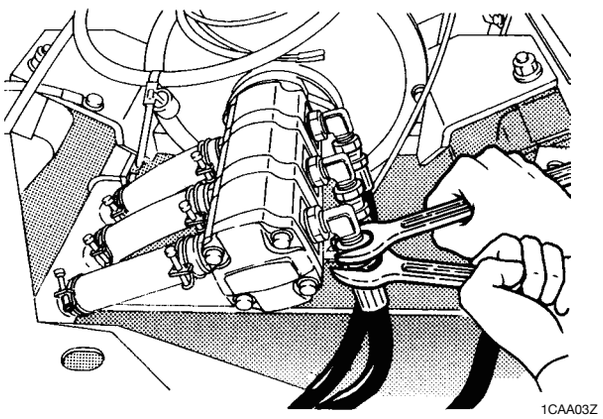


- The hydraulic oil adhering to the unit is often mistaken for an oil leak, so wipe off the unit thoroughly.
- Be sure that no damage is caused to the plating on the rod in the hydraulic cylinder.
- Removal and installation of the hydraulic cylinder should be done with the rod fully retracted.
- Be sure to bleed the air after installing the hydraulic cylinder. (☞ "4. Disassembly and assembly: Cylinder")
- Always bleed the air when hydraulic oil is changed or a hydraulic device is replaced.(☞ "4. Disassembly and assembly: Drive system")

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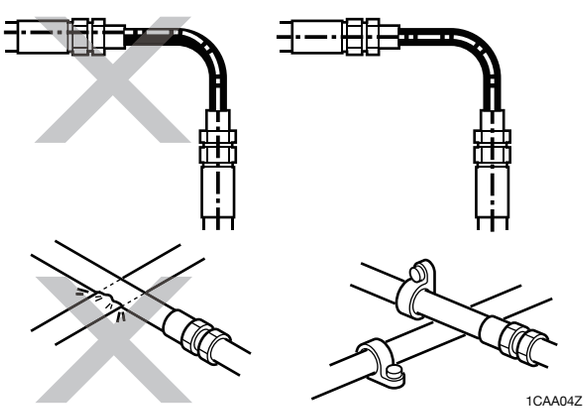
When connecting/disconnecting the hoses or pipes

- When hydraulic hoses or pipes are connected, tighten them once to the prescribed torque, then loosen them slightly and retighten them to the prescribed torque.
  a. Tighten the fittings after the installation surfaces fit snugly together.
  b. The above procedures do not apply to fittings with seal tape.
- Use two spanners, one to tighten/loosen and the other to secure the mating hose/pipe to ensure that the hose is not twisted.



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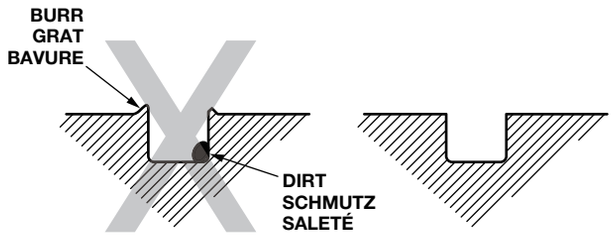
- After connecting the hydraulic hoses or pipes, apply the maximum working pressure five or six times to check for leakage.
- If high pressure, vibration or shock is applied to a twisted hose, oil leak, hose breakage or damage to the hose fitting can result.
- Be sure that the hydraulic hoses are not contacting sharp objects or each other. This could cause surface flaws on the hoses, resulting in breakage.



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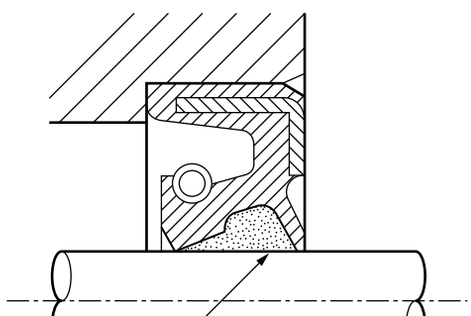
Handling of seals

- Clean the grooves for O-rings and remove any burrs.



1CAA05Z

- Be careful not to twist the O-rings. If twisted, remove it with your fingertips.
- When inserting, be careful not to damage the seal.
- Handling of the floating seal
  a. After removal, wipe all oil off the O-ring and housing of the floating seal.
  b. When assembling, apply a thin coating of gear oil to the contact surface of the housing,
  c. After assembly, turn the seal two or three times to get it to fit snugly.
- Apply grease to the lip of the oil seal.
  a. This is to prevent wear from occurring upon first start up after assembly.

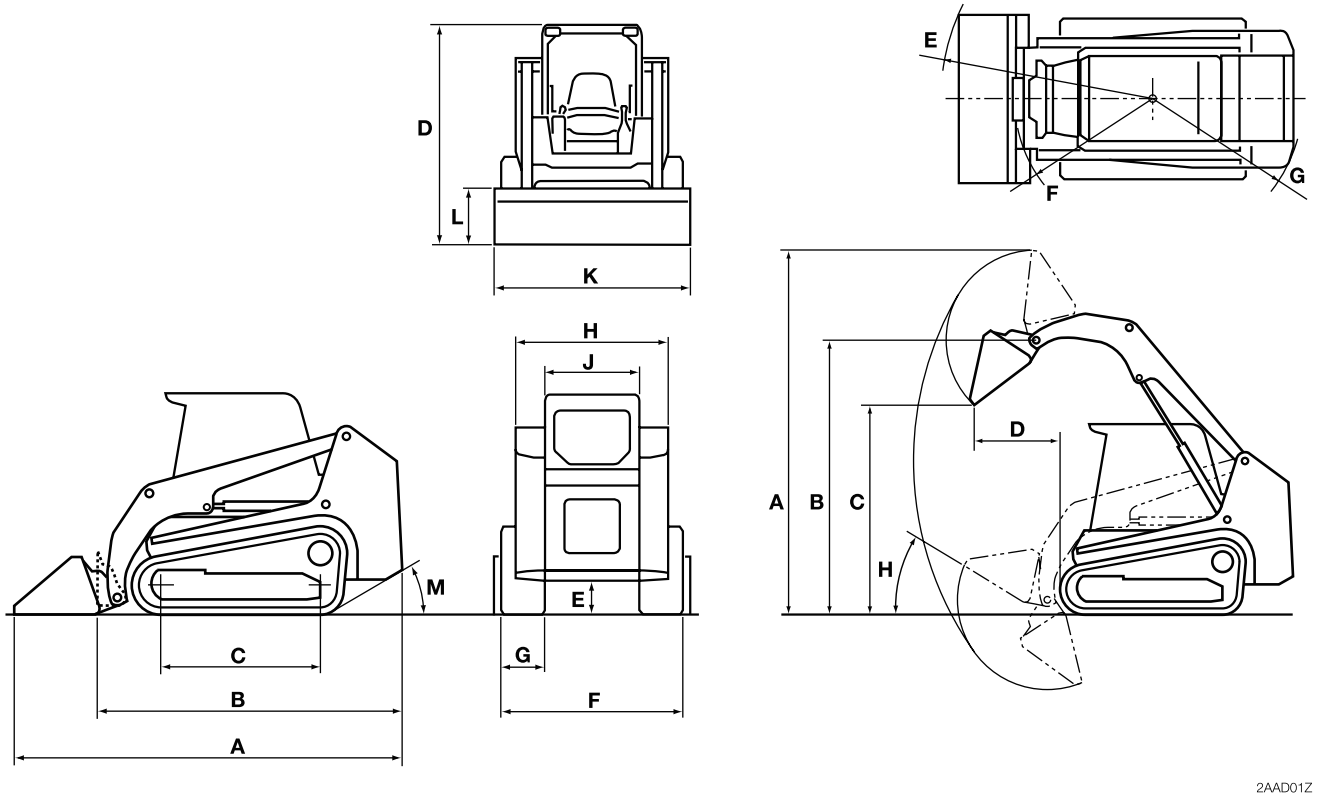


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SERVICE DATA 2

DIMENSIONAL DRAWING



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Machine dimensions

Unit: mm (in.)

	Standard bucket	
	Rubber crawler	
	Canopy	Cab
A	3430 (135.1)	←
B	2740 (107.8)	←
C	1390 (54.7)	←
D	2130 (83.9)	2235 (88.0)
E	310 (12.1)	←
F	1580 (62.2)	←
G	320 (12.6)	←
H	1430 (56.3)	←
J	980 (38.6)	985 (38.7)
K	1675 (66.0)	←
L	510 (20.0)	←
M	30°	←

Operating range

Unit: mm (in.)

	Standard bucket	
	Rubber crawler	
	Canopy	Cab
A	3905 (153.8)	←
B	3030 (119.3)	←
C	2370 (93.4)	←
D	730 (28.8)	←
E	2080 (82.0)	←
F	1375 (54.1)	←
G	1585 (62.4)	←
H	30°	←

SPECIFICATION TABLES

Performance

Bucket type				Standard bucket
Bucket capacity			m^3 ($ft.^3$)	0.351 (12.4)
Tipping load			kg (lb.)	2730 (6020)
Rated loading mass			kg (lb.)	955 (2105)
Breakout force			kN (lbf)	30.5 (6856)
Raising time (with load)			s	4.0
Lowering time			s	2.5
Bucket forward tilting time			s	2.5
Travel speed	Forward	1st	km/h (mph)	7.4 (4.6)
		2nd	km/h (mph)	11.0 (6.8)
	Reverse	1st	km/h (mph)	7.4 (4.6)
		2nd	km/h (mph)	11.0 (6.8)
Maximum tractive force			kN (lbf)	40.6 (9127)
Gradeability			deg.	30
Minimum turning radius	Outermost side of bucket		m (ft.)	2.08 (6.8)

Dimensions

Overall length in transport condition	Without teeth		mm (in.)	3430 (135.1)
	With teeth		mm (in.)	–
Overall width			mm (in.)	1580 (62.2)
Bucket width			mm (in.)	1675 (66.0)
Overall height	Bucket on ground	Canopy	mm (in.)	2130 (83.9)
		Cab	mm (in.)	2235 (88.0)
	Max. raised height of bucket		mm (in.)	3905 (153.8)
Crawler bearing length			mm (in.)	1390 (54.7)
Track gauge			mm (in.)	1260 (49.6)
Shoe width			mm (in.)	320 (12.6)
Crawler bearing area			m^2 ($ft.^2$)	0.890 (9.6)
Ground clearance of undercarriage			mm (in.)	310 (12.1)
Bucket hinge pin height			mm (in.)	3030 (119.3)
Dumping clearance (at 39-degree forward tipping)	Without teeth		mm (in.)	2370 (93.4)
	With teeth		mm (in.)	–
Dumping reach (at 39-degree forward tipping)	Without teeth		mm (in.)	730 (28.8)
	With teeth		mm (in.)	–
Bucket roll back angle	On ground		deg. (°)	29.5
Bucket dumping angle	Maximum height position		deg. (°)	38.6
Maximum digging depth			mm (in.)	0 (0)

Mass

Gross machine mass	Canopy	kg (lb.)	4395 (9689)
	Cab	kg (lb.)	4475 (9866)
Operating mass	Canopy	kg (lb.)	3835 (8455)
	Cab	kg (lb.)	3915 (8631)
Machine mass	Canopy	kg (lb.)	3760 (8289)
	Cab	kg (lb.)	3840 (8466)
Shipping mass	Canopy	kg (lb.)	3705 (8168)
	Cab	kg (lb.)	3785 (8344)

Engine

Model				Kubota V3307-CR-TE4B
Type				4-cycle, vertical, water-cooled, in-line, 4-cylinder, direct-injection
Number of cylinders – Internal diameter × stroke	Number of cylinders		Quantity	4
	Bore		mm (in.)	94 (3.7)
	Stroke		mm (in.)	120 (4.72)
Total displacement			L (cu. in.)	3.331 (203.26)
Performance	Rated output	Gross (SAE J1995)	kW/min^{-1} (hp/rpm)	55.4/2600 (74.3/2600)
		Net (ISO 14396)	kW/min^{-1} (hp/rpm)	54.6/2500 (73.2/2600)
		Net (ISO 9249/ SAEJ 1349)	kW/min^{-1} (hp/rpm)	53.2/2600 (71.3/2600)
	Maximum torque		N·m (ft.-lb.)	259.5 (191.4)/1500 (min^{-1})
	Specific fuel consumption (at rated output)		g/kW·h (lb./hp-hr.)	243 (0.39)
Fuel system	Speed governor			Electronic control
Lubrication system	Lubrication type			Trochoid pump
	Filter system			Filter paper
	Cooling system			Water cooling
Air cleaner				Centrifugal, filter paper
Cooling system	Fan			Spray
	Radiator			Pressurization
Generator	AC/DC			Three-phase, alternating current, self-rectifying
	Voltage		V	12
	Output		kW	0.72
Starter generator	Voltage		V	12
	Output		kW	3
Storage battery	Type			125D31R
	Voltage		V	12
	Capacity		A·h	72
	Quantity			1

Hydraulic drive system

Hydraulic pump	Model		Sauer-Danfoss-Daikin PVM2828
	Type		Variable displacement piston
	Displacement	cm^3/rev (cu. in./rev)	0 to 27 (0 to 1.65)
	Quantity		2
Travel motor	Model		Sauer-Danfoss-Daikin BMVT32C
	Type		Variable displacement piston
	Motor displacement	cm^3/rev (cu. in./rev)	20.6/31.5 (1.26/1.92)
	Quantity		2
Set pressure	Effective differential pressure	MPa (psi)	34.5 (5002)
Reduction gears			Epicycle 2-stage reduction gear

Brake device

Parking brake	Spring-loaded, wet-type disc brake

Undercarriage

Suspension system			Rigid type
Roller, idler	Sealing system		Floating seal
	Carrier roller (one side)	Quantity	—
	Track roller (one side)	Quantity	5
Crawler	Track adjustment		Grease adjustment
	Type		Integrated design, single grouser, rubber crawler
	Grouser height	mm (in.)	30 (1.18)
	Number of shoes (one side)	Quantity	52
	Pitch	mm (in.)	86 (3.39)
	Shoe width	mm (in.)	400, 320 (15.7,12.6)

Operating device

Operator's seat	Position		Center of machine
	Type		ROPS/FOPS (Level 2) canopy and cab
Operator's seat			Adjustable suspension seat
control lever and pedals	Lever		Travel, attachments
	Pedal		Accelerator OPT
Instruments			Cluster gauge (12 V): Water temperature gauge, Fuel gauge and Water temperature, Fuel, Hourmeter, Charge, Engine oil, Service low-speed operation, Safety bar, Air cleaner, Line filter, Glow, 2nd speed travel, Arm float, Quick hitch, Seat switch lamp
Lighting device	Front work light		12 V, 55 W × 2
	Rear work light		12 V, 55 W × 2
Others	Horn	Quantity	1
	Back buzzer	Quantity	1
	Inside rear-view mirror	Quantity	2
	Rear-view mirror	Quantity	1

Working equipment

Bucket blade type		Without teeth
Bucket teeth	Type	—
	Quantity	—
Auto adjustment mechanism		With hydraulic leveling device for bucket raising

Hydraulic system

Arm cylinder	Type		Independent piston
	Number	Quantity	2
	Bore	mm (in.)	65 (2.5)
	Stroke	mm (in.)	705 (27.8)
Bucket cylinder	Type		Independent piston
	Number	Quantity	2
	Bore	mm (in.)	65 (2.6)
	Stroke	mm (in.)	475 (18.7)
Hydraulic pump	Type		Double-gear pump
	Displacement	cm^3/rev (cu. in./rev)	27.8+16.2 (1.7+0.99)
Operating valve	Type		Hydraulic pilot operated
	Set pressure	MPa (psi)	2.9 (420)

TABLE OF MASSES

Part	kg (lb.)
Control valve	22 (49)
Sub valve	4 (9)
Control valve (High flow)	8 (17.6)
Pilot valve (L)	2.5 (6)
Pilot valve (R)	2 (4)
Gear pump assembly	4 (9)
Engine housing	15 (33)
HST pump	66 (145.5)
Double-gear pump	8 (18)
Hydraulic oil tank assembly	47 (104)
Cap COMP	256.5 (565)
Canopy COMP	146 (322)
Operator seat	30 (66)
Rubber crawler (One side)	170 (375)
Track roller	19.5 (43)
Front idler assembly	36 (79)
Track adjuster	17 (37)
Travel motor	56 (123)
Engine	284 (626)
Radiator	52 (115)
Battery	23 (51)
Fuel tank assembly	10 (22)
Quick-hitch bracket	74 (163)
Bucket	181 (399)
Arm assembly	270 (595)
Arm cylinder	27 (60)
Bucket cylinder	20 (44)

LUBRICANT AND FUEL CHART

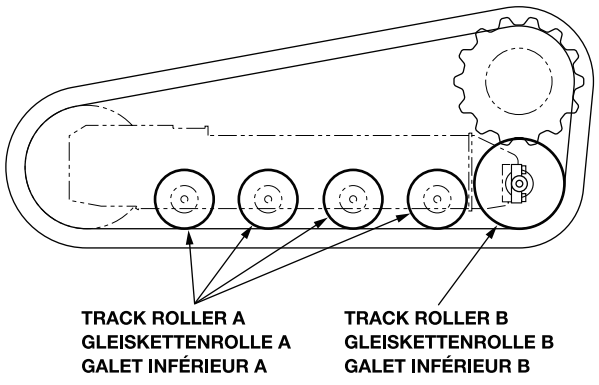
Select the appropriate fuel, lubricant, and grease according to temperature by referring to the table below.

- Regardless of the time specified below, change the oil also if it becomes too dirty or degraded.
- When adding oil, never mix oils of different brands. If a brand is to be changed, replace all of the fuel/oil.

Part	Type	Selection by air temperature -4 14 32 50 68 86 104°F -20 -10 0 10 20 30 40°C	When to change/ replenish	Capacity
Engine oil pan	Diesel engine oil API: CJ-4 class or above	SAE 10W-30	Every 500 hrs. after the first 50 hrs	Upper limit: 11.2 L (11.8 US qt.) Lower limit: 8.2 L (8.7 US qt.)
Hydraulic tank	Diesel engine oil API: CD, CE, or CF class or above	SAE 10W-30	Every 1000 hrs	Total amount of oil: 58 L (15.3 US gal.) Tank capacity: 39 L (10.3 US gal.)
Engine cooling system	Cooling water (water + coolant)** SAE: J1814C, J1034	Mixture of 50% coolant	Every 1000 hrs	14 L (14.8 US qt.)
Travel reduction gear	Gear oil API: GL-4	SAE 90	Every 500 hrs. after the first 250 hrs*	1.0 L x 2 (1.06 US qt.)
Track roller A	Engine oil API: CD class	SAE 30	–	0.18 L (6.09 fl. oz.)
Track roller B	Mobilegear SHC 680	–	–	0.14 L (4.7 fl. oz.)
Idler	Engine oil API: CD class	–	–	0.12 L (4.1 fl. oz.)
Working equipment	Lithium grease EP-2 NLGI No. 2	–	Daily or every 10 hrs	As required
Levers/pedals			As required	

* If the ratio of traveling time to total operating time is high, replace the gear oil earlier than the specified time.

** For water, use (soft) tap water. Do not use well or river water.
For regions/conditions where the ambient temperature drops below 0°C (32°F), add coolant (antifreeze). Follow the coolant manufacturer's instructions to determine the mixture ratio.



2CAD01Z

Diesel fuel standards

Use a diesel fuel that is compliant with one of the applicable standards below. The table below lists standards from various countries/regions.

Diesel fuel standards	Region
No. 2-D, S15, No. 1-D, S-15, ASTM D975-94	USA
EN590:96	EU
ISO 8217 DMX	International standard
BS 2869-A1 (or A2)	UK
JIS K2204 Grade, 2-go	Japan
KSM-2610	South Korea
GB252	China

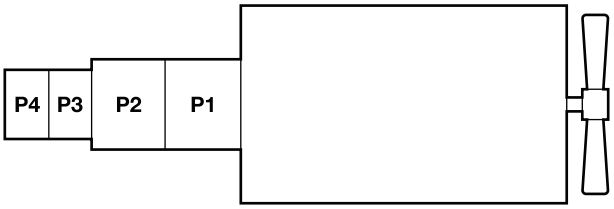
Part	Type		Capacity
Fuel tank	Diesel fuel	To maintain the performance and service life of the engine, always use clean and high-quality fuel. • To avoid freezing in cold climates, use a light oil that is rated for temperatures at least 12°C (54°F) below the lowest expected ambient temperature. • Use a diesel fuel with a cetane number of 45 or higher. For operation at a very low temperature or a high altitude, a higher cetane number fuel will be required. • Use fuel with an overall sulfur content below 0.05% to 0.0015%. Be sure to use fuel with an ultra-low sulfur content for applications in the U.S. or Canada, in particular. The use of fuel with a high sulfur content may cause sulfuric acid corrosion to occur inside the cylinder. • Do not mix fuel with any kerosene, used engine oil, or leftover fuel. • Poor quality fuel can degrade engine performance. It can also damage the engine. • Refrain from adding additives to the fuel. Some fuel additives can degrade engine performance.	75 L (19.8 US gal.)

PERFORMANCE CRITERIA

Standard values table

Item				Standard value	Allowable value
Engine speed	Low		min^{-1} (rpm)	1100^{+50}_{-50} (1100^{+50}_{-50})	–
	High		min^{-1} (rpm)	2740^{+50}_{-50} (2740^{+50}_{-50})	–
Hydraulic oil pressure	Travel	Right	MPa (psi)	$34.5^{+5.9}_{-0.5}$ (5003^{+856}_{-73})	–
		Left	MPa (psi)	$34.5^{+5.9}_{-0.5}$ (5003^{+856}_{-73})	–
	Charge	Low	MPa (psi)	$1.6^{+0.2}_{-0.2}$ (232^{+29}_{-29})	–
		High	MPa (psi)	$2.1^{+0.2}_{-0.2}$ (305^{+29}_{-29})	–
	Bucket		MPa (psi)	$21.0^{+1.2}_{-0.6}$ (3046^{+174}_{-87})	–
	Pilot pressure		MPa (psi)	$2.9^{+0.7}_{-0.1}$ (421^{+102}_{-15})	–
	High flow		MPa (psi)	$21.0^{+1.0}_{-1.0}$ (3046^{+145}_{-145})	–
Cylinder speed	Lowering speed when the arm is in float		s	$6.3^{+1.0}_{-1.0}$	7.9
	Lift arm	Raising	s	$4.0^{+0.4}_{-0.4}$	4.8
		Lowering	s	$2.5^{+0.4}_{-0.4}$	3.2
	Bucket	Roll back	s	$1.9^{+0.4}_{-0.4}$	2.5
		Dump	s	$2.5^{+0.4}_{-0.4}$	3.2
Travel speed 10 m (32.8 ft)	1st	Forward	s	$4.9^{+0.5}_{-0.5}$	5.9
		Reverse	s	$4.9^{+0.5}_{-0.5}$	5.9
	2nd	Forward	s	$3.3^{+0.4}_{-0.4}$	4.2
		Reverse	s	$3.3^{+0.4}_{-0.4}$	4.2
Crawler shoe (5 revs.)	1st Right	Forward	s	$11.2^{+0.6}_{-0.6}$	12.9
		Reverse	s	$11.2^{+0.6}_{-0.6}$	12.9
	1st Left	Forward	s	$11.2^{+0.6}_{-0.6}$	12.9
		Reverse	s	$11.2^{+0.6}_{-0.6}$	12.9
	2nd Right	Forward	s	$7.5^{+0.5}_{-0.5}$	8.8
		Reverse	s	$7.5^{+0.5}_{-0.5}$	8.8
	2nd Left	Forward	s	$7.5^{+0.5}_{-0.5}$	8.8
		Reverse	s	$7.5^{+0.5}_{-0.5}$	8.8
Straight-ahead traveling		Forward	mm (in.)	125^{+0}_{-125} ($4.9^{+0.0}_{-4.9}$)	500 (19.7)
		Reverse	mm (in.)	125^{+0}_{-125} ($4.9^{+0.0}_{-4.9}$)	500 (19.7)
Natural cylinder drop	Lift arm		mm (in.)	5^{+0}_{-5} ($0.2^{+0.0}_{-0.2}$)	10 (0.4)
	Bucket		mm (in.)	5^{+0}_{-5} ($0.2^{+0.0}_{-0.2}$)	10 (0.4)
Natural travel drop	With parking brake on	Forward	mm (in.)	0 (0.0)	–
		Reverse	mm (in.)	0 (0.0)	–
Travel parking	With manual parking brake on	Forward	mm (in.)	0 (0.0)	–
		Reverse	mm (in.)	0 (0.0)	–
Bucket front edge		Difference between right and left	mm (in.)	10^{0}_{-10} ($0.4^{0.0}_{-0.4}$)	20 (0.8)
Track tension			mm (in.)	25 to 50 (1.0 to 2.0)	–

Hydraulic pump assignment table



2DAA01Z

P1	Right travel	70.2 L/min (18.5 US gal./min)
P2	Left travel	70.2 L/min (18.5 US gal./min)
P3	Arm, bucket, auxiliary	72.3 L/min (19.1 US gal./min)
P4	Charge pressure, pilot pressure	42.1 L/min (11.1 US gal./min)

Pump P1

Right travel	Pressure: 34.5 MPa (5003 PSI)	Detection port P1

Pump P2

Left travel	Pressure: 34.5 MPa (5003 PSI)	Detection port P2

Pump P3

Arm	Pressure: 21.0 MPa (3046 PSI)	Detection port P3
Bucket	Pressure: 21.0 MPa (3046 PSI)	Detection port P3
Auxiliary	Pressure: 21.0 MPa (3046 PSI)	Detection port P3

Pump P4

Charge pressure: Low/high	Pressure: 1.6/2.1 MPa (232/305 PSI)	Detection port C
Pilot pressure	Pressure: 2.9 MPa (421 PSI)	Detection port P4

Methods for inspecting performance

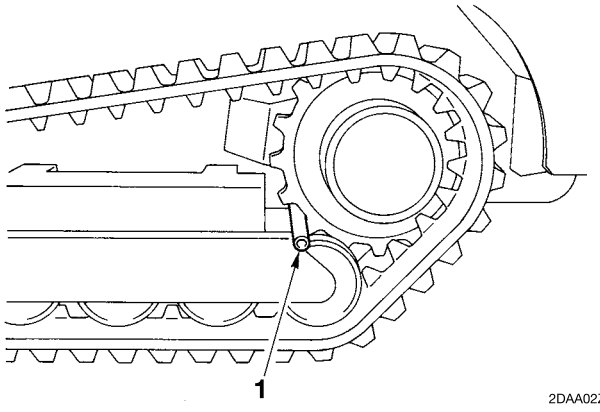
Hydraulic oil pressure

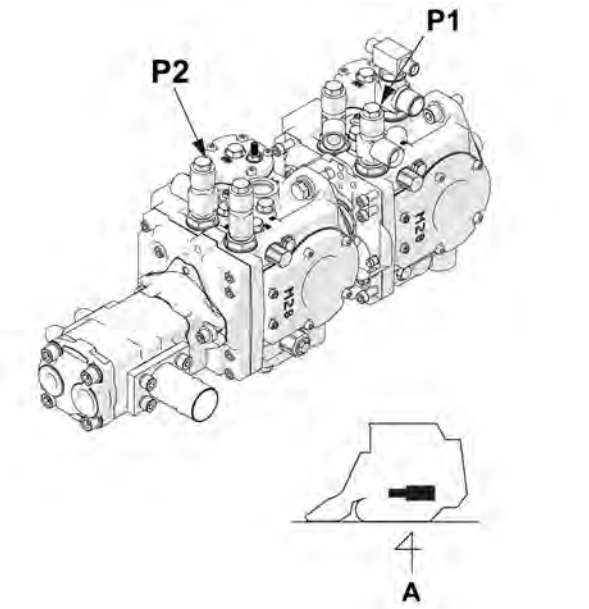
Travel

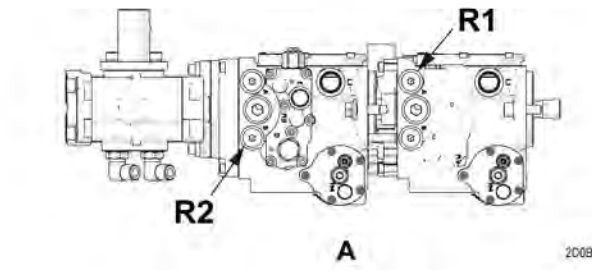
Measurement method

- Engine: Maximum R.P.M.
- Hydraulic oil temp.: 50°C to 60°C (122°F to 140°F)
- Attach a pressure gauge to the pressure detection port. Fit the pipe (1) onto the travel motor sprocket to deactivate the motor. Next, start up the hydraulic circuit to be tested, and measure the relief pressure.

Circuit	Pressure detection port		Relief valve
	Port	Size	
Right travel (forward)	P2	G1/4	R2
Left travel (forward)	P1	G1/4	R1





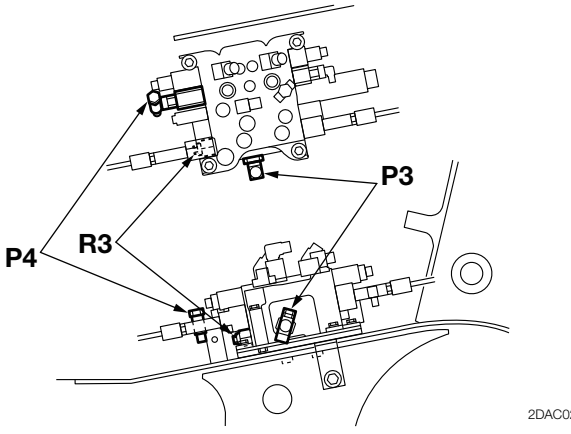


Lift arm, bucket

Measurement method

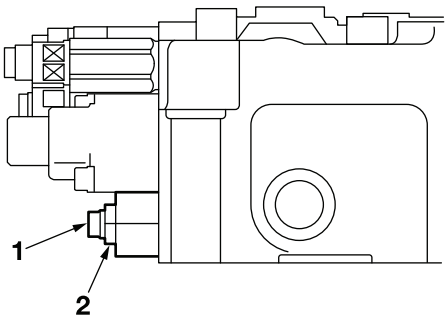
- Engine: Maximum R.P.M.
- Hydraulic oil temp.: 50°C to 60°C (122°F to 140°F)
- Attach a pressure gauge to the pressure detection port. Operate the hydraulic circuit to be tested, and measure the relief pressure.

Circuit	Pressure detection port		Relief valve
	Port	Size	
Arm, bucket	P3	G1/4	R3



Adjustment method

1. Loosen the locknut (2), and turn the setscrew (1) to adjust the set pressure.
   - Turning it clockwise raises the set pressure.
   - Turning it counterclockwise lowers the set pressure.
2. Upon completing the adjustment, tighten the lock nut (2) while holding the setscrew (1) in place to prevent it from turning.
3. Operate the relief valve again to confirm that the newly set pressure is stabilized.



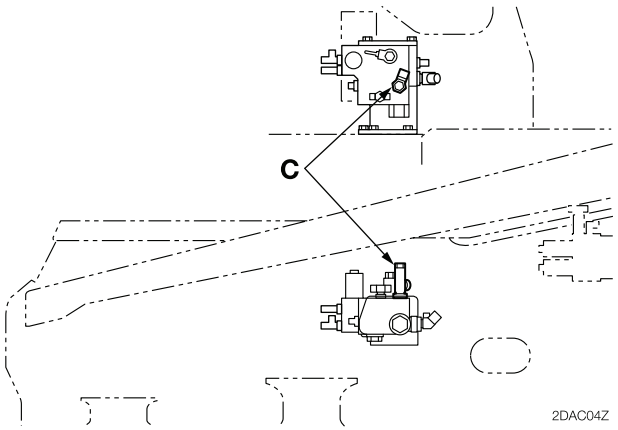
2DAC03Z

Charge pressure

Measurement method

- Engine: Idling/Maximum R.P.M.
- Hydraulic oil temp.: 50°C to 60°C (122°F to 140°F)
- Attach a pressure gauge to the pressure detection port.

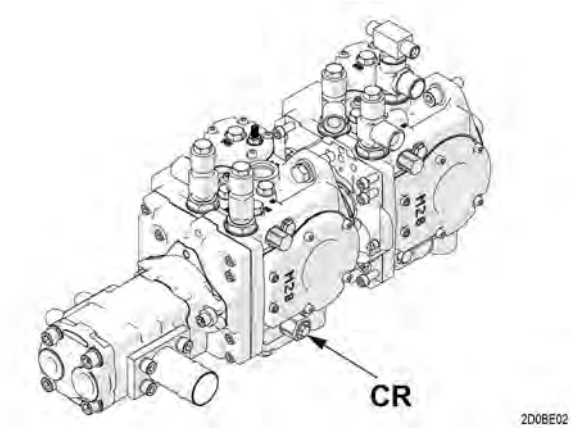
Pressure detection port		Relief valve
Port	Size	
C	G1/4	CR



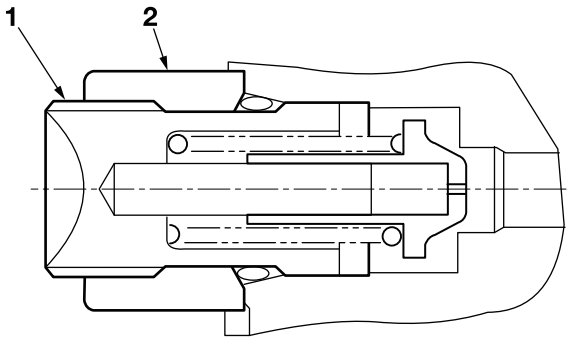
2DAC04Z

Adjustment method

1. Loosen the locknut (2), and turn the setscrew (1) to adjust the set pressure.
   - Turning it clockwise raises the set pressure.
   - Turning it counterclockwise lowers the set pressure.
2. Upon completing the adjustment, tighten the lock nut (2) while holding the setscrew (1) in place to prevent it from turning.
3. Operate the relief valve again to confirm that the newly set pressure is stabilized.



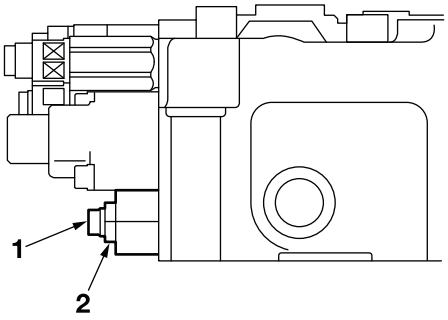
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2DAA08Z

Adjustment method

1. Loosen the locknut (2), and turn the setscrew (1) to adjust the set pressure.
   - Turning it clockwise raises the set pressure.
   - Turning it counterclockwise lowers the set pressure.
2. Upon completing the adjustment, tighten the lock nut (2) while holding the setscrew (1) in place to prevent it from turning.
3. Operate the relief valve again to confirm that the newly set pressure is stabilized.



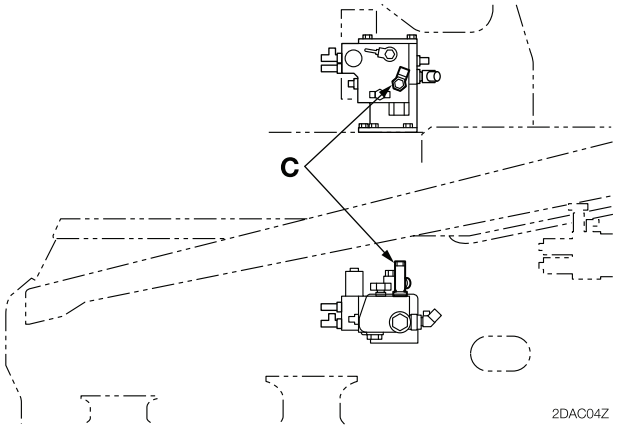
2DAC03Z

Charge pressure

Measurement method

- Engine: Idling/Maximum R.P.M.
- Hydraulic oil temp.: 50°C to 60°C (122°F to 140°F)
- Attach a pressure gauge to the pressure detection port.

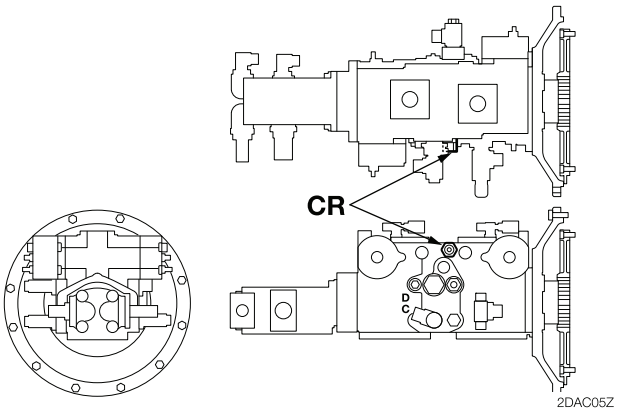
Pressure detection port		Relief valve
Port	Size	
C	G1/4	CR



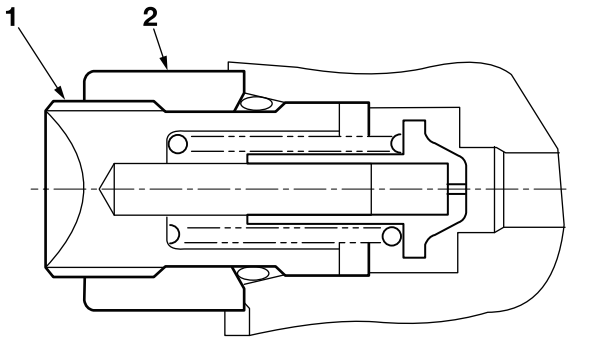
2DAC04Z

Adjustment method

1. Loosen the locknut (2), and turn the setscrew (1) to adjust the set pressure.
   - Turning it clockwise raises the set pressure.
   - Turning it counterclockwise lowers the set pressure.
2. Upon completing the adjustment, tighten the lock nut (2) while holding the setscrew (1) in place to prevent it from turning.
3. Operate the relief valve again to confirm that the newly set pressure is stabilized.



2DAC05Z



2DAA08Z

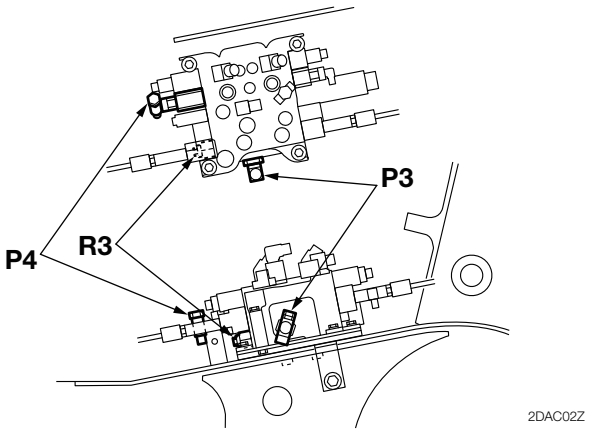
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Pilot pressure

Measurement method

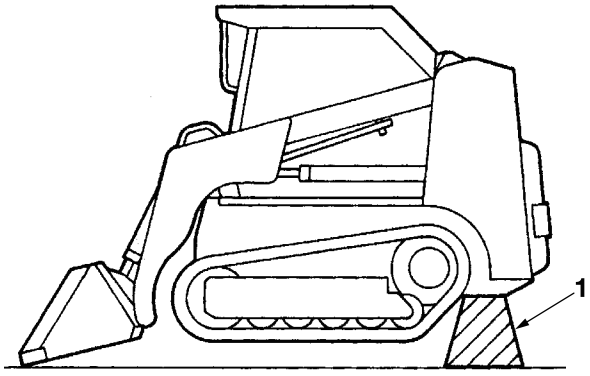
- Engine: Maximum R.P.M.
- Hydraulic oil temp.: 50°C to 60°C (122°F to 140°F)
- Attach a pressure gauge to the pressure detection port. Operate the hydraulic circuit to be tested, and measure the relief pressure.

Circuit	Pressure detection port	
	Port	Size
Bucket dump	P4	G1/4



Travel speed (5 revolutions)

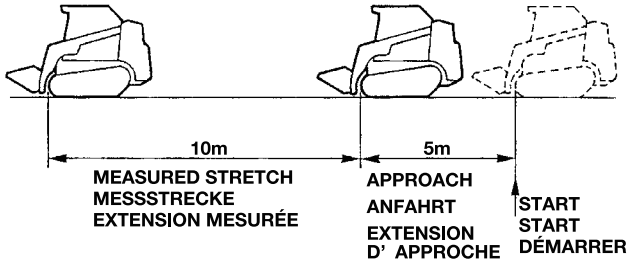
- Engine: Maximum R.P.M.
- Hydraulic oil temp.: 50°C to 60°C (122°F to 140°F)
- Measurement attitude: Place the block (1) under the rear of the machine to support it, and raise the machine using the arm and bucket. Be sure to do this work on flat and firm ground.
- Start turning both the right and left crawler belt at the same time. Wait for the first turn to finish, and then start measuring the time required for the belts to finish another five turns (measure after turning synchronized).



2DAA09Z

Travel speed (10 m)

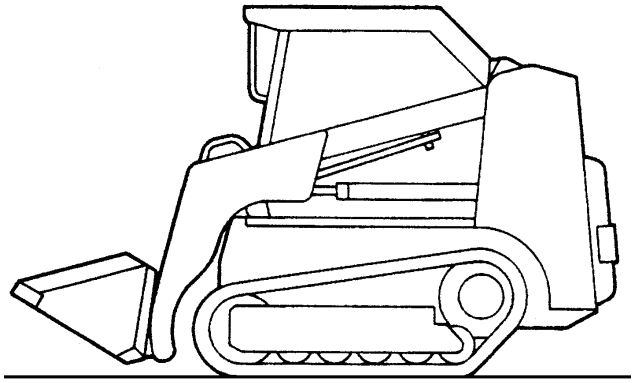
- Engine: Maximum R.P.M.
- Hydraulic oil temp.: 50°C to 60°C (122°F to 140°F)
- Measurement attitude: Traveling
- Drive 5 meters (16.4 ft) first, and then start measuring the time required for the machine to travel another 10 meters (32.8 ft). Be sure to do this work on flat and firm ground.



2DAA10Z

Traveling attitude

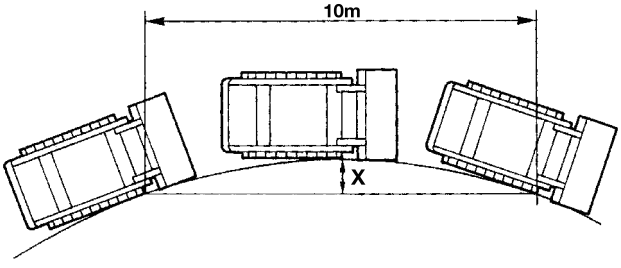
The arm and bucket cylinders should be retracted as much as possible.



2DAA11Z

Straight-ahead traveling

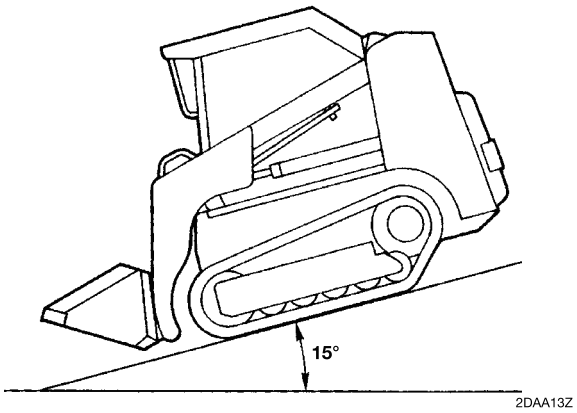
- Engine: 1500±100min^{-1}(1500±100 rpm)
- Hydraulic oil temp.: 50°C to 60°C (122°F to 140°F)
- Measurement attitude: Traveling
- Drive 5 meters (16.4 ft) first, and then 10 meters (32.8 ft). Measure the distance "X" shown in the figure at right. Be sure to do this work on flat and firm ground.



2DAA12Z

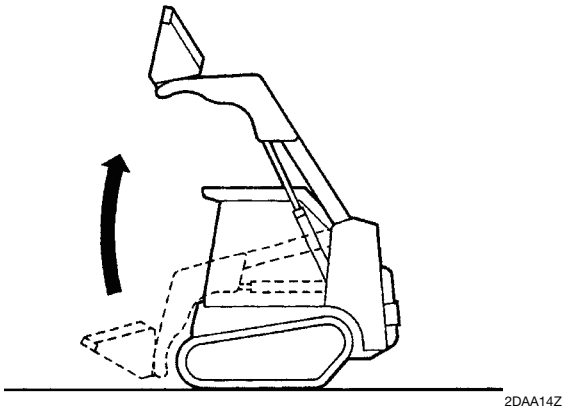
Natural travel drop

- Engine: Idling
- Hydraulic oil temp.: 50°C to 60°C (122°F to 140°F)
- Measurement attitude: Traveling
- Angle of inclination: 15°
- Park the machine with the parking brake applied, and wait for one minute. Then, measure the amount of spontaneous travel drop.



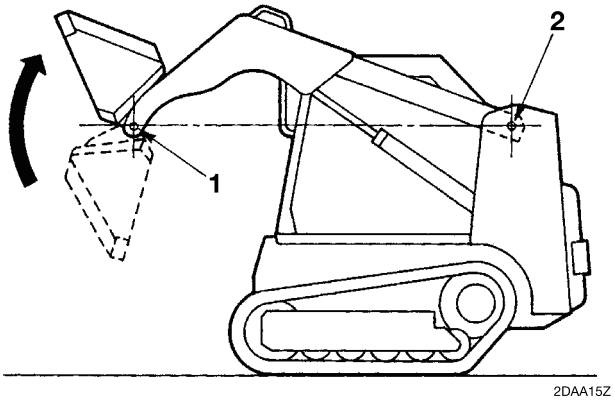
Arm cylinder speed

- Engine: Maximum R.P.M.
- Hydraulic oil temp.: 50°C to 60°C (122°F to 140°F)
- Measurement attitude: The bucket cylinder should be retracted as far as possible.
- Measure the time required to raise the arm from the fully retracted position to the fully extended position, and vice versa (exclusive of cushion operating time).



Bucket cylinder speed

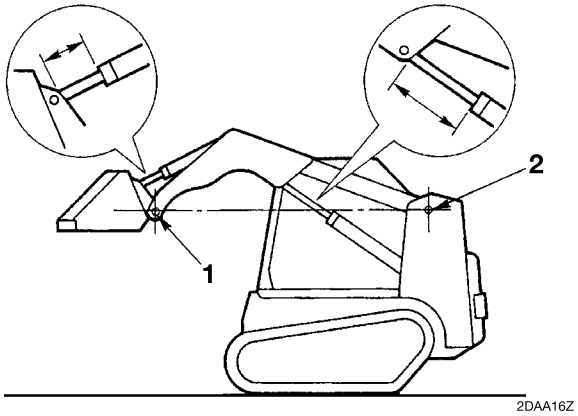
- Engine: Maximum R.P.M.
- Hydraulic oil temp.: 50°C to 60°C (122°F to 140°F)
- Measurement attitude: Make sure that the bucket pin (1) and the arm foot pin (2) are at the same height.
- Measure the time required for the bucket cylinder to move from the fully retracted position to the fully extended position, and vice versa.



Natural cylinder drop

Lift arm, bucket, bucket tip

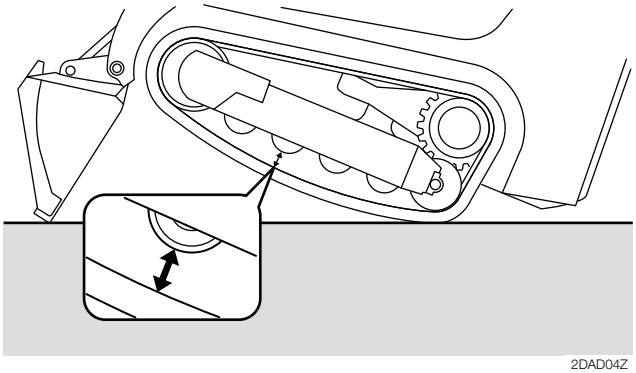
- Engine: Stopped
- Hydraulic oil temp.: 50°C to 60°C (122°F to 140°F)
- Measurement attitude: Make sure that the bucket pin (1) and the arm foot pin (2) are at the same height and that the bucket is level.
- Maintain this attitude for 5 minutes, and then measure the change in the rod length and the distance that the bucket tip moved.



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Track tension

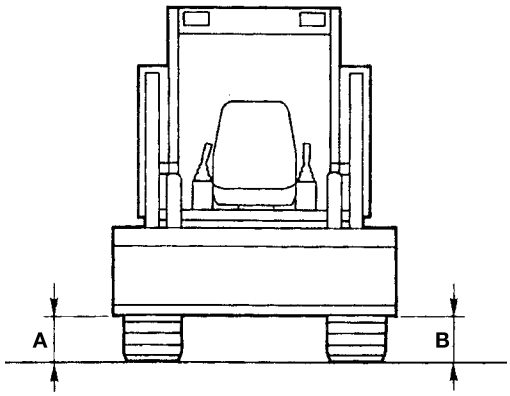
- In a stable, level area, lower the lift arm, tilt the bucket forward, and lift the front of the crawler off the ground. Measure the distance between the central track roller and the top of the crawler shoe.



2DAD04Z

Level of bucket front edge

- Measurement attitude: Keep the bucket level so that the front edge of the bucket is approximately 20 centimeters (around 7.9 inches) above the ground.
- Determine the difference by measuring the distances between the ground and both the right and the left front edges.



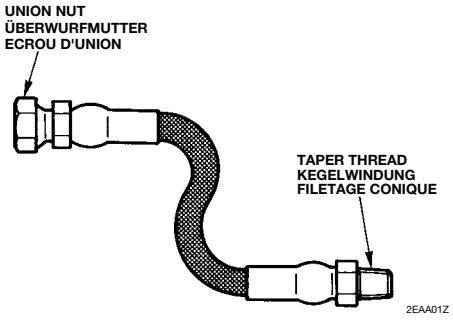
2DAA20Z

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TIGHTENING TORQUE

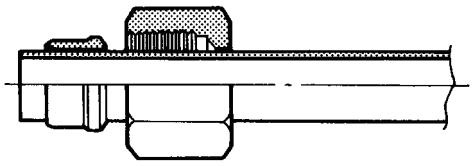
Hydraulic hose

Hose fitting size	Tightening torque			
	Union nut (G)		Taper thread (R)	
	N·m	ft.-lb	N·m	ft.-lb
1/8	$9.8^{+4.9}_{0}$	$7.3^{+3.5}_{0}$	11.8 ± 1.2	8.7 ± 0.8
1/4	$24.5^{+4.9}_{0}$	$18.1^{+3.5}_{0}$	29.4 ± 2.9	21.7 ± 2.1
3/8	$49.0^{+4.9}_{0}$	$36.2^{+3.5}_{0}$	53.9 ± 5.4	39.8 ± 3.9
1/2	$58.8^{+4.9}_{0}$	$43.4^{+3.5}_{0}$	88.3 ± 8.8	65.1 ± 6.4
3/4	$117.7^{+4.9}_{0}$	$86.8^{+3.5}_{0}$	147.1 ± 14.7	108.5 ± 10.7
1	$137.3^{+4.9}_{0}$	$101.3^{+3.5}_{0}$	196.1 ± 19.6	144.7 ± 14.3



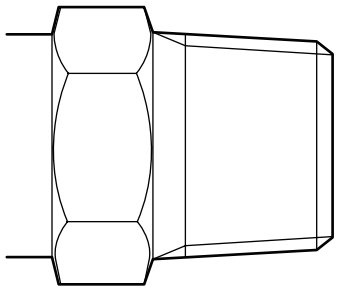
Bite-type pipe fitting for steel pipe

Outer diameter of pipe (mm)	Tightening torque	
	N·m	ft.-lb
8	34.3 ± 4.9	23.5 ± 3.5
10	41.7 ± 2.5	30.7 ± 1.7
12	58.8 ± 4.9	43.4 ± 3.5
15	88.3 ± 4.9	65.1 ± 3.5
16	93.2 ± 4.9	68.7 ± 3.5
18	132.4 ± 4.9	97.6 ± 3.5
22	205.9 ± 9.8	151.8 ± 7.2
27.2	245.2 ± 9.8	181.0 ± 7.2
28	313.8 ± 19.6	231.4 ± 14.3
32	313.8 ± 19.6	231.4 ± 14.3
35	411.9 ± 19.6	303.7 ± 14.3



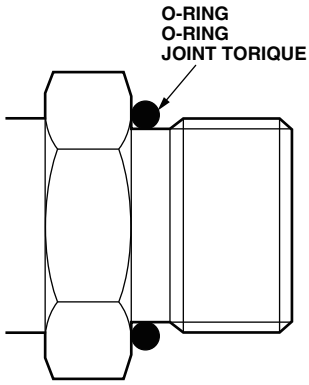
Joint for piping

Nominal thread diameter (R)	Tightening torque			
	Steel		Cast steel	
	N·m	ft.-lb	N·m	ft.-lb
1/8	11.8 ± 1.2	8.7 ± 0.8	10.8 ± 1.1	8.0 ± 0.7
1/4	29.4 ± 2.9	21.7 ± 2.1	24.5 ± 2.5	18.1 ± 1.7
3/8	53.9 ± 5.4	39.8 ± 3.9	49.0 ± 4.9	36.2 ± 3.5
1/2	88.3 ± 8.8	65.1 ± 6.4	73.5 ± 7.4	54.3 ± 5.3
3/4	147.1 ± 14.7	108.5 ± 10.7	127.5 ± 12.7	94.1 ± 9.3
1	196.1 ± 19.2	144.7 ± 14.3	171.6 ± 17.2	126.6 ± 12.5


2EAA03Z

Joint for piping (O-ring seal type)

Nominal thread diameter (G)	Tightening torque	
	N·m	ft.-lb
1/8	19.6 ± 2.0	14.5 ± 1.4
1/4	34.3 ± 4.9	25.3 ± 3.5
3/8	53.9 ± 4.9	39.8 ± 3.5
1/2	63.7 ± 4.9	47.0 ± 3.5
3/4	93.2 ± 4.9	68.7 ± 3.5
1	107.9 ± 9.8	79.5 ± 7.2
1–1/4	117.7 ± 9.8	86.8 ± 7.2
1–1/2	137.3 ± 9.8	101.2 ± 7.2



2EAA04Z

Nominal thread diameter (UNF)	Tightening torque	
	N·m	ft.-lb
7/19–20	16.7 ± 2.0	12.3 ± 1.4
1/2–20	22.6 ± 2.0	16.6 ± 1.4
9/16–18	31.4 ± 2.9	23.1 ± 2.1
3/4–16	59.8 ± 4.9	44.1 ± 3.5
1–1/16–12	102.0 ± 5.9	75.2 ± 4.4
1–5/16–12	135.3 ± 7.8	99.8 ± 5.8
1–5/8–20	181.4 ± 9.8	133.8 ± 7.2

Bolts and nuts (JIS strength category 10.9)

Thread	Size × pitch	Tightening torque			
		General tightening points		Special tightening points	
		N·m	ft.-lb	N·m	ft.-lb
Coarse·	M6 × 1.0	9.8 ± 0.5	7.2 ± 0.4	11.8 ± 1.1	8.7± 0.4
	M8 × 1.25	22.6 ± 1.1	16.6 ± 0.8	26.5 ± 2.5	19.5 ± 0.9
	M10 × 1.5	47.1 ± 2.4	34.7 ± 1.7	54.9 ± 4.9	40.5 ± 2.0
	M12 × 1.75	83.4 ± 4.1	61.5 ± 3.0	97.1 ± 7.4	71.6 ± 3.5
	M14 × 2.0	134.4 ± 6.7	99.1 ± 4.9	155.9 ± 12.7	115.0 ± 5.7
	M16 × 2.0	207.9 ± 10.4	153.3 ± 7.7	241.2 ± 17.2	177.9 ± 8.9
	M20 × 2.5	410.9 ± 20.5	303.1 ± 15.1	475.6 ± 23.7	350.8 ± 17.5
Fine	M8 × 1.0	24.5 ± 1.2	18.1 ± 0.9	28.4 ± 1.4	21.0 ± 1.0
	M10 × 1.25	50.0 ± 2.5	36.9 ± 1.8	58.8 ± 2.9	43.4 ± 2.2
	M12 × 1.5	87.3 ± 4.3	64.4 ± 3.2	102.0 ± 5.1	75.2 ± 3.8
	M14 × 1.5	135.3 ± 6.8	99.9 ± 5.0	157.9 ± 7.8	116.5 ± 5.8
	M16 × 1.5	220.6 ± 11.0	162.7 ± 8.1	256.0 ± 12.7	188.8 ± 9.4
	M20 × 1.5	452.1 ± 22.6	333.4 ± 16.6	524.7 ± 26.1	387.0 ± 19.2

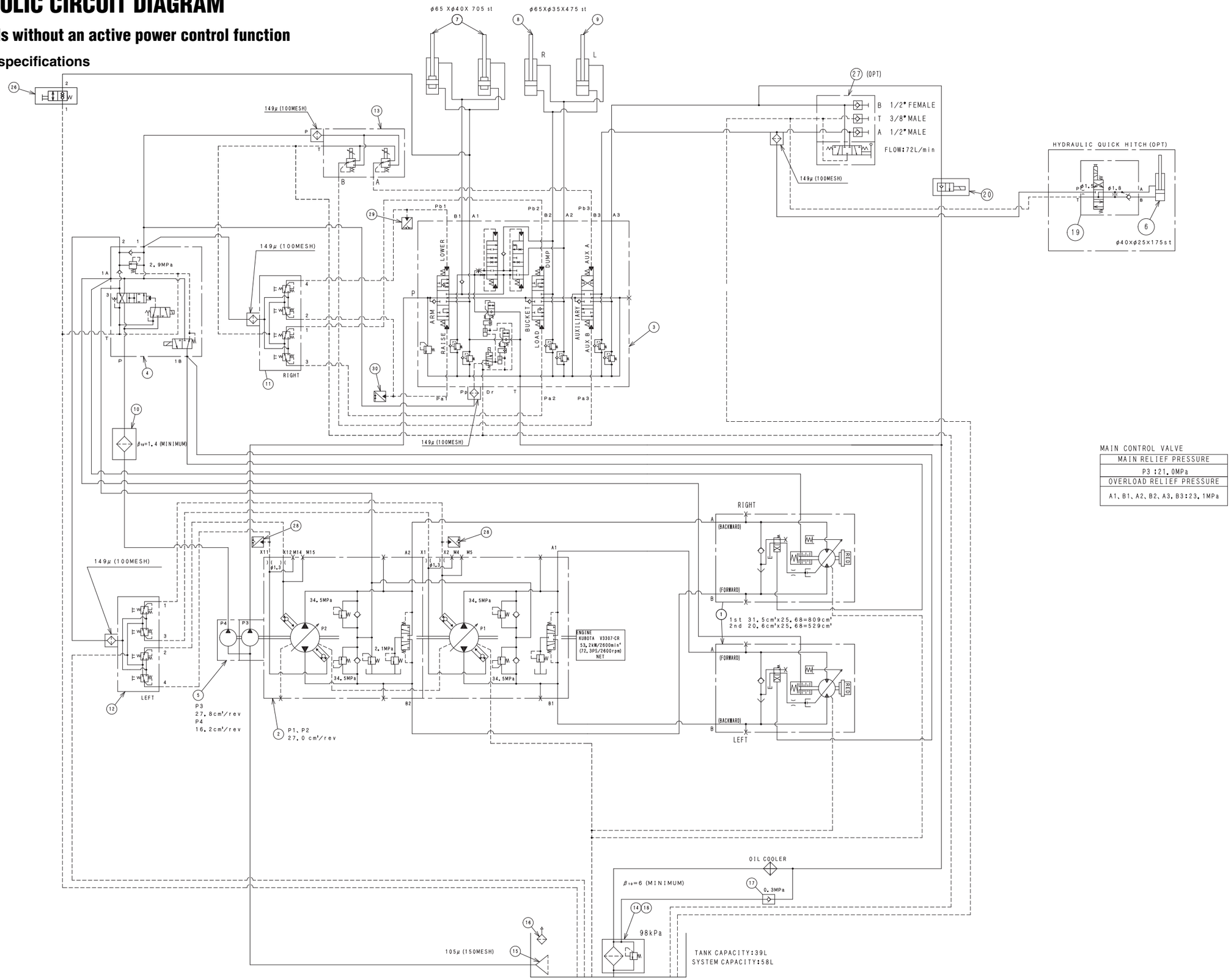
1. General tightening points (non-lubricated)
   All securing points that have no special tightening torque specified in this manual and that are not special tightening points.
2. Special tightening points (grease with molybdenum disulfide applied)
   Points where a specific tightening torque is specified in this manual.
3. Points where thread-locking compound should be applied (ThreeBond #1324).
4. If a tightening torque value is specified in this manual for a point not listed in the table above, follow the specification in the manual.
5. To tighten multiple bolts and nuts evenly, tighten opposite bolts/nuts alternately as a pair.

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HYDRAULIC CIRCUIT DIAGRAM

For models without an active power control function

Standard specifications



TL8 HYDRAULIC CIRCUIT DIAGRAM
In Compliance with EC(NRMM) EPA Tier4

MAIN CONTROL VALVE

MAIN RELIEF PRESSURE
P3 :21.0MPa
OVERLOAD RELIEF PRESSURE
A1、B1、A2、B2、A3、B3:23.1MPa

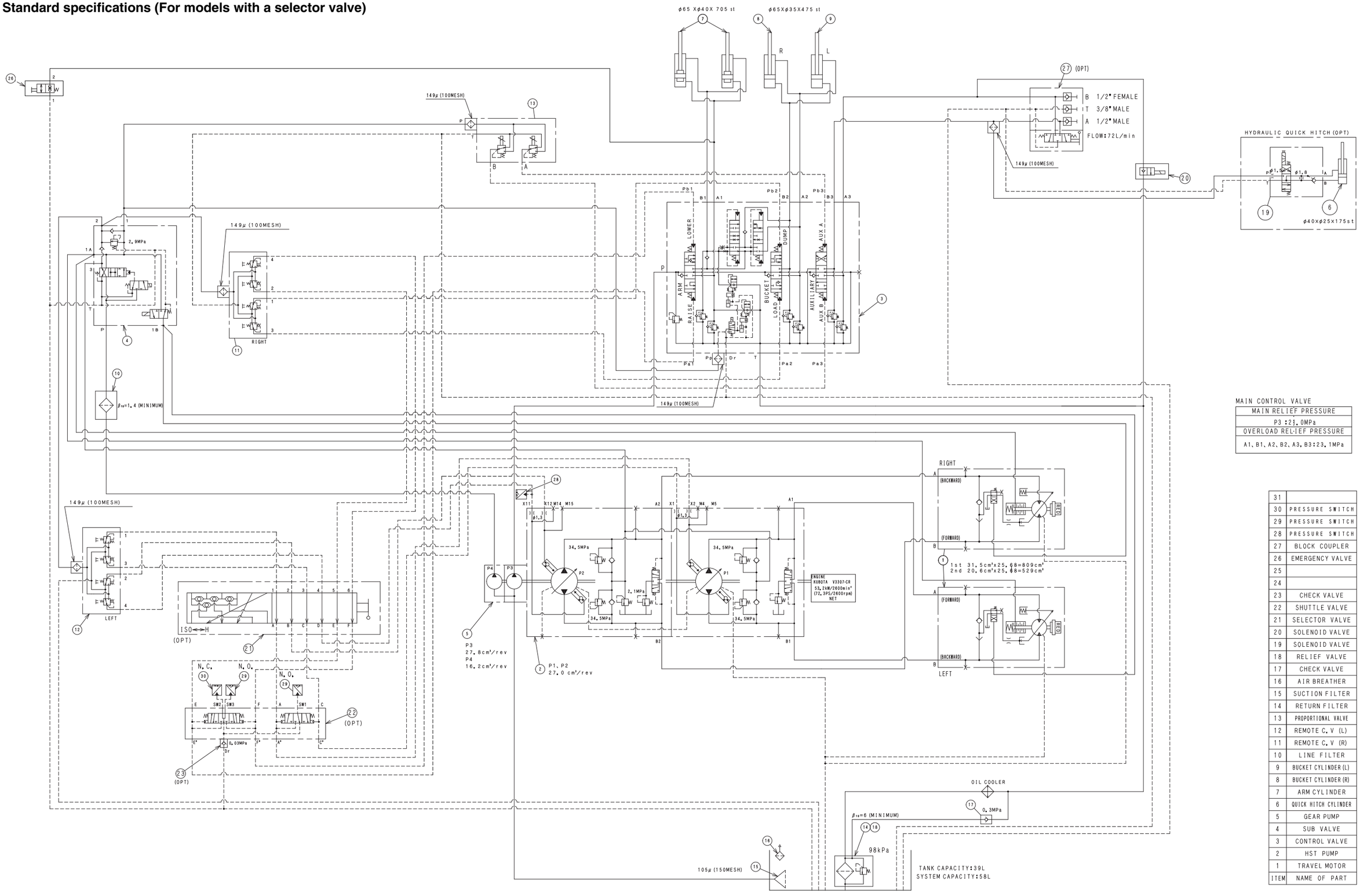
ITEM	NAME OF PART
31	
30	PRESSURE SWITCH
29	PRESSURE SWITCH
28	PRESSURE SWITCH
27	BLOCK COUPLER
26	EMERGENCY VALVE
25	
24	
23	
22	
21	
20	SOLENOID VALVE
19	SOLENOID VALVE
18	RELIEF VALVE
17	CHECK VALVE
16	AIR BREATHER
15	SUCTION FILTER
14	RETURN FILTER
13	PROPORTIONAL VALVE
12	REMOTE C.V (L)
11	REMOTE C.V (R)
10	LINE FILTER
9	BUCKET CYLINDER(L)
8	BUCKET CYLINDER(R)
7	ARM CYLINDER
6	QUICK HITCH CYLINDER
5	GEAR PUMP
4	SUB VALVE
3	CONTROL VALVE
2	HST PUMP
1	TRAVEL MOTOR

Drawing No.	1/1
06601-00006	

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Standard specifications (For models with a selector valve)



MAIN CONTROL VALVE

MAIN RELIEF PRESSURE
P3 : 27.0MPa
OVERLOAD RELIEF PRESSURE
A1, B1, A2, B2, A3, B3 : 23.1MPa

ITEM	NAME OF PART
31	
30	PRESSURE SWITCH
29	PRESSURE SWITCH
28	PRESSURE SWITCH
27	BLOCK COUPLER
26	EMERGENCY VALVE
25	
24	
23	CHECK VALVE
22	SHUTTLE VALVE
21	SELECTOR VALVE
20	SOLENOID VALVE
19	SOLENOID VALVE
18	RELIEF VALVE
17	CHECK VALVE
16	AIR BREATHER
15	SUCTION FILTER
14	RETURN FILTER
13	PROPORTIONAL VALVE
12	REMOTE C.V (L)
11	REMOTE C.V (R)
10	LINE FILTER
9	BUCKET CYLINDER (L)
8	BUCKET CYLINDER (R)
7	ARM CYLINDER
6	QUICK HITCH CYLINDER
5	GEAR PUMP
4	SUB VALVE
3	CONTROL VALVE
2	HST PUMP
1	TRAVEL MOTOR

TL8 HYDRAULIC CIRCUIT DIAGRAM
In Compliance with EC(NRMM) EPA Tier4

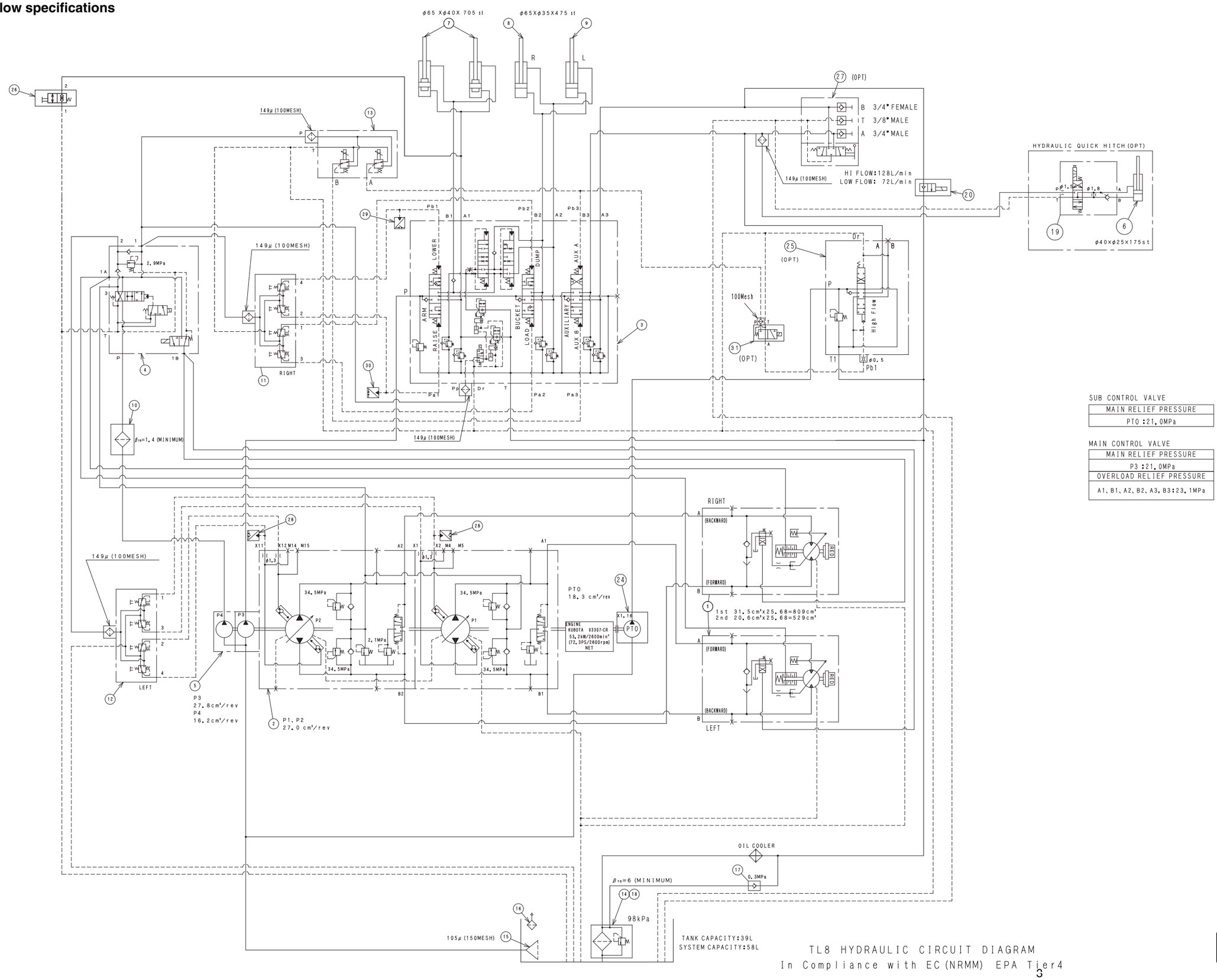
Drawing No.	1/1
06601-00007	

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High-flow specifications



SUB CONTROL VALVE
MAIN RELIEF PRESSURE
PTO :21.0MPa

MAIN CONTROL VALVE
MAIN RELIEF PRESSURE
P3 :21.0MPa
OVERLOAD RELIEF PRESSURE
A1、B1、A2、B2、A3、B3:23.1MPa

ITEM	NAME OF PART
31	SOLENOID VALVE
30	PRESSURE SWITCH
29	PRESSURE SWITCH
28	PRESSURE SWITCH
27	BLOCK COUPLER
26	EMERGENCY VALVE
25	CONTROL VALVE
24	GEAR-PUMP
23	·
22	·
21	·
20	SOLENOID VALVE
19	SOLENOID VALVE
18	RELIEF VALVE
17	CHECK-VALVE
16	AIR BREATHER
15	SUCTION FILTER
14	RETURN-FILTER
13	PROPORTIONAL VALVE
12	REMOTE C.V (L)
11	REMOTE C.V (R)
10	LINE FILTER
9	BUCKET CYLINDER(L)
8	BUCKET CYLINDER(R)
7	ARM CYLINDER
6	QUICK HITCH CYLINDER
5	GEAR-PUMP
4	SUB VALVE
3	CONTROL VALVE
2	HST PUMP
1	TRAVEL MOTOR

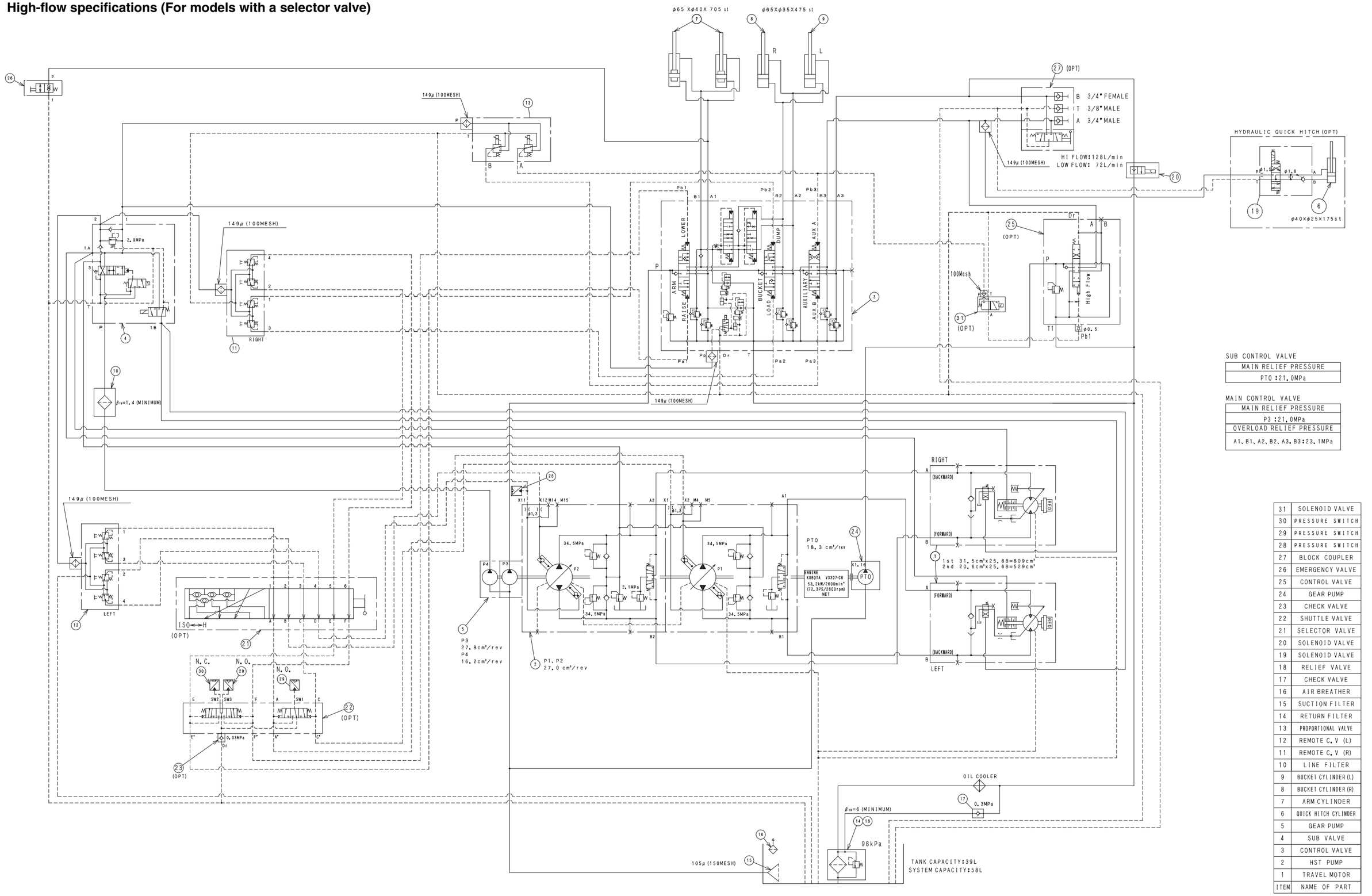
TL8 HYDRAULIC CIRCUIT DIAGRAM
In Compliance with EC(NRMM) EPA Tier4

Drawing No.	1/1
06601-00008	

2F0BE03
2F0BE002

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High-flow specifications (For models with a selector valve)



SUB CONTROL VALVE

MAIN RELIEF PRESSURE
PTO :21.0MPa

MAIN CONTROL VALVE

MAIN RELIEF PRESSURE
P3 :21.0MPa
OVERLOAD RELIEF PRESSURE
A1、B1、A2、B2、A3、B3:23.1MPa

ITEM	NAME OF PART
31	SOLENOID VALVE
30	PRESSURE SWITCH
29	PRESSURE SWITCH
28	PRESSURE SWITCH
27	BLOCK COUPLER
26	EMERGENCY VALVE
25	CONTROL VALVE
24	GEAR PUMP
23	CHECK VALVE
22	SHUTTLE VALVE
21	SELECTOR VALVE
20	SOLENOID VALVE
19	SOLENOID VALVE
18	RELIEF VALVE
17	CHECK VALVE
16	AIR BREATHER
15	SUCTION FILTER
14	RETURN FILTER
13	PROPORTIONAL VALVE
12	REMOTE C.V (L)
11	REMOTE C.V (R)
10	LINE FILTER
9	BUCKET CYLINDER (L)
8	BUCKET CYLINDER (R)
7	ARM CYLINDER
6	QUICK HITCH CYLINDER
5	GEAR PUMP
4	SUB VALVE
3	CONTROL VALVE
2	HST PUMP
1	TRAVEL MOTOR

TL8 HYDRAULIC CIRCUIT DIAGRAM
In Compliance with EC(NRMM) EPA Tier4

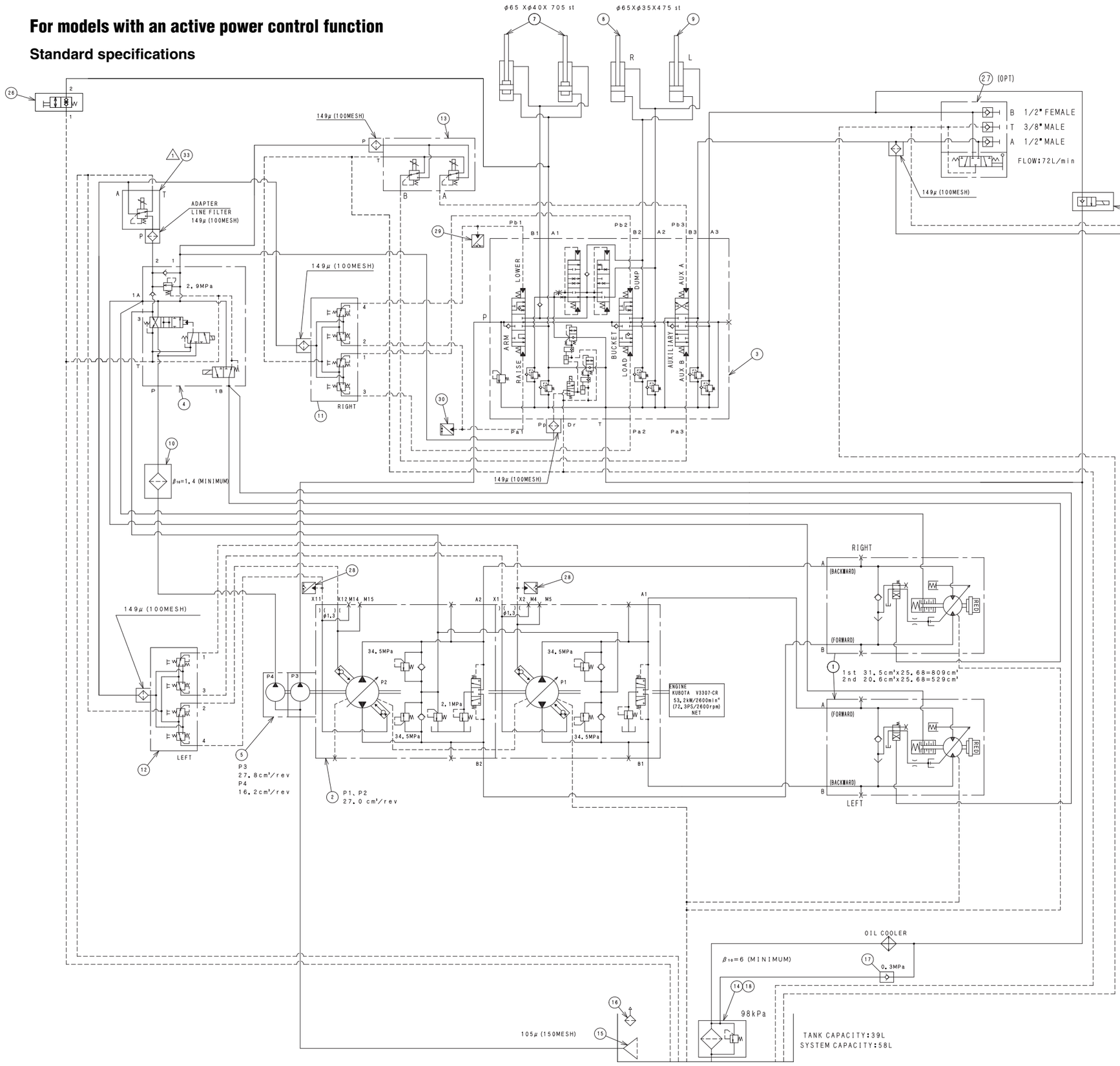
Drawing No.	1/1
06601-00009	

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For models with an active power control function

Standard specifications



MAIN CONTROL VALVE

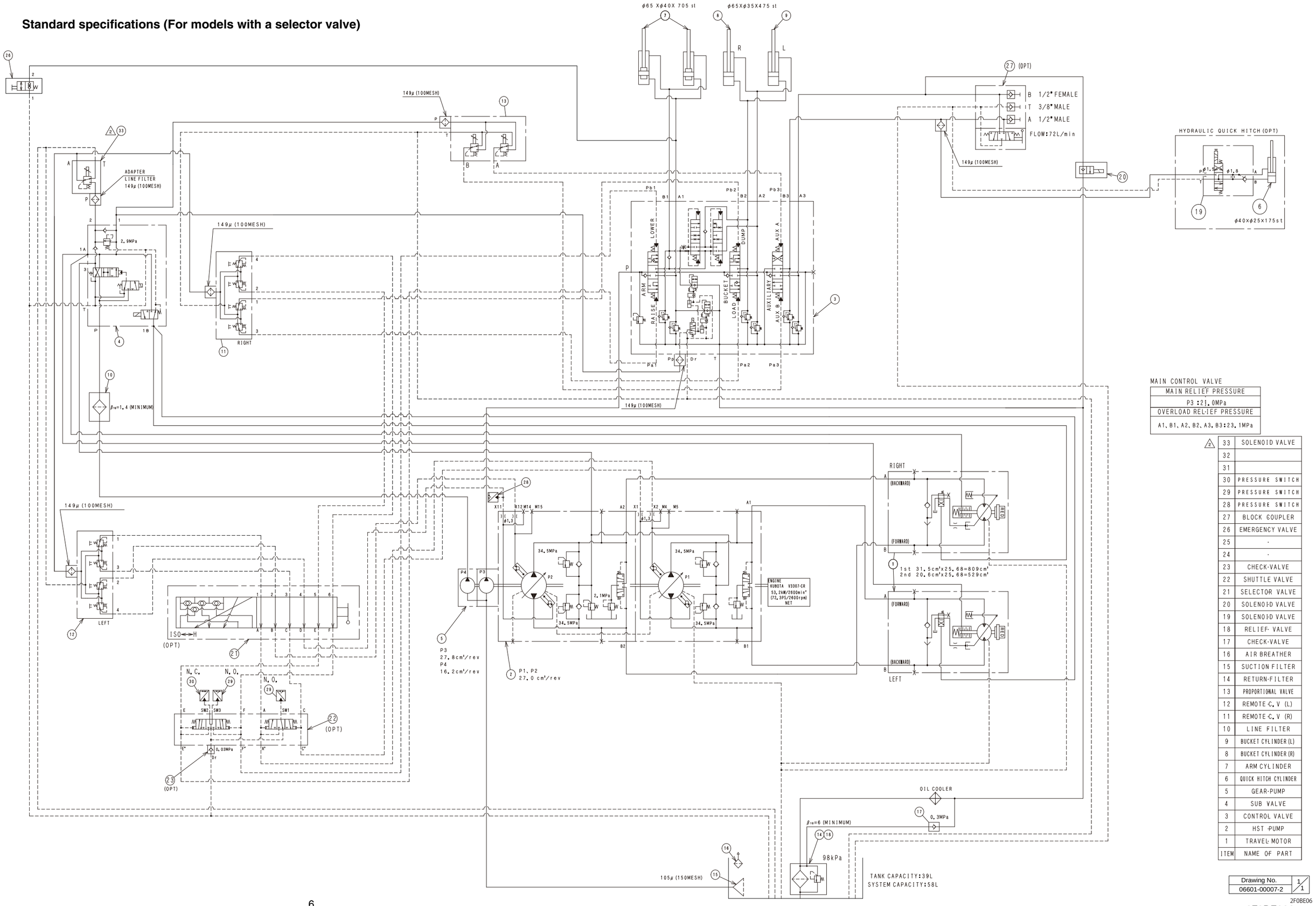
MAIN RELIEF PRESSURE
P3 :21.0MPa
OVERLOAD RELIEF PRESSURE
A1、B1、A2、B2、A3、B3:23.1MPa

ITEM	NAME OF PART
1	TRAVEL MOTOR
2	HST PUMP
3	CONTROL VALVE
4	SUB VALVE
5	GEAR PUMP
6	QUICK HITCH CYLINDER
7	ARM CYLINDER
8	BUCKET CYLINDER (R)
9	BUCKET CYLINDER (L)
10	LINE FILTER
11	REMOTE C.V (R)
12	REMOTE C.V (L)
13	PROPORTIONAL VALVE
14	RETURN FILTER
15	SUCTION FILTER
16	AIR BREATHER
17	CHECK VALVE
18	RELIEF VALVE
19	SOLENOID VALVE
20	SOLENOID VALVE
21	·
22	·
23	·
24	·
25	·
26	EMERGENCY VALVE
27	BLOCK COUPLER
28	PRESSURE SWITCH
29	PRESSURE SWITCH
30	PRESSURE SWITCH
31	
32	
△1 33	SOLENOID VALVE

Drawing No.	1/1
06601-00006-1	

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Standard specifications (For models with a selector valve)



MAIN CONTROL VALVE

MAIN RELIEF PRESSURE
P3 :21.0MPa
OVERLOAD RELIEF PRESSURE
A1, B1, A2, B2, A3, B3:23.1MPa

△2	33	SOLENOID VALVE
	32	
	31	
	30	PRESSURE SWITCH
	29	PRESSURE SWITCH
	28	PRESSURE SWITCH
	27	BLOCK COUPLER
	26	EMERGENCY VALVE
	25	·
	24	·
	23	CHECK VALVE
	22	SHUTTLE VALVE
	21	SELECTOR VALVE
	20	SOLENOID VALVE
	19	SOLENOID VALVE
	18	RELIEF VALVE
	17	CHECK VALVE
	16	AIR BREATHER
	15	SUCTION FILTER
	14	RETURN FILTER
	13	PROPORTIONAL VALVE
	12	REMOTE C.V (L)
	11	REMOTE C.V (R)
	10	LINE FILTER
	9	BUCKET CYLINDER (L)
	8	BUCKET CYLINDER (R)
	7	ARM CYLINDER
	6	QUICK HITCH CYLINDER
	5	GEAR PUMP
	4	SUB VALVE
	3	CONTROL VALVE
	2	HST PUMP
	1	TRAVEL MOTOR
ITEM		NAME OF PART

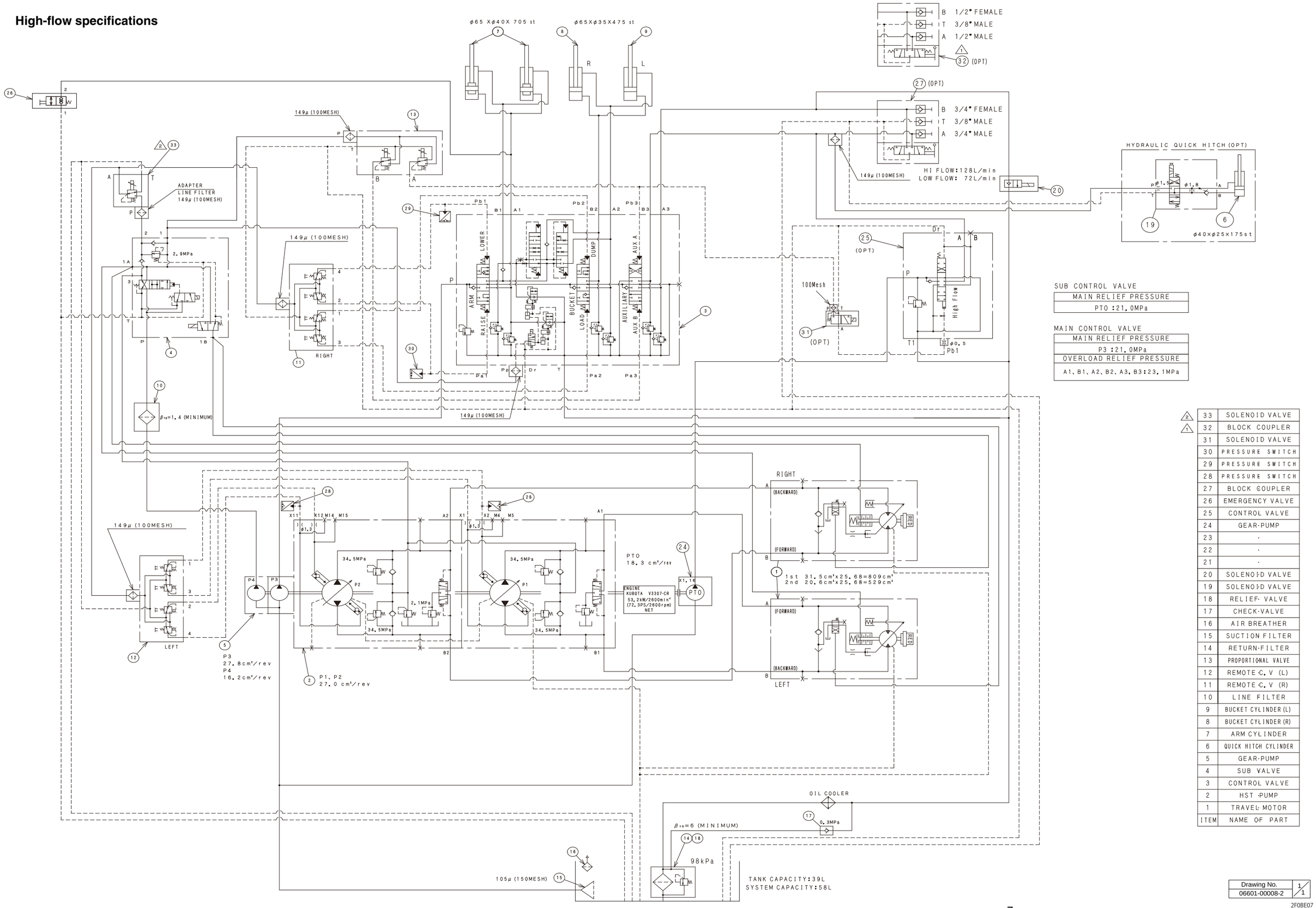
Drawing No.	1/1
06601-00007-2	

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High-flow specifications



SUB CONTROL VALVE

MAIN RELIEF PRESSURE
PTO :21.0MPa

MAIN CONTROL VALVE

MAIN RELIEF PRESSURE
P3 :21.0MPa
OVERLOAD RELIEF PRESSURE
A1、B1、A2、B2、A3、B3:23.1MPa

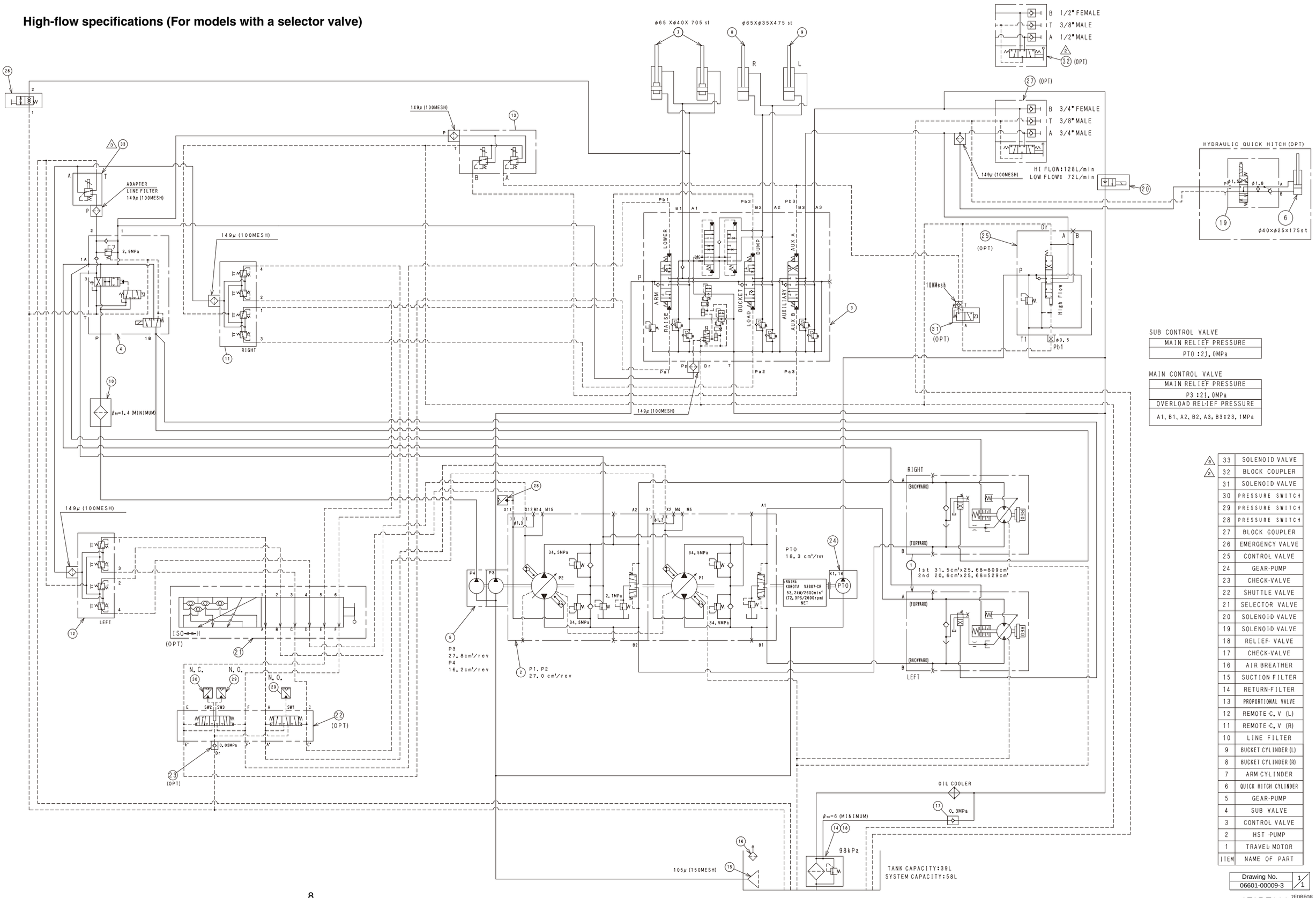
ITEM	NAME OF PART
33	SOLENOID VALVE
32	BLOCK COUPLER
31	SOLENOID VALVE
30	PRESSURE SWITCH
29	PRESSURE SWITCH
28	PRESSURE SWITCH
27	BLOCK COUPLER
26	EMERGENCY VALVE
25	CONTROL VALVE
24	GEAR·PUMP
23	·
22	·
21	·
20	SOLENOID VALVE
19	SOLENOID VALVE
18	RELIEF· VALVE
17	CHECK·VALVE
16	AIR BREATHER
15	SUCTION FILTER
14	RETURN·FILTER
13	PROPORTIONAL VALVE
12	REMOTE·C.V (L)
11	REMOTE·C.V (R)
10	LINE FILTER
9	BUCKET CYLINDER (L)
8	BUCKET CYLINDER (R)
7	ARM CYLINDER
6	QUICK HITCH CYLINDER
5	GEAR·PUMP
4	SUB VALVE
3	CONTROL VALVE
2	HST ·PUMP
1	TRAVEL· MOTOR

Drawing No.	1/1
06601-00008-2	

2F0BE07
2F0BE002

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High-flow specifications (For models with a selector valve)



SUB CONTROL VALVE

MAIN RELIEF PRESSURE
PTO :21.0MPa

MAIN CONTROL VALVE

MAIN RELIEF PRESSURE
P3 :21.0MPa
OVERLOAD RELIEF PRESSURE
A1、B1、A2、B2、A3、B3:23.1MPa

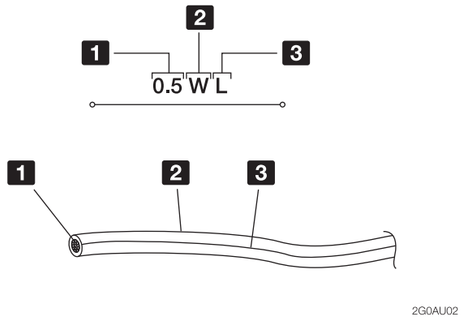
ITEM	NAME OF PART
33	SOLENOID VALVE
32	BLOCK COUPLER
31	SOLENOID VALVE
30	PRESSURE SWITCH
29	PRESSURE SWITCH
28	PRESSURE SWITCH
27	BLOCK COUPLER
26	EMERGENCY VALVE
25	CONTROL VALVE
24	GEAR-PUMP
23	CHECK-VALVE
22	SHUTTLE VALVE
21	SELECTOR VALVE
20	SOLENOID VALVE
19	SOLENOID VALVE
18	RELIEF VALVE
17	CHECK-VALVE
16	AIR BREATHER
15	SUCTION FILTER
14	RETURN-FILTER
13	PROPORTIONAL VALVE
12	REMOTE C.V (L)
11	REMOTE C.V (R)
10	LINE FILTER
9	BUCKET CYLINDER (L)
8	BUCKET CYLINDER (R)
7	ARM CYLINDER
6	QUICK HITCH CYLINDER
5	GEAR-PUMP
4	SUB VALVE
3	CONTROL VALVE
2	HST-PUMP
1	TRAVEL MOTOR

Drawing No.	1/1
06601-00009-3	

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ELECTRICAL CIRCUIT DIAGRAM

Wire/cable color symbols



2G0AU02

1 Cross-sectional area (mm^2)
2 Base color
3 Stripe color*
* There may be wires of solid color with no stripe.

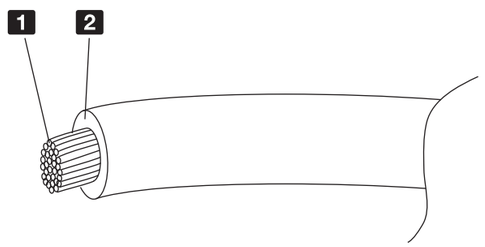
Wiring/cable Colors

Symbol	Color	Symbol	Color	Symbol	Color
B	Black	W	White	V	Violet
G	Green	Y	Yellow	Dg	Dark green
L	Blue	P	Pink	Ch	Chocolate
R	Red	O	Orange		

Types of wire to use

- Use AVSS wire for cross-sectional areas of 2 mm^2 or less.
- Use AV or AVS wire for cross-sectional areas exceeding 2 mm^2. (AVX wire can be used for wires of solid color.)

Symbol	Overview	Characteristics	Temperature limit
AV	Low-voltage cables for automobiles	• Wire used in low-voltage circuits.	80°C (176°F)
AVX	Heat-resistant, cross-linked, vinyl-insulated low-voltage cables	• A wire with dramatically improved heat resistance over that of AV wire, enabling it to provide high reliability while responding to rises in temperature in automotive wiring environments.	100°C (212°F)
AVS	Thin-insulation low-voltage cables for automobiles	• A thinner wire than the AV wire with equivalent electrical characteristics.	80°C (176°F)
AVSS	Thin-insulation low-voltage cables for automobiles	• A wire with an even thinner insulator than AVS wire that has equivalent electrical characteristics.	80°C (176°F)

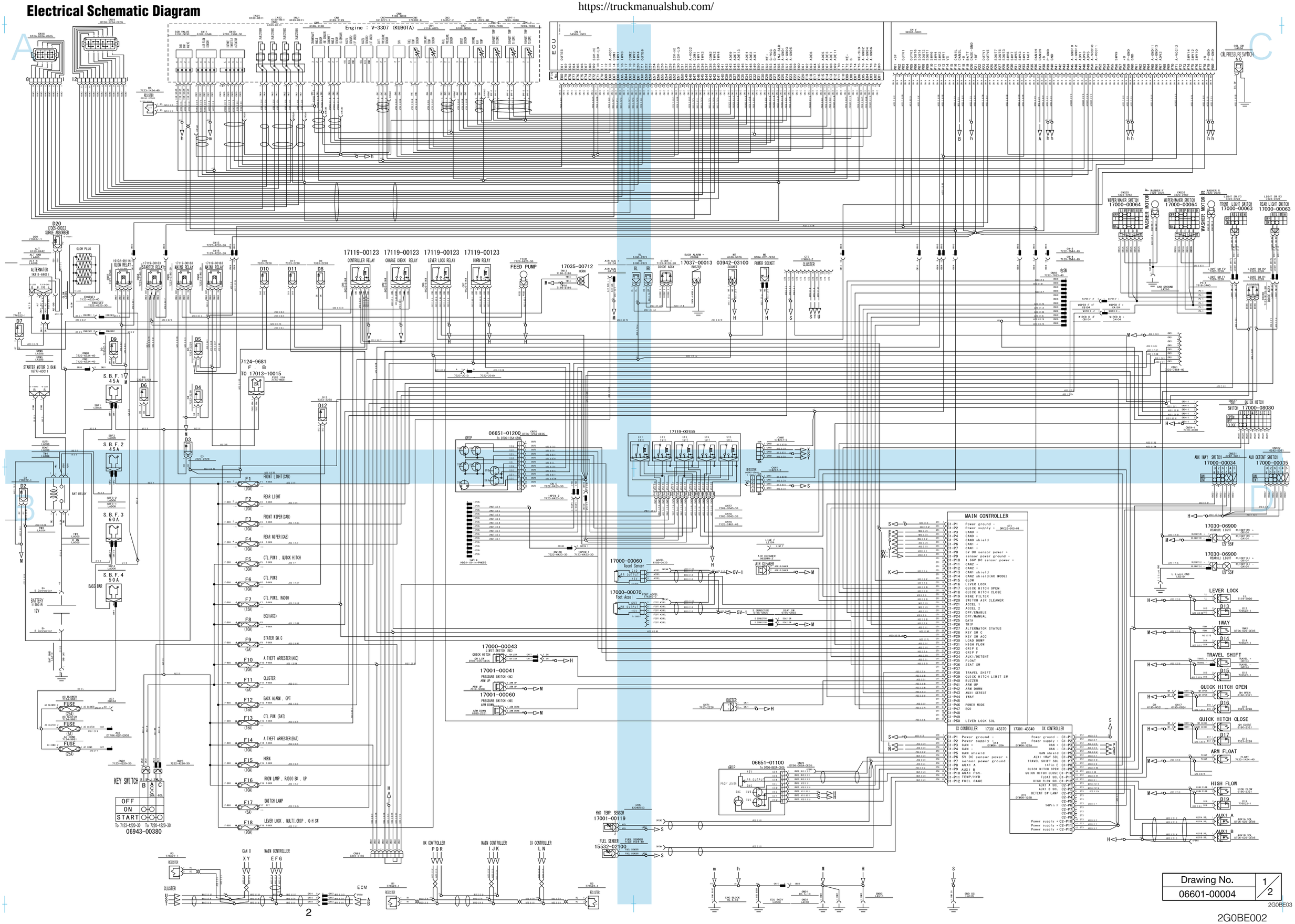


2G0AU03

1 Conductor: Annealed copper
2 Insulator: Vinyl

Electrical Schematic Diagram

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Engine : V-3307 (KUBOTA)

CN19 DT06-12SA-CE05
CN18 DT06-08SA-CE05
INJ4 6189-0611
INJ2 6189-0611
INJ3 6189-0611
INJ1 6189-0611
CN8 6189-1130
CN6 6189-0039
CN7 1813271-1
CN5 178392-6
CN3 174357-2
CN1 7283-7027-40
DPF-1 7283-7028
DPF-0 7283-7028
DPF-2 7283-7028
CN4 7116-4025
CN2 6189-0099

EGR VALVE 6195-0030
CN11 6189-1046
CN10 7283-1968-30
CAM EGR VALVE
AIR FLOW SENSOR
INTAKE THROTTLE ACTUATOR
INJECTOR4
INJECTOR3
INJECTOR2
INJECTOR1
CRANKSHAFT ANGLE SENSOR (NE SENSOR)
CAMSHAFT ANGLE SENSOR (G SENSOR)
ACCEL SENSOR2 (IF USED)
ACCEL SENSOR2 (IF USED)
DIFF. PRESSURE SENSOR
SCV
FUEL TEMP SENSOR
COOLANT TEMP SENSOR
RAIL PRESSURE SENSOR
BOOST SENSOR
INTAKE AIR TEMP
EXHAUST TEMP T0(DPF)
EXHAUST TEMP T1(DPF)
EXHAUST TEMP T2(DPF)

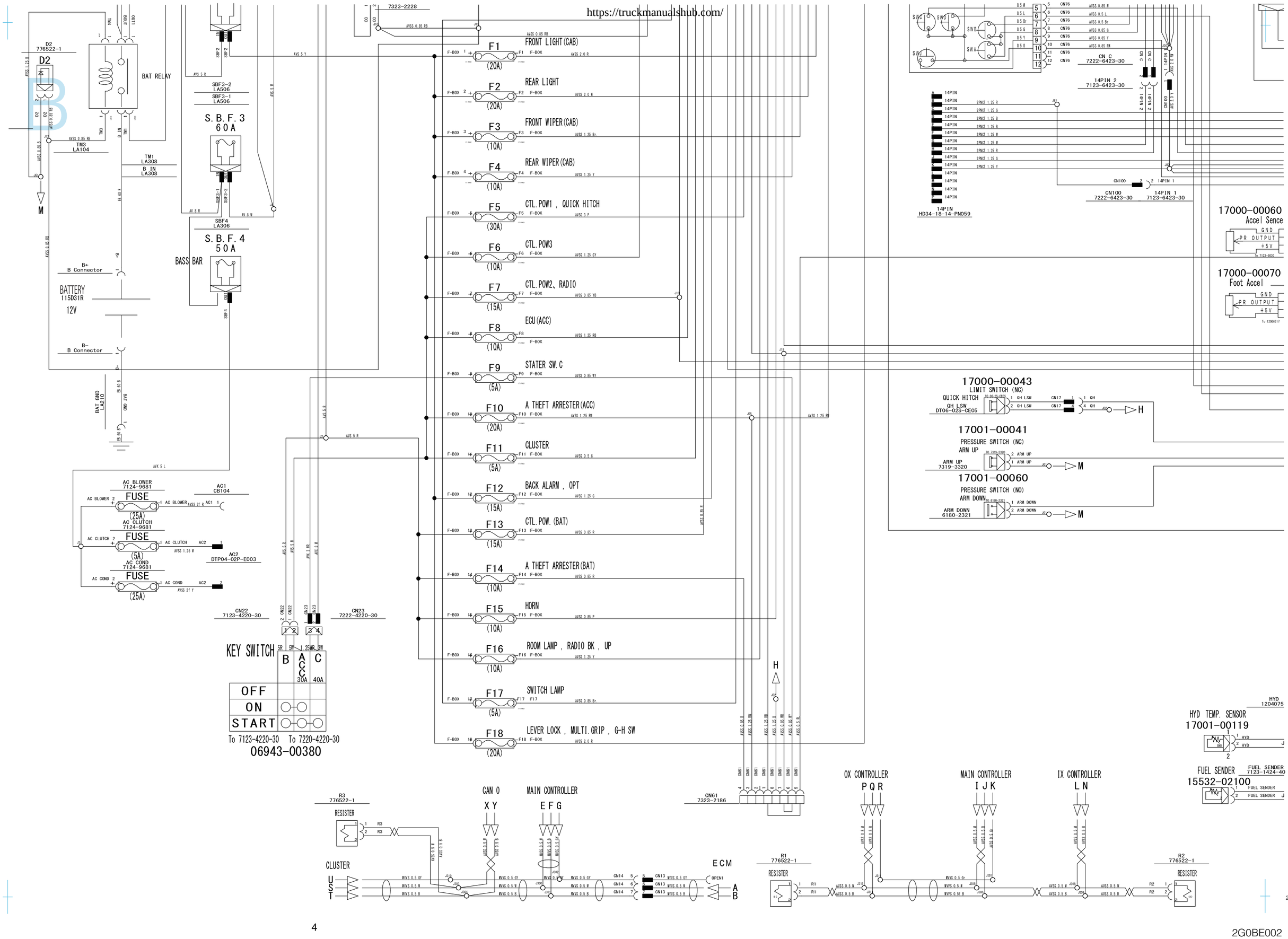
ECU
CN E 34566-1903
TO 34566-1903

Pin No.		
E01	OUTE5	
E02		
E03		
E04		
E05		
E06		
E07		
E08		
E09	SCV-HI	
E10	SCV-LO	
E11		
E12	A-VCC1	
E13	A-VCC1	
E14	COM1	
E15	TWV1	
E16	TWV3	
E17		
E18	COM2	
E19	TWV2	
E20	TWV4	
E21	OUTE6	

R5 7123-1424-40 RESISTER 06942-05589
D20 776427-1 SURGE ABSORBER 17305-00033
ALT 6189-0442
ALT GND LA105
ALT B LA306
ALTERNATOR 1K411-64011
GLOW PLUG
GLOW LA305
ENGINE1 7123-4220-40
ENGINE2 7222-4220-30
CN87 7123-9246 GLOW RELAY 19102-99116
CN84 7223-6146-30 STARTER RELAY 17119-00163
CN85 7223-6146-30 MAIN2 RELAY 17119-00163
CN86 7223-6146-30 MAIN1 RELAY 17119-00163
CN15 7222-4220-30
CN16 7123-4220-30
D10 7323-2228
D11 7323-2228
D8 7323-2228
CR6 6020-6161 CONTROLLER RELAY 17119-00123
CR9 6020-6161 CHARGE CHECK RELAY 17119-00123
CR8 6020-6161 LEVER LOCK RELAY 17119-00123
CR7 6020-6161 HORN RELAY 17119-00123
FEED 7123-6423-30 FEED PUMP
17035-00712 HORN TM13 7116-5110 TM14 7116-5110
RL 6180-2
AIR SUS + CB104
AIR SUS - CA104
D7 776522-1
STMB LA508
STMS LA305
CN20 7222-6234-40
CN21 7123-6234-40
STARTER MOTOR 3.0kW 1G777-63011
D9 776522-1
D5 7323-2228
D6 7323-2228
D4 7323-2228
D3 7323-2228
D12 7323-2228
S.B.F.1 45A
S.B.F.2 45A
SBF1 LA406
SBF2 LA306
OUT1 LA508
BOUT LA508
TM4 LA104
7124-9681 F. B TO 17013-10015 FUSE 15A 7124-9681
A 7323-2010
B 7322-2010
CN76 06651-01200 DT06-12SA-CE05 To DT06-12SA-CE05
GRIP SW1 SW2 SW3 SW4 SW5 SW6
CR1 SW-

2G0BE04
2G0BE002
3

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CN V
34566-0803

E17 COM2
E18 TWV2
E19 TWV4
E20 OUTE6
E21
E22
E23
E24
E25
E26
E27
E28 SCV-HI
E29 SCV-LO
E30
E31
E32 A-VCC2
E33
E34 COM1
E35 TWV1
E36 TWV3
E37
E38 COM2
E39 TWV2
E40 TWV4
E41
E42 ADE9
E43 ADE7
E44 ADE13
E45
E46 ADE4
E47 ADE2
E48 ADE1
E49
E50
E51 NE+
E52 G-VCC
E53 G-GND
E54 INJ-SLD
E55 A-GND1
E56 A-GND3
E57 A-GND5
E58
E59
E60 ADE8
E61
E62
E63
E64
E65
E66 ADE5
E67 ADE3
E68 ADE1
E69 ADE11
E70
E71
E72 NE-
E73 G
E74
E75 NE-SLD
E76 A-GND2
E77 A-GND4
E78 A-GND6
E79
E80

V01 +BF
V02
V03 OUTV1
V04
V05 OUTV3
V06 SOUT6
V07 SOUT4
V08 SOUT2
V09 SOUT1
V10 SWV6
V11 SWV4
V12 SWV2
V13 SWV1
V14 VS
V15
V16 CAN1L
V17 CAN2L
V18 +B
V19 BATT
V20 CASE-GND
V21 +BF
V22
V23 OUTV1
V24 OUTV5
V25
V26 SOUT7
V27 SOUT5
V28 SOUT3
V29 SWV8
V30 SWV7
V31 SWV5
V32 SWV3
V33 SWV1
V34 TAC1
V35
V36 CAN1H
V37 CAN2H
V38 +B
V39 P-GND
V40 GND
V41
V42
V43
V44
V45 A-GND10
V46 A-GND12
V47 ADV1
V48 ADV3
V49 ADV5
V50 A-VCC10
V51 A-VCC11
V52
V53
V54
V55 SWV9
V56
V57
V58 +B
V59 P-GND
V60 GND
V61
V62
V63
V64
V65 A-GND11
V66 A-GND13
V67 ADV2
V68
V69
V70
V71 A-VCC12
V72
V73
V74 SWV14
V75 SWV12
V76 SWV10
V77
V78 +B
V79 P-GND
V80 P-GND

OIL SW
LA104
OIL PRESSURE SWITCH
NO
OIL SW
AVSS 0.85 GB

CNS25
7323-2262
WIPER/WAHER SWITCH
17000-00064
L W P B1 B H
OFF
1
WA
1 2 3 4 5 6

WASHER MOTOR F
WASHER F
7123-2228
AVSS 0.85 B
CAB GROUND
LA210

CNS26
7323-2262
WIPER/WAHER SWITCH
17000-00064
L W P B1 B H
OFF
1
WA
1 2 3 4 5 6

WASHER MOTOR R
WASHER R
7123-2228

LIGHT SW F3
7323-2228
FRONT LIGHT SWITCH
17000-00063
B L M H
OFF
ON
1 2

LIGHT SW R3
7323-2228
REAR LIGHT SWITCH
17000-00063
B L M H
OFF
ON
1 2

LIGHT SW F2
7322-2228
LIGHT SW F1
7323-2228
LIGHT SW R2
7322-2228
LIGHT SW R1
7323-2228
P5-1
7318-3460
P5-1
P5-1
P5-1
P5-1
P5-1
P5-1

TD 7122-9135-50
DIODE ASSY
7123-9135-50
DIODE 1
DIODE 1
DIODE 1

RL
6180-2321
RR
6180-2321
DIODE 1
7123-9135-50
DIODE ASSY
BACK ALARM +
CB104
17037-00013
BUZZER
MT
6100-5026
03942-03100
SOCKET
MS
DT04-02P-CE03
POWER SOCKET
CT5
174045-2
CLUSTER
CT5 1 2 3 4 5 6 7 8 9 10 11 12
S
STU
H
H

CN13
7222-7544-40
CN14
7123-7544-40
右SW
CN50
7222-7923-40
CN50 1 2 3 4 5 6 7 8 9 10 11 12
AVSS 0.5 G
AVSS 0.5 Br.
AVSS 0.5 P
AVSS 0.5 PB
AVSS 0.5 LR
AVSS 0.5 RB
AVSS 0.5 RL
AVSS 0.85 YB
AVSS 0.85 YR

WIPER F +F
WIPER F +
CB104
CA104
WIPER R +F
WIPER R +
CB104
CA104

M
H
CN51
7123-7484-40
CN51 8 7 6 5 4 3 2 1
AVSS 1.25 B
AVSS 0.85 Br.
AVSS 1.25 GY
AVSS 1.25 RW
AVSS 1.25 R
AVSS 0.5 Y
CN54-1
7319-3460
CN54-1 1 2 3 4 5 6
AVSS 1.25 Y
AVSS 1.25 RB
AVSS 1.25 GW
AVSS 0.85 YB

CNS27
VCH
QUICK HITCH
SWITCH
17000-08080
1 2 3 4 5 6 7 8
OPEN
OFF
CLOSE
CNS27 1 2 3 4 5 6 7 8
AVSS 0.5 RG
AVSS 0.5 RW

17119-00155
CR1 SW-C
CR2 SW-D
CR3 SW-E
CR4 SW-F
CR5 SW-J

CAN0
174257-2
1 CAN0 AVS 0.85 RB
2 CAN0 AVSS 0.5 W
3 CAN0 AVS 0.85 B
4 CAN0 AVSS 0.5 B
X
Y
CAN1
174257-2
RESISTER
06942-056090
TO 174257-2

CNS21
6242-5061
AUX 1WAY SWITCH
17000-00034
3 2 6 1 4 5
a b c d e -

CNS22
6242-5061
AUX DETENT SWITCH
17000-00035
3 2 6 1 4 5
a b c d e -

AVSS 1.25 Lg
AVSS 1.25 LgR
AVSS 1.25 W
AVSS 1.25 B
AVSS 1.25 Y
AVSS 1.25 Br.
AVSS 2.0 R
AVSS 2.0 W
AVSS 2.0 Br.
AVSS 0.85 YB
AVSS 0.85 RB
AVSS 0.85 B
AVSS 0.5 B
AVSS 0.5 W
AVSS 0.5 RG
AVSS 0.5 RW

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MAIN CONTROLLER

CT1 DRC26-50S-01

C1-P1	Power ground −
C1-P2	Power supply +
C1-P3	CANO +
C1-P4	CANO −
C1-P5	CANO shield
C1-P6	CAN1 +
C1-P7	CAN1 −
C1-P8	5V DC sensor power +
C1-P9	sensor power ground −
C1-P10	1.66V DC sensor power +
C1-P11	CAN2 +
C1-P12	CAN2 −
C1-P13	CAN1 shield
C1-P14	CAN2 shield(AC MODE)
C1-P15	GLOW
C1-P16	LEVER LOCK
C1-P17	QUICK HITCH OPEN
C1-P18	QUICK HITCH CLOSE
C1-P19	RINE FILTER
C1-P20	SWITCH AIR CLEANER
C1-P21	ACCEL 1
C1-P22	ACCEL 2
C1-P23	DPF/ENABLE
C1-P24	DPF/MANUAL
C1-P25	DATA
C1-P26	TRIP
C1-P27	ALTERNATOR STATUS
C1-P28	KEY SW C
C1-P29	KEY SW ACC
C1-P30	LOAD DUMP
C1-P31	HIGH FLOW
C1-P32	GRIP E
C1-P33	GRIP F
C1-P34	AUX1/DETENT
C1-P35	FLOAT
C1-P36	SEAT SW
C1-P37	
C1-P38	TRAVEL SHIFT
C1-P39	QUICK HITCH LIMIT SW
C1-P40	BUZZER
C1-P41	ARM UP
C1-P42	ARM DOWN
C1-P43	AUX1 SERECT
C1-P44	1WAY
C1-P45	
C1-P46	POWER MODE
C1-P47	ECO
C1-P48	
C1-P49	
C1-P50	LEVER LOCK SOL

IX CONTROLLER 17301-43370

CT4 DTM06-12SA

C1-P1	Power ground −
C1-P2	Power supply +
C1-P3	CAN +
C1-P4	CAN −
C1-P5	CAN shield
C1-P6	5V DC sensor power +
C1-P7	sensor power ground −
C1-P8	AUX1 A
C1-P9	AUX1 B
C1-P10	AUX1 Pot.
C1-P11	TEMP/HYD
C1-P12	FUEL GAGE

17301-43340 OX CONTROLLER

CT2 DTM06-12SA

Power ground −	C1-P1
Power supply +	C1-P2
CAN +	C1-P3
CAN −	C1-P4
CAN shield	C1-P5
AUX1 1WAY SOL	C1-P6
TRAVEL SHIFT SOL	C1-P7
14Pin E	C1-P8
QUICK HITCH OPEN	C1-P9
QUICK HITCH CLOSE	C1-P10
FLOAT SOL	C1-P11
HIGH FLOW SOL	C1-P12

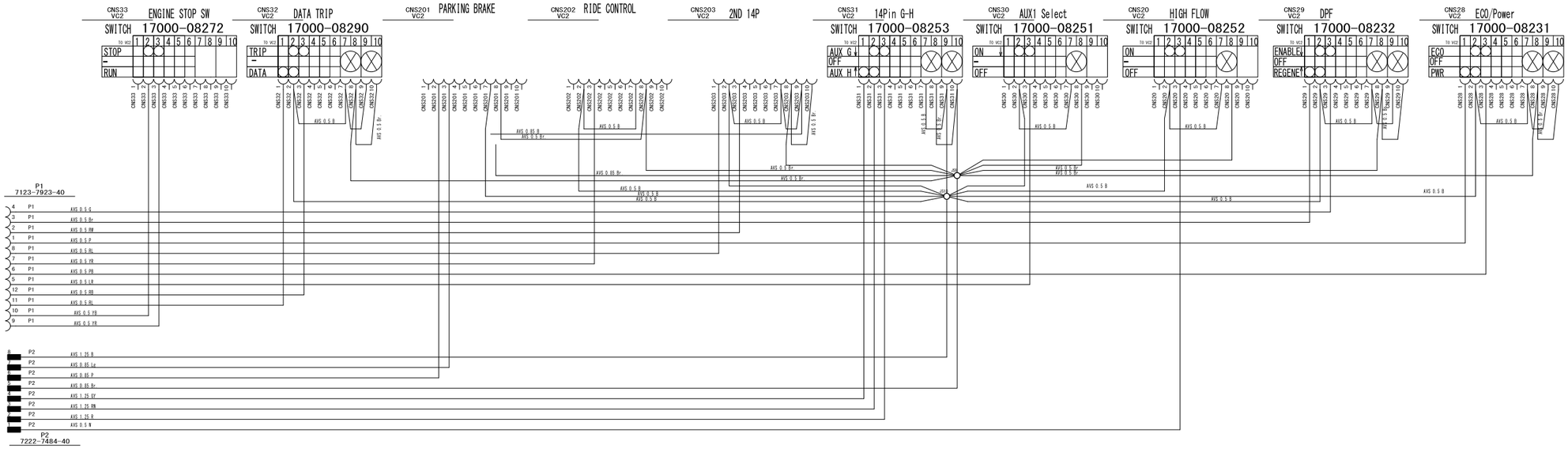
CT3 DTM06-12SB

AUX1 A SOL	C2-P1
AUX1 B SOL	C2-P2
DETENT SW LAMP	C2-P3
	C2-P4
	C2-P5
14Pin F	C2-P6
	C2-P7
	C2-P8
	C2-P9
Power supply +	C2-P10
Power supply +	C2-P11
Power supply +	C2-P12

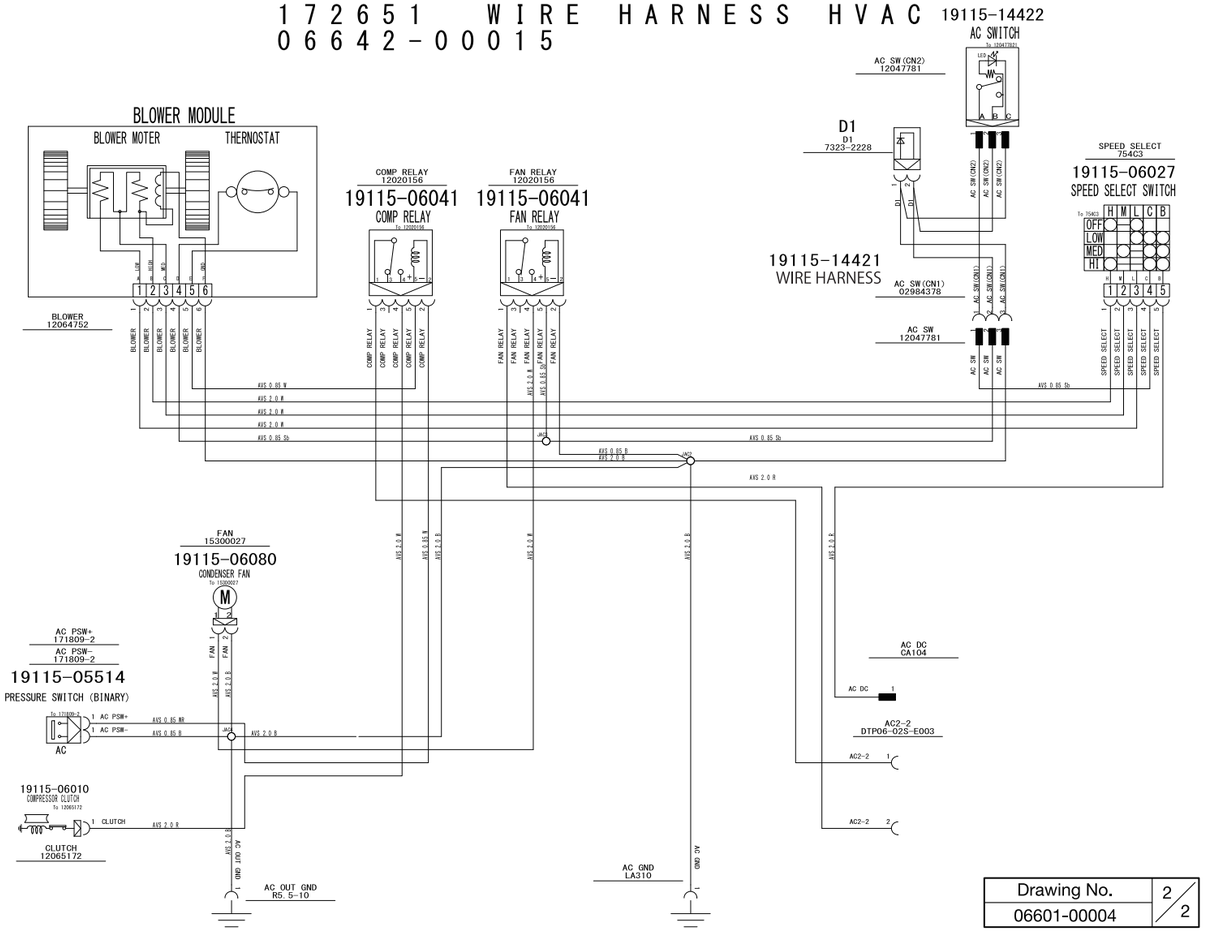
Drawing No.	1/2
06601-00004	

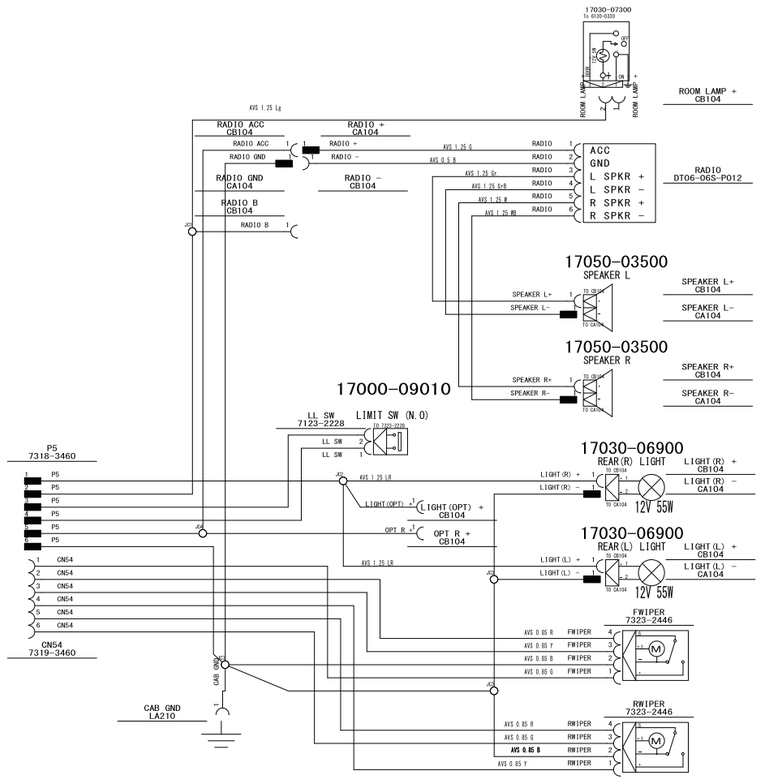
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06642-00049 WIRING HARNESS RH CONSOLE



17265 1 WIRE HARNESS HVAC 19115-14422
06642-00015



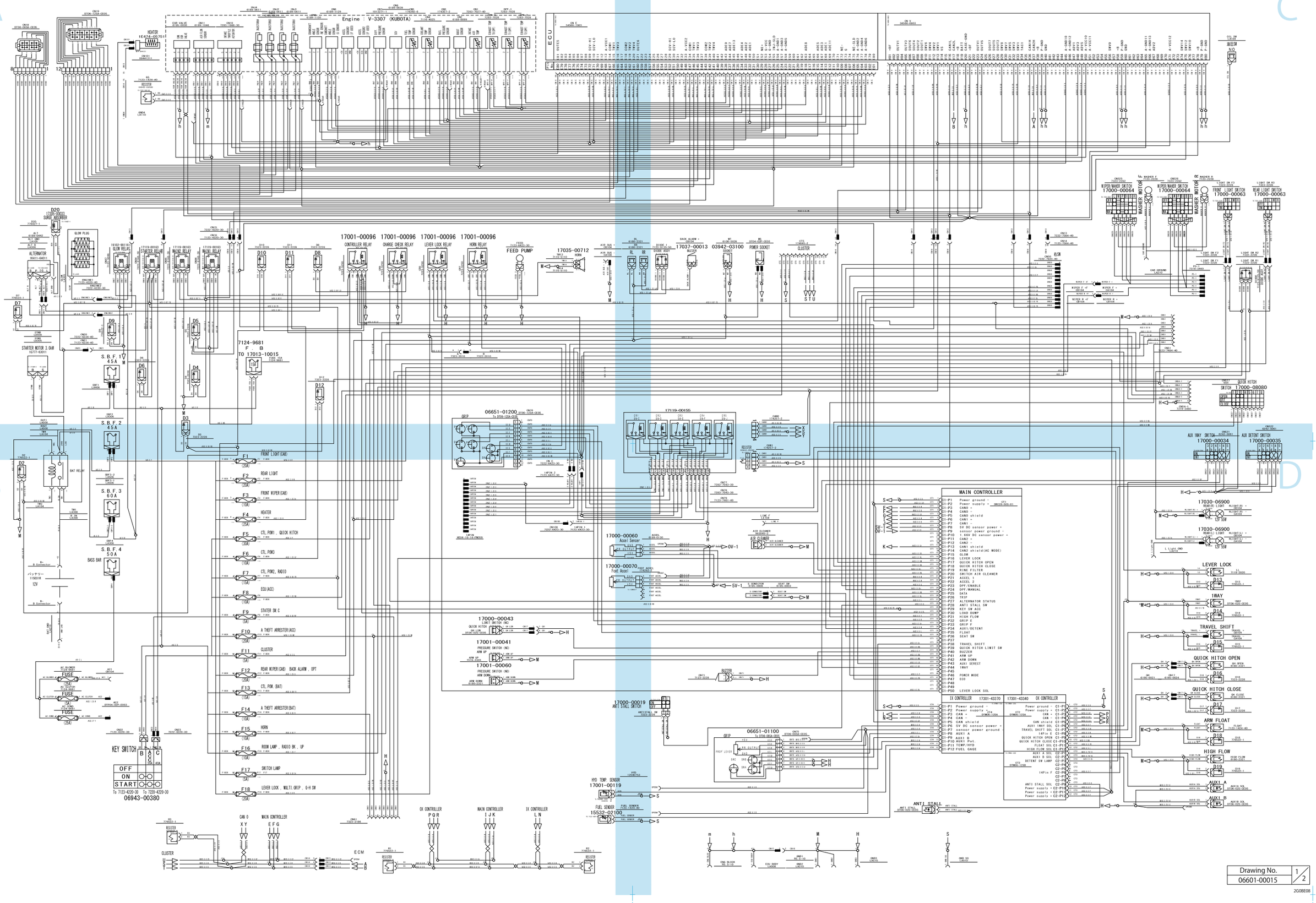


Drawing No.	2/2
06601-00004	

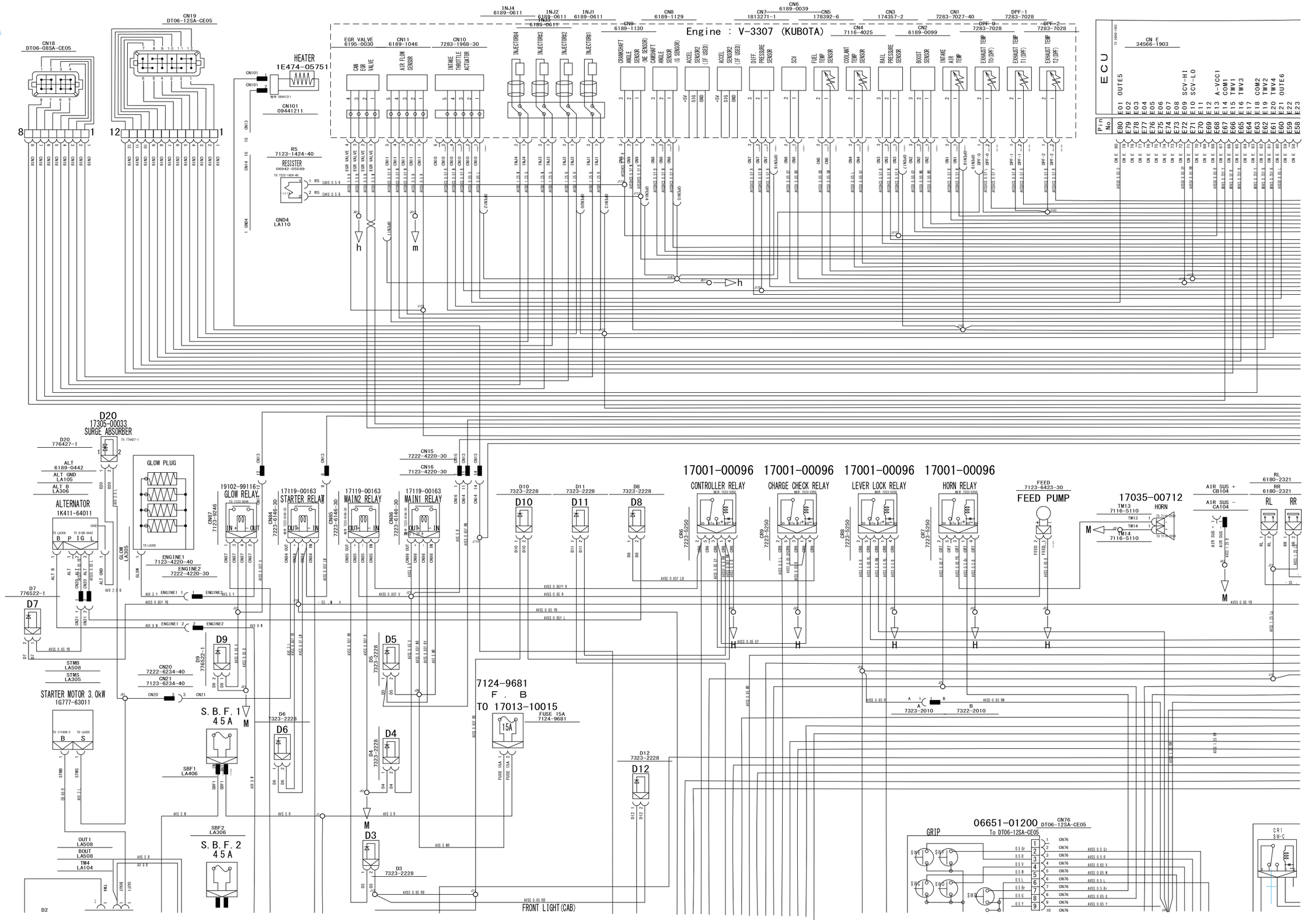
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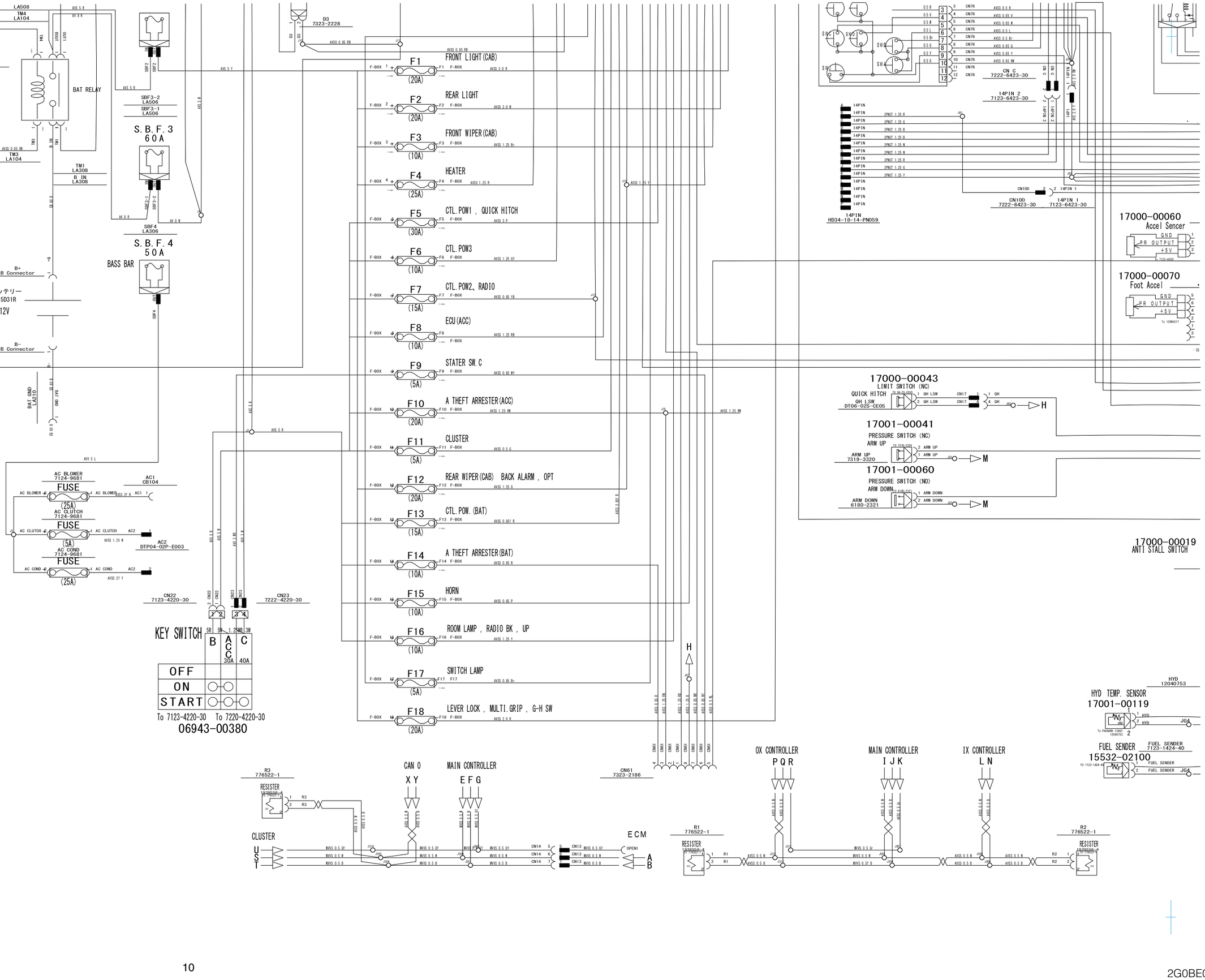
Electrical Schematic Diagram (CCV heater specification)



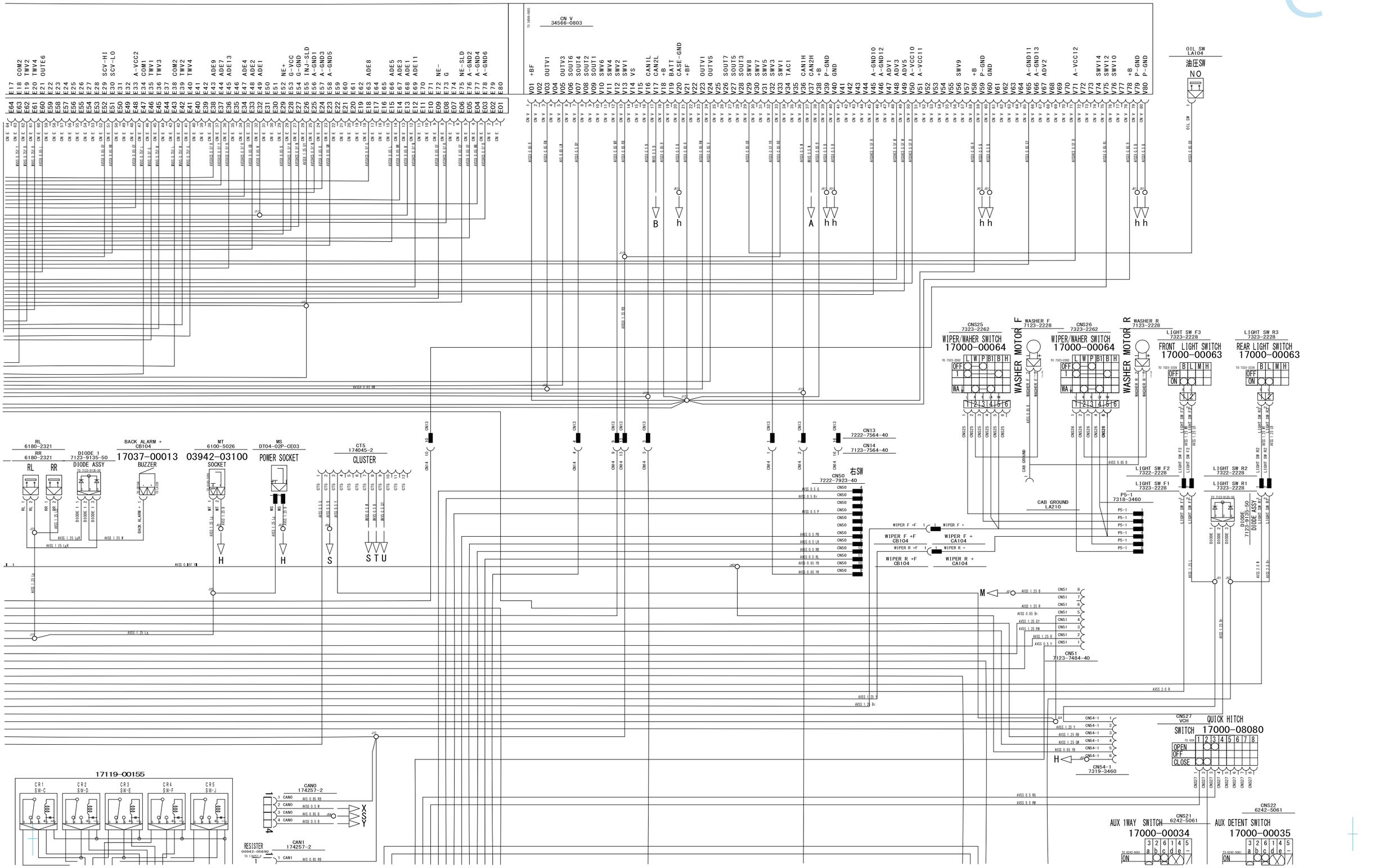
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https://truckmanualshub.com/



https://truckmanualshub.com/

MAIN CONTROLLER

CT1 DRC26-50S-01

C1-P1	Power ground −	
C1-P2	Power supply +	
C1-P3	CANO +	
C1-P4	CANO −	
C1-P5	CANO shield	
C1-P6	CAN1 +	
C1-P7	CAN1 −	
C1-P8	5V DC sensor power +	
C1-P9	sensor power ground −	
C1-P10	1.66V DC sensor power +	
C1-P11	CAN2 +	
C1-P12	CAN2 −	
C1-P13	CAN1 shield	
C1-P14	CAN2 shield(AC MODE)	
C1-P15	GLOW	
C1-P16	LEVER LOCK	
C1-P17	QUICK HITCH OPEN	
C1-P18	QUICK HITCH CLOSE	
C1-P19	RINE FILTER	
C1-P20	SWITCH AIR CLEANER	
C1-P21	ACCEL 1	
C1-P22	ACCEL 2	
C1-P23	DPF/ENABLE	
C1-P24	DPF/MANUAL	
C1-P25	DATA	
C1-P26	TRIP	
C1-P27	ALTERNATOR STATUS	
C1-P28	ANTI STALL SW	
C1-P29	KEY SW ACC	
C1-P30	LOAD DUMP	
C1-P31	HIGH FLOW	
C1-P32	GRIP E	
C1-P33	GRIP F	
C1-P34	AUX1/DETENT	
C1-P35	FLOAT	
C1-P36	SEAT SW	
C1-P37		
C1-P38	TRAVEL SHIFT	
C1-P39	QUICK HITCH LIMIT SW	
C1-P40	BUZZER	
C1-P41	ARM UP	
C1-P42	ARM DOWN	
C1-P43	AUX1 SERECT	
C1-P44	1WAY	
C1-P45		
C1-P46	POWER MODE	
C1-P47	ECO	
C1-P48		
C1-P49		
C1-P50	LEVER LOCK SOL	

IX CONTROLLER 17301-43370

CT4 DTM06-12SA

C1-P1	Power ground −
C1-P2	Power supply +
C1-P3	CAN +
C1-P4	CAN −
C1-P5	CAN shield
C1-P6	5V DC sensor power +
C1-P7	sensor power ground −
C1-P8	AUX1 A
C1-P9	AUX1 B
C1-P10	AUX1 Pot.
C1-P11	TEMP/HYD
C1-P12	FUEL GAGE

17301-43340 OX CONTROLLER

CT2 DTM06-12SA

Power ground −	C1-P1
Power supply +	C1-P2
CAN +	C1-P3
CAN −	C1-P4
CAN shield	C1-P5
AUX1 1WAY SOL	C1-P6
TRAVEL SHIFT SOL	C1-P7
14Pin E	C1-P8
QUICK HITCH OPEN	C1-P9
QUICK HITCH CLOSE	C1-P10
FLOAT SOL	C1-P11
HIGH FLOW SOL	C1-P12

CT3 DTM06-12SB

AUX1 A SOL	C2-P1
AUX1 B SOL	C2-P2
DETENT SW LAMP	C2-P3
	C2-P4
	C2-P5
14Pin F	C2-P6
	C2-P7
	C2-P8
ANTI STALL SOL	C2-P9
Power supply +	C2-P10
Power supply +	C2-P11
Power supply +	C2-P12

ACCEL 6189-0130 — Accel Sencer — GND / +5V / ACCEL

FOOT ACCEL 174262-2 — GND / +5V / FOOT ACCEL

CAN1 174257-2 — RESISTER 04942-0560 — CANO / CAN1

CN77 7282-7043-30 — CN78 7283-7043-30 — CN79 7123-7461-40

LINE F LE104 — AIR CLEANER 963040-3 — S CONECTOR 6195-0006 — SEAT SW 6195-0003

BUZZER CN71 7123-2228

ANTISTALL SW 7323-2228 — ON / OFF

06651-01100 GRIP — To DT06-08SA-CE05 — CN75 DT06-08SA-CE05 — +5V / PR OUTPUT / GND / SWC / SWB / SWA — PROP' LEVER

HYD 12040753 — FUEL SENDER 7123-1424-40

ANTI STALL DT06-02S-CE05

AUX 1WAY SWITCH 17000-00034 — CNS21 6242-5061 — AUX DETENT SWITCH 17000-00035 — 6242-5061

17030-06900 REAR(R) LIGHT — RLIGHT(R) + CB104 / RLIGHT(R) − CA104 — 12V 55W

17030-06900 REAR(L) LIGHT — RLIGHT(L) + CB104 / RLIGHT(L) − CA104 — 12V 55W

L Light GND LA210

LEVER LOCK — LL 7119-3020 — D13 776522-1

1WAY — 1WAY DT06-02S-CE05 — D14 776522-1

TRAVEL SHIFT — TRAVEL + CB104 / TRAVEL − CA104 — D15 776522-1

QUICK HITCH OPEN — QH OPEN 6180-2321 — D16 7323-2228 — QH 6195-0021 — CN17 6195-0024

QUICK HITCH CLOSE — QH CLOSE 6180-2321 — D17 7323-2228

ARM FLOAT — FLOAT 7123-1424-40 — D18 776522-1

HIGH FLOW — HIGH FLOW 6180-2321 — D19 776522-1

AUX1 A — AUX1A SOL DT06-02S-CE05

AUX1 B — AUX1B SOL DT06-02S-CE05

m — ENG BLOCK R5.5-10

h — ECU BODY LA508

M — GND1 R5.5-10 — GND2 LA310

H — GND3 LA510

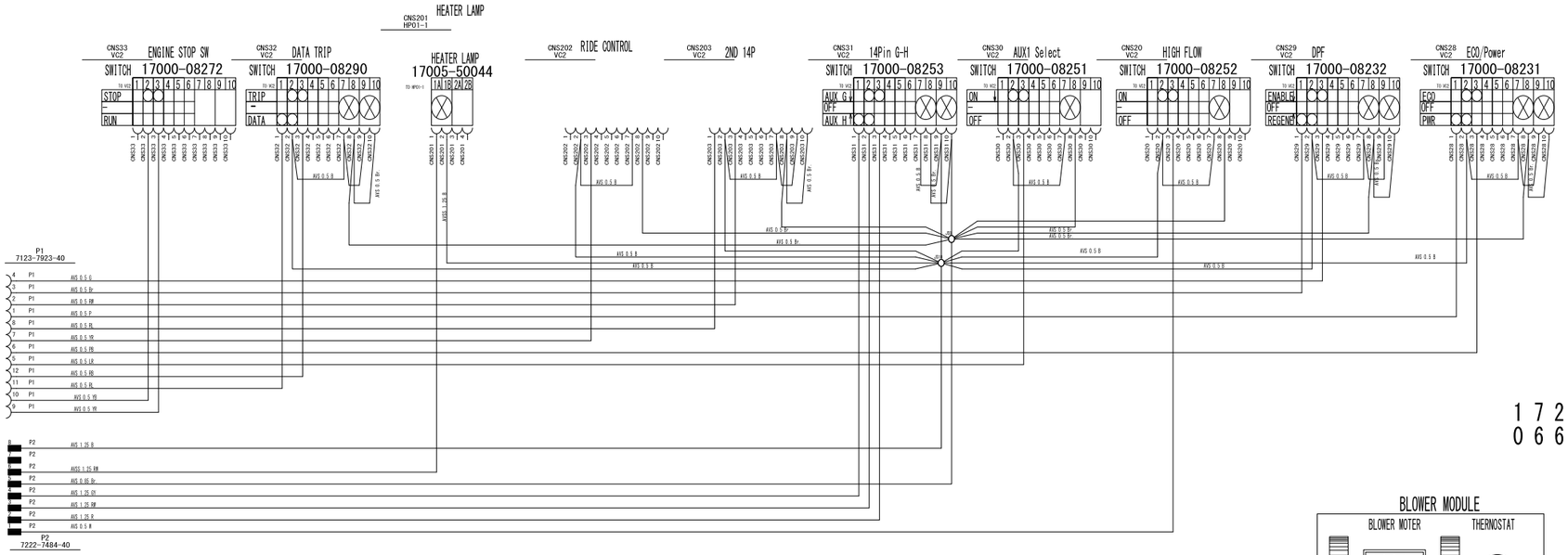
S — GND SG LA510

Drawing No.	1/2
06601-00015	

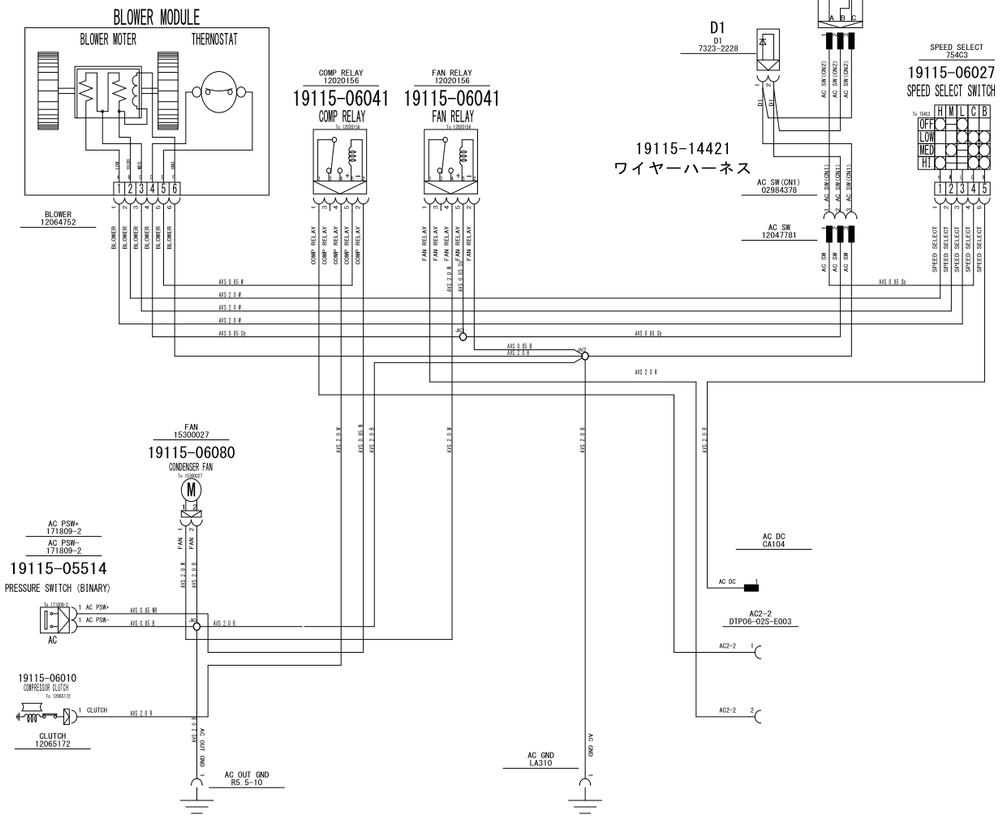
2G0BE12

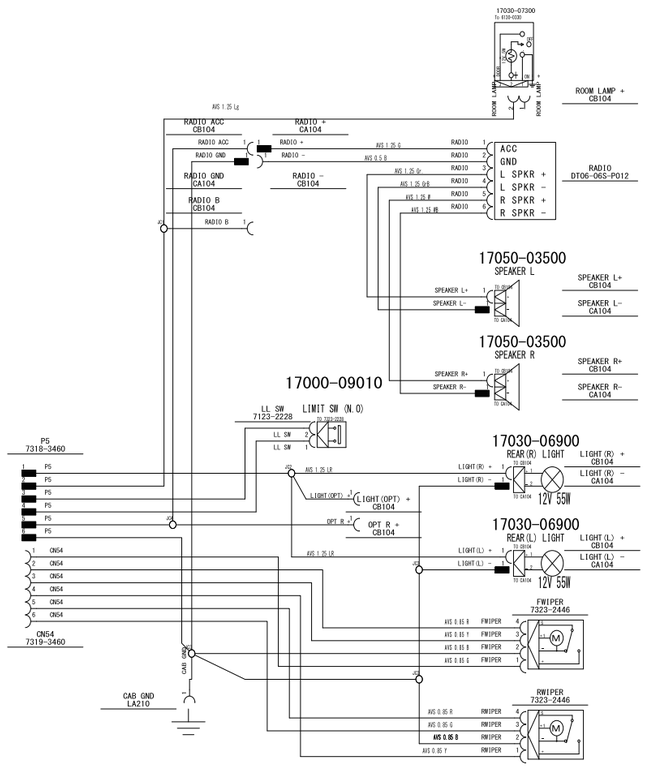
https://truckmanualshub.com/

06642-00049 WIRING HARNESS RH CONSOLE



172651 WIRE HARNESS HVAC 19115-14422
06642-00015 ワイヤハーネス





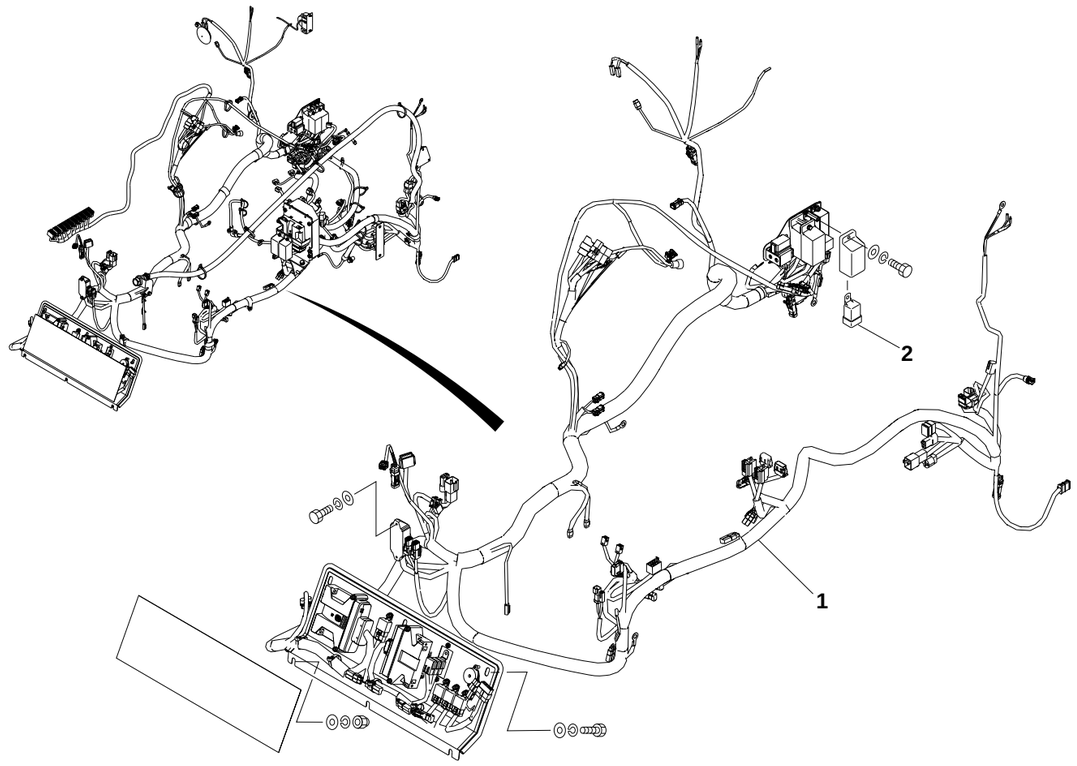
Drawing No.	2/2
06601-00015	

2G0BE13

WIRE HARNESS

With 14-pin connector

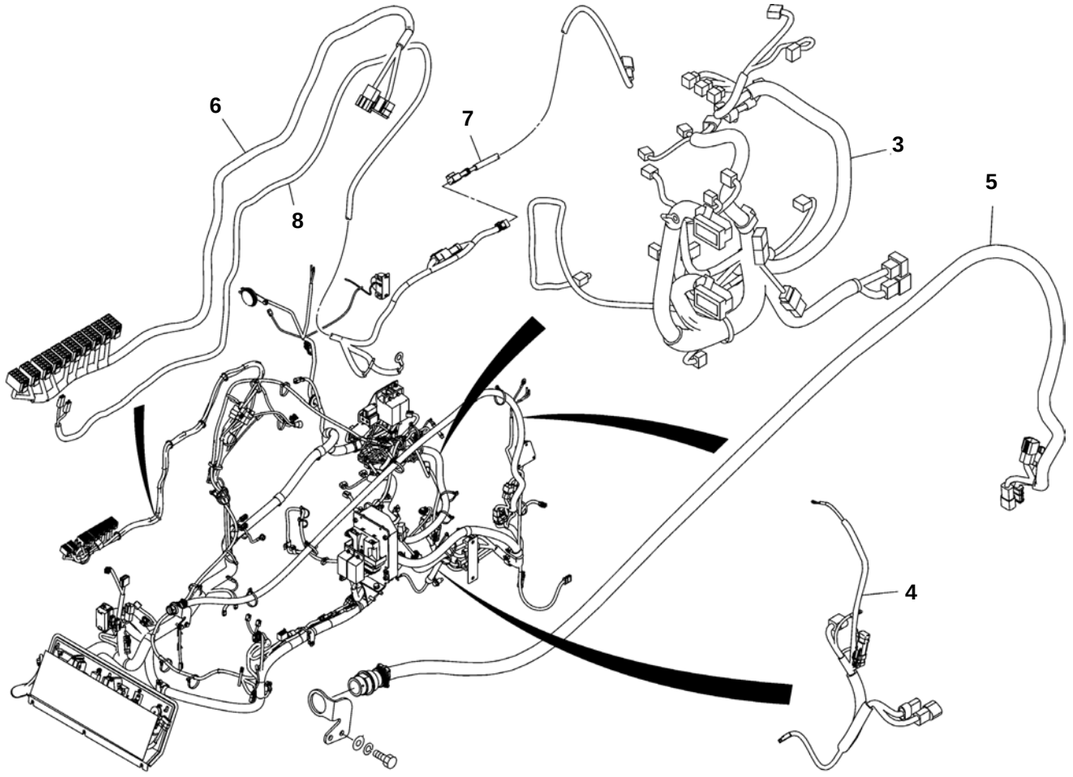
1/3



2H0BE33

1. Relay unit assembly
2. Relay

2/3

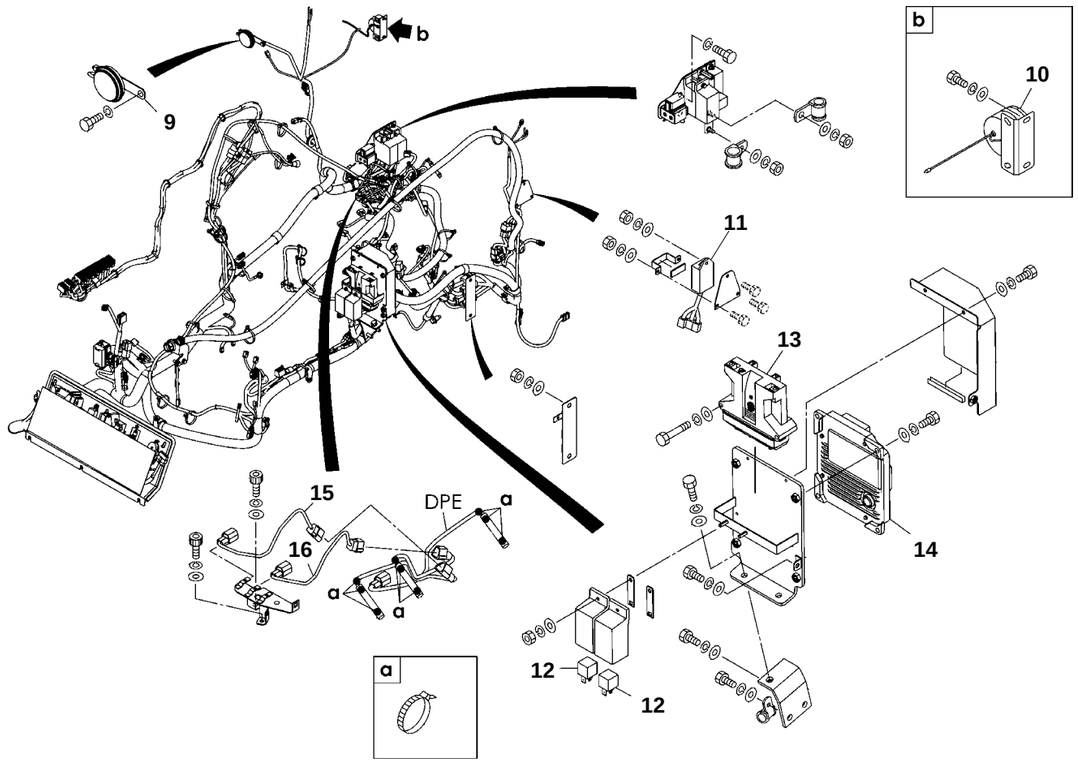


2H0BE34

3. Wire harness (06642-00022)
4. Wire harness (06642-00023)
5. Wire harness (06642-00007)
6. Wire harness (06642-00049)
7. Wire harness (06642-00068)
8. Wire harness (06842-00014)

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3/3



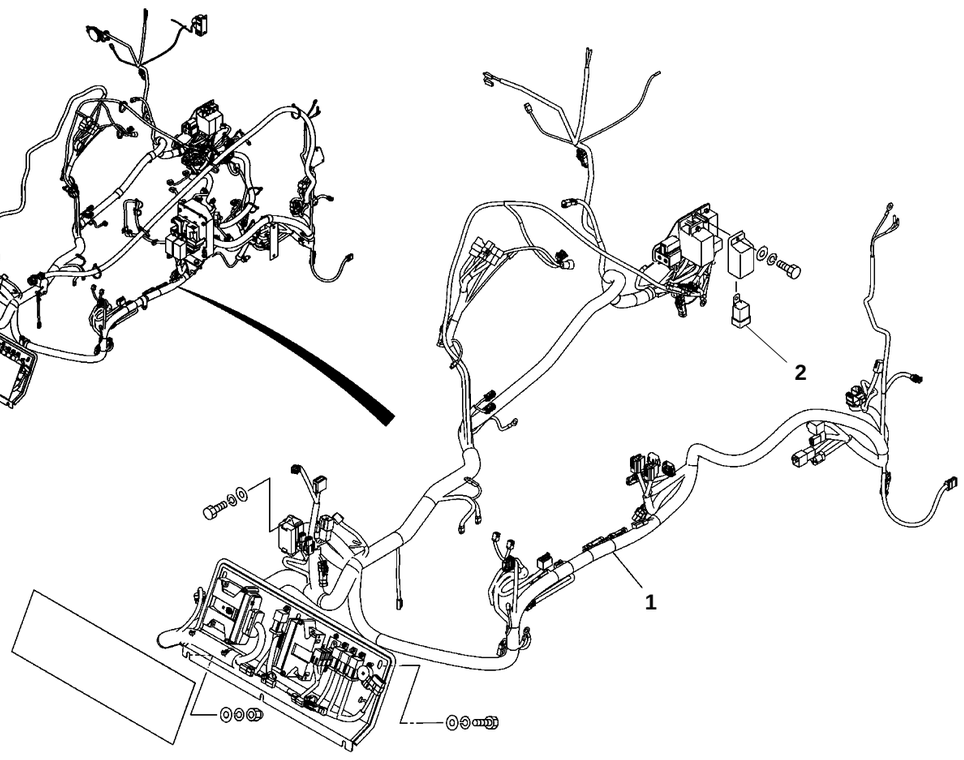
2H0BE35

9. Horn
10. Buzzer
11. Relay
12. Relay
13. Controller
14. Engine control unit (ECU)
15. Wire harness (06642-00044)
16. Wire harness (06642-00045)

https://truckmanualshub.com/

With 14-pin connector (CCV heater specification)

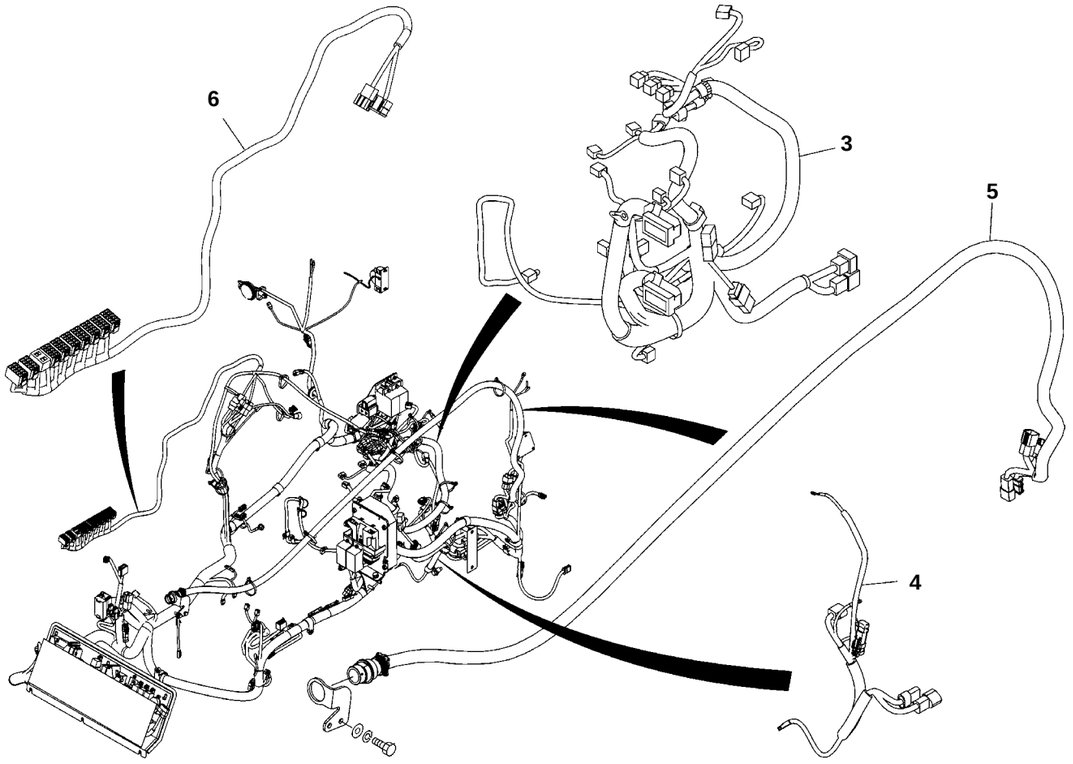
1/3



2H0BE36

1. Relay unit assembly
2. Relay

2/3

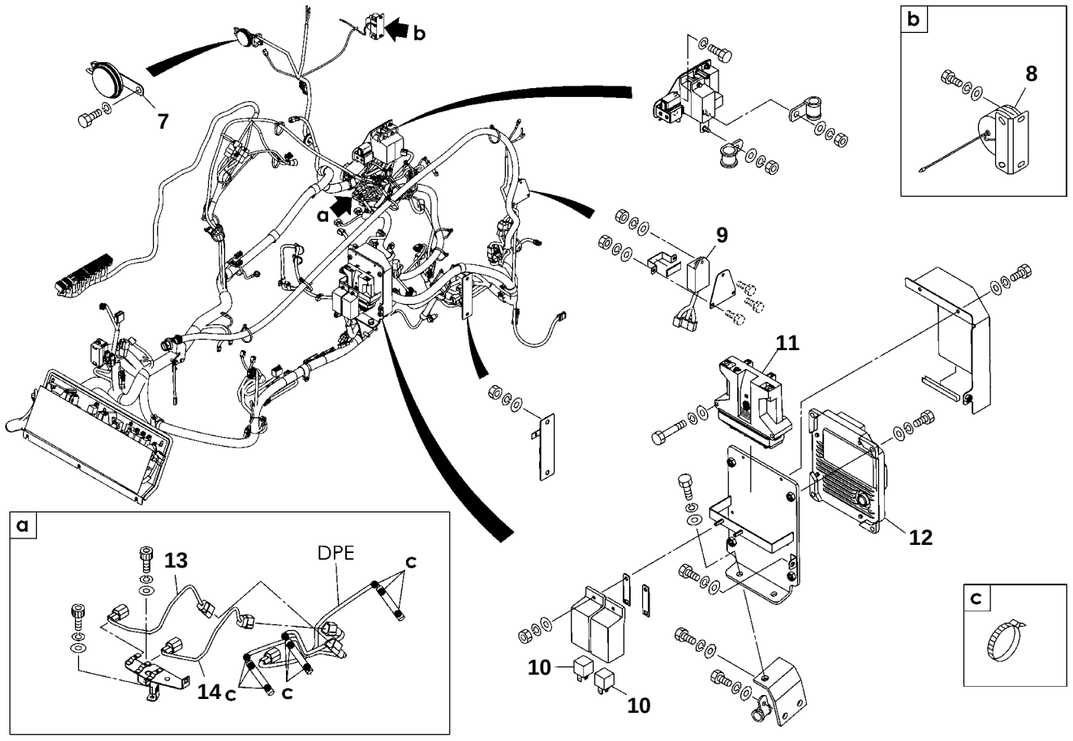


2H0BE37

3. Wire harness (06642-00071)
4. Wire harness (06642-00023)
5. Wire harness (06642-00007)
6. Wire harness (06642-00072)

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3/3



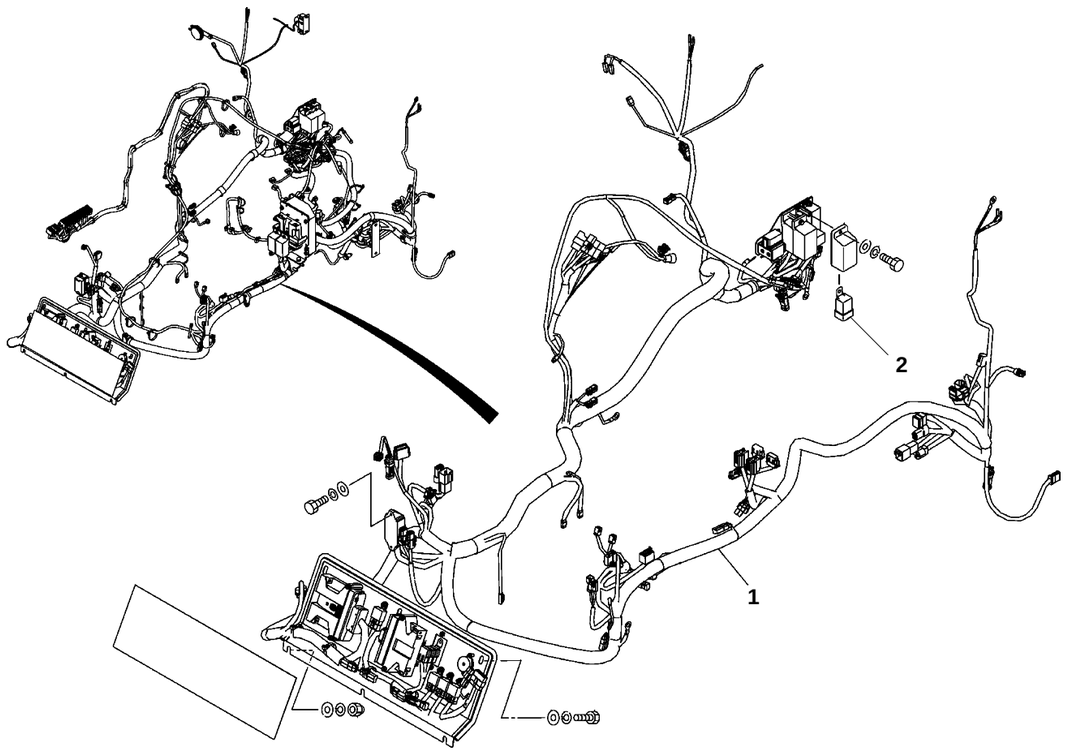
2H0BE38

7. Horn
8. Buzzer
9. Relay
10. Relay
11. Controller
12. Engine control unit (ECU)
13. Wire harness (06642-00044)
14. Wire harness (06642-00045)

https://truckmanualshub.com/

Without 14-pin connector

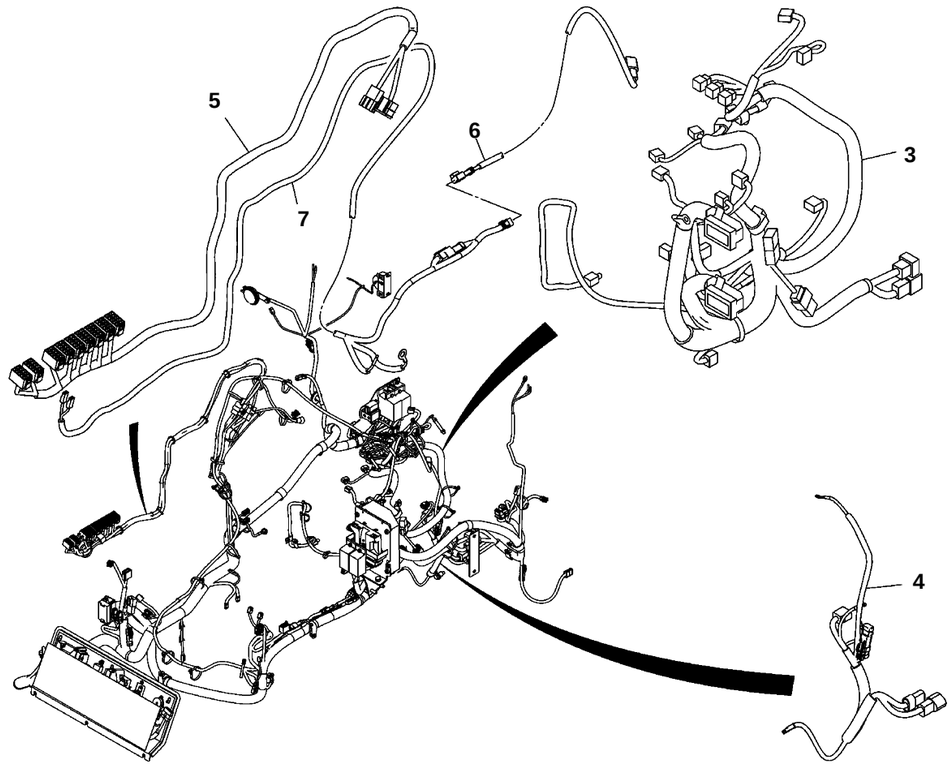
1/3



2H0BE39

1. Relay unit assembly
2. Relay

2/3

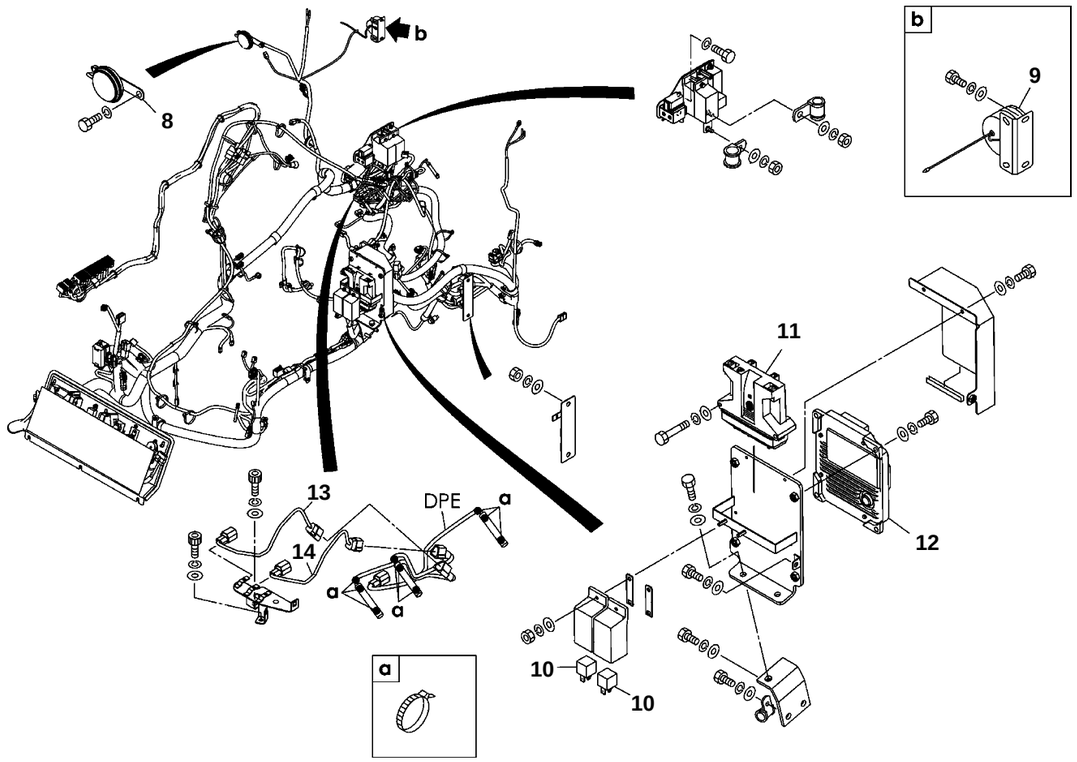


2H0BE40

3. Wire harness (06642-00022)
4. Wire harness (06642-00023)
5. Wire harness (06642-00049)
6. Wire harness (06642-00068)
7. Wire harness (06842-00014)

https://truckmanualshub.com/

3/3



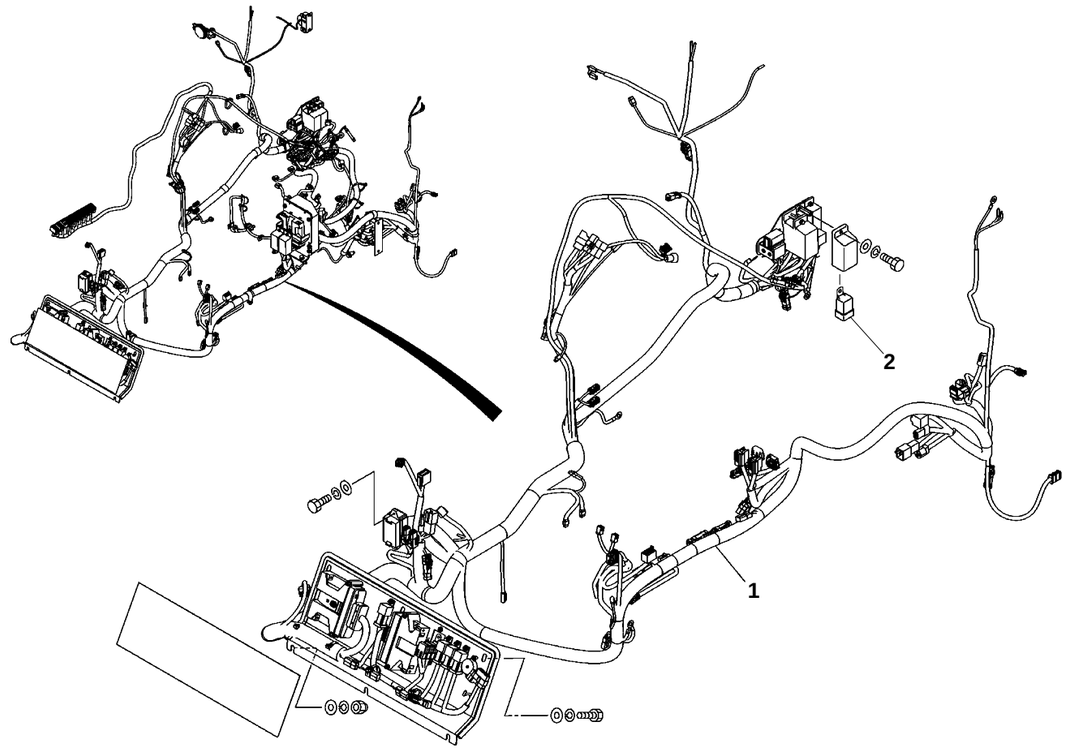
2H0BE41

8. Horn
9. Buzzer
10. Relay
11. Controller
12. Engine control unit (ECU)
13. Wire harness (06642-00044)
14. Wire harness (06642-00045)

https://truckmanualshub.com/

Without 14-pin connector (CCV heater specification)

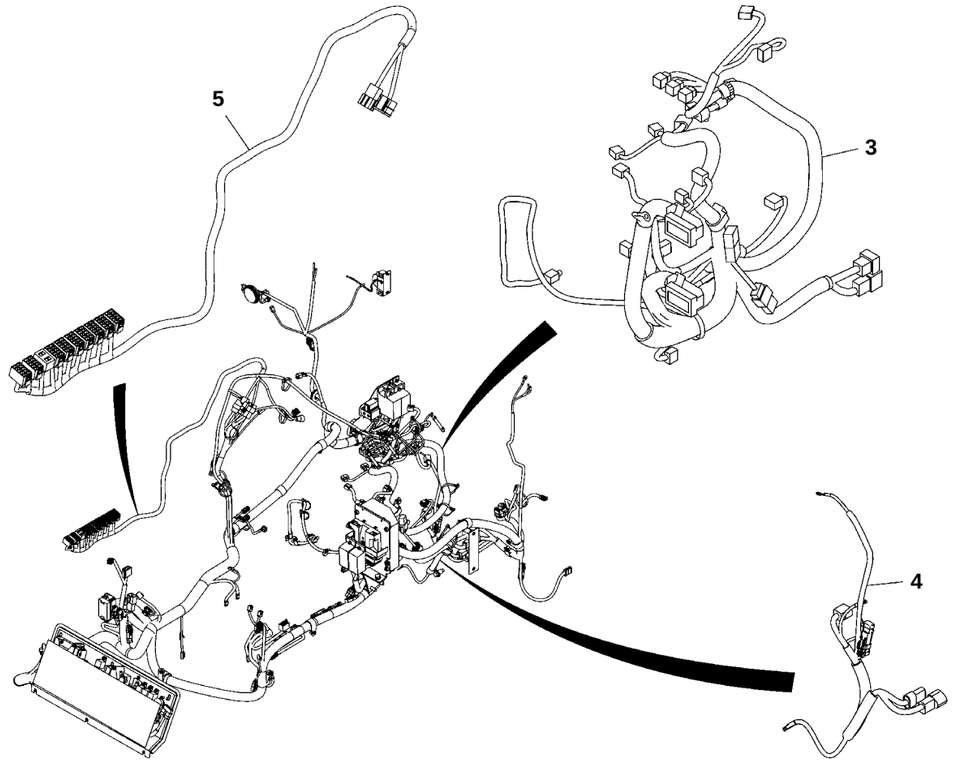
1/3



2H0BE42

1. Relay unit assembly
2. Relay

2/3

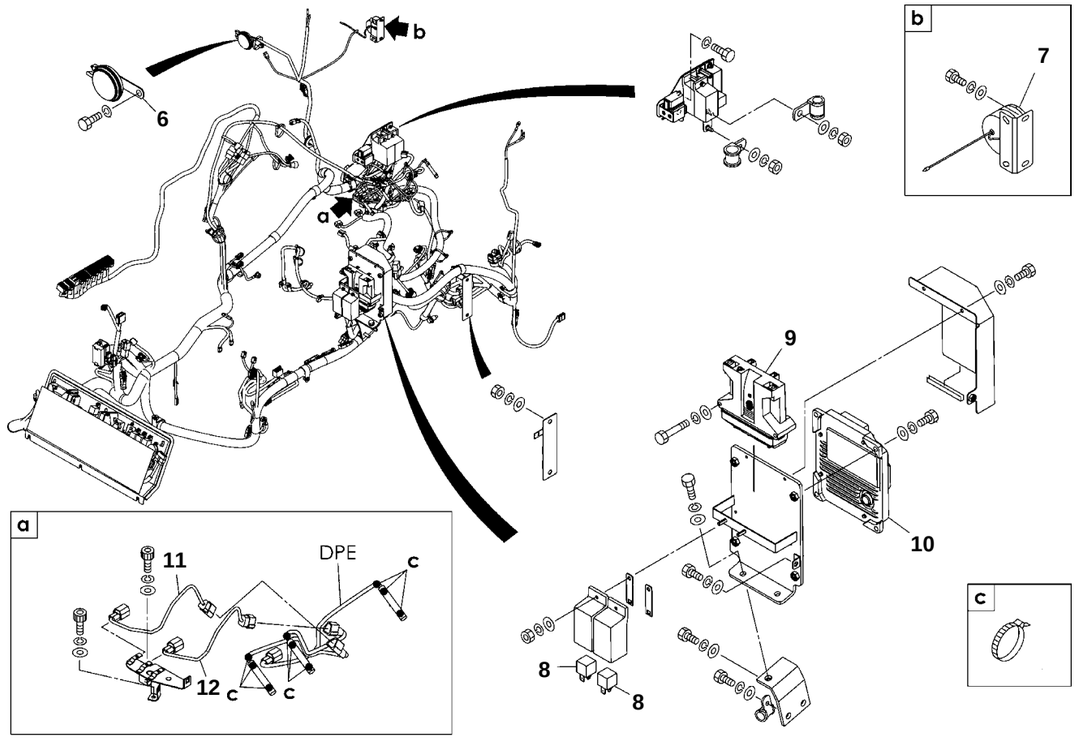


2H0BE43

3. Wire harness (06642-00071)
4. Wire harness (06642-00023)
5. Wire harness (06642-00072)

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3/3



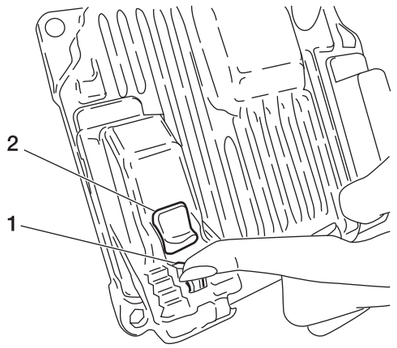
2H0BE44

6. Horn
7. Buzzer
8. Relay
9. Controller
10. Engine control unit (ECU)
11. Wire harness (06642-00044)
12. Wire harness (06642-00045)

https://truckmanualshub.com/

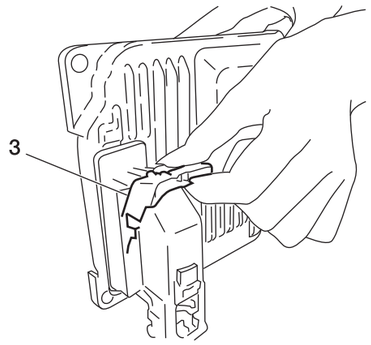
Removing the connector from the ECU

1. Release the bordeaux-colored lock (1), and push the center release button (2).



2H0AT11

2. Slowly raise the lever (3) until it reaches the initial insertion position where the lever stops.
   - Make sure to steadily raise the lever until it reaches the initial insertion position.

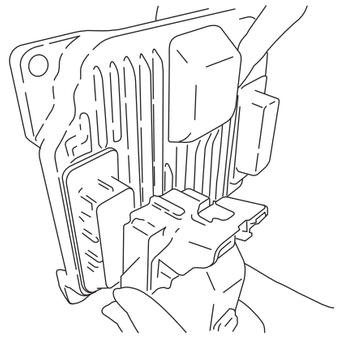


2H0AT12

3. With the lever securely raised to the proper position, firmly grasp onto the sides of the connector housing and pull it outward to disconnect the connector.

⚠ CAUTION

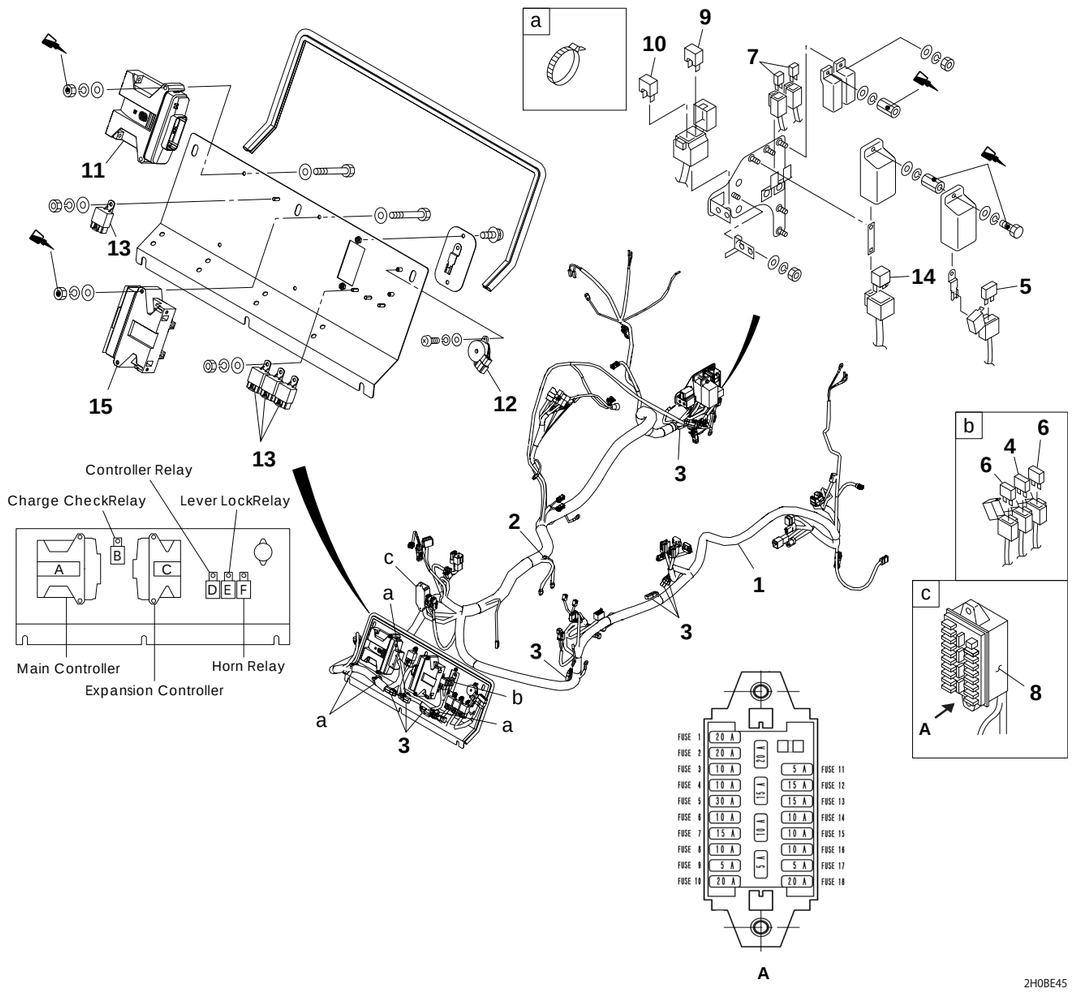
- Do not attempt to set the lock while the connector is disconnected from the ECU.
- Attempting to lock the connector while it is disconnected may damage it and render the lock unusable.



2H0AT13

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Relay unit assembly

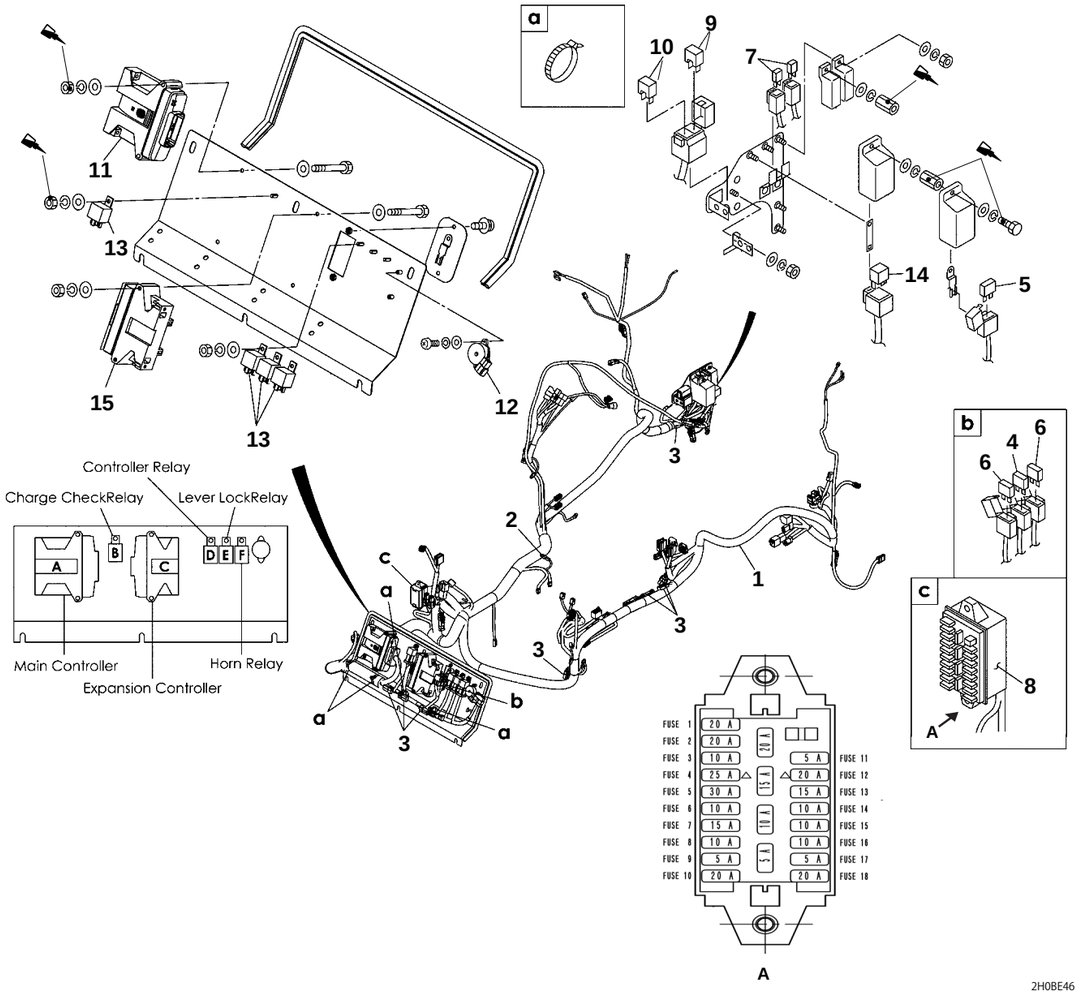


2H0BE45

Apply ThreeBond #1324 or an equivalent

1. Main harness (06642-00025)
2. Diode (1.5A)
3. Diode (3A)
4. Fuse (5A)
5. Fuse (15A)
6. Fuse (25A)
7. Fusible link (45A)
8. Fuse box
9. Fuse (50A)
10. Fuse (60A)
11. Controller
12. Buzzer
13. Relay
14. Starter relay
15. Controller

Relay unit assembly (CCV heater specification)



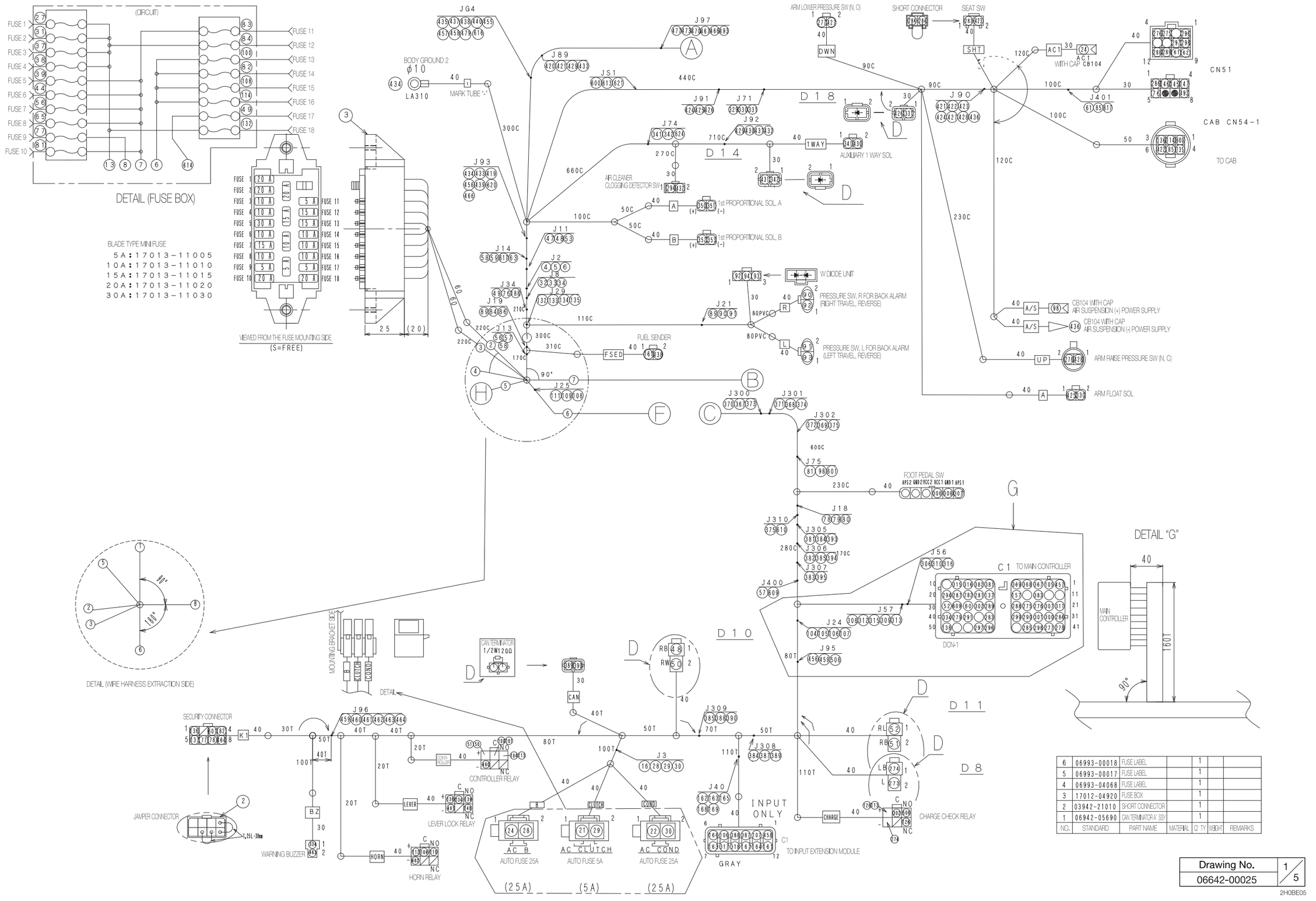
2H0BE46

Apply ThreeBond #1324 or an equivalent

1. Main harness (06642-00070)
   (CCV heater specification)
2. Diode (1.5A)
3. Diode (3A)
4. Fuse (5A)
5. Fuse (15A)
6. Fuse (25A)
7. Fusible link (45A)
8. Fuse box
9. Fuse (50A)
10. Fuse (60A)
11. Controller
12. Buzzer
13. Relay
14. Starter relay
15. Controller

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Main harness 06642-00025

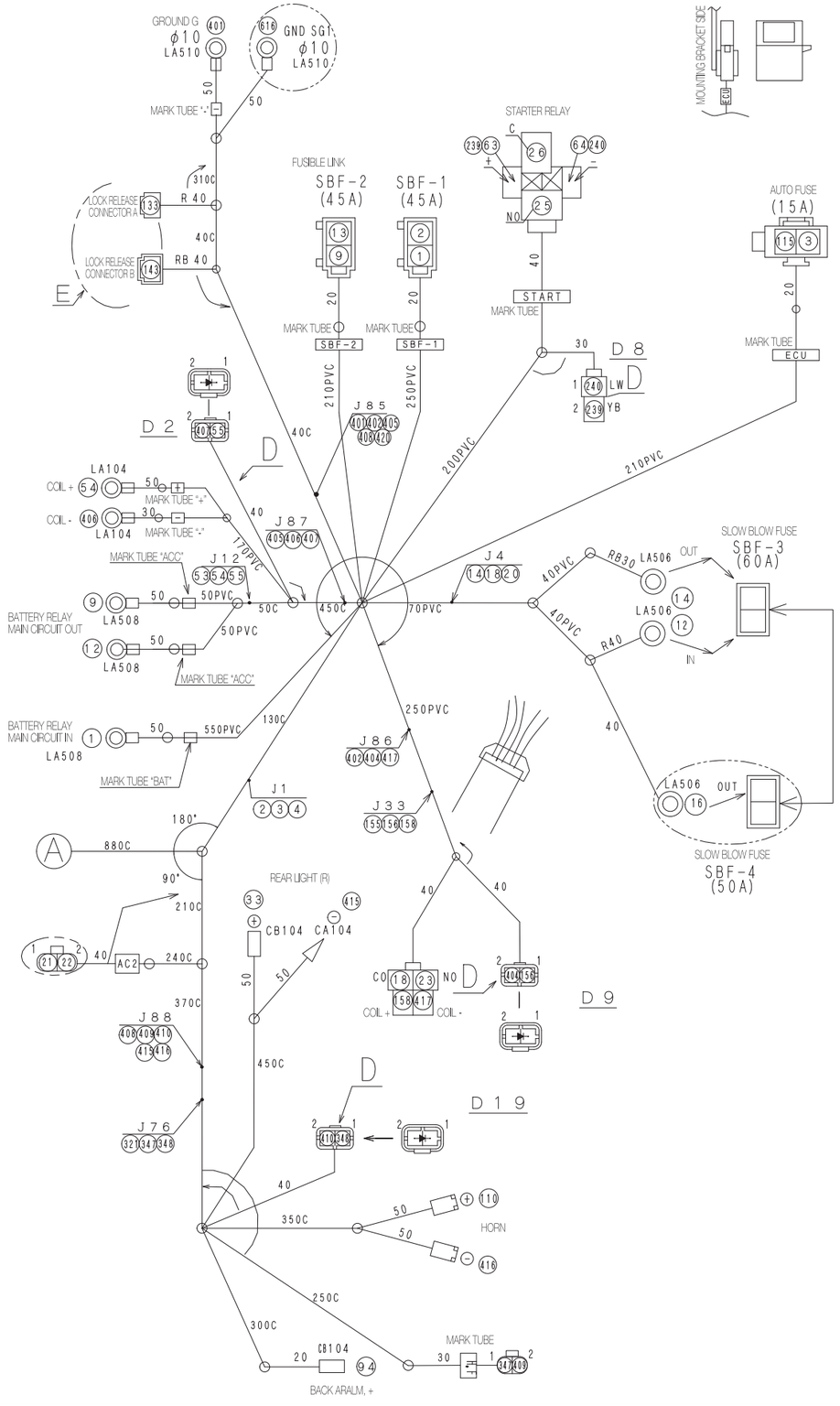


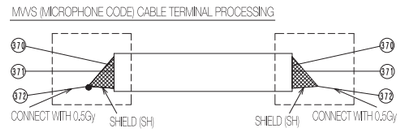
NO.	STANDARD	PART NAME	MATERIAL	Q'TY	WEIGHT	REMARKS
6	06993-00018	FUSE LABEL		1		
5	06993-00017	FUSE LABEL		1		
4	06993-04068	FUSE LABEL		1		
3	17012-04920	FUSE BOX		1		
2	03942-21010	SHORT CONNECTOR		1		
1	06942-05690	CAN TERMINATOR A' SSY		1		

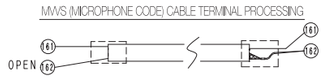
Drawing No.	1/5
06642-00025	

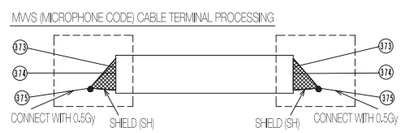
2H0BE05

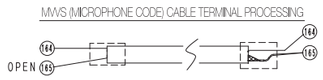
https://truckmanualshub.com/

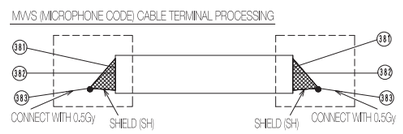


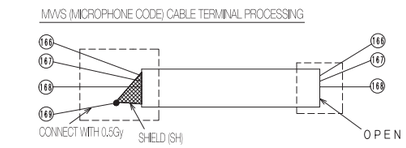


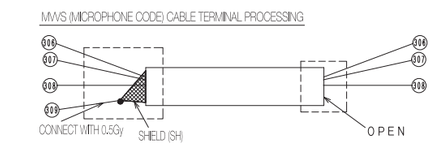


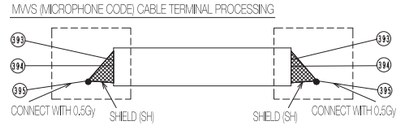


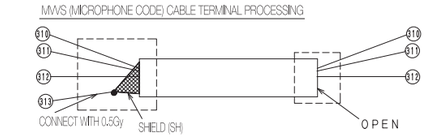


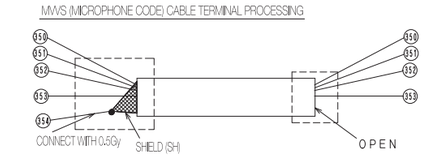


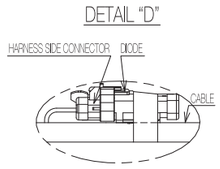


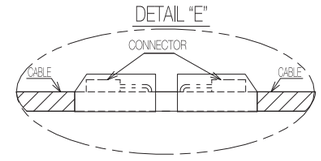


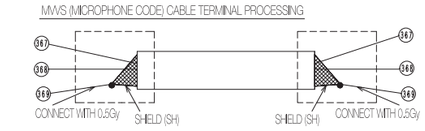








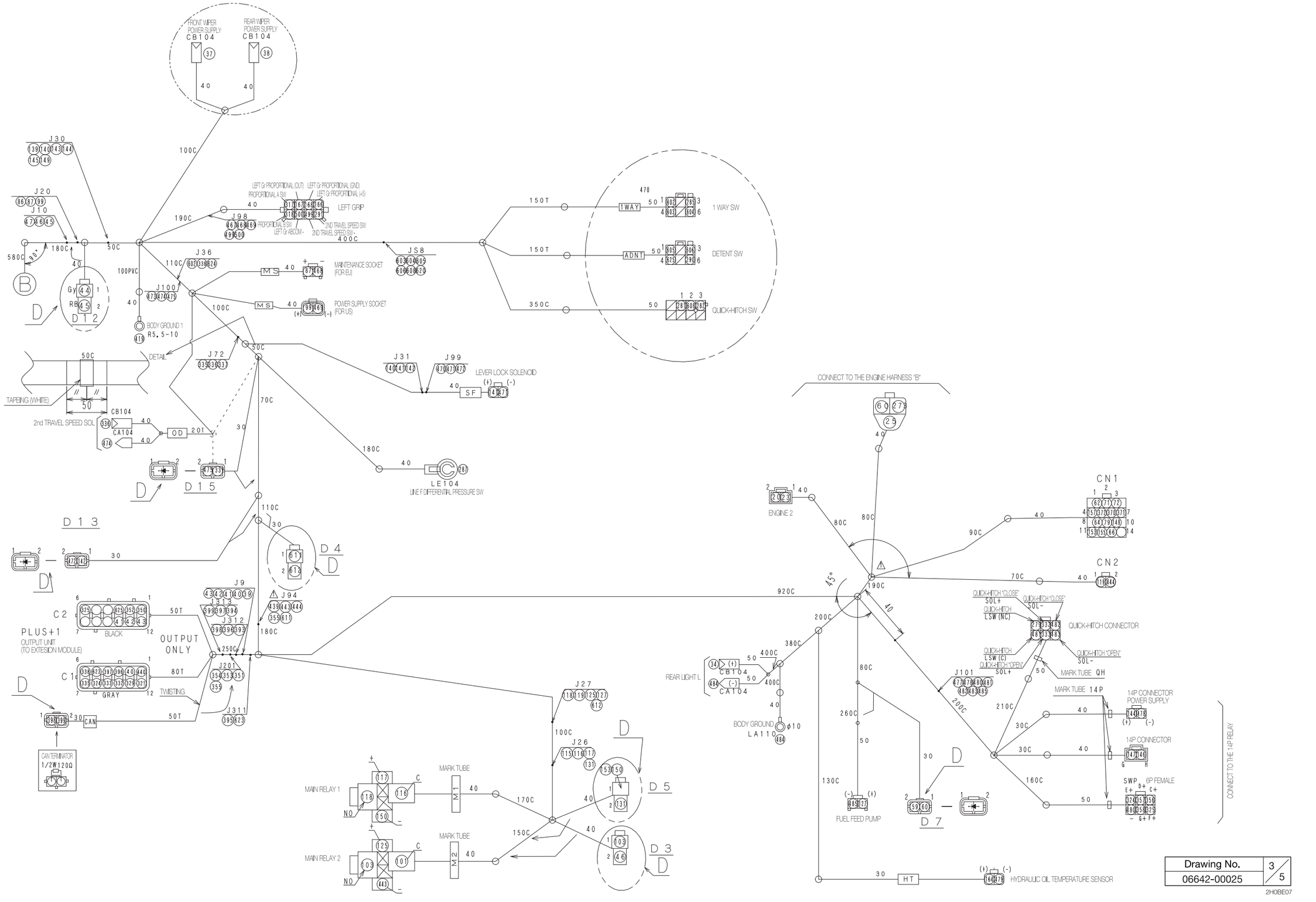




Drawing No.	2/5
06642-00025	

2H0BE06

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Drawing No.	3/5
06642-00025	

2H0BE07

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	FROM NAME	TO NAME	SIZE	COLOR	TYPE	RAMARKS
1	BAT RELAY, MAIN CIRCUIT IN	SBF-1, IN	5	W	AVS	
2	SBF-1, OUT	J1	5	R	AVS	
3	J1	FUSE BLOCK 15A, IN	5	R	AVS	
4	J1	J2	5	R	AVS	BAT
5	J2	KEY SW, B	5	R	AVS	+B
6	J2	FUSE BOX, IN	5	R	AVS	+B
7	KEY SW, ACC	FUSE BOX, IN	5	W	AVS	
8	KEY SW , C	FUSE BOX, IN	3	WR	AVX	
9	BAT RELAY, MAIN CIRCUIT OUT 1	SBF-2, IN	5	R	AVS	
10						
11						
12	BAT RELAY, MAIN CIRCUIT OUT 2	SBF-3, IN	8	R	AV	
13	SBF-2, OUT	ALT LOAD, IN	5	Y	AVS	
14	SBF-3, OUT	J4	8	W	AV	
15						
16	SBF4, OUT	J3	5	L	AVX	
17						
18	J4	GROW RELAY C	5	W	AVS	
19						
20	J4	ENGINE 2, 2	8	W	AVX	
21	AC CLUTCH, 1	AC2, 1	1.25	W		
22	AC COND, 1	AC2, 2	2	Y		
23	GROW RELAY NO	ENGINE 2, 1	5	Y	AVS	
24	AC BLOWER, 1	AC1, 1	2	R		
25	STARTER RELAY, NO	STARTER MOTOR S	3	L	AVX	
26	KEY SW, C	STARTER RELAY, C	3	W	AVX	
27	FUSE BOX, F1	LIGHT SW F1, 1	2	R		
28	AC BLOWER, 2	J3	5	L	AVX	
29	AC CLUTCH, 2	J3	5	L	AVX	
30	AC COND, 2	J3	5	L	AVX	
31	FUSE BOX, F2	LIGHT SW R1, 1	2	W		
32	JS2	J8	2	Br		
33	J8	REAR LIGHT R	1.25	Br		
34	J8	REAR LIGHT L	1.25	Br		
36						
37	FUSE BOX, F3	FRONT WIPER POWER SUPPLY +	1.25	Br		
38	FUSE BOX, F4	REAR WIPER POWER SUPPLY +	1.25	Y		
39	FUSE BOX, F5	J9	3	P	AVS	
40	J9	CONTROLLER OUTPUT UNIT C1P2	0.5	P		
41	J9	CONTROLLER OUTPUT UNIT C2P10	0.5	P		
42	J9	CONTROLLER OUTPUT UNIT C2P11	0.5	P		
43	J9	CONTROLLER OUTPUT UNIT C2P12	0.5	P		
44	FUSE BOX, F6	D12, 1	1.25	Gy		BATTERY RELAY +
45	D12, 2	J10	0.85	RB		
46	J10	D3, 2	0.85	RB		FROM MAIN RELAY
47	J10	J11	0.85	RB		
48	J11	D10, 1	0.85	RB		CONTROLLER RELAY +
49	FUSE BOX, F17	J34	0.85	Br		
50	D10, 2	CONTROLLER RELAY +	0.85	RW		CONTROLLER RELAY +
51	CONTROLLER +	D11, 2	0.5	RW		CONTROLLER RELAY +
52	D12, 1	MAIN CONTROLLER C1P30	0.5	RL		CONTROLLER RELAY BKUP
53	J11	J12	0.85	RB		
54	J12	BATTERY RELAY COIL +	0.85	RB		
55	J12	DIODE UNIT, K	0.85	RB		BATTERY RELAY SURGE KILLER
56	FUSE BOX, F7	J13	0.85	YB		
57	J13	J400	0.85	YB		
58	J13	J14	0.85	YB		
59	J14	D7, 2	0.85	Gy		ALT. 1G CHECK
60	D7, 1	OLTERNATOR IG	0.85	YB		
61	J401	ENGINE STOP SW, 2	0.85	YB		
62	ENGINE STOP SW, 3	CN1-1	0.85	YR		
63	J14	STARTER RELAY +	0.85	YB		
64	STARTER RELAY (-)	CN1-8	0.85	LW		
65	FUSE BOX, F8	J15	1.25	RB		
66	J15	CN1-13	1.25	RB		
68	J15	AUXILIARY TOOL CONNECTOR	0.85	RB		
71	AUXILIARY TOOL CONNECTOR H	CN1-2	0.5	W		CAN-H CAN-L TWISTING
72	AUXILIARY TOOL CONNECTOR L	CN1-3	0.5	B		CAN-H CAN-L TWISTING
74						
75	J15	MAIN AUXILIARY TOOL CONNECTOR	0.85	RB		
76	J34	SW, BOX, R LIGHTING +	0.85	Br		
77	FUSE BOX, F9	SECURITY CONNECTOR, 6	0.85	WY		
78	SECURITY CONNECTOR, 7	J18	0.85	WR		
79	J18	CN1-9	0.85	WR		
80	J18	MAIN CONTROLLER C1P28	0.5	WR		
81	FUSE BOX, F10	J75	0.85	RW		
82	FUSE BOX, F14	SECURITY CONNECTOR, 4	0.85	R		
83	FUSE BOX, F11	CLUSTER ACC +	0.5	G		
84	FUSE BOX, F12	J19	1.25	Lg		
85	J401	CAB CN54-1, 5	1.25	G		
86	J19	J20	1.25	Lg		
87	J20	MAINTENANCE	1.25	Lg		
89	J19	J21	1.25	Lg		
90	J21	PRESSURE SW, R, 2 FOR BACK ALARM	1.25	Lg		
91	J21	PRESSURE SW, L, 2 FOR BACK ALARM	1.25	Lg		
92	PRESSURE SW, R, 1 FOR BACK ALARM	W DIODE UNIT, 1	1.25	LgR		
93	PRESSURE SW, L, 1 FOR BACK ALARM	W DIODE UNIT, 3	1.25	LgR		
94	W DIODE UNIT, 2	BACK BUZZER, +	1.25	W		
96						
97						
98	J75	AIR SUSPENSION POWER SUPPLY (+)	1.25	RW		
99	J20	POWER SUPPLY SOCKET	1.25	Lg		
100	FUSE BOX, F13	CONTROLLER RELAY C	0.85	R		
101	CONTROLLER C	MAIN RELAY 2, C	0.85	R		
102						
103	MAIN RELAY 2, NO	C3, 1	0.85	RB		
104	CONTROLLER NO	J24	0.85	Gy		
105	J24	MAIN CONTROLLER C1P12	0.5	Gy		
106	J24	CONTROLLER INPUT UNIT C1P5	0.5	Gy		
107	J24	CONTROLLER INPUT UNIT C1P2	0.5	Gy		

	FROM NAME	TO NAME	SIZE	COLOR	TYPE	RAMARKS
108	FUSE BOX, F15	J25	0.85	P		
109	J25	HORN RELAY C	0.85	P		
110	HORN RELAY NO	HORN	0.85	PB		
111	J25	RIGHT GRIP SW, ARM F, H, COM	0.85	G		RIGHT GRIP
112	RIGHT GRIP SW, HORN PB	HORN RELAY +	0.5	Br		(+)
113	CONTROLLER RELAY, 3	CHARGE CHECK RELAY COIL +	0.85	Gy		
114	FUSE BOX, F16	CAB CN54-1, 2	1.25	Y		
115	FUSE BLOCK 15A, OUT	J26	5	WR	AVS	
116	J26	MAIN RELAY 1, C	5	WR	AVS	
117	J26	MAIN RELAY 1 +	0.85	WR		
118	MAIN RELAY 1, NO	J27	5	R	AVS	
119	J27	CN2-1	5	R	AVS	
125	J27	MAIN RELAY 2 +	0.85	V		+BP
126	CHARGE CHECK RELAY COIL +	CHARGE CHECK RELAY NC	0.85	Gy		
127	J27	FUEL FEED PUMP	0.85	R		+BP
131	J26	DIODE UNIT, K	0.85	Br		FOR MAIN RELAY 1
132	FUSE BOX, F18	J29	2	R		
133	J29	LOCK RELEASE CONNECTOR A	0.85	R		
134	J29	LEVER LOCK RELAY C	2	R		
135	J29	CAB CN54-1, 4	1.25	GW		
136	CAB CN54-1, 3	SECURITY CONNECTOR, 1	1.25	RB		
137	SECURITY CONNECTOR, 5	MAIN CONTROLLER C1P16	0.5	RL		
138	LEVER LOCK RELAY +	MAIN CONTROLLER C1P50	0.5	RL		
139	LEVER LOCK RELAY NO	J30	2	RW		
140	J30	J31	0.85	RW		
141	J31	LEVER LOCK SOL +	0.85	RW		
142	J31	D13, 1	0.85	RW		
143	J30	LOCK RELEASE CONNDETOR B	0.85	RW		
144	J30	14P CONNECTOR POWER SUPPLY +	2	RW		
145	J30	GH, SW2 POWER SUPPLY +	1.25	RW		
146	GH, SW1	14P CONNECTOR G	1.25	R		
147	GH, SW3	14P CONNECTOR H	1.25	Gy		
148	LEVER LOCK RELAY NC	CN1-10	0.85	RL		
149	J30	RIGHT GRIP SW, + COM	0.85	RW		RIGHT GRIP
150	MAIN RELAY (-)	D5, 1	0.85	RY		
153	D5, 1	CN1-11	0.85	RW		
155	J33	CN1-12	0.85	V		
156	J33	D9, 1	0.85	V		
157	MAIN CONTROLLER C1P15	CN1-4	0.5	BY		GROW LAMP +
158	J33	GROW RELAY COIL +	0.85	V		
161	CONTROLLER INPUT UNIT C1P12	FUEL SENDER, 1	MVS 0.5, SINGLE CONDUCTOR	W	MVVS	
162	J40	OPEN 4	MVS 0.5, SINGLE CONDUCTOR	B		(CONNECT WITH 0.5 B)
163	J40	CONTROLLER INPUT UNIT C1P7	0.5	B		SENSOR GND
164	CONTROLLER INPUT UNIT C1P11	HYDRAULIC OIL TEMPERATURE SENSOR, +	MVS 0.5, SINGLE CONDUCTOR	W	MVVS	
165	J40	OPEN 3	MVS 0.5, SINGLE CONDUCTOR	B		(CONNECT WITH 0.5 B)
166	CONTROLLER INPUT UNIT C1P6	LEFT PROPORTIONAL GRIP	MVS 0.75, 3-CONDUCTOR	R	MVVS	+ 5V OUT
167	CONTROLLER INPUT UNIT C1P10	LEFT PROPORTIONAL GRIP	MVS 0.75, 3-CONDUCTOR	W	MVVS	PROPORTIONAL SIGNAL INPUT
168	J40	LEFT PROPORTIONAL GRIP	MVS 0.75, 3-CONDUCTOR	B	MVVS	
169	J40	OPEN 5	MVS 0.75, 3-CONDUCTOR	Gy		CONNECT WITH 0.5 Gy
188	J34	CLUSTER INTERNAL ILLUMINATION	0.5	Y		
239	STARTER RELAY +	D6, 2	0.85	YB		
240	STARTRR RELAY (-)	D6, 1	0.5	LW		
273	OLTERNATOR L	D8, 2	0.85	L		
274	D8, 1	CHARGE CHECK RELAY COIL -	0.85	LB		
275	DPF FORCED REGENERATION SW, a	MAIN CONTROLLER C1P24	0.5	Br		
276	DPF AUTOMATIC REGENERATION INHIBITION SW, a	MAIN CONTROLLER C1P23	0.5	G		
277	ARM LOWER PRESSURE SW, 1	MAIN CONTROLLER C1P42	0.5	WB		
278	ARM RAISE PRESSURE SW, 2	MAIN CONTROLLER C1P41	0.5	RB		
279	QUICK-HITCH L SW (NC)	MAIN CONTROLLER C1P39	0.5	RB		
281	QUICK-HITCH SW, 1	MAIN CONTROLLER C1P17	0.5	RW		TO CAB UPPER SIDE LEFT SW BOX
282	QUICK-HITCH SW, 3	MAIN CONTROLLER C1P18	0.5	RG		TO CAB UPPER SIDE LEFT SW BOX
283	SEAT SW, 1	MAIN CONTROLLER C1P36	0.5	YB		
284	SEAT SW SHORT CONNECTOR	SEAT SW SHORT CONNECTOR	0.85	L		
285	1-WAY SW, 3	MAIN CONTROLLER C1P44	0.5	BY		TO CAB UPPER SIDE LEFT SW BOX
286	RIGHT SW CN51, 1	MAIN CONTROLLER C1P31	0.5	Y		TO CAB UPPER SIDE LEFT SW BOX
287	LINE DIFFERENTIAL PRESSURE SW, C	MAIN CONTROLLER C1P19	0.5	Br		
288	TRIP DATA SW, c	MAIN CONTROLLER C1P25	0.5	RB		
289	TRIP DATA SW, a	MAIN CONTROLLER C1P26	0.5	RL		
290	DETENT SW, 6	MAIN CONTROLLER C1P34	0.5	W		TO CAB UPPER SIDE LEFT SW BOX
291	2nd TRAVEL SPEED SW, C	MAIN CONTROLLER C1P38	0.5	GW		LEFT GRIP
294	AIR CLEANER CLOGGING DETECTOR SW, 1	MAIN CONTROLLER C1P20	0.5	RG		
296	POWER MODE SW, H	MAIN CONTROLLER C1P46	0.5	P		
297	ECO MODE SW, L	MAIN CONTROLLER C1P47	0.5	PB		
298	1st AUXILIARY FLOW SW, 3	MAIN CONTROLLER C1P43	0.5	LR		
299	RIGHT GRIP SW, ARM FLOAT SW	MAIN CONTROLLER C1P35	0.5	R		
300	RIGHT GRIP SW, E	MAIN CONTROLLER C1P32	0.5	R		
301	RIGHT GRIP SW, F	MAIN CONTROLLER C1P33	0.5	Gr		
302	CHARGE CHECK RELAY C	MAIN CONTROLLER C1P27	0.5	L		
306	FOOT PEDAL SW, VCC1	J56	MVS 0.5, 3-CONDUCTOR	R	MVVS	+5V
307	FOOT PEDAL SW, APS1	MAIN CONTROLLER C1P22	MVS 0.5, 3-CONDUCTOR	W	MVVS	
308	FOOT PEDAL SW, GND 1	J57	MVS 0.5, 3-CONDUCTOR	B	MVVS	
309	J57	OPEN 7	MVS 0.5, 3-CONDUCTOR	GY		CONNECT WITH 0.5 Gy
310	ACCELERATOR SW, VCC1	J56	MVS 0.5, 3-CONDUCTOR	R	MVVS	+5V
311	ACCELERATOR SW, APS1	MAIN CONTROLLER C1P21	MVS 0.5, 3-CONDUCTOR	W	MVVS	
312	ACCELERATOR SW, GND1	J57	MVS 0.5, 3-CONDUCTOR	B	MVVS	
313	J57	OPEN 6	MVS 0.5, 3-CONDUCTOR	GY		CONNECT WITH 0.5 Gy
315	J57	MAIN CONTROLLER C1P9	0.5	B		SENSOR GND
316	J56	MAIN CONTROLLER C1P8	0.5	R		+5V
317	PROPORTIONAL GRIP SW, A	CONTROLLER INPUT UNIT C1P8	0.5	L		LEFT GRIP
318	PROPORTIONAL GRIP SW, B	CONTROLLER INPUT UNIT C1P9	0.5	Br		LEFT GRIP
321	CONTROLLER OUTPUT UNIT C1P12	J76	0.5	L		
322						
324	CONTROLLER OUTPUT UNIT C1P8	14P RELAY E +	0.5	W		
325	CONTROLLER OUTPUT UNIT C2P6	14P RELAY F +	0.5	Y		
329	CONTROLLER OUTPUT UNIT C1P11	J71	0.5	YR		
330	J71	ARM FLOAT SOL, 2	0.85	YR		
331	J71	D18, 1	0.85	YR		
332	CONTROLLER OUTPUT UNIT C1P10	QUICK-HITCH CLOSE SOL, +	0.5	BW		
333	CONTROLLER OUTPUT UNIT C1P9	QUICK-HITCH OPEN SOL, +	0.5	RW		
334	MAIN CONTROLLER C1P40	WARNING BUZZER, 1	0.5	Y		

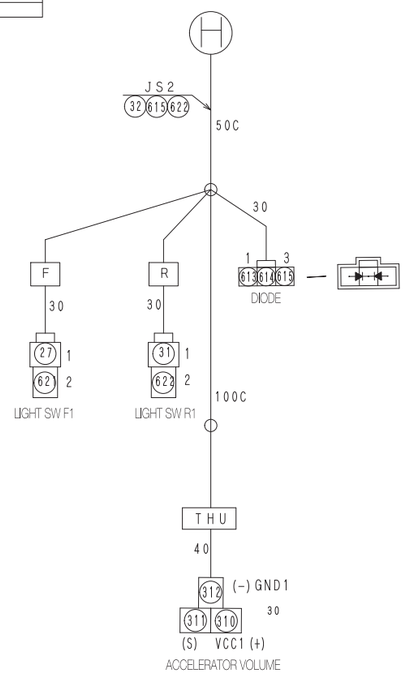
	FROM NAME	TO NAME	SIZE	COLOR	TYPE	RAMARKS
335	CONTROLLER OUTPUT UNIT C1P7	J72	0.5	Br		
336	J72	2nd TRAVEL SPEED SOL, +	0.85	Br		
337	J72	D15, 1	0.85	Br		
338	CONTROLLER OUTPUT UNIT C1P6	J36	0.5	Y		
340						
341	J74	1-WAY SOL, 1	0.85	Y		
342	J74	D14, 1	0.85	Y		
347	J76	HIGH FLOW SOL, 1	0.85	L		
348	J76	D19, 1	0.85	L		
350	CONTROLLER OUTPUT UNIT C2P1	1st PROPORTIONAL SOL, A+	MVVS 0.75, 4-CONDUCTOR	R	MVVS	
351	J201	1st PROPORTIONAL SOL, A-	MVVS 0.75, 4-CONDUCTOR	B	MVVS	
352	CONTROLLER OUTPUT UNIT C2P2	1st PROPORTIONAL SOL, B+	MVVS 0.75, 4-CONDUCTOR	W	MVVS	
353	J201	1st PROPORTIONAL SOL, B-	MVVS 0.75, 4-CONDUCTOR	G	MVVS	
354	J201	OPEN 8	MVS 0.75, 4-CONDUCTOR	GY		CONNECT WITH 0.5 Gy
355	J201	J94	0.85	G		
356	RIGHT GRIP SW, C	14P CONNECTOR C +	0.85	W		
357	RIGHT GRIP SW, D	14P CONNECTOR D +	0.85	V		
358	RIGHT GRIP SW, G	14P CONNECTOR G+	0.85	Y		
367	MAIN CONTROLLER C1P3	J300	MVS 0.5, 2-CONDUCTOR	W	MVVS	CAN-0H
368	MAIN CONTROLLER C1P4	J301	MVS 0.5, 2-CONDUCTOR	B	MVVS	CAN-0L
369	MAIN CONTROLLER C1P5	J302	MVS 0.5, 2-CONDUCTOR	GY	MVVS	CONNECT WITH 0.5 Gy
370	J300	CN1-6	MVS 0.5, 2-CONDUCTOR	W	MVVS	CAN-2H
371	J301	CN1-7	MVS 0.5, 2-CONDUCTOR	B	MVVS	CAN-2L
372	J302	CN1-5	MVS 0.5, 2-CONDUCTOR	GY	MVVS	CONNECT WITH 0.5 Gy
373	J300	J303	MVS 0.5, 2-CONDUCTOR	W	MVVS	CAN-H
374	J301	J304	MVS 0.5, 2-CONDUCTOR	B	MVVS	CAN-L
375	J302	J310	MVS 0.5, 2-CONDUCTOR	GY	MVVS	CONNECT WITH 0.5 Gy
376	J303	CLUSTRER GAUGE 7	0.5	W	MVVS	CAN-H, CAN-L TWISTING
377	J304	CLUSTER GAUGE 8	0.5	B	MVVS	CAN-H, CAN-L TWISTING
378	J303	CAN TERMINATOR	0.5	W		CAN-H, CAN-L TWISTING
379	J304	CAN TERMINATOR	0.5	B		CAN-H, CAN-L TWISTING
381	MAIN CONTROLLER C1P6	J305	0.5	W		CAN-1H
382	MAIN CONTROLLER C1P7	J306	0.5	B		CAN-1L
383	MAIN CONTROLLER C1P13	J307	MVS 0.5, 2-CONDUCTOR	Gr		CONNECT WITH 0.5 Gy
384	J305	J308	0.5	W		CAN-1H
385	J306	J309	0.5	B		CAN-1L
386						
387	J308	CONTROLLER INPUT UNIT C1P3	0.5	W		CAN-H, CAN-L TWISTING
388	J309	CONTROLLER INPUT UNIT C1P4	0.5	B		CAN-H, CAN-L TWISTING
389	J308	CAN TERMINATOR	0.5	W		CAN-H, CAN-L TWISTING
390	J309	CAN TERMINATOR	0.5	B		CAN-H, CAN-L TWISTING
391	J303	MAIN AUXILIARY TOOL CONNECTOR H	0.5	W		CAN-H, CAN-L TWISTING
392	J304	MAIN AUXILIARY TOOL CONNECTOR L	0.5	B		CAN-H, CAN-L TWISTING
393	J305	J312	MVS 0.5, 2-CONDUCTOR	W	MVVS	CAN-1H
394	J306	J313	MVS 0.5, 2-CONDUCTOR	B	MVVS	CAN-1L
395	J307	J311	MVS 0.5, 2-CONDUCTOR	Gr		CONNECT WITH 0.5 Gy
396	J312	CONTROLLER OUTPUT UNIT C1P3	0.5	W		CAN-H, CAN-L TWISTING
397	J313	CONTROLLER OUTPUT UNIT C1P4	0.5	B		CAN-H, CAN-L TWISTING
398	J312	CAN TERMINATOR, 1	0.5	W		CAN-H, CAN-L TWISTING
399	J313	CAN TERMINATOR, 2	0.5	B		CAN-H, CAN-L TWISTING
401	J85	SG, GROUND	8	B	AV	
402	J85	J86	1.25	B		
404	J86	D9, 2	1.25	B		
405	J85	J87	1.25	B		
406	J87	BATTERY RELAY COIL -	1.25	B		
407	J87	D2, 2	0.85	B		
408	J85	J88	1.25	B		
409	J88	HIGH FLOW SOL -	0.85	B		
410	J88	D19,2	0.85	B		
415	J88	REAR LIGHT (R) -	0.85	B		
416	J88	HORN -	0.85	B		
417	J86	GROW RELAY COIL -	0.85	B		
419	J93	BODY GROUND 1	5	B	AVS	
420	J85	J89	5	B	AVS	
421	J89	J90	2	B		
422	J90	CAB CN54-1, 6	2	B		
423	J90	SEAT SW, 2	0.85	B		
424	J90	J91	1.25	B		
425	J91	ARM FLOAT SOL, 2	0.85	B		
426	J91	D18, 2	0.85	B		
427	J90	ARM LOWER PRESSURE SW, 2	0.85	B		
428	J90	ARM RAISE PRESSURE SW, 1	0.85	B		
429	J89	J92	1.25	B		
430	J92	AUXILIARY 1-WAY SOL, 2	0.85	B		
431	J92	D14, 2	0.85	B		
432	J92	AIR CLEANER CLOGGING DETECTOR SW, 2	0.85	B		
433	J89	J93	5	B	AVS	
434	J93	BODY GROUND 2	5	B	AVS	
435	JG4	AUXILIARY TOOL CONNECTOR GND	0.85	B		
436	J90	AIR SUSPENSION POWER SUPPLY (-)	1.25	B		
437	JG4	CLUSTER GROUND	0.5	B		
438	JG4	FUEL SENDER, 2	0.85	B		
439	J93	J94	5	B		
440	JG4	CONTROLLER OUTPUT UNIT C1P1	0.5	B		
443	J94	MAIN RELAY 2 COIL -	0.85	B		
444	J94	CN2-2	5	B		
455	JG4	MAIN AUXILIARY TOOL CONNECTOR GND	0.85	B		
456	J93	J95	3	B	AVS	
457	JG4	MAIN CONTROLLER C1P1	0.5	B		
458	JG4	CONTROLLER INPUT UNIT C1P1	0.5	B		
459	J95	J96	1.25	B		
460	J96	CONTROLLER RELAY COIL -	0.5	B		
461	J96	LEVER LOCK RELAY COIL -	0.5	B		
462	J96	HORN RELAY COIL -	0.5	B		
463	J96	WARNING BUZZER, 2	0.5	B		
464	J96	SECURITY CONNECTOR, 8	1.25	B		
466	J93	J97	3	B	AVS	
467	J97	J98	1.25	B		
468	J98	MAINTENANCE SOCKET GROUND	1.25	B		
469	J98	POWER SUPPLY SOCKET GROUND	1.25	B		

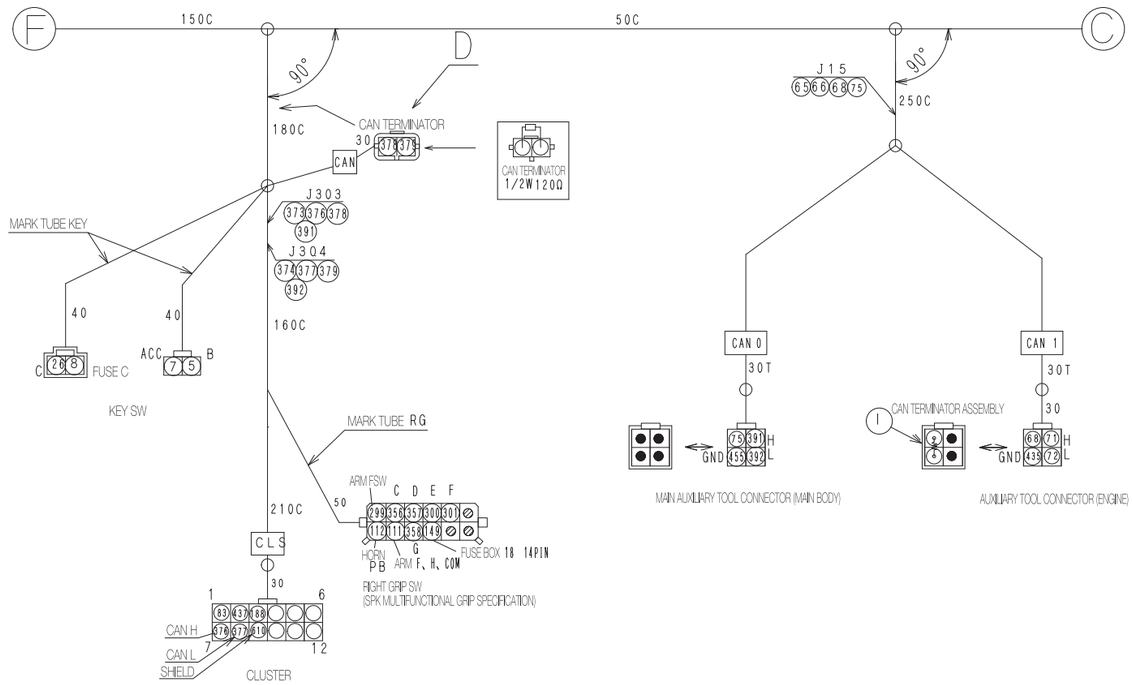
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No.	FROM NAME	TO NAME	SIZE	COLOR	TYPE	REMARKS
470	J97	J99	1.25	B		
471	J99	LEVER LOCK SOL -	0.85	B		
472	J99	D13, 2	0.85	B		
473	J97	J100	1.25	B		
474	J100	2nd TRAVEL SPEED SOL -	0.85	B		
475	J100	D15, 2	0.85	B		
477	J97	J101	3	B	AVS	
478	J101	14P CONNECTOR POWER SUPPLY -	2	B		
479	JG4	HYDRAULIC OIL TEMPERATURE SENSOR, 2	0.85	B		
480	J101	14P RELAY COIL GROUND	0.85	B		
481	J101	QUICK-HITCH LIMIT SW GROUND	0.85	B		
482	J101	QUICK-HITCH CLOSE SOL -	0.85	B		
483	J101	QUICK-HITCH CLOSE SOL -	0.85	B		
484	BODY GROUND	REAR LIGHT L GROUND	1.25	B		
485	J101	FUEL FEED PUMP -	0.85	B		
487						
493	J97	SW BOX COM -	1.25	B		
499	J98	2nd TRAVEL SPEED SW -	0.85	B		
500	J98	LEFT Gr AB COM -	0.85	B		
501						
502						
506	J95	CHARGE CHECK RELAY NO	0.85	B		
600	CAB CN54-1, 1	JS1	1.25	L		
601	SECURITY CONNECTOR, 3	J75	1.25	RW		FUSE 10
602	1 WAY SW, 1	J36	0.85	Br		FUSE 17
603	1 WAY SW, 4	JS8	0.85	B		
604	1 WAY SW, 6	JS8	0.85	B		
605	DETENT SW, 1	JS8	0.85	B		
606	DETENT SW, 3	JS8	0.85	B		
607						
608	QUICK-HITCH SW, 2	JS8	0.85	B		
609	MAIN CONTROLLER C1P29	J400	0.5	YB		C1P29: KEY SW ACC
610	CLUSTER, 9	J310	0.5	GY	MVVS	SHIELD
611	D4, 1	J94	0.85	B		D4 A
612	D4, 2	J27	0.85	V		D4 K
613	DIODE, 1	JS1	1.25	L		
614	DIODE, 2	F-BOX, 17	1.25	Br		FUSE 17 IN
615	DIODE, 3	JS2	2	Br		
616	GND SG, 1	JG4	8	B	AV	SG, GROUND
617	J14	J401	0.85	YB		RADIO ACC
618						
620	J93	JS8	1.25	B		
621	LIGHT SW F1, 2	JS1	1.25	L		
622	LIGHT SW R1, 2	JS2	2	Br		
623	CONTROLLER OUTPUT UNIT C1P5	J311	0.5	Gr		OX_C1P5: SHIELD
624	J36	J74	0.5	Br	AVSS	
625	CONTROLLER OUTPUT UNIT C2P3	DETENT SW, 4	0.5	Br	AVSS	



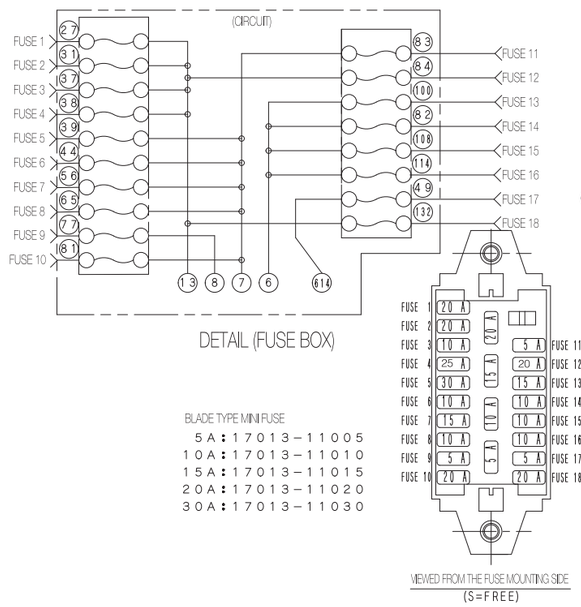


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Main harness 06642-00070 (CCV heater specification)

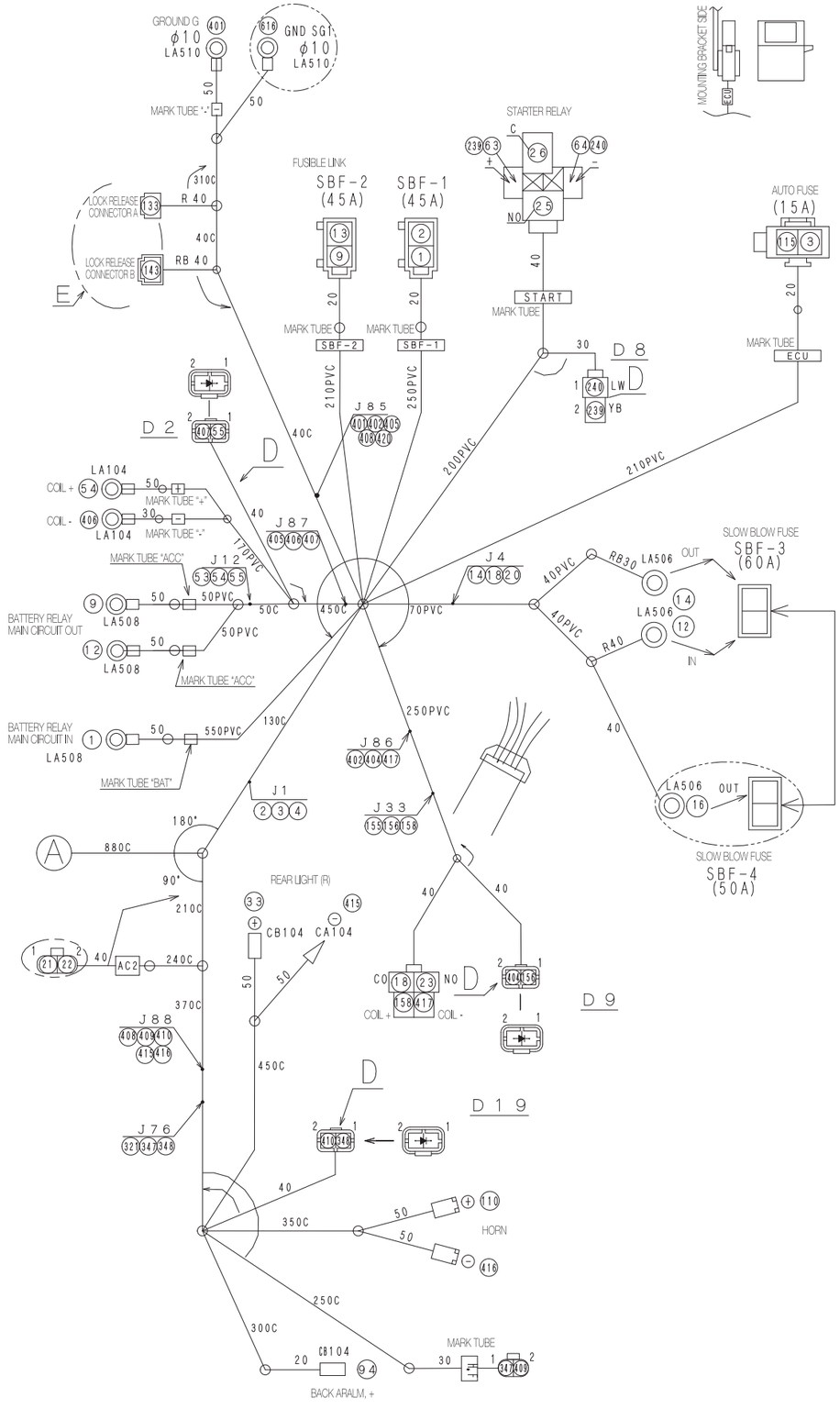


NO.	STANDARD	PART NAME	MATERIAL	Q'TY	WEIGHT	REMARKS
6	06993-00018	FUSE LABEL		1		
5	06993-00017	FUSE LABEL		1		
4	06993-04068	FUSE LABEL		1		
3	17012-04920	FUSE BOX		1		
2	03942-21010	SHORT CONNECTOR		1		
1	06942-05690	CAN TERMINATOR A' SSY		1		

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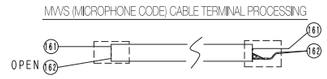
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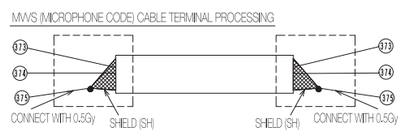
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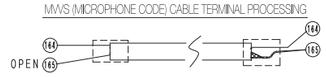
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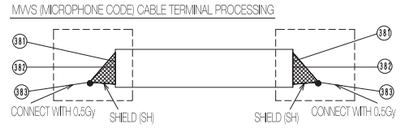
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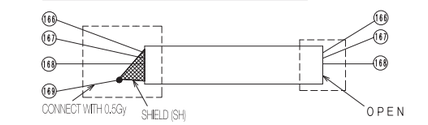
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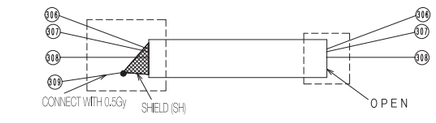
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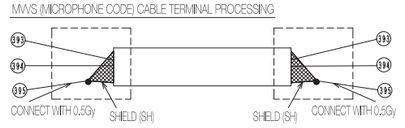
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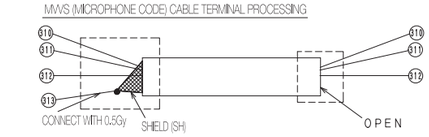
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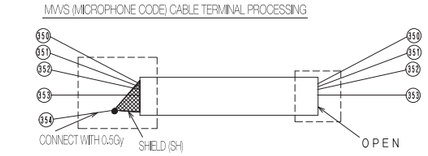
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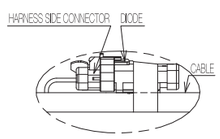
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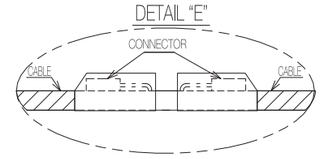
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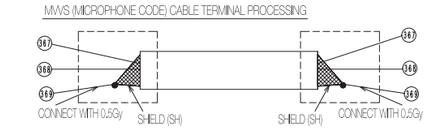
DETAIL "D"



DETAIL "E"



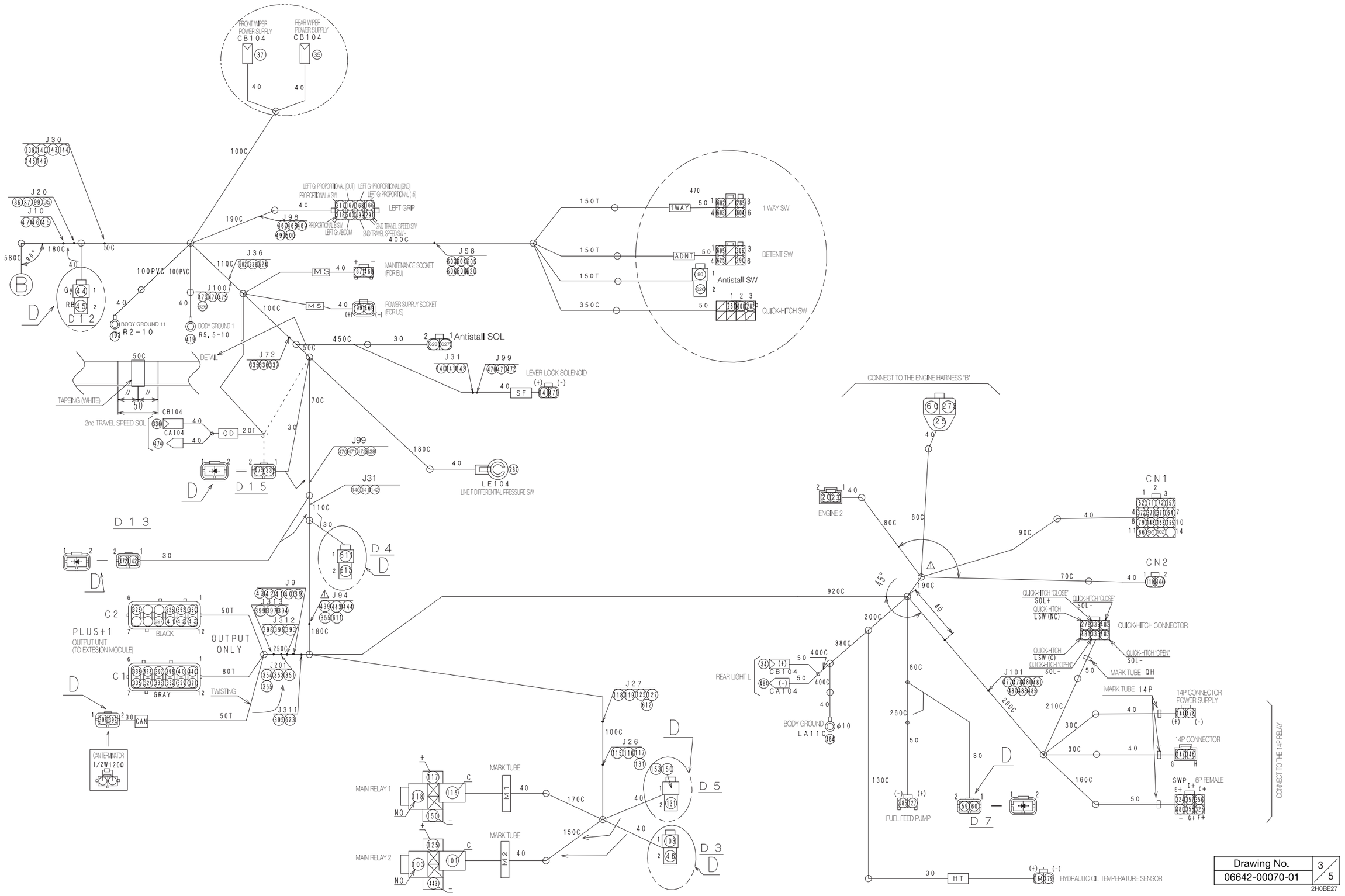
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Drawing No.	3/5
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	FROM NAME	TO NAME	SIZE	COLOR	TYPE	RAMARKS
1	BAT RELAY, MAIN CIRCUIT IN	SBF-1, IN	5	W	AVS	
2	SBF-1, OUT	J1	5	R	AVS	
3	J1	FUSE BLOCK 15A, IN	5	R	AVS	
4	J1	J2	5	R	AVS	BAT
5	J2	KEY SW, B	5	R	AVS	+B
6	J2	FUSE BOX, IN	5	R	AVS	+B
7	KEY SW, ACC	FUSE BOX, IN	5	W	AVS	
8	KEY SW , C	FUSE BOX, IN	3	WR	AVX	
9	BAT RELAY, MAIN CIRCUIT OUT 1	SBF-2, IN	5	R	AVS	
10						
11						
12	BAT RELAY, MAIN CIRCUIT OUT 2	SBF-3, IN	8	R	AV	
13	SBF-2, OUT	ALT LOAD, IN	5	Y	AVS	
14	SBF-3, OUT	J4	8	W	AV	
15						
16	SBF4, OUT	J3	5	L	AVX	
17						
18	J4	GROW RELAY C	5	W	AVS	
19						
20	J4	ENGINE 2, 2	8	W	AVX	
21	AC CLUTCH, 1	AC2, 1	1.25	W		
22	AC COND, 1	AC2, 2	2	Y		
23	GROW RELAY NO	ENGINE 2, 1	5	Y	AVS	
24	AC BLOWER, 1	AC1, 1	2	R		
25	STARTER RELAY, NO	STARTER MOTOR S	3	L	AVX	
26	KEY SW, C	STARTER RELAY, C	3	W	AVX	
27	FUSE BOX, F1	LIGHT SW F1, 1	2	R		
28	AC BLOWER, 2	J3	5	L	AVX	
29	AC CLUTCH, 2	J3	5	L	AVX	
30	AC COND, 2	J3	5	L	AVX	
31	FUSE BOX, F2	LIGHT SW R1, 1	2	W		
32	JS2	J8	2	Br		
33	J8	REAR LIGHT R	1.25	Br		
34	J8	REAR LIGHT L	1.25	Br		
35	J20	REAR WIPER POWER SUPPLY +	1.25	Y		
37	FUSE BOX, F3	FRONT WIPER POWER SUPPLY +	1.25	Br		
38	FUSE BOX, F4	J103	1.25	R		
39	FUSE BOX, F5	J9	3	P	AVS	
40	J9	CONTROLLER OUTPUT UNIT C1P2	0.5	P		
41	J9	CONTROLLER OUTPUT UNIT C2P10	0.5	P		
42	J9	CONTROLLER OUTPUT UNIT C2P11	0.5	P		
43	J9	CONTROLLER OUTPUT UNIT C2P12	0.5	P		
44	FUSE BOX, F6	D12, 1	1.25	Gy		BATTERY RELAY +
45	D12, 2	J10	0.85	RB		
46	J10	D3, 2	0.85	RB		FROM MAIN RELAY
47	J10	J11	0.85	RB		
48	J11	D10, 1	0.85	RB		CONTROLLER RELAY +
49	FUSE BOX, F17	J34	0.85	Br		
50	D10, 2	CONTROLLER RELAY +	0.85	RW		CONTROLLER RELAY +
51	CONTROLLER +	D11, 2	0.5	RW		CONTROLLER RELAY +
52	D12, 1	MAIN CONTROLLER C1P30	0.5	RL		CONTROLLER RELAY BKUP
53	J11	J12	0.85	RB		
54	J12	BATTERY RELAY COIL +	0.85	RB		
55	J12	DIODE UNIT, K	0.85	RB		BATTERY RELAY SURGE KILLER
56	FUSE BOX, F7	J13	0.85	YB		
57	J13	J400	0.85	YB		
58	J13	J14	0.85	YB		
59	J14	D7, 2	0.85	Gy		ALT. 1G CHECK
60	D7, 1	OLTERNATOR IG	0.85	YB		
61	J401	ENGINE STOP SW, 2	0.85	YB		
62	ENGINE STOP SW, 3	CN1-1	0.85	YR		
63	J14	STARTER RELAY +	0.85	YB		
64	STARTER RELAY (-)	CN1-8	0.85	LW		
65	FUSE BOX, F8	J15	1.25	RB		
66	J15	CN1-13	1.25	RB		
68	J15	AUXILIARY TOOL CONNECTOR	0.85	RB		
71	AUXILIARY TOOL CONNECTOR H	CN1-2	0.5	W		CAN-H CAN-L TWISTING
72	AUXILIARY TOOL CONNECTOR L	CN1-3	0.5	B		CAN-H CAN-L TWISTING
74						
75	J15	MAIN AUXILIARY TOOL CONNECTOR	0.85	RB		
76	J34	SW, BOX, R LIGHTING +	0.85	Br		
77	FUSE BOX, F9	SECURITY CONNECTOR, 6	0.85	WY		
78	SECURITY CONNECTOR, 7	J18	0.85	WR		
79	J18	CN1-9	0.85	WR		
80	Antistall SW,1	MAIN CONTROLLER C1P28	0.5	G		
81	FUSE BOX, F10	J75	0.85	RW		
82	FUSE BOX, F14	SECURITY CONNECTOR, 4	0.85	R		
83	FUSE BOX, F11	CLUSTER ACC +	0.5	G		
84	FUSE BOX, F12	J19	1.25	Lg		
85	J401	CAB CN54-1, 5	1.25	G		
86	J19	J20	1.25	Lg		
87	J20	MAINTENANCE	1.25	Lg		
89	J19	J21	1.25	Lg		
90	J21	PRESSURE SW, R, 2 FOR BACK ALARM	1.25	Lg		
91	J21	PRESSURE SW, L, 2 FOR BACK ALARM	1.25	Lg		
92	PRESSURE SW, R, 1 FOR BACK ALARM	W DIODE UNIT, 1	1.25	LgR		
93	PRESSURE SW, L, 1 FOR BACK ALARM	W DIODE UNIT, 3	1.25	LgR		
94	W DIODE UNIT, 2	BACK BUZZER, +	1.25	W		
95	CN51-6	J103	1.25	R		
96	CN1-14	J103	1.25	R		
98	J75	AIR SUSPENSION POWER SUPPLY (+)	1.25	RW		
99	J20	POWER SUPPLY SOCKET	1.25	Lg		
100	FUSE BOX, F13	CONTROLLER RELAY C	0.85	R		
101	CONTROLLER C	MAIN RELAY 2, C	0.85	R		
102	BODY GROUND11	CN1,15	1.25	B		
103	MAIN RELAY 2, NO	C3, 1	0.85	RB		
104	CONTROLLER NO	J24	0.85	Gy		
105	J24	MAIN CONTROLLER C1P12	0.5	Gy		
106	J24	CONTROLLER INPUT UNIT C1P5	0.5	Gy		
107	J24	CONTROLLER INPUT UNIT C1P2	0.5	Gy		

	FROM NAME	TO NAME	SIZE	COLOR	TYPE	RAMARKS
108	FUSE BOX, F15	J25	0.85	P		
109	J25	HORN RELAY C	0.85	P		
110	HORN RELAY NO	HORN	0.85	PB		
111	J25	RIGHT GRIP SW, ARM F, H, COM	0.85	G		RIGHT GRIP
112	RIGHT GRIP SW, HORN PB	HORN RELAY +	0.5	Br		(+)
113	CONTROLLER RELAY, 3	CHARGE CHECK RELAY COIL +	0.85	Gy		
114	FUSE BOX, F16	CAB CN54-1, 2	1.25	Y		
115	FUSE BLOCK 15A, OUT	J26	5	WR	AVS	
116	J26	MAIN RELAY 1, C	5	WR	AVS	
117	J26	MAIN RELAY 1 +	0.85	WR		
118	MAIN RELAY 1, NO	J27	5	R	AVS	
119	J27	CN2-1	5	R	AVS	
125	J27	MAIN RELAY 2 +	0.85	V		+BP
126	CHARGE CHECK RELAY COIL +	CHARGE CHECK RELAY NC	0.85	Gy		
127	J27	FUEL FEED PUMP	0.85	R		+BP
131	J26	DIODE UNIT, K	0.85	Br		FOR MAIN RELAY 1
132	FUSE BOX, F18	J29	2	R		
133	J29	LOCK RELEASE CONNECTOR A	0.85	R		
134	J29	LEVER LOCK RELAY C	2	R		
135	J29	CAB CN54-1, 4	1.25	GW		
136	CAB CN54-1, 3	SECURITY CONNECTOR, 1	1.25	RB		
137	SECURITY CONNECTOR, 5	MAIN CONTROLLER C1P16	0.5	RL		
138	LEVER LOCK RELAY +	MAIN CONTROLLER C1P50	0.5	RL		
139	LEVER LOCK RELAY NO	J30	2	RW		
140	J30	J31	0.85	RW		
141	J31	LEVER LOCK SOL +	0.85	RW		
142	J31	D13, 1	0.85	RW		
143	J30	LOCK RELEASE CONNDETOR B	0.85	RW		
144	J30	14P CONNECTOR POWER SUPPLY +	2	RW		
145	J30	GH, SW2 POWER SUPPLY +	1.25	RW		
146	GH, SW1	14P CONNECTOR G	1.25	R		
147	GH, SW3	14P CONNECTOR H	1.25	Gy		
148	LEVER LOCK RELAY NC	CN1-10	0.85	RL		
149	J30	RIGHT GRIP SW, + COM	0.85	RW		RIGHT GRIP
150	MAIN RELAY (-)	D5, 1	0.85	RY		
153	D5, 1	CN1-11	0.85	RW		
155	J33	CN1-12	0.85	V		
156	J33	D9, 1	0.85	V		
157	MAIN CONTROLLER C1P15	CN1-4	0.5	BY		GROW LAMP +
158	J33	GROW RELAY COIL +	0.85	V		
161	CONTROLLER INPUT UNIT C1P12	FUEL SENDER, 1	MVS 0.5, SINGLE CONDUCTOR	W	MVVS	
162	J40	OPEN 4	MVS 0.5, SINGLE CONDUCTOR	B		(CONNECT WITH 0.5 B)
163	J40	CONTROLLER INPUT UNIT C1P7	0.5	B		SENSOR GND
164	CONTROLLER INPUT UNIT C1P11	HYDRAULIC OIL TEMPERATURE SENSOR, +	MVS 0.5, SINGLE CONDUCTOR	W	MVVS	
165	J40	OPEN 3	MVS 0.5, SINGLE CONDUCTOR	B		(CONNECT WITH 0.5 B)
166	CONTROLLER INPUT UNIT C1P6	LEFT PROPORTIONAL GRIP	MVS 0.75, 3-CONDUCTOR	R	MVVS	+ 5V OUT
167	CONTROLLER INPUT UNIT C1P10	LEFT PROPORTIONAL GRIP	MVS 0.75, 3-CONDUCTOR	W	MVVS	PROPORTIONAL SIGNAL INPUT
168	J40	LEFT PROPORTIONAL GRIP	MVS 0.75, 3-CONDUCTOR	B	MVVS	
169	J40	OPEN 5	MVS 0.75, 3-CONDUCTOR	Gy		CONNECT WITH 0.5 Gy
188	J34	CLUSTER INTERNAL ILLUMINATION	0.5	Y		
239	STARTER RELAY +	D6, 2	0.85	YB		
240	STARTRR RELAY (-)	D6, 1	0.5	LW		
273	OLTERNATOR L	D8, 2	0.85	L		
274	D8, 1	CHARGE CHECK RELAY COIL -	0.85	LB		
275	DPF FORCED REGENERATION SW, a	MAIN CONTROLLER C1P24	0.5	Br		
276	DPF AUTOMATIC REGENERATION INHIBITION SW, a	MAIN CONTROLLER C1P23	0.5	G		
277	ARM LOWER PRESSURE SW, 1	MAIN CONTROLLER C1P42	0.5	WB		
278	ARM RAISE PRESSURE SW, 2	MAIN CONTROLLER C1P41	0.5	RB		
279	QUICK-HITCH L SW (NC)	MAIN CONTROLLER C1P39	0.5	RB		
281	QUICK-HITCH SW, 1	MAIN CONTROLLER C1P17	0.5	RW		TO CAB UPPER SIDE LEFT SW BOX
282	QUICK-HITCH SW, 3	MAIN CONTROLLER C1P18	0.5	RG		TO CAB UPPER SIDE LEFT SW BOX
283	SEAT SW, 1	MAIN CONTROLLER C1P36	0.5	YB		
284	SEAT SW SHORT CONNECTOR	SEAT SW SHORT CONNECTOR	0.85	L		
285	1-WAY SW, 3	MAIN CONTROLLER C1P44	0.5	BY		TO CAB UPPER SIDE LEFT SW BOX
286	RIGHT SW CN51, 1	MAIN CONTROLLER C1P31	0.5	Y		TO CAB UPPER SIDE LEFT SW BOX
287	LINE DIFFERENTIAL PRESSURE SW, C	MAIN CONTROLLER C1P19	0.5	Br		
288	TRIP DATA SW, c	MAIN CONTROLLER C1P25	0.5	RB		
289	TRIP DATA SW, a	MAIN CONTROLLER C1P26	0.5	RL		
290	DETENT SW, 6	MAIN CONTROLLER C1P34	0.5	W		TO CAB UPPER SIDE LEFT SW BOX
291	2nd TRAVEL SPEED SW, C	MAIN CONTROLLER C1P38	0.5	GW		LEFT GRIP
294	AIR CLEANER CLOGGING DETECTOR SW, 1	MAIN CONTROLLER C1P20	0.5	RG		
296	POWER MODE SW, H	MAIN CONTROLLER C1P46	0.5	P		
297	ECO MODE SW, L	MAIN CONTROLLER C1P47	0.5	PB		
298	1st AUXILIARY FLOW SW, 3	MAIN CONTROLLER C1P43	0.5	LR		
299	RIGHT GRIP SW, ARM FLOAT SW	MAIN CONTROLLER C1P35	0.5	R		
300	RIGHT GRIP SW, E	MAIN CONTROLLER C1P32	0.5	R		
301	RIGHT GRIP SW, F	MAIN CONTROLLER C1P33	0.5	Gr		
302	CHARGE CHECK RELAY C	MAIN CONTROLLER C1P27	0.5	L		
306	FOOT PEDAL SW, VCC1	J56	MVS 0.5, 3-CONDUCTOR	R	MVVS	+5V
307	FOOT PEDAL SW, APS1	MAIN CONTROLLER C1P22	MVS 0.5, 3-CONDUCTOR	W	MVVS	
308	FOOT PEDAL SW, GND 1	J57	MVS 0.5, 3-CONDUCTOR	B	MVVS	
309	J57	OPEN 7	MVS 0.5, 3-CONDUCTOR	GY		CONNECT WITH 0.5 Gy
310	ACCELERATOR SW, VCC1	J56	MVS 0.5, 3-CONDUCTOR	R	MVVS	+5V
311	ACCELERATOR SW, APS1	MAIN CONTROLLER C1P21	MVS 0.5, 3-CONDUCTOR	W	MVVS	
312	ACCELERATOR SW, GND1	J57	MVS 0.5, 3-CONDUCTOR	B	MVVS	
313	J57	OPEN 6	MVS 0.5, 3-CONDUCTOR	GY		CONNECT WITH 0.5 Gy
315	J57	MAIN CONTROLLER C1P9	0.5	B		SENSOR GND
316	J56	MAIN CONTROLLER C1P8	0.5	R		+5V
317	PROPORTIONAL GRIP SW, A	CONTROLLER INPUT UNIT C1P8	0.5	L		LEFT GRIP
318	PROPORTIONAL GRIP SW, B	CONTROLLER INPUT UNIT C1P9	0.5	Br		LEFT GRIP
321	CONTROLLER OUTPUT UNIT C1P12	J76	0.5	L		
322						
324	CONTROLLER OUTPUT UNIT C1P8	14P RELAY E +	0.5	W		
325	CONTROLLER OUTPUT UNIT C2P6	14P RELAY F +	0.5	Y		
329	CONTROLLER OUTPUT UNIT C1P11	J71	0.5	YR		
330	J71	ARM FLOAT SOL, 2	0.85	YR		
331	J71	D18, 1	0.85	YR		
332	CONTROLLER OUTPUT UNIT C1P10	QUICK-HITCH CLOSE SOL, +	0.5	BW		
333	CONTROLLER OUTPUT UNIT C1P9	QUICK-HITCH OPEN SOL, +	0.5	RW		
334	MAIN CONTROLLER C1P40	WARNING BUZZER, 1	0.5	Y		

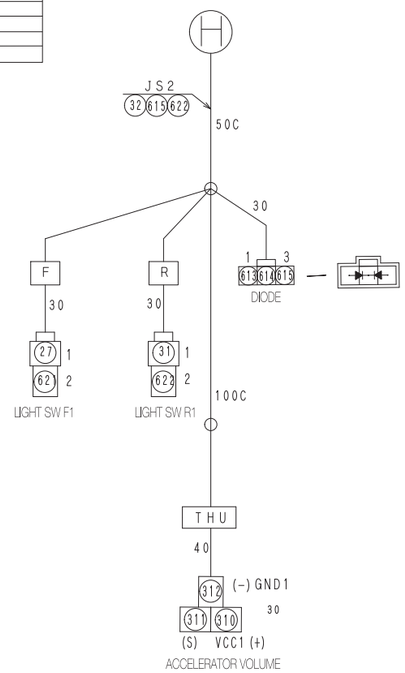
	FROM NAME	TO NAME	SIZE	COLOR	TYPE	RAMARKS
335	CONTROLLER OUTPUT UNIT C1P7	J72	0.5	Br		
336	J72	2nd TRAVEL SPEED SOL, +	0.85	Br		
337	J72	D15, 1	0.85	Br		
338	CONTROLLER OUTPUT UNIT C1P6	J36	0.5	Y		
340						
341	J74	1-WAY SOL, 1	0.85	Y		
342	J74	D14, 1	0.85	Y		
347	J76	HIGH FLOW SOL, 1	0.85	L		
348	J76	D19, 1	0.85	L		
350	CONTROLLER OUTPUT UNIT C2P1	1st PROPORTIONAL SOL, A+	MVVS 0.75, 4-CONDUCTOR	R	MVVS	
351	J201	1st PROPORTIONAL SOL, A-	MVVS 0.75, 4-CONDUCTOR	B	MVVS	
352	CONTROLLER OUTPUT UNIT C2P2	1st PROPORTIONAL SOL, B+	MVVS 0.75, 4-CONDUCTOR	W	MVVS	
353	J201	1st PROPORTIONAL SOL, B-	MVVS 0.75, 4-CONDUCTOR	G	MVVS	
354	J201	OPEN 8	MVS 0.75, 4-CONDUCTOR	GY		CONNECT WITH 0.5 Gy
355	J201	J94	0.85	G		
356	RIGHT GRIP SW, C	14P CONNECTOR C +	0.85	W		
357	RIGHT GRIP SW, D	14P CONNECTOR D +	0.85	V		
358	RIGHT GRIP SW, G	14P CONNECTOR G+	0.85	Y		
367	MAIN CONTROLLER C1P3	J300	MVS 0.5, 2-CONDUCTOR	W	MVVS	CAN-0H
368	MAIN CONTROLLER C1P4	J301	MVS 0.5, 2-CONDUCTOR	B	MVVS	CAN-0L
369	MAIN CONTROLLER C1P5	J302	MVS 0.5, 2-CONDUCTOR	GY	MVVS	CONNECT WITH 0.5 Gy
370	J300	CN1-6	MVS 0.5, 2-CONDUCTOR	W	MVVS	CAN-2H
371	J301	CN1-7	MVS 0.5, 2-CONDUCTOR	B	MVVS	CAN-2L
372	J302	CN1-5	MVS 0.5, 2-CONDUCTOR	GY	MVVS	CONNECT WITH 0.5 Gy
373	J300	J303	MVS 0.5, 2-CONDUCTOR	W	MVVS	CAN-H
374	J301	J304	MVS 0.5, 2-CONDUCTOR	B	MVVS	CAN-L
375	J302	J310	MVS 0.5, 2-CONDUCTOR	GY	MVVS	CONNECT WITH 0.5 Gy
376	J303	CLUSTRER GAUGE 7	0.5	W	MVVS	CAN-H, CAN-L TWISTING
377	J304	CLUSTER GAUGE 8	0.5	B	MVVS	CAN-H, CAN-L TWISTING
378	J303	CAN TERMINATOR	0.5	W		CAN-H, CAN-L TWISTING
379	J304	CAN TERMINATOR	0.5	B		CAN-H, CAN-L TWISTING
381	MAIN CONTROLLER C1P6	J305	0.5	W		CAN-1H
382	MAIN CONTROLLER C1P7	J306	0.5	B		CAN-1L
383	MAIN CONTROLLER C1P13	J307	MVS 0.5, 2-CONDUCTOR	Gr		CONNECT WITH 0.5 Gy
384	J305	J308	0.5	W		CAN-1H
385	J306	J309	0.5	B		CAN-1L
386						
387	J308	CONTROLLER INPUT UNIT C1P3	0.5	W		CAN-H, CAN-L TWISTING
388	J309	CONTROLLER INPUT UNIT C1P4	0.5	B		CAN-H, CAN-L TWISTING
389	J308	CAN TERMINATOR	0.5	W		CAN-H, CAN-L TWISTING
390	J309	CAN TERMINATOR	0.5	B		CAN-H, CAN-L TWISTING
391	J303	MAIN AUXILIARY TOOL CONNECTOR H	0.5	W		CAN-H, CAN-L TWISTING
392	J304	MAIN AUXILIARY TOOL CONNECTOR L	0.5	B		CAN-H, CAN-L TWISTING
393	J305	J312	MVS 0.5, 2-CONDUCTOR	W	MVVS	CAN-1H
394	J306	J313	MVS 0.5, 2-CONDUCTOR	B	MVVS	CAN-1L
395	J307	J311	MVS 0.5, 2-CONDUCTOR	Gr		CONNECT WITH 0.5 Gy
396	J312	CONTROLLER OUTPUT UNIT C1P3	0.5	W		CAN-H, CAN-L TWISTING
397	J313	CONTROLLER OUTPUT UNIT C1P4	0.5	B		CAN-H, CAN-L TWISTING
398	J312	CAN TERMINATOR, 1	0.5	W		CAN-H, CAN-L TWISTING
399	J313	CAN TERMINATOR, 2	0.5	B		CAN-H, CAN-L TWISTING
401	J85	SG, GROUND	8	B	AV	
402	J85	J86	1.25	B		
404	J86	D9, 2	1.25	B		
405	J85	J87	1.25	B		
406	J87	BATTERY RELAY COIL -	1.25	B		
407	J87	D2, 2	0.85	B		
408	J85	J88	1.25	B		
409	J88	HIGH FLOW SOL -	0.85	B		
410	J88	D19,2	0.85	B		
415	J88	REAR LIGHT (R) -	0.85	B		
416	J88	HORN -	0.85	B		
417	J86	GROW RELAY COIL -	0.85	B		
419	J93	BODY GROUND 1	5	B	AVS	
420	J85	J89	5	B	AVS	
421	J89	J90	2	B		
422	J90	CAB CN54-1, 6	2	B		
423	J90	SEAT SW, 2	0.85	B		
424	J90	J91	1.25	B		
425	J91	ARM FLOAT SOL, 2	0.85	B		
426	J91	D18, 2	0.85	B		
427	J90	ARM LOWER PRESSURE SW, 2	0.85	B		
428	J90	ARM RAISE PRESSURE SW, 1	0.85	B		
429	J89	J92	1.25	B		
430	J92	AUXILIARY 1-WAY SOL, 2	0.85	B		
431	J92	D14, 2	0.85	B		
432	J92	AIR CLEANER CLOGGING DETECTOR SW, 2	0.85	B		
433	J89	J93	5	B	AVS	
434	J93	BODY GROUND 2	5	B	AVS	
435	JG4	AUXILIARY TOOL CONNECTOR GND	0.85	B		
436	J90	AIR SUSPENSION POWER SUPPLY (-)	1.25	B		
437	JG4	CLUSTER GROUND	0.5	B		
438	JG4	FUEL SENDER, 2	0.85	B		
439	J93	J94	5	B		
440	JG4	CONTROLLER OUTPUT UNIT C1P1	0.5	B		
443	J94	MAIN RELAY 2 COIL -	0.85	B		
444	J94	CN2-2	5	B		
455	JG4	MAIN AUXILIARY TOOL CONNECTOR GND	0.85	B		
456	J93	J95	3	B	AVS	
457	JG4	MAIN CONTROLLER C1P1	0.5	B		
458	JG4	CONTROLLER INPUT UNIT C1P1	0.5	B		
459	J95	J96	1.25	B		
460	J96	CONTROLLER RELAY COIL -	0.5	B		
461	J96	LEVER LOCK RELAY COIL -	0.5	B		
462	J96	HORN RELAY COIL -	0.5	B		
463	J96	WARNING BUZZER, 2	0.5	B		
464	J96	SECURITY CONNECTOR, 8	1.25	B		
466	J93	J97	3	B	AVS	
467	J97	J98	1.25	B		
468	J98	MAINTENANCE SOCKET GROUND	1.25	B		
469	J98	POWER SUPPLY SOCKET GROUND	1.25	B		

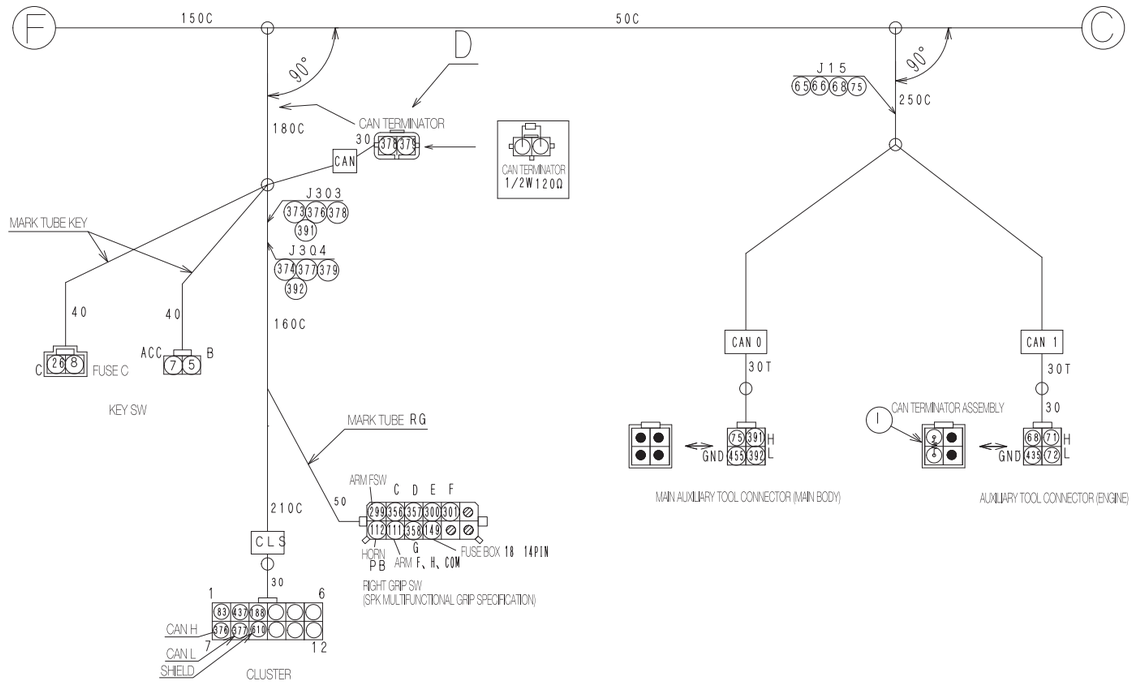
Drawing No.	4/5
06642-00070-01	

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No.	FROM NAME	TO NAME	SIZE	COLOR	TYPE	REMARKS
470	J97	J99	1.25	B		
471	J99	LEVER LOCK SOL -	0.85	B		
472	J99	D13, 2	0.85	B		
473	J97	J100	1.25	B		
474	J100	2nd TRAVEL SPEED SOL -	0.85	B		
475	J100	D15, 2	0.85	B		
477	J97	J101	3	B	AVS	
478	J101	14P CONNECTOR POWER SUPPLY -	2	B		
479	JG4	HYDRAULIC OIL TEMPERATURE SENSOR, 2	0.85	B		
480	J101	14P RELAY COIL GROUND	0.85	B		
481	J101	QUICK-HITCH LIMIT SW GROUND	0.85	B		
482	J101	QUICK-HITCH CLOSE SOL -	0.85	B		
483	J101	QUICK-HITCH CLOSE SOL -	0.85	B		
484	BODY GROUND	REAR LIGHT L GROUND	1.25	B		
485	J101	FUEL FEED PUMP -	0.85	B		
487						
493	J97	SW BOX COM -	1.25	B		
499	J98	2nd TRAVEL SPEED SW -	0.85	B		
500	J98	LEFT Gr AB COM -	0.85	B		
501						
502						
506	J95	CHARGE CHECK RELAY NO	0.85	B		
600	CAB CN54-1, 1	JS1	1.25	L		
601	SECURITY CONNECTOR, 3	J75	1.25	RW		FUSE 10
602	1 WAY SW, 1	J36	0.85	Br		FUSE 17
603	1 WAY SW, 4	JS8	0.85	B		
604	1 WAY SW, 6	JS8	0.85	B		
605	DETENT SW, 1	JS8	0.85	B		
606	DETENT SW, 3	JS8	0.85	B		
607						
608	QUICK-HITCH SW, 2	JS8	0.85	B		
609	MAIN CONTROLLER C1P29	J400	0.5	YB		C1P29: KEY SW ACC
610	CLUSTER, 9	J310	0.5	GY	MVVS	SHIELD
611	D4, 1	J94	0.85	B		D4 A
612	D4, 2	J27	0.85	V		D4 K
613	DIODE, 1	JS1	1.25	L		
614	DIODE, 2	F-BOX, 17	1.25	Br		FUSE 17 IN
615	DIODE, 3	JS2	2	Br		
616	GND SG, 1	JG4	8	B	AV	SG, GROUND
617	J14	J401	0.85	YB		RADIO ACC
620	J93	JS8	1.25	B		
621	LIGHT SW F1, 2	JS1	1.25	L		
622	LIGHT SW R1, 2	JS2	2	Br		
623	CONTROLLER OUTPUT UNIT C1P5	J311	0.5	Gr		OX_C1P5: SHIELD
624	J36	J74	0.5	Br	AVSS	
625	CONTROLLER OUTPUT UNIT C2P3	DETENT SW, 4	0.5	Br	AVSS	
626	J100	Antistall SW,2	0.5	B		
627	CONTROLLER OUTPUT UNIT C2P9	Antistall SOL,1	0.5	R		
628	J100	Antistall SOL,2	0.5	B		



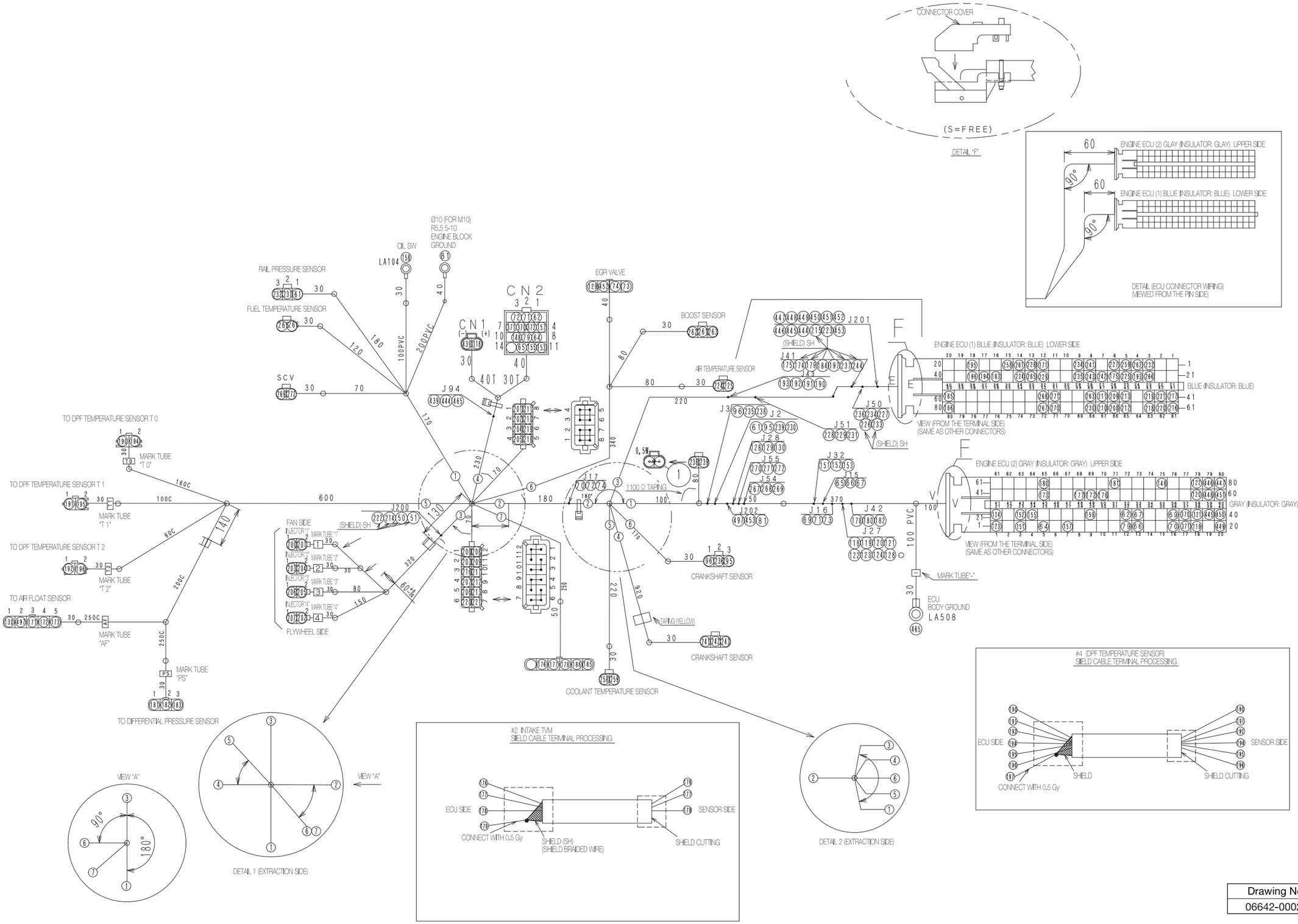


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Wire harness (for the engine) 06642-00022



Drawing No.	1/3
06642-00022	

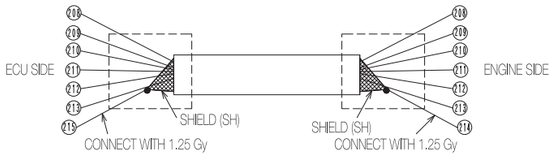
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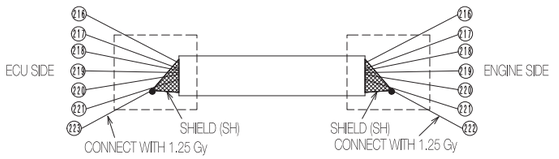
NO.	FROM NAME	TO NAME	SIZE	COLOR	REMARKS
62	CN2-1	ENGINE ECU, V32	0.5	YR	ENGINE STOP SW, 3
63					
64	CN2-8	ENGINE ECU, V05	0.85	LW	STARTER RELAY (-)
65	CN2-13	J15	1.25	RB	FUSE BOX, F8
66	J15	ENGINE ECU, V13	0.85	RB	
67	J15	ENGINE ECU, V33	0.85	RB	
68					
69	ENGINE ECU, V36	J16	0.5	R	
70	ENGINE ECU, V16	J17	0.5	W	
71	J16	CN2-2	0.5	R	CAN-H CAN-L TWISTING
72	J17	CN2-3	0.5	W	CAN-H CAN-L TWISTING
73	J16	ENGINE EGR, V1	0.5	R	CAN-H CAN-L TWISTING
74	J17	ENGINE EGR, V2	0.5	W	CAN-H CAN-L TWISTING
75					
76					
77					
78					
79	CN2-9	ENGINE ECU, V12	0.85	WR	
80					
81	J202	ENGINE GROUND	3	B	
82					
83					
116					
117					
118	CN1-1	J27	5	R	MAIN RELAY 1, NO
119	J27	ENGINE ECU, V18	0.85	R	+ BP
120	J27	ENGINE ECU, V58	0.85	R	+ BP
121	J27	ENGINE ECU, V38	0.85	R	+ BP
122	J27	ENGINE ECU, V78	0.85	R	+ BP
123	J27	ENGINE ECU, V01	0.85	R	+ BP
124	J27	ENGINE ECU, V21	0.85	R	+ BP
152					
126					
127					
128	J27	J28	2	R	+ BP
129	J28	ENGINE EGR, V4	2	R	+ BP
130	J28	AIR FLOW SENSOR 1	0.5	R	B +
131					
148	CN2-10	ENGINE ECU, V75	0.85	RL	LEVER LOCK RELAY NC
149					
150					
151	J32	ENGINE ECU, V03	0.85	RW	
152	J32	ENGINE ECU, V23	0.85	RW	
153	J32	CN2-11	0.85	RW	DIODE UNIT, A
154					
155	CN2-12	ENGINE ECU, V24	0.85	V	
156					
157	ENGINE ECU, V07	CN2-4	0.5	BY	GROW LAMP +
158	ENGINE ECU, V29	ENGINE OIL SW	0.85	GB	
159					
171	ENGINE ECU, E12	AIR FLOW SENSOR 3	AVSSXCS 0.5f 3-CONDUCTOR	B	SIG (KUBOTA SIDE 69)
172	ENGINE ECU, V49	AIR FLOW SENSOR 4	AVSSXCS 0.5f 3-CONDUCTOR	W	TEMP SENSOR -
173	ENGINE ECU,V45	AIR FLOW SENSOR 5	AVSSXCS 0.5f 3-CONDUCTOR	R	TEMP SENSOR -
174	J41	SHIELD	AVSSXCS 0.5f 3-CONDUCTOR	SH	CONNECT WITH 0.5 Gy
175	ENGINE ECU, E26	J41	0.85	Gy	(KUBOTA SIDE E55)
176	ENGINE ECU, V50	INTAKE TVM 5	AVSSHCS-5 0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	R	
177	ENGINE ECU, V48	INTAKE TVM 4	AVSSHCS-5 0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	W	
178	J42	INTAKE TVM 3	AVSSHCS-5 0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	B	
179	J41	SHIELD	AVSSHCS-5 0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	SH	CONNECT WITH 0.5 Gy
180	J42	ENGINE ECU, V65	0.85	Gy	
181	ENGINE ECU, V71	DIFFERENTIAL PRESSURE SENSOR 1	AVSSXCS 0.5f 3-CONDUCTOR	B	VCC +
182	J42	DIFFERENTIAL PRESSURE SENSOR 2	AVSSXCS 0.5f 3-CONDUCTOR	W	GND
183	ENGINE ECU, E36	DIFFERENTIAL PRESSURE SENSOR 3	AVSSXCS 0.5f 3-CONDUCTOR	R	SIG (KUBOTA SIDE E45)
184	J41	SHIELD	AVSSXCS 0.5f 3-CONDUCTOR	SH	CONNECT WITH 0.5 Gy
185	ENGINE ECU, E60	INTAKE TVM 1	0.85	L	(KUBOTA SIDE E21)
186	ENGINE ECU, E80	INTAKE TVM 2	0.85	Or	(KUBOTA SIDE E01)
187					
188					
189					
190	DPF TEMPERATURE SENSOR T 0 GROUND	J43	AVSSXCS 0.5f 6-CONDUCTOR	L	
191	DPF TEMPERATURE SENSOR T 1 GROUND	J43	AVSSXCS 0.5f 6-CONDUCTOR	W	
192	DPF TEMPERATURE SENSOR T 2 GROUND	J43	AVSSXCS 0.5f 6-CONDUCTOR	B	
193	ENGINE ECU, E24	J43	0.85	B	(KUBOTA SIDE E57)
194	ENGINE ECU, E37	DPF, TEMPERATURE SENSOR T 0	AVSSXCS 0.5f 6-CONDUCTOR	Y	(KUBOTA SIDE E44)
195	ENGINE ECU, E18	DPF, TEMPERATURE SENSOR T 1	AVSSXCS 0.5f 6-CONDUCTOR	G	(KUBOTA SIDE E63)
196	ENGINE ECU, E38	DPF, TEMPERATURE SENSOR T 2	AVSSXCS 0.5f 6-CONDUCTOR	R	(KUBOTA SIDE E43)
197	J41	SHIELD	AVSSXCS 0.5f 6-CONDUCTOR	SH	CONNECT WITH 0.5 Gy
198					
199					

NO.	FROM NAME	TO NAME	SIZE	COLOR	REMARKS
200	INJECTOR 1, 1	JOINT CONNECTOR CN1-1	AVSSB 1.25 4-CONDUCTOR [YAZAKI 181T9303441]	R	
201	INFECTOR 1, 2	JOINT CONNECTOR CN2-1	AVSSB 1.25 4-CONDUCTOR [YAZAKI 181T9303441]	B	
202	JOINT CONNECTOR CN2-2	INJECTOR 4, 2	AVSSB 1.25 4-CONDUCTOR [YAZAKI 181T9303441]	W	
207	INJECTOR 4, 1	JOINT CONNECTOR CN1-4	AVSSB 1.25 4-CONDUCTOR [YAZAKI 181T9303441]	G	
50	SHIELD	J200	AVSSB 1.25 4-CONDUCTOR [YAZAKI 181T9303441]	SH	CONNECT WITH 1.25 Gy
203	INJECTOR 2, 1	JOINT CONNECTOR CN1-2	AVSSB 1.25 4-CONDUCTOR [YAZAKI 181T9303441]	R	
204	INJECTOR 2, 2	JOINT CONNECTOR CN2-3	AVSSB 1.25 4-CONDUCTOR [YAZAKI 181T9303441]	B	
205	JOINT CONNECTOR CN2-4	INJECTOR 3, 2	AVSSB 1.25 4-CONDUCTOR [YAZAKI 181T9303441]	W	
206	INJECTOR 3, 1	JOINT CONNECTOR CN1-5	AVSSB 1.25 4-CONDUCTOR [YAZAKI 181T9303441]	G	
51	SHIELD	J200	AVSSB 1.25 4-CONDUCTOR [YAZAKI 181T9303441]	SH	CONNECT WITH 1.25 Gy
208	JOINT CONNECTOR CN1-12	ENGINE ECU, E66	MVVS 0.75 6-CONDUCTOR	R	(KUBOTA SIDE E15)
209	JOINT CONNECTOR CN1-11	ENGINE ECU, E46	MVVS 0.75 6-CONDUCTOR	G	(KUBOTA SIDE E35)
210	JOINT CONNECTOR CN2-7	ENGINE ECU, E67	MVVS 0.75 6-CONDUCTOR	Y	(KUBOTA SIDE E14)
211	JOINT CONNECTOR CN2-8	ENGINE ECU, E47	MVVS 0.75 6-CONDUCTOR	L	(KUBOTA SIDE E34)
212	JOINT CONNECTOR CN1-9	ENGINE ECU, E65	MVVS 0.75 6-CONDUCTOR	B	(KUBOTA SIDE E16)
213	JOINT CONNECTOR CN1-8	ENGINE ECU, E45	MVVS 0.75 6-CONDUCTOR	W	(KUBOTA SIDE E36)
214	J200	SHIELD (ENGINE SIDE)	MVVS 0.75 6-CONDUCTOR	SH	CONNECT WITH 1.25 Gy
215	J201	SHIELD (ECM SIDE)	MVVS 0.75 6-CONDUCTOR	SH	CONNECT WITH 1.25 Gy
216	JOINT CONNECTOR CN1-3	ENGINE ECU, E61	MVVS 0.75 6-CONDUCTOR	R	(KUBOTA SIDE E20)
217	JOINT CONNECTOR CN1-10	ENGINE ECU, E41	MVVS 0.75 6-CONDUCTOR	G	(KUBOTA SIDE E40)
218	JOINT CONNECTOR CN2-5	ENGINE ECU, E63	MVVS 0.75 6-CONDUCTOR	Y	(KUBOTA SIDE E18)
219	JOINT CONNECTOR CN2-6	ENGINE ECU, E43	MVVS 0.75 6-CONDUCTOR	L	(KUBOTA SIDE E38)
220	JOINT CONNECTOR CN1-6	ENGINE ECU, E62	MVVS 0.75 6-CONDUCTOR	B	(KUBOTA SIDE E19)
221	JOINT CONNECTOR CN1-7	ENGINE ECU, E42	MVVS 0.75 6-CONDUCTOR	W	(KUBOTA SIDE E39)
222	J200	SHIELD (ENGINE SIDE)	MVVS 0.75 6-CONDUCTOR	SH	CONNECT WITH 1.25 Gy
223	J201	SHIELD (ECM SIDE)	MVVS 0.75 6-CONDUCTOR	SH	CONNECT WITH 1.25 Gy
224	ENGINE ECU, E34	AIR TEMPERATURE SENSOR	AVSSHCS-0.5f 2-CONDUCTOR	R	(KUBOTA SIDE E47)
225	ENGINE ECU, E25	AIR TEMPERATURE SENSOR	AVSSHCS-0.5f 2-CONDUCTOR	W	(KUBOTA SIDE E56)
226	J50	SHIELD	AVSSHCS-0.5f 2-CONDUCTOR	SH	CONNECT WITH 0.5 Gy
227	ENGINE ECU, E06	J50	0.85	Gy	(KUBOTA SIDE E75)
228	ENGINE ECU, E13	J51	0.85	W	(KUBOTA SIDE E68)
229	ENGINE ECU, E32	J51	0.85	W	(KUBOTA SIDE E49)
230	ENGINE ECU, E68	J2	0.85	R	(KUBOTA SIDE E13)
234	J50	ENGINE ECU, E09	0.85	Gy	(KUBOTA SIDE E72)
235	ENGINE ECU, E29	J3	0.85	B	(KUBOTA SIDE E52)
238	J3	RESISTOR 1100 Ω	0.5	B	CAVS (TWISTING)
239	J2	RESISTOR 1100 Ω	0.5	R	CAVS (TWISTING)
61	J2	RAIL PRESSURE SENSOR 1	AVSSHCS-0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	R	(KUBOTA SIDE E13)
231	J51	RAIL PRESSURE SENSOR 2	AVSSHCS-0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	W	(KUBOTA SIDE E68, E49)
232	ENGINE ECU, E03	RAIL PRESSURE SENSOR 3	AVSSHCS-0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	B	(KUBOTA SIDE E78)
233	J50	SHIELD	AVSSHCS-0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	SH	CONNECT WITH 0.5 Gy
236	J50	CRANKSHAFT SENSOR 2	AVSSHCS-0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	W	(KUBOTA SIDE E72)
96	J3	CRANKSHAFT SENSOR 1	AVSSHCS-0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	B	(KUBOTA SIDE E52)
95	J2	CRANKSHAFT SENSOR 3	AVSSHCS-0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	R	(KUBOTA SIDE E13)
237	J41	SHIELD	AVSSHCS-0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	SH	CONNECT WITH 0.5 Gy
241	ENGINE ECU, E08	CAMSHAFT SENSOR 1	AVSSHCS-0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	R	(KUBOTA SIDE E73)
242	ENGINE ECU, E27	CAMSHAFT SENSOR 2	AVSSHCS-0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	W	(KUBOTA SIDE E54)
243	ENGINE ECU, E28	CAMSHAFT SENSOR 3	AVSSHCS-0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	B	(KUBOTA SIDE E53)
244	J41	SHIELD	AVSSHCS-0.5f 3-CONDUCTOR [YAZAKI 181F2101627]	SH	CONNECT WITH 0.5 Gy
245					
246					
247					
248					
249					
250					
251					
252					
253					
254					
255					
256					
257					
258	ENGINE ECU, E15	COOLANT TEMPERATURE SENSOR	0.85	L	(KUBOTA SIDE E66)
259	ENGINE ECU, E05	COOLANT TEMPERATURE SENSOR	0.85	Gy	(KUBOTA SIDE E76)
260					
261	ENGINE ECU, E14	BOOST SENSOR 1	0.85	WR	(KUBOTA SIDE E67)
262	ENGINE ECU, E04	BOOST SENSOR 2	0.85	WB	(KUBOTA SIDE E77)
263	ENGINE ECU, E48	BOOST SENSOR 3	0.85	Gy	(KUBOTA SIDE E33)
264					
265	ENGINE ECU, E33	FUEL TEMPERATURE	0.85	GB	(KUBOTA SIDE E48)
266	ENGINE ECU, E23	FUEL TEMPERATURE	0.85	GW	(KUBOTA SIDE E58)
267	ENGINE ECU, E72	J54	0.85	Gy	(KUBOTA SIDE E09)
268	ENGINE ECU, E52	J54	0.85	Gy	(KUBOTA SIDE E29)
269	J54	SCV +	0.85	Gy	
270	ENGINE ECU, E71	J55	0.85	BR	(KUBOTA SIDE E10)
271	ENGINE ECU, E51	J55	0.85	BR	(KUBOTA SIDE E30)
272	J55	SCV -	0.85	BR	
273					
370	ENGINE ECU, V37	CN2-6	MVVS 0.5 2-CONDUCTOR	W	CAN-2H
371	ENGINE ECU, V17	CN2-7	MVVS 0.5 2-CONDUCTOR	B	CAN-2L
372	SHIELD	CN2-5	MVVS 0.5 2-CONDUCTOR	SH	CONNECT WITH 0.5 Gy
373					
374					
438					
439	CN1-2	J94	5	B	
440					
441					
442					
443					
444	J94	J201	5	B	
445	J201	ENGINE ECU, V39	0.5	B	
446	J201	ENGINE ECU, V79	0.5	B	
447	J201	ENGINE ECU, V80	0.5	B	
448	J201	ENGINE ECU, V59	0.5	B	
449	J201	ENGINE ECU, V20	0.5	B	
450	J201	ENGINE ECU, V40	0.5	B	
451	J201	ENGINE ECU, V60	0.5	B	
452	J201	ENGINE EGR, V3	2	B	
453	J201	J202	5	B	
454					
455					
465	J94	ECU BODY GROUND	5	B	
466					
494					
495					
496					
497	J202	AIR FLOW SENSOR 2	0.5	B	
498					

#7 (INJECTOR)
SHIELD CABLE TERMINAL PROCESSING



#8 (INJECTOR)
SHIELD CABLE TERMINAL PROCESSING

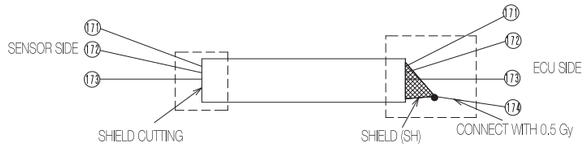


Drawing No.	2/3
06642-00022	

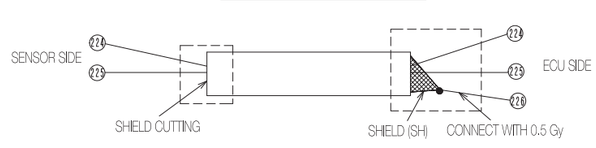
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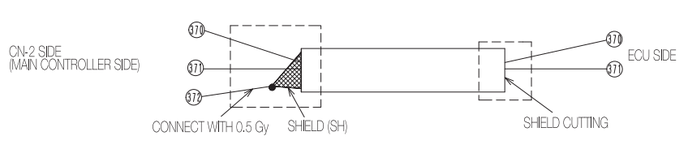
#1 (AIR FLOW SENSOR)
SHIELD CABLE TERMINAL PROCESSING



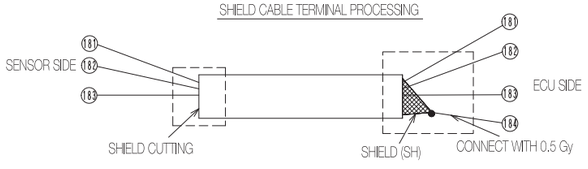
#9 (AIR TEMPERATURE SENSOR)
SHIELD CABLE TERMINAL PROCESSING



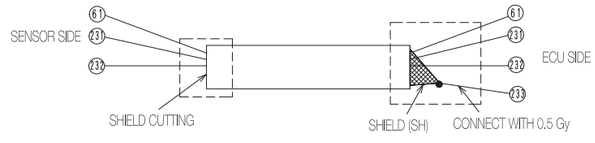
#13 (CAN WIRING)
SHIELD CABLE TERMINAL PROCESSING



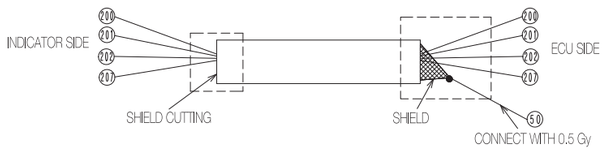
#3 (DIFFERENTIAL PRESSURE SENSOR)
SHIELD CABLE TERMINAL PROCESSING



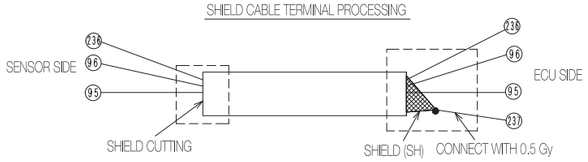
#10 (RAIL PRESSURE SENSOR)
SHIELD CABLE TERMINAL PROCESSING



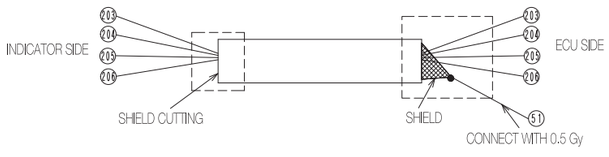
#5 (INDICATOR)
SHIELD CABLE TERMINAL PROCESSING



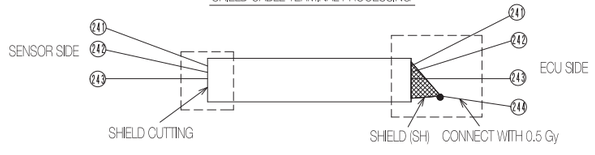
#11 (CRANKSHAFT SENSOR)
SHIELD CABLE TERMINAL PROCESSING



#6 (INDICATOR)
SHIELD CABLE TERMINAL PROCESSING



#12 (CAMSHAFT SENSOR)
SHIELD CABLE TERMINAL PROCESSING

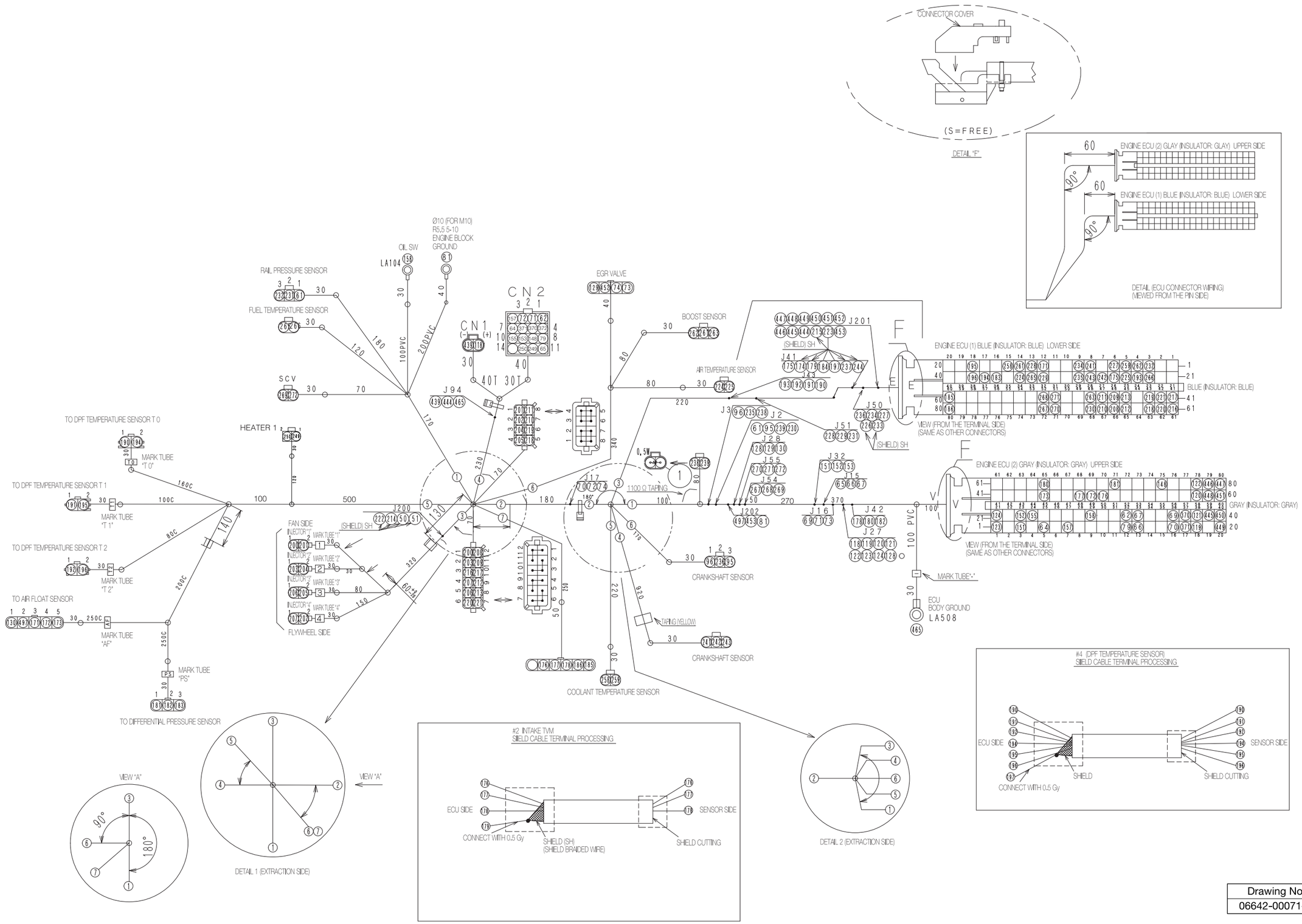


Drawing No.	3/3
06642-00022	

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Wire harness (for the engine) 06642-00071-01 (CCV heater specification)



Drawing No.	1/3
06642-00071-01	

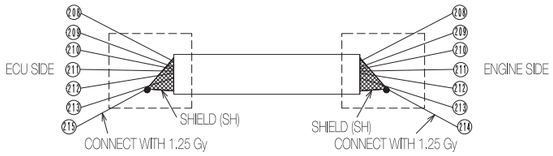
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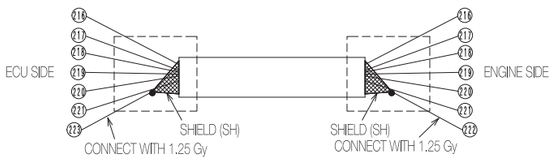
NO.	FROM NAME	TO NAME	SIZE	COLOR	REMARKS
62	CN2-1	ENGINE ECU, V32	0.5	YR	ENGINE STOP SW, 3
63					
64	CN2-8	ENGINE ECU, V05	0.85	LW	STARTER RELAY (-)
65	CN2-13	J15	1.25	RB	FUSE BOX, F8
66	J15	ENGINE ECU, V13	0.85	RB	
67	J15	ENGINE ECU, V33	0.85	RB	
68					
69	ENGINE ECU, V36	J16	0.5	R	
70	ENGINE ECU, V16	J17	0.5	W	
71	J16	CN2-2	0.5	R	CAN-H CAN-L TWISTING
72	J17	CN2-3	0.5	W	CAN-H CAN-L TWISTING
73	J16	ENGINE EGR, V1	0.5	R	CAN-H CAN-L TWISTING
74	J17	ENGINE EGR, V2	0.5	W	CAN-H CAN-L TWISTING
75					
76					
77					
78					
79	CN2-9	ENGINE ECU, V12	0.85	WR	
80					
81	J202	ENGINE GROUND	3	B	
82					
83					
116					
117					
118	CN1-1	J27	5	R	MAIN RELAY 1, NO
119	J27	ENGINE ECU, V18	0.85	R	+ BP
120	J27	ENGINE ECU, V58	0.85	R	+ BP
121	J27	ENGINE ECU, V38	0.85	R	+ BP
122	J27	ENGINE ECU, V78	0.85	R	+ BP
123	J27	ENGINE ECU, V01	0.85	R	+ BP
124	J27	ENGINE ECU, V21	0.85	R	+ BP
152					
126					
127					
128	J27	J28	2	R	+ BP
129	J28	ENGINE EGR, V4	2	R	+ BP
130	J28	AIR FLOW SENSOR 1	0.5	R	B +
131					
148	CN2-10	ENGINE ECU, V75	0.85	RL	LEVER LOCK RELAY NC
149					
150					
151	J32	ENGINE ECU, V03	0.85	RW	
152	J32	ENGINE ECU, V23	0.85	RW	
153	J32	CN2-11	0.85	RW	DIODE UNIT, A
154					
155	CN2-12	ENGINE ECU, V24	0.85	V	
156					
157	ENGINE ECU, V07	CN2-4	0.5	BY	GROW LAMP +
158	ENGINE ECU, V29	ENGINE OIL SW	0.85	GB	
159					
171	ENGINE ECU, E12	AIR FLOW SENSOR 3	AVSSXCS 0.5f 3-CONDUCTOR	B	SIG (KUBOTA SIDE 69)
172	ENGINE ECU, V49	AIR FLOW SENSOR 4	AVSSXCS 0.5f 3-CONDUCTOR	W	TEMP SENSOR -
173	ENGINE ECU,V45	AIR FLOW SENSOR 5	AVSSXCS 0.5f 3-CONDUCTOR	R	TEMP SENSOR -
174	J41	SHIELD	AVSSXCS 0.5f 3-CONDUCTOR	SH	CONNECT WITH 0.5 Gy
175	ENGINE ECU, E26	J41	0.85	Gy	(KUBOTA SIDE E55)
176	ENGINE ECU, V50	INTAKE TVM 5	AVSSHCS-S 0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	R	
177	ENGINE ECU, V48	INTAKE TVM 4	AVSSHCS-S 0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	W	
178	J42	INTAKE TVM 3	AVSSHCS-S 0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	B	
179	J41	SHIELD	AVSSHCS-S 0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	SH	CONNECT WITH 0.5 Gy
180	J42	ENGINE ECU, V65	0.85	Gy	
181	ENGINE ECU, V71	DIFFERENTIAL PRESSURE SENSOR 1	AVSSXCS 0.5f 3-CONDUCTOR	B	VCC +
182	J42	DIFFERENTIAL PRESSURE SENSOR 2	AVSSXCS 0.5f 3-CONDUCTOR	W	GND
183	ENGINE ECU, E36	DIFFERENTIAL PRESSURE SENSOR 3	AVSSXCS 0.5f 3-CONDUCTOR	R	SIG (KUBOTA SIDE E45)
184	J41	SHIELD	AVSSXCS 0.5f 3-CONDUCTOR	SH	CONNECT WITH 0.5 Gy
185	ENGINE ECU, E60	INTAKE TVM 1	0.85	L	(KUBOTA SIDE E21)
186	ENGINE ECU, E80	INTAKE TVM 2	0.85	Or	(KUBOTA SIDE E01)
187					
188					
189					
190	DPF TEMPERATURE SENSOR T 0 GROUND	J43	AVSSXCS 0.5f 6-CONDUCTOR	L	
191	DPF TEMPERATURE SENSOR T 1 GROUND	J43	AVSSXCS 0.5f 6-CONDUCTOR	W	
192	DPF TEMPERATURE SENSOR T 2 GROUND	J43	AVSSXCS 0.5f 6-CONDUCTOR	B	
193	ENGINE ECU, E24	J43	0.85	B	(KUBOTA SIDE E57)
194	ENGINE ECU, E37	DPF, TEMPERATURE SENSOR T 0	AVSSXCS 0.5f 6-CONDUCTOR	Y	(KUBOTA SIDE E44)
195	ENGINE ECU, E18	DPF, TEMPERATURE SENSOR T 1	AVSSXCS 0.5f 6-CONDUCTOR	G	(KUBOTA SIDE E63)
196	ENGINE ECU, E38	DPF, TEMPERATURE SENSOR T 2	AVSSXCS 0.5f 6-CONDUCTOR	R	(KUBOTA SIDE E43)
197	J41	SHIELD	AVSSXCS 0.5f 6-CONDUCTOR	SH	CONNECT WITH 0.5 Gy
198					
199					

NO.	FROM NAME	TO NAME	SIZE	COLOR	REMARKS
200	INJECTOR 1, 1	JOINT CONNECTOR CN1-1	AVSSS 1.25 4-CONDUCTOR YAZAKI 181T9303A11	R	
201	INFECTOR 1, 2	JOINT CONNECTOR CN2-1	AVSSS 1.25 4-CONDUCTOR YAZAKI 181T9303A11	B	
202	JOINT CONNECTOR CN2-2	INJECTOR 4, 2	AVSSS 1.25 4-CONDUCTOR YAZAKI 181T9303A11	W	
207	INJECTOR 4, 1	JOINT CONNECTOR CN1-4	AVSSS 1.25 4-CONDUCTOR YAZAKI 181T9303A11	G	
50	SHIELD	J200	AVSSS 1.25 4-CONDUCTOR YAZAKI 181T9303A11	SH	CONNECT WITH 1.25 Gy
203	INJECTOR 2, 1	JOINT CONNECTOR CN1-2	AVSSS 1.25 4-CONDUCTOR YAZAKI 181T9303A11	R	
204	INJECTOR 2, 2	JOINT CONNECTOR CN2-3	AVSSS 1.25 4-CONDUCTOR YAZAKI 181T9303A11	B	
205	JOINT CONNECTOR CN2-4	INJECTOR 3, 2	AVSSS 1.25 4-CONDUCTOR YAZAKI 181T9303A11	W	
206	INJECTOR 3, 1	JOINT CONNECTOR CN1-5	AVSSS 1.25 4-CONDUCTOR YAZAKI 181T9303A11	G	
51	SHIELD	J200	AVSSS 1.25 4-CONDUCTOR YAZAKI 181T9303A11	SH	CONNECT WITH 1.25 Gy
208	JOINT CONNECTOR CN1-12	ENGINE ECU, E66	MVVS 0.75 6-CONDUCTOR	R	(KUBOTA SIDE E15)
209	JOINT CONNECTOR CN1-11	ENGINE ECU, E46	MVVS 0.75 6-CONDUCTOR	G	(KUBOTA SIDE E35)
210	JOINT CONNECTOR CN2-7	ENGINE ECU, E67	MVVS 0.75 6-CONDUCTOR	Y	(KUBOTA SIDE E14)
211	JOINT CONNECTOR CN2-8	ENGINE ECU, E47	MVVS 0.75 6-CONDUCTOR	L	(KUBOTA SIDE E34)
212	JOINT CONNECTOR CN1-9	ENGINE ECU, E65	MVVS 0.75 6-CONDUCTOR	B	(KUBOTA SIDE E16)
213	JOINT CONNECTOR CN1-8	ENGINE ECU, E45	MVVS 0.75 6-CONDUCTOR	W	(KUBOTA SIDE E36)
214	J200	SHIELD (ENGINE SIDE)	MVVS 0.75 6-CONDUCTOR	SH	CONNECT WITH 1.25 Gy
215	J201	SHIELD (ECM SIDE)	MVVS 0.75 6-CONDUCTOR	SH	CONNECT WITH 1.25 Gy
216	JOINT CONNECTOR CN1-3	ENGINE ECU, E61	MVVS 0.75 6-CONDUCTOR	R	(KUBOTA SIDE E20)
217	JOINT CONNECTOR CN1-10	ENGINE ECU, E41	MVVS 0.75 6-CONDUCTOR	G	(KUBOTA SIDE E40)
218	JOINT CONNECTOR CN2-5	ENGINE ECU, E63	MVVS 0.75 6-CONDUCTOR	Y	(KUBOTA SIDE E18)
219	JOINT CONNECTOR CN2-6	ENGINE ECU, E43	MVVS 0.75 6-CONDUCTOR	L	(KUBOTA SIDE E38)
220	JOINT CONNECTOR CN1-6	ENGINE ECU, E62	MVVS 0.75 6-CONDUCTOR	B	(KUBOTA SIDE E19)
221	JOINT CONNECTOR CN1-7	ENGINE ECU, E42	MVVS 0.75 6-CONDUCTOR	W	(KUBOTA SIDE E39)
222	J200	SHIELD (ENGINE SIDE)	MVVS 0.75 6-CONDUCTOR	SH	CONNECT WITH 1.25 Gy
223	J201	SHIELD (ECM SIDE)	MVVS 0.75 6-CONDUCTOR	SH	CONNECT WITH 1.25 Gy
224	ENGINE ECU, E34	AIR TEMPERATURE SENSOR	AVSSHCS-0.5f 2-CONDUCTOR	R	(KUBOTA SIDE E47)
225	ENGINE ECU, E25	AIR TEMPERATURE SENSOR	AVSSHCS-0.5f 2-CONDUCTOR	W	(KUBOTA SIDE E56)
226	J50	SHIELD	AVSSHCS-0.5f 2-CONDUCTOR	SH	CONNECT WITH 0.5 Gy
227	ENGINE ECU, E06	J50	0.85	Gy	(KUBOTA SIDE E75)
228	ENGINE ECU, E13	J51	0.85	W	(KUBOTA SIDE E68)
229	ENGINE ECU, E32	J51	0.85	W	(KUBOTA SIDE E49)
230	ENGINE ECU, E68	J2	0.85	R	(KUBOTA SIDE E13)
234	J50	ENGINE ECU, E09	0.85	Gy	(KUBOTA SIDE E72)
235	ENGINE ECU, E29	J3	0.85	B	(KUBOTA SIDE E52)
238	J3	RESISTOR 1100 Ω	0.5	B	CAVS (TWISTING)
239	J2	RESISTOR 1100 Ω	0.5	R	CAVS (TWISTING)
61	J2	RAIL PRESSURE SENSOR 1	AVSSHCS-0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	R	(KUBOTA SIDE E13)
231	J51	RAIL PRESSURE SENSOR 2	AVSSHCS-0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	W	(KUBOTA SIDE E68, E49)
232	ENGINE ECU, E03	RAIL PRESSURE SENSOR 3	AVSSHCS-0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	B	(KUBOTA SIDE E78)
233	J50	SHIELD	AVSSHCS-0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	SH	CONNECT WITH 0.5 Gy
236	J50	CRANKSHAFT SENSOR 2	AVSSHCS-0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	W	(KUBOTA SIDE E72)
96	J3	CRANKSHAFT SENSOR 1	AVSSHCS-0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	B	(KUBOTA SIDE E52)
95	J2	CRANKSHAFT SENSOR 3	AVSSHCS-0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	R	(KUBOTA SIDE E13)
237	J41	SHIELD	AVSSHCS-0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	SH	CONNECT WITH 0.5 Gy
241	ENGINE ECU, E08	CAMSHAFT SENSOR 1	AVSSHCS-0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	R	(KUBOTA SIDE E73)
242	ENGINE ECU, E27	CAMSHAFT SENSOR 2	AVSSHCS-0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	W	(KUBOTA SIDE E54)
243	ENGINE ECU, E28	CAMSHAFT SENSOR 3	AVSSHCS-0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	B	(KUBOTA SIDE E53)
244	J41	SHIELD	AVSSHCS-0.5f 3-CONDUCTOR YAZAKI 181F2101ZZ	SH	CONNECT WITH 0.5 Gy
245					
246					
247					
248					
249	CN2-14	HEATER 1	0.85	R	
250	HEATER 2	CN2-15	0.85	B	
251					
252					
253					
254					
255					
256					
257					
258	ENGINE ECU, E15	COOLANT TEMPERATURE SENSOR	0.85	L	(KUBOTA SIDE E66)
259	ENGINE ECU, E05	COOLANT TEMPERATURE SENSOR	0.85	Gy	(KUBOTA SIDE E76)
260					
261	ENGINE ECU, E14	BOOST SENSOR 1	0.85	WR	(KUBOTA SIDE E67)
262	ENGINE ECU, E04	BOOST SENSOR 2	0.85	WB	(KUBOTA SIDE E77)
263	ENGINE ECU, E48	BOOST SENSOR 3	0.85	Gy	(KUBOTA SIDE E33)
264					
265	ENGINE ECU, E33	FUEL TEMPERATURE	0.85	GB	(KUBOTA SIDE E48)
266	ENGINE ECU, E23	FUEL TEMPERATURE	0.85	GW	(KUBOTA SIDE E58)
267	ENGINE ECU, E72	J54	0.85	Gy	(KUBOTA SIDE E09)
268	ENGINE ECU, E52	J54	0.85	Gy	(KUBOTA SIDE E29)
269	J54	SCV +	0.85	Gy	
270	ENGINE ECU, E71	J55	0.85	BR	(KUBOTA SIDE E10)
271	ENGINE ECU, E51	J55	0.85	BR	(KUBOTA SIDE E30)
272	J55	SCV -	0.85	BR	
273					
370	ENGINE ECU, V37	CN2-6	MVVS 0.5 2-CONDUCTOR	W	CAN-2H
371	ENGINE ECU, V17	CN2-7	MVVS 0.5 2-CONDUCTOR	B	CAN-2L
372	SHIELD	CN2-5	MVVS 0.5 2-CONDUCTOR	SH	CONNECT WITH 0.5 Gy
373					
374					
438					
439	CN1-2	J94	5	B	
440					
441					
442					
443					
444	J94	J201	5	B	
445	J201	ENGINE ECU, V39	0.5	B	
446	J201	ENGINE ECU, V79	0.5	B	
447	J201	ENGINE ECU, V80	0.5	B	
448	J201	ENGINE ECU, V59	0.5	B	
449	J201	ENGINE ECU, V20	0.5	B	
450	J201	ENGINE ECU, V40	0.5	B	
451	J201	ENGINE ECU, V60	0.5	B	
452	J201	ENGINE EGR, V3	2	B	
453	J201	J202	5	B	
454					
455					
465	J94	ECU BODY GROUND	5	B	
466					
494					
495					
496					
497	J202	AIR FLOW SENSOR 2	0.5	B	
498					

#7 (INJECTOR)
SHIELD CABLE TERMINAL PROCESSING



#8 (INJECTOR)
SHIELD CABLE TERMINAL PROCESSING

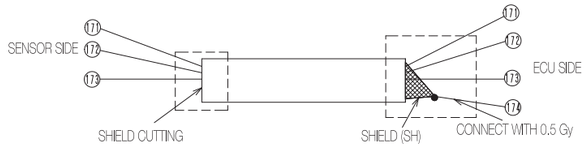


Drawing No.	2/3
06642-00071-01	

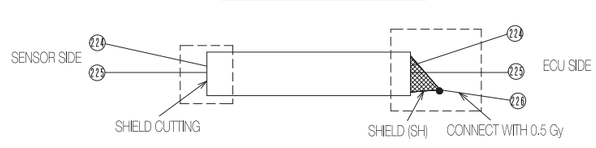
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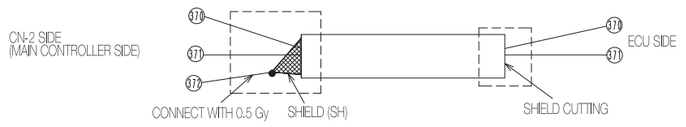
#1 (AIR FLOW SENSOR)
SHIELD CABLE TERMINAL PROCESSING



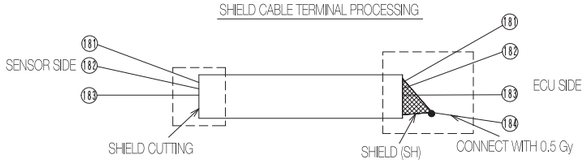
#9 (AIR TEMPERATURE SENSOR)
SHIELD CABLE TERMINAL PROCESSING



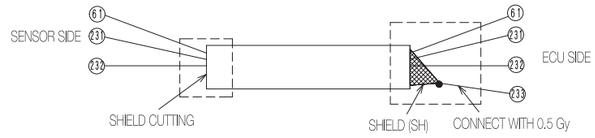
#13 (CAN WIRING)
SHIELD CABLE TERMINAL PROCESSING



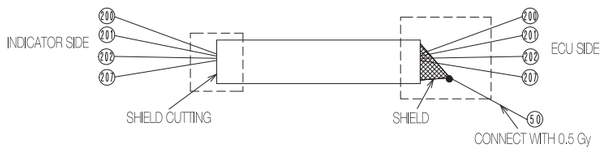
#3 (DIFFERENTIAL PRESSURE SENSOR)
SHIELD CABLE TERMINAL PROCESSING



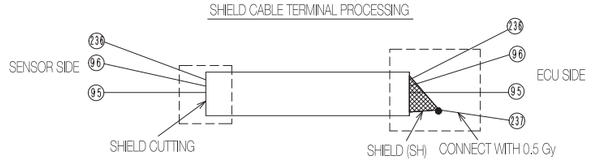
#10 (RAIL PRESSURE SENSOR)
SHIELD CABLE TERMINAL PROCESSING



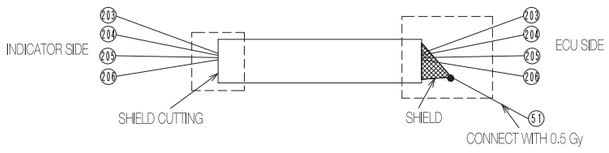
#5 (INDICATOR)
SHIELD CABLE TERMINAL PROCESSING



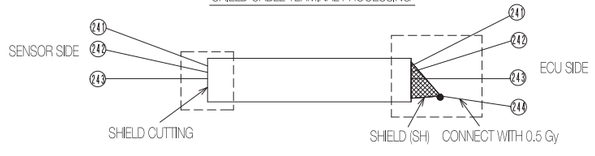
#11 (CRANKSHAFT SENSOR)
SHIELD CABLE TERMINAL PROCESSING



#6 (INDICATOR)
SHIELD CABLE TERMINAL PROCESSING



#12 (CAMSHAFT SENSOR)
SHIELD CABLE TERMINAL PROCESSING

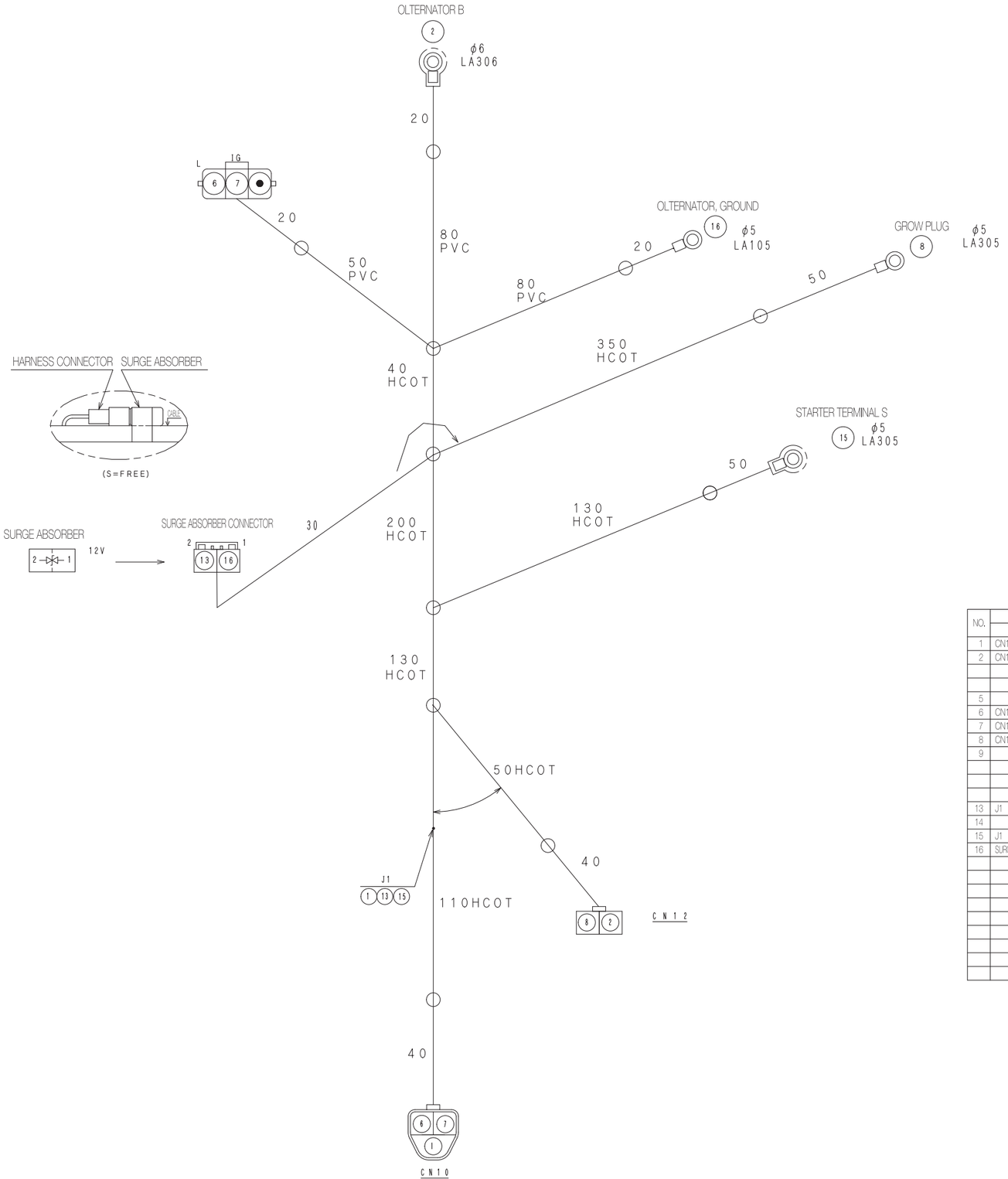


Drawing No.	3/3
06642-00071-01	

2H0BE32

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Wire harness 06642-00023



NO.	FROM NAME		TO NAME		SIZE	COROR	REMARKS
1	CN10		J1		3	L	
2	CN11		ALTERNATOR B		8	W	
5							
6	CN10		ALTERNATOR L		0.85	L	
7	CN10		ALTERNATOR IG		0.85	YB	
8	CN12		GROW PLUG		5	Y	
9							
13	J1		SURGE ABSORBER		2	L	
14							
15	J1		STARTER TERMINAL S		3	L	
16	SURGE ABSORBER		GROUND		2	B	

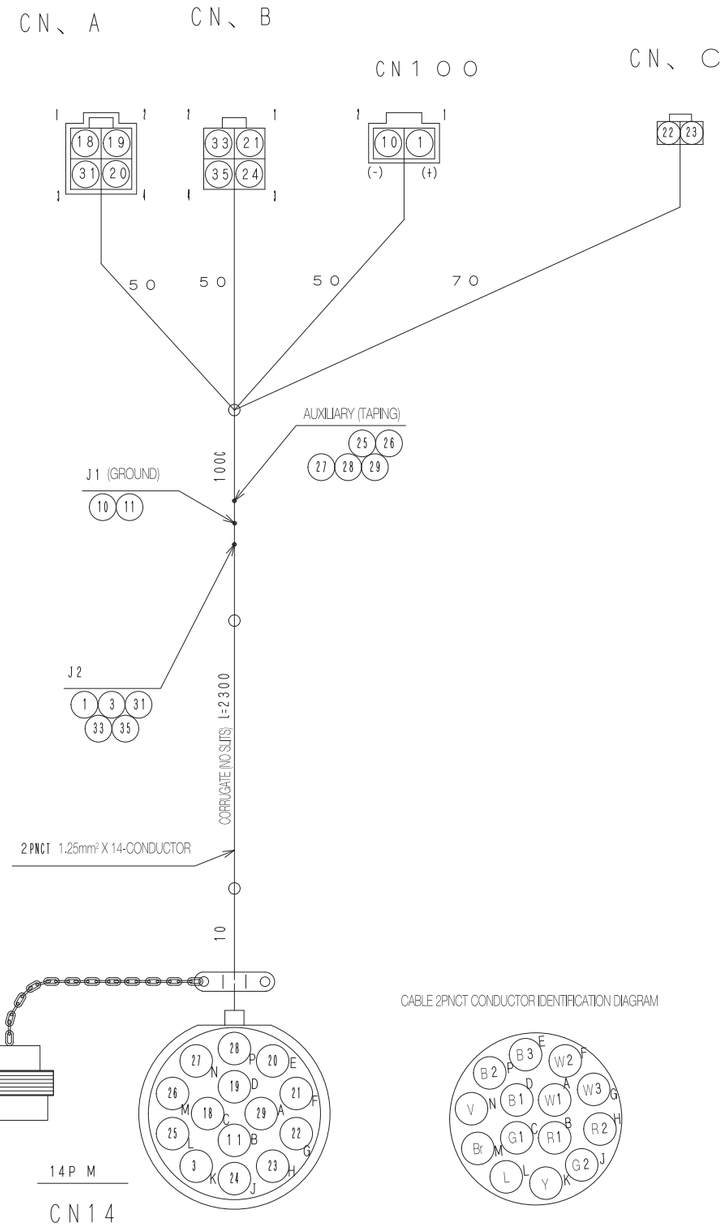
Drawing No.	1/1
06642-00023	

2H0BE12

https://truckmanualshub.com/

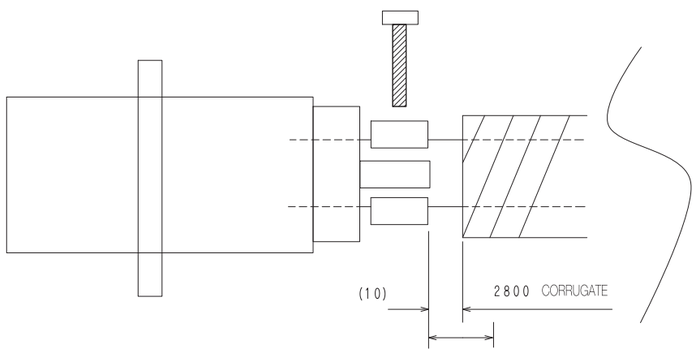
Wire harness 06642-00007

NO.	TYPE	SIZE, COLOR	FROM	TO
1	AVS	2Y	AUXILIARY + (FUSE 18)	JOINT-2
2				
3	2PNCT	1.25 YELLOW	JOINT-2	CN14-K
4				
10	AVS	2B	CN-100, BODY GROUND	JOINT-1 (GROUND)
11	2PNCT	1.25 RED 1	JOINT-1 (GROUND)	CN14-B
13				
14				
15				
16				
17				
18	2PNCT	1.25 GREEN 1	RELAY SW C, C	CN14-C
19		BLACK 1	RELAY SW D, C	CN14-D
20		BLACK 3	RELAY SW E, C	CN14-E
21		WHITE 2	RELAY SW F, C	CN14-F
22		WHITE 3	SW, G-H, 1	CN14-G
23		RED 2	SW, G-H, 4	CN14-H
24		GREEN 2	RELAY SW G, C	CN14-J
25		BULE	AUXILIARY	CN14-L
26		BROWN	AUXILIARY	CN14-M
27		VIOLET	AUXILIARY	CN14-N
28		BLACK 2	AUXILIARY	CN14-P
29		WHITE 1	AUXILIARY	CN14-A
31	AVS	2Y	JOINT-2	RELAY SW C, D NO
33		2Y	JOINT-2	RELAY SW E, F NO
35		2Y	JOINT-2	RELAY SW G, NO



CABLE 2PNCT CONDUCTOR IDENTIFICATION DIAGRAM

CONNECTOR OUTSIDE DRAWING

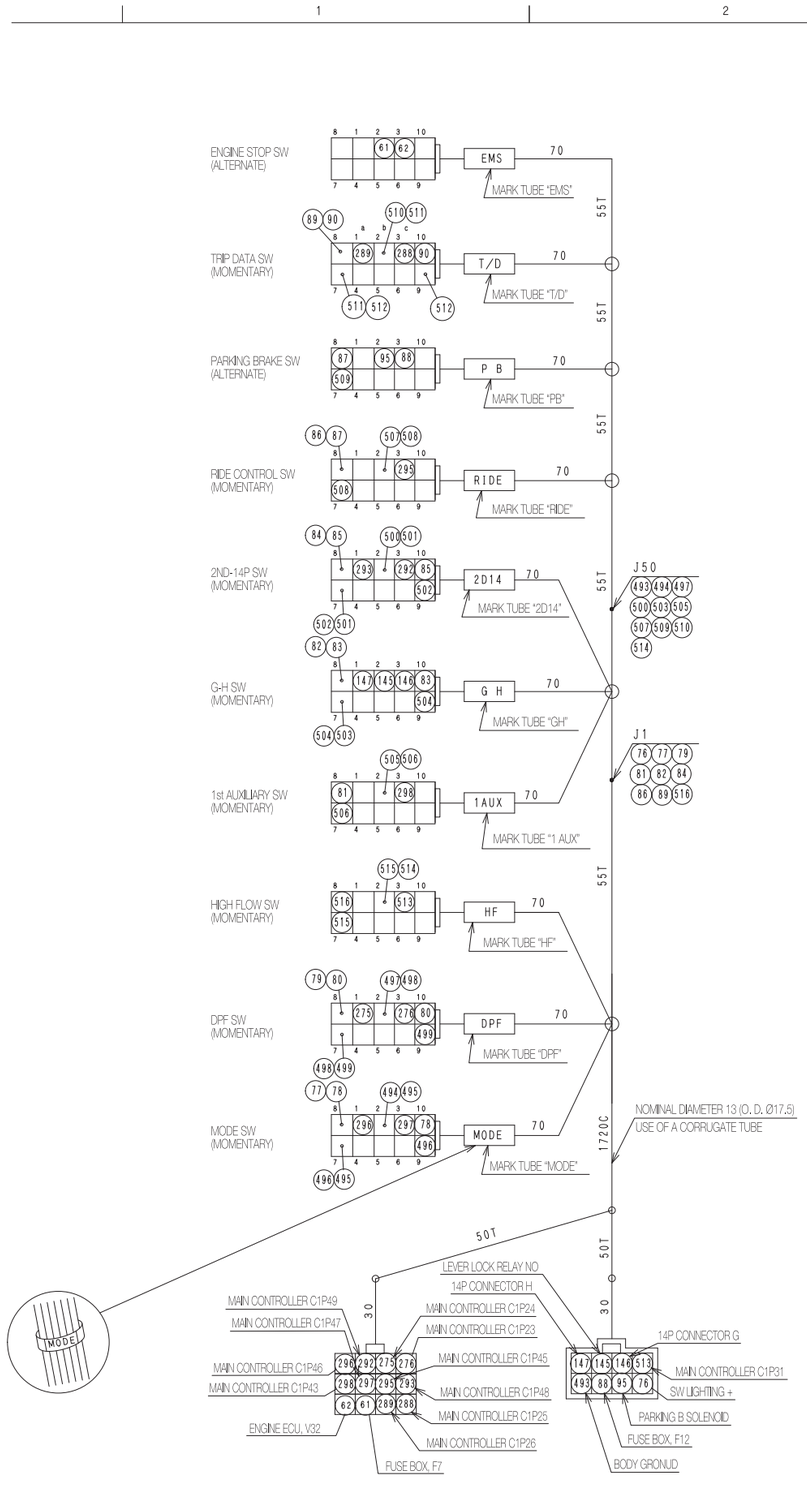


Drawing No.	1/1
06642-00007	

2H0BE13

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Wire harness 06642-00049



NO.	FROM NAME	FROM POSITION	TO NAME	TO POSITION	SIZE	COLOR	REMARKS
61	FUSE BOX, F7	1D	ENGINE STOP SW, 2	1A	0.5	YB	
62	ENGINE STOP SW , 3	1A	ENGINE ECU, V32	1D	0.5	YR	
63							
76	SW, LIGHTING +	2D	J1	2B	0.85	Br	
77	J1	2B	MODE SW, LIGHTING 8	1C	0.5	Br	
78	MODE SW, LIGHTING-8	1C	MODE SW, LIGHTING 10	1C	0.5	Br	
79	J1	2B	DPF, SW, LIGHTING 8	1C	0.5	Br	
80	DPF, SW, LIGHTING 8	1C	DPF, SW, LIGHTING 10	1C	0.5	Br	A
81	J1	2B	1st AUXILIARY SW, LIGHTING 8	1B	0.5	Br	
82	J1	2B	G-H SW, LIGHTING 8	1B	0.5	Br	
83	G-H SW, LIGHTING	1B	G-H SW, LIGHTING 10	1B	0.5	Br	
84	J1	2B	2ND-14P, SW, LIGHTING 8	1B	0.5	Br	
85	2ND-149, SW, LIGHTING 8	1B	2ND-14P, SW, LIGHTING 10	1B	0.5	Br	
86	J1	2B	RIDE CONTROL SW, LIGHTING 8	1B	0.5	Br	
87	RIDE CONTROL SW, LIGHTING 8	1B	PARKING BRAKE SW LIGHTING 8	1A	0.5	Br	
88	FUSE BOX, F12	2D	PARKING B, SW, 3	1A	0.85	Lg	
89	J1	2B	TRIP DATA SW, 8	1A	0.5	Br	
90	TRIP DATA SW, 8	1A	TRIP DATA SW, 10	1A	0.5	Br	
95	PARKING B, SW, 2	1A	PARKING B SOLENOID	2D	0.85	P	
145	LEVER LOCK RELAY NO	2D	GH, SW 2 POWER SUPPLY +	1B	1.25	RW	
146	GH, SW3	1B	14P CONNECTOR G	2D	1.25	R	
147	GH, SW1	1B	14P CONNECTOR H	2D	1.25	Gy	
275	DPF SW1 (FORCED REGENERATION)	1C	MAIN CONTROLLER C1P24	1D	0.5	Br	
276	DPF SW1(AUTOMATIC REGENERATION INHIBITION)	1C	MAIN CONTROLLER C1P23	1D	0.5	G	
288	TRIP DATA SW, 3	1A	MAIN CONTROLLER C1P25	1D	0.5	RB	
289	TRIP DATA SW 1	1A	MAIN CONTROLLER C1P26	1D	0.5	RL	
292	2ND-14P SW, 3	1B	MAIN CONTROLLER C1P49	1D	0.5	RW	
293	2ND-14P SW, 1	1B	MAIN CONTROLLER C1P48	1D	0.5	RL	
295	RIDE CONTROL SW, 3	1B	MAIN CONTROLLER C1P45	1D	0.5	YR	
296	MODE SW, 1 (POWER)	1C	MAIN CONTROLLER C1P46	1D	0.5	P	B
297	MODE SW, 3 (ECO)	1C	MAIN CONTROLLER C1P47	1D	0.5	PB	
298	1st AUXILIARY SW, 3	1B	MAIN CONTROLLER C1P43	1D	0.5	LR	
493	BODY GROUND	2D	J50	2B	1.25	B	
494	J50	2B	MODE SW, 2	1C	0.5	B	
495	MODE SW, 2	1C	MODE SW, LIGHTING 7	1C	0.5	B	
496	MODE SW, LIGHTING 7	1C	MODE SW, LIGHTING 9	1C	0.5	B	
497	J50	2B	DPR, SW, 2	1C	0.5	B	
498	DPF, SW, 2	1C	DPR, SW, LIGHTING 7	1C	0.5	B	
499	DPR, SW, LIGHTING 7	1C	DPR, SW, LIGHTING 9	1C	0.5	B	
500	J50	2B	2ND-14P SW, 2	1B	0.5	B	
501	2ND-14P SW, 2	1B	2ND-14P SW, LIGHTING 7	1B	0.5	B	
502	2ND-14P SW, LIGHTING 7	1B	2ND-14P SW, LIGHTING 9	1B	0.5	B	
503	J50	2B	G-H SW, LIGHTING 7	1B	0.5	B	
504	G-H SW, LIGHTING 7	1B	G-H SW, LIGHTING 9	1B	0.5	B	
505	J50	2B	1st AUXILIARY SW, 2	1B	0.5	B	
506	1st AUXILIARY SW, 2	1B	1st AUXILIARY SW, LIGHTING 7	1B	0.5	B	
507	J50	2B	RIDE CONTROL SW, 2	1B	0.5	B	
508	LIDE CONTROL SW, 2	1B	RIDE CONTROL SW LIGHTING 7	1B	0.5	B	C
509	J50	2B	PARKING BRAKE SW LIGHTING 7	1A	0.5	B	
510	J50	2B	TRIP DATA SW, 2	1A	0.5	B	
511	TRIP DATA SW, 2	1A	TRIP DATA SW, 7	1A	0.5	B	
512	TRIP DATA SW, 7	1A	TRIP DATA SW, 9	1A	0.5	B	
513	HIGH FLOW SW, 3	1A	MAIN CONTROLLER C1P31	2D	0.5	W	
514	J50	2B	HIGH FLOW SW, 2	1A	0.5	B	
515	HIGH FLOW SW, 2	1A	HIGH FLOW SW, 7	1A	0.5	B	
516	J1	2B	HIGH FLOW SW, 8	1A	0.5	Br	

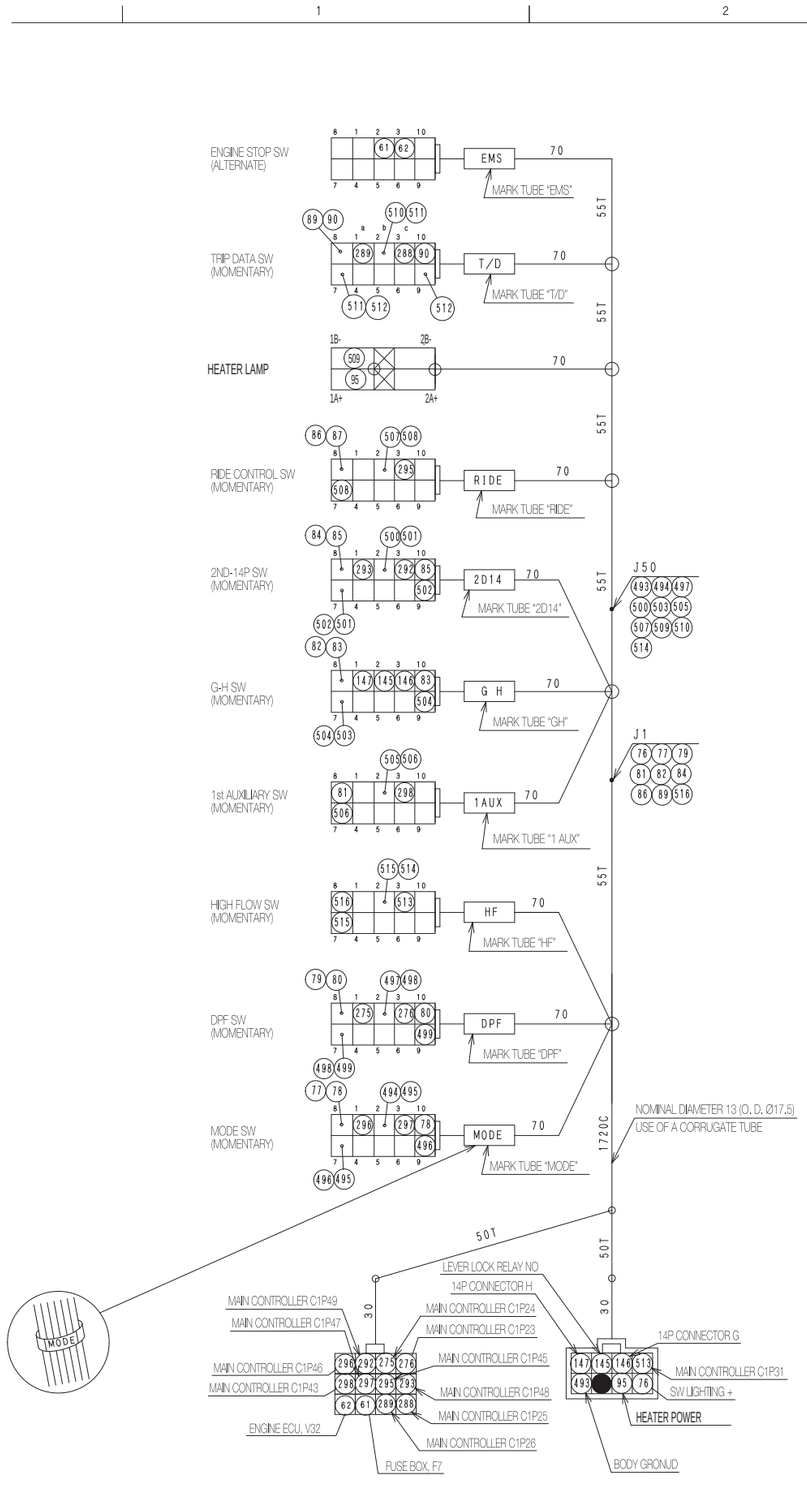
D

Drawing No.	1/1
06642-00049	

2H0BE14

https://truckmanualshub.com/

Wire harness (06642-00072)



NO.	FROM NAME	FROM POSITION	TO NAME	TO POSITION	SIZE	COLOR	REMARKS
61	FUSE BOX, F7	1D	ENGINE STOP SW, 2	1A	0.5	YB	
62	ENGINE STOP SW , 3	1A	ENGINE ECU, V32	1D	0.5	YR	
63							
76	SW, LIGHTING +	2D	J1	2B	0.85	Br	
77	J1	2B	MODE SW, LIGHTING 8	1C	0.5	Br	
78	MODE SW, LIGHTING-8	1C	MODE SW, LIGHTING 10	1C	0.5	Br	
79	J1	2B	DPF, SW, LIGHTING 8	1C	0.5	Br	
80	DPF, SW, LIGHTING 8	1C	DPF, SW, LIGHTING 10	1C	0.5	Br	A
81	J1	2B	1st AUXILIARY SW, LIGHTING 8	1B	0.5	Br	
82	J1	2B	G-H SW, LIGHTING 8	1B	0.5	Br	
83	G-H SW, LIGHTING	1B	G-H SW, LIGHTING 10	1B	0.5	Br	
84	J1	2B	2ND-14P, SW, LIGHTING 8	1B	0.5	Br	
85	2ND-149, SW, LIGHTING 8	1B	2ND-14P, SW, LIGHTING 10	1B	0.5	Br	
86	J1		RIDE CONTROL SW, LIGHTING 8	1B	0.5	Br	
89	J1	2B	TRIP DATA SW, 8	1A	0.5	Br	
90	TRIP DATA SW, 8	1A	TRIP DATA SW, 10	1A	0.5	Br	
95	**HEATER LAMP,1A+**	1A	**HEATER POWER**	2D	1.25	RW	
145	LEVER LOCK RELAY NO	2D	GH, SW 2 POWER SUPPLY +	1B	1.25	RW	
146	GH, SW3	1B	14P CONNECTOR G	2D	1.25	R	
147	GH, SW1	1B	14P CONNECTOR H	2D	1.25	Gy	
275	DPF SW1 (FORCED REGENERATION)	1C	MAIN CONTROLLER C1P24	1D	0.5	Br	
276	DPF SW1(AUTOMATIC REGENERATION INHIBITION)	1C	MAIN CONTROLLER C1P23	1D	0.5	G	
288	TRIP DATA SW, 3	1A	MAIN CONTROLLER C1P25	1D	0.5	RB	
289	TRIP DATA SW 1	1A	MAIN CONTROLLER C1P26	1D	0.5	RL	
292	2ND-14P SW, 3	1B	MAIN CONTROLLER C1P49	1D	0.5	RW	
293	2ND-14P SW, 1	1B	MAIN CONTROLLER C1P48	1D	0.5	RL	
295	RIDE CONTROL SW, 3	1B	MAIN CONTROLLER C1P45	1D	0.5	YR	
296	MODE SW, 1 (POWER)	1C	MAIN CONTROLLER C1P46	1D	0.5	P	B
297	MODE SW, 3 (ECO)	1C	MAIN CONTROLLER C1P47	1D	0.5	PB	
298	1st AUXILIARY SW, 3	1B	MAIN CONTROLLER C1P43	1D	0.5	LR	
493	BODY GROUND	2D	J50	2B	1.25	B	
494	J50	2B	MODE SW, 2	1C	0.5	B	
495	MODE SW, 2	1C	MODE SW, LIGHTING 7	1C	0.5	B	
496	MODE SW, LIGHTING 7	1C	MODE SW, LIGHTING 9	1C	0.5	B	
497	J50	2B	DPR, SW, 2	1C	0.5	B	
498	DPF, SW, 2	1C	DPR, SW, LIGHTING 7	1C	0.5	B	
499	DPR, SW, LIGHTING 7	1C	DPR, SW, LIGHTING 9	1C	0.5	B	
500	J50	2B	2ND-14P SW, 2	1B	0.5	B	
501	2ND-14P SW, 2	1B	2ND-14P SW, LIGHTING 7	1B	0.5	B	
502	2ND-14P SW, LIGHTING 7	1B	2ND-14P SW, LIGHTING 9	1B	0.5	B	
503	J50	2B	G-H SW, LIGHTING 7	1B	0.5	B	
504	G-H SW, LIGHTING 7	1B	G-H SW, LIGHTING 9	1B	0.5	B	
505	J50	2B	1st AUXILIARY SW, 2	1B	0.5	B	
506	1st AUXILIARY SW, 2	1B	1st AUXILIARY SW, LIGHTING 7	1B	0.5	B	
507	J50	2B	RIDE CONTROL SW, 2	1B	0.5	B	
508	LIDE CONTROL SW, 2	1B	RIDE CONTROL SW LIGHTING 7	1B	0.5	B	C
509	J50	2B	**HEATER LAMP,1A-**	1A	1.25	B	
510	J50	2B	TRIP DATA SW, 2	1A	0.5	B	
511	TRIP DATA SW, 2	1A	TRIP DATA SW, 7	1A	0.5	B	
512	TRIP DATA SW, 7	1A	TRIP DATA SW, 9	1A	0.5	B	
513	HIGH FLOW SW, 3	1A	MAIN CONTROLLER C1P31	2D	0.5	W	
514	J50	2B	HIGH FLOW SW, 2	1A	0.5	B	
515	HIGH FLOW SW, 2	1A	HIGH FLOW SW, 7	1A	0.5	B	
516	J1	2B	HIGH FLOW SW, 8	1A	0.5	Br	

D

Drawing No.	1/1
06642-00072	

2H0BE51

Wire harness (06842-00014)

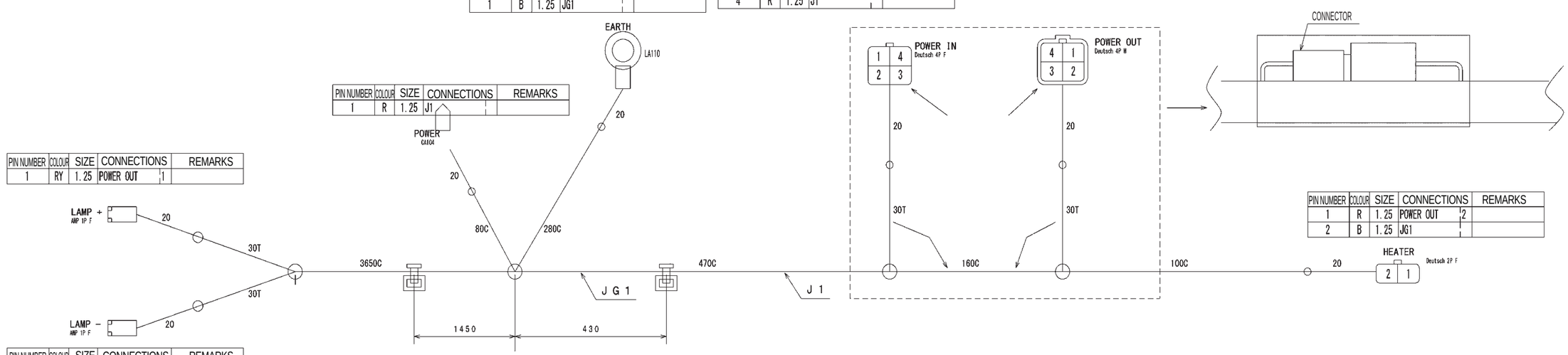
FROM			TO			COLOUR	TYPE	SIZE	REMARKS		
MODEL	CONNECTOR TYPE	PIN NUMBER	MODEL	CONNECTOR TYPE	PIN NUMBER						
EARTH	LA110	1	JG1			B	AVSS	1.25			
HEATER	DT06-02S-CE05	1	POWER OUT	DT04-04P-CE03	2	R	AVSSX	1.25			
HEATER	DT06-02S-CE05	2	JG1			B	AVSSX	1.25			
LAMP+	171809-2	1	POWER OUT	DT04-04P-CE03	1	RY	AVSS	1.25			
LAMP-	171809-2	1	JG1			B	AVSS	1.25			
POWER	CA104	1	J1			R	AVSS	1.25			
POWER IN	DT06-04S-CE05	1	J1			R	AVSS	1.25			
POWER IN	DT06-04S-CE05	2	J1			R	AVSS	1.25			
POWER IN	DT06-04S-CE05	4	J1			R	AVSS	1.25			

PIN NUMBER	COLOUR	SIZE	CONNECTIONS	REMARKS
1	B	1.25	JG1	

PIN NUMBER	COLOUR	SIZE	CONNECTIONS	REMARKS
1	R	1.25	J1	
2	R	1.25	J1	
4	R	1.25	J1	

PIN NUMBER	COLOUR	SIZE	CONNECTIONS	REMARKS
1	RY	1.25	LAMP + 1	
2	R	1.25	HEATER 1	

PIN NUMBER	COLOUR	SIZE	CONNECTIONS	REMARKS
1	R	1.25	J1	



PIN NUMBER	COLOUR	SIZE	CONNECTIONS	REMARKS
1	RY	1.25	POWER OUT 1	

PIN NUMBER	COLOUR	SIZE	CONNECTIONS	REMARKS
1	R	1.25	POWER OUT 2	
2	B	1.25	JG1	

PIN NUMBER	COLOUR	SIZE	CONNECTIONS	REMARKS
1	B	1.25	JG1	

*J1

PIN NUMBER	COLOUR	SIZE	CONNECTIONS	REMARKS
	R	1.25	POWER 1	
	R	1.25	POWER IN 1	
	R	1.25	POWER IN 2	
	R	1.25	POWER IN 4	

*JG1

PIN NUMBER	COLOUR	SIZE	CONNECTIONS	REMARKS
	B	1.25	EARTH 1	
	B	1.25	HEATER 2	
	B	1.25	LAMP- 1	

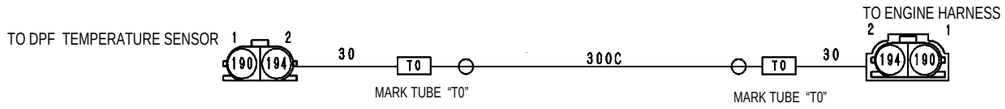
Drawing No.	1/1
06842-00014	

2H0BE48

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Wire harness (06642-00044)

No.	FROM			TO			COLOUR	LINE TYPE	SIZE	REMARKS
	MODEL	INITIAL CONNECTOR	PIN NO.	MODEL	END CONNECTOR	PIN NO.				
190	DPF"T0"	7283-7026-30	1	TO "ENGINE"	7282-7026-30	1	L		0.5	TWIST MANAGEMENT
194	DPF"T0"	7283-7026-30	2	TO "ENGINE"	7282-7026-30	2	Y		0.5	

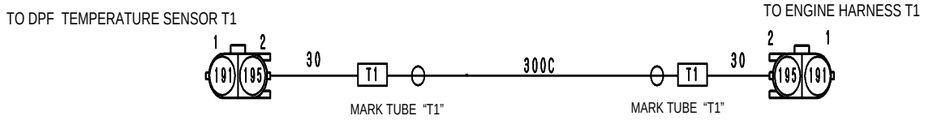


Drawing No.	1/1
06642-00044	

2H0BE49

Wire harness (06642-00045)

No.	FROM			TO			COLOUR	LINE TYPE	SIZE	REMARKS
	MODEL	INITIAL CONNECTOR	PIN NO.	MODEL	END CONNECTOR	PIN NO.				
191	DPF"T1"	7283-7028-30	1	ENGINE "T1"	7282-7028-30	1	W		0.5	TWIST MANAGEMENT
195	DPF"T1"	7283-7028-30	2	ENGINE "T1"	7282-7028-30	2	G		0.5	

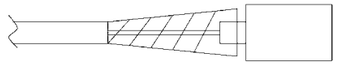


Drawing No.	1/1
06642-00045	

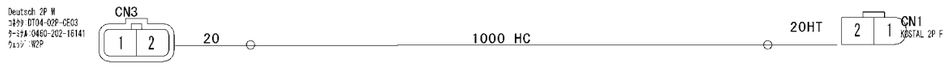
2H0BE50

Wire harness (06642-00068)

FROM			TO			COLOUR	TYPE	SIZE	REMARKS
MODEL	CONNECTOR TYPE	PIN NUMBER	MODEL	CONNECTOR TYPE	PIN NUMBER				
CN1	09441211	1	CN3	DT04-02P-CE03	1	R	AVSSX	2	+
CN1	09441211	2	CN3	DT04-02P-CE03	2	B	AVSSX	2	−



PIN NUMBER	COLOUR	SIZE	CONNECTIONS		REMARKS
1	R	2	CN3	1	
2	B	2	CN3	2	



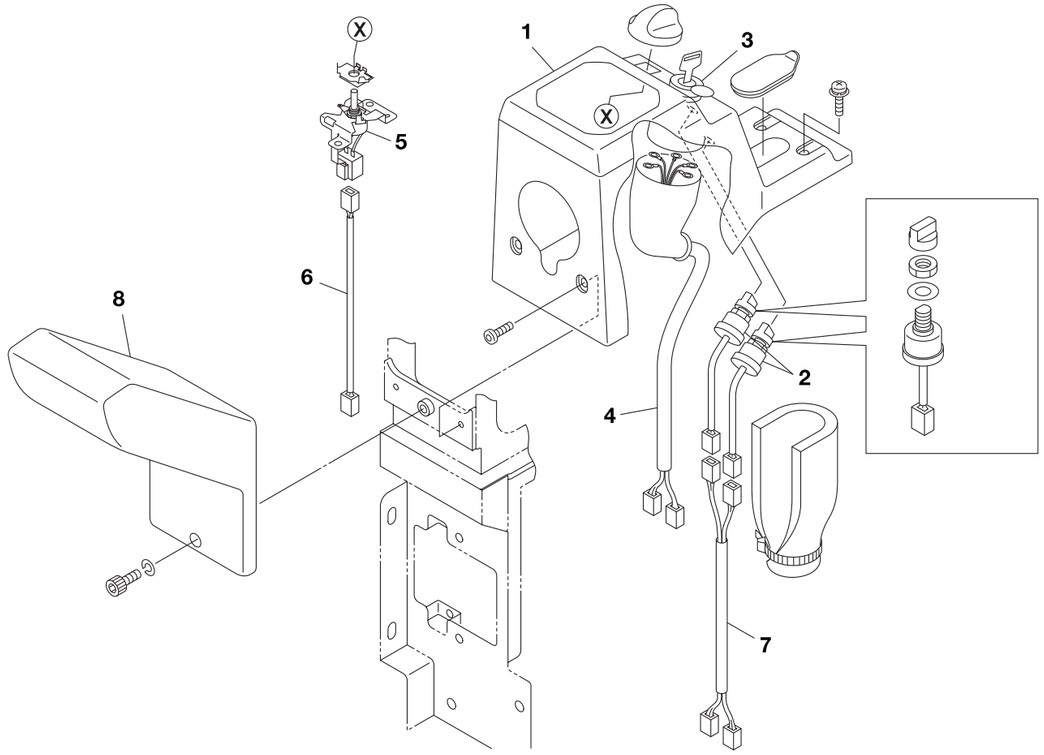
CODE	COLOUR	SIZE	CONNECTIONS		REMARKS
1	R	2	CN1	1	
2	B	2	CN1	2	

Drawing No.	1/1
06642-00068	

2H0BE47

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Cover assembly (Right)

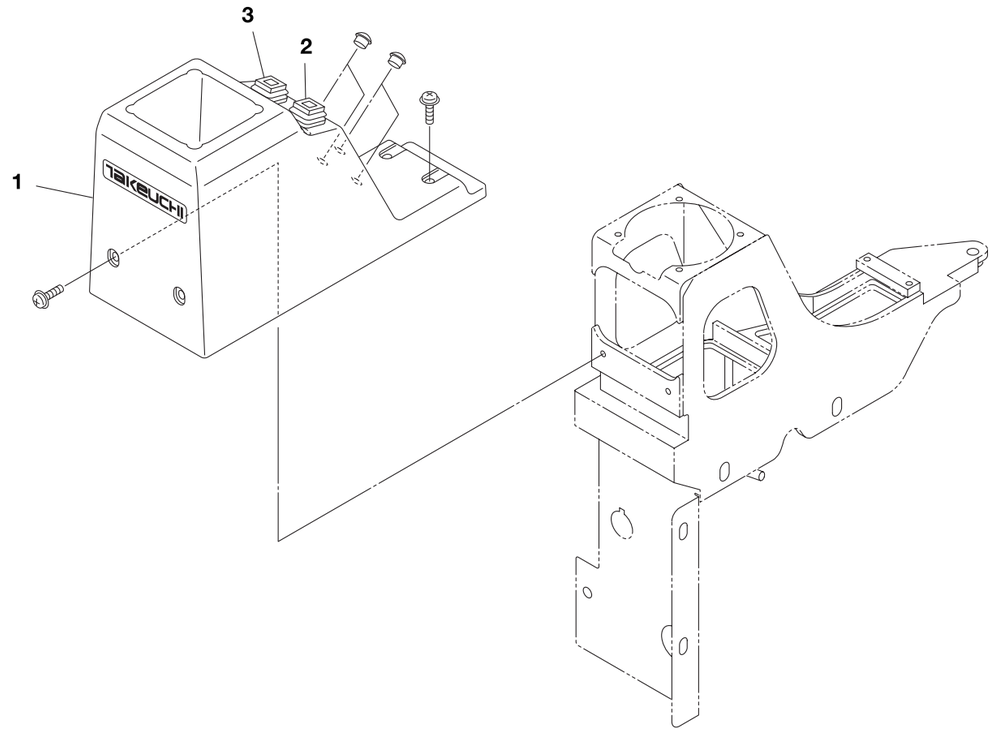


2H0BE16

1. Right cover
2. Lamp switch
3. Starter switch assembly
4. Wire harness
5. Resistor assembly
6. Wire harness
7. Wire harness
8. Cluster gauge assembly

Cover assembly (Left)

Without hydraulic quick-hitch



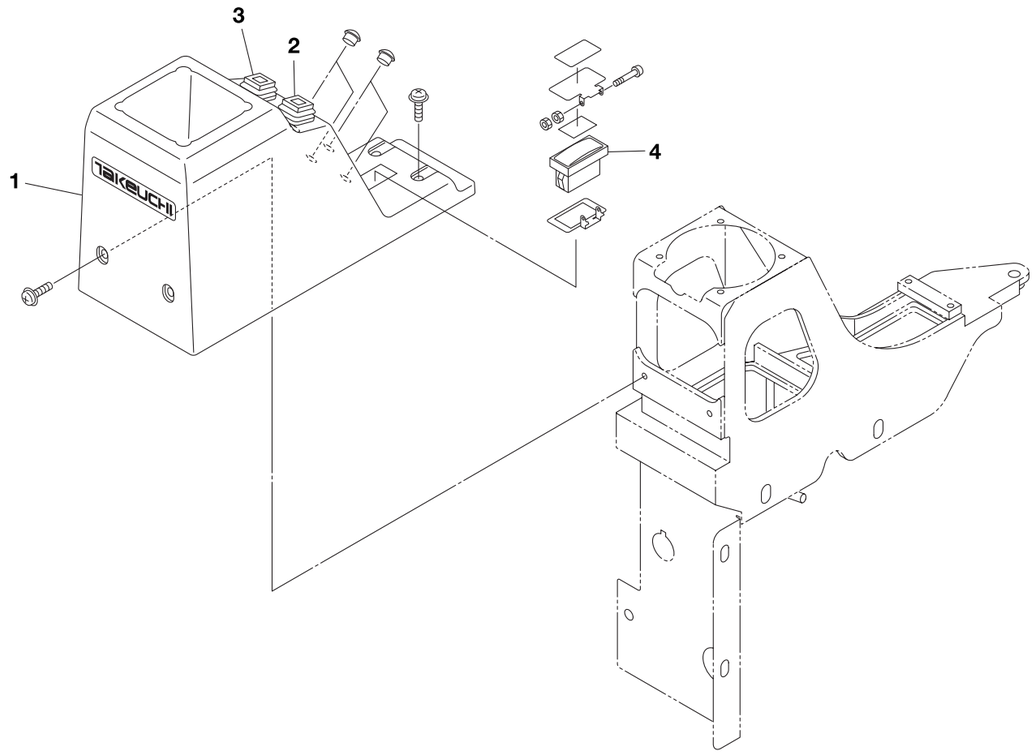
2H0BE17

1. Left cover
2. Switch
3. Switch

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Cover assembly (Left)

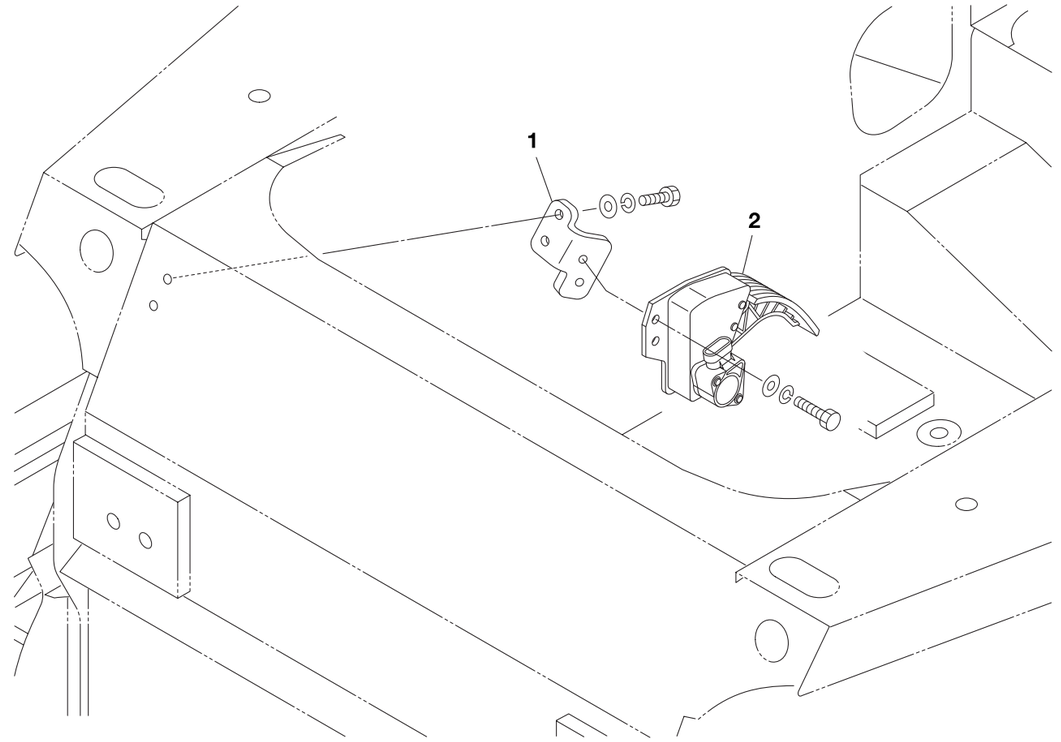
With hydraulic quick-hitch



2H0BE18

1. Left cover
2. Switch
3. Switch
4. Switch

Foot accelerator pedal assembly

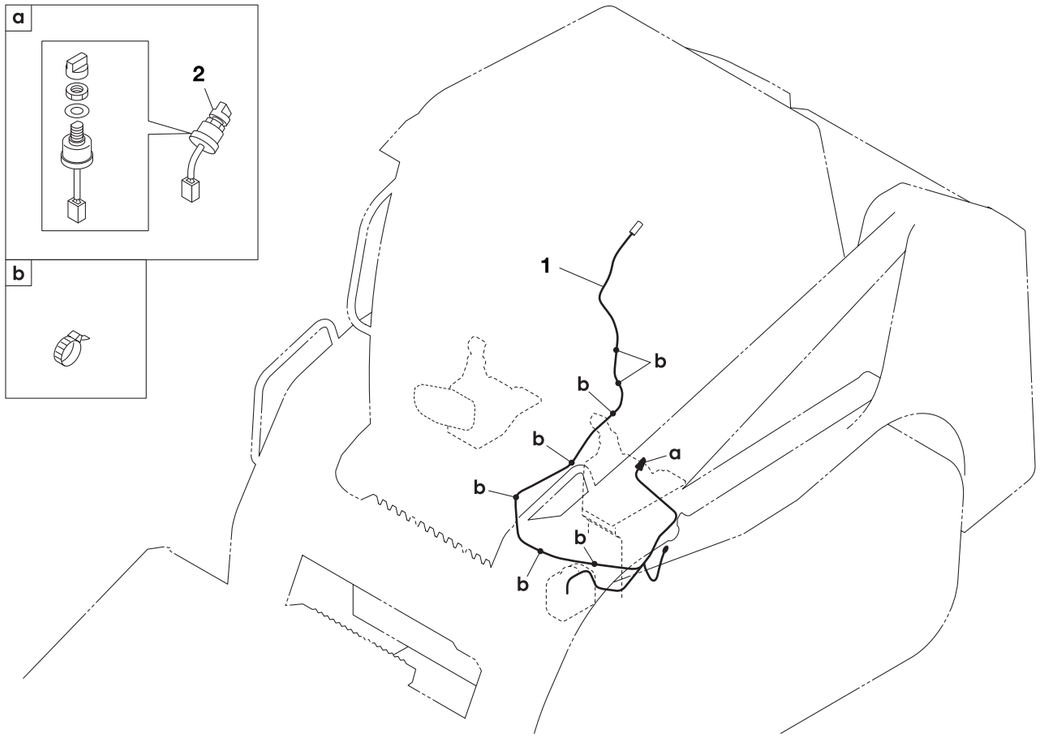


2H0BE19

1. Bracket
2. Foot accelerator pedal

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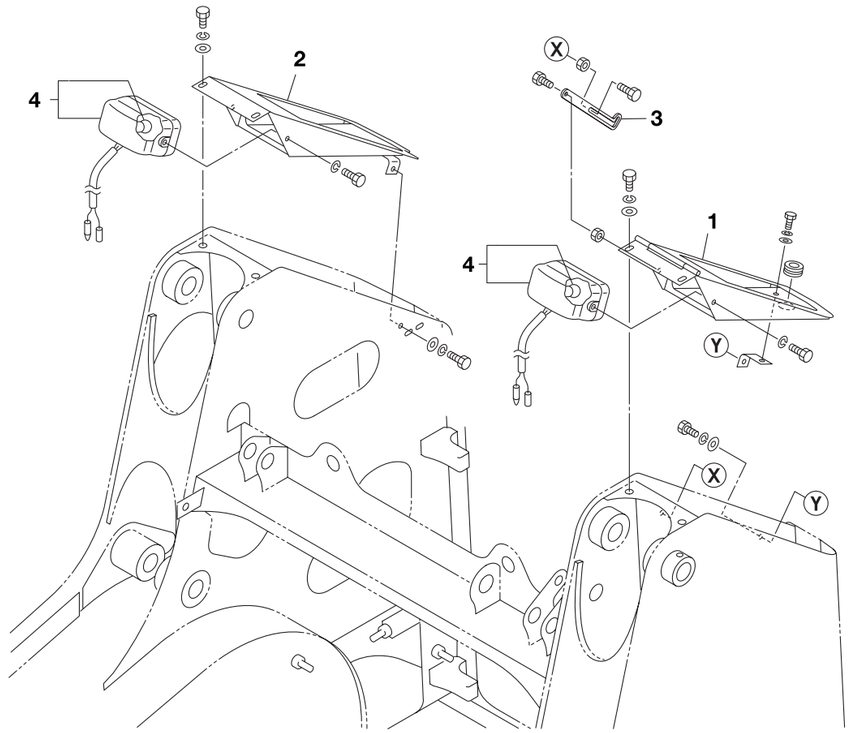
Electrical wiring (Cab)



2H0BE20

1. Wire harness
2. Wiper switch

Rear lamp assembly

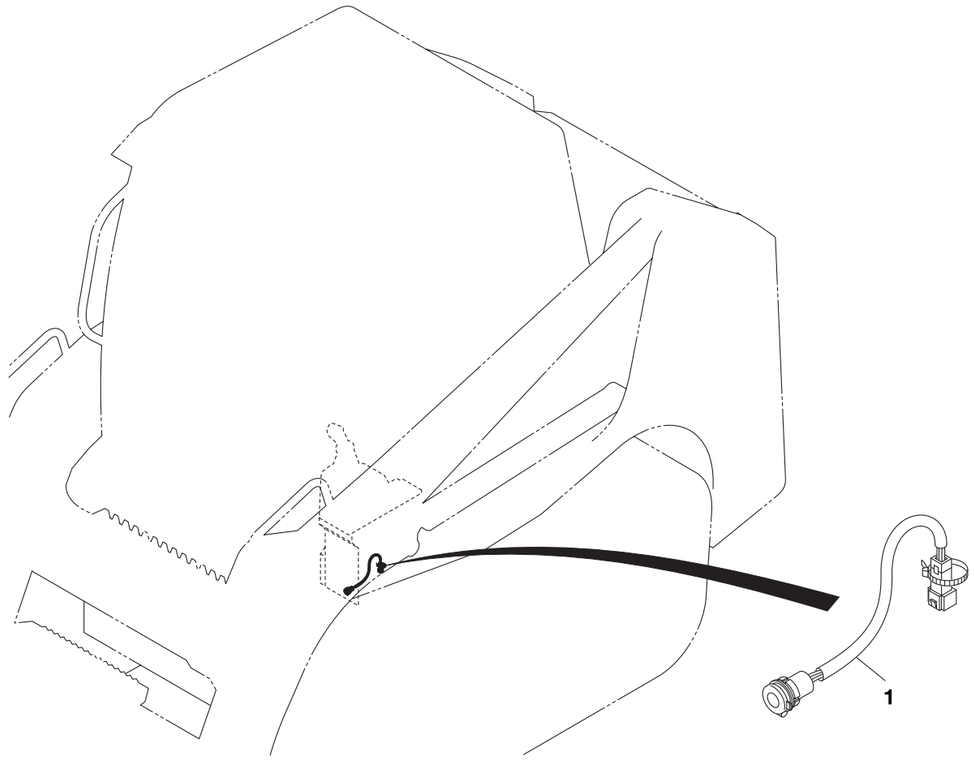


2H0BE21

1. Left cover
2. Right cover
3. Plate
4. Lamp

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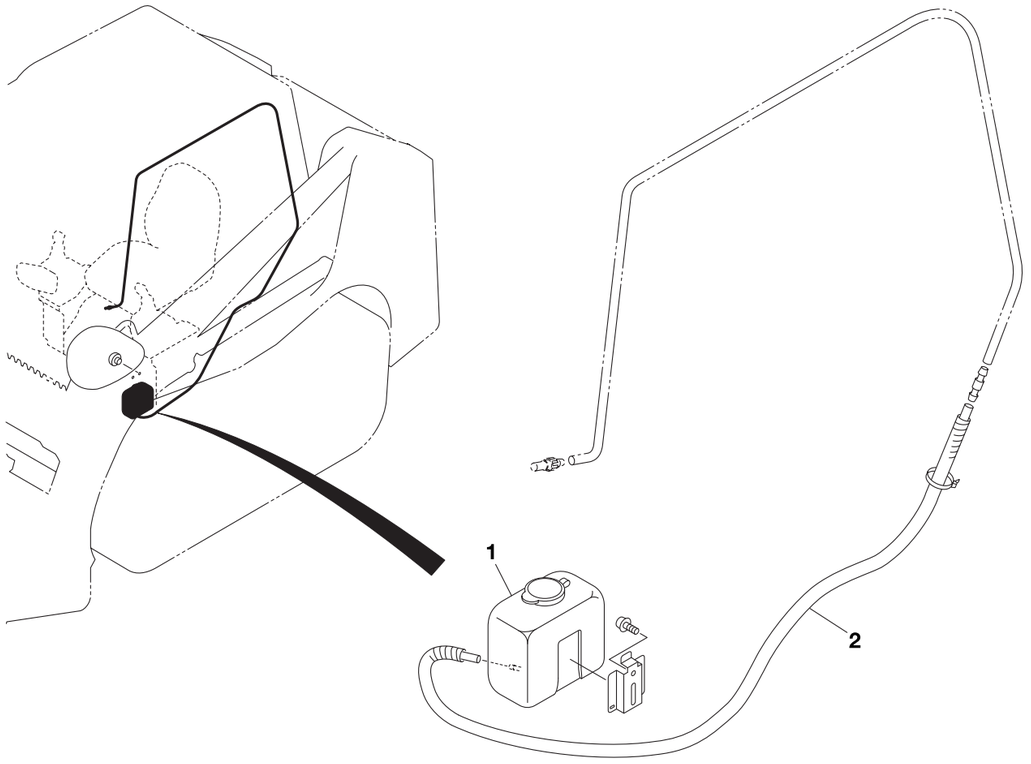
Maintenance light socket assembly



2H0BE22

1. Socket assembly

Windshield washer assembly



2H0BE23

1. Tank
2. Protector

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FUNCTION 3

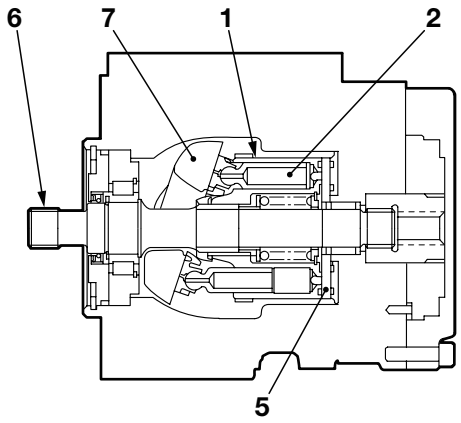
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HST PUMP

This pump is a tandem pump with a remote function for hydrostatic transmission (HST). When combined with an HST travel motor, it can control the speed of the motor from zero to the specified maximum rate steplessly.

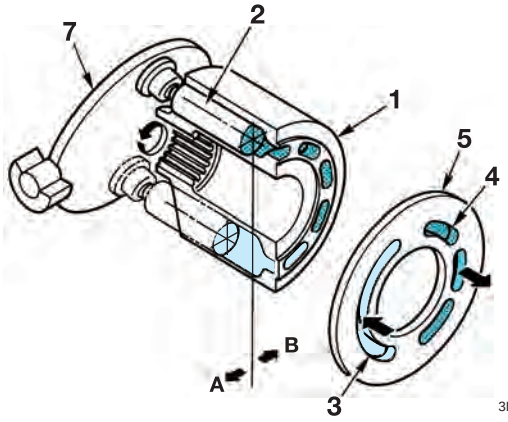
Hydraulic pump

The cylinder block (1) is constructed with the pistons (2), and at its end surface, it is in contact with the valve plate (5) that contains the intake port (3) and the exhaust port (4). The cylinder block (1) rotates freely and is connected to the drive shaft (6) via the spline. The swash plate (7), on the other hand, is fixed to the housing at an angle, and the pistons (2) are designed to rotate along with the swash plate (7).



3IAA01Z

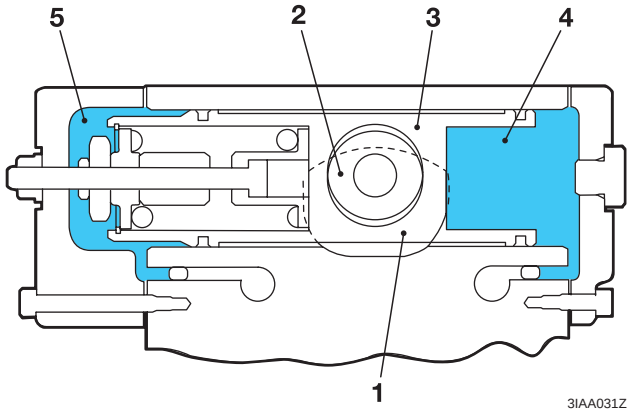
The cylinder block (1) rotates as the drive shaft (6) is rotated, and for every rotation of the cylinder block (1), the pistons (2) mounted in the cylinder block (1) complete one stroke of intake and exhaust. Thus, continuous operation of intake and exhaust can be obtained by continuous rotation of the drive shaft (6).
The displacement of the pistons (2) can be varied by modifying the tilt angle of the swash plate (7).



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Control section

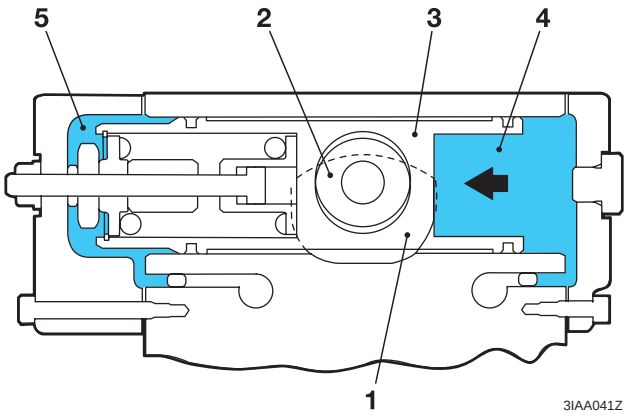
There are bearings attached to both sides of the swash plate (1), which is mounted to the housing at an angle and connected to the control cylinder (3) with the pistons (2).
The right and left spring chambers (4 and 5) are connected to the tank circuit, which makes their pressures equal. Under these conditions, the swash plate (1) is adjusted in order for it to maintain its neutral position.



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When the pilot pressure is led to the spring chamber (4), the control cylinder (3) moves to the left.
The swash plate (1) is tilted by the same amount as the control cylinder (3) is moved by the pistons (2), and the pump begins to discharge exhaust.
In this way, the amount of discharging from the pump can be controlled using the pilot pressure, and the travel motor speed can be controlled steplessly.

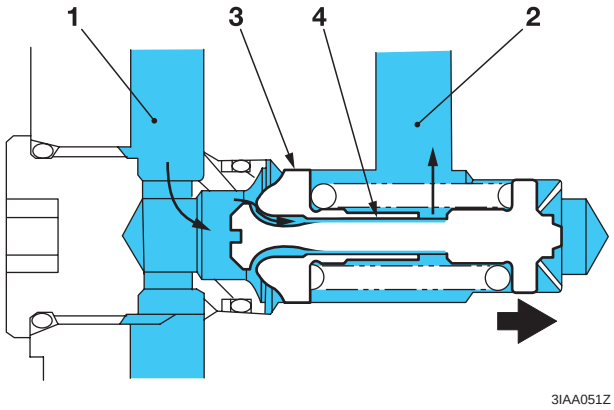


Charge check valve/high-pressure relief valve assembly

This valve is used as a charge check valve and a high-pressure relief valve.
The charge check valve supplies the closed circuit with oil to replenish the oil that has flowed to the tank. The high-pressure relief valve prevents the circuit from being damaged by the continuously flowing pressure oil and keeps the hydraulic circuit at an appropriate pressure.

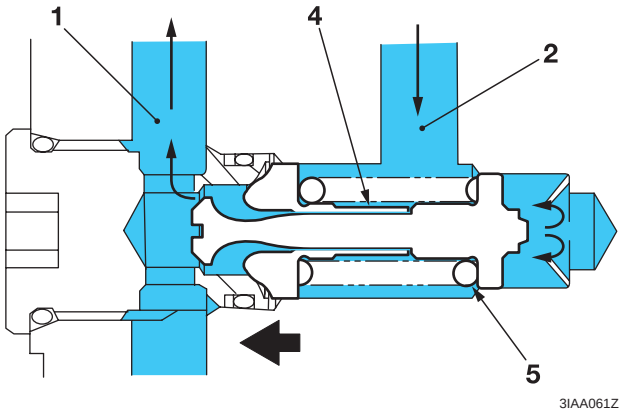
Charge check valve

When the pressure in the charge circuit (1) becomes high due to the pressure in the closed circuit (2), a clearance is generated between the check valve (4) and the spring holder (3), which allows the oil to flow into the closed circuit (2).



High-pressure relief valve

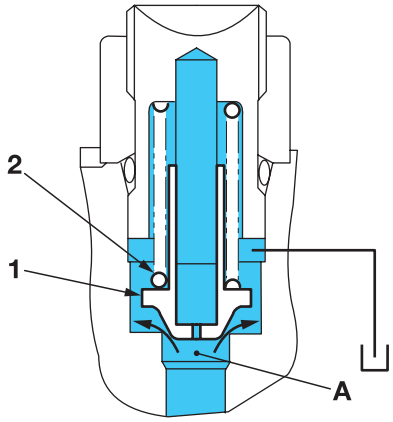
When the pressure in the closed circuit (2) becomes greater than the force of the spring (5), the check valve (4) is moved to the left, which allows the oil to flow into the charge circuit (1).



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Charge relief valve

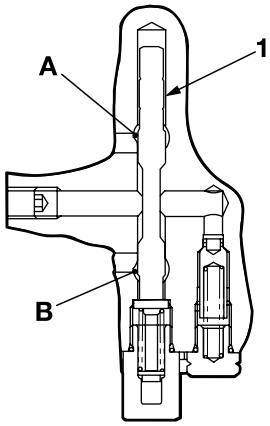
The charge relief valve keeps the pressure from the charge pump constant.
The oil from the charge pump reaches the chamber A. The spring (2) pushes against the relief valve (1). When the pressure in the chamber A becomes greater than the force of the spring (2), the relief valve (1) is moved, which allows the oil to flow into the tank circuit.



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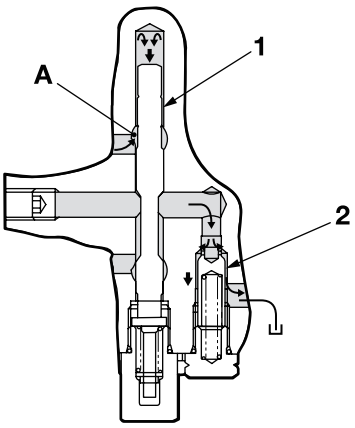
Flushing valve

This valve is used to replace the oil in the closed circuit with new oil. By doing this, the oil temperature in the circuit is prevented from becoming too high and contaminants can be removed. When the machine is stopped, the shuttle (1) is in the neutral position, because the pressures applied to the pilot chambers A and B of the flushing valve are equal.



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While traveling, when the pressure oil from the pump is led to the pilot chamber A, the shuttle (1) is moved downward. When the pressure becomes higher than the set value for the relief valve, part of the oil pushes up the poppet (2) of the relief valve and returns to the tank. When this occurs, the oil in the closed circuit becomes insufficient, and thus new oil is supplied to the closed circuit from the charge pump to replenish the oil that has returned to the tank. Therefore, the oil in the closed circuit is continuously replaced with new oil.

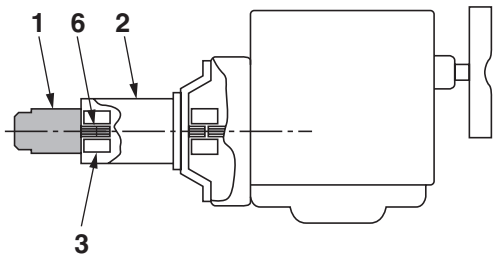


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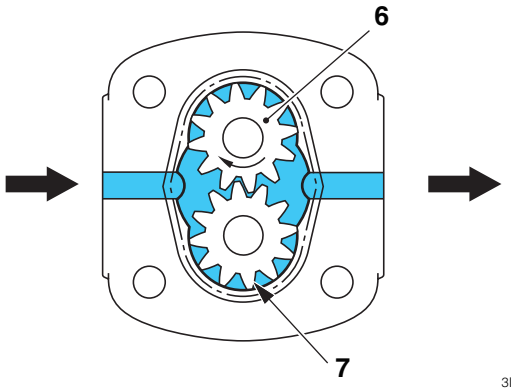
GEAR PUMP

The gear pump (1) is a constant-volume pump with double-gear pumps (P3, P4) that discharges a constant volume of exhaust material over a constant speed.
The pump P3 is used for the arm, bucket, and the auxiliary line hydraulic piping; and the pump P4 is used to discharge the charge pressure and pilot pressure oil.
The gear pump (1) is connected by the HST pump (2) and coupling (3), and the drive gear (6) of the gear pump (1) is rotated with the rotation of the engine.



3IAU01

The gear pump is located inside one of the gear cases and is interlocked with the drive gear (6) and drive gear (7). When the drive gear (6) is rotated, the space between the case and the gears is filled with the oil flowing from the inlet to the outlet.

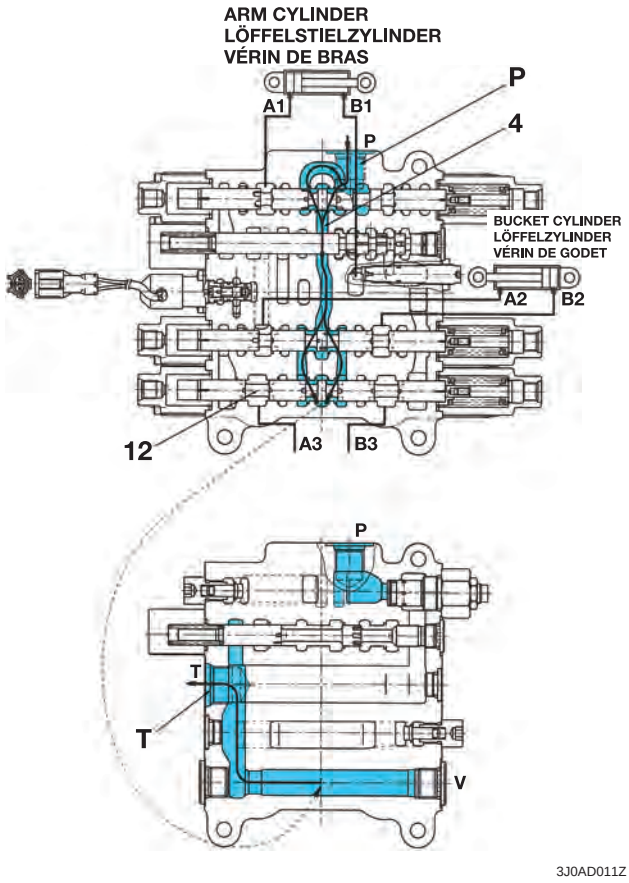


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CONTROL VALVE

The oil supplied from the hydraulic pump enters the valve through the port P.
When each spool is at the neutral position, the center bypass passage is not blocked by the spool, which enables the oil that entered the valve to flow through each center bypass passage (4) of the arm, divider, and bucket sections, the center bypass passage of the auxiliary hydraulic spool (12), and the tank passage T to return to the tank.



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Operation when arm-raising operation is activated:

When the arm-raising function is activated, the secondary pressure from the remote control valve enters the port Pa1 to move the arm spool (3). When the arm spool (3) is moved, the center bypass passage (4) is blocked. The oil that entered from the port P is then led into the open port, port A1, via the check valve (2). The oil that flowed into the port A1 is then led to the head side of the arm cylinder and used to extend the arm cylinder.

When the arm cylinder is extended, the oil on the rod side flows into the valve through the port B1. Part of this oil is led to the divider spool (7) via the flow ration adjuster throttle (6) (oil flow B). Most of the oil is led directly to the divider spool (7) (oil flow A).

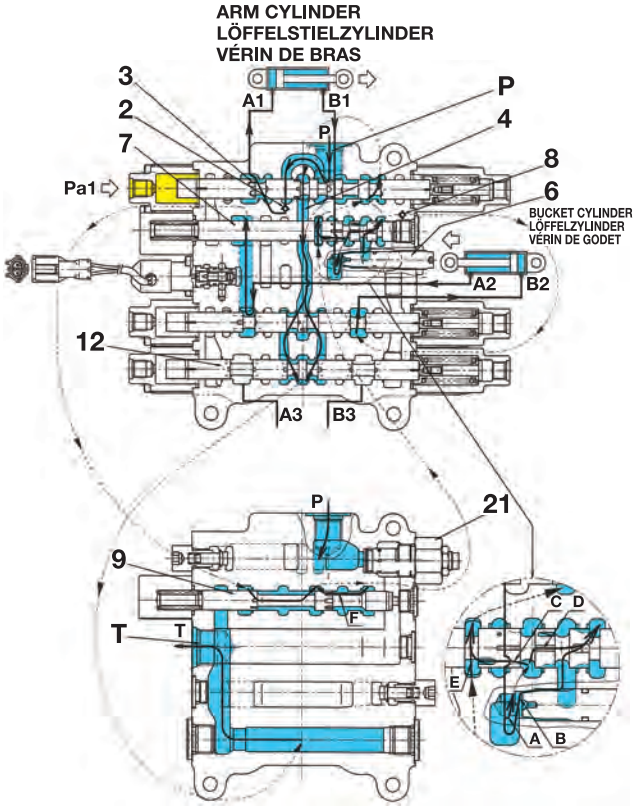
In the divider spool (7), the flow volume is divided into two parts based on the specified flow ratio: the flow volume that is to be supplied to the bucket cylinder (oil flow D) and any surplus flow volume that is to be drained through the port T (oil flow C).

The flow supplied to the bucket flows through the check valve (8) to the port B2 and is led to the head side of the bucket cylinder. This oil is used to extend the bucket cylinder, causing the bucket to be level.

When the bucket cylinder is extended, the oil on the rod side flows into the valve through the port A2. It further flows through the sequence spool (9), which is activated by the pressure on the bucket cylinder head side, the divider spool (7), and the arm spool (3) and then into the center bypass passage (4) (oil flow E). The oil then flows through each center bypass passage of the arm section, divider section, bucket section, and auxiliary hydraulic spool (12) and down into the tank passage T to return to the tank.

When the bucket cylinder is extended and reaches the stroke end during arm operation, the pressure at the head side of the bucket cylinder becomes high and causes the sequence spool to move even further. This causes the oil that was supplied to the bucket to flow not via the check valve (8) but directly through the sequence spool (oil flow F) to be combined with the oil flow E. The oil flows through each center bypass passage of the arm section, divider section, bucket section, and auxiliary hydraulic spool (12) and then down into the tank passage T to return to the tank. In this way, the arm-raising operation can be continued.

If the remote control valve for the arm is returned to the neutral position, the arm spool will be returned to the neutral position by the force of the return spring, which will cause the arm operation to stop.

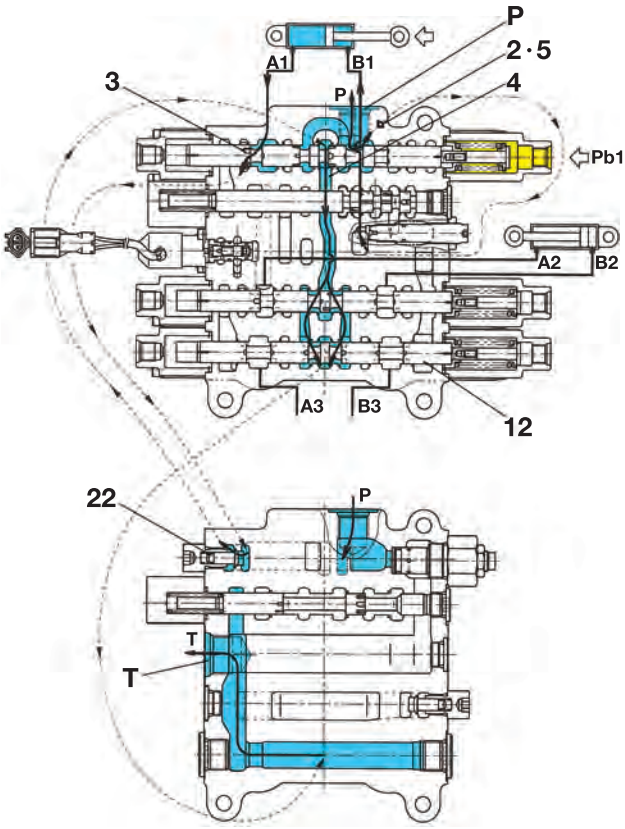


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Operation when arm-lowering operation is activated:

When the arm-lowering operation is activated, the secondary pressure from the remote control valve enters the port Pb1 to move the arm spool (3). When the arm spool (3) is moved, the center bypass passage (4) is blocked. This causes the oil that entered from the port P to be led into the open port, the port B1, via the load check valve (2) and the check valve (5). The oil that flowed into the port B1 is then led to the rod side of the arm cylinder to be used to retract the arm cylinder. When the arm cylinder is retracted, the oil on the head side flows through the port A1 and into the valve. It further flows through the check valve (22) into the center bypass passage (4).
The oil then flows through each center bypass passage of the arm section, divider section, bucket section, and auxiliary hydraulic spool (12) and down into the tank passage T to return to the tank.
If the arm remote control valve is returned to the neutral position, the arm spool will be returned to the neutral position, which will cause the arm operation to stop.



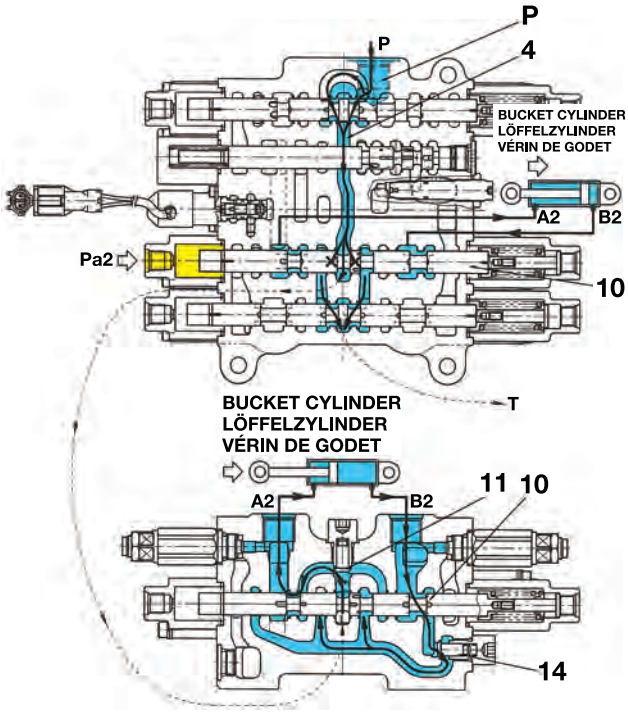
3J0AD031Z

Operation when the bucket-tilt-backward operation is activated:

When the bucket-tilt-backward (crowd) operation is activated, the secondary pressure from the remote control valve enters the port Pa2 to move the bucket spool (10). The oil that entered from the port P flows through the center bypass passage (4). The center bypass passage to the auxiliary hydraulic section is blocked when the bucket spool (10) is moved. This causes the hydraulic oil to flow out to the open port, port A2, via the load check valve (11) and then be led to the rod side of the bucket cylinder to be used to retract the bucket cylinder.

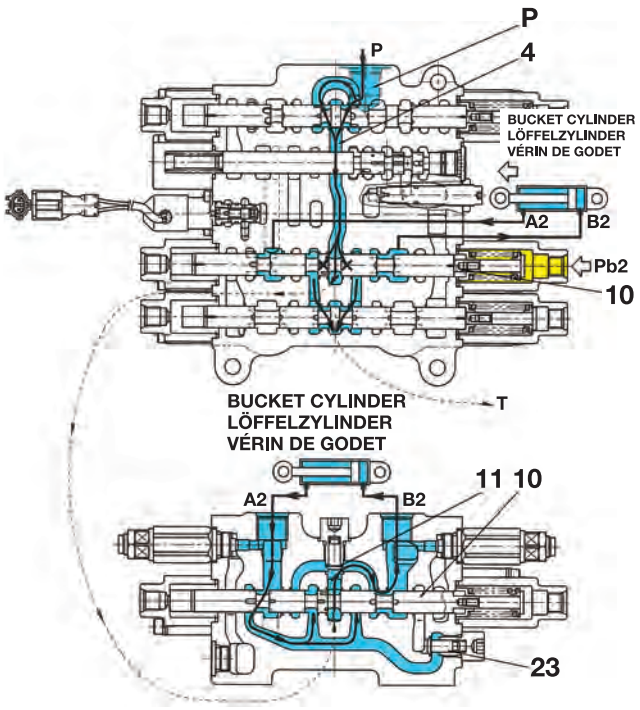
When the bucket cylinder is retracted, the oil on the head side flows through the port B2 into the valve. It further flows through the check valve (14), the center bypass passage of the auxiliary hydraulic section, and the tank passage T to return to the tank.

If the bucket remote control valve is returned to the neutral position, the bucket spool will be returned to the neutral position, which will cause bucket operation to stop.



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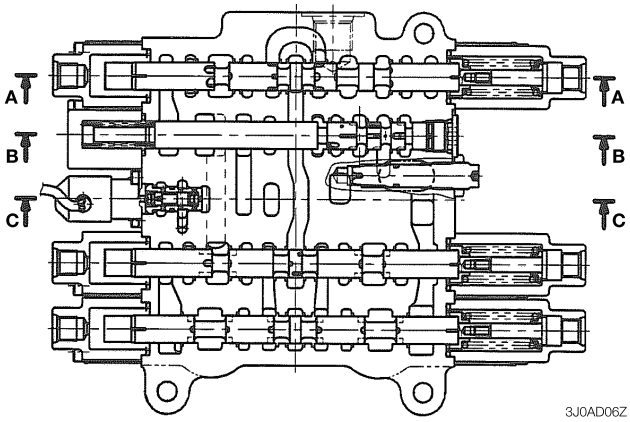
When the bucket-tilt-forward (dump) operation is activated, the secondary pressure from the remote control valve enters the port Pb2 to move the bucket spool (10). The oil that entered from the port P flows through the center bypass passage (4). The center bypass passage to the auxiliary hydraulic section is blocked when the bucket spool (10) is moved. This causes the hydraulic oil to flow out to the open port, port B2, via the load check valve (11) and then be led to the head side of the bucket cylinder to be used to extend the bucket cylinder.
When the bucket cylinder is extended, the oil on the rod side flows into the valve through the port A2. It further flows through the center bypass passage of the auxiliary hydraulic section and the tank passage T to return to the tank.
If the bucket remote control valve is returned to the neutral position, the bucket spool will be returned to the neutral position, which will cause bucket operation to stop.

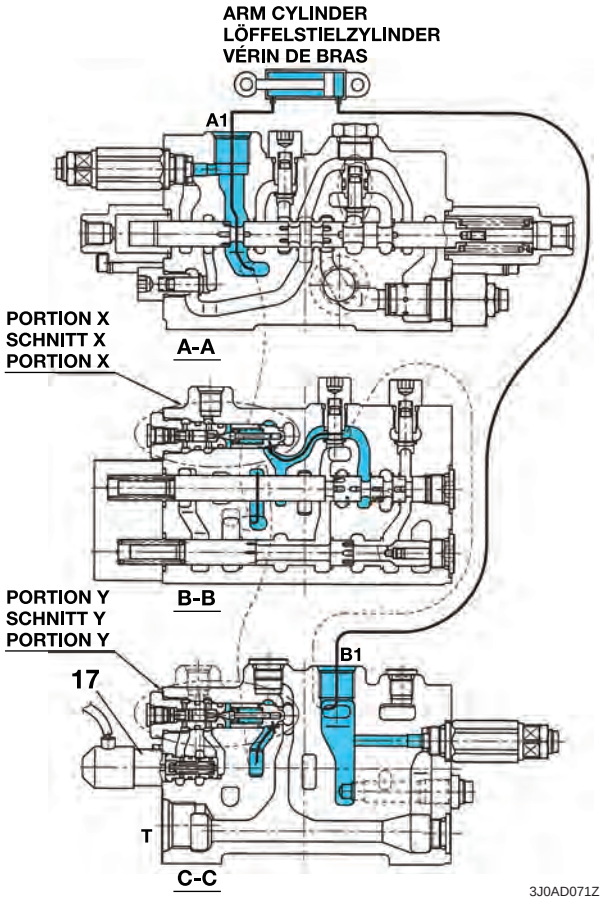


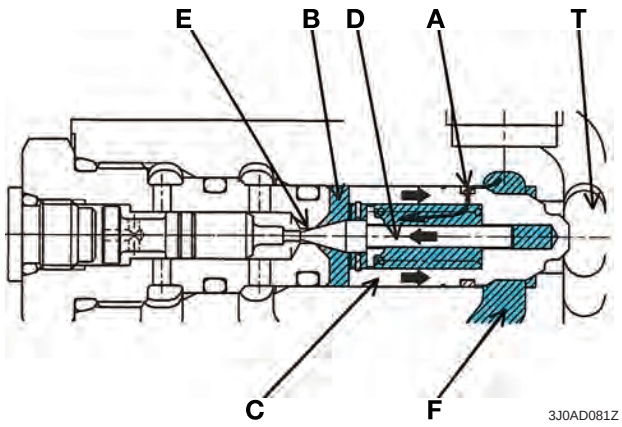
3J0AD051Z

Operation when the arm-float is turned off:

When there is no voltage applied to the solenoid (17) used for the arm-float operation, the cylinder retention pressure or the cylinder operating pressure enters the chamber B through the drilled hole A on the pilot check valve C. The needle valve D, mounted together with the pilot check valve C, is moved in the direction of the arrow due to the spring force and the retention or operating pressure, which causes the seat E of the piston case to make contact with the needle valve D. The chamber B is sealed, which causes the cylinder retention pressure or the cylinder operating pressure that entered the chamber B to make the pilot check valve C work in the direction of the arrow. This enables the arm cylinder to be retained or operated normally.

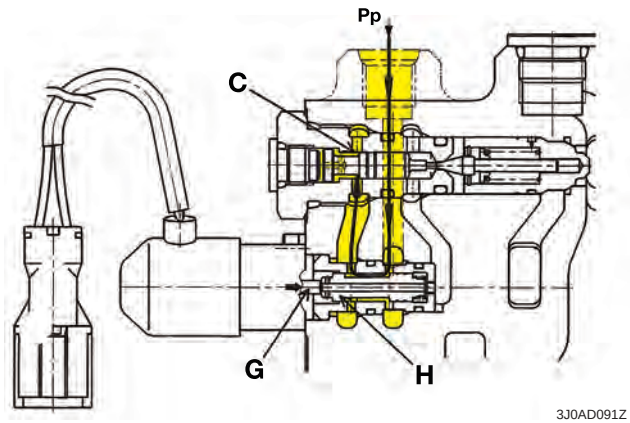






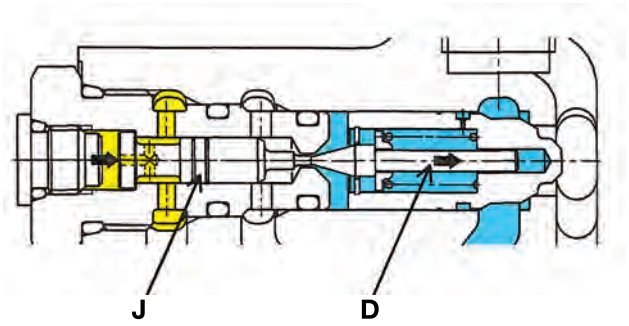
Operation when the arm-float is activated:

1. When a voltage is applied to the solenoid (17) used for the arm-float operation, the push pin G pushes against the pilot spool H. When the pilot spool H is moved, the pressure oil from the port Pb flows through the pilot spool H and into the chamber C.



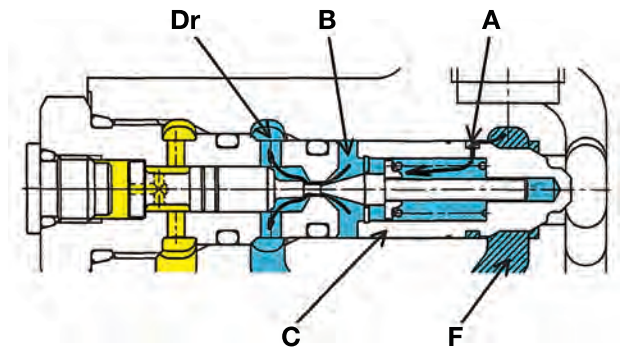
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2. The pressure oil causes the piston J to move in the direction of the arrow. At the same time, the needle valve D also is moved.



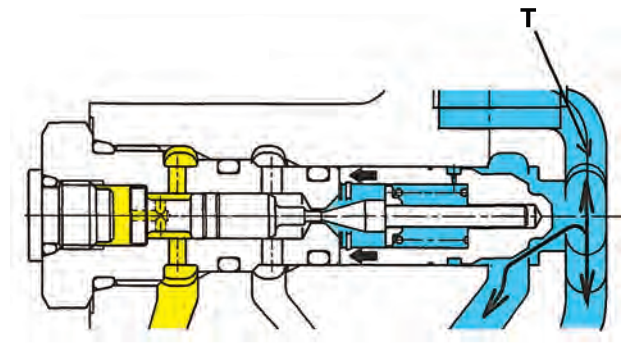
3J0AD101Z

3. As a result of movement of the needle valve D, the chamber B and the port Dr are connected and the pressure in the chamber D becomes low. The chamber B pressure is maintained at a low level despite the fact that some of the cylinder retention pressure F flows into the chamber B through the drilled hole A on the pilot check valve C. This is due to the small size of the drilled hole A.

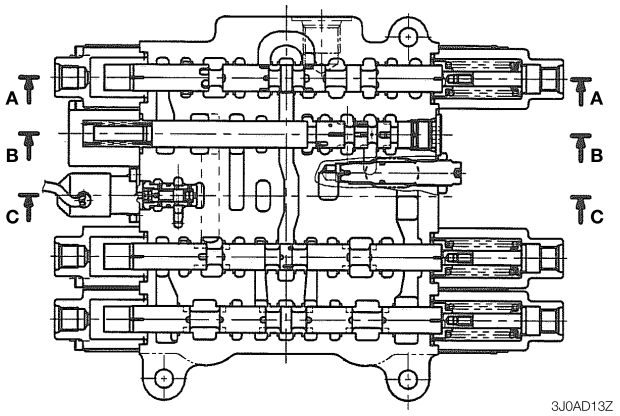


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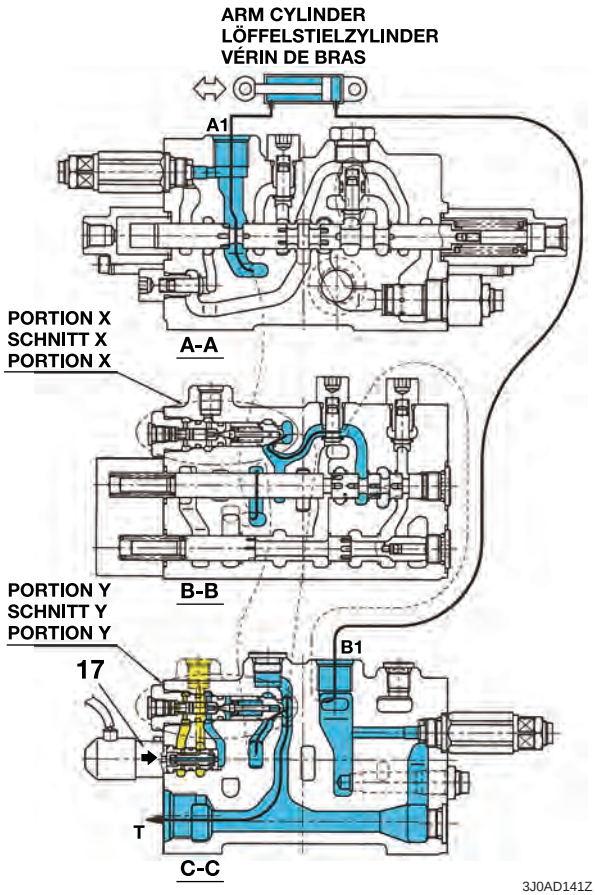
4. This results in the pilot check valve C being opened in the direction of the arrow by the differential pressure between the pressure in the chamber B and the cylinder retention pressure F.

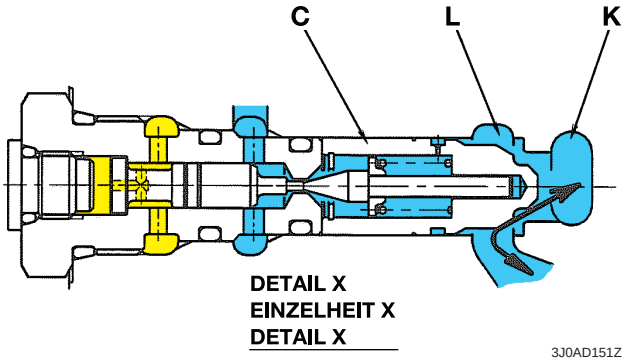


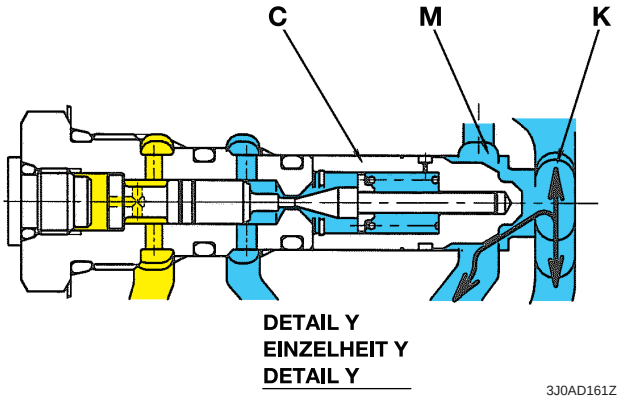
3J0AD121Z



5. The passage K is connected to the tank passage, the passage L is connected to the port B1, and the passage M is connected to the port A1. Thus, if the pilot check valve C is opened, the ports A1 and B1 will connect with the tank passage T to allow the oil to flow freely between the rod side and the head side of the arm cylinder. This makes it possible for the arm cylinder to freely extend or retract based on external forces (the terrain).

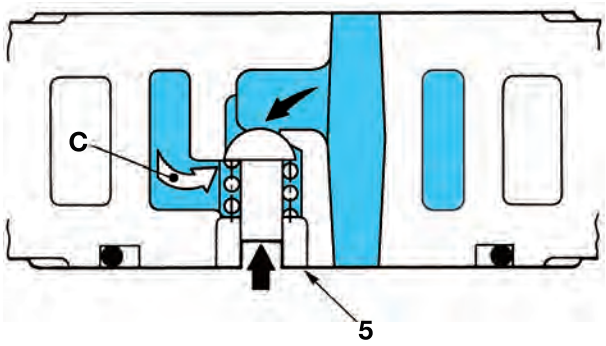






Load check valve

This valve prevents oil from flowing backward while the spool switching operation is being performed due to the load pressure C coming from the actuator port.



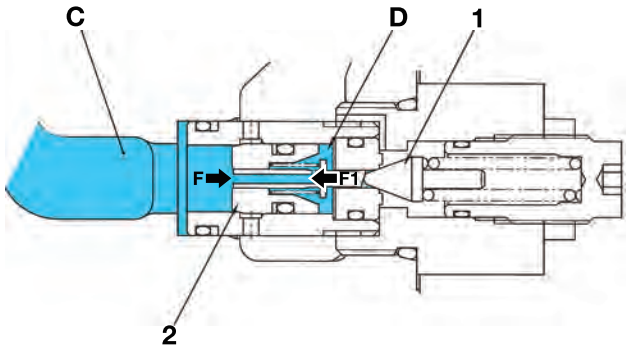
3JAA031Z

Main relief valve

The main relief valve is mounted between the pump circuit and tank circuit of each inlet housing and works to maintain the circuit pressure at the set value.

The relief valve remains turned off:

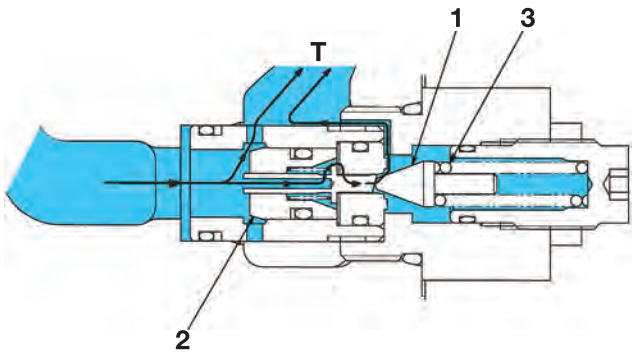
As long as the pressure in the circuit is lower than the set value, the relief valve will maintain a pressure equilibrium and remain shut off. The hydraulic pressure from the pump passes from the chamber C into the orifice and then reaches chamber D and the needle valve (1). Meanwhile, the forces F and F1 are acting in the directions indicated by the arrows on both sides of the main poppet (2).



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The relief valve is activated:

If the pressure in the circuit becomes higher than the set pressure of the spring (3), the needle valve (1) will be pushed to the right by hydraulic pressure, which will cause the oil to flow into the tank passage T. When this happens, a pressure differential is generated between the two ends of the orifice of the main poppet (2), and the main poppet is pushed to the right by the hydraulic pressure. As a result, the pressure oil in the circuit flows into the tank passage as shown by the arrows.
This operation works to maintain the pressure in the circuit at the set value.



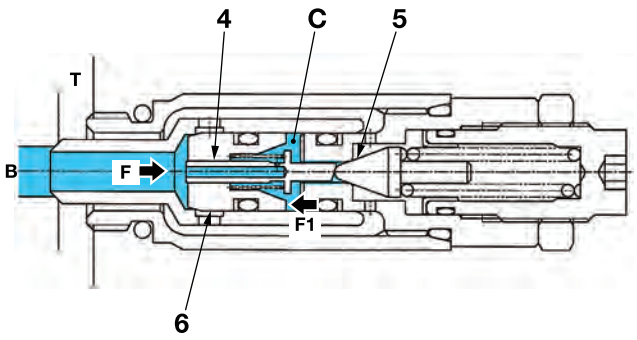
3J0AD181Z

Port relief valve

The port relief valve is located between the actuator and the tank circuit T. It protects the actuator from being affected by pressure shocks caused by the sudden blocking of the actuator port or by overloading and absorbs abnormal changes in pressure resulting from an external force.

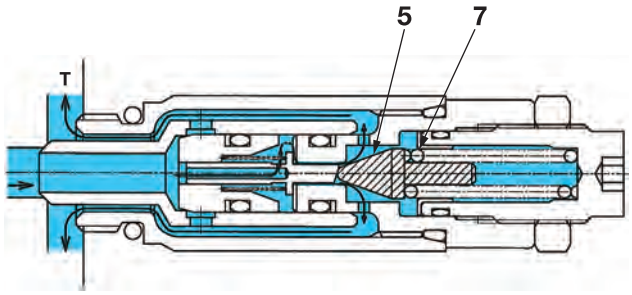
Relief operation:

As long as the pressure in the circuit is lower than the set value, the relief valve will maintain a pressure equilibrium and remain shut off. The hydraulic pressure from the pump passes from the chamber B to the orifice of the piston (4) and then reaches the chamber C and the needle valve (5).
Meanwhile, the forces F and F1 are acting in the directions indicated by the arrows on both sides of the main poppet (6).



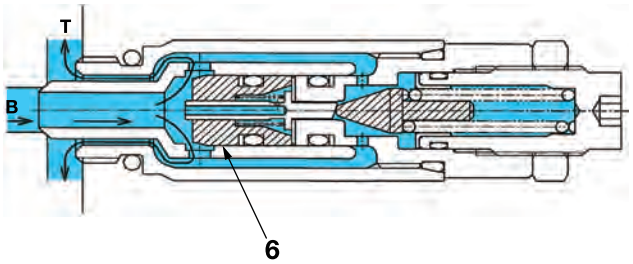
3J0AD191Z

If the pressure in the circuit becomes higher than the force of the spring (7), the needle valve (5) will be pushed to the right by the hydraulic pressure, which will cause the high-pressure area to become connected with the tank passage T. The oil then flows around the circumference of the needle valve (5), passes through the slits, and flows down into the tank passage T.



3J0AD201Z

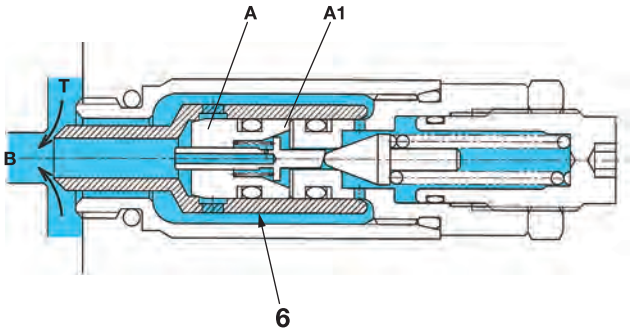
When the needle valve (5) is pushed to the right, which connects the high-pressure area with the tank passage T, the pressure behind the piston (4) drops; this causes the piston (4) to be pushed to the right and up against the needle valve (5). As a result, the flow of oil from chamber B to chamber C is cut-off, and the pressure in chamber C drops.



3J0AD211Z

Valve suction operation:

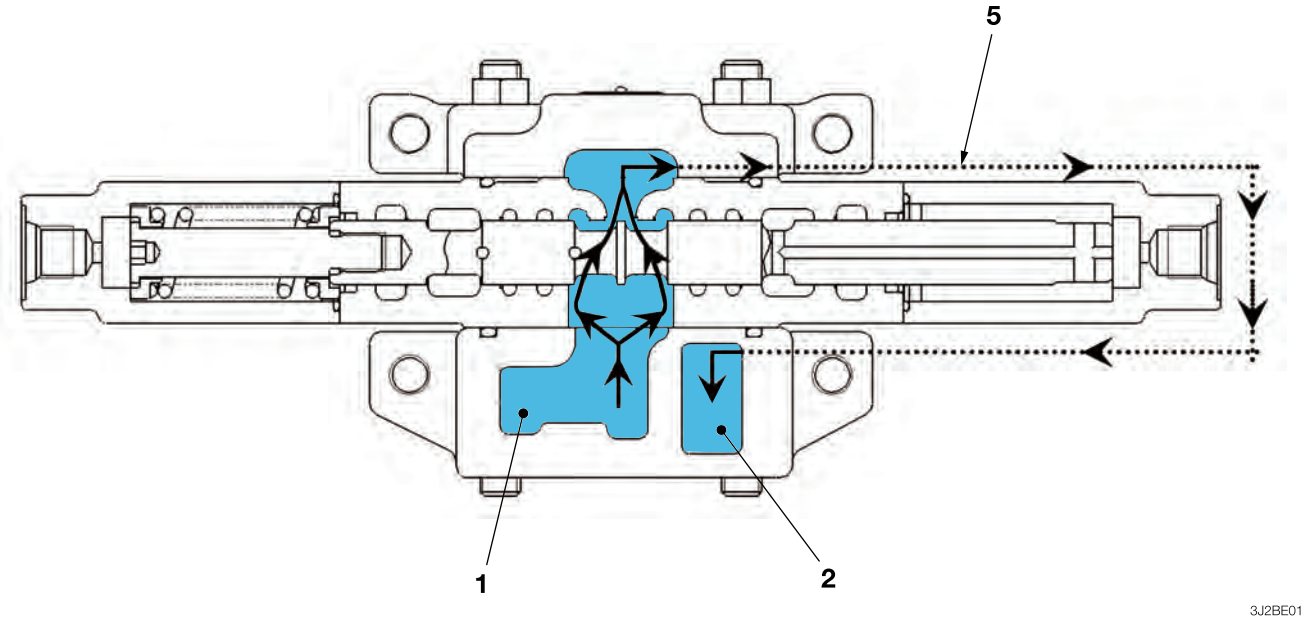
If the cylinder is operated at a speed that is too fast for the oil supply to keep up, which would cause the pressure of the chamber B to become almost negative, the oil from the tank will be supplied to prevent cavitation.
When the pressure in chamber B is lower than the pressure in the tank passage T, the pressure difference between the sectional areas of A and A1 will cause the main poppet (6) to open. This will result in oil entering from the tank passage T to fill the space in the chamber B.



3J0AD221Z

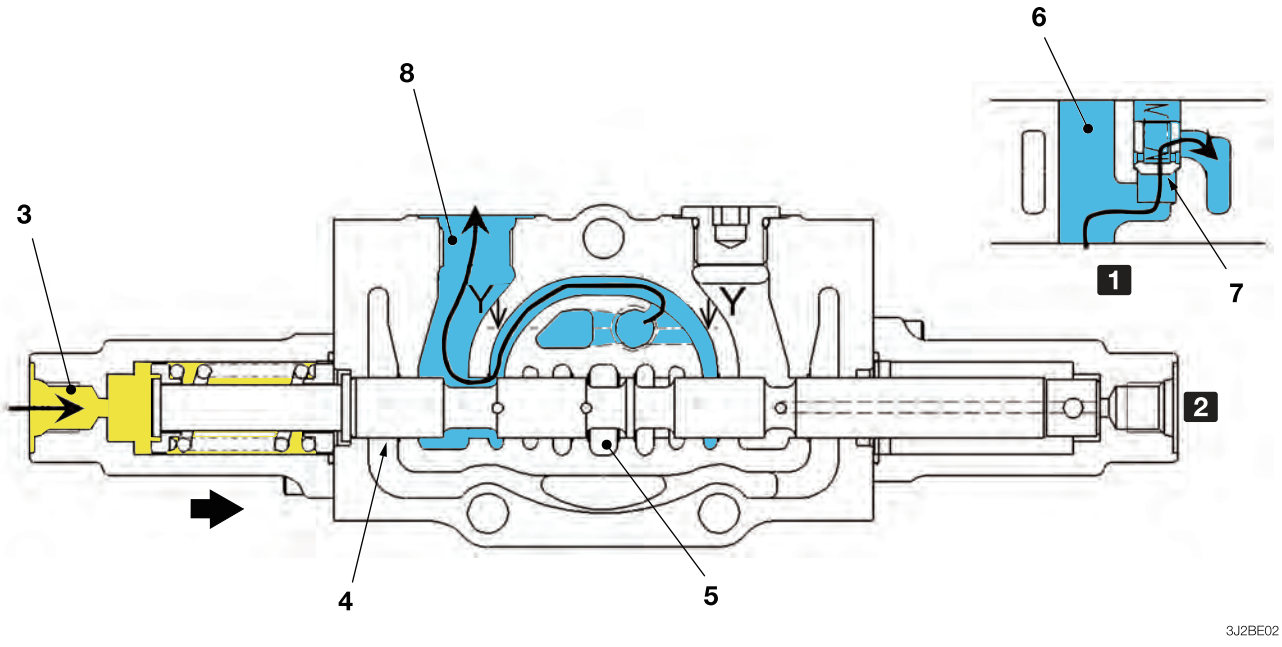
CONTROL VALVE (HIGH FLOW)

At the neutral position



The oil supplied from the (high flow) pump flows into port P (1) to return to the tank from port T (2) via the center bypass (5).

During operation



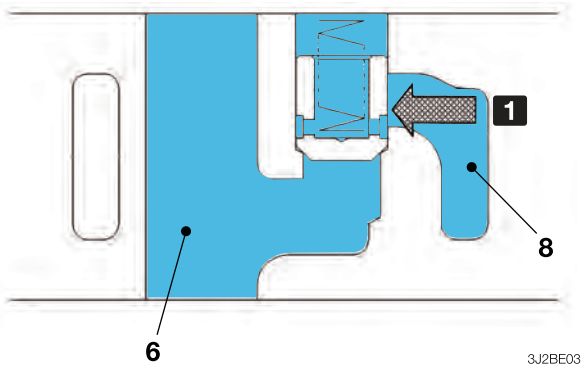
1 Section Y-Y 2 Port Dr

When the pressure increases inside port Pb1 (3), the spool (4) is moved to the right, which closes off the center bypass (5).

The oil from port P circles through the supply circuit (6), opening the check valve (7) in section Y-Y to supply oil to port A (8).

Load check valve

If the retention pressure on the port A (8) side while the spool is being switched is higher than that in the supply circuit (6), the backward flow of oil back into the supply circuit (6) from port A (8) will be blocked.



1 Retention pressure

Main relief valve

A main relief valve is mounted between the circuit P and circuit T in the inlet housing and works to prevent the circuit pressure inside the control valve from increasing to a value that exceeds the set pressure.

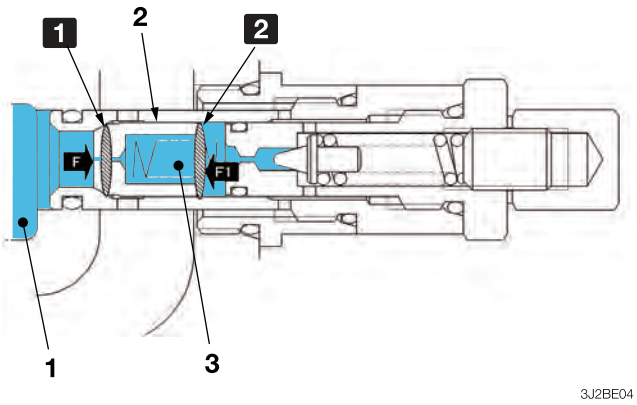
<When the circuit pressure is lower than the set pressure>

The oil from port P (1) flows into the chamber B (3) via the orifice in the end of the main poppet (2). (Note that port P and chamber B are at the same pressure)

At this time, forces F and F1 act on the two ends of the main poppet (2).

$P = P \times A$, $F1 = P \times B$ (where P: Pressure; A, B: Areas being acted on by the pressure)

Because the area A being acted on by the pressure is smaller than the area B, F1 is bigger than F, which causes the main poppet (2) to be pushed up against the seating surface by the force (F1 – F).



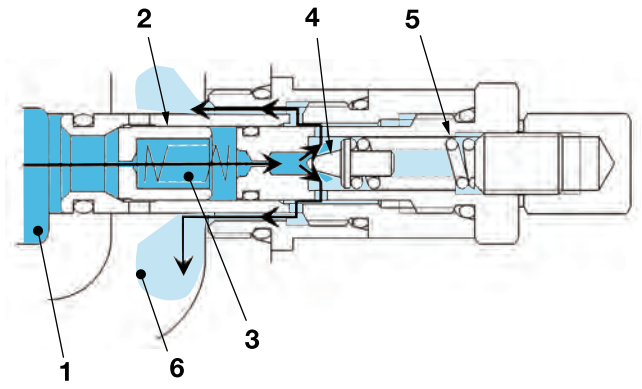
1 Area A being acted on by a pressure
2 Area B being acted on by a pressure

<When the circuit pressure is higher than the set pressure>

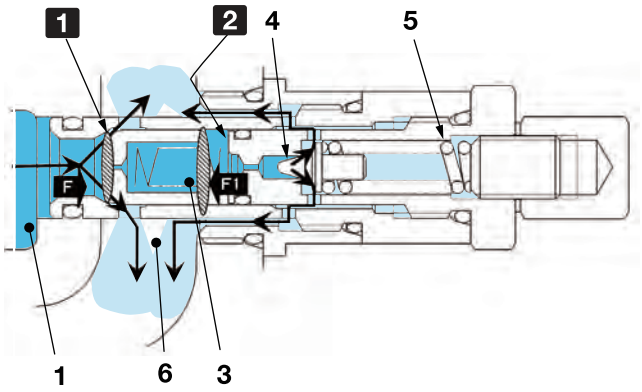
When the pressure in port P (1) increases and the force acting on the needle valve (4) overcomes the spring force of the spring (5), the needle valve (4) is moved to the right to connect the chamber B (3) and port T (6) together.

This causes oil to flow from port P (1) into the chamber B (3) and port T (6). This in turn generates a difference in pressure between the front and back of the orifice in the end of the main poppet (2). Because the pressure for F becomes greater than the pressure for F1, the main poppet (2) is moved to the right, which allows oil to flow from port P (1) into port T (6).

This operation works to maintain the pressure in the circuit at the set value.



3J2BE05



3J2BE06

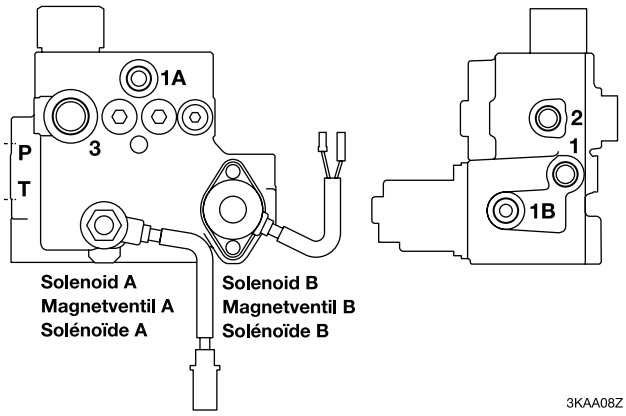
1 Area A being acted on by a pressure
2 Area B being acted on by a pressure

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SUB VALVE

This valve is composed of the solenoid valve A (lever lock), the solenoid valve B (2nd speed travel) and the relief valve.
It supplies the HST charge pressure from the pump P4 and the pilot pressure.

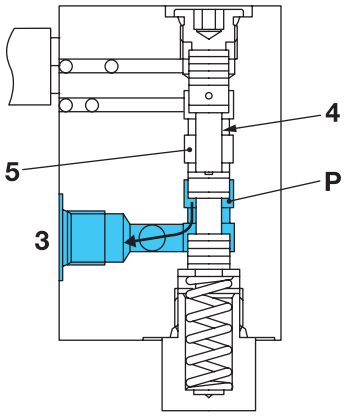
Port	Connected to:
Port 1	Right pilot valve, proportional control valve
Port 1A	Parking brake release
Port 1B	2ND SPEED TRAVEL
Port 2	Left pilot valve
Port 3	HST charge
Port P	Pump P4
Port T	Tank



3KAA08Z

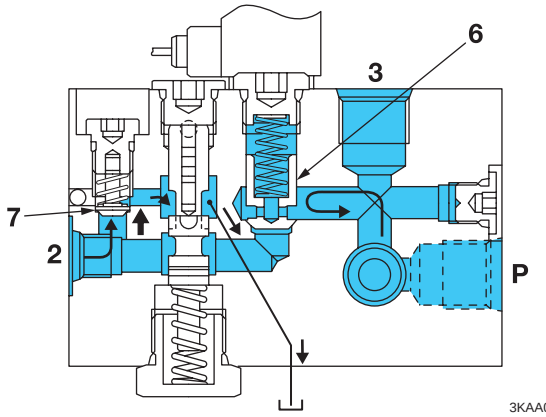
When the solenoid valve A is not energized:

The port P is connected with the circuit of the port 3 through the spool (4).
The pressure oil from the port P flows into the port 3, while the port P is disconnected from the circuit (5) of the ports 1A and 1B.



3KAA011Z

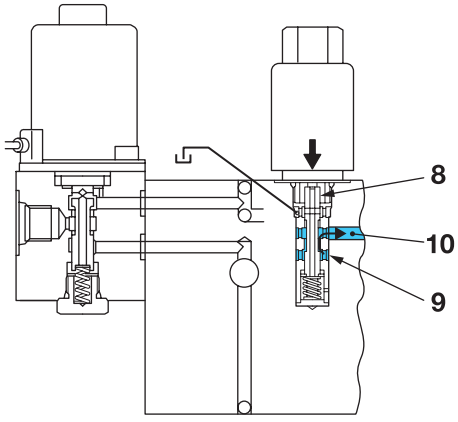
The port P is disconnected from the circuit of the port 2 by the spool (6).
The hydraulic oil from the port 2 pushes up the plunger (7), flows into the port 1 circuit, and then enters the port T together with the oil from the port 1A.



3KAA021Z

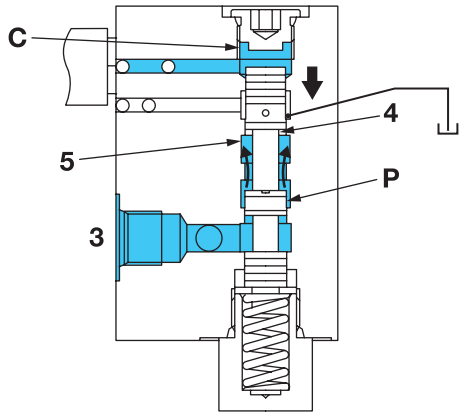
When the solenoid valve A is energized:

A magnetic field is generated around the coil that causes the push rod to be pulled downward and the spool (8) to be pushed downward. Next, the pressure oil from the port P flows through the passages (9) and (10) and into the chamber C.



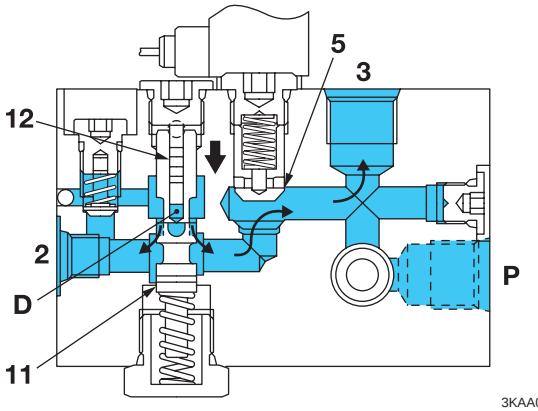
3KAA031Z

The oil that flowed into the chamber C moves the spool (4) downward. As a result, the port P and the port 3 are disconnected while the port P and the passage (5) are connected, and the oil flows from the port P to the port 1A.



3KAA041Z

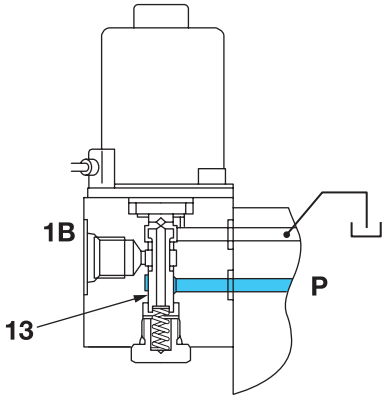
The pressure oil in the port 1A passes through the bore on the side panel of the spool (11) and the wire clearance and then flows into the chamber D of the spool (11) and piston (12). When the pressure in the chamber D becomes higher than the set pressure, the spool (11) moves downward to allow the oil in the port 1 to flow to the port 2. This keeps the pressure in the port 1 at the set pressure.
The pressure oil in the port 2 pushes up the poppet (5) and flows into the port 3.



3KAA051Z

When the solenoid valve B is not energized:

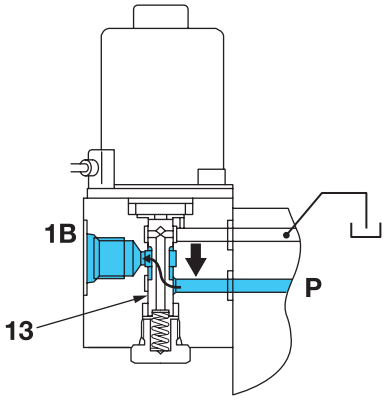
The pressure oil from the port P is blocked by the spool (13).
The port 1B is connected with the port T.



3KAA061Z

When the solenoid valve B is energized:

A magnetic field is generated around the coil that causes the push rod to be pulled downward and the spool (13) to be pushed downward. The oil flows from the port P to the port 1B, and the passage to the port T is blocked.

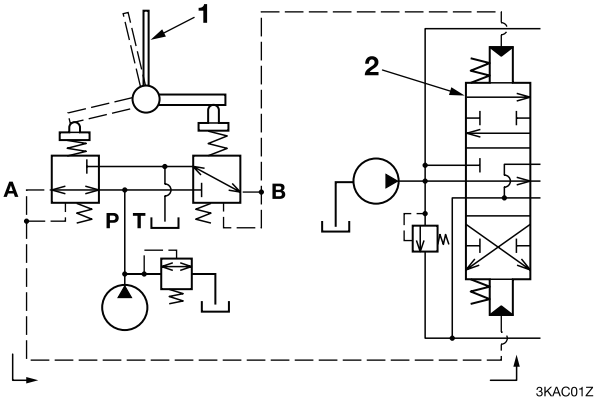


3KAA071Z

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PILOT VALVE

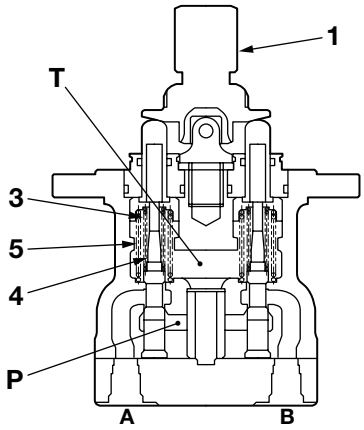
The pilot valve casing contains a vertical shaft hole that incorporates a reducing valve. When the lever is tilted, the push rod and spring seat are pushed down, which changes the spring force of the secondary pressure.
The casing contains the oil inlet port P (the primary pressure) and the tank port T. The secondary pressure corresponding to the changes in operating angle as set with the lever (1) can be provided through the output ports A and B located below the vertical shaft hole. The secondary pressure functions as the pilot pressure to activate the spool of the control valve (2).



3KAC01Z

When the lever (1) is in the neutral position:

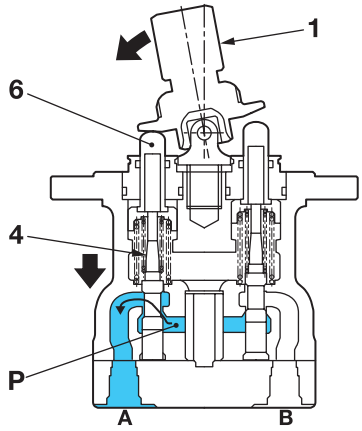
The force of the spring (3) that determines the output pressure (secondary pressure) of the pilot valve is not conveyed to the spool (4). This causes the spool (4) to be pushed up by the return spring (5) and the output ports A and B to be connected to the tank port T. This causes the pressures in the ports A and B to be equal to the pressure in the tank port T.



3KAC02Z

When the lever (1) is tilted:

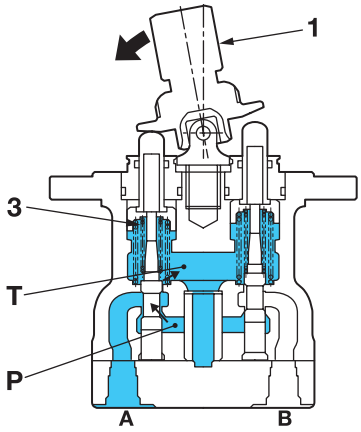
When the lever (1) is tilted and the push rod (6) is pushed in, the spool (4) moves downward and the input port P becomes connected to the output port A. Then, the oil from the pilot pump flows into the output port A, which generates a pressure.



3KAC031Z

When the lever (1) is kept at a certain position:

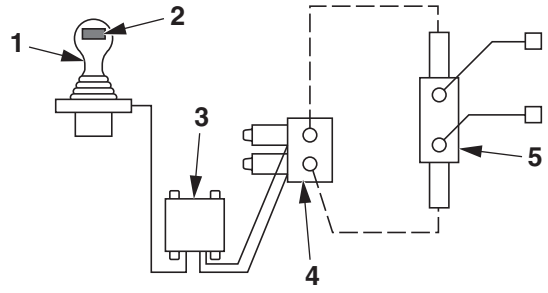
When the pressure in the output port A increases to a level equivalent to the force of the spring (3) set by the inclination of the lever (1), the hydraulic pressure is balanced with the spring force. When the pressure in the output port A becomes higher than the set spring force, the output port A is disconnected from the input port P and then becomes connected to the tank port T. When the pressure in the output port A drops below the set pressure, the output port A becomes connected to the input port P and is disconnected from the tank port T. The secondary pressure is thus always kept constant.



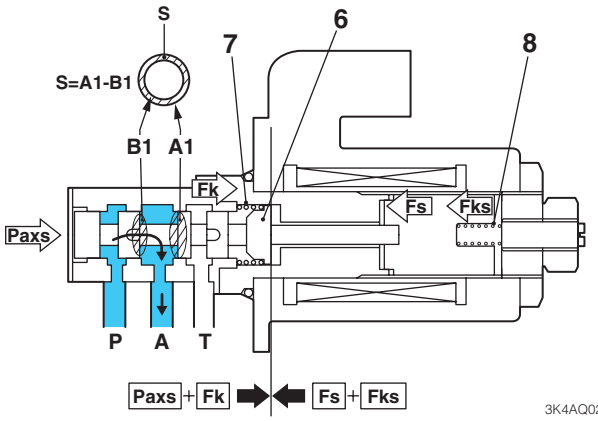
3KAC041Z

PROPORTIONAL CONTROL SOLENOID VALVE

The proportional lever (2) and proportional amplifier (3) of the pilot valve (1) control the driving current that flows to the proportional control solenoid valve (4), which controls the pilot pressure of the control valve (5) (auxiliary section) whereby the flow rate of the auxiliary line piping changes.
The proportional control solenoid valve controls the secondary pressure using the built-in proportional pressure-educing valve. The secondary pressure generated corresponds to the changes in current because of the force used to generate the secondary pressure being applied to the solenoid in accordance with the amount of current flowing through the coil.
When current flows through the solenoid, a thrust force proportional to the current is generated and moves the spool (6) so that the oil supplied from the port P is introduced into the port A on the secondary pressure side, which increases the pressure Pa of the port A.
The pressure Pa acts on the differential area S between the cross section A1 and cross section B1 of the spool (6), and the spool (6) is pushed to the solenoid side by the oil pressure, Pa × s. The spool (6) stops at the position where the sum of the oil pressure, Pa × s, and the force, Fk, exerted by the springs (7) is balanced with the thrust force, Fs, generated by the solenoid. The weight, Fks, of the spring (8) used for fine adjustment of the secondary pressure acts in the direction (left) of assistance of the thrust force from the solenoid.

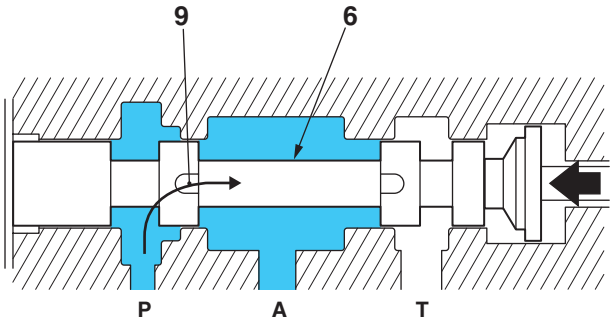


3K4AQ01Z



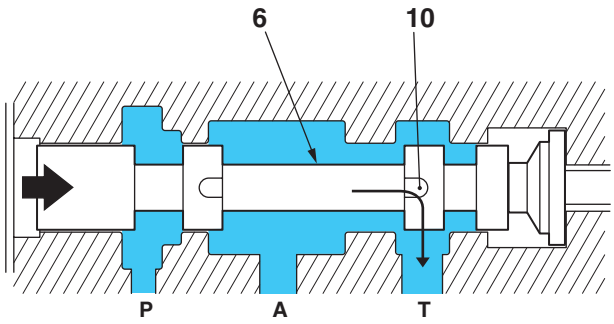
3K4AQ02Z

When the thrust force is greater than a set value, the spool (6) is moved to the left, which connects the port P (supply side) and the port A (secondary side) together through the notch (9).



3K4AQ03Z

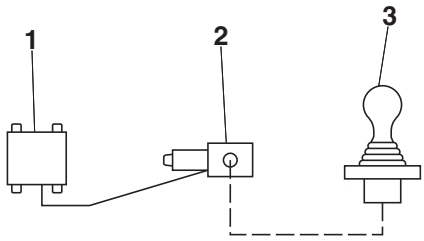
When the thrust force is lower than a set value, the spool (6) is moved to the right, which connects the port A (secondary side) and the port T (tank side) together through the notch (10).
The opening areas of the notch (9) on the supply side and the notch (10) on the discharge side are thus controlled by the movement of the spool (6), and a secondary (pilot) pressure can be provided that corresponds to the thrust force generated by the solenoid.



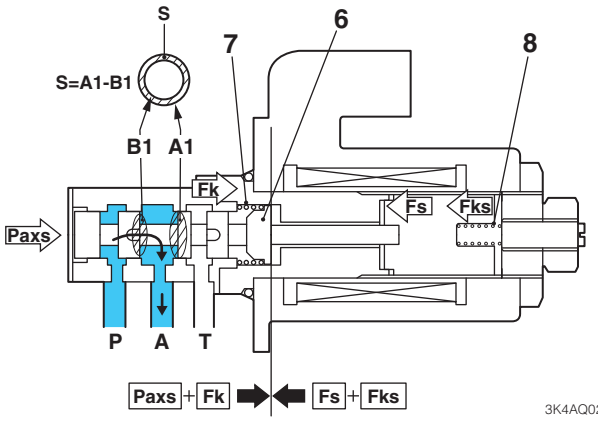
3K4AQ04Z

PROPORTIONAL CONTROL SOLENOID VALVE (ANTI-STALL VALVE)

The controller (1) controls the drive current that flows to the proportional control solenoid valve (2), which controls the pilot pressure to the pilot valve (3) to prevent the engine stalling.
The proportional control solenoid valve incorporates a proportional control valve. As the force generated in the solenoid of the proportional control valve is proportional to the size of the current flowing in the coil, secondary pressure is generated according to the fluctuations in the current.
When current flows through the solenoid, a thrust force proportional to the current is generated and moves the spool (6) so that the oil supplied from the port P is introduced into the port A on the secondary pressure side, which increases the pressure Pa of the port A.
The pressure Pa acts on the differential area S between the cross section A1 and cross section B1 of the spool (6), and the spool (6) is pushed to the solenoid side by the oil pressure, Pa × s. The spool (6) stops at the position where the sum of the oil pressure, Pa × s, and the force, Fk, exerted by the springs (7) is balanced with the thrust force, Fs, generated by the solenoid. The weight, Fks, of the spring (8) used for fine adjustment of the secondary pressure acts in the direction (left) of assistance of the thrust force from the solenoid.

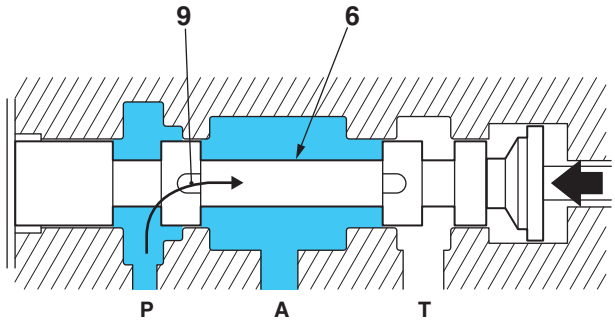


3K4BM01



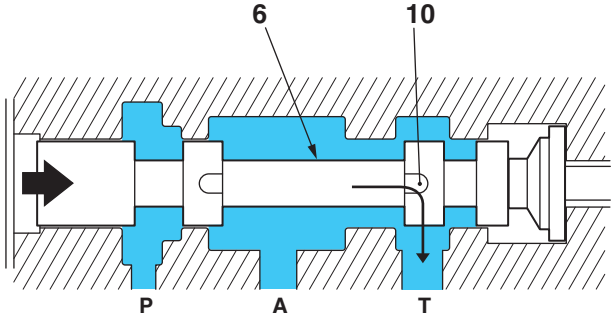
3K4AQ02Z

When the thrust force is greater than a set value, the spool (6) is moved to the left, which connects the port P (supply side) and the port A (secondary side) together through the notch (9).



3K4AQ03Z

When the thrust force is lower than a set value, the spool (6) is moved to the right, which connects the port A (secondary side) and the port T (tank side) together through the notch (10).
The opening areas of the notch (9) on the supply side and the notch (10) on the discharge side are thus controlled by the movement of the spool (6), and a secondary (pilot) pressure can be provided that corresponds to the thrust force generated by the solenoid.



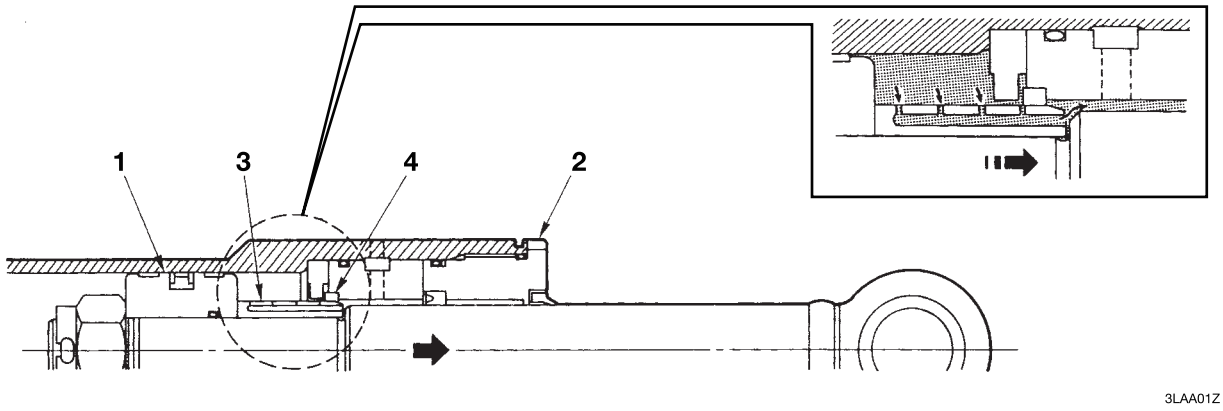
3K4AQ04Z

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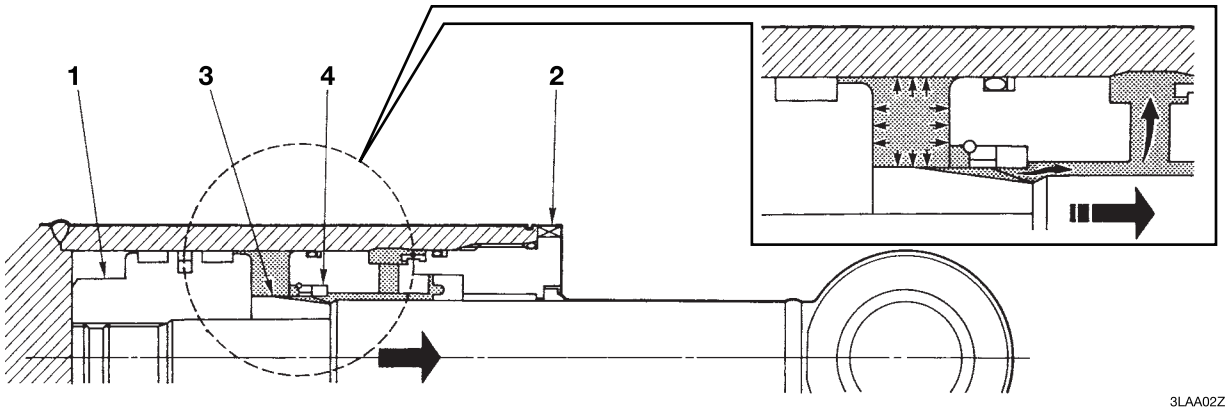
CYLINDERS

The pressure oil flowing alternately in through the outlet and inlet on both sides (head and rod sides) of the piston acts on the piston and its force causes the piston to move back and forth.
For those cylinders with a cushion mechanism, the shock resulting from the piston colliding with the cover at the stroke end is dampened by the mechanism.

Cushion mechanism



3LAA01Z



3LAA02Z

When the piston (1) approaches the stroke end and appears likely to bump into the cover (2), the cushion bearing (3) that is moving ahead of the piston enters the cushion seal (4). Since this shuts off the return channel for the hydraulic oil on the back of the piston, the oil is expelled only from the throttle hole or the groove provided in the cushion bearing (3). This causes the piston (1) backpressure to increase, slowing the piston speed.

TRAVEL MOTOR

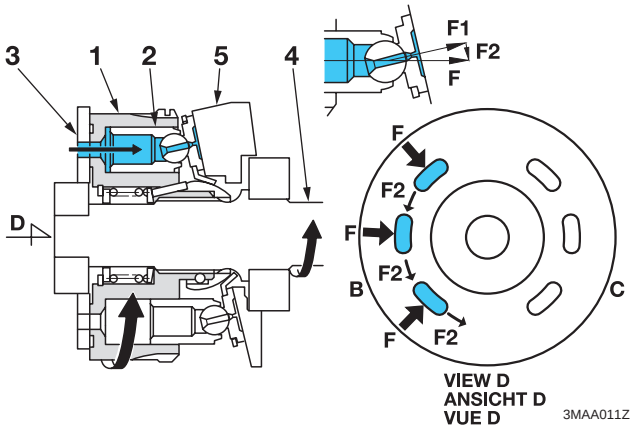
Hydraulic motor

The cylinder block (1) consists of the pistons (2), and its end surface comes in contact with the valve plate (3), which contains two half-moon-shaped ports B and C. The cylinder block (1) rotates freely and is connected to the drive shaft (4) via the spline. Meanwhile, the swash plate (5) is fixed to the housing.

When the high-pressure oil is led to the port B, the pistons (2) push against the swash plate (5) with a force F per piston.

F = P × A, where P: Pressure, A: Sectional area of the piston

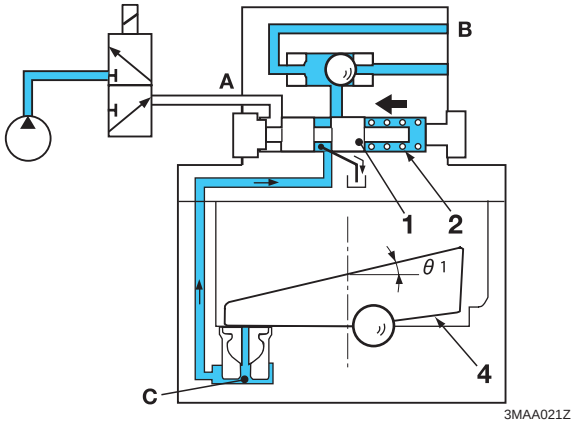
The force F that is pushed against the swash plate (5) by the pistons (2) is divided into two components: a force component F1 that pushes against the plate and a force component F2 that rotates the cylinder block (1). The total sum of the components in the direction of rotation of the piston on the high-pressure side generates a rotational force in the cylinder block (1), with the torque being transmitted via the spline to the shaft (4), which is made to turn. Alternatively, if high-pressure oil is introduced into the port C, the direction of rotation will be the reverse of that described above.



2-speed mechanism

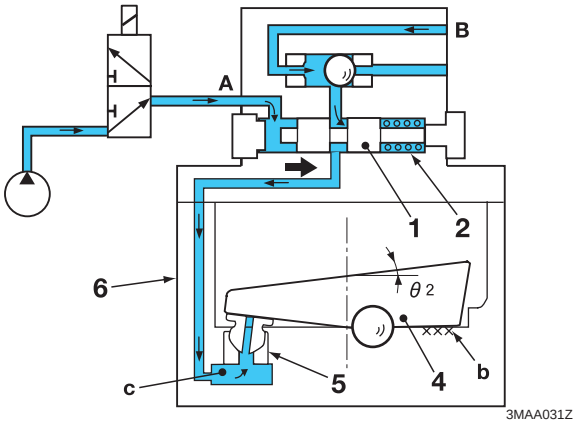
During 1st-speed operation:

If the pilot pressure is not supplied from the port A, the valve (1) is pushed to the left side by the force of the spring (2) and the pressure oil from the supply port B is blocked. At this time, the oil in the chamber C is released into the tank port via the valve. As a result, the swash plate (4) becomes tilted at the maximum angle of inclination, the motor's piston stroke capacity reaches the maximum value, and the motor turns at 1st (low) speed.



During 2nd-speed operation:

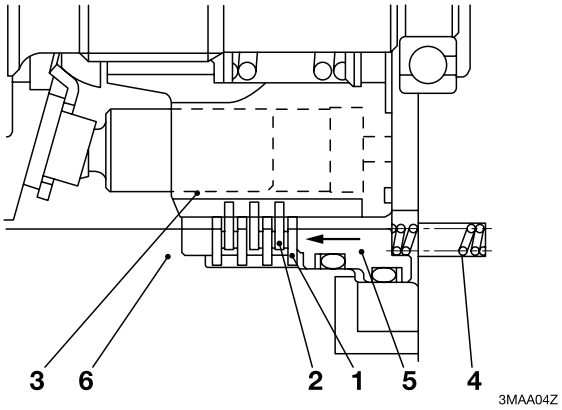
When the pilot pressure is supplied from the port A, the pilot pressure overcomes the force of the spring (2), and the valve (1) is pushed to the right side. The pressure oil of the supply port B flows into the chamber C through the valve, and the piston (5) pushes the swash plate (4) up until it touches surface "b" of the flange holder (6) and keeps it against this surface. At this time, the swash plate (4) is tilted at the minimum angle of inclination, the motor's piston stroke capacity is at the minimum value, and the motor turns at 2nd (high) speed.



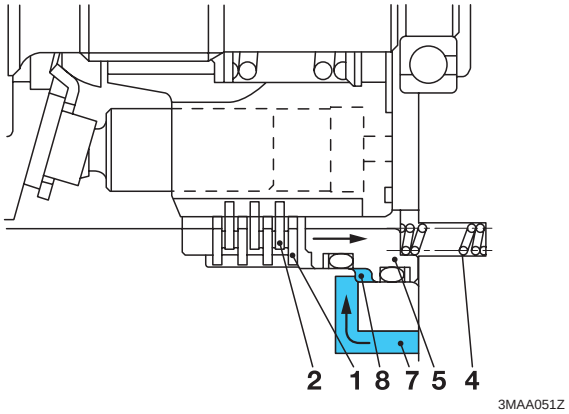
https://truckmanualshub.com/

Parking brake

The friction disc (2) and the disc (1) are connected through the spline. The friction disc (2) and the disc (1) are pressed against the flange holder (6) by the springs (4) via the brake piston (5). The friction force between these discs generates a brake torque that is used to prevent the cylinder block (3) from rotating.

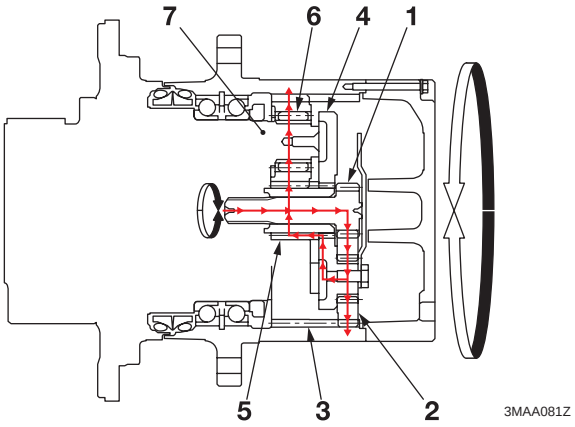


When the pressure oil is introduced into the motor, the oil flows from the parking brake release port (7) into the brake piston chamber (8). The oil pressure overpowers the spring force and moves the brake piston (5) to the right. This generates a clearance between the friction disc (2) and the disc (1) that works to release the parking brake function.
Once the motor stops, no pressure oil flows into the parking brake release port (7) and the parking brake force is used by the spring (4).



Reduction gears

The reduction gears consist of two simple planetary stages connected in series. Each planetary stage consists of a sun (input) gear, an internal tooth ring gear, and planet gears that are mounted on a carrier. The sun gear “floats” within the planet gears so as to attain uniform load distribution at the multiple gear mesh points.
The motor drives the 1st stage sun gear (1), which in turn drives the 1st planet gears (2). Since these planet gears (2) are engaged with the ring gear (3), the rotation of the planet gears (2) is transmitted to the 1st stage carrier (4). The 1st stage carrier (4) is coupled directly with the 2nd stage sun gear (5), which in turn drives the 2nd planet gears (6).
The 2nd stage carrier (7) is a part of the motor housing (non-rotating), which allows the main torque to be output to the ring gear (3). The direction of rotation for the output flange is opposite that of the input rotation.



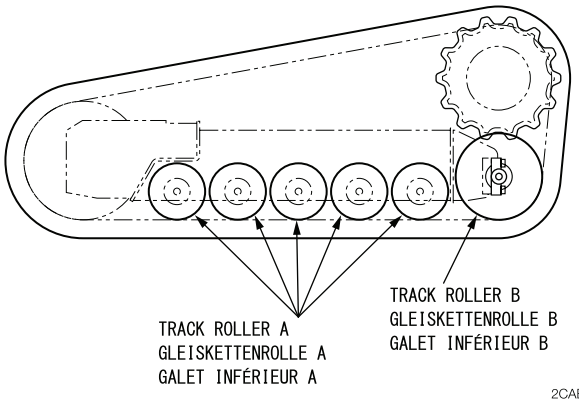
https://truckmanualshub.com/

DISASSEMBLY AND ASSEMBLY 4

SERVICE STANDARDS

Track roller A

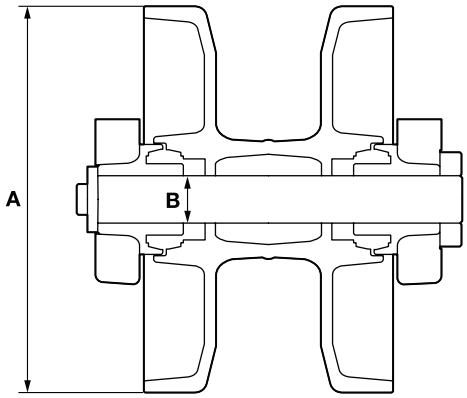
Code	Criteria, mm (in.)	
	Standard dimension	Allowable value
A	200 (7.9)	192 (7.6)
B	35 (1.4)	—



2CAB01Z

Track roller B

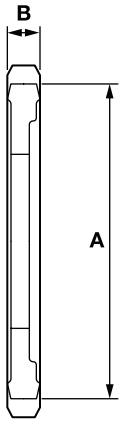
Code	Criteria, mm (in.)	
	Standard dimension	Allowable value
A	328 (12.9)	320 (12.6)
B	40 (1.6)	—



4A0AC01Z

Sprocket

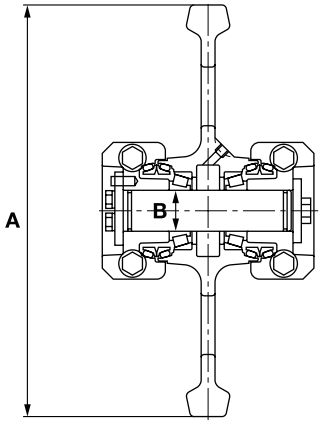
Code	Criteria, mm (in.)	
	Standard dimension	Allowable value
A	414 (16.3)	404 (15.9)
B	35 (1.4)	25 (1.0)



4A0AC02Z

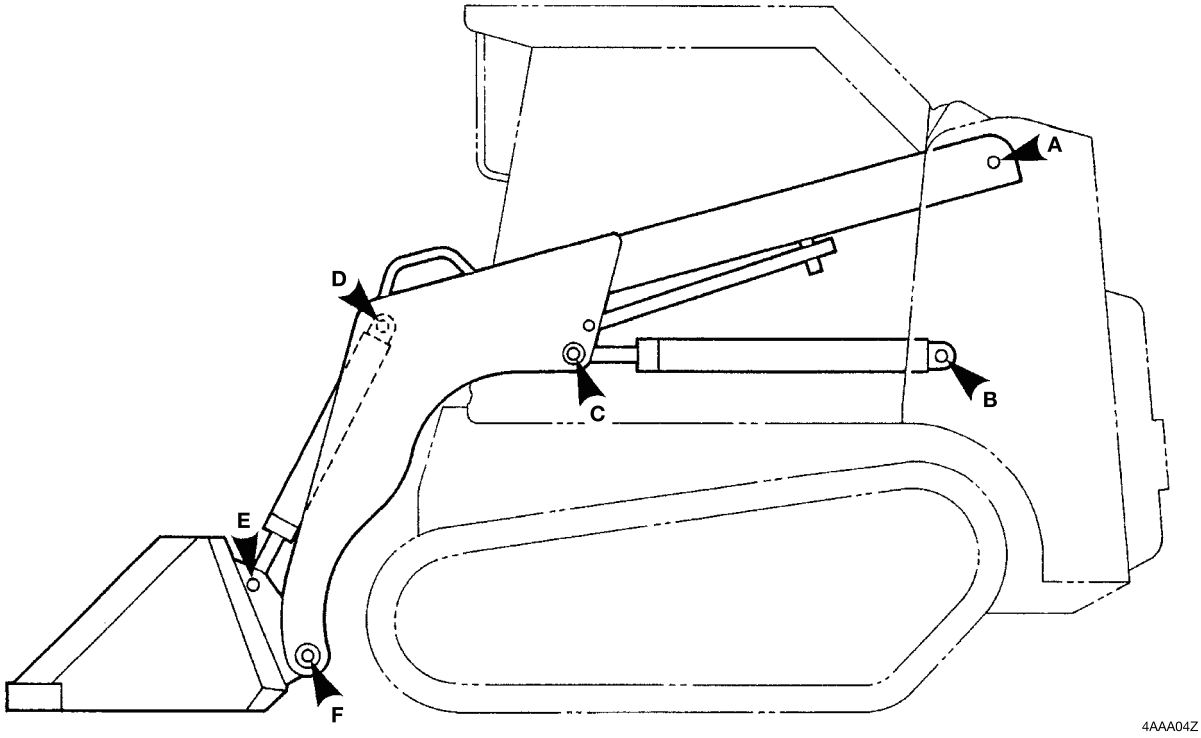
Idler

Code	Criteria, mm (in.)	
	Standard dimension	Allowable value
A	400 (15.7)	394 (15.5)
B	42 (1.7)	—



4AAA03Z

Clearance for pin and bushing



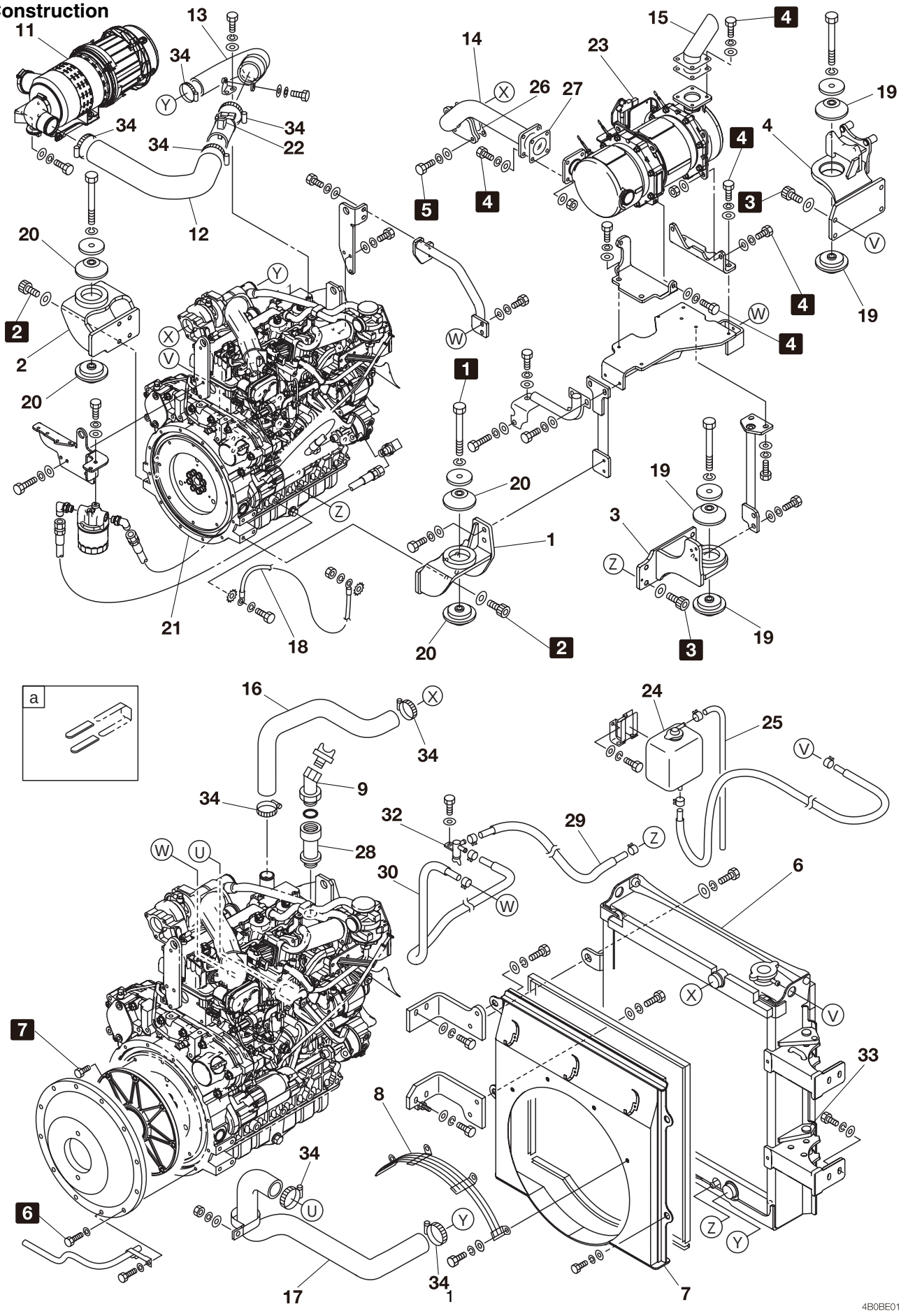
Unit: mm (in.)

Code	Item	Standard dimension
A	Lift arm and frame	40 (1.57)
B	Arm cylinder and frame	40 (1.57)
C	Arm cylinder and lift arm	40 (1.57)
D	Bucket cylinder and lift arm	35 (1.38)
E	Bucket cylinder and quick attachment	35 (1.38)
F	Lift arm and quick attachment	35 (1.38)

DRIVE SYSTEM

Engine

Construction



1 256 N·m (189 ft-lb.) Bolt: ThreeBond #1324
2 110 N·m (81 ft-lb.) Bolt: ThreeBond #1324
3 134 N·m (99 ft-lb.) Bolt: ThreeBond #1324
4 54.9 N·m (40 ft-lb.)
5 26.5 N·m (20 ft-lb.)
6 55 N·m (41 ft-lb.)
7 49 N·m (36 ft-lb.)

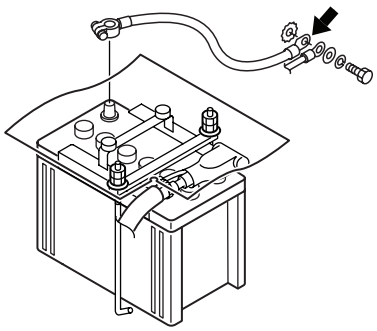
1. Engine hood FL
2. Engine hood FR
3. Engine hood RL
4. Engine hood RR
6. Radiator assembly
7. Fan shroud
8. Fan guard
9. Pipe A
10. Pipe B
11. Precleaner assembly
12. Hose
13. Hose
14. Pipe
15. Pipe
16. Hose
17. Hose
18. Cable
19. Rubber cushion (Identification code: “D”)
20. Rubber cushion (Identification code: “C”)
21. Engine
22. Air flow sensor
23. DPF assembly
24. Reserve tank
25. Hose
26. Gasket
27. Gasket
28. Pipe
29. Hose
30. Hose
32. Drain valve
33. Pin
34. Band

Removing the engine

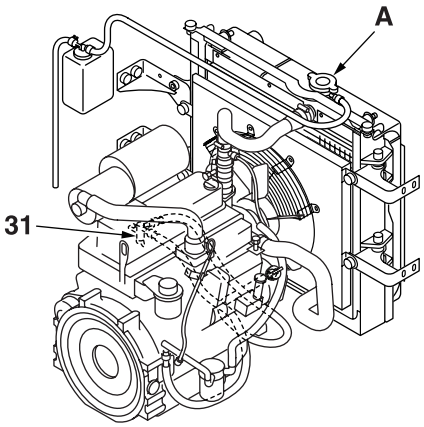
⚠ WARNING

Securely wrap or otherwise isolate the disconnected terminal to ensure that it does not make contact with the body or other parts.

1. Disconnect the ground cable on the battery from the engine body.

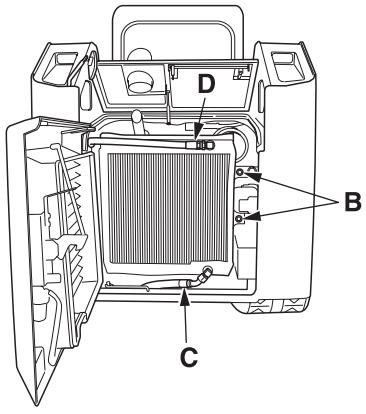

4B0AU02

2. Drain off the engine coolant.
   a. Remove the radiator cap (A).
   b. Loosen the drain valve (32), and let the engine coolant drain out.
      • Engine coolant volume: 14 L (14.8 US qt.)
3. Drain off the hydraulic oil from the hydraulic tank.
   ☞ "Removing the hydraulic tank"
   • Total oil volume: 58 L (15.3 US gal.)
4. Remove the covers.
   ☞ "Removing the covers"
5. Disconnect the hoses on the air conditioner.
   • For air conditioner specifications only
   ☞ "Removing the air conditioner"
6. Remove the canopy.
   ☞ "Removing the canopy"
7. Remove the floor frame.
   ☞ "Removing the floor frame"



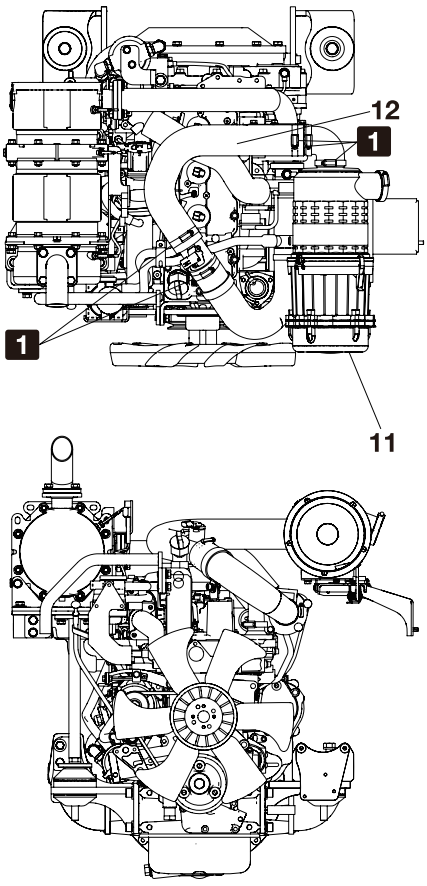
4B0AT02

8. Remove the radiator assembly (6).
   a. Remove the bolts (B), and open the radiator assembly.
   b. Disconnect the hoses (C) and (D).
      • Prepare a plate to catch drips of hydraulic oil.
   c. Disconnect the hose (29).
   d. Remove the bands, and disconnect the hoses (16) and (17).
      Band: 5 N·m (3.7 ft.-lb)
   e. Remove the pin (33), and remove the radiator assembly (6).
      Radiator assembly: 52 kg (115 lb)
      • During assembly, the radiator is to be mounted at a right angle to the frame and parallel to the cooling fan.



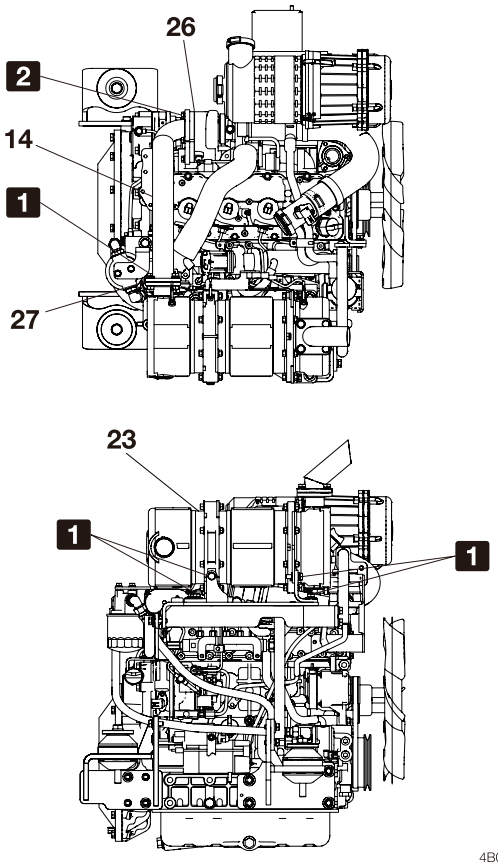
4B0AU04

9. Remove the precleaner assembly (11).
   a. Disconnect the electrical wiring to the air flow sensor (22).
   b. Loosen the band, and remove the hose (12).
      Band: 5 N·m (3.7 ft.-lb)
   c. Take out the bolts, and remove the precleaner assembly (11).



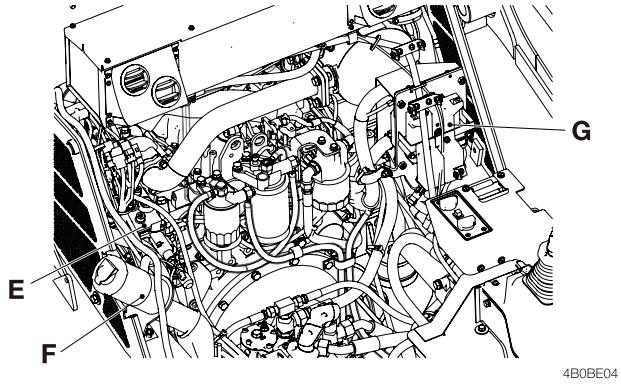
4B0BE02

10. Remove the DPF assembly (23).
    a. Disconnect the electrical wiring to the sensors in the DPF.
    b. Take out the bolts, and remove the pipe (14).
       Bolt: 54.9 N·m (40.5 ft.-lb)
       • During assembly, take out the gaskets (26) and (27) and replace them with new ones.
    c. Take out the bolts, and remove the DPF assembly (22).
       Bolt: 54.9 N·m (40.5 ft.-lb)
       • Disassembly of the DPF
       ☞ "Engine Workshop Manual"



4B0BE03

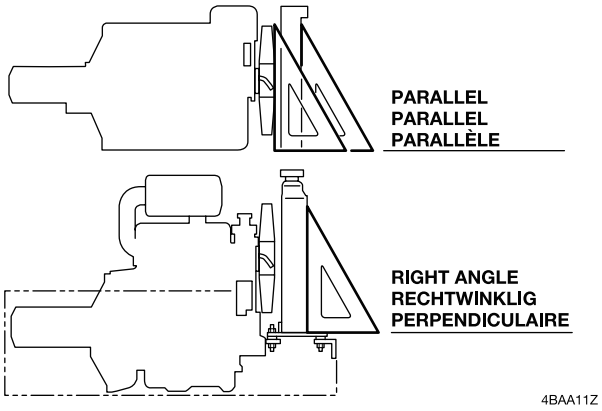
11. Remove the control valve (E), the fuel filler port (F) and the controller (G).
    - Attach identification tags to the disconnected hoses and electrical wires to use during reassembly.
12. Remove the electrical wiring to the engine.
    ☞ "Chapter 2: Wire harness diagram"
13. Remove the hydraulic pump.
    ☞ "Removing the hydraulic pump"
14. Remove the engine.
    a. Disconnect the cable (18).
    b. Take out the bolts, and remove the rubber cushions (19) (20).
       Bolt: ThreeBond #1324 or an equivalent
       Bolt: 256 N·m (188.8 ft.-lb)
    c. Suspend the engine.
       : 284 kg (626 lb)



4B0BE04

Installing the engine

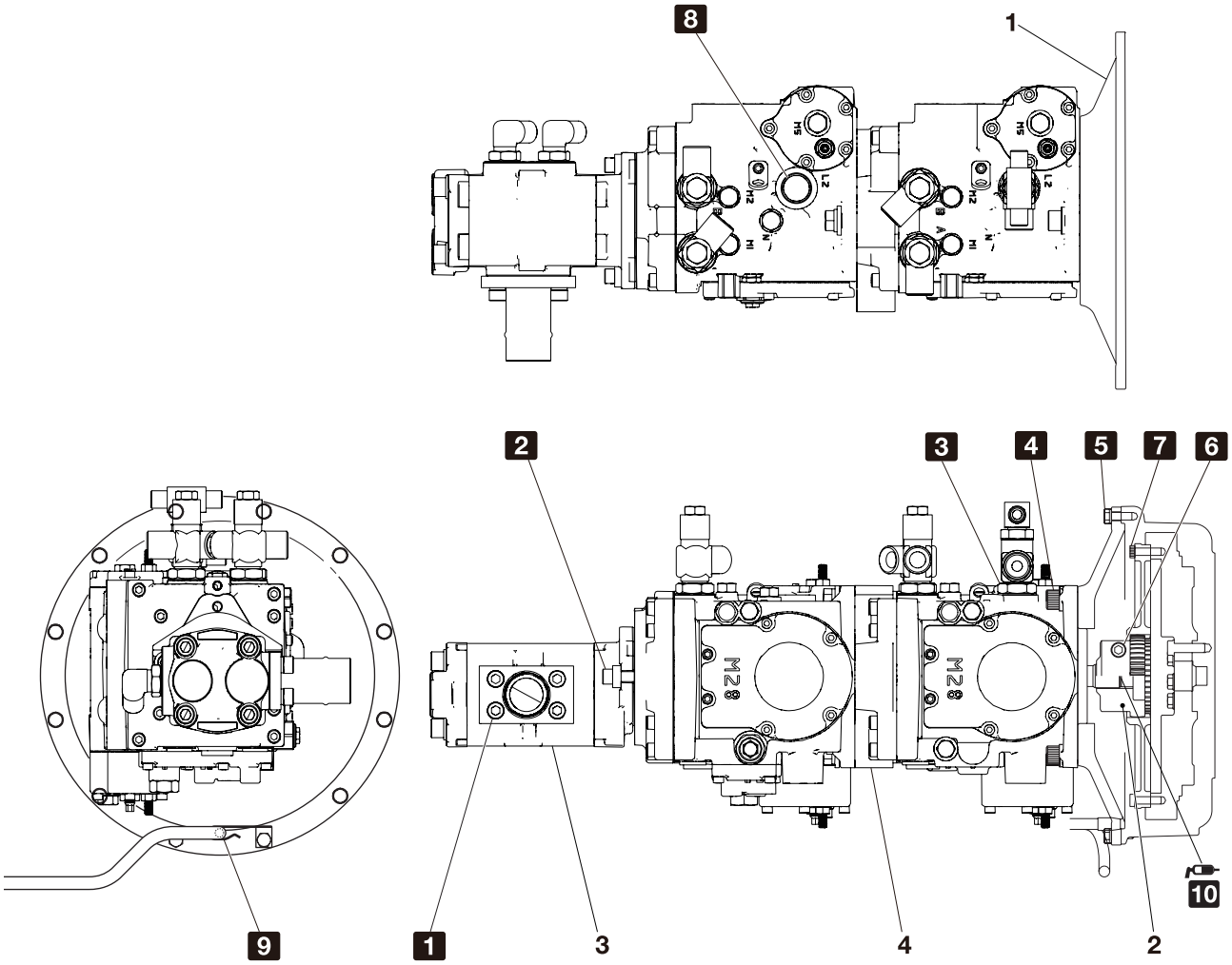
- To install the engine, follow the same procedures as for removal but in the reverse order.
- The radiator is to be mounted at a right angle to the frame and parallel to the cooling fan.



4BAA11Z

Hydraulic pump

Construction



4B0BE05

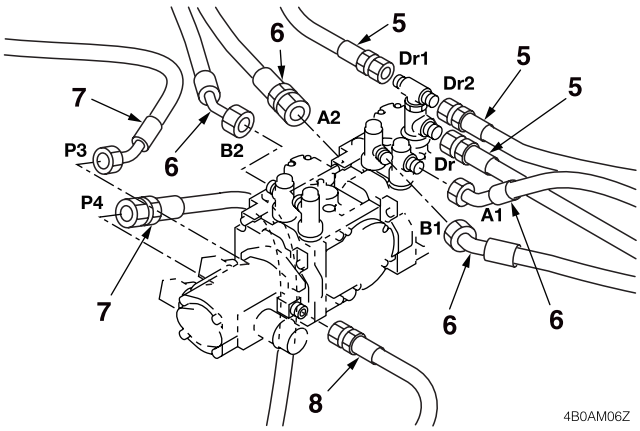
Molybdenum disulfide grease (Zemico grease AD-1 or an equivalent)

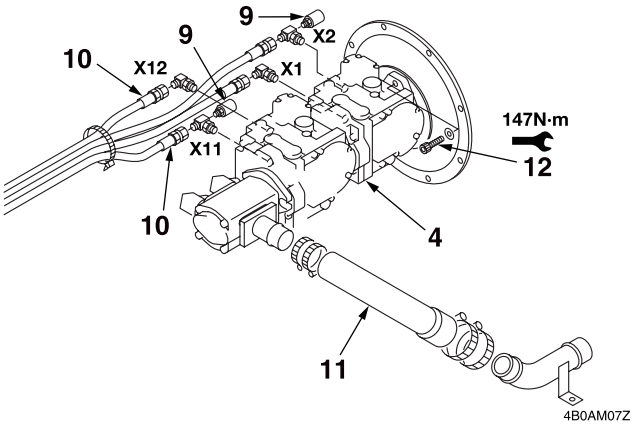
1. 59 N·m (44 ft-lb.)
2. 47.1 N·m (35 ft-lb.) ThreeBond #1324
3. 132 N·m (97 ft-lb.)
4. 147 N·m (108 ft-lb.)
5. 55 N·m (41 ft-lb.)
6. 86 N·m (63 ft-lb.)
   Make sure that the end surface of the pump shaft remains in contact with the snap ring when tightening down the bolt.
7. 49 N·m (36 ft-lb.) ThreeBond #1324
8. Air vent port
9. Water drain hole on the engine housing
10. Apply grease to the spline. Do not apply grease to the coupling assembly.

1. Engine housing
2. Coupling
3. Double-gear pump
4. HST pump

Removing the hydraulic pump

1. Drain off the hydraulic oil from the hydraulic tank.
   ☞ "Removing the hydraulic tank"
2. Disconnect the drain hoses (5) and the HST hoses (6).
3. Disconnect the discharge hoses (7) and the charge hose (8).
4. Disconnect the electrical wiring from the pressure switches (9).
5. Disconnect the pilot hoses (10).
6. Disconnect the suction hose (11).
7. Take out the cap screws (12), and remove the HST pump (4).
   - Apply molybdenum disulfide grease to the spline.
   - Cap screw: 147 N·m (108 ft.-lb.)





Installing the hydraulic pump

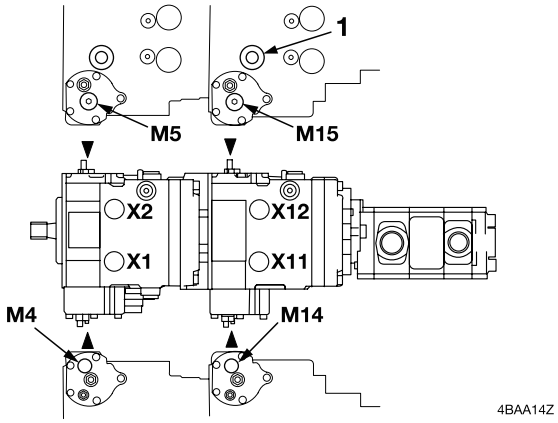
To install, follow the same procedures as for removal but in the reverse order.

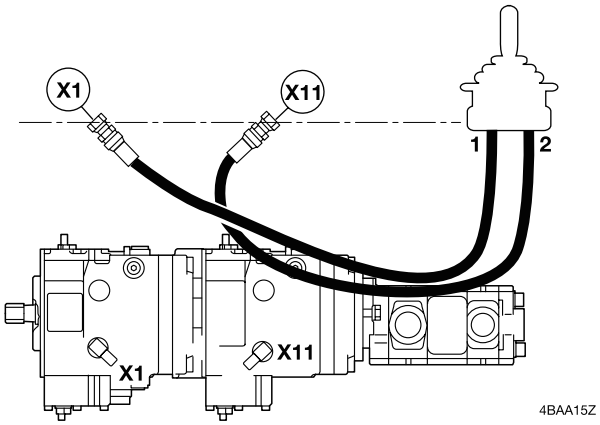
Bleeding air from the HST pump

⚠ WARNING

Before reassembling the HST, be sure to bleed the air from it. Failure to do so may cause the machine to move unexpectedly, which could result in personal injury or death.

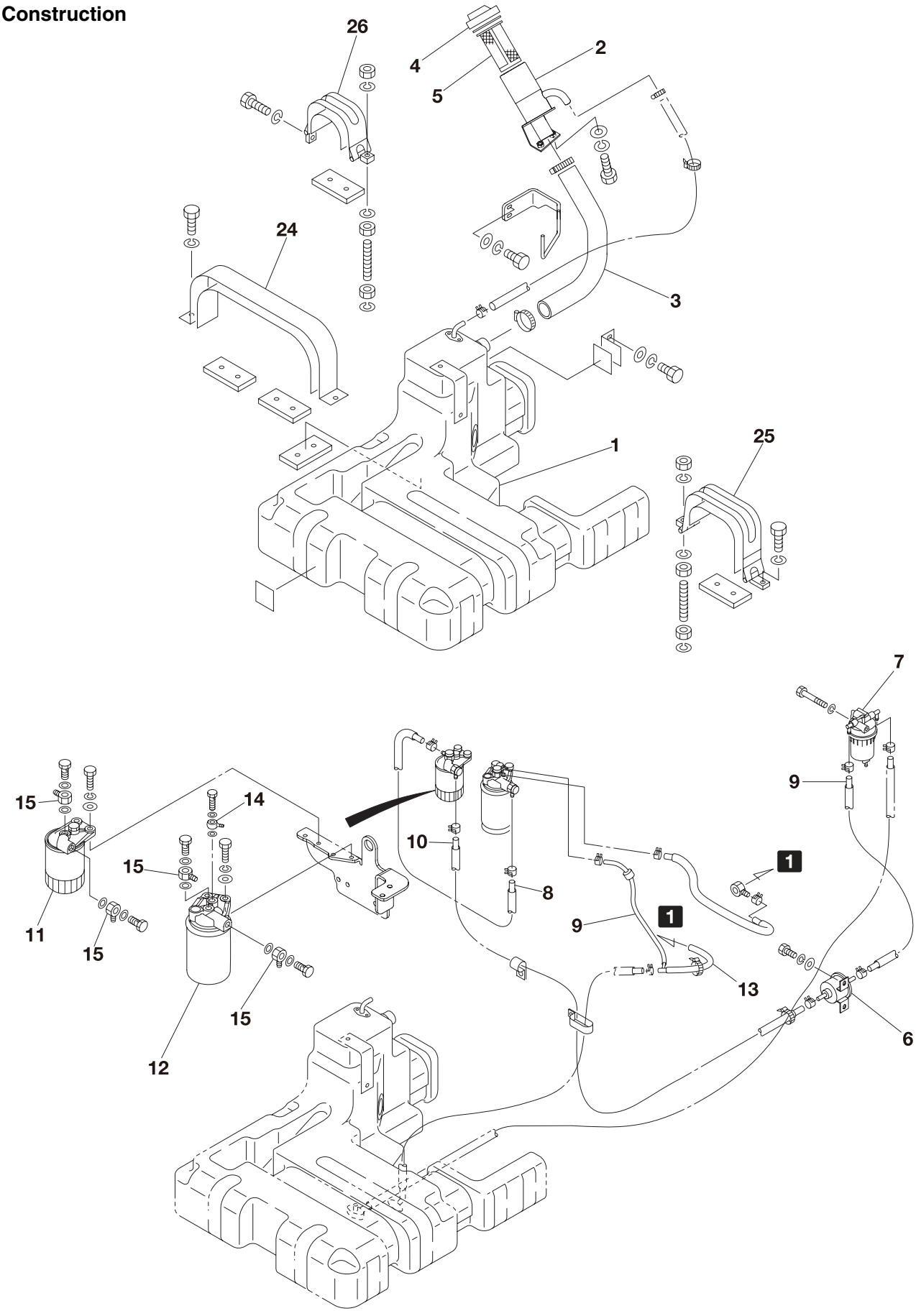
1. Before inserting the HST pump into the machine, fill the servo control chambers with hydraulic oil.
   a. Insert the plugs into the pilot ports (X1), (X2), (X11), and (X12).
   b. Fill the servo control chambers with hydraulic oil through the pressure detection ports (M4), (M5), (M14), and (M15), and tighten the plugs.
2. Install the HST pump on the machine.
3. Fill the hoses that are to be connected to the pilot ports (X1) and (X11) with hydraulic oil.
   - Fill the hoses with oil by holding the opening of the hose at the same height as the pilot valve.
     If the hose is held at a lower height than the pilot valve, air bleeding fails. If the hose is held at a higher height than the pilot valve, the oil poured into the hose will flow into the tank.
4. Remove the plugs from the pilot ports (X1) and (X11), and connect the hoses to the ports to prevent the oil from running out.
5. Remove the plugs from the pilot ports (X2) and (X12), and connect the hoses to these ports.
6. Connect the rest of the hoses to the pump.
7. Fill the pump with oil through the plug hole (1) and the pressure detection ports (M5) and (M15), and tighten the plugs.
8. Start the engine, and let it run at an idling speed for five minutes to bleed air out of the pump casing.
9. Bleed air from the main circuit and the pilot circuit by slowly operating the pilot valve.





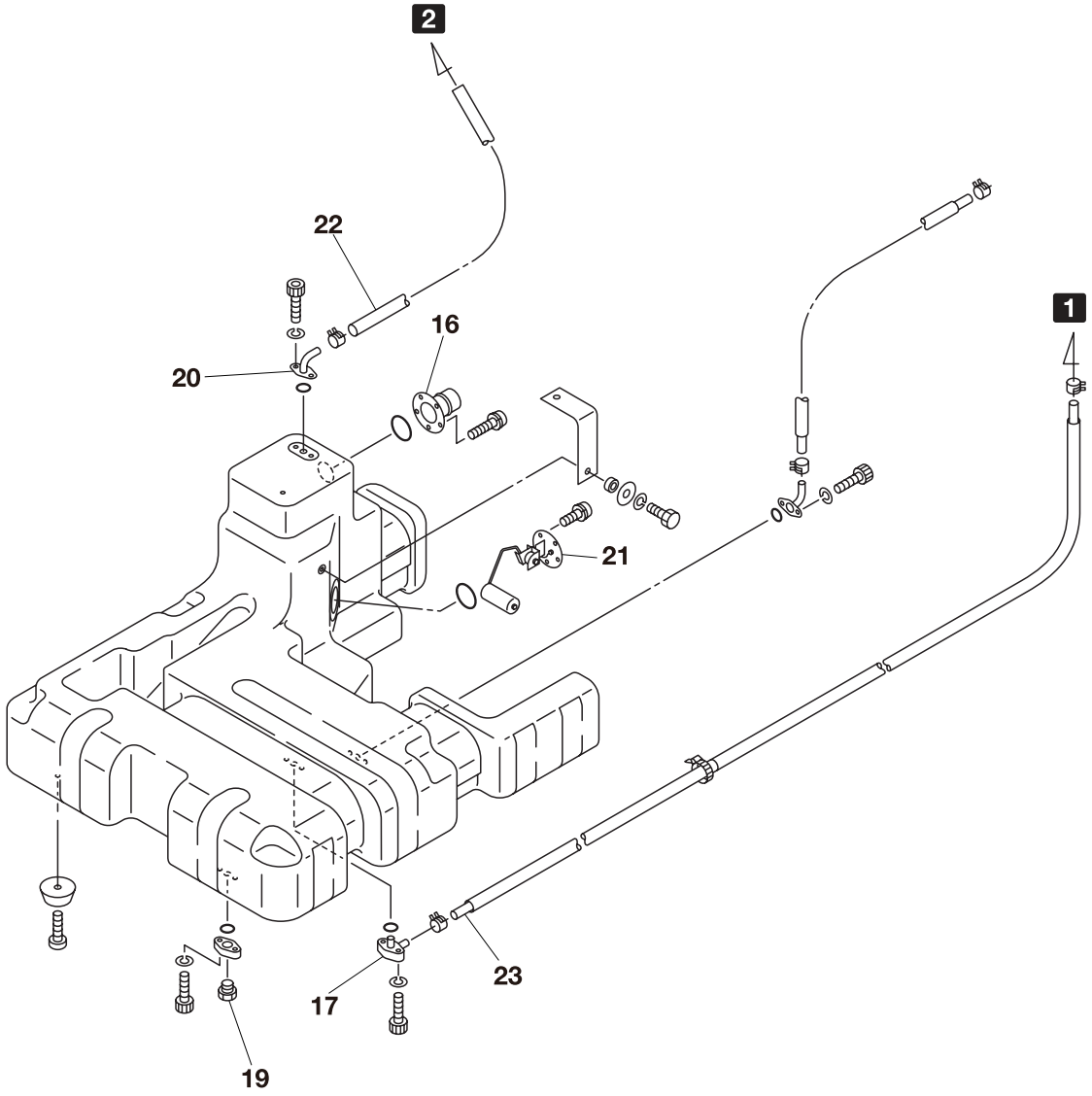
Fuel tank

Construction



1 To engine

4B0BE06



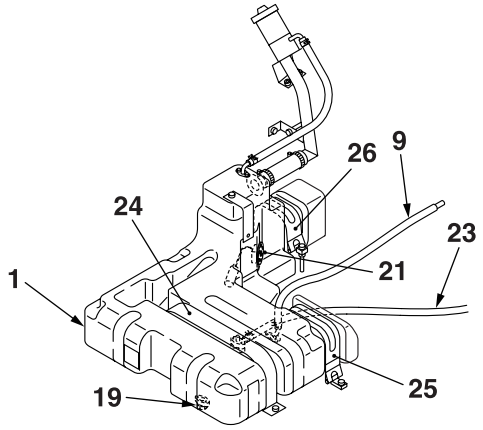
4B0BE07

1 To water separator
2 To fuel filler port

1. Fuel tank
2. Fuel filler port
3. Hose
4. Filler cap
5. Strainer
6. Feed pump
7. Water separator
8. Hose
9. Hose
10. Hose
11. Fuel filter
12. Fuel filter
13. Hose
14. Pipe
15. Pipe
16. Flange
17. Flange
19. Drain plug
20. Flange
21. Fuel sender
22. Hose
23. Hose
24. Band
25. Band
26. Band

Removing the fuel tank

1. Remove the floor frame.
   ☞ “Removing the floor frame”
2. Remove the lever stands.
   ☞ “Removing the lever stands”
3. Remove the hydraulic pump.
   ☞ “Removing the hydraulic pump”
4. Loosen the drain plug (19), and drain off the fuel.
   • Fuel tank capacity: 75 L (19.8 US gal.)
5. Disconnect the electrical wiring from the fuel sender (21).
6. Disconnect the fuel hoses (9) and (23).
7. Take out the bolts, and remove the bands (24), (25), and (26).
8. Remove the fuel tank (1).



Installing the fuel tank

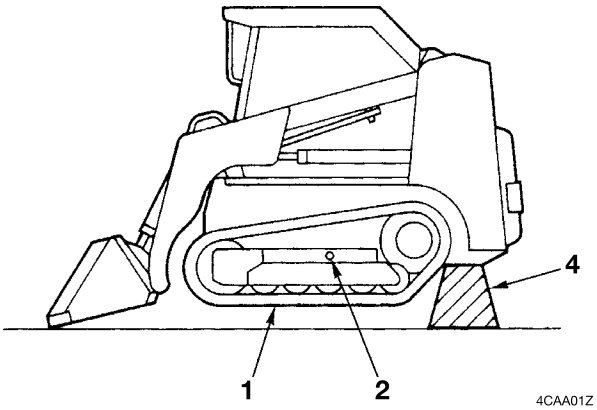
To install, follow the same procedures as for removal but in the reverse order.

TRAVEL SYSTEM

Removing the crawler belt

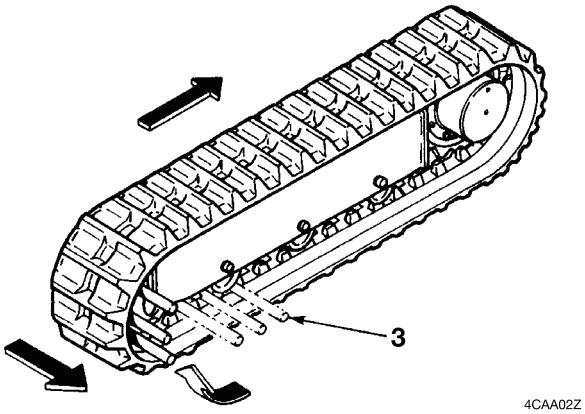
1. Loosen the tension of the crawler (1).
   - When loosening the check valve (2), do it slowly. Stop loosening it once grease starts to come out. If no grease comes out, slightly move the machine forward and backward.

   Check valve: 59 N·m (43.5 ft.-lb)
2. Place the block (4) under the machine to support it, and raise the machine using the arm and bucket.



3. Fit the iron pipe (3) into the crawler and then rotate the sprocket in the reverse direction.
4. Once the pipe reaches the side of the idler, stop rotating the sprocket.
5. Slide the crawler to the side, and remove it.

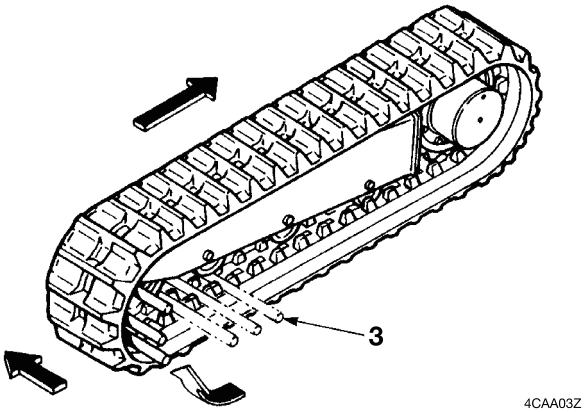
   Crawler belt: 170 kg (375 lb)



Installing the crawler belt

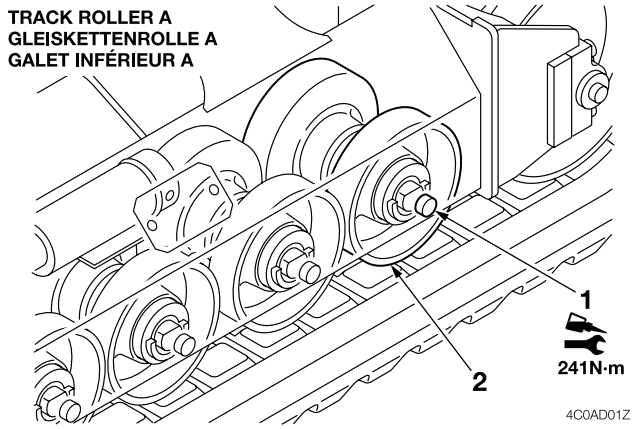
1. Place the block (4) under the machine to support it, and raise the machine using the arm and bucket.
2. Set the crawler (1) on the frame.
   - Set the crawler so that it is engaged with the sprocket.
3. Fit the iron pipe (3) into the crawler and then rotate the sprocket in the reverse direction.
4. Once the pipe (3) reaches the side of the sprocket, stop rotating the sprocket.
5. Slide the crawler to a position where it can be properly fitted with the idler.
6. Make sure that the crawler is firmly engaged with the sprocket and the idler and then adjust the crawler tension.

   “2. Service data, Performance criteria”



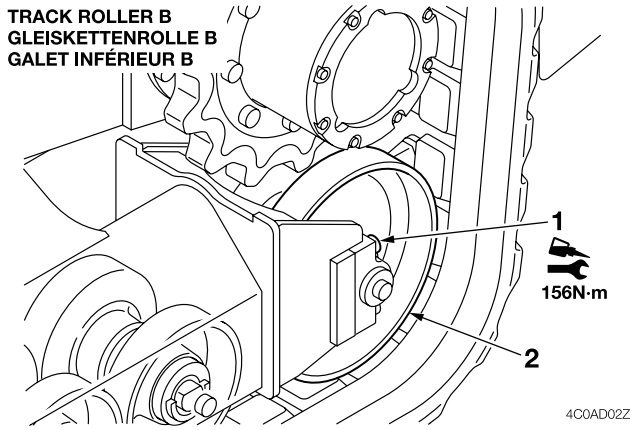
Removing the track roller

1. Loosen the crawler tension.
2. Slightly loosen the roller fixing bolt (1) (about one turn).
3. Raise the machine, remove the fixing bolt (1), and remove the roller (2).



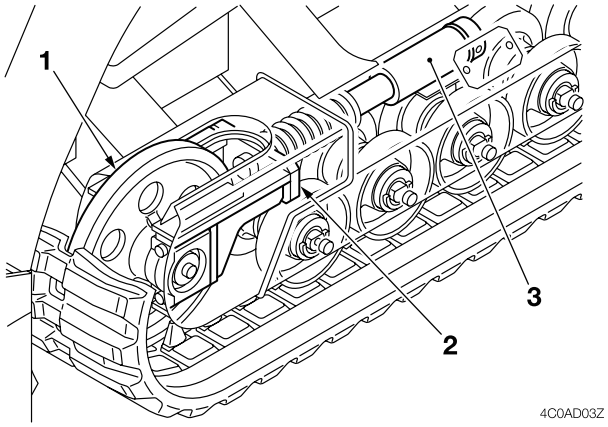
Installing the track roller

1. Temporarily tighten the fixing bolt (1) on the roller (2).
2. Lower the machine to the ground and then further tighten down the bolt.
   - Bolt: ThreeBond #1324 or equivalent
   - Bolt: 241 N·m (177.8 ft.-lb), (Track roller A)
   - Bolt: 156 N·m (115.1 ft.-lb), (Track roller B)
3. Lift up the machine, and adjust the crawler tension.



Removing the idler and track adjuster

1. Remove the crawler.
   ☞ "Removing the crawler belt"
2. Pull out the idler.
   kg Idler: 36 kg (79 lb)
3. Pull out the track adjuster spring (2) and the shoe tensioning cylinder (3).
   kg Track adjuster: 17 kg (37 lb)



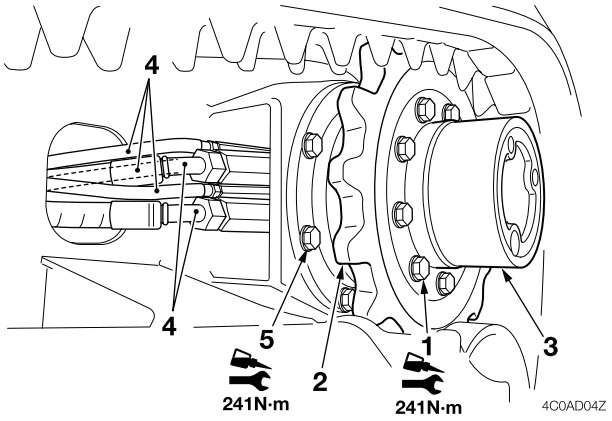
Installing the idler and the track adjuster

To install, follow the same procedures as for removal but in the reverse order.

- Apply on the sliding surfaces of the track adjuster piston and cylinder.

Removing the travel motor

1. Remove the crawler.
   ☞ "Removing the crawler belt"
2. Take out the fixing bolts (1), and remove the sprocket (2).
   Bolt: ThreeBond #1324
   Bolt: 241 N·m (177.8 ft.-lb)
3. Remove the cover, and disconnect the hydraulic hoses (4).
4. Suspend the travel motor (3) temporarily, and remove the fixing bolts (5).
   Bolt: ThreeBond #1324
   Bolt: 241 N·m (177.8 ft.-lb)
5. Raise the travel motor (3) and then remove it.
   Travel motor: 56 kg (123 lb)



Installing the travel motor

To install, follow the same procedures as for removal but in the reverse order.

FRAME

Tilting up the canopy and cab

For inspection and maintenance, the canopy and cab can be tilted up.

⚠ WARNING

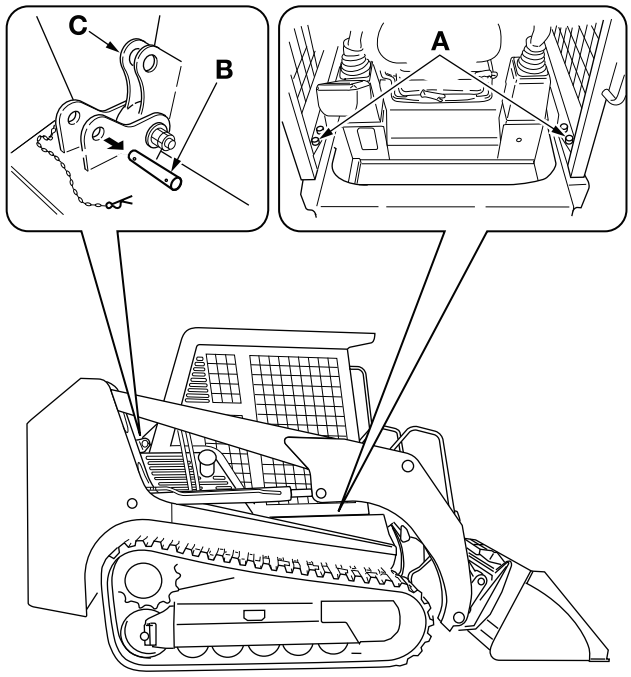
- If the canopy or cab is raised or lowered while the engine is running, the machine may accidentally start moving, which could lead to severe injury to the maintenance personnel. Stop the engine before attempting to raise or lower the canopy or cab.
- When the canopy or cab is tilted up, firmly secure it in place with a stopper to prevent it from falling.

How to raise (tilt up) the canopy and cab

1. Select a firm and level surface, lower the working equipment to the ground, and stop the engine.
2. Set the safety bar to the lock position.
3. Take out the lock bolts (A).
4. Disconnect the R-pin, and pull out the stopper pin (B).
5. Slowly raise the canopy or cab.
6. Confirm that the holes on the "C" part of the canopy/cab are overlapping with the holes from where the stopper pin (B) was pulled out, and insert the stopper pin (B) into those holes to secure the canopy/cab in place.

If the engine must be started with the canopy or cab in the raised position, follow the steps below.

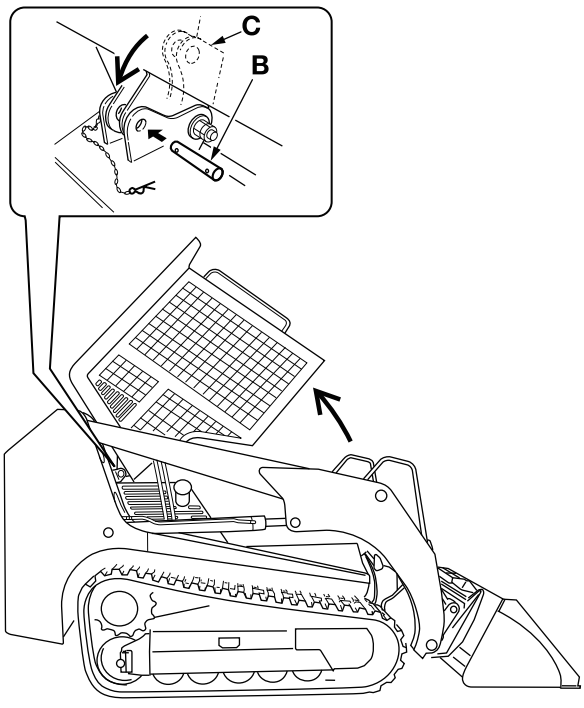
7. Make sure that each of the levers and pedals is in the neutral position.
8. Move the throttle lever to the low idling position.
9. Start the engine.
10. Stop the engine upon the completion of inspection and maintenance.



4EAA01Z

How to lower the canopy/cab

1. Disconnect the R-pin, and pull out the stopper pin (B).
2. Slowly lower the canopy/cab.
3. Insert the lock bolts (A).
4. Insert the stopper pin (B) into the holes on the holder of the machine body.



4EAA02Z

Lift arm stopper

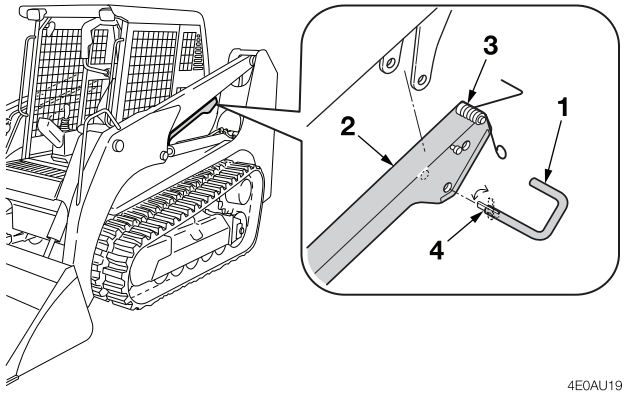
⚠ WARNING

- If you absolutely must work beneath the raised lift arm, use the lift arm stopper to securely support the lift arm. Never position yourself under the lift arm without making sure that it is securely supported.
- If there are any damaged or missing parts found in the lift arm stopper, immediately repair or replace them. Failure to do so may cause the lift arm to fall, which could lead to serious injury or death.

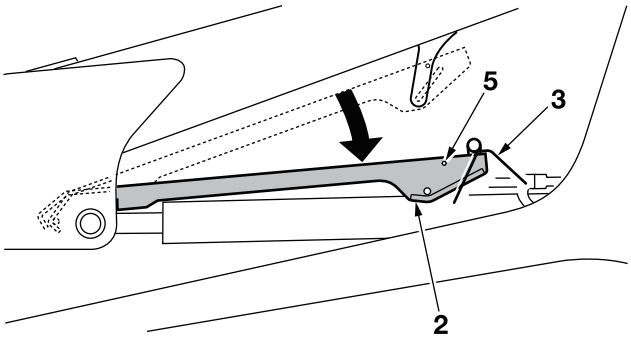
Inspection and maintenance work should be performed while the lift arm is lowered. If the lift arm needs to be raised, use our approved lift arm stopper and follow the steps below.

How to install the stopper:

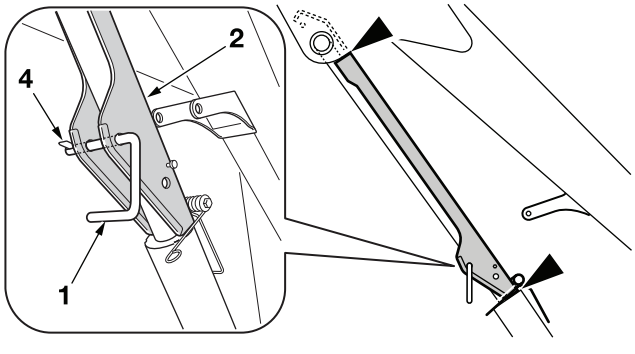
1. Park the machine on solid flat ground, and remove the bucket and/or any other attachment.
2. Lower the lift arm onto the ground, and stop the engine.
3. Align the orientation of the hook (4) on the tip with that of the lock pin (1).
4. Support the lift arm stopper (2) by hand and pull out the lock pin (1).
5. Check that the spring (3) moves freely (disengaged from the hook (5)), and then place the lift arm stopper (2) on the cylinder.
6. Sit in the seat, fasten the seat belt, start the engine and lower the safety bar.
7. Raise the lift arms until the lift arm stopper (2) drops onto the cylinder rod.
8. Slowly lower the lift arms until the lift arm stopper (2) hits against the edge surface of the cylinder tube and becomes fixed.
9. Stop the engine.
10. Insert the lock pin (1) in the front hole of the lift arm stopper (2) and pass it through under the cylinder rod to the back hole.
11. To prevent the lock pin (1) from falling off, set the hook (4) at a right angle to the lock pin (1).



4E0AU19



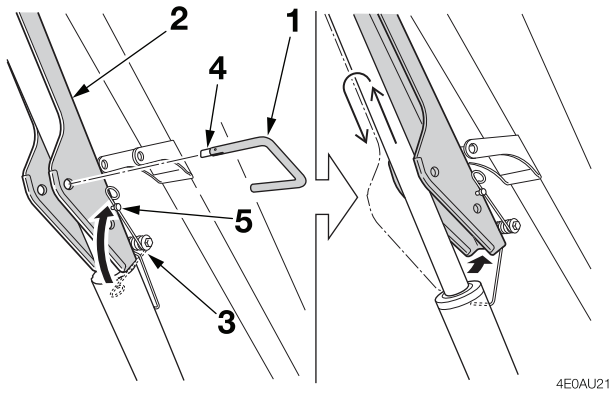
4EAA04Z



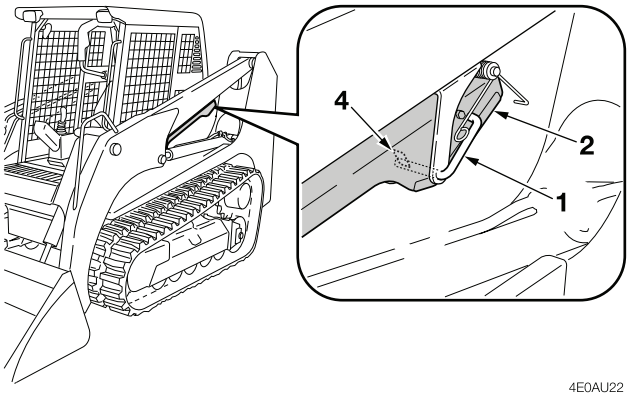
4E0AU20

How to remove the stopper:

1. Align the orientation of the hook (4) on the tip with that of the lock pin (1).
2. Pull out the lock pin (1) from the lift arm stopper (2).
3. Pick up the end loop of the spring (3) with your fingers, and then hang it onto the hook (5) of the lift arm stopper (2).
4. Sit in the seat, fasten the seat belt, start the engine and lower the safety bar.
5. Raise the lift arms. The lift arm stopper (2) disconnects from the cylinder rod.
6. Lower the lift arms to the ground, and stop the engine.
7. Raise the lift arm stopper (2) to the storage position and insert the lock pin (1) through lift arm stopper and bracket.
8. To prevent the lock pin (1) from falling off, set the hook (4) at a right angle to the lock pin (1).



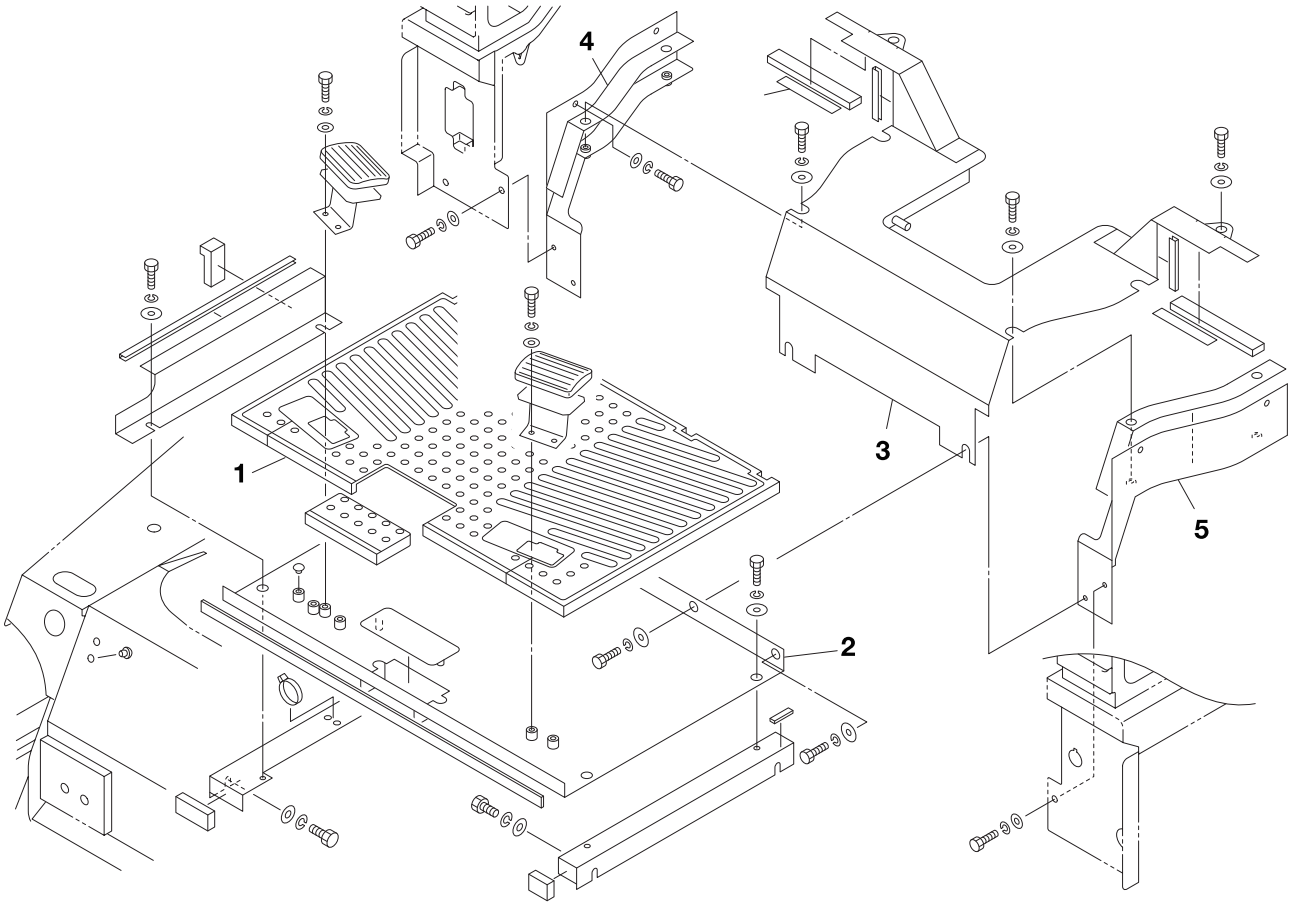
4E0AU21



4E0AU22

Floor frame

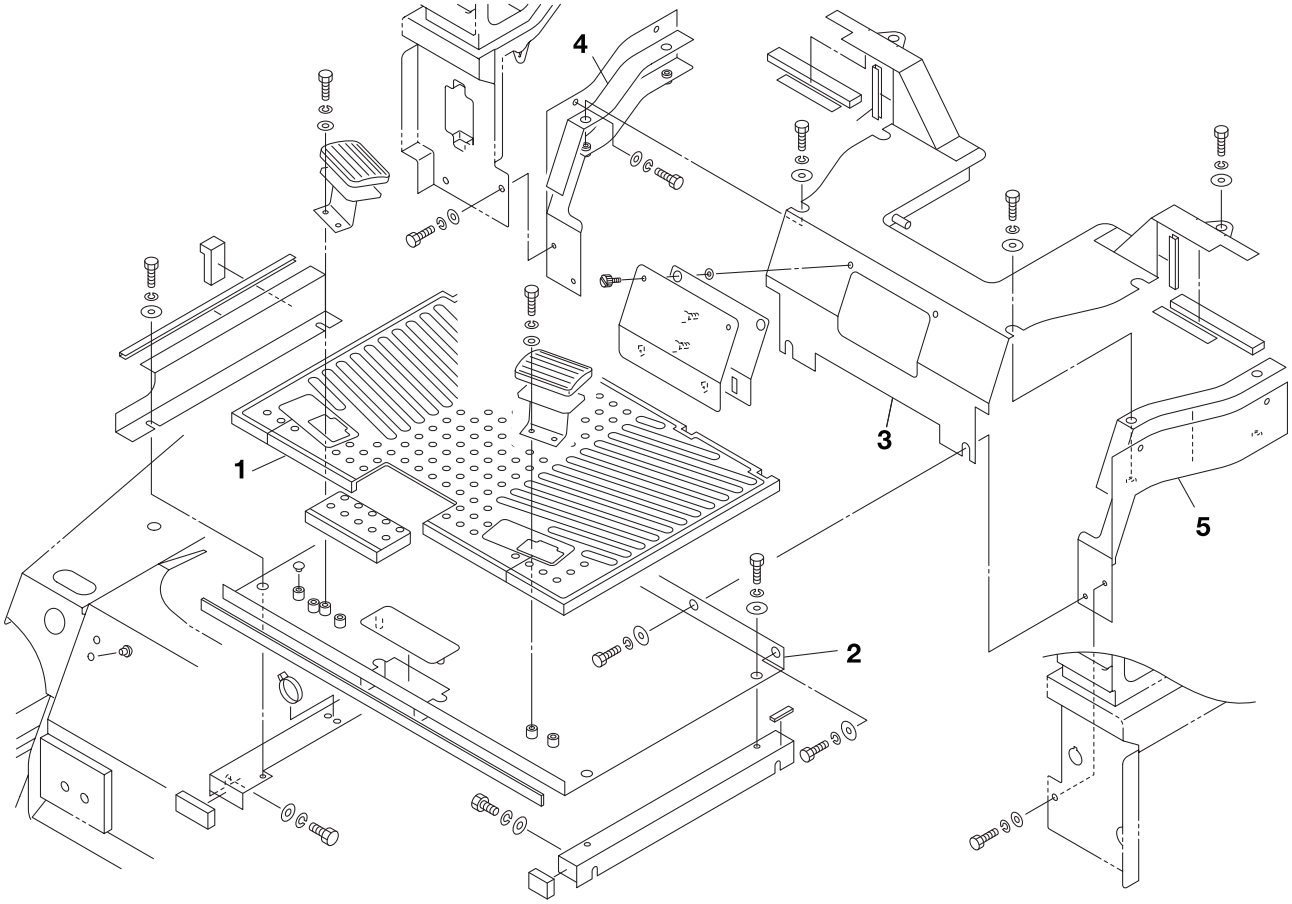
Construction



4E0BE01

1. Floor mat
2. Floor plate
3. Center cover
4. Right cover
5. Left cover

Selector valve specifications



4E0BE02

1. Floor mat
2. Floor plate
3. Center cover
4. Right cover
5. Left cover

Removing the floor frame

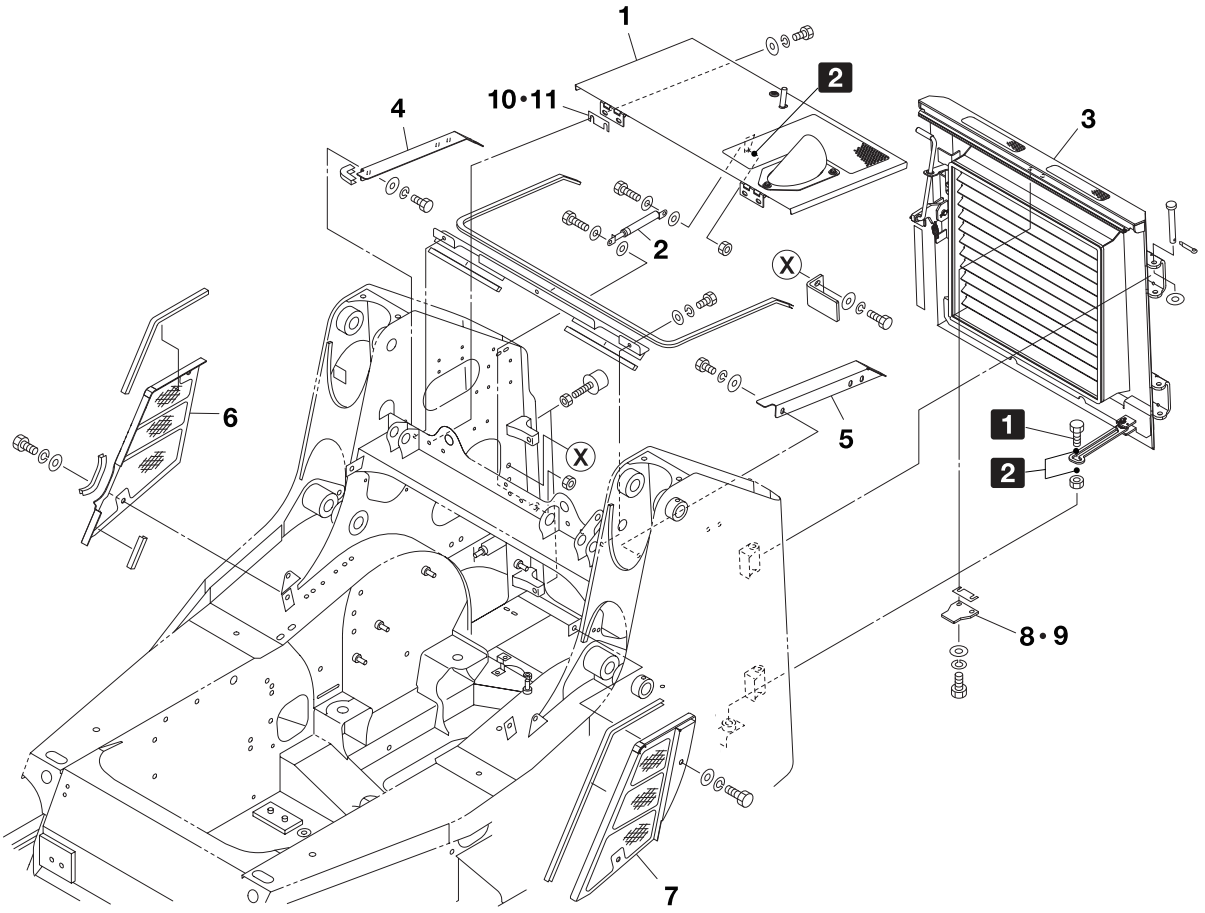
1. Tilt up the canopy/cab.
   ☞ "Tilting up the canopy and cab"
2. Remove the floor mat (1).
3. Take out the bolts holding the floor plate (2) in place, and remove the floor plate (2).
4. Take out the bolts holding the center cover (3) in place, and remove the center cover (3).
5. Take out the bolts holding the right cover (4) in place, and remove the right cover (4).
6. Take out the bolts holding the left cover (5) in place, and remove the left cover (5).

Installing the floor frame

To install, follow the same procedures as for removal but in the reverse order.

Cover

Construction



4E0BE03

1 Apply ThreeBond #1324 or an equivalent.
2 Create a clearance that is 2 mm (0.08 in.) wide.

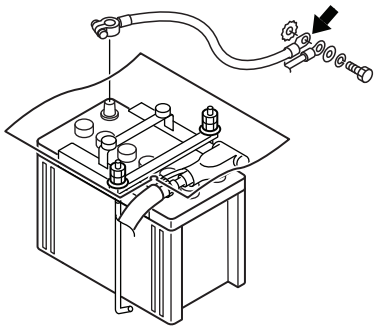
1. Engine hood
2. Gas Spring
3. Rear door
4. Right plate
5. Left plate
6. Side cover R
7. Side cover L
8. Shim, selected usage
9. Shim, selected usage
10. Shim, selected usage
11. Shim, selected usage

Removing the covers

1. Disconnect the ground cable on the battery from the engine body.

⚠ WARNING

Securely wrap or otherwise isolate the disconnected terminal to ensure that it does not make contact with the body or other parts.


4B0AU02

2. Tilt up the canopy/cab.
   ☞ "Tilting up the canopy and cab"
3. Open the engine hood (1) and suspend it with a cable.
4. Take out the bolt holding the gas spring (2) in place, and remove the gas spring (2).
5. Take out the bolts, and remove the engine hood (1).
6. Open the rear door (3), and remove the fuel hose, water separator, and feed pump from the rear door (3).
7. Lift up the rear door (3) with cables, remove the pin, and then take out the rear door (3).
8. Take out the bolts holding the right plate (4) in place, and remove the right plate (4).
9. Take out the bolts holding the left plate (5) in place, and remove the left plate (5).
10. Take out the bolts holding the side cover R (6) in place, and remove the side cover R (6).
11. Take out the bolts holding the side cover L (7), and remove the side cover L (7).

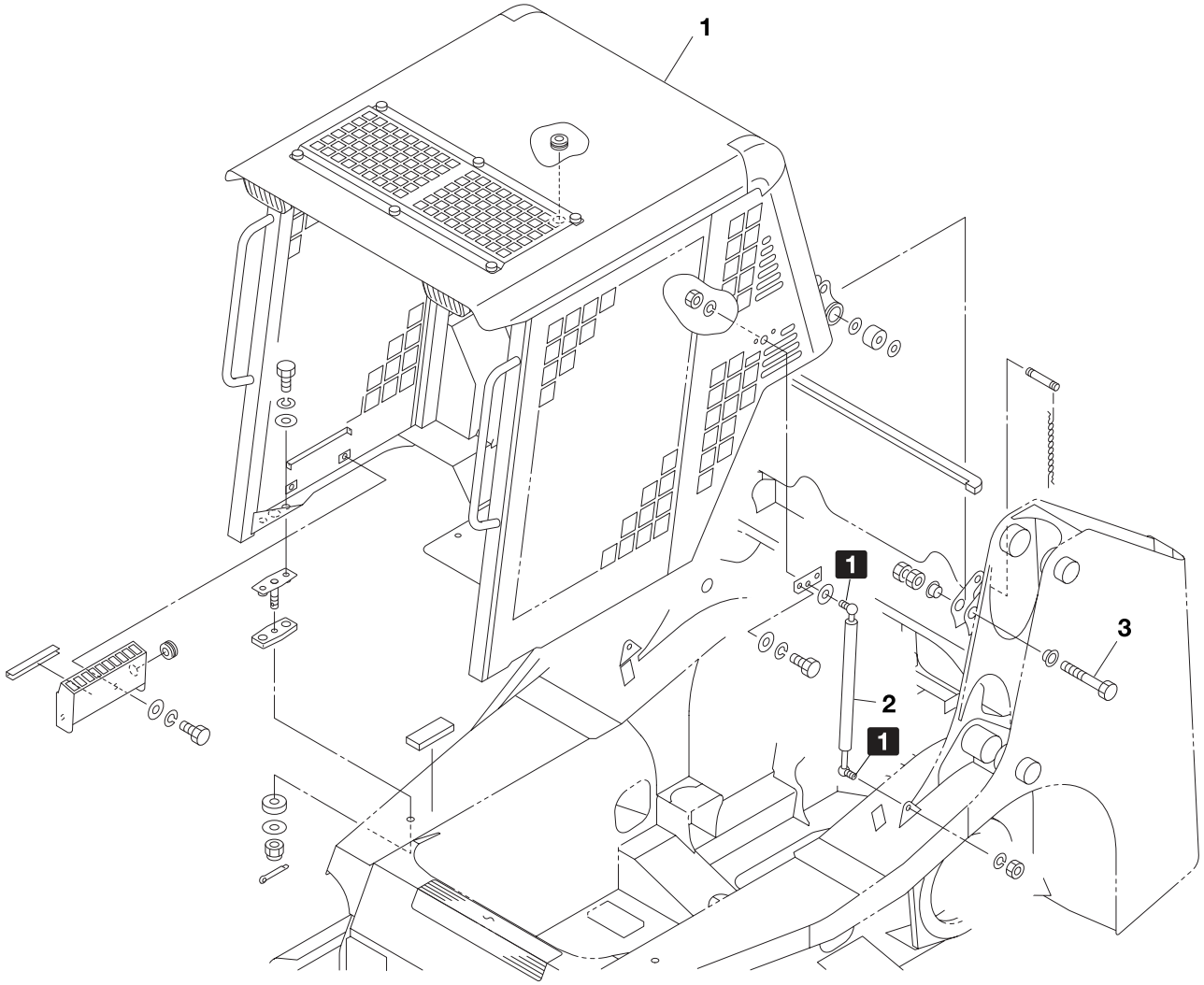
Installing the covers

To install, follow the same procedures as for removal but in the reverse order.

Canopy/cab

Construction

Canopy

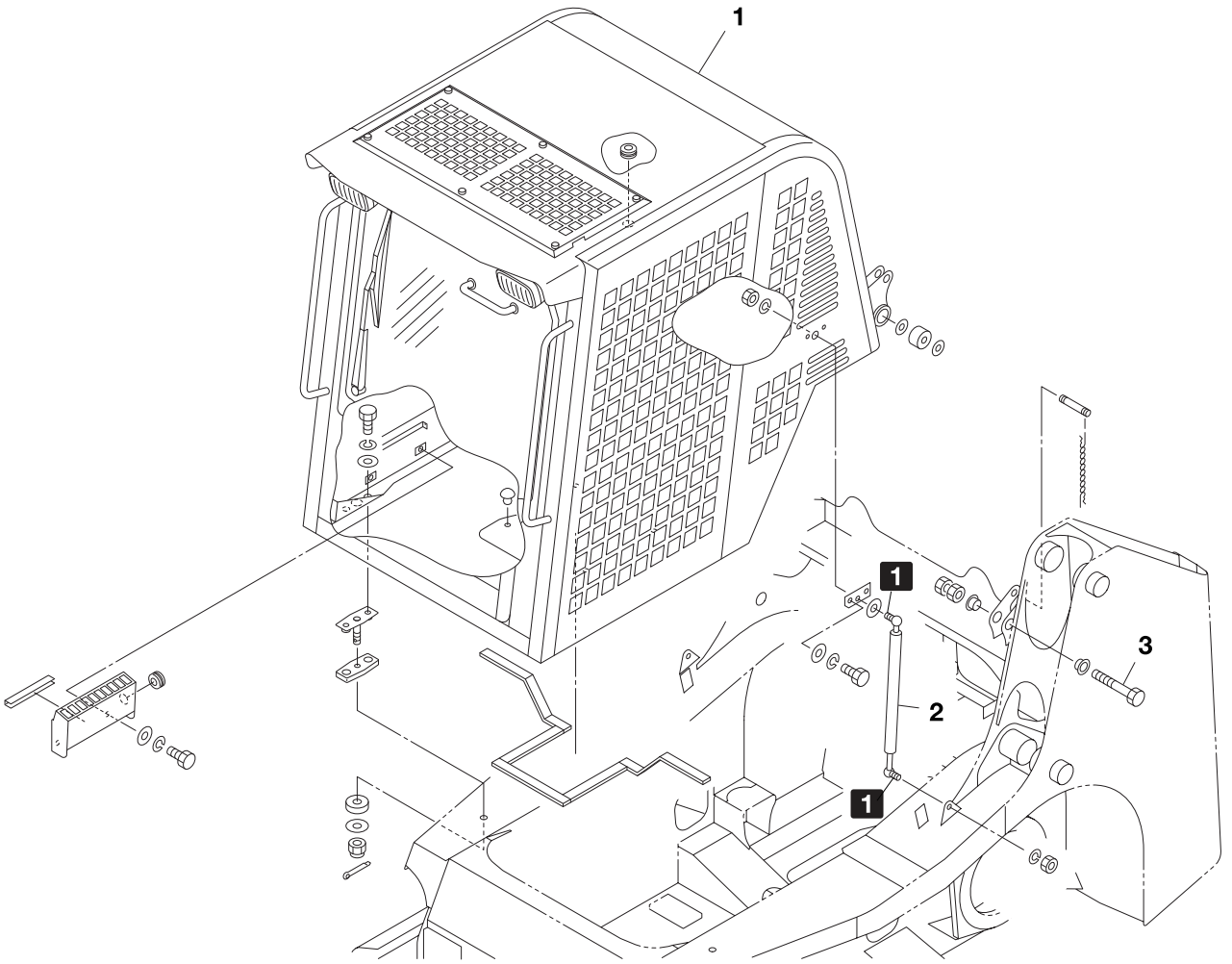


4E0BE04

1 Apply ThreeBond #1324 or an equivalent.

1. Canopy
2. Gas spring
3. Bolt

cab



4E0BE05

1 Apply ThreeBond #1324 or an equivalent.

1. Cab
2. Gas spring
3. Bolt

Removing the canopy/cab

⚠ WARNING

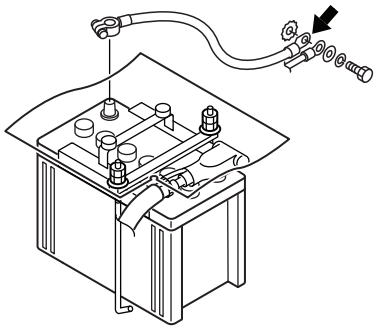
- Securely wrap or otherwise isolate the disconnected terminal to ensure that it does not make contact with the body.
- Attach the hoisting cable to the hook and do not lift the canopy/cab.

1. Raise the lift arm, and attach the arm stopper.
   ☞ "Lift arm stopper"
2. Tilt up the canopy/cab.
   ☞ "Tilting up the canopy"
3. Temporarily hold up the canopy (1).
   - Pass the hoisting cable through the canopy/cab (1) and suspend temporarily.

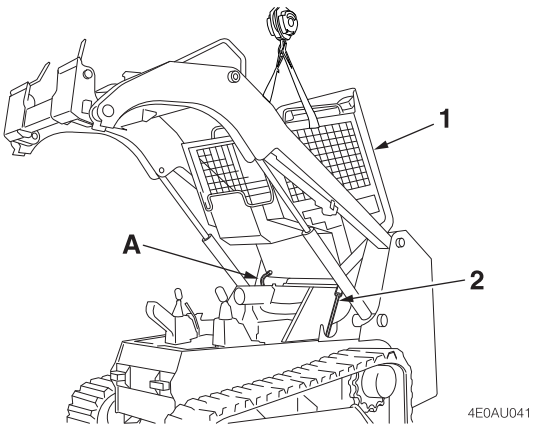
⚠ WARNING

Securely wrap or otherwise isolate the disconnected terminal to ensure that it does not make contact with the body or other parts.

4. Disconnect the earth ground cable on the battery from the engine body.


4B0AU02

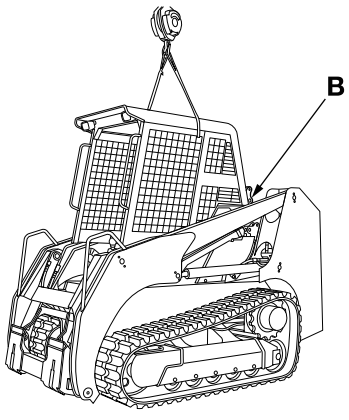
5. Disconnect the electrical wiring (A) from the canopy/cab (1).
   - If working with air conditioner specifications, disconnect the air conditioner hoses and electrical wiring.
6. Take out the nut holding the gas spring (2) in place, and remove the gas spring (2).
   - When assembling, apply a screw-locking compound to the threads on the gas spring.



4E0AU041

7. Lower the canopy/cab (1), and lower the lift arm to the ground.
8. Remove the two fixing bolts (3) located at the rear at locations (B).
9. Lift up the canopy/cab (1), and remove it.
   - Connect the hoisting cable through the center of the canopy/cab to keep it horizontal.

   Canopy (Standard): 146 kg (322 lb)
   Cab (Standard): 265 kg (585 lb)



4EAA12Z

Installing the canopy/cab

To install, follow the same procedures as for removal but in the reverse order.

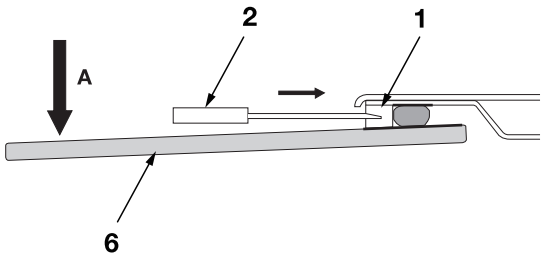
Replacing glass window panes

1. Remove the dam (1) attached along the frame and the hardened adhesive.

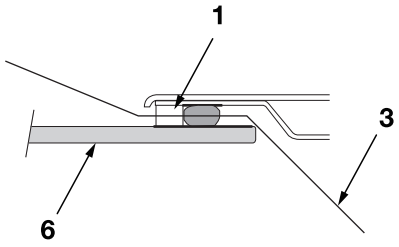
⚠ CAUTION

- Take extreme caution when completing this step as you will need to use tools with sharp edges.
- Be careful when handling broken glass as it could cause injury.

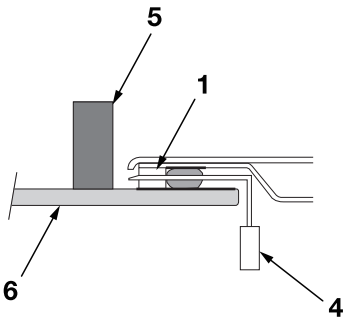
2. Insert a tool (blade) into a section that is easy to reach, and use it to work to cut away the dams (1) and adhesive while pushing down in the direction along which the adhesive is to be removed (in the direction of the arrow A).
   - Use the tool or other object (general-purpose utility knife (2), piano wire (3), or special-purpose utility knife (4)) most appropriate for the specific conditions involved including whether there are other objects that may impede removal or how hard the adhesive is.
3. The dams (1) and adhesive (5) attached to the frame are to be thoroughly removed from the surface of the frame using a spatula or other tool until the surface is smooth.
4. Ensure that the surfaces on the glass (6) are smooth.



4E0AU121



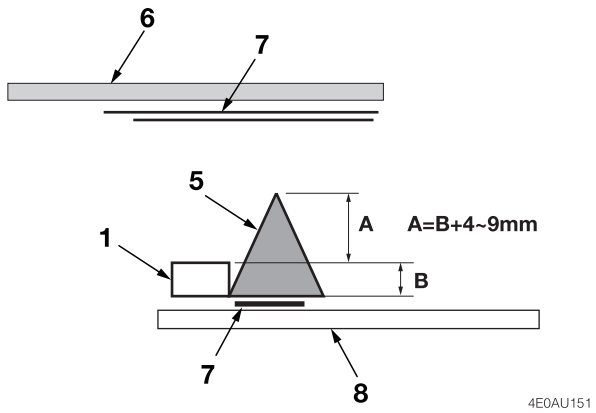
4E0AU131

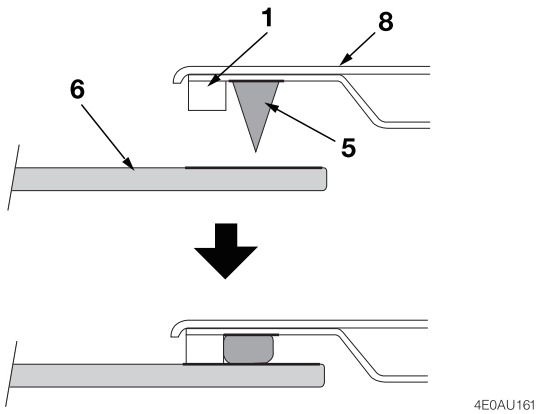


4E0AU141

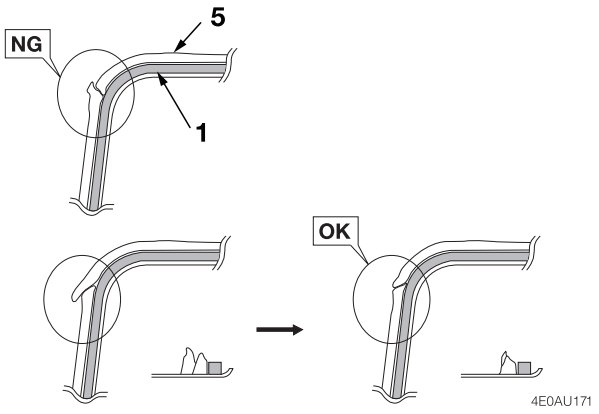
Installing glass window panes

1. Use a rag that has been soaked in cleaning detergent to remove oil and dust adhering to the surfaces on which the primer (7) is to be applied (on the cab (8) side, glass window pane (6) side).
   - Application may end up being uneven if the surfaces are not cleaned thoroughly enough.
2. Apply adhesive (5) and then place the glass window pane (6) on top of the adhesive.
   Adhesive: Sunstart 580 or an equivalent
   - Check to confirm that primer (7) has been applied to the surface on which the adhesive is applied.
   - Let the glass window pane stand for 24 hours after it has been attached to give the adhesive a chance to dry.





- Adhesive is to be added to prevent bond from protruding out as shown on the picture.
- Adjust or repair connections using a spatula or other tool to ensure a good seal to prevent air pockets from forming when the glass window pane is attached.

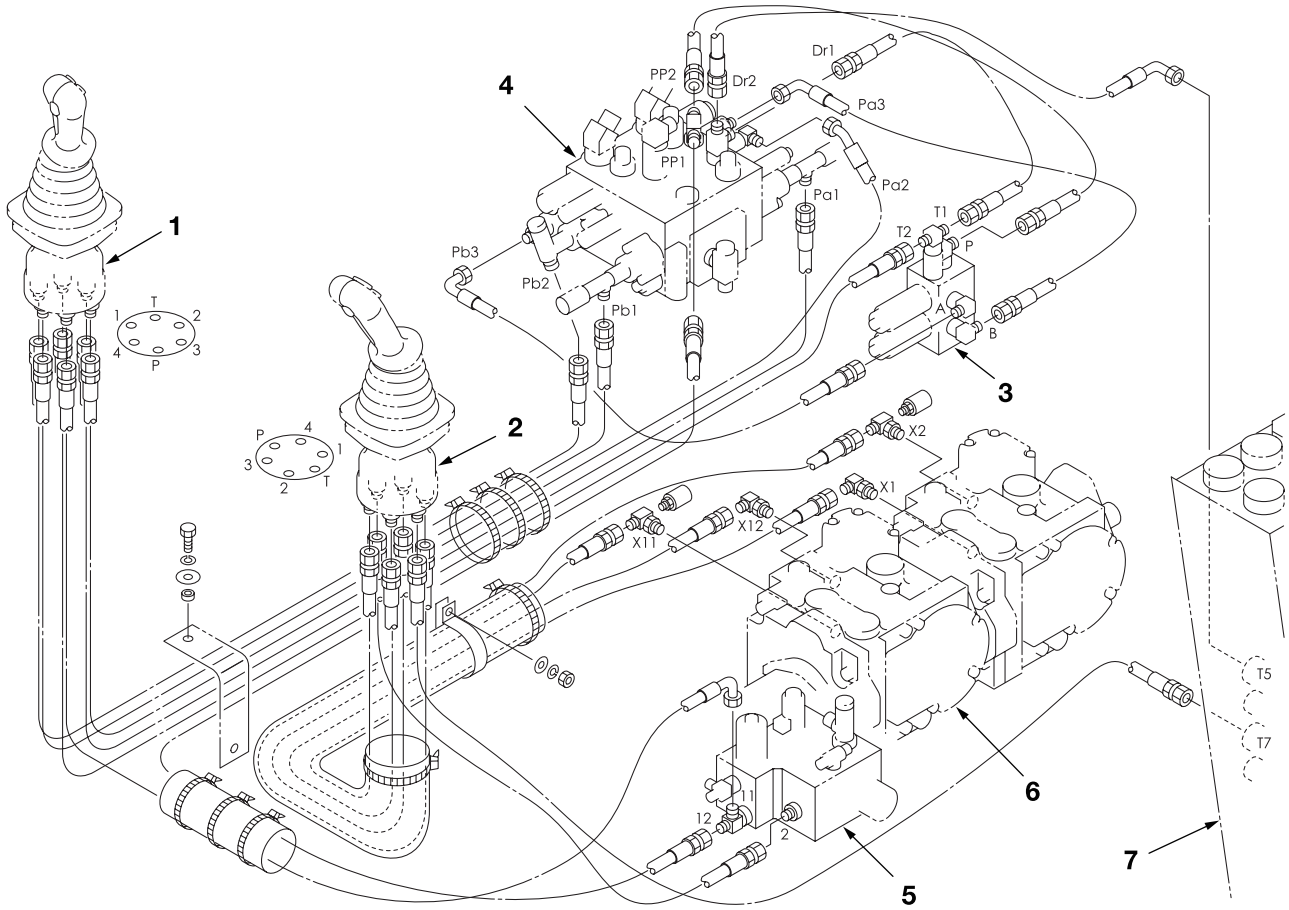


OPERATING DEVICE

Hydraulic pilot unit

Construction

Standard specifications



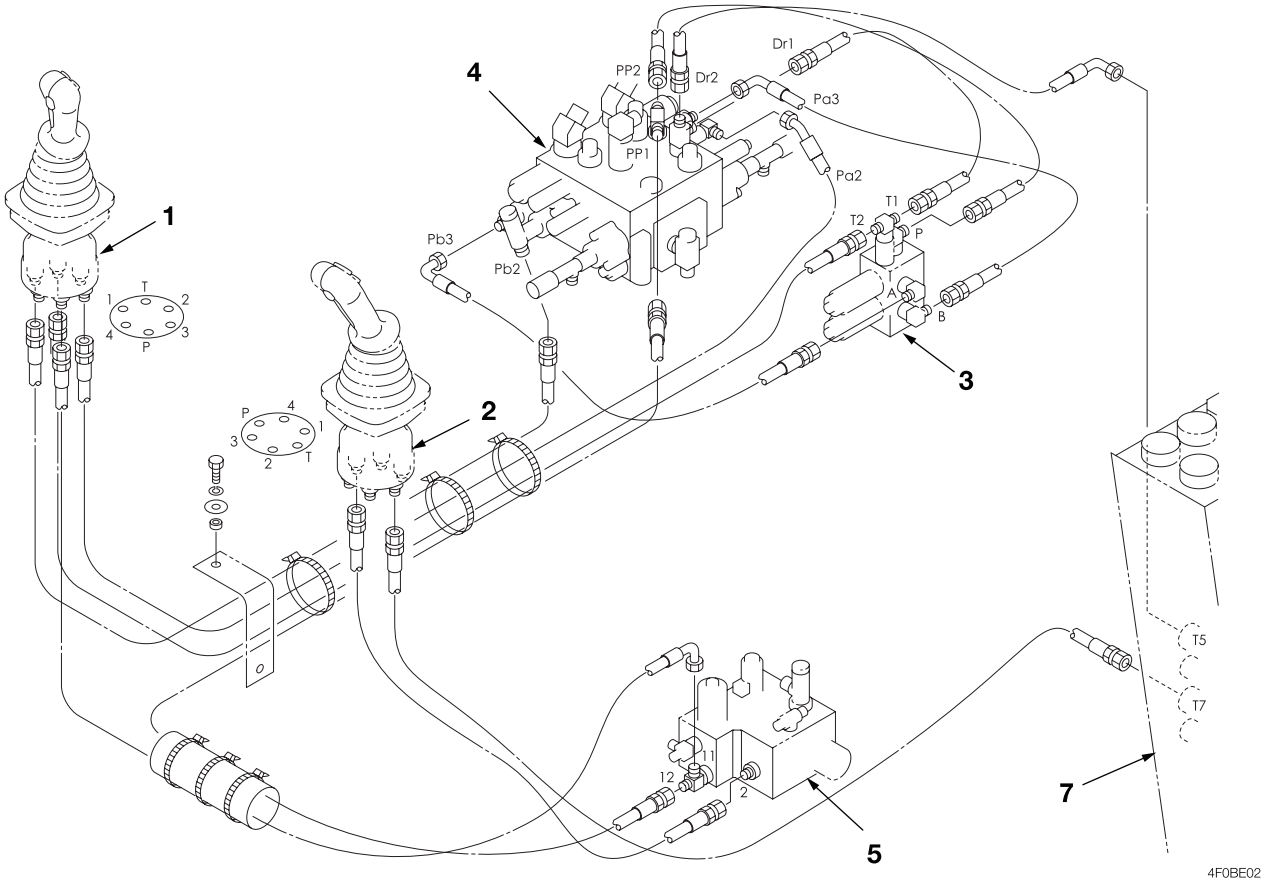
4F0BE01

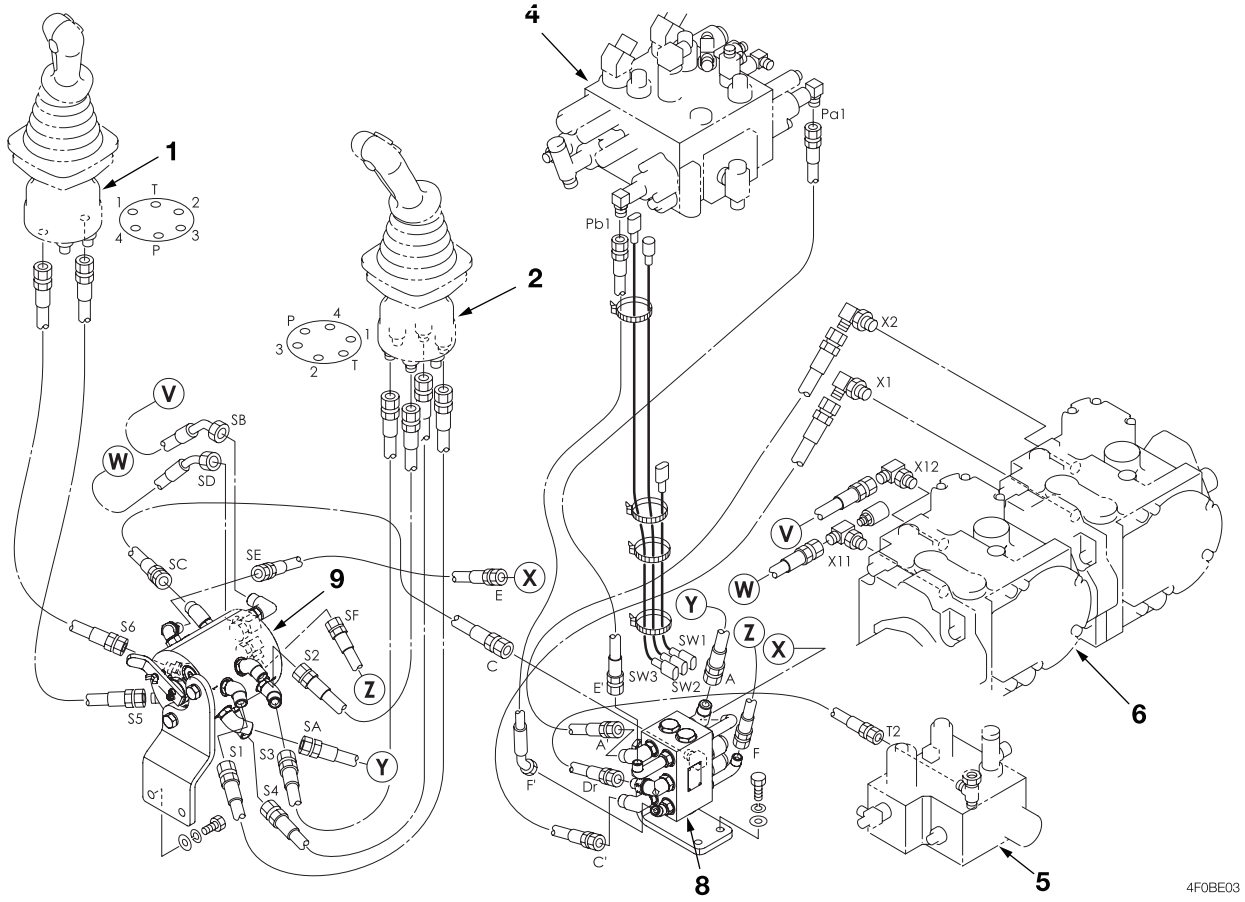
<Table of Connections>

1	R1 ↔ Pb2	4
1	R2 ↔ Pa1	4
1	R3 ↔ Pa2	4
1	R4 ↔ Pb1	4
1	RP ↔ 11	5
1	RT ↔ T2	3
2	L1 ↔ X2	6
2	L2 ↔ X12	6
2	L3 ↔ X1	6
2	L4 ↔ X11	6
2	LP ↔ 2	5
2	LT ↔ T7	7
3	A ↔ Pb3	4
3	B ↔ Pa3	4
3	P ↔ PP2	4
3	T1 ↔ Dr1	4
4	PP1 ↔ 12	5
4	Dr2 ↔ T5	7

1. Right pilot valve
2. Left pilot valve
3. Proportional control solenoid valve
4. Control valve
5. Sub valve
6. HST pump
7. Hydraulic tank

Selector valve specifications





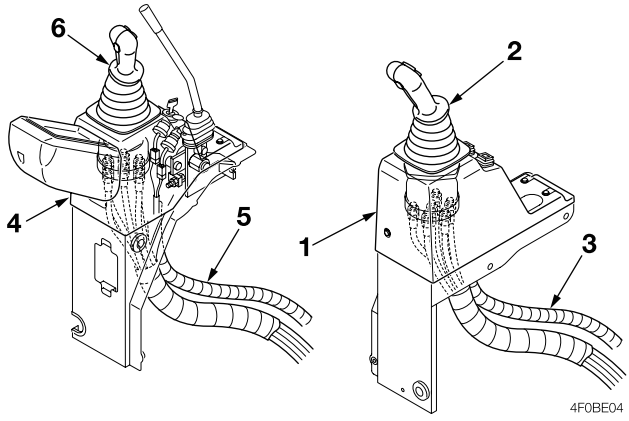
<Table of Changes in Connections during Installation of the Selector Valve>

1	R1 ↔ Pb2	4
1	R3 ↔ Pa2	4
1	RP ↔ 11	5
1	RT ↔ T2	3
2	LP ↔ 2	5
2	LT ↔ T7	7
3	A ↔ Pb3	4
3	B ↔ Pa3	4
3	P ↔ PP2	4
3	T1 ↔ Dr1	4
4	PP1 ↔ 12	5
4	Dr2 ↔ T5	7
1	R2 ↔ S5	9
1	R4 ↔ S6	9
2	L1 ↔ S1	9
2	L2 ↔ S2	9
2	L3 ↔ S3	9
2	L4 ↔ S4	9
9	SA ↔ A	8
9	SB ↔ X12	6
9	SC ↔ C	8
9	SD ↔ X11	6
9	SE ↔ E	8
9	SF ↔ F	8
8	E' ↔ Pa1	4
8	F' ↔ Pb1	4
8	A' ↔ X2	6
8	C' ↔ X1	6
8	Dr ↔ T2	5

1. Right pilot valve
2. Left pilot valve
3. Proportional control solenoid valve
4. Control valve
5. Sub valve
6. HST pump
7. Hydraulic tank
8. Shuttle valve
9. Selector valve

Removing the lever stands

1. Tilt up the canopy.
   ☞ "Tilting up the canopy"
2. Remove the floor.
   ☞ "Removing the floor frame"
3. Remove the left lever stand.
   a. Remove the cover (1).
   b. Disconnect the hydraulic hoses from the pilot valve (2).
      • Attach identification tags to the hydraulic hoses to ensure that they are put back in the proper places during reassembly.
   c. Disconnect the electrical wiring (3).
4. Remove the right lever stand.
   a. Remove the cover (4).
   b. Disconnect the electrical wiring (5).
   c. Disconnect the hydraulic hoses from the pilot valve (6).
      • Attach identification tags to the hydraulic hoses to ensure that they are put back in the proper places during reassembly.



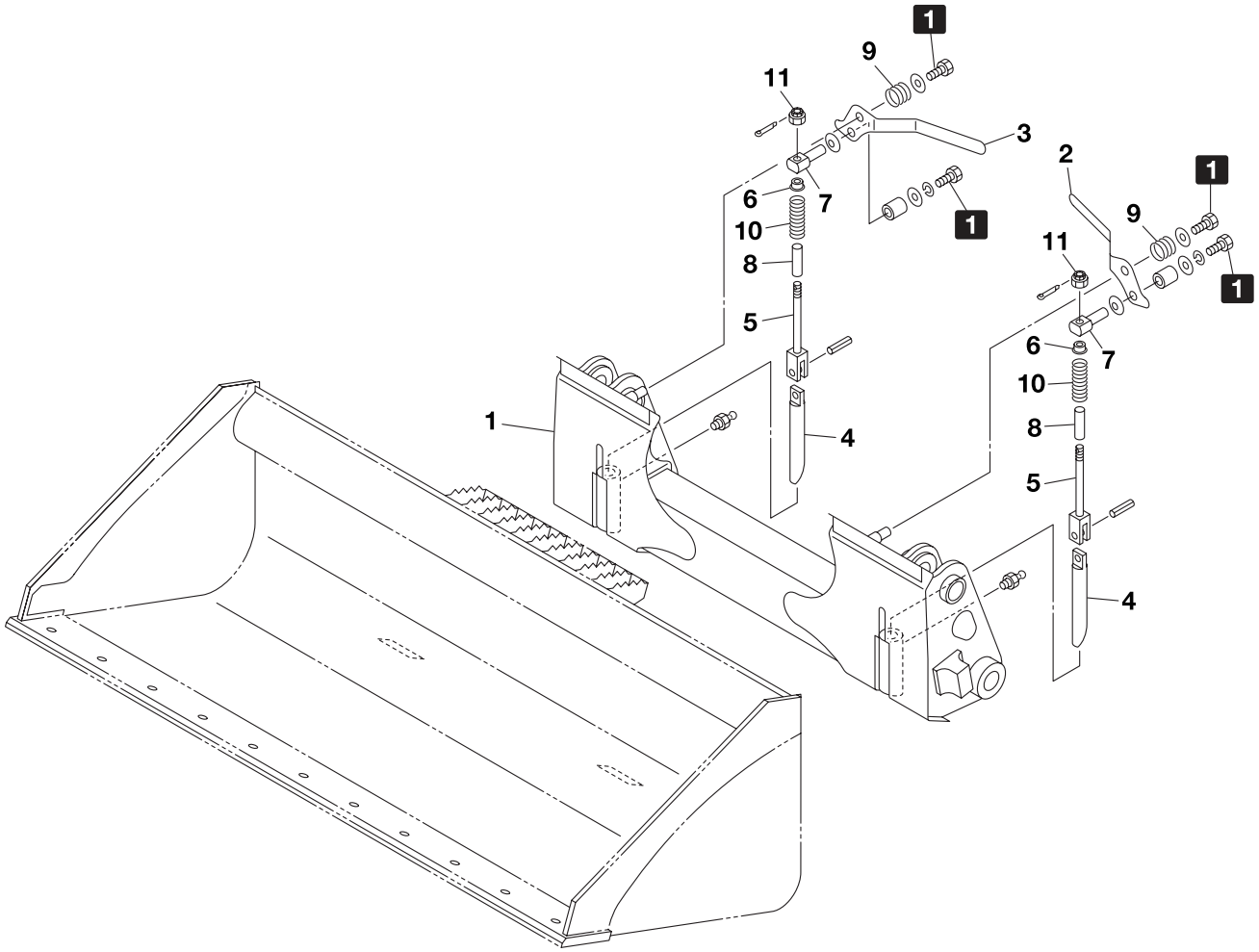
Installing the lever stands

To install, follow the same procedures as for removal but in the reverse order.

ATTACHMENTS

Construction

Quick-hitch (Mechanical)

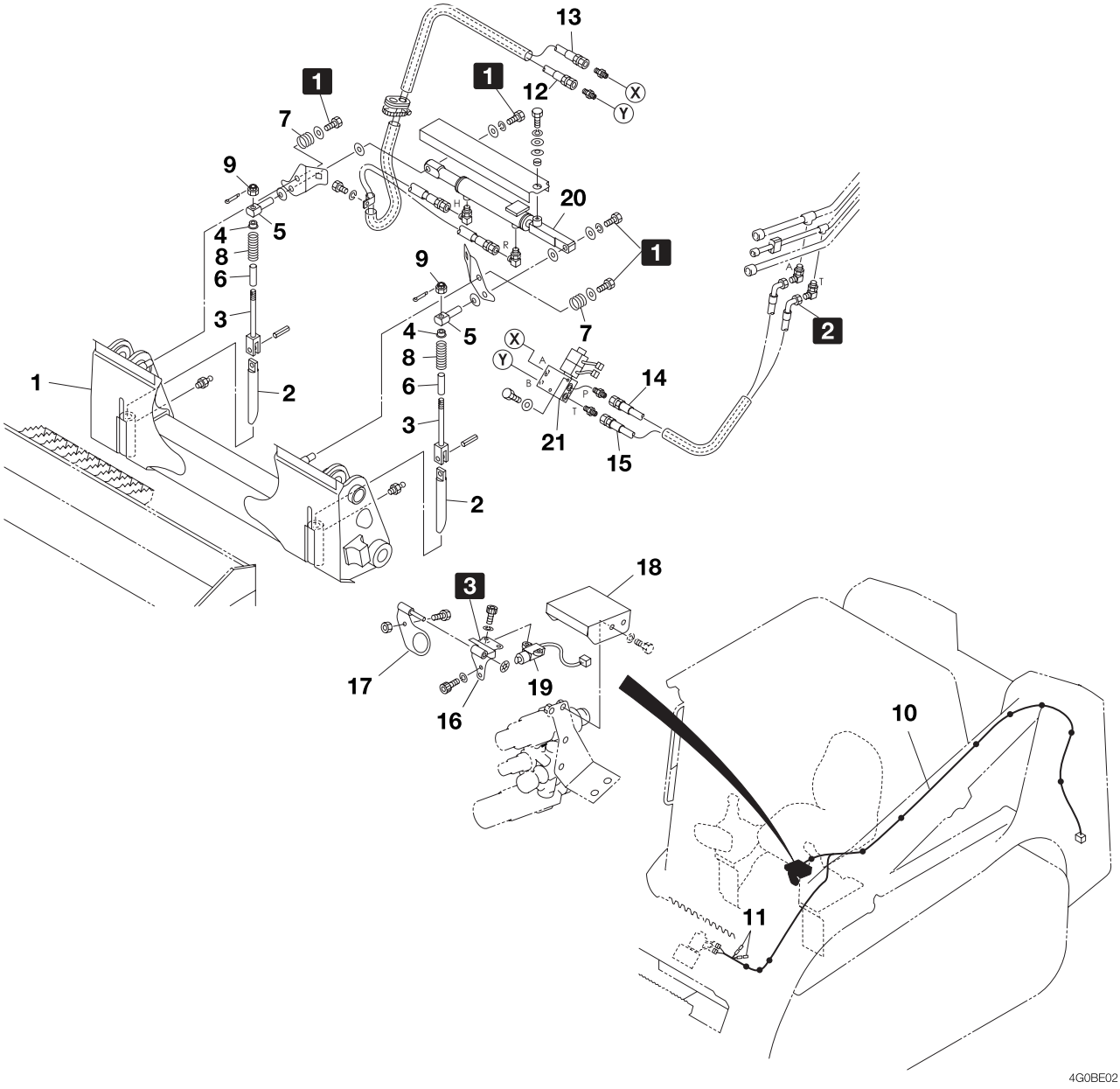


4G0BE01

1 Apply ThreeBond #1324 or an equivalent.

1. Bracket
2. Left lever
3. Right lever
4. Pin
5. Yoke
6. Washer
7. Pin
8. Pipe
9. Spring
10. Spring
11. Nut

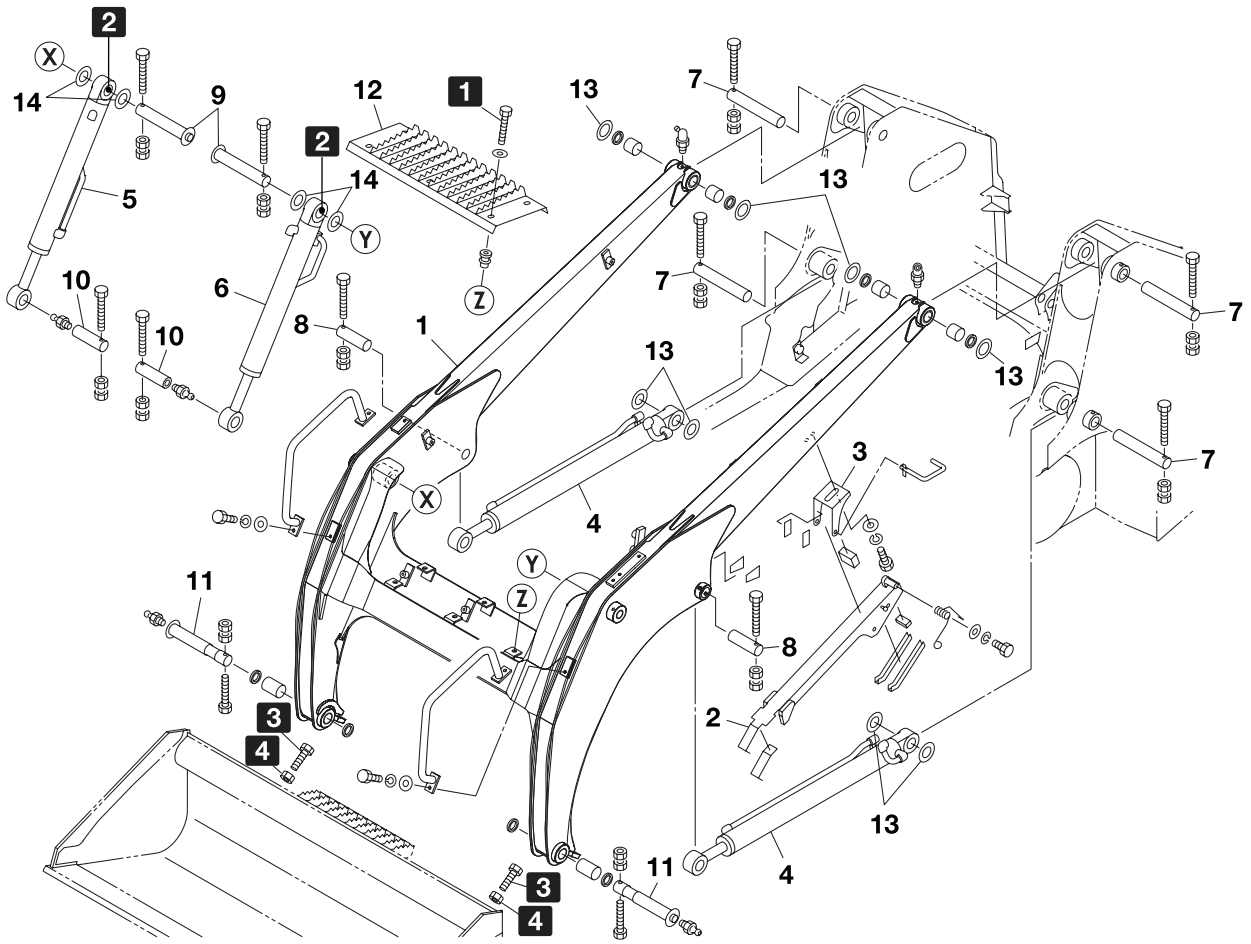
Quick-hitch (Hydraulic)



1 Apply ThreeBond #1324 or an equivalent.
2 There is to be no interference with the cab.
3 With the plate hanging vertically, adjust until the switch stroke is around 4 mm to 5 mm (0.16 in. to 0.2 in.).

1. Bracket
2. Pin
3. Yoke
4. Washer
5. Pin
6. Pipe
7. Spring
8. Spring
9. Nut
10. Wire harness
11. Diode (3A)
12. Hydraulic hose
13. Hydraulic hose
14. Hydraulic hose
15. Hydraulic hose
16. Plate
17. Plate
18. Cover
19. Switch
20. Quick-hitch cylinder
21. Solenoid valve

Arm



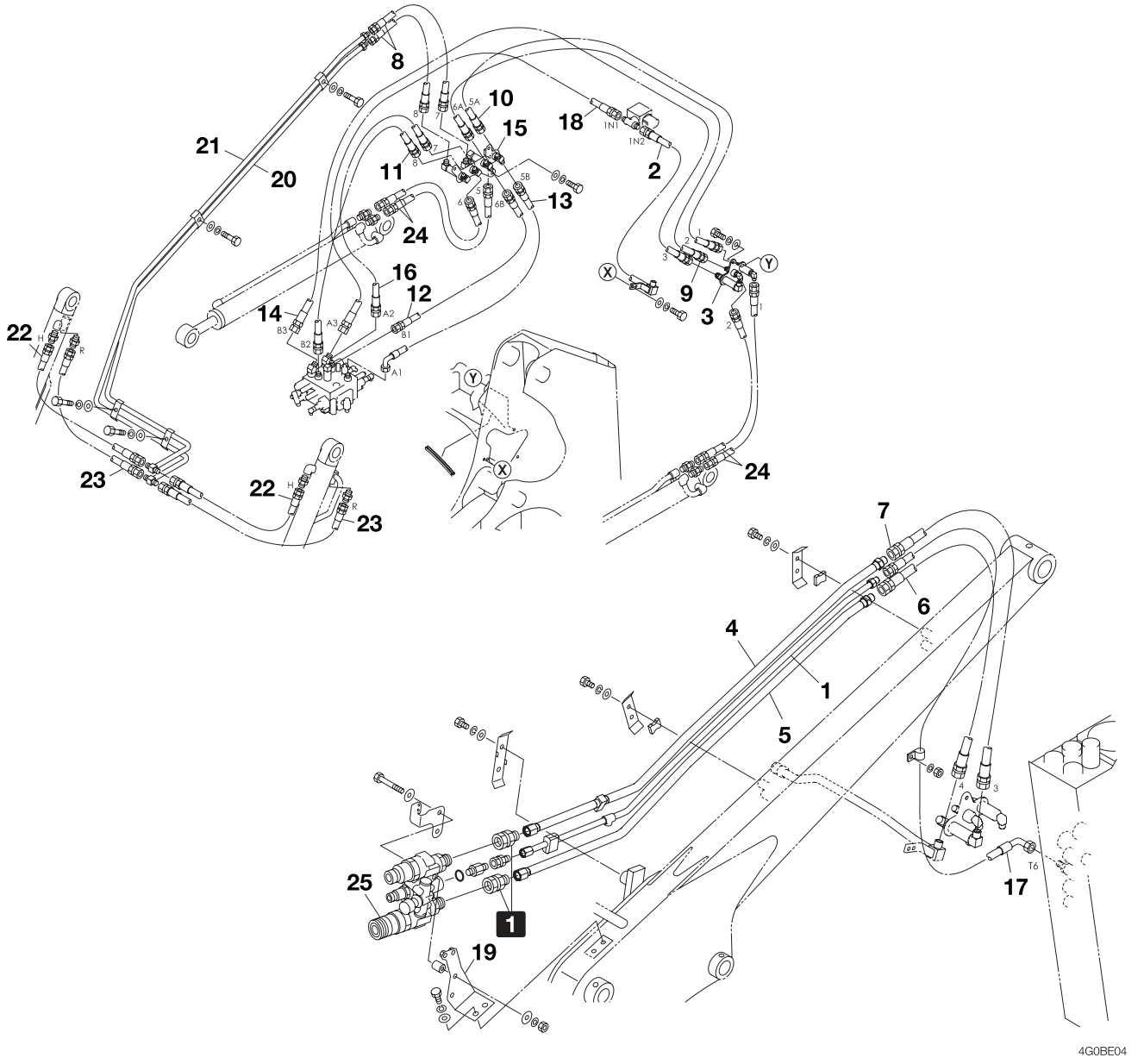
4G0BE03

1 First tighten the bolt by hand as far as you can and tighten the bolt further by three and a half turns.
2 Install the part after applying a coating of grease (Bostik NEVER-SEEZ NS-42B or its equivalent) to the stationary part on the bottom side of the bucket cylinder.
3 Apply ThreeBond #1324 or an equivalent.
4 416 N·m (307 ft.-lb.)

1. Arm
2. Lock
3. Bracket
4. Arm cylinder
5. Bucket cylinder (Right)
6. Bucket cylinder (Left)
7. Pin
8. Pin
9. Pin
10. Pin
11. Pin
12. Step
13. Shim (Selected usage)
14. Shim (Selected usage)

Attachment piping

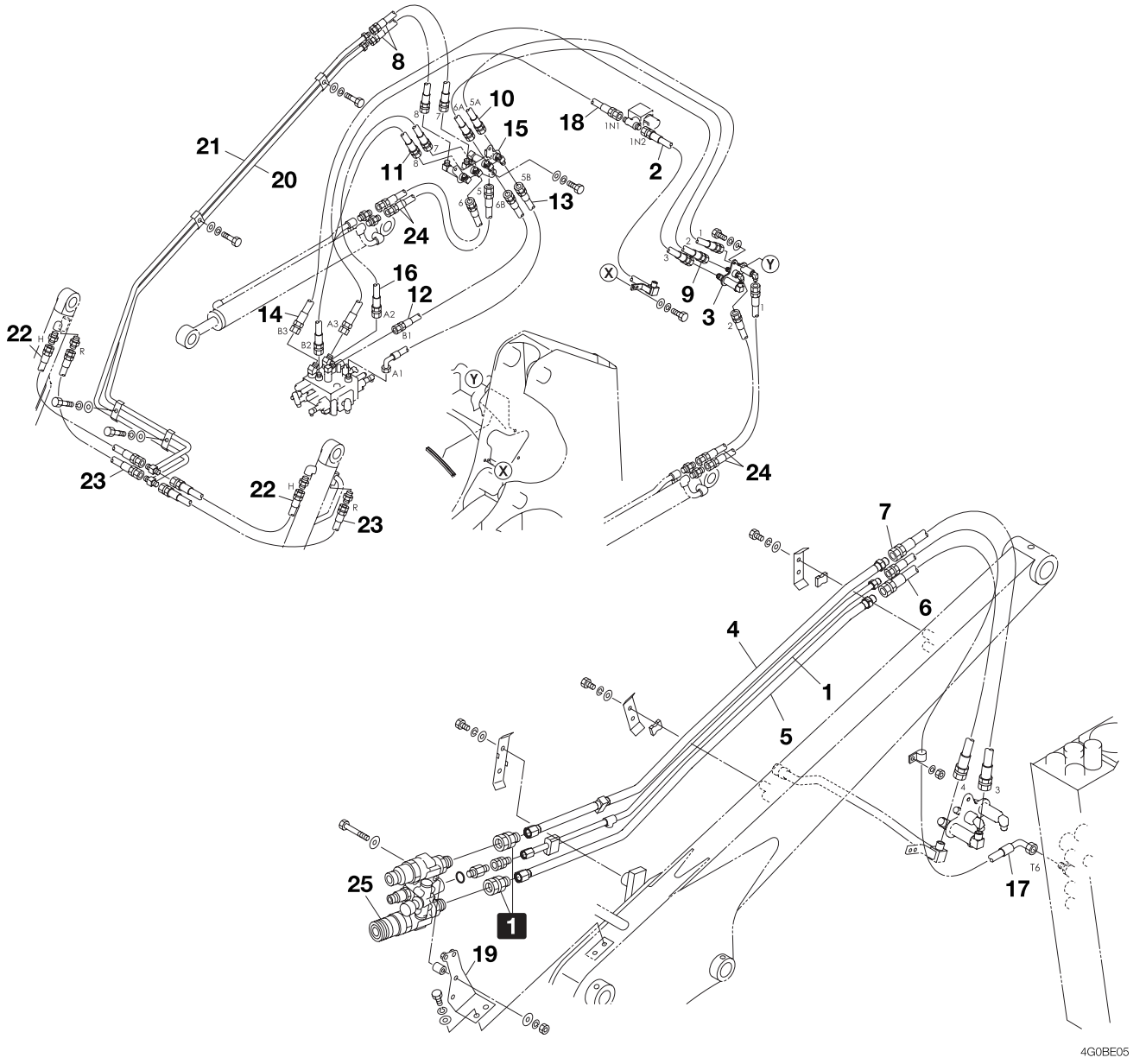
Auxiliary line hydraulic piping: Standard, coupler 1/2, with hydraulic quick-hitch



1 118 N·m (87 ft.-lb.)

1. Pipe
2. Hydraulic hose
3. Bracket (Left)
4. Pipe
5. Pipe
6. Hydraulic hose
7. Hydraulic hose
8. Hydraulic hose
9. Hydraulic hose
10. Hydraulic hose
11. Hydraulic hose
12. Hydraulic hose
13. Hydraulic hose
14. Hydraulic hose
15. Bracket (Right)
16. Hydraulic hose
17. Hydraulic hose
18. Hydraulic hose
19. Bracket
20. Pipe
21. Pipe
22. Hydraulic hose
23. Hydraulic hose
24. Hydraulic hose
25. Coupler block

Auxiliary line hydraulic piping: Standard, coupler 1/2, without hydraulic quick-hitch



1 118 N·m (87 ft.-lb.)

1. Pipe
2. Hydraulic hose
3. Bracket (Left)
4. Pipe
5. Pipe
6. Hydraulic hose
7. Hydraulic hose
8. Hydraulic hose
9. Hydraulic hose
10. Hydraulic hose
11. Hydraulic hose
12. Hydraulic hose
13. Hydraulic hose
14. Hydraulic hose
15. Bracket (Right)
16. Hydraulic hose
17. Hydraulic hose
18. Hydraulic hose
19. Bracket
20. Pipe
21. Pipe
22. Hydraulic hose
23. Hydraulic hose
24. Hydraulic hose
25. Coupler block

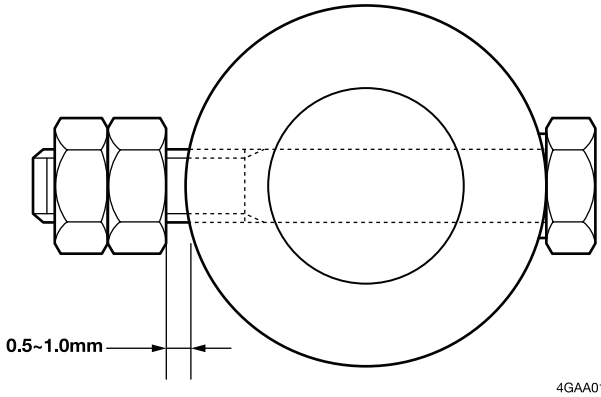
Removing the quick-hitch

⚠ WARNING

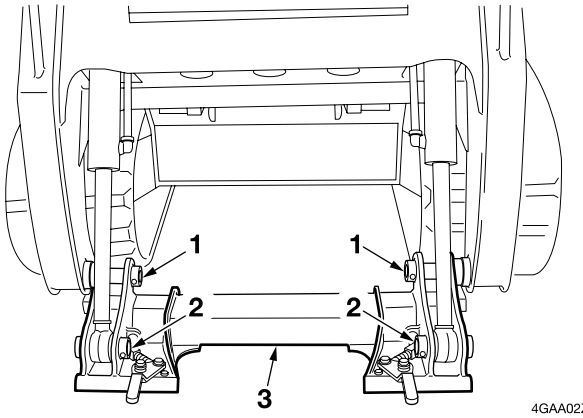
- Be sure to release the residual pressure from the hydraulic hose before disconnecting the hose.
- Never attempt to insert a finger into the pin hole when adjusting the pin hole position.

Important:

- When tightening the lock bolt with a double nut, allow a clearance of 0.5 mm to 1.0 mm (0.02 in. to 0.04 in.) between the nut and the lock collar.
- During installation, adjust the pin-connecting area with a shim so that no clearance remains. Be sure to reduce the width of the clearance until it is so narrow that a 0.2-mm-thick-shim (a 0.008-in.-thick shim) cannot be inserted into it by hand.
- Be sure to bleed the air from the cylinder before starting operation for the first time after reassembling hydraulic devices such as the hydraulic cylinder or hydraulic piping.



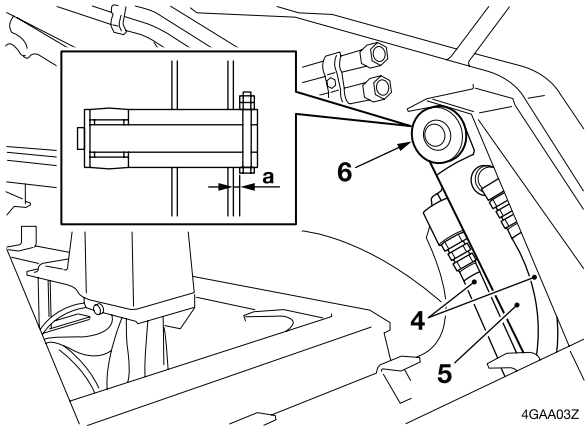
1. Lower the quick-hitch surface side on which the bucket is mounted to the ground.
2. Pull out the bucket pins (1) and (2), and remove the quick-hitch (3).
   kg Quick hitch: Approx. 74 kg (163 lb)
   Apply grease to both the bucket pin (1) and the pin hole. Bostik NEVER-SEEZ NS-42B or its equivalent.



3. Disconnect the hydraulic hoses (4) from the bucket cylinders.
4. Suspend the bucket cylinder (5) temporarily, pull out the pin (6), and then remove the bucket cylinder.
   kg Bucket cylinder: Approx. 20 kg (44 lb)
   Apply grease to both the bucket pin (6) and the pin hole. Bostik NEVER-SEEZ NS-42B or its equivalent.

Important:

During assembly, do not insert a shim so far that there is no clearance of “a” remaining between the lock bolt and the arm.

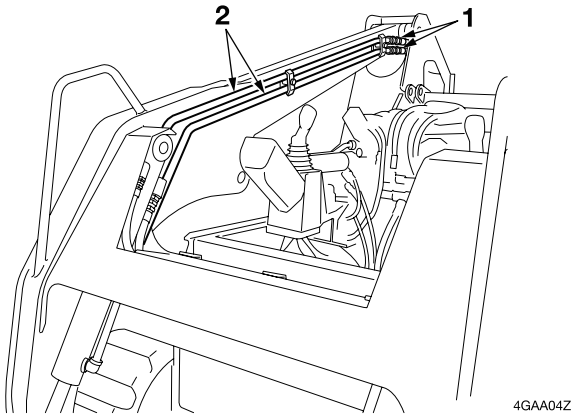


Installing the quick-hitch

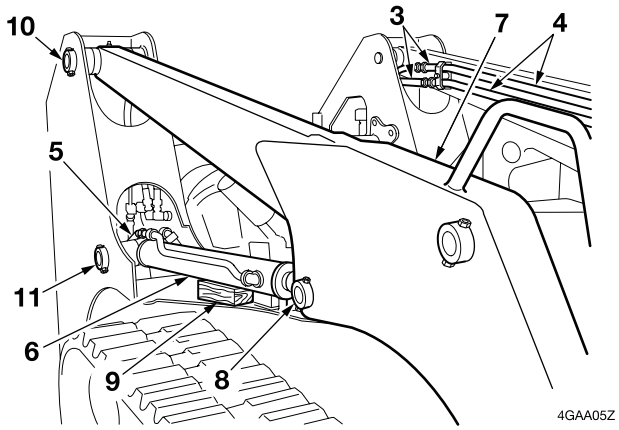
To install, follow the same procedures as for removal but in the reverse order.

Removing the lift arm

1. Disconnect the hydraulic hoses (1) from the pipes (bucket) (2).



2. Disconnect the electrical wiring.
3. Disconnect the hydraulic hoses (3) from the pipes (auxiliary line) (4).
4. Disconnect the hydraulic hoses (5) from the arm cylinder (6).
5. Suspend the lift arm (7) temporarily, and pull out the pin (8) on the rod side of the arm cylinder (6).
   - Place the skid (9) under the cylinder in advance.
6. Pull out the arm foot pin (10), and raise the lift arm (7) to remove it.
   Lift arm: Approx. 270 kg (595 lb)
7. Pull out the pin (11) on the head side of the arm cylinder, and raise the arm cylinder (6) to remove it.
   Arm cylinder: Approx. 27 kg (60 lb)



Installing the lift arm

To install, follow the same procedures as for removal but in the reverse order.

Adjusting the bucket stopper

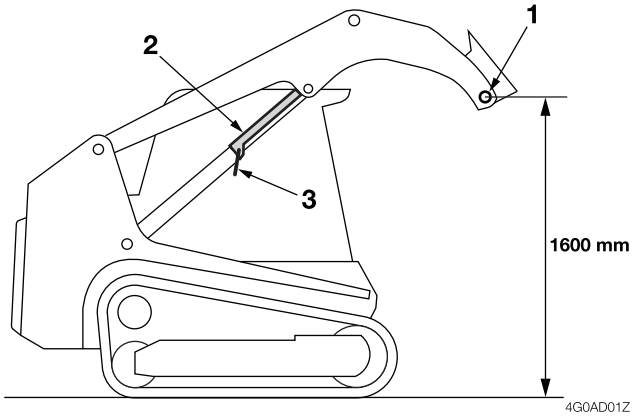
⚠ DANGER

When working under the raised lift arm, use the lift arm stopper to securely support the lift arm. Never position yourself under it without making sure that the lift arm is securely supported.

⚠ WARNING

- Complete work with the machine parked on solid flat ground.
- Make sure that work is completed by a two-person team and that communication is maintained between the two team members at all times.
  One member of the two-person team should remain in the operator's seat at all times and start and stop the engine as necessary. Make sure to exercise enough caution not to touch levers or pedals more than necessary. Set the engine speed to low when operating the control lever.
  The one who performs maintenance must make sure to keep their body and clothing away from the moving parts of the machine.

When adjusting the bucket stopper, attach the arm stopper (2) for lift arm adjustment to the lift arm cylinder with the pin hole (1) of the lift arm positioned at a height approximately 1600 mm (63 in.) above the ground, as shown in the figure on the right. Adjustment work should be done while the machine is maintained at this attitude. To ensure that inspection is completed safely, prepare the arm stopper (2) and the lock pin (3) in advance. The work should be performed by two people. One member of the two-person team is to remain in the operator's seat at all times and start and stop the engine as necessary while the other is to attach and remove the arm stopper and complete adjustments to the bucket stopper.



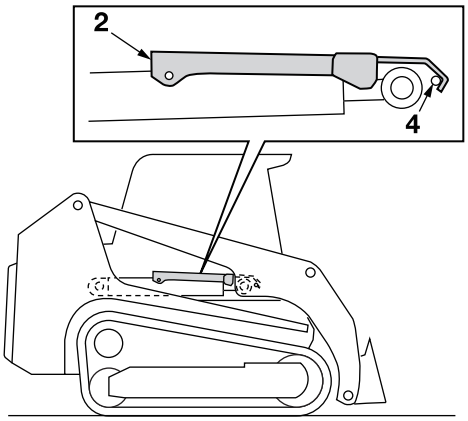
Arm stopper (2)

Part number	Qty.
08809-61910	1

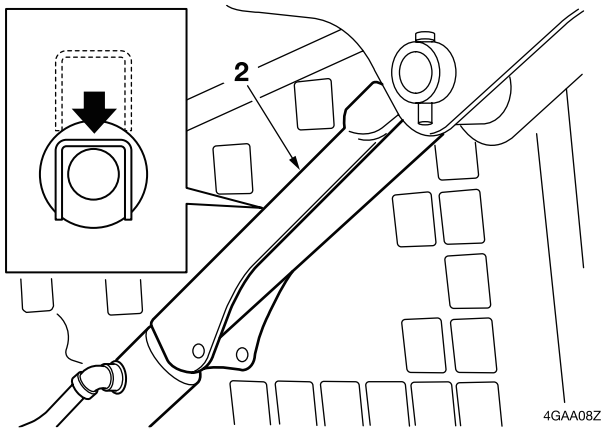
Lock pin (3)

Part number	Qty.
06560-00380	1

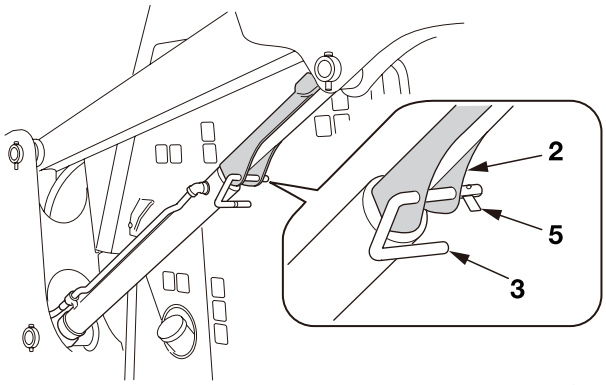
1. Park the machine on solid flat ground, and remove the bucket.
2. Lower the lift arm to its lowest position, and stop the engine.
3. Hook the arm stopper (2) onto the steel bar (4) of the lift arm, and place it on the cylinder.



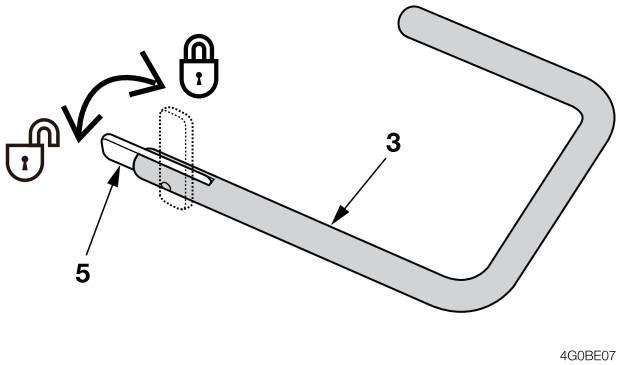
4. Start the engine, and raise the lift arm until the arm stopper (2) drops onto the cylinder rod.



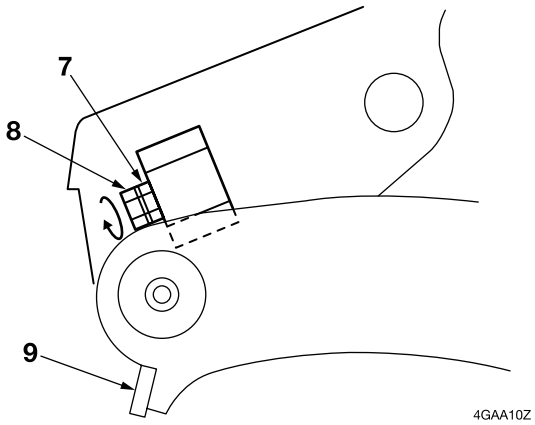
5. Slowly lower the lift arm until the arm stopper (2) comes into contact with the edge of the cylinder tube and becomes stationary and then stop the engine.



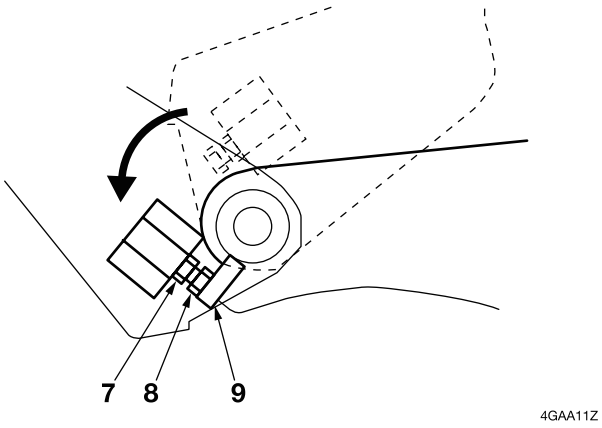
6. Insert the lock pin (3) into the front hole of the arm stopper (2) and pass it under the cylinder rod to insert it into the back hole.
7. Position the tab (5) against the lock pin (3) at a right angle to prevent the lock pin (3) from falling out.



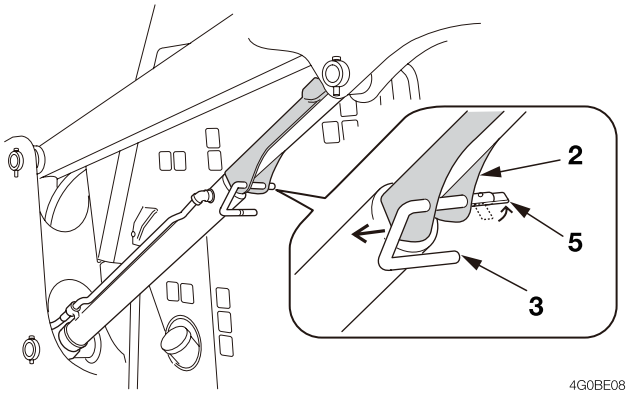
8. Loosen the lock nuts (7) and fully screw in the stopper bolts (8).



9. Start the engine, extend the bucket cylinders to the maximum length, and then stop the engine.
10. Adjust each plate (9) (right, left) and the stopper bolt (8) so that they evenly come into contact with each other.
11. Start the engine, retract the bucket cylinders to the minimum length, and then stop the engine.
12. Adjust the height of the stopper bolts (8) so that they protrude 1 mm (0.04 in.), 2/3 of a turn, and tighten them with the lock nuts (7).
    - Stopper bolt, lock nut: ThreeBond #1324
    - Lock nut: 416 N·m (307 ft.-lb)



13. Start the engine, lift the lift arm until the arm stopper is disconnected, and then stop the engine.
14. With the tab (5) positioned against the lock pin (3), remove the lock pin (3) from the lift arm stopper (2).
15. Remove the lift arm stopper (2).
16. Start the engine, lower the lift arm to its lowest position, and then stop the engine.



Adjusting the arm stopper

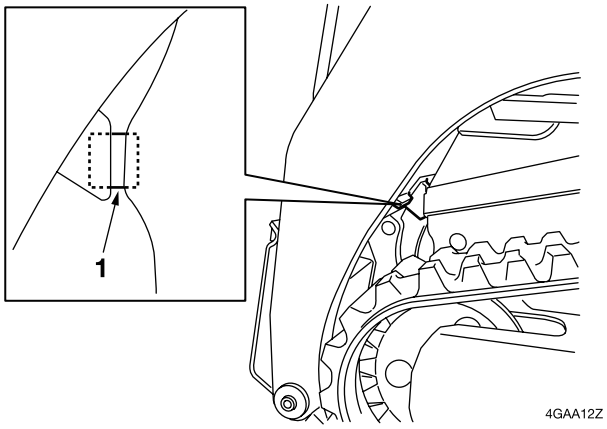
⚠ DANGER

When working under the raised lift arm, use the lift arm stopper to securely support the lift arm. Never position yourself under it without making sure that the lift arm is securely supported.

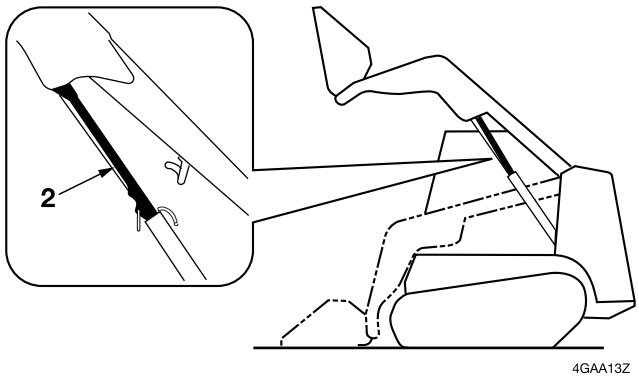
⚠ WARNING

- Complete work with the machine parked on solid flat ground.
- Make sure to remain seated on the cab while operating the machine, including when starting and stopping the engine.
- Set the engine speed to low when operating the control lever.

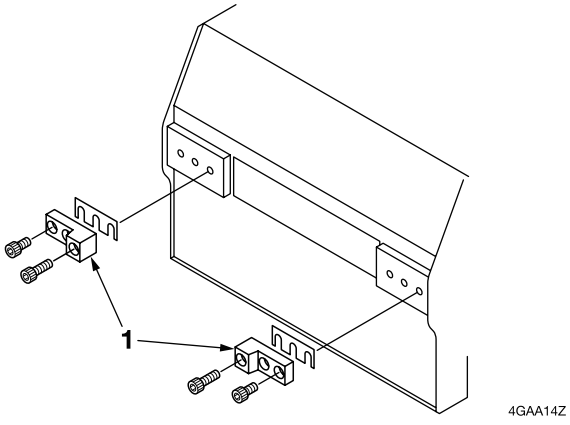
The lift arm must be adjusted so that it strikes against the right and left stoppers (1) on the frame at the same time when it is lowered.



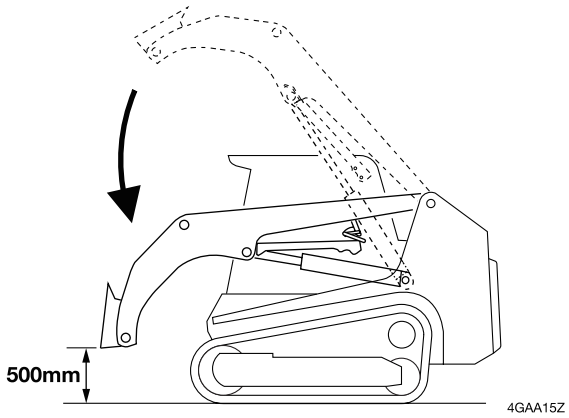
1. Raise the lift arm and support it using the lift arm stopper (2).
   ☞ "Lift arm stopper"



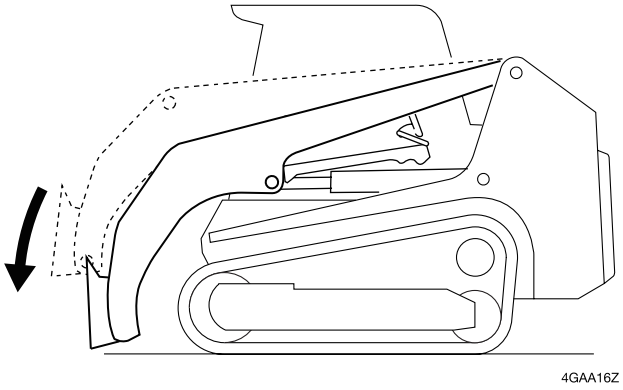
2. Take out the cap screws, and remove the stoppers (1).



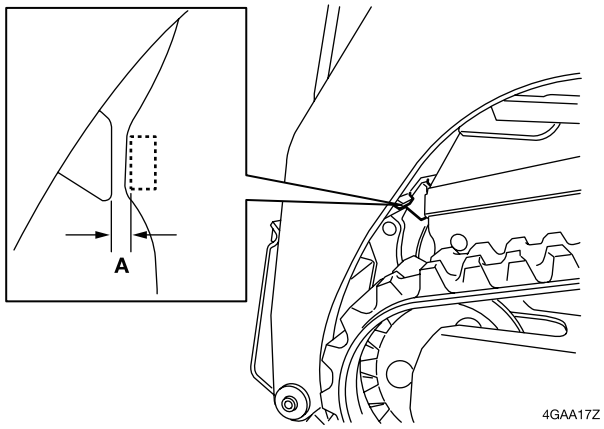
3. Remove the lift arm stopper (2).
   ☞ "Lift arm stopper"
4. Start the engine, and lower the lift arm.
   The lift arm must be positioned at a height approximately 500 mm (20 in.) above the ground.



5. Press the float switch of the right control lever to lower the lift arm and then stop the engine.

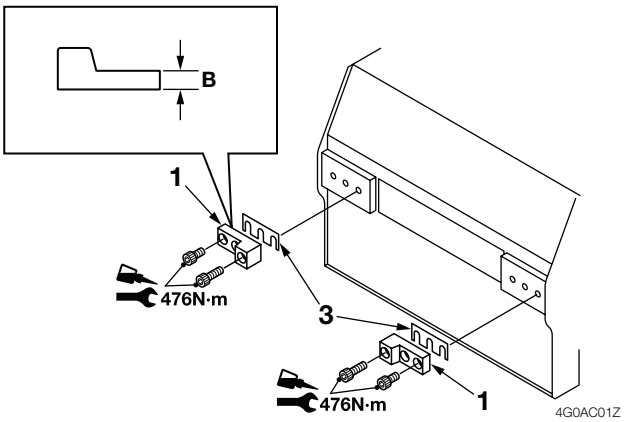


6. Measure and record the width of the clearance "A" on either side (right and left).



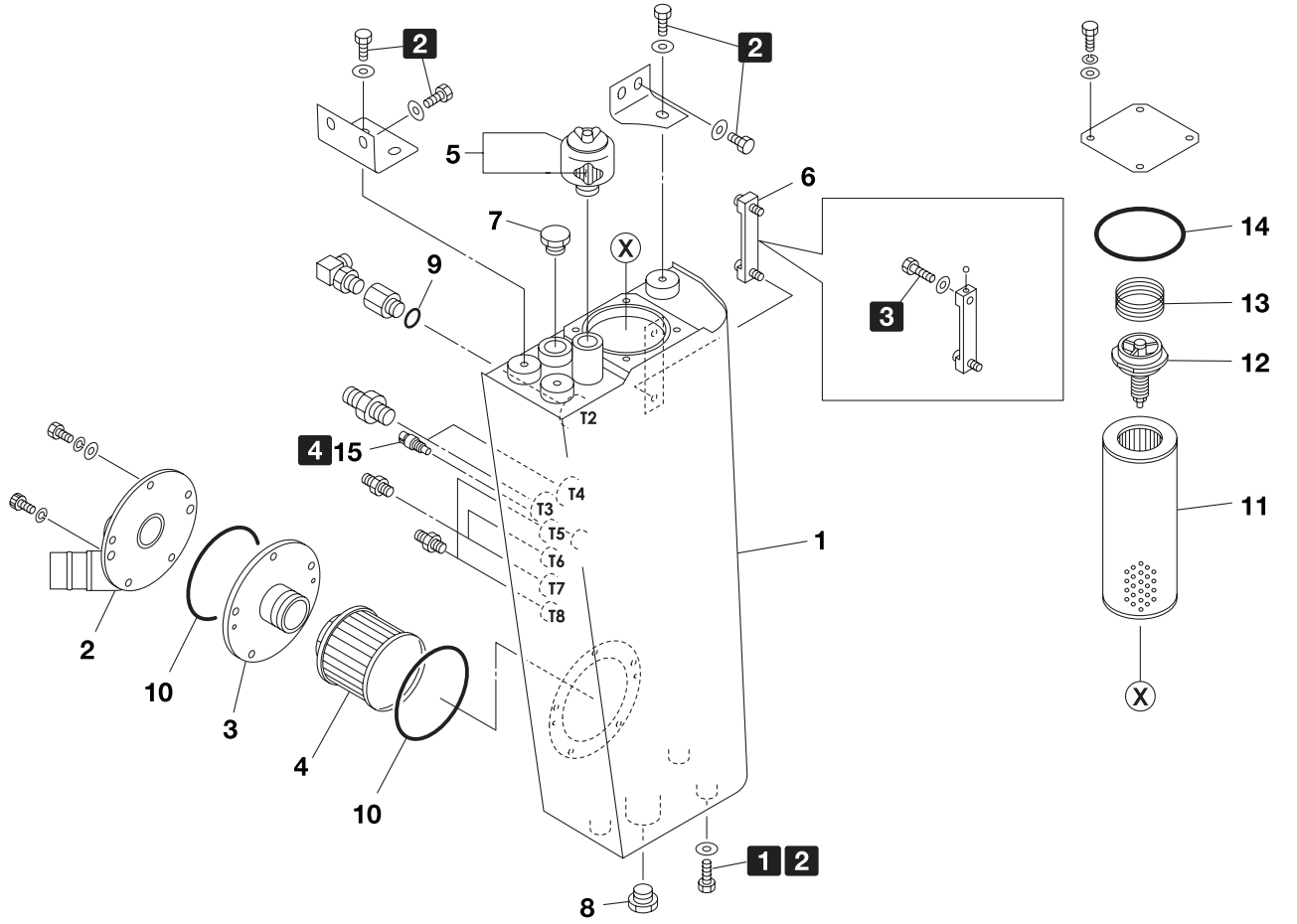
7. Install a stopper (1) and a shim (3) on each side of the frame (right and left), and fasten them in place with the cap screws.
   - The shim must be designed such that the thickness of section "B" (27 mm, 1 in.) on the stopper (1) plus the shim thickness is 1 mm (0.04 in.) greater than the width of the clearance A measured in step 6.
   - Make sure that the lift arm presses against the right and left stoppers (1) at the same time.

   Cap screw: ThreeBond #1324
   Cap screw: 241 N·m (178 ft.-lb)



HYDRAULIC TANK

Construction



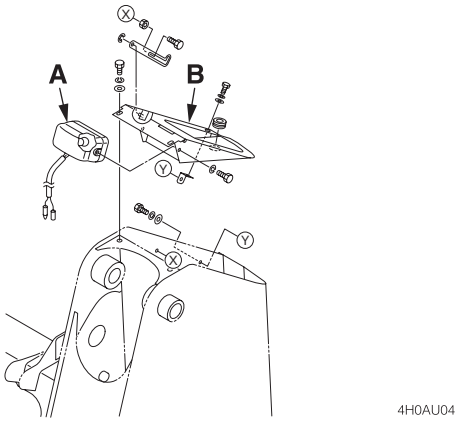
4H0BE01

1 Insert and tighten down the three mounting bolts on the bottom side for securing the hydraulic tank in place first.
2 55.0 N·m (40.5 ft.-lb.) ThreeBond #1324 or an equivalent
3 12.0 N·m (8.9 ft.-lb.)
4 Wrap sealing tape around screw areas.

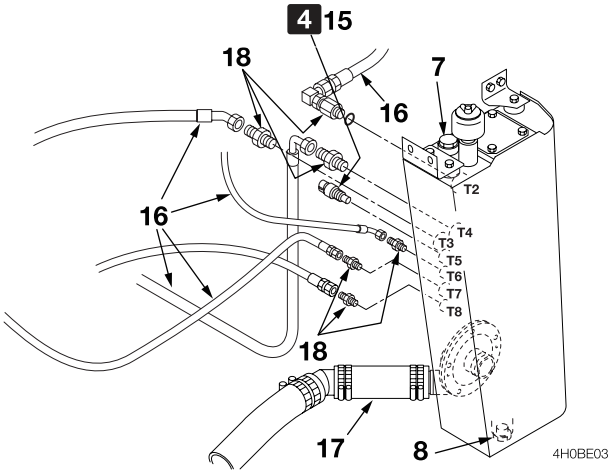
1. Tank
2. Suction pipe
3. Flange
4. Filter
5. Air breather
6. Sight gauge
7. Plug
8. Drain plug
9. O-ring
10. O-ring
11. Filter
12. Valve assembly
13. Spring
14. O-ring
15. Temperature sensor

Removing the hydraulic tank

1. Remove the left light cover.
   a. Disconnect the electrical wiring to the light (A).
   b. Take out the bolts, and remove the cover (B).
2. Remove the radiator.
   ☞ "Removing the engine"

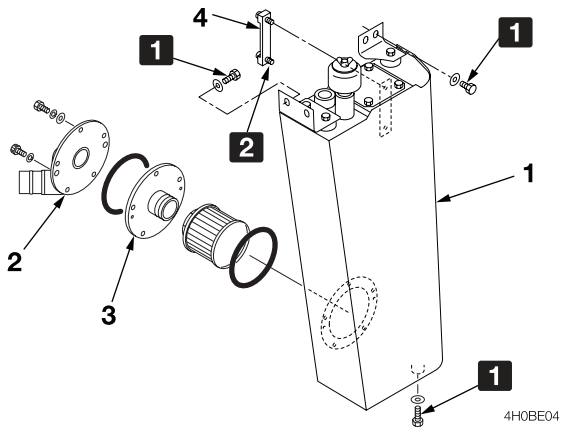


3. Drain the hydraulic oil from the tank.
   a. Loosen the plug (7).
   b. Loosen the drain plug (8), and let the hydraulic oil drain out.
   • Tank level capacity: 38.7 L (10.2 US gal.)
4. Disconnect the hydraulic hoses (16) and suction hose (17) from the tank.
5. Remove the bushings (18) and temperature sensor (15) from the tank.



4 Wrap sealing tape around screw areas during assembly.

6. Take out the bolts and the suction pipe (2), and then remove the flange (3).
7. Remove the sight gauge (4).
8. Remove the mounting bolts from the tank.
   • Insert and tighten down the three mounting bolts on the bottom side for securing the hydraulic tank in place first during assembly.
9. Suspend the tank (1) and then remove it.
   kg Tank: 47 kg (104 lb)



1 Bolt: 55.0 N·m (40.5 ft.-lb)
ThreeBond #1324 or an equivalent
2 Bolt: 12.0 N·m (8.9 ft.-lb)

Installing the hydraulic tank

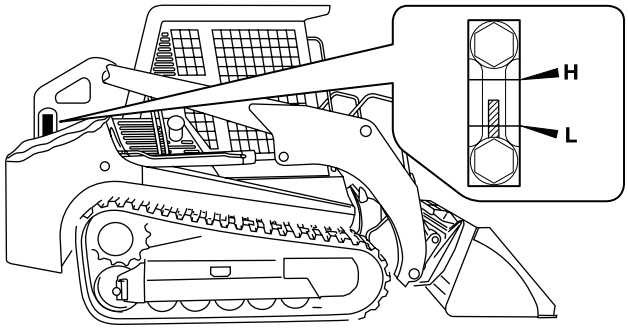
To install, follow the same procedures as for removal but in the reverse order.

Replenishing the hydraulic oil

The oil level changes with the oil temperature. Inspect the oil while maintaining the machine at the attitude shown in the figure.

Machine attitude for inspecting the hydraulic oil level

1. Start the engine, and run it at low speed.
2. Fully retract the lift arm cylinder and the bucket cylinder and then lower the bucket to the ground.
3. Stop the engine.
4. Inspect the oil level using the sight gauge.
   When the oil temperature is about 20°C (68°F): The level should be halfway between the upper limit (H) and the lower limit (L). If it is below the lower limit (L), replenish.
   When the oil temperature is about 50° to 80°C (122°F to 176°F): The level should be near the upper limit (H).



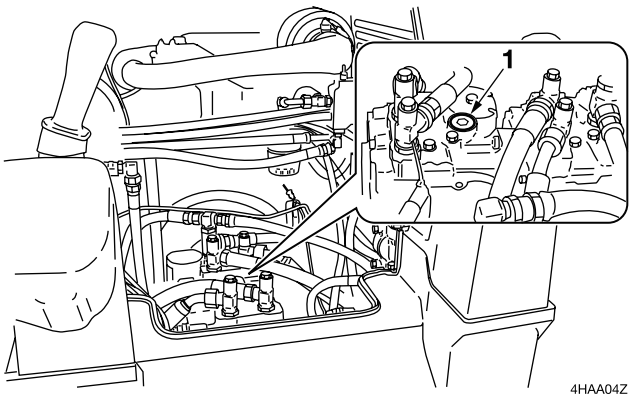
4H0BE05

Bleeding the air

After replacing the hydraulic oil, bleed the air from the hydraulic circuits and hydraulic devices. Failure to do so may damage the hydraulic devices.

Hydraulic pump

1. Slowly raise the canopy.
2. Loosen the plug (1) used for bleeding air from the hydraulic pump.
3. Tighten the plug (1) once the hydraulic oil overflows from the plug hole.



4HAA04Z

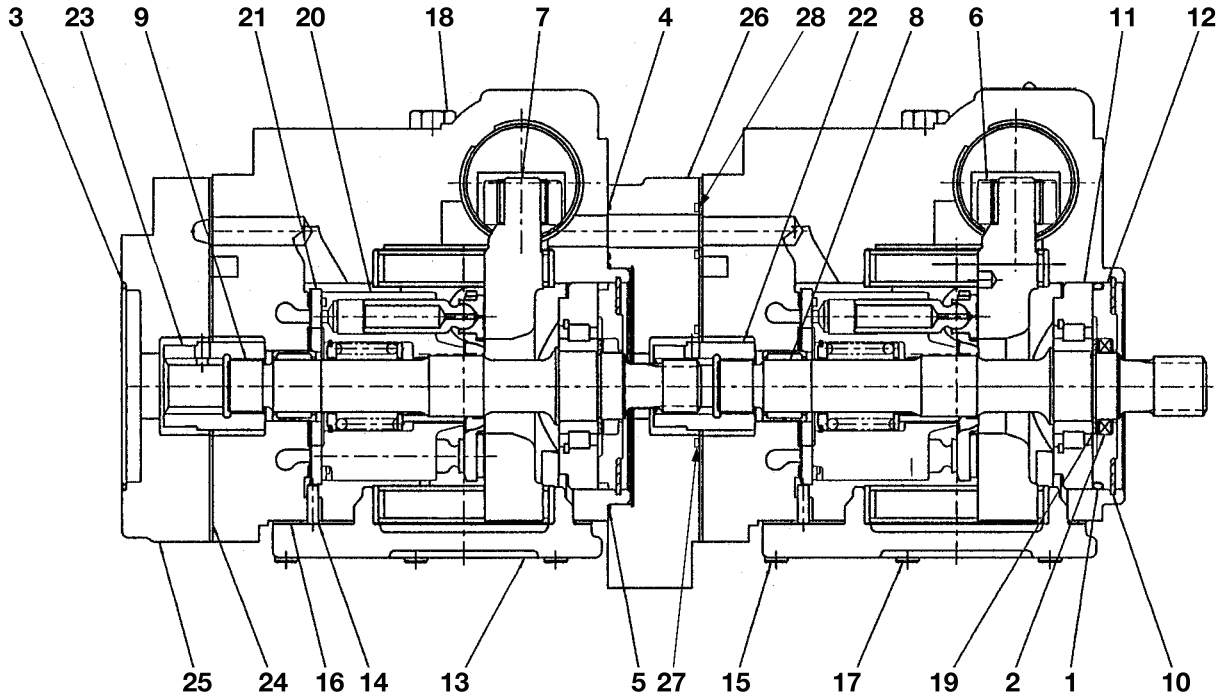
Cylinders

1. Start the engine and let it run at a low-idling speed for 10 minutes.
2. Set the engine to low idle and then extend and retract each cylinder 4 or 5 times without letting them reach the stroke end.
3. Run the engine at high speed and then extend and retract each cylinder 4 or 5 times without letting them reach the stroke end.
4. Return the engine speed to low idle and then extend and retract each cylinder 4 or 5 times without letting them reach the stroke end.

HST PUMP

Construction

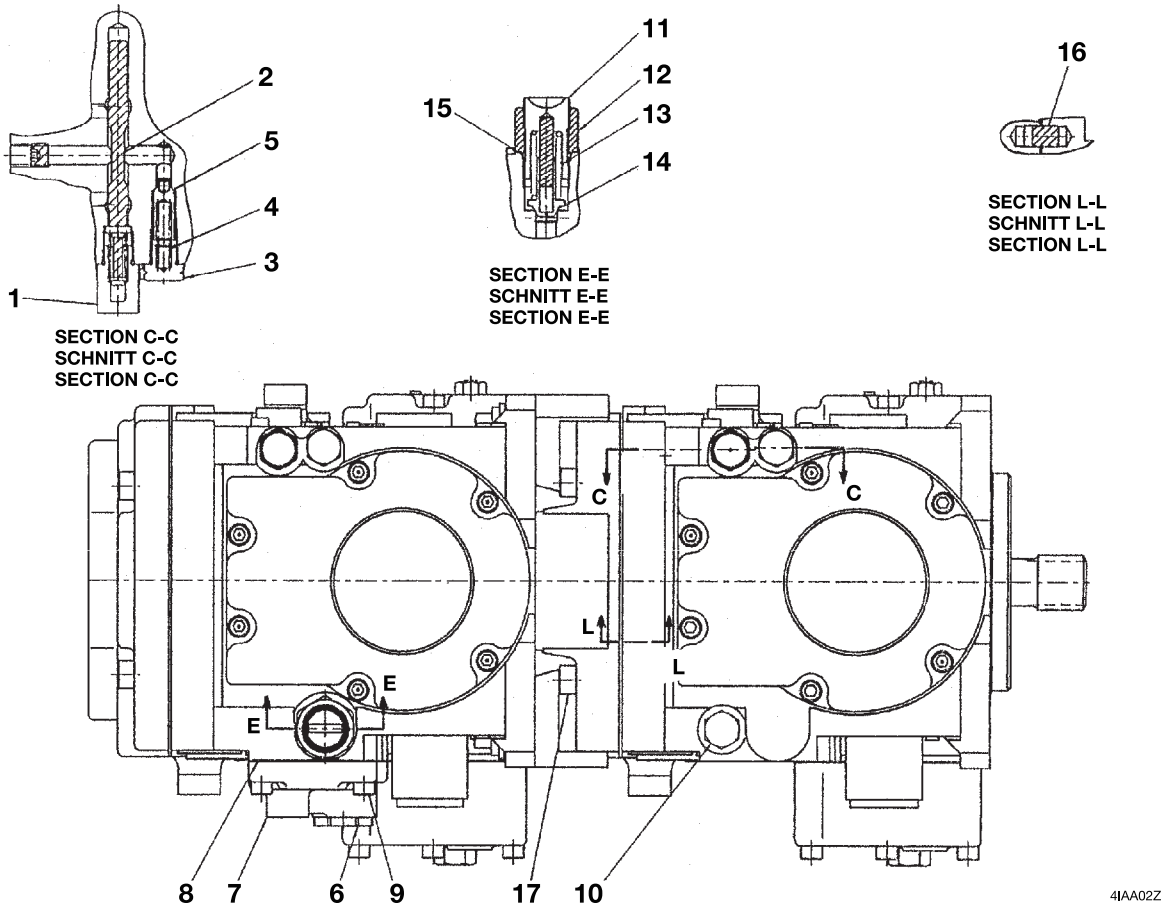
Pump assembly (1/4)



4IAA01Z

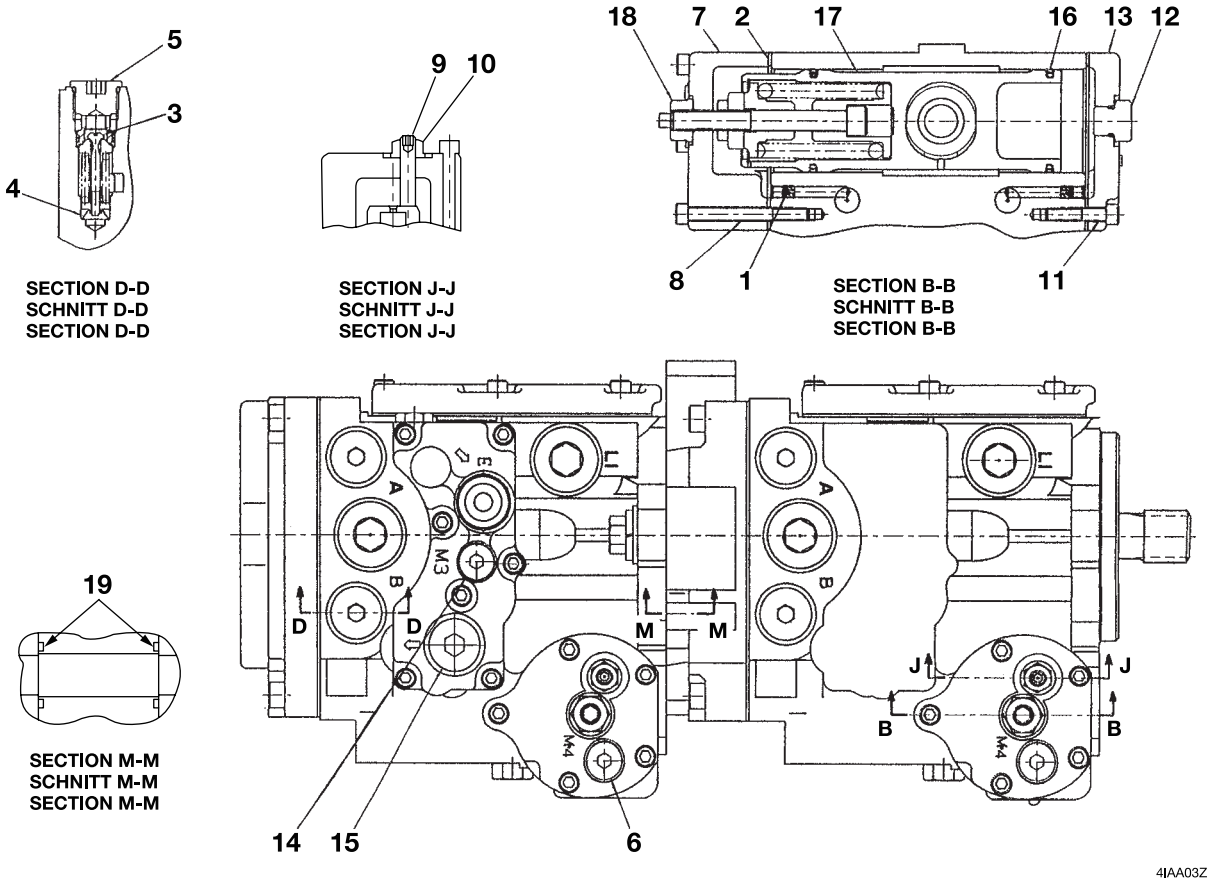
1. O-ring
2. Seal
3. O-ring
4. O-ring
5. O-ring
6. Bearing
7. Swash plate
8. Shaft
9. Shaft
10. Ring
11. Bearing
12. Seal carrier
13. Cover
14. Pin
15. Cap screw
16. Gasket
17. Cap screw
18. Plug
19. Ring
20. Cylinder block
21. Valve plate
22. Coupling
23. Coupling
24. Gasket
25. Pad “A” adaptor
26. Pad “B” adaptor
27. O-ring
28. O-ring

Pump assembly (2/4)



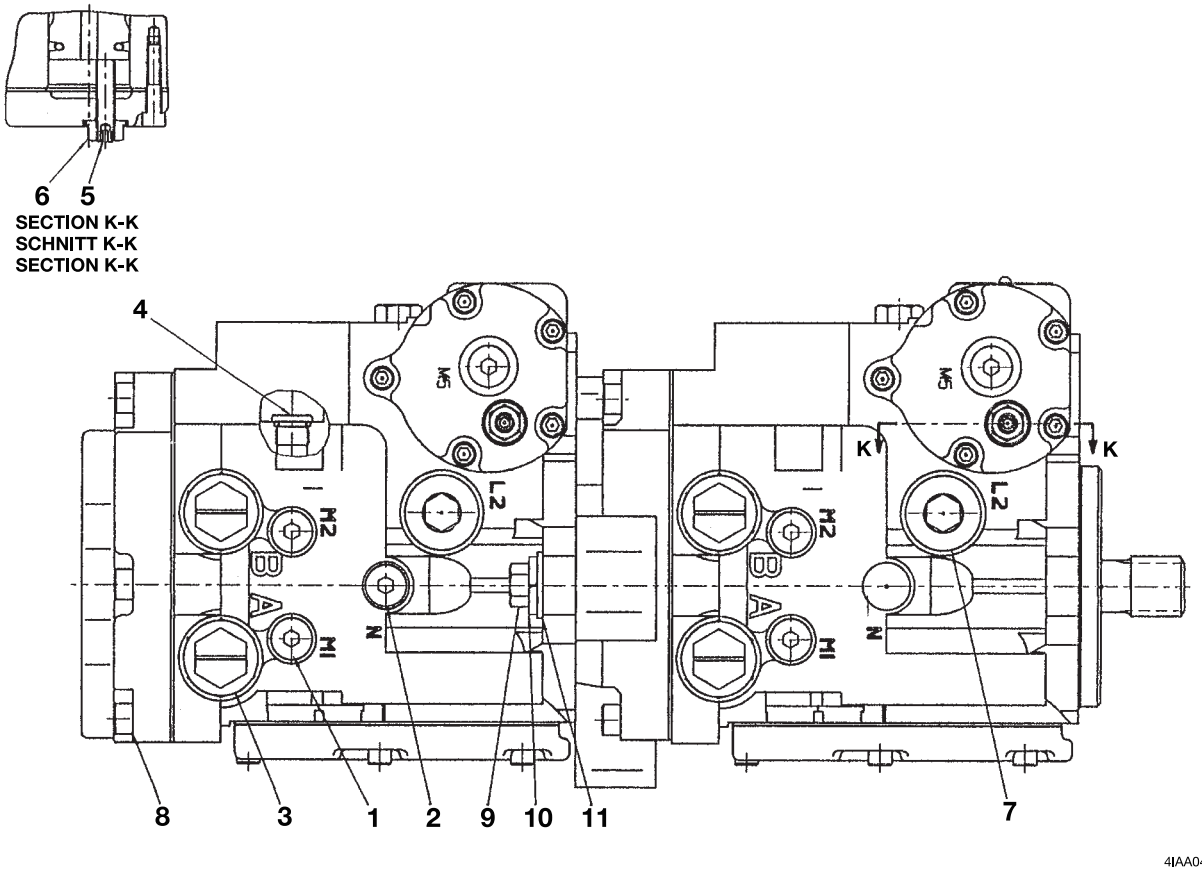
1. Plug
2. Spool
3. Plug
4. Spring
5. Poppet
6. Plug
7. Adaptor
8. Gasket
9. Cap screw
10. Plug
11. Plug
12. Nut
13. Spring
14. Poppet
15. O-ring
16. Pin
17. Cap screw

Pump assembly (3/4)



1. Orifice
2. Gasket
3. Valves
4. Spring
5. Plug
6. Plug
7. Cover
8. Cap screw
9. Screw
10. Seal nut
11. Cap screw
12. Plug
13. Cover
14. Plug
15. Plug
16. Ring
17. Piston
18. Seal nut
19. O-ring

Pump assembly (4/4)

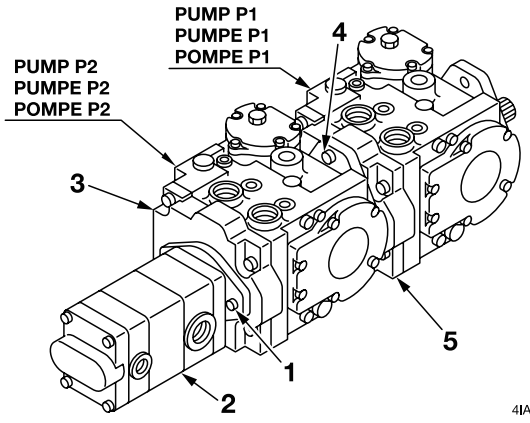


1. Plug
2. Plug
3. Plug
4. Plug
5. Screw
6. Seal nut
7. Plug
8. Cap screw
9. Bolt
10. Spring washer
11. Washer

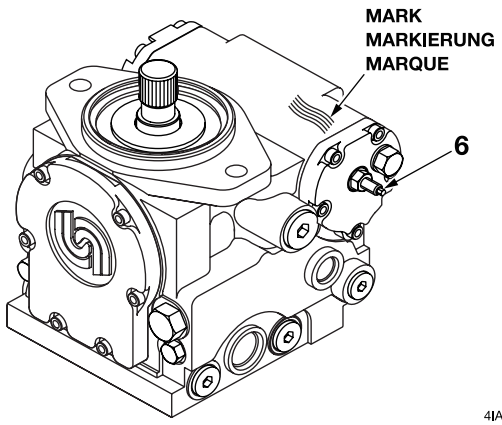
Disassembly

Pump

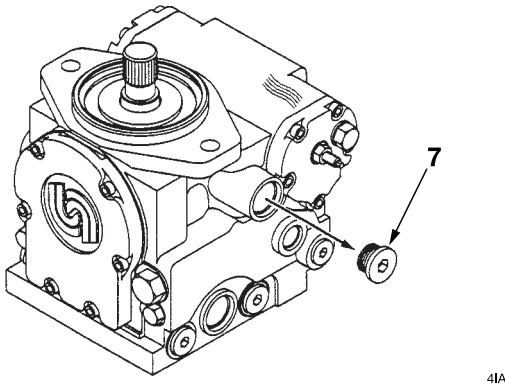
1. Disassemble the pumps P1 and P2 and the gear pump.
   - To avoid misconnection when reassembling, place indicators for matching positions.
   a. Take out the two cap screws (1), and remove the gear pump (2) from the “A” pad adapter (3).
      Remove the O-ring from the “A” pad adapter (3).
   b. Take out the two Allen bolts (4) to separate the hydraulic pump P1 from P2.
      Remove the O-ring from the “B” pad adapter (5).



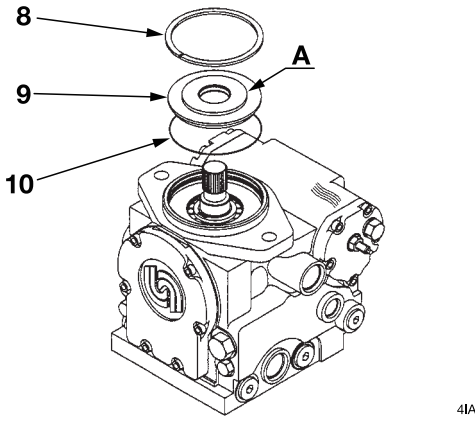
   c. Place a directional marker on the housing.
      - Place it on the side near to the tie bolt (6) used for neutral adjustment.



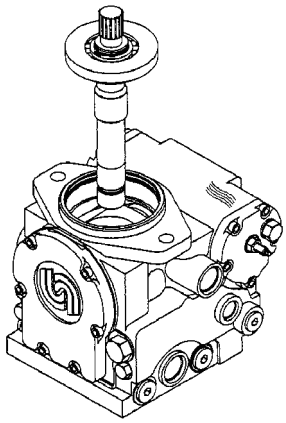
2. Remove the drain plug (7).



3. Remove the retaining ring (8).
   - Use a flat-bladed screwdriver.
4. Remove the seal carrier.
   a. Pull up the shaft and remove the seal carrier (9).
      - If it is hard to remove, insert the flat-bladed screwdriver under the convex part “A” of the seal carrier and try again.
   b. Remove the seal from the seal carrier (9).
   c. Remove the O-ring (10).

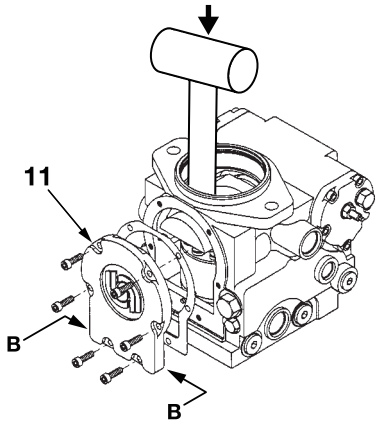


5. Remove the shaft assembly.
   - Grasp the spline of the shaft assembly and pull it up.



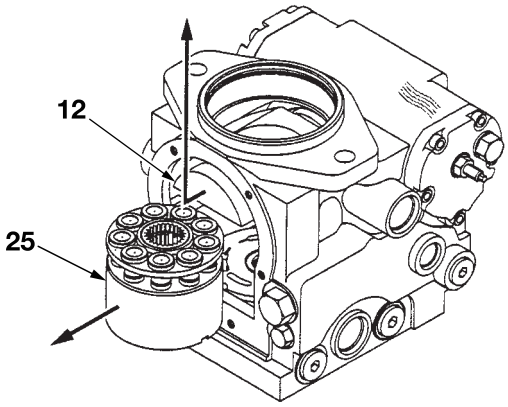
4IAA09Z

6. Remove the side cover.
   a. Remove the six cap screws.
   b. Remove the side cover (11).
   - Press down the swash plate (12) with the handle of a rubber hammer.
   - If it is hard to remove, lightly tap the section “B” of the side cover (11) with the rubber hammer.



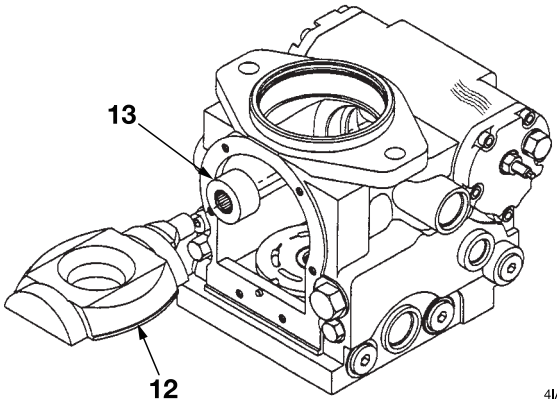
4IAA10Z

7. Remove the cylinder block.
   - Slide out the cylinder block (25) by picking and lifting the swash plate (12) end.
   - Take care not to damage the sliding surface of the cylinder block.



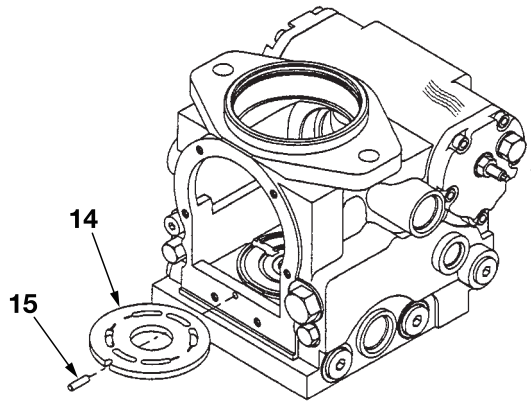
4IAA11Z

8. Remove the swash plate (12).
   - Take care not to damage the sliding surface of the swash plate.
9. Remove the needle bearing assembly (13) from the servo piston.



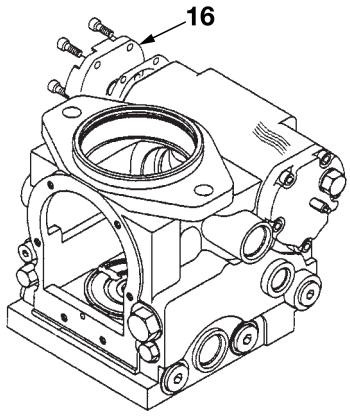
4IAA12Z

10. Remove the valve plate (14) from the housing.
    - If it is hard to remove, use a flat-bladed screwdriver.
    - Take care not to damage the valve plate.
11. Remove the timing pin (15) of the valve plate.



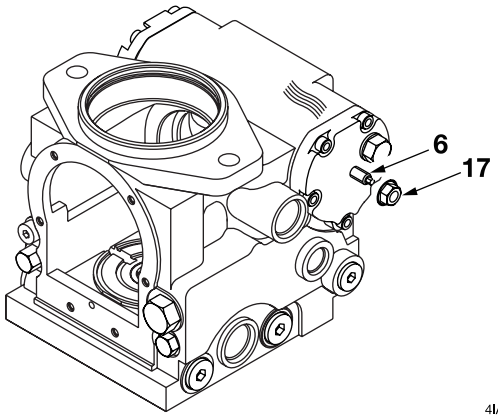
4IAA13Z

12. Remove the servo cover (16).
    a. Remove the five cap screws.
    b. Remove the servo cover (16) and the gasket.



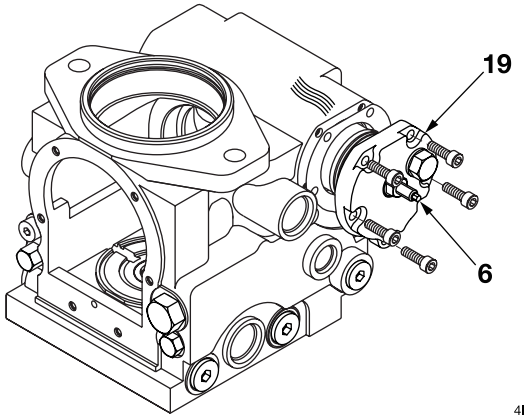
4IAA14Z

13. Remove the adjusting seal nut (17) from the tie bolt (6).
    - Hold the tie bolt with an Allen wrench to prevent it from turning.
    - Replace the adjusting seal nut with a new one when assembling.



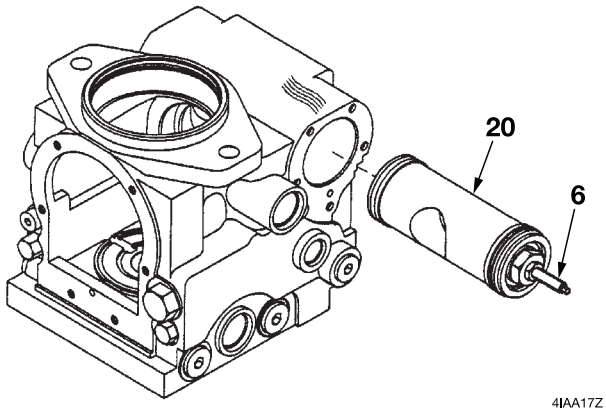
4IAA15Z

14. Remove the servo cover (19).
    a. Remove the five cap screws.
    b. Remove the servo cover (19) and the gasket.
    c. Take out the servo cover (19) from the tie bolt (6).



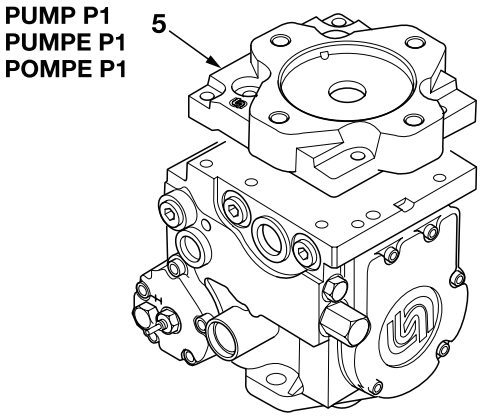
4IAA16Z

15. Remove the servo piston (20).



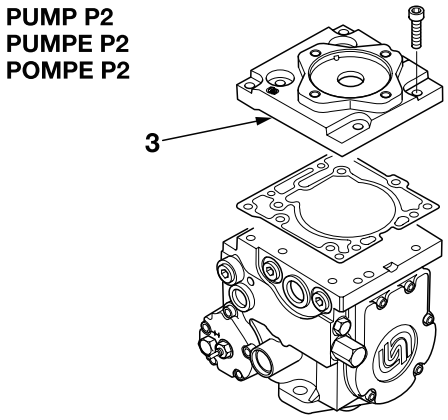
4IAA17Z

16. Remove the “B” pad adapter (on the side of the hydraulic pump P1).
    a. Take out the six cap screws and remove the “B” pad adapter (5).
        • If it is hard to remove, lightly tap the “B” adapter with a rubber hammer.
    b. Remove the O-ring.



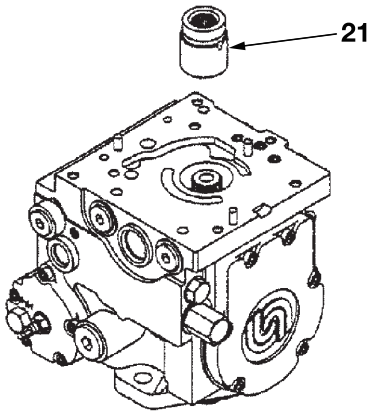
4IAA18Z

17. Remove the “A” pad adapter (on the side of the hydraulic pump P2).
    a. Take out the seven cap screws, and remove the “A” pad adapter (3).
        • If it is hard to remove, lightly tap the “A” adapter with a rubber hammer.
    b. Remove the gasket.



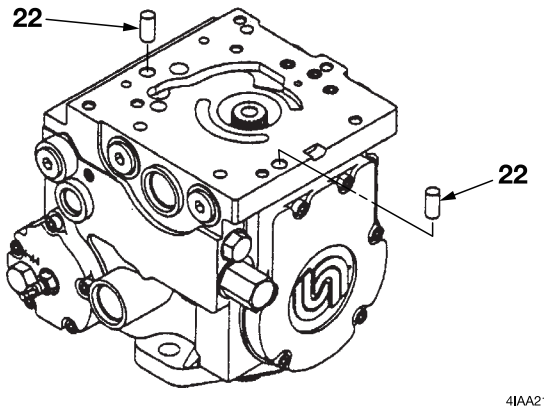
4IAA19Z

18. Remove the coupling (21).



4IAA20Z

19. Remove the two gauge pins (22).
    - Take care not to drop the pins inside the housing.

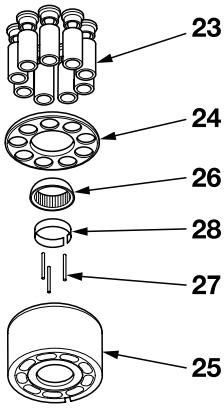


4IAA21Z

20. Disassemble the cylinder block assembly.

Important: Disassemble it only when removing any foreign matter or replacing any damaged component.

a. Remove the pistons (23) and the retainer (24) from the cylinder block (25).
b. Take out the ball guide (26), and remove the three hold-down pins (27).
c. Remove the retainer ring (28) from the cylinder block (25).



4IAA22Z

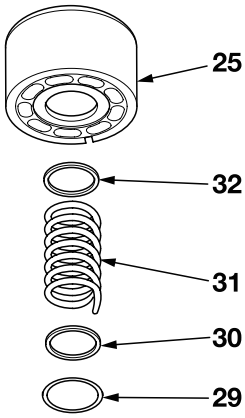
21. Disassemble the cylinder block.

⚠ WARNING

Components may pop out. Wear protective gear such as goggles and a protective face mask.

Important: Do not disassemble the cylinder block unless necessary.

a. Remove the retaining ring (29) while compressing the spring.
b. Remove the washer (30), the spring (31) and the washer (32) from the cylinder block (25).

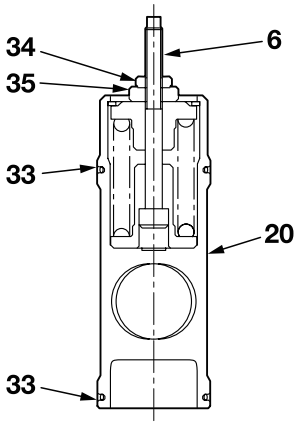


4IAA23Z

22. Disassemble the servo piston.

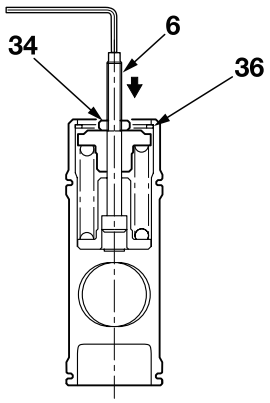
Important: Disassemble it only when removing any foreign matter or replacing any damaged component.

a. Remove the piston rings (33) from the servo piston (20).
b. Remove the nuts (34 and 35) from the tie bolt (6)



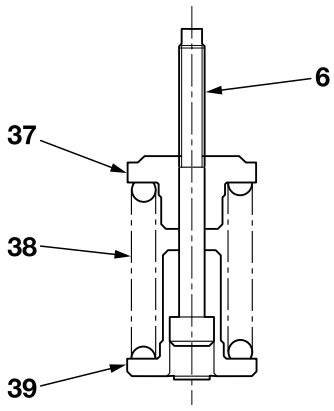
4IAA24Z

c. Attach the nut (34) to the tie bolt (6), and manually tighten the nut (34) to compress the spring.
   - Hold the tie bolt with a hex wrench to prevent it from turning.
   - Tighten the nut until no load is applied to the snap ring (36).
d. Remove the snap ring (36).
e. Remove the spring assembly.
f. Remove the nut (34).



4IAA25Z

g. Remove the spring guide (37), the spring (38) and the spring guide (39) from the tie bolt (6).

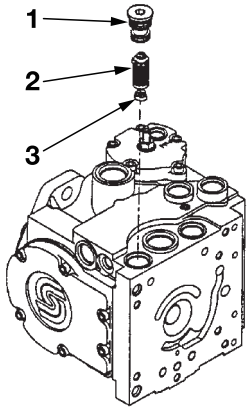


4IAA26Z

Valves

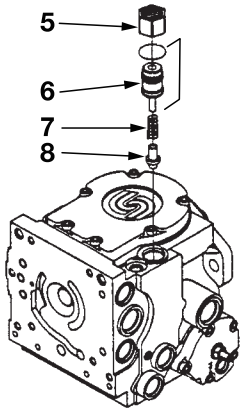
1. Remove the charge check/high-pressure relief valve.
   a. Remove the valve seat plugs (1) from the pump housing.
   b. Remove the relief valve assemblies (2) from the pump housing.

Important: Do not further disassemble the conical spring (3) of the relief valve assemblies (2).



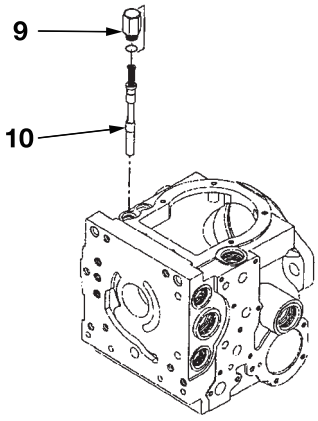
4IAA27Z

2. Remove the charge relief valve.
   a. Loosen the lock nut (5) and remove the adjuster plug (6).
      • To avoid misconnection when reassembling, place indicators showing the matching positions for the adjuster plug (6), the lock nut (5) and the housing.
   b. Remove the O-ring from the adjuster plug (6).
   c. Remove the spring (7) and the poppet (8) from the housing.



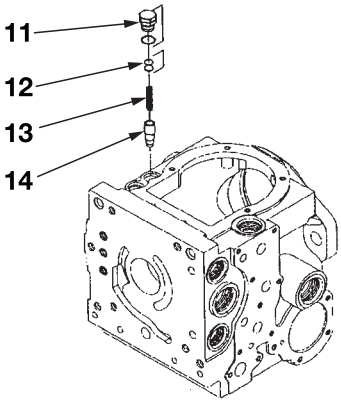
4IAA28Z

3. Remove the flushing valve.
   a. Remove the flushing valve plug (9) from the pump housing.
      Remove the O-ring from the plug.
   b. Remove the flushing valve spool (10) from the housing.



4IAA29Z

4. Remove the flushing relief valve.
   a. Remove the flushing valve plug (11) from the pump housing.
      Remove the O-ring from the plug (11).
   b. Remove the spring (13) and the poppet (14) from the housing.
      • Do not change the shim between the spring and the valve plug, or replace it with another shim of another valve.

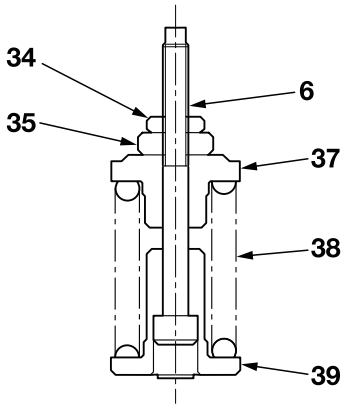


4IAA30Z

Assembly

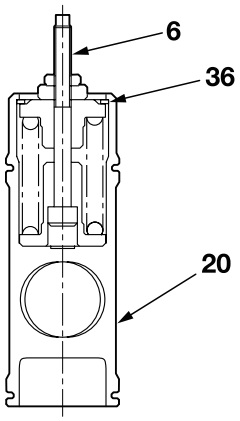
Pump

1. Assemble the servo piston.
   a. Install the spring guide (39), the spring (38) and the spring guide (37) on the tie bolt (6).
   b. Attach the nut (35) and tighten it manually until it contacts the spring guide (37).
   c. Tighten the nut (34) until it contacts the nut (35).



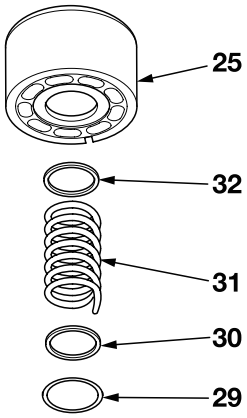
4IAA31Z

   d. Install the spring assembly on the servo piston (20), and attach the snap ring (36).
      • Compress the spring with a press machine.
      • Use a new snap ringe.
   e. After the snap ring (36) is attached, confirm that the spring load is applied to the snap ring (36) and that the tie bolt (6) rotates freely.
   f. Adjust the rotational torque of the servo piston.
      ☞ "Adjusting the rotational torque of the servo piston"



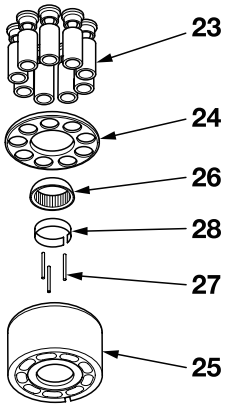
4IAA32Z

2. Assemble the cylinder block.
   • Lubricate each component of the cylinder block with hydraulic oil in advance.
   a. Install the washer (32), the spring (31), and the washer (30) on the cylinder block (25).
   b. Install the retaining ring (29) by compressing the spring.



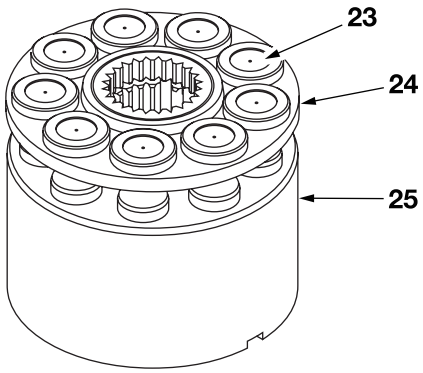
4IAA23Z

3. Assemble the cylinder block assembly.
   a. Install the retainer ring (28) on the cylinder block (25).
      • Install the ring at the position 3.2 mm (0.126 in.) below the uppermost surface of the cylinder block.
   b. Install the three hold-down pins (27) on the cylinder block (25).
   c. Install the ball guide (26) on the cylinder block (25).



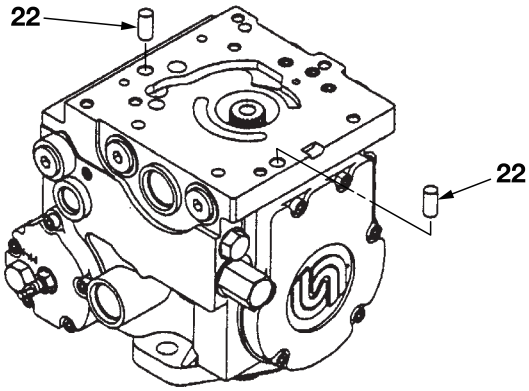
4IAA22Z

d. Insert the pistons (23) into the retainer (24), and install them on the cylinder block (25).
   - Make sure each component is properly assembled.



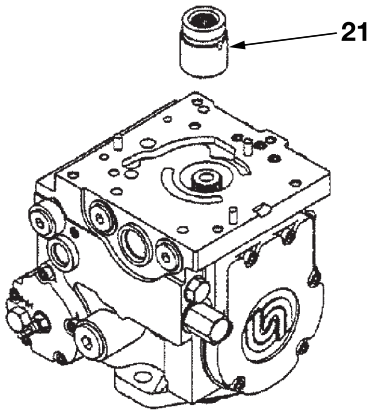
4IAA33Z

4. Install the gauge pins (22).



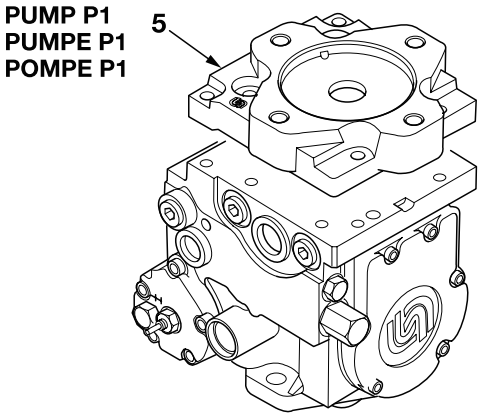
4IAA21Z

5. Install the drive coupling (21).



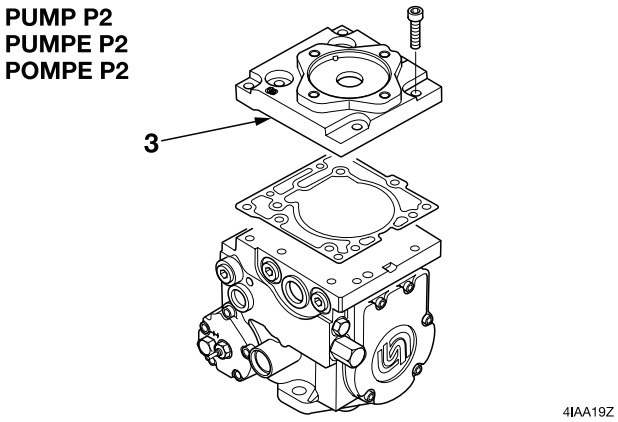
4IAA20Z

6. Install the “B” pad adapter (on the side of the hydraulic pump P1)
   a. Install the O-rings.
   b. Install the “B” pad adapter (5), and tighten it with the six cap screws.
      Cap screw: 36 to 43 N·m (26.6 to 31.7 ft-lb.)

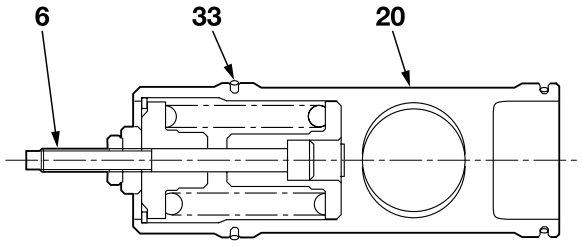


4IAA18Z

7. Install the “A” pad adapter (on the side of the hydraulic pump P2).
   a. Install the gasket.
      • Use a new gasket.
   b. Install the “A” pad adapter (3), and tighten it with the seven cap screws.
      Cap screw: 36 to 43 N·m (26.6 to 31.7 ft-lb.)

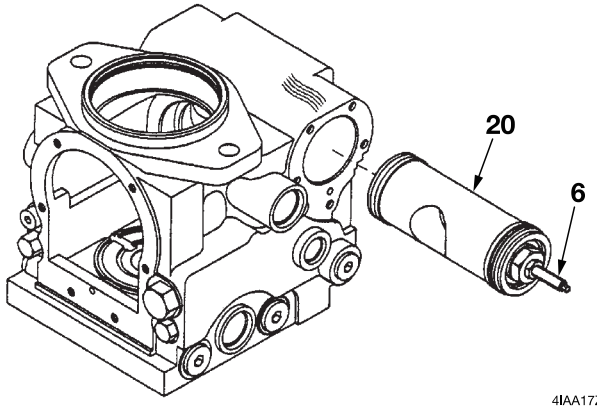


8. Install the servo piston.
   • Use a new piston ring.
   • Lubricate the piston ring (33) fully with hydraulic oil in advance to prevent it from being deformed or damaged.
   a. Install the O-rings on both sides of the servo piston (20).
   b. Install the piston ring (33) on the servo piston (20) on the opposite side from the tie bolt.
      • Install the ring only on the side of the tie bolt (6).
      • After the piston ring is installed, wait for a few minutes to let the piston ring (33) retract.

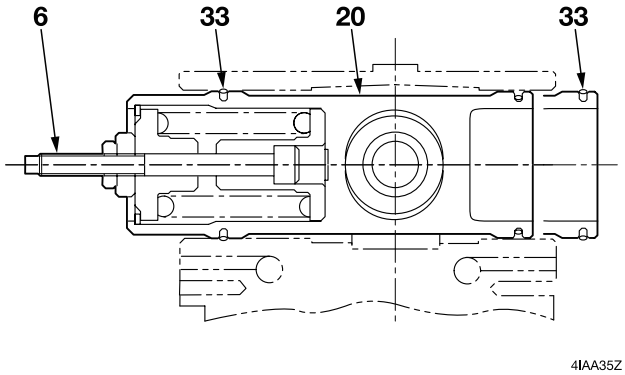


   c. Install the servo piston (20) in such a way that the tie bolt (6) is installed at the side of the mark.
      • Make sure that the hole for installing the swash plate bearing faces the center of the housing.
      • Insert the servo piston as far as the piston ring (33) on the opposite side can be installed.

Important: Take care not to insert the service piston too far; otherwise, the piston ring will be damaged by the inner edge of the servo piston.



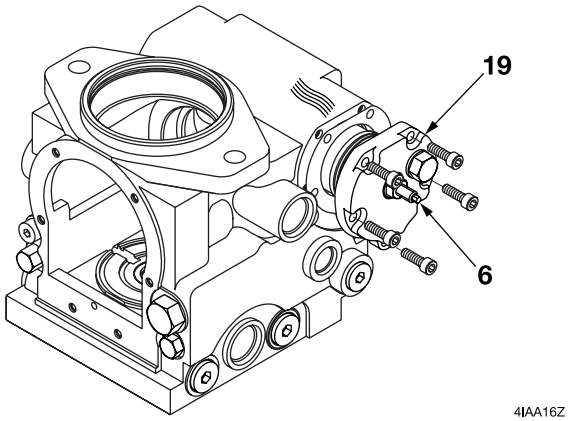
   d. Install the piston ring (33) on the servo piston (20) on the opposite side from the tie bolt.
      • Wait for a few minutes until the piston is retracted.
   e. Push back the servo piston (20).
      • Push back the piston until the piston rings (33) on both sides of the servo piston cannot be seen.



9. Install the servo cover and the gasket.
   - Use a new gasket.

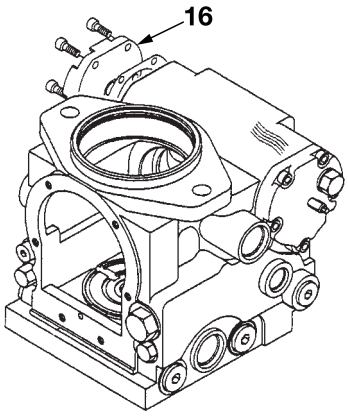
   a. Install the gasket and the servo cover (19).
      - Take care not to damage the servo cover while installing it on the tie bolt.

   b. Tighten them manually with the five cap screws.



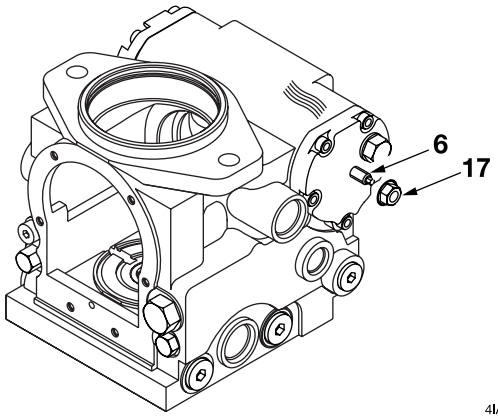
4IAA16Z

   c. Install the gasket and the servo cover (16).
   d. Tighten them manually with the five cap screws.
   e. Tighten the cap screws on both sides of the tie bolt to the stipulated torque.
      Cap screw: 15 to 17.5 N·m (11.1 to 12.9 ft-lb.)



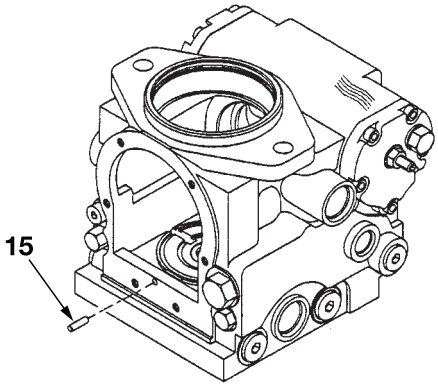
4IAA14Z

10. Install the adjusting seal nut (17) on the tie bolt (6).
    - The adjusting seal nut (17) must be tightened until the seal contacts the servo cover.



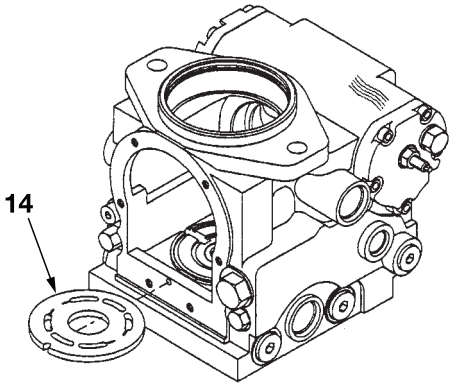
4IAA15Z

11. Install the timing pin (15) on the housing.
    - The timing pin should project approximately 1.6 mm (0.063 in.) out of the housing end surface.



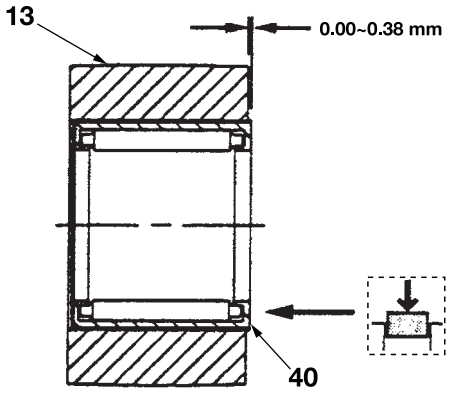
4IAA36Z

12. Install the valve plate (14) over the needle bearing of the housing.
    - Foreign matter under the valve plate may cause a pump failure.
    - Make sure that the valve plate engages with the timing pin.
    - Lubricate the top surface of the valve plate with hydraulic oil.



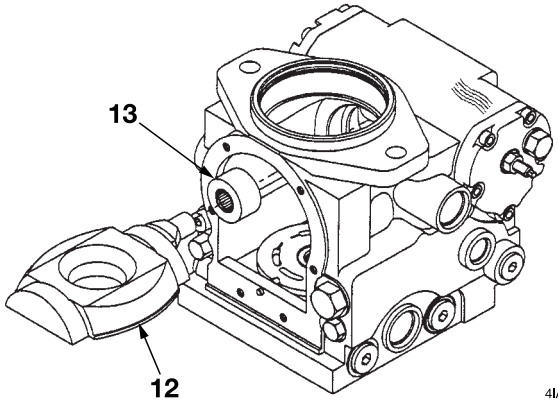
4IAA37Z

13. Install the needle bearing.
    a. Press-fit the needle bearing (40) into the carrier (13).
       - Make sure the surface having the bearing number projects 0.00 to 0.38 mm (0 to 0.015 in.) out of the carrier surface.
    b. Install the carrier (13) on the swash plate (12).



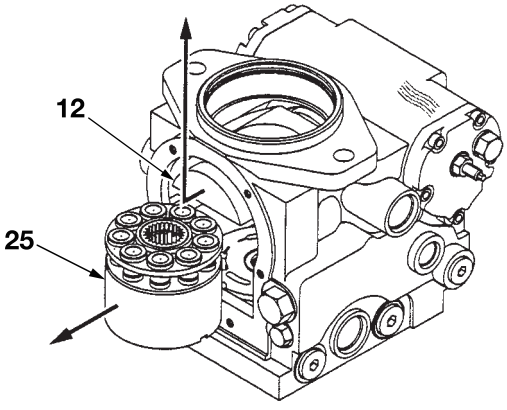
4IAA38Z

14. Install the swash plate (12) into the bearing hole of the servo piston.
    - Lubricate the bearing surface and the rear surface of the swash plate with hydraulic oil.



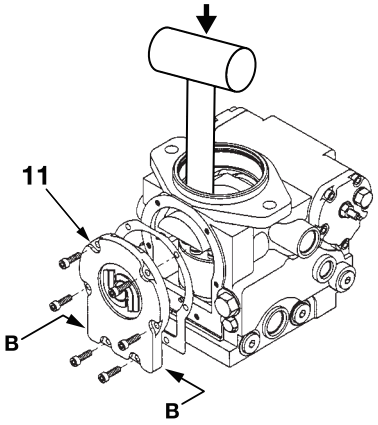
4IAA12Z

15. Install the cylinder block (25) by lifting the edges of the swash plate (12).
    - Lubricate the sliding surface of the cylinder block with hydraulic oil.



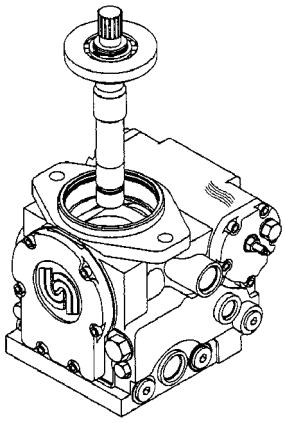
4IAA11Z

16. Install the side cover.
    a. Push down the swash plate to align with the bearing of the side cover (11).
    b. Install the gasket and the side cover (11).
       • Temporarily secure the side cover with the two cap screws used as the aligning guide. Use those cap screws that are longer than those specified for the side cover.
    c. Align the side cover (11) with the housing installation hole.
       • Lightly tap the side cover with a rubber hammer.
    d. Remove the two temporary cap screws, and install the six cap screws.
       • Tighten the cap screws, starting from the one at the lower-left corner counterclockwise.
       • Make sure the swash plate does not interfere with the side cover or the needle bearing.
       Cap screw: 15 to 17.5 N·m (11.1 to 12.9 ft-lb.)

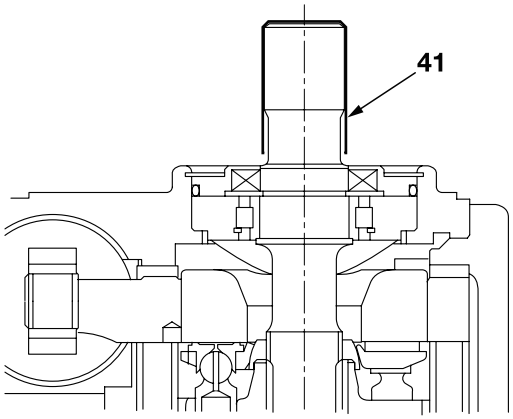


4IAA10Z

17. Install the shaft assembly on the housing.
    • Make sure the hold-down pins of the cylinder block are properly installed along the gutter.

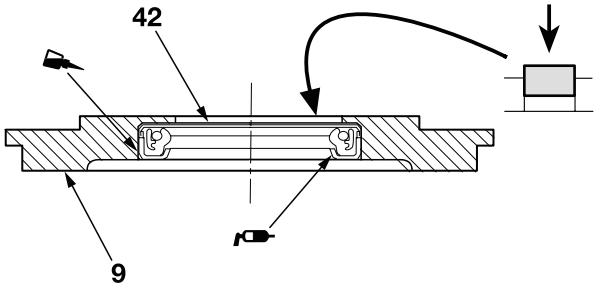

4IAA09Z

18. Install the protector cover (41) for the seal carrier on the shaft spline.
    • Use a sleeve made of plastic or the like.



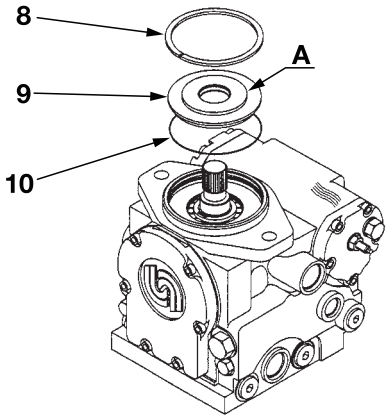
4IAA39Z

19. Assemble the seal carrier.
    a. Press-fit the seal (42) into the seal carrier (9).
       • Use a new seal.
       • Be careful not to insert the seal in the wrong direction.
       Grease the inner seal.
       Seal outer circumference: Loctite #59231
    b. Fit the O-ring (10) to the seal carrier (9).



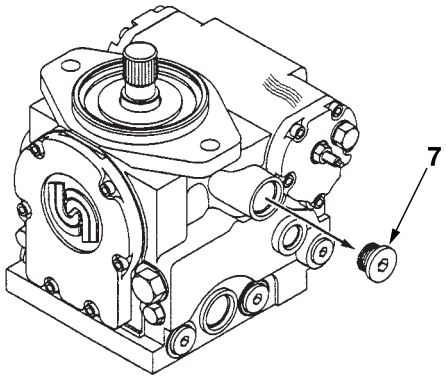
4IAA40Z

20. Install the seal carrier (9) on the housing, and then attach the retaining ring (8).
    - Make sure that the O-ring is not pinched or damaged.
    - Make sure that the retaining ring is properly installed in the installation slot in the housing.



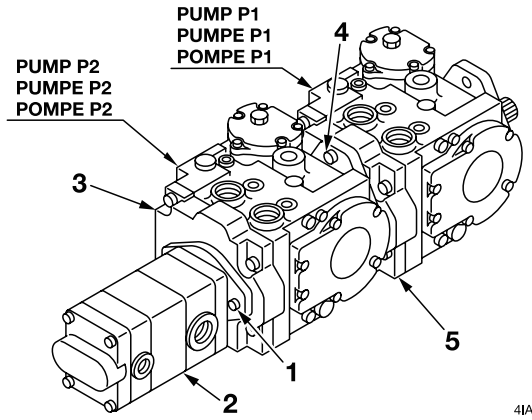
4IAA08Z

21. Install the drain plug (7).
    Drain plug: 95 to 135 N·m (70.1 to 99.6 ft-lb.)
22. Perform the idle run torque test.
    To inspect if the assembling is complete, turn the shaft while securing the pump with a vice. If the turning is not smooth, assemble it again.
    - Idle run torque: 8.5 N·m (6.27 ft-lb.) or less



4IAA07Z

23. Assemble the pumps P1 and P2, and the gear pump.
    a. Fit the O-ring to the “B” pad adapter (5) of the pump P1.
    b. Assemble the pumps P1 and P2, and then install the two Allen bolts (4) and the washers.
       Bolt: 91 to 111 N·m (61.7 to 81.9 ft-lb.)
    c. Fit the O-ring to the “A” pad adapter (3) of the pump P2.
    d. Install the gear pump (2) on the “A” pad adapter (3), and secure them with the two cap screws (1).
       Cap screw: ThreeBond #1324
       Cap screw: 47.1 N·m (34.7 ft-lb.)
24. Perform neutral adjustment of the pump.
    ☞ “Neutral adjustment of the pump”



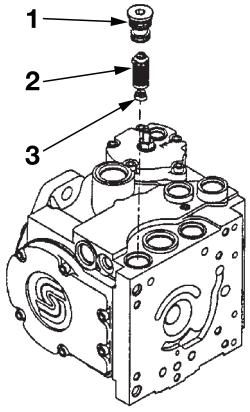
4IAA05Z

Valves

1. Install the charge check/high-pressure relief valve.
   a. Install the outer O-ring, backup ring and inner O-ring on each valve seat plug (1).
      • Check that the conical spring (3) is properly retained on the poppet or relief valve (2).

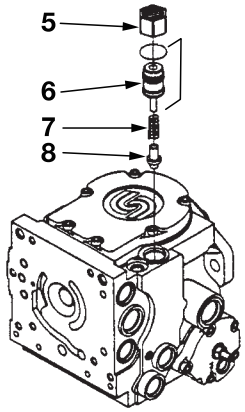
Important: If the conical spring is out of place, the pump may not properly operate.

   b. Install the valve seat plug (1) on the pump housing.
      Plug: 40 to 95 N·m (29.5 to 70.1 ft-lb.)



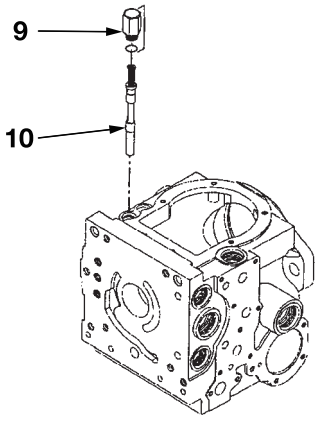
4IAA27Z

2. Install the charge relief valve.
   a. Install the poppet (8) and the spring (7).
   b. Fit the O-ring to the adjuster (6), and then install the adjuster (6).
   c. Secure the adjuster (6) with the lock nut (5).
      • Align the alignment marks of the adjuster, the lock nut and the housing.
      Lock nut: 47 to 57 N·m (34.7 to 42.7 ft-lb.)



4IAA28Z

3. Install the flushing valve.
   a. Install the flushing valve spool (10).
   b. Fit the O-ring to the plug (9), and install it.
      Plug: 27 to 47 N·m (19.9 to 34.7 ft-lb.)

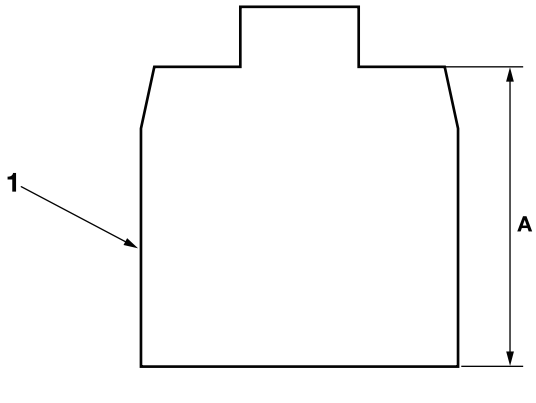


4IAA29Z

Inspection and adjustment

Checking the parts

If abnormal components are found, never reuse them; always replace with new ones.



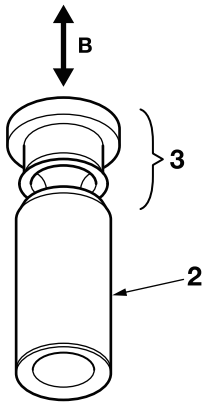
4IAA41Z

Cylinder block

- The sliding surface or the surface that contacts the valve plate must be smooth and free from any damage or burrs.
- The flatness of the sliding surface of the cylinder block (1) must be 0.002 mm (0.00008 in.) TIR.
- The maximum diameter of the cylinder bore must be 14.30 mm (0.563 in.), and the minimum height “A” of the cylinder block (1) must be 50.00 mm (1.969 in.).

Piston and slipper of the cylinder block

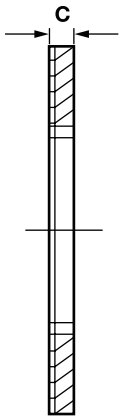
- Place a sheet of white paper behind the piston (2) to see if there is any discoloration on the piston (2).If there is, it shows that the piston has been exposed to extremely high temperature.
- The slipper (3) must not be damaged or worn excessively, and its edge must not be worn excessively.
- The slipper (3) clearance “B” must be 0.152 mm (0.00598 in.) or less.



4IAA42Z

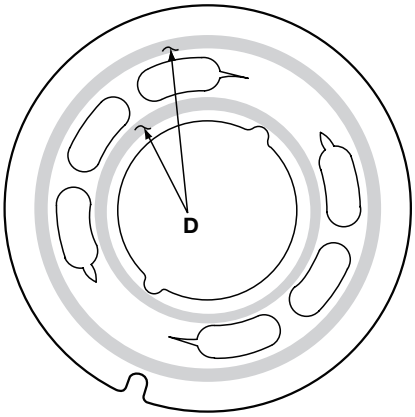
Valve plate

- The thickness “C” of the valve plate must be at least 4.97 mm (0.196 in.).
- The sliding surface and the rear surface must be smooth.
- The parallel accuracy must be at least 0.0249 mm (0.00098 in.).
- The flatness of the valve plate must be 0.0038 mm (0.00015 in.) TIR.
- Perform the magnetic particle inspection (nondestructive testing) to see if there is any cracking. No cracking must be found on any surface.



4IAA43Z

- Inspect the seal land surface “D” for damage by touching it with a prong such as the tip of a nail or pencil and by moving it in the direction of diameter.
- Check if there is any contamination on the surface where the valve plate and the housing contact. Even slight contamination reduces the flow rate.



4IAA44Z

Servo cover

- The servo cover's surface that contacts the gasket must be clean and smooth.
- There must be no scratch or foreign matter on the surface.

Input shaft

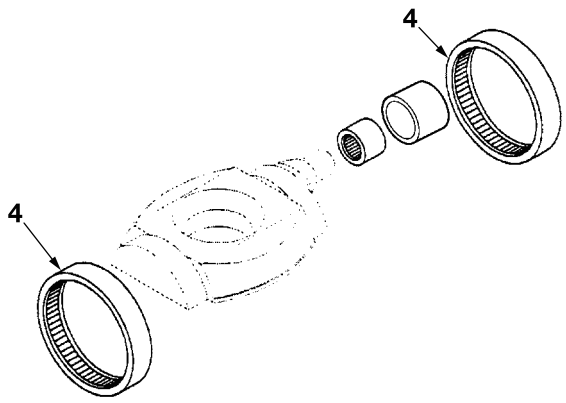
- The shaft and its spline must be straight and free from any damage or wear.
- No annular groove should be found on the shaft surface that contacts the shaft seal.
- No spalling should be found on the surface where the shaft and the bearing contact.

Shaft roller bearing

- The bearing must rotate smoothly.
- If the presence of foreign matter is suspected, clean the bearing and lubricate it with hydraulic oil.

Swash plate bearings

- Do not replace the bearings (4) on both sides of the swash plate independently as they should be replaced as a cover assembly or a housing assembly.
- The bearing must rotate smoothly.
- If the presence of foreign matter is suspected, clean the bearing and lubricate it with hydraulic oil.
- When reassembling, the surface with the bearing number attached must be positioned 0 to 0.38 mm (0 to 0.015 in.) above the carrier surface.



4IAA45Z

Swash plate

- The surface of the swash plate must be smooth and free from any projections or unusual wear.
- The thickness "A" of the contact surface of the swash plate bearing must be at least 25.58 mm (10.007 in.).
- The difference of the thickness at both ends must be no more than 0.0508 mm (0.002 in.).
- The flatness of the sliding surface with the slipper must be 0.0254 mm (0.001 in.) or less.

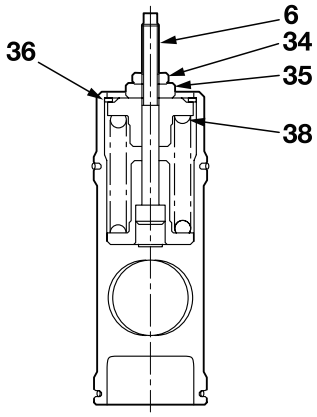


4IAA46Z

Adjusting the rotational torque of the servo piston

The adjustment should be performed so that the load of the spring (38) is applied to the snap ring (36), and the tie bolt (6) rotates freely.

1. Hold the nut (35) with a wrench, and tighten the tie bolt (6) manually by turning it to the left until firm.
2. With the nut (35) still secured, tighten the tie bolt (6) by turning it to the left with a wrench.
   - Tighten the bolt until the spring (38) starts compressing.
3. Turn the tie bolt (6) approximately 1/16 turn to the right.
4. With the nut (35) secured, tighten the nut (34) to the stipulated torque.
   Nut: 20 to 27 N·m (14.75 to 19.91 ft-lb.)

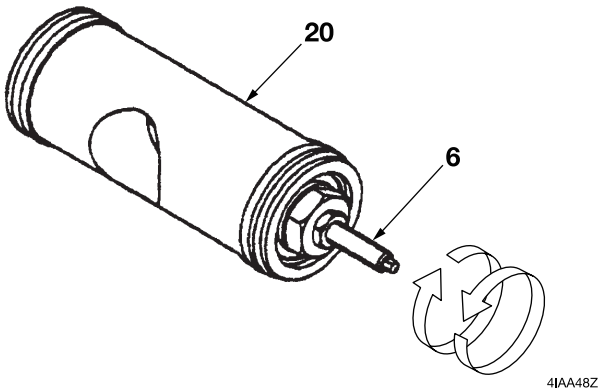


4IAA47Z

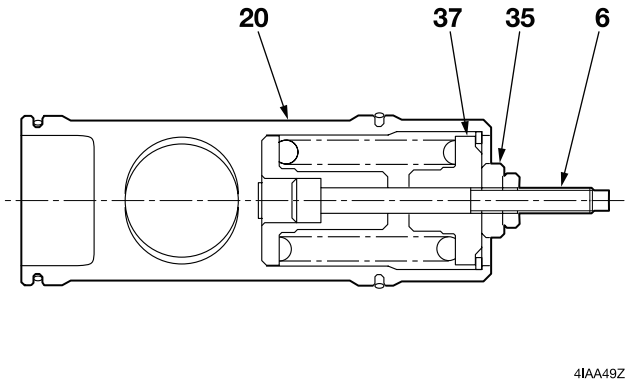
Measurement of the servo piston's rotational torque

Check whether the servo piston's rotational torque is properly adjusted:

1. Secure the servo piston (20) with your hand to prevent it from turning.
2. Rotate the tie bolt (6) for neutral adjustment and measure the torque required for rotation.
   - Measure the torque after the tie bolt (6) for neutral adjustment starts rotating.
   - Rotational torque: at least 1.13 N·m (0.83 ft-lb.)
   - The rotational torque of the servo piston must satisfy the lower limit value in both rotational directions.
   - During measurement of torque, the nut (35) may rotate, but the upper spring guide (37) must not rotate.
   - If the stipulated rotational torque is not obtained, readjust the rotational torque of the servo piston again.



4IAA48Z



4IAA49Z

Neutral adjustment of the pump

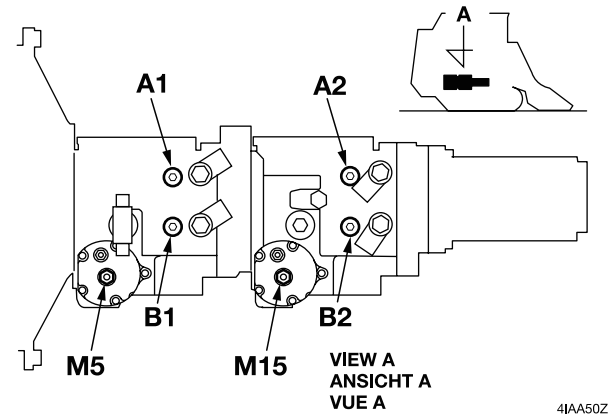
⚠ WARNING

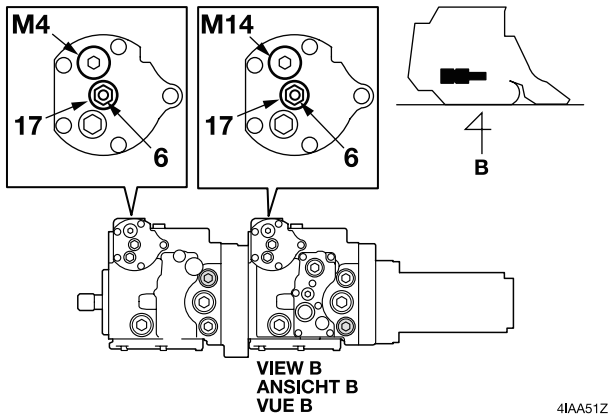
- Perform the adjustment on flat ground.
- The oil is hot immediately after the engine is stopped. Wait until it cools before working.
- When disconnecting the hydraulic hoses, oil may spurt due to the internal pressure. Be sure to loosen the hydraulic hose slowly to protect the eyes and skin from spurting oil.

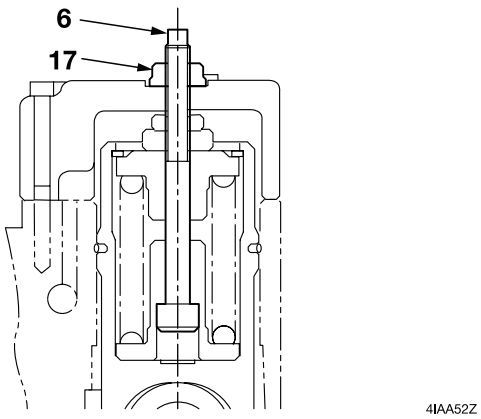
In this adjustment, the tie bolt of the controlling section should be adjusted so that the pressures on both sides of the turbo piston become equal.

1. Connect the hydraulic hoses to the gauge ports to make the pressures on both sides of the servo piston equal.
   - Hydraulic pump P1: M4 and M5
   - Hydraulic pump P2: M14 and M15
2. Install the pressure gauges to the ports to measure the circuit pressure.
   - Hydraulic pump P1: A1 and B1
   - Hydraulic pump P2: A2 and B2
3. Start the engine and run it at the rated rotational speed.
4. Loosen the adjusting seal nut (17) of the hydraulic pump and turn the tie bolt (6).
   - Turn the tie bolt (6) until the readings of the two pressure gauges become equal.
5. Turn the tie bolt (6) clockwise.
   - Turn it until the reading of one pressure gauge becomes higher than that of the other pressure gauge.
   - Record the position of the tie bolt.
6. Turn the tie bolt (6) counter-clockwise.
   - Turn it until the reading of one pressure gauge becomes higher than that of the other pressure gauge.
   - Record the position of the tie bolt.
7. Turn the tie bolt (6) until it is positioned at the middle of the two positions recorded in 5 and 6 above.
   - Make sure the readings on the two pressure gauges are equal.
8. Tighten the tie bolt (6) with the adjusting seal nut (17).
   - Be sure not to turn the tie bolt (6) itself.

   Seal nut for adjustment: 20 to 26 N·m (14.75 to 19.18 ft-lb.)
9. Stop the engine, remove the hydraulic hoses connected with the gauge ports, and attach the plugs.
10. Disconnect the pressure gauges from the ports.







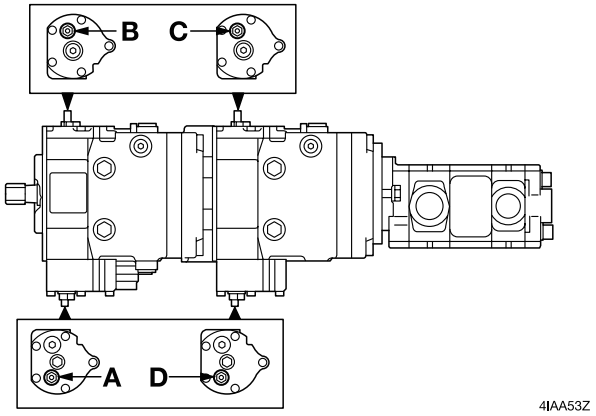
Adjustment of displacement limiter

⚠ WARNING

- Perform the adjustment on flat ground.
- The oil is hot immediately after the engine is stopped. Wait until it cools before working.
- When disconnecting the hydraulic hoses, oil may spurt due to the internal pressure. Be sure to loosen the hydraulic hose slowly to protect the eyes and skin from spurting oil.
- Failure to adjust the displacement limiter may result in uncontrollable operations of the machine during traveling.

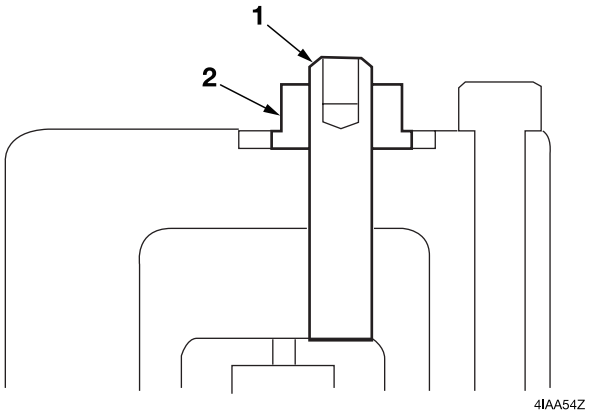
Improper adjustment of the displacement limiter may cause the “veering”. By adjusting the displacement limiter, limit the maximum gradient of the swash plate and control the discharge volume of the right and left hydraulic pumps. This will adjust the speeds of the right and left travel motors to avoid the “veering”.

		Displacement limiter
Left travel	Forward	A
	Reverse	B
Right travel	Forward	C
	Reverse	D



4IAA53Z

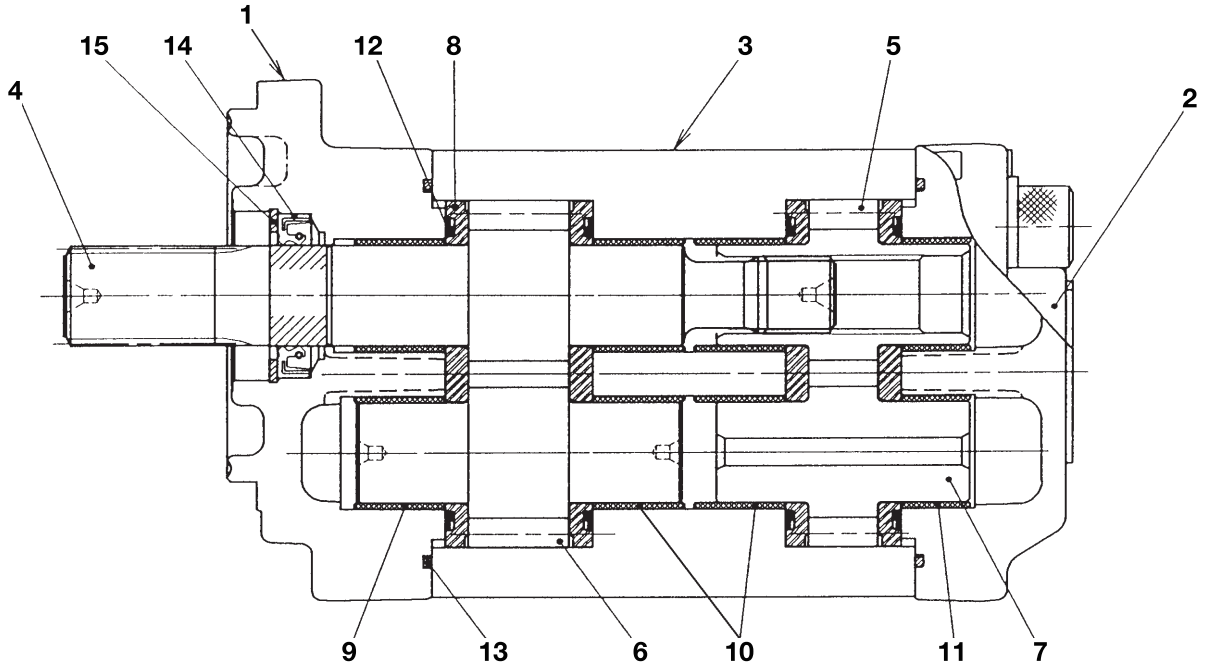
1. Loosen the locknut (2), and turn the setscrew (1) for adjustment.
   Turning to the right..... Decelerate
   Turning to the left ..... Accelerate
   - A single rotation will generate the speed of 6.2 cm^3 (0.378 in^3)/min^{-1}.
2. Upon completion of the adjustment, tighten the lock nut (2) by holding the setscrew (1) to prevent it from turning.
   Lock nut: 20 to 27 N·m (14.75 to 19.91 ft-lb.)



4IAA54Z

GEAR PUMP

Construction



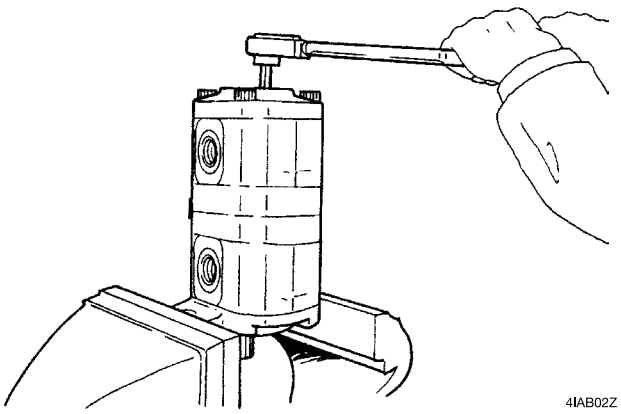
4IAB01Z

1. Flange
2. Rear cover
3. Housing
4. Drive gear
5. Drive gear
6. Driven gear
7. Driven gear
8. Bushing
9. Bushing
10. Bushing
11. Bushing
12. Gasket
13. Gasket
14. Oil seal
15. Snap ring

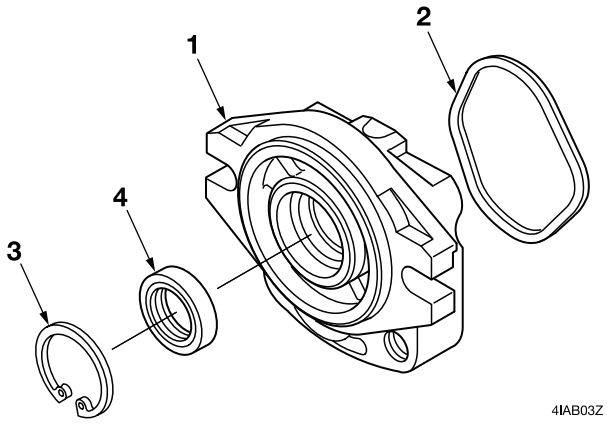
Disassembly

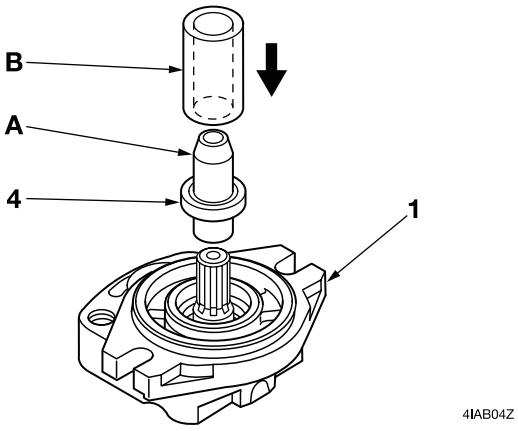
For disassembly of the gear pump, follow the steps below. For assembly, follow the same procedure as for removal in the reverse order.

1. Remove the cap screws.
   Cap screw: 88.2 to 93.1 N·m (65.1 to 68.7 ft-lb.)

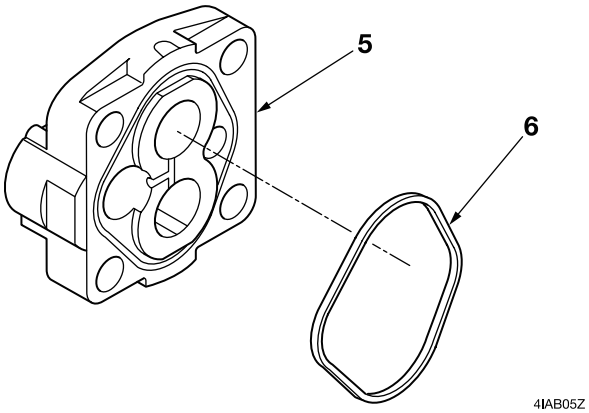


2. Remove the flange (1).
3. Remove the gasket (2) from the flange (1).
4. Remove the snap ring (3) and the oil seal (4) from the flange (1).
   - Be careful not to scratch or otherwise damage the flange.
   - When assembling, install the oil seal using the jigs “A” and “B”.

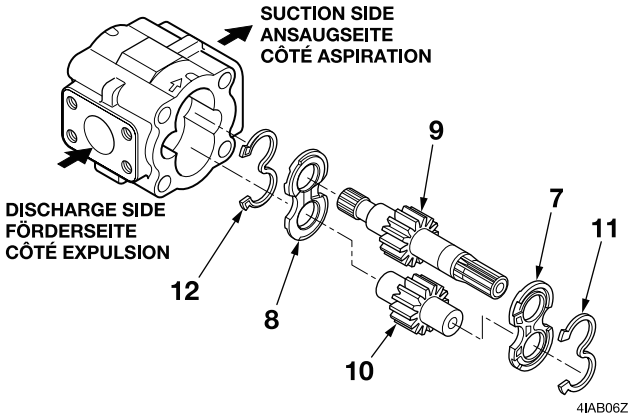




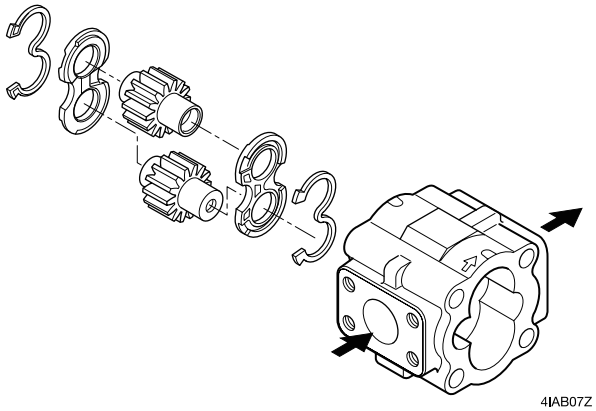
5. Remove the rear cover (5).
6. Remove the gasket (6) from the rear cover (5).



7. Disassemble the front pump.
   a. Remove the bushing “A” (7), the bushing “B” (8), the drive gear (9) and the driven gear (10) from the housing.
      - Be careful not to mix up the bushings.
      - Be careful not to scratch or otherwise damage the inner part of each housing.
8. Remove the gaskets (11) and (12) from the bushing “A” (7) and the bushing “B” (8).



9. Disassemble the rear pump using the same procedure as for the front pump.



Inspection and adjustment

Checking the parts

After checking the disassembled parts for dirt or discoloration, clean them with diesel fuel. However, do not let diesel fuel get on rubber parts. Check each part for the following points and if there is any trouble, repair or replace the part.

Housing

The gear pump is made so that the crests of the gear teeth make light contact with the housing walls as a means of increasing its efficiency. Therefore, contact marks can be seen near the suction port in any pump that has been operated. It is normal if the depth of the contact marks is within 0.1 mm (0.004 in.). If the depth exceeds the usage limit in the above figure, replace the pump assembly.

Bushing

The ideal situation is for the sliding surfaces to have no roughness and for the suction side half to be lustrous. Also, it is satisfactory if strong contact marks can be seen on the side surface on the suction side and minute contact marks can be seen on the discharge side.

Replace the bushing if it is in the following condition.

- Contact marks can be seen on the sliding surface of the entire bearing inner diameter and it is rough with scratches that easily catch a fingernail.
- There are many scratches around the circumference of the side surface and it is rough with scratches that easily catch a fingernail.
- There are marks due to trapping of foreign matter on the sliding surface of the bearing inner diameter and the side surface.

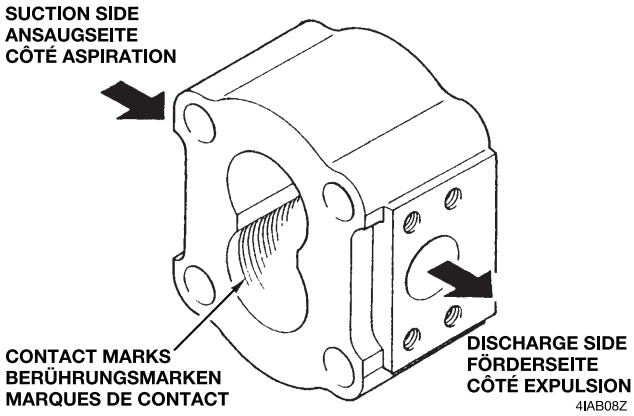
Dirty hydraulic oil is one likely cause of such wear. In such a case, replace the hydraulic oil and flush out the affected hydraulic circuit completely.

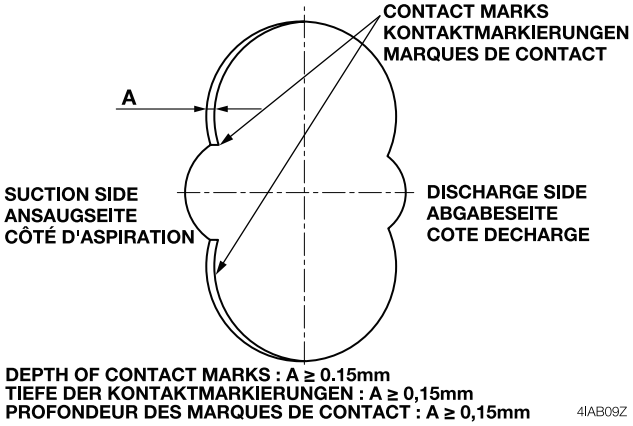
Other likely causes are as follows.

- Excessive load due to damage to the relief valve
- Cavitation or aeration
- Hydraulic oil temperature is too high.
- Hydraulic oil is deteriorated.
- The viscosity of hydraulic oil is low.

If it is necessary to replace the bushings, this means that the gear shaft and gear side surfaces are also rough or worn severely, so replace the gears at the same time as the bushings.

The dimensions for the bushing use limit are shown in the figure on the right.





Gear

Replace a gear if it is in the following condition.

1. The shaft or the gear side surfaces is rough with scratches that easily catch a fingernail.
2. There are cracks in the tooth roots and there is extreme abnormal wear in the tooth surfaces.

The shaft size for the gear use limit is shown in the figure above.

Seals

- Check oil seals for scratches in the seal surface, wear, deformation or deterioration of the rubber's elasticity. If it is abnormal, replace it.
- Replace seals each time the hydraulic pump is disassembled.
- Check the backup ring for scaling and cutting. If it is abnormal, replace it.

Test operation

The best method for testing the pump's operation is to mount it in a test stand. However, if this is not possible, use an actual machine on which the pump to be tested is mounted.

If any abnormal wear is discovered during disassembly, be sure to replace the hydraulic oil and return filter.

1. Install a pressure gauge in the high-pressure piping near the pump.
2. Run the engine at 500 to 1,000 min^{-1} (500 to 1,000 rpm) and set the control valve in the neutral position.
3. Run the pump for 10 minutes under the conditions in 2 above, then increase the engine's speed to 1,500 to 2,000 min^{-1} (1,500 to 2,000 rpm) and then run it for another 10 minutes.
4. Next, run the pump so that it reaches the rated pressure for 5 minutes at a time for each additional 1.96 to 2.94 MPa (284.2 to 426.3 PSI) of pressure.

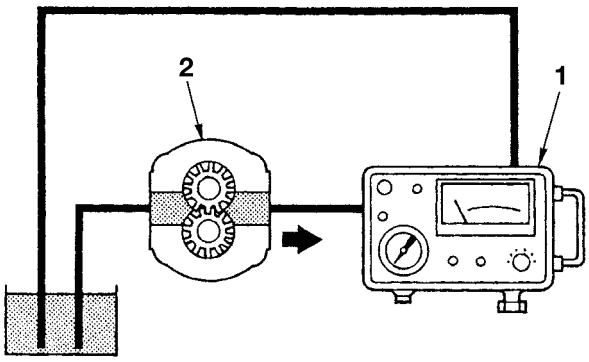
After operating each circuit for about 5 minutes, replace the return filter or clean it.

During the process of raising the pressure, pay careful attention to the oil temperature, the pump's surface temperature and the operating noise. If the oil temperature or the pump's surface temperature becomes abnormally high, eliminate the load from the pump and let the temperature drop before resuming the test.

Measuring the discharge volume

After completing the test operation, measure the discharge volume.

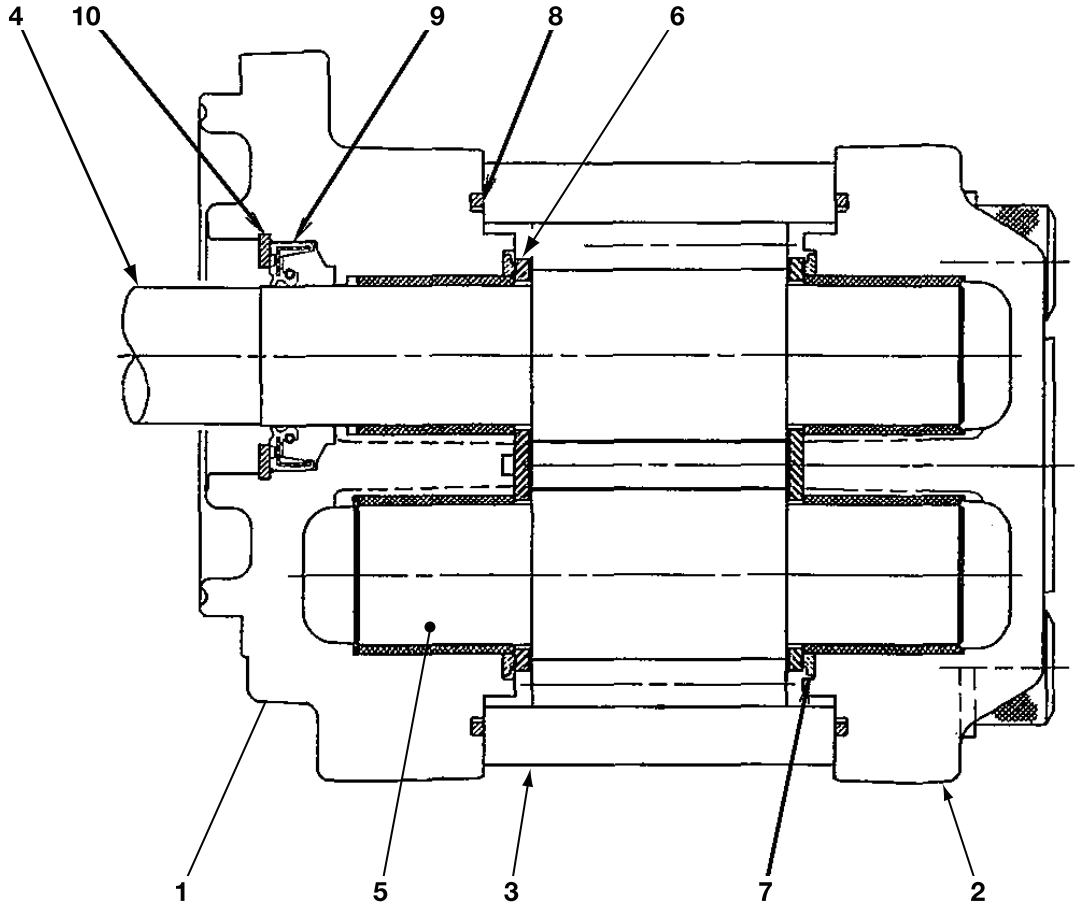
1. Connect a tester (1) to the discharge side of the pump (2).
   - Be sure to connect to the right side.
2. Open the tester's loading valve and start the engine.
3. Run the engine at the rated speed.
4. Gradually close the loading valve and apply the rated pressure to the pump (2).
5. Measure the discharge volume and the pump's rpm (engine speed).



4IAB10Z

GEAR PUMP (HIGH FLOW)

Construction

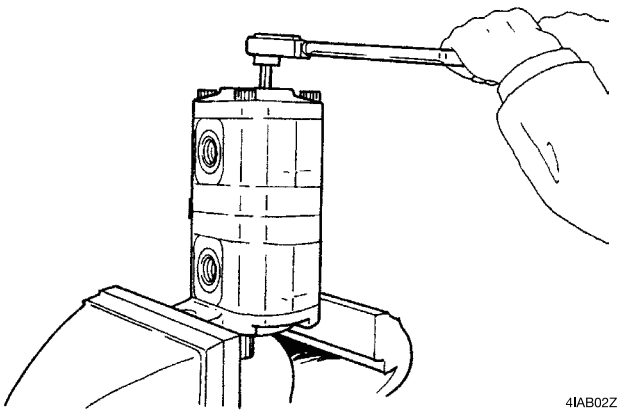


1. Flange
2. Rear cover
3. Housing
4. Drive gear
5. Driven gear
6. Bushing
7. Gasket
8. Gasket
9. Oil seal
10. Snap ring

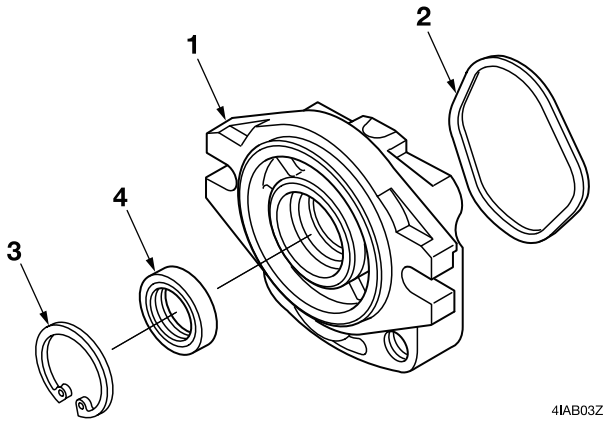
Disassembly

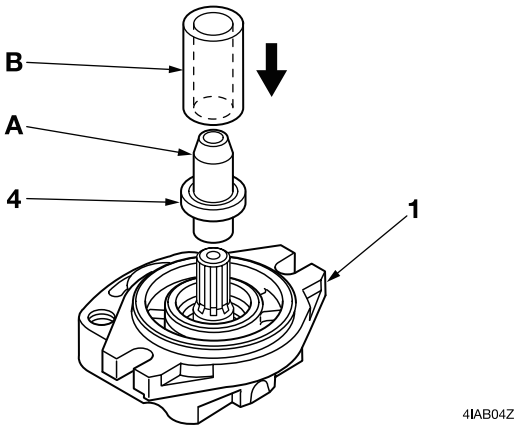
For disassembly of the gear pump, follow the steps below. For assembly, follow the same procedure as for removal in the reverse order.

1. Remove the cap screws
   Cap screw: 88.2 to 93.1 N·m (65.1 to 68.7 ft-lb.)

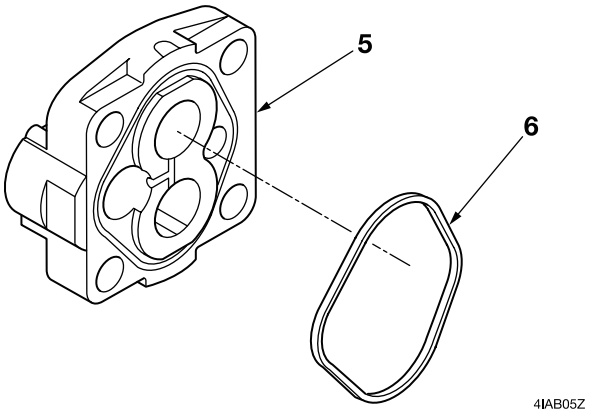


2. Remove the flange (1).
3. Remove the gasket (2) from the flange (1).
4. Remove the snap ring (3) and the oil seal (4) from the flange (1).
   - Be careful not to scratch or otherwise damage the flange.
   - When assembling, install the oil seal using the jigs “A” and “B”.

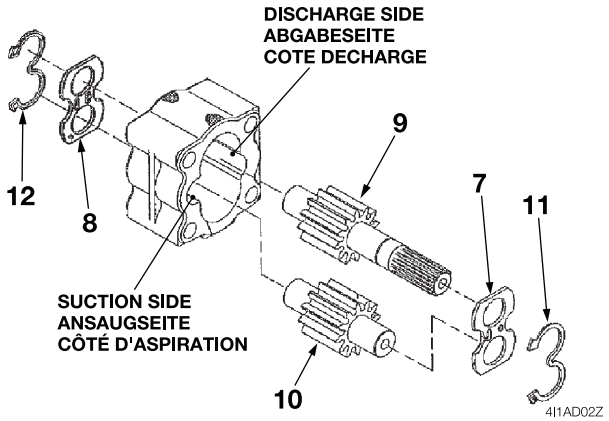


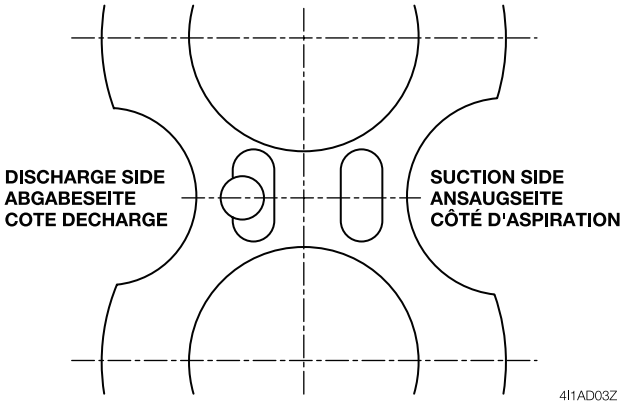


5. Remove the rear cover (5).
6. Remove the gasket (6) from the rear cover (5).



7. Remove the bushing “A” (7), the bushing “B” (8), the drive gear (9) and the driven gear (10) from the housing.
   - Be careful not to mix up the bushings.
   - Be careful not to scratch or otherwise damage the inner part of each housing.
8. Remove the gaskets (11) and (12) from the bushing “A” (7) and the bushing “B” (8).





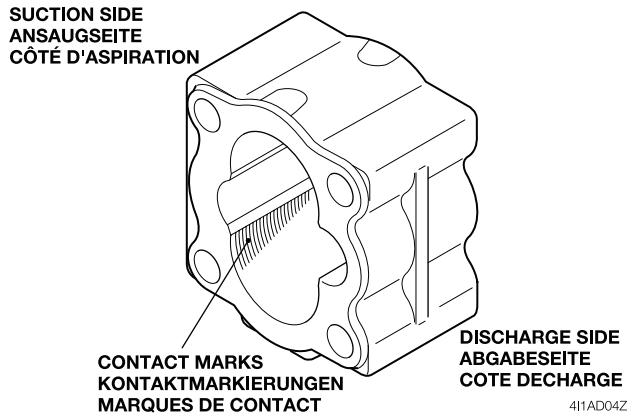
Inspection and adjustment

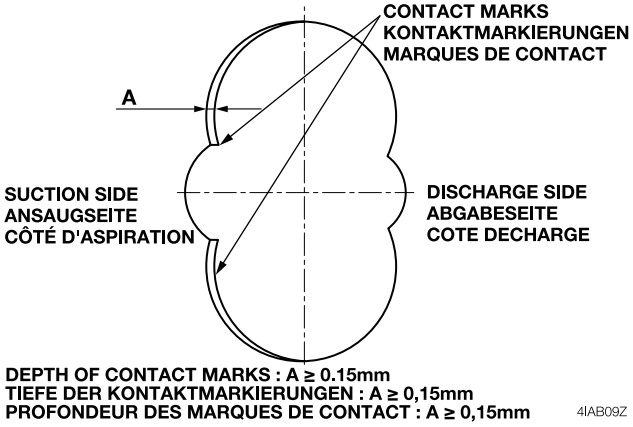
Checking the parts

After checking the disassembled parts for dirt or discoloration, clean them with diesel fuel. However, do not let diesel fuel get on rubber parts. Check each part for the following points and if there is any trouble, repair or replace the part.

Housing

The gear pump is made so that the crests of the gear teeth make light contact with the housing walls as a means of increasing its efficiency. Therefore, contact marks can be seen near the suction port in any pump that has been operated. It is normal if the depth of the contact marks is within 0.1 mm (0.004 in.). If the depth exceeds the usage limit in the above figure, replace the pump assembly.





Bushing

The ideal situation is for the sliding surfaces to have no roughness and for the suction side half to be lustrous. Also, it is satisfactory if strong contact marks can be seen on the side surface on the suction side and minute contact marks can be seen on the discharge side.

Replace the bushing if it is in the following condition.

- Contact marks can be seen on the sliding surface of the entire bearing inner diameter and it is rough with scratches that easily catch a fingernail.
- There are many scratches around the circumference of the side surface and it is rough with scratches that easily catch a fingernail.
- There are marks due to trapping of foreign matter on the sliding surface of the bearing inner diameter and the side surface.

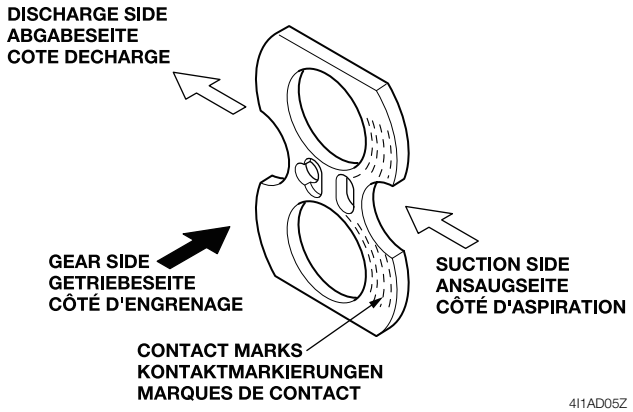
Dirty hydraulic oil is one likely cause of such wear. In such a case, replace the hydraulic oil and flush out the affected hydraulic circuit completely.

Other likely causes are as follows.

- Excessive load due to damage to the relief valve
- Cavitation or aeration
- Hydraulic oil temperature is too high.
- Hydraulic oil is deteriorated.
- The viscosity of hydraulic oil is low.

If it is necessary to replace the bushings, this means that the gear shaft and gear side surfaces are also rough or worn severely, so replace the gears at the same time as the bushings.

The dimensions for the bushing use limit are shown in the figure on the right.



Gear

Replace a gear if it is in the following condition.

1. The shaft or the gear side surfaces is rough with scratches that easily catch a fingernail.
2. There are cracks in the tooth roots and there is extreme abnormal wear in the tooth surfaces.

The shaft size for the gear use limit is shown in the figure above.

Seals

- Check oil seals for scratches in the seal surface, wear, deformation or deterioration of the rubber's elasticity. If it is abnormal, replace it.
- Replace seals each time the hydraulic pump is disassembled.
- Check the backup ring for scaling and cutting. If it is abnormal, replace it.

Test operation

The best method for testing the pump's operation is to mount it in a test stand. However, if this is not possible, use an actual machine on which the pump to be tested is mounted.

If any abnormal wear is discovered during disassembly, be sure to replace the hydraulic oil and return filter.

1. Install a pressure gauge in the high-pressure piping near the pump.
2. Run the engine at 500 to 1,000 min^{-1} (500 to 1,000 rpm) and set the control valve in the neutral position.
3. Run the pump for 10 minutes under the conditions in 2 above, then increase the engine's speed to 1,500 to 2,000 min^{-1} (1,500 to 2,000 rpm) and then run it for another 10 minutes.
4. Next, run the pump so that it reaches the rated pressure for 5 minutes at a time for each additional 1.96 to 2.94 MPa (284.2 to 426.3 PSI) of pressure.

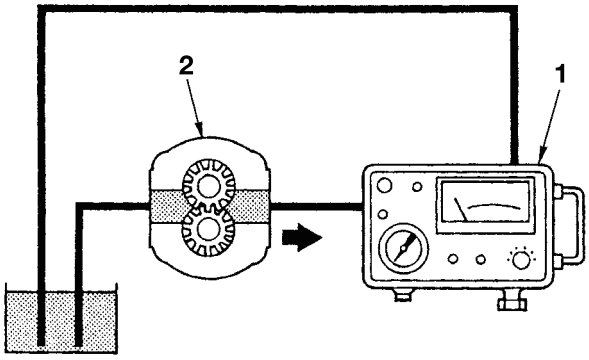
After operating each circuit for about 5 minutes, replace the return filter or clean it.

During the process of raising the pressure, pay careful attention to the oil temperature, the pump's surface temperature and the operating noise. If the oil temperature or the pump's surface temperature becomes abnormally high, eliminate the load from the pump and let the temperature drop before resuming the test.

Measuring the discharge volume

After completing the test operation, measure the discharge volume.

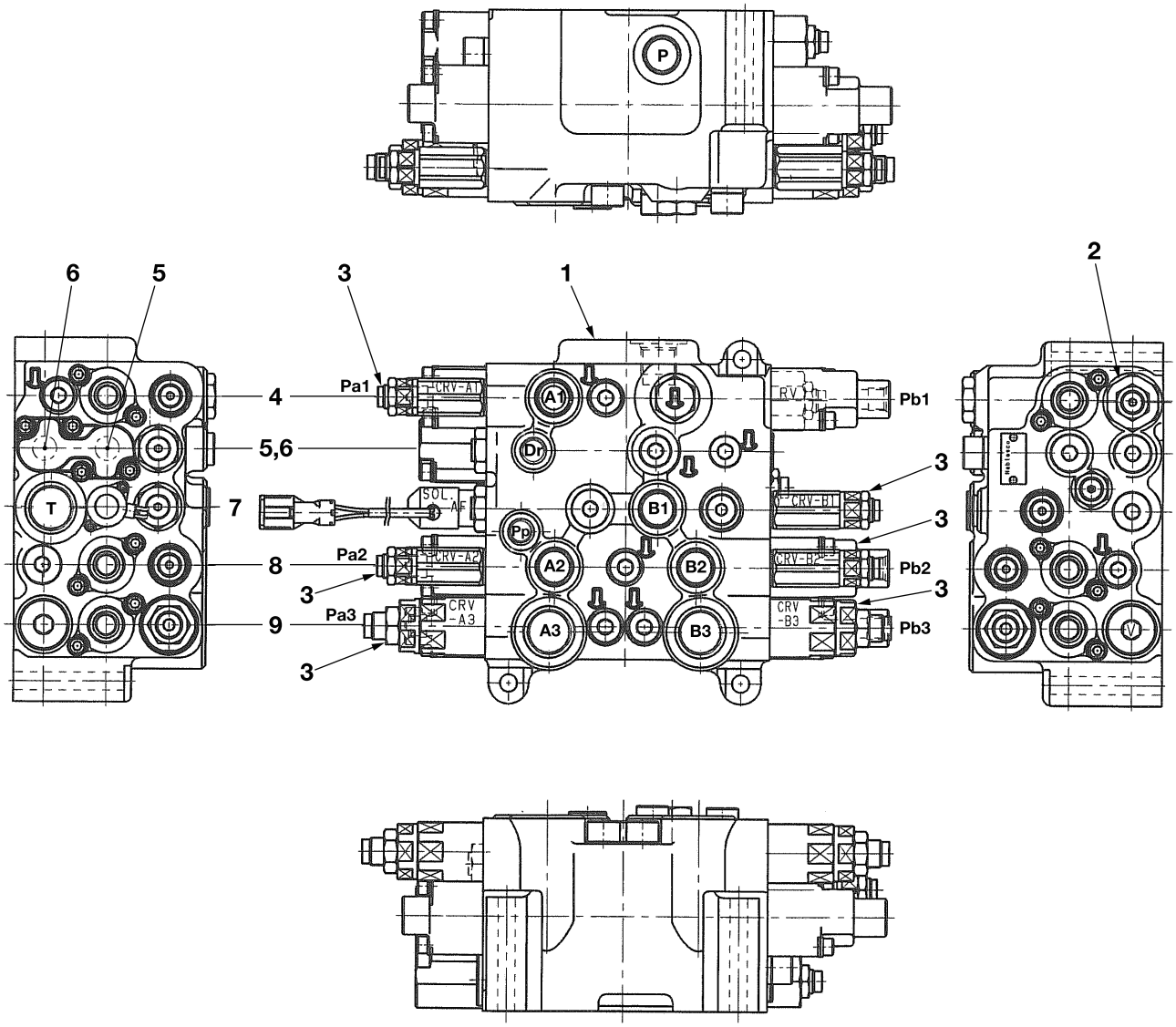
1. Connect a tester (1) to the discharge side of the pump (2).
   - Be sure to connect to the right side.
2. Open the tester's loading valve and start the engine.
3. Run the engine at the rated speed.
4. Gradually close the loading valve and apply the rated pressure to the pump (2).
5. Measure the discharge volume and the pump's rpm (engine speed).



4IAB10Z

CONTROL VALVE

Construction



4J0AD01Z

1. Housing
2. Main relief valve
3. Port relief valve
4. Lift arm section
5. Divider section
6. Sequence section
7. Arm float section
8. Bucket section
9. Auxiliary circuit section

Disassembly and assembly

General precautions

The numbers in parentheses, (), listed after the names of parts throughout this document do not correspond to the same parts as the numbers listed in the construction diagram or parts lists.

- Perform disassembly and assembly work in a clean place. Provide clean containers to store parts in during disassembly.
- Clean around the ports before disassembly. Remove paint around connectors with a wire brush.
- Clean the disassembled parts with wash oil.
- Put alignment marks on all parts to ensure that they are reassembled in the same positions.
- After each disassembly procedure, replace all seals and apply a thin layer of grease to each.
- Check each part for abnormal wear or seizing. Remove any burrs with sandpaper.
- Remove adhesive from screw holes that use the adhesive through the tap. Do not reuse mounting bolts or screws.
- Do not use cloth gloves during assembly. Fibers from the gloves could shed or fall off and clog valves, etc., which could cause parts to become faulty.
- During assembly, be sure to apply clean hydraulic oil to all moving parts in and sliding parts that come into contact with the hydraulic motor and valve parts before installing or attaching the part.
- Plug all ports once assembly has been completed in order to prevent dust and dirt from entering.

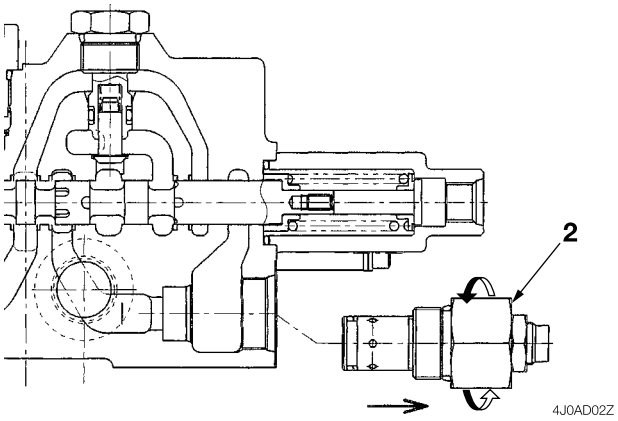
Disassembly

Main relief valve

Remove the main relief valve (2) and then remove the O-rings from the relief valve.

- Do not disassemble unless absolutely necessary. The pressure set for the valve will change if the lock nut is loosened and the set screw is turned.

Main relief valve: 58.8 N·m to 68.6 N·m (43.4 ft.-lb to 50.6 ft.-lb)



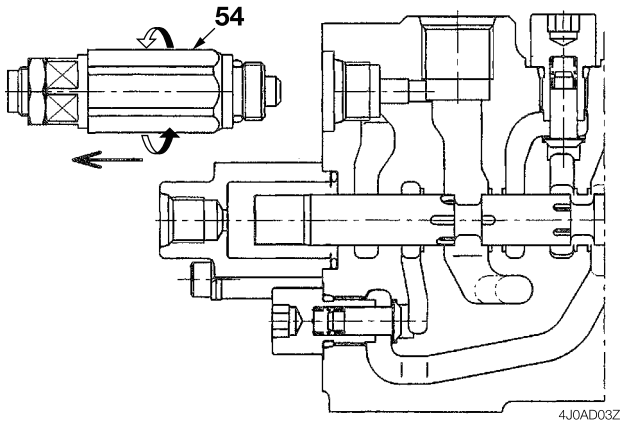
Port relief valve

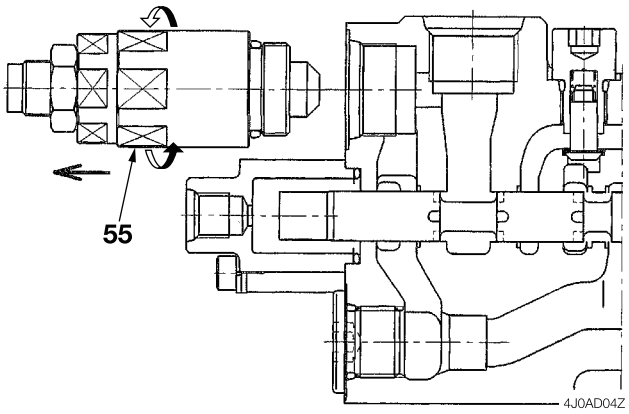
Remove the port relief valves (54) and (55) and then remove the O-rings from the relief valves.

- Be careful not to loosen the lock nut. The pressure set for the valve will change if the lock nut is loosened and the set screw is turned.
- Do not attempt to further disassemble the port relief valve as it cannot be reassembled once disassembled.

Port relief valve (54): 39.2 N·m (28.9 ft.-lb)

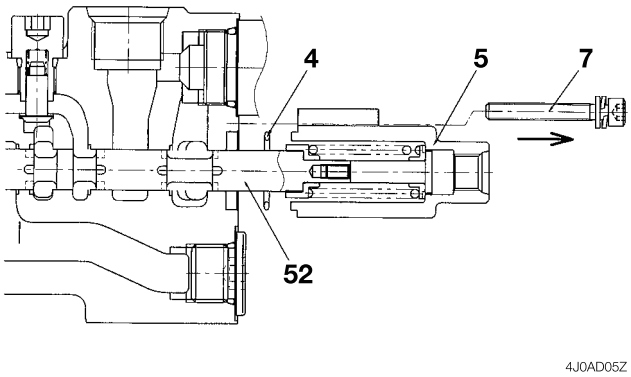
Port relief valve (55): 58.8 N·m to 68.6 N·m (43.4 ft.-lb to 50.6 ft.-lb)





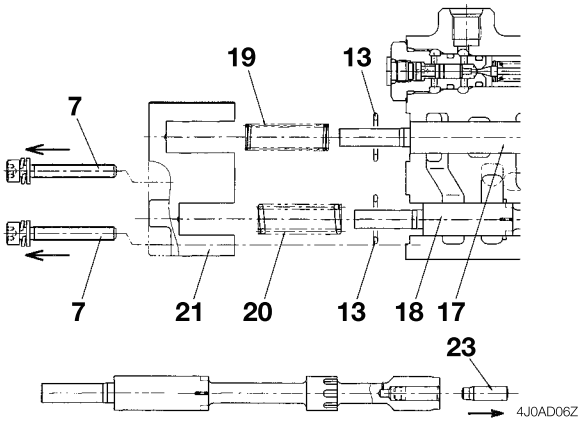
Spool (Arm, bucket, and service sections)

1. Remove the cap screws (7) and the cover (5) and then remove the O-ring (4) from the cover (5).
   - Cap screws: 24.5 N·m to 29.4 N·m (18.1 ft.-lb to 21.7 ft.-lb)
2. Remove the spool assembly from the housing.
   - There is a proper direction for spool insertion. When assembling, do not insert the spool in the wrong direction.



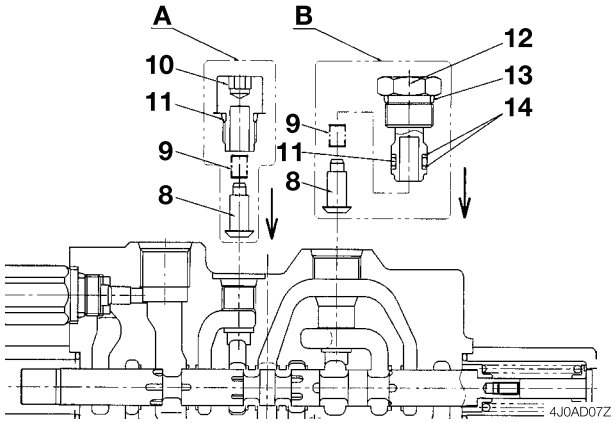
Spool (Divider and sequence sections)

1. Remove the cap screws (7) and the cover (21) and then remove the springs (19) and (20) from the cover (21).
   - When assembling, take care not to mix up the springs (19 and 20). The spring (20) used for the sequence spool is thicker and stronger than the other.
   - Cap screws: 24.5 N·m to 29.4 N·m (18.1 ft.-lb to 21.7 ft.-lb)
2. Remove the O-rings (13) from the housing.
3. Remove the divider spool (17) from the housing.
   - There is a proper direction for spool insertion. When assembling, do not insert the spool in the wrong direction.
4. Remove the sequence spool assembly (18) from the housing.
   - Do not allow the piston (23) located at the spool end to fall.
   - When assembling, install the piston (23) such that the spherical surface is facing the plug.
5. Tilt the spool assembly (18) to remove the piston (23).



Load check valve (A)

1. Take out the plug (10), and remove the O-ring (11) from the plug (10).
2. Remove the spring (9) and the check valve (8).
   - When assembling, make sure that the check valve is straight when set.



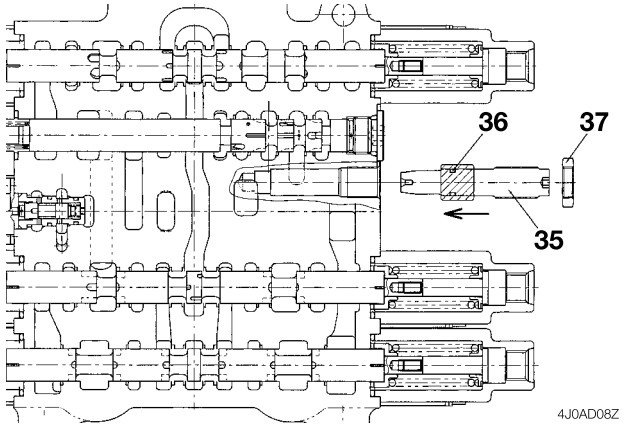
Load check valve (B)

1. Take out the plug (12), and remove the O-rings (13) and (11) and the backup rings (14) from the plug (12).
2. Remove the spring (9) and the check valve (8).
   - When assembling, make sure that the check valve is straight when set.

Flow ratio adjuster valve

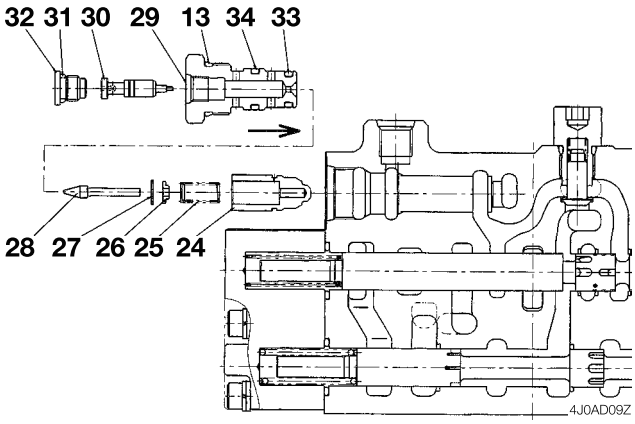
1. Loosen the lock nut (37), and remove the adjuster (35).
2. Remove the O-ring (36) from the adjuster (35).
   - When assembling, grease the diagonally shaded area in the diagram.
   - After assembly and when the flow ratio adjustment is complete, tighten the lock nut to the specified torque.

   ☞ “Adjusting the flow ratio”



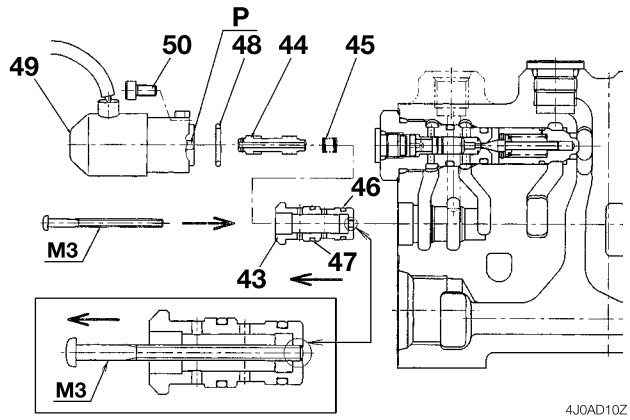
Arm float valve

1. Take out the plug (32), and remove the O-ring (31) from the plug (32).
2. Remove the piston (30).
3. Take out the plug (29), and remove the O-rings (13), (34), and (33).
4. Remove the needle valve (28) and the check valve (24).
5. Remove the snap ring (27) from the check valve (24), and remove the spring seat (26) and spring (25).



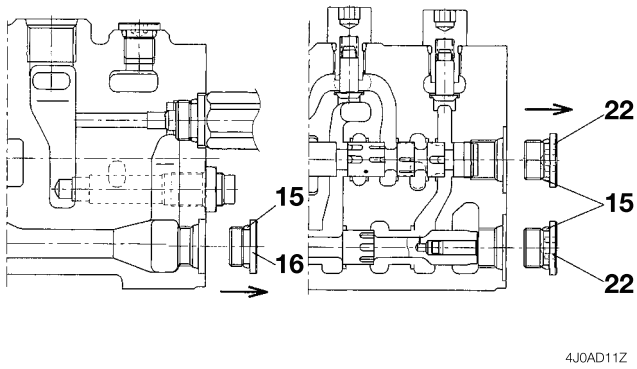
Arm float solenoid valve

1. Take out the bolts (50), and remove the solenoid (49).
   - Do not allow the push pin (P) to fall.
   - If the solenoid is faulty, replace the assembly containing the solenoid.
2. Remove the spool (44) and the spring (45) of the pilot valve.
3. Screw an M3 bolt into the threaded portion of the pilot valve sleeve (43) and then remove the O-ring (48) and the sleeve (43).
   - M3 bolt: 45 mm (1.8 in.) in length
   - If the pilot valve is faulty, replace the assembly containing the pilot valve.
4. Remove the O-rings (46) and (47) from the sleeve (43).



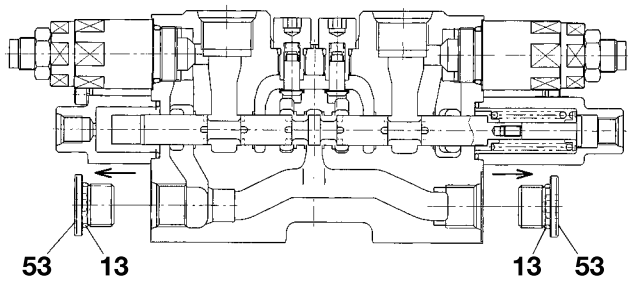
Plug (G3/8)

1. Take out the plugs (16) and (22), and remove the O-rings (15) from the plugs (16) and (22).
   - When assembling, take care not to mix up the plugs (16 and 22).
     Plug (16): 12 mm (0.5 in.) in length
     Plug (22): 14 mm (0.6 in.) in length



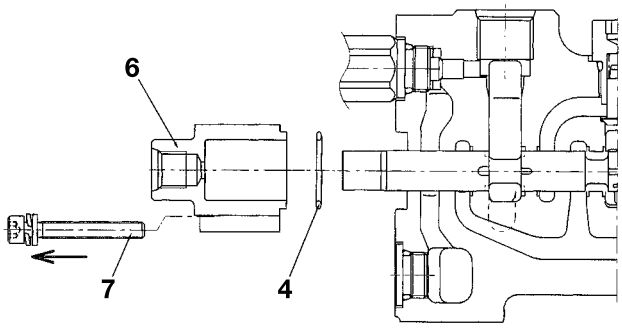
Plug (G1/2)

1. Take out the plug (53), and remove the O-ring (13) from the plug (53).



Cover (Arm, bucket, and service sections)

1. Remove the cap screw (7), and remove the cover (6).
2. Remove the O-ring (4) from the housing.



Inspection and adjustment

Adjusting the flow ratio

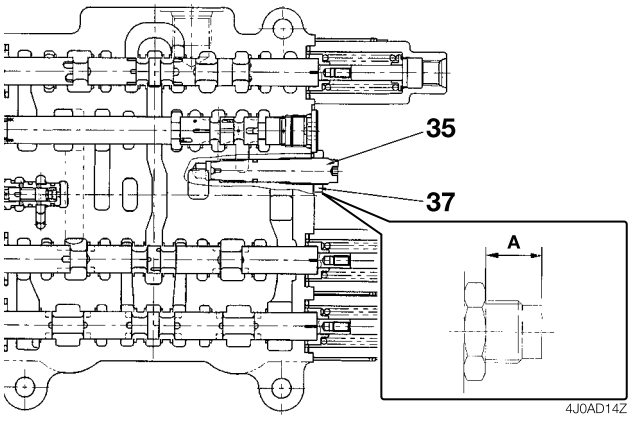
⚠ WARNING

- Make sure that the bucket is not tilted forward (dump mode). Tilting the bucket forward can be dangerous as it could cause the load to fall especially when a pallet fork is installed.
- When loosening the adjuster (35), do not turn it more than five turns from the start (fully tightened position). Otherwise, it could drop, which could create a dangerous situation. Once the adjuster (35) is turned five turns, its head will protrude from the lock nut (37) by about 13 mm (0.5 in.). Do not loosen it any further than this.

If the bucket is tilted forward (dump mode) or backward (crowding mode) when the lift arm is operated after replacement of the attachment, make fine adjustments to change the position.
Default settings set at the factory are set such that 59% to 66% of the return oil from the arm rod is supplied to the bucket head.
Note that the accuracy of the leveling mechanism is dependent on the engine speed, types of attachments in use, load, and hydraulic oil temperature. After each adjustment, make sure the bucket remains level under various conditions such as at different engine speeds (idle to top speed), with the bucket/pallet fork attached, with no load or the rated load set, and at different temperatures (low to high). In particular, be careful not to let the bucket tilt forward (dump mode).

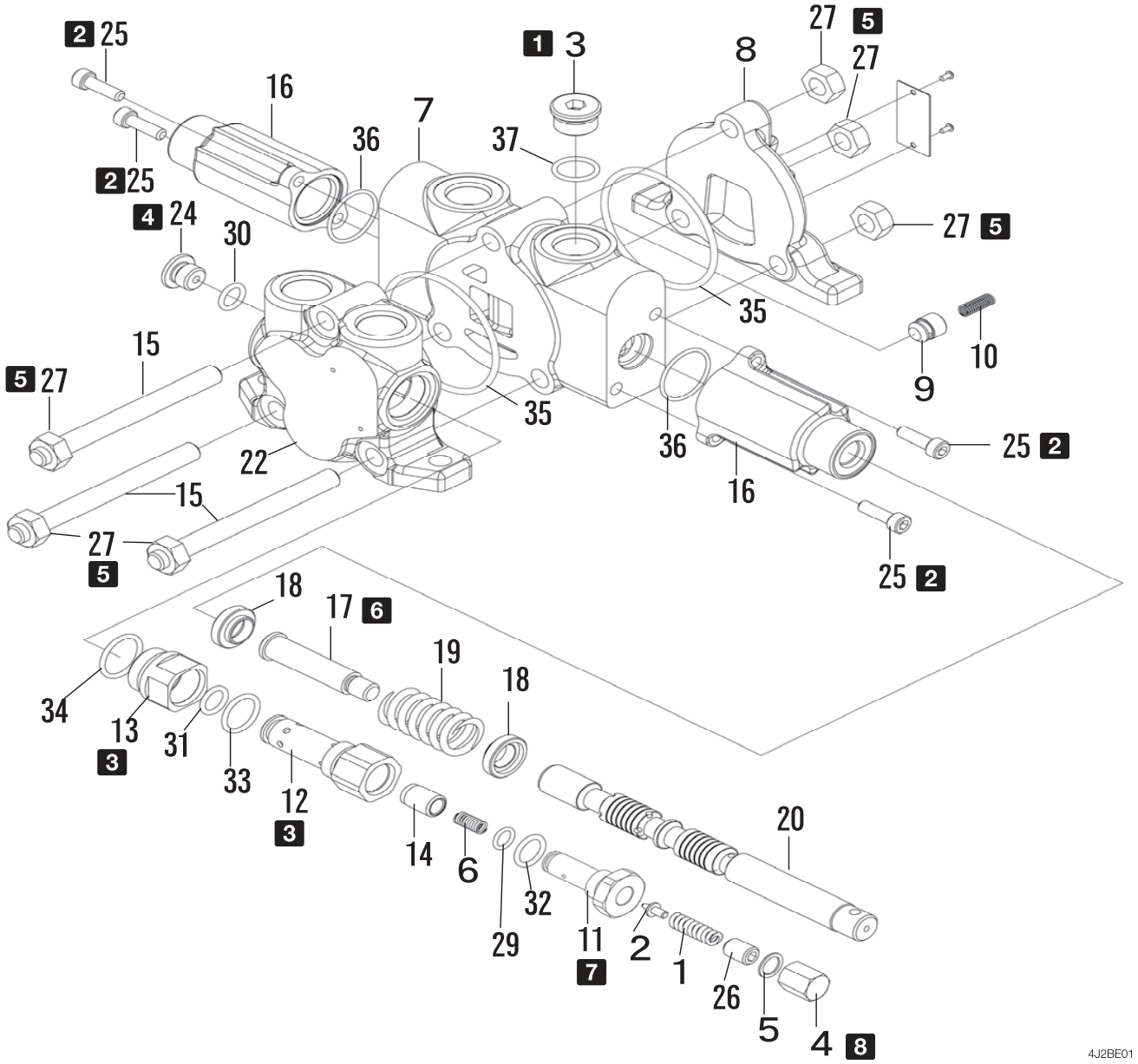
Adjustment procedure

1. Loosen the lock nut (37) of the adjuster (35).
2. After the arm-out operation is completed:
   a. If the bucket is tilted forward, tighten the adjuster (35) by turning it clockwise.
   b. If the bucket is tilted backward, loosen the adjuster (35) by turning it counterclockwise.
   When turning the adjuster, do not turn it all the way at once; turn it about 30° at a time.
   - Turn amount A: 13 mm (0.5 in.) or less or five turns
3. Tighten the lock nut (37) to secure the adjuster (35) in place.
   Lock nut (37): 19.6 N·m (14.5 ft.-lb)
4. Raise the lift arm to check to see if the bucket is level.



CONTROL VALVE (HIGH FLOW)

Construction



1 : 59.5 ± 6.0 N·m (43.9 ± 4.4 ft.-lb.)
2 : 10.8 ± 1.1 N·m (8 ± 0.8 ft.-lb.)
3 : 65.0 ± 6.5 N·m (47.9 ± 4.8 ft.-lb.)
4 : 26.5 ± 2.7 N·m (19.5 ± 2.0 ft.-lb.)
5 : 39.2 ± 3.9 N·m (28.9 ± 2.9 ft.-lb.)
6 : 4.9 ± 0.5 N·m (3.6 ± 0.4 ft.-lb.),
: Apply Loctite #243 to the screw threads
7 : 43.0 ± 4.3 N·m (31.7 ± 3.2 ft.-lb.)
8 : 18.6 ± 1.9 N·m (13.7 ± 1.4 ft.-lb.)

1. Spring
2. Needle valve
3. Plug
4. Nut
5. Gasket
6. Spring
7. Housing
8. Housing
9. Plunger
10. Spring
11. Housing
12. Sleeve
13. Sleeve
14. Poppet
15. Tie rod
16. Cover
17. Spool end
18. Spring holder
19. Spring
20. Spool
22. Housing
24. Plug
25. Cap screw
26. Set screw
27. Nut
29. O-ring
31. O-ring
32. O-ring
33. O-ring
34. O-ring
35. O-ring
36. O-ring
37. O-ring

Disassembly and assembly

General precautions

The numbers in parentheses, ( ), listed after the names of parts throughout this document are used to refer to the same parts as the numbers listed in the construction diagram and parts lists.

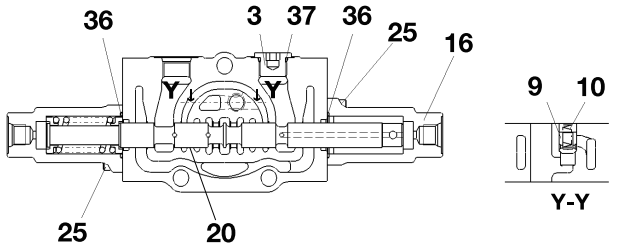
- Perform disassembly and assembly work in a clean place. Provide clean containers to hold parts during disassembly.
- Before disassembly, clean around the ports and remove coating or thread-locking compound on the joints with a wire brush.
- Clean disassembled parts with dedicated cleaning oil.
- Put alignment marks on all parts to ensure that they are reassembled in the same positions.
- Apply hydraulic oil on the sliding surfaces and thin layer of grease on the seals before assembly.
- Replace seals with new ones after each disassembly.
- Check each part for abnormal wear or seizing. Remove any burrs with sandpaper.
- Do not attempt to adjust the adjusting screws at times other than when necessary.

Disassembly

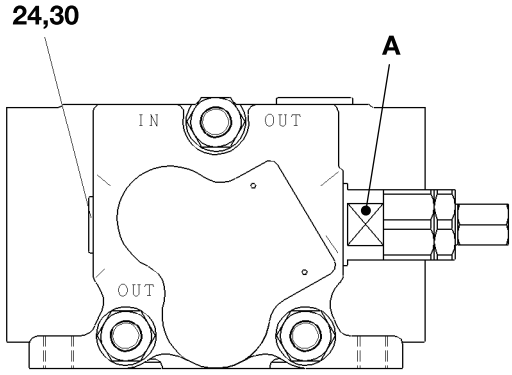
Valve assembly

1. Take out the plug (3), and remove the O-ring (37) from the plug (3).
   : 59.5 ± 6.0 N·m (43.9 ± 4.4 ft.-lb.)
2. Take out the cap screw (25) and then remove the cover (16) and O-ring (36).
   : 10.8 ± 1.1 N·m (8 ± 0.8 ft.-lb.)
3. Pull out the spool (20).
   - When removing a spool, pull it straight out so as not to dent, scratch, or otherwise damage it or any other surrounding parts.
4. Remove the main relief valve.
   - Slip a wrench onto part A on the main relief valve to loosen the part.

   : 65.0 ± 6.5 N·m (47.9 ± 4.8 ft.-lb.)
5. Take out the plug (24), and remove the O-ring (30) from the plug (24).
   : 26.5 ± 2.7 N·m (19.5 ± 2.0 ft.-lb.)

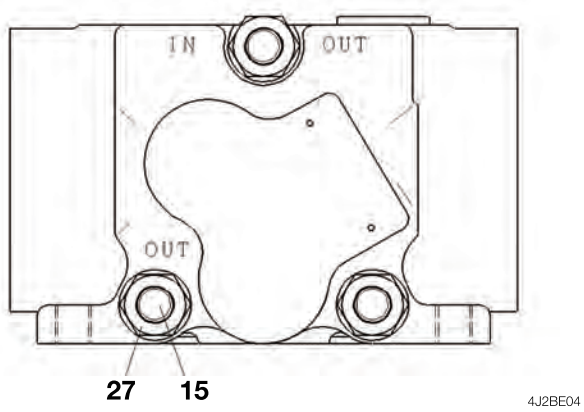


4J2BE02



4J2BE03

6. Take out the nuts (27) and then remove the tie rod (15).
   5 : 39.2 ± 3.9 N·m (28.9 ± 2.9 ft.-lb.)

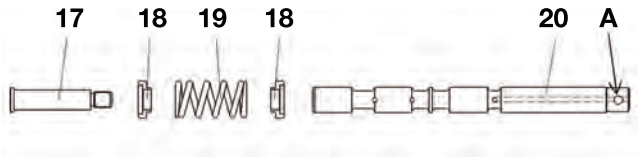


4J2BE04

Spool assembly

1. Remove the spool end (17), and take out the spring holder (18) and spring (19).
   - Insert a pin into hole A and turn it to lock the spool in place and then loosen the spool end (17). Be careful not to damage the sliding surfaces.

   : 4.9 ± 0.5 N·m (3.6 ± 0.4 ft.-lb.),
   : Apply Loctite #243 to the screw threads



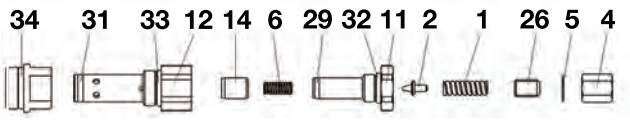
4J2BE05

Relief valve

Do not attempt to disassemble the valve unless it is absolutely necessary to do so. After disassembling or reassembling the valve, make sure to adjust the pressure.

1. Remove the O-ring (34).
2. Take out the sleeve (12), and remove the O-rings (31) and (33).
3. Take out the housing (11), and remove the O-rings (29) and (32).
   : 43.0 ± 4.3 N·m (31.7 ± 3.2 ft.-lb.)
4. Take out the spring (6) and poppet (14).
5. Take out the nut (4) and then remove the gasket (5), set screw (26), spring (1), and needle valve (2).
   - Make sure to replace the gasket (5) with a brand new part when disassembling or reassembling the parts.
   - Make sure to adjust the pressure after disassembling or reassembling the parts.

   : 18.6 ± 1.9 N·m (13.7 ± 1.4 ft.-lb.)



4J2BE06

Assembly

To assemble the parts, perform the same general steps as for disassembly but in the reverse order.

Inspection and adjustments

Checking the parts

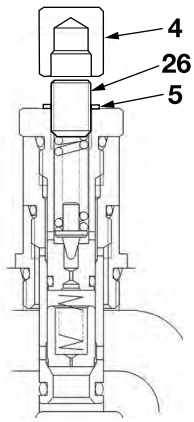
Part	Criteria	Action
Housing	• If there are scratches, rust, or corrosion present on the parts that make sliding contact with the spool	• Replace
	• If there are scratches, rust, or corrosion present on the seal pockets of sections into which the spool enters	• Replace
	• If there are scratches, rust, or corrosion of the seal part of the port in contact with the O-ring	• Replace
	• If there are scratches, rust, or corrosion in the seal part of the relief valve, etc.	• Replace
	• If there is other damage present that is thought to impair normal operation of the machine	• Replace
Spool	• If there is scratching on the outer sliding surfaces that are rough enough to be caught on a fingernail	• Replace
	• If there is scratching on sliding surfaces on the end seals	• Replace
	• If the spool does not move smoothly enough	• Repair or replace
Spring and related parts, sections	• If there is noticeable rust, corrosion, deformation, or breakage of the springs, holder, or cover	• Replace
Spool seals and related parts, sections	• If there is leakage to external	• Repair or replace
	• If there is rust, corrosion, or deformation in the seal holder	• Repair or replace
Main relief valve	• If there is rust or damage on the external surfaces of the parts	• Replace
	• If there is damage on surfaces that make contact with the valve seating	• Replace
	• If there is damage on surfaces that make contact with the needle valve	• Replace
	• If the spring is damaged or otherwise abnormal	• Replace
	• For O-rings and seals	• Replace after disassembly as a general rule

Adjusting the main relief valve pressure

Do not attempt to adjust the pressure unless there are problems occurring as doing so would cause the setting value to change.

Make sure to replace the gasket (5) with a brand new part whenever disassembling the parts or making adjustments.

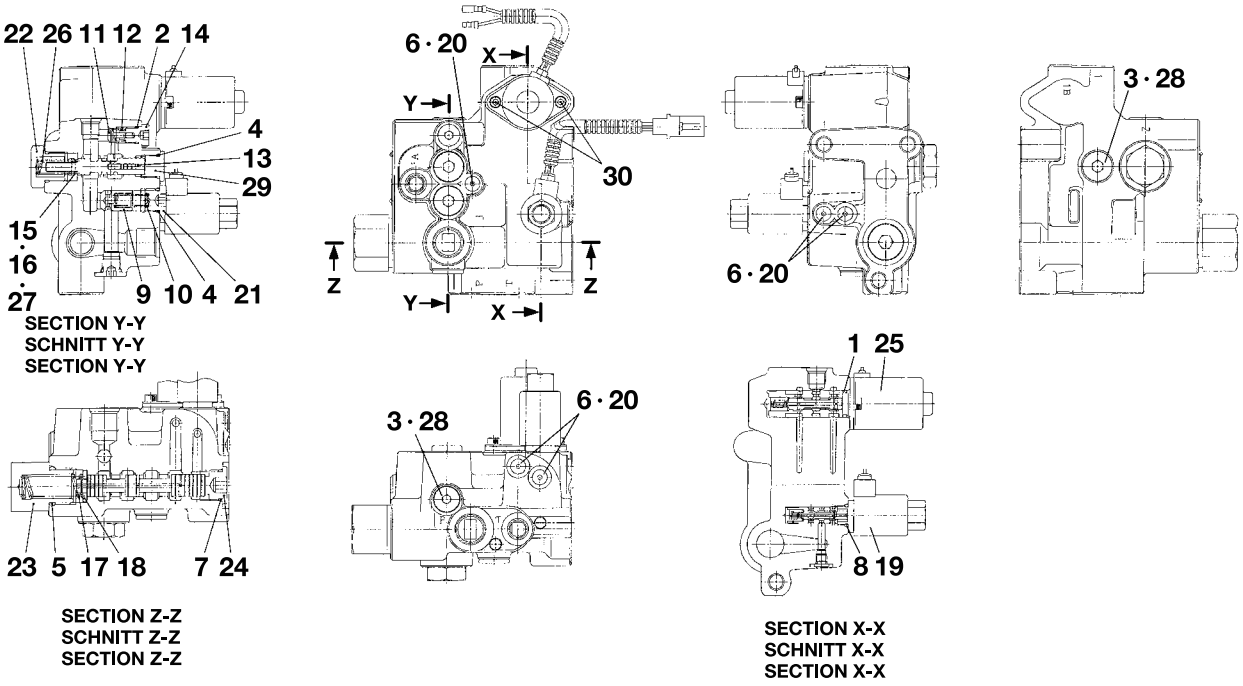
1. Loosen the nut (4), and turn the setscrew (26) to adjust the set pressure.
   - Turn the setscrew clockwise to increase the set pressure.
   - Turn the setscrew counterclockwise to decrease the set pressure.
2. In order to keep the setscrew (26) from turning after the pressure has been adjusted, tighten the nut (4) while holding the setscrew (1) firmly in place.
3. Operate the relief valve once more to confirm that the pressure that has been set has stabilized.



4J2BE07

SUB VALVE

Construction



4KAA01Z

1. O-ring	11. Plunger	21. Plug
2. O-ring	12. Spring	22. Plug
3. O-ring	13. Piston	23. Plug
4. O-ring	14. Plug	24. Plug
5. O-ring	15. Shim	25. Solenoid B
6. O-ring	16. Shim	26. Spring
7. O-ring	17. Spring	27. Shim
8. O-ring	18. Washer	28. Plug
9. Poppet	19. Solenoid A	29. Plug
10. Spring	20. Plug	30. Cap screw

Disassembly and assembly

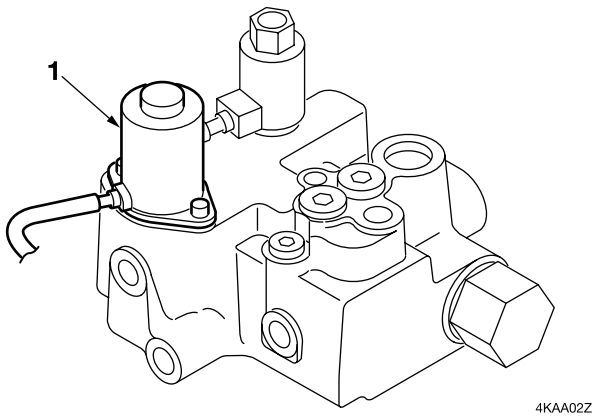
General precautions

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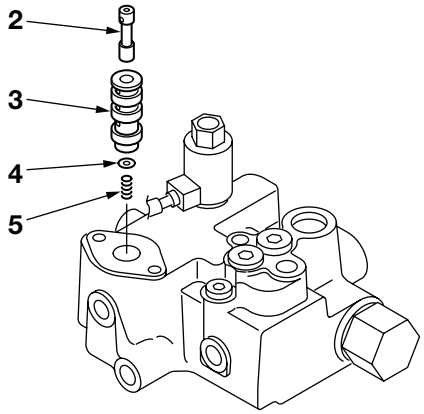
- Perform disassembly and assembly work in a clean place. Provide clean containers to store parts in during disassembly.
- Clean around the ports before disassembly. Remove paint around connectors with a wire brush.
- Clean the disassembled parts with wash oil.
- Put alignment marks on all parts to ensure that they are reassembled in the same positions.
- After each disassembly procedure, replace all seals and apply a thin layer of grease to each.
- Check each part for abnormal wear or seizing. Remove any burrs with sandpaper.
- Remove adhesive from screw holes that use the adhesive through the tap. Do not reuse mounting bolts or screws.
- Do not use cloth gloves during assembly. Fibers from the gloves could fall off and clog valves, etc., which could cause parts to become faulty.
- During assembly, be sure to apply clean hydraulic oil to all moving parts in and sliding parts that come into contact with the hydraulic motor and valve parts before installing or attaching the part.
- Plug all ports once assembly has been completed in order to prevent dust and dirt from entering.

Disassembly

1. Remove the solenoid valve B.
   a. Take out the cap screws, and remove the solenoid (1).
      Cap screw: 3.92 N·m (2.9 ft.-lb)
      - Take care not to allow the push rod to fall from the solenoid.
   b. Remove the O-ring from the solenoid (1).

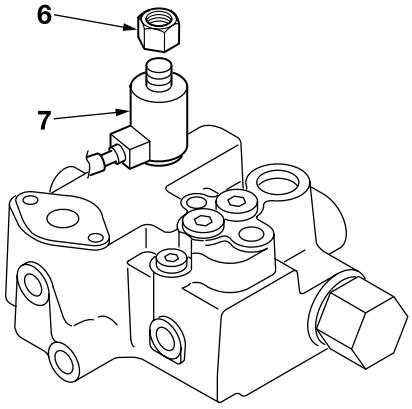


c. Remove the spool (2), the sleeve (3), the washer (4), and the spring (5).



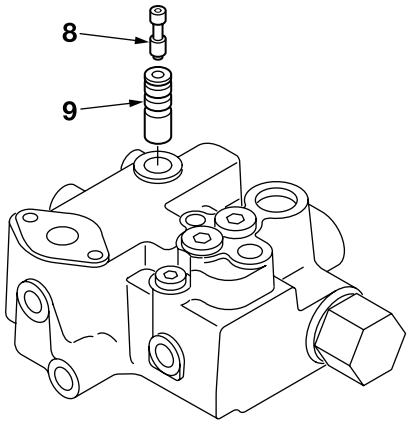
4KAA03Z

2. Remove the solenoid valve A.
   a. Take out the nut (6) and then remove the solenoid (7).
      Solenoid: 37.3 N·m (27.5 ft.-lb)
      • Take care not to allow the push rod to fall from the solenoid.
      Solenoid: 29.4 N·m (21.7 ft.-lb)
   b. Remove the O-ring from the solenoid (7).



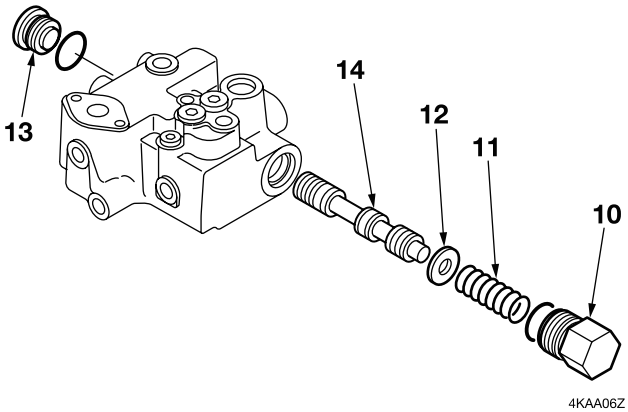
4KAA04Z

c. Remove the spool (8) and the sleeve (9).



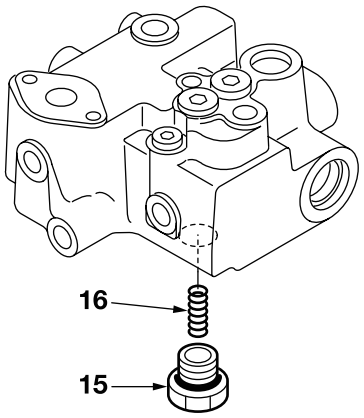
4KAA05Z

3. Take out the plug (10), and remove the O-ring from the plug (10).
   Plug: 98 N·m (72.3 ft.-lb)
4. Remove the spring (11) and the washer (12).
5. Take out the plug (13), and remove the O-ring from the plug (13).
   Plug: 76 N·m (56.1 ft.-lb)
6. Remove the spool (14).



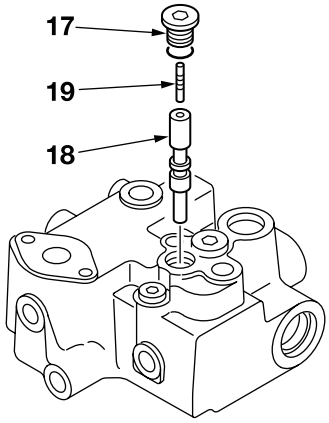
4KAA06Z

7. Take out the plug (15), and remove the O-ring from the plug (15).
   Plug: 76 N·m (56.1 ft.-lb)
8. Remove the spring (16).



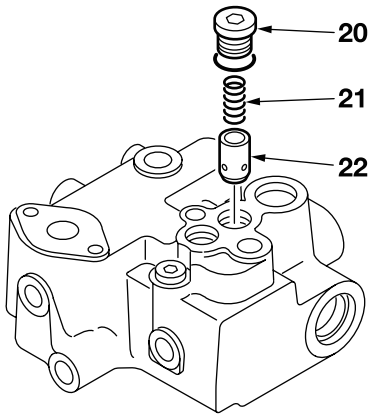
4KAA07Z

9. Take out the plug (17), and remove the O-ring from the plug (17).
   Plug: 49 N·m (36.1 ft.-lb)
10. Remove the spool (18).
11. Remove the piston (19) from the spool (18).



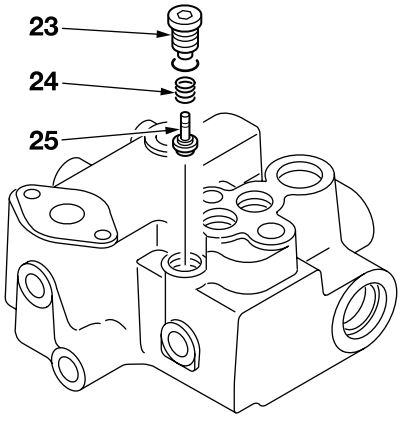
4KAA08Z

12. Take out the plug (20), and remove the O-ring from the plug (20).
    Plug: 49 N·m (36.1 ft.-lb)
13. Remove the spring (21) and the poppet (22).



4KAA09Z

14. Take out the plug (23), and remove the O-ring from the plug (23).
    Plug: 21 N·m (15.5 ft.-lb)
15. Remove the spring (24) and the plunger (25).



4KAA10Z

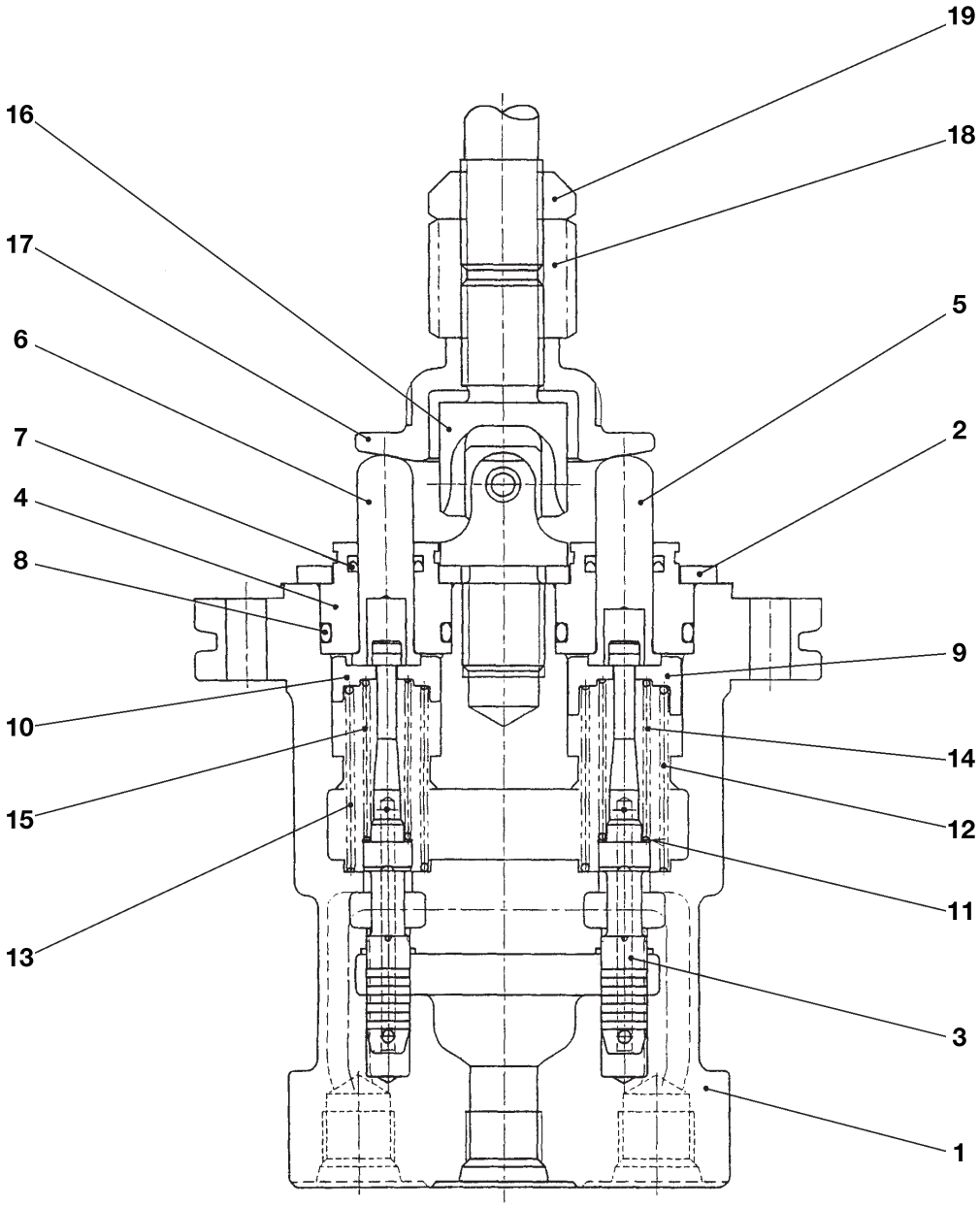
Inspection and adjustment

Checking the parts

Part	Criteria	Action
Coil assembly	• The solenoid is burned, short-circuited, or has a wire break	• Replace
	• There is a short-circuit or break in the wiring	• Replace
Body	• There are scratches, rust, or corrosion on the parts that come into sliding contact with the spool	• Replace
	• There are scratches, rust, or corrosion on the seal part that comes into contact with the O-ring	• Replace
	• There is other damage that may hinder or impair normal function	• Replace
Spool, plunger	• There are scratches on the outer circumference that could easily become caught on a fingernail	• Replace
	• The movement is not smooth	• Repair or replace
Spring	• There is rust, corrosion, deformation, breakage, or other notable damage	• Replace
O-ring	—	• Replace

PILOT VALVE

Construction



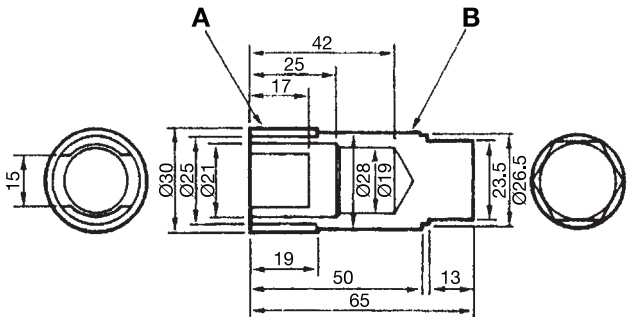
1. Casing
2. Plate
3. Spool
4. Plug
5. Push rod
6. Push rod
7. Seal
8. O-ring
9. Spring seat
10. Spring seat
11. Washer 2
12. Spring
13. Spring
14. Spring
15. Spring
16. Joint
17. Cam
18. Adjusting nut
19. Lock nut

Special tools

Unit in diagrams: mm

Installation jig A

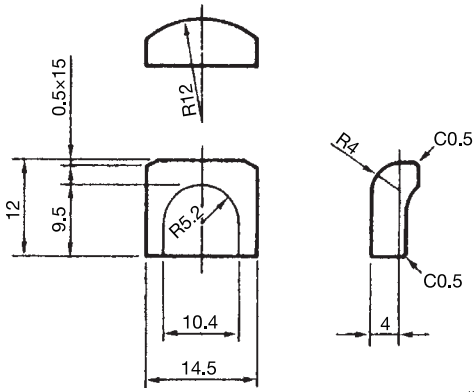
Quantity: 1
Material A: S45C
Material B: SCM415N (Carburized and hardened)



4K2AD02Z

Installation jig B

Quantity: 2
Material B: SCM415N (Carburized and hardened)



4K2AD03Z

Disassembly and assembly

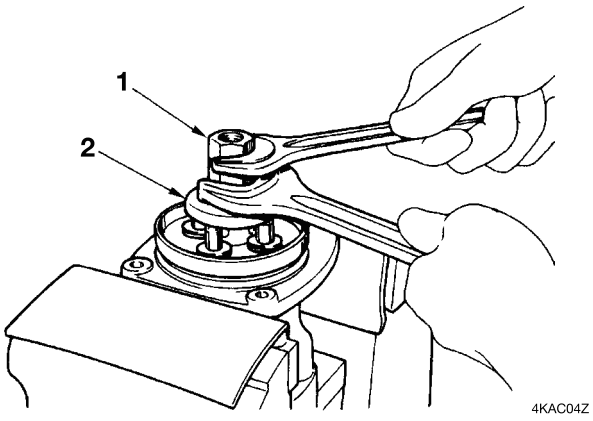
General precautions

The numbers in parentheses, (), listed after the names of parts throughout this document do not correspond to the same parts as the numbers listed in the construction diagram or parts lists.

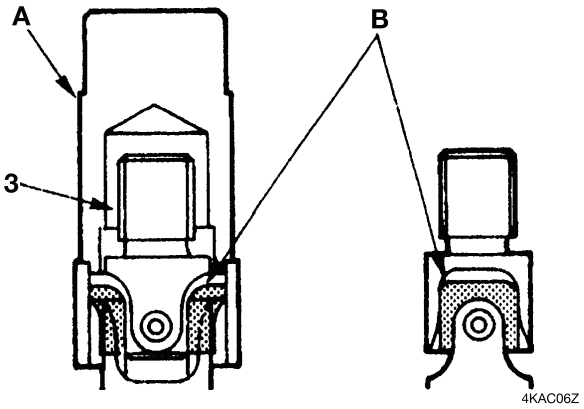
- Perform disassembly and assembly work in a clean place. Provide clean containers to store parts in during disassembly.
- Clean around the ports before disassembly. Remove paint around connectors with a wire brush.
- Clean the disassembled parts with wash oil.
- Put alignment marks on all parts to ensure that they are reassembled in the same positions.
- After each disassembly procedure, replace all seals and apply a thin layer of grease to each.
- Check each part for abnormal wear or seizing. Remove any burrs with sandpaper.
- Remove adhesive from screw holes that use the adhesive through the tap. Do not reuse mounting bolts or screws.
- Do not use cloth gloves during assembly. Fibers from the gloves could shed or fall off and clog valves, etc., which could cause parts to become faulty.
- During assembly, be sure to apply clean hydraulic oil to all moving parts in and sliding parts that come into contact with the hydraulic motor and valve parts before installing or attaching the part.
- Plug all ports once assembly has been completed in order to prevent dust and dirt from entering.

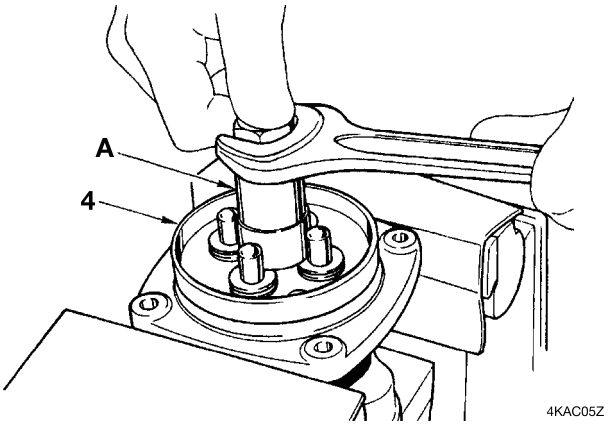
Disassembly

1. Take out the adjusting nut (1), and remove the cam (2) from the joint.
   - Secure the valve to the vice using a copper or lead plate.

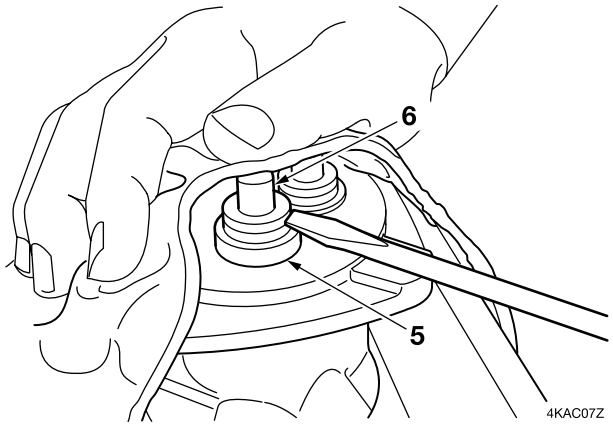


2. Take out the joint (3), and then remove the plate (4).
   - Use the installation jigs A and B.

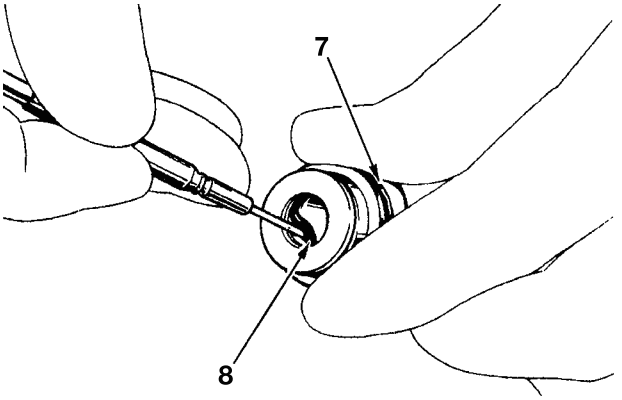




3. Take out the plug (5), and remove the push rod (6) from the plug (5).
   - If it is hard to remove by hand, use a flat-bladed screwdriver to remove it.
   - Watch out for the plug popping out due to spring pressure.

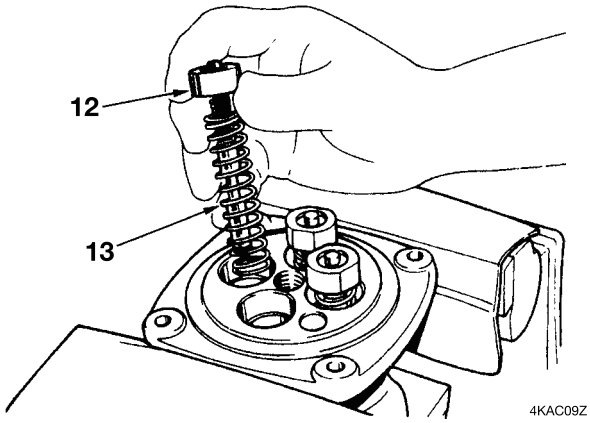


4. Remove the O-ring (7) and the seal (8) from the plug.



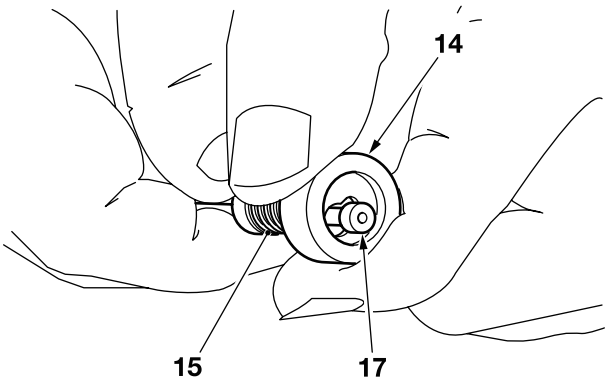
4KAC08Z

5. Remove the reducing valve (12) and the spring (13).
   - To avoid misconnection when reassembling, insert marks indicating the matching positions for the reducing valve (12) and the casing hole.



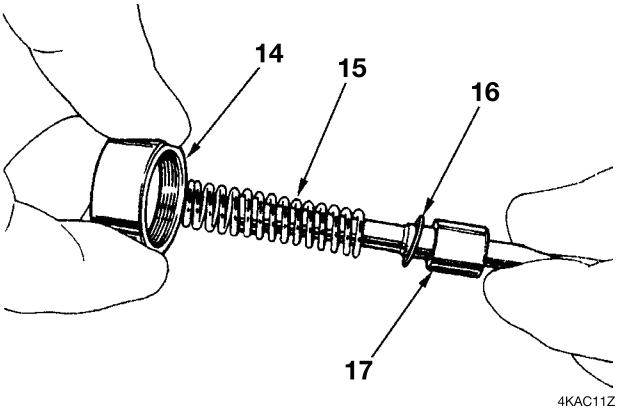
4KAC09Z

6. Disassemble the reducing valve (12).
   a. Push in the spring seat (14) to compress the spring (15) and to move the spool (17) from the small hole side to the large hole side on the spring seat (14).
      - The spring seat (14) is not to be pushed down by more than 6 mm (0.24 in.).



4KAC10Z

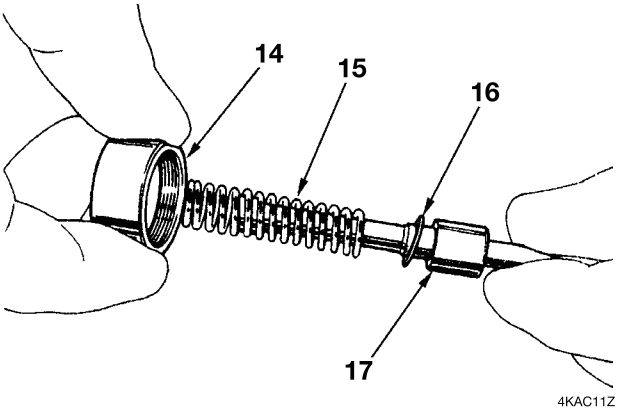
7. Remove the spring seat (14), the spring (15), and the washer 2 (16) from the spool (17).



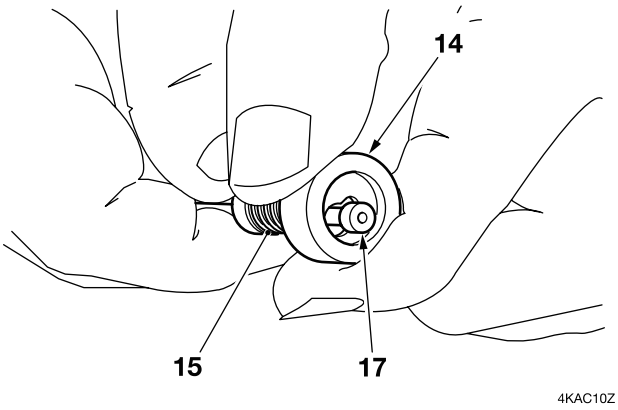
4KAC11Z

Assembly

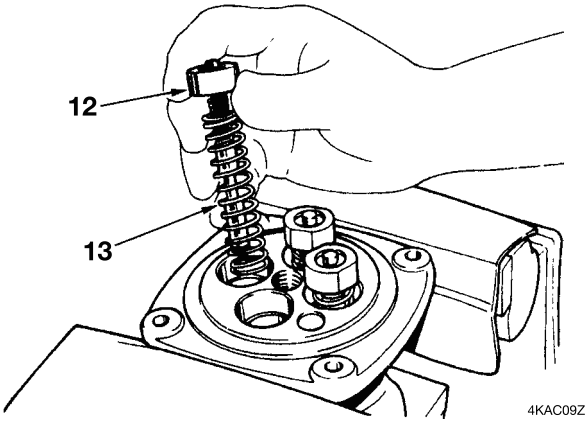
1. Assemble the reducing valve (12).
   a. Place the washer 2 (16), the spring (15), and the spring seat (14) on the spool (17).



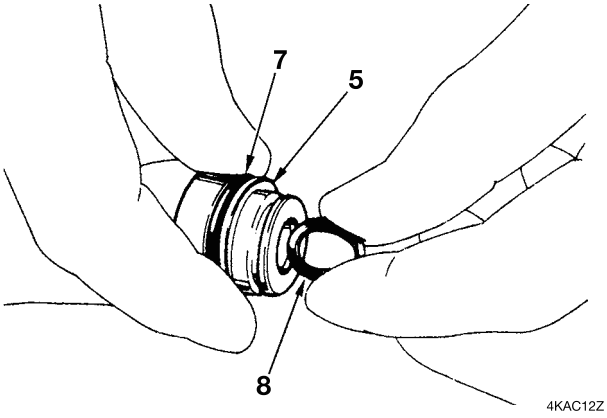
   b. Push in the spring seat (14) to compress the spring (15) and to move the spool (17) from the large hole side to the small hole side of the spring seat (14).
      • The spring seat (14) is not to be pushed down by more than 6 mm (0.24 in.).



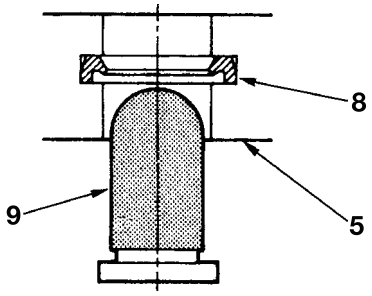
2. Install the spring (13) and the reducing valve (12).
   • Install them in the locations where they were before disassembly.



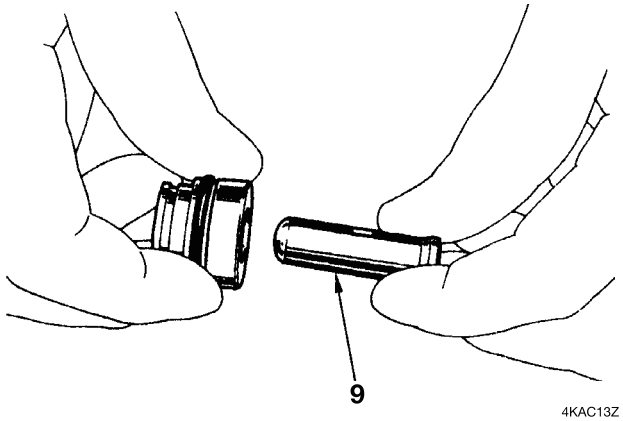
3. Fit the O-ring (7) and the seal (8) to the plug (5).



4. Install the push rod (9) on the plug (5).
   - Apply hydraulic oil to the push rod (9).



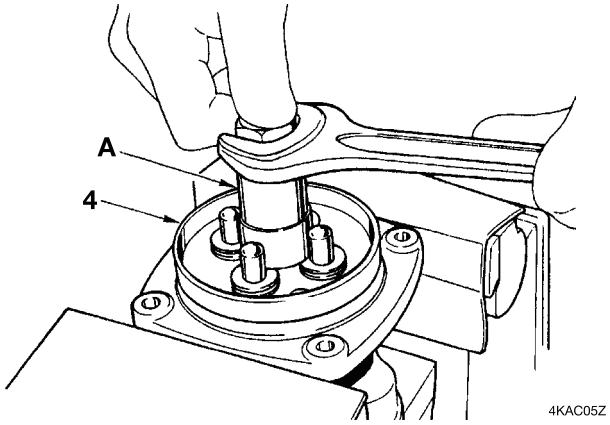
4KAC14Z



4KAC13Z

5. Install the plug (5), the plate (4), and the joint.
   - Use the installation jigs A and B to install the joint.

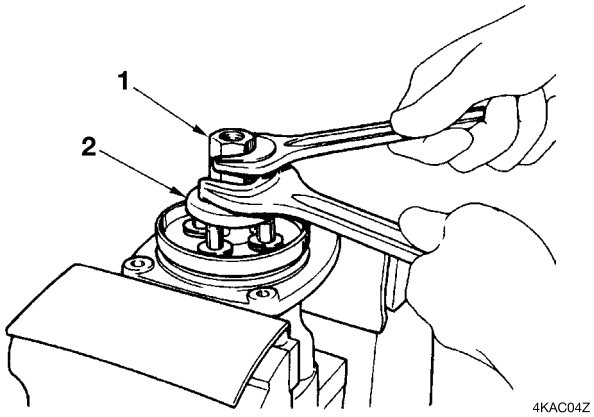
   Joint: 41.7 ± 2.9 N·m (30.8 ± 2.1 ft.-lb)



4KAC05Z

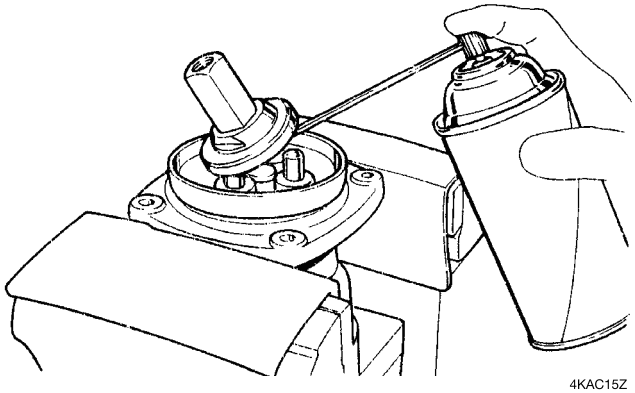
6. Install the cam (2) and the adjusting nut (1).
   - Tighten the adjusting nut (1) to the point where it uniformly contacts all four push rods.
   - When tightening the adjusting nut (1), do not move the cam (2).

   Adjusting nut: 68.6 ± 4.9 N·m (50.6 ± 3.6 ft.-lb)



4KAC04Z

Grease the rotating part of the joint and its contact surfaces with the disc and the push rod.


4KAC15Z

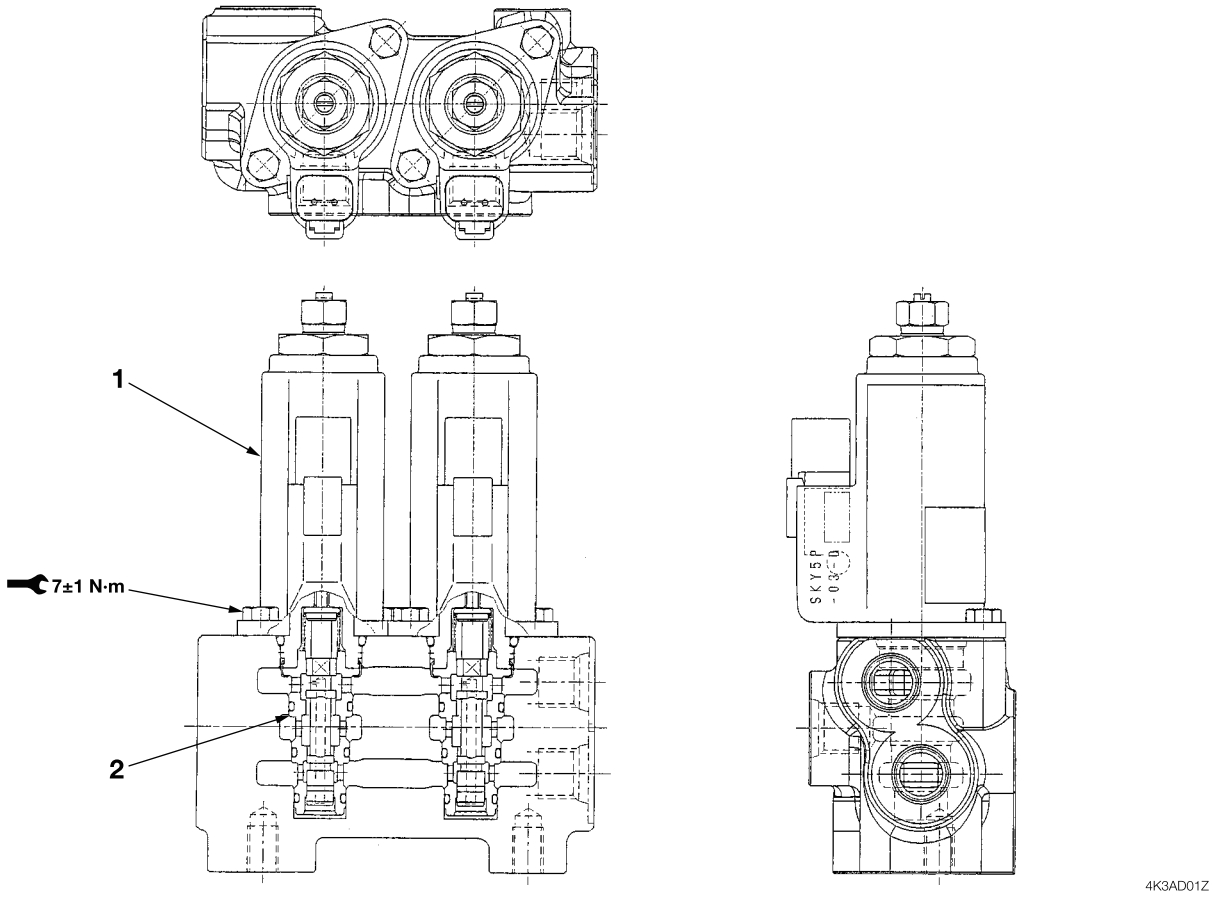
Inspection and adjustment

Checking the parts

Part	Criteria	Action
O-ring	—	• Replace
Seal	—	• Replace
Spool	• The wear on the sliding portions is 10 µm (0.0004 in.) or greater compared to that on the non-sliding portions • There are scratches on the sliding portions • The spool does not move smoothly	• Replace • Replace • Replace
Push rod	• The front end is worn by 1 mm (0.04 in.) or more • There are scratches on the sliding portions	• Replace • Replace
Plug	• The seal is imperfect due to damage	• Repair or replace
Controls	• The tightening is loose at the pin, shaft, or joint of the controls, with looseness of 2 mm (0.08 in.) or greater • The tightening is loose at the pin, shaft or joint of the controls due to wear, etc., with looseness of 2 mm (0.08 in.) or greater	• Tighten to the specified torque • Replace
Casing, port plate	• There are scratches, rust, or corrosion on the parts that come into sliding contact with the spool • There are scratches, rust, or corrosion of the seal part that comes in contact with the O-ring	• Replace • Repair or replace

PROPORTIONAL CONTROL SOLENOID VALVE

Construction

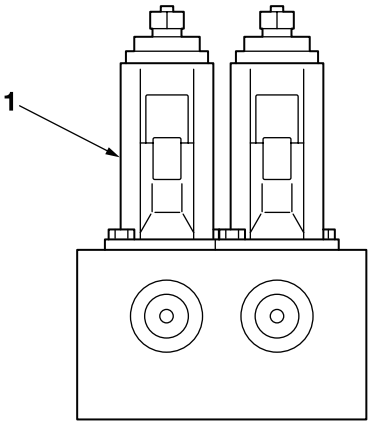


1. Proportional control solenoid
2. Spool

Disassembly and assembly

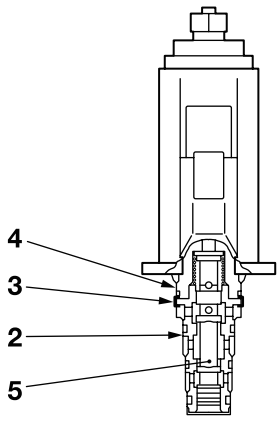
Disassembly

1. Take out the bolts and remove the proportional control solenoid valve.
   Bolt: 6.9 ± 1 N·m (5.1 ft.-lb)



4KAD02Z

2. Remove the O-ring from the proportional control solenoid valve.
   - Do not disassemble the sleeve (2) that is united to the solenoid (4) by the retaining ring (3).
   - Make sure that the spool (5) moves a little if pushed from the sleeve (2) end.



4KAD03Z

Assembly

For assembly, refer to the construction diagram and reverse the disassembly procedure.

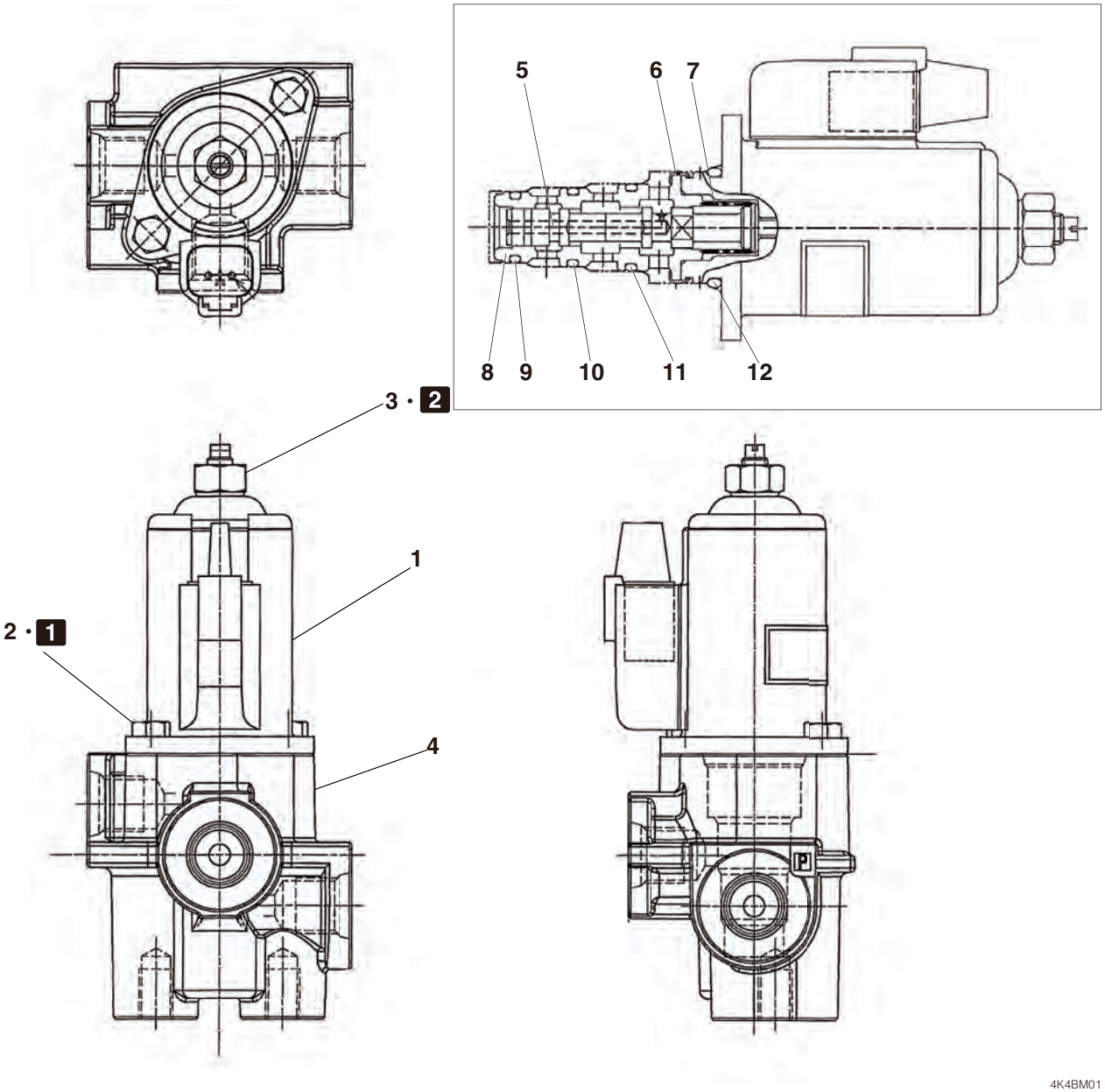
Inspection and adjustment

Checking the parts

Part	Criteria	Action
Coil assembly	• The solenoid is burned, short-circuited, or has a wire break	• Replace
	• There is a short-circuit or break in the wiring	• Replace
Body	• There are scratches, rust, or corrosion on the parts that come into sliding contact with the spool	• Replace
	• Scratches, rust, or corrosion of the seal part in contact with the O-ring	• Replace
	• There is other damage that may hinder or impair normal function	• Replace
Spool	• There are scratches on the outer circumference that could easily become caught on a fingernail	• Replace
	• The movement is not smooth	• Repair or replace
Spring	• There is rust, corrosion, deformation, breakage, or other notable damage	• Replace
O-ring	—	• Replace

PROPORTIONAL CONTROL SOLENOID VALVE (ANTI-STALL VALVE)

Construction



1 7.0 ± 1.0 N·m (5.2 ± 0.7 ft-lb.)
2 7.4 ± 0.5 N·m (5.5 ± 0.4 ft-lb.)

1. Solenoid proportional pressure reducing valve
2. Bolt
3. Seal nut
4. Casing
5. Spool
6. Retaining ring
7. Spring
8. Sleeve
9. O-ring
10. O-ring
11. O-ring
12. O-ring

Disassembly and Assembly

The numbers in parentheses () listed after the names of parts in this document match the numbers used in the construction diagrams and parts lists.

General Precautions

- Perform disassembly and assembly work in a clean place. Provide clean containers to hold parts during disassembly.
- Clean around the ports before disassembly. Remove paint around connectors with a wire brush.
- Clean the disassembled parts with wash oil.
- Put alignment marks on all parts to reassemble them in the same positions.
- After each disassembly, replace all seals and apply a thin layer of grease to them.
- Check each part for abnormal wear or seizing. Remove any burrs with sandpaper.
- Do not move adjusting screws, unless absolutely necessary.
- All components are precision parts. Take care not to drop or hit the parts when handling them.
- Never pry open or hit parts. This may cause burrs or other damage that results in loss of function.
- Leaving the parts in a disassembled state may result in rusting.

Disassembly

1. Remove the bolts (2), and remove the solenoid proportional pressure reducing valve (1).
   - Do not attempt to remove the sleeve (7) unless absolutely necessary. It is swaged to the solenoid by the retaining ring (6).

Assembly

For assembly, reverse the disassembly procedure.

Inspection and adjustment

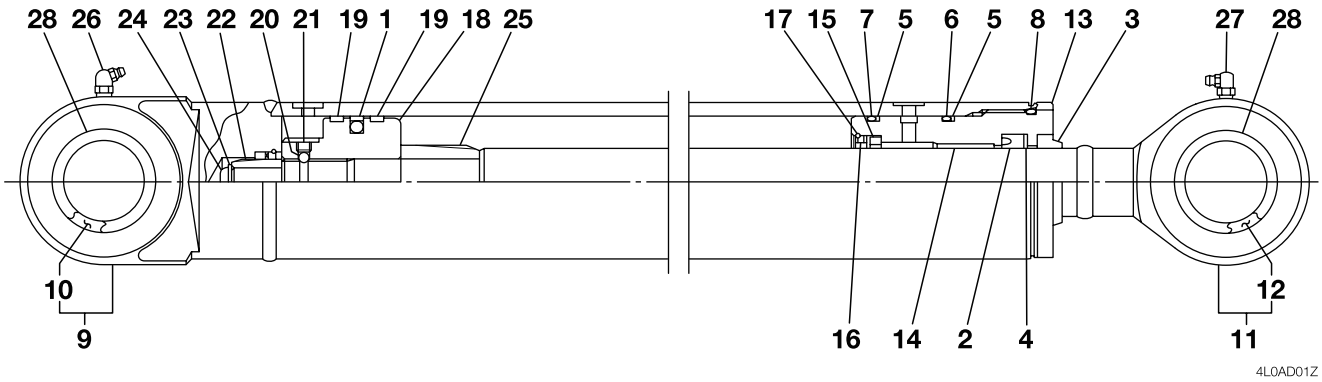
Checking the parts

Part	Criteria	Action
Coil assembly	• The solenoid is burned-out, short-circuited, or a wire is broken. • Wiring short-circuit or a wire is broken	• Replace • Replace
Body	• Scratches, rust, or corrosion at the parts in sliding contact with the spool. • Scratches, rust, or corrosion of the part of the seal in contact with the O-ring. • Other damage considered to impair the normal functions	• Replace • Replace • Replace
Spool	• Scratches on the outer circumference that easily catch a fingernail • Movement is not smooth	• Replace • Repair or replace
Spring	• Rust, corrosion, deformation, breakage, or other notable damage	• Replace
O-ring	—	• Replace

CYLINDERS

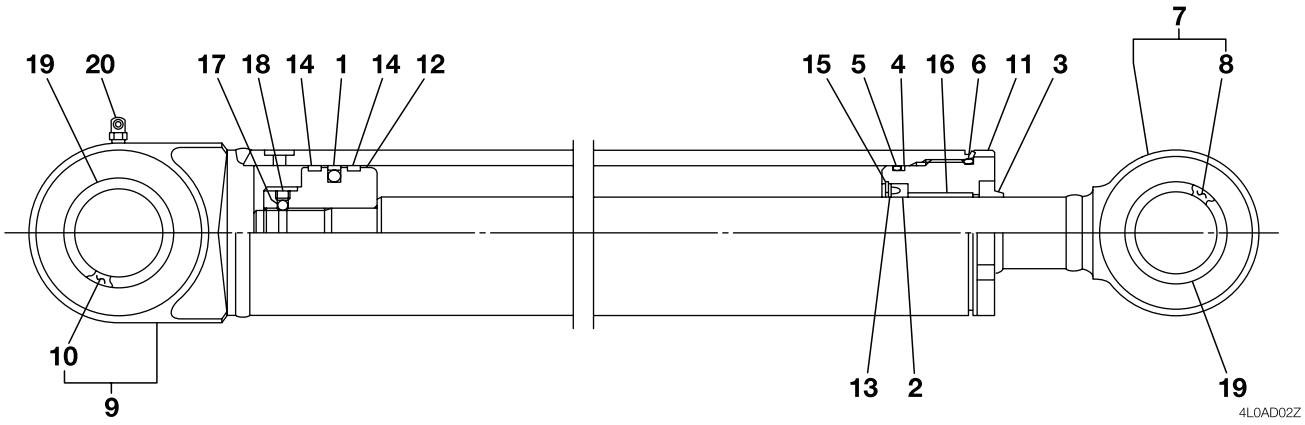
Construction

Arm cylinder



1. Piston packing
2. Rod packing
3. Dust seal
4. Backup ring
5. Backup ring
6. O-ring
7. O-ring
8. O-ring
9. Tube
10. Bushing
11. Piston rod
12. Bushing
13. Rod cover
14. Bushing
15. Cushion seal
16. Spacer
17. Stopper
18. Piston
19. Wear ring
20. Ball
21. Set screw
22. Cushion bearing
23. Washer
24. Screw
25. Cushion bearing
26. Grease nipple
27. Grease nipple
28. Dust seal

Bucket cylinder



1. Piston packing
2. Rod packing
3. Dust seal
4. Backup ring
5. O-ring
6. O-ring
7. Piston rod
8. Bushing
9. Tube
10. Bushing
11. Rod cover
12. Piston
13. Packing holder
14. Wear ring
15. Snap ring
16. Bushing
17. Ball
18. Set screw
19. Dust seal
20. Grease nipple

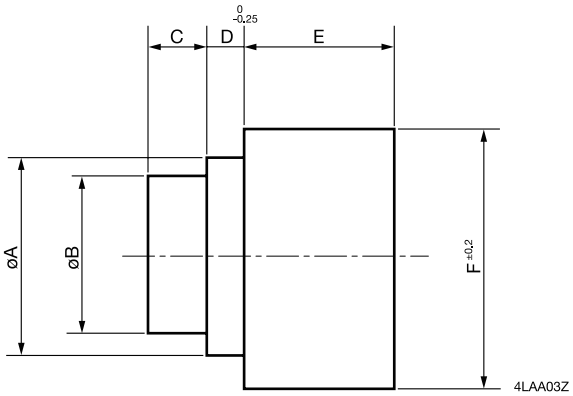
Special tools

Unit: mm

Installation jig B

Quantity: 1
Material: SS41

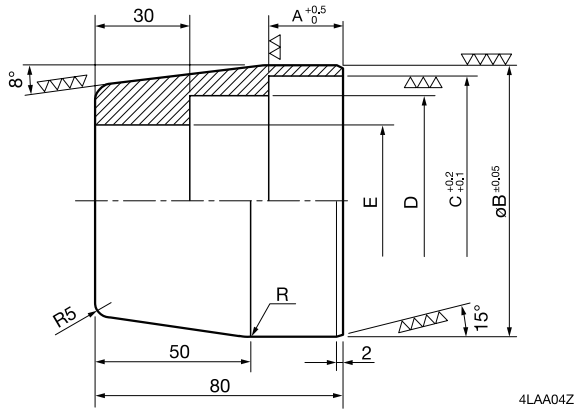
	A	B	C	D	E	F
Arm	49.0	39.5	10	5.0	15	60
Bucket	44.0	34.5	10	5.0	15	55



Sliding jig C

Quantity: 1
Material: STKM13C

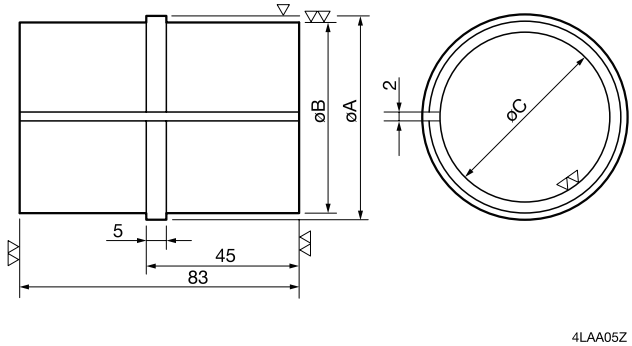
	A	B	C	D	E
Arm	15.7	65.5	63	45	25
Bucket	15.7	65.5	63	45	25



Fitting jig D

Quantity: 1
Material: Nylon

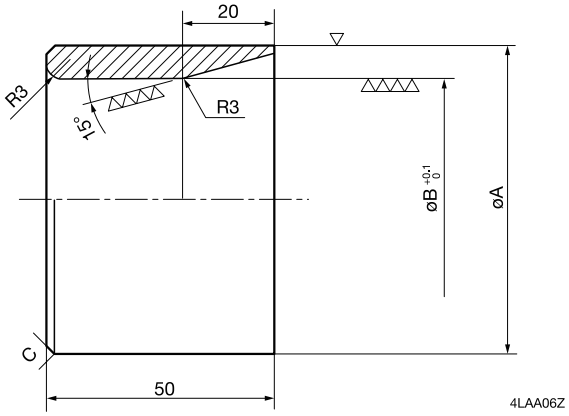
	A	B	C
Arm	70	68	60
Bucket	70	68	60



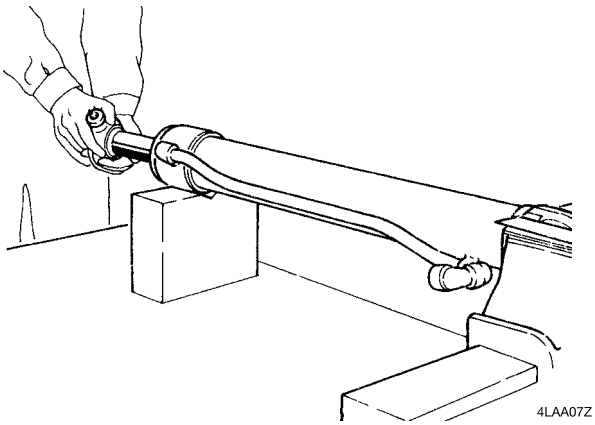
Corrective jig E

Quantity: 1
Material: STKM13C

	A	B
Arm	80	65
Bucket	80	65



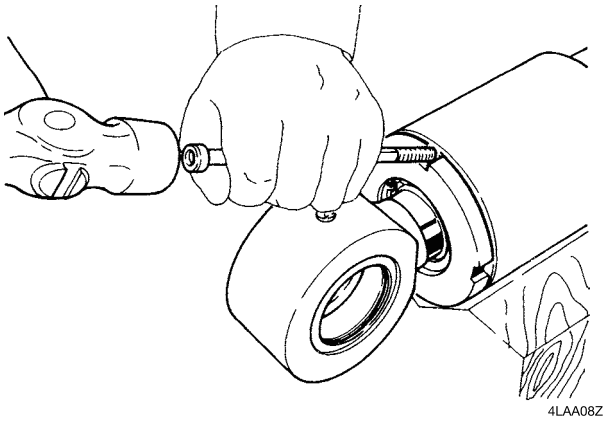
This chapter describes mainly the procedure for the arm cylinder. When disassembling/assembling the cylinder, check its construction by referring to the construction diagram shown on the preceding page.


4LAA07Z

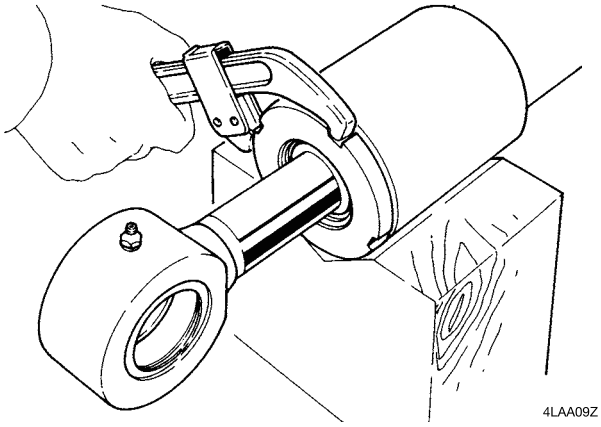
Disassembly

Cylinder assembly

1. Secure the cylinder horizontally by holding the clevis of the tube with a vice and placing a wooden support under the other end.
2. Drain out the remaining hydraulic oil in the cylinder.
   - Move the piston rod slowly to prevent the hydraulic oil from spraying out.
3. Disengage the anti-rotation lock of the rod cover.
   - Since the anti-rotation lock is built into the cylinder tube, take care not to damage the tube when disengaging the lock.

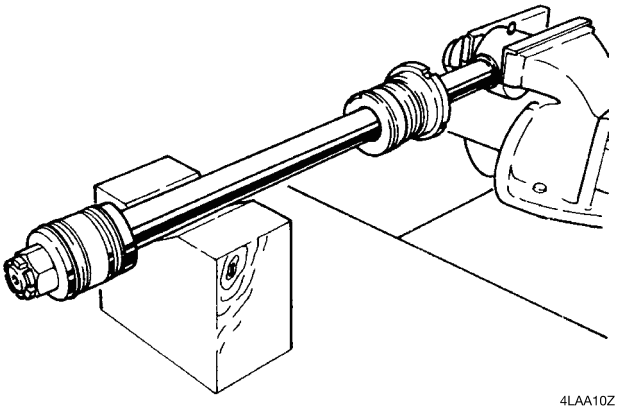

4LAA08Z

4. Loosen the rod cover.
   - The piston rod should be pulled out approx. 200 mm (7.9 in.) beforehand.
   - Cover the piston rod to prevent damage to it.
5. Take out the piston rod assembly from the tube.
   - Pull it straight so as not to damage the sliding surface.

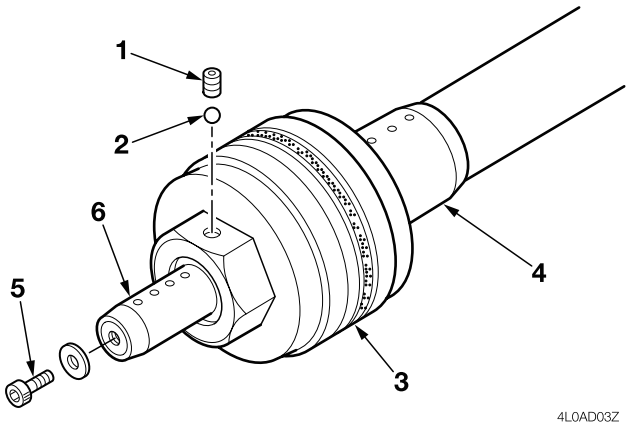

4LAA09Z

Piston rod assembly

1. Secure the piston rod assembly horizontally.

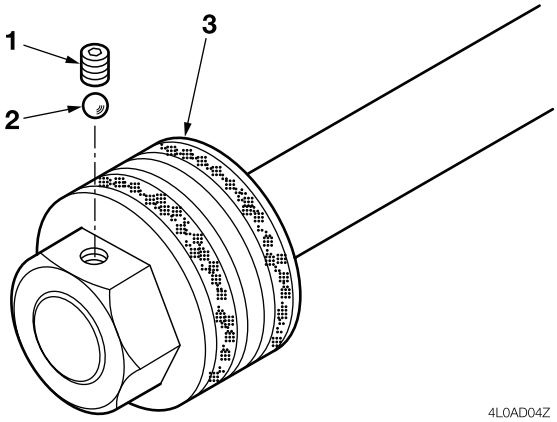

4LAA10Z

2. Remove the piston.
<Arm cylinder>
a. Take out the set screw (1) and remove the ball (2).
• The set screw (1) is caulked in two points with a punch. Remove such parts by using a hand drill.
b. Remove the piston (3) and the cushion bearing (4).
c. Remove the screw (5).
d. Remove the cushion bearing (6).



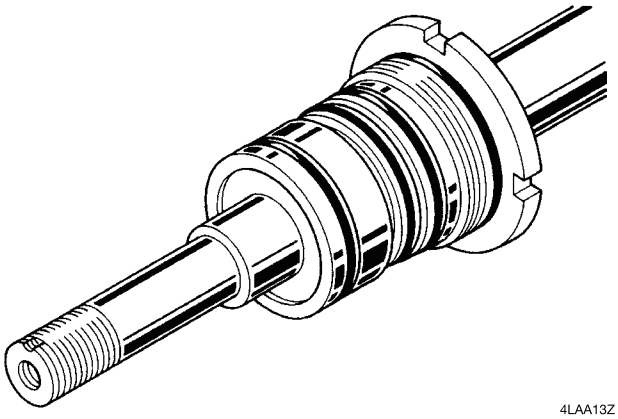
4L0AD03Z

<Bucket cylinder>
a. Take out the set screw (1) and remove the ball (2).
• The set screw (1) is caulked in two points with a punch. Remove such parts by using a hand drill.
b. Remove the piston (3).



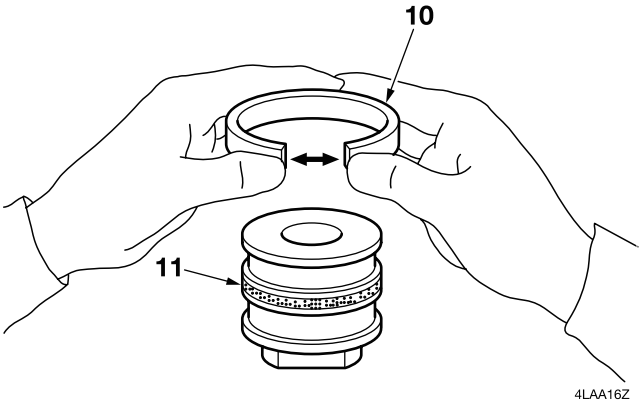
4L0AD04Z

3. Remove the rod cover assembly.


4LAA13Z

Piston

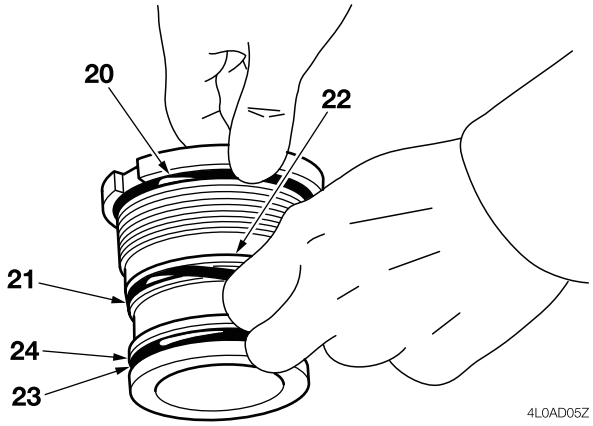
1. Take out the wear rings (10) and remove the piston packing (11).
• Stretch open the wear ring far enough to disengage it from the piston and pull it out in the direction of the shaft.
• Cut off the piston packing or take it out by using a flat-bladed screwdriver.



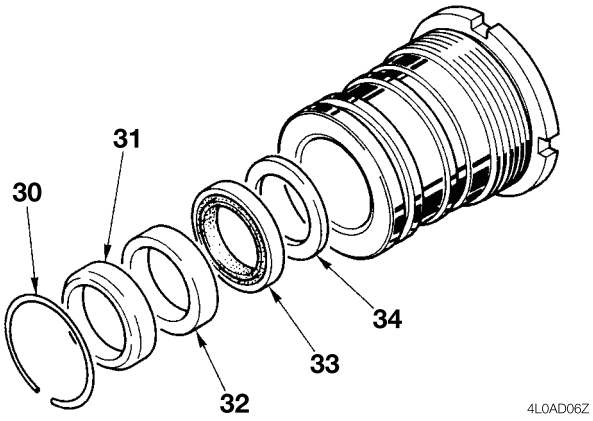
4LAA16Z

Rod cover

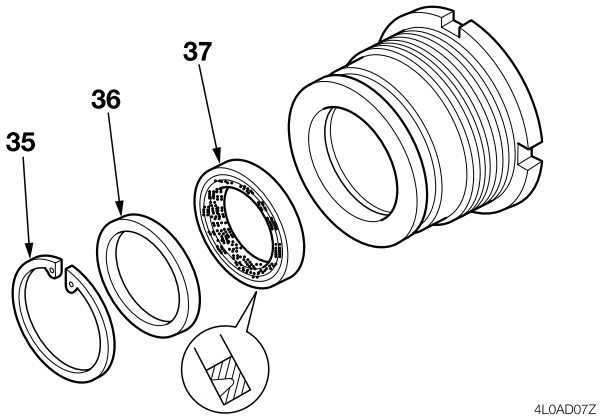
1. Remove the O-rings (20) and (21) from the outer diameter of the rod cover, and then remove the backup ring (22).
   Remove the O-ring (23) and the backup ring (24) from the rod cover outer circumference (only for arm cylinder).



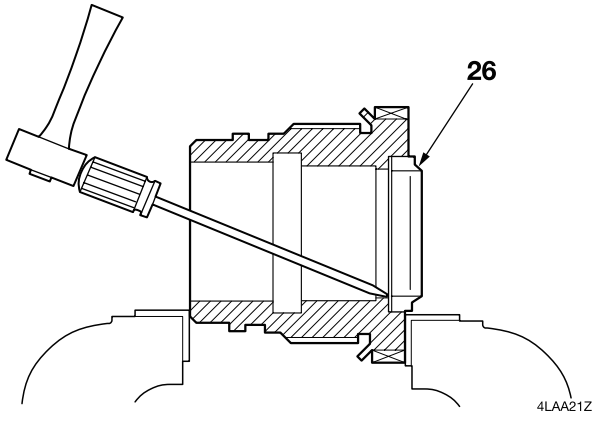
2. Remove the cushion seal (only for arm cylinder) and the rod packing.
   <Arm cylinder>
   a. Remove the stopper (30) and the spacer (31).
   b. Remove the cushion seal (32).
   c. Remove the rod packing (33).
   d. Remove the backup ring (34).



   <Bucket cylinder>
   a. Remove the snap ring (35) and the packing holder (36).
   b. Remove the rod packing (37).

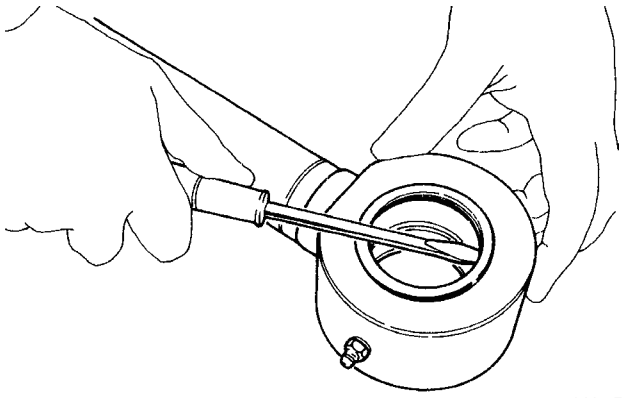


3. Remove the dust seal (26).
   • Tap alternately on several points around the inner circumference of the metal ring, gradually pushing the seal out.

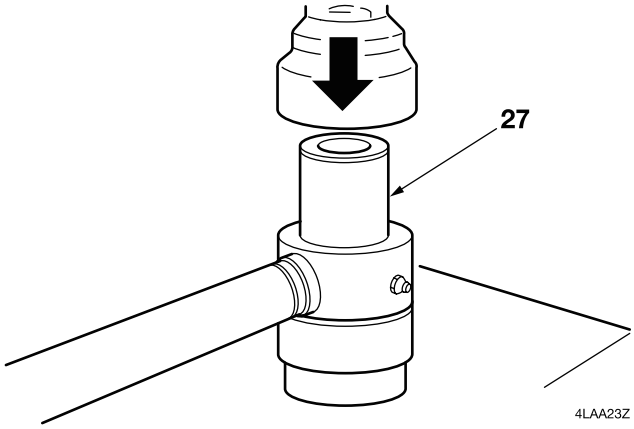


Clevis

1. Remove the dust seals from the tube and piston rod.



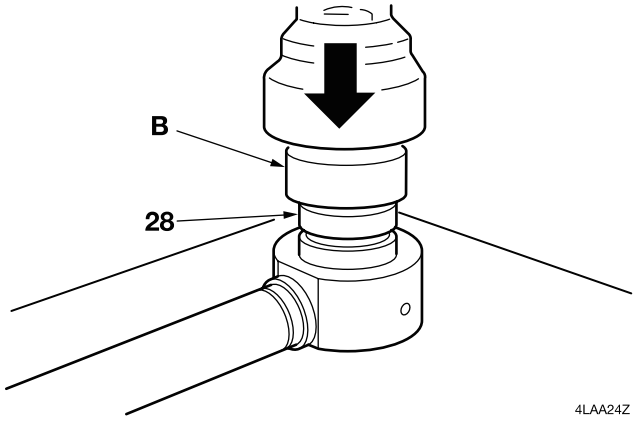
2. Remove the bushing.
   - Pull out the bushing by using a press with a supporting metal plate (27).



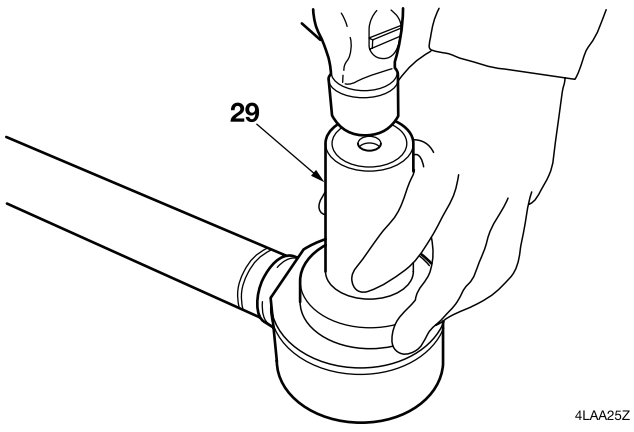
Assembly

Clevis

1. Press-fit the bushings (28) into the piston rod and tube by using the installation jig B.

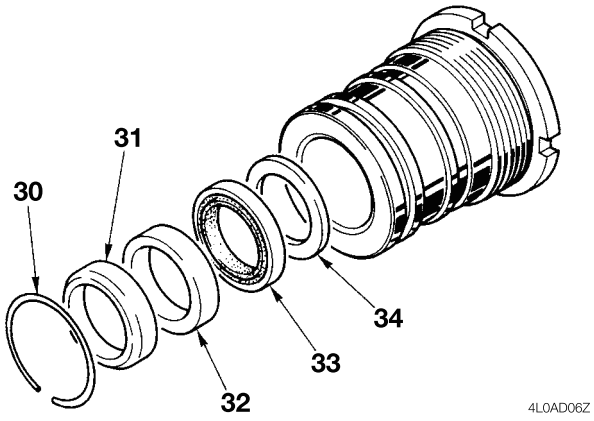


2. Install the dust seal by using a supporting metal plate (29).

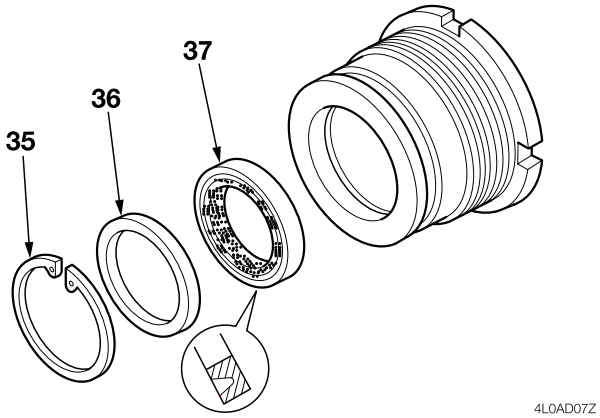


Rod cover

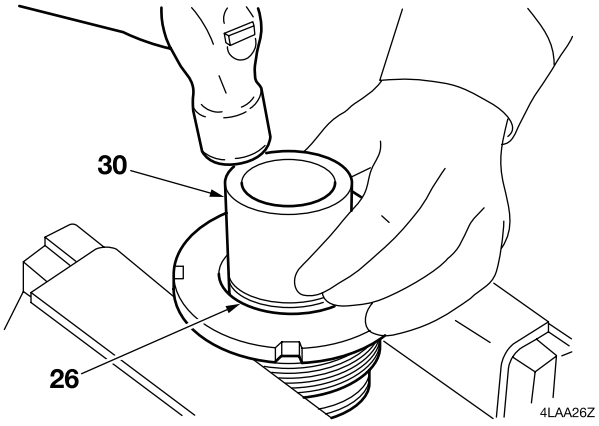
1. Install the rod packing and the cushion seal (only for arm cylinder).
   <Arm cylinder>
   a. Install the backup ring (34).
   b. Install the rod packing (33).
      • Be sure to install the rod packing in the correct direction.
   c. Install the cushion seal (32).
   d. Install the spacer (31) and the stopper (30).



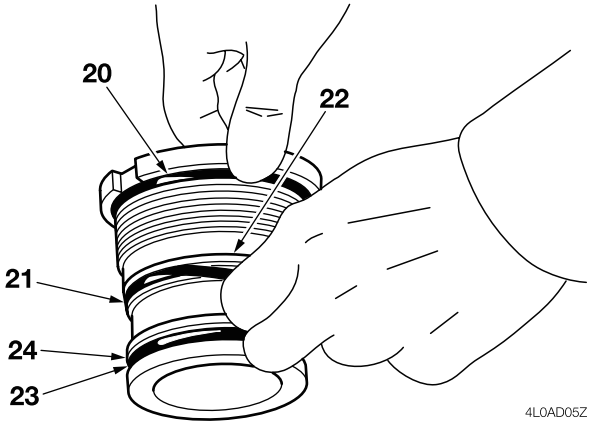
   <Bucket cylinder>
   a. Install the rod packing (37).
      • Be sure to install the rod packing in the correct direction.
   b. Install the packing holder (36) and the snap ring (35).



2. Install the dust seal (26).
   • For the dust seal with a metal ring around the perimeter, use a supporting metal plate (30) to install it.

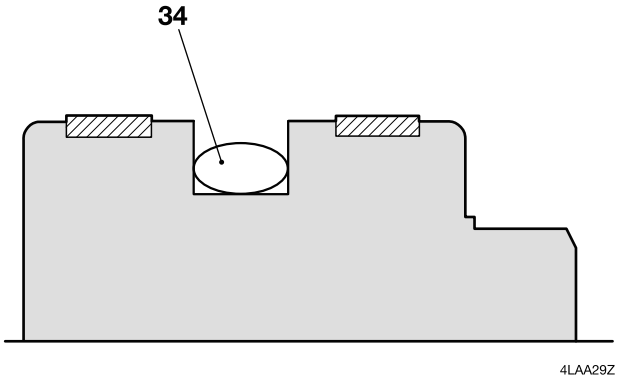


3. Install the backup ring (22) and the O-rings (20) and (21).
   Install the backup ring (24) and the O-ring (23) (only for arm cylinder).
   • The cut portions of the backup rings should overlap correctly.

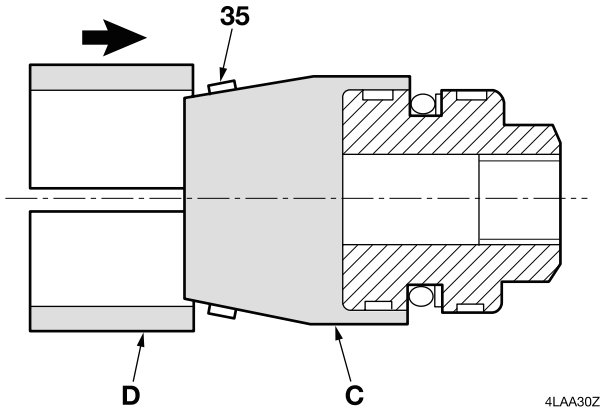


Piston

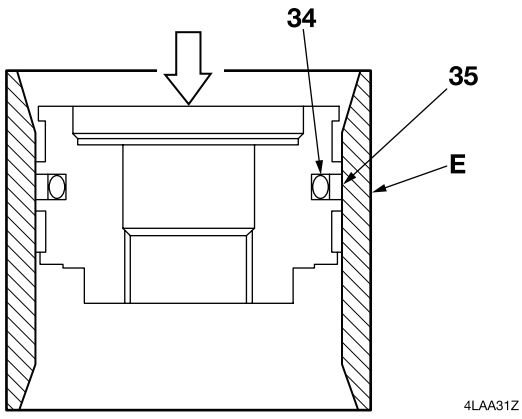
1. Install the O-ring (34).
   - If the O-ring is twisted after being fitted, correct it.



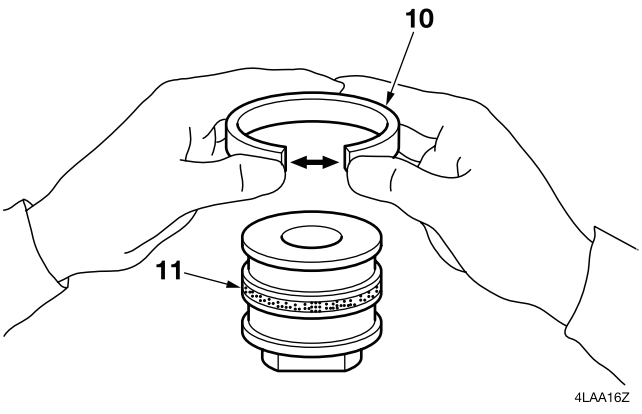
2. Cover the piston with the sliding jig C, then using the fitting jig D, insert the slipper ring (35) rapidly.



3. Correct the shape of the slipper ring (35) using the corrective jig E, as its diameter has been extended at installation.

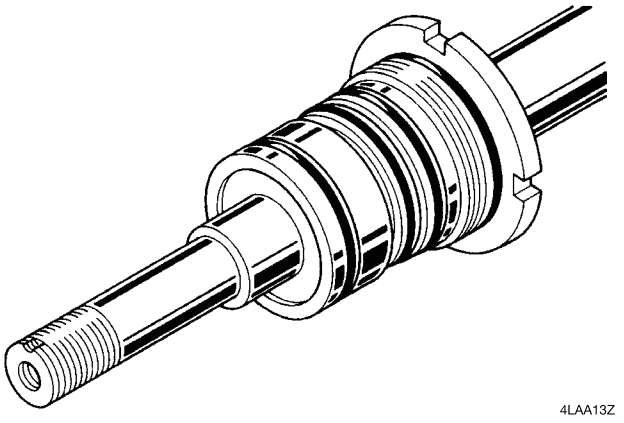


4. Install the wear ring (10).
   - Stretch open the wear ring (10) far enough to install it on the piston from the direction of the shaft.

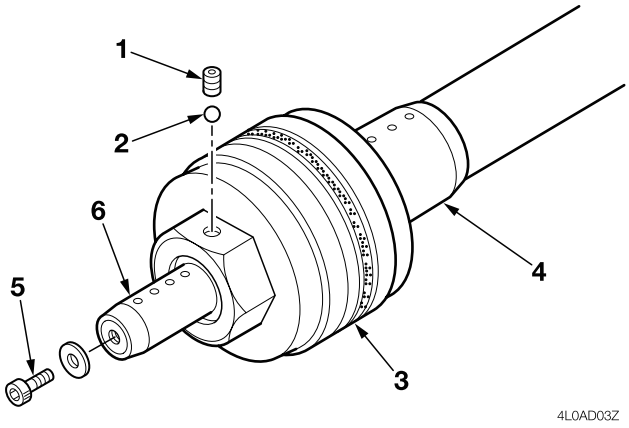


Piston rod assembly

1. Insert the rod cover assembly on the piston rod.

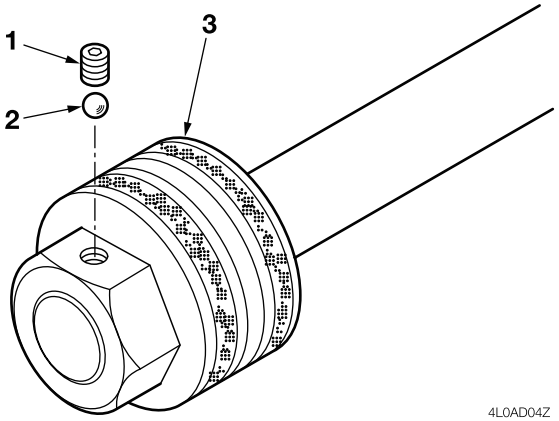

4LAA13Z

2. Install the piston unit.
   <Arm cylinder>
   a. Install the cushion bearing (4) on the piston rod.
   b. Install the piston (3) on the piston rod, and then tighten the piston.
      Piston: 528 N·m (389.4 ft-lb.)
   c. Insert the ball (2), tighten the set screw (1) and caulk at two points with a punch.
      Set screw: 6.8 N·m (5.02 ft-lb.)
   d. Install the cushion bearing (6).
   e. Install the washer and the screw (5).
      Screw: Loctite 648
      Screw: 31.4 N·m (23.16 ft-lb.)



4L0AD03Z

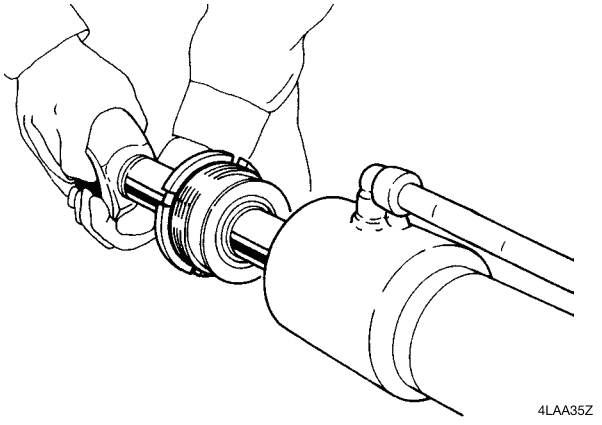
   <Bucket cylinder>
   a. Install the piston (3) and tighten the piston.
      Piston: 460 N·m (339.3 ft-lb.)
   b. Insert the ball (2), tighten the set screw (1) and caulk at two points with a punch.
      Set screw: 6.8 N·m (5.02 ft-lb.)



4L0AD04Z

Cylinder assembly

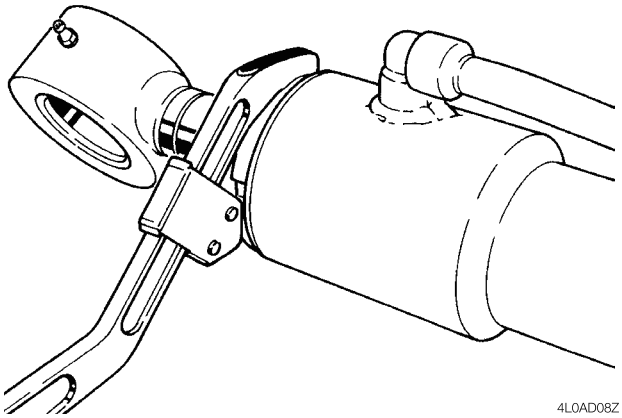
1. Secure the tube horizontally, and insert the piston rod assembly into the tube.
   • When inserting, align the center of the piston rod with the center of the tube. Insert the assembly straight so as not to damage the seal.


4LAA35Z

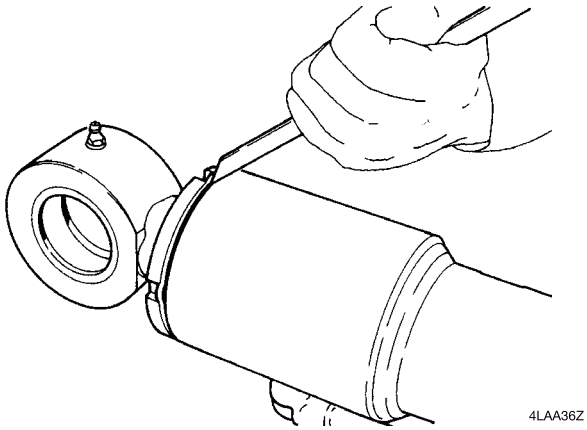
2. Tighten the rod cover.

Unit: N·m (ft-lb.)

Arm cylinder	294 (217)
Bucket cylinder	294 (217)



3. To lock, the lock rib of the tube should be bent and fitted in the notch of the rod cover.



Inspection and adjustment

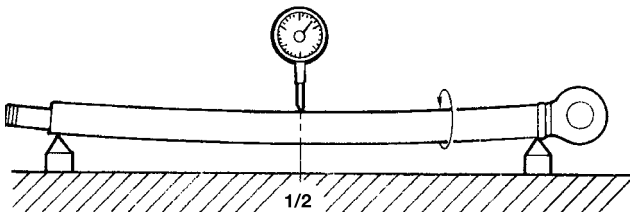
Inspection after disassembly

Clean each part thoroughly with cleaning oil, then carry out the following checks. When a cylinder has been disassembled, replace all the seals with new ones.

1. Piston rod
   - Replace the rod if there are cracks.
   - If the threads are damaged, repair them or replace the rod.
   - If the plating layer of the plated portion is broken, rusted or scratched, replace the rod.
   - If the rod is bent more than the limit of 1 mm in 1 m, replace it. (For the measurement method, refer to the figure on the right.)
   - If the inner diameter of the clevis bushing is worn, replace the bushing.

Measuring the bend

a. Support the portion of the rod with the same diameter at both ends on V-blocks.
b. Set a dial gauge at the center between the two blocks.
c. Rotate the rod and take a reading of the maximum and minimum run-out indicated by the dial gauge. If the bending of the rod is within the above limit, yet is bent a lot in a small distance so that it will not move smoothly, replace the rod if it makes a squeaking sound in the operation test after reassembly or if it catches during movement.



4LAA37Z

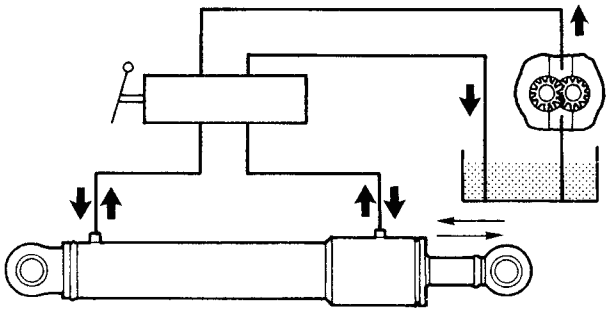
2. Tube
   - If there are cracks in the welded portion, replace the tube.
   - Replace the tube if the inside surface is scratched or if it leaks hydraulic oil.
   - If the inner diameter of the clevis bushing is worn, replace the bushing.

3. Rod cover
   - If the bushing inner diameter is worn and the clearance with the piston rod is greater than 0.25 mm (0.0098 in.), replace the bushing.
   - If the inside surface of the bushing is scratched, and the scratches are deeper than the depth of the coating layer, replace the bushing.

Inspection after assembly

No load operation test

1. Place the cylinder in a horizontal position with no load.
2. Apply gentle pressure alternately to the ports at both ends, operating the piston rod 5 or 6 times.
3. Make sure there is no abnormality in the operating condition.



4LAA38Z

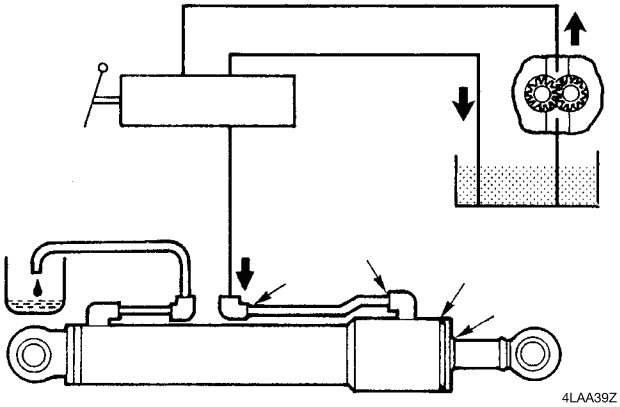
Leak test

External leak

1. Apply test pressure for 3 minutes each to the retraction side and the extension side.
2. Make sure there are no abnormalities such as external leakage or permanent deformation, etc. in the rod seal, the rod cover mount, or in any welded portion.

Internal leak

1. Disconnect the extension side hose.
2. Apply test pressure to the retraction side for 3 minutes.
3. Measure the amount of oil that has leaked from the extension side.
   - The amount of leakage should be 1 mL/3 min (0.06 in^3/3 min) or less.



4LAA39Z

Bleeding air from the hydraulic cylinder

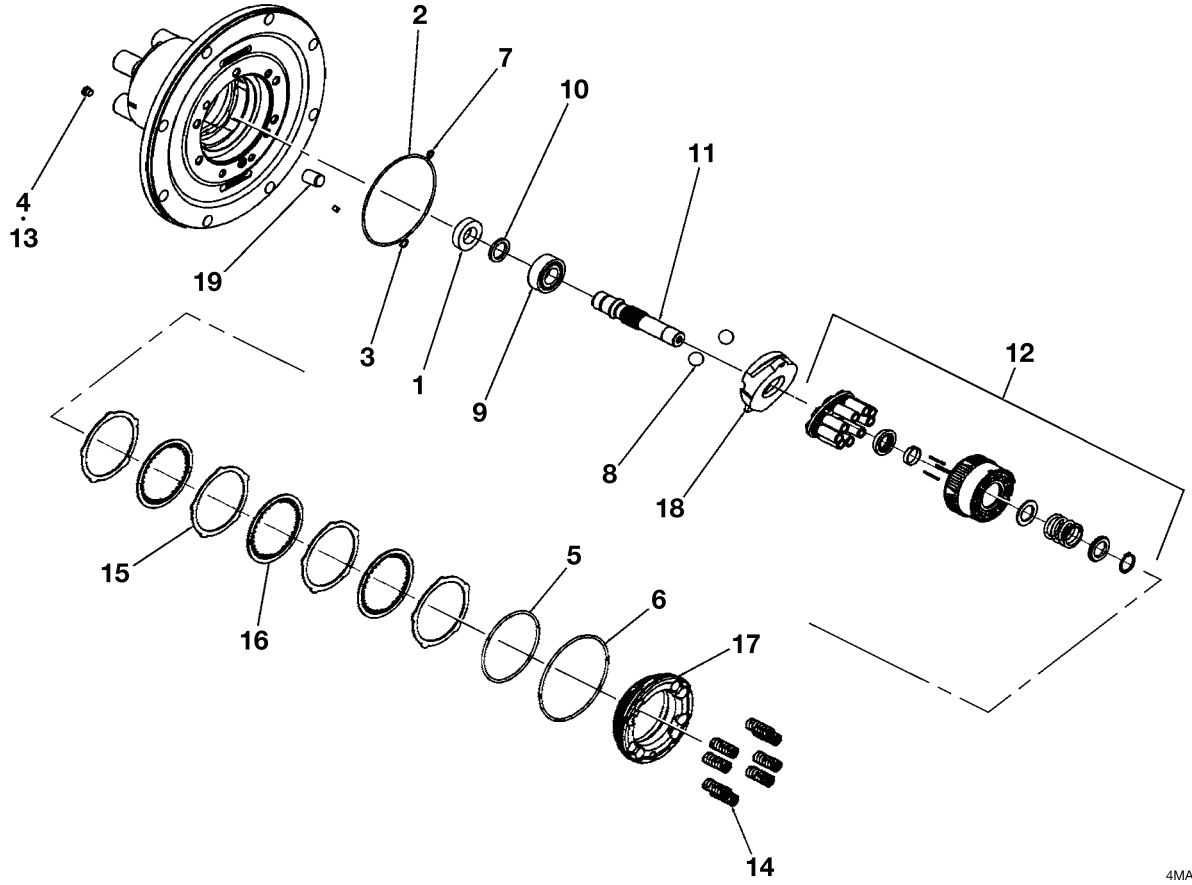
Bleed the air out of the cylinder when the cylinder is removed or when the hydraulic piping, etc. is disconnected.

1. Start the engine and let it idle for approximately 5 minutes.
2. With the engine running at slow speed, extend and retract the cylinder 4 or 5 times.
   - Move the piston rod to a position 100 mm (3.9 in.) before the end of the stroke, being careful not to relieve air.
3. With the engine at top speed, repeat the operation in (2), then with the engine running at slow speed, move the piston rod to the stroke end to relieve air.

TRAVEL MOTOR

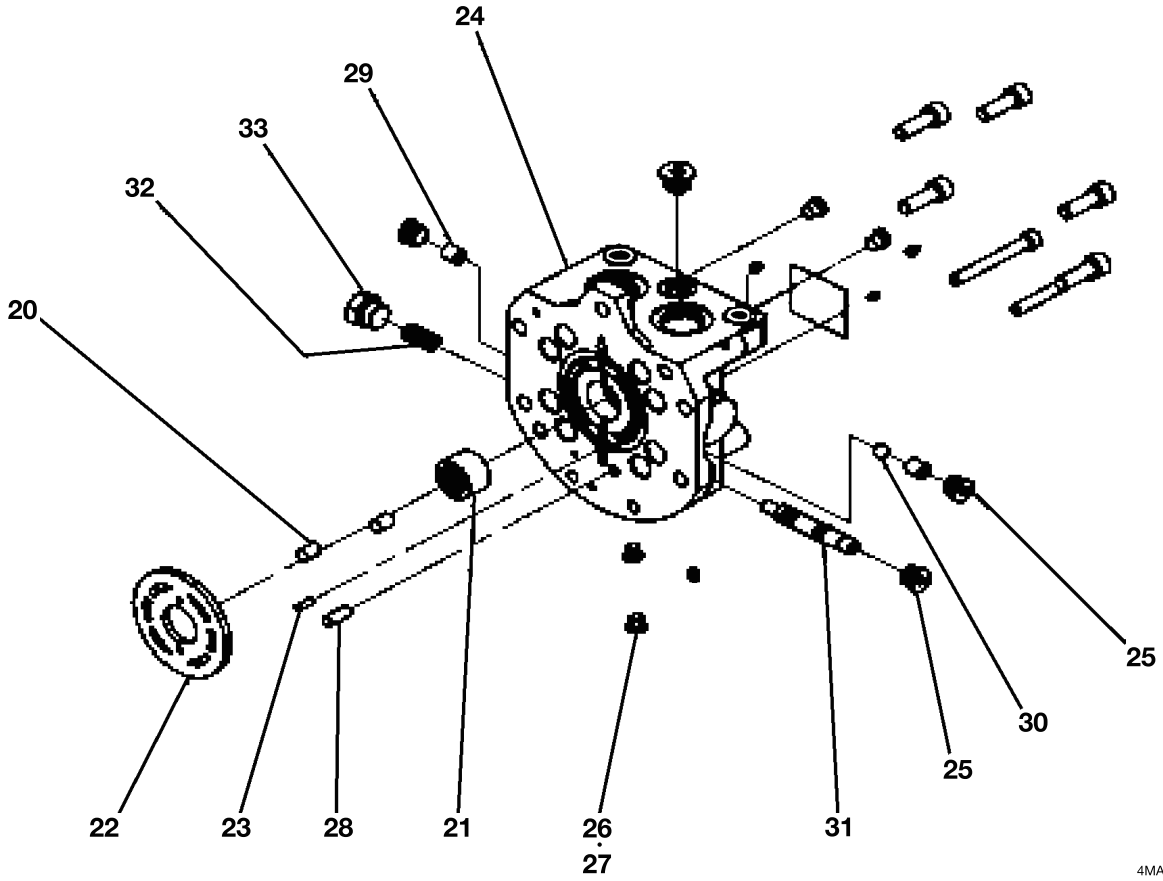
Construction

Hydraulic motor 1/2



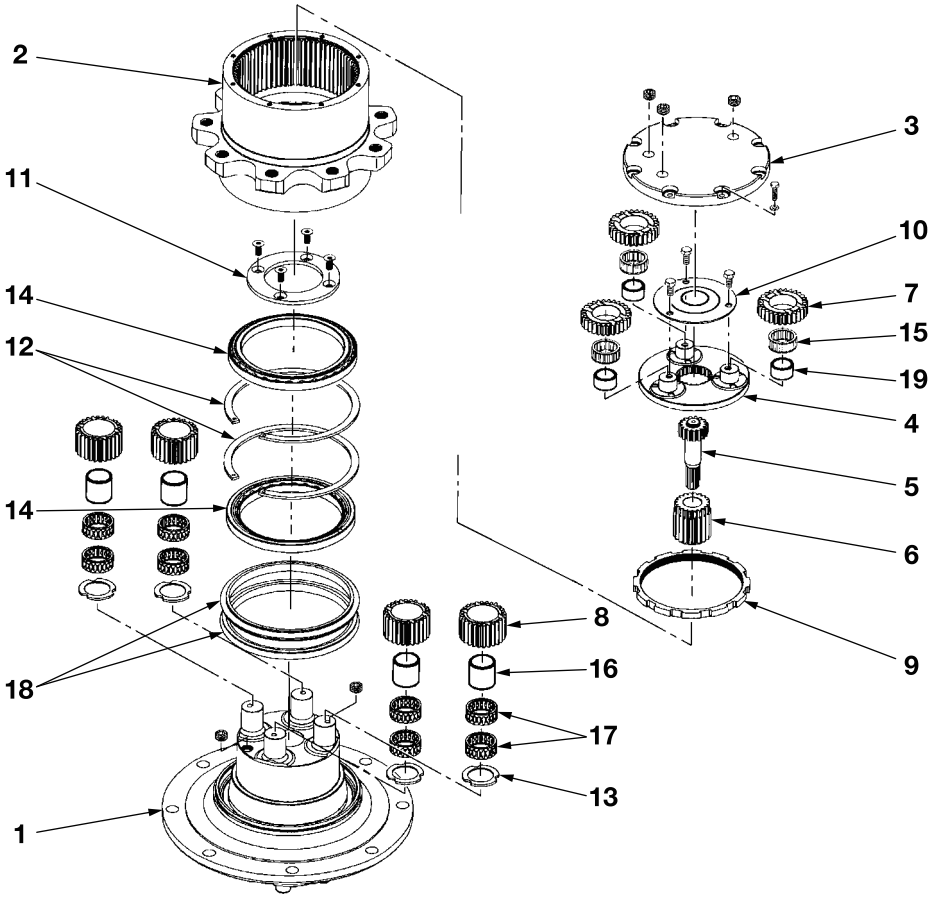
1. Oil seal
2. O-ring
3. O-ring
4. O-ring
5. O-ring
6. O-ring
7. O-ring
8. Ball
9. Bearing
10. Snap ring
11. Shaft
12. Cylinder block
13. Plug
14. Spring
15. Center disc
16. Friction disc
17. Break piston
18. Swash plate
19. Piston

Hydraulic motor 2/2



20. Pin	27. O-ring
21. Bearing	28. Pin
22. Valve plate	29. Plug
23. Pin	30. Ball
24. Valve body	31. Spool
25. Plug	32. Spring
26. Plug	33. Plug

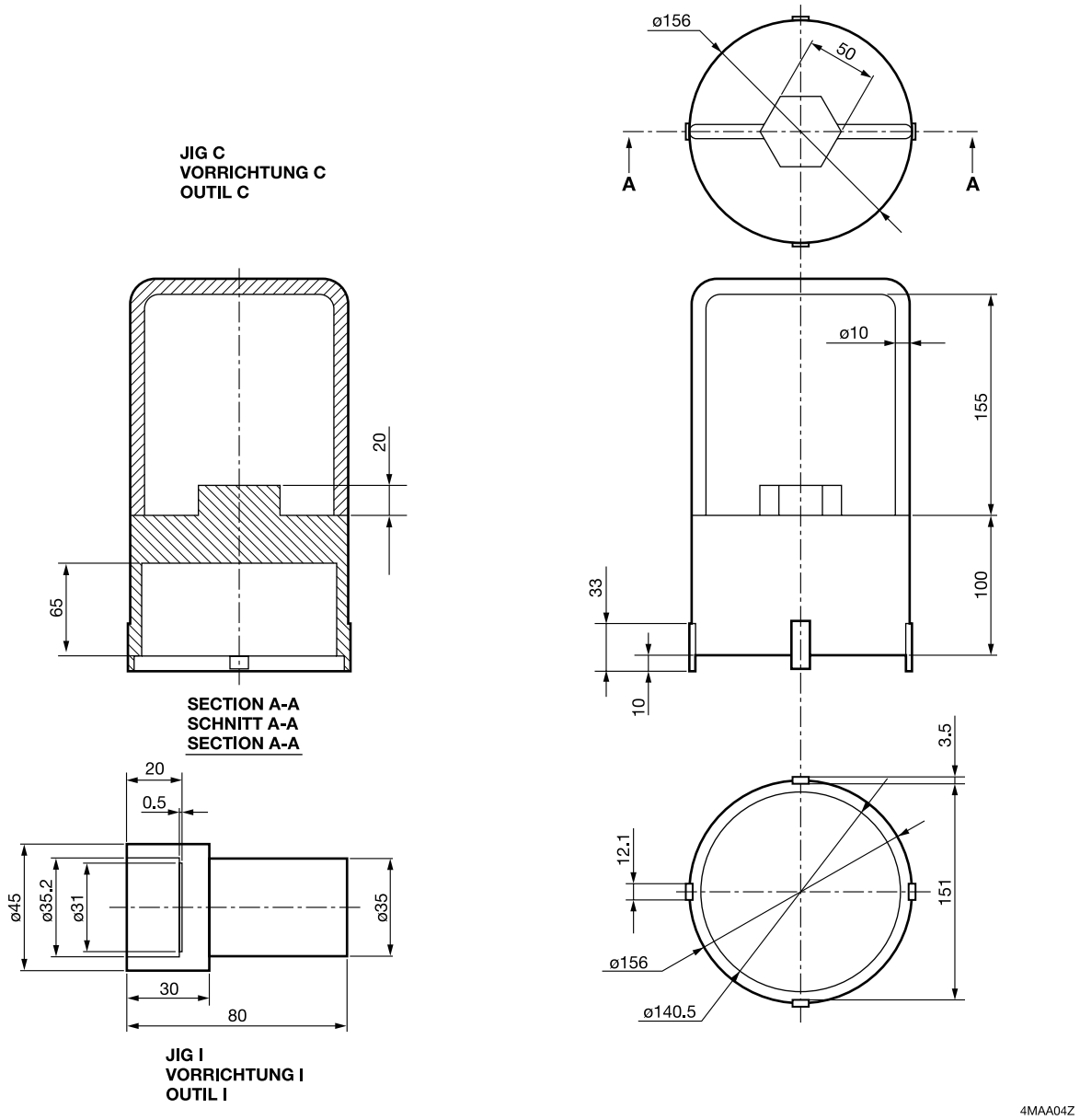
Reduction gears



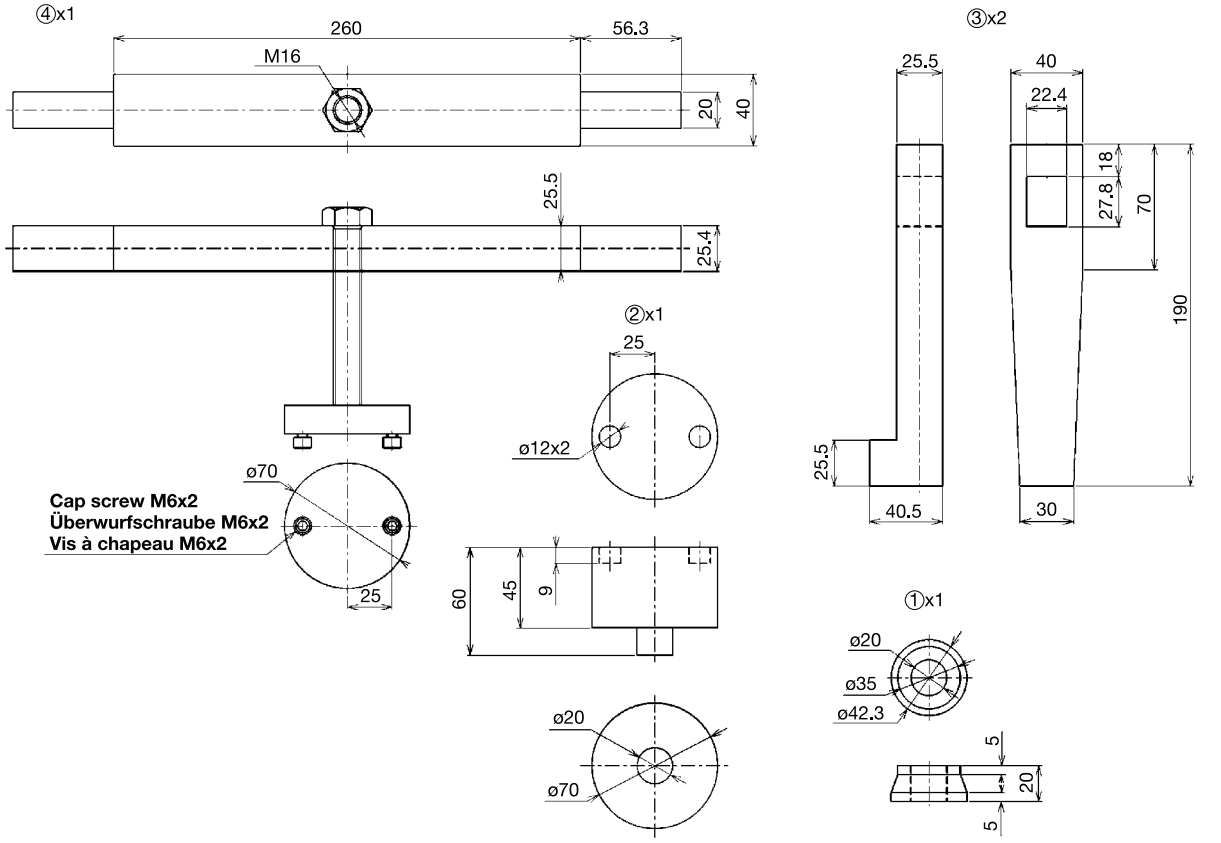
4MAA03Z

1. Flange holder
2. Housing
3. Cover
4. Carrier
5. Sun gear
6. Sun gear
7. Planet gear
8. Planet gear
9. Ring nut
10. Thrust plate
11. Thrust plate
12. Snap ring
13. Washer
14. Bearing
15. Needle bearing
16. Inner race
17. Needle bearing
18. Floating seal
19. Inner race

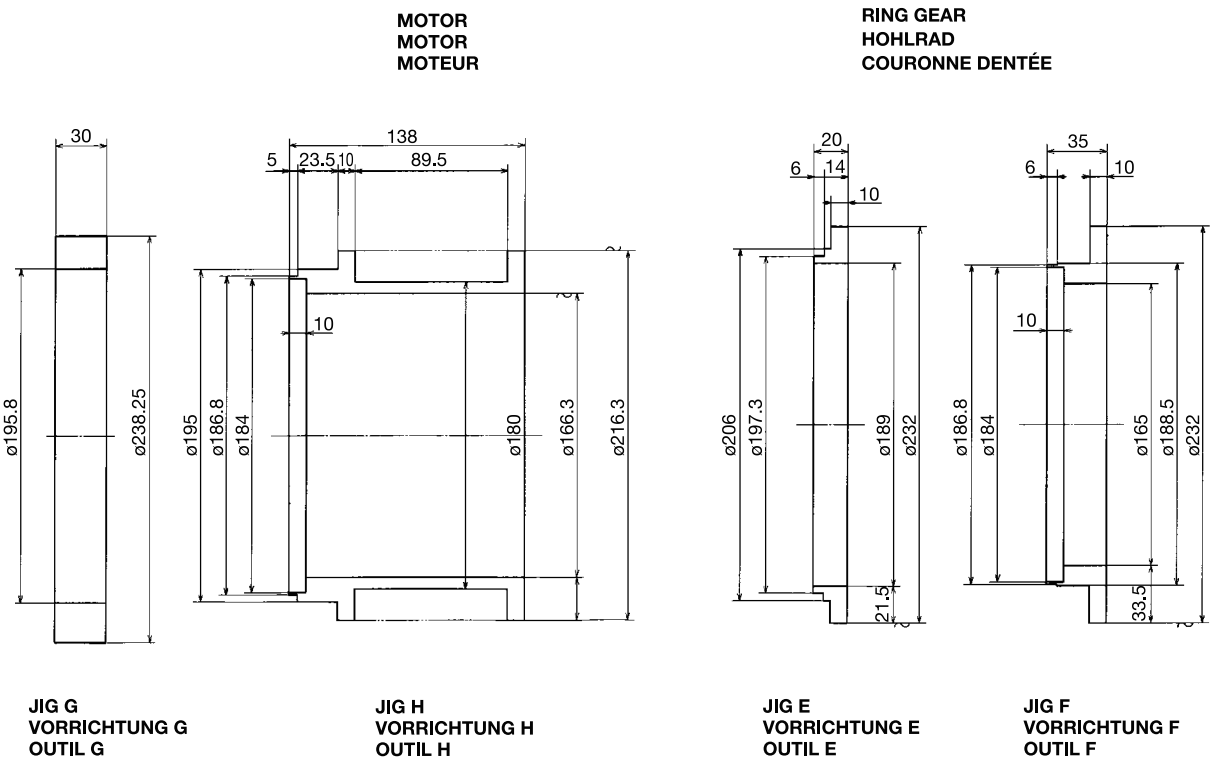
Special tools



JIG D
VORRICHTUNG D
OUTIL D



4MAA05Z



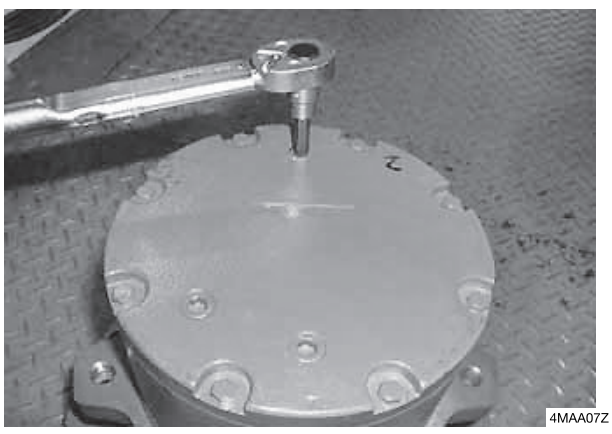
4MAA06Z

The part numbers contained in the “Disassembly and Assembly” section of this manual correspond to the numbers listed in the construction diagram. Work should be performed by referring to the diagram, as necessary.

Disassembly

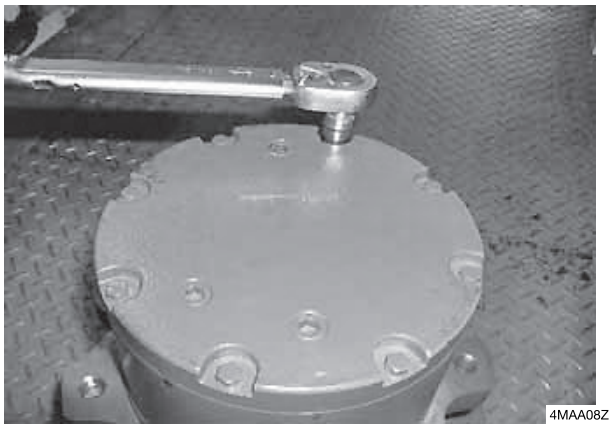
Reduction gears

1. Take out the plugs and drain out the gear oil.

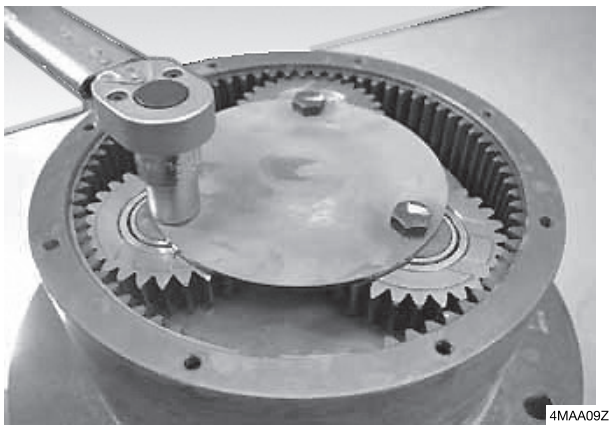


4MAA07Z

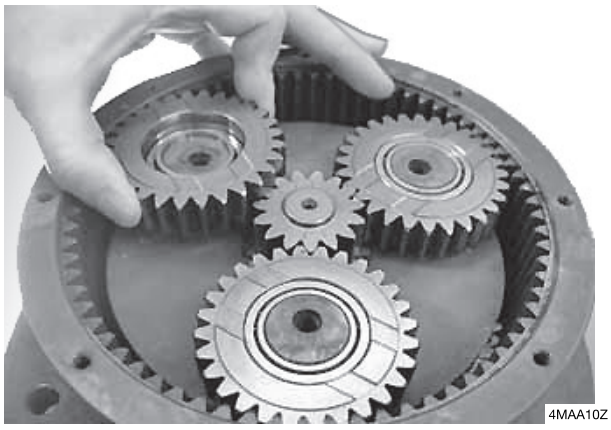
2. Take out the bolts and remove the cover (3).
   - If it is hard to remove, lightly tap the side of the cover with the rubber hammer.


4MAA08Z

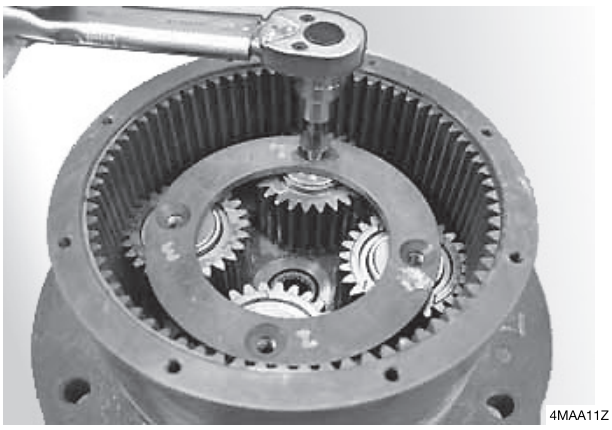
3. Take out the bolts and remove the thrust plate (10).


4MAA09Z

4. Take out the sun gear (5), and remove the planet gears (7) and the carrier (4).
   - Remove the planet gear together with the needle bearing (15).


4MAA10Z

5. Take out the screws and remove the thrust plate (11).
6. Remove the planet gear (8).
   - Remove the planet gear together with the needle bearing (17).

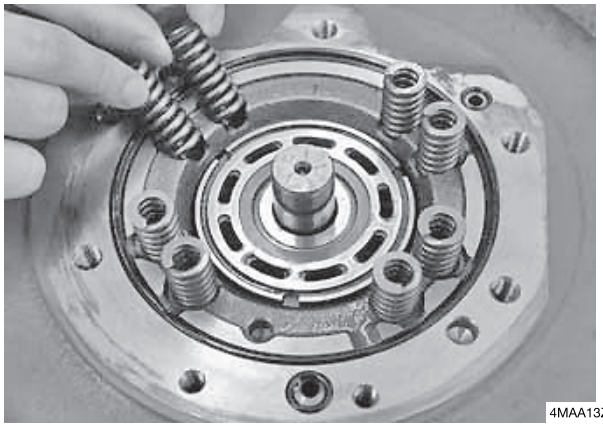

4MAA11Z

Hydraulic motor

1. Take out the cap screws, and then remove the valve body (24).
2. Remove the pins (20) and the valve plate (22) from the valve body (24).


4MAA12Z

3. Remove the springs (14) and the O-rings (2), (3), (7).

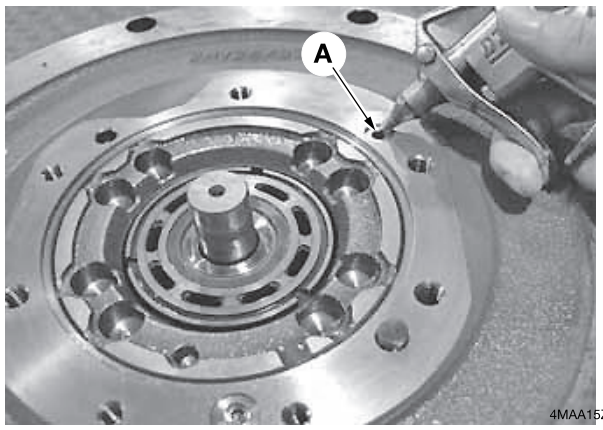

4MAA13Z

4. Remove the brake piston (17).

⚠ WARNING

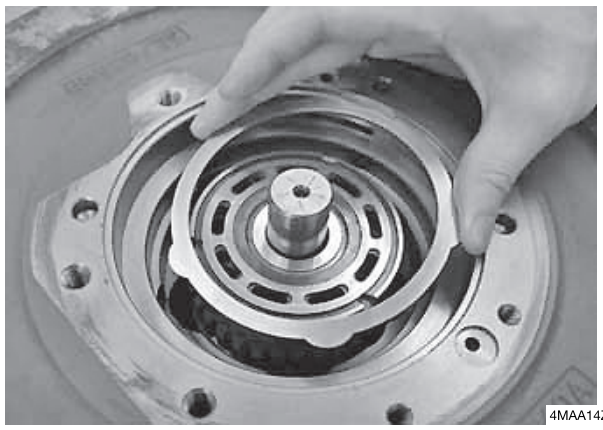
In a work area where compressed air is used, metal fragments or other objects could scatter in the air. Wear protective gear such as goggles and a protective face mask.

- Insert compressed air into the parking brake release port (A) of the flange holder, and then remove the brake piston.



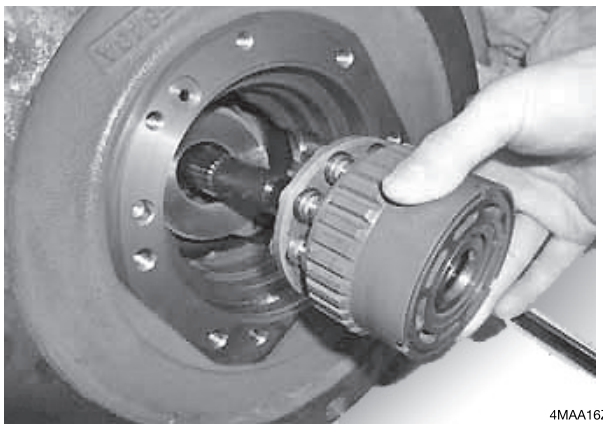
4MAA15Z

5. Remove the center discs (15) and the friction discs (16).

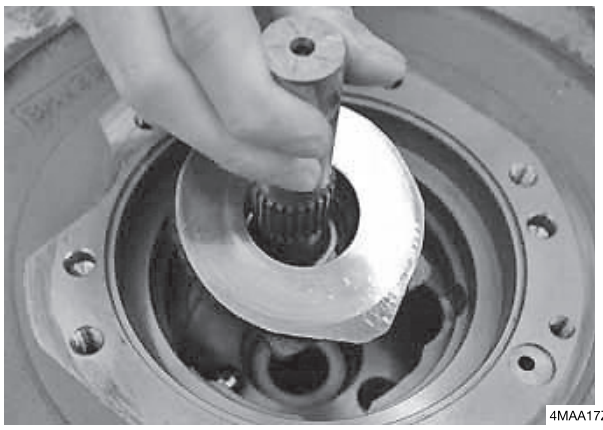

4MAA14Z

6. Remove the cylinder block assembly (12).

Important: Be sure not to damage the sliding surface.


4MAA16Z

7. Remove the shaft (11) and the swash plate (18).

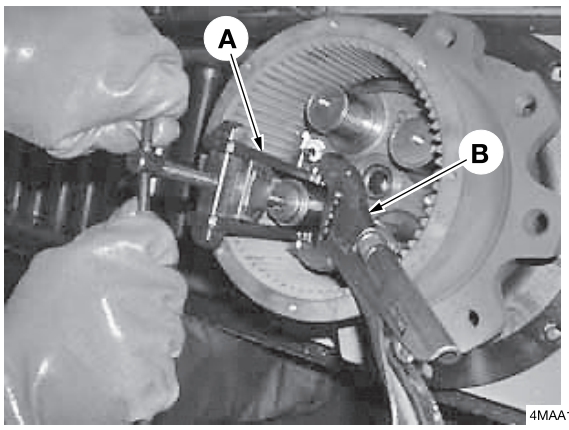

4MAA17Z

8. Remove the piston (19) and the balls (8).


4MAA18Z

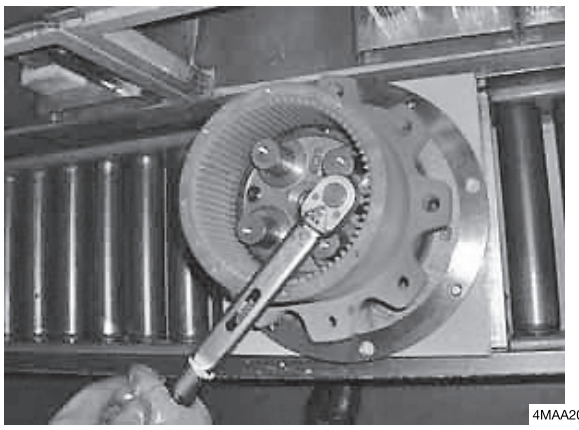
Floating seal

1. Remove the inner race (16).
   - Use the jig (A) to hook the inner race, and then use the jig (B) to hold the jig (A) so that the inner race cannot be unhooked.
     Jig manufacturer: Super tool
     Jig (A): Armature bearing puller AB2
     Jig (B): Grip pliers SG100

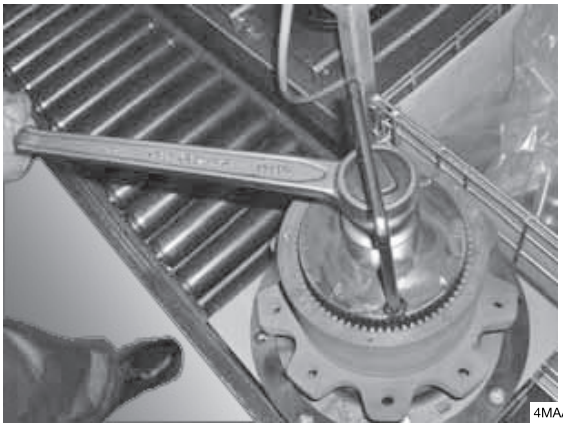


4MAA19Z

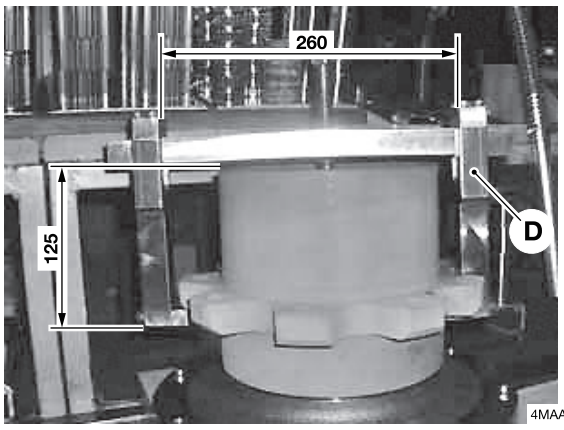
2. Remove the plugs.



3. Remove the ring nut (9).
   - Use the jig (C).



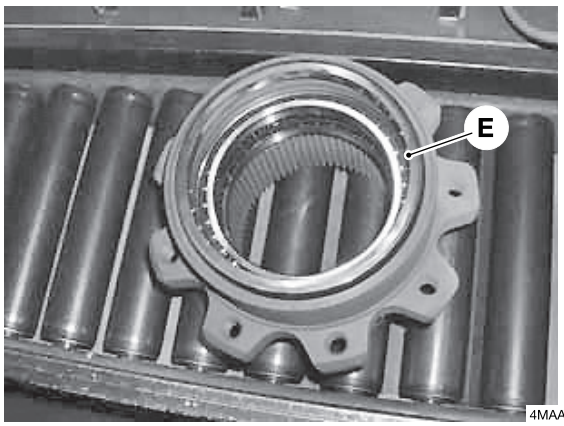
4. Remove the housing (2) from the flange holder (1).
   - Use the jig (D).
5. Remove the floating seals (18) from the housing (2) and the flange holder (1).



Assembly

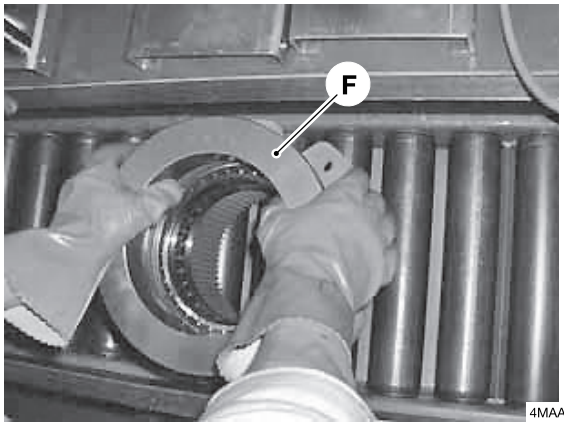
Floating seal

1. Place the floating seal (18) in the housing (2).
   - Apply gear oil on the O-ring.
2. Place the guide jig (E).

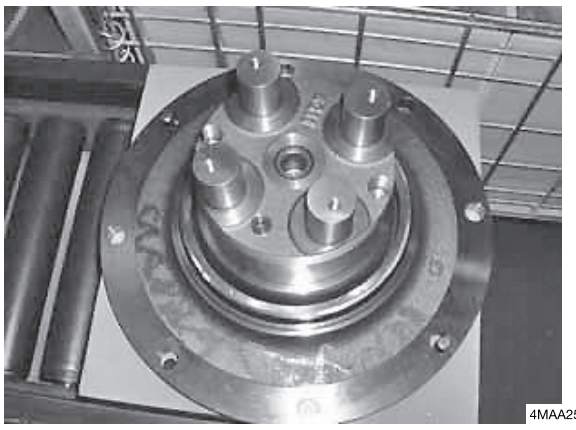


3. Fit the floating seal (18) by pressing the guide jig (E) with the jig (F).
   - Apply gear oil on the sliding surface.

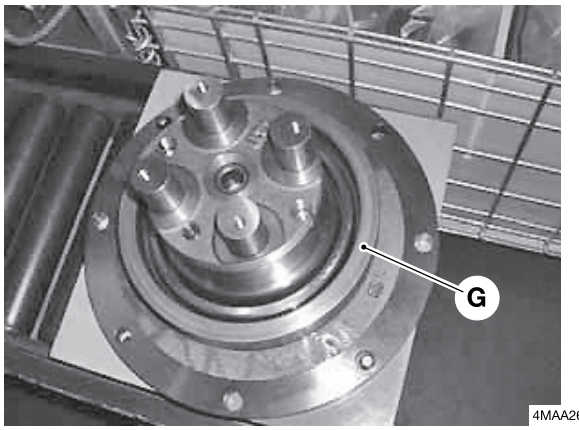
Important:
- Be sure not to damage the sliding surface.
- The floating seal must be mounted horizontally.



4. Place the floating seal (18) in the flange holder (1).
   - Apply gear oil on the O-ring.

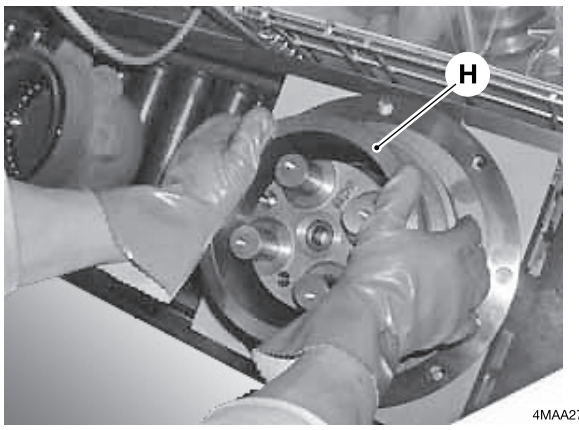


5. Place the guide jig (G) in the flange holder (1).



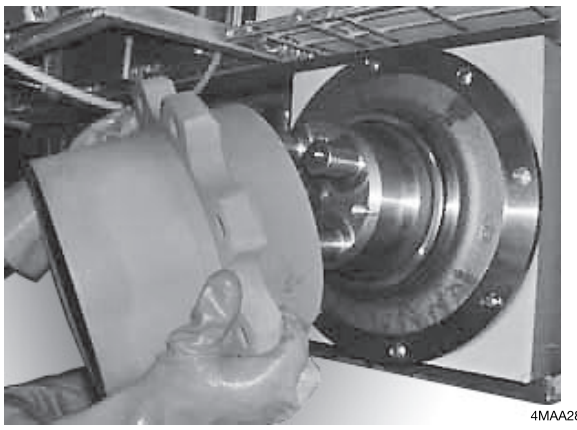
6. Press-fit the guide jig (G) with the jig (H), and then install the floating seal (18).
   - Apply gear oil on the sliding surface. Do not apply grease.

Important:
- Be sure not to damage the sliding surface.
- The floating seal must be mounted horizontally.



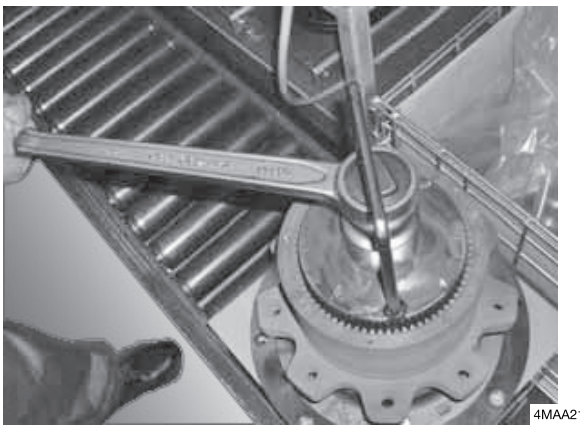
4MAA27Z

7. Install the housing (2) on the flange holder (1).


4MAA28Z

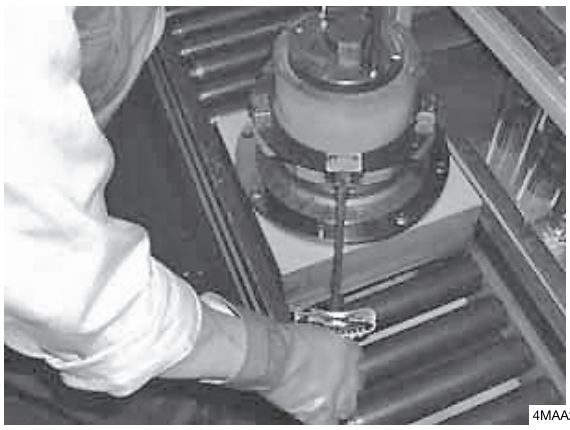
8. Fit the ring nut (9).
   - Use the jig (C).

   200 ±100 N·m (147.5 to 73.8 ft-lb.)

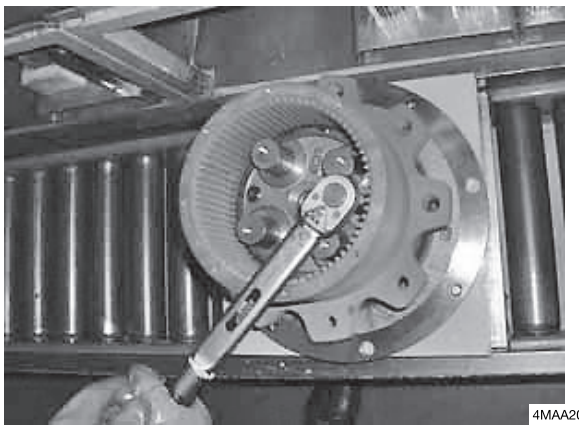

4MAA21Z

9. Check the rotational torque of the housing (2).

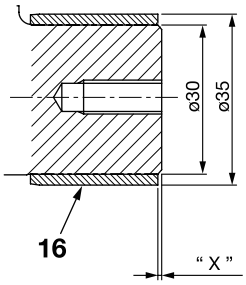
   Housing rotational torque: 4.7 to 7.8 N·m (3.5 to 5.8 ft-lb.)


4MAA29Z

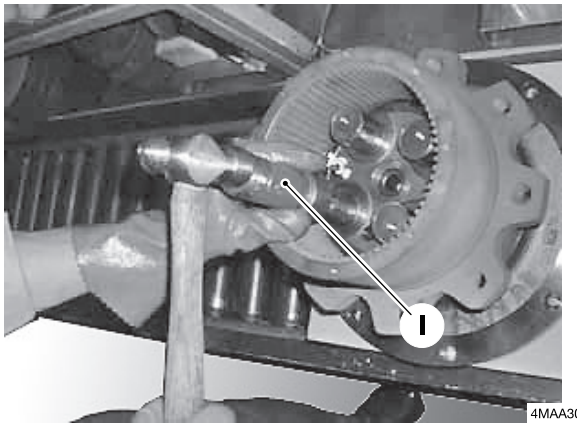
10. Fit the plugs.
    Plug: 30 N·m (22 ft-lb.)


4MAA20Z

11. Install the inner races (16).
    - Use the jig (I) and a hammer to install the inner races.
    - After assembly, the dimension "X" must be between 0 and 1 mm (0 to 0.039 in.).



4MAA31Z



4MAA30Z

Hydraulic motor

1. Install the oil seal (1).
   - Press-fit the seal with its metal edge positioned upside.
   - Grease the lip part of the oil seal.
2. Install the control piston (19) and the balls (8).


4MAA18Z

3. Install the bearing (9) on the shaft (11) and secure them with a snap ring.


4MAA33Z

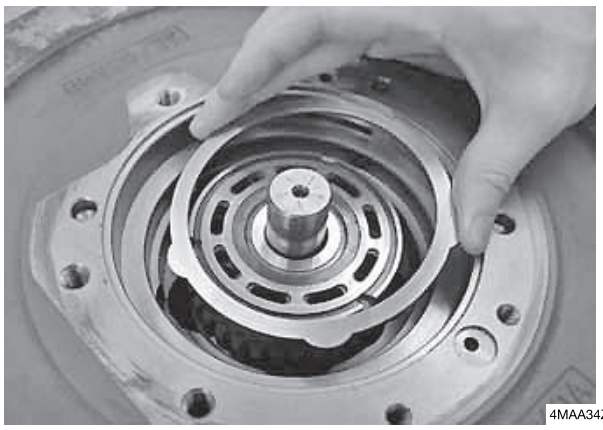
4. Install the shaft (11) and the swash plate (18).
   - Apply hydraulic oil on the sliding surface of the swash plate.


4MAA17Z

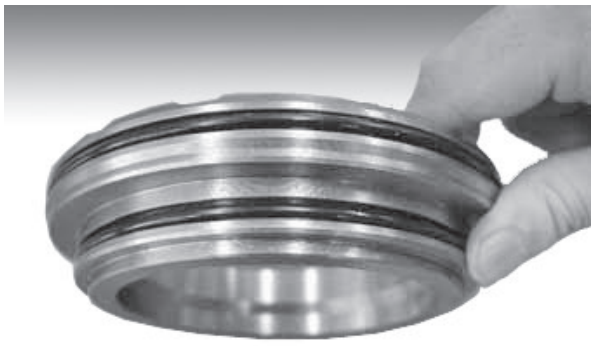
5. Install the cylinder block assembly (12).
   - Use the spline of the shaft as a guide.


4MAA16Z

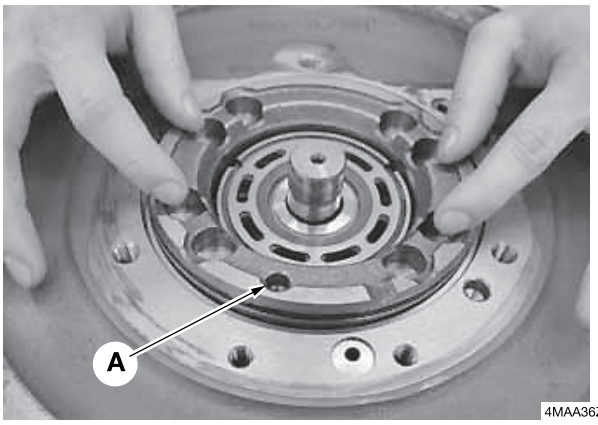
6. Install the center discs (15) and the friction discs (16) alternately.
   - The friction discs must be engaged with the spline of the cylinder block.
   - Center disc: 4 discs
   - Friction disc: 3 discs


4MAA34Z

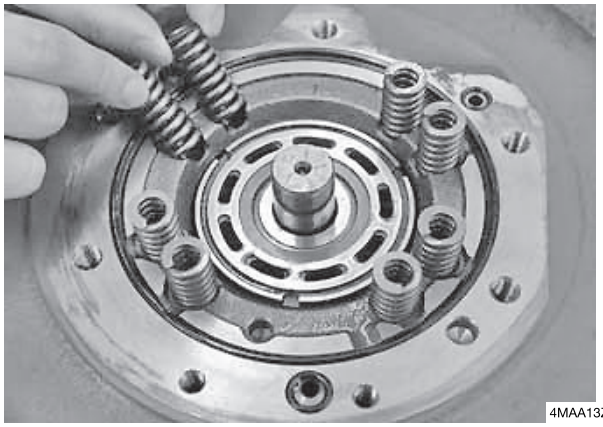
7. Fit the O-rings to the brake piston (17).
   - Lightly grease the O-rings.


4MAA35Z

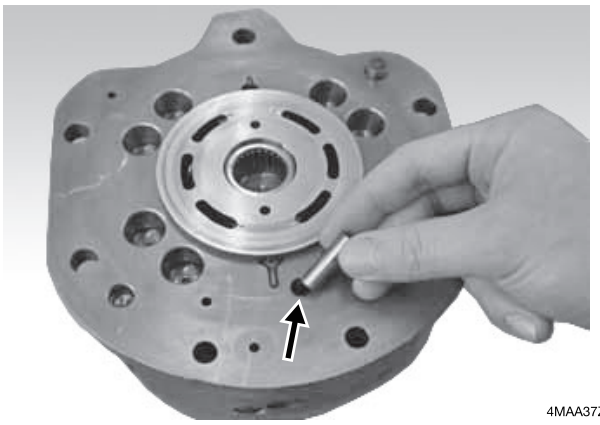
8. Install the brake piston (17).
   - Apply hydraulic oil on the sliding surface of the cylinder block.
   - Be sure that no foreign matter is present in the cylinder block port.
   - Gauge pin hole (A)



9. Install the springs (14) on the brake piston (17).
10. Install the O-rings (2), (3), (7) and the pin (20).



11. Install the valve plate (22) on the valve body (24).
    - Grease the backside of the valve plate.
12. Install the pin (28).

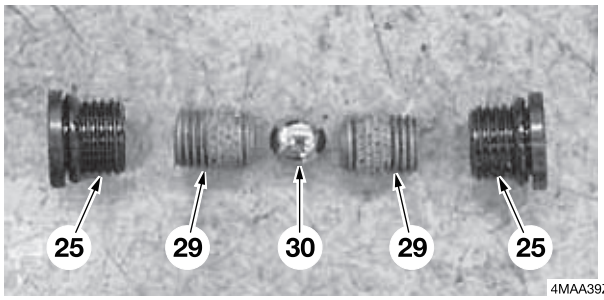


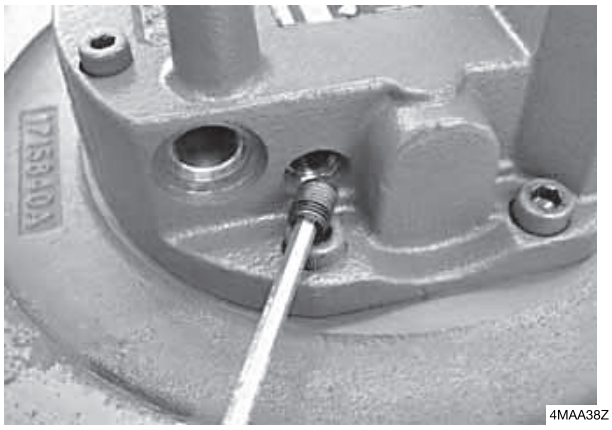
13. Install the valve body (24) and fit the cap screw.
    - The pin (28) must be fitted into the gauge pin hole (A) of the brake piston (17).

    Cap screw 6 mm (0.24 in.): 30 N·m (22.1 ft-lb.)
    Cap screw 8 mm (0.31 in.): 60 N·m (44.3 ft-lb.)

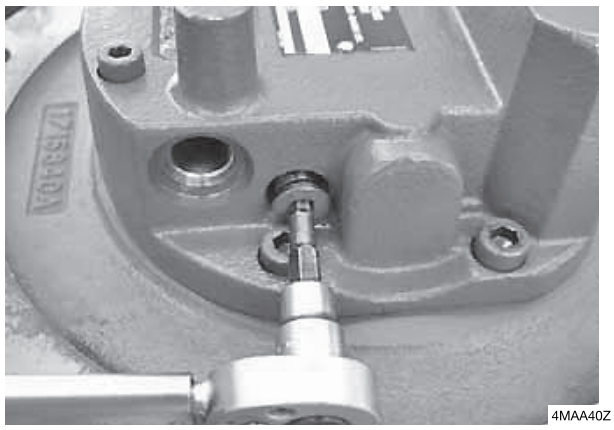


14. Fit the ball (30) and the plugs (29).
    Plug: 60 N·m (44.3 ft-lb.)





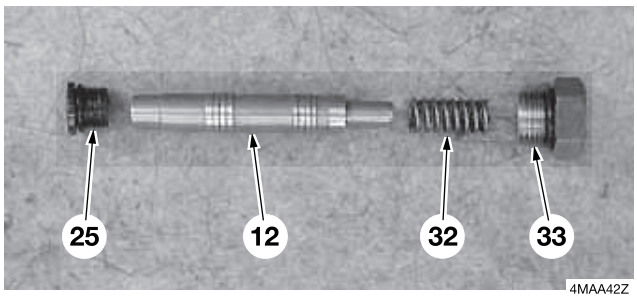
15. Fit the plug (25).
    Plug: 35 N·m (25.8 ft-lb.)



16. Fit the plugs (25), and then install the spool (12) and the spring (32).
    Plug: 35 N·m (25.8 ft-lb.)

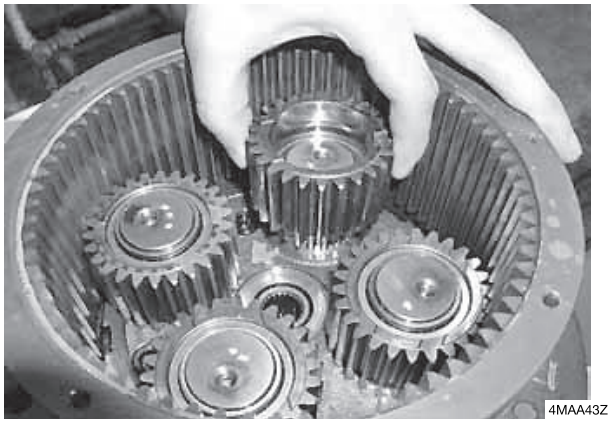


17. Fit the plug (33).
    Plug: 50 N·m (36.9 ft-lb.)

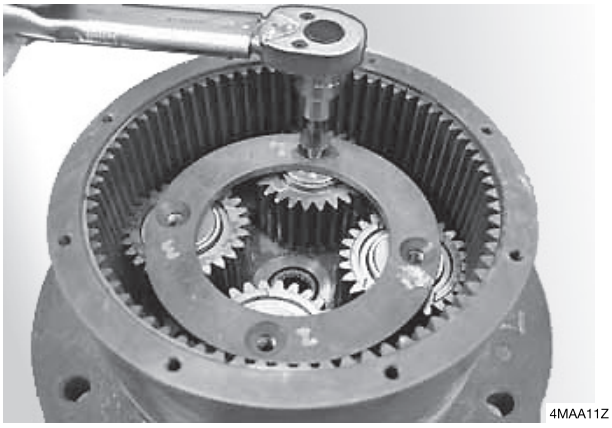


Reduction gears

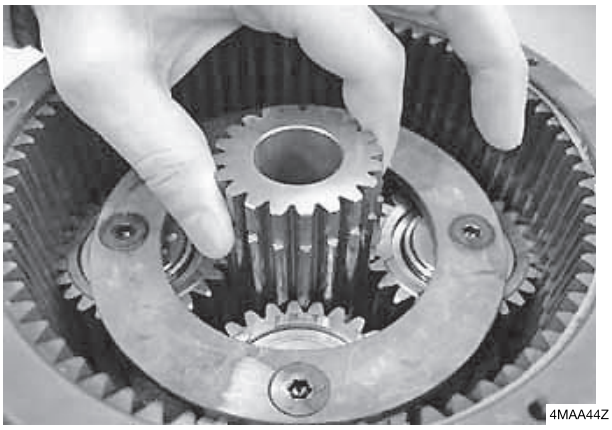
1. Install the needle bearings (17) and the planet gears (8).


4MAA43Z

2. Install the thrust plate (11) and fit the screws.
   Screw: 20 N·m (14.8 ft-lb.)


4MAA11Z

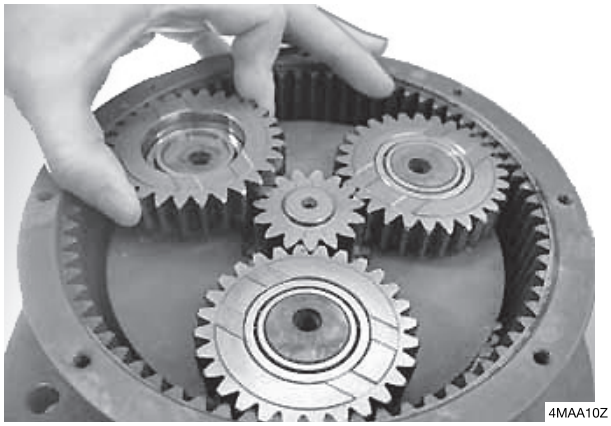
3. Install the sun gear (6).


4MAA44Z

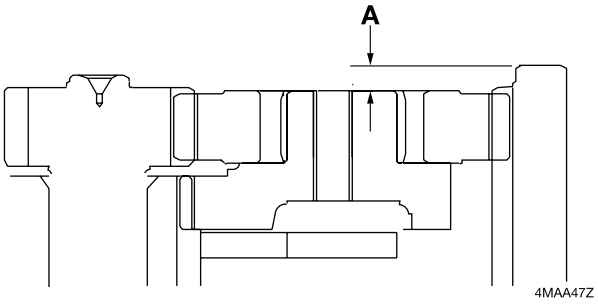
4. Install the inner races (19) on the carrier (4).
   - Apply oil on the inside and outside of the inner races.


4MAA45Z

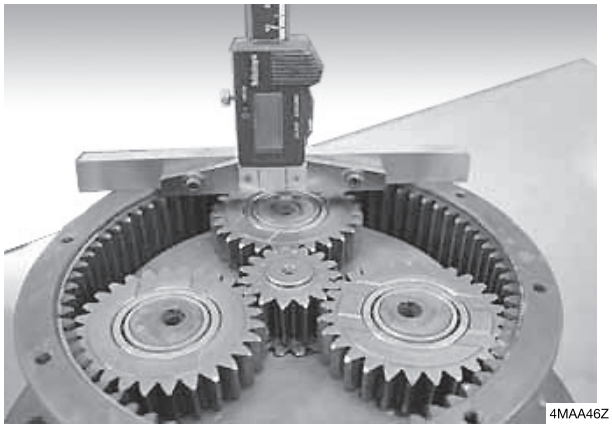
5. Install the planet gears (7) and the needle bearings (15) on the carrier (4), and then install them on the housing (2).
6. Install the sun gear (5).


4MAA10Z

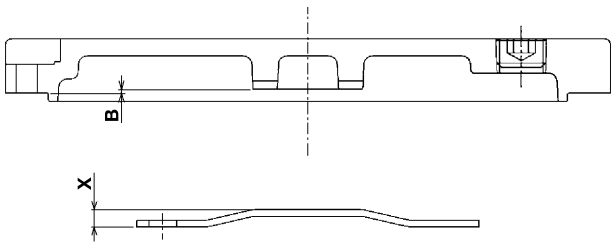
7. Measure the depth “A” from the housing end face to the holder (pin).



4MAA47Z

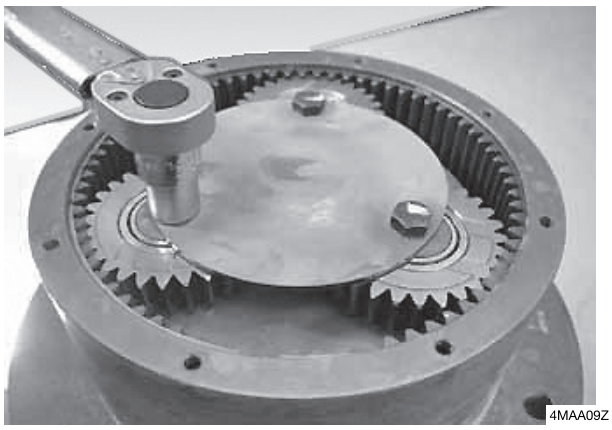

4MAA46Z

8. Measure the dimension “B” of the cover.
9. The thrust plate (10) must be such that its thickness “X” is 0.2 to 0.4 mm (0.008 to 0.016 in.) thinner than the thickness of “A” plus “B” measured above.

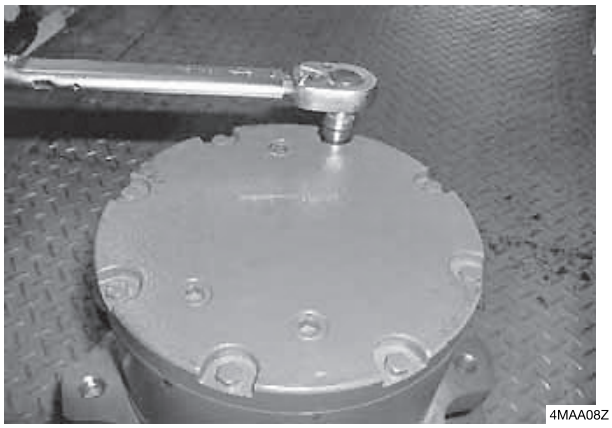


4MAA48Z

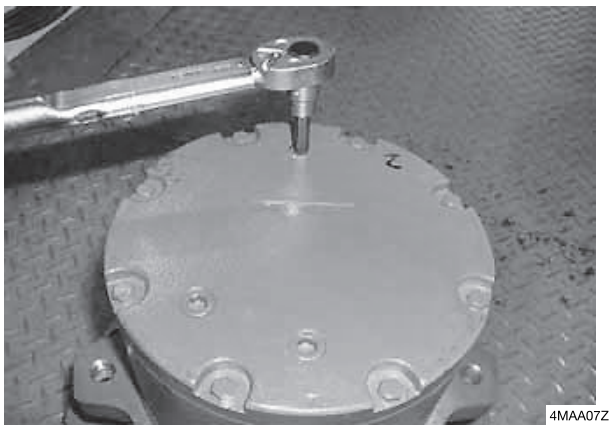
10. Install the thrust plate (10) and fit the screws.
    Bolt: 25 N·m (18.4 ft-lb.)


4MAA09Z

11. Install the cover and fit the bolts.
    - Apply either Loctite #515 or ThreeBond #1215 to the cover surface on which the housing is mounted.
    - Bolt: 16 N·m (11.8 ft-lb.)


4MAA08Z

12. Add the gear oil through the plug hole, and attach the plug.
    - Be sure to wrap seal tape around the plug.
    - Gear oil to be added: 1 L
    - Plug: 22 N·m (16.2 ft-lb.)


4MAA07Z

Inspection and adjustment

Use limit for parts

Part	Place to be checked	Criteria	Action
Planet gear	Gear tooth surface	No abnormal scratches, wear or flaking on the tooth surface	Replace
	Rolling surface of the needle bearing	No abnormal scratches, wear or flaking on the rolling surface	Replace
Needle bearing	Needle bearing surface	No abnormal scratches, wear or flaking on the surface	Replace
Housing, sun gear, drive gear	Gear tooth surface	No abnormal scratches, wear or flaking on the tooth surface	Replace
Thrust plate	Sliding surface	No abnormal scratches, wear or seizure on the surface	Replace
O-ring	—	—	Replace
Shaft	Oil seal surface	No scratches or wear	Replace
Ball bearing	Sliding surface	No abnormal scratches, wear or flaking on the ball or race	Replace
Oil seal	—	—	Replace
Swash plate	Surface of the sliding part with the piston assembly	No abnormal scratches, wear or seizure on the surface	Repair with a lapping tool (#1000) or replace
Cylinder block	Surface of the sliding part with the valve plate	No abnormal scratches, wear or seizure on the surface	Repair with a lapping tool (#1000) or replace the cylinder block and the piston together
Piston assembly	Surface of the sliding part with the swash plate	No abnormal scratches, wear or seizure on the surface	
Valve plate	Surface of the sliding part with the plunger	No abnormal scratches, wear or seizure on the surface	Repair with a lapping tool (#1000) or replace
Valve body	Surface of the sliding part with the plunger	No abnormal scratches, wear or seizure on the surface	Replace the valve body and the spool together
Spool	Surface of the sliding part with the base plate	No abnormal scratches, wear or seizure on the surface	
Center disc, friction disc	Disc thickness	Four center discs and three friction discs are worn to 13.5 mm (0.53 in.) or less	Replace

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TROUBLESHOOTING 5

This “Troubleshooting” section describes the fault diagnosis and corrective actions mainly for hydraulic systems. The cause of the problem can be investigated by following the steps in the chart shown at the beginning of each item.

Notes on troubleshooting and servicing

1. Do not disassemble the faulty part without first investigating the following.
   a. Ask the user the following questions.
      - The situation when the fault occurred.
      - Any abnormalities or changes before the fault occurred.
      - Any faulty parts other than the part in question.
      - Any identical failure in the past
   b. Drive the machine yourself and confirm the faulty condition.
      - Determine if it is really faulty by referring to the performance criteria. Note that such determination may differ depending on the person.

Important

By operating the user’s machine, you could make a bad situation worse. Therefore, before driving the machine, always ask the user’s permission to do so.

   c. Determine the cause of trouble based on the information obtained from the user and by driving the machine yourself. Also remember that once the machine has been disassembled, it is almost impossible to reproduce the conditions of the trouble, and so there will be no second chance to find out the true cause. Therefore be sure to find the true cause of the trouble before attempting disassembly.

2. When multiple causes are suspected, start with the simplest one.
3. Think why the trouble occurred and try to correct the root cause of the problem.

OVERALL MACHINE

No operation is possible.

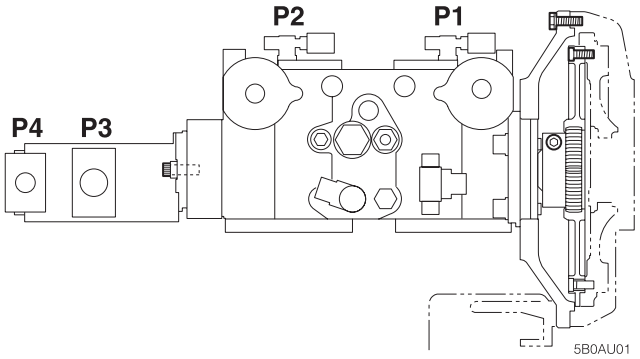
1	Check the hydraulic oil level.	Insufficient	Add oil.
		Sufficient	
2	Check the hydraulic pump.	Faulty	• Repair or replace. • Replace the coupling.
		Normal	
3	Check the fuse.	Faulty	Replace.
		Normal	
4	Check the lever lock switch.	Faulty	Replace.
		Normal	
5	Check the lever lock relay.	Faulty	Replace.
		Normal	
6	Check the lever lock solenoid.	Faulty	Repair or replace.
		Normal	
7	Check the SUB valve.	Faulty	Repair or replace.
		Normal	
8	The pilot valve is faulty.	Faulty	Repair or replace.

1. Check the hydraulic oil level.
   Check the hydraulic oil tank level.
   ☞ "4. Disassembly and assembly, Hydraulic oil tank"
   When adding, use the same brand of oil currently being used.
   ☞ "2. Service data, Fuel and lubricant table"

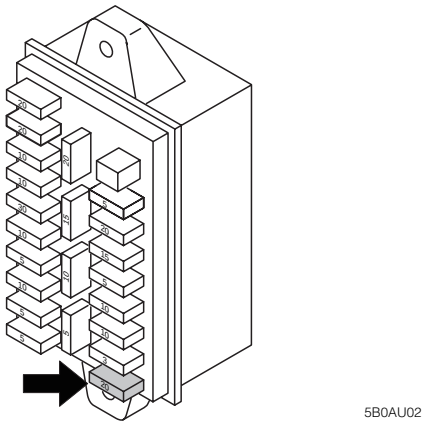
2. Check the hydraulic pump.
   - Check the discharge pressure of the pumps P1 and P2 (HST pumps).

   ☞ "2. Service data, Performance criteria"
   - Check the discharge pressure of the pumps P3 and P4 (gear pumps).

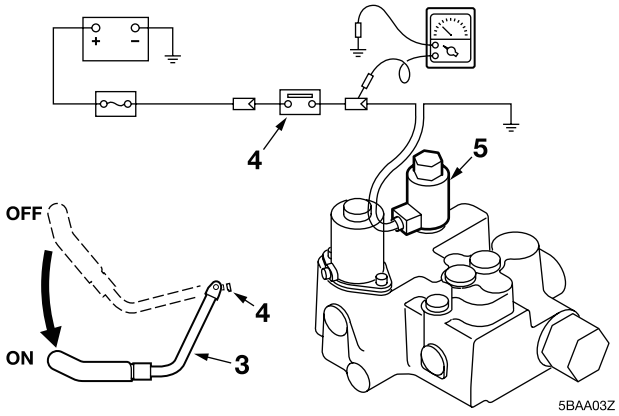
   ☞ "2. Service data, Performance criteria"
   - None of the pumps will operate if the pump coupling is faulty.



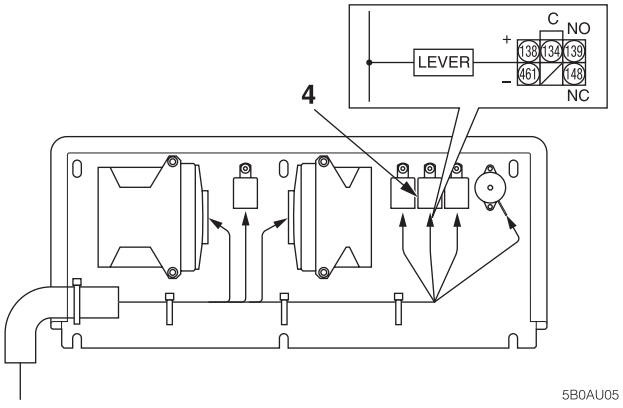
3. Check the fuse.
   Check the fuse in the power supply circuit that operates the lever lock solenoid valve.



4. Check the lever lock switch.
   The lever lock switch (4) can be switched on by moving the safety bar (3) to the driving position. Use a tester to check to see if there is voltage across the lever lock solenoid (5).
   - If there is voltage, the switch should be working.

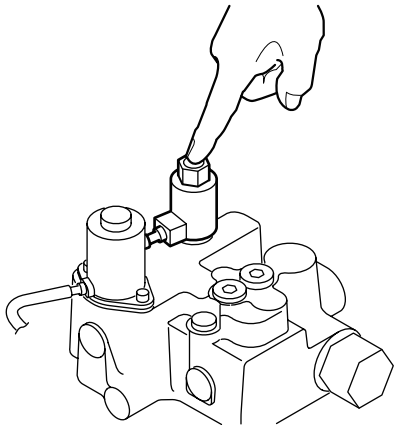


5. Check the lever lock relay.
   Remove the harness for the lever lock relay (4), and check to see if there is voltage at the (+) terminal of the harness.
   - If there is voltage present at this terminal, the lever lock relay is faulty.



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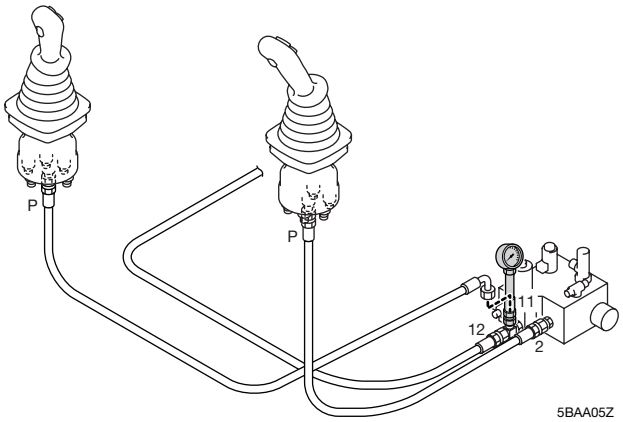
6. Check the lever lock solenoid valve.
   Check the lever lock solenoid on the SUB valve.
   a. Turn on the starter switch.
   b. Lightly press down on the protrusion on the end of the solenoid.
   c. Move the safety bar to turn on the proximity switch.
   d. If you feel vibration under your fingers when the spool is moved and the circuit is switched, the solenoid valve is normal.


5BAA04Z

7. Check the SUB valve.
   a. Disconnect the hose connecting the SUB valve and the pilot valve from the SUB valve.
   b. Attach a pressure gauge to the SUB valve, and use the pressure gauge to measure the supply pressure (pilot pressure or charge pressure) supplied to the pilot valve.
   - Port 11 of the SUB valve: Pilot pressure
   - Port 2 of the SUB valve: Charge pressure

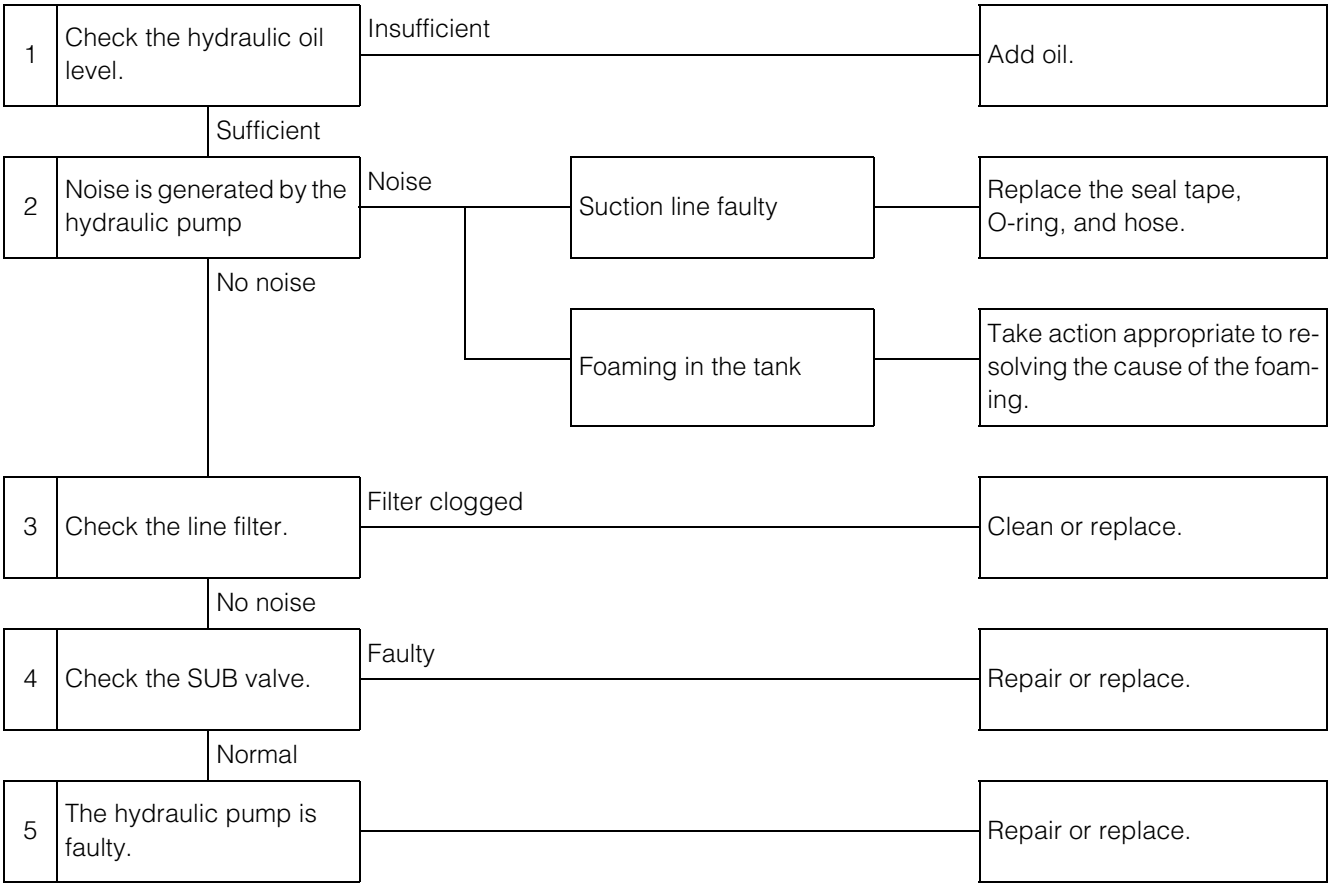
   ☞ “2. Service data, Performance criteria”

8. The pilot valve is faulty.
   ☞ “4. Disassembly and assembly, Pilot valve”



5BAA05Z

All systems working, but insufficient power.



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1. Check the hydraulic oil level.
   ☞ "4. Disassembly and assembly, Hydraulic oil tank"

2. An abnormal noise is being emitted by the hydraulic pump.
   The noise is likely to be caused by cavitation in the pump due to a faulty suction line. Check the items below.
   a. Check the lines for hydraulic oil suction.
      - Apply grease or oil to the suspected faulty sections, and check for signs of change. (Check to see if there is air suction present.)
   b. Check for clogging in the suction filter.

3. Check the line filter.
   Remove the case, and take out the filter element to check for any clogging.

4. Check the SUB valve.
   ☞ "No operation enabled, Check the SUB valve"

5. The hydraulic pump is faulty.
   If the inside of the pump is excessively worn or damaged, it is likely that there are pieces of metal present in the hydraulic oil. If this is the case, complete the items outlined below to resolve the issue.
   - Replace the elements of the line filter and spin filter.
   - Replace the hydraulic oil or flush the lines.
   - When replacing the hydraulic oil, clean the tank and suction strainer.

   ☞ "4. Disassembly and assembly, Hydraulic oil tank"
   If the pump seal is damaged, replace it.
   ☞ "4. Disassembly and assembly, HST pump"

Lift arm and bucket fail to move or are too slow.



1. Check the hydraulic pump P3.
   ☞ "No operation is possible, Check the hydraulic pump"
2. Check the main relief valve.
   Measure the relief pressure of the main relief valve.
   - The spool is operating normally if the measured value is within specifications.

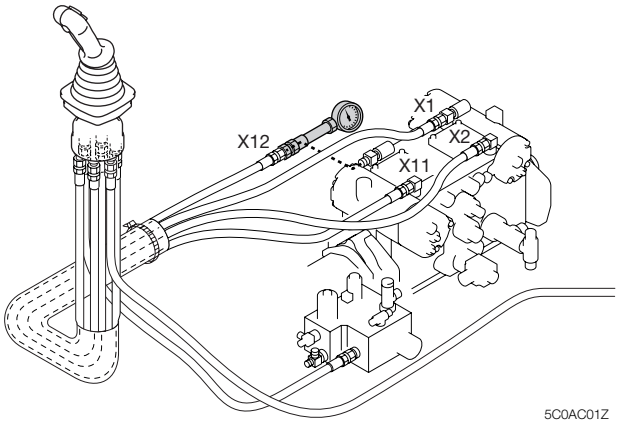
   ☞ "2. Service data, Performance criteria"
3. The pilot valve is faulty.
   ☞ "4. Disassembly and assembly, Pilot valve"

TRAVELING

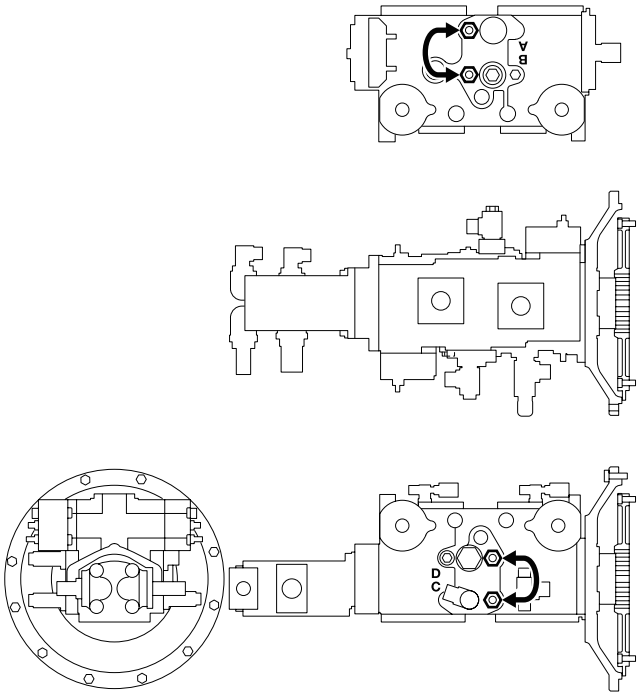
Traveling fails.

1	Check the charge pressure.	Pressure too low		Repair or replace.
	Normal			
2	Check the pilot valve.	Faulty		Repair or replace.
	Normal			
3	Check the HST pump discharge pressure.	Normal	The travel motor is faulty.	Repair or replace.
	Pressure too low			
4	Test the high-pressure relief valve using a replacement valve.	Problem solved		Repair or replace.
5	HST pump is faulty.			Repair or replace.

1. Check the charge pressure.
   Measure the charge pressure of the HST pump.
   ☞ "2. Service data, Performance criteria"
   Replace the HST pump if the charge pressure is too low.
   ☞ "4. Disassembly and assembly, HST pump"
2. Check the pilot valve.
   a. Disconnect the hose connecting the pilot valve (left) and the HST pumps (P1 and P2) from the pump side.
   b. Attach a pressure gauge to the hose that was disconnected.
   c. Operate the lever (traveling) and measure the pressure (charge pressure).
      • Replace the pilot valve if the pressure (charge pressure) is not at a normal level.
   ☞ "2. Service data, Performance criteria"
3. Check the HST pump discharge pressure.
   ☞ "2. Service data, Performance criteria"
   If the discharge pressure of the HST pump is not reading at a normal level, repair or replace the travel motor.

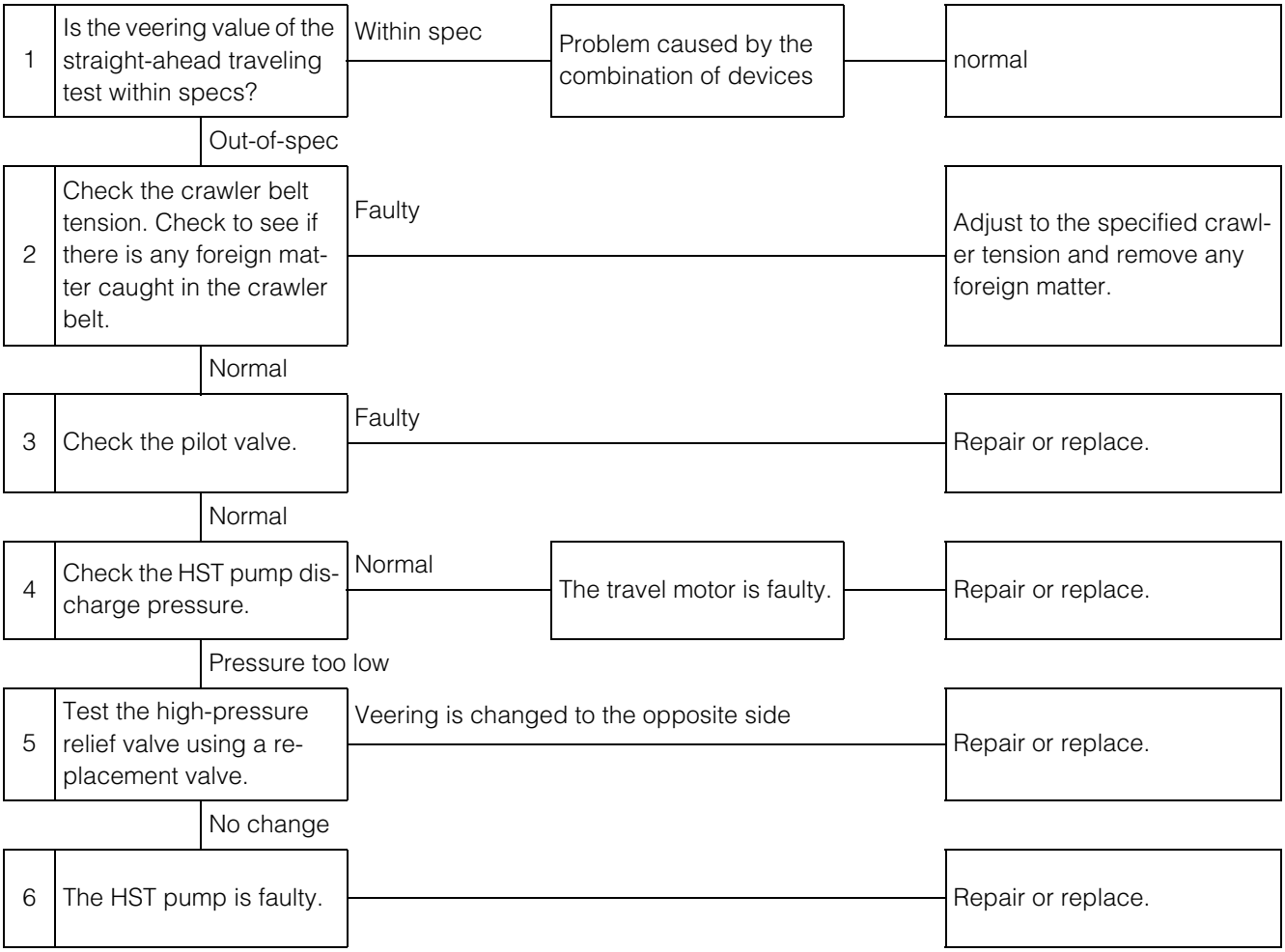


4. Test the high-pressure relief valve using a replacement valve.
   All four high-pressure relief valves are unlikely to fail simultaneously. Therefore, it is efficient to test with a replacement valve at a time.
   - If the machine is able to travel with the replacement valve, then the valve that was replaced is faulty.
5. The HST pump is faulty.
   ☞ “4. Disassembly and assembly, HST pump”



5C0AC02Z

Right or left travel speed decelerates and the machine veers to one side.



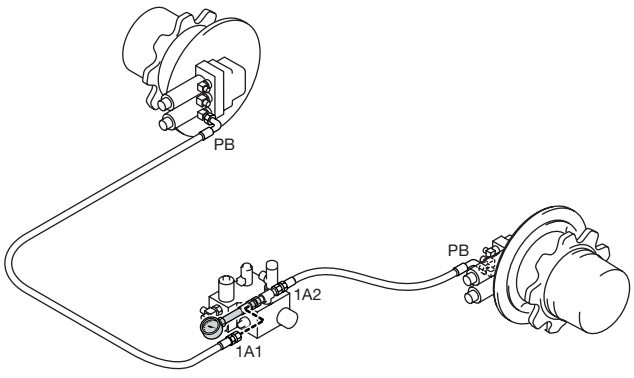
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1. Is the veering value of the straight-ahead traveling test within specs?
   If the veering value falls within the specifications, the machine is normal. The problem is caused by the combination of devices.
   ☞ "2. Service data, Performance criteria"
2. Check the crawler belt tension. Check to see if there is any foreign matter caught in the crawler belt.
   ☞ "2. Service data, Performance criteria"
3. Check the pilot valve.
   ☞ "Traveling fails, Check the pilot valve."
4. Check the HST pump discharge pressure.
   ☞ "2. Service data, Performance criteria"
   If the discharge pressure of the HST pump is not reading at a normal level, repair or replace the travel motor.
5. Test the high-pressure relief valve using a replacement valve.
   ☞ "Traveling fails, Test the high-pressure relief valve using a replacement valve.
6. The HST pump is faulty.
   ☞ "4. Disassembly and assembly, HST pump"

Operating temperature of the travel system is too high.

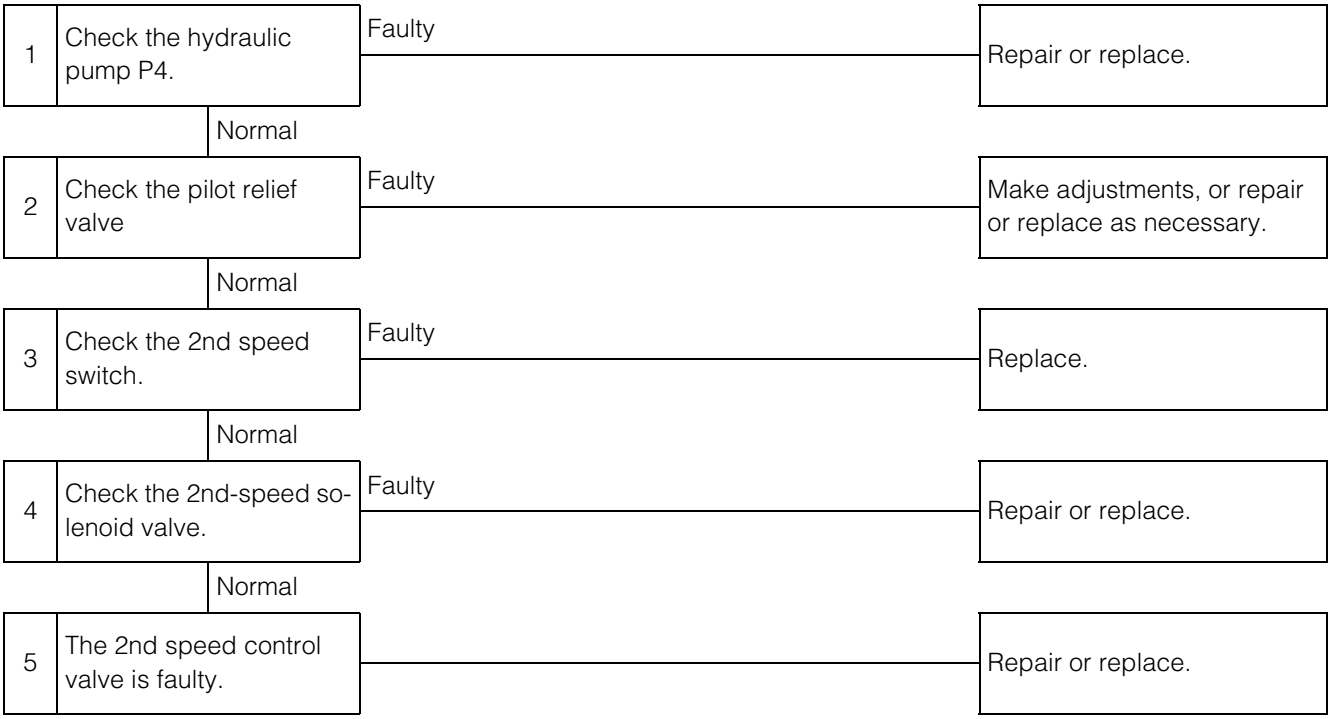
1	Check the hydraulic oil level.	Insufficient	Add oil.
		Sufficient	
2	Check the oil cooler.	Faulty	• Clean the oil cooler and radiator. • Repair or replace the oil cooler.
		Normal	
3	Check the high-pressure relief valve.	Faulty	Repair or replace.
		Normal	
4	Check the parking brake release pressure.	Pressure too low	Repair or replace.
		Normal	
5	Is the travel motor generating heat?	Yes	Repair or replace.
		No	
6	Is the HST pump generating heat?	Yes	Repair or replace.

1. Check the hydraulic oil level.
   ☞ "4. Disassembly and assembly, Hydraulic oil tank"
2. Check the oil cooler.
   Check for clogging in the suction filter and related problems. Check to see if there is an excessive amount of dirt/dust accumulated in the cooling fins of the oil cooler or radiator.
3. Check the high-pressure relief valve.
   ☞ "4. Disassembly and assembly, HST pump"
4. Check the parking brake release pressure (pilot pressure).
   a. Disconnect the hose connecting the SUB valve and the travel motor from the SUB valve.
   b. Attach a pressure gauge to the SUB valve, and measure the parking brake release pressure (pilot pressure).
   ☞ "2. Service data, Performance criteria"
5. Is the travel motor generating heat?
   ☞ "4. Disassembly and assembly, Travel motor"
6. Is the HST pump generating heat?
   ☞ "4. Disassembly and assembly, HST pump"



5CAA03Z

2nd-speed travel is not possible.

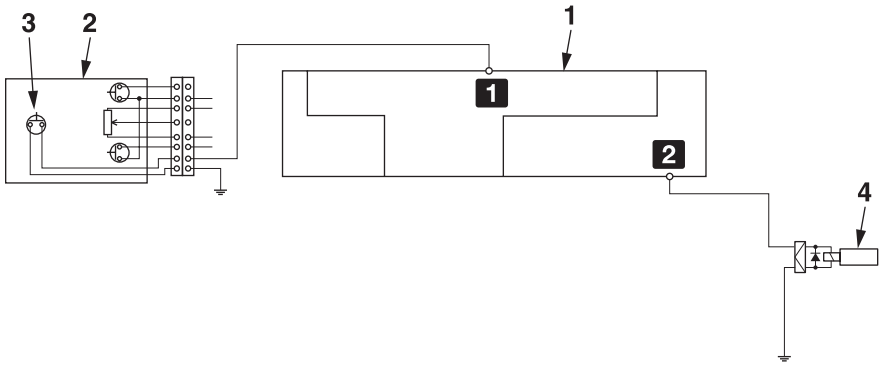


1. Check the hydraulic pump P4.
   Check the hydraulic pump P4 that supplies hydraulic pressure for the 2nd speed switching.
   ☞ "Overall Machine, No operation is possible"
   Also, check the line filter for possible clogging, and clean it as necessary.

2. Check the pilot relief valve.
   Measure the relief pressure of the pilot relief valve.
   - The valve is operating normally if the measured pressure is within specifications.

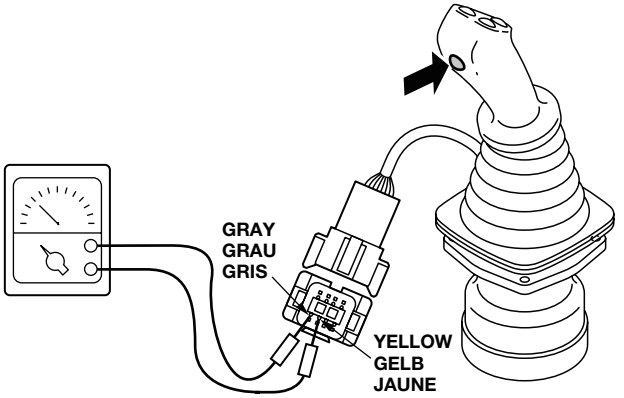
   ☞ "2. Service data, Performance criteria"

1 C1P38: 2nd speed travel switch
2 C1P7: 2nd speed travel solenoid
1. Controller
2. Pilot valve (L)
3. 2nd-speed switch
4. 2nd-speed travel solenoid



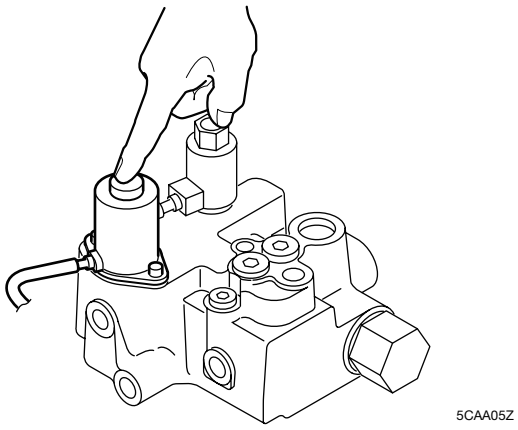
5C0AU01

3. Check the 2nd speed switch.
Press the switch to turn it on. Next, check for continuity using a multimeter.



5CAA04Z

4. Check the 2nd-speed solenoid valve.
Check the 2nd speed solenoid valve on the SUB valve.
   a. Turn on the starter switch.
   b. Lightly press down on the protrusion on the end of the solenoid.
   c. Turn on the 2nd speed switch.
   d. The solenoid valve is operating normally if you feel vibration under your fingers when the spool is moved and the circuit is switched.

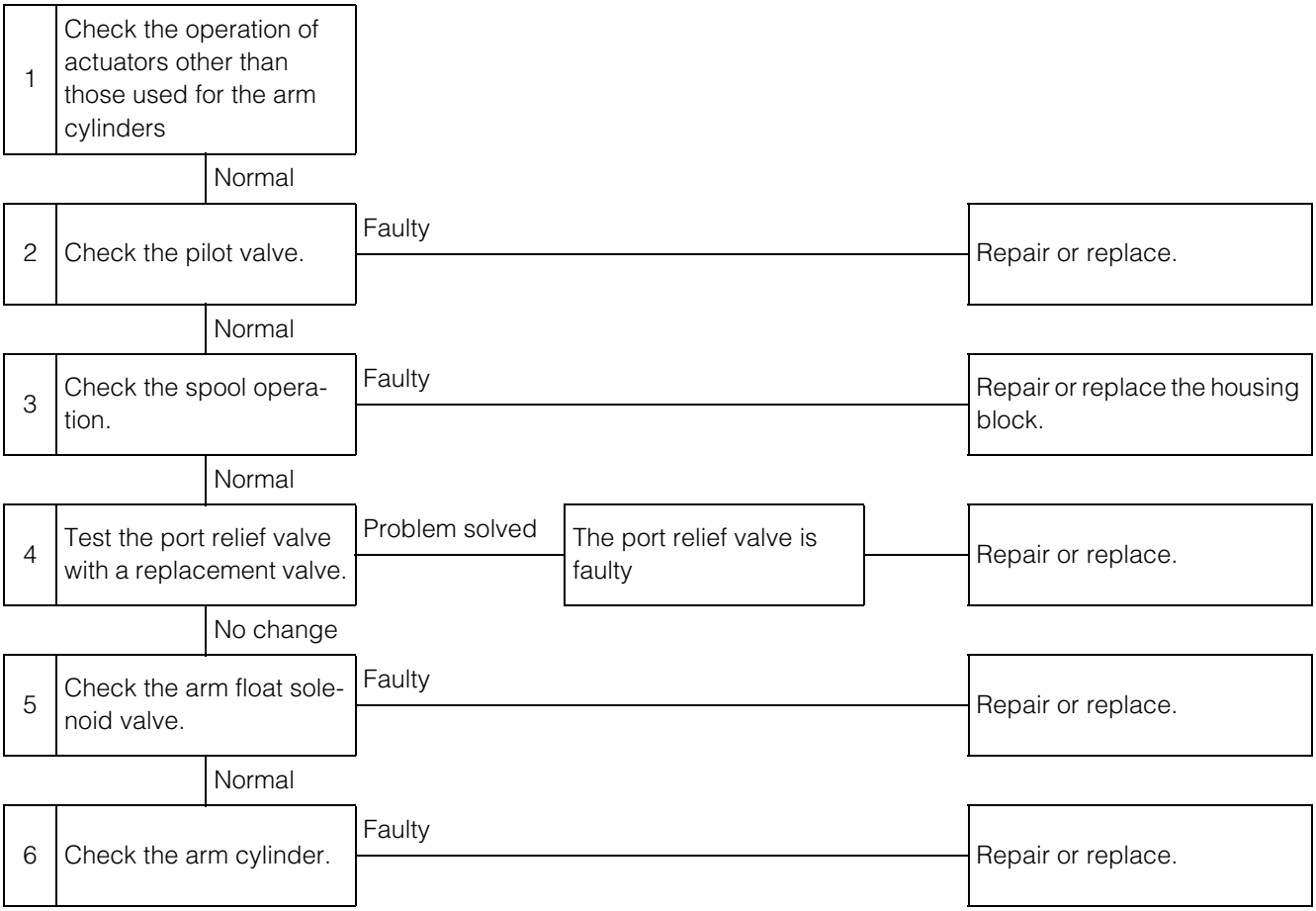

5CAA05Z

5. The 2nd speed control valve is faulty.
Check if there is sticking or foreign matter caught in the spool of the 2nd speed control valve.
☞ “4. Disassembly and assembly, Travel motor”

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LIFT ARM

Arm cylinder does not move.

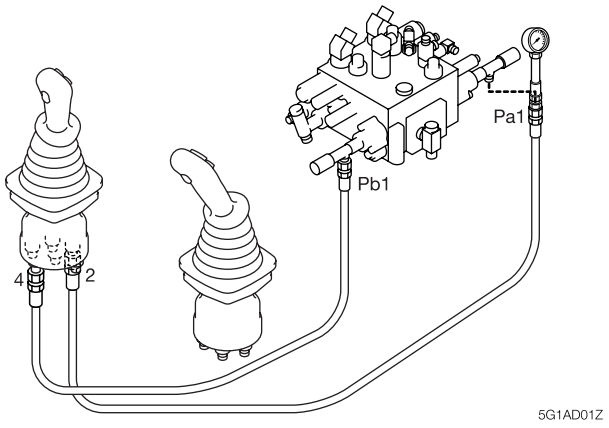


1. **Check the operation of actuators other than those used for the arm cylinders.**
   Check the operation of the lift arm only as listed in the table below.
   If operation is faulty, check the main relief valve and the hydraulic pump (P3).
   ☞ "2. Service data, Performance criteria"
   ☞ "Overall Machine, No operation is possible"

Lever to operate	Device to check	
Bucket	Relief valve R3	Pump P3

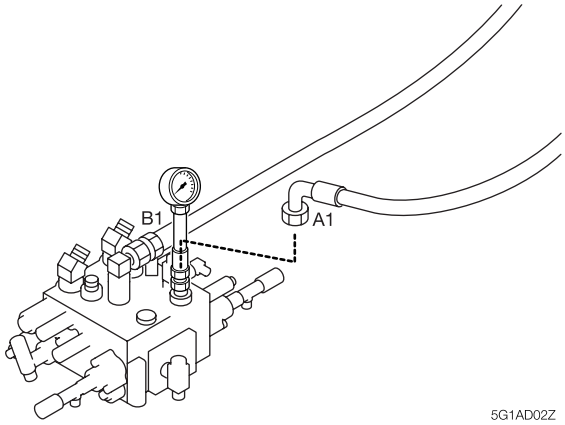
2. Check the pilot valve.
   a. Disconnect the hose connecting the pilot valve (right) and the control valve (Pa1, Pb1) from the control valve.
   b. Attach a pressure gauge to the hose that was disconnected.
   c. Operate the lever (lift arm), and measure the pressure (pilot pressure).
      • The valve is operating normally if the measured value is within specifications.

☞ "2. Service data, Performance criteria"

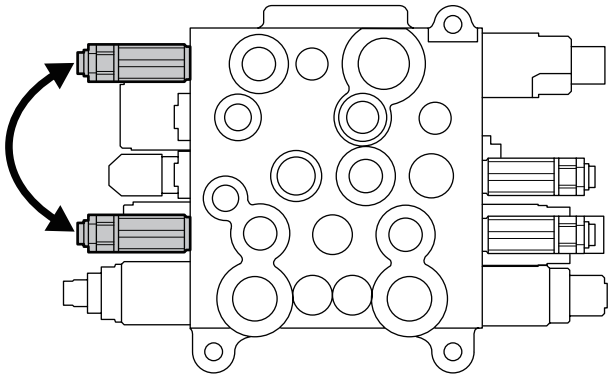


3. Check the spool operation.
   a. Disconnect one of the hoses connected to the arm block (A1, B1) of the control valve.
   b. Attach a pressure gauge to the arm block.
   c. Operate the lever (lift arm), and measure the pressure (P3).
      • The spool is operating normally if the pressure (P3) is within specifications.

☞ "2. Service data, Performance criteria"



4. Test the port relief valve using a replacement valve.
   If the arm cylinder is able to operate using a normal port relief valve taken from the bucket as a replacement valve, then the port on the arm side is faulty.

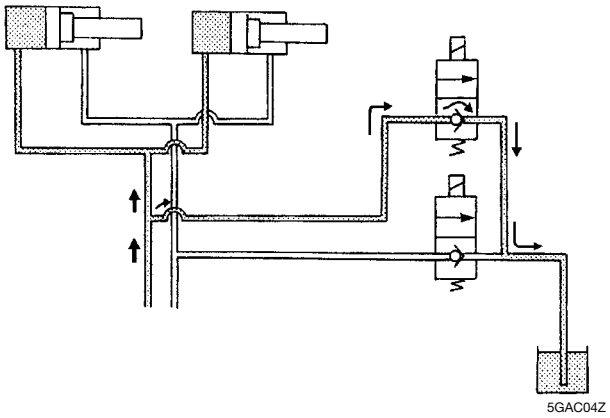


5. Check the arm float solenoid valve.
   The lift arm becomes faulty if the pressure oil supposed to flow into the cylinder starts leaking in the tank circuit, due to foreign matter caught in the valve seat surface or sticking of the poppet.

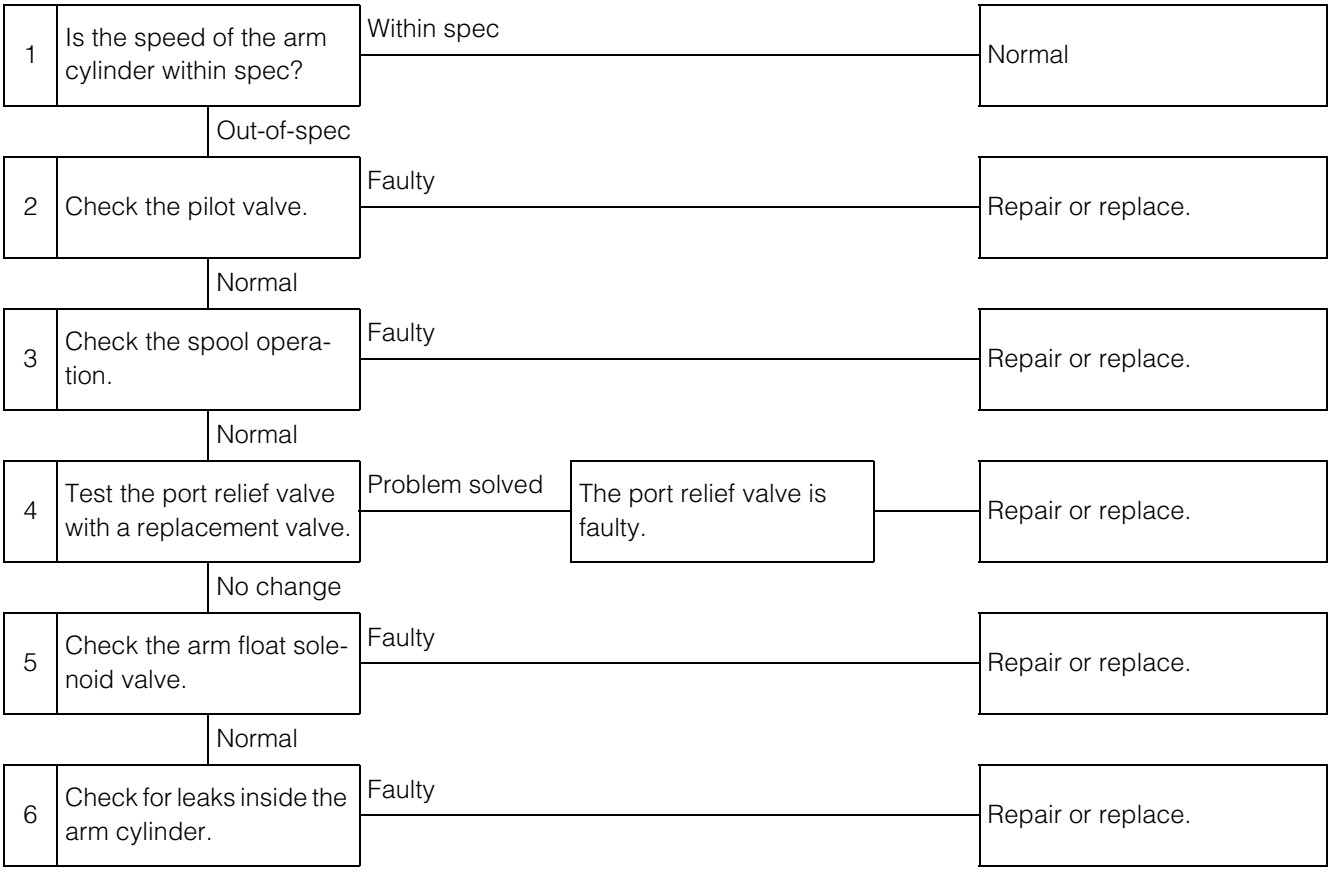
☞ "4. Disassembly and assembly, Control valve"

6. Check the arm cylinder.

☞ "4. Disassembly and assembly, Cylinders"



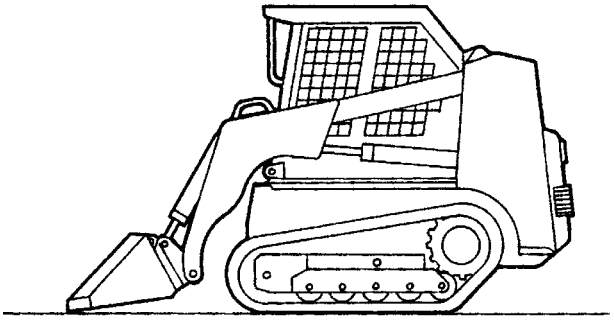
Arm cylinder is slow or lacks force.



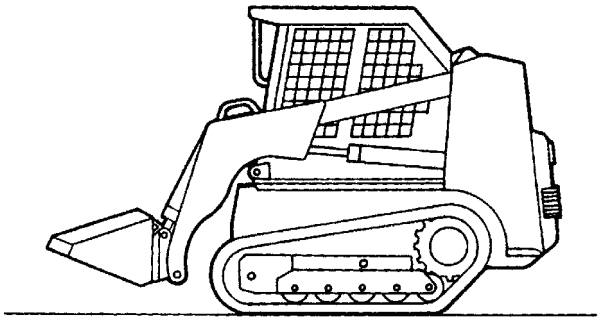
1. Is the speed of the arm cylinder within spec?
   ☞ "2. Service data, Performance criteria"
2. Check the pilot valve.
   ☞ "Arm cylinder fails to operate, Check the pilot valve."
3. Check the spool operation.
   ☞ "Arm cylinder fails to operate, Check the spool operation."
4. Test the port relief valve using a replacement valve.
   ☞ "Arm cylinder fails to operate, Test the port relief valve with a replacement."
5. Check the arm float solenoid valve.
   ☞ "Arm cylinder fails to operate, Check the arm float solenoid valve."

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6. Check for leaks inside the arm cylinder.
   a. Lower the bucket to the ground, tilting the bucket forward (approx. 10° from the horizontal) with the tip contacting the ground.
   b. Check the right and left arm cylinders individually. The hose connected to the cylinder not to be checked should be disconnected and fitted with a plug. (Do not fit the plug to the cylinder.)
   c. Disconnect the hose only from the rod side of the cylinder to be checked, and drain the oil from the piping. Insert the plug into the disconnected hose.
   d. Tilt the bucket back and raise it up from the ground.
      • If oil comes out from the piping on the side of the rod while the lift arm is being lowered, there must be oil leaking inside the control valve.



5GAC06Z



5GAC07Z

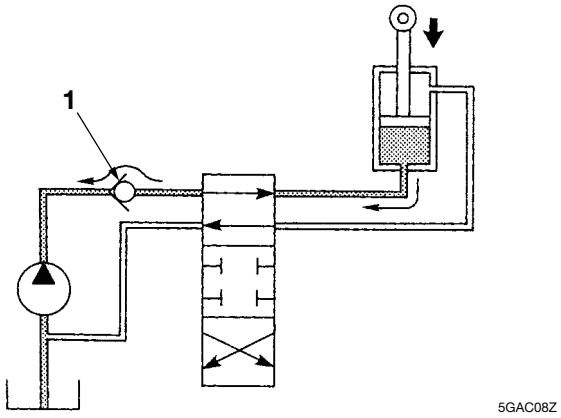
When the control lever is pulled slowly, the lift arm drops once.

1	Check the load check valve in the control valve.	Faulty	Repair or replace.
	Normal		
2	Check for leaks inside the arm cylinder.	Faulty	Repair or replace.

1. Check the load check valve on the control valve.
   a. Disconnect the hose connecting the control valve and the arm cylinder from the control valve.
   b. Connect the disconnected hose to the bucket block.
   c. Move the lever (bucket) to operate the arm cylinder.

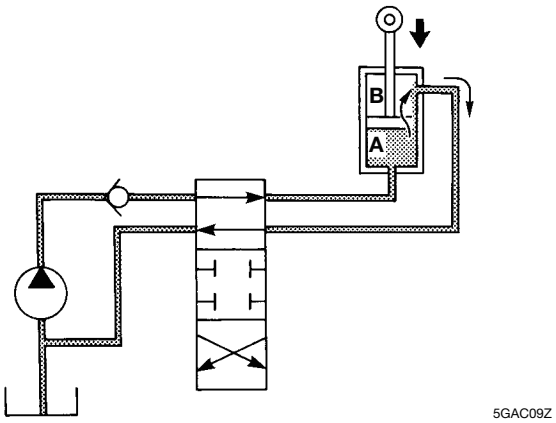
   If the arm cylinder operates normally, the load check valve (1) must be faulty.
   Before starting the above work, lower the lift arm and bring the bucket down to the ground.

   When the spool first draws, the oil pressure is low and the flow rate is small. Therefore, if the load check valve is faulty, the oil temporarily flows backward due to the load applied to the arm cylinder. As a result, the lift arm temporarily drops.



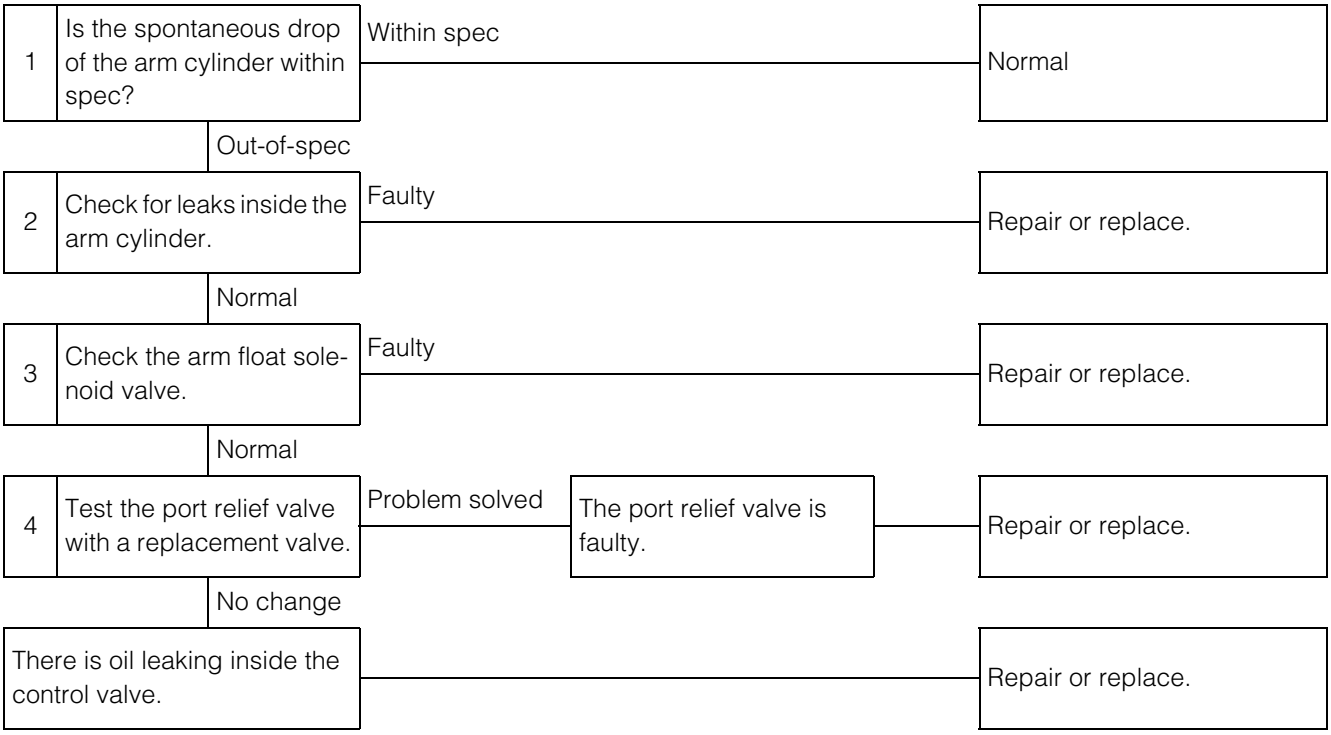
5GAC08Z

2. Check for leaks inside the arm cylinder.
   If the oil is flowing from the head side (A) to the rod side (B) due to the faulty arm cylinder piston or the tube, the lift arm temporarily drops because of the low oil pressure and small flow rate at the beginning of the spool drawing. Also, the cylinder has insufficient driving force. However, the amount of spontaneous drop is large in this case.
   ☞ "Arm cylinder is slow or power is insufficient, Check for leaks inside the arm cylinder."



5GAC09Z

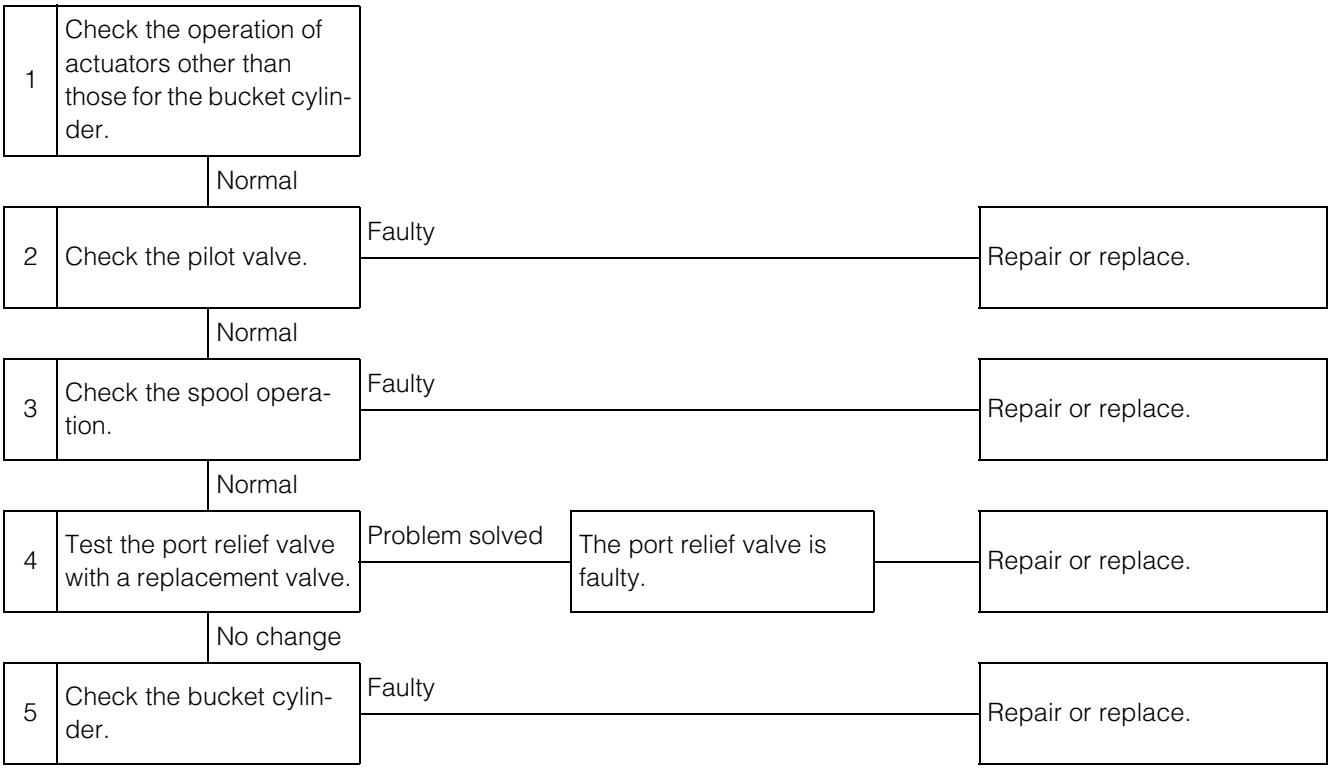
Spontaneous drop of the lift arm is too large.



1. Is the spontaneous drop of the arm cylinder within spec?
   ☞ "2. Service data, Performance criteria"
2. Check for leaks inside the arm cylinder.
   ☞ "Arm cylinder is slow or lacks force, Check for leaks inside the arm cylinder."
3. Check the arm float solenoid valve.
   ☞ "Arm cylinder is slow or lacks force, Check the arm float solenoid valve."
4. Test the port relief valve using a replacement valve.
   ☞ "Arm cylinder is slow or lacks force, Test the port relief valve with a replacement."

BUCKET

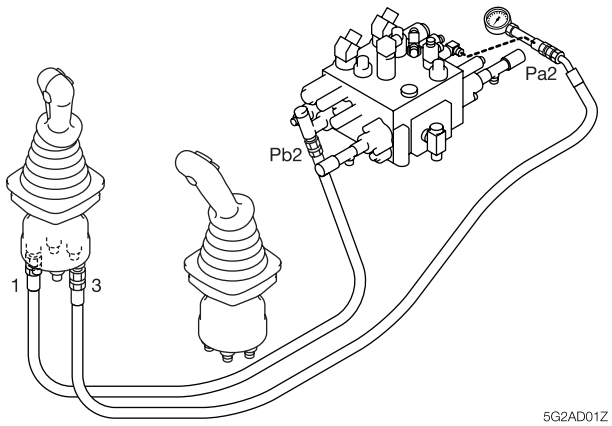
Bucket cylinder does not move.



1. Check the operation of actuators other than those used for the bucket cylinders.
   Check the lift arm as listed in the table below to check operation of the bucket only. If the lift arm is faulty, check the main relief valve and the hydraulic pump P3.
   ☞ "2. Service data, Performance criteria"

Lever to operate	Device to check	
Lift arm	Relief valve R3	Pump P3

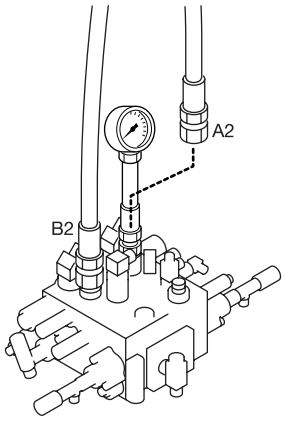
2. Check the pilot valve.
   a. Disconnect the hose connecting the pilot valve (right) and the control valve (Pa2, Pb2) from the control valve.
   b. Attach a pressure gauge to the hose that was disconnected.
   c. Operate the lever (bucket) and measure the pressure (pilot pressure).
      • The valve is operating normally if the measured value is within specifications.
   ☞ "2. Service data, Performance criteria"



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3. Check the spool operation.
   a. Disconnect one of the hoses connected to the bucket block (B2, A2) of the control valve.
   b. Attach a pressure gauge to the bucket block.
   c. Operate the lever (bucket), and measure the pressure (P3).
      • The spool is operating normally if the pressure (P3) is within specifications.

   ☞ "2. Service data, Performance criteria"

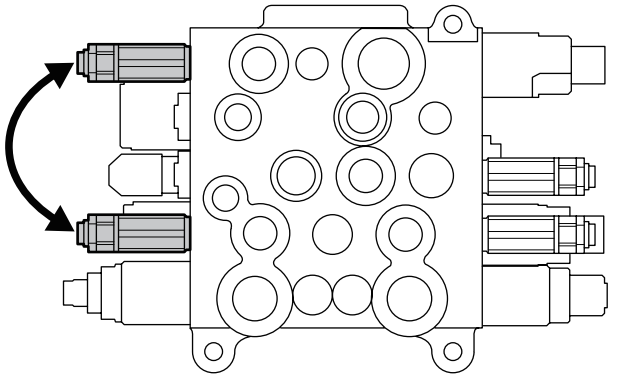


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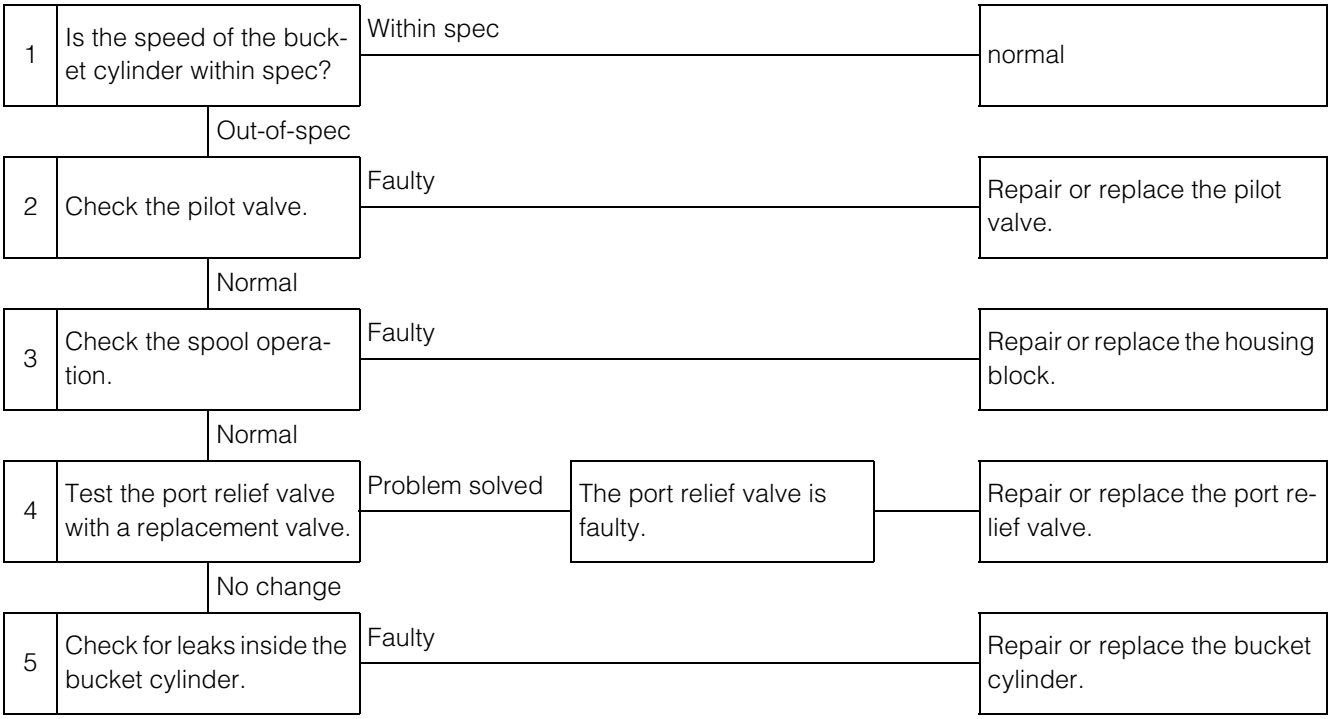
4. Test the port relief valve using a replacement valve.
   If the bucket cylinder is able to operate using a normal port relief valve taken from the lift arm as a replacement valve, then the port relief valve on the bucket side is faulty.

5. Check the bucket cylinder.

   ☞ "4. Disassembly and assembly, Cylinders"


5G1AD03Z

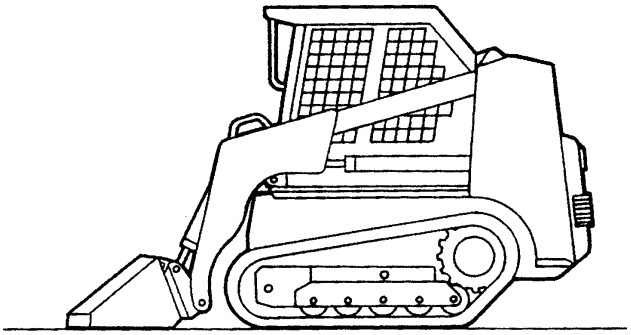
Bucket cylinder is slow or lacks force.



1. Is the speed of the bucket cylinder within spec?
   ☞ "2. Service data, Performance criteria"
2. Check the pilot valve.
   ☞ "Bucket cylinder does not move, Check the pilot valve."
3. Check the spool operation.
   ☞ "Bucket cylinder does not move, Check the spool operation."
4. Test the port relief valve using a replacement valve.
   ☞ "Bucket cylinder does not move, Test the port relief valve using a replacement"

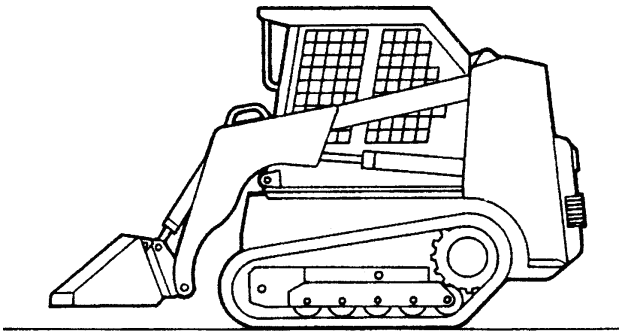
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5. Check for leaks inside the bucket cylinder.
   a. Lower the bucket to the ground in a horizontal position.
   b. Check the right and left bucket cylinders individually.
      The hose connected to the cylinder that is not to be checked should be disconnected and fitted with a plug. (Be sure to insert the plug into the hose and not into the cylinder.)
   c. Disconnect the hose from the cylinder that is to be checked. Insert plugs into the disconnected hose and the cylinder.



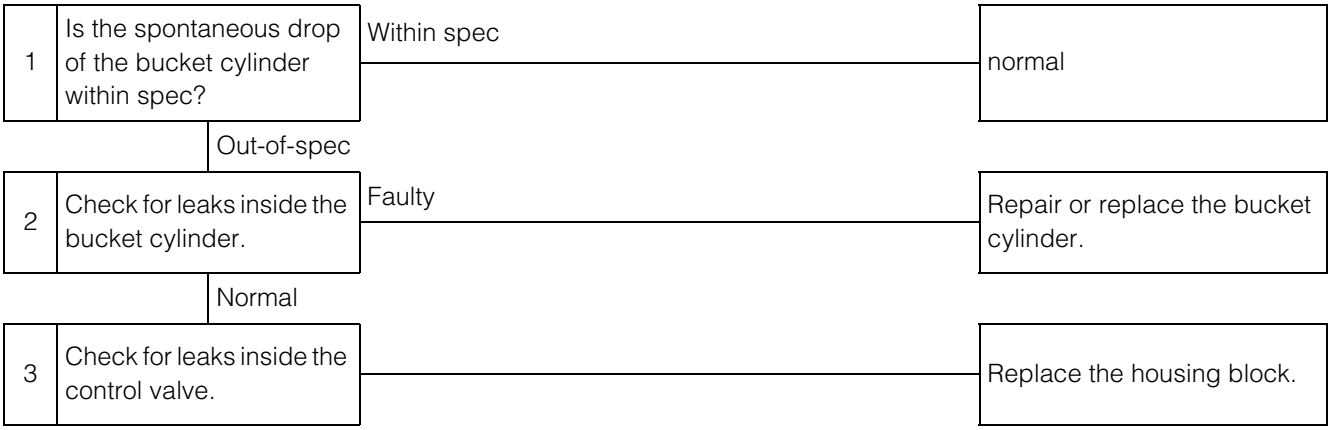
5GAD03Z

   d. Raise the lift arm to lift the bucket from the ground. If the bucket end falls, the cylinder is faulty. If it does not fall, there must be a leak present inside the control valve or the self-leveling valve.



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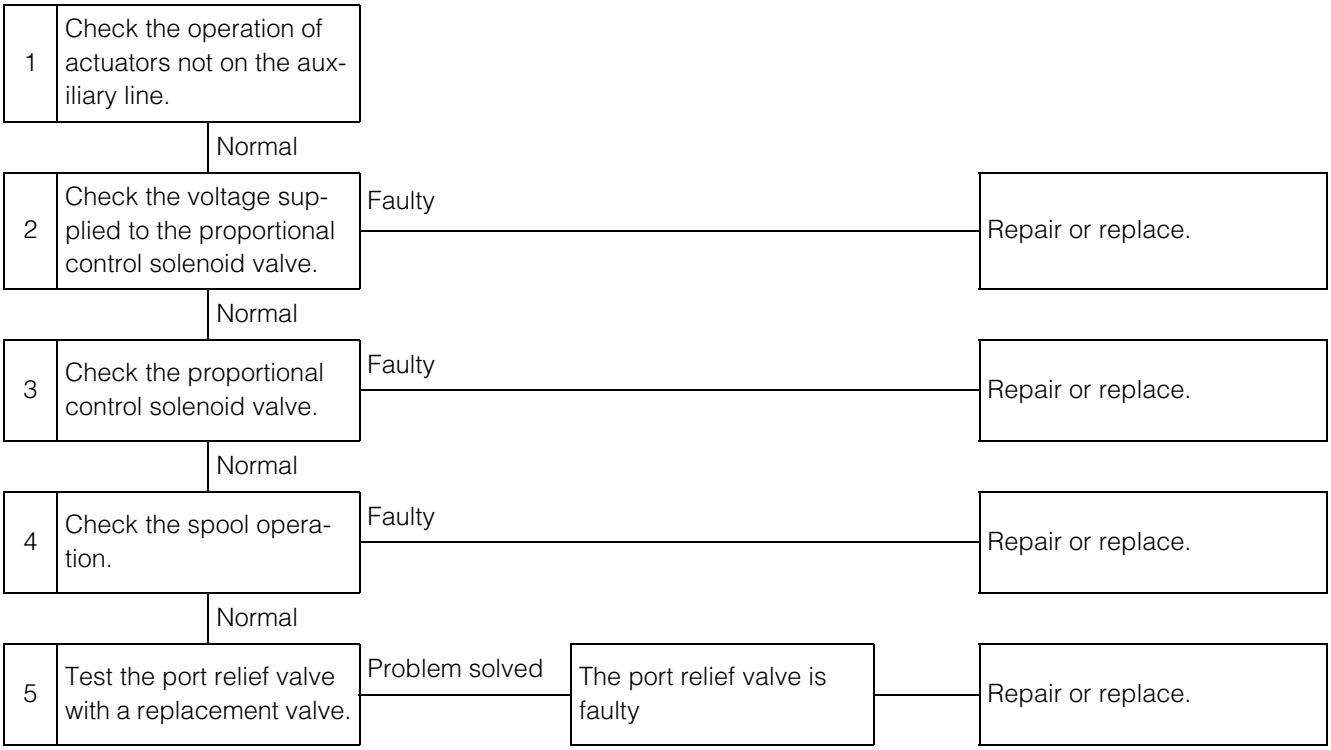
Spontaneous drop of the bucket is too large.



1. Is the spontaneous drop of the bucket cylinder within spec?
   ☞ "2. Service data, Performance criteria"
2. Check for leaks inside the bucket cylinder.
   ☞ "Bucket cylinder is slow or lacks force."
3. Check for leaks inside the control valve.
   ☞ "4. Disassembly and assembly, Control valve"

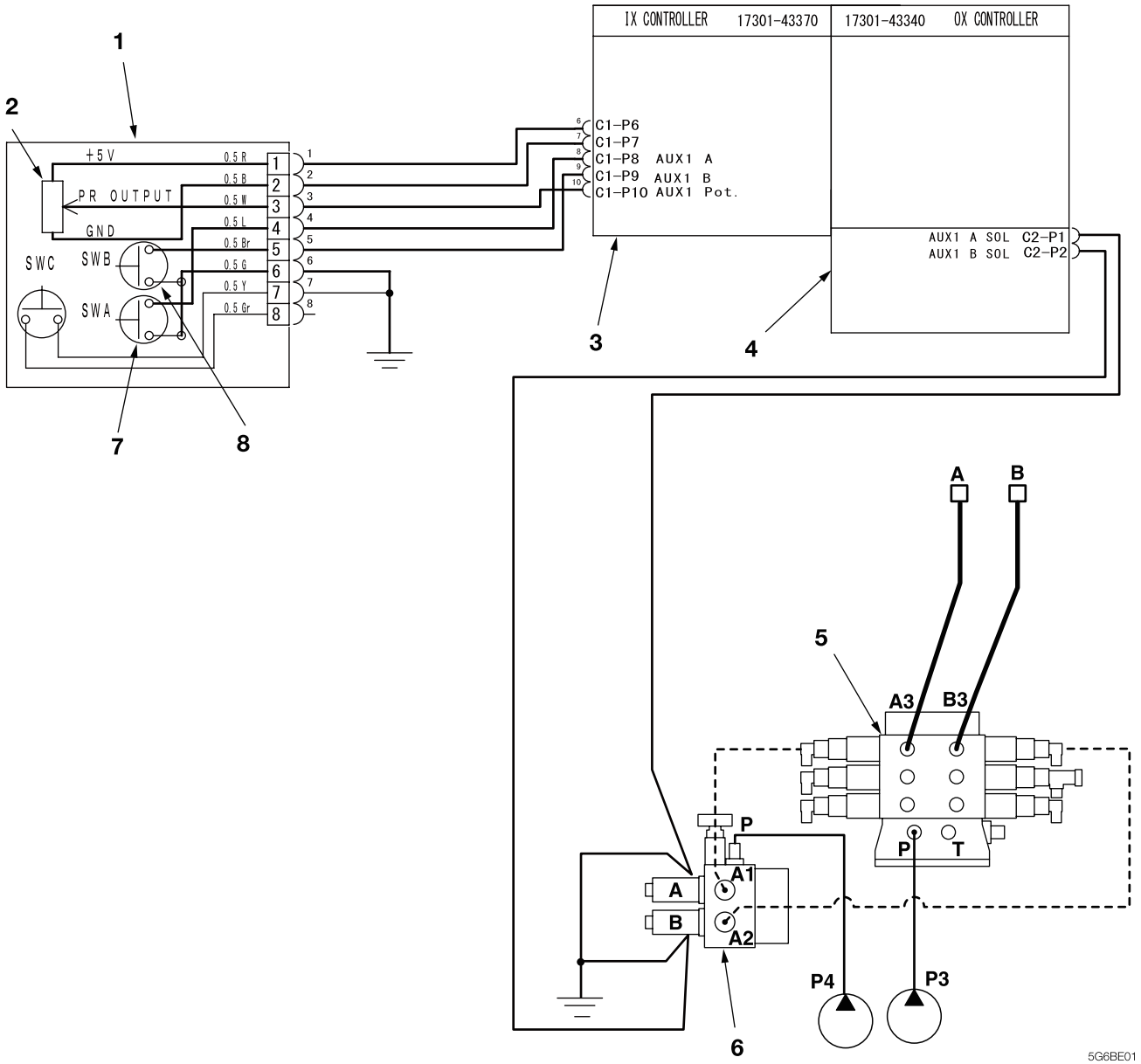
AUXILIARY HYDRAULICS

Prescribed pressure is not supplied to the auxiliary hydraulics



1. Check the operation of actuators other than those on the auxiliary line.
   Check the operation of the actuators for the devices listed in the table below to determine if the problem is in the auxiliary line alone.
   If any other actuator is faulty, check the main relief valve and the hydraulic pump (P3).
   ☞"2. Service data, Performance criteria"

Lever to operate	Device to check	
Bucket	Relief valve R3	Pump P3



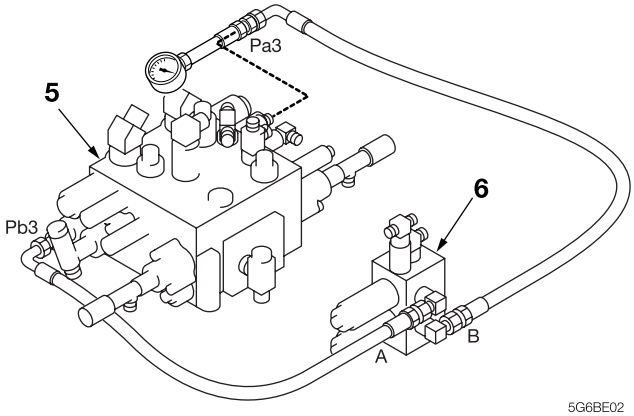
1. Pilot valve (L)
2. Proportional lever
3. Controller (17301-43370)
4. Controller (17301-43340)
5. Control valve
6. Proportional control solenoid valve
7. Button A
8. Button B

2. Check the voltage supplied to the proportional control solenoid valve.
   Operate the proportional lever (2) of the pilot valve (1), and check the voltage supplied by the controller (3) and (4) to the proportional control solenoid valve (6).

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3. Check the proportional control solenoid valve.
   a. Disconnect the hose connecting the proportional control solenoid valve (6) and the control valve (5) (auxiliary section: Pa3, Pb3) from the control valve side.
   b. Attach a pressure gauge to the hose that was disconnected.
   c. Operate the proportional control lever of the pilot valve (left), and measure the pressure (pilot pressure).
      • The valve is operating normally if the measured value is within specifications.

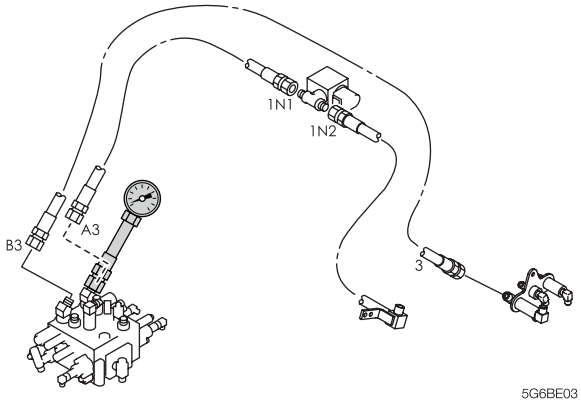
☞ "2. Service data, Performance criteria"



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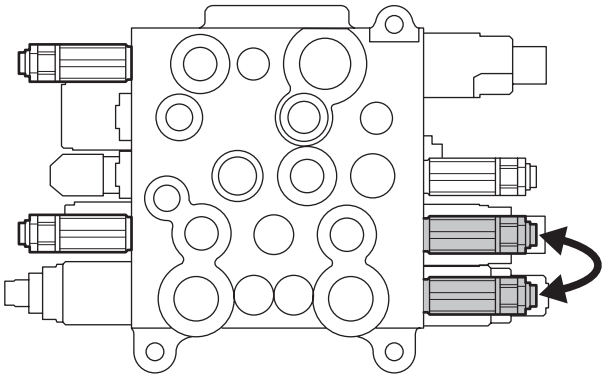
4. Check the spool operation.
   a. Disconnect one of the hoses connected to the control valve (auxiliary section: B3, A3).
   b. Attach a pressure gauge to the auxiliary line block.
   c. Operate the lever (auxiliary line), and measure the pressure (P3).

☞ "2. Service data, Performance criteria"



5G6BE03

5. Test the port relief valve using a replacement valve.
   If the auxiliary line machinery is able to operate using a normal port relief valve taken from the bucket as a replacement valve, then the port relief valve on the auxiliary line side is faulty.


5G6AU04

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HST PUMP

HST system

Symptoms	Major causes	Remedies
It is hard or impossible to set the neutral position	• Pilot valve is faulty.	• Repair or replace.
	• Poor adjustment of neutral for the HST pump.	• Attempt to readjust the neutral position of the HST pump. If this fails, replace the HST pump.
	• Poor adjustment of rotational torque for the servo piston.	• Re-adjust the rotational torque of the servo piston. If this fails, replace the HST pump.
The machinery only travels either forward or in reverse	• Pilot valve is faulty.	• Repair or replace.
	• Supply pressure to the pilot valve is insufficient.	• Check the hydraulic pump P4 and the solenoid valve and repair or replace any faulty parts.
	• Charge pressure is insufficient.	• Check the hydraulic pump P4, the solenoid valve, and the low-pressure relief valve and repair or replace any faulty parts.
	• Orifice is clogged.	• Clean the orifice.
	• High-pressure relief valve is faulty.	• Repair or replace.
	• Scoring or seizing on the servo piston.	• Repair or replace.
	• Travel motor is faulty.	• Repair or replace.
The machinery cannot travel forward or in reverse The machinery veers when attempting to travel in a straight line	• Hydraulic oil tank level is too low.	• Add oil to the specified level.
	• Pilot valve is faulty.	• Repair or replace.
	• Supply pressure to the pilot valve is insufficient.	• Check the hydraulic pump P4 and the solenoid valve and repair or replace any faulty parts.
	• Charge pressure is insufficient.	• Check the hydraulic pump P4, the solenoid valve, and the low-pressure relief valve and repair or replace faulty parts.
	• Orifice is clogged.	• Clean the orifice.
	• High-pressure relief valve is faulty.	• Repair or replace.
	• Adjustment of displacement limiter is faulty.	• Adjust the displacement limiter. If this fails, replace the HST pump.
	• Faulty travel motor.	• Repair or replace.
The system operating temperature is too high	• Hydraulic oil tank level is too low.	• Add oil to the specified level.
	• Oil cooler is faulty.	• Repair or replace.
	• High-pressure relief valve is faulty.	• Repair or replace.
	• Parking brake release pressure is too low.	• Check the hydraulic pump P4 and the solenoid valve and repair or replace any faulty parts.
	• Travel motor is generating heat.	• Repair or replace.
	• HST pump is generating heat.	• Repair or replace.

Hydraulic pump

Symptoms	Major causes	Remedies
Noise is too loud, or abnormal sounds are heard	• Suction hose is crushed or suction filter is clogged.	• Remove the dirt and correct the crushing.
	• Joint in the suction side is loose and sucking air.	• Retighten each joint.
	• Cavitations occurring due to the viscosity of the hydraulic oil being too high.	• Replace hydraulic oil with oil of the proper viscosity.
	• Pump and engine are not center aligned.	• Recenter the pump and engine.
	• Foaming of hydraulic oil.	• Investigate the cause of the foaming, and take necessary steps to resolve the issue.
	• Engine RPM is too high.	• Run at the rated RPM.
	• Mechanical damage to the parts (e.g., bearing).	• Replace any damaged part(s) or the pump.
Discharge is insufficient	• Engine RPM is too low.	• Run the machinery at the rated RPM.
	• Oil temperature is too high.	• Stop the machinery, and check the temperature again after the oil has had a chance to cool down.
	• Viscosity of hydraulic oil is too high.	• Replace hydraulic oil with oil of the proper viscosity.
	• Pump volume efficiency becomes low.	• Replace the pump.
	• Hydraulic oil tank level is too low.	• Add oil to the specified level.
	• Clogging in the suction piping or suction filter.	• Clean the piping.
	• Leak volume of hydraulic devices other than the pump is increased.	• Repair or replace any leaking hydraulic device.
Pressure does not increase	• Decreases in set relief valve pressure.	• Set the relief valve pressure again.
	• Increases in leak volume from hydraulic devices other than the pump.	• Repair or replace any leaking hydraulic device.
	• Decreases in pump volume efficiency.	• Replace the pump.
Abnormal heat is generated	• Leak volume from the pump is increased.	• Replace the pump.
	• Mechanical damage to the parts (e.g., bearing).	• Replace any damaged part(s) or the pump.
	• Seizing on sliding parts.	• Replace any damaged part(s) or the pump.
Oil leaks are occurring	• Seals are damaged.	• Replace the seal(s).
	• Wearing of sliding surfaces between the shaft and oil seal.	• Replace the shaft or pump.
	• Plugs and bolts are loosened.	• Retighten any loose plugs and bolts, or replace the seals.

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GEAR PUMP

☞ "4. Disassembly and assembly, Gear pump"

Symptoms	Major causes	Remedies
No discharging operation	• Direction of rotation is incorrect. • Hydraulic oil tank level is too low. • Clogging in the suction piping or the suction filter. • Viscosity of hydraulic oil is too high. • RPM is too low.	• Rotate in the rated direction. • Add oil to the specified level. • Clean the piping. • Replace with hydraulic oil of proper viscosity. • Run at the rated RPM.
Noise is too loud, unusual sound is heard	• Cavitation is being produced due to the crushed hose or clogged filter of the suction side. • Joint in the suction side is loose and sucking air. • Cavitation is being produced due to too high viscosity of the hydraulic oil. • Pump and engine are not center aligned. • Frothing of hydraulic oil.	• Remove the dirt and correct the crushing. • Retighten each joint. • Replace with hydraulic oil of proper viscosity. • Center them again. • Investigate the cause of frothing and correct it.
Oil leak from the oil seal	• Oil seal is deformed, worn out or damaged.	• Replace the oil seal.
Oil leak from the mating surface between the housing and the flange or housing and the cover	• Body seal is damaged, or the sliding part is worn out.	• Replace with a new one.
Discharge is insufficient	• Bushing seal is damaged. • Cavitation is being produced. • Aeration is being produced. • Viscosity of hydraulic oil is too low.	• Replace the bushing seal. • Clean the suction filter and the suction piping. • Check if piping is properly screwed in. • Replace with hydraulic oil of proper viscosity.

CONTROL VALVE

☞ "4. Disassembly and assembly, Control valve"
The problems are listed individually in the table below, but in reality, many problems have multiple causes. Therefore, try to check and eliminate each possible cause one at a time.

Symptoms	Major causes	Remedies
Oil leak from the spool seal	• Flaw is on the sealing part or the seal lip is worn out due to prolonged use.	• Replace with a new one.
	• Flaw (e.g., dents or scratches) on the sliding part of the spool seal is caused by an external factor.	• Repair or replace the spool.
	• The lid that is pushing the sealing parts in place is installed improperly (lid is distorted)	• Correct the lid, and determine the partial wear degree of the seal.
	• Old paint remains on the seal sliding part of the spool.	• Remove it by using thinner or mechanical force. When removing, take care not to damage the spool surface or the seal lip.
	• Tank pressure becomes too high for the performance of the sealing material.	• Remove the cause of the flow resistance.
Sliding part of the spool is not smooth	• Foreign matter is caught in the sliding part of the spool.	• Overhaul and repair or replace.
	• Oil film between the spool and the body becomes too thin due to the increased oil temperature.	• Try to decrease the oil temperature. If the relief valve is started often, find the cause and correct it.
	• Lubrication is disabled due to deteriorated oil.	• Oil should be replaced. The circuit also should be overhauled in some cases.
	• Spool is worn out because of prolonged use or of the unbalanced force applied.	• Replace the spool and the valve block assembly.
	• Spool is bent by the external force.	• Check for the straightness of the spool, and repair or replace.
	• Whole valve is distorted due to the distortion of the installation surface.	• Check the distortion, independent of the installation surface (loosening the bolts will help).
	• Valve is operated with the pressure or the flow rate of out-of-spec.	• For pressure, measure it with a pressure gauge. For flow rate, determine it by finding out the movement speed and capacity of the actuator.
	• Fixing bolts are over-tightened.	• Check if the fixing bolts are tightened with the specified torque. If not, tighten them again with the specified torque.
	• Oil stays in the lid (spring or detent) opposite to the spool operation.	• Oil may come out from the lid, if it is leaking in the seal of the spool. If that is the case, replace the seal.
When the actuator is being raised, it drops once	• Foreign matter is caught in the seat on the load check valve, or the seat is damaged by large foreign matter.	• Disassemble the valve and overhaul or replace the faulty part(s).

Symptoms	Major causes	Remedies
Spool's neutral position cannot be maintained (cylinder drops)	• There are cases of a large oil leak inside the cylinder.	• Check if the cylinder drops spontaneously when it is held. If the cylinder is faulty, disassemble and repair it.
	• Since the clearance between the spool and the body is too large, oil is leaking from the clearance.	• Replace the spool and the valve block assembly.
	• Spool is not completely back in the neutral position.	• Manual: Check if the link mechanism is interfering with others. Hydraulic operation: Check the pilot pressure.
	• Foreign matter is caught in the seat of the port relief valve or of the anti-cavitation valve, and thus the oil is bypassing the section. Or the seat is damaged.	• Disassemble, overhaul or replace.
Load cannot be moved (pressure cannot be increased)	• Foreign matter is caught in the seat of the port relief valve, and thus the oil is bypassing the section. Or the seat is damaged.	• Disassemble, overhaul or replace.
	• Adjuster screw on the relief valve is loose.	• Screw in the adjuster screw. If loose, set the adjustment again and fasten with a lock nut.
	• Foreign matter is caught in the seat of the port relief valve or of the anti-cavitation valve, and thus the oil is bypassing the section. Or the seat is damaged.	• Disassemble, overhaul or replace.
	• Spool stroke is out-of-spec.	• Manual: Check if the link mechanism is interfering with others. Check if the pin or pin hole on the linking section is worn out.
	• Oil supply from the pump is insufficient, because the pump is damaged.	• Hydraulic operation: Check the pilot pressure. Check for any abnormality in the pump. If the pump is faulty, replace it and find the cause of the abnormality (e.g., faulty air sucking or oil degradation).
Load cannot be moved (pressure is being increased)	• Overloading	• Compare with a one with standard load.
	• Mechanical resistance of related parts/devices (unrelated to the hydraulic pressure of the hydraulic oil) is large.	• Check and add oil, modify or repair the parts/devices.
	• Large resistance is generated, because the circuit is clogged with large foreign matter or the piping is bent.	• Repair if the location of clogging or bent is known.
	• Spool stroke is out-of-spec.	• Check if the link mechanism is interfering with others and if the pin or pin hole on the linking section is worn out.

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SUB VALVE

☞ "4. Disassembly and assembly, SUB valve"

Symptoms	Major causes	Remedies
Solenoid valve does not operate	• Wiring short-circuiting or wire disconnects.	• Replace.
	• Short-circuiting or wire disconnects in the coil assembly.	• Replace.
	• Foreign matter caught in the spool.	• Overhaul and repair or replace.
	• Damage on the outer circumference of the spool.	• Overhaul and repair or replace.
	• Foreign matter caught in the plunger.	• Overhaul and repair or replace.
	• Damage to the sliding part on the outer circumference of the plunger.	• Overhaul and repair or replace.
Oil leaks from the solenoid valve, cover, or relief valve to external parts	• O-ring is damaged.	• Replace.
Pressure does not increase	• Foreign matter caught in the relief valve.	• Clean or replace.

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PILOT VALVE

☞ "4. Disassembly and assembly, Pilot valve"

Symptoms	Major causes	Remedies
The secondary pressure is too low	• Primary pressure is insufficient. • The spring is broken or worn out. • The clearance between the spool and the casing is too large. • Too much play in the handle.	• Keep the primary pressure. • Replace • Replace the spool and the casing assembly. • Disassemble and assemble or replace.
The secondary pressure is unstable	• The sliding part is not smooth. • The tank line pressure fluctuates. • Air is present in the piping.	• Repair or replace. • Remove the faulty part(s) in the tank line. • Bleed air by operating the valve several times.
The secondary pressure is high	• Pressure in the tank line is high. • The sliding part is not smooth.	• Remove the faulty part(s) in the tank line. • Repair or replace.

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SOLENOID VALVE

☞ "4. Disassembly and assembly, solenoid valve"

Symptoms	Major causes	Remedies
Solenoid valve does not operate	• Wiring short-circuit or wire break.	• Replace
	• Coil assembly short-circuit or wire break.	• Replace
	• Foreign matter is caught in the spool.	• Overhaul and repair or replace.
	• Damage on the outer circumference of the spool.	• Overhaul and repair or replace.
	• Proportional controller is faulty.	• Repair or replace.
	• Primary pressure is insufficient.	• Keep the primary pressure.
Oil leakage from solenoid valve	• O-ring is damaged.	• Replace
	• Seal nut is damaged.	• Replace

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CYLINDERS

☞ "4. Disassembly and assembly, Cylinders"

Symptoms	Major causes	Remedies
Oil is leaking from the piston rod sliding surface (oil forms a ring on the piston rod, which becomes larger and starts dripping)	• Foreign matter is trapped in the inside diameter of the rod packing or dust seal.	• Remove the foreign matter.
	• Scratching or abnormality of the internal lip surface of the rod packing or dust seal.	• Replace the faulty part(s).
	• Scratching on the sliding surface of the piston rod.	• Smooth the sliding surface with an oilstone (1.6 S or less). • If the leak persists after smoothing the sliding surface, replace the rod packing and other seals. • If the leak persists after replacing the seals, replace the piston rod.
	• Peeling of the hard chromium plated surface.	• Re-plate the hard chromium plating.
Oil leaking around the rod cover.	• O-ring is damaged.	• Replace the faulty part(s).
	• Backup ring is damaged.	• Replace the faulty part(s).
Oil leaking from welded joint.	• Tube welding is damaged.	• Replace the faulty part(s).
Spontaneous cylinder drop ("Spontaneous drop" is defined as 0.5 mm or greater piston movement in 10 minutes when a static load is exerted on the rod. The static load is determined by multiplying the maximum operating pressure by the cylinder area.)	• Foreign matter is trapped in the wear ring sliding surface.	• Remove the foreign matter.
	• Scratching or abnormality of the wear ring sliding surface.	• Replace the faulty part(s).
	• Scratching on the piston packing sliding surface.	• Replace the faulty part(s).
	• O-ring is damaged.	• Replace the faulty part(s).

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TRAVEL MOTOR

☞ "4. Disassembly and assembly, Travel motor"

Hydraulic motor

Symptoms	Major causes	Remedies
Motor fails to start	• All the devices other than the motor and the reduction gears are not working correctly. • Pressure oil is not flowing properly due to abnormal wear of the motor's sliding part. • Motor is faulty, as its main components are damaged.	• Check whether the specified pressure is generated in the inlet port, and then check and repair each device. • Replace the abnormally worn out part(s). • Replace the damaged part(s).
Rated speed cannot be obtained	• Specified volume of flow is not supplied to the motor due to the faulty oil pump. • Motor volume efficiency becomes low.	• Check whether the specified pressure is generated in the inlet port, and then check and repair each device. • Check if there is abnormal wear on the sliding part; if so, repair or replace it.
Rotational fluctuations are large	• High-pressure oil is leaking from the drain port, because the motor's sliding part is worn out. • Bearing is worn out.	• Replace the abnormally worn part, if any. • Replace the abnormally worn part, if any.
Oil leak	• Oil leak due to O-ring breakage. • Oil seal is broken by the internal pressure generated in the motor case due to the abnormal wear of the sliding part of the motor. • Pressure increase in the drain piping caused by the clogging of foreign matter resulted in breakage of oil seal.	• Replace the oil seal and O-ring. • Repair the motor and replace the oil seal. • Clean the clogging in the drain piping and replace the oil seal.

2nd-speed control

Symptoms	Major causes	Remedies
Straight-ahead traveling level is low, switching to 2nd-speed travel is disabled	Spool cannot be switched. • Foreign matter is caught. • Spring is missing. • Spring is damaged. • Oil leak due to the abnormal wear of the 2nd-speed control piston. • 2nd-speed control piston is missing. • Ball is abnormally worn out.	 • Remove foreign matter and correct or replace the faulty part(s). • Install the spring. • Replace the spring. • Replace the 2nd-speed control piston. • Install the 2nd-speed control piston. • Replace the ball.

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Parking brake

Symptoms	Major causes	Remedies
Braking force is insufficient or not evenly applied	• Disc surface is faulty. • Spring is damaged. • Bolt for manual releasing is being fitted.	• Repair or replace • Replace the spring. • Remove the bolt for manual release, and fit the plug.
Abnormal heat generation due to brake drag	• Release of braking is faulty. • Oil leak due to O-ring breakage. • Orifice is clogged. • Pilot pressure for the releasing is not working.	 • Replace the O-ring. • Clean the orifice. • Check whether the specified pressure is generated in the pilot port, and then check and repair each device.

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Other 6

MAINTENANCE SOFTWARE MANUAL

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1. Outline

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1. OUTLINE

This software program is designed for use in maintenance procedures. You can perform the various types of maintenance listed below using this software and a maintenance cable.

Maintenance
This function can be used to check the input/output conditions for the controller, and the malfunction error codes.

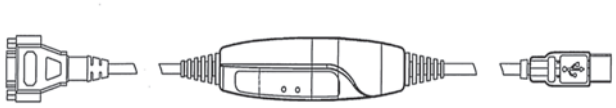
Setting
- This function can be used to check the functions for the machine.
- This function can be used to check the functions of the engine.
- This function can be used to check and set the functions for the 1st auxiliary line hydraulic piping.
- This function can be used to check and set the slide switch for the 1st auxiliary line piping and related settings and functions.
- This function can be used to set the current for the slide switch for the 1st auxiliary line piping at full stroke.
- This function can be used to set options.
- This function can be used to adjust the hourmeter.
- This function can be used to check and adjust the Active power control.

2. CONNECTION METHODS

- To use the Maintenance Software program, complete Steps 2-2 to 2-4 in sequential order.
- Screens shown and installation instructions may vary depending on the operating system used due to differences in the language settings and OS used among other factors. Refer to the instruction manual for the computer you are using for additional information should you have questions or need computer-specific assistance.
- Note that the PLUS+1 GUIDE Service Tool installation method may change without prior notice. Contact Takeuchi Manufacturing should any questions arise regarding installation.

2-1. Items needed

1. Computer
2. Service Tool (Product no.: 05601-00000)
   - Installation CD for the Maintenance Software (Product no. 06901-00001)
   - Maintenance Tool (Product no. 17301-41810)



6S1AT01

   - Cable assembly (Product no.: 17301-41820)



6S1AT02

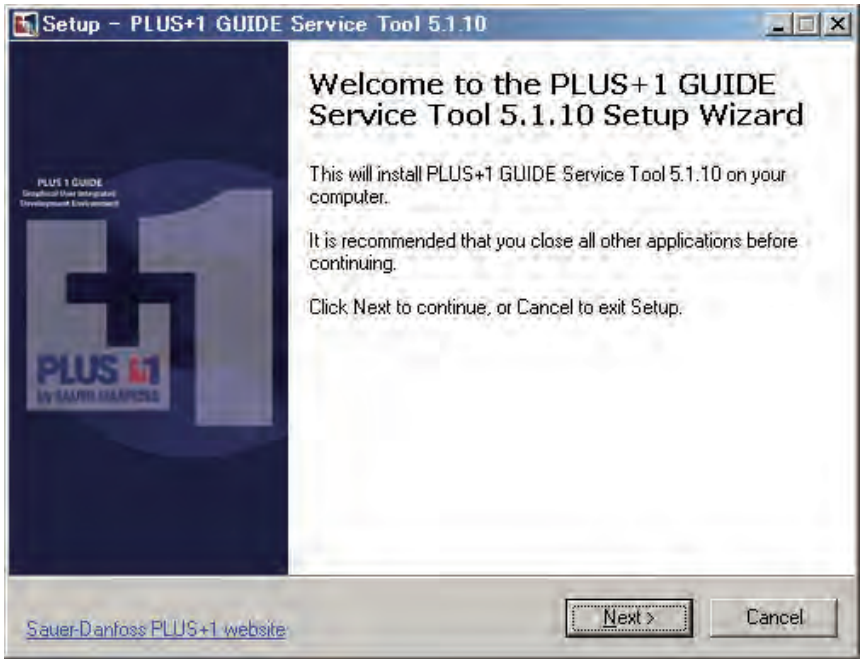
2-2. Installation of the PLUS+1 GUIDE Service Tool

a. Start up the setup.exe file (Installation CD-ROM).
   - You must have administrator privileges to start up the Setup Tool. Contact your system administrator for assistance if you are unable to execute the file.



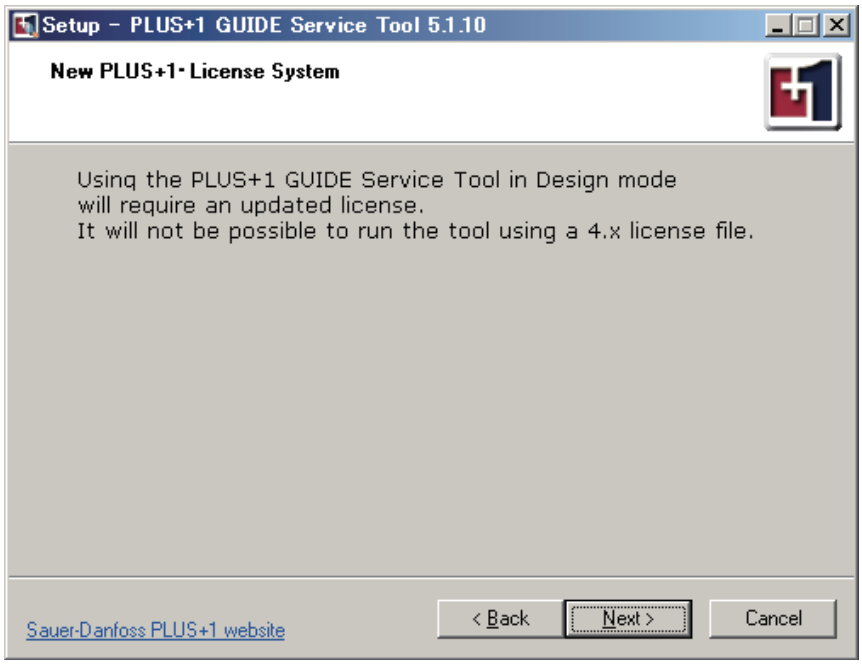
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b. Once you have executed the setup.exe file, the screen shown below will appear. Click the [Next] on the screen to proceed.



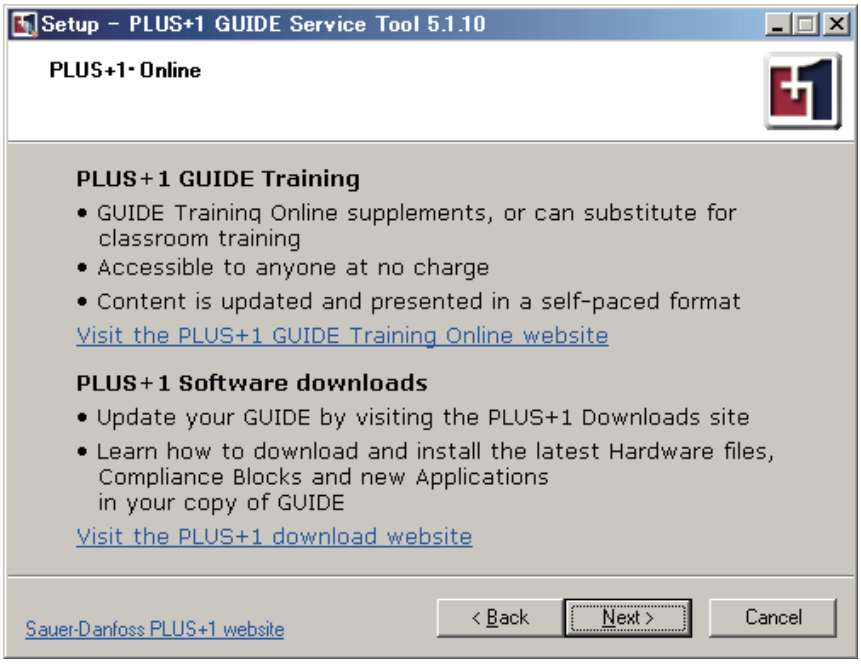
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c. Click [Next] to proceed.



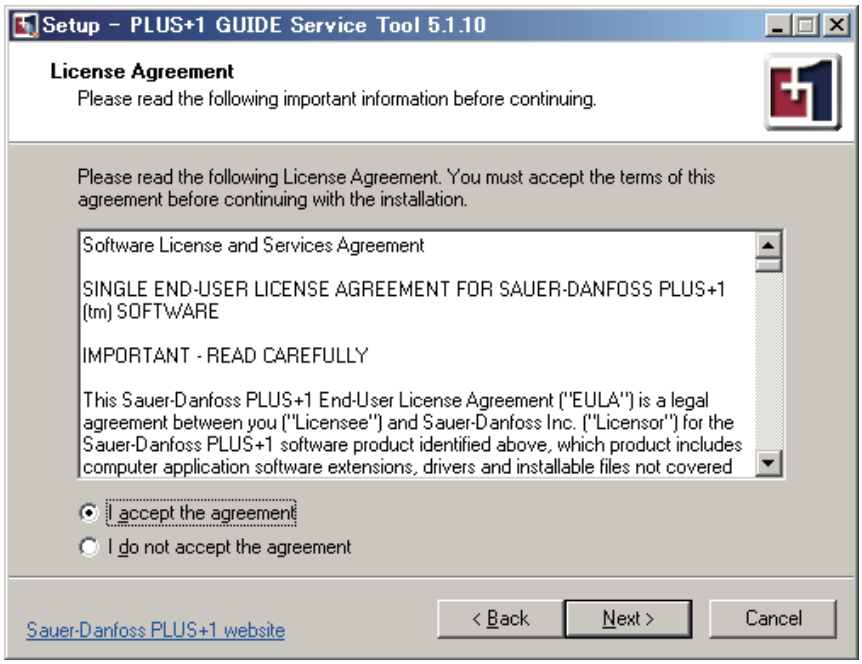
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d. Click [Next] to proceed.



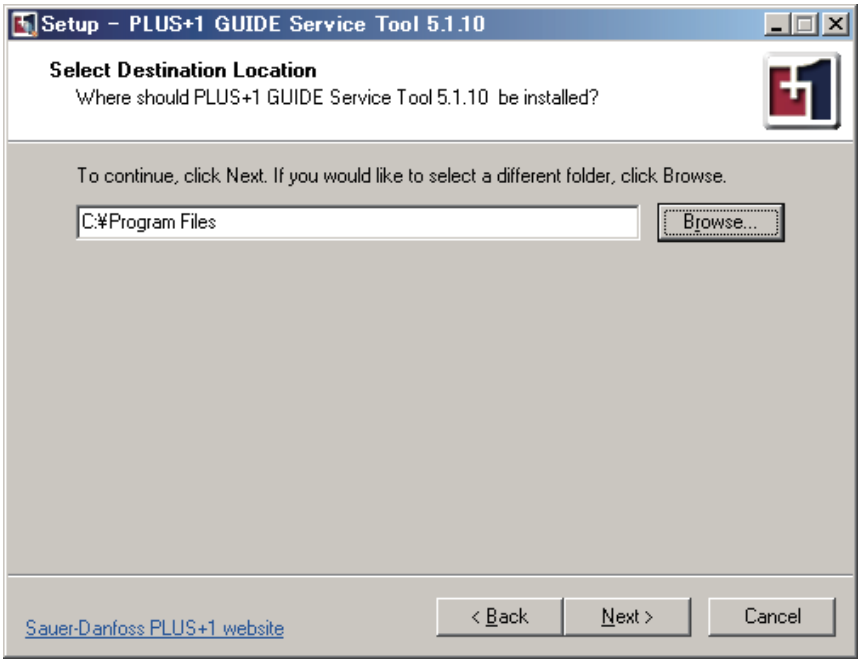
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e. Select “I accept the agreement” and then click [Next] to confirm and proceed.



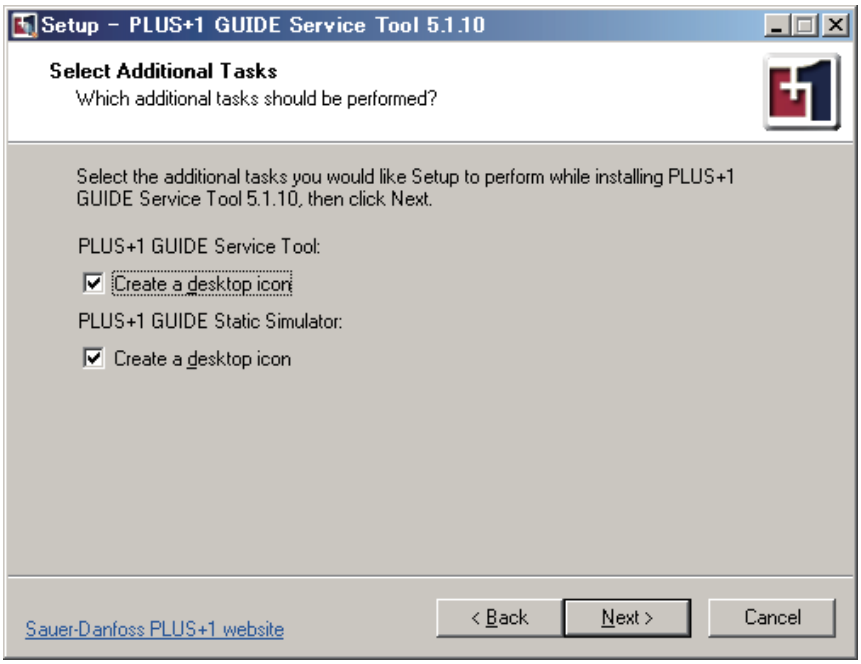
6S1AT12

f. Specify the folder for installation (continue as is unless wanting to use a folder other than the one selected) and then click [Next] to proceed.



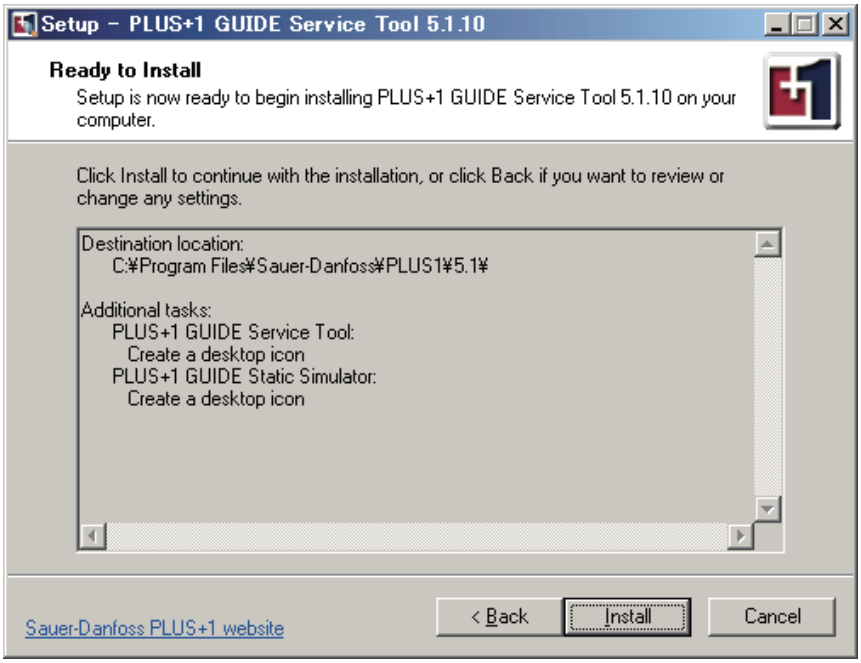
6S1AT13

g. Click [Next] to proceed.
   - Uncheck the box if you do not wish to create a desktop icon.



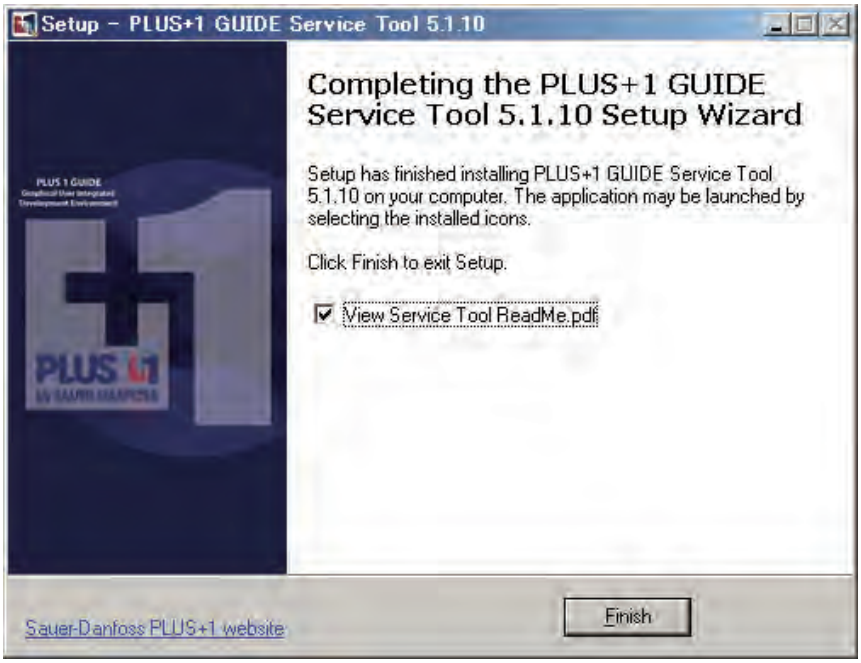
6S1AT14

h. Click [Install] to start the installation.



6S1AT15

i. The screen shown below will appear if the installation is successful.
Installation of the Maintenance Tool driver will start once the installation of the above file is completed. Proceed to Step 2-3 to continue.



6S1AT16

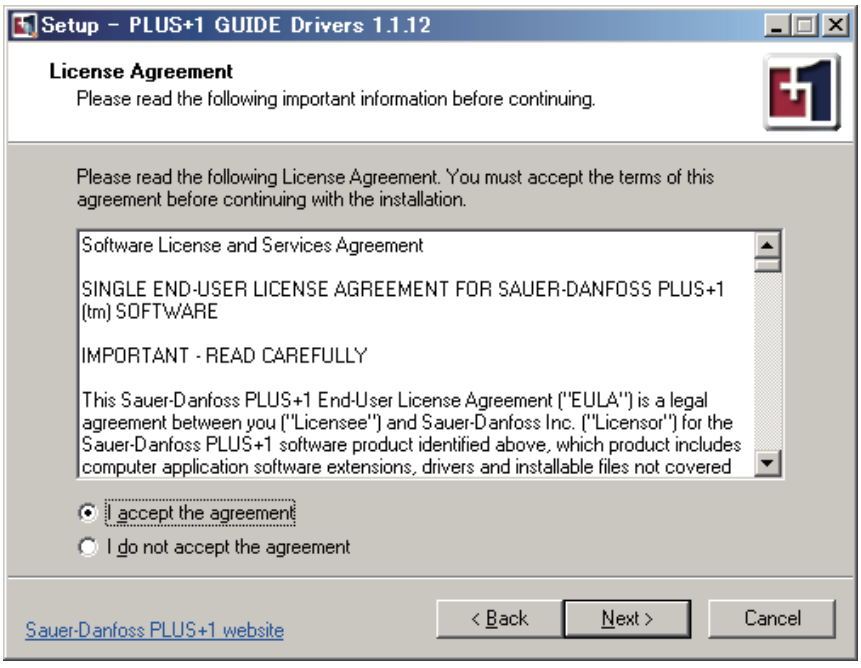
2-3. Installation of the Maintenance Tool driver

1. Install the Maintenance Tool driver.
   a. The window shown below will appear once Step 2-2 has finished. Click the [Next] in the window to proceed.



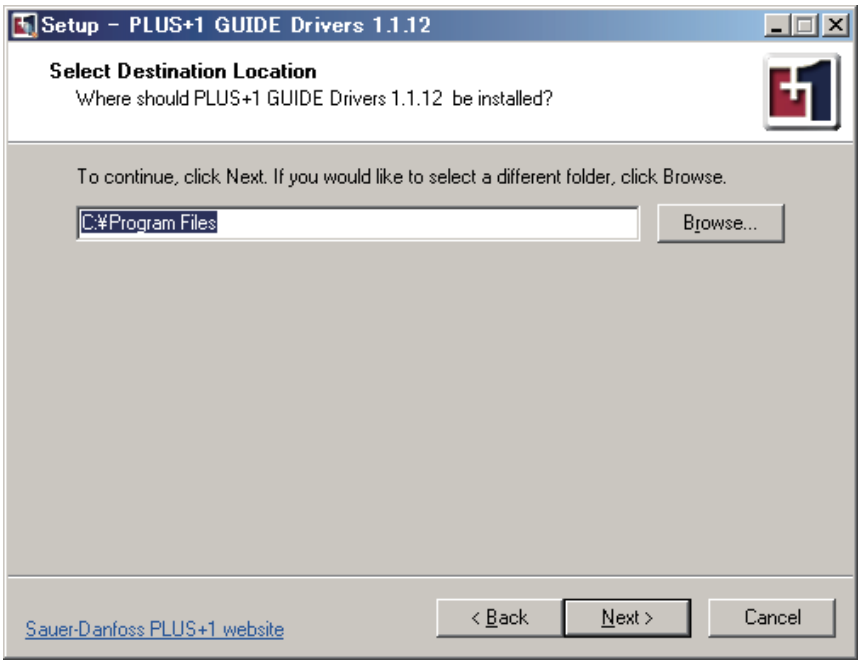
6S1AT17

   b. Select “I accept the agreement” and then click [Next] to confirm and proceed.



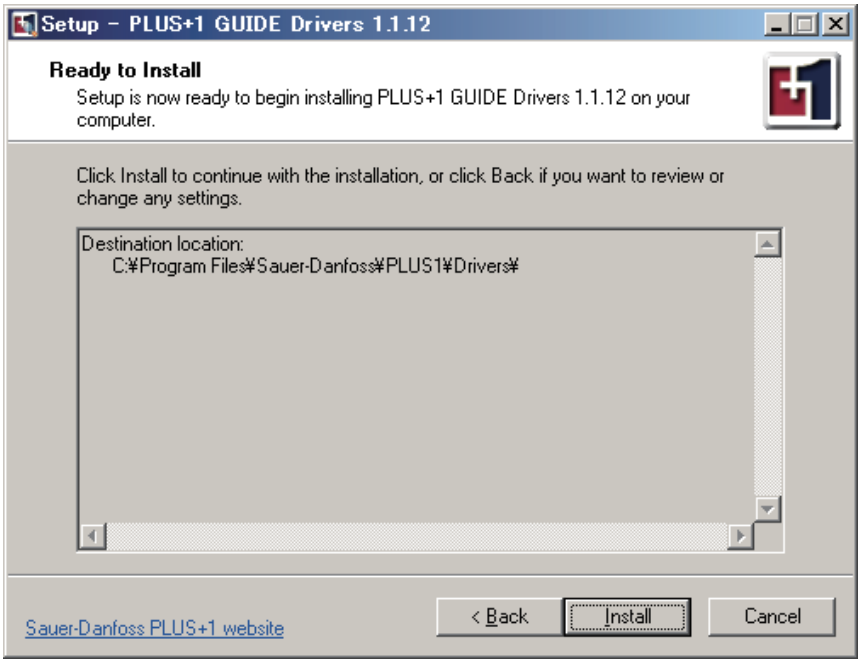
6S1AT18

c. Specify the folder for installation of the driver (continue as is unless wanting to use a folder other than the one selected) and then click [Next] to proceed.



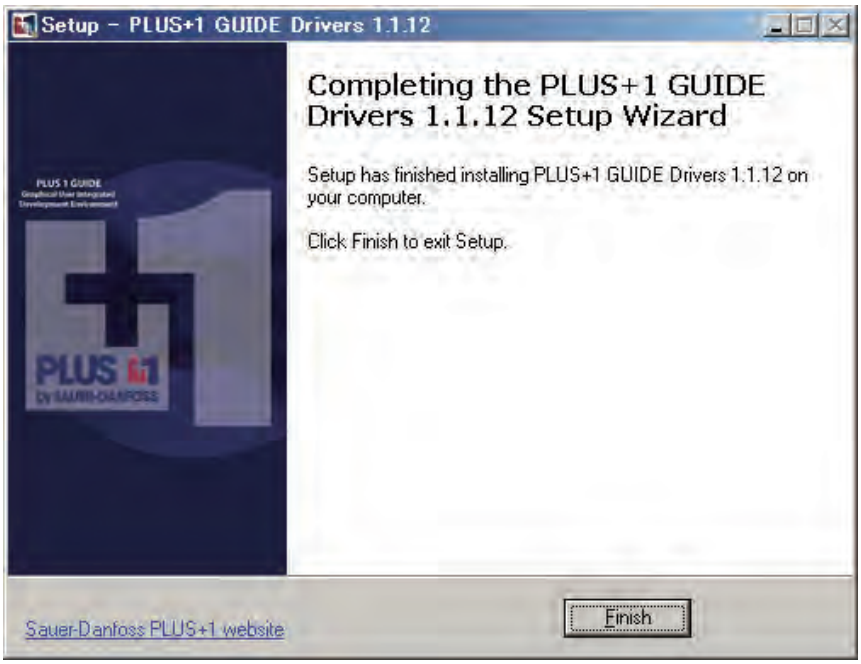
6S1AT19

d. Click [Install] to start the installation.



6S1AT20

e. The screen shown below will appear if the installation is successful.
Click [Finish] to complete the installation and close the window.



6S1AT21

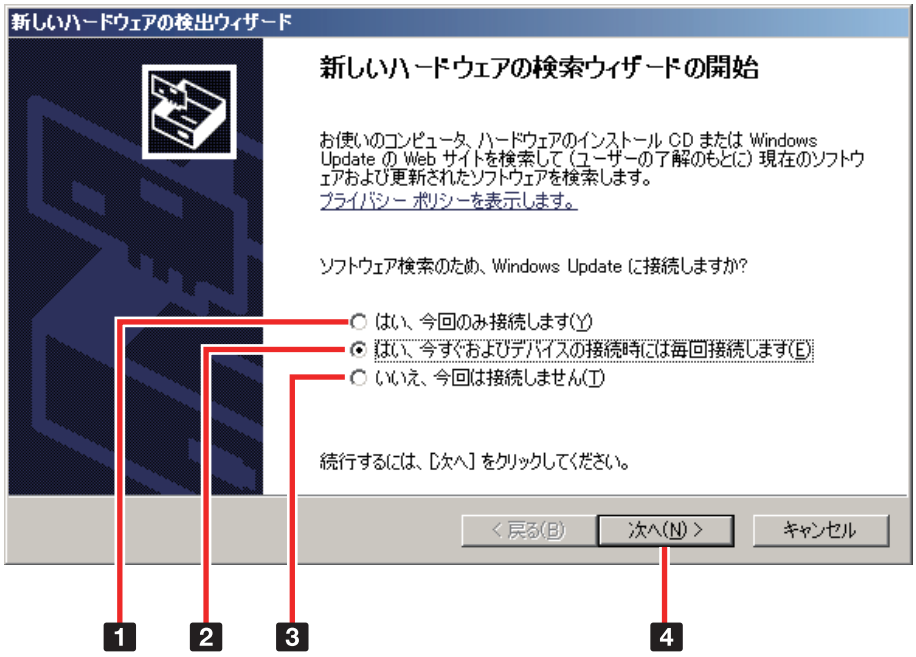
2-4. Connection to the machine and startup of the Maintenance Software

1. Connect the Maintenance Tool (product no. 17301-41810) to the USB port on your computer.
   a. The message shown at right will appear as soon as you connect the Maintenance Tool to the USB port on your computer and the device is recognized.
   Click on the message to start the Found New Hardware Wizard.



6S1AT22

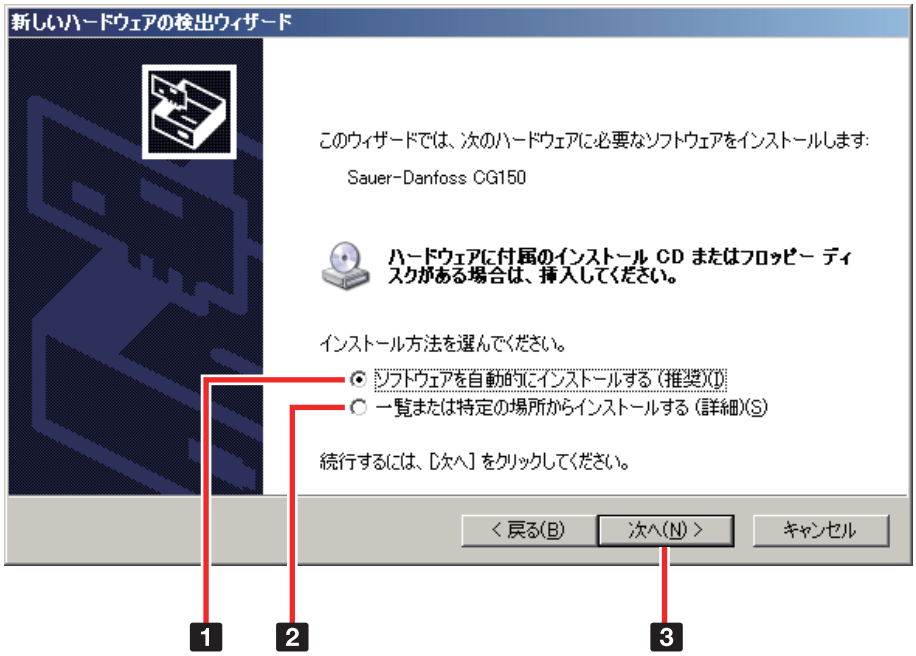
   b. Select 2 “Yes, now and every time I connect a device” and then click 4 [Next] to proceed.



6S1AT23

1 “Yes, this time only.”
2 “Yes, now and every time I connect a device.”
3 “No, not this time.”
4 Next

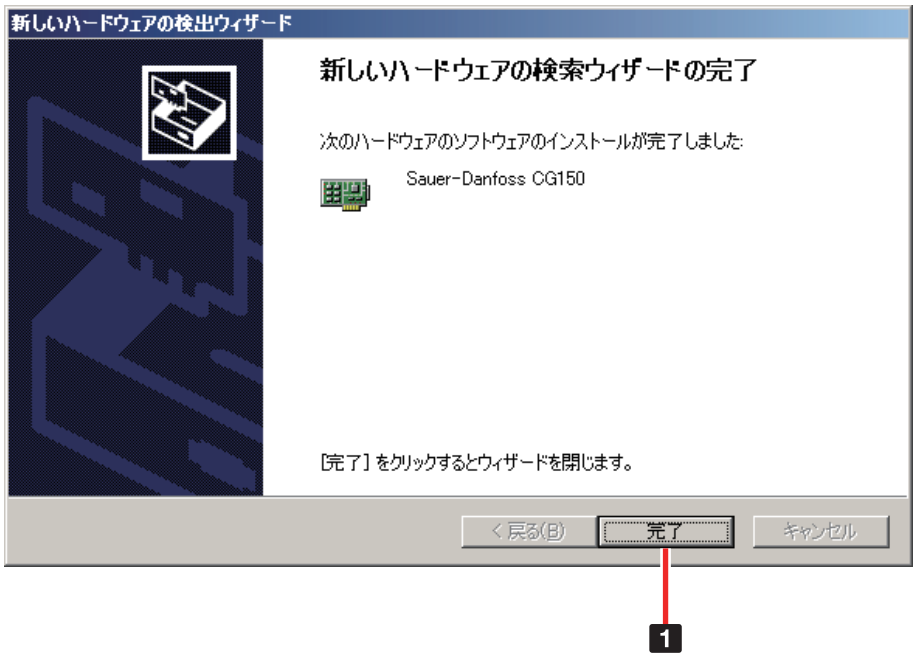
c. Select 1 “Install the software automatically.” Click 4 [Next] to start the Search wizard.



6S1AT24

1 “Install the software automatically.”
2 “Install from a list or specific location.”
3 Next

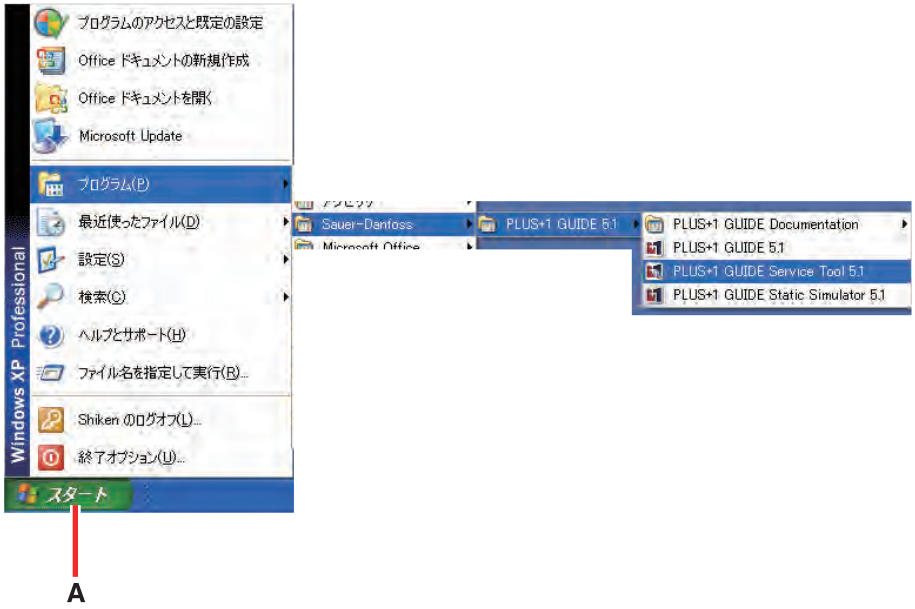
d. A message such as the one shown below will appear to inform you that the installation has been completed. Click 1 [Finish] to end the Wizard and close the window.



6S1AT25

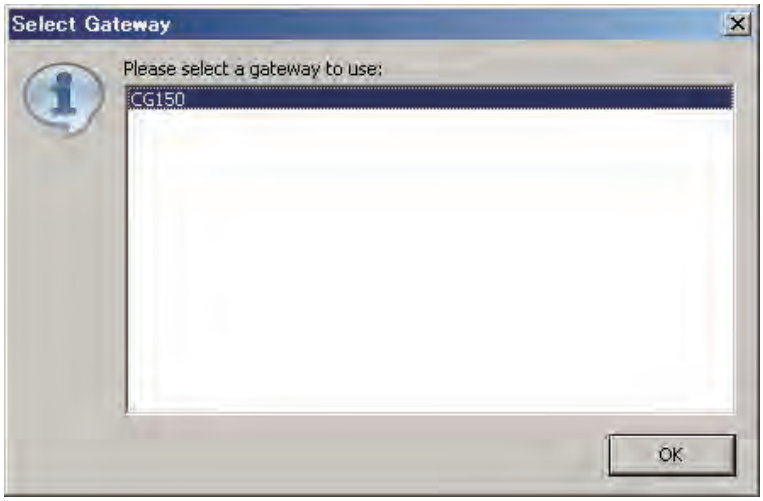
1 Finish

2. Start up the PLUS+1 GUIDE Service Tool installed in Step 2-2.
   a. Select [Program] from the Start menu and then click on [Sauer-Danfoss]. Click on PLUS+1 GUIDE 6.1.6, and select PLUS+1 GUIDE Service Tool.
      • You can also start the program by clicking on the desktop icon if you chose to create one.



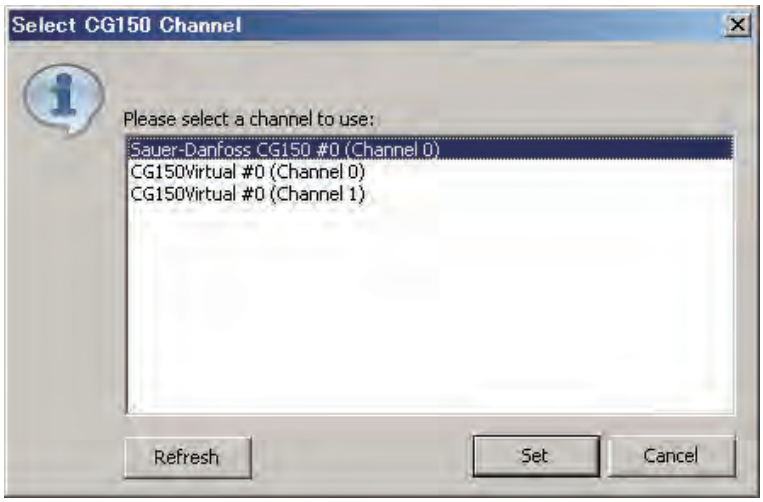
6S1AT26

   b. When the window shown below appears, confirm that [CG150] has been selected and then click [OK] to proceed.



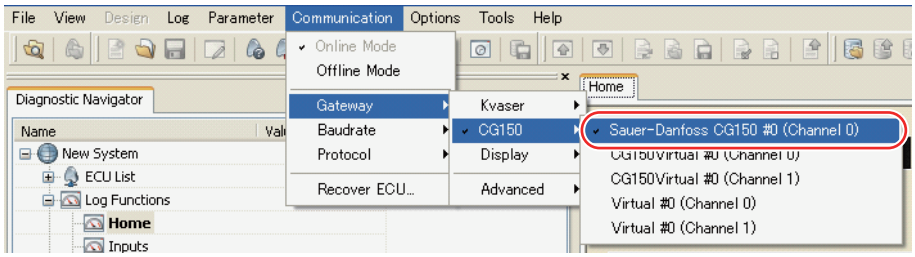
6S1AT27

c. When the window shown below appears, confirm that [Sauer-Danfoss CG150 #0 (Channel 0)] has been selected and then click [Set] to proceed.



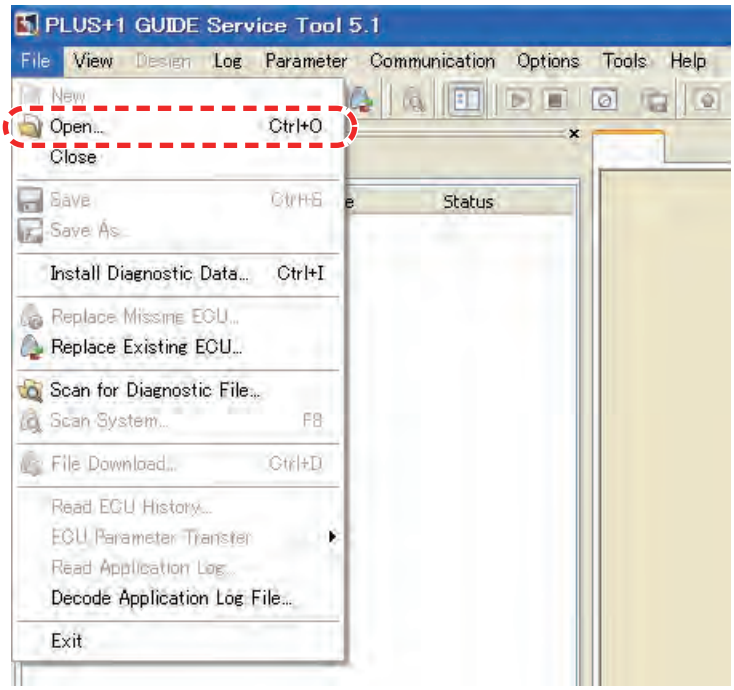
6S1AT28

3. Select [Communication]-[Gateway]-[CG150]-[Sauer-Danfoss CG150 #0 (Channel 0)].
   - The Maintenance Tool may not be properly connected if the above is not available as a selection. Make sure that the Maintenance Tool is firmly connected and then try again.



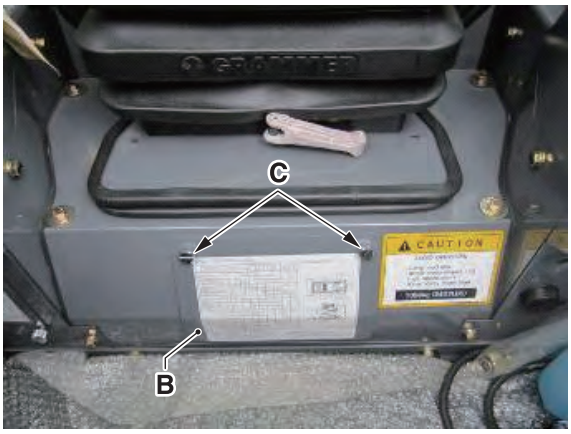
6S1AT29

4. Start up the Maintenance Software.
   a. Select [File]-[Open].



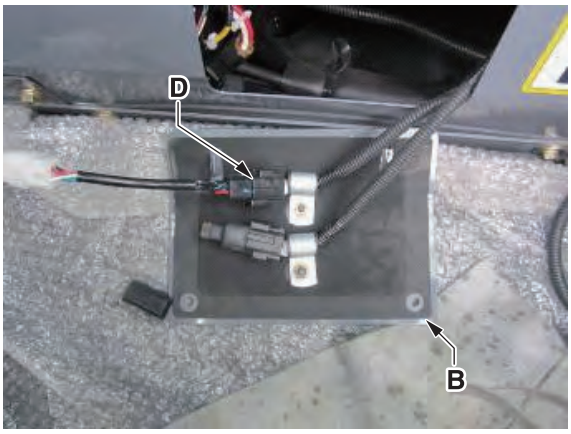
   b. Open the Maintenance Software file.
      - The file should be located in the save location selected for the Maintenance Software that was selected in Step 2-1 above. Open the .PID data file.

5. Connect to the actual machine.
   a. Remove the cover (B) on the floor space in front of the seat.
      • Remove the two screws (C) and then lift up the cover (B) to pull it out.



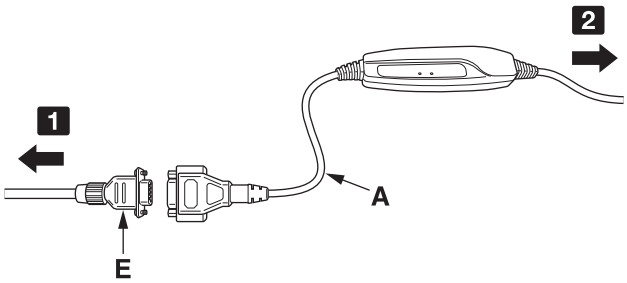
6S1AT32

   b. There is a connector (D) located under the cover (B) that is marked with a “CAN_0” marking tube. Connect the cable assembly (E) to this connector (D).



6S1AT33

   c. Connect the cable assembly (E) to the Maintenance Tool (A).



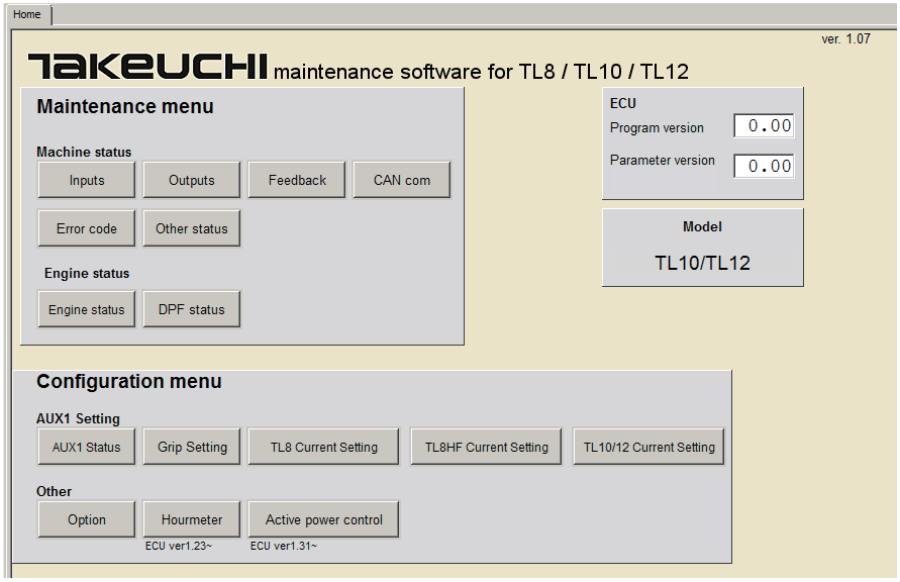
6S1AT34

1 To actual machine
2 To computer

3. DESCRIPTION OF FUNCTIONS

3-1. Home (Main screen)

Click the different buttons to jump to the associated pages.



6S1BE011

1. This function can be used to check each type of status information.
2. This function can be used to change the setting values of each function.
3. This function can be used to check the program version of the main controller.
4. This function can be used to check the model type.

Button functions

Status

Machine Status

Inputs — This function can be used to check the controller input.

Outputs — This function can be used to check the output values processed by the controller.

Feedback — This function can be used to check the output values output by the actual controller.

CAN com — This function can be used to check the CAN reception status.

Error Code — This function can be used to check error codes.

Other status — This function can be used to check status on the machine side.

Engine Status

Engine status — This function can be used to check status of the engine.

DPF status — This function can be used to check status of the diesel particulate filter (DPF).

AUX1 Settings

AUX1 Status This function can be used to check and set functions of the 1st auxiliary line piping.

Grip Setting This function can be used to check and set the slide switches and related settings and functions.

TL8 Current Setting This function can be used to set the current at full stroke. (This setting is available on TL8 models.)

TL8 Current Setting This function can be used to set the current at full stroke. (This setting is available on TL8 models with high-flow specifications.)

TL10/12 Current Setting This function can be used to set the current at full stroke. (This setting is available on TL10 and TL12 models.)

Other

Option This function can be used to set options.

Hourmeter This function can be used to adjust the hourmeter.

Active power control This function can be used to check and adjust the Active power control.

Menu button

Below are included descriptions of the menu button functions. These buttons are displayed on the settings screen for each function.

Back Use this button to return to the previous item page.

Home This function is used to return the screen to the Home screen.

Download This function is used to reflect the values set in the Service tool on the controller.

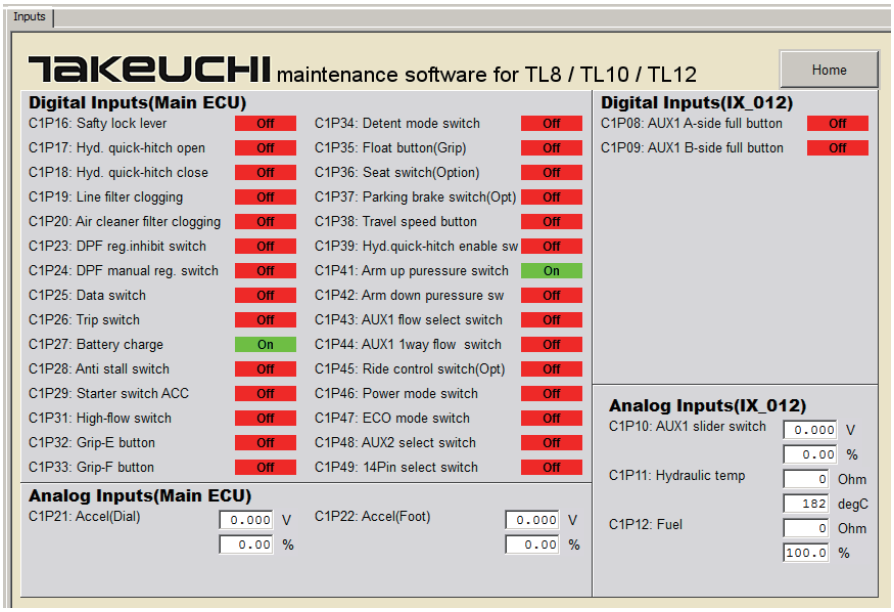
Upload This function is used to read out values actually set to the controller.

3-2. Status

3-2-1. Machine Status

Inputs

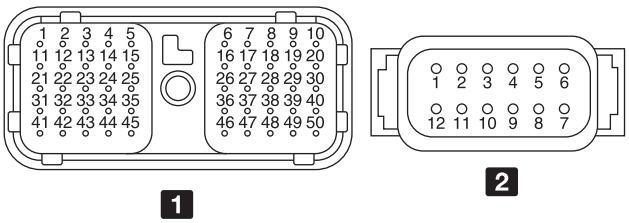
This function can be used to check the digital and analog signals input to the main controller.



6S1BE02

Main ECU

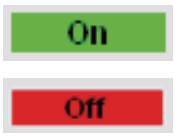
C1P21: Accel (Dial) Top: Input voltage Bottom: Degree to which the accelerator is opened (0% to 100%)
C1P22: Accel (Foot) Top: Input voltage Bottom: Degree to which the accelerator is opened (0% to 100%)
C1P10: AUX1 Slider switch Top: Voltage Bottom: Stroke (-100% to +100%)
C1P11: Hydraulic temp Top: Resistance value Bottom: Temperature (in degrees C)
C1P12: Fuel Top: Resistance value Bottom: Level of fuel remaining (0% to 100%)



6S1AT36

1 Pin wiring diagram for the main controller: C1P**
2 Pin wiring diagram for the extension module (IX012): C1P**

Digital Inputs



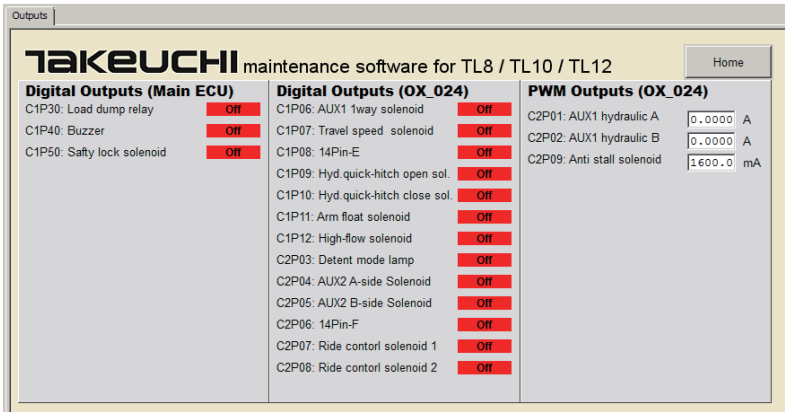
Input present

No input present

6S1B007

Outputs

This function can be used to check output signals processed by the controller.

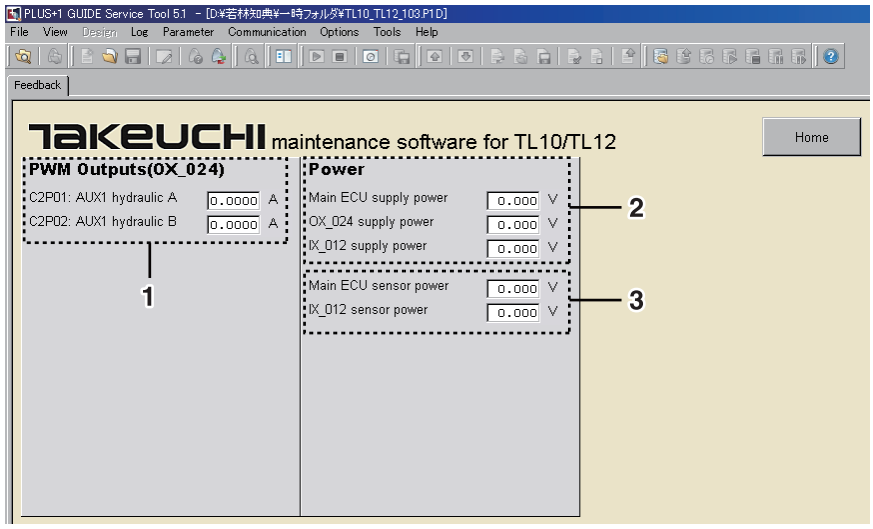


6S1BE03

This function can be used to check the PWM output of the output extension module.

Feedback

This function can be used to check values actually output from the controller.

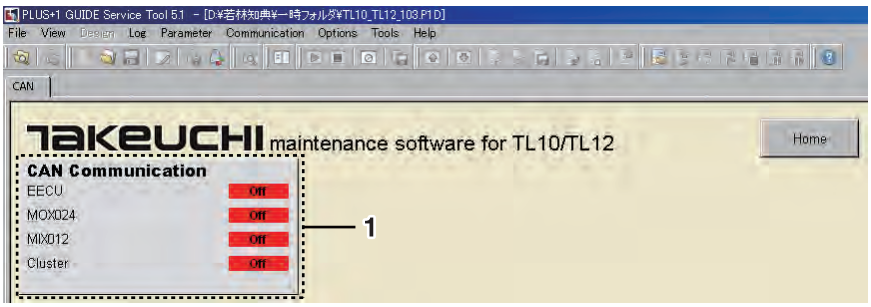


6S1AT40

1. Actual output current of the 1st auxiliary line piping
2. Power supply voltage (12 V)
   Top: Main engine control unit (ECU)
   Middle: Extension module (OX_024)
   Bottom: Extension module (IX_012)
3. Sensor voltage (5 V)
   Top: Main controller
   Bottom: Extension module (IX_012)

CAN com

This function can be used to check the CAN communication status of the main controller and other controllers.

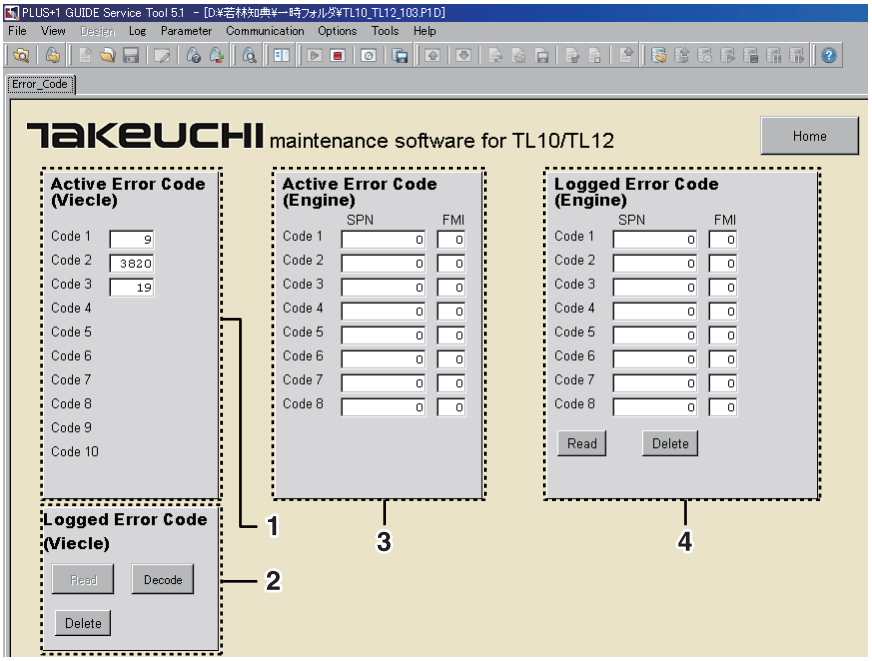


6S1AT41

1. CAN communications state
   Switching back and forth between ON/OFF: Normal
   Staying OFF: Abnormal

Error Code

This function can be used to check current active error codes and error codes that have occurred in the past.

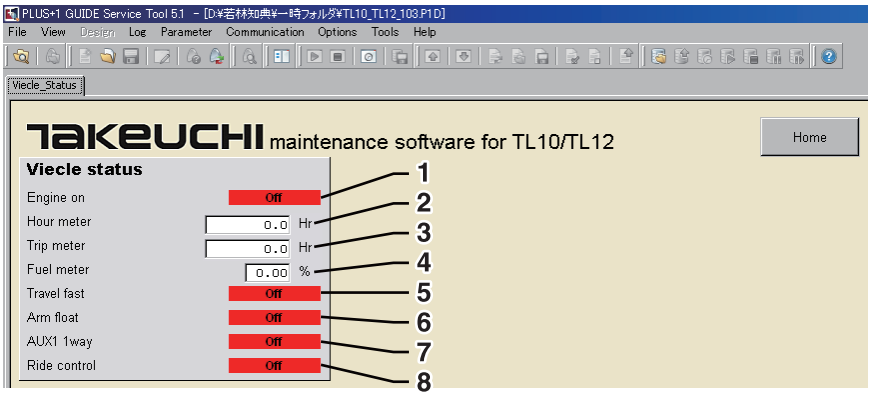


6S1AT49

1. Current malfunction codes for the machine
2. Current malfunction codes triggered on the machine are read out.
   Read: Current malfunction codes triggered on the machine are read out in CSV format.
   The P1A and CSV files for the extension modules are created with the same content.
   Decode: This is used to convert a P1A file into a CSV file.
   Delete: This is used to delete the malfunction code log.
3. Current malfunction codes for the engine
4. Past malfunction codes for the engine
   Read: This is used to display a list of malfunction codes.
   Delete: This is used to delete the malfunction code log.

Other status

This function can be used to check and set the machine status and machine functions.



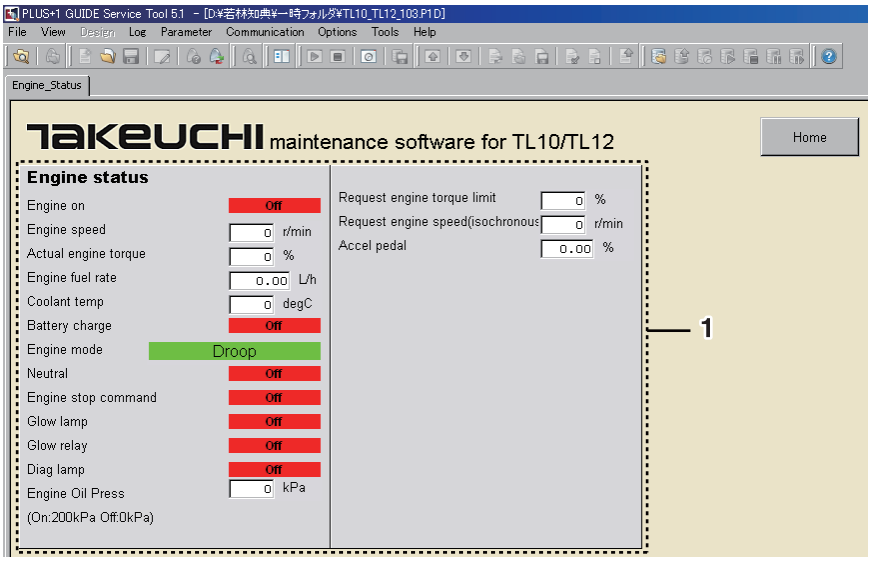
6S1AT42

1. Engine status
   ON: Engine running
   OFF: Engine stopped
2. Hourmeter
3. Trip meter
4. Fuel gauge (0% to 100%)
5. Travel speed
   ON: 2nd-speed
   OFF: 1st-speed
6. Arm float
7. Flow mode
   ON: 1-way
   OFF: 2-way
8. Ride control

3-2-2. Engine Status

Engine status

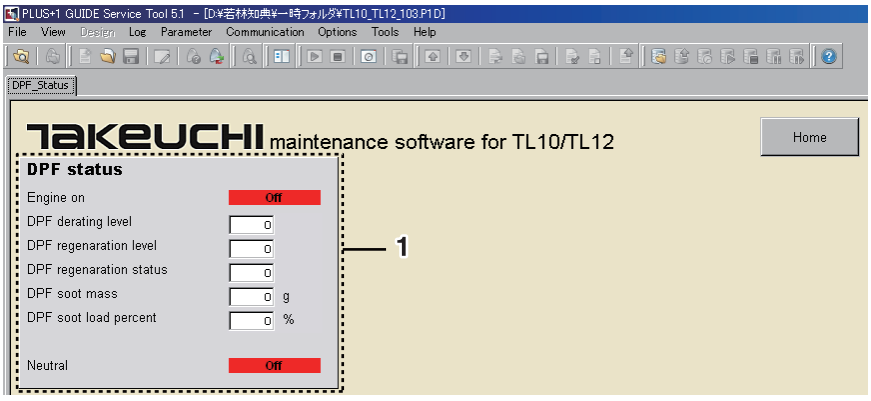
This can be used to check the status of the engine.



6S1AT43 1. Engine status

DPF status

This can be used to check the status of the diesel particulate filter (DPF).



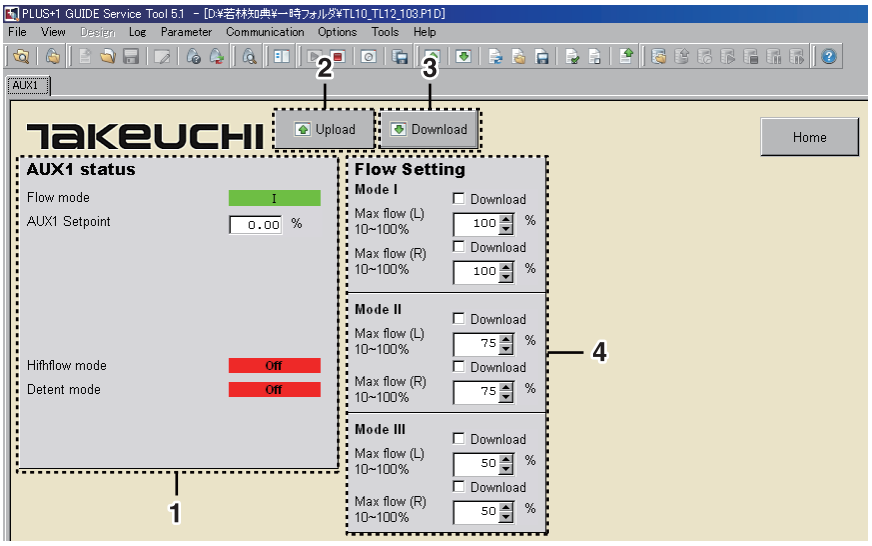
6S1AT44 1. DPF status

3-3. Configuration menu

3-3-1. AUX1 Settings

AUX1 Status

This function can be used to check the status and change the settings of the 1st Service line.



6S1AT45

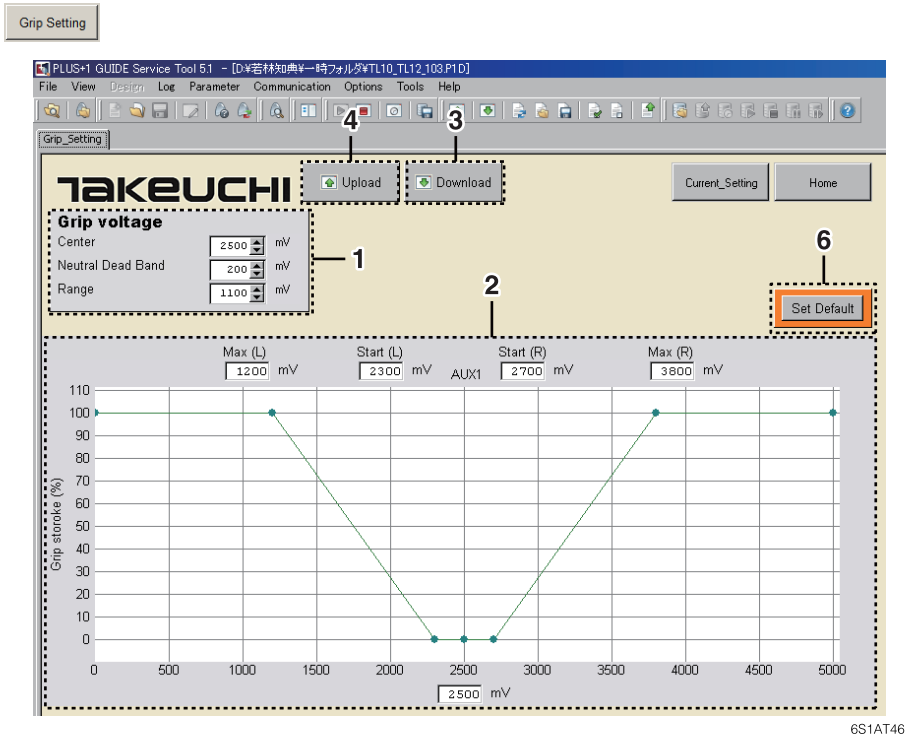
1. Current settings for the 1st auxiliary line piping
2. Download: This is used to download the settings to the controller.
3. Upload: This is used to upload the current settings from the controller.
4. Flow rate for the flow select mode

Adjusting method

⚠ DANGER

Make sure to exercise extreme caution after making adjustments as the machine could run in an unexpected way, which could in certain cases cause severe injury or even death. Be extremely careful when operating the auxiliary line piping.

a. Click on (3) to pull up the current setting conditions (4).
b. Click above or below (4) to set the flow rate to any desired value.
c. Click on the box to the left of “Download” to check it.
d. Click on (2) to download the setting values set in b. to the controller.



6S1AT46

1. Set voltage
2. Voltage (mV)-Current (%) characteristics graph
3. Download: This is used to download the settings to the controller.
4. Upload: This is used to upload the current settings from the controller.
5. Set Default: This is used to reset the settings to the default values.

Adjusting method

⚠ DANGER

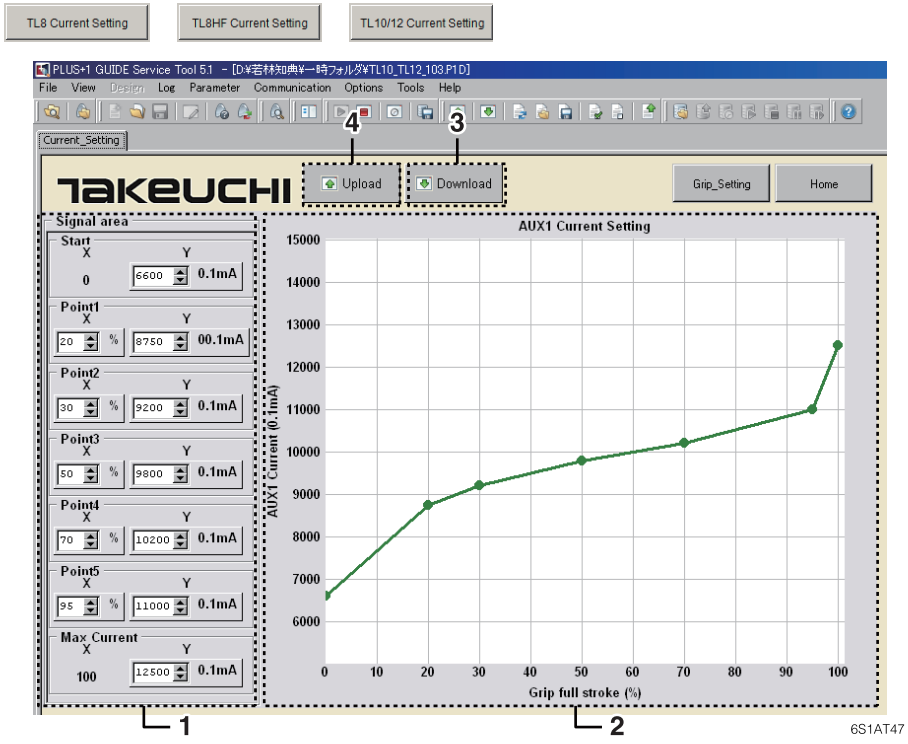
Make sure to exercise extreme caution after making adjustments as the machine could run in an unexpected way, which could in certain cases cause severe injury or even death. Be extremely careful when operating the auxiliary line piping.

The amount of voltage applied to the solenoid valve and the flow rate for the auxiliary line piping may vary depending on the slide switch operation. Here, an explanation will be given for a method for adjusting a flow rate that varies with changes in voltage.

a. Click on (4) to pull up the current setting conditions (1) and (2).
b. Click above or below (1) to set the option setting to any desired value.
c. Click on (3) to download the setting values set in b. to the controller.

Example settings

For settings with Center: 2500 mV, Neutral Dead Band: 200 mV, Range: 1100 mV
There will be no operation within the 2500 ± 200 mV band.
There will be operation within the 1200 to 2300 mV and 2700 to 3800 mV bands.



1. Set current
2. Slide switch stroke (%)-Current (×0.1 mA) characteristics graph
3. Download: This is used to download the settings to the controller.
4. Upload: This is used to upload the current settings from the controller.

Adjusting method

⚠ DANGER

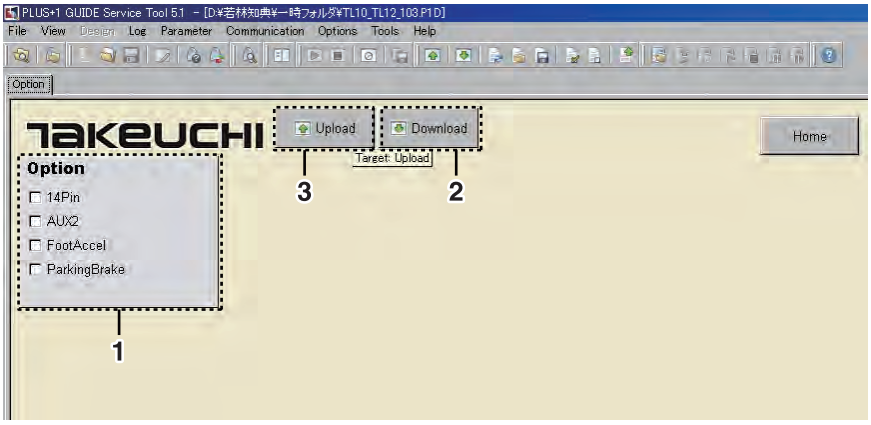
Make sure to exercise extreme caution after making adjustments as the machine could run in an unexpected way, which could in certain cases cause severe injury or even death. Be extremely careful when operating the auxiliary line piping.

The amount of voltage applied to the solenoid valve and the flow rate for the auxiliary line piping may vary depending on the slide switch operation. Here, an explanation will be given for a method for adjusting the current according to slide switch operation.

a. Click on (4) to pull up the current setting conditions (1) and (2).
b. Click above or below (1) to set the option setting to any desired value.
c. Click on (3) to download the setting values set in b. to the controller.

3-3-2. Other

Option



6S1AT48

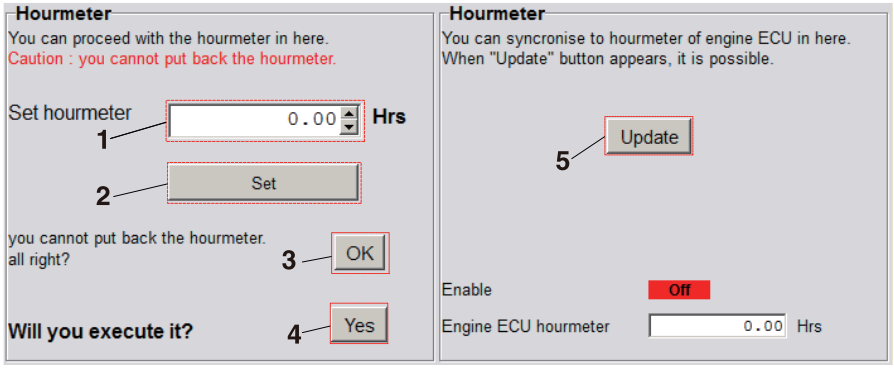
1. Option settings
2. Download: This is used to download the settings to the controller.
3. Upload: This is used to upload the current settings from the controller.

Setting the option settings

a. Click on (3) to pull up the current setting conditions (1).
b. After configuring settings for the different options, check the set items and then click (2).

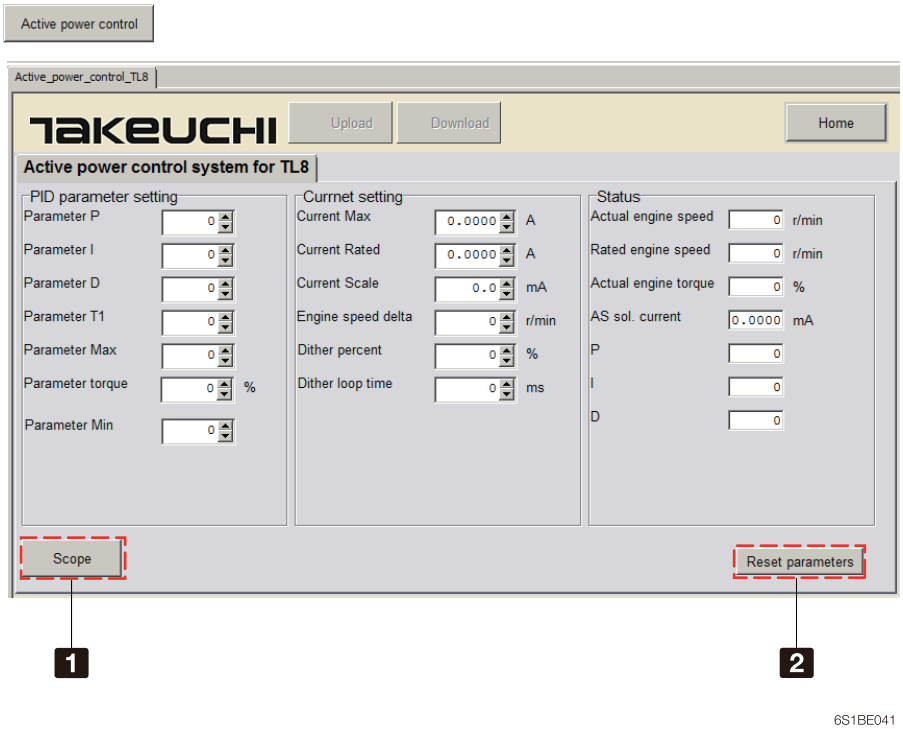
Hourmeter

This function can be used to advance the hourmeter to a desired time.



6S1BF17

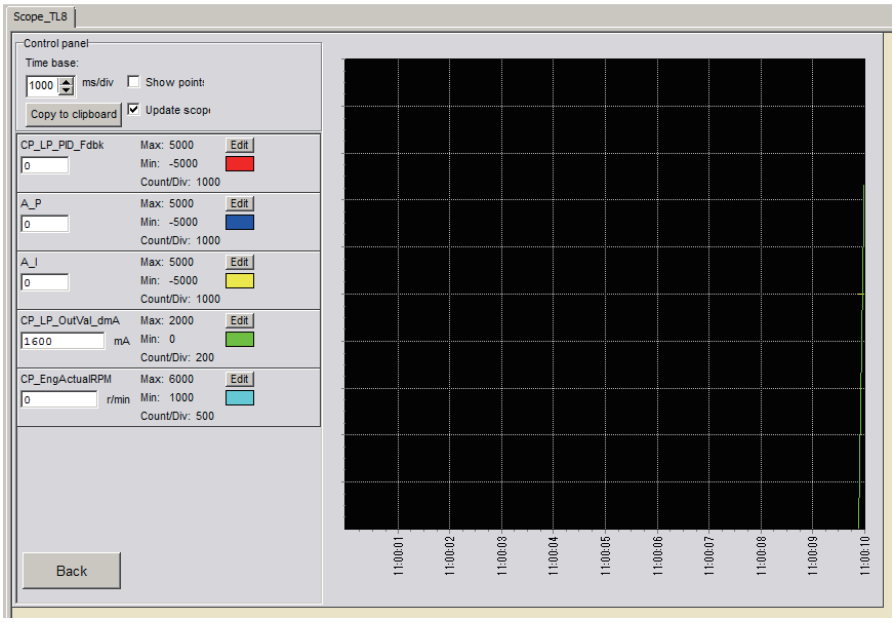
1. Use the scrollbar to enter the desired time for the hourmeter.
2. Once the desired hourmeter time has been entered, click the button to proceed.
3. Note that you will not be able to revert back to the previous hourmeter time once you have advanced the hourmeter. Make sure to check the time before clicking the button.
4. Clicking the button will confirm the time and change the hourmeter.
5. Clicking the button will synchronize the time for this hourmeter to the ECU hourmeter. (The times can be synchronized while the update button is shown or while the Enable item is ON.)



6S1BE041

1 This button will move the display to the Scope screen.
2 This will reset the settings to the default values.

Proportional-integral-derivative (PID) parameter settings	
Parameter P:	This is used to change the P (proportional) control variable for PID control.
Parameter I:	This is used to change the I (integral) control variable for PID control.
Parameter D:	This is used to change the D (derivative) control variable for PID control.
Parameter T1:	This is used to change the time (in ms) for PID control.
Parameter Max:	This is used to change the maximum current value (in increments of 0.1 mA) used to control the current value for PID control.
Parameter torque:	This is used to change the threshold value for the engine torque at which PID control starts.
Parameter Min:	This is used to change the minimum current value (in increments of 0.1 mA) used to control the current value for PID control.
Current settings	
Current Max:	This is used to change the maximum current value (A) that can be output by the controller.
Current Rated:	This is used to change the standard current value (A) at which PID control is started.
Current Scale:	This is used to change the scale conversion values for target value — feedback value for the output current.
Engine speed delta:	This is used to change the value for Rated engine speed – Engine speed delta = Target engine speed.
Dither percent:	This is used to change the dither width for pulse-width modulation (PWM).
Dither loop time:	This is used to change the dither cycle (ms) for PWM.
Status	
Actual engine speed:	This is used to check the actual engine speed.
Rated engine speed:	This is used to check the rated engine speed which varies according to the degree to which the accelerator is opened.
Actual engine torque:	This is used to check the actual engine torque.
AS sol. current:	This is used to check the target current value (A) for the Active power control solenoid.
P:	This is used to check the P control variable.
I:	This is used to check the I control variable.
D:	This is used to check the D control variable.

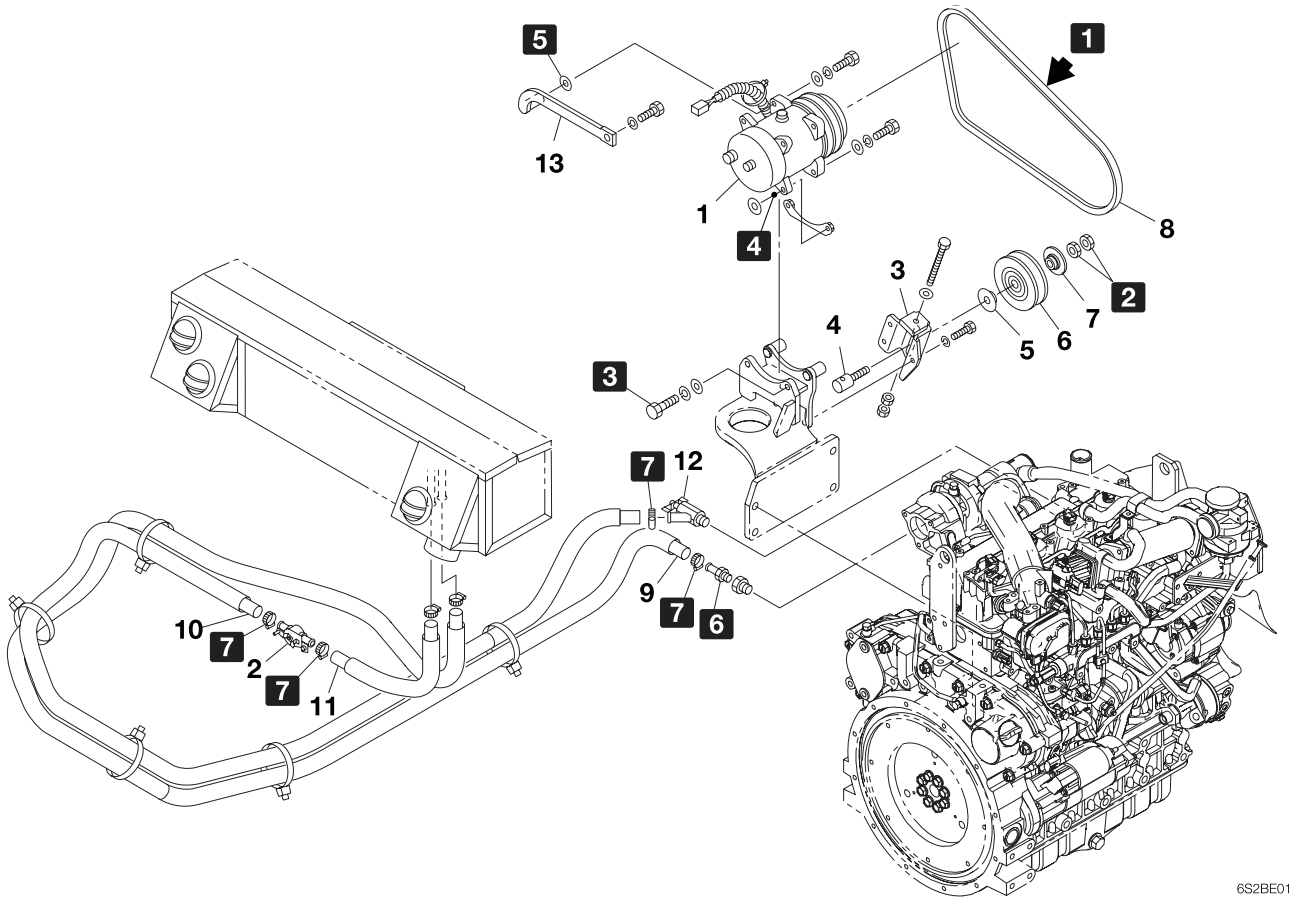


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CP_LP_PID_Fdbk:	Feedback value for PID control
A_P:	P control variable
A_I:	I control variable
CP_LP_OutVal_dmA:	Target current value (A) for the Active power control solenoid
CP_EngActualRPM:	Actual engine speed

AIR CONDITIONER

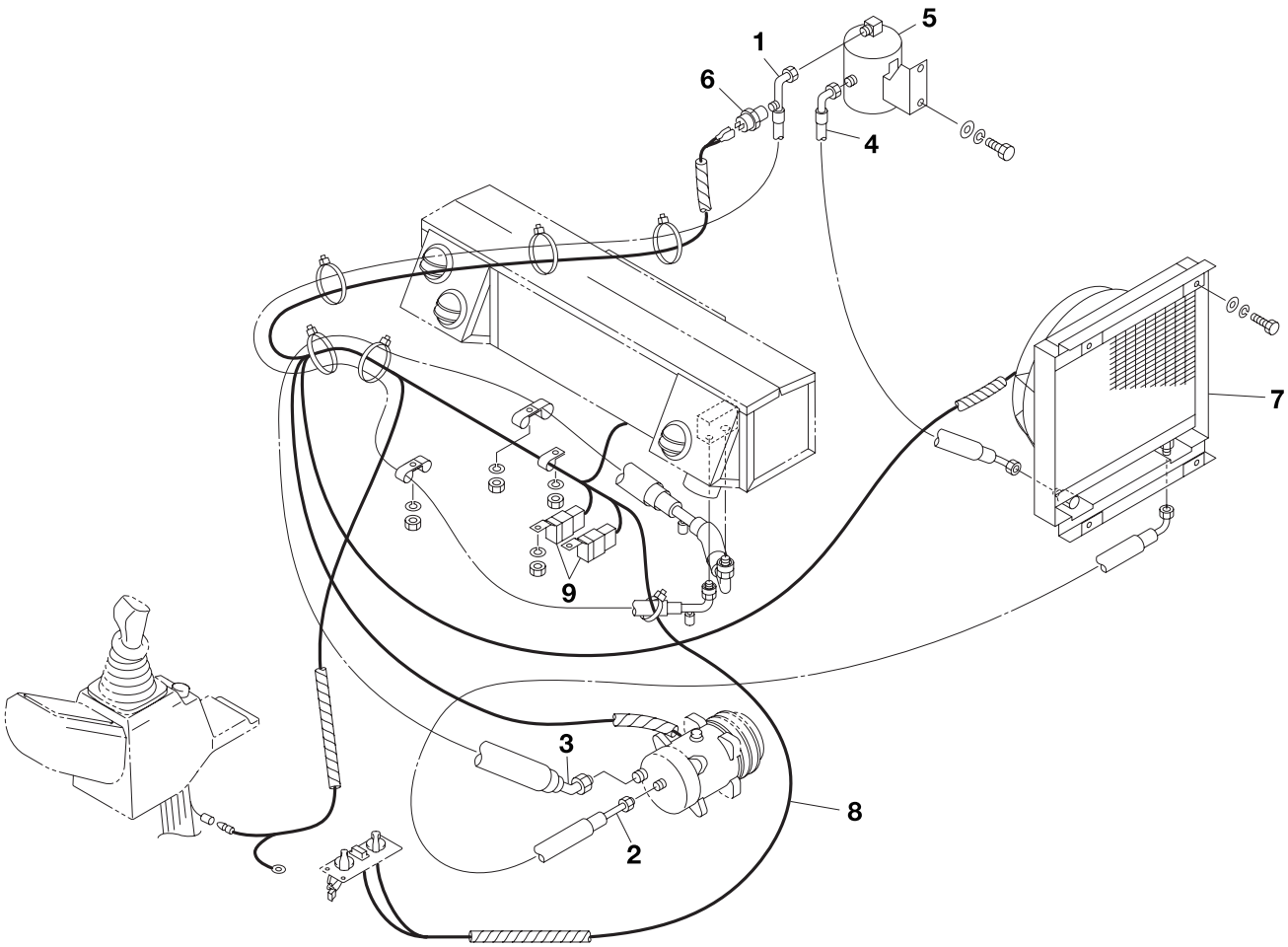
Compressor assembly



1. Adjust the fan belt until it yields approximately 8 mm (0.3 in.) when a force of 98 N (22 lbf) is applied to a midpoint between the pulley and the compressor.
2. Inner nut: 17 N·m (12.5 ft.-lb.) Outer nut: 83.4 N·m (61.5 ft.-lb.) When tightening down the outer nut, use a wrench to hold the inner nut in place to keep it from turning while turning the outer bolt to tighten it down.
3. Apply ThreeBond #1324 or an equivalent.
4. Insert a shim between the installation surface and compressor to adjust the width of the clearance so that it is between 0.1 mm to 0.6 mm (0.004 in. to 0.024 in.) or below.
5. Use a shim to adjust the width of the clearance.
6. 23.5 N·m (17.3 ft.-lb.)
7. 1.96 N·m (1.4 ft.-lb.)
8. Leave a clearance of 1 mm (0.04 in.).

1. Compressor
2. Valve
3. Bracket
4. Shaft
5. Collar
6. Pulley
7. Collar
8. Belt
9. Hose
10. Hose
11. Hose
12. Valve
13. Bracket

Condenser assembly



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Refrigerant volume: 800 g (1.76 lb)

Notes:

(1) Perform all installation and refrigerant gas filling operations carefully and accurately to prevent foreign matter from entering the pipes.

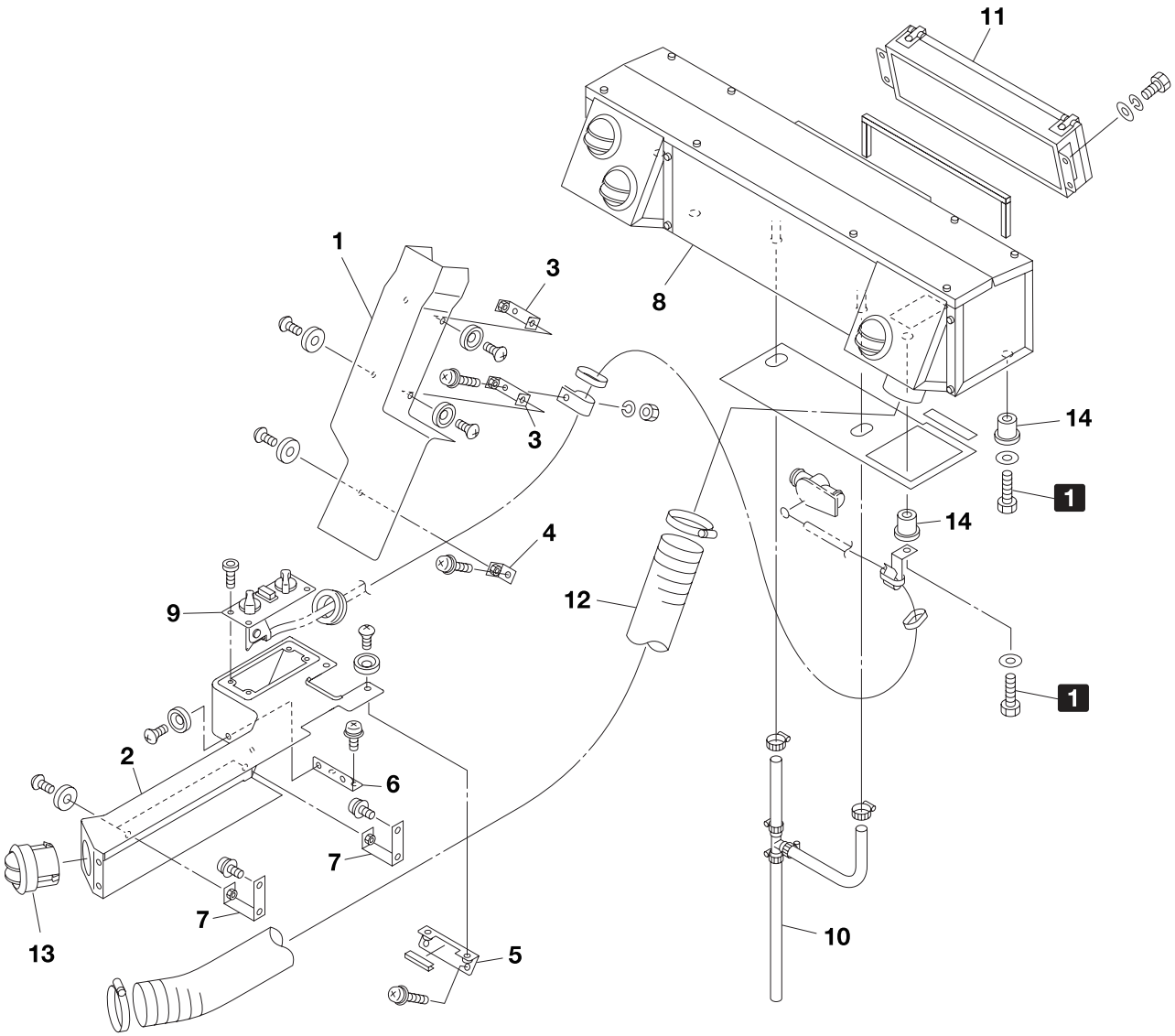
(2) When connecting the air conditioner hoses, ensure that the rubber hose sections are not twisted before attempting to connect them.

(3) The compressor is charged with a dry gas. Before connecting pipes, carefully remove the blank plugs to bleed the gas from the interior.
If a blank plug is removed too rapidly, the compressor oil may spray out.

1. Hose
2. Hose
3. Hose
4. Hose
5. Receiver dryer
6. Pressure switch
7. Condenser
8. Wire harness
9. Relay

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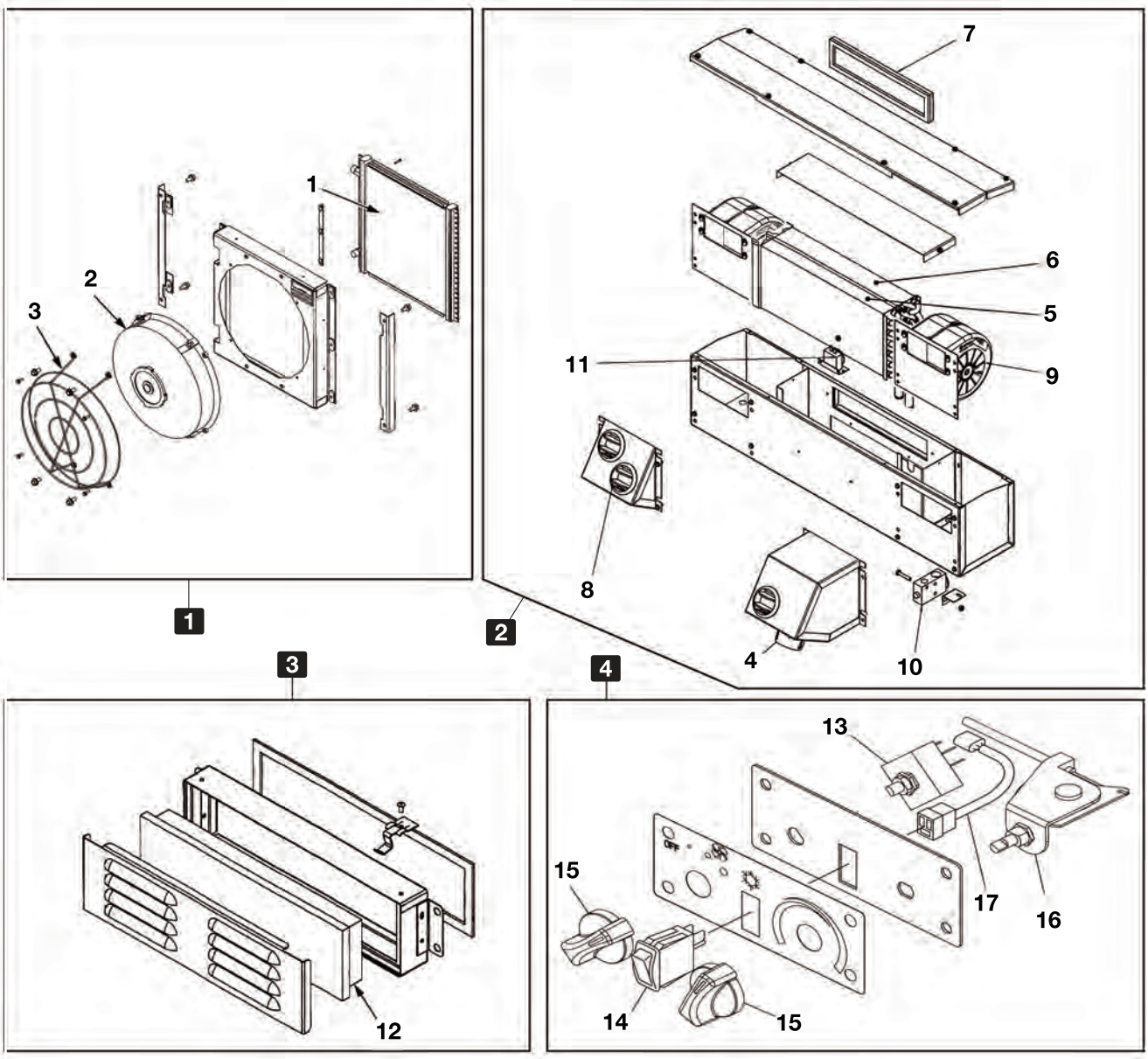
Air conditioner unit



1 After tightening the bolt down as firmly as possible by hand, use a wrench to turn it another three and a half turns.

1. Cover
2. Cover
3. Bracket
4. Bracket
5. Bracket
6. Bracket
7. Bracket
8. Air conditioner unit
9. Control panel
10. Tube
11. Filter box
12. Hose
13. Louver
14. Quietite

AC Component



6S2BE04

1 Condenser assembly
2 Air conditioner unit
3 Box
4 Panel assembly

1. Condenser
2. Motor
3. Guard
4. Adapter
5. Heater core
6. Evaporator core
7. Filter
8. Louver
9. Blower motor
10. Valve
11. Thermostat
12. Filter
13. Switch
14. Switch
15. Knob
16. Control converter
17. Wire harness

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AIR CONDITIONER SYSTEM

Overview of System Operation

- **Truck and Heavy Equipment Systems**
- **Air Conditioner-System Operation**
- **Heater System Operation**
- **Environmental Effects on System Operation**
- **Chapter Review**

Truck and Heavy Equipment Systems

A variety of HVAC systems are in use today, some old and some new. There are:

- Vehicle manufacturer installed systems
- Owner specified systems
- Add-on systems
- Retrofit systems

The system components come in different colors, shapes, and sizes. They may be mounted in or on the cab in varied locations. Owners or fleet maintenance people can modify systems by adding controls, auxiliary units or ducts. Major components are sometimes replaced due to damage or failure. All systems were, at least originally, designed and installed to meet the needs of an operator. Figure 2-1 includes illustrations of various AC and Heater systems. They illustrate system advantages and disadvantages explained in the paragraphs that follow.

The HVAC system includes both heater and air conditioner components, usually a common control, and air ducts. The system cools the cab by removing heat energy. It removes moisture from damp air in the cab and adds fresh outside air to the cab. In this way, the operator can work comfortably in all kinds of weather.

A sleeper unit, built in or added on, increases the air volumes in the cab. The air conditioner or heater must circulate and cool or heat a larger amount of air. This is accomplished by routing ducts and controls to the sleeper compartment as part of system design. Components may be increased in size to handle the larger cab air volume. A bigger heater core, air conditioning evaporator coil, condenser, blower or fan may be included. Often, on long haul trucks, auxiliary air conditioning and heater components and controls are added. The objective remains the same, to move heat energy and maintain occupant comfort.

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Air Conditioner—System Operation

We have described the movement of heat energy and basic HVAC system function in Chapter 1. Now we will go into some detail on how an air conditioner operates. The system is sealed to keep out air and moisture. To operate properly, the inside of the system contains a measured amount of refrigerant and special refrigerant oil that keeps the system lubricated. Figure 2-2 is an illustration of system components without the cab outline, in-cab controls, component housing, and air ducts or vents. Please study it for a moment. Note the information printed next to each component. Remember that the components may be positioned and attached to the truck in various locations.

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The following AC components are discussed in detail in this section:

1. Compressor/Clutch Assembly
2. Condenser
3. Receiver-Drier
4. Expansion Valve
5. Evaporator Coil

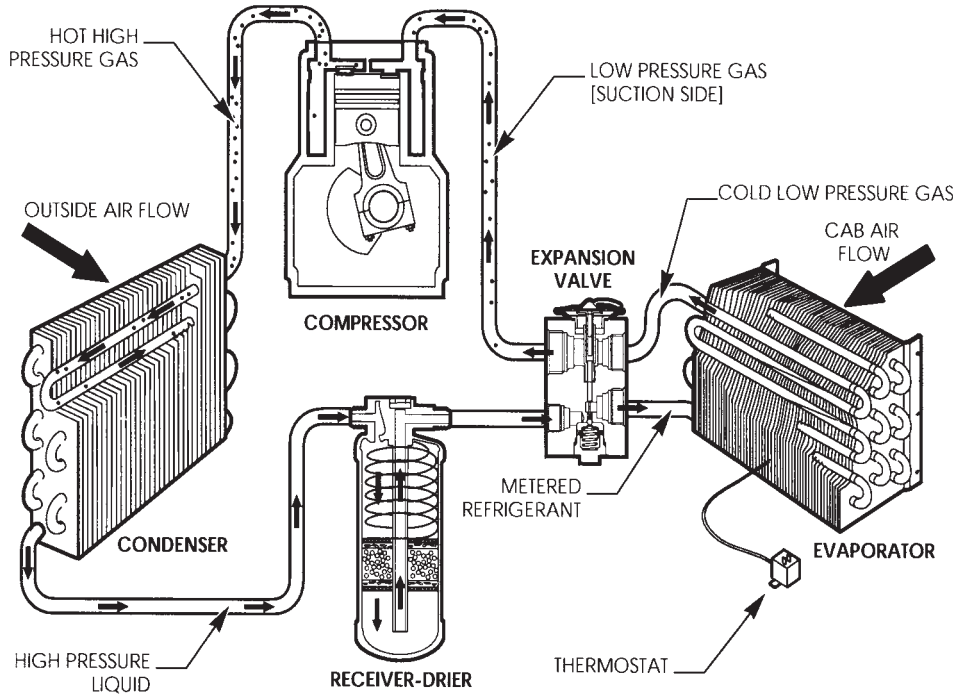


Figure 2-2
Air Conditioner components are connected together to illustrate system operation. The components shown are not to scale. The refrigerant and refrigerant oil are clear in color and not visible in this drawing. The small arrows inside the components and connecting hoses show the direction of refrigerant flow (refrigerant circuit).

1. Compressor/Clutch Assembly

The compressor/clutch assembly is the heart of the system. When the clutch is engaged, the compressor pumps refrigerant and oil around the system. It raises the temperature and pressure of the refrigerant gas, and forces it to the condenser where it changes state and becomes a liquid. The compressor also sucks the vaporized refrigerant out of the evaporator and back inside itself in the form of gas. One way valves inside the compressor separate the compressed gas (high pressure) side of the system from the suction (low pressure) side. Figure 2-3 shows a cutaway view of a compressor with the high and low pressure sides noted.

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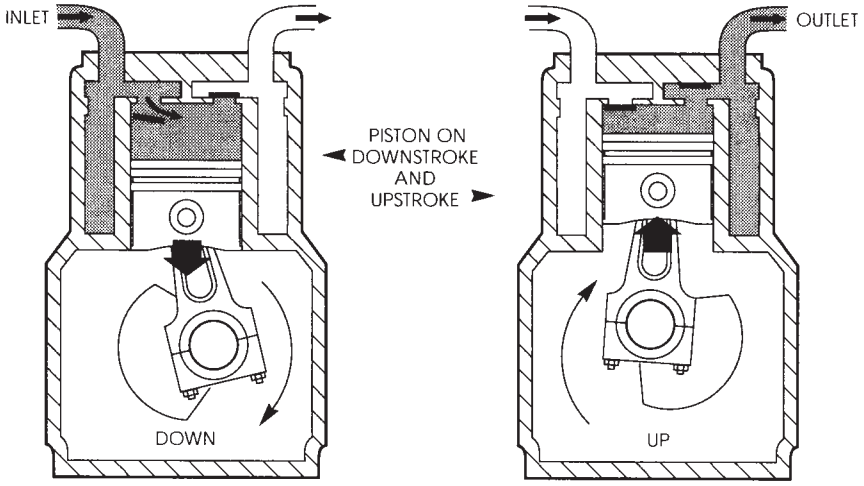


Figure 2-3
The compressor inlet is low pressure and the outlet is high pressure. The reed valves are one way. They open to allow refrigerant gas to enter the compressor on the down stroke and exit on the upstroke. Note the open valves in the illustrations.

The clutch is mounted on the shaft of the compressor and is engaged by electromagnetic action. Part of the clutch assembly is an electromagnetic wire coil. The coil is energized through a thermostat that senses the temperature in the evaporator coil. If the evaporator is too warm the electrical contacts close and allows power to flow to the clutch. The compressor shaft is engaged and moves the refrigerant around inside the system. Figure 2-4 is a cutaway view of the clutch mounted on the compressor.

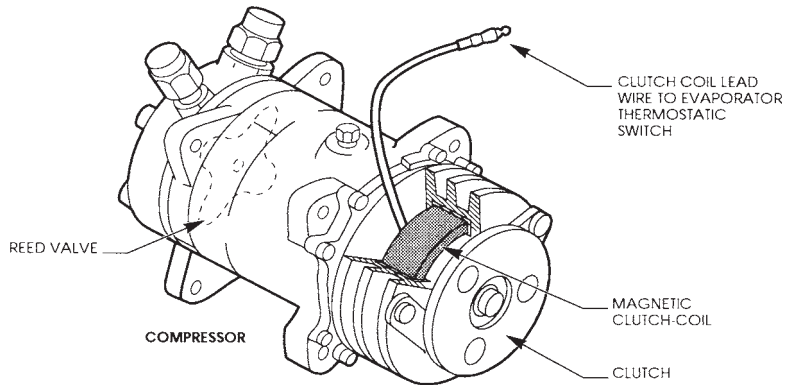


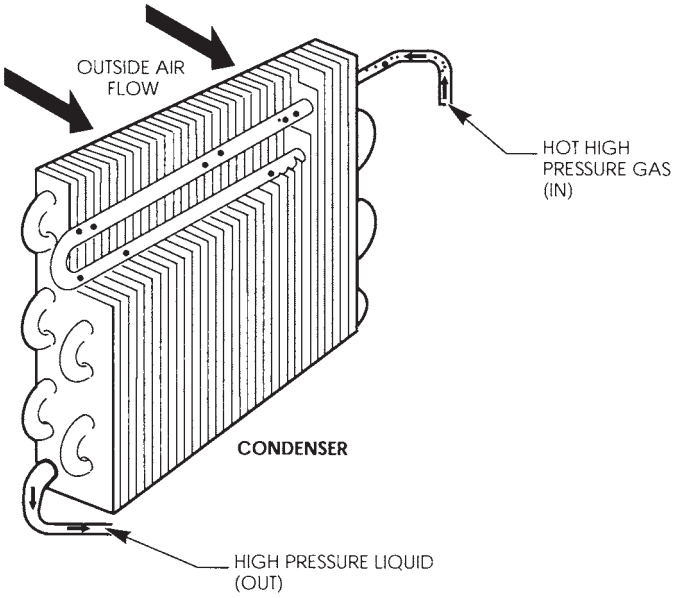
Figure 2-4
The clutch shown here has its electromagnetic coil mounted on the compressor body. When the coil is energized, magnetic force pulls the clutch drive plate into the pulley. This action locks the pulley to the compressor drive shaft and drives the compressor.

2. Condenser

The refrigerant gas leaves the compressor and moves through a high pressure hose to the condenser. Inside the condenser the gas “changes state” and becomes a liquid. It is still hot and under pressure. Remember in Chapter 1 when we talked about water at 212 degrees Fahrenheit? Heat energy was involved in the “change of state,” but the temperature did not change. The same kind of action happens inside the AC system. The refrigerant gas gives up a lot of heat energy to the outside air as it “changes state” in the condenser. Figure 2-5 illustrates a condenser. Air moving through the condenser absorbs heat from the refrigerant. The amount of air flow through the condenser is the major factor in how well the condenser functions.

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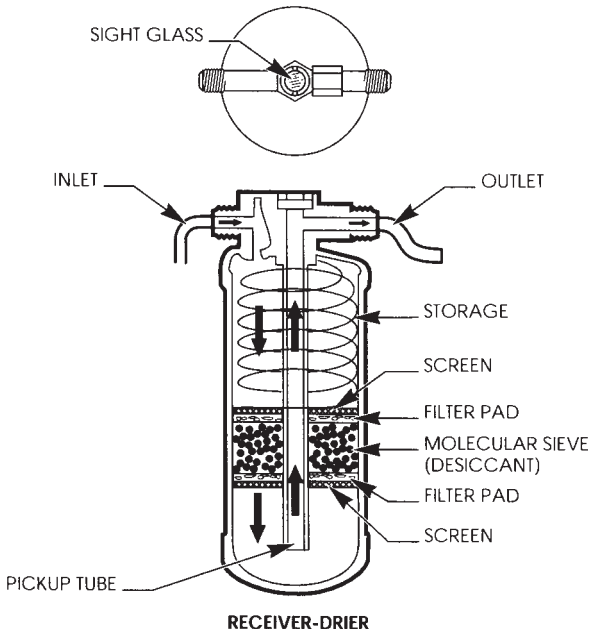
Figure 2-5
As the refrigerant gas moves through the tubing coil from top to bottom, it condenses (changes state) into a liquid. For ease of installation, condenser fittings are often routed close together.



3. Receiver-Drier

The liquid refrigerant continues to move inside the system, out of the condenser through a tube or hose to the receiver-drier. The receiver-drier serves as a small storage tank and filter for the refrigerant. It is also a good location to mount pressure switches and often contains a sight glass (small window) used to view activity inside the system. The receiver-drier, Figure 2-6, also separates gas (bubbles) from the liquid with a pick-up tube as shown in this illustration. Some receiver-driers have a spring to preload the desiccant pack.

Figure 2-6
This cutaway view of a receiver-drier shows the filter elements, inlet, outlet and refrigerant path. The sight glass is a small window into the system used in diagnosis and when adding refrigerant (charging the system).



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4. Expansion Valve (Refrigerant Metering Device)

When refrigerant moves from the receiver-drier, it travels through another high pressure hose to a metering device at the inlet of the evaporator coil. The metering device can be an expansion valve, an expansion tube or a combination (multiple function) valve. Between the compressor and this point inside the system, the pressure is high and can range from 150 to 250 pounds per square inch. The expansion valve (TXV) is closely connected to the evaporator. A diaphragm opens the valve by exerting pressure on the spring. Pressure comes from gas inside the diaphragm housing on top of the valve and in the sealed sensing bulb. The sensing tube is located in the outlet of the evaporator and picks up heat from warm refrigerant leaving the evaporator. The gas in the valve diaphragm housing and sensing tube expands when it gets warmer and forces the expansion valve open at the metering orifice.

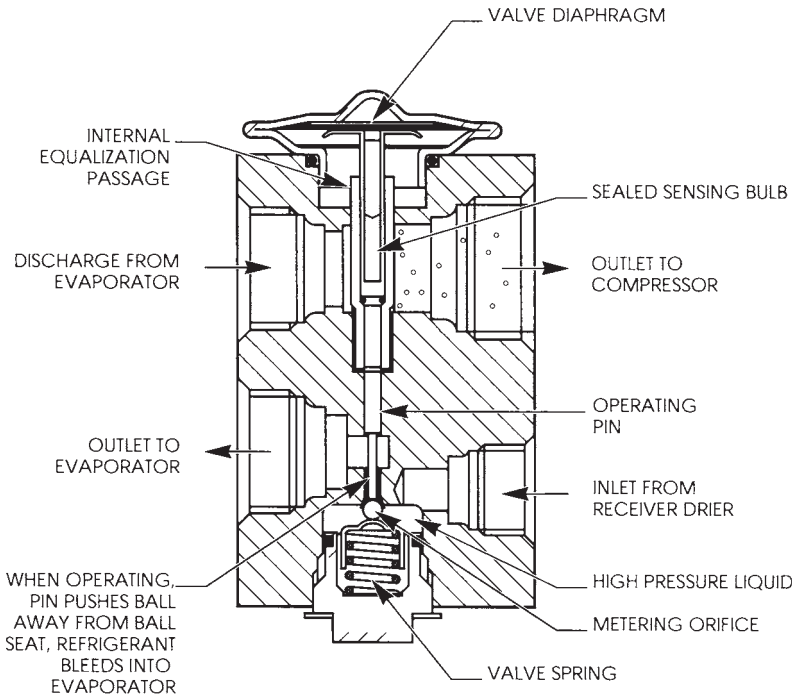


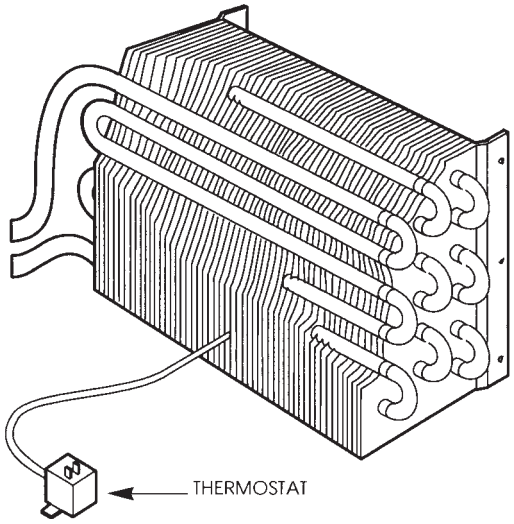
Figure 2-7
This block type expansion valve cutaway view will give you a better idea how these valves work. Spring pressure holds the valve closed.

5. Evaporator Coil

The expansion valve or other type of metering device bleeds high pressure refrigerant into the evaporator coil, where the pressure is low. The refrigerant expands rapidly in this low pressure environment. When it expands it “changes state”. The sudden drop in pressure brings the refrigerant temperature down quickly inside the evaporator coil. Figure 2-8 shows an evaporator coil and thermostat. Refrigerant is sprayed into the evaporator by the high side pressure when the expansion valve opens. The refrigerant absorbs heat from the air when the blower forces the air through the fins. When the thermostat probe senses the upper limit of the thermostat heat setting, a circuit closes. The compressor clutch engages and the compressor operates and moves more refrigerant to the high side of the system.

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Figure 2-8
The evaporator coil as shown is of fin and tube construction. The thermostat probe is positioned in between the evaporator fins and senses the temperature.



Note: Moisture in the air (humidity) condenses on the fins of the evaporator as water droplets which drain out of the evaporator through a drain hose. This action dehumidifies the air in the cab as part of system operation, and contributes to operator comfort.

Cab air forced across the evaporator coil gives up heat energy to the cold refrigerant inside the coil. The cooled air circulates in the cab for occupant comfort. Refrigerant continues to expand and absorb heat energy in the evaporator coil. Refrigerant changes from liquid to gas before it leaves the evaporator on the way back to the compressor. The refrigerant gas moves to the compressor through a low pressure (suction) hose. When the compressor is operating, it sucks the refrigerant gas back inside, compressing and raising its temperature and pressure.

Some of AC system operation is controlled by the operator, and some is automatic. The operator can turn the system on and off, regulate the air velocity with the blower control, and in some designs adjust the thermostat control. The system and component operating range settings automatically cycle the clutch on and off. The operation of the expansion valve or other refrigerant metering device at the inlet to the evaporator is automatic.

Individual system features may differ, but the basic system function remains the same. Variations in components and controls are described in Chapters 4 and 5. The engine provides the power for both air conditioner and heater operation. It drives the AC compressor and the cooling system water pump. Engine RPM affects the efficiency of both the heater and air conditioner. The slower the engine RPM, the less capacity a heater or AC system will have.

WARNING When an AC system is operating, the high pressure side components, fittings and high pressure lines or hoses can be hot enough to burn your skin if you touch them. This includes the compressor, clutch, hoses, condenser, receiver-drier, and any control devices or metal tubing. The low pressure side will be cool to the touch. In operation the AC system is under load and high side pressures normally range between 150 and 250 pounds per square inch for R-12 and higher for some other refrigerants.

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Heater System Operation

Heater and air conditioner systems both have the same basic function of moving heat. They take advantage of nature's laws where heat energy always moves from a warmer to a cooler area. In a heater system there is no "change of state" involved in system operation. The system is sealed and operates under pressure, but the pressure is low when compared to an air conditioner.

A heater system uses the engine coolant to carry excess heat energy to the cab air. The heart of the system is the water pump. The water pump forces hot coolant through a hose from the engine block and through the heater core. The coolant is returned to the engine cooling system either at the suction side of the water pump or to the radiator.

The heater fan or blower forces cab air through the heater core where heat energy moves from the engine coolant to the air in the cab. Figure 2-9 illustrates the main heater system components. In-cab controls, component housing and air vents are not shown.

The following heater components are discussed in detail in this section:

1. Heater Core
2. Water Valves
3. Defrosters and Ducts
4. Blowers and Fans

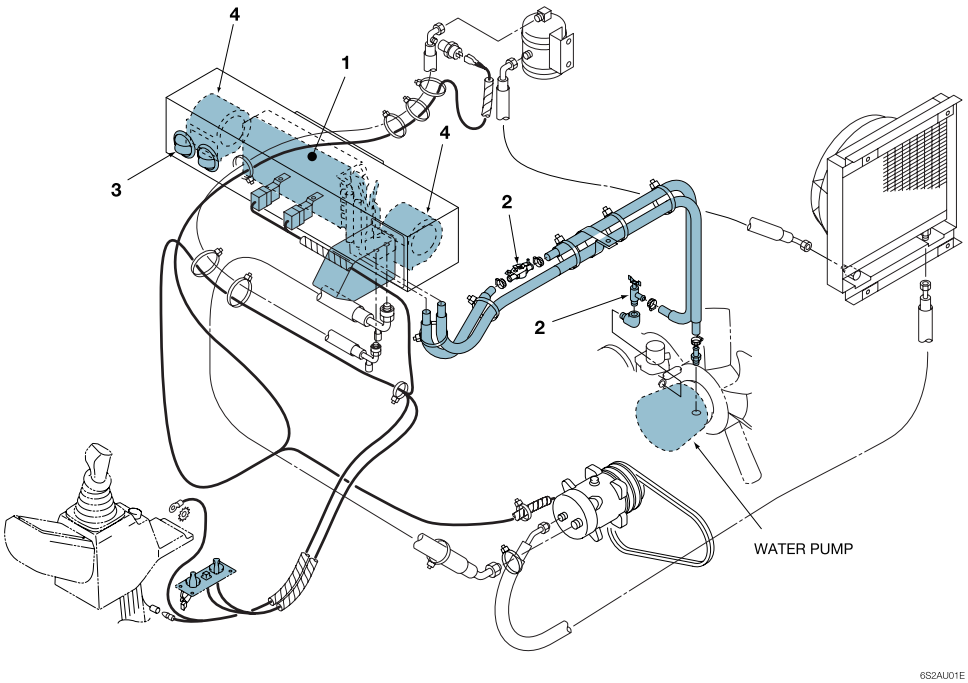


Figure 2-9
This view of a heater system shows the main components and how they are connected.

Additional heater controls, ducts, air vents, blend-air doors, temperature regulating devices and auxiliary heaters may be installed as part of a heater system. These may be air, vacuum, electrical or mechanically operated.

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1. Heater Core

Heater cores are like small radiators. The fin and tube construction is designed to route coolant flow for the best possible heat energy transfer from coolant to cab air. Hoses from and to the engine are connected to the core with clamps. The core outlet may be larger or the same size as the inlet.

2. Water Valves

Water valves may be cable, vacuum or air controlled. The valve can be either open, closed or set part way open. Some valves have a bypass design to return coolant to the engine. Most are manually controlled although electronic systems are now being installed.

3. Defrosters and Ducts

Defrosting is accomplished by directing heated dry air through ducts to the windshield. The heater system serves the dual purpose of defrosting and heating. Controls are used to route the air flow to the windshield and occupant areas by opening and closing duct doors. Controls may be manual, air or vacuum.

Many vehicles use a “defrost interlock” system which utilizes the air conditioner to dry the defrost air and clear the cab windows more quickly.

4. Blowers and Fans

Blowers or fans are used in the system to move cab air through the heater core and evaporator. Air can be pushed or pulled through the core depending on system design. Blower or fan speed is usually selected by the operator.

Environmental Effects on System Operation

The environment outside the cab involves more than the weather. It may be hot and humid or cold and dry. That is only part of the condition the HVAC system must handle to maintain an ideal comfort range. A truck can be at idle, in traffic or moving along for hours on the Interstate at 65 M.P.H. The load condition on a trip can include going out full, coming home empty, or driving across the Rockies or Kansas plains during the day or night. The truck color and shape, the windows and angle of the sun are all variables that can increase or decrease the “load” on the system. The following are a few examples of environmental effect:

- A black cab-over (COE) with a dark color interior will be more difficult to cool than the same vehicle with white paint and a light colored interior. The black cab picks up and holds the radiant heat from the sun more easily than the white one.
- In Florida or Houston the humidity in mid summer can be very high with the temperature in the high 90’s or low 100’s. The AC unit must remove a lot of moisture from the air in the cab as the air moves through the evaporator fins. The more moisture on the fins, the less effective the transfer of heat is to the refrigerant inside the evaporator coil.

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- On a cold day the temperature can drop below zero. The engine may run cooler so the engine coolant is cooler when it circulates through the heater. The heat in the cab moves out of the cab faster (remember heat always moves to a cooler area until both are the same temperature—nature's law). To maintain cab comfort you have to increase the flow of coolant through the heater, increase coolant temperature, and/or move more air through the heater core.
- On a hot day, an off-road vehicle experiences cooling at a slower rate than an on-road vehicle. This is a result of high sun-load, large window area and often less insulation.

It is important for you to keep environmental effects in mind when you are servicing or diagnosing heater or air conditioner systems. If you work in Denver the altitude will affect system function and pressure. In Houston the heat and humidity may lower heat transfer to the air at the condenser and increase system operating pressures.

Chapter Review

- HVAC systems range from simple cab heaters to multi-function combination systems. The multi-function system can heat and cool the cab and sleeper unit, and have separate auxiliary components and controls for driver and passenger comfort.
- Both heater (engine) coolant and air conditioner refrigerant circulate inside sealed, pressurized systems. The normal air conditioner operating pressure ranges from 150 to 250 pounds per square inch, sometimes higher with a different refrigerant.
- Air conditioners have a high and a low pressure side within the system. The compressor is the starting point of the high side. Pressure drops at the expansion valve opening to the evaporator.
- The basic components of an AC system are the compressorclutch assembly, high pressure lines, condenser, receiver-drier, expansion valve, evaporator, thermostat, blower assembly, and suction lines. There may be other controls installed for more complex systems.
- The basic components of a heater system are the inlet and outlet hoses, a water valve and valve control, heater core and fan or blower assembly. There may be other controls for more complex systems.
- An air conditioner system uses the "change of state" of refrigerant inside the system to move heat from the cab air to the outside air. Refrigerant changes from a gas to a liquid in the condenser, and back to a gas in the evaporator.
- A heater system uses the heat from the engine, carried to the heater core by the action of the water pump, to warm the air in the cab. There is no change of state within the heater system.
- Environmental conditions affect how both heaters and air conditioners work. Weather, driving conditions, color of the vehicle are factors. All contribute to heat gain or loss inside a cab and how much heat energy must be moved to maintain occupant comfort.

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Inspection and Maintenance-without gauges

- **Discussion of Inspection & Maintenance Survey Results**
- **Visual Inspection - System Off**
- **Electrical System Inspection**
- **Performance Inspection - Engine Running**
- **Heater System Inspection**
- **Preventive Maintenance Worksheet**
- **Chapter Review**

Discussion of Inspection & Maintenance Survey Results

There are three reasons for regular inspection and maintenance procedures:

1. They save money in the long run by reducing down time and often prevent more costly repairs.
2. They help to insure driver comfort and safety.
3. They add to your store of knowledge about these systems and maintain your level of efficiency.

About half of all heavy duty vehicles have air conditioners. Surveys of AC system owners find that over 30% of the systems are serviced every six months or less, and another 62% are serviced at least once a year.

The survey also covered how often the different components required maintenance. Figure 7.1 below shows survey finding percentages. Failure of any of the AC components listed in the survey could cause a system to malfunction or stop cooling.

Figure 7-1
This chart shows maintenance frequency, lists key parts and how often they require maintenance.

INSPECTION & MAINTENANCE SURVEY

How often are your air conditioners serviced?				
Average	1 to 6 months 30%	7 to 12 months 62%	More than 12 months 6%	Never 2%

Which AC components require frequent maintenance?					
Belts 32%	Compressor Clutch 26%	Condenser 12%	Add Refrigerant 12%	Refrigerant Lines 11%	Valves 7%

Note: The above survey results may not apply to your situation. Actual operating conditions for the vehicles you service will determine or influence maintenance frequency and requirements.

The following inspection procedures should take about 15 to 20 minutes, longer if corrective steps, part replacement or adding refrigerant is necessary. There is a "Preventive Maintenance Worksheet" you may use at the end of this chapter, Figure 7-9

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Visual Inspection - System Off

Your observations and the corrective measures you take may be different depending on circumstances. The following inspection procedures are explained in more detail below:

1. Observe the System
2. Inspect Parts
3. Check Hoses and Fittings
4. Check for Refrigerant Leaks

Use the following procedures as a general rule in performing a visual inspection with the AC system off:

1. Observe the System

Your first inspection step is to answer the following question if you can:

- Has the vehicle just come in off the road and has the HVAC system been in use?
- Did the operator or work order explain or describe any problems about the system?
- Did someone else work on the system yesterday, 700 miles down the road? Your first inspection step is to answer these questions if you can.

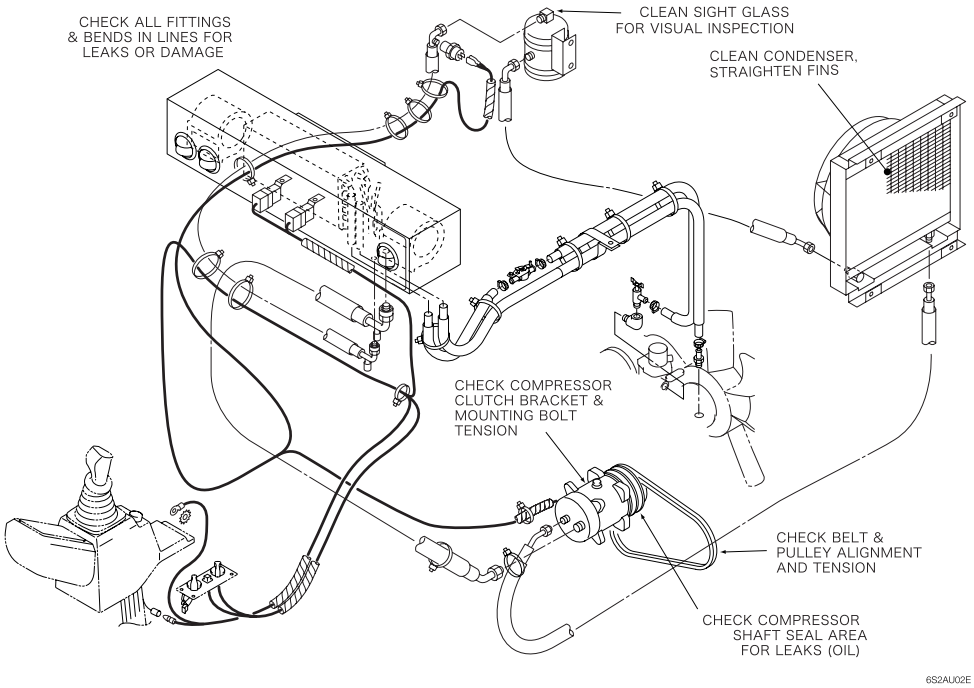
CAUTION Even when someone has told you what is wrong with an HVAC system, you should perform a visual inspection. Always make a visual inspection before you hook up the manifold gauge set. Never add refrigerant to a system until you have made a complete visual and performance inspection.

2. Inspect Parts

Look at the system for what might come loose, leak, wear out or become dirty and not function the way it should. The main points for visual inspection of the system are emphasized in Figure 7-2.

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Figure 7-2
This system illustration notes the main points for visual inspection.



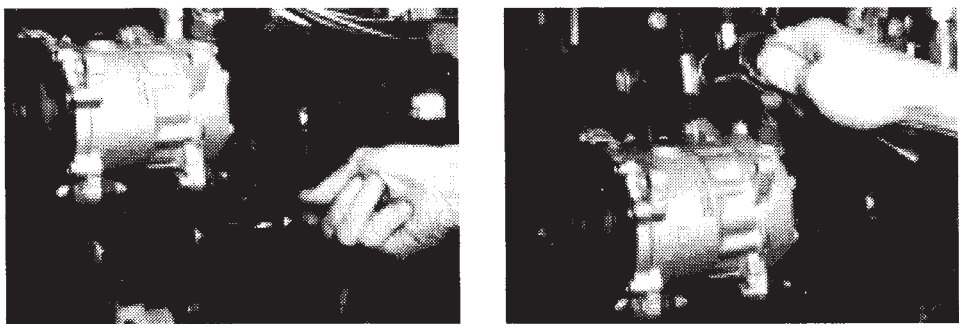
A. Condenser – Is it free of leaves, bugs, bird feathers or mud? The condenser must be relatively clean to work well as a heat exchanger. How you clean the condenser depends on where it is mounted. The condenser fin comb, air hose and nozzle, or soap and water may be used. Where possible, check condenser mounting bolts or screws and tighten them if necessary.

Condenser failure often results from loose hoses. Hose movement will cause fatigue failure of condenser tubing adjacent to the fittings. Make sure the hoses are securely clamped.

While inspecting the condenser check the receiver-drier sight glass and connections. Look to see if the sight glass has a moisture indicator that is showing moisture in the system.

B. Components Under the Hood – Tip the cab or raise the hood. Look at the compressor mounting bracket, compressor clutch assembly, drive belt and pulley alignment. The mounting bracket, compressor, clutch and drive pulley should be fastened securely, and a clutch groove (there may be two groves) should be in line with the drive pulley. Tighten all bolts shown in Figure 7-3, as you inspect.

Figure 7-3
Engine and compressor vibration can work mounting bolts loose. Tighten all mounting bolts as you inspect the system. Slots in the mounting bracket are used to move the compressor clutch assembly in order to adjust belt tension or alignment.



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C. Drive Belt – The drive belt should be tight and in good condition. Use a belt tension gauge to check tension (120 pounds maximum). With experience, you can feel belt tension by twisting the belt. Try feeling belt tension after using the gauge, when you know the tension is correct. Replace belts if they are frayed or look worn.

If the clutch pulley/belt alignment is obviously off, you need to loosen the compressor or mounting bracket, or both—and use the alignment bar to line up the clutch pulley with the drive pulley. Tighten compressor mounting bolts first, then the bolts holding the bracket. The mounting bracket should have slots or other means of adjustment to allow you to adjust the tension of the drive belt. When you use a pry bar to apply tension, be sure you do not pry against the compressor. Pry against the mounting bracket.

3. Check Hoses and Fittings

Check all hoses and fittings. Look for places where hoses flex when the cab is tilted. Any places the hoses or fittings are fastened, clamped, connected, bent or secured are potential wear points. This also applies to places where hoses are not clamped or supported but should be (often near the condenser). All of these spots are potential leak or damage points. Tighten, re-fasten, add, or replace as indicated by your inspection.

4. Check for Refrigerant Leaks

System refrigerant leaks can be anywhere but there are obvious places. You can spot some by looking for signs of refrigerant oil forced out with refrigerant leakage. One location leaks frequently occur is the compressor shaft seal. The shaft and seal are hidden behind the clutch assembly, but centrifugal force will throw the oil off the shaft and against the engine, bracket or whatever is close. Check these points when you examine the compressor clutch and mounting bracket. A solution of soap and water applied around potential leak points works well for detecting leaks. A leak in the evaporator may be indicated if you feel around the condensate drain hole and find oil present.

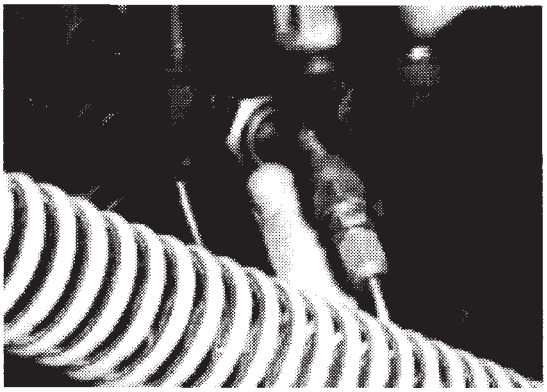
Note: You can add inexpensive dry nitrogen gas to the system instead of R-12 if system pressures are low. Dispense the gas at no more than 200-250 PSI as this is sufficient pressure to cause or indicate a leak point in the AC system. AC service procedures for complete system recovering of refrigerant, evacuating, and recharging are covered and illustrated in *Chapter 9*.

Note: A leaking heater core could also result in coolant at the condensate drain.

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You can feel for oil at the bottom of all connections (see Figure 7-4) if the system is not too hot. Of course, a few minutes with an electronic leak detector is the best way to check for leaks. Keep in mind that pressure is different in a system at rest, so small leaks may be hard to find. Pressure in a system at rest, will equalize at from 60 to 95 PSI, depending on outside air temperature. This means there is more pressure in the low side of the system at rest than during normal system operation. Just the opposite is true of the high side; at rest, high side pressure is lower. You may want to use the detector to check for leaks in the high side when the air conditioner is operating, if you suspect a leak and can't find it when the system is at rest.

Figure 7-4
This illustration shows a potential refrigerant leak point at the condenser fitting.



Electrical System Inspection

The two stages of an electrical inspection are explained in more detail below:

1. Inspect Electrical Connections
2. Check Electrical Current Flow and Device Functions

Use the following procedures to perform an electrical system inspection:

1. Inspect Electrical Connections

First, while you are making your visual inspection under the hood (cab) and/or at the roof top condenser, take a moment and check all electrical connections visually and by feel. Look for any corrosion on leads or connectors and clean them. Make sure all leads and wires are properly supported and securely connected.

2. Check Electrical Current Flow and Device Functions

Perform the following steps to check current flow and electrical device functions:

A. Turn the Ignition On – To check current flow the ignition must be on.

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B. Turn the AC System On – This will power the thermostat and clutch. If it does not come on, use the AC mode switch to check the leads to the switch. You should be able to hear a "click" from the thermostat and hear the clutch drive plate "snap" against the clutch pulley. You can not check thermostat cycling on and off until you do the performance inspection. Figure 7-5 illustrates a typical AC electrical system and the places you should inspect.

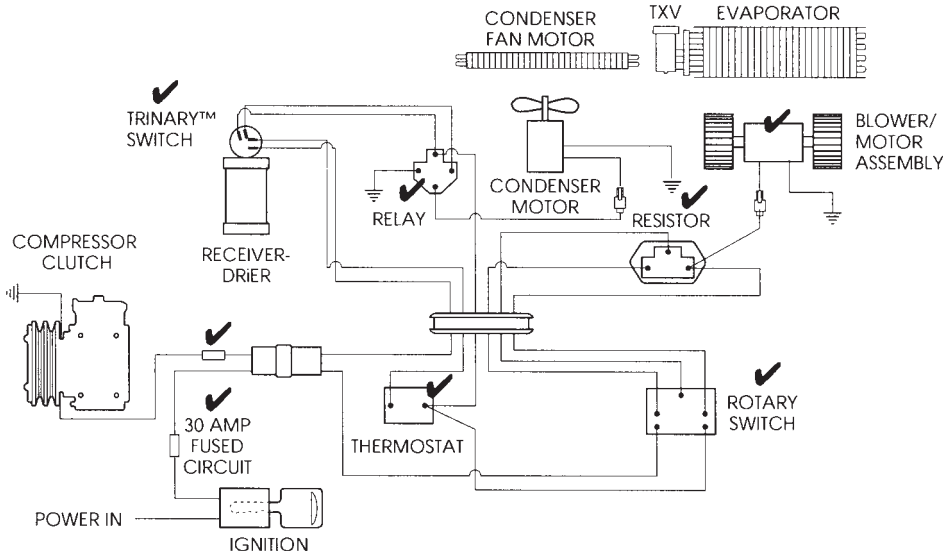


Figure 7-5
The electrical system inspection points are noted with check marks (✔) on this wiring diagram (electrical schematic).

C. Check Fuses – If there is a failure and you have made sure all connections are clean and tight, you need to check fuses—in-cab as well as in-line.

D. Check Clutch Engagement – Since you can't see and may not hear the clutch engage, get out and look at the clutch. If it's engaged, you will see that the drive plate is against the pulley and not slightly spaced from it. If you are not sure the clutch is engaged, look for the lead wire connector near the clutch. Break and close that connection. The clutch will disengage and engage again.

E. Test Blower Speed Operation – Some systems have a common switch that turns on the air conditioner and powers the blower motor. Test blower speed operation by adjusting this or the separate blower control switch. Feeling the air flow from the ducts or note blower sound (speed) changes.

F. Inspect Roof Mounted Condensers – Don't forget to inspect roof mounted condensers and AC systems for dirt and debris. Be sure the condenser fan(s) are working properly and all parts and electrical connections are securely fastened. The roof mounted condenser fans may come on when the system is turned on. Like the thermostat and most clutches, the normal on-off cycling action can not be observed until the engine is running with the AC system on.

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Performance Inspection – Engine Running

The purpose of visual and electrical inspection is to detect obvious problems and assure AC system function for an accurate performance inspection. If you do the performance inspection first, you could be mislead. Problem areas discovered during the performance inspection can give you false clues or symptoms, and result in repair errors and come-backs. The following performance inspection procedures are explained in more detail below:

1. Inspect System Component Cycling and Cab Temperature Levels
2. Check Clutch Cycling Under Load
3. Check Sight Glass

The performance inspection does not cover pressure and temperature sensitive safety devices (cutout switches, fan control, Trinary etc.). Testing these devices requires the use of the manifold gauge set for observation of internal system pressures during tests. These are explained in *Chapter 8*.

Use the following procedures as a general rule in a performance inspection:

1. Inspect System Component Cycling and Cab Temperature Levels

A. Turn On the Engine and Air Conditioner – Inspect for system component cycling and cab temperature levels.

Note: **System performance testing will be much faster if all doors and windows in the cab are closed.**
The cab air must cool down to thermostat control setting levels before system components will cycle on and off, indicating correct function. This is called 'stabilizing the system' and takes about five minutes of operation. In very hot weather the system may not cycle.

B. Check Thermometer Readings – In the cab you can use your thermometer to measure air temperature at the vents. When the evaporator is easy to reach with a thermometer probe without removing some of the dash or duct work, use the probe to measure evaporator temperature. When the AC unit is on and working correctly, you can see the thermometer dial needle move down to about 32 degrees, then rise six to ten degrees and move back down again. The movement up and down indicates that the cycling clutch and thermostat, or orifice tube and accumulator pressure switch (to the clutch) are functioning correctly. In systems with a non-cycling clutch, this movement indicates correct function of the refrigerant metering device.

The needle movement is called "temperature swing." When you can adjust the thermostat setting, the range of swing should change. For example, from full cooling (cold) to moderate (between cold and warm), the swing may change from 32-38 to 32-42 degrees.

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These readings at the vents will be higher and temperature swing slower and not as obvious. Also blower speed will cause the temperature, levels to read higher (high air speed) or lower (low air speed) at the same thermostat setting. When you measure air temperature, an electronic thermometer/pyrometer is a great tool to have. You can easily measure cab air temperature at several locations quickly.

Swing temperatures vary depending on where you measure temperature, and on outside temperature, humidity and altitude. The chart in Figure 7-6, shows some examples of typical temperature variables. Don't forget that cab and sleeper area temperatures can vary within the same vehicle. Also, electronic controls used in newer HVAC systems often keep the temperature spread within a narrower range.

AIR TEMP. DEGREES F.	70°		80°		90°		100°	
AIR QUALITY	HUMID	DRY	HUMID	DRY	HUMID	DRY	HUMID	DRY
CENTER OUTLET AIR TEMP. DEGREES F.	43° to 47°	40° to 44°	44° to 48°	40° to 44°	47° to 51°	40° to 44°	52° to 56°	41° to 45°
	LEFT & RIGHT AIR OUTLET TEMPERATURE WILL VARY							
	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
OUTLET AIR TEMP. RANGE DEGREES F.	40° to 41°	41° to 44°	41° to 45°	43° to 47°	46° to 52°	47° to 54°	48° to 55°	50° to 56°

Figure 7-6
The chart of AC system and cab temperature range shows you typical variables.

2. Check Clutch Cycling Under Load

The following operating inspections, visual and by feel, are done outside the cab while you wait for the system to stabilize.

A. Lift hood – With the hood up (or cab tilted) observe the clutch cycling under load.

Note: If the condenser is hood mounted you may not have adequate air flow through it.

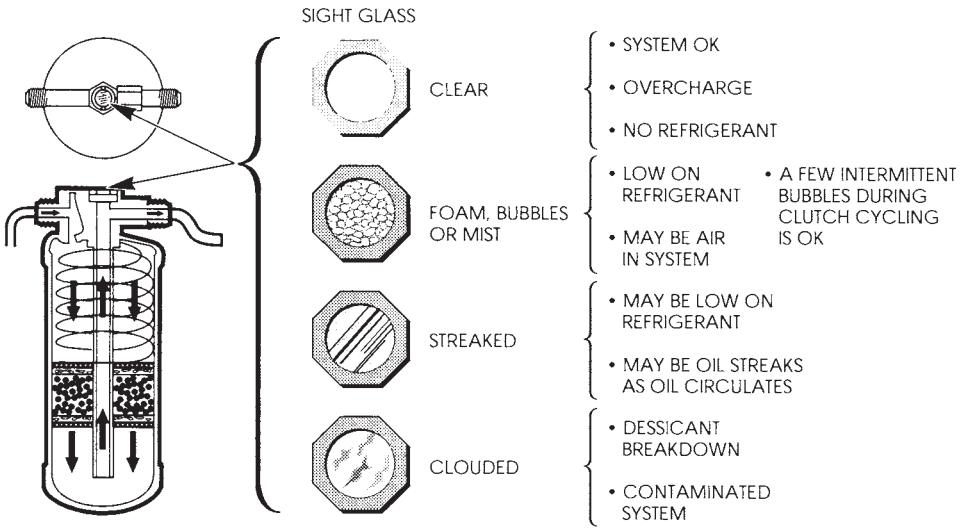
B. Touch suction and discharge lines – Soon after system start up you can safely feel the suction and discharge lines and note their change in temperature. The discharge line will get hot (after a while it may be to hot to touch) and the suction line will get cooler.

3. Check Sight Glass

The sight glass is the only point where you can actually see inside the air conditioner during operation. Check the sight glass through the window on the top of the receiver-drier (or the separate in-line sight glass). If the system is functioning properly and cooling the cab adequately, the sight glass should be clear (you will not see anything in it). If it is not clear when the system is first turned on, wait a few minutes for the system to stabilize, then look again. Figure 7-7 illustrates and explains what you may observe in the sight glass. Roof mounted condenser fans may run continuously or cycle on and off. If you can't tell by sound you may have to climb a ladder and observe the fan blades.

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Figure 7-7
These drawings illustrate conditions you may observe in the sight glass window.



Note: A roof mounted condenser or AC unit assembly often includes a roof mounted receiver-drier (and sight glass) close to the condenser.

Heater System Inspection

A heater system inspection is really a combination engine cooling system and heater inspection. All heater/cooling system rubber parts deteriorate due to the air (ozone), heat, coolant and oils. They should be replaced at regular intervals to prevent breakdown on the road. Metal parts and gaskets are subject to malfunction or breakdown due to fatigue and corrosion.

Coolant has a limited life and should be replaced regularly. If it is dirty, the cooling system should be drained and flushed or back flushed (using special equipment) before refilling with clean water and anti-freeze. Coolant must be hot when using the hydrometer to check protection (freeze-up) level. The following inspection procedures are explained in more detail below:

1. Check Heater Control Valve Function
2. Inspect Other Functions

1. Check Heater Control Valve Function

Many air conditioner/heater systems depend on the heater control valve for temperature control and positive closure. You can easily check heater control valve function as follows.

A. Cool engine – Start with the engine cool, set the temperature to cold and leave the fan off. As the engine warms up, feel the heater return hose. If the hose feels warm or hot, the heater control valve is leaking internally. This type of leak can seriously reduce air conditioning performance.

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B. Warm up engine – Next, let the engine warm up to normal operating temperature and set both fan and temperature on high. Feel both heater supply and return hoses. If there is a noticeable difference in their temperature, it indicates a low flow of coolant through the heater core (a partially closed or blocked heater control valve). This could result in poor heating performance during cold weather conditions.

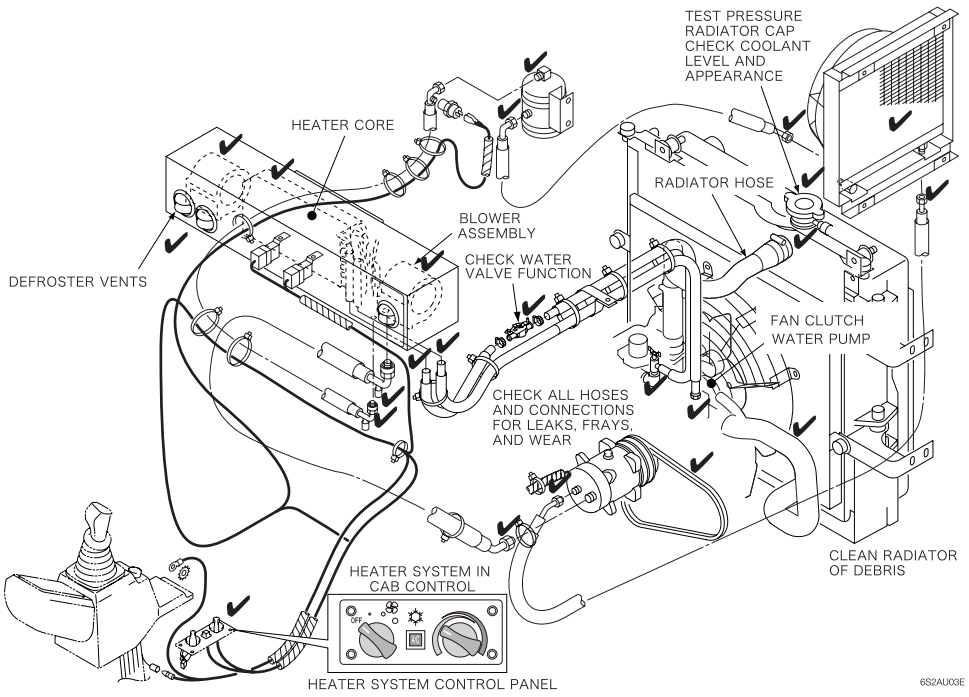


Figure 7-8
Heater/cooling system potential problem areas and checks are indicated in this drawing.

2. Inspect Other Functions

There are some things you can't see or feel when you inspect the thermostat, heater core, radiator pressure cap, electrical switch and control valve functions. Some of these can be checked with the pressure and thermostat testers as described in Chapter 6. A hand pump pressure tester can also be used to check for coolant leaks. This is done by using the pump to raise the pressure inside the system above normal operating pressure to force small suspected leaks to show up.

Heater/cooling electrical and valve component inspection is the same as air conditioner inspection. The controls are operated to see if they function correctly to maintain or vary cab temperature and air flow.

Preventive Maintenance Worksheet

Please feel free to modify or copy the worksheet in Figure 7-9. Actual vehicle use, mileage, operating conditions and maintenance budget may influence service frequency.

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Chapter Review

The purpose of these brief inspection procedures is for vehicle system maintenance and to determine if further, more detailed service is required. The uses of a manifold gauge set, system troubleshooting, recovery, flushing, evacuating and charging are explained in the next chapter.

High usage and operating condition variations are tough on air conditioning and heater components. You should establish and follow regular inspection and maintenance procedures to improve overall system function and component service life.

The typical inspection should not take more than 15 to 20 minutes unless component replacement and/or complete system evacuation and recharging is warranted. The survey results shown in Figure 7-1, indicate belts, compressor clutch assembly, condenser and the refrigerant lines are the most frequent problem areas. However, your own experience with service and maintenance may vary from survey results.

Inspection should first be visual and by feel. Some of your electrical system inspection will be done as you inspect other components (checking leads, connections and for loose wires). When you check the electrical circuit, begin with the engine off but ignition on. A system performance inspection with the engine running and system on really combines electrical and AC or heater system function.

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Figure 7-9 Preventive Maintenance Schedule.

PREVENTIVE MAINTENANCE SCHEDULE FOR AIR CONDITIONING SYSTEMS

NOTE: Typical Maintenance Schedule: 3 months or 15,000 miles, 6 Months or 30,000 miles, 12 Months or 60,000 miles

Installation Date: _____ Mileage: _____

Last Maintenance Check: _____ Mileage: _____

Checked by _____ Mileage: _____

COMPONENT	MAINTENANCE INTERVAL (months) 3*	6*	12*	DONE
1. COMPRESSOR				
Check noise level	•			❑
Check clutch pulley	•			❑
Check oil level	•			❑
Run system 5 minutes	•			❑
Check belts for tension (120 lb max.)	•			❑
Inspect shaft seal (leakage)		•		❑
Check mounting bracket (tighten bolts)		•		❑
Check alignment to clutch w/crankshaft drive pulley		•		❑
Perform manifold gauge check			•	❑
Verify clutch is engaging			•	❑
CONDENSER				
2. Clean dirt/bugs/leaves from coils (w/compressed air)	•			❑
Check inlet/outlet for obstructions/damage	•			❑
RECEIVER-DRIER				
3. Check inlet line from condenser (hot to touch)	•			❑
Check sight glass (streaks or cloudiness)	•			❑
Replace if system is opened			•	❑

COMPONENT	MAINTENANCE INTERVAL (months) 3*	6*	12*	DONE
4. EXPANSION VALVE				
Inspect capillary tube (leakage/damage/looseness)			•	❑
5. EVAPORATOR				
Clean dirt/bugs/leaves form fins/tubes (w/compressed air)			•	❑
Check solder joints on inlet/outlet tubes (leakage)			•	❑
Inspect condensate drain (R-12 or oil leak)			•	❑
6. OTHER COMPONENTS				
Check discharge lines (hot to touch)	•			❑
Check suction lines (cold to touch)	•			❑
Inspect fittings/clamps/hoses		•		❑
Check thermostatic switch (proper operation)			•	❑
Outlets in cab (temperature check; 40 to 50°F)		•		❑
Check fan clutch (proper operation)		•		❑
Inspect all wiring connections		•		❑
Operate manual controls through full functions	•			❑

The following require monthly maintenance:

*Compressor – run system at least 5 minutes (40 degrees Fahrenheit minimum outside temp.) in order to circulate oil and lubricate components.

Maintenance notes: _____

_____

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Troubleshooting & Service Procedures

- **Troubleshooting Overview**
- **Understanding System Function**
- **A Troubleshooting Example**
- **Manifold Gauge Set Installation**
- **Troubleshooting by Manifold Gauge Set Readings**
- **Review of Frequent Problem Areas**
- **Conclusion**

Can you fix an air conditioner or heater system without finding and correcting the cause of the problem? You bet you can! It happens every day and it's not good for business. Here is an example. A truck pulls in off the road and the operator asks to have his rig serviced in a hurry. He tells you the air conditioner isn't cooling like it should and dashes into the restaurant for lunch.

You tip the hood, and check the sight glass on top of the receiver-drier. You see bubbles, not a lot but a fairly constant stream of them. It is obvious the system is low on refrigerant so you hook up the manifold gauge set, purge the gauge set hoses of air, and add refrigerant until the sight glass clears. Then you check evaporator temperature and it's OK. **The air conditioner is repaired right?** Wrong! What you did is add refrigerant and the problem went away. You did not find and fix the cause of the problem.

Component failure in an air conditioning system may be the result of a problem elsewhere in the system. For example, a belt or clutch failure might be caused by a dirty condenser restricting air flow and increasing head pressures. High head pressures commonly create problems with other system components. **Take time to look beyond the obvious for a potential hidden problem.**

Troubleshooting Overview

Troubleshooting includes collecting enough information to locate the cause of the problem, then correcting the problem and its cause by replacement, adjustment, and/or repairing. You begin by gathering information from the most to the least important sources.

Starting with the most important:

1. Your personal knowledge and experience with AC systems.
2. The vehicle operator's knowledge and experience—question him or her.
3. The work order.
4. Good test equipment and the HVAC system

The routine you follow when troubleshooting should proceed from the most to least productive way of locating the problem and fixing the cause.

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Experienced troubleshooters talk to the operator if they can, then personally verify the symptoms of the problem whenever possible. They attempt quick fixes on the basis of their knowledge of common system problems and causes when appropriate. They know where components are located, and make repairs when they have a good idea of what the problem is. They fix the cause or causes as well as the problem. They are confident of their knowledge and ability.

Note: **The best troubleshooters all know who to call when they get stuck.** They know someone who knows more than they do and are not too proud to ask for help or suggestions when needed. The key—understanding system function

The Key–Understanding System Function

Your complete understanding of AC and heater systems and how they work, plus what can go wrong, is the key to troubleshooting and repair. We have talked about components and system function before. Now let's take a little different approach in describing what happens when the air conditioner is turned on. In Figure 8-1 we have used numbers on the illustration to track normal air conditioner function.

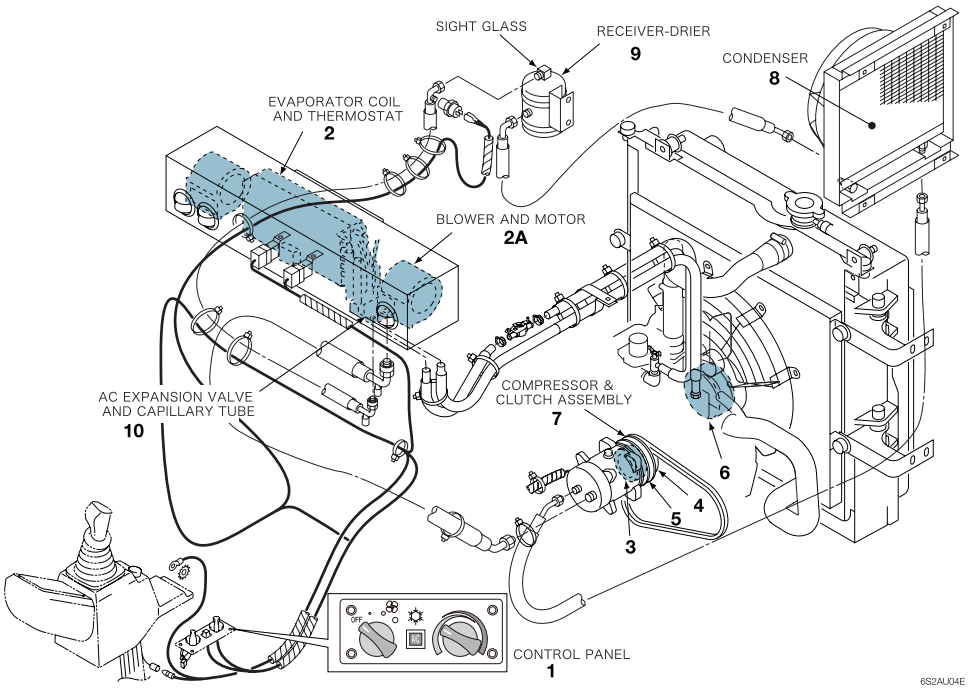


Figure 8-1
An illustration of the typical HVAC system. The numbers follow the action when the AC part of the system is working properly (moving heat out of the cab and into the outside air).

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When you turn on the air conditioner at the control panel (1), the thermostat (2), is supposed to sense a warm temperature at the evaporator. A circuit in the thermostat should close, allowing current to flow through the thermostat to the compressor clutch field coil (3). When this happens, the clutch field coil becomes an electromagnet and pulls the clutch drive plate (4) tight against the clutch pulley (5).

Note: The same AC switch (1) may also turn on the fan or blower motor (2a) to circulate air in the cab. The air feels warm at first but will cool quickly.

A belt connects the clutch pulley to a drive pulley (6) on the engine. The engine provides the power to turn the clutch pulley and drive the compressor (7) when the clutch is engaged. When operating, the compressor compresses and pushes refrigerant gas to the condenser (8), through the receiver-drier (9), and to the expansion valve (10) orifice. When it does, it puts a lot of pressure on the gas. The compressor raises the temperature and pressure of the refrigerant inside the high side of the system.

At the same time, the compressor is also sucking in low pressure refrigerant gas from the expansion valve orifice, evaporator and through the low side of the system. The movement of the refrigerant inside the system transfers heat energy from the cab to the outside air for occupant comfort.

The automatic functions of the thermostat (or the pressure valve on some accumulators), and the expansion valve, help maintain pressures and temperatures inside the system at safe and efficient operating levels. Pressure and temperature are constantly changing due to compressor and expansion valve action, the amount of heat energy being moved and the environment or weather conditions.

The engine cooling system fan and clutch (11), and the evaporator blower motor (2a), move a sufficient amount of air through the condenser and evaporator. On the road, vehicle speed provides most of the (ram) air required for the condenser to work right. In a parked or slow moving vehicle the engine fan (or roof or remote mounted condenser and fans) moves sufficient air through the condenser fins.

Note: Clean refrigerant and refrigeration oil should be inside the system in the amount specified by the manufacturer. Moisture, sludge (moisture combined with refrigerant oil or desiccant), or desiccant particles will prevent the correct performance of the system and may cause component damage.

A Troubleshooting Example

Remember the story at the beginning of this chapter? The vehicle operator pulled in off the road and asked you to repair the rig. He was in such a hurry he didn't tell you anything except that the air conditioner wasn't cooling. Here is the best way to handle that kind of situation.

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Use your knowledge and experience. Ask yourself what could have caused a lack of cooling in that rig! Did the compressor drive belt break? Did a pressure switch or relief valve cutout the compressor because of high or low system pressure? Does the switch or valve in this type of system reset itself? Could there be a superheat switch and thermal limiter with a melted fuse. Did someone else service the system recently and put in too much refrigerant?

Could there be contaminants in the system blocking the expansion valve (expansion tube)? If there is a leak, why and how did refrigerant get out of the system? You know if refrigerant can get out, air and moisture may get inside as well, especially if the leak is on the suction side of the system. Could there be a restriction to refrigerant flow in one of the high pressure lines because of a kink? From your knowledge and experience, you already know about these possibilities and others when you talk to the operator (before he has the chance to leave).

The right kind of questions can speed up troubleshooting and your service work by pinpointing the problem(s) that needs fixing. Your conversation with the operator might be as follows:

- *How long ago did the AC system stop cooling?*
  Answer: About an hour ago.

- *What steps did you take when you noticed the lack of cooling?*
  Answer: I put it on maximum cool.

- *Then what did you do?*
  Answer: When it wouldn't cool, I opened the window and turned the air conditioner off.

- *Is this problem new or has it happened before, and when?*
  Answer: In the last few days I've had problems with cooling off and on—this is the first time it's happened when I was close to a place that did AC service.

- *Do you get any cooling at all?*
  Answer: Yes but it seems to quit after a while.

- *Do you still get air flow at the vents from the blower?*
  Answer: Yes.

- *When was your air conditioner checked thoroughly?*
  Answer: Before I bought the rig last May (a year ago).

- *Has the heater been used recently and did it work OK?*
  Answer: Yes.

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- *Have you had other service problems in the last few months?*
  Answer: No.

- *(If the answer was yes, you should ask—When? Where? What was fixed or replaced?).*

- *Finally, ask the operator if he or she has a wiring diagram for the system.*

Now let's look at the information you have gathered from the operator and what you know from experience. He believes the problem is that the AC system quits cooling after it has been on for a while! You know that the AC system has not been maintained since the rig was purchased a year ago. Because of that, there could be several causes for the problem (lack of cooling) and there may be other potential problems about to develop.

It is possible that some refrigerant has leaked. Moisture and other contamination may be inside the system. You have been told there are no heater problems, but that doesn't mean there are none that might affect AC system operation. The AC system has quit cooling several times in the last few days. The problem may have become more severe than when it quit cooling the first time.

If enough refrigerant or oil has leaked out, a low pressure cutout switch may have cut the circuit to the clutch, protecting the compressor. Because the system has not been maintained in a year, there may be other components that should be serviced. You could fix the probable causes, and the system might work and then break down again as the rig drives out of your place. From your knowledge and what the operator has just told you, you know this may not be a quick fix problem.

It's up to you to describe the service situation to the operator. Tell him you need to do a complete system maintenance inspection to find and correct the problem or other potential problems. He can give you the go ahead for full service and repair now, wait till you have inspected the system to determine cause and cost, or delay repair until he has some down time available.

Normally when the operator can tell you what the problem is, you would first operate the system to verify the problem. In this situation your troubleshooting (your own knowledge added to what the operator told you), indicates the next step. You need to do a complete maintenance inspection instead! Proceed as described in *Chapter 7*. Correct any obvious problems and check carefully for leaks. Leak testing should be visual, by feel and with a leak detector. Next, do your performance test with the engine running and the AC system on.

Note: Don't forget to check the heater system too! If the water valve is not closed, then hot engine coolant flowing through the heater core would warm the air at the same time the evaporator was trying to cool it. The result would be the appearance of an AC problem.

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If your AC and heater visual, electrical and leak inspections don't turn up any problems, save time by hooking up the manifold gauge set before you make the performance test. If you find a leak and can correct it easily by tightening a connection, do so. But if too much refrigerant leaked out, you may have to add some refrigerant to the system for an effective performance test. We will get into detail on troubleshooting with gauges after we explain manifold gauge set installation and adding refrigerant.

Manifold Gauge Set Installation

CAUTION Never hook up the gauge set when the engine and air conditioner are running. Be sure all the valves on the manifold are closed all the way (turn them clockwise). Check the hose connections on the manifold for tightness.

Locate the low and high side system service fittings and remove their protective caps. Position or hang the manifold gauge set in a convenient location. Figure 8-2 illustrates a good example of manifold gauge set hookup in one service situation.

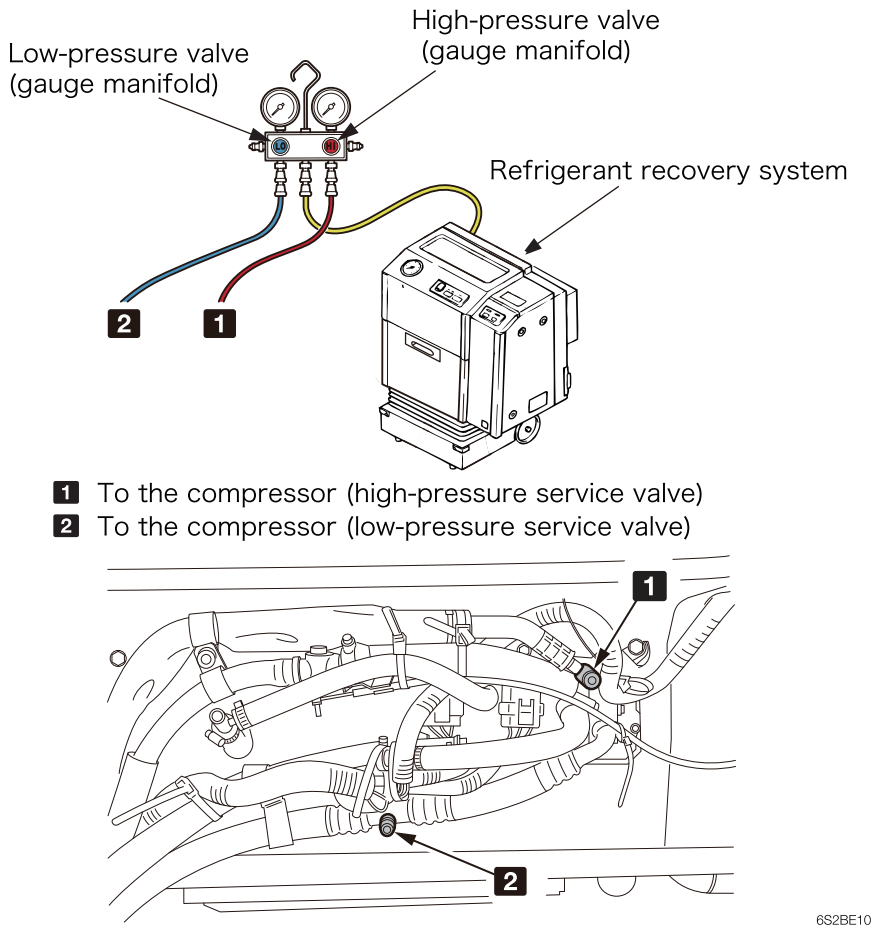


Figure 8-2
A typical manifold gauge set hookup is shown in this illustration. The center hose on the gauge set is connected to the vacuum pump.

The manifold gauge set is a necessary tool in troubleshooting AC system problems. The following steps are performed during and after installing the manifold gauge set:

1. Purging Air from the Gauge Set Hoses
2. Adding Refrigerant to the System
3. Stabilizing the AC System.

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1. Purging Air From Gauge Set Hoses

Environmental regulations require that all service hoses have a shutoff valve within 12 inches of the service end. These valves are required to ensure only a minimal amount of refrigerant is lost to the atmosphere. R-12 gauge set hoses have a valve near the end of all three hoses. R-134a gauge sets have a combination quick disconnect and shutoff valve on the high and low sides. The utility (center) hose also requires a valve.

The initial purging is best accomplished when connected to recovery or recycle equipment. Figure 8-3 illustrates the gauge set connections for purging and refrigeration recovery.

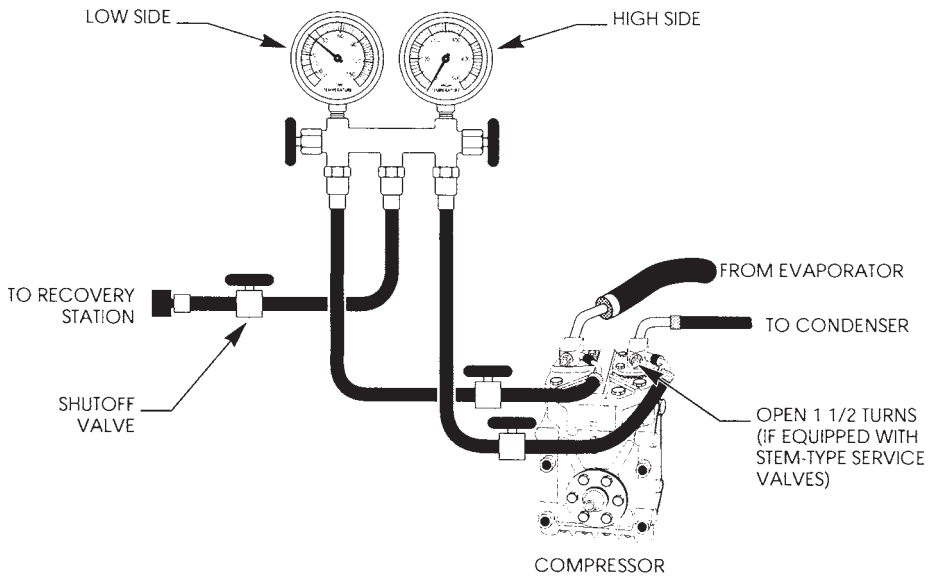


Figure 8-3
The purging setup for manifold gauge set and compressor service valves are shown here.

Note: The manifold gauges read system pressure when the hand valves are closed if the hose end valves, and the stem type service valves (if included) are open.

2. Adding Refrigerant to the System

Now that the gauges are connected, you may need to add some refrigerant to the AC system before you can do an effective performance inspection. However, if leaks are obvious they should be repaired prior to adding refrigerant.

Note: Loss of some refrigerant is not unusual over an extended period of time. Adding refrigerant is a typical procedure when the AC system is maintained on a regular basis.

When adding refrigerant to the system, connect the center hose from the manifold gauge set to the refrigerant dispensing valve on the container. Figure 8-4 illustrates this connection.

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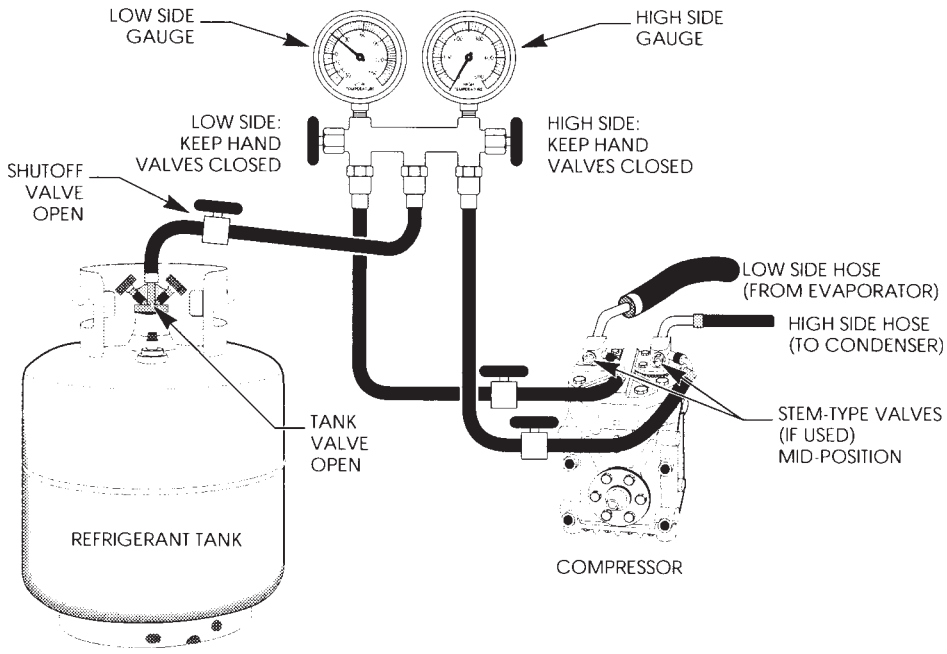


Figure 8-4
In this illustration we have noted how refrigerant is added to the air conditioner.

Before adding refrigerant to the system you should study the sight glass while the engine is running and the air conditioner is on. Even if you found a leak during the system inspection and corrected it, you have no way of knowing how much refrigerant has leaked. You will not be able to tell how much refrigerant is in there, but you can see if bubbles are present.

Then check the gauges for unusually high or low readings, or a lack of pressure. Following this procedure, and using your knowledge and experience, decide if it is safe and makes sense to add refrigerant in order to make your full performance inspection.

You are now ready to add refrigerant to the system. For your safety and to prevent system damage use the following procedure.

1. Turn on the engine and set the idle at 1200 to 1500 RPM and then turn on the air conditioner.

CAUTION Do not open the high pressure hand valve on the manifold gauge set. The compressor could pump refrigerant into the container and cause it to BURST. Be sure to keep the refrigerant container upright to prevent liquid refrigerant from entering the compressor.

2. Open the refrigerant dispensing valve on the container and then the low pressure hand valve on the manifold. This allows refrigerant to enter the system as a gas on the low pressure or suction side of the compressor. The compressor will pull refrigerant into the system.

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3. Add refrigerant until the gauges read in the normal range and the sight glass appears clear. The sight glass may not be clear for a moment just before or after the clutch cycles on and off but should generally be clear. Gauge readings will fluctuate as the compressor cycles on and off.

Note: Pressures within the air conditioning system vary with ambient temperature. A normal pressure range is defined as follows:

Low side	15–30 PSIG
High side	150–280 PSIG

If R-134a is used in place of R-12 the high side readings will be about 20 PSI higher. For this reason many OEMs are recommending an increase in condenser capacity when retrofitting to the new refrigerant, R-134a.

CAUTION If the gauges show any abnormally high or low pressures as you are adding refrigerant, stop and investigate for probable cause. Never add more than one pound of refrigerant. If the system is low enough on refrigerant to require more than that amount you should stop and check again for leaks. Then recover all of the refrigerant, repair, evacuate and recharge the air conditioner. (See *Chapter 9*). You may want to add dry nitrogen gas to the AC system instead of R-12 if pressures are below normal and a leak is suspected. Nitrogen gas is sold in cylinders under high pressure, 1800 to 2000 PSI. Be sure the cylinder has a pressure regulating valve to control the pressure when dispensing nitrogen gas. Dispose the gas at no more than 200-250 psi, as this is sufficient pressure to cause or indicate a leak point. See note under *Troubleshooting by Manifold Gauge Set Readings* in this chapter.

4. When the gauges show normal, close the hand valve on the manifold, the hose end shutoff valve, and the valve on the refrigerant container. You can now proceed with the performance inspection.

3. Stabilizing The AC System

For reliable gauge readings as an aid in troubleshooting, the AC system must be stabilized.

CAUTION Be sure your tools and test equipment are clear of all moving parts of the engine and air conditioner.

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Start the engine and set to a fast idle of 1200 to 1500 RPM. Turn on the air conditioner. After a quick in-cab performance test of control function, blower speeds and air flow, set the AC system controls to maximum cooling and blower speed on high. All windows must be closed. If cab temperature is hot (rig has been sitting in the sun with the windows closed), open the windows for a minute or so to let the hot air out. Run the engine and air conditioner about five minutes for the system to stabilize. In hot humid weather or where the AC condenser can't receive adequate air flow from the engine fan you may have to use a floor mounted fan to force sufficient air flow through condenser fins. This helps to stabilize the system by simulating ram air flow found under normal operating conditions.

When a vehicle has a tilt cab or hood and the condenser is part of the grill, you must use the floor fan to get air to the condenser. You could tilt the cab or hood back to normal position, carefully routing the manifold gauge set and hoses away from moving parts. Then place the gauges so you can read system pressure.

Troubleshooting by Manifold Gauge Set Readings

The series of figures that follow (Figures 8-6 through 8-15) show gauges with typical readings indicating AC system problems. Each figure is followed by troubleshooting tips, probable causes for the gauge readings shown, and appropriate service and repair procedures.

Low Refrigerant Charge in the System

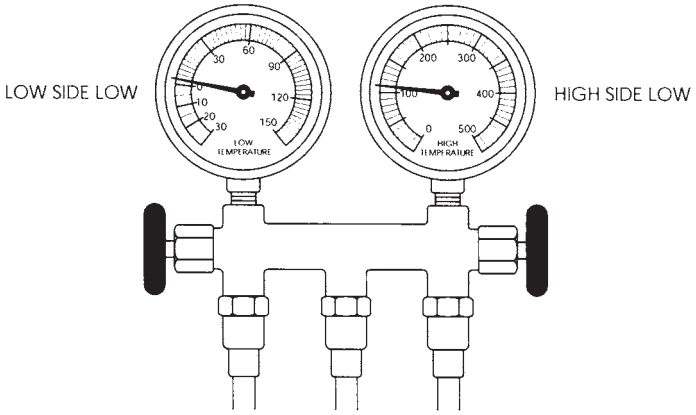


Figure 8-5
Gauge reading, low refrigerant charge in the system.

Tip: You see bubbles in the sight glass. The air from vents in the cab is only slightly cool.

Cause: Insufficient refrigerant (charge) in the system.

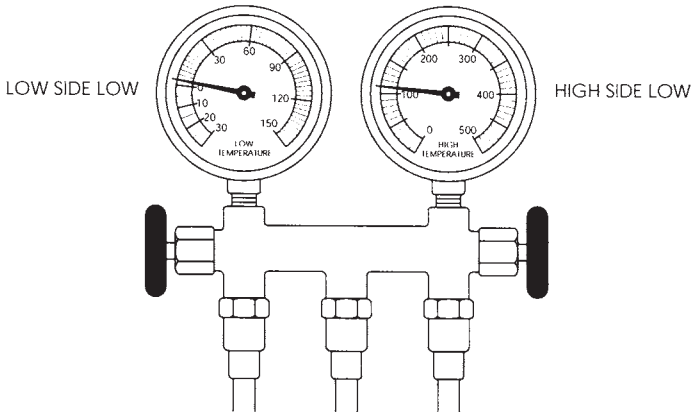
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Repair Procedure:

Check for leaks with your leak detector. If you find a leak at a connection, tighten it then add refrigerant as necessary. If a component or line is leaking (defective), recover all refrigerant from the system. Replace the defective part and then check the compressor oil level and replace missing oil. Evacuate and recharge with refrigerant, then check AC operation and performance.

Figure 8-6
Gauge reading, extremely low refrigerant charge in system.

Extremely Low Refrigerant Charge in the System



Tip: The sight glass is clear or shows oil streaks. The air from vents in the cab seems warm. If there is a low pressure or Trinary™ switch in the system it may have shut off the compressor (clutch).

Cause: Extremely low or no refrigerant in the system. There is a leak in the system.

Repair Procedure:

Add refrigerant to the system, at least half of the normal full charge amount. Then perform your leak test. As an alternative to a refrigerant, add dry nitrogen gas to the system and then test for leaks.

Note: It may be necessary to use a jumper wire to bypass some types of low pressure cutout switches to operate the compressor (clutch) when you add refrigerant to the system.

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After finding a leak, recover all refrigerant from the system and repair the leak. Check the compressor and replace any refrigeration oil lost due to leakage. Evacuate and recharge the system with refrigerant, then check AC operation and performance.

Air and/or Moisture in the System

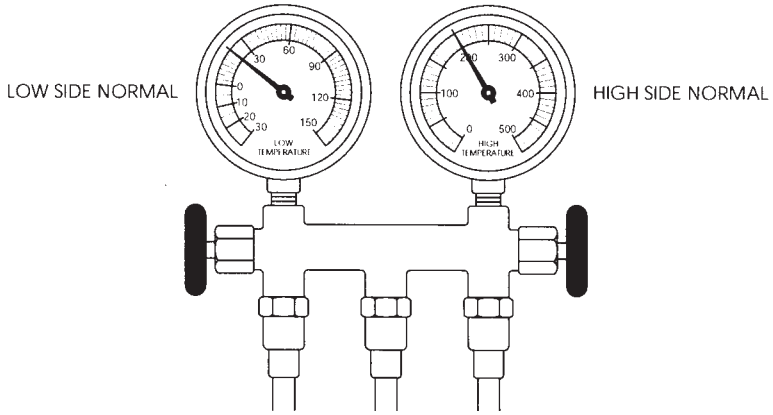


Figure 8-7
Gauge reading, air and/or moisture in the system.

Tip: The sight glass may be clear or show some bubbles. The air from vents in the cab is only slightly cool. In a cycling clutch type system with a thermostatic switch, the switch may not cycle the clutch on and off, so the low pressure gauge will not fluctuate.

Cause: Air and/or moisture in the system.

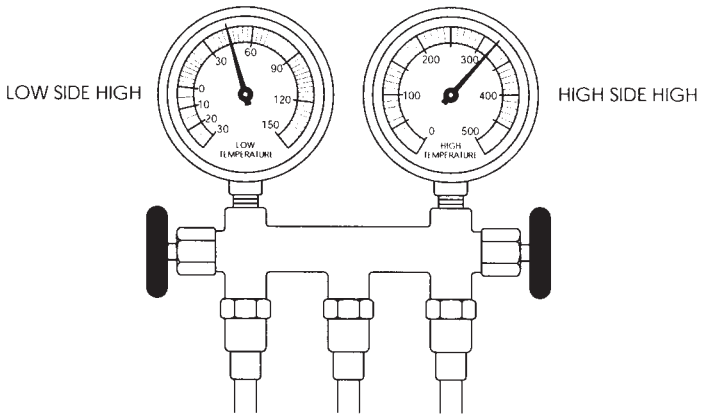
RepairProcedure:

Test for leaks, especially around the compressor shaft seal area. When the leak is found, recover refrigerant from the system and repair the leak. Replace the receiver-drier or accumulator because the desiccant may be saturated with moisture (there is no way to tell). Check the compressor and replace any refrigeration oil lost due to leakage. Evacuate and recharge the system with refrigerant, then check AC operation and performance.

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Figure 8-8
Gauge reading, excessive air and/or moisture in the system.

Excessive Air and/or Moisture in the System



Tip: There may be occasional bubbles in the sight glass. Air from vents in the cab is only slightly cool.

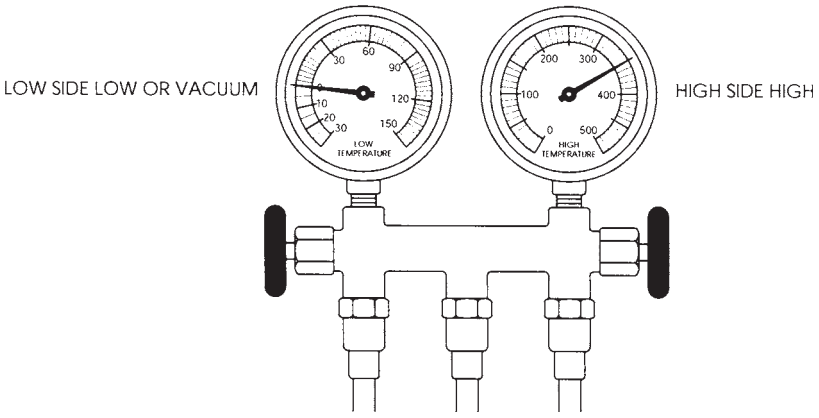
Cause: System contains excessive air and/or moisture.

Repair Procedure:

Test for leaks, recover refrigerant from the system and repair the leak. Depending on the type of system, replace the receiver-drier or accumulator. The desiccant is saturated with moisture. Check and replace any compressor oil lost due to leakage. Evacuate and recharge the system, then check AC operation and performance.

Figure 8-9
Gauge reading, expansion valve (TXV) stuck closed.

Expansion Valve (TXV) Stuck Closed or Plugged



Tip: Air from vents in the cab is only slightly cool. The expansion valve body is frosted or sweating.

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Cause: An expansion valve malfunction could mean the valve is stuck in the closed position, the filter screen is clogged (block type expansion valves do not have filter screens), moisture in the system has frozen at the expansion valve orifice, or the sensing bulb is not operating. In vehicles where the TXV and sensing bulb are accessible, perform the following test. If not accessible, then proceed to *Repair Procedure*.

Test:

1. Warm diaphragm and valve body in your hand or carefully with a heat gun. Activate system and watch to see if the low pressure gauge rises.

2. Next, carefully spray a little nitrogen, or any substance below 32 degrees Fahrenheit, on the capillary coil (bulb) or valve diaphragm. The low side gauge needle should drop and read at a lower (suction) pressure on the gauge. This indicates the valve was part way open and that your action closed it. Repeat the test, but first warm the valve diaphragm or capillary with your hand. If the low side gauge drops again, the valve is not stuck.

3. Clean the surfaces of the evaporator outlet and the capillary coil or bulb. Make sure the coil or bulb is securely clamped to the evaporator outlet tube and the insulation is in place. Next proceed with recovering refrigerant from the system.

Repair Procedure:

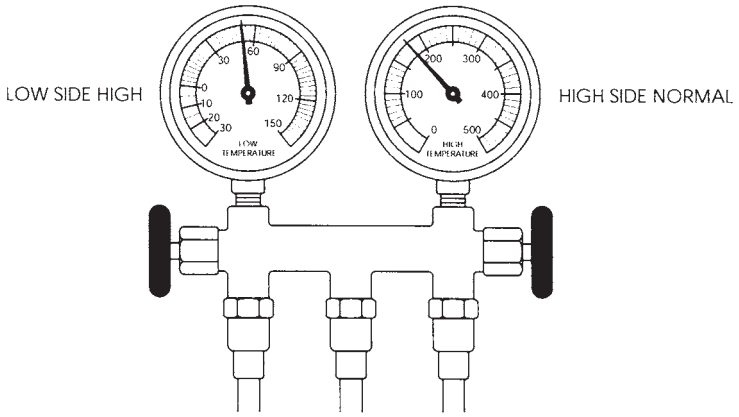
Inspect the expansion valve screen (except block type valves). To do this you must recover all refrigerant from the system. Disconnect the inlet hose fitting from the expansion valve. Remove, clean and replace the screen, then reconnect the hose. Any signs of contamination will **require** flushing the system. Next, replace the receiverdrier. Then evacuate and recharge the system with refrigerant, and check AC operation and performance.

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Note: If the expansion valve tests did not cause the low pressure gauge needle to rise and drop, and if the other procedures described did not correct the problem, the expansion valve is defective. You must recover all refrigerant from the system again, and replace the expansion valve and receiver-drier. Evacuate and recharge the system with refrigerant, then check AC operation and performance.

Expansion Valve (TXV) Stuck Open

Figure 8-10
Gauge reading, expansion valve (TXV) stuck open.



Tip: Air from vents in the cab is warm or only slightly cool.

Cause: The expansion valve is stuck open and/or the capillary tube (bulb) is not making proper contact with the evaporator outlet tube. Liquid refrigerant may be flooding the evaporator making it impossible for the refrigerant to vaporize and absorb heat normally. In vehicles where the TXV and sensing bulb are accessible, check the capillary tube for proper mounting and contact with the evaporator outlet tube. Then perform the following test. If the TXV is not accessible, then proceed to *Repair Procedure*.

Test:

1. Operate the AC system on it's coldest setting for a few minutes. Carefully spray a little nitrogen or other cold substance, on to the capillary tube coil (bulb) or head of the valve.

2. The low pressure (suction) side gauge needle should now drop on the gauge. This indicates the valve has closed and is not stuck open. Repeat the test, but first warm the valve diaphragm with your hand.

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3. If the low side gauge shows a drop again, the valve is not stuck. Clean the surfaces of the evaporator outlet and the capillary coil or bulb. Make sure the coil or bulb is securely fastened to the evaporator outlet and covered with insulation material. Operate the system and check performance.

Repair Procedure:

If the test did not result in proper operation of the expansion valve, the valve is defective and must be replaced. Recover all refrigerant from the system and replace the expansion valve and the receiver-drier. Evacuate and recharge the system with refrigerant, then check AC operation and performance.

System High Pressure Side Restriction

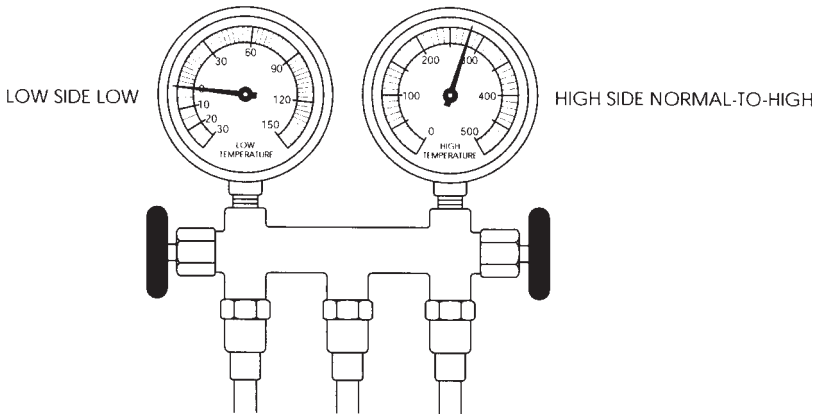


Figure 8-11
Gauge reading, system high pressure side restriction.

Tip: Air from vents in the cab is only slightly cool. Look for sweat or frost on high side hoses and tubing, and frost appearing right after the point of restriction. The hose or line may be cool to the touch near the restriction.

Cause: There could be a kink in a line, or other restriction in the high side of the system.

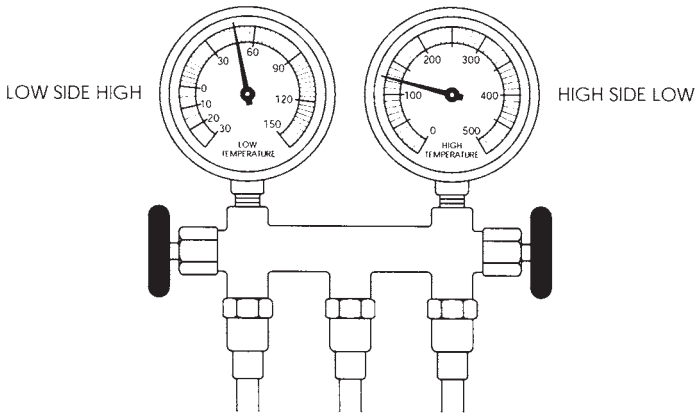
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Repair Procedure:

After you locate the defective component containing the restriction, recover all of the refrigerant. Replace the defective component and the receiver-drier. Evacuate and recharge the system with refrigerant, then check AC operation and performance.

Compressor Malfunction

Figure 8-12
Gauge reading, compressor malfunction.



Tip: The compressor may be noisy when it operates.

Cause: Defective reed valves or other compressor components. If the compressor is not noisy, there may be a worn or loose compressor clutch drive belt.

Repair Procedure:

If you find the belt worn or loose, replace or tighten it and recheck system performance and gauge readings. To inspect and service the compressor, you must isolate (front seat the stem type compressor service valves) and recover refrigerant, or fully recover R-12 from systems containing Schrader valves. Remove the compressor cylinder head and check the appearance of the reed valve plate assembly. If defective, replace the valve plate and install with new gaskets, or replace the compressor assembly.

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If you find particles of desiccant in the compressor, remove and replace it and the receiver-drier. Before doing so, back flush other system components (except the expansion valve) using a flushing kit. If there are stem type valves and you isolate the compressor, the rest of the system must be purged of refrigerant before you can disconnect and flush system components (*Chapter 9* describes the flushing procedure). After flushing, reassemble the components. Always check the oil level in the compressor, even if you install a new or rebuilt unit. Tighten all connections and evacuate the system. Recharge the air conditioner with refrigerant and check system operation and performance.

Note: Rotary compressors have a limited oil reservoir. Extra oil must be added for all truck installations

Condenser Malfunction or System Overcharge

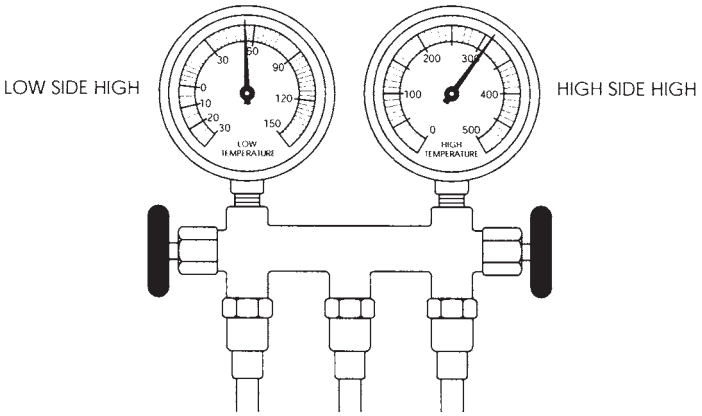


Figure 8-13
Gauge reading, condenser malfunction or system overcharge.

Tip: The air from vents in the cab may be warm. In R-12 systems there can be bubbles in the sight glass. The high pressure hoses and lines will be very hot. Don't forget to check the engine cooling system components—fan and drive belt, fan clutch operation, and the radiator shutter.

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Cause: The condenser is not functioning correctly or there may be an overcharge of refrigerant inside the system. Another possibility is lack of (ram) air flow through the condenser fins during testing. Engine cooling system component malfunction can cause high pressure by blocking air flow (radiator shutter) or not providing air flow (fan clutch) in sufficient quantity.

Repair Procedure:

Inspect the condenser for dirt, bugs or other debris and clean if necessary. Be sure the condenser is securely mounted and there is adequate clearance (about 1-1/2 inches) between it and the radiator. Check the radiator pressure cap and cooling system, including the fan, fan clutch, drive belts and radiator shutter assembly. Replace any defective parts and then recheck AC system operation, gauge readings and performance.

If the problem continues, the system may be over- charged (have too much refrigerant inside). Recover the system slowly until low and high pressure gauges read below normal, and bubbles appear in the sight glass. Then add refrigerant (charge the system) until pressures are normal and the bubbles disappear. Add another quarter to half pound of refrigerant and recheck AC system operation, gauge readings and performance.

If the high gauge readings do not change, you should recover all of the refrigerant and flush (it may be partially plugged) or replace the condenser. Also replace the receiver-drier or accumulator. Then connect the components and evacuate the system. Recharge the air conditioner with refrigerant and check system operation and performance.

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Thermostatic Switch Malfunction

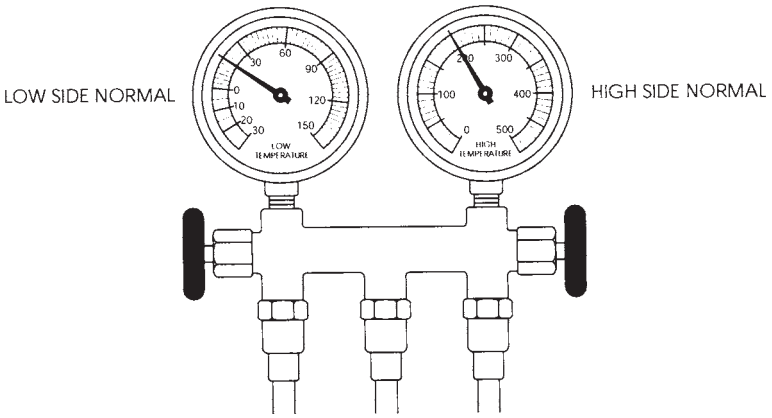


Figure 8-14
Gauge reading, thermostatic switch malfunction.

Tip: The low side gauge needle may fluctuate in a very narrow range compared to a normal range. The compressor clutch may be cycling on and off more frequently than it should.

The low side gauge needle may fluctuate in an above normal range as the clutch cycles. This may be an indication that the thermostat is set too high (someone may have attempted to adjust the factory setting). A new thermostat may have been installed incorrectly (capillary tube not inserted between the evaporator fins in the proper position).

Cause: The thermostatic switch is not functioning properly or at all.

Repair Procedure:

Replace the thermostatic switch. When you remove the old thermostat, replace it with one of the same type. (They operate in a factory preset temperature range.) Take care in removing and handling the thermostat and thin capillary tube attached to it. Don't kink or break the tube.

Position the new thermostat capillary tube at or close to the same location and seating depth between the evaporator coil fins as the old one. Connect the electrical leads.

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Note: See the Thermostat section in *Chapter 10*. Fan clutch, radiator shutter, condenser, compressor, and the newer air and water valve control systems are covered in *Chapter 10*.

Review of Frequent Problem Areas

In HVAC systems a limited number of things can go wrong. Moving parts of the compressor, clutch, and expansion valve or refrigerant metering device can malfunction or break down from metal fatigue, contamination, abnormal pressure or lack of lubrication. Electrical connections may corrode, become disconnected or break. Fuses blow from shorts or overload. Belts slip or break.

Vibration from the engine or road surface can work bolts and air or vacuum lines loose, or rub and break or wear parts out. Motors may burn out. The inside of the system can become contaminated from moisture, air or desiccant material breakdown. Refrigerant may leak out of the system quickly or very slowly. Moisture in the system can combine with refrigerant to form acid and attack (corrode) metal parts from the inside. Moisture and refrigeration oil can combine to form sludge that may block refrigerant flow.

The following problems are discussed in more detail in this section:

1. Belts and Compressor Clutch
2. Condenser
3. Refrigerant Lines, Hoses, and Fittings
4. Refrigerant Metering Valves
5. Other Problems

1. Belts and Compressor Clutch

Let's review problem areas listed at the beginning of *Chapter 7*. The most frequent repairs are replacing belts and servicing or replacing the compressor or clutch. Heavy duty vehicle operation puts a lot of stress on these parts. There are several main reasons.

There is often continuous operation for long periods of time. There may be frequent sudden RPM variations when shifting gears up or down. For this reason the AC clutches used in heavy duty systems usually have double row ball bearings. Vibration and road shock contribute to loose or broken mounting brackets, electrical connections and fittings. Belts, bearings and compressor reed valves wear out.

Various compressor clutch cutout switches are used because the AC designers know about compressor operating conditions. System leaks, high operating pressures, malfunctioning engine cooling system components—all cause compressor problems and failures. When refrigerant and refrigeration oil leaks out of a system or there is contamination blocking oil flow, the compressor will be starved for oil and seize.

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2. Condenser

Condensers get dirty and the dirt reduces heat movement by insulating the condenser. The fittings come loose or break from stress if the condenser or connecting hoses are not secured properly to keep the effects of vibration at a minimum.

Heat transfer efficiency and pressure in the condenser are affected by the amount of outside air flowing through condenser fins. A lack of air flow can mean the refrigerant doesn't give up enough heat energy to the outside air (it doesn't change state). The refrigerant arrives at the evaporator as a gas and can't pick up any heat energy from cab air. In the cab, air from the vents is only slightly cool or warm.

One possible cause of condenser malfunction could be the engine cooling system. This is why fan clutches and radiator shutters are often controlled or overridden by AC switch function. In fact, we can add fan clutch, radiator shutters and also fan motors to condenser problems. If they don't function to allow sufficient air through the condenser, pressure inside the system may become dangerously high. A lack of air through the condenser fins can raise high side pressure and blow out the weakest point in a system, or damage the compressor.

3. Refrigerant Lines, Hoses and Fittings

Problems with these parts may be caused by normal deterioration, vibration damage, lack of maintenance or human error (improper installation or replacement). All rubber parts are attacked by ozone (oxygen) in the air. Rubber parts break down slowly and become more vulnerable to the effects of vibration with the passage of time.

Heavy duty vehicle vibration causes stress on all lines, fittings and connections. Regular maintenance includes checking and tightening any suspect line, or hose retainers, or grommet position where the grommet is protecting a line or hose from abrasion. Any insulating material wrapped around hoses must be in place and securely fastened.

4. Refrigerant Metering Valves

When you consider valve problems there are obvious differences in valve construction and what can go wrong. If a valve is clogged with sludge or other obstruction, the result is a valve problem but the cause is contamination in the system. Valves get stuck open or closed, although most often closed when the gas charge is lost from the diaphragm housing in a traditional TXV. The capillary tube can vibrate loose from the evaporator outlet tube. The capillary can break and the small quantity of temperature sensitive gas can escape. The diagnosis of a valve as defective calls for replacement.

5. Other Problems—Leaks, Moisture, and Adding Refrigerant

Before any refrigerant was put inside the AC system, someone used a vacuum pump to evacuate any air and moisture. Vacuum is really a force pulling against all hoses, fittings and components from the inside. When the system is charged with refrigerant, the pressure goes from minus (a vacuum) to plus pressure inside the hoses and all components. The refrigerant and refrigeration oil are trying to escape from the system at all times.

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Technicians frequently add refrigerant to a system, replacing refrigerant seepage through system connections or fittings. If the system has been maintained regularly (every three to six months), adding a small amount of refrigerant may result in normal system function. However, the best procedure is to check all connections and look for, find and repair any leaks before adding refrigerant.

When your leak detector indicates the presence of a leak, you can't tell how long the system has been leaking. Finding one leak doesn't mean there are not others. Until you have some AC system work experience, it will be hard to guess how much refrigerant may have leaked. If you have to top a system off with a half pound of refrigerant or more, adding refrigerant is not the answer.

Find the leak. Recover all of the refrigerant and repair the system. The moisture absorbing capacity of any desiccant material is limited and cannot be measured. For that reason, replace the receiver-drier or accumulator. Then evacuate the system for an hour and recharge with refrigerant.

When a compressor shaft seal has leaked oil and the refrigerant charge is a little low, the shaft seal may have leaked because the air conditioner was not used. The seal can get a little out of round from the weight of the crankshaft and leak above the shaft. Running the compressor may cause the seal to swell and close up the leak. The shaft rotation exerts force all around the seal and puts life back into it. To prevent this from happening, manufacturers recommend regular AC system operation a minimum of every couple of weeks even in cool weather.

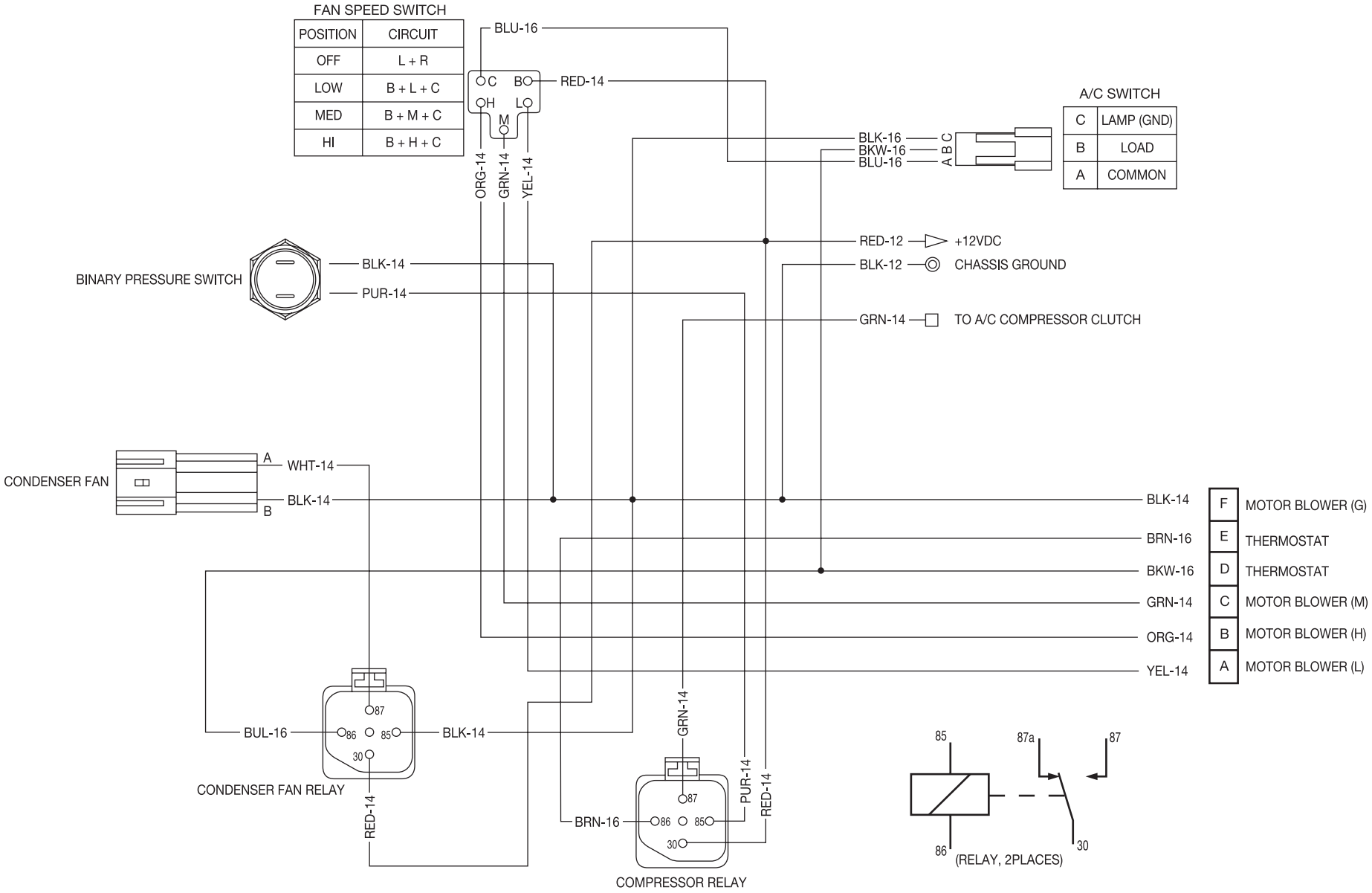
Keep in mind that the compressor can cause a vacuum inside the system if there is a restriction in the system. That means it can suck air and moisture inside under some conditions. It will pull these contaminants in through the same space where refrigerant and refrigerant oil has leaked out.

Conclusion

What could the air conditioning problem and it's cause have been at the beginning of this chapter? The operator was in a hurry, but you were able to start your troubleshooting with the answers he gave you. Problems your inspection may have turned up are a very low refrigerant charge, a contaminated system or defective compressor. Those are not quick fix jobs.

On the other hand, you might have found enough debris on the condenser fin surface to boost high side pressures to an abnormal level during the hottest part of the day. So the Trinary™ or high pressure switch would cut out from high pressure—but reset itself. You cleaned the condenser, added a half pound of refrigerant and AC system pressures and function returned to normal. Service and repair took a half hour. But there was no way to tell without using your knowledge and experience. By now you are pretty familiar with AC system problems, the reasons for some of them, troubleshooting and repair. In *Chapter 9* we will describe complete system purging, evacuation, flushing and recharging.

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OPTION SELECTION

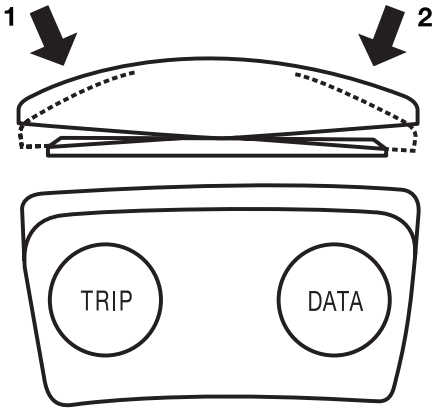
This section provides a description on how to select options.
Make sure to complete the option selection procedures for any relevant option or options if using any of the options listed below to enable them.
If the option selection procedures are not completed for the relevant optional items, the option or options will fail to be registered to the controller and will not be available for use.

- Foot accelerator pedal
- 2nd auxiliary line piping
- 14-pin connector
- Parking brake

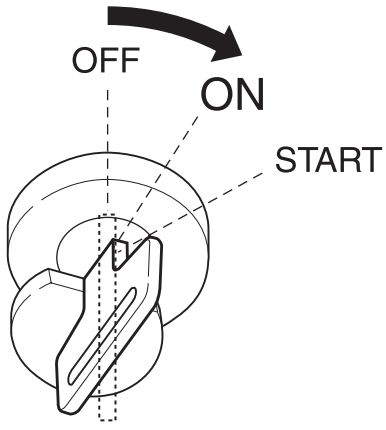
You can also complete option selection procedures using the Maintenance Software.
However, for models with any of the serial numbers listed below, option selection procedures are only available using the Maintenance Software.
S/N 201000003 to 201000367
S/N 201200003 to 201200191
For information on setting options using the Maintenance Software:
☞ “6 Maintenance Software”

Starting up and using the Option Select mode

1. Start up the Option Select mode
   With the engine turned off, turn the ignition key (3) to the ON position while holding down the data switch (2).
   Continue holding the data switch (2) down for an additional five sections to enter the Option Select mode.
   - The first screen shown in Option Select mode is the Foot Accelerator Pedal Option Select Mode screen.
   - Please be aware that you will not be able to enter the Option Select mode if you release the data switch before the Option Select mode comes up. If this occurs, turn the ignition key back to the OFF position to turn it off and then try again from the beginning.
2. Complete the Option Select mode procedures
   Press the trip switch (1) to select or deselect an option.
   Press the data switch (2) to switch between the different available options to select.



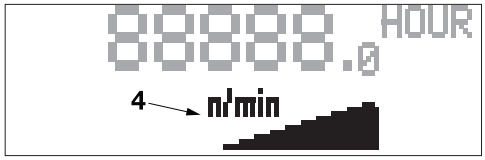
6S4AT01



6S4AT02

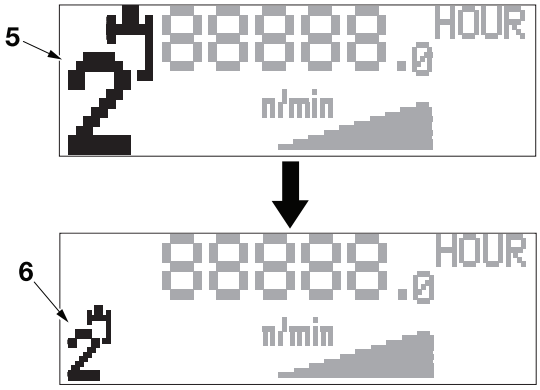
Option Select Mode screen

1. Foot accelerator pedal option selection
   Engine speed indicator (4) lighting up
   .....Selected
   Engine speed indicator (4) turned off
   .....Not selected



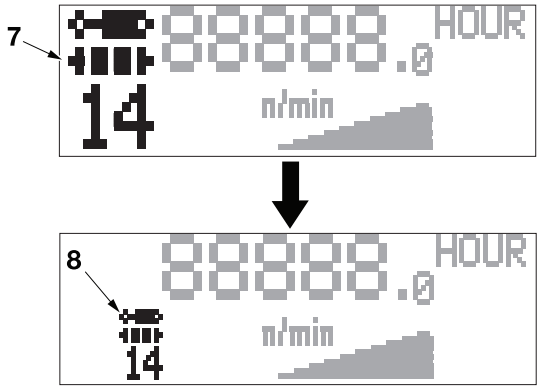
6F0AT03

2. 2nd auxiliary line piping option selection
   2nd auxiliary line piping mark (5) flashing slowly and then the small marking (6) lighting up
   .....Selected
   2nd auxiliary line piping mark (5) flashing rapidly
   .....Not selected



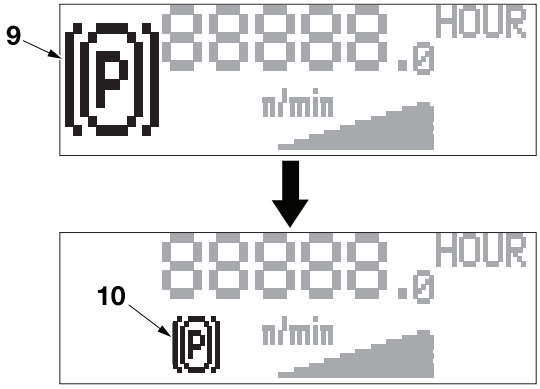
6S4AT04

3. 14-pin connector option selection
   14-pin connector mark (7) flashing slowly and then the small marking (8) lighting up .....Selected
   14-pin connector mark (7) flashing rapidly
   .....Not selected



6S4AT05

4. Parking brake option selection
   Parking brake mark (9) flashing slowly and then the small marking (10) lighting up .....Selected
   Parking brake mark (9) flashing rapidly
   .....Not selected



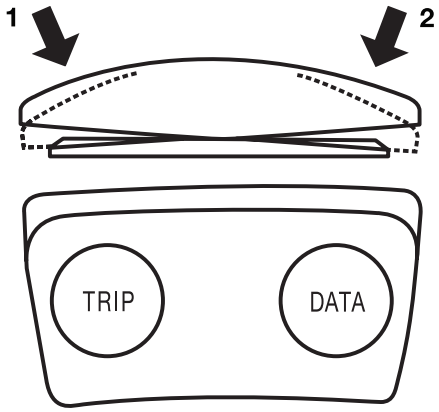
6S4AT06

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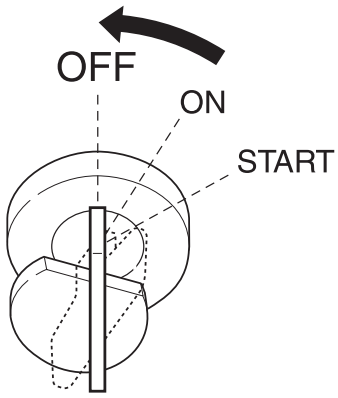
Completing option selection procedures

If these procedures are not completed properly, the selected options will fail to be recorded on the controller. Make sure to complete these procedures after completing option selection to confirm the selections.

1. Turn the ignition key (3) to the OFF position while holding down the data switch (2).



6S4AT01



6S4AT07