■ SAFETY RULES FOR LIFT TRUCK OPERATORS

◆ General

The safety rules and regulations in this section are representative of some, but not all rules and regulations that apply to lift trucks. Rules are paraphrased without representation that they have been reproduced verbatim.

All lift truck users should be familiar with their Local, Regional, and National regulations. Operate this lift truck in accordance with local regulations.

The most effective way of reducing the risk of serious injuries, or even death, to you and others, is for you to know how to operate the lift truck properly. Drive alertly and avoid maneuvers or conditions that could cause accidents.

Be professional.

Do not operate your lift truck if it is in need of maintenance, repair or appears to be unsafe in any way. Report all unsafe conditions immediately to your supervisor, then contact your authorized Cat lift truck dealer.

Do not attempt any adjustments or repairs unless you are trained and authorized to do so.

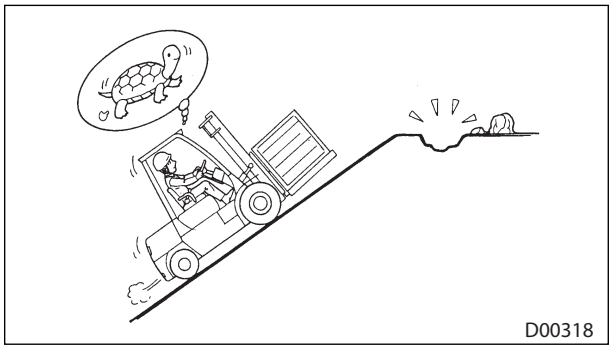
Continuing improvement and advancement of product design may have caused changes to your lift truck, which are not included in this publication. Whenever a question arises regarding your lift truck, or this publication, please contact your authorized Cat lift truck dealer for the latest available information.

All lift truck users should be familiar with their Local, Regional, and National regulations.

⚠ WARNING

Slow down at the top of upgrades!

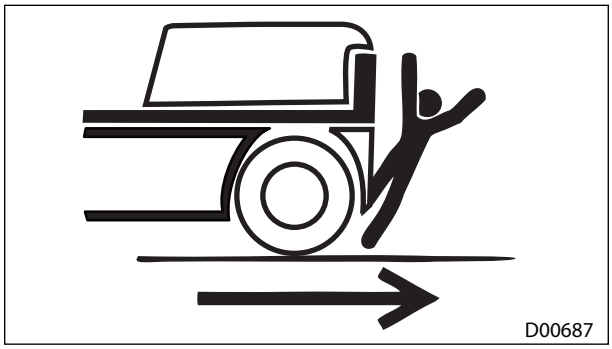
Travel slowly near the top of upgrades as the visibility is limited.



⚠ WARNING

Be careful of tail swing when turning while operating with load end leading!

Make sure that personnel stand clear of the rear swing area before making turns.



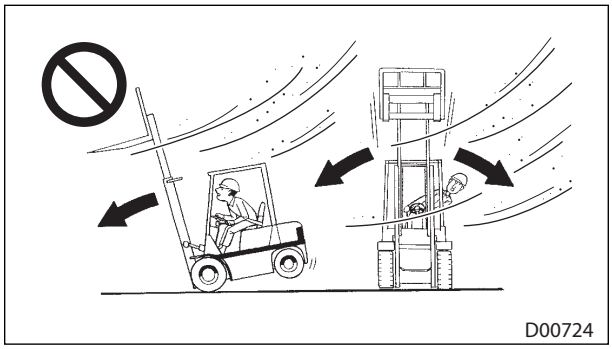
⚠ WARNING

DO NOT operate the lift truck under windy conditions!

Lift truck operation under windy conditions could cause the following situations:

- Falling of a load from the forks
- Tipover of the lift truck

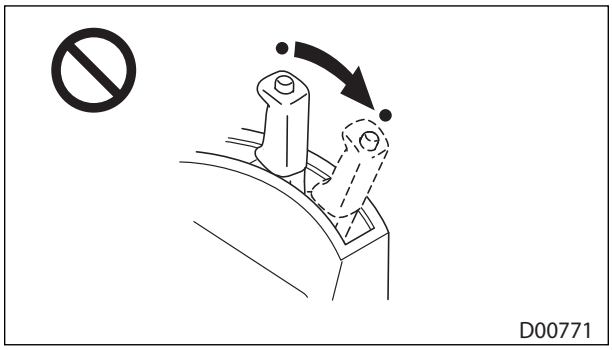
BE SURE to operate the lift truck after the wind clams down.



⚠ WARNING

DO NOT operate the parking brake lever during travel!

- Damage to the brake system could occur If you apply the parking brake lever during travel.

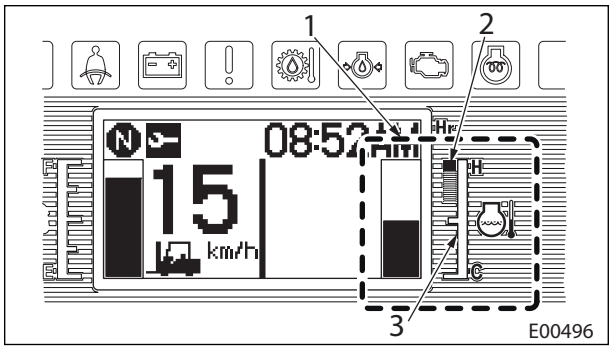


Engine coolant temperature gauge display

This gauge indicates the engine coolant temperature.

When the gauge shows the red zone, the engine may be overheated.

See 10-8 "If the Engine Coolant Temperature Gauge Shows Red Zone".



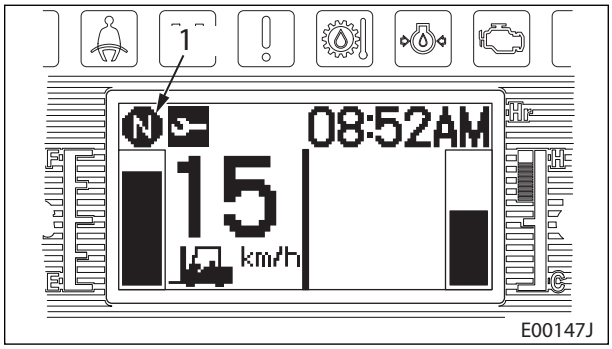
1. Engine coolant temperature gauge
2. Overheat
3. Suitable temperature

Travel direction display

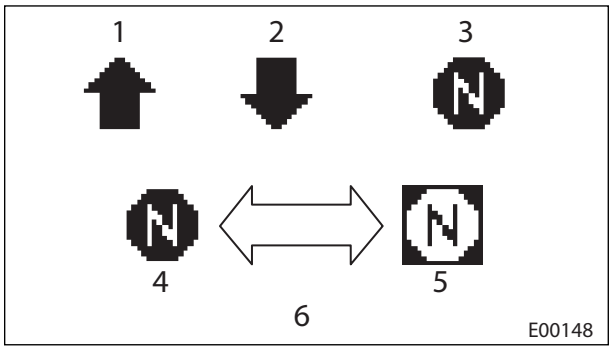
The lift truck travel direction is displayed. If the direction lever is not in the NEUTRAL position when starting the engine, the engine will not start with "N" blinking on the screen. If the operator leaves the operator seat for 3 seconds while the engine is running and the direction lever is not in the NEUTRAL position, "N" on the screen will blink, and the transmission will electrically shift into NEUTRAL.

Note:

- On the Powershift model, "N" glows when the direction lever is in the NEUTRAL position.
- Travel direction display changes to the signals from the direction lever.



1. Travel direction

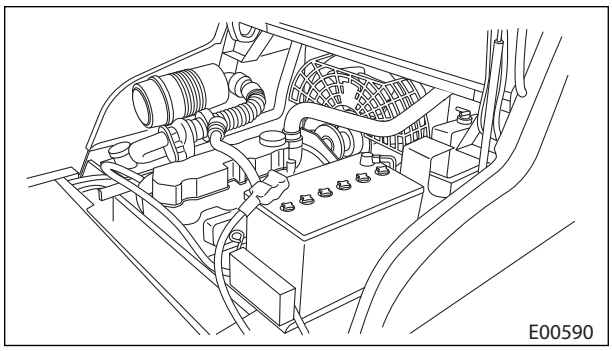


1. Forward
2. Reverse
3. Neutral
4. 0.5 sec
5. 0.5 sec
6. Travel interlock indication (Powershift model)

◆Engine Hood

The engine hood swings up to fully expose the engine compartment for daily inspection, servicing and lubrication.

- Engine Oil Level
- Engine Coolant Level
- Hydraulic Tank
- Battery Electrolyte Level
- Air Cleaner Element
- Alternator Drive Belt



⚠ CAUTION

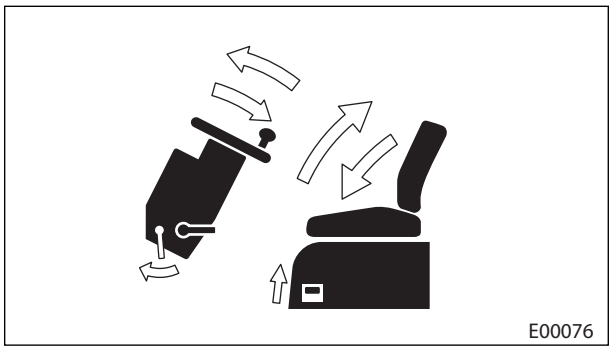
When closing the engine hood, be careful not to pinch your hand.

▶ Hood Latch

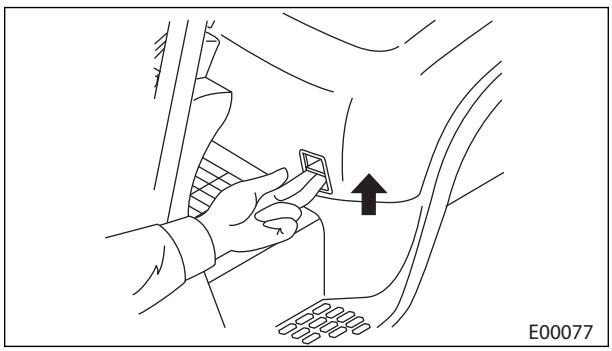
How to open

Lower seat back cushion and slide seat assembly forward before opening the engine hood.

(1) Unlock the steering column release lever and tilt the steering wheel toward the front of the lift truck.
(2) Slide seat assembly forward.
(3) Lower seat back cushion.
(4) Pull the engine hood lever in the direction of the arrow.



(5) Raise the engine hood.



How to close

(1) Push the engine hood down until it is locked.
(2) Raise seat back cushion to the upright locked position.
(3) Slide seat assembly back to desired position.
(4) Tilt the steering wheel toward the operator seat and make sure that it is automatically locked.

▶ LPG Model

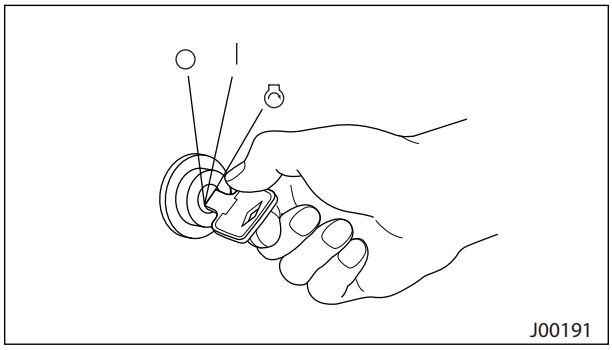
⚠ WARNING

LP-Gas is flammable and could cause injuries and fires. Inspect LPG fuel lines and fittings for leaks.

⚠ CAUTION

- DO NOT leave the key in the ON position when the engine is NOT running. This may cause the battery to run down.
- Operator seat MUST be seated before starting the engine, and seat belt MUST be fastened after starting the engine. (For powershift models with Australia specification only).

(1) Open the fuel valve by turning it slowly counterclockwise. Observe the LPG gauge. (If equipped)
(2) Turn the key switch to the START position. Release the key when the engine starts.
(3) If the engine does not start, DO NOT press the accelerator pedal. Turn the key switch to the OFF position, then repeat Step 2.

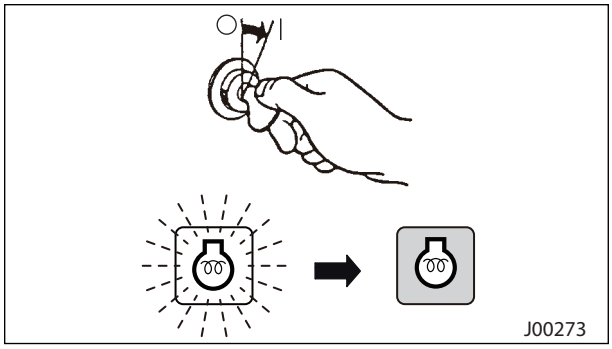

J00191

▶ Diesel Model

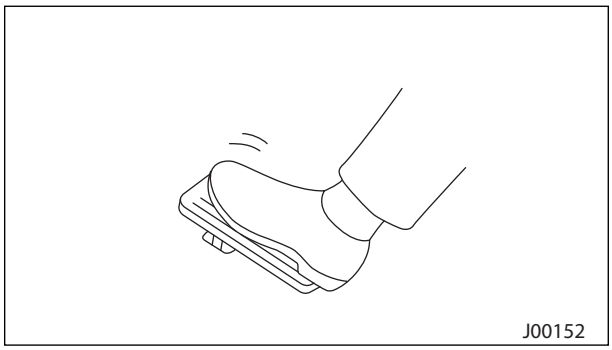
⚠ CAUTION

- DO NOT leave the key in the ON position when the engine is NOT running. This may cause the battery to run down.
- DO NOT turn the key switch to the ON position for more than 10 seconds at any one time. This may cause the battery to run down.
- Operator seat MUST be seated before starting the engine, and seat belt MUST be fastened after starting the engine. (For powershift models with Australia specification only).

(1) Turn the key switch to the ON position and wait until the glow plug pilot light goes out.

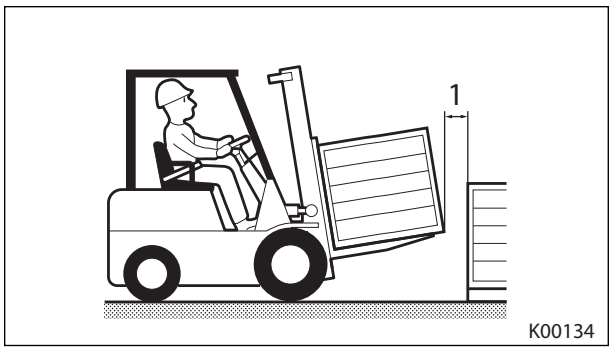

J00273

(2) Press the accelerator pedal fully and hold in this position.


J00152

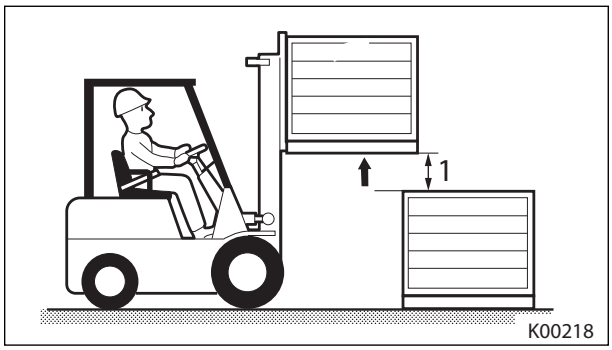
◆Unloading

(1) Stop the lift truck 20 to 30 cm (8 to 12 in.) short of the unloading zone.



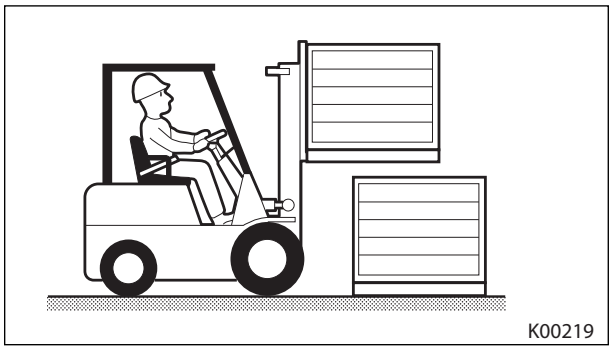
1. 20 to 30 cm (8 to 12 in.)

(2) Place the direction lever in the NEUTRAL position.
(3) Tilt the mast forward to the vertical position.
(4) Lift the load 10 to 15 cm (4 to 6 in.) higher than the stack.

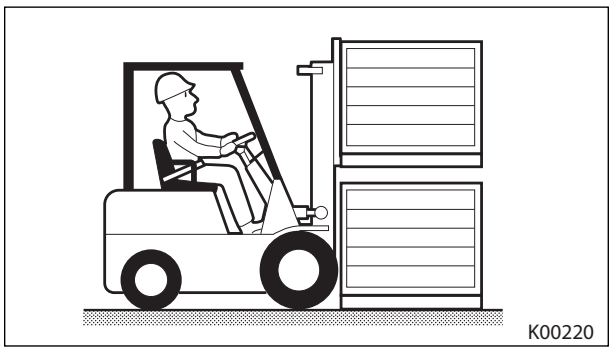


1. 10 to 15 cm (4 to 6 in.)

(5) Place the direction lever in the FORWARD position.
(6) Slowly move the lift truck forward to position the load just above the stack.



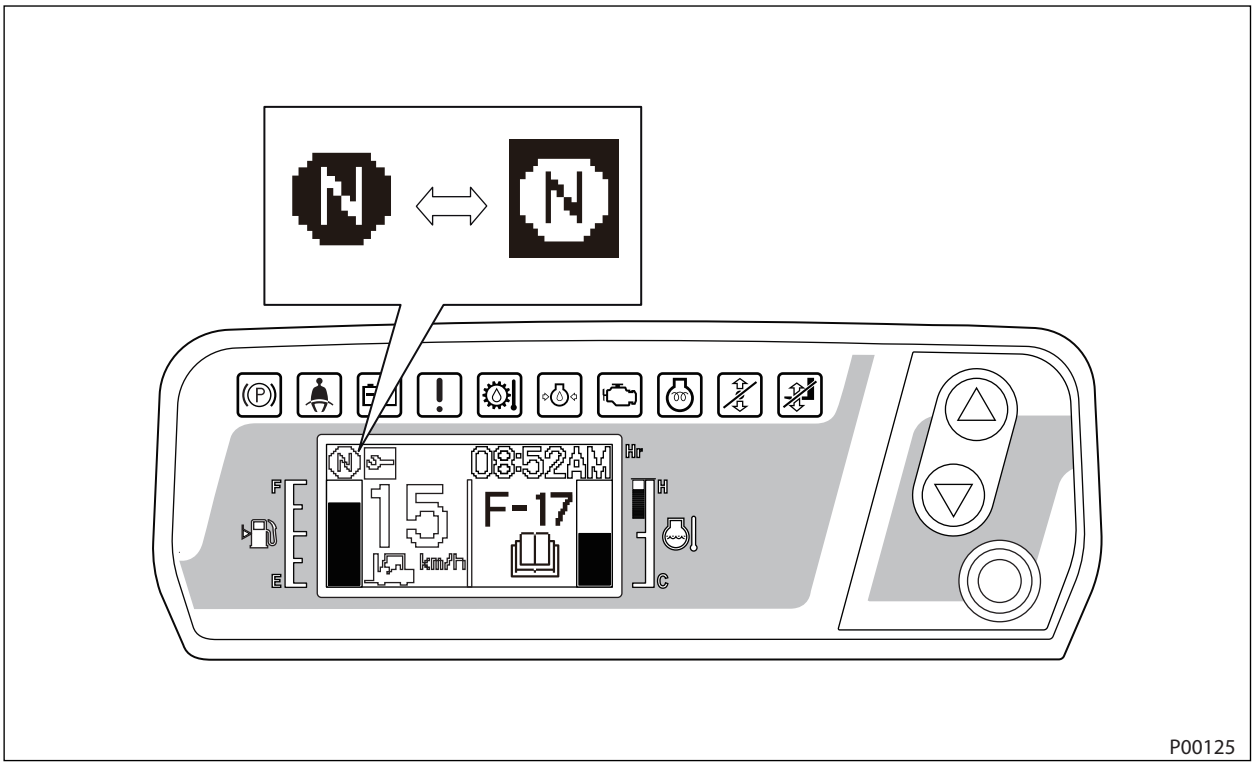
(7) Place the direction lever in the NEUTRAL position.



◆If the forklift Truck Won't Change Directions

If an operator half rises from the operator seat for more than 3 seconds with the direction lever being placed in the FORWARD or REVERSE position, a built-in seat switch in the operator seat activates the driving interlock system.

Check the following points If the lift truck will not move even after the direction lever is shifted to the FORWARD or REVERSE position.



Does the driving interlock indicator icon flicker on the LCD screen?

YES

(1) Sit properly on the operator seat.
(2) Return the direction lever to the NEUTRAL position.
(3) Place the lever to the FORWARD or REVERSE position.

NO

It is broken.

Contact your authorized Cat lift truck dealer after taking the following safety measures.

(1) Return the direction lever to the NEUTRAL position.
(2) Apply the parking brake.
(3) Turn the key switch to the OFF position.
(4) Attach a "DO NOT OPERATE" or similar warning tag to a conspicuous place at the operator compartment of the lift truck in order to let other people know your lift truck is broken.

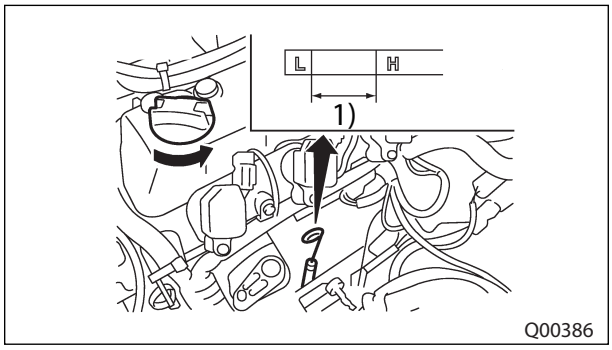
How to add engine oil

⚠ WARNING

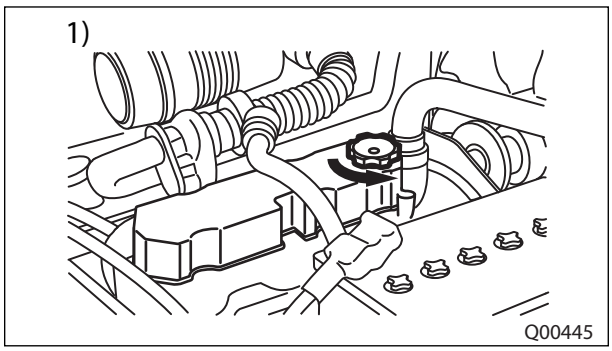
When adding engine oil:

- Perform the work on level ground.
- Clean the filler hole to prevent dirt from dropping into the engine.
- DO NOT overfill.
- Clean up spillage.

(1) Remove the oil filler cap.

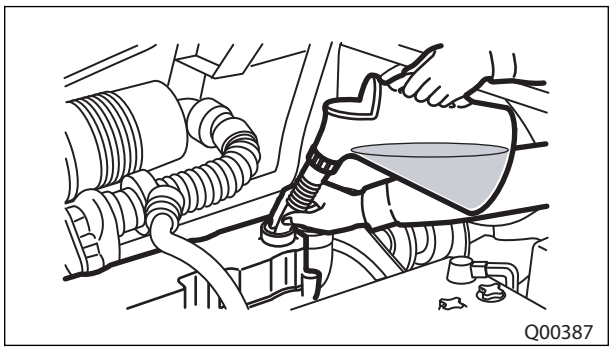


1) Correct level range



1) DIESEL

(2) Add engine oil as required.
For engine oil, see 12-4 "Recommended Fuels and Oils".
(3) After adding oil, make sure the level is in the correct range on the dip stick.
(4) Close and tighten the filler cap.

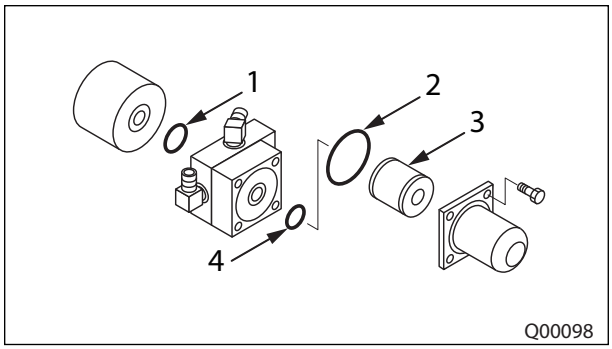


▶ Engine Cooling Fan

Check

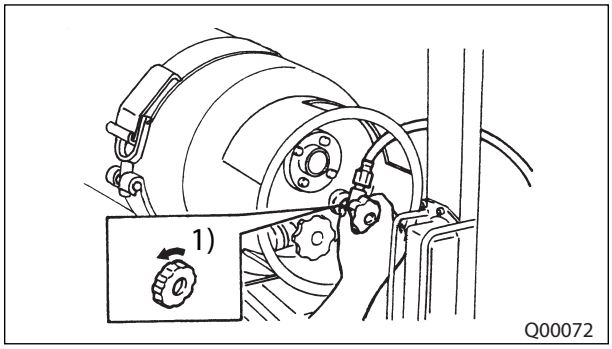
- Check for damage and rotation.

(5) Disassemble the fuel lock filter as shown.
(6) Remove the filter and O-rings.
(7) Wash the filter in cleaner. And direct air inside the filter to clean.
(8) Assemble and install the fuel lock filter.
(9) Connect the fuel line.



1. O-ring
2. O-ring
3. Filter
4. O-ring

(10) Open the fuel valve.
(11) Check the filter for fuel leaks with a soap solution.



1) Open

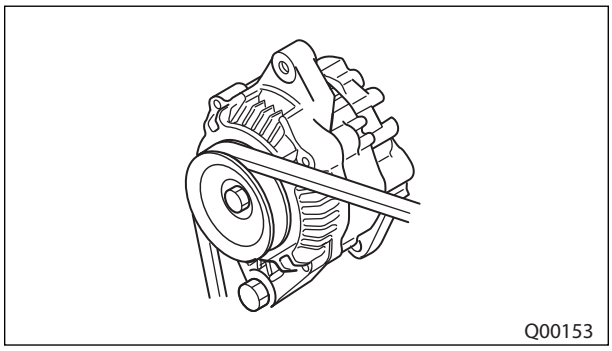
◆Every 1000 Service Hours or 6 Months, Whichever Comes First

You must read and understand the warnings and instructions contained in this manual before performing any operation or maintenance procedure.

▶ Alternator

Check

- Run the engine, and check the alternator for any unusual noise or vibration.



■ TO THE CAT LIFT TRUCK OWNER

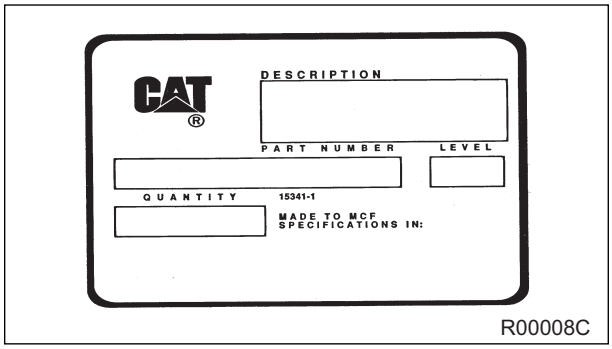
◆The Importance of Genuine Parts

The dealers and the owners are urged to use ONLY genuine parts to maintain lift trucks in a safe and efficient operating condition. Safe and efficient operation of your lift truck could be endangered by the use of inferior parts. In most cases, imitations sold as cheap parts invariably could mean a short part life and a higher maintenance cost.

Genuine parts give safe and reliable performance.

⚠ CAUTION

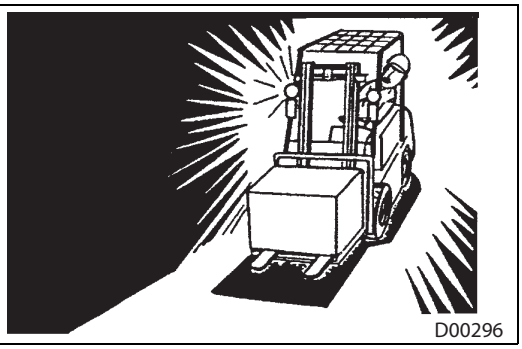
The damage caused by parts other than genuine parts is not covered by Cat Lift Trucks' warranty.



⚠ WARNING

Use lights in dark, dim areas!

Even with lights on, DO NOT assume people see you and will move out of your way.

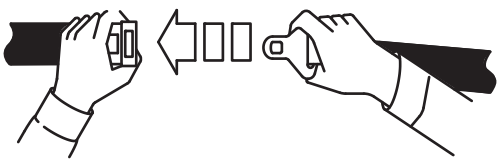


D00296

⚠ WARNING

When operating the lift truck, BE SURE to fasten the seat belt!

If not, the operator could be thrown out of the lift truck or crushed under the lift truck.

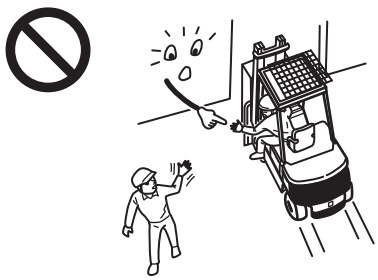


D00684

⚠ WARNING

Stay within the confines of the lift truck!

- Make sure there is enough space when passing through confined areas.
- Keep your hands and feet inside the operator compartment. DO NOT put any part of the body outside the operator compartment of the lift truck.
- In a confined area, use a helper to assist you.

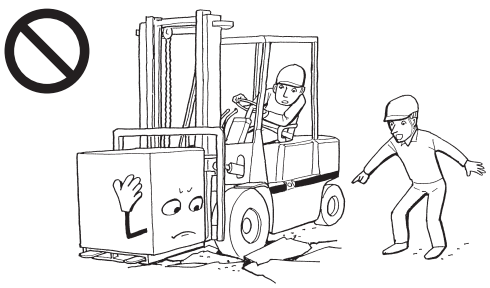


D00381

⚠ WARNING

Always be aware of floor capacity!

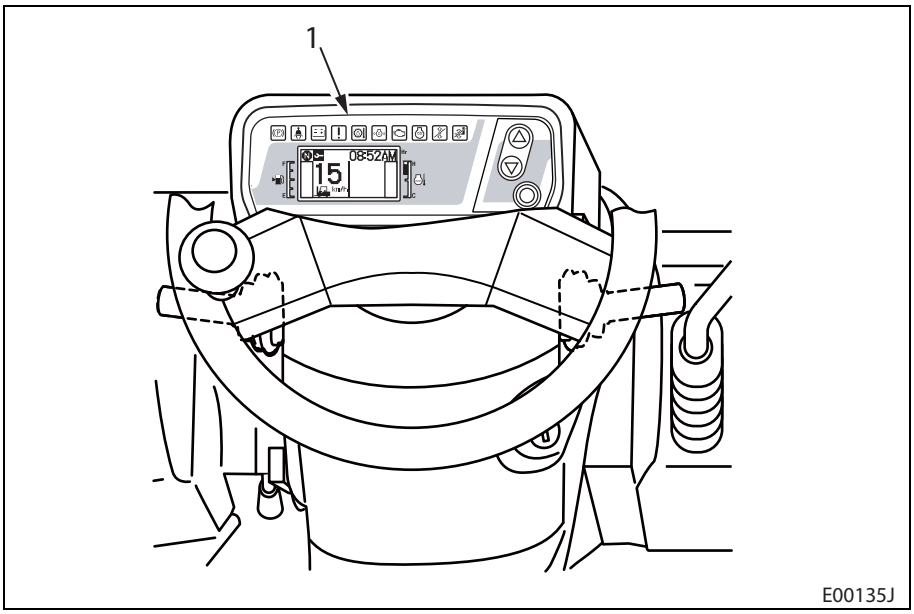
Make sure the floor will support the weight of the loaded lift truck.



D00294

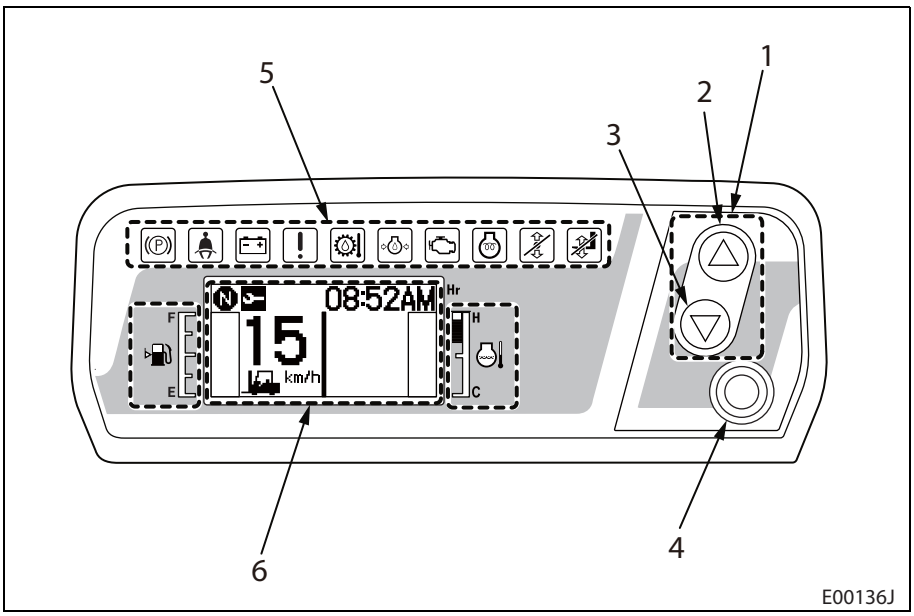
◆Meter Panel

When any warning lamp in the meter panel glows or blinks, stop the lift truck and take corrective action. (Except for the glow plug pilot indicator lamp.)



1. Meter panel

Meter panel consists of warning lamps, LCD (Liquid Crystal Display) screen, cursor buttons (△ button and ▽ button) and entry/display switch button (◎ button).



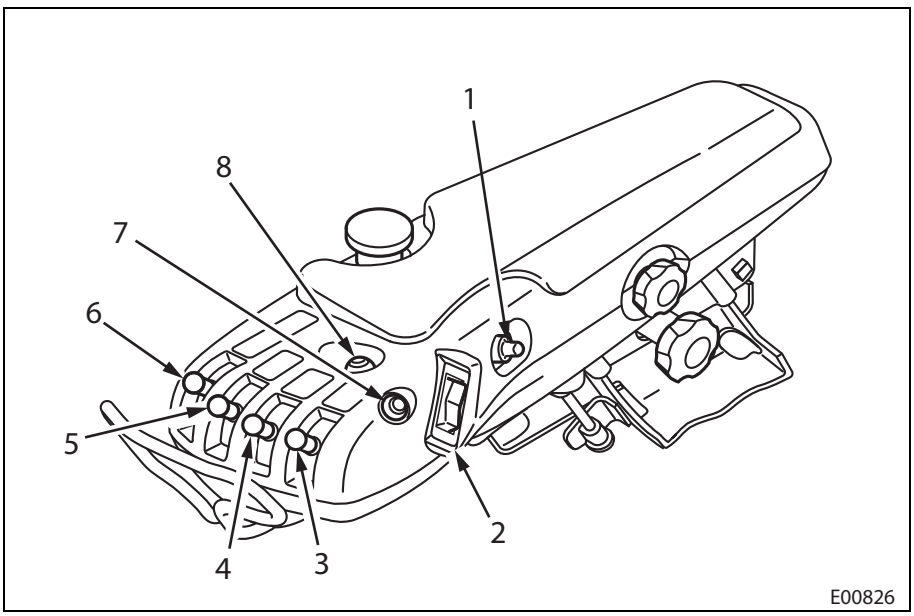
1. Cursor buttons
2. △Button
3. ▽Button
4. Enter/display switch button (◎button)
5. Warning lamps
6. LCD screen

◆Operating Switches and Controls (FC Model)

Equipped with mast interlock system

The mast interlock will work for the lift, tilt and attachment levers.

If the operator leaves the operator seat for approximately 3 seconds while the key switch is in the I (ON) position, regardless of whether the engine is running or not, the mast and attachment will not lift, lower, or tilt when the lift, tilt or attachment lever is operated. This is not a failure, but the interlock system is being activated.

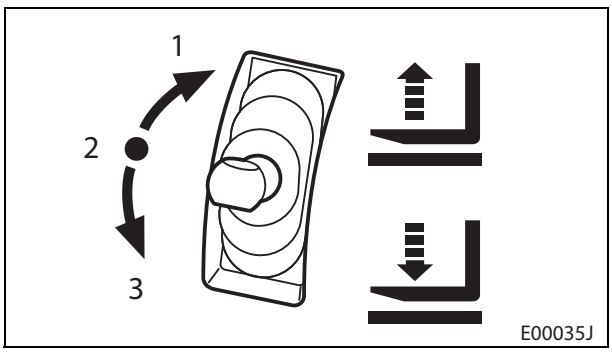


1. Lowering speed selector switch (optional)
2. Direction switch (optional)
3. Lift lever
4. Tilt lever
5. Attachment lever A
6. Attachment lever B
7. Mast vertical switch (optional)
8. Selector switch between fourth and fifth attachment (optional)

▶ Lift Lever

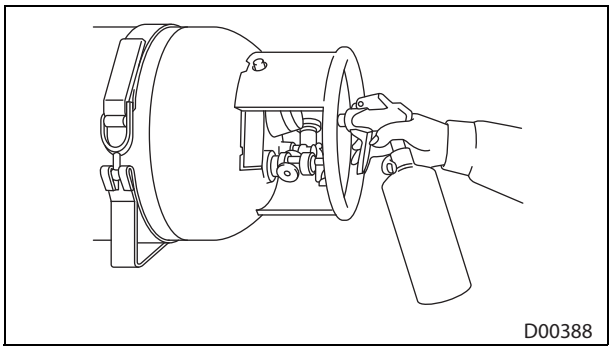
Lifting speed is controlled by the speed of the engine (the position of the accelerator pedal) and the position of the lift lever. Lowering speed is controlled only by the position of the lift lever regardless of the speed of the engine. The lever will return to the neutral position when released.

To deactivate the mast interlock system, the operator sits on the operator seat while the key switch is in the I (ON) position with the engine running, and then operate the lift lever.



1. Raise
2. Neutral
3. Lower

▶ For Standard LP-Gas Tank

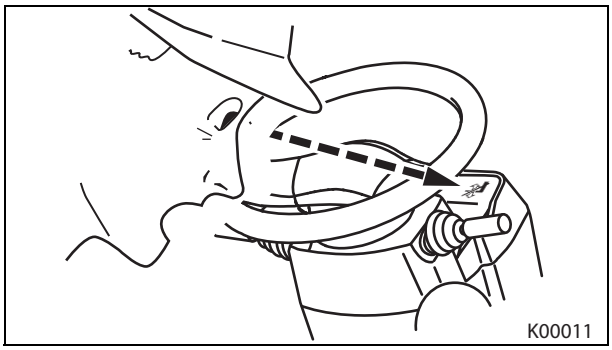

D00388

(1) Park the lift truck on level ground.
(2) Lower the forks until the fork tips touch the ground.
(3) Apply the parking brake.
(4) Place the direction lever in the NEUTRAL position.
(5) Run the engine at low idle.
(6) Discharge the static electricity.
(7) Close the fuel valve on the LP-Gas tank. Run the engine until it stops, then turn the key switch to the ○ (OFF) position.
(8) Disconnect the fuel supply line.
(9) Loosen the retaining clamps, and remove the tank.
(10) Make sure the replacement tank is the correct type.
(11) Inspect the replacement tank for damage such as dents, scrapes or gouges and for leakage at valves or threaded connections.
(12) Check for debris in the relief valve and for damage to various valves and the liquid level gauge.
(13) Inspect the couplings for deterioration, damage or missing flexible seals.
(14) When lifting the tank for mounting, hold with both hands to prevent injury, and check the tank clamp lock.
(15) Clamp the tank securely.
(16) Connect the fuel supply line.
(17) Open the fuel valve by turning it slowly counterclockwise. If the fuel valve is opened too quickly, a back pressure check valve will shut off the fuel supply. If this happens, close the fuel valve completely, wait five seconds, and then open the fuel valve very slowly.
(18) Check the LP-Gas fuel lines and fittings with a soap solution after filling the tank or when looking for leaks.

◆Flickering of the Mast Interlock Indicator Light

In the following three examples, the mast interlock indicator lamp blinks and the mast and attachment would not move (FC model) / the mast would not move (MC model) even though the operating levers are in the operating position. This is not a fault but the function of the interlock system. In this case, follow each instruction in "Remedy."

The mast interlock will work only for the lift and tilt levers. Attachments can be moved regardless of whether the mast interlock function is operating or not. Therefore, when the attachment lever is operated, some of the attachments will move, even though the engine is not running or the key switch is in the ○ (OFF) position, as a result of the handling load or of its own weight.
Refer to the table of 2-26 "Mast Interlock System"


K00011

Example 1

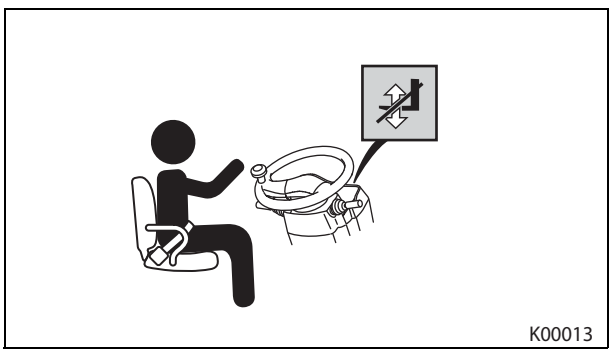
The mast interlock indicator lamp will blink when the key switch is in the I (ON) position and you are not properly sitting in the operator seat.


K00012

Remedy

Sit securely. This causes the mast interlock indicator lamp to go OUT and you can operate the lift or tilt lever.

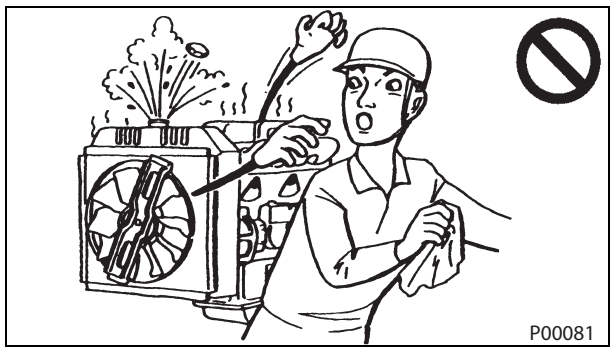
Note: The mast interlock indicator lamp will blink when you sit on the operator seat while the lift or tilt lever is placed to the operating position. To clear this function, move the lift or tilt lever to the NEUTRAL position.


K00013

◆If the Engine Coolant Temperature Gauge Shows Red Zone

⚠ WARNING

- DO NOT attempt to remove the radiator filler cap if the engine is overheated. To avoid scalding hot coolant and steam from blowing out of the radiator, wait until the engine has cooled.
- DO NOT add cold water to an overheated engine, this could cause engine damage. Wait for the engine to cool, if possible. If not, slowly pour water into the radiator.
- Immediately stop the engine if the fan belt is broken.

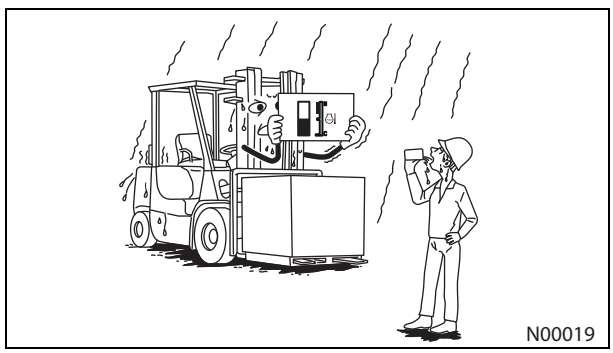

P00081

⚠ CAUTION

If any of the following liquids are spilled on the floor, clean up immediately. If not cleaned up, it may result in slipping, skidding or environmental pollution.

- Oil or grease
- Coolant
- Gasoline or diesel fuel
- Brake fluid
- Electrolyte

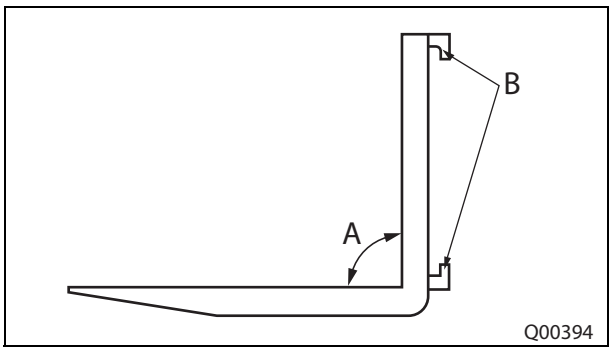
(1) Park the lift truck in a safe area.
(2) Raise the and seat assembly to ventilate the engine compartment.
(3) Allow the engine to idle for a while. Do not attempt to stop the engine.
(4) Stop the engine after the engine coolant temperature gauge shows the WHITE zone.


N00019

(5) Check for:
- Lack of coolant.
- Loose or broken fan belt.
- Engine oil level.
- Dirt buildup in radiator air passages.

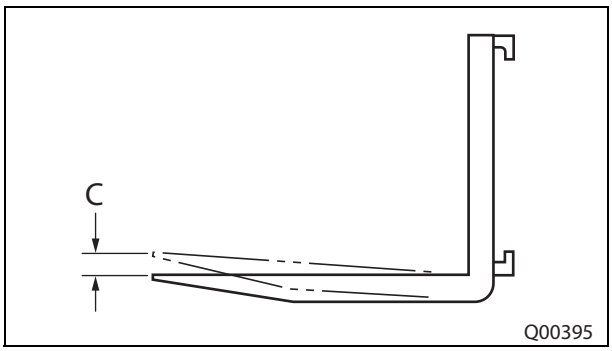
(1) Carefully inspect the forks for cracks. Special attention should be given to the heel section A, all weld areas and mounting brackets B.

Note: Do not use cracked forks. "Wet Test" magnetic particle inspection is generally recommended due to its sensitivity and the ease of interpreting the results. Portable equipment is usually recommended so it can be easily moved to the lift truck. Contact your authorized Cat Lift Truck dealer for further information.



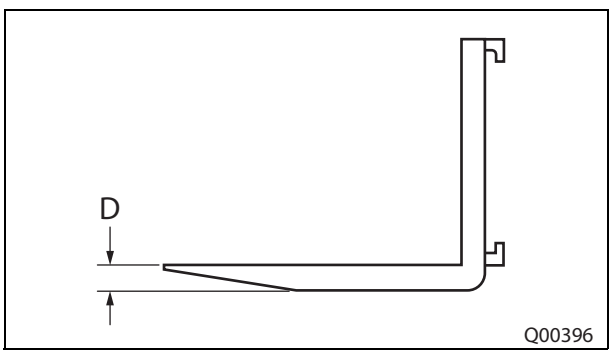
(2) Check the difference in height of one fork tip to the other when mounted on the lift bracket. Also check each fork for its deviation by setting a straight fork length pole against the fork to measure a difference in height between the fork tip and pole.

Note: A difference in fork tip height could result in uneven support of the load and cause problems when entering loads. The maximum allowable difference in fork tip elevation C is 5 mm (0.2 in.) for pallet forks. Replace one or both forks when the difference in fork tip height exceeds the maximum allowable difference.



(3) Check the fork blade D.

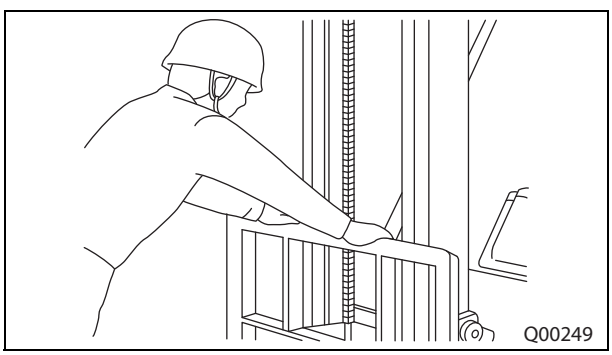
Note: Do not use the forks if the thickness is reduced to less than the tolerant thickness. Fork blade length may also be reduced by wear, especially on tapered forks and platens. Do not use the forks when the blade length is no longer adequate for the intended loads.



Tolerant Thickness	Standard	Limit
1 to 2 ton compact models	35 mm (1.4 in.)	32 mm (1.3 in.)
2 to 2.5 ton models	40 mm (1.6 in.)	36 mm (1.4 in.)
3 to 3.5 ton models	45 mm (1.7 in.)	40 mm (1.6 in.)

▶ Load Backrest Extension

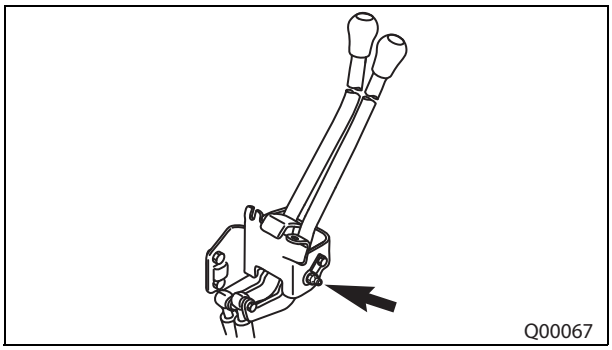
Is the load backrest extension free of distortion, cracks and other defects? Shake the load backrest extension to check for excessive rattle.



▶ Gearshift Lever (Manual)

Lubricate

Lubricate 1 fitting.

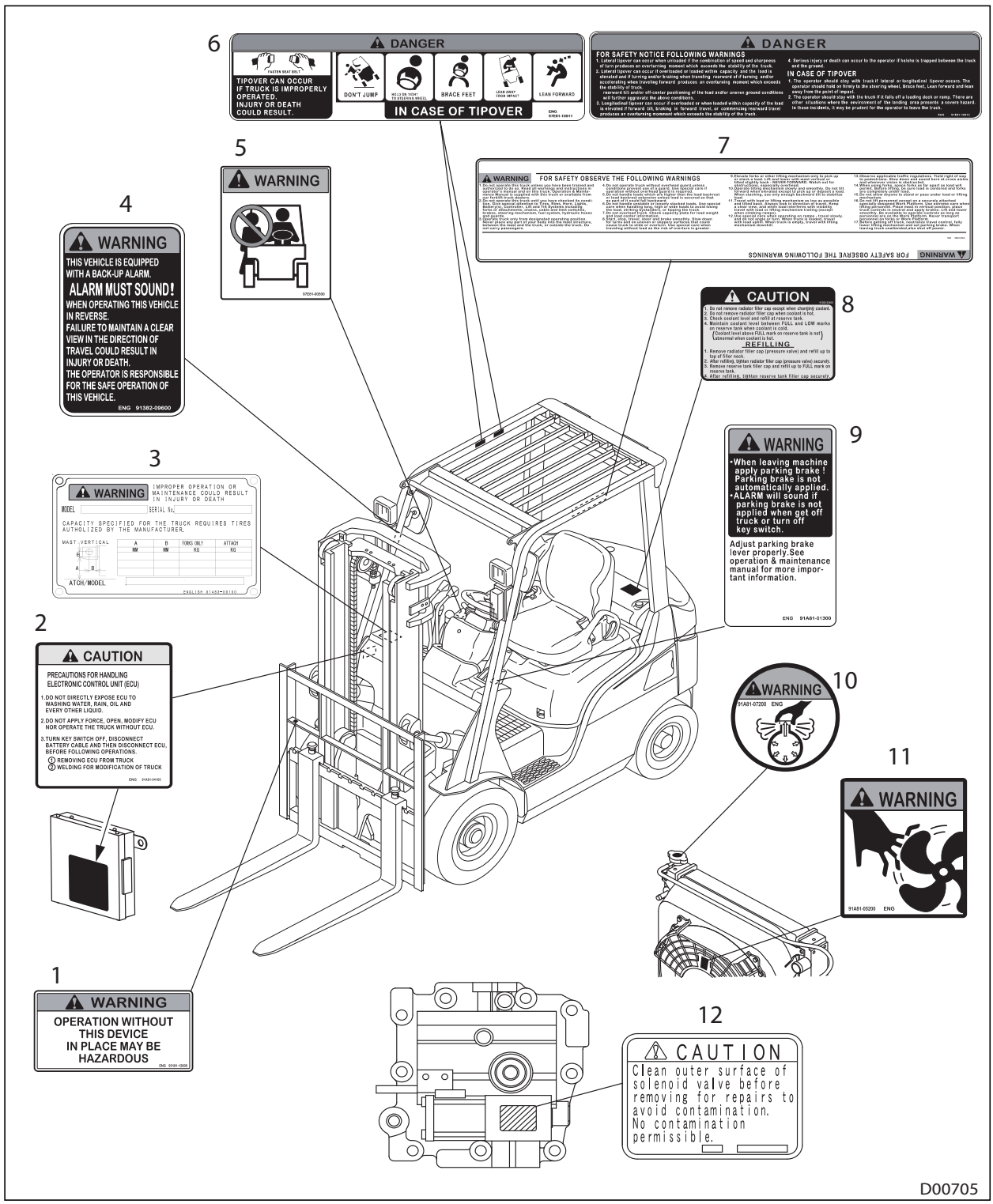


▶ Antifreeze Solution

The manufacturer recommends that the coolant mix contain 50% commercially available automotive antifreeze, or equivalent, and acceptable water to maintain an adequate water pump cavitation temperature for efficient water pump performance.

Note:

- Do not add pure (100%) antifreeze to the cooling system. Add antifreeze mixed with distilled water using the same freeze protection ratio that is in your cooling system.
- Premix the coolant solution to provide protection to the lowest expected outside (ambient) temperature. Pure undiluted antifreeze will freeze at -23°C (-10°F).
- Use a greater concentration (above 50%) of commercially available automotive antifreeze only as needed for anticipated outside (ambient) temperatures.
- Do not exceed the coolant-to-water mix ratio recommendations provided with the commercially available automotive antifreezes.
- Most commercial antifreezes are formulated for gasoline engine applications and will, therefore, have high silicate content.



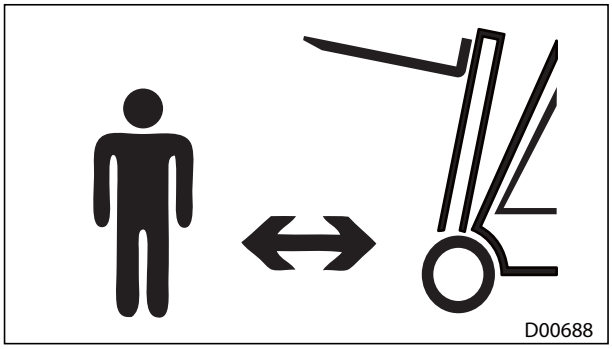
1. With Load Backrest Extension Decal
2. Precautions for Handling E.C.U. Decal
3. Capacity Plate
4. Backup Alarm Decal
5. No Riders Warning Decal
6. Survive in a Tipover Decal
7. Operation Warning Decal
8. Engine Coolant Decal
9. Parking Brake Adjustment Decal
10. Radiator Cap Warning Decal
11. No Access with Engine Running Decal
12. No Contamination Permissible Decal

◆ Working Precautions

⚠ WARNING

Keep out!

- DO NOT allow any unauthorized persons in the work area where the lift truck is operated.
- Personnel must be clear of the lift truck operating area.


D00688

⚠ WARNING

Be careful of changes in capacity!

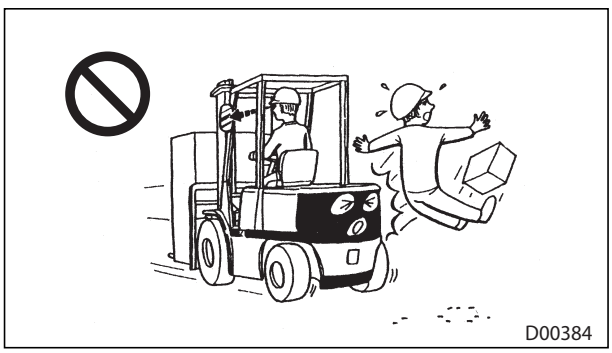
- Know the capacity when attachments are used. Extra care must be taken in securing, manipulating, positioning, and transporting the load. Operate lift trucks equipped with attachments as partially loaded lift truck when not handling loads.
- When using an attachment, BE SURE to read the attachment instructions manual and attachment warning labels carefully and understand its function fully before using it.


D00334

⚠ WARNING

Watch out for pedestrians at all times!

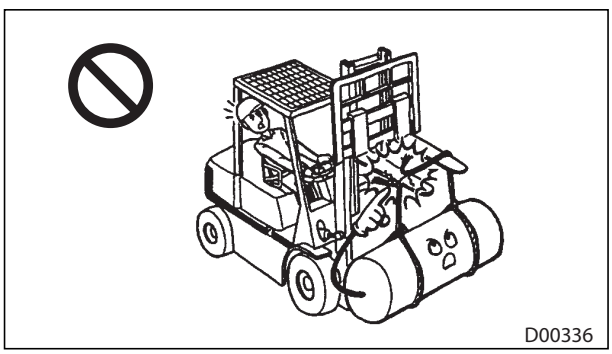
Yield the right-of-way to pedestrians at all times.


D00384

⚠ WARNING

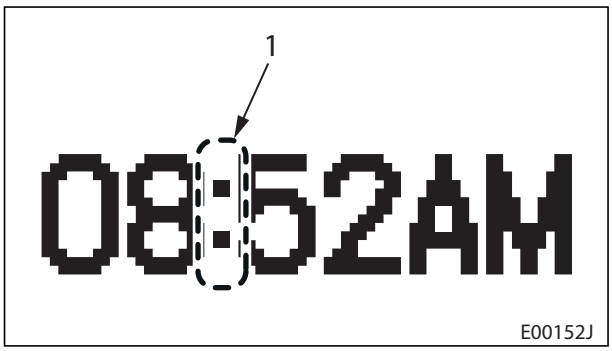
Use the proper attachment!

When lifting a load, use the proper attachment designed for the load. DO NOT operate at high speeds.


D00336

How to adjust clock time

Turn the key switch to the ON position. Do not start engine.



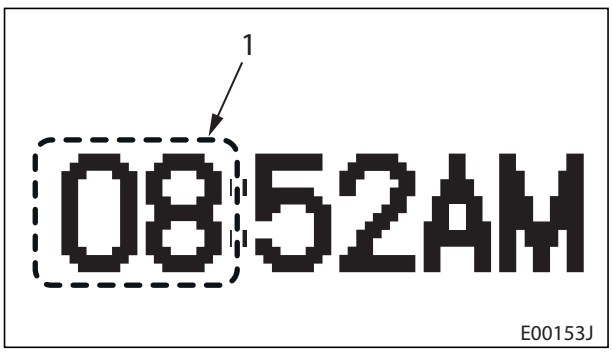
1. Blinking

Select clock time display

Button	Press	Display
◎	Short	Clock time (: Blinks)

Time adjust mode

Button	Press	Display
◎	Long	Time setting mode of hours

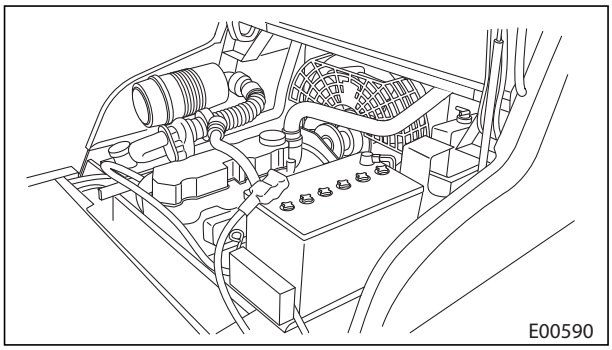


1. Digits to be adjusted is blinking

◆Engine Hood

The engine hood swings up to fully expose the engine compartment for daily inspection, servicing and lubrication.

- Engine Oil Level
- Engine Coolant Level
- Hydraulic Tank
- Battery Electrolyte Level
- Air Cleaner Element
- Alternator Drive Belt



⚠ CAUTION

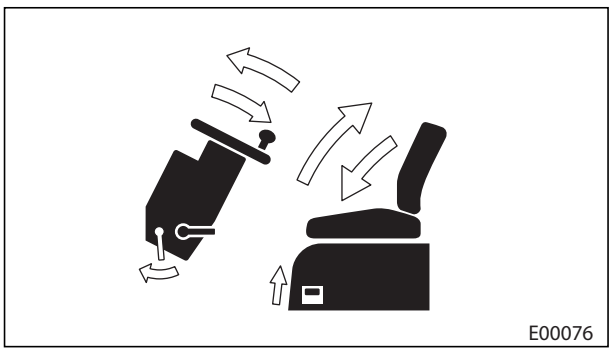
When closing the engine hood, be careful not to pinch your hand.

▶ Hood Latch

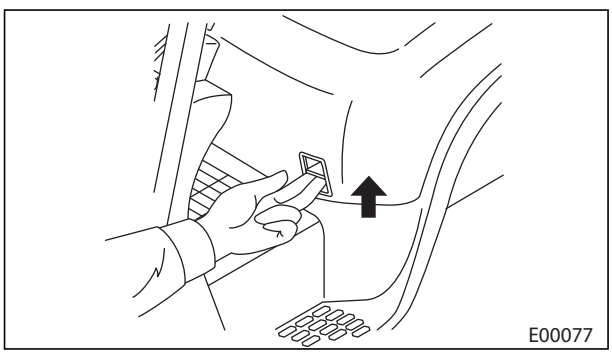
How to open

Lower seat back cushion and slide seat assembly forward before opening the engine hood.

(1) Unlock the steering column release lever and tilt the steering wheel toward the front of the lift truck.
(2) Slide seat assembly forward.
(3) Lower seat back cushion.
(4) Pull the engine hood lever in the direction of the arrow.



(5) Raise the engine hood.



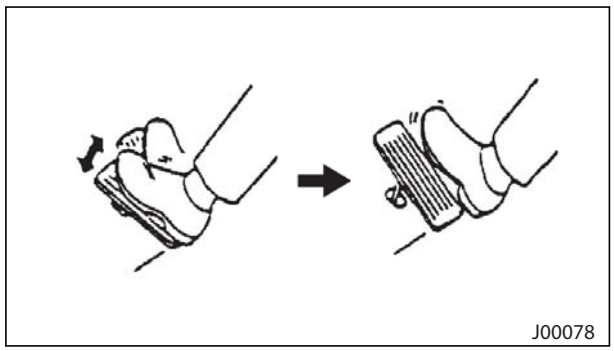
How to close

(1) Push the engine hood down until it is locked.
(2) Raise seat back cushion to the upright locked position.
(3) Slide seat assembly back to desired position.
(4) Tilt the steering wheel toward the operator seat and make sure that it is automatically locked.

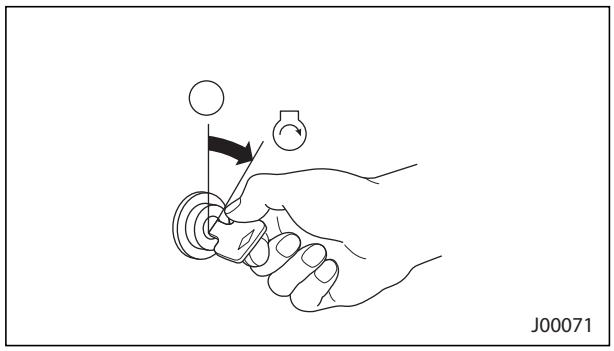
▶ When Engine Is Started after Long Idle Period

Gasoline model

(1) Press the accelerator pedal several times and release the pedal fully.



(2) Turn the key switch to the START position.



Note: The head lamps should be turned OFF for easier starting.

Diesel model

Air in the fuel system may cause starting failure. In this case, have your authorized Cat lift truck dealer prime the fuel system or check the fuel system for possible problems.

◆ After Starting Engine

⚠ WARNING

If the warning icon turns ON, correct the problem before operating the lift truck. Contact your authorized Cat lift truck dealer for repairs.

⚠ CAUTION

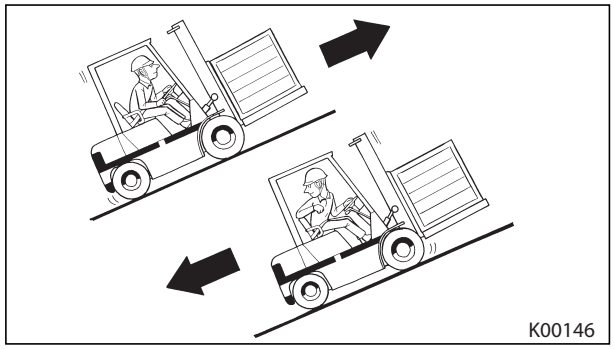
- BE SURE to warm up the engine regardless of the weather.
- If the engine is not warm up, it may cause poor lubrication and incomplete fuel combustion resulting in poor engine performance.

Check the warning icons and gauges frequently during operation to make sure all systems are working properly.

(1) Run the engine at idle speeds without a load for about 5 minutes.
(2) During warm-up, check to see that systems are operating properly.

- Are all the warning icons OFF?
- Are exhaust noise and smoke color normal?
- No excessive vibration?

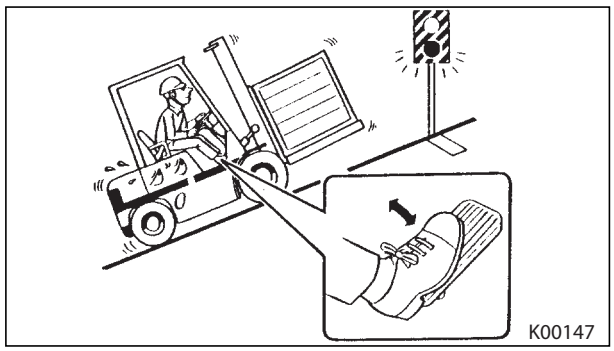
Travel up a grade in FORWARD and down a grade in REVERSE when the lift truck is loaded.



▶ Stopping on a Grade

⚠ CAUTION

Press the brake pedal when you have to bring the lift truck to a stop on a grade. DO NOT hold the lift truck by pressing the accelerator pedal. This may cause clutch plate wear or torque converter failure.



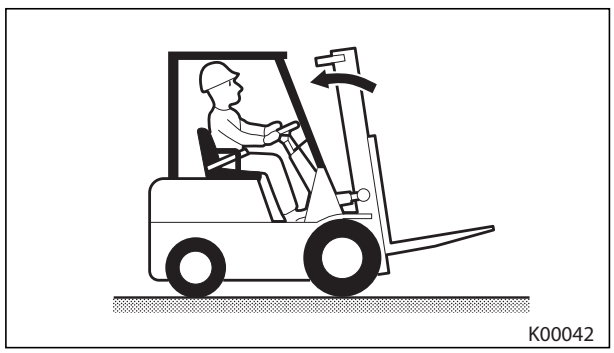
When traveling up or down a steep grade:

(1) Do not stop the engine.
(2) Do not make any turns.
(3) Do not travel across the grade.

▶ Starting on a Grade (Engine Stalls on a Grade)

Manual model

(1) Press the clutch pedal, move the gearshift lever to NEUTRAL position and start the engine.
(2) Pull the parking brake lever all the way back to hold the lift truck and lower the forks to the ground.
(3) Move the gearshift lever to 1st speed position.
(4) Raise the forks or load to the normal travel position.
(5) Press the accelerator pedal while gradually releasing the clutch pedal. As soon as the clutch is engaged, gradually release the parking brake lever.



Powershift model

(1) Apply the parking brake.
(2) Lower the forks to the ground.
(3) Press the brake pedal.
(4) Place the direction lever in the NEUTRAL position.
(5) Start the engine.
(6) Place the direction lever in the FORWARD position.
(7) Raise the forks or load to the normal travel position.
(8) Quickly shift your right foot from the brake pedal to the accelerator pedal.
(9) Release the parking brake while gradually pressing the accelerator pedal.

■ MAINTENANCE

◆General

Taking proper care of your lift truck is a vital part of the overall planned maintenance program. Your participation in this program will provide an early identification of potential maintenance problems. Do-it-yourself maintenance does not include repairs. If your lift truck requires any repairs, contact your authorized Cat lift truck dealer. The dealer's lift truck mechanics are well trained and know how to safely make repairs.

⚠ WARNING

Follow these rules to help save you from injury and to service your lift truck properly.

- Make sure the service area is safe.
- Park the lift truck on level ground with the forks lowered until the fork tips touch the ground, parking brake applied, direction lever in the NEUTRAL position, engine stopped and the wheels blocked.
- All repairs must be made by authorized personnel.
- Follow the recommended safety procedures.
- Use only the right tools for the job.

⚠ WARNING

DO NOT bypass any electrical switches on this lift truck.

⚠ WARNING

If during operation the lift truck becomes unsafe in any way, the matter must be reported immediately to the user's designated authority, and the lift truck must not be operated until it has been restored to a safe operating condition.

⚠ WARNING

BE SURE to perform inspections.

- If you fail to perform required inspections, it could lead to accidents.
- Operate the lift truck at a reduced speed when performing an operational inspection.
- If operated at higher speeds during an operational inspection, it could cause an accident if the lift truck is faulty.
- Dress properly for the job. DO NOT wear loose clothing or accessories---loose cuffs, dangling chains, neckties, scarves, or rings---that could catch in moving parts.
- Wear personal protective equipment appropriate for the conditions of your work places.

⚠ WARNING

Lines, Tubes and Hoses

- Leaks could cause fires. Contact your authorized Cat lift truck dealer for repair or replacement.
- DO NOT bend or strike high pressure lines. Check lines, tubes and hoses carefully.
- DO NOT install bent or damaged lines, tubes or hoses.
- Repair loose or damaged fuel and oil lines, tubes or hoses.
- DO NOT use your bare hands to check for leaks, use a board or cardboard.
- Tighten connections to the recommended torque.
- Make sure all clamps, guards and heat shields are installed correctly to reduce the risk of vibration, rubbing against other parts, and excessive heat during operation.
- If any of the following is found on a part, replace the part.
  - End fittings damaged or leaking.
  - Outer covering chafed or cut and wire reinforcing exposed.
  - Outer covering ballooning locally.
  - Evidence of kinked or crushed hose.
  - Metal embedded in the outer cover.
  - End fittings displaced.

Add Hydraulic Oil

⚠ CAUTION

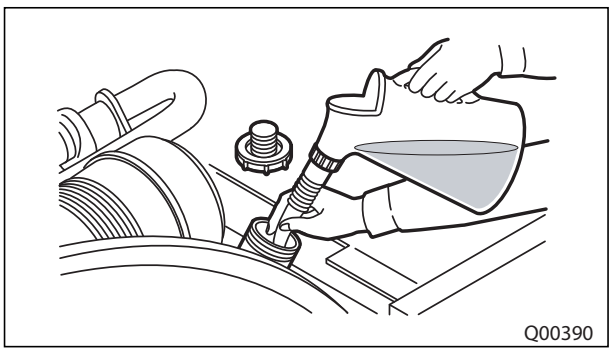
The followings are the safety precautions when adding hydraulic oil.

- Perform the work on level ground.
- Clean the filler hole to reduce the risk of dirt from dropping into the tank.
- DO NOT overfill.
- Clean up spillage.

How to add hydraulic oil

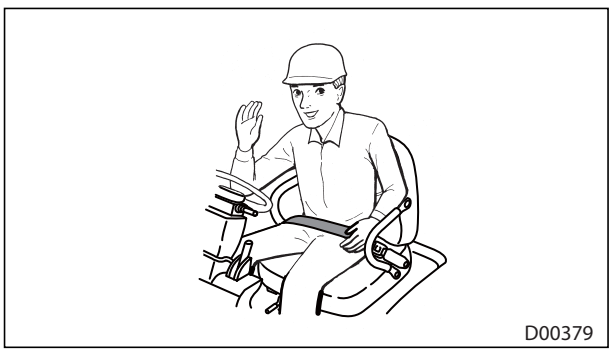
(1) Remove the hydraulic tank filler cap.
(2) Add oil to the hydraulic tank.

For hydraulic oil, see 12-4 "Recommended Fuels and Oils".


Q00390

▶ Operator Seat

- Check that the operator seat is securely locked into place by adjusting the operator seat with the slide lever.
- Make sure that there is no looseness with the operator seat.


D00379

▶ Rear View Mirror

Are their lenses clean and not defective?

▶ Steering Column

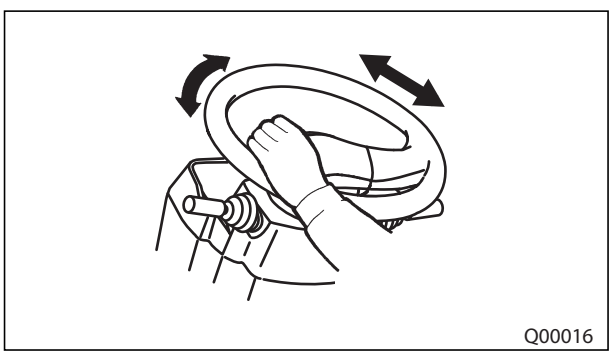
Check the defective of steering column, tilt lock lever, column lock lever.

▶ Steering Wheel

- Does the steering wheel have a free play of 15 to 30 mm (0.6 to 1.2 in.)?

Check the play at the rim of the wheel by rotating the wheel in both directions.

- Is the steering wheel loose?
  Shake the steering wheel up and down.


Q00016

▶ Fuel Filter (Diesel Model)

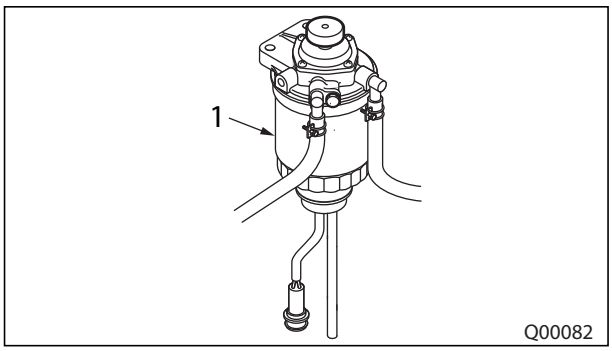
Replace

⚠ WARNING

- Fuel leaked or spilled onto hot surfaces or electrical components could cause a fire.
- Clean up any fuel spillage.
- Know the location of all emergency devices (such as fire extinguisher, first aid kit, etc.) and how to use them.
- Disconnect the battery when replacing fuel filters.

Note: Park the lift truck in an authorized refueling area with the forks lowered until the fork tips touch the floor or ground, parking brake applied, direction lever in the NEUTRAL position, engine stopped and the wheels blocked. The engine must be cooled down.

(1) Raise the engine hood.
(2) Remove the filter.
(3) Use filter wrench to remove filter element.
(4) Clean sealing surface of filter base.
(5) Apply a light coat of engine oil to the gasket of the new filter element.
(6) Install the new filter element by hand until the gasket contacts the filter base.
(7) Start the engine and check for fuel leaks.
(8) Stop the engine.
(9) Close and secure the engine hood.

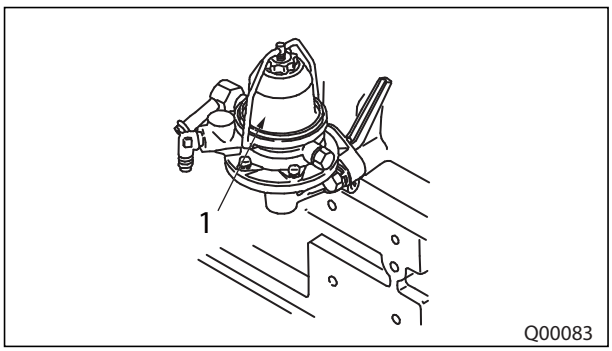


1. Filter element

▶ Fuel Filter (Gasoline Model)

Replace

- Filter of standard engine should be changed.



◆Service Registration

Fill out this sheet for your ready reference.

SERVICE REGISTRATION

<table>
<tr><td colspan="2">Lift Truck Model, Serial No.</td><td>Engine Model, Serial No.</td></tr>
<tr><td colspan="2">Mast Model, Serial No.</td><td>Attachment Model, Serial No.</td></tr>
<tr><td rowspan="3">Delivering Dealer:</td><td colspan="2">Name:</td></tr>
<tr><td colspan="2">Address:</td></tr>
<tr><td colspan="2">Delivery Date:</td></tr>
</table>

Chapter 15 SERVICE DATA

1. Maintenance Schedule 15-1
2. Tightening Torques for Standard Bolts and Nuts 15-6
2.1 Metric Fine Thread 15-6
2.2 Metric Coarse Thread 15-8
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4.1 Lubrication Chart 15-11
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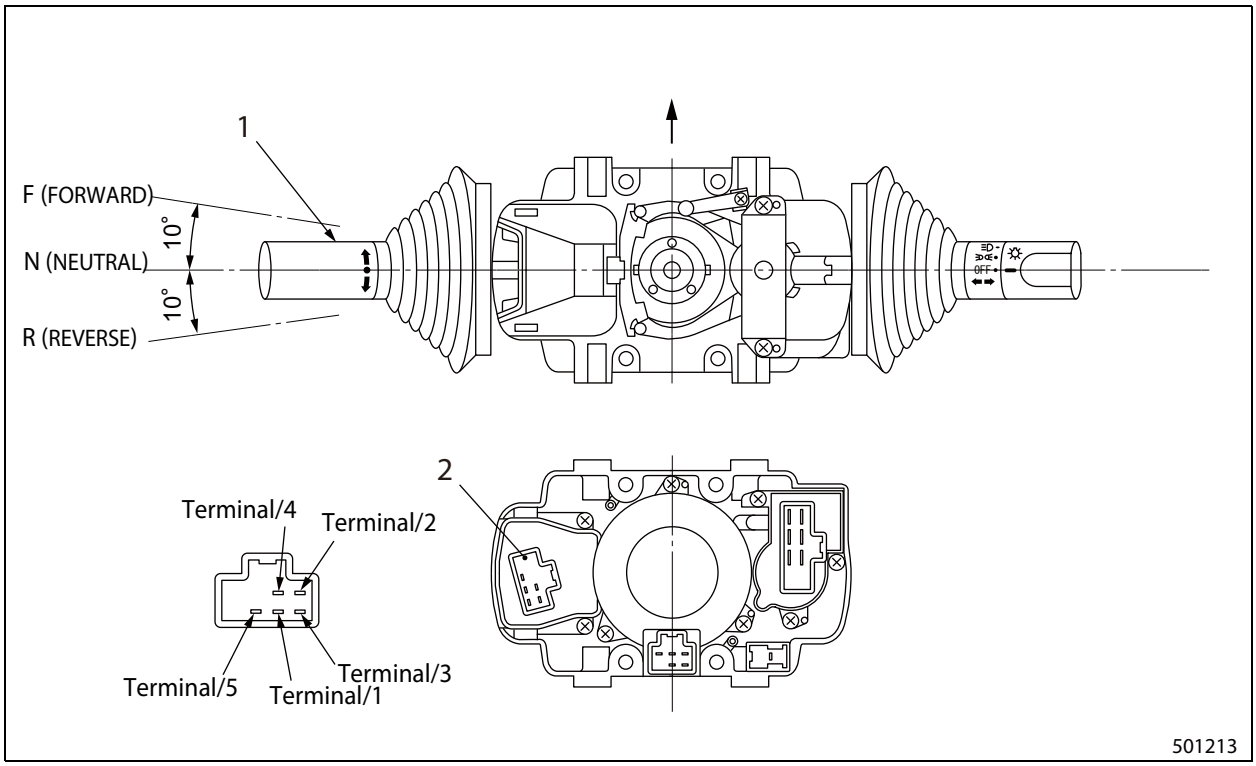
4.3 Adjustment Value and Oil Capacity 15-14
5. Special tools 15-20
5.1 Special Service Tools 15-20
5.2 Special Service Tools (For Powershift Transmission) 15-23

3.2 Direction (FNR) Switch



1. Direction (FNR) lever
2. Direction (FNR) switch

Note: Arrow indicates the front of truck.

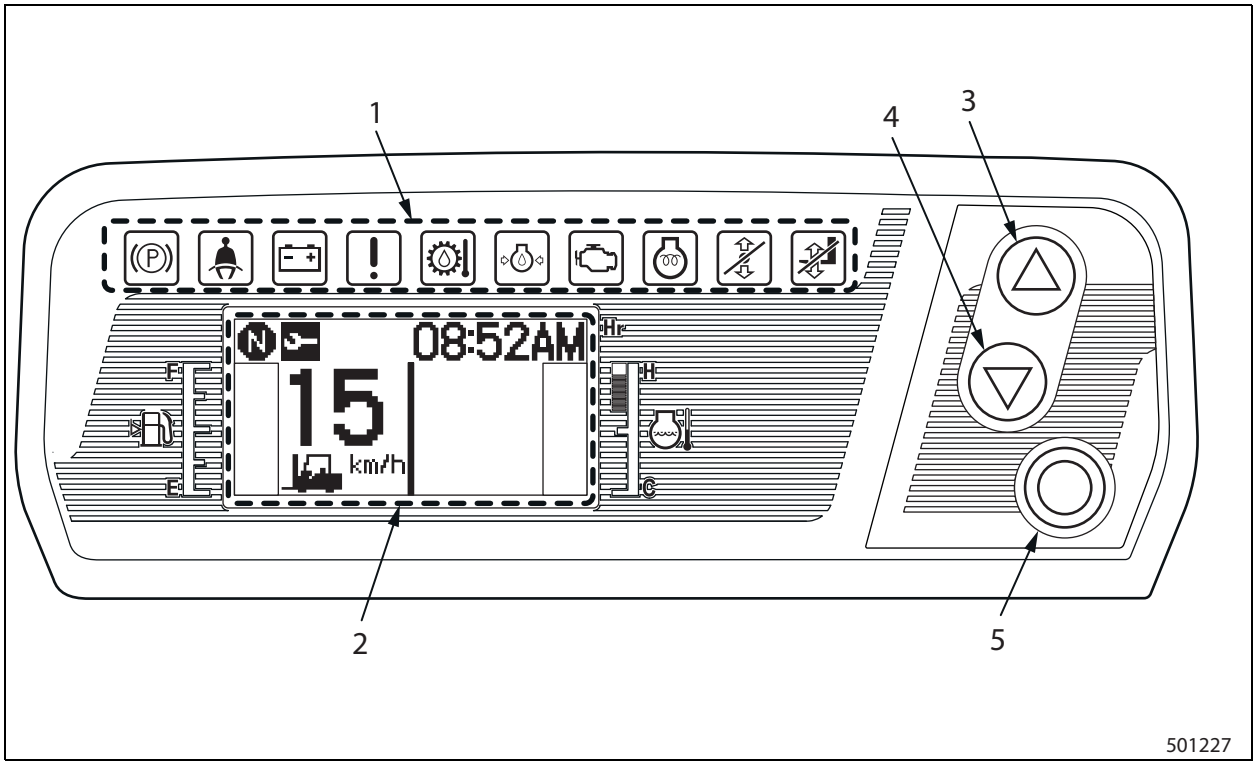
Connection table

Lever position	Terminal	1	2	3	4	5
	Destination	Truck controller	Grounding	Truck controller	Grounding	Truck controller (backup alarm/ buzzer)
F (FORWARD)			○ ------	------- ○		
N (NEUTRAL)		○ ------	----------	----------	------- ○	
R (REVERSE)			○ ------	----------	----------	---------- ○

5. Meter Panel

5.1 Meter Panel Layout

Meter panel screen consists of warning light, LCD (Liquid Crystal Display) screen, UP button, DOWN button, and ○ button (enter/select button).



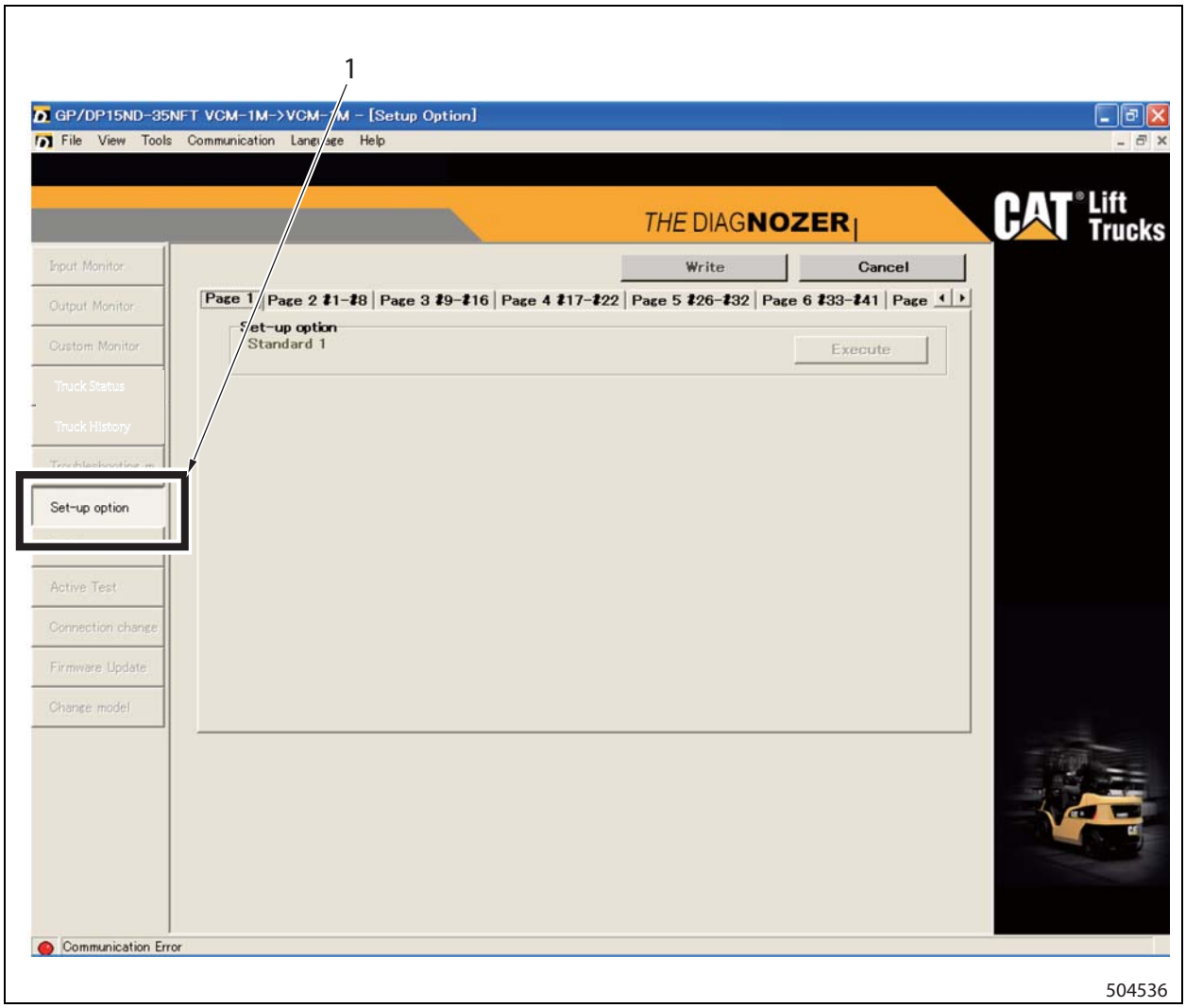
1. Warning lights
2. LCD screen
3. UP button
4. DOWN button
5. ○ button (Enter/select button)

5.9 Troubleshooting

Condition	Possible cause	Action
The fuel gauge indicates the presence of fuel, but the truck runs out of gas	On gasoline LPG dual fuel lift truck, the fuel gauge shows only gasoline amount LPG amount is not shown	To know if LPG is running out, use LPG fuel warning
Back-up light went off	Back-up light goes off when the temperature on the meter panel becomes high (105°C (221°F) or higher) to protect the back-up light	Park the truck in the shade to cool it down
LCD is not displayed	The LED is automatically turned off if the internal temperature of the meter panel becomes 85 °C (185 °F) or higher to protect LCD	Park the truck in the shade to cool it down
	LCD contrast may be adjusted to its minimum	Adjust contrast with buttons
Display switching speed is slow	When the temperature in the meter panel becomes low [0 °C (32 °F) or lower], the screen switching speed becomes slower because of the characteristic of LCD	-
LCD screen is too dark	The screen display becomes darker when the temperature on the meter panel becomes high (105°C (221°F) or higher) because of the characteristic of LCD	Adjust contrast with buttons
LCD screen is too dim	The screen display becomes dim when the temperature in the meter panel becomes low [0 °C (32 °F) or lower] because of the characteristic of LCD	Adjust contrast with buttons
Button operation (long press) is ineffective	When the engine is running, long press of a button is ineffective	Turn the key switch to the OFF position once to stop the engine, then turn the key switch to the ON position
Time becomes 00:00 AM	Changing battery will reset the time	Refer to 3-40 "Time setting" to set the time
Unable to register "0000" and "1111" passwords	You cannot register "0000" and "1111"	-
Unable to use overload warning function	This function is only available for the trucks equipped with the load meter display option	Use the load meter display (Manufacturer's option)
Exterior alarm lights do not glow (The buzzer does not sound)	Trigger speed setting should be 20km/h (12.4 mph) or less and trigger load setting should be 3.5 ton or less (depending on the truck models)	Check the exterior alarm function setting
Diagnostic code (F-73) occurs	This is caused by a difference in hour meter readings between the VCM and the meter panel when the hour meter is transferred	Update the hour meter using the service tool
The screen returns to the standard screen while conducting the clock time setting or exterior alarm setting, or while checking the truck history	If the buttons are left untouched for more than three minutes, or if the engine is started during the setting procedure, the setting being conducted becomes ineffective and its screen returns to the standard screen. Restart the setting procedure from the beginning	-
Fuel gauge and water temperature gauge display glows	Check the fuel sensor and the water temperature sensor, or all the connected wires to both sensors for electrical short circuit	-

Set-up option

Click the Set-up option button from the menu or toolbox to display the setup option screen in the main window. In the setup option screen, you can monitor the current setup values, or you can rewrite the setup values. Click the Write button to save your changes.



1. Set-up option button

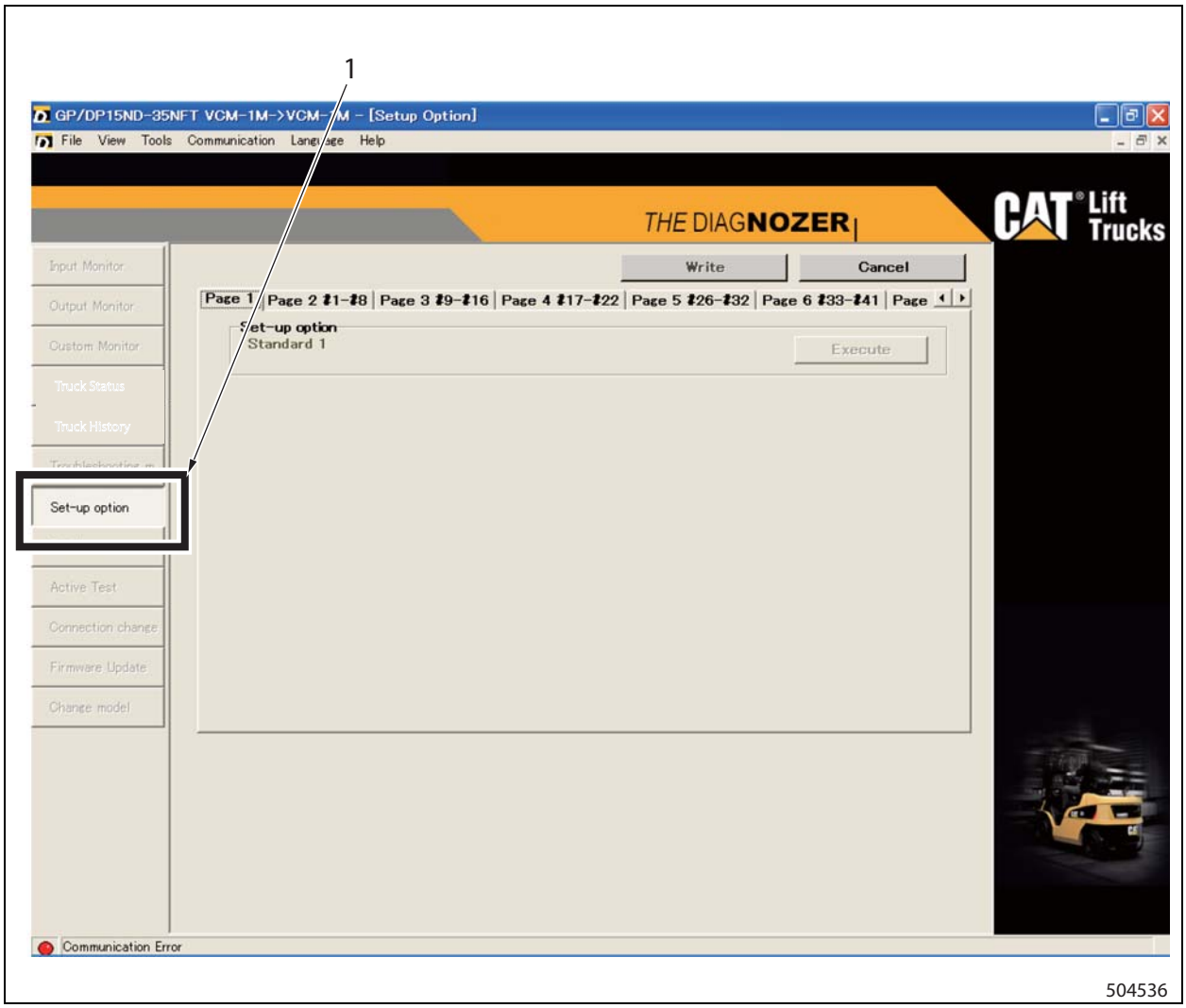
8. Harness Codes

Signal name	Wire number	Remark
Seat switch	610	0.5 Y
Seatbelt Switch	609	0.5 G/W
Seat switch GND	966	0.5 B
Parking Brake Switch N.C	373	0.5 W/L
Parking Brake Switch N.O	349	0.5 L
Parking brake switch GND	949	0.5 B
FNR Direction Lever 1	125	0.5 G/W
FNR Direction Lever 2	921	0.5 B
FNR Direction Lever 3	611	0.5 B/R
FNR Direction Lever 4	922	0.5 B
FNR Direction Lever 5	461	0.5 L/W
Speed Sensor +	702	0.5 G
Speed Sensor -	703	0.5 G/B
Forward solenoid	670	0.5 W
Forward Solenoid RET	672	0.5 R/B
Shift solenoid		
Shift solenoid RET		
Backward Solenoid	671	0.5 Y
Backward Solenoid RET	673	0.5 G
Unload solenoid	630	0.5 R/W
Unload Solenoid RET	631	0.5 G/W
Lift Lock Solenoid	628	0.5 L/Y
Lift Lock Solenoid RET	629	0.5 G/W
Warning buzzer	371(625)	0.5 Y
Warning Buzzer +12V	370	0.5 G
Warning Buzzer Relay Contact a	373	0.5 W/L
Warning Buzzer Relay Contact c	371	0.5 Y
Warning Buzzer Relay +12V	372	0.5 L/Y
Warning Buzzer Relay 0V	906	0.5 B

Diagnostic code	Diagnostic code name	Probable cause	Check items
F-12	Attachment 1 lever neutral warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Attachment 2 lever bad	3. Lever connection check
		4. Controller bad	
F-13	Attachment 2 lever neutral warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Attachment 3 lever bad	3. Lever connection check
		4. Controller bad	
F-14	Attachment 3 lever neutral warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Attachment 3 lever bad	3. Lever connection check
		4. Controller bad	
F-16	Shift lever warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Shift lever bad	3. Shift lever check
		4. Controller bad	
F-17	Vehicle speed warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Vehicle speed sensor bad	3. Sensor connection check
		4. Controller bad	
F-30	Oil pressure sensor main warning	1.VCM bad	1.VCM check
F-31	Sensor voltage warning	1. Wheel angle sensor bad	1. Wheel angle sensor check
		2. VCM bad	2. VCM check
		3. Harness bad	3. Harness connection check
F-34	Vehicle speed sensor warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Vehicle speed sensor bad	3. Sensor connection check
		4. Controller bad	
F-36	Wheel angle sensor warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Wheel angle sensor bad	3. Sensor connection check
		4. Joint and link bad	4. Joint and link check
		5. Controller bad	

Set-up option

Click the Set-up option button from the menu or toolbox to display the setup option screen in the main window. In the setup option screen, you can monitor the current setup values, or you can rewrite the setup values. Click the Write button to save your changes.



1. Set-up option button

8. Harness Codes

Signal name	Wire number	Remark
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FNR Direction Lever 1	125	0.5 G/W
FNR Direction Lever 2	921	0.5 B
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FNR Direction Lever 4	922	0.5 B
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Speed Sensor +	702	0.5 G
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Forward solenoid	670	0.5 W
Forward Solenoid RET	672	0.5 R/B
Shift solenoid		
Shift solenoid RET		
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Backward Solenoid RET	673	0.5 G
Unload solenoid	630	0.5 R/W
Unload Solenoid RET	631	0.5 G/W
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Warning buzzer	371(625)	0.5 Y
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		4. Controller bad	
F-14	Attachment 3 lever neutral warning	1. Connector contact bad	1. Connector connection check
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		3. Attachment 3 lever bad	3. Lever connection check
		4. Controller bad	
F-16	Shift lever warning	1. Connector contact bad	1. Connector connection check
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F-17	Vehicle speed warning	1. Connector contact bad	1. Connector connection check
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		3. Vehicle speed sensor bad	3. Sensor connection check
		4. Controller bad	
F-30	Oil pressure sensor main warning	1.VCM bad	1.VCM check
F-31	Sensor voltage warning	1. Wheel angle sensor bad	1. Wheel angle sensor check
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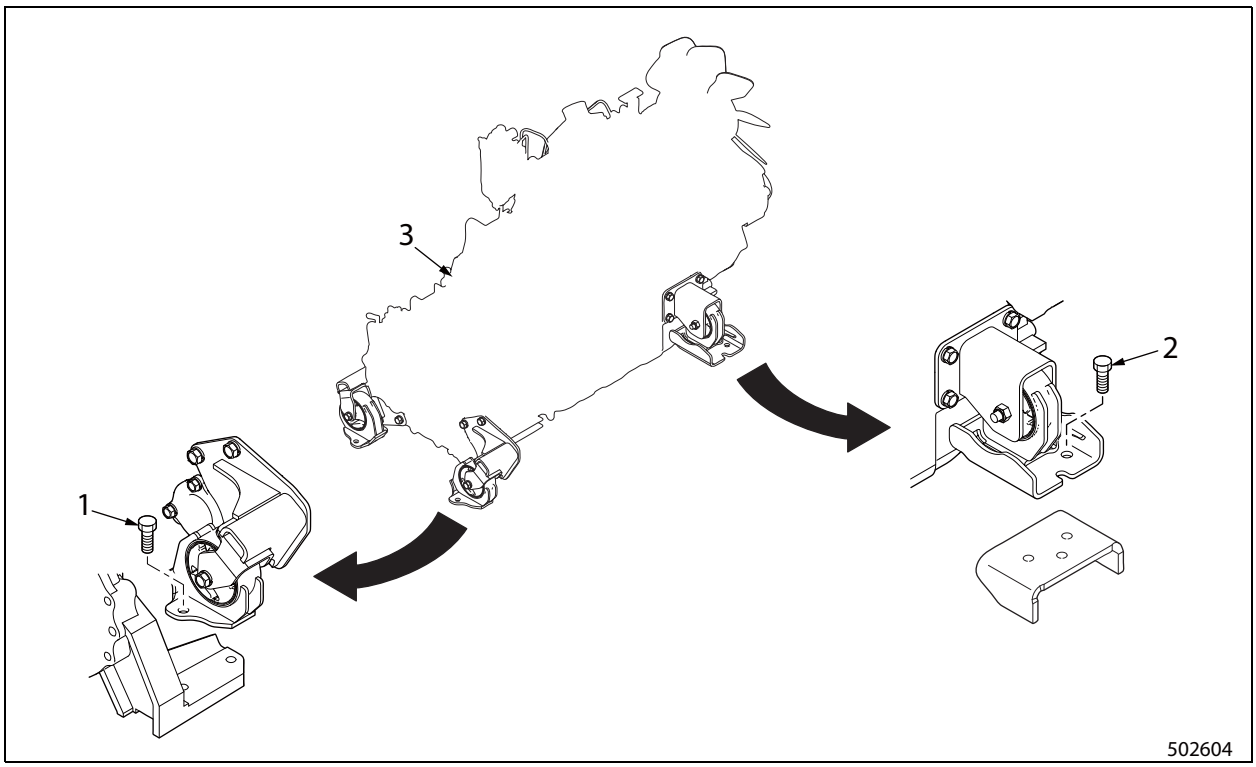
		4. Controller bad	
F-36	Wheel angle sensor warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Wheel angle sensor bad	3. Sensor connection check
		4. Joint and link bad	4. Joint and link check
		5. Controller bad	

2.12 Preparation for Removing Engine and Transmission Assembly

Lift the engine and transmission assembly with a hoist and slings.

Item	Weight
Engine and transmission assembly	Approx. 350kg (771.6 lb.)

2.13 Removal Sequence of Engine and Transmission Assembly



1. Transmission mounting bolt
2. Engine mounting bolt
3. Engine and transmission assembly

2.14 Suggestions for Removing Engine and Transmission Assembly

(1) To remove mounting bolts, lift the engine and transmission assembly high enough to lighten the weight from the mount cushions. Remove the engine mounting bolts of engine mounting.

(2) Hitch slings to the three hooks, slowly lift the engine and transmission assembly by moving it backwards while maintaining its balance.

Note:

- With the engine and transmission assembly suspended, drain the transmission oil and clutch oil.
- Only one drain plug is provided on the powershift transmission.

2.15 Suggestions for Installing Engine and Transmission Assembly

This section describes only removal and installation procedures specific to diesel engine trucks. Follow the instructions for the gasoline engine trucks in the preceding sections for the common procedures.

Difference from the gasoline engine truck

Connect the accelerator pedal linkage on the floor plate to the throttle cable. Check that the injection pump lever is at the full-open position when the accelerator pedal is fully pressed.

Air bleeder valve

- Check the air bleeder valve for damaged or deformed seat. Replace if defective.
- Check the air bleeder valve cap. Replace the air bleeder valve if a significant crack or deterioration is observed.

Push rod

- Check the push rod for bending and deformation. Replace if defective.

Boot

- Check the boot for cracks, damage and tears. Replace if defective.
- Check the boot for interference with the cylinder and push rod. Replace the boot if it has no or little interference.

13. Clutch Release Cylinder, Assembling

For assembly, follow the disassembly sequence in reverse.

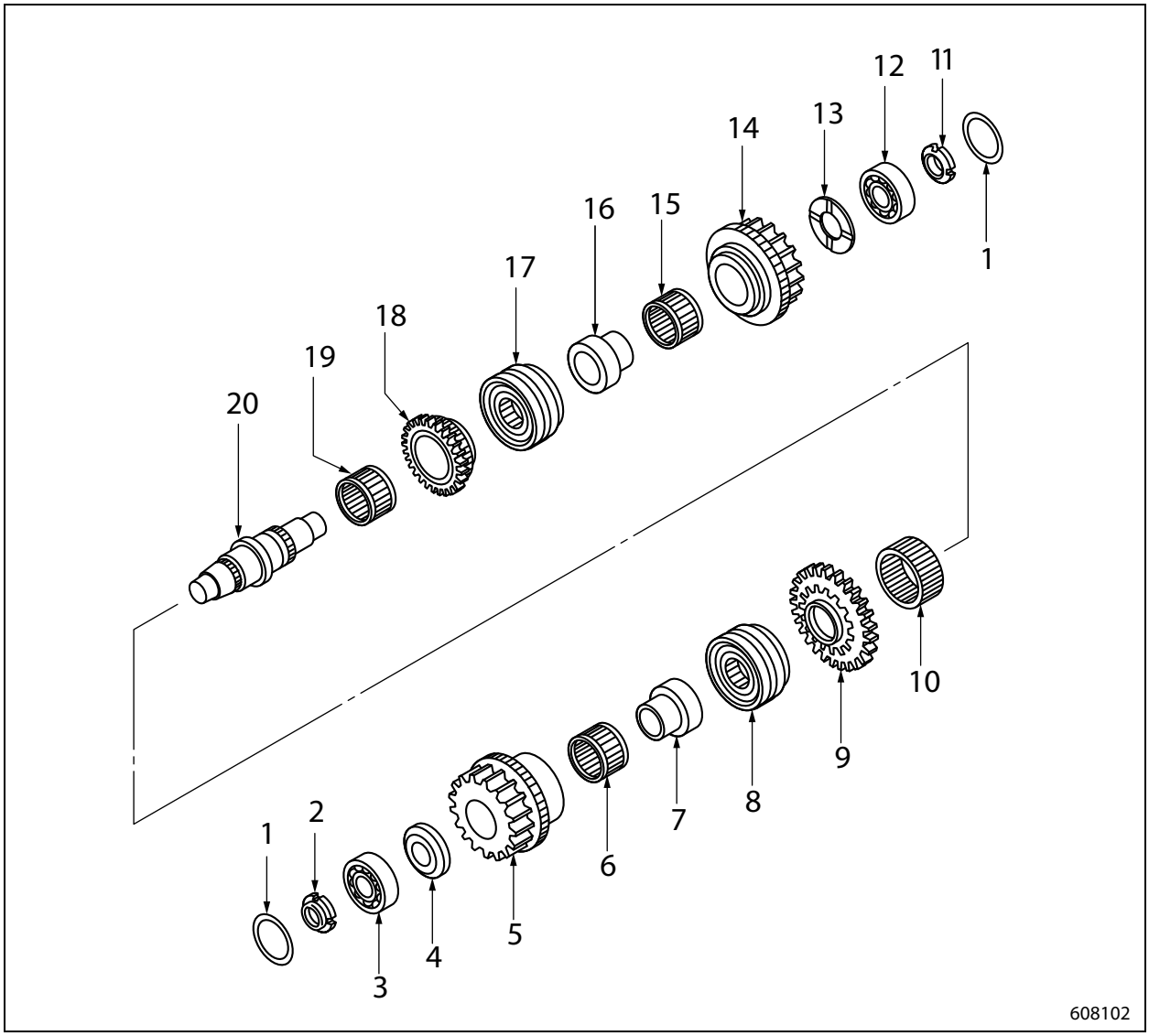
13.1 Suggestions for Assembly

- Clean metal parts with a volatile metal cleaning fluid and blow off the fluid completely with compressed air.
- Apply a thin coat of rubber grease (METAL RUBBER #20) or brake oil to the inside surface of cylinder body and the peripheral surface of piston cups. When applying grease, be careful, as the piston seal will swell up if exposed to mineral oil.
- Use care not to allow foreign matter to enter the cylinder body. Also be careful not to damage the cylinder body and the lip of piston cup.
- Tighten the following parts to the specified torque.

Item	Tightening torque
Air bleeder valve	7 to 9N·m (0.7 to 0.9 kgf·m) [5.16 to 6.64 lbf·ft]
Locknut	15 to 17N·m (1.5 to 1.7 kgf·m) [11.06 to 12.54 lbf·ft]

8. Synchro-shaft Assembly, Disassembly

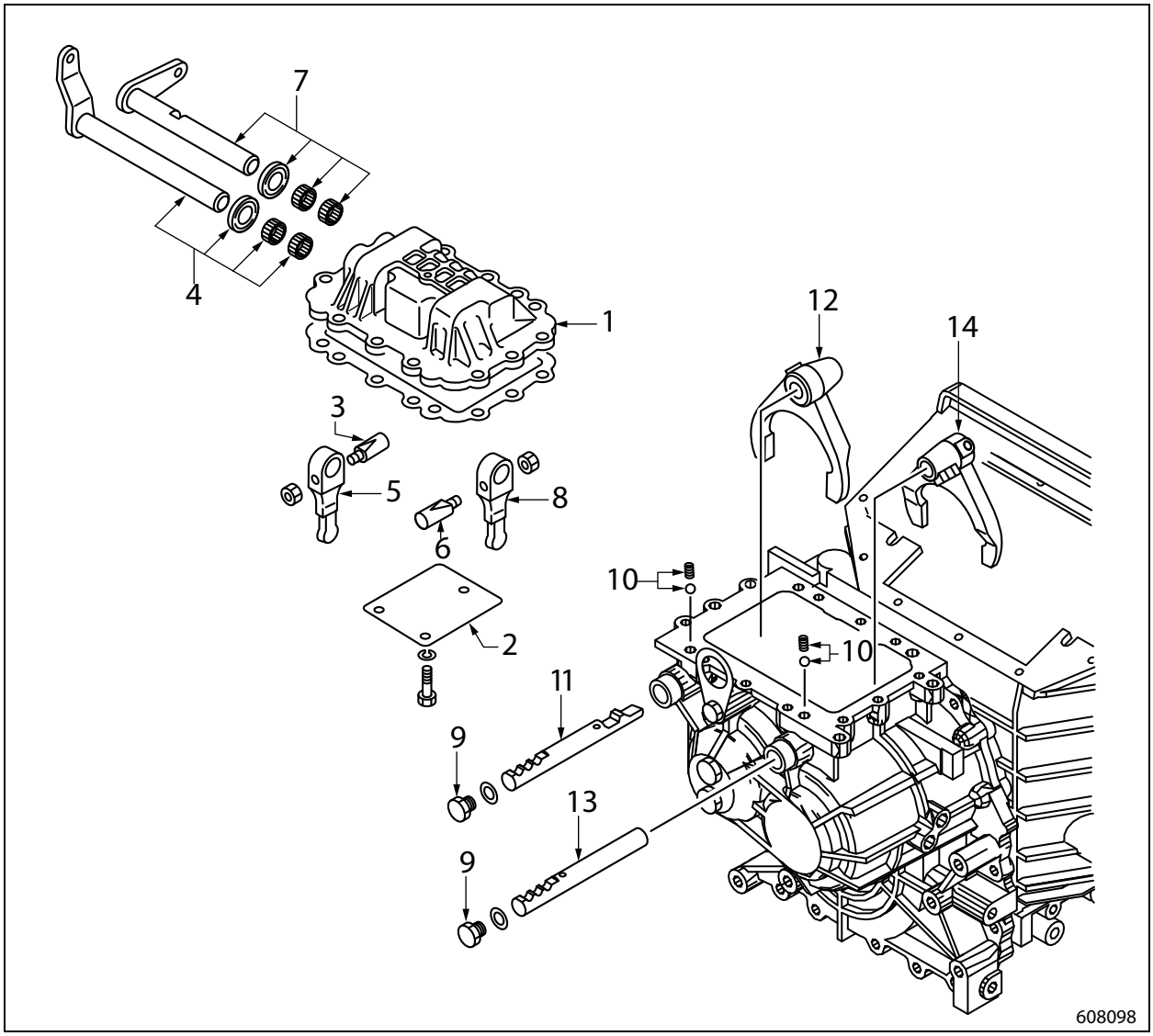
8.1 Disassembly Sequence



1. Shim
2. Nut
3. Roller bearing
4. Thrust washer
5. High gear
6. Needle roller bearing
7. Synchro-sleeve
8. Synchromesh assembly (H-L)
9. Low gear
10. Needle roller bearing
11. Nut
12. Roller bearing
13. Thrust washer
14. Forward gear
15. Needle roller bearing
16. Synchro-sleeve
17. Synchromesh assembly (F-R)
18. Reverse gear
19. Needle roller bearing
20. Main shaft

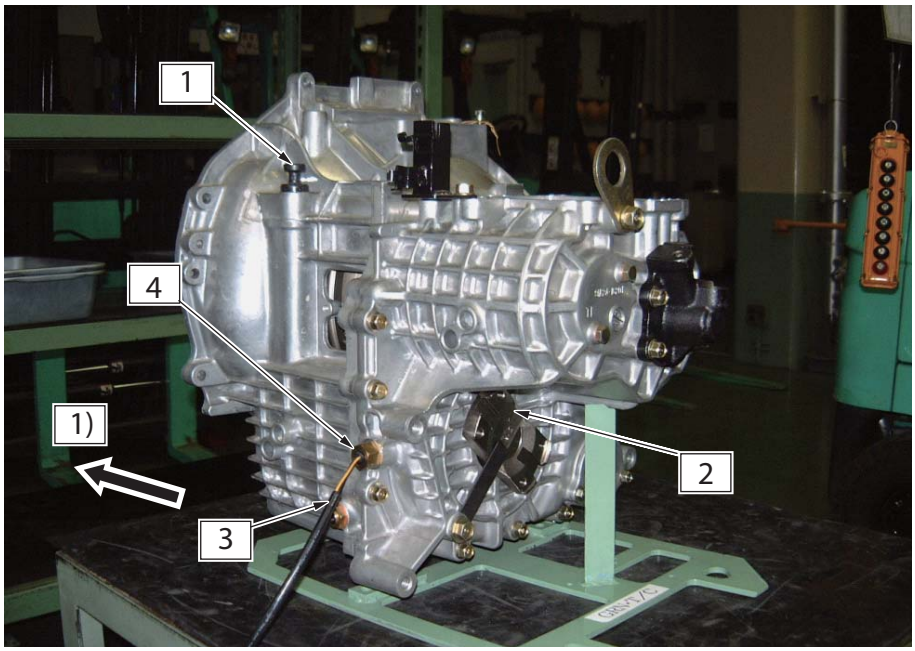
5. Control Covers, Shift Rails and Forks, Disassembly

5.1 Disassembly Sequence



1. Control cover
2. Control cover plate, Bolts, Washers
3. Lock pin, Nut
4. Control lever, Needle roller bearing, Oil Seal
5. Fork lever
6. Lock pin, Nut
7. Control lever, Needle roller bearing, Oil Seal
8. Fork lever
9. Plug, Gasket
10. Spring and Steel ball
11. Shift Rail (F-R)
12. Shift fork (F-R)
13. Shift rail (H-L)
14. Shift fork (H-L)

Right side view

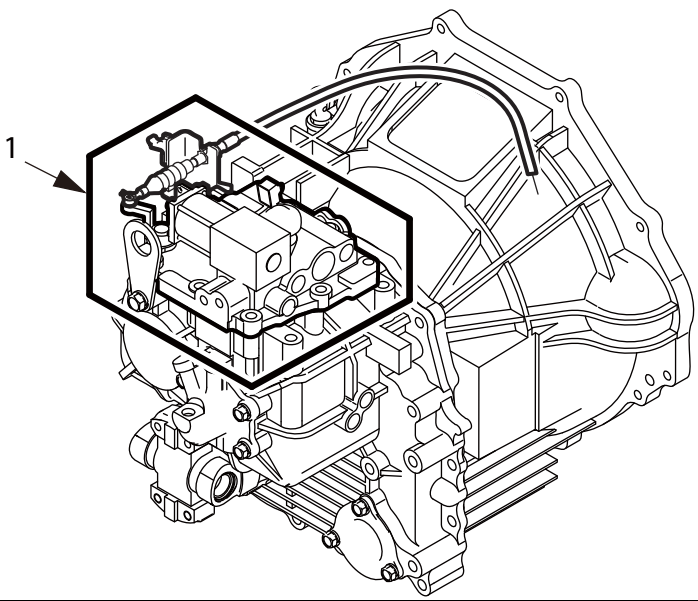


502262

1. Oil level gauge
2. Output flange
3. Thermoswitch
4. Vehicle speed sensor

1) Engine side

1.2 External View of Control Valve

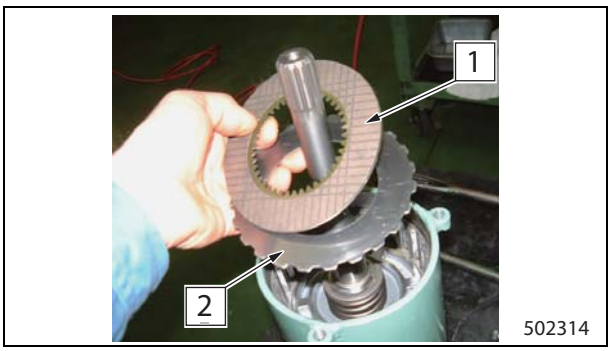


502263

1. Control valve

(2) Remove one pressure plate, one belleville spring, six mating plates and five friction plates.

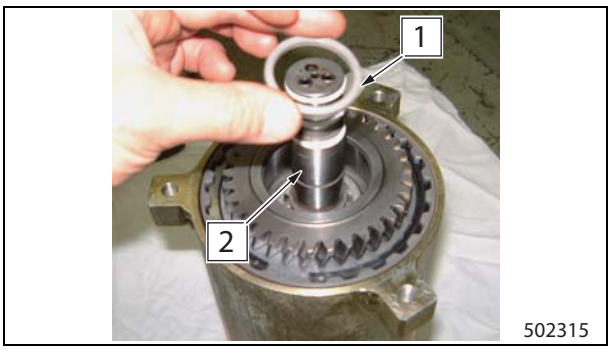
Note: Take note of the sequence of all plates as you remove.



1. Friction plate 2. Mating plate

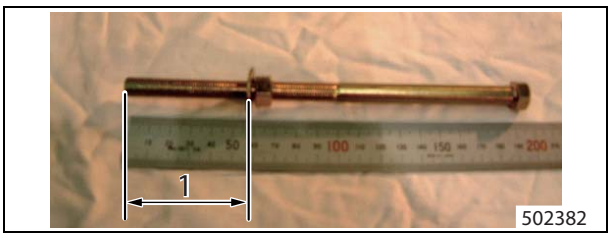
(3) Remove spacer.

Note: The old type does not have the spacer. Make sure if it has the spacer or not when disassembling.



1. Spacer 2. Input shaft

(4) Using clutch pack stand kit (special tool), compress clutch spring together with spring retainer and remove snapring.



1. 60 mm (2.36 in.) or more

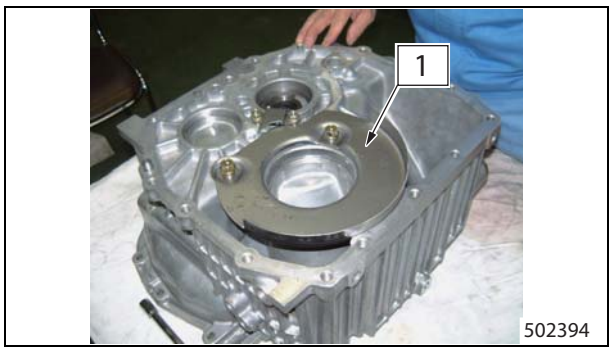
Special tool		Part number
Clutch pack stand kit		91A68-00010
Clutch pack stand kit components	Stand	91A68-01300
	Plate 1	91A68-01400
	Plate 2	91A68-01500
	Bolt	67284-15400

⚠ CAUTION

Exposed thread of the bolt under the nut should be 60 mm (2.36 in.) or more.

Baffle plate, Installing

Install the baffle plate with 2 bolts.



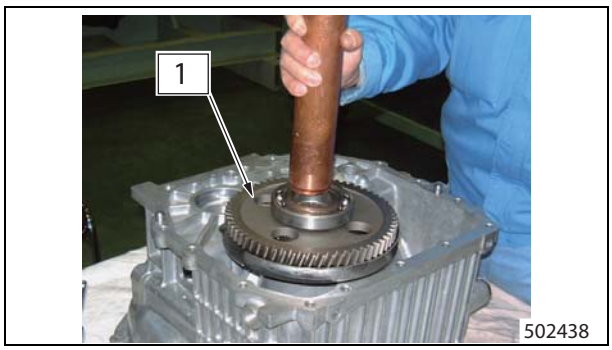
1. Baffle plate

Output gear assembly, Installing

(1) Place the torque converter housing with its torque converter assembly mounting surface facing down.

(2) Install output gear assembly to torque converter housing.

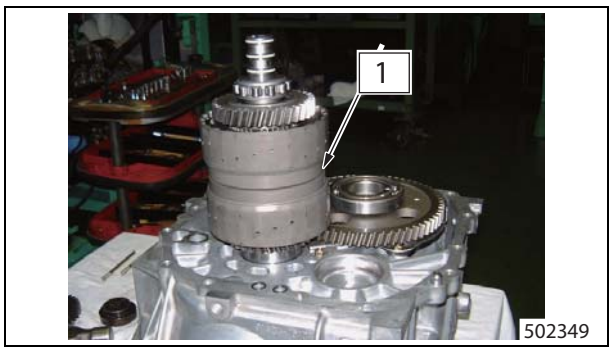
Note: The large protruding side should be positioned on the torque converter housing bottom side.



1. Output gear assembly

Input shaft gear assembly and idler gear assembly, Installing

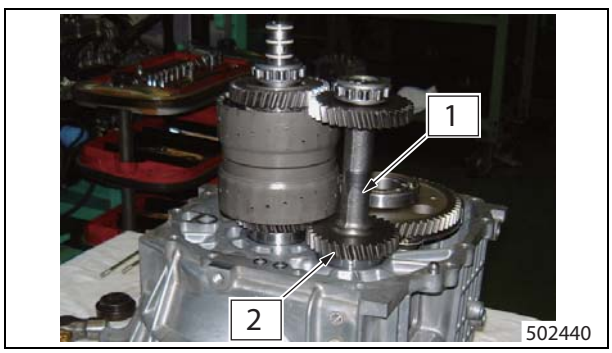
(1) Tentatively install input shaft gear assembly.



1. Input shaft gear assembly

(2) Tentatively install idler gear assembly.

Note: The gear having 30 teeth should be on the torque converter housing side and the gear having 32 teeth is on the transmission housing side.

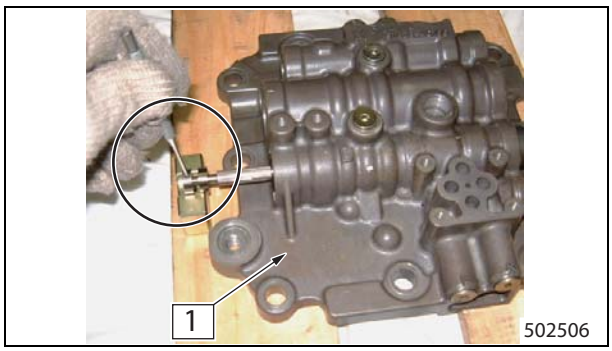


1. Idler gear assembly 2. Z = 30

Inching rod plate, Installing

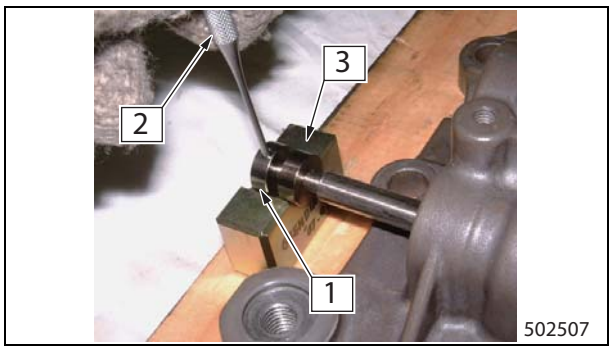
(1) Remove valve body from vise and lay on a wooden board.

(2) Apply oil to inching rod and install two inching rod plates.



1. Valve body

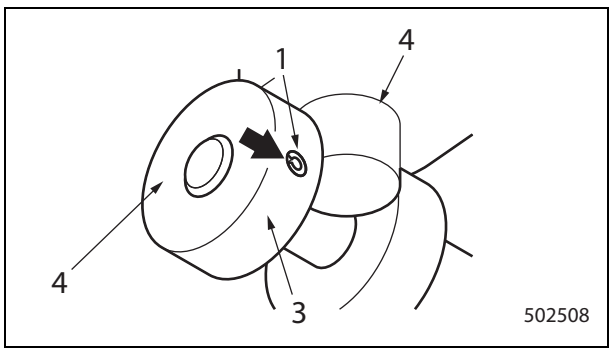
(3) Place the stand (special tool) under outer inching rod plate and install spring pin.



1. Inching rod plate
2. Pin
3. Special tool (Stand)

Note: Be sure to use the special tool when installing the

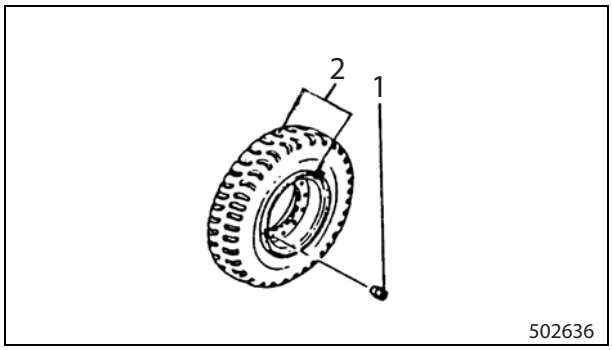
- Be sure to use the special tool when installing the spring pin. Failure to do so may cause damage to the inching rod and valve body.
- When installing spring pin, orient the pin so that its notch faces to the end of inching rod.



1. Spring pin
2. Inching rod end
3. Inching rod plate
4. Inching lever

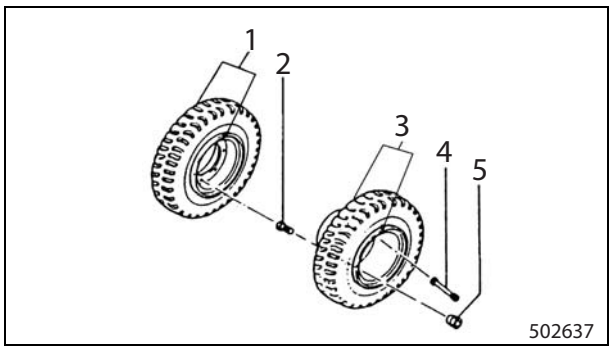
3.2 Removal Sequence

Single wheels



1. Wheel nuts
2. Front wheels

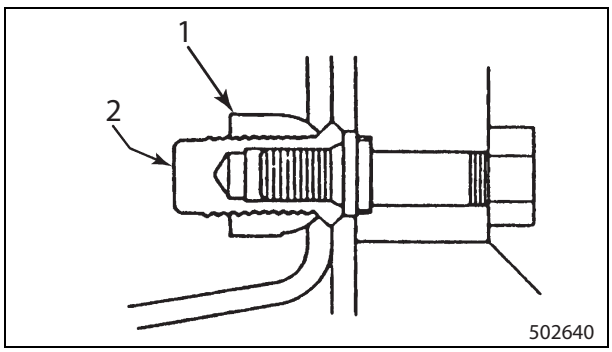
Double wheels



1. Front wheels (inner)
2. Inner wheel nuts
3. Front wheels (outer)
4. Extension valves
5. Outer wheel nuts

3.3 Suggestions for Removal

For double wheels, remove the outer wheel nuts first, then remove inner wheel nuts.



1. Outer wheel nut
2. Inner wheel nut

4. Front Wheels, Installing

For installation, follow the removal sequence in reverse and observe the instructions below:

(1) Tighten the wheel nuts evenly to the specified torque so that the wheels will not wobble.

Item	Truck classifications	
	1 ton class	2, 3 ton class
Tightening torque	156.9 ± 15.7 N·m (1.60 kgf·m) [11.580 lbf·ft]	337.6 ± 37.8 N·m (34.43 ± 3.85 kgf·m) [249.001 ± 27.87 lbf·ft]

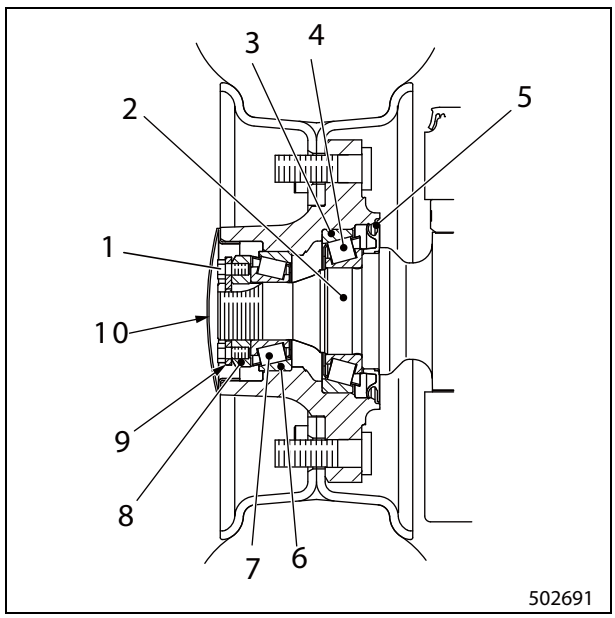
1.2 Specifications for Wheel Alignment and Steering Angle

No.	Item		Specified value		
			1 ton class	2 ton class	3 ton class
1)	Kingpin inclination angle		0°		
2)	Camber angle		0°		
3)	Caster angle		0°		
4)	Toe-in angle		0°		
5)	Maximum steering angle of inner wheel		82.2°	79.1°	
6)	Maximum steering angle of outer wheel		57.3°	55.0°	
7)	Distance between kingpins		728 mm (28.66 in.)	818 mm (32.20 in.)	
8)	Tread		900.5 mm (35.453 in.)	977.5 mm (38.484 in.)	980.5 mm (38.602 in.)
9)	Stroke		92.5 mm (3.642 in.)	87.5 mm (3.445 in.)	
10)	Wheel bolt size	2P	M14 x 1.5		
		4P	M14 x 1.5	M16 x 1.5	

Note: The steering angle is automatically determined by the stroke of the steering cylinder. It is not structured to be changed by adjustment.

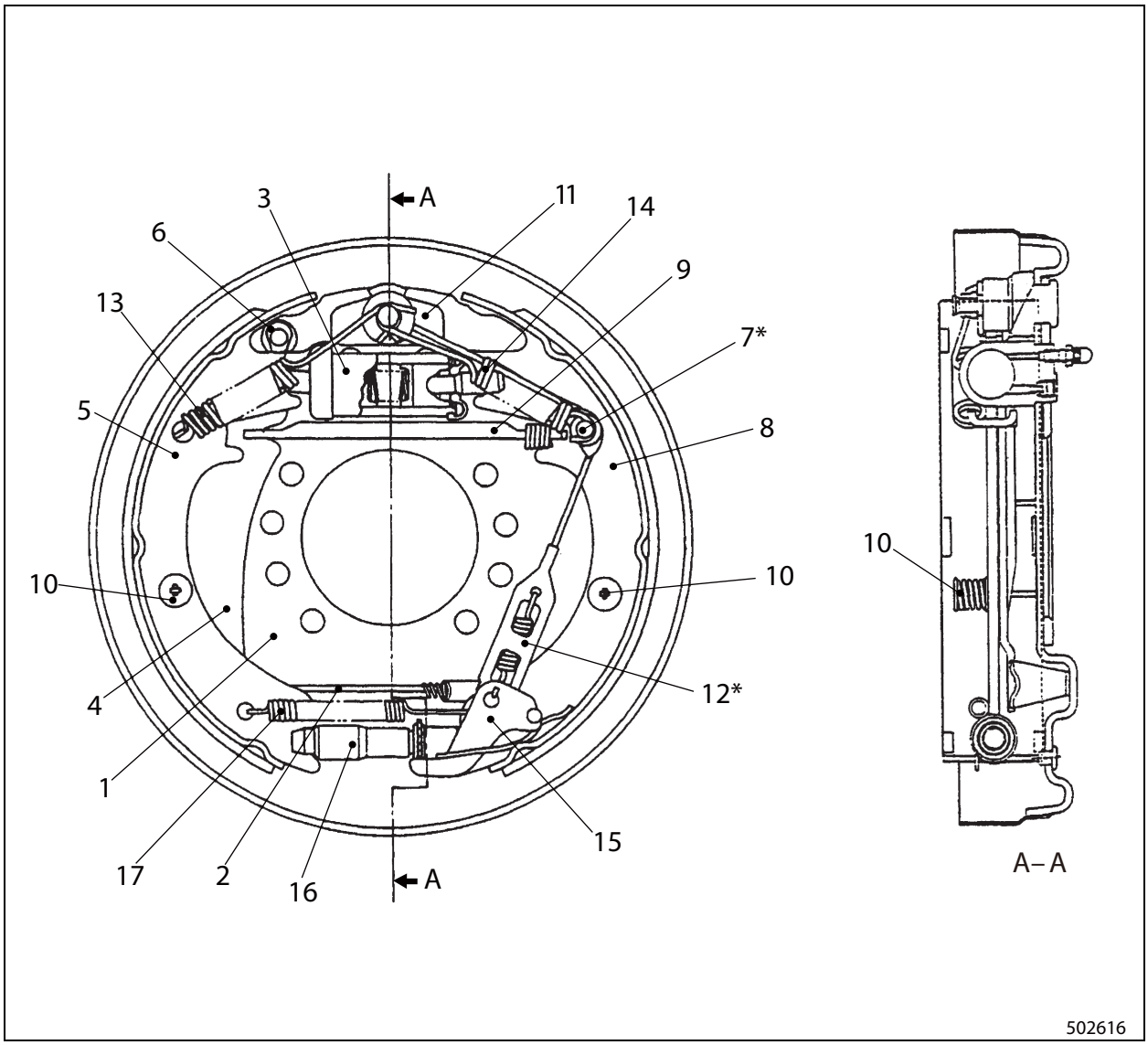
1.3 Wheel Hub Section, Main Components

Detail of wheel hub section



1. Bolt
2. Spindle of knuckle
3. Tapered roller bearing (outer race)
4. Tapered roller bearing (inner race)
5. Oil seal
6. Tapered roller bearing (outer race)
7. Tapered roller bearing (inner race)
8. Locknut (hexagon nut)
9. Lockplate
10. Hub cap

8.2 Assembly Sequence (2, 3 Ton Class)



1. Backing plate assembly
2. Parking brake cable, Snapring
3. Wheel cylinder
4. Parking brake lever
5. Primary shoe and lining assembly
6. Retainer, Washer
7. Pin, Sheave*, Washer
8. Secondary shoe and lining assembly
9. Strut, Anti-rattle spring
10. Pin, Hold-down spring, Cup
11. Shoe guide plate
12. Fitting link*
13. Return spring (primary)
14. Return spring (secondary)
15. Adjusting lever, Adjusting spring
16. Adjusting screw
17. Return spring
    (between primary shoe and secondary shoe)

Note: Assemble parts 4 thru 8 beforehand.
The parts marked with * are included in the repair kit.

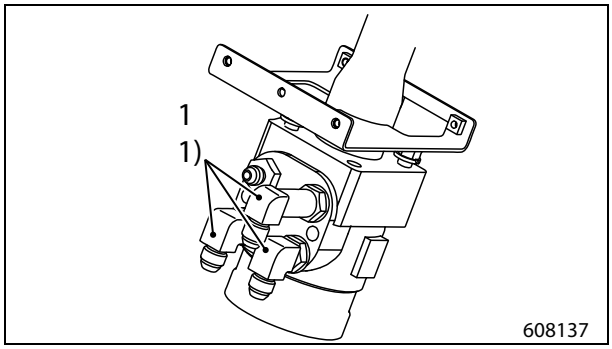
6. Steering Valve, Removing

(1) Remove the cover from the steering column.
(2) Disconnect four hoses from the steering valve.
(3) Remove bolts and remove the steering valve.

7. Steering Valve, Installing

For installation, follow the removal sequence in reverse and observe the instructions below:

(1) Apply grease to serrated portion at the lower part of the steering shaft.
(2) Tighten mounting bolts to the specified torque.
(3) Pay attention to the orientation when installing the elbow on the steering valve. Also be sure to tighten to the specified torque.

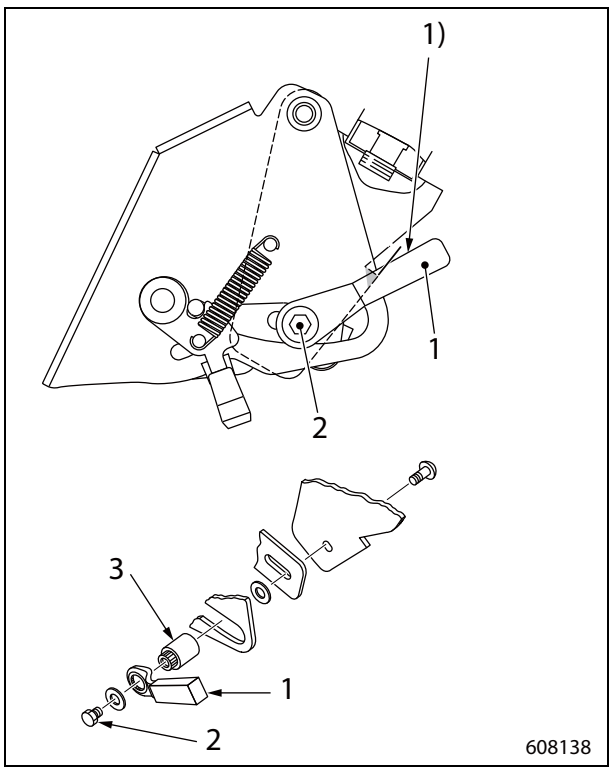


1. Elbow
1) Install the elbow facing downward

Ref.	Item	Tightening torque
1	Elbow	34 to 39 N·m (3.5 to 4.0 kgf·m) [25.08 to 28.76 lbf·ft]

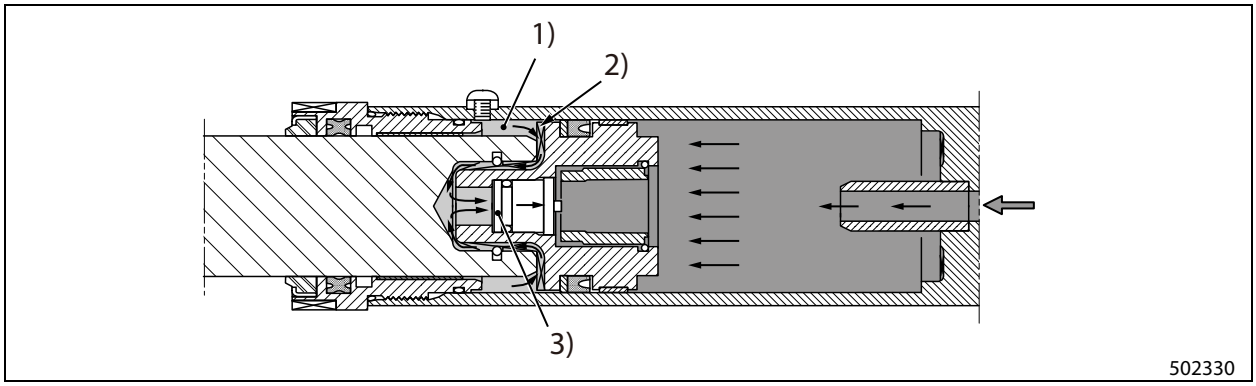
8. Tilt Lock Lever, Disassembling

(1) Make a matchmark across tilt lock lever and nut 3 for proper installation at assembly.
(2) Remove lever mounting bolt 2 and remove tilt lock lever.



1. Tilt lock lever
2. Lever mounting bolt
3. Nut
1) Lever face

Internal drain type lift cylinder

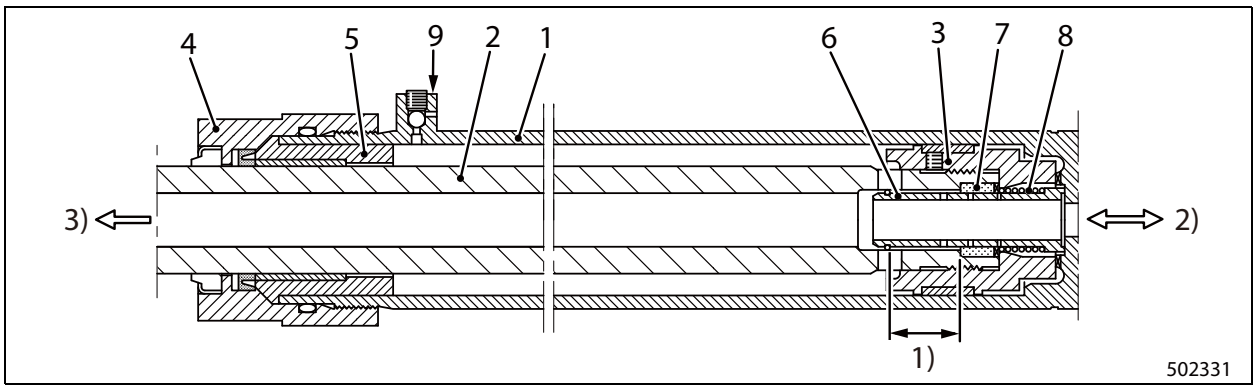


1) Trapped oil and air
(Normally this area is under slight negative pressure)
2) Groove
3) Check valve

The above figure shows the position of the piston rod assembly near the ascending stroke end. When oil or air, which is trapped inside the space between the rod and cylinder, exceeds the preset pressure of the check valve, the check valve is opened to release the oil or air (internal drain). On the lift cylinder with a return pipe, this area is connected to the hydraulic tank.

1.9 Lift Cylinder (Second Lift Cylinder for Duplex Mast)

Main Components



1. Cylinder tube
2. Rod
3. Piston
4. Holder
5. Cylinder head
6. Cushion spool
7. Check valve
8. Spring
9. Bleed valve

1) Cushion stroke: 21mm (0.83 in.)
2) Inflow, outflow
3) To first cylinder

Operation

Pressure oil first flows through the hollow area inside piston rod 2 and enters the first lift cylinder. Because the inside diameter of first lift cylinder is greater than that of second lift cylinder, the first lift cylinder ascends first. The second lift cylinder starts to ascend after the first lift cylinder ascent has been completed.

This cylinder is provided with a cushion mechanism which prevents the piston bottom from collision to the cylinder bottom during piston descent.

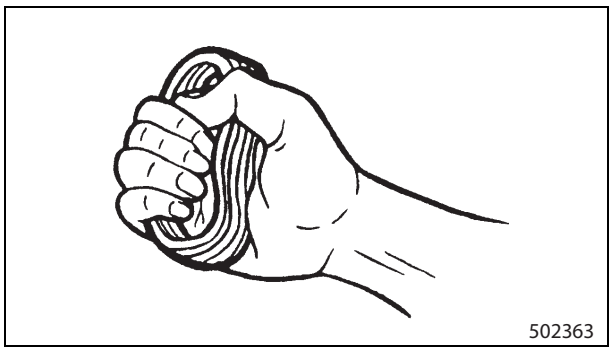
The bleed valve 9 is a valve for bleeding air out of the hydraulic system after the system is overhauled.

24.2 Suggestions for Assembly

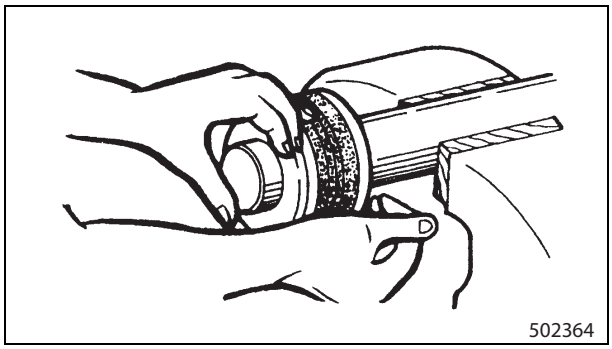
(1) Before assembly, thoroughly clean each part and make sure that they are free from foreign materials such as dust.
(2) Reassemble the cylinder in the reverse order of the disassembly. Apply hydraulic oil to O-rings, piston seals, dust seals, packings, and the bore surface of the cylinder tube before assembly. Also, pay attention to the installation orientation.
(3) When holding the cylinder tube in a vise, be careful not to distort the tube.
(4) Parts marked with * are seal kit parts.
Replace seal kit parts with new ones.

Installing piston seal

(1) Before fitting the inner piston seal, softly twist it by hand five or six times to soften it.


502363

(2) Secure the piston in a vise, while making sure not to damage any part of the piston, and then apply a thin coat of hydraulic oil to the piston seal. Fit half of the seal into the piston groove, and then press the other half into the groove.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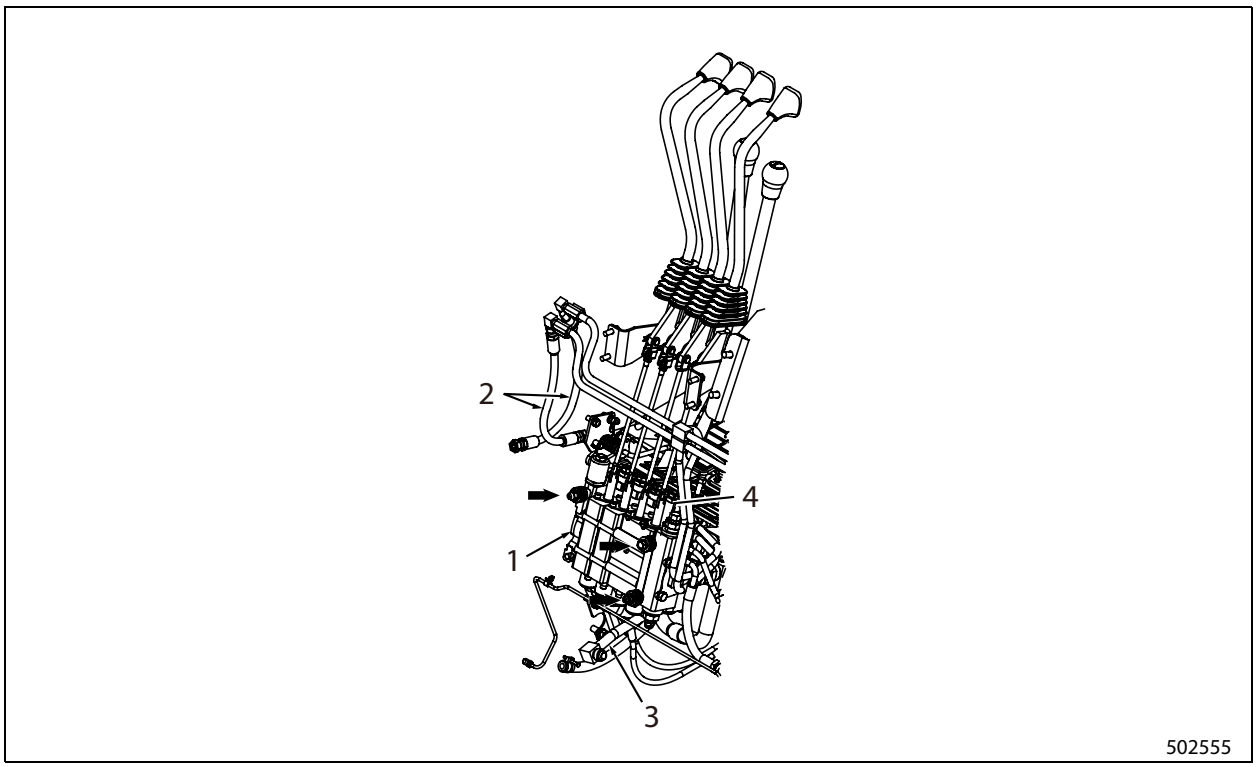
33. Control Valve, Removing



1. Control valve
2. Tilt hose
3. Lift hose
4. Clevis pin

33.1 Removal Sequence

(1) Remove the floor plate.
(2) Remove the clevis pin of the control lever rod and separate the rod from the control valve spool.
(3) Disconnect each piping from the valve.
- Pump delivery hose
- Tilt pipe
- Lift pipe
- Return hose
- Supply pipe to steering valve
- Return hose from steering valve

(4) Remove valve mounting bolts and nuts (arrows in figure) and remove the valve.

34. Control Valve, Installing

For installation, follow the removal sequence in reverse.

34.1 Suggestions for Installation

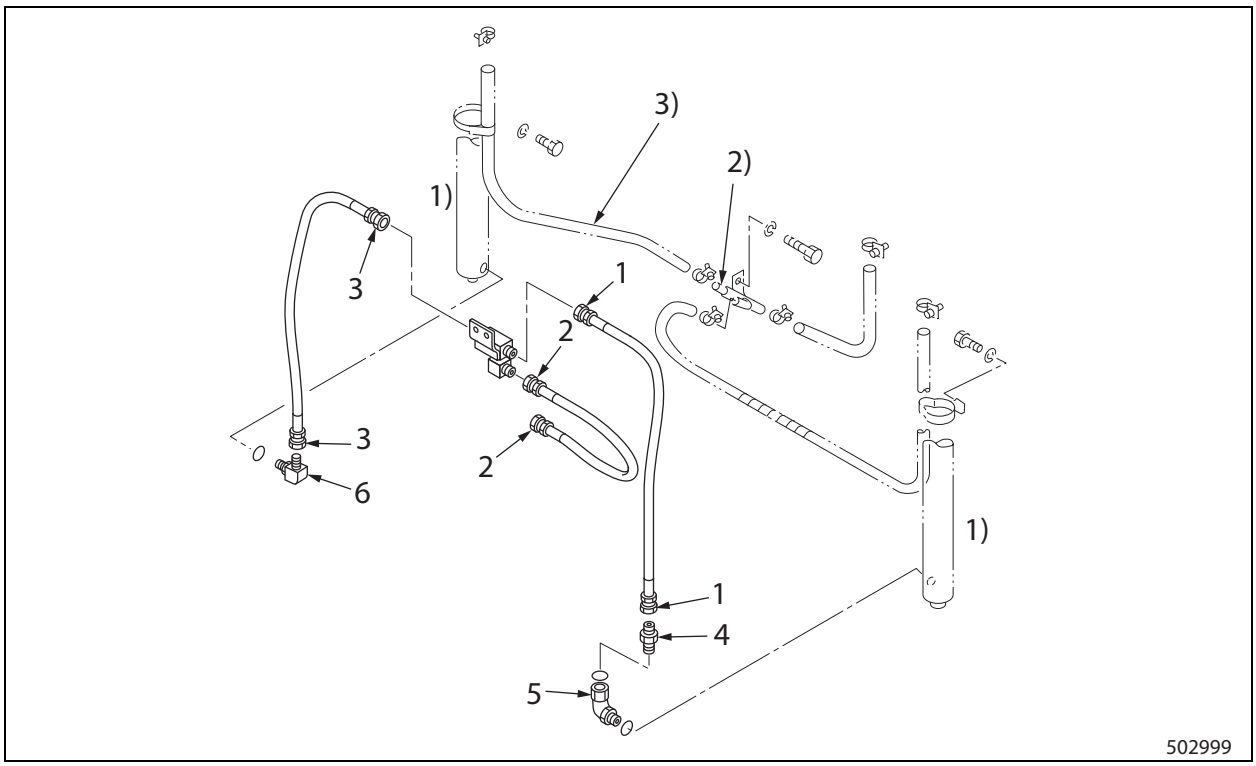
Check hydraulic oil level. Add oil up to the specified level if the level is low.

1.15 Installing Hydraulic Lines

General precautions

- Use care not to let abrasive dust or dirt to enter the hydraulic system during installation.
- Apply a coat of oil to O-rings before installation.
- Elbow connector 6 should be assembled with straight threads and O-ring seal observing the procedure 14-17 "Installation of a fitting with straight threads and O-ring seal".

Tightening torque



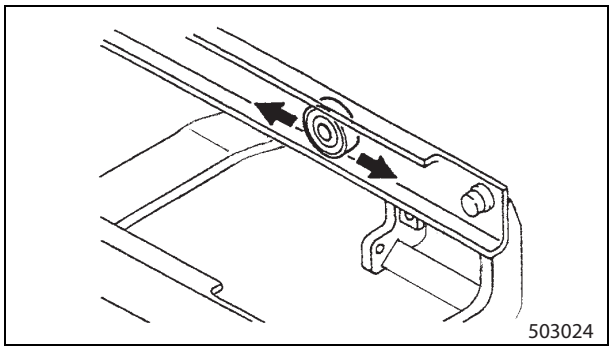
1) Lift cylinder
2) Return line connector
3) Return hose
(equipped on masts having 3.5 mm or above lifting height.)

Item		Specified value	
		1,2 ton classes	3 ton class
1	Nut	49.0 ± 4.9 N·m (5.00 ± 0.49 kgf·m) [36.141 ± 3.61 lbf·ft]	58.8 ± 5.9 N·m (6.00 ± 0.60 kgf·m) [43.369 ± 4.35 lbf·ft]
2	Nut	58.8 ± 5.9 N·m (6.00 ± 0.60 kgf·m) [43.369 ± 4.35 lbf·ft]	
3	Nut	49.0 ± 4.9 N·m (5.00 ± 0.49 kgf·m) [36.141 ± 3.61 lbf·ft]	
4	Nut	39.2 ± 3.9 N·m (4.00 ± 0.39 kgf·m) [28.912 ± 2.87 lbf·ft]	
5	Nut	39.2 ± 3.9 N·m (4.00 ± 0.39 kgf·m) [28.912 ± 2.87 lbf·ft]	
6	Nut	39.2 ± 3.9 N·m (4.00 ± 0.39 kgf·m) [28.912 ± 2.87 lbf·ft]	

2.9 Mast and Lift Bracket, Inspection (All Mast Models)

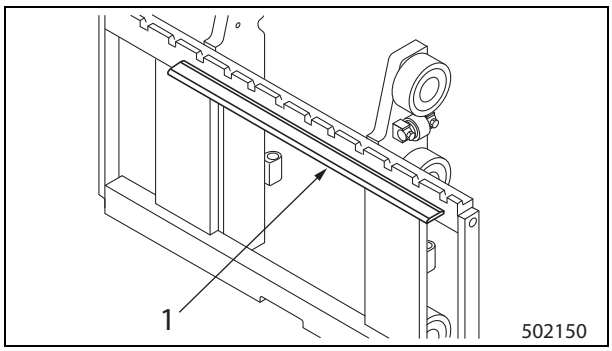
Mast

(1) Check each roller for binding, wear, and cracks.
(2) Check each roller on rolling surface for pitting or other defects.
(3) Check the mast member and the welded joints of cross-members, shafts and supports for cracks.
(4) Check the mast support bushings for wear or other defects.



Lift bracket

(1) Check the main rollers and side rollers for binding, wear, and cracks.
(2) Check the welded areas of lift bracket for cracks.
(3) Check the finger bar for bend or distortion.



1. Straight edge

Item	Standard
Distortion of finger bar	5 mm (0.20 in.) or less

Lift chains, chain wheels and chain wheel supports

(1) Measure the length of each chain to make sure that the two chains are equal in length. Also check the chains for wear, indication of breakage and link binding and twisting.
(2) Check each chain anchor bolt for cracks or thread damage.
(3) Check the chain wheel support and the chain wheel for cracks, wear, and binding.

Item		Specified value		
		1 ton class	2 ton class	3 ton class
Chain length (20 links)	Standard	317.5 mm (12.500 in.)	381 mm (15.00 in.)	508 mm (20.00 in.)
	Limit	327 mm (12.87 in.)	392 mm (15.43 in.)	523 mm (20.59 in.)

Mast strip

Check for damage, scoring, or distortion.

3. Triplex Mast

3.1 Mast System

The following table shows a combination of truck and mast models:

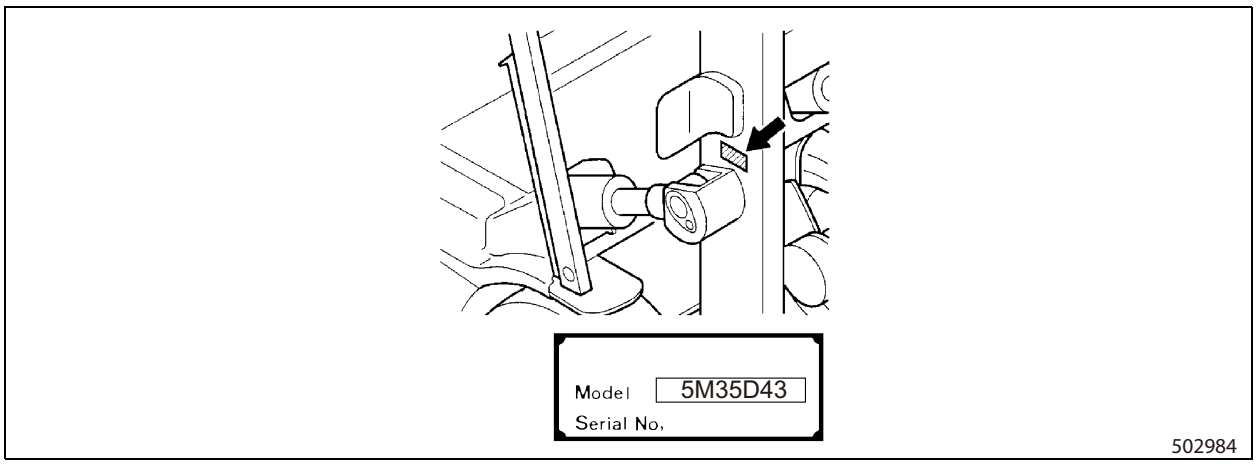
Truck classifications	Mast
1 ton class	5M15D□□
	5M20D□□
2 ton class	5M25D□□
3 ton class	5M30D□□
	5M35D□□

Note: "□□" presents maximum lift height. Example: 43 = 4300 mm (169.29 in.) lift height

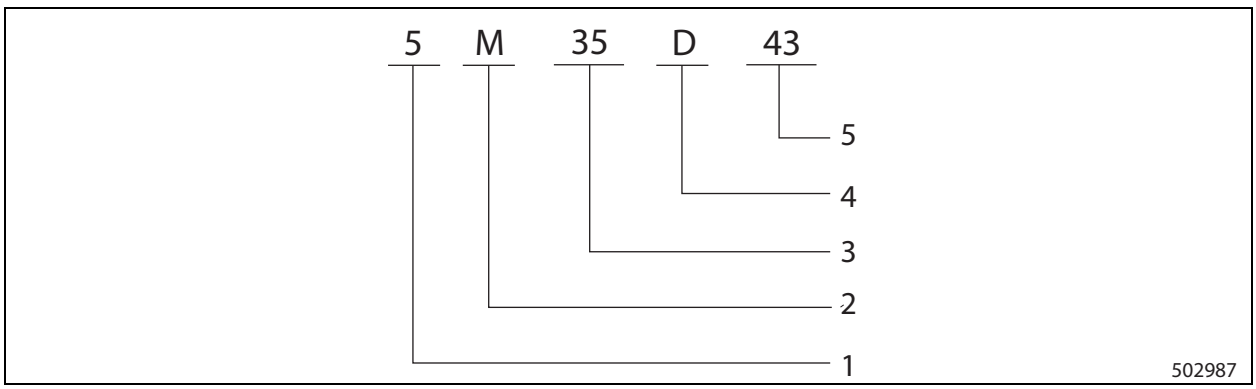
Mast type and code

Code	Mast
M	Triplex mast

Mast serial number location



How to read mast model code

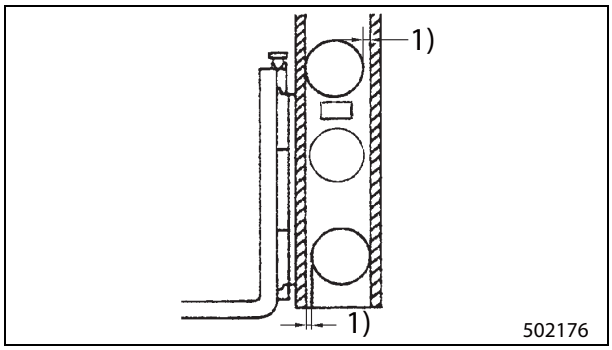


1. Truck generation (2➡3➡4···9)
2. Indicates mast type
3. Applicable truck class (Example: 3.5 ton)
4. Mast generation (A➡B➡C···Z)
5. Maximum lift height (43: 4300 mm (169.29 in.))

3.23 Adjusting Clearance Between Lift Bracket Roller and Inner Mast (All Mast Models)

Measuring back-to-front clearance on lift bracket main rollers

(1) Slightly lift the forks off the ground.
(2) Insert a claw bar between the upper part of the lift bracket and the inner mast, push the inner mast to either side. Measure the clearance between the main roller and the inner mast on the opposite side with a feeler gauge.
(3) If the clearance deviates from the specified value, replace with oversize roller.
For replacement, refer to 14-74 "Selecting roller of correct outer diameter".

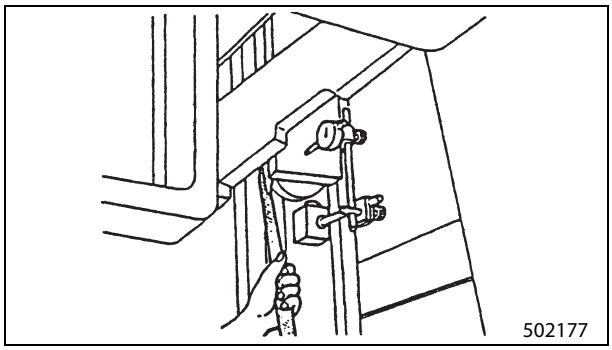


1. Clearance between main roller rolling face and inner mast

Ref.	Item	Standard
1)	Clearance between main roller rolling face and inner mast	1.0 mm (0.039 in.) or less

Measuring right-to-left clearance on lift bracket main rollers and side rollers

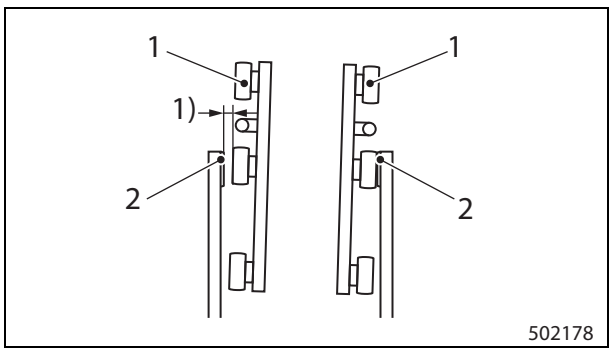
(1) Raise the lift bracket to the inner mast uppermost position.
(2) Set a dial indicator on the inner mast with its contact point rested on the side of the lift bracket.
(3) Go over to the opposite side of the mast, and slide the lift bracket to one side with a bar. Set the indicator to zero.
(4) Insert a claw bar between the inner mast and lift bracket on the dial indicator side, and push the lift bracket to the opposite side.



(5) Measure the clearance between lift bracket middle roller and thrust plate. Adjust shim thickness as required.

Note: The upper rollers do not require any measurement and adjustment.

For adjustment, refer to 14-75 "Adjusting clearance between middle roller side face and thrust plate".



1. Upper roller
2. Thrust plate

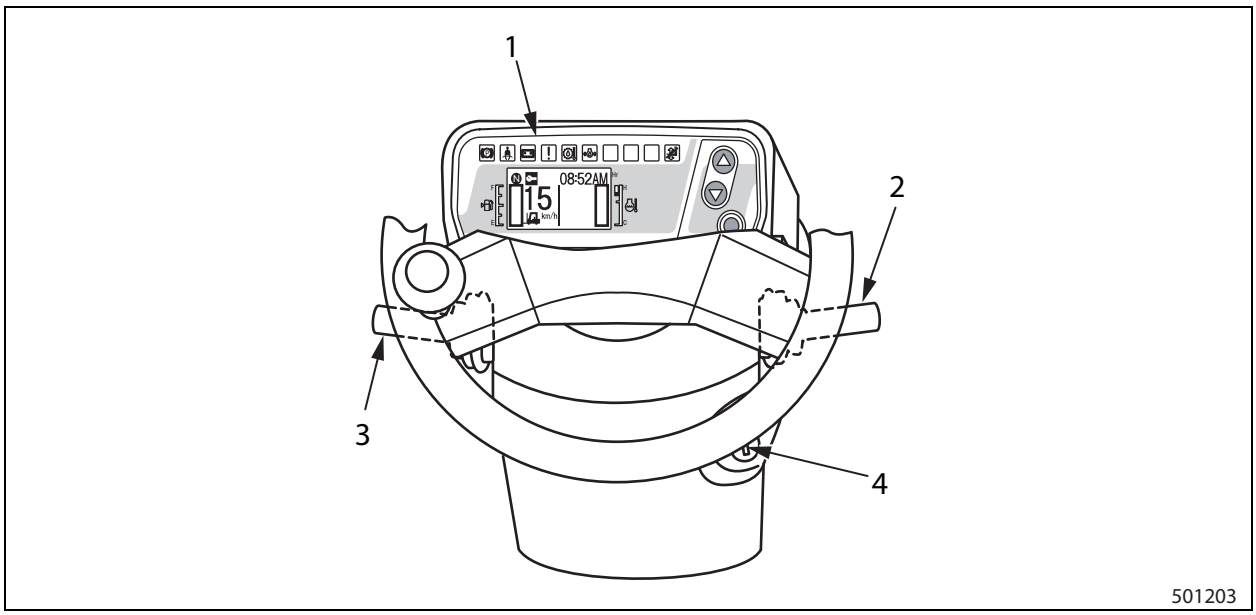
1) Clearance between middle roller side face and inner mast thrust plate

Ref.	Item	Standard
1)	Clearance between middle roller side face and inner mast thrust plate	0.1 to 0.5 mm (0.004 to 0.020 in.)

Item			Specified value		
			2C ton class	2ton class	2ton class
			Diesel		Gasoline
Alternator drive belt deflection-when pushed inward with 98 N (10.0 kgf) [22.03 lbf] pressure			10 to 12 mm (0.39 to 0.47 in.)		11 to 13 mm (0.43 to 0.51 in.)
Spark plug type			-		FR2A-D
Spark plug gap			-		0.8 to 0.9 mm (0.032 to 0.035 in.)
Engine idling speed			750 mm (29.53 in.)		700 mm (27.56 in.)
Steering wheel free play (when measured at rim with engine idling)			15 to 30 mm (0.59 to 1.18 in.)		
Clutch pedal free play (dry type)			0 to 6 mm (0.00 to 0.24 in.)		
Clutch pedal free play (wet type)			0 to 6 mm (0.00 to 0.24 in.)		
Inching pedal free play			7 mm (0.28 in.)		
Brake pedal free play	Manual Truck		7 mm (0.28 in.)		
	Powershift Truck		7 mm (0.28 in.)		
Parking brake lever operating effort			150 to 200 N (15.3 to 20.4 kgf) [33.72 to 44.96 lbf]	200 to 250 N (20.4 to 25.5 kgf) [44.96 to 56.20 lbf]	
Tire size	Front tire	Single	6.50-10/5.00PR	7.00-12-12PR	
		Dual	-	5.50-15-8PR	
	Rear tire		5.00-8/3.00PR	6.00-9-10PR	
Tire pressure	Front tire	Single	-	700 kPa (7 kgf/cm^2) [101 psi]	
		Dual	-	700 kPa (7 kgf/cm^2) [101 psi]	
	Rear tire		-	700 kPa (7 kgf/cm^2) [101 psi]	
Tightening torque for wheel nuts	Front tire		156.9 ± 15.7 N·m (16.00 ± 1.60 kgf·m) [115.723 ± 11.57 lbf·ft]	377.6 ±37.8 N·m (38.50 ± 3.85 kgf·m) [278.503 ± 27.87 lbf·ft]	
	Rear tire	2P	141.2 to 172.6 N·m (14.40 to 17.60 kgf·m) [104.144 to 127.303 lbf·ft]	210.1 to 256.7 N·m (21.42 to 26.18 kgf·m) [154.962 to 189.332 lbf·ft]	
		4P			
Lift chain elongation limit (20 links)			327 mm (12.87 in.)	392 mm (15.43 in.)	

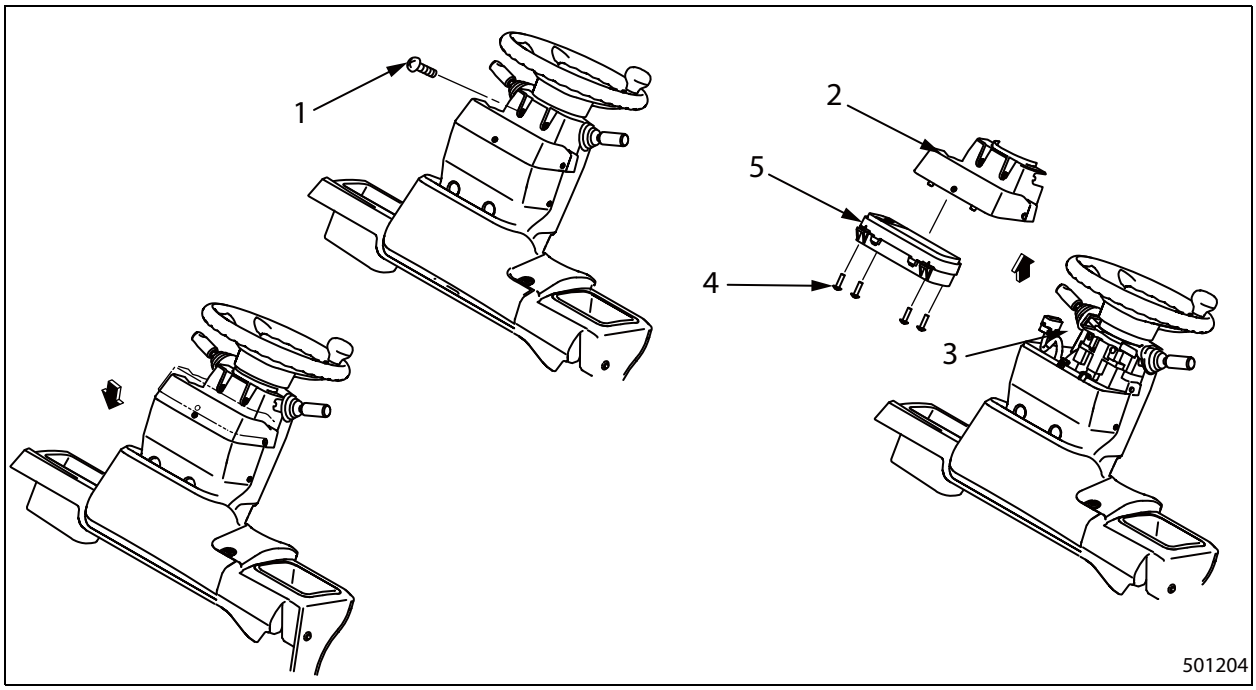
2. Console Box

2.1 Console Box Outline



1. Meter panel
2. Light switch and turn signal switch
3. FNR lever
4. Key switch

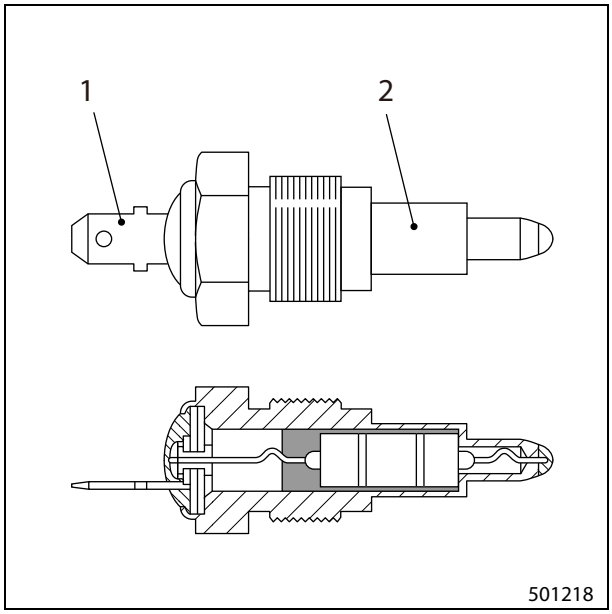
2.2 Meter Panel, Removing



1. Screw
2. Cover
3. Connector
4. Screw
5. Meter panel

3.23 Thermoswitch (T/C Oil)

Apply a tester between the terminal and the body, and check for continuity (resistance). Replace if the measured insulation resistance is less than the value below.



1. Terminal 2. Body

Item	Limit
Insulation resistance	1 M ohm or more with the contact point OFF (with 500V insulation resistance tester)

Internal resistance: 0.5 ohm or less (with contact point ON)

Allowable load: 0.5 A

Note: When installing the thermoswitch, tighten it to the specified torque.

Item	Limit
Tightening torque	31.4 to 47.1 N·m (3.20 to 4.80 kgf·m) [23.159 to 34.739 lbf·ft]

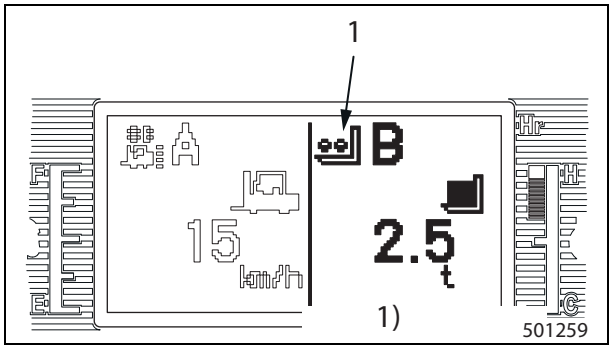
⚠ CAUTION

Replace the thermoswitch if it is dropped or abused.

Technical data		
Operating temperature	OFF➡ON	122 ± 3 °C (252 ± 5.40 °F)
	ON➡OFF	115 °C (239 °F) or higher
Insulation resistance (with contact point OFF)		1 M ohm or more

Load value setting (load value is set in screen B)

(1) With a short press on UP or DOWN button, select the load value symbol to bring up the load value setting screen on screen B. Enter it with a short press on ○ button.



1. Load setting symbol 1) Screen B

Button	Press	Display
UP or DOWN	Short press	
○	Short press	Enter (execution)

(2) With a short press on UP or DOWN button, select "load value" and enter it with ○button.

Button	Press	Display
UP	Short press	0 to 50 (0.1 at a time)
	Long press	0 to 50 (Incrementally)
DOWN	Short press	50 to 0 (0.1 at a time)
	Long press	50 to 0 (Incrementally)
○	Short press	Enter (execution)

After the setup of a load value on the screen B is completed, the setup value is displayed for one second, and then the display returns to the standard screen.

Note: The trigger load value for exterior alarm function is different from the load value for the overload warning display.

No-setting for speed and load value

(1) Long press on UP and DOWN buttons at the same time to display the exterior alarm setting screen.

Button	Press	Display
UP and DOWN	Multiple long presses	Exterior alarm setting screen

(2) With a short press on UP or DOWN button, select the symbol for "no-setting". Enter with a short press on ○ button.

Button	Press	Display
UP or DOWN	Short press	■
○	Short press	Enter (execution)

2. Tightening Torques for Standard Bolts and Nuts

(1) The tables below show the tightening torque for general bolts and nuts. For the tightening torque of the bolts and nuts for specific use, refer to the torque specified in each section.

(2) The table shows the standard value. Bolts and nuts should be tightened within ± 10% range of the torque value in the table. When you use an impact wrench, tighten bolts and nuts within ± 20% range if the value is 137 N·m (14.0 kgf·m) [101.05 lbf·ft] or less, and tighten ± 15% if the value is more than 137 N·m (14.0 kgf·m) [101.05 lbf·ft].

(3) Threads and seating faces are in a dry condition.

2.1 Metric Fine Thread

With spring washer										
Nominal size	Pitch	 500244			 500245			 500246		
mm (in.)	mm (in.)	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
6 (0.24)	1 (0.04)	7.4	0.75	5.46	9.6	0.98	7.08	12.7	1.30	9.37
8 (0.31)	1.25 (0.05)	16.7	1.70	12.32	22.6	2.30	16.67	30.4	3.10	22.42
10 (0.39)	1.25 (0.05)	34.3	3.50	25.30	45.1	4.60	33.26	69.6	7.10	51.33
12 (0.47)	1.25 (0.05)	63.7	6.50	46.98	82.4	8.40	60.77	122.6	12.50	90.42
14 (0.55)	1.5 (0.06)	102.0	10.40	75.23	132.4	13.50	97.65	192.2	19.60	141.76
16 (0.63)	1.5 (0.06)	157.9	16.10	116.46	202.0	20.60	148.99	287.3	29.30	211.90
18 (0.71)	1.5 (0.06)	224.6	22.90	165.65	292.2	29.80	215.51	413.8	42.20	305.20
20 (0.79)	1.5 (0.06)	310.9	31.70	229.30	404.0	41.20	297.97	573.8	58.51	423.21
22 (0.87)	1.5 (0.06)	413.8	42.20	305.20	537.5	54.81	396.43	763.0	77.80	562.75
24 (0.94)	1.5 (0.06)	547.2	55.80	403.59	711.0	72.50	524.40	1006.2	102.60	742.12
27 (1.06)	1.5 (0.06)	794.3	80.99	585.84	1032.6	105.29	761.59	1451.1	147.97	1072.47
30 (1.18)	1.5 (0.06)	1100.3	112.20	811.53	1430.8	145.90	1055.29	2012.3	205.19	1484.17
33 (1.30)	1.5 (0.06)	1467.1	149.60	1082.06	1907.4	194.50	1406.80	2680.2	273.30	1976.78
36 (1.42)	1.5 (0.06)	1918.2	195.70	1414.77	2493.8	254.29	1839.30	3497.1	356.60	2579.29
39 (1.54)	1.5 (0.06)	2461.5	251.00	1815.48	3198.8	326.18	2359.28	4469.9	455.80	3296.77

Service Manual

Chassis & Mast

MC

GP15N	CT25C-55001-59999	GPE15N	CT34-00001-09999	DP15N	CT16D-54001-59999
GP15ZN	CT34-52001-59999	GPE18N	CT34-40001-49999	DP18N	CT16D-74001-79999
GP18N	CT25C-75001-79999	GPE20CN	CT34-30001-39999	DP20CN	CT16D-24001-29999
GP18ZN	CT34-72001-79999	GPE20N	CT17D-20001-29999	DP20N	CT18C-20001-29999
GP20CN	CT34-22001-29999	GPE20ZN	CT35-20001-29999	DP25N	CT18C-70001-79999
GP20N	CT17D-10001-19999	GPE25N	CT17D-70001-79999	DP30N	CT14E-10001-19999
GP20ZN	CT35-10001-19999	GPE25ZN	CT35-70001-79999	DP35N	CT14E-80001-89999
GP25N	CT17D-60001-69999	GPE30N	CT13F-10001-19999		
GP25ZN	CT35-60001-69999	GPE35N	CT13F-80001-89999		
GP30N	CT13F-40001-49999				
GP35N	CT13F-60001-69999				

For use with GK15, GK21, GK25, S4Q2 and S4S Engine Service Manuals.

99719-3F120

1. SAFETY PRECAUTIONS

⚠ WARNING

- This service manual contains the proper and safe lubrication and maintenance information recommended by Cat® Lift Trucks. Please read this service manual carefully and fully understand the procedures before proceeding with any maintenance work. Improper lubrication, or maintenance work is dangerous and could result in injury or death.
- Be sure to read this service manual and understand the contents before proceeding with the work. Improper truck operation is dangerous and could result in injury or death.

Be sure to familiarize yourself with the systems and components described herein before proceeding with removal or disassembly work.

For heavyweight components, BE SURE to check the weight of each component beforehand by referring to this service manual.
Also, for safety, use proper lifting equipment for removal/ installation work.

Following is a list of basic precautions that should always be observed.

(1) Read and understand all warning plates and decals on the truck before proceeding with operation, lubrication, or repair work.

(2) Always wear safety glasses and protective shoes when working around trucks. Be sure to wear safety glasses to prevent any type of metal from getting into your eyes when using a hammer or sledge.
Use welders gloves, hood/goggles, apron, and other protective clothing appropriate to the welding operation. Do not wear loose clothing or accessories that can be caught in moving parts. Do not wear rings when you work.

(3) Do not work on any truck that is supported only by lift jacks or a hoist. Always use blocks or jack stands to support the truck before proceeding with the work.

(4) Lower the forks or other implements to the ground before performing any work on the truck. If this cannot be done, make sure the forks or other implements are blocked correctly to prevent them from dropping unexpectedly.

(5) Use steps and assist grips (if equipped) when you mount or dismount the truck. Clean the steps, hand rails, and floor of operator seat beforehand. Always face the truck when using steps, ladders, and walkways. If you cannot use the designed access system, use ladders, scaffolds, or work platforms to ensure the safety at the workplace.

(6) To avoid back injury, use a hoist when lifting components which weigh 23 kg (51 lb) or more. Make sure all chains, hooks, slings, etc., are in good condition and are of the correct capacity. Be sure hooks are positioned correctly. Make sure the load is well balanced prior to lifting.

(7) To prevent burns, DO NOT touch hot sections of the truck immediately after stopping the truck.

(8) Remove covers carefully. When removing the last two bolts or nuts, loosen gradually to release spring force or pressure.

(9) Be careful when removing filler caps, breathers and plugs on the truck. Hold a rag over the cap or plug to prevent being sprayed or splashed by liquids under pressure. Use extreme care immediately after stopping.

(10) Use well maintained tools in a proper way.

(11) Use bolts and nuts of the same part number when replacing. Do not use poor quality parts for replacement.

(12) Park the truck on level and hard ground for maintenance work. Block the wheels when working on or under the truck to prevent it from moving unexpectedly.

(13) Before starting work on the truck, hang "Do not Operate" tag in the operator compartment.

(14) Welding work must be performed only by qualified personnel. Determine the type of metal and select the correct welding procedure and electrodes, rods or wire to ensure a weld metal strength equivalent at least to that of parent metal.

(15) Do not damage electrical wiring during the removal process. Do not reuse the wiring if damaged. Be careful not to touch hot parts or sharp edges when installing wires. Also, route wire harnesses away from oil pipe.

(16) Be sure all protective devices including guards and shields are properly installed and functioning correctly before starting the work.
If protective devices have to be removed for maintenance work, be sure to install them as they were after the work.

(17) When working with the mast in the raised position, BE SURE to block the mast and bracket to prevent them falling unexpectedly.

(18) Loose or damaged fuel, lubricant, hydraulic lines, tubes, and hoses could cause fires. Do not bend high pressure lines or do not apply strong force. Inspect lines, tubes, and hoses carefully. DO NOT check oil leaks with your hands. Pin hole (very small) leaks could result in a high velocity oil stream that will be invisible close to the hose. This oil could penetrate the skin and cause personal injury. Use cardboard or paper to locate leaks from a minute pinhole.

(19) Tighten pipe connections to the correct torque. Make sure that all heat shields, clamps, and guards are installed correctly to avoid excessive heat, vibration or rubbing against other parts during operation. For protective covers, which purpose is to prevent hot oil from splashing over exhaust system, make sure they are properly installed.

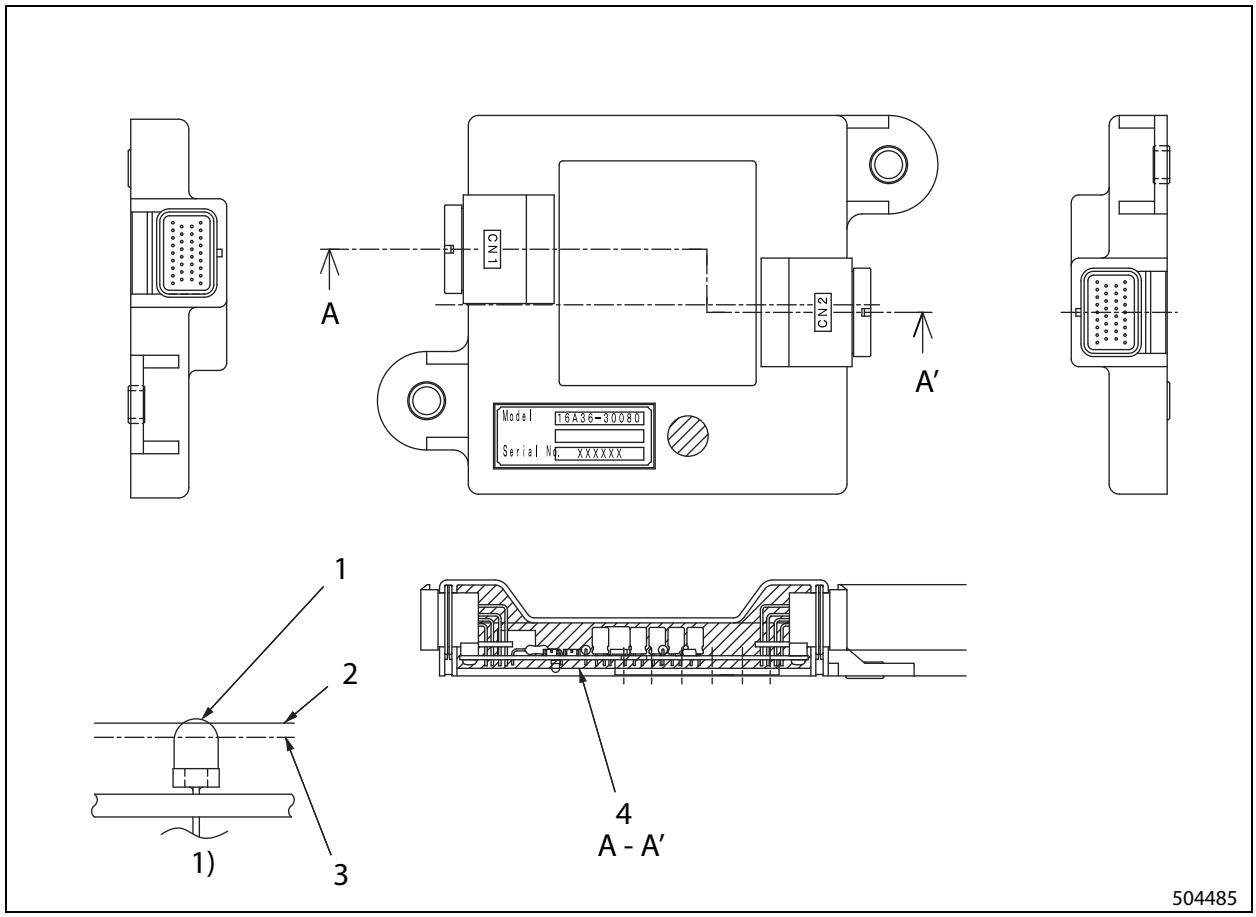
(20) Release all pressure in air, oil, or water systems before any lines, fittings, or related items are disconnected or removed.
Use blocks to prevent the implement from falling if it is in the raised position. Be careful of residual pressure when removing implements that are operated at a pressure.

(21) Do not operate the truck if any rotating part is damaged or if they have come in contact with other part.
When a high speed rotating component is replaced, be sure to check its balance before operation.

Unit: mm (in.)'

Truck model		Class	2 ton class		3 ton class	
		Gasoline engine truck	GP20N GPE20N GP20ZN GPE20ZN	GP25N GPE25N GP25ZN GPE25ZN	GP30N GPE30N	GP35N GPE35N
		Diesel engine truck	DP20N	DP25N	DP30N	DP35N
1	Maximum lift		3000 (118.1)	3000 (118.1)	3000 (118.1)	3000 (118.1)
2	Free lift height		140 (5.5)	145 (5.7)	145 (5.7)	145 (5.7)
3	Minimum turning radius		2200 (86.6)	2230 (87.8)	2380 (93.7)	2440 (96.1)
4	Overall length		3410 (134.3)	3625 (142.7)	3795 (149.4)	3860 (152.0)
5	Overall width (outside-to-outside of tires)	Single	1150 (45.3)	1150 (45.3)	1275 (50.2)	1290 (50.8)
		Double	1480 (58.3)	1480 (58.3)	1490 (58.7)	1490 (58.7)
6	Overall height (with mast lowered)		1990 (78.3)	1990 (78.3)	2015 (79.3)	2130 (83.9)
7	Overall height (with mast extended)		4055 (159.6)	4055 (159.6)	4055 (159.6)	4055 (159.6)
8	Height of the overhead guard		2074 (81.7)	2074 (81.7)	2093 (82.4)	2103 (82.8)
9	Fork size (T x W x L)		40 x 122 x 920 (1.6 x 4.8 x 36.2)	50 x 125 x 920 (2.0 x 4.9 x 36.2)	50 x 125 x 1070 (2.0 x 4.5 x x42.1)	50 x 125 x 1070 (2.0 x 4.5 x x42.1)
10	Fork spread		220 to 1000 (8.7 to 39.4)	220 to 1000 (8.7 to 39.4)	250 to 1000 (9.8 to 39.4)	250 to 1000 (9.8 to 39.4)
11	Front overhang		455 (17.9)	460 (18.1)	495 (19.5)	495 (19.5)
12	Wheel base		1600 (63.0)	1600 (63.0)	1700 (66.9)	1700 (66.9)
13	Tread (front wheel)	Single	960 (37.8)	960 (37.8)	1060 (41.7)	1060 (41.7)
		Double	1140 (44.9)	1140 (44.9)	1140 (44.9)	1140 (44.9)
14	Tread (rear wheel)		980 (38.6)	980 (38.6)	980 (38.6)	980 (38.6)
15	Under clearance (at center of frame)		167 (6.6)	167 (6.6)	189 (7.4)	202 (8.0)
16	Tilt angle (forward – backward)		6 - 12°	6 - 12°	6 - 12°	6 - 12°

3.9 VCM (Vehicle Control Module)



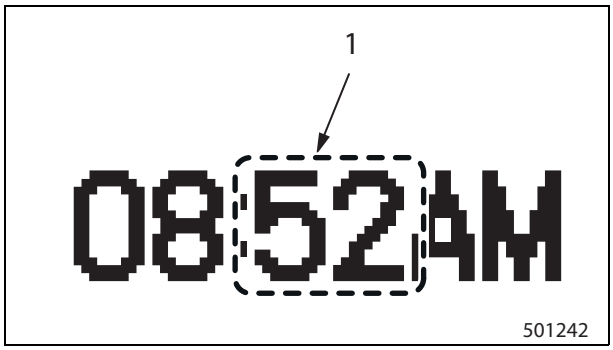
1. LED can be seen
2. Potting upper limit
3. Potting surface
4. Potting
1) Potting

Note: For the VCM connector pin location, refer to CHAPTER "CONTROLLER".

Button	Press	Display
UP	Short press	01➡12 or 24 (one hour at each press)
	Long press	01➡12 or 24 (consecutively)
DOWN	Short press	12 or 24➡01 (one hour at each press)
	Long press	12 or 24➡01 (consecutively)
○	Short press	Entry, then changes to the minute adjust mode.

Note: On 12-hour time mode display, A.M. and P.M. start immediately after Midnight and Noon (Midday) respectively (00:00 A.M. or 00:00 P.M).

(5) Minute fine adjustment



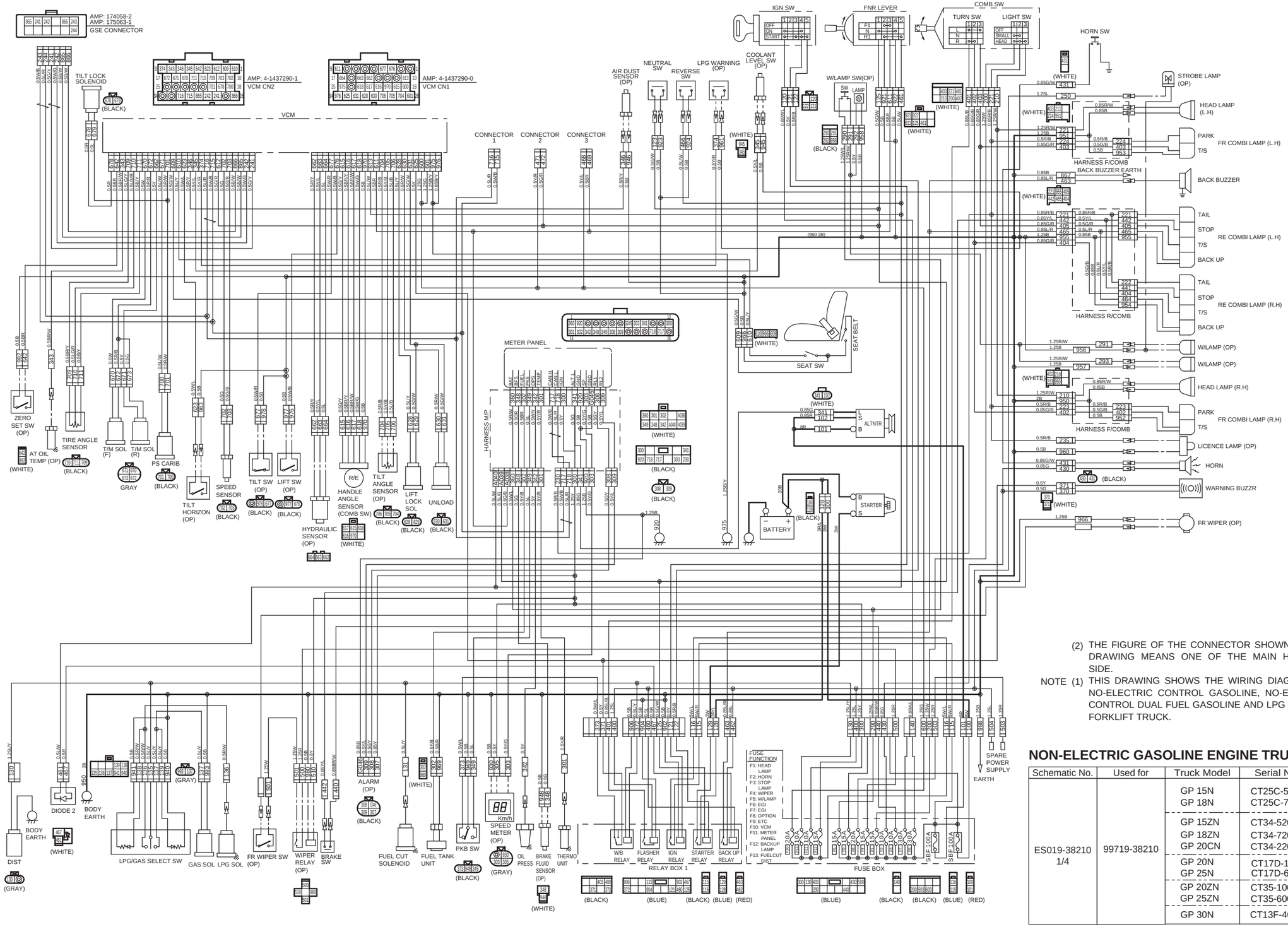
1. Digits to be adjusted will be blinking

Button	Press	Display
UP	Short press	01➡59 (one minute at each press)
	Long press	00➡59 (consecutively)
DOWN	Short press	59➡00 (one minute at each press)
	Long press	59➡00 (consecutively)
○	Short press	Entry, then screen will change to the standard screen.

Note: Setting on the second time scale is not available.

- Setting on the second time scale is not available.
- If more than 3 minutes have passed from the last button operation, the display automatically returns to the standard screen.
- Precision errors are one minute or less per month.
- If the battery is changed, the time will be reset. Thus, time setting is necessary after the change of battery.
- If the engine is started during the setting procedure, the setting being made is cancelled and the display returns to the standard screen.

Electrical Schematic (1/4)



(2) THE FIGURE OF THE CONNECTOR SHOWN IN THIS DRAWING MEANS ONE OF THE MAIN HARNESS SIDE.

NOTE (1) THIS DRAWING SHOWS THE WIRING DIAGRAM OF NO-ELECTRIC CONTROL GASOLINE, NO-ELECTRIC CONTROL DUAL FUEL GASOLINE AND LPG TYPE OF FORKLIFT TRUCK.

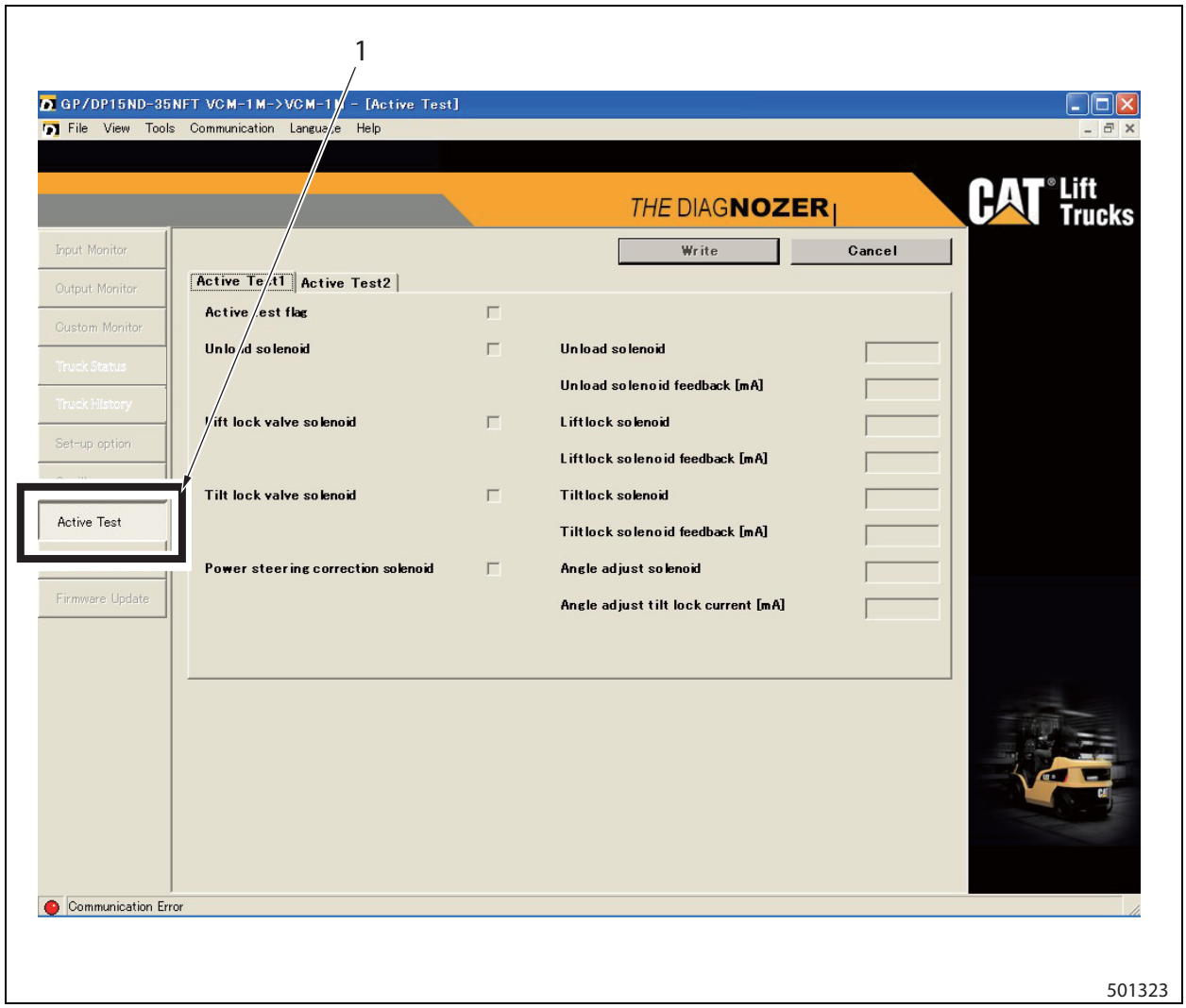
NON-ELECTRIC GASOLINE ENGINE TRUCK (MC)

Schematic No.	Used for	Truck Model	Serial No.
ES019-38210 1/4	99719-38210	GP 15N GP 18N	CT25C-55001 up CT25C-75001 up
		GP 15ZN GP 18ZN GP 20CN	CT34-52001 up CT34-72001 up CT34-22001 up
		GP 20N GP 25N	CT17D-10001 up CT17D-60001 up
		GP 20ZN GP 25ZN	CT35-10001 up CT35-60001 up
		GP 30N	CT13F-40001 up

Pub. No. 99719-38210

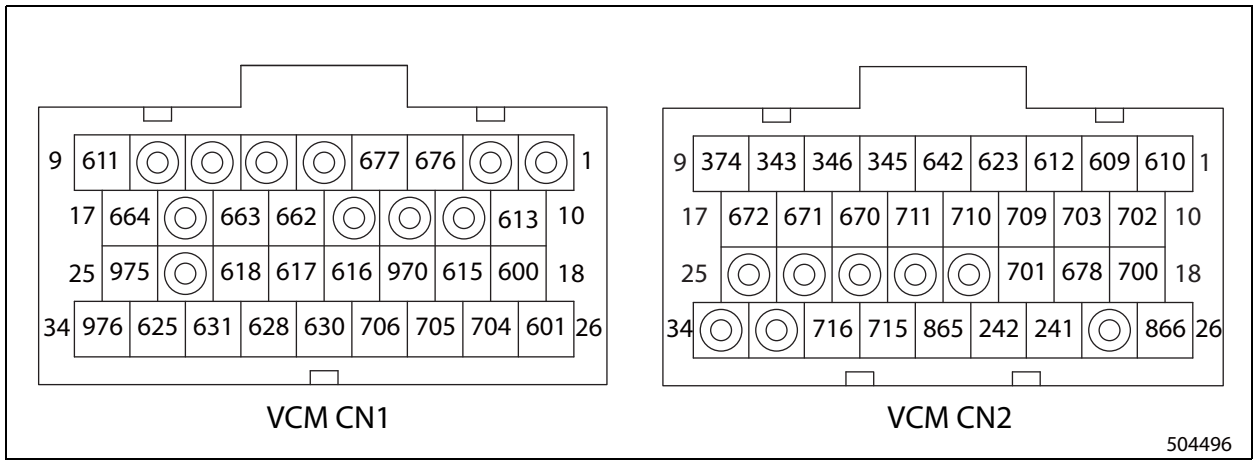
Active test

Click the active test button from the menu or toolbox to display the active test screen in the main window.
In active test screen, you can check the operating conditions by selecting signals you wish to confirm. The active test screen consists of the output signal names on the left side of screen and the monitored values on the right side of screen.

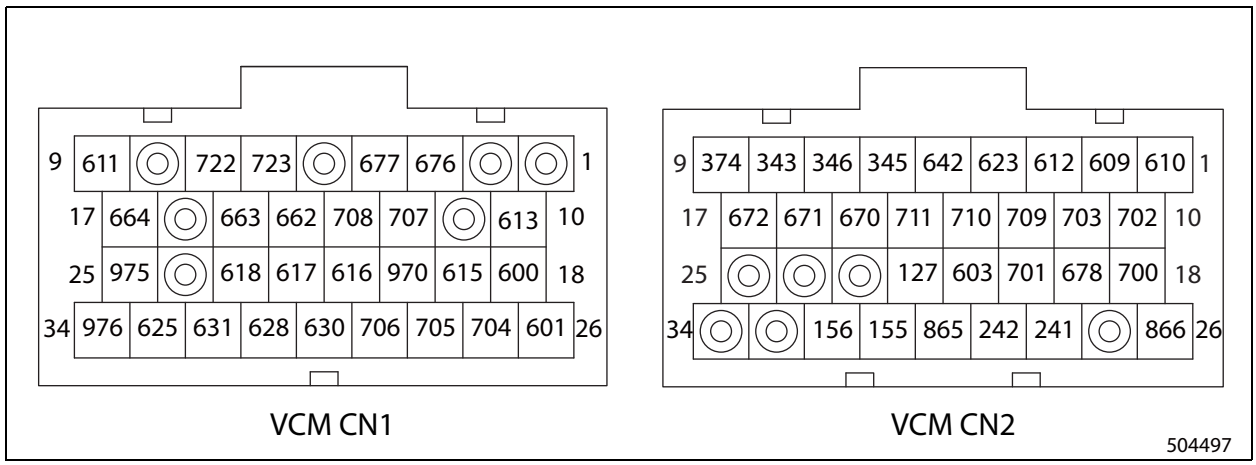


1. Active test button

Non-electronic control gasoline fuel model and non-electronic control gasoline LPG dual fuel model

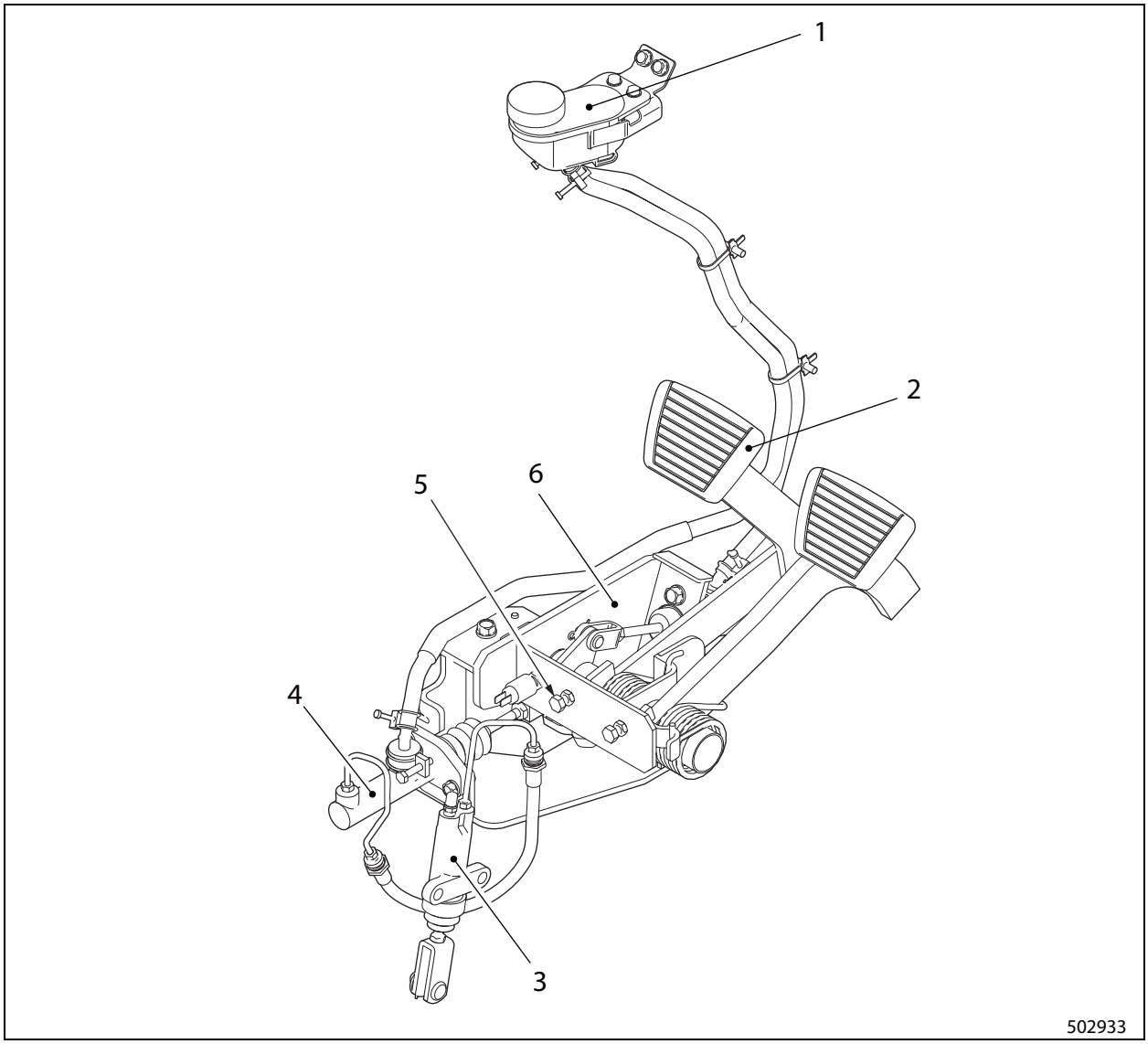


Electronic control gasoline fuel model and electronic control LPG and dual fuel models



Diagnostic code	Diagnostic code name	Probable cause	Check items
D-63	Overheat (STEP 1)	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Temp sensor bad	3. Sensor connection check
		4. Controller bad	
D-64	Overheat (STEP 2)	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Temp sensor bad	3. Sensor connection check
		4. Controller bad	
D-71	Accelerator sensor warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Accelerator sensor bad	3. Sensor connection check
		4. Controller bad	
D-73	Engine rotation speed sensor warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Engine revolution sensor bad	3. Sensor connection check
		4. Controller bad	
D-75	Idle SW warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Idle switch bad	3. Idle switch check
		4. Controller bad	
D-76	Throttle close position warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Throttle close switch bad	3. Throttle close switch check
		4. Controller bad	
D-77	Throttle open position warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Throttle open switch bad	3. Throttle open switch check
		4. Controller bad	
D-78	Throttle original position warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Controller bad	
D-79	Throttle close switch sticking warning	1. Connector contact bad	1. Connector connection check
		2. Harness bad	2. Harness connection check
		3. Throttle close switch bad	3. Throttle close switch check
		4. Controller bad	

Power clutch for dry type clutch

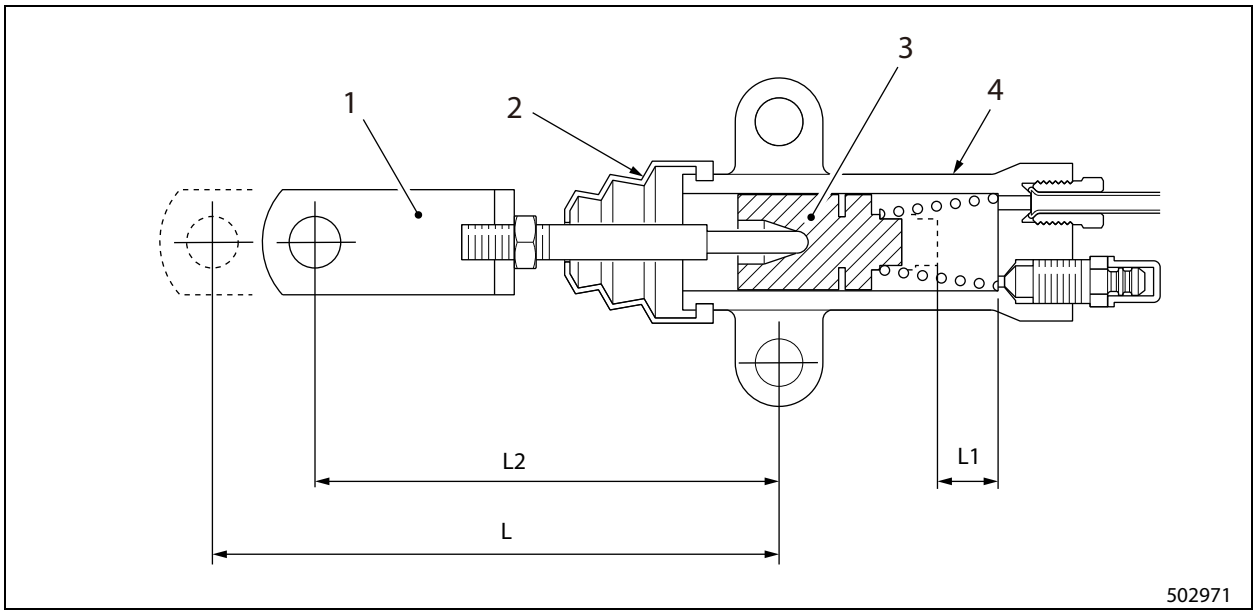


1. Reserve tank
2. Clutch pedal
3. Clutch release cylinder
4. Clutch master cylinder
5. Stopper bolt
6. Bracket

In a dry type clutch, the clutch pedal is directly connected to the push rod of the clutch master cylinder by pin.
The clutch release cylinder automatically compensates for changes in the position of the release levers of the pressure plate assembly due to clutch disc wear. Because of this feature, there is no need for further pedal adjustment once the pedal is properly adjusted at the time of assembly.

15. Checking Clutch Disc for Wear

The clutch release cylinder automatically compensates for changes in the position of the release levers of the pressure plate assembly due to clutch disc wear. There is no need for pedal adjustment once the pedal is adjusted at the time of assembly. However, measure the wear of clutch disc as instructed below so that you will know when it is the right time to replace clutch disc.



1. Push rod complete
2. Boot
3. Piston
4. Body

L : Dimension when release cylinder is assembled (mm)
L1: Dimension when release cylinder is installed to clutch shifter shaft (when clutch disc is new)
L2: Dimension between centers of cylinder body mounting bolt hole and mounting pin hole

(1) After the clutch release cylinder is installed in accordance with the clutch pedal adjustment procedure described above, measure L2 and record the measurement.

Note: L2 may deviate from the specified standard value due to error in the installed dimensions of parts, their free play, etc.

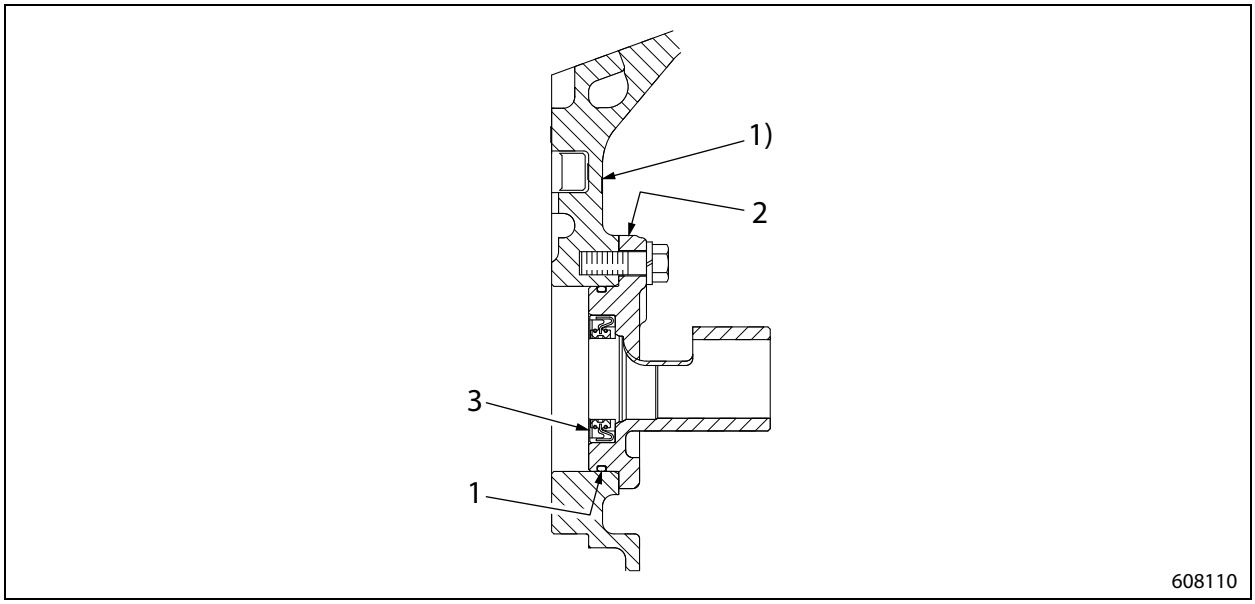
(2) As the clutch disc wears, the piston is pushed further little by little, which results in a decrease in L2 dimension. During monthly inspection, measure L2 and if the measurement exceeds the limit, replace the clutch disc.

Item		Specified value	
L1 (reference value)	Dry type clutch	Standard	22 mm (0.87 in.)
	Wet type clutch	Standard	17 mm (0.67 in.)

Item		Specified value	
L2 dimension	Dry type clutch	Standard	105.9 ± 0.5 mm (4.169 ± 0.019 in.)
	Wet type clutch	Standard	100.9 ± 0.5 mm (3.972 ± 0.019 in.)

12. Assembly

12.1 Shifter Case, Assembly Sequence



1. Oil seal
2. Shifter case, Bolts, Spring washers
3. O-ring

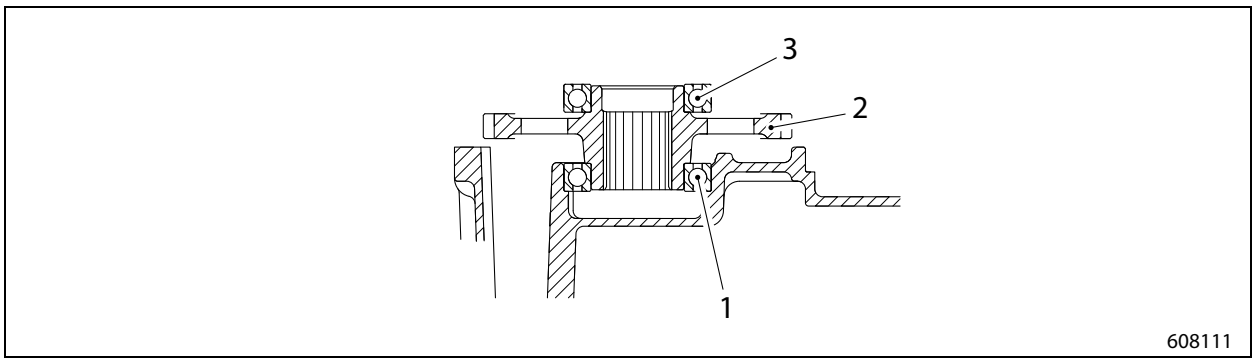
1) Clutch housing

12.2 Suggestions for Assembly

Oil seal

Apply grease (LG2) to oil seal lips. Also apply a thin coat of grease to in-between the lips, but do not overdo. Too much grease can cause oil leaks.

12.3 Output Gear, Assembly Sequence



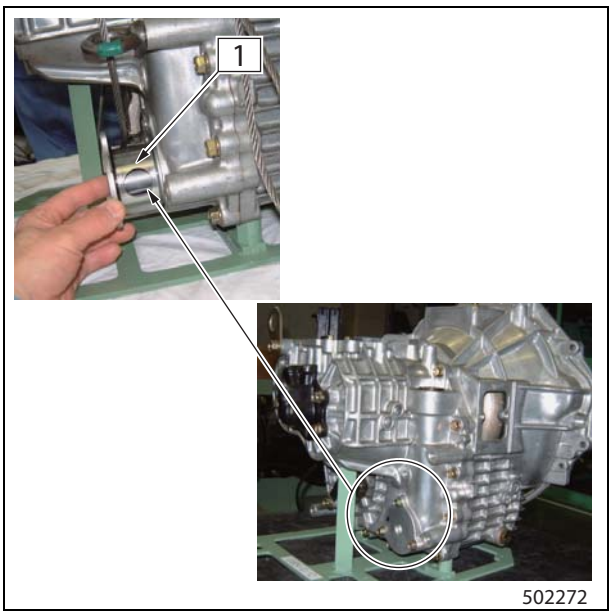
1. Ball bearing
2. Output gear
3. Ball bearing

12.4 Suggestions for Assembly

Install bearing to gear before installing to the housing.

Oil strainer, Removing

Remove oil strainer together with O-ring.

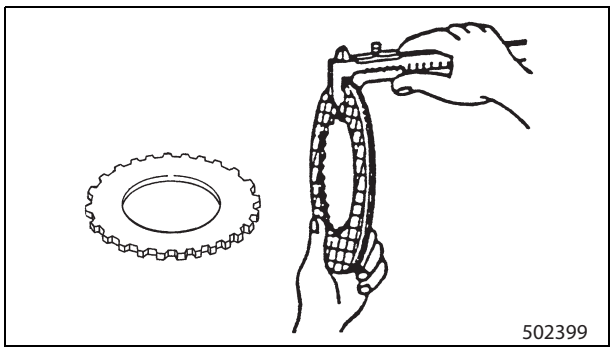


1. Oil strainer assembly

Friction plates and mating plates

(1) Inspect plates for seizure, local contact, deformation, and damage.
(2) Inspect spline for wear and damage.
(3) Measure thickness of each plate.

Note: If any of above abnormalities are found, replace all the plates.



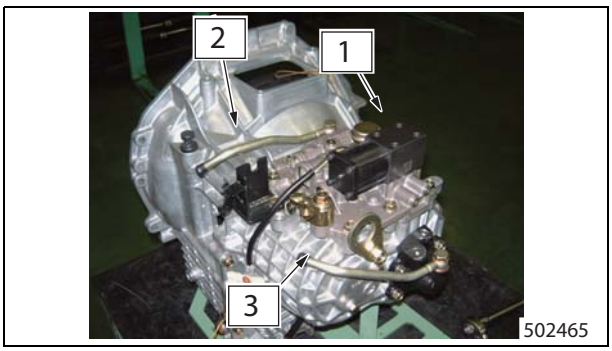
Item	Specified value	
Friction plate	Standard	2.6 ± 0.1 mm (0.102 ± 0.003 in.)
	Limit	22 mm (0.87 in.)
Mating plate	Standard	1.6 ± 0.1 mm (0.063 ± 0.003 in.)
	Limit	1.4 mm (0.055 in.)

Part name	Part number	Qty
Friction plate	91B24-10800	10
Mating plate	91324-12601	12

Cooler pipes, Installing

(1) Install eye bolt and gasket on the cooler inlet pipe and tighten the eye bolt to the specified torque.

(2) Install eye bolt and gasket on the cooler outlet pipe and tighten the eye bolt to the specified torque.



1. Control valve
2. Cooler inlet pipe
3. Cooler outlet pipe

Item	Tightening torque
Eye bolt	44.1± 4.9 N·m (4.50 ± 0.49 kgf·m) [32.526 ± 3.61 lbf·ft]

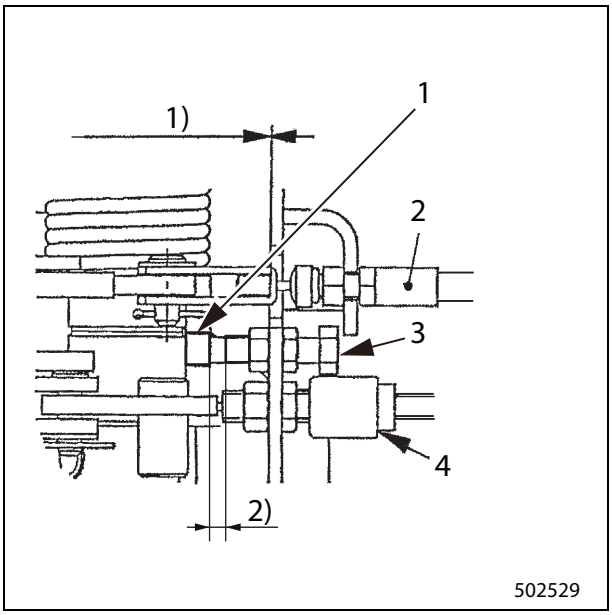
Level gauge, Installing

Install the level gauge.

8.3 Inching Cable, Adjusting

Preparation

(1) Block rear wheels and raise front wheels in the same manner as instructed in the above oil pressure measurement. Connect an oil pressure gauge to the oil pressure tap.
(2) Make sure that the projection of the inching rod is 33.5 to 34.5 mm (1.319 to 1.358 in.).
(3) Insert 0.5 mm (0.020 in.) thick shim between inching pedal stopper and inching pedal stopper bolt so that inching cable play is 0 mm (0.00 in.).
(4) Tighten the inching cable locknut.
(5) 0.5 mm (0.020 in.) shim should be removed at this point.
(6) Make sure that inching pedal stopper has contact with stopper bolt.
(7) Lightly press the inching pedal by hand, and make sure that clearance between inching pedal stopper and stopper bolt is 0.4 to 1.1 mm (0.016 to 0.043 in.) when the inching lever is just about to move.



1. Inching pedal stopper
2. Inching cable
3. Stopper bolt
4. Stop light switch

1) Inching cable play
2) Clearance (0.4 to 1.1 mm (0.016 to 0.043 in.))

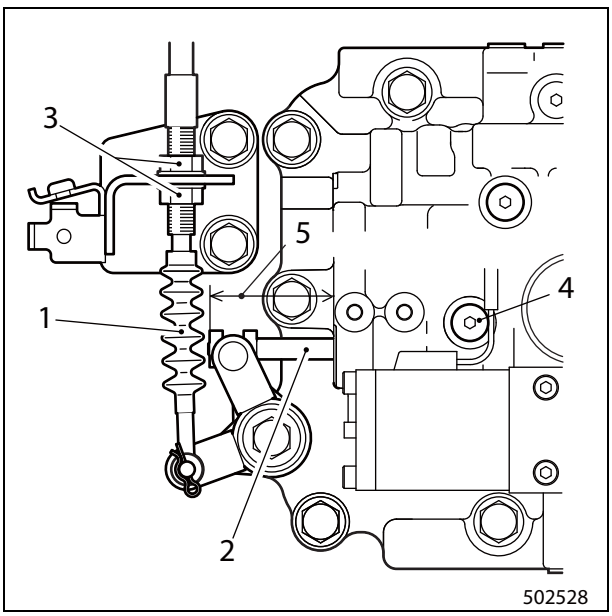
⚠ CAUTION

If the play of inching cable is not properly adjusted, the following failure will occur.

- When the play is less than 0.4 mm (0.016 in.):
  Even if the inching pedal is not pressed, or when the operator has put his/her foot on the inching pedal lightly, the clutch oil pressure decreases, and the clutch slips. This results in the premature wear or burnout of friction plates.
- When the play is greater than 1.1 mm (0.043 in.):
  Even if the inching pedal is fully pressed, the clutch oil pressure will not decrease enough to disengage the clutch completely. This results in premature wear or burnout of friction plates.

Adjusting procedure

(1) Run the engine at idle speed to raise the temperature of the transmission oil.
(2) Shift the direction lever into FORWARD position.
(3) Gradually press the inching pedal to retract the inching rod. Make sure that oil pressure becomes 0 (zero) when the projection of the inching rod is 26.9 mm (1.059 in.) or less.

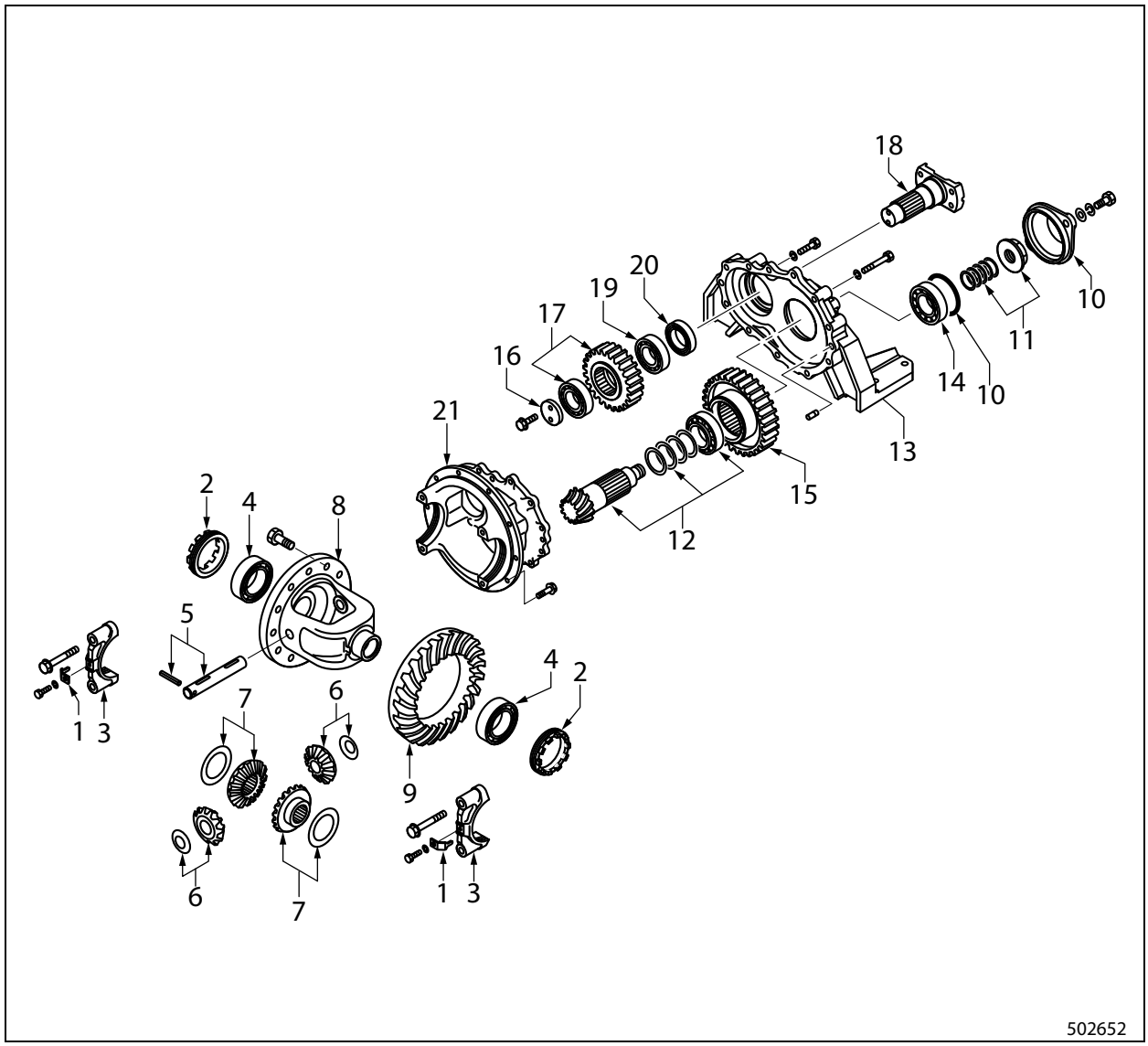


1. Inching cable
2. Inching rod
3. Locknut

4. Clutch oil pressure tap
5. Inching rod projection

10. Reduction Differential, Disassembling

10.1 Disassembly Sequence



1. Lockplate
2. Bolt, Washer, Side bearing nut
3. Bearing cap
4. Tapered roller bearing
5. Spring pin, Pinion shaft
6. Differential pinion, Thrust washer
7. Differential gear, Thrust washer
8. Differential case
9. Reduction gear
10. Cover, O-ring
11. Locknut, Shims

Note: Remove 4 through 9 as a set.

12. Reduction pinion, Tapered roller bearing (inner race), Shims
13. Carrier cover
14. Tapered roller bearing
15. Driven gear
16. Plate
17. Drive gear, Ball bearing
18. Input flange
19. Ball bearing
20. Oil seal
21. Differential case

10. Knuckle Section (Kingpin), Disassembling

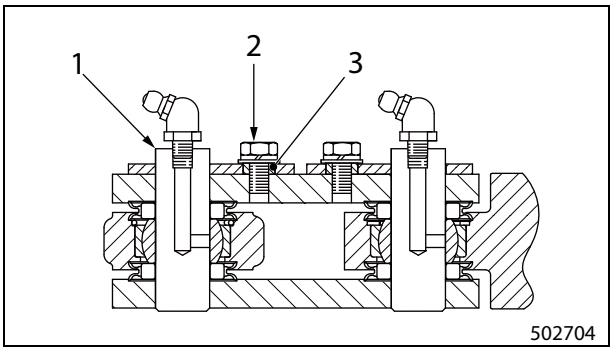
10.1 Preparation

(1) Remove the rear wheels.
(2) Remove the wheel hubs.

10.2 Suggestions for Disassembly

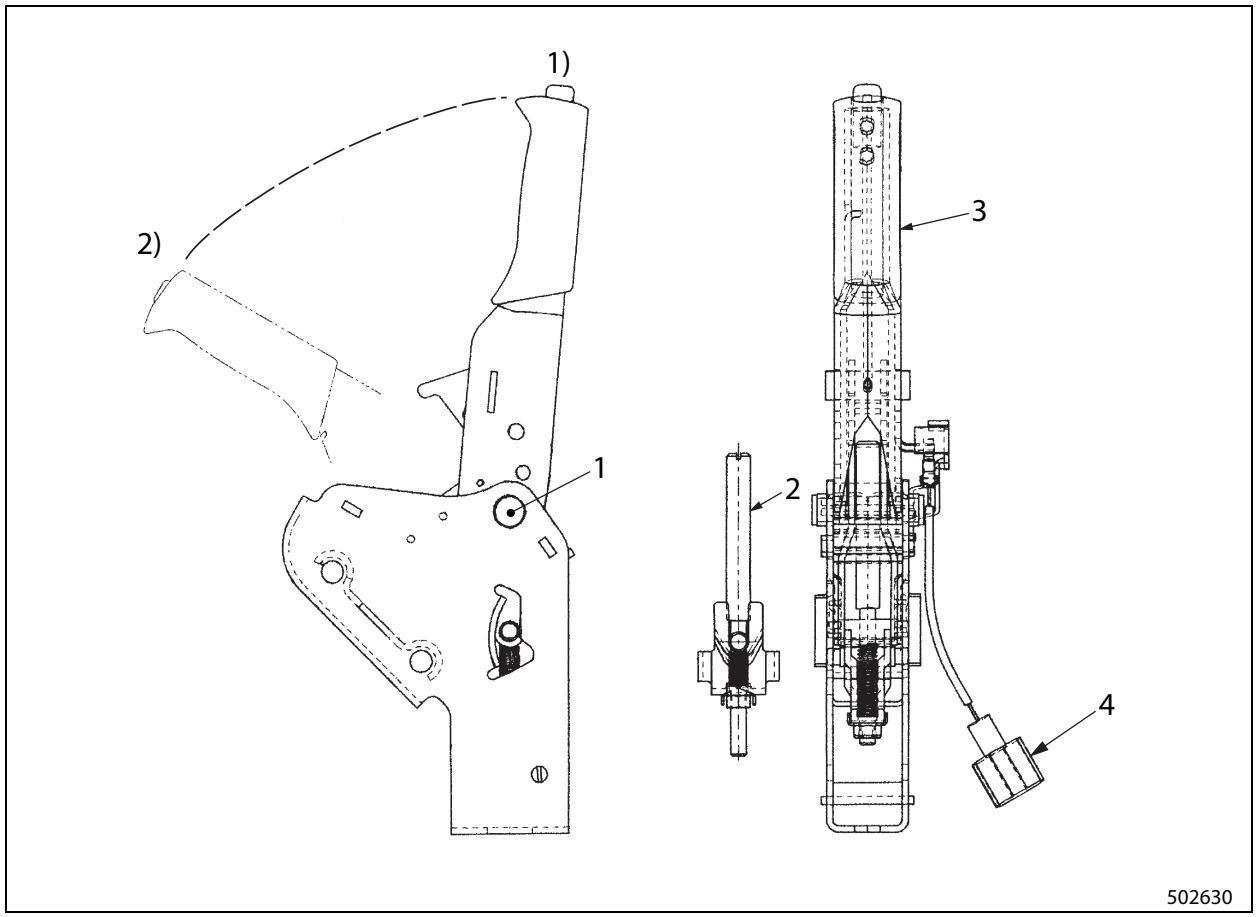
Tie rod separation

(1) To separate the knuckle from the tie rod, remove the bolt washer assembly and spacer on the knuckle and pull out the tie rod pin.
(2) For complete overhaul, further disassembly is required. For details, refer to 10-16 "Tie Rod, Disassembling".



1. Tie rod pin
2. Bolt and washer assembly
3. Spacer

12.7 Parking Brake Lever, Adjusting



1. Lever support pin
2. Adjusting screw
3. Parking brake lever assembly
4. Parking brake switch

1) Activated state
2) Released state

Inspection and repair

(1) If the lever support pin and/or lever pin hole are badly worn, replace.
(2) If parking brake cable is stretched, damaged, or rusted, replace.

Parking brake lever operating force, Checking

After the cable is connected to the parking brake lever, ensure that parking brake lever operating force is within the specified range below.

Item	Specified value		
	1 ton class	2 ton class	3 ton class
Parking brake lever operating effort	150 to 200 N (15.3 to 20.4 kgf) [33.72 to 44.96 lbf]	200 to 250 N (20.4 to 25.5 kgf) [44.96 to 56.20 lbf]	230 to 250 N (23.5 to 25.5 kgf) [51.71 to 56.20 lbf]

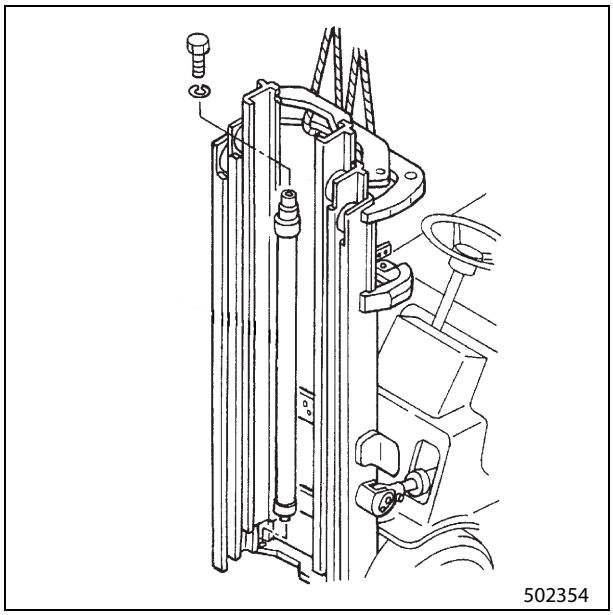
13. Troubleshooting

Condition	Problem		Possible cause	Action
Excessive steering effort	Flow priority valve malfunction	No steering flow	Foreign objects clogged in orifices of spool	Disassemble and clean
			Spring in spool fatigued	Replace spring
		Relief valve malfunction	Low relief pressure	Adjust relief pressure
			Damaged valve seating surface	Replace valve assembly
			Spring settling.	Replace spring, then adjust relief pressure
		Oil leak from relief valve	Damaged O-ring on the valve body	Replace O-ring
	Steering valve malfunction	Clogging in gerotor		Disassemble and clean
		Sleeve and spool seizure due to entry of foreign objects		Replace
		Damaged bearing		Replace
		Overtightening of end cap mounting bolts		Retighten
	Steering cylinder malfunction	Piston rod deflection		Replace
		Damaged piston seal		Replace
	Misalignment	Steering valve and tilt column assembly fault		Adjustment
	Other malfunctions	Flattened hose or pipe		Replace
Unstable steering wheel movement	Steering valve malfunction	Spool or sleeve seizure		Replace
		Damaged center spring		Replace
	Other malfunctions	Air trap		Bleed air
		Flattened hose or pipe		Replace
		Damaged piston seal of steering cylinder		Replace

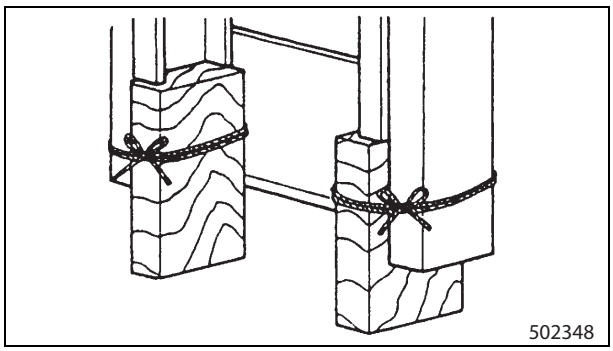
9.4 Removing Second Lift Cylinders

(1) Disconnect hoses from the second lift cylinders.

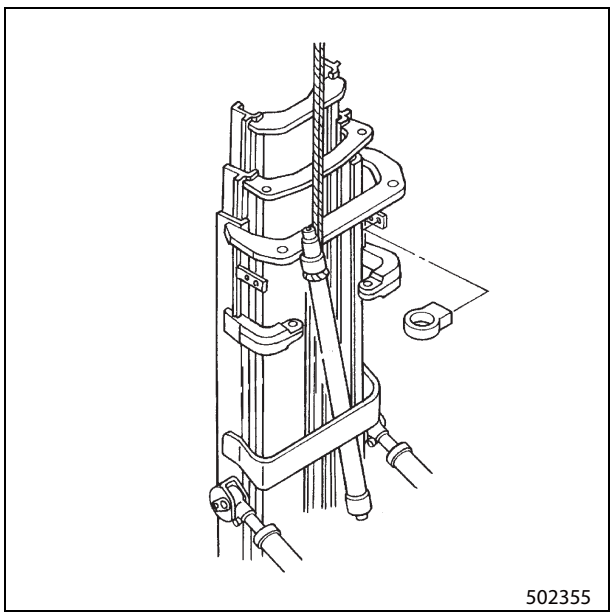
(2) Remove the set bolts located at the top of the second lift cylinders. Attach a wire rope either to the middle or inner mast, and raise the mast by approximately 55cm (2.2 in.).



(3) Place wood blocks of the same height under the both sides of the inner mast (for duplex mast) or the middle mast (for triplex mast).

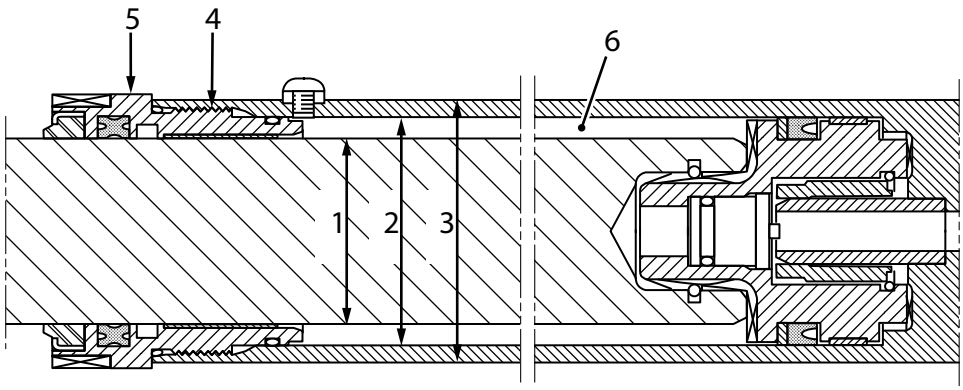


(4) Attach a wire rope to the second lift cylinder from behind the mast, and support the cylinder with a hoist. Remove the clamp bolts from the cylinder and separate the second lift cylinder 5 from the mast.Then slowly lift the cylinder.
When lifting the lift cylinder, do not lift the lift cylinder straight up because the lift cylinder will hit against the mast cross member. Tilt the lift cylinder to clear the cross member while removing. Keep hands away from any part of the lift cylinder or mast to prevent a risk of injury.



31.2 Second Cylinder for Simplex and Triplex Masts

Ref.	Item		Specified value			
			1, 2 ton classes	2.5 ton class	3 ton class	3.5 ton class
1	Rod outside diameter	Standard	35 mm (1.38 in.)	40 mm (1.57 in.)	45 mm (1.77 in.)	45 mm (1.77 in.)
2	Cylinder inside diameter	Standard	45 mm (1.77 in.)	50 mm (1.97 in.)	55 mm (2.17 in.)	60 mm (2.36 in.)
3	Cylinder outside diameter	Standard	52 mm (2.05 in.)	57 mm (2.24 in.)	63 mm (2.48 in.)	68 mm (2.68 in.)
4	Cylinder head thread size	Standard	M49	M54	M59	M64
5	Cylinder head	Tightening torque	196 ± 45.1 N·m (20.0 ± 4.59 kgf·m) [144.56 ± 33.26 lbf·ft]	235 ± 53.9 N·m (24.0 ± 5.49 kgf·m) [173.33 ± 39.75 lbf·ft]	275 ± 61.8 N·m (28.0 ± 6.30 kgf·m) [202.83 ± 45.58 lbf·ft]	304 ± 70.6 N·m (31.0 ± 7.19 kgf·m) [224.22 ± 52.07 lbf·ft]



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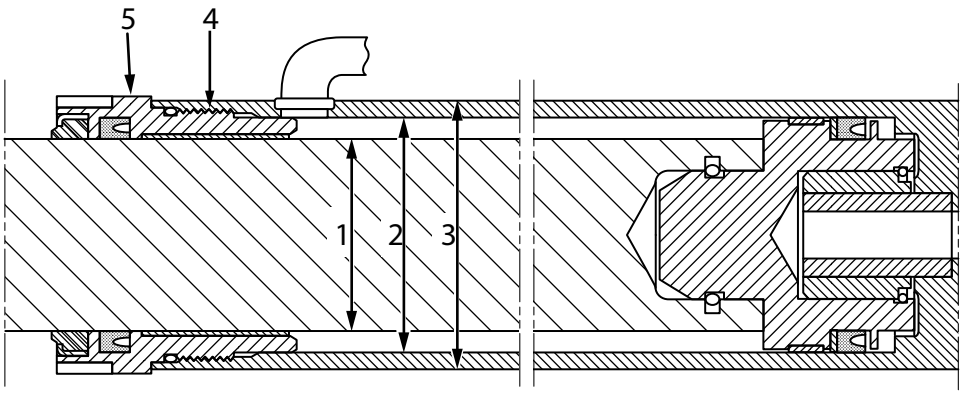

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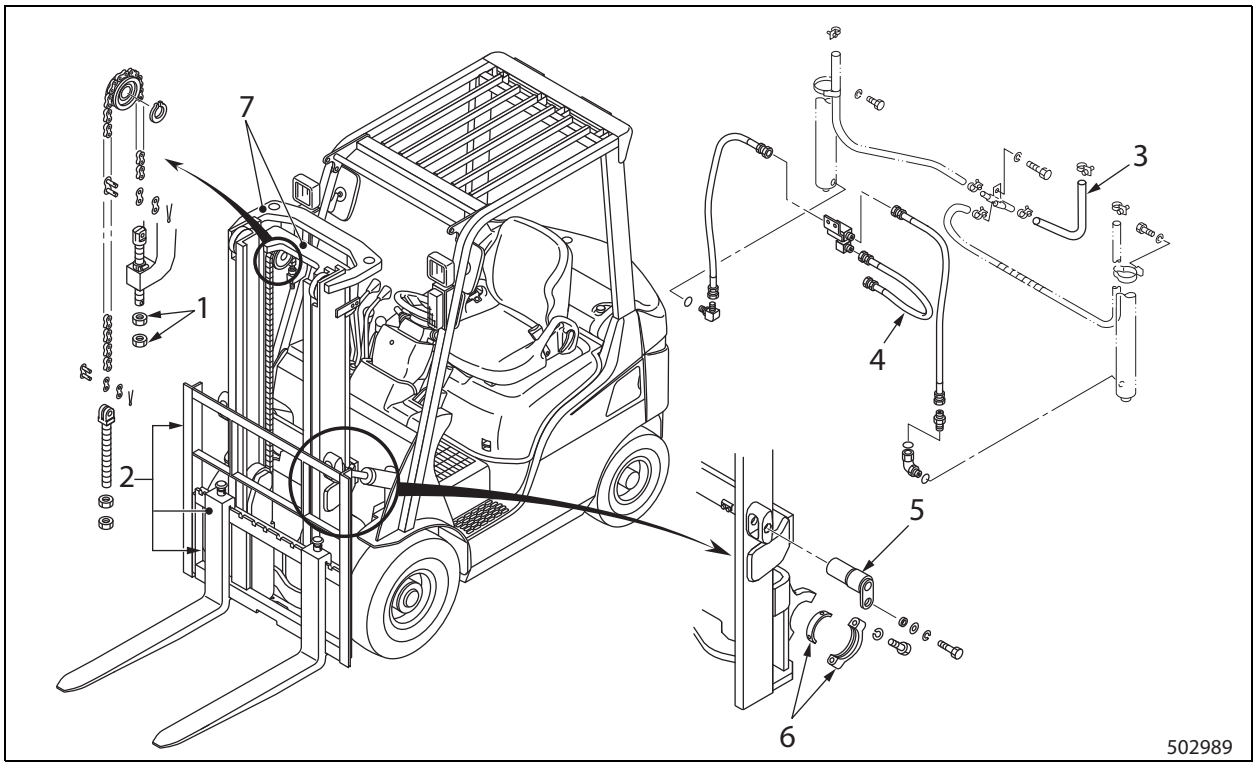
1.3 Mast and Lift Bracket Assembly, Removal Sequence

For replacement of mast roller without removing the mast from the truck, refer to 14-18 "Mast Rollers and Strips, Removal and Installation Without Removing Mast from Truck".



1. Nut
2. Load backrest extension, Lift bracket, Forks
3. Return hose (high-lift model)
4. High-pressure hose
5. Tilt socket pin
6. Mast support bearing cap, Bushing
7. Inner mast, Outer mast, Lift cylinder

1.4 Suggestions for Removing of Mast and Lift Bracket Assembly

Removing lift bracket assembly

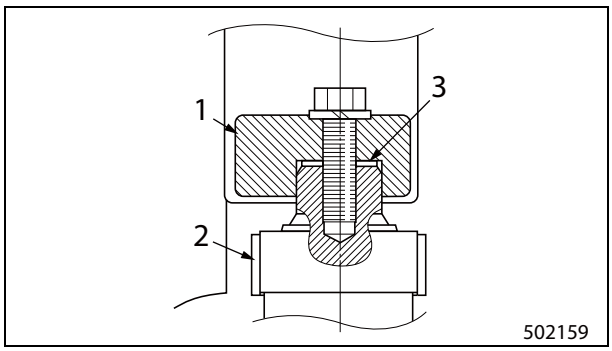
(1) Tilt the mast forward, and lower the inner mast to the ground. Slacken the lift chains, and remove nuts 1 from the anchor bolts.

(2) Tilt the mast backward to the vertical position and lift the inner mast until the lift bracket 2 becomes free. Then, slowly move the lift truck away from the lift bracket.

Note: Before overhauling the mast assembly, be sure to measure the clearance between the mast and the rollers. This helps to improve work efficiency by understanding which roller is to be replaced or the necessity of shim adjustment.
Knowing which roller should be replaced or which shims need adjustment in advance allows efficient maintenance work.

(3) Extend the piston rod, and tighten the lift cylinder set bolt. Remove the wood blocks under the inner mast.

(4) Check that the piston rods move smoothly throughout the stroke by slowly lowering the inner mast to the ground. Also check that the left and right lift cylinders come to the end of stroke simultaneously at the maximum lift position of the inner mast.

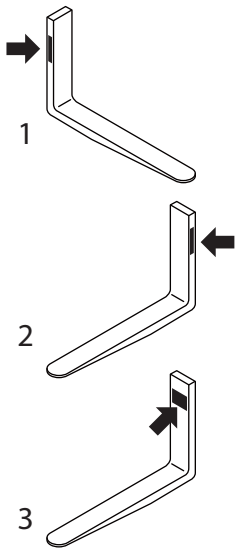


1. Inner mast
2. Cylinder bracket
3. Shim (l)

1.26 Troubleshooting

Condition	Possible cause	Action
Lift bracket and inner mast do not move smoothly	Clearance between lift rollers and side rollers is incorrect	Adjust forward/backward and right/ left clearances
	Defective roller rotation	Lubricate side rollers and replace other rollers
	Incorrect clearance on mast strip	Adjust shim thickness
Lift bracket or inner mast is tilted	Excessive clearance on side roller	Increase shim stack thickness
	Uneven tension between chains on right and left side	Adjust chain tension
	Shim adjustments are unequal between left and right lift cylinders (at the maximum height)	Adjust shim stack thickness
Mast makes noise	Defective roller rotation	Adjust or replace rollers after inspection
Drift (natural descent) of lift cylinders	Lift cylinder packing is damaged	Replace
	Sliding (inside) surface of lift cylinder tube is damaged	Replace
Whole mast shakes	Mast-support bushing or metal worn	Tighten or replace bushing metal
Mast is distorted	Off-center load or overload	Replace mast assembly
Fork tips are different in height	Distortion of finger bar	Repair or replace
	Distortion of forks	
	Uneven loading	

Model	Type		Blade size	Limit
1 to 2tC	1	HX**** x 500	35 x 100 x 770 to 1970	32.5 mm (1.280 in.)
	2	T****	35 x 100 x 770 to 1520	31.5 mm (1.240 in.)
	3	Without Mark **** or U**** or UQ****	37 x 100 x 1370 to 1970	32.5 mm (1.280 in.)
2 to 2.5t	1	HX**** x 500	40 x 122 x 920 to 1970	35.5 mm (1.398 in.)
	2	T****	40 x 122 x 920 to 1370	35.0 mm (1.378 in.)
			45 x 122 x 1520 to 1970	40.0 mm (1.575 in.)
	3	Without Mark **** or U**** or UQ****	42 x 110 x 920 to 1070	40.0 mm (1.575 in.)
			42 x 125 x 1150 to 1970	40.0 mm (1.575 in.)
3 to 3.5t	1	HX**** x 500	50 x 125 x 1070 to 1970	45.0 mm (1.772 in.)
			50 x 122 x 1070 to 1970	45.0 mm (1.772 in.)
	2	T****	50 x 122 x 1070 to 1520	45.0 mm (1.772 in.)
	3	Without Mark **** or U**** or UQ****	50 x 125 x 1070 to 1970	45.0 mm (1.772 in.)



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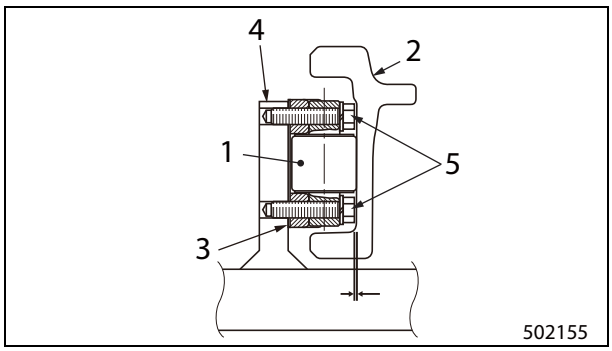
Adjusting clearance between side roller rolling face and inner mast

Measure the clearance between side roller rolling face and inner mast. If the measured clearance does not meet the standard value, adjust the clearance as follows:

Note: For measurement, refer to 14-84 "Inspection and Adjustment".

If the clearance is too large, increase shims thickness (d) as required.

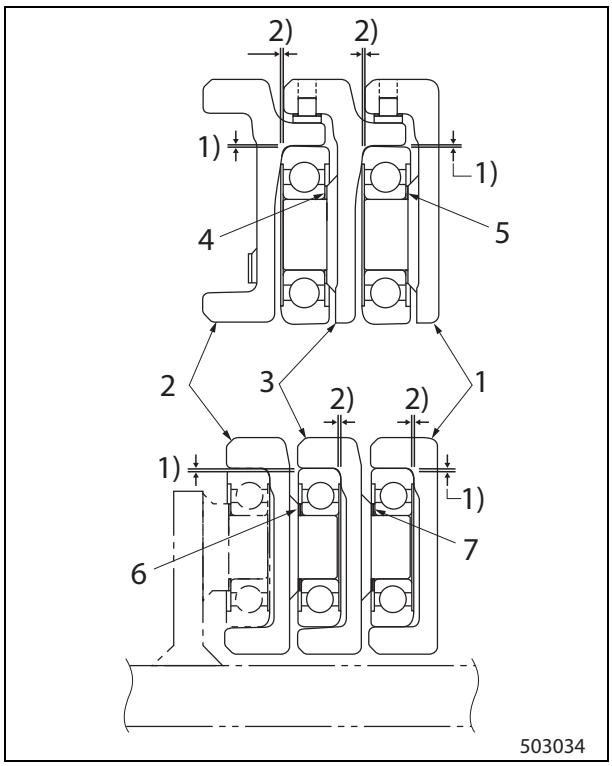
Note: At the factory, shim thickness (d) is usually adjusted to 1.5 mm (0.059 in.) for shipping.



1. Side roller
2. Inner mast
3. Shim (d)
4. Lift bracket
5. Roller mounting bolt

3.12 Installing Mast Rollers (All Mast Models)

Mast rollers are identical in shape and size with lift bracket lower rollers.



1. Outer mast
2. Inner mast
3. Middle mast
4. Shim (g)
5. Shim (h)
6. Shim (i)
7. Shim (j)

1) Clearance between main roller rolling face and mast
2) Clearance between main roller side face and mast

Ref.	Item	Standard
1)	Clearance between main roller rolling face and mast	1 mm (0.04 in.) or less
2)	Clearance between main roller side face and mast	0.1 to 0.5 mm (0.004 to 0.020 in.)

System	Check items	Pre-start (daily/10 hours)	Every 50 hrs or weekly	1st month (200 hrs)	Every 500 hrs or 3 months	Every 1000 hrs or 6 months	Every 2000 hrs or 12 months	Others (see note 1)
Front End	Check lift chains	×						
	Check lift cylinder mounting bolt	×						
	Check load backrest	×						
	Check mast and forks	×						
	Check mast strip sliding surfaces	×						
	Check tilt cylinder socket bolts	×						
	Lubricate lift chains (see note (2))			L	L			
	Lubricate mast support (see note (2))			L	L			
	Lubricate tilt socket pins (see note (2))			L	L			
	Change lift chains							***
Steering, Axle	Check front axle						×	
	Check power steering cylinder						×	
	Check rear axle						×	
	Check steering valve						×	
	Check steering wheel	×						
	Lubricate king pins (see note (2))			L	L			
	Lubricate tie rod pins (see note (2))			L	L			
	Change power steering cylinder hoses and rubber parts							**

INTRODUCTION

This service manual describes the specifications, maintenance and service procedures for Mitsubishi diesel engines.

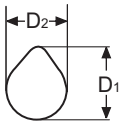
To maintain the performance of the engine for many years and to ensure safe operation, it is important to use the engine correctly and conduct regular inspection and maintenance, and it may also be necessary to take measures which involves the disassembly, inspection, repair and reassembly of the engine and engine parts.

Read this manual carefully and understand all of the work procedures fully before disassembling, inspecting, repairing or reassembling the engine.

The contents of the manual are based on the engine models that are being produced at the time of publication. Due to improvements made thereafter, the actual engine that you work on may differ partially from the one described in this manual.

Pub. No. 99729-88100

Table 2-2 Maintenance service data table - Basic engine (3 / 4) Unit: mm [in.]

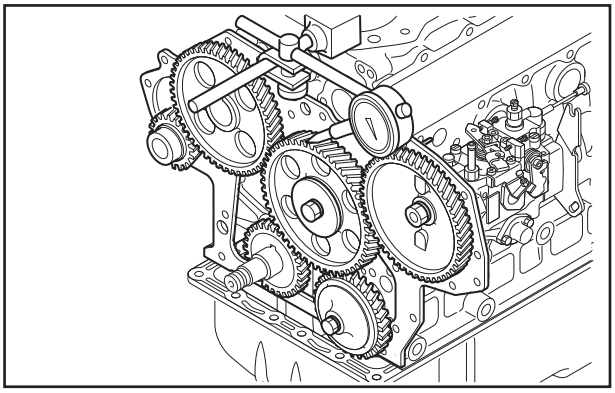
Inspection point			Nominal	Standard	Limit	Remark
Piston ring	Clearance between piston ring groove	No.1 compression ring	2.5 [0.098]	0.07 to 0.11 [0.0028 to 0.0043]	0.200 [0.0079]	Use the piston with replacement piston rings until reaching the limits. When reaching the limits, replace the piston.
		No.2 compression ring	2.0 [0.079]	0.045 to 0.085 [0.0018 to 0.0033]	0.150 [0.0059]	
		Oil ring	4.0 [0.157]	0.020 to 0.060 [0.0008 to 0.0024]	0.150 [0.0059]	
	Closed gap of ring	No.1 compression ring		0.30 to 0.50 [0.0118 to 0.0197]	1.50 [0.0591]	
		No.2 compression ring		0.50 to 0.70 [0.0197 to 0.0276]	1.50 [0.0591]	
		Oil ring		0.30 to 0.50 [0.0118 to 0.0197]	1.50 [0.0591]	
Piston pin	Outside diameter		ø 30 [1.18]	29.994 to 30.000 [1.1809 to 1.1811]		
	Clearance between piston pin			0.000 to 0.016 [0.0000 to 0.0006]	0.050 [0.0020]	
	Clearance between connecting rod bushing			0.020 to 0.091 [0.0008 to 0.0036]	0.120 [0.0047]	
Connecting rod	Bushing inside diameter		ø 30 [1.18]	30.020 to 30.045 [1.1819 to 1.1829]		
	Bend and twist			0.05/100 [0.0020/3.94] or less	0.15 [0.0059]	
	Clearance between crankpin and connecting rod bearing (oil clearance)			0.030 to 0.090 [0.0012 to 0.0035]	0.200 [0.0079]	Use connecting rod with replacement bearings until reaching the limit. When exceeding the limit, regrind the crankpin and replace the bearing with an undersized one.
	End play		33 [1.30]	0.15 to 0.35 [0.0059 to 0.0138]	0.50 [0.0197]	Replace connecting rod.
	Weight difference of connecting rod assembly in one engine			10 g [0.35 oz.] or less		
Flywheel	Flatness			0.10 [0.0039] or less	0.50 [0.0197]	
	Runout			0.15 [0.0059] or less	0.50 [0.0197]	
Camshaft	Runout			0.04 [0.0016] or less	0.10 [0.0039]	TIR
	Cam lift	Inlet	6.684 [0.2631]	6.384 to 6.784 [0.2513 to 0.2671]	6.184 [0.2435]	
		Exhaust	6.720 [0.265]	6.420 to 6.820 [0.2528 to 0.2685]	6.220 [0.2449]	
	Journal outside diameter	Front, middle	ø 54 [2.13]	53.94 to 53.96 [2.1236 to 2.1244]	53.90 [2.1220]	
		Rear	ø 53 [2.09]	52.94 to 52.96 [2.0842 to 2.0850]	52.90 [2.0827]	
	End play			0.10 to 0.25 [0.0039 to 0.0098]	0.30 [0.0118]	Replace thrust plate.

3.4 Measuring timing gear backlash

Measure the backlash of the timing gears by using one of the following two methods; measure the gear play with the dial gauge plunger applied to a tooth flank on the pitch circle at a right angle to the tooth axis, or measure the clearance between gears by inserting a thickness gauge between the gears at the tooth-to-tooth contacting area. Replace the faulty gear pair if the limit is exceeded.

Item	Standard	Limit
Timing gear backlash	0.05 to 0.15 mm [0.0020 to 0.0059 in.]	0.25 mm [0.0098 in.]

Note: With the injection pump gear attached to the pump, install the injection pump gear to the front plate.



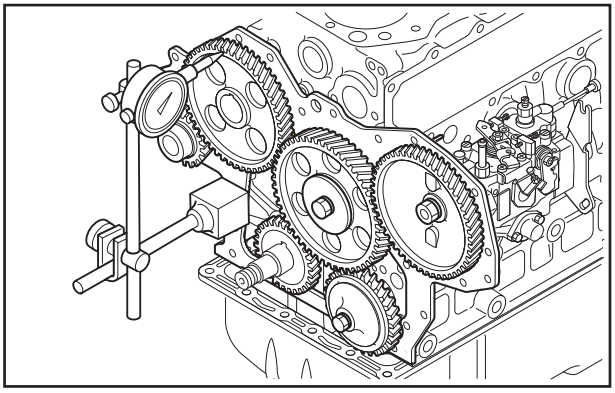
Measuring timing gear backlash

3.5 Measuring idler gear and camshaft gear end play

Using a thickness gauge or dial gauge, measure the end play of idler gear and camshaft gear.

If the measured value exceeds the limit, replace the thrust plate with a new one.

Item		Standard	Limit
End play	Idler gear	0.05 to 0.20 mm [0.0020 to 0.0079 in.]	0.35 mm [0.0138 in.]
	Camshaft	0.10 to 0.25 mm [0.0039 to 0.0098 in.]	0.30 mm [0.0118 in.]

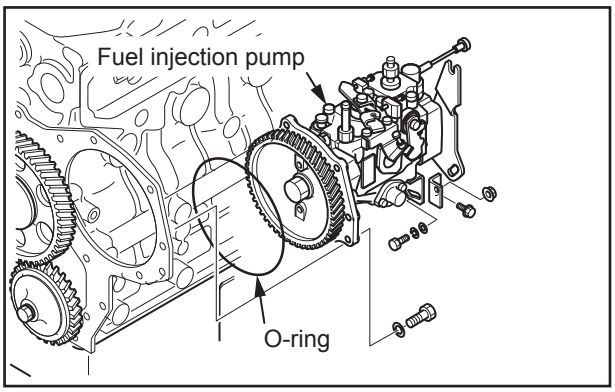


Measuring idler gear and camshaft gear end play

3.6 Removing fuel injection pump

(1) Remove the pump bracket mounting bolts.

(2) Unscrew the mounting bolts of fuel injection pump, and remove the fuel injection pump.



Removing fuel injection pump

4.7 Measuring piston protrusion

CAUTION

Piston protrusion must always meet the standard, as the amount of protrusion not only influences on the engine performance, but also it is important to prevent valve interference.

Measure the protrusion of each piston following the instructions below. If the measured value does not meet the standard, inspect the clearances between various parts involved.

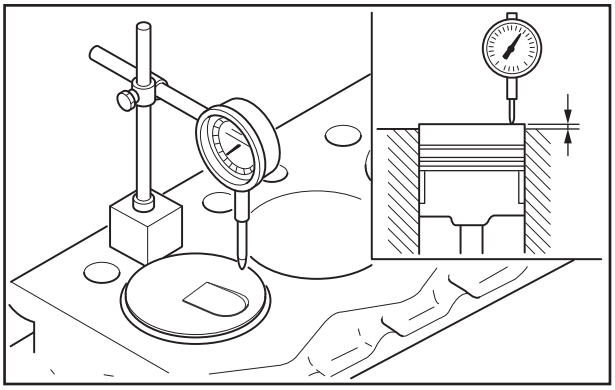
(1) Bring the piston to top dead center.

(2) Apply the dial gauge plunger to the top surface of the crankcase, and zero the dial gauge.

(3) Measure the protrusion at four points on the piston head, and calculate the mean value.

Note: Subtract the mean value from the thickness of the gasket compressed by tightening the cylinder head, and the clearance between the piston top and cylinder head will be determined.

Item	Standard
Piston protrusion	-0.25 to 0.15 mm [-0.0098 to 0.0059 in.]
Compressed thickness of cylinder head gasket	1.15 to 1.25 mm [0.0453 to 0.0492 in.]



Measuring piston protrusion

3. Reassembling flywheel

3.1 Installing rear plate

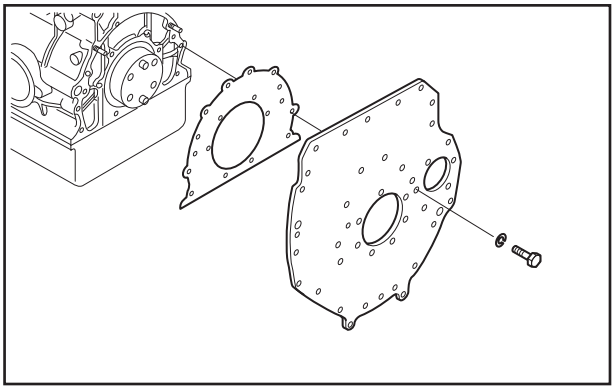
(1) Clean the mounting surface of the gasket.

(2) Apply sealant to the gasket to prevent it from falling off.

(3) Install the gasket.

(4) Install the rear plate, use a guide bar aligning its dowel pin holes and dowel pins, and tighten the bolts.

Note: When the dowel pins are worn or when the rear plate is replaced, replace the dowel pins with new ones.



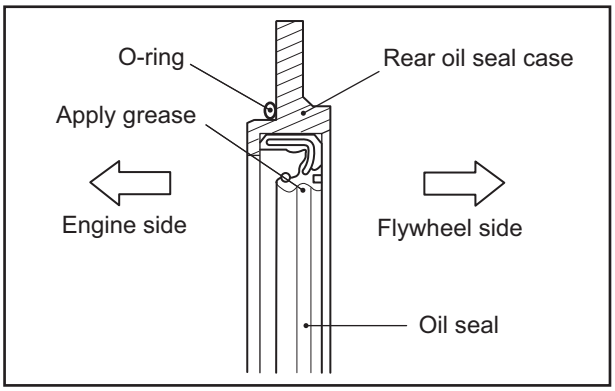
Installing rear plate

3.2 Installing oil seal

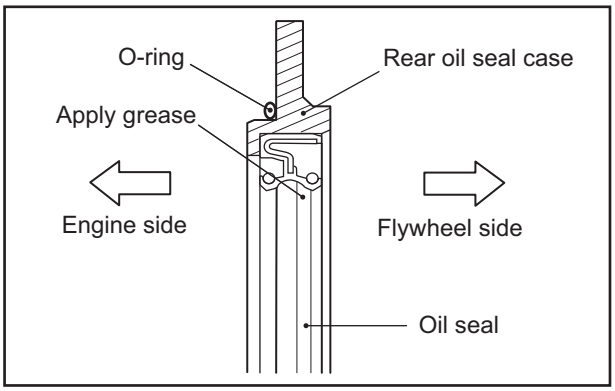
Apply a small quantity of grease to the new oil seal, and install the oil seal to the rear plate.

Be careful of the oil seal installation direction.

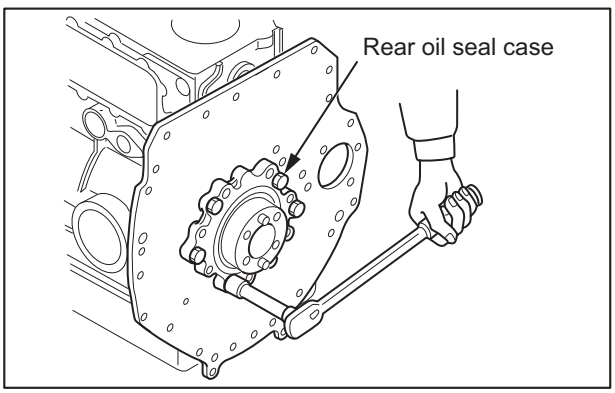
Note: Use an oil seal with a sleeve if the oil seal contacting surface of the crankshaft is worn.



Installing oil seal - Dry



Installing oil seal - Wet



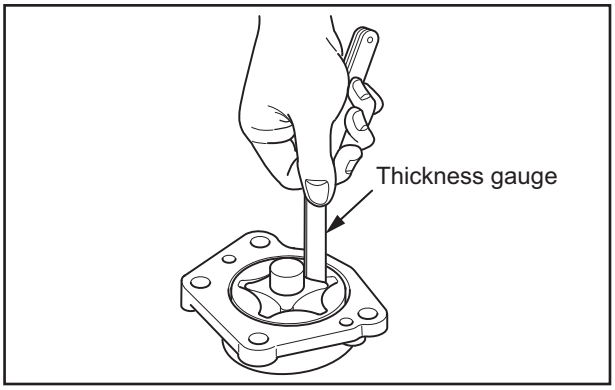
Installing rear oil seal

2.2 Inspecting oil pump

2.2.1 Measuring clearance between outer rotor and inner rotor

Measure the clearance between the outer rotor and the inner rotor. If measured value exceeds the limit, replace the oil pump with a new one.

Item	Standard	Limit
Clearance between outer rotor and inner rotor	0.13 to 0.15 mm [0.0051 to 0.0059 in.]	0.20 mm [0.0079 in.]

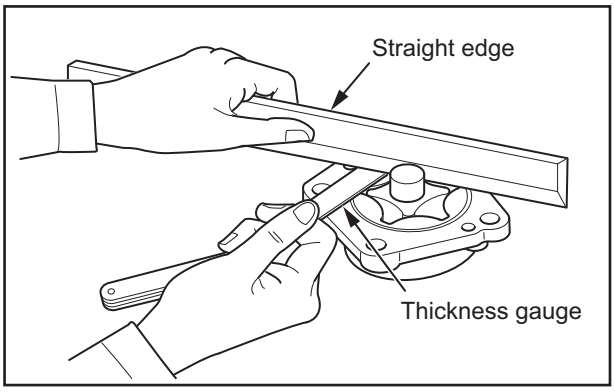


Measuring clearance between outer rotor and inner rotor

2.2.2 Measuring end play of rotor and pump case

Measure the end play of the rotor and the pump case. If measured value exceeds the limit, replace the oil pump with a new one.

Item	Standard	Limit
End play of rotor and pump case	0.04 to 0.09 mm [0.0016 to 0.0035 in.]	0.15 mm [0.0059 in.]

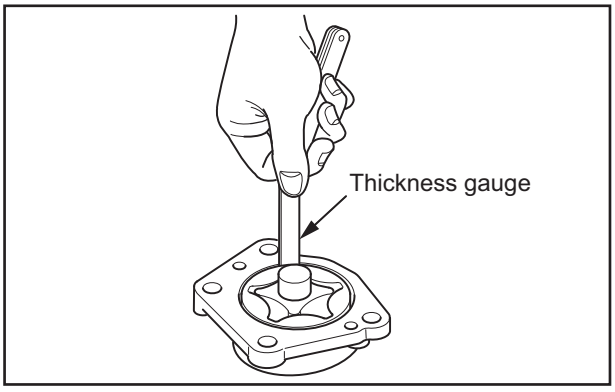


Measuring end play of rotor and pump case

2.2.3 Measuring clearance between outer rotor and pump case

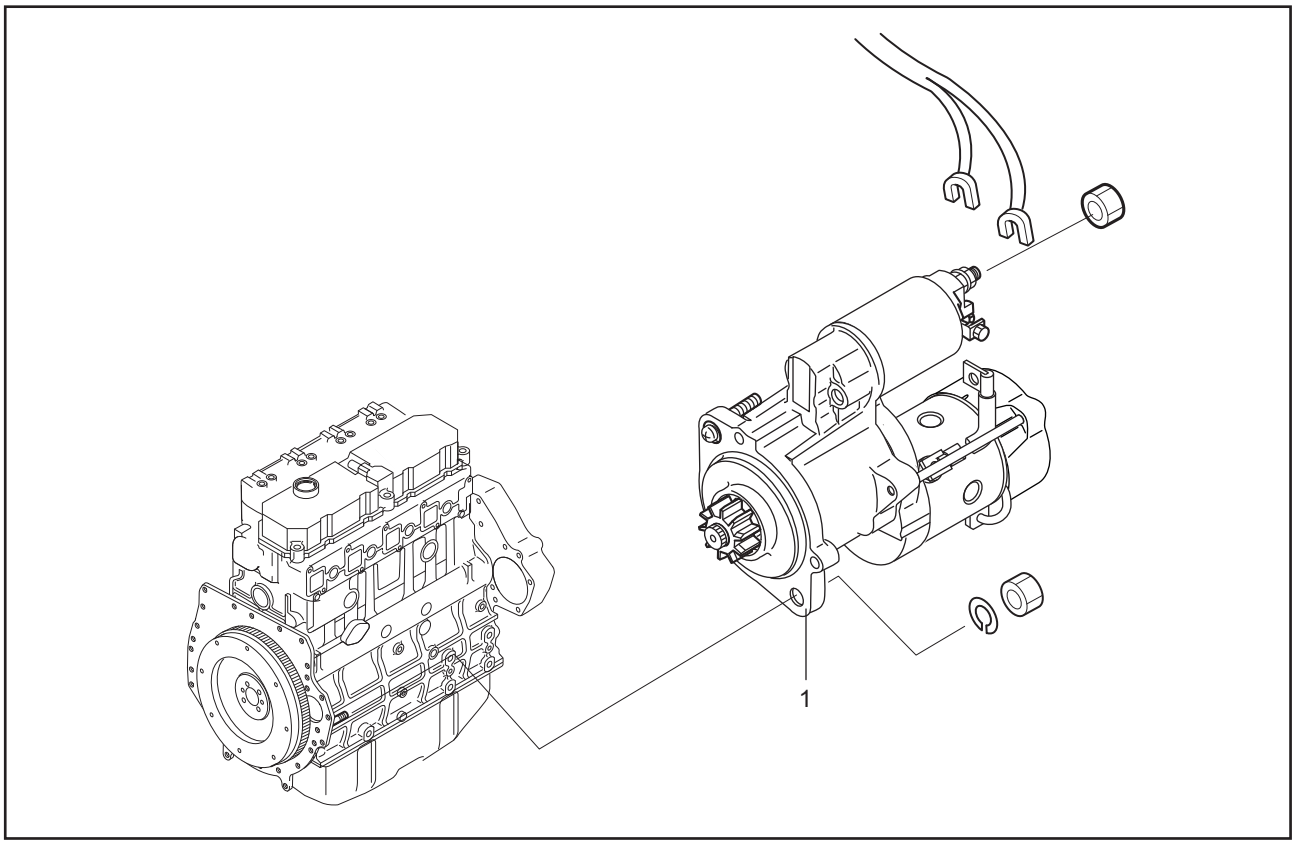
Measure the clearance between the outer rotor and the pump case. If measured value exceeds the limit, replace the oil pump with a new one.

Item	Standard	Limit
Clearance between outer rotor and case	0.20 to 0.30 mm [0.0079 to 0.0118 in.]	0.50 mm [0.0197 in.]



Measuring clearance between outer rotor and pump case

1.2 Removing starter (M002TS0071A)



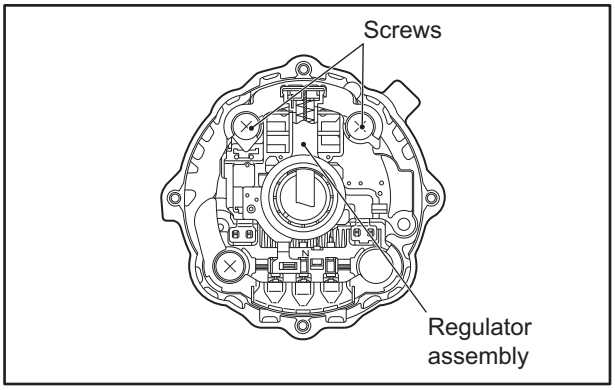
Removing starter

Removing sequence

1 Starter

2.8.6 Removing regulator assembly

Remove the screws of the regulator assembly and then remove the regulator assembly.

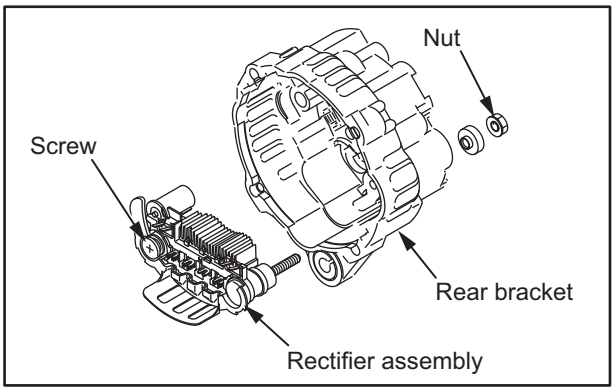


Removing regulator assembly

2.8.7 Removing rectifier assembly

(1) Remove the screw and nut from the rectifier.

(2) Remove the rectifier assembly.



Removing rectifier assembly