CEBM023802

Shop Manual

960E-1

DUMP TRUCK

SERIAL NUMBERS **A30025 - A30026**

KOMATSU®

DUMP TRUCK

960E

Machine model	Serial number
960E-1	A30025 - A30026

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Composition of shop manual

The contents of this shop manual are shown together with Form No. in a list.

Note 1: Always keep the latest version of this manual in accordance with this list and utilize accordingly.
The marks shown to the right of Form No. denote the following:
□: New module (to be filed additionally) ●: Revision (to be replaced for each Form No.)

Note 2: This shop manual can be supplied for each Form No.

Note 3: To file this shop manual in the special binder for management, handle it as follows:
- Place a divider on the top of each section in the file after matching the Tab No. with No. indicated next to each Section Name shown in the table below:
- File overview and other materials in sections in the order shown below and utilize them accordingly.

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960E Dump truck

Form No. CEN00011-02

DUMP TRUCK

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960E-2	A30027 and up

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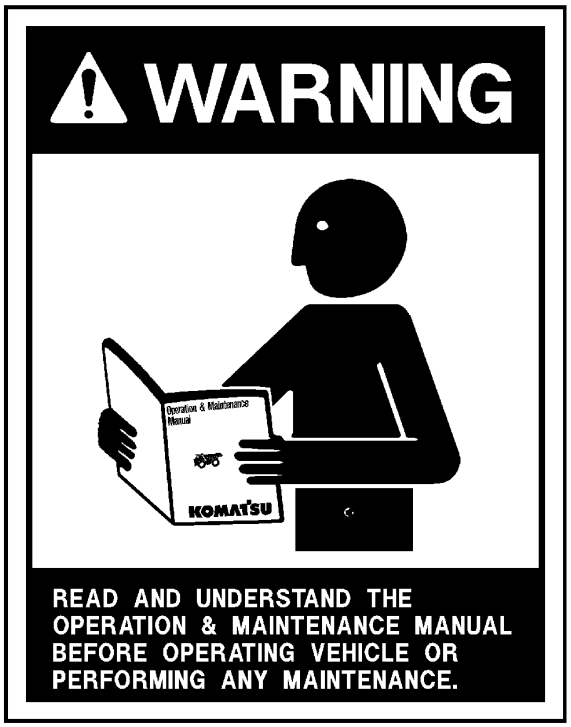


Unsafe use of this machine may cause serious injury or death. Operators and maintenance personnel must read and understand this manual before operating or maintaining this machine.

This manual should be kept in or near the machine for reference, and periodically reviewed by all personnel who will come into contact with it.

CALIFORNIA
Proposition 65 Warning

Diesel engine exhaust, some of its constituents, and certain vehicle components contain or emit chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

CALIFORNIA
Proposition 65 Warning

Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. Wash hands after handling.

CALIFORNIA
Proposition 65 Warning

Mercury and mercury compounds are known to the State of California to cause developmental problems. This machine may be equipped with optional HID lamps which contain mercury. There is no risk of exposure unless the lamps are broken. However, the lamps must be reused, recycled or properly disposed of in accordance with Local, State and Federal Laws at the end of their useful lives.

⚠WARNING

NON-OEM PARTS IN CRITICAL SYSTEMS

For safety reasons, Komatsu America Corp. strongly recommends against the use of non-OEM replacement parts in critical systems of all Komatsu equipment. Critical systems include but are not limited to steering, braking and operator safety systems.

Replacement parts manufactured and supplied by unauthorized sources may not be designed, manufactured or assembled to Komatsu's design specifications; accordingly, use of such parts may compromise the safe operation of Komatsu products and place the operator and others in danger should the part fail.

Komatsu is also aware of repair companies that will rework or modify an OEM part for reuse in critical systems. Komatsu does not generally authorize such repairs or modifications for the same reasons as noted above.

Use of non-OEM parts places full responsibility for the safe performance of the Komatsu product on the supplier and user. Komatsu will not in any case accept responsibility for the failure or performance of non-OEM parts in its products, including any damages or personal injury resulting from such use.

Foreword

This manual is written for use by the operator and/or the service technician. It is designed to help these persons to become fully knowledgeable of the truck and all of its systems in order to keep it operating safely and efficiently. All operators and maintenance personnel should read and understand the information in this manual before operating the truck or performing maintenance and/or operational checks on the truck. All safety notices, warnings, and cautions should be understood and followed when operating the truck or performing repairs on the truck.

The first section covers component descriptions, truck specifications and safe work practices, as well as other general information. The major portion of the manual pertains to disassembly, service and reassembly. Each major serviceable area is dealt with individually. For example, the disassembly, service and reassembly of the radiator group is discussed as a unit. The same is true of the engine and engine accessories, and so on through the entire mechanical detail of the truck. Disassembly should be carried only as far as necessary to accomplish needed repairs.

The illustrations used in this manual are *typical* of the component shown and may not be an *exact* reproduction of what is found on the truck.

This manual shows dimensioning of U.S. standard and metric (SI) units throughout. All references to “right,” “left,” “front,” or “rear” are made with respect to the operator's normal seated position unless specifically stated otherwise.

When assembly instructions are provided without references to specific torque values, standard torque values should be used. Standard torque values are shown in torque charts later in this section. Specific torques, when provided in the text, are in bold face type, such as **135 N·m (100 ft lb)**. All torque specifications have ±10% tolerance unless otherwise specified.

A product identification plate is located on the frame in front of the right side front wheel. It designates the Truck Model Number, Product Identification Number (vehicle serial number), and Maximum GVW (Gross Vehicle Weight) rating.

The KOMATSU truck model designation consists of three numbers and one letter (i.e. 960E).

The three numbers represent the basic truck model.

The letter “E” designates an Electrical wheel motor drive system.

The Product Identification Number (vehicle serial number) contains information which identifies several characteristics of this unit. For a more detailed explanation, refer to the Operation and Maintenance Manual.

The Gross Vehicle Weight (GVW) is what determines the load on the drive train, frame, tires, and other components. The vehicle design and application guidelines are sensitive to the maximum GVW.
GVW is *total weight*: **empty vehicle weight + fuel & lubricants + payload.**

To determine the *allowable payload*, fill all lubricants to the proper level and fill the fuel tank of an empty truck (which includes all accessories, body liners, tailgates, etc.), and then weigh the truck. Record this value and subtract it from the GVW. The result is the allowable payload.

NOTE: Accumulations of mud, frozen material, etc, become part of the GVW and reduces the allowable payload. To maximize payload and to keep from exceeding the maximum GVW rating, these accumulations should be removed as often as practical.

Exceeding the allowable payload will reduce the expected life of truck components.

How to read the shop manual

- Some attachments and optional parts in this shop manual may not be delivered to certain areas. If one of them is required, consult KOMATSU distributors.
- Materials and specifications are subject to change without notice.
- Shop manuals are divided into the “Chassis volume” and “Engine volume”. For the engine unit, see the engine volume of the engine model mounted on the machine.

Composition of shop manual

This shop manual contains the necessary technical information for services performed in a workshop. For ease of understanding, the manual is divided into the following sections.

00. Index and foreword
This section explains the shop manuals list, table of contents, safety, and basic information.

01. Specification
This section explains the specifications of the machine.

10. Structure, function and maintenance standard
This section explains the structure, function, and maintenance standard values of each component. The structure and function sub-section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for trouble-shooting. The maintenance standard sub-section explains the criteria and remedies for disassembly and service.

20. Standard value table
This section explains the standard values for new machine and judgement criteria for testing, adjusting, and troubleshooting. This standard value table is used to check the standard values in testing and adjusting and to judge parts in troubleshooting.

30. Testing and adjusting
This section explains measuring instruments and measuring methods for testing and adjusting, and method of adjusting each part. The standard values and judgement criteria for testing and adjusting are explained in Testing and adjusting.

40. Troubleshooting
This section explains how to find out failed parts and how to repair them. The troubleshooting is divided by failure modes.

50. Disassembly and assembly
This section explains the special tools and procedures for removing, installing, disassembling, and assembling each component, as well as precautions for them. In addition, tightening torque and weight of components are also explained.

90. Diagrams and drawings
This section gives hydraulic circuit diagrams and electrical circuit diagrams.

Revision and distribution

Any additions, revisions, or other change of notices will be sent to KOMATSU distributors. Get the most up-to-date information before you start any work.

Symbols

This "ALERT" symbol is used with the signal words, "DANGER", "WARNING", and "CAUTION" in this manual to alert the reader to hazards arising from improper operating and maintenance practices.

⚠ DANGER

"DANGER" identifies a specific potential hazard WHICH WILL RESULT IN EITHER INJURY OR DEATH if proper precautions are not taken.

⚠ WARNING

"WARNING" identifies a specific potential hazard WHICH MAY RESULT IN EITHER INJURY OR DEATH if proper precautions are not taken.

⚠ CAUTION

"CAUTION" is used for general reminders of proper safety practices OR to direct the reader's attention to avoid unsafe or improper practices which may result in damage to the equipment.

General safety

Safety records from most organizations will show that the greatest percentage of accidents are caused by unsafe acts performed by people. The remainder are caused by unsafe mechanical or physical conditions. Report all unsafe conditions to the proper authority.

The following safety rules are provided as a guide for the operator. However, local conditions and regulations may add many more to this list.

⚠WARNING

Read and follow all safety precautions. Failure to do so may result in serious injury or death.

Safety rules

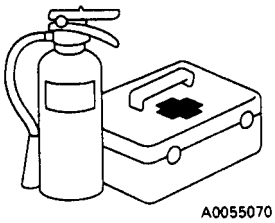
- Only trained and authorized personnel may operate and maintain the truck.
- Follow all safety rules, precautions and instructions when operating or performing maintenance on the truck.
- When working with another operator or a person on work site traffic duty, make sure that all personnel understand all hand signals that are to be used.

Safety features

- Make sure that all guards and covers are in their proper position. Have any damaged guards and covers repaired. (See Operating Instructions - “Preparing For Operation”.)
- Learn the proper use of safety features such as safety locks, safety pins, and seat belts. Use these safety features properly.
- Never remove any safety features. Always keep them in good operating condition.
- Improper use of safety features could result in serious bodily injury or death.
- Check the seat belt fabric, buckle and hardware for damage or wear. Replace any worn or damaged parts immediately.
- The seat belts must be replaced 5 years after seat belt manufacture, or after every 3 years of use, whichever comes first.

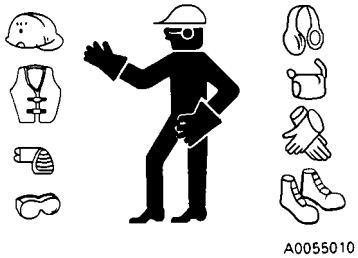
Fire extinguisher and first aid kit

- Make sure that fire extinguishers are accessible and proper usage techniques are known.
- Provide a first aid kit at the storage point.
- Know what to do in the event of a fire.
- Keep the phone numbers of persons you should contact in case of an emergency on hand.



Clothing and personal items

- Avoid loose clothing, jewelry, and loose long hair. They can catch on controls or in moving parts and cause serious injury or death. Also, never wear oily clothes as they are flammable.
- Wear a hard hat, safety glasses, safety shoes, mask and gloves when operating or maintaining a truck. Always wear safety goggles, hard hat and heavy gloves if your job involves scattering metal chips or minute materials, particularly when driving pins with a hammer or when cleaning air cleaner elements with compressed air. Also, ensure that the work area is free from other personnel during such tasks.



Leaving the operator seat

When preparing to leave the operator's seat, do not touch any control lever that is not locked. To prevent accidental operations from occurring, always perform the following:

- Move the directional control lever to PARK. **Do not use the wheel brake lock when the engine will be turned off.**
- Lower the dump body to the frame.
- Stop the engine. When exiting the truck, always lock compartments and take the keys with you. If the truck should suddenly move or move in an unexpected way, this may result in serious bodily injury or death.

Mounting and dismounting

- Use the handrails and steps when getting on or off the truck.
- Never jump on or off the truck. Never climb on or off a truck while it is moving.
- When climbing on or off a truck, face the truck and use the hand-hold and steps.
- Never hold any control levers when getting on or off a truck.
- Always maintain three-point contact with the hand-holds and steps to ensure that you support yourself.
- When bringing tools into the operator's compartment, always pass them by hand or pull them up by rope.
- If there is any oil, grease, or mud on the hand-holds or steps, wipe them clean immediately. Always keep these components clean. Repair any damage and tighten any loose bolts.

Fire prevention for fuel and oil

- Fuel, oil, and antifreeze can be ignited by a flame. Fuel is extremely flammable and can be hazardous. Keep flames away from flammable fluids.
- Keep oil and fuel in a designated location and do not allow unauthorized persons to enter.
- When refueling, stop the engine and do not smoke.
- Refueling and oiling should be done in well ventilated areas.
- Tighten all fuel and oil tank caps securely.

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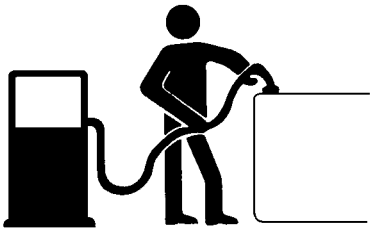

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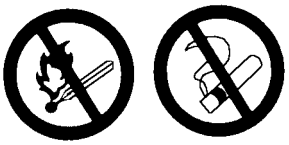

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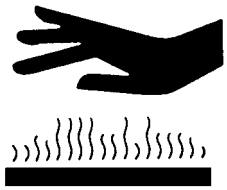
Precautions with high temperature fluids

Immediately after truck operation, engine coolant, engine oil, and hydraulic oil are at high temperatures and are pressurized. If the cap is removed, the fluids are drained, the filters are replaced, etc., there is danger of serious burns. Allow heat and pressure to dissipate before performing such tasks and follow proper procedures as outlined in the service manual.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To prevent hot coolant from spraying:

1. Stop the engine.
2. Wait for the coolant temperature to decrease.
3. Depress the pressure release button on the cap to vent cooling system pressure.
4. Turn the radiator cap slowly to release the pressure before removing.

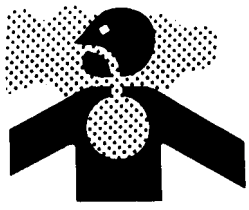
To prevent hot engine oil spray:

1. Stop the engine.
2. Wait for the oil temperature to cool down.
3. Turn the cap slowly to release the pressure before removing the cap.

Asbestos dust hazard prevention

Asbestos dust is hazardous to your health when inhaled. If you handle materials containing asbestos fibers, follow the guidelines below:

- Never use compressed air for cleaning.
- Use water for cleaning to control dust.
- Operate the truck or perform tasks with the wind to your back whenever possible.
- Use an approved respirator when necessary.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Prevention of injury by work equipment

Never enter or put your hand, arm or any other part of your body between movable parts such as the dump body, chassis or cylinders. If the work equipment is operated, clearances will change and may lead to serious bodily injury or death.

Unauthorized modification

Any modification made to this vehicle without authorization from Komatsu America Corp. can possibly create hazards.

Before making any modification, consult the authorized regional Komatsu America Corp. distributor. Komatsu will not be responsible for any injury or damage caused by any unauthorized modification.

Precautions when using ROPS

The ROPS is intended to protect the operator if the truck should roll over. It is designed not only to support the load of the truck, but also to absorb the energy of the impact.

- The Rollover Protection Structure (ROPS) must be properly installed before the truck is operated.
- ROPS installed on equipment manufactured and designed by Komatsu America Corp. fulfills all of the regulations and standards for all countries. If it is modified or repaired without authorization from Komatsu, or if it is damaged when the truck rolls over, the strength of the structure will be compromised and will not be able to fulfill its intended purpose. Optimum strength of the structure can only be achieved if it is repaired or modified as specified by Komatsu.
- When modifying or repairing the ROPS, always consult your nearest Komatsu distributor.
- Even with the ROPS installed, the operator must always use the seat belt when operating the truck.

Precautions for attachments

- When installing and using optional equipment, read the instruction manual for the attachment and the information related to attachments in this manual.
- Do not use attachments that are not authorized by Komatsu America Corp. or the authorized regional Komatsu distributor. Use of unauthorized attachments could create a safety problem and adversely affect the proper operation and useful life of the truck.
- Any injuries, accidents, and product failures resulting from the use of unauthorized attachments will not be the responsibility of Komatsu America Corp. or the authorized regional Komatsu distributor.

Precautions for starting the truck

Start the engine from the operator seat only. Never attempt to start the engine by shorting across the cranking motor terminals. This may cause a fire, serious injury or death to anyone in truck's path.

Precautions before operating the truck

Safety is thinking ahead. Prevention is the best safety program. Prevent a potential accident by knowing the employer's safety requirements and all necessary job site regulations. In addition, know the proper use and care of all the safety equipment on the truck. Only qualified operators or technicians should attempt to operate or maintain a Komatsu machine.

Safe practices start before the operator gets to the equipment.

Safety at the worksite

- When walking to and from a truck, maintain a safe distance from all machines even when the operator is visible.
- Before starting the engine, thoroughly check the area for any unusual conditions that could be dangerous.
- Examine the road surface at the job site and determine the best and safest method of operation.
- Choose an area where the ground is as horizontal and firm as possible before performing the operation.
- If you need to operate on or near a public road, protect pedestrians and cars by designating a person for work site traffic duty or by installing fences around the work site.
- The operator must personally check the work area, the roads to be used, and the existence of obstacles before starting operations.
- Always determine the travel roads at the work site and maintain them so that it is always safe for the machines to travel.
- If travel through wet areas is necessary, check the depth and flow of water before crossing the shallow parts. Never drive through water that exceeds the permissible water depth.

Fire prevention

- Remove wood chips, leaves, paper, and other flammable items that have accumulated in the engine compartment. Failure to do so could result in a fire.
- Check the fuel, lubrication, and hydraulic systems for leaks. Repair any leaks. Clean any excess oil, fuel or other flammable fluids, and dispose of them properly.
- Make sure that a fire extinguisher is present and in proper working condition.
- Do not operate the truck near open flames.

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Ventilation in enclosed areas

If it is necessary to start the engine within an enclosed area, provide adequate ventilation. Inhaling exhaust fumes from the engine can kill.

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Preparing for operation

- Always mount and dismount while facing the truck. Never attempt to mount or dismount the truck while it is in motion. Always use handrails and ladders when mounting or dismounting the truck.
- Check the deck areas for debris, loose hardware and tools. Check for people and objects that might be in the area.
- Become familiar with and use all protective equipment devices on the truck and ensure that these items (anti-skid material, grab bars, seat belts, etc.) are securely in place.

Mirrors, windows and lights

- Remove any dirt from the surface of the windshield, cab windows, mirrors and lights. Good visibility may prevent an accident.
- Adjust the rear view mirror to a position where the operator can see best from the operator's seat. If any glass or light is broken, replace it with a new part.
- Make sure that the headlights, work lights, and taillights are in proper working order. Make sure that the truck is equipped with the proper work lamps that are needed for the operating conditions.

In operator cab (before starting the engine)

- Do not leave tools or spare parts lying around. Do not allow trash to accumulate in the cab of the truck. Keep all unauthorized reading material out of the truck cab.
- Keep the cab floor, controls, steps and handrails free of oil, grease, snow and excess dirt.
- Read and understand the contents of this manual. Pay special attention to the sections pertaining to safety and operating instructions. Become thoroughly acquainted with all gauges, instruments and controls before attempting operation of the truck.
- Read and understand the **WARNING** and **CAUTION** decals in the operator's cab.
- Make sure that the steering wheel, horn, controls and pedals are free of any oil, grease or mud.
- Check the operation of the windshield wiper, condition of wiper blades, and the washer fluid reservoir level.
- Be familiar with all steering and brake system controls, warning devices, road speeds and loading capabilities before operating the truck.

Seat Belts

- On both driver and passenger seats, check the seat belt fabric, buckle, all belt retractors and hardware for damage or wear. Replace any worn or damaged parts immediately.
- Even if there are no signs of damage, replace both driver and passenger seat belts 5 years after seat belt manufacture, or every 3 years after start of use, whichever comes first. The passenger seat belt date of manufacture label is sewn into the seat belt near the buckle. The driver seat belt date of manufacture label is sewn into the shoulder harness belt, near the retractor end.

Precautions while operating the truck

When starting the engine

- Never attempt to start the engine by shorting across cranking motor terminals. This may cause a fire, or serious injury or death to anyone in truck's path.
- Never start the engine if a warning tag has been attached to the controls.
- When starting the engine, sound the horn as an alert.
- Start and operate the truck only while seated in the operator's seat.
- Do not allow any unauthorized persons in the operator's compartment or any other place on the truck.

General truck operation

- Wear the seat belt at all times.
- Only authorized persons are allowed to ride in the truck. Riders must be in the cab and belted in the passenger seat.
- Do not allow anyone to ride on the decks or steps of the truck.
- Do not allow anyone to get on or off the truck while it is in motion.
- Do not move the truck in or out of a building without a signal person present.
- Know and obey the hand signal communications between operator and spotter. When other machines and personnel are present, the operator should move in and out of buildings, loading areas, and through traffic under the direction of a signal person. Courtesy at all times is a safety precaution.
- Immediately report any adverse conditions at the haul road, pit or dump area that may cause an operating hazard.
- Check for flat tires periodically during a shift. If the truck has been operating on a "flat", do not park the truck inside a building until the tire cools. If the tire must be changed, do not stand in front of the rim and locking ring when inflating a tire mounted on the truck. Observers should not be permitted in the area and should be kept away from the side of such tires.

⚠DANGER

The tire and rim assembly may explode if subjected to excessive heat. Personnel should move to a remote or protected location if sensing excessively hot brakes, smelling burning rubber or observing evidence of fire near the tire and wheel area.

If the truck must be approached to extinguish a fire, those personnel should do so only while facing the tread area of the tire (front or back) unless protected by using large heavy equipment as a shield. Stay at least 15 m (50 ft) from the tread of the tire.

In the event of fire in the tire and wheel area (including brake fires), stay away from the truck for at least 8 hours or until the tire and wheel are cool.

- Keep serviceable fire fighting equipment on hand. Report empty extinguishers for replacement or refilling.
- Always place the directional control lever in the PARK position when the truck is parked and unattended. Do not leave the truck unattended while the engine is running.

NOTE: DO NOT use wheel brake lock when parking the truck.

- Park the truck a safe distance away from other vehicles as determined by the supervisor.
- Stay alert at all times! In the event of an emergency, be prepared to react quickly and avoid accidents. If an emergency arises, know where to get prompt assistance.

Ensuring good visibility

- When working in dark places, install work lamps and head lamps. Set up extra lighting in the work area if necessary.
- Discontinue operations if visibility is poor, such as in mist, snow, or rain. Wait for the weather to improve to allow the operation to be performed safely.

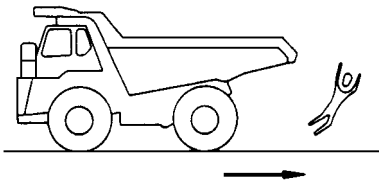
Traveling

- When traveling on rough ground, travel at low speeds. When changing direction, avoid turning suddenly.
- Lower the dump body and set the dump lever to the FLOAT position before traveling.
- If the engine stops while the truck is in motion, secondary steering and braking enable the truck to be steered and stopped. A fixed amount of reserve oil provides temporary steering and braking to briefly allow the truck to travel to a safe area. Apply the brakes immediately and stop the truck as quickly and safely as possible off of the haul road, if possible.

Traveling in reverse

Before operating the truck:

- Sound the horn to warn people in the area. Make sure that the back-up horn also works properly.
- Check for personnel near the truck. Be particularly careful to check behind the truck.
- When necessary, designate a person to watch the area near the truck and signal the operator. This is particularly necessary when traveling in reverse.
- When operating in areas that may be hazardous or have poor visibility, designate a person to direct work site traffic.
- Do not allow any one to enter the line of travel of the truck. This rule must be strictly observed even with machines equipped with a back-up horn or rear view mirror.



Traveling on slopes

- Traveling on slopes could result in the truck tipping over or slipping.
- Do not change direction on slopes. To ensure safety, drive to level ground before turning.
- Do not travel up and down on grass, fallen leaves, or wet steel plates. These materials may make the truck slip on even the slightest slope. Avoid traveling sideways, and always keep travel speed low.
- When traveling downhill, use the retarder to reduce speed. Do not turn the steering wheel suddenly. Do not use the foot brake except in an emergency.
- If the engine should stop on a slope, apply the service brakes fully and stop the truck. Move the directional control lever to PARK after the truck has stopped.

Operating on snow or ice

- When working on snowy or icy roads, there is danger that the truck may slip to the side on even the slightest slope. Always travel slowly and avoid sudden starting, turning, or stopping in these conditions.
- Be extremely careful when clearing snow. The road shoulder and other objects are buried in the snow and cannot be seen.

Avoid damage to dump body

Always be extremely cautious when working in tunnels, on bridges, under electric cables, or when entering a parking place or any other place where there are height limits. The dump body must be completely lowered before driving the truck.

Driving near high voltage cables

Driving near high voltage cables can cause electric shock. Always maintain safe distances between the truck and the high voltage cable as listed below.

Voltage	Minimum Safety Distance	
6.6 kV	3 m	10 ft.
33.0 kV	4 m	14 ft.
66.0 kV	5 m	17 ft.
154.0 kV	8 m	27 ft.
275.0 kV	10 m	33 ft.

The following actions are effective in preventing accidents while working near high voltages:

- Wear shoes with rubber or leather soles.
- Use a signalman to give warning if the truck approaches an electric cable.
- If the work equipment touches an electric cable, the operator should not leave the cab.
- When performing operations near high voltage cables, do not allow anyone to approach the truck.
- Check with the electrical maintenance department about the voltage of the cables before starting operations.

When dumping

- Before starting the dumping operation, make sure that there are no persons or objects behind the truck.
- Stop the truck in the desired location. Check again for persons or objects behind the truck. Give the determined signal, then slowly operate the dump body. If necessary, use blocks for the wheels or position a flagman.
- When dumping on slopes, truck stability is poor and there is danger of tipping over. Always use extreme care when performing such operations.
- Never travel with the dump body raised.

When loading

- Make sure that the surrounding area is safe. Stop the truck in the correct loading position, then load the body uniformly.
- Do not leave the operator seat during the loading operation.

Working on loose ground

- Avoid operating the truck near cliffs, overhangs and deep ditches. If these areas collapse, the truck could fall or tip over and result in serious injury or death. Remember that ground surfaces in these areas may be weakened after heavy rain or blasting.
- Freshly laid soil and the soil near ditches is loose. It can collapse under the weight or vibration of the truck. Avoid these areas whenever possible.

Parking the truck

- Choose a flat, level surface to park the truck. If the truck has to be parked on a slope, put blocks behind all the wheels to prevent truck movement.
- Do not activate the wheel brake lock when the parking brake is activated. Bleed down of hydraulic pressure may occur, causing the truck to roll away.
- When parking on public roads, provide fences and signs, such as flags or lights, on the truck to warn pedestrians and other vehicles. Make sure that the truck, flags or lights do not obstruct traffic.
- Lower the dump body fully, move the directional control lever to PARK, stop the engine and lock everything. Always take the key with you.

Towing

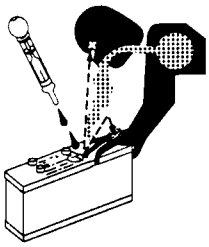
Improper towing methods may lead to serious personal injury and/or damage. For towing methods, refer to Index and foreword section **Operating instructions**.

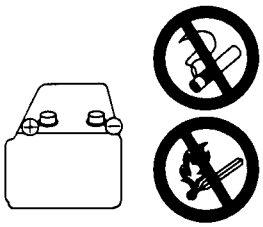
- Use a towing device with ample strength for the weight of this truck.
- Never tow a truck on a slope.
- Inspect towing components, such as tow bars and couplings, for any signs of damage. Never use damaged or worn components to tow a disabled vehicle.
- Keep a safe distance from the trucks and towing apparatus while towing a vehicle.
- When connecting a truck that is to be towed, do not allow anyone to go between the tow vehicle and the disabled vehicle.
- Set the coupling of the truck being towed in a straight line with the towing portion of the tow truck, and secure it in position.

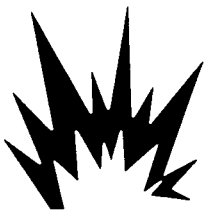
Working near batteries

Battery hazard prevention

- Battery electrolyte contains sulfuric acid, which can quickly burn the skin and eat holes in clothing. If you spill acid on yourself, immediately flush the area with water.
- Battery acid can cause blindness if splashed into your eyes. If acid gets into your eyes, flush them immediately with large quantities of water and see a doctor at once.
- If you accidentally drink acid, drink a large quantity of water, milk, beaten eggs or vegetable oil. Call a doctor or poison prevention center immediately.
- Always wear safety glasses or goggles when working with batteries.
- Batteries generate hydrogen gas. Hydrogen gas is very explosive and can easily be ignited with a small spark or flame.
- Before working with batteries, stop the engine and turn the key switch to the OFF position.
- Avoid short-circuiting the battery terminals through accidental contact with metallic objects, such as tools, across the terminals.
- When removing or installing batteries, check which is the positive (+) terminal and the negative (-) terminal.
- Tighten battery caps securely.
- Tighten the battery terminals securely. Loose terminals can generate sparks and lead to an explosion.







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Starting with booster cables

- Always wear safety glasses or goggles when starting the machine with booster cables.
- While jump starting with another machine, DO NOT allow the two machines to touch.
- Ensure the parking brake is applied on both machines.
- Ensure the size of the booster cables and clips are suitable for the battery size. Inspect the cables and clips for any damage or corrosion.
- Ensure the key switch and both battery disconnect switches on the disabled machine are in the OFF position.
- Connect the batteries in parallel: positive to positive and negative to negative.
- Connect the positive (24VDC +) cable from the good machine to the (24VDC +) on the disabled machine first.
- Then connect the ground cable on the good machine to the frame of the disabled machine, as far away as possible from the batteries. This will prevent a spark from possibly starting a battery fire.
- Allow time for the batteries to charge.

NOTE: The batteries will charge even with the battery disconnect switches are in the OFF position.

- If starting with a booster cable, perform the operation with two people. One person in the cab of the disabled machine, the other person working with the jumper cables.
- If the batteries are low, DO NOT attempt starting the machine with only one set of jumper cables installed. Install the second set of jumper cables in the same way as already described.
- Turn the battery disconnect switches to the ON position and attempt starting.
- For booster cable removal, disconnect the ground or negative (-) cable first, then the (24VDC +) cable last.
- If any tool touches between the positive (+) terminal and the chassis, it will cause sparks. Always use caution when using tools near the battery.

Jump starting with receptacles

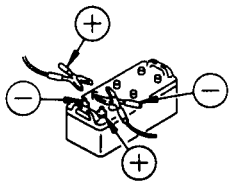
- Always wear safety glasses or goggles when starting the machine with booster cables.
- While jump starting with another machine, DO NOT allow the two machines to touch.
- Ensure the parking brake is applied on both machines.
- Inspect the cables and connectors for any damage or corrosion.
- Ensure the key switch and both battery disconnect switches on the disabled machine are in the OFF position.
- Connect the jumper cable to the receptacle on the good machine to the receptacle on the disabled machine.
- Allow time for the batteries to charge.

NOTE: The batteries will charge even with the battery disconnect switches are in the OFF position.

- If starting with a booster cable, perform the operation with two people. One person in the cab of the disabled machine, the other person working with the jumper cables.
- If the batteries are low, DO NOT attempt starting the machine with only one set of jumper cables installed. Install the second set of jumper cables in the same way as already described.
- Turn the battery disconnect switches to the ON position and attempt starting.
- For booster cable removal, disconnect the cables from each machine.

If any tool touches between the positive (+) terminal and the chassis, it will cause sparks. Always use caution when using tools near the battery.

INCORRECT



A030006

Precautions before performing service

Warning tag

Starting the engine or operating the controls while other personnel are performing maintenance on the truck can lead to serious injury and/or death. Always attach the warning tag to the control lever in the operator cab to alert others that you are working on the truck. Attach additional warning tags around the truck as necessary.

These tags are available from your Komatsu distributor. **Warning tag part number**: 09963-03001

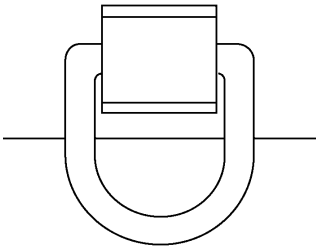
Stopping the engine

- Before performing inspections or maintenance, stop the truck on firm flat ground, lower the dump body, move the directional control lever to PARK, and stop the engine.
- If the engine must be run during service, such as when cleaning the radiator, the directional control lever must be in PARK. Always perform this work with two people. One person must sit in the operator's seat to stop the engine if necessary. During these situations, never move any controls that are not related to the task at hand.
- When servicing the truck, do not to touch any moving parts. Never wear loose clothing or jewelry.
- Put wheel blocks under the wheels to prevent truck movement.
- When performing service with the dump body raised, place the dump lever in the HOLD position and apply the lock (if equipped). Install the body-up safety sling securely.

Proper tools

Only use tools that are suited to the task. Using damaged, low quality, faulty or makeshift tools could cause personal injury.

Use of Tie-Off Anchor During Maintenance and Repair



While working at heights during assembly, maintenance or repair of the haul truck, workers should wear an appropriate fall protection harness and attach it to a tie-off anchor or tie-off point.

Komatsu anchor (58B-98-75190) is available for use with fall protection harnesses. Carefully read and understand the harness maker’s instructions before using any fall protection harness.

NOTE: The anchor must not be used for lifting.

Securing the dump body

WARNING

To avoid serious personal injury or death, the body retention sling must be installed whenever personnel are required to perform maintenance on the truck while the dump body in the raised position.

The Komatsu body-up safety sling can only be used with a Komatsu body. Non-OEM body may not accommodate the Komatsu body-up safety sling. The end user must ensure that a proper cable/sling is used.

1. To hold the dump body in the up position, raise the body to its maximum height.
2. Install two shackles (2, Figure 00-1) and body retention sling (3) between rear body ear (1) and the axle housing.
3. Secure the shackle pins with cotter pins.
4. Move the hoist lever to the FLOAT position to slowly lower the body until the calbe is supporting the full weight of the body. Then move the hoist lever to the HOLD position.
5. After service work is completed, return the sling to the stored position.

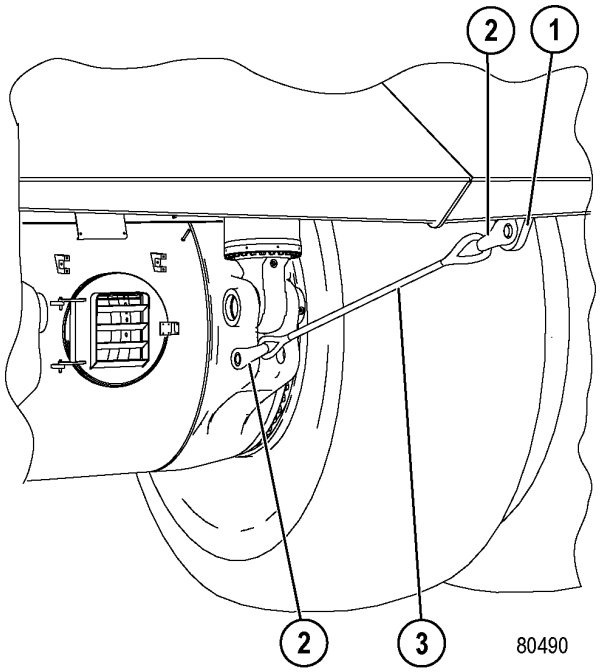


FIGURE 00-1. BODY RETENTION SLING INSTALLATION

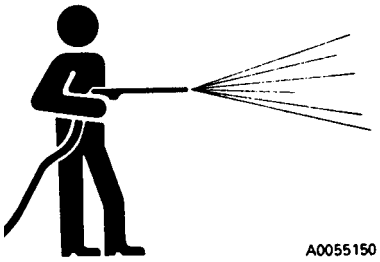
1. Rear Body Ear
2. Shackle & Pin
3. Body Retention Sling

Precautions while performing service

NOTE: Only authorized personnel should service and repair the truck.

Keep the truck clean

- Spilled oil, grease, scattered tools, etc, can cause you to slip or trip. Always keep your truck clean and tidy.
- If water gets into the electrical system, there is danger that the truck may move unexpectedly and/or damage to components may occur. Do not use water or steam to clean any sensors, connectors or the inside of the operator's compartment.
- Use extreme care when washing the electrical control cabinet. Do not allow water to enter the control cabinet around the doors or vents. Do not allow any water to enter the cooling air inlet duct above the electrical control cabinet. If water enters the control cabinet through any opening or crevice, major damage to the electrical components is possible.
- Never spray water into the rear wheel electric motor covers. Damage to the wheel motor armatures may occur.
- Do not spray water into the retarding grids. Excess water in the retarding grids can cause a ground fault, which will prevent propulsion.


A0055150

Attachments

Place attachments that have been removed from the truck in a safe place and manner to prevent them from falling.


A0055130

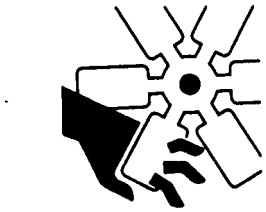
Working under the truck

- Always lower all movable work equipment to the ground or to their lowest position before performing service or repairs under the truck.
- Always block the tires of the truck securely.
- Never work under the truck if the truck is poorly supported.


A0055140

Rotating fan and belts

Stay away from all rotating parts such as the radiator fan and fan belts. Serious bodily injury may result from direct or indirect contact with rotating parts and flying objects.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Adding fuel or oil

- Spilled fuel and oil may cause slipping. Always clean up spills immediately.
- Always add fuel and oil in a well-ventilated area.
- When refueling, stop the engine and do not smoke.
- Tighten the cap of the fuel and oil fillers securely.
- Never use fuel to wash parts.

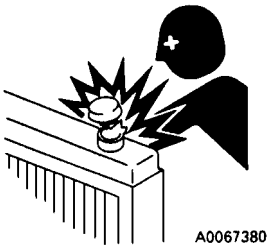
Use of lighting

When checking fuel, oil, coolant or battery electrolyte, always use lighting with anti-explosion specifications. If such lighting equipment is not used, there is danger of an explosion.


A0055160

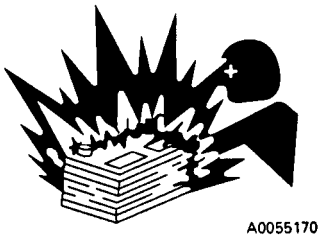
Radiator coolant level

If it is necessary to add coolant to the radiator, stop the engine and allow the engine and radiator to cool down before adding the coolant. Depress the pressure release button on the cap to vent cooling system pressure. Slowly loosen the cap to relieve any remaining pressure.



Precautions with the battery

When repairing the electrical system or performing electrical welding, remove the negative (-) terminal of the battery to stop the flow of current.



Precautions with high pressure oil

- Work equipment circuits are always under pressure. Do not add oil, drain oil or perform maintenance or inspections before completely releasing the internal pressure.
- Small, high-pressure pin hole leaks are extremely dangerous. A jet of high-pressure oil can pierce the skin and eyes. Always wear safety glasses and thick gloves. Use a piece of cardboard or a sheet of wood to check for oil leakage.
- If you are hit by a jet of high-pressure oil, consult a doctor immediately for medical attention.

Handling high pressure hoses

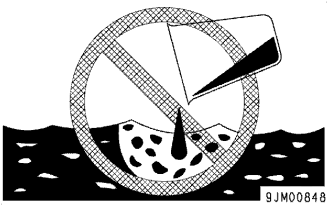
- Do not bend high pressure hoses or hit them with hard objects. Do not use any bent or cracked piping, tubes or hoses. They may burst during use.
- Always repair any loose or broken hoses. If fuel or oil leaks, it may result in a fire.

Precautions when performing maintenance near high temperature or high pressure

Immediately after stopping operation, engine coolant and operating oils are at high temperature and under high pressure. If the cap is removed, the oil or water is drained, or the filters are replaced under these conditions, it may result in burns or other injury. Wait for the temperature to cool and pressure to subside before performing the inspection and/or maintenance as outlined in the shop manual.

Waste materials

- Never dump oil into a sewer system, river, etc.
- Always put oil drained from your truck in appropriate containers. Never drain oil directly onto the ground.
- Obey appropriate laws and regulations when disposing of harmful objects such as oil, fuel, coolant, solvent, filters and batteries.
- The machine may be equipped with optional high intensity discharge lamps which contain mercury. These lamps must be reused, recycled or properly disposed of in accordance with applicable local, state and federal laws.



Tires

Handling tires

If tires are not used under the specified conditions, they may overheat and burst, or be cut and burst by sharp stones on rough road surfaces. This may lead to serious injury or damage.

To maintain tire safety, always use the specified tires. Inflate the tires to the specified pressure. An abnormal level of heat is generated when the inflation pressure is too low.

The tire inflation pressure and permissible speeds are general values. The actual values may differ depending on the type of tire and the condition under which they are used. For details, please consult the tire manufacturer.

When tires become hot, a flammable gas is produced and may ignite. It is particularly dangerous if the tires become overheated while the tires are pressurized. If the gas generated inside the tire ignites, the internal pressure will suddenly rise and the tire will explode, resulting in danger to personnel in the area. Explosions differ from punctures or tire bursts because the destructive force is extremely large. Therefore, the following operations are strictly prohibited when the tire is pressurized:

- Welding the rim
- Welding near the wheel or tire
- Smoking or creating open flames

If the proper procedure for performing maintenance or replacement of the wheel or tire is not used, the wheel or tire may burst and cause serious injury or damage. When performing such maintenance, consult your authorized regional Komatsu distributor or the tire manufacturer.

Refer to the Society of Automotive Engineers (SAE), SAE J1337, Off-Road Rim Maintenance Procedures and Service Precautions, Section 4.2 for additional information on demounting the tires and rim assemblies. Also, refer to Section 4.4 of SAE J1337 for assembly and inflation recommendations.

The U.S. Department of Labor Mine Safety and Health Administration (MSHA) addresses tire repairs in its Title 30 Code of Federal Regulations, 30 CFR 57.14104.

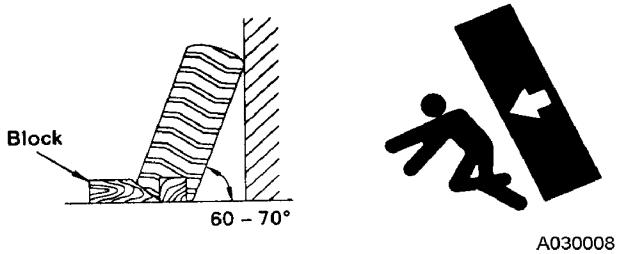
⚠WARNING

DO NOT stand in front of a rim and locking ring when inflating a tire mounted on the machine. Observers must not be permitted in the area.

DO NOT weld or heat the rim assembly with the tire mounted on the rim. Resulting gases inside the tire may ignite, causing explosion of the tire and rim.

Storing tires after removal

- As a basic rule, store the tires in a warehouse in which unauthorized persons cannot enter. If the tires are stored outside, always erect a fence around the tires and put up “No Entry” signs and other warning signs that even young children can understand.
- Stand the tire on level ground and block it securely so that it cannot roll or fall over.
- If the tire falls over, flee the area quickly. The tires for dump trucks are extremely heavy. Never attempt to hold or support the tire. Attempting to hold or support a tire may lead to serious injury.



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Mounted tires stored as spares must be inflated to the minimum inflation pressure necessary to keep the tire beads properly seated. Maximum inflation pressure of the stored tire must, in no instance, exceed 15% of the tire’s cold inflation pressure.

Precautions for performing repairs

NOTE: Only qualified maintenance personnel who understand the systems being repaired should attempt repairs. Only a qualified operator should move the truck under its own power in the repair facility or during road testing after repairs are complete.

- Many components on the Komatsu truck are large and heavy. Ensure that lifting equipment (hoists, slings, chains, and lifting eyes) are of adequate capacity to handle the load.
- Do not work under a suspended load. Do not work under a raised body unless body retention sling, props or pins are in place to hold the body in the raised position.
- Do not repair the truck while the engine is running, except when adjustments can only be made under such conditions. Keep a safe distance from moving parts.
- When servicing any air conditioning system with refrigerant, wear a face shield and cold resistant gloves for protection against freezing. Follow all current regulations for handling and recycling refrigerants. Refer to Testing and adjusting section **Cab air conditioning**.
- Follow package directions carefully when using cleaning solvents.
- If an auxiliary battery assist is needed, refer to "Starting with booster cables" or "Jump starting with receptacles" earlier in this section.
- If the truck must be towed, use a rigid tow bar. Check the truck frame for a decal recommending special towing precautions. Also refer to the towing instructions in Index and foreword section **Operating instructions**.
- Relieve hydraulic pressure before disconnecting any lines or hoses. Hydraulic oil escaping under pressure can have sufficient force to enter a person's body by penetrating the skin, resulting in serious injury and possibly death.
- After adjustments or repairs, replace all shields, screens and clamps.

Engine shutdown procedure after AC drive system failure

If the AC drive system is operating normally when the engine is shut down, the system should be safe to service. However, in the event of a drive system failure, performing the following procedure before any maintenance activities will ensure that no hazardous voltages are present in the AC drive system.

1. Before shutting down the engine, verify the status of all the drive system warning lights. Use the lamp test switch to verify that all lamps are functioning properly.

   If any of the red drive system warning lights remain on, do not attempt to open any cabinets, disconnect any cables, or reach inside the retarding grid cabinet without a trained drive system technician present, even if the engine is off. Only qualified personnel, specifically trained for servicing the AC drive system, should perform this service.
2. If all red drive system warning lights are off, follow the normal engine shutdown procedure in Index and foreword section **Operating instructions**.
3. After the engine has been stopped for at least five minutes, inspect the link voltage lights on the exterior of the main control cabinet and the DID panel on the rear wall of the operator cab.
   a. If all lights are off, it is safe to work on the retarding grids, wheel motors, alternator and related power cables. Proceed to Step 5.
   b. If any red lights continue to be illuminated after following the above procedure, a fault has occurred. Leave all cabinet doors in place. Do not touch the retarding grid elements. Do not disconnect any power cables or use them as hand or foot holds. Notify your Komatsu service representative immediately.
4. Locate the generator field contactor (GF) switch in the access panel on the left side of the main control cabinet. Place the switch in the CUTOUT position. This will prevent the alternator from re-energizing and creating system voltage until the switch is returned to its former position.
5. Leave the drive system in the rest mode until the truck is to be moved.

Precautions for welding on the truck

NOTE: Before welding or repairing an AC drive truck, notify a Komatsu service representative. Only qualified personnel, specifically trained for servicing the AC drive system, should perform this service.

If it is necessary to perform welding on the truck without the field engineer present, the following procedures and precautions must be followed to ensure that the truck is safe for maintenance personnel to work on and to reduce the chance for damage to equipment.

- Before opening any cabinets or touching a retarding grid element or a power cable, the engine must be shutdown and any red drive system warning lights must not be illuminated.
- Always disconnect the positive and negative battery cables of the truck before doing any welding on the unit. Failure to do so may seriously damage the battery and electrical equipment. Disconnect the battery charging alternator lead wire and isolate the electronic control components before making welding repairs. (It is not necessary to disconnect or remove any control circuit cards on electric drive dump trucks or any of the AID circuit control cards.)
- Always fasten the welding machine ground (-) lead to the piece being welded. The grounding clamp must be attached as near as possible to the weld area. Never allow welding current to pass through ball bearings, roller bearings, suspensions or hydraulic cylinders. Always avoid laying welding cables over or near the vehicle electrical harnesses. Welding voltage could be induced into the electrical harness and possibly cause damage to components.
- Drain, clean, and ventilate fuel tanks and hydraulic tanks before making any welding repairs on the tanks.
- Before welding on the truck, disconnect all electrical harnesses from the modules and controllers inside the auxiliary control cabinet behind the operator cab.
- **Do not weld on the rear of the control cabinet!** The metal panels on the back of the cabinet are part of capacitors and cannot be heated.
- **Do not weld on the retarding grid exhaust louvers!** They are made of stainless steel. Some power cable panels throughout the truck are also made of aluminum or stainless steel. They must be repaired with the same material or the power cables may be damaged.
- Power cables must be cleated in wood or other non-ferrous materials. Do not repair cable cleats by encircling the power cables with metal clamps or hardware. Always inspect power cable insulation before servicing the cables and returning the truck to service. Discard cables with broken insulation.
- Power cables and wiring harnesses should be protected from weld spatter and heat.
- Always fasten the welding machine ground (-) lead to the piece being welded. The grounding clamp must be attached as near as possible to the weld area.
- Always avoid laying welding cables over or near the vehicle electrical harnesses. Welding voltage could be induced into the electrical harness and cause damage to components.
- Before doing any welding on the truck, disconnect the battery charging alternator lead wire and isolate electronic control components.
- Also, always disconnect the negative and positive battery cables of the vehicle. Failure to do so may seriously damage the battery and electrical equipment.
- Never allow welding current to pass through ball bearings, roller bearings, suspensions or hydraulic cylinders.

Capacitor discharge system

The control cabinets are equipped with two capacitor charge lights, one on the exterior of the cabinet and one in the interior. The capacitor charge lights, when off, indicate to service personnel that the drive system is safe to work on. Certain drive system failures, however, can result in a condition where one or more capacitors can remain in a charged state even though the capacitor charge lights are off.

Because a danger can still exist with the capacitor charge lights off, it is necessary to adhere to the following instructions before touching or servicing drive system components. Only authorized service personnel are allowed to service the drive system.

Refer to the shop manual for rules when servicing the drive system. Adhere to the proper procedures for disabling the drive system.

Necessary tools

- 2000 VDC meter (Figure 00-2)
  (Komatsu p/n PC3186)
  (Bierer RCDC 1000 or equivalent)

FIGURE 00-2. VOLT METER (PC3186)

- Personal Protective Equipment (PPE) for working with 2000 VDC meter
  (safety shoes, high voltage gloves, and safety glasses)
- Multimeter for ground resistance measurement
- Grounding stick pair (Figure 00-3)
  (Komatsu p/n PC3299)
  (HVR Advanced Power Components MAS-000039 Ground Stick Pair or equivalent)

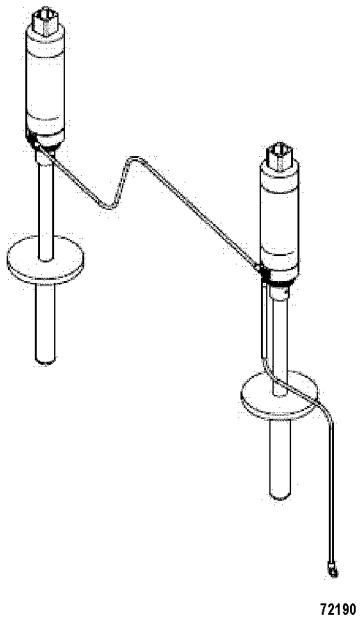


FIGURE 00-3. GROUNDING STICKS (PC3299)

Warnings and cautions

All applicable local mine, government, and industry rules for working with high voltage must be followed. Required personal protective equipment, including but not limited to safety shoes, high voltage gloves, and safety glasses must be worn.

Safety cautions and warnings appear throughout the instructions. WARNING indicates the potential for personal injury and CAUTION indicates the potential for equipment damage. Read the following warnings prior to working on this drive system.

⚠WARNING

Hazardous voltages are present in this equipment. Ensure that the Control Power Switch (CPS) is in the OFF position and that the Generator Field Contactor (GFCO) switch is in the CUTOUT position before attempting any work on the drive system components. Check that Capacitor Charge Lights (CCL's) are not illuminated.

Use measurement and protective equipment rated for 2000 VDC minimum to verify that no voltage is present before touching any terminal.

Verify functionality of the measurement equipment using site-approved procedures both before and after performing control group measurements.
Failure to observe these precautions may result in death or serious personal injury.

⚠WARNING

Verify that the Capacitor Charge Light (CCL) above the high voltage contactor area is not illuminated before opening the doors to the high voltage area or the high voltage contactor area.

Use measurement and protective equipment rated for 2000 VDC minimum to verify that no voltage is present before touching any terminal.

Verify functionality of the measurement equipment using site-approved procedures both before and after performing control group measurements.

Failure to observe these precautions may result in death or serious personal injury.

⚠WARNING

Hazardous voltages are present in this equipment. Avoid touching any energized equipment when the door to the low voltage area is open.

Failure to do so may result in personal injury and equipment damage.

⚠WARNING

Hazardous voltages may be present in this equipment even if the engine and capacitor charge lights are off.

Use measurement and protective equipment rated for 2000 VDC minimum to verify that no voltage is present before touching any terminal.

Verify functionality of the measurement equipment using site-approved procedures both before and after performing control group measurements.

Failure to observe these precautions may result in death or serious personal injury.

⚠WARNING

Voltages in excess of 1500 VDC may be present. Any measurement and/or protective equipment used must be rated at 2000 VDC minimum.

Verify functionality of the measurement equipment using site-approved procedures both before and after performing control group measurements.

Failure to observe these precautions may result in death or serious personal injury.

Manual DC link capacitor discharge procedure

Follow any and all local and site specific procedures and requirements for working on off-highway mining equipment.

Verify that:

- The engine is off and the parking brake is on.
- The generator field is cut out via GF cutout switch (2, Figure 00-4) in the low voltage area of the control cabinet.

1. Apply control power for a minimum of 30 seconds. Then, turn off control power using control power switch (1) on the switch panel.

   With control power on, an RP contactor closes and discharges the DC link through the retarding grids in less than 10 seconds.

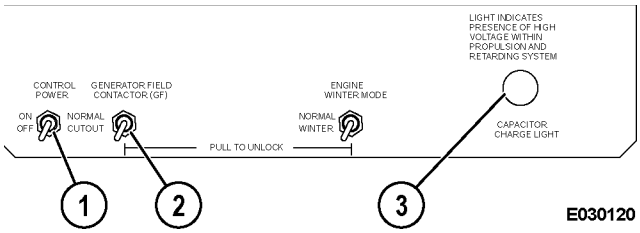


FIGURE 00-4. INFORMATION DISPLAY PANEL

1. Control Power Switch
2. GF Cutout Switch
3. Capacitor Charge Light

In most control cabinets, RP2 is the normal discharge path. In groups containing an RP3 contactor, RP2 and RP3 are alternated as the normal discharge path. Refer to Figure 00-5.

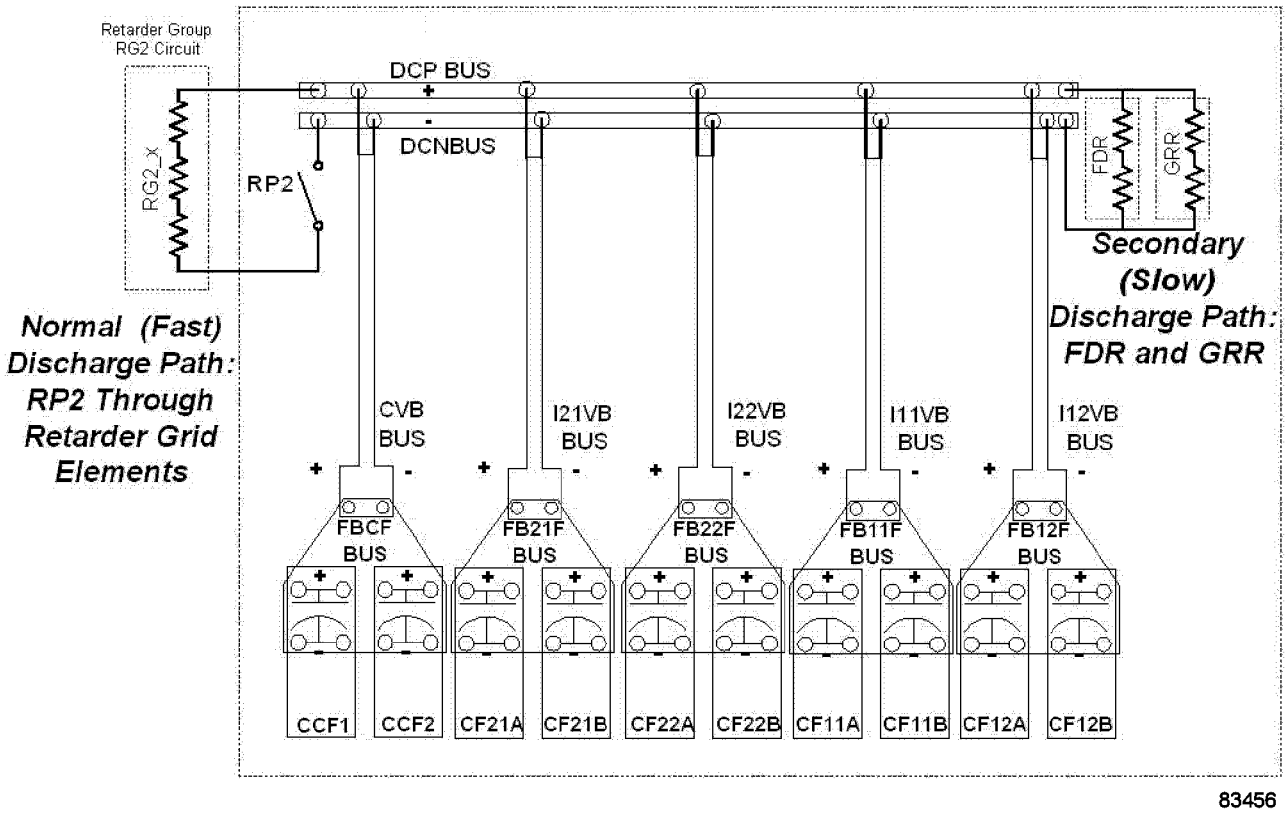


FIGURE 00-5. DISCHARGE PATHS

2. Observe both capacitor charge lights (CCL1, CCL2). CCL1 is on the outside of the contactor box. CCL2 is on the switch panel inside the low voltage area. The lights will stay illuminated as long as the voltage on the DC link is greater than 50 VDC. Refer to Figure 00-6.

⚠WARNING

Hazardous voltages may be present in this equipment even if the engine and capacitor charge lights are off.

Use measurement and protective equipment rated for 2000 VDC minimum to verify that no voltage is present before touching any terminal.

⚠WARNING

Verify functionality of the measurement equipment using site-approved procedures both before and after performing control group measurements.

Failure to observe these precautions may result in death or serious personal injury.

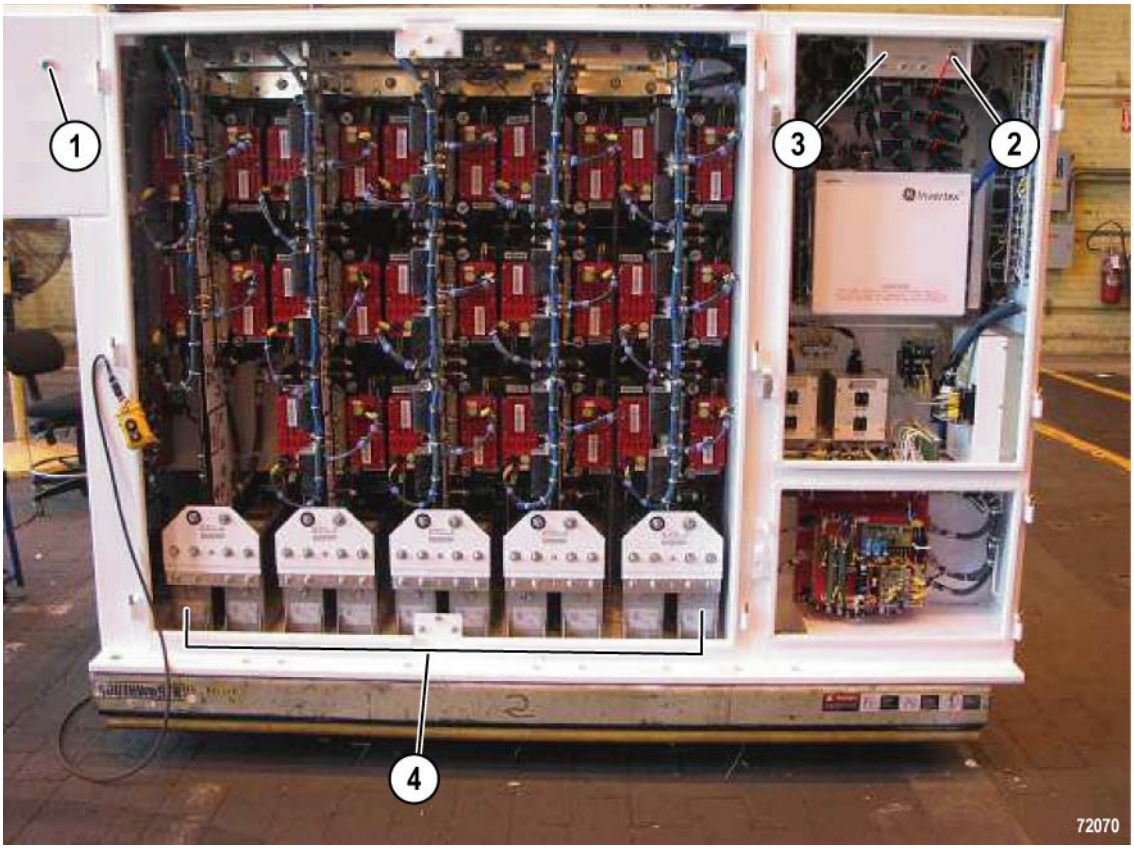


FIGURE 00-6. CAPACITOR CHARGE LIGHTS

1. Exterior Capacitor Charge Light (CCL2)
2. Interior Capacitor Charge Light (CCL1)
3. Information Display Panel
4. DC Link Capacitors

Failure of the discharge system

If the capacitor charge lights remain illuminated, a failure of the normal (fast) capacitor discharge system (RP discharge path) has likely occurred. The slow discharge resistors that are hard wired across the DC link should then discharge the capacitors. The slow discharge resistors will discharge the DC link to less than 1 VDC in under 7.5 minutes. If after 7.5 minutes, the capacitor charge lights are still illuminated, it must be assumed that the automatic discharge system is not working and that high voltage is present in the high voltage area.

1. Open the high voltage area doors.
2. With a suitable high voltage meter rated for at least 2000 VDC, such as PC3186 or equivalent, plus suitable protective equipment, measure the voltage across each of the DC link capacitors. Place one meter lead on the positive (+) capacitor terminal, and the other meter lead on the negative (-) capacitor terminal, and observe the voltage. See Figure 00-7 and Figure 00-8. If the voltage is less than 1.0 V the capacitor is sufficiently discharged. Repeat on all DC Link capacitors. If the voltage of any capacitor is above 1.0 V, manually discharge the capacitor as described in "Manual discharge of capacitors".

FIGURE 00-7. DC METER ON CAPACITOR

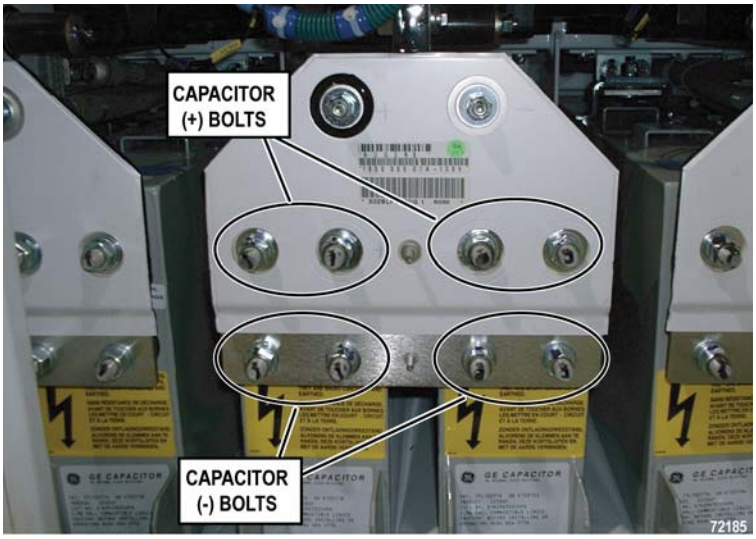


FIGURE 00-8. CAPACITOR TERMINAL POLARITY

Manual discharge of capacitors

If the voltage is greater than 1V on any of the capacitors, the capacitor must be manually discharged. With a suitable capacitor discharge device, such as ground stick pair (PC3299), discharge the capacitors where needed per the following instructions:

1. With the control cabinet high voltage compartment doors closed, connect the ground stick pair ground lead to ground. The most convenient location is the middle top bolt that attaches the door center post to the control cabinet frame.
2. Verify the ground connection and ground stick resistance levels. Measure the resistance between each individual ground stick tip to either the GND1 or GND2 ground block in the low voltage compartment of the control cabinet using a multimeter (Figure 00-9). Ensure that the resistance is within the manufacturer's specifications for the ground sticks.

   For PC3299 grounding sticks, the valid range is 80 to 125 ohms per stick.

⚠WARNING

Hazardous voltages are present in this equipment. Avoid touching any energized equipment when the door to the low voltage area is open. Failure to do so may result in personal injury and equipment damage.

3. Discharge the relevant capacitors. Open the door(s) and place one grounding stick on one of the positive (+) capacitor terminals and the other on the diagonally located negative (-) terminal. Refer to Figure 00-8 and Figure 00-10. Attempt to minimize the time between application of the positive stick and the negative stick so that the current flow will be positive to negative rather than either to ground. Leave sticks in place until capacitors are discharged. Refer to Figure 00-10.

NOTE: On the capacitors located behind the door post, it is difficult to access diagonal terminals on the same capacitor. If using adjacent terminals, use care to keep the tips separated while discharging or else use a positive terminal on one capacitor and negative terminal of the adjacent capacitor on the same bus bar.

For PC3299 grounding sticks, the discharge times from 2000 volts are:

- 15 seconds (maximum) for 2 capacitors
- 75 seconds (maximum) for 10 capacitors

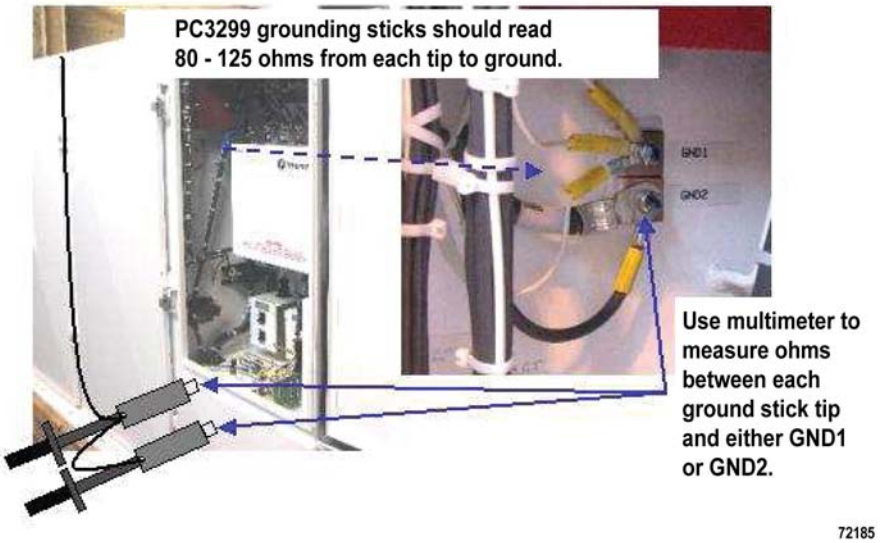


FIGURE 00-9. GROUNDING STICK LEAD CONNECTION AND CHECK

⚠WARNING

Voltages in excess of 1500 VDC may be present. Any measurement and/or protective equipment used must be rated at 2000 VDC minimum.

Verify functionality of the measurement equipment using site-approved procedures both before and after performing control group measurements.

Failure to observe these precautions may result in death or serious personal injury.

4. Measure voltage on all capacitors as described in “Failure of the discharge system” on page 28. Discharge any capacitors that show voltage.
5. If all capacitors read discharged, verify that the meter is functioning correctly using site-approved procedures. If so, proceed to "Short isolated capacitor terminals".

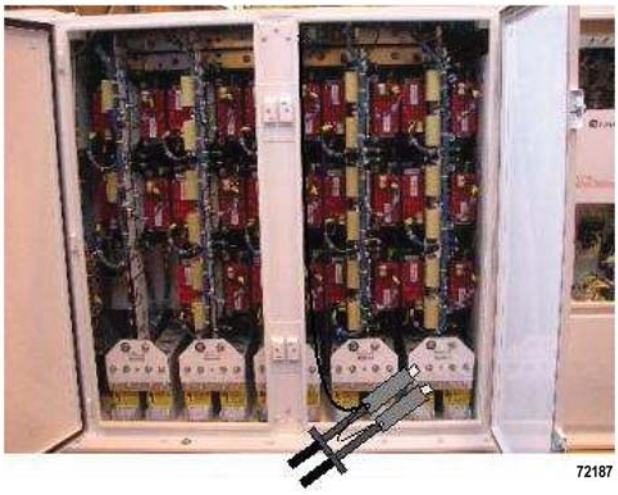


FIGURE 00-10. APPLICATION OF GROUNDING STICKS TO CAPACITOR TERMINALS

Short isolated capacitor terminals

⚠WARNING

Hazardous voltages may be present in this equipment even if the engine and capacitor charge lights are off.

Use measurement and protective equipment rated for 2000 VDC minimum to verify that no voltage is present before touching any terminal.

Verify functionality of the measurement equipment using site-approved procedures both before and after performing control group measurements.

Failure to observe these precautions may result in death or serious personal injury.

Any capacitor that is isolated from the DC link and confirmed discharged must have its terminals electrically shorted together to prevent static charge build up. Use bare wire to jumper all four terminals on the capacitor. See Figure 00-11. Proceed to troubleshoot and repair the control group to restore it to original functionality.

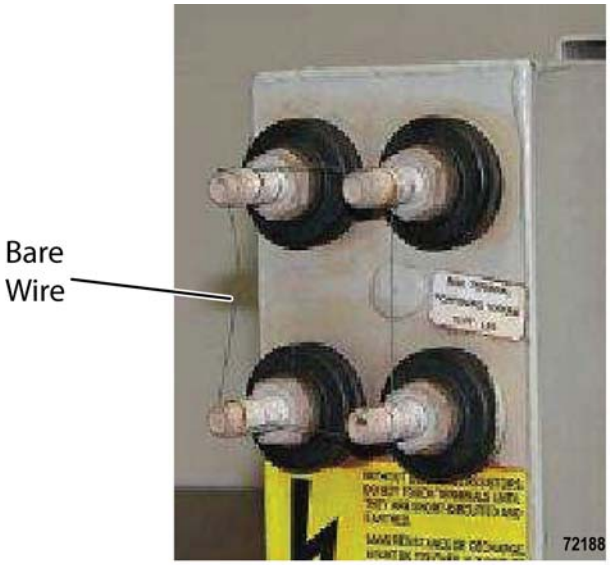


FIGURE 00-11. JUMPER ALL TERMINALS ON ISOLATED CAPACITOR

Handling electrical equipment and hydraulic components

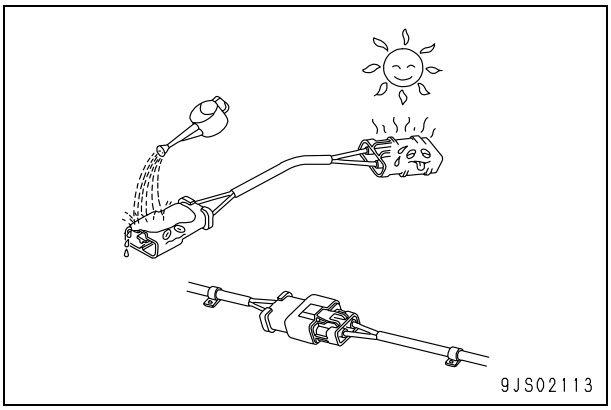
To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct “operation“, “maintenance and inspection“, “troubleshooting“, and “repairs” must be carried out. This section deals particularly with correct repair procedures for mechatronics and is aimed at improving the quality of repairs. For this purpose, it provides information on handling electrical equipment and handling hydraulic equipment (particularly gear oil and hydraulic oil).

Points to remember when handling electrical equipment

1. Handling wiring harnesses and connectors

Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protectors or tubes used for protecting the wiring.

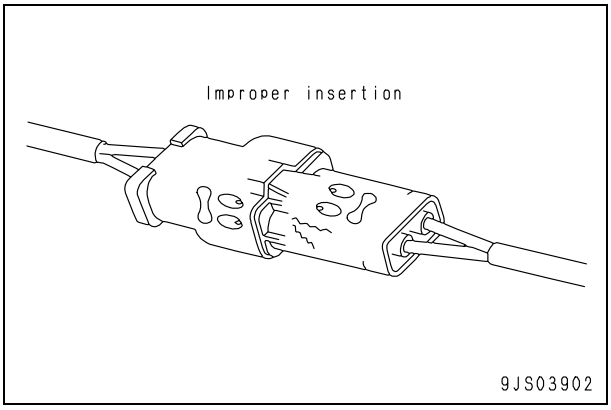
Compared with other electrical components fitted in boxes or cases, wiring harnesses are more likely to be affected by the direct effects of rain, water, heat, or vibration. Furthermore, during inspection and repair operations, they are frequently removed and installed again, so they are likely to suffer deformation or damage. For this reason, it is necessary to be extremely careful when handling wiring harnesses.



2. Main failures occurring in wiring harness

- Defective contact of connectors (defective contact between male and female)

  Problems with defective contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned, or because there is corrosion or oxidization of the contact surfaces. The corroded or oxidized contact surfaces may become shiny again (and contact may become normal) by connecting and disconnecting the connector about 10 times.



- Defective crimping or soldering of connectors

  The pins of the male and female connectors are in contact at the crimped terminal or soldered portion, but if there is excessive force brought to bear on the wiring, the plating at the joint will peel and cause improper connection or breakage.