

Shop Manual

960E-1

DUMP TRUCK

SERIAL NUMBERS **A30025 - A30026**

KOMATSU[®]

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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.

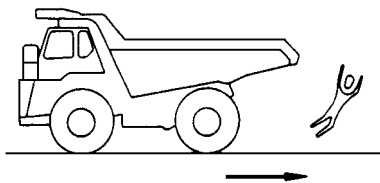
Traveling

- 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.

Precautions for welding on the truck

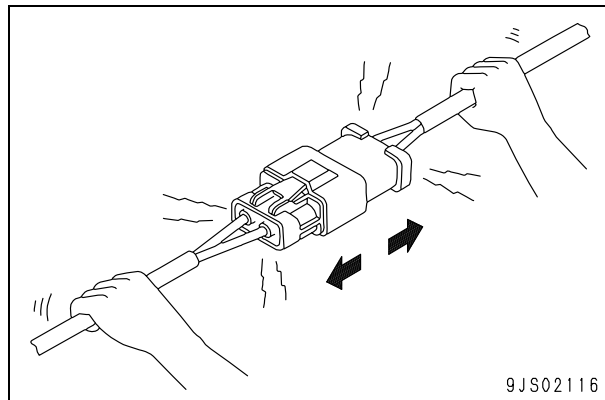
NOTE: Before welding or repairing an AC drive truck, notify a Komatsu service representative. Only qualified personnel, specifically trained for servicing the AC drive system, should perform this service.

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.

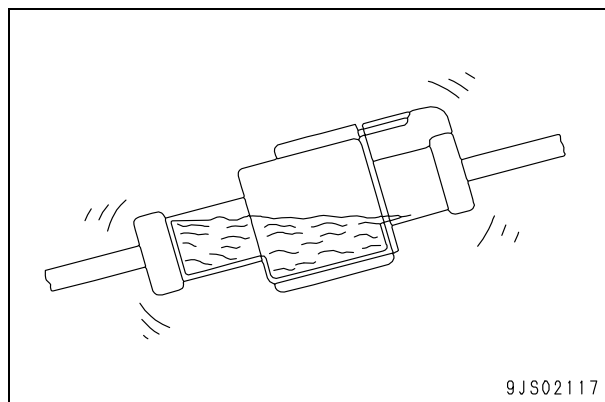
- Disconnections in wiring

If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the crimping of the connector may separate, or the soldering may be damaged, or the wiring may be broken.



- High-pressure water entering connector

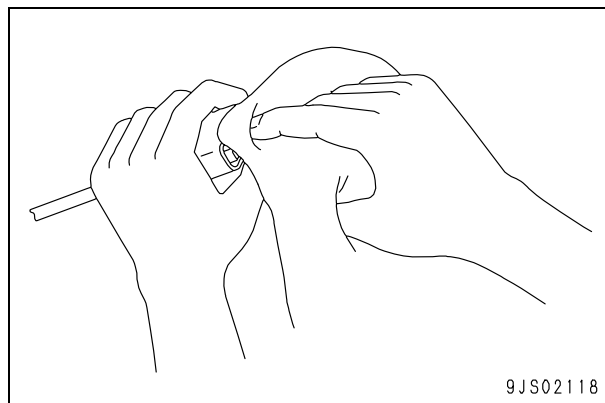
The connector is designed to make it difficult for water to enter (drip-proof structure), but if high-pressure water is sprayed directly on the connector, water may enter the connector, depending on the direction of the water jet. Accordingly, take care not to splash water over the connector. The connector is designed to prevent water from entering, but at the same time, if water does enter, it is difficult for it to be drained. Therefore, if water should get into the connector, the pins will be short-circuited by the water, so if any water gets in, immediately dry the connector or take other appropriate action before passing electricity through it.



- Oil or dirt stuck to connector

If oil or grease are stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, so there will be defective contact. If there is oil or grease stuck to the connector, wipe it off with a dry cloth or blow it dry with compressed air and spray it with a contact restorer.

- When wiping the mating portion of the connector, be careful not to use excessive force or deform the pins.
- If there is oil or water in the compressed air, the contacts will become even dirtier, so remove the oil and water from the compressed air completely before cleaning with compressed air.



Standard torque tables

This shop manual provides metric (SI) and U.S. standard units for most specifications. References throughout the shop manual to standard torques or other standard values will be to one of the following tables. For values not shown in these tables, standard conversion factors for most commonly used measurements, refer to "Conversion tables".

NOTE: Standard torque values are not to be used when "turn-of-the-nut" tightening procedures are recommended.

Effect of special lubricants on fasteners and standard torque values

Komatsu does not recommend the use of special friction-reducing lubricants, such as Copper Coat, Never-Seez[®], and other similar products, on the threads of standard fasteners where standard torque values are applied. The use of special friction-reducing lubricants will significantly alter the clamping force during the tightening process. Excessive stress and possible breakage of the fasteners may result.

When the torque tables specify "lubricated threads" for the standard torque values listed, these standard torque values are to be used with simple lithium based chassis grease (multi-purpose EP NLGI) or a rust preventive grease (see the list below) on the threads and seats unless specified otherwise.

Verify the threads and tapped holes are free of burrs and other imperfections before installing hardware.

Suggested sources for rust preventive grease:

- American Anti-Rust Grease #3-X from Standard Oil Company (also American Oil Co.)
- Gulf Norust #3 from Gulf Oil Company.
- Mobilarma 355, Product No. 66705 from Mobil Oil Corporation.
- Rust Ban 326 from Humble Oil Company.
- Rustolene B Grease from Sinclair Oil Co.
- Rust Preventive Grease - Code 312 from the Southwest Grease and Oil Company.

NOTE: This list represents the current engineering approved sources for use in Komatsu manufacture. It is not exclusive. Other products may meet the same specifications of this list.

DUMP TRUCK

960E

Machine model	Serial number
960E-1	A30003 - A30026

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Starting on a grade with a loaded truck

Initial propulsion with a loaded truck should begin from a level surface whenever possible. If the truck must be started on a hill or grade, use the following procedure:

1. Fully depress the service brake pedal. Do not use the retarder lever to hold the truck on the grade. With the service brakes fully applied, move the directional control lever to a drive position (FORWARD or REVERSE) and increase the engine rpm with the throttle pedal.
2. As the engine rpm approaches the maximum, and the operator senses the propulsion effort working against the brakes, release the brakes and let truck movement start. Completely release the service brake pedal. As the truck speed increases above 5 - 8 kph (3 - 5 mph), the propulsion system controller (PSC) will drop the propulsion if the retarder is still applied.

NOTE: Releasing and re-applying dynamic retarding during a hill start operation will result in loss of propulsion.

Sudden loss of engine power

If the engine suddenly stops, there is enough hydraulic pressure stored in the brake accumulators and steering accumulators to allow the operation of the steering and brake functions. However, this oil supply is limited, so it is important to stop the truck as quickly and safely as possible after the loss of engine power.

If the brake supply pressure drops to a pre-determined level, the warning light, alarm and low brake pressure warning message will be activated. If the brake pressure continues to decrease, the auto-apply feature will activate and the service brakes will apply automatically to stop the truck.

1. Bring the truck to a safe stop as quickly as possible by using the foot pedal to apply the service brakes. If possible, safely steer the truck to the side of the road while braking.



Dynamic retarding will not be available. Do not use the service brakes for continuous retarding purposes.

2. Move the directional control lever to PARK as soon as the truck has stopped moving.
3. Turn the key switch to the OFF position and notify maintenance personnel immediately.
4. If traffic is heavy near the disabled machine, mark the truck with warning flags during daylight hours or use flares at night. Adhere to local regulations.

DUMP TRUCK

960E

Machine model	Serial number
960E-1	A30003 - A30026
960E-2	A30027 and up

01 Specification

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DUMP TRUCK

960E

Machine model	Serial number
960E-1	A30003 - A30026
960E-1K	A50003 - A50010
960E-2	A30027 and up
960E-2K	A50011 and up

10 Structure, functions and maintenance standard

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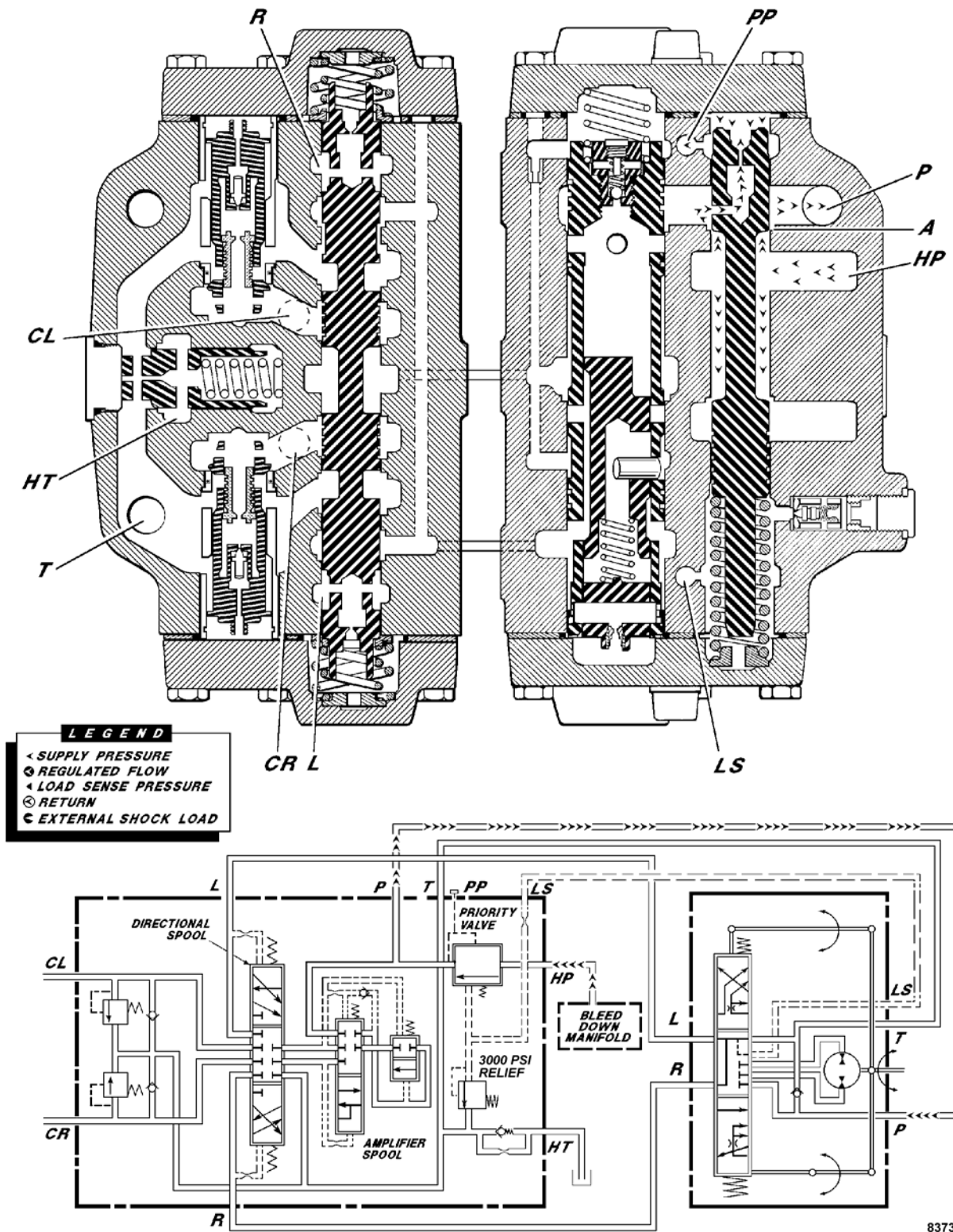


FIGURE 10-6. FLOW AMPLIFIER - NO STEER

Full pump volume

Control piston (1, Figure 10-14) controls the angle of swashblock (4). When the control piston moves to the full right position, the pump is at maximum pumping capacity.

The driveshaft turns splined housing (2), which contains pistons (3). When the housing is rotated, the pistons move in and out of their bores and the piston shoes “ride” against the angled swashblock.

As the cylinder rotates, the individual piston bores are connected alternately to the left (port “A”) and right (port “B”) crescent shaped ports in the valve plate. While connected to left side (suction) port “A”, each piston moves outward, drawing oil from port “A” into the piston bore until its outermost stroke is reached. At that point, the piston bore passes from the left crescent port to the right crescent port.

While rotating across the right side crescent, each piston moves downward on the angled swashblock face. Thus, each piston is forced inward. Each piston displaces fluid through the right side crescent to port “B” until its innermost stroke is reached. At that point, the piston bore again passes from the right to the left side crescent and the operating cycle is repeated.

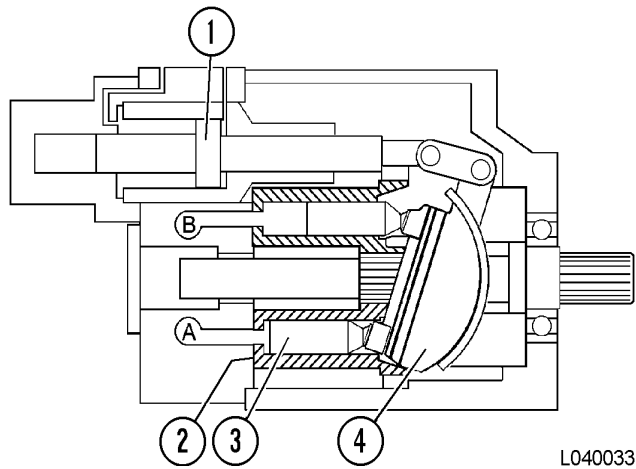


FIGURE 10-14. FULL PUMP VOLUME

- | | |
|--------------------|---------------|
| 1. Control Piston | 3. Piston |
| 2. Splined Housing | 4. Swashblock |

Half pump volume

The position of control piston (1, Figure 10-15) is near the center of its travel. Swashblock (4) is not angled as steeply as before. Therefore, the pistons have a shorter stroke. As the piston stroke gets shorter, the pump output also decreases.

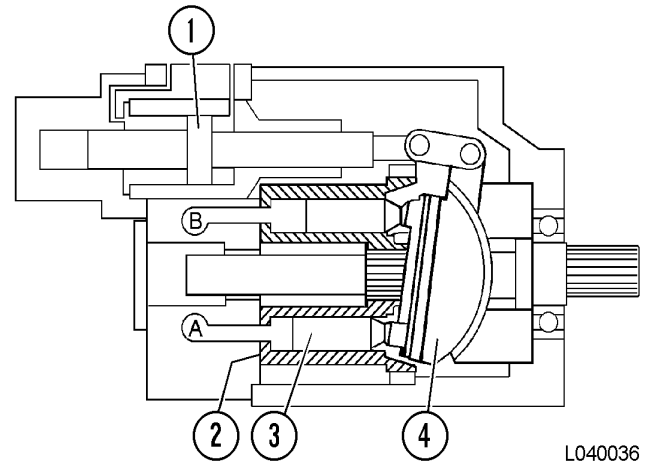


FIGURE 10-15. HALF PUMP VOLUME

- | | |
|--------------------|---------------|
| 1. Control Piston | 3. Piston |
| 2. Splined Housing | 4. Swashblock |

Overcenter manifold

Overcenter manifold (4, Figure 10-4) contains counterbalance valve (2), which controls the pressure of the cushion of oil in the annulus area of the hoist cylinder when the body approaches the maximum dump angle. The counterbalance valve limits the maximum pressure buildup by relieving pressure in excess of 20 400 kPa (3,000 psi), preventing possible seal damage.

Quick disconnect fittings (5) allow dumping of the load in a disabled truck by connecting jumper hoses to the hydraulic system of an operational truck.

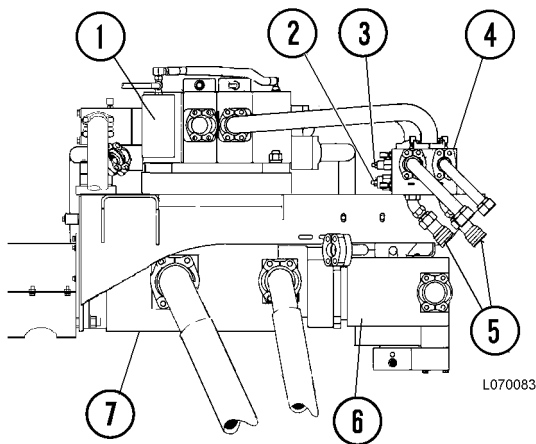


FIGURE 10-4. PUMP MODULE

- | | |
|-------------------------|------------------------|
| 1. Hoist Valve | 4. Overcenter Valve |
| 2. Counterbalance Valve | 5. Quick Disconnects |
| 3. Needle Valve | 6. Steering/Brake Pump |
| | 7. Hoist Pump |

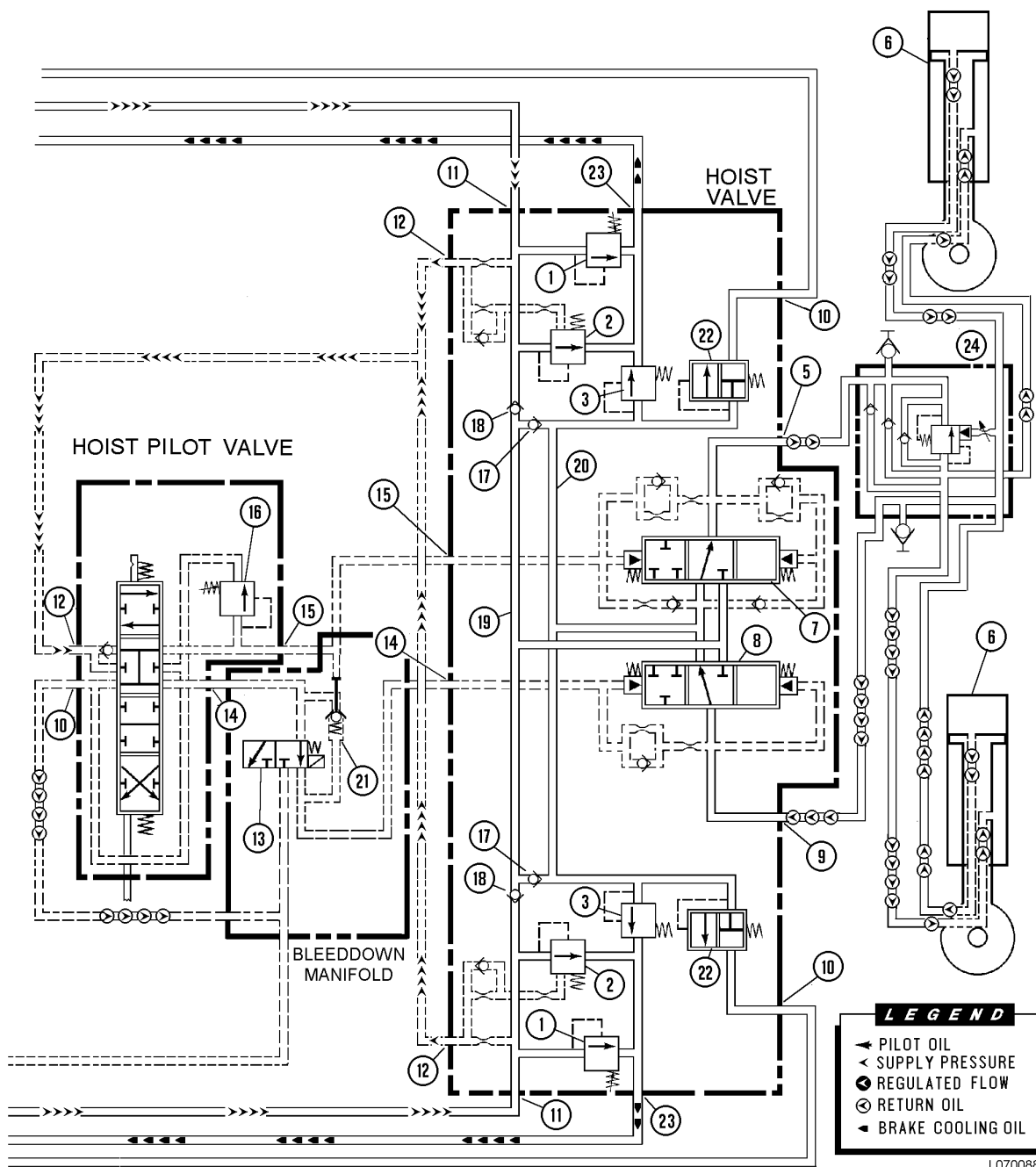


FIGURE 10-9. FLOAT POSITION

- | | | |
|---|---|--|
| 1. Hoist Relief Valve (2,750 psi) | 9. Head End Work Port | 17. Anti-Void Check Valve |
| 2. Flow Control Valve | 10. Tank Return Port | 18. Load Check Valve |
| 3. Secondary Low Pressure Valve (250 psi) | 11. Supply Port | 19. High Pressure Passage |
| 4. Snubber Valve | 12. Pilot Supply Port | 20. Low Pressure Passage |
| 5. Rod End Work Port | 13. Hoist Limit Solenoid | 21. Pilot Operated Check Valve |
| 6. Hoist Cylinders | 14. Raise Pilot Port | 22. Primary Low Pressure Relief Valve (26 psi) |
| 7. Rod End Spool | 15. Down Pilot Port | 23. Brake Cooling Circuit Port |
| 8. Head End Spool | 16. Power Down Relief Valve (1,500 psi) | 24. Overcenter Manifold |

Wheel brake lock circuit operation

The primary function of the wheel brake lock is to provide a means for the operator to hold the truck while at the shovel or dump. **The brake lock only applies the rear service brakes.** It may also provide a secondary means of stopping the truck in the event of a brake valve malfunction.

During normal operations, the wheel brake lock will function only when:

- the control power is ON,
- the key switch is ON,
- and the parking brake is not activated (directional control lever is not in PARK).

If the wheel brake lock is applied while the truck is moving, the brake lock function will remain applied after the truck is stopped regardless of the conditions stated above (except the control power must be ON for the wheel brake lock to function). The operator must deactivate the wheel brake lock.

When the wheel brake lock switch on the dash panel is activated, brake lock solenoid valve (13, Figure 10-1) and pressure reducing valve (12) will apply unmodulated pressure oil at 13 800 kPa (2,000 psi) to fully actuate the rear brakes. Shuttle valve (4) in the rear brake line provides the independence from the brake valve for brake application.

Brake warning circuit operation

The brake warning circuit is equipped with a low brake pressure warning light and an audible alarm in the cab to alert the operator to low brake pressures. Several electrical sensors, a relay and delay timer are used to detect brake system problems.

- **Brake warning relay**

When the wheel brake lock switch is ON, the brake warning relay is energized and switches the electrical connection from the terminal to brake lock degradation switch (21, Figure 10-1). When the wheel brake lock switch is OFF, the relay is de-energized and switches the connection from the brake lock degradation switch to the terminal.

- **System supply pressure switch**

The system supply pressure switch is located on the pump pressure sensing manifold. When system supply pressure drops below 15 800 kPa (2,300 psi), the low brake pressure warning and buzzer will activate.

- **Low brake pressure switch**

Low brake pressure switch (16) is located on brake manifold (5) in the hydraulic brake cabinet. When the brake accumulator with the lower pressure falls below 12 700 kPa (1,850 psi), the low brake pressure warning and buzzer will activate.

- **Brake lock degradation switch**

Brake lock degradation switch (21) is located on junction manifold (19) in the hydraulic brake cabinet. When the wheel brake lock switch is ON, brake lock solenoid (13) and the brake warning relay are energized. The brake warning relay switches the electrical connection from the terminal to the brake lock degradation switch. If the brake lock apply pressure is less than 6 900 kPa (1,000 psi), a path to ground will be completed and the low brake pressure warning and buzzer will activate.

DUMP TRUCK

960E

Machine model	Serial number
960E-1	A30025 - A30026
960E-2	A30027 and up

10 Structure, functions and maintenance standard

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Body-up switch

Body-up switch (1, Figure 10-7) is located inside the right frame rail near the front of the body. It must be adjusted to specifications to ensure that the proper electrical signal is obtained when the body is raised or lowered. The body-up switch is designed to prevent propulsion in REVERSE when the dump body is not resting on the frame rails. The switch also prevents forward propulsion with the body up unless the override button is depressed and held.

When the body is resting on the frame, magnet assembly (3) on bracket (4) causes the electrical contacts in the magnetically-operated switch to close. When the body is raised, the bracket and magnet assembly move away from the switch, opening the contacts. The electrical signal is sent to the control system and the body-up relay.

The switch must be properly adjusted at all times. Improper adjustment or loose mounting capscrews may cause false signals or damage to the switch assembly.

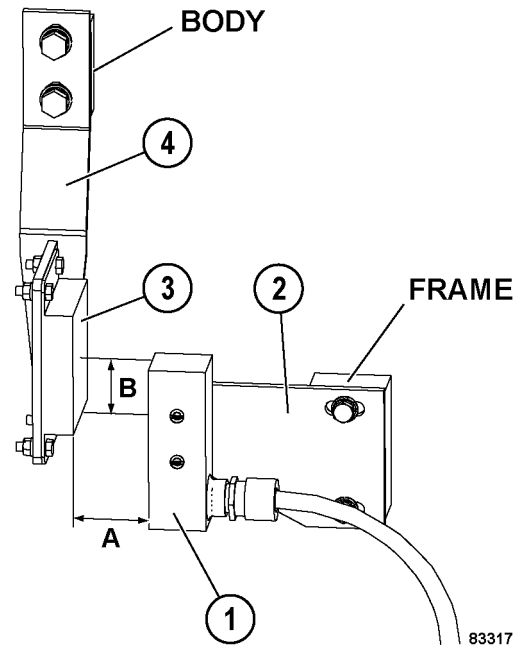


FIGURE 10-7. BODY-UP SWITCH

- | | |
|----------------------------|--------------------|
| 1. Body Up Switch | 3. Magnet Assembly |
| 2. Switch Mounting Bracket | 4. Bracket |

Dimension "A"..... 45 mm (1.77 in.)

Dimension "B"..... 32.3 mm (1.27 in.)

Table 4: Pulse outputs

Output	Display type	Source	Signal type	Input signal	Connector - Pin	Checkout type	Parm full scale
Engine speed	Digital readout	GE	Pulse	Engine speed input +	IM1-a	0 to 2083 Hz	0 to 2500 rpm
				Engine speed input -	IM1-b		
Truck speed	Digital readout	GE	Pulse	Truck speed input +	IM1-c	0 to 4772 Hz	0 to 60 mph
				Truck speed input -	IM1-d		

Table 5: Digital outputs

Output	Function type	Location	Signal type	Configure	Connector - Pin	Checkout type
Brake auto apply	Control	-	PWM/digital	PCS2, CPWM4 and SPI, OUT3	IM1-R	Low side switch
Auto lube solenoid	Display	Display	PWM/digital	PCS2, CPWM5 and SPI, OUT4	IM1-T	Low side switch
Brake cooling RPM advance 1	Control	-	PWM/digital	PCS1, TPU11 and SPI, OUT3	IM1-L	Low side switch
IM On signal	Display	Display	PWM/digital	PCS1, TPU9 and SPI, OUT1	IM1-K	Low side switch
Red warning lamp	Display	Display	PWM/digital	TPU4	IM1-G	Low side switch
Steering bleeddown valve	Display/control	Display	PWM/digital	PCS2, CPWM2 and SPI, OUT1	IM1-P	Low side switch
Sonalert	Display	Display	PWM/digital	PCS1, TPU10 and SPI, OUT2	IM1-M	Low side switch
Timed engine shutdown relay	-	-	Digital	PCS1, SPI, OUT8	IM1-H	Low side switch
Start enable	Control	-	Digital	PCS1, SPI, OUT7	IM1-B	Low side switch
Parking brake solenoid	Control	-	PWM/digital	PCS1, TPU13 and SPI, OUT9	IM1-E	Low side switch
Brake cooling RPM advance 2	Control	-	PWM/digital	PCS1, TPU14 and SPI, OUT10	IM1-X	Low side switch

PSC software functions

The operation of the AC drive system is regulated by a software program which resides in the propulsion system control panel's memory. The software program also contains instructions to test and fault isolate the system.

This section describes the PSC software program and its functions without regard to hardware.

Input processing

This function reads in all external inputs for use by the PSC. The input processing function performs any signal conditioning that is required and computes the required derived inputs.

State machine

As part of the total software package, a particular group of regulatory software commands is included called a "state machine". The state machine controls the various functions of truck operation.

The software implements the state machine by keeping track of which state the truck is in and which state the truck is allowed to move into if the operator requests a different mode of operation. Each software state is defined as follows:

Startup/Shutdown state: The purpose of this state is to ensure the system is in a desired known state upon startup or shutdown. This is an unpowered state.

NOTE: "Powered" and "unpowered" refer to the state of the DC link. 600 volts or more equals "powered", 50 volts or less equals "unpowered".

Test state: The purpose of this state is to provide an environment for the verification of system functionality. The test state will support a variety of activities, including:

- Waiting for the engine to start (if needed).
- Automatic testing on initial system startup or following rest state.
- Application of power to the DC link.
- Externally initiated testing to clear a fault, set temporary variables, or for maintenance purposes.

NOTE: The test state may be either powered or unpowered at a given point in time, depending on which activities are being performed.

Ready state: This is the default powered state. The system will be in this state whenever the engine and control system are ready to provide power, but none is requested.

Ready state is also the state where the DC link is discharged in preparation for shutdown, rest, or in reaction to certain event conditions. Therefore, the ready state should not be considered strictly a powered state (as are propel and retard).

Rest state: The purpose of this state is to conserve fuel while the truck idles for an extended period of time. The rest state also provides an environment where maintenance personnel can control the engine without causing power to be applied to the DC link. The rest state is an unpowered state.

Propel state: The purpose of this state is to provide the power system configuration and overall environment for engine-powered propulsion. This is a powered state. The system will not be allowed to maintain the propel state without sufficient power on the DC link.

Retard state: This state provides the power system configuration and overall environment for retard functions, where energy from vehicle movement is dissipated in the retarding grid resistors in an effort to slow the truck. The retard state is a powered state.

TCI:

1. With the PTU serial cable attached to the TCI port, type `c:\ACNMENU` and press {enter}.
2. Select "PTU TCI and PSC and press {enter}
3. Type your name and press {enter}.
4. Type your password and press {enter}.
5. Cursor to "Special Operation" and press {enter}.
6. Cursor to "Event Data Menu" and press {enter}.
7. Cursor to "View Data Packs" and press {enter}.
8. Type PK number to be recorded and press {enter}.
9. Watch the lower right of the screen as 100 frames are recorded. Press the F2 key.
10. Cursor to "Record Screen" and press {enter}.
11. Assign a file name for the data pack.
12. Press {escape} until back to the DOS "C:>" prompt.
13. Insert a blank disk in the appropriate drive.
14. Type the following command: `copy c:\geoh-vac\ptuaccr\2data\filename`

NOTE: Insert the name assigned to the file in Step 11 in place of "filename" in the command in Step 14.

15. Press {enter} to copy the file to the disk.

Event reset

There are two basic types of event resets: *soft* and *hard*. The difference between the soft and hard reset is that a soft reset only affects events that have not been locked out and a hard reset affects events regardless of lockout status.

Events will be reset:

- *On power-up* - A soft reset will be issued against all events at power-up.
- *By DID commands* - The TCI can issue both hard and soft resets.
- *By PTU commands* - The PTU can issue both hard and soft resets.

Serial data communications

The CPU card for the PSC uses serial data busses to communicate with the TCI, the PTU, and the two inverter CPU cards.

PSC to TCI communications processing

This software function performs the processing necessary for the PSC to communicate with the TCI. The communication is comprised of periodic data and non-periodic data.

Periodic data is a predefined set of data which is used for transferring real time control information from the PSC to the TCI and from the TCI to the PSC at a fixed rate.

The non-periodic messages are used to transfer all background data. Background data consists of DID commands, remote monitor data, and download code.

Packets containing periodic data will be asynchronously (not initiated) transmitted from the PSC to the TCI and from the TCI to the PSC every 200 ms. The TCI initiates the transfer of non-periodic data.

The TCI and the PSC are interfaced using the General Electric Asynchronous Communications Protocol (ACP). ACP provides two general types of messages: *acknowledged* and *unacknowledged*. The acknowledged messages are used to transmit the background data. The unacknowledged messages are used to transmit the periodic data.

PSC to PTU communications processing

This software function performs the processing necessary for the PSC to communicate through an RS-232 serial link to the Portable Test Unit (PTU).

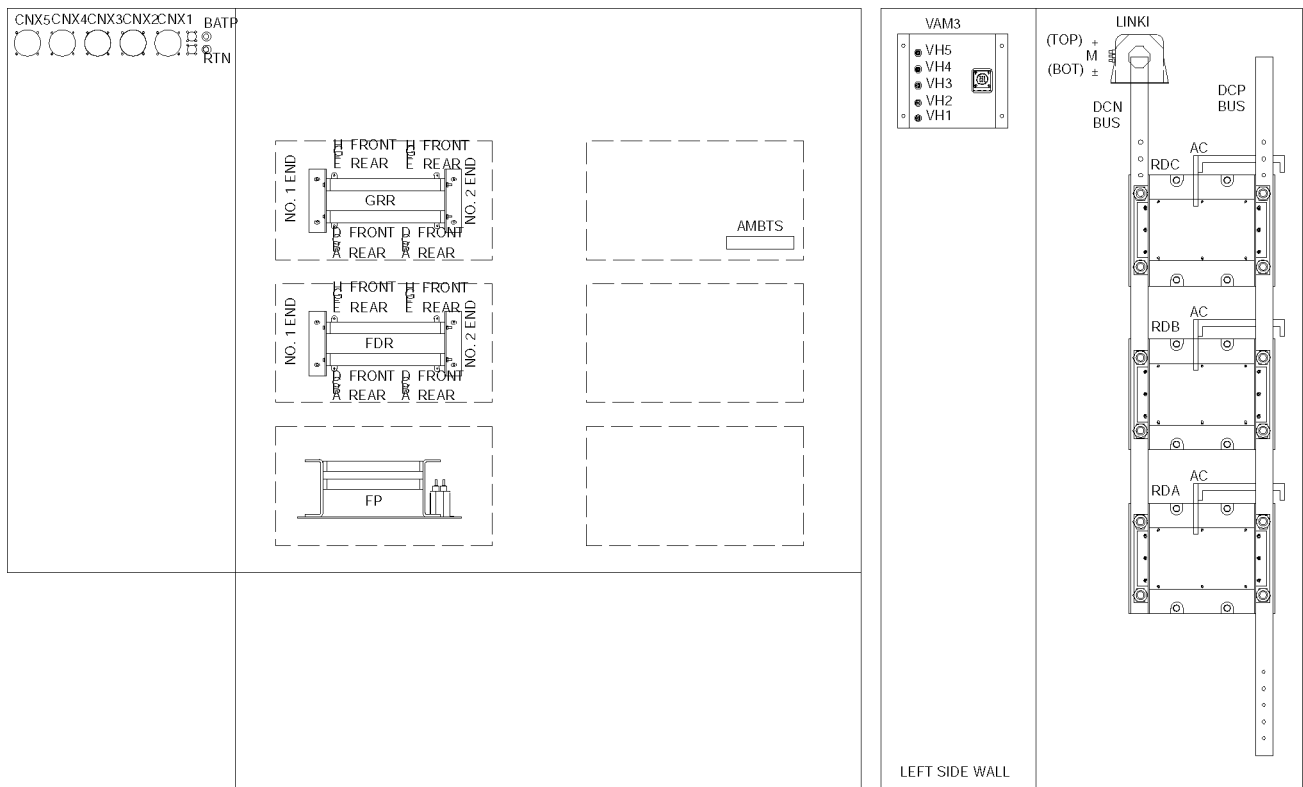


FIGURE 10-6. CONTROL CABINET COMPONENTS - REAR CABINET VIEW

E020125

Air conditioning system electrical circuit

The air conditioner's electrical circuit is fed from an accessory circuit and is fused with a 30-ampere circuit breaker.

The blower control is a switch which provides a range of blower speeds from fast to slow. When the blower switch is turned on, current is available at the compressor clutch. Once the blower is turned on, fan speeds may be changed without affecting the thermostat sensing level.

The thermostat reacts to changing temperatures which cause electrical contacts to open and close. The thermostat has a capillary tube extended into the evaporator coil to sense temperature.

When the contacts are closed, current flows to the clutch field and energizes the clutch, causing the swash plate inside the compressor to turn which starts the refrigeration cycle. When the temperature of the evaporator coil drops to a predetermined point, the contacts open and the clutch disengages.

When the clutch is disengaged, the blower remains at the set speed. After the evaporator temperature rises about twelve degrees above the cutout point, the contacts in the thermostat close and the refrigeration cycle resumes.

Thermostat

An electromagnetic clutch is used on the compressor to provide a means of constant temperature control of the cab. The clutch is controlled by a thermostat in the evaporator which is set initially by the driver to a predetermined point. Evaporator temperature is then maintained by the cycling action of the clutch.

The thermostat is simply a thermal device which controls an electrical switch. When warm, the switch is closed; when cold, it is open. Most thermostats have a positive OFF position as a means to turn the clutch off regardless of temperature.

The bellows type thermostat has a capillary tube connected to it which is filled with refrigerant. The capillary tube is attached to the bellows inside of the thermostat. Expansion of the gases inside the capillary tube exerts pressure on the bellows, which in turn closes the contacts at a predetermined temperature.

Compressor clutch

An electromagnetic clutch is used in conjunction with the thermostat to disengage the compressor when it is not needed, such as when a defrost cycle is indicated in the evaporator, or when the system or blower is turned off.

The stationary field clutch is the most desirable type since it has fewer parts to wear. The field is mounted to the compressor by mechanical means depending on the type field and compressor. The rotor is held on the armature by a bearing and snap rings. The armature is mounted on the compressor body.

When no current is fed to the field, there is no magnetic force applied to the clutch and the rotor is free to rotate on the armature, which remains stationary on the crankshaft.

When the thermostat or switch is closed, current is fed to the field. This sets up a magnetic force between the field and armature, pulling it into the rotor. When the armature becomes engaged with the rotor, the complete unit rotates while the field remains stationary. This causes the compressor crankshaft to turn, starting the refrigeration cycle.

When the switch or thermostat is opened, current is cut off. The armature snaps back out and stops while the rotor continues to turn. Pumping action of the compressor is stopped until current is again applied to the field. In addition, safety switches in the compressor clutch electrical circuit control clutch operation, disengaging the clutch if system pressures are abnormal.

DUMP TRUCK

960E

Machine model	Serial number
960E-1	A30003 - A30026
960E-2	A30027 and up

20 Standard value table

Standard value table

Standard value table for truck	3
--------------------------------------	---

Special tool list

Part number	Description	Qty.	Use
XB0887	Vaccum pump kit (requires 30 scfm air supply)	1	Retains oil in hydraulic tank while disconnecting hydraulic hoses and components
EB1759	Nitrogen charging kit	1	Suspension and accumulator charging
EC6027	Hydrair charging kit	1	
EM3708	Rear brake wear indicator	1	Brake wear measurement
EM1275	Front brake wear indicator	1	
PB6039	Female quick disconnect	4	Brake system checkout
PB9067	Bulkhead connector	1	Auxiliary battery power source
PC2525	Harness	1	Payload meter data downloading

Steering system checkout data sheet

MACHINE MODEL _____ UNIT NUMBER _____ SERIAL NUMBER _____

_____ Steering Accumulators charged to 9650 kPa (1400 psi).

Operate steering system to obtain proper operating temperature. Refer to Check-out Procedures.

STEERING PUMP PRESSURE CONTROL ADJUSTMENTS

STEP 11 _____ Steering pump unload pressure

STEP 12 _____ Steering pump reload pressure

STEERING CONTROL VALVE AND FLOW AMPLIFIER LEAKAGE TESTS

STEP 4 _____ Flow amplifier return hose leakage

STEP 5 _____ Steering control unit return hose leakage

BLEED DOWN MANIFOLD LEAKAGE TEST

STEP 4 _____ Tank return hose leakage

SHOCK AND SUCTION VALVES TEST

STEP 8 _____ Shock and suction valve pressure, left steer

STEP 10 _____ Shock and suction valve pressure, right steer

STEP 12 _____ Steering relief valve pressure setting

STEP 23 _____ Steering pump unload pressure

STEP 24 _____ Steering pump reload pressure

Name of Technician or Inspector Performing Check-Out _____

Date _____

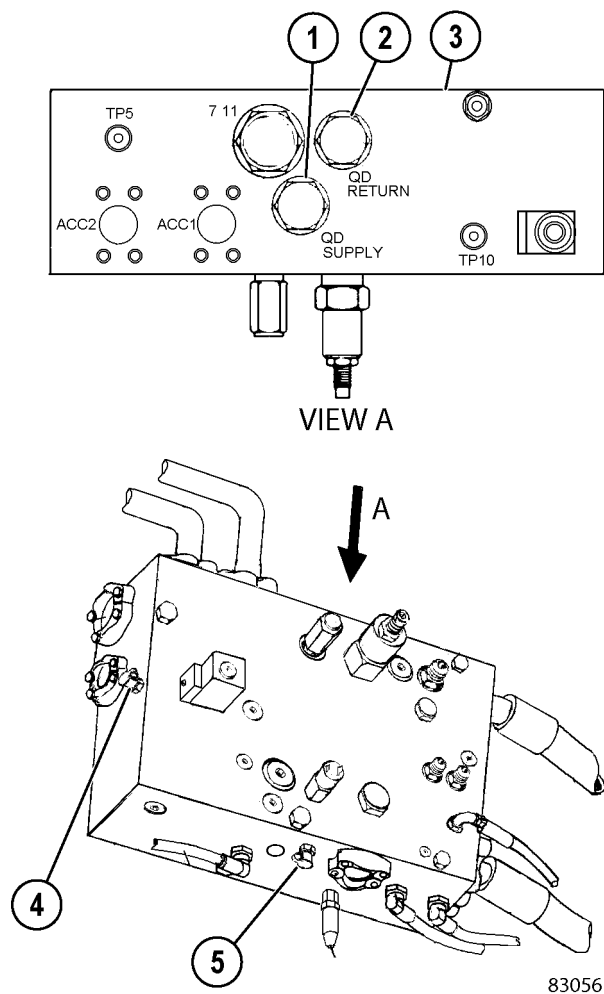


FIGURE 30-10. BLEED DOWN MANIFOLD

- 1. Plug - QD Supply Port
- 2. Plug - QD Return Port
- 3. Bleed Down Manifold
- 4. Test Port (TP3)
- 5. Test Port (TP2)

9. At the rear axle housing, connect brake cooling lines (1, 2 & 3, Figure 30-14) together using fitting assembly (3, Figure 30-15). Cap the three open fittings on the axle housing with clean caps. Several hose clamps may have to be removed to connect the three hoses to the fitting assembly.
10. At the left front brake assembly, connect cooling hoses (1 & 3, Figure 30-16) together using adapter (2). Cap the open fittings on the brake assembly. At the right front brake assembly, connect the two cooling hoses together using another adapter. Cap the open fittings on the brake assembly.

NOTE: The adapters are installed on the truck when it is shipped from the factory.

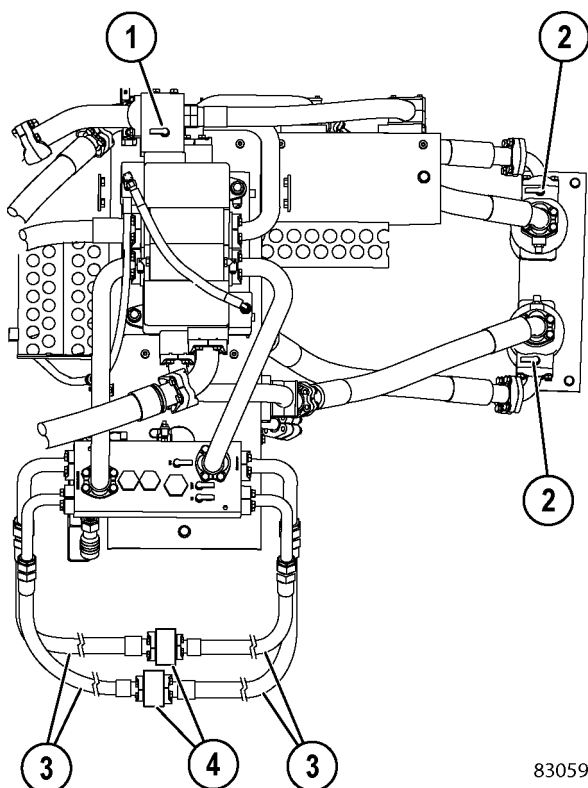


FIGURE 30-11. TEST PORT LOCATIONS AND HOIST FLUSHING HOOKUP

- 1. Test Port (Front Brake Cooling Circuit)
- 2. Test Port (Hoist Filters)
- 3. Hoist Cylinder Hoses
- 4. Bypass Blocks (PC3074)

Initial system setup

Ensure that the brakes have been properly bled to remove any trapped air. Refer to "Wet disc brake bleeding procedure". Also, before checking the brake system, make sure that the parking brake is functioning properly. Refer to "Parking brake bleeding procedure".

1. Securely block the wheels to prevent the truck from rolling away.
2. Move the directional control lever in PARK and turn the rest switch ON. Turn the key switch OFF to shut off the engine and allow 90 seconds for the steering system accumulators to depressurize.

NOTE: Leave rest switch in the ON position and the GF cutout switch in the CUTOFF position throughout brake tests.

3. Install two 24 100 kPa (3,500 psi) pressure gauges at front brake (BF) pressure test port (23, Figure 30-2) and rear brake (BR) pressure test port (22).

Install the 34 475 kPa (5,000 psi) pressure gauge at low accumulator pressure test port "LAP1" (15).

4. Open bleed down valves (7) and (9, Figure 30-1) on the brake manifold to depressurize the brake accumulators.
5. Precharge both brake accumulators. Refer to Testing and adjusting section **Accumulators and suspensions** for the accumulator charging procedure.

NOTE: For best performance, charge the accumulators in the ambient conditions in which the machine will be operating.

6. Close both brake accumulator bleed down valves.
7. Release the brake lock.
8. Start the engine. Observe the rising brake pressures as the system charges. The brake pressures should begin to fall when the auto apply valve releases. The auto apply valves should release the front and rear brakes at $11\,375 \pm 1\,380$ kPa ($1,650 \pm 200$ psi).

** Record on data sheet.*

9. Partially depress the brake pedal to bleed air from each brake. Move the directional control lever to NEUTRAL to bleed air from the parking brake. Then move the directional control lever to PARK.

10. Slowly depress the brake pedal. The rear brake pressure should begin to rise before the front brake pressure.

- Verify that the rear brake pressure is $310 - 1415$ kPa ($45 - 205$ psi) when the front brake pressure begins to rise.

** Record on data sheet.*

11. Slowly depress the brake pedal. Force feedback of the pedal on your foot should be smooth with no abnormal noise or mechanical roughness.

- Verify that the stop lights illuminate at 517 ± 34 kPa (75 ± 5 psi) rear brake pressure.

** Record on data sheet.*

12. Quickly and completely depress the brake pedal. Verify that within one second after the brake is applied:

- Rear brake (BR) pressure reads $17\,235 \pm 517$ kPa ($2,500 \pm 75$ psi).
- Front brake (FR) pressure reads $17\,235 \pm 517$ kPa ($2,500 \pm 75$ psi).
- Both pressures must remain above their minimum values for a minimum of 20 seconds.

** Record on data sheet.*

Brake lock / secondary braking checkout

13. Disconnect the lead wire from brake lock solenoid valve (13, Figure 30-1) located on the brake manifold in the hydraulic brake cabinet.

14. Move the directional control lever to NEUTRAL. Press the brake lock switch. The brake lock will not apply if the engine is not operating. Fault code A118 will become active.

15. Depress the brake pedal until fault code A118 is cleared, then very slowly release the pedal until fault code A118 is active again.

- Verify that the rear brake (BR) pressure drops to $6\,895 \pm 172$ kPa ($1,000 \pm 25$ psi) when the fault reoccurs.

** Record on data sheet.*

NOTE: There is a three second delay between the time that the brake lock degradation switch senses the pressure and fault code A118 occurs. Fault code A265 will also become active during this step.

- STEP 58 _____ Parking brake release pressure (PK3)
_____ Brake lock apply pressure (PP3)
_____ Front brake (BF) apply pressure
_____ Rear brake (BR) apply pressure
- STEP 59 _____ Parking brake release pressure (PK3)
_____ Brake lock apply pressure (PP3)
_____ Front brake (BF) apply pressure
_____ Rear brake (BR) apply pressure
- STEP 63 _____ Parking brake release pressure (PK3)
_____ Brake lock apply pressure (PP3)
_____ Front brake (BF) apply pressure
_____ Rear brake (BR) apply pressure

BRAKE LOCK CONTROL LOGIC CHECKOUT

- STEP 66 _____ Parking brake release pressure (PK3)
_____ Brake lock apply pressure (PP3)
_____ Front brake (BF) apply pressure
_____ Rear brake (BR) apply pressure
- STEP 68 _____ Parking brake release pressure (PK3)
_____ Brake lock apply pressure (PP3)
_____ Front brake (BF) apply pressure
_____ Rear brake (BR) apply pressure
- STEP 70 _____ Parking brake release pressure (PK3)
_____ Brake lock apply pressure (PP3)
_____ Front brake (BF) apply pressure
_____ Rear brake (BR) apply pressure

Test setup procedure

1. Position the valve on the test stand as shown in Figure 30-8.
2. Attach the pilot input supply line to the port labeled "PX" on the side of the valve.
3. Attach the main supply input pressure line to the port on the front of the valve labeled "P".
4. Attach the tank return line to the port labeled "T".
5. Attach the regulated output ports "B1" and "B2" to the test lines. Pressure monitoring devices in these two lines must be capable of 20 680 kPa (3,000 psi). Connect all ports according to the diagram shown in Figure 30-8. All ports must be used and connected.



All ports must be used. Relieve pressure before disconnecting hydraulic and other lines. Tighten all connections before applying pressure.

Avoid spillage and contamination! Avoid contact with hot oil if the machine has been operating. The oil will be at very high pressure.

Hydraulic fluid escaping under pressure can have sufficient force to enter a person's body by penetrating the skin and cause serious injury and possibly death if proper medical treatment by a physician familiar with this injury is not received immediately.

6. Start the hydraulic pump and regulate output pressure at 18 960 kPa (2,750 psi) at pressure gauge (3). Pressure gauges (9) and (10) should read zero.
7. Adjust pressure regulator (4) to set pilot supply pressure to 17 235 kPa (2,500 psi) on gauge (7).
8. Return line pressure during this test is not to exceed zero.
9. Test the valve with ISO 32 grade hydraulic oil at 49 ± 3 °C (120 ± 10 °F).

Relay valve output pressure adjustment

1. With the pump operating and supply pressure and pilot pressure adjusted as described earlier inspect the valve for leakage.
2. With 17 235 kPa (2,500 psi) of pilot pressure applied, verify that pressure gauges (9) and (10) read $17\,235 \pm 517$ kPa ($2,500 \pm 75$ psi).
3. Close pilot supply needle valve (5) and open pilot pressure release needle valve (6) to bleed pressure back to the reservoir. Pilot pressure gauge (7) and regulated output pressure gauges (9) and (10) should drop to zero.
4. Repeat Steps 2 and 3 approximately 50 times to cycle the valve from minimum to maximum apply pressure.
5. Verify that the output pressure remains within specifications. If not, the valve must be rebuilt.
6. While observing pilot pressure gauge (7) and regulated output pressure gauges (9) and (10), apply pilot pressure slowly and steadily until 17 235 kPa (2,500 psi) maximum pilot pressure is obtained.

Pilot pressure and regulated output pressure must track within 345 kPa (50 psi) after the pilot pressure reaches 690 kPa (100 psi).

7. Reduce pilot pressure to zero. Apply 17 235 kPa (2,500 psi) of pilot pressure as quickly as possible. Regulated output pressure must increase to $17\,235 \pm 517$ kPa ($2,500 \pm 75$ psi) within one second after pressure is applied to the pilot line.
8. Check for internal valve leakage from port "T" with full supply pressure (port "P") applied.
 - With pilot pressure released, leakage must not exceed 100 cc/minute.
 - With 17 235 kPa (2,500 psi) of pilot pressure applied, leakage must not exceed 150 cc/minute.

7. Attach the charging valve adapter to the charging valve on the accumulator. Make sure that the hose does not loop or twist. Tighten the swivel nut on the charging valve adapter finger-tight.
 8. **Brake accumulator:** Turn the "T" handle on charging valve adapter (6) clockwise to open the accumulator gas valve. Do not turn the "T" handle all the way down as it will damage the valve core.
- Steering accumulator:** Hold charging valve body (6, Figure 30-9) with a wrench while unscrewing swivel nut (4) three complete turns with another wrench. This will open the poppet inside the accumulator gas valve.
9. Slowly charge the accumulator to 690 kPa (100 psi). After 690 kPa (100 psi) is obtained, the charging rate can be increased until the accumulator is fully charged to 9 653 kPa (1,400 psi).

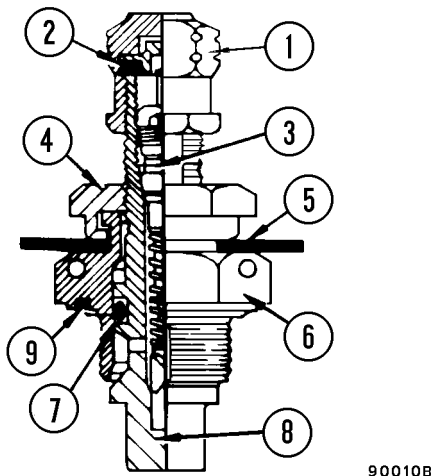


FIGURE 30-9. CHARGING VALVE

- | | |
|------------------|---------------|
| 1. Valve Cap | 6. Valve Body |
| 2. Seal | 7. O-ring |
| 3. Valve Core | 8. Valve Stem |
| 4. Swivel Nut | 9. O-ring |
| 5. Rubber Washer | |

10. **Brake accumulator:** Turn the "T" handle on charging valve adapter (6, Figure 30-6) all the way out (counterclockwise) to close the accumulator gas valve.

Steering accumulator: Hold charging valve body (6, Figure 30-9) with a wrench while tightening swivel nut (4) to **7 - 11 N·m (5 - 8 ft lb)** with another wrench. This will close the poppet inside the accumulator gas valve.

11. Submerge the accumulator assembly under water and observe it for 20 minutes. No leakage (bubbles) is permitted from the gas valve at the top or the valve port at the bottom. If leakage is present, proceed to Step 16.
12. Hold the gas valve on the accumulator stationary. Loosen the swivel nut on the charging valve adapter to remove the nitrogen charging kit.
13. **Brake accumulator:** Install protective cap (1, Figure 30-7) on the gas valve.

Steering accumulator: Install the valve cap on charging valve (6, Figure 30-8) finger-tight. Install valve guard (5) on gas valve manifold (1).

14. Ensure that the bleed valve at the bottom of the accumulator is closed. Connect a hydraulic power supply to the valve port at the bottom of the accumulator.
15. Pressurize the accumulator with oil to 24 130 kPa (3,500 psi). This may take 6 to 8 gallons of oil. No external oil leakage is permitted.
16. Slowly relieve oil pressure and remove the hydraulic power supply. Install the protective cap on the valve port to prevent contamination.
17. Install the nitrogen charging kit.
 - If any gas or oil leakage was present, discharge all nitrogen gas from the accumulator. Repair the accumulator as necessary.
 - If there were no leaks, adjust the precharge pressure to 690 - 827 kPa (100 - 120 psi).
18. Verify that all warning and caution labels are attached and legible. Install new labels as required.

DUMP TRUCK

960E

Machine model	Serial number
960E-1	A30003 - A30026
960E-2	A30027 and up

30 Testing and adjusting KOMTRAX Plus and payload meter

KOMTRAX Plus and payload meter software	3
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KOMTRAX Plus initialization check list

(Page 1 of 2)

FOR: 730E, 830E, 930E & 960E DUMP TRUCKS

Date of set-up	(MM/DD/YY) / /
Distributor and Branch	
Person performing initialization	

Item No.	To be checked when	Check Item	Results	
			Yes	No
1.	Key switch OFF	Machine Model Number		
		Machine Serial Number		
		Service Meter Reading		
		Engine Serial Number		
		Alternator Serial Number		
		KOMTRAX Plus Controller Serial Number		
		Orbcomm Controller Serial Number (if equipped)		
2.	Connect PC to KOMTRAX Plus controller	Are they properly connected?		
3.	Key switch ON	Check operation of controller LED (after segment rotation, display to count-up).		
4.	Start <i>VHMS Setting Tool</i> program	Select "VHMS Setting", then "Set up & All clear".		
5.	Initial setup of KOMTRAX Plus controller Machine Information Setting(1)	Is Product Group correct? (Dump truck)		
		Is Machine Model correct? (ex. 930E)		
		Is Type correct? (ex. -2)		
		Is Variation Code correct? (ex. SE)		
		Is Serial Number correct?		
6.	Machine Information Setting (2)	Is Engine Model - Type correct?		
		Is Engine Serial Number correct?		
7.	Date & Time Setting	Is Time Zone correct?		
		Is Date correct?		
		Is Time correct?		
		Is DST (daylight saving time) correct?		
8.	GCC Setting	Is correct GCC code selected for location?		
9.	Setting Data	Verify Setting Data is Correct.		
10.	Setting of Payload Meter	Set PLM time \pm 2 minutes of VHMS time.		
		Start Time (set to 0)		
		Interval (set to 1)		

7. At the prompt type "dispvhmsinf". Information similar to the following will be displayed:

```
>dispvhmsinf

---- MACHINE INFORMATION -----
PRODUCT GROUP: Dumptruck
MACHINE_MODEL: 930E-
MACHINE_SERIAL:
ENG_MODEL: QSK60
ENG_SERIAL_NO1:
ENG_SERIAL_NO2:
PRG_NO1: 12000100100
PRG_NO2: 782613R290
---- DEVICES -----
PLC NO CONNECTION
PLM23 Disabled
PLM3 CONNECTED
---- Condition -----
SMR: 90.0 H
DATE 04-10-25 TIME14:44:24
TIMEZONE: 0.0 H SUMMERTIME 0
----Controller Info -----
PartNumber: 0000000000
Serial No.: 000000
Compo Name: KDE1010
SilkyID: VA011740744
>
```

NOTE: Use the results of step 6 and 7 to confirm that the correct software is installed in the KOMTRAX Plus controller.

8. The KOMTRAX Plus controller also has two red LED lights (10 and 11, Figure 13-6). Verify the connection status and repair any problems.

Light (10) PLM III communication

- OFF - No communication with the PLM III controller. Troubleshoot and repair the connection.
- ON - Communication with the PLM III controller is good.

Light (11) OrbComm

- OFF - No communication with OrbComm controller. Troubleshoot and repair the connection.
- ON - Communication with Orbcomm controller is good.
- FLASHING - Satellite signal is established. This may take as long as 15 minutes to occur.

Interface module checkout procedures

⚠ IMPORTANT ⚠

If a new truck with KOMTRAX Plus is being assembled, or a new KOMTRAX Plus system has just been installed, refer to Testing and adjusting section KOMTRAX Plus and payload meter for instructions regarding the KOMTRAX Plus Initialization Procedure. The initialization procedure and form must be completed before the truck can be put into service.

Necessary equipment

- System schematic
- Laptop computer
- *Interface Module Realtime Data Monitor* software
- Serial cable (RS232)
- Jumper wire 77 mm (3 in.) or longer
- Voltmeter
- 300 to 332 ohm resistor
- 3/8 in. nut driver

NOTE: The interface module must already have the application code installed.

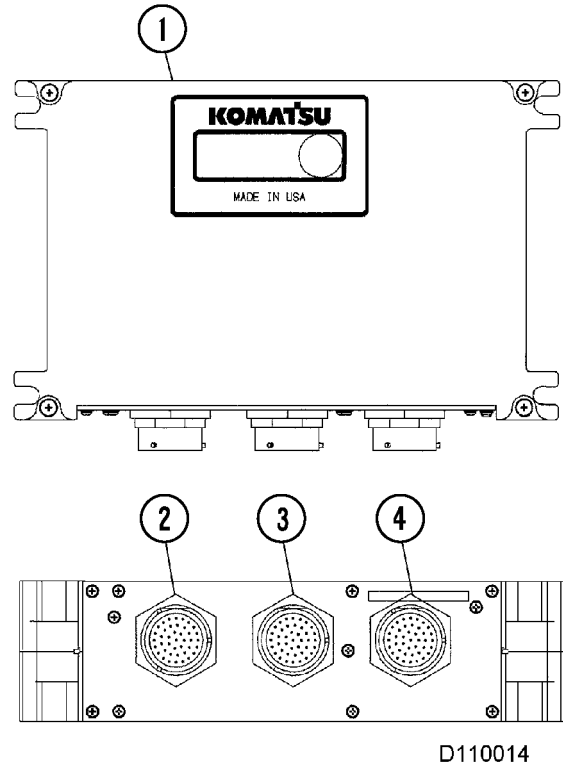


FIGURE 30-1. INTERFACE MODULE

- | | |
|---------------------|------------------|
| 1. Interface Module | 3. Connector IM2 |
| 2. Connector IM1 | 4. Connector IM3 |

Service tools and equipment

Recovery/recycle station

Whenever refrigerant must be removed from the system, a dual purpose station (Figure 30-1) performs both recovery and recycle procedures which follows the new guidelines for handling used refrigerant. The recovered refrigerant is recycled to reduce contaminants, and can then be reused in the same machine or fleet.

To accomplish this, the recovery/recycle station separates the oil from the refrigerant and filters the refrigerant multiple times to reduce moisture, acidity, and particulate matter found in a used refrigerant.

NOTE: To be re-sold, the gas must be "reclaimed" which leaves it as pure as new, but requires equipment normally too expensive for all but the largest refrigeration shops.

Equipment is also available to just remove or extract the refrigerant. Extraction equipment does not clean the refrigerant; it is used to recover the refrigerant from an A/C system prior to servicing.

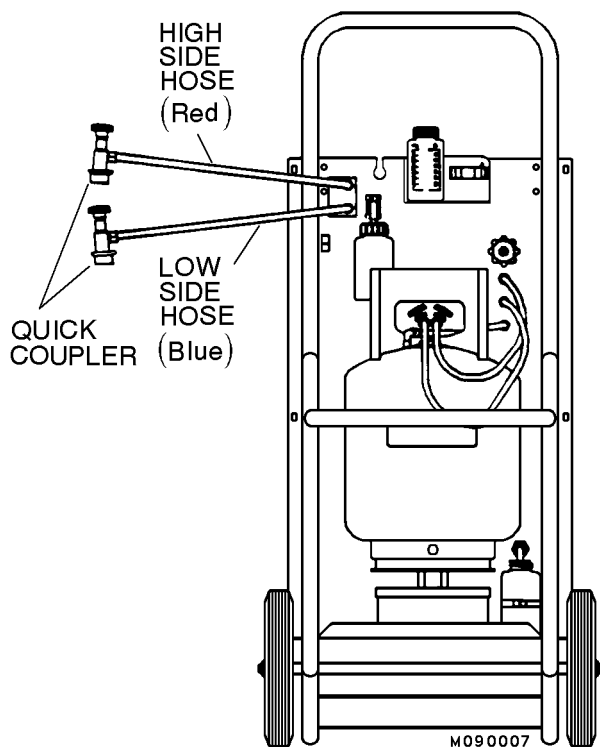


FIGURE 30-1. RECOVERY/RECYCLE STATION



Mixing different types of refrigerant will damage equipment. Dedicate one recovery/recycle station to each type of refrigerant processing to avoid equipment damage. DISPOSAL of the gas removed requires laboratory or manufacturing facilities.

Test equipment is available to confirm whether the refrigerant in the system is actually the type intended for the system and has not been contaminated by a mixture of refrigerant types.

Recycling equipment must meet certain standards as published by the Society of Automotive Engineers (SAE) and carry a UL approved label. The basic principals of operation remain the same for all machines, even if the details of operation differ somewhat.

Leak detector

The electronic leak detector (Figure 30-2) is very accurate and safe. It is a small hand-held device with a flexible probe used to seek refrigerant leaks. A buzzer, alarm or light will announce the presence of even the smallest leak.

Some leak detectors are only applicable to one type of refrigerant. Ensure that the leak detector being used applies to the refrigerant in the system.

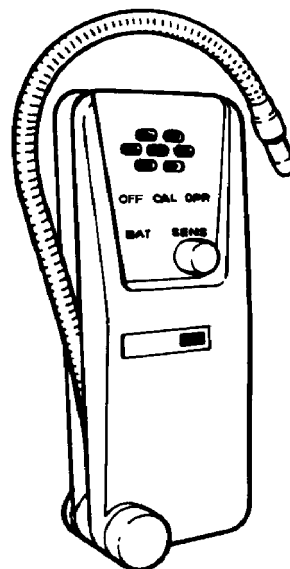


FIGURE 30-2. TYPICAL ELECTRONIC LEAK DETECTOR

Evacuating the air conditioning system

Evacuating the complete air conditioning system is required for all new system installations, when repairs are made on systems requiring a component replacement (system opened), or when a major loss of refrigerant has occurred. All these conditions will require that a vacuum be pulled using a vacuum pump that completely removes any moisture from the system. Once properly evacuated, the system can be recharged again.

Using a pump to create a vacuum in the air conditioning system effectively vaporizes any moisture, allowing the water vapor to be easily drawn out by the pump. The pump does this by reducing the point at which water boils (100 °C, 212 °F at sea level with 14.7 psi). In a vacuum, water will boil at a lower temperature depending upon how much of a vacuum is created.

As an example, if the ambient air outside the truck is 24 °C (75 °F) at sea level, by creating a vacuum in the system so that the pressure is below that of the outside air (in this case, at least 749.3 mm (29.5 in.) of vacuum is needed), the boiling point of water will be lowered to 22 °C (72 °F). Thus any moisture in the system will vaporize and be drawn out by the pump if the pump is run for approximately an hour. The following steps indicate the proper procedure for evacuating all moisture from the heavy duty air conditioning systems.



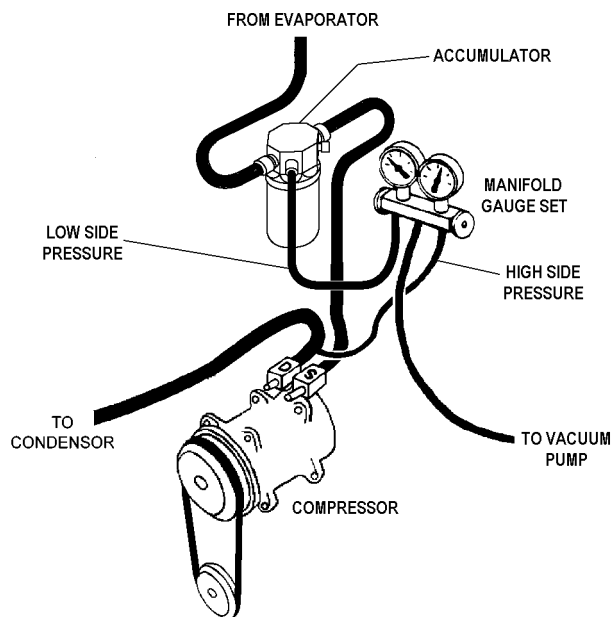
Do not attempt to use the air conditioning compressor as a vacuum pump or the compressor will be damaged.

NOTE: Refer to Table 3 for optimal vacuum specifications at various altitudes.

1. With the manifold gauge set still connected (after discharging the system), connect the center hose to the inlet fitting of the vacuum pump as shown in Figure 30-8. Then open both hand valves to maximum.

2. Open the discharge valve on the vacuum pump or remove the dust cap from the discharge outlet. Turn on the pump and watch the low side gauge. The pump should pull the system into a vacuum. If not, the system has a leak. Find the source of the leak, repair, and attempt to evacuate the system again.
3. Allow the vacuum pump to run for at least 45 minutes.
4. Shut off the vacuum pump and observe the gauges. The system should hold the vacuum within 5 cm Hg (2 in. Hg) of the optimal vacuum for five minutes. If the vacuum does not hold, moisture may still be present in the system. Repeat the previous step. If the vacuum still does not hold, a leak may be present in the system. Find the source of the leak, repair, and evacuate the system again.

NOTE: In some cases, 45 minutes of evacuation may not be sufficient to vaporize all of the moisture and draw it out of the system. If it has been verified that no system leaks exist and gauge readings increase after 45 minutes, extend the evacuation time to ensure total moisture removal.



N040071

FIGURE 30-8. VACUUM PUMP HOOKUP

NOTES

Table 2: DID panel fault codes (received from PSC)				
Fault code		Description	Restriction	Cause of fault
076		FB173 CARD	No power	FB173 card failure
	:01	speed FPGA DL		
	:02	speed FPGA run		
	:03	ALT FPGA DL		
	:04	Microcontroller		
	:05	slow task		
	:06	med task		
	:07	fast task		
	:08	FD task		
	:09	Alternator 3 phase volts bad		
	:10	alt FPGA timeout		
077		INVERTER FAILED VI TEST	No power	Inverter failed during test.
078		Inverter Background Communication Failure	Sys Event	A failure in the inverter background communication was detected.
084		CONTROL POWER SWITCH OFF	SYS Event	Control power switch is turned off while truck is moving.
085		AUX COOLING	SYS Event	A fault has occurred in the auxiliary blower operation.
	:02	aux rpmfb input		Rpm of Aux Blower out of range.
	:03	aux rpm feedback		Rpm feedback does not match rpm command.
	:04	abnormal shutdown		A fault occurred during shutdown
087		HP LOW	SYS Event	Horsepower adjust is at negative limit for 30 seconds.
088		HP LIMIT	SYS Event	Horsepower limit exceeded while in propulsion.
089		ENGINE SPEED DOES NOT MATCH COMMAND	SYS Event	Engine speed feedback does not match commanded speed.
	:02	RPM does not match command		
091		INVERTER 1 CUTOUT	SYS Event	
092		INVERTER 2 CUTOUT	SYS Event	
094		ILLEGAL LIMP REQUEST	SYS Event	A "limp mode" request is received while truck is moving.
095		BAD BRAM BATTERY	SYS Event	BRAM battery voltage is low.
096		UNEXPECTED PSC CPU RESET	SYS Event	PSC CPU reset without request.
098		DATA STORE	SYS Event	PTU data store command

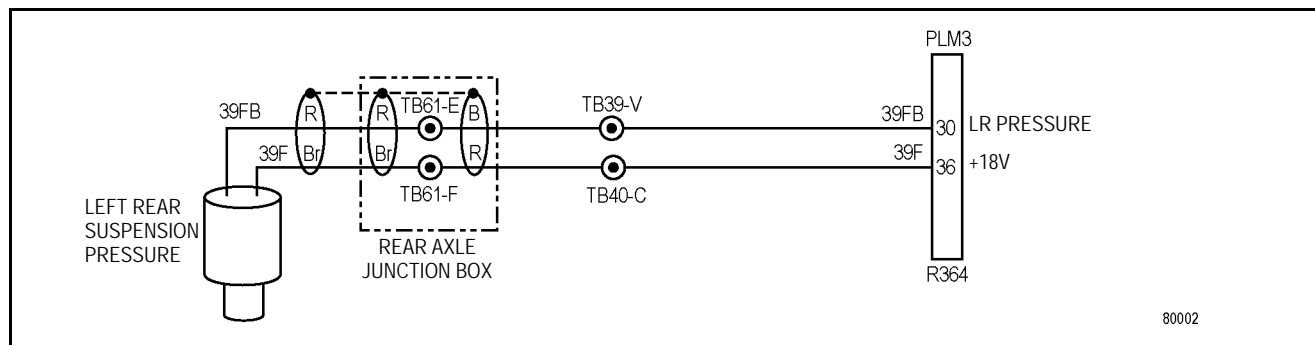
Table 4: DID panel fault codes (received from TCI)				
Fault code	Description	Restriction	Cause of fault	
601	TCI FB144 CPU CARD	No propel	TCI CPU card problem	
	:01 10ms task failed to init			
	:02 20ms task failed to init			
	:03 50ms task failed to init			
	:04 100ms task failed to init			
	:05 200ms task failed to init			
	:06 flt manager task			
	:07 flash CRC			Flash CRC computation did not match expected value.
	:09 main task failed to init			Upon power-up, excessive bus timeouts occurred.
	:10 excess timeouts			
	:11 BBRAM bad			
	:12 BBRAM CRC			CRC on BBRAM did not match expected value.
602	FB104 DIGITAL I/O CARD FAULT	No propel	Internal TCI self-test detected a digital I/O card problem.	
603	FB160 ANALOG I/O CARD FAULT	No propel	Internal TCI self-test detected an analog I/O card problem.	
604	PSC FAULT	Speed limit	Lost RS422 communication with PSC.	
	:01 missing message			
	:02 bad tick			
	:03 bad CRC			
	:04 FIFO overflow			
	:05 bad start bit			
	:06 bad stop bit			
605	AUX BLOWER COMM. FAULT	None	Lost RS422 communication with auxiliary blower controller while auxiliary blower is in failure mode and DC link is not energized.	
607	POSITIVE 5 VOLTS	Speed limit	+5V power supply out of limits	
608	POSITIVE 15 VOLTS	Speed limit	+15V power supply out of limits	
609	NEGATIVE 15 VOLTS	Speed limit	-15V power supply out of limits	
610	POT REFERENCE	Speed limit	Pot reference (10.8V) out of limits	
611	FREQUENCY INPUT	None	Front wheel speed input out of range	
	:01 left front wheel speed		Left front wheel sensor out of range	
	:02 right front wheel speed		Right front wheel sensor out of range	
613	ANALOG INPUT	Speed limit	Signal is outside the design range of valid values.	
	:01 A2D gnd			
	:02 A2D gainchk			
614	BATTERY SEPARATE CONTACTOR FAILURE	SYS Event	Signal is outside the design range of valid values. Voltage difference greater than 3V	
	:01 Battery Separate Failure			
	:02 crank batt > cntrl batt			
	:03 cntrl batt > crank batt			
616	DIRECTION MISMATCH	No propel	Simultaneous FORWARD and REVERSE commands were received.	

Fault Code A005: Left rear suspension pressure sensor signal high

Operator Action	None
Fault Code	A005
Description	Left rear suspension pressure sensor signal high.
Fault Conditions	Sets if pressure signal is out of range high (sensor current over 22 ma). Resets if reading returns to normal.
Operator Alerting System Response	Repair Lamp Display Operator Action: None Display Fault Description: PLM LR PRESS SENS HI Display Fault Code: A005
Resulting Problem(s)	Bad payload computation.
Related Information	A laptop running "IM Realtime Data Monitor" software may be required to resolve this fault.

Table	
<p>1. This fault is generated by PLM3 in response to a problem in the sensor circuit. This sensor circuit may have a related fault that can be used to resolve the problem. Refer to the Troubleshooting Instructions for the active parameter fault(s).</p> <p>2. If there are no active parameter fault codes, then based on the truck's setup while this fault is active, determine which of the parameters in the Table is not shown in its expected state on the IM Realtime Data Monitor program. Refer to the schematic to identify which item(s) may be causing the parameter(s) to be in the unexpected state. Troubleshoot these items.</p> <p>3. If this fault is not currently active or if no parameters are currently in the unexpected state and the malfunction is still unresolved, then check each of the parameters in the Table for proper functionality. Troubleshoot all item(s) related to the parameter(s) which are found to be malfunctioning.</p>	
Parameter	Expected State and/or Related Fault(s)
Left Rear Pressure Sensor (PLM3 36,30)	Sensor current >22 ma: failed high Sensor current <2 ma: failed low Sensor current >2 ma but less than 22 ma: valid readings Fault(s): A006

Related circuit diagram



80002

Fault Code A017: Payload meter flash memory read has failed

Operator Action	None
Fault Code	A017
Description	A payload meter flash memory read has failed.
Fault Conditions	Payload meter reports a failure of flash memory read.
Operator Alerting System Response	Lamp or Buzzer: None - Maintenance Item Display Fault Description: PLM FLASH MEM READ Display Fault Code: A017
Resulting Problem(s)	Payload and haul cycle data is bad.
Related Information	A laptop running "IM Realtime Data Monitor" software may be required to resolve this fault.

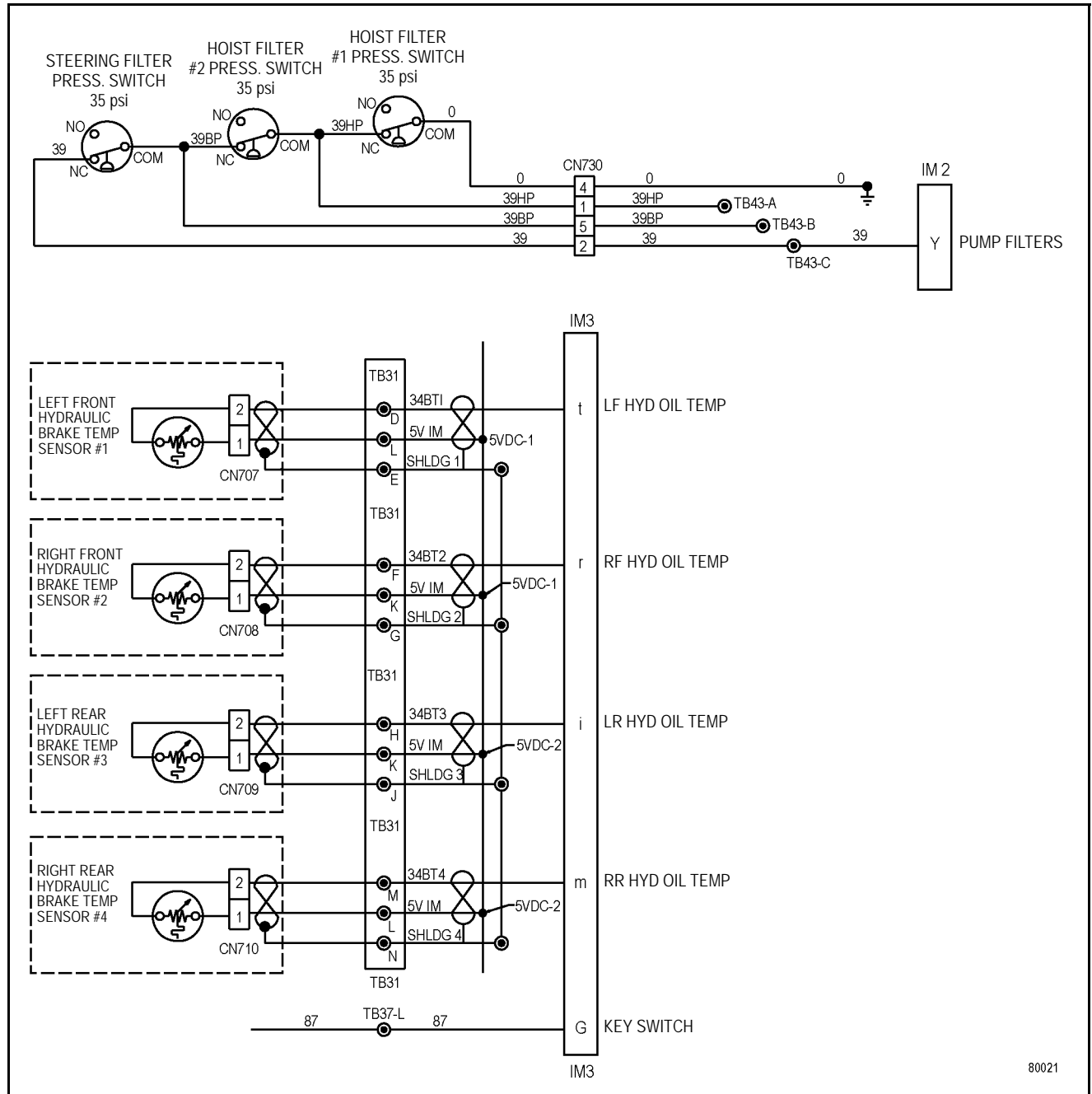
Table	
1. This fault is totally contained within the payload meter.	
Parameter	Expected State and/or Related Fault(s)
Payload Meter	

Related circuit diagram

None.

Engine Speed [RPM]	Less than 300 RPM: engine is not running Greater than 300 RPM for 4 seconds: engine is running
Keyswitch (IM 3G)	0: keyswitch is off and the truck is not moving and the engine is not running 1: keyswitch is on or the truck is moving (GE power not yet off) Fault(s): A240

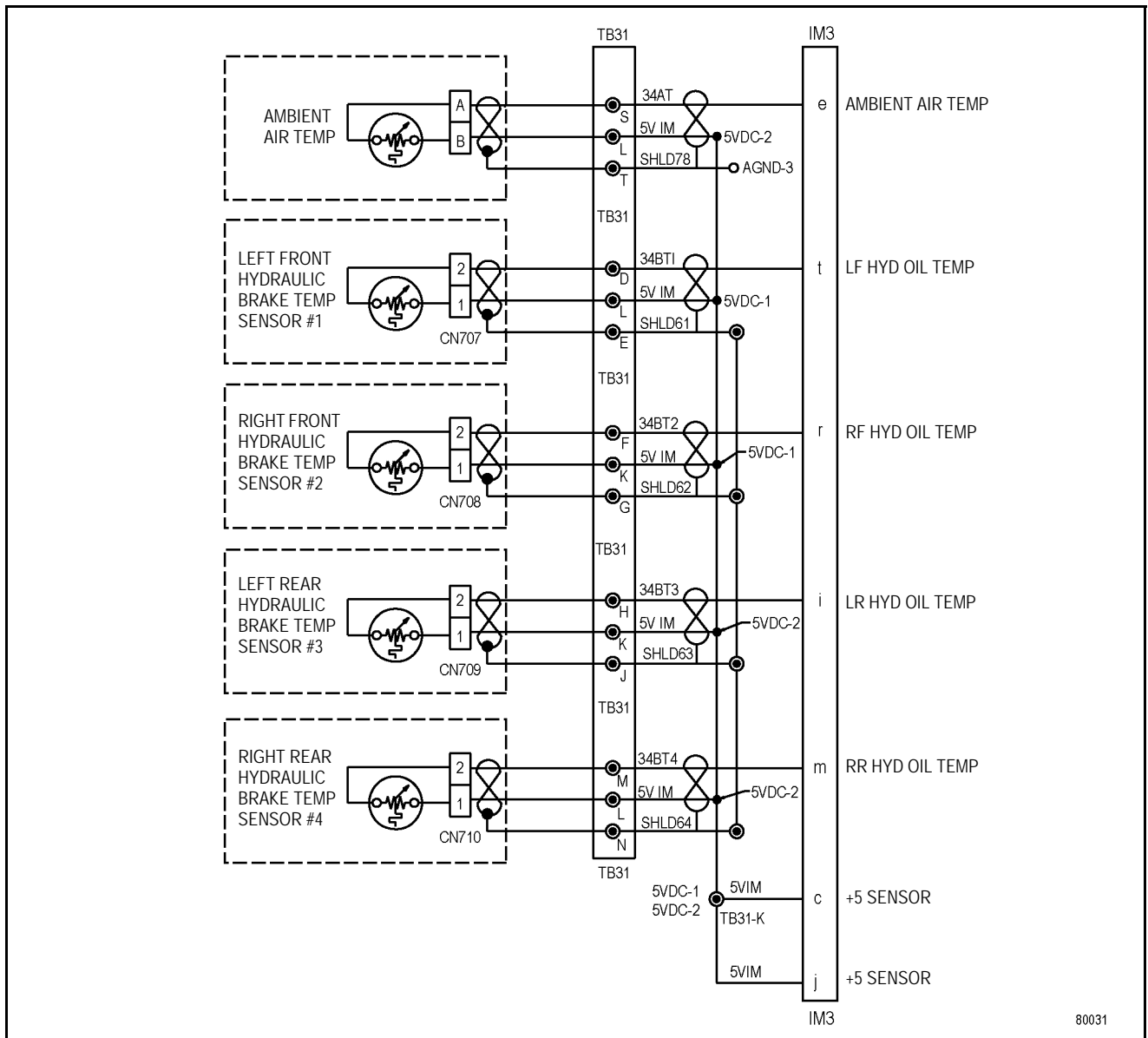
Related circuit diagram



80021

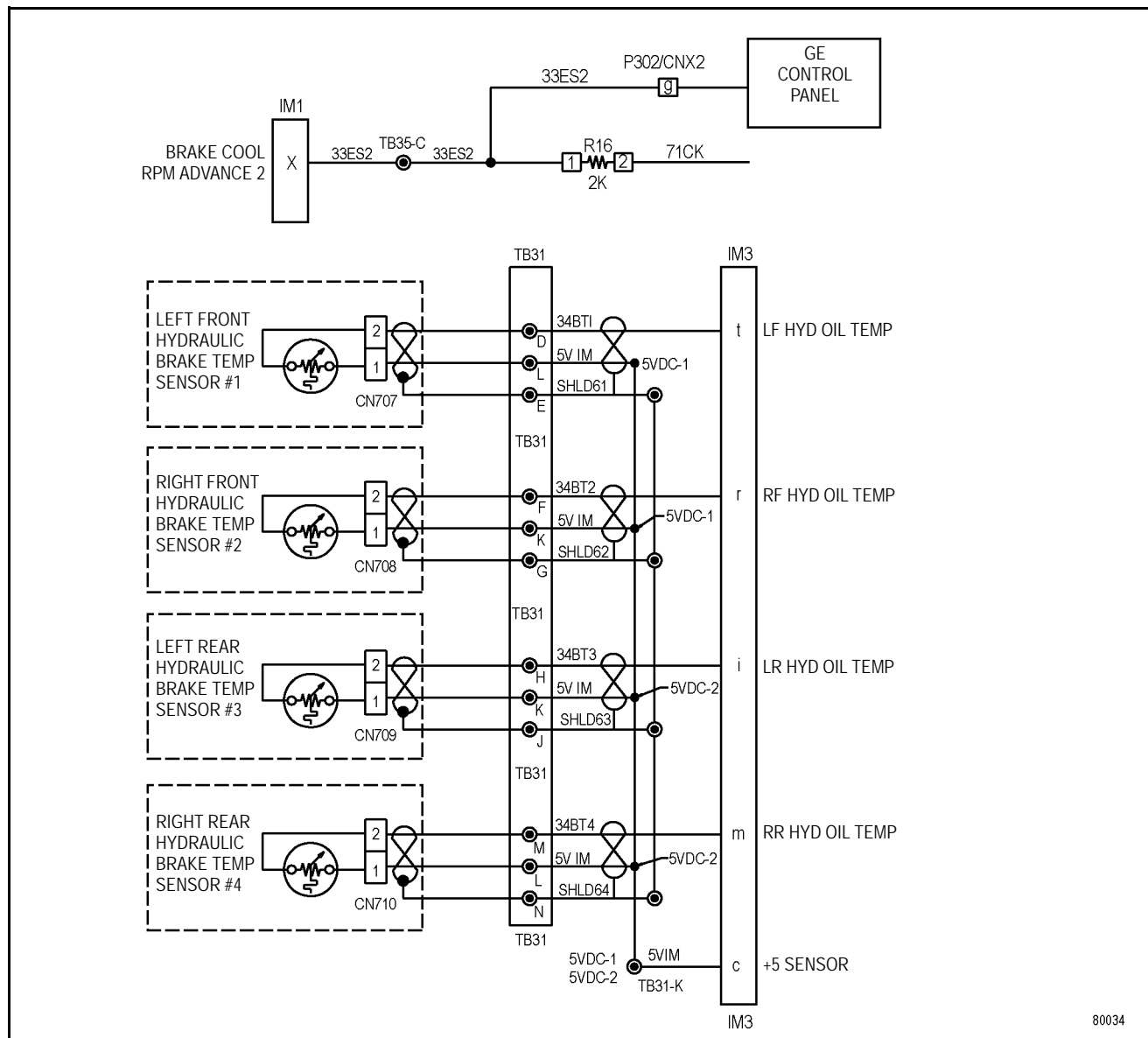
NOTES

Related circuit diagram



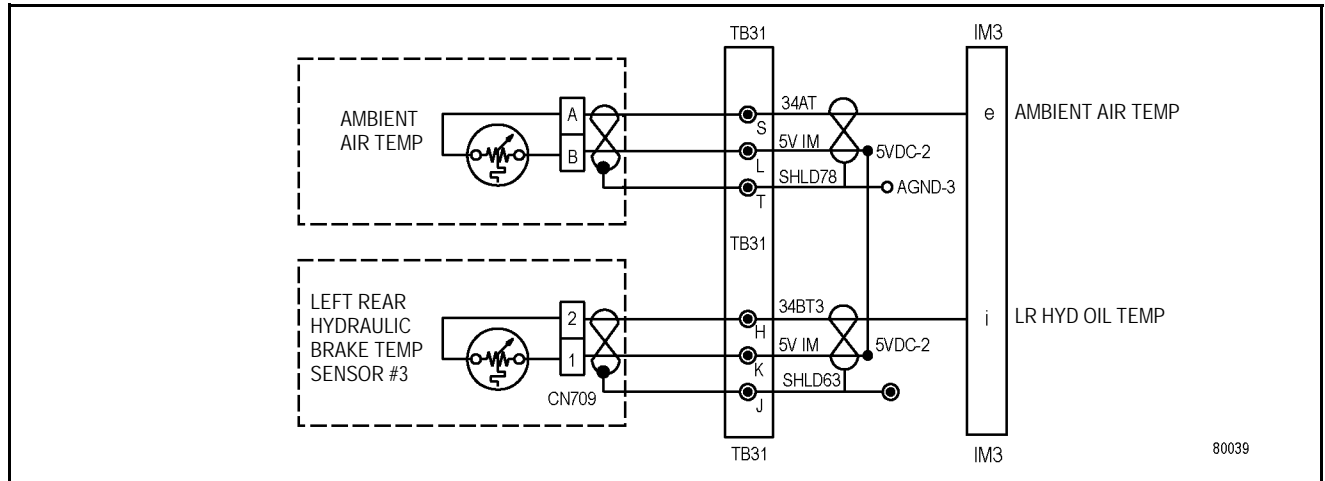
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Related circuit diagram



80034

Related circuit diagram



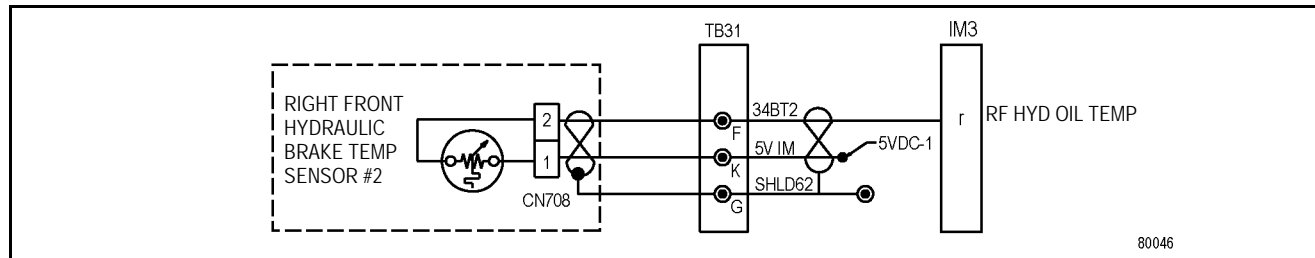
80039

Fault Code A173: Right front hydraulic oil temperature sensor is high

Operator Action	None
Fault Code	A173
Description	Right Front Hydraulic Oil Temp Sensor is high.
Fault Conditions	Sets if temperature reading rises to 211°C (4.89 Volts) for 3 seconds. Resets if temperature reading drops to 188°C (4.77 Volt) for 3 seconds.
Operator Alerting System Response	Lamp or Buzzer: None - Maintenance Item Display Fault Description: RF OIL TEMP SENS HI Display Fault Code: A173
Resulting Problem(s)	Loss of monitoring of the Right Front brake temperature begins a compromise of the brake system temperature monitoring that can only worsen if other sensors are lost.
Related Information	A laptop running "IM Realtime Data Monitor" software may be required to resolve this fault.

Table	
1. The primary correction for this fault is to correct any external wiring or replace the sensor.	
2. This fault's logic contains only one parameter.	
Parameter	Expected State and/or Related Fault(s)
Hydraulic Oil Temperature - Right Front (IM 3r)	0.016 Volt to 4.89 Volt: Good Readings <0.016 Volt or >4.89 Volt: Defective Sensor or Circuit Fault(s): A169

Related circuit diagram

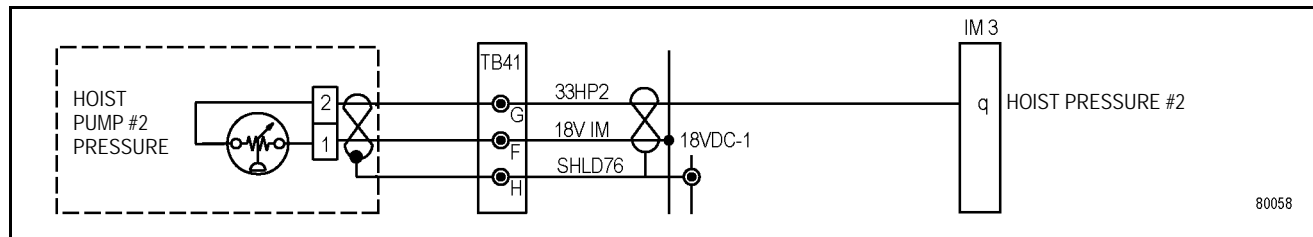


Fault Code A199: Hoist pressure 2 sensor is high

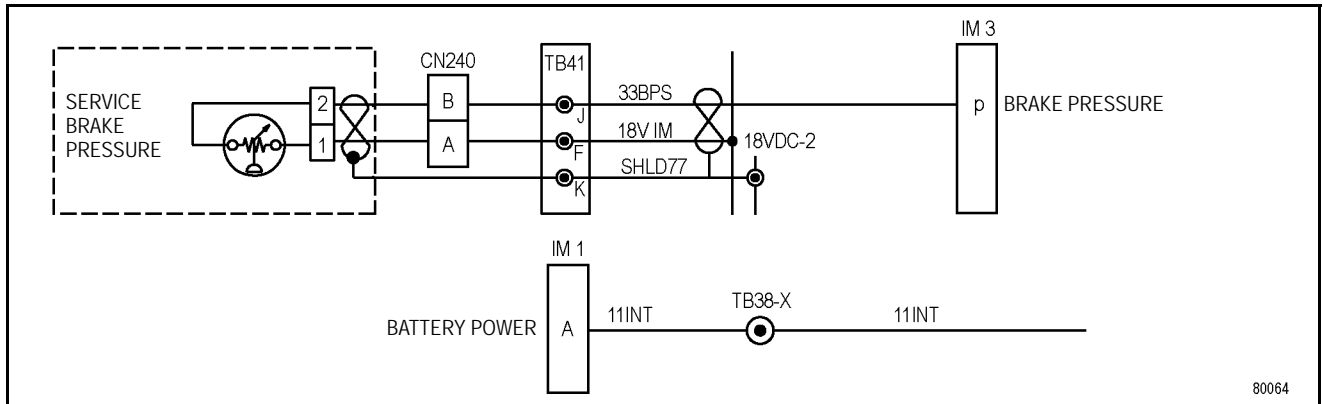
Operator Action	None
Fault Code	A199
Description	Hoist Pressure 2 Sensor is high.
Fault Conditions	Sets at 4025 psi (20.1mA) for 5 seconds. Resets at 3650 pi (18.6 mA) for 5 seconds.
Operator Alerting System Response	Lamp or Buzzer: None - Maintenance Item Display Fault Description: HOIST PRES 2 SENS HI Display Fault Code: A199
Resulting Problem(s)	Monitoring of hoist pressures in KOMTRAX Plus will be compromised.
Related Information	A laptop running "IM Realtime Data Monitor" software may be required to resolve this fault.

Table	
1. The primary correction for this fault is to correct any external wiring or replace the sensor.	
2. This fault's logic contains only one parameter.	
Parameter	Expected State and/or Related Fault(s)
Hoist Pressure 2 Sensor (IM 3q)	2.4 mA to 20.1 mA: good readings Less than 2.4 mA or more than 20.1 mA: Defective sensor or circuit Fault(s): A203

Related circuit diagram



Related circuit diagram



80064

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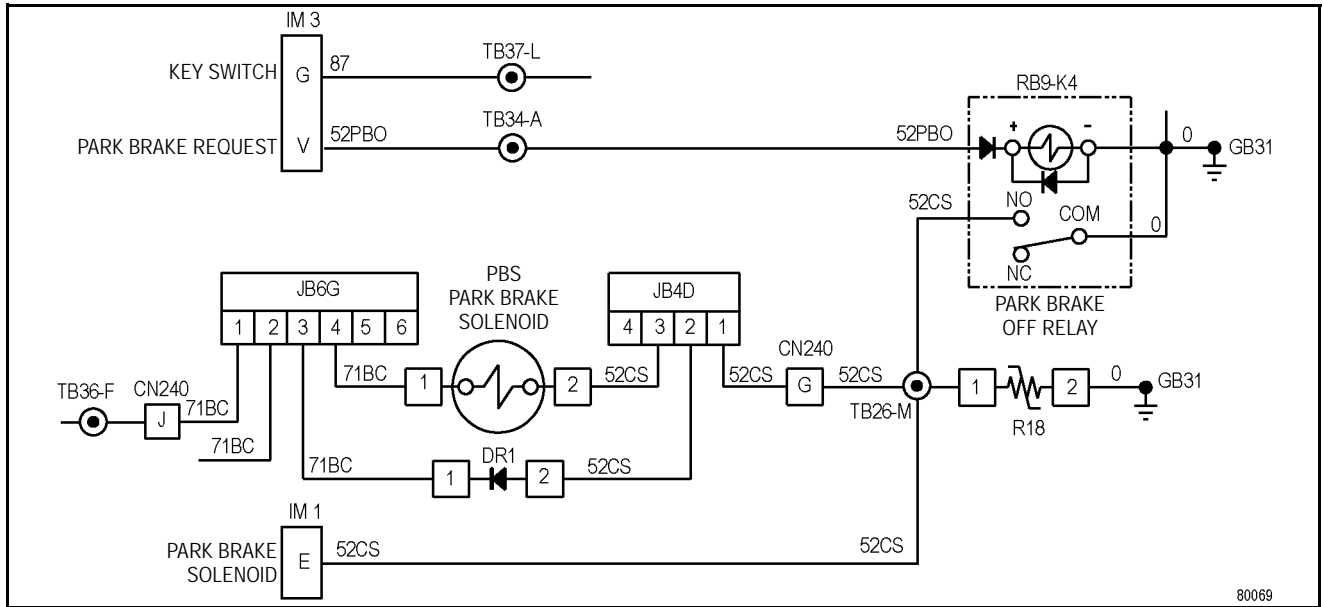


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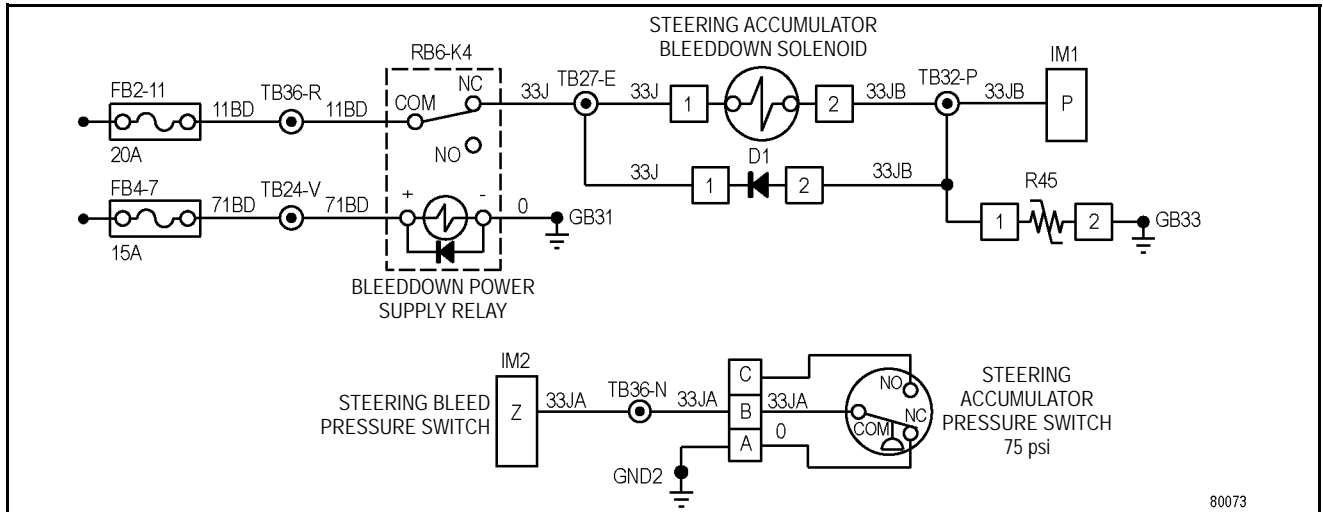
Selector Switch (Park) (IM 3T)	0: shifter is not in park 1: shifter is in park Fault(s): A271, A303
Park Brake Request (IM 3V)	0: shifter is not in the forward, neutral, or reverse positions or the engine oil pressure is below the setpoint of the engine oil pressure switch 1: shifter is in the forward, neutral, or reverse positions and the engine oil pressure is above the setpoint of the engine oil pressure switch Fault(s): A264
Engine Speed [RPM]	0: engine is not running Greater than 0: engine is running
Truck Speed [kph] (IM1gh)	0: truck is not moving Greater than 0: truck is moving Fault(s): A212
CAN J1939 connection (IM1qrs)	Fault(s): A184
Keyswitch (IM 3G)	0: keyswitch is off and the truck is not moving and the engine is not running 1: keyswitch is on or the truck is moving or the engine is running Fault(s): A240
Park Brake Solenoid (IM 1E)	Status - Open Load: Unexpected. Troubleshoot. Status - Normal: Expected. No Problem. Status - Shorted to Ground: Expected if shifter is in the forward, neutral, or reverse positions and the engine oil pressure is above the setpoint of the engine oil pressure switch. Otherwise unexpected and must troubleshoot. Status - Overload: Unexpected. Troubleshoot. 0: shifter is not in the forward, neutral, or reverse positions or the engine oil pressure is below the setpoint of the engine oil pressure switch and either the speed of the truck has been 0.8kph or less for 1 second or the service brakes are applied. 1: shifter is in the forward, neutral, or reverse positions and the engine oil pressure is above the setpoint of the engine oil pressure switch. Fault(s): A216,

Related circuit diagram



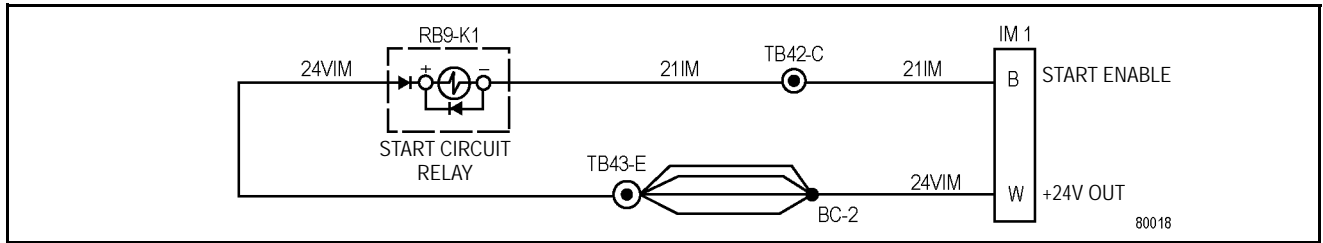
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Related circuit diagram



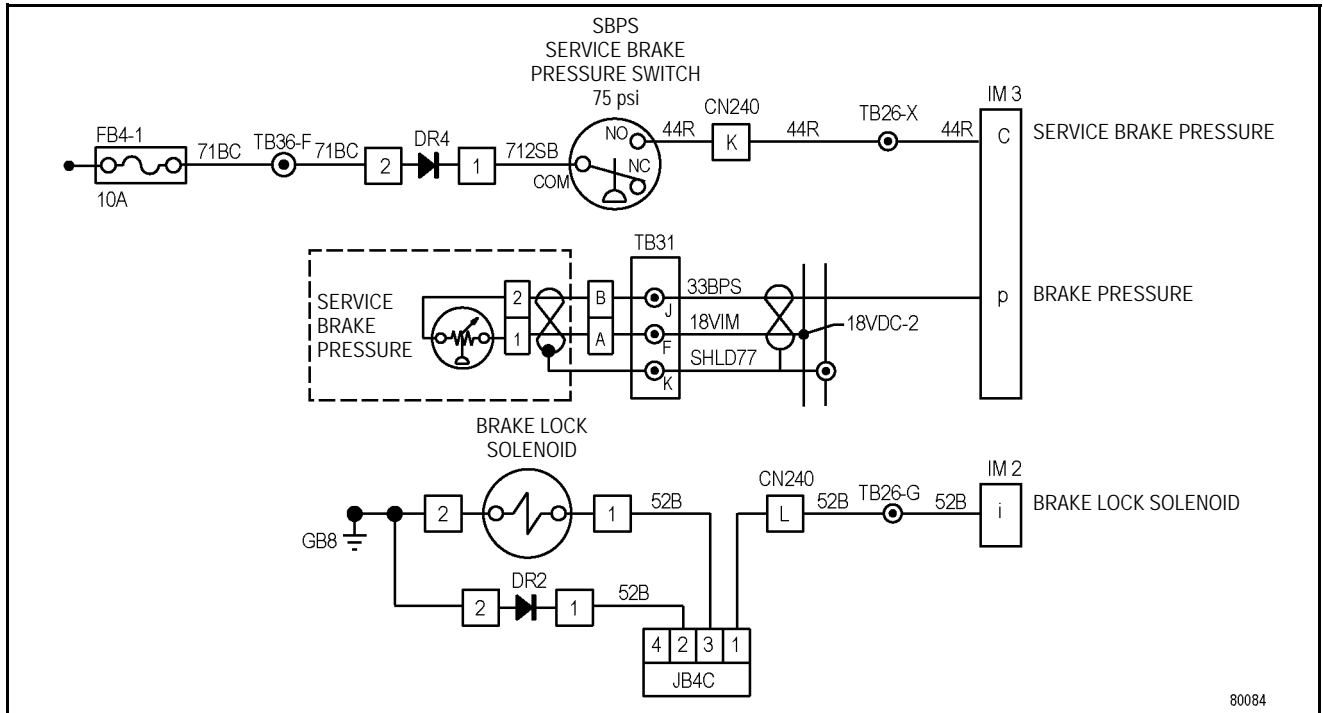
NOTES

Related circuit diagram

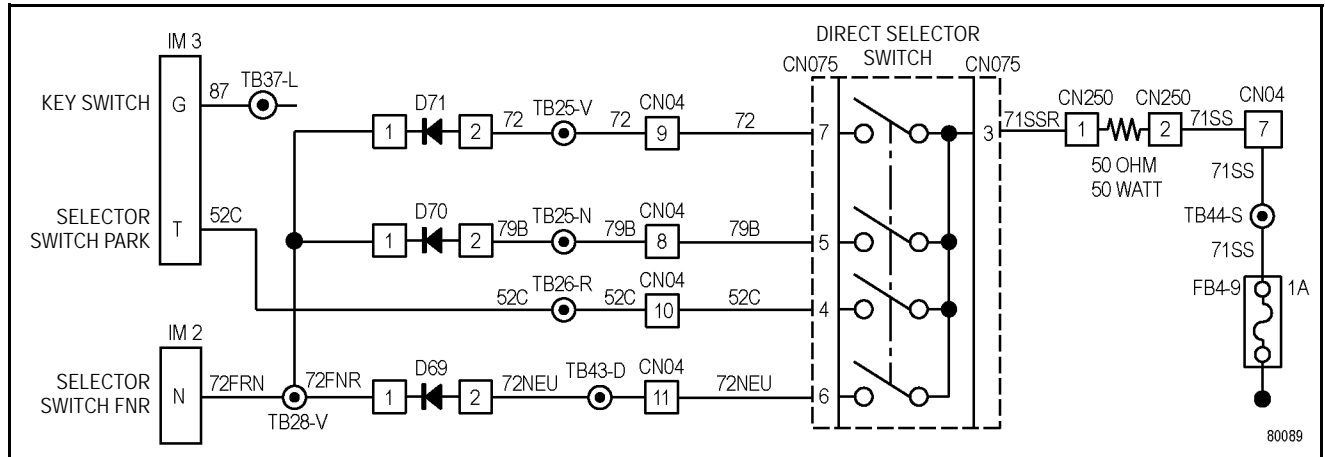


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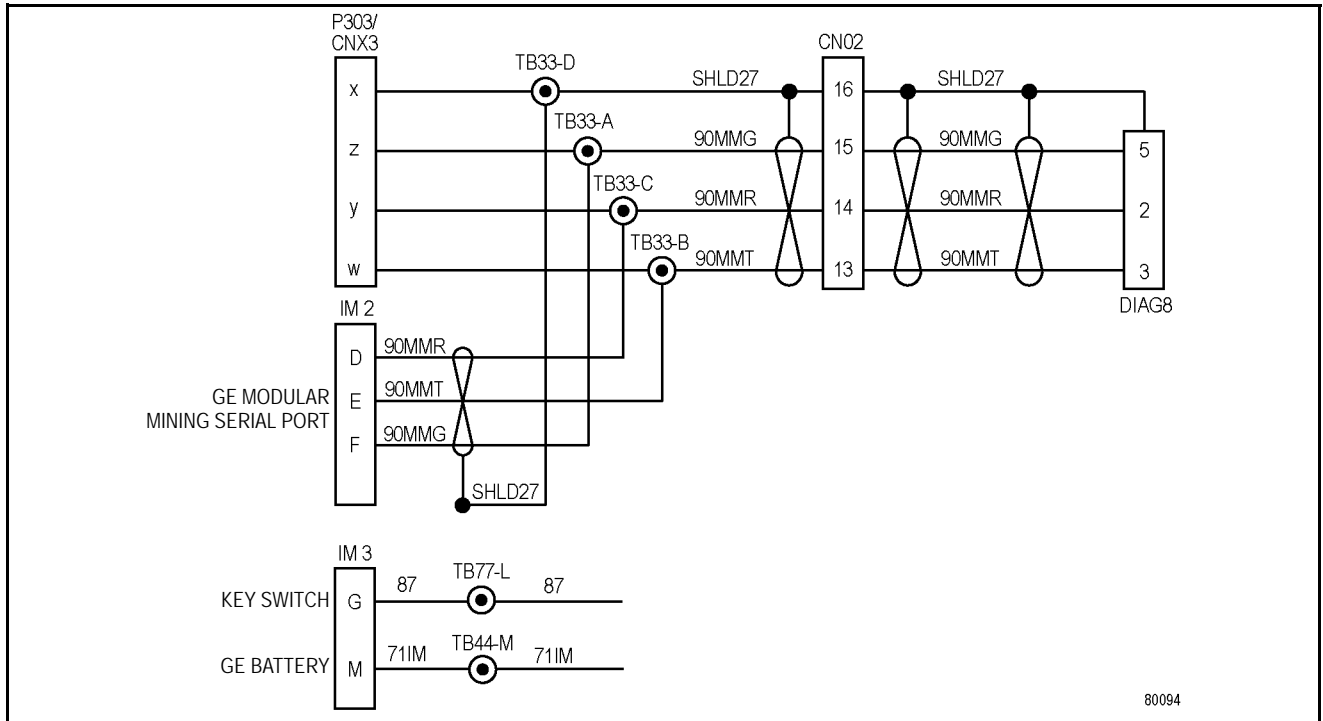
Related circuit diagram



Related circuit diagram



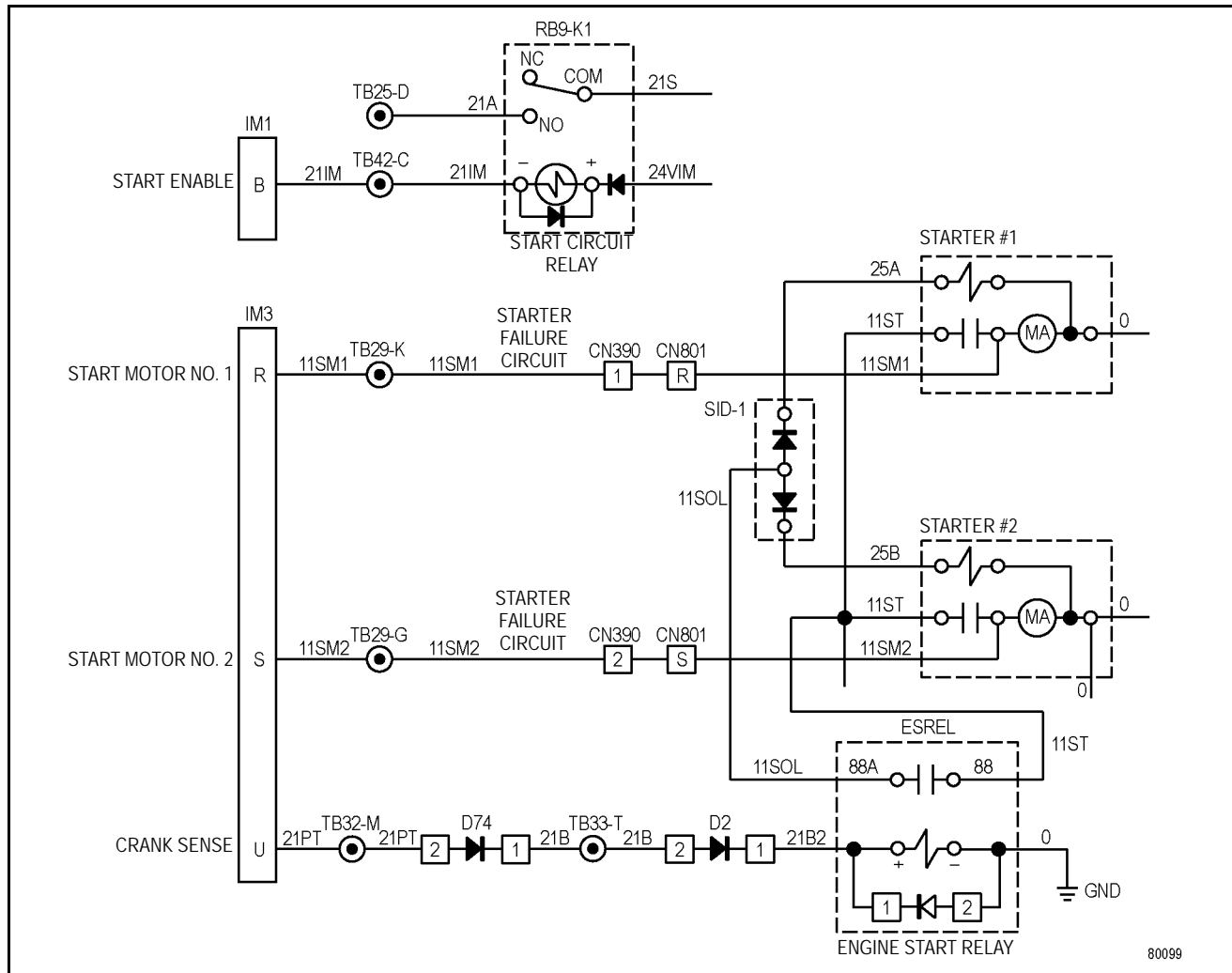
Related circuit diagram



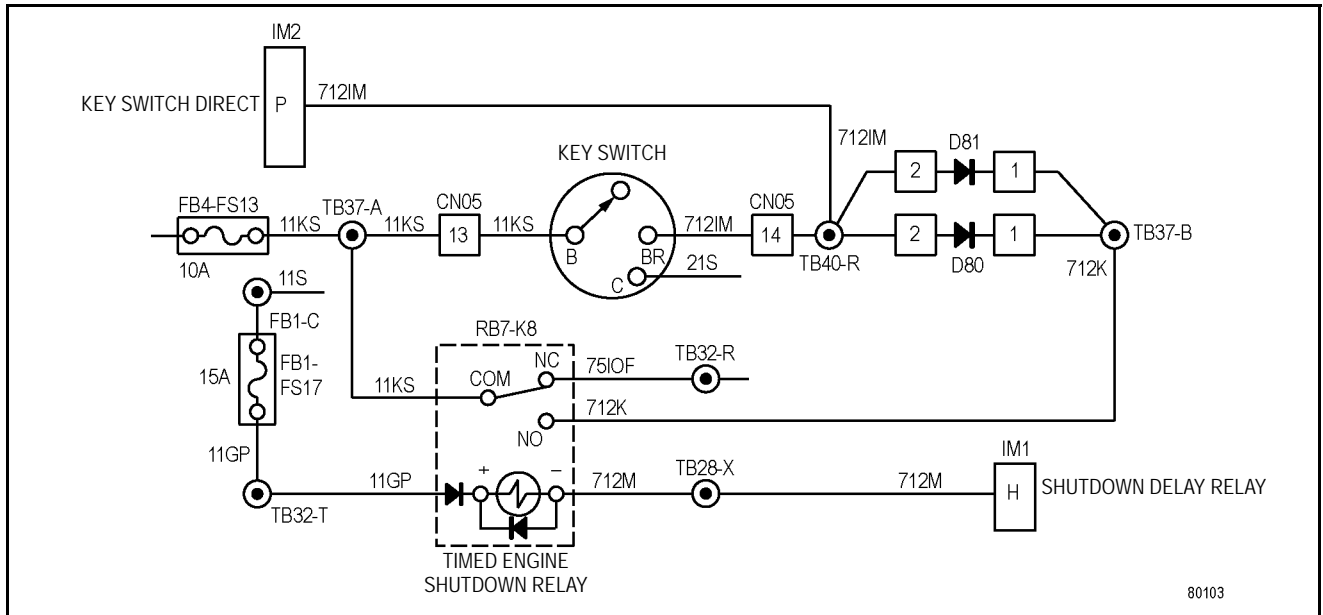
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Related circuit diagram

S/N A30003 - A30024

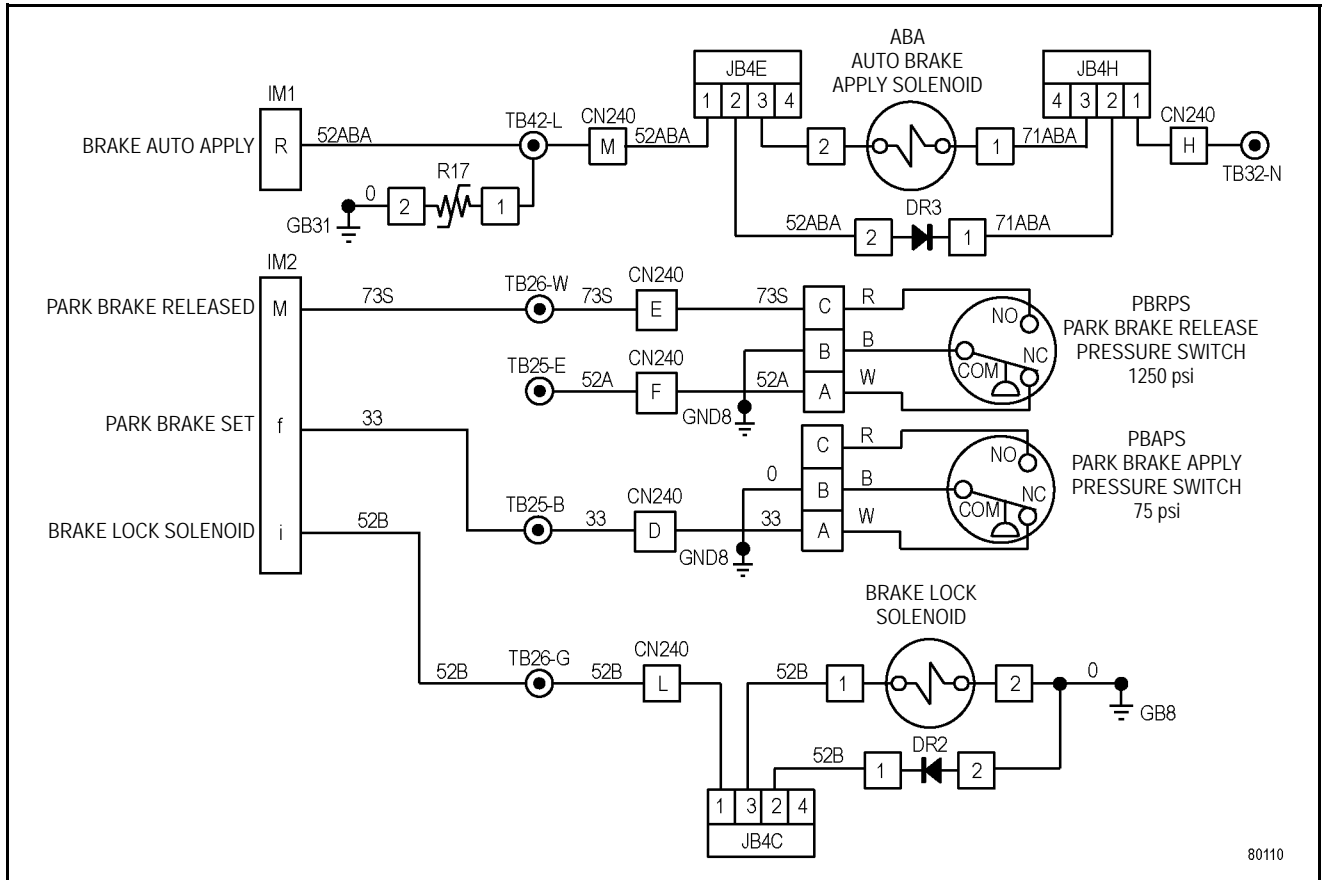


Related circuit diagram



NOTES

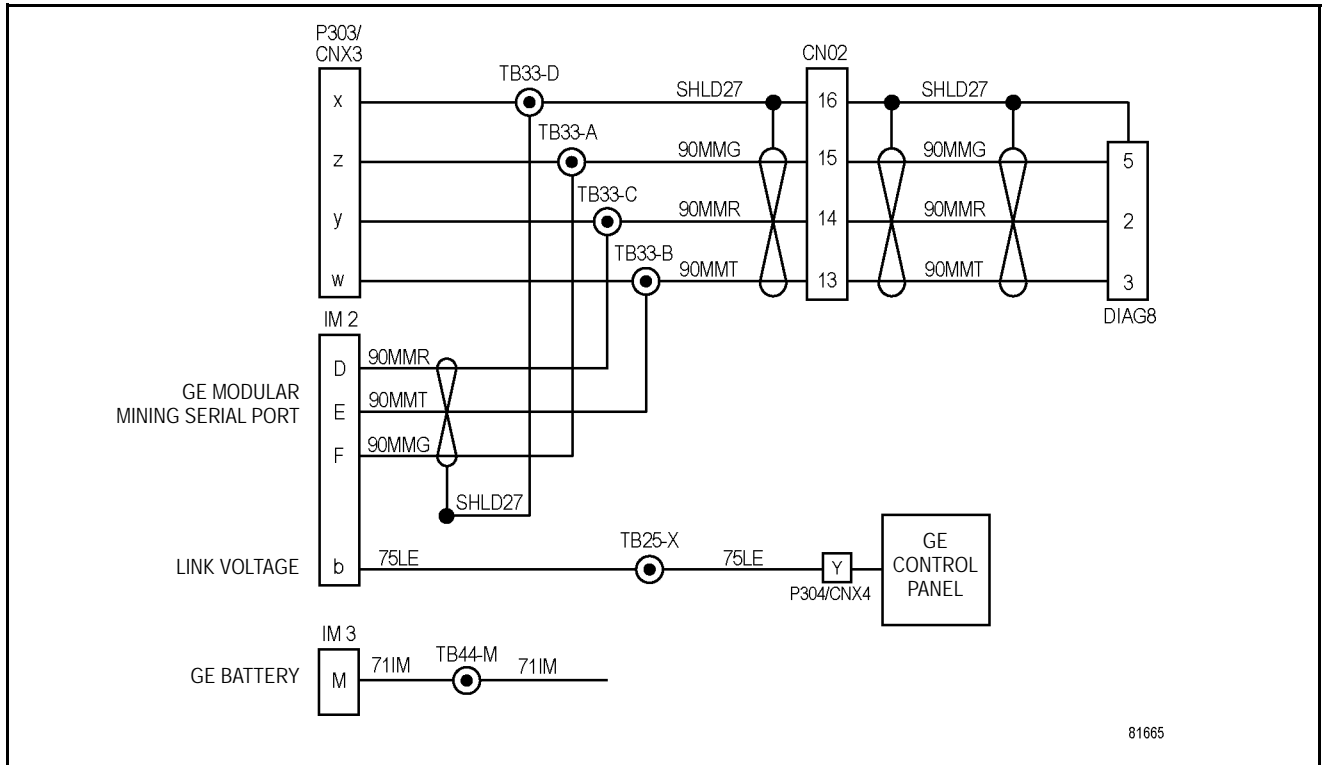
Related circuit diagram



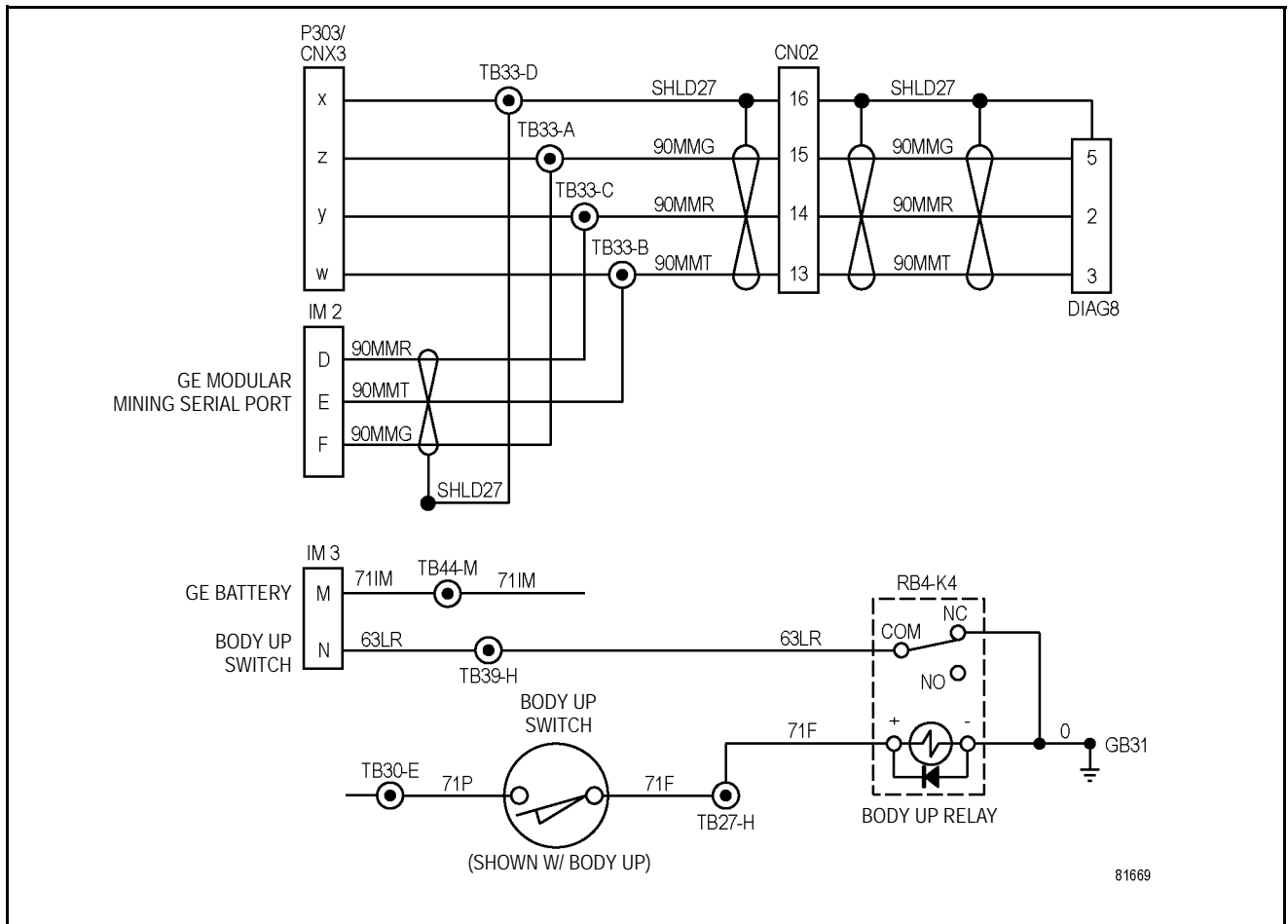
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NOTES

Related circuit diagram



Related circuit diagram



Fault Code A353: Overload on output 1J

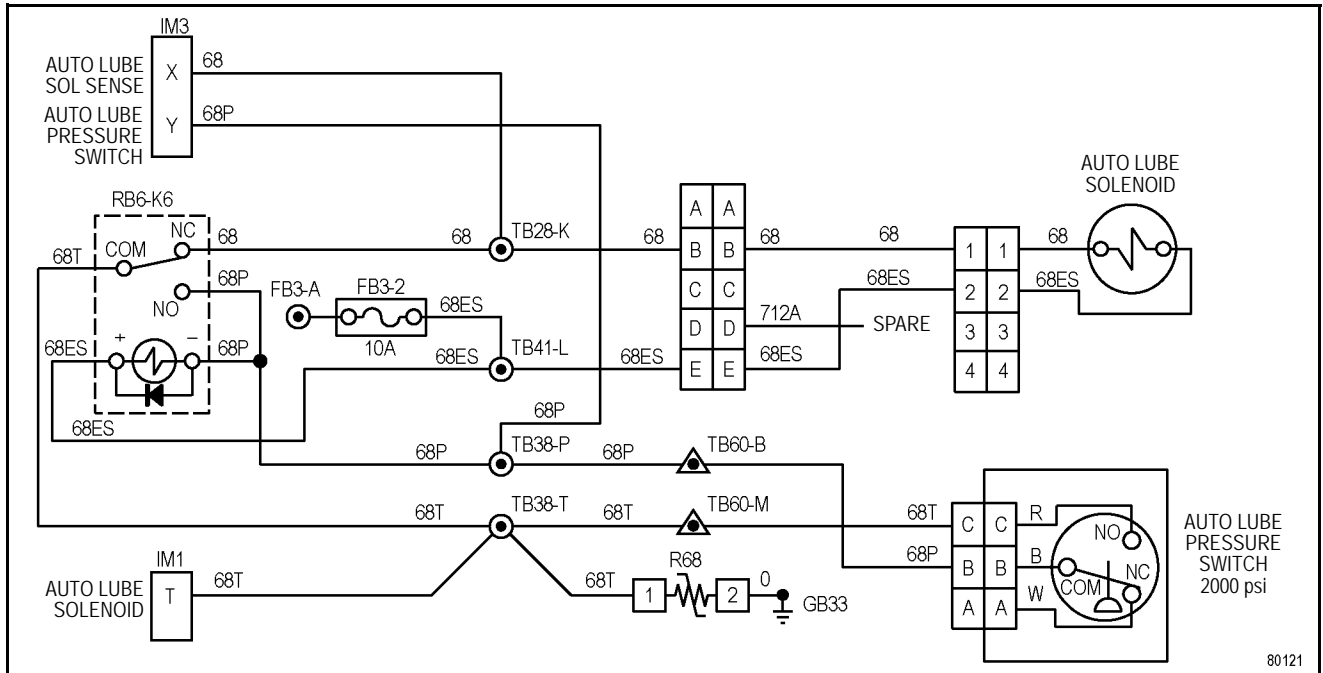
Operator Action	None
Fault Code	A353
Description	Overload on output 1J.
Fault Conditions	Sets if driver chip detects overcurrent or over temp on output 1J. Output is turned off when overload is detected. Resets at power down.
Operator Alerting System Response	Repair Lamp Display Fault Description: IM OUTPUT 1J FAULT Display Fault Code: A353
Resulting Problem(s)	Unused outputs with short circuits on them might damage the driver chip if not corrected.
Related Information	A laptop running "IM Realtime Data Monitor" software may be required to resolve this fault.

Table	
1. This fault's logic contains just one parameter. There are no additional fault codes to investigate.	
2. Any spare wires connected to this output should be removed to prevent ultimate failure of the driver chip.	
Parameter	Expected State and/or Related Fault(s)
Spare IM Output (IM 1J)	Status - Open Load: Unexpected. Troubleshoot Status - Normal: Expected. No problem. Status - Shorted to Ground: Unexpected. Troubleshoot. Status - Overload: Unexpected. Troubleshoot. 0: Off 1: On

Related circuit diagram

None.

Related circuit diagram



Preliminary checks

If the system indicates insufficient cooling, or no cooling, the following points should be checked before proceeding with the system diagnosis procedures.

NOTE: Ensure that the rest switch in the cab is ON. Place the GF cutout switch in the CUTOFF position.

Some simple, but effective checks can be performed to help determine the cause of poor system performance. Check the following to ensure proper system operation.

- Compressor belt - Must be tight, and aligned.
- Compressor clutch - The clutch must engage. If it does not, check fuses, wiring, and switches.
- Oil leaks - Inspect all connection or components for refrigeration oil leaks (especially in the area of the compressor shaft). A leak indicates a refrigerant leak.
- Electrical check - Check all wires and connections for possible open circuits or shorts. Check all system fuses.
- Cooling system - Check for correct cooling system operation. Inspect the radiator hoses, heater hoses, clamps, belts, water pump, thermostat and radiator for condition or proper operation.
- Radiator shutters - Inspect for correct operation and controls, if equipped.
- Fan and shroud - Check for proper operation of fan clutch. Check installation of fan and shroud.
- Heater/water valve - Check for malfunction or leaking. With the heat switch set to COLD, the heater hoses should be cool.
- System ducts and doors - Check the ducts and doors for proper function.
- Refrigerant charge - Make sure system is properly charged with the correct amount of refrigerant.
- Cab filters - Ensure the outside air filter and inside recirculation filter are clean and free of restriction.
- Condenser - Check the condenser for debris and clogging. Air must be able to flow freely through the condenser.
- Evaporator - Check the evaporator for debris and clogging. Air must be able to flow freely through the condenser.

Diagnosis of gauge readings and system performance

Successfully servicing an air conditioning system, beyond the basic procedures outlined in the previous section, requires additional knowledge of system testing and diagnosis.

A good working knowledge of the manifold gauge set is required to correctly test and diagnose an air conditioning system. An accurate testing sequence is usually the quickest way to diagnose an internal problem. When correctly done, diagnosis becomes an accurate procedure rather than guesswork.

The following troubleshooting charts list typical malfunctions encountered in air conditioning systems. Indications and or problems may differ from one system to the next. Read all applicable situations, service procedures, and explanations to gain a full understanding of the system malfunction. Refer to information listed under "Suggested Corrective Action" for service procedures.

Pumping unit LED signals

It is important to understand the LED signal for the pumping unit. It is used primarily to verify that the system is maintaining the oil level at the level of the open end of the withdrawal tube in the engine oil pan. The signal is also a valuable tool in troubleshooting the system.

- When the LED signal is STEADY (not flashing), pump 1 is running and oil is being withdrawn from the engine and being transferred to the reserve tank.
- When the LED signal is FLASHING, pump 1 is drawing air from the suction tube, which triggers pump 2 to operate and transfer oil back to the engine from the tank (the flashing is actually the pulses of pump 2). When the oil is at the correct level in the engine, air and oil are alternatively entering the suction tube, with pump 1 commanding operation of pump 2 with each portion of air that comes through the line.

This is a complete test for proper operation of the pumping unit. This operation can be accomplished without running the engine by jumping the oil pressure switch that activates the system.

1. If the LED signal is STEADY, pump 1 should be pumping oil. Verify by loosening the hose at pump 1 outlet to check that oil is coming through (pump 1 is marked by a groove on its outlet).
2. Loosen the hose at the inlet of pump 1 to admit air. Pump 2 should then run and the LED signal should be FLASHING. Verify proper operation of pump 2 by loosening the hose at its outlet to check that oil is coming through.
3. Re-tighten the inlet hose on pump 1. The pump should again receive oil and the flashing of the LED signal should stop.

NOTE: There is a condition that would show a level higher than the controlled point. If both the engine and reserve tank are overfilled, there is no room in the tank to draw the oil level down in the engine. In this case, the LED signal would never start FLASHING because pump 1 is never receiving air. It will continue to pump oil from the engine to the tank, but because the tank is full, the oil will be routed back to the engine via the air relief valve on top of the tank.

There are two explanations for an overfilled tank and engine:

- The tank is filled to "FULL" and the engine is overfilled.
- Oil has been added directly to the engine between oil changes. The system transfers the oil to the reserve tank until it can not receive any more and the engine remains overfilled. It is, therefore, important that oil should be added only to the reserve tank between oil changes (except if the engine oil level is extremely low).

Circuit fuses

The reserve system fill control unit is protected by a 15 amp fuse (fuse block 2, position 10) located in the auxiliary control cabinet.

The pump unit is protected by a 15 amp fuse (fuse block 2, position 9) located in the auxiliary control cabinet.

For circuit information, refer to the electrical circuit diagrams in Section 90.

DUMP TRUCK

960E

Machine model	Serial number
960E-1	A30003 - A30026
960E-2	A30027 and up

50 Disassembly and assembly

Wheels, spindles and rear axle

General information for tires and rims.....	3
Removal and installation of front wheel	4
Removal and installation of rear wheel	6
Removal and installation of tires	8
Removal and installation of front wheel hub and spindle.....	10
Disassembly and assembly of front wheel hub and spindle	17
Removal and installation of rear axle	22
Removal and installation of anti-sway bar	24
Removal and installation of pivot pin	25
Pivot eye and bearing service.....	26
Removal and installation of wheel motor	28
Removal and installation of rear brake assembly	35

Removal

1. After the truck is properly shut down, depressurize the brake accumulators by using the bleed valves on the brake manifold.
2. Activate the battery disconnect switches.
3. Remove the front tire and rim assembly. Refer to "Removal and installation of front wheel".
4. Disconnect speed sensor connectors (5, Figure 50-8). Tie the cables back away from the spindle to prevent damage during spindle removal.
5. Install vacuum pump kit (XB0887) on the hydraulic tank to prevent the loss of oil when disconnecting hydraulic lines.
6. Disconnect brake cooling lines (4) at the inlet and outlet ports on the brake housing. Plug the hoses and ports to help prevent contamination.
7. Disconnect the brake apply line. Cap the hoses and ports to prevent contamination.
8. After all hydraulic lines have been disconnected and capped, turn off the vacuum pump.
9. Remove drain plug (2) and drain the oil from the brake housing and hub bearings into a suitable container.
10. Remove the lubrication lines from the tie rod and steering cylinder.
11. Disconnect the steering cylinder and the tie rod from the spindle that is being removed. Refer to Disassembly and assembly section **Steering system**.

⚠ WARNING

The front wheel hub, spindle, and brake assembly weighs approximately 5 180 kg (11,420 lb). Ensure that the lifting device has sufficient capacity for lifting the load.

12. Position a fork lift under the wheel hub and spindle assembly as shown in Figure 50-9. Use blocking as necessary to keep the assembly level.

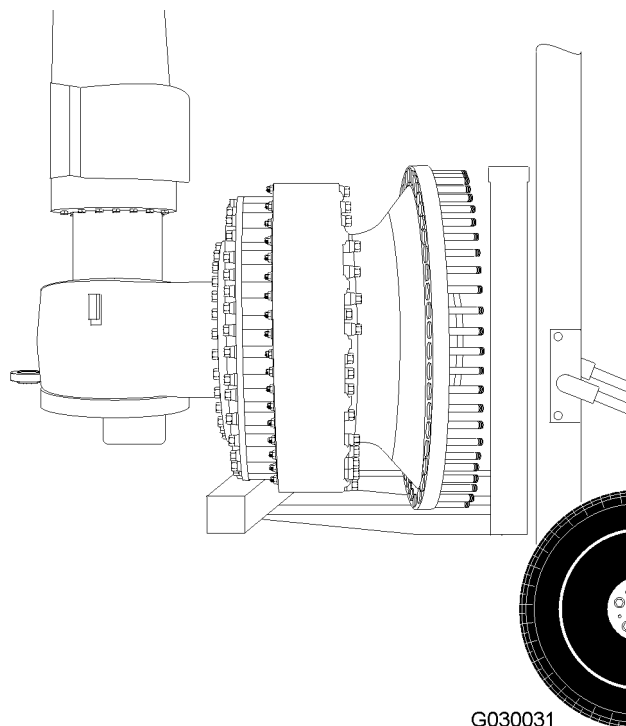


FIGURE 50-9. TYPICAL LIFTING DEVICE (FORKLIFT)

Brake installation

20. Install seal assembly (30, Figure 50-14) into the seal cavities of the back plate and seal carrier (37). Install oil seal (19) in the back plate. Pack the area between the seal lips with grease.
21. Install lifting eyes on the brake assembly and attach it to an overhead hoist. Lower the brake assembly onto the hub.
22. Attach brake assembly (18) to wheel hub (1) with capscrews (23) and hardened washers (24). Tighten the capscrews to **2 705 ± 135 N·m (1,995 ± 100 ft lb)**.
23. Install plates (38) with flat washers and nuts at three equally-spaced locations around the wheel.

NOTE: Do not remove the shipping bars until the inner gear ring of the brake assembly is attached to the hub.

24. Lubricate and install O-ring (25) onto spindle (26). Ensure that the O-ring is not twisted.
25. Install the wheel hub/brake assembly onto the spindle. Align the brake assembly with the spindle by installing three capscrews (31) with hardened washers (32) hand-tight only.
26. Install retainer pin (20) and bearing cone (7).
27. Remove plates (38), the nuts and flat washers. Remove the shipping bars from the brake assembly.
28. Install remaining capscrews (31) with hardened washers (32). Tighten all 54 capscrews to **1 166 ± 116 N·m (860 ± 86 ft lb)**.
29. Lubricate and install O-ring (9) onto bearing retainer (13). Ensure that the O-ring is not twisted.
30. Install shim pack (8) that was determined in Step 13, bearing retainer (13), capscrews (11), and hardened washers (12). While rotating the hub, tighten the capscrews alternately in several successive increments to a final torque of **1 017 ± 102 N·m (750 ± 75 ft lb)**.
31. Lubricate and install new O-ring (15) on cover (5). Install the cover, capscrews (3), and washers (4). Tighten the capscrews to the standard torque.

Speed sensor installation and adjustment

32. Install speed sensor (16, Figure 50-14) and bracket (17). Adjust the sensor as follows:
 - a. Rotate the hub to position the center line of a gear tooth directly under the sensor tip.
 - b. Turn in the sensor until the tip contacts the gear tooth. Then, back off 1/2 turn.
 - c. Continue turning out the sensor until the flats of the sensor housing are perpendicular to the gear tooth motion (See Figure 50-16).
 - d. Lock the sensor in place. Rotate the hub 180 degrees to verify that there is enough sensor clearance. There should be 1 - 2 mm (0.04 - 0.08 in.) of clearance.

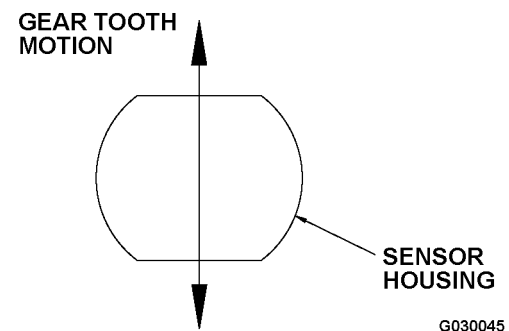


FIGURE 50-16. SPEED SENSOR ADJUSTMENT

33. Install the speed sensor cables.
34. Install the spindle, hub and brake assembly on the suspension per instructions in Installation.

Installation

1. Apply a lithium based grease containing 5% molybdenum disulphide to the threaded holes in the rear axle housing.
2. Install two guide pins 180° apart (3 o'clock and 9 o'clock positions) in the rear axle housing.



Each complete wheel motor and transmission assembly weighs approximately 22 930 kg (50,555 lb). Ensure that the lifting device is capable of handling the load safely.

3. Lift the wheel motor into position on the rear axle housing. Ensure that all cables and hoses are clear before installation.

If the brake system hoses are installed, guide them through the spindle holes during installation.



The wheel motors must be properly aligned before installing them onto the axle housing. Two sets of dimples are located at the 3 o'clock and 9 o'clock positions on each wheel motor. The hole closest to the identification plate on the motor side of the mounting flange is the 12 o'clock position of the wheel motor.

The axle housing also has two sets of dimples at the 3 o'clock and 9 o'clock positions next to the wheel motor mounting rings. Refer to Figure 50-23.

When installing the wheel motors, ensure the dimples on both components line up. Then rotate each wheel motor slightly clockwise (while viewed from the outer end) to align the bolt holes properly.

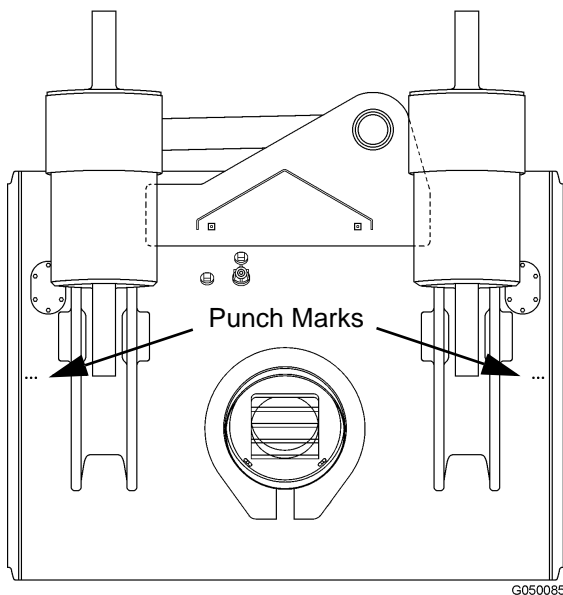


FIGURE 50-23. REAR AXLE HOUSING DIMPLE MARKINGS

Removal and installation of brake valve

Removal

NOTE: If the brake valve is to be removed from the truck, additional equipment will be required as outlined in the disassembly and assembly procedures. Minor repairs and service adjustment may not require the removal of the brake valve.

⚠ WARNING

Before disconnecting pressure lines, replacing components in the hydraulic circuits, or installing test gauges, always depressurize the steering accumulators and the brake accumulators.

1. Shut down the truck. For the proper shutdown procedure, refer to Index and foreword section **Operating instructions**.
2. Open bleed down valves (1 Figure 50-1) on brake manifold (2) to depressurize the brake accumulators.
3. To verify that the brake accumulators are depressurized, press the brake lock switch (key switch ON, engine off) and apply the service brake pedal. The service brake light should not come on.
4. Close the bleed down valves by rotating them clockwise.

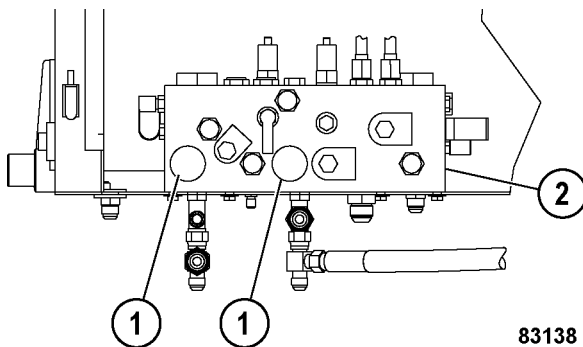


FIGURE 50-1. BRAKE MANIFOLD

1. Accumulator Bleed Down Valves
2. Brake Manifold

5. Remove the access panel at the front of the operator cab.
6. Tag and remove all hydraulic lines from the brake valve. Plug all lines and ports to prevent possible contamination. Remove all valve fittings except the fitting at port "PX".
7. Disconnect the retarder pedal harness.
8. Remove capscrews (1, Figure 50-2) and lockwashers (2) that secure brake valve (3) to the mounting structure.
9. Slide the brake valve assembly downward and remove it from the cab. Move the brake valve assembly to a clean work area for disassembly.

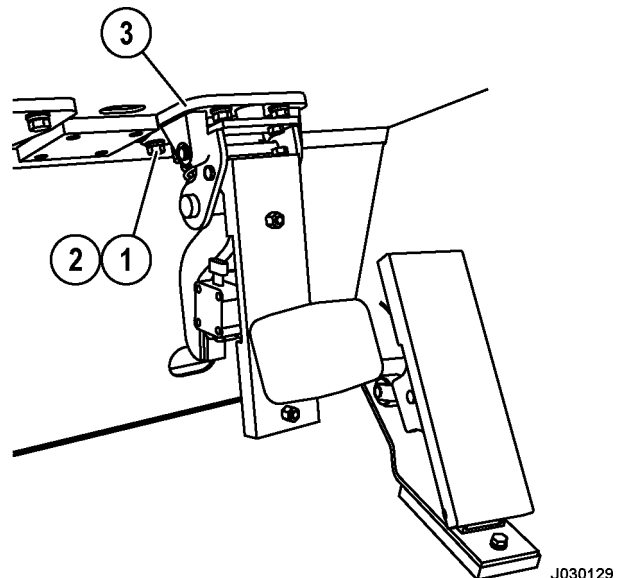


FIGURE 50-2. BRAKE VALVE REMOVAL

1. Capscrews
2. Lockwashers
3. Brake Valve Assembly

Disassembly and assembly of dual relay valve

Disassembly

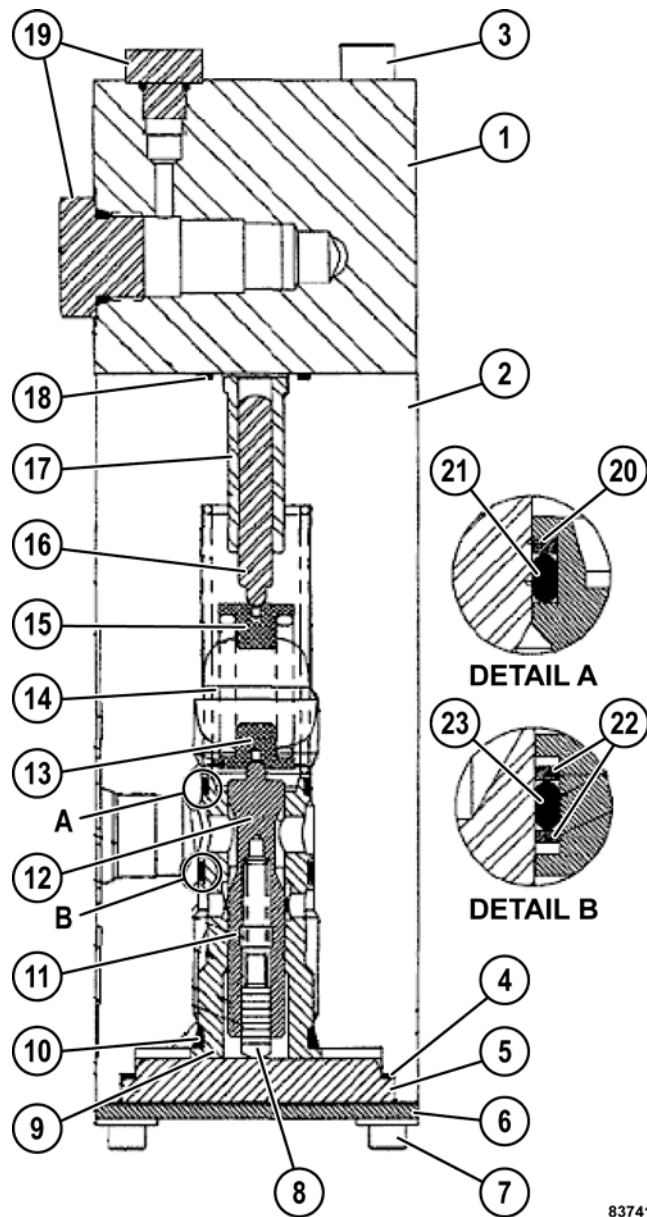


The parts installed in the valve body for the “B1” and “B2” bores are identical. However, the parts must not be interchanged between the two bores.

1. Thoroughly clean the valve to remove any dirt accumulation. Drain the oil from all valve ports by rotating the valve over a suitable container.
2. Use a felt tip pen to mark manifold body (1, Figure 50-12) and valve body (2) to ensure correct reassembly.

NOTE: As the valve is disassembled, lay out the parts in the order of disassembly. Note the valve body bore from which the parts are removed. The parts must be reinstalled in the same bore from which they are removed.

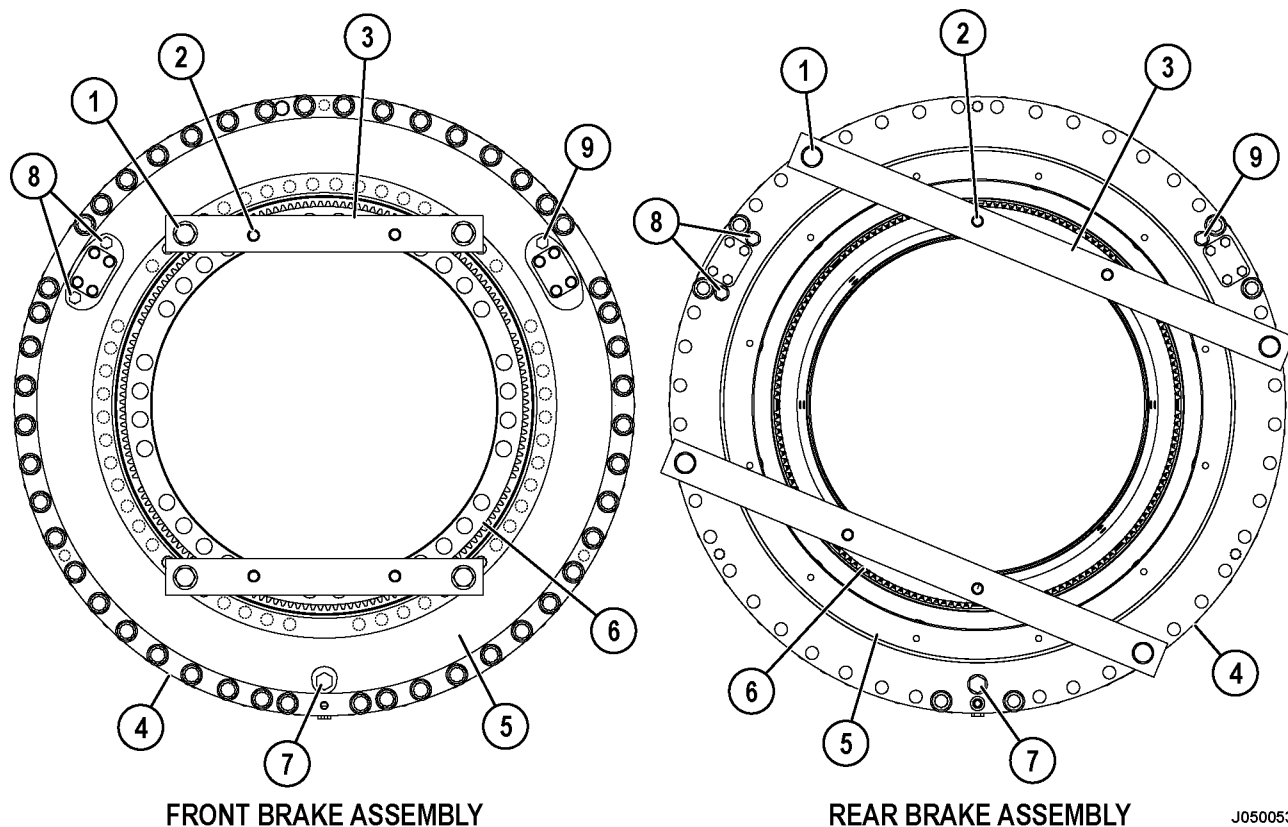
3. Secure the valve in an upright position in a vice.
4. Remove two socket head capscrews (3) that hold manifold body (1) to valve body (2). Remove the manifold body and discard O-rings (18).
5. Remove plungers (16) and sleeves (17).
6. Remove the controller from the vice.
7. Remove four capscrews and washers (7) from the base of the valve.
8. Remove sleeve retainer (6).
10. With the valve upright, plug (5) should fall out. If not, tap the valve body lightly to dislodge it.
11. Remove spools (12), reaction plungers (8) and spool return springs (11). Keep the parts separate so they can be installed in the same spool from which they were removed.
12. Remove and discard packing (4) from the counterbore in the base of the valve body.
13. Turn the valve on its side on the work bench and remove sleeves (9) from the valve body.
14. Remove and discard seal (10), O-rings (22) and (24), and backup rings (21) and (23).
15. Remove spring seats (13) and (15) and regulator springs (14).



83741

FIGURE 50-12. DUAL RELAY VALVE

- | | |
|------------------------|-----------------------|
| 1. Manifold Body | 13. Lower Spring Seat |
| 2. Valve Body | 14. Regulator Spring |
| 3. Capscrew | 15. Upper Spring Seat |
| 4. Packing | 16. Plunger |
| 5. Plug | 17. Sleeve |
| 6. Sleeve Retainer | 18. O-Ring |
| 7. Capscrews & Washers | 19. Plugs |
| 8. Reaction Plunger | 20. Backup Ring |
| 9. Sleeve | 21. O-Ring |
| 10. Seal | 22. Backup Rings |
| 11. Spool Spring | 23. O-Ring |
| 12. Regulator Spool | |



J050053

FIGURE 50-23. INNER GEAR INSTALLATION

- | | | |
|-----------------------------|-------------------|-------------------------------|
| 1. Capscrew and Flat Washer | 4. Ring Gear | 7. Drain Plug |
| 2. Capscrew and Lockwasher | 5. Piston Housing | 8. Brake Apply Pressure Ports |
| 3. Retainer Bar | 6. Inner Gear | 9. Brake Wear Indicator Port |

10. Turn over the brake assembly to position the ring gear retainer bars on top as shown in Figure 50-23.
11. Remove capscrews (1, Figure 50-23) and (2) that attach retainer bars (3) to piston housing (5) and inner gear (6).
12. Attach a lifting strap through retainer bars (3) and lift inner gear (6) out of the brake assembly. Remove the retainer bars and spacers.

Removal and installation of parking brake

Removal

NOTE: Whenever possible, parking brake repairs should be performed when the wheel motor is removed from the truck. If repairs are necessary when the wheel motor is installed, a lifting device must be set up inside the rear axle housing to support the weight of the parking brake assembly when it is removed from the wheel motor.



The parking brake assembly weighs approximately 159 kg (350 lb). Ensure that the lifting device is capable of supporting the weight of the brake assembly when removed.

1. Shut down the truck. For the proper shutdown procedure, refer to Index and foreword section **Operating instructions**.
2. Open bleed down valves (1, Figure 50-31) on brake manifold (2) to depressurize the brake accumulators.

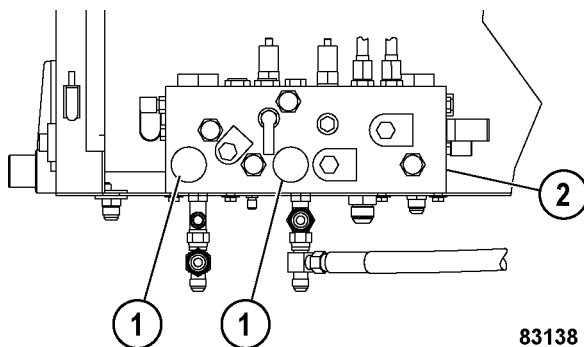


FIGURE 50-31. BRAKE MANIFOLD

1. Accumulator Bleed Down Valves
2. Brake Manifold

3. To verify that the brake accumulators are depressurized, press the brake lock switch (key switch ON, engine off) and applying the service brake pedal. The service brake light should not come on.
4. Close the bleed down valves by rotating them clockwise.
5. If the wheel motor is installed in the rear axle housing, open the rear axle housing hatch. Disconnect the parking brake apply supply hose from the parking brake.
6. Remove capscrews and lockwashers (7, Figure 50-32). Install guide studs in two of the mounting holes to support parking brake assembly (3) when it is removed from the wheel motor frame.
7. Disconnect the parking brake supply hose from the parking brake. Plug and cap the hose and port to help prevent contamination.
8. Slide the parking brake assembly out of wheel motor frame (2) and off rotor shaft gear (4). If the wheel motor is still installed in the rear axle housing, remove the parking brake assembly from the rear axle housing.
9. If the rotor shaft gear is worn, damaged, or otherwise requires removal, perform the following steps:

NOTE: The gear is shrink fit on the splined motor shaft.

- a. Remove capscrew and hardened flat washer (6) from the shaft. Remove retainer plate (5).
- b. Install a gear puller using the tapped holes provided in rotor shaft gear (4).
- c. Apply heat around gear hub area while tightening the puller until gear is removed from shaft.

DUMP TRUCK

960E

Machine model	Serial number
960E-1	A30003 - A30026
960E-1K	A50003 - A50010

50 Disassembly and assembly

Steering system

Removal and installation of steering control unit	3
Disassembly and assembly of steering control unit	5
Removal and installation of steering column	10
Removal and installation of steering wheel.....	11
Removal and installation of bleed down manifold.....	13
Removal and installation of flow amplifier.....	15
Disassembly and assembly of flow amplifier	15
Removal and installation of steering cylinders and tie rod.....	18
Disassembly and assembly of steering cylinders	20
Removal and installation of steering/brake pump	21
Disassembly and assembly of steering/brake pump.....	24
Removal and installation of steering accumulators.....	33
Disassembly and assembly of steering accumulators	34

Installation

1. Insert capscrew (10, Figure 50-13) with lockwashers (11) and flat washers (5) through brackets (8) and (9), then through the steering column flange. Add second flat washer (5) and nut (13) to each capscrew to hold the parts together. Tighten the nuts securely.
2. Slide the entire assembly down the tapered blocks until brackets (8) and (9) contact the mounting surface in the cab. Install capscrews (4) and (12) with flat washers (5) and lockwashers (6). Tighten capscrews (4) only.
3. Inspect brackets (8) and (9) to see whether they contact the mounting surface evenly and are flat and inline with the surface. If they are, tighten capscrews (12). If brackets are not quite parallel, install flat washers as needed between the brackets and mounting surface to eliminate any gaps. Tighten capscrews (12) to the standard torque.
4. After capscrews (4) and (12) are tightened to the standard torque, remove nuts (13) and flat washers (5) that were holding the steering column to the two brackets. Do not remove capscrews (10) from the brackets.
5. Lubricate the male splines on the end of the steering column shaft.

NOTE: There is no lower end bearing in this steering column assembly. Therefore, the male end of the shaft will have to be guided into the mating female part of the steering control unit.

6. Without removing capscrews (10) from the holes, move steering control unit (7) into place and start each of the capscrews.
7. Tighten four capscrews (10) to the standard torque.
8. Ensure that the steering wheel turns properly without binding and that the steering wheel returns to its centered position after rotating 1/4 turn to the left and to the right.
9. If disconnected, reconnect the hoses to the steering control unit.
10. Connect the steering column wire harness to the harness in the cab.
11. Install access cover (15) and trim cover (14).

Removal and installation of steering wheel

Removal

1. Park the truck on a hard, level surface. Turn the key switch to OFF. Chock the wheels.
2. Turn off the battery disconnect switch to remove battery power from the horn circuit.
3. Use a pocket screwdriver to pry horn button (4, Figure 50-14) from steering wheel (1).
4. Disconnect horn wire (3) and set the horn button aside.
5. Remove nut (2).
6. Use a marker to make alignment marks on the steering wheel and the shaft.
7. Pull the steering wheel from the column. If the steering wheel will not slide off the shaft it may be necessary to install a puller into the tapped holes (5/16" - 24NF) in the steering wheel.



FIGURE 50-14. STEERING WHEEL RETAINER

- | | |
|-------------------|----------------|
| 1. Steering Wheel | 3. Horn Wire |
| 2. Nut | 4. Horn Button |

Assembly

NOTE: Lubricate the O-rings with clean Type C-4 hydraulic oil before installation.

1. Install new bushing (15, Figure 50-23), ring (14), packing (13), dust seal (12), snap ring (11) and O-ring (6) in gland (8).
2. Install O-ring (16), piston ring (5) and wear ring (4) on piston (3).
3. Heat backup rings (7) and (17) in 50 - 60 °C (122 - 140 °F) water for 3 to 4 minutes. Install the backup rings immediately after removing them from the water, applying pressure evenly around the backup rings.
4. Slowly push rod (10) through the top of the gland. Be careful not to damage the dust seal and packing.
5. Apply Loctite No. 262 to the threads of piston (3) and screw it onto the rod. Tighten the piston to **294 ± 30 N·m (217 ± 22 ft lb)**.
6. Apply Loctite No. 262 to the threads of screw (2). Tighten the screw to **59 - 74 N·m (44 - 55 ft lb)**.
7. Coat the piston and the rod with clean Type C-4 hydraulic oil and carefully install the rod and gland assembly into housing (1). Ensure that backup ring (7) and O-ring (6) are not damaged during installation.
8. Install capscrews (9) with flat washers. Tighten the capscrews evenly to **343 ± 34 N·m (253 ± 25 ft lb)**.
9. After steering cylinder is assembled, perform the following tests to verify that performance is within acceptable limits:
 - a. Piston leakage must not exceed 2.5 cm³/min. (0.15 in³/min.) at 20 700 kPa (3,000 psi), port to port.
 - b. Rod seal leakage must not exceed one drop of oil in eight cycles of operation.
 - c. Piston break-away force should not exceed 690 kPa (100 psi).

Removal and installation of steering/brake pump

Removal



Relieve pressure before disconnecting hydraulic lines. Tighten all connections before applying pressure.

Hydraulic oil escaping under pressure can have sufficient force to enter a person's body by penetrating the skin and cause serious injury and possibly death if proper medical treatment by a physician familiar with this injury is not received immediately.

1. Park the truck on a hard level surface. Turn the key switch OFF and allow at least 90 seconds for the steering accumulators to depressurize completely. Turn the steering wheel in both directions to ensure that no oil remains under pressure. Chock the wheels.
2. Drain the hydraulic tank by using the drain located on the bottom side of the tank.

NOTE: Be prepared to contain approximately 947 liters (250 gallons) of hydraulic oil. If the oil is to be reused, clean containers must be used with a 3 micron filtering system available for refill.

As an alternative to draining the hydraulic oil, install vacuum pump kit (XB0887) on the hydraulic tank to prevent the loss of oil when disconnecting hydraulic lines.

3. Clean the steering pump and surrounding area carefully to help avoid contamination of hydraulic oil when lines are opened.

Driveshaft group

NOTE: Ensure that the punch marks on cylinder bearing (26, Figure 50-27) will face toward the shaft end of the pump.

10. Insert cylinder bearing (26) straight into the pump housing. Ensure that the bearing is positioned so that bearing retainer pins (17, Figure 6-9) can be inserted in the case and into the bearing.
11. Install O-rings (18) on pins (17). Install the pins.
12. An arbor press is required to install bearing (2, Figure 50-26) onto driveshaft (1). Press only on the inner race of the bearing. Press the bearing until it contacts the shoulder on the driveshaft.
13. Use a 153 mm (6 in.) long sleeve with an inside diameter that is slightly larger than the retaining ring inside diameter to press retaining ring (4) toward the bearing until it seats in the groove.
14. Place seal retainer (22) over shaft seal (26) inside pump housing (21). Lubricate the shaft seal with clean hydraulic oil.
15. Install the entire driveshaft assembly through the front of the pump housing. A mallet will be required to install the driveshaft through the shaft seal.
16. Once the driveshaft assembly is fully seated in the pump housing, install retaining ring (3).

Rotating group

17. Grease the mating surfaces. Place the cylinder assembly on a clean work bench with the valve plate side down.
18. Assemble the rotating group by inserting retainer springs (28, Figure 50-27) into the same spring bores in cylinder barrel (10) from which they came.
19. Slide fulcrum ball (12) over the nose of cylinder barrel (10).
20. Place retainer (27) over the fulcrum ball and align the holes in the retainer with the corresponding holes (marked during disassembly) in the cylinder barrel. Once aligned, insert piston shoe assemblies (13) into their corresponding holes.



The assembled rotating group weighs approximately 14 kg (30 lb). Assistance from others and use of proper lifting techniques is strongly recommended to prevent personal injury.

21. The rotating group can now be carefully installed over the end of the driveshaft and into the pump housing.
22. When installing the rotating group, support the weight of cylinder barrel (10) as the cylinder spline is passed over the end of the driveshaft to avoid scratching or damage.
23. Push the cylinder barrel forward until the cylinder spline reaches the driveshaft spline. Rotate the cylinder slightly to engage the shaft splines.
24. Continue to slide cylinder barrel forward until it encounters cylinder bearing (26). Lifting the driveshaft slightly helps cylinder barrel-to-cylinder bearing engagement. Continue pushing the cylinder forward until the piston shoes contact swashblock (25).
25. At this point, the back of the cylinder barrel should be located approximately 6 mm (0.25 in.) inside the back of the pump housing.

Control piston group

26. Install seal (2) and piston ring (3) into their respective grooves on control piston (11).
27. Insert the control piston assembly into sleeve (4).
28. While supporting the control piston, press or slip in pin (8) and secure it with cotter or roll pin (18).

Removal and installation of front suspension

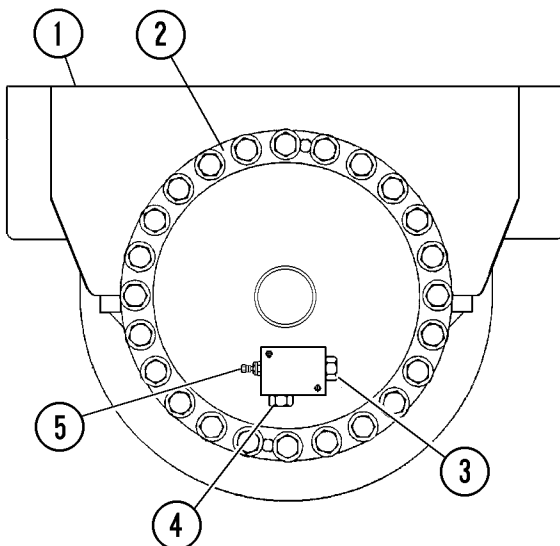
Hydrair® II suspensions are hydro-pneumatic components containing oil and nitrogen gas. The oil and gas in the four suspensions carry the gross truck weight less wheels, spindles and rear axle assembly.

The front suspension cylinders consist of two basic components: a suspension housing attached to the truck frame and a suspension rod attached to the front spindle.

Check valves and orifice dampening holes control suspension travel to provide good ride qualities on haul roads under loaded and empty conditions.

The front suspension rods also act as kingpins for steering the truck.

The suspension cylinder requires only normal care when handling as a unit. However, after being disassembled, these parts must be handled carefully to prevent damage to the machined surfaces. Surfaces are machined to extremely close tolerances and are precisely fitted. All parts must be completely clean during assembly.



H020026

FIGURE 50-1. SUSPENSION CHARGING VALVE

- | | |
|-------------------------|-------------------|
| 1. Suspension Housing | 4. Vent Plug |
| 2. Cap Structure | 5. Charging Valve |
| 3. Pressure Sensor Port | |

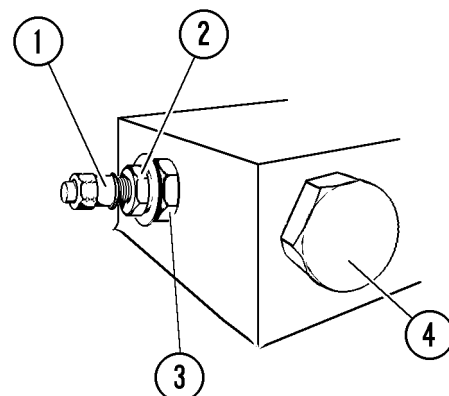
Removal

1. Remove the front tire and rim. Refer to Disassembly and assembly section **Tires, spindles and rear axle**.
2. Remove the front wheel hub and spindle. Refer to Disassembly and assembly section **Tires, spindles and rear axle**.
3. Remove the boot clamp and boot from the front suspension.

WARNING

Wear a face mask or goggles. Make sure that only the swivel nut turns. Turning the entire charging valve assembly may result in the valve assembly being forced out of the suspension by the gas pressure inside.

4. Discharge the nitrogen pressure from the suspension as follows:
 - a. Remove the cap from charging valve (5, Figure 50-1).
 - b. Turn charging valve swivel nut (small hex) (2, Figure 50-2) counterclockwise three full turns to unseat the valve seal. Do not turn more than three turns. Do not turn charging valve body (large hex) (3).
 - c. Depress the valve stem until all nitrogen pressure has been relieved.
5. After all nitrogen pressure has been relieved, loosen valve body (3) and remove the charging valve assembly. Discard the O-ring seal.



H020027

FIGURE 50-2. CHARGING VALVE INSTALLATION

- | | |
|---------------------------|------------------------------------|
| 1. Valve Cap | 3. Charging Valve Body (Large Hex) |
| 2. Swivel Nut (Small Hex) | 4. Vent Plug |

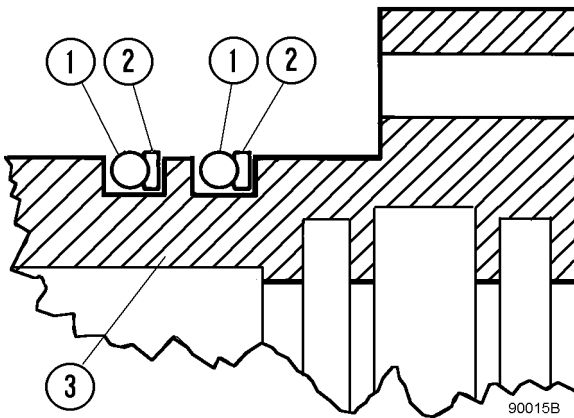


FIGURE 50-15. BACKUP RING REPLACEMENT

- | | |
|----------------|---------------------------|
| 1. O-Ring | 3. Lower Bearing Retainer |
| 2. Backup Ring | |

6. Install new upper bearing (14) on upper bearing retainer (5).
 7. Slide upper bearing retainer (5) over the rod of cap structure (16).
 8. Install key (13) and piston stop (12) on the cap structure rod. Ensure that the piston stop is fully seated against the rod shoulder. Install locknut (11) against the piston stop. Tighten locknut one-half turn further until the hole for rollpin (10) is in alignment. Install the rollpin.
 9. Attach a lifting device to top side of the end cap assembly. Lower the end cap onto piston (7). Insert steel balls (9) in the holes in the piston before fully seating the bearing on top of the piston. A small amount of petroleum jelly will prevent the balls from dropping out during assembly.
 10. Install upper bearing retainer (5) onto the piston rod. Secure the bearing in place with new capscrews (3) and hardened washers (4). Tighten the capscrews to **678 N·m (500 ft lb)**.
- NOTE: Always use new capscrews (3, Figure 50-13) during assembly. Used capscrews will be stressed and fatigued because of loads imposed on these capscrews during operation.*
11. Apply a light coating of petroleum jelly to the seals, wiper and bearings. With the suspension housing in a vertical position, carefully lower the piston rod and end cap assembly into the bore of the cylinder housing to its fully retracted position.
 12. Install hardened washers (2) and capscrews (1). Tighten the capscrews to **678 N·m (500 ft lb)**.
 13. Install drain plug (11, Figure 50-12) and tighten to **17 N·m (13 ft lb)**.
- NOTE: If the suspension is to be stored, put in one liter (two pints) of a rust preventive oil. This oil must be drained when the suspension is put into service.*
14. Install the charging valve with a new O-ring. Lubricate all O-rings with clean Hydrair II oil before threading the charging valve into the end cap. Tighten valve body (large hex) (3, Figure 50-2) to **23 N·m (17 ft lb)**.
 15. Pressure test the suspension. Refer to the Testing and adjusting section **Accumulators and suspensions**.
 16. After a successful pressure test, add approximately 107.1 liters (28.3 gallons) of suspension oil.
 17. Apply rust preventative grease to any exposed machined surfaces.

Removal and installation of hoist pump

Removal

NOTE: The hoist pump can be removed without removing the steering/brake pump from the truck if desired.

1. Shut down the truck properly. Refer to Index and foreword section **Operating instructions** for the shutdown procedure.
2. If necessary, drain the hydraulic tank by using the drain valve on the bottom of the tank.
3. Remove the rear axle blower duct to allow the hoist pump to be lowered from the pump mount bracket for removal. Remove the duct support bracket.

▲ IMPORTANT ▲

Always maintain complete cleanliness when opening any hydraulic connection. Ensure that all system lines and components are capped while the component is removed from the truck.

4. Loosen the capscrews that secure the inlet hoses and outlet hoses to hoist pump (3, Figure 50-1). Allow the oil to drain into a suitable container.
5. Remove the inlet and outlet hoses. Cap or cover all lines and pump inlets and outlets to prevent contamination.
6. Remove the capscrews that secure the hoist pump drive flange to the driveshaft.

▲ WARNING

The hoist pump weighs approximately 140 kg (310 lb). The hoist pump and steering/brake pump combined weigh approximately 254 kg (560 lb). Use a suitable lifting device that can handle the load safely.

7. Attach a suitable lifting device to the hoist pump. Attach a support to the front end of steering/brake pump (5) to hold it in place during removal of the hoist pump.

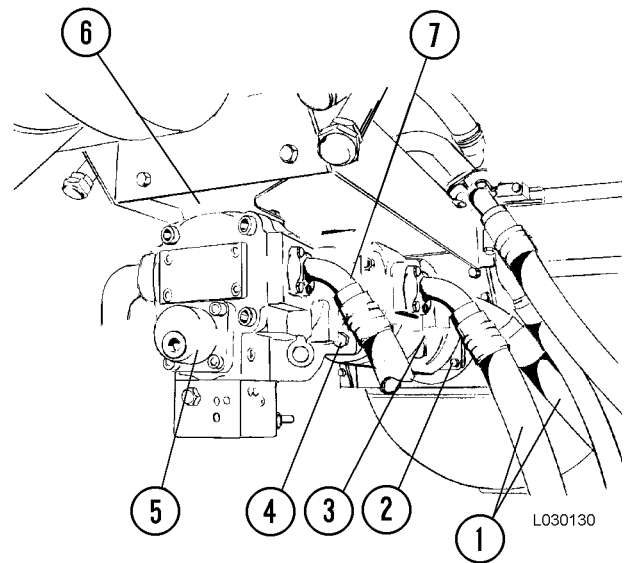


FIGURE 50-1. HOIST PUMP REMOVAL

1. Pump Outlet Hoses
 2. Capscrews
 3. Hoist Pump
 4. Mounting Capscrews
 5. Steering/Brake Pump
 6. Pump Mount Bracket
 7. Outlet Hose
8. Remove four capscrews (2) that secure the hoist pump to the front support bracket. Remove the six capscrews that secure pump mount bracket (6) to the pump module support. Remove the pump mount bracket.
 9. Ensure that the lifting and support devices are in place on both pumps. Loosen (but do not remove) the rear support bracket capscrews holding steering/brake pump (5). Lower the pumps, allowing the hoist pump to come down farther than the steering/brake pump.
 10. Remove four steering/brake pump mounting capscrews (4). Slide the hoist pump forward to disengage the splines of coupling (9, Figure 50-2) from the steering/brake pump.
 11. Move the hoist pump to a clean work area for disassembly.

Removal and installation of hoist valve

Removal



Relieve all pressure before disconnecting hydraulic lines. Tighten all connections securely before applying pressure.

Hydraulic oil escaping under pressure can have sufficient force to enter a person's body by penetrating the skin and cause serious injury and possibly death if proper medical treatment by a physician familiar with this type of injury is not received immediately.

1. Make sure that there is adequate overhead clearance and raise the truck body. Secure the body in the raised position with the body-up retention cable. Refer to Index and foreword section **Foreword and general information** for the procedure.

2. Shut down the truck properly. Refer to Index and foreword section **Operating instructions** for the shutdown procedure.
3. Slowly move the hoist control lever to the LOWER position until the body lowers against the body-up retention cable to relieve hoist cylinder pressure.
4. Thoroughly clean the exterior of the hoist valve.
5. Disconnect and plug all hydraulic lines and ports to help prevent contamination. Mark each hydraulic line to aid in correct installation.
6. Remove the capscrews and lockwashers that secure hoist valve (5, Figure 50-16).



The hoist valve weighs approximately 193 kg (425 lb). Use a suitable lifting device that can handle the load safely.

7. Attach a lifting device to the hoist valve and remove it from the truck. Move the hoist valve to a clean work area for disassembly.

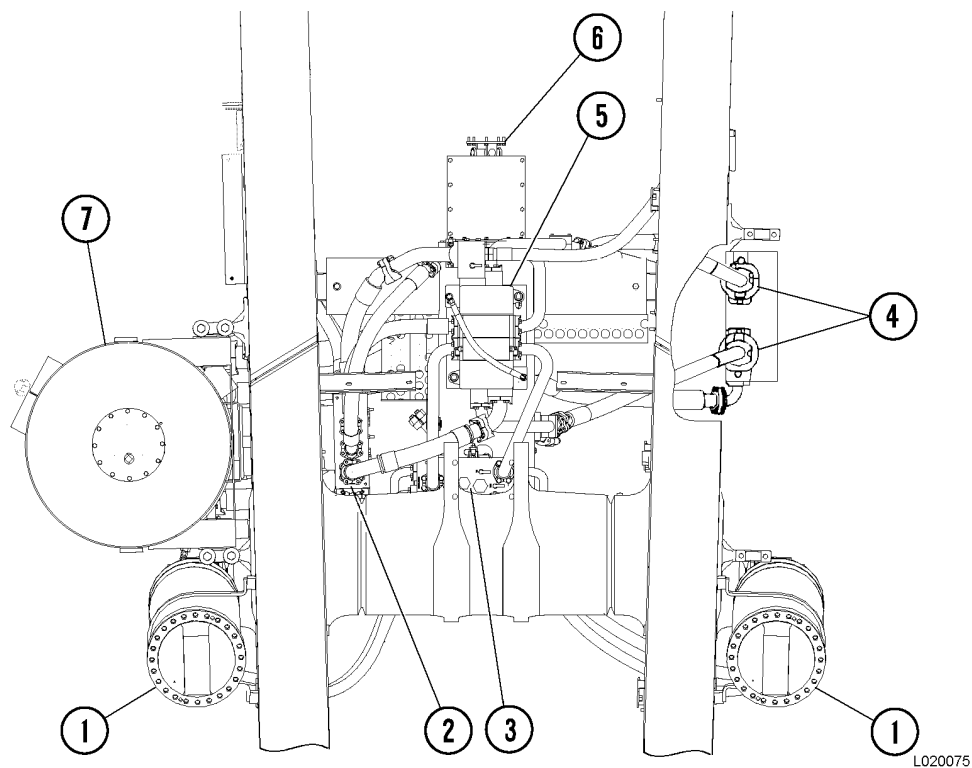


FIGURE 50-16. HOIST VALVE & PIPING (Top View)

- | | | |
|------------------------------------|--------------------------|---------------------|
| 1. Hoist Cylinder | 3. Overcenter Manifold | 6. Pump Drive Shaft |
| 2. Brake/Hoist Return Oil Manifold | 4. Hoist Circuit Filters | 7. Hydraulic Tank |
| | 5. Hoist Valve | |

Disassembly and assembly of hoist pilot valve

Disassembly

1. Thoroughly clean the exterior of the valve. Match mark the components to ensure proper reassembly.
2. Remove machine screw (15, Figure 50-32), seal plate (16), wiper (13) and O-ring (12).
3. Remove snap ring (1), capscrews (6), cap (24), spacer (23), and detent sleeve (22). Detent balls (2) and (21) will fall free when the cap and detent sleeve are removed. Separate cap (24), spacer (23) and detent sleeve (22).
4. Carefully slide spool (14) out of spool housing (17). Remove seal retainer (25), wiper (26) and O-ring (27) from the spool.
5. Insert a rod in the cross holes of detent pin (3) and unscrew it from spool (14). Exert slight pressure against the detent pin as it disengages and spring tension is released.
6. Remove spring seats (19), spring (4) and spacer (5).
7. Remove relief valve (2, Figure 50-31) from spool housing (1).
8. Match mark the inlet and outlet housings in relation to the spool housing to ensure correct location during reassembly.

9. Remove nuts (8) and (10, Figure 50-32) and remove tie rods (9). Separate the valve housings. Remove O-ring (11). Remove the poppet check and spring (located on the outlet housing side of the spool housing) from the spool housing.

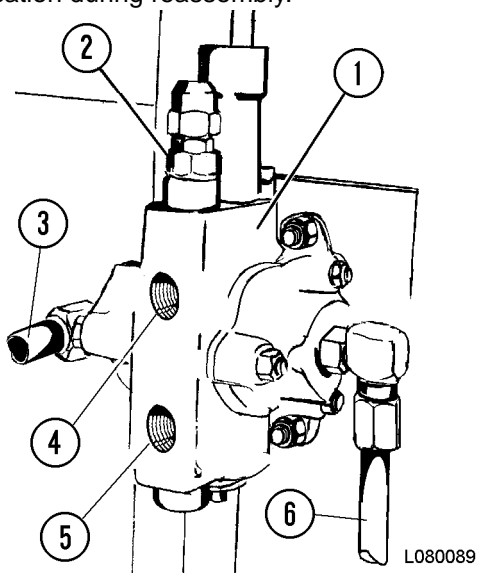


FIGURE 50-31. RELIEF VALVE

- | | |
|-----------------------------|------------------------------|
| 1. Spool Housing | 5. To Hoist Valve (Base End) |
| 2. Relief Valve | 6. Return to Tank |
| 3. Supply Port | |
| 4. To Hoist Valve (Rod End) | |

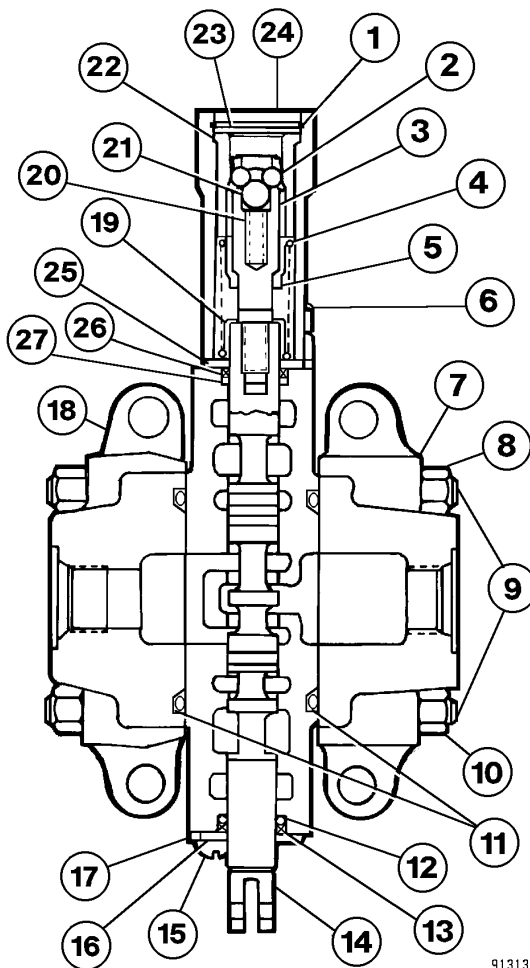


FIGURE 50-32. HOIST PILOT VALVE

- | | |
|-------------------|-------------------|
| 1. Snap Ring | 15. Machine Screw |
| 2. Ball (4) | 16. Seal Plate |
| 3. Detent Pin | 17. Spool Housing |
| 4. Spring | 18. Inlet Housing |
| 5. Spacer | 19. Spring Seat |
| 6. Capscrew | 20. Spring |
| 7. Outlet Housing | 21. Ball (1) |
| 8. Nut | 22. Detent Sleeve |
| 9. Tie Rod | 23. Spacer |
| 10. Nut | 24. Cap |
| 11. O-Ring | 25. Seal Retainer |
| 12. O-Ring | 26. Wiper |
| 13. Wiper | 27. O-Ring |
| 14. Spool | |

NOTES

Replacing door assembly seal and door hinge seal

1. The door assembly seal is glued on the door. This seal can be replaced by peeling the seal away from the door frame. Then use a suitable cleaner to remove the remaining seal and glue material.
2. The area where the door seal mounts should be free of dirt and oil. Spread or spray a glue which is quick drying and waterproof onto the area where the seal is to be installed.
3. Install the seal so that the corners of the seal fit up into the corners of door frame (3, Figure 50-7).
4. Door hinge seal (2, Figure 50-8) is glued to the hinge. Use the same procedure as above for this seal.

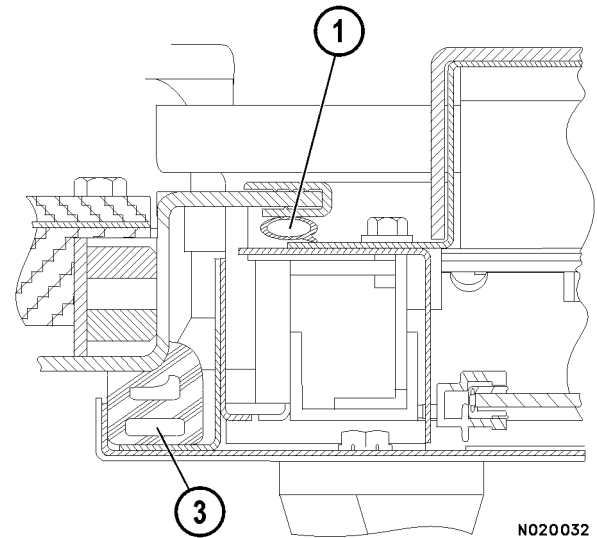


FIGURE 50-7. DOOR SEALS

1. Door Opening Seal 3. Door Assembly Seal

Replacing door opening seal

1. Starting at the lower center of the door opening, pull up on one end of the seal. The seal should pull loose from the cab opening lip. Pull door opening seal (1, Figure 50-7 and Figure 50-8) loose all the way around the opening.
2. Inspect the cab opening lip for damage, dirt, and oil. Repair or clean the cab opening as necessary. Remove all dirt and old sealant. Ensure that the perimeter of the opening is clean and free of burrs.
3. Install the seal material around the door opening in the cab. Start at the bottom center of the cab opening and work the seal lip over the edge of the opening. Go all the way around the opening. Ensure that the seal fits tightly in the corners. A soft face tool may be used to work the seal up into the corners.
4. Continue going all the way around the opening. When the ends of the seal meet at the bottom center of the cab opening, it may be necessary to trim off some of the seal.

NOTE: The ends of the seal material need to be square-cut to assure a proper fit.

5. Fit both ends so that they meet squarely. Then while holding the ends together, push them firmly into the center of the opening.

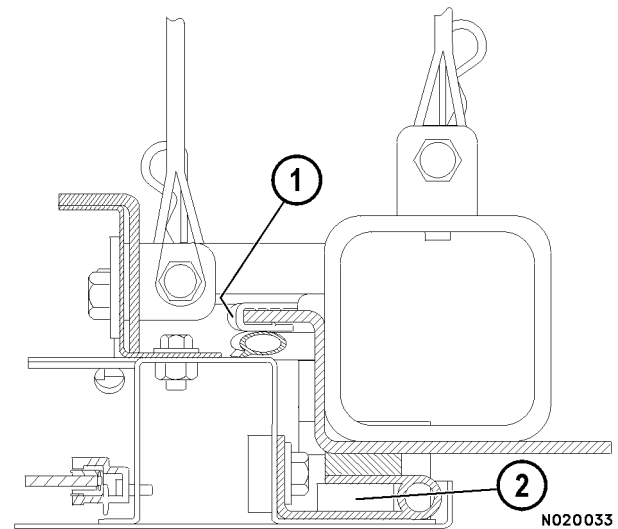


FIGURE 50-8. DOOR SEALS

1. Door Opening Seal 2. Door Hinge Seal

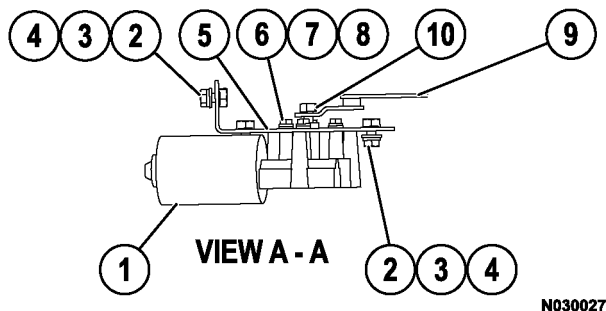
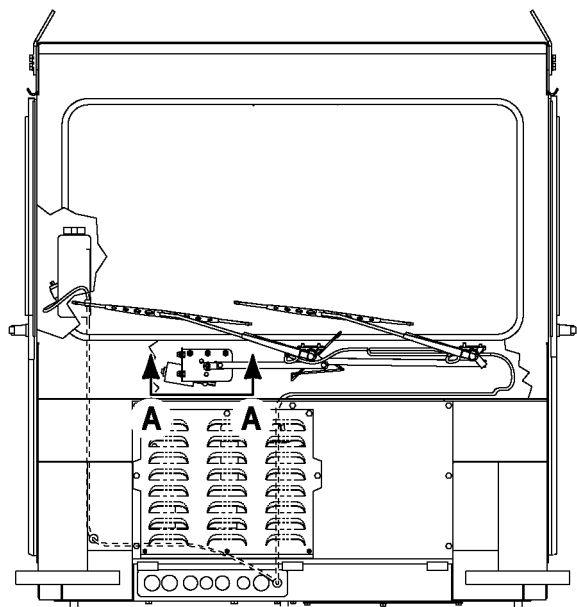


FIGURE 50-22. WINDSHIELD WIPER INSTALLATION

- | | |
|----------------|------------------|
| 1. Wiper Motor | 6. Cap Screw |
| 2. Cap Screw | 7. Flat Washer |
| 3. Flat Washer | 8. Lock Washer |
| 4. Lock Washer | 9. Wiper Linkage |
| 5. Plate | 10. Nut |

Removal and installation of windshield wiper arm

Removal

1. Note the parked position of wiper arm (1, Figure 50-23).
2. Lift the wiper arm cover. Remove nut (2) and washer (3).
3. Disconnect the washer hose, then remove the wiper arm.

Installation

1. Place wiper arm (1, Figure 50-23) into the parked position noted during removal. Install washer (3) and nut (2). Tighten the nut to **16-20 N·m (142-177 in lb)**. Close the wiper arm cover.
2. Connect the washer hose to the wiper arm.
3. Verify that the wipers operate properly and park in the proper position (See to Figure 50-24).

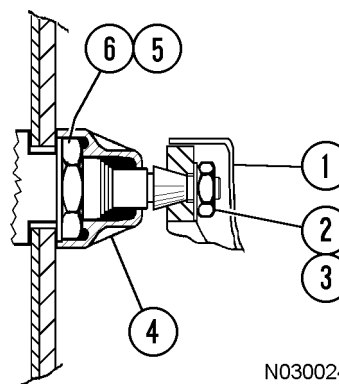


FIGURE 50-23. WIPER ARM DETAIL

- | | |
|------------------|-----------|
| 1. Wiper Arm | 4. Cap |
| 2. Nut | 5. Washer |
| 3. Spring Washer | 6. Nut |

NOTES

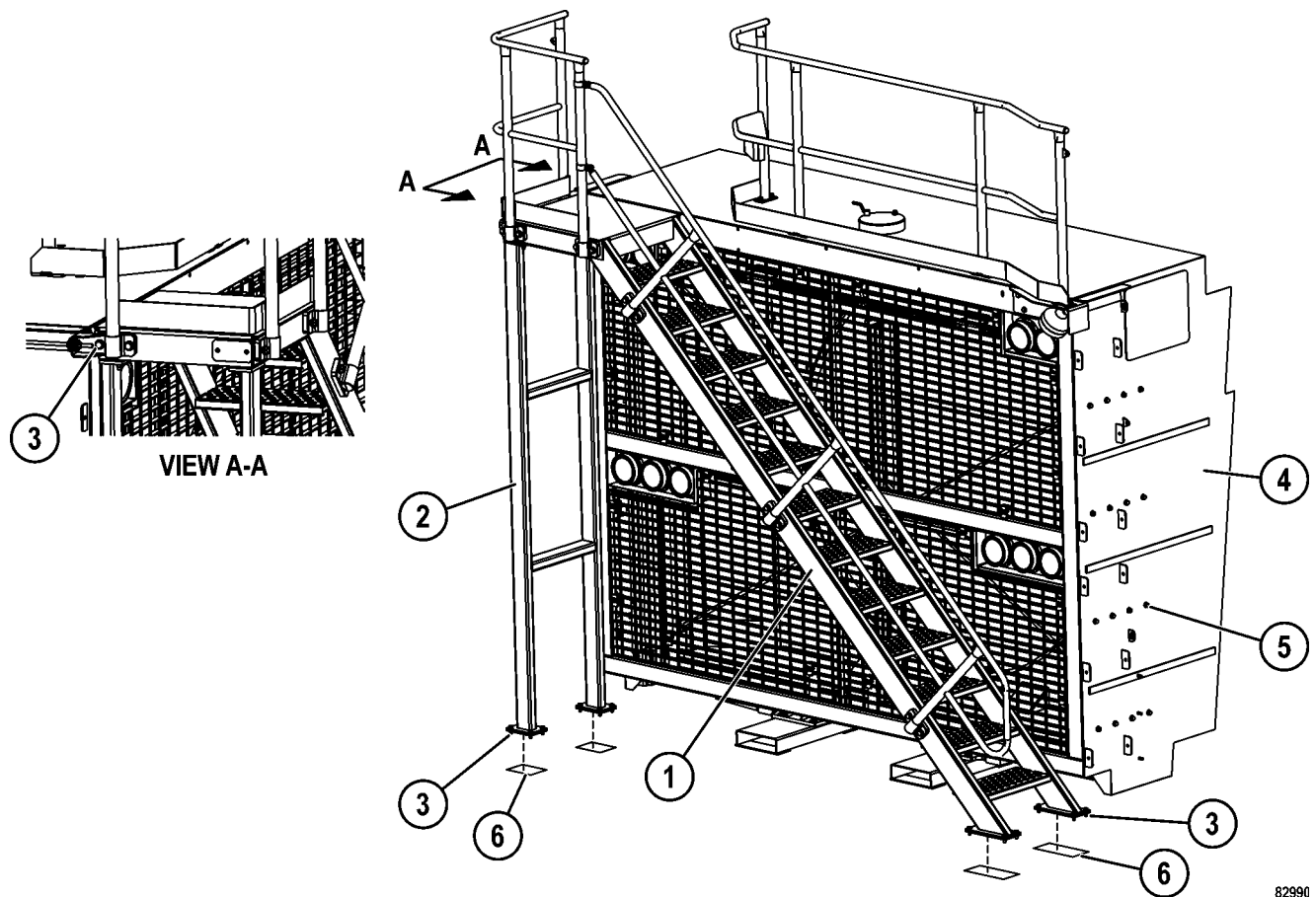


FIGURE 50-7. DIAGONAL LADDER, GRILLE & HOOD REMOVAL

1. Diagonal Ladder
2. Support

3. Ladder Mounting Hardware
4. Grille and Hood Assembly

5. Hood Mounting Hardware
6. Shims

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NOTES

NOTES

⚠ WARNING

Lift the power module only at the lifting points on the subframe and engine/alternator cradle structure. Refer to Figure 50-7 and Figure 50-9.

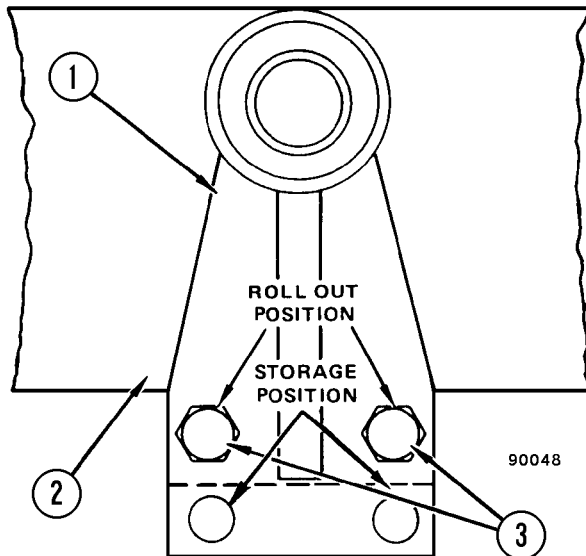


FIGURE 50-8. SUBFRAME ROLLERS

- | | |
|--------------------|--------------|
| 1. Roller Assembly | 3. Capscrews |
| 2. Subframe | |

24. Place a jack under the rear of the power module. Raise the rear portion of engine subframe and install subframe rollers (see Figure 50-8). Lower the rear portion of the subframe carefully until the rollers rest on the main frame guide rail.

NOTE: Subframe rollers are supplied in the optional truck tool group and can be installed in the storage position after use as shown in Figure 50-8.

25. Position the hoist at front subframe lifting points (7, Figure 50-7). Raise the engine subframe until the engine is on a level plane. Remove the safety chain.

⚠ WARNING

The complete power module, including the hood and grille, weighs approximately 19 200 kg (42,335 lb). Ensure the lifting device to be used has adequate capacity.

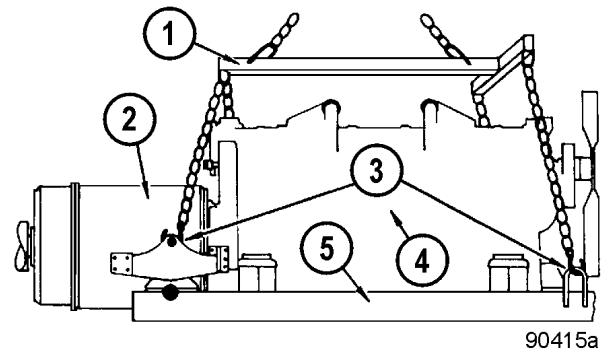


FIGURE 50-9. POWER MODULE LIFTING POINTS

- | | |
|-------------------|--------------------------|
| 1. Lifting Tool | 4. Engine |
| 2. Alternator | 5. Power Module Subframe |
| 3. Lifting Points | |

26. Roll the power module forward so that adequate clearance is provided in front of the control cabinet for the lifting device to be attached to engine/alternator cradle (4, Figure 50-7) and front subframe lifting points (7). Place stands or a block under the front of the subframe. Lower the hoist until the front of the subframe is supported. Install a safety chain to prevent the subframe from rolling.
27. Attach lifting tool (1, Figure 50-9) to the hoist and attach it to the engine/alternator cradle structure and front subframe lifting points as shown in Figure 50-9. Remove the safety chain.
28. Raise the power module slightly to determine whether the module is on an even plane. Move the power module straight out of truck to a clean work area for disassembly.

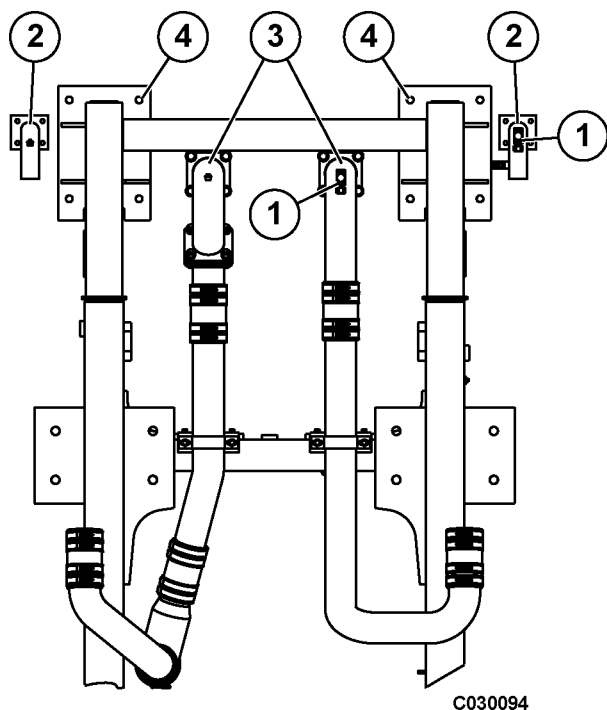


FIGURE 50-20. RADIATOR PIPING, BOTTOM VIEW

- | | |
|-------------------------|-------------------------------|
| 1. Drain Cock | 4. Radiator Mounting Hardware |
| 2. Outlet Elbow (Front) | |
| 3. Outlet Elbow (Rear) | |

5. Unclamp and separate all upper hoses between the radiator and the engine.
6. Remove outlet elbows (2) and (3, Figure 50-20) at the bottom tanks. Cap all coolant lines to prevent contamination.
7. Remove and cap the hoses from the radiator top tank and surge tank.
8. Remove the capscrews and lockwashers to free the fan guard from radiator shroud (4, Figure 50-21).

NOTE: The three-piece fan guard may be disassembled and removed, or the complete fan guard may be moved toward the engine to clear the shroud during removal of the radiator.

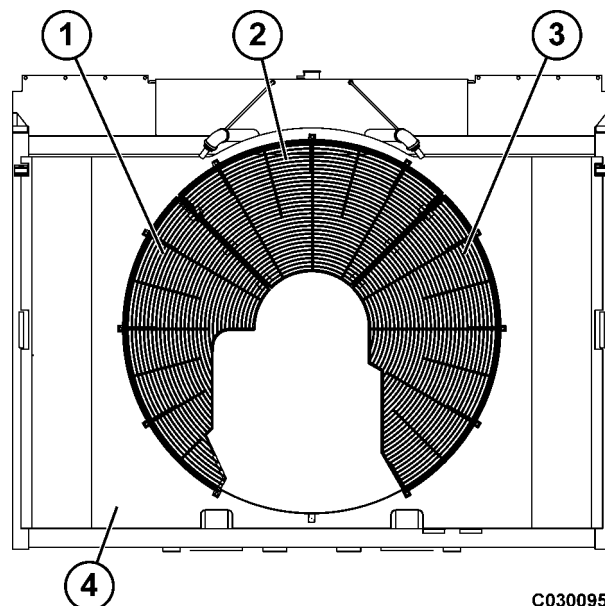


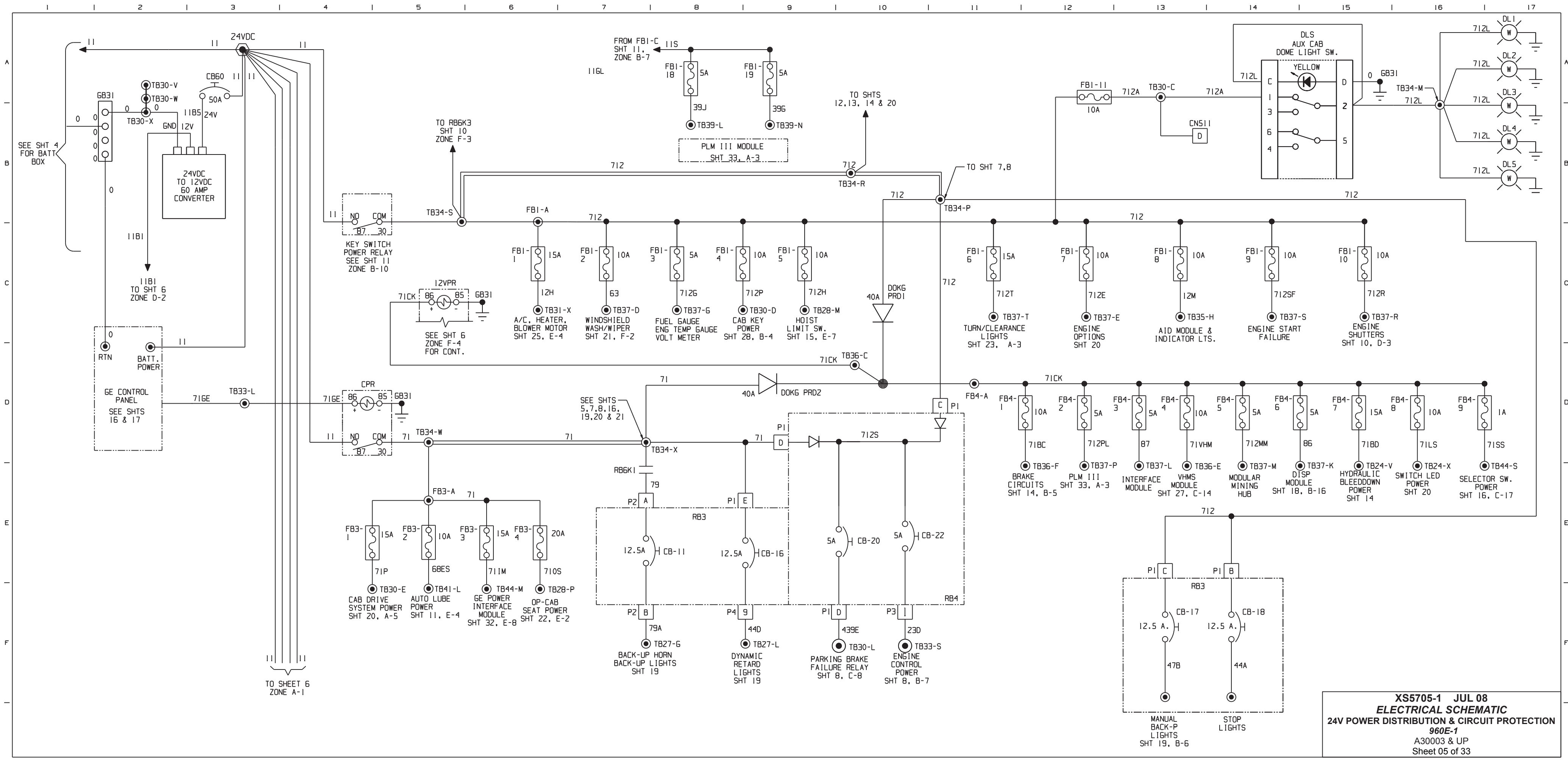
FIGURE 50-21. FAN GUARD

- | | |
|---------------------|--------------------|
| 1. LH Fan Guard | 3. RH Fan Guard |
| 2. Center Fan Guard | 2. Radiator Shroud |

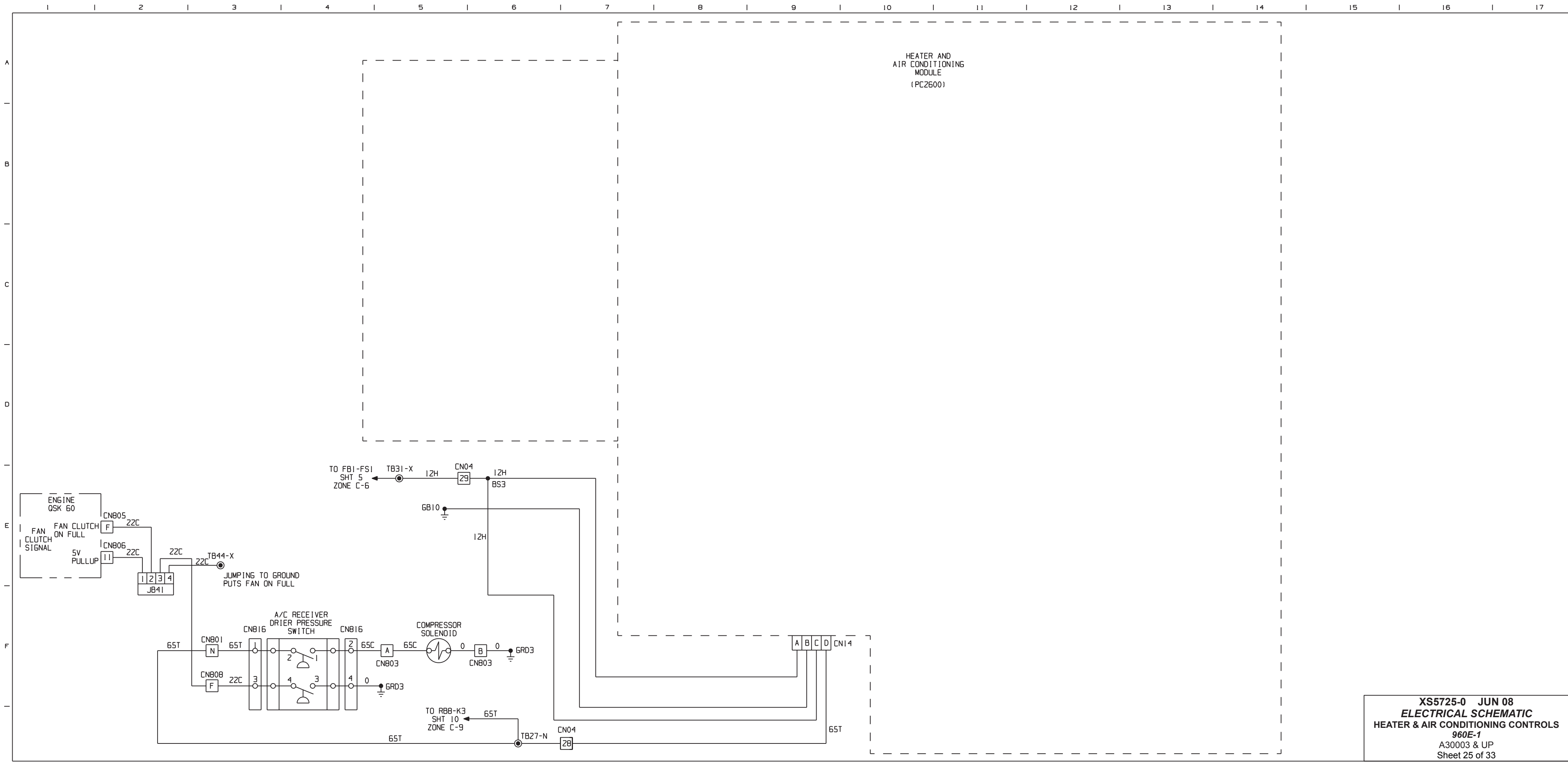
⚠ WARNING

The radiator and shroud assembly weighs approximately 2 100 kg (4,360 lb). Ensure that the lifting device to be used has adequate capacity.

9. Attach the hoist to the radiator and take up any slack.
10. Remove upper support rods (2, Figure 50-22) and stabilizer bars (3).
11. Remove radiator mounting hardware (4, Figure 50-20) that secures the radiator and to the power module subframe.
12. Ensure that all hoses and wiring harnesses have been removed. Lift the radiator slightly with the hoist and move the radiator forward until it is clear of the engine fan. Move the radiator to a work area for service.



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