CEBM026301

Shop Manual

960E-2K

DUMP TRUCK

SERIAL NUMBERS **A50011 & UP**

KOMATSU®

⚠WARNING

NON-OEM PARTS IN CRITICAL SYSTEMS

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

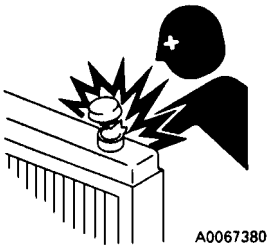
Replacement parts manufactured and supplied by unauthorized sources may not be designed, manufactured or assembled to Komatsu's design specifications; accordingly, use of such parts may compromise the safe operation of Komatsu products and place the operator and others in danger should the part fail.

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

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

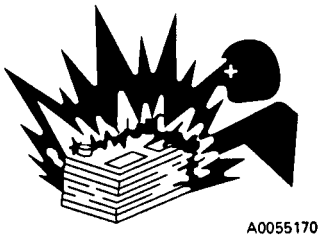
Radiator coolant level

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



Precautions with the battery

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



Precautions with high pressure oil

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

Handling high pressure hoses

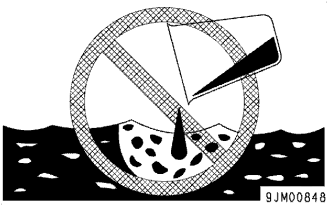
- Do not bend high pressure hoses or hit them with hard objects. Do not use any bent or cracked piping, tubes or hoses. They may burst during use.
- Always repair any loose or broken hoses. If fuel or oil leaks, it may result in a fire.

Precautions when performing maintenance near high temperature or high pressure

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

Waste materials

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



Standard assembly torques for 12-point, grade 9 capscrews (SAE)

The following specifications apply to required assembly torques for all 12-point, grade 9 (170,000 psi minimum tensile) capscrews.

- Capscrew threads and seats shall be lubricated when assembled. Refer to "Effect of special lubricants on fasteners and standard torque values".
- Torques are calculated to give a clamping force of approximately 75% of proof load.
- The maximum torque tolerance shall be ±10% of the torque value shown.

Table 8: Standard assembly torques for 12-point, grade 9 capscrews

Capscrew size*	Torque ft lb	Torque kg·m	Torque N·m
0.250 - 20	12	1.7	16
0.312 - 18	24	3.3	33
0.375 - 16	42	5.8	57
0.438 - 14	70	9.7	95
0.500 - 13	105	14.5	142
0.562 - 12	150	20.7	203
0.625 - 11	205	28.3	278
0.750 - 10	360	49.7	488
0.875 - 9	575	79.4	780
1.000 - 8	860	119	1166
1.000 - 12	915	126	1240
1.125 - 7	1230	170	1670
1.125 - 12	1330	184	1800
1.250 - 7	1715	237	2325
1.250 - 12	1840	254	2495
1.375 - 6	2270	313	3080
1.375 - 12	2475	342	3355
1.500 - 6	2980	411	4040
1.500 - 12	3225	445	4375
* Shank diameter (in.) - Threads per inch			
NOTE: This table represents standard values only. Do not use these values to replace torque values which are specified in assembly instructions.			

Standard assembly torques for class 10.9 capscrews and class 10 nuts

The following specifications apply to required assembly torques for all metric class 10.9 finished hexagon head capscrews and class 10 nuts.

- Capscrew threads and seats shall not be lubricated when assembled. These specifications are based on all capscrews, nuts, and hardened washers being phosphate and oil coated.

NOTE: If zinc-plated hardware is used, each piece must be lubricated with simple lithium based chassis grease (multi-purpose EP NLGI) or a rust preventive grease to achieve the same clamping forces provided in the table.

- Torques are calculated to give a clamping force of approximately 75% of proof load.
- The maximum torque tolerance shall be ±10% of the torque value shown.

Table 9: Standard assembly torques for metric class 10.9 capscrews and class 10 nuts

Capscrew size*	Torque N·m	Torque ft lb	Torque kg·m
M6 x1	12	9	1.22
M8 x 1.25	30	22	3.06
M10 x 1.5	55	40	5.61
M12 x 1.75	95	70	9.69
M14 x 2	155	114	15.81
M16 x 2	240	177	24.48
M20 x 2.25	465	343	47.43
M24 x 3	800	590	81.6
M30 x 3.5	1600	1180	163.2
M36 x 4	2750	2028	280.5
* Shank diameter (mm) - Thread pitch in millimeter			
NOTE: This table represents standard values only. Do not use these values to replace torque values which are specified in assembly instructions.			

Precautions during truck operation

After the engine is started and all systems are functioning properly, the operator must follow all local safety rules to ensure safe machine operation.

⚠WARNING

If any of the red warning lights come on or if any gauge reads in the red area during truck operation, a malfunction is indicated. Stop the truck as soon as possible and turn off the engine. Have the problem corrected before resuming truck operation.

⚠CAUTION

The truck is equipped with "slip/slide" control. If this function becomes inoperative, operating the truck with stalled or free spinning wheel motors may cause serious damage to the wheel motors. If the truck does not begin to move within 10 seconds after depressing the throttle pedal with the directional control lever in a F or R position, release the throttle pedal and allow the wheels to regain traction before accelerating again.

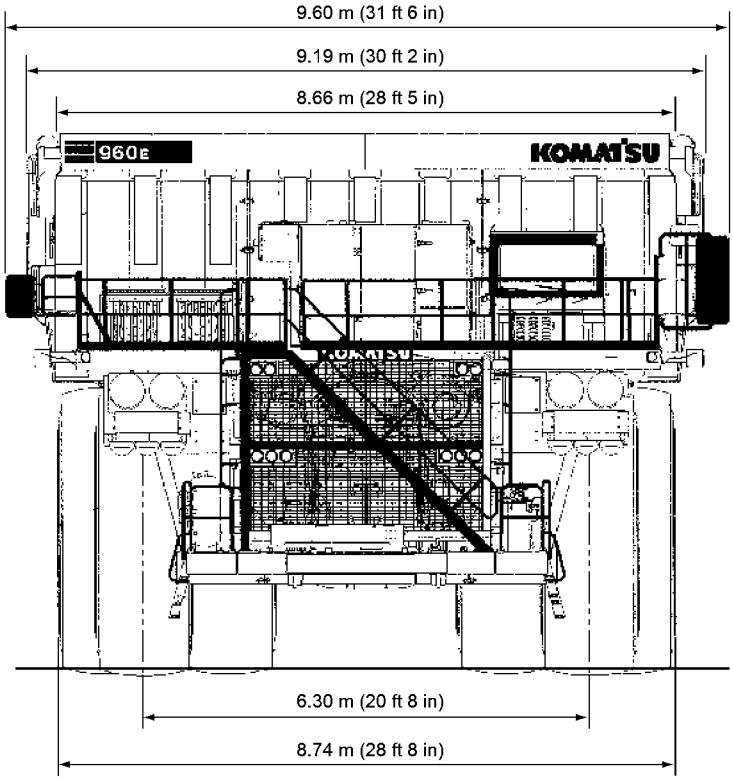
- Operate the truck only while properly seated with seat belt fastened. Keep hands and feet inside the cab while the truck is in operation.
- Do not allow unauthorized personnel to ride in or on the truck. Do not allow anyone to ride on the ladder of the truck.
- Always look to the rear before backing the truck. Watch for and obey the ground spotter's hand signals before making any reverse movements. The spotter should have a clear view of the entire area at the rear of the truck.
- When backing up the truck, give a back-up signal of three blasts on the horn. When starting forward, give two blasts on the horn. These signals must be given each time the truck is moved forward or backward.
- Truck operation requires concentrated effort by the driver. Avoid distractions of any kind while operating the truck.
- Check the gauges and instruments frequently during operation for proper readings.
- Observe all regulations pertaining to the job site's traffic pattern. Be alert to any unusual traffic pattern. Obey the spotter's signals.
- Match the truck speed to haul road conditions. Slow down the truck in congested areas. Keep a firm grip on the steering wheel at all times.
- Do not allow the engine to run at idle for extended periods of time.
- When the truck body is in the dump position, do not allow anyone beneath it unless the body-up retaining pin or cable is in place.

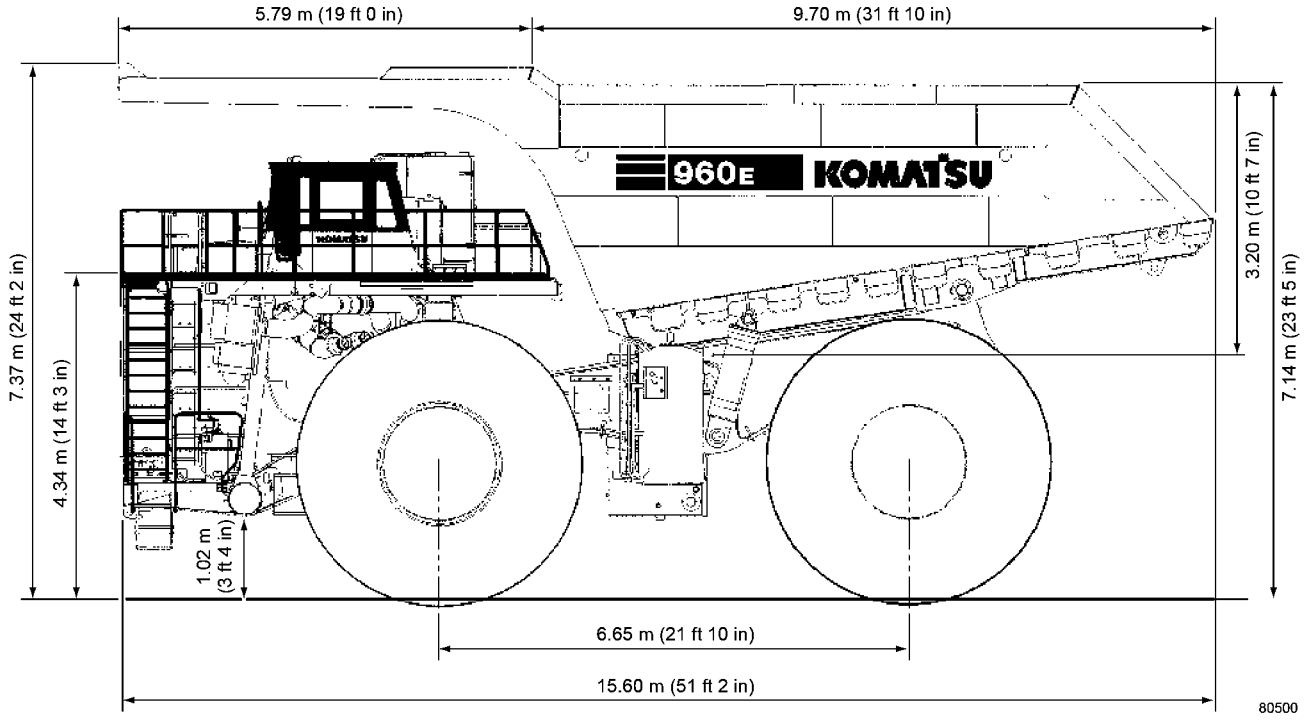
⚠WARNING

Do not use the brake lock for parking. With the engine stopped, hydraulic pressure will bleeddown, allowing the brakes to release.

- Check the brake lock performance periodically for safe loading and dump operation.
- Proceed slowly on rough terrain to avoid deep ruts or large obstacles. Avoid traveling close to soft edges or the edge of a fill area.
- Do not drive over unprotected power cables.
- Check the tires for proper inflation periodically during your shift. If the truck has been run on a "flat" or under-inflated tire, it must not be parked in a building until the tire cools.

Specification drawing





No steer

Refer to Figure 10-6.

High pressure oil from the steering pump and steering accumulators is available through the bleeddown manifold to the “HP” port on the flow amplifier.

Upon entering the priority valve, the oil goes past the spool to the closed amplifier valve and also out port “P” through a hose to port “P” on the steering control unit. In the steering control unit, the oil goes to a closed area in the control.

As pressure builds up in these two areas, oil passes through orifices in the end of the priority valve and builds pressure on the end of the valve and port PP. When pressure reaches approximately 3 500 kPa (500 psi), the spool moves, compressing its spring and closing off oil supply through area “A”, resulting in high pressure at “PP” but only 3 500 kPa (500 psi) at the amplifier spool and steering control unit.

Hoist circuit operation

Hydraulic fluid is supplied by a tank (1, Figure 10-1) located on the left frame rail. Hydraulic oil is routed to hoist pump (2). A second pump, coupled to the rear of the hoist pump, supplies oil for the steering and brake systems. The pumps are driven by an accessory drive at the end of the traction alternator.

Hoist pump output is directed to a pair of high pressure filters (3) mounted to the inboard side of the fuel tank. Hydraulic oil from the hoist filters is directed to hoist valve (7), which is mounted above the pumps.

The hoist valve directs oil to hoist cylinders (10) for raising and lowering of the dump body. Hoist valve functions are controlled by the operator through the hoist control lever that is connected to hoist pilot valve (4) located in the hydraulic brake cabinet.Hoist limit solenoid (5), located in the bleeddown manifold, shifts the hoist valve out of POWER UP before the hoist cylinders extend to their maximum physical limit.

When the hoist valve is in the HOLD or FLOAT position, hoist circuit oil flows to the front and rear service brakes, cooling the wet disc brakes during truck operation.

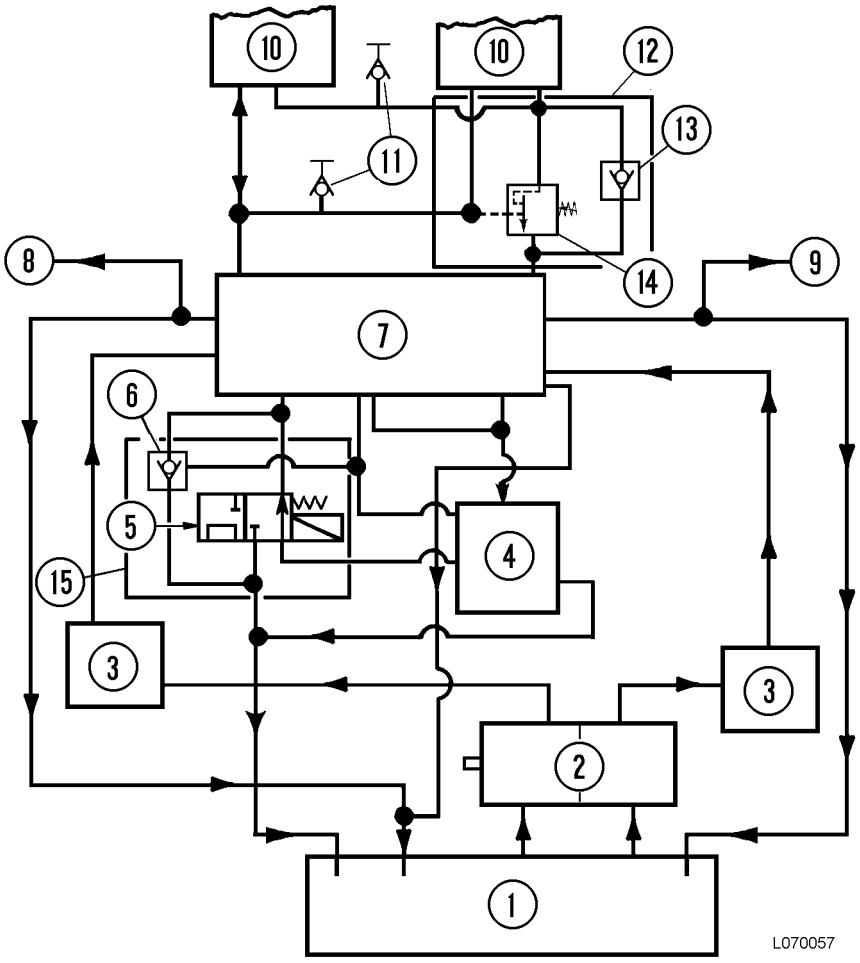


FIGURE 10-1. HOIST CIRCUIT SCHEMATIC

1. Hydraulic Tank
2. Hoist Pump
3. High Pressure Filter
4. Hoist Pilot Valve
5. Hoist Limit Solenoid
6. Pilot Operated Check Valve
7. Hoist Valve
8. Brake Cooling Oil Supply (Front)
9. Brake Cooling Oil Supply (Rear)
10. Hoist Cylinder
11. Quick Disconnect
12. Overcenter Manifold
13. Check Valve
14. Counterbalance Valve
15. Bleeddown Manifold

960E Dump truck

Form No. CEN10002-01

DUMP TRUCK

960E

Machine model	Serial number
960E-1K	A50009 - A50010
960E-2K	A50011 and up

10 Structure, functions and maintenance standard
Electrical system, 24 volt

Table 2: Digital inputs

Input	Display type	Source	Signal type	Input signal	Connector - Pin	Force to	On
Circuit breaker tripped	Amber caution	Truck	Digital	Circuit breaker tripped	IM2-g	Ground	0
Hydraulic oil filter	Amber caution	Truck	Digital	Pump filter switches	IM2-Y	Ground	1
Low steering pressure alert	Red light	Truck	Digital	Low steering pressure switch 1	IM2-S	Ground	1
Low steering precharge alert	Red light	Truck	Digital	Low steering precharge switch 1	IM2-W	Ground	1
Steering accum pressure	Red light	Truck	Digital	Steering accum pressure switch	IM2-Z	Ground	0
Composite brake alert	Red light	Truck	Digital	Brake lock	IM2-i	24VDC	1
				Brake accum pressure switch	IM2-U	Ground	1
				Brake lock degrade	IM2-V	Ground	1
Park Brake Set	None	Truck	Digital	PB Set	IM2-f	Ground	0
Park Brake Released	None	Truck	Digital	PB Released	IM2-M	Ground	0
Drive System Fault Lamp	None	Drive System	Digital	Drive System Fault	IM2-b	Ground	0
Drive System Fault Buzzer	None	Drive System	Digital	Drive System Fault	IM2-c	Ground	0
Hydraulic tank oil level alert	Red light	Truck	Digital	Hydraulic tank oil level	IM2-k	Ground	1
Selector switch (FNR)	None	Truck	Digital	Selector switch (FNR)	IM2-N	24VDC	1
Crank request	None	Truck	Digital	Crank request	IM2j	24VDC	1
Key switch, direct	None	Truck	Digital	Key switch	IM2-P	24VDC	1
Timed engine shutdown	None	Engine	Digital	Timed engine shutdown	IM3-F	24VDC	1
Drive System batt+	None	Truck	Digital	Drive System batt+	IM3-M	24VDC	1
Snapshot in progress	None	VHMS	Digital	Snapshot in progress	IM2-L	Ground	0
Mode switch 1 - left arrow	None	Truck	Digital	-	IM3-H	Ground	0
Mode switch 2 - OK	None	Truck	Digital	-	IM3-J	Ground	0
Mode switch 3 - down arrow	None	Truck	Digital	-	IM3-K	Ground	0

Fuses (control power and trolley box contactor)

80937

FIGURE 10-24. FUSE HOLDER FOR FIELD REGULATOR, FRONT VIEW

Technical Data

4A, 250V (control power, FU401-FU405)

10A, 250V (trolley box contactor, FU1001)

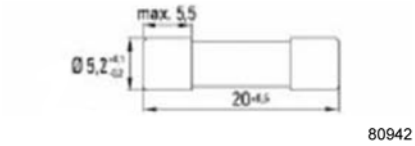


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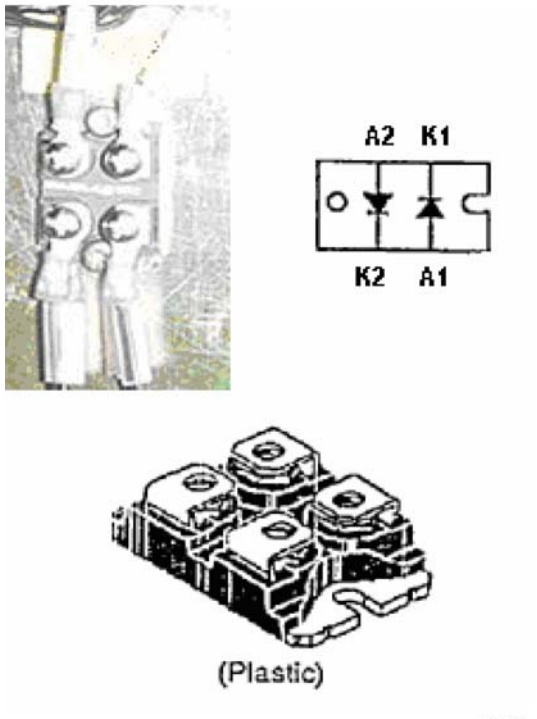
FIGURE 10-25. DIMENSIONS (MM)

Diode modules



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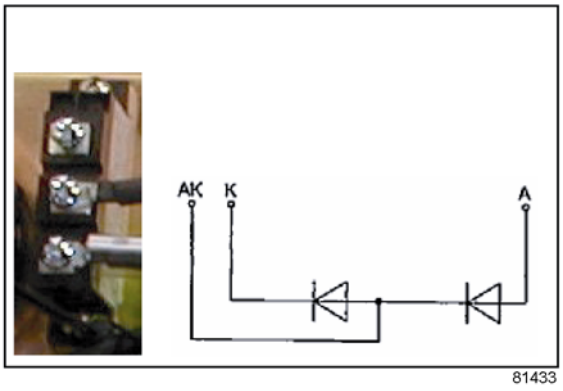

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FIGURE 10-26. DIODE MODULES, MULTIPLE VIEWS OF V121/V122

The latching diodes (V121 and V122) allow multiple sources to be used for the SiBASØ ON signal, while the blocking diodes (V120, V13, V101, and V102) prevent the positive 24V input to the SiBASØ filter from energizing the wrong portion of the circuit.

Technical Data

30A (V121, V122)

89A (V120, V13, V101, V102)

Ground voltage monitoring resistors

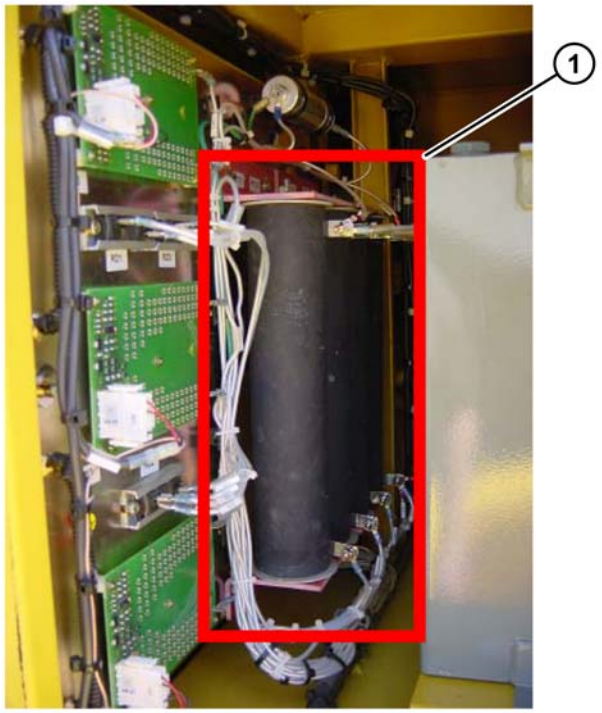

FIGURE 10-64. RESISTORS, SIDE VIEW (LOCATED ON REAR SIDE OF CONTROL CABINET IN UPPER RIGHT DOOR)

1. Resistors (qty: 4)

Used to establish the proper ratio of the DC link voltage.

Protection thyristor assembly (crowbar)

FIGURE 10-65. PROTECTION THYRISTOR ASSEMBLY, TOP VIEW

1. Protection thyristor assembly

Protects against ground faults.

Grid box

Device name: M04

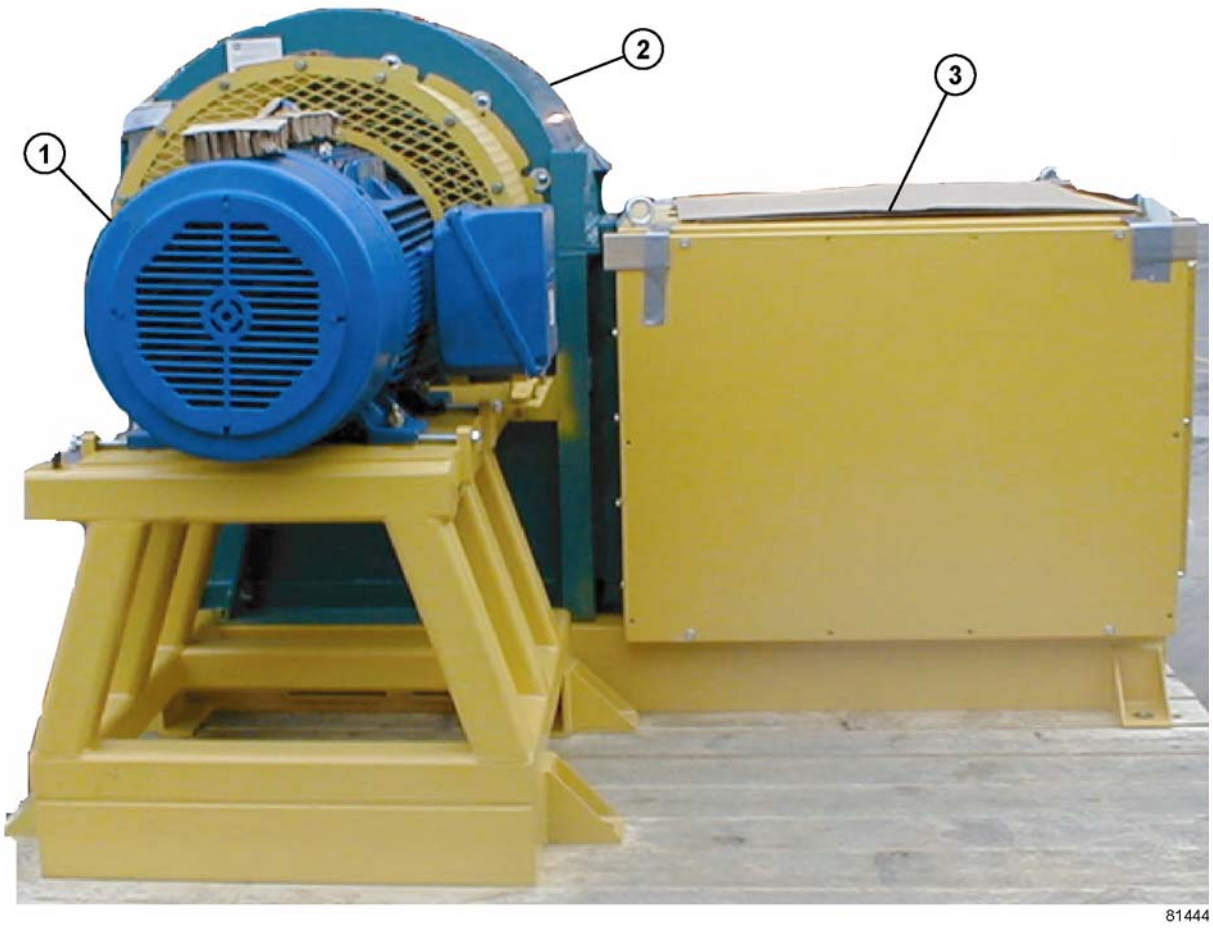

FIGURE 10-90. GRID BOX

1. Motor 2. Blower 3. Resistor Housing

Technical Data

Nominal speed: 1500 rpm

Maximum speed: 1800 rpm

Approx. weight: 7,000 lbs. (entire grid box with blower, motor, and resistors)

Operation

Engine oil is circulated between engine oil pan (1, Figure 10-2) and reserve tank (2) by two electrically driven pumps (pump 1 and pump 2) within a single pumping unit (4). The pumping unit is mounted on the side of the reserve tank. The pump unit is equipped with an LED monitor light on one side.

Pump 1 draws oil from the engine oil pan (1) at a preset control point determined by the height of the suction tube (3). Oil above this point is withdrawn and transferred to the reserve tank. This lowers the level in the engine oil pan until air is drawn.

Air reaching the pumping unit activates pump 2, which returns oil from reserve tank (2) and raises the engine oil level until air is no longer drawn by pump 1. Pump 2 then turns off. The running level is continuously adjusted at the control point by alternating between withdrawal and return of oil at the engine oil pan. The oil returning to the engine oil pan is below the normal operating level to prevent aeration of the oil.

LED monitor light

- Steady - Pump 1 is withdrawing oil from the engine sump and bringing down the oil level.
- Regular pulsing - Pump 2 is returning oil to the engine sump and raising the oil level.
- Irregular pulsing - Oil is at the correct running level.

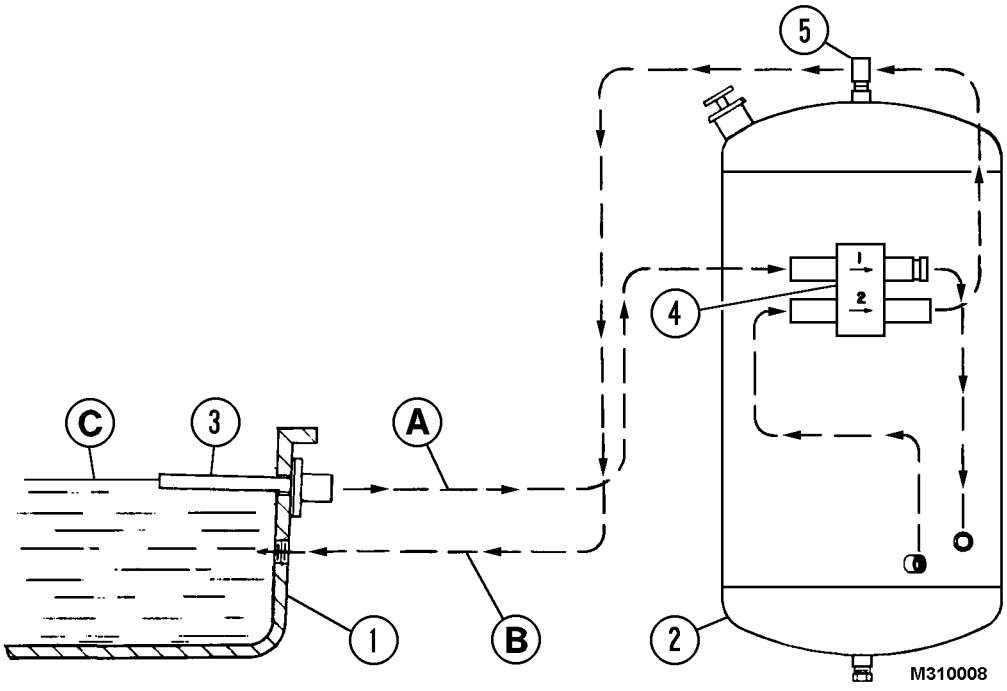

FIGURE 10-2. RESERVE SYSTEM SCHEMATIC

1. Engine Oil Pan (Sump)
2. Oil Tank
3. Suction Tube
4. Pumping Unit (1 & 2)
5. Air Relief Valve

A. Oil Suction Line
B. Oil Return Line
C. Engine Oil Level

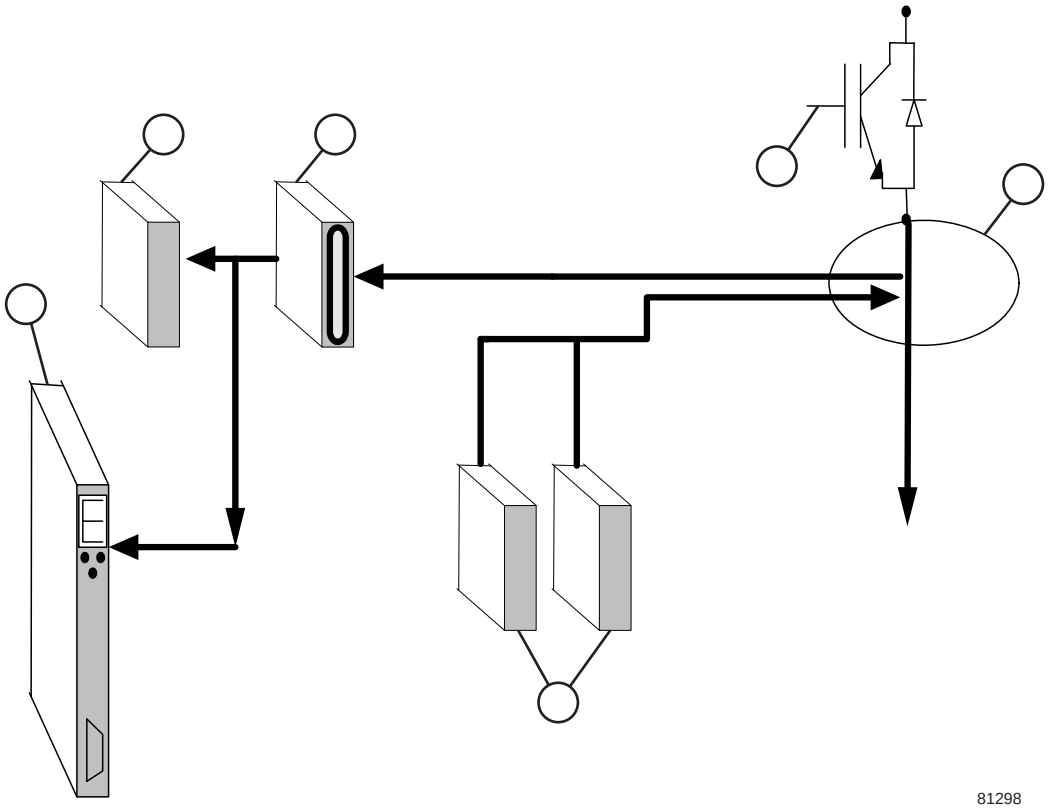

FIGURE 10-9. SiBAS®32 CARDS AND SYSTEM CURRENT FEEDBACK

1. Inverter DSPs
1. UWS
2. V/F card
3. IGBT
4. CT
5. SiBAS®32 +/- 24 volt power supplies

Current feedbacks all go from the CT, to a voltage frequency converter (U/f) in the SiBAS®32. From the V/F, it is distributed to the UWS for protection and the DSP for regulation.

Technical data

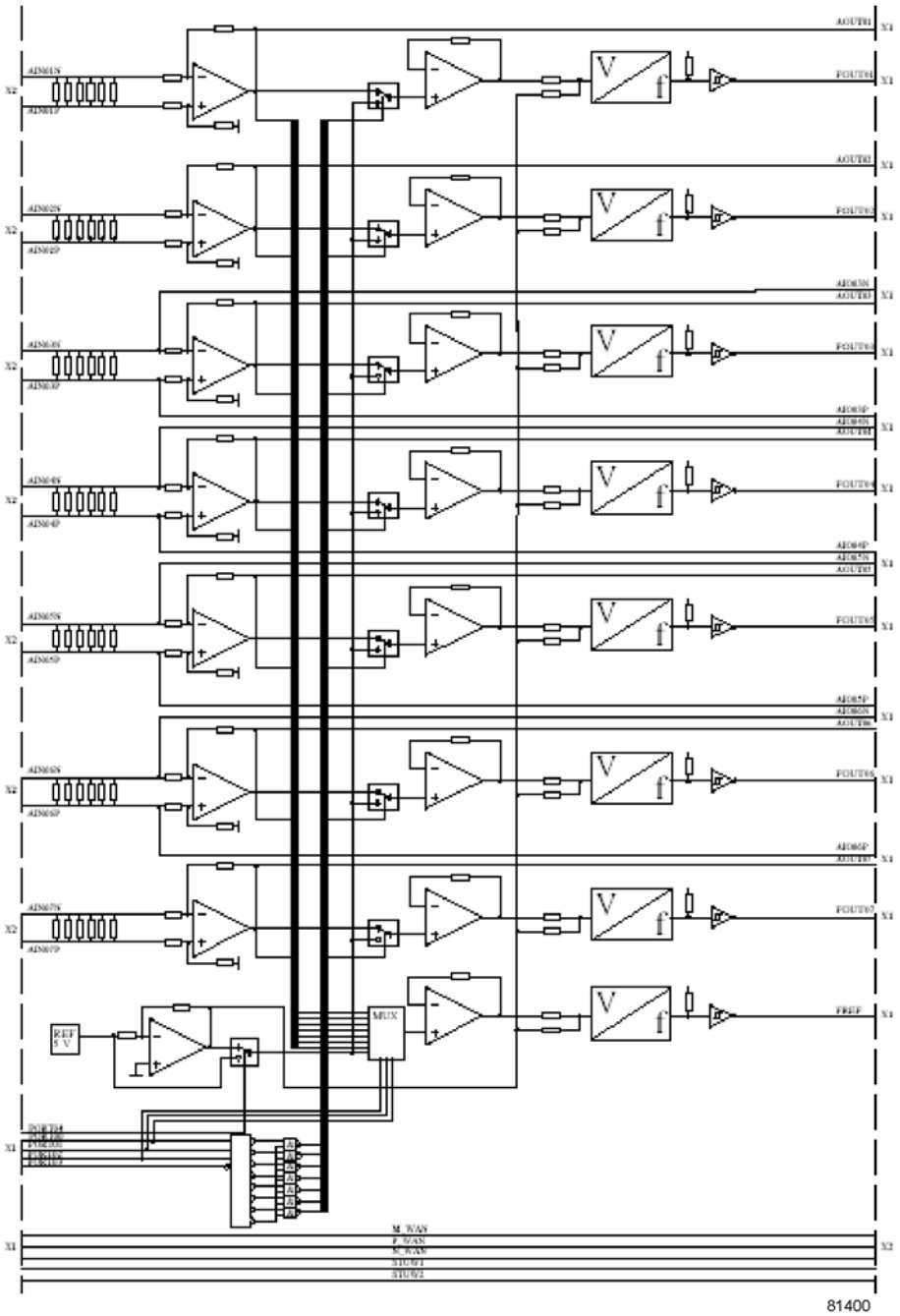

FIGURE 10-23. L055, L063 AND L071 BLOCK DIAGRAM

The card can be operated on the small SiBAS®32 bus without wiring. A test signal input on the backplane connector ("TSTE#") permits a function test of all circuit sections which are located behind the optocouplers. The signals output in the normal state (TSTE# = "High", i.e., test pin is not connected) are negated to "Low" signal by clamping the TSTE# input. Negation of the TSTE# input signal, "TSTA", is present at connector X1/b8 for further use. The current state of the TSTE# input can be read out via the data bus under the address xx02H at data bit 7 (there, TSTA is displayed).

Under the same address, the card code is stored in the data bits DB 4 to DB 6; with all ICBP cards, the data bit DB 4 is equal to logical "0". The card identifier is read out under the address **1FFFEH** and characterizes the card type and its version. Every input and output circuit possesses an RC element for interference or bounce suppression. The smoothing time constant T_S is the sum of the input and output time delays.

860E Dump truck
960E Dump truck

Form No. CEN10016-01

Special tool list

Part number	Description	Qty.	Use
XB0887	Vacuum 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

Brake cooling and hoist system checkout data sheet

MACHINE MODEL _____ UNIT NUMBER _____ SERIAL NUMBER_____

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

BRAKE COOLING CIRCUIT TEST

STEP 1 _____ Hoist pump outlet pressures, low idle, FLOAT position

_____ Brake cooling circuit pressure, low idle, FLOAT position

STEP 2 _____ Brake cooling circuit pressure, low idle, POWER UP/DOWN position

STEP 3 _____ Brake cooling circuit pressure, 1500 RPM, HOLD/FLOAT position

STEP 4 _____ Brake cooling circuit pressure, 1500 RPM, POWER UP/DOWN position

POWER UP RELIEF PRESSURE TEST

STEP 2 _____ Hoist relief pressure, front pump section

_____ Hoist relief pressure, rear pump section

POWER DOWN RELIEF PRESSURE TEST

STEP 2 _____ Power down relief pressure

COUNTERBALANCE VALVE PRESSURE CHECK

STEP 6c _____ Counterbalance valve pressure

Name of Technician or Inspector Performing Check-Out_____

DATE _____

44. Move the directional control lever to NEUTRAL. Turn the key switch OFF and allow 90 seconds for the steering accumulators to depressurize completely.
45. Turn the key switch ON, but do not start the engine.
46. Provide a speed signal of 2.5 kph (1.5 mph) from the SiBAS connector PUTHD1.MIN. Fault code A260 will occur 1.5 seconds later.
47. Very slowly open rear brake accumulator bleeddown valve (7) a small amount while observing the decreasing pressure at low accumulator pressure (LAP1) test port (15).
    - ❑ The low brake pressure fault code A261 must occur when the pressure drops to within 690 kPa (100 psi) of the pressure that was recorded in Step 40.

    * *Record on data sheet.*

    - ❑ When the low accumulator pressure reaches within 690 kPa (100 psi) of the pressure that was recorded in Step 40, front brake pressures (BF) and (BR) should begin to rise due to the auto apply feature.

    * *Record on data sheet.*
48. Close rear brake accumulator bleeddown valve (7). Record the front and rear brake apply pressures after auto apply has occurred.
    - ❑ Front brake (BF) pressure reads 16 545 ± 517 kPa (2,400 ± 75 psi) or higher.
    - ❑ Rear brake (BR) pressure reads 9 825 kPa (1,425 psi) or higher.
    - ❑ Low brake accumulator pressure (LAP1) reads 11 375 ± 517 kPa (1,650 ± 75 psi).

    * *Record on data sheet.*
49. Use SiBAS to remove the speed signal. Set the speed signal to 0 kph (0 mph).

Reapplication

50. Start the engine and allow the low brake accumulator pressure (LAP1) to increase to 21 718 ± 344 kPa (3,150 ± 50 psi).
51. Pull up on the engine shutdown switch on the center console to shut off the engine. **Do not turn the key switch OFF.** The steering accumulators must not be allowed to depressurize.
52. Move the directional control lever to NEUTRAL. Provide a speed signal of 2.5 kph (1.5 mph) from the SiBAS connector PUTHD1.MIN. Fault code A260 will occur 1.5 seconds later.
53. While observing the pressure gauges, make repeated, slow brake applications until fault code A261 occurs.
    - ❑ Fault code A261 must not occur before the sixth pedal application.

    * *Record on data sheet.*

    - ❑ Auto apply must not occur until after fault code A261 occurs.
54. Use SiBAS to remove the speed signal. Set the speed signal to 0 kph (0 mph).

Final test and adjustment

1. The brake pedal actuator must be installed on the brake valve body before the final test and adjustment. Refer to "Disassembly and assembly of brake valve" in Disassembly and assembly section **Brake system**.

NOTE: The final test and adjustment procedure can also be performed with the brake valve installed in the truck. Install the gauges at the "B1" and "B2" diagnostic test connectors in the brake cabinet.

2. Reinstall the brake valve with the actuator pedal attached on the test stand.
3. With the test stand pump adjusted for 18 960 kPa (2,750 psi) or with the engine running and the brake system supply pressure at or above 18 960 kPa (2,750 psi), depress the pedal as quickly as possible. The pressure on the output circuits must reach at least 17 235 ± 517 kPa (2,500 ± 75 psi) at port "B1" and port "B2" within one second. Measurement of time begins the moment force is applied to move the pedal.
4. With "B1" and "B2" plugged into a strip chart recorder (if available), check the modulation by slowly applying pressure until the maximum pressure is reached. Make sure that the pressure increase is smooth and no sticking of the spools is observed. Fully depress the pedal. The pressures must remain within specification at "B1" and "B2" for 20 seconds.
5. Adjust the set screw until it is not touching the actuator cap. Apply Loctite® Threadlocker Blue 242 to the adjustment screw before setting the deadband.
6. Set the deadband by placing a 0.254 mm (0.010 in.) thick shim at location (9) between the pedal structure and the return stop boss on the pivot structure.
7. Adjust the set screw until it is just touching the cap.
8. Continue turning the set screw until the pressure begins to rise on one of the brake apply pressure gauges.
9. Back off the set screw by 1/8 turn.
10. Tighten the jam nut and remove the shim that was inserted previously.
11. Fully stroke the brake pedal actuator to verify that the output pressures at port "B1" and "B2" are within specifications.

NOTE: If the pedal is adjusted properly, the spring and spring pivots will not interfere with pedal travel.

12. If the pressures are not within specifications, re-adjust the set screw. If the pressure is within specifications, apply a few drops of Loctite® Threadlocker Blue 242 to the jam nut.
13. Check for internal leakage at port "T". Leakage must be less than 100 cc/minute with the valve in the released position and system pressure supplied to the "P1" and "P2" inlet ports.
14. "T" port leakage must be less than 250 cc/minute with valve pilot pressure or manually applied.

Front suspension nitrogen charging

⚠WARNING

Lifting equipment (crane or hydraulic jacks) must be of sufficient capacity to lift the truck weight. Make sure that all personnel are clear of the lift area before the lift is started. Clearances under the truck may be suddenly reduced.

1. If removed, install the charging valve with new O-ring (9, Figure 30-12). Lubricate the O-ring with clean Hydrair oil.
2. Tighten valve body (large hex) (6) to **23 N·m (17 ft lb)**. Swivel nut (small hex) (4) must be unseated by turning it counterclockwise three full turns.

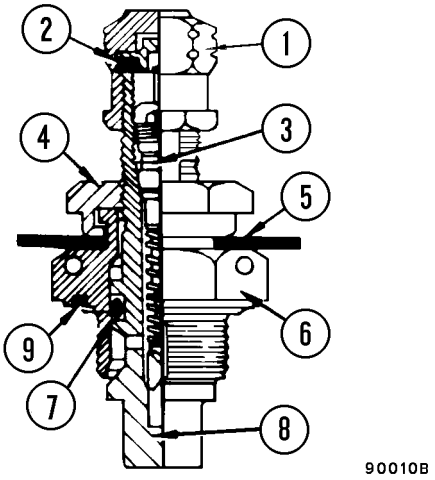

FIGURE 30-12. CHARGING VALVE

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

⚠WARNING

Dry nitrogen is the only gas approved for use in Hydrair II suspensions. Charging of these components with oxygen or other gases may result in an explosion which could cause fatalities, serious injuries and/or major property damage. Use only nitrogen gas meeting the specifications shown in the oil and nitrogen specification charts in the Specifications section.

3. Install the Hydrair charging kit and a bottle of pure dry nitrogen. Refer to "Installing the charging kit".
4. Charge the suspensions with nitrogen gas to 50.8 mm (2 in.) greater than the charging height listed in Table 2. Close inlet valve (4, Figure 30-10).

NOTE: If the truck starts to lift off the blocks before charging pressure is attained, stop charging.

5. Remove the oiling blocks from the suspensions and install the nitrogen charging blocks. Secure the blocks to prevent accidental dislodging.

NOTE: Use caution to prevent damage to plated cylinder surfaces and oil seals when installing the blocks.

6. Remove the center hose from manifold (6).
7. Open inlet valve (4) until the pressure drops below the pressure listed in Table 2, then close the valve.
8. Install the center hose to manifold (6).
9. Charge the suspensions to the pressure listed in Table 2. Do not use an overcharge of nitrogen to lift the suspensions off the charging blocks.
10. Close inlet valve (4). Leave outlet valves (3) open for five minutes to allow the pressures in the suspensions to equalize.
11. Close outlet valves (3). Remove the charging kit components. Refer to "Removing the charging kit".
12. If the charging valve is being reused, tighten swivel nut (4, Figure 30-12) to **6 N·m (50 in lb)**.

960E Dump truck

Form No. CEN30026-01

DUMP TRUCK

860E
960E

Machine model	Serial number
860E-1K	A30003 and up
860E-1KT	A30003 and up
960E-1K	A50003 - A50010
960E-2K	A50011 and up

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The /CFG switch is of interest only in connection with the Transient Recorder (TRACO). It specifies the configuration file which is to be used for reading out data or during starting of the Transient Recorder, unless the configuration file corresponding to the identifier stored in the TRACO is to be used.

The /Data switch is also of interest only in connection with the Transient Recorder (TRACO). During automatic read-out of the TRACO data (see Autoread command in the documentation concerning TRACO), the names of the files in which the TRACO data records are to be stored are allocated according to PC date and the configured TRACO identifier by the Customer Monitor. The /Data switch is used to specify the directory in which these files are to be stored. Unless this is specified, the data is stored in the directory of MONI32.EXE or in the default directory selected by means of the environment variable *SI_DEFAULT* (see Environment Variables).

If the path of a connector file for the software transient recorder (/SWTR-CNN) is indicated, the SWTR start command stores in this file the names of the last twenty connectors or signals used. When the software transient recorder is called, these names are then displayed to the user in a dialog box, so that the user does not need to enter them again.

It is advisable to enter the commands for setting the strings in the initialization batch file INIT.MON (see Set Make).

Example

```
Set String /Record-File: C:\PRJ\WORKB-
NCH\MONITOR\PROT.MON
```

If recording of the work window is activated (Set Record), the record will be stored in the file specified.

```
Set String /Graphic-File: E:\PRJ\WORKB-
NCH\MONITOR\PROT.MON
```

This specifies the temporary work file E:\GRAPH.TMP for display of the line graphics.

"Set Make"

Creates a monitor batch file.

Options

Table 5: Set Make options

Command	Output
INIT.MON	One-off automatic execution when the monitor is called
BATCH1.MON	Batch file with the permanently assigned name BATCH1.MON
BATCH2.MON	Batch file with the permanently assigned name BATCH2.MON
BATCH FILE:	Batch file with freely selectable file name (incl. path)

Monitor commands can be stored with the Set Make command in monitor batch files and executed via the Set Execute command (see Set Execute). The batch file INIT.MON is an exception and is executed automatically (if implemented) for the purpose of initialization after the Customer Monitor has been called.

All selection and input options which are visible in the Edit line on initiation of a command are recognized automatically. Commands that are nested at a lower level and which require further entries to be made after initiation of the command, remain interactive in batch mode. The command with all its options is called automatically.

Calling of application-specific background programs (see Background Commands) can also be automated in this way.

With the Set Make command, the Customer Monitor is set to a recording mode in which the commands called are **not** executed but are only entered in the batch file. This recording mode is cancelled by pressing [*Ctrl*]+[*C*].

"Hardw. DSP"

For switching to the monitor of a Signal Processing Unit module.

With this command, the Central Processing Unit is switched to Transparent Mode in which it relays all characters of the monitor via the dual port RAM to a Signal Processing Unit module and vice versa. The monitor program can now communicate with the module without the service interface having to be changed.

After the command has been initiated, a dialog box appears that lists all DSPs available. The required link is established by making a suitable selection. If the Hardw. DSP command is called from within a monitor batch file, this dialog box can be avoided by adding the name of the DSP to the command call (see also Set Make). This means the user does not have to enter anything when switching to a DSP.

The following modules are supported:

- Signal Processing Unit 6FH9265 (DSP5600x)
- TRACO module 6FH9388

"Hardw. BCD"

For simulating the BCD switch.

Options

Table 17: Significance of Hardw. BCD switch positions

0	Normal mode
1	All operating system access to the system interface is suppressed
2	No significance (normal mode)
3	No significance (normal mode)
4	No significance (normal mode)
5	No significance (normal mode)
6	No significance (normal mode)
7	Operation buffer active
8	No significance (normal mode)
9	The BCD switch is simulated by the operating system (Software BCD switch)

Because the BCD switch has different positions, the operating system can run in different modes after a reset or start-up. The BCD switch can be set to 9 for commissioning of systems whose control units are not accessible or are poorly accessible. This enables the user to simulate switch settings 0 to 8 via the service interface.

Example

Hardw. BCD Disp. /Mod.

For positions 0 to 8, the switch position is displayed after this command has been called. For position 9, a dialog box appears which indicates the position of the Software BCD switch. This can be modified by making an appropriate selection.

"Hardw. RESET"

RESET command.

Options

Table 18: Hardw. RESET options

Command	Description
`Normal`	Normal mode
`Monitor`	*Monitor Only* mode

The RESET command triggers the following activities:

1. Interrupt disable (normal mode).
2. In normal mode, the NMI1 handler is called.
3. The RESOUT signal of the Central Processing Unit is activated.
4. RESOUT is present for 300 ms.
5. RESOUT is deactivated again.
6. The CPU operating system branches to the start of its program.

By activating the RESOUT signal, this command also affects the control unit periphery, e.g., the Signal Processing Units and communication modules. In the event of a *Monitor Only* reset, the operating system also ensures that the Signal Processing Units change to *Monitor Only* mode as well.

Options

NOTE: Stop the traco before changing any of the parameters, and then start it again when finished.

ZR traco basic parameters:

NOTE: Do not enter the units; enter only the numbers

/Time slice [1-8]: Sets the sampling time between data points. T1=3ms, T2=6ms, T3=12ms, T4=24ms, T5=60ms, T6=120ms, T7=300ms, and T8=750ms.

/Delay [0 – 100%]: Sets the percentage of data points before and after the trigger condition. 0% = all recorded data is after the trigger; 50% is half the data is before the trigger and half the data is after; 100% is all the data is before the trigger.

/Record time: [0 – 12s]: Sets the amount of time the recording should take place before stopping. Keep in mind this includes the delay. Example: if the delay was set to 50% and the record time was 6s, then there would be 3s of data before the trigger and 3s after for a total of 6s. Also, the longer the record time is, the lower number of available data partitions. At 6s there are 8 available data partitions to store the blocks of data at each trigger.

/Number of signals: Sets the number of connectors to record at each trigger. The default is 16 and the maximum is 20. The actual connectors to record are defined in another menu option.

```
Enter Item Number :   1
Time slice [1 - 8 ]     :  (   3) 3
Delay [0 - 100%]:  (  50 %) 50 %
Record time:        [0 -  12.000 s] :
0 = Using maximum value    ( 7.000 s) 7 s
Number of signals [1-20]:  (  16) 16

1 = ZR traco basic parameters
2 = ZR traco record signal table
3 = ZR traco trigger signals
4 = Start ZR recorder
5 = Stop ZR recorder
6 = Define trigger for DSP A traco
7 = Define trigger for DSP B traco
8 = Define trigger for DSP T traco
q = Exit menu

Enter Item Number :   |
```

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FIGURE 30-6. ZR TRACO BASIC PARAMETERS

ZR traco record signal table:

Allows the setting of the signals (connectors) that should be recorded. These are software variable names. Depending on the setting for the number of signals, you will be prompted to enter that many connectors. At each selection the software will poll the SIBAS® to be sure the connector is valid. If valid, the user is asked for the next connector name. If invalid, the user is asked again for the connector. The values in ( ) are the current setting and can be used by pressing only Enter.

```
Select record signal 14:

Connector-name     :  ($MS6B       )

Select record signal 15:

Connector-name     :  ($MSOLLSA    )

Select record signal 16:

Connector-name     :  ($MSOLLSB    )

1 = ZR traco basic parameters
2 = ZR traco record signal table
3 = ZR traco trigger signals
4 = Start ZR recorder
5 = Stop ZR recorder
6 = Define trigger for DSP A traco
7 = Define trigger for DSP B traco
8 = Define trigger for DSP T traco
q = Exit menu

Enter Item Number :   |
```

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FIGURE 30-7. ZR TRACO RECORD SIGNAL TABLE

CN:Clear Norm

Calling this menu will erase the diagnosis memory data with the exception of still active events. Still active events will remain stored in the diagnosis memory. This option is password protected and does not help the system to operate again. See User – commands or press service reset to force the system to try to operate again, if inhibited.

CA:Clear All

Calling this menu will first erase the diagnosis memory data completely. After that, still active events will be stored again with the current environmental data (also including the current time). This option is password protected and does not help the system to operate again. See User – commands or press service reset to force the system to try to operate again, if inhibited.

Test-Code

This menu will lead to a diagnosis entry with the event code 359 being stored. The menu allows storage of a diagnosis data field by monitor. The data is viewable like every other menu.

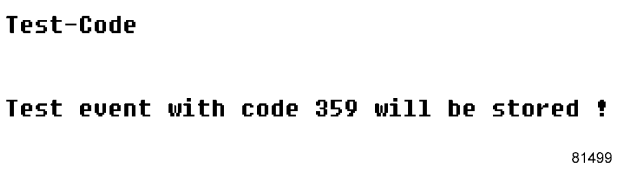

FIGURE 30-23. TEST CODE

Component status listings:

Field regulator status:

- Enabled = The software is sending the enable command and the feedback indicates it is enabled.
- Disabled = The software is either not sending the enable command or there is a problem in the system. Below the Field regulator status line, there will be text to describe the problem if present:
  - Inhibit by monitor active = connector BSTOPEX is set to 1, normally done via the service PC during commissioning.
  - Total block active = A total block of inverter pulses is present; refer to the events listing for the cause(s).
- Both voltage sensors are not OK = Neither DC bus voltage sensor has given an acceptable value; check wiring.
- ADC-conversion on IO for voltage sensor faulty = The analog to digital converter responsible for reading the DC bus voltage has indicated a failure.
- Traction inverter pulses not blocked = The field regulator tried to enable, but at least one of the inverters was in operation.
- DC bus discharging active = The DC bus has been commanded to discharge, either by the menu option or by a serious event. View the event code listings for more information
- Field regulator set point too high for start = The field regulator tried to enable, but the set point was already greater than 2 Amps.
- Recharging timer running = A problem was encountered trying to enable the field regulator. The system will try again in 60s; refer to the event code listing for the exact cause.
- Fault inhibit active = The field regulator is blocked because of an active fault inhibit. Press the reset button (override button) to clear.
- Permanent inhibit active = The field regulator is blocked because of an active permanent inhibit. Press the service reset button (in diagnostic panel) to clear.
- Alternator overtemperature active = The measured alternator temperature bearing and/or stator is too high. Also includes other system temperatures. See event code listing for information on cause.
- Precharging supervision active = The field regulator was enabled, but the bus voltage did not reach an expected level in a given amount of time. See event code listing for more information.
- Engine speed is too low = The measured engine speed is below 650 rpm.
- Contactor K109 not open = The crowbar bypass contactor is indicating it is closed. This contactor connects positive and negative DC bus, so for safety reasons the field regulator status disabled until it is verified as open.
- Buffered inhibit field regulator = A serious event code has logged, and repair is required. After repair, the service reset is required before the field regulator will try to enable.
- DC power off request active = The rest switch (operator cab switch) is in the on position commanding no DC bus; the field regulator stays disabled.

Status gate unit power supply A:

- Enabled = The software is sending the enable command and the feedback indicates it is enabled.
- Disabled = The software is either not sending the enable command or there is a problem in the system. Check the event code listing if the power supply should be enabled.

Status gate unit power supply B:

- Enabled = The software is sending the enable command and the feedback indicates it is enabled.
- Disabled = The software is either not sending the enable command or there is a problem in the system. Check the event code listing if the power supply should be enabled.

DUMP TRUCK

860E
960E

Machine model	Serial number
860E-1K	A30003 and up
860E-1KT	A30003 and up
960E-1K	A50003 - A50010
960E-2K	A50011 and up

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9. Choose option 3 to view current setting, then choose q.

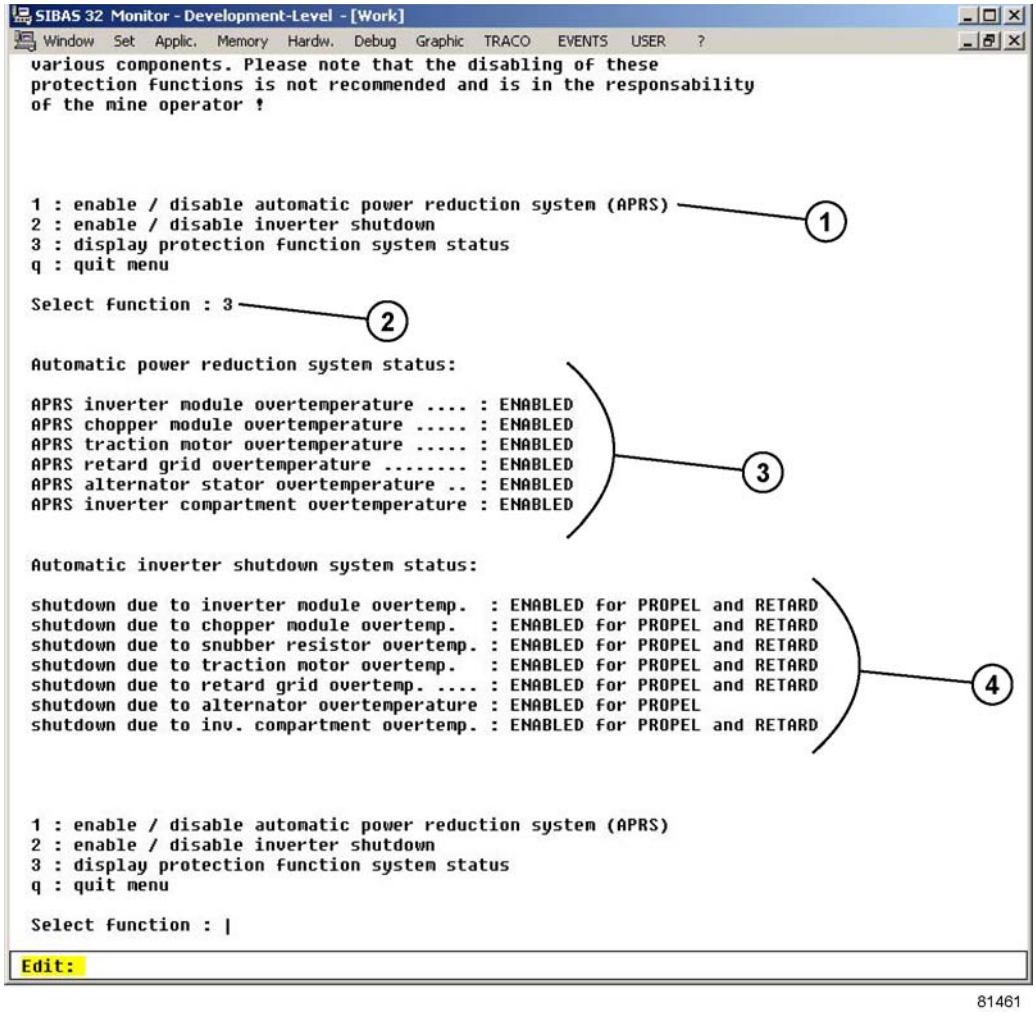


FIGURE 30-16. USER TEMP_PROT SCREEN

1. "User - Temp Prot" text menu
2. Option "3" selected
3. APRS current settings
4. Shutdown current settings

Fault Code A003: Right front suspension pressure sensor signal high

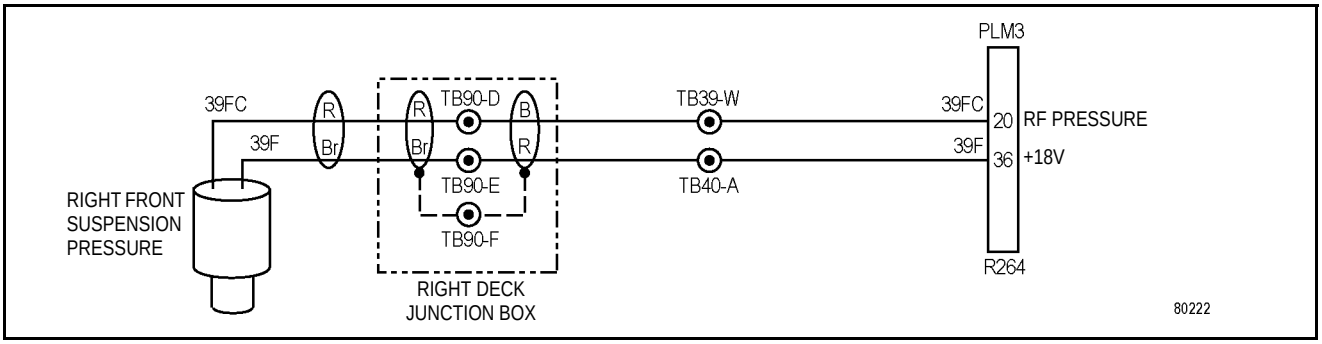
Operator Action	None
Fault Code	A003
Description	Right front suspension pressure sensor signal high.
Fault Conditions	Sets if pressure signal is out of range high (sensor current over 22 ma). Resets if reading returns to normal.
Operator Alerting System Response	Repair Lamp Display Operator Action: None Display Fault Description: PLM RF PRESS SENS HI Display Fault Code: A003
Resulting Problem(s)	Bad payload computation.
Related Information	A laptop running "IM Realtime Data Monitor" software may be required to resolve this fault.

Table

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).
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.
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.

Parameter	Expected State and/or Related Fault(s)
Right Front Pressure Sensor (PLM3 36,20)	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): A004

Related circuit diagram



Fault Code A022: Carryback load excessive

Operator Action	None
Fault Code	A022
Description	Carryback load excessive.
Fault Conditions	Sets if PLM3 detects excessive load remaining in the bed after dumping is complete. Resets if conditions clears.
Operator Alerting System Response	Display Operator Action: None Display Fault Description: None Display Fault Code: None
Resulting Problem(s)	Reduced production.
Related Information	A laptop running "IM Realtime Data Monitor" software may be required to resolve this fault.

Table

1. The logic that produces this fault is intended to identify excessive carryback load. This is a KOMTRAX Plus recording only. No display announces the fault. If excessive carryback does not exist, troubleshoot the payload system.
2. This fault's logic contains more than one parameter, each of which may have its own related fault code(s). This fault may be resolved by resolving the parameter(s) active fault code(s). Refer to the Troubleshooting Instructions for the active parameter fault(s).
3. 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.
4. 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.

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): A005, A006
Right Rear Pressure Sensor (PLM3 36, 40)	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): A007, A008
Left Front Pressure Sensor (PLM3 36, 39)	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): A001, A002
Right Front Pressure Sensor (PLM3 36, 20)	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): A003, A004
Incline Sensor (PLM3 36, 29, 19)	Sensor voltage <0.565: failed high Sensor voltage >5.08: failed low Sensor voltage >0.565 but <5.08: valid readings Fault(s): A009, A010

NOTES

Fault Code A153: Battery voltage is low with the truck in operation

Operator Action	Stop; Park
Fault Code	A153
Description	Battery voltage is low with the truck in operation.
Fault Conditions	Sets if battery voltage with the engine running or truck moving is below 23 volts for 5 seconds. Truck moving sets if truck speed is above 0 or if no communication from drive system and the park brake is not set. Park brake set is defined as the closure of the park brake set switch indicating low pressure and the opening of the park brake release pressure switch indicating not high pressure. Resets if voltage recovers to 25.5 volts for 5 seconds or when steering bleed begins at shutdown.
Operator Alerting System Response	Sound Buzzer Flash IM Warning Indicator Display Operator Action: STOP: PARK Display Fault Description: BATTERY VOLTS LOW Display Fault Code: A153
Resulting Problem(s)	Voltage may continue to drop and cause improper operation of the many electrical controls on the truck.
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 charge the batteries.
2. This fault's logic contains more than one parameter, each of which may have its own related fault code(s). This fault may be resolved by resolving the parameter(s) active fault code(s). Refer to the Troubleshooting Instructions for the active parameter fault(s).
3. 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.
4. 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.

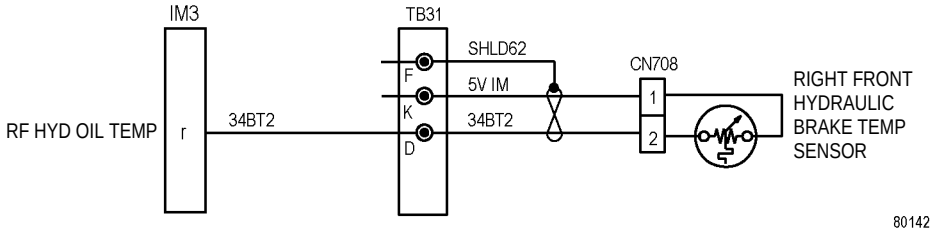
Parameter	Expected State and/or Related Fault(s)
Battery Voltage, 24 Volt (IM 1A)	<23.0 volts: Too low to continue operation. >23.0 volts: OK to continue operation. Fault(s): A250, A155
Engine Speed [RPM]	Less than 300 RPM: engine is not running Greater than 300 RPM for 4 seconds: engine is running
Truck Speed [kph]	0: truck is not moving Greater than 0: truck is moving
Park Brake Set	0: the park brake set switch or park brake release switch indicates park brake not properly set 1: the park brake set switch indicates low pressure and park brake set and the park brake release switch indicates no high pressure and park brake not released

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 (412°F) (4.89 Volts) for 3 seconds. Resets if temperature reading drops to 188°C (370°F) (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

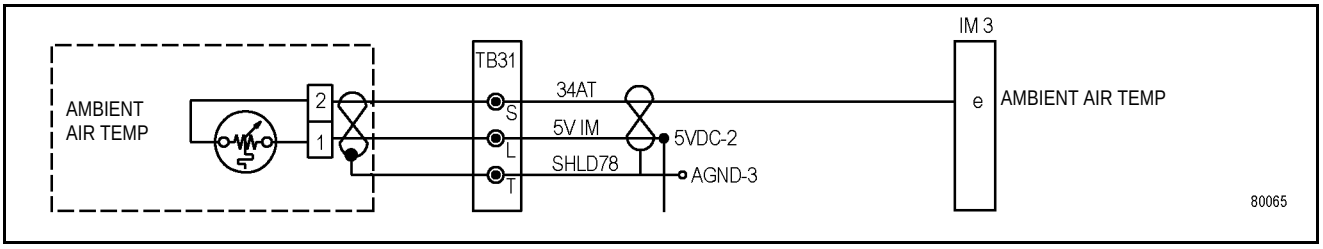


Fault Code A206: Ambient temperature sensor is high

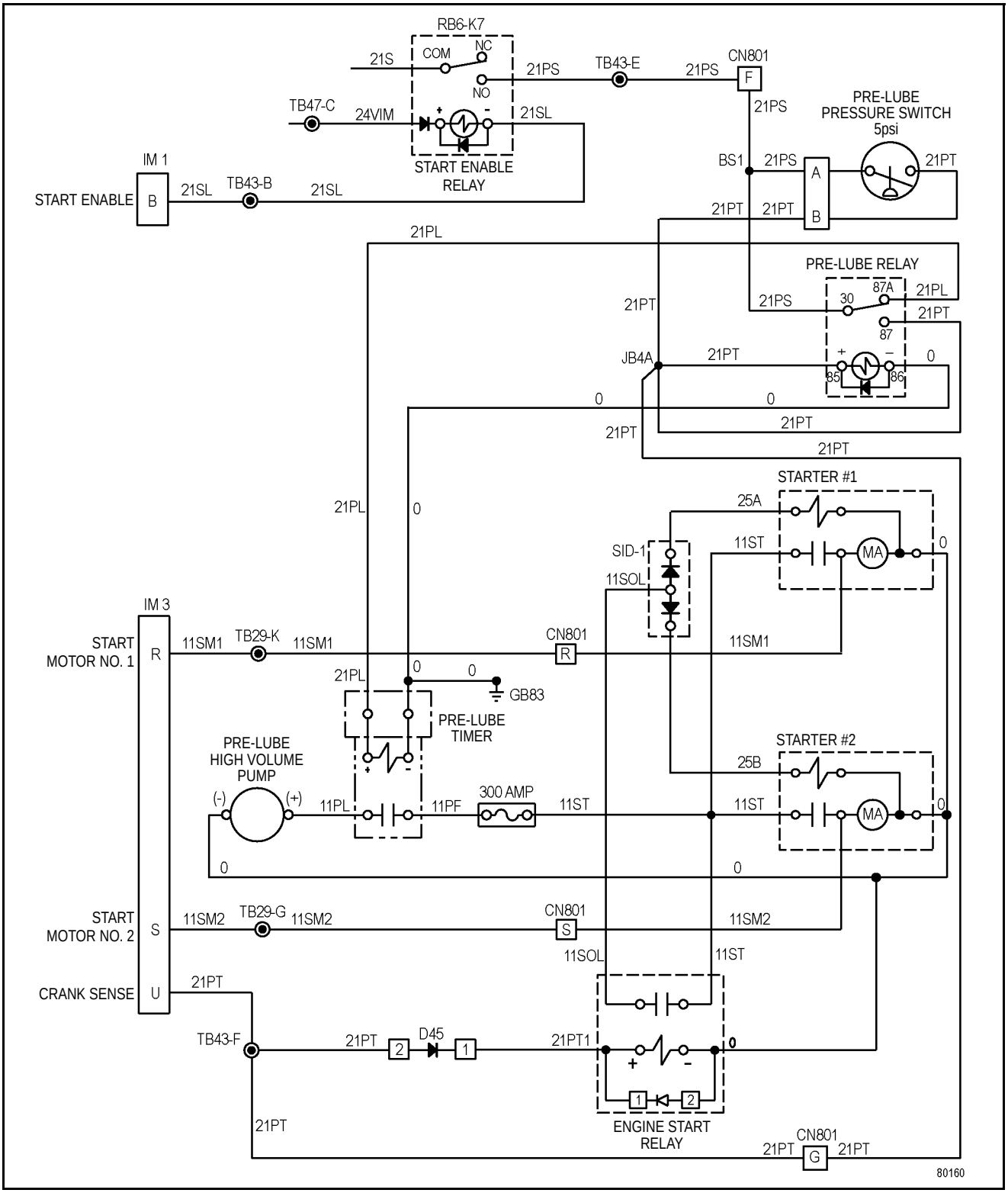
Operator Action	None
Fault Code	A206
Description	Ambient Temperature Sensor is high
Fault Conditions	Sets at 133°C (271°F) (4.89V) for 3 seconds. Resets at 107°C (225°F) (4.77V) for 3 seconds.
Operator Alerting System Response	Lamp or Buzzer: None - Maintenance Item Display Fault Description: AMBIENT TEMP SENS HI Display Fault Code: A206
Resulting Problem(s)	Monitoring of temperatures will be compromised without ambient temperature information.
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)**
Ambient Temperature Sensor (IM 3e)	0.016 Volt to 4.89 Volt: Good Readings <0.016 Volt or >4.89 Volt: Defective Sensor or Circuit Fault(s): A207

Related circuit diagram



Related circuit diagram



Fault Code A240: The keyswitch input to the Interface Module is open

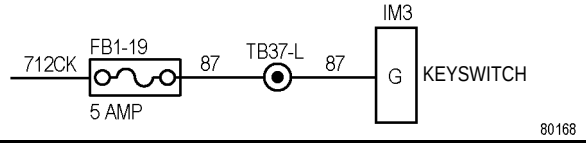
Operator Action	Stop, Park, Repair
Fault Code	A240
Description	The keyswitch input to the Interface Module is open.
Fault Conditions	Sets if both Keyswitch input and Steering Bleed valve are missing for 15 seconds. Resets if either one turns on.
Operator Alerting System Response	Sound Buzzer Flash IM Warning Indicator Display Operator Action: STOP: PARK: REPAIR Display Fault Description: IM KEYSW POWER LOST Display Fault Code: A240
Resulting Problem(s)	Many warnings will be non-functional. Some controls will not function as normal. Steering will bleed as soon as truck comes to a complete stop and the engine stops running without the keyswitch being turned off.
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 the wiring from the keyswitch to the Interface Module.
2. This fault's logic contains more than one parameter, each of which may have its own related fault code(s). This fault may be resolved by resolving the parameter(s) active fault code(s). Refer to the Troubleshooting Instructions for the active parameter fault(s).
3. 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.
4. 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.

Parameter	Expected State and/or Related Fault(s)
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
Steering Bleed Valve	Status - Open Load: Expected with key switch on. No problem. Otherwise, unexpected. Must troubleshoot. Status - Normal: Expected only with key off and steering bleed in process. Troubleshoot if found with key on. Status - Shorted to Ground: Unexpected. Troubleshoot. Status - Overload: Unexpected. Troubleshoot. 0: steering bleed valve is off. This is expected in normal running operation. 1: steering bleed valve is on. This is expected after key off initiates steering bleed operation. Fault(s): A253, A262, A358

Related circuit diagram

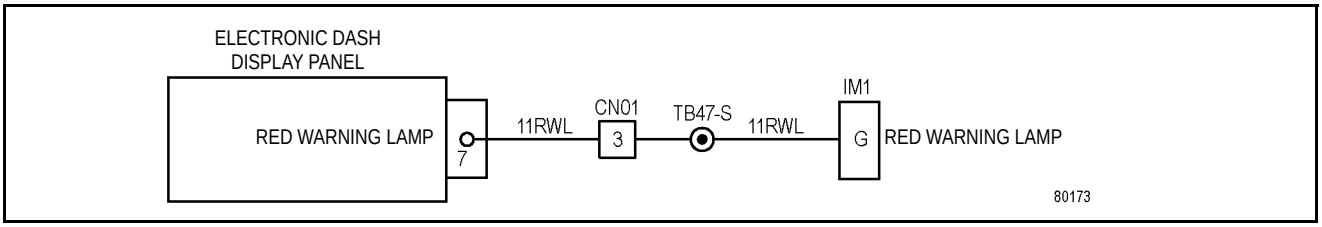


Fault Code A256: Red warning lamp in the dash display (driven by IM) is open

Operator Action	Go to Shop
Fault Code	A256
Description	Red warning lamp in the dash display but driven by IM, is open.
Fault Conditions	Sets if red lamp stays open for 1 second with steering bleed off. (The red lamp is open if feedback voltage stays low for 400 ms with red lamp off.) Resets if red lamp returns to normal or steering bleed operates for 1 sec. (The red lamp is normal if feedback voltage goes high for 400 ms with red lamp off.)
Operator Alerting System Response	Sound Buzzer Flash IM Warning Indicator Display Operator Action: GO TO SHOP NOW Display Fault Description: RED WARN LAMP FLT Display Fault Code: A256
Resulting Problem(s)	Warnings will be audible only.
Related Information	A laptop running "IM Realtime Data Monitor" software may be required to resolve this fault.

Table	
1. This fault's logic contains no additional external parameters. The red warning lamp feedback connection is made internally. 2. Check wiring and connections between IM and the dash display and wiring within the display to the red warning lamp as well as the lamp itself.	
Parameter	**Expected State and/or Related Fault(s)**
Red Warning Lamp (IM 1G)	0: red lamp is not on 1: red lamp is on Fault(s): A249
Red Warning Lamp Feedback (IM 1G)	Below 3.75 volts for 400 ms with the lamp off: open Above 3.75 volts for 400 ms with the lamp off: normal

Related circuit diagram



Fault Code A265: Service brake failure

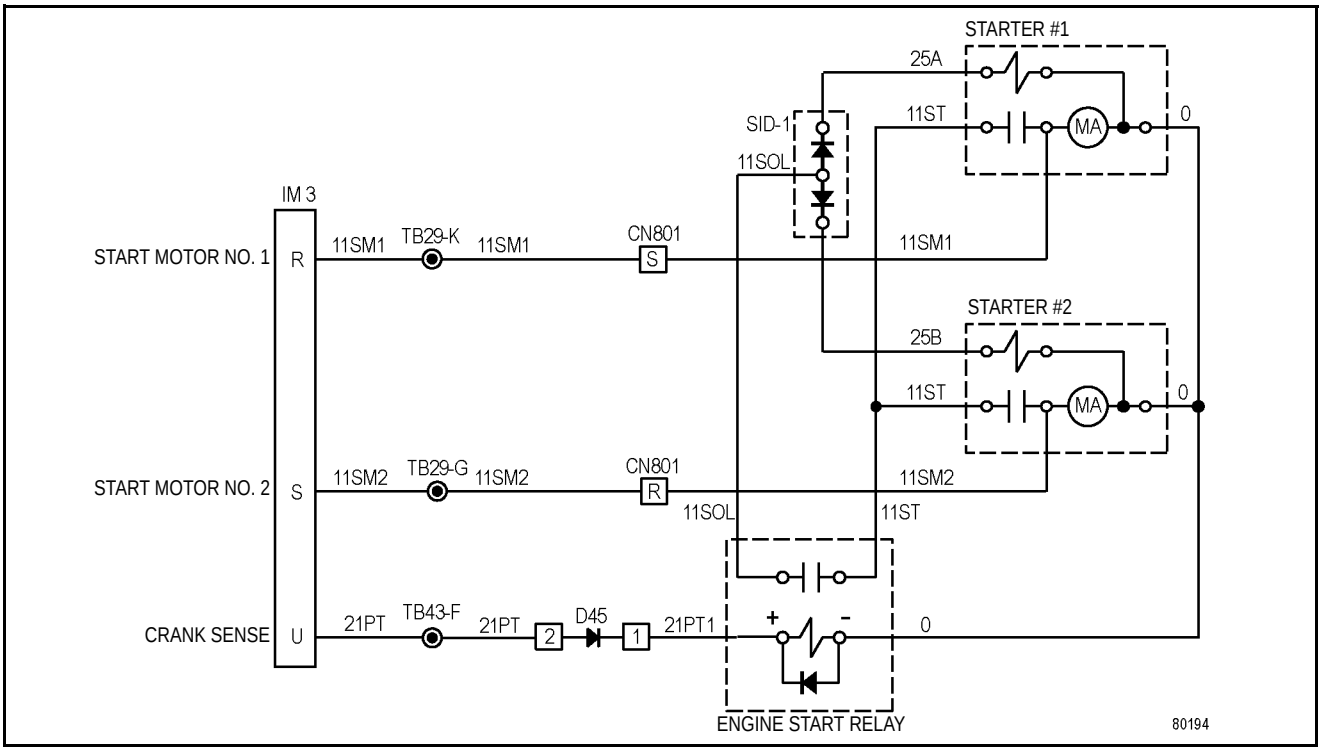
Operator Action	Stop: Park
Fault Code	A265
Description	A service brake failure exists. Operation of either brake lock or brake pedal does not produce brake light switch operation.
Fault Conditions	Sets if brake lock is on or if front brake pressure is above 250 psi for 2 seconds and the service brake pressure switch does not turn on if the engine has been running for 90 seconds. Resets if conditions change for 2 seconds.
Operator Alerting System Response	Sound Buzzer Flash IM Warning Indicator Display Operator Action: STOP: PARK Display Fault Description: SERV BRAKE FAILURE Display Fault Code: A265
Resulting Problem(s)	Service brake may not respond to brake lock switch or pedal. Brake light switch and brake lights may not respond to brake application.
Related Information	A laptop running "IM Realtime Data Monitor" software may be required to resolve this fault.

Table

1. This fault's logic contains more than one parameter, each of which may have its own related fault code(s). This fault may be resolved by resolving the parameter(s) active fault code(s). Refer to the Troubleshooting Instructions for the active parameter fault(s).
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.
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.

Parameter	**Expected State and/or Related Fault(s)**
Brake Lock Input (IM 2i)	0: brake lock valve is off 1: brake lock valve is on
Brake Pressure (kPa) (IM 3bp)	Less than 1724 kPa (250 psi): front brake not applied Greater than 1724 kPa (250 pse): front brake applied Fault(s): A201, A205
Service Brake Set - CAN/RPC	0: Service brake reported as not applied by Siemens 1: Service brake reported as applied by Siemens
Engine Speed [RPM]	Less than 400 rpm: engine is not running Greater than 400 rpm for 15 seconds: engine is running Fault(s): A184
Service Brake Set by Drive System	0: Siemens reports service brake not set by drive system 1: Siemens reports service brake is set by drive system.
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

Related circuit diagram



Fault Code A286: A fault was detected in the shutdown delay relay circuit

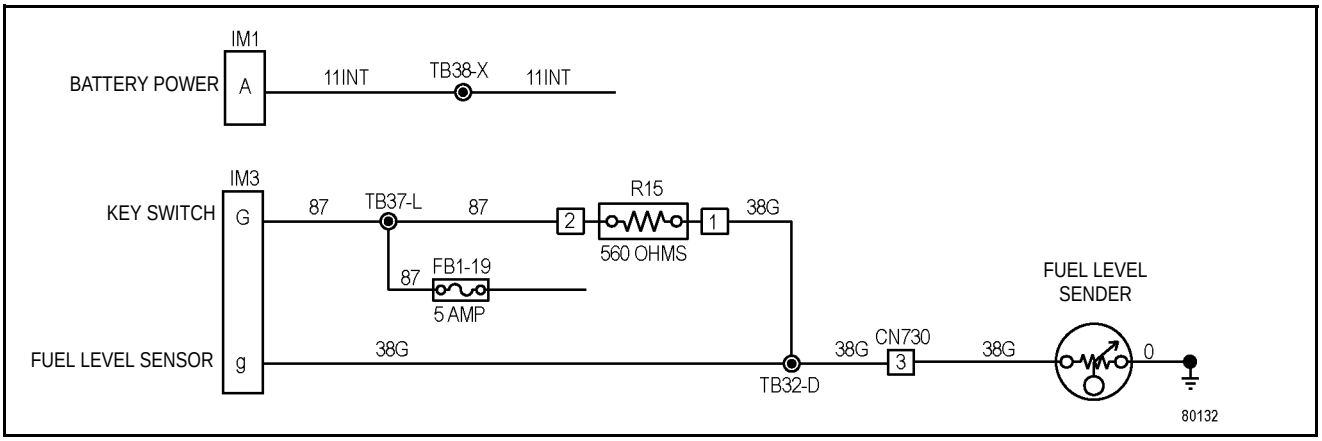
Operator Action	None
Fault Code	A286
Description	A fault was detected in the shutdown delay relay circuit.
Fault Conditions	Sets if an open circuit or short to ground is detected in the relay driver circuit. Resets only at power down.
Operator Alerting System Response	Repair Lamp Display Fault Description: SHT DWN DEL REL CKT Display Fault Code: A286
Resulting Problem(s)	A malfunctioning shutdown delay circuit could cause damage to the engine.
Related Information	A laptop running "IM Realtime Data Monitor" software may be required to resolve this fault.

Table

1. This fault's logic contains more than one parameter, each of which may have its own related fault code(s). This fault may be resolved by resolving the parameter(s) active fault code(s). Refer to the Troubleshooting Instructions for the active parameter fault(s).
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.
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.

Parameter	**Expected State and/or Related Fault(s)**
Shutdown Delay Relay (IM 1H)	Status - Open Load: Unexpected. Troubleshoot Status - Normal: Expected. No problem. Status - Shorted to Ground: Unexpected. Troubleshoot. Status - Overload: Unexpected. Troubleshoot. 0. Turns off when conditions clear or engine speed drops to zero. 1: Turns on when Keyswitch, Direct is off, Engine Shutdown Delay is on, Park brake is set, Selector Switch is in park, but not J1939 Not Connected, not High Batt Charge Voltage, not Starter Stuck On, not Active Engine Red Light, and engine speed above 300. Fault(s): A292
Keyswitch, Direct (IM 2P)	0: keyswitch is off 1: keyswitch is on Fault(s): A240

Related circuit diagram



Fault Code A352: Overload on output 1H

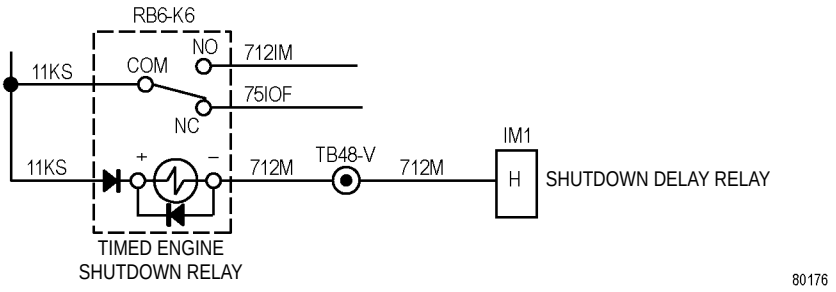
Operator Action	None
Fault Code	A352
Description	Overload on output 1H.
Fault Conditions	Sets if driver chip detects overcurrent or over temp on output 1H. Output is turned off when overload is detected. Resets at power down.
Operator Alerting System Response	Repair Lamp Display Fault Description: SHUTDOWN DELAY CKT Display Fault Code: A352
Resulting Problem(s)	Shutdown delay (5 Minute Idle Latch or Shutdown Delay Relay) circuit is disabled.
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, which may have additional fault code(s). This fault may be resolved by resolving the parameter(s) active fault code(s). Refer to the Troubleshooting Instructions for the active parameter fault(s).
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.
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.

Parameter	Expected State and/or Related Fault(s)
Shutdown Delay Relay (IM 1H)	Status - Open Load: Unexpected. Troubleshoot. Status - Normal: Expected. No problem. Status - Shorted to Ground: Unexpected. Troubleshoot. Status - Overload: Unexpected. Troubleshoot. 0. Turns off when conditions clear or engine speed drops to zero. 1: Turns on when Keyswitch, Direct is off, Cummins Shutdown Delay is on, Park brake is set, Selector Switch is in park,but not J1939 Not Connected, not High Batt Charge Voltage, not Starter Stuck On, not Active Engine Red Light, and engine speed above 300. Fault(s): A286, A292

Related circuit diagram



DUMP TRUCK

860E
960E

Machine model	Serial number
860E-1K	A30003 and up
860E-1KT	A30003 and up
960E-1K	A50003 - A50010
960E-2K	A50011 and up

40 Troubleshooting
Drive system fault code table, Part 1

21 L3C SYS: FPGA clock missing for PSU

Description	FPGA clock of the power supply start-up unit is missing.
Threshold(s)	
Detection by	Power start-up unit (G163), I9 and P2 time slice
Possible reasons	• Defective power start-up unit
Action to reset	• Switch off/on ignition. • Reset by service person via laptop.
Action to repair	• Replace power supply startup unit (G163).
Operator displayed code	S4
Notes	
Protection reactions	• Propel Inhibit • Retard Inhibit • Engine Self-Load Test Inhibit • Field Regulator Inhibit • Turn On Choppers • Main Inverter Temporary Pulse Block • ST Inverter Temporary Pulse Block • Total Block

43 L3A DSP A: Overcurrent fault

Description	One of the three-phase currents of INVA exceeded the limit. phase currents of INVA: • Phase U=U+U1 • Phase W=W+W1 • Phase V=–(U+W)
Threshold(s)	Current value >>4300A
Detection by	DSP A (G019), T4 time slice
Possible reasons	• Short circuit between motor A phases by power cable • Defective motor A • Defective IGBT module (shorted) (A101, A102, or A103) • Defective current transducer (U101, U102, U103, or, U104) • Defective U/F card (L055) • Defective DSP A card (G019)
Action to reset	• Automatic reset 2 seconds after event is not active
Action to repair	• Locate and fix the cable connection problem causing short circuit. • Locate and replace defective IGBT module (A101, A102, or A103). • Locate and replace defective current transducer (U101, U102, U103, or U104). • Replace defective U/F card (L055). • Replace defective DSP A card (G019). • Replace defective motor A.
Operator displayed code	S12
Notes	This event blocks only the affected inverter for 2 seconds after event is not active. Additionally, there is hardware protection for peak currents.
Protection reactions	• Propel Inhibit • Main Inverter Temporary Pulse Block

62 L3C DSP B: Initialization fault detected by CPU

Description	A fault is detected during the initialization of DSP B by the CPU. It includes: wrong base address, wrong software identifier, error in LCA0/1 loading, error on dual RAM test, etc.
Threshold(s)	Incorrect base address, software identifier, error in LCA0/1 loading, error on dual RAM test, etc.
Detection by	CPU card (G011), G9 time slice
Possible reasons	• Defective DSP B card (G027) • Defective DSP software setting: error in wrong base address, wrong software identifier. • Defective CPU software setting: error in wrong base address, wrong software identifier.
Action to reset	• Switch off/on ignition. • Reset by service person via laptop.
Action to repair	• Replace DSP B card (G027). • Re-load the correct DSP B software. • Re-load the correct CPU software. • Consult with KOMATSU.
Operator displayed code	S16
Notes	Total block can’t be reset during the start-up sequence.
Protection reactions	• Propel Inhibit • Retard Inhibit • Engine Self-Load Test Inhibit • Field Regulator Inhibit • Turn On Choppers • Main Inverter Temporary Pulse Block • ST Inverter Temporary Pulse Block • Total Block

84 L3C DSP B: U/F Card defective

Description	Offset or amplification of a U/F card-channel is out of the admissible range from the reference value during internal calibration.
Threshold(s)	Offset is >>10% or amplification is >>18%.
Detection by	DSP B (G027), T4 time slice
Possible reasons	• Defective U/F card (L063) • Defective DSP B card (G027)
Action to reset	• Press operator reset button (limp mode is possible). • Switch off/on ignition.
Action to repair	• Replace U/F card (L063). • Replace DSP B card (G027)*.
Operator displayed code	S21
Notes	*Software needs to be reloaded if DSP card is replaced.
Protection reactions	• Propel Inhibit • Main Inverter Temporary Pulse Block • Main Inverter Permanent Pulse Block • Limp Mode

103 L3A DSP T: Overcurrent fault

Description	The output current of the ST module has exceeded the allowable maximum peak current.
Threshold(s)	Measured peak current of U, V, or W >>900A.
Detection by	DSP T (G035), T4 time slice
Possible reasons	• Wiring problems causing a short circuit of ST output • Defective primary side of transformer at ST output • Defective motor at transformer secondary side (grid blower, main blower, water pump, inside cooler) • Defective ST module, shorted (A301) • Defective current transducer (U301, U302, or U303) • Defective U/F card (L071) • Defective DSP T card (G035)
Action to reset	• Automatic reset 2 seconds after event is not active
Action to repair	• Locate and fix the wiring problem causing a short circuit. • Test and replace (if defective) ST module. • Locate and replace defective current transducer (U301, U302, U303). • Replace defective U/F card (L071). • Replace defective DSP T card (G035). • Replace defective motor (grid blower, main blower, water pump, inside cooler). • Replace defective transformer.
Operator displayed code	S24
Notes	This event only blocks the ST inverter for 2 seconds after event is no longer active. There is hardware protection for peak current of ST module.
Protection reactions	• Propel Inhibit • Retard Inhibit • Engine Self-Load Test Inhibit • ST Inverter Temporary Pulse Block

125 L3C/L1A IO: AD Converter faulty

Description	The conversion time for a analog to digital converter on the I/O card has been exceeded.
Threshold(s)	Conversion time >40 µs
Detection by	CPU card (G011), T3 or T6 time slice
Possible reasons	• Defective I/O card (G043) • Incorrect CPU software (G011)
Action to reset	• Switch off/on ignition.
Action to repair	• Replace defective I/O card (G043). • Load correct version of CPU software (G011).
Operator displayed code	S40
Notes	The A/D converter for bus voltage causes the following protection. If any other A/D converter is detected to be faulty, only a warning reaction occurs.
Protection reactions	• Warning • Propel Inhibit • Retard Inhibit • Engine Self-Load Test Inhibit • Field Regulator Inhibit • Main Inverter Temporary Pulse Block • ST Inverter Temporary Pulse Block

155 L2B IO: Trolley line current transducer faulty

Description	Under trolley mode: trolley line current is less than 50A when traction motor power is higher than 150 KW or trolley line current is higher than 100A when trolley mode is not active.
Threshold(s)	
Detection by	I/O card (G043), T1 time slice
Possible reasons	• Short circuit inside the drive system, power circuit • Protection thyristor (crowbar) activated • Defective current transducer (U302) • Defective analog interface card (L087) • Defective I/O card (G043)
Action to reset	• Press reset button.
Action to repair	• Repair source of short on power circuit, e.g., failed IGBT module. • Replace defective IGBT module. • Replace defective current transducer (U302). • Replace defective analog interface card (L087). • Replace defective I/O card (G043).
Operator displayed code	S47
Notes	There is no hardware protection reaction, i.e., from I/O card FPGA. No trolley operation available until the fault is reset.
Protection reactions	• Propel Inhibit • Retard Inhibit

193 L1A UWSA1: Overvoltage level 1 exceeded

Description	DC bus voltage exceeded the level 1 limit (GW3 and GW4).
Threshold(s)	Measured DC bus voltage >>2120V.
Detection by	UWSA1 card (G055), T1 time slice

Possible reasons	• Defective DC bus voltage sensor A (U31)
	• Failure grid resistor(s) or chopper module(s)
	• Defective U/F card (L055)
	• Defective UWSA1 card (G055)
	• DC bus control issue:
	  • DC bus regulator is in CPU software.
	  • Chopper regulator is in DSP software.

Action to reset	• Automatic reset after bus voltage is below 2000V (GW2).
Action to repair	• Replace defective DC bus voltage sensor A (U31). • Locate and replace defective grid resistor(s) or chopper module(s). • Replace defective U/F card (L055). • Replace defective UWSA1 card (G055). • Consult with KOMATSU (regarding bus control issue).
Operator displayed code	W21
Notes	Chopper A is turned on by UWSA1 FPGA logic to discharge bus below 2000V.
Protection reactions	• Warning

219 L3D UWSB1: Peak current protection pulse start

Description	A peak current protection (code 218) occurred during the start phase of the inverter.
Threshold(s)	
Detection by	CPU (G011), T2 time slice
Possible reasons	• Power cable wiring problem on motor B • Defective current transducer for inverter B (U201, U203) • Defective U/F card (L063) • Defective analog interface card (L095, L103) • Defective UWSB1 card (G063) • Defective IGBT module of inverter B (A201, A202, A203) • Defective motor B
Action to reset	• Press operator reset button limp mode is possible. • Reset by service person via laptop.
Action to repair	• Check power cable connections on motor B. • Replace defective current transducer (U201, U203). • Replace U/F card (L063). • Replace defective analog interface card (L095, L103). • Replace UWSb1 card (G063). • Replace defective IGBT module (A201, A202, A203). • Replace defective motor B.
Operator displayed code	S71
Notes	When this event occurs, Inverter B is buffer inhibited, a service person is required to reset the system before inverter operation is allowed again.
Protection reactions	• Propel Inhibit • Main Inverter Temporary Pulse Block • Main Inverter Permanent Pulse Block • Limp Mode

250 L3D UWSA2: Number of peak current protection >limit

Description	The number of peak current protections within a time frame exceeded the permissible limit.
Threshold(s)	Over 10 ms peak current protection events >>10 Over 20 ms peak current protection events >>20 Over 96 ms peak current protection events >>160
Detection by	CPU (G011), T1 time slice
Possible reasons	• Bad/abnormal road condition • Power cable wiring problem on motor A • Defective current transducer for inverter A (U102, U104) • Defective U/F card (L055) • Defective analog interface card (L087) • Defective UWSA2 card (G071) • Defective IGBT module of inverter A (A101, A102, A103) • Defective motor A
Action to reset	• Press operator reset button limp mode is possible. • Reset by service person via laptop.
Action to repair	• Check power cable connections on motor A. • Replace defective current transducer (U102, U104). • Replace U/F card (L055). • Replace defective analog interface card (L087). • Replace UWSA2 card (G071). • Replace defective IGBT module (A101, A102, A103). • Replace defective motor A.
Operator displayed code	S81
Notes	When this event occurs, Inverter A is buffer inhibited, a service person is required to reset the system before inverter operation is allowed again.
Protection reactions	• Propel Inhibit • Main Inverter Temporary Pulse Block • Main Inverter Permanent Pulse Block • Limp Mode

281 L3D UWSB2: Supervision switching frequency

Description	The switching frequency of inverter A exceeded one of the limits.
Threshold(s)	Over 5ms the number of pulses was >>12 Over 10ms the number of pulses was >>13 Over 20ms the number of pulses was >>23 Over 160ms the number of pulses was >>122
Detection by	CPU card (G011), T1 time slice
Possible reasons	• Open circuit of IGBT module or output (A201, A202, A203) • Defective UWSB2 card (G079) • Defective DSP B card (G027) • Incorrect CPU software (G011)
Action to reset	• Press operator reset button limp mode is possible. • Reset by service person via laptop.
Action to repair	• Replace defective IGBT (A201, A202, A203). • Replace defective UWSB2 card (G079). • Replace defective DSP B card (G027). • Consult with KOMATSU.
Operator displayed code	S91
Notes	When this event occurs, Inverter B is buffer inhibited, a service is required person to reset the system before inverter operation is allowed again.
Protection reactions	• Propel Inhibit • Main Inverter Temporary Pulse Block • Main Inverter Permanent Pulse Block • Limp Mode

307 L1A UWSST: Hardware failure counter / processor

Description	The micro controller of the UWSST card is not ready for operation.
Threshold(s)	
Detection by	CPU card (G011), T1 time slice
Possible reasons	• Defective UWSST card
Action to reset	• Switch off/on ignition.
Action to repair	• Replace UWSST card (G087).
Operator displayed code	S100
Notes	
Protection reactions	• Warning

343 L1A ETM: ADC Failure for ETM4

Description	The conversion time for the AD converter on the ETM4 card (G151) was exceeded. This card measures various temperature sensors in the drive system.
Threshold(s)	Conversion time >>40 µs.
Detection by	CPU (G011), T6 time slice
Possible reasons	• Defective I/O card (G055)
Action to reset	• Switch off/on ignition.
Action to repair	• Replace defective I/O card (G055).
Operator displayed code	W48
Notes	The temperatures are set at 83ºC and may cause other faults when ADC is faulty.
Protection reactions	• Warning

364 L2A EXT: Engine derate protection active

Description	The engine OK feedback signal is not active for more than 2 seconds while the system's bus voltage is more then 900V. The output from the engine used for this is the same pin that causes the red engine light to activate. A relay is normally added because the drive system is expecting the input to be 24V when everything is OK.
Threshold(s)	Input not seen for >>2 seconds with precharging finished (bus voltage >>900V)
Detection by	CPU (G011), T6 time slice
Possible reasons	• If red engine light is on, problem with engine (e.g., low coolant) • Wiring problem for engine derate signal into drive system • Defective digital input card (G111)
Action to reset	• Automatically reset (once input is active)
Action to repair	• Have engine service person check the engine fault and fix the problem. • Check wiring problem from engine derate signal into drive system. • Replace digital input card (G111) if input is 24V but fault is still active.
Operator displayed code	S122
Notes	While this event is active. propel and engine testing is blocked. Retard is still possible.
Protection reactions	• Propel Inhibit

387 L1A BEF: Limp mode selector defective

Description	Switch input for limp mode A and limp mode B is active. The limp mode selector switch is located on the front diagnostic panel. In normal operation the three-position switch is in the middle and neither switch input for limp mode is active.
Threshold(s)	
Detection by	CPU (G011), T6 time slice.
Possible reasons	• Wiring problem for limp mode selector switch. • Defective digital input card (G119). • Defective limp mode selector switch on front diagnostic panel.
Action to reset	• Automatic reset.
Action to repair	• Check wiring for limp mode selector switch. • Check if digital input card (G119) is fully plugged in. • Replace digital input card (G119). • Replace limp mode selector switch on front diagnostic panel.
Operator displayed code	W80
Notes	Limp mode is a term to describe the operation of only one of the two main inverters. Certain faults can be reset to limp mode of the selector switch can be used to force limp mode. Limp mode A means inverter A and motor A operate (this is the wheel motor on the grid box side of the truck).
Protection reactions	• Warning

402 L3C IUW: Alternator AC current sensor faulty

Description	The maximum measured peak alternator current is above the limit when all inverters are pulse blocked. OR The maximum measured rms alternator current is less than 50A when total power to wheel motors + cooling motors + grid box is higher then 150kW.
Threshold(s)	Alternator peak current >>100A with all inverters blocked OR Alternator rms current <<50A with total power >>150kW
Detection by	CPU (G011), T4 time slice
Possible reasons	• Wiring problem from SIBAS® (A101) to current transducer (U107) • Defective current transducer (U107) • Defective U/F card (L071) • Defective DSP T card (G035)
Action to reset	• Switch ignition off/on. • Reset by service person via laptop.
Action to repair	• Check wiring for transducer (U107) to SIBAS® (A101). • Replace the defective current transducer (U107). • Replace U/F card (L071). • Replace DSP T card (G035).
Operator displayed code	S145
Notes	When this event occurs, the field regulator is permanent inhibited; the control power is required to be cycled or reset by service personnel.
Protection reactions	• Propel Inhibit • Engine Self-Load Test Inhibit • Field Regulator Inhibit

419 L2A IUW: Vehicle overspeed supervisioN

Description	The drive system has detected the truck grossly exceeding the system allowable maximum speed. The maximum value from the wheel motors, and front speed sensors (if installed), is used and compared to the threshold. Because the drive system is monitoring rotational speed, and not real truck speed, a calculation is done. This calculation uses the gear ratio and tire diameter for the wheel motors. For the front speed sensors, this calculation uses only the tire diameter. These values are set in the USER parameters menus.
Threshold(s)	Truck speed >>69 km/h.
Detection by	CPU (G011), T6 time slice
Possible reasons	• Truck was driven out of retard envelope. • Incorrect setting for gear ratio, tire diameter, and/ or speed sensor tooth number in USER parameters menus. • Defective front wheel speed sensor. • Defective wheel motor speed sensor. • Poor road conditions caused the truck's rear wheels to lose traction in propel.
Action to reset	• Automatic reset (when speed <<64km/h).
Action to repair	• Train operator, so system retarding envelope is followed. • Check the setting for gear ratio, tire diameter, and speed sensor gear teeth number. There is a setting for each wheel motor and the front wheel speed sensors. • Replace defective front speed sensor. • Replace defective wheel motor speed sensor. • Check why slip-slide control did not properly compensate for the poor road condition (e.g, disabled by operator or not set properly).
Operator displayed code	W88
Notes	
Protection reactions	• Warning

436 L3A DRZ: Motor A/B rotation incosistency

Description	The measured direction of rotation for motor A and B are different without there being any other active event to explain why. The direction of each wheel is latched once the absolute value of the sensor reading is >>90 rpm. The speed sensor monitoring each wheel motor has two channels. Front or rear rotation is detected by the DSP and passed along with the value to the CPU.
Threshold(s)	Direction of motor A <> direction of motor B without another speed sensor event code active.
Detection by	CPU (G011), T4 time slice
Possible reasons	• Wiring problem from SIBAS® to the wheel motor speed sensor(s) • Poor road conditions caused the truck's rear wheel(s) to loose traction in retard. • Slip-slide control not functioning properly • Defective wheel motor speed sensor(s) • Defective DSP A or B card (G019, G027)
Action to reset	• Automatic reset.
Action to repair	• Check/repair wiring problem from SIBAS® to wheel motor speed sensor(s). • Check why slip-slide control did not function properly. Some causes could be no front speed sensor feedback, or slip-slide control disabled by the operator. • Replace defective wheel motor speed sensor. • Replace defective DSP A or B card (G019, G027) if multiple instances of event are logged.
Operator displayed code	W95
Notes	
Protection reactions	• Warning

452 L3B TMP: SIBAS® Temperature > shutdown limit

Description	The temperature measured at the SiBAS rack is above the shutdown protection limit for more then 1 second. This temperature sensor is located on the I/O card (G043).
Threshold(s)	Measured temperature >>82ºC.
Detection by	CPU (G011), T7 time slice
Possible reasons	• Ambient temperature is too high, system only rated for +55ºC • Cooling fan(s) in bottom of SIBAS® rack not functioning properly • Defective temperature sensor on I/O card (G043)
Action to reset	• Automatic reset (when temperature <<60ºC).
Action to repair	• Check if SIBAS® rack fans are working. There is a total of three fans on the pullout assembly. If any is not working, then the defective fan assembly must be replaced. • Replace defective I/O card (G043).
Operator displayed code	S180
Notes	Field regulator is fault inhibit.
Protection reactions	• Propel Inhibit • Engine Self-Load Test Inhibit • Field Regulator Inhibit

469 L2C TMP: SR Module temperature > warning limit

Description	The SR rectifier module (A1) temperature is above the warning limit for more then 1 second. Each rectifier module has a temperature sensor attached to the bottom side of the heat sink. This sensor is a separate part from the rectifier module and attaches via a peel and stick adhesive backing. The sensor is an RTD type with the characteristic of 100 ohms at 0ºC.
Threshold(s)	At least one measured temperature >>64ºC.
Detection by	CPU (G011), T7 time slice
Possible reasons	• Ambient temperature is too high, system only rated to +55ºC • Wiring problem from SIBAS® to SR module temperature sensor • Defective temperature sensor (PT205) • ST output frequency is not high enough • Defective temperature sensor interface card (G151) • Defective system coolant pump (M05) • Defective drive system radiator • Defective I/O interface card (G043)
Action to reset	• Automatic reset (when temperature <<62ºC).
Action to repair	• Check/repair wiring from SIBAS® to IGBT SR module temperature sensor (PT105). • Replace temperature sensor (PT205). • Check if ST is running at maximum frequency. • Replace temperature sensor interface card (G151). • Replace defective system coolant pump (M05). • Replace defective drive system radiator. • Replace I/O card (G043).
Operator displayed code	W102
Notes	While this event is active, maximum motor A and B propel torque is reduced by 25%.
Protection reactions	• Power Reduction

486 L2B TMP: Alternator bearing temperature > shutdown limit

Description	The main alternator rear bearing temperature is above the shutdown protection limit for more then 1 second (coupled to rear of engine). The alternator has two RTD type temperature probes extending into the rear bearing. This RTD type sensor has the characteristics of 100 ohms at 0ºC.
Threshold(s)	Measured temperature >>90ºC
Detection by	CPU (G011), T7 time slice
Possible reasons	• Ambient temperature is too high, system only rated to +55ºC • Wiring problem from SIBAS® to alternator bearing temperature sensor. • Broken air duct for alternator cooling • Defective alternator bearing temperature sensor • Defective temperature sensor interface card (L163) • External heat source near alternator rear bearing • Alternator bearing needs grease added (follow maintenance intervals and procedure for correct type/amount of grease) • Defective I/O card (G043) • Defective alternator bearing
Action to reset	• Press operator reset button (when temperature <<80ºC).
Action to repair	• Check/repair wiring from SIBAS® to alternator bearing temperature sensor. • Check air duct from main blower to alternator inlet. • Change wiring at alternator to use other bearing temperature sensor. • Replace temperature input card (L163). • Investigate cause for external heat source near alternator bearing. • Add grease based on maintenance interval and procedure guidelines. • Replace defective I/O card (G043). • Replace defective alternator bearing.
Operator displayed code	S186
Notes	When this event occurs, the field regulator is fault inhibited and propel is blocked; retard is available to stop the truck.
Protection reactions	• Propel Inhibit • Engine Self-Load Test Inhibit • Field Regulator Inhibit

516 L1A ETM2: Motor A NDE Bearing PT100 open circuit
517 L1A ETM2: Motor A DE Bearing PT100 open circuit
518 L1A ETM2: Motor B NDE Bearing PT100 open circuit
519 L1A ETM2: Motor B DE Bearing PT100 open circuit
520 L1A ETM2: Alternator Bearing PT100 open circuit
521 L1A ETM2: Motor A stator PT100 open circuit
522 L1A ETM2: Motor B stator PT100 open circuit
523 L1A ETM2: Motor inlet air PT100 open circuit

Description	The specific channel (based on event logged) of the temperature sensor card (L163) is reading as an open circuit. An open circuit is determined if either the reading changes too quickly or the resistance gets outside the system limits. Once detected as open, the channel does not reset until power is cycled with the input in range.
Threshold(s)	Induced voltage at input <<-10V or >>+10V. Or a change of >>30ºC in 750 ms.
Detection by	CPU (G011), T6 time slice
Possible reasons	• Wiring problem from SIBAS® to temperature sensor(s) • Defective temperature sensor(s) • Defective temperature card (L163) • Defective I/O card (G043)
Action to reset	• Switch off/on ignition.
Action to repair	• Check/repair wiring problem from SIBAS® to temperature sensor(s). • Replace defective temperature sensor(s). • Replace defective temperature card (L163). • Replace defective I/O card (G043).
Operator displayed code	W117
Notes	While this event is active, the temperature value to be used by the software from the open channel is set to a default value of 0ºC.
Protection reactions	• Warning

860E Dump truck
960E Dump truck

Form No.CEN40047-00

TROUBLE	POSSIBLE CAUSE	SUGGESTED CORRECTIVE ACTION
Excessive free play at steered wheels	1. Broken or worn linkage between steering cylinder and steered wheels 2. Leaky steering cylinder seals	1. Check for loose fitting bearings at anchor points in steering linkage between cylinder and steered wheels. 2. Repair or replace steering cylinder.
Binding or poor centering of steered wheels	1. Binding or misalignment in steering column or splined coupling and steering control unit 2. High back pressure in tank can cause slow return to center - should not exceed 2 068 kPa (300 psi) 3. Large particles can cause binding between the spool and sleeve in the steering control unit	1. Align column to steering control unit. 2. Remove restriction in the lines or circuit. Check for obstruction or pinched lines. 3. Clean steering control unit and filter the oil. If another component has malfunctioned (generating contaminating materials), flush the entire hydraulic system.
Steering control unit locks up	1. Large particles in meter section 2. Insufficient hydraulic power 3. Severe wear and/or broken pin	1. Clean the steering control unit. 2. Check hydraulic system pressure. 3. Repair or replace steering control unit.
Steering wheel oscillates or turns by itself	1. Lines connected to wrong ports 2. Parts assembled wrong; steering control unit improperly timed	1. Check line routing and connections. 2. Reassemble correctly and re-time control valve.
Steered wheels turn in opposite direction when operator turns steering wheel	1. Lines connected to wrong cylinder ports	1. Inspect and correct line connections.

NOTES

Removal and installation of front wheel hub and spindle

The following instructions will cover the complete removal, installation, disassembly, assembly and bearing adjustment of the front wheel hub and spindle. If only brake service is to be performed, refer to Disassembly and assembly section **Brake system**.

⚠WARNING

Do not loosen or disconnect any hydraulic line or component until the engine is stopped, the key switch is OFF for 90 seconds, and the brake accumulators are depressurized.

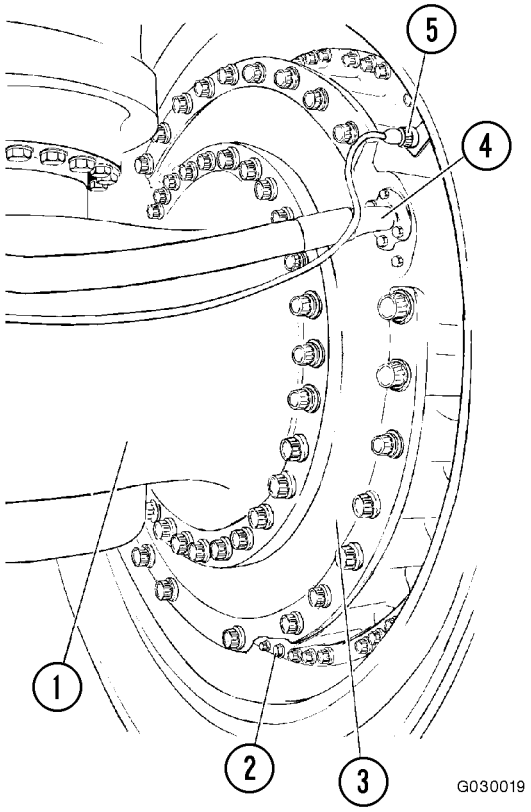


FIGURE 50-8. FRONT WHEEL & SPINDLE REMOVAL

1. Spindle
2. Brake Oil Drain Plug
3. Disc Brake Housing
4. Brake Cooling Line
5. Speed Sensor Connector

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. Install a vacuum pump on the hydraulic tank to prevent oil loss while disconnecting hoses.
5. Disconnect speed sensor connectors (5, Figure 50-8). Tie the cables back away from the spindle to prevent damage during spindle removal.
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 and park brake line. Cap the hoses and ports to prevent contamination.
8. After the 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.
10. 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.

11. 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.
12. Remove capscrews and washers (1, Figure 50-10) that secure retainer plate (2) to the spindle and suspension. To prevent thread damage, loosen the capscrews in a circular pattern in torque increments of **678 N·m (500 ft lb)**. Remove retainer plate (2).

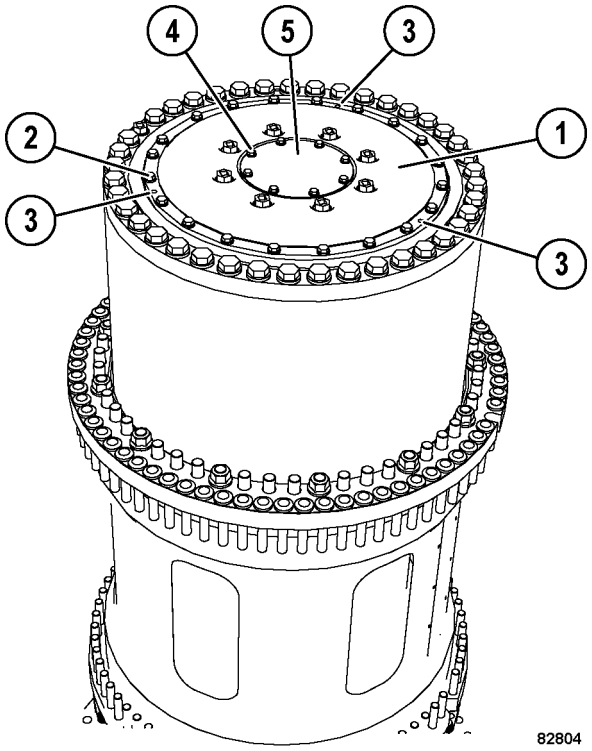


FIGURE 50-23.

1. Cover
2. Cap Screws
3. Tapped Holes
4. Cap Screw
5. Inspection Cover

6. Remove the pusher screws and install three lift eye into the cover. Attach lifting chains and a hoist to the lift eyes. Lift the cover from the assembly. The weight of the cover is approximately 150 kg (330 lb).
7. Remove the O-ring seal that seals the cover to the assembly.

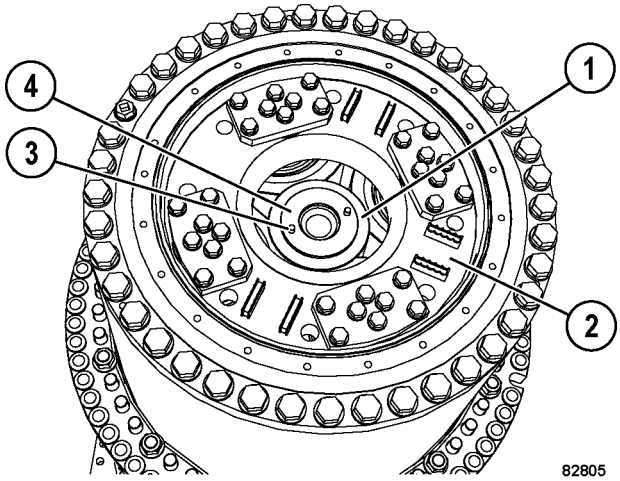


FIGURE 50-24.

1. Low Speed Sun Gear
2. Low Speed Carrier
3. Dowel Pin
4. Spacer

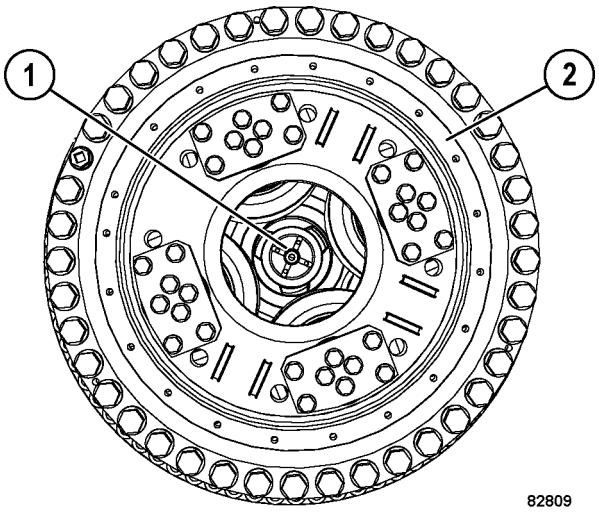


FIGURE 50-25.

1. Button
2. Low Speed Carrier

8. Remove spacer (4, Figure 50-24) and two dowel pins (3) from the cover.
9. Attach two lift eyes (M12 x 1.75) to low speed sun gear (1). Attach lifting straps and a hoist to the lift eyes. Lift the sun gear from the assembly. The weight of the sun gear is approximately 120 kg (265 lb).

51. Install 24 capscrews (2, Figure 50-57) and the washers that secure cover (1) to the assembly. Tighten the capscrews to **277 ± 32 N·m (204 ± 24 ft lb)**.
52. Ensure there are four magnets (1, Figure 50-58) attached to main cover. Install a new O-ring (2) and then place cover (5, Figure 50-57) into position. Install eight capscrews (4) and the washers. Tighten the capscrews to **110 ± 12 N·m (81 ± 9 ft lb)**.

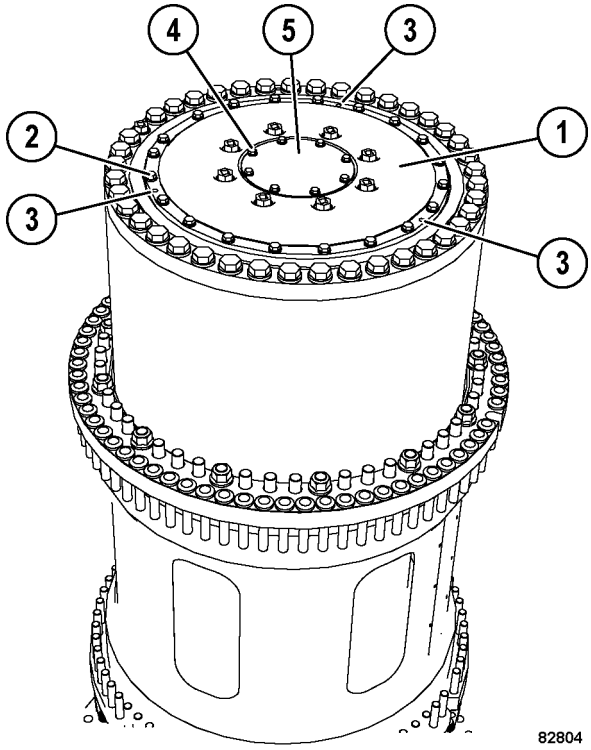


FIGURE 50-57.

1. Cover
2. Cap Screws
3. Tapped Holes
4. Cap Screws
5. Cover

53. Install the outboard wheel adapter nuts.
54. Install the electric motor onto the wheel motor transmission. Refer to "Removal and installation of electric motor" for instructions.

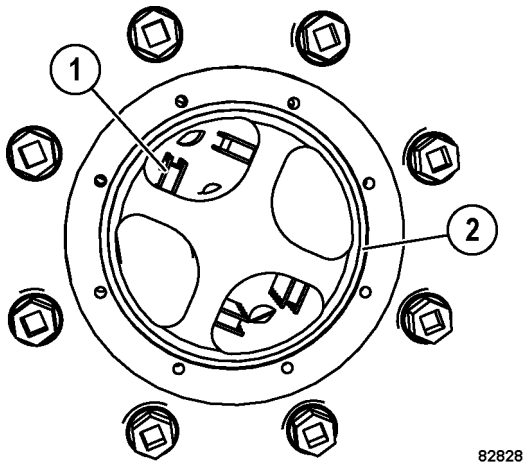


FIGURE 50-58.

1. Magnet
2. O-ring

960E Dump truck

Form No. CEN50022-03

Removal and installation of brake accumulator

Removal

1. Shut down the truck. For the proper shutdown procedure, refer to Index and foreword section **Operating instructions**.
2. Open bleeddown valves (1, Figure 50-13) and (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 bleeddown valves by rotating them clockwise.
5. Remove protective cover (3, Figure 50-15) from the charging valve guard on top of the accumulator.
6. Install a charging valve kit onto the accumulator charging valve. Use the charging kit to release nitrogen from the accumulator that is to be removed. Refer to Disassembly and assembly section **General information** for more information.
7. Disconnect oil line (6) from the bottom hydraulic port. Cap the port and hose fitting to prevent contamination.
8. Attach a lifting device to accumulator.

⚠WARNING

Each accumulator weighs approximately 100 kg (220 lb). Ensure that the lifting device has adequate capacity for handling the load.

9. Remove accumulator mounting clamps (5) and lift the accumulator off the mounting pad. Move the accumulator to a clean work area.

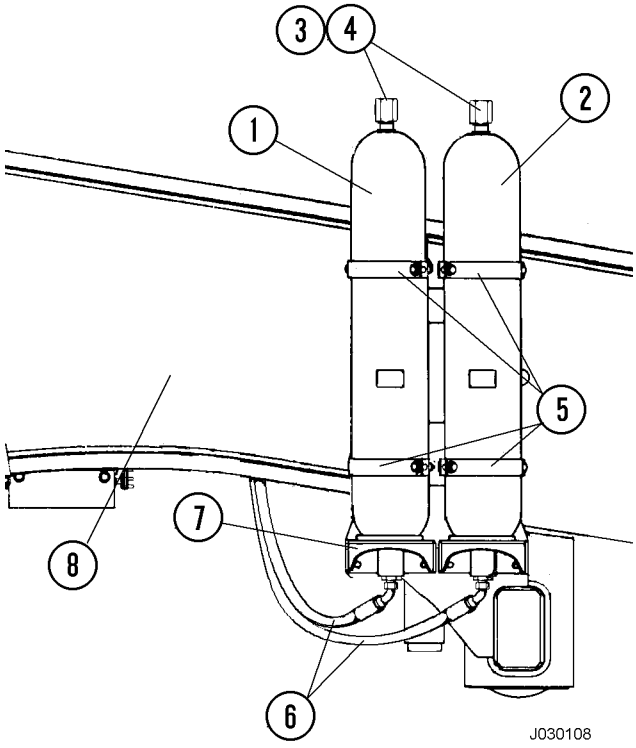


FIGURE 50-15. BRAKE SYSTEM

1. Rear Brake Circuit Accumulator
2. Front Brake Circuit Accumulator
3. Protective Cover
4. Charging Valve
5. Mounting Clamps
6. Oil Lines
7. Mounting Bracket
8. R.H. Frame Rail

Installation

1. Position the accumulator on mounting bracket (7, Figure 50-15) with warning label visible.
2. Install mounting clamps and hardware. Tighten capscrews to standard torque.
3. Install oil line (6) at bottom (hydraulic) port.
4. Precharge the accumulator to 690 - 827 kPa (100 - 120 psi). Refer to Testing and adjusting section **Accumulators and suspensions** for the accumulator charging procedure.
5. Install protective cover (3) over charging valve on top of accumulator.

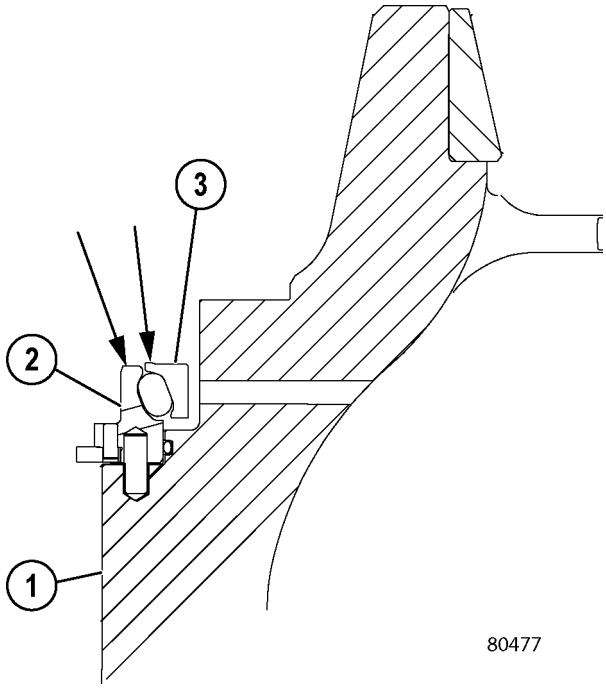


FIGURE 50-44. CHECKING SEAL HEIGHT

1. Housing
2. Seal Carrier
3. Seal Ring

14. After both seal ring heights have been checked and adjusted, wipe the polished seal ring surfaces with a lint free material and isopropyl alcohol to remove all foreign material and fingerprints.

⚠CAUTION

No foreign particles of any kind are allowed on the polished seal ring faces. Something as small as a paper towel fiber will hold the seal faces apart and could cause damage or leakage.

15. Apply a thin film of clean hydraulic oil (C-4 type SAE 10W) on the polished seal faces on both seal rings. Use a lint-free applicator or a clean finger to distribute the oil evenly.

16. During assembly, ensure that both housings are square, and concentric and in correct alignment. Move the parts slowly and carefully toward each other. Do not slam, bump or drop the seal rings together. High impact can damage the seal ring face and cause leakage.

17. The toric ring must not slip on the ramps of either the seal ring or housing. To prevent slippage, wait at least two minutes to let all the tri-chloroethane evaporate before further assembly. Once it is correctly in place, the toric ring must roll on the ramps only. If correct installation is not obvious, repeat Steps 3 - 8.

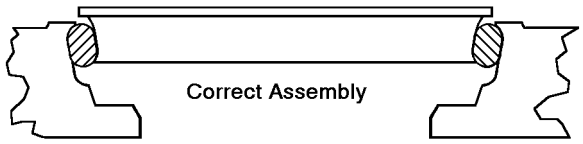


FIGURE 50-45. CORRECT ASSEMBLY

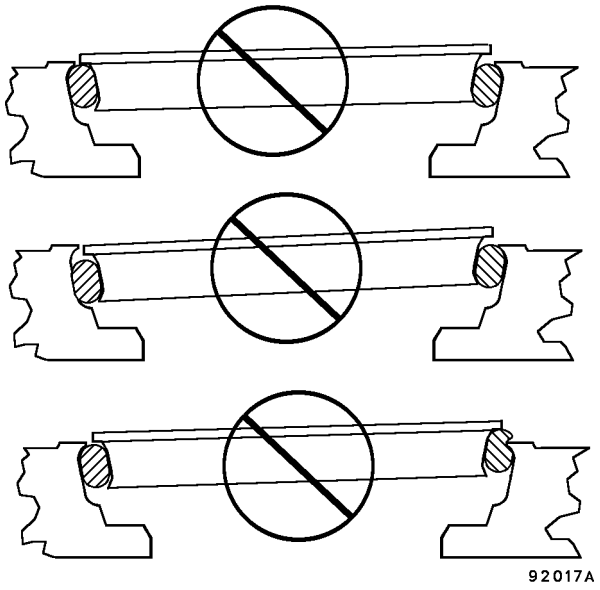


FIGURE 50-46. INCORRECT ASSEMBLY

18. Wipe the polished metal seal surfaces with clean tri-chloroethane to remove any foreign material or fingerprints. No foreign particles of any kind should be on the seal ring faces. Something as small as a paper towel raveling will hold the seal faces apart and cause leakage.

Removal and installation of steering control unit

Removal

WARNING

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 type of 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. Remove the access cover on the front of the operator cab.

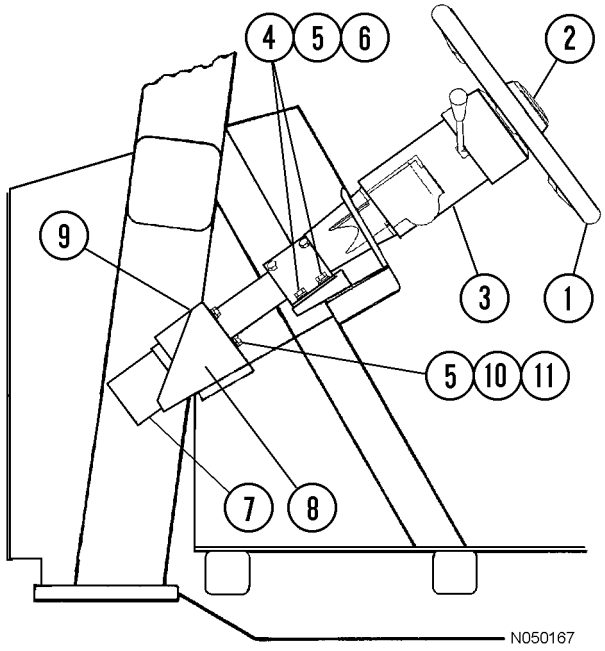


FIGURE 50-1. STEERING CONTROL UNIT

1. Steering Wheel
2. Button Horn
3. Steering Column
4. Capscrew
5. Flat Washer
6. Lockwasher
7. Steering Control Unit
8. Bracket L.H.
9. Bracket R.H.
10. Capscrew
11. Lockwasher

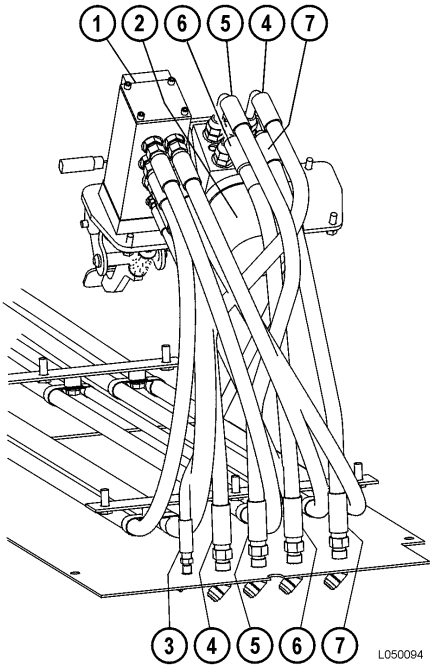


FIGURE 50-2. STEERING CONTROL UNIT HOSES

1. Brake Valve
2. Steering Control Unit
3. "LS" Port Hose
4. "L" Port Hose
5. "T" Port Hose
6. "P" Port Hose
7. "R" Port Hose

3. Clean steering control unit (7, Figure 50-1) and surrounding area to help avoid contaminating the hydraulic oil when any lines are opened.
4. Before disconnecting any hydraulic lines, tag all hydraulic lines for proper identification during installation. Disconnect hydraulic lines (3, Figure 50-2) through (7) at the steering control unit. Plug all hoses.
5. Remove four mounting capscrews (10, Figure 50-1), flat washers and lockwashers. Remove steering control unit (7).
6. Place the steering control unit in a clean work area for disassembly, if required.
7. Whenever the steering column or steering control unit is removed for service, inspect the splines of the steering column shaft. Refer to "Removal and installation of steering column".

Assembly

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

1. Install new bushing (15, Figure 50-22), 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 cm^3/min. (0.15 in^3/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

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

⚠DANGER

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

1. Perform the normal truck shutdown procedure. Turn key switch OFF and allow 90 seconds for the accumulators to bleeddown. Turn the steering wheel to ensure that no oil remains under pressure.

NOTE: As an alternative to draining the hydraulic oil, a vacuum can be placed on the hydraulic tank to hold the oil in the tank.

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.
4. Disconnect supply hose (2, Figure 50-23) and steering filter hose (4) at steering/brake pump (1). Disconnect case drain hose (7) and unloader feedback hose (3) from the fittings on the pump housing. Plug all hoses and ports to prevent oil contamination.
5. If used, turn off vacuum pump kit (XB0887) after all hydraulic lines have been plugged.

10. If removed, install charging valve assembly (11) onto gas valve manifold (14). Then tighten swivel nut (4, Figure 50-36) to **5 N·m (45 in lb)**.

    If a new charging valve was installed, the valve stem must be seated as follows:

    a. Tighten swivel nut (4) to **14 N·m (10 ft lb)**.

    b. Loosen the swivel nut.

    c. Retighten the swivel nut to **14 N·m (10 ft lb)**.

    d. Loosen the swivel nut again.

    e. Finally, tighten the swivel nut to **5 N·m (45 in lb)**.

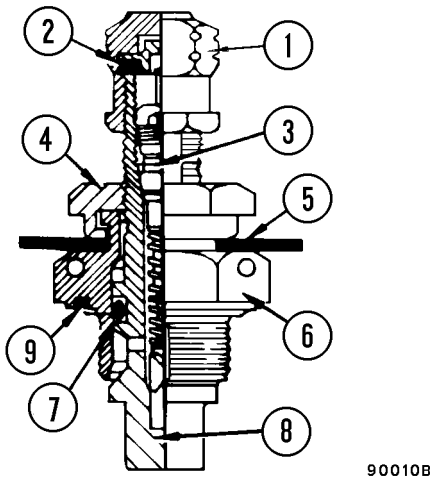


FIGURE 50-36. CHARGING VALVE

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

11. Install valve cap (1) finger-tight. Install the valve cover and tighten the capscrews to **40 N·m (25 ft lb)**.
12. Install new O-ring (16, Figure 50-35) on gas valve manifold (14). Hold the bladder valve stem with a wrench and install gas valve manifold (14) securely.
13. While holding hydraulic port assembly (2) by the threaded end, insert the poppet end into the shell fluid port. Lay the complete assembly inside the shell.
14. Fold anti-extrusion ring (3) to enable insertion into the shell. Once the anti-extrusion ring has cleared the fluid port opening, place the anti-extrusion ring on the hydraulic port assembly with the steel collar facing toward the shell fluid port.
15. Pull the threaded end of the port assembly through the shell fluid port until it seats solidly into position on the shell fluid port opening.
16. Connect the nitrogen charging kit to the charging valve. With the hydraulic port assembly firmly in place, slowly pressurize the bladder using dry nitrogen and a sufficient pressure of approximately 275 - 345 kPa (40 - 50 psi) to hold the port assembly in place so that both of your hands are free to continue with the assembly.
17. Install metal backup washer (6) over the hydraulic port assembly. Push it into the shell fluid port to bottom it out on the anti-extrusion ring.
18. Install O-ring (7) over the hydraulic port assembly. Push it into the shell fluid port until it bottoms out against metal backup washer (6). Ensure that the O-ring does not twist.
19. Install O-ring backup (8) over the hydraulic port assembly. Push it into the shell fluid port until it bottoms out against O-ring (7).
20. Insert spacer (9) with the smaller diameter of the shoulder facing the accumulator shell.
21. Install locking ring (10) on the hydraulic port assembly and tighten it securely. This will squeeze the O-ring into position. Use an appropriate wrench on the flats on the port assembly to ensure that the unit does not turn.
22. Install bleed plug (12) into the hydraulic port assembly.
23. Verify that all warning labels are attached to the shell and that they are legible. Install new labels as required.
24. Precharge the accumulator to 690 - 827 kPa (100 - 120 psi). Refer to Testing and adjusting section **Accumulators and suspensions** for the accumulator charging procedure.
25. After precharging is completed, install a plastic cover over the hydraulic port to prevent contamination. **Do not use a screw-in type plug.**

9. Install pin removal tool (1, Figure 50-18) to each lower pin using the capscrews listed in Table 1. Tighten the capscrews to **240 ± 24 Nm (177 ± 17 ft lb)**.
10. Attach both shackles (2) to cylinder (3).
11. Attach each shackle to the pin removal tool, as shown.

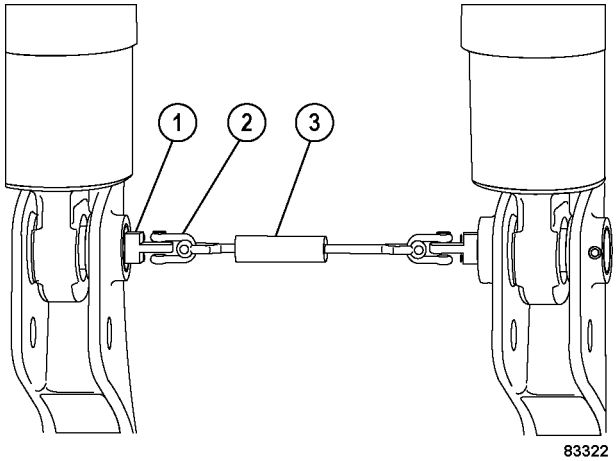


FIGURE 50-18. REAR SUSPENSION PIN REMOVAL TOOL

1. Pin Removal Tool
2. Shackle
3. Cylinder

CAUTION

Do not exceed 10 tons of force when applying pressure to the cylinder. Damage to the tool or suspension components may result, as well as personal injury to maintenance personnel.

12. Apply pressure to the cylinder using the hand pump (not shown).
13. When the cylinder reaches the end of its stroke, remove one of the shackles from the cylinder and connect the cylinder shackle directly to the pin removal tool. This is necessary to pull the pin the remaining distance.
14. Remove pin (5, Figure 50-19) from the lower mounting.

NOTE: Spacers (7) will fall free.

15. Install the tool on the upper pin and repeat the pin removal process.
16. If it is necessary to remove the remaining rear suspension cylinder, insert the pins back into the upper and lower mountings. Secure the pins using shoulder bolts (2), flat washers (3) and locknuts (4), and repeat the removal process for the remaining cylinder.
17. Remove the cylinder from the truck.

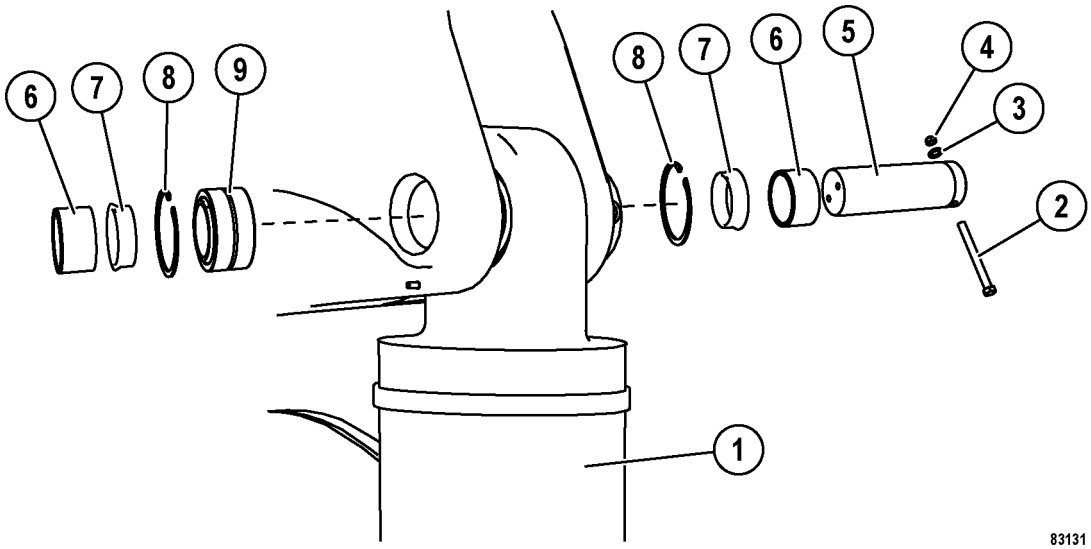


FIGURE 50-19. REAR SUSPENSION CYLINDER PIN INSTALLATION

1. Suspension Cylinder
2. Shoulder Bolt
3. Flat Washer
4. Locknut
5. Pin
6. Sleeve
7. Spacer
8. Retaining Ring
9. Bearing

Removal and installation of hoist valve

Removal

DANGER

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).

WARNING

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.

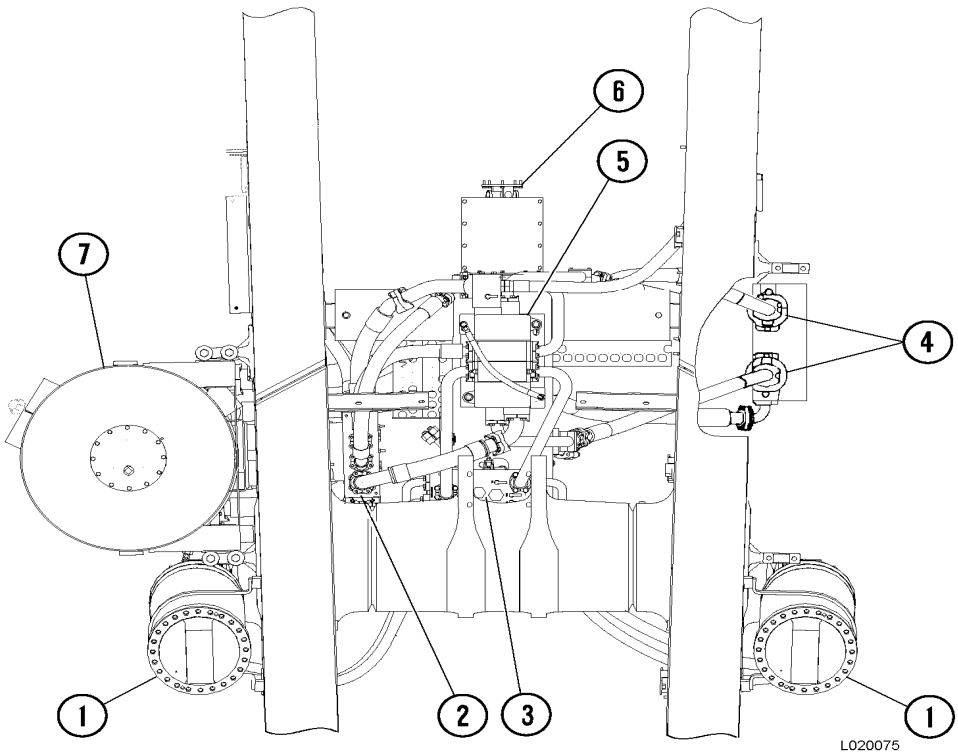


FIGURE 50-16. HOIST VALVE & PIPING (Top View)

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

Installation of the quill

NOTE: Use only new seals, bearings and O-rings during reassembly. Thoroughly lubricate all parts and seals with hydraulic oil to aid in assembly and to provide lubrication during initial operation.

1. Inspect plugs (3, Figure 50-39) and check balls (4) in the quill to ensure that the plugs are tight and the ball seats are not damaged. Refer to "Installation of check balls and plugs in quill" on the next page.
2. Secure cap assembly (1) in a sturdy fixture. Ensure that the threads in the cap and the threads on the quill are clean, dry and free of oil and solvent.
3. Spray the mating threads of both cap assembly (1) and quill assembly (2) with LOCQUIC® Primer T (Komatsu part number TL8753) or equivalent. Allow the primer to dry for three to five minutes.
4. Apply Loctite® Sealant #277 (Komatsu part number VJ6863) or equivalent to the mating threads of both the cap assembly and quill assembly.
5. Install the quill. Use SS1143 tool to tighten the quill to **1 356 N·m (1,000 ft lb)**. Allow the parts to cure for two hours before exposing the threaded areas to oil.

NOTE: If LOCQUIC Primer T (TL8753) was not used, the cure time will require 24 hours instead of two hours.

6. Tack weld the quill in two places as shown in Figure 50-39.
7. Remove all slag and foreign material from the tack weld area before assembling the cylinder.

During future cylinder rebuilds, removal of the quill will not be necessary unless it has loosened or is damaged. Removal will require a break-loose force of at least **2 712 N·m (2,000 ft lb)** after the tack welds are ground off.

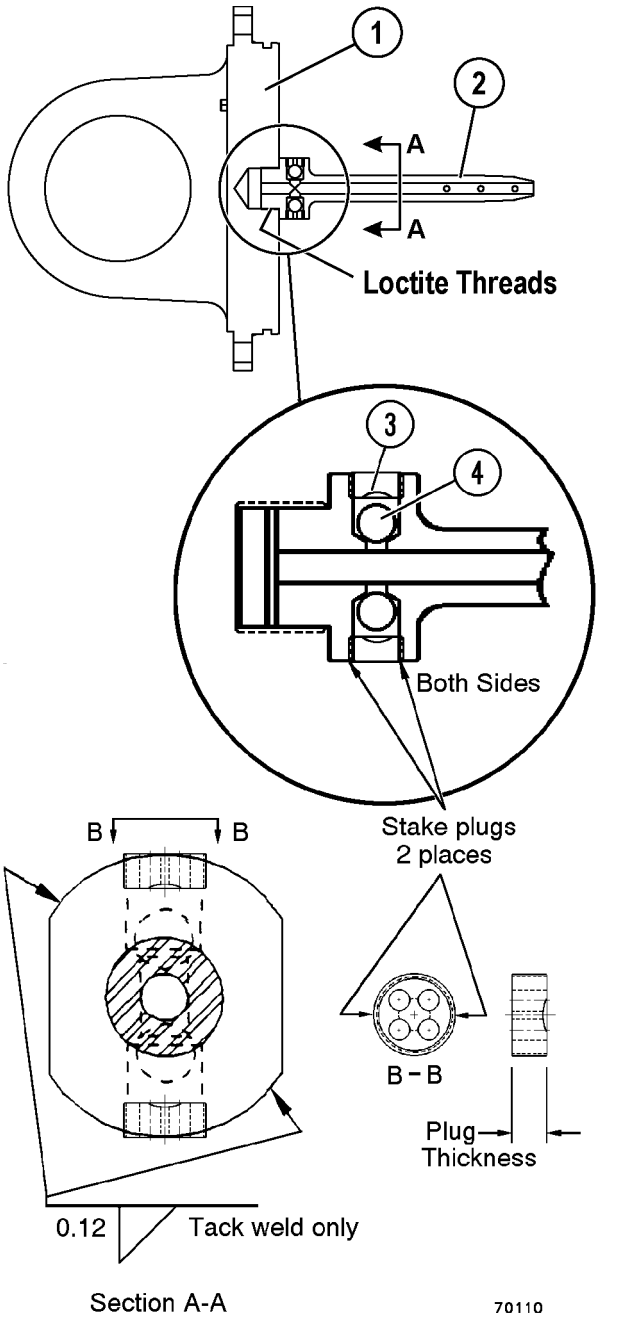


FIGURE 50-39. QUILL ASSEMBLY INSTALLATION

1. Cap Assembly
2. Quill Assembly
3. Plug
4. Check Ball

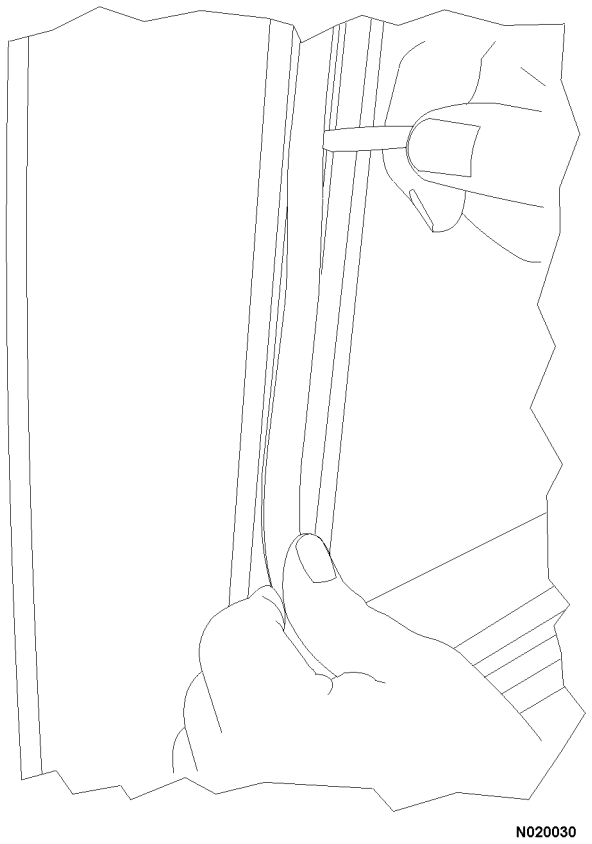


FIGURE 50-16. INSTALLING TRIM MATERIAL

Adjustment of cab door

Door jamb bolt adjustment

Over time, the door latch mechanism may wear. To ensure proper latching of the door, the door jamb bolt may need to be adjusted periodically.

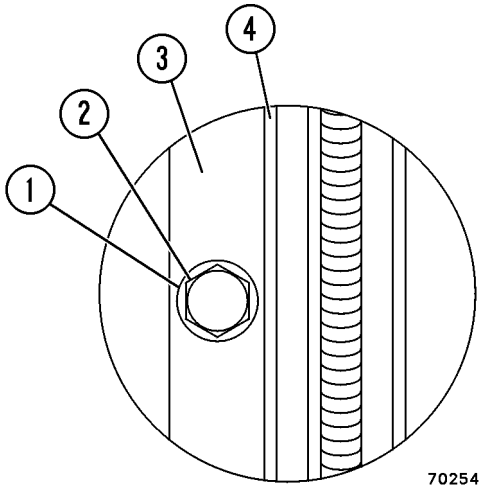


FIGURE 50-17. DOOR JAMB BOLT ADJUSTMENT

1. Washer
2. Striker Bolt
3. Frame
4. Door Seal

NOTE: Always check the condition of the door assembly seal before making adjustments.

- If the door closes, but not tightly enough to give a good seal between the door seal and the cab skin:
  1. Mark washer location (1, Figure 50-17) portion of the door jamb bolt with a marker, pen, or pencil by circumscribing the outside edge of the washer onto the jamb.
  2. Loosen striker bolt (2). Move it straight inwards 1.5 mm (1/16 inch) and retighten the bolt.
  3. Hold a piece of paper where door seal (4) will contact the skin of the cab and firmly close the door on the paper.

NOTE: The door latch mechanism has a double catch mechanism, so ensure that it latches on the second catch.

Removal and installation of seat belts (optional seats)

General

Inspect the date of manufacture on the seat belt. If the seat belt is over five years old, replace the seat belt. Or, if the seat belt has been in service for more than three years, replace the seat belt.

Follow the instructions to install the new seat belts. The instructions are the same for operator or passenger seats except where noted.

Required Tools:

- Rubber mallet
- Rivet press
- box end wrench - 17 mm
- Torx - T40
- Torx - T45
- Allen Head - 6 mm
- Allen Head - 5mm
- Torque wrench

Removal

1. Lift up tilt handle (2, Figure 50-47). Remove lower seat belt bolt (1) and discard.

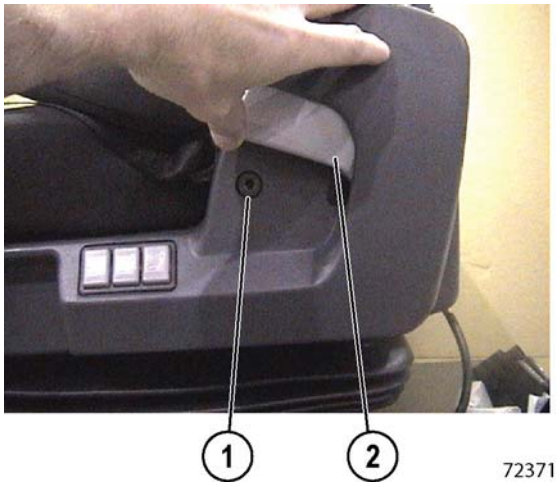


FIGURE 50-47.

1. Bolt 2. Tilt Handle

2. Remove seat belt buckle bolt (1, Figure 50-48) and discard bolt and buckle.

FIGURE 50-48.

1. Bolt

3. Remove two screws (2, Figure 50-49) from upper seat belt cover (1).

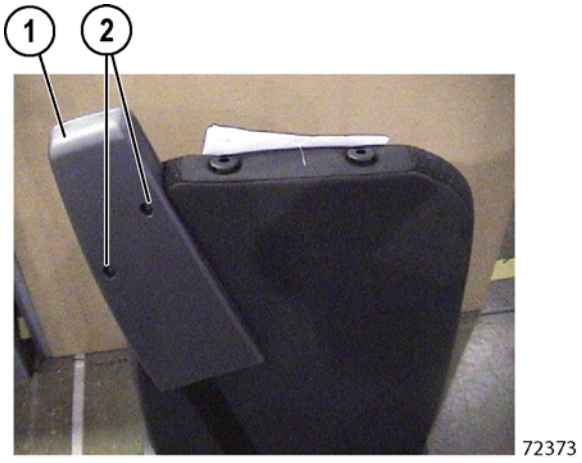


FIGURE 50-49.

1. Cover 2. Screws

Removal and installation of fuel tank

Removal

1. Raise the truck body and install the body up retention cable.
2. Loosen filler cap (5, Figure 50-11) and open drain cock (10) to drain the fuel from the tank into clean containers. Tighten the filler cap when the fuel is completely drained.
3. Disconnect wire harness (13) and remove the clamps attached to the fuel tank. Remove ground wire (17).
4. If equipped, close the inline shutoff valves. Remove fuel return hose (6) and fuel supply hose (8). Cap the hoses and tank fittings to help prevent contamination.
5. Remove hoist circuit filter assemblies (11) and steering circuit filter assembly (12) from the frame side of the tank. Support the filter assembly by placing a chain over the frame rail. It is not necessary to remove the hydraulic hoses.

⚠WARNING

The weight of the empty fuel tank is approximately 2 056 kg (4,533 lb). Use a lifting device with adequate capacity to remove the component.

6. Attach a lifting device to the lifting eyes on each side of the tank.
7. Remove lower mounting hardware (14), flat washer (15) and rubber dampeners (16). Remove upper mounting hardware (3) and mounting caps (4).
8. Lift the fuel tank from the brackets and move it to a work area.
9. Remove fuel gauge sender (9), breather (5), and other fittings as required to perform interior cleaning. See "Removal and installation of fuel gauge sender (S/N A50003 - A50011)" for further instructions.

Cleaning and inspection

NOTE: If a tank has been damaged and requires structural repair, perform such repairs before final cleaning.

⚠WARNING

If a tank is to be weld repaired, special precautions are necessary to prevent fire or explosion. Consult local authorities for safety regulations before proceeding.

The fuel tank has drain cock (10) and a cleaning port in the side that allows steam or solvent to be used for cleaning tanks that have accumulated foreign material.

It is not necessary to remove the tank from the truck for cleaning of sediment. However, rust and scale on the walls and baffles may require complete tank removal. This allows cleaning solutions to be in contact with all interior surfaces by rotating the tank in various positions.

Before a cleaning procedure of this type, all vents, the fuel gauge sender, and hose connections must be removed and temporarily sealed. After cleaning is complete, the temporary plugs can be removed.

If the tank is to remain out of service, a small amount of light oil should be sprayed into the tank to prevent rust. All openings should be sealed for rust prevention.

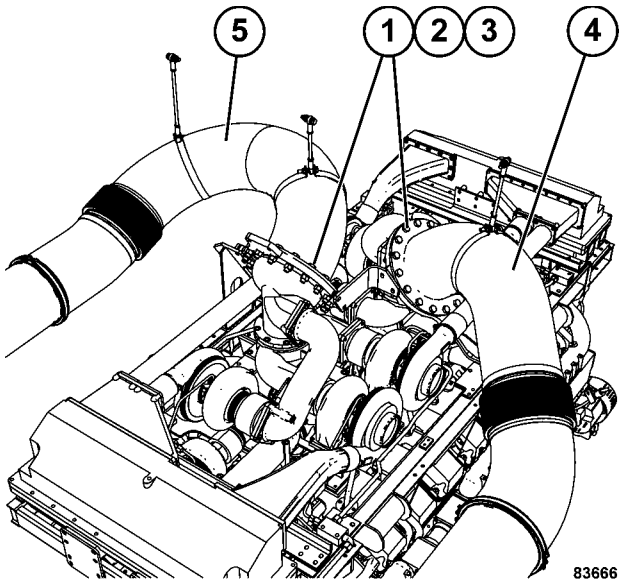


FIGURE 50-4. ENGINE EXHAUST PIPING

1. Capscrew
2. Lockwasher
3. Nut
4. Front Exhaust Pipe
5. Rear Exhaust Pipe

9. Remove the exhaust duct clamps. Remove capscrews (1, Figure 50-4), lockwashers (2) and nuts (3) that secure the exhaust pipes to the turbocharger outlet flange. Remove exhaust ducts (4) and (5). Cover the opening on the engine exhaust outlets.
10. Disconnect the electric power cables from the control cabinet. Disconnect all (already marked) electrical cables, oil lines and fuel lines that would interfere with removal of the power module. Cover or plug all lines and their connections to prevent entrance of dirt or foreign material. To simplify this procedure, most connections use quick disconnects.
11. Disconnect all ground straps between the frame and subframe. Disconnect wire harnesses at the power module subframe connectors.
12. Close the water shutoff valves on the engine. Disconnect the water lines and drain the water from the heater core. Secure the water lines away from the engine compartment to prevent interference during removal of the power module.
13. Drain the coolant into clean containers for reuse after engine installation. Refer to the Operation and Maintenance Manual for the cooling system capacity.
14. Remove all piping (1, Figure 50-5) from the engine water pump and radiator (2) to heat exchanger (3).
15. Remove the upper radiator support rod at each side of the radiator.
16. Remove the mounting hardware at the diagonal ladder mounting pads. Disconnect wiring from ladder light. Lift the ladder and vertical support from the truck and move it to a storage area.

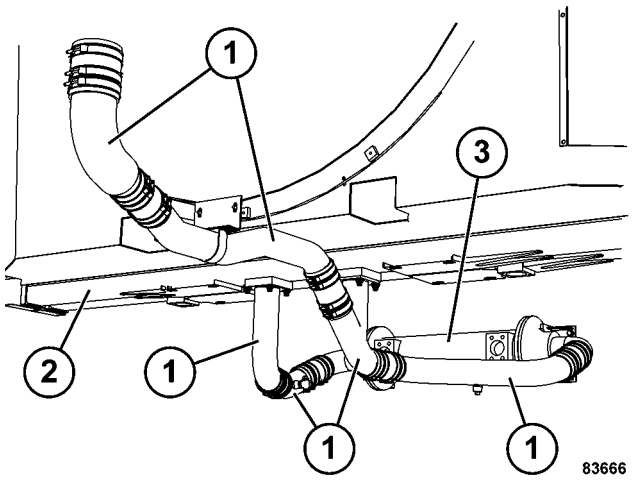


FIGURE 50-5. HEAT EXCHANGER PIPING

1. Piping
2. Radiator
3. Heat Exchanger

Assembly

NOTE: For easier installation, soak the seals in hot water before installing.

1. Install new tube seals onto the bottom tank and the bottom side of the center tank. Do not install seals in the top core at this time. Seals for the top of the tubes do not have locking grooves; bottom tube seals do. Ensure the correct seals are installed in the proper position.

   The seal holes must be dry during installation. Use a rubber mallet and a flat metal plate to lightly tap the seals into place. Using excessive force will drive the seals in too far. When installed properly, the seals should be slightly convex. Improperly installed seals are concave with a smaller diameter hole. Refer to Figure 50-26.
2. Use a 13 mm (1/2 in.) diameter brush to lubricate the seals with lube/release agent (XA2308).
3. Use a spray bottle to lubricate the tube ends with the lube/release agent.

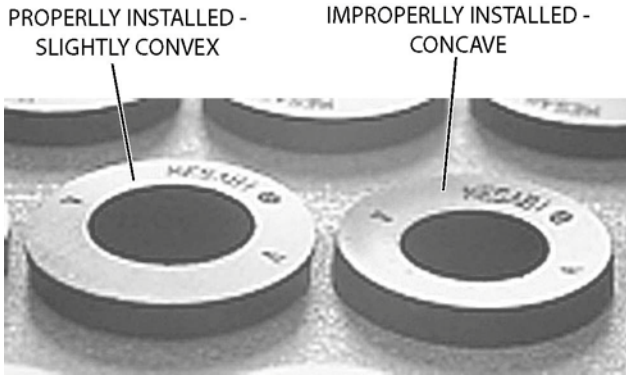


FIGURE 50-26. PROPER SEAL INSTALLATION

4. When installing tubes, start at one end and work toward the center. After you reach the center, move to the opposite end, and again work toward the center. If any of the tubes are difficult to install, do not force the tube. Remove the tube and determine the problem. Possible causes may be:
   - inadequate seal/tube lubrication
   - improperly installed seal
   - damaged seal or tube end
   - tube angle excessive during installation and/or tube not centered in seal.
5. Inspect the seals and tube ends for damage before trying to reinstall a tube. Replace as necessary.
6. Working from the front of the radiator (opposite of fan side), install the bottom row of tubes starting with the fan side row.
   When installing the tubes, center the top of the tube in the top seal while angling the tube only as much as necessary. Twist the tube while applying upward force. Push the tube into the seal until enough clearance is available to install the bottom end of the tube into the bottom seal.

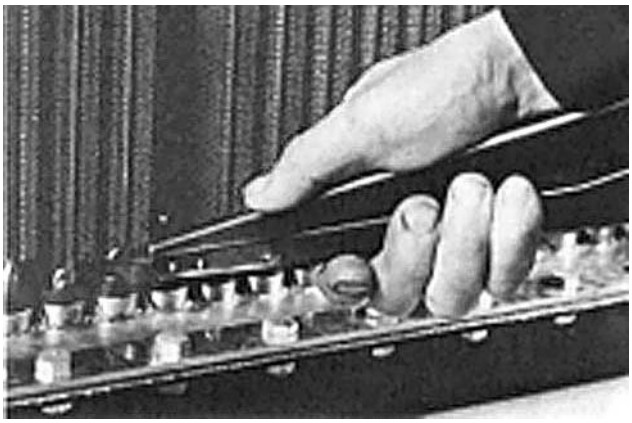


FIGURE 50-27. USING INSTALLATION TOOL (VJ6567) TO INSTALL TUBE

Maintenance intervals

Careful and regular maintenance is necessary to detect and eliminate possible problems before extensive damage can occur.

The maintenance intervals given in this manual are valid for typical working conditions. Special working conditions and/or legal and official regulations may necessitate more frequent maintenance.

In the case of malfunctioning or unusual operating conditions that could indicate electrical or mechanical overloading of the motor, the appropriate maintenance work and tests should be performed without delay.

The motor should be visually inspected in the course of all maintenance work. See “Checking for external damage” on page 8 and see “Regreasing the bearings” on page 9, which specify that damaged or missing parts must be replaced or replaced in accordance with assembling the motor (see “Assembling the motor” on page 24).

If the motor has been removed and completely or partially dismantled because of necessary repairs, all maintenance work described in dismantling the motor (see “Disassembling the motor” on page 11) that is possible in this state of dismantling should also be performed.

Maintenance work on the installed motor

If screw connections can be tightened:

- Open the screw connection and clean the thread.
- Replace the screw retainer and assemble the screw connection again.

Checking for external damage

- Inspect the motor for external damage of mechanical origin (visual inspection of all accessible parts).
- Dismantle damaged parts and either repair the damage or replace with new parts.
- Touch up damaged painted parts as described (see “Stator inspection” on page 21).
- Remove coarse impurities (leaves, paper, etc.) from the air outlet area.

Checking the connections

- Check that all screw connections for the connecting leads are securely attached and retighten them where necessary.
- Check the connecting leads for damage and, where necessary, replace them.

Checking the interior of the motor for water

- To check for water inside the motor, remove the plug from the bearing shield. Allow any water to drain. Clean the drain hole. Reinstall the plug.
- To check for water in the bottom of the terminal box, remove the screw. Allow any water to drain. Clean the drain hole. Apply activator (Loctite®7471™) to the screw threads and allow it to dry. Coat the screw threads with Loctite®243™. Insert the screw, tighten to **40 N·m (29.5 ft lb)**.

Maintenance intervals	Maintenance work
After every 6000 hours or once every year for minor service	• Check for external damage • Check the connections • Clean the drain holes • Regrease the bearings with rolling-contact bearing grease
After every 30,000 hours or once every 5 years for general service	On the disassembled, dismantled, and cleaned motor: • Replace the bearing (D-end) • Replace the bearing (N-end) • Check the insulation of the stator winding, insulation resistance greater than 2 M ohms • After cleaning: Insulation resistance 10 M ohms • Check the winding resistances

Assembling the rubber seals and the air baffles

NOTE: Assembly sequence:
Air baffles (2 and 4) (N-end and D-end)
Rubber seals (3) (N-end and D-end)

1. Remove all sealant residue from the surfaces of the stator frame and the air baffles. Then clean with cleaning agent (Loctite® 7063™).

NOTE: The drying time must always be observed.

2. Apply a zigzag bead of sealant (Loctite®518™) to the surfaces of the stator frame (5) and the air baffles (2 and 4) (N-end and D-end). Use a sufficient quantity to completely coat all surfaces, so that sealant (Loctite® 7471™) is evenly pressed out at the edges when the air baffles are assembled.
3. Apply activator (Loctite® 518™) to the threads of the screws (1), then coat threads with Loctite® 243™.
4. Arrange the individual air baffles (2 and 4) (N-end and D-end) in the correct positions as marked at the time of dismantling.
5. Insert the screws (1) and tighten to **20 N·m (14.8 ft lb)**.
6. Assemble the rubber seals:

NOTE: All dismantled rubber seals must always be replaced.

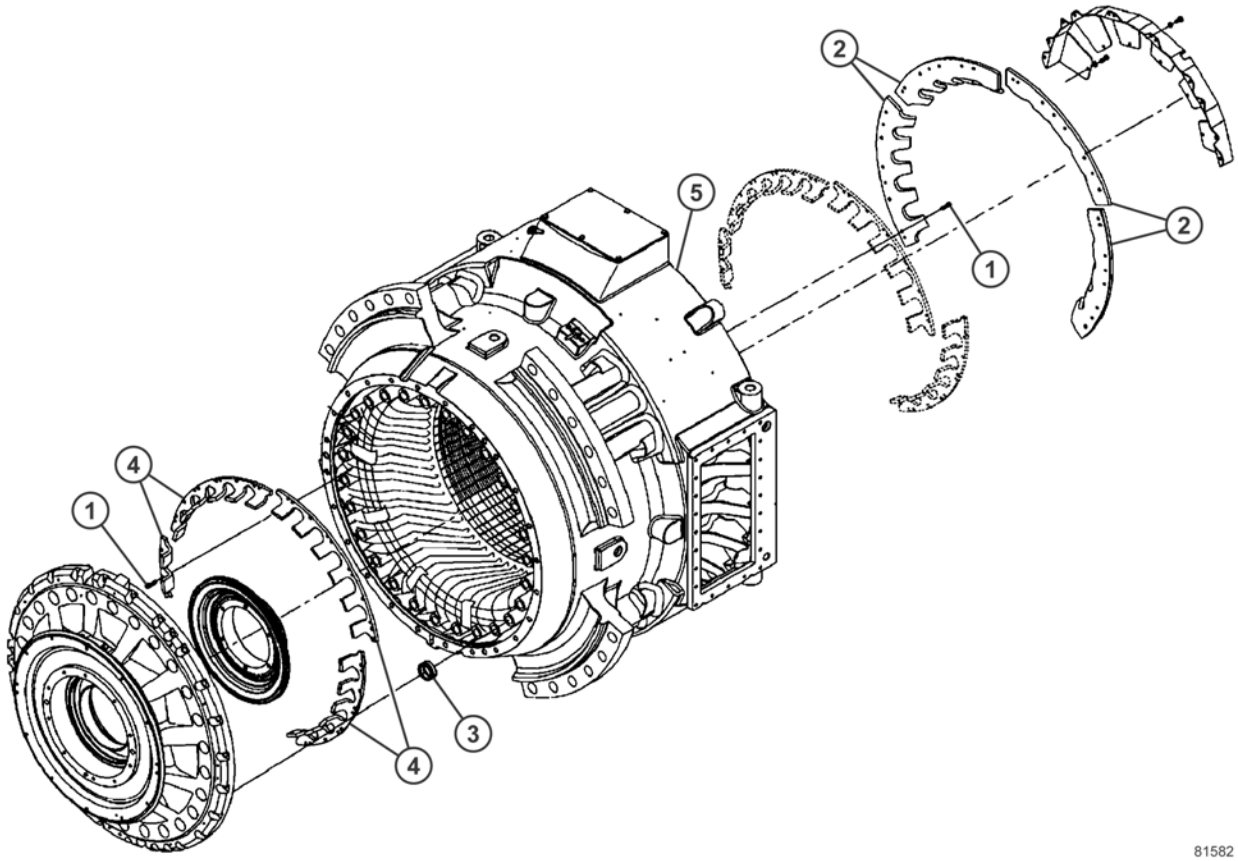


FIGURE 50-17. ASSEMBLING THE RUBBER SEALS AND THE AIR BAFFLES

1. Screw
2. Air Baffle (N-End)
3. Rubber Seal
4. Air Baffle (D-End)
5. Stator Frame

Installing accessories (D- and N-end)

1. Lay the lubricant hoses (1) and (2) as shown in Figure 50-32.
2. Fasten them with screws (8), clips (9), and cable ties (10), and connect them to the screw connections (3).
3. Apply activator (Loctite® 7471™) to the threads of the screws (8) and allow them to dry.
4. Coat the threads of the screws with Loctite® 243™, insert the screws, and tighten.
5. Completely fill the lubricant hose (1) with rolling-contact bearing grease (Shell RETINAX LX2).
6. Fill the locating hole of the temperature sensors (7) with thermo-lubricant (TEGO Z thermo-lubricant), so that lubricant is pressed out of the hole when the sensor is inserted.
7. Insert the temperature sensors (7) into the bearing shields (4) and (11) with thermo-lubricant (TEGO Z thermo-lubricant).
8. Apply activator (Loctite® 7471™) to the threads of the screws (5) and allow them to dry.
9. Coat the threads of the screws (5) with Loctite® 243™, insert the screws with washers (6), and tighten to **8 N·m (5.9 ft lb)**.

DUMP TRUCK

860E
960E

Machine model	Serial number
860E-1K	A30003 and up
860E-1KT	A30003 and up
960E-1K	A50003 - A50010
960E-2K	A50011 and up

50 Disassembly and assembly
Main blower

22. Install cover (28) and 16 capscrews and washers (29) on both inlet boxes.

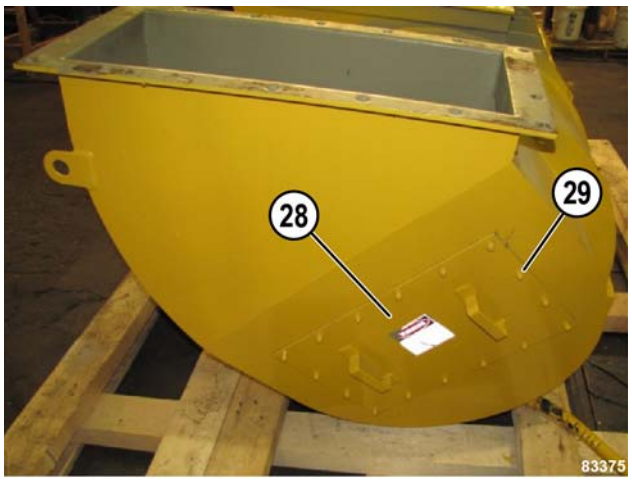


FIGURE 50-58. INSTALLING THE INLET BOX COVERS

28. Cover
29. Capscrew and Washer

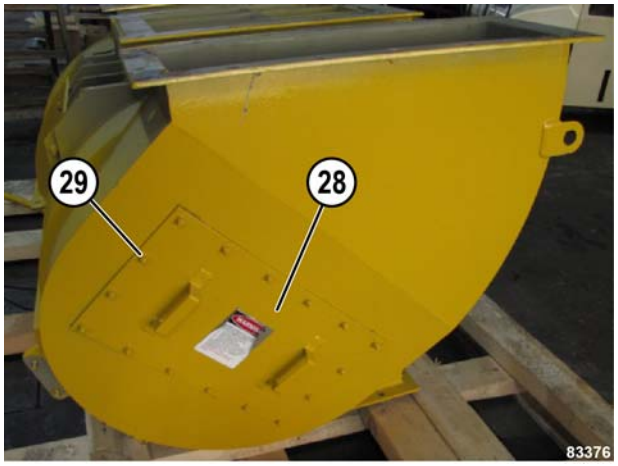


FIGURE 50-59. INSTALLING THE INLET BOX COVERS

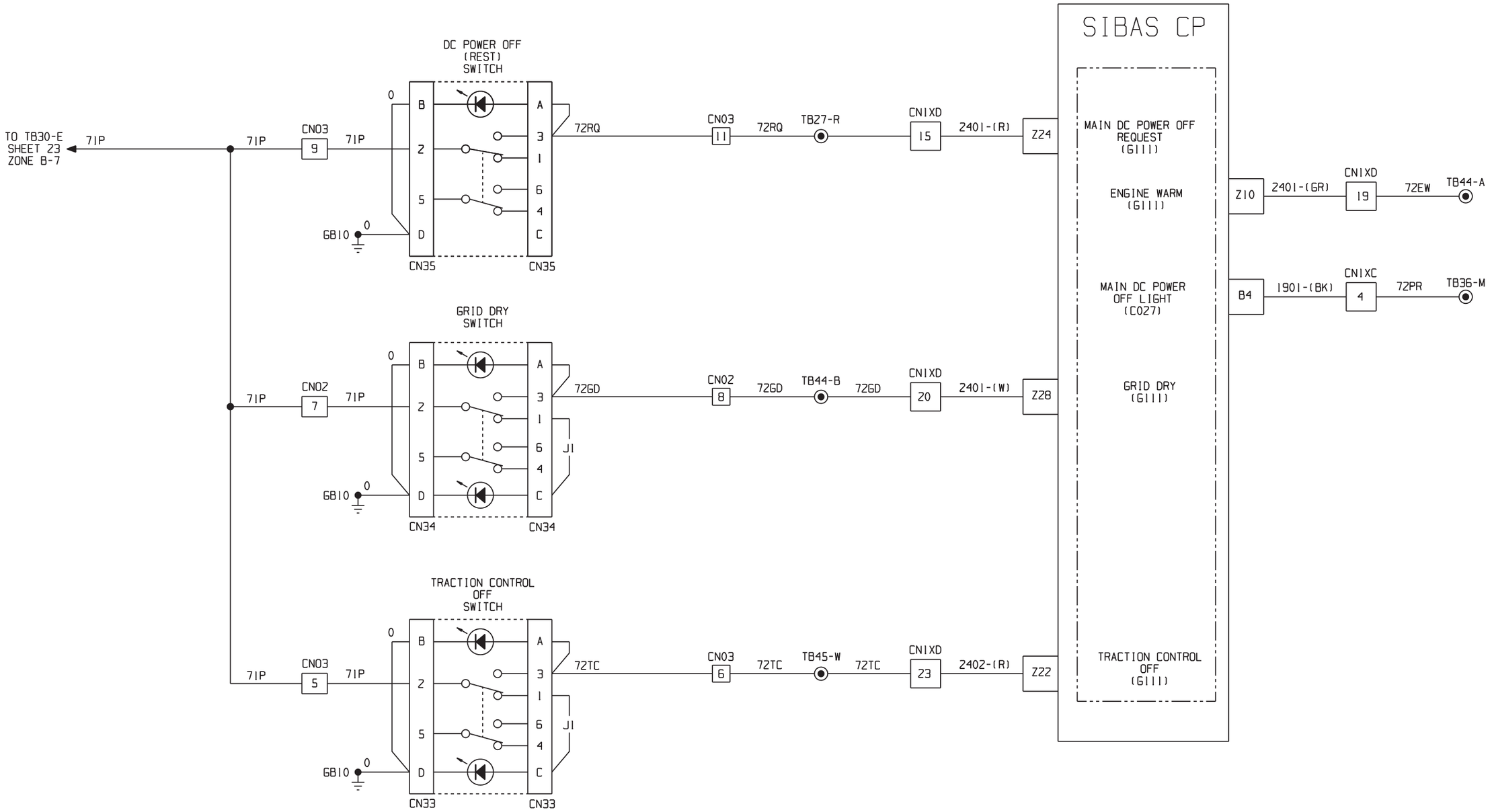
28. Cover
29. Capscrew and Washer

DUMP TRUCK

860E
960E

Machine model	Serial number
860E-1K	A30003 and up
860E-1KT	A30003 and up
960E-1K	A50003 - A50010
960E-2K	A50011 and up

50 Disassembly and assembly
Control cabinet



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ELECTRICAL SCHEMATIC

R.H. LOWER DASH SWITCH CIRCUITS

960E-1K / 960E-2K

A50003 & UP

VHMS MODULE

CN2B-9 — JUMPER — CN2B-12

SATELLITE ANTENNA

ORBCOMM MODEM

ANT. — ORBCOMM-ANTENNA

WAKE-UP — CN2A-17 — 7HMWU — TB48-J — 7HMWU — A-19 — WAKE-UP

TO SHEET 6 ZONE C-4 — 85 — TB37-J — 85 — 85 — A-36 — BATT. POWER

85 — A-39 — BATT. POWER

85 — A-40 — BATT. POWER

BATT. POWER — CN1-6 — 85

BATT. POWER — CN1-7 — 85

KEY SW. POWER — CN1-8 — 71VHM — 71VHM — TB36-E — 71VHM — TO SHEET 6 ZONE B-7

KEY SW. POWER — CN1-9 — 71VHM

GROUND — CN1-19 — 0 — 0 — TB30-V — 0 — 0 — A-37 — GROUND

GROUND — CN1-20 — 0

GROUND — CN1-11 — 0 — 0 — 0 — A-38 — GROUND

GROUND — CN1-12 — 0

SNAPSHOT IN-PROGRESS INDICATOR — CN1-16 — 74DS — TB48-W — TO IM2-L SHEET 31 ZONE A-3

TO TB30-X SHEET 29 ZONE A-4

RS232 VHMS-T/ORB-R — CN4B-4 — 900CR — R — TB48-C — R — R — 900CR — A-4 — RS232 VHMS-T/ORB-R

RS232 VHMS-R/ORB-T — CN4B-10 — 900CT — W — TB48-B — W — W — 900CT — A-5 — RS232 VHMS-R/ORB-T

RS232 GND — CN4B-3 — 900CG — B — TB48-D — B — B — 900CG — A-11 — RS232 GND

CN4B-9 — SHLD — S — TB48-A — S

CNA

DATA STORE — CN3B-2 — 73DS — 73DS — TO TB27-T SHEET 23 ZONE B-3

CN26

CAN/1939-H — CN4A-4 — 939YE — Y — A

CAN/1939-L — CN4A-12 — 939GE — G — B — TO CAN (1939) SHEET 35 ZONE D-3

CAN/1939-S — CN4A-13 — C

CN850

CAN/RPC-H — CN4A-6 — 939YP — Y — A

CAN/RPC-L — CN4A-14 — 939GP — G — B — TO CAN (RPC) SHEET 35 ZONE C-3

CAN/RPC-S — CN4A-5 — C

SHLD80 — TB48-E — S

DATAPORT T — CN4A-10 — 90VHT — TB48-F — W

DATAPORT R — CN4A-11 — 90VHR — TB48-G — R

DATAPORT G — CN4A-9 — 90VHG — TB48-H — B

CN07

W — 10 — W — 90VHT — 3 — DIAG 6 OPERATOR CAB VHMS

R — 11 — R — 90VHR — 2

B — 12 — B — 90VHG — 5

S — 9 — S — SHLD

W — 90VHT — 3 — VHMS - DIAG. AUXILLARY CAB

R — 90VHR — 2

B — 90VHG — 5

SHLD — R382

TRUCK CONFIGURATION PORT

CN3A-3 — SE1

CN3A-5 — SE2

CN3A-9 — SE6

CN3A-13 — SE6

CN3A-14 — SE3

CN3A-15 — SE4

CN3A-16 — SE5

CN16

6	6
2	2
4	4
5	5
3	3
1	1

QSK 78 JUMPER PLUG

XS6934-0 APR 09

ELECTRICAL SCHEMATIC

VHMS & ORBCOMM MODULES

960E-1K / 960E-2K

A50003 & UP