CEBM006502

Shop Manual

930E-2

DUMP TRUCK

SERIAL NUMBERS **A30156 thru A30180**
w/ Cummins QSK60 Engine

KOMATSU

MAJOR COMPONENT DESCRIPTION

Truck And Engine

The 930E Dump Truck is an off-highway, rear dump truck with AC Electric Drive. The gross vehicle weight is 1,100,000 lbs. (498 960 kg). The engine is a Cummins QSK60C rated @ 2700 HP (2014 kW).

Alternator (GE-GTA34)

The diesel engine drives an in-line alternator at engine speed. The alternator produces AC current which is rectified to DC within the main control cabinet. The rectified DC power is converted back to AC by groups of devices called "inverters", also within the main control cabinet. Each inverter consists of six "phase modules" under the control of a "gate drive unit" (GDU). The GDU controls the operation of each phase module.

Each phase module contains an air-cooled solid-state switch referred to as a "gate turn-off thyristor" (GTO). The GTO cycles on and off at varying frequencies to create an AC power signal from the DC supply.

The AC power signal produced by each inverter is a variable-voltage, variable-frequency signal (VVVF). Frequency and voltage are changed to suit the operating conditions.

AC Induction Traction Motorized Wheels

The alternator output supplies electrical energy to the two wheel motors attached to the rear axle housing. The motorized wheels use three-phase AC induction motors with full-wave AC power.

The two wheel motors convert electrical energy back to mechanical energy through built-in gear trains within the wheel motor assembly. The direction of the wheel motors is controlled by a forward or reverse hand selector switch located on the center console.

Blower

Both the inverters and the wheel motors produce heat while in operation and must be cooled. Cooling air is provided by a separate AC drive blower using rectified DC as its power source. Cooling air flow volume is modulated based on thermal requirements.

Suspension

HYDRAIR®II suspension cylinders located at each wheel provide a smooth and comfortable ride for the operator and dampens shock loads to the chassis during loading and operation.

Operator's Cab

The operator cab has been engineered for operator comfort and to allow for efficient and safe operation of the truck. The cab provides wide visibility, with an integral 4-post ROPS/FOPS stucture, and an advanced analog operator environment. It includes a tinted safety-glass windshield and power-operated side windows, a deluxe interior with a fully adjustable seat with lumbar support, a fully adjustable/tilt steering wheel, controls mounted within easy reach of the operator, and an analog instrument panel which provides the operator with all instruments and gauges which are necessary to control and/or monitor the truck's operating systems.

Power Steering

The truck is equipped with a full time power steering system which provides positive steering control with minimum operator effort. The system includes nitrogen-charged accumulators which automatically provide emergency power if the steering hydraulic pressure is reduced below an established minimum.

Dynamic Retarding

The dynamic retarding is used to slow the truck during normal operation or control speed coming down a grade. The dynamic retarding ability of the electric system is controlled by the operator through the activation of the retarder pedal (or by operating a lever on the steering wheel) in the operators cab and by setting the RSC (Retarder Speed Control). Dynamic Retarding is automatically activated, if the truck speed goes to a preset overspeed setting.

Brake System

Service brakes at each wheel are oil-cooled multiple disc brakes applied by an all-hydraulic actuation system. Depressing the brake pedal actuates both front and rear brakes, after first applying the retarder. All wheel brakes will be applied automatically, if system pressure decreases below a preset minimum.

The parking brake is a dry disc type, mounted inboard on each rear wheel motor, and is spring-applied/hydraulically-released with wheel speed application protection (will not apply with truck moving).

In The Operator's Cab - Before Starting The Engine

- DO NOT leave tools or spare parts lying around or allow trash to accumulate in the cab of the truck. Keep all unauthorized reading material out of the truck cab.
- Keep the cab floor, controls, steps, and handrails free of oil, grease, snow, and excess dirt.
- Check the seat belt, buckle and hardware for damage or wear. Replace any worn or damaged parts. Always use the seat belts when operating a machine.
- Read and understand the contents of the Operation & Maintenance manual. Read safety and operating instructions with special attention. Become thoroughly acquainted with all gauges, instruments and controls before attempting operation of the truck.
- Read and understand the **WARNING** and **CAUTION** decals in the operator's cab.
- Ensure the steering wheel, horn, controls and pedals are free of any oil, grease or mud.
- Check operation of the windshield wiper, condition of wiper blades, and check the washer fluid reservoir level.
- Be familiar with all steering and brake system controls, warning devices, road speeds and loading capabilities, before operating the truck.

OPERATING THE MACHINE

Starting The Engine

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

Truck Operation - General

- Wear seat belts at all times.
- Only authorized persons are allowed to ride in the truck. Passengers must be in the cab and belted in the passenger seat.
- DO NOT allow anyone to ride on the decks or on the steps of the truck.
- DO NOT allow anyone to get on or off the truck while it is in motion.
- DO NOT move the truck in or out of a building without a signal person present.
- Know and obey hand signal communications between the operator and spotter. When other machines and personnel are present, the operator should move in and out of buildings, loading areas and through traffic, under the direction of a signal person. Courtesy at all times is a safety precaution!
- Immediately report any adverse conditions on haul road, pit or dump area that may cause an operating hazard.

SPECIAL PRECAUTIONS FOR WORKING ON A 930E TRUCK

Preliminary Procedures before Welding or Performing Maintenance

Prior to welding and/or repairing a 930E dump truck, maintenance personnel should attempt to notify a Komatsu service representative. Only qualified personnel, specifically trained for servicing the A-C drive system, should perform this service.

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

⚠DANGER

Anytime the engine is operating:

- ***DO NOT open any of the cabinet doors or remove any covers.***
- ***DO NOT use any of the power cables for hand holds or foot steps.***
- ***DO NOT touch the retarding grid elements.***

⚠WARNING

Before opening any cabinets or touching a grid element or a power cable, the engine must be shutdown and the red drive system warning lights must not be illuminated.

Normal Engine Shutdown Procedure

1. Stop the truck out of the way of other traffic on a level surface (dry, if possible) and free of overhead power lines or other obstructions (in case the dump body should need to be raised).
   a. Reduce engine speed to idle. Allow the engine to cool gradually by running at low idle for approximately 5 minutes.
   b. Place the selector switch in NEUTRAL.
   c. Apply the parking brake. Be sure the parking brake applied indicator light in the overhead display panel is illuminated.
2. Turn the rest switch to the ON position to put the A-C drive system in “rest” mode of operation. Be sure the “rest” indicator light in the overhead panel is illuminated.
3. After the engine cools, turn the key switch counterclockwise to OFF for normal engine shutdon.
   If the engine does not shutdown with the key switch, use the engine shutdown switch on the center console. Pull the switch up until the engine stops. Push the switch back down to allow future engine operation.
4. With the key switch OFF, and the engine stopped, wait at least 90 seconds. Ensure the steering circuit is completely bled down by turning the steering wheel back and forth several times. No front wheel movement will occur when hydraulic pressure is relieved. If the vehicle continues to steer after shutdown, notify maintenance personnel.
5. Verify that all the link voltage lights are off (one on back wall of operator cab, and two on deck control cabinets). Notify maintenance personnel if any light remains illuminated longer than five minutes after engine shutdown.
6. Close and lock all windows, remove the key from the key switch, and lock the cab to prevent possible unauthorized truck operation. Dismount the truck properly. Place wheel chocks around the wheels.

Engine Shutdown Procedure before Welding or Performing Maintenance

Normal operation of the drive system at shutdown should leave the system safe to maintain. However, in the event of a system failure, performing the following procedure prior to any maintenance activities will ensure that no hazardous voltages are present in the A-C drive system.

1. Before shutting down the engine, verify the status of all the drive system warning lights on the overhead display panel. Use the lamp test switch to verify that all lamps are functioning properly.
   If any of the red drive system warning lights remain on, DO NOT attempt to open any cabinets, disconnect any cables, or reach inside the retarder grid cabinet without a trained drive system technician present - even if engine is off.
   Only qualified personnel, specifically trained for servicing the A-C drive system, should perform this service.
2. If all red drive system warning lights are off, follow the “Normal Engine Shutdown Procedure”.

DYNAMIC RETARDING OPERATION

Dynamic retarding is a braking torque (not a brake) produced through electrical generation by the wheel motors when the truck motion (momentum) is the propelling force. For normal truck operation, dynamic retarding should be used to slow and control the speed of the truck.

Dynamic retarding is available in FORWARD/ REVERSE at all truck speeds above 0 mph/kph; however, as the truck speed slows below 3 mph (4.8 kph), the available retarding force may not be effective. Use the service brakes to bring the truck to a complete stop.

Dynamic retarding will not hold a stationary truck on an incline; use the parking brake for this purpose.

Dynamic retarding is available in NEUTRAL only when truck speed is above 3 mph (4.8 kph).

When dynamic retarding is active, the engine rpm will automatically go to an advance rpm retard speed setting (usually 900 - 1000 rpm*).

NOTE: The exact engine speed in retarding may vary due to the temperature of certain components; this is controlled by the Propulsion System Controller (PSC).

Dynamic retarding will be applied automatically if the speed of the truck reaches the maximum truck speed of 40 mph (64 kph). Any application of the dynamic retarding system (automatic, retarder lever, or foot pedal) will cause an indicator light to illuminate in the overhead display panel.

Dynamic Retarder Control Lever

The dynamic retarder control lever mounted on the right side of the steering column can be used to modulate retarding effort. The lever will command the full range of retarding and will remain at a fixed position when released.

a. When the lever is rotated to full "up" (counterclockwise) position, it is in the OFF (No Retard) position.

b. When the lever is rotated to full "down" (clockwise) position, it is in the full ON (Retard) position.

c. For long downhill hauls, the lever may be positioned to provide a desired retarding effort. It will remain where it is positioned.

NOTE: The retard control lever must be rotated back to the OFF position before the truck will resume the "propel" mode of operation.

The lever and foot-operated retarder/service brake pedal can be used simultaneously or independently. The PSC will determine which device is requesting the most retarding effort and apply that amount.

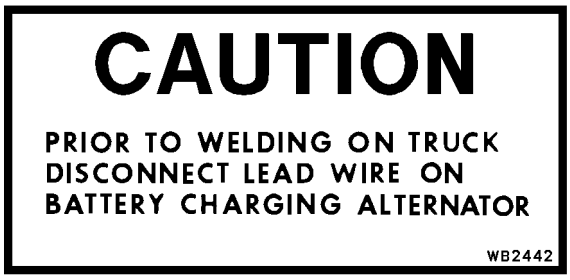
Dynamic Retarder/Service Brake Pedal

The dynamic retarder/service brake pedal is a single, foot-operated pedal which controls both retarding and service brake functions. The first portion of pedal travel commands retarding effort through a rotary potentiometer. The second portion of pedal travel modulates service brake pressure directly through a hydraulic valve. Thus, the operator must first apply, and maintain, full dynamic retarding in order to apply the service brakes. Releasing the pedal returns the brake and retarder to the OFF position.

When the pedal is partially depressed, dynamic retarding is actuated. As the pedal is further depressed to where dynamic retarding is fully applied, the service brakes (while maintaining full retarding) are then actuated through a hydraulic valve, which modulates pressure to the service brakes. Completely depressing the pedal causes full application of both dynamic retarding and the service brakes. An indicator light in the overhead panel will illuminate, and an increase in pedal resistance, will be felt when the service brakes are applied.

Use dynamic retarding (lever or foot-operated pedal), during normal truck operation, to slow and control the speed of the truck. Apply the service brakes only when dynamic retarding requires additional braking force to slow the truck speed quickly, or when bringing the truck to a complete stop.

This caution decal is placed near the battery disconnect switches on the right side of the front bumper to alert servicing technicians that before doing any welding on the truck, always disconnect the battery charging alternator lead wire and isolate electronic control components before making welding repairs.



In addition, always disconnect the positive and negative battery cables of the vehicle. Failure to do so may seriously damage the battery and electrical equipment.

Always fasten the welding machine ground (-) lead to the piece being welded; **grounding clamp must be attached as near as possible to the weld area**. Never allow welding current to pass through ball bearings, roller bearings, suspensions, or hydraulic cylinders. Always avoid laying welding cables over or near the vehicle electrical harnesses. Welding voltage could be induced into the electrical harness and possibly cause damage to components.

A high voltage danger plate is attached to the door of the rear hatch cover. High voltage may be present!

Only authorized personnel should access this rear housing.

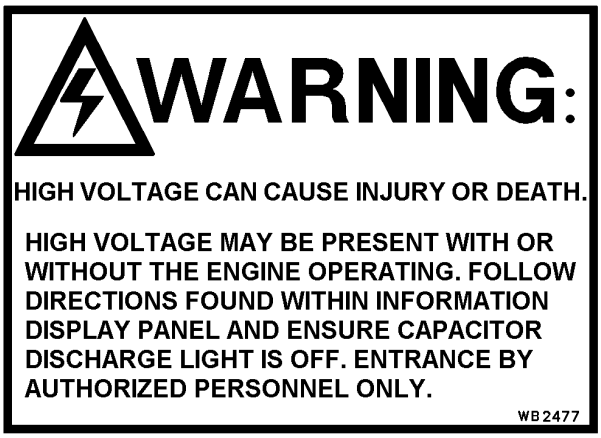
A caution decal is also attached to the door of the rear hatch cover to alert personnel that hot exhaust air is present and may cause injury.

This caution decal is also placed around the retarding grid cabinet.

These warning plates are mounted on all of the AC drive control housings and cabinets.

High voltage may be present, with or without, the engine running!

Only authorized personnel should access these cabinets.



SECTION A7
STORAGE AND IDLE MACHINE PREPARATION
INDEX

After The Engine Has Started

Any machine which is unsafe and/or not in top operating condition should not be assigned to an operator for production use.

1. Become thoroughly familiar with steering and emergency controls. Test the steering in extreme right and left directions. If the steering system is not operating properly, shut engine down immediately. Determine the steering system problem and have repairs made before resuming operation.
2. Operate each of the brake circuits at least twice prior to operating and moving the machine. These circuits include individual activation of the service brake and parking brake from the operator's cab.
   a. Activate each circuit individually with the engine running and with hydraulic circuit fully charged.
   b. If any application or release of any brake circuit does not appear proper or if sluggishness is apparent on application or release, shut the engine down and notify maintenance personnel. Do not operate machine until brake circuit in question is fully operational.
3. Check gauges, warning lights and instruments before moving the machine to insure proper system operation and proper gauge functioning. Give special attention to braking and steering circuit warning lights. If warning lights come on, shut down the engine immediately and determine the cause.
4. Cycle hoist controls and steering several times to remove trapped air. Complete steering cycles in both directions to verify steering response, smoothness and reliability. Check seals and lines for leaks.
5. When satisfied that all discrepancies have been corrected, the vehicle is ready for a road test. This test should be done only by a capable and experienced operator and should be accomplished in a large open area where plenty of maneuvering room is available. Some of the road test items which should be covered will include:

- Repeated test of braking efficiency at progressively higher speeds. Start at slow speeds. Don't take chances with higher speeds until the machine is determined to be completely safe.

6. When all tests and checks have been made and the vehicle is ready for work, it should be visually rechecked and fully serviced according to Section P, Lubrication and Service.

A few of the conditions (others may be found) which might be encountered after a machine has been exposed to the elements for a long period would include:

- Increased corrosion and fungus growth on electrical components in humid/tropical areas.
- Accelerated rust formation in humid climates.
- Increased sand and dust infiltration in windy, dry dusty areas. (These conditions can approach sand blasting effects.)
- Deterioration of rubber products in extreme cold areas. Cables, hoses, O- rings, seals and tires may become weather checked and brittle.
- Animal or bird's nests in unsealed openings.

SECTION B2
STRUCTURAL COMPONENTS
INDEX

BODY PADS

It is not necessary to remove the dump body to replace body pads. Pads should be inspected during scheduled maintenance inspections and replaced if worn excessively.

1. Raise the unloaded dump body to a height sufficient to allow access to all pads.

⚠WARNING

Place blocks between the body and frame. Secure blocks in place.

2. Remove hardware attaching pads to the dump body. Refer to Figure 3-4.
3. Remove body pad and shims. Note number of shims installed at each pad location. (The rear pad on each side should have one less shim than the other pads.)
4. Install new pads with the same number of shims as removed in step 3.
5. Install the mounting hardware and torque to **65 ft.lbs. (88.1 N-m).**
6. Remove blocks from frame and lower body onto the frame.

Adjustment

1. Vehicle must be parked on a flat, level surface for inspection.
2. All pads, except the rear pad on each side, should contact the frame with approximately equal compression of the rubber.
3. A gap of approximately 0.075 in. (1.9 mm) is required at each rear pad. This can be accomplished by using one less shim at each rear pad.
4. If pad contact appears to be unequal, repeat the above procedure.

! IMPORTANT !
Proper body pad to frame contact is required to assure maximum pad life.

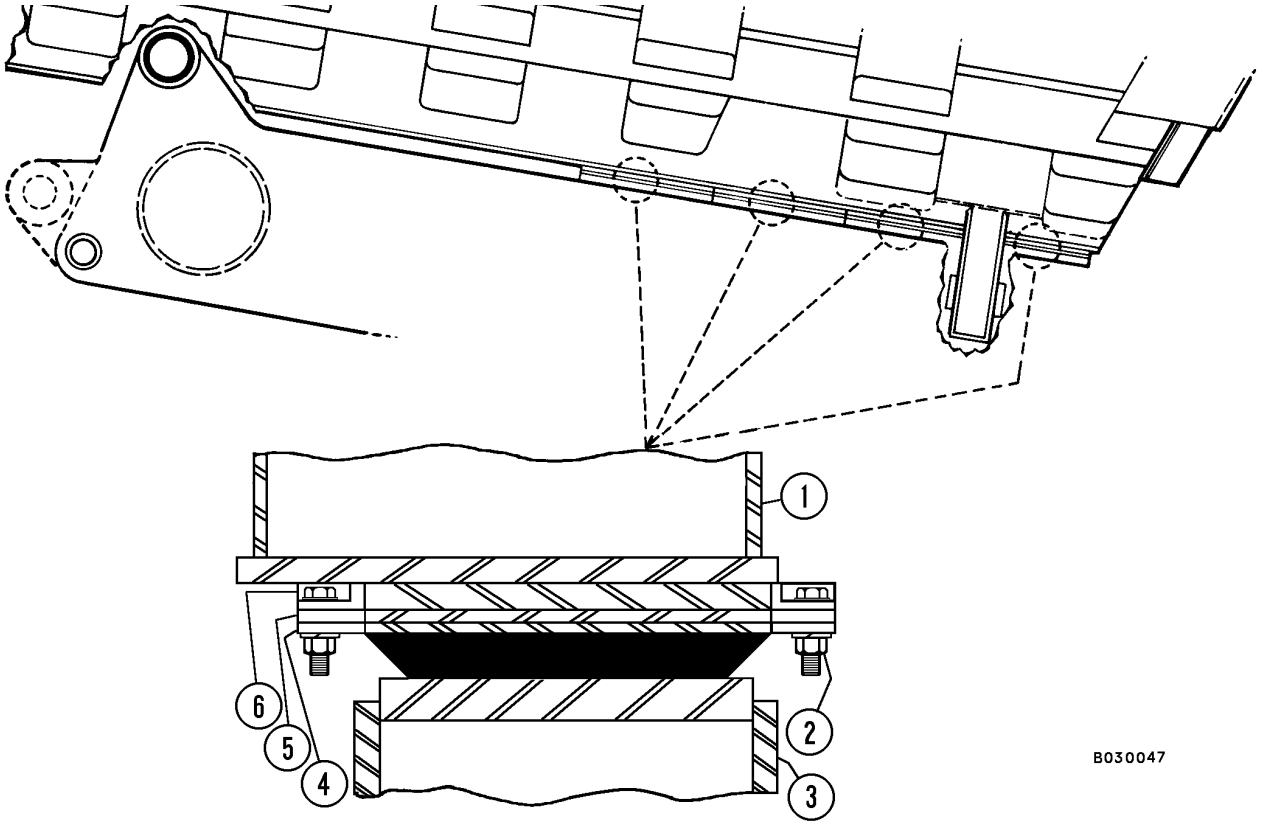


FIGURE 3-4. BODY PAD INSTALLATION

1. Dump Body
2. Pad Mounting Hardware
3. Frame
4. Body Pad
5. Shim
6. Mounting Pad

LEFT SIDE FILL

This location permits fueling the truck from the left side.

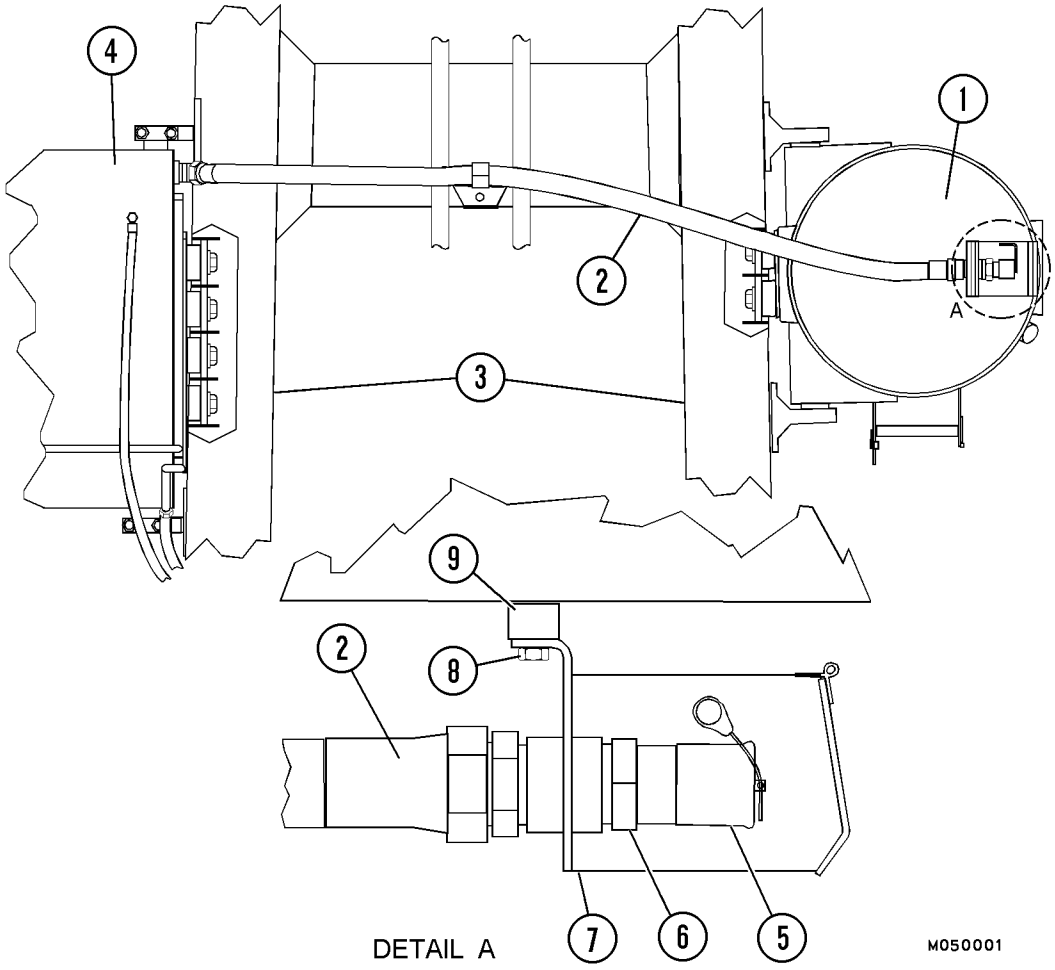


FIGURE 4-3. LEFT SIDE FILL

1. Hydraulic Tank
2. Filler Hose
3. Frame Rails
4. Fuel Tank
5. Filler Cap
6. Receiver Assembly
7. Refueling Box
8. Capscrew
9. Tapped Bar

NOTE: This illustration represents a typical installation. Installation may vary depending on truck model.

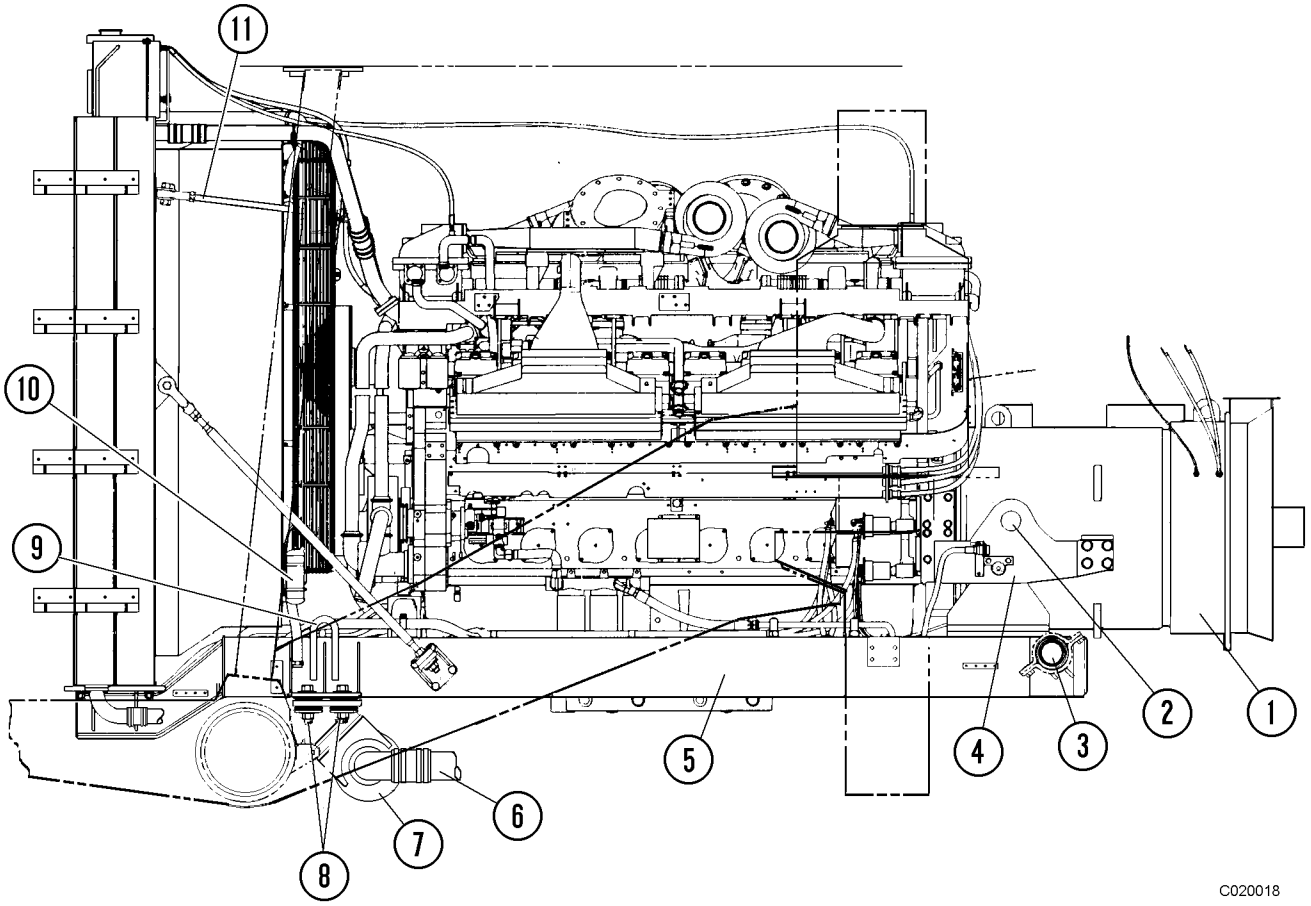


FIGURE 2-5. POWER MODULE REMOVAL & INSTALLATION

1. 1. Alternator
2. 2. Rear Power Module Lift Eye
3. Rear Frame/Sub-frame Mount
4. Engine/Alternator Cradle Structure
5. Power Module Sub-frame
6. Heat Exchanger Piping
7. Heat Exchanger
8. Front Frame/Sub-frame Mount
9. Front Power Module Lift Eye
10. Receiver/Drier
11. Upper Radiator Support Rod

Removal - Power Module

Recheck to be certain all hoses, electrical cables, ground straps etc. have been removed.

1. Remove capscrews, nuts and washers (8, Figure 2-5) securing front subframe support to main frame.

⚠WARNING

Install safety chain around the engine subframe cross member and main frame to prevent the power module from rolling when the subframe rollers are installed.

2. Remove capscrews and caps securing subframe mounting bushings to the subframe support bracket (3) at rear of subframe.
3. Check engine and alternator to make sure all cables, wires, hoses, tubing and linkages have been disconnected.

⚠WARNING

Lift power module only at the lifting points on subframe and engine/alternator cradle structure. (Refer to Figure 2-5 and 2-7.)

4. Remove all the tubes at the top, before removing the bottom tubes.
5. After all of the tubes are removed, pliers can be used to remove the seals from the tanks. Discard all seals. New seals must be used for assembly.

Cleaning and Inspection

1. Clean tube holes using a drill with a 3/4 in. (19 mm) wire brush.
2. Clean the holes of any foreign debris and wipe clean.
3. Clean the inside of the tanks and tubes. In most cases just flushing the inside with a high pressure hot water washer, with soap, will do the job. If not, contact an L&M manufacturing facility or visit the L&M website for further instruction at ***www.mesabi.com***.
4. Check for signs of internal blockage in tubes and tanks. If desired, you may cut open tubes for inspection. If contamination is present, the tube should be analyzed. The radiator must be properly flushed of all contaminants and corrective action must be taken to prevent such contamination from occurring in the future. Refer to Internal Inspection in this section.
5. Buff the tube ends with a polishing wheel and a copper polishing compound. If any debris can not be removed by buffing, emery cloth, steel wool, or a wire wheel (wire size 0.006 - 0.008 in. (0.15 - 0.20 mm) is acceptable for use. Use extreme care not to mar the tube ends.

Assembly

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

1. Install the new tube seals onto the bottom tank and the bottom side of the center tank. Do not install seals for 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. The seals should be slightly convex when installed properly. Improperly installed seals are concave with a smaller diameter hole. Refer to Figure 3-9.

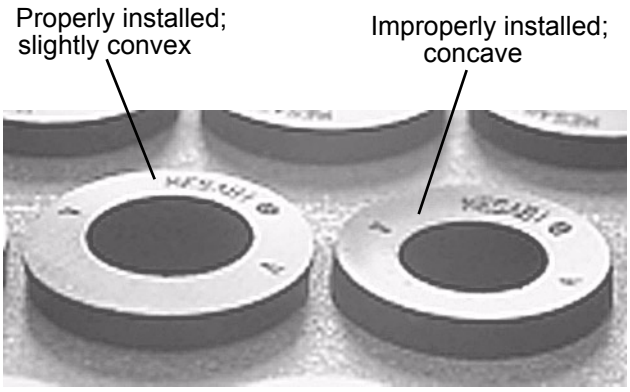


FIGURE 3-9. PROPER SEAL INSTALLATION

2. Use a 1/2 in. (13 mm) diameter brush to lubricate the seals with lube/release agent (XA2308).

⚠WARNING

When lifting the alternator, attach hoist to lift eyes only. The alternator weighs approximately 8,200 lbs. (3,720 kg). Use a lifting device that can handle the load safely.

1. Use the two top lift brackets provided on the alternator for lifting. The top front lifting bracket should be equipped with some method of adjusting the alternator to keep it horizontal.
2. Carefully move alternator into place and engage the engine drive ring (6, Figure 4-6) into the alternator rotor drive (7) using shims “B”, if required (refer to step 5.a. “Determining Shims”, in Measuring Procedure).
3. Install flywheel housing adapter capscrews (2) into alternator housing (1). Tighten to **175 ft. lbs. (237 N.m)** torque.
4. Install capscrews (5) through engine drive ring (6) into the alternator rotor adapter (7). Rotate crankshaft to access and align holes. Tighten capscrews (5) to **175 ft. lbs. (237 N.m)** torque.
5. Install alternator-to-cradle structure mounting capscrews and washers (2, Figure 4-2) and tighten to **525 ft. lbs. (712 N.m)** torque.
6. Tighten engine-to-cradle structure mounting capscrews (5, Figure 4-2) to **345 ft. lbs. (465 N.m)** torque.

⚠IMPORTANT⚠

Never pry on the engine crankshaft damper!

7. With magnetic base mounted on the front of the engine and the dial indicator on the front of the crankshaft, measure total crankshaft end-play:

   Record Total Crankshaft End-play:_____

8. Compare the step 7 value to the measurement taken before alternator was installed on engine.

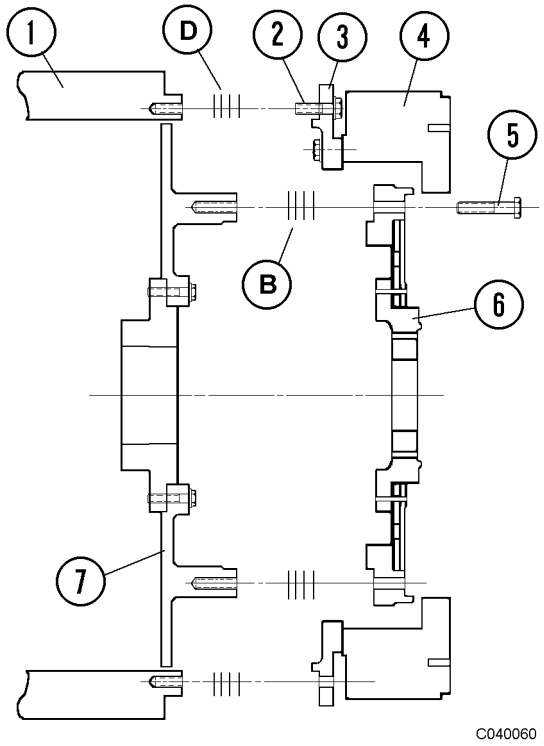


FIGURE 4-6. ALTERNATOR TO ENGINE MOUNTING

1. Alternator Housing
2. Point Capscrew
3. Flywheel Housing Adapter
4. Engine Flywheel Housing
5. Capscrew
6. Engine Drive Ring
7. Alternator Rotor

“B” - Drive Shims
“D” - Housing Shims

The total engine crankshaft end-play (step 7) must equal the original measurement or 0.020 in. (0.51 mm) (alternator end-play), whichever is smaller.

If the end-play after the alternator and engine are assembled is less than 0.020 in. (0.51 mm), and less than the starting engine crankshaft end-play, *Reshimming is required.*

9. Rotate the crankshaft one full revolution and listen for any unusual noise caused by moving components contacting stationary parts.
10. Install engine side cover, if removed. Install lockwire on all alternator mounting capscrews.
11. Install access cover on flywheel housing.

SECTION C7
FAN CLUTCH
INDEX

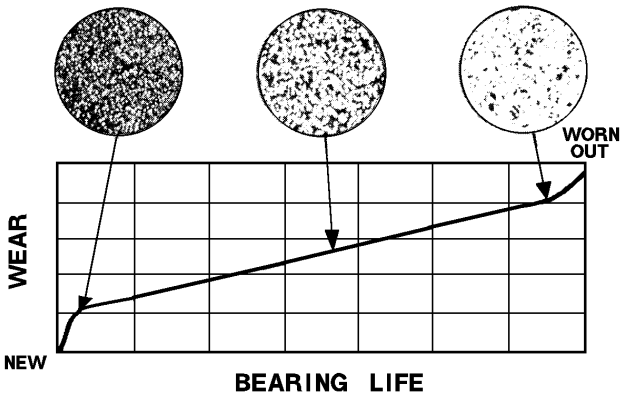


FIGURE 7-14.

12. Inspect sleeve bearing (44) and sleeve bearing (41). Compare the color of each bearing to the chart below. The lighter the appearance of the bearing, the more worn it is. If either bearing needs replacing, proceed to the next step. If the bearings are in good condition, skip the next step.

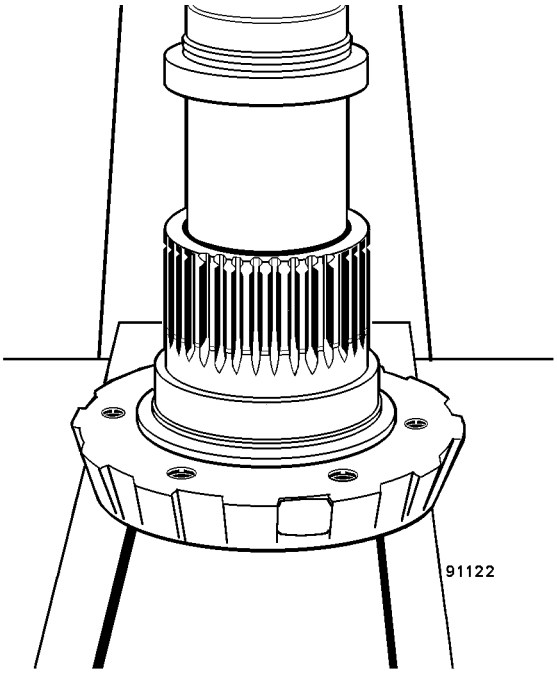


FIGURE 7-15.

13. Position tooling (C) against sleeve bearing (41). Press the front sleeve bearing downward to press it out of the fan mounting hub. Rear sleeve bearing (44) will be pressed out simultaneously.

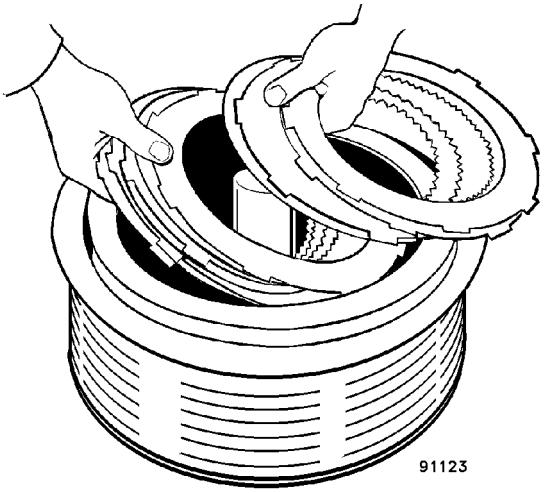


FIGURE 7-16.

14. Remove the stack of facing plates (30) and steel clutch plates (31) from inside the pulley.

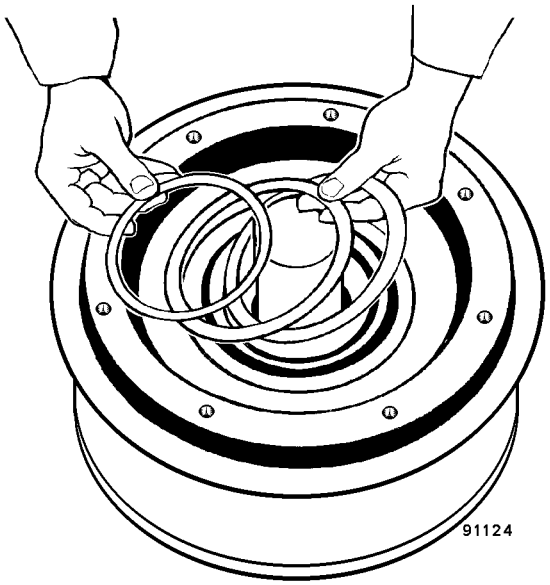


FIGURE 7-17.

15. Remove external snap ring (27), shim (26), and spring washer (25).

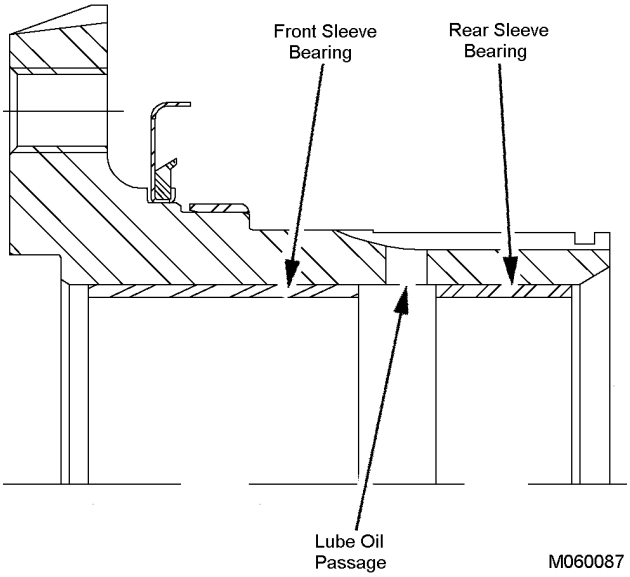


FIGURE 7-40.

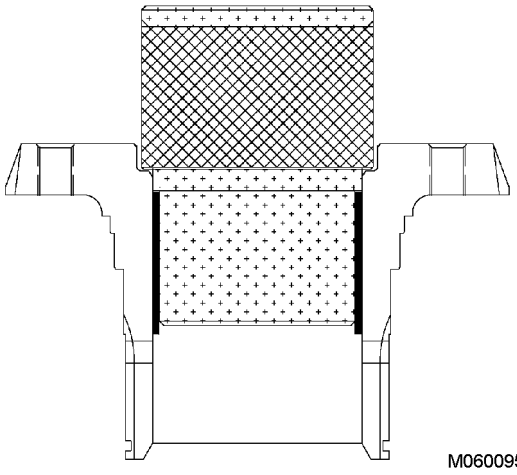


FIGURE 7-41.

3. Using tooling (A), press front (long) sleeve bearing (44) into the fan mounting hub until the tool contacts the shoulder of the hub. Ensure the correct bearing is installed. There are two sleeve bearings, and each one must be installed in the proper area of the hub to ensure the lube passage is not restricted. Refer to Figure 7-40.

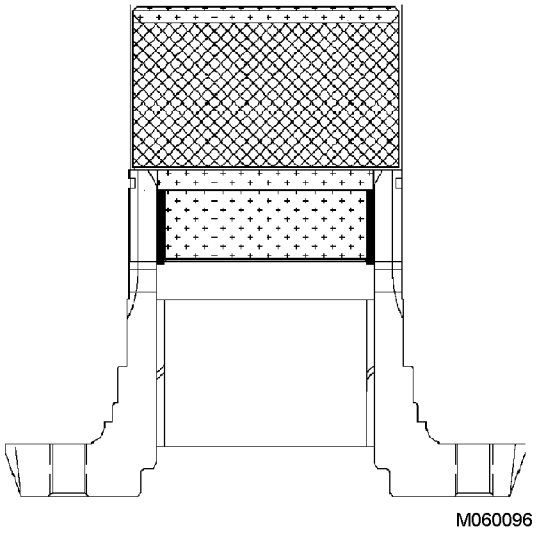


FIGURE 7-42.

4. Turn the hub over on the bed of the press. Again using tooling (B), press rear sleeve bearing (41) into the fan mounting hub until the tool contacts the shoulder of the hub.

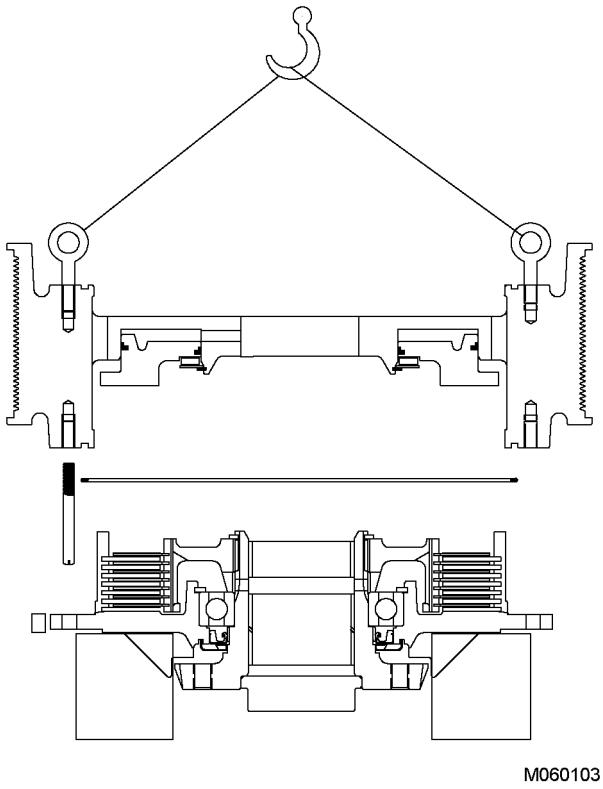


FIGURE 7-71.

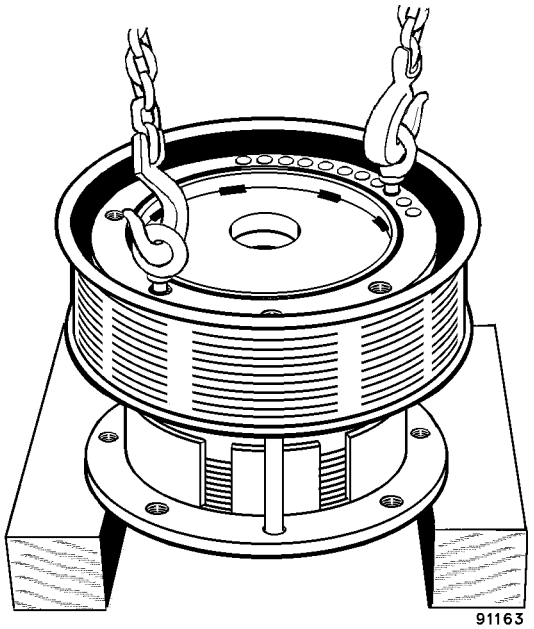


FIGURE 7-72.

32. Turn the pulley adapter assembly over and install two lifting eyes 180° apart. Install a guide-bolt in one bolt hole of the pulley. Refer to Figure 7-71.

    Coat front O-Ring seal (34) with petroleum jelly or an oil-soluble grease. Place the seal in the groove in the pulley. The grease should secure the seal in the groove during installation.

    Carefully lower the pulley. Ensure the guide bolt is aligned with a bolt hole in the bearing retainer assembly and the O-ring seal is still securely in place. Lower the pulley until it rests on the front bearing retainer.

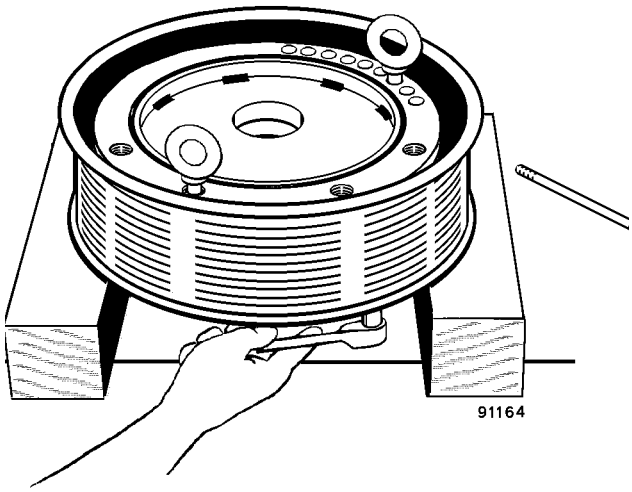


FIGURE 7-73.

33. Install at least four bolts (38) with lockwashers (37) and snug. Insert the bolts 90° apart.

BATTERY SUPPLY SYSTEM

24VDC Battery Charging Alternator

Refer to Section D, Battery Charging Alternator for information regarding the truck battery charging alternator.

Battery Box

The truck batteries are located in an enclosure (1, Figure 2-1) in the center of the truck behind the front bumper. For access to the batteries, remove the two covers by turning the cover handles counterclockwise until released. Lift eyes are attached to the ends of the enclosure if the entire battery container must be removed.

Four, type 8D batteries (2) are installed in the battery box and are used for the 24VDC engine cranking circuit and the 12VDC circuits. Two Type 4D batteries (3) are installed to provide 24VDC for the truck systems other than engine starting. A system battery starter disconnect relay isolates these batteries from the engine starter circuit during engine cranking.

Battery Control Box

The battery control box (4) is located near the right corner of the front bumper. This box contains the battery disconnect switches and other components listed below.

System Battery Starter Disconnect Relay

The system battery starter disconnect relay (7, Figure 2-2) isolates the engine cranking circuit, when the starter is actuated, from the system battery circuits to ensure the high current demand in the starter circuit does not affect the control system circuits.

When the operator turns the keyswitch to the start position, a signal is sent from the keyswitch to the Truck Control Interface (TCI) located in the electrical interface cabinet. If all conditions required to engage the starter are acceptable, the TCI panel provides a signal to energize the system battery starter disconnect relay, disconnecting the system batteries from the start circuit until the cranking sequence is completed and cranking battery voltage returns above a programmed voltage.

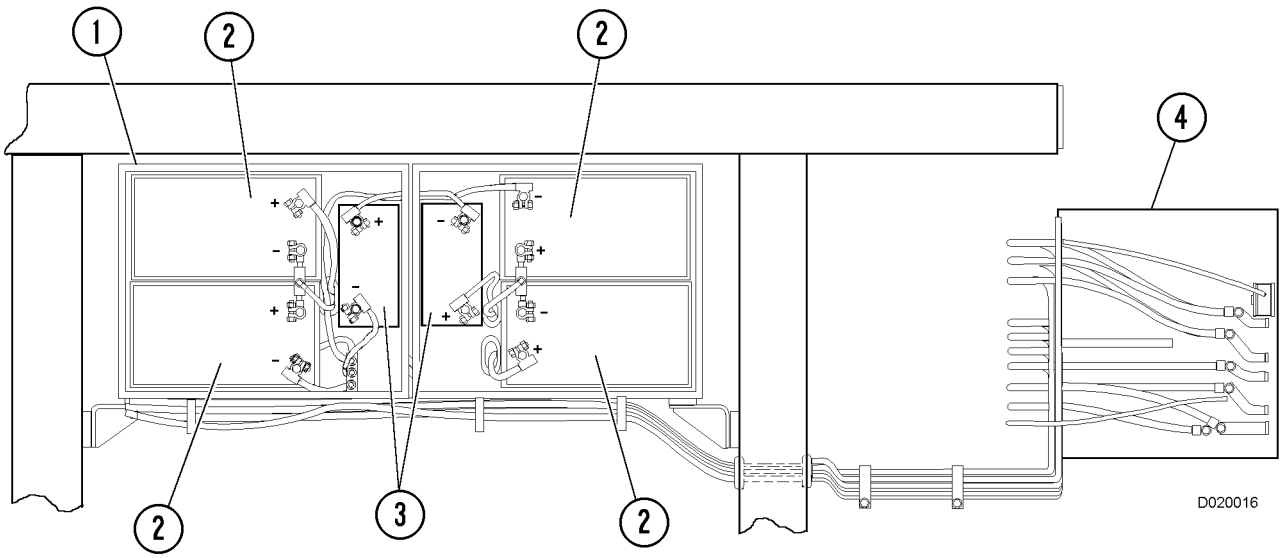


FIGURE 2-1. BATTERY BOX AND BATTERY CONTROL BOX

1. Battery Box
2. Engine Cranking Batteries
3. System Batteries
4. Battery Control Box

Hot Switch Inverter Card (Slot 4) (Not Used)

Oil Level

The oil level card is used to turn on the low oil level indicator light to warn the operator engine oil/hydraulic tank oil level is below acceptable levels. The oil float is connected to a variable resistor. As the oil level decreases, the resistance goes down causing Q3 to turn on, grounding the indicator light and alarm horn.

Temperature

The temperature card (**Optional**) is used to turn on the high oil temperature indicator light. The indicator light tells the operator that the hydraulic tank oil temperature has exceeded acceptable levels. Normal temperature setting is 250°F (121°C). As the temperature goes up the resistance in the probe decreases providing a ground path for the indicator light and alarm horn.

Diode Matrix (Without Sound)

The diode matrix **without sound** card consists of a series of diodes capable of working with eight different indicator circuits. The indicator light can be a flashing light by connecting it to the 12F circuit or a steady light by connecting it to the 12M circuit. In addition, some of the indicator light circuits are routed through a dimmer module to allow the operator to vary the intensity of the lamps. These lamps are fed by circuits 12FD (flashing) and 12MD (steady).

When an indicator circuit is not activated, there is no ground circuit for the bulb. When the Indicator detecting switch activates the circuit, it grounds the lamp and grounds the flasher circuit through the diodes. Any circuits connected to terminals C1 through C8 will operate in the same manner. The alarm horn is not activated by this card.

Diode Matrix (With Sound)

The diode matrix **with sound** card works very much like the other diode matrix card, except that it contains extra diodes to activate the alarm horn in addition to the flasher. The circuits connected to terminals A1 through A8 operate in the same manner.

Lamp Test

All of the card circuits are connected to the lamp test switch on the overhead display area. In normal operation, these circuits are open and not functional. When the operator pushes the lamp test switch, it activates all the indicator circuits by grounding them. This is used to verify that all lamps are functional.

CIRCUIT BREAKERS				
	AMPS	**DEVICES(S) PROTECTED**	**CIRCUIT**	**LOCATION**
CB00	50	12 Volt Power Source	11B1	Battery Control Box
CB1	5	Fan Clutch Power	440	Electrical Interface Cabinet
CB2	20	ECM Main Power	240M	Electrical Interface Cabinet
CB3	20	ECM Main Power	241M	Electrical Interface Cabinet
CB4	20	ECM Main Power	240R1	Electrical Interface Cabinet
CB5	20	ECM Main Power	241R1	Electrical Interface Cabinet
CB6	15	Engine Service Solenoids	11SL	Electrical Interface Cabinet
CB7	10	Lincoln Lube Solenoids	68	Electrical Interface Cabinet
CB8	10	Body-up Limit Switch/Solenoid	712H	Electrical Interface Cabinet
CB9	10	Spare		Electrical Interface Cabinet
CB10	10	Spare		Electrical Interface Cabinet
CB11	15	Spare		Electrical Interface Cabinet
CB12	5	Spare		Electrical Interface Cabinet
CB13	15	Clearance Lights	11CL	RB1, Elect. Interface Cabinet
CB14	15	Turn Signals	11Z	RB1, Elect. Interface Cabinet
CB15	15	RD1, RD2, & Tail Lights	41T	RB1, Elect. Interface Cabinet
CB16	15	Dynamic Retard Lights	44C	RB3, Elect. Interface Cabinet
CB17	15	Manual Back-up Lights	47B	RB3, Elect. Interface Cabinet
CB18	15	Stop Lights	44A	RB3, Elect. Interface Cabinet
CB19	15	Back-up Horn	79A	RB3, Elect. Interface Cabinet
CB20	5	439E Circuit & Park Brake Fail Relay Coil	439E	RB4, Elect. Interface Cabinet
CB21	15	Steering Bleeddown, Horn	11A	RB4, Elect. Interface Cabinet
CB22	5	Relay Board RB6, K2 coil (Engine Run/Ignition)	23D	RB4, Elect. Interface Cabinet
CB23	15	Low Beam Headlight, L.H.	11DL	RB5, Elect. Interface Cabinet
CB24	15	Low Beam Headlight, R.H.	11DR	RB5, Elect. Interface Cabinet
CB25	15	High Beam Headlight, L.H.	11HL	RB5, Elect. Interface Cabinet
CB26	15	High Beam Headlight, R.H.	11HR	RB5, Elect. Interface Cabinet
CB27	15	Headlight Switch	11D	RB5, Elect. Interface Cabinet
CB28	15	Payload Meter	39J	RB2, Elect. Interface Cabinet
CB29	15	Payload Meter	39G	RB2, Elect. Interface Cabinet
CB30	15	Hazard Light Switch	11L	Power Distribution Module
CB31	15	Cab Heater/AC Blower Motor	12H	Power Distribution Module
CB32	15	Warning Lights, A.I.D. Module	12M	Power Distribution Module
CB33		Not Used		Power Distribution Module
CB34		Not Used		Power Distribution Module
CB35		Not Used		Power Distribution Module
CB36	10	Cigar Lighter	11B2	Power Distribution Module
CB37	10	Windshield Washer & Wiper	712W	Power Distribution Module
CB38	5	Fuel, Engine Temp., Oil Pressure, Voltmeter	712D	Power Distribution Module
CB39		Not Used		Power Distribution Module
CB40A	5	Accessory Plug (12VDC)	12GE	Power Distribution Module
CB40B	10	Radio/Cassette Player	11B4	Power Distribution Module
CB41A	15	Cab Door Window, L.H.	11B6	Power Distribution Module

ON VEHICLE TROUBLESHOOTING GUIDE

ALTERNATOR ELECTRICAL CONDITIONS - Low Voltage - High Voltage - No Voltage

PRELIMINARY PROCEDURES

Common problems, all applications:

Check alternator drive belt (s).

Check alternator positive connection

Check alternator ground connection on alternator.

Check condition of connector between regulator and alternator.

Identify model of alternator_____

Identify model of regulator_____

Record voltage regulator set points stated on regulator tag:

1)_____ 2)_____ 3)_____ (if applicable)

TOOLS AND EQUIPMENT:

1 - Voltmeter (Digital type preferred.)
1 - Ammeter (Digital, Inductive type preferred.)
1 - 12 gauge lead, 12 inches long, with alligator clip at each end.

LOW VOLTAGE OUTPUT

Causes of low voltage:

Loose drive belt.

Low state of charge of battery.

Current load on system greater than alternator can produce.

Defective wiring or poor ground path.

Low regulator set point.

Defective voltage regulator.

Defective alternator.

HIGH VOLTAGE OUTPUT

Causes of high voltage:

Wrong regulator.

High regulator set point.

Defective regulator.

Defective alternator.

NO VOLTAGE OUTPUT

Causes of no voltage output:

No drive belt.

No battery (B+) voltage at alternator's "B+" terminal (except isolator type systems).

No "link" from "R" terminal to energize ("E") terminal on alternator when engine operating.

Defective regulator.

Defective alternator.

BATTERY CONDITIONS AND CHARGE VOLTAGE REACTIONS:

NOTE: Until electrical system component temperatures stabilize, these conditions may be observed during cold start voltage tests.

Maintenance type:

Immediately after engine start, system volts are lower than regulator set-point with medium amps.

3-5 minutes into charge cycle, higher system volts and reduced amps.

5-10 minutes into charge cycle, system volts are at, or nearly at, regulator set point, and amps are reduced to a minimum.

Low Maintenance types:

Same as above, except cycle times may be longer.

BENCH TEST

Results of on-vehicle test should be confirmed by these bench tests, if possible. When it is not possible to perform on-vehicle test, alternator performance can be checked quickly by referring to these bench tests.

Equipment:

- Test Bench, with 15 - 20 Hp motor set up to drive alternator to 7000 RPM.
- Voltmeter, 0 - 40 Volt Range
- Ammeter, 0 - 400 Amp Range

Mount alternator on test bench according to the bench manufacturer's instructions. Refer to Figure 10-5 for set-up to measure voltage and amperage produced by alternator. Voltage within ± 0.2V of regulator setpoint is "normal". Amperage within ± 10% of rated output at 5000 rpm is "high".

TEST 1 - No Load Test

Without electrical load but with battery connected, run alternator at 5000 rpm. Refer to Table 10-5 below.

Table 10-5: N0-LOAD TEST

AMPS	VOLTS	DIAGNOSIS
HIGH	**LOW**	Test bench battery is discharged (or defective). Allow to charge or replace.
HIGH	**NORMAL**	Give time to stabilize while monitoring VOLTS. If VOLTS rise above normal range (Table 13-2) regulator and/or field coil must be replaced. If AMPS fall, charging system is OK.
HIGH	**HIGH**	Stop test. Regulator and/or field coil should be replaced. (Go to Static Tests.)
LOW	**LOW**	Alternator and/or regulator must be repaired or replaced. Go to Test 3.
LOW	**NORMAL**	Regulator OK. Go to Test 2.
LOW	**HIGH**	Stop test. Bench malfunction or wiring error.

TEST 2 - Full Load Test

With load set to rated output (nameplate) ± 10%, run alternator at 5000 rpm. Refer to Table 10-6.

Table 10-6: FULL-LOAD TEST

AMPS	VOLTS	DIAGNOSIS
HIGH	**LOW**	Test bench battery is discharged (or defective). Allow to charge or replace.
HIGH	**NORMAL**	Charging system OK.
HIGH	**HIGH**	Stop test. Regulator and/or field coil should be replaced. (Go to Static Tests.)
LOW	**LOW**	Alternator and/or regulator must be repaired or replaced. Go to Test 3.
LOW	**NORMAL**	Increase load.
LOW	**HIGH**	Stop test. Bench malfunction or wiring error.

TEST 3 - Regulator Bypass Test

Perform this test only when suggested by other tests.

Alternator connections and load same as test 2. Bypass regulator as shown in Figure 10-7. Note whether amps rise to within ± 10% of output rating when connecting F- terminal to ground. Note whether amps fall when disconnecting F- terminal. Then refer to Table 10-7 below.

⚠CAUTION

Limit terminal connection to a few seconds to protect charging system from excessive voltage.

Table 10-7: REGULATOR BYPASS TEST

CONNECT	DISCONNECT	DIAGNOSIS
Amps Rise	Amps Fall	Alternator is OK. See note, replace regulator only if low AMPS/low VOLTS indicated in Test 1 and/or Test 2.
No Change	No Change	Alternator must be repaired. Go to Static Tests.
Note: Before replacing regulator, check continuity of energize circuit (refer to Static Tests, Test 5).		

4. Seat field coil bobbin ears over stator tabs (Figure 10-25) by inserting field winding and rotating about 20 degrees after insertion with tool BF4820. Align screw holes in bobbin ears with screw holes in stator tabs.

Note: Bobbin ears go over stator tabs as viewed from both ends of tube assembly.

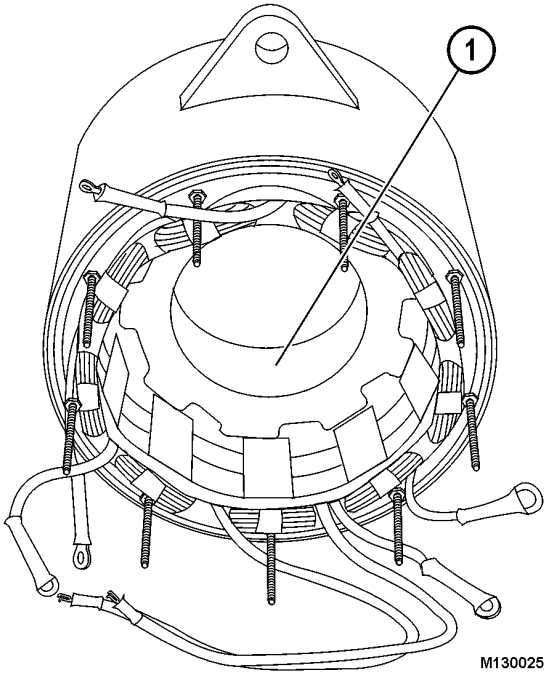


FIGURE 10-25.

1. Field Coil Bobbin Ear

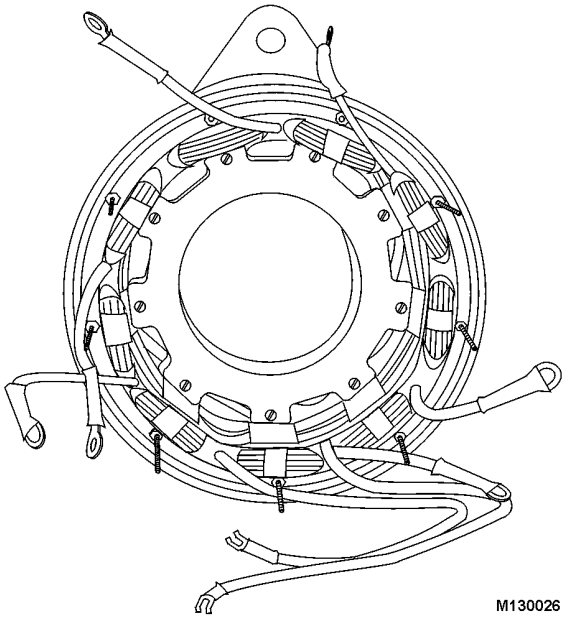


FIGURE 10-26.

5. Make sure field coil leads (white spade terminals) are pulled through proper stator openings with no slack at the field coil and that neither wire is pinched by the bobbin ears.
6. Using eighteen screws coated with loctite, fasten field coil bobbin ears to stator tabs (Figure 10-26). Tighten screws to **8-10 lb-in. (0.9- 1.1 Nm)** torque.

Note: If field coil leads cannot be threaded through stator openings with the terminal attached, unsolder terminals, remove sleeving and then insert leads. After field coil is in place slip sleeving on field leads, solder terminals to wires and slip sleeving back over terminal.

Front Bearing Assembly

1. Clean bearing I.D. surface of front housing.
2. Install retaining ring in rear inner groove of front housing.

Note: This retaining ring has two flat sides (3, Figure 10-27).

3. Coat outer race of front bearing (4, Figure 10-27) with thin coat of loctite.

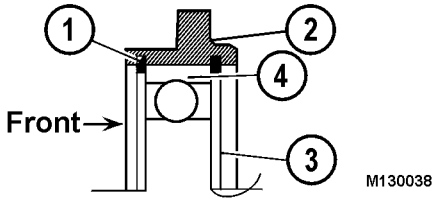


FIGURE 10-27.

1. Retaining Ring (Tapered)
2. Front Housing
3. Retaining Ring (Flat, both sides)
4. Bearing - Outer Race

Pressure Plate Setup (Refer to Figure 10-46)

8. Place thrust washer on jack screw. Lube the jack screw for 1", about 1" from the tip of the jack screw. Lubricate approximately 1" of the jack screw where it enters the pressure plate with white lube or a wheel bearing type of grease. Also place a dab of this grease on both sides of the thrust washer that is placed under the hex head of the jack screw.

   Insert the jack screw through the top thrust plate. Screw jack screw into the pressure plate about 5 turns. Place a dab of lube on both sides of the thrust washer under hex head of the jack screw. Screw jack screw into the pressure plate until contact is make between head of the jack screw and top thrust plate.
9. Continue threading the jack screw in, until stator contacts shell/shell assembly. Measure from top of locating pin to the top of the top thrust plate. Record this measurement as starting point to be used later.
10. Check the position of stator leads by looking through the large torque arm holes in the top thrust plate. Turn jack screw until significant resistance is encountered.

NOTE:If the tool assembly starts to rotate, insert torque arm into holes in the top thrust plate for additional leverage.

11. Check the distance the stator has been inserted into the shell by measuring from the top of the locating pin to the top of the top thrust plate (first measurement taken in step 9, above). This measurement should increase, which indicates the stator is entering the shell.
12. After the stator has been properly seated, disassemble the tool. Pull the stator leads through the correct slots. Continue with the alternator assembly as per instructions in this manual.

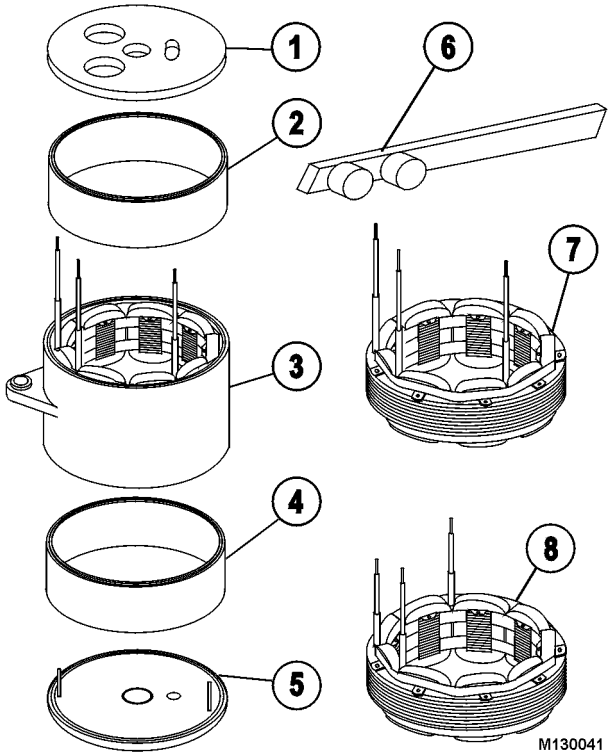


FIGURE 10-46.

1. Top Thrust Plate
2. Support Ring
3. Stator & Shell Assembly
4. Support Ring
5. Bottom Thrust Plate
6. Torque Arm
7. Front Stator
8. Rear Stator

Diagnostic Information Display

The 17FM558 Diagnostic Information Display (DID) (Figure 2-2) is located in the cab, behind the passenger seat. The display provides a means of communications with the TCI by service personnel. Information from the PSC Aux Inverter is also routed through the TCI for display on the DID.

The panel has two display lines, each line 40 characters long. The top line is the "message" line and is used by the TCI to inform service personnel of the truck systems and components status.

The bottom display line provides information in addition to the top line or relates to the keypad, displaying possible selection options and display functions. The keypad, located below the display lines is used by service personnel to direct the activity of the TCI.

The display provides service and status information on the various truck systems and the propulsion system by displaying system status information or fault codes as well as a description of the system status or a problem on the top display line. Information on the second display line may change to indicate what functions are available by pressing the [F1] through [F5] keys.

In addition, the DID panel can be used by to perform the self-load test.

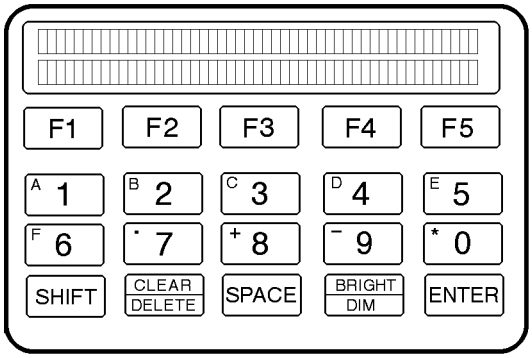


FIGURE 2-2. DIAGNOSTIC INFORMATION DISPLAY

DID PANEL EVENT CODES

The Tables on the following pages list the possible event codes which may be displayed on the DID panel when accessed. Table I (below) describes restrictions to operation of the propulsion and retarding systems when a fault occurs for a particular code listed in Tables II, III and IV.

NOTE: Event codes numbered 000 through 099 are applicable to the PSC and are listed in Table II. Codes numbered 100 through 199 are applicable to Inverter 1, and codes numbered 200 through 299 are applicable to Inverter 2 and are listed in Table III. Codes numbered 600 through 699 are applicable to the TCI and are listed in Table IV.The codes listed in the Tables are applicable to Release 18 software.

TABLE I

RESTRICTION	DEFINITION
No Power	"NO RETARD" (red) light illuminates. • No retarding allowed • No propulsion allowed • No power on the link
No Propel	"NO PROPEL" (red) light illuminates. • No propulsion allowed • Retarding allowed • Link power allowed
Speed Limit	"PROPEL SYSTEM CAUTION" (amber) light illuminates. • Propel, retard and DC link power still allowed. • Speed is limited to 10 MPH (16 KPH)
INV1 Disable	Prohibits system from enabling inverter #1 drive signal.
INV2 Disable	Prohibits system from enabling inverter #2 drive signal.
Engspd/RP	Raises engine speed to account for a possible stuck RP contactor. Closes RP1
None	No restrictions. Event is for information purposes only.

TABLE III: DID PANEL FAULT CODES (Codes Received from Inverter 1, 2)				
EVENT NUMBER		**EVENT DESCRIPTION**	**EVENT RESTRICTION**	**DETECTION INFORMATION**
103/203 (cont.)				
	:21	link V too hi	None	Link voltage too positive
	:22	infilV too hi		Input filter voltage too positive
	:23	DB chop VCO hi		High freq. on VCO DB chopper channel
	:24	DB chopV too hi		DB chopper voltage too positive
	:25	VA VCO hi		High freq. on VCO VA channel
	:26	VB VCO hi		High freq. on VCO VB channel
	:27	VC VCO hi		High freq. on VCO VC channel
	:28	VA volts too hi		VA voltage too positive
	:29	VB volts too hi		VB voltage too positive
	:30	volt scale C flt		Scale C volts out of range 70%, 120%
	:31	VC volts too hi		VC voltage too positive
104/204		FIBER OPTIC CARD	INV1 (INV2) off	
	:01	fo ps low		Fiber optic power supply monitor
	:02	fo card disable		Fiber optic card disabled
	:03	fo card enable		Fiber optic card enabled and no dir
105/205		POWER SUPPLY CARD	INV1 (INV2) off	
	:01	P5V not ok		+5 volt not in tolerance
	:02	P15V not ok		+15 volt not in tolerance
	:03	N15V not ok		-15 volt not in tolerance
	:06	P24V not ok		+24 volt not in tolerance
	:07	N24V not ok		-24 volt not in tolerance
106/206		DC WIRING	INV1 (INV2) off	
	:01	DC pwr conn open		DC power connection open
	:02	link V phase V mismatch		Link and phase voltage mismatch
107/207		GDPS FAILURE	INV1 (INV2) off	
	:01	gate dr ps off		No power to gate drive power supply or it failed
	:02	gate dr ps off S		No power to gate drive power supply or it failed with enable/DC volts
	:03	multiple GTO not off S		Multiple GTOs not off with enable/DC volts
109/209		LINK VOLTS SENSOR	INV1 (INV2) off	
	:01	linkV sensor flt		Link voltage sensor failed
111/211		INPUT VOLTS SENSOR	INV1 (INV2) off	
	:01	Vfil not ok		Filter voltage outside limits

TABLE IV: DID PANEL FAULT CODES (Codes Received from TCI)				
EVENT NUMBER		**EVENT DESCRIPTION**	**EVENT RESTRICTION**	**DETECTION INFORMATION**
601		TCI FB144 CPU CARD	No propel	TCI CPU card problem.
	:01	10ms task failed to init		TCI CPU card problem.
	:02	20ms task failed to init		TCI CPU card problem.
	:03	50ms task failed to init		TCI CPU card problem.
	:04	100ms task failed to init		TCI CPU card problem.
	:05	200ms task failed to init		TCI CPU card problem.
	:06	flt manager task		TCI CPU card problem.
	:07	flash CRC		Flash CRC computation did not match expected value.
	:09	maint task failed to init		Flash CRC computation did not match expected value.
	:10	excess timeouts		Upon power-up, excessive bus timeouts occurred.
	:11	BBRAM bad		
	:12	BBRAM CRC		CRC on BBRAM did not match expected value.
602		FB104 DIGITAL I/O CARD FAULT	No propel	Internal TCI self-test detected a digital I/O card problem.
603		FB160 ANALOG I/O CARD FAULT	No propel	Internal TCI self-test detected an analog I/O card problem.
604		PSC FAULT	Speed limit	Lost RS422 communication with PSC.
	:01	missing message		Lost RS422 communication with PSC.
	:02	bad tick		Lost RS422 communication with PSC.
	:03	bad CRC		Lost RS422 communication with PSC.
	:04	FIFO overflow		Lost RS422 communication with PSC.
	:05	bad start bit		Lost RS422 communication with PSC.
	:06	bad stop bit		Lost RS422 communication with PSC.
605		AUX BLOWER COMM. FAULT	None	Lost RS422 communication with Aux Blower Controller while Aux Blower in failure mode and DC link not energized.
607		POSITIVE 5 VOLTS	Speed limit	+5V power supply out of limits
608		POSITIVE 15 VOLTS	Speed limit	+15V power supply out of limits
609		NEGATIVE 15 VOLTS	Speed limit	-15V power supply out of limits
610		POT REFERENCE	Speed limit	Pot reference (10.8V) out of limits

Propel Torque Control

This software function commands the appropriate motor torque to the inverters during propel. The torque command is primarily a function of the accel pedal position and is limited by the physical constraints of the system.

Each wheel torque is computed independently because the wheels may be operating at different speeds. Each torque command is adjusted to account for the following constraints:

- **Speed Override**

  The propulsion system will attempt to limit truck speed to the design envelope of the wheel motors. As such, the torque command will be modulated as the truck speed approaches the motor overspeed limit so that this limit is not exceeded if possible. Note, however, that steady state operation is kept as close to the overspeed limit as possible without exceeding it.

- **Motor Torque Limits**

  The torque command will be constrained to the operating envelope of the inverters and the traction motors. The maximum torque that can be commanded is dependent on motor speed and on DC link voltage.

- **Gear Stress**

  The torque commanded will not exceed that which will produce excess gear stress.

- **Horsepower Available**

  The horsepower available will be estimated from the engine speed. Parasitic loads are taken into account. The torque will be limited such that the engine does not overload.

- **Jerk Limit**

  The torque command will be slew-rate limited to prevent jerking motion.

- **Wheel Spin**

  In the event that the inverters detect a wheel spin condition and reduce torque in the slipping wheel, the motor torque in the other wheel may be increased within the above constraints such that as much of the total desired torque as possible is maintained.

Retard Torque Control

The retard system converts braking torque from the wheel motors to energy dissipated in the resistor grid. The requested retard torque is based on the following three sources:

- **Retard Foot Pedal or Lever**

  The maximum short time retard torque (at any speed, hence the constant torque level) will be scaled (linearly) by the retard foot pedal input (RPINHI) to produce the foot pedal retard torque call.

- **Overspeed**

  While overspeed is active, the full available retard torque will be requested.

- **Retard Speed Control**

  While RSC is active, the RSC retard torque call will be adjusted to control truck speed to the RSC set point. Retard speed control will not request any retard torque if RSC is not active.

The maximum torque call from the above three sources will be selected as the retard torque call.

Retard Torque Limits are as follows:

1. The retard torque call will be limited to the maximum torque level based on speed.
2. The retard torque call will be limited to the maximum torque level available within the thermal constraints of the motors.
3. The retard torque call will be limited as needed to prevent overvoltage on the DC link.
4. While in retard, the minimum retard torque call will provide enough power to support at least one grid with 600 volts on the DC link. Retard will be dropped if the torque call falls below this value.
5. At low speed, the available retard torque will be ramped to zero.

Wheel Slide Control

The inverters prevent wheel slide by limiting torque to maintain wheel speeds above preset limits. These preset limits are a function of truck speed and the allowable creep; additional compensation will be applied to provide for differences between wheel speeds during turns.

TABLE V: PROPULSION SYSTEM COMPONENTS DESCRIPTION			
	REF. NO.	**COMPONENT**	**FUNCTION**
GFR	52	Alternator Field Relay (17LV66)	Picks up with GF contactor and applies B+ to the AFSE (battery boost) during initial acceleration phase.
GFRS	50	Alternator Field Relay Coil Suppression Module	Suppresses voltage spikes when GF coil is de-energized.
GRR	26	Ground Resistor Panel	Detects power circuit grounds.
INV1 TMC CARD		Inverter 1 Central Processing Unit Card and Input/Output Card (17FB172)	Generates Phase Module turn-on/turn-off commands for the Inverter 1. Monitors voltages and currents from various areas for Inverter 1. Monitors Traction Motor 1 speed.
INV2 TMC CARD		Inverter 2 Central Processing Unit Card and Input/Output Card (17FB172)	Generates Phase Module turn-on/turn-off commands for the Inverter 2. Monitors voltages and currents from various areas for Inverter 2. Monitors Traction Motor 2 speed.
I1CO	57	Inverter 1 Cut Out Switch	Cuts out inverter 1 when in the "cutout" position. Located on switch/LED panel, left front corner of electrical cabinet.
I2CO	58	Inverter 2 Cut Out Switch	Cuts out inverter 2 when in the "cutout" position. Located on switch/LED panel, left front corner of electrical cabinet.
KEYSW		Key Switch	Connects battery voltage to CPR and control circuits when closed. (Located on instrument panel.)
LDBXI	48	Load Box Current Sensing Module	Monitors current during load box test.
LEDP	60	Light Emitting Diode Panel	LED's indicate status of the following: **CPR**: Illuminated when CPR is energized. **SYS RUN**: Illuminated when the PSC power-up sequence has completed successfully and control logic is executing. **NAFLT**: When illuminated, indicates a fault has occurred that prevents propulsion or retarding. **TEST**: Illuminated when system is in the Test state. **REST**: Illuminated when system is in Rest state and there is essentially no voltage on the DC link.
LINKI	7	Link Current Sensing Module	Detects amount of current flow through the DC link.
LINKV	3	Link Voltage Measuring Module (17FM458)	Attenuates the high voltage from the DC link to a level acceptable to the electronics on the Analog I/O card in the PSC.
L1, 2, 3		Cabinet Lights	Provide interior cabinet illumination.
M1, 2		Motorized Wheels (5GDY85)	Each Motorized Wheel consists of a Traction Motor and a Transmission Assembly. The 3-phase asynchronous Traction Motors convert electrical energy into mechanical energy. This mechanical energy is transmitted to the wheel hub through a double reduction gear train (Transmission).

AC DRIVE SYSTEM ELECTRICAL CHECKOUT PROCEDURE

AC DRIVE SYSTEM MAINTENANCE

⚠DANGER

DANGEROUS VOLTAGE LEVELS ARE PRESENT WHEN THE ENGINE IS RUNNING AND CONTINUE TO EXIST AFTER SHUTDOWN IF THE REQUIRED SHUTDOWN PROCEDURES ARE NOT FOLLOWED. Before attempting repairs or working near propulsion system components, the following precautions and truck shutdown procedure must be followed:

- ***DO NOT step on or use any power cable as a handhold when the engine is running.***
- ***NEVER open any electrical cabinet covers or touch the Retarding Grid elements until all shutdown procedures have been completed.***
- ***ALL removal, repairs and installation of propulsion system electrical components, cables etc. must be performed by an electrical maintenance technician properly trained to service the system.***
- ***Power cables must be cleated in wood or other non-ferrous materials. Do not repair cable cleats by encircling the power cables with metal clamps or hardware. Always inspect power cable insulation prior to servicing the cables and prior to returning the truck to service. Discard cables with broken insulation.***
- ***IN THE EVENT OF A PROPULSION SYSTEM MALFUNCTION, a qualified technician should inspect the truck and verify the propulsion system does not have dangerous voltage levels present before repairs are started.***

⚠WARNING

- ***If weld repairs are required, the welding ground electrode should be attached as close as possible to the area to be welded. NEVER weld on the rear of the Electrical Control Cabinet or the retard grid exhaust air louvers. Power cables and wiring harnesses should be protected from weld spatter and heat.***
- ***Prior to welding, disconnect Engine Control System (ECS) harnesses and ground wire (MTU engine). If equipped with DDEC or Komatsu engine, disconnect ECM harnesses. GE cards should be pulled forward far enough to disconnect card from backplane connector.***
- ***Some power cable panels throughout the truck are made of aluminum or stainless steel. They must be repaired with the same material or the power cables may be damaged.***

TRUCK SHUTDOWN PROCEDURES

After the truck is parked in position for the repairs, the truck must be shut down properly to ensure the safety of those working in the areas of the deck, electrical cabinet, traction motors, and retarding grids. The following procedures will ensure the electrical system is properly discharged before repairs are started.

⚠DANGER

If a problem occurs in the AC drive system preventing NORMAL shutdown procedures, ADDITIONAL PRECAUTIONS ARE NECESSARY to ensure dangerous drive system voltages are not present when tests or repairs are performed.

TCI PROGRAMMING

⚠WARNING

BE SURE TO VERIFY LINK VOLTAGE IS DISCHARGED BEFORE PERFORMING THE FOLLOWING PROCEDURES.

1. Disconnect Circuits 21SS and 21SR, and insulate from engine starter if equipped with MTU 396 engine. If MTU/DDC 16V4000 or Komatsu engine is installed, disconnect and insulate 21B circuits at starter solenoids. Apply park brake and brake lock.
   a. Connect the serial communication cable from the PTU to the TCI port located behind the center console in the cab on the passenger side.
   b. Be certain the Rest Switch in the cab is in the REST position.
2. Turn the key switch ON.

To program the 17FB144 CPU card:

- c:\>ACNMENU {enter}
- Highlight “PROGRAM TCI PANEL” {enter}
- Highlight “SELECT TCI SETUP” {enter}
- Cursor to the appropriate configuration file for the truck being programmed from the list of configuration files {enter}
- Highlight- “PROGRAM TCI PANEL” {enter}
- Highlight- “PROGRAM TCI” {enter}

3. Cycle keyswitch or CPS when requested on screen.
4. Verify the Object Code and Configuration file shown on the screen for downloading is correct.

PSC PROGRAMMING

⚠WARNING

BE SURE TO VERIFY LINK VOLTAGE IS DISCHARGED BEFORE PERFORMING THE FOLLOWING PROCEDURES.

1. Disconnect Circuits 21SS and 21SR and insulate from engine starter if equipped with MTU 396 engine. If MTU/DDC 16V4000 or Komatsu engine is installed, disconnect and insulate circuit 21B at the starter solenoids. Apply park brake and brake lock.
   a. Connect the serial communication cable from the PTU to the PSC port located behind the center console in the cab on the operator’s side.
   b. Be certain the Rest Switch in the cab is in the REST position.
2. Turn the Key Switch ON.

To program the 17FB147 CPU card:

- c:\>ACNMENU {enter}
- Highlight “PROGRAM PSC PANEL” {enter}
- Highlight “SELECT PSC SETUP”
- Cursor to the appropriate configuration file for the truck being programmed from the list of configuration files {enter}
- Highlight “PROGRAM PSC PANEL”
- Highlight “PROGRAM PSC”

3. Cycle keyswitch or CPS when requested on screen.
4. verify the Object Code and Configuration file shown on the screen for downloading is correct.

9. Press {enter}. Verify the values on the PTU are similar Figure 3-7 below:

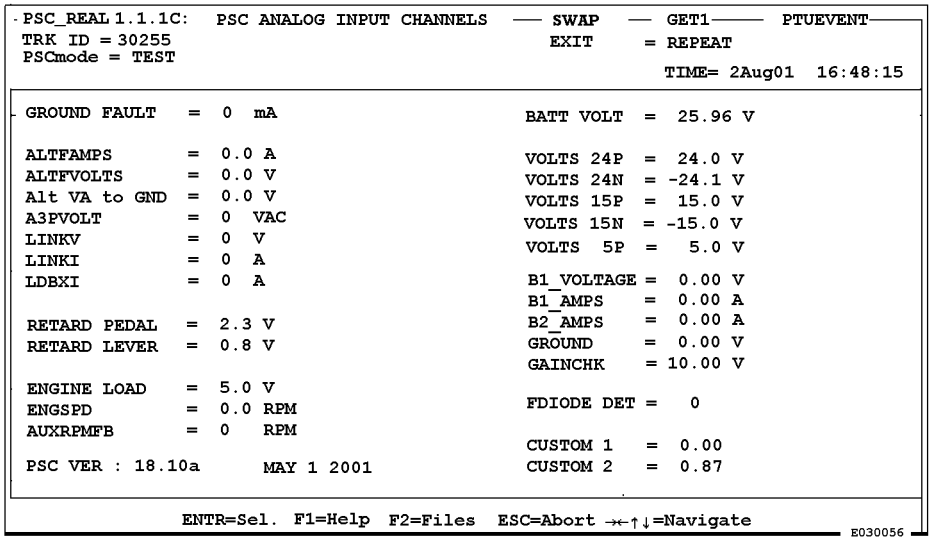


FIGURE 3-7. PSC ANALOG INPUT CHANNELS SCREEN

10. Press {enter}. Verify the values on the PTU are similar to Figure 3-8 below:

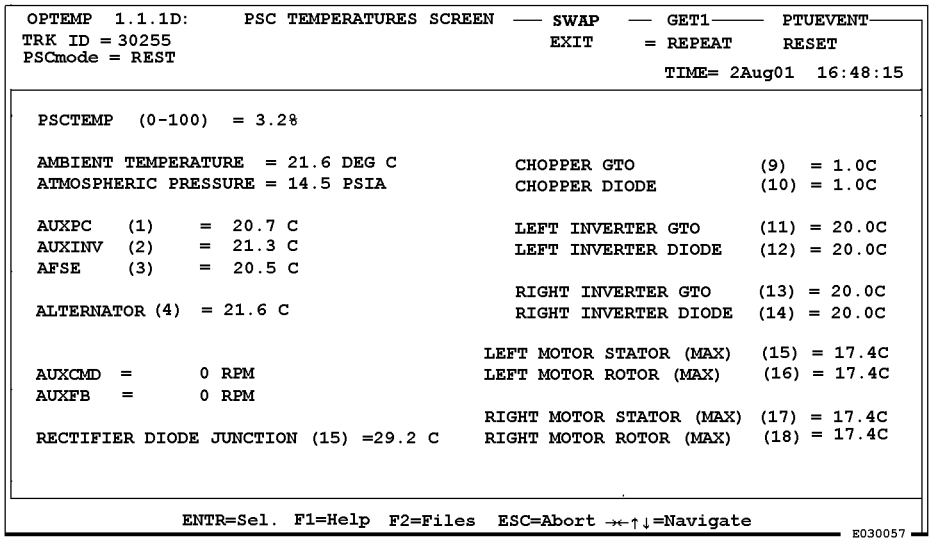


FIGURE 3-8. PSC TEMPERATURES SCREEN

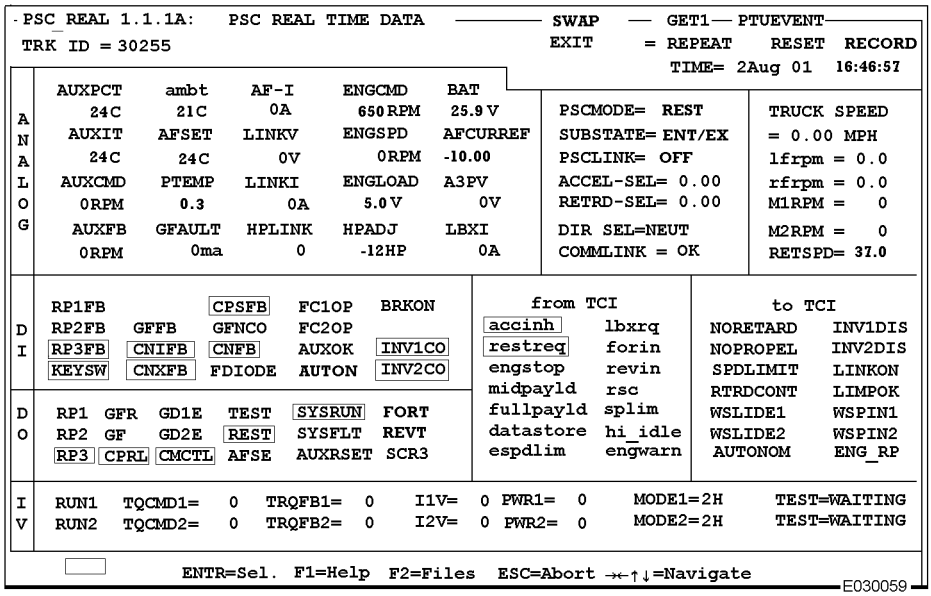


FIGURE 3-10. PSC REAL TIME DATA SCREEN

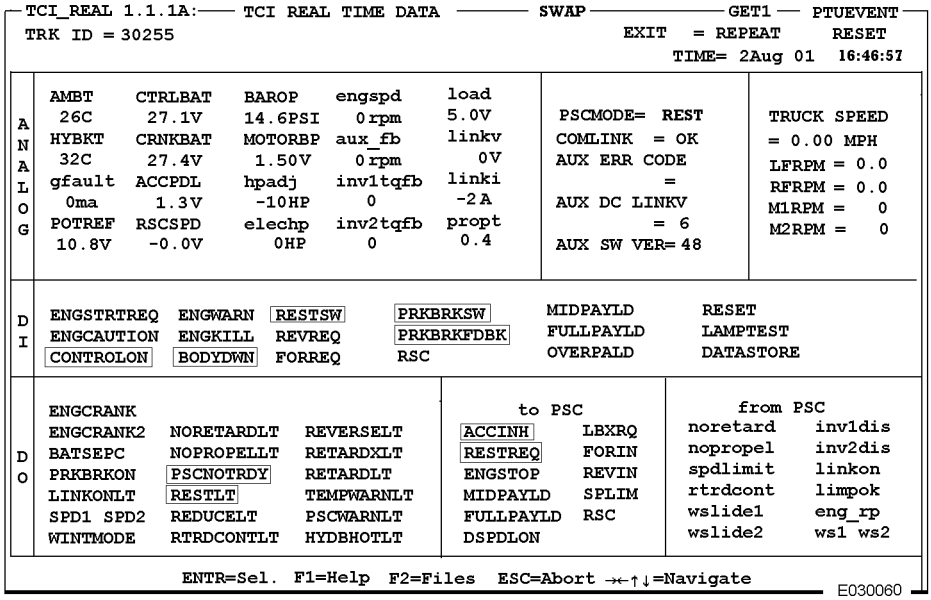


FIGURE 3-11. TCI REAL TIME DATA SCREEN

PVM Optimum Load Curve Handshaking Troubleshooting

Note: a value of below 0.5VDC or above 9.5VDC (on circuit 72E) indicates a failure.

Trucks equipped with DDEC engine:

1. 1. With the engine shut down, keyswitch ON and control power ON, measure voltage between 72E (+) and 0 (-) lead. Voltage should be 5.0VDC.
   a. If the voltage is low or 0VDC, check voltage of circuit 15VL @ TB32. (This supply is from the GE drive system power supply card through the GE/Auxiliary Control harness.)
   ☐ Voltage should be 5.0 volts.
   b. Then check voltage of circuit 15SIM @ TB32.
   ☐ Voltage should be approximately 14.5 VDC.
   c. If voltage is 0VDC or considerably lower than 14.5 volts, check the 20 ohm resistor on DB1.
2. 2. With the engine running and under load, with keyswitch and control power switch ON, check the voltage at 72E(+) to 0 (-).
   ☐ Voltage should be 5.0 volts
   a. If the voltage in step 2 is lower or higher than 5.0 volts, check using the DDR to see the percent of load the engine is given to the PVM module.
   b. Multiply the percentage value in the previous step by 10. This should equal the 72E to 0 voltage reading. (i.e. 50% X 10 = 5.0 VDC)

Note: The DDR is updated every second and is not a true real (electronic) time value. The GE system updates every 20msec. A more accurate method of measuring the updated value is to attach an oscilloscope to the circuit 908M terminal point to ground and measure the time the signal is positive divided by the total time of the signal wave form and multiply it by a factor of 10. This should equal the 72E to 0 circuit voltage. This is a 50HZ signal.

Examples:

10ms/20ms = .50 X 10 = 5.0VDC

15ms/20ms = .75 X 10 = 7.5VDC

5ms/20ms = .25 X 10 = 2.5VDC

   c. Verify circuit 0 is connected to ground.
   d. If the signal “908M” is correct and the supply voltage (15SIM) to the PVM is correct, but output is incorrect, replace the PVM module.

Trucks equipped with Komatsu engine:

1. With the engine shut down, keyswitch ON and control power ON, measure voltage between 72E (+) and 0 (-) lead.
   ☐ Voltage should be 5.0 volts.
   a. Jumper circuit 22FO to ground and verify voltage on 72E to 0 changes to 7.0VDC.
   b. If the voltage is 0VDC, verify the connections to the PVM are correct and circuit 439 and 11SL connected to CN P382 positions 5 and 40 are 24VDC.
2. With the engine running and under load, with keyswitch and control power switch ON, check the voltage at 72E(+) to 0 (-).
   ☐ Voltage should be 5.0 volts
   a. Check the PVM diagnostic connector P381.
   b. Verify the voltage between position A to B is 8 to 11VDC. (A reading of 0VDC indicates the 1939 transmission line failed. Check 1939 wiring.)
   c. Verify the voltage between position C to B is 8 to 11VDC. (A reading of 0VDC indicates the PVM has failed only if the voltage from position A to B is correct and the filtering circuit is correct.) Check filtering circuit resistors and capacitors connected to P383 positions 12 and 20 and P382 position 33 mounted on diode board DB1.
3. If both step 1 and 2 are 0VDC, then circuit 439 or 11SL or both are incorrect.

Trucks with Either Engine:

If necessary, a variable voltage can be substituted for the 72E/0 circuit voltage to determine if the problem is caused by the engine or the GE drive system.

This voltage can be varied above and below 5VDC to see if the GE drive system follows this signal, dropping load when the signal is below 5VDC and increasing load if the signal is above 5VDC.

If the GE drive system follows the signal and with 5VDC the system can produce full power, but cannot function normally, troubleshoot engine boost or fuel injection system.

SECTION G

REAR AXLE, SPINDLES AND WHEELS

INDEX

8. Secure inner and outer dual tire inflation lines to bracket (14) on outer rim.
9. Remove blocks from under truck and lower truck to the ground. Operate truck for one load and retighten outer wheel nuts (11) and adapter flange nuts (10) to **1715 ± 100 ft. lbs. (2326 ± 136 N.m)** torque.

NOTE: Inner flanged nuts (5 & 7) and studs should be visually inspected for breakage or missing nuts during scheduled maintenance checks by inserting a mirror between the rear tires.

RIM

Tire Removal

⚠DANGER

DO NOT weld or apply heat on the rim assembly with the tire mounted on the rim. Resulting gases inside the tire may ignite causing explosion of tire.
When inflating tires always use a safety cage. Never inflate a tire until the lockring is securely in place. Do not stand in front of or over the lock-ring during inflation procedures. Never overin-flate a tire. Refer to tire manufacturers recommendations.

1. Place tire and wheel assembly in safety cage and discharge all air pressure from tire.
2. Attach a hydraulic bead breaker to the rim by slipping the jaws of frame assembly over the outer edge of flange (7, Figure 2-7). Make sure the jaws of the frame are as near to the bead seat band (6) as possible.
3. Following tool manufacturers instructions, move tire bead in far enough to permit placing a wedge between tire and flange at side of tool.
4. Repeat this procedure at locations approxi-mately 90° from the first application. Continue this procedure until tire bead is free from rim.
5. After bead is broken loose, insert flat of tire tool in beading notch on lockring (8). Pry lockring up and out of groove on rim.
6. Pry in on bead seat band (6) until O-ring (9) is exposed. Remove O-ring.
7. Remove bead seat band (6) from rim (5) and remove flange (7).
8. Reposition wheel assembly and repeat removal procedure on opposite side of tire. Remove tire from rim.

Disassembly - Wheel Hub and Spindle Assembly

1. Remove the wheel hub and spindle as covered in "Removal" before proceeding to Step 2. Remove any dirt and mud from the assembly.
2. To aid in complete disassembly of the wheel hub and spindle assembly, support the assembly in a vertical (hub cover up) position using a fabricated spindle stand.
3. Install six, 0.50 in. -13 x 0.75 in. long socket head capscrews (34, Figure 3-6) through the disc brake back plate into the mating holes in the seal retainer. Tighten securely.

NOTE: The capscrews installed in Step 3 will secure the seal carrier and face seal assembly to the brake housing during brake removal. ***DO NOT rotate the wheel hub.***

4. Disconnect speed sensor cables. Loosen sensor clamping capscrews and remove speed sensors (16).
5. Remove capscrews (20) and hardened flatwashers (21) securing brake adapter (19) to brake housing.
6. Remove the capscrews and washers that secure cover (5). Remove the cover and discard O-ring seal (41).
7. Remove capscrews (11) and hardened flatwashers (12). Remove bearing retainer (13) and shims (8).
8. Attach a lifting device to the wheel hub/brake assembly and carefully lift it straight up and off the spindle.
9. Remove outer bearing cone (7) and retainer pin (40).
10. Remove spindle cap (10) and O-ring (9).
11. Rotate hub vertically 180° and place on blocking to prevent damage to wheel studs and machined surfaces.
10. Remove capscrews (14) and washers (15) securing seal carrier (37) sensor gear (35) and shims (36) to wheel hub.
11. Remove capscrews (23) and hardened washers (24) securing brake assembly inner gear to wheel hub.
12. Attach a lifting eyes and an overhead hoist to the brake assembly. Carefully lift the assembly off the hub.

    Refer to Section "J" for brake assembly rebuild instructions.
13. Remove and discard seal carrier O-ring (38).
14. Remove speed sensor gear (35) and shims (36).
15. If bearings require replacement, press cups (6 & 29) from the wheel hub.
16. Remove capscrews (31) and hardened flatwashers (32). Remove brake adapter (19) and discard O-rings (22 & 25).
17. Remove inner bearing cone (28) and retainer pin (39).
18. Remove bearing spacer (27).

Cleaning and Inspection - Wheel Hub and Spindle Assembly

1. Clean all metal parts in fresh cleaning solvent.
2. Inspect wheel hub studs (2, Figure 3-6) and replace if damaged or broken.

NOTE: If new studs are installed, coat the hole in the hub and serrated portion of the stud with an anti-seize compound prior to installation. DO NOT coat threads.

3. Inspect tapped hole threads and re-tap if necessary.
4. Inspect bearing seating surfaces in hub and on spindle. Inspect bearing spacer. Use a stone to carefully dress high spots that may interfere with re-assembly.
5. Inspect all other machined surfaces for damage.
6. Always use new O-ring seals during assembly.

SECTION G4

REAR AXLE HOUSING ATTACHMENT

INDEX

Cleaning and Inspection - Rear Axle Housing

1. Thoroughly clean the capscrew holes and wheel motor mounting faces. Re-tap holes if threads are damaged.
2. Check wheel motor mounting faces for nicks, scratches or other damage. Inspect all welds and repair as necessary.
3. Inspect pivot pin bearing. If worn or damaged, refer to Section G, Rear Axle Housing Attachment - Pivot Eye Bearing, and repair as required.
4. Inspect brake system relay valve (6, Figure 5-1) and hoses for leaks. Inspect manifold (4) hose connections and repair leaks or damaged hoses.

Installation - Rear Axle Housing

1. Position axle housing under frame.
2. Align pivot pin bores and install pivot pin. Refer to Section G, Rear Axle Housing Attachment.
3. Install anti-sway bar. Refer to Section G, Rear Axle Housing Attachment.
4. Install rear suspensions, as described in Section H, Rear Suspensions.
5. Connect auto lube system hoses and clamps.
6. Route wheel motor cables (7, Figure 5-1) into housing and clamp in place. Install cable grip mounting plate and cable grips.
7. Install speed sensor harness (9, Figure 5-1) through housing. Install cable grip.
8. Install air sensor/light harness through housing, clamp in place and install connectors. Install cable grip.
9. Install wheel motors, cables, brake lines and tires as described on the following pages.
10. Connect hoses to manifold (4) at front of housing.
11. Install air duct (5). Close duct inspection covers and install duct tube in rear opening of axle housing.
12. Reconnect wheel motor cooling air duct and clamp securely.
13. Open pump shut-off valves. Service hydraulic system.

Wheel Motor Oil Sampling Record

Mine truck number:		KMS truck serial number:	
Truck side:	Left or Right (circle)	Oil:	
Wheel serial number:			
Wheel install date:			

Sample Date	Sample #	Hours on Truck	Hours on oil	Iron	Chromium	Nickel	Copper	Silicon	Phosphorus	Zinc	Calcium	Viscosity @ 100' C
			Max Values:	600	10	10	50	50	400	75	40	53

"Turn-Of-The-Nut" Tightening Procedure

a. Tighten all fourteen capscrews (1, 6, 8, Figure 2-3) to **400 ± 40 ft.lbs. (542 ± 5 N.m)**. Use a torque wrench of known calibration.

b. Maintain this torque on the top two corner capscrews and the bottom, outer four capscrews (the bottom four capscrews without spacers).

c. Loosen the 8 remaining capscrews and then tighten again using "turn-of-the-nut" tightening procedure as follows:

d. For the four capscrews (1, Figure 2-3) at the upper mount, initially tighten the capscrews to **70 ft. lbs. (95 N.m)**, then advance the capscrew head 60° using steps d-1.) through d-3.). Refer to Figure 2-6.

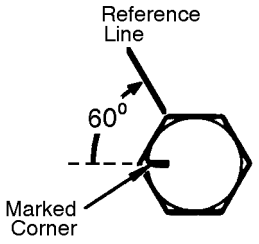


FIGURE 2-6. REFERENCE MARKS FOR 60 DEGREE ADVANCE

(6.0 in. (15 cm) Capscrews)

For the bottom four capscrews (6, Figure 2-3), initially tighten the capscrews to **100 ft. lbs. (136 N.m)**, then advance the capscrew head 120° using steps d-1) through d-3). Refer to Figure 2-7.

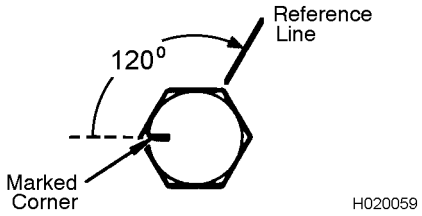


FIGURE 2-7. REFERENCE MARKS FOR 120 DEGREE ADVANCE

14.0 in. (36 mm) Capscrews

1.) Mark a reference line on a corner of the hexagonal capscrew head or nut and the mounting surface opposite this corner, as shown. Then mark the position located 60° or 120° clockwise relative to the first reference line on the mounting surface. Refer to Figures 2-6 and 2-7.

2.) To ensure that the opposite end of the turning member, either the capscrew head or nut, remains stationary, scribe a reference mark for this check.

3.) Each corner of a hexagon represents 60°. The turning member, either the capscrew head or nut, is turned until the marked corner is adjacent with the marked reference line. Ensure that the opposite end of the turning member has NOT turned during the tightening procedure.

NOTE: Do not exceed 4 RPM tightening speed. Do not hammer or jerk the wrench during the tightening procedure.

e. Loosen the top two corner capscrews (1) and the bottom outer four capscrews (8), (the bottom four capscrews without spacers).

1.) Tighten the top two corner capscrews to **70 ft. lbs. (95 N.m)**, then use "turn-of-the-nut" method to advance the capscrew heads 60°.

2.) Tighten the bottom, outer four capscrews to **200 ft. lbs. (271 N.m)**, then use the "turn-of-the-nut" method to advance the capscrew heads 120°.

NOTE: If for any reason, these fasteners need to be checked for tightness after completing the above procedure; loosen and inspect all 14 capscrews and repeat the entire process, starting with cleaning and lubricating the capscrews, washers, and nuts.

7. Charge the suspension with dry nitrogen to fully extend the suspension piston before installing the front wheel hub and spindle.
8. Install spindle, wheel and tire according to instructions in Section G.
9. Service the suspension. For instructions refer to Section H, Oiling and Charging Procedures.
10. Install the suspension boot and secure with the boot clamp.

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 the pin from the lower mounting.
15. Install the tool on the upper pin and repeat the pin removal process. (If the pin does not contain the necessary puller holes, an alternative removal method is needed.)
16. Remove the cylinder from the truck.
17. If it is necessary to remove the remaining rear suspension cylinder, insert the pins back into the upper and lower mountings.
18. Secure the pins using locking capscrews (4), and repeat the removal process.

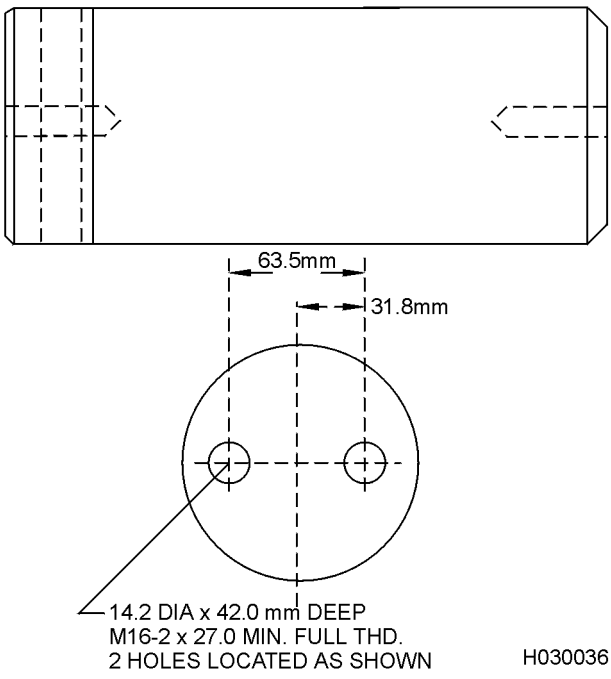


FIGURE 3-5. SUSPENSION PIN REWORK

Installation - Rear Suspension

1. Inspect mounting bore sleeves (9, Figure 3-3) and bearing spacers for damage or wear. Check fit of pins in bores prior to installing suspension. Replace worn or damaged parts.
2. As noted earlier, all pins must have 2 threaded holes at the inboard ends of the pin for future pin removal tool usage. Install new pins or rework the existing pins per Figure 3-5.
3. Secure suspension to fork lift and raise into position. (Suspension assembly should be retracted as far as possible prior to installation.)
4. Position top suspension eye with its spherical bearing, between the ears on the frame as shown in Figure 3-3. Be certain the upper and lower mounting eyes are aligned and the vent plugs are positioned to the rear.
5. Lubricate all pin to bearing and pin to sleeve contact surfaces with Anti-Seize. Lubricating the pin surfaces aids in removal and installation, as well as prevention of rust and corrosion.
6. Align the retaining capscrew hole in pin (1, Figure 3-3) with the hole in the mounting bore. Drive in far enough to hold pin in position.
7. Insert spacer (4) and continue to drive the pin in through the spherical bearing. Insert the remaining spacer and continue to drive the pin in until the retaining capscrew hole is aligned with the hole in the pin.
8. Install capscrew (2) and locknut (3). Tighten to **343 ft. lbs. (465 N.m)** torque. If further alignment of the capscrew and hole are necessary, install a pin removal tool onto the pin. Use the tool in conjunction with a large pipe wrench or other suitable device to align the locking capscrew holes.
9. Lower the suspension housing until the lower mount bearing aligns with the bore in the rear axle housing and repeat the above procedure to install the bottom pin. Mounting components in the top and bottom joints are identical.
10. Install the nitrogen charging kit and add nitrogen to raise frame off stands or cribbing, or use a lifting device if available.
11. Connect lubrication lines and pressure sensor.
12. Service the suspension. For instructions, refer to Section H, Oiling and Charging Procedures.
13. Install piston rod shield (2, Figure 3-1) with the capscrews, flat washers, and lockwashers.

14. Install the protective guard over the charging valve.
15. Raise the truck body in order to extend the front suspensions and allow for removal of the nitrogen charging blocks. **Ensure that sufficient overhead clearance exists before raising the body.** If the suspensions do not extend after raising the body, turn the steering wheel from stop to stop several times. If the suspensions still do not extend enough to allow for removal of the blocks, use a crane or floor jacks to raise the truck and remove the blocks.

The front Hydrair® suspensions are now ready for operation. Visually check the extension with the truck both empty and loaded. Record the extension dimensions. Maximum downward travel is indicated by the dirt ring at the base of the piston. Operator comments on steering response and suspension rebound should also be noted.

REAR SUSPENSION

1. Park the unloaded truck on a hard, level surface. Apply the parking brake, and chock the wheels.
2. Thoroughly clean the area around the charging valve on the suspensions. Remove the protective covers from the charging valves and the metal covers from the suspension piston.

⚠WARNING

When the blocks are in place on a suspension, they must be secured in place with a strap or other means to insure the blocks staying in place while being used. An unsecured block could fly loose as weight is applied, presenting the possibility of serious injury and/or damage.

NOTE: For longer life of suspension components, a friction modifier must be added to the suspension oil. See the Oil and Nitrogen Specifications Chart, Figure 4-5, at the end of this chapter.

Rear Suspension Oiling

1. If the suspensions are extended, position and secure oiling height dimension blocks (supports) in place (See Figure 4-4) so the blocks are seated between the piston flange and the cylinder housing. Ensure the blocks do not mar or scratch the plated surfaces on the piston or damage the wiper seals in the cylinder barrel. Support blocks must seat on the piston flange and the cylinder housing. The blocks should be positioned 180° apart to provide stability.

⚠WARNING

Make certain all personnel are clear and support blocks are secure before relieving nitrogen pressure from the suspension. Use a face mask or goggles when venting nitrogen.

2. Remove charging valve cap. Turn the charging valve swivel nut (small hex) counterclockwise three full turns to unseat valve seal. **DO NOT turn the large hex.** The charging valve body has a bleeder groove in its mounting threads, but for safety of all personnel, the valve body **must not** be loosened until all nitrogen pressure has been vented from the suspension.

SECONDARY BRAKING AND AUTOMATIC APPLY

A fundamental function of the secondary brake system is to provide reserve braking in the event of any single failure. For this reason, the system is divided into multiple circuits, each with its own isolation check valve, two accumulators, and circuit regulator. The secondary system becomes whatever circuit(s) is operable after a failure. If the failure is a jammed treadle valve, then the brake lock becomes the secondary system, otherwise, either of the two brake circuits would be the secondary system.

The four brake accumulators perform two functions; to provide rapid flow for good response and to store energy for secondary braking. The check valves assure this energy is retained should a failure occur in the brake system supply or an accumulator circuit. An additional check valve located between the supply line from the brake/steering pump and the brake manifold, provides additional protection against pressure loss if the oil supply is interrupted.

If a failure occurs in the pump, steering or either brake accumulator circuit, a low brake pressure warning light (on the overhead display panel in the cab) and an audible alarm will actuate and the vehicle should be stopped as soon as practical. When the pressure in one accumulator circuit is less than the preset level, all the service brakes will be automatically applied. Automatic brake application is accomplished by the "automatic apply valve" (PS), located in the brake manifold. This valve senses the lower brake accumulator pressure, and when the pressure is less than 1650 psi (11.4 MPa), the valve shifts, operating the brake treadle valve hydraulically which in turn applies pressure to the dual relay valves and applying all the brakes.

Regardless of the nature of location of a failure, sensing the lowest brake accumulator circuit pressure assures two to four full brake applications after the low brake warning light and buzzer, and before automatic apply. This allows the operator the opportunity to safely stop the truck after the warning has turned on.

PARKING BRAKE CIRCUIT

The parking brakes are spring applied and hydraulically released.

NOTE: Whenever the park brake solenoid is de-energized, a spring in the solenoid valve will shift the spool, diverting oil pressure from the parking brakes to direct the oil back to the hydraulic tank.

Normal Operation (key switch on, engine running)

- **Parking brake switch ON**
  The parking brake solenoid (15, Figure 2-1) is de-energized. The oil pressure in the parking brake lines return to tank and the springs in the parking brake will apply the brake. The parking brake pressure switch (21) will close, completing a path to ground, and illuminating the parking brake light on the overhead display panel.
- **Parking brake switch OFF**
  The parking brake solenoid is energized. The oil flow is routed from the park brake solenoid, to the park brake calipers for release. The parking brake circuit is protected against accidental application by monitoring a wheel motor speed sensor to determine truck ground speed. The park brake will not apply until the truck is virtually stopped. This eliminates park brake damage and will extend brake adjustment intervals.
- If the **key switch is turned OFF** (park brake switch ON or OFF), the park brake will not apply until vehicle speed is less than 1/3 MPH (0.5 km/h).
- If a loss of hydraulic supply pressure occurs, **with the parking brake switch OFF**, the parking brake solenoid will still be energized. The supply circuit (that lost pressure) is still open to the parking brake calipers. To prevent park brake pressure oil from returning to the supply circuit, a check valve (in the park brake circuit) traps the oil, holding the parking brake in the released position.

NOTE: Normal internal leakage in the parking brake solenoid may allow leakage of the trapped oil to return back to tank, and eventually allow park brake application.

- If 24 volt power to the solenoid is interrupted, the park brake will apply at any vehicle speed. The spring in the solenoid will cause it to shift, opening a path for the oil pressure in the park brake line to return to tank and the springs in the parking brake will apply the brake. The parking brake pressure switch (21) will close, completing a path to ground, illuminating the parking brake light on the overhead display panel and interrupting propulsion.

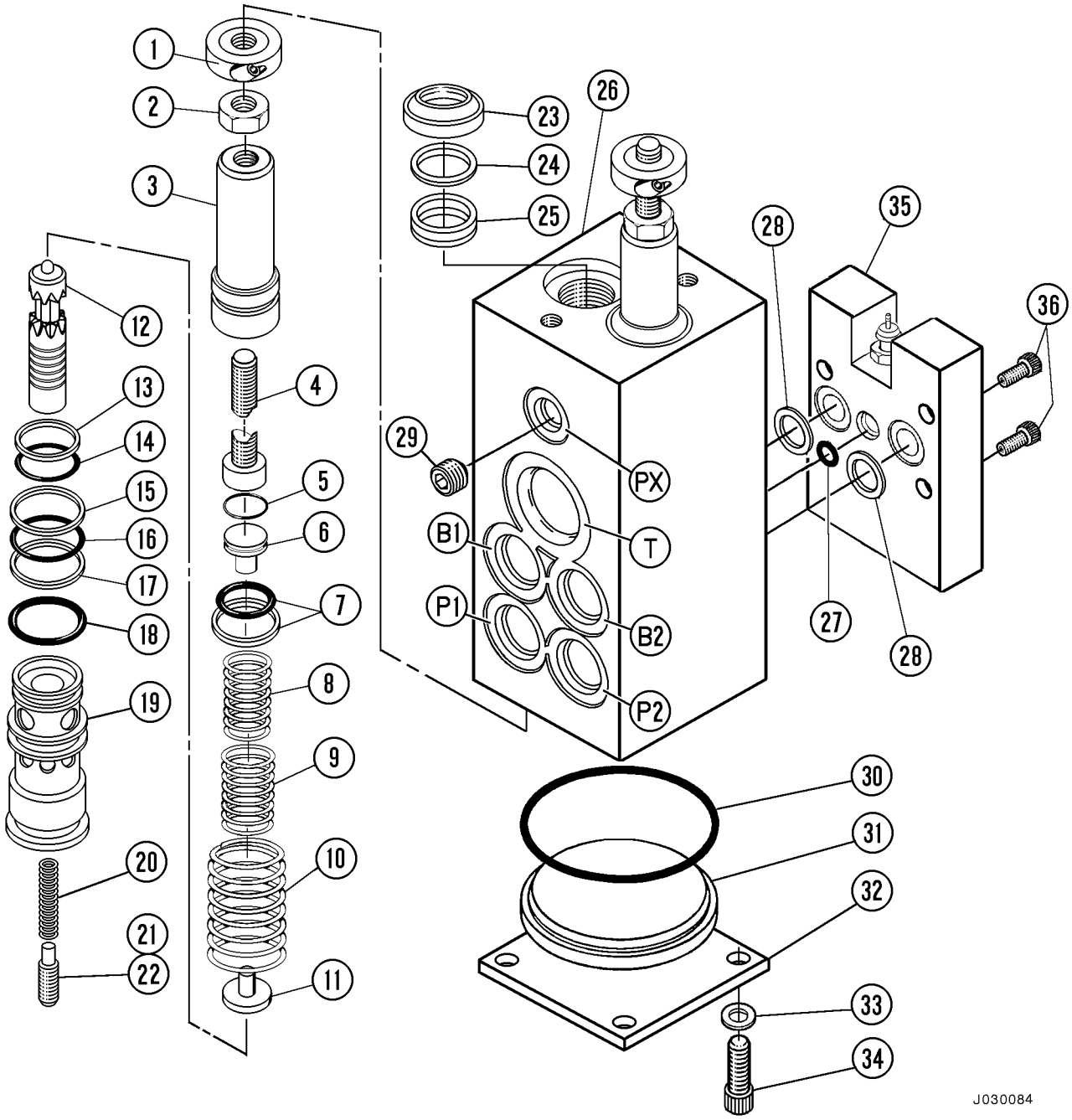


FIGURE 3-4. BRAKE VALVE

1. Adjustment Collar
2. Nut
3. Actuator Plunger
4. Stud
5. Packing
6. Staging Seat
7. Glyde Ring Assembly
8. Regulator Spring
9. Regulator Spring
10. Plunger Return Spring
11. Spring Seat
12. Regulator Spool
13. Back-up Ring
14. O-Ring
15. Back-up Ring
16. O-Ring
17. Back-up Ring
18. O-Ring
19. Regulator Sleeve
20. Spool Return Spring
21. Reaction Plunger (B1)
22. Reaction Plunger (B2)
23. Wiper Seal
24. Back-up Ring
25. Poly-Pak Seal
26. Valve Body
27. Seal
28. Seal
29. Set Screw Orifice Plug
30. O-Ring
31. Retaining Plug
32. Base Plate
33. Washer
34. Capscrew
35. Differential Pressure Switch
36. Capscrew

DUAL RELAY VALVE

The dual relay valves (one for front and one for rear brake circuits) supply the apply pressure for each disc brake assembly. When the operator depresses the brake valve, hydraulic pressure, proportional to the amount of brake valve application, is applied to the pilot pressure circuit of each dual relay valve. Regulated pressure (proportional to the pilot pressure applied) is then delivered from the "B1" and "B2" ports of each dual relay valve to each wheel.

The regulated pressures supplied to each wheel are equal. If a malfunction occurs, causing a pressure differential greater than 600 psi (4137 kPa) between the right and left brake apply circuit, a differential pressure switch (3, Figure 3-11) mounted on the valve activates a warning horn and lamp in the cab. If a pressure differential greater than 600 psi (4137 kPa) occurs in the pilot circuit supplying the front and rear dual relay valves, a differential pressure switch mounted on the brake valve activates the warning horn and lamp in the cab.

The dual relay valve for the front brake circuit is located in the hydraulic components cabinet behind the cab. The dual relay valve for the rear brake circuit is located in the rear axle housing and requires removal of the wheel motor cooling air duct components for access to the valve as described below.

⚠DANGER

Before disconnecting pressure lines, replacing components in the hydraulic circuits, or installing test gauges, always bleed down hydraulic steering and brake accumulators. The steering accumulators can be bled down with engine shut down, turning the key switch OFF and waiting 90 seconds. Confirm the steering pressure is released by turning the steering wheel - No front wheel movement should occur.

Open bleed down valves (6 & 7, Figure 3-1) located on the brake manifold. This will allow both accumulators for the rear brakes and both accumulators for the front brakes to bleed down. Before disabling brake circuit, be sure truck wheels are blocked to prevent possible roll-away.

Removal

1. Securely block the wheels of the truck.
2. Place selector switch in NEUTRAL, turn the rest switch ON. Turn key switch OFF to shut down engine and allow 90 seconds for steering system accumulators to bleed down. Open valves (6 & 7, Figure 3-1) to bleed down all four brake accumulators. Close valves after all pressure is released.

NOTE: Follow Steps 3 & 4 below for the front valve or Steps 5 through 9 for rear valve removal.

Front Brake Circuit:

3. Tag and remove all hydraulic lines from dual relay valve. Plug lines and ports to prevent possible contamination. Disconnect wiring harness at differential pressure switch connector.
4. Remove two capscrews and washers securing valve to rear wall of cabinet. Remove valve and move to clean work area for disassembly.

Rear Brake Circuit:

5. Open rear access cover and remove wing nuts securing duct tube to axle housing. Remove tube.
6. Open access covers inside axle housing.
7. Remove wheel motor cooling air exhaust duct from between wheel motors.
8. Tag and remove all hydraulic lines from dual relay valve. Plug lines and ports to prevent possible contamination. Disconnect wiring harness at differential pressure switch connector.
9. Remove two capscrews and washers securing valve to mounting bracket. Remove valve and move to clean work area for disassembly.

Installation

1. Install dual relay valve in hydraulic components cabinet (front brake circuit) or rear axle housing (rear brake circuit). Install the two mounting capscrews and lockwashers to secure valve. Tighten capscrews to standard torque.
2. Remove hose and fitting caps and plugs and attach hoses to the proper valve ports. Connect differential pressure switch connector to wire harness.
3. Start engine and check for leaks and proper brake operation. Shut down engine.
4. For the rear valve, reinstall the wheel motor cooling air duct between wheel motors. Close access covers and reinstall tube in axle access opening.

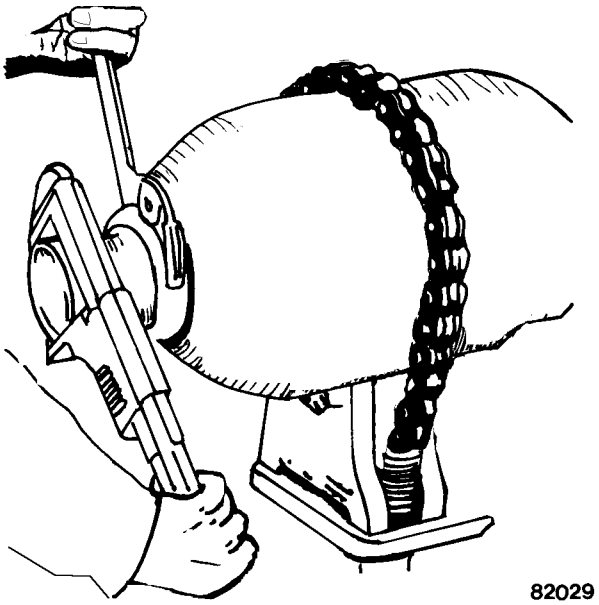


FIGURE 3-16. LOCKNUT REMOVAL

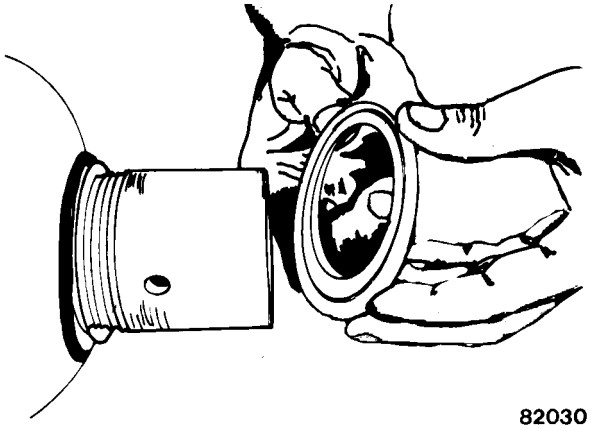


FIGURE 3-17. SPACER REMOVAL

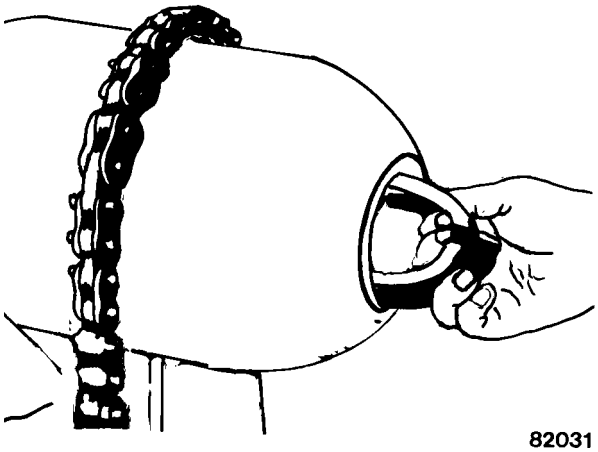


FIGURE 3-18. ANTI-EXTRUSION RING REMOVAL

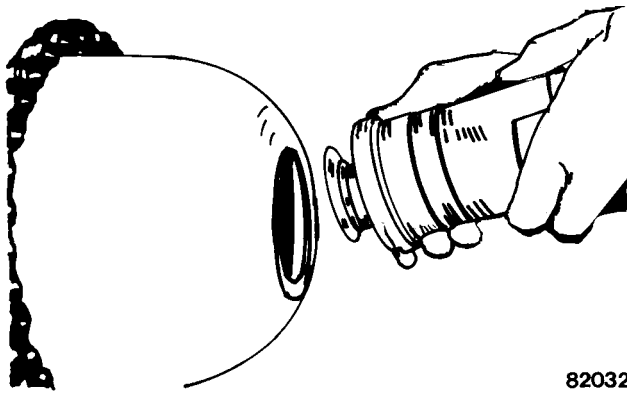


FIGURE 3-19. PLUG AND POPPET REMOVAL

8. Remove plug and poppet assembly from shell. (Refer to Figure 3-19.)
9. With wrench on valve stem flats, remove the nut from the valve stem.
10. Insert hand into shell fluid opening. Depress bag and eliminate as much gas pressure as possible.

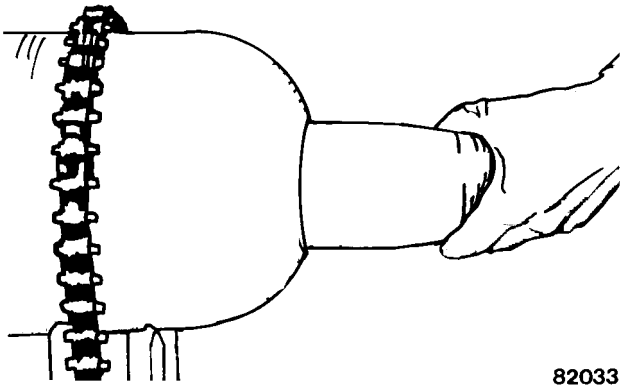


FIGURE 3-20. BLADDER REMOVAL

11. Grasp heel of the bladder and withdraw from shell. (Refer to Figure 3-20).

ACCUMULATOR CHARGING PROCEDURE

(Frame Mounted Brake Accumulators)

⚠WARNING

Do not loosen or disconnect any hydraulic line or component until engine is stopped and key switch has been OFF for at least 90 seconds and the brake accumulators have been manually bled down.

Pure dry nitrogen is the only gas approved for use in the brake accumulators. The accidental charging of oxygen or any other gas in this compartment may cause an explosion. Be sure pure dry nitrogen gas is being used to charge the accumulators.

When charging/discharging accumulators, be sure the warning labels are observed and the instructions regarding the charging valve are carefully read and understood.

1. With engine shut down, the rest switch ON and key switch in the OFF position, allow at least 90 seconds for steering accumulators to bleed down. Turn steering wheel to be certain no oil remains in accumulators.
2. Open the bleed valves (6 & 7, Figure 3-1) located on the brake manifold in the hydraulic components cabinet to completely bleed the pressure from all brake system accumulators.
3. Remove charging valve guards.

⚠WARNING

If nitrogen pressure is present in the accumulators, make certain only the small swivel hex nut is turned during the next step. Turning the complete valve assembly may result in the valve assembly being forced out of the accumulator by the nitrogen pressure inside.

4. Remove charging valve cap (1, Figure 3-31). Turn small swivel hex nut (4) three complete turns counterclockwise.
5. Depress the valve stem and hold down until all nitrogen has been released.
6. If a loss in nitrogen pressure is the reason for recharging, inspect the charging valve and accumulator for damage. Replace or repair items, as necessary, before recharging.

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

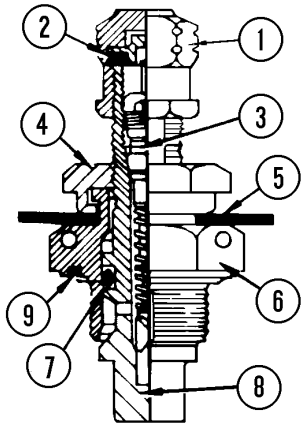


FIGURE 3-32. CHARGING VALVE

7. Connect the charging kit to the charging valves. Open the regulator and charge the accumulators simultaneously to 1400 psi (9.8 MPa).

NOTE: When charging the accumulators, allow adequate time for the system to fully charge. Insure all oil has returned from the accumulators to the hydraulic tank.

8. Shut off charging kit and check pressure gauge reading. If gauge does not maintain 1400 psi (9.7 MPa) continue charging procedure until pressure is stabilized.
9. Remove charging kit and tighten small hex nut on charging valve to **4 ft.lbs. (5.4 N.m)** torque.

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

   a. Tighten small hex swivel nut to **10.5 ft.lbs. (14.2 N.m)** torque.
   b. Loosen swivel nut.
   c. Retighten swivel nut to **10.5 ft.lbs. (14.2 N.m)** torque.
   d. Again, loosen swivel nut.
   e. Finally, tighten swivel nut to **4 ft.lbs. (5.4 N.m)** torque.

10. Install charging valve cap (1) and tighten finger tight. Install charging valve guard and tighten capscrews to **25 ft.lbs. (33.9 N.m)** torque.
11. Close brake accumulator bleed valves.
12. If necessary, recharge the smaller brake accumulators. Refer to Bladder Accumulator Charging Procedure.
13. Operate truck and check brake system operation.

BRAKE SYSTEM CHECKOUT

NOTE: Unless otherwise specified, perform the following checks with engine running, rest switch in the ON position, park brake on and brake lock released.

9. Apply brake lock. Turn the parking brake switch to the OFF position:
   - ❑ Verify park brake indicator lamp is off.
   - ❑ Verify park brake release pressure (gauge installed in "PK2" port in hydraulic cabinet) is 2700 ± 100 psi (18,615 ± 690 kPa).

* *Record on data sheet.*

10. Cycle park brake several times to assure crisp application and release of oil pressure when switch is OFF.
11. Place parking brake switch in the ON position and release the brake lock.
12. Install a 3000 psi (20,685 kPa) pressure gauge at the "LBP" (9, Figure 4-5) and "RBP" (8) test ports on the junction block at the left front corner of the rear axle housing.
13. Very slowly depress brake pedal. Force feedback of pedal on foot should be smooth with no abnormal noise or mechanical roughness.
14. Slowly depress brake pedal:
    - ❑ Verify brake indicator lamp and stop lights illuminate at 75 ± 5 psi (517 ± 34 kPa) rear brake pressure.

* *Record on data sheet.*

15. Quickly and completely depress pedal. Verify that within 1 second after brake is applied:
    - ❑ Left rear brake pressure ("LBP", 9) reads 2400 ± 75 psi (16,545 ± 517 kPa).
    - ❑ Right rear brake pressure ("RBP", 8) reads 2400 ± 75 psi (16,545 ± 517 kPa).
    - ❑ Both pressures must remain above their minimum values for a minimum of 20 seconds.

* *Record on data sheet.*

16. Release pedal, assure that each circuit's pressure is zero.
17. Move the two 3000 psi (20,685 kPa) gauges to the test ports on the front brake backplates.
18. Quickly and completely depress pedal. Verify that within 1 second after brake is applied:
    - ❑ Left front brake pressure reads 2400 ± 75 psi (16,545 ± 517 kPa)
    - ❑ Right front brake pressure reads 2400 ± 75 psi (16,545 ± 517 kPa).
    - ❑ Both pressures must remain above their minimum values for a minimum of 20 seconds.

* *Record on data sheet.*

19. Release pedal, assure that each circuit's pressure is zero.
20. Remove gauges from front brake test ports and install at the "BR" and "BF" test ports in the hydraulic cabinet.
21. Disconnect circuit #52B wire on the coil of the brake lock solenoid (SV1) (14, Figure 4-1). Install a jumper wire between circuits #33 and #33W at the brake warning delay timer (27, Figure 4-1).
22. Apply the brake lock; the brake lock degradation switch should close:
    - ❑ Verify the warning buzzer turns on.
    - ❑ Verify the low brake pressure warning lamp illuminates.
23. Depress the brake pedal until the warning stops.
24. **Very slowly**, release the brake pedal while observing the "BR" pressure gauge:
    - ❑ Verify warning resumes when pressure drops to 1000 ± 25 psi (6,895 ± 172 kPa).

* *Record pressure reading when alarm resumes.*

25. Reconnect #52B wire at brake lock solenoid coil. Remove jumper between circuits #33 and #33W.
26. Cycle brake lock several times to assure crisp shift of solenoid valve and release of oil pressure. Verify stop lights illuminate when brake lock is on.
27. Apply brake lock and read brake pressure at "BR" gauge:
    - ❑ Pressure should be 2000 ± 100 psi (13,788 ± 690 kPa).

* *Record on data sheet.*

28. If above pressure is not correct, remove plug on end of PR valve (13, Figure 4-1) and adjust to obtain correct pressure. Reinstall plug after adjustment.

SECTION J5

WET DISC BRAKE ASSEMBLY

INDEX

17. Follow procedures in Floating Ring Seal Assembly/Installation to install seal assembly in cavities in the back plate and seal carrier.

18. Install seal carrier on back plate. Secure in place with six 1/2 UNC x 0.75 in. socket head capscrews to retain seal carrier in position until brake assembly is installed on the truck.

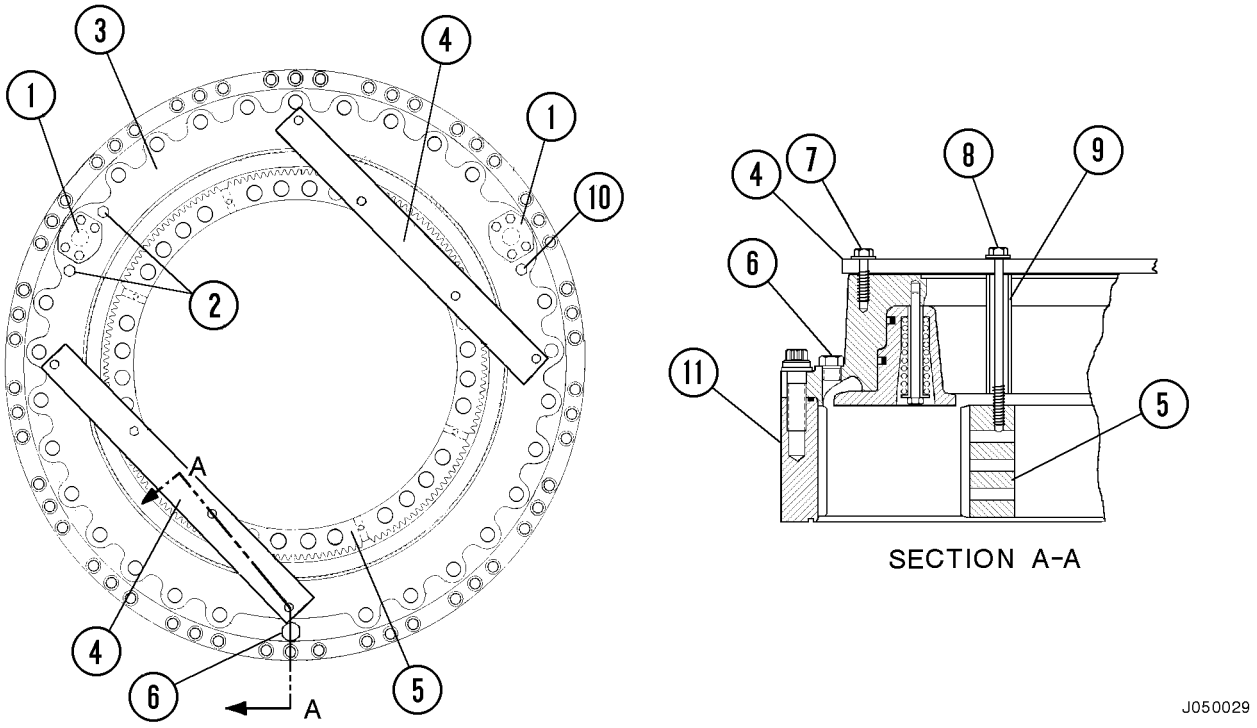


FIGURE 5-9. INNER GEAR INSTALLATION

1. Cooling Oil Port
2. Brake Apply Pressure Ports
3. Piston Housing
4. Shipping Bar
5. Inner Gear
6. Drain Plug
7. Capscrew & Washer
8. Capscrew & Washer
9. Spacer
10. Wear Indicator Installation Port
11. Ring Gear

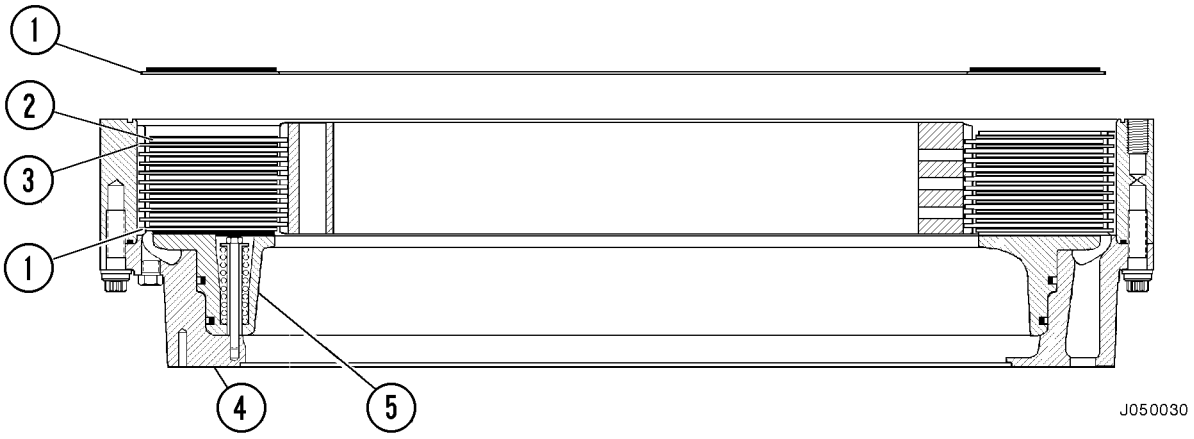


FIGURE 5-10. DISC PACK INSTALLATION

1. Damper
2. Friction Disc
3. Separator Plate
4. Piston Housing
5. Piston

Gear Removal:

If the rotor shaft gear (4, Figure 7-1) is worn, damaged or otherwise requires removal, follow the procedures below:

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

1. Remove capscrew and hardened washer (6, Figure 7-1) from shaft. Remove retainer plate (5).
2. Install a gear puller using tapped holes provided in gear (4).
3. Apply heat around gear hub area while tightening puller until gear is removed from shaft.

Installation - Parking Brake

Gear Installation:

If the wheel motor rotor shaft gear was removed, install gear prior to parking brake installation.

1. Thoroughly clean gear (4, Figure 7-1) and shaft. Inspect splines and remove burrs, etc. that may interfere with installation.
2. Heat gear to 536°F (280°C). Install immediately on shaft; gear must be **fully seated against shoulder** on rotor shaft.
3. Install retainer plate (5), washer and capscrew (6). Tighten capscrew to **440-495 ft. lbs. (595-670 N.m)**.

Park Brake Installation:

NOTE: Two oil supply ports are provided on the lower half of the parking brake assembly. Install the O-ring fitting for attaching the supply hose (7, Figure 7-1) to the lowest port, depending on whether the brake is to be installed on the right or left wheel motor. Install an O-ring plug in the unused port.

1. Install two guide studs in wheel motor end frame to guide brake assembly into position. Be certain mating surfaces are clean and free of burrs.
2. Lift parking brake into position for installation. Note proper orientation depending on whether brake is to be installed on a left or right wheel motor. (Bleeder screw at top of brake will be tilted toward front of truck.)
3. Slide assembly over guide studs and gear on wheel motor rotor shaft.
4. Install capscrews and lockwashers (9, Figure 7-1) Tighten evenly to be certain brake housing is properly seated on the wheel motor. Tighten to **220 ft. lbs. (298 N.m)** final torque.
5. Install brake oil supply hose (7). Remove lifting equipment.
6. Refer to Park Brake Bleeding Procedure in this chapter and bleed air from brake apply line and housing.
7. Reinstall all ducts removed.

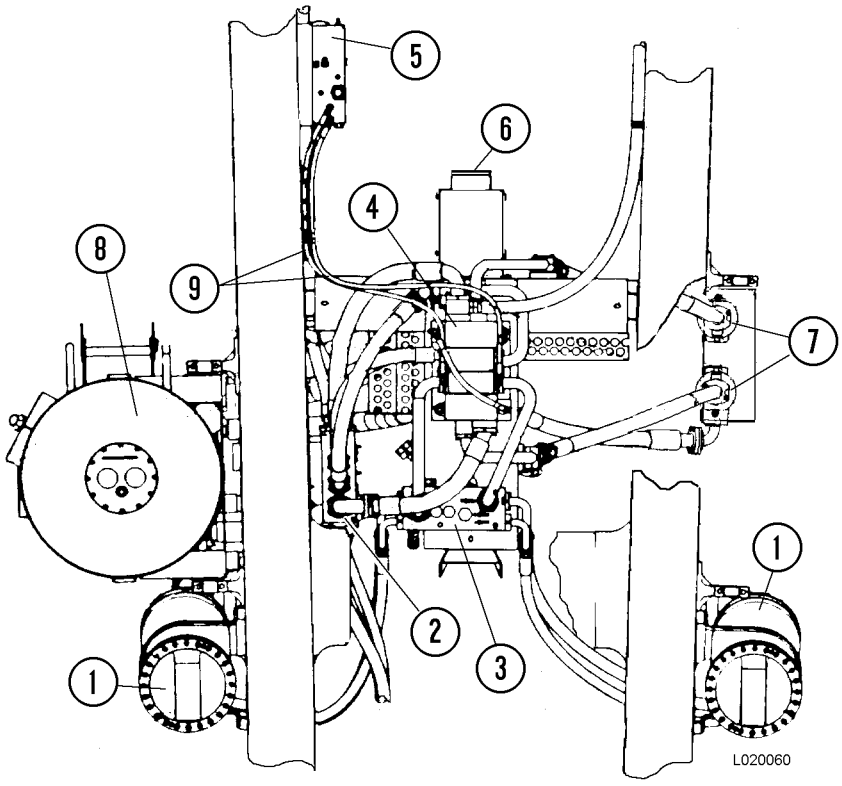


FIGURE 2-2. HOIST PUMP PIPING (Top View)

1. Hoist Cylinders
2. Brake/Hoist Return Oil Manifold
3. Overcenter Manifold
4. Hoist Valve
5. Bleeddown Manifold
6. Pump Drive Shaft
7. Hoist Circuit Filters
8. Hydraulic Tank
9. Hoist Valve Pilot Circuit Hoses

7. Attach a suitable lifting or support device to the hoist pump capable of handling approximately 250 lbs (113 kg). Attach a support to the front end of the steering pump to hold it in place during removal of the hoist pump.
8. Remove the four capscrews (2, Figure 3-2) securing the hoist pump to the front support bracket. Remove the six capscrews holding the support bracket (6) to the pump module support. Remove support bracket.
9. Make sure the lifting and support devices are in place on both pumps. Loosen (but do not remove) the rear support bracket capscrews holding the steering pump. Lower the pumps allowing hoist pump to come down further than steering pump.
10. Remove the four steering/brake pump mounting capscrews (4). Slide hoist pump forward to disengage the splines of drive coupling (9, Figure 3-3) from the steering pump.
11. Move pump to a clean work area for disassembly.

Installation

NOTE: The following assumes the steering pump is already in position on the truck.

1. Install O-ring (16, Figure 3-3) to steering pump (11). Install coupler (9) to hoist pump.

⚠WARNING

The hoist pump weighs approximately 310 lbs (140 kg). The hoist and steering pump together weigh approximately 560 lbs (254 kg). Use a suitable lifting or support device that can handle the load safely.

2. Attach a suitable lifting or support device to the hoist pump capable of handling approximately 250 lbs (113 kg). Move pump into position in truck.
3. Lubricate the steering pump spline shaft and align with coupling (9). Install hoist pump to steering pump and install capscrews (10) with hardened washers and tighten to standard torque. Raise pumps up into position.
4. Attach front support bracket to the pump module support structure and to the pump with capscrews, lockwashers and nuts. Tighten capscrews to standard torque.
5. Connect hoist pump drive flange to drive shaft with capscrews, lockwashers and nuts. Tighten to standard torque.
6. Tighten steering pump support bracket (7, Figure 3-2) capscrews to standard torque.
7. Uncap inlet and outlet hoses and install to pumps using new O-rings. Tighten capscrews securely.
8. Service the hydraulic tank with C-4 type hydraulic fluid. Refer to Hydraulic Tank in this section for filling instructions.
9. Open the three suction line shut-off valves. Loosen capscrews (at the pump) on suction hoses to bleed trapped air. Then loosen capscrews (at the pump) on pressure hoses to bleed any trapped air. Tighten all capscrews securely.

NOTE: If trapped air is not bled from steering pump, possible pump damage and no output may result.

10. Reinstall blower duct and support bracket.

TROUBLESHOOTING GUIDE (HOIST PUMP)

TROUBLE	POSSIBLE CAUSE	SUGGESTED CORRECTIVE ACTION
1. Sandblasted band around pressure plate bores 2. Angle groove on face of pressure plate 3. Lube groove enlarged and edges rounded 4. Dull area on shaft at root of tooth 5. Dull finish on shaft in bearing area 6. Sandblasted gear bore in housing	1. Abrasive wear caused by fine particles. a. Dirt (fine contaminants, not visible to the eye)	1. Was clean oil used? 2. Was filter element change period correct? 3. Were correct filter elements used? 4. Hoist cylinder rod wiper and seals in good condition? 5. Cylinder rods dented or scored? 6. Was system flushed properly after previous failure?
1. Scored pressure plates. 2. Scored shafts 3. Scored gear bore	2. Abrasive wear caused by metal particles a. Metal (coarse)contaminants, visible to the eye	1. Was system flushed properly after previous failure? 2. Contaminants generated elsewhere in hydraulic system? 3. Contaminants generated by wearing pump components?
1. Any external damage to pump 2. Damage on rear of drive gear and rear pressure plate only	3. Incorrect installation	1. Did shaft bottom in mating part? 2. Any interference between pump and machine?
1. Eroded pump housing 2. Eroded pressure plates	4. Aeration-Cavitation a. Restricted oil flow to pump inlet b. Aerated Oil	1. Tank oil level correct? 2. Oil viscosity as recommended? 3. Restriction in pump inlet line? 4. Air leak in pump inlet line? 5. Loose hose or tube connection?
1. Heavy wear on pressure plate 2. Heavy wear on end of gear	5. Lack of oil	1. Was oil level correct? 2. Any leaks in piping inside tank?
1. Housing scored heavily 2. Inlet peened and battered 3. Foreign object caught in gear teeth	6. Damage caused by metal object	1. Metal object left in system during initial assembly or previous repair? 2. Metal object generated by another failure in system?
1. Pressure plate black 2. O-rings and seals brittle 3. Gear and journals black	7. Excessive Heat	1. Metal object left in system during initial assembly or previous repair? 2. Was relief valve setting too low? 3. Was oil viscosity correct? 4. Was oil level correct?
1. Broken shaft 2. Broken housing or flange	8. Over Pressure	1. Relief valve setting correct? 2. Did relief valve function?

Relief Valves

The 4000 psi (28. MPa) relief valve limits maximum steering circuit pressure by returning oil to the hydraulic tank through internal passages in the bleeddown manifold.

The 600 psi (4.1 MPa) relief valve provides maximum pressure protection for the oil returning to the hydraulic tank.

Hoist Limit Solenoid

The body-up limit solenoid is a 3-way valve, activated by the hoist limit switch (refer to Section D for additional information) when the hoist cylinders approach the maximum extension limit. When activated, the solenoid will close the power up pilot line to the hoist valve from the hoist pilot valve mounted in the hydraulic cabinet.

Pilot operated check valve (30, Figure 4-4) is opened by the power down pilot pressure line (19) to allow oil in the raise port to bypass the body-up limit solenoid (24) for the initial power down operation while the solenoid is activated by the hoist limit switch.

Refer to Section D, Electrical System (24VDC) for adjustment procedure of the hoist limit switches.

Accumulators

The steering accumulators (5, Figure 4-1) are a floating piston type. The top side of the accumulators are charged to 1400 psi (9.7 MPa) with pure dry nitrogen with the piston at the bottom.

Oil entering the accumulators pushes the piston upward compressing the nitrogen on the top side of the piston. The nitrogen pressure increases directly with steering circuit pressure. When steering circuit pressure reaches 3025 psi (20.9 MPa) the unloader valve will unload the pump. The accumulators will contain a quantity of oil under pressure and held by check valves in the bleeddown manifold, available for steering the truck. When system pressure drops to 2750 psi (19.0 MPa) the pump output will again increase, to refill the accumulators and increase steering system pressure. The accumulators also provide oil, for a limited period of time, to be used in case the pump becomes inoperative.

Low Precharge Warning Switch

Pressure switches located in the top of each accumulator monitor nitrogen pressure and are used to activate the accumulator precharge warning light if the nitrogen pressure drops below 1100 psi (7.6 MPa).

The switches monitor nitrogen pressure when the key switch is turned ON and before the engine is started. If nitrogen pressure is too low, the warning lamp turns on - a latching circuit prevents the warning lamp from turning off when the engine is started and steering system pressure compresses the nitrogen remaining in the accumulator.

⚠WARNING

Do not operate the truck with less than 1100 psi (7.6 MPa) nitrogen precharge in the accumulator. Low nitrogen pressure may not provide an adequate supply of steering system oil in some emergency conditions. If the low precharge warning light remains on, check accumulator precharge pressure and recharge if necessary.

High Pressure Filters

The high pressure filter (10, Figure 4-1) filters oil for the steering and brake circuits.

If the filter element becomes restricted, a warning indicator is activated at 40 psi (276 kPa) and oil will bypass the element at 50 psi (345 kPa).

Refer to Section L, Hydraulic System Filters, for further information regarding the various system filters and maintenance procedures.

Quick Disconnect Ports

Ports on the bleeddown manifold allow service personnel to connect an external hydraulic supply to allow operation of the truck steering and service brake systems if the steering/brake pump, engine etc. is not operational.

The external supply is connected to port 13, Figure 4-4 and the return is connected to port 15. This feature should only be used for emergency use to allow operation of the truck to return to the shop for service or move the truck out of haul road traffic.

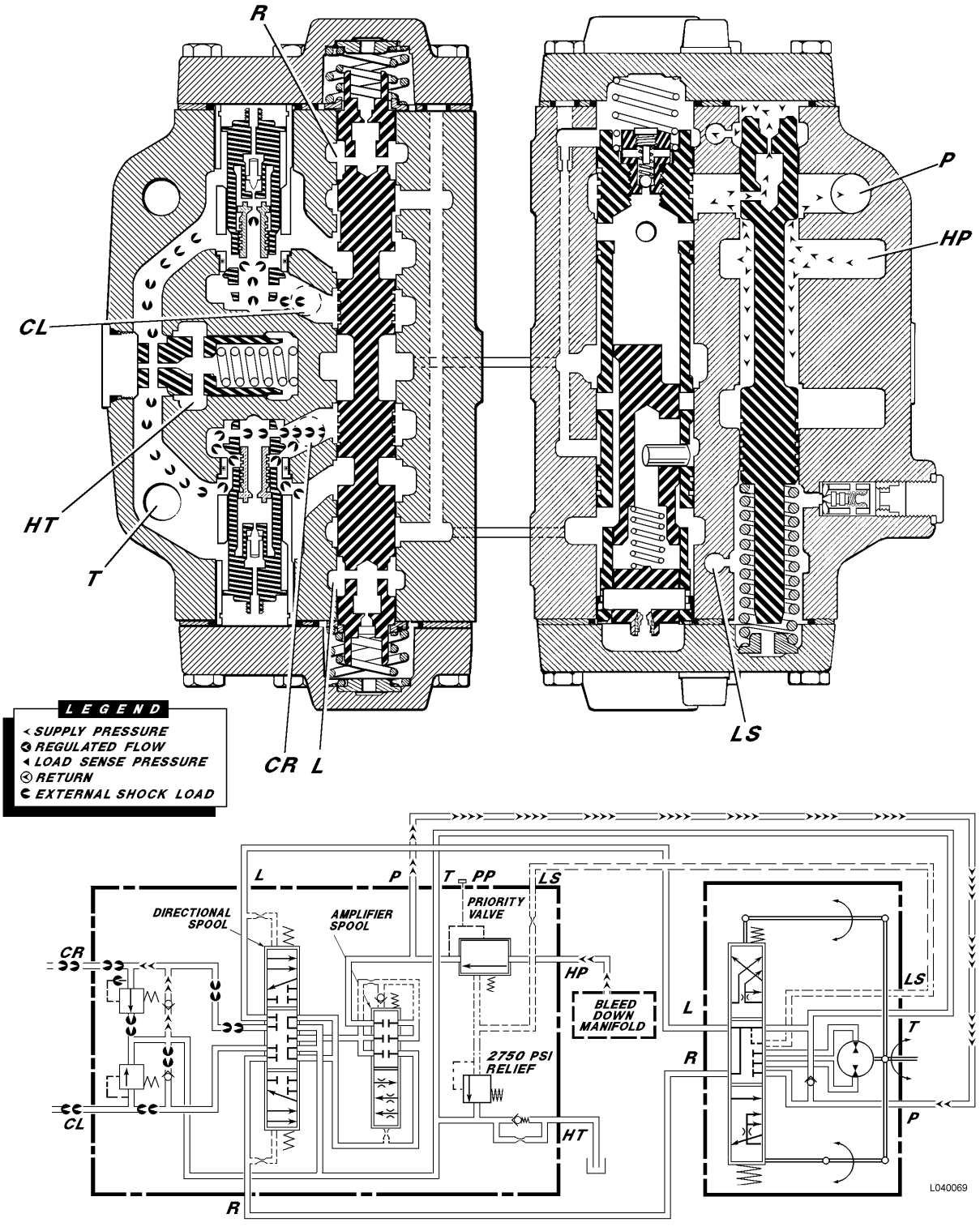


FIGURE 4-9. FLOW AMPLIFIER
NO STEER - EXTERNAL SHOCK LOAD

4. Remove end cover (4) and O-ring (2, Figure 5-5).

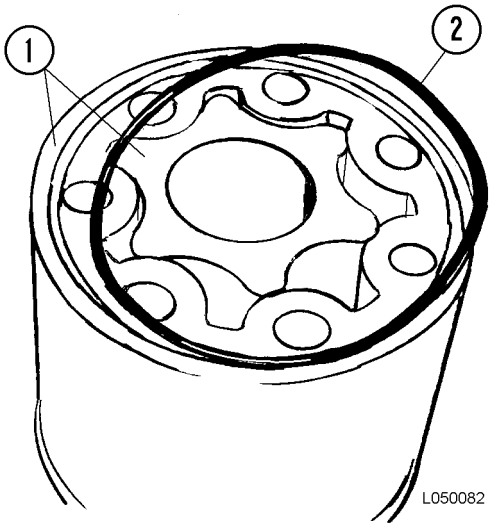


FIGURE 5-5. END COVER REMOVAL

1. Gear Wheel Set 2. O-Ring

5. Remove outer gear of gear wheel set (1) and O-ring between gear set and distribution plate.
6. Lift inner gear off cardan shaft.
7. Remove cardan shaft (11, Figure 5-7), distribution plate (15) and O-ring (14).
8. Remove threaded bushing (4) and ball (3).
9. With valve housing positioned with the spool and sleeve vertical, carefully lift spool assembly out of housing bore.

⚠ IMPORTANT ⚠

If housing is not vertical when spool and sleeve are removed, pin (9) may slip out of position and trap spools inside housing bore.

10. Remove O-ring (5), kin ring (6) and bearing assembly (7).
11. Remove ring (8) and pin (9) and carefully push inner spool out of outer sleeve.
12. Press the neutral position springs (10) out of their slot in the inner spool.
13. Remove the dust seal (2, Figure 5-6) using a screwdriver. Take care not to scratch or damage the dust seal bore.

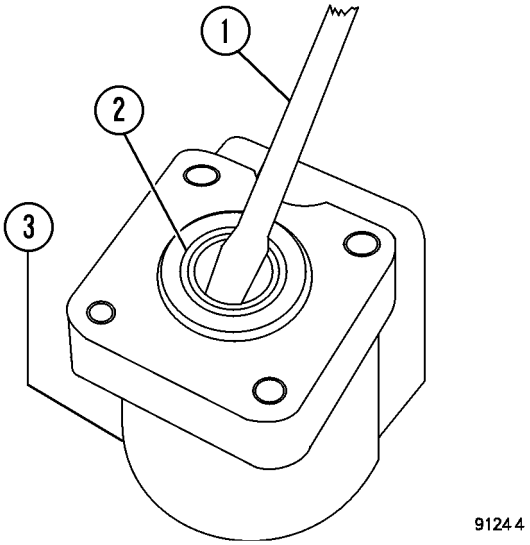


FIGURE 5-6. DUST SEAL REMOVAL

1. Screwdriver 3. Housing
2. Dust Seal

Cleaning and Inspection - Steering Control Unit

1. Clean all parts carefully with fresh cleaning solvent.
2. Inspect all parts carefully and make any replacements necessary.

NOTE: All O-rings, seals and neutral position springs should be replaced with new. Prior to reassembly thoroughly lubricate all parts with clean type C-4 hydraulic oil.

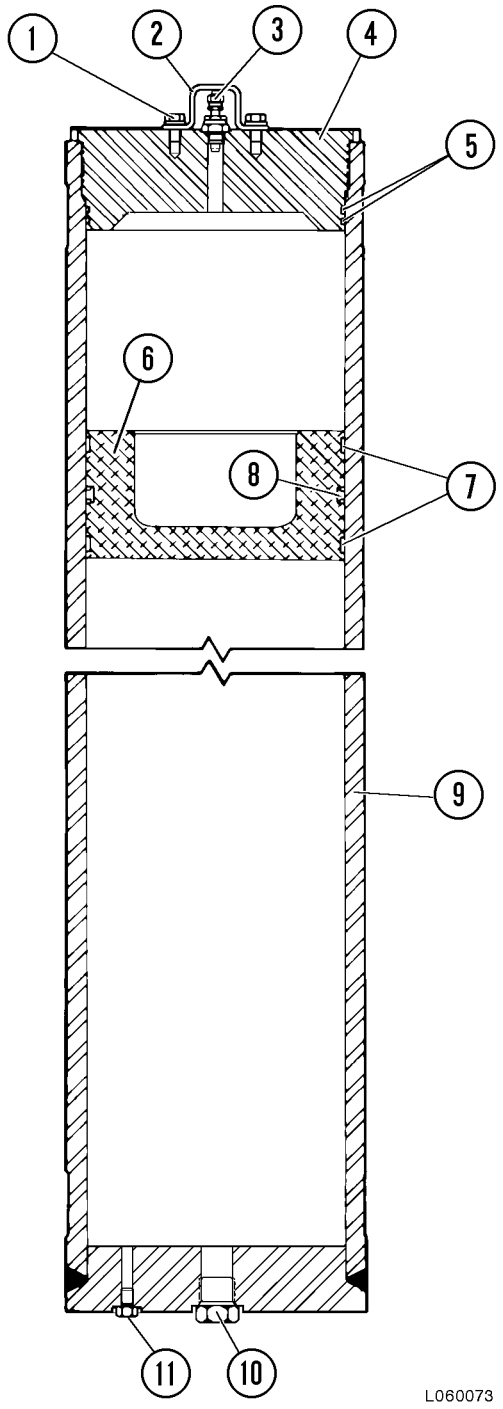


FIGURE 6-4. ACCUMULATOR ASSEMBLY

1. Capscrew
2. Cover
3. Charging Valve
4. Gland
5. O-ring & Backup Ring
6. Piston
7. Bearing
8. "T" Ring Seal
9. Housing
10. Plug (or Adaptor)
11. Plug

Disassembly - Accumulators

1. Remove charging valve (3, Figure 6-4).
2. Remove gland (4).

Note: Figure 6-5 illustrates a tool that can be fabricated locally to aid in removing the gland.

3. Remove plugs and/or adaptor (10 & 11). Using a round rod, push piston (6) out of accumulator.
4. Remove piston rings (7) and seal (8).

Cleaning and Inspection - Accumulators

1. Clean parts using fresh cleaning solvent, lint free wiping cloth and filtered compressed air. All parts must be absolutely free of any foreign matter larger than 3 microns.
2. Inspect piston for damage. If scored or otherwise damaged, replace with a new part.
3. Minor defects in the housing bore may be corrected by honing.
   a. Measure the bore at several places along the length of the housing. Make two measurements, 90° apart at each point to verify tube is not out-of-round.

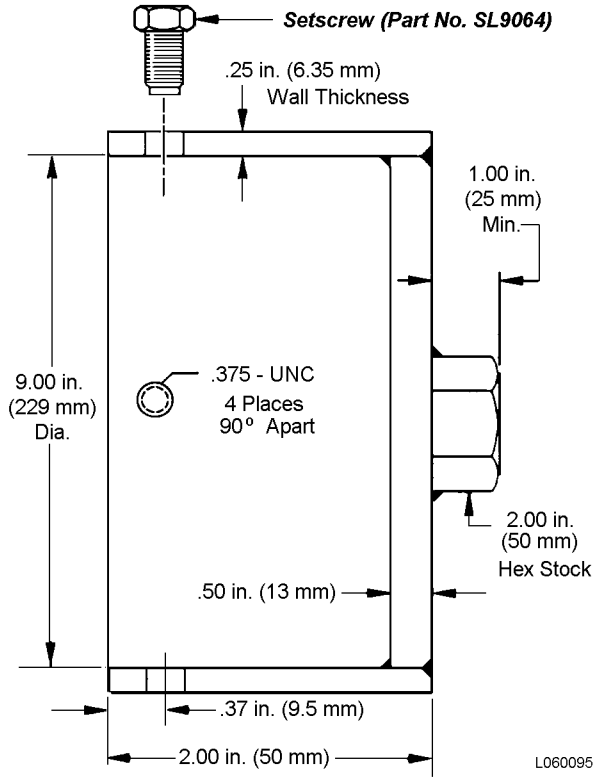


FIGURE 6-5. GLAND REMOVAL TOOL
(Fabricate Locally)

3. Move the steering pump into position. Engage steering pump shaft with hoist pump spline coupler.
4. Install rear support bracket with capscrews (6, Figure 6-12). Do not tighten capscrews at this time.
5. Align capscrew holes and install steering pump mounting capscrews (4). Tighten mounting capscrews to standard torque. Tighten rear support capscrews to standard torque.
6. Remove plugs from pump inlet and outlet ports. Remove caps from inlet and outlet lines and install to steering pump using new O-rings. Tighten capscrews securely. Do not connect steering pump drain hose to the steering pump, at this time (see Step 7).
7. Remove case drain fitting from top of pump housing and **add clean C-4 oil to pump through opening until steering pump housing is full.** This may require 2 - 3 qt. (2 - 3 L) of oil.
8. Uncap the case drain line, connect to steering pump fitting and tighten case drain line.
9. Replace hydraulic filter elements. Refer to Section L, Hydraulic System Filters.

⚠ IMPORTANT ⚠

Use only Komatsu filter elements, or elements that meet the Komatsu hydraulic filtration specification of Beta 12 = 200.

10. Open shut-off valve in steering pump suction line completely.
11. With the body down and the engine shut-off, fill the hydraulic tank with clean C-4 hydraulic fluid (as specified on the truck Lubrication Chart) to the upper sight glass level.
12. With suction line shut-off valve open, loosen suction (inlet) hose capscrews (at the pump) to bleed any trapped air. Tighten hose connection capscrews to standard torque.

⚠ IMPORTANT ⚠

If trapped air is not bled from steering pump, possible pump damage and no output may result.

13. If required, top-off the oil level in the hydraulic tank, to the level of the upper sight glass.
14. In the hydraulic components cabinet, open both brake accumulator needle valves completely to allow the steering pump to start under a reduced load.
15. Move the hoist pilot control valve to the FLOAT position.
16. Start the truck engine and operate at low idle for one (1) to two (2) minutes.

⚠ WARNING

Do not allow the engine to run with the needle valves in the open position for longer than this recommendation: excessive hydraulic system heating will occur.

Do Not start any hydraulic pump for the first time after an oil change, or pump replacement, with the truck dump body raised. Oil level in the hydraulic tank may be below the level of the pump(s) causing extreme pump wear during this initial pump start-up.

17. Shutdown the engine. Fully close both brake accumulator needle valves in the hydraulic components cabinet.
18. Verify that the oil level in the hydraulic tank is at the upper sight glass when the engine is off and the body is resting on the frame. If the hydraulic oil level is not at the upper sight glass, follow service manual instructions for filling/adding oil.
19. Start engine and check for proper pump operation. If necessary, refer to Steering Circuit Check-out and Adjustment Procedure in Section L10, or the Troubleshooting Chart at the end of this section.

TROUBLESHOOTING CHART
(STEERING CIRCUIT)

POSSIBLE CAUSES	SUGGESTED CORRECTIVE ACTION
TROUBLE: Slow steering, hard steering or loss of power assist	
Overloaded steering axle	Reduce axle loading
Malfunctioning relief valve preventing adequate system pressure build-up	Check system pressure. Adjust or replace relief valve.
Worn or malfunctioning pump	Replace pump.
Restricted high pressure filter or suction strainer	Replace filter element or clean strainer.
TROUBLE: Drift - truck veers slowly in one direction.	
Rod end of cylinder slowly extends without turning the steering wheel	A small rate of extension may be normal on a closed center system.
Worn or damaged steering linkage	Inspect and replace linkage if necessary. Check alignment or toe-in of the front wheels.
TROUBLE: Wander - truck will not stay in straight line	
Air in system due to low oil level, pump cavitation, leaking fitting, pinched hoses, etc.	Correct oil supply problem or bleed air.
Loose cylinder piston	Repair or replace steering cylinder.
Broken centering springs (spool valve, steering valve)	Repair or replace steering control unit.
Worn mechanical linkage	Repair or replace.
Bent linkage or cylinder rod	Repair or replace defective components.
Severe wear in steering control unit	Repair or replace steering control unit.
TROUBLE: Slip - a slow movement of steering wheel fails to steer front wheels	
Leakage of steering cylinder piston seals	Repair or replace steering cylinder
Worn steering control unit meter	Replace steering control unit.
TROUBLE: Spongy or soft steering	
Low oil level	Service hydraulic tank and check for leakage.
Air in hydraulic system. Probably air trapped in cylinders or lines.	Bleed air from system.

The secondary low pressure relief is located between the low pressure core and the outlet to the brake cooling circuit. It provides for pressure relief if pressure spikes occur in the low pressure passage area.

The load check allows free flow from the inlet to the high pressure core and prevents flow from the high pressure core to the inlet.

The anti-void check valve allows free flow from the low pressure core to the high pressure core and prevents flow from the high pressure core to the low pressure core.

Spool Sections - Hoist Valve

Work Ports (Rear) Spool Section

The rear spool section of the hoist valve consists of the following components:

- Pilot ports
- Main spools
- Work ports
- Check poppets

The pilot ports are located in the spool section cover. These ports provide connections for a pilot line to the hoist pilot valve. Each work port has a corresponding pilot port.

The work ports provide for a line connection between the spool section and the hoist cylinders. One main spool for each work port is spring biased at both end to block the work port from the high and low pressure cores when there is no flow through the spool cross holes.

When there is flow through the pilot ports to the spools, a positive differential pressure at the top of the spool will overcome the bottom spring bias and the spool will shift to connect the work port to the high pressure core.

When there is flow from the main valve work port to the pilot port through the cross-holes, a positive differential pressure at the bottom of the spool will overcome the top spring bias and the spool will shift to connect the work port to the low pressure core.

The check poppets located in the spool section permit free flow from the work port to the pilot port and restrict flow from the pilot port to the work port. These check poppets control spool response and spool movements during void conditions.

Tank Ports (Front) Spool Section

The primary low pressure valves are located in the front spool section of the hoist valve. These valves maintain back pressure on the low pressure passage and direct the hoist cylinder return oil back to the hydraulic tank.

Hoist Pilot Valve

The hoist pilot valve (Figure 7-3) is mounted in the hydraulic components cabinet behind the operator's cab. The hoist pilot valve spool is spring centered to the neutral position and is controlled directly by the operator through a lever mounted on the console between the operator and passenger seat. A cable connects the cab mounted lever to the hoist pilot valve in the hydraulic components cabinet.

When the operator moves the lever, the pilot valve spool moves and directs pilot flow to the appropriate pilot port on the hoist valve. The pilot flow causes the main spool to direct oil flow to the hoist cylinders.

The hoist pilot valve is equipped with a one way load check valve which allows free flow from the center passage to bridge core and prevents reverse flow. The valve also contains the power down relief valve (2), used to limit power down pressure to 1500 psi (10.4 MPa).

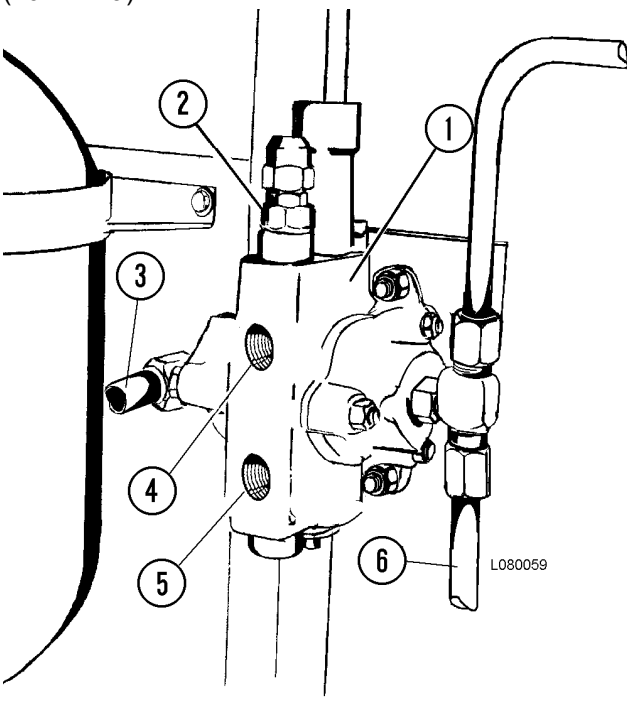


FIGURE 7-3. HOIST PILOT VALVE

1. Hoist Pilot Valve
2. Relief Valve
3. Supply Port
4. To Hoist Valve (Rod End)
5. To Hoist Valve (Base End)

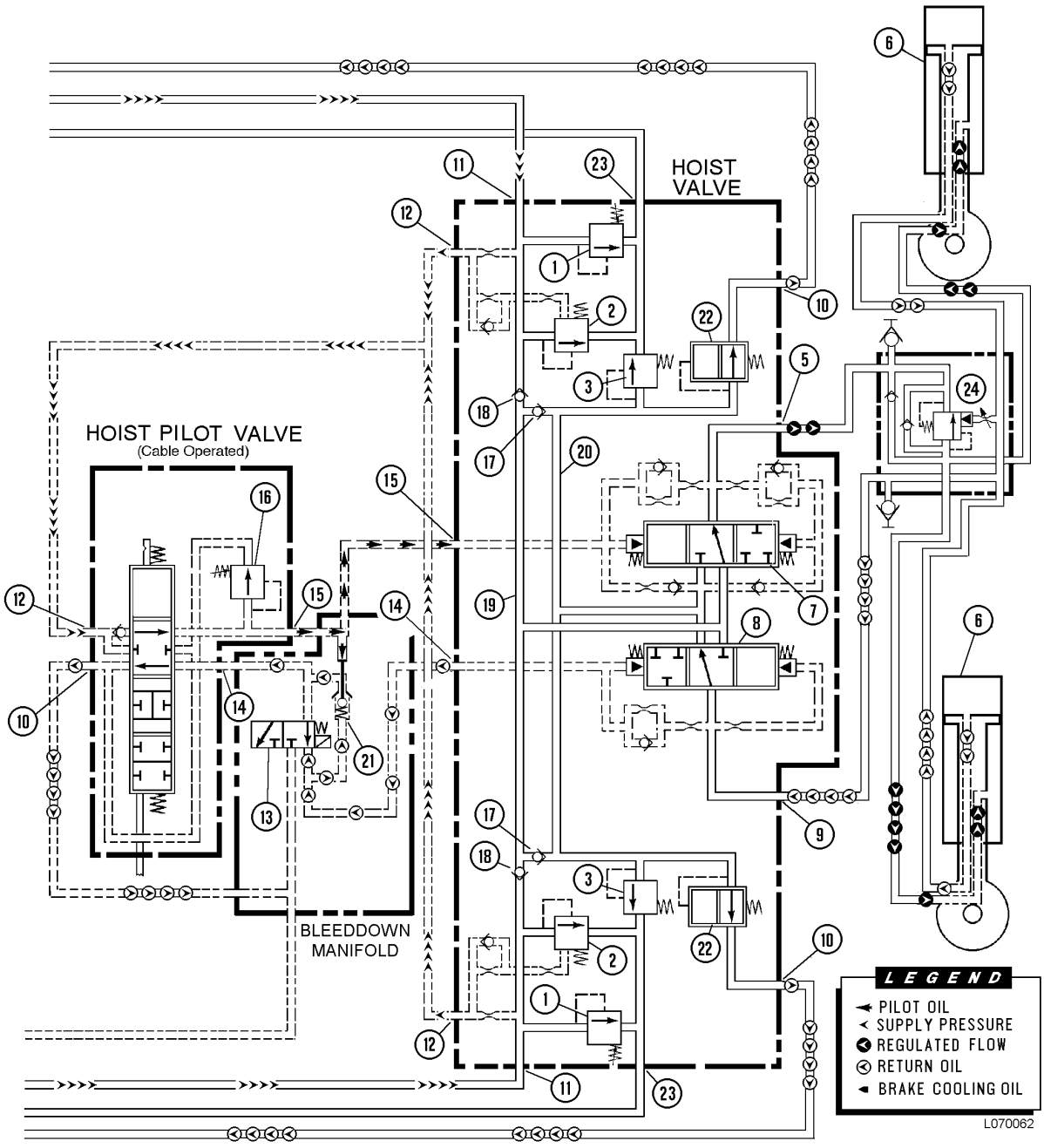


FIGURE 7-8. POWER DOWN POSITION

1. Hoist Relief Valve (2500 psi)
2. Flow Control Valve
3. Secondary Low Pressure Valve (250 psi)
4. Snubber Valve
5. Rod End Work Port
6. Hoist Cylinders
7. Rod End Spool
8. Head End Spool
9. Head End Work Port
10. Tank Return Port
11. Supply Port
12. Pilot Supply Port
13. Hoist Limit Solenoid
14. Raise Pilot Port
15. Down Pilot Port
16. Power Down Relief Valve (1500 psi)
17. Anti-void Check Valve
18. Load Check Valve
19. High Pressure Passage
20. Low Pressure Passage
21. Pilot Operated Check Valve
22. Primary Low Pressure Valve (26 psi)
23. Brake Cooling Circuit Port
24. Overcenter Manifold

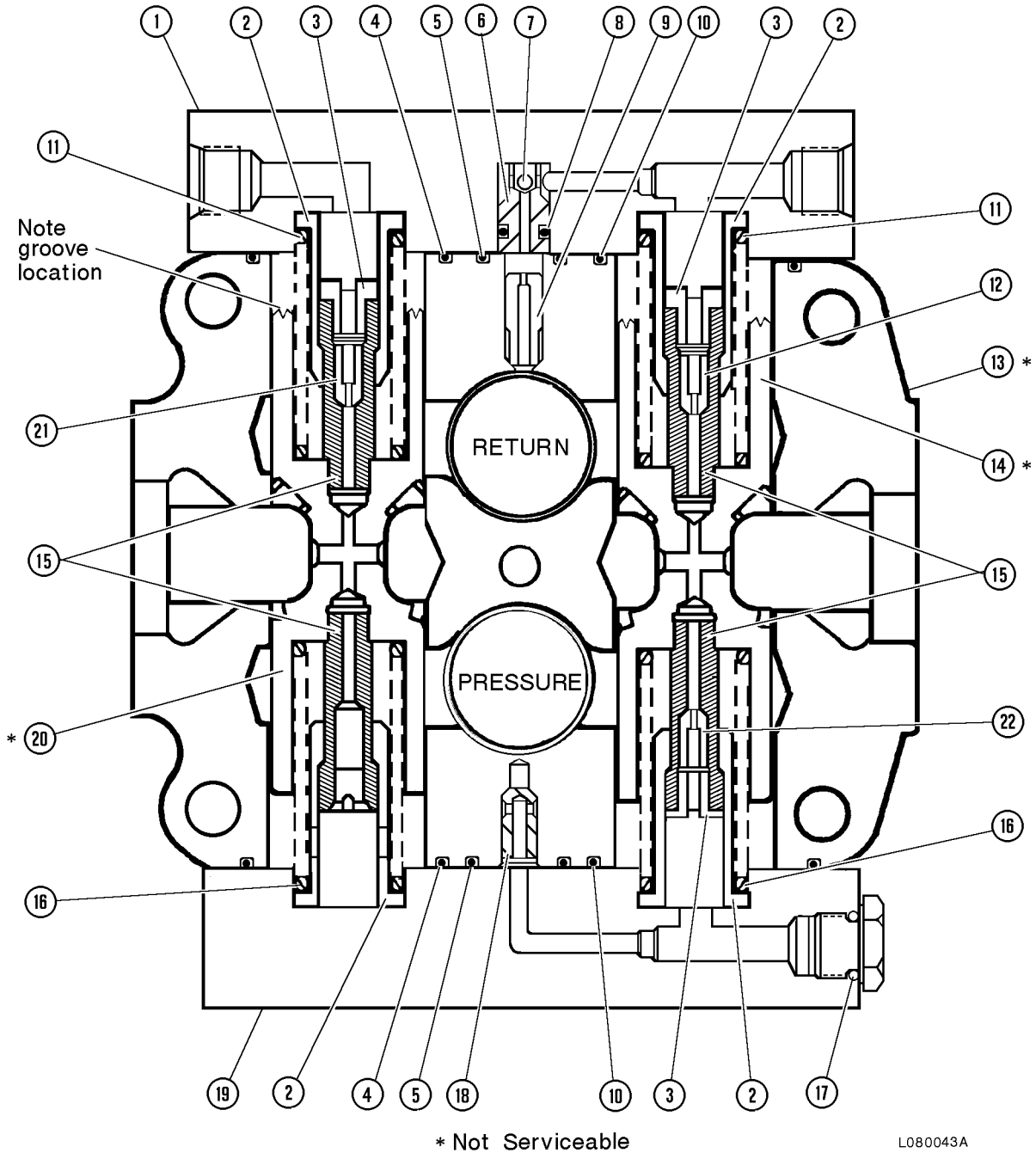


FIGURE 8-9. WORK PORTS SPOOL SECTION ASSEMBLY

1. Spool Cover
2. Spring Seat
3. Plug
4. O-Ring
5. O-Ring
6. Poppet
7. Ball
8. O-Ring
9. Restrictor Poppet
10. O-Ring
11. Spring
12. Restrictor Poppet (Red)
13. Spool Housing
14. Spool Assembly
15. Spool End
16. Spring (Blue)
17. O-Ring
18. Poppet
19. Spool Cover
20. Spool Assembly
21. Restrictor Poppet (Green)
22. Restrictor Poppet (White)

Disassembly - Hoist Cylinder

1. If removal of the hoist cylinder eye bearings is necessary, remove retainer ring (4, Figure 8-19) and press out bearing (5).
2. Mount the hoist cylinder in a fixture which will allow it to be rotated 180°.
3. Position cylinder with the cover (10, Figure 8-20) mounting eye at the top. Remove capscrews (11) and lockwashers retaining the cover to the housing (4).
4. Install two 0.88 in. dia. x 9 in. long, threaded capscrews into the two threaded holes in the cover (10). Screw the capscrews in evenly until the cover can be removed. Lift cover straight up until quill assembly (22) is clear. Remove O-ring (12) and backup ring (23).
5. Remove capscrews (7) and plate (5) attaching the rod bearing retainer (6) to the rod (1). Remove the seal (8).
6. Fabricate a retainer bar using a 1/4" x 1" x 18" (6 x 25 x 460 mm) steel flat. Drill holes in the bar to align with a pair of tapped holes spaced 180° apart in the housing. Attach bar to housing using capscrews (11).

NOTE: A retainer bar is required to prevent the first and second stage cylinders from dropping out when the housing is inverted.

7. Rotate the cylinder assembly 180°, to position the lower mounting eye at the top. Hook a lifting device to the eye on the rod (1) and lift the rod and third stage cylinder assembly out of the cylinder housing.

NOTE: As internal parts are exposed during disassembly, protect machined surfaces from scratches or nicks.

8. Rotate the cylinder housing 180°. Remove the retainer installed in step 6.
9. Fabricate a round disc 12.5 in. (318 mm) in diameter 0.38 in. (10 mm) thick with a 0.56 in. (14 mm) hole in the center. Align the disc over the second (2) and first (3) stage cylinders at the bottom of the cylinder housing.
10. Insert a 0.50 in. (13 mm) dia. x 53 in. (1350 mm) threaded rod through the top and through the hole in the disc. Thread a nut on the bottom end of the threaded rod below the disc.
11. Screw a lifting eye on the top end of the rod. Attach it to a lifting device and lift the second and first stage cylinders out of the housing.
12. Remove lifting tools from the second and first stage cylinder assembly.
13. Slide the second stage cylinder (2) down inside the first stage cylinder (3). Remove snap ring (9) from inside the first stage cylinder.
14. Remove second stage cylinder from first stage cylinder by sliding it out the top.
15. Remove all old bearings, O-rings, and seals from the hoist cylinder parts.

STEERING CIRCUIT FILTER

The steering circuit filter (Figure 9-2) is located on the inboard side of the fuel tank. The filter provides secondary filtering protection for hydraulic oil flowing to the bleeddown manifold valve for the steering and brake systems.

An indicator switch (1) is designed to alert the operator of filter restriction before actual bypass occurs. The switch contacts close at 35 ± 5 psid (240 ± 35 kPa) to actuate a warning lamp on the overhead display panel. Actual filter bypass occurs at 50 psi (345 kPa).

NOTE: When the engine is initially started and the hydraulic oil is cold, the warning lamp may actuate. Allow the hydraulic system oil to reach operating temperature before using the warning lamp as an indicator to change the element.

Refer to Section P, Lubrication and Service for recommended normal filter element replacement interval. Earlier replacement may be required if the restriction indicator lamp turns on.

Premature filter restriction may indicate a system component failure and signal a service requirement before extensive secondary damage can occur.

NOTE: An early indication of the filter warning light at first installation may be due to restriction in the filter as it cleans the system. Unless the fluid appears contaminated or has a strong foul odor, do not change the oil; replace only the filter element.

Filter Element Replacement

WARNING

Relieve pressure before disconnecting hydraulic and other 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.

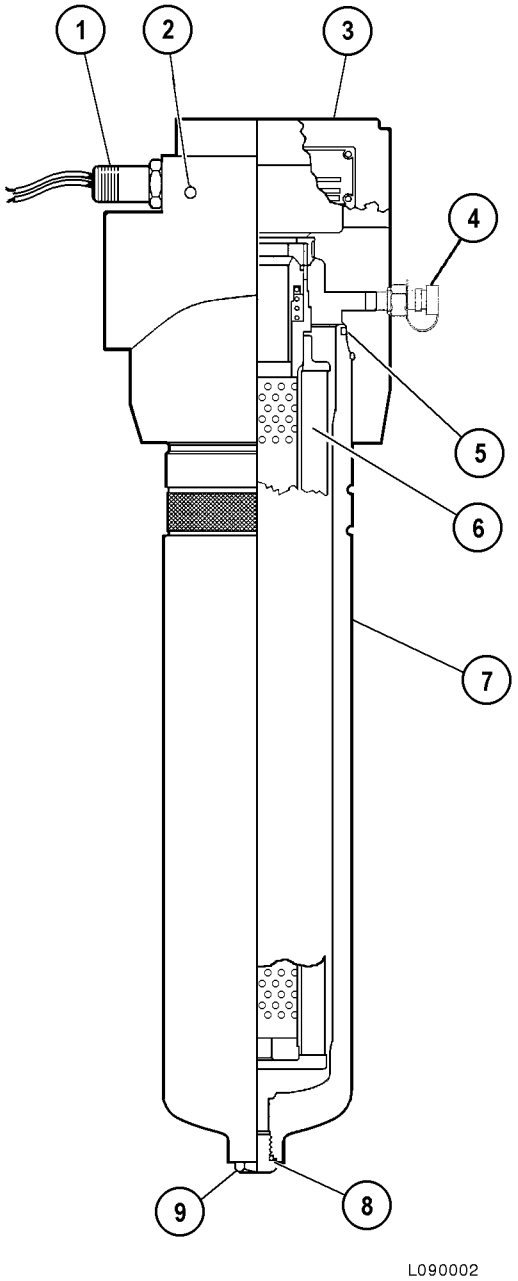


FIGURE 9-2. STEERING CIRCUIT FILTER

1. Indicator Switch
2. Setscrew
3. Head
4. Pressure Tap
5. O-Ring
6. Filter Element
7. Bowl
8. O-Ring
9. Drain Plug

Shock And Suction Valves

Equipment Requirements

The following equipment will be necessary to properly test the steering circuit shock and suction valves:

- Hydraulic schematic, refer to Section "R".
- Three 0-5000 psi (0-35,000 kPa) range calibrated pressure gauges and hoses.

Before the shock and suction valves in the steering circuit can be tested, steering system pressure must be increased to obtain sufficient pressure for testing. In addition, the steering relief valve pressure must be raised above the pressure required to actuate the shock and suction valves.

1. Install a 5000 psi (0-35,000 kPa) pressure gauge at "TP2" (3, Figure 10-2) in the steering bleeddown manifold.
2. Install a 5000 psi (0-35,000 kPa) gauge in each steering cylinder manifold test port. (Located on frame crossmember, under engine.)
3. Raise steering relief valve pressure as follows:
   a. Remove external plug (2, Figure 10-3) on flow amplifier valve, using an 8 mm allen wrench.
   b. Insert a 5 mm allen wrench into opening and gently bottom out adjustment (4) by turning clockwise.
4. Start the engine and allow steering system to build pressure.
5. While observing gauge at the "TP2" steering pressure test port, turn unloader valve adjustment (2, Figure 10-1) clockwise until approximately 3300 psi (22,750 kPa) is obtained.

NOTE: This pressure is near the pump compensator pressure setting and the pump may not unload, however it is not necessary for the pump to unload during this test.

6. While observing the two gauges installed on the steering manifold, steer the truck against the left stop.

   ❑ Pressure on one of the gauges should read 3100 psi (21,370 kPa).

**Record on Data Sheet*

7. Steer the truck to the opposite stop.

   ❑ The other gauge should read 3100 psi (21,370 kPa).

**Record on Data Sheet*

8. If pressure is incorrect during step 6 or 7, the shock and suction valves must be replaced.

NOTE: The shock and suction valves are only serviced as complete units, and cannot be adjusted while installed in the flow amplifier valve.

9. After the above test is complete, lower the steering relief pressure to 2750 psi (18,960 kPa) as follows:
   a. Steer full left or right and maintain a slight pressure against the steering wheel.
   b. Adjust steering relief valve, using the 5 mm allen wrench to obtain 2750 psi (18,960 kPa) on the gauge showing pressure.

**Record on Data Sheet*

10. After adjustment is complete, install plug (2, Figure 10-3) with O-ring (3) on valve body.
11. Reset unloader valve to specified unload pressure; back out the unloader valve adjustment screw completely counterclockwise.
12. Steer the truck to reduce pressure in the steering circuit and cause the pump to load.
    a. Observe increasing pressure readings on the gauge installed at the steering pressure, "TP2" test port (3, Figure 10-2).

    ❑ When pressure increases to 3000 to 3050 psi (20,680 to 21,025 kPa), adjust unloader valve by turning adjustment screw clockwise until the pump unloads and feedback pressure begins to decrease.

    b. Steer the truck again while observing the steering pressure feedback gauge.

    ❑ The pump must reload when pressure drops to 2750 psi (18,960 kPa) minimum.

**Record on Data Sheet*

13. If minimum reloading pressure in step 12. is not correct, repeat unloader valve adjustment.

**Record on Data Sheet*

NOTE: The critical pressure setting is the 2750 psi (18,960 kPa) when the pump loads. The unloading pressure follows the loading pressure adjustment and should occur at approximately 3025 psi (20,855 kPa).

SECTION M

OPTIONS AND SPECIAL TOOLS

INDEX

Installation Procedure for Squib

After all testing has been completed and all test kit components removed, proceed to arm the system.

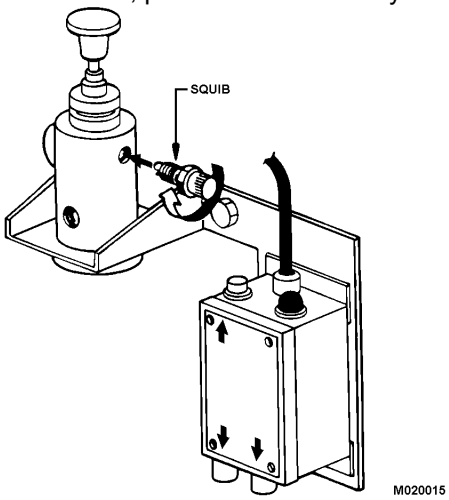


FIGURE 2-18.

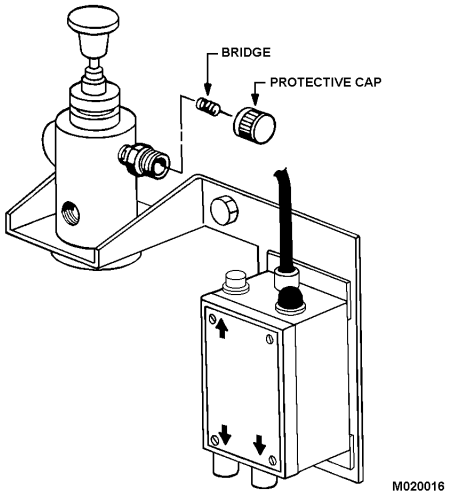


FIGURE 2-19.

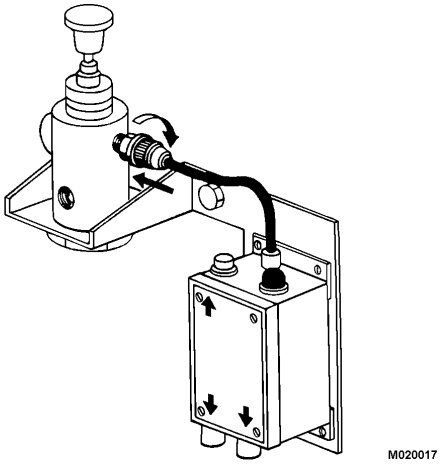


FIGURE 2-20.

Using wrench, insert squib into upper right inlet hole on actuator body and firmly tighten (Figure 2-18).

After installing squib into actuator body, loosen protective shipping cap from squib and remove bridge (Figure 2-19).

⚠CAUTION

Always install squib into actuator body first, before installing connector onto threaded body of squib. Possible injury could result if squib was actuated outside of actuator body.

Install squib connector onto threaded stud of squib (Figure 2-20). Hand tighten as firmly as possible.

Placing the Electric Detection & Actuation System Into Service

To place the electric detection and actuation system into service, proceed as follows:

1. Check all fasteners for tightness. Insure jam nut on actuator body is securely tightened.
2. Before installing actuator cartridge, push manual puncture lever several times to insure smooth operation.
3. Insert ring pin in hole and attach lead wire seal (See Figure 2-21).

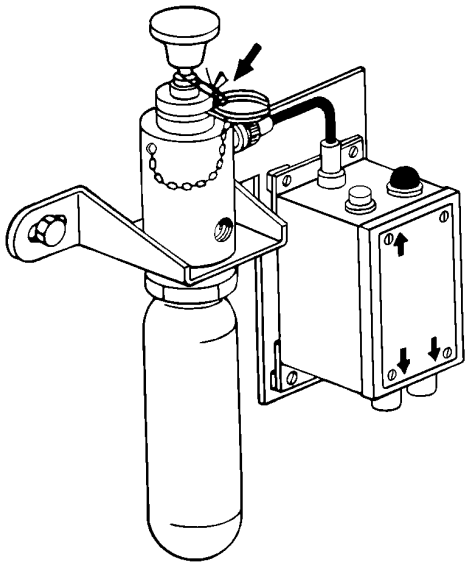
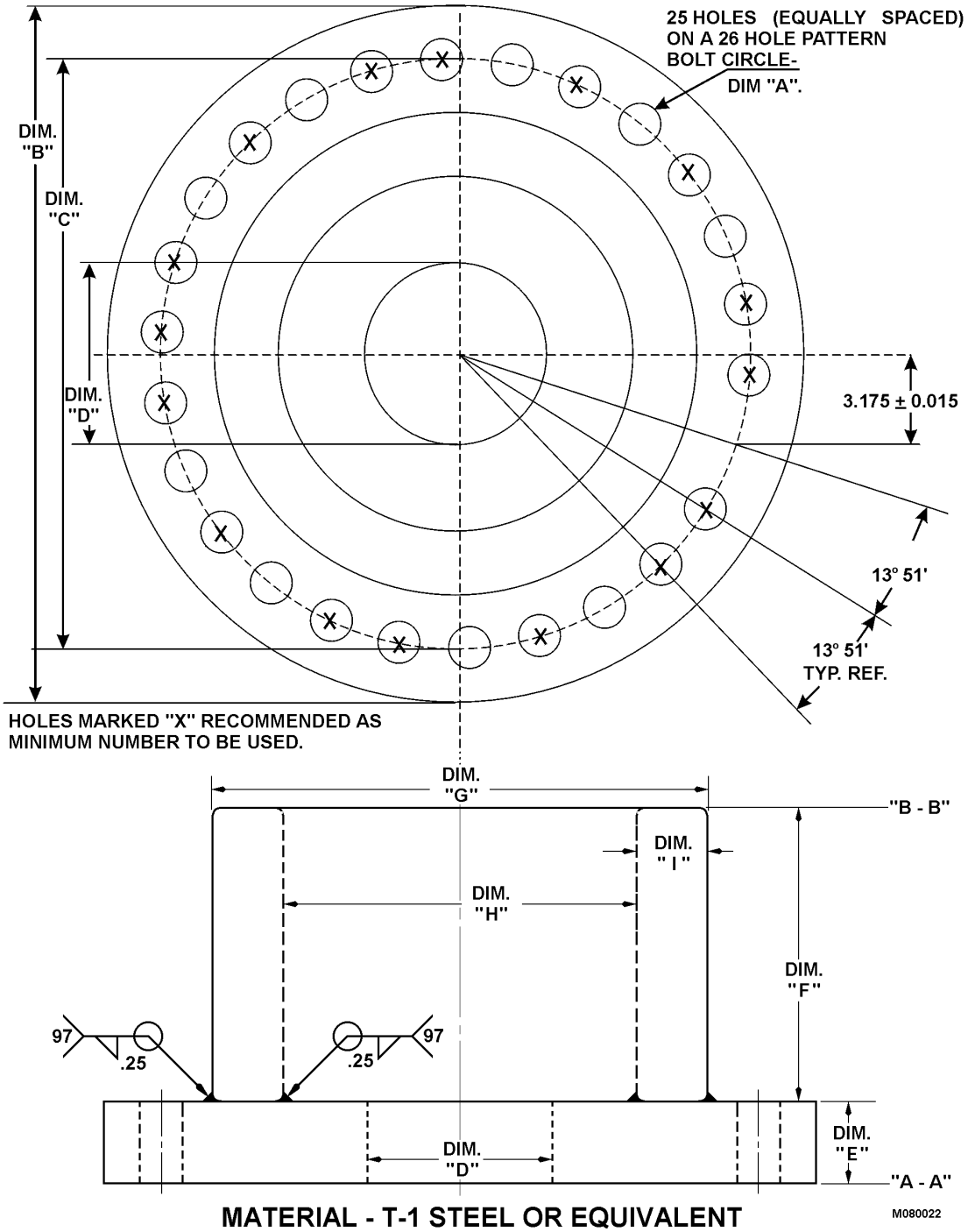


FIGURE 2-21. INSTALL ACTUATOR CARTRIDGE

4. Insert LT-5-R cartridge (PB0674) into lower actuator body and hand tighten firmly.
5. Record date that system was placed in service.



MATERIAL - T-1 STEEL OR EQUIVALENT

930E-2 SPINDLE REMOVAL TOOL

Dimension "A" - Bolt Hole Diameter
Dimension "B" - Plate Outside Diameter
Dimension "C" - Bolt Circle Diameter
Dimension "D" - Plate Inside Diameter
Dimension "E" - Plate Thickness
Dimension "F" - Cylinder Height
Dimension "G" - Cylinder Outer Diameter
Dimension "H" - Cylinder Inner Diameter
Dimension "I" - Cylinder Wall Thickness

NOTE: Surface A-A must be parallel to surface B-B within 0.062 in. after welding.

Checking the Gain

1. Press and hold the LIGHT/INC and MODE switches until "CHEC" is flashing on the meter.

2. Press and hold the LIGHT/INC switch until "ALL0" is flashing on the display. "A.FUL" may also be displayed.

3. Press the LIGHT/INC switch14 times. The number displayed will be the current G_t gain. Press MODE twice to return to normal operation.

Adjusting the Gain

Before adjusting the gain perform the following steps:

1. Confirm the suspension oil and nitrogen charges are at the levels specified in the shop manual.
2. Weigh the empty truck and then calibrate the payload meter. Do both in succession to ensure the weights are nearly identical.
3. Weigh at least 10 different loads to get an accurate deviation from actual scale weight and the payload calculation from the payload meter. Complete the gain adjustment worksheet at the end of this module. The worksheet is an accurate way to calculate the necessary gain adjustment.

Adjustment Procedure:

1. Ensure the PLM II™ is in normal operating mode.
2. Adjust the gain potentiometer on the side of the meter. Right to decrease, left to increase.
3. Press and hold the LIGHT/INC and MODE switches until "CHEC" is flashing on the meter.

4. Press and hold the LIGHT/INC switch until "ALL0" is flashing on the display. "A.FUL" may also be displayed.

5. Press the LIGHT/INC switch14 times. The number displayed will be the current G_t gain. This is not a "live" reading. Any time the gain is changed, this cycle must be repeated to view the new change.
6. Press MODE once and "CHEC" will flash on the display.

7. Press MODE once and the meter will return to normal operation.

Setting The Machine I.D. Code

1. Press and hold the MODE switch until "Cd:dP" is displayed.

2. Press the MODE switch once. The display will show:

3. Press the MODE switch once. The display will show:

4. Press the MODE switch once."d.XXX" is displayed.

5. Press the LIGHT/INC switch to change the last digit to the desired number.
6. Press the TOTAL/SFT switch and the display will show:

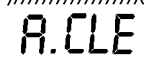
7. Press the LIGHT/INC switch to change the middle digit to the desired number.
8. Press the TOTAL/SFT switch and the display will show:

9. Press the LIGHT/INC switch to change the first digit to the desired number.
10. Press the MODE switch to return to normal operation.

Setting The Operator I.D. Code

1. Press and hold the MODE switch until "Cd:dP" is displayed.

2. Press the MODE switch once. The display will show:



3. Press the MODE switch once. The display will show:

4. Press the MODE switch repeatedly until "o.XXX" is displayed.

5. Press the LIGHT/INC switch to change the last digit to the desired number.
6. Press the TOTAL/SFT switch and the display will then indicate:

7. Press the LIGHT/INC switch to change the middle digit to the desired number.
8. Press the TOTAL/SFT switch and the display will show:

9. Press the LIGHT/INC switch to change the first digit to the desired number.
10. Press the MODE switch to return to normal operation.

Setting The Time and Date

1. Press and hold the MODE switch until "Cd:dP" is displayed.

2. Press the MODE switch once. The display will show:

3. Press the MODE switch once. The display will show:

4. Press the MODE switch repeatedly until "XX:XX" is displayed.

5. Press the LIGHT/INC switch to change the minutes.
6. Press the TOTAL/SFT switch and the display will then indicate:

7. Press the LIGHT/INC switch to change the hours. The clock is a 24 hour clock.
8. Press the TOTAL/SFT switch and the display will then indicate:

9. Press the LIGHT/INC switch to change the day.
10. Press the TOTAL/SFT switch and the display will then indicate:

11. Press the LIGHT/INC switch to change the month.
12. Press the TOTAL/SFT switch and the display will then indicate:

13. Press the LIGHT/INC switch to change the year.
14. Press MODE switch to return to normal operation.

Installation

1. Install a new O-ring onto sensor (4, Figure 20-11) and install sensor onto adapter (3). Tighten the sensor to **22-29 ft.lbs. (30-39 N.m)** torque.
2. Install a new O-ring onto adapter (3) and install complete adapter/sensor assembly onto valve (2). Hold the valve body and tighten adapter/sensor assembly to **103 ft.lbs. (176 N.m)** torque.
3. Connect the sensor wiring to the truck wiring harness. The sensors have three wires. Be sure that wires are connected correctly. (Figure 20-12)

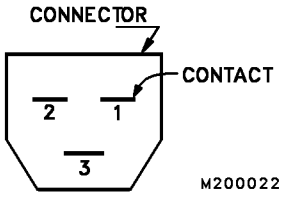


FIGURE 20-12. SENSOR SIDE CONNECTOR VIEW

Pin Number	Wire Color	Wire Function
1	Black	Ground (GND)
2	Red	+ Power
3	White	Signal

INCLINOMETER

As the truck is tilted fore or aft, the weight distribution between the front and rear axles changes. To compensate for this, the inclinometer measures the ground angle at which the truck rests. This data is then sent to the payload meter so it can calculate the correct payload weight. The inclinometer is located below the operator's center console (passenger seat structure).

Removal

1. Disconnect inclinometer wire lead from harness.
2. Remove the three capscrews, nuts and lockwashers (4, Figure 20-13) and inclinometer (3).

Installation

1. Install inclinometer (3, Figure 20-13) with capscrews, nuts and lockwashers (4).

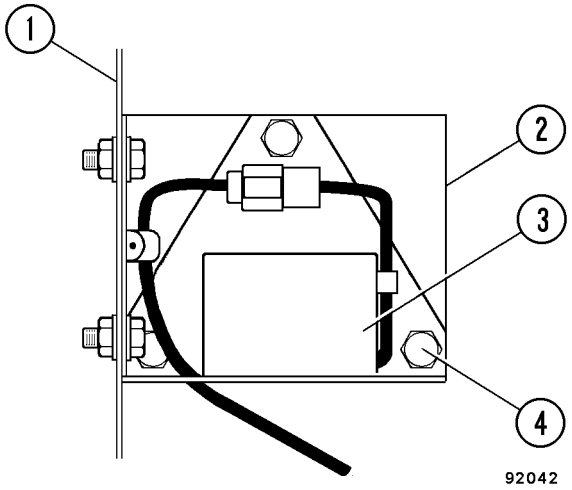


FIGURE 20-13. INCLINOMETER

1. Operator's Center Console Frame
2. Bracket
3. Inclinometer
4. Capscrew, Nut and Lockwasher

2. Connect inclinometer wiring to the truck wiring harness. (Figure 20-14) Be sure that wires are connected correctly.

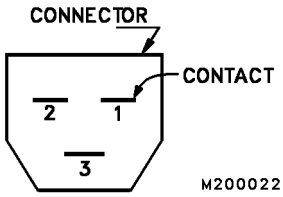


FIGURE 20-14. INCLINOMETER SIDE CONNECTOR VIEW

Pin Number	Wire Color	Wire Function
1	Black	Ground (GND)
2	Red	+ Power
3	White	Signal

Adjustment

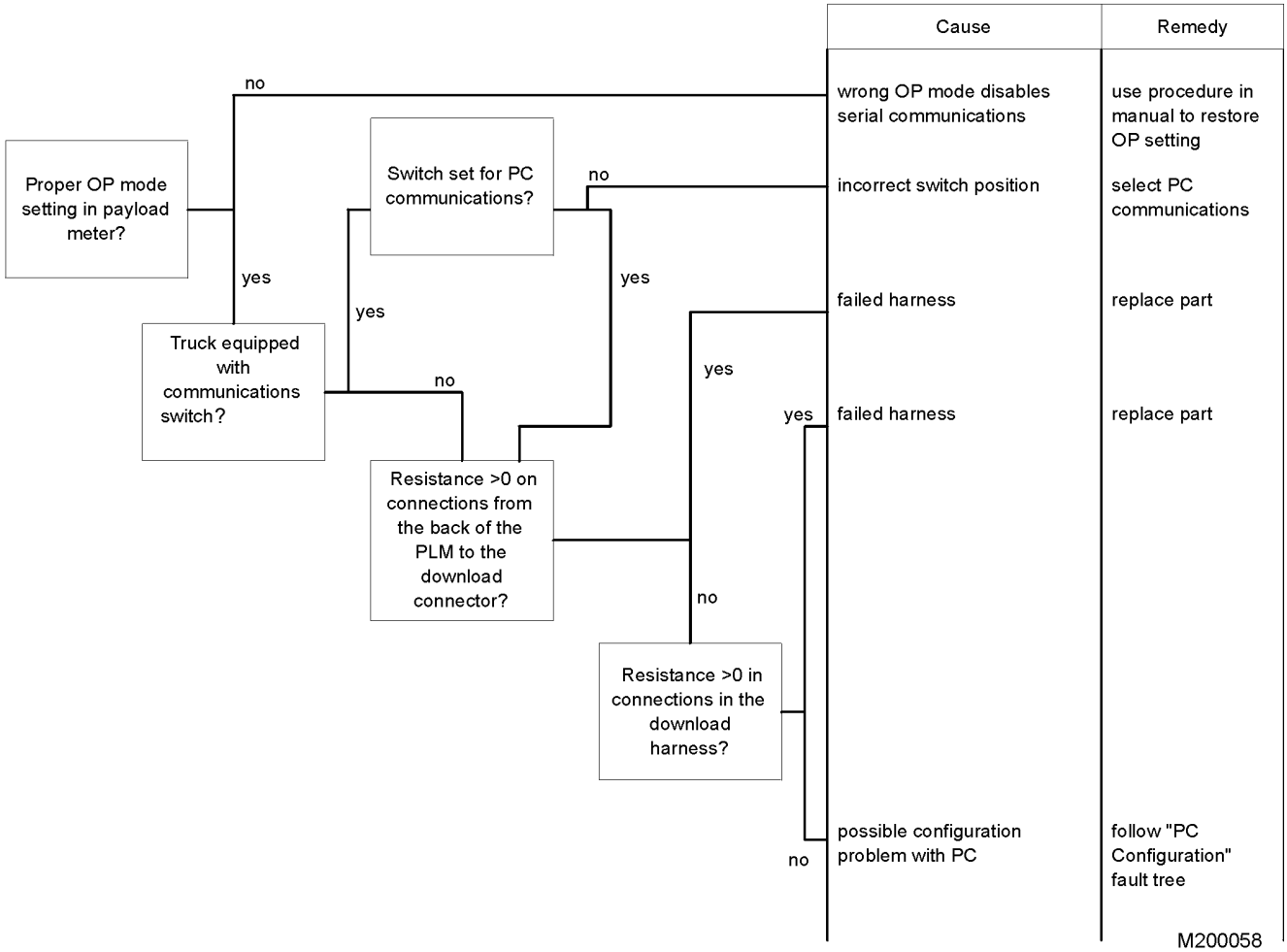
1. Park the truck on a 0% grade.
2. Loosen the three inclinometer mounting capscrews (4, Figure 20-13) and rotate the inclinometer until a voltage range of 2.6 ± 0.1 volts can be measured (using a volt-meter) at pins 1 and 2 of the inclinometer harness connector.
3. Tighten all capscrews (4, Figure 20-13) to standard torque, after the adjustment.

Cannot Download - PC Communications

The most common problem with PC communications to the payload meter is configuration of the PC. Be sure the correct serial port is selected for your laptop. In addition, be sure you have the latest PC software by checking with your distributor.

Verify the payload meter is using the proper OP setting. Refer to “Setting the Option Code” for information on OP settings.

No body-up input signal can be perceived as a communication problem with the payload meter. Without the body-up signal, the payload meter never starts a new haul cycle. When the payload meter is downloaded, and no haul cycles have been stored in memory, a technician may assume that the laptop did not communicate with the payload meter.

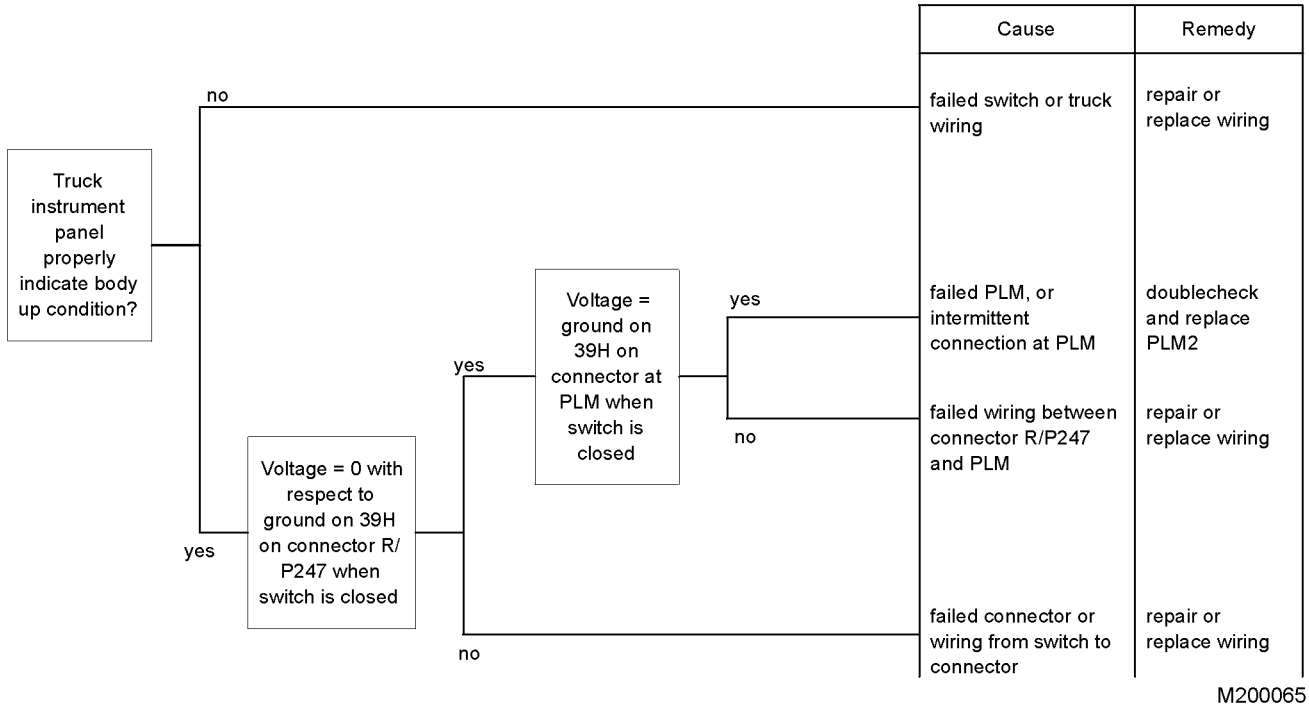


Brake Lock Input

The brake lock is used to lock only the rear wheels during loading. This allows the front wheels to rotate slightly and allows the payload meter to more accurately estimate payload. It is very important that only the brake lock be used during loading. Using the service brakes will significantly decrease payload meter accuracy.

The brake lock connects circuit 39H to ground. The circuit is wired through a small black connector behind the dash panel.

Confirm that the warning light panel indicates that the brake lock is recognized by the other truck systems. If so, follow the signal from the switch to the payload meter. It may also be that the connector on the back of the payload meter needs to be disconnected and re-inserted to clean the contacts.



All data is comma separated and can be imported into most popular spreadsheets and data analysis programs. A typical file looks like this:

9:40:27	R	4	458.21	439.71	283.18	247.6	1.28	22	2	0	1	1	1
9:40:27	R	4	465.32	448.25	278.91	246.18	1.04	22	2	0	1	1	1
9:40:28	R	4	456.78	451.09	274.64	247.6	1.33	22	2	0	1	1	1
9:40:28	R	4	443.98	465.32	276.06	256.14	2.14	23	2	0	1	1	1
9:40:28	R	3	432.59	445.4	277.49	261.83	2.61	23	2	0	1	1	1
9:40:28	R	3	436.86	424.05	278.91	256.14	2.99	24	2	0	1	1	1
9:40:29	R	3	461.05	421.21	288.87	251.87	2.61	24	2	0	1	1	1
9:40:29	R	2	486.67	421.21	286.02	241.91	1.52	24	2	0	1	1	1
9:40:29	R	2	483.82	415.52	288.87	251.87	1.85	25	2	0	1	1	1

In the sample data shown, the column marked "Type" refers to the type of data being transmitted; “R” is used for Real-Time, “F” is used for Final Load and “S” is used for Swing Load.

For the swing load data line the format is Time, S, Swing Load, Predicted Load, FL, FR, RL, RR.

For a final load transmission the format is Time, F, Final Load, FL, FR, RL, RR.

Connections to Payload Meter II™

Two harnesses are required to connect a PC to the Payload Meter II™.

- EF9159 - Connects to the back of the Payload Meter II™ to a panel mount connector.
- EF9160 - Connects from the panel mount connector to the PC.

The connectors and pins typically used for the payload meter connection are :

Description	Part Number
Terminal	7827101440
Connector	7845253670

The Payload Meter requires 5 wire RS232 communications. Payload Meter communications connections are :

1 - RTS **2** - Signal Ground **3** - RxD **4** - TxD **5** - CTS

TRUCK CAB

Description

The truck cab is a fully insulated design incorporating an integral ROPS structure for maximum operator comfort and safety. All gauges, switches, and controls have been designed to simplify operation and are placed within easy reach of the operator. Servicing of cab and associated electrical systems is simplified by use of heavy-duty connectors on the various wiring harnesses. Hydraulic components are located outside of the interior and are accessed through covers (2, Figure 2-1) on the front of the cab.

⚠WARNING

DO NOT attempt to modify or repair damage to the ROPS structure without written approval from the manufacturer. Unauthorized repairs to the ROPS structure will void certification. If modification or repairs are required, contact the servicing Komatsu Distributor.

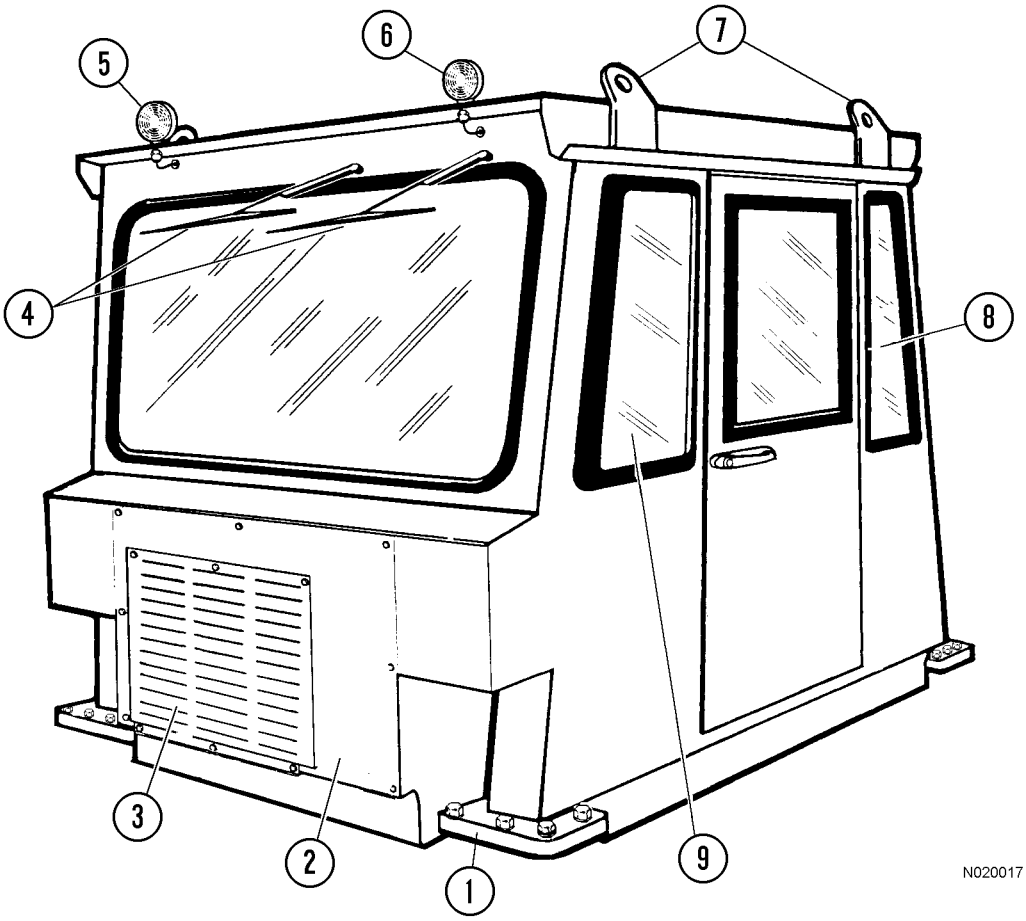


FIGURE 2-1. CAB ASSEMBLY

1. Mounting Pad
2. Access Covers
3. Filter Cover
4. Windshield Wiper Arms
5. Stop Light (Service Brakes Applied)
6. Retard Light (Retarder Applied)
7. Lifting Eye
8. Rear, Side Glass
9. Front, Side Glass

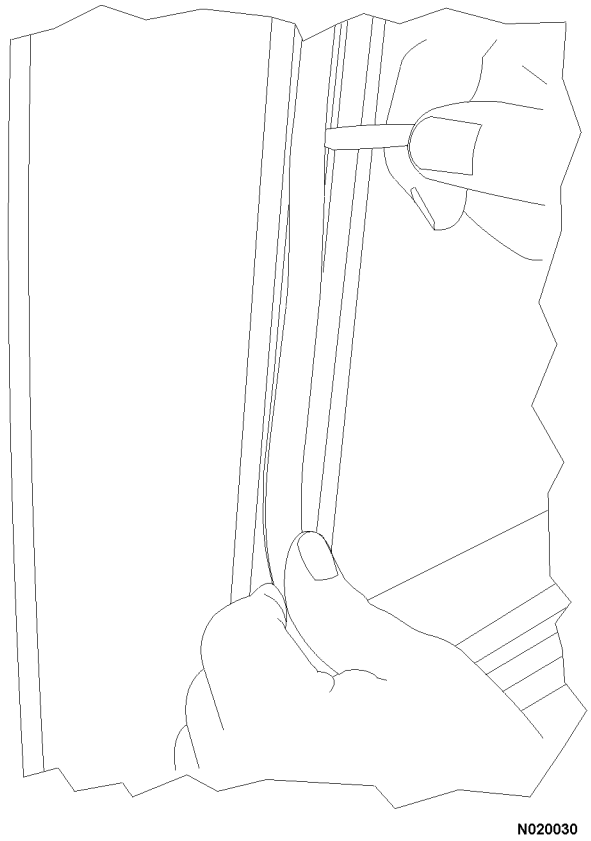


FIGURE 2-15.

21. Lift door panel, regulator and glass up to align screw holes in the panel with holes in door frame. Install screws that retain panel to door frame.
22. Hook-up electrical connector for the window regulator. Install the two cap screws that hold the door strap bracket to the door frame.
23. Align door check strap opening with holes in the bracket and install bolt. Install the hair pin clip. See Figure 2-6.

Door Window Regulator Replacement

1. Follow Steps 1-6 procedure for door glass replacement.
2. Move inner panel assembly to a work area to enable replacement of the window regulator. Remove 4 mounting screws. See 6, Figure 2-6.
3. Replacing Window Regulator Motor, or Window Regulator Assembly:
   a. If replacing the motor assembly of the window regulator, be sure the worm gear on the motor is engaged properly into the regulator gear. Also, the regulator should be in the "up" position before replacing the motor assembly. Be sure the motor mounting screws are tight.
   b. If replacing the window regulator assembly, the new regulator should be in the "up" position before being mounted.
4. Mount window regulator to the inner panel with the 4 mounting screws removed in Step 2. Be sure screws are tight.
5. Refer to door glass replace procedure and follow steps 20-23 to complete replacement.

Door Handle or Latch Assembly Replacement

The cab doors are equipped with serviceable latch handle assemblies (inner and outer). If they become inoperative, they should be replaced by a new assembly. The outer latch handle assembly on each door is furnished with a key-operated lock to enable the operator to lock the truck cab while the truck is parked unattended.

1. Follow steps 1-6 procedure for door glass replacement.
2. Refer to Figure 2-14. Remove capscrew and nut (1) from inside door handle.
3. Remove 4 mounting screws (2) for the latch. Remove old latch assembly.
   * If replacing the latch assembly go to step 5.
4. If replacing the outside door handle, remove 3 screws holding handle to door panel (3, Figure 2-14).

Note: Only 1 screw is shown, the other 2 are behind the latch assembly.

5. Install new latch assembly and align mounting holes. Install 4 mounting screws. Be sure they are tight.
6. Align inside door handle and install capscrew and nut (3 Figure 2-14).
7. Follow steps 20-23 of the door glass replacement procedure to complete the repair.

WINDSHIELD WASHER

Operation

The windshield washer, mounted on the right side of the hydraulic components cabinet behind the cab, has a 3.8 liter (1 gal) plastic reservoir (1, Figure 3-5) with a 24 volt electric pump (2).

The washer is controlled by the windshield wiper switch mounted on the instrument panel and is activated by pressing the knob. When the switch is activated, washing solution is pumped through the outlet hose (3) and fed to a jet located in each of the windshield wiper arms.

Service

If windshield washer maintenance is required, check the strainer opening for obstructions and inspect the hoses for damage. Check the voltage to the pump from the control switch. If the pump is inoperable, replace it with a new pump assembly.

Note: The pump is only available as an assembly and cannot be repaired.

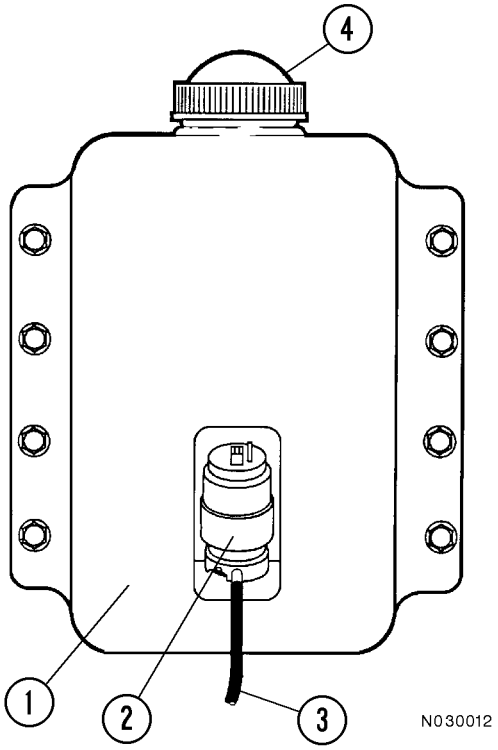


FIGURE 3-5. WINDSHIELD WASHER FLUID RESERVOIR AND PUMP

1. Reservoir
2. Pump
3. Outlet Hose
4. Filler Cap

Refrigeration - The Act Of Cooling

- There is no process for producing cold; there is only heat removal.
- Heat always travels toward cooler temperatures. This principle is the basis for the operation of a cooling unit. As long as one object has a temperature lower than another, this heat transfer will occur.
- Temperature is the measurement of the intensity of heat in degrees. The most common measuring device is the thermometer.
- All liquids have a point at which they will turn to vapor. Water boiling is the most common example of heating until vapor is formed. Boiling is a rapid form of evaporation. Steam is a great deal hotter than boiling water. The water will not increase in temperature once brought to a boil. The heat energy is used in the vaporization process. The boiling point of a liquid is directly affected by pressure. By changing pressure, we can control the boiling point and temperature at which a vapor will condense. When a liquid is heated and vaporizes, the gas will absorb heat without changing pressure.
- Reversing the process, when heat is removed from water vapor, it will return to the liquid state. Heat from air moves to a cooler object. Usually the moisture in the cooled air will condense on the cooler object.
- Refrigerant - Only R-134a should be used in the new mobile systems which are designed for this refrigerant.

The Refrigeration Cycle

In an air conditioning system, the refrigerant is circulated under pressure through the five major components in a closed circuit. At these points in the system, the refrigerant undergoes predetermined pressure and temperature changes.

The compressor (refrigerant pump) takes in low pressure heat laden refrigerant gas through the suction valve (low side), and as its name indicates, pressurizes the heat laden refrigerant and forces it through the discharge valve (high side) on to the condenser.

Ambient air, passing through the condenser removes heat from the circulating refrigerant resulting in the conversion of the refrigerant from gas to liquid.

The liquid refrigerant moves on to the receiver drier where impurities are filtered out, and moisture removed. This component also serves as the temporary storage unit for some liquid refrigerant.

The liquid refrigerant, still under high pressure, then flows to the expansion valve. This valve meters the amount of refrigerant entering the evaporator. As the refrigerant passes through the valve, it becomes a low temperature, low pressure liquid and saturated vapor. This causes the refrigerant to become cold.

The remaining low pressure liquid immediately starts to boil and vaporize as it approaches the evaporator, adding to the cooling. The hot, humid air of the cab is pulled through the evaporator by the evaporator blower. Since the refrigerant is colder than the air, it absorbs the heat from the air producing cool air which is pushed back into the cab. The moisture in the air condenses upon movement into the evaporator and drops into the drain pan from which it drains out of the cab.

Refrigerant leaving the evaporator enters the accumulator (If equipped.) The accumulator functions as a sump for liquid refrigerant in the system. Because of its design, the accumulator only allows vaporized refrigerant to return to the compressor, preventing compressor slugging from occurring. Desiccant is located at the bottom of the accumulators to remove moisture that is trapped in the system.

The cycle is completed when the heated low pressure gas is again drawn into the compressor through the suction side.

This simplified explanation of the principles of refrigeration does not call attention to the fine points of refrigeration technology. Some of these will be covered in the following discussions of the components, controls, and techniques involved in preparing the unit for efficient operation.

SYSTEM PERFORMANCE TEST

This test is performed to establish the condition of all components in the system. Observe these conditions during testing:

1. Place a fan in front of the condenser to simulate normal ram air flow and allow the system to stabilize.
2. Install a thermometer into the air conditioning vent closest to the evaporator.
3. Start the engine and operate at 1000 rpm.
4. Evaluate the readings obtained from the gauges to see if they match the readings for the ambient temperature.
5. Set air conditioning system at maximum cooling and maximum blower speed operation.
6. Close all windows and doors to the cab.
7. Carefully feel the hoses and components on the high side. All should be warm-hot to the touch. Check the inlet and outlet of receiver-drier for even temperatures, if outlet is cooler than inlet, a restriction is indicated.

⚠WARNING

Use extreme caution when placing hands on high side components and hoses. Under most normal conditions these items can be extremely hot.

8. Feel the hoses and components on the low side. They should be cool to the touch. Check connections near the expansion valve; the inlet side should be warm and the outlet side cold.
9. After a minimum of 10 minutes has elapsed and the system has stabilized, observe the gauge readings. Compare the readings to the specifications in Table 1.

NOTE: Pressures may be slightly higher in very humid conditions and lower in very dry conditions.

Pressures listed in the table are during compressor clutch engagement.

10. Check the cab vents for cool air. Outlet air temperature should be approximately 30 - 40° F (16 - 22° C) below ambient air temperature.
11. If pressures and temperatures are not within the specified ranges, the system is not operating properly. Refer to Preliminary Checks near the end of this chapter for tips on diagnosing poor system performance.

TABLE 1. NOMINAL R-134a PRESSURE RANGES

Ambient Air Temperature	High Side Pressure	Low Side Pressure
70° F (21° C)	120 - 190 psi (820 - 1300 kPa)	10 - 20 psi (70 - 138 kPa)
80° F (27° C)	140 - 210 psi (950 - 1450 kPa)	10 - 25 psi (70 - 173 kPa)
90° F (32° C)	170 - 240 psi (1175 - 1650 kPa)	15 - 30 psi (105 - 210 kPa)
100° F (38° C)	190 - 270 psi (1300 - 1850 kPa)	15 - 30 psi (105 - 210 kPa)
110° F (43° C)	210 - 300 psi (1450 - 2075 kPa)	15 - 30 psi (105 - 210 kPa)

NOTE: All pressures in this chart are for reference, only. Weight is the only absolute means of determining proper refrigerant charge.

10. Tighten the center screw on the puller against the shaft of the compressor to remove the pulley.
11. Clean the pulley and pulley bearing with solvent. Inspect the assembly for damage. Check the bearing for brinneling, excessive looseness, noise, and lubricant leakage. Replace the assembly if any of these warning signs are evident.

Clutch Coil Check

12. Use a multi-meter to ohm check the clutch coil. The resistance should be as follows:
    12 ± 0.37 ohms @ 68° F (20° C)
    16.1 ± 0.62 ohms @ 239° F (115° C)

If the resistance of the coil is not within the specifications, the clutch will not operate properly. Remove the retaining ring and replace the coil.

Pulley Installation

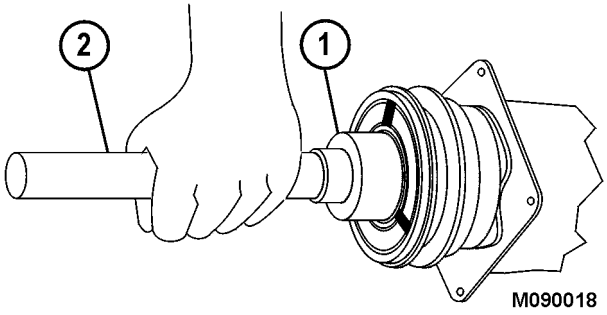


FIGURE 4-20.

1. Bearing Installer 2. Universal Handle

1. Place the pulley assembly into position on the compressor. Use bearing installer (1, Figure 4-20), universal handle (2), and a hammer to lightly tap the pulley assembly onto the compressor until it seats. Use of the installer or the equivalent ensures that the force driving the bearing into position acts on the inner race of the bearing. Applying force to the outer race of the bearing will result in bearing damage.
2. Ensure the pulley rotates freely. If the pulley does not rotate freely, remove the pulley and check for damaged components. Replace any damaged components and reinstall the pulley.
3. Install the pulley retainer ring and ensure that the ring is properly seated.
4. Install the absorbent sleeve into the neck of the compressor. Install the sleeve retainer.

Clutch Assembly Installation

1. Insert square key (1, Figure 4-16) into the keyway in the clutch hub. Allow the key to protrude about 4.5 mm (0.18 in.) from the outer edge of the hub. Use petroleum jelly to hold the key in place.

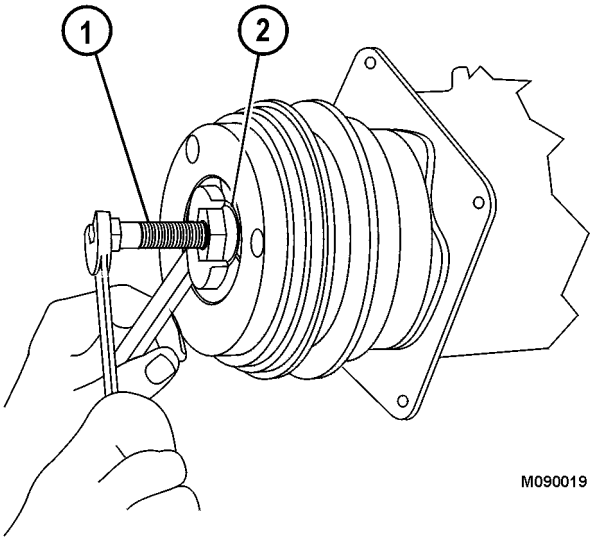


FIGURE 4-21.

1. Drive Plate Installer 2. Spacer

2. Place the clutch assembly into position on the compressor. Align the square key with the keyway on the shaft.
3. Thread drive plate installer (1, Figure 4-21) onto the shaft of the compressor. Spacer (2) should be in place under the hex nut on the tool.

PROBLEM: Compressor Malfunction

Indications:

Low side pressure - HIGH
High side pressure - LOW
Compressor operates noisily.

Possible Causes	Suggested Corrective Actions
- Defective reed valves or other internal components.	**Repair Procedure:** If the belt is worn or loose, replace or tighten it and recheck system performance and gauge readings. If inspection of the compressor is required, all of the refrigerant must be recovered and the compressor disassembled to the point that inspection can be performed. Replace defective components or replace the compressor. If particles of desiccant are found in the compressor, flushing of the system will be required. It will also be necessary to replace the receiver-drier. Always check the oil level in the compressor, even if a new unit has been installed. Rotary compressors have a limited oil reservoir. Extra oil must be added for all truck installations. Tighten all connections and evacuate the system. Recharge the system with refrigerant using a scale. Check system operation and performance.

PROBLEM: Thermostatic Switch Malfunction

Indications:

Low side pressure - Normal
High side pressure - Normal
Low side pressure may cycle within a smaller range as the compressor clutch cycles more frequently than normal. This may indicate the thermostat is set too high.

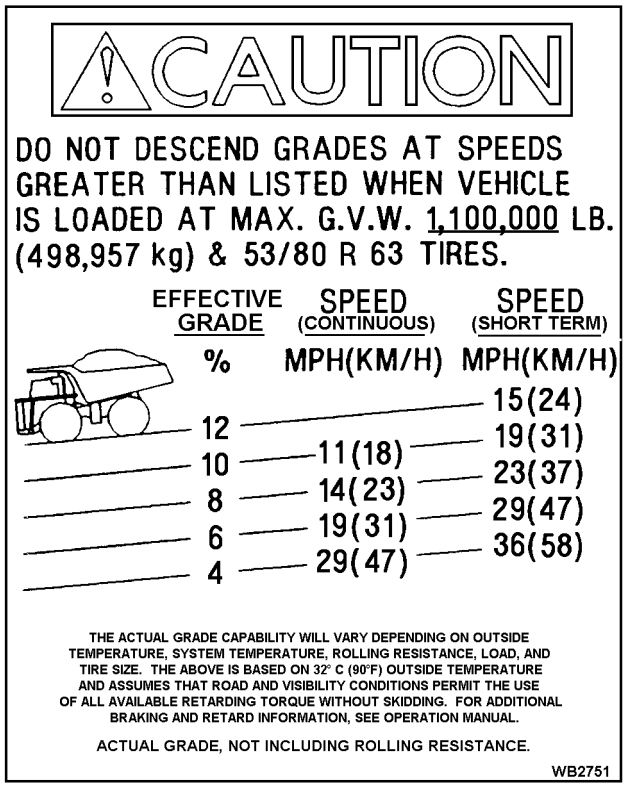
Possible Causes	Suggested Corrective Actions
- Thermostat malfunctioning possibly due to incorrect installation.	Replace the thermostatic switch. When removing the old thermostat, replace it with one of the same type. Take care in removing and handling the thermostat and the capillary tube that is attached to it. Use care not to kink or break the tube. Position the new thermostat capillary tube at or close to the same location and seating depth between the evaporator coil fins as the old one. Connect the electrical leads

GRADE/SPEED RETARD CHART

The Grade/Speed Retard chart (8, Figure 5-2 & shown below) provides the recommended MAXIMUM retarding limits at various truck speeds and grades with a fully loaded truck.

This decal in the truck may differ from the decal below due to OPTIONAL truck equipment such as: wheel motor drive train ratios, retarder grids, tire sizes, etc. **ALWAYS refer to this decal in the operator's cab**, and follow these recommendations for truck operation.

The operator should reference this chart before descending any grade with a loaded truck. Proper use of Dynamic Retarding will maintain a safe speed.



Two speed lists are provided, one for continuous retarding, and the second, for short term (approx. 3-minute) retarding. Both lists are matched to the truck at maximum Gross Vehicle Weight (GVW). The two ratings are guidelines for proper usage of the retard function on downhill grades.

The "short term" numbers listed on the chart indicate the combination of speeds and grades which the vehicle can safely negotiate for a short duration before system components reach the maximum allowable temperature during retarding. These speeds are faster than the "continuous" values, reflecting the thermal capacity of various system components. System components can accept heating at a higher-than-continuous rate for a short period of time. Beyond this short duration of time, the system would become overheated.

If the vehicle is operated at "short term" grade and speed limits for a period of time exceeding thermal capacity, the Propulsion System Controller (PSC) gradually reduces retarding effort from "short term" to "continuous". The "Retard @ Continuous" indicator light will illuminate alerting the operator of the retarding reduction and the need for a reduction in speed. The operator must use the service brakes to **quickly** slow the truck to maximum "continuous" retarding limits or less.

⚠CAUTION

Do Not LIGHTLY apply the service brakes when attempting to slow the truck on a downhill grade. Overheating of the brakes will result. Fully apply the brakes (within safe limits for road conditions) in order to quickly slow the truck to maximum "continuous" retarding limits or less.

NOTE: The "three minute" curve is a minimum and the actual time limit could be greater. Ambient temperature, barometric pressure and recent motor power levels can affect this number.

The "short term" rating will successfully accommodate most downhill loaded hauls. It is necessary to divide haul road grade segment length by allowable speed to determine actual time on grade. If actual time on the grade exceeds the allowable limits, the grade will need to be negotiated at the "continuous" speed.

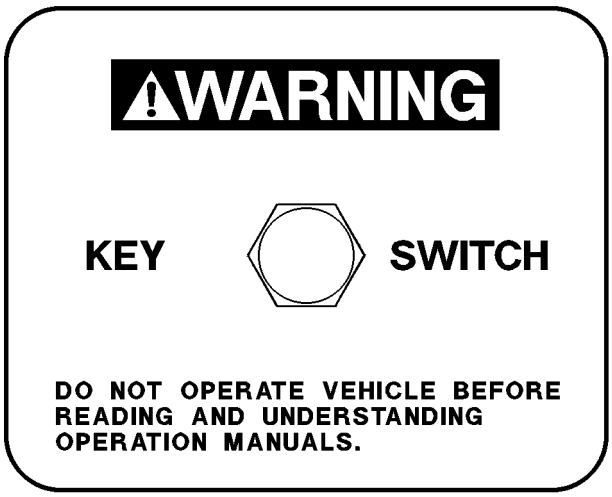
The "continuous" numbers on the chart indicate the combination of speeds and grades which the vehicle can safely negotiate for unlimited time or distance during retarding.

DO NOT exceed these recommended MAXIMUM speeds when descending grades with a loaded truck.

PANEL GAUGES, INDICATORS, AND CONTROLS (Figure 5-6)

Key Switch

The key switch (1, Figure 5-6) is a three position (Off, Run, Start) switch.



Starting

When the switch is rotated one position clockwise, it is in the "Run" position and all electrical circuits (except "Start") are activated.

1. With Selector Switch in "Neutral", rotate keyswitch fully clockwise to "Start" position, and hold this position until engine starts. "Start" position is spring-loaded to return to "Run" when key is released.
2. After engine has started, place REST switch in "Off" position (de-activate the "REST" mode of operation). Refer to discussion of REST SWITCH (26, Figure 5-6).

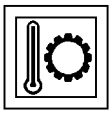
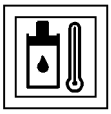
Cold Weather Starting

Do not crank an electric starter for more than 30 seconds at a time. Allow two minutes for cooling before attempting to start engine again. Severe damage to starter motor can result from overheating.

Normal Engine Shutdown

1. Stop truck. Reduce engine RPM to low idle. Place Selector Switch in "Neutral" and apply Parking Brake switch.
2. Place REST switch in "On" position (put drive system in "REST" mode of operation). Refer to discussion of REST SWITCH (26, Figure 5-6).
3. Allow engine to cool gradually by running at low idle for 3 to 5 minutes or use the Engine Shutdown with Timer Delay as described on the following page.
4. With truck stopped and engine cooled down, turn keyswitch counterclockwise to "Off" for normal shutdown of engine. If engine does not shutdown with keyswitch, use Engine Shutdown Switch on center console (see "Operator Controls" section) and hold this switch down until engine stops.
5. With keyswitch "Off", and engine stopped, wait at least 90 seconds. Insure steering circuit is completely bled down by turning steering wheel back and forth several times. No front wheel movement will occur when hydraulic pressure is relieved.
6. Verify all the LINK VOLTAGE lights turn off within 5 minutes after the engine is shut down. (One is located in cab, behind the operator seat, two others are located in the access panel at the left front corner of the electrical cabinet.) If lights remain on, refer to Section "E" for additional instructions and information.
7. Close and lock all windows, remove key from keyswitch and lock cab to prevent possible unauthorized truck operation. Dismount truck properly.

NOTE: A ground level shutdown switch is located on lower front left side of truck.

	A5	No Power	RED
	B5	Propulsion System Warning	AMBER
	C5	Propulsion System Temperature	AMBER
	D5	High Hydraulic Oil Temperature	RED
	E5	Stop Engine	RED

A5. NO POWER

This red "No Propel/No Retard" indicator light indicates a fault has occurred which has eliminated the retarding and propulsion capability. A warning buzzer will also sound.
If this condition occurs, the operator should safely stop the truck, move Selector Switch to Neutral, apply the Park Brake, shutdown engine, and notify maintenance personnel immediately.

B5. PROPULSION SYSTEM WARNING

When this amber indicator is illuminated, the light indicates a "No Propel" or "No Retard" event may be about to occur. It is intended to provide advance notice of these events when possible. It does not require the operator to stop the truck, but may suggest that truck operation be appropriately modified, in case a red alarm does occur.

C5. PROPULSION SYSTEM TEMPERATURE

This amber AC Drive System "Temperature Warning" light indicates the drive system temperature is above a certain level. When this condition occurs, the operator should consider modifying truck operation in order to reduce system temperature. The operator is not required to stop the truck at this time.

D5. HIGH HYDRAULIC OIL TEMPERATURE

This red warning light indicates high oil temperature in the hydraulic tank. Several things occur before the red light illuminates:

- If the truck is moving, and the oil temperature exceeds 221° F (105° C), the minimum idle speed will be 1200 RPM (normally 1050).
- If the truck is moving, and the oil temperature goes above 230° F (110° C), the minimum idle speed will be 1700 RPM (normally 1050).
- If the truck is stopped, and the oil temperature goes above 212° F (100° C) the minimum idle speed will be 1000 RPM (normally 750).

NOTE: Once the oil cools down to the normal operating range, the engine RPM will return to normal speed.

- The red warning light will illuminate if the oil temperature rises above 248° F (120° C). Continued operation could damage components in the hydraulic system.

If this condition occurs, the operator should safely stop the truck, move Selector Switch to Neutral, apply the Park Brake, and operate engine at 1200 - 1500 RPM to reduce system temperature.

If temperature gauge (25, Figure 5-6) does not move into the Green range after a few minutes, and the RED overhead indictor light does not go out, notify maintenance personnel immediately.

E5. STOP ENGINE

This red engine monitor warning light will illuminate if a serious engine malfunction is detected in the electronic engine control system.

- Electric propulsion to the wheel motors will still be available.
- Dynamic retarding will still be available if needed to slow the truck.

⚠WARNING

Stop the truck as soon as possible in a safe area and apply the parking brake.
SHUT DOWN THE ENGINE immediately. Additional engine damage is likely to occur if operation is continued.

An example of a condition that could cause the Stop Engine light to illuminate:

- If the governor senses an overspeed condition, the ECM will close the fuel solenoid and stop the flow of fuel to the engine until engine speed is back within normal operating range.

LUBRICATION CHART

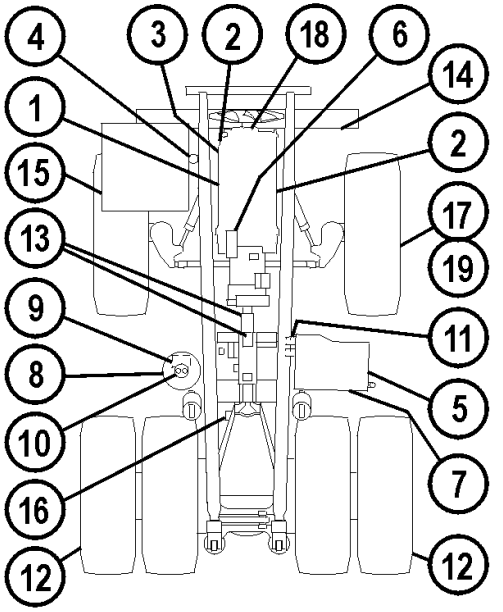
LUBRICATION SPECIFICATIONS

LUBE KEY	TYPE LUBRICANT
A	ENGINE OIL - - - - - SEE ENGINE MANUAL
B	HYDRAULIC OIL - - - - - SAE 10W C - 4 - - - - - AUXILIARY HEATERS REQUIRED BELOW -10°F(-23°C)
C	HEAVY-DUTY SYNTHETIC GEAR OIL - - - - - SEE DRIVE SYSTEM MANUAL
D	MULTI - PURPOSE EXTREME PRESSURE GREASE - - - - - NLGI NO.2 (5% MIN. MOLY-DISULFIDE)
E	MULTI - PURPOSE GEAR OIL - - - - - SAE 80W - 90

SYM	DESCRIPTION	PTS	LUBE KEY	10 HR	50 HR	100 HR	250 HR	500 HR	1000 HR	2000 HR	2500 HR
1	CRANKCASE OIL LEVEL	1	A	CHECK							
2	ENGINE LUBE OIL FILTERS										
3	FUEL FILTER										
4	FUEL SEPERATOR (DAVCO)										
5	FUEL TANK	1					DRAIN H_2O & SEDIMENT				
6	GE PREFILTER BLOWER	1	D				GREASE				
7	FUEL TANK BREATHER	1							CLEAN		
8	HYDRAULIC OIL LEVEL	1	B	CHECK					*CHANGE		
9	HYDRAULIC STRAINER	2							CLEAN		
10	HYDRAULIC TANK BREATHER	2						CHANGE			
11	HYDRAULIC FILTERS	3			**	**	**	CHANGE			
12	MOTORIZED WHEEL OIL LEVEL	2	C				SEE DRIVE SYSTEM MANUAL				
13	HYD. PUMP DRIVE SHAFT	2	D				GREASE				
14	CHASSIS LUBE LEVEL	1	D				GREASE				
15	SEAT SLIDES & STEER SHAFT	4	D						GREASE		
16	WHEEL MOTOR BLOWER	2	D				GREASE				
17	FRONT WHEEL BEARINGS ***	2	E				CHECK				CHANGE
18	FRONT TRUNION	1	D						GREASE		
19	MAGNETIC PLUG FRONT WHL COVER ****	2					CHECK				

SEE ENGINE MANUAL

* 1000 HR INTERVAL CAN BE EXTENDED TO 2500 HR PROVIDED OIL SAMPLING AND ANALYSIS IS CONDUCTED EVERY 250 HR.
** ONE-TIME CHANGE AT 50, 100 AND 250 HR.
*** NOT APPLICABLE FOR 930E
**** APPLICABLE FOR 930E ONLY



630E, 730E, 830E, & 930E

WB2790

LUBRICATION CHART

1000 HOURS LUBRICATION AND MAINTENANCE CHECKS

Maintenance for every 10, 250, & 500 hour Lubrication and Maintenance Checks should be performed at this time.

NOTE: "Lube Key" references are to the Lubrication Chart.

Truck Serial Number_____ Site Unit Number_____ Date_____
Hourmeter_____ Name of Service Technician_____

	TASK	COMMENTS	CHECKED	INITIALS
1.	HYDRAULIC TANK - Drain the hydraulic tank and clean the inlet strainer. Refill the tank with oil; approximate capacity 250 gal. (947 l). Use Lube Key "B".			
2.	RADIATOR - Clean the cooling system with a quality cleaning compound. Flush with water. Refill the system with anti-freeze and water solution. Check the Cooling System Recommendation Chart in this section for the correct mixture. Refer to the Cummin's Operation and Maintenance Manual for the correct additive mixture.			
3.	FUEL TANK - Remove the breather and clean in solvent. Dry with pressurized air and reinstall.			
4.	OPERATOR'S SEAT - Apply grease to the slide rails. Lube Key "D".			
5.	AUTOMATIC BRAKE APPLICATION - Ensure the brakes are automatically applied when brake pressure decreases below the specified limit. Refer to Section J, Brake Check-out Procedure.			
6.	AUXILIARY BLOWER - Apply a few applications of grease to the auxiliary blower bearings. Two grease zerks (1, Figure 2-9) are located on blower (2).			

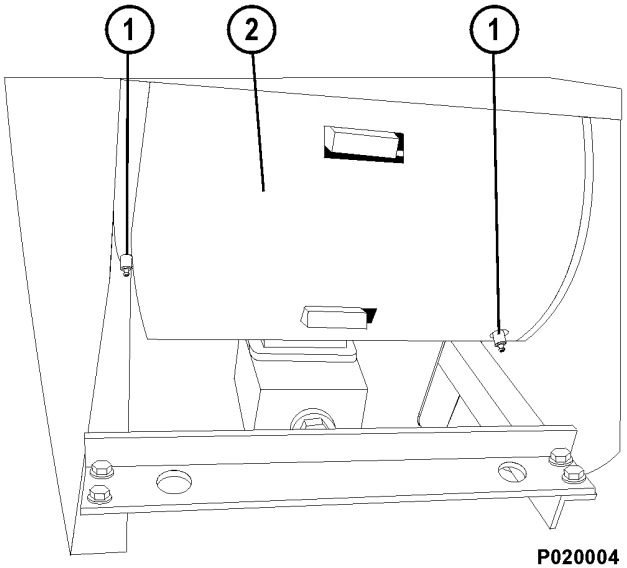
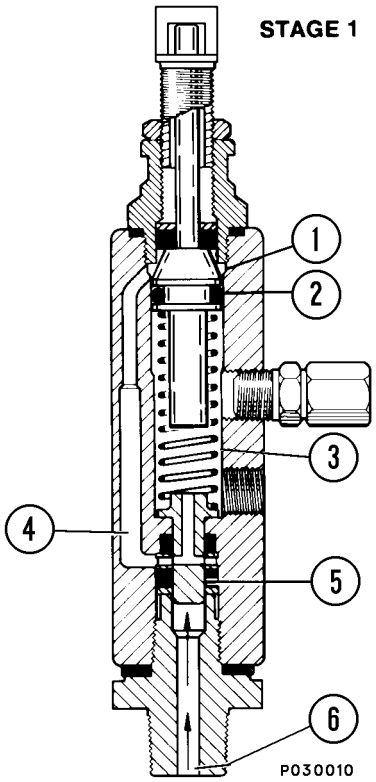


FIGURE 2-8. AUXILIARY BLOWER

1. Grease Zerk 2. Auxiliary Blower

INJECTOR OPERATION

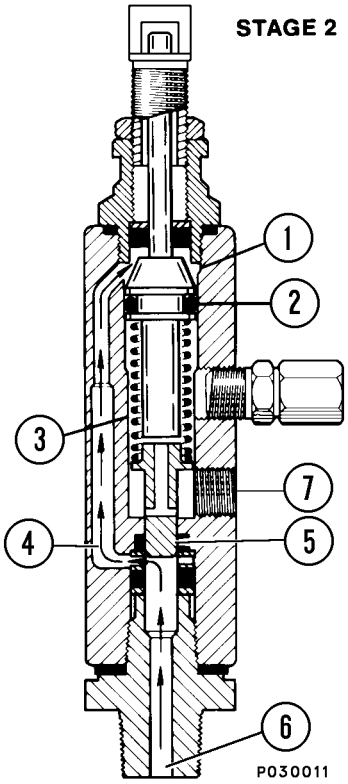


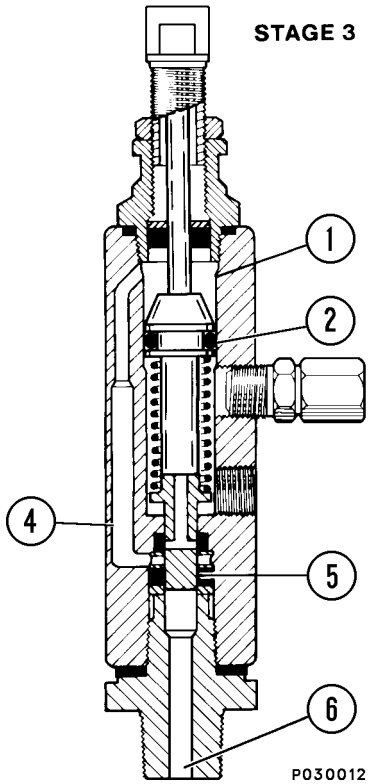
STAGE 1.

The injector piston (2) is in its normal or “rest” position. The discharge chamber (3) is filled with lubricant from the previous cycle. Under the pressure of incoming lubricant (6), the slide valve (5) is about to open the passage (4) leading to the measuring chamber (1) above the injector piston (2).

STAGE 2.

When the slide valve (5) uncovers the passage (4), lubricant (6) is admitted to the measuring chamber (1) above the injector piston (2) which forces lubricant from the discharge chamber (3) through the outlet port (7) to the bearing.





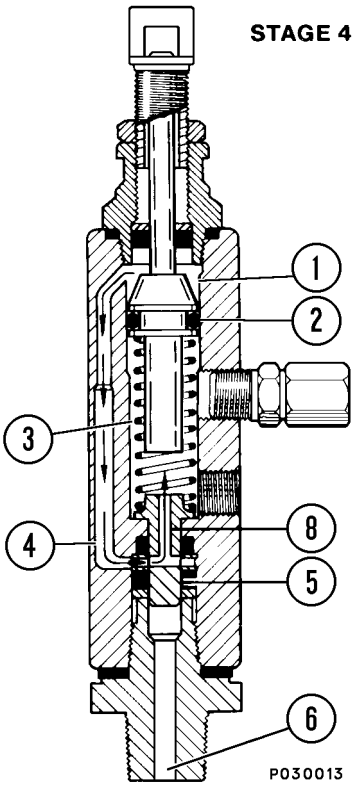
STAGE 3.

As the injector piston (2) completes its stroke, it pushes the slide valve (5) past the passage (4), cutting off further admission of lubricant (6) to the passage (4) and measuring chamber (1). The injector piston (2) and slide valve (5) remain in this position until lubricant pressure in the supply line (6) is vented.

STAGE 4.

After venting, the injector spring expands, causing the slide valve (5) to move, so that the passage (4) and discharge chamber (3) are connected by a valve port (8). Further expansion of the spring causes the piston to move upward, forcing the lubricant in the measuring chamber (1) through the passage (4) and valve port (8) to refill the discharge chamber (3).

The injector is now ready for the next cycle.



M

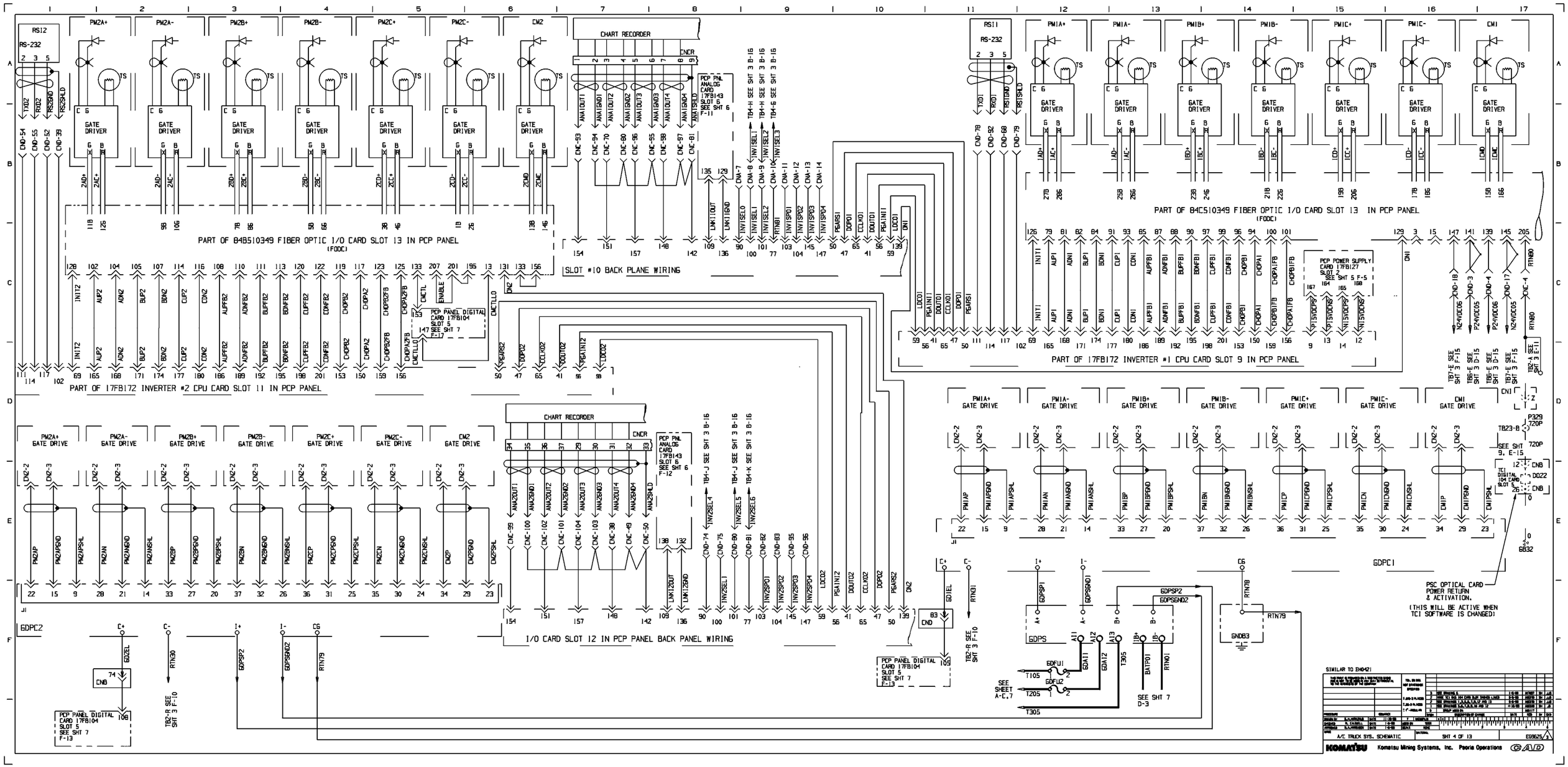
N

O

P

R

S


RS12
RS-232
PM2A+
PM2A-
PM2B+
PM2B-
PM2C+
PM2C-
CM2
CHART RECORDER
PCP PNL ANALOG CARD 17FB143 SLOT 6 SEE SHT 6 F-11
RS11
RS-232
PM1A+
PM1A-
PM1B+
PM1B-
PM1C+
PM1C-
CM1
GATE DRIVER
PART OF 84B510349 FIBER OPTIC I/O CARD SLOT 13 IN PCP PANEL (FODC)
PART OF 84C510349 FIBER OPTIC I/O CARD SLOT 13 IN PCP PANEL (FODC)
SLOT #10 BACK PLANE WIRING
PART OF 17FB172 INVERTER #2 CPU CARD SLOT 11 IN PCP PANEL
PART OF 17FB172 INVERTER #1 CPU CARD SLOT 9 IN PCP PANEL
PCP PANEL DIGITAL CARD 17FB104 SLOT 5 SEE SHT 7
PCP POWER SUPPLY CARD 17FB127 SLOT 2 SEE SHT 5 F-5
I/O CARD SLOT 12 IN PCP PANEL BACK PANEL WIRING
GDPC1
GDPC2
PSC OPTICAL CARD POWER RETURN 2 ACTIVATION.
(THIS WILL BE ACTIVE WHEN TCI SOFTWARE IS CHANGED)
SIMILAR TO EH042
A/C TRUCK SYS. SCHEMATIC
SHT 4 OF 13
E69625
Komatsu Mining Systems, Inc. Peoria Operations