CEBM018400

Shop Manual

730E TROLLEY

DUMP TRUCK

SERIAL NUMBERS A30392 & A30393

KOMATSU®

MAJOR COMPONENT DESCRIPTION

The Komatsu model 730E dump truck is an electric drive, off-highway, rear dump truck. Standard 730E gross vehicle weight is 324,322 kg (715,000 lbs) rated for a nominal payload of 185 t (203 tons). Some Trolley versions may have a higher GVW. Refer to the grade/speed chart in the operator's cab for the appropriate GVW.

ENGINE

The Komatsu 730E dump truck is powered by a Komatsu SSA16V159 engine rated at 2000 HP (1492 kW).

ALTERNATOR (GE GTA-22)

The diesel engine drives an alternator mounted in-line with the engine. The Alternating Current (AC) output of the alternator is rectified to Direct Current (DC) and sent to the DC drive wheel motors.

WHEEL MOTORS (GE 788)

The output of the alternator supplies electrical energy to the two wheel motors attached to the rear axle housing. 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 a console to the right side of the operator.

BLOWER

The blower supplies cooling air for the rectifiers, AC alternator, and to both wheel motors, where it is then exhausted to the atmosphere.

OPERATOR'S CAB

The operator's cab for the Komatsu 730E dump truck has been engineered for operator comfort and to allow for efficient and safe operation of the truck.

The cab provides for wide visibility, with an integral four-post Rollover Protective Structure/Falling Object Protective Structure (ROPS/FOPS), 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 Komatsu 730E dump truck is equipped with a full-time power steering system, which provides positive steering control with a minimum of effort by the operator. The system includes nitrogen-charged accumulators which automatically provide emergency power if the steering hydraulic pressure is reduced below an established minimum.

DYNAMIC RETARDING

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

BRAKE SYSTEM

The wheel service brakes are caliper/dry disc brakes applied by an all hydraulic actuation system. Depressing the brake pedal actuates wheel-speed single disc front brakes and armature-speed dual disc rear brakes. The rear brakes can also be activated by operating a switch on the instrument panel.

All wheel brakes will be applied automatically if the system pressure decreases below a preset minimum.

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

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.

Mirrors, Windows, And Lights

- Remove any dirt from the surface of the windshield, cab windows, mirrors, and lights. Good visibility may prevent an accident.
- Adjust the mirrors to a position where the operator can see best from the operator's seat.
- Ensure the headlights, work lights, and taillights are in proper working order. Ensure that the machine is equipped with the proper work lamps needed for the operating conditions.
- Replace any broken mirrors, windows, or lights.

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. Use the seat belts when operating a machine.
- Read and understand the contents of the Operation and Maintenance manual. Read the safety and operating instructions with special attention. Become thoroughly acquainted with all the gauges, instruments, and controls before operating 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 the windshield wiper, the condition of the wiper blades, and the washer fluid reservoir level.
- Be familiar with all steering and brake system controls, warning devices, road speeds, and loading capabilities before operating the truck.

OPERATING THE MACHINE

Starting The Engine

- DO NOT attempt to start the machine by shorting across the starter terminals. This may cause a fire, or serious injury or death, to anyone in the machine's path.
- Check for people and objects that remain on or around the truck.
- DO NOT 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.
- For machines equipped with a back-up alarm, check that the alarm works properly.

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 must 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 the haul road, pit, or dump area that may cause an operating hazard.

ADDITIONAL JOB SITE RULES

- Use this space to add any additional job site rules not covered in any of the previous discussions.
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DUMPING

1. Approach the dump area with extreme caution. Ensure the area is clear of persons and obstructions, including overhead utility lines. Obey signals directed by the spotter, if present.

   Avoid unstable areas. Stay a safe distance from the edge of the dump area. Position the truck on a solid, level surface before dumping.

⚠DANGER

As the body raises, the truck center of gravity will move. The truck must be on a level surface to prevent tipping/rolling!

2. Carefully maneuver the truck into the dump position. When backing the truck into the dump position, use only the brake pedal to stop and hold the truck. DO NOT rely on the wheel brake lock to stop the truck. This control is unmodulated and applies the rear service brakes only.
3. When the truck is stopped and in the dump position, apply the wheel brake lock. Move the selector switch to the NEUTRAL position.

To Raise The Dump Body:

⚠WARNING

Dumping certain types of material can result in sudden and violent movement of the truck. This truck movement may cause injury to the operator. It may also cause damage to the hoist cylinders, frame, and/or body hinge pins. Use caution when dumping large rocks (10% of payload, or greater) to prevent the load from shifting too quickly. Sticky material (loads that do not flow freely from the body) may also cause sudden truck movement if the load releases quickly.

4. Move the lever to the HOIST position. Refer to Fig. 3-1. Releasing the lever while in the HOIST position will cause the lever to move to the HOLD position.
5. Raise the engine rpm to accelerate the hoist speed.

⚠CAUTION

If dumping very large rocks or sticky material, as described in the warning, slowly accelerate the engine rpm to raise the body. When the material starts to move, release the hoist lever to the HOLD position. If the material does not continue to exit the body, repeat this procedure as necessary.

6. Reduce the engine rpm as the last stage of the hoist cylinder begins to extend. Let the engine go to low idle as the last stage reaches half-extension.

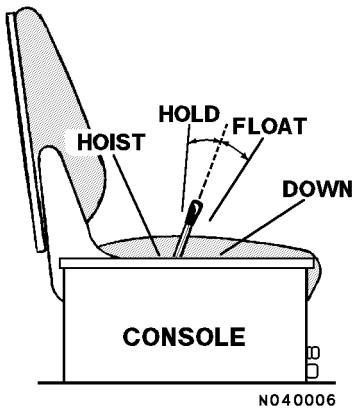


FIGURE 3-1. HOIST LEVER POSITIONS

7. Release the hoist lever as the last stage of the hoist cylinder reaches full extension.

d. Check for oncoming traffic. Vehicles on the trolley line should have right-of-way if possible.

e. Align the truck with the trolley navigational aids in the same manner as when entering the line and re-enter the trolley system.

f. Move the Master Control Lever to the TROLLEY mode position and proceed as previously instructed.

9. Drive the truck aligned as instructed previously. The operator must ensure that the alignment is correct at all times while operating. If the truck drifts too far to either side, an automatic switch will lower the pantograph, and the truck will switch back to diesel mode. If the operator releases the throttle, the pantograph will lower and the truck will switch back to diesel mode. To be able to return to trolley operation the system must first be reset.

⚠CAUTION

DO NOT operate the truck on the trolley line if the truck trolley system is not working correctly.

GETTING OFF LINE

As the truck approaches the end of the trolley line, it must exit the line properly. There will be signs or signals near the end of the line indicating to the operator to exit the trolley lines. The operator must lower the pantograph which drops out the trolley, and the truck will go back to diesel. This is done by moving the master control lever rearward to the straight up, DIESEL position. This will start the drop out sequence.

NOTE: Following this procedure will cause the trolley power and the ready for trolley lights to turn off.

The overhead cables taper upward as the truck approaches the end of the line. If the proper drop out sequence is not started the truck will drive out from under the cables with the pantograph still UP. This will cause damage to the pantograph because of the arcing that will occur.

In the event an operator is required to get off of a trolley line to drive around an obstruction, such as rocks or disabled equipment, the operator will follow the procedure for getting off line, drive around the obstacle and follow the procedure for getting on line.

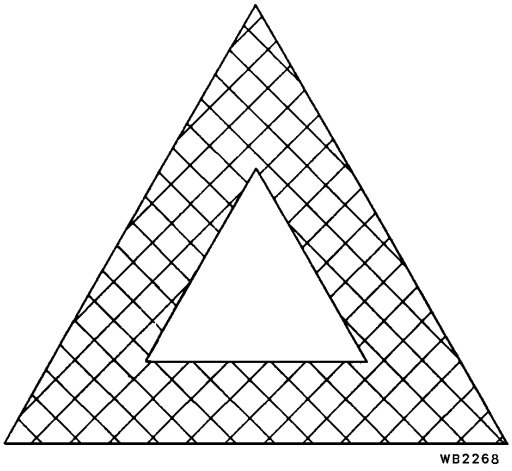
⚠WARNING

DO NOT trolley assist lines unless the system has been de-energized and grounded by qualified electricians.
Only persons who have been properly trained and are qualified to perform the lock-out and grounding will be authorized to isolate the line or lines. Such authorization will be made in writing by the electrical engineering or electrical maintenance departments.

LINE STATUS SIGNALS

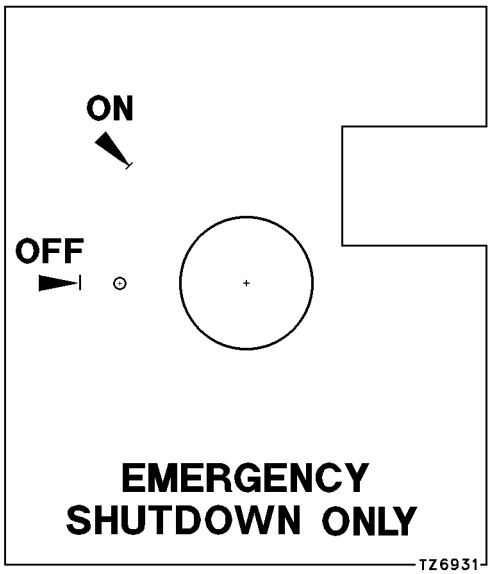
Line status signals are lights (much like traffic lights) that advise operators whether segments of trolley lines are energized and ready to accept haulage traffic. A different status signal light is used for each section of the trolley line that is energized.

The lights are mounted to allow the driver to check the status of the line that the truck is approaching, so the pantograph can be lowered before that section of line is reached if the line is not able to accept haulage trucks. Each ramp that is trolley equipped may have several different sections of energized trolley lines that make up the trolley line for the entire ramp. Each section of line that is energized will have a separate line status signal.



WB2268

This plate is placed near the four jacking points on the truck. Two are placed at the front of the truck next to the right and left frame upright supports. Two are placed at the rear of the truck under the right and left suspension supports.

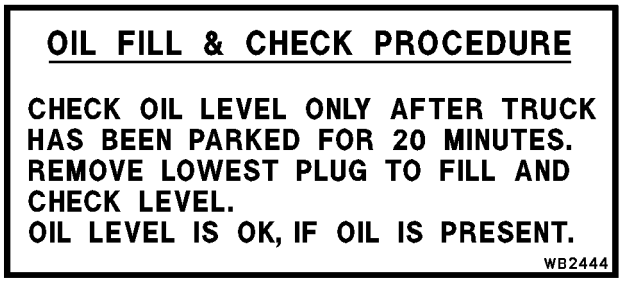


This plate is located below the left-hand battery box.

It identifies the emergency engine shutdown switch. This switch is spring-loaded to the OFF position. It must be held in the ON position until the engine stops.

A warning plate is located above the hydraulic system (APU) quick disconnect fittings in front of the hydraulic tank. This plate provides instructions to the operator or technician for towing a disabled truck. This plate specifies the requirements for an auxiliary source of supply for hydraulic oil and the proper hook-up.

Ensure the steering and brake systems are operating properly before towing the truck.



A wheel motor oil level decal is attached to the gear cover on both the electric wheel motors. This decal stresses that the truck must be on a level surface and parked for 20 minutes prior to checking the oil level. This is necessary in order to get an accurate reading.

STORAGE AND IDLE MACHINE PREPARATION

There may be periods when it is necessary for a machine to be idle for an extended period of time. If properly prepared, a stored machine may promptly and safely be put back into operation. Improper preparation, or complete lack of preparation, can make the job of getting the vehicle back to operating status difficult.

The following information outlines the essential steps for preparing a unit for extended storage, and the necessary steps for bringing the unit back to operational status. Additional information is given to help restore machines that were not put into storage, but merely shut down and left idle for a long period of time.

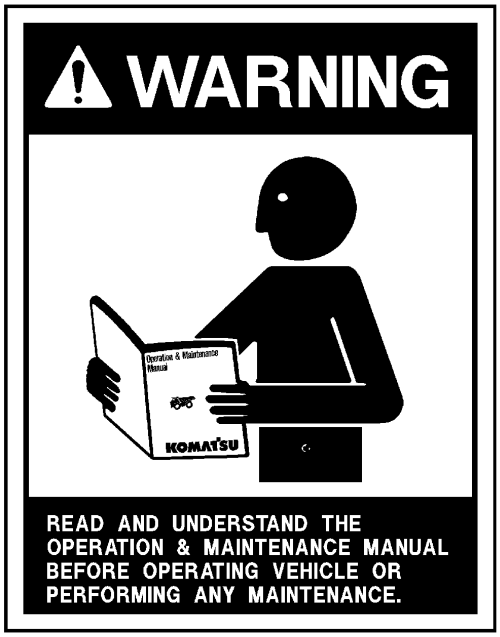
Much of this material is of a general nature since the environment where the machine has been standing idle will play a big part in its overall condition. A hot, humid climate will affect vehicle components much differently than a dry desert atmosphere or a cold arctic environment. These climatic aspects must be considered and appropriate actions taken when restoring a long term idle vehicle.

These instructions are not intended to be all inclusive, but are minimum guidelines. The final aim must be to provide the operator with a safe, reliable, and fully productive vehicle.

SHORT TERM IDLE PERIODS

There may be periods when a vehicle is idle from 30 to 60 days, but must be ready for use at any time. To most effectively handle this type of situation, follow the procedure below to prevent any deterioration from the beginning of vehicle idle time.

1. Keep the vehicle fully serviced.
2. Perform a visual check of the vehicle every week. Start the engine until it is at operating temperature. Move the vehicle around the yard for a few minutes to ensure that all internal gears and bearings are freshly lubricated.
3. Operate all hydraulic functions through their complete range to ensure that the cylinder rods and seals are fully lubricated.
4. Check and operate all systems.
5. Once a month, perform the 10 hour service items shown in the Operation and Maintenance manual. Keep the batteries properly serviced.



ELECTRIC DRIVE TRUCKS

These instructions provide the recommended procedures for protecting equipment from damage during both short-term and long-term storage periods. Also included are instructions for placing this equipment into service after having been stored.

For the purposes of this instruction, a short-term storage period is considered to be less than three months; a long-term storage period is considered to be three months or longer.

General Electric recommends a maximum storage period of three years, with these storage procedures being repeated after each year. After a storage period of three years or more, the motorized wheels must be removed and sent to an overhaul facility for tear down and inspection of seals and bearings. These must be replaced, if necessary.

Periodic (every three months) inspections must be made to determine the lasting qualities of long-term storage protection measures. Such inspections will indicate the need for renewing protective measures when necessary to prevent equipment deterioration.

Proper storage of this equipment is vital to equipment life. Bearings, gears, and insulation may deteriorate unless adequate protective measures are taken to protect against the elements. For example, bearings and gears in the motorized wheel gear case are susceptible to the formation of rust, insulation in rotating electrical equipment can accumulate moisture, and bearings may become pitted.

Never apply any spray, coating, or other protective materials to areas not specifically recommended.

It is also important to note that these instructions cannot possibly anticipate every type of storage condition and, therefore, cannot prevent all equipment deterioration problems caused by inadequate storage. These instructions are not intended to be all-inclusive, but are minimum guidelines for achieving the best possible equipment life and the lowest operating cost when the equipment is returned to service.

NOTE: Local conditions and/or experience may require additional procedures and/or additional storage precautions.

Storing A Truck That Is Operational

When a fully-operational truck is being placed into storage for less than three months, the best protective measure which can be taken is to drive the truck once a week for at least 30 minutes. Prior to driving the truck, the rotating equipment must be Meggered and:

- If greater than 2 megohms, run normally.
- If less than 2 megohms, isolate the condition and correct it before running.

Driving the truck circulates oil in the gear case to keep gears and bearings lubricated and free from rust. It also prevents deterioration of the brushes, commutators, and slip rings.

When a fully-operational truck is being placed into storage for three months or longer, and the truck cannot be operated weekly throughout the storage period, as indicated above, perform the following:

1. Drain the oil from the gear case and install rust preventive 4161 (a product of Van Straaten Chemical Co.), or equivalent. Fill per General Electric Motorized Wheel Service manual.

4. Attach the overhead hoist to the lifting eyes on the grid.

NOTE: DO NOT attach the lifting device to the handrail.

5. Remove the hardware attaching the grid to the deck. Lift the assembly off the deck, and move to the storage or work area.

NOTE: If grid assembly or cooling blower repairs are required, refer to the applicable G.E. publication for service and maintenance procedures.

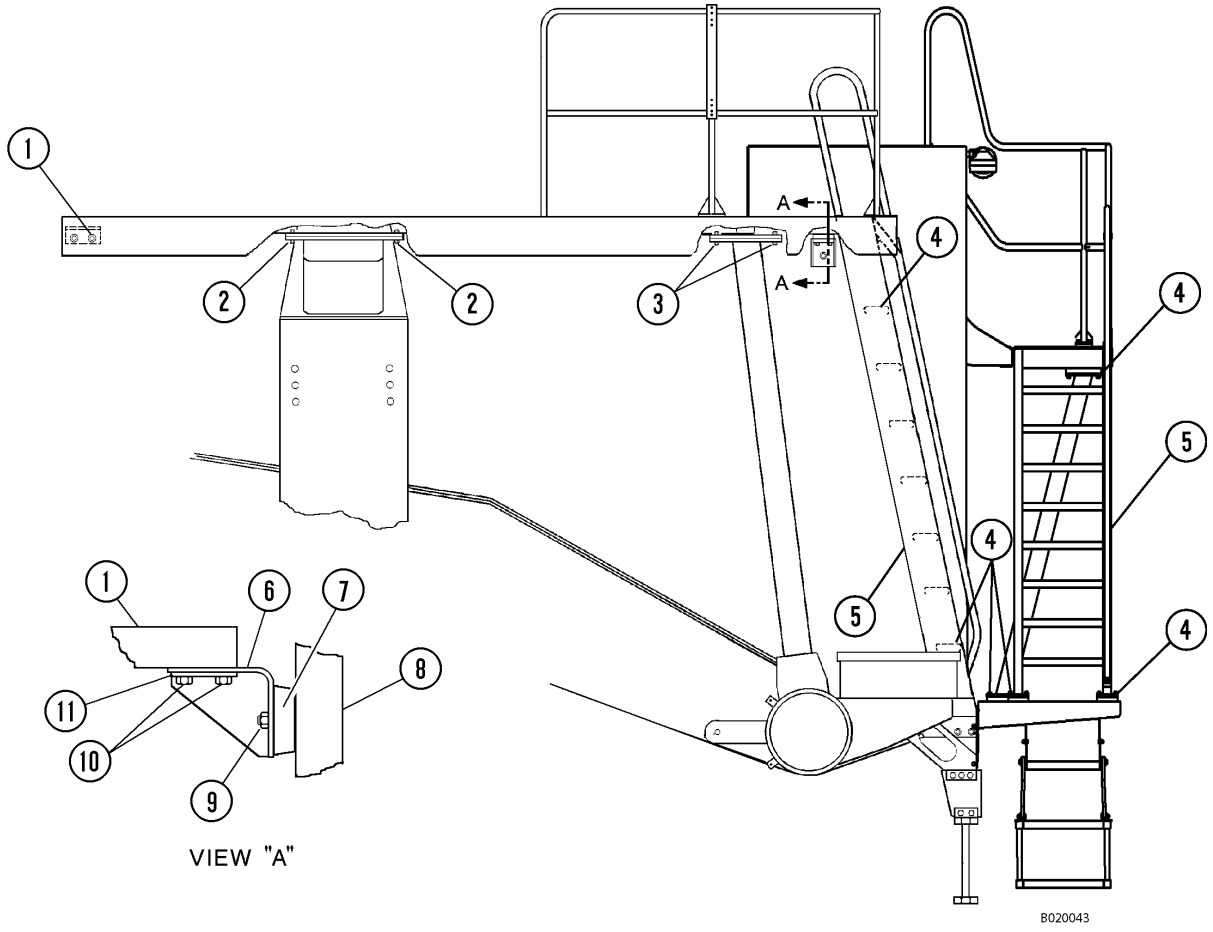


FIGURE 2-3. TYPICAL DECK MOUNTING
NOTE: RH Deck Shown. LH Deck Mounting is similar to RH Deck.

1. Mounting Hardware
2. Mounting Hardware
3. Mounting Hardware
4. Ladder Mounting Hardware
5. Ladder
6. Bracket
7. Rubber Dampener
8. Hood
9. Nut and Flat Washer
10. Mounting Hardware
11. Plate

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FUEL TANK
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FAN DRIVE CLUTCH

GENERAL DESCRIPTION

The fan drive clutch is an oil pressure actuated, oil cooled and lubricated, multi-plate clutch designed for continuous, infinite fan-to-engine pulley speed ratios assuring prescribed engine coolant temperatures and minimum engine horsepower losses. Engine (sump) lubricating oil is piped to the fan clutch to provide a supply of filtered and cooled oil.

Engine cooling temperature demands are automatically transmitted to the clutch through a thermal sensor and solenoid valve. The fan clutch automatically adjusts the fan to the precise minimum speed necessary to maintain specified coolant temperature.

Modulated control by the thermal sensor and solenoid valve cause the fan speed to be increased or decreased smoothly without shock loads. Oil cooled plates permit continuous clutch slip to give variable fan speeds.

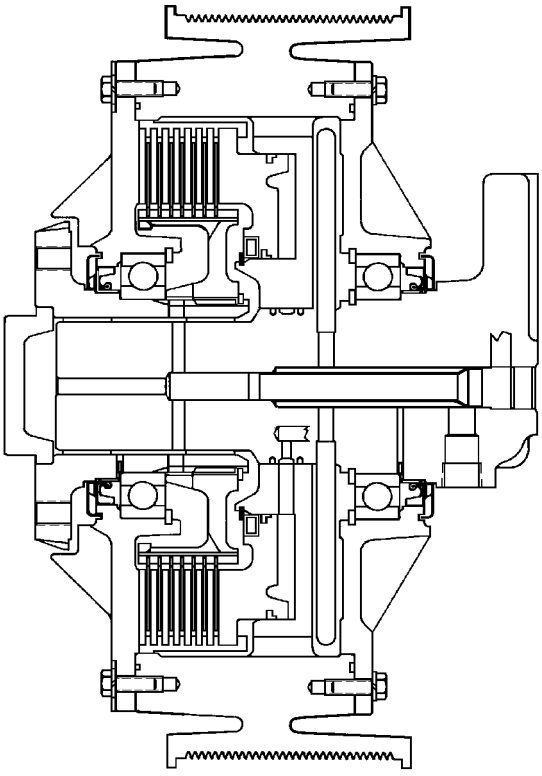


FIGURE 7-1. FAN CLUTCH ASSEMBLY

The fan clutch shaft is a permanent, integral part of the shaft and bracket assembly, and acts as a bearing surface for the moving parts. Internal ports and orifices distribute lubricating/cooling oil, and oil control pressure which controls fan speed and modulates the engagement and disengagement of the fan clutch.

COMPONENTS

Input

(Refer to Figure 7-2): The input for the clutch is through pulley (1) and bearing retainers (2,3) which are bolted together forming the pulley cavity. The pulley cavity is sealed at shaft (5) and fan mounting hub (4) by rotating seals and is supported by heavy-duty ball bearings (6). The slotted cup section of the front bearing retainer drives externally tanged steel clutch plates (7) and clutch piston (8).

Output

(Refer to Figure 7-3): The output for the clutch is through clutch facing plates (1) which are splined to and drive clutch hub (2). The inside diameter of the hub is splined to and drives fan mounting hub (3). The fan is bolted to the fan mounting hub. Fan spacer (4) is used on the fan mounting hub to position the fan relative to the radiator.

Off Truck Test

Test Conditions and Requirements:

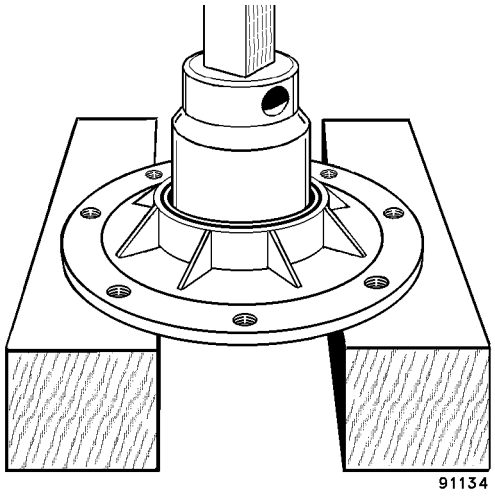
1. The thermal sensor must be tested under load.
2. Water must be flowing across the thermal tip.
3. Water temperature at the tip must be accurately measured.
4. Voltage output from the thermal sensor must be measured.
5. Pressurized oil, 275 min. - 689 max. kPa (40 psi min.-100 psi max.), must be supplied to the solenoid.
6. Attach pressure gauge and drain line to the solenoid. Pressure from the solenoid must be measured.

Test:

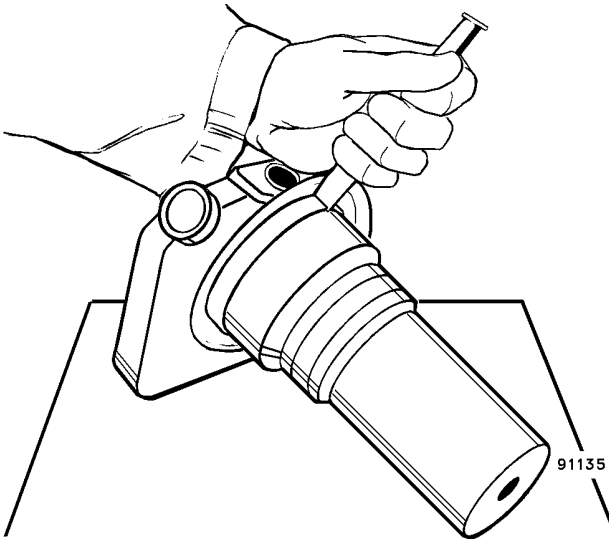
1. Set up equipment per figure 7-7.
2. Heat the water gradually.
3. Read temperature vs. voltage vs. pressure out of solenoid.

Refer to operating temperature range tag on the thermal sensor and chart below for conditions and proper operation.

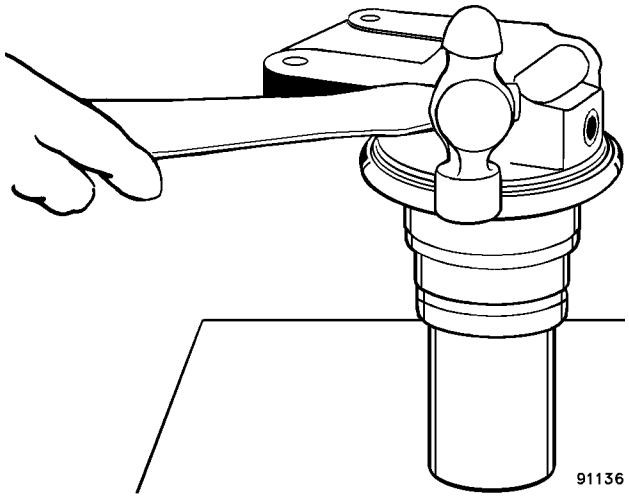
THERMAL SENSOR AND SOLENOID TEST SPECIFICATIONS		
TEST CONDITION	SENSOR VOLTAGE	SOLENOID PRESSURE
Temperature Below Thermal Sensor Operating Range	+24VDC	0.0 kPa (0.0 psi)(1)
Temperature Within Thermal Sensor Operating Range	+24VDC - 0.0VDC(2)	0.0 - Max. kPa (0.0 - Max. psi)(1)
Temperature Above Thermal Sensor Operating Range	0.0VDC	Max. Supplied Pressure
NOTE: 1: Actual 0.0 psi will not be attained if tested under normal operating conditions (connected to a fan clutch). 0.0 - 55 kPa (0.0 - 8.0 psi) internal clutch pressure will read on the gauge.		
NOTE: 2: As water temperature increases or decreases within the temperature range of the thermal sensor, voltage output from the thermal sensor and pressure output from solenoid valve must also increase or decrease (although not in direct proportion). An increase in water temperature produces an increase in voltage output and a decrease in pressure.		



25. Press rear bearing (37) out of rear bearing retainer (23).



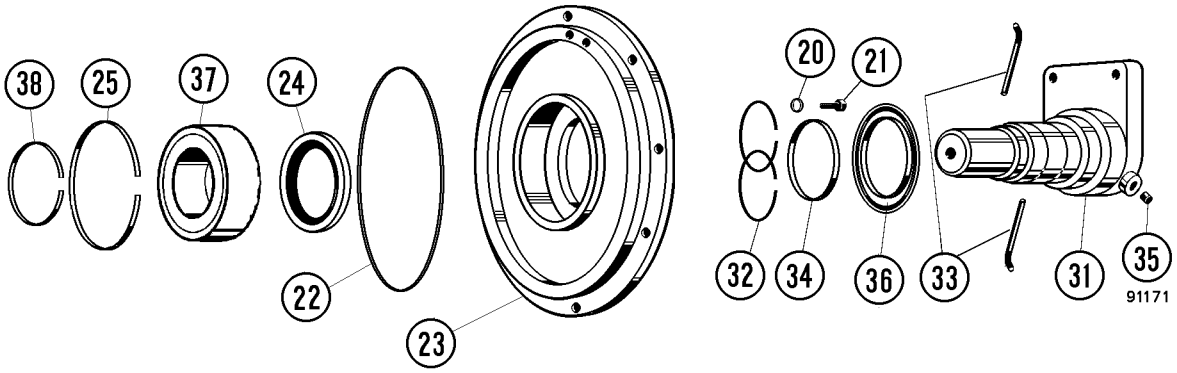
26. Remove wear sleeve (34). Split the wear sleeve with a chisel to loosen it. Use care not to damage the shaft.



NOTE: If the retainer/seal assembly is not damaged, worn, or otherwise in need or replacement, removal may be omitted.

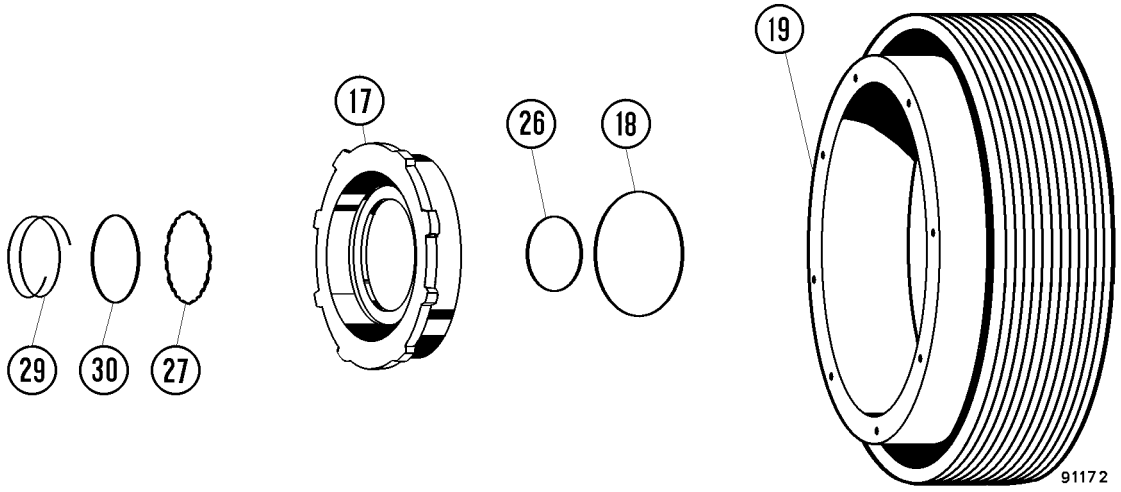
27. Remove rear retainer/seal assembly (36). Drive the assembly off the shaft or wedge a large chisel or other appropriate tool behind the retainer to force it off.

Disassembly of the fan clutch is complete. DO NOT attempt to disassemble further.



REF.	DESCRIPTION
20	Lock Washer
21	Bolt
22	O-Ring Seal
23	Rear Bearing Retainer
24	Rear Oil Seal
25	Internal Snap Ring
31	Shaft/Bracket Assembly

REF.	DESCRIPTION
32	Seal Rings
33	Pitot Tubes
34	Rear Wear Sleeve
35	Orifice
36	Rear Retainer/Seal Assembly
37	Rear Bearing
38	External Snap Ring



REF.	DESCRIPTION
17	Piston
18	Seal Ring (Large)
19	Pulley
26	Seal Ring (Small)

REF.	DESCRIPTION
27	Spring Washer
29	External Snap Ring
30	Shim

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24VDC ELECTRIC SUPPLY SYSTEM
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Field Coil Checks

Field coils (46) can be checked for grounds and opens by using a test lamp.

1. Grounds - The ground connections must be disconnected during this check. Connect one lead of the 110-Volt test lamp to field frame (35) and the other lead to field coil connector (42). If the lamp lights, at least one field coil is grounded and must be repaired or replaced.
2. Opens - Connect the test lamp leads to the ends of field coils (46). If the lamp does not light, the field coils are open.

Field Coil Removal

Field coils can be removed from the field frame assembly by using a pole shoe screwdriver. A pole shoe spreader must also be used to prevent distortion of the field frame. Careful installation of the field coils is necessary to prevent shorting or grounding of the field coils as the pole shoes are tightened into place. Where the pole shoe has a long lip on one side and a short lip on the other, the long lip must be assembled in the direction of armature rotation so it becomes the trailing (not leading) edge of the pole shoe.

Solenoid Checks

A basic solenoid circuit is shown in Figure 2-4. Solenoids can be checked electrically using the following procedure.

Test

1. With all leads disconnected from the solenoid, make test connections, as shown, to the solenoid, switch terminal, and to the second switch terminal G, to check the hold-in winding (Figure 2-5).
2. Use the carbon pile to decrease the battery voltage to 20-Volts. Close the switch and read the current. The ammeter must read 6.8 amps maximum.
3. To check the pull-in winding, connect from the solenoid switch terminal S to the solenoid motor M or MTR terminal (Figure 2-6).

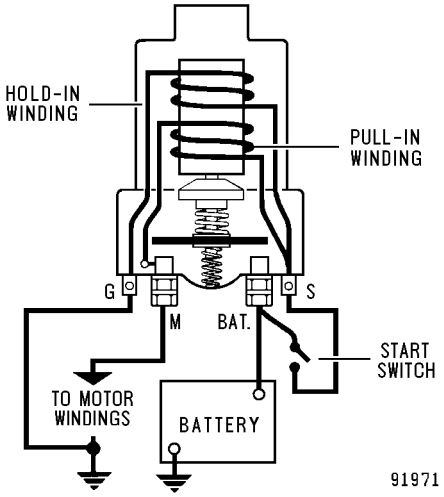

FIGURE 2-4. SIMPLIFIED SOLENOID CIRCUIT

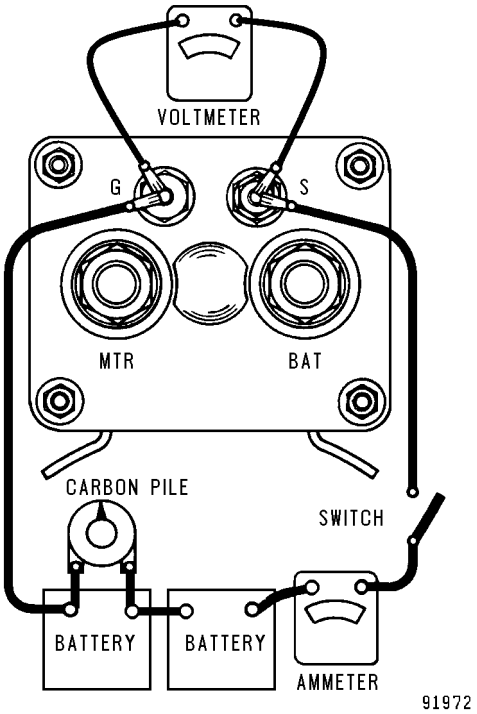

FIGURE 2-5. SOLENOID HOLD-IN WINDING TEST

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RELAY BOARDS

Description

Each relay board (RB1, RB3, RB4, and RB5) is equipped with five green lights (8 & 9, Figure 3-6) and one red light (7). Four green lights are labeled K1, K2, K3, or K4. These lights will be on only when that particular control circuit has been switched on and the relay coil is being energized. The light will not turn on if the relay board does not receive the 24-Volt signal to turn on a component, or if the relay coil has an open circuit.

The red breaker open light (if on) indicates that a circuit breaker, on that relay board, is in the OFF position. A light on the overhead display panel will also illuminate, informing the operator that a circuit breaker is in the OFF position. The red breaker open light will turn on whenever there is a voltage difference across the two terminals of a circuit breaker.

If a control switch has been turned on and a green (K) light is on, but that component is not operating, check the following on the relay board for that circuit:

- ❑ Check for a circuit breaker that is in the OFF position or a red (breaker open) light is on. If a circuit breaker is off, turn it on. Check the operation of the component. If it trips again, check the wiring or component for defects that could be causing the circuit to be overloaded.
- ❑ The contacts inside the relay may not be closing, preventing an electrical connection. Swap relays and check again. Replace the defective relays.
- ❑ Check the wiring and all of the connections between the relay board and the component for an open circuit.
- ❑ Defective component. Replace the component.
- ❑ Poor ground at the component. Repair the ground connection.

SERVICE

To Replace A Relay:

NOTE: The relays are labelled to identify the applicable circuits and components. Also, refer to the Fuse Block chart at the end of this section.

1. Remove one screw (10, Figure 3-6) holding the crossbar in place and loosen the other screw.
2. Swing the crossbar away.
3. Gently wiggle and pull upward to remove relay (11).
4. Line up tabs and install new relay.
5. Place crossbar in original position and install screw (10) that was removed and tighten both screws.

To Replace A Circuit Breaker:

NOTE: Replace a circuit breaker with one of the same amperage capacity as the one being removed.

1. Place the battery disconnect switch in the OFF position.
2. Unplug all the wiring harness(es) from the relay board. Remove four relay mounting screws and remove the relay board from the truck.
3. Remove four hold down screws (2, Figure 3-6) (one in each corner) in circuit breaker cover plate. Remove two screws (6) and card (5).
4. Remove nuts on wire terminal leads on the circuit breaker to be replaced. Remove mounting screws on circuit breaker to be replaced.
5. Lift out circuit breaker. Retain flat washers from wire terminals.
6. Install new circuit breaker of the same capacity rating as the one removed. Install one nut and two flat washers for each wire connection to the new circuit breaker.
7. Install cover plate and all screws removed during disassembly.
8. Carefully install card (5) with screws (6).
9. Install relay board in truck and connect all wiring harnesses.

BATTERY CHARGING SYSTEM

ELECTRICAL SYSTEM DESCRIPTION

The Komatsu truck utilizes a 24VDC electrical system which supplies power for all non-propulsion electrical components. The 24VDC power is supplied by two pairs of 12-Volt storage batteries wired in series. The batteries are a lead-acid type, each containing six 2-Volt cells. With the key switch on and the engine off, power is supplied by the batteries. When the engine is operating, the electrical power (non-propulsion) is supplied by a 28-Volt alternator. Refer to Schematics, Section R, for specific electrical hook-up information.

CHARGE VOLT AND AMP VALUES

The volt and amp levels are a function of the battery state-of-charge. If the batteries are in a state of discharge, as after extended cranking time to start the engine, system voltage, when measured after the engine is started, will be lower than the regulator set point. The system amperage will also be high. This is a normal condition for the charging system. The measured values of system Volts and amps will depend on the level of battery discharge. In other words, the greater the battery discharge level, the lower the system Volts and the higher the system amperage will be. The Volt and amp readings will change; system Volts reading will increase up to the regulator set point and the system amperage will decrease to a low level (depending on other loads) as the batteries recover and become fully charged.

BATTERY

During operation, the storage batteries function as an electrochemical device for converting chemical energy into the electrical energy required for operating the accessories when the engine is off.

⚠WARNING

Lead-acid storage batteries contain sulfuric acid, which if handled improperly, may cause serious burns on the skin or other serious injuries. Wear protective gloves, aprons, and eye protection when handling and servicing lead-acid storage batteries. See the precautions in General Information, Section A, of this manual to ensure proper handling of the batteries and/or accidents involving sulfuric acid.

Maintenance and Service

Check the electrolyte level of each cell at the interval specified in Lubrication and Service, Section P. Add water, if necessary. The proper electrolyte level is 10 to 13 mm (0.375 - 0.50 in.) to above the plates. To ensure maximum battery life, use only distilled water or water recommended by the battery manufacturer. After adding water in freezing temperature, operate the engine for at least 30 minutes to thoroughly mix the electrolyte.

⚠WARNING

DO NOT smoke or allow a flame around a dead battery or during recharging. The expelled gas from a dead battery cell or a charging battery is extremely explosive and can cause serious bodily injury.

Excessive consumption of water indicates leakage or overcharging. Normal water usage for a truck operating eight hours per day is about 30-60 ml (1-2 oz) per cell, per month. For heavy-duty operation (24 hours per day), normal consumption is about 30-60 ml (1-2 oz) per cell, per week. Any appreciable increase in water consumption is considered a danger signal. No water consumption may indicate undercharging or sulfated battery plates.

8. Check the battery. The batteries must be in good condition and fully charged. If any battery condition is marginal, replace it with one known to be in good condition.
   For split battery pack, dual voltage systems, battery rest voltages with 0.3 V. When the 12V battery voltage is more than 0.3 V lower than 24V battery voltage, check the 12V battery circuit to verify adequate charge.
   Polarity of the battery and the alternator must agree; reverse polarity will damage the alternator. The alternator is negative ground.
9. Check the voltage output and use the information below to determine possible cause.
   a. Causes of low voltage
      1). Loose or broken drive belt
      2). Batteries low state of charge
      3). Current load on system greater than the alternator can produce
      4). Defective wiring or poor ground path
      5). Low regulator set point
      6). Defective voltage regulator
      7). Defective alternator
      8). Lost residual magnetism
   b. Causes of high voltage
      1). Wrong regulator
      2). High regulator set point
      3). Defective regulator
      4). Defective alternator
   c. Causes of no voltage output. See Regulator Bypass Test (No Output) for additional testing information.
      1). No drive belt
      2). No battery (B+) voltage at alternator's (B+) terminal
      3). Defective regulator
      4). Defective alternator
      5). Lost residual magnetism
10. Check the condition of the battery and the charge voltage reactions.

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

   a. Maintenance-type batteries display the following characteristics.
      1). Immediately after engine start, the system Volts are lower than regulator set point with medium amps.
      2).Three to five minutes into the charge cycle, higher system Volts and reduced amps.
      3). Five to ten minutes into the charge cycle, system Volts are at, or nearly at, the regulator set point, and the amps are reduced to a minimum.
   b. Low maintenance-type batteries display the same characteristics as maintenance-type batteries, except cycle times may be longer.
   c. Maintenance free-type batteries display the following characteristics.
      1). Immediately after engine start, the system Volts are lower than the regulator set point with low charging amps.
      2). Fifteen to thirty minutes into the charge cycle, still low Volts and low amps.
      3). Fifteen to thirty minutes into the charge cycle, Volts increase several tenths, amps increase gradually, then increase quickly to medium to high amps.
      4). Twenty to thirty-five minutes into the charge cycle, Volts increase to the set point and amps decrease.
   d. High-cycle, maintenance-free type batteries display the following characteristics.
      1). These batteries respond much better than the standard maintenance-free batteries.
      2). The charge acceptance of these batteries may display characteristics similar to standard, maintenance-type batteries.

3. Move the drive lead from pin A (F-) to pin F (F+) in the harness plug. The DMM must show a very high resistance. If the ohmmeter shows less than 100K ohms, the field coil is grounded. Replace the field coil.

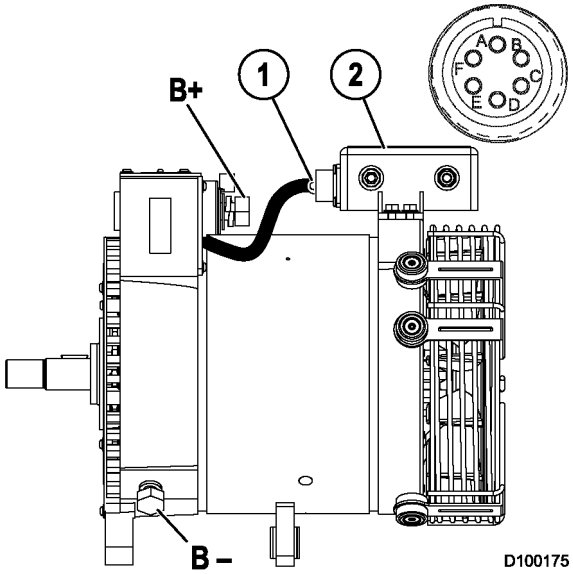


FIGURE 10-14. WIRING HARNESS PLUG JUMPER WIRE CONNECTION

1. Wiring Harness Plug 2. Regulator

STATOR TESTS

These alternators have delta-wound stators. Test 1 will show the condition of the phase lead from the ring terminal at the diode end of the lead to the soldered connection at the phase winding. Test the phase coil windings on a bench stator tester, following the tester's instructions.

Before performing tests:

1. Check the stator for signs of damage, such as burnt insulation or a loose coil.
2. Disconnect the phase lead wire from the mounting terminals.

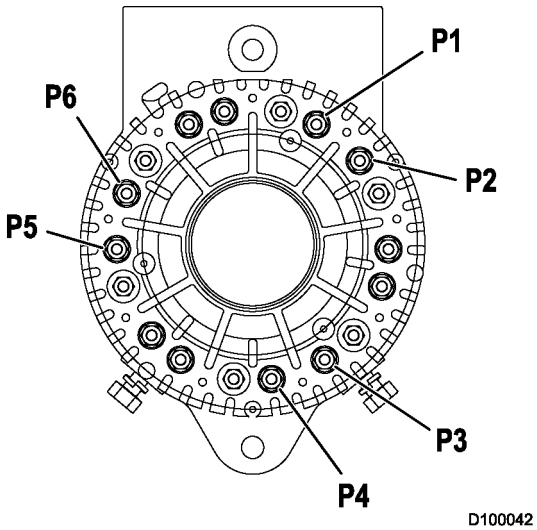


FIGURE 10-15. PHASE LEAD LOCATIONS

Stator Test 1: Check For Stator-To-Stator Continuity

1. Set the DMM to the ohms scale and zero the meter.
2. Connect one meter lead to phase lead P1 (Figure 10-15), connect other meter lead (one at a time) to each phase lead P4, P5, and P6. Repeat for P2 and P3.
3. The DMM must show OL (out of limits) each time. If the DMM shows a value, replace the stator.

Epoxy Adhesive

Master Bond, Inc.
154 Hobart Street
Hackensack, NJ 07601 USA
Phone: 201-343-8983
Fax: 201-343-2132
www.masterbond.com

Epoxy adhesive, EP11HT, is a one component, heat curing, structural epoxy adhesive with high shear strength, easy handling, and high temperature resistance. Cures at elevated temperatures, e.g. 90-120 minutes at 121°C (250°F) or 60-90 minutes at 149°C (300°F). The minimum cure temperature is 121°C (250°F). EP11HT attains tensile shear strengths in excess of 22753 kPa (3,300 psi) and forms rigid and dimensionally stable bonds. The service temperature range is -51°C to 204°C (-60°F to 400°F). As a one part system, it does not require mixing prior to use and has an unlimited working life at room temperature. EP11HT bonds well to a wide variety of substrates, including metals and most plastics. It has excellent resistance to a wide range of chemicals including acids, bases, oils, salts, and many solvents. This adhesive is 100% reactive and does not contain any solvents or volatiles. The standard color is tan. The cured adhesive fully meets the requirements of MIL-MMM-A-132.

Liquid Threadlockers

Loctite 222 Low Strength Threadlocker is an anaerobic sealant. This low-strength threadlock is used for small screws less than 6 mm (.25 in.) in diameter. The parts can be separated using hand tools.

Henkel Corporation
1001 Trout Brook Crossing
Rocky Hill, Connecticut 06067 USA
Phone: 860-571-5100
Internet: www.loctite.com

Elastoplastic Silicone Resin

Dow Corning 1-2577 Low VOC RTV is a one-part clear, RTV cure with mild heat acceleration possible. It has a hard slick finish with abrasion resistance, solvent-borne with low VOC which is ozone-safe. This silicon meets UL and MIL Specs and contains a UV indicator.

Typical Properties:
Viscosity/Flowability
(cps or mPa sec) = 1,250;
Durometer = 25 D;
Specific Gravity = 0.88;
RT Tack Free Time = 6 minutes;
Room Temp Cure Time = 60 minutes;
Heat Cure Time = 2 minutes @ 60°C (140°F;
Agency Listing = UL 94 V-0 or HB & 746C / Mil Spec;
Dielectric Strength, Volts/mil = 340;
Dielectric Strength kV/mm = 13.4;
Volume Resistivity ohm-cm = 1.9E+14

Dow Corning Corporation
Corporate Center
PO Box 994
Midland MI 48686-0994 USA
Phone: 989-496-7881
Fax: 989-496-6731
www.dowcorning.com

⚠CAUTION

The rotor retaining screws have been installed with a thread lock compound (Loctite). DO NOT use air impact tools to remove screws (46). Use only hand tools to carefully remove these screws. Using air tools can cause the screws to break, resulting in damage.

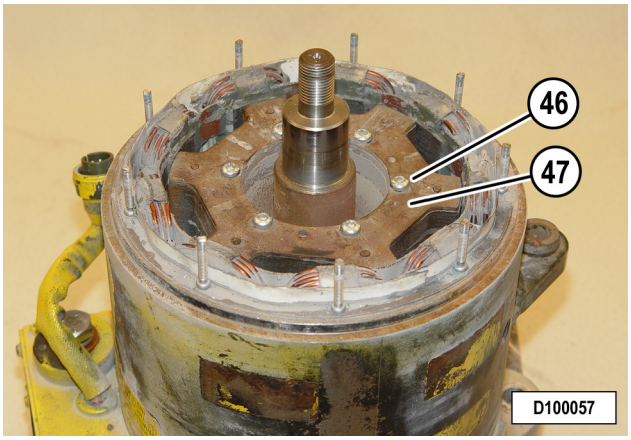


FIGURE 10-46.

46. Screw
47. Rotor

2. Remove remaining five Torx screws (46) using a number T25 Torx bit.
3. Clean out three threaded puller holes in top of rotor (47).

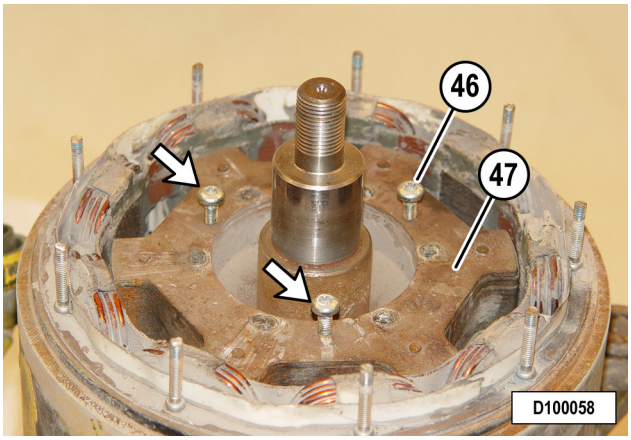


FIGURE 10-47.

46. Screw
47. Rotor

NOTE: If necessary to loosen rust, use an air chisel with a rounded-point hammer bit to vibrate the area between screw holes on the rotor face.

4. Thread three screws (46) into the puller holes. Tighten the screws evenly to start removing rotor (47) from rotor shaft (48).

.

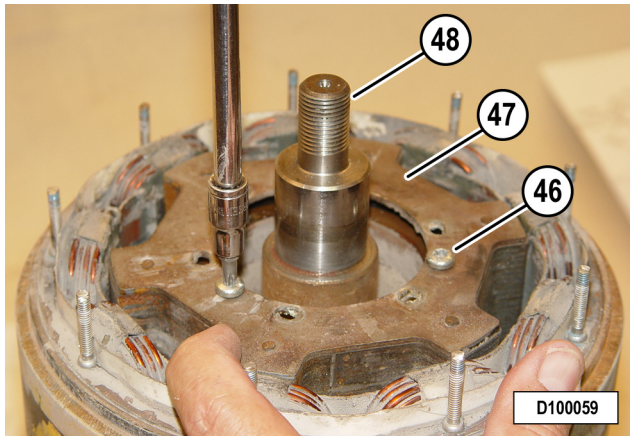


FIGURE 10-48.

46. Screw
47. Rotor
48. Rotor Shaft

⚠CAUTION

Threaded screws (46) may not be long enough to completely remove rotor (47) from the rotor shaft. If necessary, use a three jaw gear puller to completely remove the rotor. Using the three jaw gear puller may damage the rotor if it is rusted to the rotor shaft.

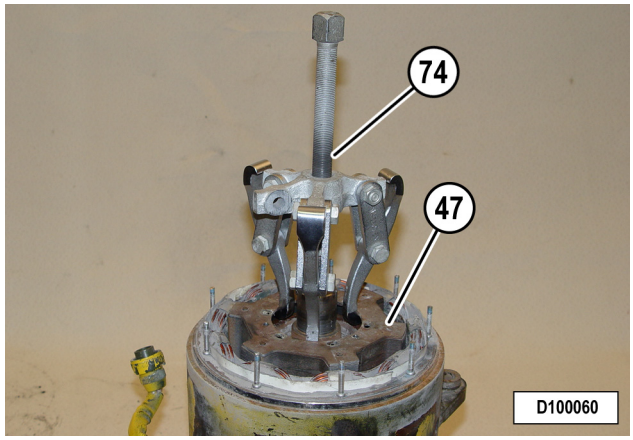


FIGURE 10-49.

47. Rotor.
74. Three Jaw Gear Puller

Drive End and/or Anti-Drive End Stator Removal

IMPORTANT

Remove and replace one faulty stator at a time. This process will ensure the alignment of stators (56, 59) to shell (58). Refer to the appropriate Installation section for specific installation instructions.

1. Position the alternator in the support stand with the drive end facing up.
2. Permanently scribe or etch a single mark, aligned with the center of a stud hole, across the top surface of drive end stator (56) and end of shell (58).

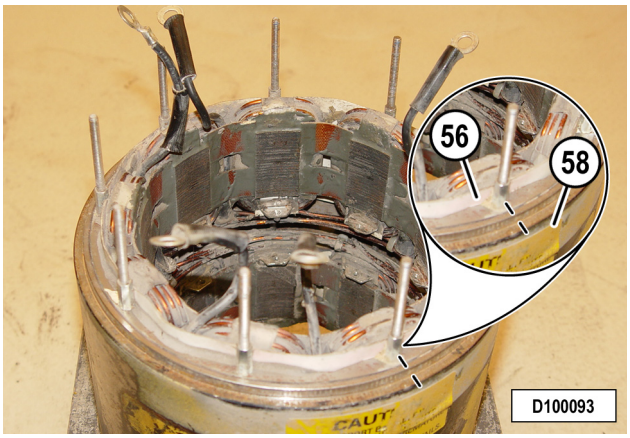


FIGURE 10-83.

56. Drive End Stator
58. Shell

3. Reposition the alternator in the support stand with the anti-drive end facing up.
4. Permanently scribe or etch a single mark aligned with the center of two stud holes, across the top surface of anti-drive end stator (59) and end of shell (58). Repeat at an adjacent hole.

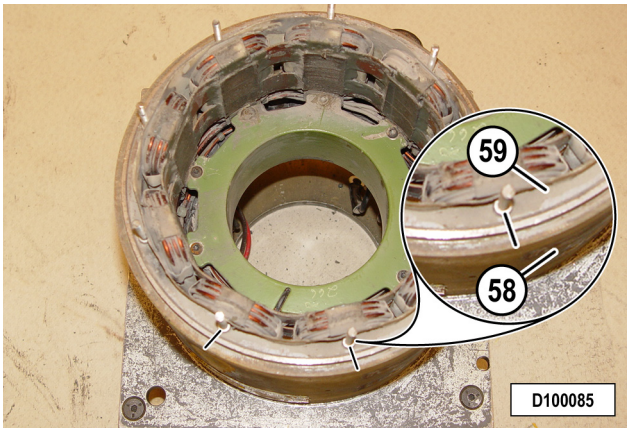


FIGURE 10-84.

58. Shell
59. Anti-Drive End Stator

IMPORTANT

A single scribe mark identifies the stator as the drive end stator. The double mark identifies the stator as the anti-drive end stator. It is critical that these marks be precisely aligned during assembly. If the marks are not precisely aligned, the phase leads, field coil leads, and the mounting holes will not properly align. If a new stator is being installed, it is critical to precisely transfer the location of the mark(s) to the new part.

2. Place drive end housing (20) and front bearing (9) in a hydraulic press. Press the bearing into the bore until completely seated against the flat retainer ring.

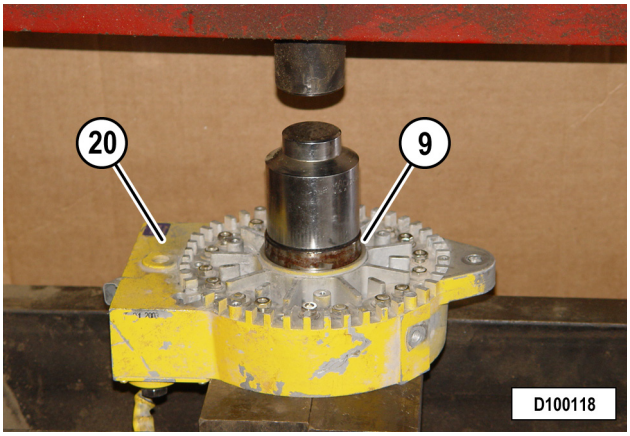


FIGURE 10-112.

9. Front Bearing 20. Drive End Housing

3. Install beveled retainer ring (8) using heavy-duty, internal snap ring pliers. Position the beveled portion of the retaining ring facing up.

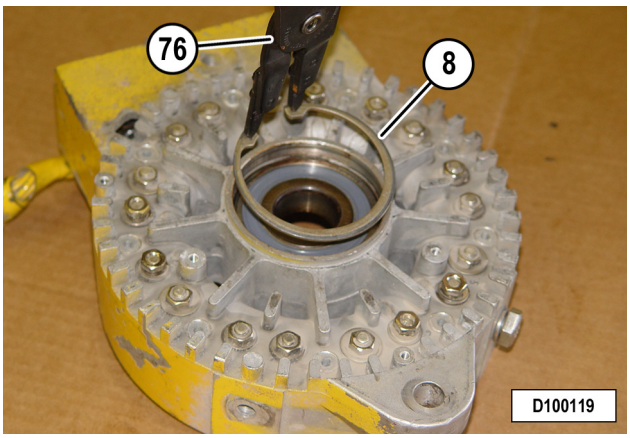


FIGURE 10-113.

8. Beveled Retainer Ring 76. Snap Ring Pliers

4. Lubricate the spiral ring with Komatsu grease XA3401. Wind new spiral ring (5) into the groove around pulley bushing (44).

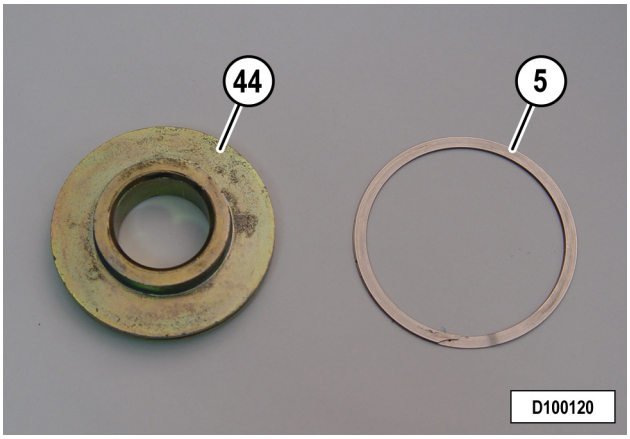


FIGURE 10-114.

5. Spiral Ring 44. Pulley Bushing

5. Compress spiral ring (5) and install pulley bushing assembly into the inside bore of the drive end housing. Position the thickest flange of the pulley bushing facing up (towards the inside of the alternator).

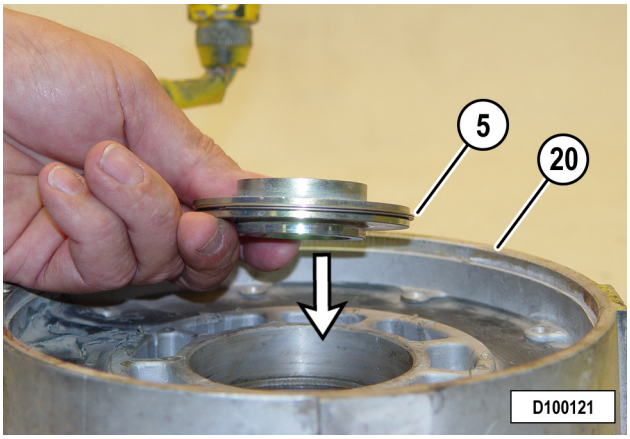


FIGURE 10-115.

5. Spiral Ring 20. Drive End Housing

11. Remove the alternator from the support stand. Install woodruff key (49) in the rotor shaft. Install pulley (3) with flat washer (2) and nut (1). Use an air impact wrench and a 30 mm impact socket to tighten the nut to **163 N·m** (120 ft lb).

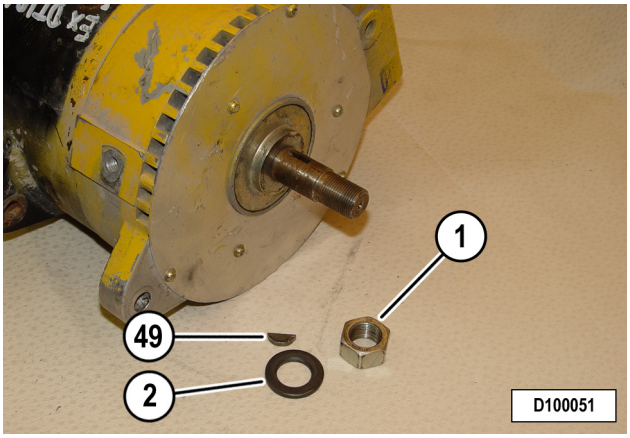


FIGURE 10-146.

1. Lock Nut
2. Flat Washer
49. Woodruff Key

Regulator Installation

1. Set the selectable voltage set point switch on the back side of the regulator to the correct position.

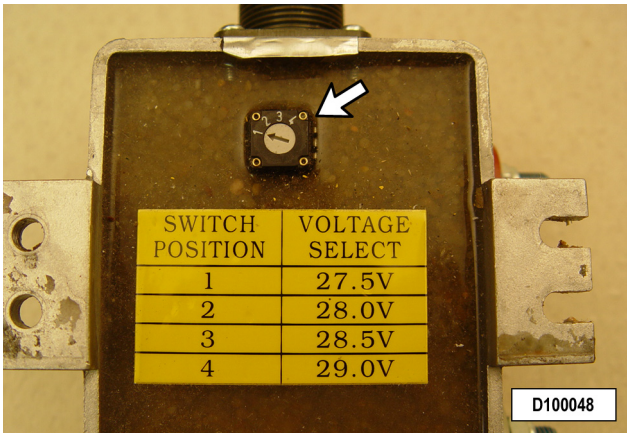


FIGURE 10-147.

NOTE: The setting of this switch can depend on the type of battery being used. Refer to Battery in this chapter for additional information.

2. Place the regulator on the alternator. Install four screws (38) with Bellville washers (39) using an 8 mm socket. Tighten the screws to **8 N·m** (70 in. lb).

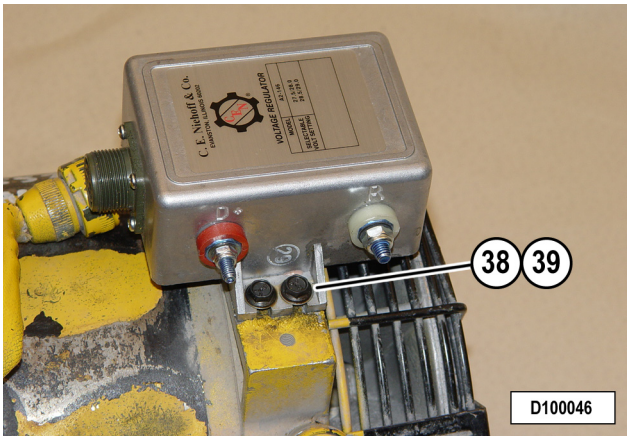


FIGURE 10-148.

38. Screws
39. Bellville Washers

3. Connect wiring harness (36) to voltage regulator (37).

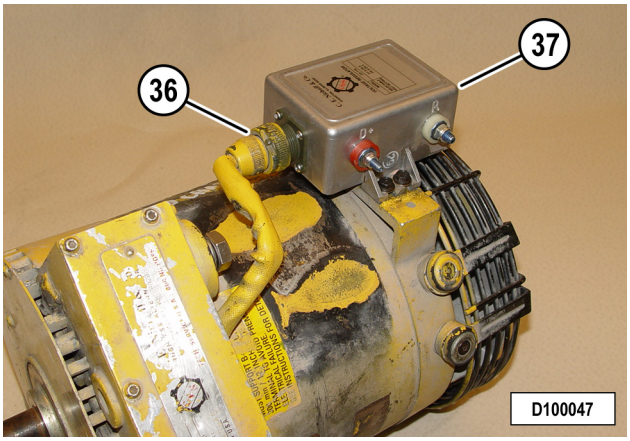


FIGURE 10-149.

36. Wiring Harness
37. Voltage Regulator

OPERATION SECTION

INTRODUCTION

Payload Meter III (PLMIII) measures, displays, and records the weight of material being carried by an off-highway truck. The system generally consists of a payload meter, a gauge display, deck-mounted lights, and sensors. The primary sensors are four suspension pressures and an inclinometer. Other inputs include a body-up signal, brake lock signal, and speed.

Data Summary

5208 haul cycles can be stored in memory. The following information is recorded for each haul cycle:

- Payload
- Operator ID number (0000-9999)
- Distance traveled loaded and empty
- The amount of time spent empty run/stop, loading, loaded run/stop, and dumping
- Maximum speed loaded and empty with time of day
- Average speed loaded and empty
- Empty carry-back load
- Haul-cycle, loading, dumping start time of day
- Peak positive and peak negative frame torque with time of day
- Peak sprung load with time of day
- Tire ton-mph for each front and average per rear tires

The payload meter stores lifetime data that cannot be erased. This data includes:

- Top five maximum payloads and time stamps
- Top five positive and negative frame torque and time stamps
- Top five maximum speeds and time stamps

Data Gathering

Windows 95/98/NT software is available to download, store, and view payload and fault information. The PC software will download an entire truck fleet into one Paradox database file. Users can query the database by date, time, truck type, and truck number to produce reports, graphs, and export the data. The software can export the data in '.CSV' format that can be easily imported into most spreadsheet applications. The Windows software is not compatible with the Payload Meter II system.

It is important that each payload meter be configured for each truck using the PC software. The information for frame serial number and truck number is used by the database program to organize the payload data. In addition, the payload meter must be configured to make calculations for the proper truck model. Improper configuration can lead to data loss and inaccurate payload calculations.

Haul Cycle Data

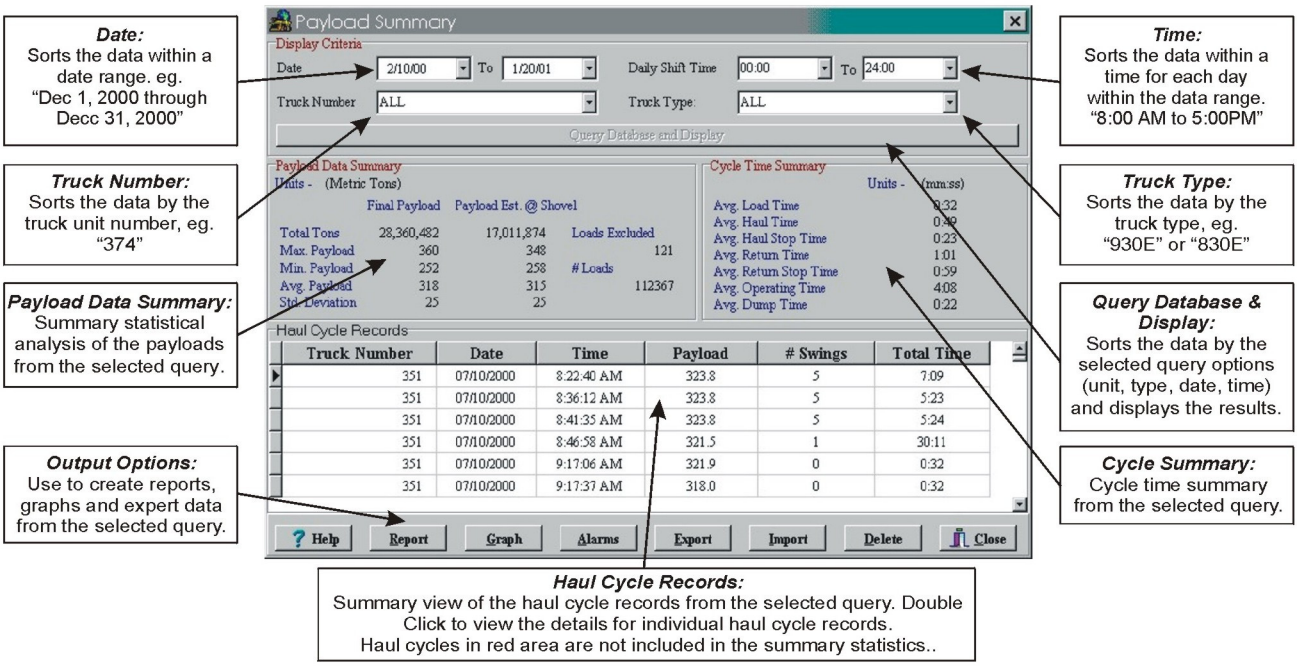
The following information is recorded for each haul cycle:

Table 1: HAUL CYCLE DATA

Data	Unit	Remarks
Truck #	alpha-numeric	Up to 22 characters can be stored in this field to identify the truck. Typically this field will be just the truck number.
Haul cycle start date/time	seconds	Number of seconds from 1/1/70 to the start of the haul cycle. Haul cycle starts when the meter transitions from dumping to empty state after the previous haul cycle. Download program converts seconds into date and time for display.
Payload	tons	Stored as metric, download program allows for conversion to short or long tons.
Number of swingloads	number	The number of swingloads detected by the payload meter.
Operator ID	number	This is a four digit number that can be entered by the operator at the start of the shift.
Warning flags	alpha	Each letter represents a particular warning message about the haul cycle. Details are located on page 19.
Carry-back load	tons	The difference between the latest empty tare and the clean truck tare.
Empty haul time	seconds	Number of seconds in the tare_zone and empty states with the truck moving.
Empty stop time	seconds	Number of seconds in the tare_zone and empty states with the truck stopped.
Loading time	seconds	Number of seconds in the loading state.
Loaded haul time	seconds	Number of seconds in the maneuvering, final_zone, and loaded states with the truck moving.
Loaded stop time	seconds	Number of seconds in the maneuvering, final_zone, and loaded states with the truck stopped.
Dumping time	seconds	Number of seconds in the dumping state.
Loading start time	seconds	Number of seconds from the start of the haul cycle to when the meter transitions from empty to loading state.
Dump start time	seconds	Number of seconds from the start of the haul cycle to the time when the meter switches from loaded to dumping state.
Loaded haul distance	m	Distance traveled while loaded.
Empty haul distance	m	Distance traveled while empty.
Loaded max speed	km/h	Maximum speed recorded while the truck is loaded.
Loaded max speed time	seconds	Number of seconds from the start of the haul cycle to the time when the max speed occurred.
Empty max speed	km/h	Maximum speed recorded while the truck is empty.
Empty max speed time	seconds	Number of seconds from the start of the haul cycle to the time when the max speed occurred.
Peak positive frame torque	ton-meter	Positive frame torque is measured as the frame twists in the clockwise direction as viewed from the operator’s seat.
Peak frame torque time	seconds	Number of seconds from the start of the haul cycle to the peak torque. Download program converts to time for display.
Peak negative frame torque	ton-meter	Negative frame torque is measured as the frame twists in the counter-clockwise direction as viewed from the operator's seat.
Peak frame torque time	seconds	Number of seconds from the start of the haul cycle to the peak torque. Download program converts to time for display.
Peak sprung load	tons	Peak dynamic load calculation.
Peak sprung load time	seconds	Number of seconds from the start of the haul cycle to the peak instantaneous load calculation.
Front-left tire-ton-km/h	t-km/h	Tire ton-km/h for haul cycle.
Front-right tire-ton-km/h	t-km/h	Tire ton-km/h for haul cycle.
Average rear tire-ton-km/h	t-km/h	Tire ton-km/h for haul cycle.
Truck frame serial number	alpha	The truck serial number from the nameplate on the truck frame.
Reserved 1-10	number	These values are internal calculations used in the continued development of the PLMIII system and must be ignored.

DATA ANALYSIS

PAYLOAD SUMMARY FORM



The data analysis tools allow the user to monitor the performance of the payload systems across the fleet. Analysis begins when the "View Payload Data" button is pressed. This starts an all trucks, all dates, all times query of the database and displays the results in the Payload Summary form.

The user can change the query by changing the dates, times, or trucks to include in the query for display.

Haul cycles in the data grid box at the bottom can be double clicked to display the detailed results of that haul.

Creating a Query

The program defaults to show all trucks, all types, all dates, and all times for the initial query. The display can be narrowed by selecting which trucks or types to view and for what dates and times.

The query items are added in the AND condition. If the user selects a truck # and date range, the query will sort the data for that truck number and the date range.

Sorting on Truck Unit Number

The truck unit number is the truck unit number entered into the payload meter when it was configured at installation. The query can be set to look for all trucks or one particular truck number. When the program begins, it searches through the database for all the unique truck numbers and creates a list to select from.

Choosing one particular truck number will limit the data in the displays, summaries and reports to the one selected truck. To create reports for truck number 374, select 374 from the pull-down menu and hit the "Query Database and Display" button.

Sorting on Truck Type

The truck type is the size of the truck from the family of Komatsu trucks. This allows the user to quickly view results from different types of trucks on the property. For example, a separate report can be generated for 830E and 930E trucks.

Abnormal Displays at Power-Up

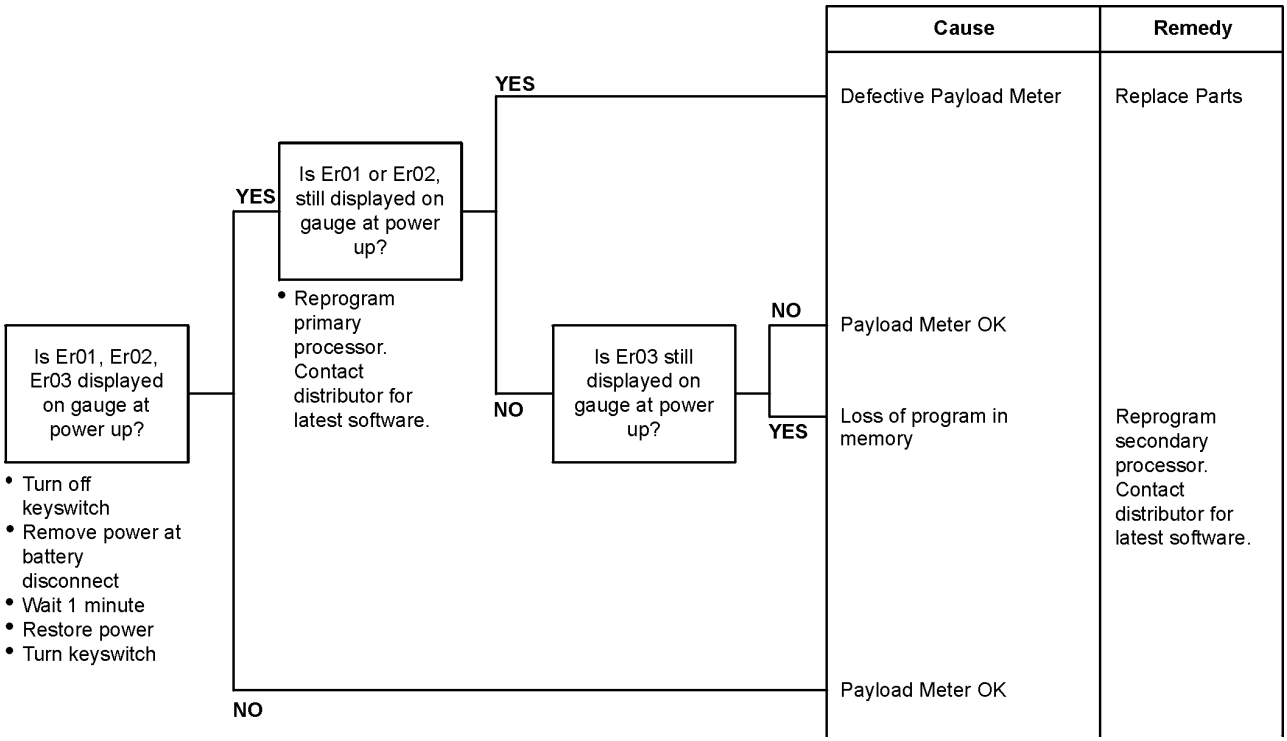
The payload meter performs several internal memory system checks every time it powers-up. In case of error, the operator gauge may display an error code when power is applied to the PLMIII system.

Er:01 - Bad Truck Configuration error indicates that the meter encountered an error while reading the current truck configuration record from memory.

Er:02 - Bad Calibration Record error indicates that the meter encountered an error while passing messages between the microprocessors on the circuit board.

Er:03 - Interprocessor Communications error indicates that the meter encountered an error while passing messages between the microprocessors on the circuit board.

To resolve these errors:



- If these errors persist after reprogramming the primary and secondary processors, then the payload meter must be replaced.

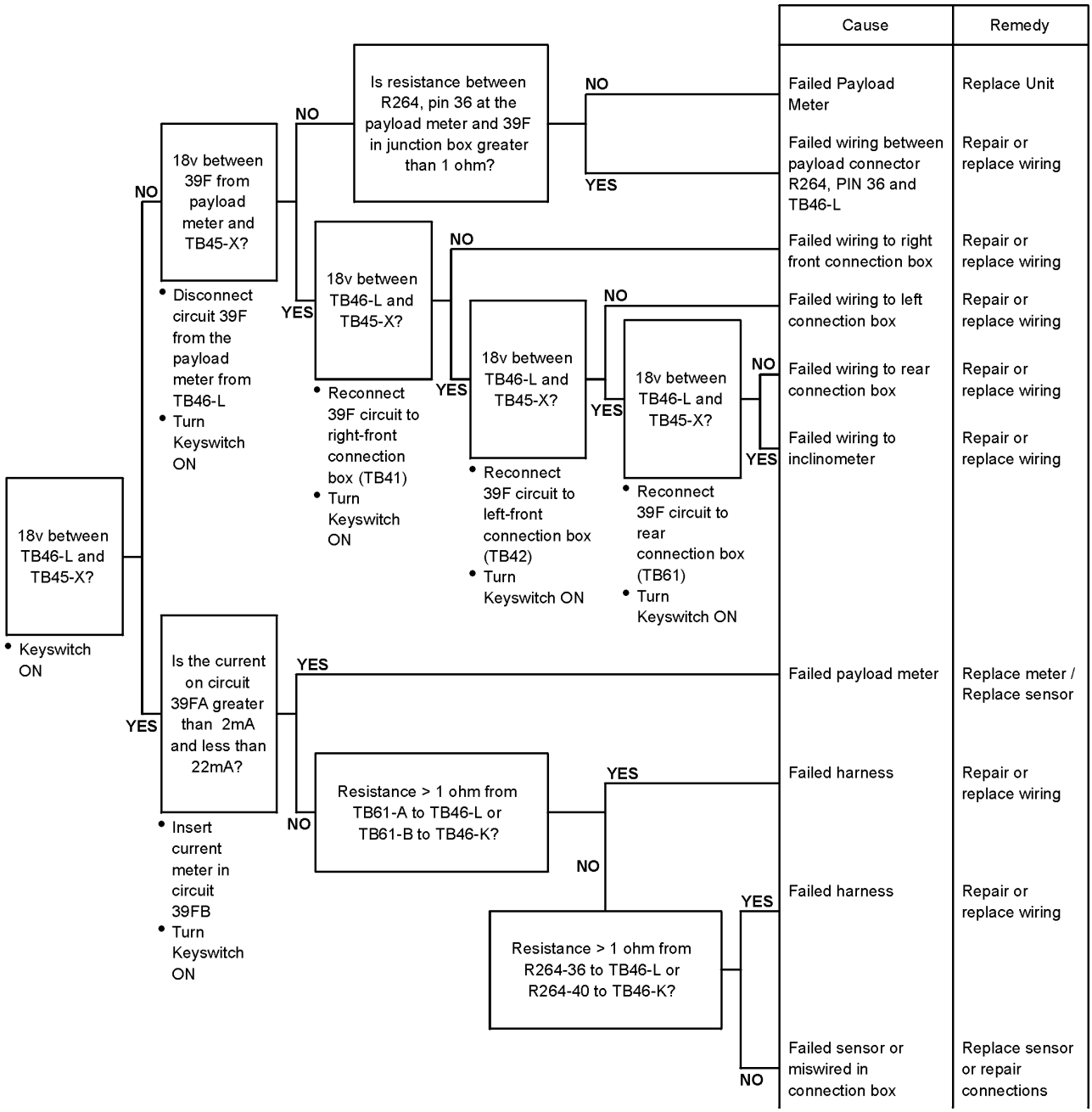
Alarm 7 - Right-Rear Pressure High

Alarm 8 - Right-Rear Pressure Low

Troubleshoot Wiring to Right-Rear Suspension

These alarms indicate that the current being read by the payload meter is higher than 22ma or lower than 2ma. The pressure sensor is designed to output 4-20ma over a pressure range of 4000 psi.

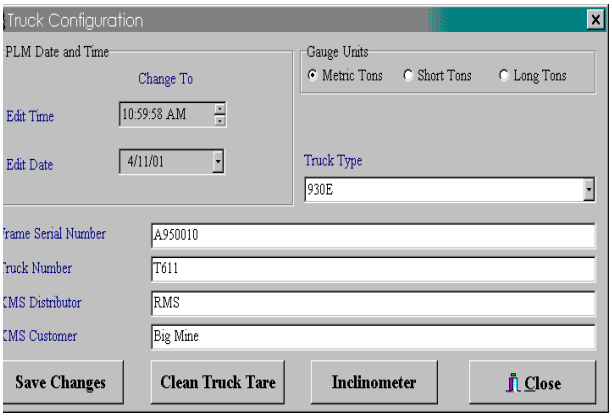
- Confirm 18v sensor supply at TB46-L in payload junction box.
- Confirm proper connection of signal circuit 39FC from right suspension connection box, TB41-B to payload junction box TB46-G to payload meter connector R264, pin 20.



21. The Connection Menu will be displayed. Select Configure Payload Meter.

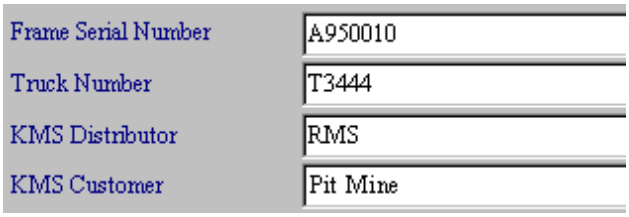
22. Confirm that the PLMIII software version matches the latest available version. As of 09-May-01 the EJ0575-1 software version will display as 01/28/01A. The latest version can be found at http://www.kms-peoria.com/payload. If the version does not match the latest indicated on the internet, download the latest and update the PLMIII software using the Flashburn software. See Checkout Procedure Confirmation for more information.

23. Using the Truck Configuration menu, set the following:



- Set the time.
- Set the date to today's date.
- Set the gauge display units to metric, short tons or long tons according to the final destination of the vehicle. If nothing has been specified, set to metric tons.
- Set the truck type to the proper truck model.
- Press the "Save Changes" button to program the change into the payload meter.

24. Setting the Frame Serial Number.



NOTE: The frame serial number is located on a plate mounted to the truck frame. The plate is outboard on the lower right rail facing the right-front tire. It is very important to enter the correct frame serial number. This number is one of the key fields used within the haul cycle database. The field will hold 20 alpha-numeric characters.

- On the Truck Configuration screen, enter the frame serial number in the appropriate field.
- Press the "Save Changes" button to program the change into the payload meter.

25. Setting the customer unit number.

NOTE: Most mining operations assign a number to each piece of equipment for quick identification. This number or name can be entered in the customer unit number field. It is very important to enter the customer unit number. This number is one of the key fields used within the haul cycle database. The field will hold 20 alpha-numeric characters. If no truck number has been specified, enter the frame serial number.

- On the Truck Configuration screen, enter the truck number in the appropriate field.
- Press the "Save Changes" button to program the change into the payload meter.

26. Setting the Komatsu Distributor.

NOTE: This field in the haul cycle record can hold the name of the Komatsu distributor that helped install the system. Komatsu also assigns a distributor number to each distributor. This number is used on all warranty claims. This Komatsu distributor number can also be put into this field. This number is one of the key fields used within the haul cycle database. The field will hold 20 alpha-numeric characters. If the distributor is not known, enter "UNKOWN".

- On the Truck Configuration screen, enter the distributor name or number in the appropriate field.
- Press the "Save Changes" button to program the change into the payload meter.

Frames

Every few seconds the system also collects frames which are bits of time. The time duration of each frame is set using the PTU in increments of 0.01 seconds. Frames are collected right after all of the systems' input/output functions (events) are complete, as a record of system function at the time of the event.

Each frame contains 40 floating point values, all digital input and output values, the state machine's current state at the time of the event.

Each time an event is reported, a frame (known as the trigger frame) is kept for that event until the event is erased.

Windows

Some events may also have frame windows - a collection of 51 frames, that is, all the frames that occur for 40 frames before the event, a frame at the event, and 10 frames after the event.

The system will save each event window for the first 16 events that are qualified to have windows. They will be saved until the event is erased. After 16 windows are stored, no additional windows can be stored.

System Categories

All of the possible events which can occur have been programmed to fall into eight different categories to enable the system to respond correctly. They are:

Active Events Count

This is the current number of events of this type which are active, i.e., which may affect truck operation.

Decay Active Events Count Time

This is the time in seconds which specified the rate at which the active events count decays, allowing a certain number of events to occur normally over a given time frame without affecting truck operation.

Lockout DOS Limit

This controls how often a truck operator may reset the operating restrictions caused by an event type, using the Dump Override Switch (DOS) in the cab.

If the active events count is equal to the lockout DOS limit for a given type, the override switch (DOS) will have no effect on operating restrictions caused by that event. The active events count for that type will not be decayed by the decay active events count.

Running Count

This is the total count of all events of this type seen since running count was last cleared by the PTU.

Life Count

This is the total count of all events of this type ever recorded. The maximum number which can be recorded is 4,294,967,295. When this number is reached, the count will roll over.

Accept Limit

This is the number of events of this type that will be recorded by the system. See the discussion under Limits On Resetting Faults.

Window Captures Allowed Limit

This tells how many windows will be captured for events of this type, subject to space restrictions. When the window capture limit is exceeded, only a single frame of data is saved.

Window Captures Count

This is the count of windows saved for this event type. This value is incremented by one each time a window is saved for this event type. It is decremented or cleared when events are cleared by the PTU.

Limits On Resetting Faults

In the fault system, there are three limits associated with resetting faults:

Accept limit (accept_limit)

This is the limit on the number of faults which may be stored. When the limit of a given fault is exceeded, the oldest event of this type recorded without a window will be replaced with the new event, it will not be overwritten. The system does not allow events with windows to be overwritten. If the oldest event has a window, the oldest non-window event will be overwritten.

TABLE II. TWO-DIGIT DISPLAY PANEL SUBCODES (Cont.)

PRIMARY CODE No.	SUBCODE No.	TERM	DESCRIPTION
		ANALOG INPUT	
32:	44	VOLTS_15P	A/D Scaled output > 16.5 or <13.5 for 0.1 seconds
	45	VOLTS_15N	A/D Scaled output > -13.5 or <-16.5 for 0.1 seconds
	46	LO_BATT_VOLT	A/D Scaled output < 15.0 for 4.0 seconds
	47	HI_BATT_VOLT	A/D Scaled output > 33.0 for 4.0 seconds
	48	VOLTS_19P	A/D Scaled output > 20.9 OR <17.1 for 1.0 second
	49	TAMB	A/D Scaled output > 5.2 or <-5.2 for 1.0 second
	50	Undefined3	A/D Scaled output > 5.2 or <-5.2 for 1.0 second
		FREQUENCY INPUT	
33:	51	ENG_SPD	ENGSPD exceeds ENG_MAX_RPM = 2400 rpm
	52	M1_SPD	MOTOR1SPD exceeds MTR_RPM_MAX = 3000 rpm
	53	M2_SPD	MOTOR2SPD exceeds MTR_RPM_MAX = 3000 rpm
		HARDWARE STARTUP	
37:	1	EPROM CRC	Checksum failed for base monitor buck EPROMS
	2	WATCHDOG TEST	Test for infinite loop failed
	3	READY TIMEOUT	Test for bad address failed
	4	CLOCK INTERRUPT	Test of interrupt circuitry failed
	5	FLASH CRC	Checksum failed for OBJ application code
	6	SRAM TEST	Static RAM read/write test failed
	7	BRAM CRC	Battery backed RAM checksum failed
	8	BRAM BATTERY CHK	Battery voltage low for BRAM
	9	DATE/TIME CHECK	Hour <24, day<32, Check for realistic date and time
	10	BUCK RAM STACK	Check of static RAM used by buck
	11	INTERRUPT OVERFLOW	Not enough real-time for master loop
	12	WATCHDOG	Application tripped an infinite loop
	13	BAD MEMORY	Application bad memory address
	14	MANUAL	Command to manually test 37 was issued
	15	ANALOG READBACK	Output signal feedbacks indicate error
	16	ANALOG A TO D	Analog to digital conversion too long
	17	ANALOG GNDCHK	Analog input conversion lost power
	18	FCLOCK STATUS	Frequency input conversion error
	19	FCLOCK STOPPED	Frequency input conversion error
	20	FCLOCK SEQUENCE	Frequency input conversion error
	21	FPULSE STATUS	Frequency input conversion error
	22	FPULSE SEQUENCE	Frequency input conversion error
	23	FPULSE COUNT	Frequency input conversion error

14. Press [F4] to create the new file. The mine data from the file in the first column is copied and put into the OEM file in the third column to create the name you entered in the fourth column. Note that both asterisks (*) have changed to plus signs (+), indicating the file has been created and copied to the hard disk.

Use the down arrow to move the cursor to the next file name. Note the equal (=) signs move with the cursor.

15. Use the right arrow key and move the cursor to the right.
16. Type in the new file name.
17. Press [ENTER]. The example in Figure 2-9 shows the new file name to be TEST2.
18. Use the down arrow key and move the cursor to the next file name.
19. Move the cursor to the right to position the cursor on the name.
20. Type in the new file name and press [ENTER]. Note an asterisk (*) appears in front of both file names, indicating the names have been changed but the files have not yet been created.
21. You can now press [F5] to create all new files at once.
    a. Note the screen prompts you to make a decision; (O) for Overwrite the file name, (S) for Skip creation of the noted file and continue with the remaining files, and (A) for Abort creation of any new files. This is because the [F5] key tries to create all of the new files, and the first file has already been created. The computer is looking at the first file and is asking which of these three options to apply. Since the first file has already been created, the correct option is (S) for Skip and continue.

NOTE: This feature can be used to change a file name which was already created by selecting (O), or abort the last changes made by selecting (A).

22. Press [S]. Note the computer went directly to the second file and created it, and went on to the third file and created it. Note also that all asterisks (*) are now changed to plus signs (+).
23. Press [F9] or [ESC] to exit this screen and return to the GE OHV STATEX III menu.
24. Select Truck Setup (CFG) and press [ENTER].
25. Select No. [1] to view the current truck configurations on file. Note that the new configuration files are listed and are available for use. These new files contain the latest release of GE software and all of the truck configuration data from the previous files.

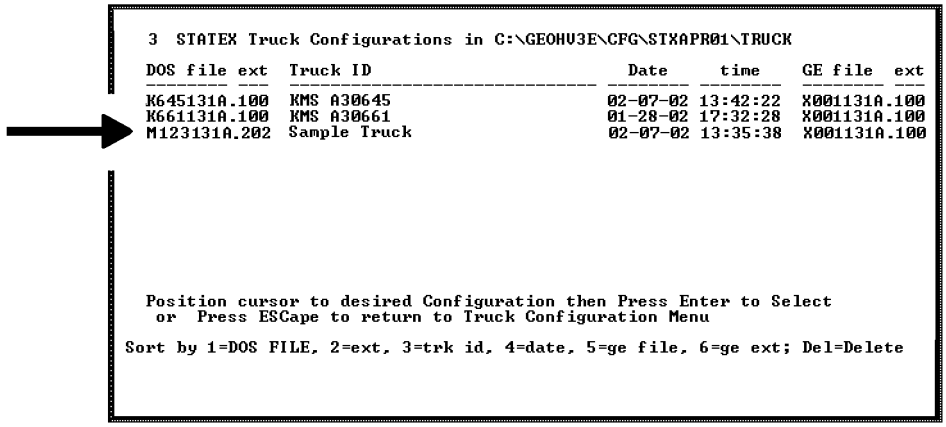


FIGURE 2-17. TRUCK CONFIGURATION FILE LIST
(Sample file name shown added to the list)

8) Save Directory: . . .

At the end of line 8) a directory is displayed for storing the new truck configuration file. The sample in Figure 2-16 shows:

> "C:\GEOHV3E\CFG\STXAPR01\TRUCK.
> This directory will be the same as the directory shown in line A).

If the newly created configuration file is to be stored in this directory, it is not necessary to change line 8). When line 7) is selected and the file saved, it will automatically be saved to the directory shown in line 8).

If the configuration file is to be saved in a different directory, use the following procedure before selecting line 7) to save the file*:*

1. Move the cursor to line 8) and press [ENTER] or press [8].
2. Type in the full DOS path name of the directory in which to store the new configuration file. Press [ENTER].

NOTE: If a new directory is specified, the directory name must exist on the PTU hard drive. The software is not capable of creating a new directory. New directories must be created using DOS.

3. Move the cursor to line 7) and press [ENTER] or press [7].
4. The current file name will appear at the end of line 7).
5. Type in the new file name (M123131A.202 in the example shown). The original filename will disappear as the new name is typed.
6. Press [ENTER] to save the new file name into the directory shown on line 8).
7. Move the cursor to line 1) and press [ENTER] or press [1]. This will display the list of configuration files as shown in Figure 2-17. Verify the new file name has been added to the list.
8. When finished with the Truck Setup Configuration Mine Menu, move the cursor to line 9) and press [ENTER] or press the [9] key to quit.
   a. The prompt, "Quitting, Are you sure (Y/N):" appears as a warning against quitting without saving the modified configuration file. Press [Y] key if you are sure that the mine renamed configuration file has been properly saved.
9. The GE OHV STATEX III menu will appear on the PTU screen.

NOTE: It is advisable to make a backup copy to a floppy disk of the current truck configuration file whenever changes are made to the file. This will provide a backup copy of configuration information which will not have to be manually re-entered in the event data on the PTU hard disk drive is lost. Refer to the DOS operating system manuals supplied with the PTU for specific procedures for copying files from the PTU to a floppy disk.

STATISTICAL DATA CODES - COUNTERS

TABLE III. STATISTICAL DATA CODES - COUNTERS

PAR No.	DESCRIPTION	UNITS	COUNT CONDITIONS
1	Engine Operating Hours	Hours	Number of hours engine has operated above 450 rpm
2	Wheel #1 Operating Hours	Hours	Number of hours wheel was powered in either propulsion or retard mode and: . . . Speed is above 50 rpm . . . Current is above 50 amps (absolute value)
3	Wheel #2 Operating Hours	Hours	Number of hours wheel was powered in either propulsion or retard mode and: . . . Speed is above 50 rpm . . . Current is above 50 amps (absolute value)
4	Alternator Operating Hours	Hours	Number of hours alternator has been rotating at or above 450 rpm
5	Propulsion Mode Hours	Hours	Number of hours in propulsion mode when propulsion mode is active and: . . . Wheel #1 or wheel #2 speed is above 50 rpm and . . . Motor #1 or motor #2 current is above 50 amps (absolute value)
6	Retard Mode Hours	Hours	Number of hours in retarding mode when propulsion mode is active and: . . . Wheel #1 or wheel #2 speed is above 50 rpm and . . . Motor #1 or motor #2 current is above 50 amps (absolute value)
7	Coast Mode Hours	Hours	Number of hours in coast mode when propulsion mode is active and: . . . Wheel #1 or wheel #2 speed is above 50 rpm and . . . Motor #1 or motor #2 current is above 50 amps (absolute value)
8	Idle Hours	Hours	Number of hours engine is idling, truck is stationary and: . . . Engine speed is above 450 rpm . . . Wheel #1 and wheel #2 speeds are both less than 50 rpm
9	Fault Down Time Hours	Hours	Number of hours truck has propulsion system faults and the accelerator pedal is depressed. . . . Clock will start anytime a fault is recorded that restricts propulsion and . . . the propulsion mode is requested. . . . Clock will stop when propulsion mode is no longer requested or . . . when all restrictive faults are reset
10	Truck Operating Hours	Hours	Sum of propulsion mode, retard mode, coast mode, and idle hours
11	Propulsion Mode Net KW Hours	Hours	Net KW hours generated by the alternator in propulsion mode
12	Retard Mode KW Hours	Hours	KW hours generated by the alternator in retard mode
13	Truck Distance Travelled	Miles	Value is calculated by integrating the higher of the two wheel speed signals and displaying the cumulative value in miles . . . Active when control power (CPR) is on . . . Not sensitive to vehicle direction
14	Truck Distance Travelled	Kilometers	Value is calculated by integrating the higher of the two wheel speed signals and displaying the cumulative value in kilometers . . . Active when control power (CPR) is on . . . Not sensitive to vehicle direction
19	Spin Mode	Occurrences	Number of times the spin/stall mode has been entered
20	Speed Override	Occurrences	Number of times speed override mode condition has changed from false to true
21	Body Up Switch	Occurrences	Number of times dump body switch input has changed from false to true
22	RS Switch	Occurrences	Number of times retard switch input has changed from false to true
23	AS Switch	Occurrences	Number of times accel switch input has changed from false to true
24	Override Switch	Occurrences	Number of times override switch input has changed from false to true
25	Forward Switch	Occurrences	Number of times selector switch was moved to FORWARD position
26	Reverse Switch	Occurrences	Number of times selector switch was moved to REVERSE position
27	Neutral Switch	Occurrences	Number of times selector switch was moved to NEUTRAL position
28	Retard Mode	Occurrences	Number of times retard contactor sequence has been completed or retard mode entered

Temporary Truck Settings

When troubleshooting a truck, it is sometimes necessary to make temporary changes to the system. The temporary truck settings menu allows changes to be made to speed settings, retard current, or event data collection intervals. Since any changes made on these screens are temporary, changes made using the options on this menu will be lost when control power is turned off. If the changes made using this menu will be made permanent, the truck configuration file must be changed accordingly and the CPU reprogrammed.

⚠WARNING

Selecting Special Operation in the following procedures may present a safety hazard if the engine is on. Control of the propulsion system may transfer to the PTU operator from the truck driver with this software operation. Refer to Step 1. below:

1. With the GE STATEX III PTU Main Menu displayed, select “SPECIAL OPERATION” and press [ENTER]. The screen shown in Figure 2-26 will be displayed to alert the operator about the state of the truck software.This warning notifies the operator when control of the truck is being transferred from the truck driver to the PTU, based on the PTU selection of Special Operation. When finished and the PTU is returned to the GE STATEX III PTU Main Menu**,** control of the propulsion system is returned to the truck driver. Before activating this command, the screen, shown in Figure 2-27, will be displayed. The PTU user must keep the truck driver appraised of this control.
2. Select “YES” on the caution screen (Figure 2-26) and press [ENTER]. The Special Operation Menu will be displayed.
3. Use the arrow keys to move the cursor to the Temporary Truck Settings Menu selection and press [ENTER].

Selections available on this menu are:

- Speed Settings

  New speed setting values may be typed over the existing values to override the current configuration file settings.

  1. Move the cursor to the speed to be changed and type the first digit of the speed desired.
  2. A screen will appear with the instruction “ENTER FLOATING POINT NUMBER”. Type the remaining digits and press [ENTER].

NOTE: It is not necessary to enter values for every line. For example, if only Loaded Speed Limit is to be changed, select that line with the cursor, and type in the desired value. The remaining speeds will be determined by the values in the truck configuration file.

  3. When the new values have been entered, move the cursor to “ACTIVATE TEMPORARY SPEED SETTINGS and TRKSPD SCALE” and press [ENTER].
  4. The Temporary Speed Set screen will change to reflect the new values entered.
  5. Select Exit to return to the previous menu.

- Retard Current Adjust

  This screen allows entering a value to adjust retard current. Enter the amount to be added or subtracted from the nominal retard current limit value to make the computer control the proper current limit as measured at the shunt.

  1. For example, if the shunt reads 1300 amps, and the retard current limit is 1320 amps, enter 20 to add 20 amps to what the computer receives as feedback. This will cause the control to current limit at 1300 + 20 amps instead of the 1300 amps.
  2. In another example, if the shunt reads 1340 amps, enter -20 to subtract 20 amps from what the computer receives as feedback. This will cause the control to current limit at 1340 - 20 amps instead of 1340 amps.
  3. Select “ACTIVATE TEMPORARY RETARD CURRENT ADJUST” and press [ENTER]. Exit to the PTU Main Menu.

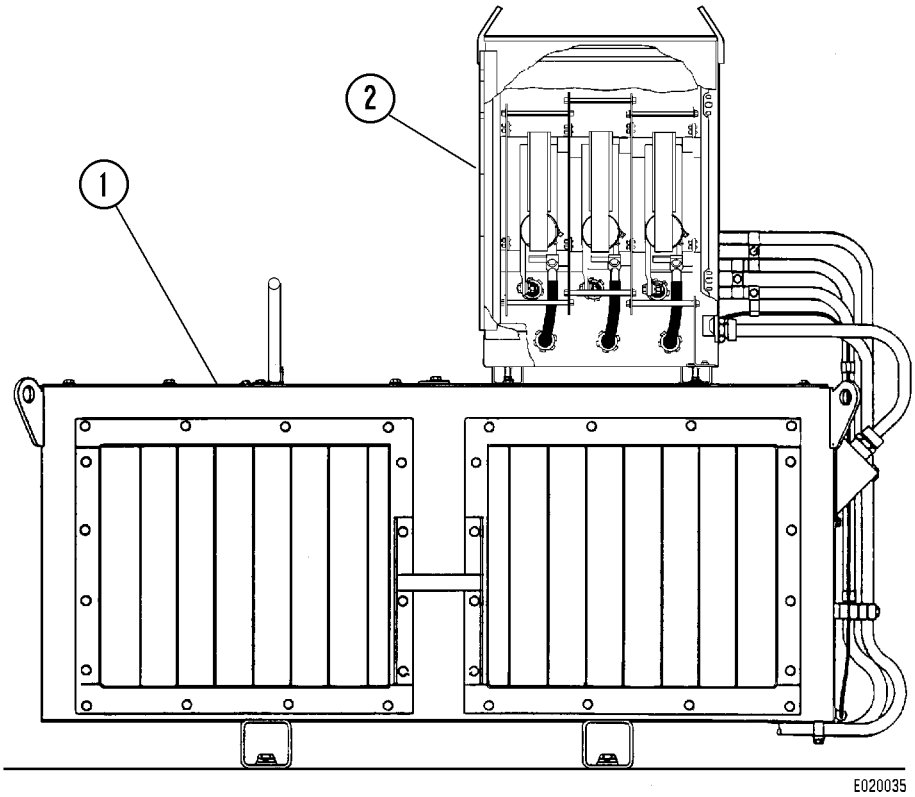


FIGURE 2-37. RETARDING GRIDS AND CONTACTORS (RH DECK)

1. Retarding Grids and Blower(s)
2. Retarding Contactor Box

7. The Special Operation menu will appear.
8. Use the arrow keys to move the cursor to the "EVENT DATA MENU" selection and press [ENTER]. The Event Data Menu screen will be displayed.
   a. If no event data has been stored, the screen will indicate 0 (zero) events stored. If no events have been stored, the cursor will be positioned on "EXIT". Press the [ENTER] key to return to the previous menu.

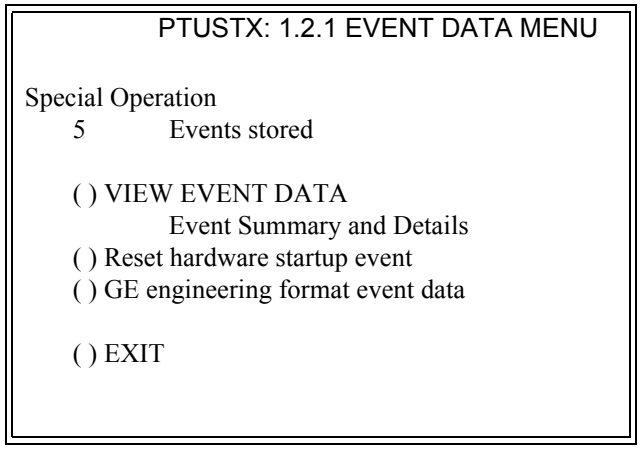


FIGURE 3-2. EVENT DATA MENU
(Requires Control System Reset)

9. If one or more events have been stored, a screen, as shown in either Figure 3-2 or 3-3, will be displayed.
10. If Figure 3-2 is displayed, select "reset hardware startup event" with the cursor and press [ENTER].
    a. A screen will appear with instructions for cycling control power to reset the system. Follow the on-screen instructions to cycle power to the control system.
    b. After the system is powered up, repeat Steps 4 through 8 to return to the event data.
11. If Figure 3-3 is displayed, you may select "VIEW EVENT DATA" and press [ENTER] to view events currently stored. A screen displaying a list of stored events appears.
12. Any stored events may be uploaded to a file for storage by selecting "GE engineering format event data" and following directions on the subsequent screens.
13. To erase the event data currently stored, select "erase event data yes/no menu" from the EVENT DATA MENU screen.
    a. On the screen titled RESET ALL YES/NO MENU, move the cursor to YES, Erase Truck Events, and press [ENTER].
    b. Exit back to the GE STATEX III MENU following screen instructions as they appear.

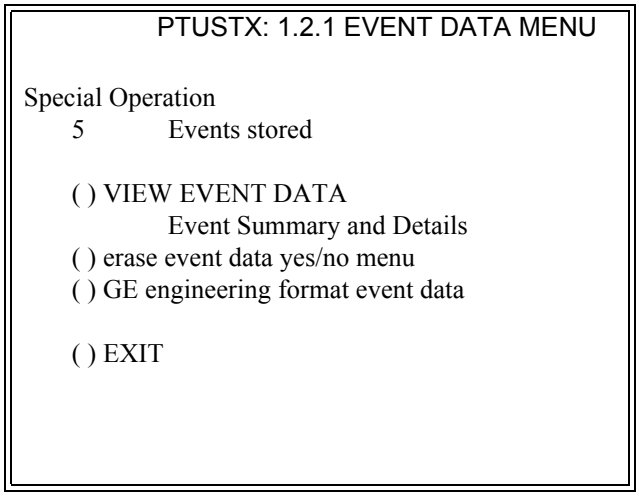


FIGURE 3-3. EVENT DATA MENU

4.0 SEQUENCE TESTS - (ENGINE NOT ON)

Preparation and Setup

It is assumed the truck has been programmed using the correct truck configuration file and GE Statex III enhanced version 1.00 (if truck is equipped with a 17FB144 CPU card), or version 14.00 (if truck is equipped with a 17FB101 CPU card) or later software prior to proceeding with the following tests. If not, refer to Electrical Propulsion Components for instructions for preparing the truck configuration file, programming the truck, and usage of the GE software menu system.

- Disconnect 74C at GFR for static testings (engine not on). Failure to do so may result in damage to battery boost SCR and/or dead batteries.
- If the truck body has not been installed or the body is raised, place a steel washer on body up switch or jumper circuit 71F to circuit 71, to simulate body down condition.
- If hydraulic pressure is low, connect a jumper wire between circuit 73S and 710. This step will be necessary if all hydraulic brakes are installed and engine is not on.

DI NAME	DESCRIPTION	PROCEDURE TO ACTIVATE	FUNCTION
SRVBRKPSW	SERVICE BRAKE PRESSURE SWITCH	In control cabinet, jumper 28 Volts from 712 to 44R to simulate service brake applied.	= true (inverse display) = brake applied = 28v input
		Remove jumper.	false (regular display) = brake released = 0v input
FORIN	SELECTOR SWITCH FORWARD SIGNAL	Move selector switch to FORWARD position.	= true (inverse display) = FORWARD selected
REVIN	SELECTOR SWITCH REVERSE SIGNAL	Move selector switch to REVERSE position.	= true (inverse display) = REVERSE selected
DSTORE	DATA STORE SWITCH	Press data store switch.	= true (inverse display) = switch closed = 28v input
		Release switch.	false (regular display) = switch open = 0v input
BLOWP	BLOWER PRESSURE SWITCH	Remove 75A1 wire.	= true (inverse display) = ok pressure = 0v input
		Re-attach wire 75A1.	false (regular display) = no pressure = 28v input
PARKBRKSW	PARK BRAKE	Turn park brake switch to ON.	= true (inverse display) = apply brake request = 0v input
		Turn park brake switch to OFF.	false (regular display) = release brake request = 28v input
KEYSW	KEY SWITCH	Key switch on.	= true (inverse display)
		Key switch off.	false (regular display)
CPSFB	CONTROL POWERSWITCH	Control power switch on.	= true (inverse display)
		Control power switch off.	false (regular display)
ENGSERV	ENGINE SERVICE SIGNAL	Jumper 419 to GND at the junction box.	= true (inverse display) = with jumper = 0v input Verify engine check light in cab turns on.
		Remove jumper.	false (regular display) = w/o jumper = 28v input

5.3 DIGITAL OUTPUT CHECKS

- For each of the digital outputs listed in the following tables, perform the procedure as specified in Steps 1 and 2, and verify the results on the MANUAL DIGITAL OUTPUT TEST SCREEN as noted in the following table. Restore any switch settings and wiring changes to their original condition before moving on to check the next digital output.

1. Set digital output driver on.

   a. Move cursor with the arrow keys to the output name (DO NAME) of the desired output.

   b. Press [ENTER] key to change status of selected output from off to on.

   c. The display status of the output name DO NAME on the MANUAL DIGITAL OUTPUT TEST SCREEN changes from off (regular display) to = on (inverse display) in a flashing mode.

   d. Output device will be energized, or take voltage reading to verify that output driver is turned on, as noted in the OUTPUT DEVICE CHECKOUT column.

   e. Status of related feedback input name DI NAME (if used) on the MANUAL DIGITAL OUTPUT TEST SCREEN changes from false (regular display) to = true (inverse display).

4. MOTOR 2 SPEED
Motor 2: 0.0 rpm; 0.0 mph

a. Connect oscillator to circuits 714 and 714A at control cabinet terminal board. Repeat same test procedure for motor 2 as used for motor 1.

5. CONVERSION FACTOR - RPM TO MPH
rpm x 0.00000 = mph

- Value displayed 0.00000 is conversion factor to convert from wheel motor rpm to mph. Compare value displayed with value given in Maximum Truck Speed chart. Refer to Miscellaneous Charts; Maximum Allowable Truck Speeds.

Return to Main Menu

1. This completes Analog and Frequency Input Checks.
2. Move cursor to select “EXIT” on the menu and press [ENTER] key.
3. Select “EXIT” as necessary until returned to GE STATEX III PTU MAIN MENU.
4. Move cursor to select “EXIT” on this menu and press [ENTER] key.
5. At “QUIT PTU?” menu screen prompt, press [Y] key (or any key except [N]) to exit back to the GE OHV STATEX III MENU.
6. Turn control power switch off.
7. Turn key switch off.

7.0 SPEED EVENT CHECKS

Preparation and Setup

- Disconnect 74C at GFR for static testings. Failure to do so may result in damage to battery boost SCR and/or dead batteries.
- If the truck is equipped with the two speed overspeed, remove and insulate circuit wire 73LS going to the control cabinet junction box. There will be one circuit wire 73LS from the terminal block to the FL275 card panel.

⚠WARNING

If the 73LS circuit wire going to the control cabinet junction box hasn't been removed and insulated, damage may result to the rear suspension pressure switches.

- Wheel motor speed sensors:a. Disconnect external 714 wire and external 77 wire at control cabinet terminal board.b. Jumper from 77 to 714 and jumper from 77A to 714A. c. Connect an oscillator to 714 and 714A.
- All checks are to be made with control power on and the selector switch in FORWARD.
- Obtain speed event setting information and extended range retarding pickup speeds from the truck configuration file and use the retard state logic screen as instructed below:

Setup PTU

1. With the GE OHV STATEX III MENU on the screen, select TRUCK SETUP (CFG).
2. At the TRUCK SETUP CONFIGURATION MINE MENU screen, select the proper truck configuration file.
3. From the TRUCK SETUP CONFIGURATION MINE MENU screen, select “6) Change/View Overspeeds.”
4. Record the values shown on the OVERPEEDS ENTRY SCREEN.
5. Exit back to the TRUCK SETUP CONFIGURATION MINE MENU and select “1) View truck configuration screen; data curves screen”.
6. Record the values for “EXT RANGE PICK_UPS” listed on the second screen that appears.
7. Exit back to the GE OHV STATEX III MENU and select “PTU TALK TO TRUCK”.
8. After logging on, select “NORMAL OPERATION” from the GE STATEX III PTU MAIN MENU.
9. From the NORMAL OPERATION menu, select “RETARD STATE LOGIC”. Information will be read from this screen for the following procedures.

12.2 MAXIMUM ALLOWABLE TRUCK SPEEDS

MAX TRUCK MPH = (MAX. WHEEL RPM x ROLLING RADIUS) ÷ (GEAR RATIO x 168)

RPM/MPH CONVERSION FACTOR = MAX. WHEEL RPM ÷ MAX. TRUCK SPEED

MPH/RPM CONVERSION FACTOR = MAX. TRUCK SPEED ÷ MAX. WHEEL RPM

MAXIMUM TRUCK SPEED CHART FOR GIVEN WHEEL MOTOR

WHEEL MOTOR	GEAR RATIO XX.X:1	TIRE SIZE	ROLLING RADIUS	MAX. WHEEL RPM	MAX. TRUCK MPH	CONV. FACTOR RPM/MPH	CONV. FACTOR MPH/RPM
772	28.8	30 x 51	55.1	2750	31.32	87.81	0.01139
776	28.8	30 x 51	55.1	2750	31.32	87.81	0.01139
776	23.0	36 x 51	61.1	2750	43.48	63.24	0.01581
776	28.8	36 x 51	61.1	2750	34.73	79.19	0.01263
791	23.0	33 x 51	57.0	2750	40.57	67.79	0.01475
791	28.8	33 x 51	57.0	2750	32.40	84.88	0.01178
788	26.1	36 x 51	61.1	2320	32.33	71.76	0.01394
788	26.1	37 x 57	65.4	2320	34.60	67.05	0.01491
788	21.7	37 x 57	65.4	2320	41.62	55.74	0.01794
788	21.7	36 x 51	61.1	2320	38.88	59.67	0.01676
788	26.825	36 x 51	61.1	2320	31.48	73.69	0.01357
788	26.825	37 x 57	65.4	2320	33.67	68.92	0.01451
788	22.354	36 x 51	61.1	2320	37.75	61.45	0.01627
788	22.354	37 x 57	65.4	2320	40.40	57.42	0.01741
787	28.125	40 x 57	68.4	2320	33.58	69.06	0.01448
787	36.4	40 x 57	68.4	2320	25.95	89.40	0.01119
787	32.4	40 x 57	68.4	2320	29.15	79.58	0.01256
787	31.9	40 x 57	68.4	2320	29.61	78.35	0.01276
787	26.6	40 x 57	68.4	2320	35.51	65.33	0.01531

REAR TIRES AND RIMS

If the studs in the rear wheel motor require replacement, use a special tool and tighten the studs to **732 N·m (540 ft lbs)**.

Removal

1. Park the truck on a hard, level surface and chock the front wheels. Position a jack in the recess of the rear suspension mount casting, as shown in Figure 2-3.
2. Raise the rear axle housing of the truck until the tires clear the ground. Securely block up the rear axle housing near the wheel motor mounting flange.
3. Disconnect the inner wheel valve stem extension from the outer wheel valve stem vinyl clamp by loosening the cap screws. Lift the valve extension out of the vinyl clamp.

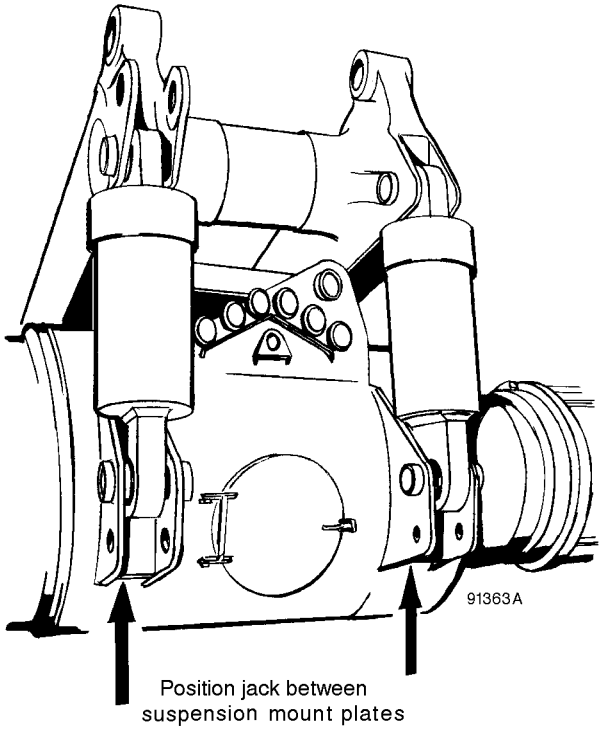


FIGURE 2-3. TIRE LIFTING SLING (BODY REMOVED)

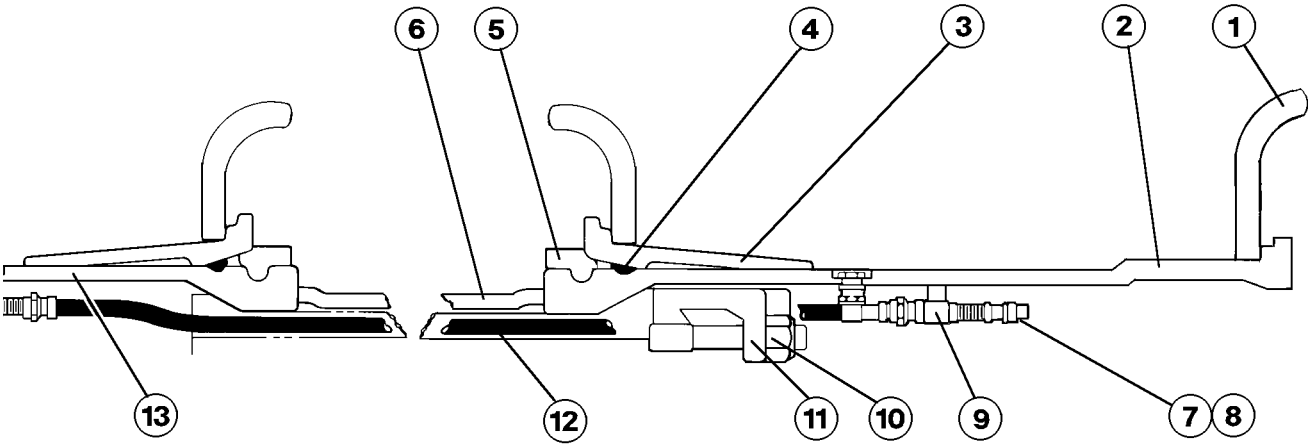


FIGURE 2-4. REAR WHEEL ASSEMBLY

1. Side Flange
2. Outer Wheel Rim
3. Bead Seat Band
4. O-Ring
5. Lock Ring
6. Spacer
7. Valve Cap
8. Core
9. Clamp
10. Nut
11. Wheel Retainer Wedge
12. Valve Extension Tube
13. Inner Wheel Rim

7. Position a fork lift and support block under the wheel hub and spindle assembly, as shown in Figure 3-4. The weight of the wheel hub and spindle is 2700 kg (5950 lbs).
8. Place a jack under retainer plate (2) and remove cap screws and flat washers (1, Figure 3-2). Loosen the cap screws alternately in torque increments of **678 N·m (500 ft lbs)**. Remove the retainer plate, which weighs 31 kg (68 lbs).
9. Install the spindle puller tool, Section M, Special Tool Module, in place of retainer plate (2, Figure 3-2). Secure it in place with the cap screws.
10. Tighten the puller tool cap screws until the suspension rod is released from the spindle bore. Remove the puller tool. Lower the wheel hub and spindle assembly away from the suspension piston rod, as shown in Figure 3-4.

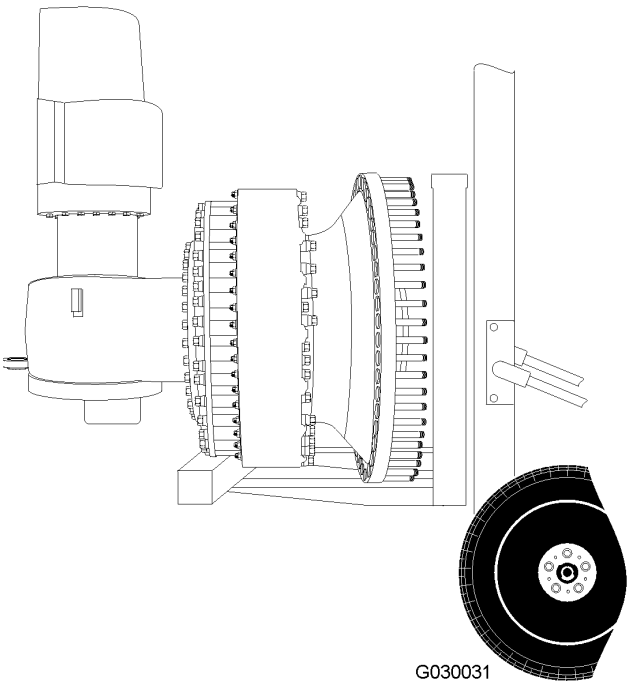


FIGURE 3-4. SPINDLE AND WHEEL HUB REMOVAL

⚠CAUTION

Use care during removal to prevent damage to the suspension piston rod taper and tapered spindle bore.

NOTE: If heat is used to aid in the removal of the spindle from the suspension rod, allow the spindle and rod to cool without the use of water, compressed air, or other means.

11. Move the spindle and hub assembly to clean the work area for repair.

Installation

1. Clean the spindle bore and suspension rod taper to remove rust, dirt, etc.
2. Lubricate the spindle bore and suspension rod taper with multi-purpose grease Number 2 with 5% Molybdenum Disulphide.

NOTE: DO NOT use any lubricants on the spindle bore containing copper, such as anti-seize compounds. Products containing copper will contribute to corrosion in this area.

3. Position the spindle and wheel hub assembly on a fork lift and support block or similar lifting device, as shown in Figure 3-4.

Installation

1. Align steering cylinder (1) or tie rod (10) bearing bore with the pin bores in the spindle or frame. Insert bearing spacers (5) and washer (13), if used.
2. Install pins (12), cap screws (3), and retainers (4) and secure with locknut (6). Tighten to **465 ± 46 N·m (343 ± 34 ft lbs)**.
3. Connect the hydraulic and lubrication lines to their respective ports. Operate the steering and check for leaks and proper operation
4. Check hydraulic tank oil level. Refer to Section P, Lubrication and Service.

NOTE: The tie rod is to be installed with the clamping bolts toward the rear of the truck.

Bearing Replacement

1. Remove cap screws (2, Figure 3-13) and lock washers (3). Remove bearing retainer (4).
2. Press bearing (1) out of the bore in the steering cylinder or rod end.
3. Press the new bearing into the bore.
4. Install the bearing retainers with the cap screws and lock washers. Tighten the cap screws to standard torque.

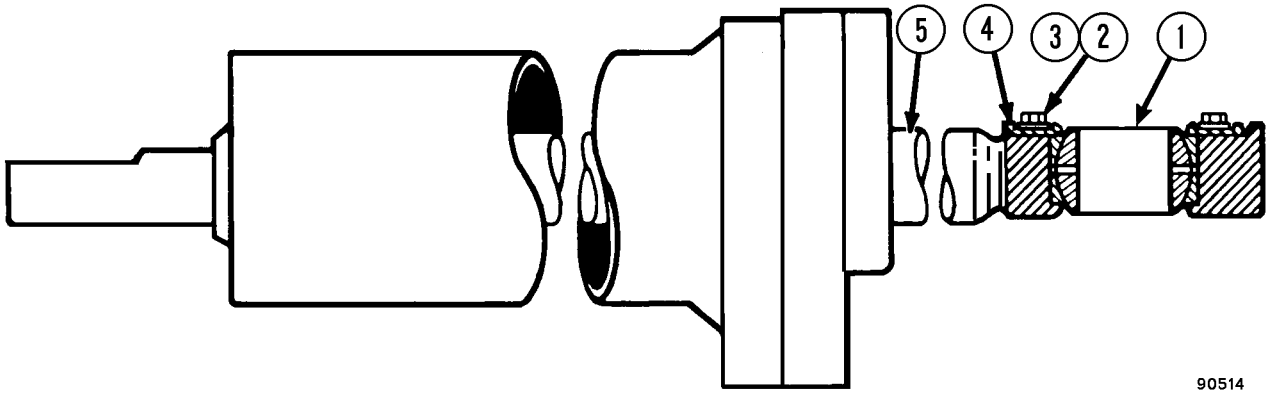


FIGURE 3-13. TYPICAL BEARING INSTALLATION

1. Bearing
2. Cap Screw
3. Lock Washer
4. Bearing Retainer
5. Rod End

SECTION G5
REAR AXLE HOUSING
INDEX

FRONT SUSPENSION

The front suspensions are hydro-pneumatic components containing oil and nitrogen gas. The oil and gas in the four suspensions carry the gross truck weight less wheels, spindles, and final drive assembly. The front suspension cylinders consist of two basic components; a suspension housing attached to the truck frame, and a suspension rod attached to the front spindle. The front suspension rods also act as kingpins for steering the truck.

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

Removal

1. Park unloaded truck on a hard level surface. Block the wheels and set the parking brake. Remove the front wheel and tire as per removal instructions in section G, Front Tire and Rim. Remove the front wheel hub and spindle as covered in section G.
2. Remove boot clamp and boot from around the suspension.
3. Discharge nitrogen pressure from the suspension by removing charging valve guard (1, Figure 2-2) and charging valve cover (2). Turn charging valve swivel nut (small hex) (3) counterclockwise three full turns to unseat the valve seal. DO NOT turn more than three turns. DO NOT turn the large hex. Wearing a face mask or goggles, depress the valve stem until all nitrogen pressure has been relieved.

⚠DANGER

Ensure only the swivel nut turns. Turning the complete charging valve assembly may result in the valve assembly being forced out of the suspension by the gas pressure inside.

4. After all nitrogen pressure has been relieved, remove charging valve assembly (Figure 2-3) and discard O-ring (9).
5. Place a suitable container under the suspension cylinder. Remove bottom O-ring plug (23, Figure 2-8) and allow the cylinder to drain completely.

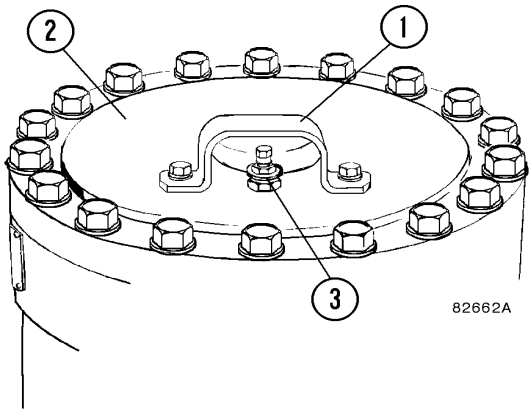


FIGURE 2-1. SUSPENSION CHARGING VALVE

1. Charging Valve Guard
2. Suspension
3. Charging Valve

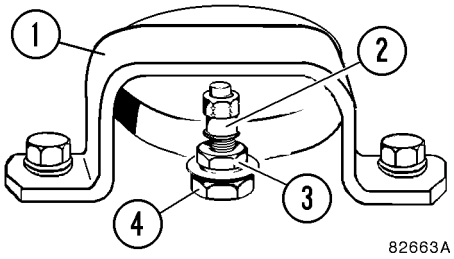


FIGURE 2-2. CHARGING VALVE INSTALLATION

1. Charging Valve Guard
2. Charging Valve Cover
3. Swivel Nut (small hex)
4. Charging Valve Body (large hex)

SECTION H3
REAR SUSPENSIONS
INDEX

SECTION H4
OILING AND CHARGING PROCEDURES
INDEX

OIL AND NITROGEN SPECIFICATIONS CHART

HYDRAIR® II OIL SPECIFICATIONS			
Ambient Temperature Range	**Part No.**	**Approved Sources**	
-34.5°C- and above (30°F and above)	VJ3911 (need to add 6% of AK3761)	Mobil 424 Mobil D.T.E. 15 Texaco TDH Oil Amoco Ultimate Motor Oil 5W-30	Sunfleet TH Universal Tractor Fluid Chevron Tractor Hydraulic Fluid- Conoco Power Tran III Fluid Petro Canada Duratran Fluid Shell Canada Donax TDL
	AK4063	Suspension Oil (premixed with 6% friction modifier)	5 Gallon container
	AK4064		55 Gallon container
-48.5°C and above (-55°F and above)	VJ5925 (need to add 6% of AK3761)	Emery 2811, SG-CD, 5W-30 Mobil Delvac I, 5W-30	Petro Canada Super Arctic Motor Oil, 0W-30 Conoco High Performance Synthetic Motor Oil, 5W-30
	AK4065	Suspension Oil (premixed with 6% friction modifier)	5 Gallon container
	AK4066		55 Gallon container
NOTE: VJ3911 and VJ5925 oils are not compatible and must not be mixed in a suspension.VJ3911 and VJ5925 oils are supplied in 19 Liter (5 gallon) cans.			

FRICTION MODIFIER	FRICTION MODIFIER Mixing Instructions (94% Suspension Oil, 6% Friction Modifier)	
Part No.	**Suspension Oil**	**Amount of Friction Modifier to Add**
AK3761 (5 Gallon container of 100% friction modifier)	1 gallon of suspension oil	add 7.7 oz.
	5 gallons of suspension oil	add 38.4 oz.
	55 gallons of suspension oil	add 3.3 gal.

NITROGEN GAS (N_2)SPECIFICATIONS		
	Property	**Value**
Nitrogen gas used in Hydrair® II suspension cylinders must meet or exceed CGA specification G-10.1 for Type 1, Grade F nitrogen gas	Nitrogen	99.9% minimum
	Water	32 PPM maximum
	Dew Point	-55°C (-68°F) maximum
	Oxygen	0.1% maximum

FIGURE 4-6. SPECIFICATIONS CHART

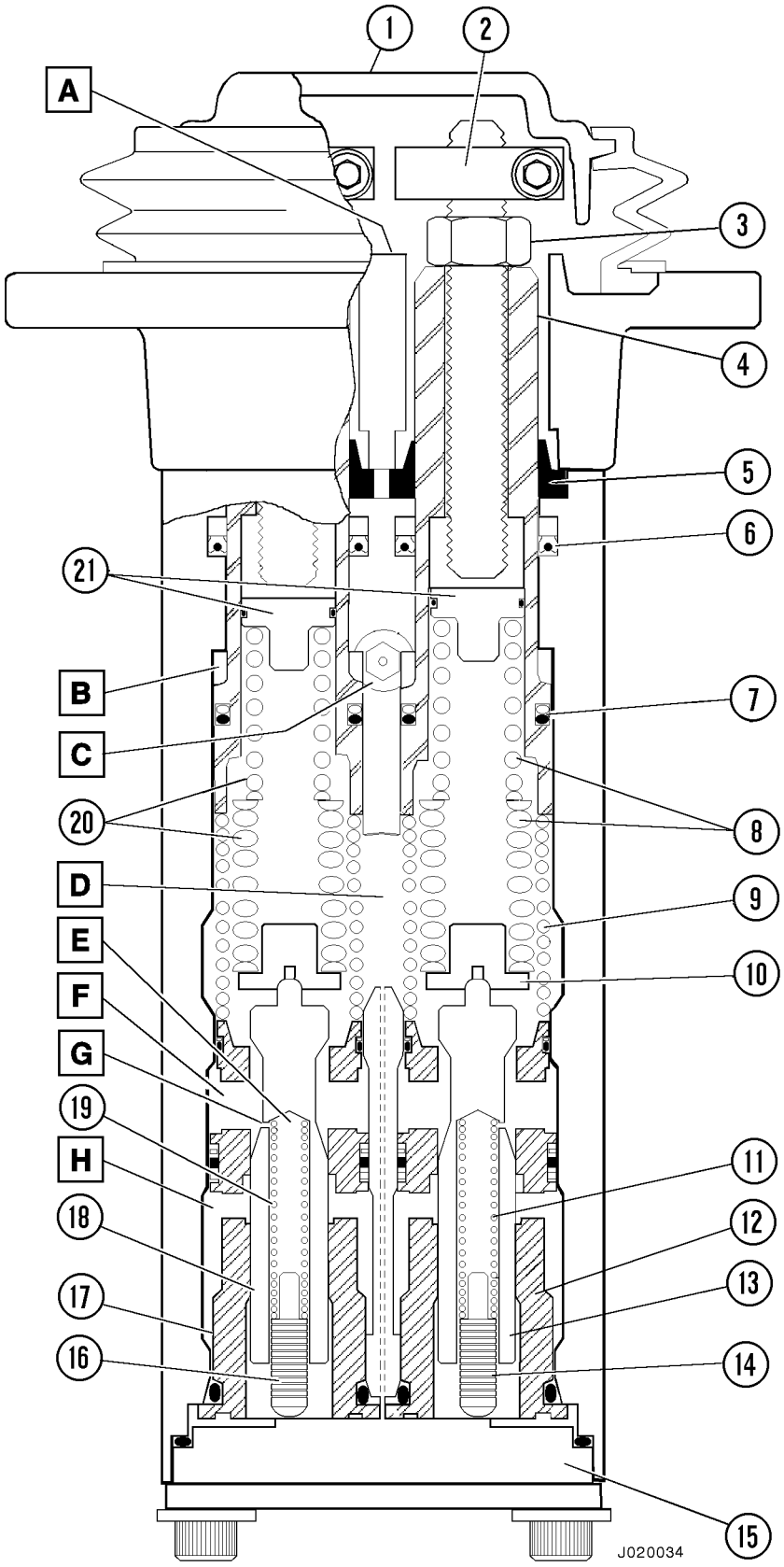


FIGURE 2-2. BRAKE VALVE
(Full Cut-Away)

1. Actuator Cap
2. Adjustment Collar
3. Nut
4. Actuator Plunger
5. Wiper Seal
6. Poly-Pak Seal Assembly
7. Glyde Ring Assembly
8. Regulator Spring (B1)
9. Plunger Return Spring
10. Spring Seat
11. Spool Return Spring (B1)
12. Regulator Sleeve (B1)
13. Regulator Spool (B1)
14. Reaction Plunger (B1)
15. Base Plate
16. Reaction Plunger (B2)
17. Regulator Sleeve (B2)
18. Regulator Spool (B2)
19. Spool Return Spring (B2)
20. Regulator Springs (B2)
21. Staging Seat

A. Adjustment Collar Maximum Pressure Contact Area
B. Automatic Apply Piston Area
C. PX Port
D. Tank Port
E. Reactionary Pressure Area
F. Brake Apply Port
G. Orifice
H. Supply Port

NOTE: B1 = Rear Brakes
B2 = Front Brakes

ASSEMBLY

Actuator Base Threaded Inserts

1. If any inserts (7, Figure 3-3) were removed from the actuator base (6), position the actuator base upside down on the work bench and support directly under each of the four floor mounting holes.
2. Install the threaded inserts into the actuator base by tapping lightly with a small hammer until the insert flanges become flush with the actuator base. Be sure the base is supported to avoid breaking the base.
3. Thoroughly clean the actuator base and set aside.

Boot and Cap

1. Examine the boot (2, Figure 3-3) for any cracks, tears, or other damage. If damage is evident, the boot must be replaced To replace the boot, follow the procedure below.
2. Remove the boot from the actuator cap (1) and discard the old boot. Thoroughly clean the sides of the cap by scraping the lip where the cap contacts the boot. Use a knife or suitable scraper. Clean thoroughly to remove all residual adhesive or particles of the old boot.
3. Apply a thin bead of Loctite Prism 410 onto the upper sides of the cap. Apply the bead to the two long sides only. Do not apply it to the rounded ends, these must not be sealed to allow the boot to "breathe".
4. Carefully position the cap into the new boot groove wiping off the excess glue.
5. Position the boot such that it conforms to the contour of the cap, then set aside. Adhesive requires about 30 minutes to cure.

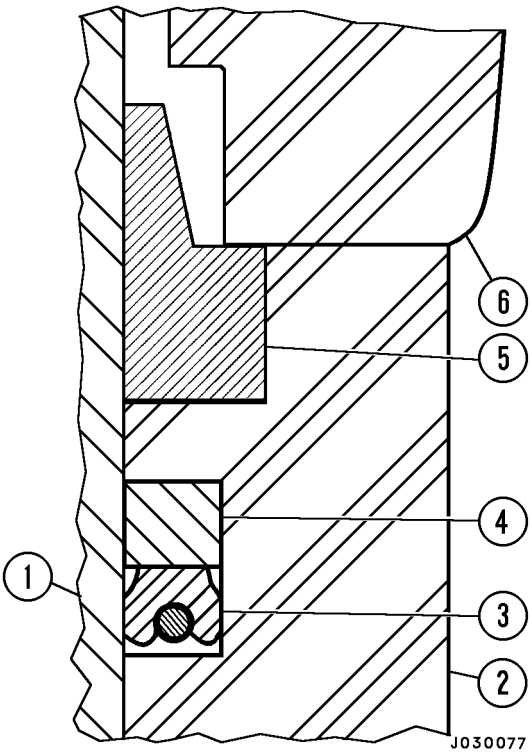


FIGURE 3-5. VALVE BODY SEAL INSTALLATION

1. Actuator Plunger
2. Valve Body
3. Poly-Pak Seal
4. Back-Up Ring
5. Wiper Seal
6. Actuator Base

HYDRAULIC BRAKE ACCUMULATORS

There are two hydraulic brake accumulators located on the brake manifold in the brake control cabinet behind the operator's cab. The larger accumulator [2.5 gal. (9.51 l) capacity] supplies the pressure necessary for actuation of the front service brakes. The small accumulator [1 gal. (3.79 l) capacity] supplies pressure to activate the rear service brakes.

⚠DANGER

Accumulators maintain high pressure. DO NOT disconnect any hydraulic line from the accumulators or brake system until all hydraulic pressure has been manually drained from accumulators. Open manual drain valves located on the brake manifold in the brake cabinet to drain pressurized oil. The manual bleeddown valve for the rear accumulator is identified as "NV1". The manual bleeddown valve for the front accumulator is identified as "NV2".

Brake Accumulator Bleed Down Procedure

The brake accumulators can be bled down by rotating the manual bleeddown valves (NV1 and NV2) counterclockwise. The valves are located on the brake manifold in the hydraulic brake cabinet.

1. Turn handles counterclockwise to open valves.
2. Confirm accumulators are bled down by applying the "Brake Lock" switch (key switch ON, engine shut down) and applying service brake pedal. The service brake light should not come on.
3. Close the bleeddown valves by rotating clockwise.

Removal

1. Shut down engine and exhaust all hydraulic pressure from the system by opening accumulator manual drain valves.
2. Remove the valve guard and "Dyna-seal" from top of accumulators.
3. Depress valve core to release gas precharge pressure from accumulator bladder.
4. Remove accumulator mounting bracket. Loosen and remove accumulator from the brake manifold. Plug opening on brake manifold to prevent contamination.
5. Transfer accumulator to work area.

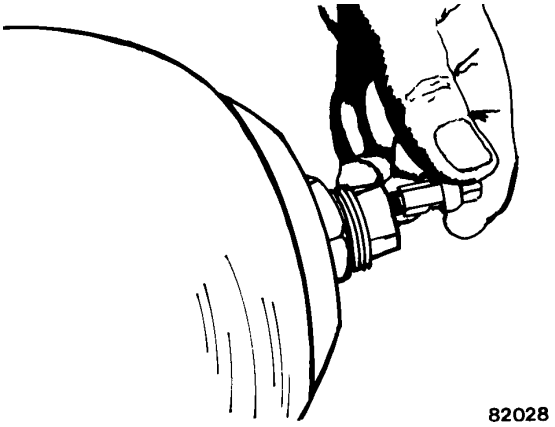


FIGURE 3-11. VALVE CORE REMOVAL

Installation

1. After service repairs or bench test has been completed, move the accumulators to the brake control cabinet. DO NOT precharge accumulators on the bench test.
2. Position the accumulators on the brake manifold. Tighten fittings securely. Install mounting brackets. Secure mounting brackets in place with capscrews and lockwashers. Tighten capscrews to standard torque.
3. Refer to "Charging Procedure" in this section.
4. Replace "Dyna-seal" and valve guard on top of accumulators.

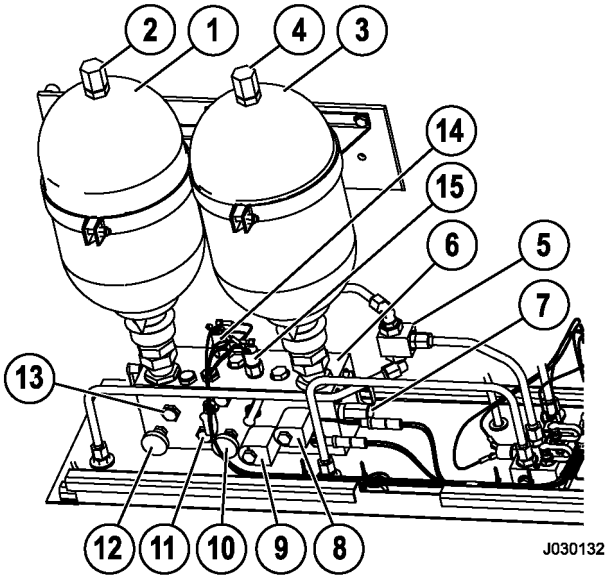


FIGURE 3-24. ACCUMULATORS AND BRAKE MANIFOLD

1. Rear Brake Accumulator
2. Charging Valve
3. Front Brake Accumulator
4. Charging Valve
5. Brake Lock Shuttle Valve
6. Brake Manifold
7. Pressure Reducing Valve (PR)
8. Brake Lock Solenoid
9. Parking Brake Solenoid
10. Accumulator Bleed-Down Valve (Front)
11. Automatic Apply Valve
12. Accumulator Bleed-Down Valve (Rear)
13. Low Accumulator Pressure Test Port (LAP1)
14. Low Brake Pressure Switch
15. Parking Brake Pressure Switch

9. If the manifold has to be removed from the truck, remove accumulators and disconnect hydraulic lines and wires necessary to allow removal of the manifold.
10. Plug lines and ports to prevent possible contamination.
11. Remove mounting hardware and move brake manifold to a clean work area for disassembly.

Installation

1. Install brake manifold in truck and tighten mounting hardware to standard torque.
2. Connect all lines and electrical connections to proper locations.
3. Install brake accumulators.
4. Charge brake accumulators with nitrogen. Refer to “Charging Procedure” in the brake accumulator service area for complete charging instructions.
5. Start truck and check for leaks and proper operation.
6. Shut down engine and check for proper oil level in hydraulic tank.

Disassembly

1. Mark all plugs, valves and cartridges before removal to insure proper assembly.
2. Remove plugs, valves and cartridges.

NOTE: Check Valve (7, Figure 3-25) and Reducing Valve (6) both have an orifice disc located below them. Do not mix these up, as the orifices are different sizes.

Cleaning and Inspection.

1. After disassembly, clean all parts with an approved cleaning solution.
2. Blow all parts dry with air and keep free from foreign matter.
3. Replace all O-rings and any other items deemed unsuitable for further usage.

16. Connect the lead wire on the brake lock solenoid, and remove the jumper from the lead wires to the timer.
17. Cycle the brake lock several times to ensure crisp application of and release of pressure and proper function of the status light. Record the rear brake pressure, which will be 10342 ± 689 kPa (1500 ± 100 psi).

*Record on the data sheet.

Low Brake Pressure and Auto Apply

18. Allow the engine to operate until the low brake accumulator pressure stabilizes at or above 18616 kPa (2700 psi).
19. Shut the engine off. Allow the steering accumulator to bleed-down completely. Disable the steering pressure switch from the brake warning circuit by unplugging the diode between circuits 33 and 33F. This is diode 22 on diode board 1. Turn the key switch on. After two minutes, record the low accumulator pressure (LAP1 port). If the LAP1 pressure is below 14479 kPa (2100 psi), then leakage in the system is excessive, and the source of the leakage needs to be identified.

*Record on the data sheet.

20. Crack the front brake accumulator bleed-down valve and observe the LAP1 pressure. The low brake pressure lamp and buzzer will actuate at 12755 ± 517 kPa (1850 ± 75 psi). Record this value. Brake pressures will begin to rise (auto apply) when the LAP1 reaches 11376 ± 689 kPa (1650 ± 100 psi). Record this value. Close the front brake accumulator bleed-down valve.

*Record on the data sheet.

21. Record auto apply brake pressures.

*Record on the data sheet.

22. Start the engine to recharge the hydraulic system. Allow the engine to operate until the low brake accumulator pressure stabilizes at or above 18616 ± kPa (2700 psi).
23. Shut the engine off. Allow the steering accumulator to bleed-down completely. Turn the key switch on. Crack the rear brake accumulator bleed-down valve and observe the LAP1 pressure. Verify that the low brake pressure lamp and buzzer, and auto apply set points, are within a 689 kPa (100 psi) of those recorded in Step 20. Close the rear brake accumulator bleed-down valve.
24. Record the auto apply brake pressures. Enable the steering pressure switch by plugging in the diode removed between circuits 33 and 33F.

Reapplications

25. Start the engine to recharge the hydraulic system. Allow the engine to operate until the low brake accumulator pressure stabilizes at or above 18616 kPa (2700 psi).
26. Shut the engine off. DO NOT allow the steering accumulator to bleed-down. Make repeated slow, complete brake applications with the pedal until the auto apply comes on. Record the number of brake applications prior to the auto apply.

*Record on the data sheet.

Differential Pressure Switch

27. Open each brake accumulator bleed-down valve, and bleed-down the entire brake system.
28. Outside the brake cabinet, disconnect the hose that supplies oil from the front brake accumulator to the brake pedal in the cab for the front brakes and plug the tube end at the cabinet. Leave the end of the hose vented to the atmosphere.
29. Start the engine. Allow the engine to operate until the LAP1 pressure stabilizes at or above 18616 kPa (2700 psi).

FRONT DISC BRAKES

BRAKE CALIPER

Each front wheel brake assembly has three calipers and one disc. Each caliper has six pistons and two linings (three apply pistons and one lining for each side of the disc). The lining must be changed when the friction material is worn to 3.22 mm (0.125 in.) thickness. Refer to Figure 5-4 for maximum wear limits of the front disc.

Clean the brake assemblies before servicing. If the brake has not accumulated excessive surface dirt, preliminary cleaning can be done in the overhaul area. However, preliminary cleaning must be done before removal of the pistons from the housing.

- Cleaning may be done by brush or spray, using a petroleum base cleaning solvent.
- Clean diesel fuel is acceptable for this operation.
- Cleaning must be thorough enough for the preliminary inspection and disassembly.
- Subassemblies must be blown dry with compressed air after cleaning. Dust shields must be wiped dry with a clean cloth.
- The use of vapor degreasing or steam cleaning is not recommended for the brake assemblies or the component parts. Moisture will cause the parts to rust.

⚠WARNING

Chock the wheels to prevent the truck from moving and causing personal injury or death.
DO NOT loosen or disconnect any hydraulic brake line or component until the engine is stopped, the key switch is off, the drain valves on the brake accumulators are opened, and the steering accumulators are bled-down. Turn the steering wheel to ensure the steering accumulators are completely bled-down.

Removal

1. Remove the front tires and rims. Refer to Section G, Tires and Rims.
2. If necessary, remove the disc from the front wheel hub. Refer to Section G, Front Wheel Hub and Spindle Removal.

NOTE: Label each brake caliper with the correct location. DO NOT interchange parts.

3. Open bleeder valves (2, Figure 5-3) at each caliper and depressurize the caliper by disconnecting the two lower hoses at tee fittings (5 and 6, Figure 5-1). Drain the fluid into a container. DO NOT reuse the fluid.
4. Disconnect the top brake hose at tee fitting (3).
5. Disconnect and remove crossover tubes (2, 4, and 7).

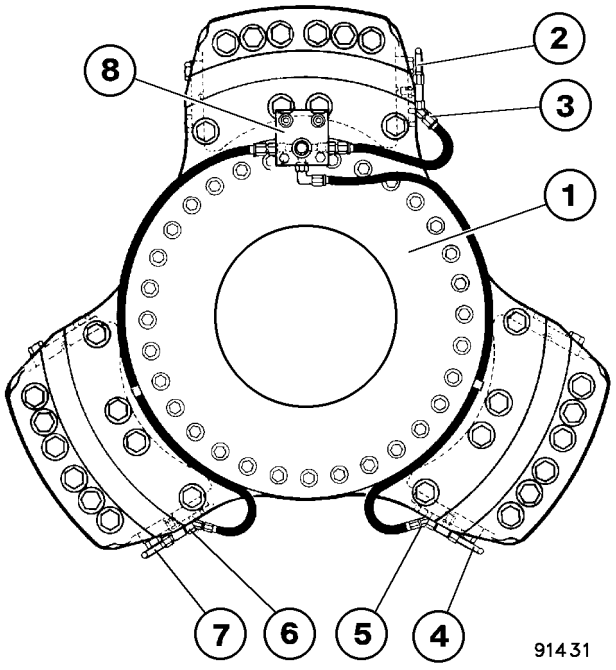


FIGURE 5-1. FRONT BRAKE ASSEMBLY

1. Brake Adapter
2. Crossover Tube
3. Tee Fitting
4. Crossover Tube
5. Tee Fitting
6. Tee Fitting
7. Crossover Tube
8. Junction Block

REAR DISC BRAKES

REAR BRAKES

Each rear wheel service brake assembly consists of two discs, each with a four piston caliper and a lining on each side of the disc. Both discs are attached by adapters to the wheel motor armature. Also mounted on each wheel motor are two dual piston, two lining calipers acting on each outboard disc as a parking brake.

A constant brake-release clearance between the pistons and linings, and the lining and disc, is maintained by an automatic adjustment feature of the piston subassembly. As the lining wears, the position of the grips on a return pin advances to allow the maximum piston force to be applied to the lining. Upon the brake release, the piston is retracted by a return spring for the amount of the predetermined clearance.

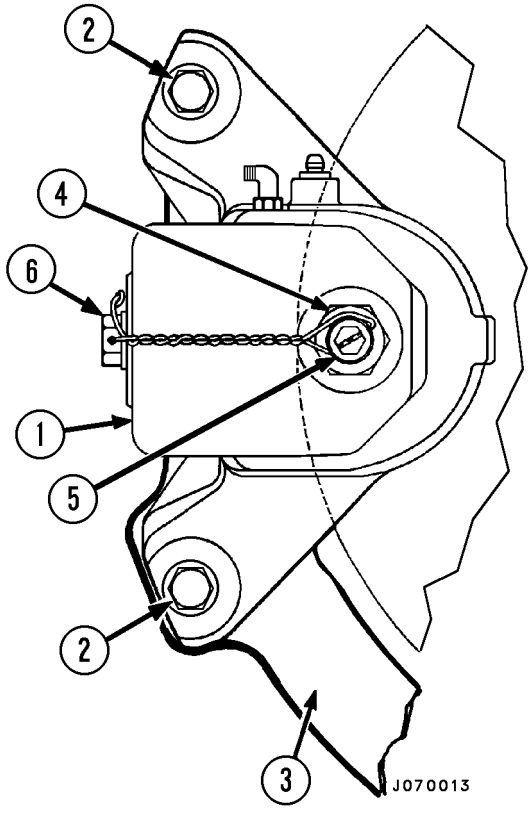


FIGURE 6-1. PARKING BRAKE

1. Parking Brake Caliper
2. Cap Screw
3. Mounting Bracket
4. Jam Nut
5. Adjustment Bolt
6. Clamping Cap Screw

CALIPER, DISC, AND PARKING BRAKE

⚠WARNING

DO NOT loosen or disconnect any hydraulic brake line or component until the engine is stopped, the key switch is off, the drain valves on the brake accumulators are opened, and the steering accumulator is bled-down. Turn the steering wheel to ensure the steering accumulator is completely bled-down.

Removal

NOTE: For electric wheels equipped with a two-piece brake disc adapter and armature shaft drive (9 and 20, Figure 6-3), follow the instructions below. For electric wheels equipped with a one-piece adapter/armature shaft drive (16, Figure 6-3A), refer to page 6.

NOTE: The parking brake caliper may be removed from either wheel motor without disassembly of the other brake components.

1. Securely block the wheels to prevent truck movement.
2. Remove the rear wheel cover.
3. Open the highest bleed valve (5, Figure 6-2) and attach a bleeder hose to lowest bleed valve (6). Open the bleed valve and allow the oil to drain into a container. Disconnect and remove the brake supply tubes from the service and parking brake calipers. Prevent the hydraulic oil from coming in contact with the commutator and the brushes of the wheel motor.
4. Disconnect the brake line connected to the parking brake caliper.

Use a 3447 kPa (500 psi) gauge, with a shutoff valve provided between the pump and the gauge to protect the gauge from damage when the press is used for higher pressure duty. Pump pressure must be applied slowly. Where a hydraulic press is not available, refer to the illustration in Figure 6-10 for a special tool, or similar, used in conjunction with a standard arbor press, to make the grip force measurements. To make the grip force measurements, use the special tools illustrated in Figures 6-9 and 6-10.

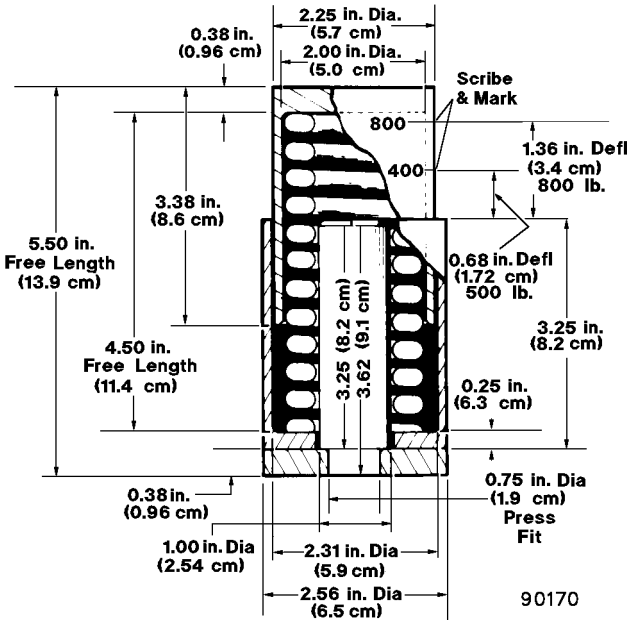


FIGURE 6-9. CALIBRATED SPRING POD

NOTE: The spring for the calibrated spring pod is from Danly Machine Corporation, spring part number 9-3218-21. If a Danly spring is not available, use an equivalent, stamping die spring, with these specifications.

- 5.08 cm (2.00 in.) Hole Diameter
- 2.54 cm (1.00 in.) Rod Diameter
- 11.43 cm (4.50 in.) Free Length
- 2624 N/cm (590 lbs/in.) Force Required to Deflect

1. Normally, the piston assembly will be removed from the brake assembly with the return pin in an extended position. Set the calibrated spring pod (Figure 6-9) on the table of the arbor press, place the piston assembly on top of the spring pod, and apply the arbor force slowly to return the pin to the retracted position. The pin will slip between 1779-3558 N (400-800 lb) scribed marks on the spring pod.
2. If slippage definitely occurs before the 1779 N (400 lbs) mark on the spring pod, the grips and the return pin must be replaced. Slippage above the 3558 N (800 lb) limit is unlikely, but if this occurs, the return pin and grip assembly must be removed and inspected for grip slippage, and the return pin examined for damage. If slippage of the return pin and the grip assemblies are over 3558 N (800 lb), the pins and grip must also be replaced.
3. The return pin must be placed in an extended position when assembling into the brake caliper for a special pin retraction tool (Figure 6-10), or equivalent, is required for this. Insert the piston assembly in the tool and secure firmly with a knurled nut. Place the pin return tool/piston assembly combination on the arbor press table, drop in three dowel pins, as indicated, place the spring pod tool on top of the dowels, apply force slowly to the top of the spring pod and again observe if grip slippage occurs within the prescribed limits

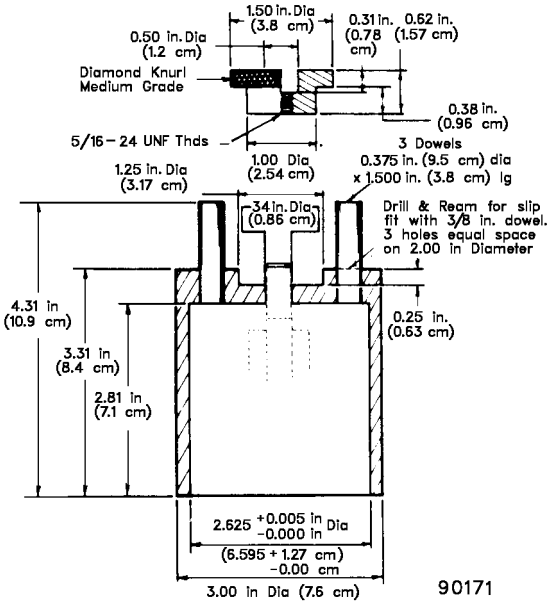


FIGURE 6-10. RETURN PIN RETRACTION

3. Allow the brake discs to cool to approximately 121°C (250°F) between cycles.
4. Repeat Steps 2 and 3.
5. If the linings smoke or smell during the second cycle, continue to repeat the burnishing cycle until the smoke and smell are gone or are significantly reduced.
6. Reconnect the front brakes.
   a. Relieve the pressure in the hydraulic system according to the previous warning instructions.
   b. Remove the cap nuts and reinstall tube (5). Tighten the tube nuts to standard torque.
   c. Close accumulator bleed valve (7) handles.
7. Start the engine and check for leaks. Bleed the brakes according to the procedure on the following page.
8. Ensure all the brakes are functioning properly before releasing the truck.

BRAKE BLEEDING PROCEDURE

Attach the brake lines and the bleed brake calipers according to the following instructions:

1. Fill the hydraulic tank following the procedure in Section P, Hydraulic Tank Service.
2. Close brake accumulator drain valves (7, Figure 6-19) if open.
3. Securely attach the bleeder hose to the highest bleeder valve of each caliper, and direct the hose away from the brake caliper into a container to catch the excess oil.
4. With the engine idle, make the partial brake application of the service brake pedal:
   a. Maintaining partial application, open the bleeder valve until a clean stream of oil is discharged from the caliper.
   b. Close the bleeder valve.
5. Repeat the above steps until all the air is bled from all the calipers.
6. Check the hydraulic reservoir level as bleeding takes place, and maintain the correct level.
7. Before returning the truck to production, the brake lining must be burnished.

⚠WARNING

All new brake linings must be burnished prior to being put in service. Refer to Service Brake Conditioning.

8. If slippage occurs between the specified force limits, move the grips to position on the pin, shown in Figure 6-13, and install in the piston assembly.
9. If slippage occurs below the 1779 N (400 lb) limit, either the grips or the grips and return pin assembly must be replaced. Use sleeve (A, Figure 6-6) and the arbor press to slip both grips off the return pin. Inspect the return pin for nicks and wear. Slight nicks that can be polished out by hand can be reused, if subsequent slip inspection is acceptable. Any rework of the return pin must be avoided unless absolutely necessary. Burred threads can be repaired by use of a 3/8-24 UNF three thread die. Bent, battered, or badly worn return pins must be replaced.

⚠CAUTION

Grip assemblies and return pins are critical items in the operation of the piston return mechanism and must not be mishandled. Under no circumstances must the pin diameter be clamped in a vise or gripped with pliers. In normal use, the surface of the pin will show only a very slow rate of wear and both pins and grips will normally last through many brake lining changes and brake overhauls.

BRAKE BLEEDING PROCEDURE

1. Start the engine.
2. Move the parking brake switch to the OFF position. Connect the bleed hose to the bleed valve and open the valve. Allow the oil to flow until it is clear and air-free (no bubbles). Close the bleed valve.
3. Repeat for all bleed valves.

Axle Blower System Operation

Hydraulic oil from the tank is supplied to a constant pressure, piston type pump (21, Figure 2-5), rated at approximately 16.5 gpm (62.4 l/min.) at 1920 rpm and 2500 psi. Oil from the pump is directed through a load orifice, through the load sensing system filter (7), to a hydraulic piston motor (12). A load sensing line (6) between the orifice and the filter returns a signal to the pump which allows the pump to maintain constant flow to the motor. The hydraulic pump is protected by the relief valve (3).

The motor (12) is a variable displacement motor and it is set at approximately 1.6 in^3 / rev. The motor must be adjusted so that maximum blower impeller speed never exceeds 2500 rpm or catastrophic failure of the impeller will result. Normal blower speed is 2300 rpm. Oil returns from the motor, through a heat exchanger and then to the hydraulic tank.

FIGURE 3-4. AXLE BLOWER HYDRAULICS

1. Hose, Pump LSS2 - Relief Valve
2. Hose, Pump LSS1 - Filter Inlet
3. Relief Valve - 3750psi
4. Hose, Relief Valve - Tank
5. Hose, Filter - Blower Motor Supply
6. Hose, Pump LSS3 - Filter (Load Sensing)
7. Piston Pump Filter
8. Hose, Blower Motor Return - Manifold (Heat Exchanger)
9. Hose, Inlet of Blower Motor - Anti Cavitation Valve
10. Anti-Cavitation Check Valve
11. Hose, Anti-Cavitation Check Valve - Outlet of Blower Motor
12. Motor, Blower (Piston)
13. Hose, Hoist Pump Inlet
14. Hose, Blower Motor Pump Inlet
15. Hose, Steering / Brake Pump Inlet
16. Hose, Motor Case Drain - Tank
17. Tank, Hydraulic
18. Hose, Pump Case Drain - Tank
19. Pump, Steering / Brake
20. Hose, Steering / Brake Pump Outlet
21. Pump, Blower Motor

Assembly

A suitable seal press ring or plug and two small wood blocks should be available.

The following seal installation procedures are outlined for use with a vise, but they can be adapted for use with a press if one is available.

1. Open the vise jaws wide enough to accept the combined thickness of the flange, wood blocks and press ring.
2. Place the wood blocks flat against the fixed jaw of the vise. Place the flange plate against the blocks in such a position that the bearing projections are between the blocks and clear of the vise jaw. Refer to Figure 3-7.

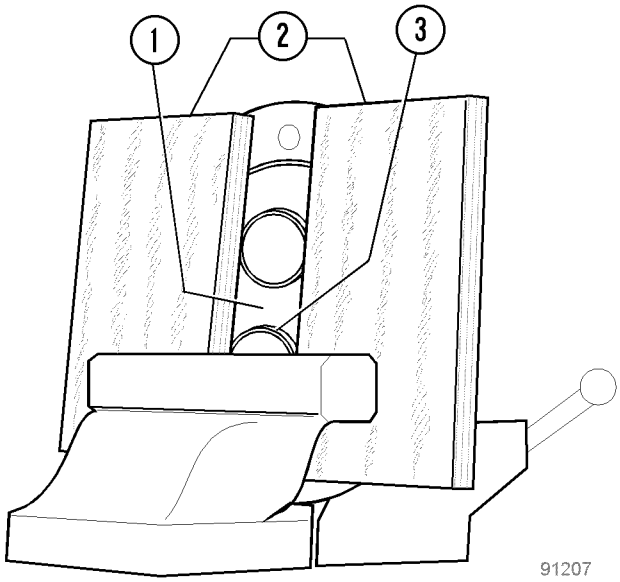


FIGURE 3-7. SHAFT SEAL INSTALLATION

1. Flange
2. Wood Blocks
3. Bearing Projection

3. Position the inboard shaft seal (3, Figure 3-8) with the metal face toward the outboard end of the flange and the lip (spring side) facing towards the inside of the pump.
4. Position the press ring over the seal. Make sure that the seal stays centered and true with the bore, and start applying pressure with the vise. Continue pressing the seal until It just clears the snap ring groove in the bore.
5. Install snap ring (2, Figure 3-8). Make sure the snap ring opening is over the weep hole opening (10).
6. Install the outboard seal with metal face out (1, Figure 3-8), until it just contacts the snap ring. Lubricate the seals with hydraulic oil.
7. Lubricate the thru stud threads (14, Figure 3-8) with hydraulic oil. Thread the studs into flange until snug. There are 4 long studs (11, Figure 3-9) and 4 short studs (12). Refer to Figure 3-9 for proper stud location.
8. Lubricate and install O-ring (7, Figure 3-8). Install dowel pins (12), if removed. Install gear plate (13) with recess in gear plate facing up or toward the connector plate when gear plate is installed.
9. Install steel rings (5, Figure 3-9). Lubricate and install backup ring (8), O-ring (7) and ring retainer (6).
10. Install the isolation plate (9) on the suction side of the gear plate. The isolation plate has relief area milled on one side, turn that side up or toward the pressure plate.
11. With the bronze side up and the milled slot facing toward the discharge side, slide pressure plate (2, Figure 3-10) down into the gear bores until it rests on the backup ring and O-ring. Do not force the plate down the gear bores. If it hangs up on the way down, work it back and forth until it slides freely into place.
12. Coat the inside of the gear plate and the gears with clean hydraulic oil.

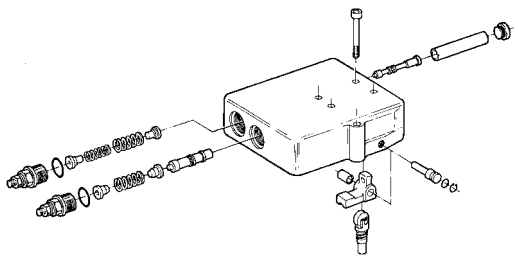


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FIGURE 3-18. VALVE DISASSEMBLY

5. Disassemble valve as shown in Figure 3-18.

NOTE: Do not disturb valve setting adjustments.

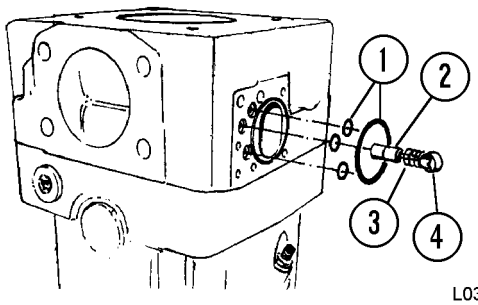

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FIGURE 3-19. MEASURING PISTON

1. O-Rings
2. Measuring Piston
3. Spring
4. Bushing

6. Remove O-rings (1, Figure 3-19), measuring piston (2) with bushing (4) and spring (3).

7. Mark the position of the port plate(1, Figure 3-20) in relation to housing. Remove the four capscrews (4).

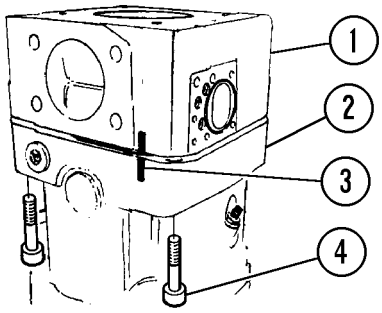

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FIGURE 3-20. PORT PLATE REMOVAL

1. Port Plate
2. Housing
3. Mark
4. Capscrews

8. Remove the port plate (1, Figure 3-20) with control plate from the housing. Remove the control rods (1 and 2, Figure 3- 21).

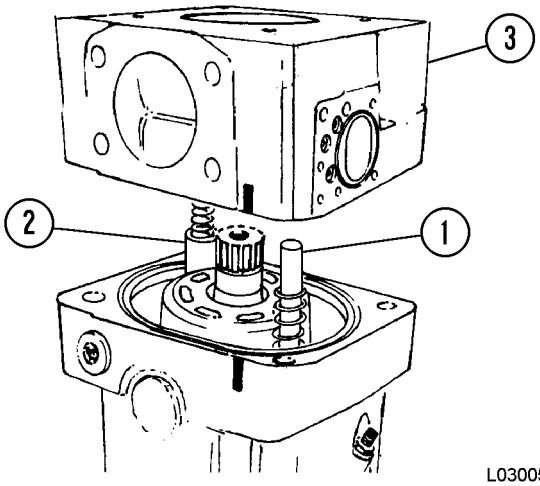

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FIGURE 3-21. CONTROL ROD REMOVAL

1. Port Plate
2. Control Rod (large)
3. Control Rod (small)

17. Install stop displacement screws and adjust to height recorded during disassembly.

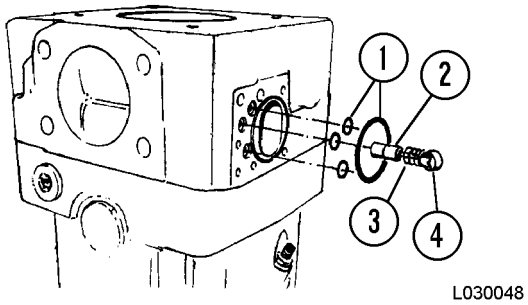

FIGURE 3-62. MEASURING PISTON INSTALLATION

1. O-Rings
2. Measuring Piston
3. Spring
4. Bushing

18. Install measuring piston (2, Figure 3-62) with O-rings.

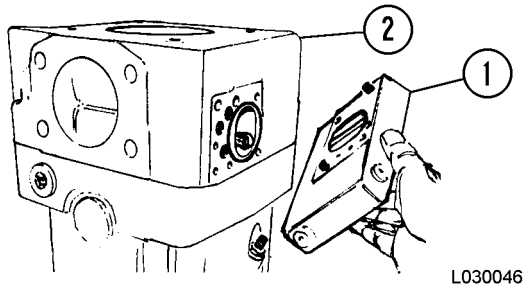

FIGURE 3-63. CONTROL VALVE MOUNTING

1. Control Valve
2. Housing

19. Assemble and mount the regulator control valve (1, Figure 3-63).

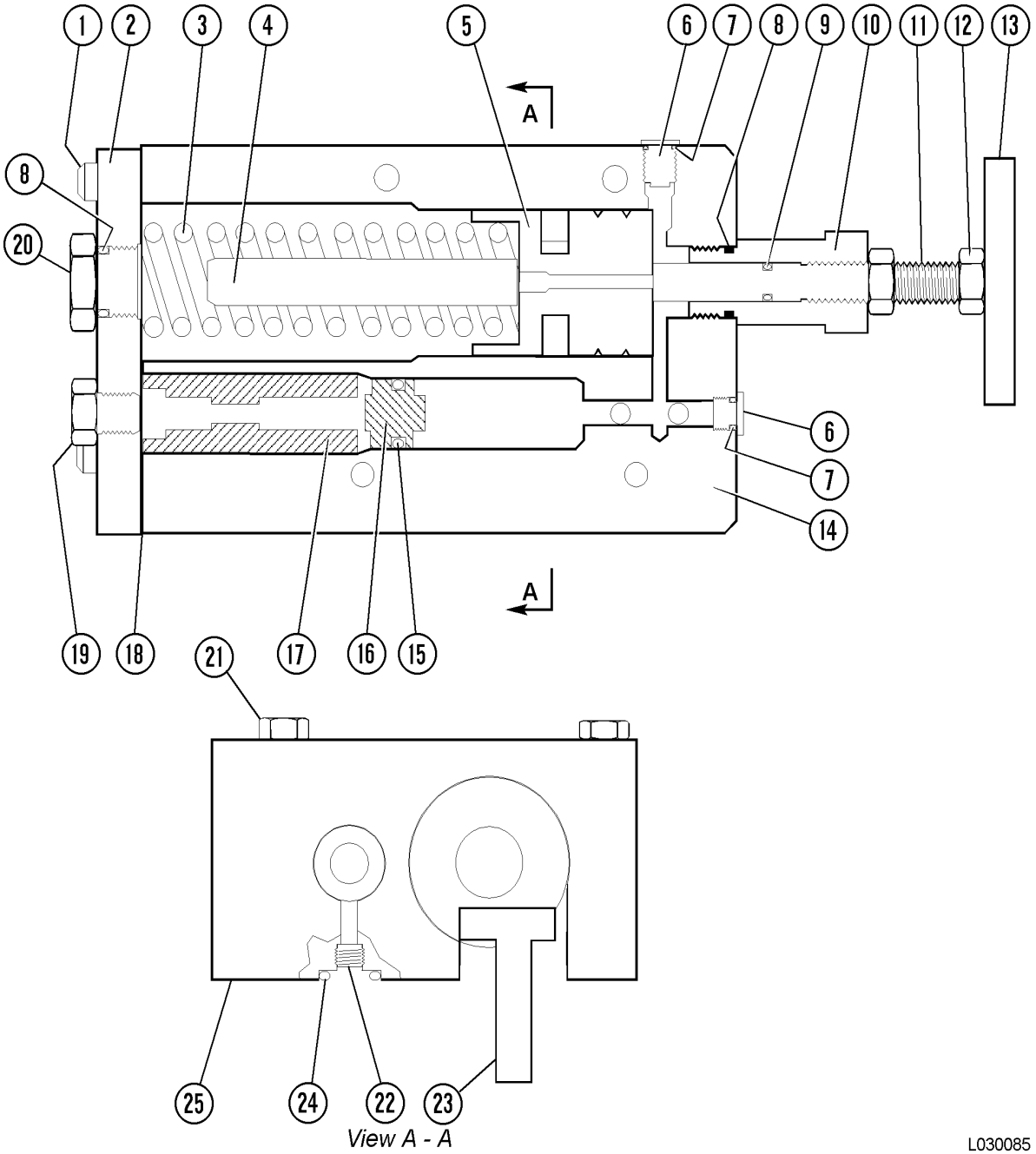

FIGURE 3-69. HAND WHEEL CONTROL

1. Socket Capscrew
2. Control Cover
3. Control Spring
4. Piston Stop
5. Control Piston
6. Plug
7. O-Ring
8. O-Ring
9. O-Ring
10. Volume Stem Adapter
11. Maximum Stop Stem
12. Jam Nut
13. Control Knob
14. Hand Wheel Housing
15. O-Ring
16. Control Plug
17. Spacer
18. Cover Gasket
19. Capscrew
20. Plug
21. Capscrew
22. Capscrew
23. Piston Pin
24. O-Ring
25. Top Plate Gasket

If for any reason the steering pump supply is lost, the truck can be slaved from another truck by using the quick disconnects, or by attaching an auxiliary power unit at the APU fitting. Refer to Figure 4-6 and 4-7.

The relief valves, accumulator bleed-down solenoid, and steering pressure switch are factory preset and not individually rebuildable. Refer to Steering Circuit Check-Out Procedure for relief valve setting.

Each time the key switch is turned OFF, it energizes the bleed-down solenoid. When the bleed-down solenoid is energized, all hydraulic steering pressure, including the accumulator, is bled back to the hydraulic tank. Refer to Figure 4-8. The brake pressure, however, will not bleed-down due to internal check valves in the brake manifold.

After approximately 90 seconds, the solenoid will de-energize to close the return port to tank. By this time all the oil in the accumulator will be returned to the tank. At start-up, the steering circuit will be charged, including the brake circuit. The low steering pressure light and buzzer will turn on until the steering pressure reaches 14,480 kPa (2100 psi). This is controlled by steering pressure switch (15, Figure 4-5) located on the bleed-down manifold. During operation, if the steering pressure falls below 14480 kPa (2100 psi), the low steering pressure warning light will illuminate until the pressure returns to normal.

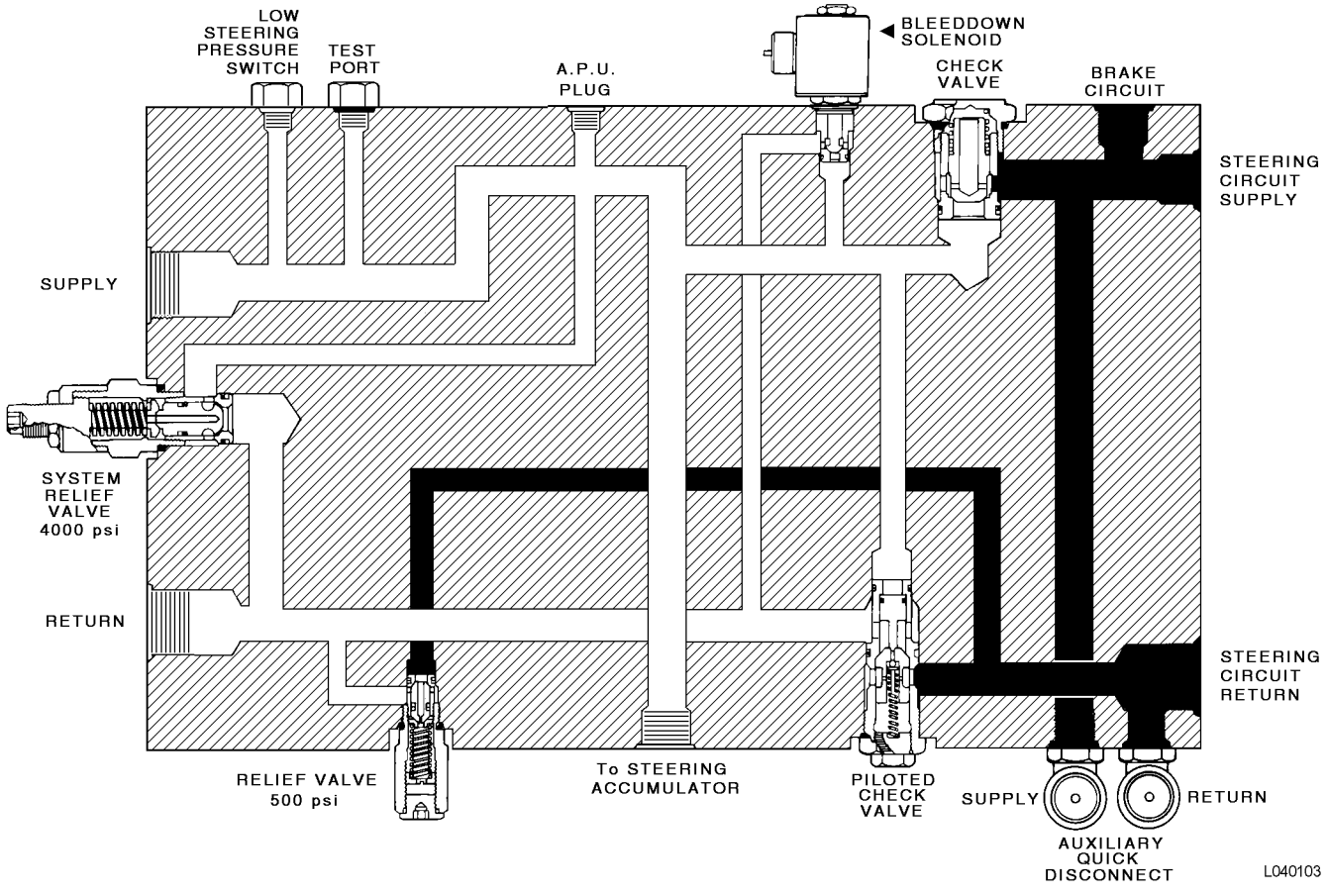

FIGURE 4-6. EXTERNAL SUPPLY SOURCE

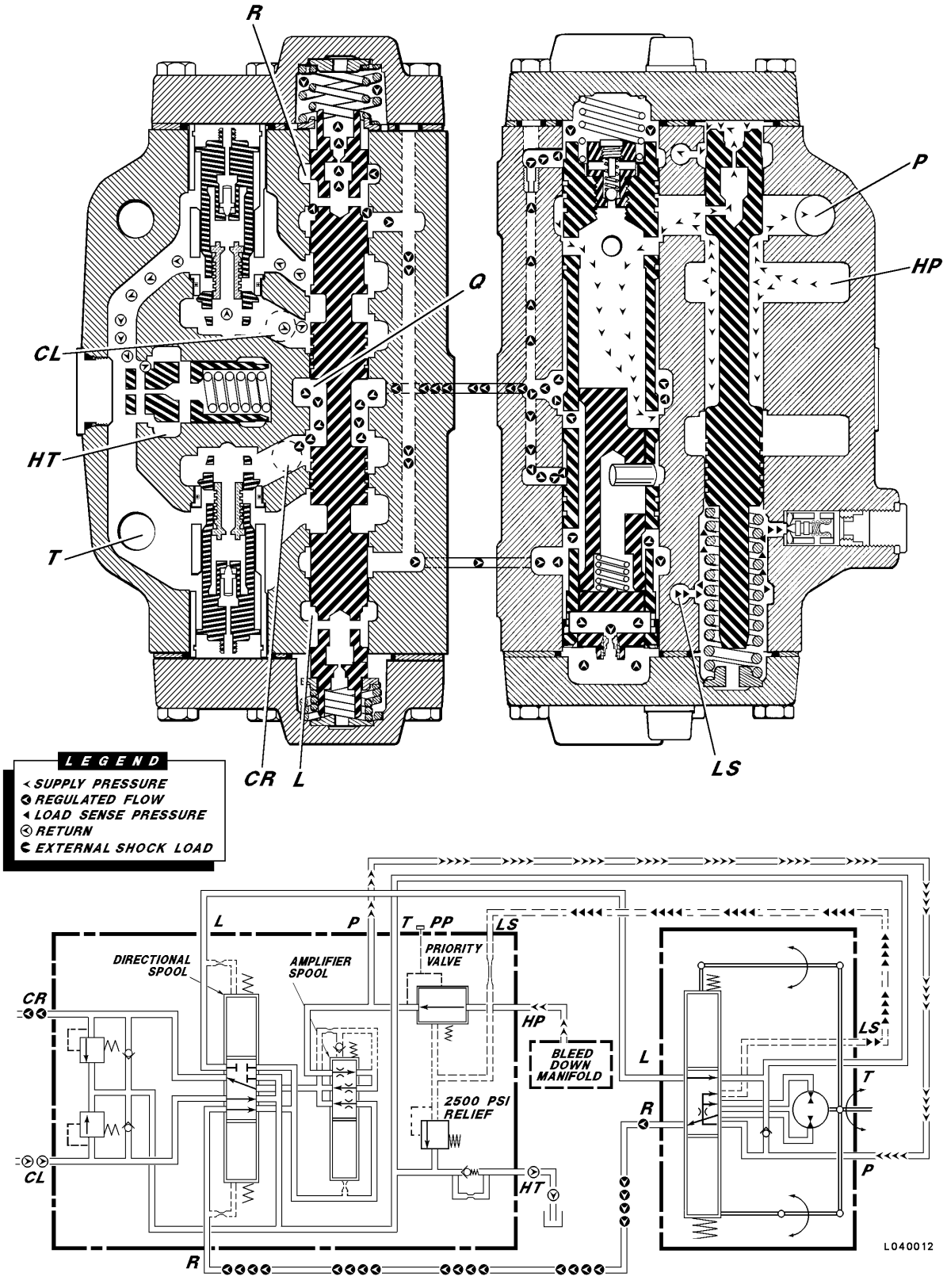

FIGURE 4-14. FLOW AMPLIFIER
(STEERING RIGHT)

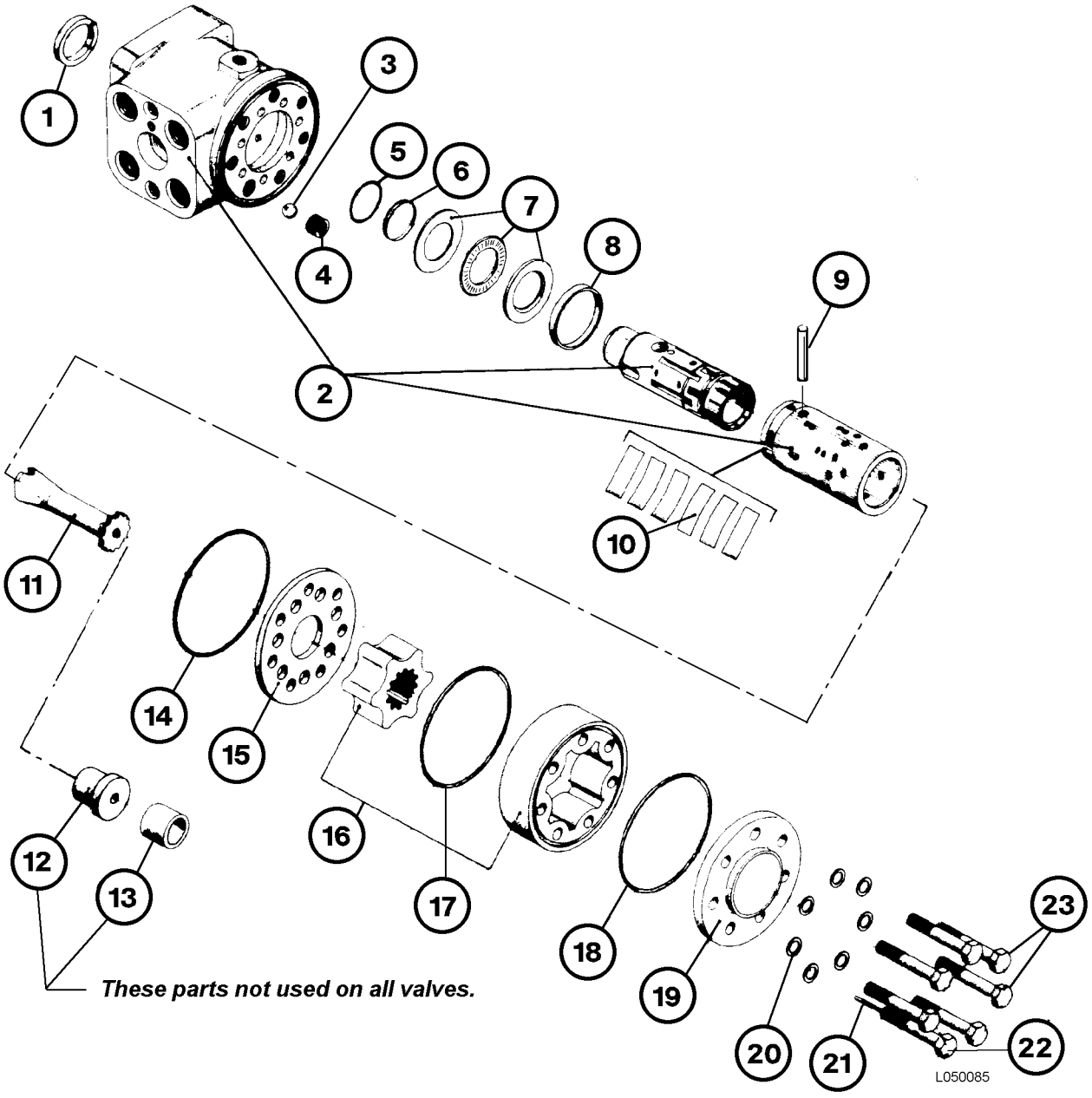

FIGURE 5-7. STEERING CONTROL VALVE

1. Dust Seal
2. Housing & Spools
3. Ball
4. Threaded Bushing
5. O-ring
6. Kin Ring
7. Bearing Assembly
8. Ring
9. Pin
10. Neutral Position Springs
11. Cardan Shaft
12. Spacer
13. Tube
14. O- ring
15. Distribution Plate
16. Gear Wheel Set
17. O-ring
18. O-ring
19. End Cover
20. Washers
21. Rolled Pin
22. Capscrew With Pin
23. Capscrews

SECTION L6
STEERING CIRCUIT COMPONENT REPAIR
INDEX

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⚠WARNING

Nitrogen pressure may be present in the accumulator. 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.

8. Hold gas valve stationary at valve body (6, Figure 5-6) with one wrench and loosen swivel nut (4) at top with a second wrench. This will open the poppet inside the gas valve.

Note: Three turns will fully open the valve.

9. Turn "T" handle (3) clockwise to open gas valve.
10. Refer to Table 1 to obtain fill time rate based on accumulator capacity.

⚠CAUTION

If the pre-charge is not done slowly, the bladder may suffer permanent damage. A "starburst" rupture in the lower end of the bladder is a characteristic failure caused by pre-charging too rapidly.

11. If the precharge is greater than 25 psi (172 kPa), proceed to Step 13. If the precharge is less than 25 psi (172 kPa), then set the regulator (6, Figure 5-7) for 25 psi (172 kPa) at gauge (5). Completely open valve (1 or 8, which ever one is connected to the accumulator), then slightly open valve (2) and slowly fill the accumulator based on the fill time rate specified in Table 1.
12. After 25 psi (172 kPa) precharge pressure is obtained in gauge (9), close valve (2).
13. If accumulator is not installed on the truck, set pressure regulator to 100 psi (690 kPa). If the accumulator is installed on the truck, set the regulator (6) for the operating precharge pressure listed in Table 2 based on the current ambient temperature the truck is in. Then open valve (2) and fill the accumulator.
14. After charging to the correct pressure, close valve (2). Let the pre-charge set for 15 minutes. This will allow the gas temperature and pressure to stabilize. If the desired precharge is low, adjust regulator, open valve (2) and add more nitrogen to obtain correct pressure on gauge (9). If precharge has exceeded the recomended pressure, then slowly bleed-off nitrogen pressure to obtain correct pressure. Nitrogen precharge is 1400 psi (9653 kPa) at 70°F (21°C) for all accumulators.

TABLE 1. Fill Rates and Lubrication Quantities

Capacity (Gallons)	Fill time (Minutes) to obtain Low Pressure (25 psi, 172 kPa)	Oil Lubrication Quantity (5%)
5 (and below)	2	32 oz (0.94 l)
7.5	3	48 oz (1.4 l)
10	3	64 oz (1.9 l)
12.5	4	80 oz (2.3 l)
16.5	4	106 oz (3.1 l)

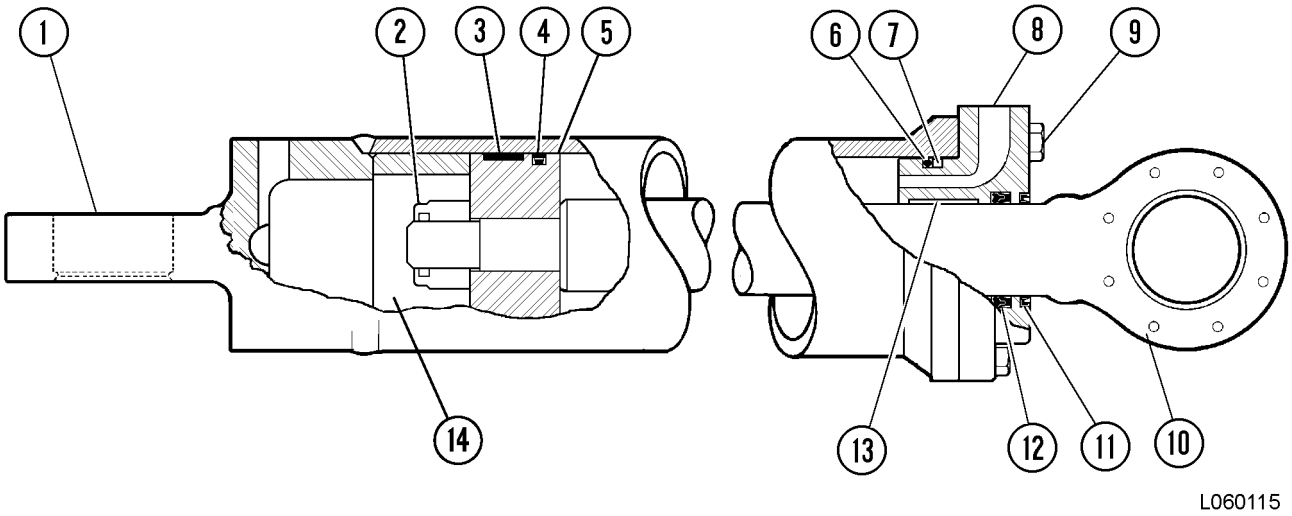


FIGURE 6-12. STEERING CYLINDER ASSEMBLY

1. Housing
2. Locknut
3. Piston
4. Piston Bearing
5. Piston Seal Assembly
6. O-Ring
7. Backup Ring
8. Gland
9. Capscrew
10. Rod
11. Rod Wiper
12. Rod Seal
13. Bearing
14. Spacer

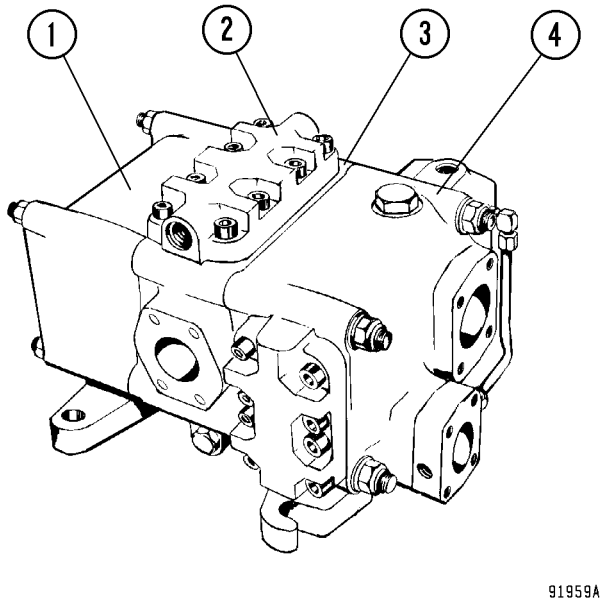


FIGURE 7-2. HOIST VALVE

1. Outlet Section
2. Spool Section Cover
3. Spool Section
4. Inlet Section

The hoist valve is a split spool design. (The term "split spool" describes the spool section of the valve.) The spools operate in synchronization with, or in opposition to its mate. The main valve precisely follows differential pressure input signals generated by the hoist pilot valve.

The inlet section of the hoist valve consists of the following components: (Refer to Figure 7-4.)

- Flow control and main relief valve (system relief) (1)
- Low pressure relief valve (3)
- Load check poppet (18)
- Anti-void poppet (17)

The flow control portion of the flow control and main relief valve allows pump flow to return directly to tank through the inlet section with low pressure loss. The relief portion of the valve is direct acting and has the capacity to limit the working pressure at full pump flow.

The low pressure relief is located between the low pressure core and the outlet, and provides a controlled back pressure in the low pressure core when oil is returning to tank.

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 and prevents flow from the high pressure core to the low pressure core.

The 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 ends 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.

FLOAT OPERATION (Figure 7-8)

When the operator releases the lever as the body travels down, The Hoist Pilot Valve spool returns to the FLOAT position. In this position all ports (10, 12, 14, & 15) are common with each other. Therefore; the pilot supply oil is returning to tank with no pressure build-up thus allowing the Flow Control Valve(2) to remain open to allow the pump oil to return to the tank through Hoist Valve Port(10). With no blockage of either Raise or Down Pilot Ports(14&15) in the Pilot Valve, there is no pressure on the top of either main spool. The oil returning from the Head End of the hoist cylinders builds pressure on the bottom of the Head End Spool(8) exactly like in Power Down allowing the returning oil to transfer to the Low Pressure Passage(20). The back pressure in the Low Pressure Passage created by the Low Pressure Relief Valve(3) causes pressure under the Rod End Spool(7) to move the spool upward. This connects the Low Pressure Passage to the Rod End of the hoist cylinders. The 75 psi (517 kPa) in the Low Pressure Passage causes oil to flow to the rod end of the cylinders to keep them full of oil as they retract. When the body reaches the frame and there is no more oil flow from the cylinders, the Main Spools center themselves and close the cylinder ports and the High and Low Pressure Passages.

NOTE: If the restrictor poppet removal in inlet cover (2) is required, refer to Step 4 and figure 8-6.

4. Remove sleeve (9), back-up ring (8), O-ring (7), and back-up ring (6). Remove back-up ring (5), O-ring (4), back-up ring (3), and restrictor poppet (2).
5. Repeat Steps 1 through 4 for the opposite inlet section if disassembly is required.

Cleaning and Inspection

1. Discard all O-rings and back-up rings. Clean all parts in solvent and dry with compressed air.
2. Inspect all springs for breaks or distortion. Inspect the poppet seating surfaces for nicks or excessive wear. All seats must be sharp and free of nicks.
3. Inspect all the bores and surfaces of the sliding parts for nicks, scores, or excessive wear.
4. Inspect the poppets in their respective bore for fit. The poppets will move freely through a complete revolution, without binding.
5. Inspect the fit and movement between the sleeve and the low pressure relief valve.

Assembly

1. Coat all the parts including the housing bores with clean type C-4 hydraulic oil. Lubricate the O-rings lightly with a multipurpose grease.
2. If restrictor poppet (2, Figure 8-6) was removed, reassemble in the order shown.
3. Install check valves (11, Figure 8-5) in their respective bores. Install springs (12).
4. Install O-rings (10), and cover (13). Install cap screws (14). Tighten the cap screws to **81 N·m (60 ft lbs)**.

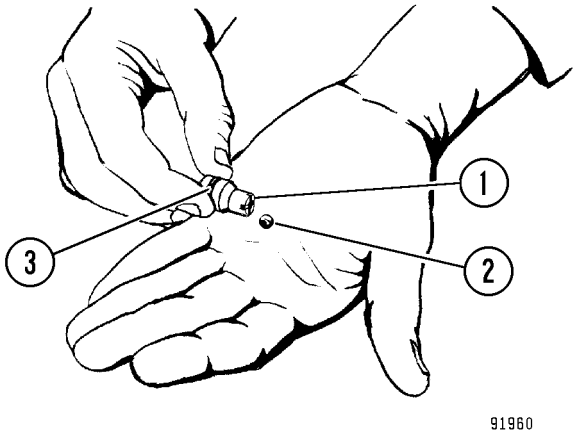


FIGURE 8-7. POPPET AND BALL

1. Poppet
2. Steel Ball
3. O-Ring

5. Install secondary low pressure relief (7) in sleeve (6) and install the assembly in inlet valve body (9). Install flow control/main relief valve (4). Install springs (3 and 5). Install inlet cover (2). Install cap screws (1). Tighten the cap screws to **81 N·m (60 ft lbs)**. Connect the external tube, and tighten the nuts to **34 N·m (25 ft lbs)**.

1. Raise the cylinder into position over the pivot point on the frame. The cylinder must be positioned with the air bleed vent plug on top, toward the front of the truck. Install spacer (6, Figure 8-18). Align the bearing eye with the pivot point and push the cylinder into place.
2. Install retainer plate (3), lock plate (2), and cap screws. Tighten the cap screws to **298 N·m (220 ft lbs)**. Bend the lock plate tabs over the cap screw flats.
3. Align the top hoist cylinder bearing eye with the bore of the upper mounting bracket. Refer to Figure 8-17.
4. Align the retaining cap screw hole in the pin with the hole in the mounting bracket and install the pin. Install cap screw (5) and locknut (4) and tighten to standard torque.
5. Install new O-rings in the grooves on the hose flange connections and lubricate with clean hydraulic oil. Position the flanges over the hoist cylinder ports and install the flange clamps. Secure the clamps with the cap screws and lock washers. Tighten the cap screws to standard torque.
6. Reconnect the lubrication lines for the upper and lower hoist cylinder bearings.
7. Start the engine, and raise and lower the body several times to bleed air from the cylinder. Check for proper operation and inspect for leaks.
8. Service the hydraulic tank if necessary.

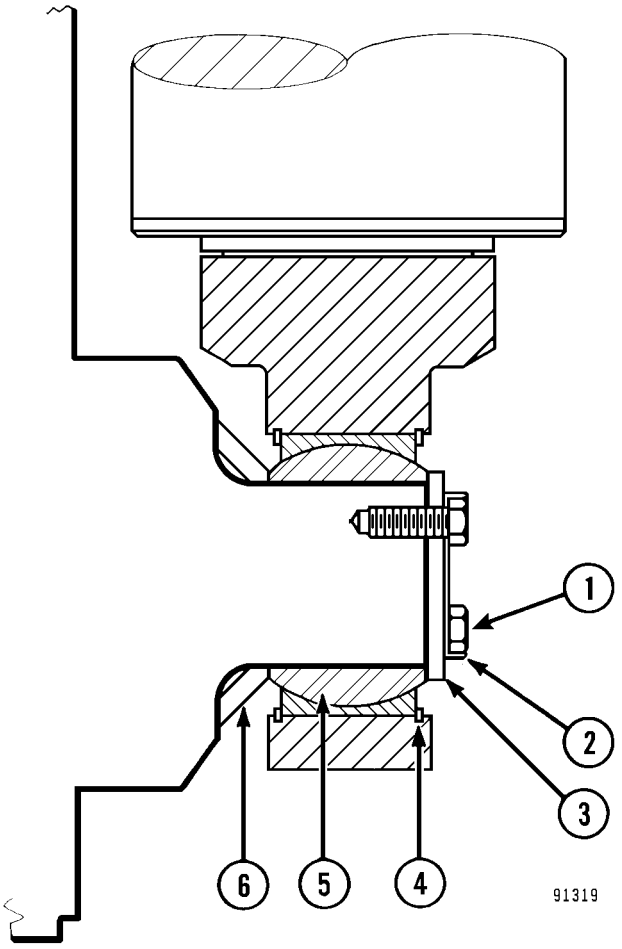


FIGURE 8-18. HOIST CYLINDER LOWER MOUNT

1. Cap Screw
2. Lock Plate
3. Retainer Plate
4. Retainer Ring
5. Bearing
6. Spacer

SECTION L9
HIGH PRESSURE FILTERS
INDEX

HYDRAULIC CHECKOUT PROCEDURE

⚠DANGER

Relieve pressure before disconnecting hydraulic lines. Tighten all connections securely 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 type of injury is not received immediately.

Blocking pressure line between pump and system (or pump) high pressure relief valve will result in damage and could result in serious personal injury.
Be sure accumulators are bled down before loosening any hydraulic fitting.

NOTE: Carefully disconnect all hoses, tubing, gauges, and plugs in case hydraulic pressure is trapped.

1. Precharge all steering and brake accumulators as follows:

⚠CAUTION

Permanent damage to bladder accumulators will result if the engine is started without all accumulators properly precharged.

NOTE: Use only dry Nitrogen to precharge accumulators.

Precharging rates of all bladder accumulators must follow details in step b or permanent damage to accumulator bladders will result.

a. Open both needle valves in brake cabinet to vent the oil side of the brake accumulators to tank. This will also vent the oil side of the rear steering accumulator to tank.

b. All accumulators are to be precharged only with dry Nitrogen as follows:

c. Check Nitrogen precharge pressure in each accumulator, then follow steps ii and iii below for each accumulator.

d. If precharge pressure is below 100 psi, set pressure regulator 25 psi above measured pressure. Increase precharge pressure very slowly to the regulator setting according to the times listed below:

   •Brake accumulators in brake cabinet - 2 minutes to initially raise pressure by 25 psi.

   •Steering accumulators - 4 minutes to initially raise pressure by 25 psi

   Note: Failure to add Nitrogen precharge slowly at the rates listed above will result in permanent damage to accumulator bladder.

   If precharge pressure is still below 100 psi after adding Nitrogen at the rates listed above, slowly raise precharge pressure until 100 psi is reached. After 100 psi or above is reached, follow step iii below.

e. If precharge pressure is 100 psi or above, accumulator bladder is fully expanded, and precharging rate can be then safely increased when adding Nitrogen until 1400 psi is reached. Allow the precharge to set for 15 minutes so the Nitrogen temperature will stabilize. Adjust precharge pressure to 1400 psi as necessary. Precharge pressure is 1400 psi for all bladder accumulators for 70 degree ambient temperature.

4. Start the engine on the good truck, place the hoist control in the power down position and increase engine RPM to high idle to dump the disabled truck. If the body of the disabled truck fails to raise, increase the good truck power down relief pressure as follows:
   a. Shut down engine and allow the hydraulic system to bleed down.
   b. Remove the cap from the Hoist Pilot Valve relief valve (2, Figure 10-6). While counting the number of turns, slowly screw the relief valve adjustment screw clockwise until it bottoms.
5. Repeat step 4 to dump the disabled truck.

Lowering the Body:

6. Place the hoist lever of the good truck in FLOAT to lower the body. If necessary, momentarily place the hoist control in POWER UP until the body is able to descend in FLOAT. Do not accelerate the engine.
7. After body is lowered, shut down the truck, bleed the hydraulic system and disconnect the hoses.
8. Reduce power down relief valve pressure to normal on good truck by turning the adjustment counterclockwise the same number of turns as required in step 4 b.
9. Check power down relief pressure per instructions on the previous page. Check hydraulic tank oil level.

SECTION M4
ELECTRIC DRIVE COOLING AIR FILTER SYSTEM
INDEX

4. Shaft seals should be replaced. All O-ring seals and back-up rings or strips should be replaced with new.
5. Bearing I.D.'s should have a gray coating.
   a. If bronze can be seen shining through the teflon on the inlet side, the bearings and plate they are in, should be replaced.

Assembly

1. Using an arbor press, press the new seal (3, Figure 4-5) into flange bore.
   a. Center the seal over the seal bore with metal face of the seal facing out.
   b. Make sure the seal is started and pressed straight into the bore.
   c. Place a socket wrench (having an O.D. just slightly smaller than seal bore) against seal.
   d. Press against socket and press seal in until seal has just cleared snap ring groove in seal bore.
2. Apply two or three drops of # 290 Loctite against seal bore and O.D. of seal.
   a. Hold the flange at a 45 degree angle and rotate it slowly to allow the loctite to flow all the way around the O.D. of the seal.
3. Install the snap ring and wipe the excess Loctite out of seal bore and seal lip.
4. Install O-ring (1, Figure 4-6) in cover plate (5). After O-ring has been placed in groove, spread a light coat of grease on the O-ring to hold it in place.
5. If for any reason, gear plate (3, Figure 4-7) had to be replaced, dowels (4) must be pressed into both sides of replacement gear plate before assembling it to cover plate. Dowels can be tapped in with hammer, but it is best to use a dowel guide and press. Whichever method is used, make sure they are straight in dowel bores. If press is used, do not apply rapid force on dowels. If a hammer is used, do not drive the dowels in aggressively. Tap them lightly until they are against the shoulder.
6. With matching marks made in step 2 toward you, and the four cast recesses in the outer edge of gear plate toward cover plate, line up dowels. Tap gear plate lightly until it is against O-ring in cover plate.
7. Install back-up ring (3, Figure 4-6) and O-ring (2).
8. Install O-ring (5, Figure 4-7) in pressure plate (2). With trap (small oblong hole) in pressure plate toward inlet side of gear plate and bronze side up, slide pressure plate down gear bores.
9. Install drive gear in gear bore nearest to matching mark and idler gear in opposite bore.
10. Install O-ring in remaining pressure plate. With trap toward inlet side and bronze side down, place pressure plate down against gear faces.

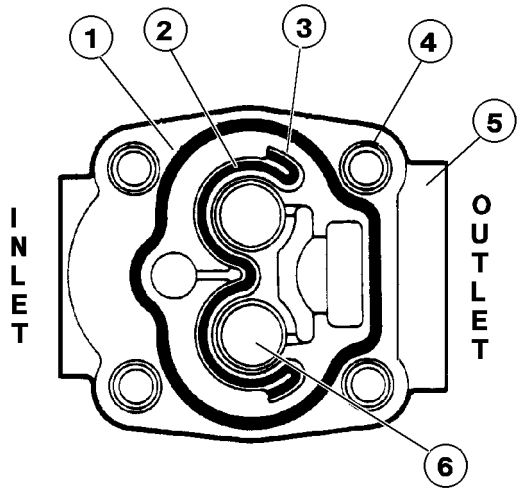
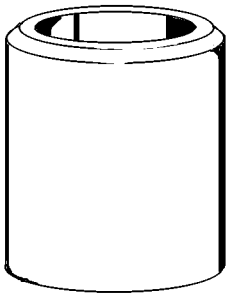


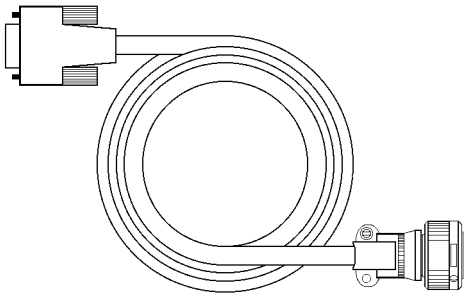
FIGURE 4-6. COVER PLATE SEALS

1. O-Ring
2. O-Ring
3. Backup Ring
4. Dowel
5. Cover Plate
6. Drive Gear Bore

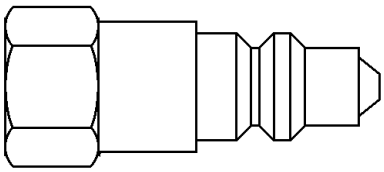
Part Number	Description	Use
EC1741 EC1742 TZ0992	Sleeve Alignment Tool	Steering Linkage and Tie Rod Assembly. Refer to Section G.



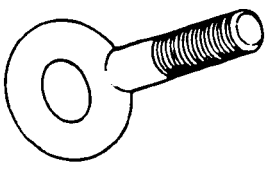
Part Number	Description	Use
AK4720	Payload Data Manger	Payload Meter Download. Refer to Section D.
EF9160	PLM Download Harness	



Part Number	Description	Use
PB6039	Hydraulic Coupling	Miscellaneous



Part Number	Description	Use
TG1106	Eye Bolt	Miscellaneous Lifting Requirements



SECTION N2
TRUCK CAB
INDEX

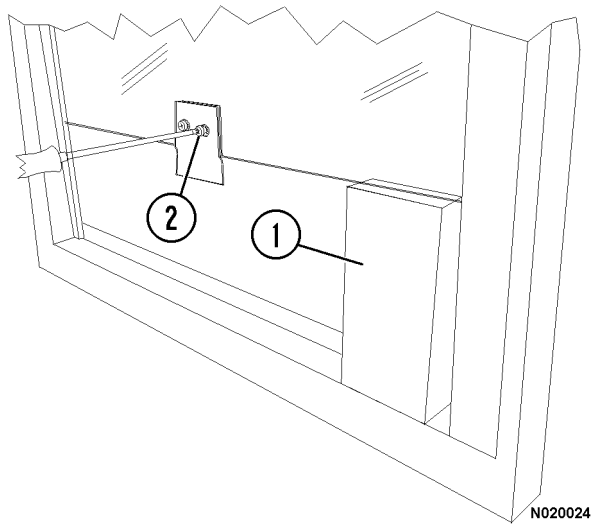


FIGURE 2-9.

1. Support Block 2. Screw

4. Remove rubber felt insert (2, Figure 2-10) from the channel. Remove screw (1) at the lower end of the window channels.

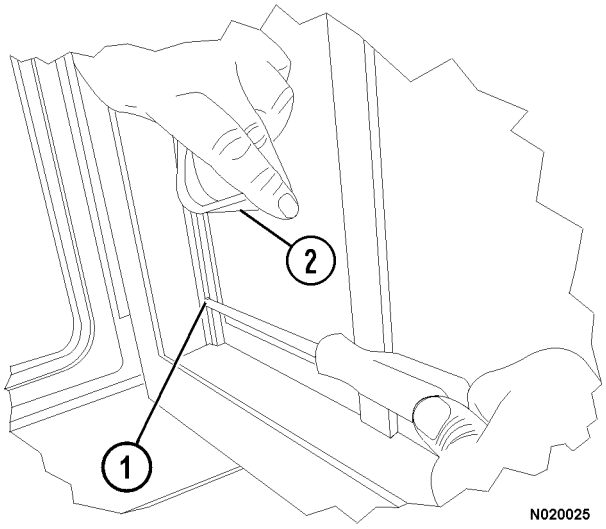


FIGURE 2-10.

1. Screw 2. Rubber Felt Insert

5. Remove the trim material covering the screws holding the window frame to the door. Remove screws (1, Figure 2-11).

Note: The screws along the bottom of the window frame may be shorter than along the top and sides.

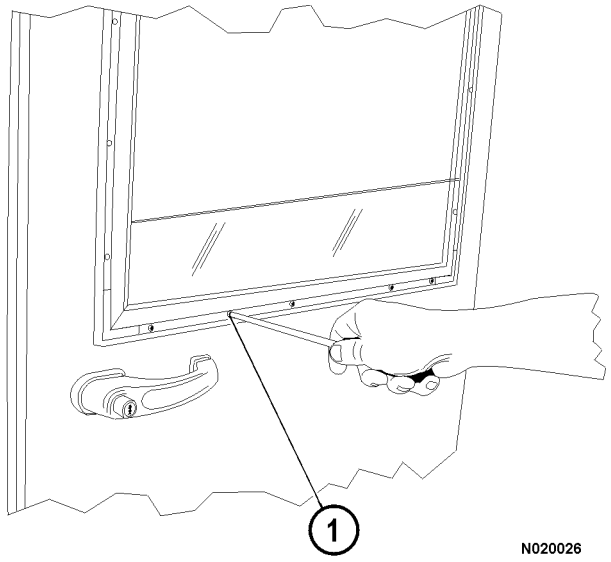


FIGURE 2-11.

1. Screws

6. Lift the door glass in window frame (1, Figure 2-12) so that it is near the top. Holding the glass in place, tilt the frame out at the top. Lift the frame and glass straight up and out of the door.

⚠CAUTION

Ensure window bracket (2, Figure 2-12) at the bottom of the glass will clear the door frame, if still on the glass.

CAB COMPONENTS

WINDSHIELD WIPERS

The windshield wipers are operated by a 24 Volt electric motor. The wipers can be adjusted for variable intermittent delay, constant low, or constant high speed, They are operated by a switch mounted on the instrument panel.

WIPER MOTOR REPLACEMENT

Removal

1. Remove the five screws, inside of cab, that secure the visor assembly/access panel and lower the access panel.
2. Disconnect the wire harness from the wiper motor. Hold the wiper linkage stationary and remove nut (4, Figure 3-1). Disconnect the wiper linkage from the motor.
3. Remove three cap screws (3) and the washers attaching the motor to plate (2). Remove wiper motor (1).

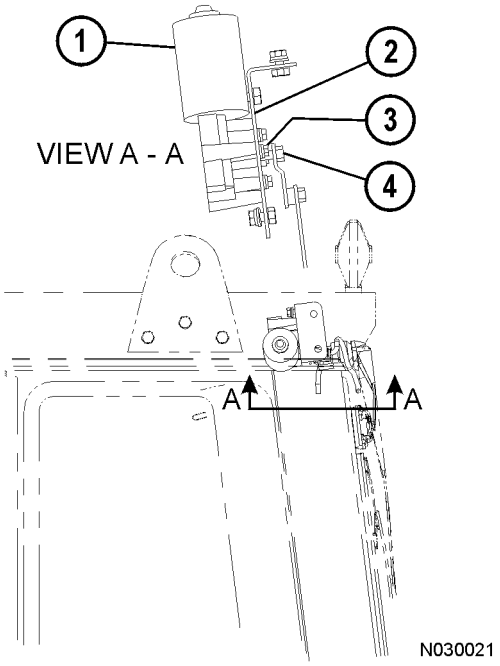


FIGURE 3-1. WINDSHIELD WIPER REMOVAL/INSTALLATION

1. Wiper Motor
2. Plate
3. Cap Screw
4. Nut

Installation

1. Place wiper motor (1, Figure 3-1) onto plate (2).
2. Install three cap screws (3) and the washers. Tighten the cap screws to **8-9 N·m (71-79 in. lbs)**.
3. Align the motor output shaft with the wiper linkage. Hold the linkage stationary and install nut (4). Tighten the nut to **22-24 N·m (16-18 ft lbs).**
4. Reconnect the wiper motor wire harness.
5. Verify the wipers operate properly and stop in the proper position. Refer to Figure 3-3.

WIPER ARM REPLACEMENT

Removal

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

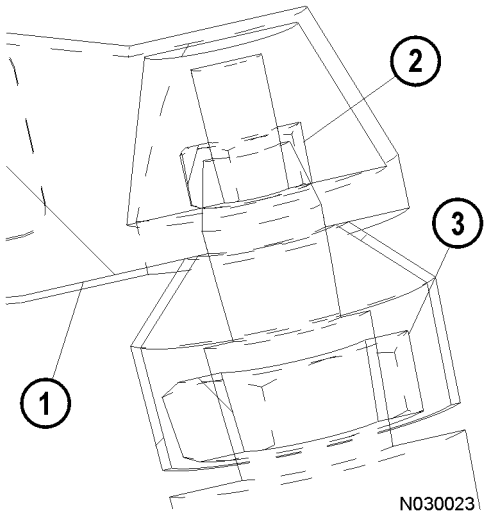


FIGURE 3-2. WIPER ARM DETAIL

1. Wiper Arm
2. Nut
3. Nut (20 mm)

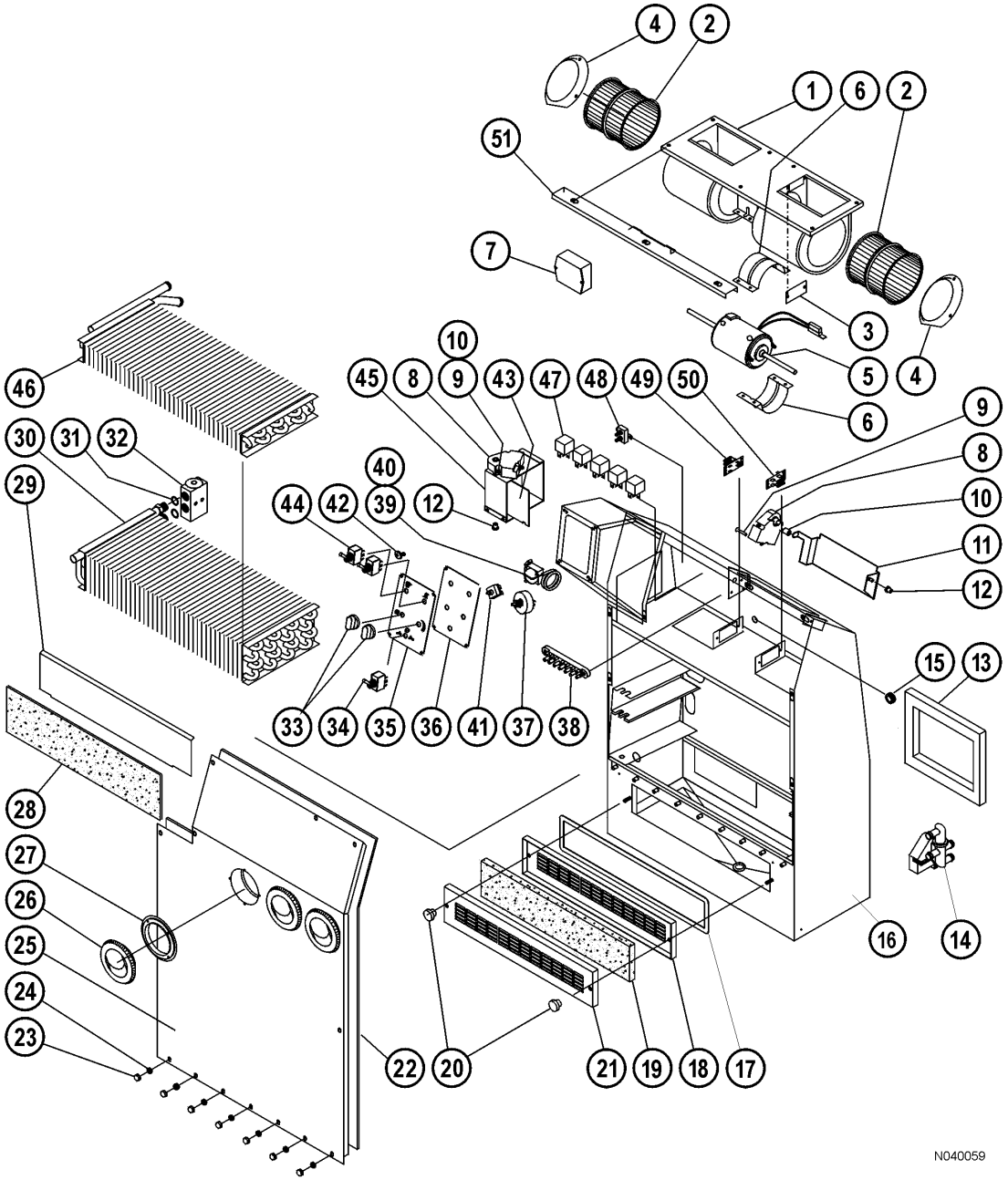


FIGURE 4-4. HEATER/AIR CONDITIONER ASSEMBLY

1. Blower Housing
2. Blower Wheel
3. Cover Plate
4. Venturi
5. Motor, 24V
6. Motor Mount
7. Converter (24V-12V)
8. Actuator Motor
9. Screw
10. Spacer
11. Defrost Flapper
12. Snap Bushing
13. Foam
14. Heater Valve
15. Grommet
16. Casing
17. Gasket
18. Filter Holder
19. Recirculation Air Filter
20. Knob
21. Filter Holder
22. Foam Insulation
23. Nut
24. Flat Washer
25. Cover
26. Louver
27. Louver Adapter
28. Foam
29. Coil Plate
30. Evaporator Core
31. O-Ring
32. Expansion Valve
33. Knob
34. Toggle Switch (3 pos.)
35. Overlay
36. Plate, Control
37. Potentiometer
38. Junction Block
39. Thermostat
40. Hose
41. Blower Switch
42. Screw
43. Discharge Flapper
44. Toggle Switch (2 pos.)
45. Bracket, Flapper
46. Heater Core
47. Relay (12V)
48. Circuit Breaker
49. Resistor (12 Volt)
50. Resistor (24 Volt)
51. Blower Retainer

⚠CAUTION

Trucks operating in cold weather climates must continue to keep the A/C system charged during cold weather months. Keeping the system charged helps prevent moisture intrusion into system oil and desiccants.

SERVICE TOOLS AND EQUIPMENT

Recovery/Recycle Station

Whenever refrigerant must be removed from the system, a dual purpose station, as shown in Figure 4-6, performs both recovery and recycle procedures which follows the new guidelines for handling used refrigerant. The recovered refrigerant is recycled to reduce contaminants, and can then be reused in the same machine or fleet.

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

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

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

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

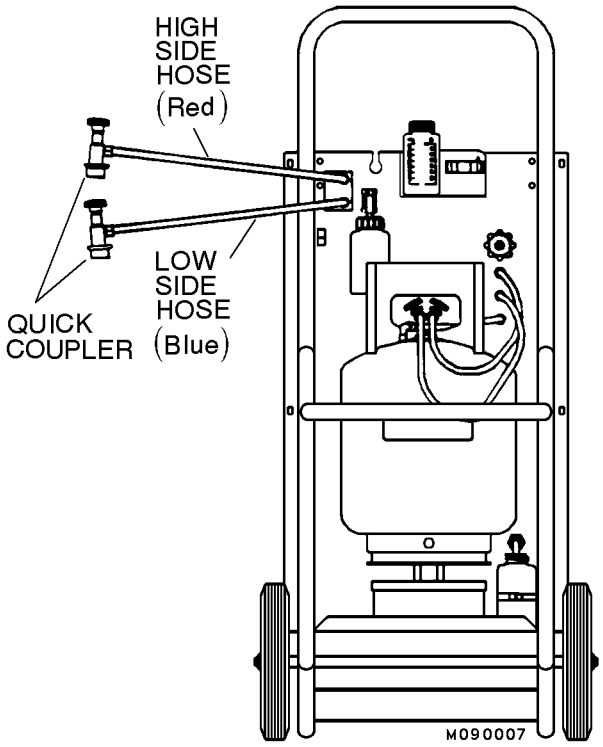


FIGURE 4-6. RECOVERY/RECYCLE STATION

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

⚠CAUTION

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

SYSTEM REPAIR

The following service and repair procedures are not any different than typical vehicle service work. However, A/C system components are made of soft metals (copper, aluminum, brass, etc.). Comments and tips that follow will make the job easier and reduce unnecessary component replacement.

⚠WARNING

All of the service procedures described are only performed after the system has been discharged. DO NOT use any lubricant or joint compound to lubricate or seal any A/C connections.

NOTE: To help prevent air, moisture, or debris from entering an open system, cap or plug open lines, fittings, components, and lubricant containers. Keep all connections, caps, and plugs clean

⚠CAUTION

DO NOT leave A/C components, hoses, oil, etc. exposed to the atmosphere. Keep sealed or plugged until the components are to be installed and the system is ready for evacuation and charging. RPAG oil and receiver-drier/accumulator desiccants attract moisture. Leaving system components open to the atmosphere will allow moisture to invade the system, resulting in component and system failures.

System Flushing

If any contaminants are found in the system hoses, components, or oil, the entire system must be flushed. Major components, such as the compressor, are extremely susceptible to foreign particles and must be replaced.

If any contaminants are found, the entire system must be flushed. Major components, such as the compressor, are extremely sensitive to foreign particles and must be replaced.

⚠CAUTION

Only SAE and/or Mobile Air Conditioning Society (MACS) approved flushing methods with the appropriate refrigerants are to be performed when removing debris from the system. Other methods may be harmful to the environment, as well as air conditioning components.

1. Remove the compressor, receiver-drier, expansion valve, and accumulator.
2. Inspect all other components, such as the condenser, evaporator, hoses, and fittings. If any of these items are damaged or highly contaminated, replace the components.
3. Flush the remaining hoses and components with a flushing unit. Use only approved flushing solutions, such as Dura 41.
4. After flushing, blow out the system with dry shop air for 5 to 10 minutes.
5. If the expansion valve has been removed of all foreign contamination, it may be re-installed back into the system. If contamination is still present, replace the valve.
6. Install a new compressor, receiver-drier, and accumulator.
7. Add oil to the system, as outlined in Checking System Oil.

CHARGING THE A/C SYSTEM

The proper method for charging refrigerant into an R-134a system is to first, recover all of the refrigerant from the system. The charging refrigerant will then be weighed on a scale to ensure the proper amount is charged into the system. Most recovery units include a scale within the apparatus, thus making it very easy to charge the correct amount every time. If equipment such as this is not available, a common scale can be used to determine the weight of charge. Simply weigh the charging tank, subtract the weight of the proper charge, and charge the system until the difference is shown on the scale. On certain types of equipment, it is also possible to add any necessary lubricant when charging the system.

If a scale is not used when charging R-134a into a system, it is difficult to tell if the correct charge has been achieved. The sight glass can provide some indication, but it is not a reliable tool for determining proper charge.

NOTE: Charging is to be performed with the engine and compressor operating. Charge the A/C system through the low side service port. Trucks without accumulators must be charged with the refrigerant in vapor form. Trucks equipped with accumulators may charge the refrigerant as a liquid or as a vapor.

1. Ensure the system has no leaks. Refer to System Leak Testing.
2. If necessary, add 207 ml (7 oz) of new RPAG oil PC2212 to the inlet side of the accumulator or receiver-drier.
3. Connect all the hoses and components for the A-C system.

NOTE: Lubricate the oil rings before assembly.

4. Evacuate the system down to a minimum of 73.6 cm Hg (29 in. Hg) for a minimum of 45 minutes.
5. Shut the vacuum pump off and observe the gauges. The system will hold a minimum vacuum of 71.1 em Hg (28.0 in. Hg) for 15 minutes. If the vacuum does not hold, find and repair the leak. Repeat the evacuate procedure again.
6. Charge the A/C system with R-134a refrigerant.

   System capacity . . . . . 3.4 kg (7.4 lbs)

7. Observe pressures and check for leaks.
8. Observe the cab vent outlet temperatures, fan on low and the temperature setting on maximum.
9. Check the evaporator condensation drain line to see if it is open.

PREVENTATIVE MAINTENANCE SCHEDULE FOR A/C SYSTEM

Truck Serial Number_____

Site Unit Number_____

Date:_____Hour Meter:_____

Last Maintenance Check:_____

Name of Service Technician_____

NOTE: The compressor must be run at least five minutes [4.4°C (40°F minimum ambient temperature)] every month, in order to circulate the oil and lubricate the components.

COMPONENT	Maintenance Interval (months)			
	3	6	12	Done
1. Compressor Check noise level Check clutch pulley Check oil level Run system five minutes Check belt tension 36-45 kg (80-100 lbs); V-belt gauge Inspect shaft seal for leakage Check mounting bracket (tighten bolts) Check clutch alignment w/ crankshaft pulley (within 3 mm (0.13 in.) Perform manifold gauge check Verify clutch is engaging				
2. Condenser Clean dirt, bugs, leaves, etc. from coils (w/compressed air) Verify engine fan clutch is engaging, if installed Check inlet/outlet for obstructions or damage				
3. Receiver-Drier Check inlet line from condenser (will be hot to touch) Replace, if system is opened				
4. Accumulator (if equipped) Check the inlet line from the evaporator. It will be cool to cold. Replace the accumulator each time the system is opened.				

COMPONENT	Maintenance Interval (months)			
	3	6	12	Done
5. Expansion Valve Inspect capillary tube, if used, for leakage, damage, looseness			X	
6. Evaporator Clean dirt, bugs, leaves, etc. from fins (w/compressed air) Check solder joints on inlet/outlet tubes (leakage) Inspect condensation drain				
7. Other Components Check discharge lines (hot to touch) Check suction lines (cold to touch) Inspect fittings/clamps/hoses Check thermostatic switch for proper operation Outlets in cab: 4.4 to 10°C (40° to 50°F) Inspect all wiring connections Operate all manual controls through full functions				

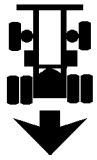
CENTER CONSOLE

TRUCK CONTROLS

F-N-R Selector Switch

F-N-R selector switch 3, Figure 5-7) is mounted on a console to the right of the operator's seat. It is a three-position switch that controls the forward-neutral-reverse motion of the truck. When the selector switch handle is in the center N position, it is in NEUTRAL. The handle must be in NEUTRAL to start the engine.

The operator can select forward drive by moving the handle forward.



Reverse drive can be selected by moving the handle rearward.

The truck must be stopped before the selector handle is moved to a forward or reverse drive position.

Hoist Control Lever

Hoist control lever (4, Figure 5-7) is a four-position, hand-operated lever located between the operator seat and the center console.

Refer to Section A, General Safety and Operation for complete details concerning this control.

Trolley Master Control Lever

Trolley master control lever (2) is mounted on the console to the right of the operator's seat. It is a four position switch that controls the speed and use of trolley assistance. For more information regarding the control lever, refer to Section A, General Safety and Operation - Trolley Operating Instructions.

CONSOLE SWITCHES AND CONTROLS

Cigarette Lighter

Cigarette lighter (10, Figure 5-7) may be used for lighting cigars/cigarettes.

Use caution with smoking materials!

This socket may also be used for a 12VDC power supply.

Window Control Switches

Window control switches (9, Figure 5-7) are spring-loaded to the OFF position. Pushing the front of each switch raises the cab windows. Pushing the rear of the switch lowers the window.

Engine Shutdown Switch

Engine shutdown switch (8, Figure 5-7) is used to turn the engine off. Pull the switch up to stop the engine. Push the switch down to enable the engine to start.

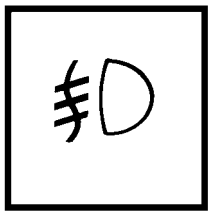
SWITCH UP
ENGINE OFF

SWITCH DOWN
ENGINE ON

Use this switch to shut the engine off if the key switch fails to operate, or to stop the engine without turning off the 24VDC electrical circuits.

A ground level engine shutdown switch is also located at the right, front corner of the truck.

Fog Light Switch

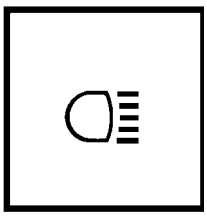


Fog light switch (3, Figure 5-11) is used by pressing the top of the rocker switch to turn the lights on. Pressing the bottom of the switch turns the lights off. The fog lights are optional.

Ladder Light Switch

Ladder light switch (4, Figure 5-11) turns the ladder lights on and off. Pressing the top of the rocker switch turns the lights on. Pressing the bottom of the switch turns the lights off. Another switch is mounted at the front left of the truck near the base of the ladder.

Backup Light Switch



Backup light switch (5, Figure 5-11) allows the backup lights to be turned ON providing added visibility and safety when the selector switch (see operator controls) is not in the REV position. When the switch is pressed toward the ON position, manual backup light indicator (B4, overhead panel) will be illuminated.

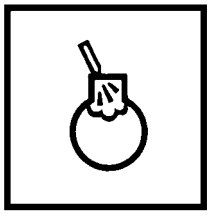
Panel Illumination Lights

Panel illumination lights (6, Figure 5-11) provide illumination for the instrument panel. Brightness is controlled by panel illumination lights dimmer rheostat (28).

Cab Air Conditioner/Heater Vents

Cab air conditioner/heater vents (7, Figure 5-11) are spherically mounted and may be directed by the operator to provide the most comfortable cabin air flow.

Engine Cold Weather Starting Aid Switch

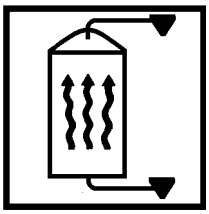


Optional engine cold weather starting aid switch (8, Figure 5-11) is spring-loaded to the OFF position. Use only when the ambient temperature is below 10°C (50°F). When the switch is held in the ON position, ether is injected into the engine intake manifold to aid the engine starting in cold weather. For additional information, refer to Section A, General Safety and Operation - Engine Start-Up.

Rotating Beacon Light Switch

Press rotating beacon light switch (9, Figure 5-11) to the ON position to activate the rotating beacon. This is an optional feature.

Heated Mirror Switch



Press heated mirror switch (10, Figure 5-11) to activate the heating element in the mirrors. This is an optional feature.

Wheel Brake Lock Switch

Wheel brake lock switch (12, Figure 5-11) must only be used when the engine is on. Use this function during dumping and loading. The brake lock switch actuates the hydraulic brake system, which locks the rear wheel service brakes only. When approaching the shovel or dump area, stop the truck using the service brake pedal. When the truck is completely stopped and in the loading position, apply the brake lock by pressing the rocker switch toward the ON symbol. To release, press the rocker switch toward the OFF symbol.

Max Speed Indicator

The max speed indicator (A8) lights when the operator has selected the fourth, and last, detent position of the master control lever. When the lever is in this detent position, the truck will be able to reach it's maximum trolley speed. Depending on the overhead line voltage, the truck speed may vary from 12.7 to 14.7 mph. Refer to the trolley speed table in Section A, General Safety and Operation, for speed ranges with different line voltages. The max speed indicator is green.

NOTE: The speed indicator lamps indicate the speed level of the master control lever position. If the slowest speed is selected, only the low speed indicator lamp will light. In maximum spped, all speed level lamps will light.

High Speed Indicator

The high speed indicator (B8) lights when the operator has selected the third detent position of the master control lever. In this position, depending on the overhead line voltage, the truck speed may vary from 11.0 to 13.1 mph while on trolley. Refer to the trolley speed table in Section A, General Safety and Operation, for speed ranges with different line voltages. The max speed indicator is green.

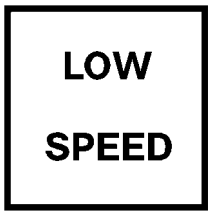
NOTE: The speed indicator lamps indicate the speed level of the master control lever position. If the slowest speed is selected, only the low speed indicator lamp will light. In maximum spped, all speed level lamps will light.

Med Speed Indicator

The medium speed indicator (C8) lights when the operator has selected the second detent position of the master control lever. In this position, depending on the overhead line voltage, the truck speed may vary from 8.9 to 11.2 mph while on trolley. Refer to the trolley speed table in Section A, General Safety and Operation, for speed ranges with different line voltages. The max speed indicator is green.

NOTE: The speed indicator lamps indicate the speed level of the master control lever position. If the slowest speed is selected, only the low speed indicator lamp will light. In maximum spped, all speed level lamps will light.

Low Speed Indicator



The low speed indicator (D8) lights when the operator has selected the first detent position of the master control lever. This lever position will cause the truck to move at it's slowest speed while on trolley. In this position, depending on the overhead line voltage, the truck speed may vary from 7.6 to 10.0 mph. Refer to the trolley speed table in Section A, General Safety and Operation, for speed ranges with different line voltages. The max speed indicator is green.

NOTE: The speed indicator lamps indicate the speed level of the master control lever position. If the slowest speed is selected, only the low speed indicator lamp will light. In maximum spped, all speed level lamps will light.

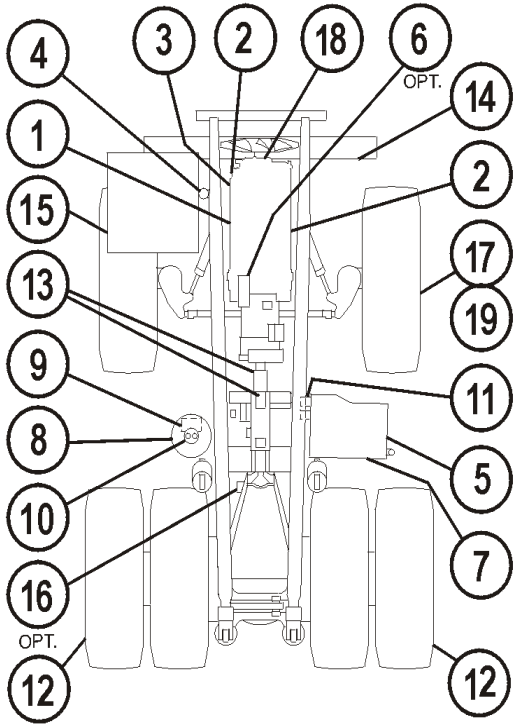
LUBRICATION CHART

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



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

* 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

WB2790