CEBM014501

Shop Manual

930E-3

DUMP TRUCK

SERIAL NUMBERS **A30329 - A30363**

KOMATSU®

TRUCK COMPONENTS AND SPECIFICATIONS

Truck And Engine

The 930E-3 Dump Truck is an off-highway, rear dump truck with AC Electric Drive. The gross vehicle weight is 1,100,000 lbs. (498 960 kg). The engine is a Komatsu SSDA16V160 rated @ 2700 HP (2014 kW).

Alternator (GE-GTA41)

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

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

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

Cooling air for the control / power group and wheel motors, as well as the alternator itself, is provided by dual fans mounted on the alternator shaft.

AC Induction Traction Motorized Wheels

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

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

Suspension

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

Operator's Cab

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

Power Steering

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

Dynamic Retarding

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

Brake System

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

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

In The Operator's Cab - Before Starting The Engine

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

OPERATING THE MACHINE

Starting The Engine

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

Truck Operation - General

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

SPECIAL PRECAUTIONS FOR WORKING ON A 930E TRUCK

Preliminary Procedures before Welding or Performing Maintenance

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

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

⚠DANGER

Anytime the engine is operating:

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

⚠WARNING

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

Normal Engine Shutdown Procedure

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

Engine Shutdown Procedure before Welding or Performing Maintenance

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

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

DYNAMIC RETARDING OPERATION

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

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

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

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

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

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

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

Dynamic Retarder Control Lever

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

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

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

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

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

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

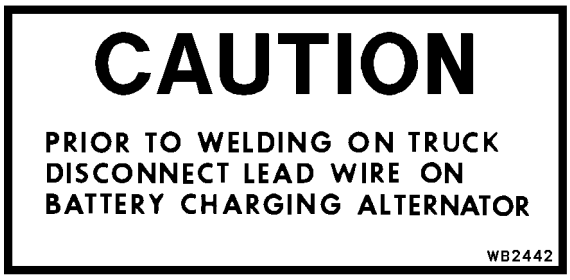
Dynamic Retarder/Service Brake Pedal

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

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

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

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



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

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

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

Only authorized personnel should access this rear housing.

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

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

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

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

Only authorized personnel should access these cabinets.

TABLE XI. PRESSURE CONVERSIONS
Pounds/square inch (psi) To Megapascals (MPa)
Formula: psi x 0.0069 = MPa

PSI	0	10	20	30	40	50	60	70	80	90
0	(MPa)	0.069	0.14	0.21	0.28	0.34	0.41	0.48	0.55	0.62
100	0.69	0.76	0.83	0.90	0.97	1.03	1.10	1.17	1.24	1.31
200	1.38	1.45	1.52	1.59	1.65	1.72	1.79	1.86	1.93	2.00
300	2.07	2.14	2.21	2.28	2.34	2.41	2.48	2.55	2.62	2.69
400	2.76	2.83	2.90	2.96	3.03	3.10	3.17	3.24	3.31	3.38
500	3.45	3.52	3.59	3.65	3.72	3.79	3.86	3.93	4.00	4.07
600	4.14	4.21	4.27	4.34	4.41	4.48	4.55	4.62	4.69	4.76
700	4.83	4.90	4.96	5.03	5.10	5.17	5.24	5.31	5.38	5.45
800	5.52	5.58	5.65	5.72	5.79	5.86	5.93	6.00	6.07	6.14
900	6.21	6.27	6.34	6.41	6.48	6.55	6.62	6.69	6.76	6.83
See NOTE below regarding Table usage										

NOTE: Tables such as Table VIII, IX, X, and XI may be used as in the following example:

Example: Convert 975 psi to kilopascals (kPa).

1. Select Table X.
2. Go to PSI row 90, column 7; read 668.8
   97 psi = 668.8 kPa.
3. Multiply by 10:
   970 psi = 6688 kPa.
4. Go to PSI row 0, column 5; read 34.475
   psi = 34.47 kPa. Add to step 3.
5. 970 + 5 psi = 6688 + 34 = 6722 kPa.

TABLE XII. TEMPERATURE CONVERSIONS
Formula: F° - 32 / 1.8 = C° or C° x 1.8 + 32 = F°

CELSIUS C°		FAHRENHEIT F°	CELSIUS C°		FAHRENHEIT F°	CELSIUS C°		FAHRENHEIT F°
121	250	482	63	145	293	4	40	104
118	245	473	60	140	284	2	35	95
116	240	464	57	135	275	– 1	30	86
113	235	455	54	130	266	– 4	25	77
110	230	446	52	125	257	– 7	20	68
107	225	437	49	120	248	– 9	15	59
104	220	428	46	115	239	– 12	10	50
102	215	419	43	110	230	– 15	5	41
99	210	410	41	105	221	– 18	0	32
96	205	401	38	100	212	– 21	– 5	23
93	200	392	35	95	293	– 23	– 10	14
91	195	383	32	90	194	– 26	– 15	5
88	190	374	29	85	185	– 29	– 20	– 4
85	185	365	27	80	176	– 32	– 25	– 13
82	180	356	24	75	167	– 34	– 30	– 22
79	175	347	21	70	158	– 37	– 35	– 31
77	170	338	18	65	149	– 40	– 40	– 40
74	165	329	15	60	140	– 43	– 45	– 49
71	160	320	13	55	131	– 46	– 50	– 58
68	155	311	10	50	122	– 48	– 55	– 67
66	150	302	7	45	113	– 51	– 60	– 76

NOTE: The numbers in the unmarked columns refer to temperature in either degrees Celsius (C°) or Fahrenheit (F°). Select a number in this unmarked column and read to the left to convert to degrees Celsius (C°) or read to the right to convert to degrees Fahrenheit (F°). If starting with a known temperature (either C° or F°), find that temperature in the **marked** column and read the converted temperature in the center, **unmarked** column.

d. Check exposed portions of all hydraulic cylinder rams for rust, pitting and corrosion. If plating is deteriorated, the cylinder should be removed and overhauled or replaced; pitted or scored plating will cause leakage at the cylinder seals.

8. Check front wheel hub, final drive and wheel axle lubricant. If contamination is suspected, oil should be drained completely and the component serviced with clean prescribed lubricant. If major contamination is present, disassembly and overhaul will be in order.
9. Check parking brake. Since it is spring applied, the brake pads may be stuck tightly to the disc; it may be necessary to remove and overhaul the parking brake assembly.
10. Lubricate all grease fittings with prescribed lubricants which are not part of the automatic lubrication system. Pay particular attention to the steering linkage connections. All pivot points must be free of any binding.
11. Check battery charging alternator for corrosion or deterioration. Alternator rotor must be free, with no binding or roughness. Inspect, install and properly tension the alternator drive belts.
12. Check security of steering cylinder ball joints link and hydraulic connections.
13. Examine Hydrair suspensions for signs of damage.
    a. Discharge nitrogen from suspensions as outlined in the service manual. Check conditon of suspension oil and cylinder wipers. If wipers are cracked or hardened, the suspension must be rebuilt. Recharge suspension with new oil if old oil is deteriorated.
    b. Check exposed chrome portions of cylinder for rust, pitting and corrosion. If plating is deteriorated the suspension should be removed and overhauled or replaced; pitted or scored plating will rapidly cause leakage at the seals.
    c. Recharge suspensions as outlined in the service manual.

If not previously done, install fully-charged batteries and insure that hook-up is correct.

SECTION B

STRUCTURES

INDEX

DUMP BODY

Removal

⚠WARNING

Inspect all lifting devices. Slings, chains, and/or cables used for lifting components must be inspected daily for serviceable condition. Refer to the manufacturer's manual for correct capacities and safety procedures when lifting components. Replace any questionable items.

Slings, chains, and/or cables used for lifting components must be rated to supply a safety factor of approximately 2X the weight being lifted.

When in doubt as to the weight of components or any assembly procedure, contact the Komatsu area representative for further information.

Lifting eyes and hooks should be fabricated from the proper materials and rated to lift the load being placed on them.

Never stand beneath a suspended load. Use of guy ropes are recommended for guiding and positioning a suspended load.

Before raising or lifting the body, be sure there is adequate clearance between the body and overhead structures or electric power lines.

Be sure that the lifting device is rated for at least a 45 ton capacity.

1. Park truck on a hard, level surface and block all the wheels. Connect cables and lifting device to the dump body and take up the slack as shown in Figure 3-1.

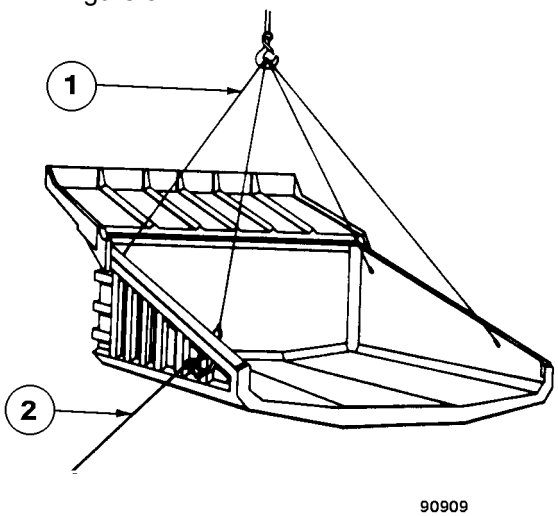


FIGURE 3-1. DUMP BODY REMOVAL

1. Lifting Cables
2. Guide Rope

2. Remove mud flaps and rock ejectors from both sides of the body. Remove electrical cables, lubrication hoses etc. attached to the body.
3. Attach chains around upper end of hoist cylinders to support them after the mounting pins are removed.
4. Remove pin retainer capscrew (4, Figure 3-2) from each of the upper hoist cylinder mounting eyes. With adequate means of supporting the hoist cylinders in place, remove each of the mounting pins (2, Figure 3-2).

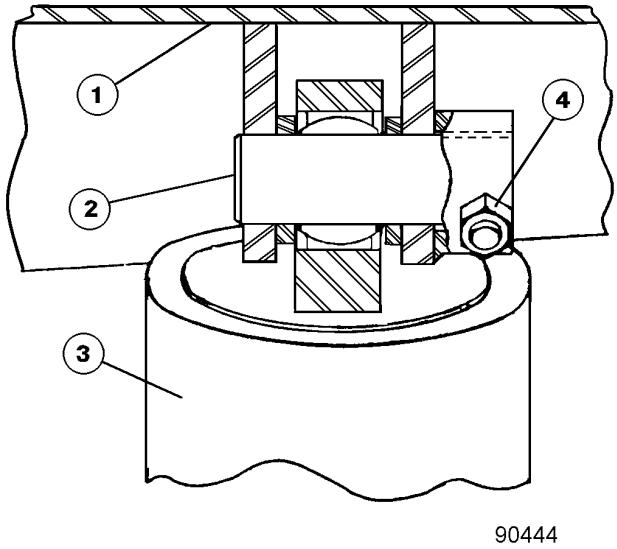


FIGURE 3-2. HOIST CYLINDER MOUNT (UPPER)

1. Dump Body
2. Hoist Cylinder Pin
3. Hoist Cylinder
4. Pin Retainer

5. Remove capscrews (1, Figure 3-3) and lock nuts (2) from each pivot pin.
6. Attach a body pivot pin support fixture to bracket on underside of dump body to aid in supporting the pin as it is removed.

   Remove body pivot pins (3) far enough to allow shims (6) to drop out. Complete removal of pins is not necessary unless new pins are to be installed.
7. Lift dump body clear off the chassis and move to storage or work area. Block the body to prevent damage to the body guide etc.
8. Inspect bushings (5, 8, & 9), body ear (4), and frame pivot (7) for excessive wear or damage.

FUEL GAUGE SENDER

A fuel gauge sending unit (9, Figure 4-1) mounted on the side of the tank provides an electrical signal to operate the fuel gauge on the instrument panel.

Removal

1. Drain the fuel below the level of the gauge sender.
2. Disconnect the wire from the terminal.
3. Loosen the small screws holding the fuel gauge sender unit and carefully remove.

Installation

1. Clean mating surfaces, and install a new gasket.
2. Reinstall the sender unit in the tank. Use care and ensure that the float is oriented properly and works freely in the vertical plane during installation.
3. Reinstall the four socket head capscrews and tighten to standard torque. Reconnect the wire to the terminal.
4. Refill the tank and check for leaks.

LOW FUEL SWITCH

Low fuel switch (13, Figure 4-1) controls the low fuel level indicator on the overhead warning indicator light panel in the operator cab. The switch is calibrated to turn on the low fuel indicator when the usable fuel remaining in the tank is approximately 25 gallons (95 liters).

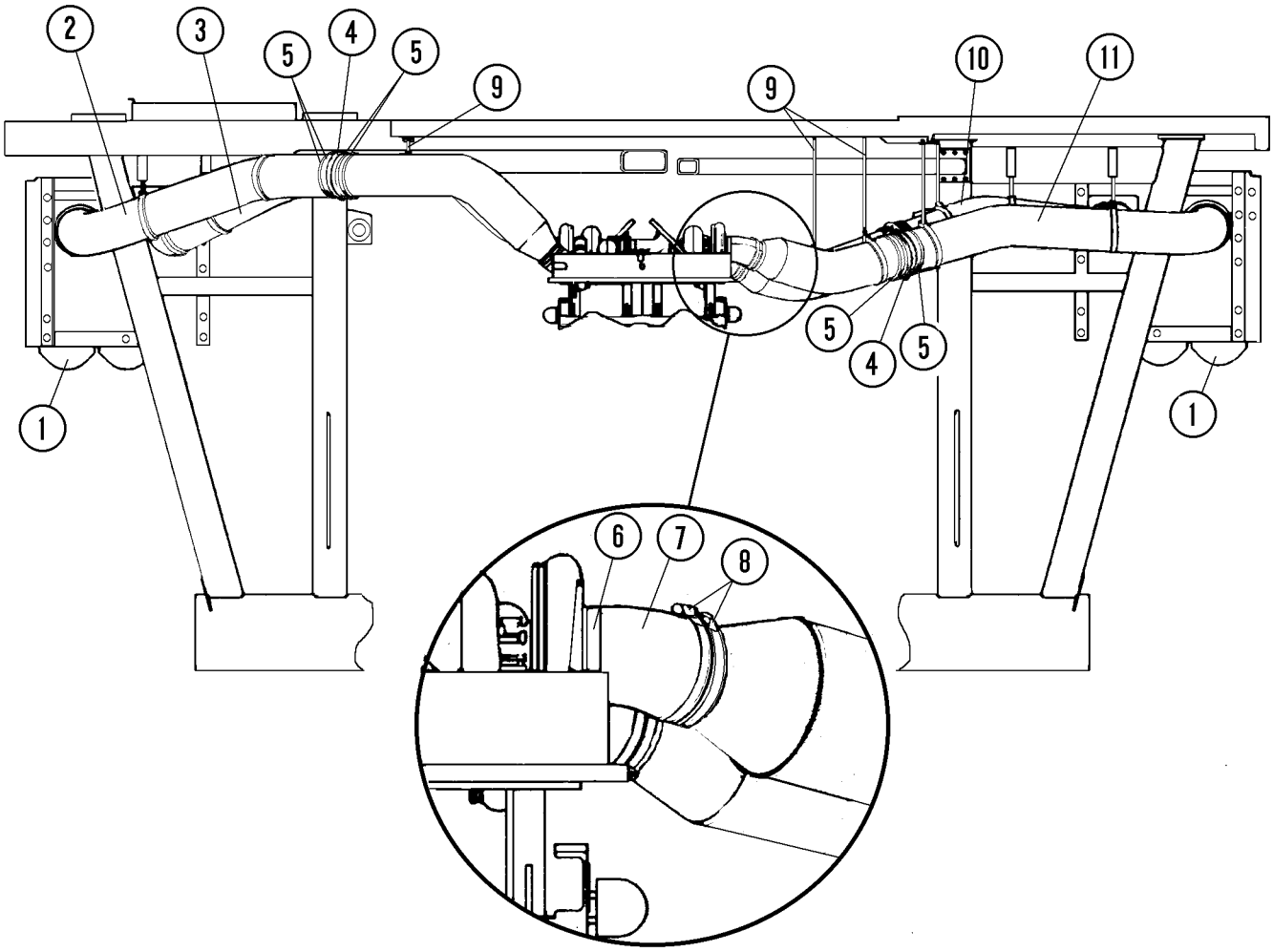


FIGURE 2-3. ENGINE AIR INLET PIPING

1. Air Cleaner Assemblies
2. Left Rear Intake Duct
3. Left Front Intake Duct
4. Hump Hose
5. T-Bolt Clamp
6. T-Bolt Clamp
7. Reducer Elbow
8. T-Bolt Clamp
9. Duct Support Rod
10. Right Front Intake Duct
11. Right Rear Intake Duct

10. Remove the upper radiator side support rods (4, Figure 3-1). Remove lower support rods (5).
11. Remove nuts, lockwashers, flat washers and capscrews (2, Figure 3-6) from power module subframe (3) at the lower radiator mounts.
12. Verify all hoses and wiring harnesses have been removed. Lift radiator slightly with the hoist, move assembly forward until clear of engine fan. Move radiator to work area for service.

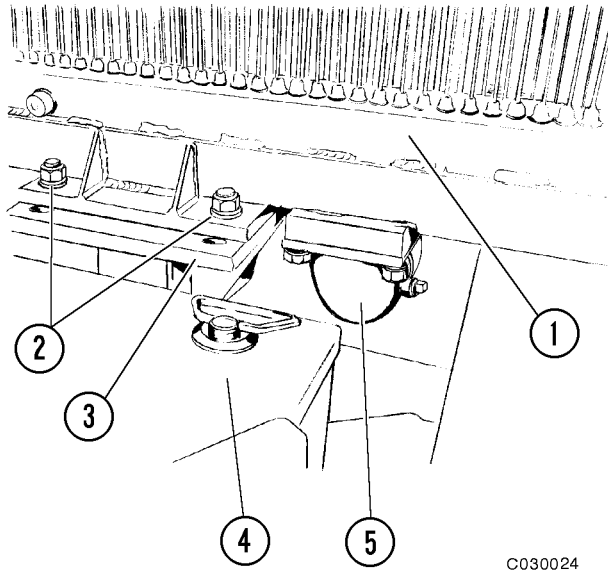


FIGURE 3-6. RADIATOR MOUNT

1. Radiator
2. Mounting Hardware
3. Subframe
4. Battery Box
5. Outlet Elbow

Installation - Radiator

1. Attach a hoist to the radiator assembly and lift into position on the subframe.
2. Insert the capscrews, washers, and nuts (2, Figure 3-6) at the lower radiator mounting brackets but do not tighten at this time.
3. Inspect rubber bushings for lower support rods (5, Figure 3-1) and replace if worn or damaged. Install flatwashers, rubber bushings and nuts on the lower end of radiator support rods and insert rods into the subframe mounting brackets. Insert remaining bushings, flatwashers and locknuts but do not tighten. Install rods at radiator brackets and tighten to standard torque.
4. Install upper support rods (4) and mounting hardware at radiator brackets and front upright brackets. Do not tighten at this time.
5. Adjust the lower stabilizer support rods to position the radiator perpendicular to the subframe within ± 0.12 in. (3.0 mm) measured at top of radiator. When position is established, tighten locknuts to **525 ft. lbs (712 N.m)** to lock adjustment.
6. Tighten upper support rod mounts and recheck perpendicularity of radiator.
7. Tighten nuts on capscrews (2, Figure 3-6) at lower radiator mounting brackets to standard torque.
8. Install the fan guard using capscrews and washers removed during disassembly.
9. Install upper radiator hoses and lines between radiator and engine, seat hoses fully and tighten clamps securely.
10. Install lower radiator hoses and lines between radiator and engine, seat hoses fully and tighten clamps. If outlet elbows (2 & 4, Figure 3-3) have been removed during radiator removal, install new gaskets during installation.
11. Route hoses to fuel cooler, clamp in place and attach to fuel cooler fittings.
12. Reinstall air conditioning system components:
    a. Install condenser, condenser hoses, and clamps.
    b. Install receiver/drier and clamp hoses. Attach wires to low pressure switch.
    c. Clamp all hoses and wiring to studs using clamps removed during disassembly. Refer to Section N, Operator Comfort, for complete instructions to evacuate and recharge the air conditioning system refrigerant supply.
13. Install grille and hood according to instructions in Section B, Structural Components.
14. Make sure all coolant drains are closed, pipe plugs installed, and all hoses installed. Service cooling system with the proper mixture of antifreeze as recommended in Section P, Lubrication and Service Check for static leakage and correct any leaks. Start engine and run until cooling system reaches operating temperature, recheck the cooling system for leakage during engine operation.

ENGINE/ALTERNATOR MATING

⚠ IMPORTANT ⚠

The following instructions must be followed to ensure proper alignment and engine crankshaft endplay. Failure to follow these instructions can result in serious damage to the engine and/or alternator.

General Instructions

- Never pry on the engine crankshaft damper!
- Loosen or remove fan belts prior to measuring crankshaft end-play to insure that the crankshaft moves easily and completely.
- When taking measurements, always take four equally spaced readings and average them.
- Always measure from mating surface to mating surface.
- References to crankshaft rotation; clockwise (CW), or counterclockwise (CCW), is the direction of rotation when looking at the front (damper end) of engine.
- **Crankshaft end-play: 0.13 - 0.38 mm (0.005 - 0.015 in.)**

SERVICE DATA - Eccentricity & Runout Limits	
Description	**T.I.R**
Max. Flywheel Housing Bore Eccentricity	0.66 mm
Max. Face Runout Flywheel Housing	0.25 mm
Max. Eccentricity of Flywheel (Coupling Assy.)	0.18 mm
Max. Axial Runout of Flywheel Face (Coupling Assy.)	0.25 mm

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Measuring Procedure

1. Thoroughly clean the alternator housing mounting surface, rotor drive adapter mounting surface and flywheel housing adapter mounting surfaces.
2. With magnetic base mounted on the front of the engine and the dial indicator on the front of the crankshaft, measure total crankshaft end-play:

   ❑ Verify end play is within 0.13 - 0.38 mm (0.005 - 0.015 in.)

   Record Total Crankshaft End_____
3. Refer to Figure 4-4. Move the engine crankshaft to the rear of its end travel.

   a. Carefully measure Dimension “C” at four locations, 90° apart:
   1st measurement:_____
   2nd measurement:_____
   3rd measurement:_____
   4th measurement:_____
   Dimension “C”: Average_____

   b. Add 1/2 (one-half) of Total End-play (Step 2).

   c. Record (a + b) as;
   ”Measurement C”:_____

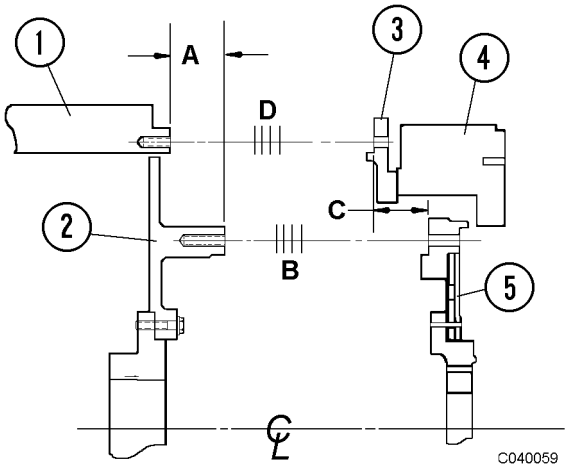


FIGURE 4-4. SHIM LOCATION

1. Alternator Housing
2. Alternator Rotor
3. Flywheel Housing Adapter
4. Engine Flywheel Housing
5. Engine Drive Ring

“A” - Dimension “A”
“B” - Drive Shims
“C” - Dimension “C”
“D” - Housing Shims

5. Submerge precleaner section (see Figure 5-6.) in a solution of Donaldson D-1400 and warm water (mix solution according to package directions). Tube section must be down. Soak for 30 minutes, remove from solution and rinse thoroughly with fresh water and blow dry.
6. Severe plugging may require the use of an Oakite 202 and water solution. The solution should be mixed 50% Oakite 202 and 50% fresh water. Soak precleaner section for 30 minutes, rinse clean with fresh water and blow dry completely.
7. Check precleaner gaskets carefully for any evidence of air leaks and replace if necessary
8. Install precleaner section, with serviceable gaskets, on air cleaner assembly and install all mounting hardware removed.
9. With a serviceable gasket, install dust collector cup assembly on precleaner section and secure with mounting clamps.

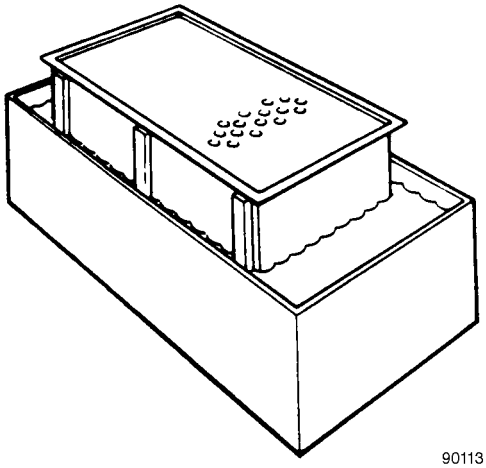


FIGURE 5-6. WASHING AND SOAKING PRECLEANER SECTION

AIR INTAKE TROUBLESHOOTING

To insure maximum engine protection, be sure that all connections between air cleaners and engine intake are tight and positively sealed. If air leaks are suspected, check the following:

1. All intake lines, tubes and hump hoses for breaks, cracks, holes, etc., which could allow an intake air leak.
2. Check all air cleaner gaskets for positive sealing.
3. Check air cleaner elements, main and safety, for ruptures, holes or cracks.
4. Check air cleaner assembly for structural damage, cracks, breaks or other defects which could allow air leakage. Check all mounting hardware for tightness.

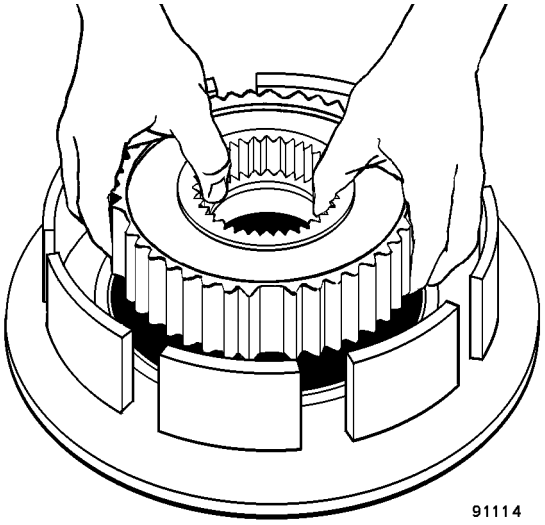


FIGURE 7-6.

5. Remove clutch hub (29).

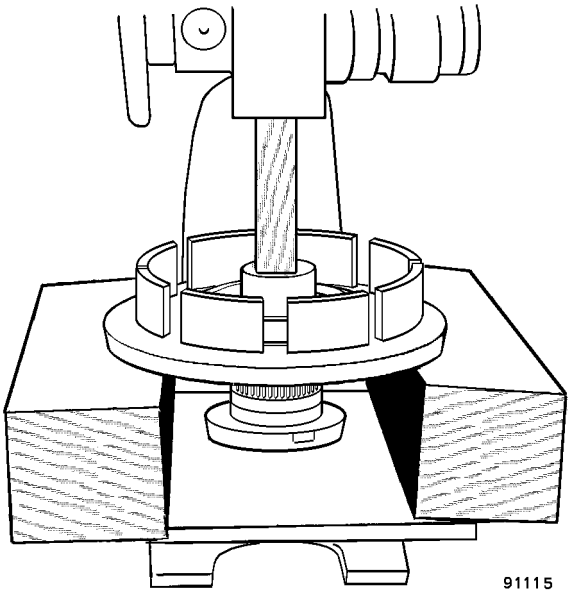


FIGURE 7-7.

6. Position the sub-assembly beneath the ram of a press. Support the assembly beneath the bearing retainer as close as possible to fan mounting hub (42). Press the fan mounting hub out of the front bearing using tooling (B).

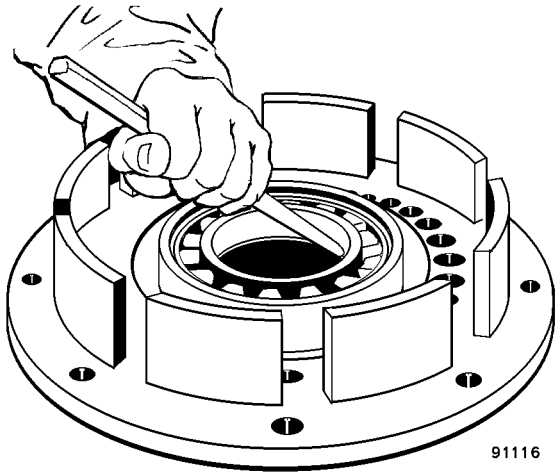


FIGURE 7-8.

7. Remove front oil seal (36).

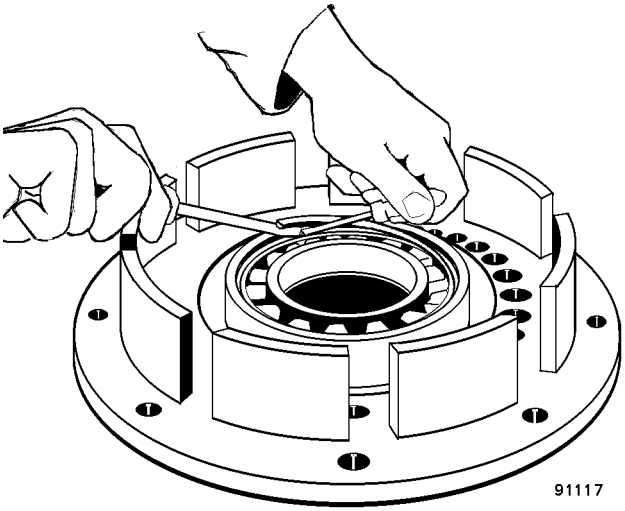


FIGURE 7-9.

8. Remove internal snap ring (32).

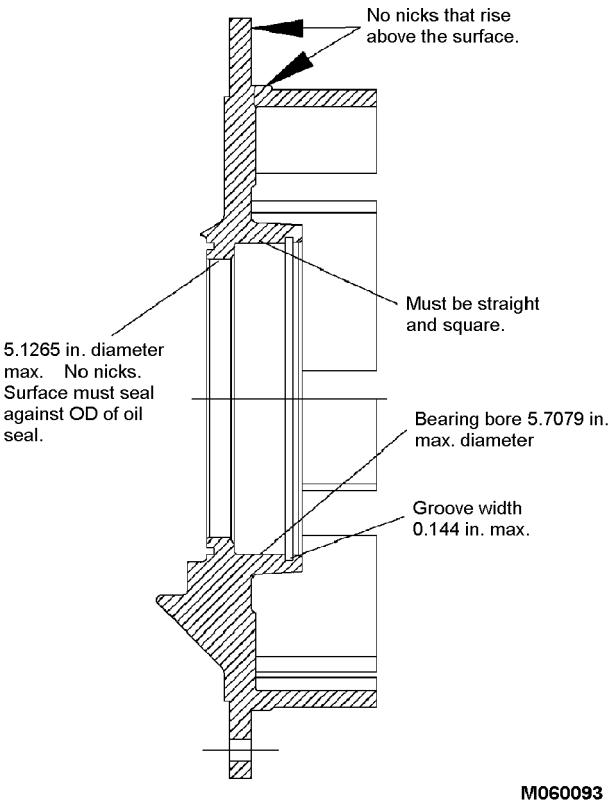


FIGURE 7-37.

11. Inspect front bearing retainer (35).
12. Inspect end cap (45) for any wear or raised nicks.

tube to approximately 0.75 in. (20 mm) from the end.

Push the pitot tubes to the bottom of the hole. The outer end of the tube should be located well within the pulley-locating shoulder of the bearing retainer. Rotate the tube so the open, bent end faces in a counter-clockwise direction, and is *exactly* parallel to the surface of the bearing retainer. (A large phillips-head screwdriver inserted in the end of the tube can be conveniently used as an alignment gage).

Install the second pitot tube in the same manner as the first. Stake each pitot tube in three places, (at the 9, 12, and 3 o'clock positions) to prevent the tubes from rotating in operation.

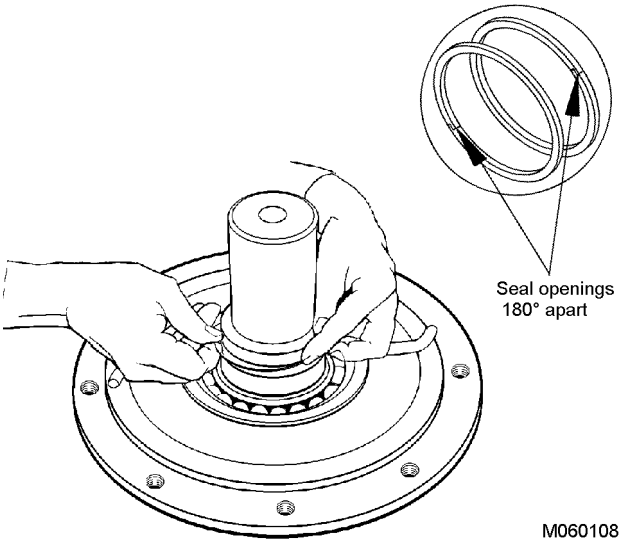


FIGURE 7-65.

25. Install both hook-type seal rings (17) in the grooves in the shaft. Rotate the rings so the slits in the rings are 180° apart from one another.

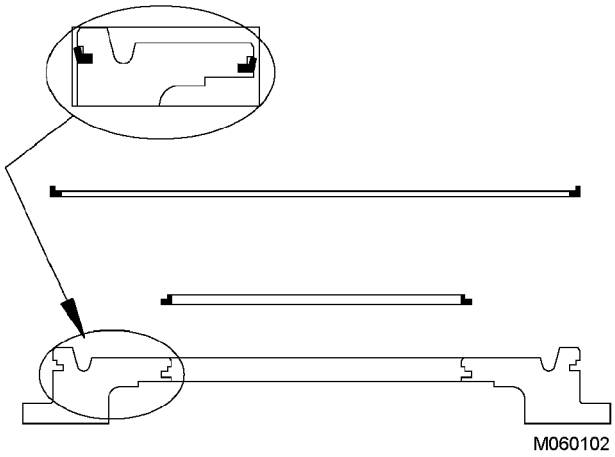


FIGURE 7-66.

26. Install small seal ring (24) in the inside groove, and large seal ring (22) in the outside groove of piston (23). Lubricate the seal ring grooves with an oil-soluble lubricant such as engine assembly grease before installation. Refer to the Figure 7-66 for proper orientation.

FIGURE 7-67.

27. Lubricate the external surfaces of seal rings (22 & 24) with an oil-soluble lubricant such as engine assembly grease. Also, lubricate the seal mating surfaces in the pulley adapter.

24VDC ELECTRIC SUPPLY SYSTEM

ELECTRICAL SYSTEM DESCRIPTION

The truck utilizes a 24VDC electrical system which supplies power for engine starting circuits and most non-propulsion electrical components. The 24VDC engine starting circuit is supplied by four, heavy duty Type 8D, 12 volt storage batteries. Several components require 12VDC and are supplied by circuits tapped off the starting batteries. Two, smaller, 12VDC batteries (Group 31Type) supply 24VDC for the non-propulsion components; engine control system, circuit relays, indicator lamps, etc.

The batteries are of the lead-acid type, each containing six 2-volt cells. With the engine off, power is supplied by batteries. During engine cranking, power is supplied by the four engine cranking batteries only. When the engine is running, power is supplied by an engine driven high capacity alternator.

⚠DANGER

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

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 shut down.

BATTERIES

Maintenance and Service

The electrolyte level of each cell should be checked at the interval specified in the Lubrication and Service Section P, and water added if necessary. The proper level to maintain is 3/8 to 1/2 in. (10-13 mm) above the plates. To insure maximum battery life, use only distilled water or water recommended by the battery manufacturer. After adding water in freezing weather, operate the engine for at least 30 minutes to thoroughly mix the electrolyte.

⚠DANGER

DO NOT SMOKE or allow flame around a dead battery or during the recharging operation. The expelled gas from a dead cell is extremely explosive.

Excessive consumption of water indicates leakage or overcharging. Normal water usage for a unit operating eight hours per day is about one to two ounces per cell per month. For heavy duty operation (24 hour) normal consumption should run about one to two ounces per cell per week. Any appreciable increase over these figures should be considered a danger signal.

Troubleshooting

Two most common troubles that occur in the charging system are undercharging and overcharging of the truck's batteries.

An undercharged battery is incapable of providing sufficient power to the truck's electrical system.

Some possible causes for an undercharged battery are:

- Sulfated battery plates
- Loose or corroded battery connections
- Defective wire in electrical system
- Loose alternator drive belt
- A defective alternator

Overcharging, which causes overheating, is first indicated by excessive use of water. If allowed to continue, cell covers will push up at the positive ends and in extreme cases the battery container will become distorted and cracked.

Leakage can be detected by continual wetness of the battery or excessive corrosion of the terminals, battery carrier and surrounding area. (A slight amount of corrosion is normal in lead-acid batteries). Inspect the case, covers and sealing compound for holes, cracks or other signs of leakage. Check battery hold down connections to make sure the tension is not great enough to crack the battery, or loose enough to allow vibration to open the seams. A leaking battery should be replaced.

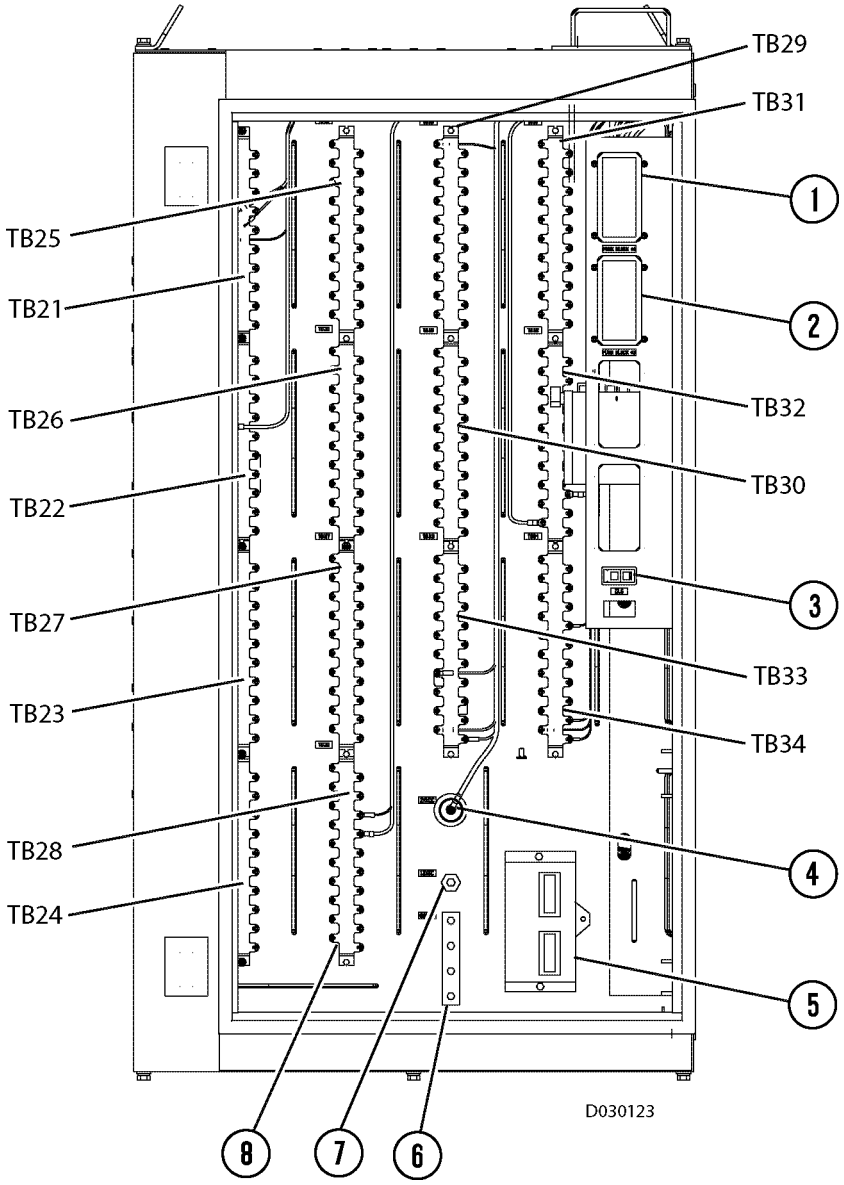


FIGURE 3-1. AUXILIARY CONTROL CABINET - BACK WALL

1. Fuse Block 1
2. Fuse Block 2
3. Dome Light Switch
4. Terminal - 24VDC
5. Pulse Voltage Monitor (PVM)
6. Ground Block (GB31)
7. Terminal - 12VDC
8. Terminal Boards (TB21-TB34)

RELAY BOARD FUNCTIONS

The following describes the components and functions of each relay board.

Relay Board 1 (RB1)

1 - Flasher Power Light (Green): This light will be "ON" when the turn signals or hazard lights are activated.

- ❑ 1 light will be "ON" during right turn signal operation
- ❑ 2 light will be "ON" during left turn signal operation
- ❑ 3 light will be on when clearance lights are activated.
- ❑ 4 light will be flashing when the turn signals or hazard lights are in operation.

NOTE: If circuit breakers (CB13 & CB15) are in the off position, no warning will be noticed until the clearance light switch is turned "ON".

1 - Flasher Module card.

3 - 15 amp circuit breakers (CB13, CB14, CB15)

4 - Relays

- Left Turn Light Relay (K1)
- Right Turn Light Relay (K2)
- Clearance Lights Relay (K3)
- Flasher Relay (K4)

Relay Board 3 (RB3)

1 - Light Module Display card

1 - Rev Light (Green): This light is "ON" whenever the selector switch is in the "reverse" position, and the key switch is in the "ON" position.

4 - 15 amp circuit breakers (CB16, CB17, CB18, CB19)

4 - Relays

- Manual Back-up Lights Relay (K1)
- Stop Lights Relay (K2)
- Retard Lights Relay (K3)
- Slippery Road Relay (K4) (Not used)

Relay Board 4 (RB4)

1- Steering Pressure Bleed Down Timer Module card.

1 - Bleed Down Light (Green): This light is "ON" when the bleeddown solenoid is being energized. The bleeddown timer will energize the solenoid for 90 seconds after key switch is turned "OFF".

2 - 5 amp circuit breakers (CB20, CB22)

1 - 15 amp circuit breaker (CB21)

4 - Relays

- Park Brake Failure Relay (K1)
- Engine Cranking Oil Pressure Interlock Relay (K2)
- Horn Relay (K3)
- Body Up Relay (K4)

Relay Board 5 (RB5)

1 - Light Display Module card

1 - Lights Control Light (Green): This light is "ON" when 24 volts is being supplied to the battery terminal of the light switch.

5 - 15 amp circuit breakers (CB23, CB24, CB25, CB26, CB27)

4 - Relays

- Left Low Beam Relay (K1)
- Right Low Beam Relay (K2)
- Left High Beam Relay (K3)
- Right High Beam Relay (K4)

BATTERY CHARGING SYSTEM (Niehoff)

General Description

The Niehoff model N1227 or C609 (Figure 10-1) is a heavy duty, 24 VDC unit rated at 240 amps. A solid state voltage regulator (6) mounted externally on the end housing assembly provides voltage control during operation. A single output connection (5) is located on the face of the control unit (4) for connection to the truck battery positive circuit. The ground circuit cable can be attached to either of two terminals (10) located on the front housing. A fan guard (7) protects maintenance personnel from the rotating fan when the engine is operating.

TROUBLESHOOTING PROCEDURES (On-Truck)

Most 24 volt charging system problems can be diagnosed with the alternator installed on the truck, operating under normal conditions. Many problems can be attributed to loose or corroded cable connectors. It is essential that all battery charging circuit cables are in satisfactory condition and all connections are clean and securely tightened.

Equipment Required:

- Belt tension scale
- Voltmeter, 0 - 40 volt range
- Ammeter, 0 - 400 amp range

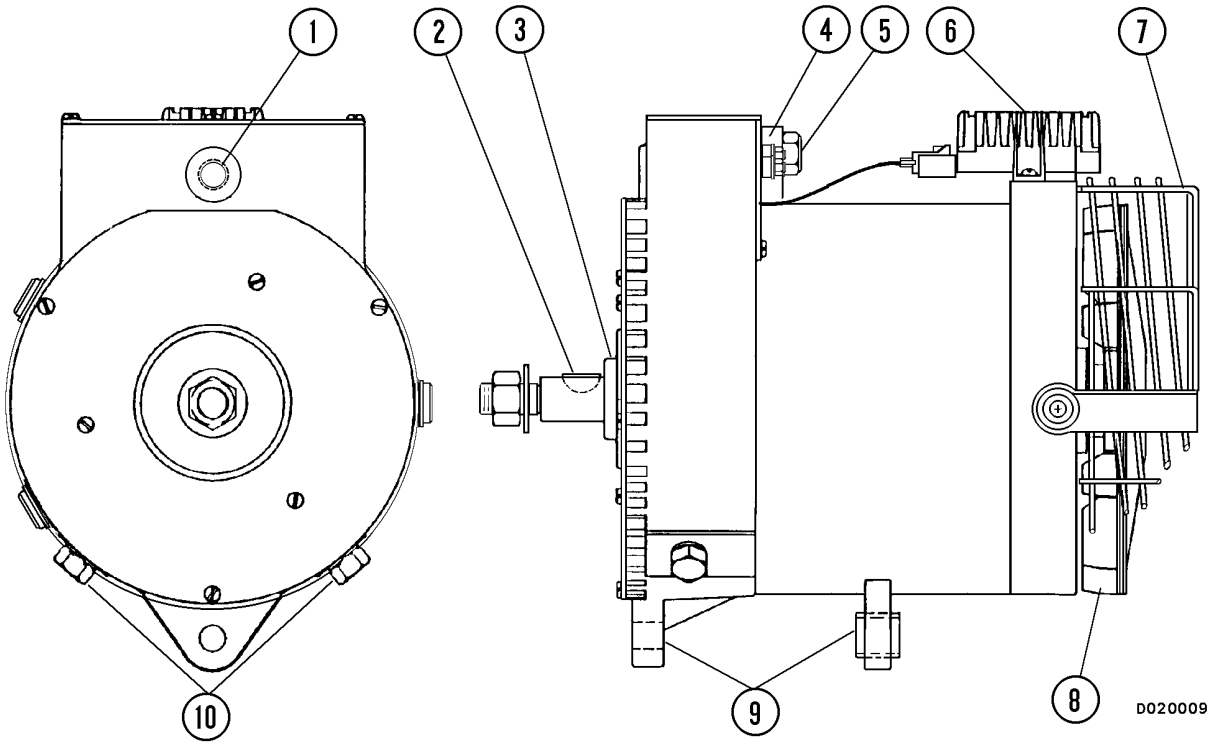


FIGURE 10-1. ALTERNATOR EXTERIOR

1. Belt Tension Adjustment Capscrew
2. Shaft Key
3. Pulley Bushing
4. Control Unit
5. Battery Positive Terminal
6. Voltage Regulator
7. Fan Guard
8. Cooling Fan Assembly
9. Mounting Lugs
10. Ground Terminals

SERVICE PARTS

Ref No.	Part No.	Qty.	Description
1	BF3715	1	LOCKNUT (1)
2	BF1997	1	FLAT WASHER (1)
3	EF3527	1	PULLEY
4	BF1966	1	BUSHING, PULLEY
5	BF1989	1	RING, RETAINER (1)
6	BF1968	1	BEARING, FRONT
7	BF1988	1	RING, RETAINER (1)
8	BF1990	15	SCREW, PAN HEAD - #8 - 32NC X 3/8" (1)
9	BF1970	1	PLATE, COVER
9.a	BF3712	1	HOUSING, FRONT
10	BF2002	18	NUT - (SPECIAL)
11	BF1969	1	COVER, CONTROL UNIT
12	BF1972	1	TERMINAL, OUTPUT
13	BF1971	1	CONTROL UNIT
14	BF3716	1	BOLT (+) - 5/16" - 18NC X 3/4"
15	BF1995	1	LOCKWASHER - 5/16" (1)
16	BF1996	1	FLAT WASHER (1)
17	BF3717	1	LOCKWASHER (1)
18	BF3718	1	CAPSCREW - 1/2" - 13NC X 1" (1)
19	BF3720	1	KEY WOODRUFF (1)
20	BF1973	1	SHAFT/CORE/ROTOR ASSEMBLY
20.a	BF1974	2	ROTOR ASSEMBLY
20.b	BF1975	1	SHAFT/CORE ASSEMBLY
20.c	BF3713	2	RING, RETAINING
21	BF1992	2	LOCKWASHER (1)
22	BF1991	2	CAPSCREW - 3/8" - 16NC X 5/8" (1)
23	BF3719	12	CAPSCREW - #10 - 32NF X 1/2" (1)
24	BF3721	9	NUT - #8 - 32NC (1)
25	BF1976	1	SHELL/STATOR/FIELD ASSEMBLY
25.a	BF1977	1	STATOR, FRONT
25.b	BF1980	9	STUD
25.c		1	SHELL (2)
25.d	BF1981	1	BUSHING, TENSION
25.e	BF1978	1	COIL
25.f	BF1979	1	STATOR, REAR
26	BF3722	18	SCREW, PAN HEAD - #6 - 32NF X 3/8" (1)
27	BF3723	9	NUT - #8 (1)
28	BF1982	1	HOUSING, END
29	BF1983	1	BEARING, REAR
30	BF3724	2	SCREW, LOCK - #10 - 32NC X 5/8" (1)
31	BF1962	1	REGULATOR
32	BF3714	1	O-RING
33	BF1985	1	FAN
34	BF2003	1	FLAT WASHER (HARDENED) (1)
35	BF2004	1	LOCKNUT - 1/4" - 20NF (1)
36	BF1961	1	GUARD, FAN
37	BF3725	3	SCREW, SOCKET HEAD - #10 - 32NF X 7/8" (1)

NOTE: (1) NOT SERVICED SEPARATELY - SUPPLIED ONLY IN BF1986 KIT.NOTE: (2) NOT SOLD SEPARATELY

Front Housing Removal

Note: All control box and front housing connections are coated with RTV Silicone Rubber. Remove RTV Silicone Rubber as alternator is disassembled.

1. Remove five screws from control box cover.
2. Remove control box cover (Figure 10-17 A).
3. Loosen terminal strip screws and disconnect 2 field leads (white wires) from control box terminal strip.
4. Remove six screws from front housing cover plate (Figure 10-17 B).
5. Remove front housing cover plate.
6. Remove the six nuts holding phase leads (black wires) to diode studs (Figure 10-17 C).
7. Remove the six phase leads from the diode studs and push the phase leads back through the large openings in front housing (this will facilitate separation of front housing from tube).
8. Remove nine flanged locknuts from stator/tube assembly studs at front of front housing.

Note: The Front housing is attached to the rotor/shaft core assembly.

9. Separate front housing with the rotor/shaft/core assembly from the stator/tube assembly. Light taps with a soft faced mallet will help in the separation of parts.
10. Support front housing on wood blocks. Using a press, press shaft through front housing bearing.

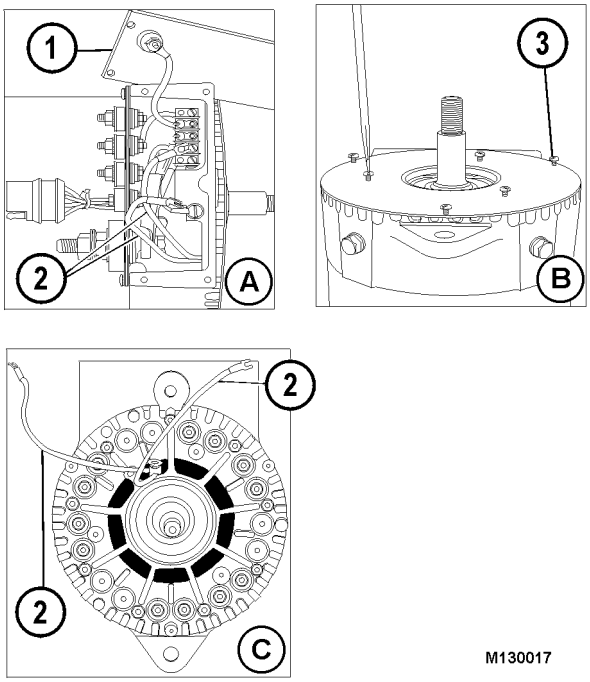


FIGURE 10-17.

1. Cover
2. Field Leads (white wires)
3. Front Cover Screw

Rear Bearing Assembly

1. Assembly alternator, including end housing, but leave out rear bearing and fan. Make sure mounting feet are aligned.Install front pulley bushing on shaft.
2. There are two types of rear bearing systems used: press fit and loose fit.

Press Fit Bearings

Stand alternator on front end, in a press, supporting the front bearing bushing. Insert bearing over rear end of shaft. Place bearing insertion tool (part of BF4821 package) over bearing and press until inner race of bearing is seated onto shaft shoulder (Figure 10-41). Use caution when bearing outer race begins to enter end housing bore because misalignment at this point can damage housing.

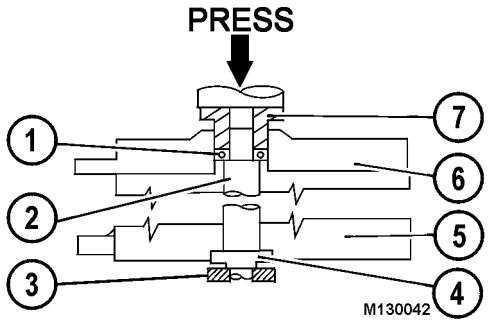


FIGURE 10-41.

1. Ball Bearing
2. Shaft
3. Support
4. Bushing
5. Front Housing
6. End Housing
7. BF4821 Insertion Tool

Loose Fit Bearings

Before starting installation of loose fit rear bearings, check that O-ring is greased (grease with Amoco Rykon or equivalent) and properly installed in O-ring groove in housing bore. Continue with bearing installation as above.

3. Turn shaft by hand to make sure it spins freely. Fan and fan hardware can now be installed.

Regulator Assembly

1. Set regulator on rear housing with regulator plug toward control box.
2. Using mounting hardware (coated with Loctite), attach regulator to end housing (Figure 10-42). Torque screw to **32 in. lbs. (3.6 N.m)** maximum.
3. Connect regulator to regulator harness from control unit.

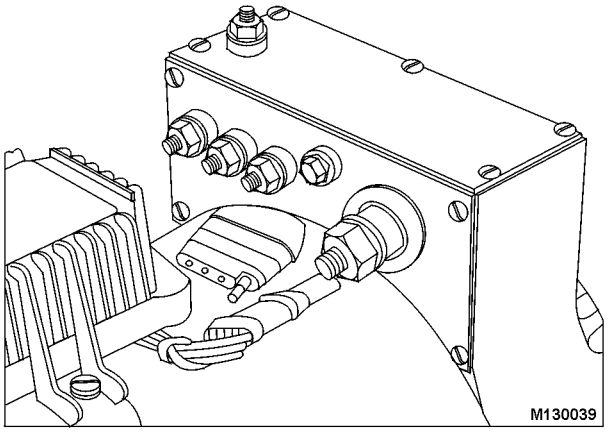


FIGURE 10-42.

ELECTRICAL PROPULSION SYSTEM COMPONENTS

The following information provides a brief description of system operation and major components of the AC propulsion system. Refer to the appropriate GE publication for detailed information and theory of operation.

A list of commonly used propulsion system component abbreviations is listed in Table V at the end of this Section. Figures 2-3 through 2-11 illustrate the physical location of these components where applicable.

GENERAL SYSTEM DESCRIPTION

The AC drive system consists of the following major components:

- Alternator coupled to a diesel engine
- In-line Cooling Blower
- Gate Drive Power Converters
- Main Rectifier
- AC Power Inverters
- AC Induction Traction Motors

The Alternator supplies three phase power for the Gate Drive Power Converters and Main Rectifier. The Main Rectifier supplies DC power to two AC Power Inverters. Each AC Power Inverter inverts the rectified DC voltage, delivering variable voltage, variable frequency power to each of the AC Induction Traction Motors.

Refer to the diagram in Figure 2-1 for the following description.

The two AC Induction Traction Motors, each with its own Inverter, are connected in parallel across the rectified output of the Alternator. The Inverters change the rectified voltage back to AC by turning on and off (chopping) the applied DC voltage.

The output AC voltage and frequency are controlled to produce optimum slip and efficiency in the traction motors. At low speeds, the rectified alternator output (DC link, or DC bus) voltage is chopped with patterns called pulse width modulation (PWM) inverter operation. At higher speeds, the DC link voltage is applied to the motors using square wave inverter operation. The voltage of the DC link is dependent upon the Propulsion System Controller (PSC) and engine RPM during propulsion. The link voltage will vary between 600 and 1400 volts during propulsion and 600 and 1500 volts during retarding.

The alternator field is supplied from a tertiary winding on the alternator and is controlled by a silicon controlled rectifier (SCR) bridge. A starting boost circuit initially energizes the alternator from the truck batteries until the flux builds up enough to sustain excitation.

Cooling air for the Alternator, Control Cabinet and traction motors is supplied by a dual in-line fan assembly mounted on the rear of the alternator. This blower provides cooling air to the traction motors, propulsion inverters, dynamic retarding choppers, and auxiliary inverter.

A resistor grid package is used to dissipate power from the traction motors (operating as generators) when in dynamic retarding mode. The total retard power produced by the traction motors is controlled by the two motor Inverters. The amount of retard power dissipated by the grid package is controlled by a GTO Chopper circuit and stage-controlled contactors.

The PSC, mounted in the main Electrical Control Cabinet, determines optimum engine operating speeds based on what the operator requests, propulsion system requirements, and efficient fuel usage. Interfaces between the PSC and the truck brake system allow the PSC to provide proper retarding, braking, and wheel slide control.

The PSC interfaces with the Truck Control Interface (TCI), mounted in the same card rack as the PSC. System status and control signals are transmitted and received between these two components to access real time data and event information stored in the PSC for displaying on a Diagnostic Information Display (DID), located in the cab behind the operator's seat.

TABLE II: DID PANEL FAULT CODES
(Codes Received from PSC)

EVENT NUMBER		EVENT DESCRIPTION	EVENT RESTRICTION	DETECTION INFORMATION
	:09	chopper GTO temp	Speed limit	Temp out of range.
	:10	chopper diode temp		Temp out of range.
	:11	left GTO module temp		Temp out of range.
	:12	left diode temp		Temp out of range.
	:13	right GTO module temp		Temp out of range.
	:14	right diode temp		Temp out of range.
	:15	rectifier diode temp		Temp out of range.
070		LINK CAPACITANCE LEVEL LOW	SYS Event	Link capacitance level low, but OK
071		LINK CAPACITANCE LEVEL TOO LOW	Speed Limit	Link capacitance level too low
072		GROUND FAULT CIRCUIT	Speed Limit	Ground fault detection circuit
074		INV1 COMM FAILED	INV1 Disable	
	:01	No communication Inverter #1		
	:02	Inverter #1 customer option bit		
075		INV2 COMM FAILED	INV2 Disable	
	:01	No communication Inverter #2		
	:02	Inverter #2 customer option bit		
076		FB173 CARD	No power	FB173 card failure
	:01	speed FPGA DL		
	:02	speed FPGA run		
	:03	ALT FPGA DL		
	:04	Microcontroller		
	:05	slow task		
	:06	med task		
	:07	fast task		
	:08	FD task		
	:09	Alternator 3 phase volts bad		
	:10	alt FPGA timeout		
077		INVERTER FAILED VI TEST	No power	Inverter failed during test.
078		Inverter Background Communication Failure	Sys Event	A failure in the inverter background communication was detected.
084		CONTROL POWER SWITCH OFF	SYS Event	Control Power Switch is turned off while truck is moving.
085		AUX COOLING	SYS Event	A fault has occurred in the auxiliary blower operation.
	:02	aux rpmfb input		Rpm of Aux Blower out of range.
	:03	aux rpm feedback		Rpm feedback does not match rpm command.
	:04	abnormal shutdown		A fault occurred during shutdown
087		HP LOW		Horsepower adjust is at negative limit for 30 seconds.

TABLE III: DID PANEL FAULT CODES (Codes Received from Inverter 1, 2)				
EVENT NUMBER		**EVENT DESCRIPTION**	**EVENT RESTRICTION**	**DETECTION INFORMATION**
135/235		INVERTER, PHASE C+/C-	INV1 (INV2) off	
	:01	alarm CP		Phase C positive GTO did not turn off
	:02	Cup fb not off		Phase C up feedback not off
	:03	phase C modl pos		Phase C positive module failed
	:04	hold CP		Phase C positive and negative GTOs on (positive turn on)
	:05	Cup fb not on		Phase C up feedback not on
	:06	Cup GTO not on		Phase C positive GTO did not turn on
	:07	IGBT_PS_CP		IGBT protective shutoff
136/236		INVERTER, PHASE C+	None	
	:02	Cup temp short		Phase C up thermistor short
	:03	Cup temp open		Phase C up thermistor open
	:04	Cup temp warm		Phase C up thermistor warm
	:05	Cup temp hot		Phase C up thermistor hot
	:06	Cup fb not off S		Phase C up not off with enable/DC volts
137/237		INVERTER, PHASE C-	INV1 (INV2) off	
	:01	alarm CN		Phase C negative GTO did not turn off
	:02	Cdn fb not off		Phase C down feedback not off
	:03	phase C modl neg		Phase C negative module failed
	:04	hold CN		Phase C positive and negative GTOs on (negative turn on)
	:05	Cdn fb not on		Phase C down feedback not on
	:06	Cdn GTO not on		Phase C negative GTO did not turn on
	:07	IGBT_PS_CN		IGBT protective shutoff
138/238		INVERTER, PHASE C- (NR)	None	
	:02	Cdn temp short		Phase C down thermistor short
	:03	Cdn temp open		Phase C down thermistor open
	:04	Cdn temp warm		Phase C down thermistor warm
	:05	Cdn temp hot		Phase C down thermistor hot
	:06	Cdn fb not off S		Phase C down not off with enable/DC volts
141/241		INVERTER, PHASE C VOLTS	INV1 (INV2) off	
	:01	V sensor phase C		Phase C voltage sensor failed
	:02	VC not ok		Phase C voltage too high

Transition from Ready State to Retard State:

The system will transition from Ready state to Retard state if truck speed is such that retard is allowed and at least one of the following conditions exists:

1. The retard pedal or lever is pressed such that a significant amount of retarding effort is requested.
2. All of the following conditions are true:
   a. Retard speed control is selected.
   b. Truck speed exceeds the set retard speed, or the truck is accelerating such that the truck speed will soon exceed the set retard speed if no action is taken.
   c. One or both of the following conditions are true:
      1.) The accel pedal is not pressed, or
      2.) The truck is configured such that accel pedal signal does not override retard speed control.
3. Truck speed is greater than or equal to motor overspeed limit. Overspeed will not be engaged such that it prevents the truck from propelling at 40 mph (64 kph).

Transition from Rest State to Test State:

The system will transition from Rest state to Test state upon release of the TCI rest request.

NOTE: A transition directly from Rest state to Ready state is not allowed because the system is essentially off and should be brought back on-line and checked out before Ready state is entered.

Transition from Propel State to Ready State:

The system will transition from Propel state to Ready state if all of the following conditions exist:

1. The accel pedal is not pressed.
2. The retard pedal or lever is not pressed or is pressed such that an insignificant amount of retarding effort is requested.
3. Truck speed is less than the motor overspeed limit.
4. At least one of the following conditions is true:
   a. Retard speed control is not selected.
   b. Truck speed is below the set retard speed, and acceleration is such that no retard effort is (currently) required to maintain this condition.

Transition from Propel State to Retard State:

The system will transition directly from Propel state to Retard state if at least one of the following conditions exists:

1. Truck speed is such that retard is allowed, and the retard pedal or lever is pressed such that a significant amount of retarding effort is
2. Truck speed exceeds the motor speed limit. Overspeed Will not be engaged such that it prevents the truck from propelling at 40 mph (64 kph).
3. All of the following conditions are true:
   a. Retard speed control is selected.
   b. Truck speed exceeds the set retard speed, or the truck is accelerating such that the truck speed will soon exceed the set retard speed if no action is taken.
   c. The truck is configured such that accel pedal signal does not override retard speed control.

Transition from Retard State to Ready State:

The system will transition from Retard state to Ready state if all of the following conditions exist:

1. Overspeed is not active.
2. At least one of the following conditions is true:
   a. The retard pedal or lever is not pressed or is pressed such that an insignificant amount of retarding effort is requested.
   b. Truck speed is such that retard is not allowed.
3. At least one of the following conditions exists:
   a. Retard speed control is not selected.
   b. Truck speed is low enough such that retard speed control is not active.
   c. The accel pedal is pressed, and the truck is configured such that the accel pedal overrides retard speed control. This allows the configuration constant to determine if pressing on the accel pedal kicks the truck out of retard, even if retard speed control is still active.
4. The retard torque control logic exit sequence is complete.

PROPULSION SYSTEM COMPONENT ABBREVIATIONS

The following Tables list component abbreviations used in schematics and system description information. Refer to Figures 2-3 through 2-11 for the location on the truck of components listed in the Ref. No. column.

The GE part number for major components is shown in parentheses. A short description of the component's primary function is also listed.

TABLE V: PROPULSION SYSTEM COMPONENTS DESCRIPTION

	REF. NO.	COMPONENT	FUNCTION
AFSE	36	Alternator Field Static Exciter Panel (17FM466)	Regulates current in the alternator field based on firing pulses from the PSC.
AFSER	62	Resistor	AFSE Battery boost command pull up resistor.
ALT		Alternator (5GTA34)	Main alternator, propulsion and control system.
AMBTS	11	Ambient Temperature Sensor	Provides ambient air temperature input to the control group.
ANALOG I/O CARD		System analog input/output card (17FB173)	Provides signal conditioning for analog signals to and from the TCI and PSC.
BATFU1, 2	19	System Fuse	Provides overload protection for control equipment and the System Batteries.
BATTSW		Battery Disconnect Switch (System Batteries)	Connects and disconnects the 12 VDC and 24 VDC circuit batteries (located at right front corner of truck).
BDI	30	Battery Blocking Diode	Works in conjunction with BFC and BLFP to maintain battery voltage to CPU.
BFC	34	Battery Line Filter Capacitor	Additional capacitance for BLFP to prevent nuisance CPU resets.
BFCR	60	Battery Filter Resistor	Added to replace Battery line filter that was removed.
BM1, 2	24	Grid Blower Motors 1 and 2 (5GY19)	DC motors driving blowers to provide cooling air for the retarding grids.

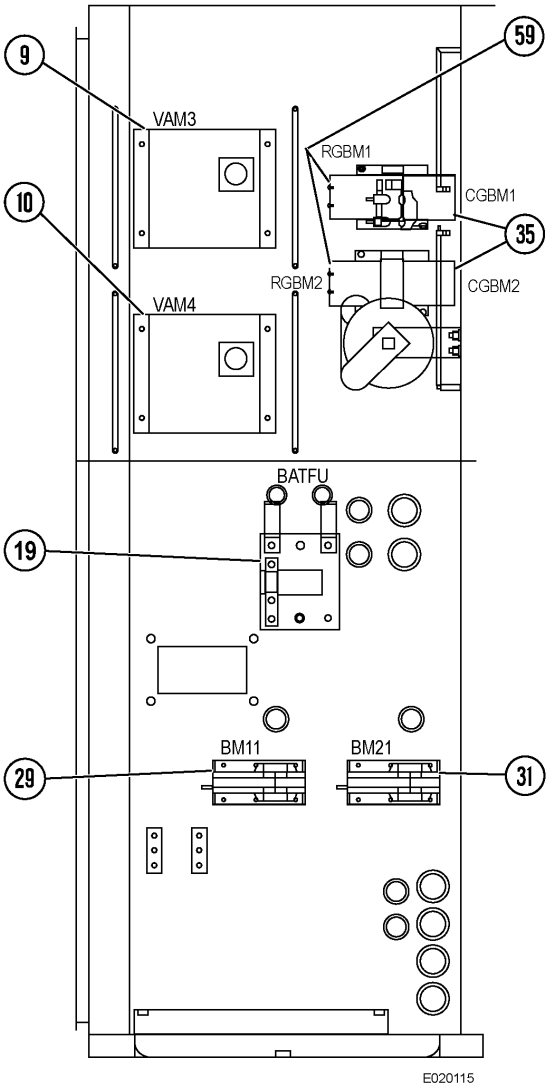


FIGURE 2-7. ELECTRICAL CABINET
VIEW B-B, END VIEW

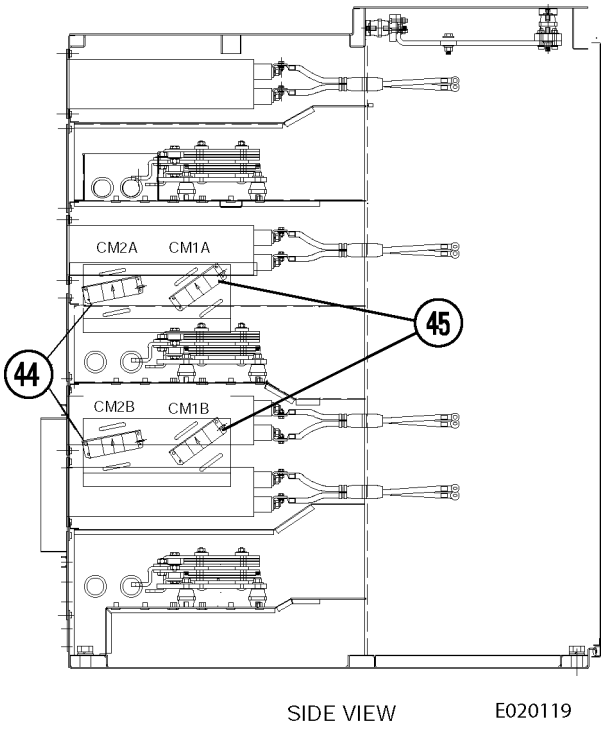
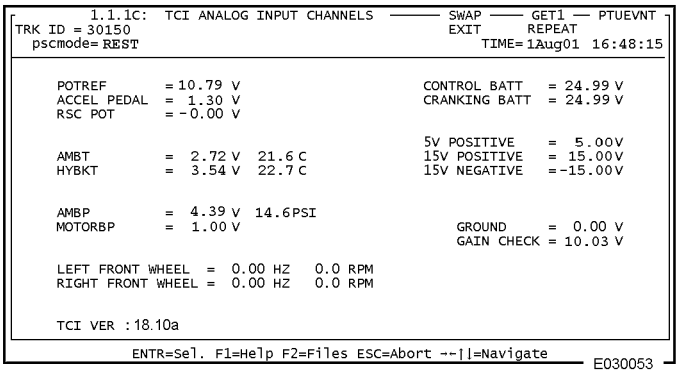


FIGURE 2-8. ELECTRICAL CABINET
VIEW C-C

TABLE I. CIRCUIT RESISTANCE CHECKS
(All readings - from circuit to ground)

CIRCUIT	LOCATION	APPROX. VALUE	NOTES
11B1	*	∞	* Measure at the 12VDC insulator in the Electrical Interface Cabinet
11	*	∞	*Measure at the 24VDC insulator in the Electrical Interface Cabinet. All devices listed for 11A circuit reading must be OFF.
15V	TB21	∞	
71GE	TB22	120Ω	
71TCI	TB23	120Ω	17FL349 Panel Only (Not applicable on 17FL373 Panel.)
439	TB25	∞	
10V	TB28	∞	
11SL	TB28	∞	Engine service lights turned OFF.
11ST	TB28	∞	
15PV	TB29	∞	
11S	TB30	∞	Ground level engine shutdown switch open
11A	TB30	∞	*The following must be turned OFF:* Brake cabinet service light, operator cab light, passenger seat compartment service light, hazard lights, headlights, ground level engine shutdown switch, engine governor heater switch (MTU 396 only - in Electrical Interface Cabinet), left and right side engine service lights.
11T	TB30	>36Ω	Engine governor heater switch in Electrical Interface Cabinet open. (MTU 396 engine only)
11FR	TB30	∞	(MTU 396 engine only)
11HTR	TB30	∞	(MTU 396 engine only)
712	TB32	∞	The Electrical Interface Cabinet service lights must be switched OFF.
71	TB32	∞	
11L	CB30	∞	Measure at circuit breaker CB30 in cab.
12M	*	>10Ω	*Measure at AID Module terminal B-13 under passenger seat in cab.
12F	*	>200Ω	*Measure at AID Module terminal B-12 under passenger seat in cab.

3. Press {enter} to display “TCI ANALOG INPUT CHANNELS” screen below:



Miscellaneous Checks

A3PV Panel

1. Remove the wires from panel terminals A and C.
2. With the Control Power Switch ON, measure voltage between terminals D and F:
   - ☐ Verify 0.0 ±30 Millivolts.
3. Connect a jumper wire from the BATFU fuse located on the bottom left wall in the left compartment to terminal A on A3PV.
4. Connect a jumper wire from a cabinet ground to terminal C on A3PV.
5. Measured voltage between terminals D and F.
   - ☐ Verify panel output is 0.12 volts (battery volts divided by 200)
6. Connect a serial communication cable from the PTU to the PSC.
7. On the PSC PTU, enter the following:

- ◆ c:\>ACNMENU {enter}
- ◆ Highlight “PTU TCI & PSC” {enter}
- ◆ Type your name {enter}
- ◆ Type your password {enter}
- ◆ Cursor to Normal Operation {enter}
- ◆ Cursor to “PSC Real Time Data Screen” {enter}
  - ☐ Verify A3PV is approximately 1.17 X battery volts

8. Remove the jumper wires.
9. Reconnect the wires to terminals A and C.

LINKV Panel

1. Remove the wires from panel terminals A and C.
2. With the Control Power Switch ON, measure voltage between terminals D and F:
   - ☐ Verify 0.0 ±30 Millivolts.
3. Connect a jumper wire from the BATFU fuse located on the bottom left wall in the left compartment to terminal A on LINKV.
4. Connect a jumper wire from a cabinet ground to terminal C on LINKV.
5. Measure voltage between terminals D and F.
   - ☐ Verify panel output is 0.12 volts (battery volts divided by 200)
6. With the PTU connected to the PSC, enter the following:

- ◆ c:\>ACNMENU {enter}
- ◆ Highlight “PTU TCI & PSC” {enter}
- ◆ Type your name {enter}
- ◆ Type your password {enter}
- ◆ Cursor to Normal Operation {enter}
- ◆ Cursor to “PSC Real Time Data” {enter}
  - ☐ Verify LINKV is equal to battery volts

7. Remove the jumper wires. Reconnect the wires to terminals A and C.

Thermistor Checks

1. With the PTU connected to the PSC:

- ◆ Cursor to Normal Operation {enter}
- ◆ Cursor to “PSC Real Time Data” {enter}
  - ☐ Verify AUXPCT is showing ambient temperature
  - ☐ Verify AUXIT is showing ambient temperature
  - ☐ Verify AFSET is showing ambient temperature

17FM384 Panel Check

1. With the PTU connected to the PSC;

- ◆ Cursor to Normal Operation {enter}.
- ◆ Cursor to “PSC Real Time Data” {enter}

2. Carefully remove the “FAILDIOD” wire from terminal D on the 17FM384 panel.
   - ☐ Verify FDIODE is highlighted on PTU screen
3. Reconnect wire to terminal D.

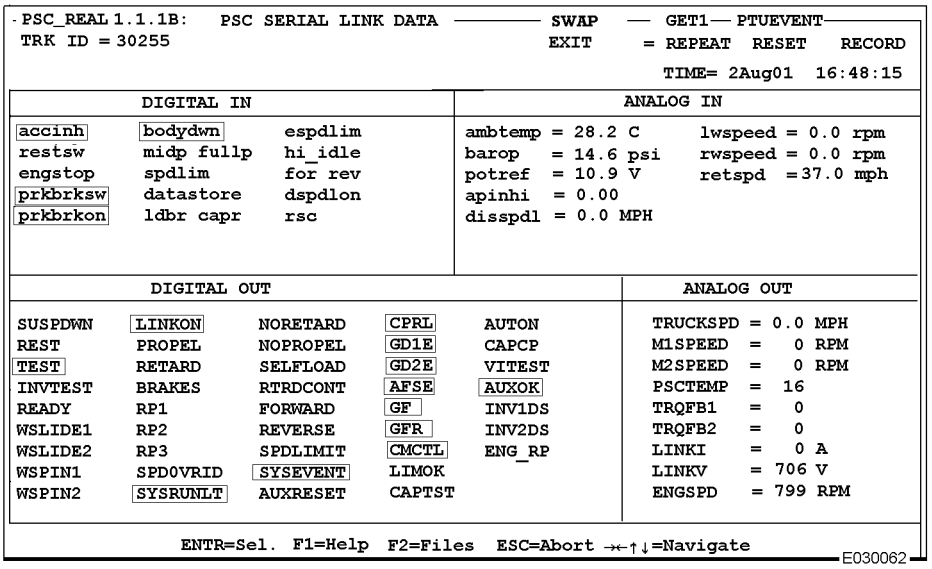


FIGURE 3-14. PSC SERIAL LINK DATA SCREEN

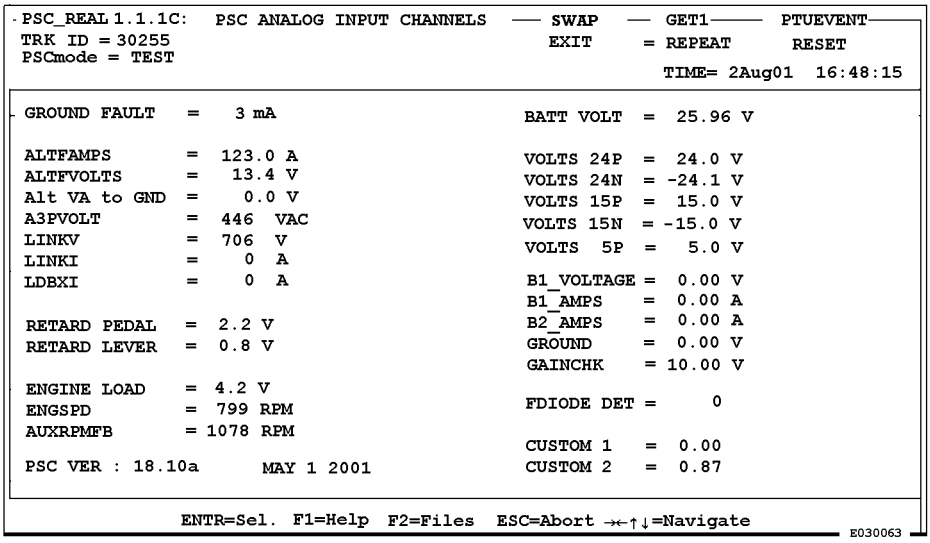


FIGURE 3-15. PSC ANALOG INPUT CHANNELS

Subcode 07:

Description: A low DC bus voltage was detected after the phase controller power up sequence.

1. Check the 3-phase input connections and fuses F1 and F2.
2. If no problem was found in step 1, use an ohmmeter to check for short circuits between AM101, AM201, and AM301 wires and between IV+ and IV-.
3. If no problem was found in step 1 or 2, replace the controller.

Subcode 08:

Description: A high DC bus voltage was detected during operation.

1. Check Capacitor Bank and Controller connections.
2. Check DC Sense connection (connector J13 to IV+ (red wire) and IV- (black wire)).
3. If problem still exists, replace controller.

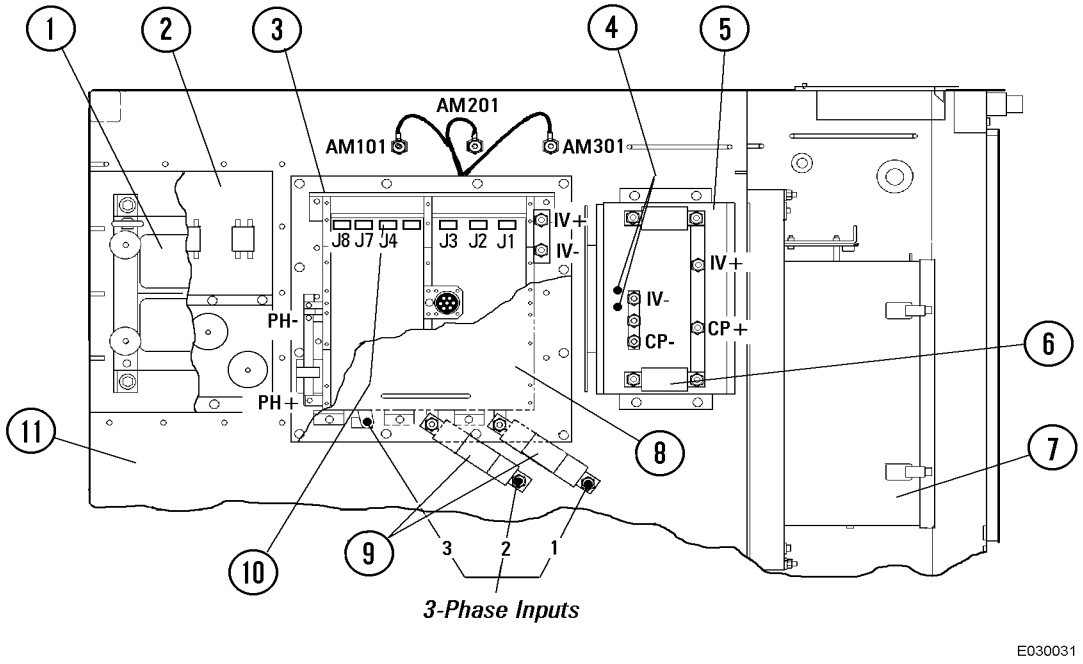


FIGURE 3-22. AUXILIARY BLOWER CONTROL COMPONENTS

1. Auxiliary Inductor (AXIND)
2. Snubber (AUX SNUB)
3. Auxiliary Inverter (Controller AXINV)
4. Blower Control System Warning LED's
5. Auxiliary Power Filter Capacitor Bank (AXCAP)
6. Capacitor Fuses
7. Propulsion System Controller (PSC)
8. Cover
9. Input Fuses (F1 & F2)
10. 3- Pin Connector

TIRES AND RIMS

The truck tires should be inspected and tire pressure checked with an accurate pressure gauge before each working shift. Tire pressure will vary according to manufacturer and local working conditions. Consult the tire manufacturer for recommended tire pressure.

Insure valve caps are securely applied to valve stems. The caps protect valves from dirt build up and damage. DO NOT bleed air from tires which are hot due to operation; under such circumstances, it is normal for pressure to increase in the tire due to expansion.

A bent or damaged rim which does not support the bead properly may cause abnormal strain on the tire resulting in tire damage. If a tire becomes deeply cut, it should be removed and repaired. Neglected cuts cause many tire problems; water, sand, dirt and other foreign materials work into the tire through a cut, eventually causing tread or ply separation.

Tires should be stored indoors if possible. If stored outdoors, cover tires with tarpaulin to keep out dirt, water and other foreign materials. Long exposure to the sun will cause ozone cracks. Storage should be in a cool, dry, dark, draft free location. Tires should be stored vertically. If they must be laid on their sides for a short period, avoid distortion by stacking no more than three tires on top of one another. Avoid contact with oil, grease and other petroleum products.

Before storing used tires, clean thoroughly and inspect for damage. Repair as necessary. When a truck is placed in storage, it should be blocked to remove the weight from the tires. If a stored truck cannot be blocked, check air pressure and inspect tires twice a month for proper inflation pressure.

⚠WARNING

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

DO NOT go near a tire if a brake or wheel motor has experienced a fire until the tire has cooled.

⚠DANGER

When inflating tires always use a safety cage. Never inflate a tire until the lockring is securely in place. Do not stand in front of or over the lockring during inflation procedures. Never overinflate a tire. Refer to tire manufacturers recommendations.
Always keep personnel away from a wheel and tire assembly when it is being removed or installed.
The tire and rim weigh approximately 14,285 lbs. (6,480 kg). Be certain tire handling equipment is capable of lifting and maneuvering the load.

Due to the size and weight of the tire and rim assemblies, special handling equipment such as a modified fork lift (“tire handler”) as shown in Figure 2-1 is desirable. Consult local tire vendors for sources of equipment designed especially to remove, repair, and install large off-highway truck tires.

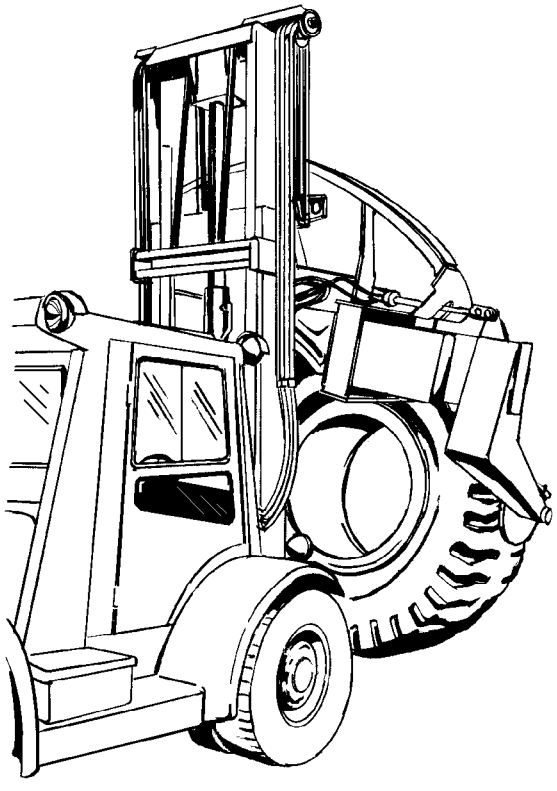


FIGURE 2-1. TYPICAL TIRE HANDLER

SECTION G3

FRONT WHEEL HUB AND SPINDLE

INDEX

23. After the brake assembly is properly positioned on the adapter and the four capscrews are snug, remove the alignment studs.

    Remove socket head capscrews (34) securing seal retainer (37) to brake assembly (18).

    Install the remaining brake adapter/brake assembly mounting capscrews (20) and hardened flatwashers (21). Tighten the capscrews to **1995 ± 100 ft. lbs. (2705 ± 136 N.m)**.

24. Install bearing retainer pin (40) in groove in spindle. Align and slide outer bearing cone (7) over pin. Lubricate the bearing with clean hydraulic oil.

25. Install shim pack (8), retainer (13), capscrews (11), and washers (12). Tighten the capscrews alternately in several successive increments while rotating the hub. Final torque is **750 ± 75 ft. lbs. (1017 ± 100 N.m)**.

26. Install a new O-ring (41) on cover (5). Install the cover, capscrews, and washers. Tighten the capscrews to standard torque.

Seal Assembly Gap Check

After the assembly of the wheel and brake is complete, the gap between seal carrier (3, Figure 3-7) and the brake assembly back plate (6) must be measured and adjusted if necessary.

The ideal gap is 0.433 in (11.0 mm). If necessary, the gap must be adjusted, using shims as required to maintain a **minimum** gap of 0.423 in (10.75 mm) to 0.443 in (11.25 mm) **maximum**.

27. Measure seal gap as follows:

    a. Measure gap, dimension "A", Figure 3-7 at three, equally spaced places and record the results.

    b. Add the three dimensions and divide the result by 3 to obtain the average gap width

28. If average gap width is not between the minimum and maximum allowable range, loosen the seal retainer capscrews (4, Figure 3-6) and add shims (5) as required to **reduce** the gap or remove shims to **increase** the gap. **The quantity and thickness of shims at each of the six locations must be equal.**

29. Re-tighten seal retainer capscrews to standard torque and measure gap as described in Step 28. If necessary, repeat Step 29 until the proper gap is maintained.

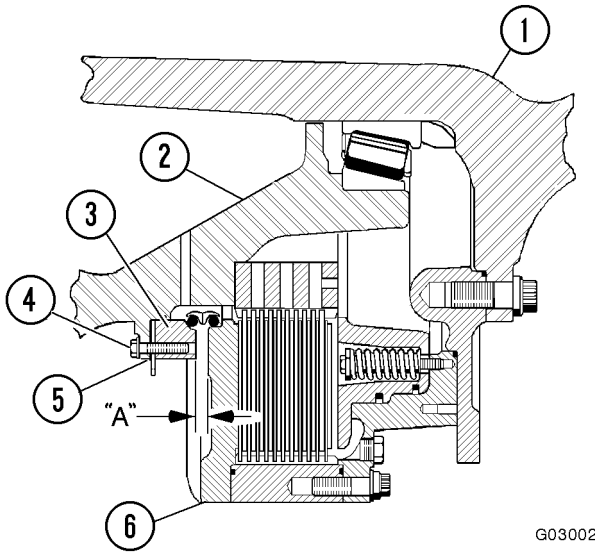


FIGURE 3-7. MEASURING SEAL GAP

1. Spindle
2. Wheel Hub
3. Seal Carrier
4. Capscrews
5. Shims
6. Brake Back Plate

30. Install speed sensor(s) (16, Figure 3-6) in support bracket(s) (17). Adjust sensor gap as follows:

    a. Rotate hub to position the top of a gear tooth directly under the sensor tip.

    b. Insert a 0.060 in (1.5 mm) feeler gauge between sensor tip and gear tooth. Loosen and adjust sensor clearance.

    c. Lock the sensor in place.

    d. Rotate hub 180° and verify clearance remains within 0.040 in (1.0 mm) minimum to 0.080 in (2.0 mm) maximum.

31. Install speed sensor cables.

32. Install hub and spindle assembly on suspension per instructions in Installation.

PIVOT EYE BEARING

Removal

1. Remove capscrews and locknuts (5 and 6, Figure 4-2).
2. Remove bearing retainers (2).
3. Setup an appropriate tool to press spherical bearing (4) from the pivot eye.
4. Inspect all parts for wear or damage. Replace any parts showing excessive wear or damage.

Spherical bearing outer race O.D.:

8.7500 - 8.7488 in. (222.25 - 222.22 mm)

Bearing bore I.D.:

5.9990 - 6.0000 in. (152.37 - 152.40 mm)

5. If bearing carrier (3) is damaged or worn, refer to Pivot Eye Repair in this section for repair procedure.

NOTE: Some trucks may not be equipped with bearing carrier (3).

Installation

1. Set up an appropriate tool to press spherical bearing (4, Figure 4-2) into the pivot eye. Ensure the bearing is centered and properly installed in the pivot eye to allow proper lubrication.
2. Install bearing retainers (2) using capscrews (5) and locknuts (6). Tighten the capscrews to standard torque.

PIVOT EYE REPAIR

If damage occurs to pivot eye (4, Figure 4-3), it may be necessary to remove it from rear axle structure (1) to facilitate repair and bearing replacement.

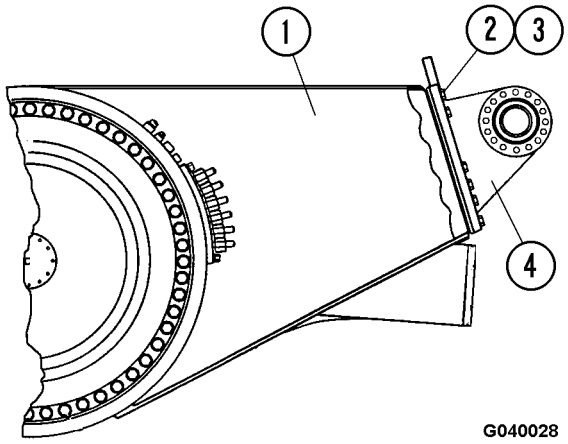


FIGURE 4-3. PIVOT EYE ATTACHMENT

1. Rear Axle Structure
2. Capscrew
3. Flatwasher
4. Pivot Eye

Removal

To remove the axle housing pivot eye:

1. Follow all preceding instructions in Pivot Pin - Removal.

Be certain axle housing (1) and wheels are blocked, securely.

2. Attach a lifting device to pivot eye (4). The weight of the pivot eye is 762 lbs. (346 kg).
3. Remove capscrews (2) and flatwashers (3). Remove pivot eye.

Disassembly

1. Remove spherical bearing (4, Figure 4-2) as described in Pivot Eye Bearing - Disassembly.
2. If bearing carrier (3) (if equipped) is damaged or worn, setup an appropriate tool to press the bearing carrier out of the pivot eye bore.

Bearing carrier (new) (if equipped):

I.D. = 8.7484 ± 0.0005 in. (222.209 ± 0.013 mm)

O.D.= 9.7520 ± 0.0005 in. (247.701 ± 0.013 mm)

3. Inspect pivot eye structure bore for excessive wear or damage.

11. Disconnect wheel motor power cables (7) at wheel motor terminals. Disconnect speed sensor cable at connector in center of housing.
12. Tie up cables and hoses as necessary to prevent damage during wheel motor removal.

⚠ IMPORTANT ⚠

Each complete wheel motor assembly weighs approximately 39,975 lbs. (18,132 kg.). Be certain lifting device is capable of handling the load safely.

13. Attach lifting device to wheel motor assembly. **DO NOT allow lifting device to contact brake housing.**
14. Remove capscrews (15) and hardened flatwashers (16) securing wheel motor to rear housing.
15. Move wheel motor assembly out of axle housing, using care to prevent damage to brake hoses if not removed previously.
16. Refer to appropriate GE service information for wheel motor repair instructions.

Cleaning and Inspection - Wheel Motor

1. Thoroughly clean the capscrew holes and mounting faces of the rear housing and the wheel motor.
2. Re-tap holes if threads are damaged.
3. Check mounting faces of wheel motor and rear housing for nicks, scratches or other damage.
4. Check components inside axle housing. Inspect brake system relay valve (6, Figure 5-1) and hoses for leaks. Inspect manifold (4) hose connections and repair leaks or damaged hoses.
5. Inspect wheel motor power cables, terminals, cable grips, and clamps. Replace any cables or hardware that is damaged or worn.

⚠ IMPORTANT ⚠

All propulsion system power cables must be properly secured in their wood or other non-ferrous cable cleats. If clamps are cracked or broken, replace them with new parts. Inspect cable insulation and replace entire cable if insulation is damaged.

⚠ CAUTION

High tightening force is required on wheel motor mounting capscrews. Repeated tightening will cause capscrew material to fatigue and break. DO NOT reuse wheel motor mounting capscrews and washers more than twice after original installation. The mounting hardware must be replaced after the third use.

The following method is suggested to control the "3 - Use" maximum:

Punch mark the capscrew heads with a center punch after each tightening as follows:

- Initial Installation . . . . . .Zero marks
- Second Installation . . . . . One punch mark
- Third Installation . . . . . .Two punch marks

Before installation, inspect each capscrew for any defects and number of punch marks. Replace capscrews and washers if two punch marks are evident; do not reuse if any defect is suspected. Hardware showing signs of rust, corrosion, galling, or local yielding on any seat or thread surfaces should be replaced. Replace mounting hardware if the truck was operated with the wheel motors in a loose joint condition. Replace wheel motor mounting hardware with original Komatsu parts.

The hardened flat washers used in this application are punched during the manufacturing process, therefore, they must be assembled with the punch lip away from head of the mounting capscrews to prevent damage to the fillet between capscrew head and shank. Refer to Figure 5-2.

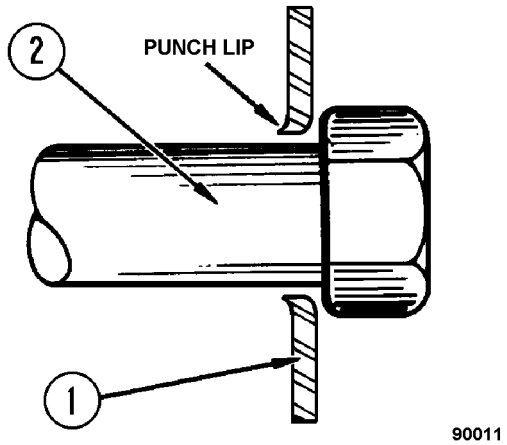


FIGURE 5-2. MOUNTING HARDWARE

1. Washer 2. Capscrew

SECTION H

HYDRAIR® II SUSPENSIONS

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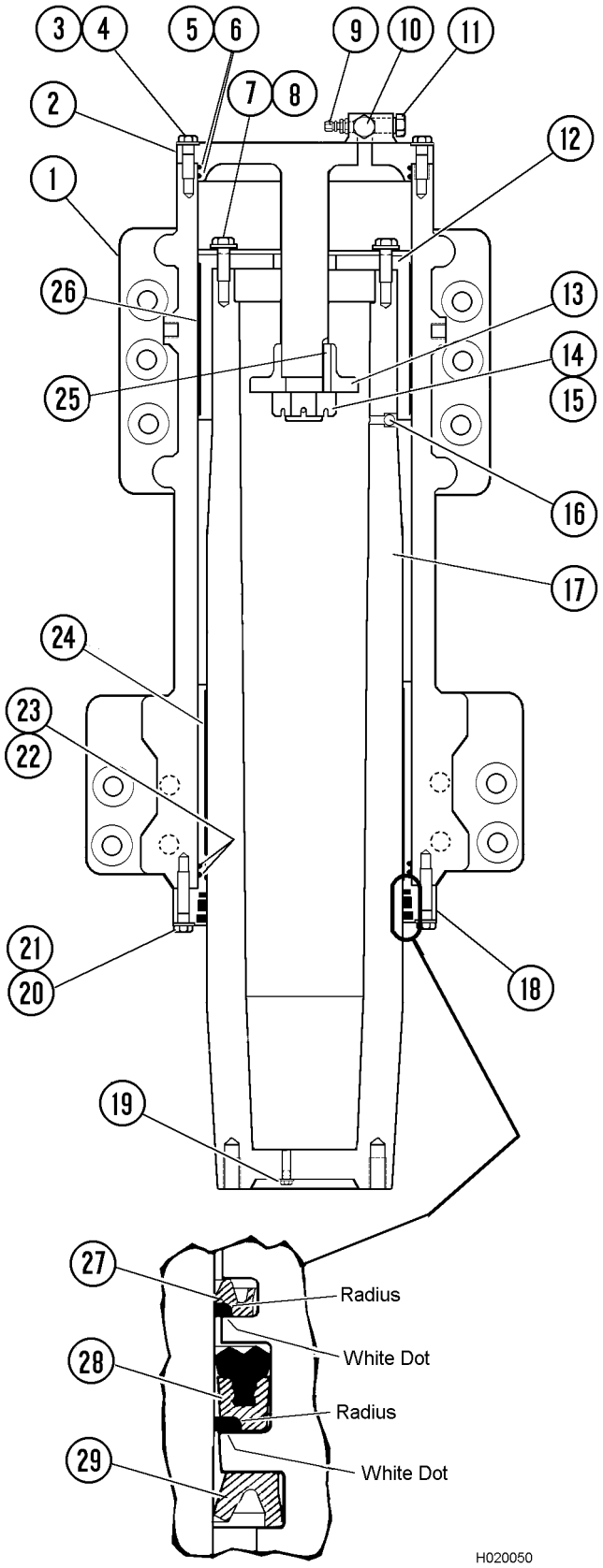


FIGURE 2-9. FRONT SUSPENSION

1. Housing
2. Cap Structure
3. Capscrew
4. Hardened Washer
5. O-Ring
6. Backup Ring
7. Capscrew
8. Hardened Washer
9. Charging Valve Assembly
10. Vent Plug
11. Plug (Pressure Sensor Port)
12. Upper Bearing Retainer
13. Piston Stop
14. Nut
15. Roll Pin
16. Steel Check Ball
17. Piston
18. Lower Bearing Retainer
19. Plug
20. Capscrew
21. Hardened Washer
22. O-Ring
23. Backup Ring
24. Lower Bearing
25. Key
26. Upper Bearing
27. Step Seal
28. Rod Seal
29. Rod Wiper

Assembly - Rear Suspension

Assembly must be performed in a clean, dust free work area. All parts must be completely clean, dry and free of rust or scale. Lubricate all interior parts and bores with fresh suspension oil. Refer to the Oil and Nitrogen Specifications Chart in Section H, Oiling and Charging Procedures.

1. If removed, install spherical bearing (6, Figure 3-3) in the eye of the piston rod and cylinder housing.
2. Install retaining rings (5) to secure the bearings.
3. Install wiper seal (12, Figure 3-5), double lip seal (11), buffer seal (10), O-ring (13) and backup ring (14) onto bearing retainer (5).

NOTE: Refer to the seal installation illustration and details (Figure 3-5) for proper orientation.

4. Install rod bearing (4).
5. Slide piston bearing (3) onto the lubricated piston rod.
6. With the lubricated housing (1) held in a vertical position, slide the piston assembly partially into the housing. Slide retainer (5) onto the housing and fasten with capscrews (6) and washers (7). Tighten the capscrews to standard torque. Use care during piston installation to prevent damage to machined and chrome surfaces.

NOTE: If the suspension is to be stored, fill with two pints (1.0 l) of a rust preventive oil. This oil must be drained when the suspension is put into service.

7. Install a new O-ring onto the charging valve, and install the charging valve onto the cylinder. Tighten the large hex of the charging valve to **16.5 ft.lbs. (22.4 N.m)**.

   If a new charging valve is being used, tighten the swivel nut to **10.5 ft. lbs. (14.2 N.m)**, then loosen, and retighten the swivel nut to **10.5 ft. lbs. (14.2 N.m)**. Again, loosen the swivel nut, and retighten to **4 ft. lbs. (5.4 N.m)**. Install the valve cap, and tighten to **2.5 ft. lbs. (3.3 N.m)**.
8. Install the charging valve, pressure sensor, and plugs, if not already installed.
9. Install cover (16) onto the suspension.
10. Pressure test the suspension. Refer to Suspension Pressure Test.

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

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

REAR SUSPENSION

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

⚠WARNING

When oiling blocks are used, they must be secured in place with a strap or some other means. An unsecured block can fly loose as weight is applied, presenting the possibility of serious injury and/or damage.

Rear Suspension Oiling

NOTE: For longer life of suspension components, a friction modifier must be added to the suspension oil. See Specifications Chart, Figure 4-6 at the end of this chapter.

1. Position and secure the oiling blocks in place (Figure 4-4) so the blocks are seated between the frame and the rear axle housing. A block should be used on both the left and right sides of the truck.

⚠WARNING

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

2. Remove charging valve cap. Turn the charging valve swivel nut (small hex) counterclockwise three full turns to unseat the valve seal. DO NOT turn the large hex. The charging valve body has a bleeder groove in its mounting threads, but for safety of all personnel, the valve body **must not** be loosened until all nitrogen pressure has been vented from the suspension.
3. Depress the charging valve core to release nitrogen pressure from the suspension. When all nitrogen pressure has been vented to atmosphere, loosen and remove the fill plug. The suspension should have collapsed slowly as gas pressure was released. The weight of the truck is now supported by the support blocks.

SECONDARY BRAKING AND AUTOMATIC APPLY

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

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

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

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

PARKING BRAKE CIRCUIT

The parking brakes are spring applied and hydraulically released.

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

Normal Operation (key switch on, engine running)

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

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

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

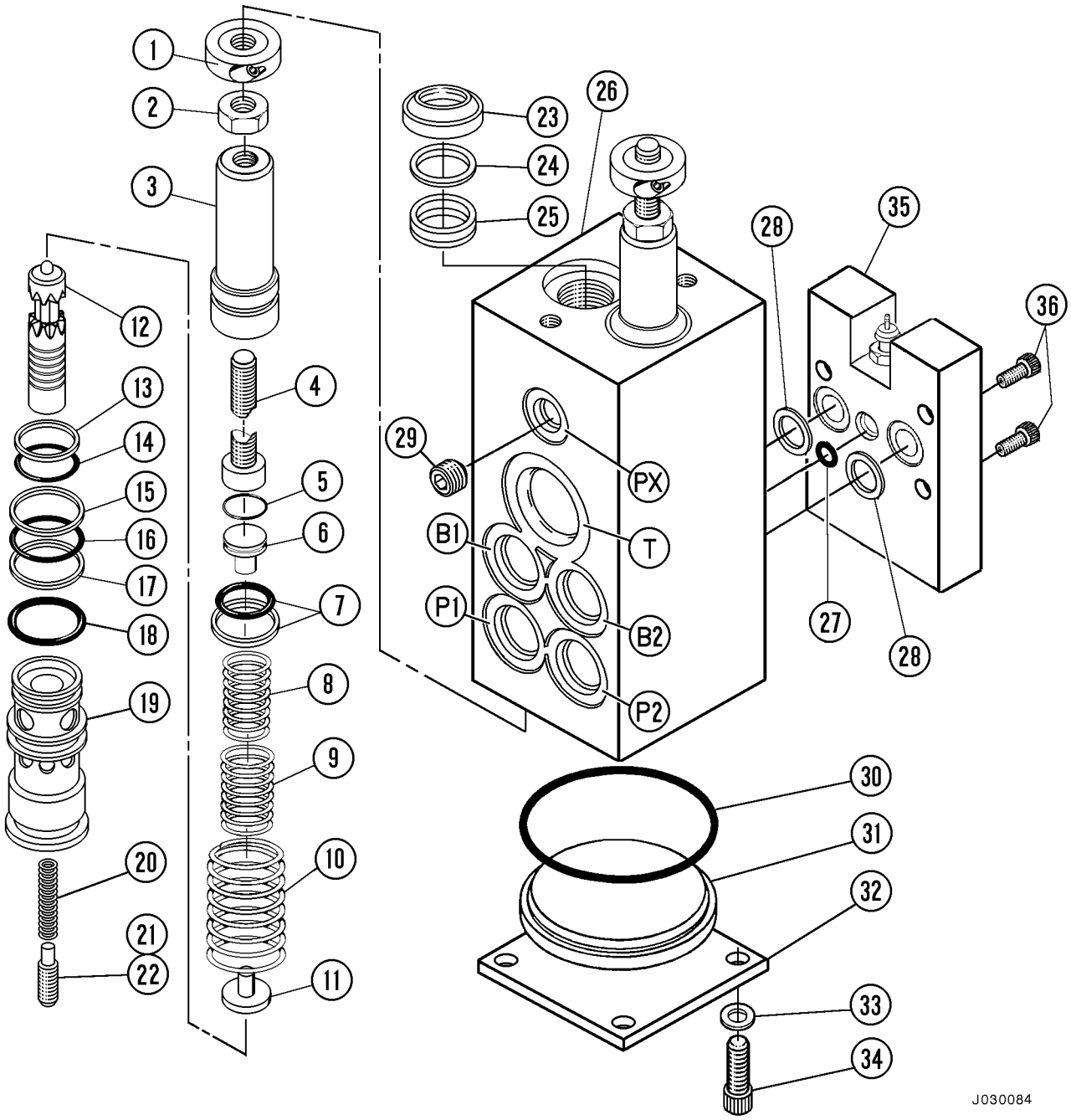


FIGURE 3-4. BRAKE VALVE

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

DUAL RELAY VALVE

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

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

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

⚠DANGER

Before disconnecting pressure lines, replacing components in the hydraulic circuits, or installing test gauges, always bleed down hydraulic steering and brake accumulators. The steering accumulators can be bled down with engine shut down, turning the key switch OFF and waiting 90 seconds. Confirm the steering pressure is released by turning the steering wheel - No front wheel movement should occur. Open bleed down valves (2 & 4, Figure 3-1) located on the brake manifold. This will allow the accumulator for the rear brakes and the accumulator for the front brakes to bleed down. Before disabling brake circuit, be sure truck wheels are blocked to prevent possible roll-away.

Removal

1. Securely block the wheels to prevent possible roll-away.
2. Place selector switch in NEUTRAL, turn the rest switch ON. Turn key switch OFF to shut down engine and allow 90 seconds for steering system accumulators to bleed down. Open valves (2 & 4, Figure 3-1) to bleed down the brake accumulators. Close valves after all pressure is released.

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

Front Brake Circuit:

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

Rear Brake Circuit:

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

Installation

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

BRAKE ACCUMULATOR REPAIR

Removal

1. Shut down engine to bleed steering accumulators. Exhaust all pressure from the brake system by opening accumulator manual drain valves as described in Brake Accumulator Bleeddown Procedure.
2. Remove the protective cover (3, Figure 3-16) from charging valve guard on top of accumulator.
3. Install charging valve kit hose on charging valve. Use charging kit to release nitrogen from accumulator to be repaired.
4. Disconnect oil line (6) from bottom hydraulic port. Cap port and hose fitting to prevent contamination.
5. Remove accumulator mounting clamps (5).
6. Attach lifting device to accumulator and remove from mounting bracket (7).

⚠WARNING

Each accumulator weighs approximately 220 lbs. (100 kg). Be certain lifting device is adequate for load.

7. Transfer accumulator to work area.

Installation

1. Position the accumulator on the mounting bracket (7, Figure 3-16) with warning label visible.
2. Install mounting clamps and hardware. Tighten capscrews to standard torque.
3. Install oil line (6) at bottom (hydraulic) port.
4. Refer to Charging Procedure in this section.
5. Install protective cover (3) over charging valve on top of accumulator.

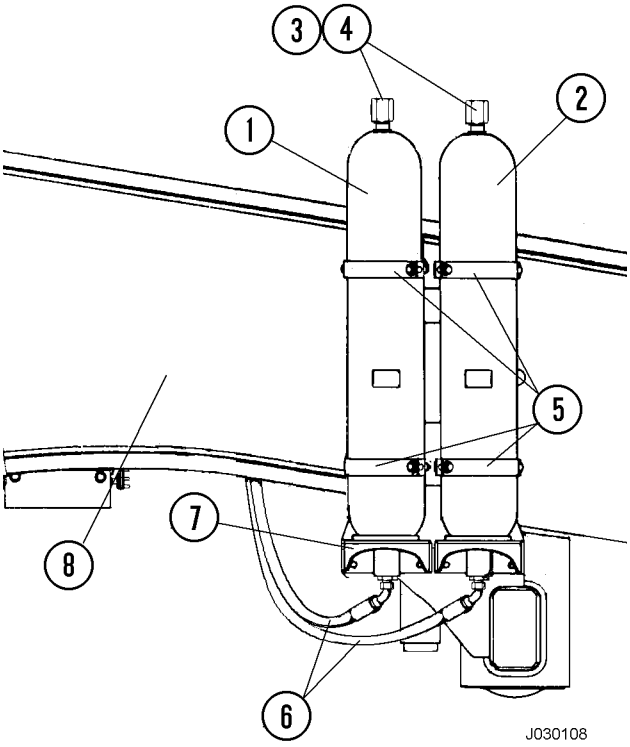


FIGURE 3-16. BRAKE SYSTEM ACCUMULATORS

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

Potentiometer Check

Potentiometer (9, Figure 3-23) is spring-loaded to the OFF position. With the switch assembly removed from the retarder control lever, make the following checks:

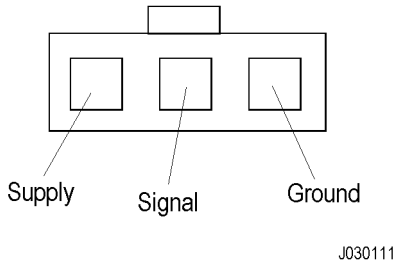


FIGURE 3-22. POTENTIOMETER CONNECTOR

1. Obtain a 10 volt power supply for testing the potentiometer.
2. Connect the positive lead of the 10 volt power supply to the SUPPLY terminal on the potentiometer connector as shown in Figure 3-24.
3. Connect the negative lead of the 10 volt power supply to the GROUND terminal on the connector.
4. Connect a voltmeter to the SIGNAL and GROUND connections.
5. Measure and record the signal voltage in the OFF position.
6. Rotate the potentiometer clockwise to the full ON position. Measure and record the signal voltage.
7. Determine whether the potentiometer falls within the specifications. When the potentiometer is in the OFF position, the signal voltage must be within 5 - 15% of input voltage. When the potentiometer is in the full ON position, the signal voltage must be within 75 - 95% of input voltage.

$$\%\ \text{of input voltage} = \left(\frac{\text{signal voltage}}{\text{input voltage}}\right) \times 100$$

NOTE: With a 10 volt power supply, the potentiometer voltage specifications are as follows:

OFF position . . . . . 0.5 - 1.5 volts
Full ON position . . . . . 7.5 - 9.5 volts

8. Replace the potentiometer if it does not meet these specifications.

Assembly

1. Inspect the shaft bore and interior friction faces in housing (15). Remove any scratches or burrs, or replace the housing. Lightly lubricate the surfaces with a Multi-Purpose EP NLGI Consistency #2 grease.
2. If handle (18, Figure 3-23) or lever (17) has been removed from shaft (16), assemble as follows:
   a. Apply Loctite™ #271 to the threads on each end of lever (17).
   b. Install the lever into shaft (16). **Hand tighten, only!**
   c. Install handle (18) onto the lever. **Hand tighten, only!**
3. Insert the lever, handle, and shaft assembly into housing (15).
4. Install washer (13), new spring (12) [with the outer spring diameter against washer (13)], tang washer (11), and locknut (10) onto shaft (16).
5. Tighten and secure locknut (10) as described in Step 3.b. of Disassembly and Adjustment for proper lever resistance.
6. Move the lever to the full OFF (up) position. Align the slot in potentiometer (9) with the key on shaft (16) and rotate the potentiometer until the capscrew holes line up with the housing. Install washers (8) and capscrews (7) to secure the potentiometer to the housing. Tighten the socket head capscrews to **12 - 15 in. lbs. (1.36 - 1.69 N.m)**.
7. Install set screw (14). Refer to Step 3.b. of Disassembly and Adjustment for procedure for proper detent adjustment.
8. Install the retarder control lever on the steering column. Refer to Installation procedure.

48. Reconnect hose (4, Figure 4-4) to Tee at “AF1” port, bottom of hydraulic cabinet.
49. Disconnect the hose (5, Figure 4-4) that supplies oil to the brake valve (“P1” port), rear brake circuit, by removing at the tee attached to the bottom of the hydraulic cabinet (brake manifold port “AR1”). Cap the tee fitting, but hose must be vented to atmosphere.
50. Start engine and allow low brake accumulator pressure (LAP1 gauge) to stabilize at or above 2700 psi (18,613 kPa).
51. Depress the brake pedal very slowly until the brake differential pressure switch activates the low brake pressure lamp and buzzer.
    - ❑ Verify fault indicators are activated at 600 ±50 psi (4 137 ±345 kPa) at the BR test port.

    ** Record Pressure on data sheet.*
52. Shut down the engine and turn key switch OFF. Allow steering accumulators to bleed down. Open both accumulator bleeddown valves and bleed entire brake system. Close valves after all pressure is released.
53. Reconnect hose (5, Figure 4-4) to Tee at “AR1” port, bottom of hydraulic cabinet.
54. Remove all test equipment and verify all hoses have been reconnected.

NOTE: If hoses (4, Figure 4-3) and (10) are switched, the rear brakes will be slow to apply and slow to release.

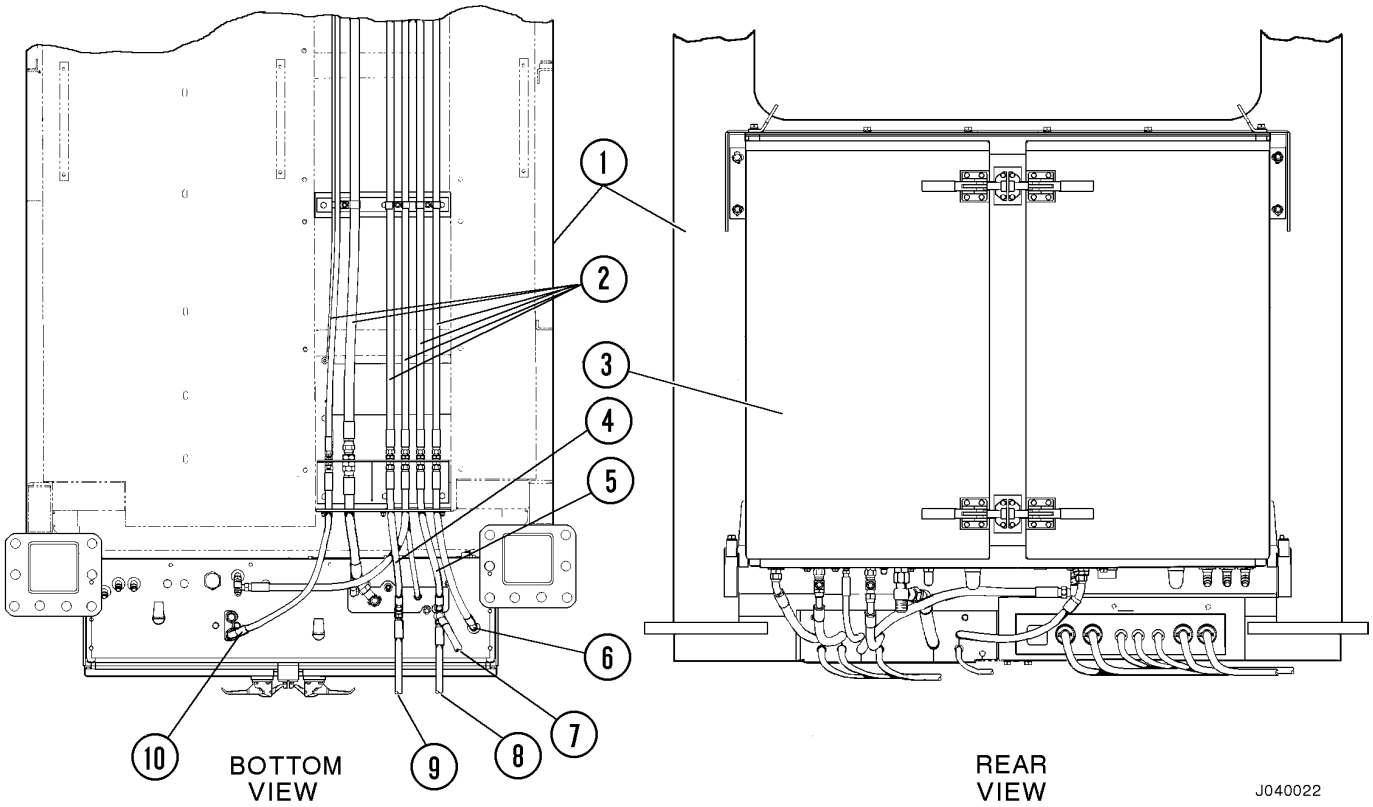


FIGURE 3-4. HYDRAULIC COMPONENTS CABINET

1. Operator's Cab
2. Hoses to Brake Valve & Steering Control Valve
3. Hydraulic Components Cabinet
4. To Brake Valve, Port “P2”
5. To Brake Valve, Port “P1”
6. To Brake Valve, Port “B1”
7. From Rear Brake Accumulator
8. To Rear Axle Junction Block, Port “P1”
9. From Front Brake Accumulator
10. To Brake Valve, Port “B2”

6. While fully applying the service brake pedal, check brake wear as follows:
   a. Remove wear indicator cover (1, Figure 5-2).
   b. Push pin (8) in until it stops against brake piston.
   c. Measure the distance from indicator pin end face (2) to housing face (3).

- ❑ If pin end face (2) is even with the housing face (3) or below, disc pack is worn to maximum safe wear limits. Brakes should be scheduled for rebuild.
- ❑ If pin end face (2) extends out beyond housing face (3), brake disc wear is still within allowable limits.

7. Pull pin (8) out until it stops against tool housing (6) and install protective cover (1).
8. Release brakes. Shut down engine, allow steering accumulators to bleed down. Open brake accumulator bleeddown valves to remove all pressure from the brake system. Close valves after all pressure is released.
9. Remove the brake disc wear indicator tool and reinstall O-ring plug in port.
10. To check the remaining brake assemblies, repeat Steps 4 through 9.

NOTE: Checking disc wear in all brake assemblies is recommended. Disc wear in one brake assembly may be different from the other due to dissimilar operation of parts and/or haul profiles which require repeated braking while steering in one direction only.

11. Refill hydraulic tank as required.
12. If brake repairs are necessary, refer to Brake Rebuild this section.

NOTE: If any leakage is observed around the brake disc wear indicator tool, replace O-rings (4, 5 and 7 Figure 5-2).

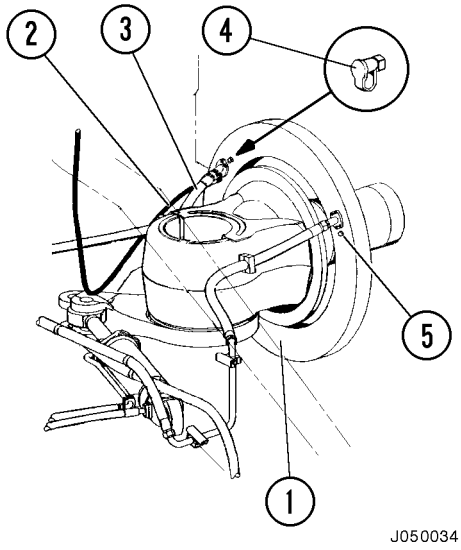
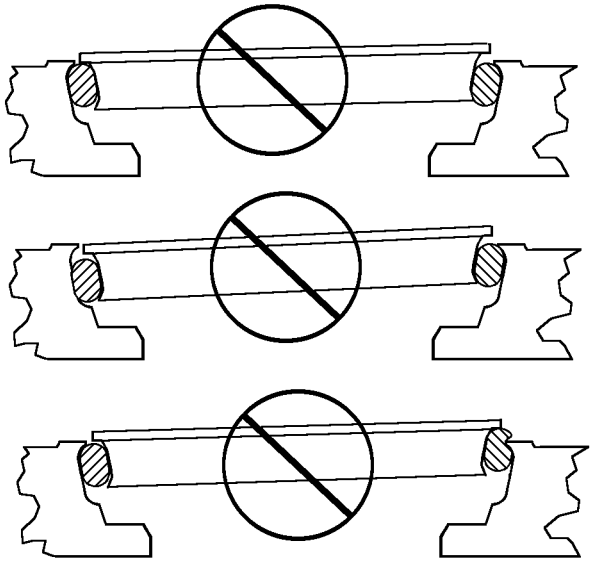
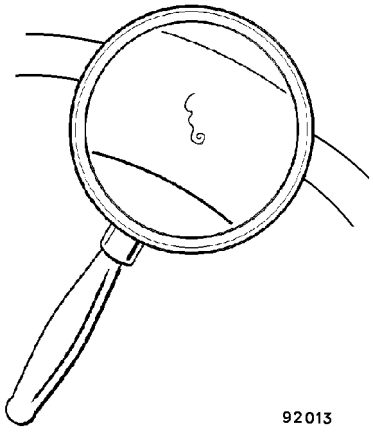


FIGURE 5-3. BRAKE WEAR INDICATOR INSTALLATION
(Left Front Brake Shown)

1. Brake Assembly
2. Brake Apply Line
3. Brake Cooling Line
4. Diagnostic Coupler
5. Wear Indicator Installation Port

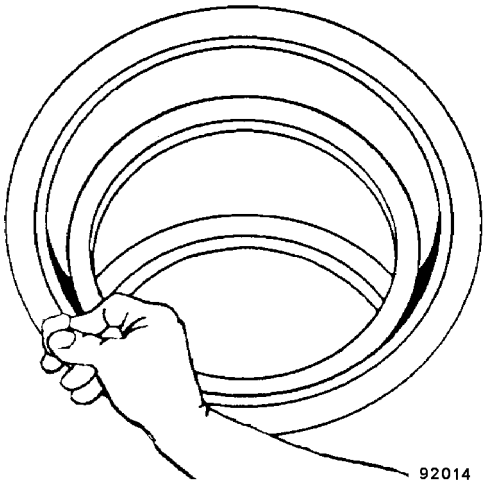


8. Wipe the polished metal seal surfaces with clean tri-chloroethane to remove any foreign material or fingerprints. No foreign particles of any kind should be on the seal ring faces. Something as small as a paper towel raveling will hold the seal faces apart and cause leakage.

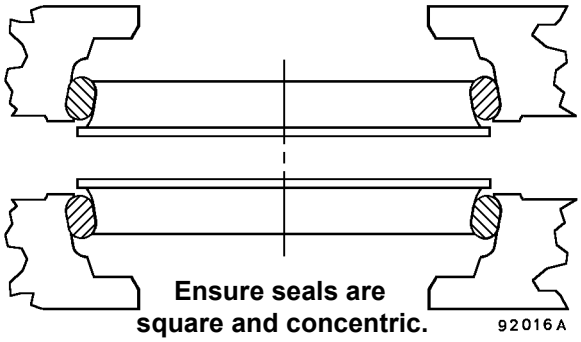


9. Apply a thin film of clean oil on the seal faces. Use a lint-free applicator or a clean finger to distribute the oil evenly. Make sure no oil comes in contact with the rubber toric rings or their mating surfaces.

   Before assembling both seals & housing together **- WAIT -** at least two minutes. Let all tri-chloroethane evaporate. (Some may still be trapped between toric and housing ramp.)

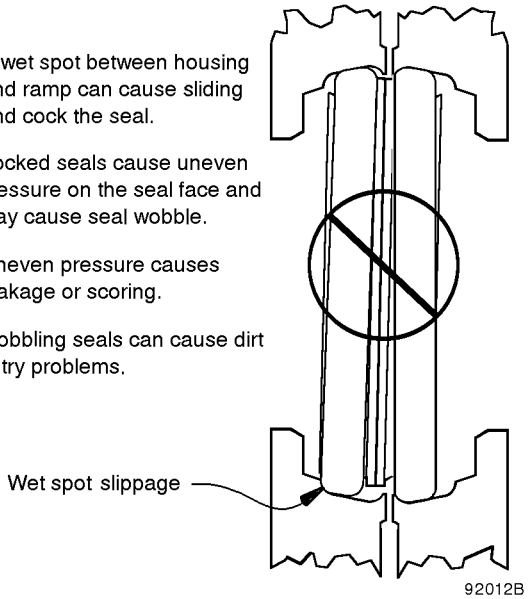


10. Be certain both housings are in correct alignment and are square and concentric. Move the parts slowly and carefully toward each other.



NOTE: Do not slam, bump or drop seals together. High impact can damage the seal face and cause leakage.

- A wet spot between housing and ramp can cause sliding and cock the seal.
- Cocked seals cause uneven pressure on the seal face and may cause seal wobble.
- Uneven pressure causes leakage or scoring.
- Wobbling seals can cause dirt entry problems.



SECTION L

HYDRAULIC SYSTEM

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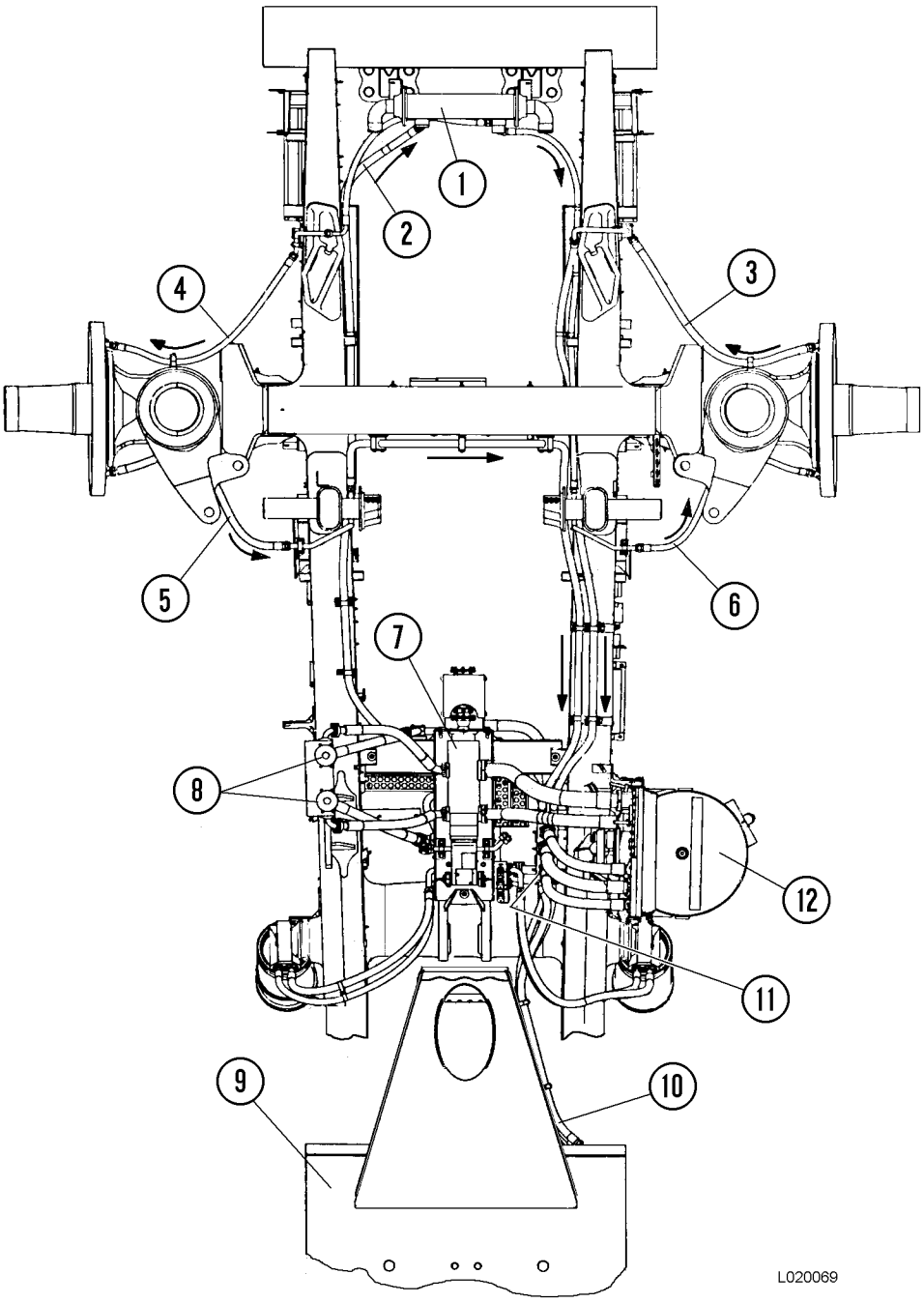

FIGURE 2-5. DISC BRAKE COOLING CIRCUIT (Bottom View)

1. Heat Exchanger
2. Front Brake Cooling Oil Supply From Hoist Valve
3. L. F. Brake Cooling Outlet Hose
4. R. F. Brake Cooling Inlet Hose
5. R. F. Brake Cooling Outlet Hose
6. L. F. Brake Cooling Inlet Hose
7. Hoist Pump
8. Filters
9. Rear Axle Housing
10. Rear Brake Cooling Supply & Return Lines
11. Brake/Hoist Return Oil Manifold
12. Hydraulic Tank

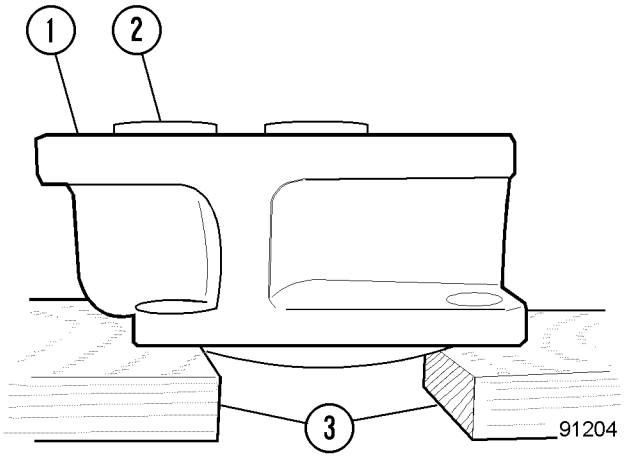

FIGURE 3-7. PREPARATION FOR SEAL REMOVAL

1. Flange
2. Bearings
3. Wooden Blocks

14. Remove outboard shaft seal (2), snap ring (21) and inboard shaft seal (20).

NOTE: To aid in shaft seal removal place the flange on two small wooden blocks as shown in Figure 3-7.

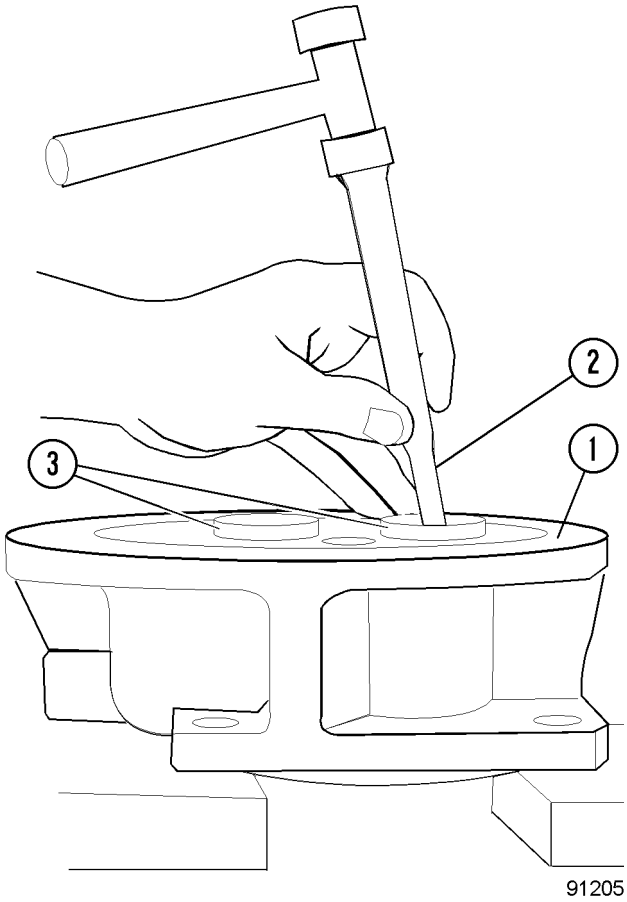

FIGURE 3-8. SHAFT SEAL REMOVAL

1. Flange
2. Punch
3. Bearings

15. Use a punch and hammer and tap the outboard shaft seal out of the flange bore. (Refer to Figure 3-8.) Use care not to mar, scratch or damage the seal bore surface, or bearings.
16. After the seals and snap ring have been removed, clean the bore thoroughly. If necessary, the bore may be smoothed with number 400 emery paper (only).

SECTION L4
STEERING CIRCUIT
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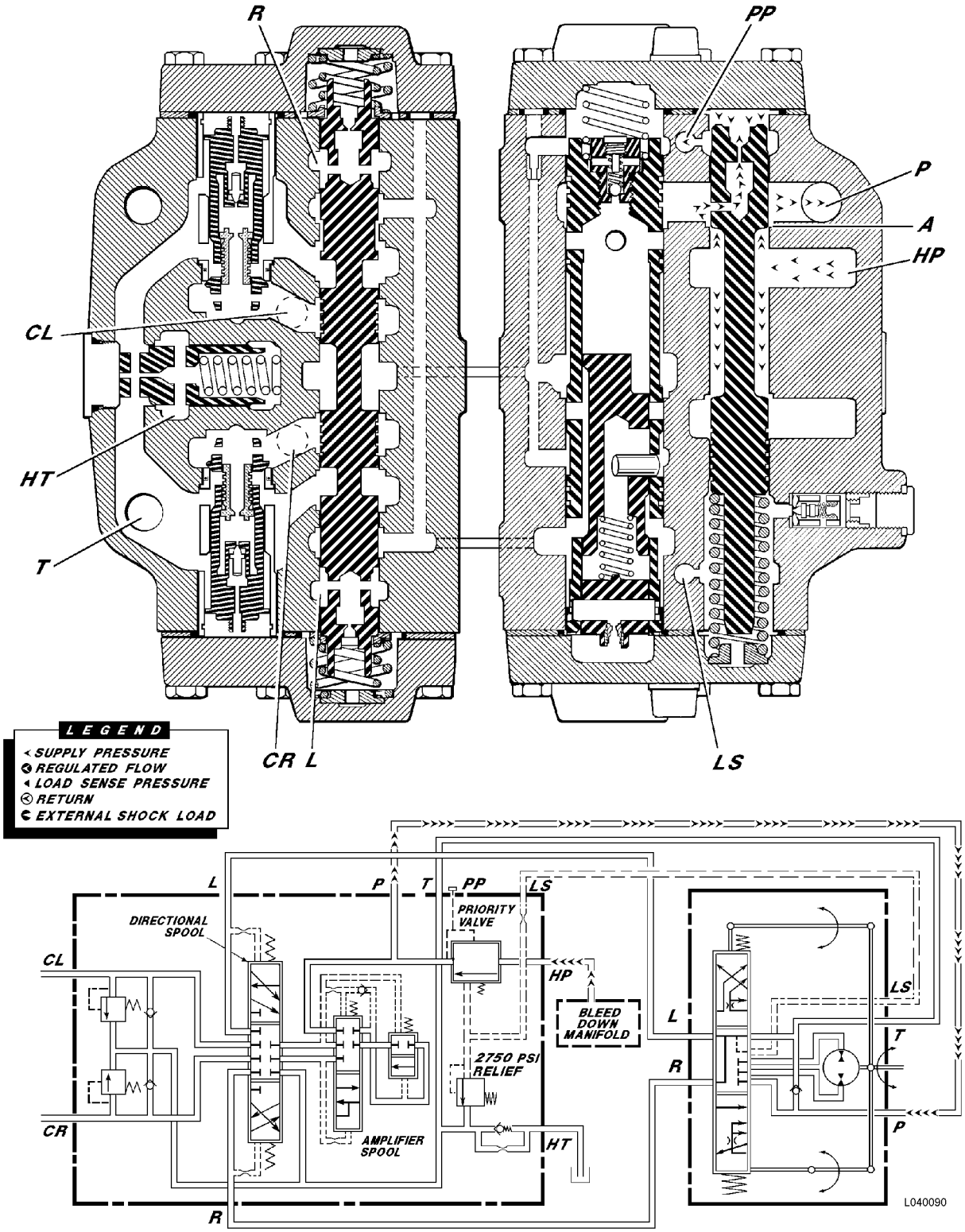


FIGURE 4-7. FLOW AMPLIFIER - NO STEER

Steering Pump

Figure 4-15 shows the steering pump and the location of the pressure control adjustments and stroke (flow) adjuster.

Note: Stroke adjuster (3, Figure 4-15) is set at the factory to provide maximum pump flow and adjustment is not normally required. If the truck is operated at high elevations, 10,000 ft. (3,050 meters) above sea level or more, it may be necessary to readjust the stroke control to reduce pump flow to prevent pump cavitation under certain conditions. If the truck is operating at high altitude and problems are experienced, consult your Komatsu service representative for adjustment procedures.

Figure 4-16 shows the schematic of the pump and the pressure control valves.

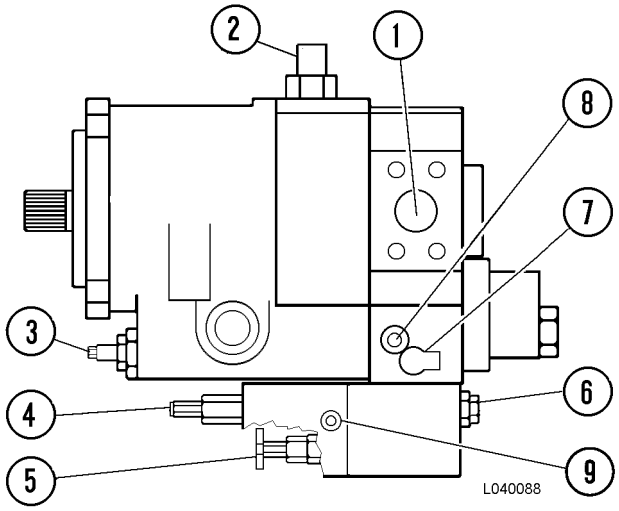


FIGURE 4-15. PUMP ASSEMBLY

1. Outlet Port
2. Case Drain
3. Stroke Adjuster
4. Unloader Valve Press. Adjust
5. Compensator Press. Adjust
6. 4-Way Valve
7. GPA Test Port
8. GP2 Test Port
9. “ACC” Port

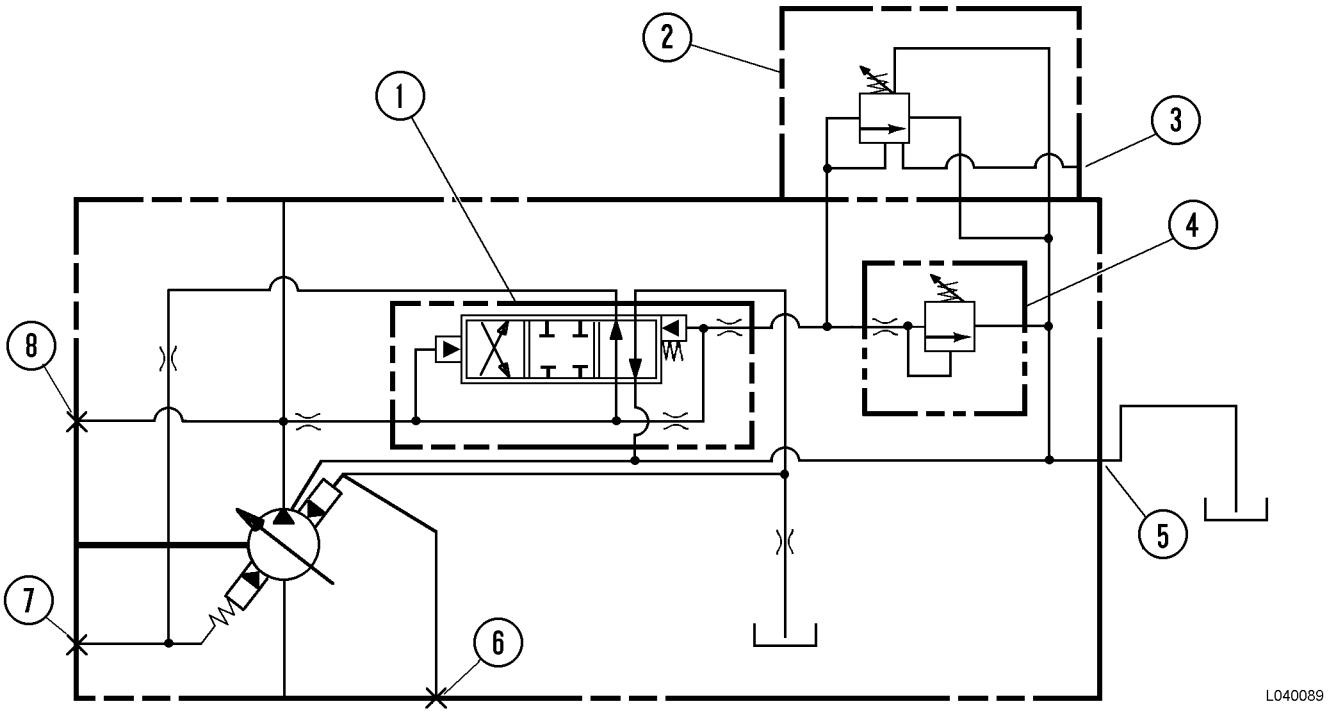


FIGURE 4-16. STEERING PUMP PRESSURE CONTROL SCHEMATIC

1. 4-Way Valve
2. Unloader Control Block
3. “ACC” Port
4. Pressure Compensator Control Block
5. Case Drain
6. GP2 Port
7. GP4 Port
8. GPA Test Port

10. Install the check ball in the hole shown in Figure 5-12. Install threaded bushing and lightly tighten.

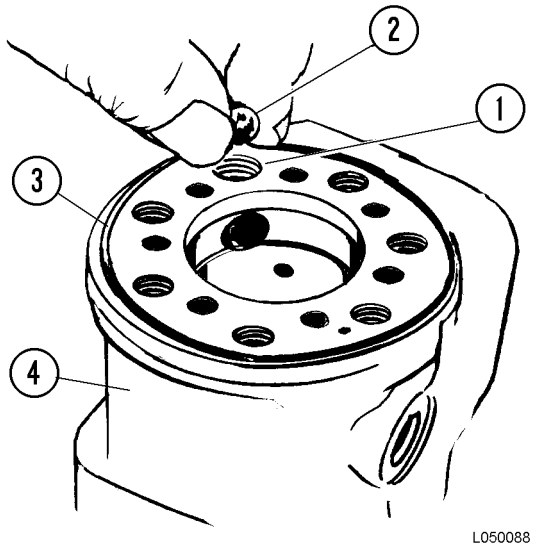


FIGURE 5-12. CHECK BALL INSTALLATION

1. Check Ball hole
2. Check Ball
3. O-Ring
4. Housing

11. Grease the housing O-ring (3) with Vaseline and install in the housing groove.
12. Install the distribution plate (15, Figure 5-7) with plate holes matching the corresponding holes in the housing.
13. Guide the cardan shaft (11) down into the bore with the slot in the cardan shaft aligned with the cross pin (9).
14. Position inner gear wheel onto cardan shaft. It may be necessary to rotate the gear slightly to find the matching splines on the cardan shaft. (Splines are machined to insure proper alignment of cardan shaft and inner gear wheel.)
15. Grease the O-rings (17 & 18) on both sides of the outer gear wheel with Vaseline and install.
16. Align outer gear wheel bolt holes with tapped holes in housing and match marks.
17. Align cover (19) using match marks as a reference and install using capscrews (23) and washers (20).
18. Install capscrew with pin (22) into proper hole.
19. Tighten cover capscrews in a criss-cross pattern to **2 ± 0.4 ft. lbs. (3 ± 0.5 N.m)**.

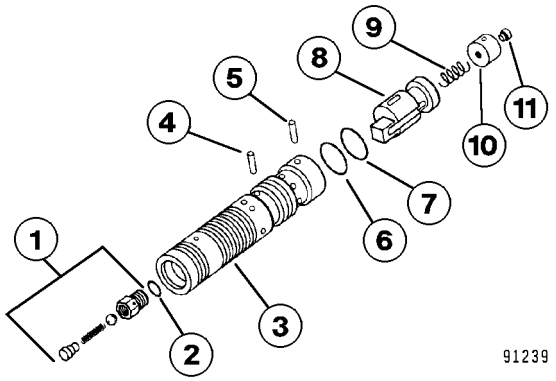


FIGURE 6-5. AMPLIFIER SPOOL ASSEMBLY

1. Check Valve
2. O-Ring
3. Spool
4. Pin
5. Pin
6. Retaining Ring
7. Retaining Ring
8. Inner Spool
9. Spring
10. Plug
11. Orifice Plug

Assembly

1. Thoroughly lubricate each part prior to installation using clean, type C-4 hydraulic oil.
2. Reassemble the Amplifier spool assembly in reverse order. Refer to Steps 12 & 13, and Figure 6-5 under disassembly.
3. Install orifice screw (13, Figure 6-3). Tighten orifice screw to **4 in. lbs. (.5 N.m)**.
4. Install check valve (47). Tighten check valve to **8 in. lbs. (1 N.m)**.
5. Install orifice screw (45). Tighten orifice screw to **8 in. lbs. (1 N.m)**.
6. Install seal (55) and relief valve assembly (54). Install seal (19), and plug (18). Tighten plug to **22 in. lbs. (2.5 N.m)**.
7. Install counterpressure valve assembly (15). Install plug (17) using new O-ring (16).
8. Install both shock and suction valves (12 & 26) as complete units. Install spring stop (20) springs (21 & 22) and spring control (23). Install orifice screws (24 & 33) if removed from main spool (27). Install main spool (27).
9. Install amplifier spool assembly (53). Install priority valve spool (44) and spring (43). Install spring (52).
10. Install spring control (29), springs (30 & 31) and spring stop (32).
11. Lubricate O-rings (6, 7 & 8) with molycote grease and position on cover (5). Install end cover (5). Install capscrews (3) with lockwashers (4). Tighten capscrews to **2 ft. lbs. (2.7 N.m)**. Install capscrew (1) and lockwasher (2). Tighten capscrew to **6 ft. lbs. (8 N.m)**.
12. Lubricate O-rings (38 & 40) with molycote grease and install on cover (39). Install end cover (39). Install capscrews (34) with lockwashers (37). Tighten capscrews to **2 ft. lbs. (2.7 N.m)**. Install capscrew (35) with lockwasher (36). Tighten capscrew to **6 ft. lbs. (8 N.m)**.
13. To prevent contamination, fit plastic plugs to each open valve port.

Swashblock Group

11. Inspect swashblock (25, Figure 6-10) for scratches, grooves, cracks or uneven surface. Replace if defective.

NOTE: The wear face is coated with a gray colored epoxy based dry film lubricant for break-in purposes. Scratching or wear of this coating is not detrimental as long as the metal surface underneath the coating is not scored or "picked-up".

12. Compare saddle bearing (24) thickness in wear area to thickness in a non-wear area. Replace the saddle bearings if the difference is greater than 0.004 in (0.102 mm).
13. Check mating surface of swashblock for cracks or excessive wear. Replace if necessary.
14. Swashblock movement in the saddle and saddle bearing must be smooth.

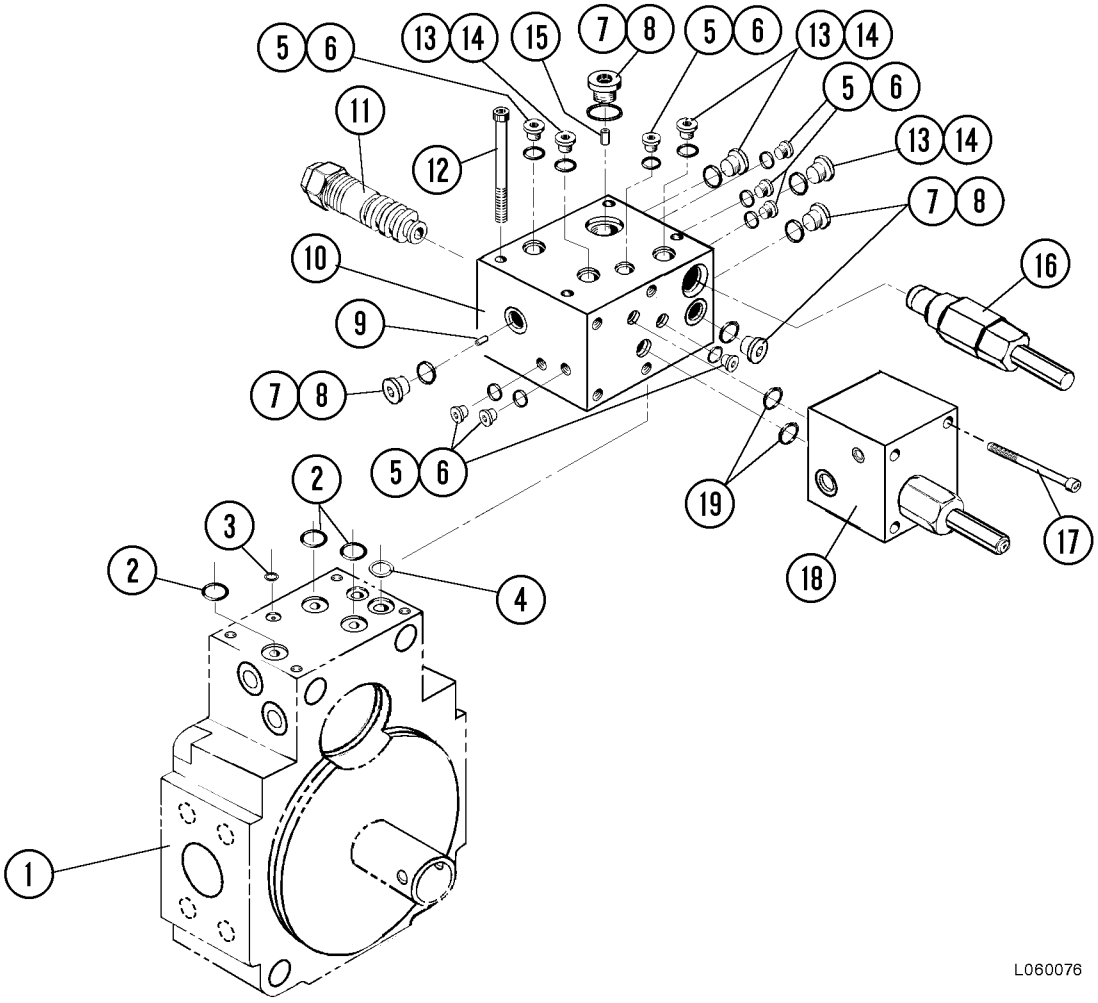


FIGURE 6-12. UNLOADER & COMPENSATOR CONTROLS

1. Valve Plate
2. O-Ring
3. O-Ring
4. O-Ring
5. Plug
6. O-Ring
7. Plug
8. O-Ring
9. Orifice (0.062 in.)
10. Compensator Control Block
11. 4-Way Valve
12. Screw
13. Plug
14. O-Ring
15. Orifice (0.032 in.)
16. Compensator
17. Screw
18. Unloader Module
19. O-Ring

7. Set the regulator for 25 psi (172 kPa), then, slightly open the nitrogen bottle. Slowly fill the accumulator. The fill rate time for this accumulator is four minutes.

⚠CAUTION

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

8. After 25 psi (172 kPa) precharge pressure is obtained, close the nitrogen valve. Set the regulator for the operating precharge pressure based on the current ambient temperature the truck is in. Refer to Table 1. Then, open the nitrogen bottle, and fill the accumulator.
9. Let the pre-charge set for 15 minutes. This will allow the gas temperature to stabilize. If the desired precharge is exceeded, close the nitrogen bottle valve, and slowly open the bleed valve. Nitrogen precharge pressure is 1400 psi (9653 kPa) at 70°F (21°C).

⚠CAUTION

Do not reduce the precharge by depressing the valve core with a foreign object. High pressure may rupture the rubber valve seat.

10. Turn the top hex to close the internal poppet. Tighten the hex nut to **(5-8 ft.-lb.) (5.7-9.2 cm-kg)**.
11. Hold the gas valve stationary, and loosen the swivel nut to remove the assembly. Check for nitrogen leaks using a common leak reactant.
12. Install, and tighten the gas valve cap to **(10-15 in-lb.) (11.5-17 cm-kg)**. The gas valve cap serves as a secondary seal.
13. Install the valve guard.

Temperature During Precharge

Temperature variation can affect the precharge pressure of an accumulator. As the temperature increases, the pre-charge pressure increases. Conversely, decreasing temperature will decrease the precharge pressure. In order to assure the accuracy of the accumulator precharge pressure, the temperature variation must be accounted for. A temperature variation factor is determined by the ambient temperature encountered at the time when charging the accumulator on a truck that has been shut down for 1 hour. Refer to Table 1 for charging pressures in different ambient operating conditions that the truck is currently exposed to DURING the charging procedure.

Example: Assuming the ambient temperature is 50°F, charge the accumulator to 1348 psi (9294 kPa).

TABLE 1. Relationship Between Charging Pressure and Ambient Temperature

Ambient Temperature	Charging Pressure ± 10 psi (70 kPa)
-10°F (-23°C) and below	1194 psi (8232 kPa)
0°F (-17°C)	1220 psi (8412 kPa)
10°F (-12°C)	1245 psi (8584 kPa)
20°F (-7°C)	1271 psi (8763 kPa)
30°F (-1°C)	1297 psi (8943 kPa)
40°F (4°C)	1323 psi (9122 kPa)
50°F (10°C)	1348 psi (9294 kPa)
60°F (16°C)	1374 psi (9473 kPa)
70°F (21°C)	1400 psi (9653 kPa)
80°F (27°C)	1426 psi (9832 kPa)
90°F (32°C)	1452 psi (10011 kPa)
100°F (38°C)	1477 psi (10184 kPa)
110°F (43°C)	1503 psi (10363 kPa)
120°F (49°C)	1529 psi (10542 kPa)

NOTE: Precharge pressures below 1194 psi (8232 kPa) are not recommended because of low precharge pressure warnings. The low accumulator precharge pressure warning switch activates at 1100 ± 45 psi (7584 ± 310 kPa).

HOIST CIRCUIT

HOIST CIRCUIT OPERATION

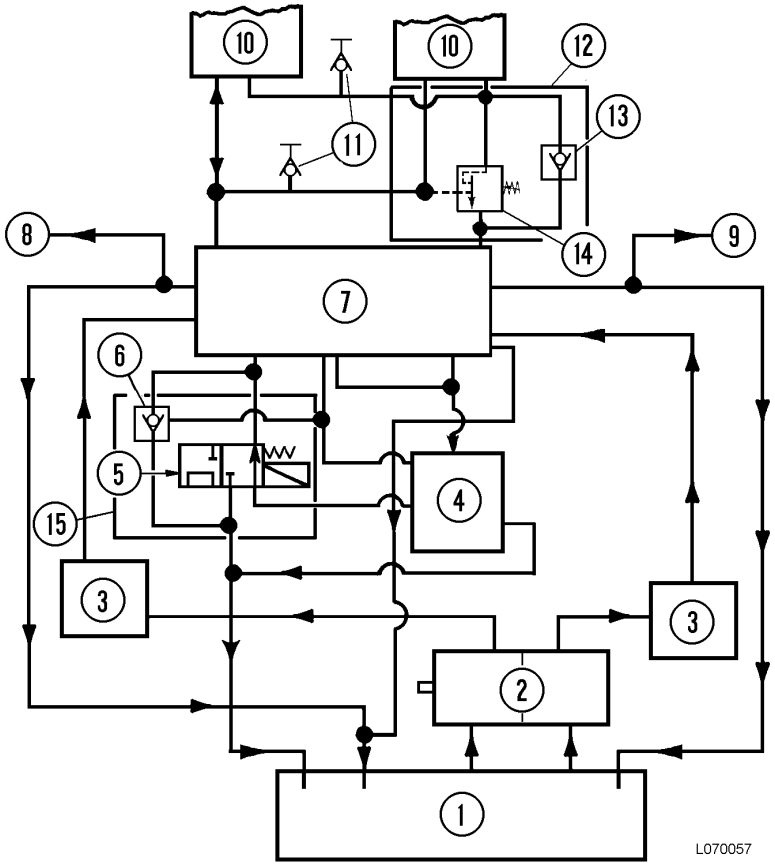
The following information describes the basic hoist system circuit as shown in Figure 7-1. Detailed component operation is outlined under the individual component descriptions.

Hydraulic fluid is supplied by a tank (1) located on the left frame rail. The tank's service capacity is approximately 250 gal. (947 l). Hydraulic oil is routed to a tandem gear type pump (2). A second pump, coupled to the rear of the hoist pump, supplies oil for the steering and brake systems. The pumps are driven by an accessory drive at the end of the traction alternator.

Hoist pump output is directed to a pair of high pressure filters (3), mounted to the inboard side of the fuel tank.

Hydraulic oil from the hoist filters is directed to the hoist valve (7), mounted above the pumps The hoist valve directs oil to the body hoist cylinders (10) for raising and lowering of the dump body. Hoist valve functions are controlled by the operator through the lever connected to the hoist pilot valve (4) located in the hydraulic components cabinet. A hoist limit solenoid (5) located in the bleeddown manifold shifts the hoist valve out of POWER UP before the hoist cylinders extend to their maximum physical limit.

When the hoist valve is in the HOLD or FLOAT position, hoist circuit oil flows to the front (8) and rear (9) service brakes, cooling the wet disc brakes during truck operation.



⚠WARNING

Hydraulic hoses deteriorate with age and use. Prevent possible malfunctions by inspecting all hoses periodically. Replace any hose showing wear, damage or deterioration.

FIGURE 7-1. HOIST CIRCUIT SCHEMATIC

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

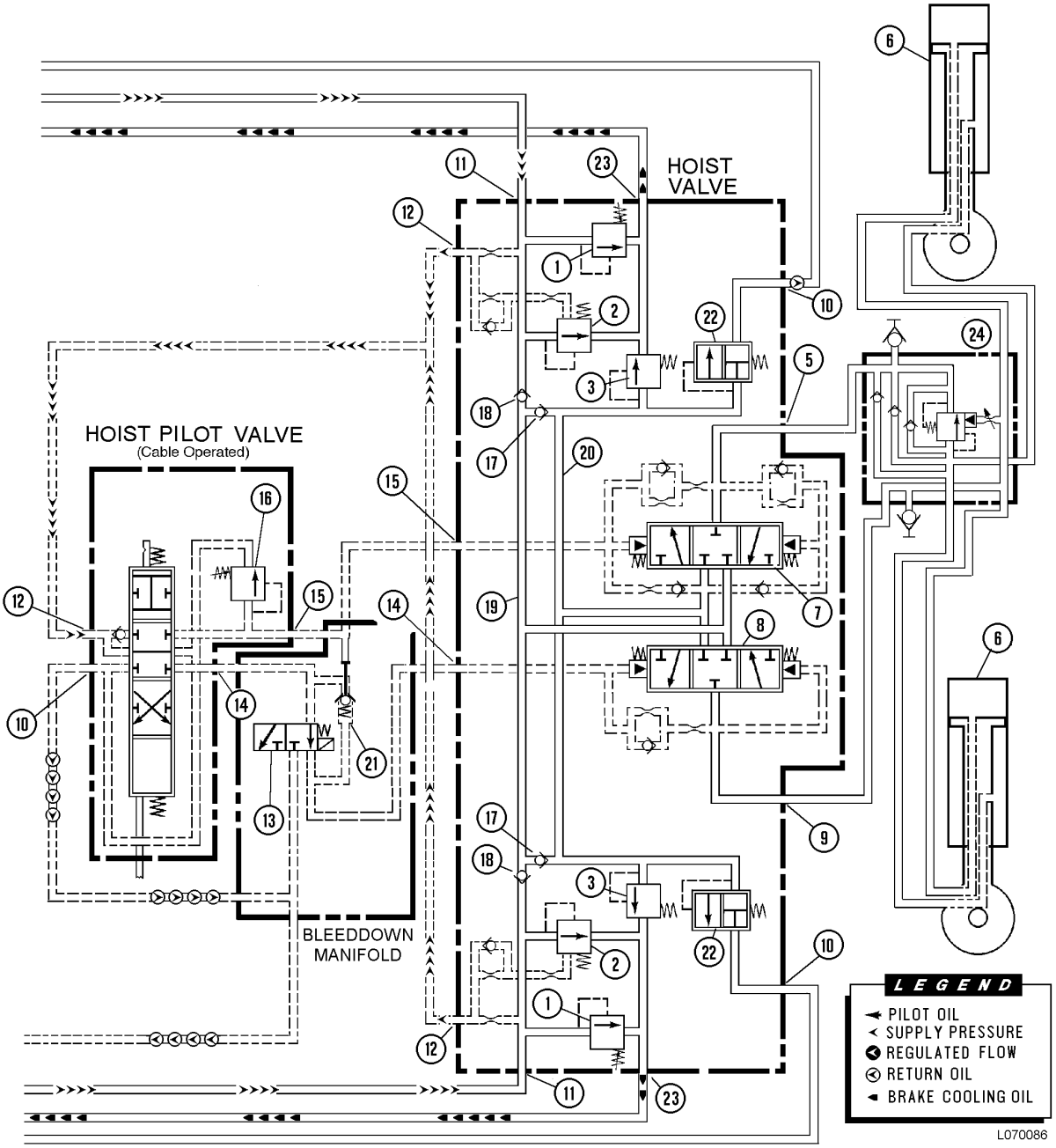


FIGURE 7-7. HOLD POSITION

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

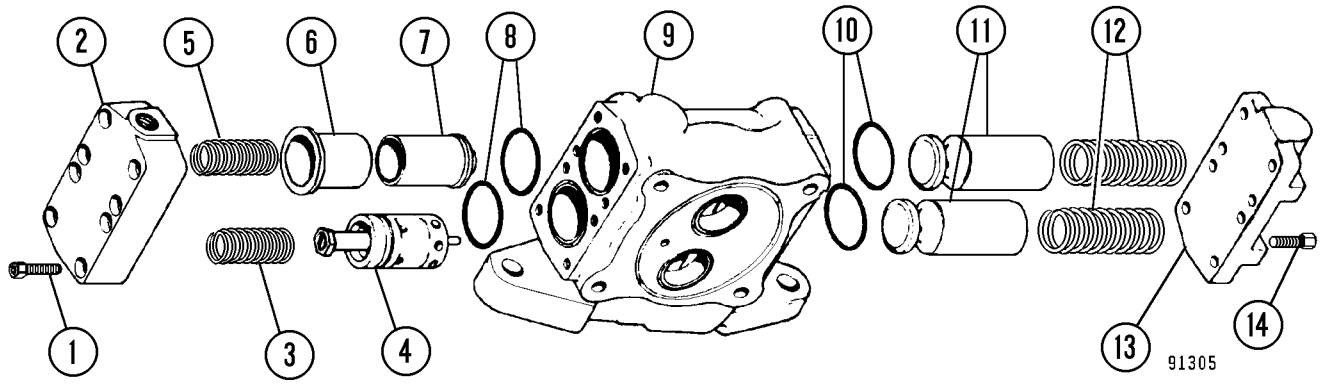


FIGURE 8-5. INLET SECTION DISASSEMBLY

1. Capscrew
2. Inlet Cover
3. Spring (Orange)
4. Flow Control & Main Relief Valve
5. Spring
6. Sleeve
7. Secondary Low Pressure Relief
8. O-Rings
9. Inlet Valve Body
10. O-Rings
11. Check Valves
12. Springs
13. Cover
14. Capscrews

INLET SECTION

Disassembly

1. Match mark or identify each part when removed in respect to its location or respect to its mating bore to aid reassembly.
2. Disconnect the external tube (7, Figure 8-2) at the cover end and remove. Remove capscrews (14, Figure 8-5), remove cover (13). Remove springs (12), check valves (11) and O-rings (10).

NOTE: Inlet section shown removed from main valve body for clarity.

3. Remove capscrews (1) and cover (2). Remove springs (3 & 5) and flow control/main relief valve (4). Remove sleeve (6), low pressure relief (7) and O-rings (8).

NOTE: If restrictor poppet removal in cover (2, Figure 8-5) is required, refer to Step 4 and Figure 8-6.

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

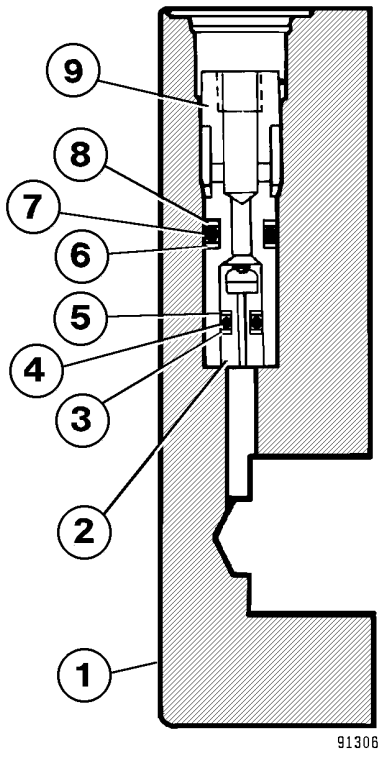


FIGURE 8-6. RESTRICTOR POPPET REMOVAL (Inlet Cover)

1. Inlet Cover
2. Restrictor Poppet
3. Backup Ring
4. O-Ring
5. Backup Ring
6. Backup Ring
7. O-ring
8. Backup Ring
9. Sleeve

Installation

⚠WARNING

Install a retaining strap or chain to prevent the cylinder from extending during handling. The hoist cylinder weighs approximately 2500 lbs. (1135 kg). Use a suitable lifting device that can handle the load safely.

1. Raise the cylinder into position over the pivot point on the frame. The cylinder should be positioned with the air bleed vent plug on top, toward the front of the truck. Install spacer (6, Figure 8-19). Align bearing eye with pivot point and push cylinder into place.
2. Install retaining plate (3), locking plate (2),and capscrews. Tighten capscrews to **220 ft. lbs. (298 N.m)**. Bend locking plate tabs over capscrew flats.
3. Align the top hoist cylinder bearing eye with the bore of the upper mounting bracket. Refer to Figure 8-18.
4. Align retaining capscrew hole in pin with hole in mounting bracket and install pin. Install capscrew (5) and self-locking nut (4) and tighten to standard torque.
5. Install new O-rings in grooves on hose flange connections and lubricate with clean hydraulic oil. Position flanges over hoist cylinder ports and install flange clamps. Secure clamps with capscrews and lockwashers. Tighten capscrews to standard torque.
6. Reconnect lubrication lines for the upper and lower hoist cylinder bearings.
7. Start engine, raise and lower body several times to bleed air from cylinder. Check for proper operation and inspect for leaks.
8. Service hydraulic tank if necessary.

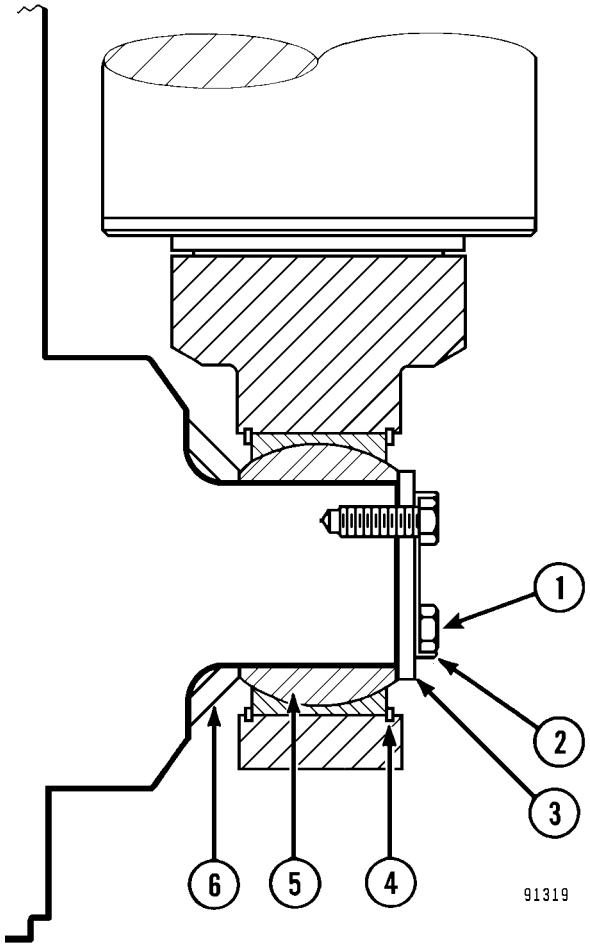


FIGURE 8-18. HOIST CYLINDER LOWER MOUNT

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

SECTION L9

HYDRAULIC SYSTEM FILTERS

INDEX

HYDRAULIC CHECK-OUT PROCEDURE

GENERAL INFORMATION

The hydraulic check-out procedure is intended to help the technician check, adjust, and diagnose problems in the steering and hoist circuits. The technician should read the entire check-out procedure prior to performing any steps to become familiar with the procedures and all the warnings and cautions. The check-out procedure begins by checking the basic system before checking individual components.

Included on the last page is a data sheet to record the information observed during the hydraulic system check-out procedure. The data sheet is designed to be removed, copied, and used during the check-out procedure.

* *Steps indicated in this manner should be* ***recorded on the data sheet*** *for reference.*

⚠WARNING

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.

Before disconnecting pressure lines, replacing components in the hydraulic circuits, or installing test gauges, ALWAYS bleed down hydraulic steering accumulators.

The steering accumulators can be bled down by shutting down the engine, turning key switch OFF, and waiting 90 seconds. Confirm the steering pressure is released by turning the steering wheel; no front wheel movement should occur. Bleed down brake system accumulators prior to removing any hoses supplying oil to the brake system.

⚠WARNING

The AC drive system rest switch, located on the instrument panel, must be in the ON position and the GF cutout switch in the CUTOUT position during test procedures. (See Figure 3-1, page E3-4, Propulsion System, for GF switch location.)

STEERING CIRCUIT CHECK-OUT & ADJUSTMENT PROCEDURE

The steering circuit hydraulic pressure is supplied from the piston pump and steering accumulators. Some steering system problems, such as spongy or slow steering or abnormal operation of the low steering pressure warning light can sometimes be traced to internal leakage of steering components. If internal leakage is suspected, perform the steering component leakage tests outlined in this chapter.

NOTE: Excessive internal leakage within the brake circuit may contribute to problems within the steering circuit. Be certain that brake circuit leakage is not excessive before troubleshooting the steering circuit.

The steering circuit can be isolated from the brake circuit by releasing all steering system pressure and then releasing all pressure from the brake accumulators and removing the brake system supply line (4, Figure 10-2) from the bleeddown manifold (see WARNING). Plug the brake supply hose and cap the fitting at the bleeddown manifold to prevent high pressure leakage.

Prior to checking the steering system, the hydraulic steering and brake systems must have the correct accumulator precharge and be up to normal operating temperatures. Refer to Steering Circuit Component Repair - Steering Accumulator Charging Procedure in this section of the manual for accumulator charging instructions.

⚠IMPORTANT⚠

If the steering and brake pump has just been installed, it is essential that the steering pump case is full of oil prior to starting the engine. Refer to Steering Circuit Component Repair - Steering and Brake Pump, Section L6 for instructions.

HYDRAULIC SYSTEM FLUSHING PROCEDURE

The following instructions outline the procedure for flushing the hydraulic system.

Preparation

1. Place selector switch in NEUTRAL, apply the parking brake and place the rest switch in the ON position. (Leave the rest switch ON for all the following procedures.)
   a. Shut down engine and turn key switch OFF. **Be certain the link voltage warning lamps turn off.**
   b. Allow at least 90 seconds for the steering accumulators to bleed down. Turn the steering wheel to verify all pressure is relieved.
   c. Open the brake accumulator bleed down valves on the brake manifold. (This will return contaminants in the brake accumulators to the hydraulic tank.)
2. Thoroughly clean the exterior of the hydraulic tank. Drain the hydraulic tank, remove the strainers and diffusers, and clean. Flush the interior of the hydraulic tank with a cleaning solvent. Inspect all hydraulic hoses for deterioration or damage.

NOTE: If a system component fails, all hoses and tubing should be removed and back flushed with a cleaning solvent. Inspect for small particles which may be trapped inside.

3. Inspect the hydraulic tank strainers and diffusers. If damaged, install new components.
4. Change all high pressure filter elements.
5. Fill hydraulic tank with clean, type C-4 hydraulic oil.
6. Be certain suction line shut-off valves are open.
7. Bleed trapped air inside steering pump. (Refer to Steering and Brake Pump, Section L.)

Flushing Procedure

⚠ IMPORTANT ⚠

If at any time during the flushing procedure the filter indicator warning light comes on, replace all filters, immediately.

1. Verify the accumulators are properly precharged. With key on, engine off, the accumulator precharge warning light must not be off before proceeding.
2. Install a jumper hose to the “disabled truck” fittings on the overcenter manifold, and a jumper to the “disabled truck” fittings on the bleeddown manifold. The jumper hoses must be made of SAE 100R12 (rated at 4000 psi (27,580 kPa)).
3. Set all controls in the NEUTRAL position. Do not steer the truck or operate controls until the next step is completed.
4. Start the engine and run at 1000 RPM for five minutes. This will circulate oil with all valves in the neutral position.
5. To increase flow and turbulence in the system, increase engine speed to full throttle and maintain for 15 minutes.

   Move the hoist control to POWER UP for 30 seconds, and then move the control to POWER DOWN for 30 seconds. Repeat this cycle for a total of five times. This process will carry contaminates to the hydraulic tank.
6. Shut down engine, and turn key switch OFF. Allow at least 90 seconds for the accumulators to bleed down. Turn the steering wheel to verify all pressure is relieved.
7. Remove the jumper hoses from the “disabled truck” hookups.
8. Close the brake accumulator bleed down valves on the brake manifold (opened in Step 1.c. of Preparation)
9. To enable full extension of the hoist cylinders, disconnect hoist limit solenoid on bottom of bleeddown manifold.

CHECKFIRE ELECTRIC DETECTION AND ACTUATION SYSTEM - SERIES 1

The Checkfire Electric Detection and Actuation System - Series 1 (Figure 2-5) uses linear detection wire. This is a two conductor heat rated thermo cable. When the detection cable is subjected to 221°F (105°C) the insulating coating of the cable melts allowing the conductors to short together closing the electric circuit to the squib which detonates to depress the puncture pin and actuate the expellant cartridge.

Components of the checkfire electric detection and actuation system are shown in Figure 2-5.

Control Module
(Figure 2-4):

Provides the electrical connections necessary between the power lead and the linear detection wire to the power lead supplying electrical power, via the squib, to the actuator. Also provides a visual check of power availability - pressing the switch button will illuminate the green indicator light if electrical power is available in the system.

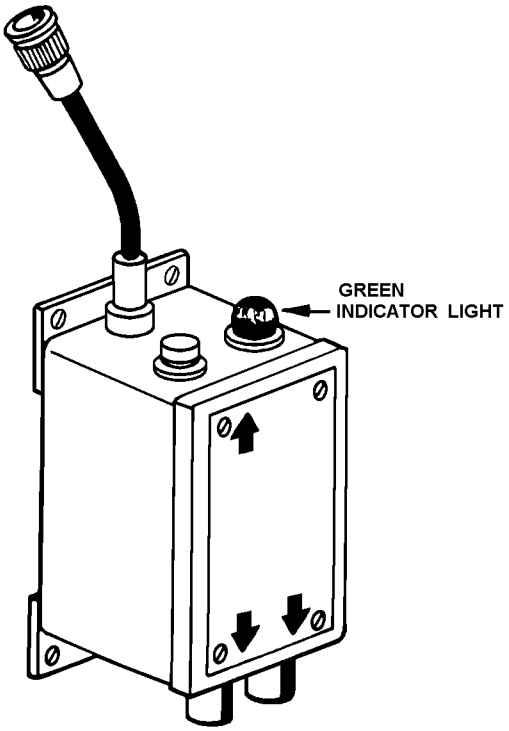


FIGURE 2-4. CONTROL MODULE

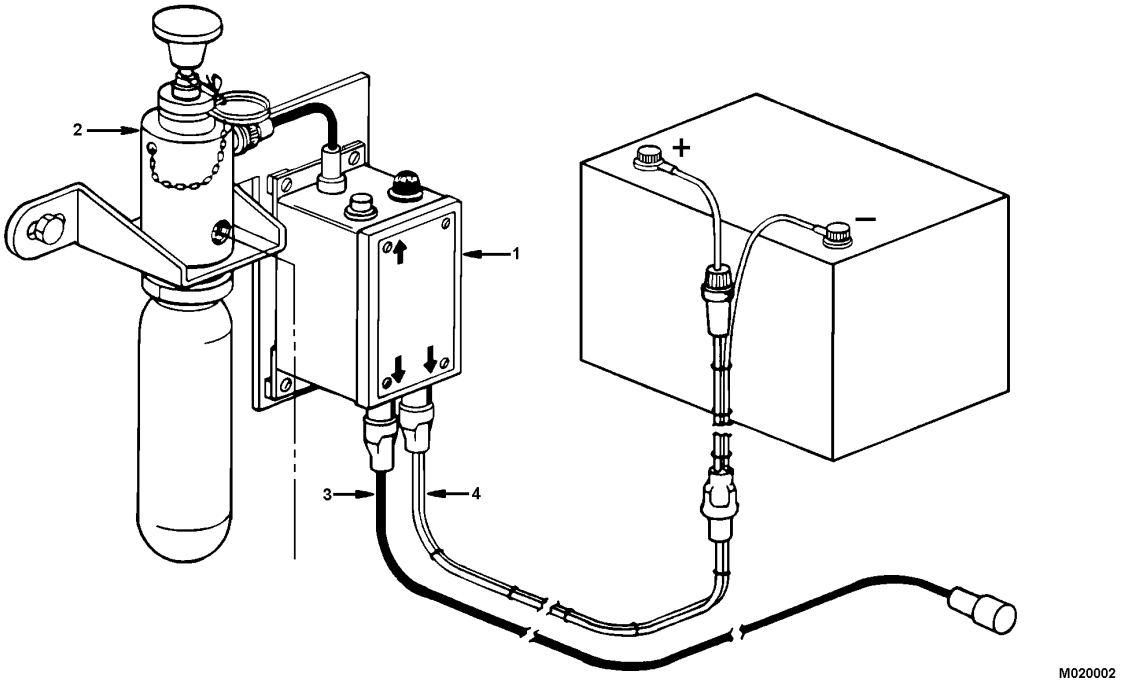


FIGURE 2-5. CHECKFIRE ELECTRIC DETECTION/ACTUATION SYSTEM

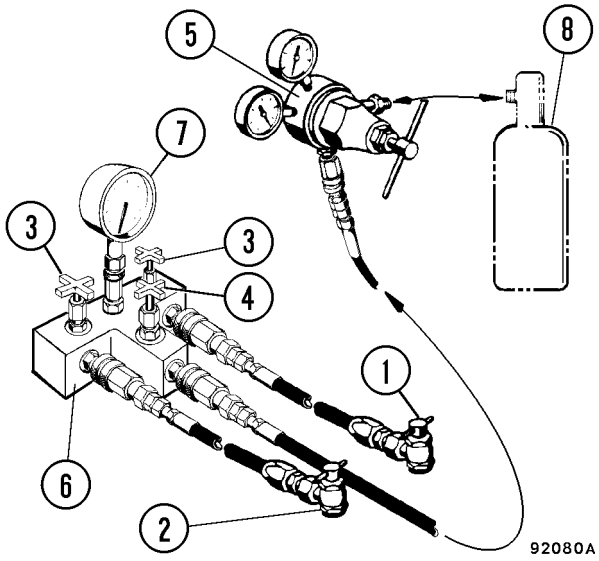
1. Control Module
2. Manual/Automatic Actuator
3. Linear Detection Wire
4. Power Wire
5. Test Kit (Not Shown)

SPECIAL TOOLS

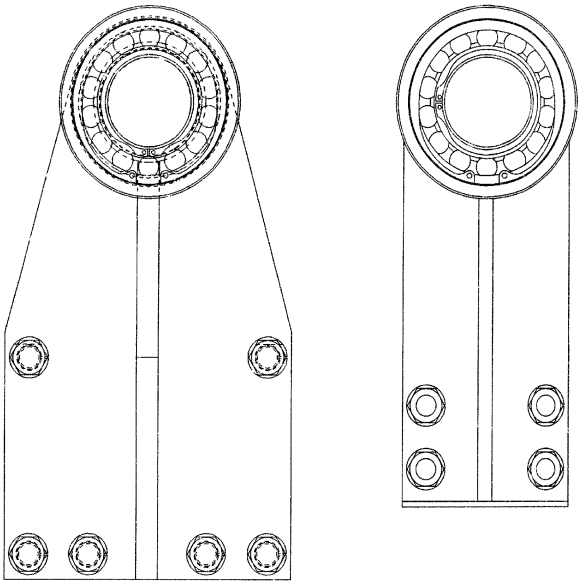
Part Number	Description	Use
EB1759	Nitrogen Charging Kit	Suspension & Accumulator Nitrogen Charging

1. “T” Handle Valve
2. Charging Valve Adapter
3. Manifold Outlet Valves (from gauge)
4. Inlet Valve (from regulator)
5. Regulator Valve (Nitrogen Pressure)
6. Manifold
7. Charging Pressure Gauge (Suspensions)
8. Dry Nitrogen Gas

NOTE: Arrangement of parts may vary from illustration shown, depending on Charging Kit P/N.



Part Number	Description	Use
EJ2626	Roller Assembly	930E-3
EH8687	Roller Assembly	930E-3SE
(No longer available as complete unit)		Power Module Remove & Install 930E-3
EJ2271	Roller Mount	930E-3
EH8681	Roller Mount	930E-3SE
PC0706	Bearing	
TH9449	Bearing Retainer Ring	
TG1680	Roller Retainer Ring	
C1645	Capscrew 0.75 -10 NC x 2 1/4 in.	
C1542	Lockwasher 0.75 in.	
EH8686	Roller Ring	



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 5 maximum payloads and time stamps.
- Top 5 positive and negative frame torque and time stamps
- Top 5 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.

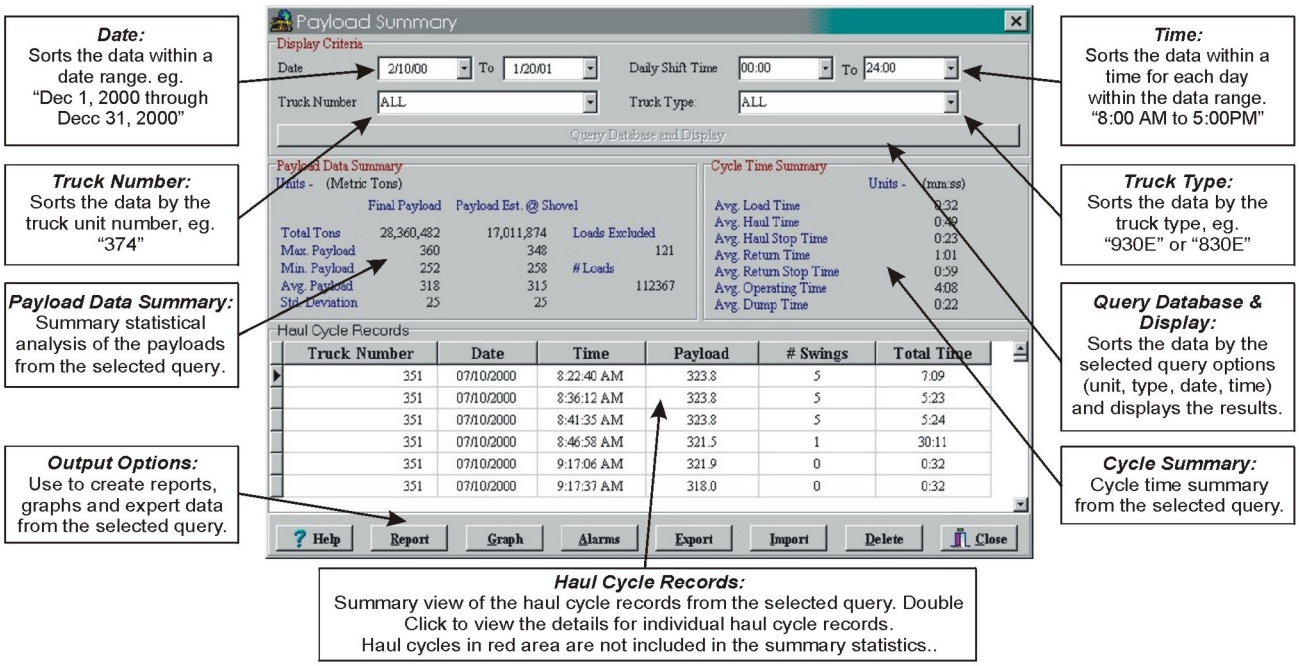
Haul Cycle Data

The following information is recorded for each haul cycle:

Table 1: HAUL CYCLE DATA		
Data	Unit	Remark
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 4 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 should 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

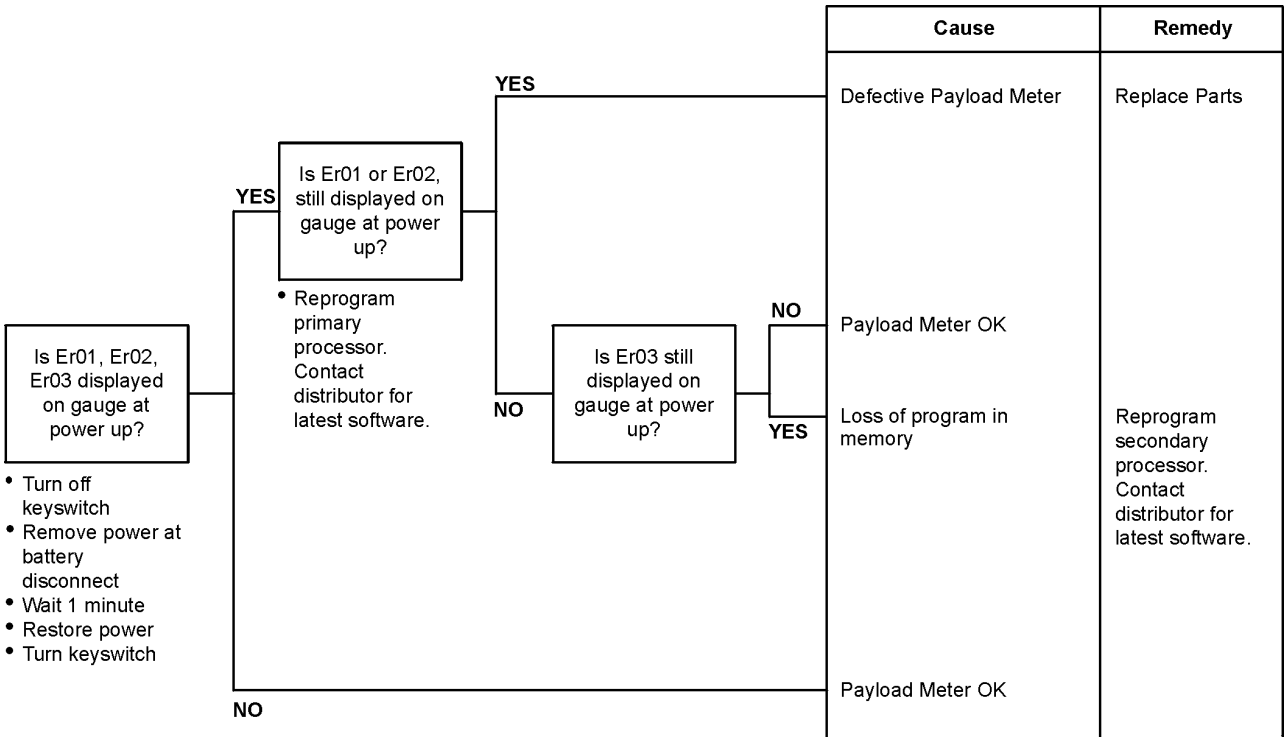
The payload meter performs several internal memory system checks every time it powers-up. In case of error, the operator gauge may display an error code when power is applied to the PLMIII system.

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.

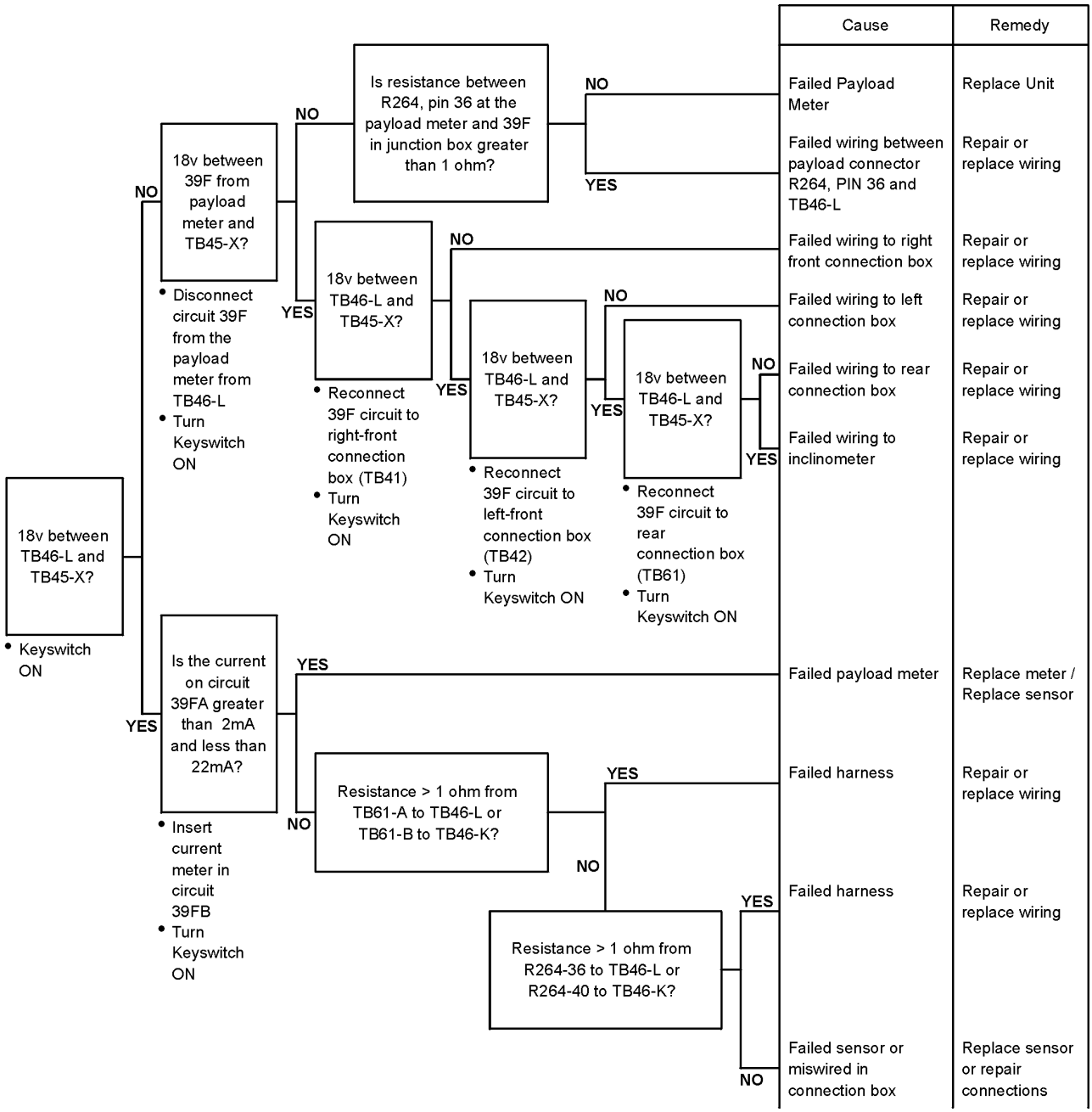
Alarm 7 - Right Rear Pressure High

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.

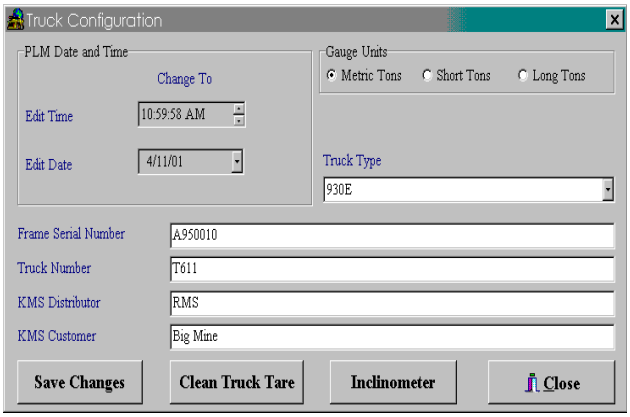
- Confirm 18v sensor supply at TB46-L in payload junction box.
- Confirm proper connection of signal circuit 39FC from right suspension connection box, TB41-B to payload junction box TB46-G to payload meter connector R264, pin 20.



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

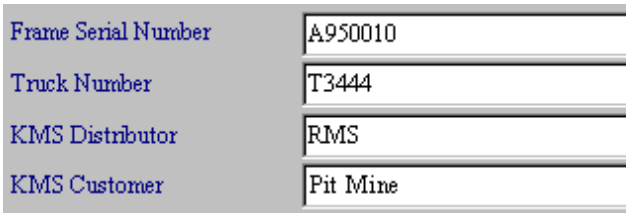
22. Confirm that the PLMIII software version matches the latest available version. As of 09-May-01 the EJ0575-1 software version will display as "01/28/01A". The latest version can be found at *http://www.kms-peoria.com/payload*. If the version does not match the latest indicated on the internet, download 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 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.

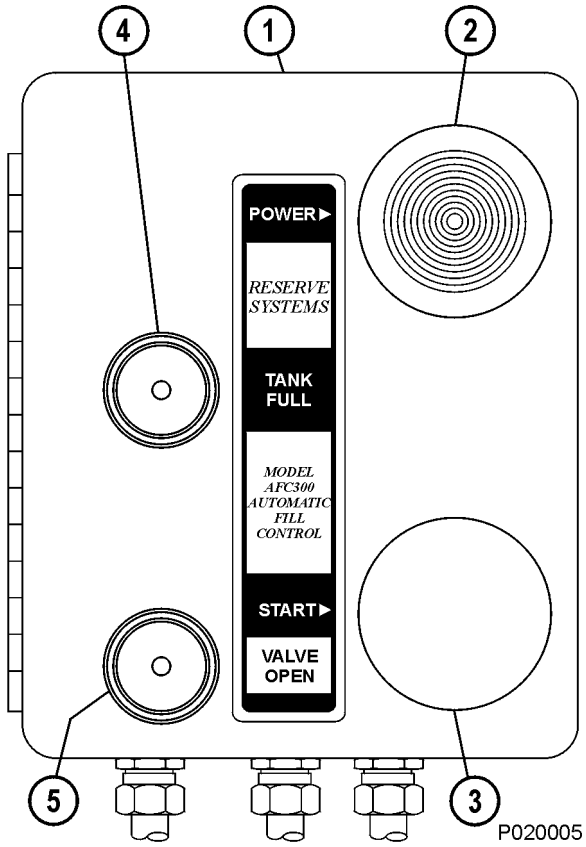


FIGURE 31-3. RESERVE OIL TANK REMOTE FILL

1. Remote Control Box
2. System Switch
3. Start Switch
4. FULL Light
5. VALVE OPEN Light

SERVICE

Between oil drains, the only normal servicing required is routine replenishment of oil at the reserve supply tank. Maintenance of running levels should be checked routinely; manually before starting the engine and with the LED system monitor on the reserve tank pumping unit (11, Figure 31-1) when the engine is running.

There is also an in-line filter (screen) installed at the inlet of the fill valve (3, Figure 31-1). This filter requires no periodic maintenance, but it can be cleaned by removing it from the system and back flushing through the filter.

CAUTION: Always check the engine oil level before starting engine. Use the engine dipstick.

Every 10 Hours, or once each shift:

1. Before starting engine, check oil level using engine dipstick. Oil level should be in normal operating range. If not, check the reserve system for proper operation.
2. The engine oil quality will be best if the reserve tank is kept reasonably full. Check the oil level in the reserve tank. As a minimum guideline, if the oil is below the half-full level, fill the tank manually so the oil is just visible in the top sight glass or by using the automatic fill control method.
3. After starting and warm-up, check engine oil level signal (LED) to verify that the engine is being maintained at the preset running oil level. The signal should alternate between periods of ‘steady on’ and ‘flashing’.

Every 500 Hours:

1. Change all engine and system filters, if applicable.
2. More system failures result from bad electrical connections than all other causes combined. Check electrical system connections for tightness, corrosion and physical damage. Check battery, alternator, oil pressure switch, junction boxes, remote control fill box and circuit breakers.
3. Examine electrical cables over their length for possible damage.
4. Small hose leaks can cause system malfunction. Examine all hoses, including those on the reserve tank and the ones leading to and from the engine for leaks, cracks or damage. Check all fittings for tightness, leakage or damage.

Changing Oil

1. Drain both the engine sump and the reserve tank. Refill both engine and reserve tank with new oil to proper levels.
2. Change engine and reserve tank filters as required.
3. Start engine and check for proper operation.

NOTE: Do not use the oil in the reserve tank to fill the engine sump. Both must be at proper level before starting engine.

The engine oil level should be checked with the engine dipstick at every shift change. The oil level in the reserve tank must also be checked at every shift change. Oil must be visible in the middle sight gauge. If not, add oil to the reserve tank until oil is visible in the top sight gauge

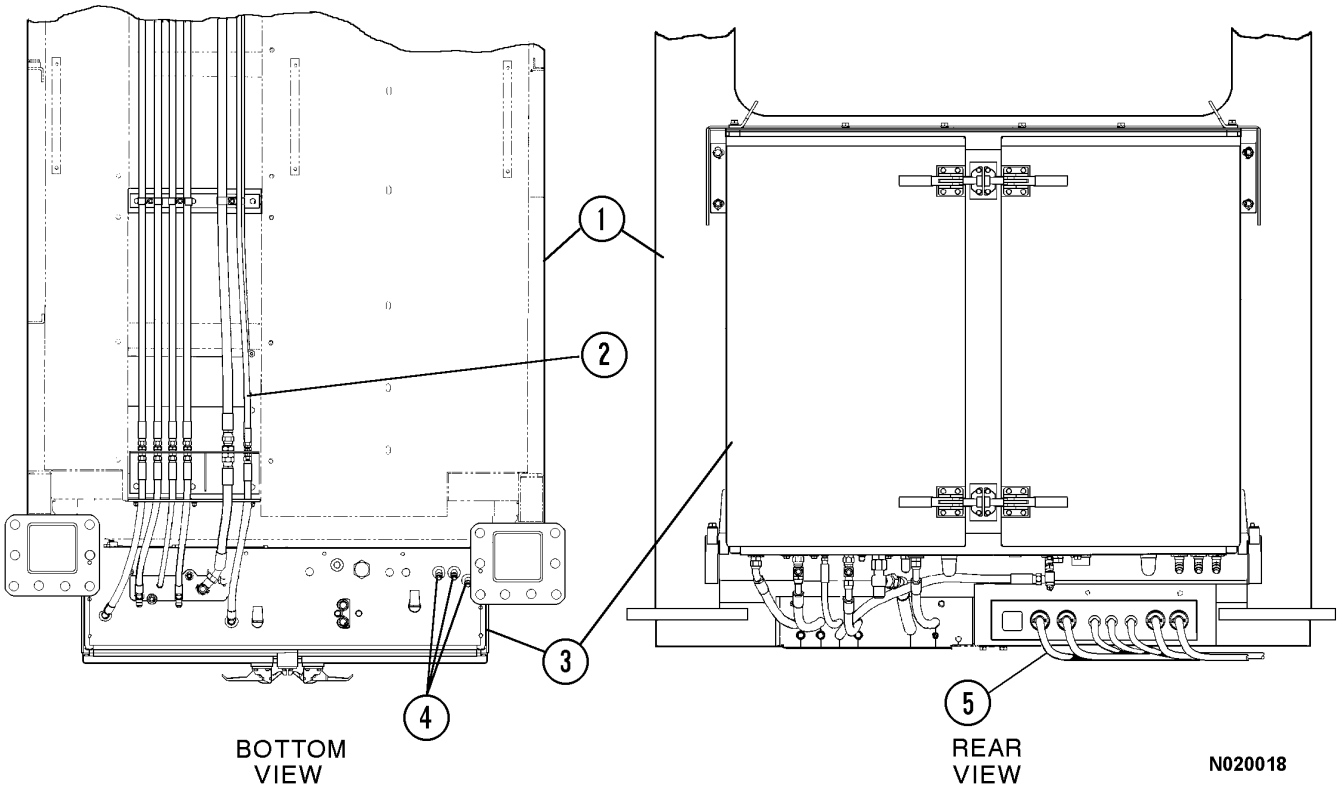


FIGURE 2-2. CAB HYDRAULIC AND ELECTRICAL CONNECTIONS

1. Cab
2. Hydraulic System Hoses
3. Hydraulics Components Cabinet
4. Electrical Harnesses

4. Close heater shutoff valves located at the water pump inlet housing on the right side of the engine and at the water manifold. Disconnect heater hoses at each valve and drain coolant into a container.
5. Remove clamps and heater hoses from fittings underside of deck, below heater. Cap fittings and plug hoses.
6. Remove air cleaner restriction indicator hoses near front, inside corner under cab.

⚠ IMPORTANT ⚠

Federal regulations prohibit venting air conditioning system refrigerants into the atmosphere. An approved Recovery/Recycle Station must be used to remove the refrigerant from the air conditioning system.

7. Evacuate air conditioning system:
   a. Attach a recycle/recovery station at the air conditioning compressor service valves. (Refer to Section N, Operator Comfort for detailed instructions.)
   b. Evacuate air conditioning system refrigerant.
   c. Remove the air conditioner system hoses which are routed to the bottom of the cab from the receiver/drier and compressor. Cap hoses and fittings to prevent contamination.
8. Attach a lifting device to the lifting eyes provided on top of the cab.

⚠WARNING

The cab assembly weighs approximately 5000 lbs. (2270 kg). Be sure lifting device is capable of lifting the load.

GLASS REPLACEMENT

Adhesive Bonded Windows

Recommended Tools/Supplies

- Cold knife, pneumatic knife, or a piano wire cutting device, long knife. Cutout tools are available at an auto glass supply store.
- Heavy protective gloves
- Safety eyeglass goggles
- Windshield adhesives, proper cleaners, primers & application gun
- SM2897 glass installation bumpers (6 - 7 per window)
- Window glass (Refer to Parts Catalog)

Recommended adhesives: SikaTack Ultrafast or Ultrafast II (both heated). Vehicle can be put into service in 4 hours under optimum conditions. Heated adhesives require a Sika approved oven to heat adhesive to 80° C (176° F).
Sikaflex 255FC or Drive (unheated). Vehicle can be put into service in 8 hours under optimum conditions.

Sika Corporation
30800 Stephenson Hwy.
Madison Heights, MI 48071
Toll Free Number: 1-800-688-7452
Fax number: 248-616-7452
http://www.sika.com or
http://www.sikasolutions.com

⚠WARNING

Due to the severe duty application of off-highway vehicles, the cure times listed by the adhesive manufacturer should be doubled before a truck is moved. If the cure time is not doubled, vibration or movement from a moving truck will weaken the adhesive bond before it cures, and the glass may fall off the cab.
If another adhesive manufacturer is used, be certain to follow that manufacturer's instructions for use, including the use of any primers, and double the allowances for proper curing time.

Replacement Procedure

⚠IMPORTANT⚠

The first concern with all glass replacement is SAFETY! Wear heavy protective gloves and safety eyeglass goggles when working with glass.

1. Using chosen cut-out tool, slice into existing urethane adhesive and remove window.
2. Carefully clean and remove all broken glass chips from any remaining window adhesive. The surface should be smooth and even. Use only clean water.

NOTE: Removal of all old adhesive is not required; just enough to provide an even bedding base.

3. Using a long knife, cut remaining urethane from vehicle, leaving a bed 2-4 mm thick. If existing urethane is loose or otherwise unsound, completely remove. Leave the installation bumpers in place, if possible. Clean metal with Sika Aktivator, allow ten minutes to dry. Then paint on a thin coat of Sika Primer 206G+P and allow ten minutes to dry.
4. Using only the new side window(s) which are to be bonded in place, center the new glass over opening in the cab. Using a permanent marker, mark on the cab skin along all the edges of the new glass that is to be installed. All edges must be marked on the cab in order to apply the adhesive in the proper location.
5. Using Sika Primer 206G+P, touch up any bright metal scratches on the metal frame of vehicle. Do not prime existing urethane bed. Allow to dry for ten minutes.
6. Using a clean lint free cloth, apply Sika Aktivator to the black ceramic Frit surrounding the new window. Use a clean cloth and wipe off Sika Aktivator. Allow ten minutes to dry.
7. For the **side windows**, be sure to utilize a total of six or seven (SM2897) glass installation bumpers to the cab, equally spaced around the previously marked glass perimeter, approximately 0.75 in (19 mm) inboard from where the edge of the glass will be when installed.

NOTE: Be careful not to place adhesive too far inboard, as it will make any future replacement more difficult.

SECTION N4
OPERATOR COMFORT
INDEX

Expansion Block Valve

The expansion block valve controls the amount of refrigerant entering the evaporator coil. Both internally and externally equalized valves are used.

The expansion valve is located near the inlet of the evaporator and provides the functions of throttling, modulating, and controlling the liquid refrigerant to the evaporator coil.

The refrigerant flows through a restriction creating a pressure drop across the valve. Since the expansion valve also separates the high side of the system from the low side, the state of the refrigerant entering the valve is warm to hot high pressure liquid; exiting it is low pressure liquid and gas. The change to low pressure allows the flowing refrigerant to immediately begin changing to gas as it moves toward the evaporator. This produces the desired cooling effect.

The amount of refrigerant metered into the evaporator varies with different heat loads. The valve modulates from wide open to the nearly closed position, seeking a point between for proper metering of the refrigerant.

As the load increases, the valve responds by opening wider to allow more refrigerant to pass into the evaporator. As the load decreases, the valve reacts and allows less refrigerant into the evaporator. It is this controlling action that provides the proper pressure and temperature control in the evaporator.

This system uses an internally equalized, block type expansion valve. With this type valve, the refrigerant leaving the evaporator coil is also directed back through the valve so the temperature of the refrigerant is monitored internally rather than by a remote sensing bulb. The expansion valve is controlled by both the temperature of the power element bulb and the pressure of the liquid in the evaporator.

NOTE: It is important that the sensing bulb, if present, is tight against the output line and protected from ambient temperatures with insulation tape.

Accumulator

As the accumulator (if equipped) receives vaporized refrigerant from the evaporator, moisture and/or any residual liquid refrigerant is collected at the bottom of the component. The moisture is absorbed by the desiccant where it is safely isolated from the rest of the system.

The storage of the liquid refrigerant is temporary. When the liquid vaporizes into a gas it will be pulled from the bottom of the accumulator into the compressor. This process not only allows the accumulator to act as a storage device, but also protects the compressor from liquid slugging.

The low side service port is also located on the accumulator.

Evaporator

The evaporator cools and dehumidifies the air before it enters the cab. Cooling a large area requires that large volumes of air be passed through the evaporator coil for heat exchange. Therefore, a blower becomes a vital part of the evaporator assembly. It not only draws heat laden air into the evaporator, but also forces this air over the evaporator fins and coils where the heat is surrendered to the refrigerant. The blower forces the cooled air out of the evaporator into the cab.

Heat exchange, as explained under condenser operation, depends upon a temperature differential of the air and the refrigerant. The greater the temperature differential, the greater will be the amount of heat exchanged between the air and the refrigerant. A high heat load condition, as is generally encountered when the air conditioning system is turned on, will allow rapid heat transfer between the air and the cooler refrigerant.

The change of state of the refrigerant in and going through the evaporator coil is as important as that of the air flow over the coil.

All or most of the liquid that did not change to vapor in the expansion valve or connecting tubes boils (expands) and vaporizes immediately in the evaporator, becoming very cold. As the process of heat loss from the air to the evaporator coil surface is taking place, any moisture (humidity) in the air condenses on the cool outside surface of the evaporator coil and is drained off as water.

At atmospheric pressure, refrigerant boils at a point lower than water freezes. Therefore, the temperature in the evaporator must be controlled so that the water collecting on the coil surface does not freeze on and between the fins and restrict air flow. The evaporator temperature is controlled through pressure inside the evaporator, and temperature and pressure at the outlet of the evaporator.

REFRIGERANT

Recycled Refrigerant

Recycled refrigerant has been extracted from a mobile air conditioning system using a recovery unit. The refrigerant is cleaned by the recovery unit as it passes through filters located on the unit that meet specifications stipulated by Society of Automotive Engineers, SAE J2099. The refrigerant that has passed through the filtering process has only been cleaned of contaminants that are associated with mobile systems. Therefore, recycled refrigerant from mobile systems is only acceptable for reuse in mobile systems.

Reclaimed Refrigerant

Reclaimed refrigerant has been filtered through a more thorough filtering process and has been processed to the same standards of purity as virgin refrigerant. Because of this, reclaimed refrigerant is acceptable for use in all systems, not just mobile. The reclaiming equipment used for this process is expensive, and therefore, not common among normal maintenance shops. Equipment such as this is more commonly found in air conditioning specialty shops.

⚠CAUTION

Always use new, recycled, or reclaimed refrigerant when charging a system. Failure to adhere to this recommendation may result in premature wear or damage to air conditioning system components and poor cooling performance.

Refrigerant Quantity

If not enough refrigerant is charged into the system, cooling ability will be diminished. If too much refrigerant is charged into the system, the system will operate at higher pressures, and in some cases, may damage system components. Exceeding the specified refrigerant charge will not provide better cooling.

If an incorrect charge is suspected, recover the refrigerant from the system, and charge the system with the correct operating weight. This is not only the recommended procedure, but it is also the best way to ensure that the system is operating with the proper charge and providing optimum cooling. **Using the sight glass to determine the charge is not an accurate method.**

Systems without accumulators. . . . . **(6.9 lb, 3.1 kg)**

Systems with accumulators **(7.4 lb, 3.4 kg)**

⚠IMPORTANT⚠

An unclear sight glass on R-134a systems can indicate that the system may be low on refrigerant. However, the sight glass should not be used as a gauge for charging the system. Charging the system must be done with a scale to ensure the proper amount of refrigerant has been added.

R-134a Refrigerant Containers

Two basic, readily available containers are used to store R-134a: the 30 or 60 pound bulk canisters (Figure 4-12).

Always read the container label to verify the contents are correct for the system being serviced. Note the containers for R-134a are painted light blue.

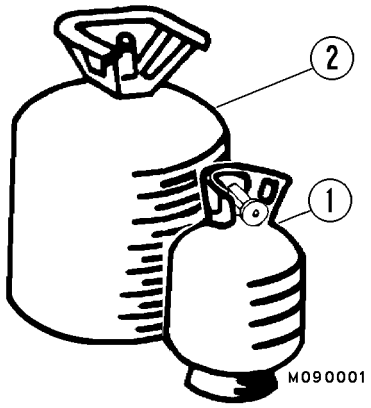


FIGURE 4-12. R-134a CONTAINERS

1. 30 lb. Cylinder 2. 60 lb. Cylinder

EVACUATING THE SYSTEM

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

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

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

⚠CAUTION

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

NOTE: Refer to Table 2 for optimal vacuum specifications at various altitudes.

1. With the manifold gauge set still connected (after discharging the system), connect the center hose to the inlet fitting of the vacuum pump as shown in Figure 4-23. Then open the low side hand valves to maximum.
2. Open the discharge valve on the vacuum pump or remove the dust cap from the discharge outlet. Turn the pump on and watch the low side gauge. The pump should pull the system into a vacuum. If not, the system has a leak. Find the source of the leak, repair, and attempt to evacuate the system, again.
3. Allow the vacuum pump to run for at least 45 minutes.

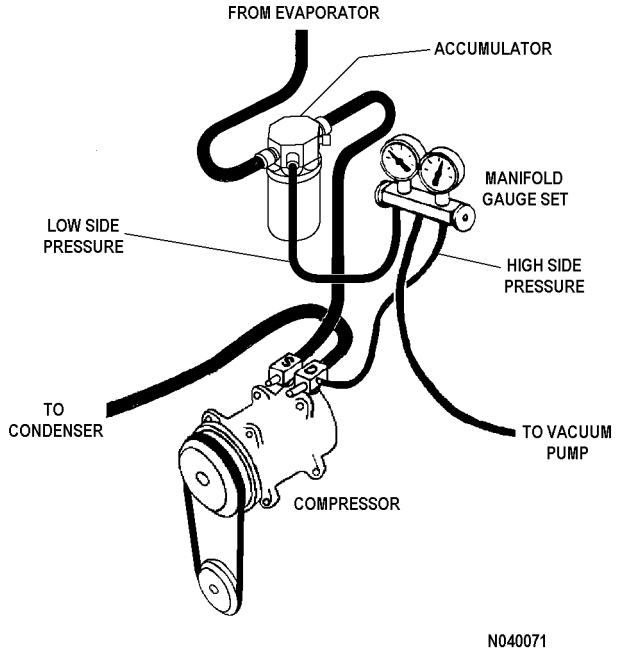


FIGURE 4-23. VACUUM PUMP HOOKUP (ACCUMULATOR SYSTEM SHOWN)

PREVENTATIVE MAINTENANCE SCHEDULE FOR A/C SYSTEM

Truck Serial Number_____

Site Unit Number_____

Date:_____Hour Meter:_____

Last Maintenance Check:_____

Name of Service Technician_____

NOTE: Compressor should be run at least 5 minutes (40°F minimum ambient temperature) every month, in order to circulate oil and lubricate components.

COMPONENT	Maintenance Interval (months)			
	3	6	12	Done
1. Compressor Check noise level Check clutch pulley Check oil level Run system 5 minutes Check belt tension (80-100) lbs; V-belt Inspect shaft seal for leakage Check mounting bracket (tighten bolts) Check clutch alignment w/ crankshaft pulley (within 0.06 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 (should be hot to touch) Replace, if system is opened				
4. Accumulator (If Equipped Check the inlet line from the evaporator. It should 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: 40°F to 50° F Inspect all wiring connections Operate all manual controls through full functions				

INSTRUMENT PANEL

Instrument panel (7, Figure 5-2) includes a wide variety of switches, gauges, and indicators. Refer to Instrument Panel and Indicator Lights, in this chapter for a detailed description of function and location of these components.

OVERHEAD PANEL AND DISPLAYS

The items listed below are located on the overhead panel. Refer to Figure 5-2 for the location of each item. A brief description of each component is documented below.

Radio Speakers

Radio speakers (9, Figure 5-2) for the AM/FM Stereo radio are located at the far left and right of the overhead panel.

Warning Alarm Buzzer

Warning alarm buzzer (10, Figure 5-2) will sound when activated by any one of several truck functions. Refer to Instrument Panel and Indicator Lights, in this chapter for a detailed description of functions and indicators that will activate this alarm.

Cab Radio (Optional)

This panel will normally contain AM/FM stereo radio (11, Figure 5-2). Refer to Section 7 in the Operation and Maintenance Manual for a more complete description of the radio and its functions. Individual customers may use this area for other purposes, such as a two-way communications radio.

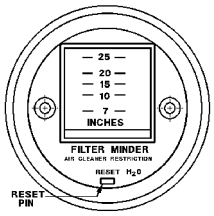
Warning Indicator Light Dimmer Control

Dimmer control (12, Figure 5-2) permits the operator to adjust the brightness of warning indicator lights (13).

Status/Warning Indicator Light Panel

Panel (13, Figure 5-2) contains an array of indicator lights to provide the operator with important status messages concerning selected truck functions. Refer to Instrument Panel and Indicator Lights, in this chapter for a detailed description of these indicators.

Air Cleaner Vacuum Gauges



Air cleaner vacuum gauges (14, Figure 5-2) provide a continuous reading of maximum air cleaner restriction reached during operation. The air cleaner(s) should be serviced when the gauge(s) shows the following maximum recommended restriction:

Komatsu SSDA16V160 Engine: 25 inches of H2O vacuum.

NOTE: After service, push the reset button on face of gauge to allow the gauge to return to zero.

Windshield Wipers

Windshield wipers (15, Figure 5-2) are powered by an electric motor. Refer to Instrument Panel and Indicator Lights, in this chapter for a location and description of the windshield wiper and washer controls.

Panel Illumination Lights

These lights (6, Figure 5-6) provide illumination for the instrument panel. Brightness is controlled by the panel light dimmer switch (28).

Cab/Air Conditioner Vents

Vents (7, Figure 5-6) are spherically mounted and may be directed by the operator to provide the most comfortable cabin air flow.

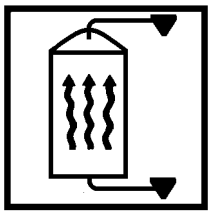
(8, Figure 5-6) Not Used

Rotating Beacon Light Switch (Optional)

The optional rotating beacon light (9, Figure 5-6), is activated by this rocker-type switch (if equipped) when it is pressed toward the ON position.

Heated Mirror Switch (Optional)

The optional heated mirror (10, Figure 5-6), is activated by this rocker-type switch (if equipped) when it is pressed toward the ON position.

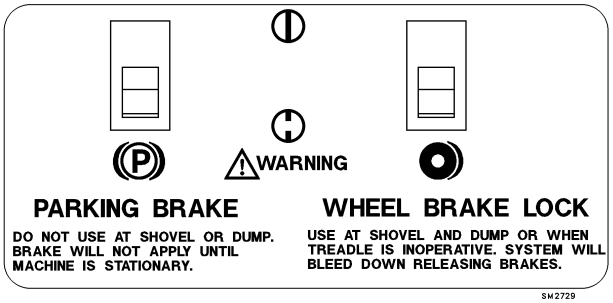


(11, Figure 5-6) Not Used

Wheel Brake Lock Control

Wheel brake lock (12, Figure 5-6) should be used with engine running for dumping and loading operations only. The brake lock switch actuates the hydraulic brake system which locks the **rear wheel service brakes only**. When pulling into shovel or dump area, stop the truck using the foot-operated service brake pedal. When truck is completely stopped and in 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.

Use at shovel and dump only to hold truck in position.



Do not use this switch to stop the truck, unless the foot-operated treadle valve is inoperative. Use of this switch applies the rear service brakes at a reduced, unmodulated pressure!
Do not use the brake lock for parking. With the engine stopped, hydraulic apply pressure will bleed down, allowing the brakes to release!

Parking Brake Control

The parking brake (13, Figure 5-6) is spring applied and hydraulically released. It is designed to hold a stationary truck when the engine is shutdown and keyswitch is turned OFF. The truck must be completely stopped before applying the parking brake, or damage may occur to parking brake. To apply the parking brake, press the rocker switch toward the ON symbol. To release the parking brake, press the rocker switch toward the OFF symbol. When the keyswitch is ON and parking brake switch is applied, the parking brake indicator light (A3, overhead panel, Figure 5-8) will be illuminated.

NOTE: Do not use the parking brake at shovel or dump. With keyswitch ON and engine running, sudden shock caused by loading or dumping could cause the system's motion sensor to release the park brake.

D6. REDUCED PROPULSION

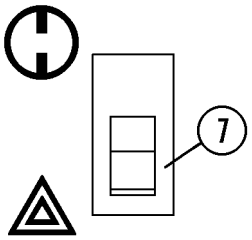
The amber "reduced propulsion" light is used to indicate that the full AC drive system performance in propulsion is not available. At this time, the only event that should activate this light is the use of "limp home mode". This mode of operation requires a technician to enable.

E6. RETARD AT CONTINUOUS LEVEL

The amber "retard continuous" light indicates the retarding effort is at a reduced level. The operator should control the speed of the truck in accordance to the "continuous" speeds on the grade/speed retard chart. The chart is shown in Grade/Speed Retard Chart earlier in this chapter.

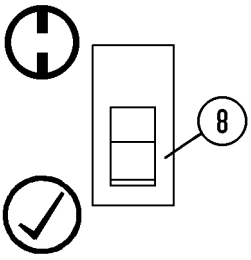
Hazard Warning Lights

The hazard warning light switch (7, Figure 5-7) flashes all the turn signal lights. Pressing the bottom side of the rocker switch (toward the triangle) activates these lights. Pressing the top side of the rocker switch (toward the OFF symbol) turns these lights off.

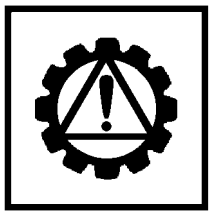


Lamp Test Switch

The lamp test switch (8, Figure 5-7) is provided to allow the operator to test the indicator lamps prior to starting the engine. To test the lamps, and the warning horn, turn the key switch (1, Figure 5-6) to the RUN position and press the bottom side of the rocker switch for the CHECK position. All lamps should illuminate, except those which are for optional equipment that may not be installed. The warning horn should also sound. Any lamp bulbs which do not illuminate should be replaced before operating the truck. Releasing the spring-loaded switch will allow the switch to return to the OFF position.

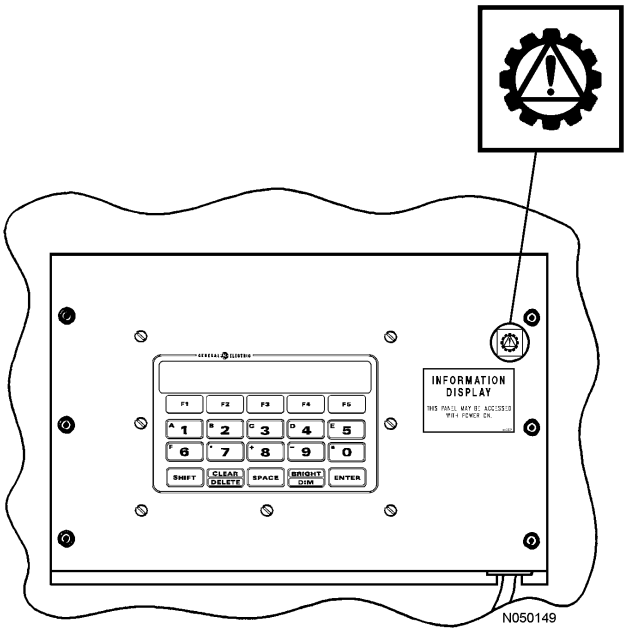


Link-On Warning Light



The "link-on", or "link energized", indicator light is located next to the D.I.D. display panel behind the passenger seat and indicates the AC drive system is energized.

The D.I.D. display panel is for use by maintenance personnel only, and is located out of the operator's field of vision for that reason.



10 HOUR (DAILY) INSPECTION (Continued)

Truck Serial Number_____ **Site Unit Number**_____ **Date**_____
Hourmeter_____ **Name of Service Technician**_____

	TASK	COMMENTS	CHECKED	INITIALS
8.	AIR INTAKE PIPING - Check all mounting hardware, joints, and connections. Ensure no air leaks exist and all hardware is properly tightened. Figure 2-2.			
9.	AIR CLEANERS - Check the air cleaner vacuum gauges in the operator cab, Figure 2-3. The air cleaner(s) should be serviced if the gauge(s) shows the following maximum restriction: Komatsu SSDA16V160 Engine: . . . . . 25 in. of H_2O vacuum. Refer to Section C in the service manual for servicing instructions for the air cleaner elements. Empty the air cleaner dust caps. *NOTE: After service, push the reset button on face of gauge to allow the gauge to return to zero.*			
10.	CAB AIR FILTER - Under normal operating conditions, clean every 250 hours. In extremely dusty conditions, service as frequently as required. Clean the filter element with mild soap and water. Rinse completely clean and air dry with a maximum of 40 psi (275 kPa). Reinstall the filter. Refer to Figure 2-4.			

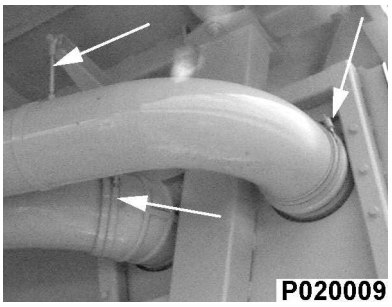


FIGURE 2-2.

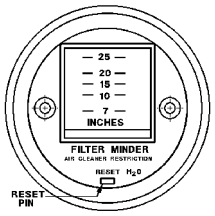


FIGURE 2-3.

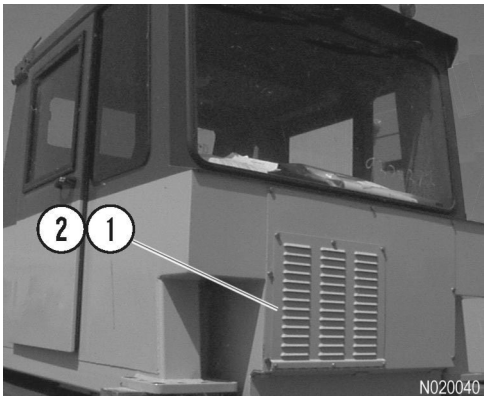


FIGURE 2-4.

1. Filter Cover 2. Cab Filter

SECTION P3

AUTOMATIC LUBRICATION SYSTEM

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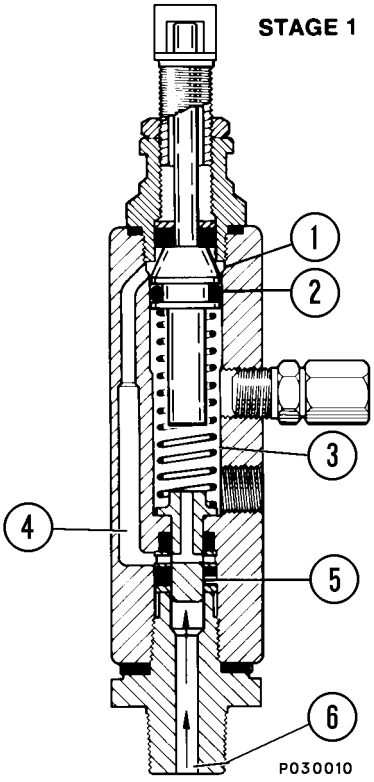
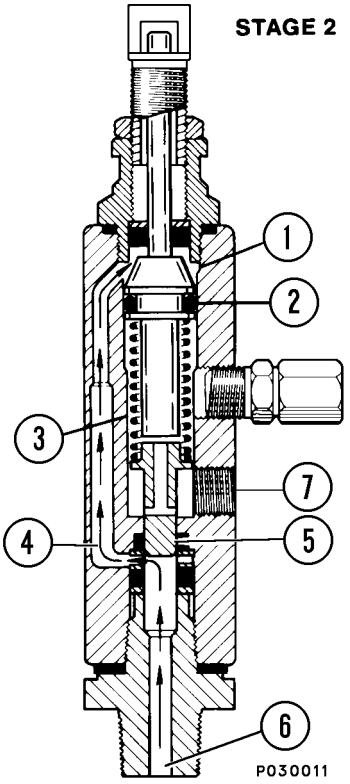
INJECTOR OPERATION



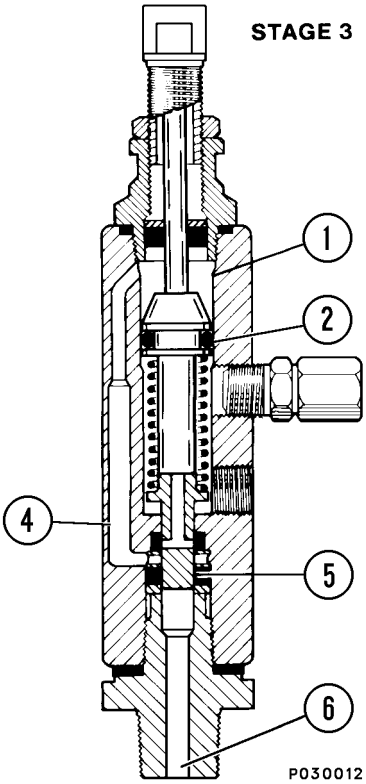
STAGE 1.

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



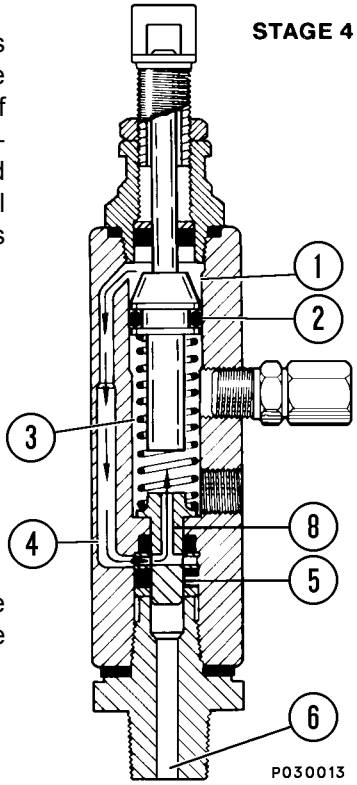
STAGE 2.

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



STAGE 3.

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



STAGE 4.

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

The injector is now ready for the next cycle.

SECTION Q
ALPHABETICAL INDEX

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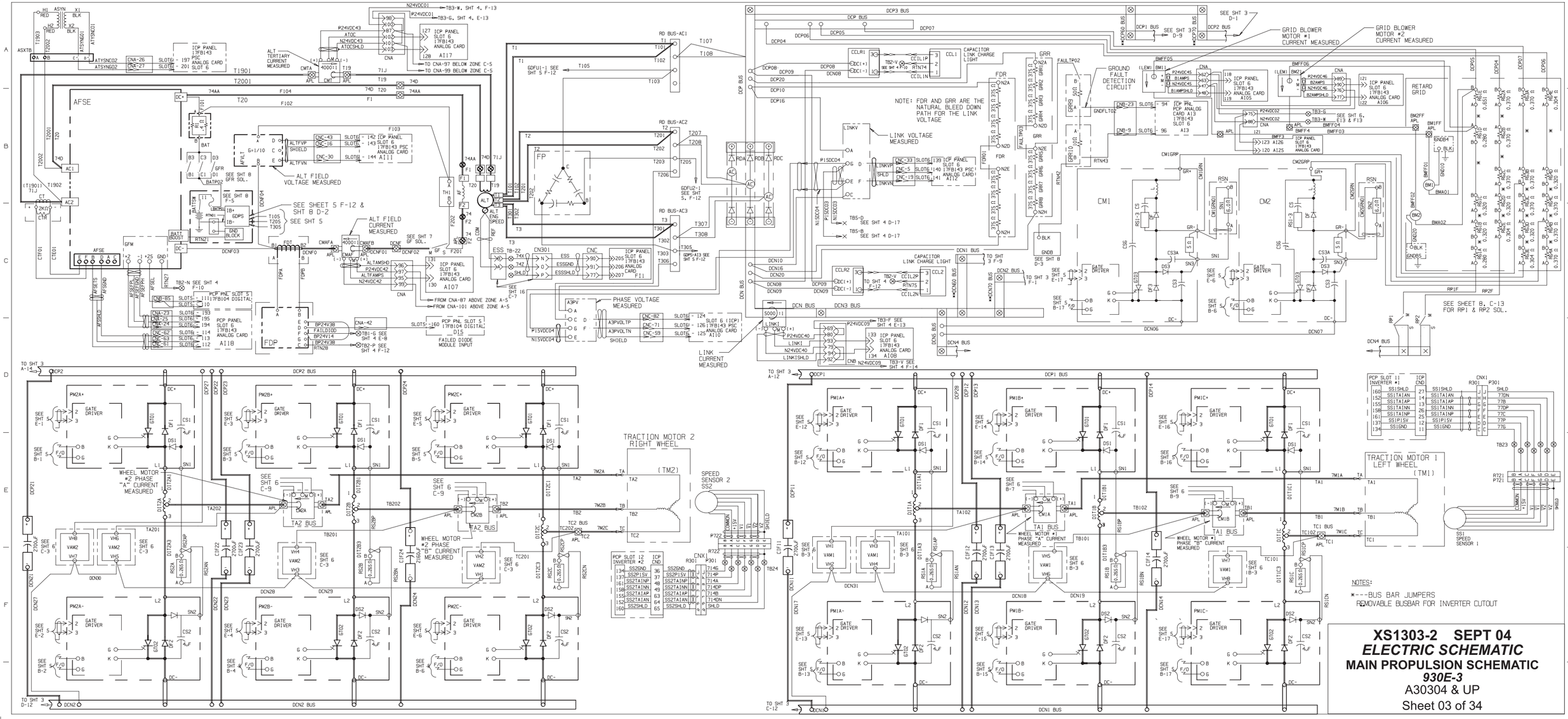
B

C



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ELECTRIC SCHEMATIC

MAIN PROPULSION SCHEMATIC

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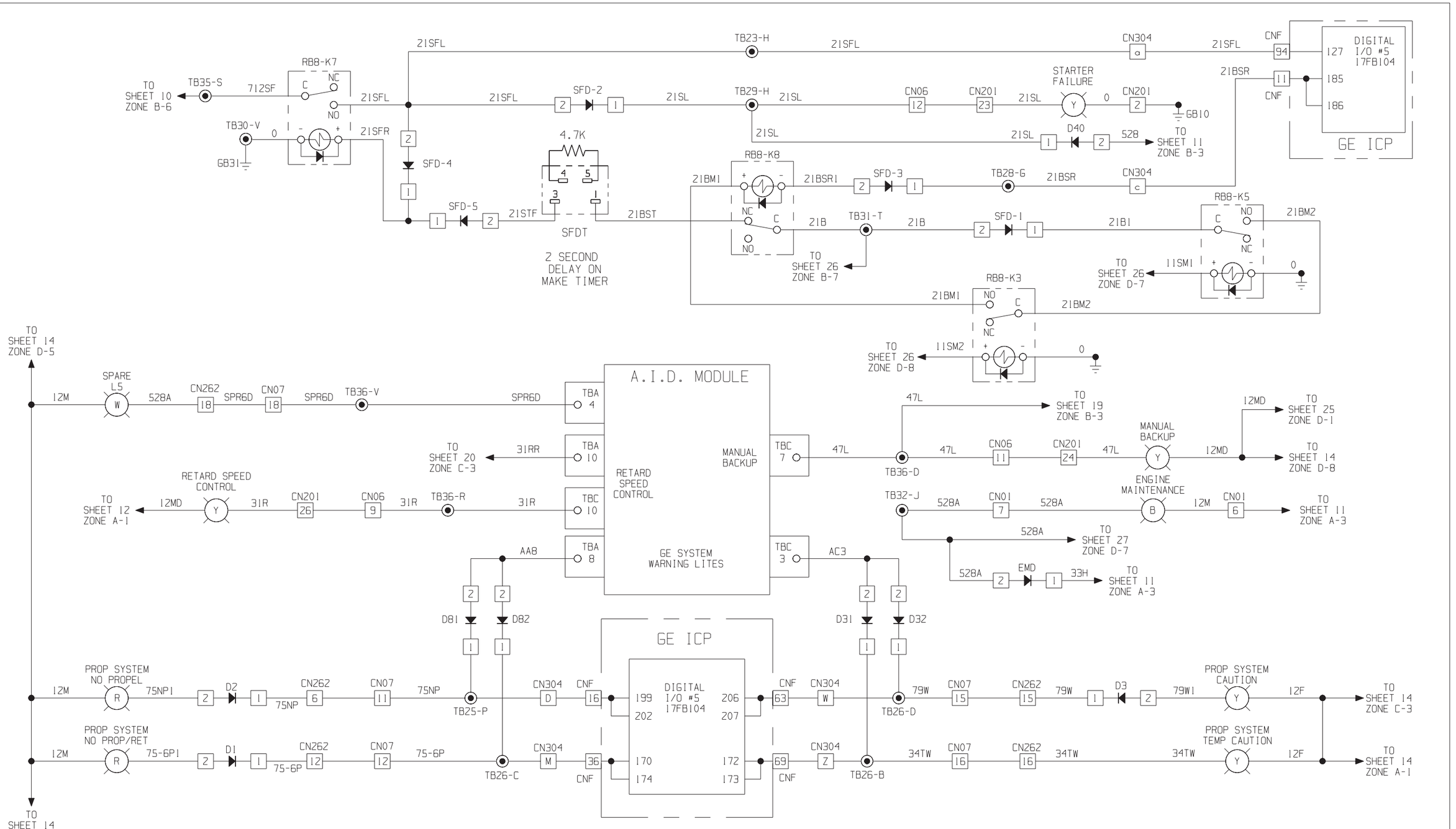

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ELECTRIC SCHEMATIC

OPERATOR / CAB OVERHEAD WARNING LIGHTS

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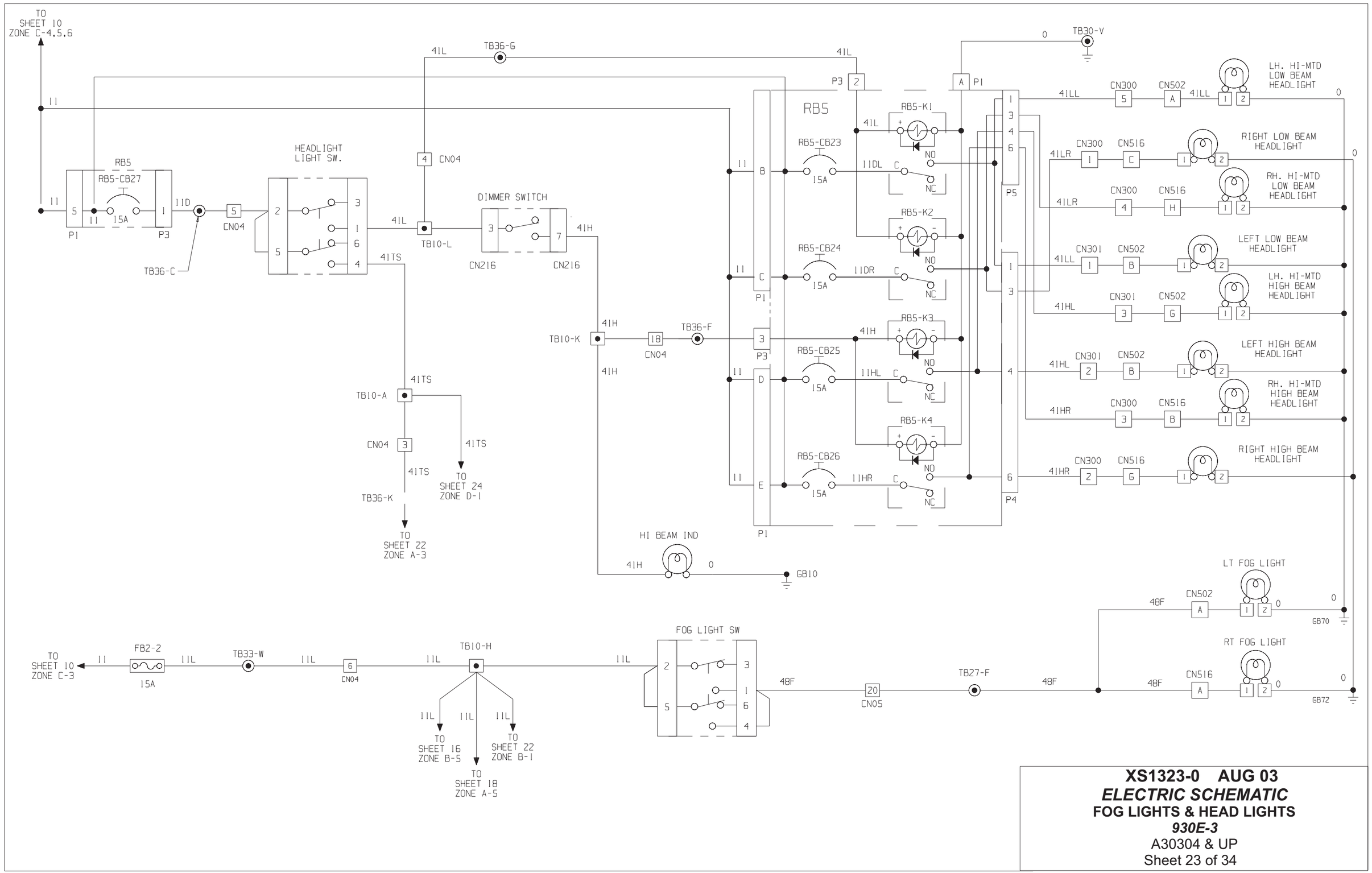

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ELECTRIC SCHEMATIC

FOG LIGHTS & HEAD LIGHTS

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