DG727

Shop Manual

830E

DUMP TRUCK

SERIAL SUFFIX

AFE32-DJ - AFE32-DM
AFE32-DS & UP

KOMATSU®

SPECIFICATIONS

These specifications are for the standard basic 830E HAULPAK® Truck. Customer Options may change this listing.

ENGINES -

MTU 16V 396 TE44

Number of Cylinders 16
Operating Cycle . . . . . 4- Cycle
Rated Brake HP . 2467 HP (1840kW) @ 1900 RPM
Flywheel HP . . . 2292 HP (1709kW) @ 1900 RPM
Weight (Dry) . . . . . 13,690 pounds (6210 kg)

DDC 16V-149TIB

Number of Cylinders 16
Operating Cycle 2-Stroke
Rated Brake HP . 2200 HP (1640kW) @ 1900 RPM
Flywheel HP . . . 2054 HP (1532kW) @ 1900 RPM
Weight (Dry) . . . . . 11,210 pounds (5085 kg)

DDC 20V-149TIB

Number of Cylinders 20
Operating Cycle 2-Stroke
Rated Brake HP . 2500 HP (1750kW) @ 1900 RPM
Flywheel HP . . . 2334 HP (1635kW) @ 1900 RPM
(Weight (Dry) . . . . . 15,210 pounds (6899 kg)

ELECTRIC DRIVE SYSTEM - STATEX III

(AC/DC Current)
Alternator . . . . . General Electric GTA - 26
Dual Impeller, In-Line Blower 9000 cfm (255 m^3/min)
Motorized Wheels . . . . . General Electric 787
Ratio 28.125:1
Maximum Speed* . . . . . 35.3 MPH (56.9 km/h)
(*w/40.00-57 Tires and 28.125:1 gear train)

DYNAMIC RETARDING

Extended Range Retarding With Fully Blown
18-Resistor Grids and Reverse Retarding Standard
Maximum Rating . . . . . 4000 HP (2983 kW)

TIRES

Rock Service, Deep Tread . . . . . (E-4) Tubeless
Standard Tire . . . . . 40.00 - 57, 68 Ply Rating
(w/787 Wheelmotor)
Separable Tire Rims *
5 Piece New Generation™ Rims *
Rims* are interchangeable with different positions on the truck, but due to improved design for greater load support, rims are not interchangeable with other manufacturer's rims.
Rim Size
29 in. (737 mm) X 57 in. (1448 mm) X 5 in. (127 mm)

24 VDC ELECTRIC SYSTEM

Batteries . . . . . Two 12 Volt Batteries in Series
. 220 Ampere-Hour Capacity w/Disconnect Switch
Alternator (DDC eng.) 24 Volt, 175 Ampere Output
Generator (MTU supplied) 24 V, 100 Amp. Nominal
Lighting . . . . . 24 Volt

SERVICE CAPACITIES

	U.S. Gallons	(Liters)
MTU Crankcase *	55.0	210.0
Detroit Diesel Crankcase *	52.5	198.7
* Includes Lube Oil Filters		
Cooling System		
MTU	152	575
DDC (2200) HP	135	511
DDC (2500) HP	160	625
Fuel	1000	3785
Hydraulic System	250	947
Wheel Motor Gear Box (each)	10.5	39.7

AIR SYSTEM

Compressor . . . . . MTU supplied
Compressor (DDC only) . . . . B-W TU-FLO 501
Capacity . . . . . 12 cfm (0.34 m^3/min)
Starter with Interlock . Varies with Customer Option
Main Tank Capacity . . . . . 15 $ft.^3$ (425 liters)

HYDRAULIC SYSTEMS

Pumps
Hoist . . . . . Tandem Gear Pumps
Rated @ . . . 230 GPM (870 l/min.) @ 1900 RPM
Steering . . Radial Piston-Pressure Compensating
(also Brake) . 65 GPM (246 l/min.) @ 1900 RPM
System Relief Pressures
Hoist/Steering . . . . . 2500 psi (17.2 MPa)
Brakes . . . . . 3500 psi (24.1 MPa)
Hoist Cylinders (2) 3-Stage
Tank (Vertical/Cylindrical) . . . . . Non-Pressurized
Filtration Remote-mounted, Replaceable, Elements
Suction . . . . . Single, Full Flow, 100 Mesh
Hoist & Steering Full Flow, 7 Micron, High Pressure

STEERING (w / Accumulators)

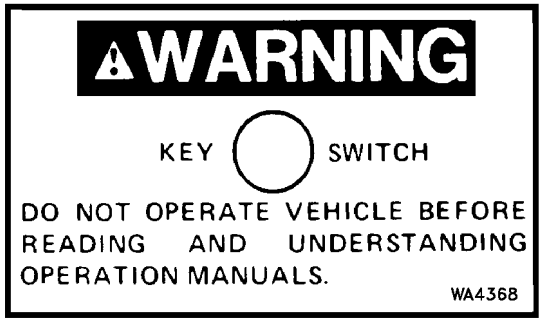
Turning Circle - Front Wheel Track . 93 ft. (28.35 m)
Full Time Power Steering . . . . . Twin Cylinders
Automatic Emergency Steering . . . . . Standard

WARNINGS AND CAUTIONS

The following paragraphs give an explanation of the Warning, Caution, and Service Instruction plates and decals attached to the HAULPAK® truck. The plates and decals listed here are typical of this HAULPAK® model, but because of customer options, individual trucks may have plates and decals that are different from those shown here.

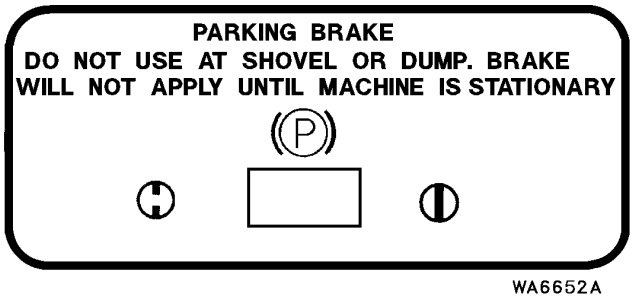
The plates and decals must be kept clean and legible. If any decal or plate becomes unable to be read or damaged, it should be replaced with a new one.

A warning plate is mounted around the key switch on the instrument panel. The warning stresses the importance of reading the operator's manual before operation.

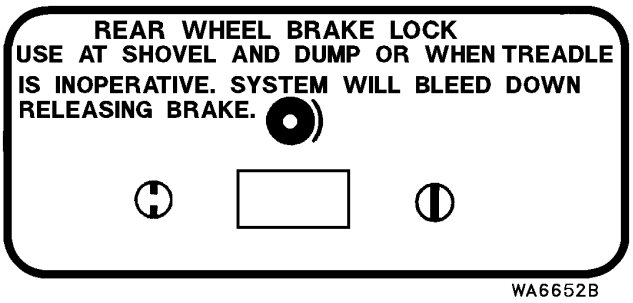


A warning plate is mounted directly over the parking brake switch. The plate stresses the parking brake is not to be used while the truck is being loaded at a shovel or when parked at a dump.

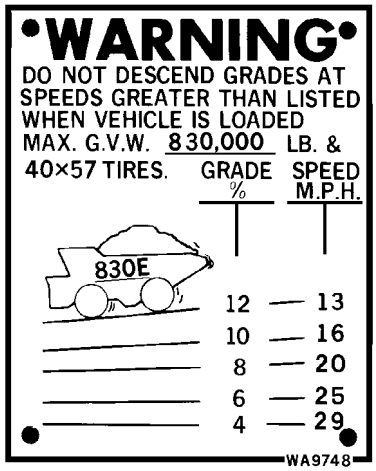
The truck must be completely stopped before applying the parking brake or damage may occur to parking brake. The parking brake is **not** designed to stop a moving truck.



A warning plate over the "Rear Wheel Brake Lock" switch stresses the use of this brake for use during truck loading while parked at a shovel or during dumping. If an emergency occurs where the brake treadle valve does not operate, apply this brake to stop the truck. Do not use this brake as a parking brake when leaving the truck as the hydraulic system will eventually bleed down, releasing the Brake Lock.



A plate located on the instrument panel in the operator's cab lists maximum speeds when descending various grades with a loaded truck.



MAXIMUM ALLOWABLE TRUCK SPEED IS 30.1 MPH (48.4 km/h)

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.

AFTER ENGINE HAS STARTED

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

1. Become thoroughly familiar with steering and emergency controls. Test the steering in extreme right and left directions. If the steering system is not operating properly, shut engine down immediately. Determine the steering system problem and have repairs made before resuming operation.
2. Operate each of the brake circuits at least twice prior to operating and moving the machine. These circuits include individual activation of the service brake and parking brake from the operator's cab.
   a. Activate each circuit individually with the engine running and with hydraulic circuit fully charged.
   b. If any application or release of any brake circuit does not appear proper or if sluggishness is apparent on application or release, shut the engine down and notify maintenance personnel. Do not operate machine until brake circuit in question is fully operational.
3. Check gauges, warning lights and instruments before moving the machine to insure proper system operation and proper gauge functioning. Give special attention to braking and steering circuit warning lights. If warning lights come on, shut down the engine immediately and determine the cause.
4. Cycle hoist controls and steering several times to remove trapped air. Complete steering cycles in both directions to verify steering response, smoothness and reliability. Check seals and lines for leaks.
5. When satisfied that all discrepancies have been corrected, the vehicle is ready for a road test. This test should be done only by a capable and experienced operator and should be accomplished in a large open area where plenty of maneuvering room is available. Some of the road test items which should be covered will include:
   a. Repeated test of braking efficiency at progressively higher speeds. Start at slow speeds. Don't take chances with higher speeds until the machine is determined to be completely safe.
   b. Mechanical Drive vehicles - Progressive upshifting and downshifting through all speed ranges to insure proper transmission shifting and synchronization.
6. When all tests and checks have been made and the vehicle is ready for work, it should be visually rechecked and fully serviced according to Section "P", Lubrication and Service, of the Shop Manual.

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

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

PRESERVATION AND STORAGE ALLISON TRANSMISSION

Storage, New Transmission

(Prior to installation). New transmissions are tested at Allison with preservative oil and drained prior to shipment. The residual oil remaining in the transmission provides adequate protection to safely store the transmission for up to one year (stored inside the conditions of normal climate and with all shipping plugs installed) without further treatment.

Preservation Methods. When the transmission is to be stored or remain inactive for an extended period (one or more years), specific preservation methods are recommended to prevent damage due to rust, corrosion, and organic growth in the oil. Preservation methods are presented for storage with and without transmission fluid.

Storage, One Year -- Without Oil

1. Drain the oil.
2. Spray two ounces (60 milliliters) of VCI #10 through the fill tube.
3. Seal all openings and the breather with moisture-proof tape.
4. Coat all exposed, unpainted surfaces with preservative grease such as petroleum (MIL-C-11796, Class 2).
5. If additional storage time is required, repeat steps (2), (3) and (4) at yearly intervals.

Storage, One Year With Oil (normally in a vehicle chassis)

1. Drain the oil and replace the oil filter element(s).
2. Fill the transmission to operating level with a mixture of one part VCI #10 (or equivalent) to 30 parts C-4 transmission fluid. Add 1/4 teaspoon of Biobor JF (or equivalent) for each 3 gallons (11 liters) of fluid in the system.

NOTE: When calculating the amount of Biobor JF required, use the total volume of the system, not just the quantity required to fill the transmission. Include external lines, filters, and the cooler.

3. Run the engine for approximately five minutes at 1500 rpm with the transmission in neutral.
4. Drive the vehicle. Make sure the transmission shifts through all ranges. Make sure the lockup clutch is working.
5. Continue running the engine at 1500 rpm with the transmission in neutral until normal operating temperature is reached.

⚠WARNING

f the unit does not have a converter-out temperature gage, do not stall the converter.

6. If normal operating temperature is less than 225° F (107° C), shift the transmission to the highest forward range and stall the converter.When the converter-out temperature reaches 225° F (107° C), stop the engine. Do not exceed 225° F (107° C).
7. As soon as the transmission is cool enough to touch, seal all openings and the breather with moisture-proof tape.
8. Coat all exposed, unpainted surfaces with preservative grease such as petrolatum (MIL-C-11796, Class 2).
9. If additional storage time is required, repeat steps (2) through (8) at yearly intervals; except, it is not necessary to drain the transmission each year. Just add Motorstor and Biobor Jf (or equivalents).

Restoring Transmission to Service

1. Remove all tape from openings and the breather.
2. Wash off all external grease with mineral spirits.
3. If the transmission is new, drain the residual preservative oil. Refill the transmission to the proper level with C-4 transmission fluid.
4. If the transmission was prepared for storage without oil, drain the residual oil and replace the oil filter elements. Refill the transmission to the proper level with C-4 transmission fluid.
5. If the transmission was prepared for storage with oil, it is not necessary to drain and refill the transmission with new transmission fluid. Check for proper fluid level. Add or drain transmission fluid as required to obtain to proper level.

BODY PADS

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

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

⚠WARNING

Place blocks between the body and frame. Secure blocks in place. Never work under a raised body unless safety device(s) are in position to prevent dump body from lowering.

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

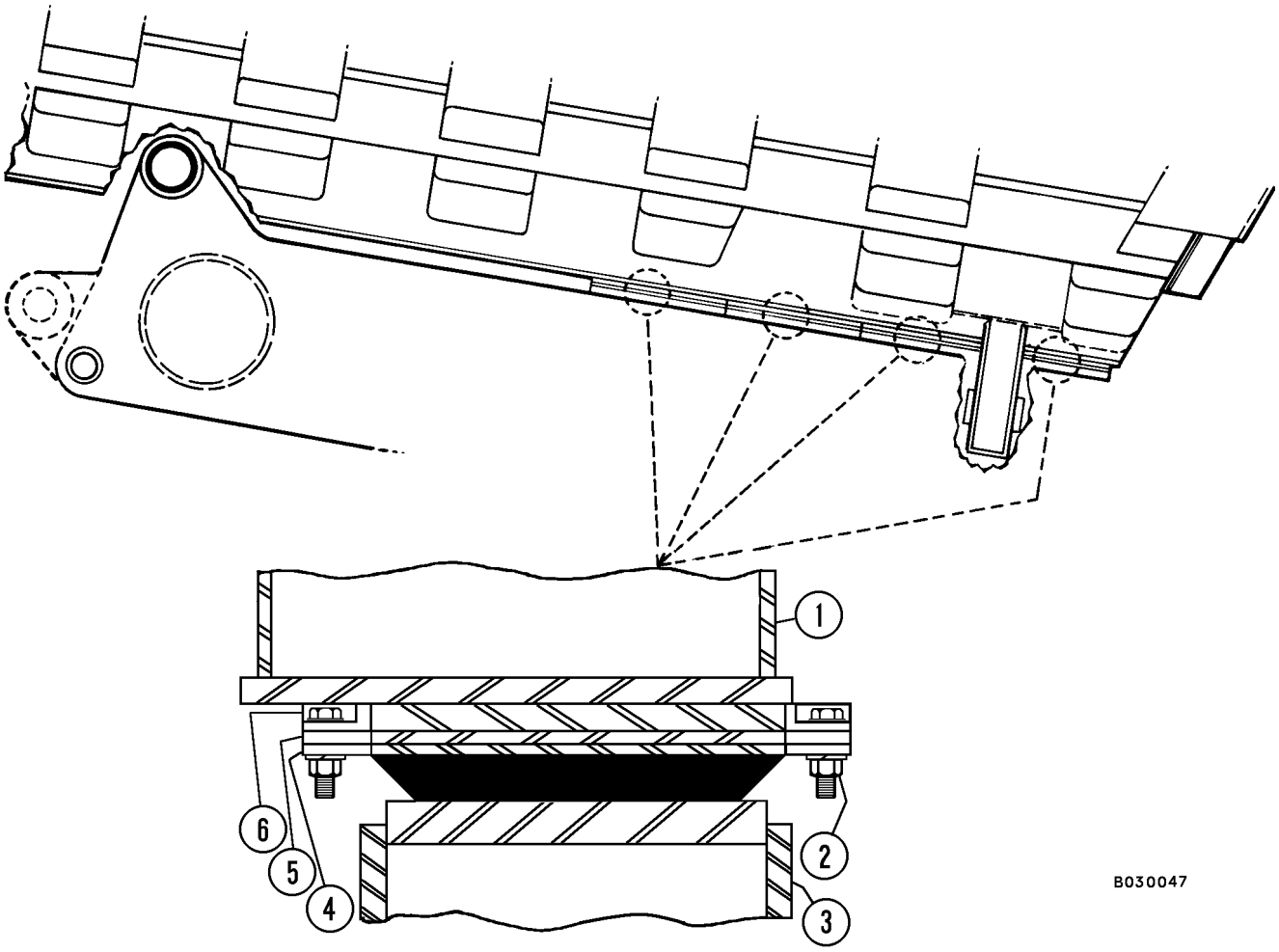


FIGURE 3-4. BODY PAD INSTALLATION

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

6. Lower the power module to the subframe guide rails, relax the hoist slightly and roll the power module into truck frame until lifting chains contact cross frame.

7. Place stands or blocking under front of subframe to support assembly while repositioning hoist.

8. Install a safety chain around the truck frame and the front subframe cross member. The safety chain will prevent the power unit from rolling forward.

9. Place a small block behind each rear subframe roller to prevent rolling.

10. Lower hoist to allow subframe to rest on stands and rollers. Remove lifting device.

11. Attach hoist to front lifting eyes on subframe.

12. Remove the small blocks behind the subframe rollers, remove safety chain, and slowly roll the power module into position over the main frame mounts. Lower hoist until front subframe mount is aligned and seated on the front, main frame mount. Reinstall safety chain.

13. Relocate hoist to the rear portion of the engine/alternator cradle structure and raise just enough to permit removing the subframe rollers.

14. Lower the rear portion of the subframe until the subframe rubber bushings are seated in the rear mounting brackets located on the main frame of the truck.

15. After subframe is seated in frame mounts, the safety chain may be removed from the front subframe member.

16. Install capscrews and lockwashers in the front mount and tighten capscrews to **220 (±) 22 ft.lbs**. **(298 (±) 30 N-m)** torque. (Refer to Figure 2-5). Reinstall air dam .

17. Install the rear subframe mounting caps and secure caps in place with lubricated capscrews. Tighten capscrews to **407 (±**) **15 ft.lbs. (551 (±) 21 N-m)** torque. (Refer to Figure 2-6).

18. Install ground strap between frame and subframe. Install radiator support struts.

20. Install air duct supports and connect exhausts at engine turbochargers. Connect all engine air intake ducts. Tighten clamps securely to insure a positive seal is made. (Refer to Figure 2-3).

21. Connect the cab heater inlet and outlet hoses and open both valves.

22. Connect wheel motor cooling blower air outlet hose. Tighten all clamps securely to insure a positive air seal.

23. Lift main alternator blower intake duct into position and install hardware at mounts. (Refer to Figure 2-2)
    a. Install hardware at transition structure to blower inlet joint, electrical cabinet, and deck mounts.
    b. Install control cabinet air hose, electrical cables and any other hoses and wiring removed during power module removal.
    c. Lift rear, center deck structure in place and install hardware.

24. Connect the hydraulic pump drive shaft from the alternator to the companion flange on the pump. (Refer to Figure 2-1). Tighten capscrews to standard torque.

25. Connect hoses from air compressor to tubes routed to the main air tank. Reconnect the air compressor air supply hose to the air inlet duct.

26. Connect all remaining electric, oil, and fuel lines.

27. Attach hoist to the front center deck and lift into position. Align the rear center deck mounting holes with the support structure in front of the electrical cabinet. Install capscrews and flat washers. Do not tighten at this time.

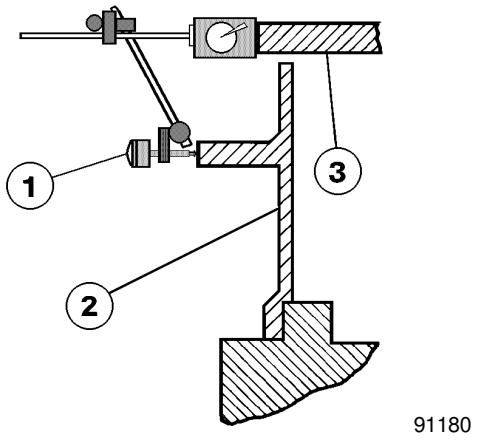
28. Align the front center deck, front mounting holes with both left and right fender supports. Install capscrews and flat washers.

29. Tighten all deck mounting capscrews to standard torque values.

30. Connect the air filter restriction gauge hoses.

31. Connect the batteries as follows:
    a. Install battery positive (+) cable.
    b. Install battery ground (-) cable.
    c. Install battery equalizer + 24V (input) terminal.
    d. Install equalizer + 12V (output) terminal.
    e. Install equalizer GND (-) terminal.
    f. Close battery disconnect switch.

32. Service radiator and engine with appropriate fluids. Refer to Section “P” for capacity and fluid specifications.



FIIGURE 4-4. MEASURING ALTERNATOR ROTOR ENDPLAY

1. Dial Indicator
2. Rotor Drive Adapter
3. Alternator Housing

7. Move the rotor to half the distance of the bearing movement reading, this should place the bearing at center line of bearing race.

8. With the rotor in this position, place a parallel steel bar across the rotor drive adapter face and measure the distance between the adapter face and the alternator housing frame face. Take four readings 90° apart and record the average of readings as measurement “A”. (Refer to Figure 4-5.)

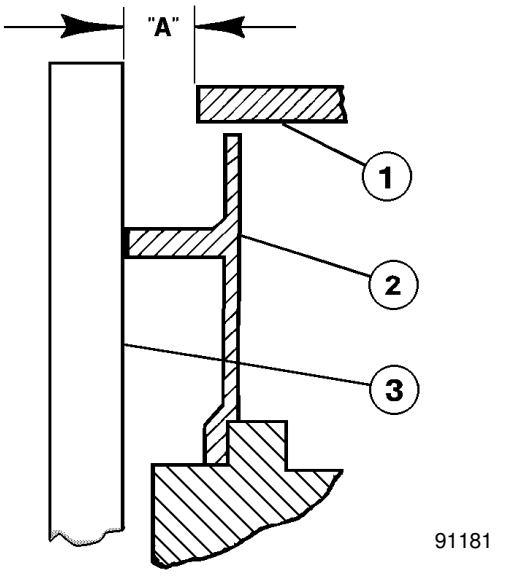


FIGURE 4-5. DETERMINING MEASUREMENT "A"

1. Alternator Housing
2. Rotor Drive Adapter
3. Parallel Bar

Engine Endplay Measurement

1. Place dial indicator on flywheel housing adapter with dial pointer on flywheel face. (Refer to Figure 4-6.)
   a. If available, remove front crankshaft pulley and vibration dampener and install tool for prying crankshaft forward and backward.
   b. If above tool is not available, an engine side plate cover can be removed and a bar used to pry the crankshaft forward and backward. This method does not require removal of the pulley or vibration dampener. Use caution to prevent internal engine damage or entrance of dirt. **Do not pry on vibration dampener!**
2. Pull crankshaft toward front of engine as far as crankshaft bearings will allow it to move. Hold crankshaft in this position and set dial indicator at “0" reading.
3. Push crankshaft toward rear of engine, read total bearing movement, taking two or three readings for verification.
4. Move crankshaft to half the distance of the total end play reading; this should place the crankshaft in the center of its end play.

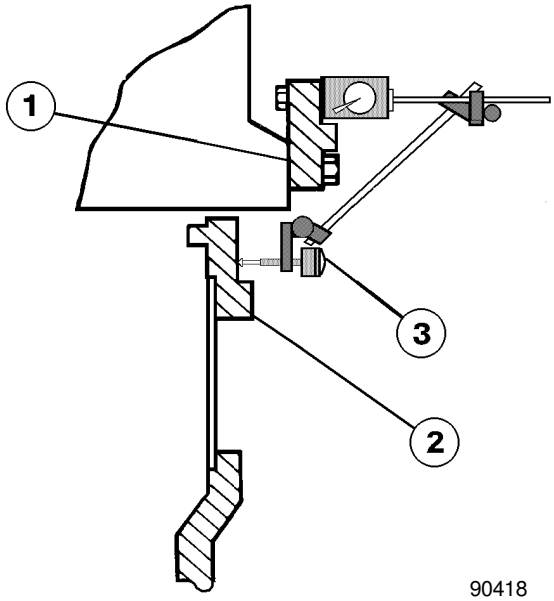


FIGURE 4-6. MEASURING CRANKSHAFT ENDPLAY

1. Flywheel Housing Adapter
2. Engine Flywheel
3. Dial Indicator

SAFETY FILTER ELEMENT

⚠CAUTION

Have a new safety (secondary) filter element on hand before removing old one. Do not keep intake system open to the atmosphere any longer than absolutely necessary.

Removal

The function of the safety filter is to increase overall reliability and engine protection. If the safety element indicator shows red the element has become clogged, and should be discarded and replaced with a new one.

1. Shut down the engine. Clean the dirt and dust off the element end cover.
2. Loosen wing nut (5, Figure 5-2) and remove end cover (8) and main element (10).
3. Remove indicator nut (7) holding safety element in place. Remove safety element (9). Inspect gasket (14) and replace if necessary.
4. Remove any dust lodged in the clean air outlet and around element sealing surface.

Installation

1. Reset the indicator nut from red to green by gently blowing air through threaded hole from gasket end of indicator wing nut.
2. Replace safety element and tighten the safety indicator nut to **10 ft. lbs. (13 N.m)** torque.

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.

AIR CLEANER ASSEMBLY CLEANING

Main Filter Cleaning

For best results, after inspection, determine the condition of the element and choose either the "Washing" or "Compressed Air" method for cleaning the filter element.

1. Wash elements with water and liquid detergent or a 50-50 solution of Oakite 202 and warm water.

NOTE: This method is best when element is loaded with carbon, soot, oil or dust.

a. Soak the element in a solution of liquid detergent and water for 15 to 30 minutes. Rotate element back and forth in the solution to free element of dirt deposits. DO NOT soak elements for more than 24 hours.

b. Rinse element with a stream of fresh water in the opposite direction of normal air flow until rinse water runs clear. Maximum permissible water pressure is 40 psi (276 kPa). A complete, thorough rinse is essential.

c. Dry the element thoroughly. If drying is done with heated air, the maximum temperature must not exceed 140°F (60°C) and must be circulated continually. Do not use a light bulb for drying elements.

d. After cleaning the element, inspect thoroughly for slightest ruptures and damaged gaskets. A good method to detect paper ruptures is to place a light inside the filter element as shown in Figure 5-3, and inspect the outer surface of the filter element.

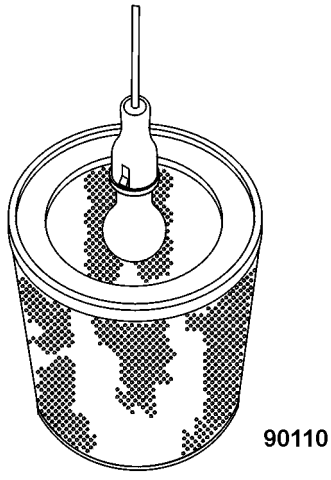


FIGURE 5-3. INSPECTING THE FILTER ELEMENT

INTEGRAL CHARGING SYSTEM
(Battery Charging Alternator)

Troubleshooting Procedures

A typical 30-SI cross-sectional view is shown in Figure 2-4. A basic wiring diagram is shown in Figure 2-5.

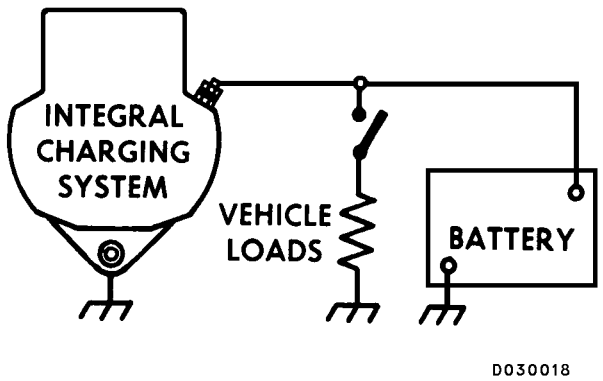


FIGURE 2-5. TYPICAL CHARGING CIRCUIT

1. Check the drive belt for proper tension.
2. Insure that an undercharged battery condition has not been caused by accessories having been left ON for extended periods.
3. If a battery defect is suspected, check battery as specified in "Battery - Troubleshooting".
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including battery connectors.
5. Connect a voltmeter from the battery charging alternator output terminal ("BAT") to ground (-). A zero reading indicates an open between voltmeter connection and battery.
6. With all accessories turned OFF, increase engine speed as required to obtain maximum voltage reading.
7. If voltage is not within the 26 - 30 Volts operating range, remove the unit for repair as covered under heading of "Integral Charging System Repair", as there is no voltage adjustment on this model.
8. If previous Steps 1 through 7 check satisfactorily, check generator as follows:
   a. Disconnect battery ground cable.
   b. Connect an ammeter in the circuit at the output terminal of the battery charging alternator.
   c. Reconnect battery ground cable.
   d. Turn on accessories. Connect a carbon pile across the battery.
   e. Operate engine at moderate speed, and adjust carbon pile as required, to obtain maximum current output.

IMPORTANT: Initial Voltage build-up is by residual magnetism in the rotor. Increase the speed as required to obtain maximum current output.

   f. If ampere output IS within 10 amperes of rated output as stamped on the battery charging alternator frame, unit is not defective.
   g. If ampere output IS NOT within 10 amperes of rated output as stamped on the battery charging alternator frame, remove the unit for repair as covered in "Integral Charging System Repair".

Integral Charging System Repair

Component parts and connections are shown in Figure 2-6.

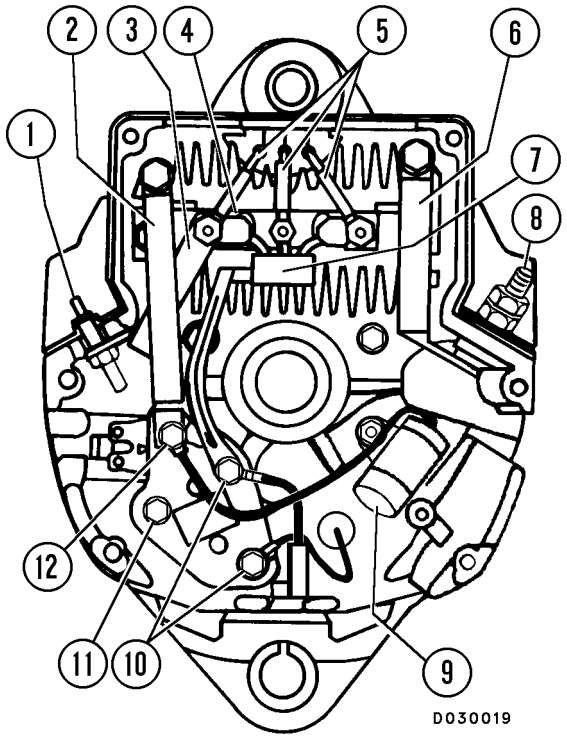


FIGURE 2-6. 30-SI COMPONENT PARTS

1. Relay Terminal “R”
2. Reg. Stud Connector
3. “R” Terminal Connector
4. Rectifier Bridge
5. Stator Leads
6. Output Term. Connector
7. Diode Trio
8. Output Terminal
9. Capacitor
10. Field Leads (Insulated Screws)
11. Ground Screw
12. Regulator

GROUND LEVEL SHUTDOWN

The Ground Level Shutdown switch (Figure 3-6) is located on the left side of the truck near the bottom of the ladder. This switch is intended for emergency use. The normal engine shutdown procedure is to turn the key switch on the instrument panel to the “Off” position.

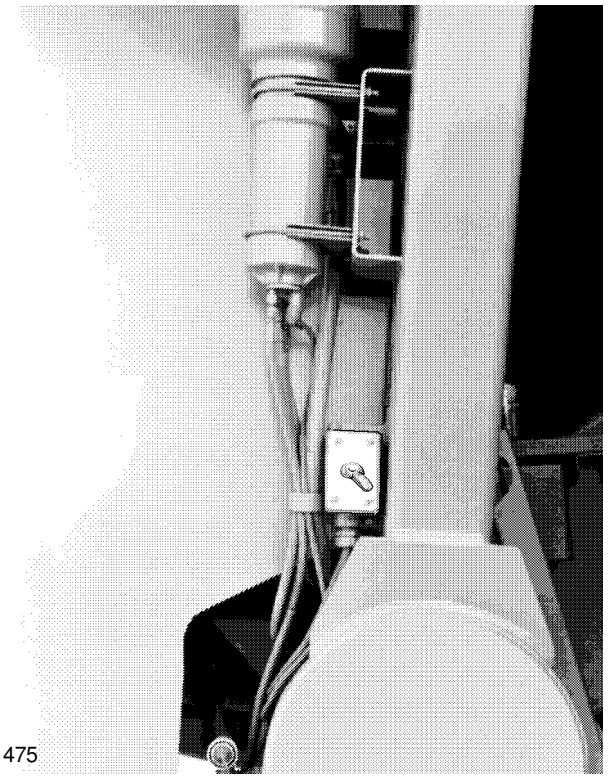


FIGURE 3-6. GROUND LEVEL SHUTDOWN SWITCH

ELECTRICAL PROPULSION COMPONENTS

GENERAL SYSTEM DESCRIPTION

The electric propulsion and control system of the Haulpak truck consists of an engine driven alternator and cooling air blower, control system, wheel motors, retarding grids and blower motor. The alternator produces A.C. current which is rectified to D.C. current. The wheel motors use D.C. current to operate as motors in propulsion and generators in retarding.

When the operator selects FORWARD or REVERSE propulsion, the armatures of the motors drive planetary gear sets connected to the rear wheels to propel the truck in FORWARD or REVERSE.

During truck operation, the operator initiates command signals to the engine and control system. The signals are received at the FL275 electronic card panel initiating a series of checks to determine the status of system components. After checking the control system, the FL275 panel energizes the necessary contactors to set up the control system for propulsion or retarding and send a control signal to the static exciters.

During it's operation, the FL275 panel maintains the propulsion system within the design limits of the alternator, engine, and wheel motors. Regulation of alternator field current and engine speed determine traction motor armature current. Regulation of motor field current determines traction motor horsepower.

The control system responds to electrical signals generated by the operator and by "feedback" signals generated by various devices within the system. These feedback signals monitor voltage, current, speed, etc. of the various control and propulsion equipment.

When the operator depresses the retard pedal or the truck exceeds the automatic overspeed setting, the dynamic retarding circuit is activated causing the wheel motors to become generators. The truck momentum causes the armatures of the wheel motors to rotate, generating a D.C. output that is applied across the retarding grids. This load opposes armature rotation to slow the truck. The energy from the wheel motor is dissipated in the retarding grids in the form of heat.

Retarding grid cooling is provided by a motor-driven fan, blowing air across the grids. The cooling air blower connected in-line to the rear of the alternator provides cooling air for the static exciters, alternator and wheel motors during truck operation.

Refer to the following information for detailed descriptions of component functions.

CONTROL SYSTEM

The Statex III control system electronics provide all of the functions necessary to initiate and regulate operation of the truck. It monitors operator input and system feedback signals, calculates a response, and initiates the appropriate control action.

The system . . . .

- Establishes the propulsion circuit by energizing contactors P1, P2 (if installed), MF, GF, and GFR to power the wheelmotors.
- Establishes the retarding circuit by energizing contactors MF, GF, GFR, RP1, RP2, RP3, RP4, RP5, (and optionally RP6, RP7, RP8 and RP9) for extended range retarding to connect grid resistors RG1 and RG2 in the motor circuits. Extended range retarding is regulated automatically by sequentially energizing the RP3-RP9 contactors.
- Provides current limit control so that specific rates may be maintained in both motoring and retarding.
- Provides Retard Speed Control for automatic speed regulation on long down-hill runs.
- Provides two-speed overspeed control which allows a higher overspeed restriction when traveling empty.
- Provides Alternator Tertiary Winding protection and Wheelmotor overcurrent protection.
- Initiates the necessary operating restrictions, including the shut down of the truck if a system fault is detected. Lesser faults or events cause respective indicating lights to light. All events are recorded for future review by technicians.
- Provides fault/event information to the operator/technician as to the status of the system via the 2-digit display panel, located in the control cabinet. This panel, showing a two digit display of 00 to 99, indicates to the technician the existence of possible faults or other events which have occurred within the control and/or propulsion system.
- Provides automatic and manual diagnostic self-test routines to detect faults and to assist maintenance personnel in locating a poorly operating system/subsystem.
- Provides a statistical data history log which indicates lifetime, quarterly, monthly and daily performance data. This history log can be accessed using a "laptop" computer, and can be a valuable aid in determining equipment use and maintenance schedules.

NOTE: The information listed under “Event Values” provides additional detail for each event and is described as follows:

Decay Time . . . How long events are held in “active count” memory (in seconds).

Lock Limit . . . Operator cab reset is disabled when lock limit is reached within decay time.

Acceptable Limit: . . . . . Maximum number of occurrances of an event code which can be recorded in FL275.

Window Limit: . . Maximum number of an event with 51 frame windows.

TABLE I: TWO-DIGIT DISPLAY PANEL CODES

EVENT CODE	EVENT DESCRIPTION	EVENT RESTRICTION	DETECTION INFORMATION	EVENT VALUES			
				Decay Time	Lock Limit	Accept Limit	Window Limit
00	Reset All (no events displayed)	None	Used to reset all events				
01	Low level ground fault	System Event In ACCEL: No propel and turn on SYSFLT light. In RETARD: Turn on SYSFLT light only.	A ground fault is detected if leakage current to ground (truck chassis) exceeds 114 ma.There is a 0.2 second delay on shutdown. In the following order, check for: Moisture in motors, grids, power cables, motor flash, insulation failure in power circuit, defective FB102/140 card.	1800	5	20	5
02	High Level Ground Fault	System Event In ACCEL: No propel and turn on SYSFLT light. In RETARD: Turn on SYSFLT light only.	A ground fault is detected if leakage current to ground (truck chassis) exceeds 400 ma.There is a 0.05 second delay on shutdown. Same checks as No. 01.	N/A	1	1	1
08	Pedal Accel	System Event Turn on SYSFLT light only.	Incorrect accelerator output.	3600	3	10	2
09	Pedal Retard	System Event Turn on SYSFLT light only.	Incorrect retard pedal output.	3600	3	10	2
10	GF Contactor	System Event In ACCEL: No propel and turn on SYSFLT light. In RETARD: Turn on SYSFLT light only.	GF Contactor command and feedback do not agree. In the following order, Check for: welded tips, blocked armature, defective coil or position sensor, loose wiring connections, mechanical obstruction, defective FB104 card.	3600	3	10	2
11	GFR Relay	System Event In ACCEL: No propel and turn on SYSFLT light. In RETARD: Turn on SYSFLT light only.	GFR Relay command and feedback do not agree. Check for: Same as No. 10.	N/A	1	20	5

PORTABLE TEST UNIT (PTU)

DESCRIPTION

The minimum requirements for the laptop computer to be used for the PTU are as follows:

- IBM compatible, portable PC
- 20 megabyte hard disk drive
- 3.5" floppy diskette drive
- 2 megabytes RAM
- Serial Port & cable
- Battery charger

A larger capacity hard disk, additional RAM, and a spare battery pack are desirable.

Control software provided by GE or KMS on 3.5" floppy disks must be transferred to the PTU hard disk drive prior to transferring the Control Program to the truck.

All adjustments, setup procedures and diagnostic troubleshooting of the truck's control system can be made via this PTU. Most of the procedures are menu driven, with function screens provided as part of the operating software. Figure 2-2. illustrates the "Main Menu" which appears when the software program opens. Figure 2-3 illustrates the "menu tree" showing the various screen menus available from the main menu and the path required to reach the next level sub-menu.

Sample PTU screens illustrated on the following pages show menus and data screens as they appear in the version 12.10, March 1996 STATEX III software release. Earlier and later versions of the software may differ.

The information that follows is presented in the sequence that would most likely be used at a mine site that was receiving new Statex III trucks or a mine that was updating software from previous release versions. It is assumed the technician is familiar with the basic operation of a laptop computer.

OPERATIONAL HINTS

Here are a few things to remember about the use of the PTU and software:

- ☐ Some instructions in this manual call for the user to type certain operating commands. These commands are shown in a typewriter style type font within quotation marks to indicate the characters to be typed from the keyboard. The operating commands should be typed in lower case letters. Do not type the quotation marks when entering commands on the PTU.
  (Refer to the chart below.)
  Other operations require pressing an individual key on the keyboard; these keys are shown in square brackets. For example, if an operation requires pressing the key labelled "Enter", it will be shown as [ENTER]. Keys shown as [F1] through [F10] refer to the Function keys across the top of the keyboard. Note that many portable computers require pressing another key (usually labelled "Fn") in conjunction with each Function key.
- ☐ Keep the PTU plugged into its charger when possible to maintain a full charge on the battery.
- ☐ There is an indicator light on the PTU which, when lit, indicates low battery power. If this light should come on while using the PTU, continue until you reach a convenient break point. Return to the main menu and turn off the PTU. Then, replace the battery with a spare and continue.
- ☐ If a spare battery pack is available, switch the PTU battery occasionally to ensure that both batteries are kept fully charged. Battery life can be extended by fully discharging and recharging every 3 months.

CONVENTION	APPLIES TO:	SAMPLE
Bold Type	Menu & Screen Titles	**GE OHV STATEX III MENU**
Quotation Marks	Menu Selection Choice	"PTU TALK TO TRUCK"
Typewriter Font in Quotes	Command to be typed from keyboard	"gemenu"
[Brackets]	Keyboard Key To Press	[ENTER], [CTRL], [ALT], [F1] etc.
NOTE: When sample file names are listed as *"this_release"* or "prior_release", make the following substitutions:		
"this_release"	STXMAR96	
"prior_release"	STXOCT95	
"ver"	2.10	
"oldver"	1.25	

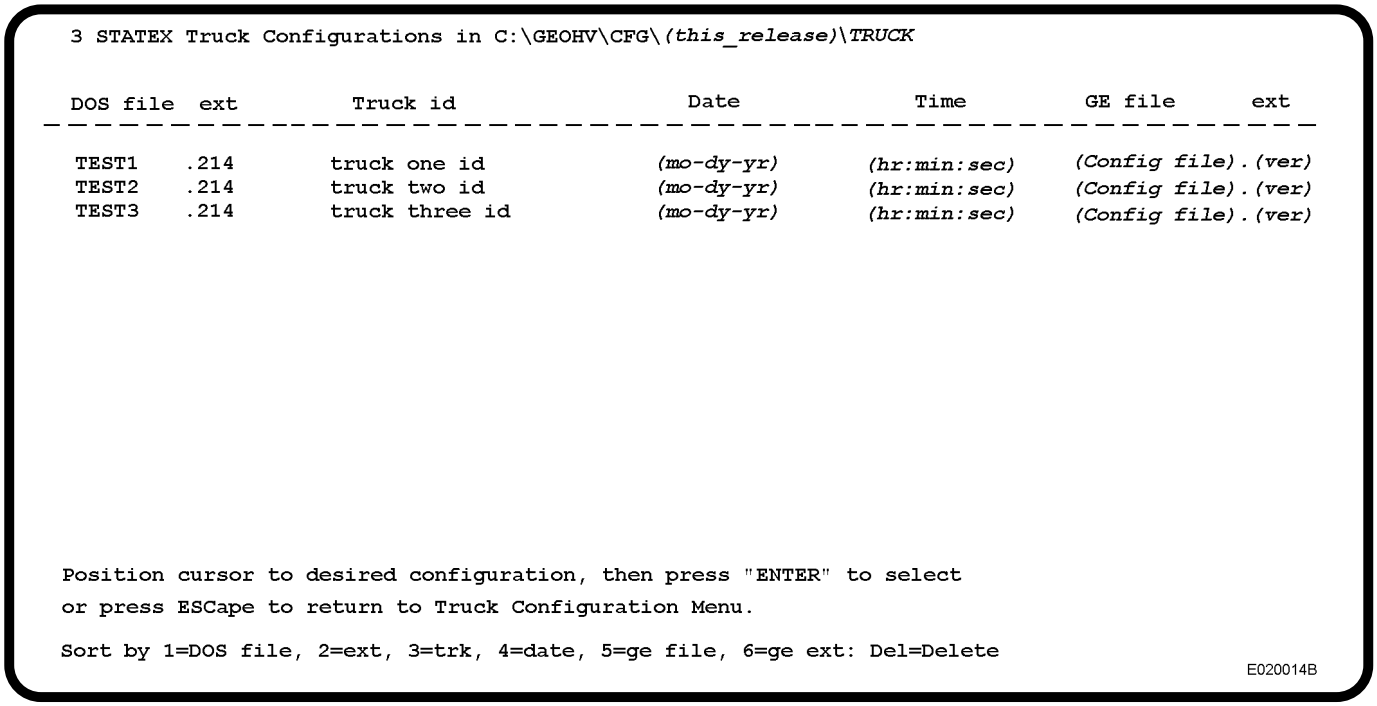


FIGURE 2-11. CONVERTED TRUCK CONFIGURATION FILE LIST

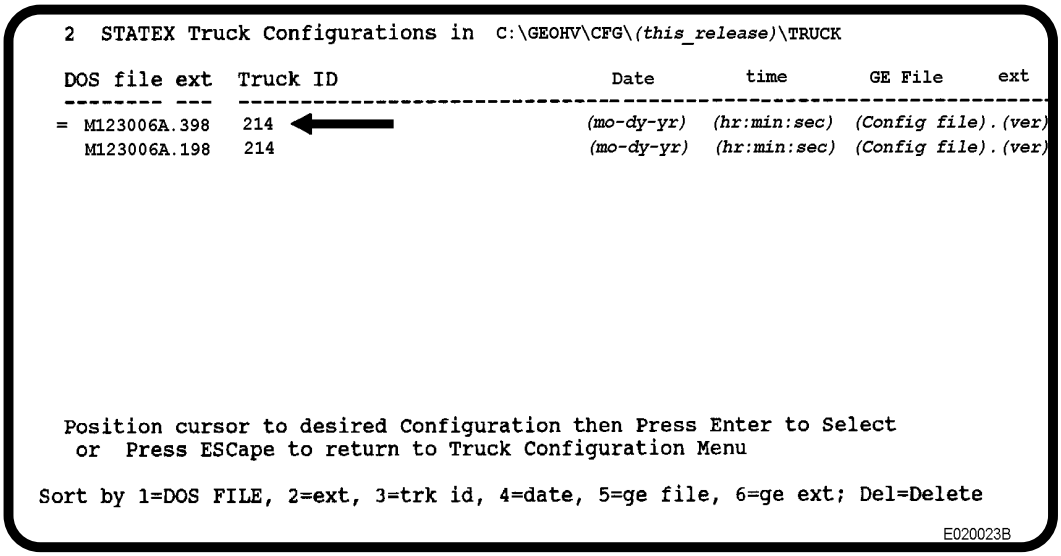


FIGURE 2-21. TRUCK CONFIGURATIONS FILE LIST
(Sample file name shown added to list)

"8) Save Directory: . . ."

At the end of line 8) a directory is displayed for storing the new truck configuration file. The sample in Figure 2-20 shows:
"C:\GEOHV\CFG*(this_release)*\TRUCK".
This directory will be the same as the directory shown in line A).

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

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

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

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

3. Move the cursor to line 7) and press [ENTER] or press [7].
4. The current file name will appear at the end of line 7).
5. Type in the new file name (M123006A.398 in the example shown). The original filename will disappear as the new name is typed.
6. Press [ENTER] to save the new file name into the directory shown on line 8).
7. Move the cursor to line 1) and press [ENTER] or press [1]. This will display the list of configuration files as shown in Figure 2-21. Verify the new file name has been added to the list.
8. When finished with the **TRUCK SETUP CONFIGURATION MINE MENU**, move the cursor to line 9) and press [ENTER] or press the [9] key to Quit.
   a. The prompt, "Quitting, Are you sure (Y/N):" appears as a warning against quitting without saving the modified configuration file. Press [Y] key if you are sure that the Mine renamed configuration file has been properly saved.
9. The **GE OHV STATEX III MENU** will appear on the PTU screen.

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

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

TABLE III. STATISTICAL DATA CODES - COUNTERS

TEMPORARY TRUCK SETTINGS

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

⚠WARNING

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

1. With the **GE STATEX III PTU MAIN MENU** displayed, select "SPECIAL OPERATION" and press [ENTER].
   The screen shown in Figure 2-30 will be displayed to alert the operator about the state of the truck software.
   This warning notifies the operator when control of the truck is being transferred from the truck driver to the PTU, based on the PTU selection of "SPECIAL OPERATION".
   When finished and the PTU is returned to the **GE STATEX III PTU MAIN MENU**, control of the propulsion system is returned to the truck driver. Before activating this command, the screen shown in Figure 2-31 will be displayed.
   The PTU user should always keep the truck driver appraised of this control.
2. Select "YES" on the caution screen (Figure 2-30) and press [ENTER]. The **SPECIAL OPERATION MENU** will be displayed.
3. Use the arrow keys to move the cursor to the "TEMPORARY TRUCK SETTINGS MENU" selection and press [ENTER].

Selections available on this menu are:

» "SPEED SETTINGS"

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

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

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

3. When the new values have been entered, move the cursor to "ACTIVATE TEMPORARY SPEED SETTINGS and TRKSPD SCALE" and press [ENTER].
4. The **TEMPORARY SPEED SET SCREEN** will change to reflect the new values entered.
5. Select "EXIT" to return to the previous menu.

» "RETARD CURRENT ADJUST"

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

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

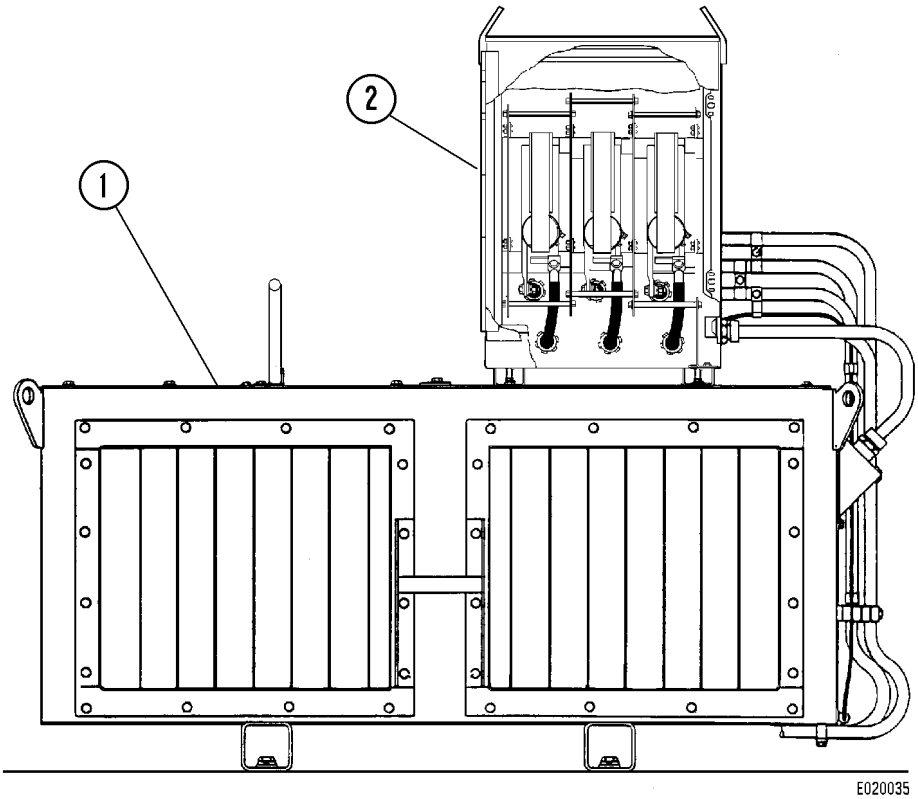


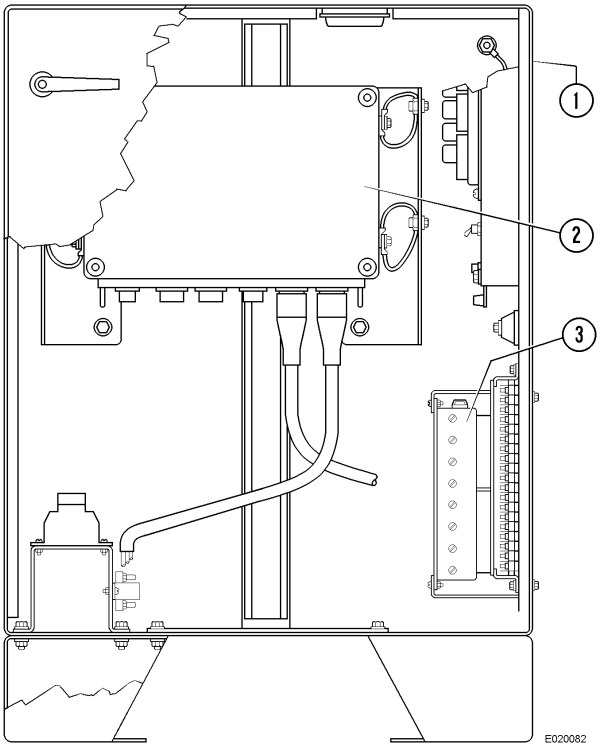
FIGURE 2-42. RETARDING GRIDS AND CONTACTORS (R.H. DECK)

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

FIGURE 2-43. ENGINE GOVERNOR CABINET
(MTU Engine Only)

1. Governor Cabinet
2. MTU Governor
3. Terminal Board (TB-50)

NOTE: Governor cabinet is mounted on left hand deck, behind cab.



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

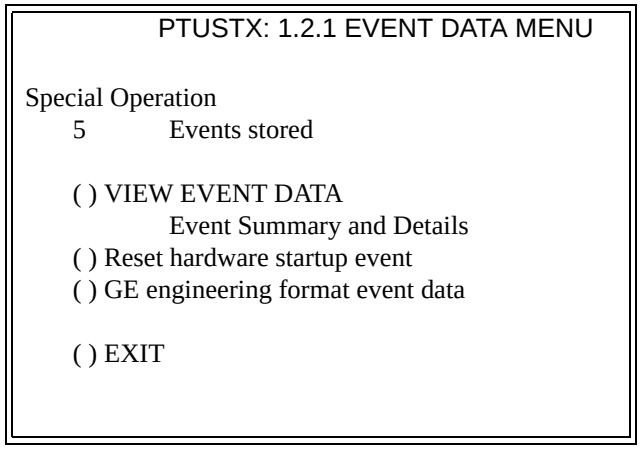


FIGURE 3-2. EVENT DATA MENU
(Requires Control System Reset)

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

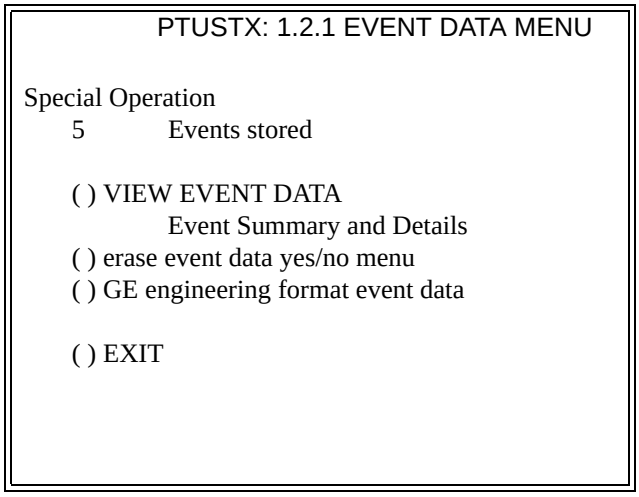


FIGURE 3-3. EVENT DATA MENU

4.0 SEQUENCE TESTS - (ENGINE NOT ON)

Preparation and Setup

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

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

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

5.3 DIGITAL OUTPUT CHECKS

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

1. Set digital output driver on.

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

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

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

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

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

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

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

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

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

Return to Main Menu

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

7.0 SPEED EVENT CHECKS

Preparation and Setup

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

⚠WARNING

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

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

Setup PTU

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

12.2 MAXIMUM ALLOWABLE TRUCK SPEEDS

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

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

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

MAXIMUM TRUCK SPEED CHART FOR GIVEN WHEEL MOTOR

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

7. Secure inner and outer dual tire inflation lines to bracket on outer rim. Tighten capscrews to standard torque.
8. Install wheel cover. Remove blocks from under truck and lower truck to the ground.
9. Operate truck for one load and retighten wheel nuts as specified in Step 6. Recheck nut torque daily (each 24 hours of operation) to insure proper torque is maintained on each nut. Once torque is maintained, daily checking is no longer required. Check intermittently to insure torque is maintained.

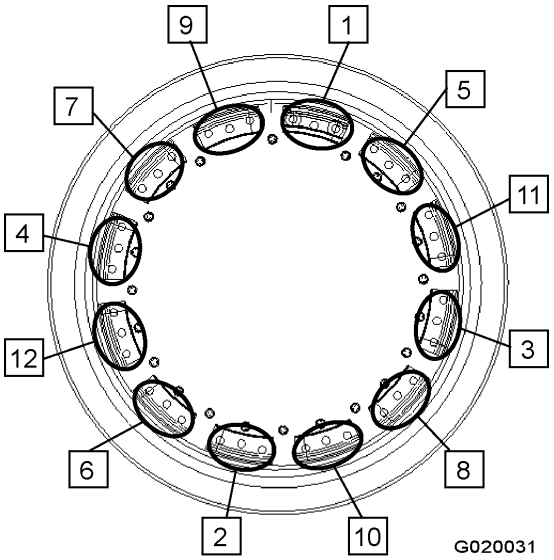


FIGURE 2-7. REAR WHEEL TIGHTENING SEQUENCE

RIM

Tire Removal

⚠DANGER

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

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

RIM AND TIRE PREPARATION

The first step in mounting radial off-road tires is to properly prepare the tire and rim assembly.

1. Clean the rim base, bead seat band, and flanges with a wire brush. Remove all paint from knurling on bead seat band and back section.

⚠DANGER

Never weld or repair damaged rims.

2. Check rim assembly for damage or corrosion. Replace any damaged or broken components. Verify that the rim does not have any burrs.
3. Apply rust inhibitor to any corrosion.
4. Clean the tire and bead area.
5. Check for and remove any object(s) from the interior of the tire that could cause damage to the tire.
6. Check the tire bead area and inner liner for damage that would allow air to leak from the tire. Replace or repair any tire with bead damage.

9. In successive increments of **250 ft. lbs. (339 N.m)** torque, while rotating the hub (3 revolutions min), tighten capscrews alternately to **750 ± 75 ft. lbs. (1017 ± 102 N.m)** final torque.
10. Using a new O-ring (10, Figure 3-3), install cover (3). Install capscrews and washers (2) and tighten capscrews to standard torque.
11. Install hub and spindle assembly and add oil per instructions in "Front Wheel Hub" Installation.

Wheel Bearing Adjustment (Tire mounted)

The following procedure covers adjustment of front wheel bearings while the tire and rim, hub, and spindle are installed on the truck.

1. Park truck in a level area.
2. Apply the parking brake and block wheels to prevent movement.
3. Lift the truck until the tire of the wheel being adjusted is off the ground. Place blocking securely under truck frame.

NOTE: The placement of binder chains (2 & 3, Figure 3-10) is necessary anytime that the retainer plate (8, Figure 3-3) is removed in the following procedure. These binders must be tight enough to prevent the wheel hub from moving out and dislocating the floating seal assembly (16). An additional chain (1, Figure 3-10) may be installed to prevent full extension of the suspension cylinder when the truck is raised off the ground.

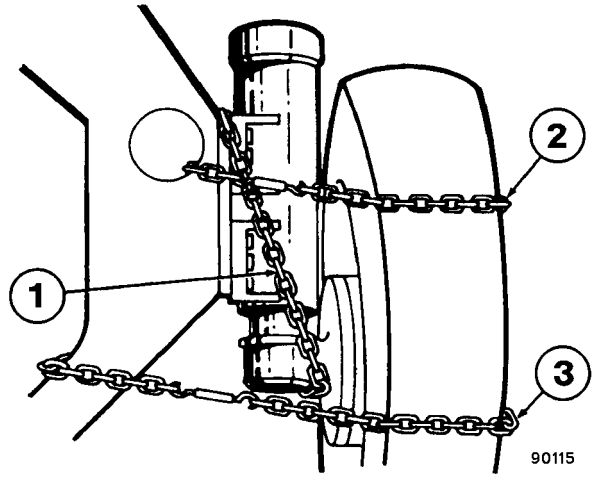


FIGURE 3-10. WHEEL SUPPORT CHAIN INSTALLATION

1. Suspension Support Chain
2. Chain & Binder
3. Chain & Binder

4. Wrap a chain and chain binder (2, Figure 3-10) around the top half of the tire. Secure chain through the frame. Chain should be tightened enough to prevent movement during bearing adjustment procedure when the retainer plate is removed.
5. Install another chain (3) around the bottom half of the tire and tighten enough to prevent movement during bearing adjustment procedure.
6. Drain oil at wheel hub drain plug (24, Figure 3-3). Remove cover (3).
7. Remove capscrews (5), retainer plate (8), and shims (7).
8. Reinstall retainer plate (with the thickness dimension stamp facing toward the outside), capscrews, and hardened washers. **Do not install shims.**
9. Remove tire retaining chains (2 & 3, Figure 3-10).
10. Torque retainer capscrews alternately using the following procedure:
    a. Tighten all capscrews to **60 ft. lbs. (81 N.m)** torque while rotating the hub.
    b. Increase torque on all capscrews to **120 ft. lbs. (163 N.m)** while rotating hub.
    c. Increase torque on all capscrews to **180 ft. lbs. (244 N.m)** while rotating hub.
    d. Increase torque on all capscrews to **240 ft. lbs. (325 N.m)** while rotating hub.
    e. Increase torque on all capscrews to **250 ft. lbs. (339 N.m)** while rotating hub.
11. Loosen all six capscrews until the flat washers are free, then select two capscrews 180° apart and adjacent to the 0.50 in. (13 mm) holes in the retainer plate. Tighten only these two capscrews to **55 ft. lbs. (75 N.m)** torque while rotating the wheel hub. Refer to Figure 3-9.
12. Tighten the same two capscrews to **110 ft. lbs. (149 N.m)** while rotating the hub.
13. Using a depth micrometer, measure and record the depth to the end of the spindle from the face of the retainer plate through each of the two holes in the retainer plate adjacent to the capscrews tightened in step 12.
14. Add the two depth dimensions measured in step 13 and divide the total by 2, to obtain an averaged depth dimension.
    Record average Depth (d_a): _____

SECTION H

HYDRAIR® II SUSPENSIONS

INDEX

⚠ DANGER

HIGH PRESSURE CYLINDER CHARGED WITH DRY NITROGEN

DO NOT REMOVE ANY HARDWARE INCLUDING CAPSCREWS, PLUGS, VALVE, OR VALVE CORE UNTIL ALL PRESSURE HAS BEEN RELEASED.
REMOVAL OF ANY HARDWARE WHILE CYLINDER IS UNDER PRESSURE MAY RESULT IN HARDWARE FLYING VIOLENTLY FROM CYLINDER.
TO RELEASE PRESSURE, REMOVE VALVE CAP, TURN TOP HEX ON VALVE THREE TURNS IN A COUNTER CLOCKWISE DIRECTION AND DEPRESS VALVE CORE.
DO NOT TURN BOTTOM HEX UNTIL PRESSURE HAS BEEN RELEASED.

1. **CHECK OIL LEVEL PER INSTRUCTION MANUAL.**
2. **CHARGE WITH DRY NITROGEN GAS ONLY.**

TO CHARGE CYLINDER: SEE YOUR HAULPAK Distributor WHO HAS ALL TOOLS AND INFORMATION REQUIRED FOR CHARGING CYLINDERS.

WA2892

REAR SUSPENSIONS

The HYDRAIR® II suspensions are hydro-pneumatic components containing oil and nitrogen gas. The oil an gas in the four suspensions carry the gross truck weight less wheels, spindles and final drive assembly. The rear suspension cylinders consist of two basic components; a suspension housing attached to the rear axle housing, and a suspension rod attached to the frame.

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

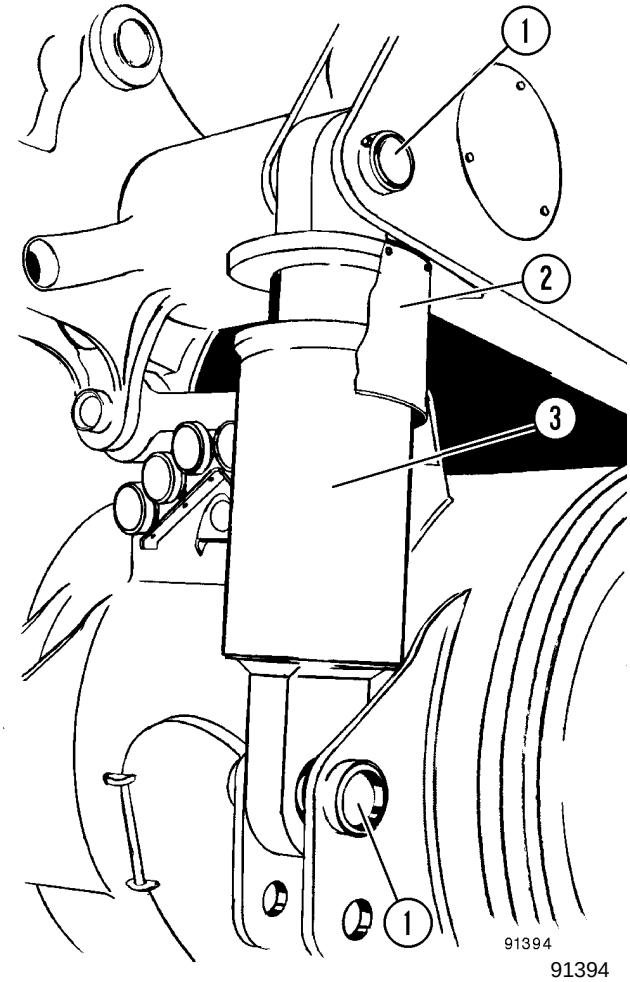


FIGURE 3-1. REAR SUSPENSION INSTALLATION

1. Mounting Pins
2. Piston Rod Cover
3. Suspension Cylinder

Removal

1. Remove capscrews, washers, and metal cover (2, Figure 3-1) from the suspension.
2. Remove charging valve cap, (1, Figure 3-2) loosen small hex (4) on charging valve and turn counterclockwise three full turns to unseat valve seal. Connect suspension charging kit.

⚠WARNING

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

3. If necessary, charge the suspension to be removed with dry nitrogen until the rod is exposed approximately 5.0 in. (127 mm).
4. Place stands or cribbing under the truck frame at each hoist cylinder mount.

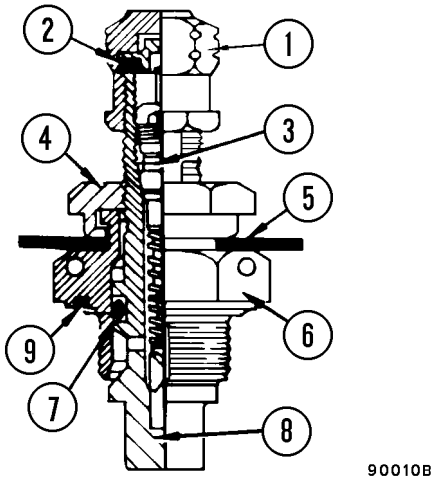


FIGURE 3-2. CHARGING VALVE

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

6. Close inlet valve (4, Figure 4-1). Leave outlet valves (3) open for five minutes in order to allow the pressures in the suspensions to equalize.
7. Ensure both of the suspension cylinders are extended the same distance ± 10 mm (0.39 in.). If the difference in the extension from side to side exceeds 10 mm, check the front suspensions for equal extension. Adjust the front as necessary.

NOTE: A low left front suspension will cause the right rear suspension to be high. A low right front suspension will cause the left rear suspension to be high.

8. Close outlet valves (3) and remove charging kit components. Refer to *Removal of Charging Kit*.
9. If the charging valve is being reused, tighten swivel nut (4, Figure 4-3) to **4 ft. lbs. (5.4 N.m)** torque.
10. If a new charging valve is being used, tighten swivel nut to **10.5 ft. lbs. (14.2 N.m)** torque, then loosen and retighten the swivel nut to **10.5 ft. lbs. (14.2 N.m)** torque. Again, loosen the swivel nut and retighten to **4 ft. lbs. (5.4 N.m)** torque. Replace valve cap (1) and tighten to **2.5 ft. lbs. (3.3 N.m)** torque (finger tight).
11. Install the protective guards over the charging valves and install the metal covers over the piston rods.

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

BRAKE CIRCUIT COMPONENT SERVICE

NOTE: *Approximately February, 1995, the rear brake pressure for 830E HAULPAK® Trucks with S/N 32395-AFE32-CV and higher, was raised* ***from*** *1,500 psi (10342 kPa)* ***to*** *2,000 psi (13790 kPa).*
This rear brake system pressure change causes the Part Number and adjustment of the Brake Valve and Brake Differential Pressure Switch to change; it also causes a change to the rear brake calipers.
It is very important to match the correct Brake Componenents to the rear brake system pressure on the truck.

Be aware of these requirements throughout the following rebuild and adjustment procedures.

BRAKE VALVE

The Brake Valve is a pressure modulating valve actuated mechanically (brake pedal) or hydraulically through solenoid valves.

The Brake Valve independently controls the pressure delivered to the front and rear service brake assemblies. Apply pressure can be modulated from zero to maximum braking effort by use of the foot pedal.

Rebuild Criteria

If any one of the following conditions exist, the brake valve should be removed and repaired:

- Excessive cam rock in pedal actuator.
- Any sign of external leakage.
- Internal leakage at the tank port must be less than 100 cc/minute with the valve in the released position and system pressure supplied to the “P1" and ”P2" inlet ports.
- Tank port leakage must be less than 250 cc/minute with valve pilot or manual applied at 3,000 psi (20,685 kPa) system pressure.
- Failure of the pedal to return to full release position.
- Valve holds pressure when in the neutral position.
- Varying output pressure with the pedal fully depressed.

Removal

If the Brake Valve is to be removed from the vehicle for repair or adjustment, additional equipment will be required as outlined in disassembly, assembly.

NOTE: Minor repairs and service adjustment may not require the removal of the brake valve.

⚠WARNING

Before disconnecting pressure lines, replacing components in the hydraulic circuits, or installing test gauges, always bleed down hydraulic steering and brake accumulators.
The steering accumulators can be bled down by turning the key switch “Off”, waiting for engine to stop, and then waiting approximately 90 seconds. Confirm the steering pressure is released by turning the steering wheel - No front wheel movement should occur. Open bleed down valves (8 & 9, Figure 3-1) located on the brake manifold and allow both brake accumulators to bleed down.

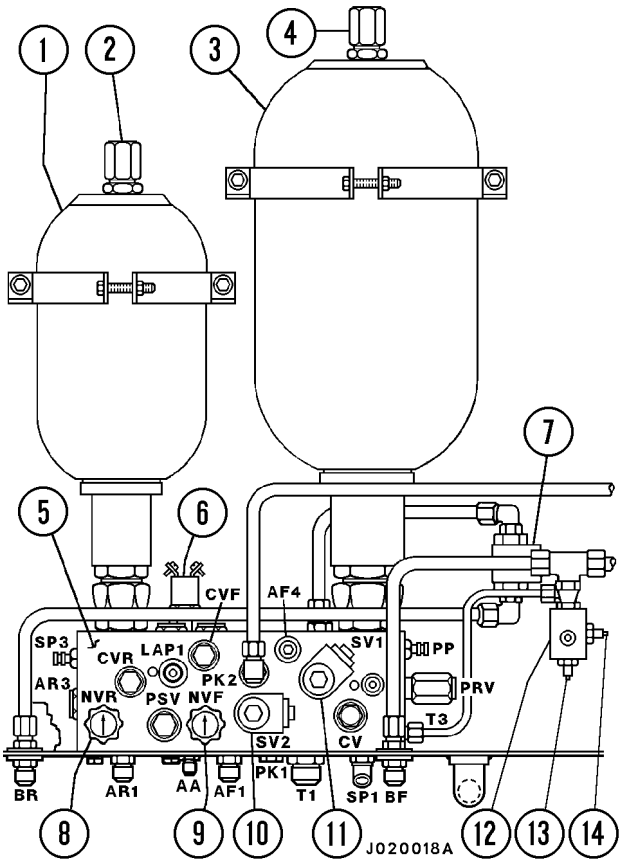


FIGURE 3-1. BRAKE ACCUMULATOR BLEED DOWN

1. Rear Brake Accumulator
2. Charging Valve
3. Front Brake Accumulator
4. Charging Valve
5. Brake Manifold
6. Low Accumulator Pressure Switch
7. Brake Lock Shuttle Valve
8. Bleed Down Valve (Rear)
9. Bleed Down Valve (Front)
10. Park Brake Solenoid
11. Brake Lock Solenoid
12. Differential Pressure Manifold
13. Differential Pressure Switch (rear)
14. Differential Pressure Switch (front)

Installation Of Brake Pedal Actuator Assembly to Brake Valve

1. Install jam nut (9, Figure 3-10) and set screw (10) to brake pedal actuator (7).
2. Insert nylon bushings (4) into brake pedal actuator.
3. Install one retaining clip (2) to one end of pivot shaft.
4. Align pedal structure to brake valve (1) and partially insert pivot pin. Move pedal structure to the “B2" side of valve and insert shims (5) between pedal structure and brake valve ear to fill gap. Fully insert the pivot shaft (3). Install the remaining retainer clip (2).
5. Assemble spring assembly (8) and install complete assembly to brake pedal actuator as shown. ***Be sure to install spring assembly correctly, with larger ball socket end pointing down and smaller end up***.

NOTE: If pedal is adjusted properly, the spring assembly will not interfer with pedal travel.

⚠CAUTION

The spring and spring pivots are different for pedals equipped with and without the electric retard pedal mounted to the brake pedal. DO NOT interchange the springs or spring pivots.

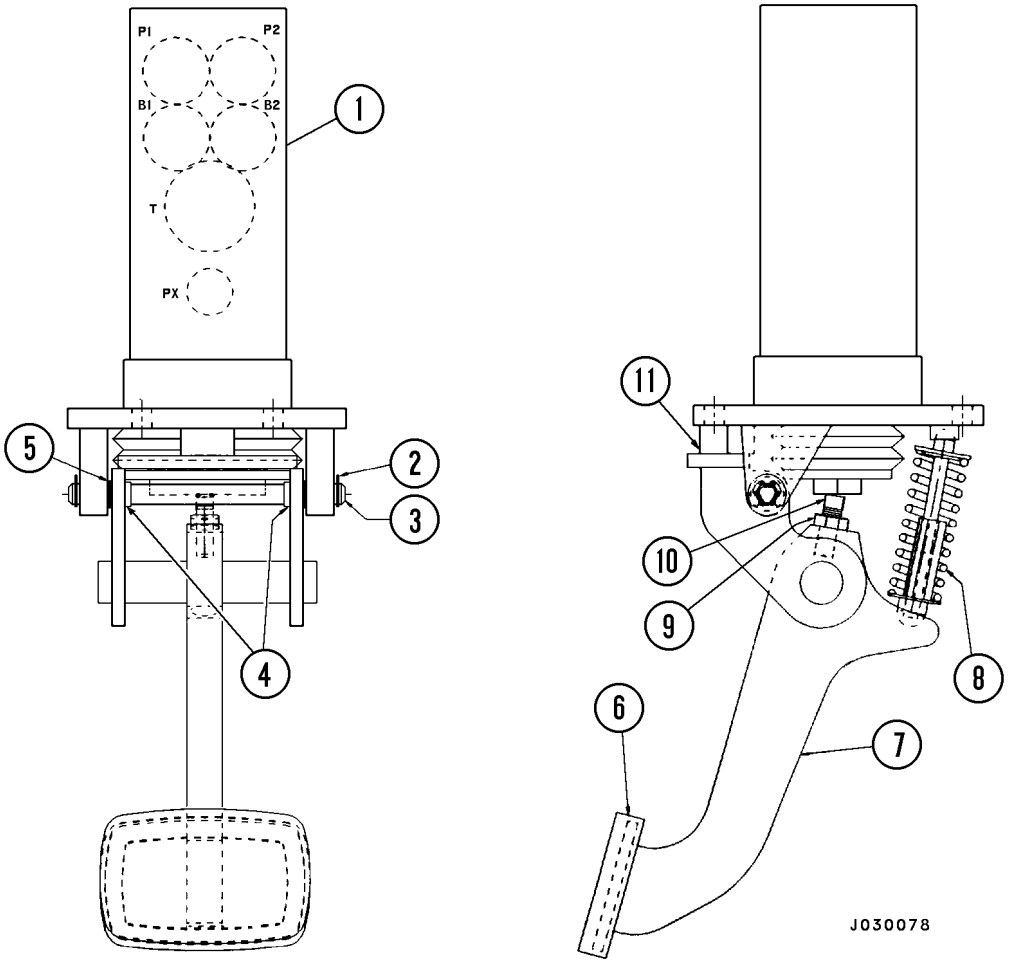


FIGURE 3-10. SINGLE PEDAL BRAKE VALVE ASSEMBLY

1. Brake Valve
2. Retainer Clip
3. Pivot Shaft
4. Bushings
5. Shims
6. Foot Pad
7. Brake Pedal Actuator
8. Spring Assembly
9. Jam Nut
10. Set Screw
11. Pedal Return Stop

BRAKE CIRCUIT CHECK-OUT PROCEDURE

The brake circuit hydraulic pressure is supplied from the steering circuit at the bleed down manifold. Some brake system problems, such as spongy brakes, slow brake release, or abnormal operation of the instrument panel mounted “Low Brake Pressure” warning light can sometimes be traced to internal leakage of brake components. If internal leakage is suspected, refer to Brake Circuit Component Leakage Test.

NOTE: If internal leakage within the steering circuit is excessive, this also may contribute to problems within the brake circuit. Be certain that steering circuit leakage is not excessive before troubleshooting brake circuit. For Steering Circuit Test Procedure, refer to Section “L”, Hydraulic System.

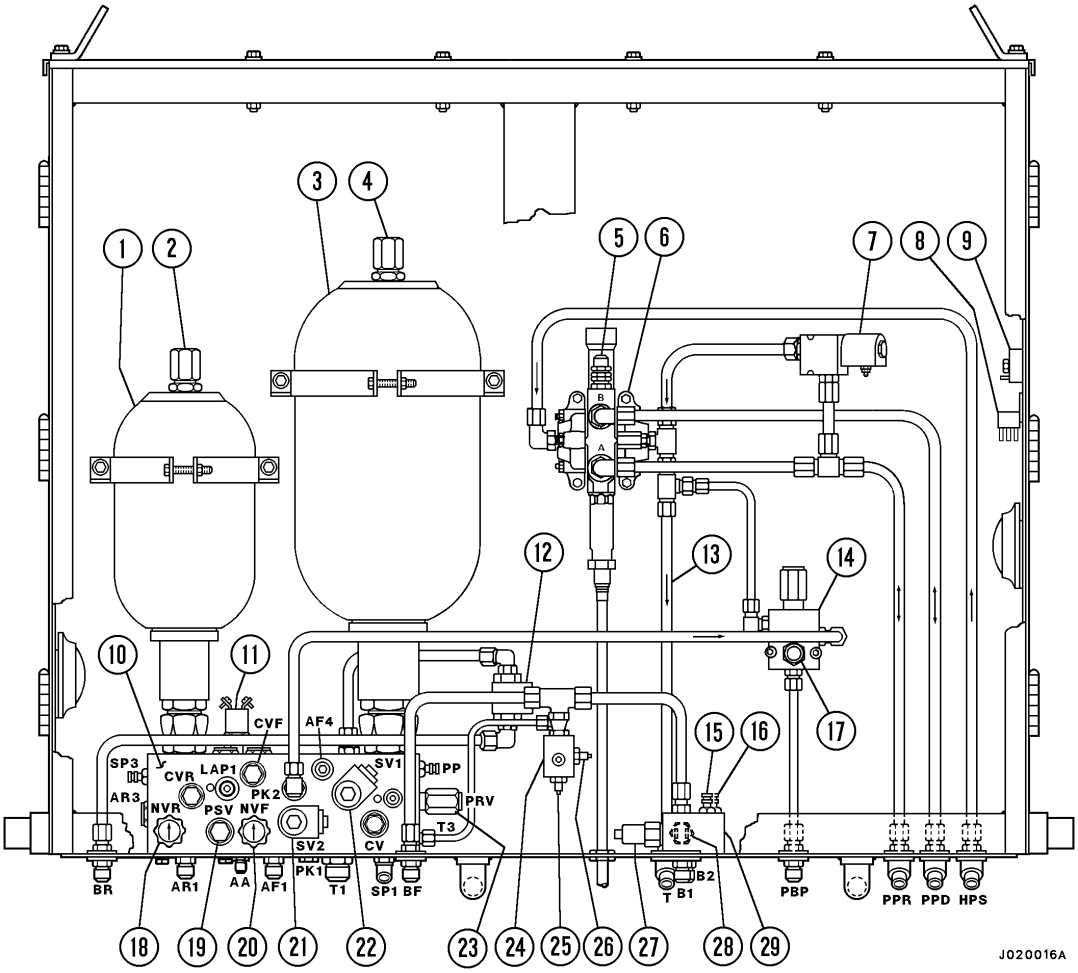


FIGURE 4-1. HYDRAULIC BRAKE CABINET

1. Rear Brake Accumulator
2. Charging Valve
3. Front Brake Accumulator
4. Charging Valve
5. Relief Valve (Power Down)
6. Hoist Pilot Valve
7. Hoist-Up Limit Solenoid
8. Brake Warning light Relay
9. Brake Warning Delay Timer
10. Brake Manifold
11. Low Accumulator Pressure Switch
12. Brake Lock Shuttle Valve
13. Return Line
14. Parking Brake Regulator
15. BF Test Port (Front Brake)
16. BR Test Port (Rear Brake)
17. Park Brake Pressure Switch
18. Bleed Down Valve (Rear Brake Accumulator)
19. Automatic Apply Valve
20. Bleed Down Valve (Front Brake Accumulator)
21. Park Brake Solenoid
22. Brake Lock Solenoid
23. Brake Lock Pressure Reducing Valve
24. Differential Pressure Manifold
25. Differential Pressure Switch (Rear)
26. Differential Pressure Switch (Front)
27. Brake Light Switch
28. Brake Lock Degradation Switch
29. Junction Block

KOMATSU CHECK-OUT PROCEDURE
HYDRAULIC BRAKE SYSTEM DATA SHEET

MACHINE MODEL _____ UNIT NUMBER _____ SERIAL NUMBER _____

I. INITIAL SYSTEM SET-UP

Operate Hydraulic Steering System to obtain proper operating temperature. Refer to Check-out Procedures.

STEP 2 _____ Brake Accumulators charged to 1400 psi (9.65 mPa).

STEP 7 _____ Maximum rear brake pressure (brake lock).

STEP 8 _____ Maximum rear brake pressure.
_____ Maximum front brake pressure.

II. SERVICE BRAKE SYSTEM CHECK-OUT

Refer to appropriate Service Manual procedures and Bleed brakes; Bleed park brakes.

STEP 9 _____ Rear brake Circuit Pressure when front circuit actuates.
or _____ Front brake circuit pressure when rear circuit actuates.

STEP 10 _____ Pressure at which brake indicator light come on.
_____ Pressure at which stop lights come on.

STEP 11 _____ Front brake pressure within one second.
_____ Rear brake pressure within one second.
_____ Brake pressures remain above 2850 psi (19648 kPa) front and 1880 psi (12960 kPa) rear for 20 seconds

STEP 12 _____ Front brake circuit pressure, pedal completely released.
_____ Rear brake circuit pressure, pedal completely released.

ROCKWELL WHEEL SPEED FRONT DISC BRAKES

BRAKE CALIPER

Each front wheel speed brake assembly has three* calipers on one disc. Each caliper has six pistons and two linings, three apply pistons and one lining for each side of disc. Lining should be changed when friction material is worn to 0.125 in. (3.22 mm) thickness.

**NOTE: Some trucks may be equipped with FOUR (4) Brake Calipers per wheel. Service and adjustment for these calipers are the same as presented here.*

If inspection of front brake calipers and disc assembly indicate repair beyond lining replacement, it is necessary to remove calipers and disc from front wheel hub and spindle. Refer to Figure 5-4 for maximum wear limits of front disc. Clean brake assemblies before performing any service. Cleaning may be done by brush or spray, using a petroleum base cleaning solvent. Clean diesel fuel is acceptable for this operation. Cleaning should be thorough enough for preliminary inspection and disassembly. Subassemblies should be blown dry with compressed air after cleaning. Dust shields should be wiped dry with a clean cloth.

NOTE: If brake has not accumulated excessive surface dirt, preliminary cleaning can be done in the overhaul area. However, preliminary cleaning should be done before removal of pistons from housing.

⚠CAUTION

The use of vapor degreasing or steam cleaning is not recommended for the brake assemblies or the component parts. Moisture will cause parts to rust.

⚠WARNING

Be certain that all wheels are securely blocked to prevent truck from moving.

Do not loosen or disconnect any hydraulic brake line or component until engine is stopped, key switch is "Off" and drain valves on brake accumulators are opened and steering accumulators are bled down. Turn steering wheel to be sure steering accumulators are completely bled down.

Removal

1. Remove front tires and rims according to procedure in Section "G".
2. If necessary, remove disc from front wheel hub. Refer to Section "G", "Front Wheel Hub and Spindle Removal".

NOTE: Mark or tag each brake caliper assembly for reassembly at its correct location. Do not interchange parts.

3. Open the brake bleed valves (2, Figure 5-2) at each caliper and bleed down the caliper by disconnecting the two lower hoses at "T" connection (5 & 6, Figure 5-1). Drain the fluid into a container. Do not reuse fluid.
4. Disconnect the top brake hose at "T" connection (3, Figure 5-1).
5. Disconnect and remove crossover tubes (2, 4, 7).

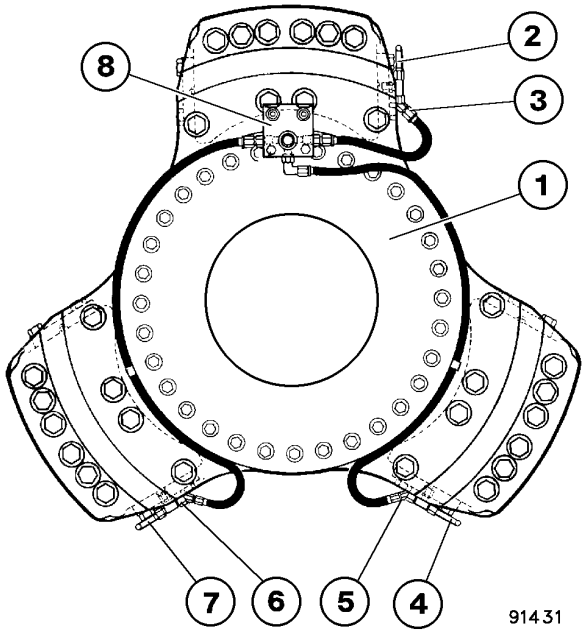


FIGURE 5-1. BRAKE LINES

1. Adapter
2. Crossover Tube
3. “T” Connection
4. Crossover Tube
5. “T” Connection
6. “T” Connection
7. Crossover Tube
8. Junction Block

3. Remove parking brake as described in "Parking Brake Removal".
4. Remove service brake lines and brake cross-over tubes (1, Figure 6-1). Cap all lines and brake ports to prevent contamination of brake system.
5. Remove two outside capscrews (5) and two spacers (6). Remove brake lining assemblies.

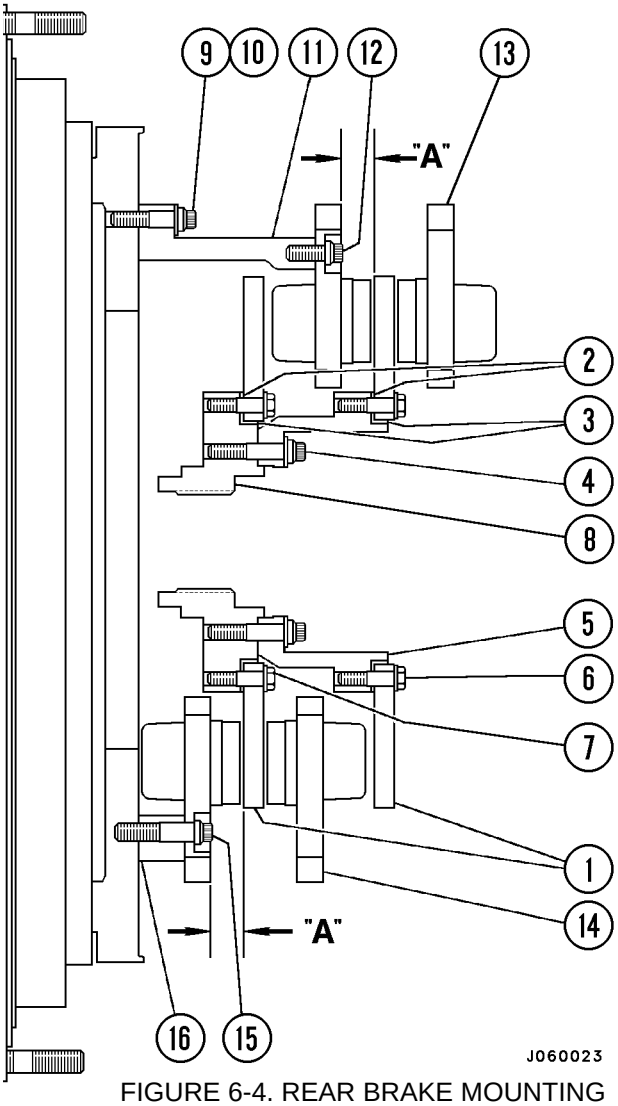


FIGURE 6-4. REAR BRAKE MOUNTING

1. Brake Disc
2. Shims
3. Bushing
4. Capscrew
5. Disc Support
6. Capscrew/ Flatwasher
7. Capscrew/ Flatwasher
8. Hub
9. Capscrew
10. Hardened Washer
11. Caliper Mount
12. Capscrew
13. Outboard Caliper
14. Inboard Caliper
15. Capscrew
16. Spacer

6. Install two threaded alignment studs (1, Figure 6-2) in two outside capscrew locations. Remove center capscrew (10, Figure 6-1), outside torque plate (7) and spacer block (9).
7. Remove capscrews and flatwashers (6, Figures 6-4, 6-5 & 6-6) while supporting outboard disc (1). Tap disc and bushing assembly (3) off disc adapter (5). Remove shims (2) and record number, thickness and location of shims for use in assembly.

NOTE: Keep shims together for use in assembly.

8. Remove capscrews (4, Figures 6-4, 6-5, & 6-6) and disc support (5).
9. Remove capscrews (12, Figure 6-4) and inside torque plate from caliper mount (11).
10. Remove two capscrews (4 & 8, Figure 6-3) from the inboard brake caliper and insert two 1.000-14UNS X 11.00 inch threaded studs.
11. Remove the center capscrew and slide the park brake support arm off the stud. Record the number, thickness and location of shims between parking brake support arm (5) and spacer (7). Keep shims together for use in assembly.

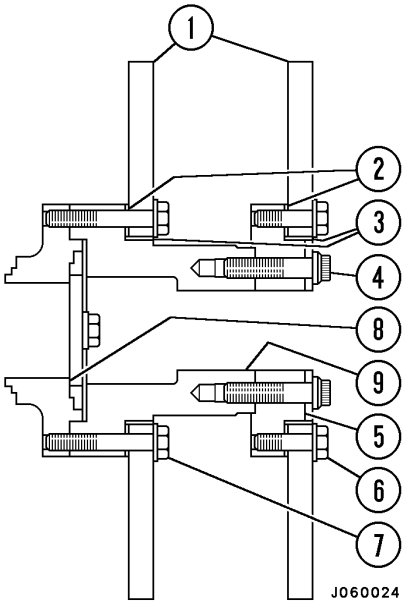


FIGURE 6-5. DISC BRAKE MOUNTING

1. Brake Disc
2. Shims
3. Bushing
4. Capscrew
5. Disc Support
6. Capscrew/ Flatwasher
7. Capscrew/ Flatwasher
8. Hub
9. Disc Adapter

ROCKWELL ARMATURE SPEED REAR DISC BRAKES

REAR BRAKES

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

NOTE: Some trucks may be equipped with TWO (2) Park Brake Calipers per wheel. Service and adjustment for these calipers are the same as presented here.

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

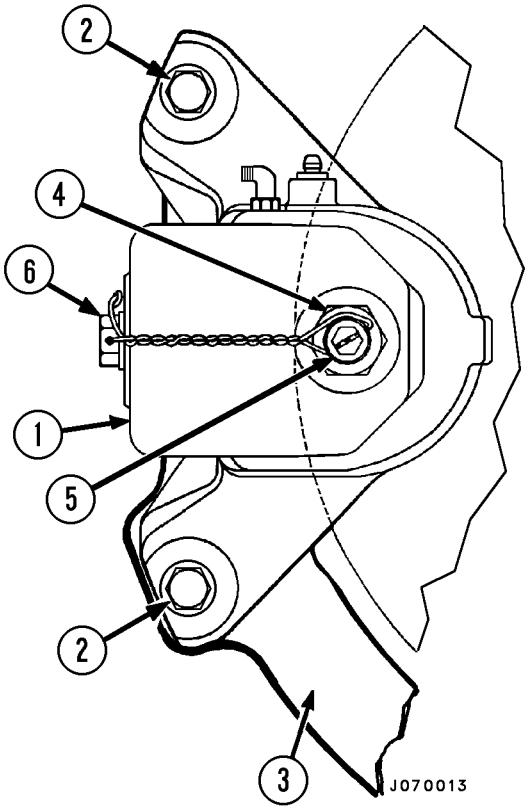


FIGURE 6-1. PARKING BRAKE

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

CALIPER, DISC, AND PARKING BRAKE

⚠WARNING

Do not loosen or disconnect any hydraulic brake line or component until engine is stopped, key switch is "Off" and drain valves on brake accumulators are opened and steering accumulator is bled down. Turn steering wheel to be sure steering accumulator is completely bled down.

Caliper, Disc, And Parking Brake Removal

NOTE: For electric wheels equipped with a two-piece brake hub adapter (9 & 20, Figure 6-3), follow the instructions below. For electric wheels equipped with a one-piece wheel adapter (16, Figure 6-3A), refer to page 4.

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

1. Securely block wheels to prevent truck movement.
2. Remove rear wheel cover.
3. Open the highest bleeder valve (5, Figure 6-2) and attach a bleeder hose to the lowest bleeder valve (6). Open bleed valve and allow oil to drain into a container. Disconnect and remove brake supply tubes from service and park brake calipers. Take care to prevent hydraulic oil from coming in contact with commutator and brushes of wheel motor.
4. Disconnect brake line connected to the park brake caliper.
5. Loosen jam nut (4, Figure 6-1) on park brake adjustment bolt (5). Loosen clamping capscrew (6) one turn and back out adjustment bolt (5) six turns to release park brake linings from outer disc.
6. Support park brake caliper and remove capscrews (2) securing caliper (1) to park brake mounting bracket (3). Remove caliper from disc.
7. Remove crossover tube (4, Figure 6-2) from upper service brake caliper. Remove crossover tube on lower brake assembly.
8. Removal of brake caliper is easier with linings removed. Remove retainer capscrews (1), lining retainers (2) and linings.

a. Set up dial indicator spring between checker arbor and table.

b. Place outer spring guide under checker arbor.

c. Lower arbor firmly onto spring guide and hold arbor in this position.

d. Set indicator dial to zero (Figure 6-12) and raise arbor.

e. Place spring over spring guide and lower arbor slowly until dial indicator again reads zero.

f. Read spring force on checker scale (Figure 6-12).

3. The value read in Step 2 (f.) is the spring return force exerted by spring the under maximum deflection while installed in the piston assembly. Because of manufacturing tolerances, this can be as low as 180 lb. (800 N), but will usually measure greater than 200 lb. (890 N). It is recommended that springs measuring a force of 180 lbs. (800 N) or less under these test conditions be replaced.

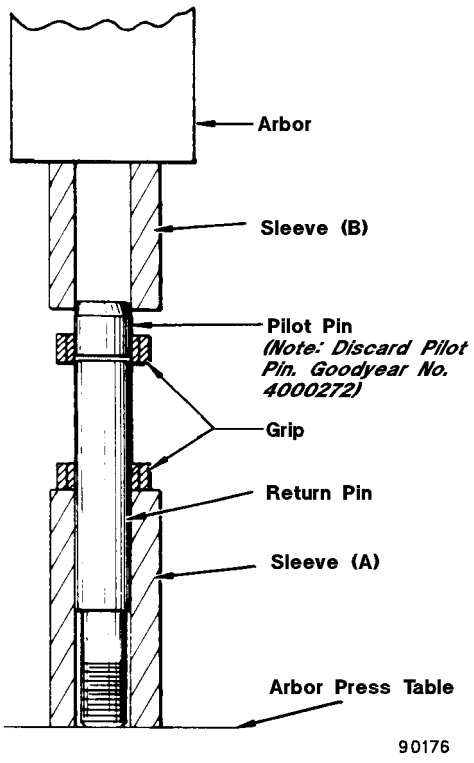


FIGURE 6-13. GRIP INSTALLATION

Disassembly of Piston Assembly

To disassemble piston assembly for separate inspection of return spring (14, Figure 6-7), return pin and grip assembly (6), proceed as follows:

1. Remove O-ring (2, Figure 6-7) and return pin washer (3) from return pin.
2. Remove lockwire ring (15).
3. Place piston assembly on arbor press table, place sleeve (A) special tool illustrated in Figure 6-6 or equivalent) over return pin, lower arbor and fully compress return spring (Figure 6-14) and hold.
4. Back out threaded retaining ring (4, Figure 6-7). With compression relieved, threaded ring can usually be unscrewed by hand. If threads are burred it may be necessary to use a spanner wrench. Spanner wrench may also be necessary for assembly and for setting of built-in clearance.
5. Slowly raise arbor until all compression on the piston return spring (14) is relieved.

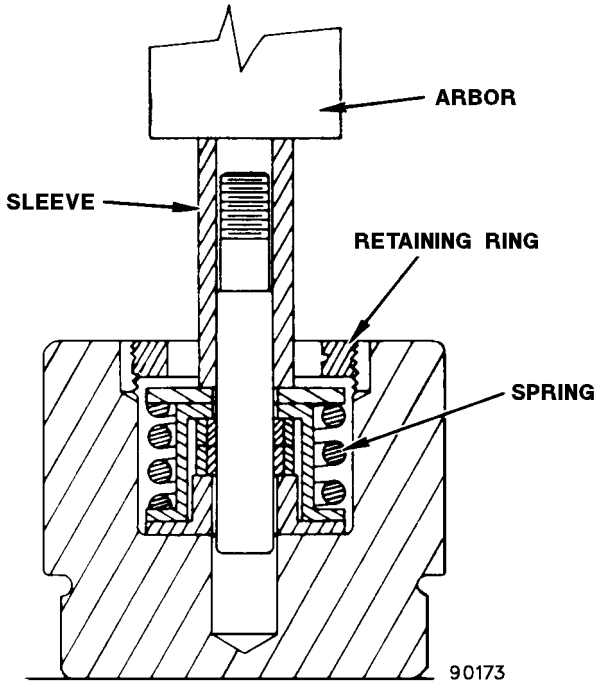


FIGURE 6-14. RETAINING RING REMOVAL

9. Tighten clamp capscrew (3) to **125 ft.lbs. (170 N.m)** torque to lock yoke (1) to housing (2).
10. Turn adjusting bolt (16) **OUT** (counterclockwise) 1/4 turn.
11. Hold adjusting bolt (16) to prevent turning in either direction and tighten jam nut (17).

⚠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 injury is not received immediately.

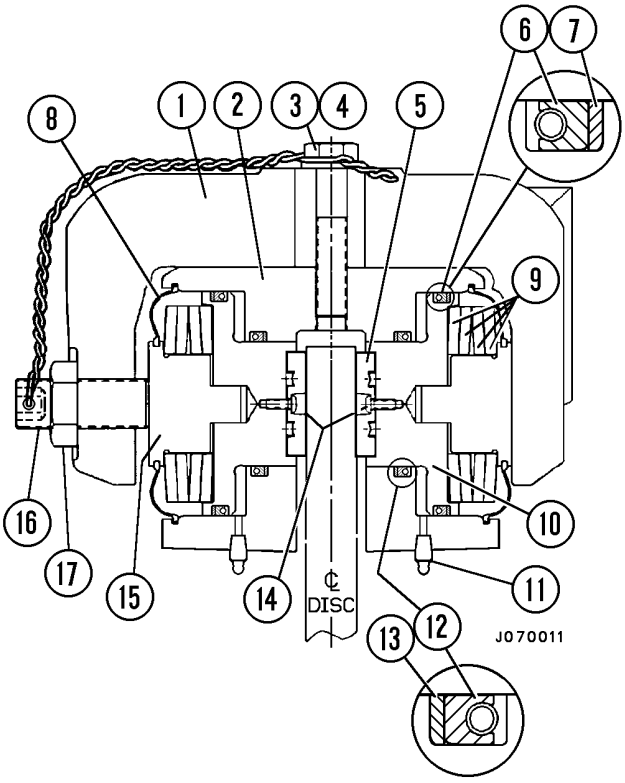


FIGURE 16-1. PARK BRAKE ASSEMBLY (SCL70-4)

1. Yoke
2. Housing
3. Clamping Capscrew
4. Washer
5. Lining
6. Seal Assembly
7. Backup Ring
8. Dust Boot
9. Spring (4/piston)
10. Piston
11. Bleed Screw
12. Seal Assembly
13. Backup Ring
14. Screw
15. Spring Retainers(2)
16. Adjustment Bolt
17. Jam Nut

NOTE: Earlier version (SCL70-3) had a different style Seal Assembly, 6 & 12, and did not have Backup Rings, 7 & 13.

12. With truck engine running, apply and release park brake three (3) times. Check for leaks. If caliper leaks, refer to "Caliper Removal and Disassemby" procedures and repair leaking caliper.

NOTE: If another source of hydraulic power (such as "porta-power") is used for this check, install a gauge in line. Use 2200 - 2500 psi (10.3 MPa - 17.2 MPa) pressure for adjustment.

⚠CAUTION

Exceeding MAXIMUM pressure of 3000 psi (20.7 MPa) may rupture seals in park brake caliper and cause leakage.

13. Tighten clamp capscrew (3) to **125 ft.lbs. (170 N.m)** torque and insure parking brake lines are tightly connected. Lockwire clamp capscrew (3) to adjusting bolt (16) as shown to prevent loosening.
14. Bleed park brake after starting engine. Refer to "Brake Bleeding Procedure".
15. With engine running and park brake switch "OFF" (brake released*), check the lining-to-disc clearance for both inboard and outboard linings with a long feeler gauge. Clearance should be **0.025 in. - 0.060 in. (0.635 mm - 1.524 mm)** for both inboard and outboard linings.

**NOTE: If another source of hydraulic power (such as "porta-power") is used for this check, install a gauge in line and use 2200 - 2500 psi (10.3 MPa - 17.2 MPa) pressure for adjustment.*

⚠CAUTION

Exceeding MAXIMUM pressure of 3000 psi (20.7 MPa) may rupture seals in park brake caliper and cause leakage.

16. If the lining-to-disc clearance is not as specified, repeat steps 2 through 14 and also refer to determination of Dimension "B", "Caliper, Disc, And Park Brake Installation", in Armature Speed Rear Disc Brakes section. Re-shim disc if necessary.
17. Condition park brake linings according to "Lining Conditioning" procedure before releasing truck to production.

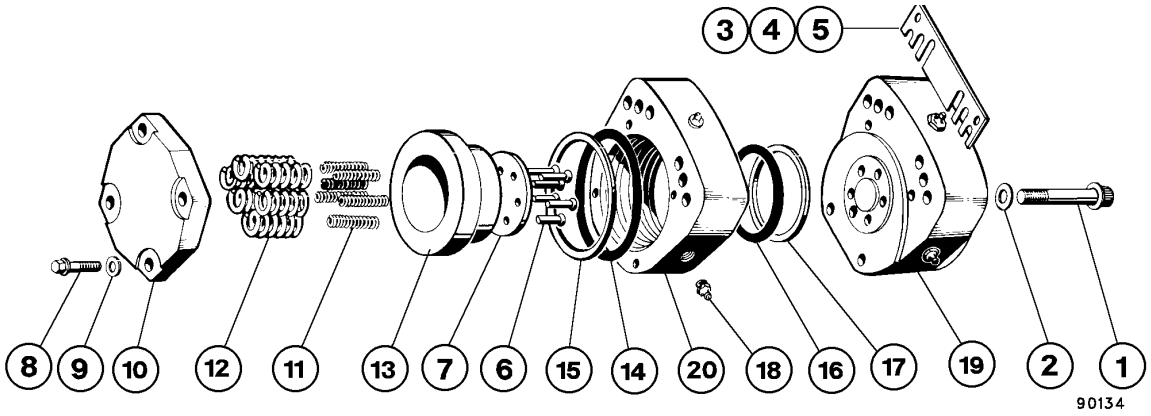


FIGURE 7-4. DISC PARKING BRAKE ASSEMBLY

1. 12 pt. Capscrew
2. Special Flatwasher
3. 0.060 in. Shim
4. 0.020 in. Shim
5. 0.030 in. Shim
6. Flat Head Screw
7. Carrier & Lining
8. 12 pt. Capscrew
9. Flatwasher
10. Cap
11. Spring
12. Compression Spring
13. Piston
14. Backing
15. Backup Ring
16. Packing
17. Backup Ring
18. Bleeder Screw
19. Piston Housing (Inboard)
20. Piston Housing (Outboard)

3. Inspect pistons (13) for scratches, nicks and other slight surface damage. Slight surface damage may be smoothed with fine crocus cloth.
4. Inspect piston housings (19 & 20) for cracks, breaks or surface damage. Use crocus cloth to smooth minor surface damage on sealing surfaces. Replace piston housings that are cracked or broken.
5. Check disc for wear and cracks. Replace if worn below 0.750 in. (19 mm) or cracked.
6. Check all bleeder screws (18) and fittings for thread damage. Replace damaged thread parts.
7. Replace all packings (14 & 16) and backup rings (15 & 17) at each overhaul.

Caliper Assembly

1. Thoroughly clean housings (19 & 20, Figure 7-4), caps (10) and piston (13). Lightly coat pistons (13) and housing (19 & 20) with clean hydraulic oil.

⚠CAUTION

Lubricating oil used must be of the same type as used in the Brake Circuit on the HAULPAK® truck.

2. Lubricate packings (14 & 16) and backup rings (15 & 17) with clean hydraulic oil.
3. Install packings (14 & 16) and backup rings (15 & 17) in grooves of housings (19 & 20) with rounded surfaces of backup rings against the packings and flat surface of backup rings against the piston housing as shown in Figure 7-5.

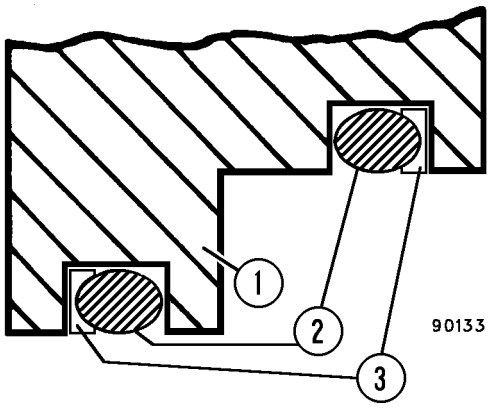


FIGURE 7-5. CORRECT INSTALLATION OF PACKINGS AND BACKUP RINGS IN PISTON HOUSING

1. Housing
2. Packing
3. Backup Ring

NOTE: Make sure packings and backup rings are properly seated in grooves before continuing assembly.

4. Install piston and lining assemblies (13 & 7, Figure 7-4) into housings (19 & 20), being careful not to damage packings. Make sure thread holes are free of lubricant, clean and dry.

AIR SYSTEM COMPONENT REPAIR

AIR COMPRESSOR SERVICE

The air compressor is a component of the engine assembly. Refer to the engine manufacturer's service manual for removal and repair instructions.

AIR DRYER/AFTERCOOLER

Due to several different customer options for Air Dryers and/or Aftercooler, service for this component is not covered in this section. When Aftercooler or Air Dryer service is required, refer to Section "M", Options and Accessories, in this manual.

SAFETY VALVE

⚠WARNING

Exhaust ALL air pressure from the main air tank PRIOR TO safety valve removal.

The Safety Valve can be disassembled, cleaned and assembled, but normal procedure is to replace the valve.

NOTE: Figure 3-1. may not represent the exact valve on the truck, but represents the internal working of most valves.

Operating Test

With air system fully charged 135 psi (930 kPa), test the safety valve to insure its operating capability. Pull out on the exposed end of the valve stem. This will relieve spring load on the ball valve and let it unseat. Air should exhaust from the valve when the valve stem is pulled out; if not, remove the safety valve and disassemble and clean or replace valve assembly.

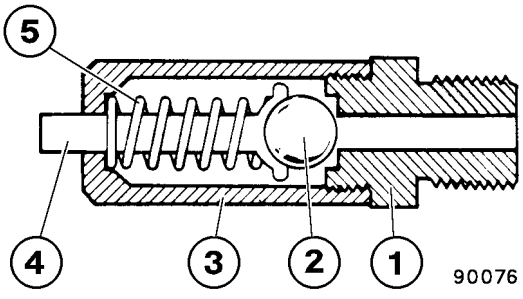


FIGURE 3-1. SAFETY VALVE

1. Body
2. Valve Ball
3. Spring Cage
4. Stem
5. Spring

AIR GOVERNOR

Disassembly

1. Loosen and remove top cover (17, Figure 3-2).
2. Remove the spring assembly retaining ring (12) and lift out spring assembly.
3. Remove locknut (10) and upper spring guide (9) from adjusting screw (11).
4. Remove pressure setting spring (7), spring guide (6) and spring guide (8) from adjusting screw.
5. Remove the exhaust stem (13) and its spring (14) from top of piston (3).

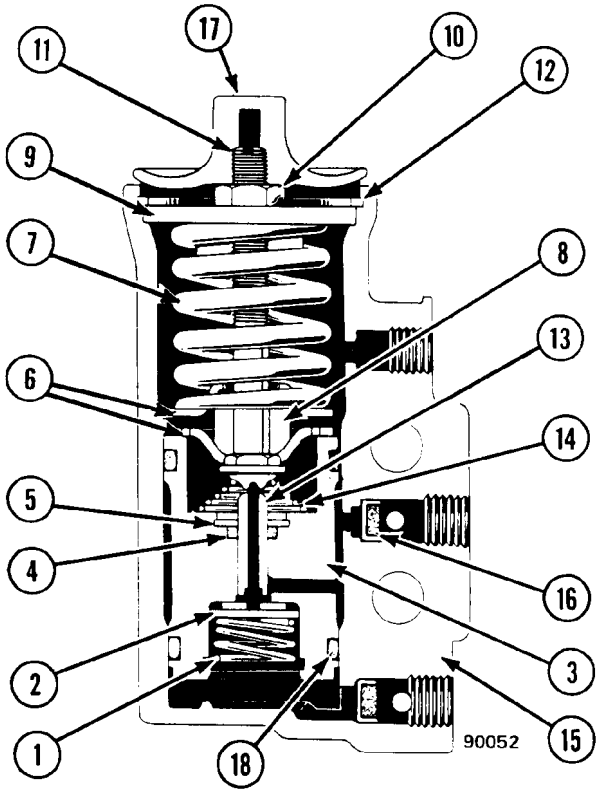


FIGURE 3-2. AIR GOVERNOR

1. Valve Spring
2. Inlet & Exhaust Valve
3. Piston
4. Grommet
5. Washer
6. Spring Guide (Lower)
7. Spring
8. Spring Guide
9. Spring Guide (Upper)
10. Locknut
11. Adjusting Screw
12. Retaining Ring
13. Exhaust Stem
14. Exhaust Stem Spring
15. Body
16. Filter
17. Cover
18. O-Ring

TROUBLESHOOTING CHART

POSSIBLE CAUSES	SUGGESTED CORRECTIVE ACTION
TROUBLE: Loss of Power	
Worn Motor Parts	Remove the motor from the Motor Housing (1, Figure 4-6) and disassemble the Motor. Examine all parts and replace any that are worn or damaged. Use the following guidelines for determining unserviceable parts. 1. Vanes (15) - Install a set of new vanes if any vane is cracked, spalled or worn to the extent that its width is 1.250 in. (32 mm) at either end. 2. Rotor Bearings (10 or 18) - Replace if any roughness or looseness is apparent. 3. Rotor (13) - Replace if the body has deep scoring that cannot be removed by polishing with emery cloth. 4. Cylinder (5) - Replace if there are any cracks or deep scoring. 5. End Plates (9 or 16) - Clean up scoring by rubbing it with emery cloth placed on a flat surface.
Inadequate Lubrication	Check the lubricator, inlet hose, fitting and oil supply hose to make sure they are vacuum tight and free of leaks. Tighten all joints and replace the lubricator if necessary.
TROUBLE: Air or Gas Leakage	
Worn Seals	Check the Motor Seals (8 or 31). Plug the exhaust. Apply 30 psi (207 kPa) air to the inlet and immerse the unit for 30 seconds in nonflammable solvent. If bubbles appear, replace the Seals.
TROUBLE: Pinion Does Not Engage the Flywheel	
Broken clutch jaws or other broken parts.	Repair Unit.
TROUBLE: Motor Runs, Pinion Engages but Does Not Rotate	
Broken shafting, gearing or clutch jaws.	Repair Unit.
TROUBLE: Harsh Engagement	
Dry Drive Pinion Spline	Remove the drive pinion (23) and lubricate the drive pinion and the drive shaft helical spline with grease.

3. Lubricate the steering pump spline shaft and align with coupling (9). Install hoist pump to steering pump and install capscrews (10) with hardened washers and tighten to standard torque. Raise pumps up into position.

4. Attach front support bracket to the "T" bracket and to the pump with capscrews, lockwashers and nuts. Tighten capscrews to standard torque.

5. Connect hoist pump drive flange with drive shaft with capscrews, lockwashers and nuts. Tighten to standard torque.

6. Tighten support bracket capscrew (on rear of steering pump) to standard torque.

7. Uncap inlet and outlet hoses and install to pumps using new O-rings. Tighten capscrews securely.

8. Service the hydraulic tank with C-4 type hydraulic fluid. Refer to Hydraulic Tank this section for filling instructions.

9. Open the three suction line shut-off valves (13 & 18, Figure 3-1). Loosen capscrews (at the pump) on suction hoses (12 & 16) to bleed trapped air. Then loosen capscrews (at the pump) on pressure hoses to bleed any trapped air. Tighten all capscrews securely.

10. Reconnect blower tube and install blower tube support strap.

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

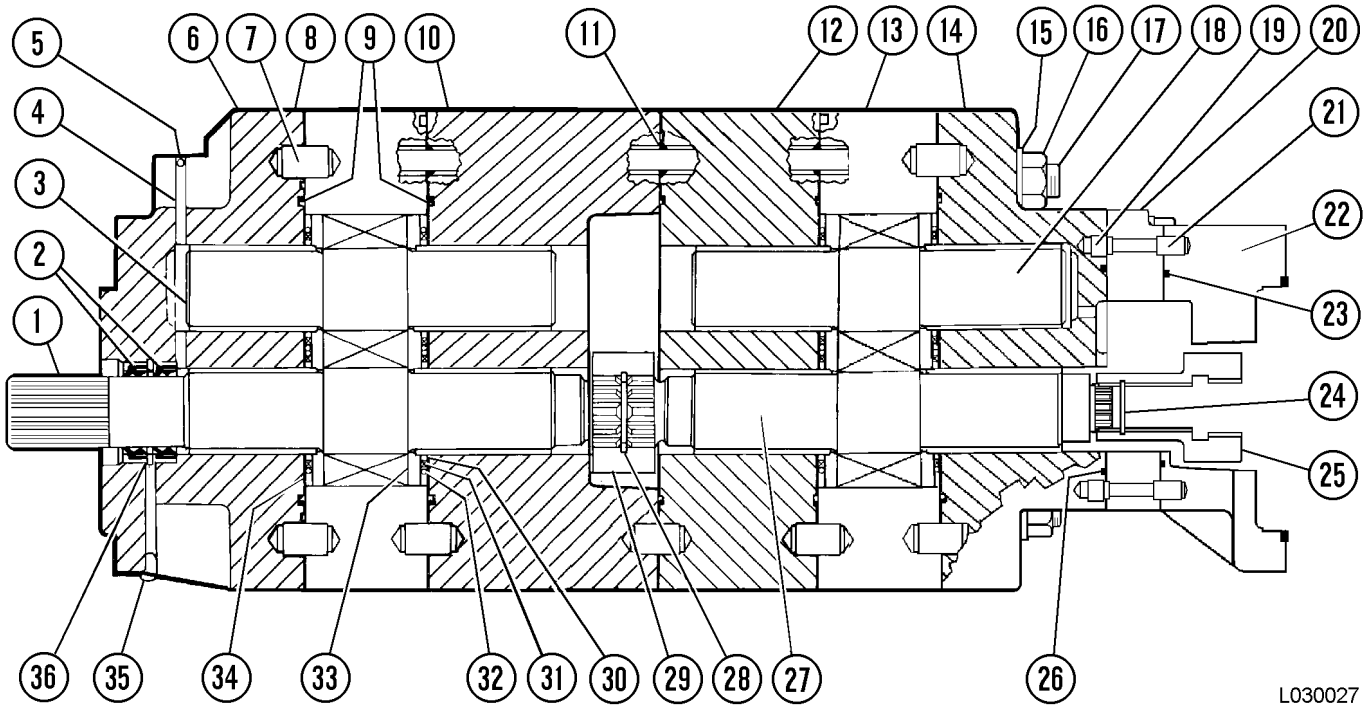


FIGURE 3-3. HOIST PUMP

1. Drive Gear & Shaft
2. Seal
3. Idler Gear
4. Stud
5. Steel Ball
6. Flange
7. Dowel
8. Gear Plate
9. O-ring
10. Connector Plate
11. O-ring
12. Bearing Plate
13. Gear Plate
14. Connector Plate
15. Washer
16. Nut
17. Stud
18. Idler Gear
19. Dowel
20. Bearing Plate
21. Dowel
22. Transition Plate
23. O-ring
24. Snap Ring
25. Coupler
26. O-ring
27. Drive Gear (Rear)
28. Snap Ring
29. Coupler
30. Steel Ring
31. Backup Ring
32. O-ring
33. Pressure Plate
34. Isolation Plate
35. Plug
36. Snap Ring

Installation

1. Install hydraulic tank and secure with capscrews and lockwashers. Tighten to standard torque.
2. Uncap hydraulic lines and attach to the proper connections.
3. Replace breather filters if required.
4. Fill the hydraulic tank with clean, filtered C-4 hydraulic oil. Refer to “Filling Instructions”.
5. Bleed all air from hydraulic lines.
6. Bleed trapped air inside steering pump. Refer to "Pump Pressure Setting", Section "L" for air bleeding procedure.

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

HYDRAULIC TANK STRAINERS

Removal

⚠WARNING

Prior to opening the hydraulic tank, allow at least 90 seconds for the accumulator to bleed down after engine shutdown with the key switch “Off”.

1. Shut down the engine and the key switch “Off” for at least 90 seconds.

NOTE: If the oil is to be reused, clean containers must be used with a filtering (3-micron) system available for refill.

2. Be prepared to contain approximately 230 gal. (870 l) of hydraulic oil. Drain hydraulic oil from tank.
3. Disconnect pump suction hoses. (4, Figure 3-18).
4. Remove capscrews and lockwashers (2) securing cover (5) to the hydraulic tank. Remove and discard gasket.
5. Remove capscrews and lockwashers securing suction strainers. Remove suction strainers.

Inspect and Clean

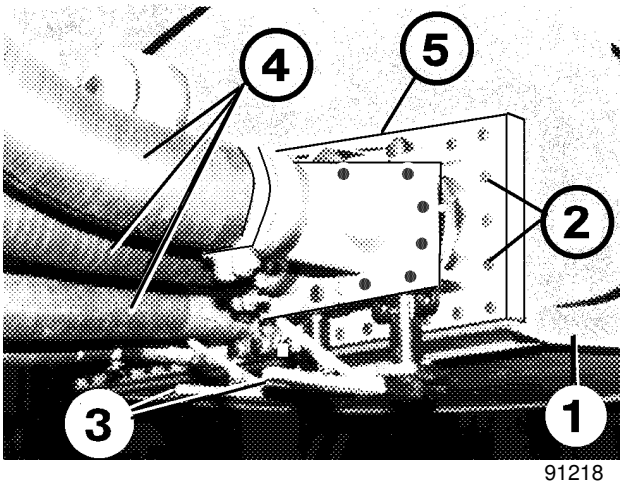
NOTE: Inspect the strainers thoroughly for metallic particles and varnish build up (if oil has been overheated). The quantity and size of any particles may be an indication of excessive wear of components in the hydraulic system.

1. Clean the strainers with fresh cleaning solvent from the inside out.
2. Inspect the strainers for cracks or wear. Replace, if necessary.
3. Clean any sediment from bottom of hydraulic tank.

Installation

1. Install suction strainers and secure in place with capscrews and lockwashers. Tighten capscrews to standard torque.
2. Using new cover gasket move cover into place and install capscrews and lockwashers. Tighten capscrews to standard torque.
3. Fill the hydraulic tank, refer to Hydraulic Tank Filling Instructions. Open both suction line shutoff valves.
5. Loosen suction line connections at both pumps to bleed any trapped air. Tighten hose connections.
6. Bleed trapped air inside steering pump. Refer to "Pump Pressure Setting", Section "L" for air bleeding procedure.

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



91218

FIGURE 3-18. STRAINER REMOVAL

1. Hydraulic Tank
2. Capscrews & Lockwashers
3. Shutoff Valve
4. Pump Inlet Lines
5. Cover

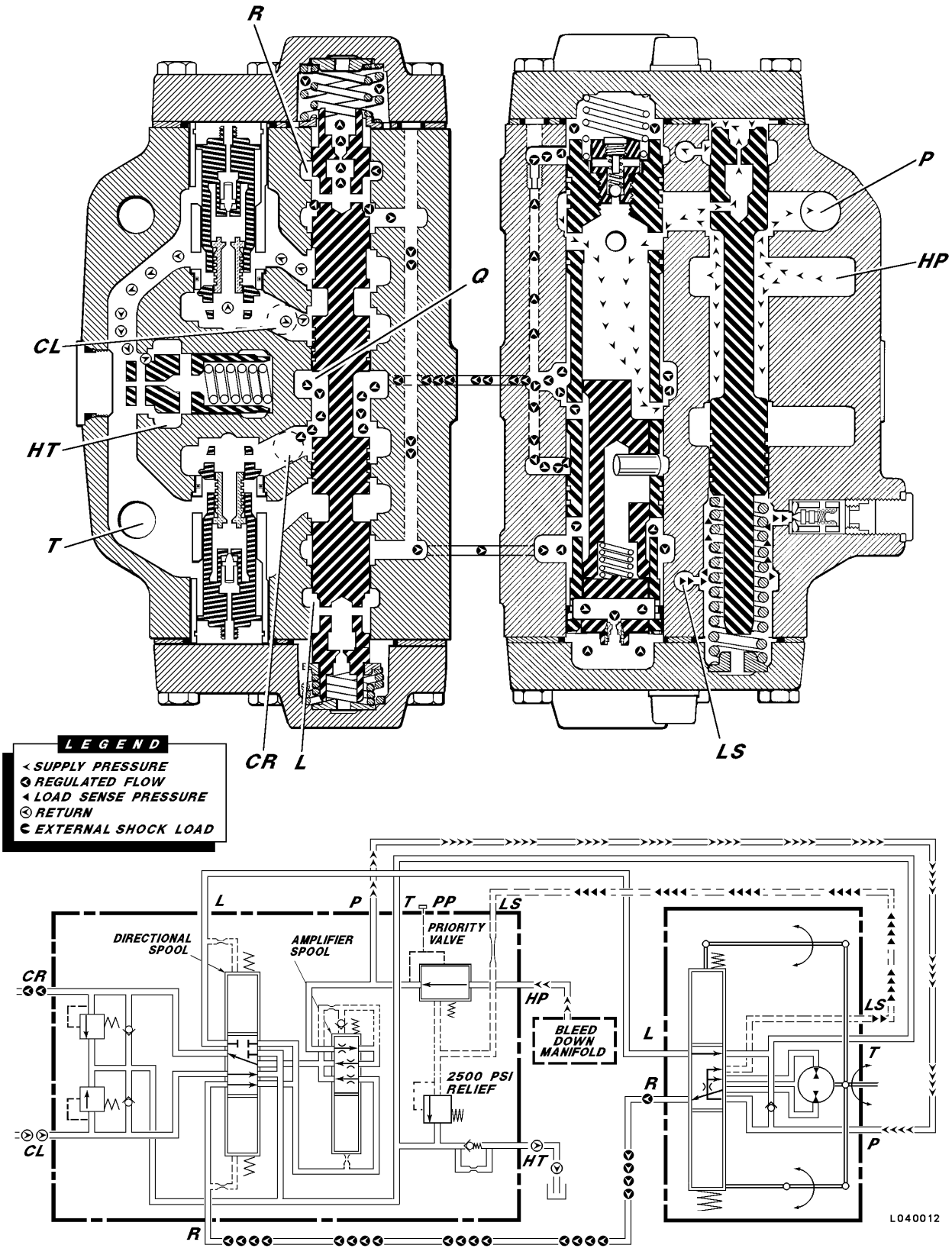


FIGURE 4-5. FLOW AMPLIFIER
(Steering Right)

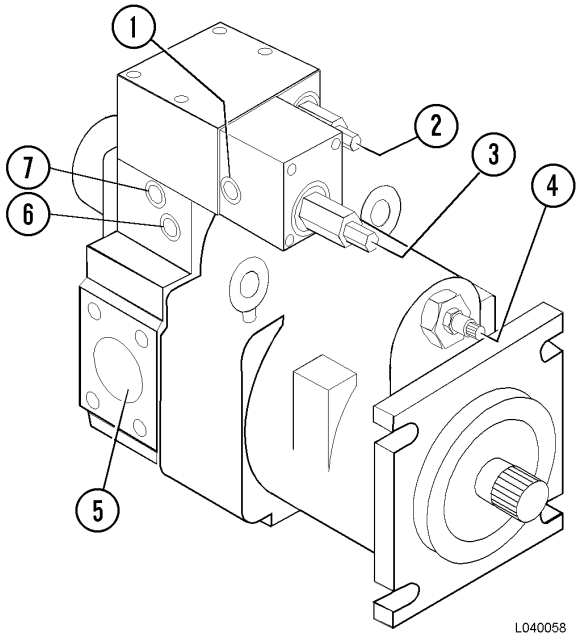


FIGURE 4-18. STEERING PUMP

1. Accumulator Connection
2. Pressure Compensator Adjuster
3. Unloader Adjuster
4. Stroke Adjuster
5. Pressure Port

Steering Pump

Figure 4-18 shows the location of various steering pump components. Figure 4-19 shows the schematic view of the steering pump.

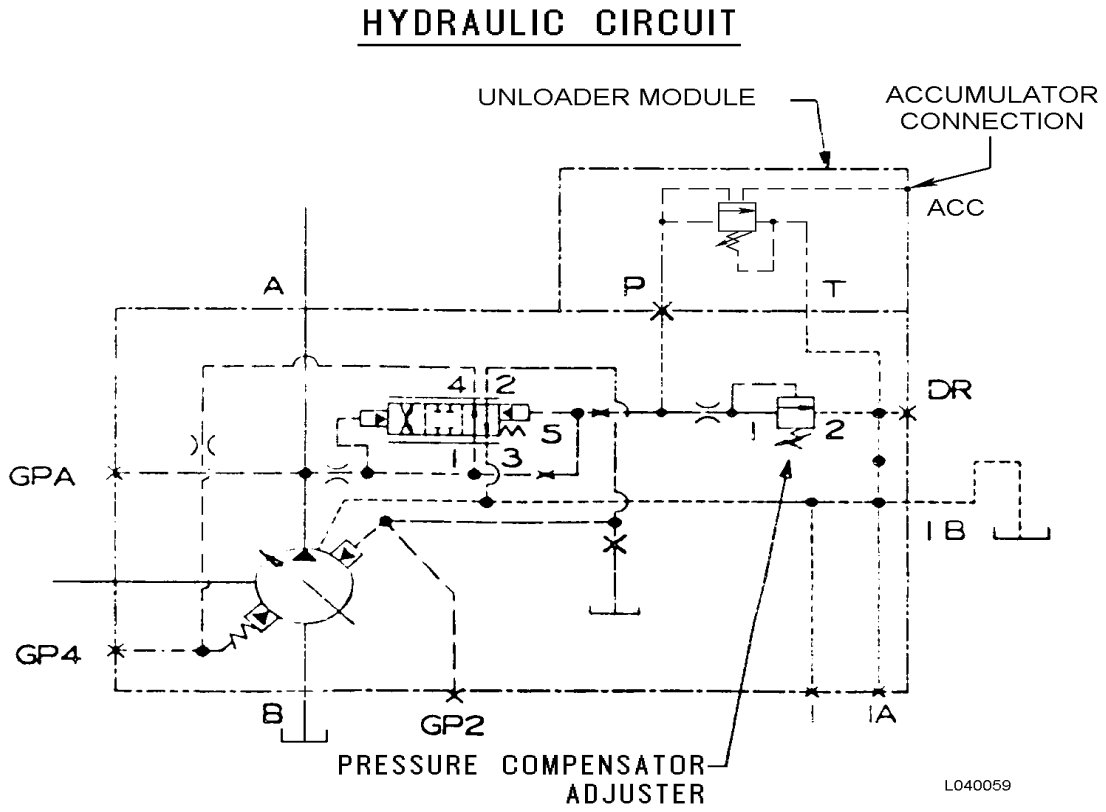


FIGURE 4-19. SCHEMATIC OF STEERING PUMP

Reassembly

1. Thoroughly lubricate each part prior to installation using clean, type C-3 hydraulic oil.
2. Reassemble the Amplifier spool assembly in reverse order. Refer to steps 12 & 13, and Figure 5-7 under disassembly.
3. Install orifice screw (13, Figure 5-5). Tighten orifice screw to **4 in. lbs. (.5 N.m)**. Install check valve (54). Tighten check valve to **8 in. lbs. (1 N.m).** Install orifice screw (53). Tighten orifice screw to **8 in. lbs. (1 N.m).**
4. Install seal (21). Install relief valve assembly (20), seal (5), and plug (20). Tighten plug to **22 in. lbs. (2.5 N.m).**
5. Install counterpressure valve assembly (15). Install plug (17) using new O-ring (16).
6. Install both shock and suction valves (12 & 28) as complete units. Install spring stop (22) springs (23 & 24) and spring control (25). Install orifice screws (26 & 35) if removed from main spool (29). Install main spool (29).
7. Install amplifier spool assembly (51). Install priority valve spool (43) and spring (42). Install spring (55).
8. Install spring control (31), springs (32 & 33) and spring stop (34).
9. Lubricate O-rings (6, 7 & 8) with molycote grease and position on cover (5) with seal plate (9). Install end cover (5). Install capscrews (3) with lockwashers (4). Tighten capscrews to **2 ft. lbs. (2.5 N.m)**. Install capscrew (1) and lockwasher (2). Tighten capscrew to **6 ft. lbs. (8 N.m)**.
10. Lubricate O-rings (40 & 49) with molycote grease and install on cover (47). Position seal plate (5) on end cover. Install end cover (47). Install capscrews (36) with lockwashers (39). Tighten capscrews to **2 ft. lbs. (2.5 N.m)**. Install capscrew (37) with lockwasher (38). Tighten capscrew to **6 ft. lbs. (8 N.m).**
11. To help prevent contamination, fit plastic plugs to each valve port.

STEERING AND BRAKE PUMP

Removal

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

⚠WARNING

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

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

1. Turn keyswitch "Off" and allow 90 seconds for the accumulator to bleed down. Turn the steering wheel to be sure no oil remains under pressure.

NOTE: If oil in the hydraulic tank has not been contaminated, the shut-off valve between the tank and steering pump can be closed, eliminating the need to completely drain the tank.

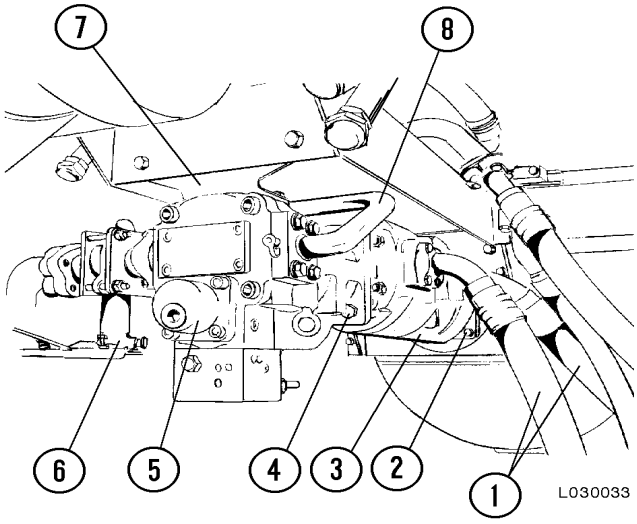


FIGURE 5-25. STEERING PUMP REMOVAL

1. Hoist Pump Outlet Hoses
2. Pump Mount Capscrews
3. Hoist Pump
4. Pump Mount Capscrews
5. Steering/Brake Pump
6. Shut-Off Valve
7. Pump Mount Bracket
8. Outlet Tube

2. Drain the hydraulic tank by use of the drain located on the bottom side of the tank.

NOTE: Be prepared to contain approximately 238 gal. (901 L) of hydraulic oil.
If the oil is to be reused, clean containers must be used with a 3 micron filtering system available for refill.

3. Disconnect the suction and discharge lines at the steering pump. Disconnect and cap pump case drain line from fitting at top of pump housing. Plug all lines to prevent oil contamination.

⚠CAUTION

The steering pump weighs approximately 250 lbs (113 kgs). Use a suitable lifting device capable of handling the load safely.

4. Support the steering pump and the rear section of the hoist pump. Remove mounting capscrews and rear support bracket. Remove the four pump mounting capscrews.
5. Move the steering pump rearward to disengage the drive coupler splines fromt the hoist pump and remove pump.
6. Clean exterior of steering pump.
7. Move the steering pump to a clean work area for disassembly.

Installation

1. Install a new O-ring on pump mounting flange.
2. Make sure the steering pump spline coupler is in place (inside hoist pump) prior to steering pump installation.

⚠CAUTION

The steering pump weighs approximately 250 lbs (113 kgs). Use a suitable lifting device capable of handling the load safely.

3. Move the steering pump into position. Engage steering pump shaft with hoist pump spline coupler.

45. Install O-rings (26, 27 and 28) in proper location on top of valve plate. Install block (13) to valve plate with capscrew (9) and tighten securely.

46. Install 4-way valve (8), and relief valve (14).

47. Install 0.062 in. (1.575 mm) diameter orifice (30) and plug (7) with new o-ring (6) in side of compensator block as shown in Figure 5-28. Install 0.032 in. (0.813 mm) diameter orifice (10), plug (7) and o-ring (6) in top of block.

48. Install remaining plugs with new o-rings.

49. Install unloader module (29) on compensator block with new o-rings (25) and socket head capscrews (31). Tighten capscrews to **87 in. lbs. (9.8 N.m) torque**.

50. Install plugs (9 & 23, Figure 5-26) and o-rings (10 & 15) in pump housing.

51. Measure pump rotation torque. Rotation torque should be approximately 15 ft. lbs. (20.4 N.m).

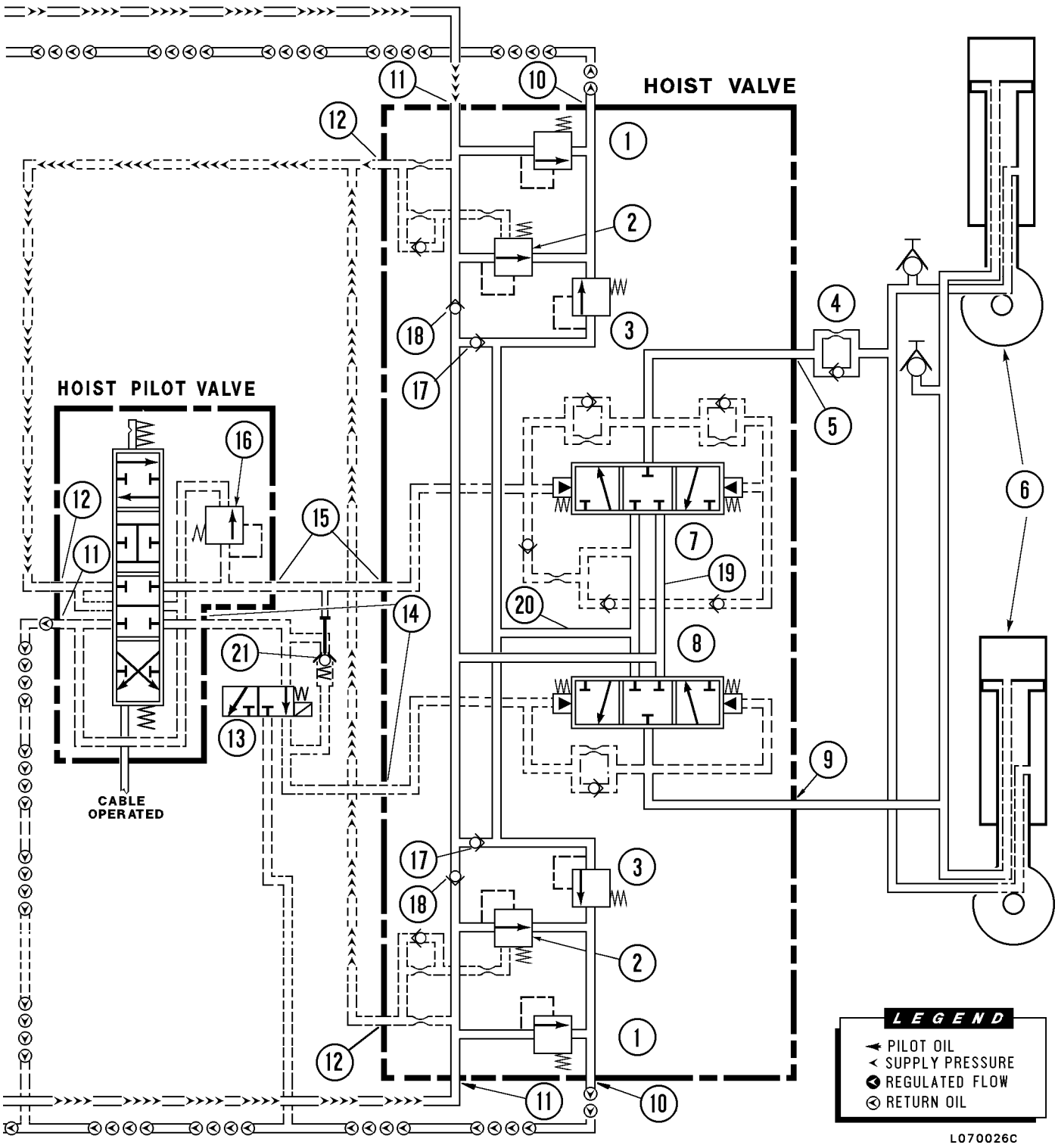


FIGURE 7-6. HOLD POSITION

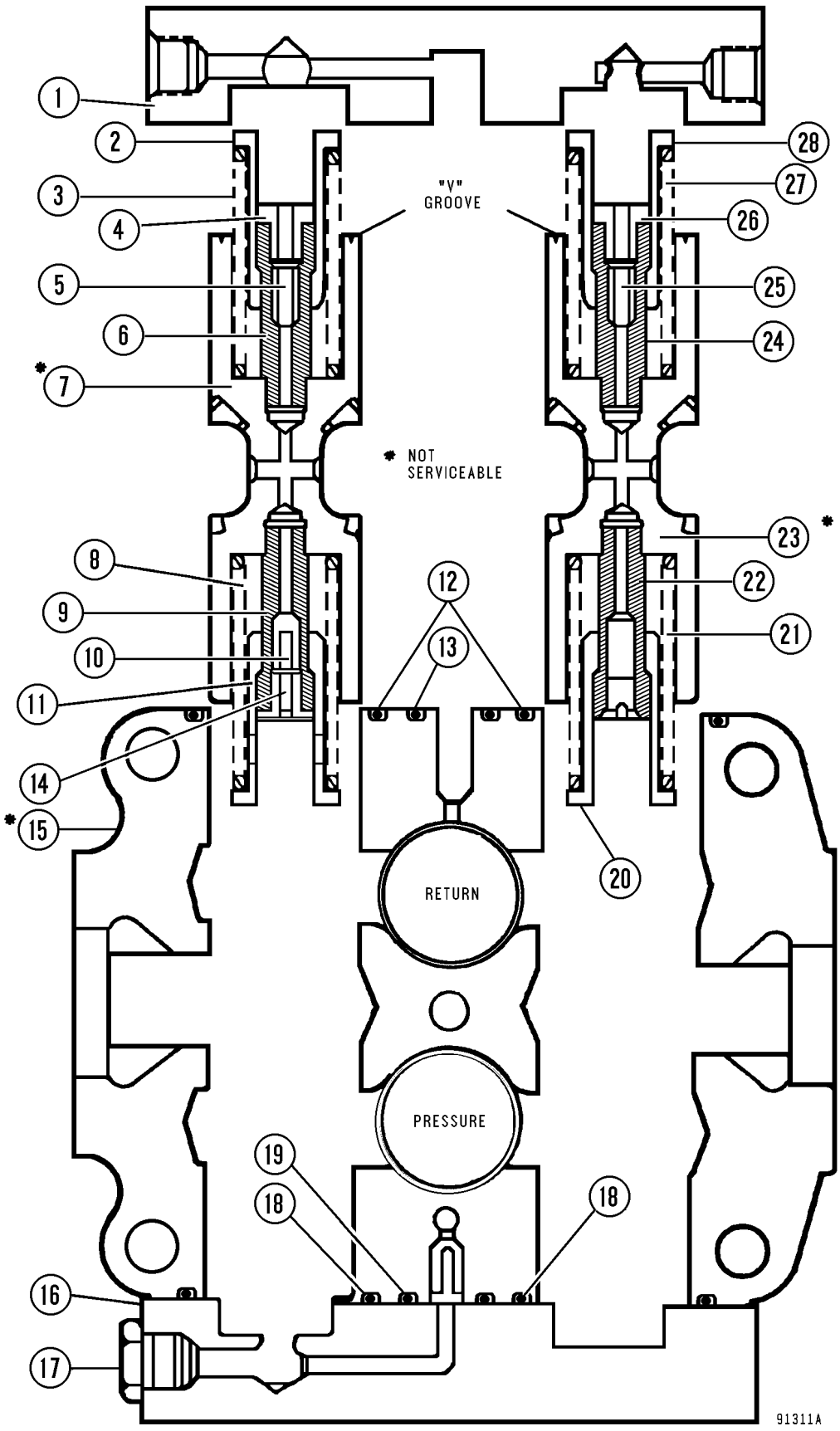


FIGURE 8-10. SPOOL SECTION ASSEMBLY

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

ASSEMBLY OF QUILL AND CYLINDER

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

Quill Installation

1. The plugs (3, Figure 8-20) and the check balls (4) in the quill should be checked during any cylinder repair to insure the plugs are tight and ball seats are not damaged. Refer to "Installation of Check Balls and Plugs in Quill".
2. Secure cap assembly (1) in a sturdy fixture. Make certain threads in cap and threads on quill are clean and dry (free of oil and solvent).
3. Using Loctite "LOCQUIC" Primer "T" (TL8753, or equivalent), spray mating threads of both cap assembly (1) and quill assembly (2). Allow primer to dry 3 to 5 minutes.
4. Apply Loctite Sealant # 277 (VJ6863, or equivalent) to mating threads of both cap assembly and quill assembly.
5. Install quill and use SS1143 tool to tighten quill to **1000 ft. lbs. (1356 N.m)** torque. Allow parts to cure for 2* hours before exposing threaded areas to oil.

* Note: If "LOCQUIC" primer "T" (TL8753) was not used, the cure time will require 24 hours instead of 2 hours.

6. Tack weld quill in 2 places as shown in Figure 8-20.
7. Remove all slag and foreign material from tack weld area before assembly of cylinder.

During future cylinder rebuilds, removal of the quill will not be necessary, unless it has loosened or is damaged. Removal, if necessary, will require a break-loose force of at least **2000 ft. lbs. (2712 N.m) torque** after the tack welds are ground off.

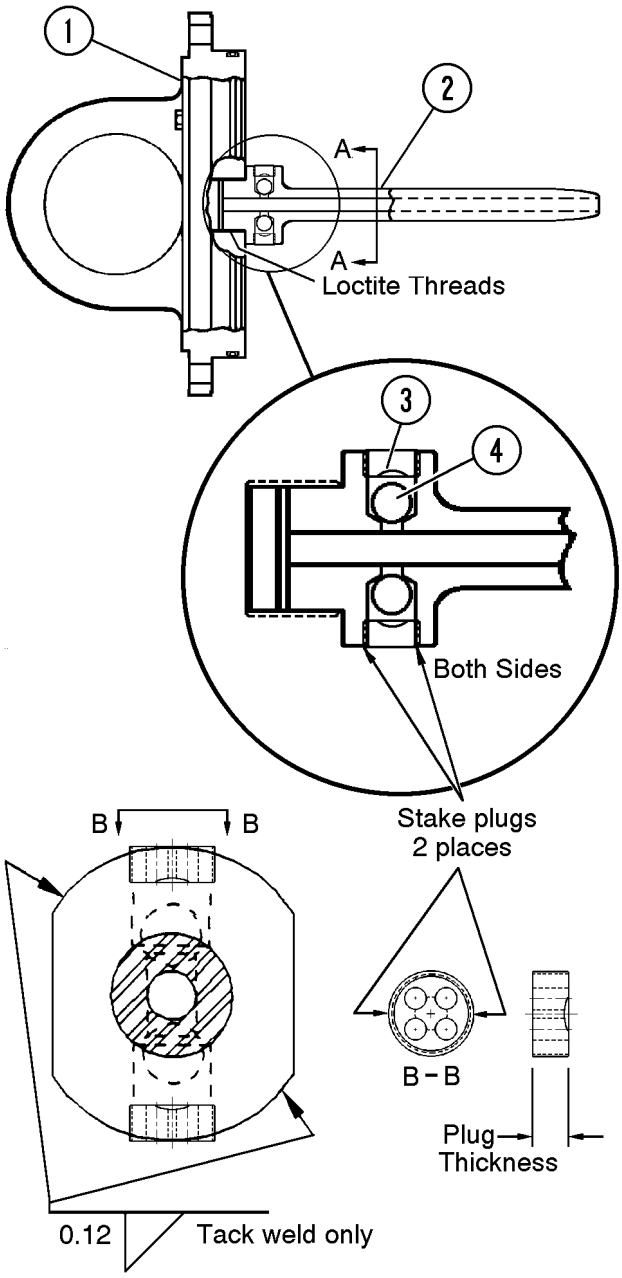


FIGURE 8-20. PLUG and CHECK BALL INSTALLATION

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

POSSIBLE CAUSES	SUGGESTED CORRECTIVE ACTION
TROUBLE: Erratic Steering	
Air in system due to low oil level, cavitating pump, leaky fittings, pinched hose, etc.	Correct condition and add oil as necessary.
Loose cylinder piston.	Replace cylinder.
TROUBLE: Free Wheeling - Steering Wheel Turns Freely with No Back Pressure or No Action of the Front Wheels	
Lower splines of column may be disengaged or damaged.	Repair or replace steering column.
No flow to steering valve can be caused by: 1. Low oil level 2. Ruptured hose 3. Broken cardan shaft pin (steering valve)	 1. Add oil and check for leakage 2. Replace hose 3. Replace pin
TROUBLE: Excessive Free Play at Steered Wheels	
Broken or worn linkage between cylinder and steered wheels.	Check for loose fitting bearings at anchor points in steering linkage between cylinder and steered wheels.
Leaky cylinder seals.	Replace cylinder seals.
TROUBLE: Binding or Poor Centering of Steered Wheels	
Binding or misalignment in steering column or splined column or splined input connection.	Align column pilot and spline to steering control valve.
High back pressure in tank can cause slow return to center. Should not exceed 300 psi (2068 kPa).	Reduce restriction in the lines or circuit by removing obstruction or pinched lines, etc.
Large particles can cause binding between the spool and sleeve.	Clean the steering control valve. If another component has malfunctioned generating contaminating materials, flush the entire hydraulic system.
TROUBLE: Steering Control Valve Locks Up	
Large particles in spool section.	Clean the steering control valve.
Insufficient hydraulic power.	Check hydraulic oil supply.
Severe wear and/or broken cardan shaft pin.	Replace pin or the steering control valve.

HYDRAULIC SYSTEM FLUSHING PROCEDURE

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

1. Shut down engine and turn key switch "Off". Allow at least 90 seconds for the accumulator to bleed down.
2. Thoroughly clean the exterior of the tank. Be prepared to contain approximately 238 gal. (901 l) of hydraulic oil. Drain the hydraulic tank and flush the interior of hydraulic tank with a cleaning solvent. Inspect all hydraulic hoses for deterioration or damage.
3. Remove, clean and replace the hydraulic tank strainers. Change both hydraulic filter elements, and also high pressure steering filter element.

NOTE: The final filter in the filling apparatus must be 3 micron.

4. Fill the hydraulic tank with clean, Type C-4 hydraulic oil.
5. Bleed trapped air inside steering pump. Refer to "Pump Pressure Setting", Section "L" for air bleeding procedure.

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

6. Set all controls in the "Neutral" position. Do not steer the truck or operate controls until the next step is completed.
7. Start the engine and run at 1000 RPM for five minutes. This will circulate oil with all valves in the neutral position.
8. To increase flow and turbulence in the system, increase engine speed to full throttle and maintain for four minutes. This will circulate oil with all valves in the neutral position.
9. Shut down engine and turn key switch "Off". Allow at least 90 seconds for the accumulator to bleed down. This will return all contaminants to the hydraulic tank.

NOTE: Hydraulic tank oil temperature should be 110°-130°F (43°- 54°C) after accomplishing Step 13. If not, repeat Step 11 to increase oil temperature to the proper operating range.

10. To be able to fully extend the hoist cylinders in the following procedure, disconnect hoist limit solenoid in brake cabinet behind cab.
11. Restart engine and run at 1000 RPM while performing the following:
    a. Steer truck full left then full right - repeat four times.
    b. Steer full left (keeping pressure against the steering wheel) and hold for 10 seconds.
    c. Steer full right (keeping pressure against the steering wheel) and hold for 10 seconds.
12. Increase engine speed to full throttle and steer full left and full right.
13. Return all controls to "Neutral".

⚠WARNING

Be certain that their is enough clearance from power lines, ceiling or any other structures that will allow raising the body to the full up position without hitting anything.

14. Reduce engine speed to 1000 RPM and perform the following:
    a. Extend hoist cylinders fully and "FLOAT" down - repeat four times.
    b. Extend hoist cylinders and hold at full extension for 10 seconds. Hoist control lever must be held in the power up position.
    c. Lower hoist cylinders and hold lever in power down position for 10 seconds after cylinders are fully retracted.
15. Increase engine speed to full throttle and perform the following:
    a. Hoist up to full extension, hold for 10 seconds, then allow cylinders to float down.
16. Return hoist control to "Neutral".
17. Shut down engine and turn key switch "Off". Allow at least 90 seconds for the accumulator to bleed down.
18. Reconnect hoist limit solenoid in brake cabinet.
19. Close both hoist pump suction line shut-off valves. Close steering pump suction line shut-off valve.
20. Remove hoist & steering filter elements. Clean housings and install new elements.
21. Fill hydraulic tank if necessary.
22. Open all (three) suction line shut-off valves. Bleed all air from pump suction lines and steering pump before starting engine. Refer to "Pump Pressure Setting", Section "L" for air bleeding procedure.

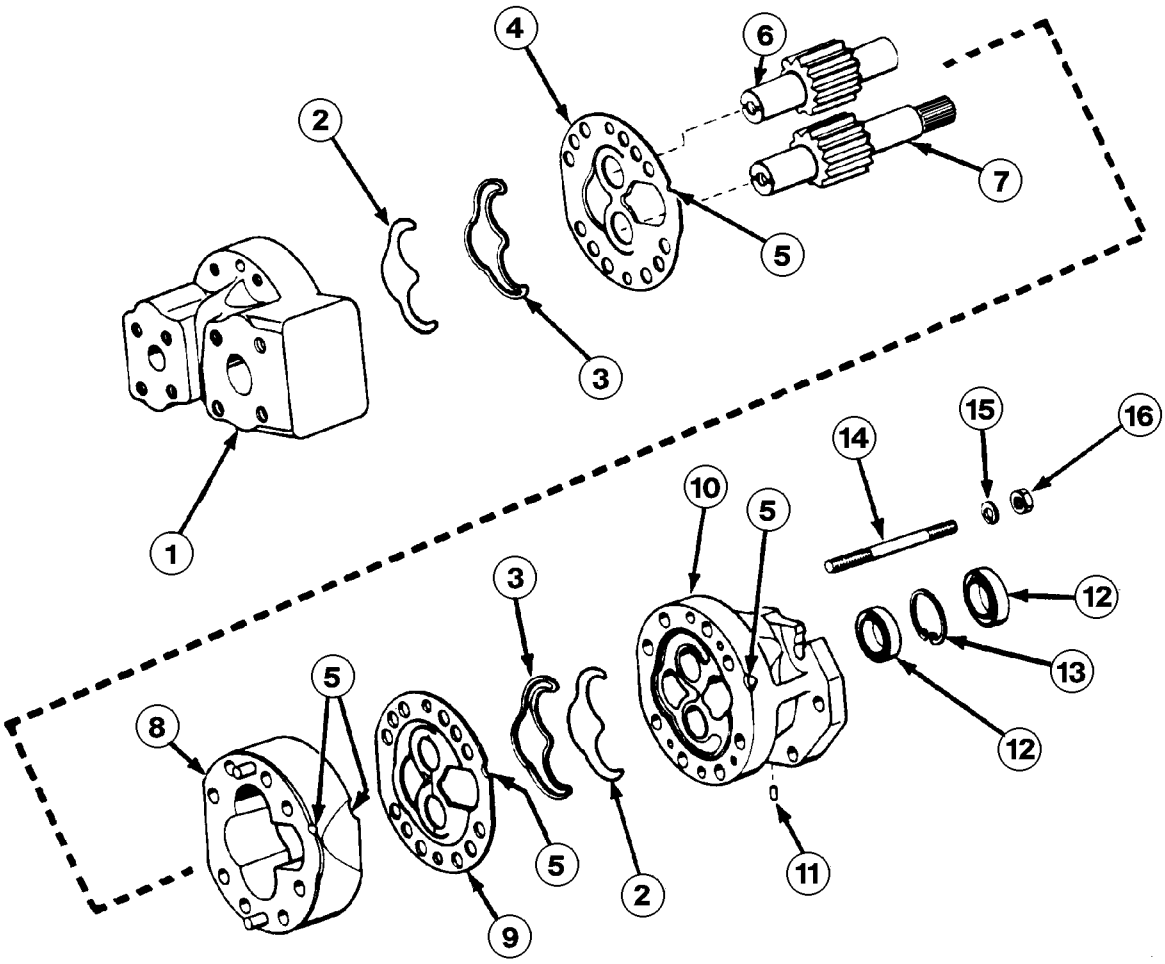


FIGURE 4-2. HYDRAULIC PUMP

1. Rear Cover
2. Seal
3. Seal Retainer
4. Rear Wear Plate
5. Notch
6. Driver Gear
7. Drive Gear
8. Center Section
9. Front Wear Plate
10. Front Cover
10. Plug
10. Shaft Seal
10. Snap Ring
10. Stud
10. Lockwasher
10. Nut

Inspection

a. Inspect wear plate for scoring and erosion.

b. Inspect gears for wear.

c. Inspect center section for scoring and scratches.

d. Check all bushings for scoring.

e. If any damage is found to these components, replace pump assembly. Only seals are available for pump repair.

Assembly

1. Install seal retainer (3) and seal gland (2), flat side of seal retainer against wear plate face (4).
2. Install wear plate (4) on rear cover, bronze side toward gears.
3. Position center section on rear cover wear plate.
4. Install idler and drive gears (6 & 7).
5. Install front wear plate (9), bronze against gears. Install seal retainer (3) and seal gland (2).

BUCKEYE QUICK FUEL SYSTEM

FUEL TANK BREATHER VALVE

Maintenance

Normal maintenance involves cleaning or replacement of the breather valve filter during 1000 hour servicing. Operation in extremely dusty conditions may require more frequent cleaning or replacement intervals.

Filter Service

1. Remove three cap screws (7, Figure 5-1) on vent housing.
2. Remove housing (1) and filter (3).
3. Clean the filter in solvent and blow dry with compressed air.
4. Inspect filter for damage and replace if necessary.
5. Install filter on seat (6).
6. Inspect the housing O-ring seal (8) and replace if necessary.
7. Install the housing and secure in place with cap screws (7).

Disassembly

1. Remove breather valve assembly from the fuel tank. (Refer to Figure 5-2.)
2. Loosen three cap screws (7, Figure 5-1) and remove vent housing (1).
3. Remove filter (3).
4. Compress the spring (12, Figure 5-1) and remove the cotter pin (17).
5. Remove the retaining washer (16), spring and balls (13, 14, and 15).

Inspection

1. Inspect filter and clean or replace as required.
2. Clean all parts thoroughly and inspect for damage.

Assembly

1. Assemble using new O-ring seals.
2. Install filter (3) and housing (1).
3. Insert balls in order as shown in Figure 5-1.
   a. Install aluminum ball.
   b. Install plastic ball.
   c. Install steel ball.
4. Insert spring (12) and retaining washer (16). Compress spring to insert cotter pin (17).
5. Install assembly in fuel tank.

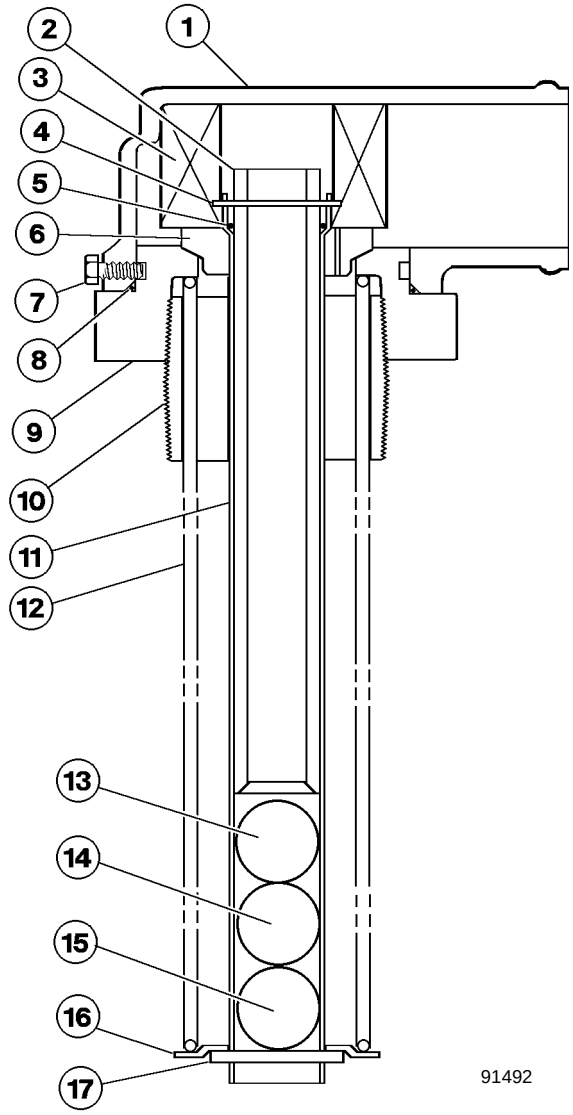


FIGURE 5-1. FUEL TANK BREATHER VALVE

1. Vent Housing
2. Inner Tube
3. Filter
4. Cotter Pin
5. O-ring
6. Seat
7. Cap Screw
8. O-ring
9. Vent Base
10. Nipple
11. Outer Tube
12. Spring
13. Aluminum Ball
14. Plastic Ball
15. Steel Ball
16. Retaining Washer
17. Cotter Pin

NOTE: At any point in the thermal sensor operating range the increasing fan speed may draw sufficient air to arrest and stabilize engine temperature. If this occurs, control pressure to the fan clutch will stop increasing (will stabilize) and will not increase or decrease until a change in engine temperature occurs.

a. As engine temperature decreases through the range of the thermal sensor, control pressure should smoothly decrease. Fan speed should smoothly decrease to idle. Control pressure must reach less than 8 psi (55KPa) when coolant temperature has decreased to the lower limit of the thermal sensor operating range.

NOTE: Engine temperature may stabilize at any temperature during a "cool down" cycle as explained in above.

If the thermal sensor does not perform as described in 2.a and 2.b above, replace the thermal sensor. The thermal sensor cannot be repaired or calibrated.

Off Truck Test

Test Conditions and Requirements:

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

TEST:

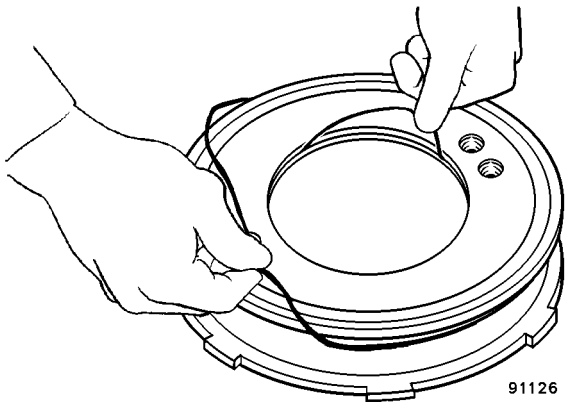
1. Set up equipment per figure 6-7.
2. Heat the water gradually.
3. Read temperature vs. voltage vs. pressure out of solenoid.
4. Refer to operating temperature range tag on the thermal sensor and chart below for conditions and proper operation.

THERMAL SENSOR AND SOLENOID TEST SPECIFICATIONS

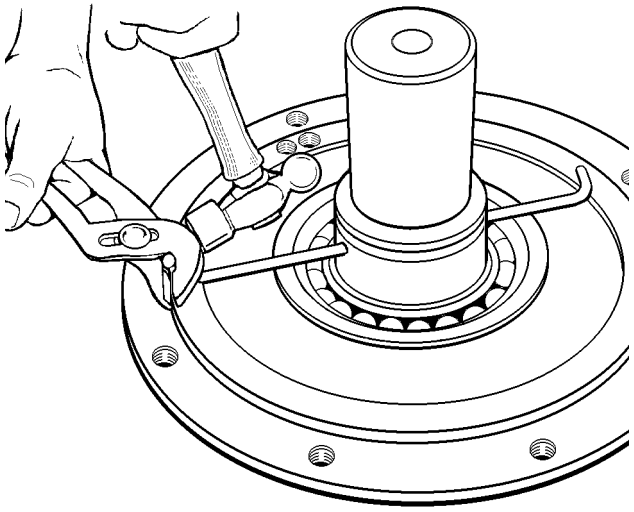
TEST CONDITION	SENSOR VOLTAGE	SOLENOID PRESSURE
Temperature Below Thermal Sensor Operating Range	+24 VDC	0.0 psi (0.0 kPa)(1)
Temperature Within Thermal Sensor Operating Range	+24 VDC - 0.0 VDC(2)	0.0 - Max.psi (0.0 - Max. kPa)(1)
Temperature Above Thermal Sensor Operating Range	0.0 VDC	Max. Supplied Pressure

NOTE 1: Actual 0.0 psi will not be attained if tested under normal operating conditions (connected to a fan clutch). 0.0 - 8.0 psi (0.0 - 55 kPa) internal clutch pressure will read on the gauge.

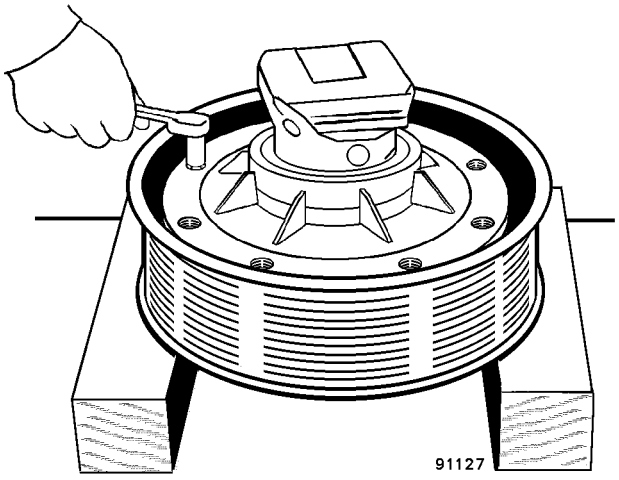
NOTE 2: As water temperature increases or decreases within the temperature range of the thermal sensor, voltage output from the thermal sensor and pressure output from solenoid valve should also increase or decrease (although not in direct proportion). An increase in water temperature produces an increase in voltage output and a decrease in pressure.



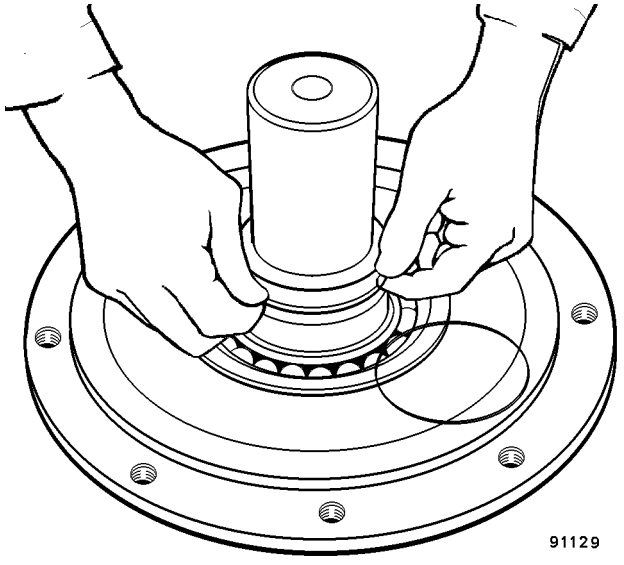
17. Remove the seal rings (18 and 26) from the piston.



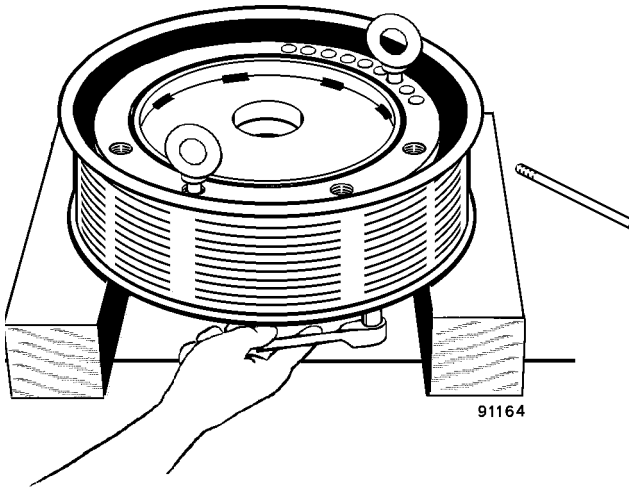
19. Remove the shaft and rest it on the mounting bracket with the nose up. Insert a phillips-head screwdriver into the pitot tubes (33) to loosen and remove them from the shaft. Rotate the pitot tube until the sealant holding it tight is broken loose. Then, grip the pitot tube with a pair of pliers, and gently tap on the pliers to remove the pitot tubes from the hole in the shaft.



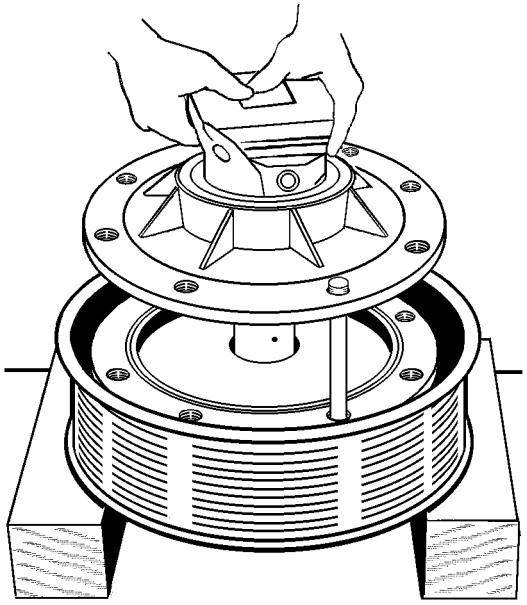
18. Support beneath the pulley to prevent it from dropping to the bench. Remove bolts (21) with lockwashers (20). The pulley should not be allowed to drop to the bench when the supports are removed, but if it is not free of the bearing retainer, stand the unit on the bench resting on the nose of the shaft. Rap the pulley with a soft, but heavy mallet to break it loose from the rear bearing retainer.



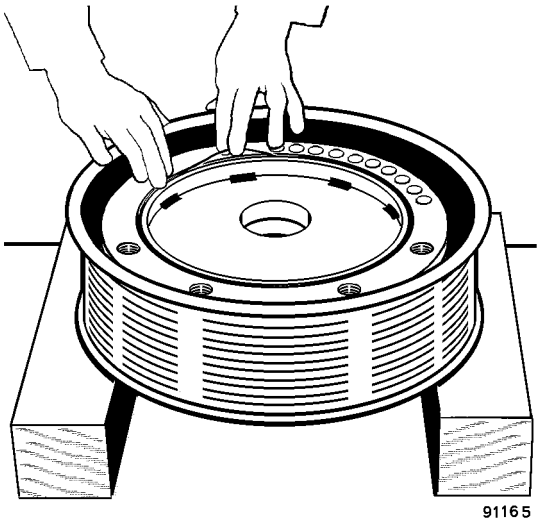
20. Remove both seal rings (32).



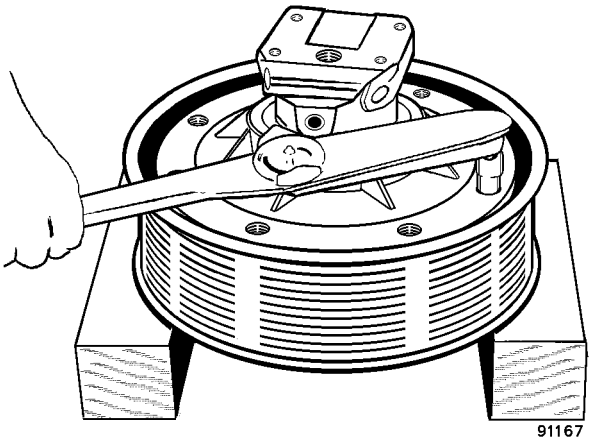
56. Install and snug 3 or 4 bolts (14) with lockwashers (15).



58. Lubricate the bore of the pulley, and carefully lower the shaft sub-assembly into the pulley bore and onto the pulley until the retainer rests on the pulley.



57. Using petroleum jelly or an oil-soluble grease, "stick" the rear O-Ring seal (22) in the pulley groove.



59. Install bolts (21) with lockwashers (20), and torque each one to **38-42 ft. lbs. (5-57 N-m)**.

ENGINE COOLANT HEATER

To aid in cold weather starting, the truck can be equipped with cooling system heaters. Two high capacity coolant heating units are mounted under the engine on the power module subframe. The system includes:

- Heaters
- Thermostats
- Coolant Shutoff Valves and Hoses
- 220 volt Receptacle
- Power Cables, Thermostat Wiring, and Junction Box

Heater operation is controlled by a thermostat mounted on the intake end of the heating units. The thermostat turns the heater ON at 120°F (48°C) and OFF at 140°F (60°C). Shutoff valves allow heater element or thermostat sensor replacement without loss of engine coolant.

⚠CAUTION

Do not operate engine while the cooling system heater is plugged in. The flow check valve eliminates coolant flow through the heater while the engine is running. This will cause a lack of circulation in the heater and burn out the heating elements.

Maintenance

To check for operation of the heating units, the outlet water hoses should feel warm to the touch.

1. Check all electrical connections to insure proper connections are made.
2. Check for a burned out heating element. (Do not remove heating unit from the truck.)
   a. Remove the two Phillips head screws and slide end cover out of the way.
   b. Connect a voltmeter at the two electrical terminals and check for operating voltage (220 to 230 volts) while coolant temperature is below 120°F (48°C). If correct voltage is present, the heating element is defective and should be replaced.
3. If correct voltage (measured above) is not read at heating element terminals, the thermostat is defective and should be replaced.

HEATING ELEMENT

Removal

1. Disconnect the external power source at the plug-in receptacle.
2. Close the shut-off valves located at the inlet and outlet ports.
3. Remove heating element.
   a. Remove the two Phillips head screws from cover at power cable entry. Slide cover out of the way.
   b. Disconnect the two electrical leads and remove heating element from the cartridge.

Installation

1. Install new heating element.
   a. Cover the new heating element threads with an anti-seize thread compound.

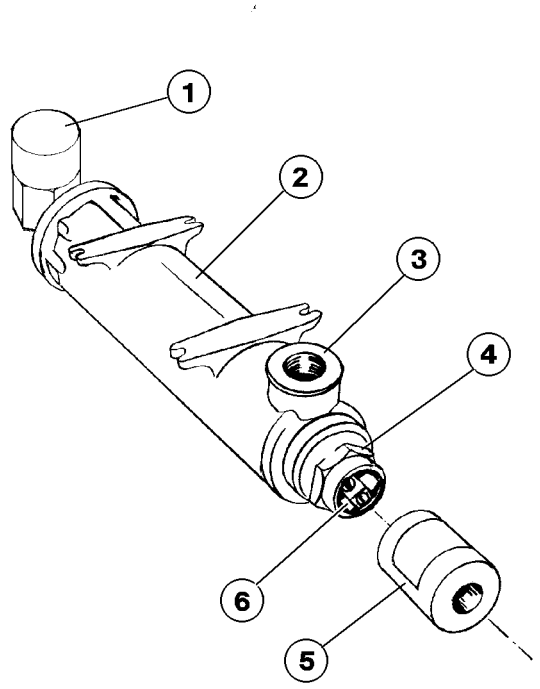


FIGURE 7-1. COOLANT HEATER

1. Thermostat
2. Heater Assembly
3. Water Outlet Port
4. Heating Element
5. Cover
6. Terminals

AIR CONDITIONING SYSTEM

Environmental Impact

Environmental studies have indicated a weakening of the earth's protective Ozone (O_3) layer in the outer stratosphere. Chloro-flouro-carbon compounds (CFC's), such as R-12 refrigerant (Freon), commonly used in mobile equipment air conditioning systems, have been identified as a possible contributing factor of the Ozone depletion.

Consequently, legislative bodies in more than 130 countries have mandated that the production and distribution of R-12 refrigerant be discontinued after 1995. Therefore, a more "environmentally-friendly" hydro-flouro-carbon.

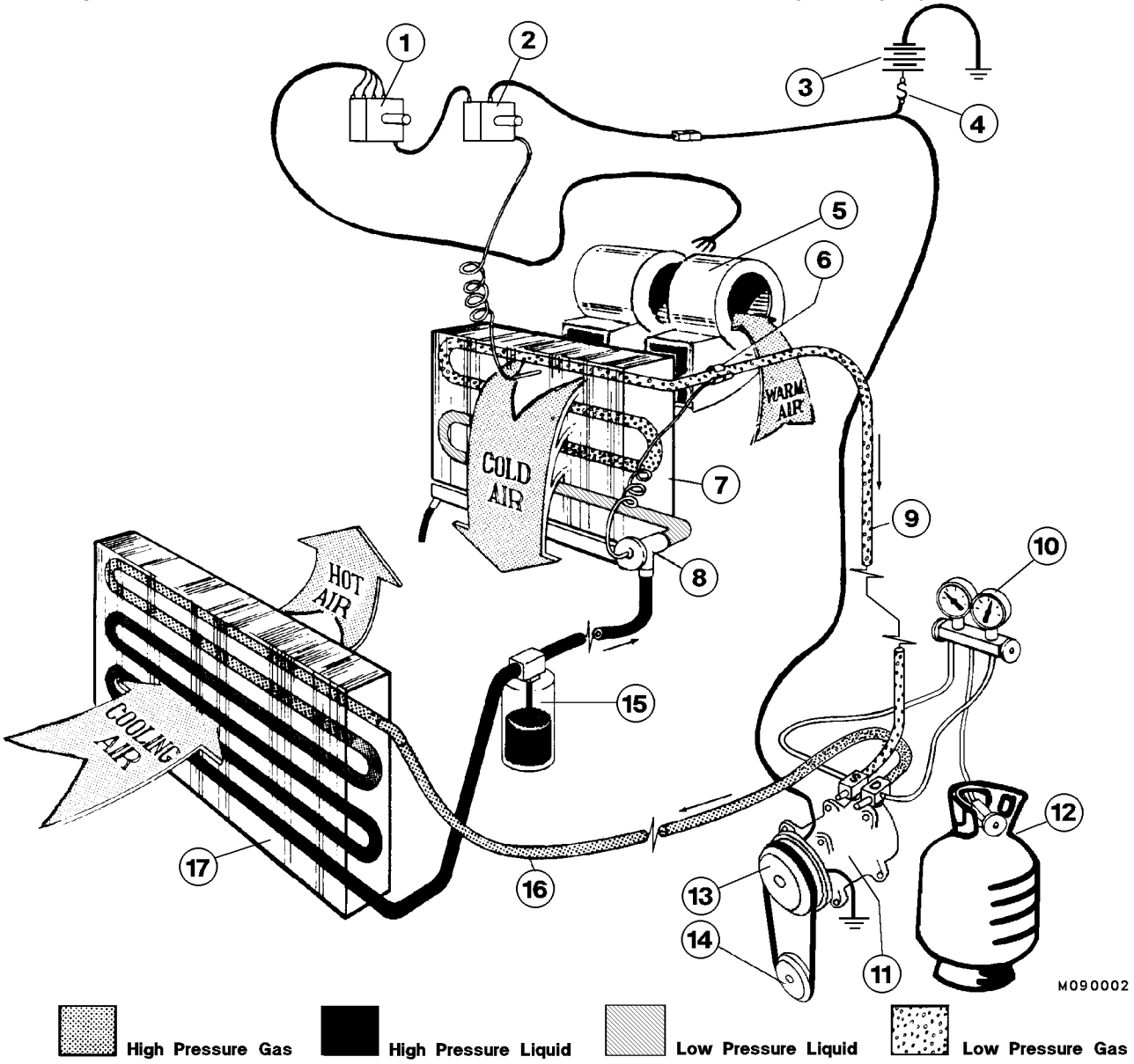


FIGURE 9-1. BASIC AIR CONDITIONING SYSTEM

1. Blower Switch
2. Thermostatic Switch
3. Battery Supply
4. Circuit Breaker
5. Blower
6. Temperature Sensor
7. Evaporator
8. Expansion Valve
9. Suction Line
10. Test Gauges & Manifold
11. Compressor
12. Refrigerant Container
13. Magnetic Clutch
14. Compressor Drive Pulley
15. Receiver-Drier
16. Discharge Line
17. Condenser

SERVICE TOOLS AND EQUIPMENT

Recovery/Recycle Station

Whenever refrigerant must be removed from the system, a dual purpose station as shown in Figure 9-3, performs both recovery and recycle procedures which follows the new guidelines for handling used refrigerant. The recovered refrigerant is recycled to reduce contaminants, and can then be reused in the same machine or fleet.

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

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

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

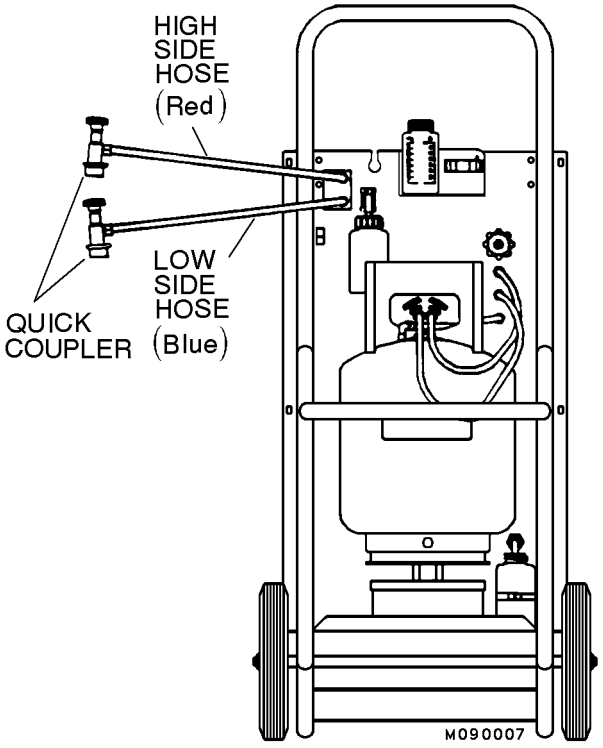


FIGURE 9-3. RECOVERY/RECYCLE STATION

⚠CAUTION

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

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

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

Leak Detector

The electronic detector (Figure 9-4) is very accurate and safe. It is a small hand-held device with a flexible probe used to seek refrigerant leaks. A buzzer, alarm or light will announce the presence of even the smallest leak.

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

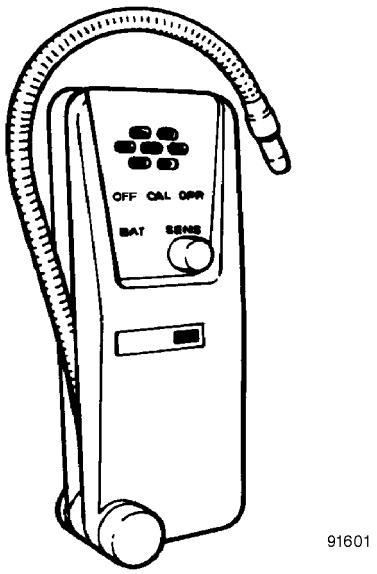


FIGURE 9-4. TYPICAL ELECTRONIC LEAK DETECTOR

3. Remove locknut (4) using thin wall socket (1, Figure 9-11) or the equivalent. Use clutch hub holding tool (2), spanner wrench (J-9403), or the equivalent to hold clutch plate (3) while removing the locknut. It is recommended that the locknut be replaced after it has been removed.

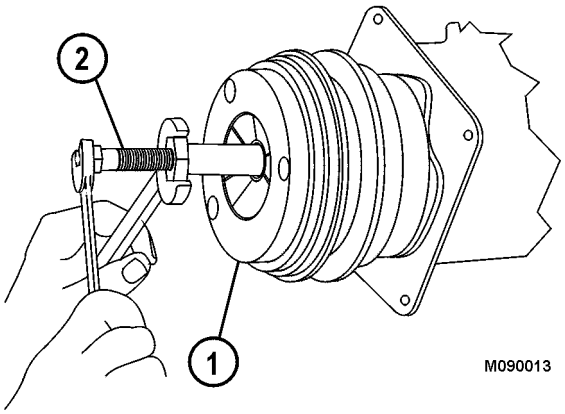


FIGURE 9-12.

1. Clutch Assembly
2. Clutch Plate & Hub Assembly Remover

4. Thread clutch plate and hub assembly remover (2, Figure 9-12) into the hub of clutch assembly (1). Hold the body of the remover with a wrench and tighten the center screw to pull the clutch plate and hub assembly from the compressor.

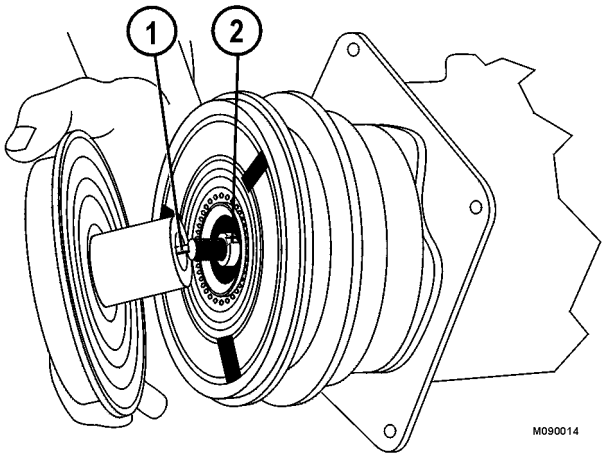


FIGURE 9-13.

1. Square Key
2. Keyway in Shaft

5. Remove square key (1, Figure 9-13) from the keyways.

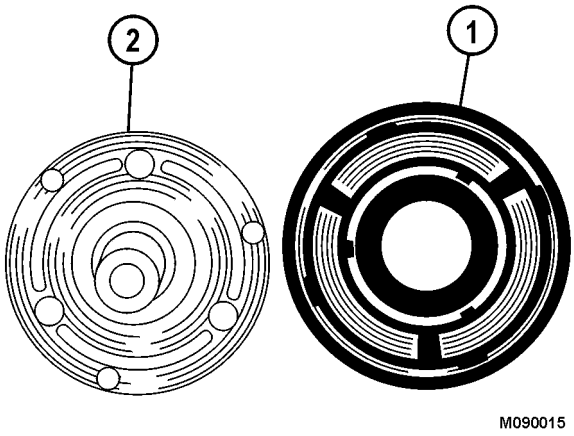


FIGURE 9-14.

1. Clutch Hub
2. Pulley

6. Inspect the friction surface on the clutch hub and the friction surface on the pulley. Scoring on the friction surfaces is normal. DO NOT replace these components for this condition only.

⚠ IMPORTANT ⚠

Inspect the steel friction surface on the clutch and ensure that it is not damaged by excessive heat. Inspect the other components near the clutch for damage due to heat. If signs of excessive heat are evident, it may be necessary to replace the compressor. Excessive heat may cause leakage in the seals and damage to internal components as well as external components.

PROBLEM: Air and/or Moisture in the System

Indications:

Low side pressure - HIGH
High side pressure - HIGH
Discharge air is only slightly cool.

Possible Causes	Suggested Corrective Actions
- Leaks in system.	Test for leaks, especially around the compressor shaft seal area. After leaks are found, recover refrigerant from the system and repair leaks. Replace the receiver-drier. Check the compressor and replace any oil lost due to leakage. Evacuate and recharge the system using a scale to ensure proper quantity. Check AC operation and performance.

PROBLEM: Expansion Valve Stuck or Plugged

Indications:

Low side pressure - VERY LOW or in a Vacuum
High side pressure - HIGH
Discharge air only slightly cool.
Expansion valve body is frosted or sweaty.

Possible Causes	Suggested Corrective Actions
An expansion valve malfunction could mean the valve is stuck in the closed position, the filter screen is clogged (block expansion valves do not have filter screens), moisture in the system has frozen at the expansion valve orifice, or the sensing bulb is not operating. If the sensing bulb is accessible, perform the following test. If not, proceed to the Repair Procedure.	**Test:** Warm diaphragm and valve body with your hand, or very carefully with a heat gun. Activate the system and watch to see if the low pressure gauge rises. Next, carefully spray a little nitrogen, or any substance below 32° F, on the capillary coil (bulb) or valve diaphragm. The low side gauge needle should drop and read at a lower (suction) pressure on the gauge. This indicates the valve was partially open and that your action closed it. Repeat the test, but first warm the valve diaphragm or capillary with your hand. If the low side gauge drops again, the valve is not stuck. **Repair Procedure:** Inspect the expansion valve screen (except block type valves). To do this, remove all refrigerant from the system. Disconnect the inlet hose fitting from the expansion valve. Remove, clean, and replace the screen. Reconnect the hose and replace the receiver-drier. Evacuate and recharge the system with refrigerant using a scale. Check AC operation and performance. If the expansion valve tests did not cause the low pressure gauge needle to rise and drop, and if the other procedure described did not correct the problem, the expansion valve is defective. Replace the valve.

AFTERCOOLER OPERATION AND REPAIR

OPERATION

The aftercooler is designed to remove suspended water and oil particles from air before going to the air tank. Air from the compressor enters the aftercooler inlet port and is directed upward between the deflector and the outer shell. The air cools as it moves upward condensing water and oil droplets which drop to the sump of the aftercooler housing. Air then passes through the filter media which removes dirt particles. As the air moves up through the filter, the moisture content is progressively decreased. Cool air then flows through the cap, check valve and into the air tank.

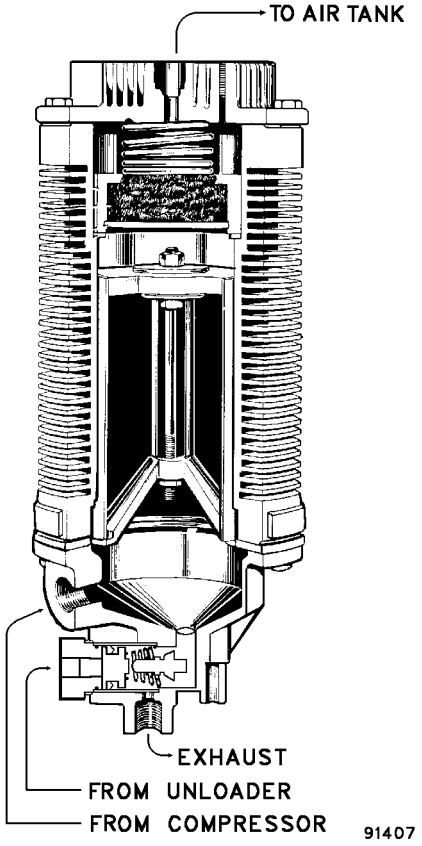


FIGURE 10-1. AFTERCOOLER

When the air tank is fully charged, air pressure from the governor unloader line is ported to the aftercooler. This pilot pressure opens the purge valve, discharging accumulated oil and water from the sump. Each time the governor cuts out, the air dryer is purged of oil and water which has accumulated in the deflector. When air compression resumes, the unloader line is exhausted to the atmosphere, the purge valve closes and the cooling process is repeated.

MAINTENANCE

Removal

1. Tag or mark air lines before disconnecting.

NOTE: If replacement of the filter assembly is the only service required, the aftercooler does not have to be removed from the truck. Proceed to the disassembly procedure for filter replacement

2. Remove outlet air line leading to air tank.
3. Remove air line from inlet port.
4. Remove electrical connection from heater assembly if aftercooler is equipped with this option.
5. Remove nuts securing aftercooler assembly to mounting bracket. Remove aftercooler and place in a clean work area for disassembly.

Installation

1. Install aftercooler assembly on mounting bracket and secure in place.
2. Connect air lines and electrical heater wire, if equipped.
3. Charge air system and check for leaks.

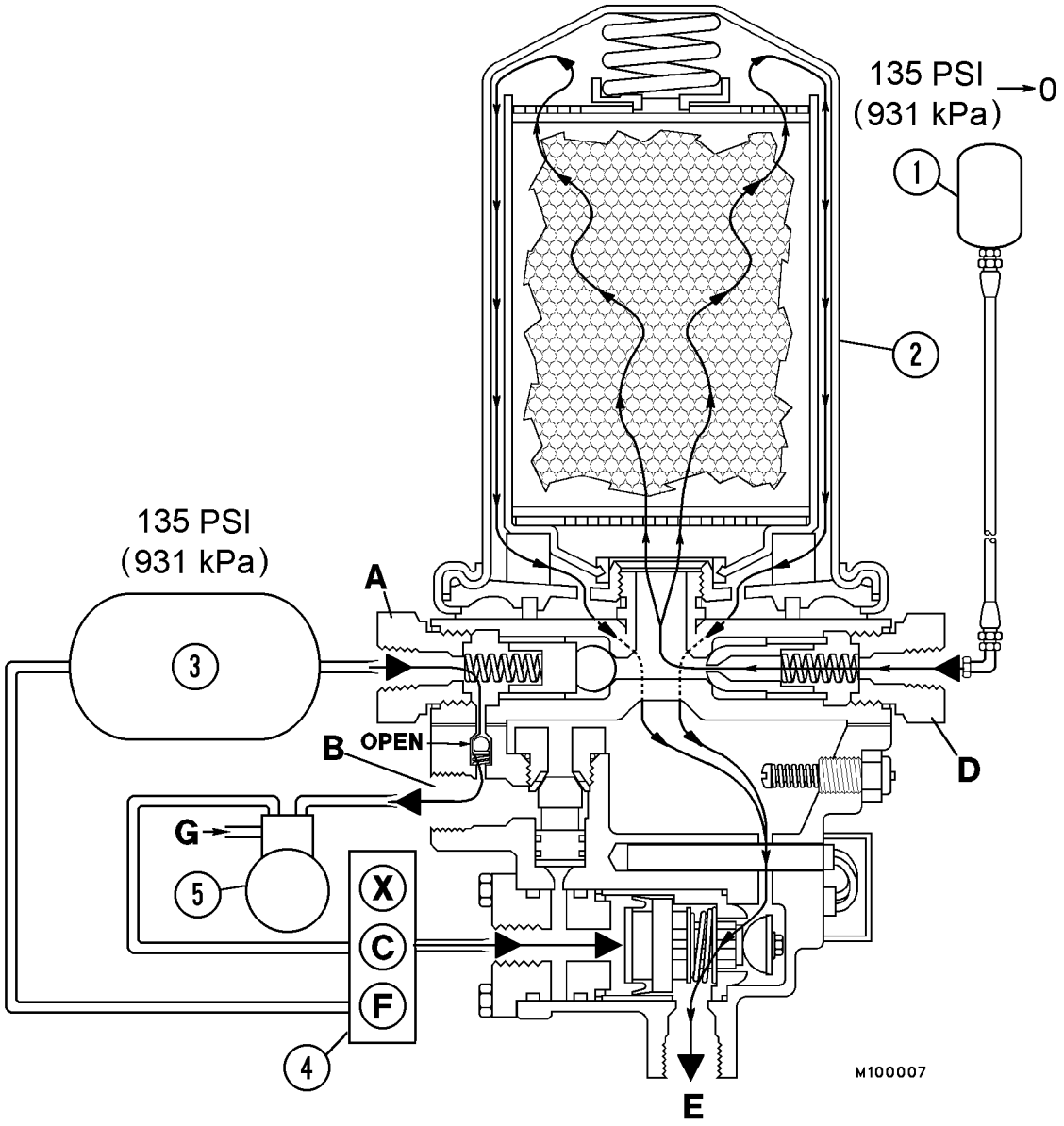


FIGURE 10-3. UNLOAD / PURGE CYCLE

COMPONENTS	PORTS
1. Purge Tank	A. Check Valve
2. Air Dryer	B. Dryer Intake
3. Supply Tank	C. Unloader
4. Air Governor	D. Purge Tank
5. Air Compressor	E. Dryer Exhaust
	F. Governor Air Supply
	G. Compressor Air Intake
	X. Governor Exhaust

Refer to FIGURE 10-4 for Valve Locations:

VALVES OPEN - Ball Check Valve (5); Unloader Valve (9)
VALVES CLOSED - Check Valve (2); Bleed Valve (13); Turbo Valve (7)

24VDC ELECTRIC SUPPLY SYSTEM

ELECTRICAL SYSTEM DESCRIPTION

The Komatsu Truck utilizes a 24VDC electrical system which supplies power for all non-propulsion electrical components. The 24VDC is supplied by pairs of 12 volt storage batteries wired in series. The batteries are a lead-acid type, each containing six 2-volt cells. With keyswitch ON and engine **not** operating, power is supplied by batteries. When the engine is operating, electrical power (non-propulsion) **is** supplied by a 24 volt alternator.

BATTERY

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

⚠WARNING

Lead-acid storage batteries contain sulphuric 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 sulphuric acid.

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 - 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.

⚠WARNING

DO NOT SMOKE or allow flame around a dead battery or during the recharging operation. The expelled gas from a dead cell or charging battery 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. No water consumption may indicate undercharging or sulphated plates.

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
- ❑ ❑ A defective battery equalizer

Overcharging, which causes battery 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.

To remove corrosion, clean the battery with a solution of ordinary baking soda and a stiff, non-wire brush and flush with clean water. Make sure none of the soda solution is allowed into the battery cells. Dry off battery. Be sure terminals are clean and tight. Clean terminals are very important in a voltage regulated system.

NIEHOFF Alternator Overhaul Manual

TABLE OF CONTENTS

Note: Do not allow sleeving on leads to slide down leads; phase terminal without sleeves can short against alternator body.

The diode heat sink assembly is normally checked using a diode tester. If a diode tester is used, refer to manufacturer's instructions for proper connections. When a diode tester is not available, use an ohmmeter and refer to the following procedure.

Note: Do not use an AC Device such as a leakage tester to check the diode heat sink.

TEST 7 - Check Positive Diodes

Refer to Figure 13-6. Set ohmmeter to x100 scale and make sure ohmmeter is zeroed. Connect one ohmmeter lead to the "B+" output stud, connect the other ohmmeter lead to each of the six heat sink phase terminals "S". All six readings should be nearly alike; either less than 600 ohms or very high. If all six readings are not alike, the diode rectifier assembly is defective and front housing assembly must be replaced.

TEST 8 - Check Negative Diodes

Refer to Figure 13-6, set ohmmeter to x100 scale, and make sure ohmmeter is zeroed. Connect one ohmmeter lead to "B-" terminal located on the outside of the front housing, connect the other ohmmeter lead to each of the six heat sink phase terminals "S". All six readings should be nearly alike; and all should read very high. If all six readings are not alike the diode rectifier assembly is defective and the front housing assembly must be replaced.

Reverse ohmmeter leads, and again observe resistance between "B+" terminal and each of the six heat sink phase terminals "S". All six readings should be very high. If any reading is not alike, the diode rectifier assembly is defective and the front housing assembly must be replaced.

STATOR TESTS

NOTE: The front stator related Phase leads are "P1", "P2", & "P3"; The rear ststor phase leads are "P4", "P5", & "P6"

The Alternator has two separate assemblies that will be checked individually. Make sure all phase leads are disconnected from the heat sink (Refer to Figure 13-6).

TEST 9 - Check Front & Rear Stator

Set ohmmeter to x1 scale and make sure ohmmeter is zeroed. Check for open stator winding by connecting ohmmeter between each successive pair of stator phase leads (Refer to Figure 13-6: "P-1" - "P2"; "P2" - "P3"; "P1" - "P3"; "P-4" - "P5"; "P5" - "P6"; & "P4" - "P6").

Note: It may be necessary to probe under the sleeves of the phase leads in order to make electrical contact. Ohmmeter should read less than 1 ohm between each pair of stator phase windings. If ohmmeter reads very high, the stator is open and must be replaced (replace or repair stator or stator / shell assembly).

Set ohmmeter to x10K scale and make sure ohmmeter is zeroed. Check for shorted stator windings by connecting ohmmeter between each phase lead ("P1", "P2", "P3", "P4", "P5", & "P6") and the ground terminal located on the outside of the front housing. Ohmmeter should read very high. If ohmmeter reads zero for the related test point, the stator is grounded and must be replaced (replace or repair stator or stator / shell assembly).

Note: Grounded stator is difficult to confirm by static test. Examine stator for burnt insulation or loose coil.

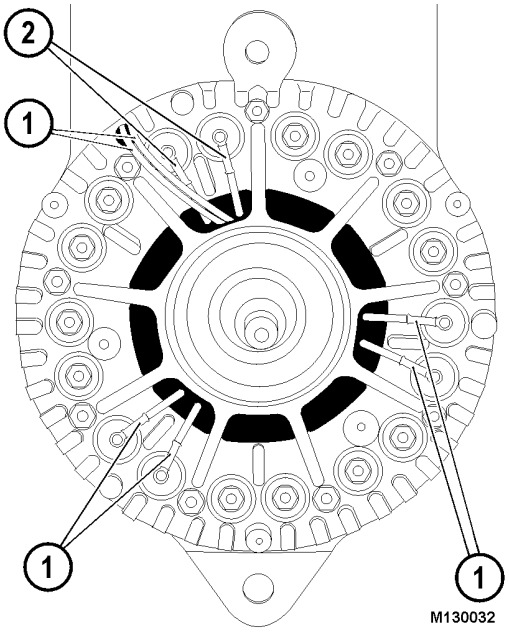


FIGURE 13-29.
1. Field Leads 2. Phase Leads

CONTROL UNIT ASSEMBLY REPLACEMENT

Refer to Figures 13-30 and 13-31 for the following steps:

1. Hold the new regulator connector harness in its approximate installation position and bend wires into their proper position.
2. Solder both the regulator connector lead "3", and the output lead from "B+" buss, to the terminal block, "B+" position. (right of center)
3. Position nuts on the terminal block attaching screws about 2 threads from the tip of the screw.

NOTE: These nuts are used as spacers.

4. Attach the terminal block to the alternator housing.

CAUTION: Thread both screws in evenly so as not to cock the terminal block. Failure to keep the terminal block parallel to the housing may break the terminal block.

5. Attach the ground lead from the regulator harness (lead "2") to the housing.
6. Route the regulator harness under “B+” buss leads. Care should be taken to keep the regulator connector flat with “A” pin properly positioned.

NOTE: Wires in steps 7 & 8 should slant away from both "E" & "R" terminals (down and left, as viewed from outside).

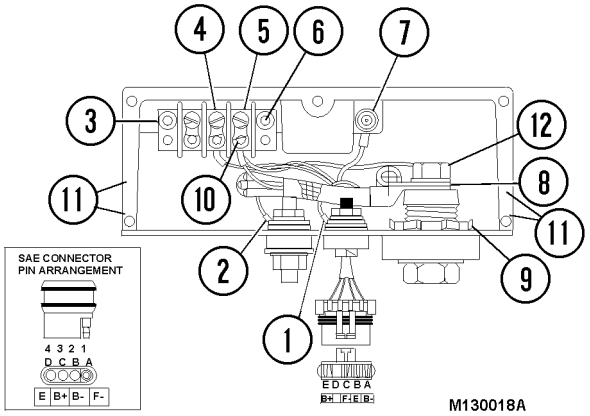


FIGURE 13-30. CONTROL UNIT ASSEMBLY

1. Ignition (E) (Harness Lead #4)
2. Relay (R)
3. Terminal Block
4. F- (Harness Lead #1)
5. F+ (Harness Lead #3); 10 in. lbs. (1.3 Nm) torque
6. Terminal Block Screw; 30 in. lbs. (3.5 Nm) torqu
7. Ground Wire from Regulator (Harness Lead #2) 24 in. lbs. (2.7 Nm) torque
8. B+ Buss Leads to Rectifier
9. When replacing output stud only; tighten to 12-15 ft.lbs. (16-20 N.m) torque, coat with epoxy.
10. Solder here.
11. Apply RTV here.
12. Tighten to 180 in.lbs. (20 N.m) torque.

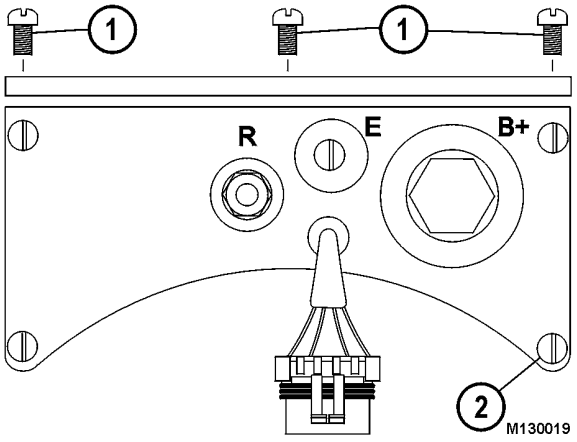


FIGURE 13-31.

1.Cover Screws (TOP) 2. Control Unit Screw

NOTE: Tighten nine screws to 20 in.lbs. (2 Nm) torque.

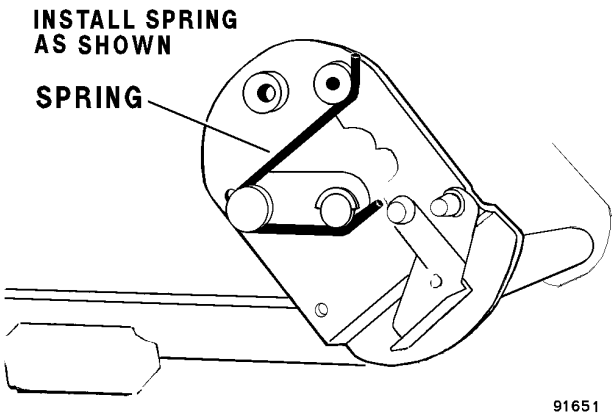


FIGURE 14-5. BACKREST SPRING INSTALLATION

5. If height and tilt handles or slide springs require replacement, proceed as follows:

   a. Remove connector spring (1, Figure 14-6). Remove both handle springs (5).

   b. Remove slide spring (2).

   c. Remove height and tilt handles (3 and 4). Handles are press fit.

   d. Remove handle arms if replacement is necessary by removing handle arm retainer (1, Figure 14-7). Use care during retainer removal to prevent retainer breakage.

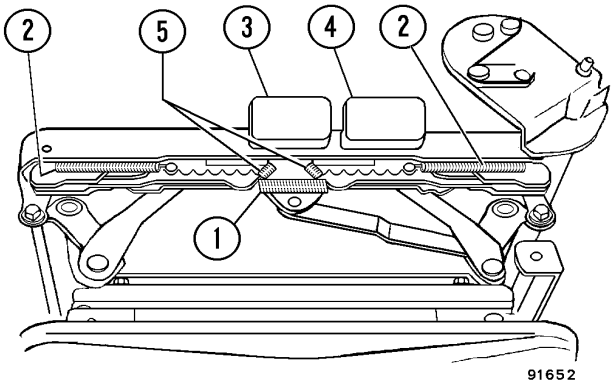


FIGURE 14-6. SPRING REMOVAL

1. Connector Spring
2. Fore and Aft Slide Springs
3. Height Handle
4. Tilt Handle
5. Handle Springs

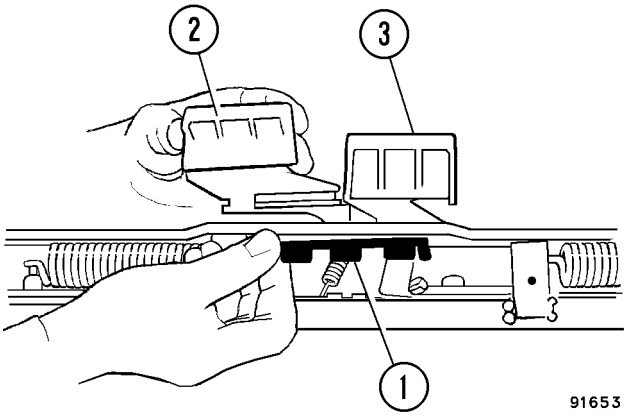


FIGURE 14-7. HANDLE ARM REMOVAL

1. Handle Arm Retainer
2. Height Handle
3. Tilt Handle

6. Remove "E" washer from pins (1, Figure 14-8). Remove slide stop (2). Remove slide assembly (3).

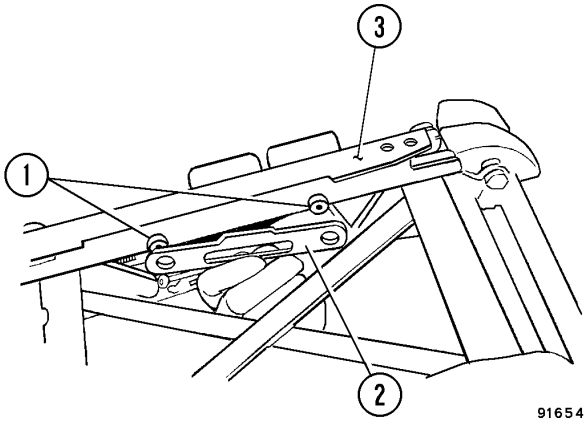


FIGURE 14-8. SLIDE REMOVAL

1. Pins
2. Slide Stop
3. Slide Rail

⚠CAUTION

Do not allow the shaft to drop out during the next procedure. Be prepared to catch the shaft to prevent damage to the sungear.

16. Remove six screws (26) and retainer plate (25). Support the turbine housing and using a .650 in. (16.5 mm) maximum dia. round, press the turbine shaft (1, Figure 15-8) out of the bearing.
17. Using a puller, remove the bearing (3) and spacer (4).
18. Tap the bearing (7, Figure 15-2) lightly to remove. Remove the spring seat (9), spring (10) and O-ring (8).

Do not attempt further disassembly of the following parts:

- ❑ Internal ring gear (24)
- ❑ Set Screw (19)
- ❑ Turbine nozzle from housing

Cleaning

NOTE: Do not wash the bendix assembly or shielded ball bearings in solvents.

1. Clean all metal parts thoroughly using commercially approved solvents such as acetone or trichloroethylene.
2. Clean aluminum parts using a solvent suitable for aluminum alloys. Follow manufacturer's recommendations and cautions. Corroded aluminum parts may be cleaned further by immersing in the following chromic-nitric-phosphoric acid pickling solution:

- 8 lbs (3.63 kg) chromic acid
- 1.9 gallons (7.2 liters) phosphoric acid
- 1.5 gallons (5.7 liters) nitric acid
- Add water to make a total of 10 gallons (37.9 liters) of solution.

After parts are soaked, rinse in hot water and blow dry with clean compressed air.

3. Clean corroded steel parts with a commercially approved stripper.

Parts Inspection

NOTE: Refer to the chart which follows for detailed inspection information.

1. In general, inspect all threaded parts for galled, stripped, crossed, or broken threads. Inspect all parts for cracks, corrosion, distortion, scoring or damage.
2. Inspect all bearing bores for wear and scoring. Maximum permissible scoring:
   0.005 in. (0.13 mm) wide and
   0.005 in. (0.13 mm) deep.
3. Check gear teeth for excessive wear (Figure 15-9). Also inspect teeth for spalling, fretting, surface flaking, splitting, rubbing, and corrosion. Nicks and dents that cannot be felt with a .020 in. (.50 mm) radius scribe are acceptable for reuse.

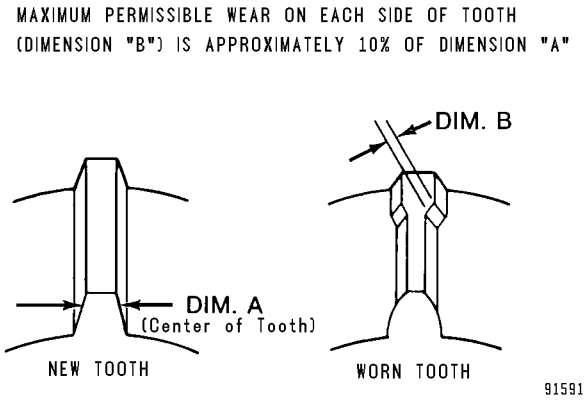


FIGURE 15-9. GEAR TOOTH WEAR LIMITS

TDI TWO-STAGE AIR STARTER

AIR STARTER

The optional two-stage TDI starter provides distinct advantages of size and efficiency as compared to electric motor, vane-type or other turbine-type air starters. It is a turbine driven air starter with a pre-engage starter drive and is designed for use with compressed air. Small amounts of foreign matter or liquid in the air stream will normally not adversely affect it. No lubrication is required in the air supply. The unit has a pilot air solenoid valve installed. The exclusive electronic control module reads output shaft speed and shuts off air to the inlet in case of an over speed condition. This prevents excessive cranking speeds, which could damage the starter or waste compressed air.

The following instructions provide information for servicing, parts replacement and reassembly of the starter. The parts illustrations (Figure 15-24 & 25) identify parts which can be disassembled and replaced by field service personnel. Parts that are identified as assemblies should not be disassembled as individual replacement parts are not available.

Removal

1. Disconnect the air inlet hose at the relay valve.
2. Disconnect the hoses routed to the starter solenoid valve.
3. Cap all hoses to prevent entrance of dirt.
4. Mark the starter mounting flange and the engine mounting boss to ensure proper alignment when reinstalling.
5. Remove the three capscrews and lockwashers attaching the starter to the engine and remove assembly.

Installation

1. Apply a liberal coat of molybdenum disulphide grease on the starter pinion teeth.
2. Lower starter assembly into position and align the mounting flange holes using match marks made during removal with the tapped holes in the engine.
3. Install the three capscrews and lockwashers and tighten to **100 ft. lbs. (136 N.m)** torque.
4. Install starter relay valve (if removed) at the inlet port and attach hoses.
5. Install the main air inlet hose. Tighten all hoses securely.

⚠WARNING

The TDI two-stage air starter must be installed and operated in accordance with the instructions given in the installation and operating manuals. Failure to properly install the starter, or failure to operate it according to these instructions may result in damage to the starter or engine, or personal injury.

Description of Basic Groups

The unit can descriptively be grouped into four basic segments: (1) Inlet Housing - Nozzle/Valve Seat; (2) Turbine Housing; (3) Stage One Gear Carrier; and (4) Gearbox - Drive Housing. The following Disassembly and Assembly sections will generally follow the above mentioned groups for instruction.

The Inlet Housing-Nozzle/Valve Seat area generally includes items (1) through (25) in Figure 15-24. It should be noted, however, that some items, such as control lines and muffler parts, are addressed where they are best removed and assembled.

The Turbine Housing includes items (26) through (38) in Figure 15-24.

The Stage One Gear Carrier area includes items (39) through (47), plus the Ring Gear pieces (48, 49, 50) in Figure 15-25.

The Gearbox Drive Housing area includes items (51) through (102) in Figure 15-25. It should be noted, however, that some items, such as control lines, are addressed where they are best removed and assembled.

36. Lube with Aeroshell #6 and install the o-rings (74) and (76) onto the pre-engage piston (75).
37. Use Aeroshell #6 to grease the inside of the gearbox housing (66) and the inside and outside of the pre-engage piston (75).
38. Hand press the pre-engage piston (75) into the gearbox housing (66) and onto the bearing hub (69). Set the gearbox housing (66) aside.

⚠CAUTION

The more deeply recessed end of the pre-engage piston (75) must be fitted onto the bearing hub (69).

39. Press the three needle bearings (52) flush into the three stage two planet gears (53).

⚠CAUTION

The bearings (52) have a flat end and a radius end. Be certain to press against the flat end. Press each bearing (52) flush with the face of the gear (53).

40. Install three anti-rotation roll pins (41A) into three stage two planet gear shafts (54). Tap the pins (41A) into position with a small hammer.
41. Place one of the gear spacers (51) on each side of the stage two planet gears (53).
42. Insert the three gears (53), with spacers (51), into the gear carrier (55) and align the shaft bores.
43. Hand install the three gear shafts (54) into the gear carrier (55) and tap into position.

⚠CAUTION

The gear shafts (54) must be inserted from the output shaft side of the gear carrier (55). Be sure to align the anti-rotation pins on the gear shafts (54) with the slots in the gear carrier (55).
Check gear rotation. The gears (53) must rotate freely in the gear carrier (55).

44. Set the shaft retention plate (56) onto the gear carrier (55). Be sure to properly align the screw holes.
45. Install the three screws (57) and tighten to **45 LB-in (5.1 Nm)** torque.

NOTE: Coat the bronze bearing (58) with NYE 377AL Grease.

46. Insert the seal positioning tool through the lip of the seal (71).
47. Install the gearbox housing (66) onto the output shaft of the gear carrier (55).
48. With the gearbox housing (66) in place, remove the seal positioning tool.

⚠CAUTION

While handling the gearbox housing/gear carrier, do not let the gear carrier (55) fall out of the gearbox housing (66) or the lip seal procedure on seal (71) will have to be repeated. If the lip on the lip seal (71) becomes reversed during assembly of the gearbox housing (66) onto the output shaft (55), the lip seal (71) must be replaced.

49. Install the two thrust washers (72) onto the output shaft (55).
50. Install the retainer ring (73) onto the output shaft (55).
51. Set the inlet housing - containment ring (5, 18) assembly on the inlet housing (5).
52. Install the turbine assembly (32) into the containment ring (18).

NOTE: Since the major components must attach to each other, be sure to align the components for both the proper general orientation and for screw holes.

53. Lube with o-ring lube and install the o-rings (48, 50) onto the ring gear (49). Install the ring gear (49) onto the turbine housing (32).
54. Install the two shims (43) onto the sun gear pin of the stage one gear carrier (47). One shim (43) goes on each end.

NOTE: NYE 377AL grease can be used to hold these shims (43) in position during assembly.

⚠CAUTION

Use NYE 377AL grease to coat the interior of the ring gear (49), the stage one gear carrier/second stage sun gear (47) and the stage two gear carrier (55).

6. Grasp the rear of the motor assembly (10, Figure 15-5) and pull it from the rear of the motor housing. If the motor assembly is difficult to remove, lightly push the motor pinion which is on the front of the motor assembly toward the exhaust side of the motor housing in order to free motor assembly.
7. Tap the intermediate gear case (25, Figure 15-6) with a plastic hammer to dislodge it from the gear case (29).
8. Position the intermediate gear case on a bench in a copper faced vise so that the intermediate pinion (27, Figure 15-7) is secured in the jaws of the vise. Tighten the vise only enough to hold the intermediate pinion securely.
9. Loosen the intermediate pinion retaining screw (28) 1 1/2 turns only. **Do not remove**.

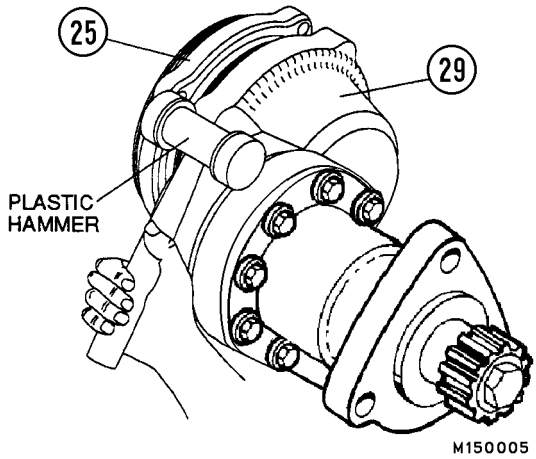


FIGURE 15-6.

⚠WARNING

If the intermediate gear case is not supported on a bench and if the intermediate pinion retaining screw is completely removed, the intermediate gear case and components could fall causing injury to personnel and/or damage to part.

Tap the intermediate pinion lightly to back the planet gear frame assembly (Figure 15-8) out of the intermediate gear case (25).

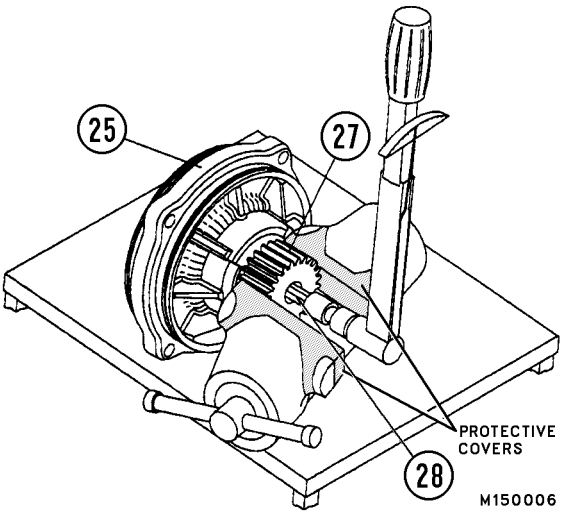


FIGURE 15-7.

10. Remove the intermediate gear case assembly from the vise and remove the intermediate pinion (27). Remove the rear case O-ring (24, Figure 15-1) and front gear case O-ring (26) from the intermediate gear case.

11. Remove the planet gear frame assembly (Figure 15-8) from the intermediate gear case (25). Using a sleeve that contacts the outer race of the front gear frame bearing (23), press the planet gear frame shaft seal (22) and the front gear frame bearing (23) from the front end and out of the rear of the intermediate gear case (25).

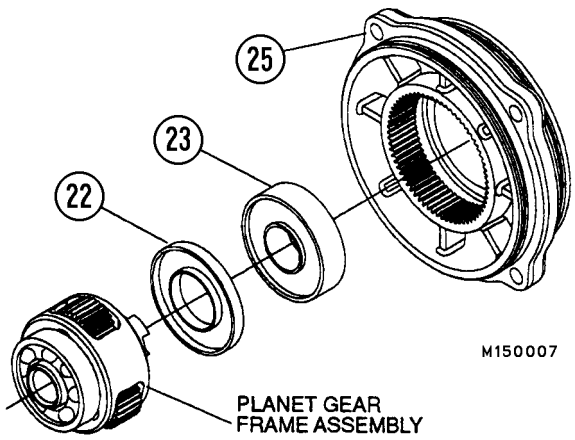


FIGURE 15-8.

TEST AND INSPECTION PROCEDURE

⚠WARNING

Inadvertent application of air pressure to the "OUT" port will result in drive malfunction (Pinion will fail to retract). If this condition occurs, loosen the drive housing cap screws (60, Figure 15-1) to vent the gear case (29). Also, loosen housing plugs (11) and (12) to vent the motor.

1. Clutch Ratcheting - Turn the drive shaft pinion (64, Figure 15-1) by hand in the direction of starter rotation. The clutch should ratchet smoothly with a slight clicking action.
2. Motor and Gearing Freeness - Turn the drive shaft pinion (64, Figure 15-1) opposite the direction of starter rotation. The drive shaft pinion should turn by hand.
3. Pinion Engagement - Plug the "OUT" port in the drive housing (58, Figure 15-1). Apply 70 psi (483 kPa) as needed. In its normal position, the distance from the mounting flange to the end of the drive shaft (50) should be 1-3/4". In its extended position, the distance from the mounting flange to the end of the drive shaft should be 2-7/8". While the drive shaft is extended, push the drive pinion (64) back on the helical splined shaft. The rear face of the drive pinion must move back 0.47" ±0.035".
4. Motor Action - Secure the starter in a vise and apply 90 psi (620 kPa) pressure using a 3/8" (9 mm) supply line to the inlet of the motor. Starter should run smoothly.
5. Motor Seals - Plug the exhaust and slowly apply 20 psi (138 kPa) pressure to the inlet of the motor. Immerse the starter for 30 seconds in a nonflammable, bubble producing liquid. If the starter is properly sealed, no bubbles will appear.
6. Gear Case Seals - Plug the exhaust and slowly apply 20 psi (138 kPa) pressure to the inlet of the motor. Immerse the starter for 30 seconds in a nonflammable, bubble-producing liquid. There should be no leakage in the housing joints in the gear case area or in the shaft seal in the intermediate gear system. If the starter is properly sealed, no bubbles will appear.
7. Confirm Motor Rotation - Remove housing plug (12, Figure 15-1). Use a 1/4" hex drive to rotate the motor to verify proper motor adjustment. Intermediate gearing output should rotate opposite the required starter rotation while observing from the pinion side. Replace the housing plug when finished.
8. Confirm Drive Rotation - Apply low pressure to the motor and observe rotation. The drive pinion (64, Figure 15-1) must rotate in the direction stamped on the nameplate. Chamfer on pinion teeth should be on the trailing edge of the gear tooth.
9. Drive Housing Function - Apply 150 psi (1034 kPa) to the "IN" port of the drive housing (58, Figure 15-1). Cycle five times. Air should exhaust through the "OUT" port during each cycle.
10. Exhaust Deflector Operation - Install starter on testing fixture. Apply low air pressure to the motor and observe. The deflector must return to its normal position after operation of the starter.
11. Drive Housing Leakage - Plug the drive housing (58, Figure 15-1) "OUT" port and apply 150 psi (1034 kPa) to the "IN" port to extend the drive shaft (50). There should be no leakage.
12. Drive Shaft Seal Leakage - Plug the "OUT" port on the drive housing (58, Figure 15-1). Apply 90 psi (620 kPa) to the "IN" port and 20 psi (138 kPa) to the vent hole. After five seconds, there should be no leakage.

38. Press the inserted parts into the drive shaft, and using a screwdriver, install the clutch spring cup retainer (39).

39. Using an arbor press, press the piston seal (51), cover side out, into the piston until it is flush with the piston face.

40. Install the piston (49) onto the drive shaft until the rear drive shaft bearing seats into the piston.

41. Lubricate piston O-ring (50) and install it in the groove of the piston.

42. Slide the rear piston bumper (38) onto the piston until it is seated at the large diameter of the piston.

43. Position the drive housing in an arbor press, pinion end down and install the drive housing seal (33) into the drive housing with the lip of the seal facing the pinion end.

44. Using a sleeve that contacts the outer race of the front drive shaft bearing (32), press the bearing into the drive housing until it seats.

45. Install piston return spring (57) and bumper backup ring (54).

46. Install the front piston bumper (55) in the groove of the drive housing.

47. Slide the piston return spring (56) onto the drive shaft and snap it into the front of the piston so that it is against the large drive shaft bearing retainer.

48. Lubricate and insert the assembled drive shaft into the drive housing.

49. Lubricate and install the outer bulkhead O-ring (36) and the inner bulkhead O-ring (37) on bulkhead (35).

50. Slide the bulkhead onto the piston.

51. With the drive housing in the arbor press, press down on the rear face of the piston.

NOTE: Feel the underside of the drive housing to make sure the drive shaft passes through the bearing. Install the bulkhead retainer (34).

⚠WARNING

Make sure the bulkhead retainer is properly seated in the motor housing groove before releasing the arbor press.

52. Remove the drive housing from the arbor press.

53. Lubricate and install the drive housing O-ring (31) in the groove of the drive housing.

54. Position the assembled motor housing and gear case on a workbench. Assembled unit must be upright to accept the drive housing.

55. Carefully position the assembled drive housing (30) onto the gear case so as not to damage the piston seal. Align the punch marks of the gear case and drive housing.

56. Install the drive housing capscrew lockwasher (29) and the drive housing capscrews (28) and tighten to **28 ft.lbs. (38 N.m)** torque.

57. Insert a 3/8 in. square drive extension bar through the hole in the motor housing cover to prevent the rotor from turning. Using a 5/8 in. x 8 in. long socket wrench inserted into the end of the drive shaft, tighten the drive gear screw (26) to **57 ft.lbs. (77 N.m)** torque.

58. Lubricate and slide the pinion spring (25) and the pinion spring sleeve (24) over the pinion end of the drive shaft.

59. Lubricate the pinion end of the drive shaft and install the drive pinion (23).

60. Grasp the drive pinion in a copper covered vise with the starter supported on a workbench.

61. Place the drive pinion washer (22) onto the drive pinion retaining screw (21). Install the drive pinion retaining screw into the end of the drive shaft and tighten to **80 ft.lbs. (109 N.m)** torque. Remove the starter from the vise.

62. Install the rear motor housing cover plug (3) and tighten securely.

Assembly

Lubricate all bearings, wicks, and oil reservoirs with SAE No. 20 oil during assembly.

Bearing Replacement:

1. If any of the bronze bearings are to be replaced, dip each bearing in SAE No. 20 oil before pressing into place.
2. Install wick, soaked in oil, prior to installing bearings.
3. **Do not** attempt to drill or ream sintered bearings. These bearings are supplied to size. If drilled or reamed, the I.D. will be too large and the bearing pores will seal over.
4. Do not cross-drill bearings. Because the bearing is so highly porous, oil from the wick touching the outside bearing surface will bleed through and provide adequate lubrication.
5. The middle bearing is a support bearing used to prevent armature deflection during cranking. The clearance between this bearing and the armature shaft is large compared to the end frame bearings.

Motor Assembly:

1. Install the end frame (with brushes) onto the field frame as follows:
   a. Insert the armature (45, Figure 17-3) into the field frame (35). Pull the armature out of the field frame just far enough to permit the brushes to be placed over the commutator.
   b. Place the end frame (1) on the armature shaft. Slide end frame and armature into place against the field frame.
   c. Insert screws (34) and washers (33) and tighten securely.
2. Assemble lever (63) into lever housing (78) If removed.
3. Place washer (79) on armature shaft and install new O-ring (80). Position drive assembly (71) in lever (63) in lever housing. Apply a light coat of lubricant (Delco Remy Part No. 1960954) on washer(75) and install over armature shaft. Align lever housing with field frame and slide assembly over armature shaft. Secure with screws (76) and washers (77).
4. Assemble and install solenoid assembly through lever housing and attach to field frame. Install nut (64) but do not tighten at this time. Install brush inspection plugs (52).

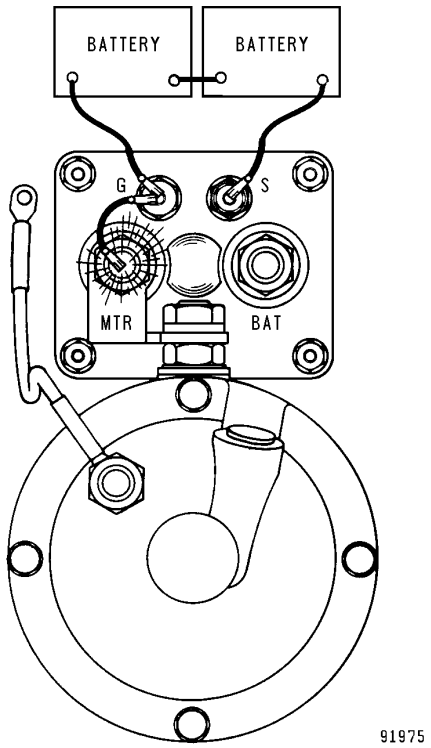


FIGURE 17-7. PINION CLEARANCE CHECK CIRCUIT

5. Using a new gasket (72), install drive housing (69) and secure with screws (70).
6. Assemble field coil connector (42) to solenoid.
7. Adjust pinion clearance per instructions on the following page.
8. After pinion clearance has been adjusted, install gasket (74) and plug(73).

Pinion Clearance

To adjust pinion clearance, follow the steps listed below.

1. Make connections as shown in Figure 17-7.
2. Momentarily flash a jumper lead from terminal “G” to terminal “MTR”. The drive will now shift into cranking position and remain so until the batteries are disconnected.
3. Push the pinion or drive back towards the commutator end to eliminate slack movement.
4. The distance between the drive pinion and housing should be between .330 in. to .390 in. (8.3 mm to 9.9 mm) as shown in Figure 17-8.
5. Adjust clearance by turning shaft nut (64, Figure 17-3).

To Replace Paper:

1. Press the "FEED" button to roll out the remaining paper. ***Do not forcibly pull the paper out!***
2. Pull the cover open from the top.
3. Unroll about 3 in. (8 cm) from a new roll of paper.
4. Hold the new roll in front of the printer paper input with the 3 in. (8 cm) leader coming from the top of the roll.
5. Insert the leader into the printer paper input and press the "FEED" button. Hold the button until about 6 in. (15 cm) has fed through the printer.
6. Pass the paper through the cover slot and close.

NOTE: Paper path must be properly aligned before going through printer; if not, paper path will become jammed. Improper cutting off and "yanking" on printed data report will contribute to this problem.

Troubleshooting Paper Printer

1. If the printer's FEED and PRINT switches don't work, check the printer paper for clogging. Cut off the paper as indicated (Figure 20-5), then slowly pull out the upper side of the paper that remains inside of the printer.
2. After removing the paper, replace the printer paper roll as described above.
3. If the printer starts working normally after the paper replacement, the cause of the trouble was probably improper alignment of the paper.
4. If the printer still doesn't work properly, the printer module should be replaced.

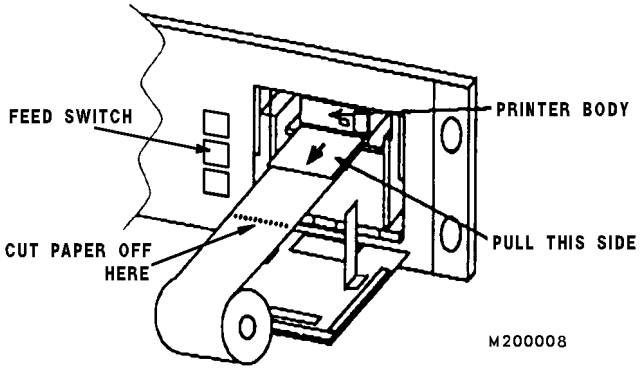


FIGURE 20-5. CLEARING PAPER PATH

REPLACEMENT OF PRINTER MODULE

Printer Module Removal

⚠CAUTION **WHEN HANDLING PAYLOAD METER**

- ***Electronic parts are easily affected by static electricity. Anyone servicing payload meter should be certain that body is grounded.***
- ***Take special care not to leave anything, particularly metallic matter, in the payload meter.***
- ***Don't touch or remove the printer head (white). If removed, it will become impossible to repair.***
- ***Don't touch the electronic parts on the printed cards; these parts are easily broken.***
- ***Handle the harness and the printer cable with great care. Avoid kink, tight bends and contact with other parts. Don't put too much force on them.***
- ***If the battery in the payload meter is removed, it will cause loss of data.***
- ***Avoid heavy shock – Do not drop!***

1. Remove 11 screws from the payload meter (Figure 20-6), and remove the top cover.

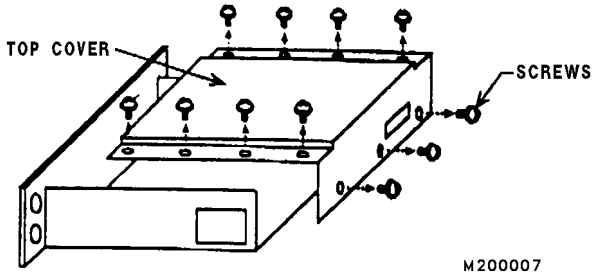
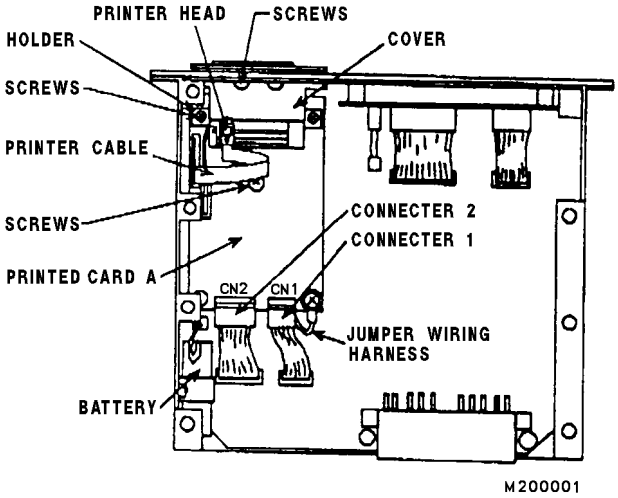


FIGURE 20-6. COVER REMOVAL



PROBLEM: CODE E-33 IS DISPLAYED.

Explanation: The back-up battery inside the payload meter controller is almost dead and needs replacement. Refer to the OBWS manual for instructions on replacement.

After replacing the battery, recalibrate the payload meter computer and reset the time and date.

PROBLEM: CODE E-41 or E-42 IS DISPLAYED.

Explanation: The inclinometer output is greater than + 10 °for code 41, or less than -10 °for code 42.

POSSIBLE CAUSES	*CORRECTION*
Truck ascending or descending grades in excess of 10°.	Normal.
Open or short in circuit 39FE.	Examine wiring on inclinometer and housing for opens.
Open in circuit 39F at inclinometer.	Examine wiring for opens.
Faulty inclinometer.	Replace if no shorts or opens in wiring are found.
Broken inclinometer mounting.	Repair mount.

PROBLEM: CODE 'PAPE' IS DISPLAYED.

Explanation: The printer paper is jammed in the printer. Open the printer paper door and gently clear the jam from the printer.

⚠CAUTION ***Do not tug or pull hard on the paper as this will damage the printer.***

PROBLEM: CODE 'FULL' IS DISPLAYED.

Explanation: The 200 haul cycle memory is full of data. Additional loads will be ignored until the memory is cleared. Print out the data, if desired, and clear the memory.

OTHER PROBLEMS –

A problem may be suspected with the system that does not show an error code.
Some of the common occurrences are outlined below.

PROBLEM: Load data will not store in memory.

POSSIBLE CAUSES	*CORRECTION*
Operators not using brake lock switch at loading area.	Remind operators to use brake lock switch at loading area and at dumping area.
Memory is full.	Clear memory if "FULL" error code is displayed.
Excess carryback in body.	Remove carryback to allow system to reset to record next load.
Fault in DSTM wiring or module.	Check for proper operation of DSTM, check wiring, and replace module if necessary.
Fault in TR1 wiring.	Troubleshoot wiring and replace relay if necessary.
Fault in body up circuit (63L) from AID module.	Troubleshoot wiring.
Material in body is less than 50% of rated payload.	Normal.

- **Set Truck Number** - This selection allows you to enter the truck identification for storage into the expanded memory box. All future download information retrieved from this payload system will be identified by the number you enter here.
  1. Arrow down to highlight "Set Truck Number". Press "ENTER".
  2. Press tab key to select the change box and then enter the truck identification number.
  3. Press "ESC" to cancel the command or press "ENTER" to execute the command and save any changes.

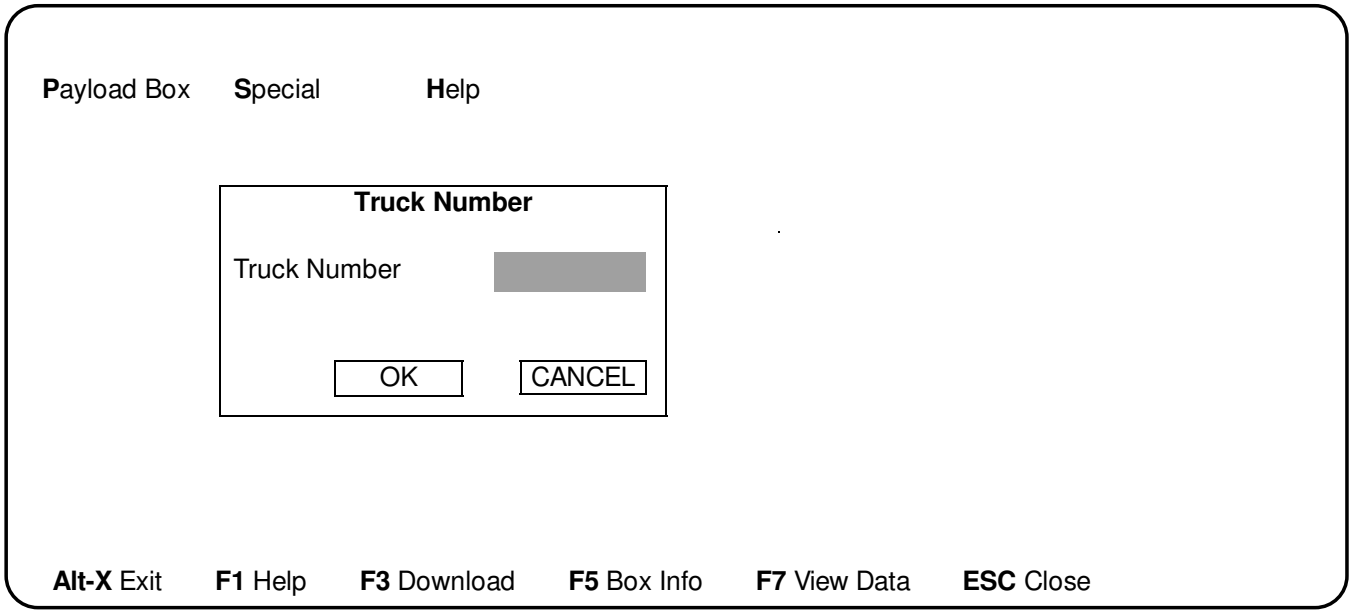


FIGURE 20-24. SPECIAL "SET TRUCK NUMBER" SCREEN

- **View Data in Box** - This selection will allow you to view payload data stored in the expanded memory box without erasing the information.
  1. Arrow down to highlight "View Data in Box". Press "ENTER".
  2. The screen will display a message indicating the amount of time to download the information for viewing.
  3. Press "ENTER" to view the data. Use the arrow keys to scroll up or down through the data.
  4. Press "ESC" to return to the main menu screen.

Battery Replacement

NOTE: If the battery goes dead or is unplugged from the payload memory card, all payload data, truck I.D. number and date will be erased. Refer to "Initial Start Up Of The Expanded Memory Box" to reset the truck I.D. number and date.

1. Carefully unplug battery connector (5, Figure 20-20) from payload memory card (3).
2. Remove nut, screw and washer and remove battery (2) from clamp.
3. Install new battery in clamp and attach to payload memory card with screw, washer and nut.
4. Carefully plug battery connector (5) into payload memory card (3).

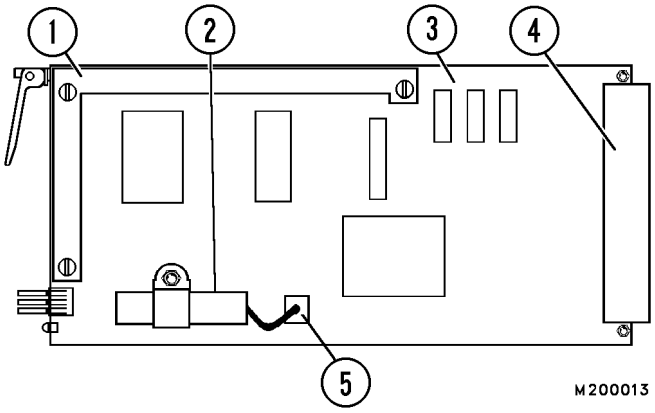


FIGURE 20-20. PAYLOAD MEMORY CARD

1. Handle
2. Battery
3. Payload Memory Card
4. Pin Connector
5. Battery Connector

Assembly

1. Install end cover (4, Figure 20-19) with gasket and four screws.
2. With lever (5, Figure 20-19) in the unlocked position, carefully install payload memory card (6) into box using slots highlighted with white paint. Wiggle the card slightly to engage the card pins into the receptacle. Be certain that the card is fully seated and the pins are fully engaged. Press lever (5) over to lock card into place.
3. Connect wire lead from end cover (1) to card (6).
4. Install end cover (1) with gasket and four screws.

Wire Connections

Refer to Figure 20-21 for wire connections made on the expanded memory box.

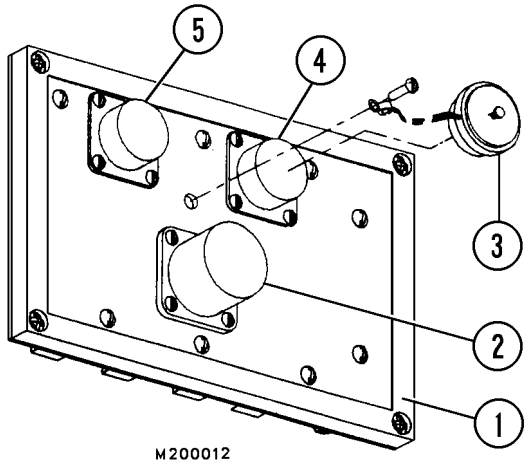


FIGURE 20-21. END PLATE

1. End Plate
2. Power Connector
3. Dust Cap
4. Connector (To Modular Mining or Truck Harness)
5. Connector (To Payload Meter)

CAB COMPONENTS

WINDSHIELD WIPER

The windshield wiper is operated by a 24 volt electric motor. The wiper can be adjusted for a variable intermittent delay or a constant low or high speed by the switch mounted on the instrument panel.

Removal

1. Remove the access panel (1, Figure 3-1) above the windshield (3).
2. Disconnect motor wiring at the connector. Disconnect radio if equipped.
3. Remove the windshield washer hose.
4. Lift wiper arm cover (1, Figure 3-2) and remove arm retaining nut (2) and spring washer (3).
5. Note position of arm and remove arm.
6. Remove cap (4), nut (6) and washer (7) from pivot.
7. Remove capscrews and remove wiper motor assembly.

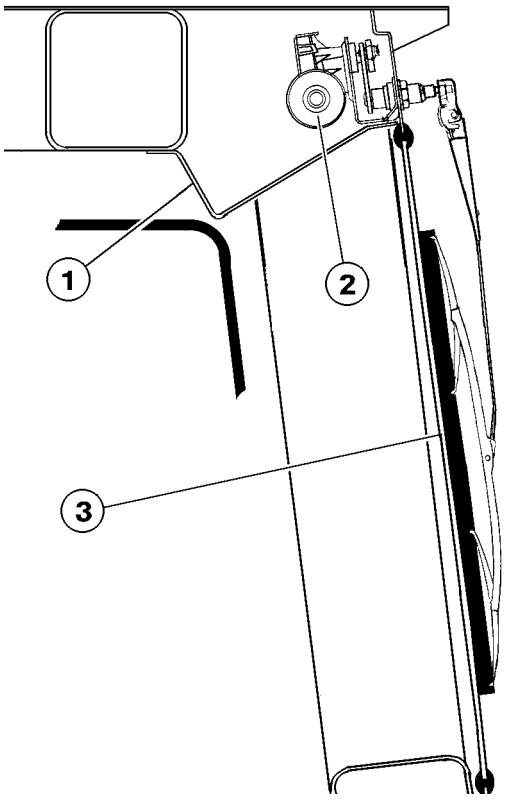


FIGURE 3-1. WINDSHIELD WIPER INSTALLATION

1. Access Panel
2. Wiper Motor Assembly
3. Windshield

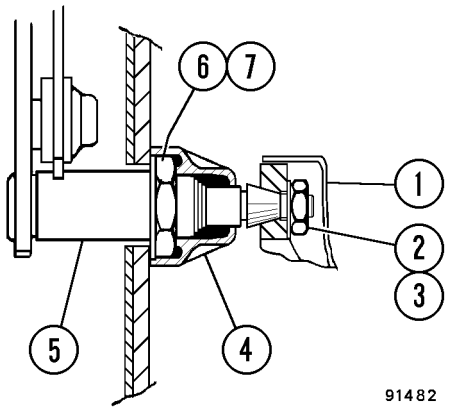


FIGURE 3-2. WIPER ARM DETAIL

1. Wiper Arm
2. Nut
3. Spring Washer
4. Cap
5. Pivot
6. Nut
7. Washer

Installation

1. Insert wiper motor assembly pivot (5, Figure 3-2) through hole in windshield frame and install mounting capscrews and washers.
2. Install pivot washer (7) and nut (6). Tighten nut (6) to **160-177 in.lbs. (18-20 Nm) torque.** Install cap (4).
3. Install wiper arm (1) in location noted during removal and install spring washer (3) and retaining nut (2). Tighten nut (2) to **142-177 in.lbs. (16-20 Nm) torque**.

NOTE: With wiper motor in the "park" position, the wiper arm should be approximately 7 degrees below parallel from the top edge of the windshield. Test wiper to be certain wiper blade does not travel off the glass and onto the weatherstrip.

4. Connect windshield washer hose and motor wire connector.
5. Install access panel and machine screws.
6. Verify proper operation and arc of wiper arm. Reposition arm on pivot splines if blade contacts windshield weatherstrip.

OPERATOR CONTROLS

STEERING COLUMN

HAULPAK® trucks are equipped with a steering column and steering wheel which will adjust through a tilt angle to provide a comfortable wheel position for most operators.

Tilt angle is adjusted by pulling the tilt lever (3, Figure 5-1) toward the steering wheel and moving the wheel to the desired position. Releasing the lever will lock the wheel in one of five positions.

The steering column also contains a directional signal flasher control lever (2) combined with a headlight high and low beam selector switch. A right turn is signalled by raising the lever, and a left turn by lowering the lever. Indicator lights located above the speedometer and tachometer will flash to indicate the turn direction selected. To select the headlight low beams, pull the lever (2) toward the steering wheel. To select high beams, pull the lever again. An indicator light mounted between the turn indicators will illuminate when high beams are selected. The horn is controlled by pressing the button in the center of the steering wheel.

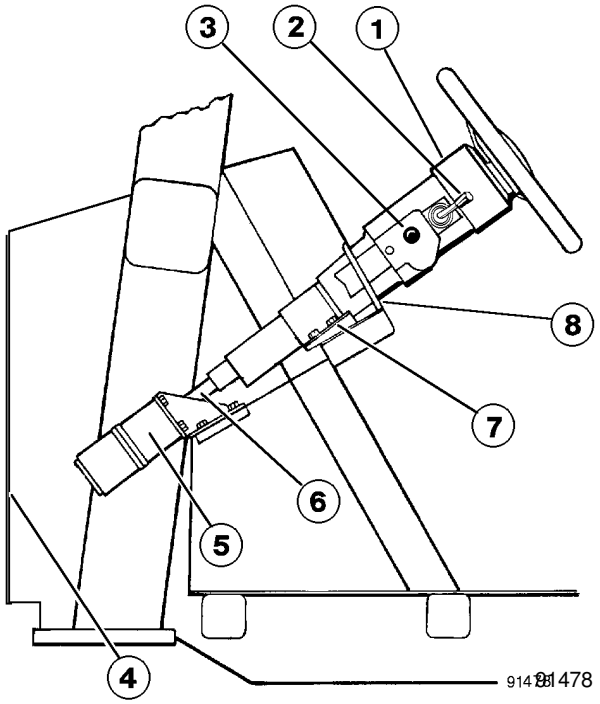


FIGURE 5-1. STEERING COLUMN INSTALLATION

1. Steering Column
2. Turn Signal/Dimmer
3. Tilt Lever
4. Access Cover
5. Steering Control Valve
6. Shaft
7. Capscrews & Washers
8. Seal & Retainers

Removal

1. Shut down the engine by turning the key switch "Off" and allow the steering accumulator to bleed down. Allow at least 90 seconds for bleed down. Turn the steering wheel to ensure no pressure remains.
2. Open the battery disconnect switch.
3. Remove the access cover (4, Figure 5-1) from the front of the cab.
4. Disconnect the wire harness from the steering column at the connecter.
5. Remove screws retaining seal retainer plates (8) where steering column enters the instrument panel. Remove both retainer plates.
6. Remove the four capscrews and washers (7) at the mounting bracket. (Access to these capscrews is from outside the cab, through the access opening.)
7. Lift the steering column to disengage the column from the steering shaft (6), and lift out of the instrument panel.

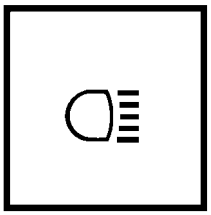
Installation

1. With the steering column tilted at approximately 45°, insert the lower end of the column into the opening in the instrument panel.
2. Position the steering shaft (6) on the steering control valve (5) and align the splines with the steering column shaft splines.
3. Position steering column mounting holes over tapped holes in mounting bracket and in alignment with steering control valve.
4. Install four capscrews (7), lockwashers, and hardened flat washers through steering column mounts. Tighten to **25 ft. lbs. (33.9 N.m)** torque. Check for proper steering wheel rotation without binding. If binding occurs, realign column by loosening mounting capscrews and adjusting column in the slotted mounting holes.
5. Position the steering column seal (8) and install the seal retainer halves.
6. Connect the column wire harness to the instrument panel harness.
7. Reinstall access cover (4) on front of cab and close battery disconnect switch.

24D: Low Fuel (Optional)

This amber low fuel indicator will illuminate when the usable fuel remaining in the tank is approximately 25 gallons (95 liters). A warning buzzer will also sound.

24E: Manual Backup Lights

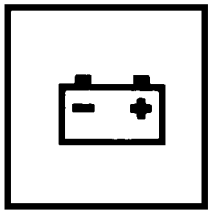


This amber indicator will illuminate when the manually operated Manual Backup switch (19) is turned "on".

(25) INDICATOR LIGHT PANEL (AMBER)

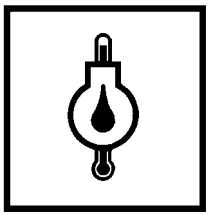
This Indicator Light Panel is not currently used, however, an indicator strip may be physically in place.

25A: Battery Protection (MTU Engine Only)



Not currently used.
Reserved for future use or options.

25B: Low Engine Oil Temperature (MTU Engine Only)



Not currently used.
Reserved for future use or options.

25C/D/E: NOT USED

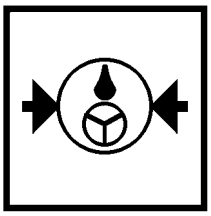
Not currently used.
Reserved for future use or options.

WARNING INDICATOR LIGHTS

Warning Indicator light Strips (26, 27, Figure 5-5) are RED in color and alert the operator to safely stop the truck and shut down the engine.
DO NOT OPERATE THE TRUCK WITH A RED WARNING LIGHT ILLUMINATED.
Refer to Figure 5-6 for location of symbols (A-E) for the indicator Strips.

(26) WARNING LIGHT PANEL (RED)

26A: Low Steering Pressure



When the keyswitch is turned "ON", the low steering pressure warning light will illuminate until the steering system hydraulic pressure reaches 2100 psi (14.7 MPa). The warning horn will also turn on, and both will remain on, until the accumulator has been charged.

⚠WARNING

If the low steering warning light continues to illuminate and the alarm continues to sound, low steering pressure is indicated. The remaining pressure in the accumulators allows the operator to control the truck to a stop.
Do not attempt further operation until the malfunction is located and corrected.

If the indicator light and warning horn do not turn off after running engine for a few minutes, quickly turn keyswitch "Off", then "On".

- If the indicator light goes "Off", and remains "Off", DO NOT OPERATE TRUCK. Low accumulator nitrogen precharge pressure [below 1300 psi (9.1 MPa)] is the most probable cause of this occurrance.
  Do not operate truck until the accumulator has been properly recharged.
- If the indicator light remains "On", DO NOT OPERATE TRUCK. A problem exists in either the steering system hydraulic circuit, or its monitoring circuit.
  Do not operate truck until the fault has been corrected.

10 HOUR (DAILY) INSPECTION

Prior to each operating shift, a “walk around” inspection should be performed. Check the truck for general condition. Look for evidence of hydraulic leaks; check all lights and mirrors for clean and unbroken lenses; check operator’s cab for clean and unbroken glass; check frame, sheet metal and body for cracks. Notify the proper maintenance authority if any discrepancies are found. Give particular attention to the following:

10 HOUR LUBRICATION AND MAINTENANCE CHECKS

1. FAN DRIVE AND TURBOCHARGERS - Check for leaks, vibration or unusual noise. Check alternator and fan belts for proper tension, condition and for alignment.
2. RADIATOR - Check coolant level and fill with proper mixture as shown in Cooling System Recommendation Chart. Refer to Engine Manual for proper DCA levels.
3. ENGINE - Check oil level.
   Refer to engine manufacturer’s service manual for oil recommendations. (Lube Key "A").
4. FUEL FILTER - Drain water from bottom of filter housing.
5. FUEL STRAINER - Drain water and sediment at drain cock.
6. MOTORIZED WHEELS - Refer to G.E. Motorized Wheel Service & Maintenance Manual for lubrication specifications and service intervals.
7. HYDRAULIC TANK - Check oil level in tank, add if necessary. Refer to "Hydraulic Tank Service".
   Oil should be visible in sight glass. - DO NOT OVERFILL. Lube Key "D".
8. AIR TANK (NOT SHOWN) - Drain water from tank.
9. BATTERIES (NOT SHOWN) - Check electrolyte level and add water if necessary.
10. AIR CLEANERS (NOT SHOWN) - Check air cleaner vacuum gauges in operator cab. The air cleaner(s) should be serviced, if the gauge(s) shows the following maximum restriction:
    20 in. of H_2O vacuum for Detroit Diesel engine.

Truck Serial Number _____

Site Unit Number _____

Date:_____Hour Meter_____

Name of Service person_____

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

COMMENTS	√’d	INITIALS

100 HOUR LUBRICATION AND MAINTENANCE CHECKS

Maintenance for every 10 & 50 hour Lubrication and Maintenance Checks should also be carried out at this time.

Truck Serial Number _____

Site Unit Number _____

Date:_____Hour Meter_____

Name of Service person_____

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

1. REAR HYDRAIR® SUSPENSION PIN JOINTS - Add one or two applications of grease to each grease fitting for the upper and lower suspension mount pins. Use Lube Key "E".
2. HYDRAULIC PUMP & U-JOINT - Add one or two applications of grease to each grease fitting on the cross and bearing assemblies and splines. Use Lube Key "F".
3. BODY HINGE PINS - Add one or two applications of grease to each grease fitting. Lube Key "E" for the body hinge pins.
4. HOIST CYLINDER - Add one or two applications of grease to each grease fitting for bearing and pivots. Use Lube Key "E".
5. ANTI-SWAY BAR - Add one or two applications of grease to each grease fitting for pin and bearings. Use Lube Key "E".
6. FRONT WHEEL BEARINGS - Check oil level.
7. FUEL TANK - Drain H_2O and sediment.
8. HYDRAULIC OIL FILTERS - Change filter elements after the initial 100 hours of operation; then at 250 hours; and then each 500 hours of operation thereafter.
9. AIR SYSTEM LUBRICATOR - (Not Shown) - May not be on some trucks. If available, fill with oil, use Lube Key "D".

COMMENTS	√'d	INITIALS

POSSIBLE CAUSES	*SUGGESTED CORRECTIVE ACTION*
TROUBLE: Pump Will Not Build Pressure	
Pump not primed.	See items in “Pump Will Not Prime”.
Air trapped in lubricant supply line.	Prime system to remove trapped air.
Lubricant supply line leaking.	Check lines and connections to repair leakage.
Vent valve leaking.	Clean or replace vent valve.
Pump cylinder scored, by-passing air.	Repair or replace pump cylinder or pump assembly.

TROUBLE: Injector Indicator Stem Does Not Operate

NOTE: Normally, during operation, the injector indicator stem (Figure 3-4) will move into the body of the injector when pressure builds properly. When the system vents (pressure release) the indicator stem will again move out into the adjusting yoke.

Malfunctioning injector - usually indicated by the air pump building pressure and then venting.	Replace individual injector assembly.
All injectors inoperative - pump build up not sufficient to cycle injectors.	Service and/or replace pump assembly.

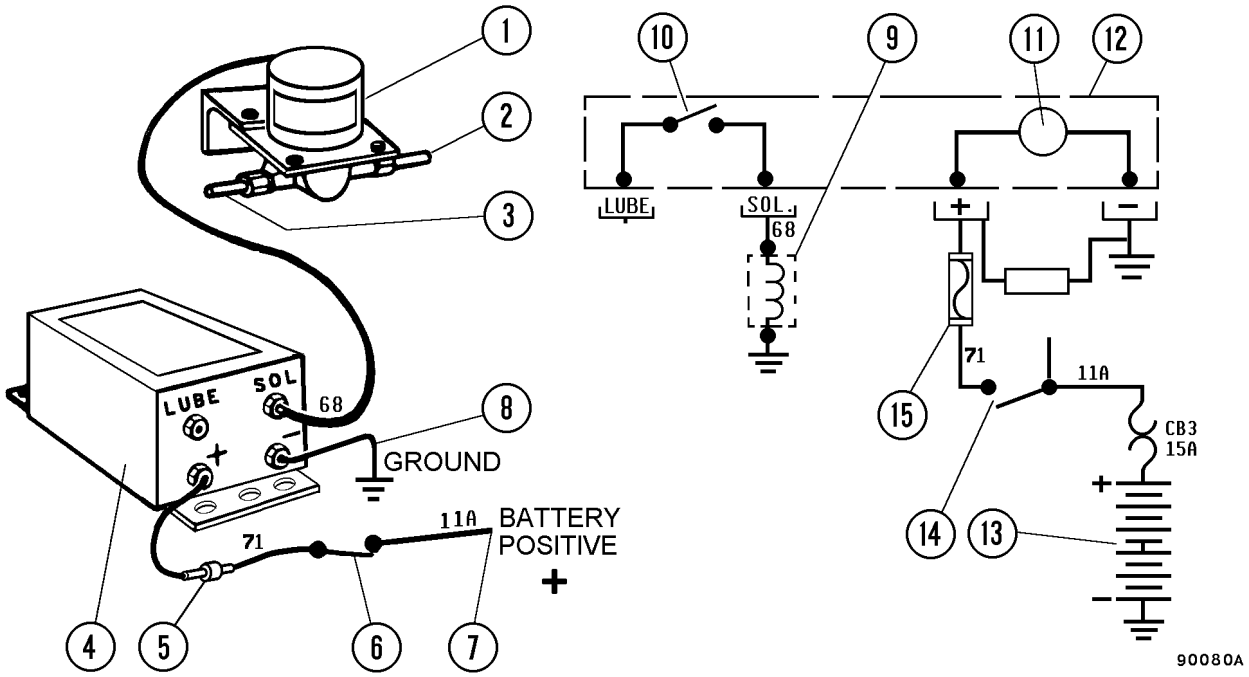


FIGURE 3-5. TYPICAL ELECTRICAL HOOKUP FOR AUTOMATIC LUBE

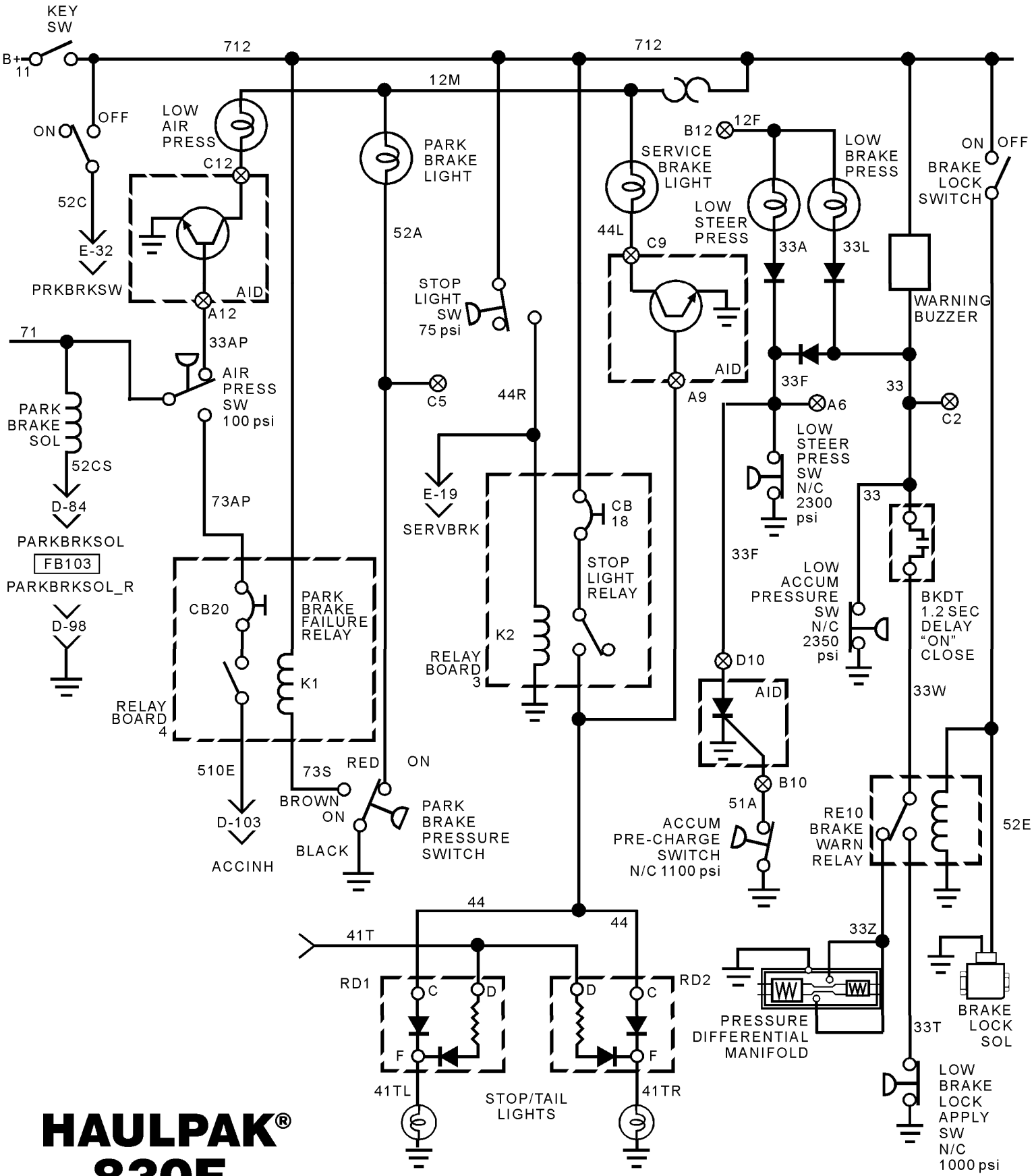
1. Solenoid Air Valve
2. Main Air Supply
3. To Air Pump Motor
4. Timer *
5. Fuse Holder
6. Keyswitch
7. To Battery (+)
8. To Ground (-)
9. Solenoid
10. Relay
11. Timer (solid State)
12. Timer (Housing)
13. Battery
14. Keyswitch
15. 7.5 Amp Fuse

* Keyswitch (6) must be closed ("ON") to energize Timer (4).

SECTION R

SYSTEM SCHEMATICS

INDEX



HAULPAK® 830E
STATEX III

WIRE NUMBERS AND SHEET LOCATIONS

0	9,10
0A0V	5
0AFA	7
0ATA	7
0GF	7
0M1A	7
0M2R	7
0M2V	5
0MFA	7
0MTA	7
0S1	4
0S2	4
0S3	4
0S4	4
0S5	4
1	11
11	7,11,16,18
11A	17
11B1	11
11C	14
11CL	18
11D	18
11DL	18
11DR	18
11F	18
11H	17
11HL	18
11HS	17
11L	18
11LL	18
11P	
11RL	18
11S	
11T	18
11X	17
115M	13
12F	9,18
12H	9
12M	14,17,18
12T	18
150M	11
150R1	11
150R2	12
499M	13
523M	13
524M	13
531M	13
542M	13
545M	13
563M	13
564M	13
573	13
749M	13
908M	13
988M	13
18S1	4
18S2	4
18S3	4
18S4	4
18S5	4
21	11
21A	11
21C	11
21N	
23F	13
240M	11,12
240R1	11,12
240R2	12
241M	11,12
241R1	11,12
241R2	12
2DDA	4
2DDB	4
2DDC	4
2DDD	4
2DDE	4
2DDF	4
2DDG	4
2DDH	4
2DDL	4
2DDM	4
2DP1	4
2DP2	4
2DP2	4
2DP3	4
2DP4	4
2DP5	4
31A	18
31MT	13
31MTR	13
31R	17
31RR	14,16
31TS	11,12
32B	9
32P	8
33	18
33A	18
33AP	17
33F	18
33H	17
33J	17
33L	18
33RR	16
33T	18
33W	18
33Z	18
34L	9
34LL	9
34T	9
34TL	9
36	17
38	17
38G	9
39	9
39A	20
39AA	20
39B	20
39BA	20
39C	20
39CA	20
39F	20
39FA	20
39FB	20
39FC	20
39FD	20
39FE	20
39G	20
39H	18
39J	20
39JA	20
39K	20
39L	20
39M	20
39Z	20
419	13
419I	13
419M	13
41H	18
41HL	18
41HR	18
41L	18
41LL	18
41LR	18
41T	17,18
41TL	17
41TR	17
41TS	10,18
439	13
439E	13,15,17
44	17
44A	17
44D	18
44DL	18
44DR	18
44R	17
451M	13
451R1	13
451R2	13
45L	18
45LL	18
45R	18
45RL	18
47	14
47B	14
47L	14
47S	14
48	18
48A	18
48B	18
48F	18
49	10
509	13
509MA	13
510	13
510D	
510E	17
51A	17
525	13
528	13
52A	17
52B	18
52C	14
52CS	14
53H	15
556	4,13
557	13
61H	9
61L	9
61M	9
63L	17
65C	9
65P	9
65R	9
65T	9
66	9
66L	9
66P	9
66S	9
68	16
71	4,5,6,7,8,13,14,16,17,18
710	4,5,6,7,8,9,11,13,14,15
710	16,17,18
711A	7
711B	7
712	9,11,12,13,14,15,17,18
712H	15
712L	14
712N	
712S	13
714	5,6
714A	5,6
716A	7
716B	7
716C	7
716D	7
716E	7
716F	7
716H	7
716J	7
717E	7
717F	7
717G	16
717H	16
717R	7
717S	7
71D	7
71E	7
71F	17
71G	5,6,7
71H	8
71J	5,6,7
71K	7
72	14
722A	5,6
722C	5,6
722F	5,6
722H	5,6
722L	9
72D	5,6
72F	5,6
72FF	16
72G	8
72H	16
72J	8
72L	16
72LL	16
72N	5,6
72P	7
72PP	8
72R	7
72RR	16
72S	7
72T	7
72V	7
72W	7
72X	7
72Y	7
73A	16
73AP	17
73C	8
73D	5,6
73DS	14
73E	8
73J	8
73L	8
73LL	8,14
73LS	14
73R	16
73S	17
73Y	7
73Z	7
74	5,6,7
74A	7
74AA	5,6,7
74AF	5,6
74B	7
74C	7
74D	5,6,7
74E	7
74F	5,6,7
74G	8
74GS	16
74H	8
74HS	16
74N	15
74X	5,6
74XA	5,6,7
74XB	14
74XC	5,6,7
74Z	5,6
75A	5,6,7
75AI	8
75B	5,6,7
75C	5,6,7
75D	5,6,7
75X	5,6,7
76B	15
76L	15
76M	15
76MM	15
76N	8
76R	8
76RS	16
76S	8
76SS	16
76T	8
76TS	16
76W	8
76WS	16
76X	8
76XS	16
76Y	8
76YS	16
76Z	8
76ZS	16
77	5,6
77A	5,6
79	8,14
79B	14
79C	7
79D	7
79H	7
79J	7
79V	9
79VD	9
79VG	9
79VS	9
7GAI	5,6
7GAZ	5,6
7J1	5,6,7
7J10	5,6
7J13	5,6
7J14	5,6
7J15	5,6
7J16	5,6
7J17	5,6
7J18	5,6
7J1L	5,6
7J1LS	5,6
7J1R	5,6
7J1RS	5,6
7J2	5,6
7J3	5,6
7J30	5,6
7J32	5,6
7J34	5,6
7J36	5,6
7J38	5,6
7J4	5,6
7J40	6
7J42	6
7J44	6
7J46	6
7J48	6
7J5	5,6
7J7	5,6
7J8	5,6
7J9	5,6
84	19
85	19
86	19
87	19
88	19
89	19
90	19
900	13
901	13
90CAD	10
90CAG	10
90CAR	10
90CBD	10
90CBG	10
90CBR	10
952M	13
952M	13
T1	5,6
T2	5,6
T3	5,6
440	11,12
151	11,12
953	11,12,13
954	11,12
541M	11,12,13
556M	13
979	13
544	13
583	13
10V	13,15,16
79A	14

ABREVIATIONS

A	- AMPERE
A.I.D.	- ALARM INDICATING DEVICE
A/C	- AIR CONDITIONER
ACCUM.	- ACCUMULATOR
AUX.	- AUXILIARY
BATT	- BATTERY
BLD.	- BLEED
BLWR.	- BLOWER
BRK.	- BRAKE
BUZZ.	- BUZZER
CB	- CIRCUIT BREAKER
CHK.	- CHECK
CLR.	- COOLER
COMP.	- COMPARTMENT
CONN.	- CONNECTOR
CONT.	- CONTROL
DET.	- DETECTOR
DIAG.	- DIAGNOSTIC
DIFF.	- DIFFERENTIAL
DN.	- DOWN
DYN.	- DYNAMIC
ECM	- ENG. CONTROL MONITOR
ELECT.	- ELECTRICAL
ENG.	- ENGINE
EQ.	- EQUALIZER
EXT.	- EXTERNAL
FLTR.	- FILTER
FOR	- FORWARD
GA.	- GAUGE
HSG.	- HOUSING
HTR.	- HEATER
IND.	- INDICATING
JUNCT.	- JUNCTION
L.H.	- LEFT HAND
LK.	- LEAK
LOC.	- LOCATION
LT	- LIGHT
M	- MOTOR
MAN.	- MANUAL
MFA	- MOTOR FIELD 'A'
MFB	- MOTOR FIELD 'B'
MNTR.	- MONITOR
MOD.	- MODULE
MTD.	- MOUNTED
MTR.	- MOTOR
P	- PLUG
POS.	- POSITION
PRESS.	- PRESSURE
PROP.	- PROPULSION
R	- RECEPTACLE
R.H.	- RIGHT HAND
RAD	- RADIATOR
RD.	- ROAD
RET.	- RETARD LIGHT
REV	- REVERSE
RLY.	- RELAY
SEC.	-SECOND
SEC.	- SECONDARY
SEL.	- SELECTOR
SNDR.	- SENDER
SOL.	- SOLENOID
SRV.	- SERVICE
SS1	- SPEED SENSOR 1
SS2	- SPEED SENSOR 2
STR.	- STEERING
STRG.	- STEERING
SW	- SWITCH
SYS.	- SYSTEM
TACH.	- TACHOMETER
TB	- TERMINAL BOARD
THERMO.	- THERMOSTAT
THRTL.	- THROTTLE
VLV.	- VALVE
WT.	- WEIGHT

EF1869 JUNE 96

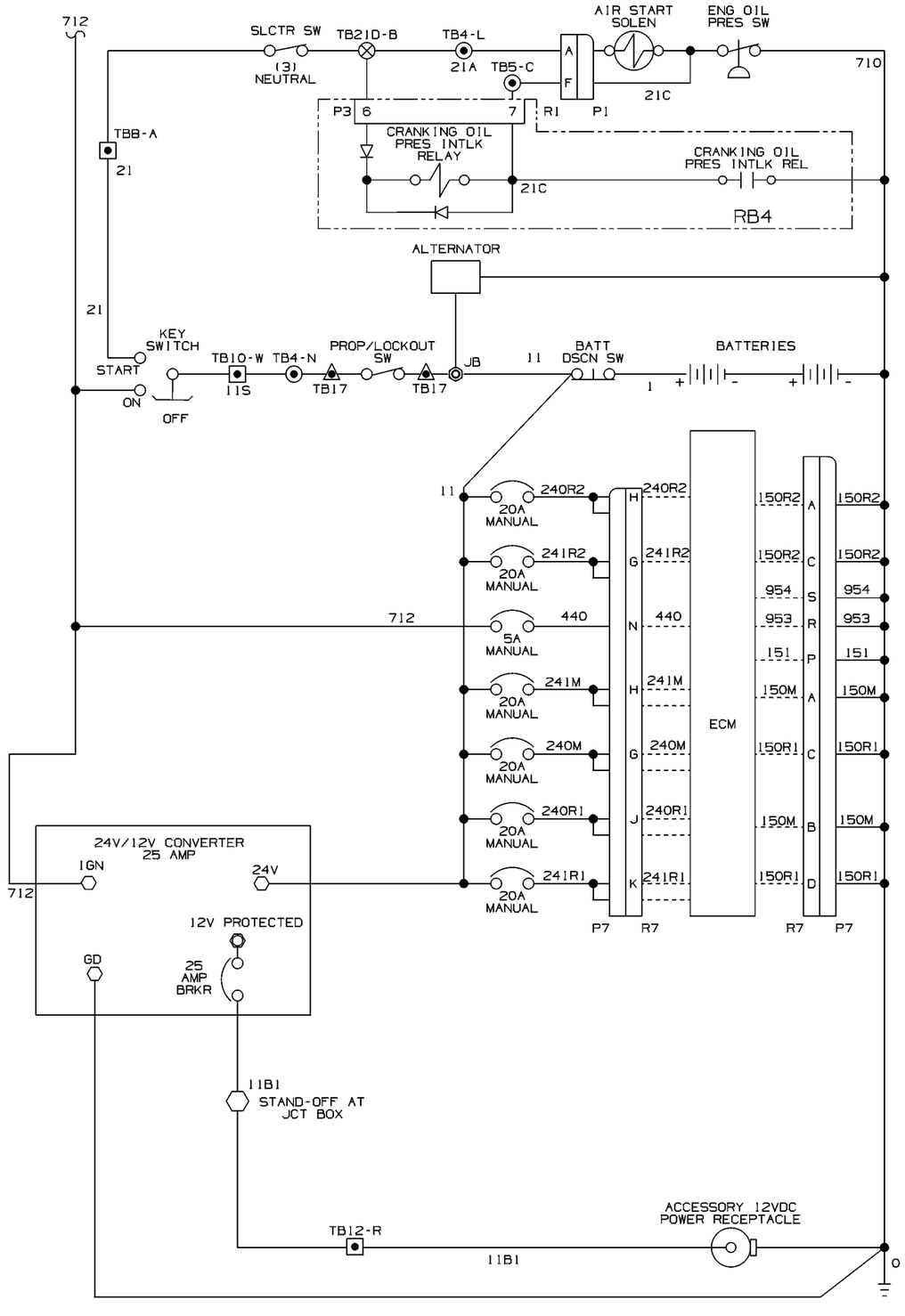
ELECTRIC SCHEMATIC

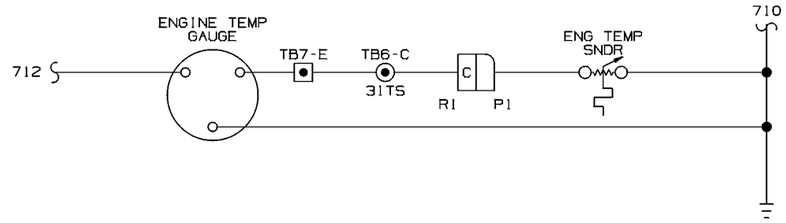
CIRCUIT NUMBER LOCATOR

830E

AFE32-AS & UP

Sheet 02 of 23





EF1869 JUNE 96

ELECTRIC SCHEMATIC

DDEC III - 2500 H.P.

830E

AFE32-AS & UP

Sheet 12 of 23