CEBM006300

Shop Manual

830E

DUMP TRUCK

SERIAL NUMBERS **A30625 thru A30649**

KOMATSU

SECTION A

GENERAL INFORMATION

INDEX

PRECAUTIONS DURING OPERATION

SAFETY IS THINKING AHEAD

Prevention is the best safety program. Prevent a potential accident by knowing the employer's safety requirements and all necessary job site regulations. In addition, know the proper use and care of all the safety equipment on the truck. Only qualified operators or technicians should attempt to operate or maintain the truck.

Safe practices start before the operator gets to the equipment!

SAFETY AT THE WORKSITE

- When walking to and from the truck, maintain a safe distance from all machines even if the operator is visible.
- Before starting the engine, thoroughly check the area for any unusual conditions that could be dangerous.
- Examine the road surface in the jobsite and determine the best and safest method of operation.
- Choose an area where the ground is as horizontal and firm as possible before carrying out the operation.
- If you need to operate on a road, protect pedestrians and cars by designating a person for worksite traffic duty or by installing fences around the worksite.
- The operator must check personally the work position, roads to be used, and existence of obstacles before starting operations.
- Always determine the travel roads in the worksite and maintain them so that it is always safe for the machines to travel.
- If travel through wet areas is necessary,check the depth and flow of water before crossing shallow parts. NEVER be in water which is in excess of the permissible water depth.

FIRE PREVENTION

- Thoroughly remove wood chips, leaves, paper and other flammable items accumulated in the engine compartment. They could cause a fire.
- Check fuel, lubrication, and hydraulic systems for leaks. Have any leaks repaired. Wipe up any excess oil, fuel or other flammable fluids.
- Be sure a fire extinguisher is present and working.
- Do not operate the machine near any flame.

PREPARING FOR OPERATION

- Always mount and dismount facing the truck. Never attempt to mount or dismount the truck while it is in motion. Always use the ladder and handrails when mounting or dismounting the truck.
- Check the deck areas for debris, loose hardware or tools. Check for people and objects that might be in the way.
- Become familiar with and use all protective equipment and devices on the truck and insure that these items (anti-skid material, grab bars, seat belts etc.) are securely in place.

VENTILATION FOR ENCLOSED AREAS

- If it is necessary to start the engine within an enclosed area, provide adequate ventilation. Exhaust fumes from the engine can KILL.

TIRES

HANDLING TIRES

If tires are not used under the specified conditions, they may overheat and burst or be cut and burst by sharp stones on rough road surfaces. This may lead to serious injury or damage.

To maintain safety, always keep to the following conditions:

- Inflate the tires to the specified pressure. Abnormal heat is generated particularly when the inflation pressure is too low.
- Use the specified tires.

The tire inflation pressure and permissible speeds are general values. The actual values may differ depending on the type of tire and the condition under which they are used. For details, please consult the tire manufacturer.

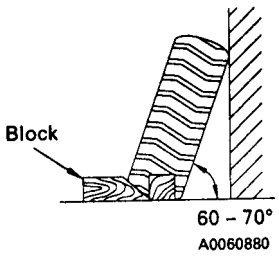
If the tires become hot, a flammable gas is produced, and this may ignite. It is particularly dangerous if the tires become overheated when the tires are under pressure. If the gas generated inside the tire ignites, the internal pressure will suddenly rise, and the tire will explode, and this may lead to serious personal injury. Explosions differ from punctures or tire bursts, because the destructive force is extremely large. **Therefore, the following operations are strictly prohibited when the tire is under high internal pressure:**

- Welding the rim
- Building fires or carrying out welding near the wheel or tire.

If the proper procedure for carrying out maintenance or replacement of the wheel or tire is not used, the wheel or tire may burst and cause serious injury or damage. When carrying out such maintenance, please consult the regional Komatsu Mining Systems, Inc. distributor or tire manufacturer.

STORING TIRES AFTER REMOVAL

- As a basic rule, store the tires in a warehouse which unauthorized persons cannot enter. If the tires are stored outside, always erect a fence around the tires and put up “No Entry” and other warning signs that even young children can understand.
- Stand the tire on level ground, and block it securely so that it cannot roll or fall over.
- If the tire should fall over, get out of the way quickly. The tires for construction equipment are extremely heavy, so trying to hold the tire may lead to serious injury.



DUMPING

1. Pull into dump area with extreme caution. Make sure area is clear of persons and obstructions, including overhead utility lines. Carefully maneuver truck into dump position. Obey signals directed by the spotter, if present.
2. Avoid unstable areas. Stay a safe distance from edge of dump area.
   Position truck on a solid, level surface before dumping.

⚠DANGER

As body raises, the truck Center of Gravity (CG) will move. Truck must be on level surface to prevent tipping / rolling!

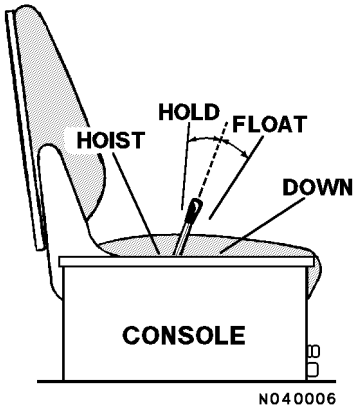
3. When in dump position, apply Brake Lock and move Selector Switch to the "**N**eutral" position.

To Raise dump body:

⚠WARNING

The dumping of very large rocks (10% of payload, or greater) or sticky material (loads that do not flow freely from the body) may allow the material to move too fast and cause the body to move RAPIDLY and SUDDENLY. This sudden movement may jolt the truck violently and cause possible injury to the operator, and/or damage to the hoist cylinders, frame, and/or body hinge pins. If it is necessary to dump this kind of material, refer to the CAUTION in the following procedure:

4. Pull the lever to the rear to actuate hoist circuit. (Releasing the lever anywhere during "hoist up" will place the body in "hold" at that position.)



5. Raise engine RPM to accelerate hoist speed. Refer to the CAUTION below.

⚠CAUTION

If dumping very large rocks ,or sticky materials, as described in the previous WARNING, slowly accelerate engine RPM to raise body.
When the material starts to move, release hoist lever to "HOLD" position.
If material does not continue moving and clear body, repeat this procedure until material has cleared body.

6. Reduce engine RPM as last stage of hoist cylinder begins to extend and let engine go to low idle as last stage reaches half-extension.
7. Release hoist lever as last stage of hoist cylinder reaches full extension.

To Lower Body
(When dumping over a berm or into a crusher):

8. Move hoist lever forward to "down" position and release. Releasing the lever places hoist control valve in the "float" position allowing the body to return to frame.

NOTE: If dumped material builds up at the rear of the body and the body cannot be lowered, perform steps "a" & "b" below:

a. Move hoist lever back to the "hoist" position to fully raise the dump body. Then release the hoist lever so it returns to the "hold" position.

*NOTE: **DO NOT** drive forward if the tail of body will not clear the crusher wall in the fully raised position.*

b. Shift Selector Switch to "Forward", release Brake Lock, depress Override button and drive forward to clear the material. Stop, shift Selector Switch to "Neutral", apply Brake Lock and lower body again.

*NOTE: Failure to "hoist" the body after making an unsuccessful attempt at lowering the body may result in the dump body **suddenly lowering** after the truck has pulled ahead of the material that was previously preventing the body from lowering.*

CAUTION! The truck is not to be moved with the dump body raised except for emergency moves only. Failure to lower body before moving truck may cause damage to hoist cylinders, frame and/or body hinge pins.

STANDARD CHARTS AND TABLES

This manual provides dual dimensioning for most specifications. U.S. standard units are specified first, with metric (SI) units in parentheses. References throughout the manual to standard torques or other standard values will be to one of the following Charts or Tables. For values not shown in any of the charts or tables, standard conversion factors for most commonly used measurements are provided in TABLE XIII, page 1-14.

INDEX OF TABLES

EFFECT OF SPECIAL LUBRICANTS On Fasteners and Standard Torque Values

KOMATSU engineering department does NOT recommend the use of special “friction-reducing” lubricants such as, “Copper Coat”, “Never Seize”, and other similar products on the threads of standard fasteners where “standard torque” values are applied.

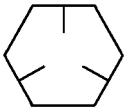
The use of special “friction-reducing” lubricants will significantly alter the clamping force being applied to fasteners during the tightening process.

If special “friction-reducing” lubricants are used with the “Standard Torque” values listed below in Table I (and in Komatsu shop manuals), excessive stress and possible breakage of the fasteners may result.

Where Torque Tables specify “Lubricated Threads” for the Standard Torque values listed, **these standard torque values are to be used with simple lithium base chassis grease (multi-purpose EP NLGI) or a rust- preventive grease (see list, page 1-10) on the threads and seats,** unless specified otherwise.

NOTE: Always be sure threads of fasteners and tapped holes are free of burrs and other imperfections before assembling.

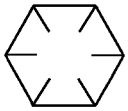
Standard torque values are not to be used when “Turn-of-the-Nut” tightening procedures are recommended.



Grade 5

TABLE I. -STANDARD TORQUE CHART SAE HEX HEAD CAPSCREW AND NUT ASSEMBLY (LUBRICATED THREADS) - TOLERANCES ±10%

Grade 8



Cap-screw Thread Size	TORQUE - GRADE 5			TORQUE - GRADE 8			Cap-screw Thread Size	TORQUE - GRADE 5			TORQUE - GRADE 8		
	ft. lbs.	kg.m	N.m	ft. lbs.	kg.m	N.m		ft. lbs.	kg.m	N.m	ft. lbs.	kg.m	N.m
1/4-20	7	0.97	9.5	10	1.38	13.6	3/4-16	235	32.5	319	335	46.3	454
1/4-28	8	1.11	10.8	11	1.52	14.9	7/8-9	350	48.4	475	500	69.2	678
5/16-18	15	2.07	20.3	21	2.90	28	7/8-14	375	51.9	508	530	73.3	719
5/16-24	16	2.21	22	22	3.04	30	1.0-8	525	72.6	712	750	103.7	1017
3/8-16	25	3.46	34	35	4.84	47	1.0-12	560	77.4	759	790	109.3	1071
3/8-24	30	4.15	41	40	5.5	54	1.0-14	570	78.8	773	800	110.6	1085
7/16-14	40	5.5	54	58	8.0	79	1 1/8-7	650	89.9	881	1050	145	1424
7/16-20	45	6.2	61	62	8.57	84	1 1/8-12	700	96.8	949	1140	158	1546
1/2-13	65	9	88	90	12.4	122	1 1/4-7	910	125.9	1234	1480	205	2007
1/2-20	70	9.7	95	95	13.1	129	1 1/4-12	975	134.8	1322	1580	219	2142
9/16-12	90	12.4	122	125	17.3	169	1 3/8-6	1200	166	1627	1940	268	2630
9/16-18	95	13.1	129	135	18.7	183	1 3/8-12	1310	181	1776	2120	293	2874
5/8-11	125	17.3	169	175	24.2	237	1 1/2-6	1580	219	2142	2560	354	3471
5/8-18	135	18.7	183	190	26.2	258	1 1/2-12	1700	235	2305	2770	383	3756
3/4-10	220	30.4	298	310	42.8	420							

1 ft. lbs. = 0.138 kg.m = 1.356 N.m

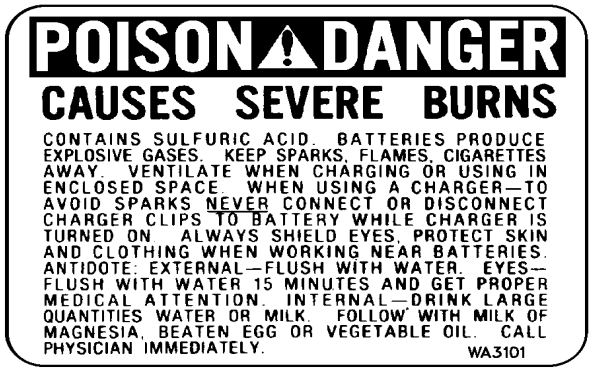
RECONDITIONING AN IDLE VEHICLE

⚠WARNING

NEVER attempt operation of a vehicle which has been standing idle for a long period until all systems which affect steering, brakes, engine, transmission and running gear have been completely reconditioned. An unsafe vehicle can cause serious injuries and/or major property damage - DON'T TAKE CHANCES!

At times a vehicle is subjected to long idle periods without being properly serviced for storage - merely shut down and left to the elements for an extended period. Reconditioning of this vehicle can and does present a major expenditure of time and money when it is to be put into operating condition.

1. Remove all trash and thoroughly clean the vehicle before starting any inspection or maintenance.



2. Remove vehicle batteries and move to battery shop for service and charging or replacement as necessary.

⚠WARNING

Do not disassemble an inflated tire. Remove valve core slowly, and allow pressure to bleed off, before attempting to remove lockring. Also, eye protection should be worn during tire deflation to protect against any foreign object being projected into the eyes.

3. Inspect tires thoroughly for tread and side wall condition, weathering, cuts and cracks.
   a. Any tire suspected of being unserviceable should be dismounted and thoroughly inspected inside and out before being inflated.

⚠WARNING

Do not mix rim parts of different rim manufacturers. Rim parts may resemble those of a different manufacturer, but the required tolerances may be wrong. Use of mismatched rim parts is hazardous.

   b. If tires are dismounted, all wheel components must be cleaned, inspected, all rust and corrosion removed and parts repainted as applicable before remounting the tires. Follow the safety rules when mounting and inflating tires.
   c. Mount and inflate tires as shown in Operation and Maintenance Manual or service manual.
4. Inspect vehicle service brakes carefully.

⚠WARNING

Before disabling the brake circuit, block all wheels to prevent possible movement of the vehicle.

   a. If dust covers are installed on the inboard side of the wheels, remove the covers to allow for inspection of brake calipers/shoes and/or brake discs/drums.

⚠WARNING

The use of vapor degreasing or steam cleaning is not recommended, either for brake assemblies or the component parts. Corrosion and rusting may occur.

   b. All brake lines, connections and pressure converters must be clean, serviced and free of rust and corrosion.
   c. Check condition of brake fluid; fill or replace fluid as necessary.

ELECTRIC DRIVE TRUCKS

Storage Instructions and Procedures

This instruction provides the recommended procedures for protecting equipment from damage during both short-term and long-term storage periods and for maintaining adequate protection while in storage. Also included are instructions for placing this equipment into service after having been stored.

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

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

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

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

⚠WARNING

NEVER APPLY ANY SPRAY, COATING OR OTHER PROTECTIVE MATERIALS TO AREAS NOT SPECIFICALLY RECOMMENDED .

It is also important to note that these instructions cannot possibly anticipate every type of storage condition and, therefore, cannot prevent all equipment deterioration problems caused by inadequate storage. However, these instructions should be considered as a minimum procedure to achieve the best possible equipment life and the lowest operating cost when the equipment is returned to service.

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

Placing Equipment Into Storage

Perform the following instructions when preparing General Electric equipment for storage. There are three main equipment categories to consider:

1. When storing a truck that is operational.
2. When storing a truck that is not operational.
3. When storing major components (Motorized Wheel, alternator, etc.).

These three major categories are the basis for determining required protective measures.

NOTE: In addition to these instructions, refer to truck storage instructions.

When Storing A Truck That Is Operational

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

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

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

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

1. Drain the oil from the gear case and install rust preventive compound 4161 (product of Van Straaten Chemical Co.)or equivalent. Fill per General Electric Motorized Wheel Service Manual.
2. Megger the wheels as indicated in the instructions above. Operate the truck for at least 30 minutes to insure that the rust preventive compound has been thoroughly circulated throughout the gear case. Stop the truck and drain the rust preventive compound.

NOTE: Do not run a LOADED truck with rust preventive compound in Motorized Wheel gear cases.

CENTER AND LEFT HAND DECK COMPONENTS

The center deck and left hand deck utilize several individual structures mounted on the main deck supports. Refer to Figure 2-2 for the location of individual sections. Figure 2-4 shows the location of the left deck supports and attachment points. If cab removal is required, refer to Section “N” for removal instructions.

⚠WARNING

Before performing deck removal or repairs, be certain the battery disconnect switch is open and all hydraulic pressure has been released prior to removing any hoses, electrical harness connectors, etc.

⚠CAUTION

The decks are covered with anti-slip surfaces. These surfaces must be kept clean and replaced as they become worn.

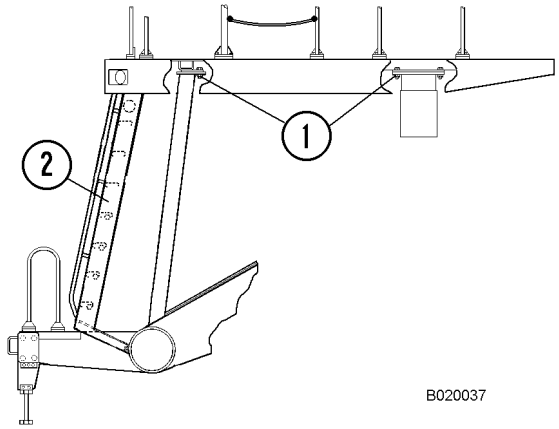


FIGURE 2-4. LEFT DECK MOUNTING

1. Mounting Hardware 2. Vertical Ladder

POWER MODULE

The radiator, engine and alternator/blower assemblies are mounted on a roller equipped subframe which is contained within the truck's main frame and is referred to as a “Power Module”. This arrangement permits removal and installation of these components with a minimum amount of disconnect being made and by utilizing the unique “Roll In/Roll Out” feature.

Although the instructions in this section are primarily based upon the “Rollout” method for major component removal, the radiator and fan may be removed as separate items. Instructions for radiator and fan removal are contained later in this section.

PREPARATION

⚠WARNING

The complete power module weighs approximately 36,950 lbs. (16 760 kg). Make sure lifting device to be used is of an adequate capacity.

1. Position the truck in a work area with a flat, level surface and adequate overhead clearance to permit raising the dump body.
2. Apply parking brake and block wheels to prevent truck movement. Raise body and install safety lock pin and body cable.

⚠WARNING

Do not work under raised body without first making sure the body lock pin and body cable is installed.

3. Tag or mark all air lines, oil lines, fuel lines and electrical connections to assure correct hookup at time of power module installation. Plug all ports and cover all hose fittings or connections when disconnected to prevent dirt or foreign material from entering.
4. It is not necessary to remove the grille or radiator prior to the removal of the power module. If radiator removal is desired or if only radiator repair is necessary, refer to “Cooling System” in this section.

Removal

1. Disconnect batteries using the following procedure in this order:
   a. Open battery disconnect switch located on battery equalizer box on deck of truck.
   b. Remove battery equalizer GND (-) terminal.
   c. Remove +12V (output) terminal at equalizer.
   d. Remove +24V (input) terminal at equalizer.
   e. Disconnect battery negative (-) terminal at battery box.
   f. Disconnect battery positive (+) terminal.
2. Disconnect hydraulic pump drive shaft (1, Figure 2-4) at the drive shaft U-joint companion flange.
3. Remove main alternator blower duct (Refer to Figure 2-1):
   a. Remove clamps and disconnect power cables from the rectifier diode and resistor panels (2, 3) located on the rear of the blower intake duct. Remove cover and disconnect cables (routed to main alternator) from front side of transition structure (5).
   b. Attach a lifting device to the rear center deck structure (4), remove attaching hardware and remove from truck.
   c. Remove clamps and disconnect air hose (6) at electrical cabinet and main alternator.
   d. Attach hoist to lifting eyes on blower inlet duct assembly. Remove hardware attaching duct to main alternator inlet. Remove hardware attaching upper duct mounts to electrical cabinet. Remove hardware attaching duct to deck at right and left sides.
   e. Recheck for any other cables or hoses and lift duct assembly from the truck. Cover all openings to prevent entrance of foreign material.

POWER TRAIN

ALTERNATOR REMOVAL PROCEDURE

Removal (Komatsu SSDA16V160 Engine)

The following instructions cover the removal of the main alternator from the engine after the power module has been removed from the truck. (Refer to Figure 4-2.)

⚠WARNING

When lifting alternator, attach hoist to lift eyes only. The alternator weighs approximately 7,700 lbs. (3493 kg). Use a lifting device that can handle the load safely.

1. Attach hoist with two lifting chains to the alternator lifting eyes (7, Figure 4-2).
2. Block under rear of engine
   a. Loosen cradle adjustments setscrews (3, Figure 4-1).
   b. Loosen engine/cradle capscrews (3, Figure 4-2).

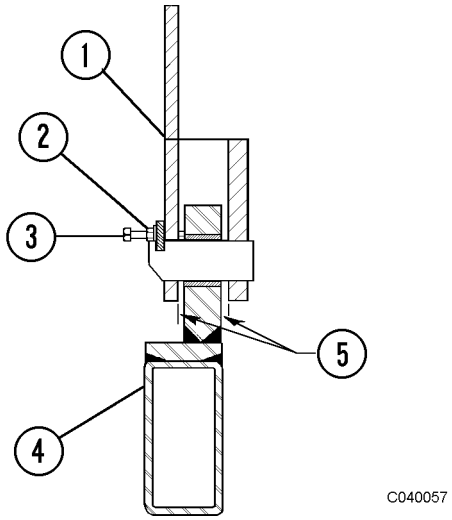


FIGURE 4-1. CRADLE STRUCTURE

1. Cradle Structure
2. Jam Nut
3. Adjustment Setscrew
4. Subframe
5. Gap

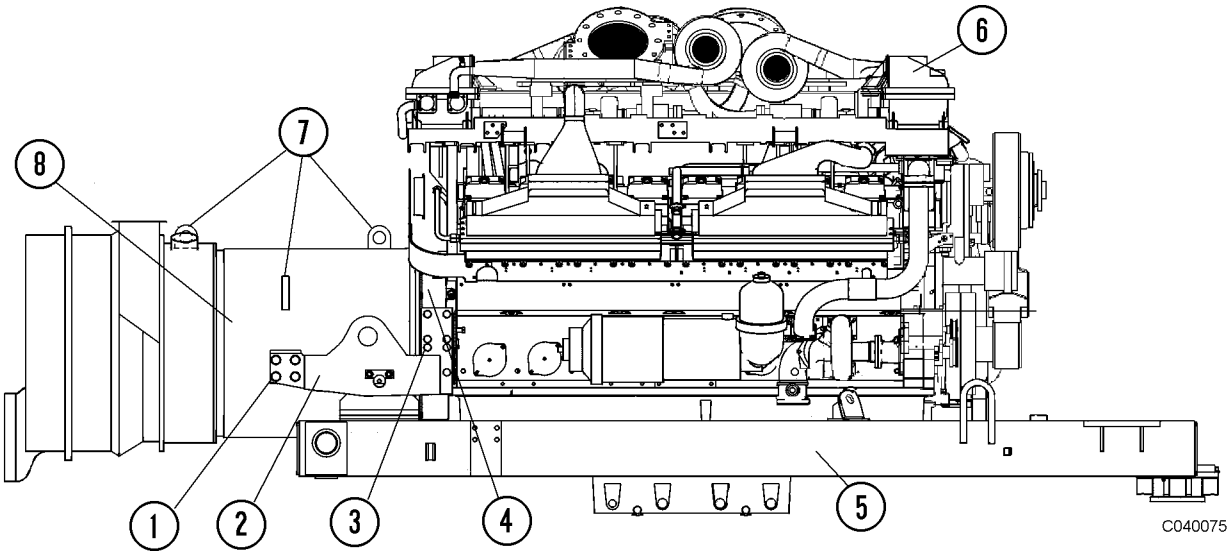


FIGURE 4-2. ENGINE AND ALTERNATOR

1. Capscrews & Lockwashers
2. Cradle Structure
3. Capscrews
4. Flywheel Housing
5. Subframe
6. Engine
7. Alternator Lift Eyes
8. Alternator/Blower

5. Submerge precleaner section (see Figure 5-6.) in a solution of Donaldson D-1400 and warm water (mix solution according to package directions). Soak for 30 minutes, remove from solution and rinse thoroughly with fresh water and blow dry.

6. Severe plugging may require the use of an Oakite 202 and water solution. The solution should be mixed 50% Oakite 202 and 50% fresh water. Soak precleaner section for 30 minutes, rinse clean with fresh water and blow dry completely.

7. Check precleaner gaskets (13) carefully for any evidence of air leaks, replace if necessary

8. Install precleaner section, with serviceable gaskets, on air cleaner assembly and install all mounting hardware removed.

9. With a serviceable gasket (2), install dust collector cup assembly on precleaner section and secure with mounting clamps.

Maintenance Free types:

- Immediately after engine start, system volts are lower than regulator setpoint with low amps.
- 15-30 minutes into charge cycle, still low volts and low amps.
- 15-30 minutes into charge cycle, volts rise several tenths, amps increase gradually then increase quicker to medium to high amps.
- 20-35 minutes into charge cycle, volts rise to setpoint and amps lower.

High-Cycle Maintenance Free Types:

These types respond much better than standard maintenance free types. The charge acceptance of these batteries may display characteristics similar to standard, maintenance type batteries.

CHARGE VOLT AND AMP VALUES

Voltage and amperage levels are functions of battery state of charge. If the batteries are charged 95% or higher when the engine is cranked, the charge voltage will be near regulator setpoint and the amps will taper quickly from medium to low. True battery voltage is obtained AFTER removing any surface charge from the battery or after 24 hours of non-use.

DEFINITIONS

NOTE: Charge voltage and amp rates vary from battery type to battery type, based on battery construction technology and physical size of battery.

Low amps are the necessary amps that a battery will take continuously over a period of time without damage to the battery when the battery *is in an operating system and is constantly cycling.* Batteries such as the Group-8D may accept rates up to 15 amps over several hours without raising their internal temperature more than a few degrees. Group-31 batteries may accept rates up to 5 amps over several hours with minimal temperature rise.

Medium amps are defined as some multiple of the low amp value, perhaps 30 amps for the Group-8D and 10-15 amps for the Group-31. This rate of amperage will cause a rise in battery temperature over a long period of time (4-8 hrs) and may lead to an overcharge condition if temperature elevates too high.

High amps would be 50 to 75 amps for a Group-8D, and 25 to 35 amps for a Group-31 size. High amperage rates over a short period of time (2-3 hrs.) can severely damage any battery by overheating the battery and causing thermal runaway. The battery, in effect, forgets its state of charge and will accept all amps offered. The electrolyte solution is boiled off as the battery moves into an excessive gassing stage.

Charge voltage is the voltage delivered to the battery when the alternator and regulator are operating properly. This charge voltage value is the voltage regulator's setpoint. At times the charge voltage value may be less than the regulator's setpoint but it will never be higher than that setpoint.

Battery voltage is the steady state voltage of the battery. The value of this voltage relates directly to state of charge.

B+ voltage is battery positive voltage, but does not refer to a specific value as does battery voltage.

Surface charge is a higher than normal terminal voltage a battery has when it comes off a charger or after extended time in vehicle operation. The surface charge must be removed to determine true battery voltage.

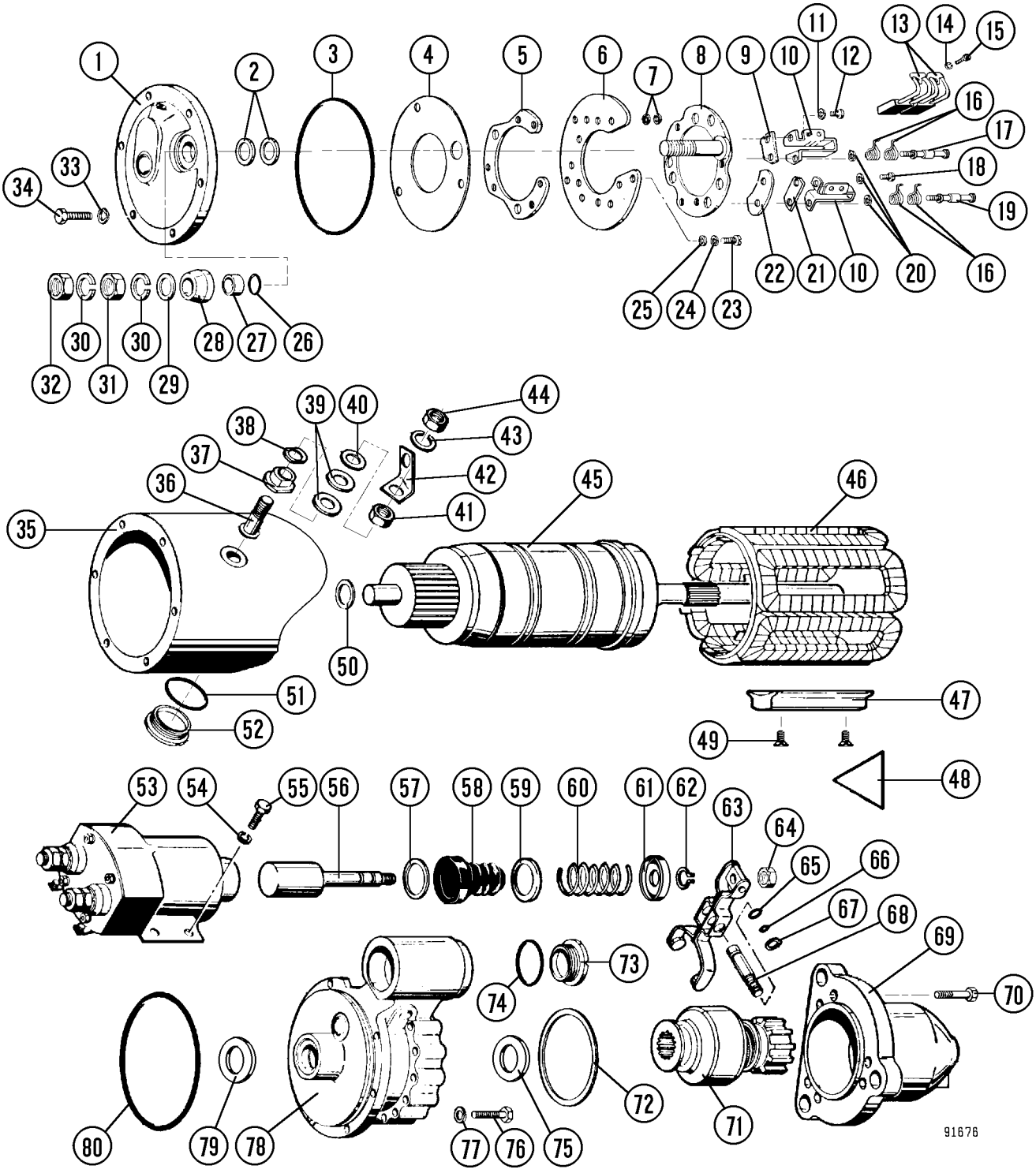


FIGURE 2-8. CRANKING MOTOR ASSEMBLY

24 VOLT RELAY AND DIODE BOARDS

The truck is equipped with 5 relay boards and a diode board to provide control in many of the 24 volt electrical system circuits. Some trucks may have a sixth (Auxiliary) relay board installed.

Each relay board contains 4 relays, all of which are interchangeable.

Each relay board also contains circuit breakers, which are also interchangeable between the relay boards.

⚠WARNING

DO NOT interchange or replace any circuit breaker with one of a different capacity than specified for that circuit. Serious damage or fire may result if the wrong capacity circuit breaker is used.

The six relay boards and their primary use are identified as follows:

- Relay Board 1 Turn Signal
- Relay Board 2 Payload Meter (Optional)
- Relay Board 3 Stop Lights
- Relay Board 4 Parking Brake
- Relay Board 5 Head Lights
- Relay Board 6 Auxiliary Panel

The truck is also equipped with a diode board:

- Diode Board 1

Refer to Circuit Breaker chart for the circuits each circuit breaker protects.

RELAY BOARDS

Description

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

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

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

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

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	

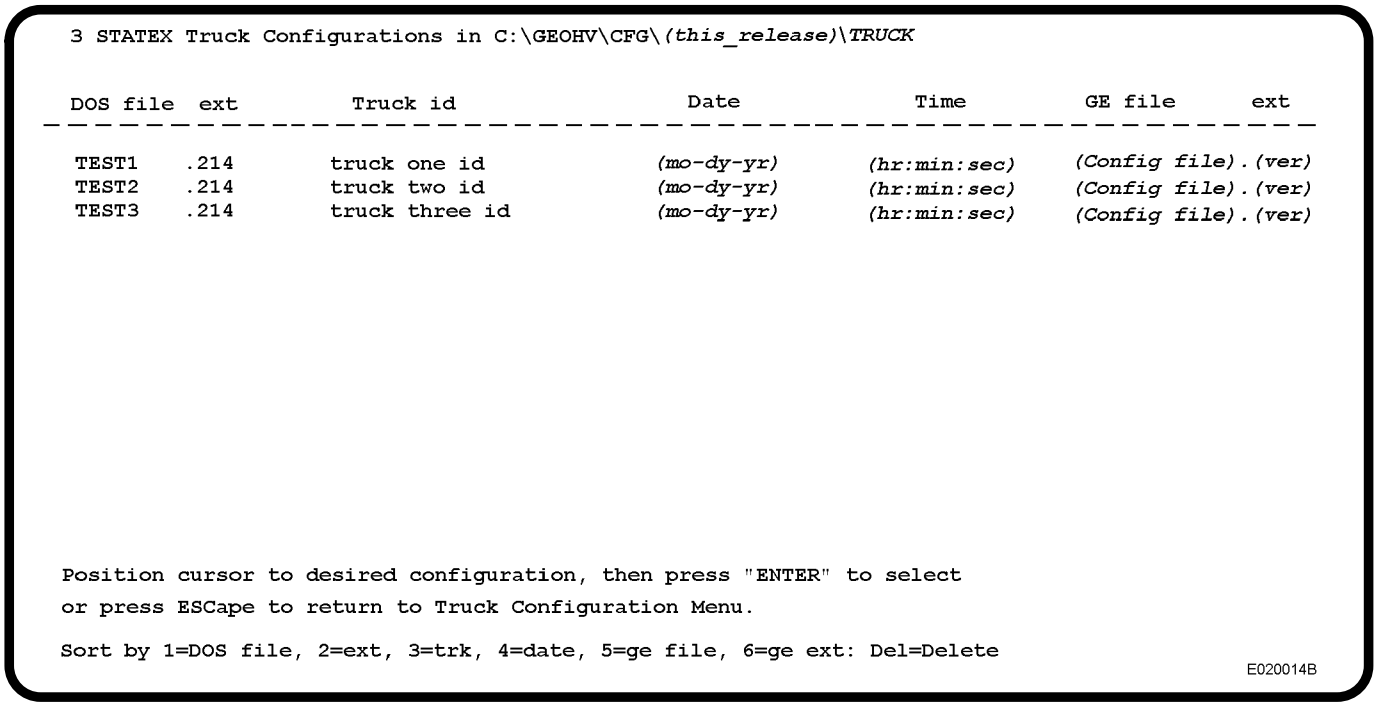


FIGURE 2-11. CONVERTED TRUCK CONFIGURATION FILE LIST

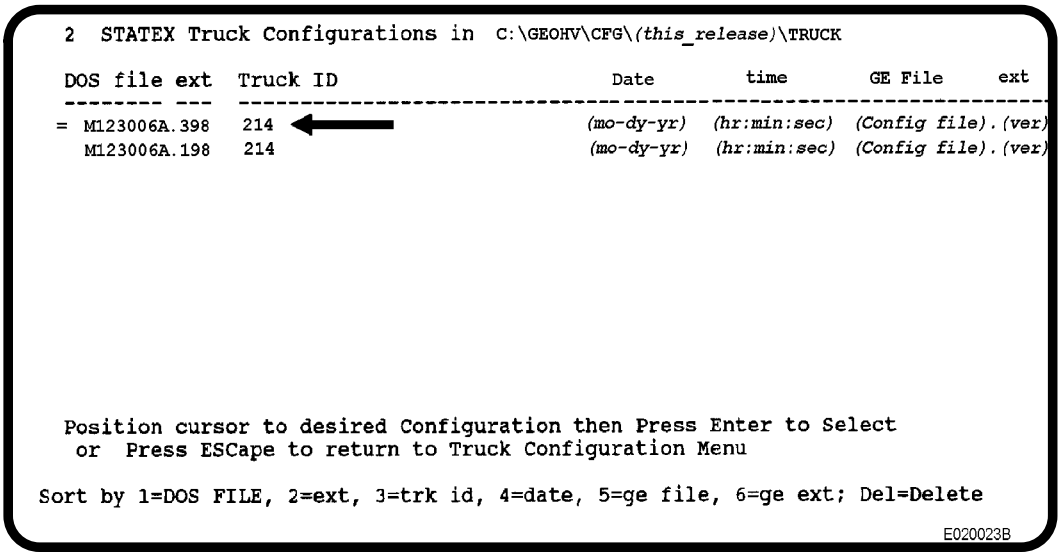


FIGURE 2-21. TRUCK CONFIGURATIONS FILE LIST
(Sample file name shown added to list)

"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].

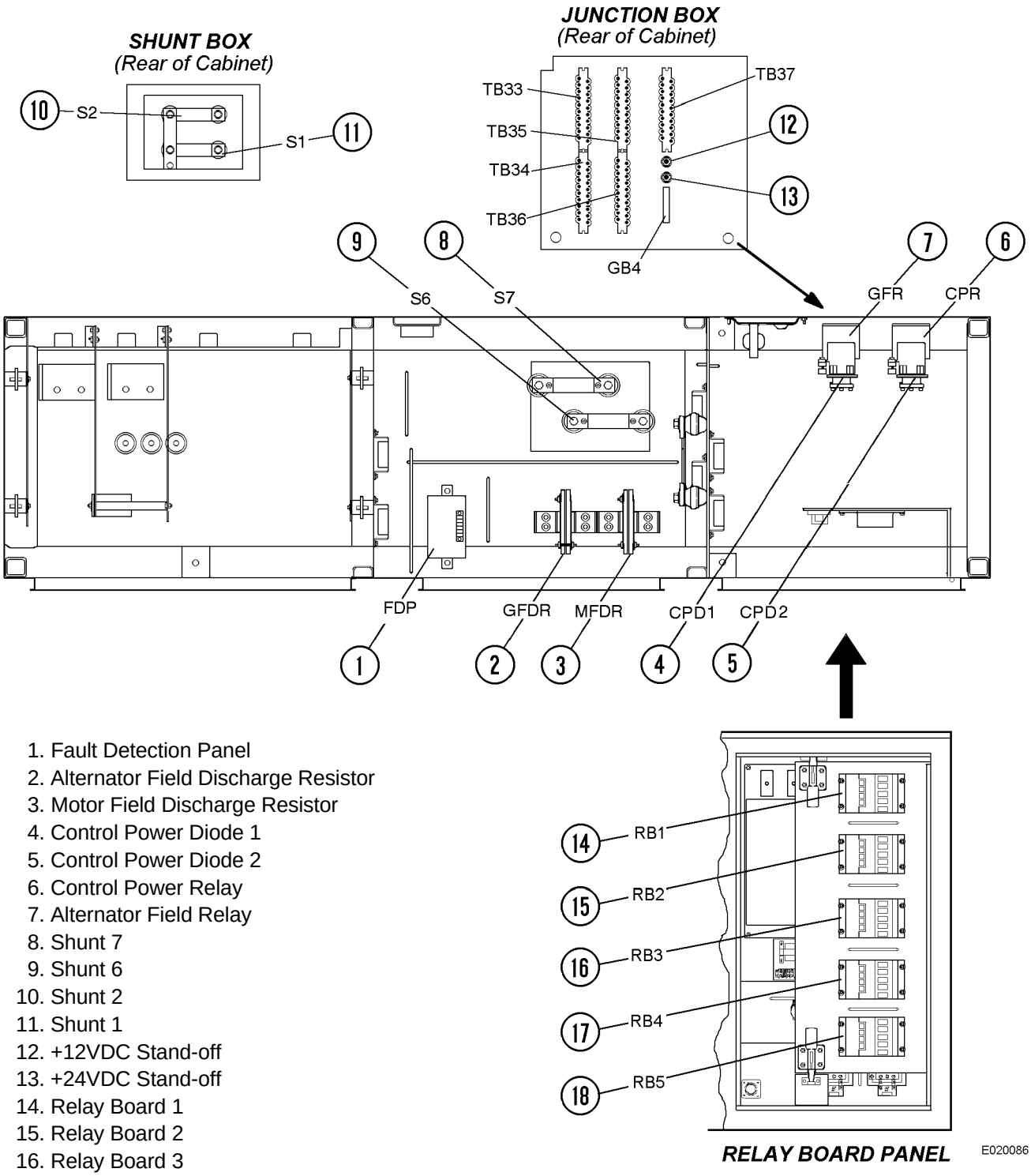
NOTE: It is not necessary to enter values for every line. For example, if only Loaded Speed Limit is to be changed, select that line with the cursor, and type in the desired value. The remaining speeds will be determined by the values in the truck configuration file.

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**.



1. Fault Detection Panel
2. Alternator Field Discharge Resistor
3. Motor Field Discharge Resistor
4. Control Power Diode 1
5. Control Power Diode 2
6. Control Power Relay
7. Alternator Field Relay
8. Shunt 7
9. Shunt 6
10. Shunt 2
11. Shunt 1
12. +12VDC Stand-off
13. +24VDC Stand-off
14. Relay Board 1
15. Relay Board 2
16. Relay Board 3
17. Relay Board 4
18. Relay Board 5

FIGURE 2-41. CONTROL CABINET, VIEW E

1.1.1 Electronic Throttle System. (Williams electronic foot pedal, Dresser ACC/RET Interface Circuit and Pedal Detector Card).

NOTE: *Foot pedal with <u>adjustable</u> pedal potentiometer is used with a TZ6661 or EB2635 (non- adjustable) ACC card.*
<u>Non-adjustable</u> foot pedal requires use of EC1806 (adjustable) ACC card.

1. Turn key switch On.
2. Turn control power switch in control cabinet to the Off position.
3. Normal/Advance Idle switch should be in the Off ("Normal") position.

   ☐ Measure 4.80 ± 0.10 vdc between circuits 916 and 952 in Control Cabinet.
4. If not correct, check 916 circuit to engine.
5. If available, use the DDR (DDEC engine trucks) to read the PTO counts or use a voltmeter to measure voltages shown below. (The Control Power switch and Normal/Advance Idle switch should be in the Off ("Normal") position and the accelerator pedal released.) If unable to adjust properly, replace ACC card.

STEP	CIRCUIT	ACC CARD	VDC	PTO COUNTS	ADJUSTMENT
1	525(+) to 952(-)	**TZ6661**	.75 (approx.)	18 ± 1	Position of pedal potentiometer. If unable to adjust, replace potentiometer.
		EB2635	.78 (approx.)	17 ± 1	
		EC1806	.53 (approx.)	21 ± 3	Adjust P1 on ACC card. If unable to adjust, replace pedal assembly.
2	510(+) to 952(-)	**TZ6661**	.34 (approx.)	18 ± 1	If out of tolerance, replace ACC card.
		EB2635	.37 (approx.)	17 ± 1	
		EC1806	.40 (approx.)	21 ± 3	Adjust P1 on ACC card (Seal pot). If unable to adjust, replace pedal assembly.

6. Measure the voltage between circuits 76L and 710.

   ☐ Read 25.25 to 28 vdc. If voltage is low, recharge batteries.
7. With the Normal/Advance Idle switch in Off ("Normal") position, turn key switch Off, then On.

   ☐ Measure voltage between circuits 510 to 952. Repeat 3 times. If voltage ever reaches or exceeds 2.0 vdc, replace ACC card. Verify the Normal/Advance Idle switch is in Off position.
8. Turn control power switch On, place selector switch in FORWARD. With throttle pedal depressed just until propulsion contactors pick up, measure the following:

CIRCUIT	ACC CARD	VDC	PTO COUNTS
510(+) to 952(-)	**TZ6661**	.107 (approx.)	33 ± 2
	EB2635	.68 (approx.)	32 ± 2
	EC1806	.64 (approx.)	34 ± 2

9. With throttle pedal fully depressed, measure the following:

CIRCUIT	ACC CARD	VDC	PTO COUNTS	ACTION IF OUT OF TOLERANCE
510(+) to 952(-)	**TZ6661**	3.80 (approx.)	203 -4/+ 10	Replace ACC card or pedal
	EB2635	4.35 (approx.)	215 -4/+ 10	
	EC1806	4.05 (approx.)	215 -4/+ 10	

10. Release throttle pedal.

1.9. Anti-Reversal Function (AR) Check

- Disconnect wheel motor speed sensor wires 77, 77A, 714 & 714A in control cabinet. Jumper circuit 77 to 714. Jumper circuit 77A to 714A.
- Connect an oscillator to circuit 77 and 77A at control cabinet terminal board. Do not turn oscillator on.

1. Move Selector Switch to FORWARD. Depress throttle.

FORIN AS

   a. Verify the feedback signal:

FORFB

2. Propulsion contactors MF, P1/(P2), GF, and GFR should energize.

MF P1 (P2) GF GFR

   a. Verify the feedback signals:

MFFB P1FB (P2FB) GFFB GFRFB

3. Turn oscillator On and increase frequency until **M1-SPD** & **M2-SPD** reads 3 mph.
4. Move Selector Switch to REVERSE.
5. All contactors should drop out, Reverser should stay in forward position (to the right).
6. Release throttle and remove oscillator. Remove jumpers and reconnect speed sensor wires at terminal board.
7. Reverser should shift to REVERSE position (to the left).
   a. Verify the feedback signal:

REVFB

8. Move selector switch to NEUTRAL.

1.10. Overspeed Retard Operation Check

- Disconnect wheel motor speed sensor wires 77, 77A, 714 & 714A at control cabinet terminal board.
- Jumper circuit 77 to 714, jumper circuit 77A to 714A on terminal board.
- Connect an oscillator to circuit 77 and 77A at terminal board.

1. Move Selector Switch to FORWARD, and depress throttle.

FORIN AS

   a. Verify the feedback signal:

FORFB

2. Propulsion contactors MF, P1/(P2), GF, and GFR should energize.

MF P1 (P2) GF GFR

   a. Verify the feedback signals:

MFFB P1FB (P2FB) GFFB GFRFB

3. Increase the oscillator frequency until **OVRSPD** DIGITAL OUTPUT changes from **off** to = **on**, which will indicate that overspeed condition has been obtained.

OVRSPD

3. ANALOG INPUT SIGNALS TEST - FL275 CARD PANEL

The PTU will be used to test analog inputs to the FL275 panel analog I/O Card, to verify proper truck wiring, control panel wiring and component operation.

- Connect PTU at control cabinet as described previously.
- Turn PTU On and type "gemenu" at the DOS "C:> " prompt. Press [ENTER].

3.1. Setup Analog Input Monitor Screen on PTU

1. With control power On, select "PTU TALK TO TRUCK" on **GE OHV STATEX III MENU.** Press [ENTER] key.
2. At "Enter your name:" type your name. Press [ENTER] key.
3. At "Enter your password:" type your password. Press [ENTER] key.
4. The **GE STATEX III PTU MAIN MENU** should appear on the screen.
5. Move cursor to select "NORMAL OPERATION". Press [ENTER] key.
   a. A screen will appear that states: "Selection of NORMAL OPERATION gives truck control to the driver. Continue?"
   b. With the cursor next to "Yes", press [ENTER].
6. The **NORMAL OPERATION MENU** should appear on the screen.
7. Move cursor to select "MONITOR ANALOG INPUT CHANNELS". Press [ENTER] key.
8. The **MONITOR ANALOG INPUT CHANNELS** screen, Figure 3-10. should appear.

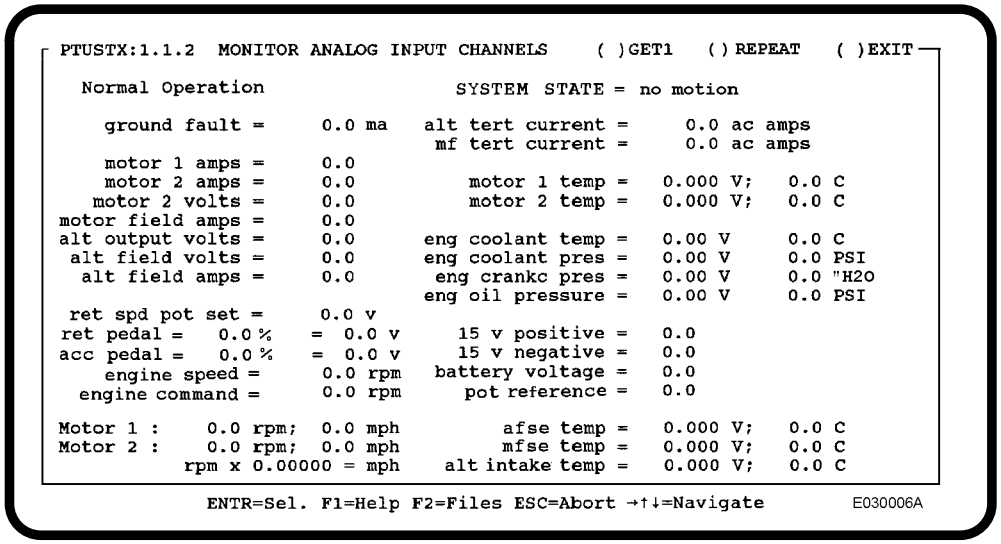


FIGURE 3-10. MONITOR ANALOG INPUT CHANNELS SCREEN

4.1. Single Speed Overspeed Truck - Overspeed Settings Check

1. While observing the **RETARD STATE LOGIC SCREEN**, increase the oscillator frequency from minimum until the retard contactors RP1 and RP2 pick up in overspeed.
2. Verify the **M1- SPD** and **M2 - SPD** mph readings agree with values recorded from the truck configuration file **OVERSPEEDS ENTRY SCREEN.**
3. Lower the oscillator frequency and verify that retard contactors RP1 and RP2 drop out at the specified dropout frequency as recorded from the **OVERSPEEDS ENTRY SCREEN.**

4.2. Two Speed Overspeed Truck (Empty Truck) - Overspeed Settings Check

1. Jumper 71 to 73LS in control cabinet to simulate an empty truck.
2. While observing the **RETARD STATE LOGIC SCREEN**, increase the oscillator frequency from minimum until the retard contactors RP1 and RP2 pick up in overspeed.
3. Verify the **M1- SPD** and **M2 - SPD** mph readings agree with values recorded from the truck configuration file **OVERSPEEDS ENTRY SCREEN.**
4. Lower the oscillator frequency and verify that retard contactors RP1 and RP2 drop out at the specified dropout frequency as recorded from the **OVERSPEEDS ENTRY SCREEN.**

4.3. Two Speed Overspeed Truck (Loaded Truck) - Overspeed Settings Check

1. Remove jumper 71 to 73LS to simulate a Loaded Truck.
2. While observing the **RETARD STATE LOGIC SCREEN**, increase the oscillator frequency from minimum until the retard contactors RP1 and RP2 pick up in overspeed.
3. Verify the **M1- SPD** and **M2 - SPD** mph readings agree with values recorded from the truck configuration file **OVERSPEEDS ENTRY SCREEN.**
4. Lower the oscillator frequency and verify that retard contactors RP1 and RP2 drop out at the specified dropout frequency as recorded from the **OVERSPEEDS ENTRY SCREEN.**

4.4. Other Speed Events Checks

NOTE: 3 Step or 7 Step Extended Range Retarding Contactors (RP3-RP5, and RP6-RP9 if used) should all be picked up at low frequencies, then drop out one by one when frequency is increased to their specified DROPOUT point. They should then pick up one by one as frequency is decreased to their specified PICKUP point.

1. With the selector switch in FORWARD position, depress retard pedal.
2. While observing the **RETARD STATE LOGIC SCREEN**, verify the **M1- SPD** and **M2 - SPD** mph readings agree with values recorded from the **TRUCK CONFIGURATIONS DATA CURVES SCREEN.**
3. Turn the oscillator frequency to minimum. Verify that the RP contactors drop out in the sequence listed, as the oscillator frequency is slowly increased.
   a. 3 Step Extended Range Retarding - RP5, RP4, and RP3 contactors.
   b. 7 Step Extended Range Retarding - RP9, RP8, RP7, RP6, RP5, RP4, and RP3 contactors.

8.6.1 Voltage Measuring Module Test (VMM1 and VMM2)

- NOTE: There are two recommended test procedures for testing the 17FM458 Voltage Measuring Module. One test requires the use of a high voltage power supply and can be found in the 17FM458 Instruction Book and all appropriate vehicle test books. The alternate test method is detailed below.

1. Disconnect 74C at GFR relay.
2. Disconnect the wires from terminals "A" and "C".
3. Turn On control voltage (B+).
   - ☐ Verify + 15V on terminal "G" and -15V on terminal "E."
   - ☐ Measure and record B+ voltage on wire 71.
4. Connect a voltmeter from terminals "D" (+) to "F" (-).
5. Jumper terminals "C" to "F" and terminals "A" to "F".
   - ☐ Verify 0.00 ± 0.02V on the voltmeter.
6. Remove jumper from terminals "A" to "F".
7. Jumper terminal "A" to B+ .
   - ☐ Verify voltmeter reads (B+)÷ 200, ± 2%.

   Example: If B+ = 25v, the voltmeter should read:
   25÷ 200 = 0.125 ± 0.0025 volts.
8. Turn off control power, disconnect voltmeter and jumpers and reconnect all wiring to the panel.

8.6.2 ISOA3, ISOA4, ISOA5, ISOA6, ISOA-7, and ISOA-8 Test.

1. Connect a voltmeter between terminal "D" (+) and terminal "F" (-) of the Iso-Amp to be tested.
2. Turn the control power On.
   - ☐ Verify the voltage at "D" is less than 0.030 volts.
3. Turn the control power switch "Off". Disconnect the terminal "B" input for each Iso-Amp:
   a. 75A for ISOA3
   b. 75C for ISOA4
   c. 717S for ISOA5
   d. 72T for ISOA6
   e. 72W for ISOA7
   f. 73Y for ISOA8
4. Connect a jumper wire from terminal "C" to terminal "F" and another from terminal "A" to terminal "G".
5. Turn the control power switch On.
   - ☐ Verify the voltage at terminal "D" is 1.00 ± 0.05 volt.
6. Turn the control power switch Off. Remove the jumper wires and meter.
7. Reconnect 75A, 75C, 717S , 72T, 72W, and 73Y wires disconnected at ISOA3, ISOA4, ISOA5, ISOA6, ISOA7, and ISOA8.
8. Reconnect 74C at GFR.

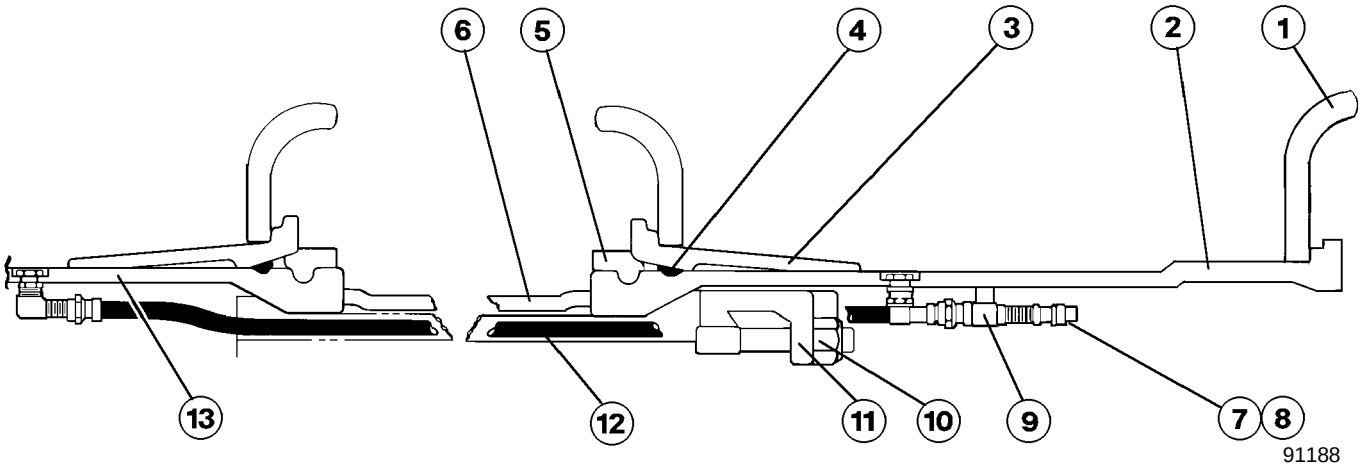


FIGURE 2-2. REAR WHEEL ASSEMBLY

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

⚠CAUTION

Use a strap or other means, to secure inner wheel before removing outer wheel assembly. This will prevent the accidental slipping of inner wheel during this operation.

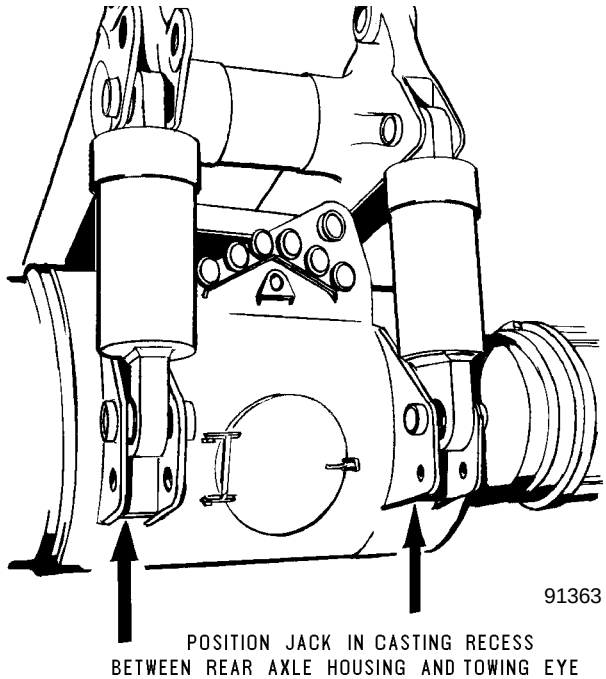


FIGURE 2-3. REAR AXLE JACK LOCATION

5. Pull straight out on outer wheel assembly and remove.
6. If inner wheel removal is necessary, remove spacer (6, Figure 2-2) by pulling straight out and removing from rear hub. (Refer to Figure 2-5.)

NOTE: Use care when removing spacer and inner wheel so as not to damage tire inflation extension tube.

7. Secure a lifting device to inner wheel and pull straight out to remove from wheel hub.

Installation

NOTE: Clean all mating surfaces before installing wheel assembly.

1. Attach lifting device to inner dual and install inner dual onto wheel motor hub. Use care not to damage tire inflation extension line.

NOTE: During inner wheel installation be sure air inflation line lays in channel on wheel hub assembly.

2. Using a lifting device, install spacer (6, Figure 2-2) onto wheel motor hub. Tap spacer up against inner dual.
3. Attach lifting device to outer dual and position onto wheel motor hub.

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.

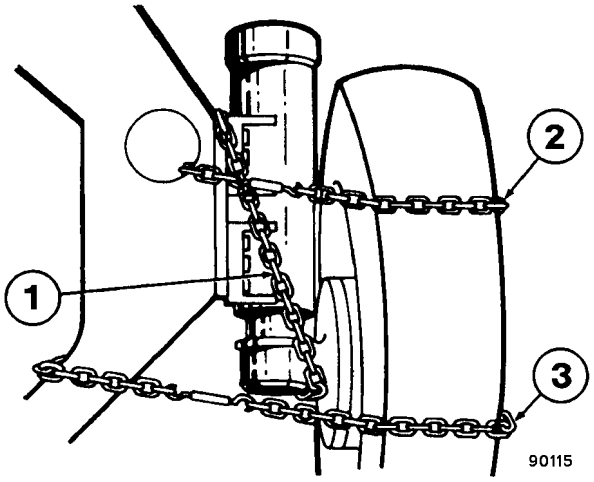


FIGURE 3-10. WHEEL SUPPORT CHAIN INSTALLATION

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 micorometer, 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

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.

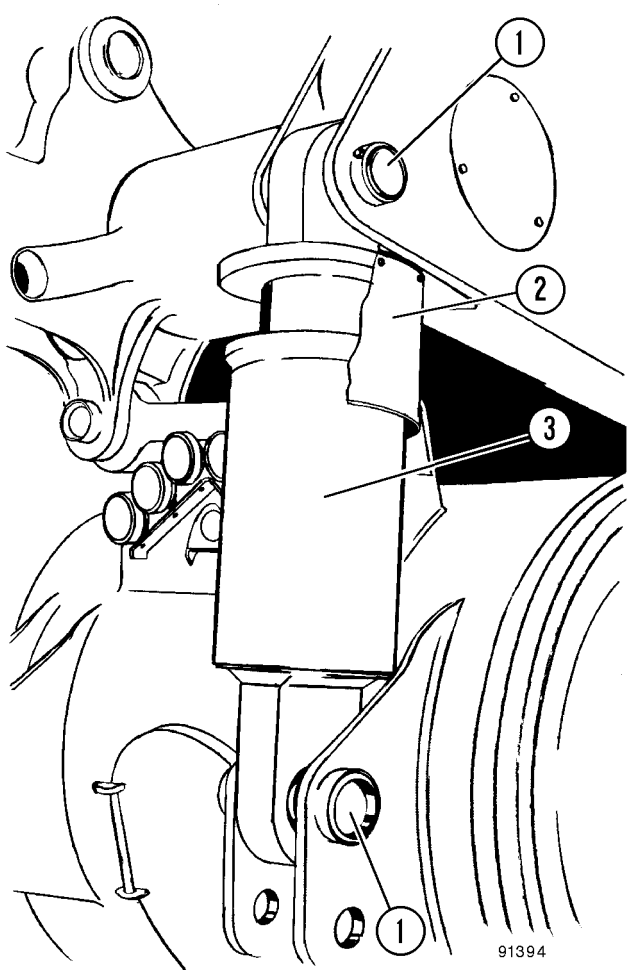


FIGURE 3-1. REAR SUSPENSION INSTALLATION

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

Removal

1. Remove capscrews, washers, and metal shield (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.

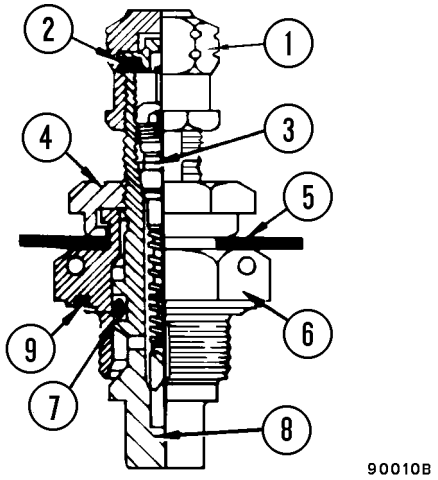


FIGURE 3-2. NITROGEN CHARGING VALVE

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

3. Depress the charging valve core to release nitrogen pressure from the suspension. When nitrogen pressure has been vented to atmosphere, loosen and remove the charging valve. The suspension should have collapsed slowly as gas pressure was released. Truck weight is now supported by the support blocks.

4. Use a plastic tube to help bleed off trapped air inside the piston. Remove vent plugs and the bleeder screw. Service the suspension with clean HYDRAIR® Oil until clean oil comes out of the port where the bleeder screw and plug were removed from the side of the housing. Drip pans should be used and all spillage cleaned from outside of suspension. Allow suspension to stand for at least 15 minutes to clear any trapped nitrogen and/or air bubbles from the oil. Add oil if necessary. Loosely install charging valve.

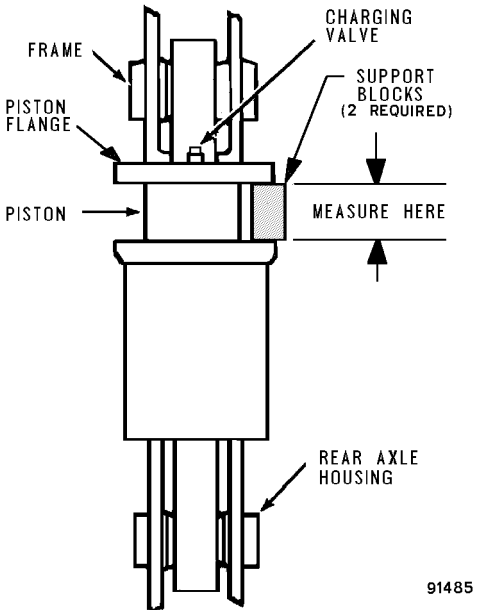


FIGURE 4-4. REAR SUSPENSION

REAR SUSPENSION DIMENSIONS (EMPTY)			
TRUCK MODEL & OPTIONS	OILING HEIGHT in. (mm)	CHARGING HEIGHT in. (mm)	CHARGING PRESSURE psi (kPa)
730E*	1.0 (25.4)	9.0 (229)	280 (1931)
830E*	1.0 (25.4)	9.5 (241)	250 (1724)
830E**	1.0 (25.4)	9.5 (241)	315 (2172)
930E*, E-2*	1.0 (25.4)	7.5 (190)	215 (1482)

* with Standard Rock Body

** with Combination Body /Tailgate

Note: If truck starts to lift off blocks before charging pressure is attained, STOP CHARGING.

Rear Suspension Nitrogen Charging

⚠WARNING

Lifting equipment (overhead or mobile cranes, or hydraulic jacks) must be of sufficient capacity to lift the truck weight. Be certain that all personnel are clear of lift area before lift is started.

1. With nitrogen charging support blocks at hand (see Figure 4-4), proceed as follows:
   a. With overhead crane or jacks raise the truck frame to provide clearance for blocks.
   b. Install nitrogen charging dimension blocks; secure blocks so they will not fly free.
   c. Lower truck frame until the blocks are firmly and squarely seated between the piston flange and cylinder housing.

NOTE: Prevent damage to plated surface, oil seals and capscrew heads.

⚠WARNING

Dry nitrogen is the only gas approved for use in HYDRAIR® II suspensions and accumulators. Charging of these components with oxygen or other gases may result in an explosion which could cause fatalities, serious injuries and/or major property damage.
Use only nitrogen gas meeting the specifications on the "Nitrogen Specifications Chart".

2. Install charging valve, with a new lubricated sealing O-ring (9, Figure 4-2) (use fresh HYDRAIR® oil). Tighten valve body (large hex) (6) to **16.5 ft. lbs. (22.4 N.m)** torque. The valve swivel nut (4) (small hex) must be unseated (counterclockwise) about three full turns.

3. Install HYDRAIR® Charging Kit and bottle of pure dry nitrogen. Following previous instructions, charge the suspensions with nitrogen gas to the pressure shown in Figure 4-4 for the truck being serviced. DO NOT use an overcharge of nitrogen gas to lift the suspension off the blocks.

4. Shut off gas pressure and remove charging kit components.

BRAKE CIRCUIT COMPONENT SERVICE

BRAKE VALVE

The Brake Valve is a pressure modulating valve, actuated mechanically (brake pedal) or hydraulically through the automatic apply valve (11, Figure 3-1).

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 with engine shut down, turning the key switch “Off” and waiting 90 seconds. Confirm the steering pressure is released by turning the steering wheel - No front wheel movement should occur. Open bleed down valves (10 & 12, Figure 3-1) located on the brake manifold and allow both accumulators to bleed down.

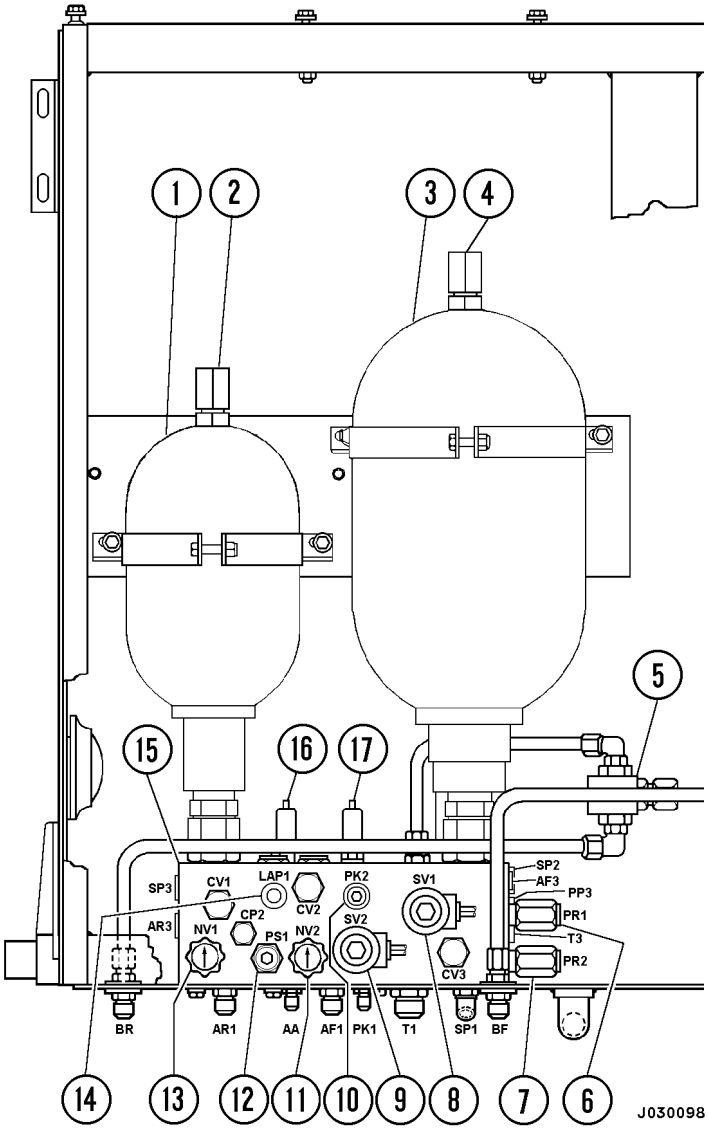


FIGURE 3-1. BRAKE ACCUMULATOR BLEED DOWN

1. Rear Brake Accumulator
2. Charging Valve
3. Front Brake Accumulator
4. Charging Valve
5. Brake Lock Shuttle Valve
6. Brake Lock Pressure Reducing Valve (PR1)
7. Park Brake Reducing Valve (PR2)
8. Brake Lock Solenoid
9. Park Brake Solenoid
10. Park Brake Test Port
11. Bleed Down Valve (Front Brake Accumulator)
12. Automatic Apply Valve
13. Bleed Down Valve (Rear Brake Accumulator)
14. Accumulator Test Port (LAP1)
15. Brake Manifold
16. Low Brake Accumulator Pressure Switch
17. Park Brake Pressure Switch

Test Set Up Procedure

1. Position the valve in the fixture to allow plungers to be activated by hand using a lever (refer to Figure 3-10).
2. Attach the pilot input supply pressure to the pilot port labeled “PX” on the rear of the valve.
3. Attach the main supply input pressure to the O-ring ports on the rear of the valve labeled “P1" and "P2".
4. Attach the tank return line to the O-ring port labeled “T” on the rear of the valve.
5. Attach the O-ring regulated output ports “B1” and “B2” to the test lines. Pressure monitoring devices in these two lines must be capable of 3,500 psi (24 132 kPa). Connect all ports. The connections should be according to the diagram shown in Figure 3-10. All ports must be used and connected.

⚠DANGER

All ports must be used. Relieve pressure before disconnecting hydraulic and other lines. Tighten all connections before applying pressure.

Avoid spillage and contamination! Avoid contact with hot oil if the machine has been operating. The oil will be at very high 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.

6. Start hydraulic pump and regulate output pressure to 3200 psi (22 064 kPa) at pressure gauge (3). Pressure gauges (7 & 10) should read zero.
7. Set pilot supply pressure on test stand to 3200 psi (22 064 kPa).
8. Return line pressure during this test is not to exceed 5 psi (34 kPa).
9. Test the valve with ISO grade hydraulic oil at 120° ±10° F (49° ±3° C).

Brake Valve Output Pressure Adjustment

1. Install the pedal pivot shaft pin in the actuator base by itself without installing the pedal assembly.
2. By taking a screw driver or pry bar and placing it under the pivot pin and on top of the threaded plunger assembly, each circuit can be actuated individually. Refer to Figure 3-10.
3. Gradually apply pressure on each circuit (one at a time) to check for leaks around the plunger. Make sure the adjustment collar is screwed all the way down on the threads.
4. **“B1” Adjustment:** Adjust the adjustment collar up (counter-clockwise) starting with one turn increments until the output pressure at port “B1” is 2000 -0/+75 psi (13 790 -0/+517 kPa) with the adjustment collar contacting the actuator base **(fully actuated)**. Fine adjustment will require turning the collar only in 1/8 turn increments.
5. **“B2” Adjustment:** Adjust the adjustment collar up (counter-clockwise) starting with one turn increments until the output pressure at port “B2” is 3000 -0/+150 psi (20 685 -0/+1 034 kPa) with the adjustment collar contacting the actuator base **(fully actuated)**. Fine adjustment will require turning the collar only in 1/8 turn increments.
6. Tighten the setscrews in the adjustment collars to **25 - 30 in.lbs. (2.8 - 3.4 N.m) torque.** The entire plunger may have to be rotated to get to the capscrews.
7. Check pressures again after tightening the set screws. If the pressures have moved out of specified range, loosen the appropriate set screw and re-adjust.
8. Cycle each circuit 50 times using pilot apply. This is done by closing needle valve (5) and opening needle valve (4). Read pressure on gauges (7 & 10). Close valve (4) and open valve (5). The pressure gauges (7 & 10) should read 0 psi.
9. Recheck pressures after cycling. If they have changed, re-adjust pressures.

Differential Pressure Switch Test

10. Attach ohmmeter lead to connector on differential pressure switch wire. Attach other lead to valve body.
11. Insert pry bar under pivot pin to actuate the “B1” section of valve.
12. Slowly depress plunger while observing the ohmmeter; switch contacts should close at pressure shown in Table I.

Table I - Differential Pressure Switch Adjustment

Spring Color	Pressure - Switch Contacts Closing	
	“B1” Valve Spool	“B2” Valve Spool
Red	250 ±30 psi (1 724 ±207 kPa)	375 ±50 psi (2 585 ±345 kPa)
Green	600 ±50 psi (4 137 ±345 kPa)	1000 ±75 psi (6 895 ±517 kPa)

BRAKE CIRCUIT ABBREVIATIONS	
AA	Automatic Apply Pressure
AF	Accumulator, Front Brake
AF1	Supply Pressure to Dual Controller for Front Brakes
AR	Accumulator, Rear Brake
AR1	Supply Pressure to Dual Controller for Rear Brakes
BF	Brake Pressure, Front (11, Figure 4-1)
BL	Brake Lock Apply Pressure
BR	Brake Pressure, Rear (11, Figure 4-1)
CV,F or R	Check Valve, Front or Rear
DSV	Shuttle Valve
DSV 4	Low Pressure Emergency Apply Shuttle Apply Valve
LAP1	Pressure Tap Test Port Low Accumulator Pressure
LAP2	Low Accumulator Pressure Switch [N.C., 2350 ± 75 psi (16.2 MPa)]
NVF	Front Accumulator Manual Drain Valve
NVR	Rear Accumulator Manual Drain Valve
PBP	Park Brake Pressure Regulator (To Release)
PK1 & 2	Park Brake Release Pressure
PP	Pressure Tap Test Port Brake Lock Pressure
PR	Pressure Reducing Valve
PSV	Automatic Apply Valve
SP1	Supply Oil Inlet
SP3	Pressure Tap Test Port Brake Circuit Supply Oil Pressure
SV1	Brake Lock Solenoid
SV2	Park Brake Solenoid
T, 1 & 3	Return To Tank

EQUIPMENT REQUIRED

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

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

The following equipment will be necessary to properly check-out the hydraulic brake circuit.

a. Hydraulic brake schematic, refer to Section "R" this manual.

b. Calibrated pressure gauges:

Two 0-5000 psi (0-34,475 kPa) range.

Three 0-3000 psi (0-20,685 kPa) range.

c. One PB6039 female quick disconnect and hose long enough to reach from brake cabinet to the inside of the operator's cab for each gauge.

d. Accumulator charging kit (EB1759 or equivalent) with gauges and dry nitrogen.

NOTE: A gas intensifier pump will be required, if using "T type" nitrogen bottles.

e. Clear plastic hose and bucket for bleeding brakes.

f. Volt/ohm meter with leads and two 24 inch (61 mm) leads with alligator clips.

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 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).
6. Remove nuts and flatwashers (5, Figure 5-3) and remove outboard half of brake caliper. Remove capscrews and flatwashers (6) securing inboard half of caliper to the brake adapter (4). Remove Inboard caliper.
   NOTE: It may be necessary to pry between the brake lining and disc in order to force the piston inward to permit inboard caliper removal.

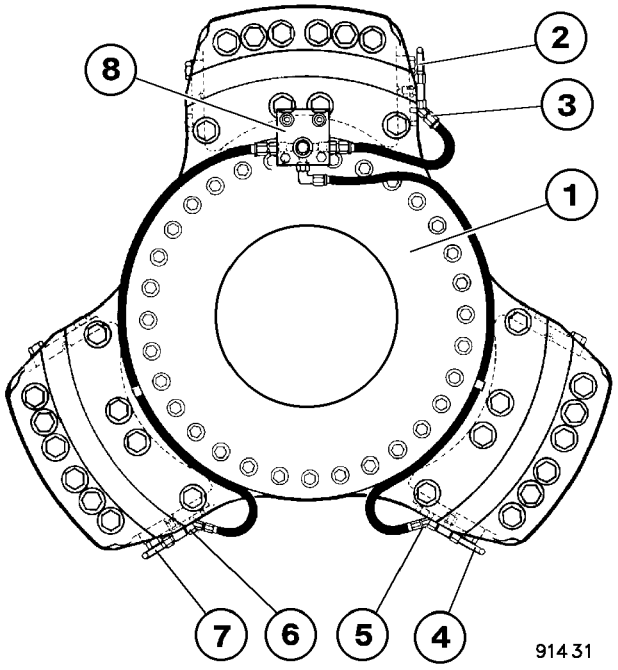


FIGURE 5-1. BRAKE LINES

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

SHIM PACK CHART		
Shim Pack Required (inch)	**0.010 in. Shim Quantities**	**0.040 in. Shim Quantities**
0.000 – 0.005	0	0
0.005 – 0.015	1	0
0.015 – 0.025	2	0
0.025 – 0.035	3	0
0.035 – 0.045	0	1
0.045 – 0.055	1	1
0.055 – 0.065	2	1
0.065 – 0.075	3	1
0.075 – 0.085	0	2
0.085 – 0.095	1	2
0.095 – 0.105	2	2
0.105 – 0.115	3	2
0.115 – 0.125	0	3
0.125 – 0.135	1	3
0.135 – 0.145	2	3
0.145 – 0.155	3	3
0.155 – 0.165	0	4
0.165 – 0.175	1	4
0.175 – 0.185	2	4

15. Install two 7/8 UNC-16 in. studs in the two center caliper mounting capscrew holes for the upper brake caliper (5).
16. Install park brake bracket (3).
17. Install outboard disc (16) with four equally spaced mounting capscrews (15). Tighten, but do not establish final torque at this time.
18. Measure distance from outer face of park brake bracket (3) [caliper mounting surface] to inner face of outboard disc (Dimension "B", Figure 6-3).
19. Subtract distance determined in Step 18 from 4.375 in (11.113 cm). This difference is the shim pack thickness to be placed between adapter (8) and outer brake disc (16). Refer to Shim Pack Chart.
20. Make up shim pack from Shim Pack Chart.
21. Remove outer disc and install inner half of caliper (5) over the two studs.
22. Install shim pack determined in Step 19 on adapter (8).
23. Install outboard disc (16) and bushings (14). Install capscrews and flatwashers (15). Tighten capscrews to standard torque.
24. Remove studs and install outer caliper half (5) and secure in place with capscrews and flatwashers (4). Tighten capscrews to standard torque.

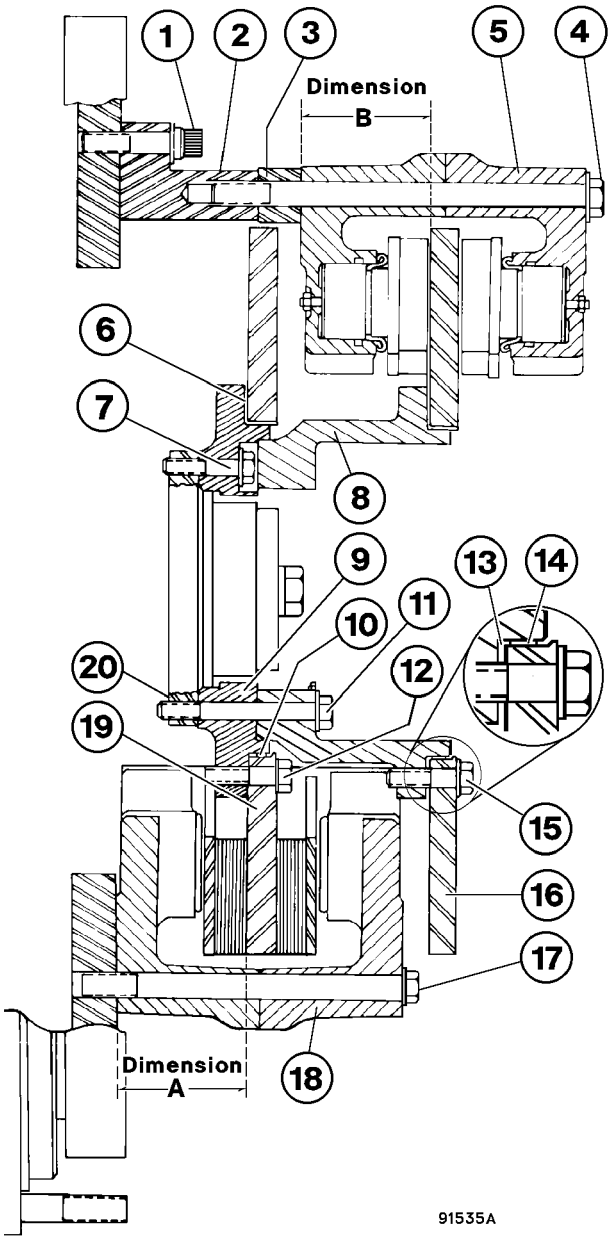


FIGURE 6-3. REAR DISC BRAKE
(For trucks equipped with two-piece adapter, 9 & 20)

1. Capscrew/Flatwasher
2. Adapter
3. Park Brake Bracket
4. Capscrew/Flatwasher
5. Brake Assembly
6. Shim
7. Capscrew/Flatwasher
8. Adapter, Brake Disc
9. Adapter, Brake Disc
10. Bushing
11. Capscrew/Flatwasher
12. Capscrew/Flatwasher
13. Shim
14. Bushing
15. Capscrew/Flatwasher
16. Disc
17. Capscrew/Flatwasher
18. Brake Assembly
19. Disc
20. Armature Shaft Drive

⚠CAUTION

Oil used in the hydraulic source must be of the same type as used in the Brake Circuit on the HAULPAK® truck.

4. Attach hydraulic source to inlet port of caliper assembly.
5. Bleed air from caliper assembly.

⚠CAUTION

During testing or bleeding procedure, DO NOT allow oil to come into contact with brake linings.

6. Gradually increase hydraulic pressure to 1200 psi (8.4 MPa), observing piston assembly for leakage.
7. Reduce pressure to 0 psi (0 MPa) and repeat Step 6 three times.
8. If no leakage has been observed, reduce pressure to 0 psi (0 MPa) and disconnect hydraulic source.
9. After caliper has been installed on wheel assembly prior to lining installation, pry each piston until fully retracted into caliper housing.

NOTE: Use adequate force to pry each piston into caliper fully into housing.

10. Install brake calipers according to "Installation" instructions this Section.

BRAKE LINING

Replacement

Inspect brakes periodically for wear. Linings must be replaced when lining material has been worn to a minimum of 0.31 in. (7.8 mm). Use of linings beyond this wear limit will result in a decrease of braking action, and possible damage to disc.

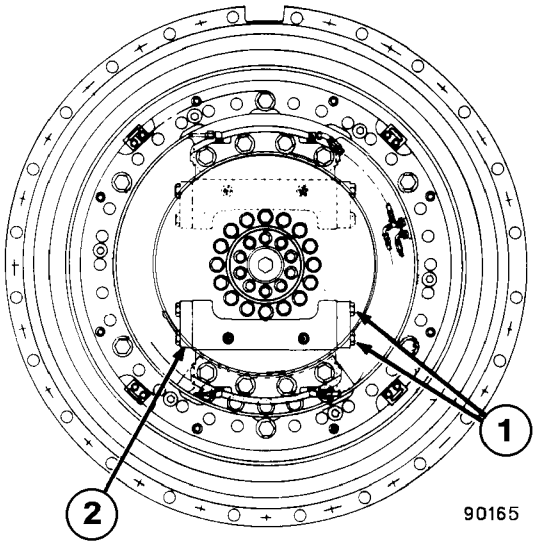


FIGURE 6-16. REAR BRAKE CALIPER LINING REPLACEMENT

1. Capscrew
2. Retaining Plates

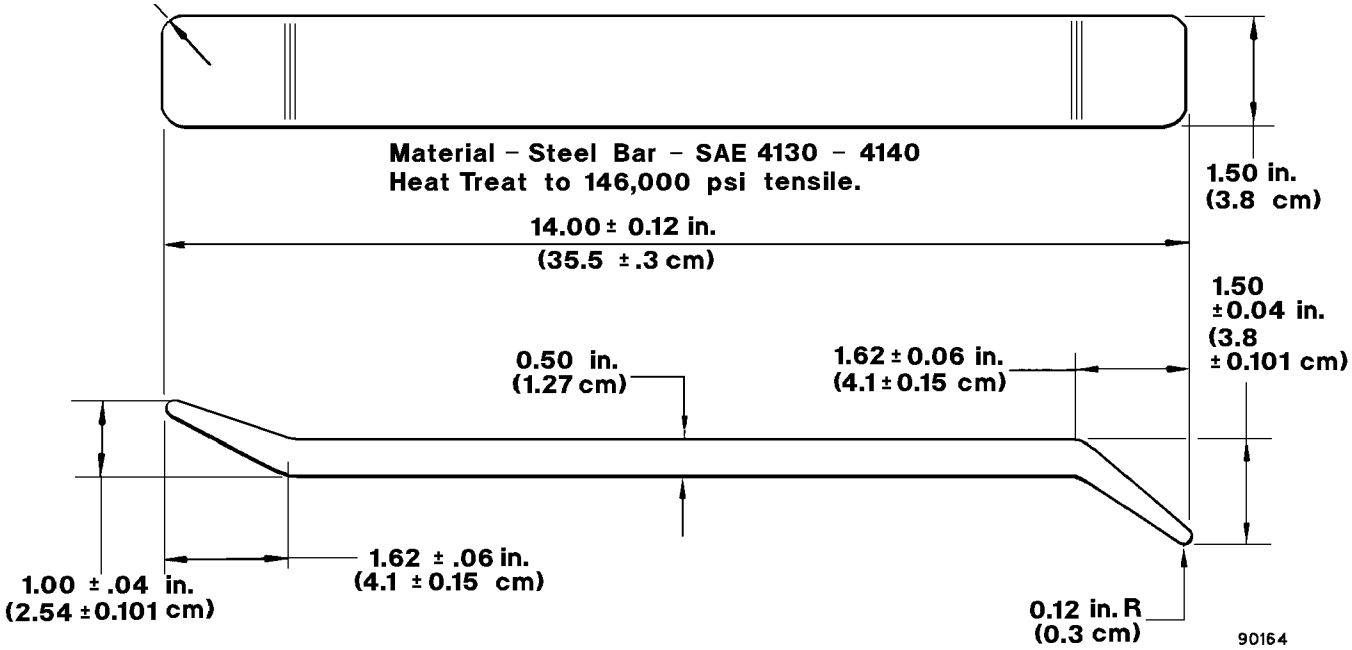


FIGURE 6-17. PISTON RETRACTION TOOL

13. Check the **Inboard** lining-to-disc clearance with the engine running and the Park Brake Switch "OFF" (brake released). Using a long feeler gauge, clearance should be **0.030 – 0.040 in. (0.762 – 1.016 mm)**.

14. If the **inboard** lining-to-disc clearance is not as specified in step 13. above, record clearance measurement and:

    a. With truck engine not running, apply parking brake.

    b. Loosen clamp capscrew (3).

    c. Turn adjusting bolt (16) to obtain the correct clearance specified in step 13. above. Turning adjusting bolt **clockwise decreases** clearance while turning **counterclockwise increases** clearance. **Each $^{1}/_{4}$ turn of adjusting bolt changes clearance 0.009 in. (0.228 mm)**.

    d. Tighten clamp capscrew (3) to **125 ft.lbs. (170 N.m**) torque.

    e. With truck engine running, apply and release parking brake three (3) times.

    f. Release parking brake and repeat step 13. If clearance is not correct, repeat step 14. (a.-f.) until correct clearance is established.

15. Insure clamp capscrew (3) is tightened to **125 ft.lbs. (170 N.m)** torque.

16. Check the **outboard** lining-to-disc clearance with truck engine running and park brake switch OFF (brake released). Using feeler gauge, clearance should be **0.030-0.040 in. (0.762-1.016 mm)**.

17. If the **outboard** lining-to-disc clearance is not as specified in step 16. above, record clearance measurement and:

    a. With truck engine not running, apply parking brake.

NOTE: The clamp capscrew (3) is <u>NOT</u> loosened in this procedure.

    b. Insure clamp capscrew (3) is tightened to **125 ft.lbs. (170 N.m)** torque.

    c. Turn adjusting bolt (16) to obtain the correct clearance specified in step 13 above. Turning adjusting bolt **clockwise decreases** clearance while turning **counterclockwise increases** clearance. **Each $^{1}/_{8}$ (<u>one eighth</u>) turn of adjusting bolt changes clearance 0.009 in. (0.228 mm)**.

    d. With truck engine running, apply and release parking brake three (3) times.

    e. Release parking brake and repeat step 16. If clearance is not correct, repeat step 17. (a.-e.) until correct clearance is established.

18. With engine running, turn park brake switch OFF (brake released).

19. Check the lining-to-disc clearance for both inboard and outboard linings with feeler gauge. Clearance should be **0.030-0.040 in. (0.762-1.016 mm)** for both inboard and outboard linings. If the lining-to-disc clearance is not as specified, repeat steps 2 through 19.

20. Hold adjusting bolt (16) to prevent turning in either direction and tighten jam nut (17) to **210 ft.lbs. (285 N.m)** torque.

21. Condition park brake linings according to "Lining Conditioning" procedure before releasing truck to production.

Park Brake Caliper Disassembly

NOTE: To assure that tension on springs (9, Figure 7-2 & 2A) has been released, be certain that jam nut (17) has been loosened on adjustment bolt (16) and that clamping capscrew (3) has been loosened one turn. Be sure that adjustment bolt (16) has been loosened six turns.

1. Remove bleeder screws (11, Figure 7-2 / 2A) from housing (2) and drain fluid from brake caliper.

2. Loosen jam nut (17) and remove adjustment bolt (16) from yoke (1).

3. Remove clamp capscrew (3) and washer (4) to release housing (2) from yoke (1).

4. Remove piston dust boots (8) from spring retainers (15).

5. Remove spring retainers (15) and springs (9). Note order and orientation of springs.

6. Remove pistons (10) from housing.

7. Remove seal and backup ring (6 &7, Figure 2) or O-ring & backup ring (6 &7,Figure 2A) from pistons and discard these parts.

8. Remove screws (14) releasing the lining (5) from pistons.

9. Remove seal and backup ring (6 &7, Figure 2) or O-ring & backup ring (6 &7,Figure 2A) from housing and discard these parts.

HYDRAULIC SYSTEM COMPONENT REPAIR

HOIST PUMP

Removal

NOTE: It is not necessary to remove the steering pump with the hoist pump. The steering pump may be disengaged and supported as the hoist pump is removed.

1. Turn the keyswitch “Off” and allow ample time (approximately 90 seconds) for the accumulators to bleed down. Turn the steering wheel to be sure no oil remains under pressure.
2. Drain the hydraulic tank by use of the drain valve (12, Figure 3-1) located on the bottom of the tank.

NOTE: If oil in the hydraulic tank has not been contaminated, the shut-off valves can be closed and both pump inlet lines can be drained, eliminating the need to completely drain the tank. Refer to Figure 3-1.

3. Remove the rear axle blower hose support strap.

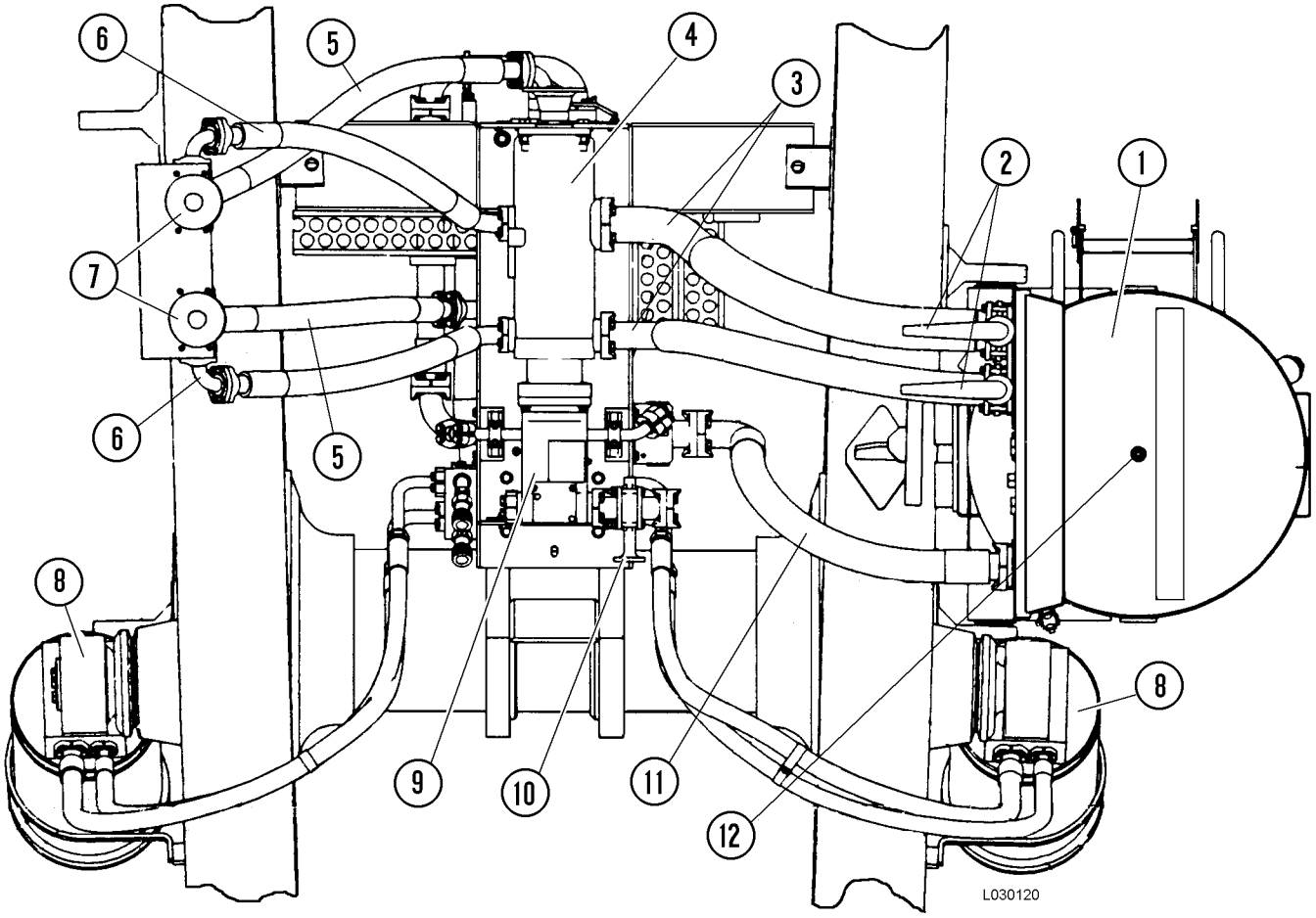


FIGURE 3-1. HOIST PUMP PIPING (BOTTOM VIEW)

1. Hydraulic Tank
2. Hoist Pump Shut-off Valves
3. Hoist Pump Suction Hoses
4. Hoist Pump
5. Filter Outlet To Hoist Valve Hose
6. Hoist Pump Outlet To Filter Hose
7. Hoist Circuit Filters
8. Hoist Cylinders
9. Steering/Brake Pump
10. Steering Pump Shutoff Valve
11. Hoist Valve Return To Tank Hose
12. Hydraulic Tank Drain

28. Using an 18 inch (45 cm) adjustable wrench, check pump drive shaft rotation. The drive shaft will be tight but should turn freely with a maximum of **5 to 10 ft lbs (7 to 14 N.m)** torque, after the initial surge. (Refer to Figure 3-15.)
29. If the shaft will not turn properly, disassemble the pump and examine the parts for burrs or foreign material causing buildup or interference between parts.
30. When the input shaft turns properly install the remaining hardened washers and nuts. Tighten nuts to **240 to 250 ft lbs (325 to 339 N.m)** torque.
31. Install a new O-ring on steering pump flange and install steering pump to the transition plate (16, Figure 3-14). Install capscrews and tighten to standard torque.
32. Install companion flange on pump driveshaft. If necessary, heat to 400° to 500°F (204° to 260°C) to ease installation.

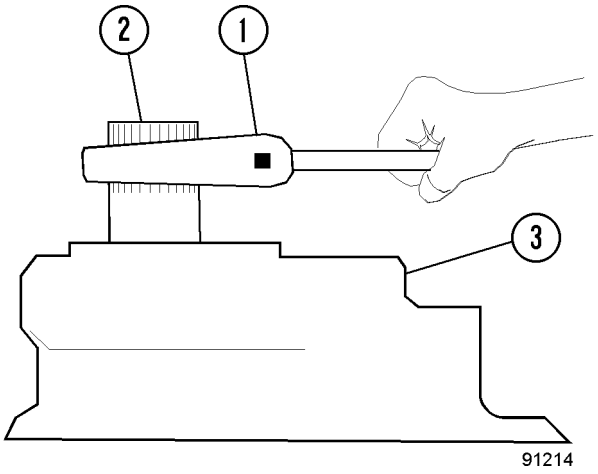


FIGURE 3-15. PUMP ROTATION CHECK

1. Wrench
2. Input Shaft
3. Pump

⚠ IMPORTANT ⚠

Do not force flange onto shaft. Be certain flange is bottomed on shaft before it cools.

33. After flange has cooled, install nut and washer on pump shaft. Tighten to **300 ft. lbs. (407 N.m)** torque.

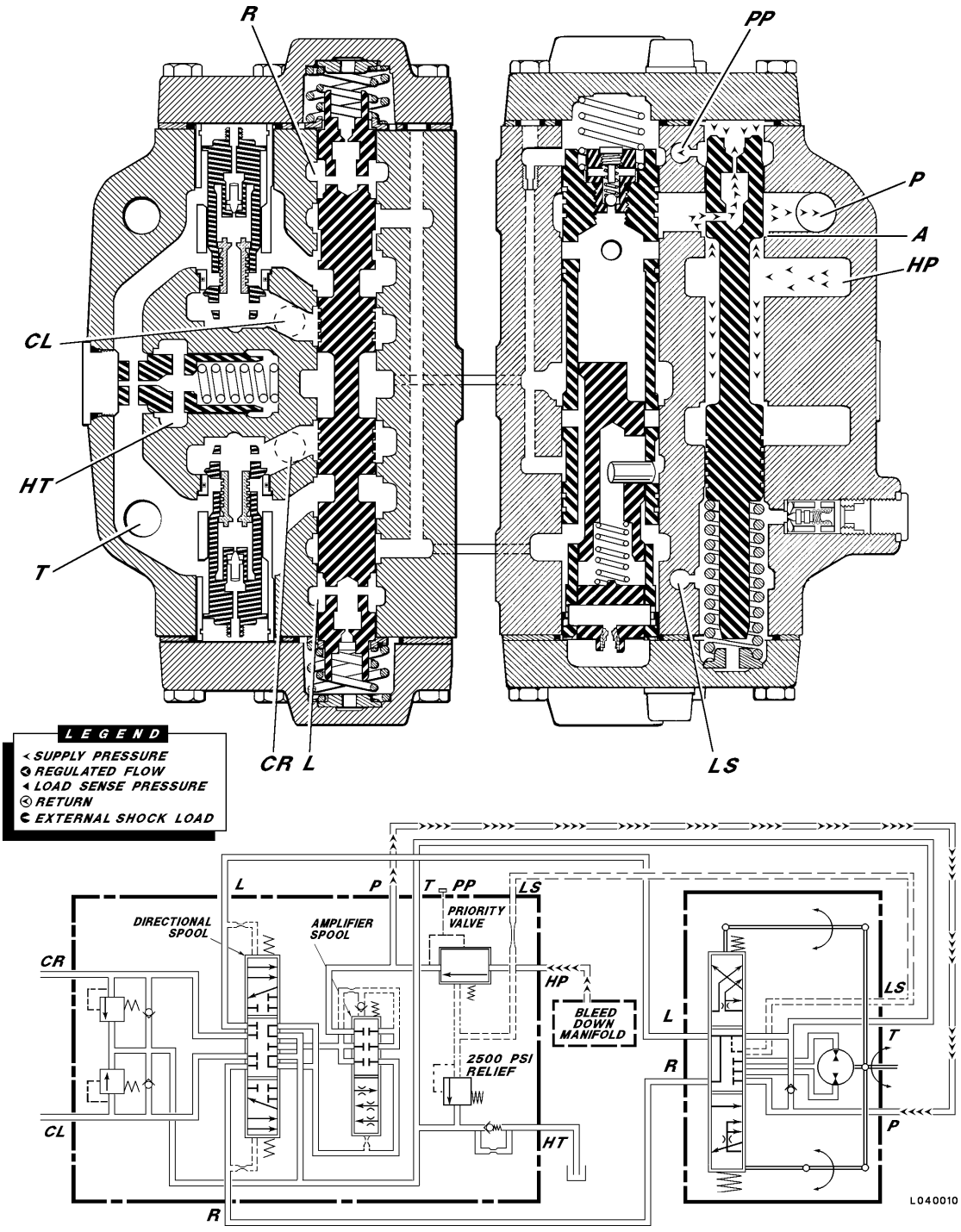
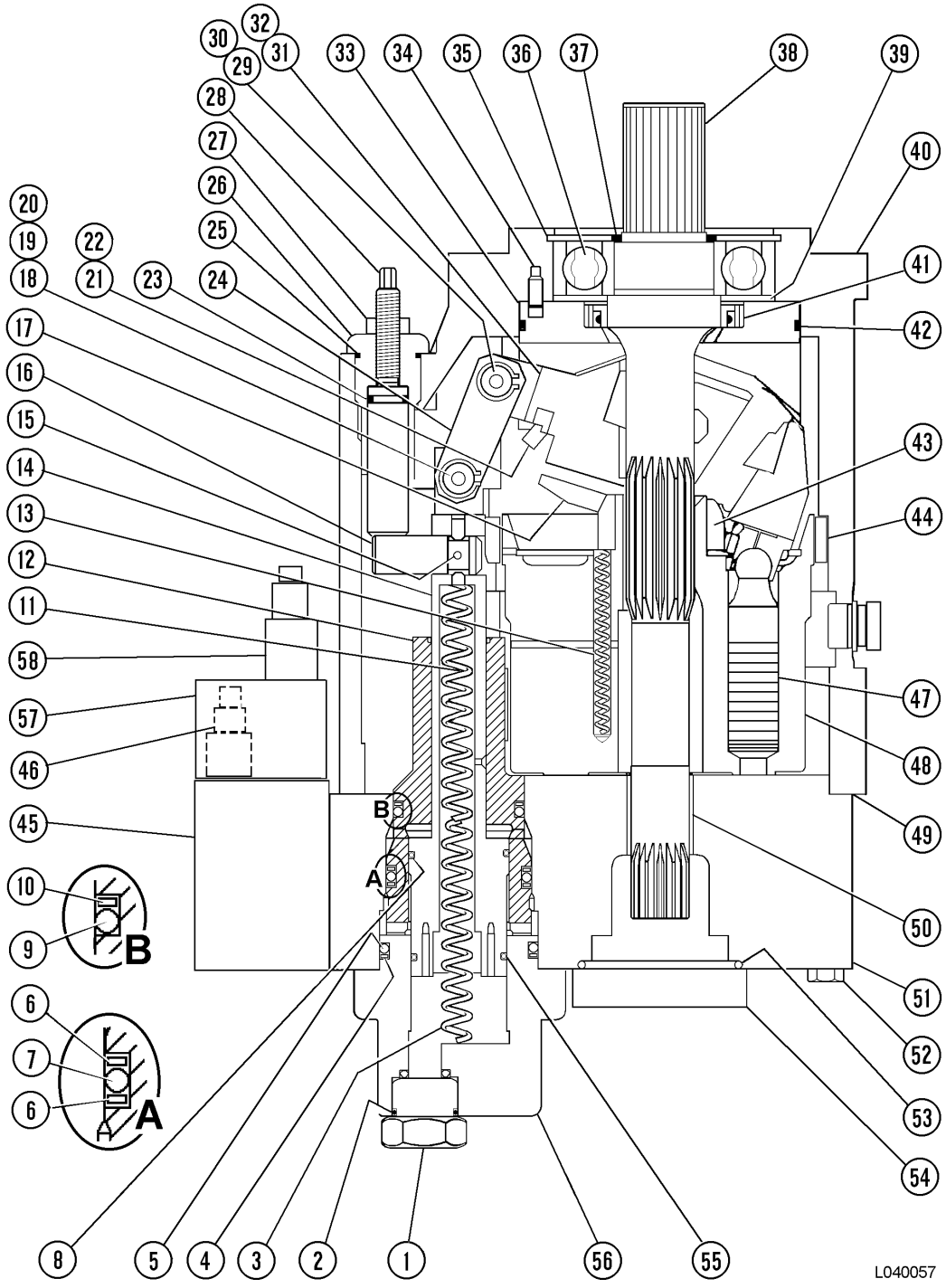


FIGURE 4-3. FLOW AMPLIFIER (No Steer)

FIGURE 4-9. CUT-AWAY VIEW OF STEERING PUMP



FLOW AMPLIFIER

Removal

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 accumulators to bleed down. Turn steering wheel to make sure no oil under pressure remains. Disconnect, plug, and identify each hydraulic line.
2. Support the flow amplifier valve and remove the mounting capscrews. Remove valve.
3. Move valve to a clean work area for disassembly.

Installation

1. Support the flow amplifier and move into position.
2. Install mounting capscrews and tighten to standard torque.
3. Identify hydraulic line location, unplug lines and connect at proper location, tighten fittings securely. Use new O-rings on the flange fittings.

10. Install the check ball in the hole shown in Figure 5-18. Install threaded bushing and lightly tighten.

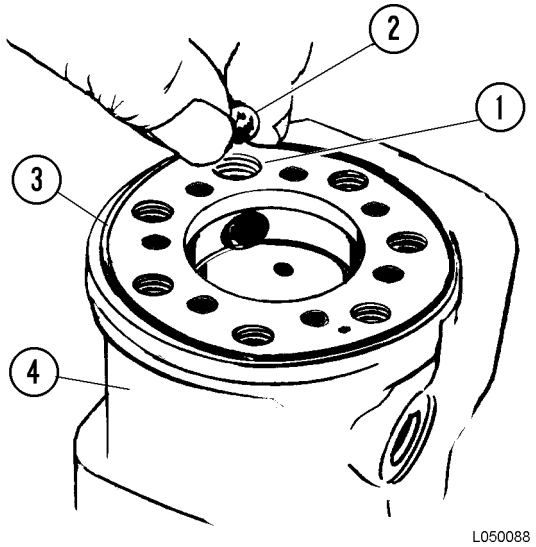


FIGURE 5-18. CHECK BALL INSTALLATION

1. Check Ball Hole
2. Check ball
3. O-Ring
4. Housing

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

9. Piston shoes must pivot smoothly, but end play must not exceed 0.003 in (0.076 mm).

10. Check end play as follows:

    a. Place square end of piston on bench and hold down firmly. Pull on end of shoe with other hand and note end play. A good piston/shoe fit will have no end play, but the shoe may rotate and pivot on the piston ball. Inspect each shoe face for nicks or scratches.

    b. Measure shoe thickness (the part held between retainer (27, Figure 5-23) and cradle. All shoes must be equal within 0.0001in (0.003 mm). If one or more piston/shoe assemblies (13) needs to be replaced, all piston/shoes assemblies must be replaced.

    c. Inspect cylinder bearing (26) and matching cylinder barrel bearing mating surface for galling, pitting or roughness. Replace if necessary.

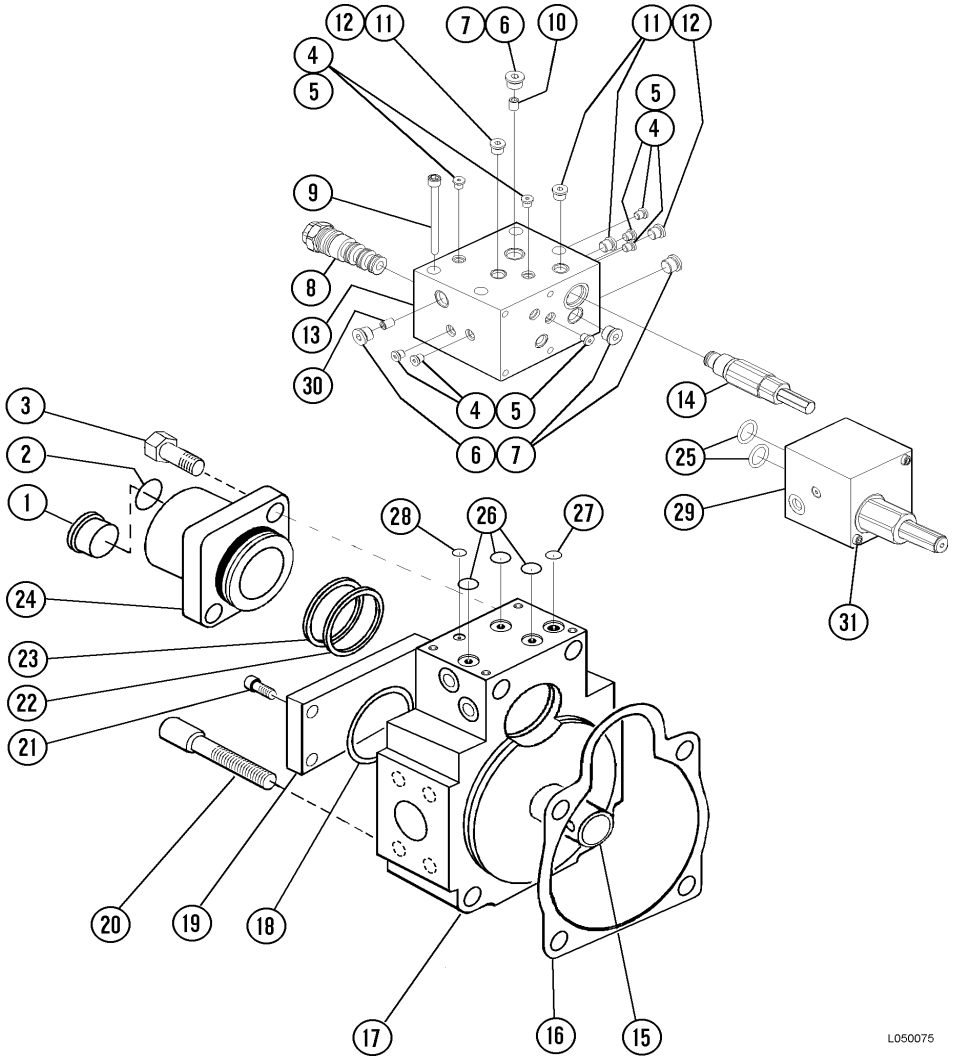


FIGURE 5-24. PUMP, REAR HOUSING

1. Plug
2. O-Ring
3. Capscrew
4. O-Ring
5. Plug
6. O-Ring
7. Plug
8. Valve, 4-Way
9. Capscrew
10. Orifice
11. O-Ring
12. Plug
13. Compensator Block
14. Valve, Relief
15. Bearing
16. Gasket
17. Valve Plate
18. O-Ring
19. Cover Plate
20. Capscrew
21. Capscrew
22. O-Ring
23. Back-Up Ring
24. Cap
25. O-Ring
26. O-Ring
27. O-Ring
28. O-Ring
29. Unloader Module
30. Orifice
31. Capscrew

The following pages describe hoist circuit operation in the float, power up, hold, and power down positions. (Refer to Figures 7-5 through 7-9.)

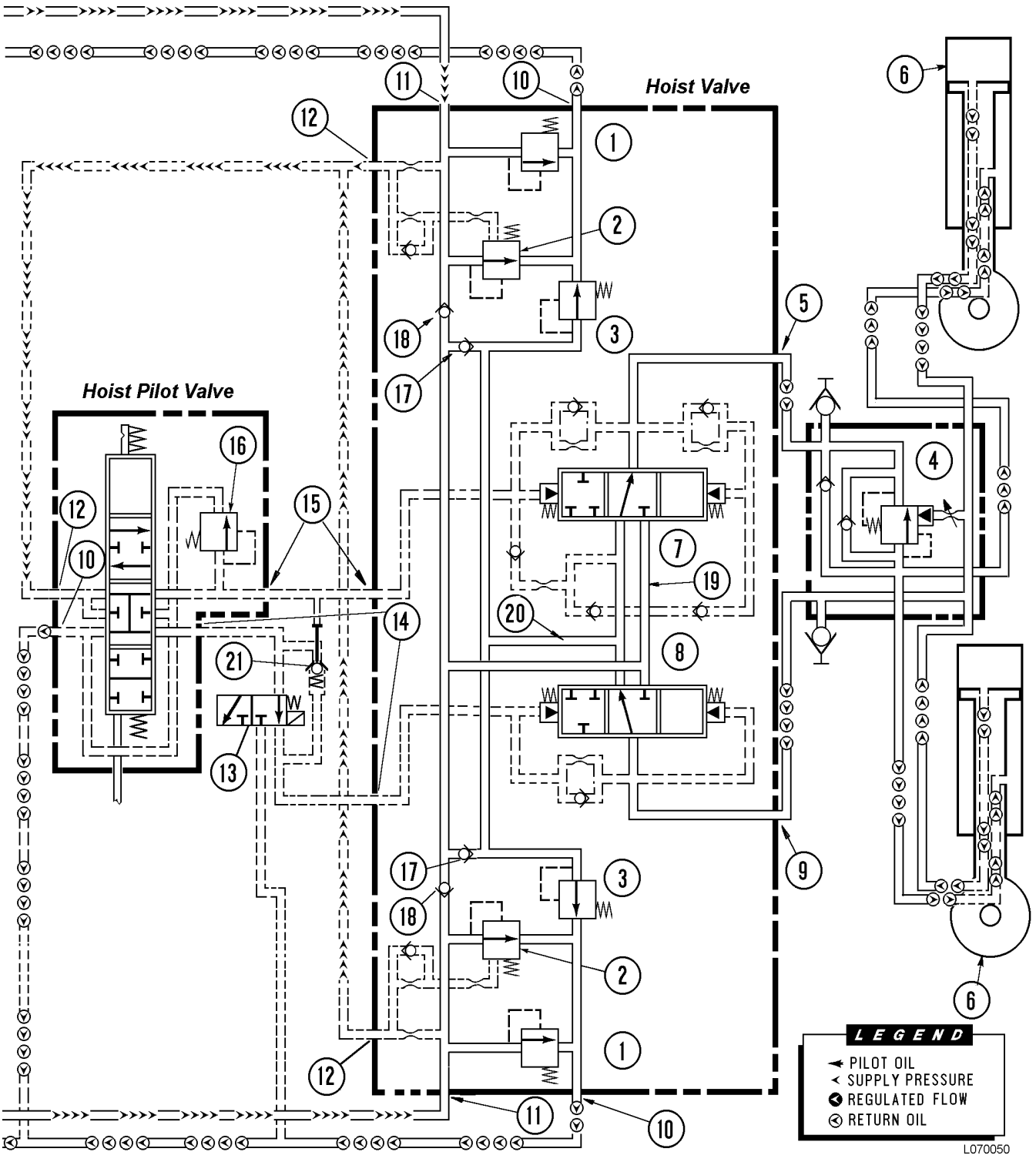


FIGURE 7-9. FLOAT POSITION

Cleaning and Inspection

1. Clean all parts including housings in solvent and blow dry with compressed air.
2. Inspect seal counter bores, they must be free of nicks or grooves.
3. Examine springs for breaks or distortion.
4. Inspect spool (14, Figure 8-12). The spool must be free of longitudinal score marks, nicks or grooves.
5. Test spool (14) in spool housing for fit. Spool must fit freely, without binding, through a complete revolution.

NOTE: The spool housing (17), spool (14), inlet housing (18) and outlet housing (7) are not serviced separately. Should any of these parts require replacement, the entire control valve must be replaced.

Assembly

1. Thoroughly coat all parts including housing bores with clean type C-4 hydraulic oil.
2. If the inlet and outlet housings were removed follow steps 3 through 5 for reassembly.
3. Install check poppet (2, Figure 8-14) and spring (3) in spool housing (1).
4. Install new O-ring (4) in spool housing. Move the inlet and outlet housings into position.
5. Install tie rods. Install tie rod nuts. Tighten tie rod nuts to the torques shown in Figure 8-15.
6. Install a new O-ring (27, Figure 8-12) and wiper (26). Install seal retainer (25).
7. Install spacer (5), spring seats (19), and spring (4). Thread detent pin (3) into spool (14). Slight pressure will be required to compress the detent spring. Tighten detent pin **84-96 in. lbs. (9-11 N.m)** torque. Install spring (20). Carefully install spool into spool housing.
8. Apply grease to the cross holes of the detent pin (3) to hold balls (21) and (2).
9. Slide detent sleeve (22) into cap (24) and place over a punch. Using this punch, depress ball (21) and insert balls (2) in detent pin cross holes.
10. While holding down on ball (21), slide detent sleeve (22) and cap (24) as an assembly over the detent pin (3). Continue to insert detent sleeve (22) until it contacts spring seat (19).
11. Secure cap (24) in place with capscrews (6). Tighten capscrews (6) to **5 ft. lbs. (7 N.m)** torque. Install spacer (23) and snap ring (1).
12. Install a new O-ring (12) and wiper (13). Install seal plate (16). Install machine screws (15).
13. Using new O-rings, install relief valve (2, Figure 8-13) in spool housing.

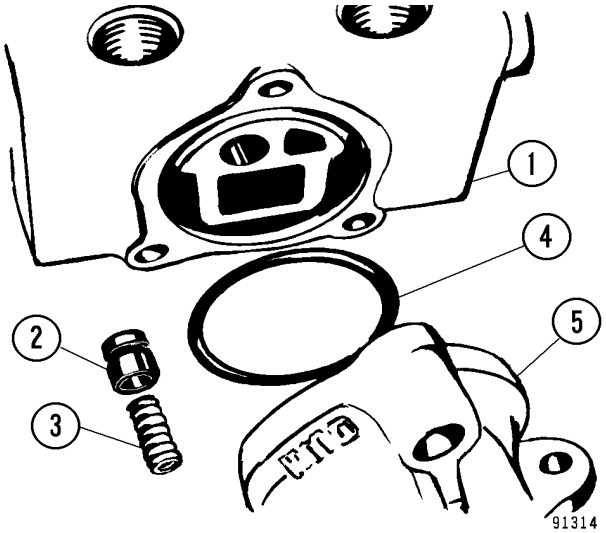


FIGURE 8-14. HOIST PILOT VALVE REASSEMBLY

1. Spool Housing
2. Check Poppet
3. Spring
4. O-ring
5. Outlet Housing

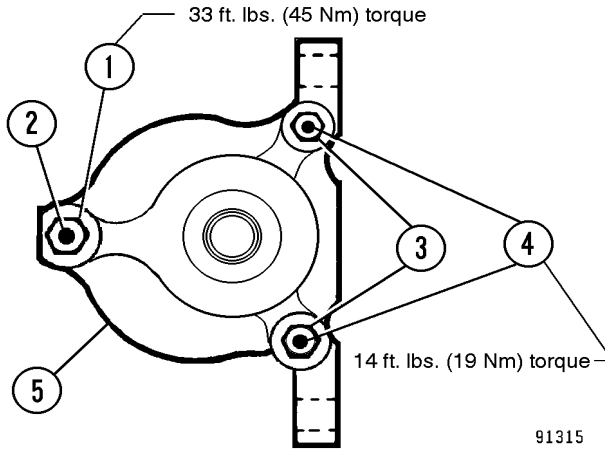


FIGURE 8-15. TIE ROD NUT TORQUE

1. Nut
2. Tie Rod
3. Nut
4. Tie Rod
5. Outlet Housing

HYDRAULIC CHECK-OUT PROCEDURE

STEERING AND BRAKE PUMP

Pressure Check And Adjustment Procedure

NOTE: If steering and brake pump has just been installed, make sure the steering pump crankcase is full of oil prior to starting the engine.

⚠ DANGER

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

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

Blocking pressure line between pump and system (or pump) high pressure relief valve will result in damage and could result in serious personal injury.

1. Shut down engine, turn keyswitch "Off" and allow accumulator to completely bleed down before opening circuits to take measurements, to make repairs, or to install or remove gauges.
2. Install a calibrated 5000 psi (35,000 kPa) gauge on the diagnostic coupling on the steering pump test port marked "GPA", located on the same side of the pump as the suction port.
3. Make sure all steering pump suction line shut-off valves are fully open. (The shut-off valves are open when the handles are in line with the hose.

NOTE: Serious pump damage will result if all shut-off valves are not completely open when the engine is started.

4. If the pump has just been installed on the machine, and prior to starting the engine, bleed air from inside pump to make sure the steering pump crankcase is full of oil.

To Bleed Air From Pump:

a. With the engine shut down and the hydraulic oil level in the tank is at the proper level, open shut-off valve in steering pump suction line.

b. With suction line shut-off valve open, loosen suction hose capscrews (at the pump) to bleed any trapped air. Then loosen pressure hose capscrews (at the pump) to bleed any trapped air. Tighten hose connection capscrews to standard torque.

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

c. Disconnect pump case return hose (from fitting 2, Figure 6-1) and cap the hose.

d. Remove fitting (2) and add clean C-4 type oil to pump through opening until pump housing is completely full.

e. When pump housing is full of oil, install fitting (2) and connect pump case return hose to fitting.

f. Check for proper oil level in hydraulic tank. Add oil if necessary.

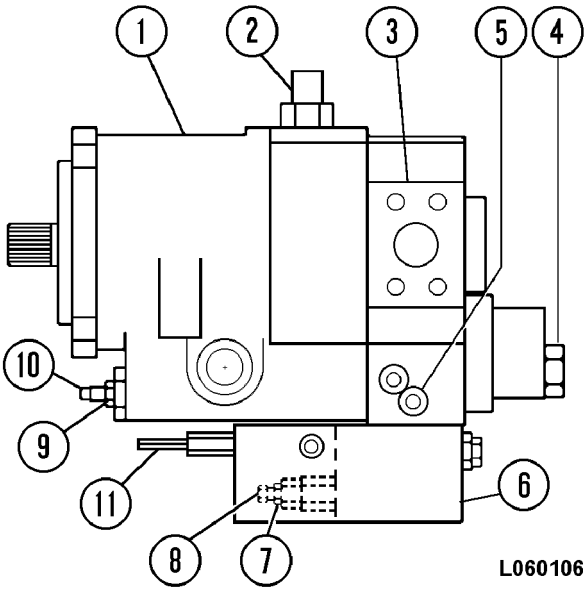


FIGURE 10-1. STEERING PUMP

1. Steering Pump
2. Pump Crankcase Return Fitting
3. Inlet Port
4. Plug
5. Diagnostic Port (GPA)
6. Compensator Housing
7. Jam Nut
8. Adjusting Screw
9. Jam Nut
10. Maximum Stroke Screw
11. Unloader Adjuster

POSSIBLE CAUSES	SUGGESTED CORRECTIVE ACTION
TROUBLE: Excessive Heating	
Operating pump above rated pressure.	Refer to "Pressure Check and Adjustment Procedure", this section.
Low fluid level in reservoir.	Check for proper oil level in hydraulic tank.
Air entering hydraulic system.	Inspect inlet hose and connections.
Worn piston pump.	Repair or replace worn components.
Worn or grooved cylinder wear plate and/or port plate.	Repair or replace worn components.
Faulty output circuit components.	Repair or replace relief valve or pressure compensator valve.

FIRE CONTROL SYSTEM (MANUAL)

The fire control system aids in protecting the machine in the event of a fire. The system consists of:

- Actuators
- Pneumatic Actuator/Cartridge Receivers
- Pressure Relief Valve
- Check Valves
- Dry Chemical Tanks
- Hoses And Nozzles.

When either actuator is depressed, a nitrogen cartridge will pressurize the dry chemical tank. Once the dry chemical tank has pressurized to a sufficient pressure, a bursting disc in the tank outlet will break, allowing the fluidized chemical to flow to the nozzles. The nozzles will direct the agent at the fire and extinguish the flames.

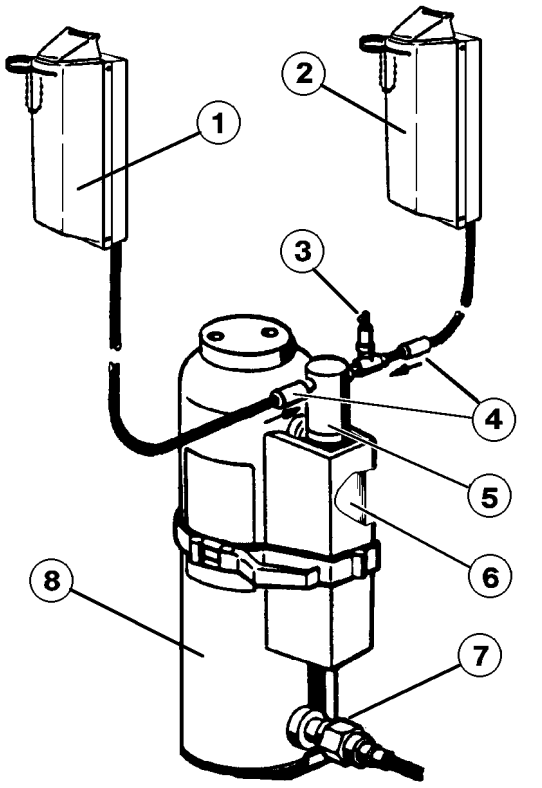


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FIGURE 2-1. FIRE CONTROL SYSTEM

1. Cab Actuator
2. Remote Actuator
3. Safety Relief Valve
4. Check Valves
5. Actuator Receiver
6. Cartridge
7. Bursting Disc Union
8. Dry Chemical Tank

Operation

To actuate the fire control system, pull the safety ring on either of the actuators and depress the lever. One actuator is located in the cab near the operator. Another actuator is located on the left fender structure near the bumper.

NOTE: Operating either actuator will activate fire control system.

Inspection and Maintenance

It is imperative that the fire control system is inspected at least every six months. To insure that it will operate effectively:

1. Check the system for general appearance, mechanical damage and corrosion.
2. Inspect each chemical tank fill cap gasket for damage and replace if necessary. Examine cap for nicks, burrs, cross threading or rough edges.
3. Check the level of dry chemical. The level should not be less than three inches (76 mm) from bottom of fill opening. Dry chemical must be free flowing, with no caking.
4. Insure that the vent in the fill opening threads is not obstructed.
5. Remove the cartridge from the extinguisher and examine the disc-seal. Replace seal if necessary. Install cartridge hand tight.

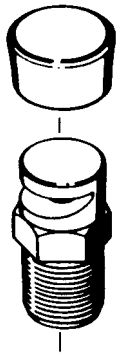

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FIGURE 2-2. NOZZLE AND BLOW-OFF CAP

WIGGINS QUICK FILL FUEL SYSTEM

FUEL RECEIVER

The fuel receiver (3, Figure 5-1) is normally mounted on the fuel tank (1). Optional locations are the left hand frame rail (Figure 5-3) or at the Service Center in front.

Keep the cap on the receiver to prevent dirt build up in valve area and nozzle grooves. If fuel spills from tank breather valve, or tank does not completely fill, check breather valve to see that float balls are in place and outlet screen is clean. If valve is operating properly, the problem will be with the fuel supply system.

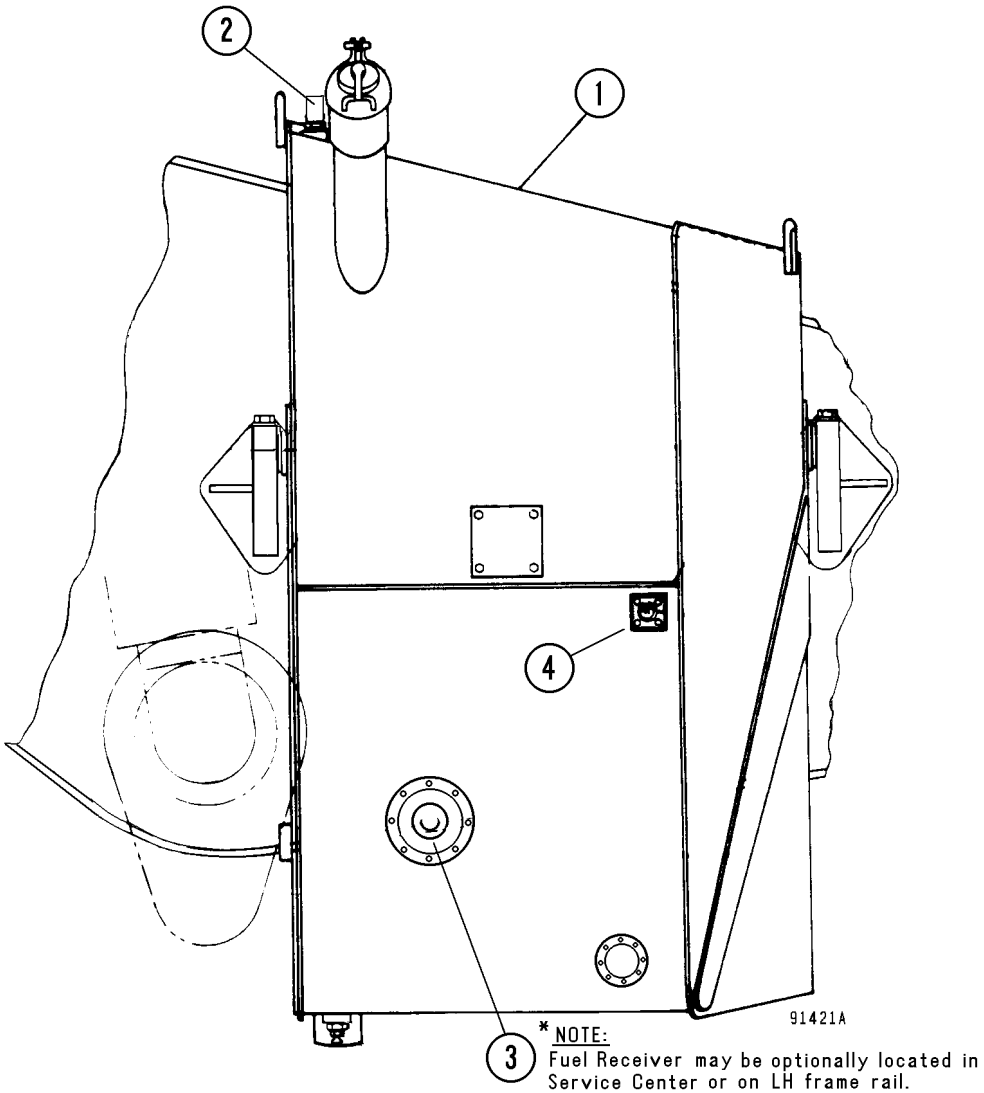
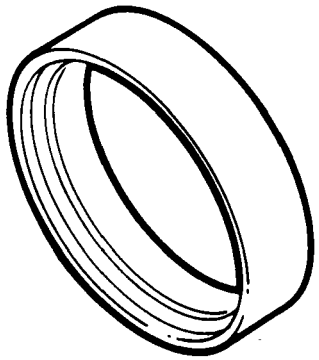


FIGURE 5-1. FUEL TANK BREATHER & RECEIVER INSTALLATION

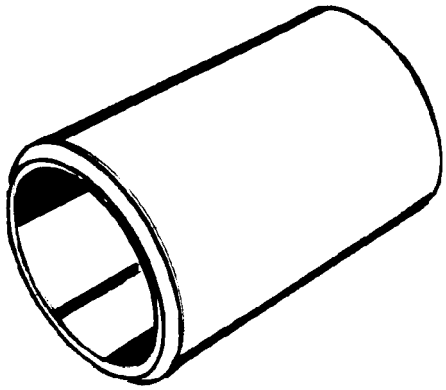
1. Fuel Tank
2. Breather Valve
3. Fuel Receiver
4. Fuel Level Gauge

NOTE: This Illustration Represents a Typical Installation.
Fuel tank may vary in size, shape and location depending on truck model.

PART NO.	DESCRIPTION	USE
TY2150	Seal Installation Tool	Installation of Front Wheel Bearing Face Seals



PART NO.	DESCRIPTION	USE
TZ0992	Alignment Sleeve	Rear Suspension And Anti-sway Bar Installation
TY4576	Alignment Sleeve	Steering Linkage Assembly



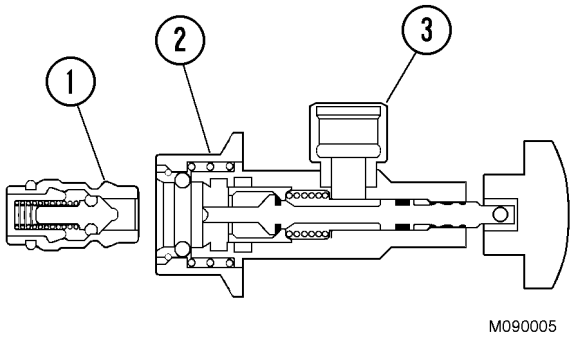


FIGURE 9-5. R-134a SERVICE VALVE

1. System Service Port Fitting
2. Quick Connect
3. Service Hose Connection

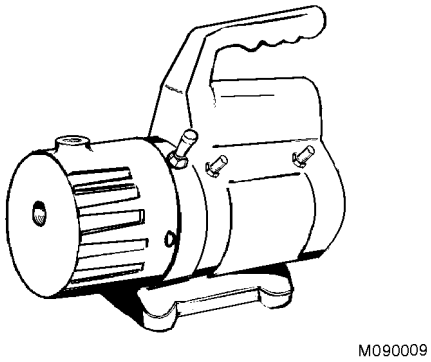


FIGURE 9-6. VACUUM PUMP

SERVICE VALVES

Because an air conditioning system is a sealed system, two service valves are provided on the compressor to enable diagnostic tests, system charging or evacuation. Connecting the applicable hoses from the manifold gauge set to the compressor service valves enables each of these to be readily performed.

New and unique service hose fittings (Figure 9-5) have been specified for R-134a systems. Their purpose is to avoid accidental cross-mixing of refrigerants and lubricants with R-12 based systems. The service ports on the system are quick disconnect type with no external threads. They do contain a Schrader type valve. The low side fitting has a smaller diameter than the high side attachment.

Protective caps are provided for each service valve. When not being used these caps should be in place to prevent contamination or damage to the service valves.

VACUUM PUMP

The vacuum pump (Figure 9-6) is used to completely evacuate all of the refrigerant, air, and moisture from the system by deliberately lowering the pressure within the system to the point where water turns to a vapor (boils) and together with all air and refrigerant is withdrawn (pumped) from the system. Normally the vacuum pump is only used when a system has completely lost its refrigerant charge.

TROUBLESHOOTING

PRE-DIAGNOSIS CHECKS

If the system indicates Insufficient cooling, or no cooling, the following points should be checked before proceeding with the system diagnosis procedures.

NOTE: If the truck being serviced is a Model 930E, be certain the Rest Switch in the cab is ON. Place the GF Cutout Switch in the CUTOUT position. (Refer to Fig. 3-1, Page E3-2, Propulsion System, for switch location.)

PREPARING FOR DIAGNOSIS

Successfully servicing an air conditioning system, beyond the basic procedures outlined in the previous section, requires additional knowledge of system testing and diagnosis.

A good working knowledge of the manifold gauge set is required to correctly test and diagnose an air conditioning system. An accurate testing sequence is usually the quickest way to diagnose an internal problem. When correctly done, diagnosis becomes an accurate procedure rather than guesswork.

- ☐ Compressor Belt - Must be tight, and aligned.
- ☐ Compressor Clutch - The clutch must engage. If it does not, check fuses, wiring, and switches.
- ☐ Oil Leaks - Inspect all connection or components for refrigeration oil leaks (especially in the area of the compressor shaft). A leak indicates a refrigerant leak.
- ☐ Electrical Check - Check all wires and connections for possible open circuits or shorts. Check all system fuses.

Note: Some systems use different safety devices in the compressor circuit to protect the compressor. Check the thermal fuse, the low pressure cutout switch, high pressure cutout switch or trinary pressure switch if equipped.

- ☐ Cooling System - Check for correct cooling system operation. Inspect the radiator hoses, heater hoses, clamps, belts, water pump, thermostat and radiator for condition or proper operation.
- ☐ Radiator Shutters - Inspect for correct operation and controls, if equipped.
- ☐ Fan and Shroud - Check for proper operation of fan clutch. Check installation of fan and shroud.
- ☐ Heater/Water Valve - Check for malfunction or leaking.
- ☐ System Ducts and Doors - Check the ducts and doors for proper function.
- ☐ Refrigerant Charge - Make sure system is properly charged with the correct amount of refrigerant.

PRELIMINARY STEPS

The following steps outline the correct procedures necessary to prepare the truck and the system for testing and diagnosis:

1. Correctly connect the manifold gauge set to the system. Refer to the connection and purging procedures outlined in this section.
2. Run the engine with the air conditioning system on for five to ten minutes to stabilize the system.
3. With the engine and the system at normal operating temperature, conduct a Performance Test as outlined in this section.

SYSTEM PERFORMANCE TEST

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

1. Start engine and operate at 1200 to 1500 RPM.
2. Place fan in front of condenser to simulate normal ram air flow and allow system to stablize.
3. Place a thermometer in air conditioning vent closest to evaporator.
4. Evaluate the readings obtained from the gauges to see if they match the readings for the ambient temperature.

As preliminary steps to begin checkout of the system, perform the following:

1. Close all windows and doors to the cab.
2. Set air conditioning system at maximum cooling and blower speed operation.
3. Readings on the two manifold gauges should be within normal range, adjust for ambient temperature.
4. Compare evaporator discharge air temperature reading to see if it matches the recommended temperature for the ambient temperature and gauge readings obtained.

PAYLOAD METER II
ON BOARD WEIGHING SYSTEM (OBWS)
INDEX

Engine Operation

ITEM	UNIT	RANGE	REMARKS
Number when Canceled	Number	1 - 65535	Every time the engine is started the number advances by one.
Last Two Digits Of Year	Year	0 - 99	
Month	Month	1 - 12	
Day	Day	1 - 31	
Time Hour	Hour	24 Hour Clock	
Time Minute	Minute	0 - 59	
NOTE: If the engine operation number is a 0, this indicates that the problem occurred or was canceled (depends on the operation that was performed) when the key switch was in the ON position and the engine was not running.			

Total Payload and Total Number of Cycles

The total payload and overall number of cycles can be displayed using the forced display operation. Both values start from a zero point whenever the memory has been cleared. The payload total is automatically displayed when the load is dumped.

ITEM	UNIT	RANGE	REMARKS
Total Payload	Metric Tons Short Tons	0 - 999900.0	The total payload since the unit was cleared.
Total Number Of Cycles	Digital Number	0 - 9999	The number of cycles since the unit was cleared.
Last Two Digits Of Year	Year	0 - 99	Date and time the unit was cleared.
Month	Month	1 - 12	
Day	Day	1 - 31	
Time Hour	Hour	24 Hour Clock	
Time Minute	Minute	0 - 59	

Other Data

CONTENT	ITEM	UNIT	RANGE	REMARKS
Set Up Data That The Operator Can Check	Speed Limit	Km/MPH	0 - 99	
	Option Code	Digital Number	0 - 13	Communication Mode
Calibration Data	Year	Year	0 - 99	Date and time when calibrated.
	Month	Month	1 - 12	
	Day	Day	1 - 31	
	Hour	Hour	24 Hour Clock	
	Minute	Minute	0 - 59	

FAULT CODES				
FAULT	**CAUSE**	**CORRECTIVE ACTION**	**DECK LIGHTS**	**PRIORITY**
F-25 Flashing	Left front pressure signal is greater than 5V (1-5V normal).	Trouble shoot wiring, likely sensor wires are shorted together.	Flash	11
F-26 Flashing	Right front pressure signal is greater than 5V (1-5V normal).		Flash	12
F-27 Flashing	Left rear pressure signal is greater than 5V (1-5V normal).		Flash	13
F-28 Flashing	Right rear pressure signal is greater than 5V (1-5V normal).		Flash	14
F-31 Flashing	Inclinometer input less than 1.57V (more than + 10 degrees, nose up).	Trouble shoot wiring, likely an open circuit (Inclinometer output is 2.6V when horizontal, calibration: -103mV/degree)	Flash	15
F-32 Flashing	Inclinometer input greater than 3.63V (more than - 10 degrees, nose down).	Trouble shoot wiring, likely sensor wires are shorted together.	Flash	16
F.CAL	No calibration has been performed or cal data has been cleared.	Perform calibration.	Flash	17
F-41 Flashing	Light relay #1 driver short circuit.	Trouble shoot wiring, relay coil likely shorted.		18
F-42 Flashing	Light relay #2 driver short circuit.			19
F-43 Flashing	Light relay #3 driver short circuit.			20
F-44 Flashing	Light relay #4 driver short circuit.			21
F-45 Flashing	Light relay #5 driver short circuit.			22
L.bad Flashing	Payload measured while chassis is pitching.	Data ignored, error will clear for next load.		23
SP:SP Flashing	Speed limit setting is being exceeded.	Set the speed limit, using Operator Check Mode, to 62 mph or 99Km/h depending on the position of the unit selection switch (switch #7 behind the left side panel).		24
F-71 F-73 F-80 F-81 F-91 F-92 F-93 F-94 F-95 F-96 F-97 F-98 All Flashing	Communtications port error.	Check communication wiring (RS-232) to Modular Mining Hub or to Scoreboard. Check OP setting.		25

M200052

CONNECTIONS

CN1 - AMP MIC-MKII 13 Pins White Connector		
No.	**Description**	**Comments**
1	Power +24V (Battery)	
2	Lamp Relay 1	
3	Lamp Relay 2	
4	Lamp Relay 3	
5	Lamp Relay 4	
6	Lamp Relay 5	
7	Speed Sensor (Signal)	
8	Speed Sensor (GND)	
9	Alternator R Terminal (Charge Signal)	Running - 28VDC Off - 0VDC
10	Key Switch ACC Terminal (ACC Signal)	
11		
12		
13	GND (Power GND)	

CN3 - AMP MIC-MKII 9 Pins White (RS-232C Port)	
No.	**Description**
1	RTS
2	SG
3	RD
4	TX
5	CTS
6	DTR
7	DSR
8	

CN2 - AMP 040 12 Pins Black Connector		
No.	Description	**Comments**
1	Engine Oil Pressure Switch	Running Open Off - Closed
2	Sensor Power Out	+18V
3	Sensor GND	
4	Left FrontSuspension Pressure Sensor	1-5VDC Normal
5	Right Front Suspension PressureSensor	1-5VDC Normal
6	Left Rear Suspension Pressure Sensor	1-5VDC Normal
7	Right Rear Suspension Pressure Sensor	1-5VDC Normal
8	Inclinometer	
9	Body Rise Signal	Body Down - Open Body Up - Gnd
10	Break Lock Signal/Neutral Signal	Lock Off - Open Lock On - Gnd
11		
12		

CN4 - AMP 040 8 Pins Black (Optional Input, Reserved)	
No.	**Description**
1	Optional Input GND
2	Analog Input 1
3	Analog Input 2
4	Digital Input 1
5	Digital Input 2
6	
7	

3. Hold a piece of paper such as a dollar bill between where the door seal (4) will hit the skin of the cab and firmly close the door ensuring that it latches on the second catch. (The door latch mechanism has a double catch mechanism.)

4. The door seal should firmly grip the paper all along the top, front, and bottom edge of the door. If the paper is loose all around, REPEAT STEP 2. If the paper is firmly gripped, but can be removed without tearing it, open door and tighten the jam bolt completely without affecting the adjustment.

5. If the paper slips out from the door seal easily along the top and not at the bottom, the door itself will have to be "adjusted". Or if the paper slips out easier at the bottom than at the top, the door will have to be "adjusted".

- If seals are tight at bottom of door, but not at top, place a 4 x 4 block of wood at the bottom edge of the door, below the handle. Close the door on the wood block and press firmly inward on the top corner of the door. Press in one or two times, then remove the wood block and check seal tension again using the paper method. Seal compression should be equal all the way around the door. If seal is still loose at the top, repeat procedure again until seal compression is the same all the way around.
- If seal compression is greater at the top than at the bottom of the door, place a 4 x 4 block of wood at the top corner of the cab door. Then press firmly inward on the lower corner of the door. Press in one or two times, then remove the wood block and check seal compression again. Seal compression should be equal all the way around the door. If seal is still loose at the bottom, repeat procedure again until seal compression is uniform all the way around.

Step B. If the door bucks back when trying to close it, the striker bolt (2, Figure 2-4) has probably loosened and slipped down from where the catch can engage with the bolt.

1. Open the door and close both claws (3 & 5, Figure 2-4) on the catch until they are both fully closed.

2. Transfer the center of this opening onto the skin of the cab nearest where the door jam bolt is located. Use a T-square or other measuring equipment and mark on the cab with a pencil. ***NOTE: Release the door catch before trying to close the door.***

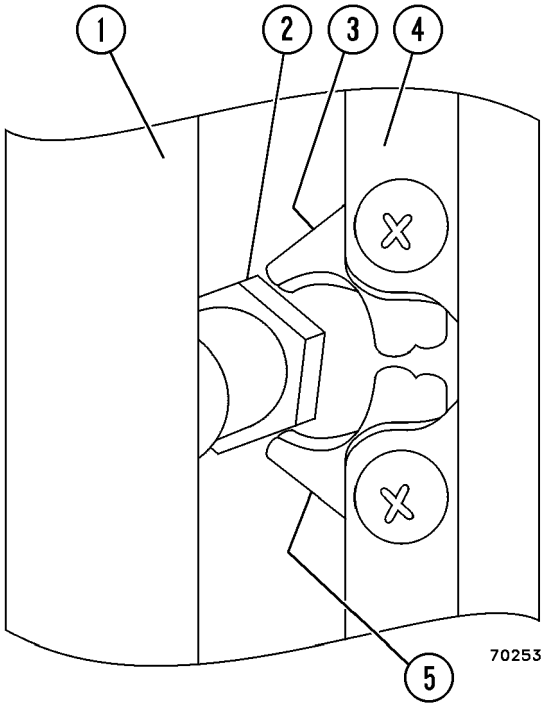


FIGURE 2-4. DOOR JAM BOLT ADJUSTMENT

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

3. Loosen and vertically align (center) the door jam bolt with this mark and tighten it firmly enough to hold it in place but still allow some slippage.

4. Carefully try to close the door (4) and determine if this has helped the "bucking" problem. If the door latches but not firmly enough, follow procedures listed previously in "Step A". If the door latch does not catch, move the bolt outwards and try again. When corrected, follow adjustment procedures listed in "Step A" to ensure a good seal. By design, if both seals are in good condition, proper adjustment of the outside seal will ensure good contact on the inside seal to prevent dust and moisture from entering the cab.

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.

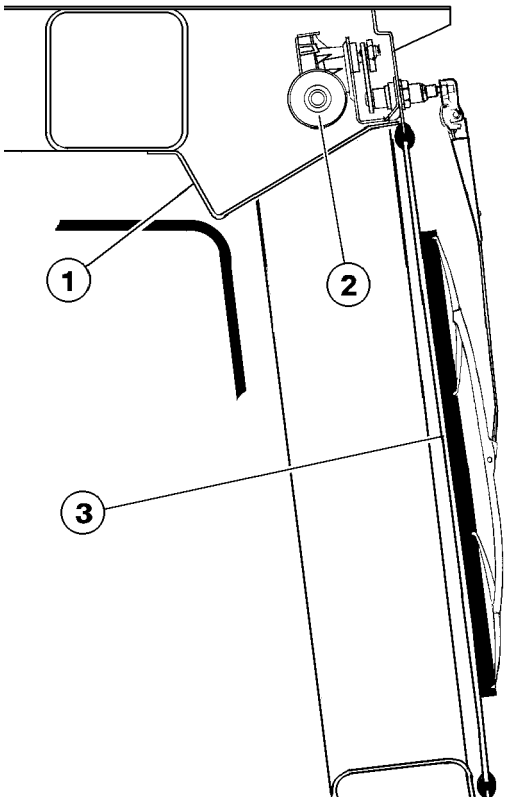


FIGURE 3-1. WINDSHIELD WIPER INSTALLATION

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

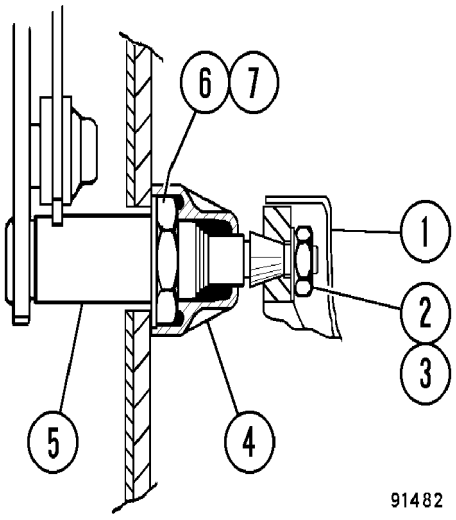


FIGURE 3-2. WIPER ARM DETAIL

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

7. Remove capscrews and remove wiper motor assembly.

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), nut (6) and cap (4).
3. Install wiper arm (1) in location noted during removal and install spring washer (3) and retaining nut (2).
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.

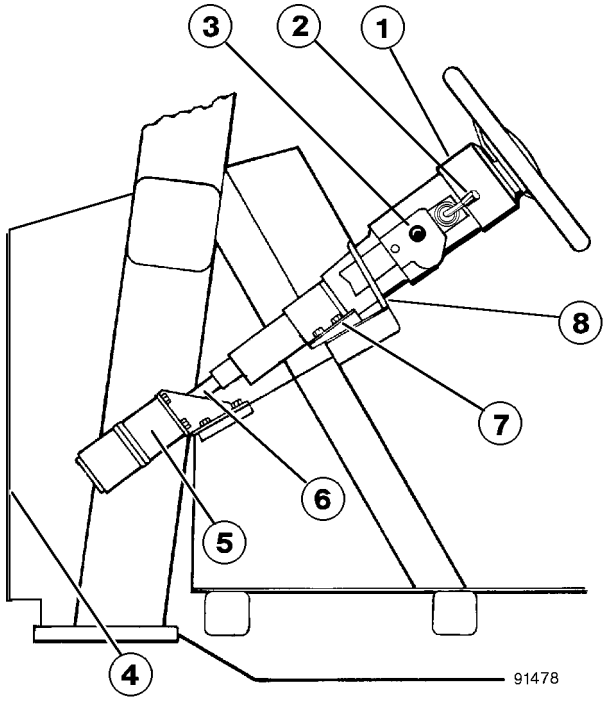


FIGURE 5-3. STEERING COLUMN INSTALLATION

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

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 the steering column mounting holes over the tapped holes in the mounting bracket and in alignment with the steering control valve.
4. Install four capscrews (7), lockwashers, and hardened flatwashers 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 retainer halves.
6. Connect the steering column wire harness to the instrument panel harness.
7. Reinstall access cover (4) on front of cab.
8. Close battery disconnect switch.

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

(1, Figure 5-6) KEY SWITCH

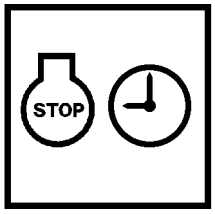
The key switch is a 3-position (Off, Run, Start) switch.

- When the switch is rotated one position clockwise, it is in the “Run” position and all electrical circuits (except “Start”) are activated.
- With the Selector Switch in “Neutral”, rotate keyswitch fully clockwise to “Start” position and hold this position until engine starts. “Start” position is spring loaded to return to “Run” when key is released. If the engine is equipped with a Prelub system, a noticeable delay will occur before cranking begins. Refer to Section “A”, *Engine Startup Safety Practices* for detail instructions.
- With truck stopped, turn keyswitch counterclockwise to “Off” for normal engine shutdown.

Use the Engine Shutdown switch on center console, if engine does not shutdown with keyswitch.

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

(2, Figure 5-6) ENGINE SHUTDOWN SWITCH with TIMER DELAY (OPTIONAL)



This is a 3-position rocker type switch (Off-On-Momentary). Refer to “Operating Instructions” section, “DELAYED ENGINE SHUTDOWN PROCEDURE”, for a complete detailed operation of this switch.

1. Press top of switch to the “On” (center position), then press firmly to the “Momentary” (upper position) and hold this position briefly to activate the 5 Minute Idle Timer (switch is spring-loaded to return to “On” position when released). At the SAME time while holding the “Momentary” switch position, turn the Keyswitch counterclockwise to the “Off” position. When the engine stops after the 5 minute idle period, the hydraulic bleeddown timer will be activated and turn off the 24 VDC electric circuits controlled by the keyswitch.

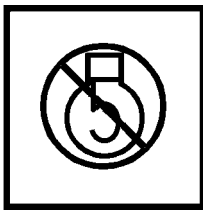
⚠ IMPORTANT ⚠

Engine WILL NOT SHUT DOWN, if keyswitch is not turned “Off” in this manner.

NOTE: To cancel the 5 Minute Idle Timer sequence, press Timer Delay Shutdown switch to the “Off” (lower) position.

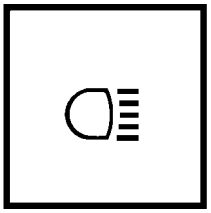
- If keyswitch is in “Off” position, engine will stop.
- If keyswitch is in “On” position, engine will continue to run.

If engine does not shutdown with keyswitch, use Engine Shutdown Switch on operator cab center console, and hold this switch down until engine stops. The Ground Level Shutdown Switch will also stop the engine during this time-out.



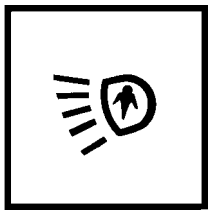
2. When the Engine Shutdown Timer has been activated, the Timer Delay indicator light in the overhead display panel (C4, Figure 5-7) will illuminate to indicate that the shutdown timing sequence has been started. The engine will continue to run at Idle RPM for approximately 5 minutes to allow for proper engine cool-down before stopping.

(3, Figure 5-6) MANUAL BACKUP SWITCH



The Manual Backup Switch allows backup lights to be turned “On” providing added visibility and safety when the Selector Switch (see OPERATOR CONTROLS) is not in “REV” position. When the SWITCH is pressed toward the “On” position, the MANUAL BACK UP LIGHT indicator (B4, Overhead Panel) will be illuminated.

(4, Figure 5-6) LADDER LIGHT SWITCH



The switch turns the ladder lights “On” or “Off” after or before using ladder. Pressing the top of the rocker switch turns the lights “On”. Pressing the bottom of the switch turns the lights “Off”. Another switch is mounted at the front left of truck near the base of ladder.

SECTION P
LUBRICATION AND SERVICE
INDEX

250 HOUR LUBRICATION AND MAINTENANCE CHECKS (CONTINUED)

5. COOLING SYSTEM -
   a. Check cooling system for proper coolant mixture. Add coolant mixture as required.
   b. COOLANT FILTERS - Change coolant filters. Refer to engine manufacturer's Operation and Maintenance Manual for coolant filter replacement instructions and recommended coolant mixture and additives.
6. STEERING LINKAGE - Check torque on steering pin nuts **525 ft. lbs. (712 N.m)** torque. Inspect all lube points to be certain all are receiving adequate grease. Look for broken lines, or signs that injectors may be inoperative. Check torque on tie rod clamping capscrews, 310 ft.lbs. (420 N.m) torque.
7. CAB AIR FILTER (NOT SHOWN) - Under normal operating conditions, clean every 250 hours. In extremely dusty conditions, service as frequently as required. Clean filter element with mild soap and water, rinse completely clean and air dry with maximum of 40 psi (275 kPa). Reinstall filter.
8. HYDRAULIC SYSTEM FILTERS - Replace filter elements, after the initial 50, 100, and 250 hours of operation; then at each 500 hours of operation thereafter. Check oil level. Add oil as necessary. Lube Key “B”.
9. FRONT WHEELS - Check oil level. Lube key “E”.
10. CHASSIS LUBE LEVEL - Check reservoir grease level. Add grease to insure supply is not exhausted before next scheduled service. Lube key “D”. Check grease filter bypass indicator. Replace element if restricted. Refer to *“Automatic Lubrication System”,* this Section.
11. MOTORIZED WHEEL GEAR CASE - Refer to the G.E. Planned Maintenance Manual and specific motorized wheel shop manual. Check for correct oil level. Lube key “C”.
12. WHEEL MOTOR BLOWER - Grease motor blower shaft bearings. Lube key “D”.
13. G.E. PREFILTER BLOWER - Add one or two applications of grease to the grease fitting. Lube key “D”.

COMMENTS	√’d	INITIALS

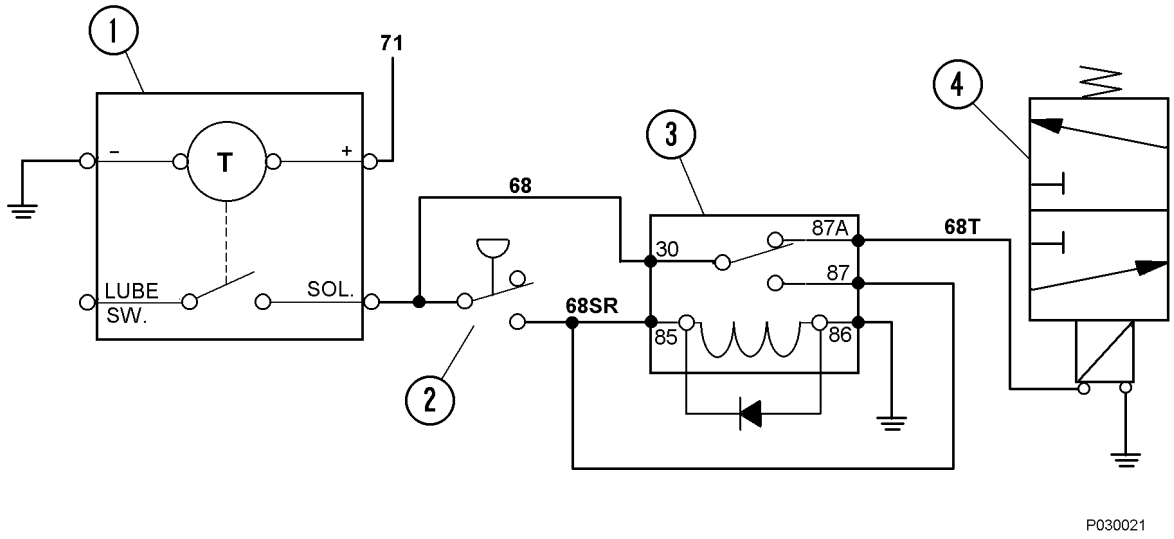


FIGURE 3-4. ELECTRICAL SCHEMATIC

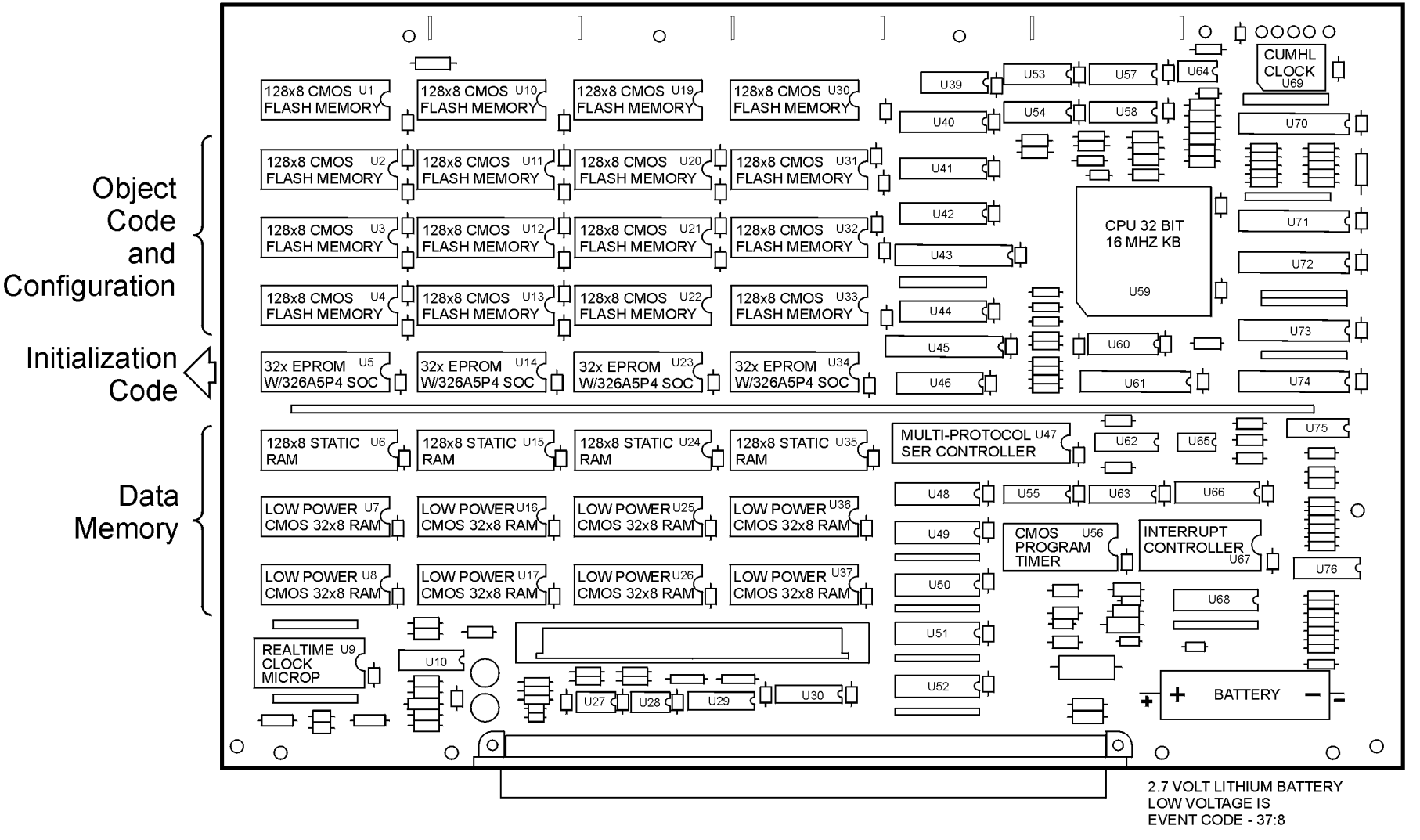
1. Solid State Timer
2. Pressure Switch; N.O., 2500 psi (17 237 kPa)
3. Relay
4. Pump Solenoid Valve

POSSIBLE CAUSES	*SUGGESTED CORRECTIVE ACTION*
TROUBLE: Timer Turns On At Intervals Two (2) To Ten (10) Times More Often Than Set Time Interval	
Electrical noise is being introduced into the power supply to the timer overcoming suppressor capacitor causing uncontrolled turn-on of its output relay.	***IMPORTANT: In some instances, electrical noise may be generated into vehicle electrical system which may cause timer to turn on at random intervals, independent of timer setting.*** ***If this occurs, a 250 to 1,000 MFD capacitor rated 150 to 350 VDC should be added across BAT (+) and BAT (-) terminals to suppress this noise and improve timer performance.***
TROUBLE: Timer Turns On At Intervals Faster Than Allowable Tolerances Of Settings	
Timer out of adjustment or damaged component.	Refer to “Timer Adjustment and re-adjust timer or replace timer.

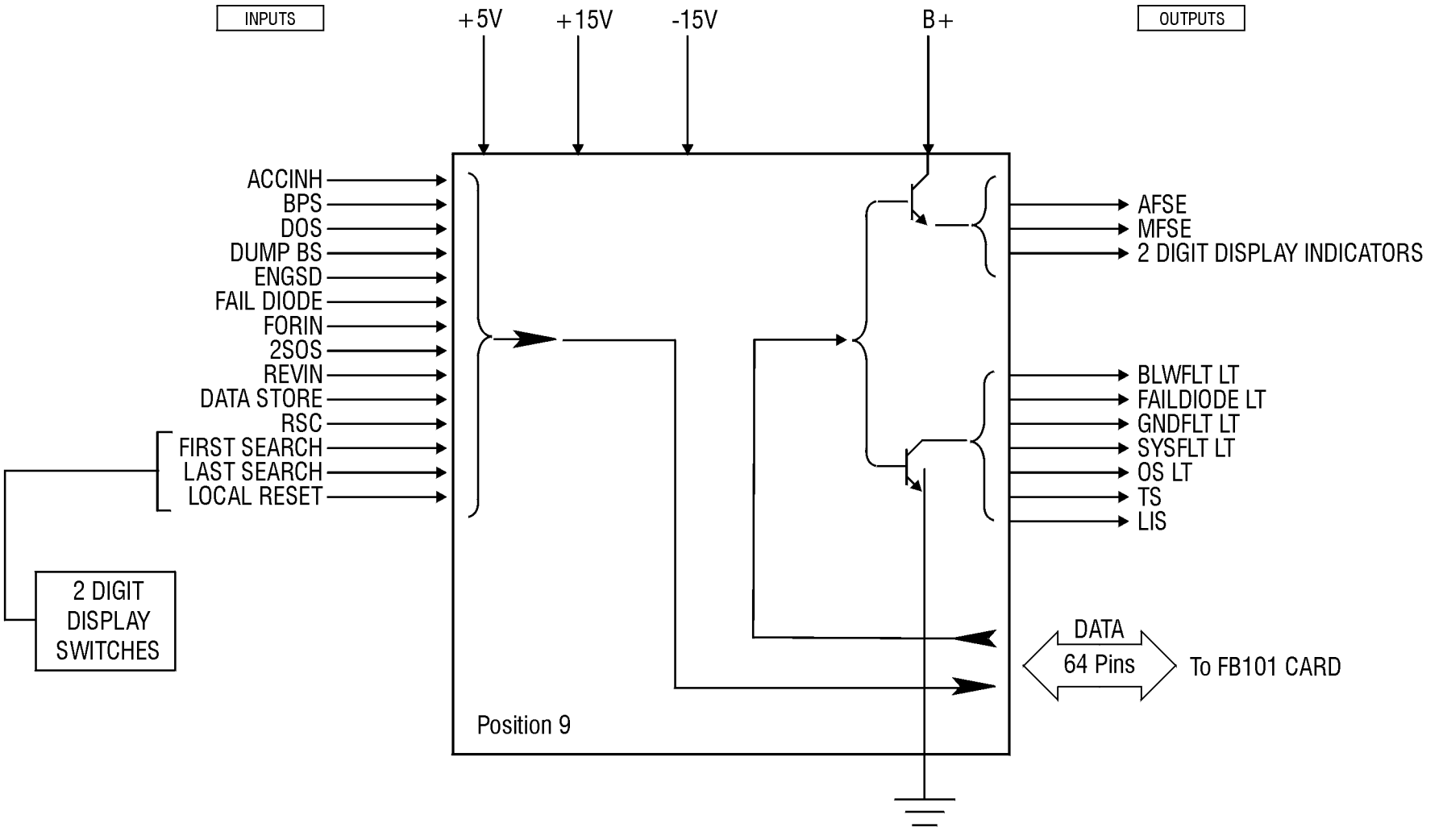
SECTION R

SYSTEM SCHEMATICS

INDEX



FB101
PROCESSOR CARD



FB103
DIGITAL I/O CARD

Figure E
CONNECTOR E
(All Signals Digital)

SIGNAL NAME	DESCRIPTION	CONNECTOR PIN NO. [ ] = +5V < > = GROUND ( ) = SHIELD	TYPE OF SIGNAL
AFSE	B+ Supply for AFSE Firing (GFM) High Side Driver	36(B+), 49	OUTPUT
BLWFLT_LT	Turns on Blower Warning Light Low Side Driver	27 <13>	OUTPUT
CPRL	Control Power Relay Latch High Side Driver	99(B+) 88	OUTPUT
CPSFB	Control Power Switch Feedback	62	INPUT
DISPARE1	(Not Currently Used)	103	INPUT
DISPARE2	(Not Currently Used)	6	INPUT
DISPARE3	(Not Currently Used)	8	INPUT
DISPARE4	(Not Currently Used)	101	INPUT
DISPARE7	(Not Currently Used)	18	INPUT
ENGSDNLT	(Not Currently Used)	100 <102>	OUTPUT
ENGSRVLT	(Not Currently Used)	86 <87>	OUTPUT
FAILDIODE_LT	Turns on Electric System Failure Light Low Side Driver	12 <48>	OUTPUT
FOR	Energizes Reverser Forward Coil Low Side Driver	73 <61>	OUTPUT
FORFB	Reverser is in Forward Position	60	INPUT
GF	Energizes GF Contactor Coil Low Side Driver	98 <20>	OUTPUT
GFFB	GF Contactor is Closed	31	INPUT
GFR	Energizes GFR Relay Coil Low Side Driver	71 <85>	OUTPUT
GFRFB	GFR Relay is Closed	4	INPUT
GND	Battery Ground	<5> <7> <24> <34> <35> <46> <90>	INPUT
GNDFLT_LT	Turns on Electric System Failure Light Low Side Driver	66 <67>	OUTPUT