MT 4400AC MECHANICAL MANUAL (MHTOC6)

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INTRODUCTION

This manual has been prepared to provide a description, operation, servicing, and repair procedures for BUCYRUS® vehicles manufactured by BUCYRUS®.

Before attempting any maintenance on the truck, personnel should become familiar with various systems and components and understand their operation and importance. Information contained in this manual pertains to the mechanical aspects of the truck. For detailed information concerning the electrical systems and components, refer to the appropriate BUCYRUS® Electrical Maintenance Manual or manufacturer's information for the specific truck model and electrical propulsion system.

The systems and schematics shown in this manual do not necessarily reflect all vehicle configurations. Consideration should be given to modifications and system changes which may have been made after purchase or items unique to your application.

The contents of this manual do not claim to cover all details or variations in equipment, nor provide for every possible contingency to be met in connection with maintenance repair, or operation.

Safety and informational highlights used in this manual include:

SAFETY ALERT SYMBOL

The safety alert symbol is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

HAZARD CLASSSIFICATION

The multi-tier hazard classification system is used to communicate potential personal injury hazards. The following signal words used with the safety alert symbol indicate a specific level of severity of the potential hazard. Signal words used without the safety alert symbol relate to property damage and protection only. All are used as attention-getting devices throughout this manual as well as on decals and labels to assist in potential hazard recognition and prevention.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION used without the safety alert symbols indicates a potential hazardous situation which, if not avoided, may result in property damage.

IMPORTANT and **NOTE** indicate operations, conditions, or specific information of sufficient importance to call for additional specific instructions or information.

SAFE POSITION DEFINITION

In this manual a SAFE POSITION is defined as a parking position in which the truck cannot move even if all of the truck's brakes are released.

Three examples of a SAFE POSITION ARE:

1. The truck is driven into a ditch or over a berm line.
   or
2. The truck is driven up against a berm or bank.
   or
3. Chocks are placed in front of and behind the wheels. These chocks must be of sufficient size to hold the truck on the grade on which it is parked.

Remember, the truck will be in a SAFE POSITION only if it is parked so that it cannot move even if the brakes are released.

USE OF THIS MANUAL

This manual has been prepared in modules (small, loose-leaf packets of information) to assist in keeping the

information up-to-date and maintaining technical accuracy. It is designed to allow information to be changed on specific topics without upsetting other unaffected areas.

The manual is divided into 10 sections:

1. DESCRIPTION AND OPERATION
2. STRUCTURE
3. ELECTRICAL SYSTEM
4. POWER PACKAGE
5. HYDRAULIC SYSTEM
6. PNEUMATIC SYSTEM
7. RUNNING GEAR
8. BRAKE SYSTEM
9. OPTIONS
10. MISCELLANEOUS

All material covered in this manual are organized in one of these sections. Dividers are used to provide easy access to the first page of each section. A Table of Contents located on the first page lists the modules included in that section.

The remainder of the section consists of the individual modules (or packets of information). Each module is an individual “chapter” with the important maintenance information of the topic of interest. They are prepared on systems, sub-systems, and individual components. Each module is further subdivided into topics as follows:

1. DESCRIPTION AND LOCATION
2. OPERATION
3. TROUBLESHOOTING
4. MAINTENANCE AND ADJUSTMENT
5. REMOVAL
6. DISASSEMBLY
7. INSPECTION AND REPAIR
8. ASSEMBLY
9. INSTALLATION

All Table of Contents in this manual include this system. The modules themselves will be changed on their next update/modification.

Illustrations, in the form of line drawings, cut-away views, photos, etc., are included to assist in the understanding of the text. Safety related items are identified by the DANGER, WARNING, and CAUTION headings preceding the instructions or statements. Highlighted information is identified by the term IMPORTANT or NOTE preceding the text.

Proper use of the manual will improve your ability to keep the truck operating safely and efficiently. When referring to the manual for information:

1. Determine what system or component is involved.

2. Determine what section you feel it would be organized in. Remember, there are several possible sections for many components.

3. Use the divider and turn to the Table of Contents on the first page of the section.

4. Use the Table of Contents to locate the appropriate module. If not listed in the Table of Contents, refer to another appropriate section and check again.

5. Locate the module in the section.

6. Read the Description and Location material to positively identify the component.

7. Use the Operation material to check your understanding of its operation. It is important you understand how it works before beginning to work on it.

8. Use the Troubleshooting guide to assist in identifying the problem.

9. Follow the procedures outlined in Maintenance and Adjustment to attempt to correct the problem before continuing. A simple adjustment may correct a problem without component replacement.

10. If replacement or repair is required, follow the procedures listed under Removal, Disassembly, Inspection and Repair, Assembly, and Installation. Be sure to read and understand all instructions prior to beginning the task. A few moments of reading this manual or questioning personnel familiar with the procedure can prevent many wasted hours of effort and unnecessary expenses.

11. Double check to ensure all connects, mounts, etc., are tight. A complete Walk-Around Inspection similar to that outlined in Section 1 - Description and Operation is recommended prior to starting or moving the truck. For check-out and road-test procedures, check the recommendations of your facility.

Remember, this manual is for your reference and should be treated as any reference work. The procedures outlined may not be the only way to accomplish a task, but they are a standard method of doing so. Use them as a tool and your job should be easier.

DESCRIPTION

DESCRIPTION

The BUCYRUS® dump truck is a heavy-duty, large-capacity haulage truck specifically designed for the open pit mining industry. The large payloads that can be carried make this an efficient means of transporting material from one point to another in a mine or similar off-highway haulage operation.

Propulsion for the truck is supplied by either “diesel-electric” or “trolley-assist” depending on the mode of operation available and selected. The operating principal of both is to supply a regulated source of dc voltage and current to the wheelmotors, which convert this energy into a mechanical form through a self contained traction motor and planetary gear drive system which is directly mounted to the rear dual tire assemblies.

In the “diesel-electric” mode, an alternator, directly coupled to a turbo-charger diesel engine, supplies the basic electrical energy. A primarily solid state control system regulates the power output based on a number of operating factors (including such items as truck and engine speed, demand requirements, and engine power available).

In the “trolley assisted” operating mode, the electrical power supply is automatically switched to an external source. Wayside equipment typically is used to regulate the incoming power and transmit it through overhead cables (or similar devices) on the haul roads. Truck mounted collectors (typically pantograph or pole assemblies) with attached mechanical/electrical connectors, transfer this energy from the cables to the on-board electrical propulsion control circuitry, an integrated semi-solid state system similar in function to that controlling “diesel-electric” operation.

NOTE: *During trolley assisted operation the normal diesel-electric supply system is not operating.*

In normal operation, the truck’s speed on downgrades and slowing for normal stopping is controlled by an electrical dynamic retarding system. When this system is activated, the wheelmotors function as generators and convert truck’s kinetic energy (force keeping the truck moving) into electrical energy. This electrical energy is dissipated as heat through a series of air-cooled resistors. For further explanation of the dynamic retarding system, refer to Section 6 of the Operator’s manual.

IMPORTANT: *The amount of retarding effort available is related to the speed of the truck. This amount remains at a maximum at speeds of 1 to approximately 15 mph (2 to 28 km/hr). Above this speed the amount of retarding effort available reduces as the speed continues to increase. However, the amount of dynamic retarding required to control the truck will continue to increase throughout the entire operating range. This creates a range “envelope” or limits within which the truck should be operated that will vary with truck load, speed, electrical propulsion system, and the grade involved. Operation at speeds in excess of these limits will mean that sufficient retarding effort may not be available to control the truck without the assistance of the friction brakes. Information on how to determine this safe operating range is contained in Section 6 of the Operator’s manual, but always check with the appropriate mine personnel for these speeds in particular areas of your mine.*

For slow speed stopping, in emergencies (at any speed), and short term parking (operator remains in cab with engine running), the friction brake system is used. This system functions in a manner similar to automotive brakes and allows the vehicle to be brought to a complete stop. These brakes are not intended for use in normal operation at high speeds - except in emergencies. Use at high speeds may result in the generation of excess heat which will reduce the effectiveness of the brakes (should they be required in an emergency) and increased wear on the system’s components.

A separate mechanical parking brake system is provided for long term parking (operator leaves cab or the engine is not running). This system mechanically locks the rear brakes and must be applied only when the truck is completely stopped. It is recommended that the truck is parked in a SAFE POSITION and the Park Brake is applied prior to the operator leaving the cab.

The truck is suspended at all tire locations by struts that use a combination of lightweight oil and nitrogen gas. Each of the suspension assemblies contains integral rebound provisions to dampen movement resulting from the suspensions absorbing a shock.

Many of the controls on the truck are electrically, hydraulically or in some cases pneumatically operated or assisted. Electrical energy is provided by a 24

volt battery system, with the charge maintained by a separate engine mounted battery charging alternator. Pressurized hydraulic fluid for the system is obtained from tandem or triple pumps driven directly from the main traction alternator. Detailed descriptions and explanations of the operation are available elsewhere in this manual.

The operator's control cab is equipped with the controls and indicators necessary to provide safe, efficient operation of the vehicle. The simplicity of the diesel-electric drive system has reduced the main controls to a steering wheel, throttle, dynamic retarder, brake pedal, shifter, (forward, neutral, and reverse), and dump control lever. The function of each indicator, gauge, and control in the cab is discussed in detail in Section 3 - Indicators, Gauges, and Controls of the Operator's manual.

TABLE 1 - GENERAL SPECIFICATIONS

MT 4400AC TRUCKS

NOTE: *The included specifications are standard features on the trucks. Other features/combinations are available upon customer request or to conform to specific applications*

STRUCTURE

CAB

The enlarged Mega cab features integral ROPS (Rollover Protective Structure) that accommodates two full size seats. All steel construction with indicators, gauges, and controls required to operate the truck and featuring a curved windshield to provide a greater field of view.

DUMP BODY

Horizontal bolster deep vee design with a flat floor and a 45° dumping angle. Fabricated from high strength steel with optional highly wear resistant liners.

Dump body sized to reflect material density and payload rating.

FRAME

Completely computer aided design utilizing special alloy steel, fabricated with double box-section (separate sides and top and bottom wrappers welded together) construction. Center crossmember incorporates wrap around spherical axlebox/nosecone connection. Continuous frame rail beams with deep section in critical areas along with ROPS supports for rugged, dependable service.

FUEL AND HYDRAULIC TANKS

2 Saddle mounted tanks - 800 gallons (3,030 liters) fuel; 155 gallons (590 liters) hydraulic oil.

ELECTRICAL CONTROL SYSTEM

24 V dc power supplied by six (6) 12V dc batteries (three (3) pairs) connected in series. Batteries supplied by 24V dc, 100 Amp battery charging alternator standard.

POWER PACKAGE

ELECTRICAL DRIVE

General Electric Standard:

- GTA 41 Alternator
- 17FL375 Control Panel (GE AC Control)
- GEB 25 Wheelmotors

Air cooled grids, cooled by a self-contained blower unit, are used for retarding.

POWER PACKAGE (continued)

ENGINE
MTU/DDC Series 4000 – 2700 hp (2 015 kW)
Cummins QSK60 - 2700 hp (2 015 kW)

EXHAUST
Right side dual exhaust with mufflers.

FAN
Engine mounted, fixed pitch.

RADIATOR
Bolted type with multiple row with either a mechanically welded or removable tube core, typically with separate assemblies for engine coolant and engine inlet air coolant provisions.

HYDRAULIC SYSTEM

SUPPLY SYSTEM
Multiple pumps driven by drive shaft from alternator. The front two gear pump sections supply the dump system requirement. The rear piston pump section provides the steering system requirements, with flow diverted to the brake system as required to maintain proper accumulator pressures.

Pump capacities (at 1900 rpm, 2000 psi (13 800 kPa))
Front (Dump) - 115 gpm (435 liters/min.) each
Rear (Steering) - 35 gpm (132 liters/min.) - standard

High pressure filtration units with three (3) 6 micron (nominal) filtration and environmentally disposable elements. Hydraulic tank outlet contains a strainer with 100 mesh screening.

Hydraulic gauges and quick disconnect test points are standard.

DUMP SYSTEM
Manually operated pilot system controlling a dump valve, operating two double-acting, telescoping, two-stage cylinders. Flow of oil to and from cylinders controlled by a totally hydraulic dump valve.

Relief valve pressure preset at 2400 psi (16 550 kPa).

STEERING SYSTEM
Full time, closed center, load sensing system, operating two double acting cylinders. Supplied by two (2) accumulators that are replenished by a constant pressure compensated piston pump maintaining a pressure of 3500 psi (24 130 kPa).

Relief valve pressure: Main 2700 psi (18 615 kPa)
Accumulator Nitrogen precharge pressure: 1500 psi (10 340 kPa)

Auxiliary steering powered by accumulator capacity.

A separate manual power supply powered by a 24 Vdc electric driven motor/pump combination is available for use in maintenance, with both automatic and manual activation provisions.

HYDRAULIC SYSTEM (continued)

BRAKE SYSTEM
Hydraulic brake actuation system featuring fully modulated service brakes (foot pedal operated), fully modulated secondary brakes (hand control operated), loading brake (hydraulic actuation of the rear service brakes) and separate spring applied and hydraulically released separate park brake calipers.

Supplied by three (3) accumulators that are replenished by a constant pressure compensated piston pump maintaining a pressure of 3500 psi (24 130 kPa).

Brake Pressures
- Front 2800 psi (19 305 kPa)
- Rear 1400 psi (9 650 kPa)
- Accumulator Nitrogen precharge pressure: 1000 psi (6 895 kPa)

PNEUMATIC SYSTEM

Not installed or required in standard configuration.

RUNNING GEAR

TIRES AND WHEELS
Standard: Six (6) tires on individual rims. Size determined by application.

FRONT WHEELS
Solid disc wheels mounted on tapered roller bearings - one wheel mounted on each front spindle.

REAR WHEELS
Motorized wheel units flange mounted to the axlebox - dual tires mounted on each wheelmotor.

SUSPENSION
Front: Nitrogen/Oil standard.
Rear: Nitrogen/Oil standard.

BRAKES

Carlisle (Goodrich)
Arvin/Meritor (Rockwell/Goodyear)
See Section 5 - Hydraulic System or Section 8 - Brake System for details.

FRONT
Single disc/quad caliper (hydraulically actuated), mounted on each front wheel.

REAR
Dual disc/single caliper per disc (hydraulically actuated), mounted on each wheelmotor.

PARK
Mechanically (spring) applied/hydraulically released, mounted on each wheelmotor.

SAFETY

SAFETY

Safety should be the primary concern of anyone working on or around any vehicle. As safety-conscious individuals, you should do nothing that will place yourself, other personnel or any equipment in a position of possible injury or damage.

DANGER, WARNING AND CAUTION EMBLEMS

Safety and informational highlights used in this manual include:

This symbol means your safety is involved! Read, understand and follow all Danger, Warning, and Caution decals on your machine and instructions in this manual.

The signal word **DANGER** indicates an imminent hazard situation which, if not avoided, will result in death or serious injury or death.

The signal word **WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

The signal word **CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

The signal words **IMPORTANT** and **NOTE** indicate operations, conditions, or specific information of sufficient importance to call for additional specific instructions or information.

There are a number of such decals identifying areas of potential safety hazards. Refer to the illustrations for identification of those decals.

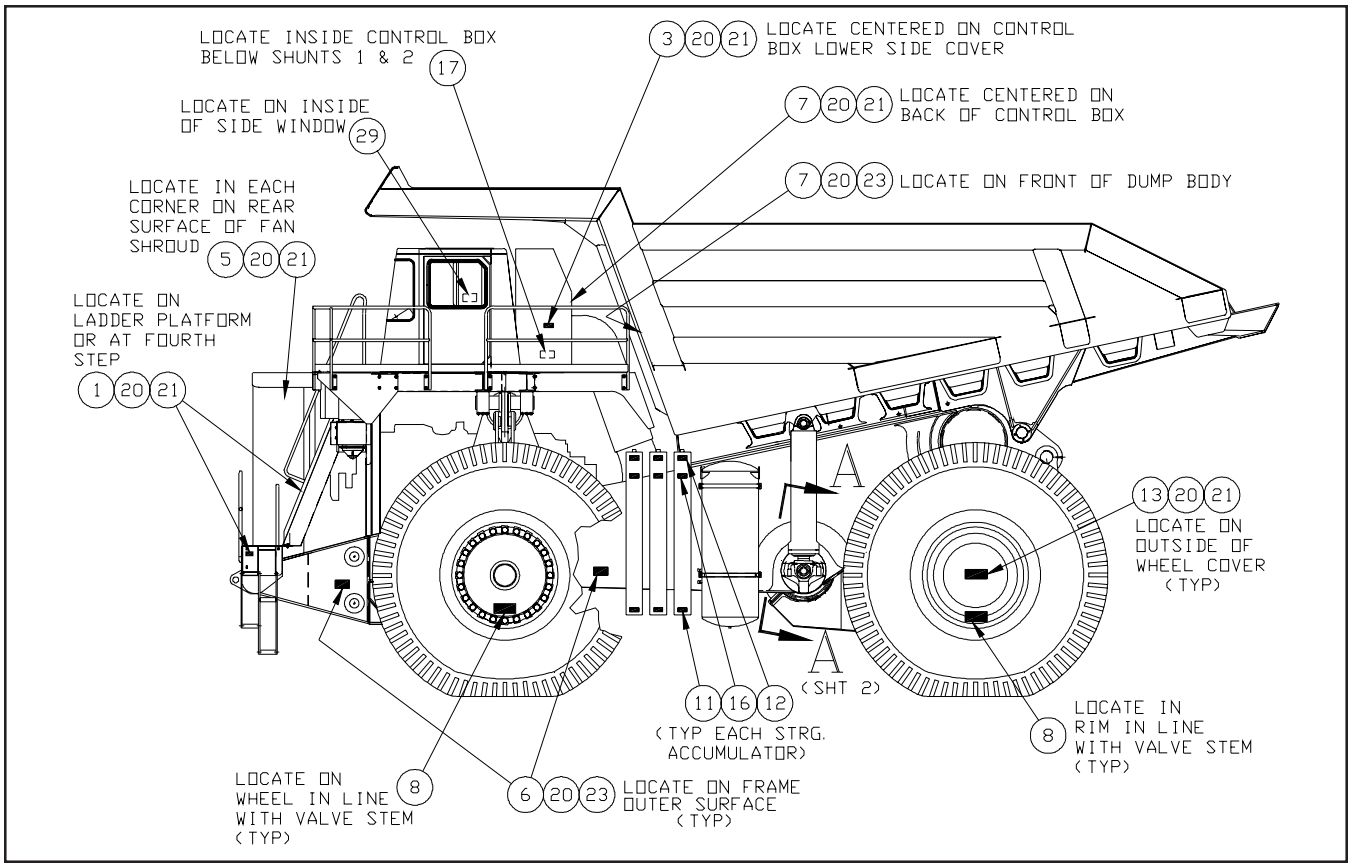


FIGURE 1 - HAZARD DECALS (A83678, SHEET 1 OF 5)

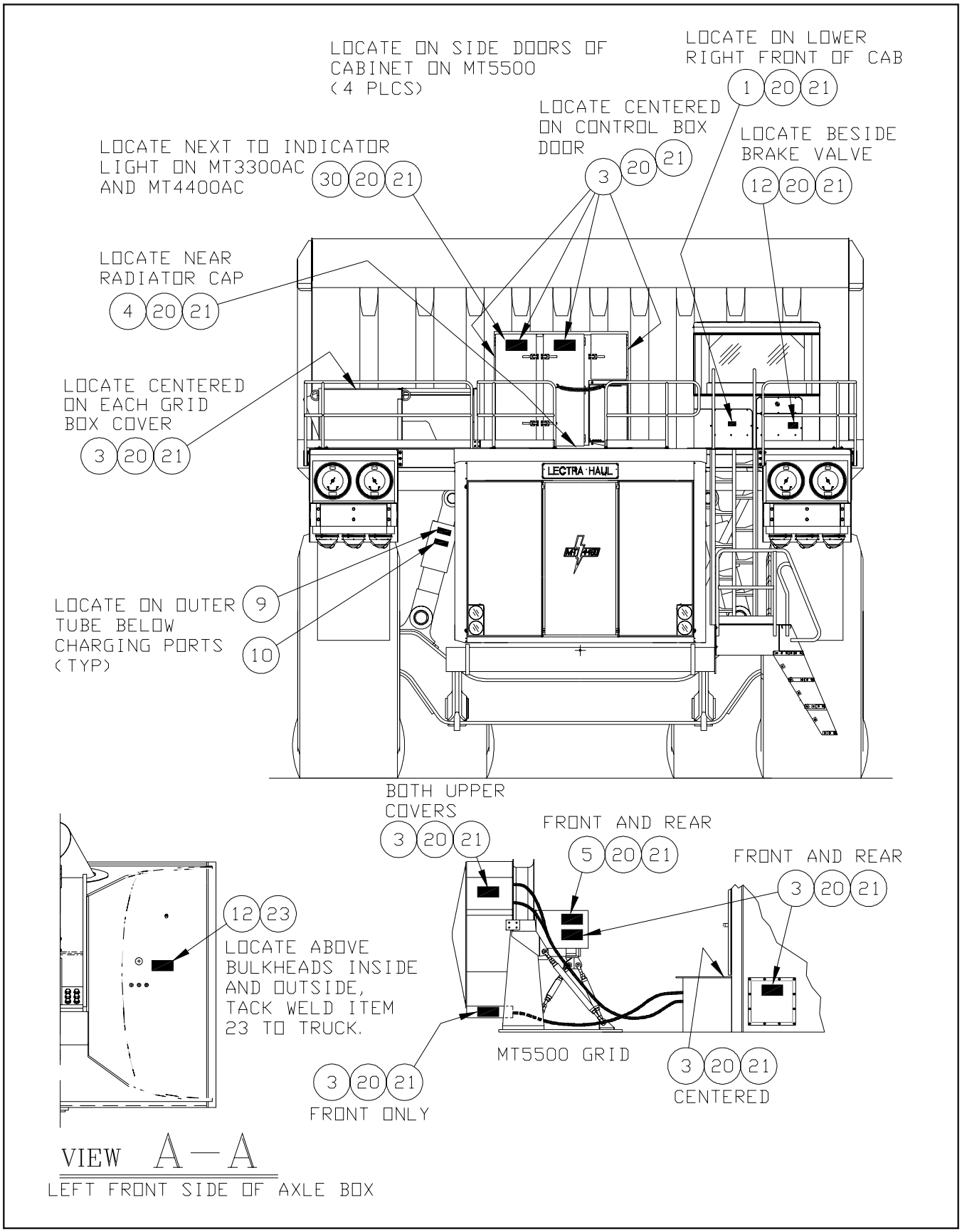


FIGURE 1 - HAZARD DECALS (A83678, SHEET 2 OF 5)

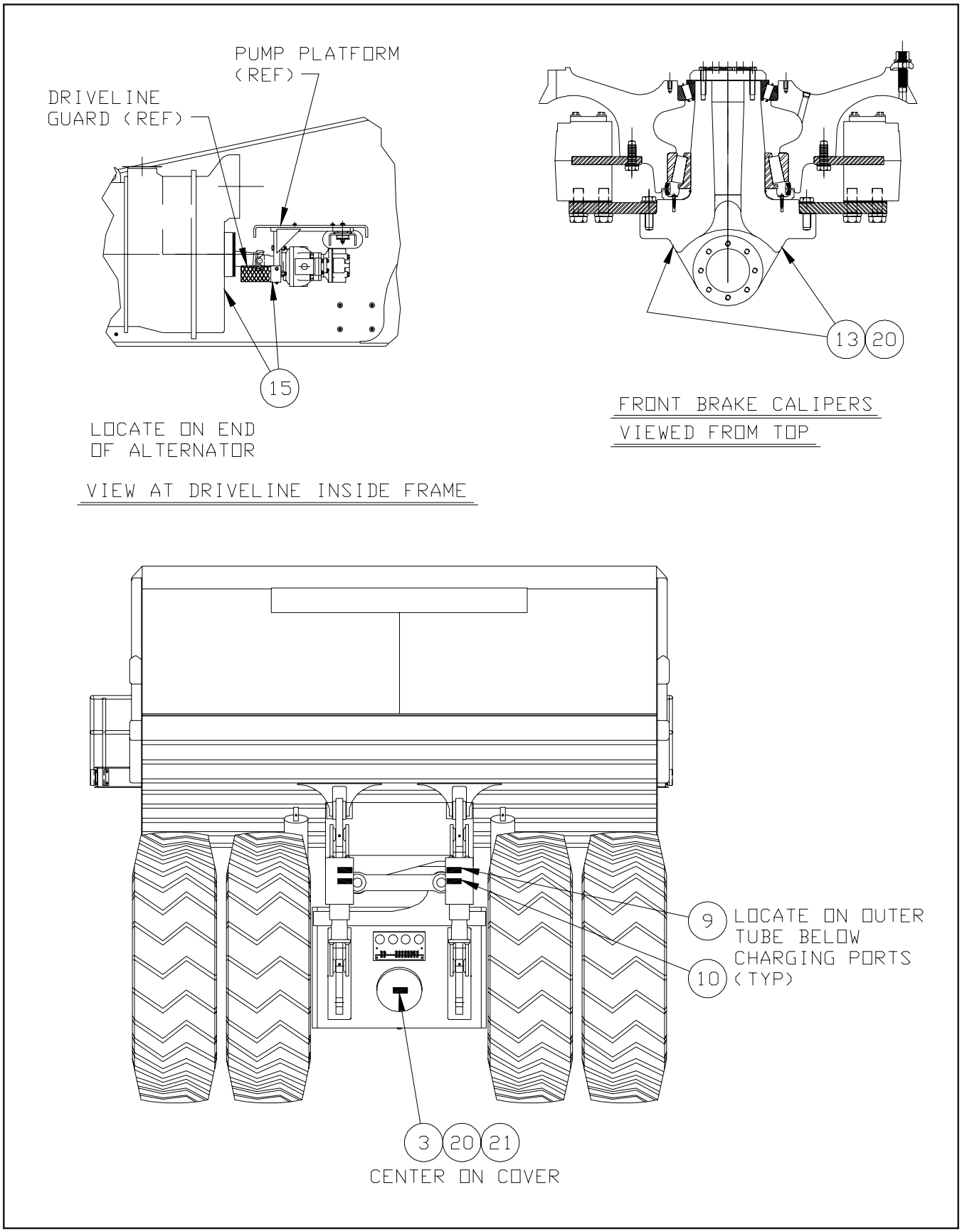


FIGURE 1 - HAZARD DECALS (A83678, SHEET 3 OF 5)

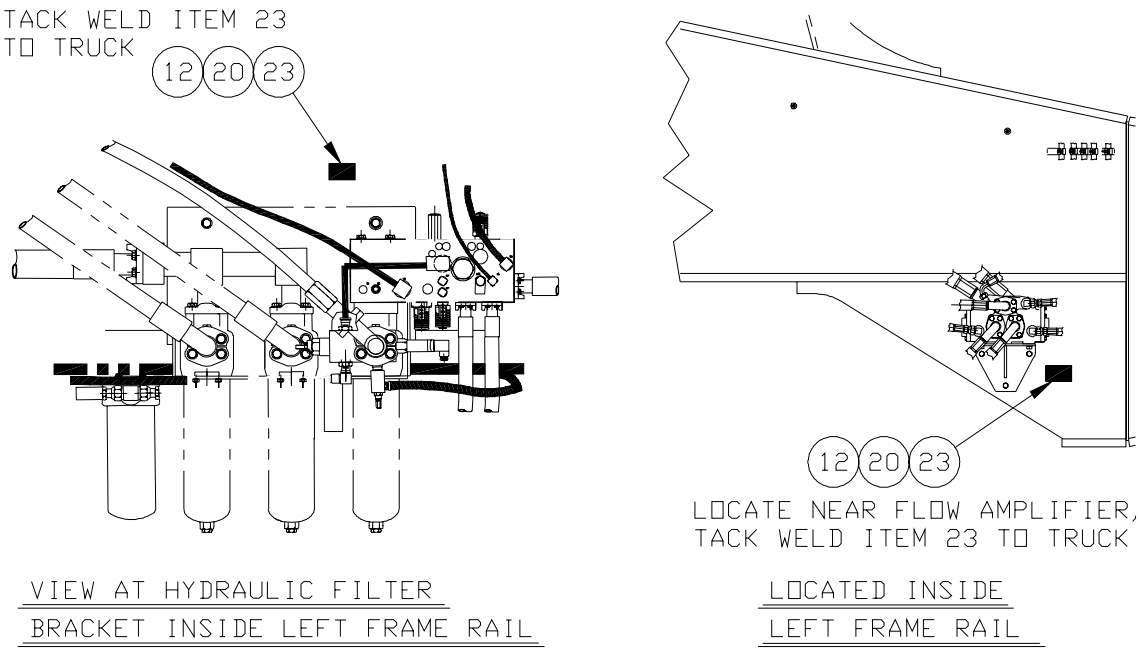


FIGURE 1 - HAZARD DECALS (A83678, SHEET 4 OF 5)

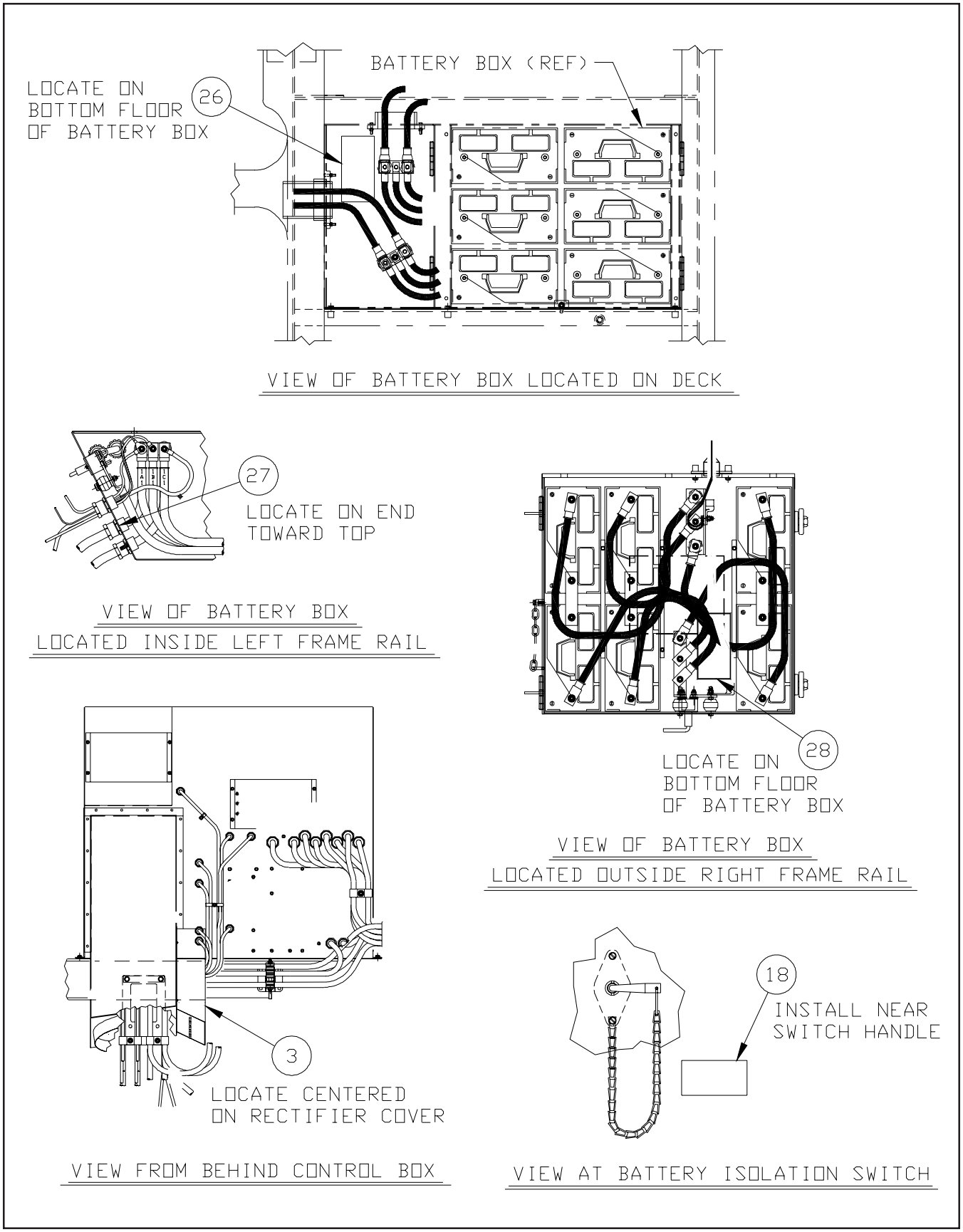


FIGURE 1 - HAZARD DECALS (A83678, SHEET 5 OF 5)

Item 1

Handrails are provided to assist in ascending and descending of the access ladders. Always use the rails for support whenever using the ladder to reduce the potential of falling.

Item 4

The cooling system is of automotive type design and operates under pressure when hot. The radiator cap and related controlling assemblies are designed to regulate and maintain this pressure. Extra care must be taken when loosening or removing the cap to prevent the sudden release of pressure and escape of fluid. This release could injure personnel through contact with the cap or heated fluids. Proper procedures for removal are included in this manual.

DO NOT LOCK THE REVERSER IN THE NEUTRAL POSITION

Item 2

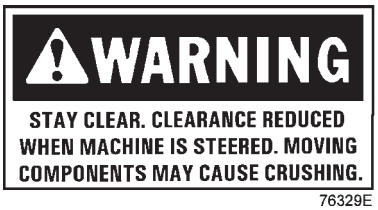
The reverser is an electrical switching device that directs the flow of electrical power to the wheelmotor fields to provide for both forward and reverse operation. In this application, it is designed to remain in the "forward" configuration when the shifter is in both Forward and Neutral and shift to the reverse configuration when the shifter is in Reverse. Locking the Reverser in the neutral position could create unwanted conditions that could injure personnel or damage equipment and should not be done at any time.

Item 5

The engine radiator fan assembly is operating much of the time the engine is operating. On most trucks (equipped with a clutching type fan assembly), the fan may rotate at various speeds depending upon ambient and engine temperature, load, etc. Extra care must be taken when working in this area to prevent the engine from being started and to avoid contact with the moving fan parts when the engine is operating.

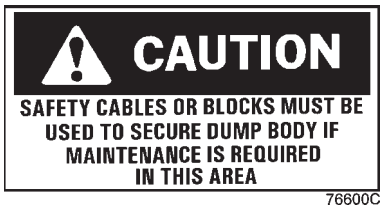
Item 3

The electrical propulsion system utilizes high voltage and current levels to efficiently transmit power to the electric wheelmotors. Exteme care should be exercised when working in the designated areas, particularly if the engine is operating.



Item 6

As the trucks steering wheel is turned, the front tire assemblies are caused to move. The movement causes the clearance between the frame and the tire to increase or decrease. Anyone in this area during the steering movement (such as in a shop environment) may be caught and injured. It is imperative that all personnel and equipment be kept from this area when the truck is being steered.



Item 7

The dump body must be secured by safety cable(s) or block whenever raised to access components. Never work on or near a truck when the dump body is raised if not so secured.

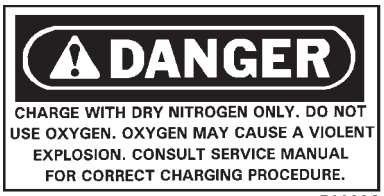
Item 8

The pressurized air in the tire could be released with explosive force if the rim or tire is improperly secured. Always completely deflate all tires prior to loosening any lug nuts. Also, always install and secure all tire and rim assemblies before re-installing.

Item 9

The accumulators are precharged with dry nitrogen, an inert, non-explosive gas. This precharge pressure may be released with explosive force if not totally exhausted from the accumulator prior to beginning component disassembly. It must be released prior to beginning any such servicing. For detailed information refer to the appropriate information in the BUCYRUS® Mechanical Maintenance Manual.

Also, the use of other gases (such as oxygen), may create an explosive condition. Use dry nitrogen only.



Item 10

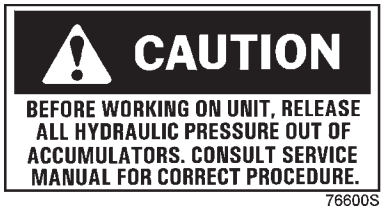
The nitrogen/oil suspension components are precharged with dry nitrogen, an inert, non-explosive gas. This precharge pressure may be released with explosive force if not totally exhausted from the suspension prior to beginning component disassembly. It must be released prior to beginning any such servicing. For detailed information refer to the appropriate information in the BUCYRUS® Mechanical Maintenance Manual.

Also, the use of other gases (such as oxygen), may create an explosive conditon. Use dry nitrogen only.

Item 11

The accumulators are precharged with dry nitrogen, an inert, non-explosive gas. This precharge pressure may be released with explosive force if not totally exhausted from the accumulator prior to beginning component disassembly. It must be released prior to beginning any such servicing. For detailed information refer to the appropriate information in the BUCYRUS® Mechanical Maintenance Manual.

Also, the use of other gases (such as oxygen), may create an explosive condition. Use dry nitrogen only.

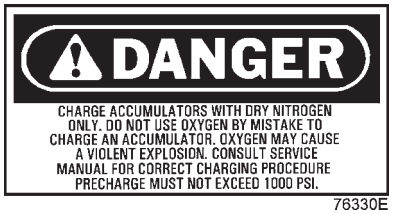


Item 12

The accumulators are charged to a high pressure during operation and may maintain this pressure even after the truck is parked and the engine stopped. Malfunction of the system could release this pressurized oil, injuring personnel and contaminating equipment. Refer to the information in the Mechanical Maintenance Manual for correct procedures.

Item 13

The accumulators are charged to a high pressure during operation and may maintain this pressure even after the truck is parked and the engine stopped. Malfunction of the system could release this pressurized oil, injuring personnel and contaminating equipment. Refer to the information in the Mechanical Maintenance Manual for correct procedures.



Item 14

The accumulators are precharged with dry nitrogen, an inert, non-explosive gas. This precharge pressure may be released with explosive force if not totally exhausted from the accumulator prior to beginning component disassembly. It must be released prior to beginning any such servicing. For detailed information refer to the appropriate information in the Unit Rig Mechanical Maintenance Manual.

Also, the use of other gases (such as oxygen), may create an explosive condition. Use dry nitrogen only.

Item 15

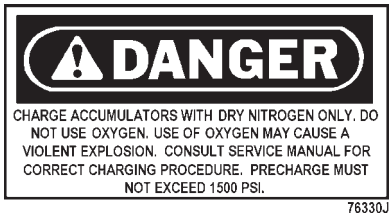
The drive shaft shield serves several functions:

1. To prevent individuals working near the shaft (as during maintenance or testing) from coming into contact with the rotating shaft.

2. Protect the drive shaft from contact with foreign objects.

3. Protect surrounding equipment from damage if the drive shaft malfunctions.

Never start or operate the truck without this important shield in place.



Item 16

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Also, the use of other gases (such as oxygen), may create an explosive condition. Use dry nitrogen only.

Item 17

The shunts are electrical devices used in the high voltage and current electrical system to assist in the measuring and proper monitoring of the operation of the trucks propulsion and retarding systems. During some testing, a shunt is moved between insulators to assist in this testing. To properly allow the wires and the shunt to conduct the high currents and voltages, good, tight connections are essential.

Item 18

On trucks equipped with the dual solenoid latching park brake valve, power is required to shift the valve to and from the detented Apply and Release positions. Moving the Battery Isolation Switch to the Off position before applying the park brakes (releasing the pressure holding the caliper released) removes this power and prevents application of the park brake system. Without this mechanically applied, hydraulically released system, loss of pressure in the other friction brake systems

on the truck (through manual release or internal by-passing, particularly when the engine is off) removes any brake system securing the truck. It is then free to roll.

This re-emphasizes the importance of placing the truck in a SAFE POSITION so that it cannot move, even if all brakes are released, prior to performing any work on the truck, even switching off electrical power with the Battery Isolation Switch. The additional securing of the truck with the park brake system, switched on prior to the turning off of the Battery Isolation Switch, serves to increase the safety of the situation.

Item 26
A battery disconnect or isolation system has been incorporated that isolates the truck's standard 24 Vdc electrical systems by interrupting the battery ground circuit. The "TX" terminals are common junction points of battery grounds. Connection of other circuits (especially if they are grounds) may adversely affect the operation of the isolation system and leave circuits closed or potentially energized. The different decals represent the different wiring configuration in use.

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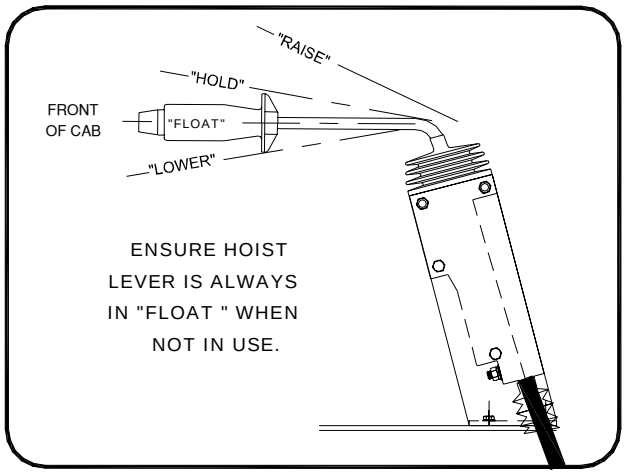
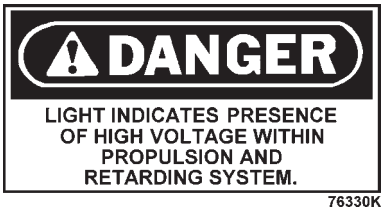


Item 29
The dump system is designed so that the dump control valve should be in the "Float" position at all times the dump body is not raised. In this configuration, the flow from the dump pump(s) and the dump cylinders is routed directly back to the hydraulic reservoir. This reduces system circulating pressures and also prevents the cylinders and mounts from carrying any of the load, except when actually dumping. On trucks equipped with hydraulic oil cooler assemblies, the oil is directed through the cooler only when the dump control pilot valve is in the "Float" position.



Item 30
The large red Capacitor Charged (Indicator) Light (CCL) in and on the electrical system control cabinet on trucks equipped with GE AC drive systems, is lighted whenever

there is high voltage in the truck's propulsion or dynamic retarding system. The indicator lights when there is 50 Vdc or more in the DC Link portion of the system.

DO NOT open the doors or touch any terminals or components when either of the indicators is lighted. Wait until the indicators turn off and then check with a meter to ensure that no voltage remains in the circuit.

WEARING APPAREL

It is recommended that all personnel wear appropriate safety hard hat, safety glasses, and approved safety shoes whenever operating or working on or around the truck. In addition, you should avoid loose, heavy, or bulky clothing that might restrict movement, reducing your ability to control the truck or tools. Loose or slippery gloves and slippery footwear should also be avoided.

Remember; always follow the specific recommendations or requirements at your mine.

BEFORE BEGINNING WORK

It is important to become familiar with each of the truck's components or systems prior to starting any work on them. Unfamiliarity with them may cause excessive delays in repair and downtime and needless component replacement.

1. Check that the truck is parked in a SAFE POSITION and is secured against unapproved starting, movement, system activation or component operation.

2. Always refer to the specific information in this manual and others like it and mine recommendations as a guide whenever servicing the truck.

3. Always remove any residual pressure or force on a system or component prior to loosening anything.

PARKING

The truck may be parked in SAFE POSITION for long term parking as follows:

NOTE: *A SAFE POSITION is defined as:*

1. The trucks front or rear wheels are driven into a ditch, or

2. The truck is driven up against a berm or a bank, or

3. Chocks are placed in front of and behind the rear wheels, and are sufficient to hold the truck on the grade it is parked.

The truck will be in a SAFE POSITION if these practices are followed, and if the truck will not move if the brakes are released.

NOTE: *These procedures must be followed any time*

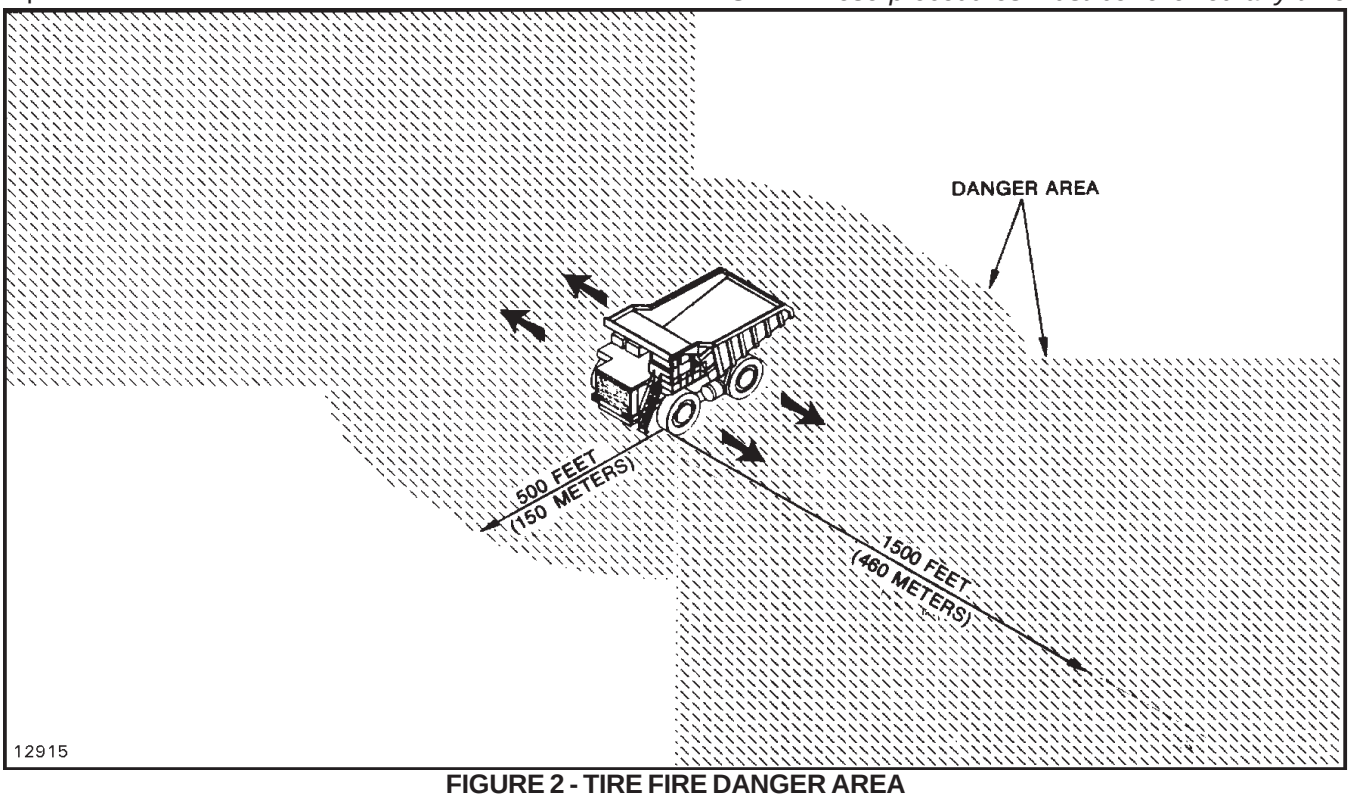


FIGURE 2 - TIRE FIRE DANGER AREA

the truck is left unattended, the engine is shut down, or a problem exists in the friction brake system.

1. Bring the truck to a complete stop with the truck's dynamic retarding and friction brake systems, as described in the instructions under Braking. Fully depress the Brake pedal once the truck is stopped.

2. Move the Shifter to the N (Neutral) position.

3. Pull the Load Brake Switch out to apply the brakes.

4. Move the Park Brake switch to Apply position **and hold** until the Park Brake indicator lights (approximately 2 seconds).

⚠WARNING

Do not leave the truck parked unattended with the Loading Brake only applied. Always park the truck securely in a SAFE POSITION, with the Park Brake applied.

5. Release the Brake pedal and Hand or Load Brake. The truck must remain stationary.

6. If the engine is to be stopped, follow the steps outlined under Engine Shut-Down.

7. Only after it is certain that the truck will remain secure and cannot accidentally move, should the truck be left unattended.

8. If available, use wheel chocks to secure the truck.

NOTE: *Always park the truck where other vehicles can easily pass. If for any reason it is necessary to park on the haul road, it is recommended that flares or some other warning sign be used. (Flares should be used for poor visibility, darkness, blind curves, narrow roads, or any other similar situation).*

Before any service work is begun, the truck should be properly parked in a SAFE POSITION and steps taken to ensure that it cannot be started or driven without the knowledge of the person servicing the unit.

IMPORTANT: *Always park your truck where other vehicles can easily pass you. If for any reason you are forced to park on the haul road or other thoroughfare, it is recommended that you put out a flare or some other warning sign to alert others of your position. (The flare should be put up if visibility is poor because of darkness, a blind curve, a narrow road, or any other similar situation).*

TIRE SAFETY

⚠DANGER

Danger of tire explosion due to fire/excessive heat in wheel area.

Whenever smell of burning rubber or excessively hot brakes is detected on the truck, there could be a distinct possibility of the danger of a tire explosion. It could also occur when fire on the truck reaches the tire and wheel area. Under such conditions DO NOT APPROACH THE TRUCK OR ENTER THE DANGER AREA (See Figure 2). Move the truck to a remote area only if it can be done without endangering the operator or other personnel in the area.

Stay at least 500 feet (150 meters) away from the tread area and 1500 feet (460 meters) from the tire sidewall. If it is absolutely necessary to reach the suspect tire, approach from the front or the back of the truck and use a large bulldozer blade as shield in front. If there is evidence of brake fire or smell of burning rubber, do not go near the truck. Fight these fires from a distant remote location. Do not rush to the truck with hand-held fire extinguisher in an effort to control the blaze. Allow at least eight hours for the tire to cool before approaching the truck.

DO NOT WELD OR HEAT RIM COMPONENTS WHILE TIRE IS MOUNTED ON THE RIM. The gases that build up inside the tire during arc welding or while applying heat on rim components can ignite, resulting in explosive-like failures of the tire and rim. This warning also applies to nitrogen inflated tires. Although ignition will not occur in the nitrogen atmosphere, the pressure build-up from the heat of welding may be sufficient to cause a blowout severe enough to injure or kill. Scrap all rim components that require heat to repair.

PRE-OPERATIONAL INSPECTION

Prior to placing a truck into operation (at each shift change or after repair or service work has been performed), it is recommended that the vehicle be inspected for evidence of damage or component wear. The following procedures are designed to allow the operator/inspector to make the inspection in one continuous trip around the truck, beginning at the access ladder. Correct discrepancies before placing truck in service.

NOTES:
1. The truck must be parked in a SAFE POSITION on level ground to permit accurate checking of the various fluid levels.
2. While making the inspection note any indications or signs that lockout or tagout provisions may be in place. If noted, determine their relevance and proceed per mine or local provisions.

1. Inspect the access ladder to be certain it is free of debris, securely fastened to the truck, and in general good condition. After confirming its condition, climb the ladder to the superstructure level. Clean and adjust all mirrors.

⚠ CAUTION

Use the handrails whenever climbing or descending the ladder.

2. If so equipped, verify that all battery disconnect switches are in their on or operating positions.

3. Visually inspect the superstructure area to ensure that it is free of debris and in general good condition. After confirming its condition, enter the cab.

NOTE: *If the truck is not equipped with an extension on the left hand side of the superstructure it is recommended that entry and exit of cab be made through the right (passenger) side door.*

4. Switch on all exterior lights including the emergency flashers. The lights should be checked during the inspection to verify that they light and can be seen. Return to ground level and continue the inspection.

NOTE: *During the remainder of the walk-around inspection, check the overall condition of the vehicle for evidence of air, hydraulic oil, or fuel leaks, broken, cracked, or missing parts.*

5. Verify that all headlights and other lights are clean and illuminated.

6. Visually inspect the air cleaner assembly and engine supply lines for evidence of damage or leakage.

If the air cleaners are equipped with self-purging Vacuator assemblies on the bottom cups, squeeze each assembly to ensure that they are functioning properly and exhausting the accumulated dust from the bottom of the air cleaner.

If not equipped with the assemblies, empty each air cleaner dust bowl by unsnapping the latch and allowing the bowl to pivot down. After all of the debris is dumped, close and latch in place.

NOTES:
1. A ladder will be required to reach these assemblies.
2. Do not stand directly under the bowl when releasing the latch.

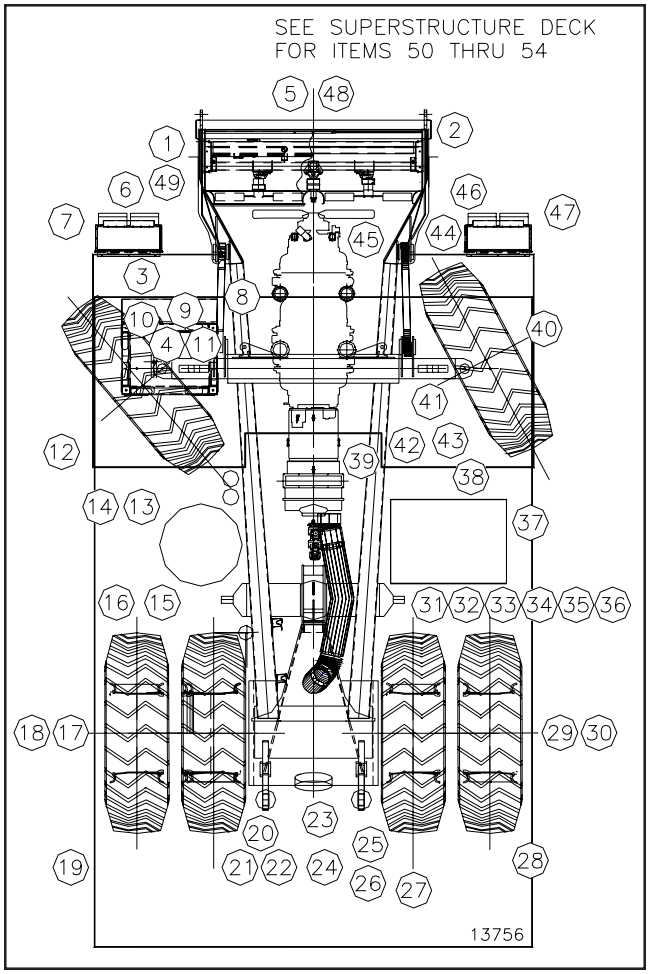


FIGURE 1 - TYPICAL VIEWING POSITIONS (13756)

7. Verify that the left front marker light is clean and illuminated.

8. Check the engine oil level as follows:

a. Carefully climb up the tie rod step, using the frame mounted handholds for support. If the truck is not so equipped, use a ladder to climb to the required level.

b. Pull the engine dipstick from the engine, wipe clean with a clean rag, and reinsert.

NOTE: *If the engine has a self-sealing style dipstick, it may be necessary to turn the handle counter-clockwise several turns to release the seal. Remember to reseal the dipstick after completing the oil level check.*

c. Pull the dipstick out again and read the level; it should be in the safe, normal, or operating range. If not, bring the level up to proper range prior to operating the truck.

d. Reinstall the dipstick and carefully return to ground level.

NOTE: *On trucks equipped with dipsticks on the right hand side of the engine, the oil should be checked when checking the other side of the truck.*

9. Visually inspect the left front suspension assembly for evidence of wear, damage, or leakage and verify that it is at the proper ride height (extension). Also, verify that the assembly is securely attached to the truck.

10. Visually inspect the left front brake and axle kingpin assemblies for evidence of wear, damage, leakage, or looseness. Also, inspect the area around the wheel bearing seal and brake calipers for indications of leakage or damage.

11. Visually inspect the steering system components - clevis pins, tie rods, steering arms, and cylinders for the left side of the truck.

12. Visually inspect the left front tire and rim assembly for deep cuts, missing chunks, adequate tread depth, proper mounting, missing lug nuts, and proper inflation.

NOTE: *Check the condition of the automatic tire pressure maintenance system hoses if so equipped.*

13. Visually inspect the left tank for evidence of damage or leaks. Check level with sight glass or petcocks as applicable.

14. Visually inspect all hydraulic and other components mounted near the tank for evidence of damage or leakage.

15. Visually inspect the left dump cylinder for evidence of leakage, wear, or damage. Verify that the upper and lower mounting points are secure and properly lubricated. Verify that the hoses are properly routed and in good condition.

16. Visually inspect the dump body pad assemblies for evidence of wear, damage, or improper shimming.

17. Inspect each of the left rear dual tire and rim assemblies for deep cuts, missing chunks, adequate tread depth, proper mounting, missing lug nuts, and proper inflation. Inspect the rock knocker assembly (if so equipped) for free movement and evidence of wear or damage.

NOTE: *Check the condition of the automatic tire pressure maintenance system hoses if so equipped.*

18. Visually inspect the left wheelmotor hubcap area for evidence of brake oil leakage. Verify that the hubcap is securely fastened to the wheel and cover (if applicable) is closed.

19. Verify that the left rear marker light is clean and illuminated.

20. Visually inspect the exterior of the left wheelmotor for evidence of damage or leakage.

21. Visually inspect the left dump body hinge pin for evidence of damage or wear, and proper installation and lubrication.

22. Visually inspect the left rear suspension for evidence of wear, damage, and leakage and verify that it is at the proper ride height (extension). Verify that the upper and lower mounting points are secure and properly lubricated.

23. Verify that all tail, stop, warning (turn signal), retarding, and back-up lights on the truck are clean and operational.

24. Open the axlebox access door. Verify that the components and mounting hardware are in general good repair. Close the door securely to form a good, air-tight seal.

⚠ CAUTION

Failure to maintain a good seal around the access door may allow air to escape from the axlebox.

Operation of the truck in this condition could result in damage to the electrical propulsion system components.

25. Visually inspect the right rear suspension for evidence of damage, wear, and leakage and verify that it is at the proper ride height (extension). Verify that the upper and lower mounting points are secure and properly lubricated.

26. Visually inspect the right dump body hinge pin for evidence of damage or wear, and proper installation and lubrication.

27. Visually inspect the exterior of the right wheelmotor for evidence of damage or leakage.

NOTE: *Check the condition of the automatic tire pressure maintenance system hoses if so equipped.*

28. Verify that the right rear marker light is clean and illuminated.

29. Visually inspect the right wheelmotor hubcap area for evidence of brake oil leakage. Verify that the hubcap is securely fastened to the wheel and cover (if applicable) is closed.

30. Visually inspect each of the right rear dual tire and rim assemblies for deep cuts, missing chunks, adequate tread depth, proper mounting, missing lug nuts, and proper inflation. Inspect the rock knockers (if so equipped) for free movement and evidence of wear or damage.

31. Visually inspect all hydraulic and other system components for evidence of damage or leakage.

32. Inspect the axlebox nosecone and attachment assemblies for evidence of damage or wear, proper installation and lubrication.

33. Inspect the underside of the truck for evidence of damage or leakage. Hoses should be free of kinks and cracks, and should be secured away from moving parts. All components and mounting hardware should be properly installed and in good operating condition.

34. Visually inspect the dump body pad assemblies for evidence of wear, damage, or improper shimming.

35. Visually inspect the right dump cylinder for leakage, wear, or damage. Verify that the upper and lower mounting points are secure and properly lubricated. Verify that the hoses are properly routed and in good condition.

36. Visually inspect the hydraulic pumps, pump drives, and related hoses for evidence of leakage, damage, or wear.

37. Visually inspect the right tank for evidence of damage or leakage. Check level with sight glass or petcocks as applicable.

38. Check the blower housing and related ducting for evidence of leakage or damage. If so equipped, inspect the cooling air blower or precleaner systems for evidence of leakage or damage.

39. Visually inspect all hydraulic and other components mounted near the tank for evidence of damage or leakage.

40. Visually inspect the right front tire and rim assembly for deep cuts, missing chunks, adequate tread depth, proper mounting, missing lug nuts, and proper inflation.

NOTE: *Check the condition of the automatic tire pressure maintenance system hoses if so equipped.*

41. Visually inspect the steering system components; clevis assemblies, tie rods, steering arms, and steering cylinder on the right side of the truck. If any piece is damaged, bent, or leaking, do not drive the truck. Report the condition immediately.

42. Visually inspect the right front suspension assembly for evidence of wear, damage, or leakage and verify that it is at the proper ride height (extension). Verify that the assembly is securely attached to the truck.

43. Visually inspect the right front brake and axle kingpin assemblies for evidence of wear, damage, leakage or looseness. Inspect the area around the wheel bearing seal and brake calipers for indications of leakage or damage.

44. Visually inspect underside of the truck for indications of damage or leakage. Hoses should be free of kinks and cracks, and should be secured away from moving parts.

NOTE: *On trucks with the engine oil dipstick located on the right-hand side of the engine, check the engine oil level prior to continuing with the remaining steps.*

45. Inspect the engine drive belts overall condition. Check condition of fan and fan shroud and guard assemblies.

46. Visually inspect the air cleaner assembly and engine supply lines for evidence of damage or leakage.

If the air cleaners are equipped with self-purging Vacuator assemblies on the bottom cups, squeeze each assembly to ensure that they are functioning properly and exhausting the accumulated dust from the bottom of the air cleaner.

If not equipped with the assemblies, empty each air cleaner dust bowl by unsnapping the latch and allowing the bowl to pivot down. After all of the debris is dumped, close and latch in place.

NOTES:
1. A ladder will be required to reach these assemblies.
2. Do not stand directly under the bowl when releasing the latch.

47. Verify that the right front marker light is clean and illuminated.

48. Visually inspect the radiator and grille area to be free of debris and damage.

49. Climb the access ladder to the superstructure level. Visually inspect the retarding grid and electrical drive system component box to ensure that they are free of damage, that the doors are securely closed, and that the air intakes are free of debris.

NOTE: *On trucks so equipped, verify the condition of fire suppressant remote actuation system.*

50. Check the engine coolant level in the radiator using the radiator sight glass.

⚠WARNING

Use extreme care when removing the radiator cap; remove it slowly after the engine has cooled. The sudden release of pressure from a heated cooling system can result in the loss of coolant and possible injury from the hot liquid.

51. Visually inspect the brake system accumulator and components for evidence of leakage, damage, or any other abnormal condition.

52. On trucks equipped with the available automatic lubrication system, check the level of the lubricating grease in the main supply reservoir. Be sure the supply is adequate to maintain the system during the entire operating period.

53. On trucks equipped with the available fire suppressant system, check the pressure level of the actuation system. Also inspect the system for evidence of wear or damage. Report all problems before proceeding.

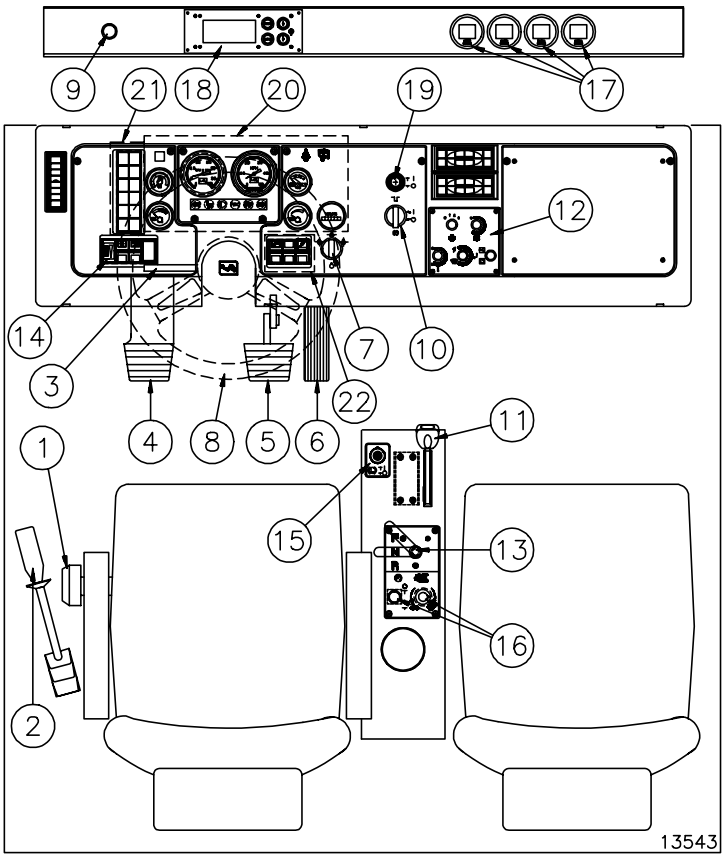
54. Return to the cab. Turn all light switches off.

OPERATION

Prior to operating the truck for any reason, even if just for testing components or operation, the driver should be properly trained in general operating guidelines and characteristics, and be familiar with specific rules at the location. Refer to the appropriate BUCYRUS® Operator'sManual and mine safety personnel for this information.

Do not ride on the superstructure or any other area other than inside the cab when the truck is in operation. The driver and the observer/passenger MUST be seated in the cab with seat belt fastened whenever the truck is in operation.

Again, NEVER operate the truck without first being thoroughly trained and familiar with the truck's operator's manual and mine operating procedures.



KEY			13543
1.	SEAT ADJUSTMENT CONTROLS	12.	HEAT & AIR CONDITIONER CONTROLS
2.	DUMP CONTROLLER LEVER	13.	SHIFTER
3.	DIMMER SWITCH	14.	LIGHT SWITCHES
4.	BRAKE PEDAL	15.	LOAD BRAKE SWITCH
5.	DYNAMIC RETARDER PEDAL	16.	RETARD SPEED CONTROLS
6.	THROTTLE PEDAL	17.	AIR CLEANER RESTRICTION INDICATORS
7.	ENGINE STOP/START SWITCH	18.	UNIT RIG WEIGH SYSTEM
8.	STEERING WHEEL	19.	MANUAL POWER SUPPLY
9.	WIPER CONTROL	20.	GAUGES
10.	PARK BRAKE	21.	INDICATOR LIGHTS
11.	HAND BRAKE	22.	MISCELLANEOUS SWITCHES

FIGURE 1 - TYPICAL CAB LAYOUT

MAIN FRAME

DESCRIPTION AND LOCATION (Figure 1)

The main frame is of double box section design fabricated from plates of high strength steel. The side plates are manufactured separately, then tied together by top and bottom wrappers which are welded to them. This construction forms a strong, durable frame that remains relatively light in weight.

The frame extends the entire length of the truck beneath the equipment it supports.

OPERATION

The frame serves as the basic support structure for the truck. It provides the mounting points for the front and rear suspension, axlebox assembly, engine module, drive train components, the superstructure, operator's cab, and the dump body.

TROUBLESHOOTING

Refer specific problems to BUCYRUS® for assistance in repairing damage and in determining and eliminating the potential causes.

MAINTENANCE AND ADJUSTMENT

Regularly inspect the frame for damage. Repair as directed by BUCYRUS® personnel and standards.

REPAIR

General instructions for field welding repairs are contained in Section 10 - Miscellaneous of this manual. For detailed instructions, it is recommended that BUCYRUS® personnel be consulted on an "as required" basis to ensure that correct, proper, up-to-date procedures and materials are used.

⚠ CAUTION

Do not weld on the top or bottom wrappers of the main frame, unless repair is required. Incorrect welding will weaken the frame. Follow current BUCYRUS® welding procedures.

KEY	13550
01.	Radiator Module Mounting Area
02.	Engine Module Mounting Area
03.	Front Suspension Upper Mount
04.	Superstructure Mount
05.	Front Axle Lateral Link Mount
06.	Upper or Front Crossmember
07.	Right Side Rail Assembly
08.	Dump Cylinder Mounting Bracket
09.	Center Frame Crosstube
10.	Axlebox Nosecone Inner Bearing Surface
11.	Dump Body Rear Mounting Point
12.	Rear Suspension Upper Mounting Point
13.	Rear Crossmember
14.	Left Side Rail Assembly
15.	Front Axle Link Mounting Points
16.	Front Bumper
17.	Axlebox Radius Rod Mounting Bracket

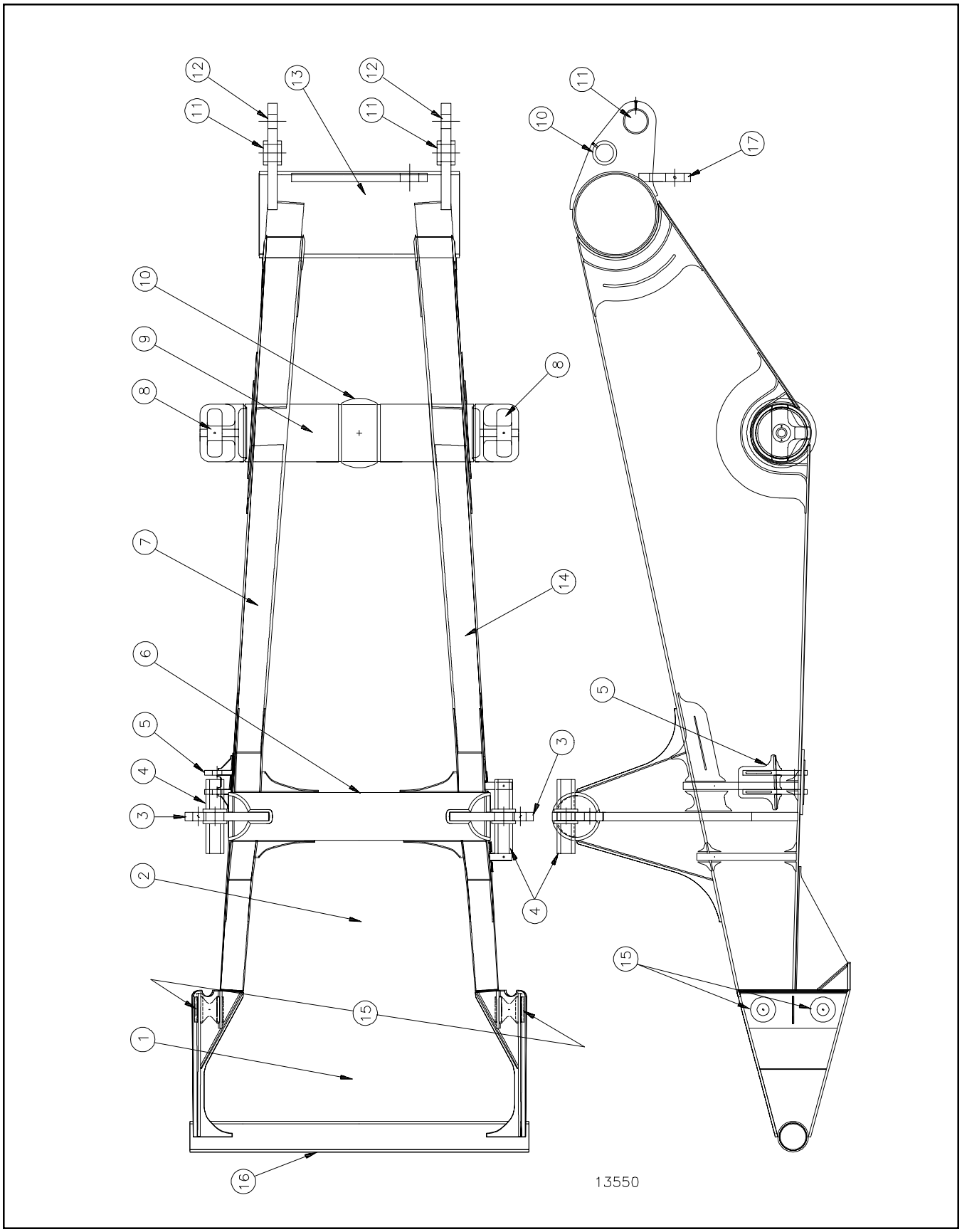


FIGURE 1 - MT 4400 MAIN FRAME

SUPERSTRUCTURE

DESCRIPTION AND LOCATION

The superstructure is the large floor like area on which the cab, electric drive system components box, and retarding grid package is mounted. It is mounted on the crossmember attached to the two vertical beams, secured on each side. Extra supports supplied where needed to assist in stabilizing the superstructure and its contents.

OPERATION

The superstructure is used as a mount for the components such as the cab, electrical drive system component (inverter) box, dynamic retarding grids, air cleaners and fenders. It also serves as a protective enclosure for various components in the hydraulic and electrical system. Several doors are provided in the superstructure for access to these components. A series of components are provided on the superstructure to protect the components from contamination and damage during operation.

TROUBLESHOOTING

Refer specific problems to the appropriate BUCYRUS® personnel for assistance in repairing damage and determining and eliminating the potential causes.

MAINTENANCE AND ADJUSTMENT

Normal maintenance of the superstructure includes inspecting for evidence of damage, verifying that all equipment is properly mounted and secured, and that all door hinges are in good repair and properly lubricated. Repair or replace equipment as required.

Also, verify that all mounts and mounting hardware and support arms are secure and that all drain holes are open and free of restrictions.

REMOVAL

The superstructure may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Remove the dump body as outlined in the instructions in Section 2 -Structure, or raise it to its maximum position and properly secure it.

3. Drain all stored oil pressure from the hydraulic brake and steering accumulators by using the appropriate manual drain valves.

Release all pressure in the hydraulic brake and steering accumulators before disconnecting any hydraulic lines.

4. Check all components to ensure that no residual hydraulic or air pressure remains.

5. Remove the positive and negative cables from the battery. Isolate and secure.

6. Remove all electrical, hydraulic, and other connections between the superstructure and the main frame assembly. Cap and plug all hydraulic connections. Label each connection to ensure proper reassembly.

7. Remove the flexible coupling between the cooling air inlet and the blower as outlined in the information in Section 4 - Power Package.

8. Remove the ladder and handrail assembly as outlined in the instructions as in Section 2 - Structure.

9. Remove the hood and grille assembly as outlined in the instructions in Section 2 - Structure.

10. Install the lifting eyes as required on the superstructure platform.

11. Connect the lifting eyes to an overhead crane using a spreader bar or other suitable means of proper support. Adjust the slings to ensure that the lines are equally tensioned and are free of slack.

12. Remove the capscrews and washers to the frame crossmember and all other supports.

13. Carefully raise the superstructure clear of the frame.

14. Lower the assembly onto support stands.

NOTE: *The stands should support the superstructure at the frame rails.*

INSPECTION AND REPAIR

The superstructure may be serviced as follows:

1. Inspect all mounting and support arms and brackets for evidence of damage and wear. Repair or replace as required.

2. Inspect all doors and hinges for evidence of wear, damage, and proper lubrication. Repair or replace as required.

3. Repair any structural damage. General field welding instructions are included in Section 10 - Miscellaneous. Detailed instructions and assistance may be available from BUCYRUS®; contact your local representative.

INSTALLATION

The superstructure may be installed as follows:

1. Before installation, verify that the proper lifting eyes are securely attached.

2. Connect the crane slings to the superstructure lifting eyes. A spreader bar or suitable substitute is recommended. Adjust the length of each sling that all four lines are equally tensioned and free of slack. Verify that the cable length is sufficient to permit the superstructure to be lifted without interference or damage to mounted components.

3. Raise the superstructure platform into position on the frame. Align the superstructure mounting pads with all truck frame supports and brackets.

4. Install the ROPS links. They should be in a compressive mode when the superstructure is secured. Once the capscrews and nuts securing the pins are properly torqued, tack the nut to the capscrew threads.

5. Install the capscrews, washers, and locknuts that attach the superstructure to the frame. After all are installed, tighten/torque sequentially as required.

6. Remove the lifting cables, eyes, and remainder of the lifting equipment.

7. Install the ladder and railing assemblies removed as instructed in the Section 2 - Structure. Torque the mounting capscrews as required.

8. Install the hood assembly as outlined in Section 2 - Structure.

9. Connect and secure the flexible blower duct connections between the cooling air inlet and/or the superstructure.

10. Connect all electrical, hydraulic and other lines removed.

11. Test all operating functions as outlined in the appropriate procedures.

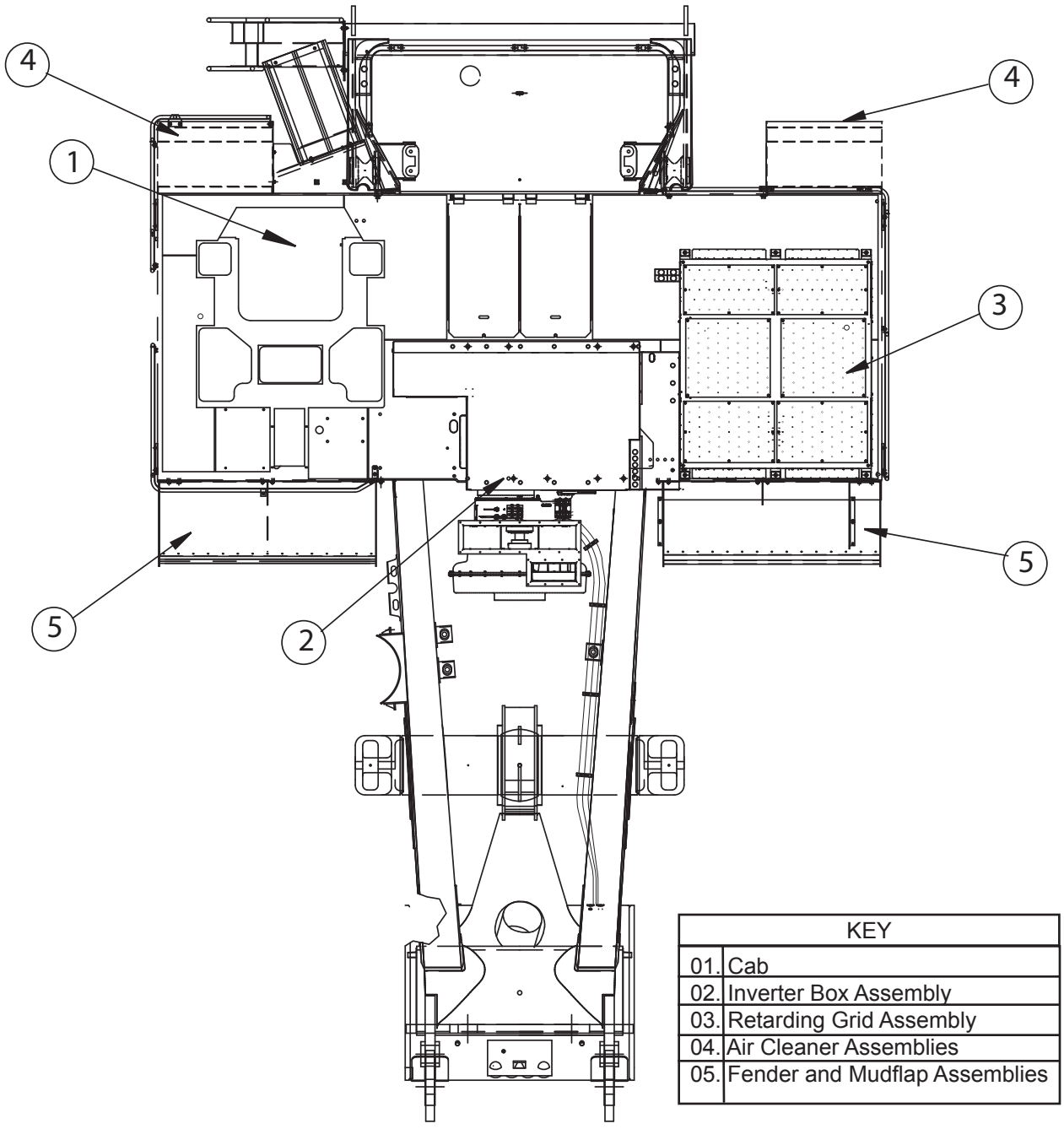
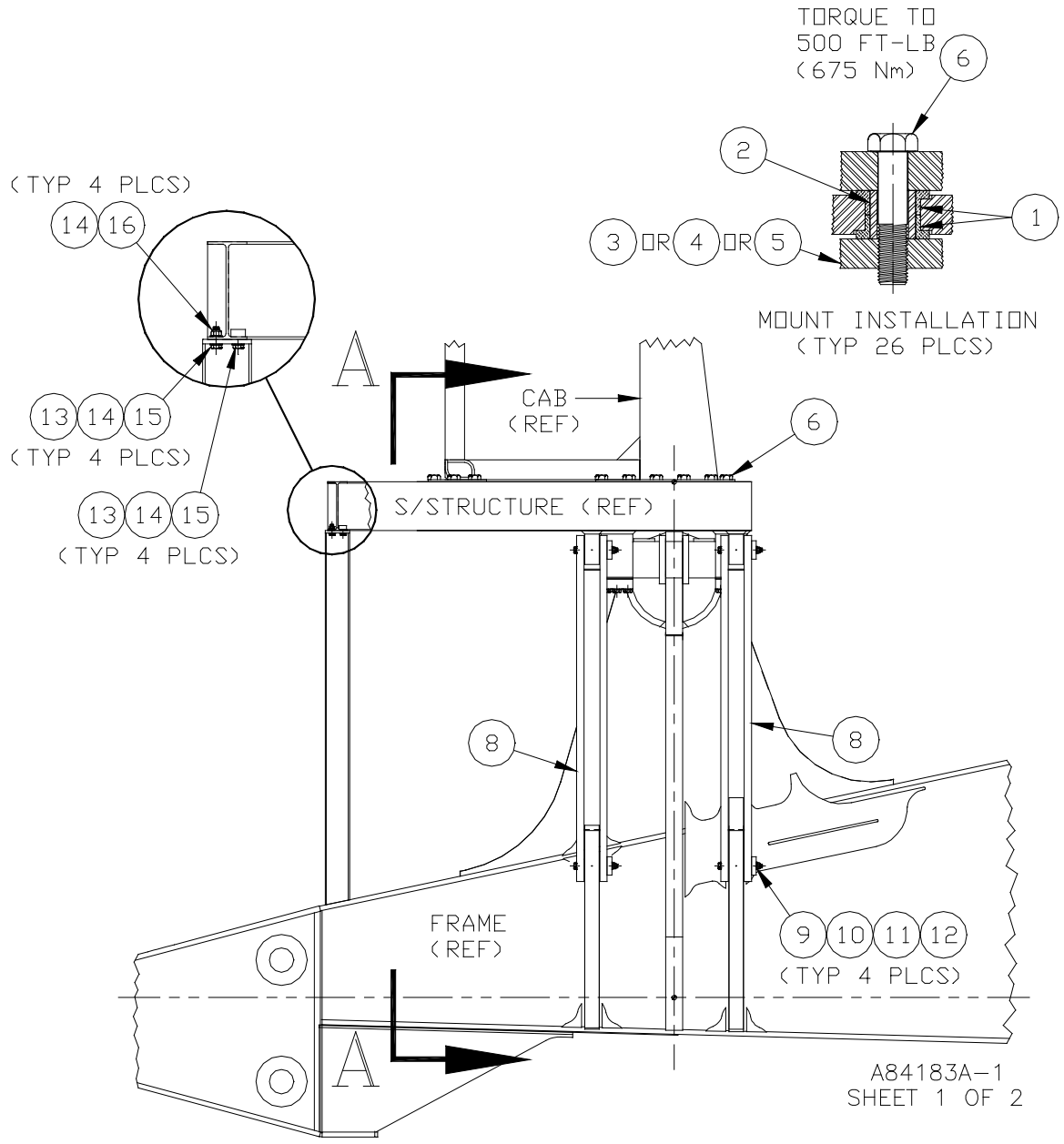


FIGURE 1 – SUPERSTRUCTURE POSITION



KEY			A84183A
01.	VIBRATION MOUNT	11.	CAPSCREW
02.	SPACER MOUNT	12.	LOCKNUT
03.	CAB FRONT RETAINER PLATE	13.	CAPSCREW (GRADE 8)
04.	CAB REAR RETAINER PLATE	14.	SPECIAL WASHER
05.	CAB REAR RETAINER PLATE	15.	FLATWASHER
06.	CAPSCREW (GRADE 8)	16.	LOCKNUT
07.	NOT USED	17.	ROPS MOUNTING CAP
08.	ROPS LINK	18.	CAPSCREW (GRADE 8)
09.	ROPS PIN	19.	HARDENED FLATWASHER
10.	ROPS PIN RETAINER		

FIGURE 2 - SUPERSTRUCTURE INSTALLATION

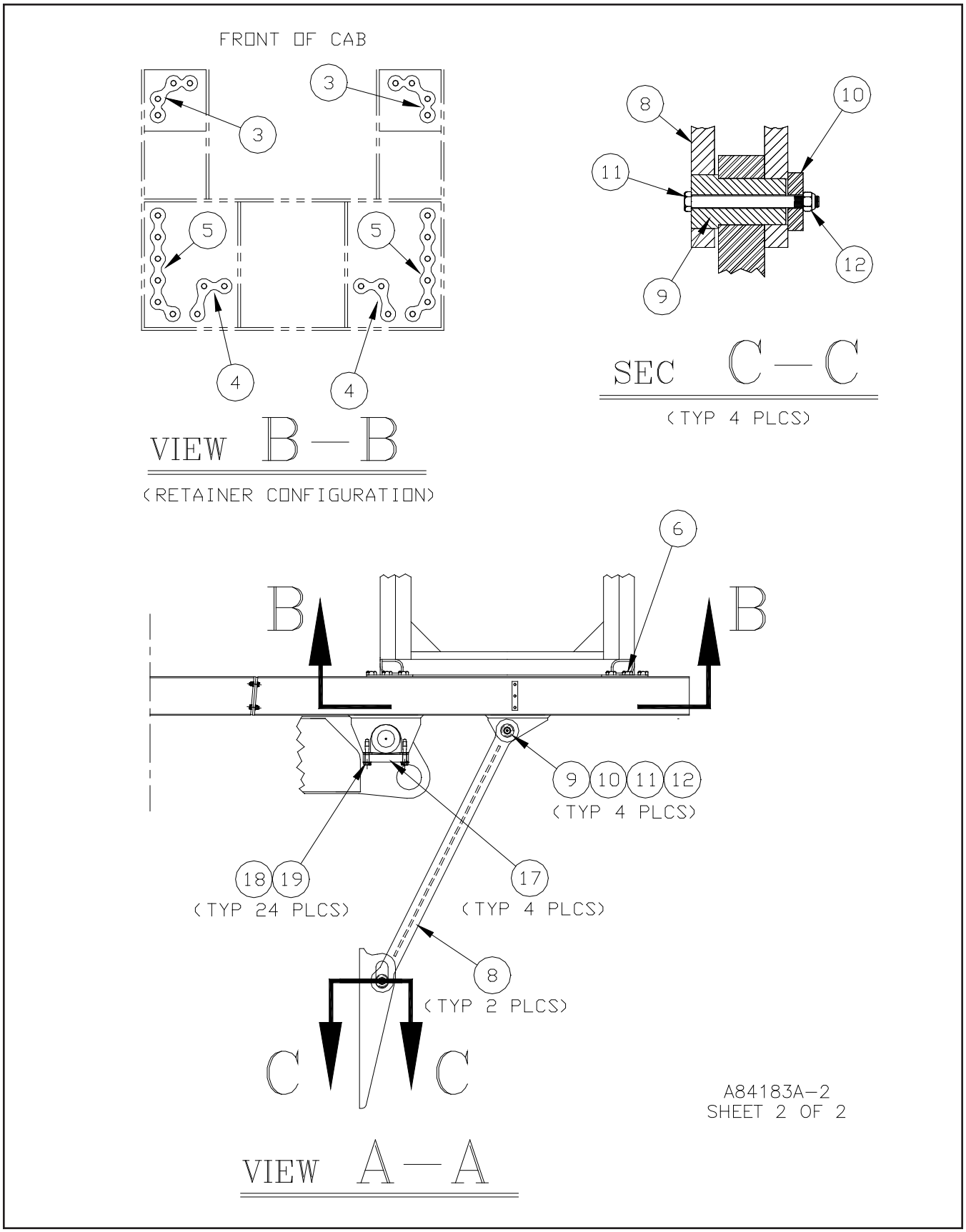


FIGURE 2 - SUPERSTRUCTURE INSTALLATION - CONTINUED

LADDER AND RAILING ASSEMBLY

DESCRIPTION AND LOCATION

The standard superstructure access ladder is alternate tread, Lapeyre step ladder assembly with expanded steel steps and handrails. The upper section connects the superstructure deck and the lower frame mounted platform and is totally made of metal. The lower section is positioned perpendicular to the upper section and utilizes rubber side support members to secure the steps. Typical installation is shown in Figure 1.

Other alternative flat step and diagonal ladder alternatives are shown in Figure 2.

Separate access ladders are included to provide increased access to the engine and frame areas from the superstructure and ground level.

The handrail assemblies are tubular rails. There is a handrail assembly on both the left and right outer edges of the superstructure.

OPERATION

The main access ladder provides a means of reaching the superstructure and cab area. The other ladders provided increased access to the engine and main frame areas.

The handrail provides personal protection at each end of the superstructure.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following:

1. Clean the ladder and all handrail assemblies.

2. Inspect the steps and handrails for damage. Repair or replace as required.

3. Verify that all mounting bolts and brackets are secure and in good condition. Tighten, repair, or replace as required.

4. Inspect the lower portion of the ladder for damage and loose components. Repair or replace as required.

REMOVAL (Figure 1)

The ladder may be removed by removing the mounting hardware and air-arcing the welded support from the ladder, removing the mounting capscrews, and appropriate sections from the truck.

The rails are secured to the superstructure in sockets. Removal is accomplished by lifting the rail clear of the sockets. (Railings are welded in place except as noted.)

INSPECTION AND REPAIR

Inspect all components for damage. Repair or replace as required.

INSTALLATION (Figure 1)

The ladder and handrail assemblies may be installed in the reverse order of removal.

KEY A84213A

01.	Lapeyre Stair	39.	Flexible Ladder Tread
02.	Ladder Mudguard	40.	Flexible Ladder Tread
03.	Ladder Platform	41.	Flexible Ladder Tread
04.	Platform Mounting Plate	42.	Flexible Ladder Cap
05.	Lapeyre Bracket	43.	Flexible Ladder Cap
06.	Capscrew	44.	Spacer
07.	Hardened Flatwasher	45.	Capscrew
08.	Locknut	46.	Flatwasher
09.	Hardened Flatwasher	47.	Locknut
10.	Capscrew	48.	Switch Mounting Bracket
11.	Special Washer	49.	Capscrew
12.	Locknut	50.	Flatwasher
13.	Capscrew	51.	Locknut
14.	Lockwasher	52.	Left Rear Fender
15.	Flatwasher	53.	Right Rear Fender
16.	Left Air Cleaner Mount	54.	Capscrew
17.	Right Air Cleaner Mount	55.	Capscrew
18.	Capscrew	56.	Lockwasher
19.	Capscrew	57.	Flatwasher
20.	Lockwasher	58.	Fender Cover Plate
21.	Flatwasher	59.	Capscrew
22.	Rear Cab Handrail	60.	Lockwasher
23.	Front Cab Handrail	61.	Flatwasher
24.	Right Side Handrail	62.	Pipe Flange
25.	Left Hood Handrail	63.	Pipe
26.	Right Hood Handrail	64.	Not Used
27.	Chain	65.	PVC Conduit Adhesive
28.	Heat Shrink Chain Cover	66.	Capscrew
29.	Shackle	67.	Lockwasher
30.	Capscrew	68.	Access Ladder
31.	Lockwasher	69.	Not Used
32.	Not Used	70.	Fender Handrail
33.	Special Washer	71.	Capscrew
34.	Toe Board Plate	72.	Locknut
35.	Capscrew	73.	Flatwasher
36.	Flatwasher	74.	Capscrew
37.	Locknut	75.	Locknut
38.	Ladder Strap	76.	Chain Shackle Bracket

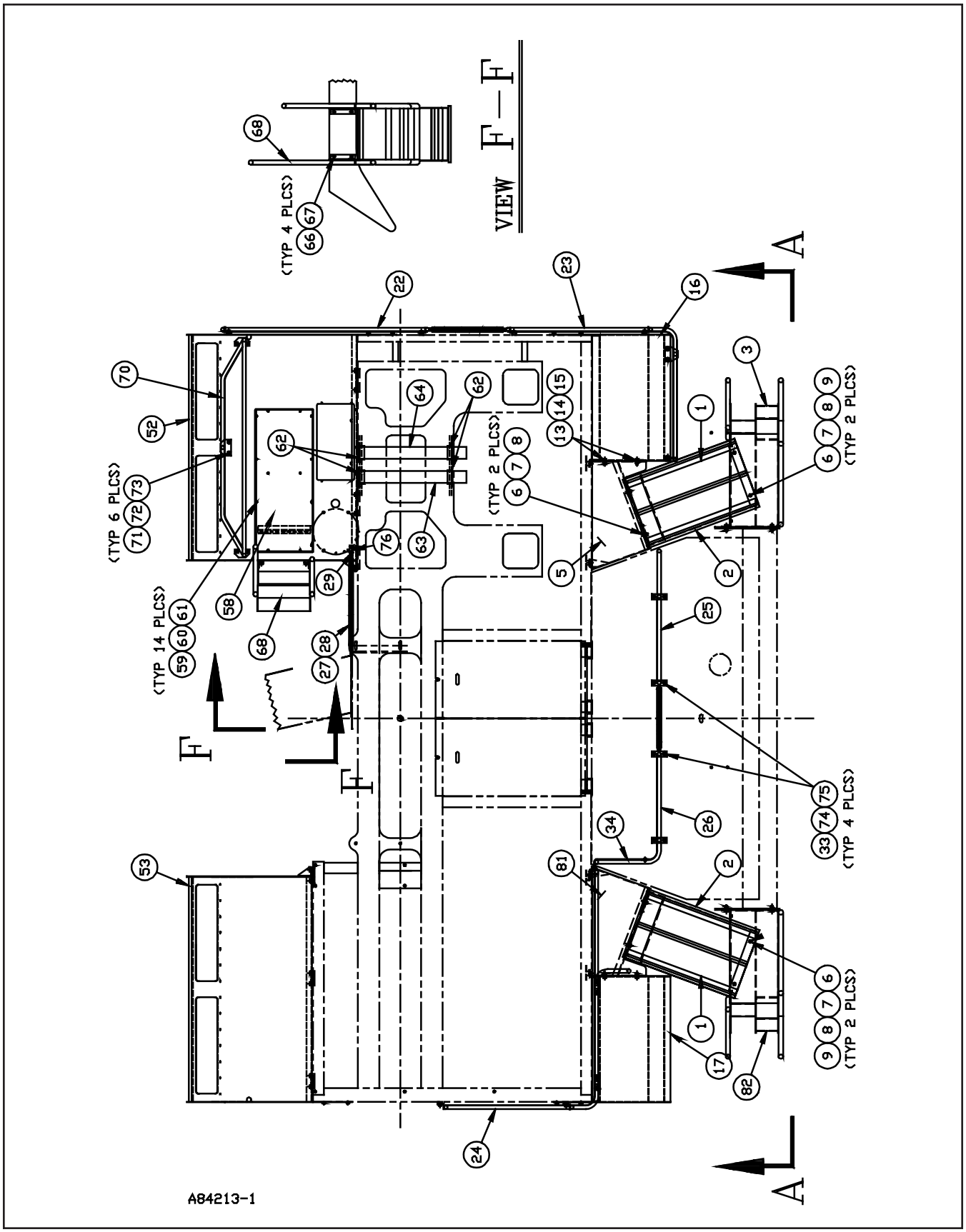


FIGURE 1 - LADDER AND RAILING ASSEMBLY

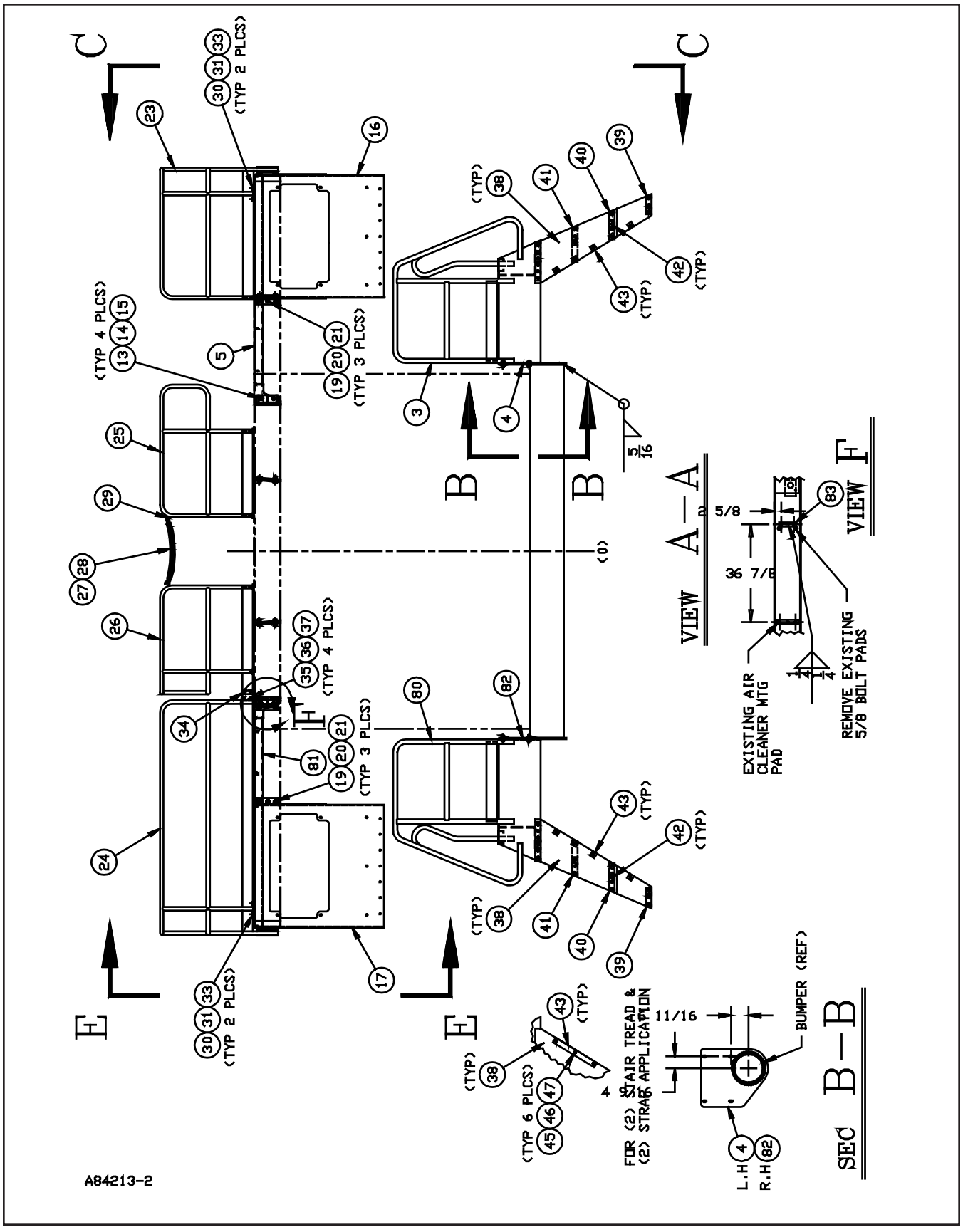


FIGURE 1 - LADDER AND RAILING ASSEMBLY - CONTINUED

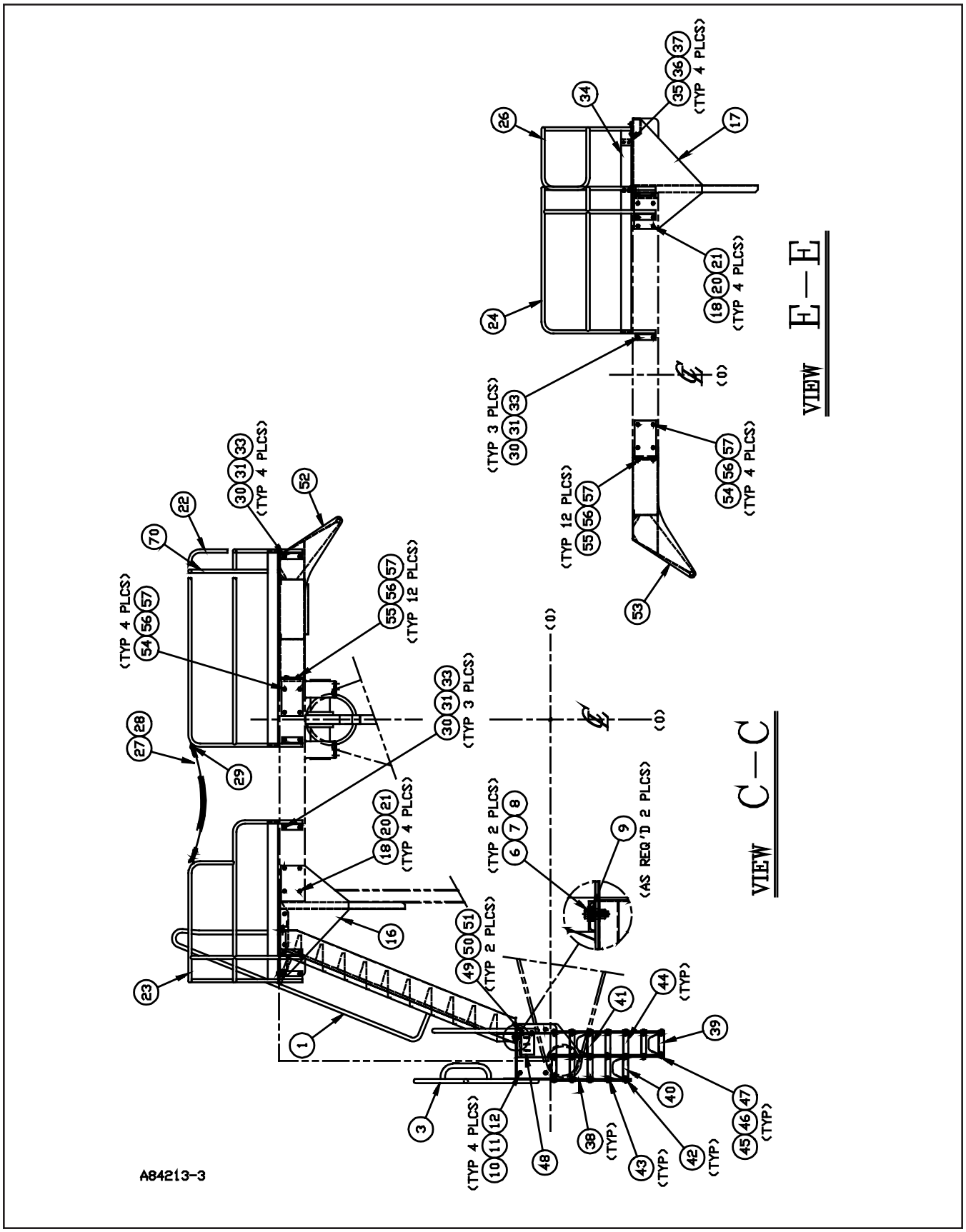


FIGURE 1 - LADDER AND RAILING ASSEMBLY - CONTINUED

KEY			A86175
01.	Stair Assembly	47.	Locknut
02.	Ladder Mudguard	48.	Switch Mounting Bracket
03.	Ladder Platform	49.	Capscrew
04.	Platform Mounting Plate	50.	Flatwasher
05.	Stair Mounting Bracket	51.	Locknut
06.	Capscrew	52.	Silencer Support
07.	Hardened Flatwasher	53.	Muffler Support
08.	Locknut	54.	Capscrew
09.	Hardened Flatwasher	55.	Capscrew
10.	Capscrew	56.	Not Used
11.	Hardened Flatwasher	57.	Hardened Flatwasher
12.	Locknut	58.	– 61. Not Used
13.	Capscrew	62.	Pipe Flange
14.	Not Used	63.	Pipe
15.	Hardened Flatwasher	64.	Pipe
16.	LH Air Cleaner Mount	65.	Adhesive
17.	RH Air Cleaner Mount	66.	– 69. Not Used
18.	Capscrew	70.	Toeboard
19.	Capscrew	71.	Capscrew
20.	Not Used	72.	Flatwasher
21.	Hardened Flatwasher	73.	Locknut
22.	Rear Handrail	74.	– 79. Not Used
23.	Front Handrail	80.	Diagonal Ladder
24.	Right Side Handrail	81.	Stair Platform
25.	Not Used	82.	– 89. Not Used
26.	Not Used	90.	Hood Handrail
27.	Chain	91.	Capscrew
28.	Heat Shrink	92.	Locknut
29.	Shackle	93.	Hardened Flatwasher
30.	Capscrew	94.	Platform Mount
31.	Capscrew	95.	Platform Support
32.	Not Used	96.	Access Ladder
33.	Hardened Flatwasher	97.	Not Used
34.	– 37. Not Used	98.	Not Used
38.	Ladder Strap	99.	Capscrew
39.	Ladder Tread	100.	Ladder Bracket
40.	Ladder Tread	101.	Ladder Bracket
41.	Ladder Tread	102.	Capscrew
42.	Flexible Ladder Cap	103.	Ladder End Cap
43.	Flexible Ladder Cap	104.	Ladder Strap
44.	Spacer	105.	Ladder Stair step
45.	Capscrew		
46.	Flatwasher		

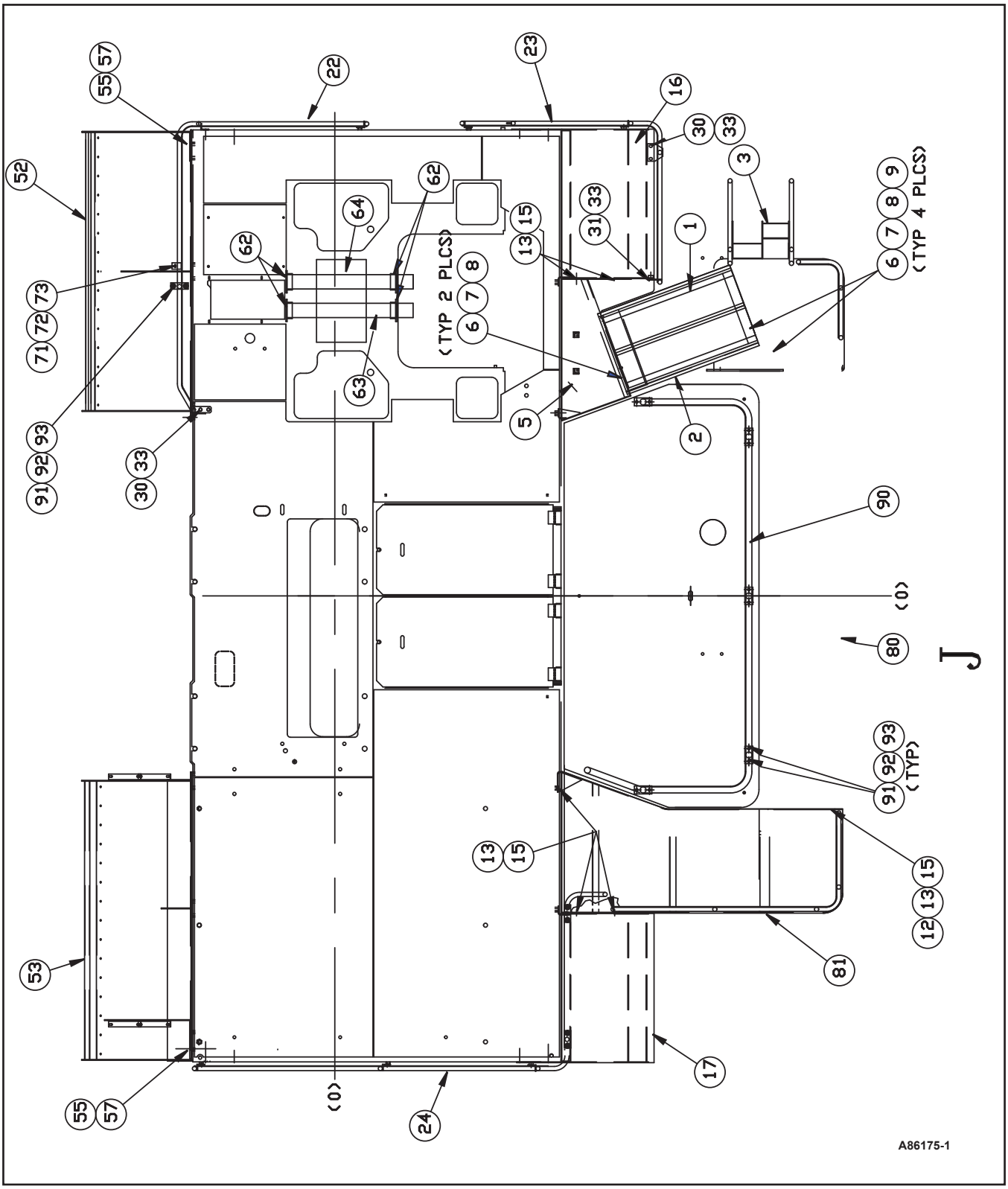


FIGURE 2 – ALTERNATIVE LADDER COMPOSITE - CONTINUED A86175

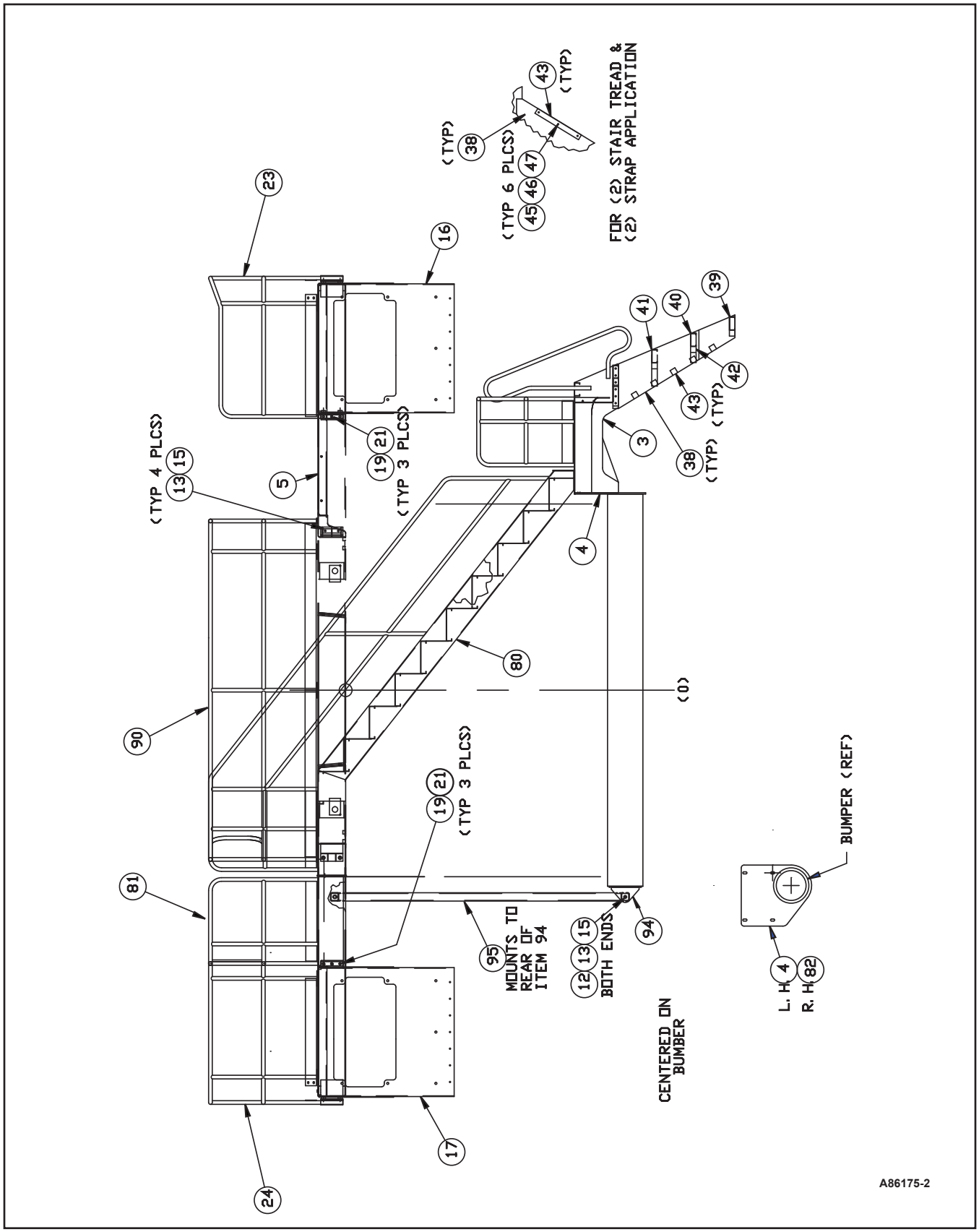


FIGURE 2 – ALTERNATIVE LADDER COMPOSITE - CONTINUED A86175

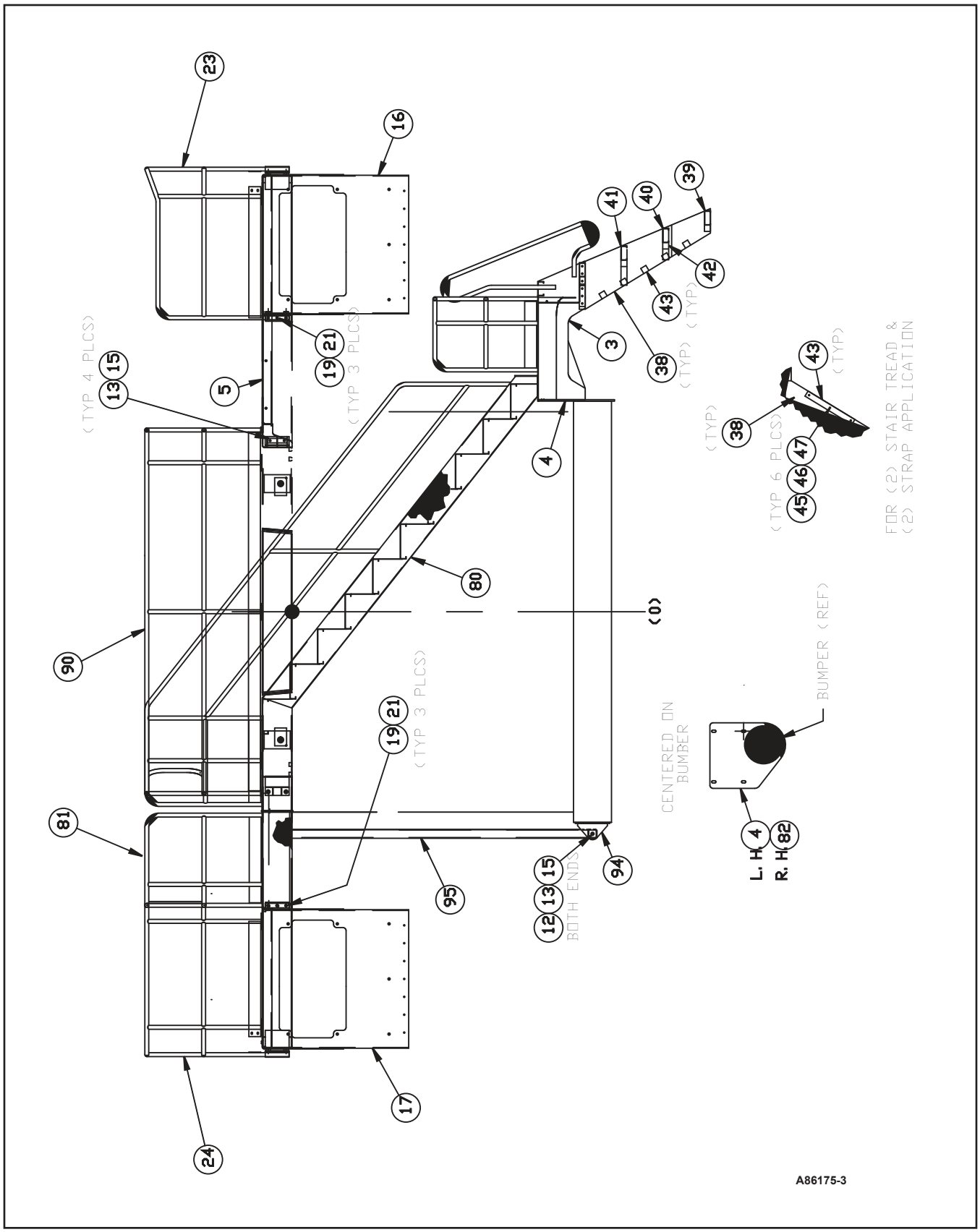


FIGURE 2 – ALTERNATIVE LADDER COMPOSITE - CONTINUED A86175

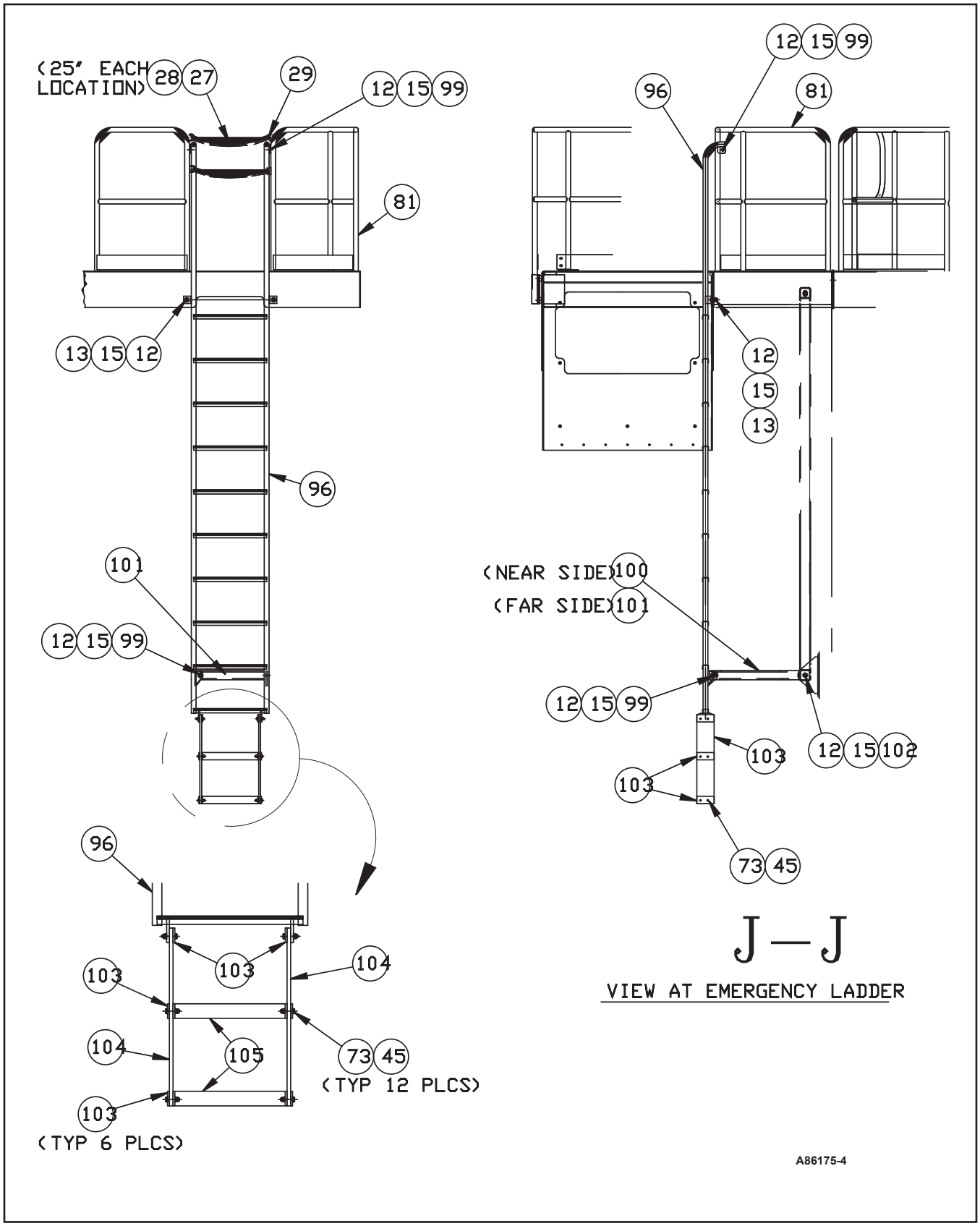


FIGURE 2 – ALTERNATIVE LADDER COMPOSITE - CONTINUED A86175

HOOD ASSEMBLY

DESCRIPTION AND LOCATION

The engine hood assembly covers the engine area from the front of the superstructure to the front of the radiator area.

OPERATION

The hood assembly provides two distinct functions:

1. Protect the engine and radiator assemblies from damage from falling foreign and environmental material, and;

2. Serve as additional support for securing the top of the radiator assembly.

MAINTENANCE AND ADJUSTMENT

Maintenance of the assembly involves verifying that all mounts and mounting bolts are kept tight, the assembly is free of damage and in general good repair.

NOTE: *There should be a nominal ½ inch (13 mm) the hood assembly and the radiator top tank. If not, snubbing washers should be used `to achieve this clearance.*

REMOVAL

The hood assembly may be removed as follows:

1. Disconnect the electrical wiring at the nearest connection or wire.

2. Attach the lifting cables from the crane to the hood.

3. Remove the capscrews and washers securing the hood to the superstructure.

4. Remove the capscrews and washers securing the hood to the radiator assembly.

5. Lift the hood assembly clear of the truck and set in an appropriate work area.

SERVICE

Service of the hood assembly should include the following:

1. Repair or replace any structural damage to the metal parts.

2. Inspect the condition of the radiator pads and shock mounts (4). Repair or replace as required.

INSTALLATION

The hood assembly may be installed as follows:

1. Lift the hood assembly from the work area and align the appropriate mounting holes on the hood, radiator and superstructure.

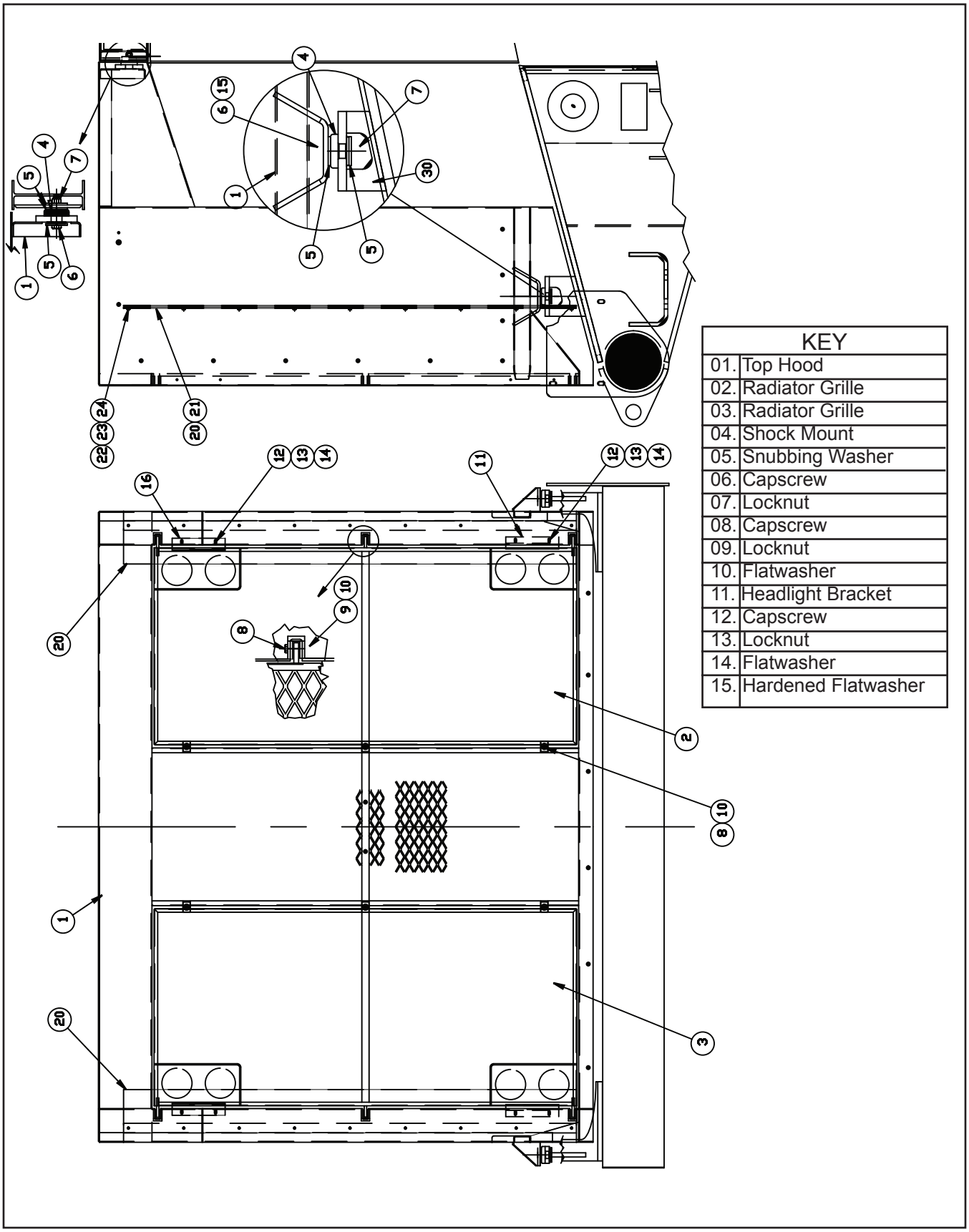
2. Install the capscrews and washers securing the hood to the radiator assembly.

NOTE: *Additional snubbing washers (5) between the hood assembly (1) and shock mount (4) to obtain a nominal clearance of 1/2 inch (13 mm) between the hood assembly and the radiator top tank.*

3. Install the capscrews and washers securing the hood to the superstructure. Use care not to overtighten and damage the shock mounts. Use sufficient snubbing washers to compensate for structural irregularities.

4. Remove the lifting cables from the crane to the hood.

5. Reconnect the electrical wiring removed.



KEY	
01.	Top Hood
02.	Radiator Grille
03.	Radiator Grille
04.	Shock Mount
05.	Snubbing Washer
06.	Capscrew
07.	Locknut
08.	Capscrew
09.	Locknut
10.	Flatwasher
11.	Headlight Bracket
12.	Capscrew
13.	Locknut
14.	Flatwasher
15.	Hardened Flatwasher

FIGURE 1 - HOOD ASSEMBLY

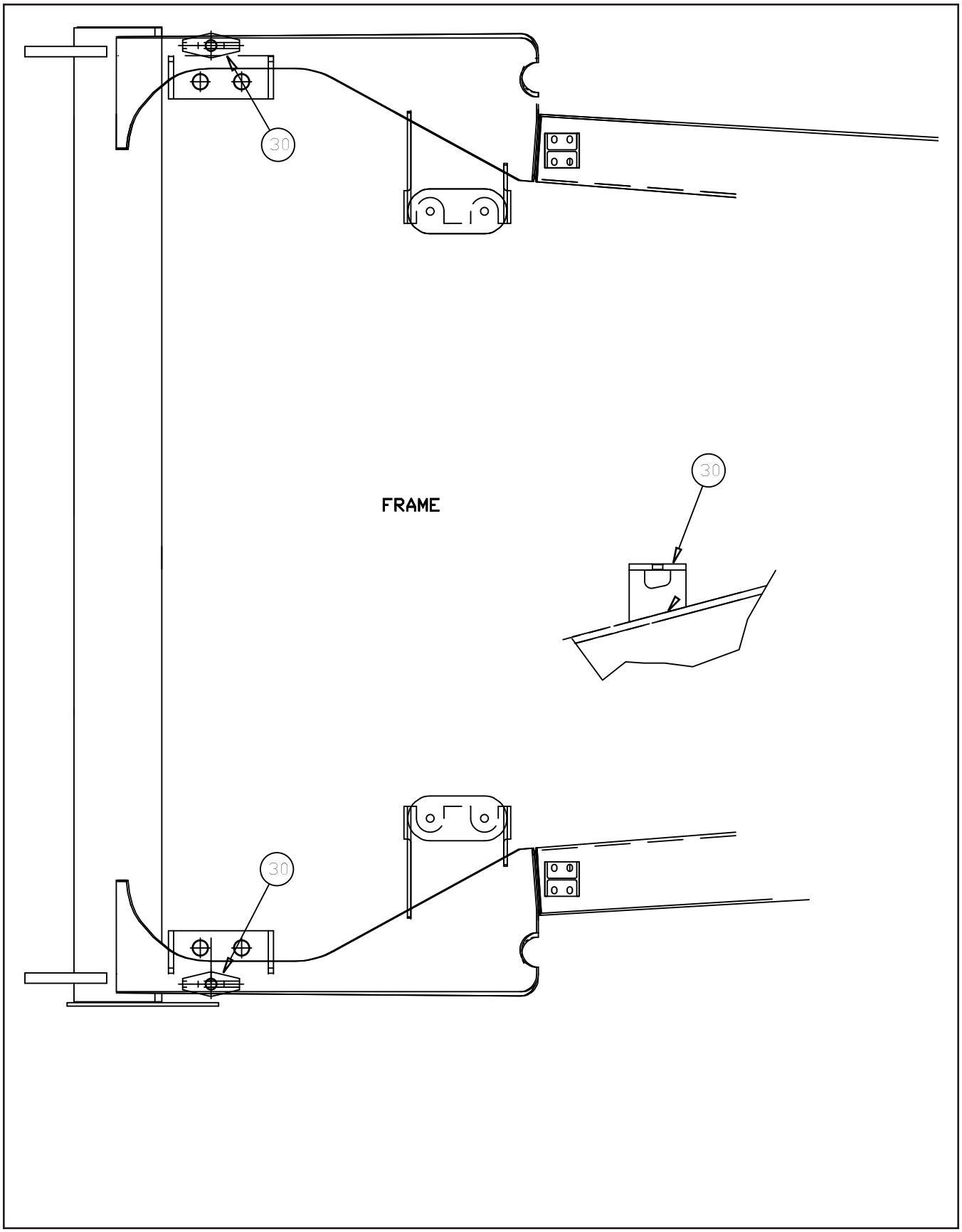


FIGURE 1 - HOOD ASSEMBLY - CONTINUED

CAB

DESCRIPTION AND LOCATION

The cab is the metal shell structure mounted on the left side of the superstructure. The cab is equipped with controls and instruments necessary for operation of the truck.

OPERATION

The cab provides the operator with a large comfortable environment. Large windows provide good visibility in all directions. Doors on both sides provide easy movement in and out. Removable panels ease maintenance by improving access to cab mounted components.

The outer structural assembly includes the required integral ROPS fabrications.

NOTE: *The use and function of the cab indicators, gauges, and controls is explained in the appropriate operator's manual.*

MAINTENANCE AND ADJUSTMENT

Periodically inspect the cab for evidence of damage. Repair or replace as required. Inspect each component as outlined in its respective module.

REMOVAL (Figure 2)

The cab may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Remove the dump body as outlined in the instructions in Section 2 -Structure, or raise it to its maximum position and properly secure it.

3. Drain all stored oil pressure from the hydraulic brake and steering accumulators by using the appropriate manual drain valves.

Release all pressure in the hydraulic brake and steering accumulators before disconnecting any hydraulic lines.

4. If so equipped, drain all air from the truck's pneumatic system. Verify that all pressure is exhausted from all tanks and components.

5. Check all components to ensure that no residual hydraulic or air pressure remains.

6. Remove the positive and negative cables from the battery. Isolate and secure.

7. Remove all electrical, hydraulic, and pneumatic connections between the cab and the superstructure assembly. Cap and plug all hydraulic and pneumatic connections. Label each connection to ensure proper reassembly.

8. Remove the weld securing the mounting capscrews (6) to the superstructure.

9. Secure the cab so that it will not move when the mounts are removed.

10. Remove the capscrews (6). As the individual retainer plates (3, 4, and 50 are removed, mark the location removed from to aid in installation).

11. Install the appropriate lifting device to lift the cab.

12. Connect the device to an overhead crane using a spreader bar or other suitable means of proper support. Adjust the slings to ensure that the lines are equally tensioned and are free of slack. Carefully raise the superstructure clear of the frame and lower onto support material.

NOTE: *The support material should support the cab at the mounting points and be secured to prevent unwanted movement.*

INSPECTION AND REPAIR

The cab may be serviced as follows:

1. Inspect all mounting and support arms and brackets for evidence of damage and wear. Repair or replace as required.

2. Inspect all doors and hinges for evidence of wear, damage, and proper lubrication. Repair or replace as required.

3. Repair any structural damage. General field welding instructions are included in Section 10 - Miscellaneous. Detailed instructions and assistance may be available from BUCYRUS®; contact your local representative. It is imperative that proper procedures be followed at all times to maintain the integrity of the ROPS structure in the cab shell.

4. Inspect the vibration mount (1) and spacer mounts (2) in the superstructure for evidence of wear or damage. Repair or replace as required.

INSTALLATION (Figure 2)

The cab may be installed as follows:

1. Before installation, verify that the vibration mount (1) and spacer mounts (2) in the superstructure are free of evidence of wear or damage. Repair or replace if required.

2. Connect the crane slings to the lifting fixture. A spreader bar or suitable substitute are recommended. Adjust the length of each sling that all four lines are equally tensioned and free of slack. Verify that the cable length is sufficient to permit the cab to be lifted with out interference or damage to mounted components.

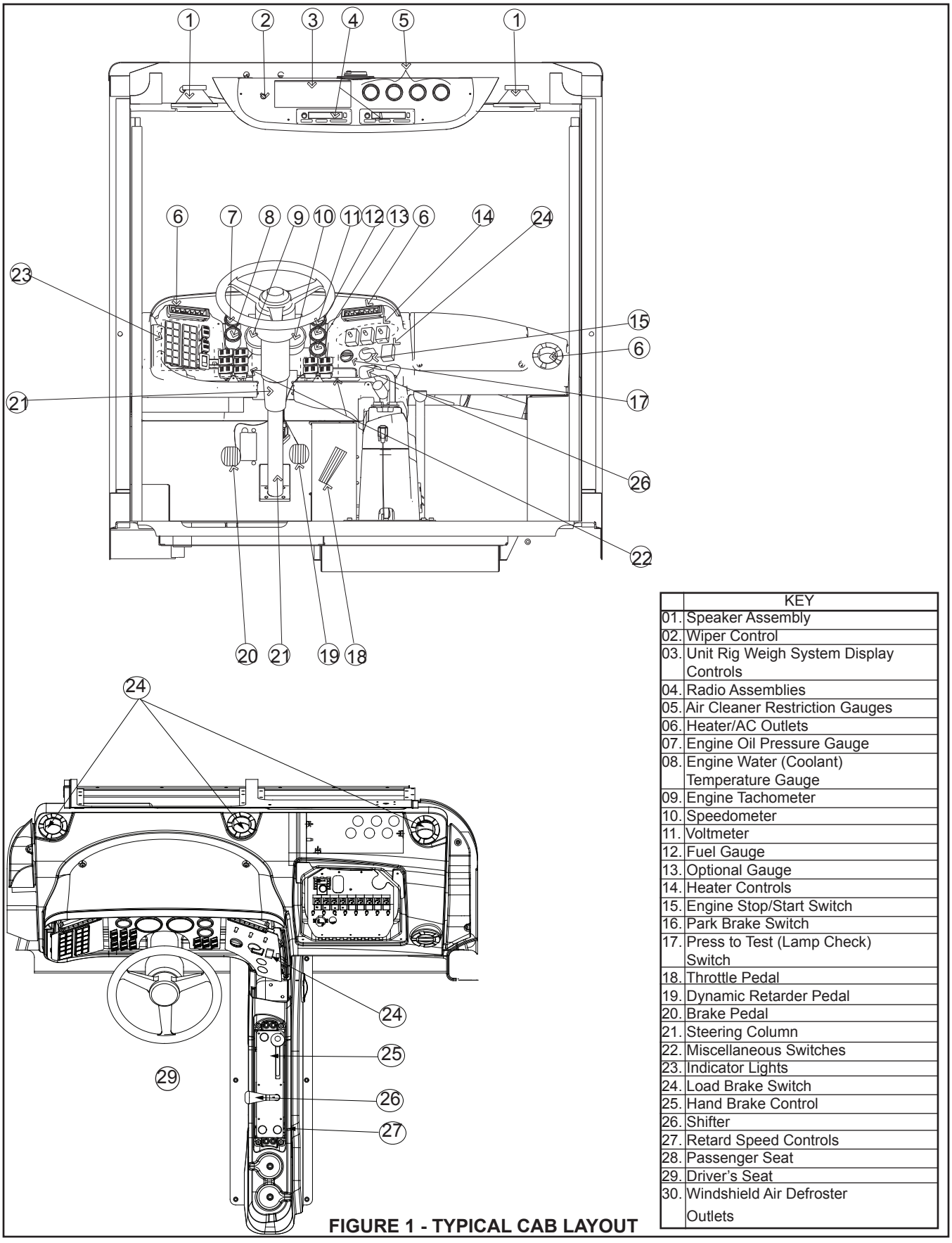
3. Raise the cab platform into position on the superstructure. Align the cab mounting pads with the corresponding locations in the superstructure.

4. Install the capscrews (6) and appropriate retainer plates (3, 4, and 5). After all are installed, tighten/torque sequentially to 500 ft-lb (675 Nm).

5. Remove the lifting slings.

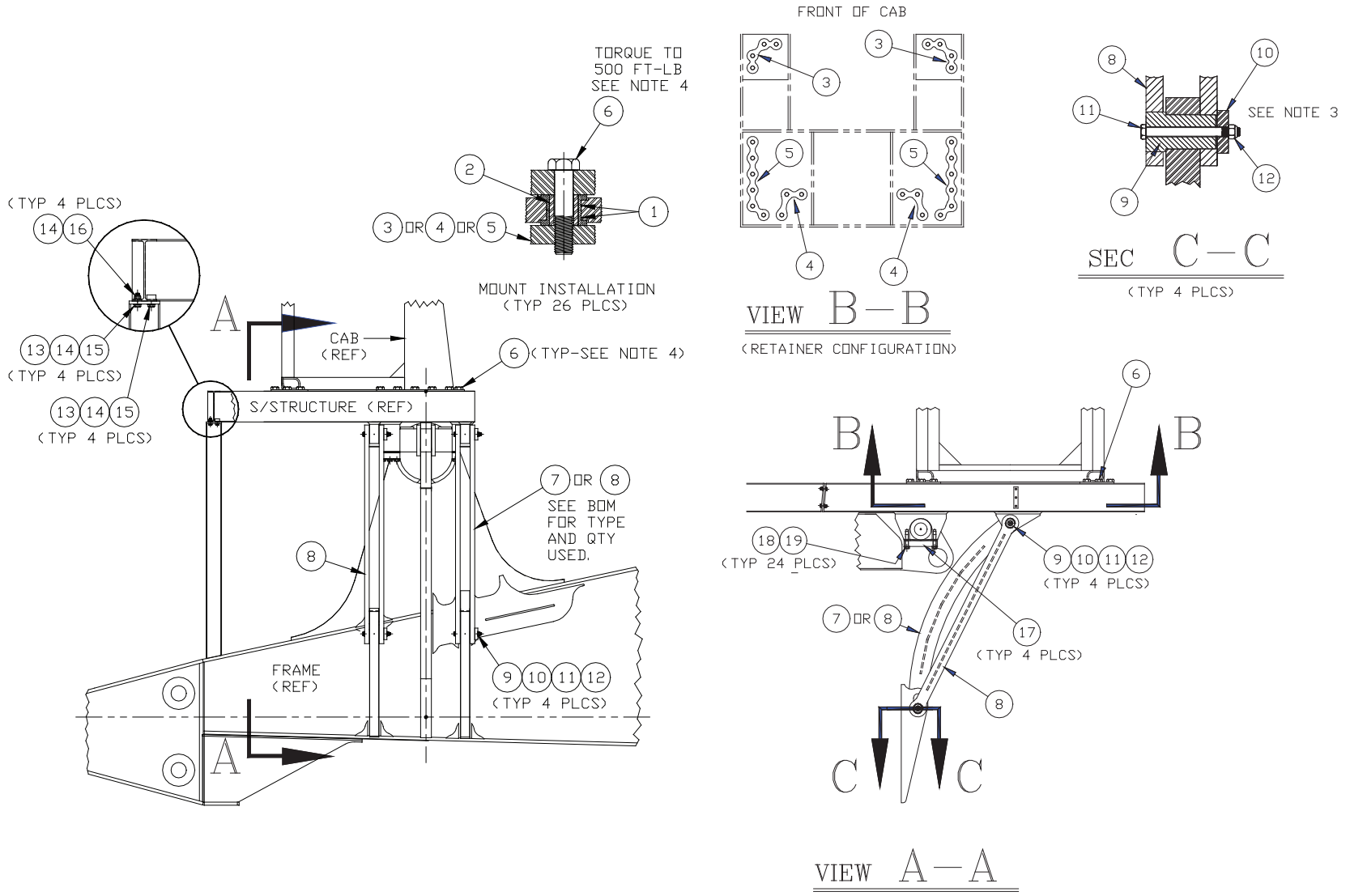
6. Connect all electrical, hydraulic and pneumatic lines removed.

7. Test all operating functions as outlined in the appropriate procedures.



	KEY
01.	Speaker Assembly
02.	Wiper Control
03.	Unit Rig Weigh System Display Controls
04.	Radio Assemblies
05.	Air Cleaner Restriction Gauges
06.	Heater/AC Outlets
07.	Engine Oil Pressure Gauge
08.	Engine Water (Coolant) Temperature Gauge
09.	Engine Tachometer
10.	Speedometer
11.	Voltmeter
12.	Fuel Gauge
13.	Optional Gauge
14.	Heater Controls
15.	Engine Stop/Start Switch
16.	Park Brake Switch
17.	Press to Test (Lamp Check) Switch
18.	Throttle Pedal
19.	Dynamic Retarder Pedal
20.	Brake Pedal
21.	Steering Column
22.	Miscellaneous Switches
23.	Indicator Lights
24.	Load Brake Switch
25.	Hand Brake Control
26.	Shifter
27.	Retard Speed Controls
28.	Passenger Seat
29.	Driver's Seat
30.	Windshield Air Defroster Outlets

FIGURE 1 - TYPICAL CAB LAYOUT



Key			
01. Vibration Mount	06. Capscrew (Grade 8)	11. Capscrew	16. Locknut
02. Spacer Mount	07. Not Used	12. Locknut	17. ROPS Mounting Cap
03. Cab Front Retainer Plate	08. ROPS Link	13. Capscrew (Grade 8)	18. Capscrew (Grade 8)
04. Cab Rear Retainer Plate	09. ROPS Pin	14. Special Washer	19. Hardened Flatwasher
05. Cab Rear Retainer Plate	10. ROPS Pin Retainer	15. Flatwasher	

FIGURE 2 - CAB ASSEMBLY

STEERING COLUMN

DESCRIPTION AND LOCATION

The steering column is a tilt type unit that also includes the electrical switches for the horn, turn signal, hazard warning, and headlight beam control assemblies. The steering hand pump or orbital valve assembly is attached to base end of the column assembly.

It is mounted in the cab assembly.

OPERATION

The primary function of the column is to transfer operator's steering input requirements from the movement of the steering wheel to corresponding movement of the hand pump assembly. The tilt function provides additional adjustment that improves the operator's comfort.

In the center of the steering wheel is a horn button assembly that controls the operation of the standard truck horn assembly.

The electrical switch assembly on the upper left hand side of the column provides several functions. Moving the lever up or down controls the operation of the turn signal assembly. Moving the switch toward the steering wheel controls the operation of the high and low beam of the headlights, alternating the configuration with each switch movement.

The hazard warning light function is controlled by a separate switch assembly.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the column assembly should include:

1. Clean all foreign material from the assembly, especially the steering wheel and electrical controls. Use care not to contaminate the internal electrical components.

2. Test the operation of the horn, turn signals, hazard warning, and headlight beam control functions. Repair or replace as required.

3. If the steering wheel or horn button assemblies require service, it may be done as follows:

a. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

b. Turn the Master Switch Off.

c. Remove the steering column locking ring (3).

d. Remove the 3/8-16 nut securing the horn button (4). Remove the horn button.

e. Remove the stop bracket from the column assembly.

f. Remove the 7/8-20 nut securing the steering wheel to the column. Remove the steering wheel using a suitable puller assembly.

g. Install the steering wheel. Secure with the 7/8-20 nut, tightened to a torque of 50 to 55 ft-lbs (68 to 75 Nm).

h. Install the stop bracket.

i. Install the horn button assembly. Secure with the 3/8-16 nut, tightened to a torque of 8 to 10 ft-lbs (11 to 14 Nm)

j. Install the Steering column locking ring assembly.

REMOVAL

The steering column may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

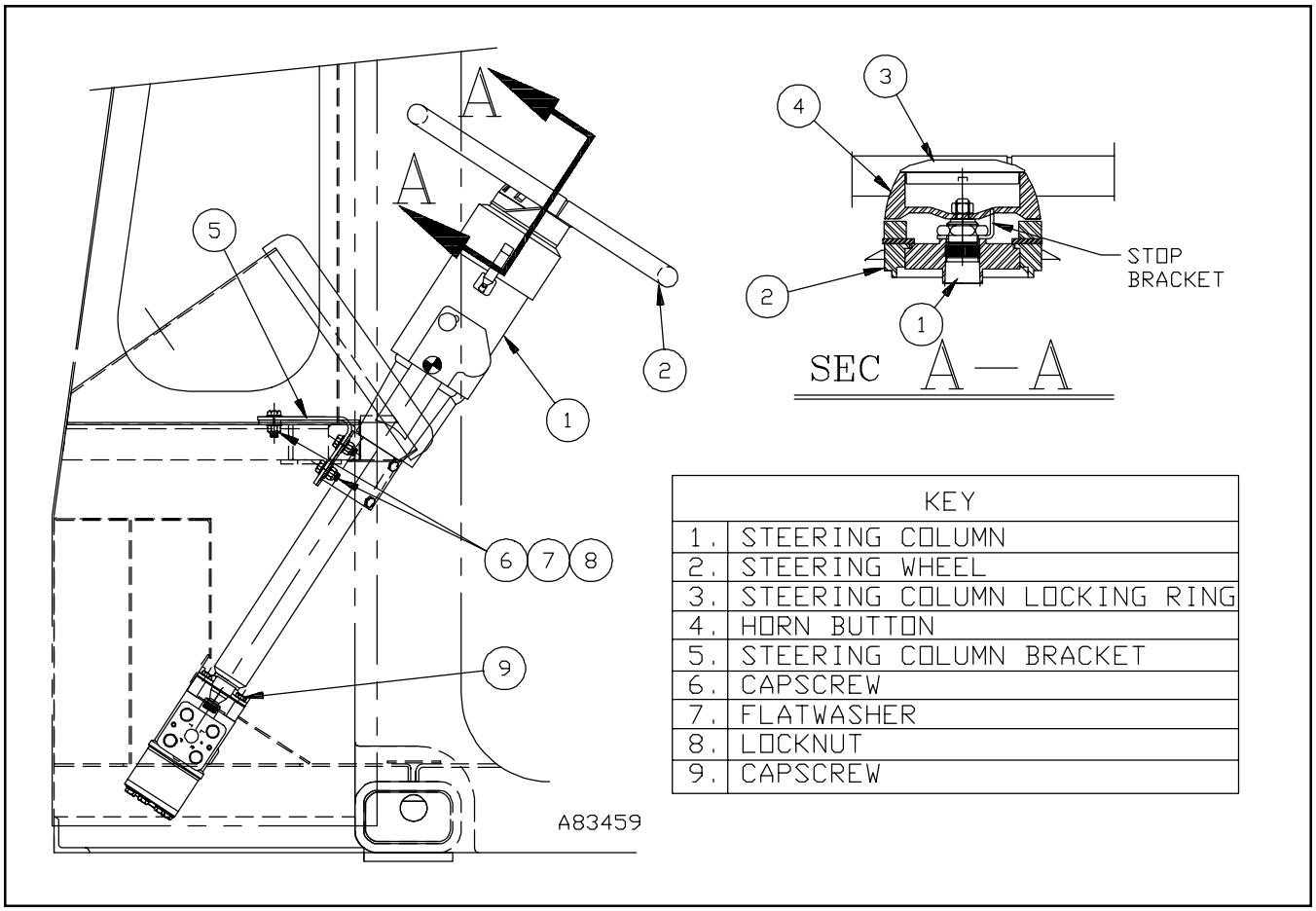
2. Turn the Master Switch Off.

3. Disconnect the electrical wiring from the cab by disconnecting the connector assembly at the base of the steering column.

4. Remove the hand pump assembly as outlined in the instructions in Section 5 - Hydraulic System.

5. Secure the column assembly to prevent unwanted movement.

6. Remove the capscrews, flatwashers, and locknuts securing the steering column assembly to the cab.



KEY	
1.	STEERING COLUMN
2.	STEERING WHEEL
3.	STEERING COLUMN LOCKING RING
4.	HORN BUTTON
5.	STEERING COLUMN BRACKET
6.	CAPSCREW
7.	FLATWASHER
8.	LOCKNUT
9.	CAPSCREW

FIGURE 1 - STEERING COLUMN INSTALLATION

7. Remove the column from the cab.

SERVICE

For detailed service instructions, contact your local BUCYRUS® representative.

INSTALLATION

The steering column may be installed as follows:

1. Insert the column into position.

2. Secure the column with the capscrews (6), flatwashers (7), and locknuts (8) securing the steering column assembly to the cab.

3. Install the hand pump assembly as outlined in the instructions in Section 5 - Hydraulic System.

4. Reconnect the electrical harness.

5. Test the steering column/hand pump operation as outlined in the instructions in Section 5 - Hydraulic system.

6. Test the electrical functions as outlined in Maintenance and Adjustment.

CAB HEATER ASSEMBLY

DESCRIPTION AND LOCATION

The cab heater assembly contains the blower and air control assemblies and heater core to provide a flow of filtered, pressurized and, if desired, warmed air to the interior of the cab.

The heater blower and core assembly and related hardware are located in front of the cab in front of the passenger seat. The air filter assembly is mounted to the rear wall of the cab, behind the seats.

OPERATION

Depending upon the operator's setting of the controls, either outside air, drawn in through the filter assembly, or the interior air being recirculated, is pressurized by the dual fan assemblies and is directed either through the dash and console mounted or the defroster ducts.

Adjustment of the controls provides a method of obtaining the desired temperature and flow patterns required to maintain desirable environmental conditions within the cab.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the heater system should include the following:

1. Park the truck in SAFE POSITION. It must be secured by means other than the truck's friction brake system.

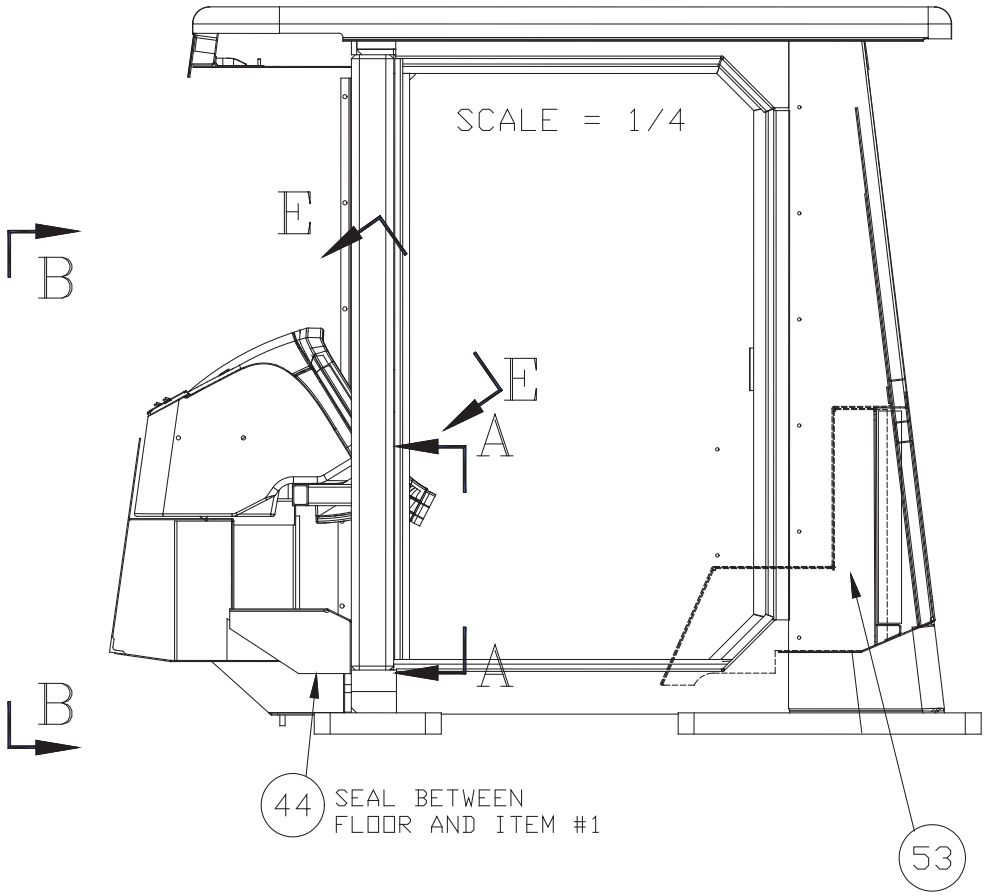
2. Inspect the system for evidence of wear, leakage, damage, etc. and are in general good repair and operating condition. Repair or replace as required.

3. Verify that the blower motor operates in all of its speed settings. Repair or replace as required.

4. Check the air flow from the various outlets. If not to normal standards, check the condition of the filter assembly and the controls, particularly the doors and cable assemblies. Repair or replace as required.

SERVICE

The individual components are not serviceable and should be replaced if not operating properly.



Key

01.	Heater/Air Conditioner Box	23	– 26. Not Used	45	Not Used	60	Not Used
		27	Elbow	46	Resistor	61	Not Used
02.	Blower Housing	28	Electric Heater Valve	47	Machine Screw	62	Not Used
03.	Blower Wheel	29	Not Used	48	Hose	63	Jam Nut
04.	Motor	30	Not Used	49	Hex Nut	64	Not Used
05.	Motor Mounting Plate	31	Capscrew	50	Push-on Hose	65	Not Used
06.	Heater Core	32	Hose Clamp	51	Not Used	66	Not Used
07.	Evaporator Core	33	Not Used	52	Not Used	67	Heater Control Valve
08.	Not Used	34	Knob	53	Air Filter	68	Grommet
09.	Retainer Clip	35	Not Used	54	Flatwasher	69	Expansion Valve
10.	– 13. Not Used	36	Mot Used	55	Not Used	70	Thermostat
14.	Blower Outlet Adapter	37	Not Used	56	Not Used	71	Not Used
15.	Blower Outlet Gasket	38	Blower (Speed) Switch	57	Adapter Fitting	72	Bulk Seal
16.	– 21. Duct Adapter	39	– 43. Not Used	58	Bushing	73	O-ring
22.	Tapping Screw	44	Insulation Tape	59	Barbed Fitting		

FIGURE 1 - CAB HEATER ASSEMBLY

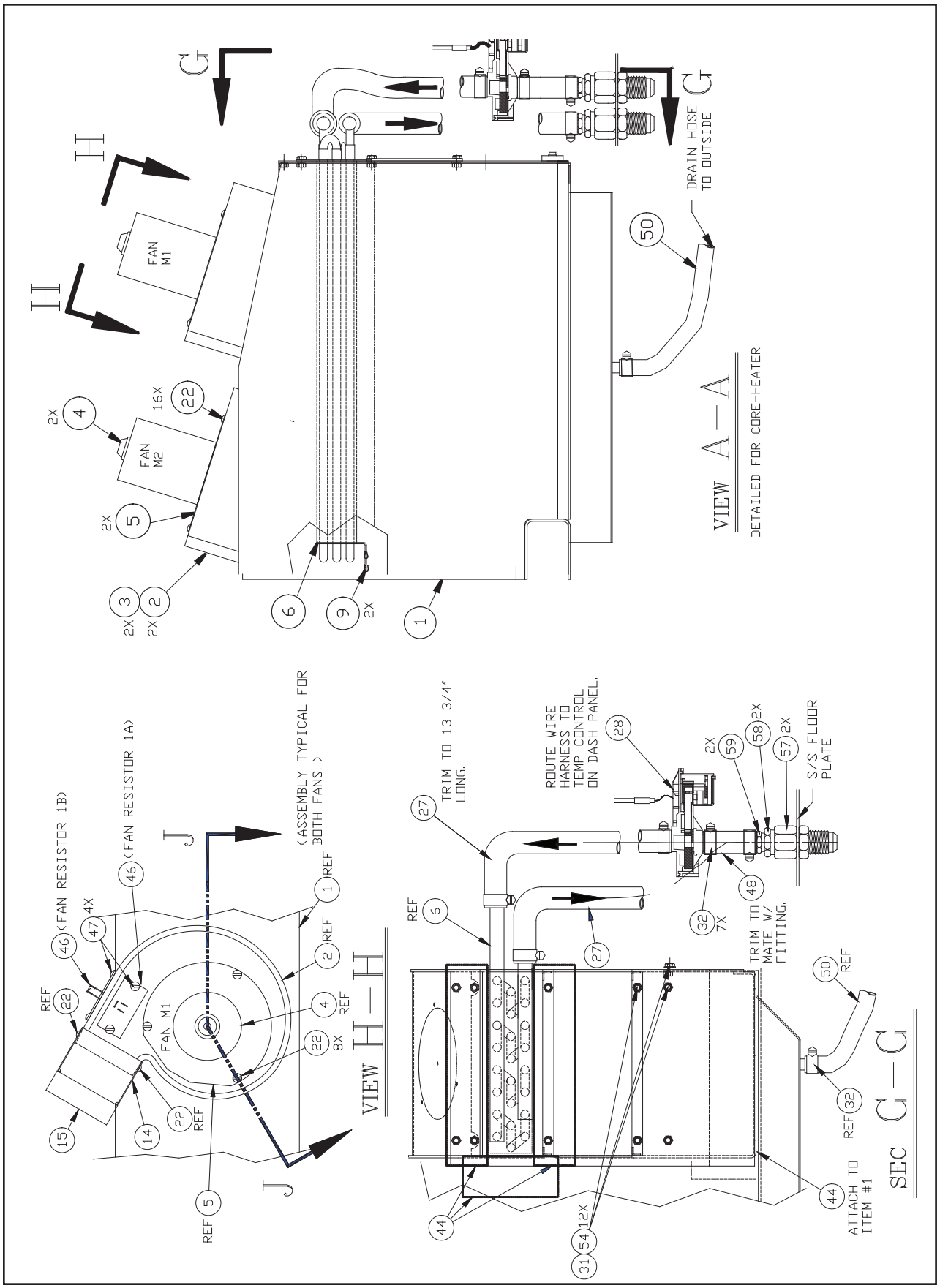


FIGURE 1CONT. - CAB HEATER ASSEMBLY

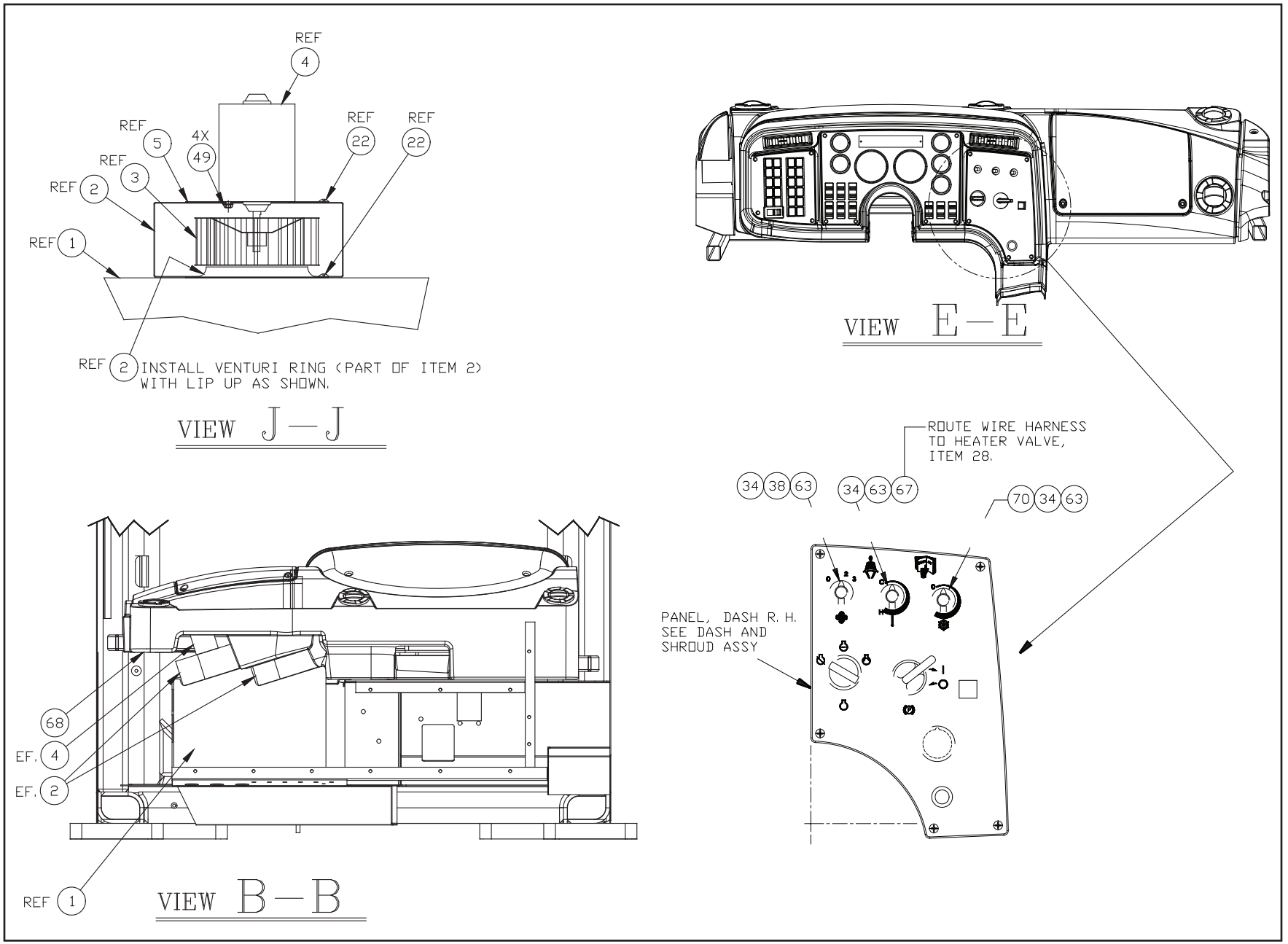


FIGURE 1CONT. - CAB HEATER ASSEMBLY

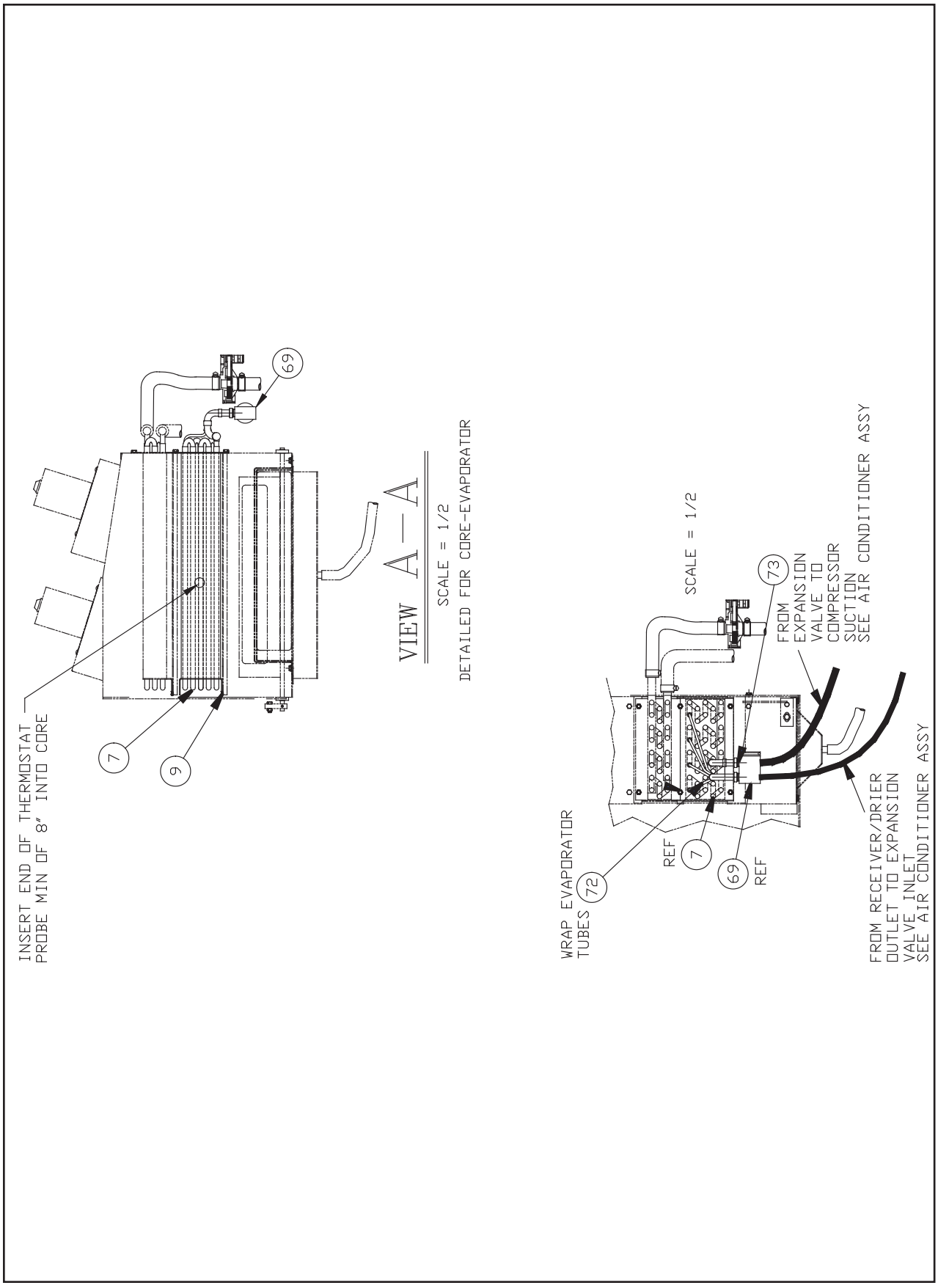


FIGURE 1CONT. - CAB HEATER ASSEMBLY

WINDSHIELD WIPER/WASHER SYSTEMS

DESCRIPTION AND LOCATION

The windshield wiper assembly is the operating equipment that clears moisture and other materials from the windshield assembly. It generally consists of the following items:

1. Wiper Drive Assembly – Includes the 24 Vdc electric motor and drive assembly and the linkages to operate the two separate arms. These items are all installed in overhead panel in the cab interior above the dash assembly.

2. Arm and blade assemblies – includes the metal, mechanical arms and the rubber/metal blade assemblies that actually contact and clean the windshield area.

3. Switch Assembly – electrical switch that controls the operation and speed of the motor and “park” provisions in the wiper drive assembly.

NOTE: *In most installation configurations, a “delay” feature is incorporated into the switch that will provide for intermittent operation when full time wiping is not required.*

A separate, but integrated windshield washer assembly provides fluid to assist in removing materials that are stuck to the windshield’s outer surface. This system consists of:

1. A reservoir assembly typically mounted in the hydraulic components cabinet on the superstructure behind the cab. An electric pump is mounted on the large reservoir to provide a flow of pressurized fluid to the remainder of the system. Operation of the pump is typically controlled by separate internal contacts in the wiper switch assembly.

2. Hoses and nozzles to transport and spray the liquid on the windshield surface.

OPERATION

The 24 Vdc power to operate the wiper motor assembly is controlled by a series of contacts in the switch assembly. Combinations of open and closed pairs of contacts allow the flow of electrical current to specific windings in the motor assembly, regulating the motor shaft output speed. This rotation is then converted to linear motion by an eccentric on the output shaft.

Linkages to each of the wiper assemblies transfer the movement to the drive splined hubs that convert it to a back and forth ‘‘semi-rotational’’ effect.

The arm assemblies transfer this motion to the individual blade assemblies. The rubber edges on the blades move liquids in the wiping path. Spring mechanisms in the arms maintain a constant force on the blade assemblies to aid in their cleaning efforts.

The windshield washer assembly stores the cleaning/washer antifreeze solution in a large reservoir. An integral electric motor draws fluid from the reservoir and transmits it through the hoses to the nozzles that spray it in a regular pattern on the windshield area.

NOTE: Special spring loaded “check” valves prevent fluid flow to the nozzles except when the system is operating.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the system and its components should include the following:

1. Inspect the condition of the arm and blade assemblies for evidence of proper installation, contamination, wear or damage. Clean, repair, or replace as required.

a. The rubber edges on the blade should be clean, pliable, and free of cuts or other damage. They must be properly attached to the arms to allow adequate freedom of movement.

b. The arm assemblies should be free of damage and with adequate spring force to ensure proper contact to be maintained between the blade edge and the glass surface.

NOTE: *When cleaning the windows or inspecting or service any portion of the wiper assembly, never pull the arm away from the window. This will weaken the spring and reduce the arm and blades’ tension against the glass.*

2. Inspect the drive assembly and associated linkages for evidence of proper installation, wear, or damage. Repair or replace as required.

3. Inspect the windshield washer assembly components for evidence of proper installation and routing,

wear or damage. Verify that there is an adequate supply of the proper liquid for the conditions. Service, repair, or replace as required.

4. If there are any indications of corrosion, electrical noise in electronics, or faulty operation, clean all electrical connections in the two systems.

5. Test the operation of the systems to ensure that:

NOTE: *If the windshield is dry, it may be necessary to adequately wet the surface with a hose or other alternate source, to properly allow the system to operate.*

a. The wipers operate throughout their normal operating ranges in all speed and delay settings.

b. When switched to the Off position, the wipers "park" with the blades as close to and parallel to the upper rubber seal as possible. If they do not, adjust as outlined in the instructions in Installation later in the module.

c. The windshield washer assembly sprays fluid while the switch is activated, then stops and does not drip once the switch is released.

NOTE: *Clean the window and the blade edge often. This increases the blade life significantly and reduces the potential of scratching the glass.*

REMOVAL

The windshield wiper components may be removed as follows:

1. Park the truck in a Safe Position. It must be secured by means other than the truck's friction brake system.

2. Secure both the truck's Master and Battery Isolation switches in the Off positions. Tag appropriately to prevent accidental activation of the system power.

3. Before working on the system, verify that there is no electrical power to the switch or any component in the system.

4. Remove the blade/arm assembly as follows:

a. Remove the nut securing the arm to the serrated drive assembly.

b. Carefully remove the saddle to the arm assembly, using extra care not to damage the arm or the serrations on the drive end.

5. Open the overhead panel in the cab to allow access to the drive components.

6. Remove the arm and shaft assemblies (5) from the cab structure by removing the capscrews securing each. The assemblies may then be pushed inside of the cab.

7. Secure the drive system components to prevent unwanted movement.

8. Disconnect all wiring to the drive system components.

9. Remove the capscrews securing the drive assembly components in the console assembly and to the cab. Remove the drive assembly components.

10. Remove the switch assembly (18) as follows:

a. Separate and remove the wiring at the connectors.

b. While securing or holding the switch assembly, remove the knob and locknut securing the switch, then remove the switch.

If components of the washer system need to be removed, they may be serviced as shown in Figure 2.

NOTE: *Be sure to drain the fluid from the reservoir and lines prior to disconnecting or removing.*

SERVICE

The components may be serviced as follows:

1. Clean each component carefully with a soft brush (or equivalent). Inspect for evidence of contamination, wear, or damage. Repair or replace as required.

INSTALLATION

The components in the wiper assembly may be installed as follows:

1. To install the wiper switch:

a. Properly orient the switch in the mounting hole and secure with locknut.

b. Install the knob assembly.

2. To install the drive assembly:

NOTE: *In order to properly install the crank arms, linkages, and drive assemblies the drive motor must be in its "parked" or off position. If not, it may be installed and the installation positions modified as required prior to placing into service.*

IMPORTANT: *If a new motor or drive system is being installed, it is imperative that the component's wiring be configured as shown in the Wiper Motor Modification insert (below View B-B) in Figure 1.*

a. Install the drive motor/assembly into its location in the cab overhead console, carefully orienting each of the linkages and drive ends before finally securing.

NOTE: *Loctite should be coated on the threads of capscrews (items 4 and 19) before installation.*

b. Verify or install the crank arm (3) on the wiper motor shaft as shown in Position 3 in View E-E, Figure 1.

NOTE: *The view is oriented as when looking from the driver's seat into the overhead console.*

c. Install the two arm and shaft assemblies (5) securing with the appropriate screws (12) and lockwashers (13).

d. Install the link (7) onto the crank arm (3) and right side arm and shaft assembly (5) in the inner hole as shown in Position 2 in View E-E, Figure 1.

e. Install the link (8) onto the crank arm (3) and left side arm and shaft assembly (5) in the center hole as shown in Position 1 in View E-E, Figure 1.

f. Install the wiper arms (15) and flexible blades (16) in the park (upper) position as shown in Figure 1.

(1) Position the saddle on the wiper arms so the flexible blades are parallel to the upper windshield seal rubber.

(2) Position the wiper arms with the flexible blades as close to the upper windshield seal rubber as possible.

3. Tighten the shaft nut just enough to cause the arm and blade assemblies to travel across the glass together for testing.

4. Turn on the Master Switch.

5. Turn on the wiper switch and allow the assembly to operate through several cycles to verify that the arm position is correct.

NOTES:
1. It may be necessary to clean the window first to prevent scratching.
2. It may also be necessary to wet the glass surface sufficiently to allow smooth operation with minimal drag.

6. To correct alignment errors:

a. Turn off the switch and allow the wiper operation to totally stop.

b. Turn off the Master Switch to prevent unwanted operation.

c. Remove the shaft nut and gently pull the arm off of the shaft.

NOTE: *Do not attempt to rotate or twist the arm on the shaft. This will cause damage to the splined end of the driveshaft, allowing the arm and blade assembly to slip during regular operation.*

d. Re-align the blade/arm and shaft assemblies, re-install and retest as outlined previously.

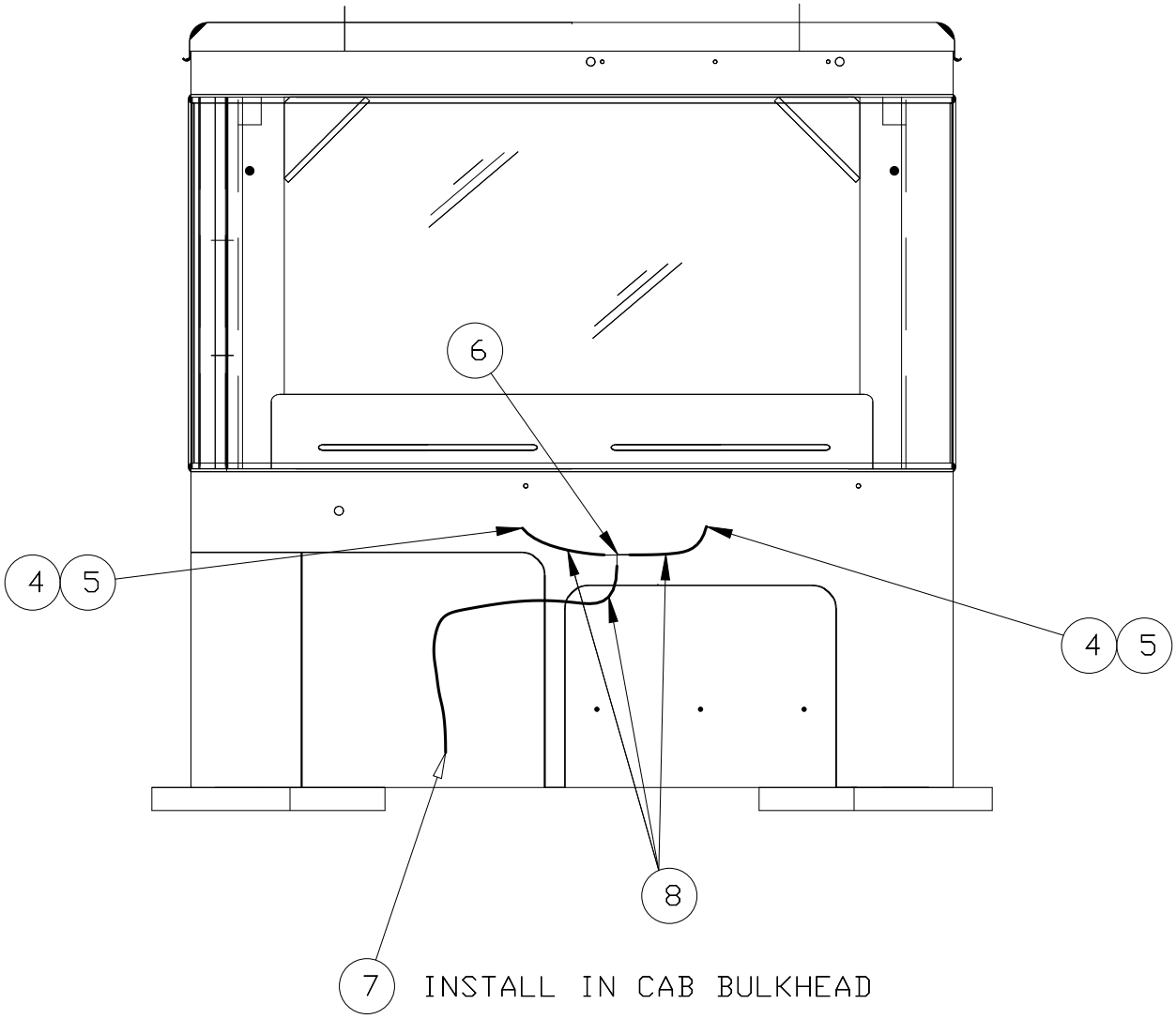
7. When the test is complete, stop the assembly operation and turn the Master Switch Off.

8. Tighten the shaft nut and serrated washer securely.

9. Close and secure the overhead console.

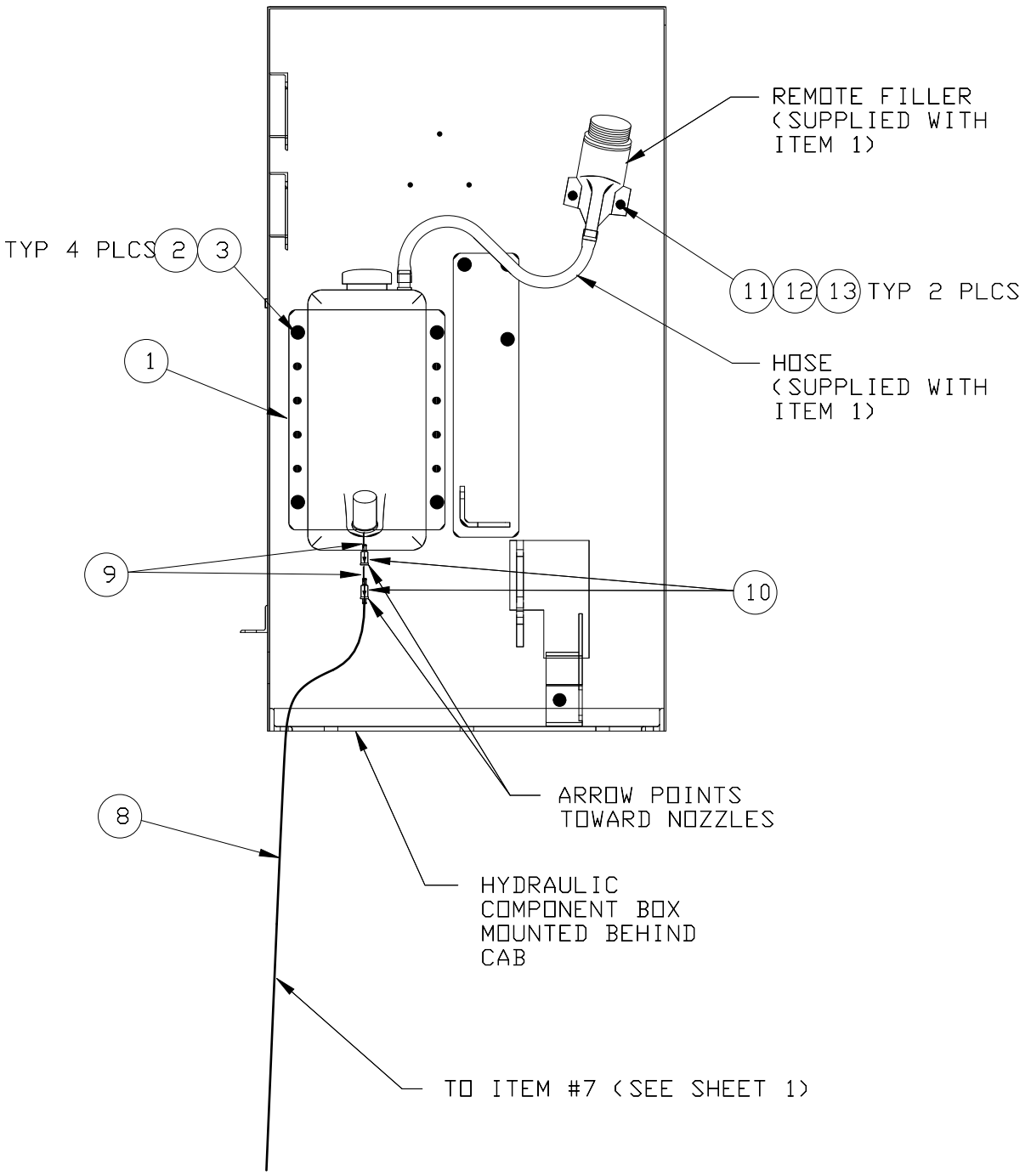
Components in the windshield washer assembly should be installed as shown in Figure 2.

NOTE: *The two special check valves are installed in line approximately 2 inches (50 mm) apart, as shown in Figure 2 with the arrows on both pointed in the direction of fluid flow to the nozzles.*



KEY			
01.	Wiper Motor *	11.	Wiper Bracket *
02.	Wiper Motor Bracket *	12.	Machine Screw
03.	Motor Crank Arm *	13.	Lockwasher
04.	Capscrew *	14.	Capscrew
05.	Arm and Shaft Assembly *	15.	Wiper Arm
06.	Wiper Motor Nut *	16.	Flexible Blade
07.	Link *	17.	Insert Nut or Flatwasher
08.	Link *	18.	Wiper/Washer Control Switch
09.	Spring Clip *	19.	Capscrew
10.	Spacing Washer *	20.	Wiper Drive Assembly
* On later units, items 01 through 11 were all incorporated into a new assembly, item 20			

FIGURE 1 – TYPICAL WIPER SYSTEM INSTALLATION



KEY			
01.	Washer Bottle Kit (Includes integral electric pump)	08.	Hose
02.	Capscrew	09.	Hose
03.	Lockwasher	10.	Special Check Valve
04.	Washer Nozzle	11.	Capscrew
05.	Nut	12.	Flatwasher
06.	Hose Tee	13.	Locknut.
07.	Hose Fitting		

FIGURE 2 – TYPICAL WINDSHIELD WASHER INSTALLATION

FUEL TANK

DESCRIPTION AND LOCATION

The fuel tank is the round, horizontally mounted tank mounted on the right side of the trucks main frame between the front and rear tires.

OPERATION

The fuel tank hold between 800 and 1300 gallons (3 030 and 4 920 liters) of diesel fuel, depending upon customer specification. Glass plugs allow the relative fluid level to be seen externally without removing any covering. Vent caps are installed to prevent the build up of positive pressure (during fuel filling) or vacuum (during normal operation when fuel is being used). An internal mounted sending unit provides the input needed by a cab mounted Fuel Level gauge to allow normal monitoring of the fuel level during normal operation.

The tank may be filled through either a hinged cap and strainer assembly or through a remote mounted quick fill assembly.

NOTE: *The tank is grounded to the truck frame to add additional safety and durability.*

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following:

1. Inspect the exterior of the tank for evidence of damage or leakage. Repair or replace as required.

2. Inspect the mounts and brackets. They should be secure and in general good repair. Adjust, repair, or replace as required.

3. Inspect the cap on the fill ports. It should seal sufficiently to prevent contamination from entering. Repair or replace as required.

4. Inspect the inlet strainers on the fill port. It should be free of contamination and in general good repair. Repair or replace as required.

5. Inspect all inlet and outlet lines and ports. They should be free of damage and in general good repair. Repair or replace as required.

6. Periodically inspect the inside of the tank for evidence of rust, dust, or other contamination. Flush the tanks and clean as required if evidence of contamination is found.

REMOVAL

The fuel tank may be removed as follows:

1. Empty the contents of the tank into the appropriate cleaned containers. This may be accomplished by use of a transfer pump or other suitable device. Plugs and/or drain cocks are provided in the bottom of each tank to allow for final draining.

IMPORTANT: *Check the fluid level in the tank prior to beginning the emptying procedure and make the appropriate provisions for the large volumes of fuel that will be transferred.*

2. Disconnect and cap or plug all lines attached to the tank. Label all hoses removed to assist in later reconnection.

3. Disconnect all wires connected to the tank.

4. Disconnect the ground strap.

5. Support the tank so the weight is removed from the mounting brackets. Secure so that it cannot move when the brackets are released.

6. Remove all remaining capscrews, pads, shims, etc.

7. Remove the tank assembly from the truck.

DISASSEMBLY

The tank assembly may be disassembled as follows:

1. Remove all fill ports and strainer assemblies.

2. Remove all clean-out port covers.

3. Remove all internal strainers and filters.

4. If necessary to remove the tank from the mounting bracket, remove the capscrews and separate the bracket sections. Remove the tank.

INSPECTION ND REPAIR

The disassembled tank may be inspected as follows:

1. Inspect all threads on ports or plugs for damage. Repair or replace as required.

2. Inspect all exterior and interior surfaces for evidence of corrosion, or damage. Clean, repair, or replace as required.

3. Inspect all welds and mounting brackets for evidence of damage. Repair or replace as required.

4. Inspect the mounted brackets for evidence of wear or damage. Inspect the neoprene webbing on the inside of the strap assemblies. Repair or replace as required.

ASSEMBLY

The tank may be assembled as follows:

IMPORTANT: *Always use new gaskets and gasket sealer during assembly.*

1. Verify that the internal surfaces and components are free of contamination.

2. Install all strainers, filters, and other components.

3. Install the clean out port covers using care to tighten and torque all of the capscrews sequentially and evenly in small stages to ensure proper sealing.

4. Install the inlet and outlet manifolds and attached hardware.

5. Install the fill port/strainer assemblies and tighten sufficiently to form a firm seal. Verify that the rubber seal material on the cover forms a good seal.

NOTE: *It is recommended that thread sealant be applied to all pipe threads.*

INSTALLATION

The tank may be installed as follows:

1. If removed, install the brackets and securing straps on the frame mounts. Use the appropriate mounting hardware to secure the brackets.

NOTE: *It is generally considered easier to install the brackets, straps, and tank separately.*

2. Separate the straps as required.

3. Lift the tank carefully and position on the straps. Verify that the filler cap is properly oriented and that the tank is located far enough away from the wheels to prevent contact.

NOTE: *During steering, the front wheels move rearward and sufficient clearance for this must be allowed for.*

5. Move the straps around the tank and secure with the capscrews. Use self-locking nuts to secure the capscrews.

NOTE: *Tighten the capscrews sufficiently to secure the tanks. Do not over-tighten, as damage to the tank or strap may result.*

6. Connect all wiring to the tank.

7. Connect all hoses removed from the tank.

8. Connect the ground strap making sure to make solid connections at both ends.

9. Fill the tank with fuel using the appropriate filtering transfer device.

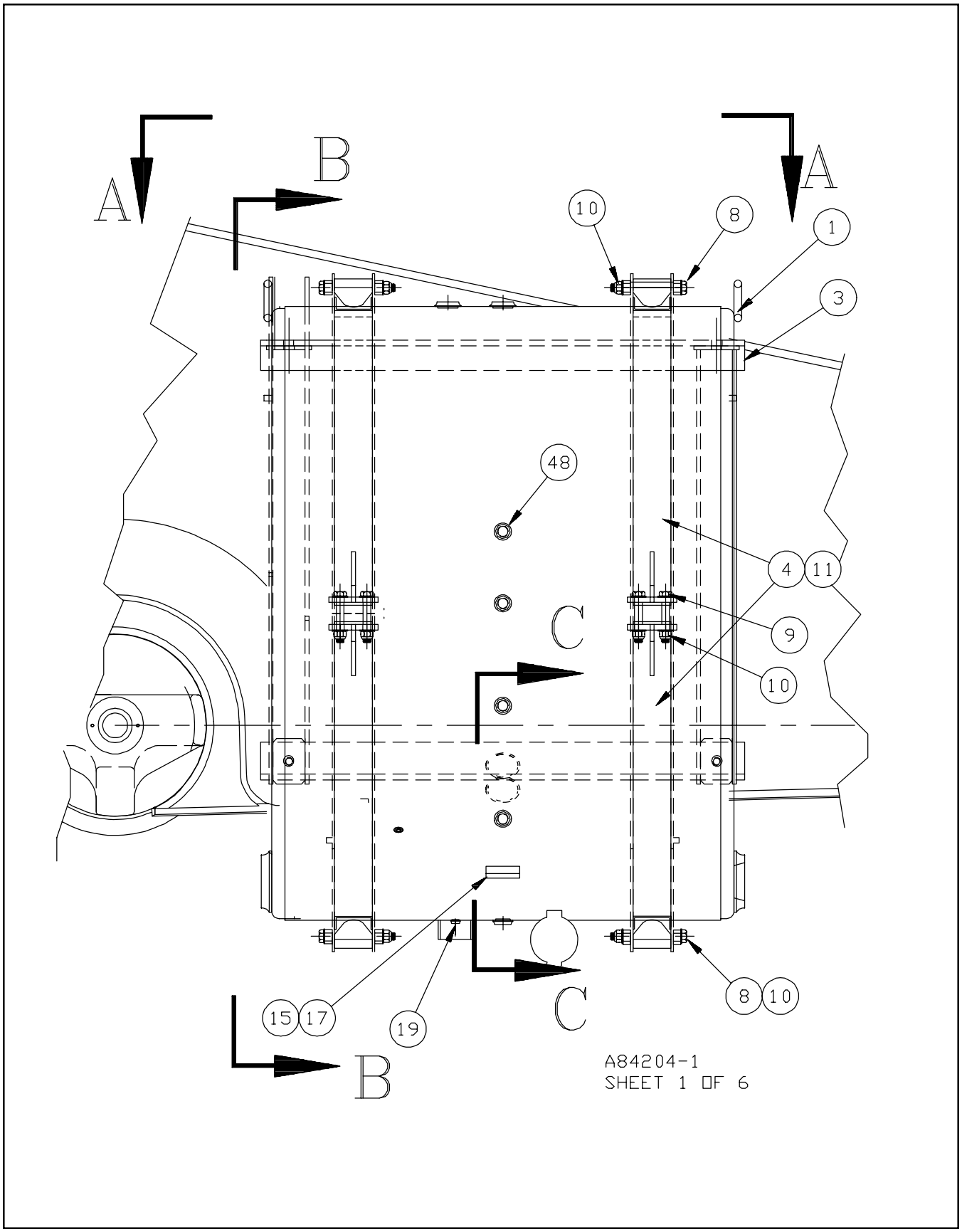


FIGURE 1 - FUEL TANK ASSEMBLY

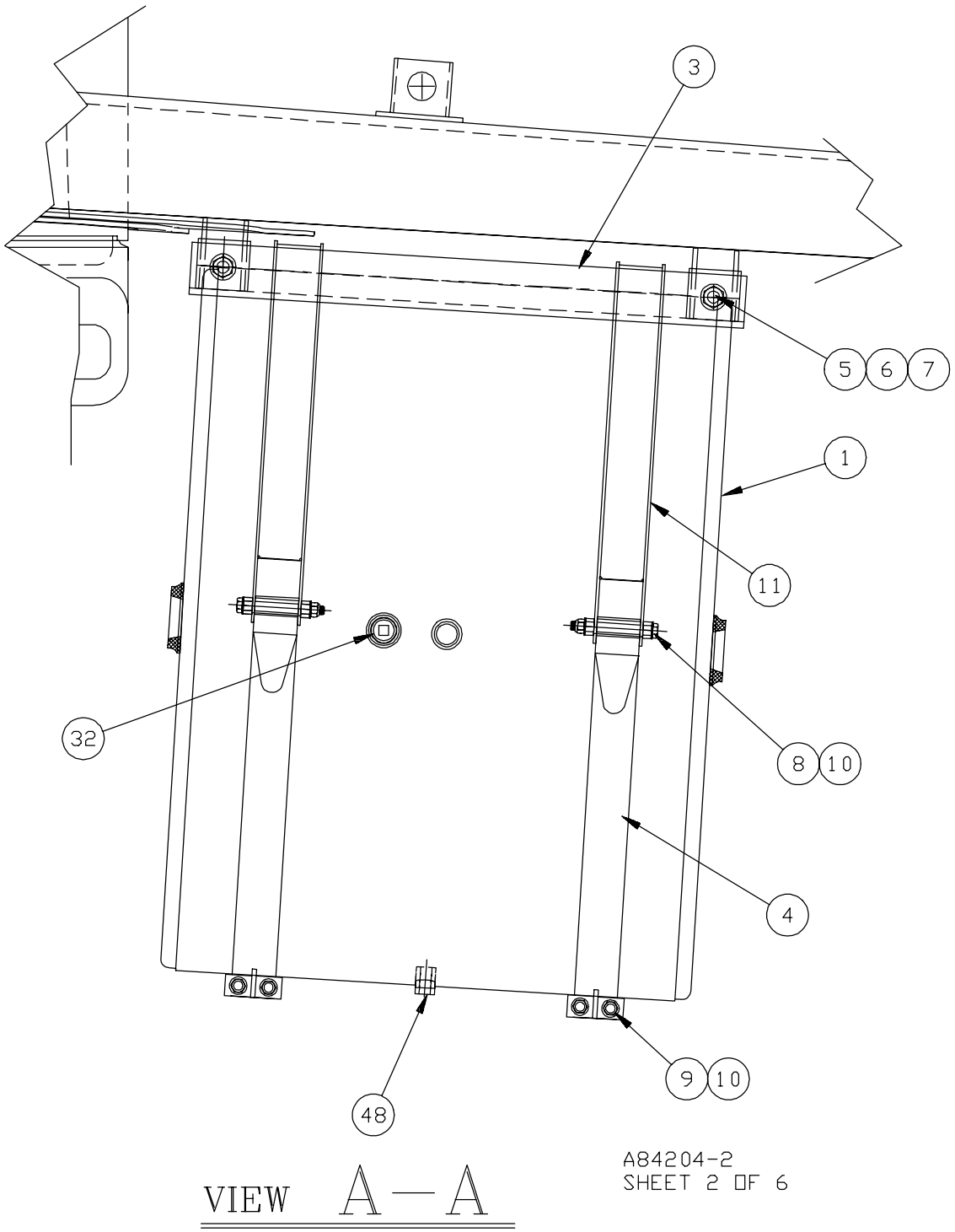


FIGURE 1 - FUEL TANK ASSEMBLY - CONTINUED

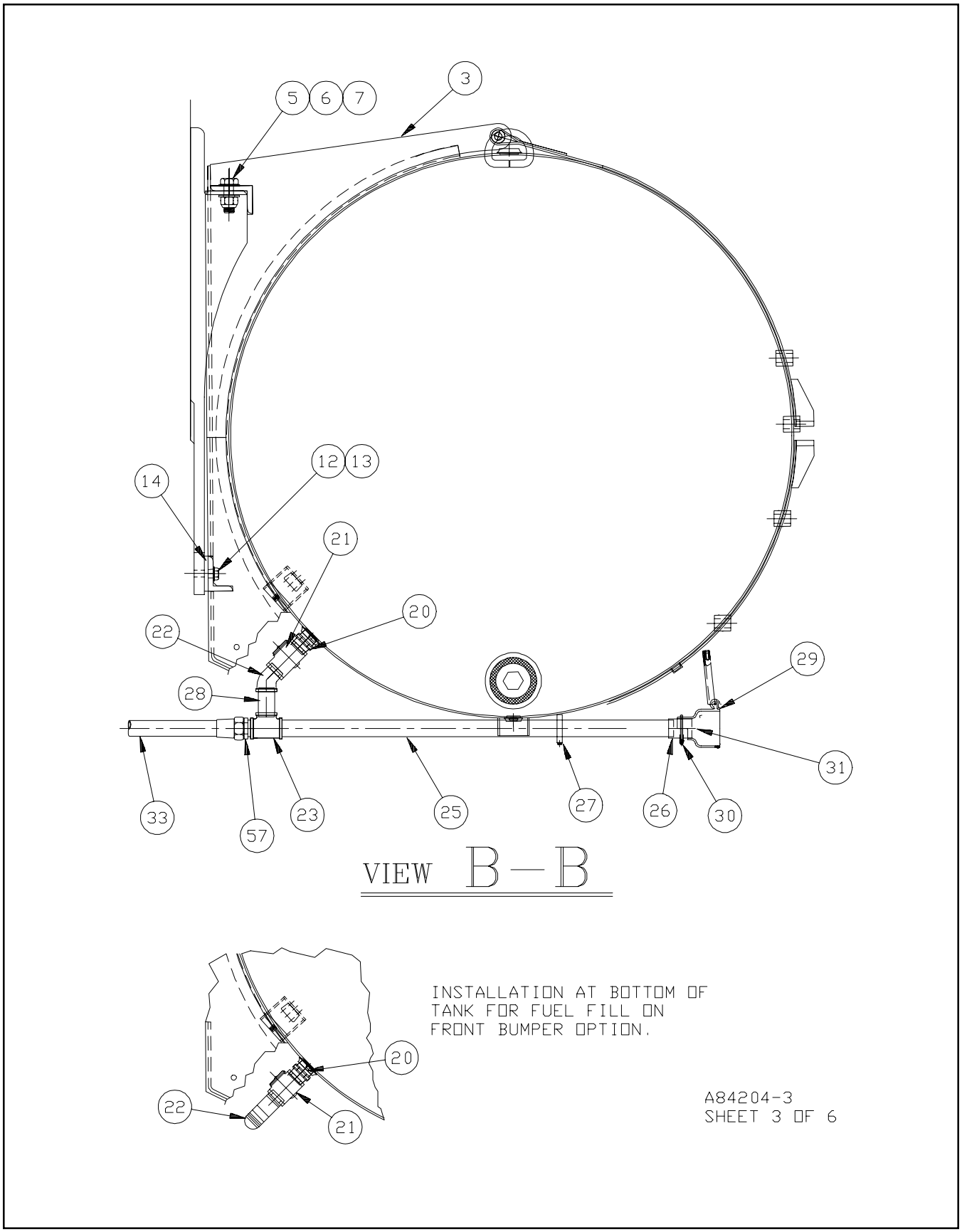


FIGURE 1 - FUEL TANK ASSEMBLY - CONTINUED

KEY					
01.	Fuel Tank	22.	45° Adapter	43.	Cover
02.	Not Used	23.	Pipe Tee	44.	Capscrew
03.	Fuel Tank Bracket	24.	Straight Adapter	45.	Lockwasher
04.	Fuel Tank Strap	25.	Pipe Nipple	46.	Grip
05.	Capscrew (Grade 8)	26.	Pipe Coupling	47.	Conduit Locknut
06.	Locknut	27.	Pipe Clamp	48.	Liquid Level Sight Plug
07.	Hardened Flatwasher	28.	Pipe Nipple	49.	Level Sensor
08.	Capscrew	29.	Dry Break Fuel Guard	50.	Dry Break Fuel Bracket
09.	Capscrew	30.	U-Bolt Clamp	51.	Cushion Clamp
10.	Locknut	31.	Dry Brake Receiver	52.	Bolting Pad
11.	Neoprene Webbing	32.	Fuel Tank Vent	53.	Capscrew
12.	Capscrew	33.	Hose Assembly	54.	Lockwasher
13.	Hardened Flatwasher	34.	Hose Clamp	55.	Capscrew
14.	Spacer	35.	Fuel Suction Pipe	56.	Chain
15.	Nameplate	36.	Pipe Nipple	57.	Adapter Fitting
16.	Lockwasher	37.	Pipe Elbow	58.	Capscrew
17.	Drive Screw	38.	Gate Valve	59.	Locknut
18.	Not Used	39.	Straight Adapter	60.	Flatwasher
19.	Drain Cock	40.	Fuel Level Transmitter	61.	Pipe Nipple
20.	Pipe Nipple	41.	Rubber Gasket		
21.	Ball Valve	42.	Capscrew		

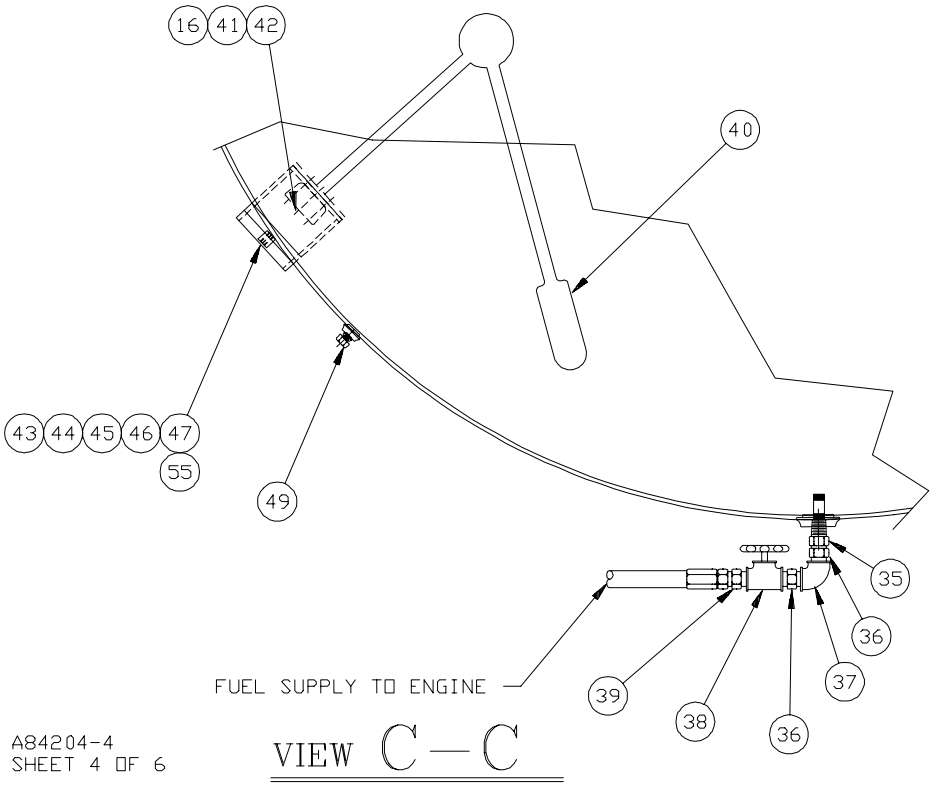


FIGURE 1 - FUEL TANK ASSEMBLY - CONTINUED

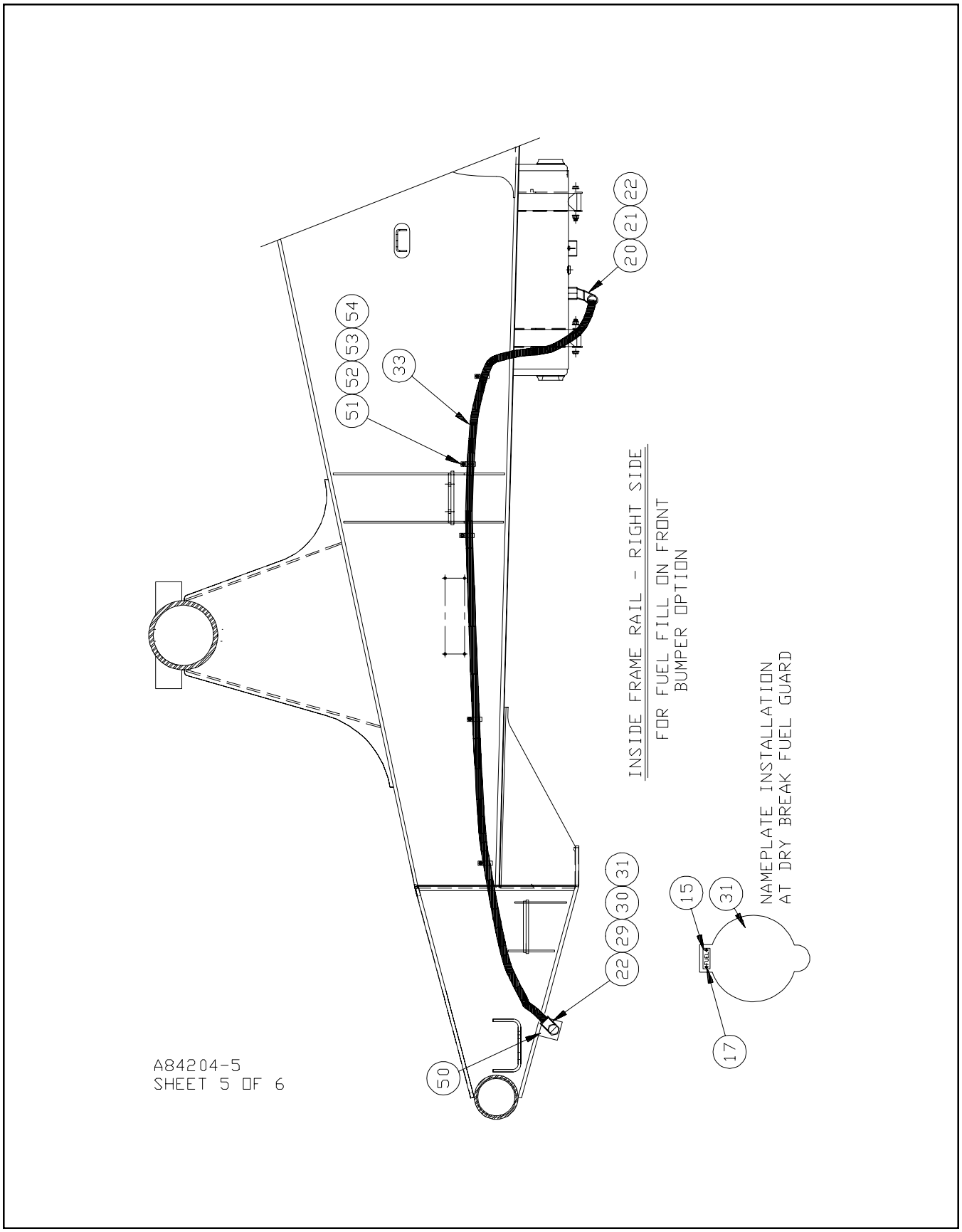


FIGURE 1 - FUEL TANK ASSEMBLY - CONTINUED

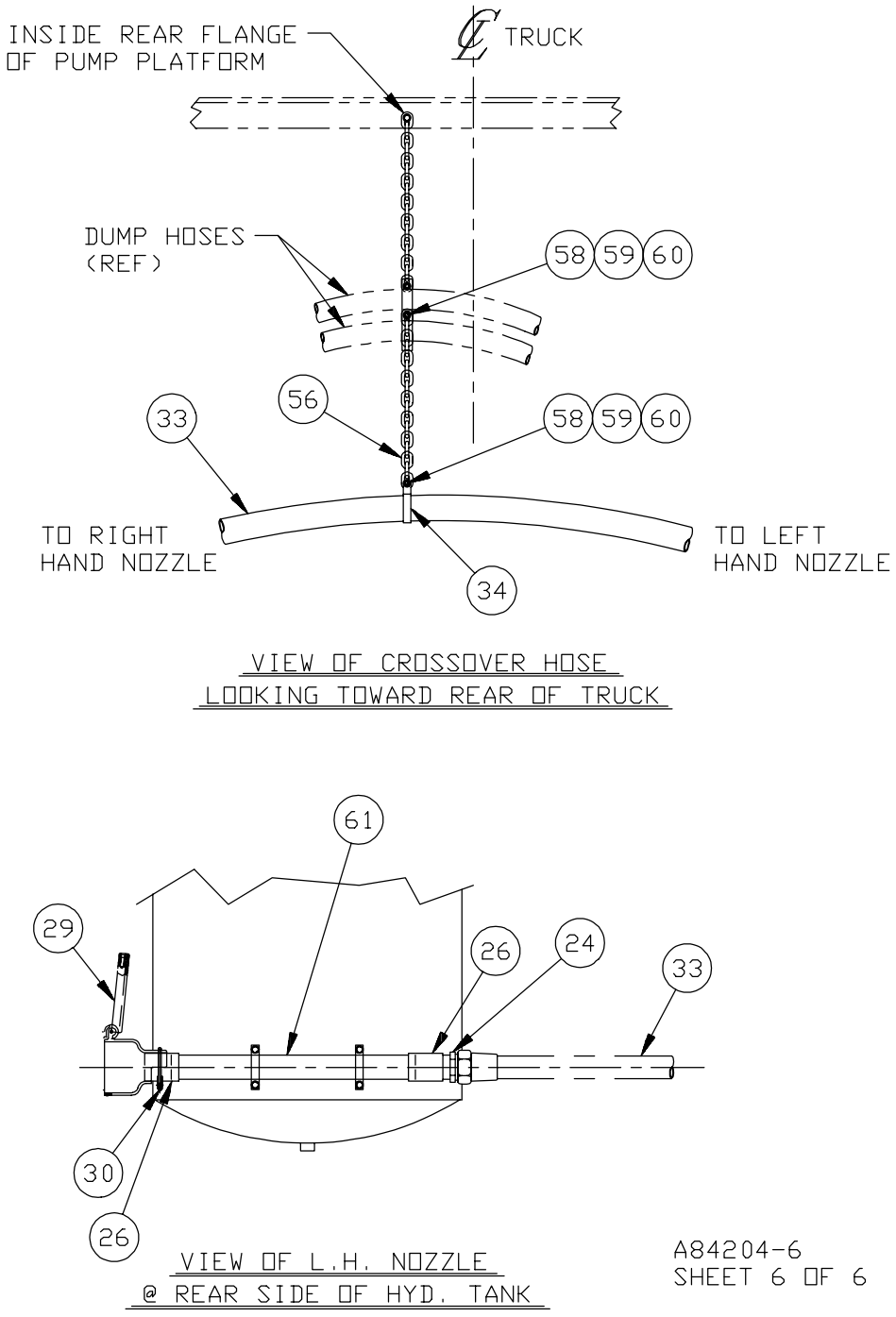


FIGURE 1 - FUEL TANK ASSEMBLY - CONTINUED

DUMP BODY

DESCRIPTION AND LOCATION

The dump body is the large load carrying area mounted above the rear of the frame. It is available in various sizes to accommodate the variety of materials hauled.

OPERATION

The dump body serves as the load-carrying member for moving the desired payload. The large, wide floor and low height eases loading requirements while the flat smooth walls, floor, and rear pivot mounts are designed to facilitate fast and efficient dumping.

Liners of high, abrasive-resistant steel are provided as an option to increase useful component life by reducing the wear caused by material in the high wear areas. Liners also provide a fast and efficient means of replacing worn out surfaces.

The dump body assembly has four major support components:

1. Rubber pads, mounted on the dump body, support the dump body when it is resting on the frame. They are designed to carry and distribute the weight of the dump body and load and require proper shimming.

2. The guide structure assists in limiting the lateral movement of the dump body when it is lowered and resting on the frame.

3. The dump cylinders raise and lower the front of the dump body. It is important that these cylinders do not carry any load except during the dumping operation. Detailed information about these cylinders is contained in Section 5 - Hydraulic System.

4. The dump body pivot assembly serves as the point of rotation for the body. It is designed to carry loads during the dumping operation and a limited load during haulage. This load should be controlled by proper shimming of the dump body pads.

On some trucks the engine exhaust is routed through channels on the outer portion of the dump body. The heat from the exhaust warms the dump body to assist in reducing sticking or freezing of material to the metal, especially in areas prone to these conditions.

Rock knockers or ejectors are provided to remove rocks and other material which may be wedged between the dual tires. These are suspended from the bottom of the dump body and are free to move on their pivots as required. Provisions have been included to support these devices in a temporary “storage” position to aid in tire, wheel motor and other removal and maintenance procedures that are affected by their presence. (See Figure 1.)

Provision has been made for securing the dump body in its fully raised (dump) position. Cables attach from the dump body to a lug located on the back of the axle box. To secure in position, raise the dump body fully, and connect the cables. During normal operation, the cables are stowed under the dump body with both ends attached to brackets on the body. (See Figure 2.)

⚠WARNING

Never work on the truck without the dump body resting on the frame or secured by the cables. Never operate the truck or attempt to lower the dump body with the cable securing the dump body in its raised position.

MAINTENANCE AND ADJUSTMENT (Figures 1, 2, 3 and 4)

Periodic maintenance should include the following steps:

1. Inspect the dump body for wear and damage. Repair as required by following the approved BUCYRUS® welding specifications and procedures as outlined on the instructions for Field Welding in Section 10 - Miscellaneous of this manual as well as other BUCYRUS® information.

2. Inspect the liners for wear or damage. Repair or replace as required.

3. Inspect the condition of the rock ejectors. They should have proper freedom of movement. Repair or replace as required.

NOTE: *If temporary “storage” of the ejectors in a raised position (clear of the tires) is desired during tire or other maintenance, it may be secured as shown in Figure 1.*

4. Inspect the dump body lock-up cables, brackets and other provisions for evidence of wear or damage.

NOTE: *The dump body is secured in the raised position as outlined in the information in Figure 2. The cable is*

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Exhaust leakage	Damaged exhaust components	Check all components for damage and proper fit. Repair or replace as required.
Excessive lateral movement	Improperly shimmed guide assembly	Check guide assembly shimming. Reshim as outlined in Maintenance and Adjustment.
	Dump pins, hinge or pivot structure worn or damaged	Inspect and repair or replace as required.
Dump Cylinder damaged (bottomed out)	Dump body improperly shimmed (too low)	Check dump body shimming. Reshim as outlined in Maintenance and Adjustment.
	Dump valve not in FLOAT position during truck operation	Check operation of dump valve. Also check that operators are properly operating the control.
Dump Cylinder damaged (bent or pulled out lengthwise (piston damaged)) - damage to attachment pins	Dump body raised during truck operation (pulling away from the dump too soon)	Refer to operator's manual for dumping procedures. Report this condition to supervisor for corrective action.
	Dump body rear edge is being used to blade or spread material	
	Dump Body is "powered up" too fast (especially when in overcenter condition)	

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stowed by securing the front eyelet assembly to bracket item 2.

5. Inspect the pivot pin assembly for evidence of wear or damage. Also verify that the pin is secured to cause the pin to rotate with the body only as shown in Figure 3. Repair or replace as required.

6. On trucks equipped with dump body heating:

a. Inspect the dump body heating exhaust ducting and connections for evidence of damage which might result in leakage or restriction in the exhaust flow. Repair as required.

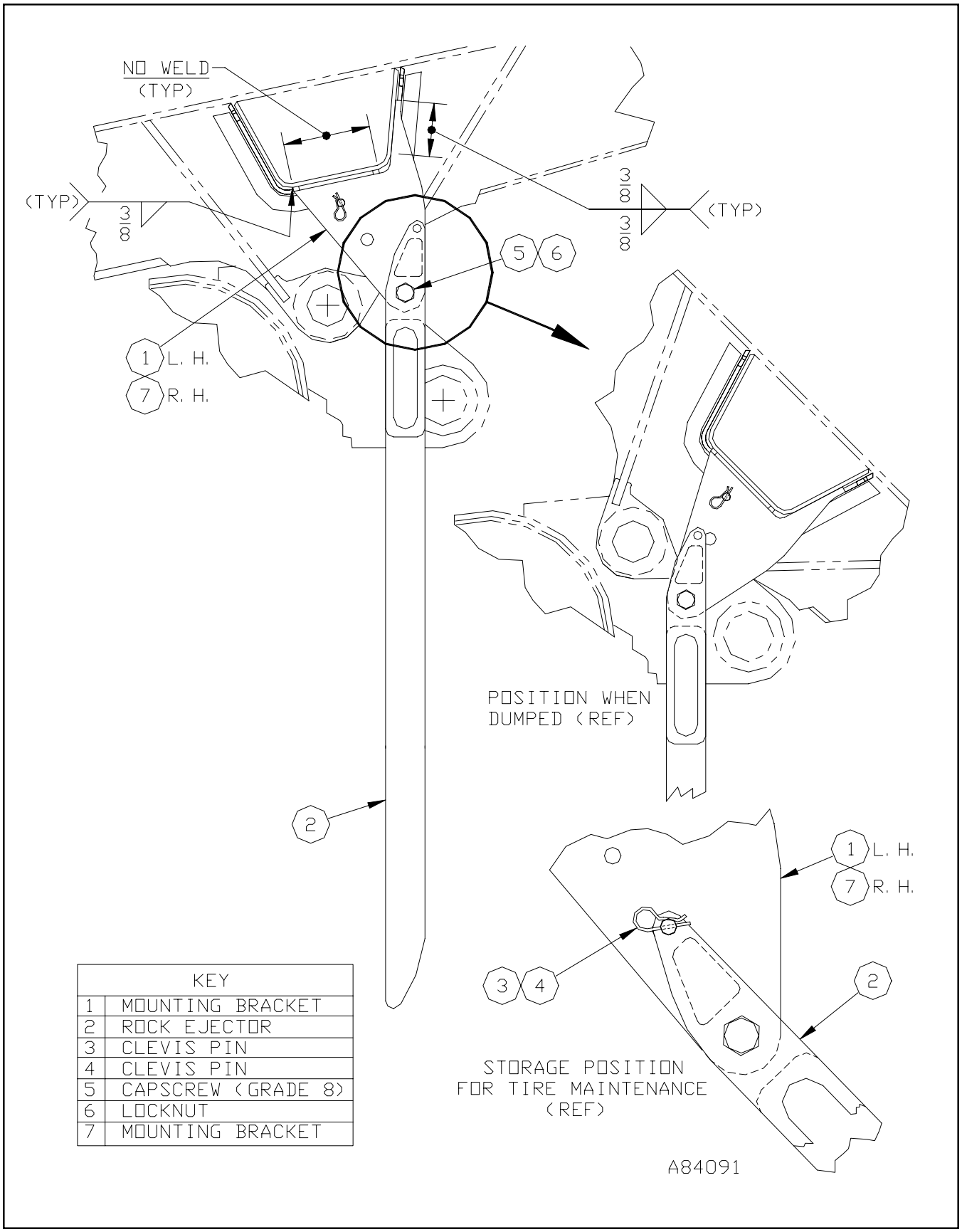
b. Inspect the internal dump body heating passages for excess carbon deposits. Accumulation of carbon and related deposits will block passages and restrict the flow of exhaust gases, reducing engine performance and body heating efficiency. To clean, raise the dump body and flush with water. Additional cleaning may be done by “rodding” or similar means. Do not use fire or similar methods to clean the passages.

⚠WARNING

Oxygen and oil should not be blown into the passages in an attempt to burn out deposits as they may form a highly explosive mixture.

7. Inspect the dump body pads at every service period (approximately 150-250 hours) for deterioration of the rubber, broken mounting lugs, or other evidence of wear or damage. Repair or replace as required. The proper installation and shimming procedure is included later in this portion of the module.

8. Inspect the dump body guide wear plates every 500 hours as follows: (Figure 4)



KEY	
1	MOUNTING BRACKET
2	ROCK EJECTOR
3	CLEVIS PIN
4	CLEVIS PIN
5	CAPSCREW (GRADE 8)
6	LOCKNUT
7	MOUNTING BRACKET

FIGURE 1 - ROCK EJECTOR ASSEMBLY

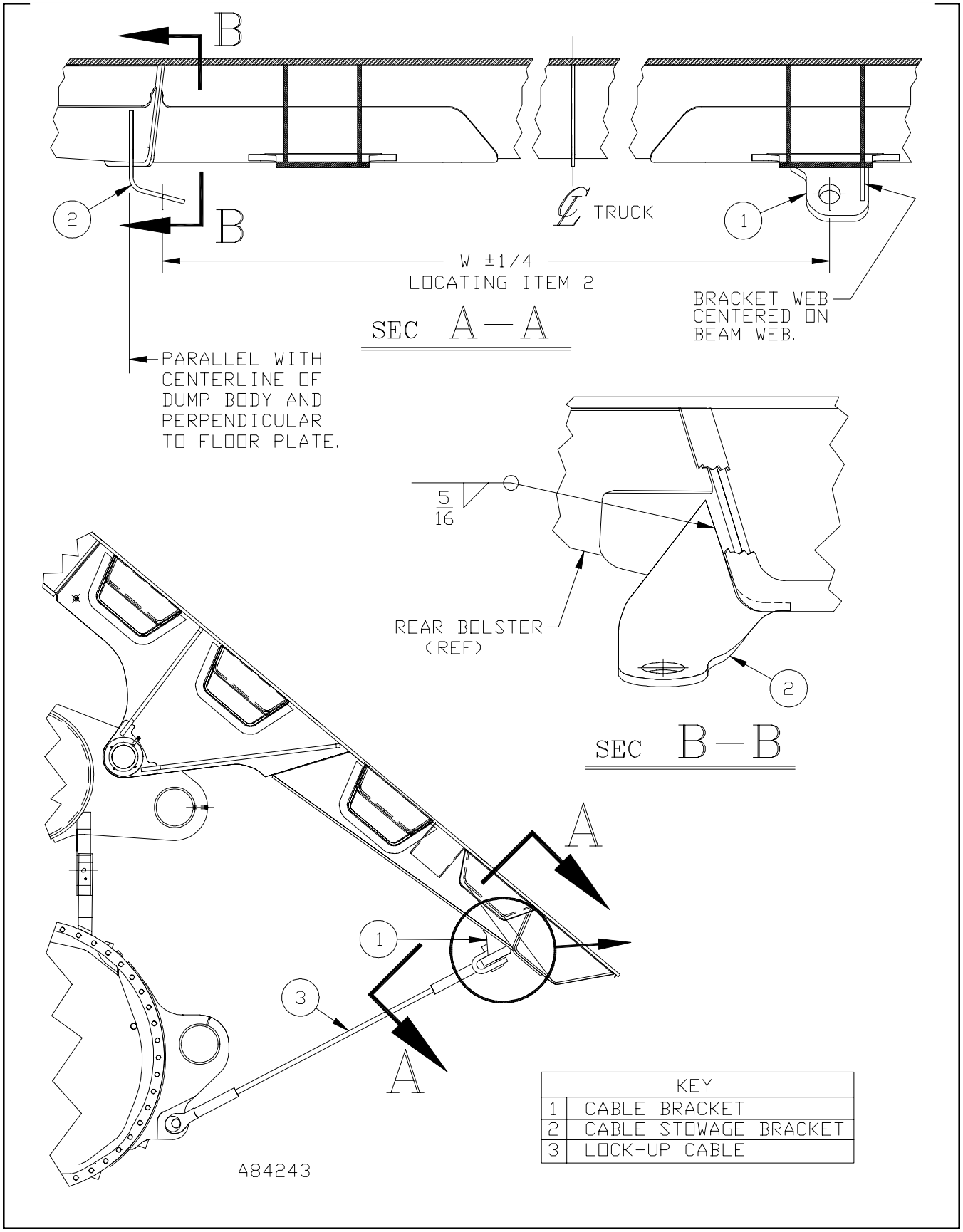


FIGURE 2 - DUMP BODY LOCK-UP PROVISION

a. With the dump body down and resting on the frame rails, measure the distance between the dump body guides (3) and rub plates (4 and 5) on both sides of the truck.

b. If the total of the two clearances is less than 1/2 inch (13 mm), the guides are properly shimmed and require no maintenance.

c. If the total of the two clearances is greater than 1/2 inch (13 mm), the guides should be re-shimmed as outlined in the appropriate procedures later in this module.

NOTE: *Excessive wear on one or both of the dump body guide assemblies may indicate excessive wear in other areas (e.g. pivot pins and/or bushings) or improper operating practices. These should be reviewed and corrected to minimize dump body guide wear.*

SHIMMING THE PADS (Figure 3)

The dump body pads may be shimmed as follows:

1. Park the truck in a SAFE POSITION in a level area. It must be secured by means other than the truck's friction brake system.

2. Raise the dump body and secure as required to prevent unwanted movement of the body.

⚠WARNING

Never work under or around the truck unless the dump body is solidly secured in place at all times it is not resting on the frame.

3. Inspect the condition of the rubber pad and securing assemblies. Replace any if found to be worn or damaged.

4. Install the shim block (15) on the top flange of the frame, perpendicular to the frame rail. The block should be located approximately 3 inches (76 mm) in front of the first set of pad mounting slots.

5. Remove the securing device and fully lower the dump body until the dump body runners rest on the shimming block.

NOTE: *If the pads contact the frame prior to this occurring, it may be necessary to remove the appropriate pad(s), marking their location for later reinstallation.*

6. Measure the distance between the dump body flange and the frame flange at a distance of approximately 3 inches (76 mm) behind the last set of pad mounting slots. If this dimension is found to be less than 1-3/16 inch (30 mm), raise the dump body and install an appropriate amount of shims to obtain this minimum dimension.

7. Measure the gap between the dump body and frame flanges at the center slot for each pad assembly, both on the inside and outside to the runners/rails. This provides the A1 though A5 dimensions shown.

NOTE: *If the inside and outside dimensions are found to be different, the dimension should be an average of the two measured gaps.*

8. Measure the thickness of each pad.

9. Subtract the pad thickness from the corresponding gap distance and record the required shim thickness.

10. Prepare a stack of shims of the required thickness. Raise and secure the dump body and install the shims under the correct pad.

NOTE: *The thicker pad goes against the frame.*

11. Remove the shim block. Correctly shimmed, the pads should contact the frame within +/- 1/32 inches (0.030 mm) at each pad location.

12. Place truck into service for 6 to 8 typical load cycles.

13. Re-inspect and re-shim (if required) as outlined previously.

NOTE: *At the next maintenance period of the truck, raise the dump body and inspect the contact areas for even wear on the dump body runners. Be sure to secure the body prior to working under it.*

SHIMMING THE GUIDES (Figure 4)

The dump body guides should be shimmed as follows:

1. Verify the truck is parked in a SAFE POSITION on level ground.

2. Verify that the:

a. Pivot pins and bushings are in good condition.

b. The rub plate and guide surfaces are in good repair.

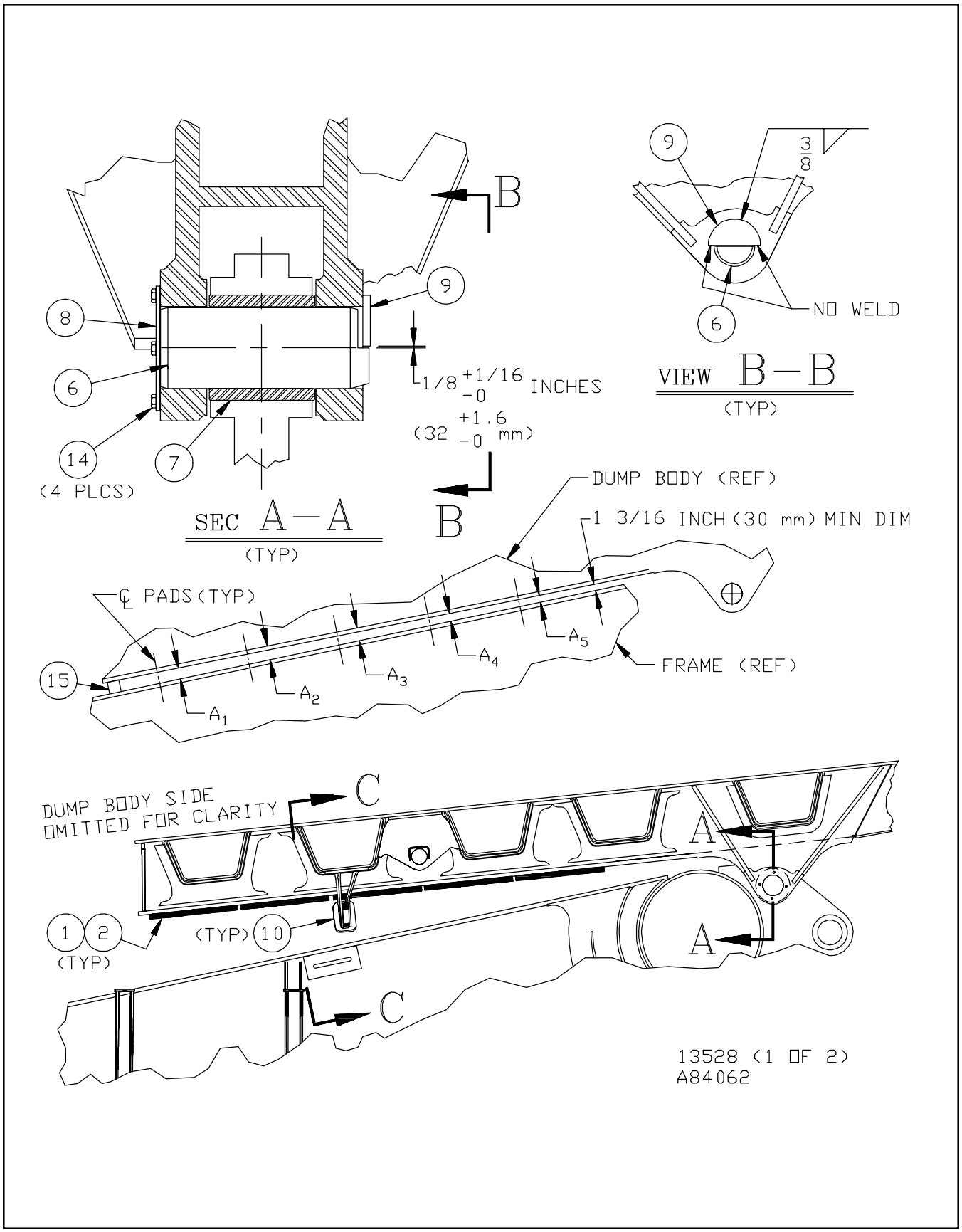
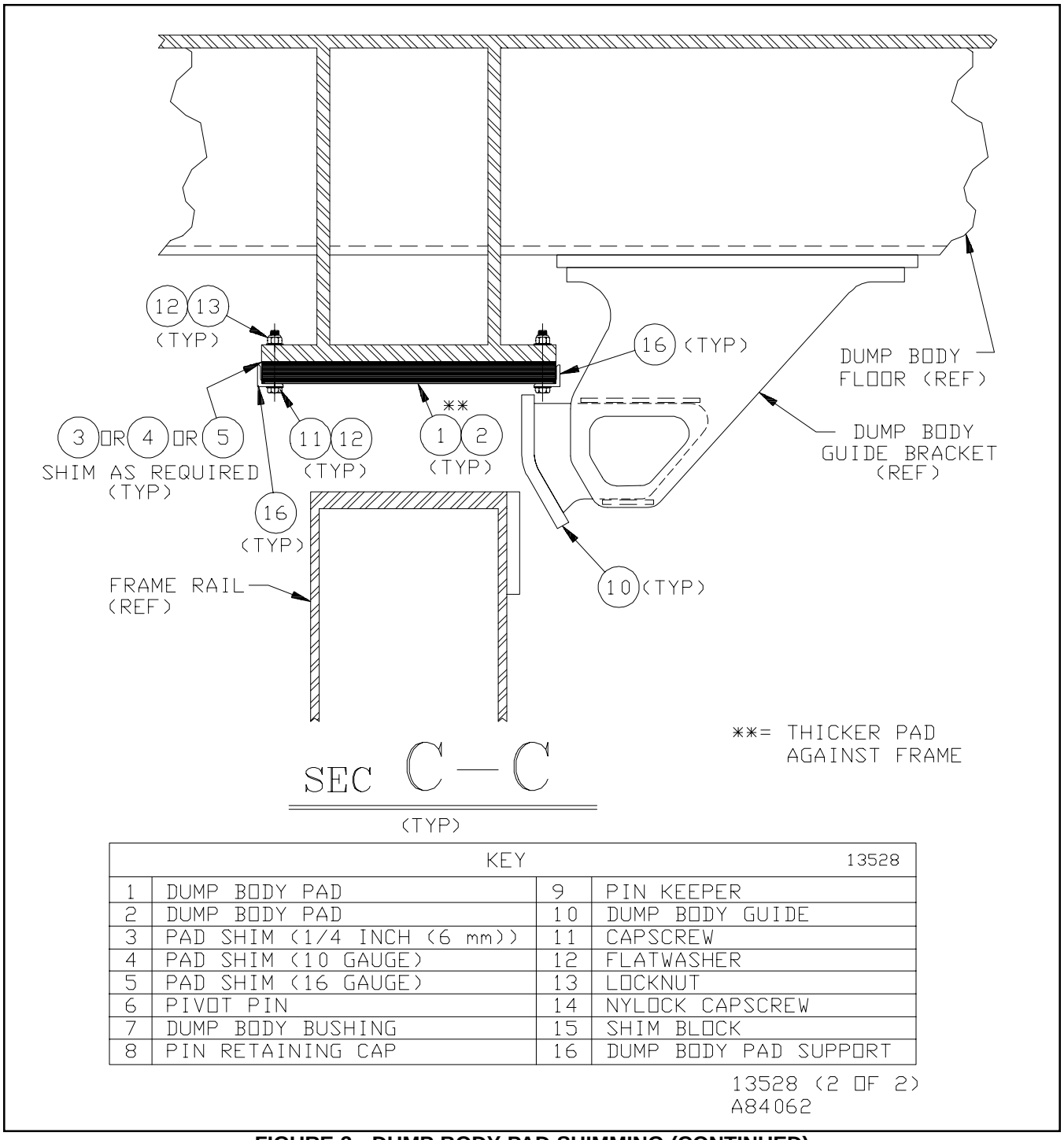


FIGURE 3 - DUMP BODY PAD SHIMMING



KEY			13528
1	DUMP BODY PAD	9	PIN KEEPER
2	DUMP BODY PAD	10	DUMP BODY GUIDE
3	PAD SHIM (1/4 INCH (6 mm))	11	CAPSCREW
4	PAD SHIM (10 GAUGE)	12	FLATWASHER
5	PAD SHIM (16 GAUGE)	13	LOCKNUT
6	PIVOT PIN	14	NYLOCK CAPSCREW
7	DUMP BODY BUSHING	15	SHIM BLOCK
8	PIN RETAINING CAP	16	DUMP BODY PAD SUPPORT

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FIGURE 3 - DUMP BODY PAD SHIMMING (CONTINUED)

c. Dump body is resting squarely on the frame rails, and that the body pads have been properly shimmed.

3. Completely raise and lower the dump body a minimum of 3 times.

4. With the dump body resting on the frame, in as near a centered position as possible, measure the gap between the dump body surface and the inside surface of each of the dump body guides.

a. If the total of the two clearances is less than 1/2 inch (13 mm), the guides are properly shimmed and require no maintenance.

b. If the total of the two clearances is greater than 1/2 inch (13 mm), the guides should be re-shimmed as outlined below.

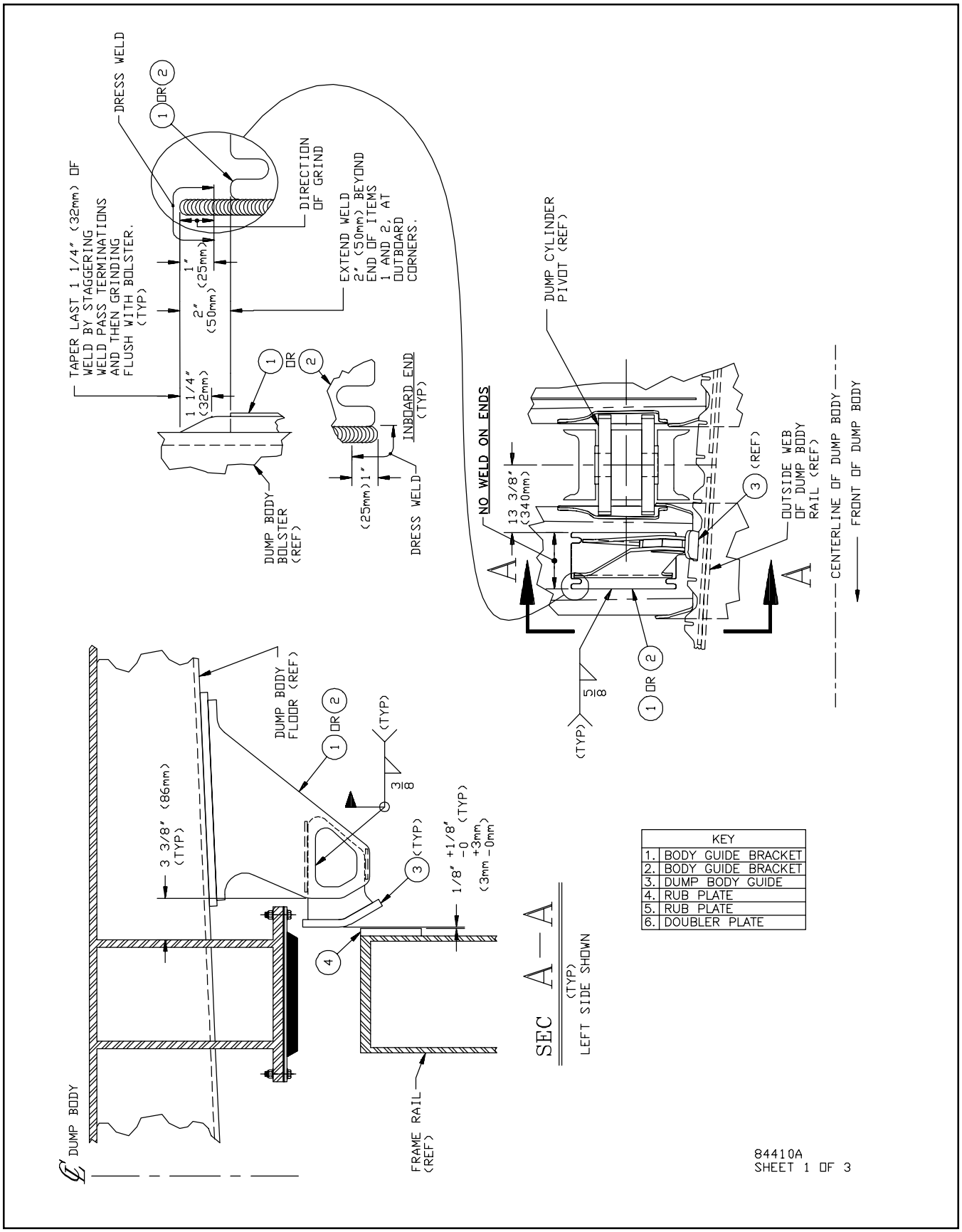


FIGURE 4 - DUMP BODY GUIDE SHIMMING

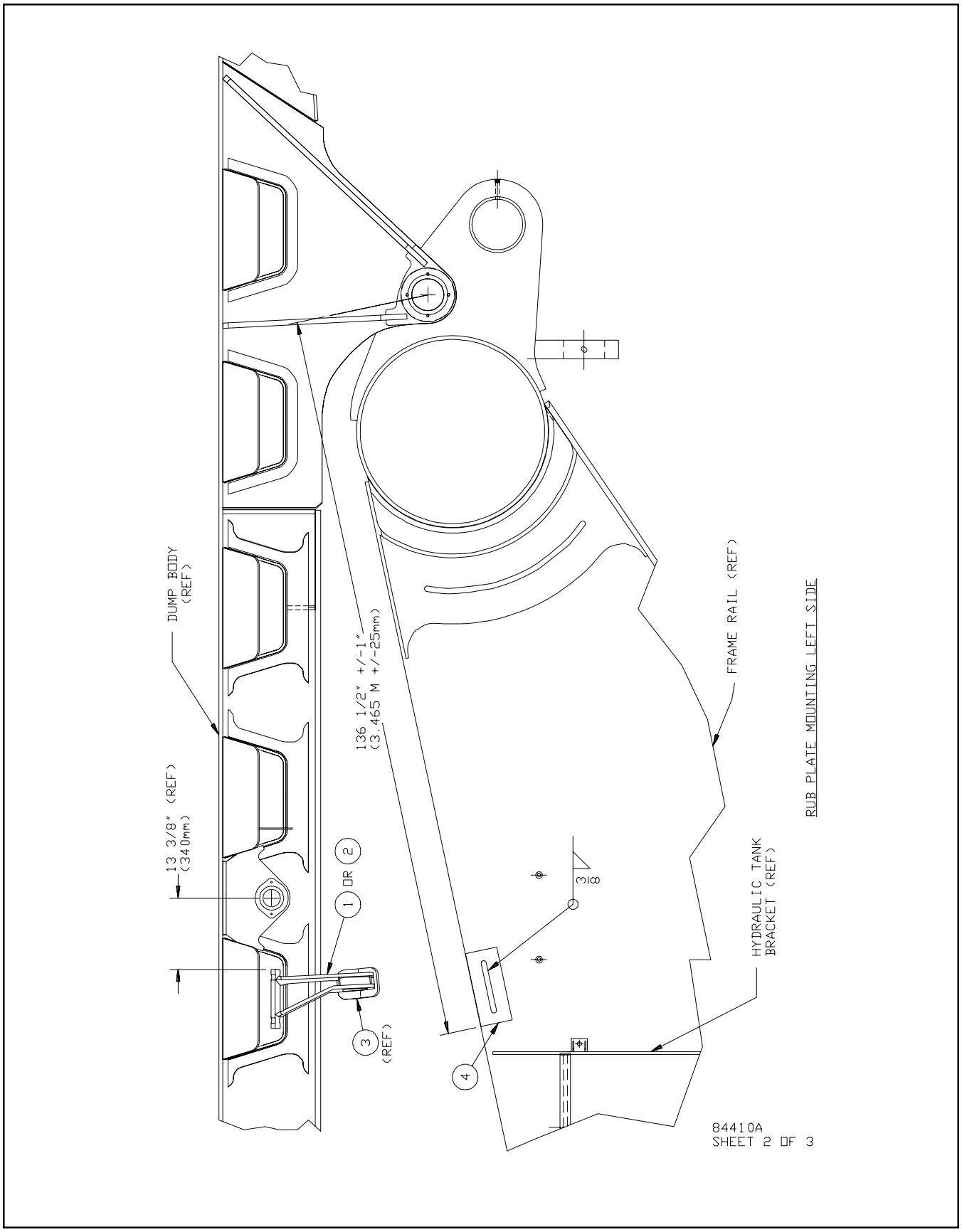


FIGURE 4 - DUMP BODY GUIDE SHIMMING (CONTINUED)

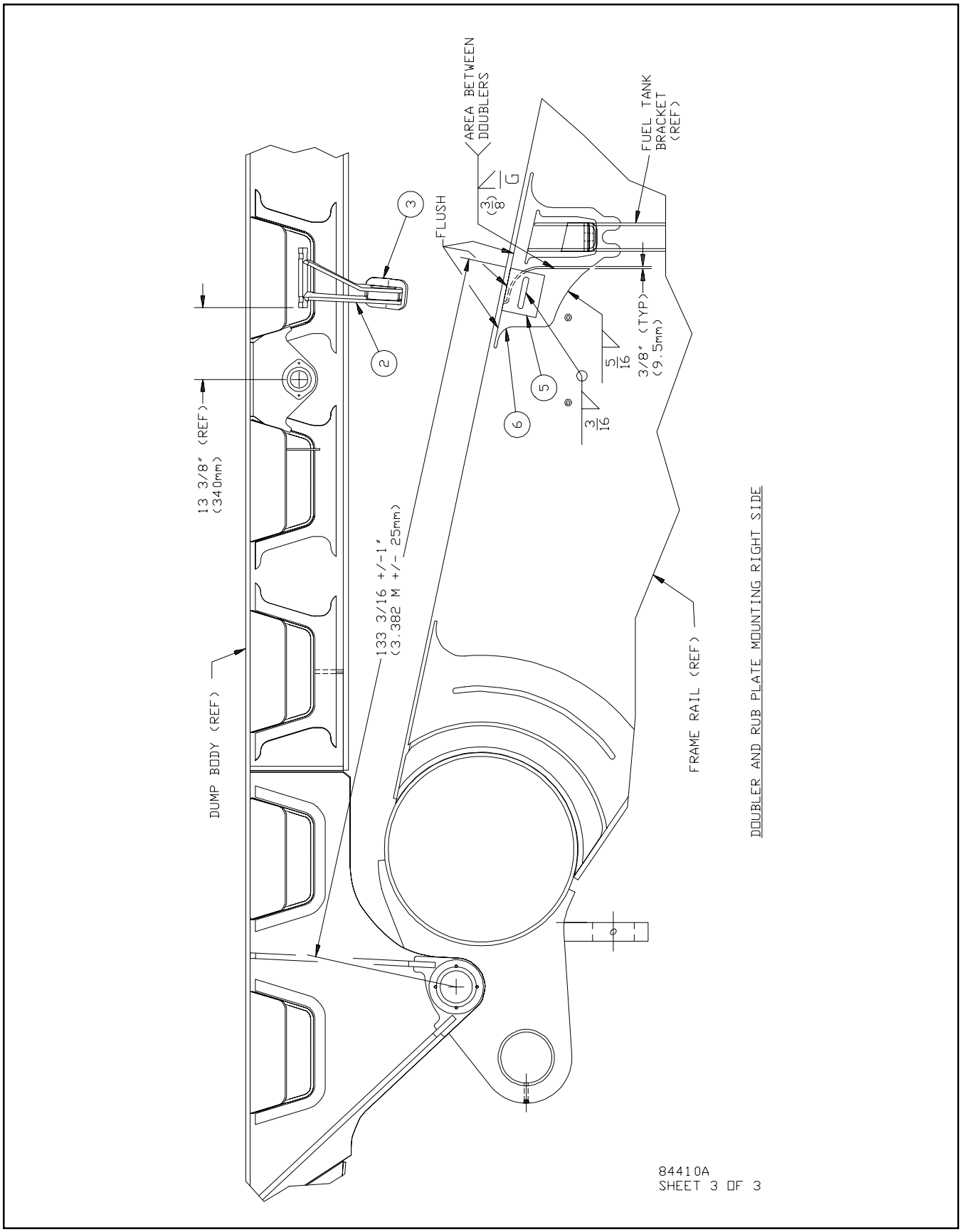


FIGURE 4 - DUMP BODY GUIDE SHIMMING (CONTINUED)

5. Examine the condition and relative thicknesses of the two guides (3) and rub plates (4 and 5). If damaged or worn severely, the appropriate components should be replaced.

NOTES:
Excessive wear on one or both of the dump body guide assemblies may indicate excessive wear in other areas (e.g. pivot pins and/or bushings) or improper operating practices. These should be reviewed and corrected to minimize dump body guide wear.

6. Remove the welds securing the dump body guides in place on the bracket assembly. Grind them off of both the bracket and the guide assemblies.

7. Install both of the dump body guides (3) with the 1/8 inch (3 mm) clearance to their respective rub plates (4 and 5) shown in Figure 4 and weld securely in place.

8. Raise and lower the body a minimum of 3 additional cycles, then recheck the guide clearances. Readjust as necessary.

REMOVAL

The dump body may be removed from the truck as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Fully lower the dump body until it is resting on the frame. Place the Dump Control lever in the Float position.

3. Remove each "rock knocker" as follows:

a. Remove the locking pin.

b. Secure in place with a means suitable to allow lowering to the ground.

c. Remove the pivot pin on each side.

d. Remove the unit.

4. Raise the dump body slightly and securely block with dump body slightly above the frame rails. Once secure, move the Dump Control lever to the Float position to ensure that no pressure is entrapped in either cylinder.

5. Secure the dump cylinders in place with chains or other suitable means to prevent their movement when the dump body is lifted.

6. Remove the retaining or keeper bolts, and the dump cylinder pins securing the dump cylinders to the dump body.

7. Secure the dump body for lifting. Two holes (one on each of the upper runners) are provided as lifting points. When lifted at these points, the dump body should be in a position with the front end slightly higher than the rear.

IMPORTANT: *A special clevis lifting fixture is available for lifting the body. If slings are used, extra care must be taken, since a relatively flat sling multiplies the load factor, and decreases its effective load rating. Also, it is recommended that spreader bars be used between the upper rails and the sling legs to reduce the possibility of damaging the sides.*

8. Remove the pivot pin "keeper" bolts or strap assemblies and other retainers.

9. Remove the pivot pins.

10. Lift the dump body slightly to remove the load on the rear hinge pins. Be careful to ensure that the dump cylinders separate from the body cleanly, do not move, and remain securely fastened.

IMPORTANT: *Do not allow the cylinders to rotate in either direction as this may cause excessive twisting in the hoses.*

11. Lift the body clear of the truck and set on the ground as required. Tag or guide lines are recommended for guiding the structure.

SERVICE

For replacement of liners and repair of damage, refer to specific instructions on the details of the unit available from your mine personnel or BUCYRUS® representatives.

The pin bushings may be installed as follows:

1. Press/cut out the old bushing.

2. Remove all burrs or nicks from the ID of the tube.

3. Verify that the ID and OD of the new bushing is free of damage.

4. Measure both the ID of the outer bore and OD of the bushing. If an interference fit, it may prove helpful to

cool the bushing (typically in dry ice) and/or heat the bore prior to assembly.

5. Use an adequate press to install the new bushing.

INSTALLATION

The dump body may be installed as follows:

1. Verify the following:

a. The dump cylinders are fully retracted and secured in a position relatively close to their normal operating position.

b. The dump body is of the proper size and construction for the truck, and all repairs are complete.

2. Secure the dump body for lifting. Refer to the Removal instructions for details.

3. Slowly lift the dump body above the ground. Normally the front of the dump body will be slightly higher than the rear. This is the preferred position for installing the dump body.

4. Using a crane and guide lines, direct the dump body over the frame so that the hinge assembly aligns with the bushing in the frame.

NOTE: *When lowering the dump body, verify that the canopy or "headache rack" does not come in contact with the cab or other superstructure mounted components.*

5. Insert the pivot pins from the end opposite the anti-rotation stop. Verify that the pin is installed such that the longer portion protrudes under the stop to cause the pin to rotate with the body only.

6. Raise the dump body slightly and align the body and dump cylinders.

7. Lower the body and install the upper dump cylinder attachment pins.

NOTE: *With the Dump Control lever in the Float position, the dump cylinders can be moved in and out relatively easily to align the holes.*

8. Install the "keeper" or retention bolts on all four pins (Figure 3).

a. Where bolts are used as "keepers" self locking nuts (in good condition) should be used. If self locking nuts are not used, secure the nuts by:

(1) Locking with an additional nut - double nut, or

(2) Tack welding the nut on the bolt, or

(3) With a cotter pin.

b. Where straps or brackets are used, install with capscrews and lockwashers.

9. Shim the dump body pads and guides as directed in Maintenance and Adjustment.

10. Move the dump body through several complete cycles to ensure that it operates properly.

11. Reinstall any mudguards or other items removed with the previous body.

12. Check the operation the Dump Body Up Switch and adjust as required to obtain the desired operation.

ELECTRICAL SYSTEM

DESCRIPTION

Each truck has two electrical systems:

1. A 24 Vdc control system to power various system functions including control of the propulsion and retarding systems.

2. A high voltage ac drive system that serves as the propulsion and retarding system.

OPERATION

The 24 Vdc system provides the energy required to operate many of the systems that operate the truck including the engine, electrical propulsion, lights, system monitoring, and other related systems.

This system is maintained by 12 Vdc batteries connected in pairs in series with each other. On trucks with the standard electric start system, 3 or more pairs of batteries are used. On trucks equipped with optional pneumatic start, this may be reduced to a single pair.

The power for the system and to maintain the charge in the batteries is provided by an engine mounted 24 Vdc battery charging alternator. An internal voltage regulator controls its operation, keeping the batteries at their maximum state of charge.

To aid in maintenance of the system, the schematics for this system are included at the end of this module.

The high voltage propulsion system provides the power to propel the truck. The directly coupled, engine driven traction alternator provides the electrical energy that is routed to the wheelmotors in each of the rear dual tire and rim assemblies. These motors convert the electrical energy to mechanical power to propel the truck. A computer based control system monitors the operation and controls the operation of the truck's engine and traction alternator to provide efficient operation of the system.

The high voltage system also provides an operation mode called dynamic retarding. This system is used to slow the truck and control its speed on downgrades. During dynamic retarding, the truck's kinetic energy (force that keeps the truck moving) is converted by the wheelmotors (functioning as generators) into electrical energy. This energy is then dissipated to the atmosphere through air-cooled grids. The energy conversion controls the wheelmotor speed. This system also controls the system's computer.

SERVICE

⚠WARNING

Turn the Master Switch and any extra battery disconnect switch Off at all times that servicing is being done on any components in the electrical system (both 24 Vdc and high voltage).

For complete operation and service details, refer to the appropriate manufacturer's service manuals.

AIR CLEANERS

DESCRIPTION AND LOCATION (Figure 1)

The standard air cleaners are rectangular boxes mounted at the front of the superstructure just below the bottom panels on one or both sides of the engine.

The optional rock guards are steel plates mounted above the air cleaners designed to deflect falling rocks and debris.

The optional vacuator valves are special rubber components attached to the specially modified dust cups on the bottom of the air cleaner.

OPERATION (Figure 1)

The air cleaner supplies clean, filtered air to the engine. As the engine runs, its demand for air creates a vacuum in the intake assembly and causes air to be drawn into the air inlet on the cleaner assembly. Air from the inlet is drawn through a series of tubes inside of the lower or tube body assembly (6) that are designed to create a cyclone action and separate out foreign material. As air passes downward in the outer portion of the tubes, it goes into a circular motion. At the bottom of the outer tubes, the air enters the lower plenum chamber, then is immediately pulled upward through the inner portion of the tubes. The swirling motion and abrupt change in direction causes much of the heavier dust and debris in the air to be removed and deposited in the dust cap for later disposal. Approximately 80 to 90% of the contamination is removed from the inlet air in this manner.

The pre-cleaned air is then drawn through the primary or outer main (15) filter element. The filtering material in the element collects the remaining contamination and absorbs it for future removal. Finally the air is drawn through the inner secondary or safety element (22), which is designed to serve both as a final filter and a reserve, in case of primary element failure. Clean air flows through the outlet flange (2) from the center of the safety elements, through the ducting to the inlet of the engine (usually the turbocharger inlet).

Normally the restriction in the air system (read as vacuum developed through the system) is monitored by indicators or gauges connected at taps on the engine inlet pipes between the air cleaner and the inlets to the engine (turbochargers).

The optional vacuator valves provide a means of periodically “ejecting” some of the material separated out of the air stream by the pre-cleaner assembly. During normal “power” operation, the vacuum in the system causes the valve sides to contract and seal. When changes in engine speed and power cause the vacuum levels to vary, the resulting pressure pulse causes a short term separation of the walls, rejection of material contained in the bowl, and then allows the valve to reset. Also the valve provides a second means of periodically removing loose material in the bowl without requiring normal bowl opening.

NOTE: *Special bowls, without provisions for pivoting to dump and with special mounting brackets for support, are required to accommodate the use of these valves.*

MAINTENANCE AND ADJUSTMENT

NOTE: *To prevent dust entering the engine, always turn off the engine prior to servicing any air intake components. Take precautions to prevent any dust or contamination from entering the system while working on it.*

Periodic maintenance of the air cleaner should include the following steps:

1. Check and empty each dust collector cup at least daily (more often in dusty operating conditions). The level of the dust should not be allowed to come too close (within 1 inch (25 mm)) to the pre-cleaner (Dynaclone) tube chambers.

a. On units with the vacuator valves, squeeze each of the valves to check operation and to allow debris to escape. This may take several repetitions.

b. Inspect the valve for evidence of clogging or damage. Clean or replace as required.

2. Inspect all air inlets for damage or obstruction. Verify that the air tap port on each outlet flange is properly plugged if not used.

3. Inspect all piping and connections for damage or leaks. Verify that all seals are tight.

4. Verify that the nuts securing the element are tight and that the elements and seals are not leaking.

5. Verify that the restriction gauges or indicators in the cab operate properly.

NOTE: *The Air Cleaner Restriction indicator is used only to indicate the service requirements of the air cleaner element (and other intake components). Under normal operating conditions, the green band is exposed in the indicator. Should the filter elements become significantly plugged or restricted, a red band will appear and remain in place until the element is serviced and the indicator is reset.*

The Air Cleaner Restriction gauge indicates the amount of restriction in the air cleaner and induction system in inches of water. Normally, the air cleaner elements should be serviced if the indicated restriction exceeds:

IMPORTANT: *This pressure is measured at rated horsepower and speed.*

12 inches of water (3.0 kPa) on MTU engine equipped units.

20 inches of water (5.0 kPa) on Detroit Diesel engine equipped units.

25 inches of water (6.2 kPa) on Cummins engine equipped units.

IMPORTANT: *If one or more gauges indicate unusually low readings, it may indicate a leak in the air induction system. Check the system before continuing operation of the vehicle.*

When need of service is indicated, the elements may be changed as follows:

NOTE: *The air cleaner assembly need not be removed from the vehicle to change elements.*

1. Remove the primary filter element as follows:

a. Park the vehicle in a SAFE POSITION. It must be secured by means other than the friction brake system.

b. Turn the engine off.

c. Clean all dirt, dust, and debris from the element cover and air cleaner assembly.

d. Remove the wing nut, washer, and gasket.

e. Remove the primary or outer element from the assembly.

NOTE: *Do not remove a filter for inspection as this will do more harm than good.*

(1) Gently move the end of the filter back and forth to effectively break the seal formed between the filter and the outer tube.

(2) Be careful not to allow entrapped material to fall from the element or damage the element in any way.

NOTE: *To prevent dust from entering the air cleaner, the safety element should not be removed while servicing the primary element. If the element is not immediately being replaced, cover the opening until the replacement is made.*

(3) Never “tap” a filter to clean it as this may damage the filter and the seals.

NOTE: *Deeply embedded dirt is not released by tapping. It is always safer to keep operating until a new filter can be installed.*

f. Using a clean cloth, wipe the filter sealing surface and the inside of the outlet tube.

NOTE: *Contaminant on the sealing surface could hinder an effective seal and allow leakage. Be careful not to damage the sealing area on the tube.*

g. Inspect and service the element as required.

NOTE: *A streak of dust on the clean side of the filter may be a tell-tale sign of leakage and should be found and corrected before replacing with new elements.*

h. Repeat steps a through d for the other primary element.

2. If the secondary or inner safety element requires changing, it may be removed as follows:

NOTE: *This element should be changed on a regularly schedule basis or only if damaged, dirty, or when the safety element service indicator dot is red, indicating a large restriction in the element. This indicator serves as a locking nut that secures the inner element. Normal recommendation is replace every third time the primary element is changed.*

a. Remove the cotter pin and safety element service indicator from the inner element assembly.

b. Remove the cover, safety element, and gasket.

c. Remove all dust and contamination lodged in the cleaner assembly, ducts, and sealing surfaces. Use extra care to ensure that no contamination enters the clean air chamber or inlet tubes in the air induction system.

d. Replace the element as soon as possible to minimize the possibility of contamination entering the system. If the element is not being replaced immediately, carefully seal the unit to prevent the contamination of the interior surfaces.

NOTES:

1. The function of the secondary or safety element is to increase the air cleaning system's overall reliability and effectiveness. In order to maximize reliability and system effectiveness, the safety element should not be cleaned. If the safety element becomes restricted, it should be discarded and replaced.

2. It is typically recommended that the safety element be changed every third time the primary element is changed.

⚠ CAUTION

Never use an air cleaner without both filter elements installed and in good condition.

3. If the safety (inner) element has been removed, it may be installed as follows:

a. Prior to installation:

(1) Inspect the new filter carefully, paying attention to the inside of the open end which is the sealing area.

NOTES:

1. Never install a damaged, dented or bunched filter.
2. New filters may have a dry lubricant on the seal to aid in installation.

(2) Inspect all gaskets and surfaces to be clean and free of damage. Replace if required.

NOTE: *Replace any cover gaskets, making sure that no piece of the old gasket remains in the housing and the gasket is not worn.*

b. Insert the new filter element carefully. Seat the filter by hand; making certain that it is completely seated into the housing.

NOTES:

1. The critical sealing area will stretch slightly, adjust itself, and distribute the sealing pressure evenly.
2. To complete a tight seal, apply pressure by hand to the outer rim of the filter, not the flexible center.
3. Never use the service cover to push the filter into place as this could cause damage to the housing and leaks.

c. Install the gasket, washer, and safety element indicator or locking nut. Be sure a good seal is formed at all points.

⚠ CAUTION

Proper seal of these gaskets is very important. If these gaskets are damaged or show signs of leakage, they must be replaced.

NOTE: *If the cover contacts the filter before it is fully in place, remove the cover and push the filter (by hand) further into the air cleaner. The cover should go on with no extra force.*

d. Reset service indicators or gauges (if the truck is so equipped).

e. Check all connections and system components for damage or leakage.

NOTE: *The Dynaclone or pre-cleaner tube may also be cleaned. For detailed instructions on cleaning, refer to the instructions in Inspection and Repair.*

4. Install the primary filter elements as follows:

a. Prior to installation:

(1) Inspect the new filter carefully, paying attention to the inside of the open end which is the sealing area.

NOTES:

1. Never install a damaged, dented or bunched filter.
2. New filters may have a dry lubricant on the seal to aid in installation.

(2) Inspect all gaskets and surfaces to be clean and free of damage. Replace if required.

NOTE: *Replace any cover gaskets, making sure that no piece of the old gasket remains in the housing and the gasket is not worn.*

b. Insert the new filter element carefully. Seat the filter by hand; making certain that it is completely seated into the housing.

NOTES:
1. The critical sealing area will stretch slightly, adjust itself, and distribute the sealing pressure evenly.
2. To complete a tight seal, apply pressure by hand to the outer rim of the filter, not the flexible center.
3. Never use the service cover to push the filter into place as this could cause damage to the housing and leaks.

c. Install the gasket, washer, and wing nut over the cover. Be sure a good seal is formed at all points.

⚠ CAUTION

Proper seal of these gaskets is very important. If these gaskets are damaged or show signs of leakage, they must be replaced.

NOTE: *If the cover contacts the filter before it is fully in place, remove the cover and push the filter (by hand) further into the air cleaner. The cover should go on with no extra force.*

d. Reset service indicators or gauges (if the truck is so equipped).

e. Check all connections and system components for damage or leakage.

NOTE: *The Dynaclone or pre-cleaner tube may also be cleaned. For detailed instructions on cleaning, refer to the instructions in Inspection and Repair.*

REMOVAL

NOTE: *The air cleaner assembly need not be removed from the truck to perform maintenance in the form of element changing or tube cleaning.*

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction brake system.

2. Disconnect the intake piping from the air cleaner assembly. Seal the air cleaner assembly and intake pipes to prevent dust from entering.

3. Support the air cleaner assembly by cable or suitable device. Be sure the cables cannot damage the assembly during removal.

4. Remove the bolts that secure the assembly to the rear braces.

5. Remove the bolts that secure the assembly to the superstructure.

6. Lower to ground level. Be careful during handling not to damage any components.

DISASSEMBLY

The pre-cleaning section may be removed from the filter assembly as follows:

1. Open and empty each of the dust caps on the assembly.

2. Remove the capscrews securing the filtration and the pre-cleaning sections.

3. Separate the sections.

INSPECTION AND REPAIR

The unit may be serviced as follows:

1. Clean all metal components with clean solvent and wipe dry. Inspect for evidence of damage or leakage. Repair or replace as required.

2. Inspect all gaskets, seals and vacuator valves (if so equipped) for evidence of wear, leakage, or damage. Repair or replace as required.

3. Inspect the elements as outlined in Maintenance and Adjustment. Replace as required.

4. Inspect the pre-cleaner tubing. Replace if damaged. If cleaning is required, proceed as follows:

NOTES:
1. The tube should be thoroughly cleaned yearly or at least every engine overhaul period. More frequent cleaning may be required if contaminated by oil or sludge caused by a broken oil line, etc.
2. Never steam clean the tubes.

a. Light dust plugging of the tubes can be removed with a stiff fiber brush, then blown with compressed air from the bottom and/or the inlet area.

⚠ DANGER

Do not use a wire brush. Both the primary and safety elements should always be installed when cleaning the tubes. This prevents dirt from entering the clean air chamber.

b. Heavy plugging may require washing as follows:

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Dirt entering engine	Leaks in intake ducting or air cleaner housing	Inspect, repair, or replace as required.
	Filtration elements not properly sealing	
	Holes in filtration elements	
Filter elements require constant changing	Dirty or dusty environment	Reduce the contamination in the operating environment.
	Precleaning (Dynadone) tubes not functioning properly	Inspect, clean, repair or replace as required.
	Elements are holding air due to moisture, oil or carbon build-up, etc.	
Low engine power (usually accompanied by black smoke)	Filtration elements are contaminated causing restriction	Inspect and service elements as required.
	Restriction in intake ducting	Inspect, repair or replace as required.

(1) Submerge the tube section in a solution, e.g., Donaldson D-1400, and warm water - 150° F (66° C) maximum.

(2) Soak for 30 minutes, then agitate for an additional 15 minutes.

(3) Rinse clean with clear water and dry thoroughly.

(4) If plugging is severe, use a solution of Oakite 202 (50% Oakite and 50% water) and follow steps 2 and 3.

ASSEMBLY

The pre-cleaner assembly may be installed onto the filtration assembly as follows:

IMPORTANT: *Due to the potential problems of air leaks, it is recommended that new gaskets be used each time any portion of the air cleaner is disassembled or serviced.*

1. Inspect the gasket between the assemblies. Replace if damaged or worn.

2. Align the bolt holes on the two sections.

3. Install the capscrews. Tighten sequentially in even increments to form a good seal between the assemblies, and torque to final values as required.

4. Install the dust cup assemblies if removed. Be sure all seals are in good condition.

5. Install any rain shield removed.

INSTALLATION

NOTE: *Prior to installation, verify that the air cleaner assembly and supply ducting are free of damage and that all seals are in good condition.*

1. Raise the assembly to position and install the mounting bolts.

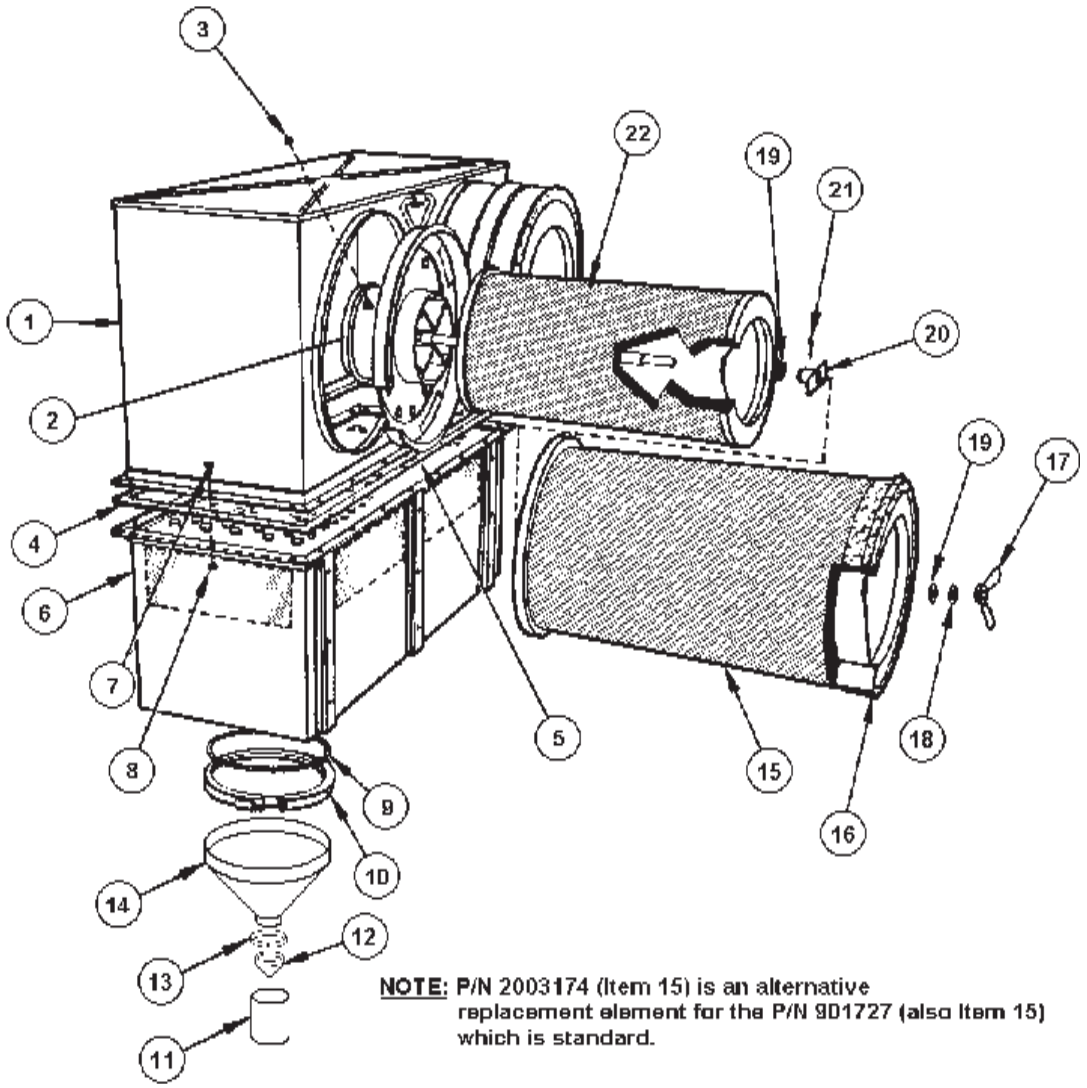
2. Install the rear braces and capscrews.

3. Connect the intake piping to the engine, air compressor service indicators, etc.

4. Inspect the entire system for leaks or damage.

5. Reset the air cleaner service indicators.

6. Start the truck engine and check again for leaks. This may be done with a solution of soapy water, or other equivalent means.



KEY 55396

01.	Filter Element Body Assembly	12.	Vacuator Valve (Optional)
02.	Outlet Flange Assembly	13.	Clamp Assembly
03.	Restriction Adapter	14.	Dust Cup (special version for vacuator valves)
04.	Gasket	15.	Primary Element Assembly
05.	Gasket	16.	Gasket
06.	Tube Body Assembly	17.	Wing Nut
07.	Bolt	18.	Clip
08.	Flange Nut	19.	Gasket Washer
09.	O-ring	20.	Safety Element Indicator (or nut)
10.	Bowl Clamp Assembly	21.	Cotter Pin
11.	Protective Tube (With item 12)	22.	Secondary Element Assembly

FIGURE 1 – TYPICAL DONALDSON SRG AIR CLEANER

ENGINE MODULE

DESCRIPTION AND LOCATION (Figure 1)

The engine module consists of the following:

1. Diesel engine.

2. Main traction alternator with in-line electrical equipment cooling blower assembly.

3. Radiator (may be mounted separately).

4. 24 Vdc battery charging alternator.

NOTE: *On some trucks, the engine skid assembly is omitted and the engine/alternator and radiator are mounted directly to the frame. With these exceptions, the information contained in this module remains the same.*

The engine module is mounted to the front portion of the main frame. Rubber insulation pads are mounted between the main frame and sub-frame to reduce vibration.

OPERATION

The engine module provides power for a variety of functions. The diesel engine provides power to turn the main traction alternator. The alternator, in turn, supplies power to the electric wheelmotors. The engine module also drives the truck's hydraulic pumps, battery charging alternator, and air compressor.

TROUBLESHOOTING

Refer to the appropriate manufacturer's information for detailed troubleshooting.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Clean the engine module assembly.

2. Check the condition of all components, including checking for leaks or other damage.

3. Verify that all mounting hardware is secure.

4. Check the condition of the rubber isolation mounting pads.

5. Test the power package for proper operation and power levels.

REMOVAL (Figure 1)

The complete engine module may be removed from the truck as follows:

NOTE: *It is recommended that the engine module be removed with the alternator and radiator assembly attached.*

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Drain all pressure from the pneumatic, hydraulic, fuel, and cooling systems.

3. If the truck is equipped with a separate cooling system module, remove the module assembly as outlined in Section 4 - Power Package.

4. Remove the hood and grille assemblies as outlined in Section 2 - Structure.

5. Disconnect all fluid lines between the engine and other areas at the terminal assembly on the engine skid.

6. Disconnect the main electrical lines from the alternator.

7. Remove the blower ducting as required as outlined in Section 4 - Power Package.

8. Disconnect the air intake and exhaust ducting from the engine. Cover all openings to prevent contamination.

9. Remove all other lines and hoses coupled to the module.

10. Uncouple the driveshaft between the alternator and the hydraulic pump as outlined in Section 5 - Hydraulic System.

11. Remove the module from truck as follows:

NOTE: *It is recommended that a lifting device built specifically for the type of engine and truck involved (like those available from BUCYRUS®) be used. The use of a come-along is recommended during removal and instal-*

lation, as it allows the engine to be tilted front-to-rear.

a. Use an overhead crane or other suitable hoist with sufficient lifting capacity, and position the engine module lifting beam over the engine module. Attach the rear cables to the alternator support brackets, and the front lifting hooks to the appropriate engine or engine skid brackets.

b. Insert a come-along with a sufficient lifting capacity between the front lifting hook and the main lifting lug area.

c. Remove the mounting bolts that secure the module to the truck frame.

d. Carefully raise and remove the engine module. Use the come-along to tilt the module as required.

12. Place the engine module on suitable stands, or block it to ensure safe conditions for future work or storage.

⚠WARNING

Before beginning any work on the engine module, ensure that it is supported on suitable stands or blocking. Failure to do so may result in personal injury, equipment damage, or both.

DISASSEMBLY

The alternator may be removed from the engine as follows:

1. Install a gear adapter for engine barring into the starter access opening.

NOTE: *If the same engine and alternator are to be reassembled, mark the position of the coupling on the flywheel, and reinstall with the same "clocking".*

2. If so equipped, remove the mounting brackets secured to both the engine and alternator.

3. Use the gear adapter and a ratchet to rotate the engine crankshaft. Remove the capscrews that attach the armature to the flywheel. Access to the capscrew is gained through the starter access opening.

4. Remove the bolts from each bracket, and remove the motor support brackets.

5. Using suitable adapters and a sling, support the alternator with a crane.

6. Remove the bolts and nuts that attach the alternator to the flywheel housing adapter.

7. Remove the alternator by moving it rearward, then lifting it clear of the engine.

NOTE: *The shims removed should be retained with the alternator. Before installation, however, it is recommended that the entire shimming procedure be followed*

KEY			A84530
01.	Engine	21.	Lockwasher
02.	Main Traction Alternator	22.	Capscrew
03.	Engine Mounting Skid	23.	Not Used
04.	Left Engine/Alternator Support	24.	Not Used
05.	Right Engine/Alternator Support	25.	Not Used
06.	Mud Guard	26.	Not Used
07.	Flywheel/Rotor Shim (2 pieces make 1 part)	27.	Socket Head Capscrew
08.	Flywheel/Rotor Shim (2 pieces make 1 part)	28.	Engine Mounting Pad
09.	Flywheel/Rotor Shim (2 pieces make 1 part)	29.	Washer
10.	Flywheel/Rotor Shim (2 pieces make 1 part)	30.	Mounting Plate
11.	Flywheel/Rotor Shim (2 pieces make 1 part)	31.	Locknut
12.	Engine Housing/Alternator Shim (4 pieces make 1 part)	32.	Capscrew
13.	Engine Housing/Alternator Shim (4 pieces make 1 part)	33.	Capscrew
14.	Engine Housing/Alternator Shim (4 pieces make 1 part)	34.	Not Used
15.	Special Grade 8 Capscrew	35.	Radiator Fan
16.	Special Washer	36.	Capscrew
17.	Capscrew	37.	Lockwasher
18.	Lockwasher	38.	Fan Spacer
19.	Lockwasher	39.	Fan Spacer
20.	Capscrew		

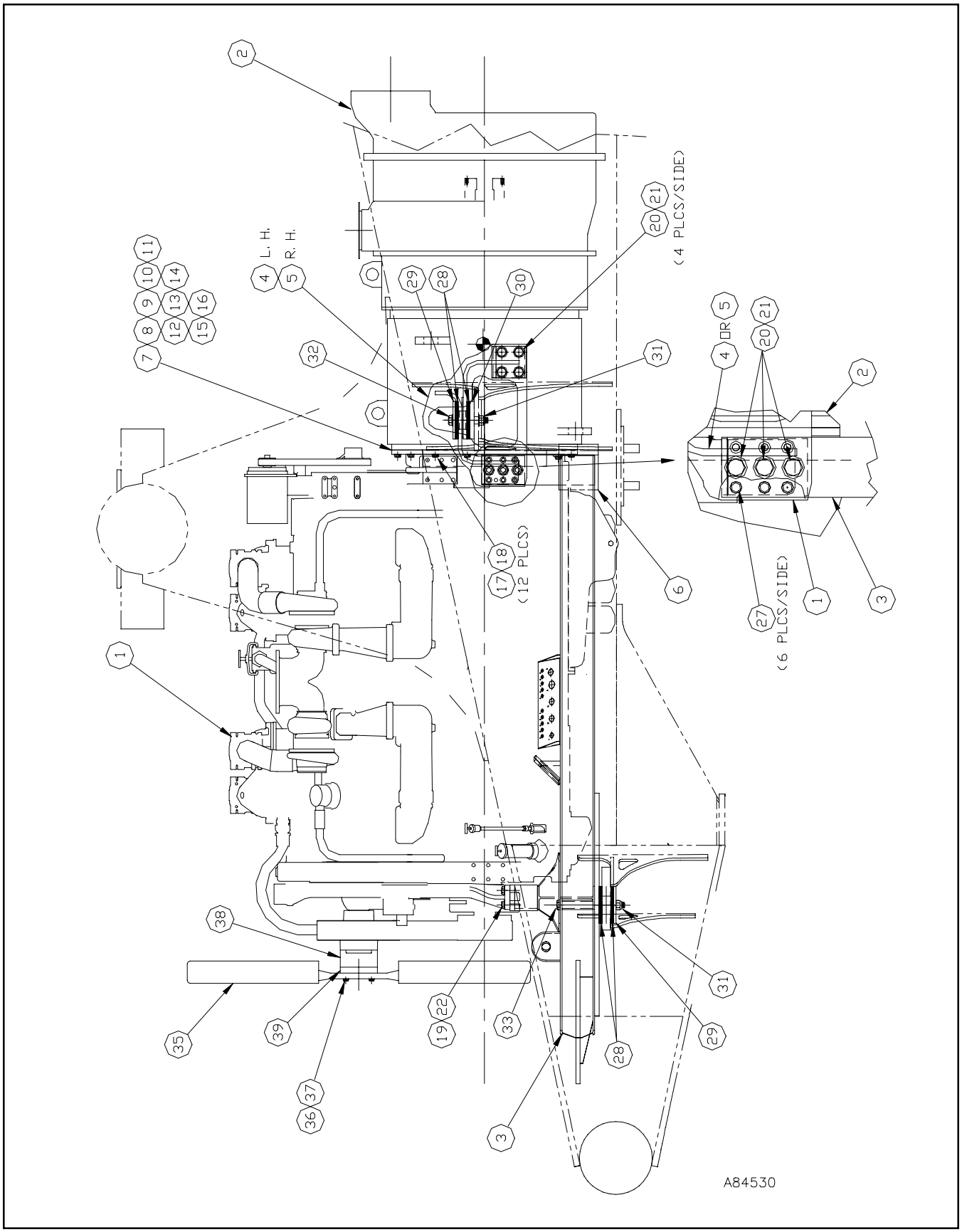


FIGURE 1 - TYPICAL ENGINE MODULE ASSEMBLY

for mounting the alternator on the engine, even if it is the same engine and alternator. This will ensure that the proper clearances are maintained.

ASSEMBLY

The alternator may be installed on the engine as follows:

NOTE: *Special equipment and tools required to assist in assembly including:*
1. Dial indicator with a variety of mounting feet.
2. Mounting fixtures to allow the indicator to rotate with and also measure dimensions on the flywheel.
3. An engine barring tool and related equipment to allow the engine crankshaft to be easily rotated slowly while taking measurements.
4. A special gauge bar assembly (manufactured by Unit Rig) should be used to assist in obtaining certain measurements. Because of special requirements on MTU/DDC Series 4000 engines, two gauge bars are required, one for the engine and the other for the alternator measurements.
5. A 2 to 3 inch (50 to 75 mm) depth micrometer to use in conjunction with the gauge bar in acquiring the needed measurements.

It is also recommended that a worksheet of important measurements be maintained during assembly for possible future reference. An example worksheet is shown in Table 1.

1. Install the gear adapter for engine barring into starter opening on either side of engine.

2. Clean all protective coating, dirt, etc., from the flywheel assembly and flywheel housing adapter. Smooth any nicks, burrs, gouges, etc. from mounting surfaces or pilots.

3. Check the crankshaft endplay as follows:

a. Remove the crankshaft access cover.

b. Install a dial indicator on the flywheel or on the crankshaft vibration damper, so that it will measure the total fore and aft movement of the crankshaft.

c. Loosen all belts on the engine.

d. Mark the initial point of measurement on the flywheel or vibration damper.

e. Rotate the engine crankshaft one complete revolution clockwise as viewed from the rear while prying the crankshaft forward.

IMPORTANT: *Never pry on the crankshaft vibration damper; pry only on the crankshaft through the open access cover. Take care not to damage the crankshaft or other engine components while prying.*

f. Set the dial indicator at zero (pry bar relaxed) and rotate the engine crankshaft one complete revolution counterclockwise (as viewed from the rear) while prying the crankshaft rearward.

NOTE: *To get a true dial indicator reading, one full rotation of the crankshaft is required to cancel out any axial run-out. Clockwise rotation should cause the crankshaft to move forward; counterclockwise rotation should cause it to move to the rear. All references to direction are as viewed from the flywheel.*

g. Record the measurement on the dial indicator.

h. Without touching the dial indicator, rotate the engine crankshaft one complete revolution clockwise while prying the crankshaft forward. If the dial indicator does not return to zero, repeat this step.

i. Repeat this procedure several times to check the measurements.

j. Check the allowable end clearances from Table 2. If within tolerance, proceed. If not, determine the cause and correct.

4. Clean all protective coating, dirt, etc., from the flywheel assembly and flywheel housing adapter. Smooth any nicks, burrs, gouges, etc. from mounting surfaces or pilots.

5. Measure the flywheel pilot (radial) run-out as follows:

a. Move the crankshaft so that it is at the forward end of its endplay.

b. Install the dial indicator so that it will measure the flywheel pilot run-out (base on the flywheel housing adapter, indicator on flywheel), measuring the radial run-out of the self-contained pilot ring.

c. Zero the indicator and mark the starting position. Rotate the crankshaft clockwise one complete revolution.

NOTE: *When the crankshaft is rotated one complete revolution, the dial indicator must return to zero. If it does not, either the crankshaft has shifted or the dial*

I. ENGINE MEASUREMENTS

A. Crankshaft end clearance _____inch (mm)

B. Flywheel pilot radial runout _____inch (mm) (TIR--Total Indicated Runout)

C. Flywheel housing adapter axial (face) _____inch (mm) (TIR)

D. Flywheel housing adapter concentric (centered) runout_____inch (mm) (TIR)

II. SHIM REQUIREMENT MEASUREMENTS

A. Engine (flywheel) measurement (Crankshaft to rear of endplay)

1	_____	inch (mm)
2	_____	
3	_____	
4	_____	
Total	_____	inch (mm)

Average engine measurement "A" (Divide above total by 4 and add 1/2 of the crankshaft end clearance) A = _____ inch (mm)

B. Alternator measurements

1. With armature at rear (bottom)

1	_____	inch (mm)
2	_____	
3	_____	
4	_____	

2. With armature at front (lifted)

1	_____	
2	_____	
3	_____	
4	_____	
Total	_____	inch (mm)

Average alternator measurement "B" (Divide total above by 8) B = _____ inch (mm)

III. SHIM REQUIREMENTS

A. If dimension "B" is greater than "A", the shims are required between the flywheel housing adapter and the alternator housing.

B. If dimension "A" is greater than "B", the shims are required between the flywheel (coupler) and the armature.

C. The shim thickness to be installed is equal to the difference between the two dimensions--a tolerance of 0.005 inch (1.3 mm) is the maximum allowed.

Shims Required _____ inch (mm)

Where Located _____

IV. FINAL CHECK

A. Crankshaft end clearance _____inch (mm)

B. Armature end clearance _____inch (mm)

12708

TABLE - 1 - ENGINE/ALTERNATOR SHIMMING WORKSHEET

ALLOWABLE CRANKSHAFT CLEARANCES						
ENGINE	**MINIMUM CLEARANCE (NEW ENGINE)**		**MAXIMUM CLEARANCE (NEW ENGINE)**		**DO NOT OPERATE IF CLEARANCE EXCEEDS**	
DDC						
12V-149	0.004 inch	(0.10 mm)	0.014 inch	(0.35 mm)	0.018 inch	(0.45 mm)
16V-149	0.004 inch	(0.10 mm)	0.014 inch	(0.35 mm)	0.020 inch	(0.50 mm)
20V-149	0.007 inch	(0.17 mm)	0.016 inch	(0.40 mm)	0.020 inch	(0.50 mm)
16V-2000	0.005 inch	(0.13 mm)	0.016 inch	(0.40 mm)	----------	----------
12V-4000	0.010 inch	(0.25 mm)	0.022 inch	(0.57 mm)	----------	----------
16V-4000	0.010 inch	(0.25 mm)	0.022 inch	(0.57 mm)	----------	----------
CUMMINS						
KT/KTA 38	0.005 inch	(0.13 mm)	0.015 inch	(0.38 mm)	0.020 inch	(0.50 mm)
QSK 45	0.005 inch	(0.13 mm)	0.015 inch	(0.38 mm)	0.020 inch	(0.50 mm)
KTA/KTTA 50	0.005 inch	(0.13 mm)	0.015 inch	(0.38 mm)	0.020 inch	(0.50 mm)
QSK 60	0.005 inch	(0.13 mm)	0.015 inch	(0.38 mm)	0.020 inch	(0.50 mm)

TABLE 2 - ALLOWABLE CRANKSHAFT CLEARANCES 13423

indicator has moved. The run-out measured is useless unless the indicator return to zero. Repeat this step as necessary.

d. Record the measurement and compare with the allowable run-out from Table 3. If within tolerance, proceed. If not, determine the cause and correct.

6. Measure the flywheel housing adapter axial (face) run-out as follows:

a. Move the crankshaft so that it is at the forward end of its endplay.

b. Install the indicator so that it will measure the axial run-out (base on flywheel, indicator on adapter face), but will not be obstructed by bolt holes.

c. Zero the indicator and mark the starting position. Rotate the crankshaft clockwise one complete revolution with the barring mechanism. Observe the maximum indicator readings and record TIR.

Example: +0.005 inch (0.13 mm) and -0.004 inch (0.10 mm) would be 0.009 inch (0.23 mm) TIR.

NOTE: *The indicator must return to zero with one complete revolution. Repeat this step if necessary.*

d. Record the measurement and compare with the allowable run-out from Table 4. If within tolerance, proceed. If not, determine the cause and correct.

7. Measure the flywheel housing adapter concentric (radial) run-out as follows:

a. Move the crankshaft so that it is at the forward end of its endplay.

b. Install the dial indicator so that it will measure the flywheel housing adapter concentricity (base on flywheel, indicator on adapter housing inner surface), but will not be obstructed by bolt holes.

c. Zero the indicator and mark the starting position. Rotate the crankshaft clockwise one complete revolution with the barring mechanism. Observe maximum indicator readings and record TIR.

Example: +0.005 inch (0.13 mm) and -0.004 inch (0.10 mm) would be 0.009 inch (0.23 mm).

NOTE: *The indicator must return to zero with one complete revolution. Repeat this step if necessary.*

d. Record the measurement and compare with the allowable run-out from Table 4. If within tolerance, proceed. If not, determine the cause and correct.

8. After ensuring that all of the engine measurements are within tolerances, measurements for determining the "A" dimension for shimming may be taken as follows:

a. Locate the crankshaft at the extreme rear of its endplay by rotating the crankshaft counterclockwise while prying the rear of the crankshaft.

⚠ CAUTION

Never pry on the engine vibration damper.

b. Using the appropriate special gauge bar (available from BUCYRUS®) and the 2 to 3 inch (50 to 75 mm) depth micrometer, measure the distance between the flywheel housing adapter mounting face and the drive ring mounting face. Record four measurements: at 12, 3, 6 and 9 o'clock.

NOTE: *Because of special requirements on MTU/DDC Series 4000 engines, two gauge bars are required, one for the engine and the other for the alternator measurements.*

c. Average the four measurements, and add to 1/2 of the crankshaft end clearance. Record this dimension as "A". This average measurement is equal to a measurement taken with the crankshaft located at the center of its endplay.

9. Determine the alternator "B" measurements as follows:

MAXIMUM FLYWHEEL RADIAL RUNOUT		
ENGINE	**MAXIMUM ALLOWABLE FLYWHEEL RADIAL RUNOUT**	
DDC		
12V-149	0.011 inch	(0.27 mm)
16V-149	0.011 inch	(0.27 mm)
20V-149	0.011 inch	(0.27 mm)
16V-2000	0.011 inch	(0.27 mm)
12V-4000	0.008 inch	(0.20 mm)
16V-4000	0.008 inch	(0.20 mm)
CUMMINS		
KT/KTA 38	0.08 inch	(0.20 mm)
QSK 45	0.08 inch	(0.20 mm)
KTA/KTTA 50	0.007 inch	(0.17 mm)
QSK 60	0.010 inch	(0.25 mm)

TABLE 3 - MAXIMUM FLYWHEEL RADIAL RUN-OUT 13424

a. Clean all protective coating, dirt, etc., and smooth any nicks, burrs, gouges, etc., from the mounting surfaces or pilots.

b. Using the appropriate sling, place the alternator in a vertical position with the mounting face up. Place a stand or blocks under the alternator of sufficient height to prevent the sheaves, electrical terminals, etc., from touching the floor.

NOTE: *A special stand/jig is used for engines fitted with in-line blowers. With this jig the engine can be moved around in different planes to carryout the measurements accurately for shimming purposes.*

⚠ CAUTION

Balance and lift the alternator high enough to prevent the sheaves, electrical terminals, etc., from hitting the floor. Protect the in-line blower assembly (if so equipped).

MAXIMUM FLYWHEEL HOUSING ADAPTER RUNOUT				
ENGINE	**MINIMUM (FACES) ALLOWABLE AXIAL (NEW ENGINE)**		**MAXIMUM CLEARANCE (INNER SURFACES) (NEW ENGINE)**	
DDC				
12V-149	0.026 inch	(0.66 mm)	0.026 inch	(0.66 mm)
16V-149	0.026 inch	(0.66 mm)	0.026 inch	(0.66 mm)
20V-149	0.026 inch	(0.66 mm)	0.026 inch	(0.66 mm)
16V-2000	0.026 inch	(0.66 mm)	0.026 inch	(0.66 mm)
12V-4000	0.016 inch	(0.40 mm)	0.016 inch	(0.40 mm)
16V-4000	0.016 inch	(0.40 mm)	0.016 inch	(0.40 mm)
CUMMINS				
KT/KTA 38	0.010 inch	(0.25 mm)	0.020 inch	(0.51 mm)
QSK 45	0.010 inch	(0.25 mm)	0.020 inch	(0.51 mm)
KTA/KTTA 50	0.010 inch	(0.25 mm)	0.020 inch	(0.51 mm)
QSK 60 (U.R. Alt.)	0.012 inch	(0.30 mm)	0.010 inch	(0.25 mm)
QSK 60 (G.E. Alt.)	0.010 inch	(0.25 mm)	0.010 inch	(0.25 mm)

TABLE 4 - MAXIMUM FLYWHEEL HOUSING ADAPTER RUN-OUT 13425

c. Shim the front of the armature to the approximate center of the housing by using equal shims between the armature and housing.

⚠ CAUTION

Care must be taken to ensure that the shims do not fall into the armature. It is suggested that the shims have tabs on the ends and/or be held in place by tape.

d. Measure and record the distance between the mounting face on the armature and the mounting face on the housing (with the same special gauge bar and depth micrometer specified for the engine) at four places, (12, 3, 6 and 9 o'clock).

NOTE: *Because of special requirements on MTU/DDC Series 4000 engines, two gauge bars are required, one for the engine and the other for the alternator measurements.*

e. Install two eye bolts at 180° intervals in the armature mounting face, and remove the shims between the armature and alternator housing. Attach chains to the eye bolts and lift the armature to the top or forward position. Install the shims between the armature and housing. Do not allow the shims to fall into the alternator.

⚠ DANGER

Do not lift the alternator off the stand as this may damage the bearings. Be sure the armature is at its maximum top (or forward) position, as it is most important that the armature bearing endplay be measured accurately.

f. Measure and record the alternator dimensions outlined in step 7d.

g. Add the four measurements in 7f to those taken in 7d. Calculate the average of these 8 dimensions. This dimension, called “B”, is the equivalent of a measurement with the armature at the center of its endplay.

h. Remove the shims between the armature and alternator housing used to center the armature, and lower the armature into a resting position in the housing.

10. The amount of shims required is the difference between dimensions “A” and “B”.

a. If dimension “B” is greater than dimension “A”, place the shims between the flywheel housing adapter and the alternator housing.

b. If dimension “A” is greater than dimension “B”, place the shims between the flywheel coupling and the alternator armature.

⚠ CAUTION

The shim stack must be measured to verify correct thickness. If tape is used to hold shims in place, it must not be left in during final assembly. Shims installed in the wrong location are worse than no shims, and could cause crankshaft and alternator failure due to axial pre-load.

NOTE: *The smaller shims are one or two piece; the larger shims require four parts to form one shim.*

11. The engine and alternator may be mated as follows:

a. On trucks equipped with the MTU/DDC Series 4000 engine:

(1) Remove the capscrews securing the flywheel housing adapter to the flywheel housing.

(2) Install the flywheel housing adapter to the alternator frame with the appropriate shims in place if required.

b. Rotate the crankshaft to position dowel pins on the flywheel at the 6 and 12 o’clock positions.

c. Rotate the armature to position the dowel pin holes on the armature mounting face at the 6 and 12 o’clock positions.

d. Lift the alternator using a sling, and rotate it to a horizontal position.

⚠ CAUTION

Do not bump sheaves, electrical terminals, etc., on the floor while handling the alternator.

e. Move the alternator close enough to the engine to start at least two capscrews through the adapter and into the alternator. At the same time, rotate the crankshaft to align the dowel pins with the appropriate holes.

NOTES:
1. To ease in installation, the upper capscrews should be inserted into the flywheel housing adapter prior to mating.
2. On trucks equipped with MTU/DDC Series 4000 engines, the capscrews are inserted through to install the flywheel housing adapter to the flywheel housing.

f. If the supports are still in place on the alternator, the bolts should be loose enough to not interfere with the coupling.

g. Look through the access hole in the flywheel housing to ensure the capscrew holes are aligned. Install all capscrews through the adapter and into the alternator housing.

h. Rotate the crankshaft as required to install all capscrews and washers through the flywheel and into the armature.

IMPORTANT: *Use only SAE Grade 8 capscrews or equivalent. Substitution of lower grade capscrews may result in damage to the equipment.*

i. Torque each capscrew progressively in 50 ft-lb. (70 Nm) increments (lubricated) until a final torque of 180 to 190 ft-lb. (245 to 260 Nm) is reached. This procedure also applies to the capscrews on the flywheel/armature and those connecting the housing adapter and the alternator.

j. Install both the right and left engine skid supports.

k. Block the rear end of the alternator housing to help support the alternator and to allow removal of the sling.

12. As a final check to determine if the assembly is properly shimmed:

a. Install a dial indicator to measure end clearance on both the vibration damper and the armature sheave.

b. Rotate the crankshaft clockwise and pry forward.

c. Zero both dial indicators (with the pry bar relaxed) and mark the position of the reading on the damper and sheave.

d. Rotate the crankshaft counterclockwise one full turn while prying rearward as far as possible.

e. Read both indictors (with the pry bar relaxed).

NOTE: *The crankshaft movement should be the same as its original measurement; the armature shaft must have moved, but not necessarily the same amount as the crankshaft.*

f. Re-zero both indicators.

g. Rotate the crankshaft one full turn clockwise while prying forward.

h. Read both indicators (with the pry bar relaxed).

NOTE: *The crankshaft movement should be the same as it was originally and the armature shaft must have some movement, but not necessarily the same as the crankshaft. This indicates no axial pre-load; thus the assembly is properly shimmed.*

13. Install the crankshaft access cover.

14. Install the supports/mounting brackets, if removed.

15. If removed, install the fiberglass alternator blower cover, making sure it is indexed as instructed in the unit's assembly instructions.

16. Verify there is a 1/2 inch (13 mm) diameter drain hole in the 6 o'clock position on the rear section of the blower housing. If not:

a. Determine that the housings are properly oriented.

b. Drill one a hole using care not to:

(1) Contact any internal parts of the alternator assembly.

(2) Damage the fiberglass housing assembly.

INSTALLATION (Figure 1)

The engine module may be installed as follows:

1. Use an overhead crane or other suitable hoist, with sufficient capacity, and position the lifting device over the engine module. Attach the cables to the alternator and the front mount to the front lifting lug on the engine or engine module skid.

2. Install a come-along with sufficient lifting capacity from the front beam to the main lifting hook.

3. Use the come-along to tilt the engine module as required. Carefully place the module into position in the main frame.

IMPORTANT: *Extra care must be taken to avoid damage to all duct work, piping, electrical lines, etc., during installation. If any damage should occur, inspect and repair immediately.*

4. Install the rubber cushioning pads and capscrews. Torque the nuts as required, but do not over compress the isolation mounts.

5. Connect the cooling air ducting to the alternator and axlebox as outlined in Section 4 - Power Package.

⚠ CAUTION

When installing the ducting, make sure that all connections form tight seals, and that all passageways are free of damage. Holes or restrictions will result in reduced cooling air flow and could cause overheating of components.

6. Connect the driveshaft between the alternator and the hydraulic pump as outlined in Section 5 - Hydraulic System.

7. Connect all engine air and exhaust ducting. Check all components and connections for evidence of damage or leakage. A small leak will allow enough contamination to destroy an engine.

8. Connect all electrical, fuel, air, and hydraulic connections.

9. On trucks equipped with a separate cooling system module, install the module as outlined in the instructions in Section 4 - Power Package including the fan drive, and all hosing and wiring previously removed.

10. Install the hood and grille assemblies as outlined in Section 2 - Structure.

11. Verify proper fluid levels. Check the engine and electrical system for leakage and proper operation and power levels prior to placing the truck into service.

EXHAUST ASSEMBLY - DUMP BODY HEATING

DESCRIPTION

The dump body heating exhaust assembly provides a method of routing the hot exhaust gases produced by the engine through portions of the dump body. It consists of the following:

1. Exhaust piping - rigid and flexible tubing sections from the engine turbocharger exhaust outlets to the exhaust boxes.

2. Exhaust box assembly - spring loaded mechanical device mounted on the left side of the truck frame.

3. Exhaust muffler or silencer – special assembly mounted to the right rear of the engine.

OPERATION

Hot exhaust gases from the engine are utilized to warm the panels in the dump body. This assists in preventing the accumulation of moisture and freezing of materials in and to the dump body.

The exhaust gases are routed from the front engine turbocharger to the exhaust box mounted on the truck main frame rail near the front end of the dump body. In normal operation with the dump body lowered, the gases flow through the box and seal assemblies and into the body. There it is routed through the passages until it exits at the rear of the dump body.

When the dump body is raised, the spring loaded moveable portion of the exhaust box extends until it reaches the end of its travel. During this movement the exhaust flow is redirected and allowed to exit downward through an alternate passage. This directs the exhaust noise and gases away from the operator's cab.

When the body is again lowered, the gaskets on the moveable assembly contacts and aligns with the openings in the dump body, reforming the seal. As movement continues, the heated gases are again directed through the exhaust box and dump body.

The exhaust gases from the rear engine turbocharger are routed to the muffler/silencer mounted near the right front fender assembly. The muffler's special construction reduces the overall sound output and directs it away from the operator and the operating equipment.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the system should include the following:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the trucks friction brake system.

2. Stop the engine.

3. Clean the exhaust system and verify that the exhaust piping is not damaged or leaking anywhere.

4. Verify that all mounting hangers are secure.

NOTES:
1. Adjust the position of the exhaust supports (16) and the lengths of rod ends and connectors (17 and 18) so that the exhaust elbows and pipes are supported and do not apply loads into the bellows.
2. Typically the muffler pipe ends (8) are oriented toward the rear of the truck.

5. Verify that all piping connections are clamped securely.

6. Verify that all exhaust blanket assemblies are in place and free of damage. Repair or replace as required.

NOTE: *The blankets should be installed with the seams pointed upward and not aligned with those on adjacent blankets.*

7. Verify that the exhaust box assemblies are free of damage and securely mounted on the frame assembly.

8. Clean the areas near the springs and moveable assemblies so that the movement is free.

9. Test the system as follows:

a. Start the engine and allow to operate at idle speed.

b. Verify that with the dump body fully lowered and the exhaust gases travel through the exhaust piping, muffler, exhaust box and dump body assemblies.

c. Raise the dump body.

d. Verify that as the body rises, the exhaust gases are diverted properly through the exhaust box and out the alternate outlet.

e. Lower the body and recheck the exhaust path.

10. If required to properly seal on the dump body, the exhaust box can be aligned as follows:

⚠ DANGER

Never work under or around the truck unless the dump body is secured in place at all times it is not at rest on the frame.

a. Verify that all of the dump body pads are installed and properly shimmed.

b. Verify that the dump body is resting squarely on the frame and pads.

c. Compress the plunger spring on the exhaust box (11) until the holes in the sides of the plunger wall line up with the holes in the exhaust box.

d. Insert a pin or capscrew through the holes to secure the plunger in place.

e. Using the jackscrews provided, align the exhaust box outlet with the holes in the dump body.

f. Install and tighten the mounting bolts.

g. Shim any gaps between the exhaust box and the mounting plate.

h. Compress the plunger and remove the pins in the exhaust box.

i. Install the exhaust pipes to the muffler and exhaust box. They should be positioned for best fit and maximum clearance.

j. Install and secure the support brackets.

k. Test the system's operation as outlined previously.

SERVICE

This is limited to repairing damaged or leaking components as required.

KEY A86519

01.	Muffler	14.	Not Used	26.	Flatwasher
02.	Exhaust Elbow	15.	Clamp	27.	Flatwasher
03.	Exhaust Pipe	16.	Exhaust Support	28.	Hanger Beam Clamp
04.	Exhaust Pipe	17.	Rod End – RH Thread	29.	Rod Connector - LH/RH Thread
05.	Exhaust Gasket	18.	Rod End – LH Thread		
06.	Not Used	19.	Rod Connector – LH/RH Thread	30.	Capscrew
07.	Not Used			31.	Lockwasher
08.	Muffler End Pipe	20.	Capscrew	32.	Hardened Flatwasher
09.	Seal Clamp	21.	Locknut	33.	Tap Bolt
10.	Exhaust Pipe	22.	Hardened Flatwasher	34.	Hex Jam Nut
11.	(Left) Exhaust Box	23.	Hex Nut	35.	– 39. Not Used
12.	(Left) Mounting Plate	24.	Capscrew	40.	– 46. Exhaust Blanket
13.	Tube Support	25.	Capscrew		

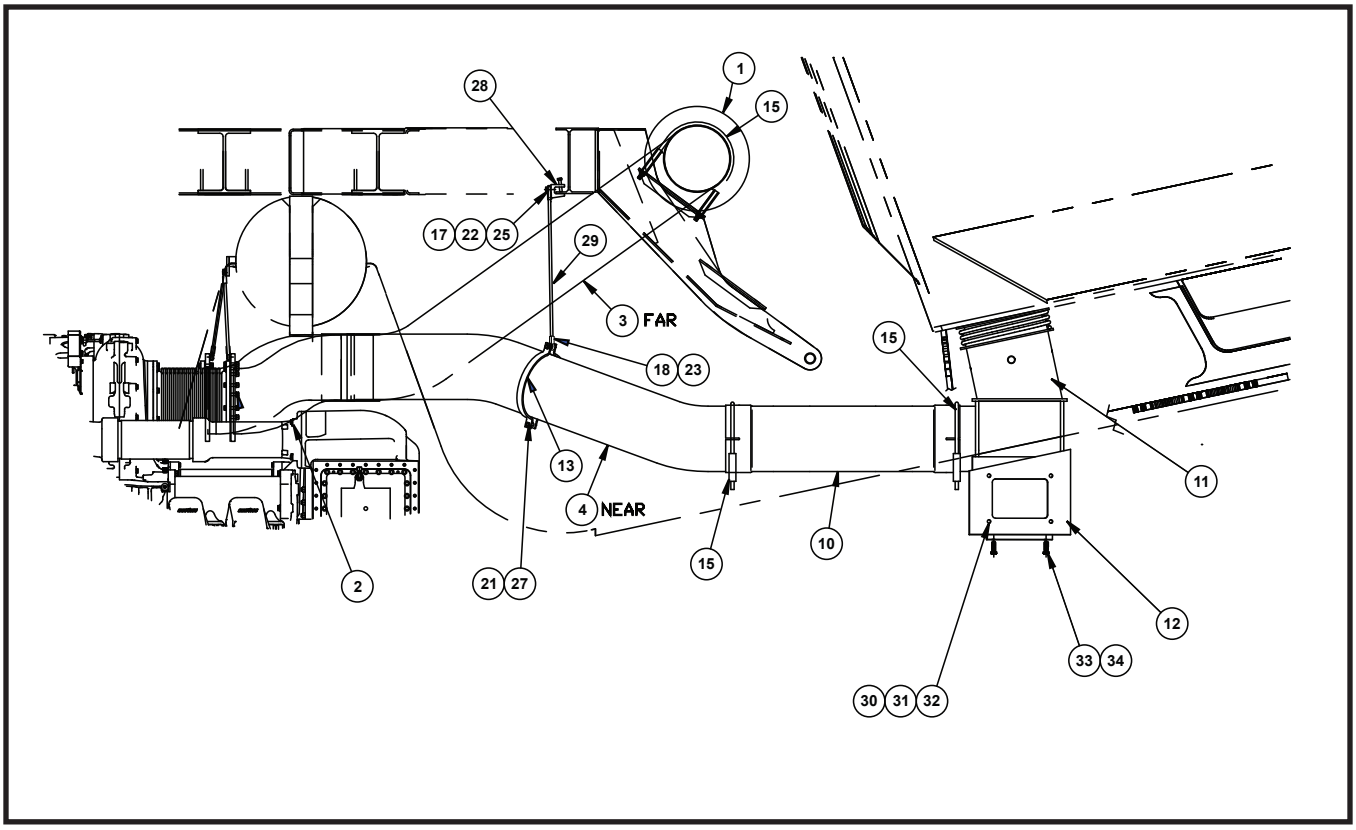


FIGURE 1 - DUMP BODY HEATING EXHAUST ASSEMBLY (A86519, SHEET 1 OF 3)

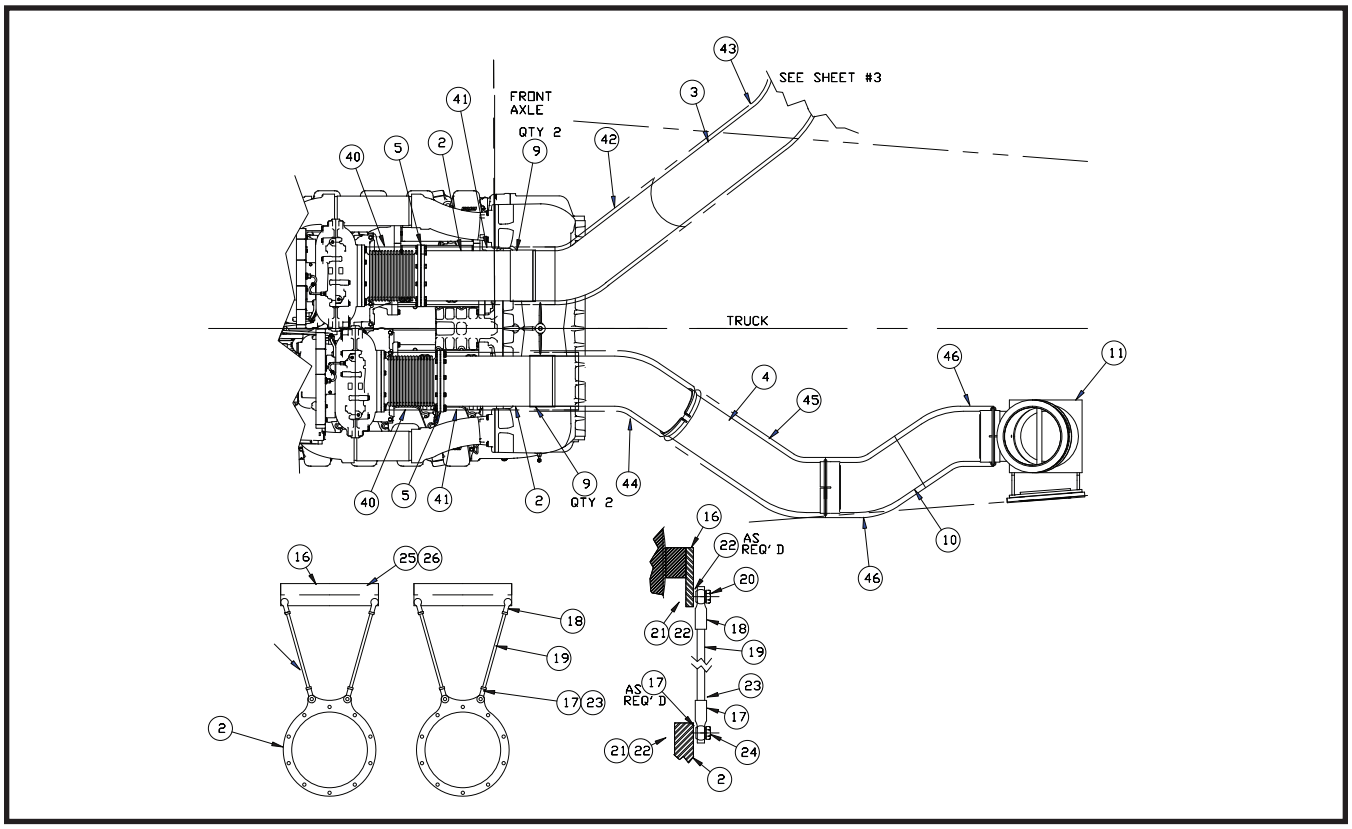


FIGURE 1 - DUMP BODY HEATING EXHAUST ASSEMBLY (A86519, SHEET 2 OF 3)

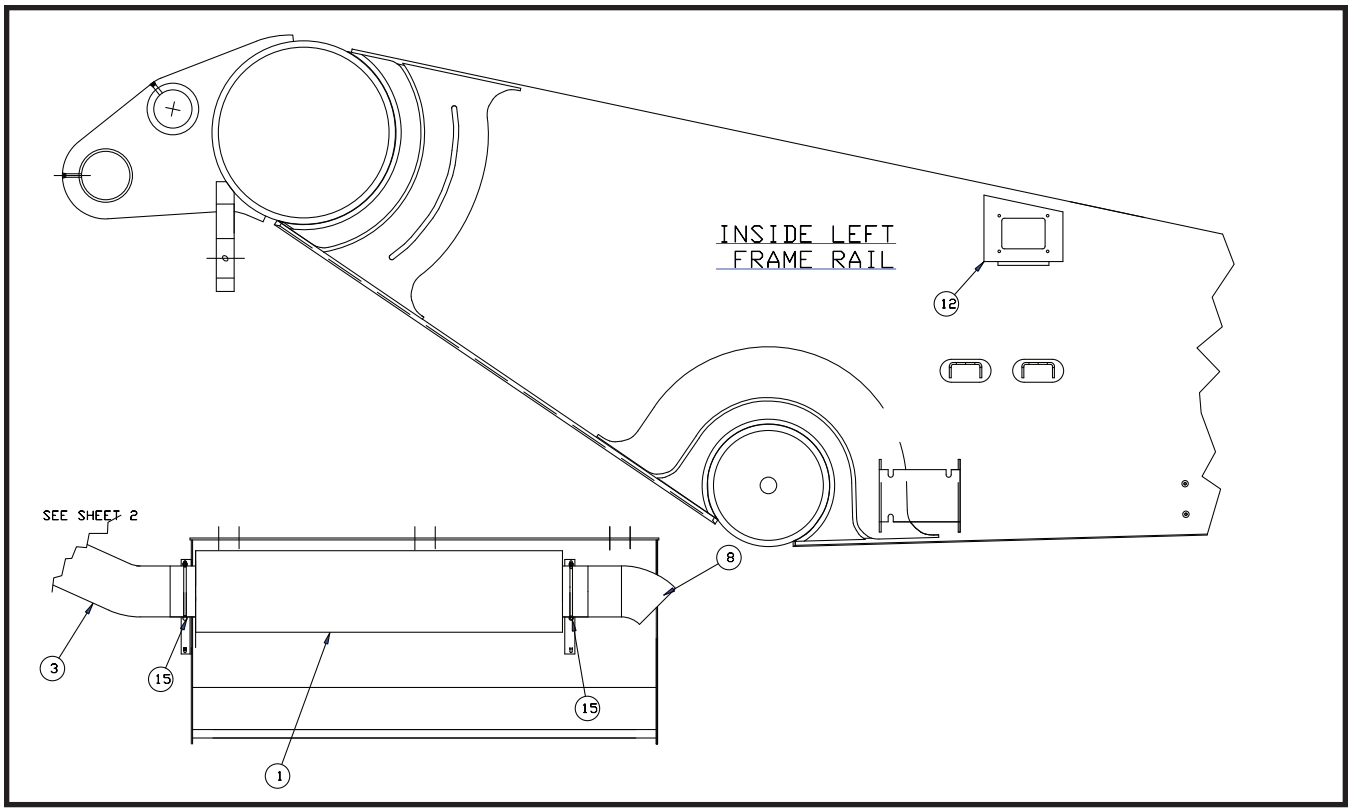


FIGURE 1 - DUMP BODY HEATING EXHAUST ASSEMBLY (A86082A, SHEET 3 OF 3)

EXHAUST ASSEMBLY - MUFFLERS

DESCRIPTION

The exhaust assembly provides a method of routing the noise and the exhaust gases produced by the engine away from the cab and reduce its outlet volume. It consists of the following:

1. Exhaust piping - rigid and flexible tubing sections from the engine turbocharger exhaust outlets to the exhaust mufflers.

2. Exhaust mufflers - specially assembled silencer assemblies mounted to the right rear of the engine assembly.

OPERATION

The exhaust gases are routed from the engine turbocharger to the two muffler assemblies mounted near the right fender assembly. Their special construction reduces the overall sound output and directs away from the operating equipment.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the system should include:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the trucks friction brake system.

2. Stop the engine.

3. Clean the exhaust system and verify that the exhaust piping is not damaged or leaking anywhere.

4. Verify that all mounting hangers are secure.

NOTES:
1. Adjust the position of the exhaust supports (11) and the lengths of rod ends and connectors (11, 12, and 13) so that the exhaust elbows and pipes are supported and do not apply loads into the bellows.
2. Typically the muffler pipe ends (8) are oriented toward the rear of the truck.

5. Verify that all piping connections are clamped securely.

6. Verify that all exhaust blanket assemblies are in place and free of damage. Repair or replace as required.

NOTE: *The blankets should be installed with the seams pointed upward and not aligned with those on adjacent blankets.*

SERVICE

This is limited to repairing damaged or leaking components as required.

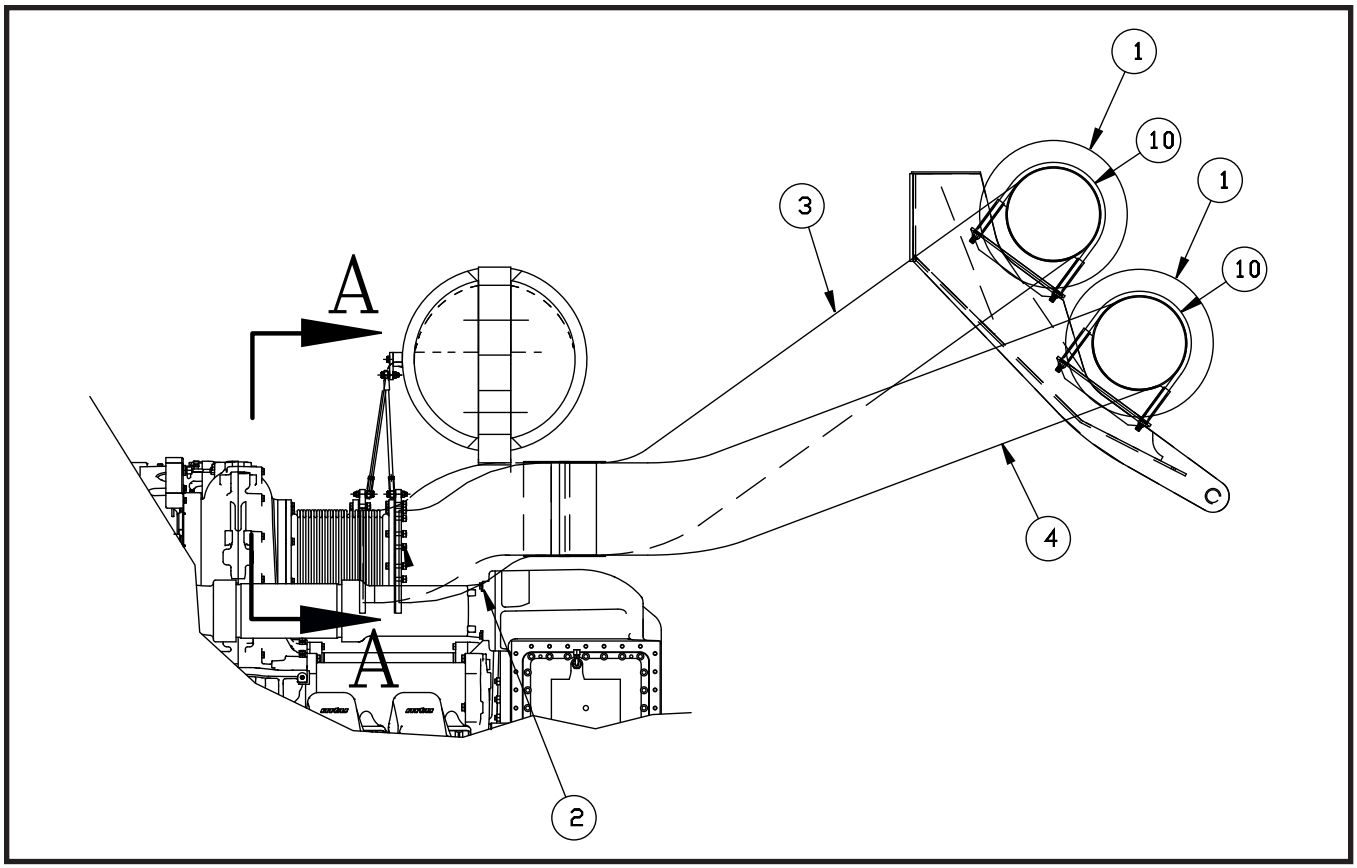


FIGURE 1 - MUFFLER EXHAUST ASSEMBLY – DDC SERIES 4000 ENGINE (A86372, SHEET 1 OF 3)

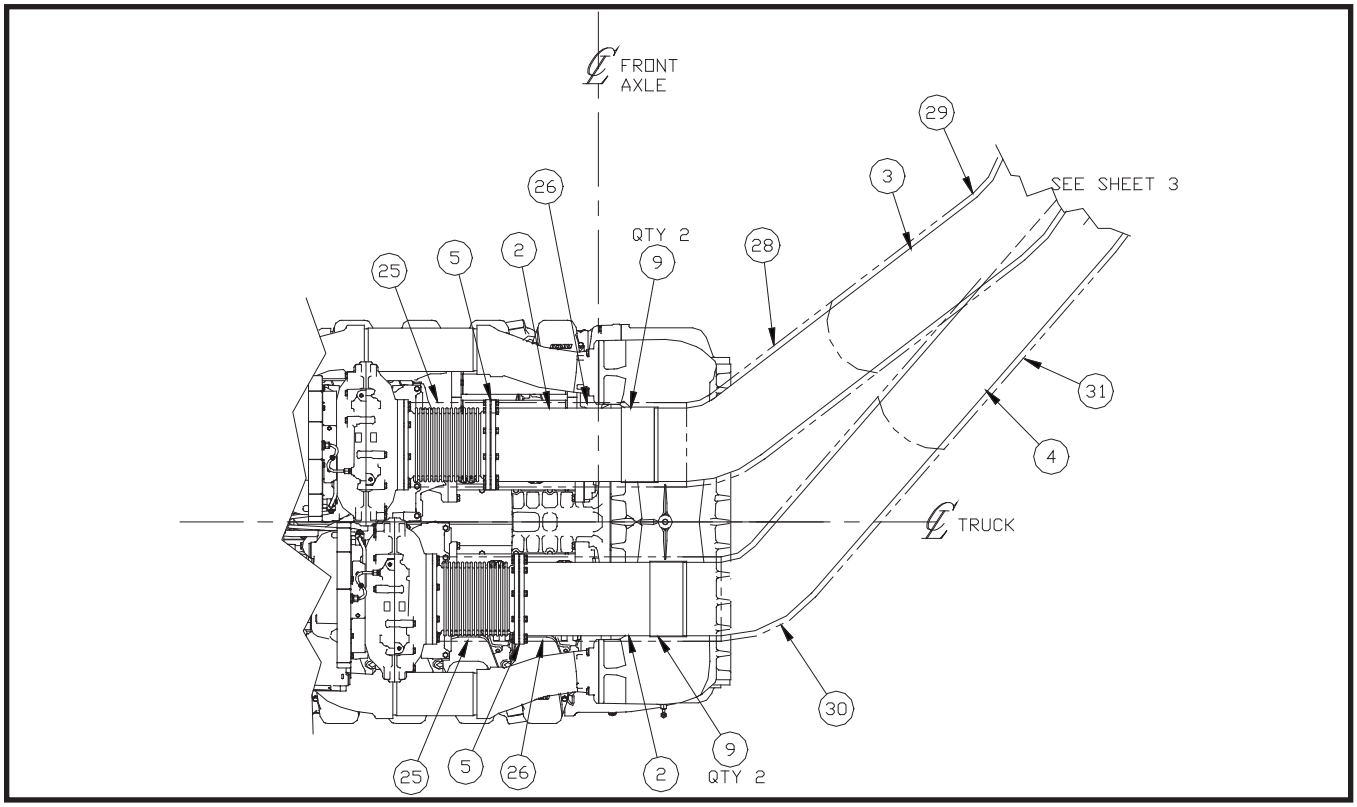


FIGURE 1 - MUFFLER EXHAUST ASSEMBLY – DDC SERIES 4000 ENGINE (A86372, SHEET 2 OF 3)

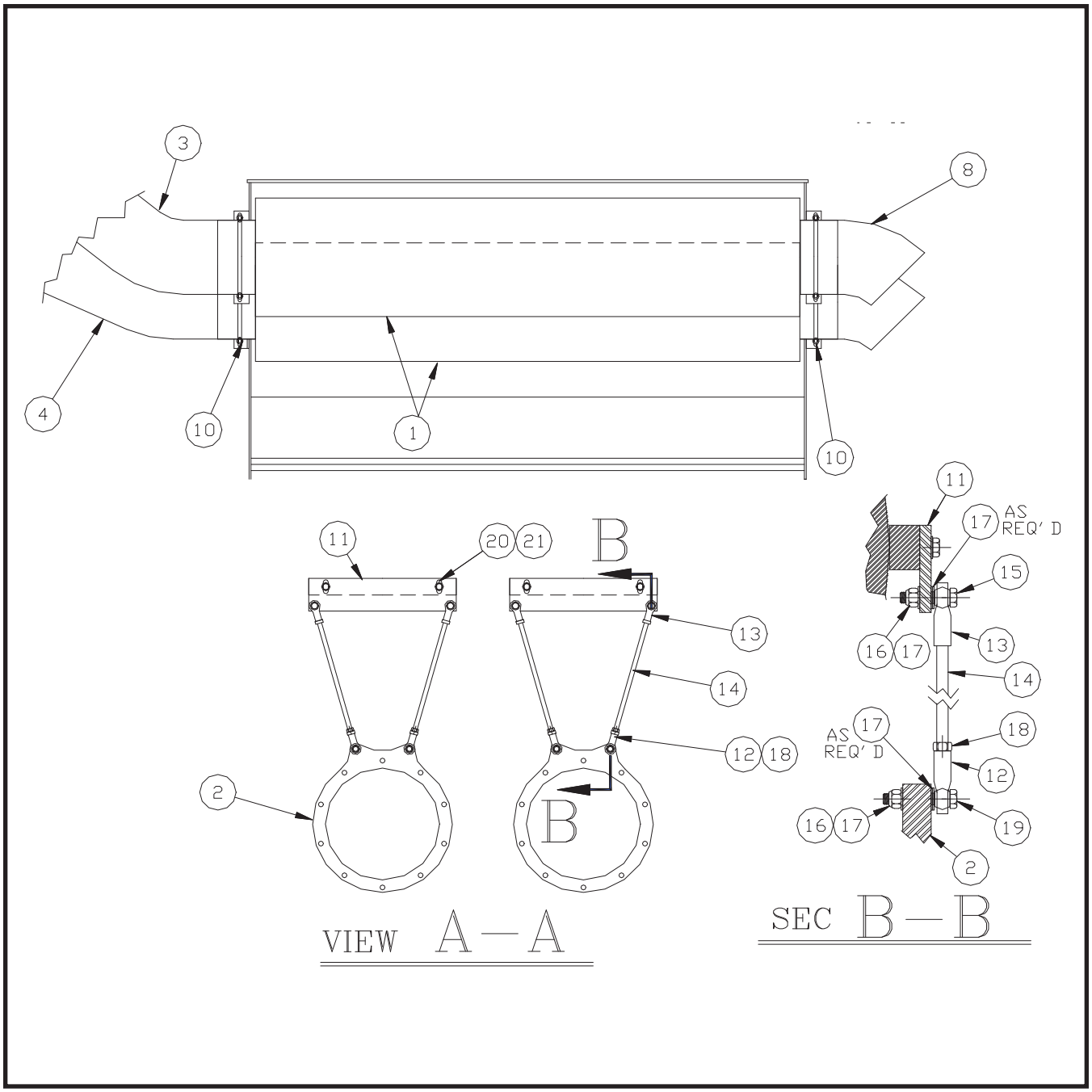


FIGURE 1 - MUFFLER EXHAUST ASSEMBLY – DDC SERIES 4000 ENGINE (A86372, SHEET 3 OF 3)

KEY A86372

01.	Muffler/Exhaust Silencer	10.	Clamp	19.	Capscrew
02.	Exhaust Elbow	11.	Exhaust Support	20.	Capscrew
03.	Exhaust Pipe	12.	Rod End – RH Thread	21.	– 24 Not Used
04.	Exhaust Pipe	13.	Rod End – LH Thread	25.	Exhaust Blanket
05.	Exhaust Gasket	14.	Rod Connector – LH/RH Thread	26.	Exhaust Blanket
06.	Not Used	15.	Capscrew	27.	Not Used
07.	Not Used	16.	Locknut	28.	Exhaust Blanket
08.	Pipe End (Muffler)	17.	Hardened Flatwasher	29.	Exhaust Blanket
09.	Seal Clamp	18.	Nut	30.	Exhaust Blanket

COOLING SYSTEM TRUCKS EQUIPPED WITH SEPARATE COOLING MODULES

DESCRIPTION AND LOCATION

The cooling system consists of the following:

1. Engine mounted

a. Coolant pump - supplies a positive flow of coolant from the lower portion of the radiator to the engine and circulates it through internal lines.

b. Thermostat - regulates the flow of coolant through the engine to maintain engine operating temperatures within the maximum and minimum limits.

c. Oil coolers - remove heat from the engine oil by transferring it to the engine coolant.

d. Coolant heaters (optional) - preheat the coolant to aid in cold weather starting.

e. Radiator fan - supplies a flow of air through the radiator to assist the thermostat in cooling in warm environment conditions, or under large loads.

f. Optional radiator pressurization system - a pressure regulator adjusted to 10 psi (70 kPa) provides air from a separate system to maintain pressure in the cooling system.

NOTE: *This option is mandated on some engine configurations and in some operating environments.*

g. Filters - filter the foreign material from the coolant, soften the water and incorporate corrosive inhibitors by releasing chemical into the coolant, and provide galvanic protection by providing sacrificial metal.

2. Radiator mounted

a. Radiator - transfers the heat from the engine coolant to the surrounding air through a series of fins.

b. Fan shroud assembly - improves the efficiency of the movement of cooling air through the radiator core assembly by improving the overall efficiency of the fan. Also it serves as protection for and from the fan when used in conjunction with the attached fan guard assembly.

c. Hood and grille assembly - provided as an integral part of the radiator/cooling module assembly.

3. Miscellaneous

a. Hoses and tubing - allow for the transfer of coolant between the engine, radiator, and other assemblies.

OPERATION

Internal combustion engines produce heat by burning fuel in the cylinders. Only a portion of this heat is converted to mechanical energy. The heat which has not been converted to mechanical energy must be removed from the engine in a controlled manner so as to protect the metal of the engine from damage. In order to maintain peak engine efficiency the engine temperatures must be maintained within a limited operating range, the primary function of the cooling system.

Efficient transfer of heat from the engine to the coolant and from the coolant to the radiator requires the interior surfaces of engine cooling passages and the radiator to be free of mineral scale, corrosion, petroleum, contaminates, and deposits resulting from chemical incompatibility. These materials form an insulating layer on metal surfaces and greatly reduce the rate of heat transfer.

NOTE: *Air bubbles in the coolant have a similar effect.*

Normally the cooling system operates under pressure, created by the expansion of the coolant during its warming from cool to operating temperature. If the cap is removed (e.g. to check coolant level) once there is pressure in the system, the system will not be able to fully re-pressurize until allowed to cool to ambient pressure. This could adversely affect operation of the cooling system.

To prevent this loss of pressure, an auxiliary pressurization system is often installed which provides regulated pressure typically 10 psi (70 kPa) pneumatic system to maintain pressure in the system at all times during operation.

SERVICE

Periodic service should include the following steps:

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Engine coolant temperature excessively high	Low coolant level	Fill system to proper level. Check for leaks.
	Obstruction in radiator core	Remove obstruction and clean radiator fins.
	Defective fan drive	Repair or replace as required.
	Improper functioning of water pump	Repair or replace as required.
	Improper thermostat opening	Replace thermostat.
	Internal plugging of core tubes	Flush entire cooling system - - additional cleaning as required.
	Improper operation of shutters or clutching fan	Repair or replace as required.
	Air or exhaust gases in coolant	Determine where gases are entering the system. Correct leak.
	Defective temperature indicator	Adjust or replace as required.
	Collapsed hose between radiator and engine (NOTE: May be internal)	Check condition of hoses - - cold and with truck warmed and engine running. Repair or replace as required.
	Engine not running properly	Check engine settings including injector size and timing. Adjust or repair as required.
	Dirt covering exterior of engine and radiator	Clean exteriors. (The dirt lowers the heat transfer rate.)
	Improper radiator size	Check the radiator size recommended for the application.
Engine coolant temperature too low	Improper operation of thermostat (not closing or leakage)	Replace thermostat.
	Improper operation of shutters	Repair or replace as required.
	Lack of pressure cap	Check operation of pressure cap. Replace as required.

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Low coolant level	External leaks 1. Loose clamps, faulty hose or pipes 2. Radiator 3. Gaskets 4. Drain cocks 5. Seals (water pump, thermostat) 6. Engine or air compressor gaskets 7. Engine accessories	Repair or replace as required.
	Internal leaks 1. Engine or air compressor (into cylinders) 2. Injector sleeves 3. Porous cylinder head 4. Engine accessories	Repair or replace as required.
	Overflow 1. Overfilled radiator 2. Faulty pressure cap 3. Plugged radiator core 4. Dirt in system 5. Combustion gases entering system displacing coolant 6. Excessive intake air temperature 7. Improperly routed fill line	Repair or replace as required.

⚠WARNING

Use extreme care when removing the radiator cap or other cooling system components. Remove slowly, only after the engine has cooled. The sudden release of pressure from a heated cooling system can result in the loss of coolant and possible injury (scalding) from the hot liquid.

1. Check the engine coolant level in the radiator as follows:

a. If the truck is equipped with an optional auxiliary pressurization system, disable the system (to prevent accidental activation) as required.

b. Open the metal cover over the cap.

c. Press the pressure release feature in the cap or cover the cap with a rag and slowly turn it to the first detent stop. Let any system pressure vent to atmosphere.

d. When the system pressure is fully exhausted, rotate and remove the radiator cap.

e. The coolant should be at level approximately even with the bottom of the radiator cap neck. If low, fill with the designated fluid prior to starting the truck. If coolant system is empty, remove flare cap on radiator and verify both tank sections are full.

NOTE: *Refer to the engine manufacturer's maintenance and service manual for the proper formulation of coolant. Always use the required antifreeze and inhibitors and follow the recommendations on service intervals and maintenance.*

f. Inspect the radiator cap gasket. Replace if necessary.

g. If possible, pressure test the cap assembly to ensure proper operation.

h. Install the caps and tighten securely. Close and securely fasten the cover plate.

2. Check the condition of the coolant. Refer to the engine manufacturer's maintenance and service manuals for the test requirements. If a change of coolant is required, proceed as follows:

a. Open all radiator and engine drain cocks as instructed in the engine manufacturer's manual.

b. Remove the radiator cap. This will speed the draining process by allowing air into the system to replace the coolant.

c. Flush the cooling system if required. Follow the recommendations of the engine and radiator manufacturer.

⚠ CAUTION

Chemical cleaning should always be performed first. Back-flushing should be done only if chemical cleaning is not satisfactory. Reverse or back-flushing forces a flow of liquid in the direction opposite to normal flow which loosens and removes scale and contaminant deposits that otherwise may remain lodged in the system, but it can also cause the system to clog at a later date.

NOTE: *If a flushing gun is not available, use a combination of water and air hoses as a substitute.*

d. Attach a hose at the top of the radiator to direct water away from the area and into the proper drain or storage container.

e. Fill the radiator with water from the gun.

f. Apply air pressure gradually until a pressure of 10 to 20 psi (70 to 140 kPa) is obtained.

⚠ CAUTION

Exceeding this pressure may cause damage to cooling system components.

g. Alternately fill with water and flush with air until the water exiting from the top is clean.

NOTE: *Short, quick blasts of air may be used to dislodge material if care is taken not to exceed the 20 psi (140 kPa) maximum pressure.*

h. Remove, clean and inspect the radiator cap. All deposits should be removed.

3. Verify the operation of the radiator pressurization system as follows:

a. Stop the engine. Turn off the Master Switch.

b. Remove the radiator cap (as outlined previously in these instructions) or use an equivalent means to relieve any residual pressure in the cooling system. Reinstall the cap.

c. Remove the air hose from the outlet and end of the check valve, and install a 0 to 60 psi (0 to 420 kPa) pressure gauge with bleed off provision into check valve outlet.

d. Verify that the air pressure gauge reads 40 psi (275 kPa).

e. Turn on the Master Switch and all circuit breakers. Take whatever action is required to allow air to flow to the radiator.

f. Verify that the pressure gauge on the check valve reads 10 +/- 1 psi (70 +/- 7 kPa).

g. Stop the flow of air to the system. Verify that the gauge remains at 10 +/- 1 psi (70 +/- 7 kPa). If not, find the leak and repair or replace.

NOTE: *Verify that the leakage is not through the check valve or radiator core.*

h. If adjustment is required adjust the pressure regulator as required then repeat steps through g.

i. Relieve all pressure in the cooling system as outlined previously.

j. Remove the gauge and reconnect all hoses.

4. Check all hoses and connections for leaks or damage.

5. Check the engine lubricating oil level. Oil levels too low or too high can cause overheating and possible loss of coolant.

6. Check for coolant in the oil and water in the oil. If either case is found, determine the cause and correct.

7. Check the fan for damaged or bent blades. Repair or replace as required.

8. Inspect the radiator for bent core fins or accumulation of road debris.

9. Check for leaks in the system.

RADIATOR COOLING MODULE

DESCRIPTION AND LOCATION (Figures 8 and 9)

The cooling module is an assembly which includes a radiator that consists of a number of series of separate cooling tubes mounted between top and bottom reservoirs. This finned tube assembly is mounted at the front of the truck between the grille and the cooling fan.

The hood side curtain and expanded metal grille assemblies are included in the cooling module.

OPERATION

The heated coolant from the engine enters the radiator through the inlet located at the top. The water then flows down through the finned copper tubes to the lower reservoir. While in the tubes, the heat is transferred from the water to the tubes and fins which in turn transfer it to the air moving through the radiator. The coolant exits the radiator through the outlet in the lower reservoir, returning to the engine to cycle again.

The radiator is constructed in a manner that allows each of the tubes to function independently. If a tube is damaged or plugged, it may be removed and replaced without removing the radiator.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Check the level of coolant in the radiator. Follow the instructions on the cooling system in Section 4 - Power Package.

2. Check the radiator exterior for accumulation of dirt and debris. This foreign material will reduce the radiator's capacity to transfer heat to the air. Clean as required.

NOTE: *If there is any doubt as to procedure or equipment, try the method on a single tube first or contact your Unit Rig representative.*

a. Blow out the loose material using high pressure air, typically first blowing from the air exit side toward the inlet side, then reverse the flow.

IMPORTANT: *The air should be sprayed straight into the core and not at an angle.*

b. Use a high pressure hot water washer with up to 1200 psi (8 275 kPa).

(1) Starting with the nozzle held closely to the fins near the top on the air exit side, working on a small area.

IMPORTANT: *The water flow should be sprayed straight into the core and not at an angle.*

(2) Continue washing from the top down until the exiting water is clean.

(3) Repeat on the opposite side.

IMPORTANT: *Many radiator shops use a high alkaline soap, caustic soda, or chemical additives to their boil-out tank which attach solders. If a tube is soaked in such a solution, the solder bond between the finning and tubes will be adversely affected. If it is known that the particular solution used is not harmful to solder, then it will not hurt the solder on the tube. Be sure to completely rinse the cleaned tube or core in clean water after removing from the boil-out tank.*

3. Inspect the radiator interior for accumulation of dirt and debris. This foreign material will reduce the radiator's capacity to transfer heat to the air. Clean as required.

IMPORTANT: *Corrosion, silicate gelling, and other forms of contamination can have a great adverse affect on the operation of the radiator and entire cooling system. Consult your antifreeze supplier, engine manufacturer, and Unit Rig representative on recommendations to eliminate or reduce these conditions.*

4. If so equipped, verify the operation of the radiator pressurization system as outlined in the module on the Cooling System in Section 4 - Power Package.

5. Inspect the inlet and outlet fittings and hoses. If loose or showing evidence of deterioration, repair or replace as required.

6. Inspect the fan shroud, guards and other accessories installed on the radiator. It should be firmly attached to the radiator and in good condition. Repair or replace as required.

7. Inspect the crossbraces. They should be tensioned evenly without distorting the radiator assembly.

8. Inspect all mounting points. The rubber shock mount should be pliable and in good condition. The support arms should be properly adjusted to support the radiator evenly on each side - not to place it in a twisting bind. The lower mounting points should be tight and in good repair. Repair or replace as required.

REMOVAL (Figure 8)

NOTE: *It is not necessary to remove the radiator to replace individual core tubes. These may be replaced with the radiator in place. Refer to the instructions on Disassembly and Assembly in this module for this procedure.*

The radiator may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release all pressure from the cooling system as outlined in the instructions in Section 4 - Power Package.

3. Drain all coolant from the radiator and engine assembly.

4. Disconnect all hoses attached to the radiator. (See Figure 9.) Mark these hoses to aid in reassembly.

5. Remove the hood assembly as outlined in the instructions in Section 2 - Structure.

6. Disconnect and remove the radiator top brace assembly.

7. Support the radiator assembly by means of the lifting hose provided in the radiator side channels.

8. Remove the hardware that secures the radiator to the main frame assembly.

9. Remove the radiator assembly from the truck, taking care not to damage the radiator core on the radiator fan assembly.

NOTE: *The thin non-ferrous fins and tubes of the radiator core sections are easily damaged. Extreme care should be used when handling the radiator.*

DISASSEMBLY (Figure 4)

The individual tubes may be removed from the radiator as follows:

NOTE: *It is not necessary to remove the radiator to replace individual core tubes. These may be replaced with the radiator in the truck.*

1. Heat the tubes and rubber seals with hot water to assist in tube removal.

2. Loosen the tube using a breaker tool (Figure 1) placed at the top and bottom, as near the seals as possible. Do not attach in the middle as this may result in the twisting or deformation of the tube.

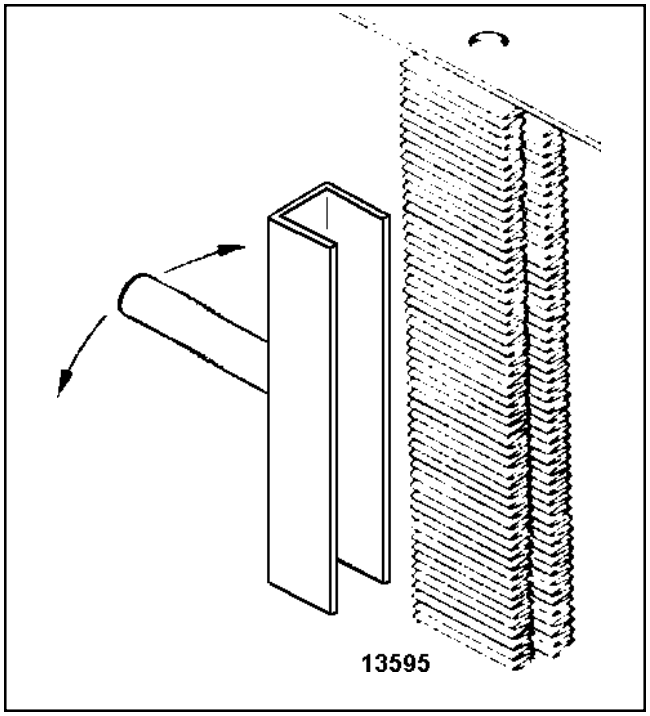


FIGURE 1 - TUBE BREAKER TOOL

3. After the tube is free, place the upper jaw of the installation tool (Figure 2) around the round portion of the tube just below the flattened portion.

4. Insert the lower jaw of the tool so that the taper of the jaw seats between the seal and metal ferrule, not on top of the seal.

5. Squeeze the handles together and raise the tube only enough to clear lower rubber grommet. (Refer to Figure 3).

6. Remove the tool and swing the tube to clear the lower seal. Pull the tube down to remove it from the upper seal.

7. Repeat the procedure for the remaining tubes.

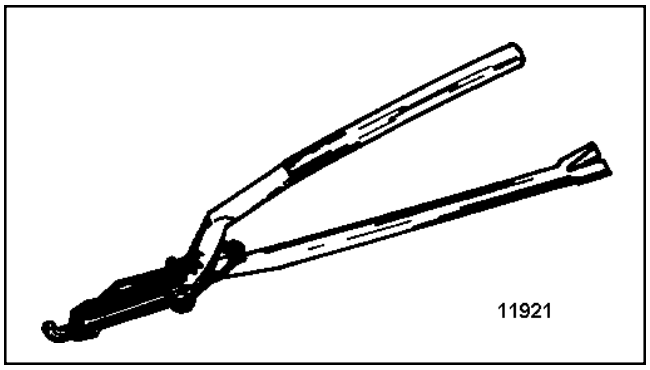


FIGURE 2 - RADIATOR TUBE INSTALLATION TOOL

⚠ CAUTION

Remove the upper tubes first when repairing radiators with split cores. The lower tubes cannot be raised for removal with upper tubes in place.

Also, care should be exercised when removing the tubes from the lower core. This is because when the tubes are in a completely raised position, the upper end may extend into the plate above, and, when the tube is swung out, it may bind, bending the upper end.

8. Remove all seals from the metal ferrules.

The radiator may be disassembled as follows:

1. Remove the fan shroud, guards, etc. by unbolting the attaching bolts.

2. Remove the radiator crossbraces.

3. Remove the top and bottom reservoir tanks by removing the attaching bolts, washers, and nuts.

4. Remove the bolts that attach the member to be removed from the side members.

5. Disassemble the remainder of the assembly as required.

INSPECTION AND REPAIR

The unit may be serviced as follows:

1. Inspect the metal ferrules for evidence of damage. Repair or replace as required.

NOTE: *The tube holes should be cleaned of foreign debris using a 3/4 inch (19 mm) wire brush in an electric or air drill or similar device.*

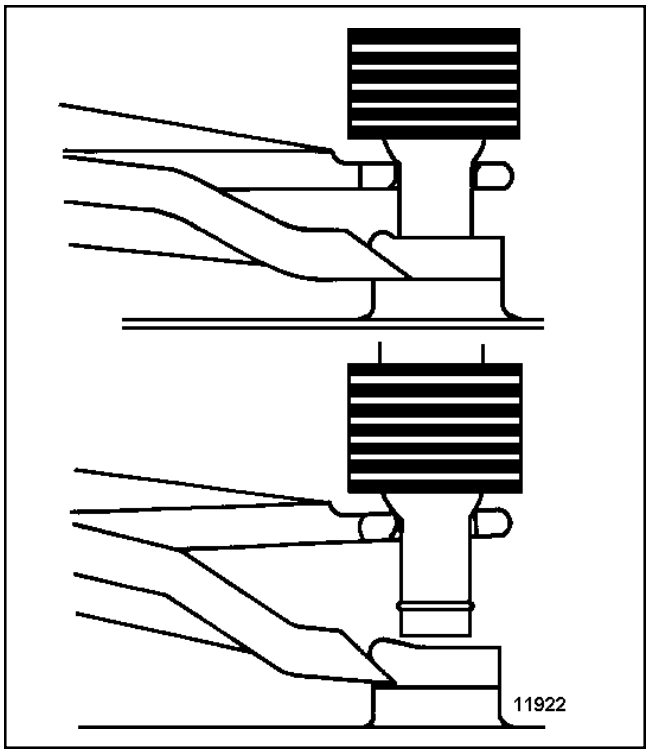


FIGURE 3 - RADIATOR TUBE REMOVAL

2. Clean all foreign material from the ferrules.

3. Clean all gasket material from sealing surfaces.

4. Repair or replace all damaged or leaking tubes. Check all repaired tubes for leakage prior to reinstalling.

5. Check the condition of the fins and tubes. Damage or accumulated dirt will reduce heat transfer and radiator efficiency. Clean, or replace as required.

a. If the original tubes are reinstalled, the tube ends must be clean of foreign materiel. Buffing with a polishing wheel and copper polish is a recommended method.

b. If the debris can not be removed by buffing:

(1) Use a wire wheel to remove the material. Use care not to mar the tube ends.

(2) Use a buffer as outlined in step a, to smooth the surface to improve installation and sealing.

IMPORTANT: *Corrosion, silicate gelling, and other forms of contamination can have a great adverse affect*

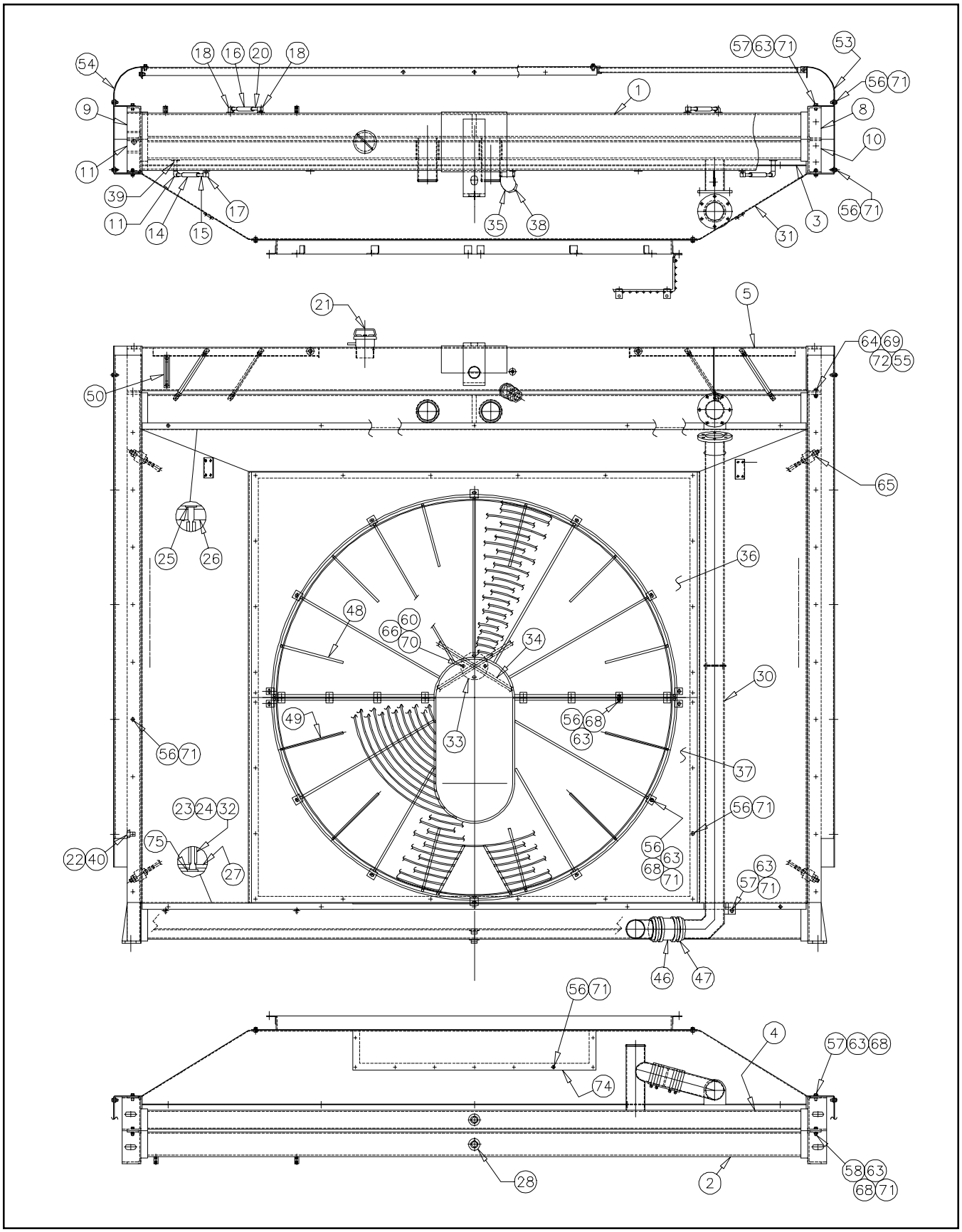


FIGURE 4 - TYPICAL RADIATOR ASSEMBLY

KEY							
01.	Tank	20.	Threaded Fitting	39.	Pipe Nipple	58.	Capscrew
02.	Tank	21.	Radiator Cap	40.	Overflow Hose Clip	59.	Capscrew
03.	Tank	22.	Overflow Hose	41.	Bracket	60.	Capscrew
04.	Tank	23.	Locking Tube Assembly	42.	Core Guard	61	Shoulder Screw
05.	Surge Tank	24.	Locking Tube	43.	Core Guard	62.	Nut
06.	Center Tank	25.	Rubber Seal	44.	Channel	63.	Nut
07.	Center Tank	26.	Top Felt Air Baffle	45.	Channel	64.	Nut
08.	Side Tank	27.	Bottom Felt Air Baffle	46.	Hose	65.	Nut
09.	Side Tank	28.	Pipe Plug	47.	Hose Clamp	66.	Nut
10.	Side Tank	29.	Fill Tube	48.	Fan Guard	67.	Lockwasher
11.	Side Tank	30.	Fill Tube	49.	Fan Guard	68.	Lockwasher
12.	Center Support	31.	Fan Shroud	50.	Sight Glass Assembly	69.	Lockwasher
13.	Center Support	32.	Tube Stay End	51.	Bracket	70.	Lockwasher
14.	Pipe Elbow	33.	Crossbrace Clamp	52.	Bracket	71.	Lockwasher
15.	Hose	34.	Crossbrace Rod	53.	Core Guard	72.	Capscrew
16.	Hose	35.	Street Elbow	54.	Core Guard	73.	Core Guard
17.	Pipe Adapter	36.	Fan Ring	55.	Flatwasher	74.	Side Fan Shroud
18.	Pipe Adapter	37.	Fan Ring	56.	Capscrew		
19.	Threaded Fitting	38.	Reducer Bushing	57.	Capscrew		

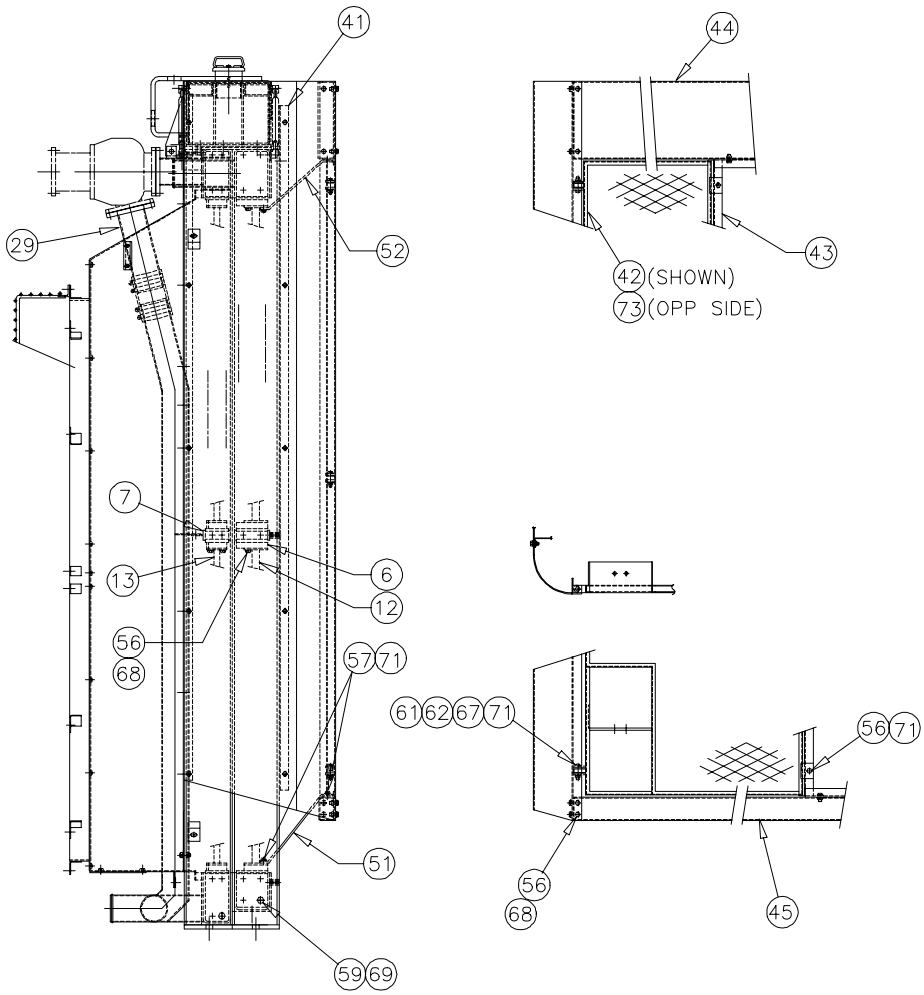


FIGURE 4 - TYPICAL RADIATOR ASSEMBLY (CONTINUED)

on the operation of the radiator and entire cooling system. Consult your antifreeze supplier, engine manufacturer, and Unit Rig representative on recommendations to eliminate or reduce these conditions.

IMPORTANT: *Many radiator shops use a high alkaline soap, caustic soda, or chemical additives to their boil-out tank which attach solders. If a tube is soaked in such a solution, the solder bond between the finning and tubes will be adversely affected. If it is known that the particular solution used is not harmful to solder, then it will not hurt the solder on the tube. Be sure to completely rinse the cleaned tube or core in clean water after removing from the boil-out tank.*

ASSEMBLY

The individual tubes may be installed in the radiator as follows:

1. Clean all foreign material from the metal ferrules.

2. Install new rubber seals in the ferrules and seat the seals firmly against the mounting face, using a small mallet.

IMPORTANT: *There is a difference in the tubes and seals used in the single upset and "new" locking tube designs. Be sure to install the correct seals for the tube being installed. The "new" seal cannot be used at the bottom of the single upset tube design. See Figure 5.*

3. Using a 1/2 inch (13 mm) diameter, soft bristle brush, coat the inside of the seals and ends of the tubes with a special lubricant (or small amounts of petroleum jelly, mineral oil, or equivalent). This will ease the installation.

4. Install the tubes starting with an inner row. Insert the end of the tube with the longest round section into the seal of the upper plate.

⚠ CAUTION

Care should be taken to minimize the angle of the tube with respect to the seal and to center the tube in the seal.

NOTE: *As outlined previously, install the lower tubes first as they cannot be raised once the upper tube is in place.*

5. Insert the other end of the tube into the seal in the corresponding hose of the lower plate. Push the tube into the seal until the bead of the tube seats on the seal or in the in the groove of the lower seal, depending upon the tube and seal assembly installed. Use the installation tool as shown in Figure 6.

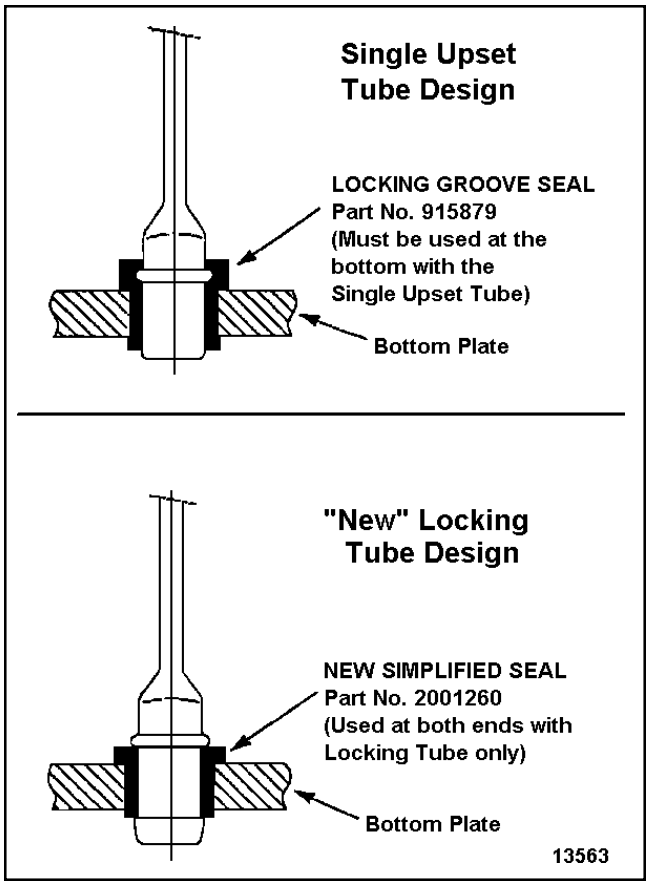


FIGURE 5 - TUBE STYLES

IMPORTANT: *Precautions should be taken to be sure that the tubes are centered correctly in the seals. When properly lubricated and centered, the tubes are easily installed, and no scuffing or tearing of the seals occurs. This scuffing or tearing could result in seal leakage.*

6. Complete the row of tubes. Make sure that the tubes are straight and aligned to ensure maximum air flow.

7. Install the individual tube stay (and stay ends if required) to interlock the tubes. The stays should be installed between each row of tubes.

8. Install the top and bottom felt baffles between the first and second rows of the tubes as shown in Figure 7.

NOTE: *The top felt baffle is larger than the bottom baffle.*

9. Install the remaining rows of tubes in a similar manner.

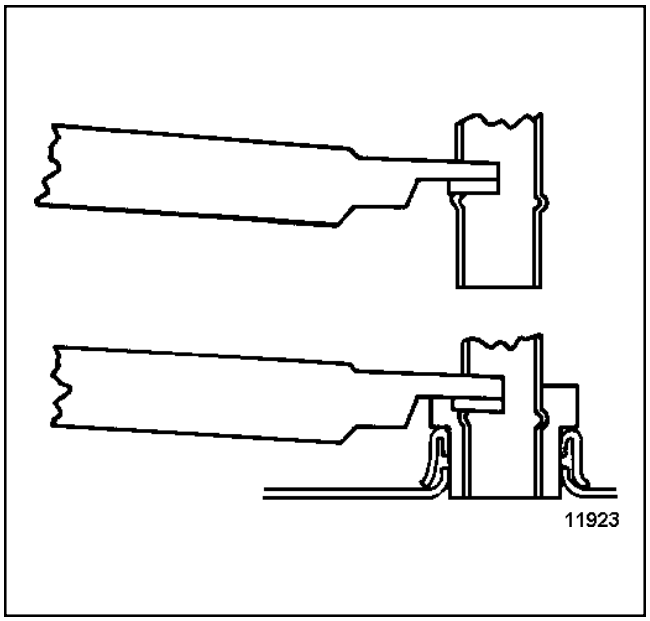


FIGURE 6 - RADIATOR TUBE REMOVAL/INSTALLATION TOOL

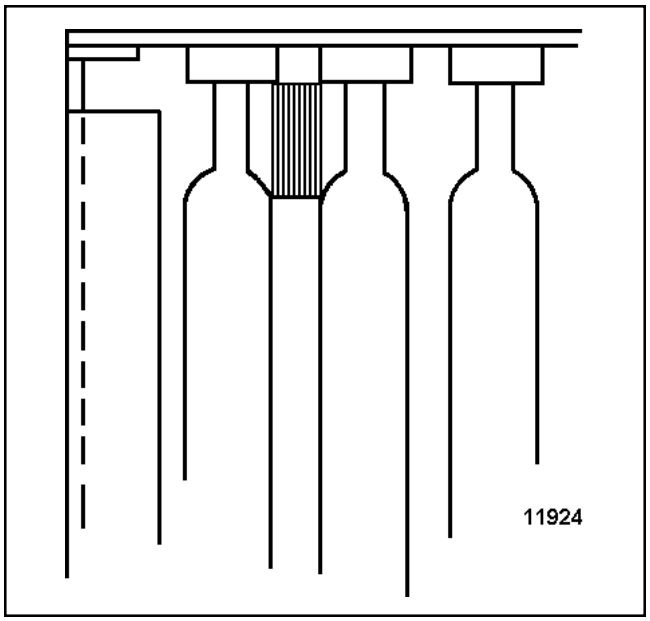


FIGURE 7 - INSTALLATION OF FELT BAFFLES

The radiator may be assembled as follows:

1. If the reservoir tanks were removed, reassemble them. Always install the core bolting straps and gaskets as shown in Figure 4.

IMPORTANT: *Use only cork neoprene gaskets soaked in light oil. Do not use any cement type sealers such as Permatex or Instant Gasket.*

2. Tighten the assembled bolts until the gasket protrudes 0.06 to 0.12 inch (1 to 3 mm). Trim off the excess gasket material.

3. Install the reservoir tanks as directed in steps 1 and 2.

4. Secure all components to the side members.

5. Install crossbrace members. Tighten each in small, 1 ft-lb (1.5 Nm), increments to a torque of 5 ft-lb. (7 Nm).

6. Install fan shroud and guards and other accessory parts.

INSTALLATION

The radiator may be installed as follows: (Figure 8)

1. Using a suitable lifting device attached to the radiator lifting brackets, position the radiator assembly on the radiator support brackets located on the front of the main frame structure.

2. Securely install the radiator with the shock mounts (9), snubbing washers (10), capscrews (3), and locknuts (4).

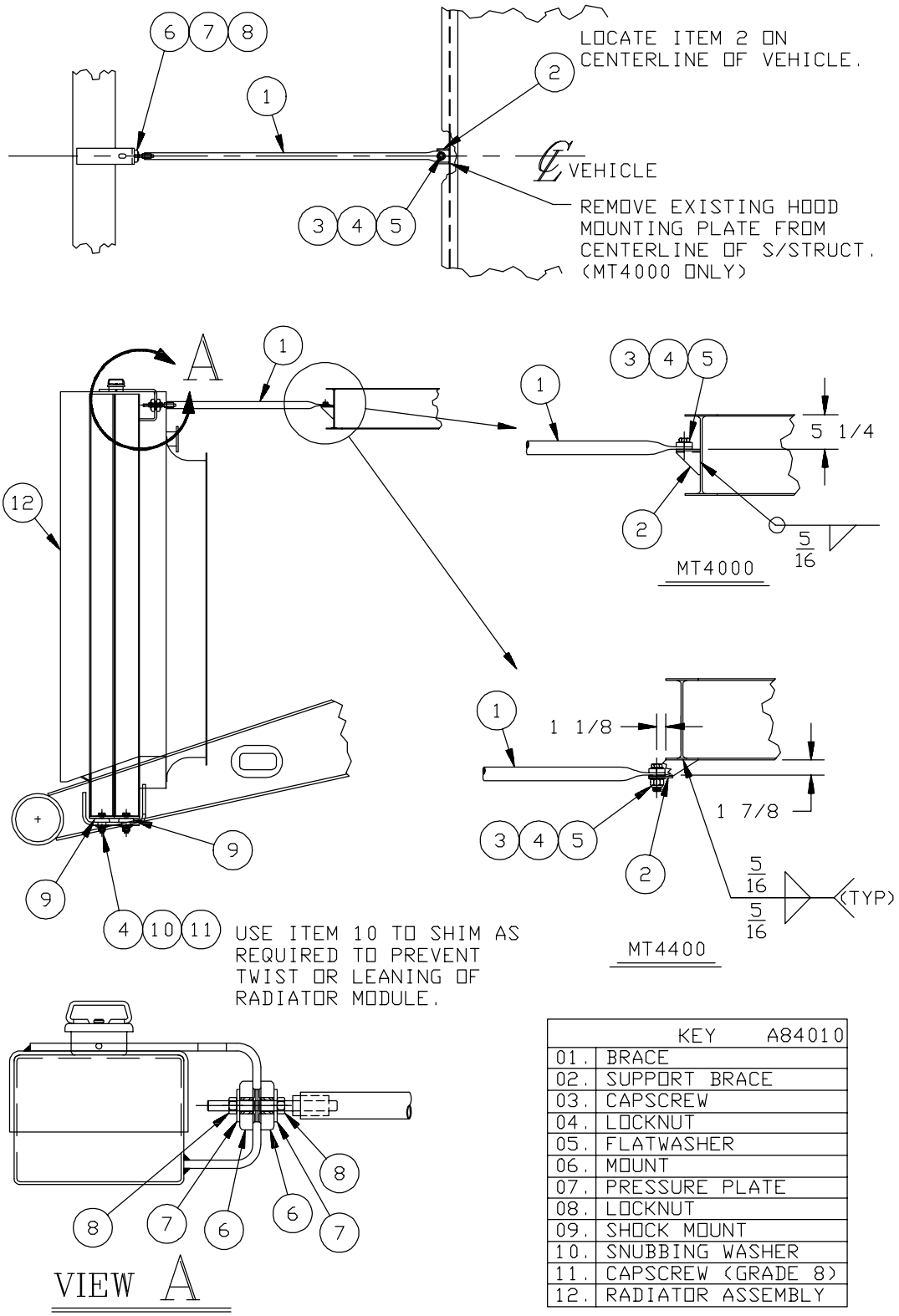
NOTE: *Use the snubbing washers to shim the radiator assembly as required to prevent the module from twisting or leaning. Do not over-tighten the locknuts to extrude or damage the rubber shock mounts.*

3. Install the upper brace assembly as shown in Figure 8. Adjust the length as required to support the radiator in the vertical position. Do not over-tighten the locknuts to extrude or damage the rubber cushion mounts on either end.

4. Install the radiator piping as outlined in Figure 9.

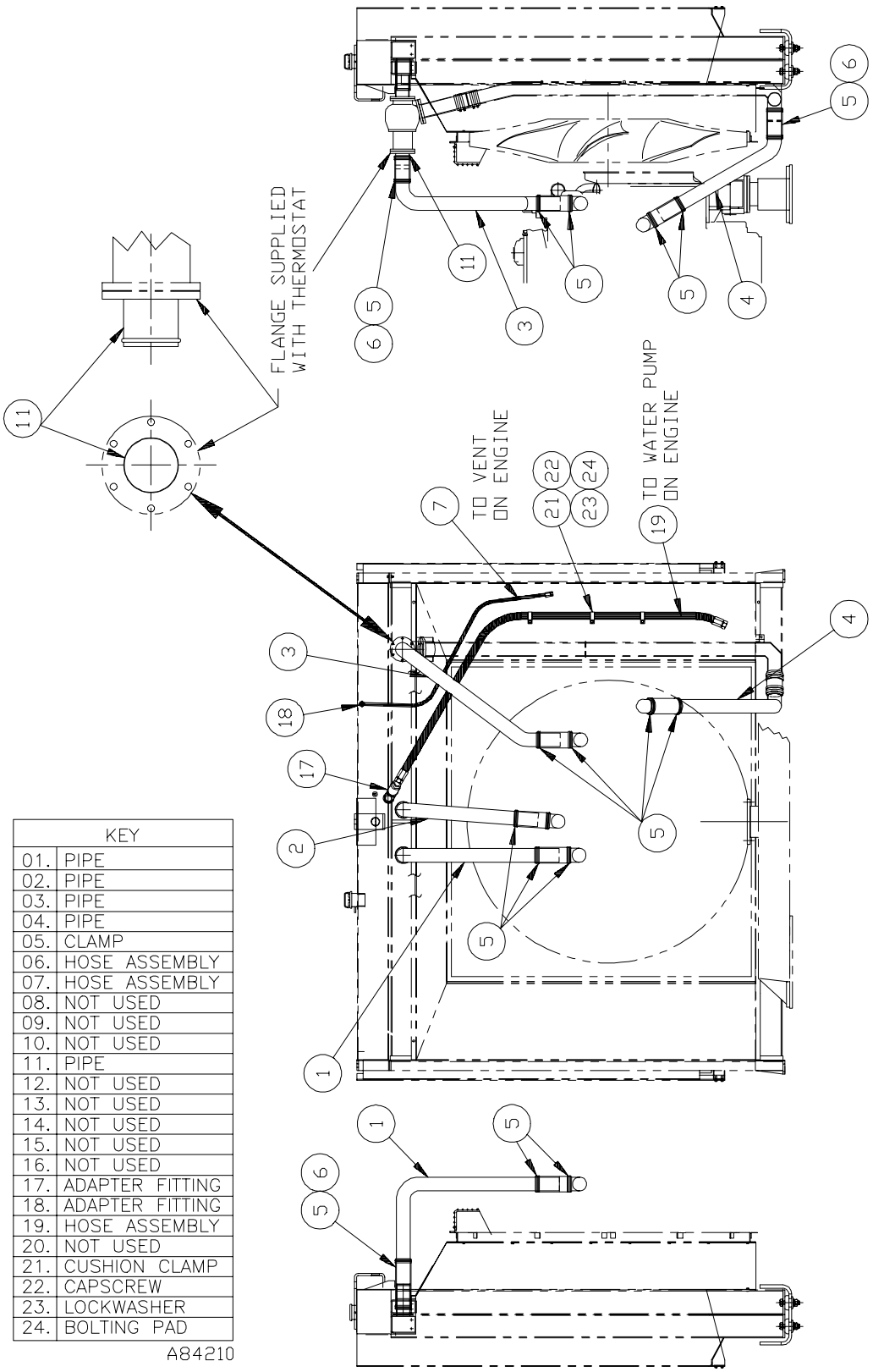
5. Install the hood assembly as outlined in the instructions in Section 2 - Structure.

6. Close all cooling system drain cocks and refill the cooling system. Check the cooling system for leaks. Follow the instructions in Section 4 - Power Package.



KEY A84010	
01.	BRACE
02.	SUPPORT BRACE
03.	CAPSCREW
04.	LOCKNUT
05.	FLATWASHER
06.	MOUNT
07.	PRESSURE PLATE
08.	LOCKNUT
09.	SHOCK MOUNT
10.	SNUBBING WASHER
11.	CAPSCREW (GRADE 8)
12.	RADIATOR ASSEMBLY

FIGURE 8 - RADIATOR INSTALLATION ASSEMBLY



KEY	
01.	PIPE
02.	PIPE
03.	PIPE
04.	PIPE
05.	CLAMP
06.	HOSE ASSEMBLY
07.	HOSE ASSEMBLY
08.	NOT USED
09.	NOT USED
10.	NOT USED
11.	PIPE
12.	NOT USED
13.	NOT USED
14.	NOT USED
15.	NOT USED
16.	NOT USED
17.	ADAPTER FITTING
18.	ADAPTER FITTING
19.	HOSE ASSEMBLY
20.	NOT USED
21.	CUSHION CLAMP
22.	CAPSCREW
23.	LOCKWASHER
24.	BOLTING PAD

FIGURE 9 - TYPICAL RADIATOR PIPING

RADIATOR – MECHANICALLY BONDED CORE

DESCRIPTION AND LOCATION (Figures 1, 2, and 3)

The radiator cores consist of separate cooling assemblies mounted between top and bottom reservoir tanks. These finned assemblies are mounted at the front of the truck between the grille and the cooling fan.

OPERATION

The heated coolant from the engine enters the radiator through the inlet located in the top reservoir tank. The water then flows through the finned tubes to the lower reservoir. While in the tubes, the heat is transferred from the water to the tubes and fins which in turn transfer it to the air moving through the radiator. The coolant exits the radiator through the outlet in the lower reservoir, returning to the engine to cycle again.

On some installations, there are two separate cores, typically with common top and bottom reservoir assemblies. One core, known as the High Temperature Core (HTC) is typically the thickest and toward the rear is for the control of the engines heat of combustion and cools the coolant as per normal processes. The other core, known as the Low Temperature Core (LTC) is typically used to cool the incoming or charge air after it has been compressed by the turbochargers and before it enters the cylinders' combustion chambers.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Check the level of coolant in the radiator. Follow the instructions on the cooling system in Section 4 - Power Package.

2. Check the radiator exterior for accumulation of dirt and debris. This foreign material will reduce the radiator's capacity to transfer heat to the air. Clean as required.

NOTE: *If there is any doubt as to procedure or equipment, try the method on a single tube first or contact your BUCYRUS® representative.*

a. Blow out the loose material using high pressure air, typically first blowing from the air exit side toward the inlet side, and then reverse the flow. A soft brush may be used to assist in dislodging the material.

IMPORTANT: *The air should be sprayed straight into the core and not at an angle.*

b. If grease, oil, or other contamination is evident, use a steam jet washer to assist with the cleaning.

(1) Starting with the nozzle held closely to the fins near the top on the air exit side, working on a small area.

IMPORTANT: *The water flow should be sprayed straight into the core and not at an angle.*

(2) Continue washing from the top down until the exiting water is clean.

(3) Repeat on the opposite side.

IMPORTANT: *Many radiator shops use a high alkaline soap, caustic soda, or chemical additives to their boil-out tank which attack solders. If a tube is soaked in such a solution, the solder bond between the finning and tubes will be adversely affected. If it is known that the particular solution used is not harmful to solder, then it will not hurt the solder on the tube. Be sure to completely rinse the cleaned tube or core in clean water after removing from the boil-out tank.*

3. Inspect the radiator interior for accumulation of dirt and debris. This foreign material will reduce the radiator's capacity to transfer heat to the air. Clean as required.

IMPORTANT: *Corrosion, silicate gelling, and other forms of contamination can have an adverse affect on the operation of the radiator and entire cooling system. Consult your antifreeze supplier, engine manufacturer, and BUCYRUS® representative on recommendations to eliminate or reduce these conditions. Typically, Pentray 2010 Cleaner and 2011 Neutralizer Flush products (or equivalent) may be used, following the manufacturer's specific material concentrations and instructions.*

4. If so equipped, verify the operation of the radiator pressurization system as outlined in the module on the Cooling System in Section 4 - Power Package.

5. Inspect the inlet and outlet fittings and hoses. If loose or showing evidence of deterioration, repair or replace as required.

6. Inspect the fan shroud, guards and other accessories installed on the radiator. It should be firmly attached to the radiator and in good condition. Repair or replace as

required.

7. Inspect the cross-braces. They should be tensioned evenly without distorting the radiator assembly.

8. Inspect all mounting points. The rubber shock mount should be pliable and in good condition. The support arms should be properly adjusted to support the radiator evenly on each side - not to place it in a twisting bind. The lower mounting points should be tight and in good repair. Repair or replace as required.

9. Individual leaking tubes may be plugged to prevent leakage as follows:

NOTE: *This process is recommended for limited quantities of tubes as the by-passing of each tube reduces the overall ability of the radiator to transfer heat. Permanent mechanical repairs are recommended as soon as practical.*

a. Disassemble the radiator as outlined in the instructions for DISASSEMBLY in this module to expose both of the tube ends.

b. Clean and dry the inside of the tube to be plugged.

c. Place the appropriate phenolic plugs in each of the tube ends.

NOTE: *Plug both ends of the leaking tube.*

d. Using the proper hammer, tap the plug in until it is tightly installed.

e. Carefully trim off all excess with a hacksaw or equivalent.

f. Carefully file off all excess plug material to within 0.25 inches (6.4 mm) of the tube end.

g. Reassemble and install the disassembled radiator and related components as outlined in the instructions for ASSEMBLY and INSTALLATION in this module.

h. Test the radiator for leaks before putting back into service.

10. Individual tube/header repairs (tube removal and plugging) to prevent leakage as follows:

NOTE: *This process is recommended for limited quantities of tubes as the removal of each tube reduces the overall ability of the radiator to transfer heat. Permanent*

KEY	84863J
01.	HTC Radiator
02.	HTC Core & Header Assembly
03.	HTC Top Tank Assembly
04.	HTC Bottom Tank Assembly
05.	HTC Header Gaskets
06.	HTC Right Hand Side Assembly
07.	HTC Left Hand Side Assembly
08.	LTC Radiator
09.	LTC Core & Header Assembly
10.	LTC Top Tank Assembly
11.	LTC Bottom Tank Assembly
12.	LTC Header Gaskets
13.	LTC Right Hand Side Assembly
14.	LTC Left Hand Side Assembly
15.	Capscrew
16.	Lockwasher
17.	Nut
18.	Surge Tank
19.	Capscrew
20.	Lockwasher
21.	Nut
22.	Tie Rods
23.	Nut
24.	Tie Rod Bracket
25.	Capscrew
26.	Lockwasher
27.	Flatwasher
28.	Nut
29.	Fan Shroud Assembly
30.	Capscrew
31.	Lockwasher
32.	Nut
33.	Ring & Panel Assembly
34.	Capscrew
35.	Lockwasher
36.	Nut
37.	Fan Guard Half
38.	Capscrew
39.	Lockwasher
40.	Flatwasher
41.	Flatwasher
42.	Nut
43.	Cap, 4 Inch, 14 psi with Release Button
44.	Adapter Fitting
45.	Hose Assembly
46.	Pipe Fitting
47.	Pipe Fitting
48.	Flat Round Plate
49.	Serial Number Plate
50.	Sight Glass

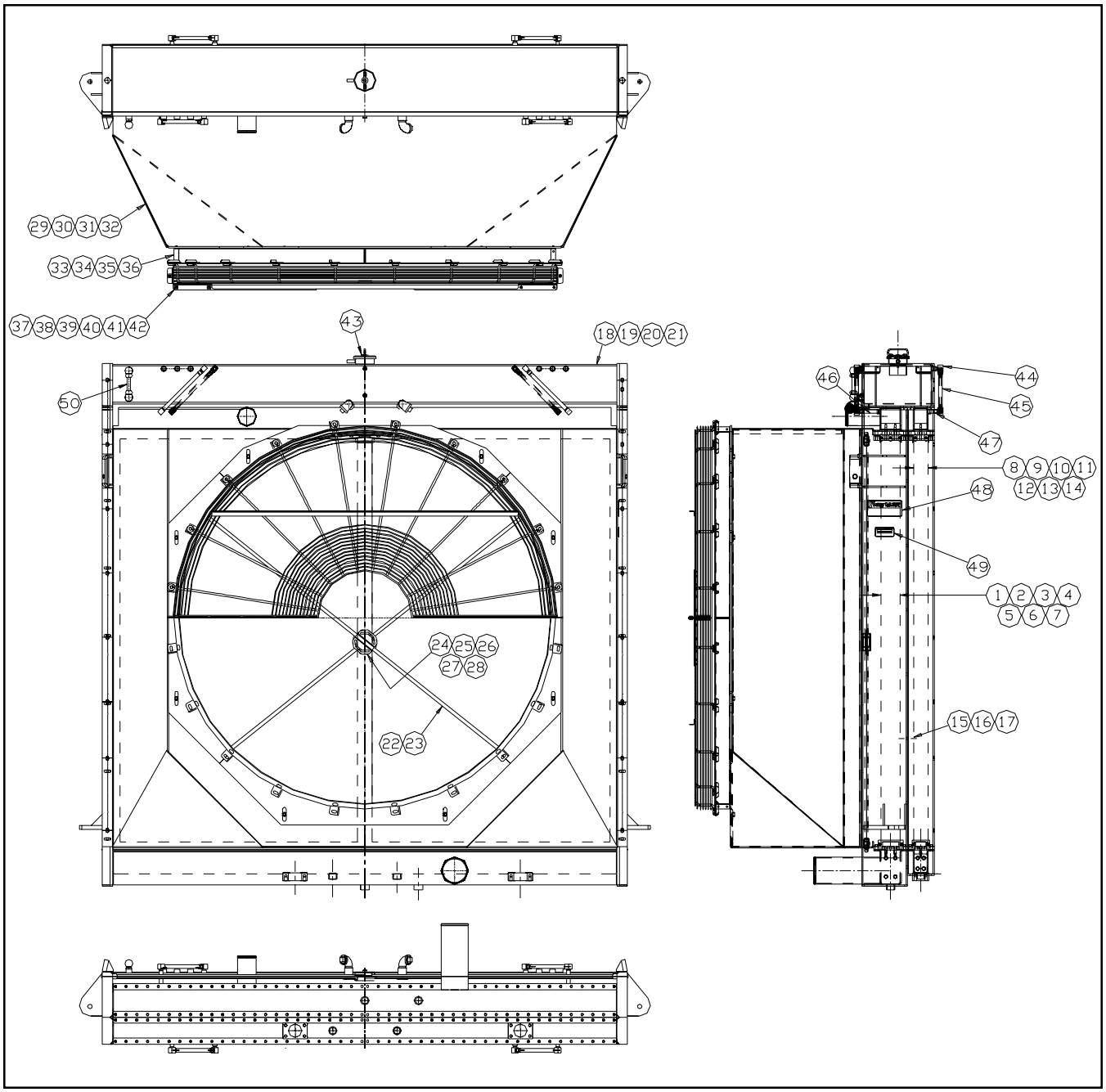


FIGURE 1 - TYPICAL RADIATOR ASSEMBLY (84863J)

mechanical repairs are recommended as soon as practical.

a. Disassemble the radiator as outlined in the instructions for DISASSEMBLY in this module to expose both of the tube ends.

b. Using the appropriate tools, drill out the tube from the header plate at both ends.

c. Clean and dry the inside of the holes in the header plate.

d. Place the appropriate phenolic plugs in each of the header plate holes.

NOTE: *Plug both ends of the removed tube.*

e. Using the proper hammer, tap the plug in until it is tightly installed.

f. Carefully trim off all excess with a hacksaw or

equivalent.

g. Carefully file off all excess plug material.

h. Reassemble and install the disassembled radiator and related components as outlined in the instructions in ASSEMBLY and INSTALLATION in this module.

i. Test the radiator for leaks before putting back into service.

REMOVAL (Figures 2 and 3)

The radiator may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release all pressure from the cooling system as outlined in the instructions in Section 4 - Power Package.

3. Drain all coolant from the radiator and engine assembly.

4. Disconnect all hoses attached to the radiator. (See Figure 3.) Mark these hoses to aid in reassembly.

5. Remove the hood assembly as outlined in the instructions in Section 2 - Structure.

6. Disconnect and remove the radiator top brace assembly.

7. Support the radiator assembly by means of the lifting hose provided in the radiator side channels.

8. Remove the hardware that secures the radiator to the main frame assembly.

9. Remove the radiator assembly from the truck, taking care not to damage the radiator core on the radiator fan assembly.

NOTE: *The thin non-ferrous fins and tubes of the radiator core sections are easily damaged. Extreme care should be used when handling the radiator.*

DISASSEMBLY (Figure 1)

The radiator may be disassembled as follows:

1. Remove the fan shroud, guards, etc. by unbolting the attaching bolts.

2. Remove the radiator cross-braces.

3. Remove the top and bottom reservoir tanks by removing the attaching bolts, washers, and nuts.

4. Remove the bolts that attach the member to be removed from the side members.

5. Disassemble the remainder of the assembly as required.

INSPECTION AND REPAIR

The unit may be serviced as follows:

1. Check the condition of the fins and tubes. Damage or accumulated dirt will reduce heat transfer and radiator efficiency. Clean or repair as required, following the instructions in the Maintenance and Adjustment portion of this module.

IMPORTANT: *Corrosion, silicate gelling, and other forms of contamination can have an affect on the operation of the radiator and entire cooling system. Consult your antifreeze supplier, engine manufacturer, and BUCYRUS® representative on recommendations to eliminate or reduce these conditions.*

IMPORTANT: *Many radiator shops use a high alkaline soap, caustic soda, or chemical additives to their boil-out tank which attack solders. If a tube is soaked in such a solution, the solder bond between the finning and tubes will be adversely affected. If it is known that the particular solution used is not harmful to solder, then it will not hurt the solder on the tube. Be sure to completely rinse the cleaned tube or core in clean water after removing from the boil-out tank.*

2. Clean all gasket material from sealing surfaces.

ASSEMBLY (Figure 1)

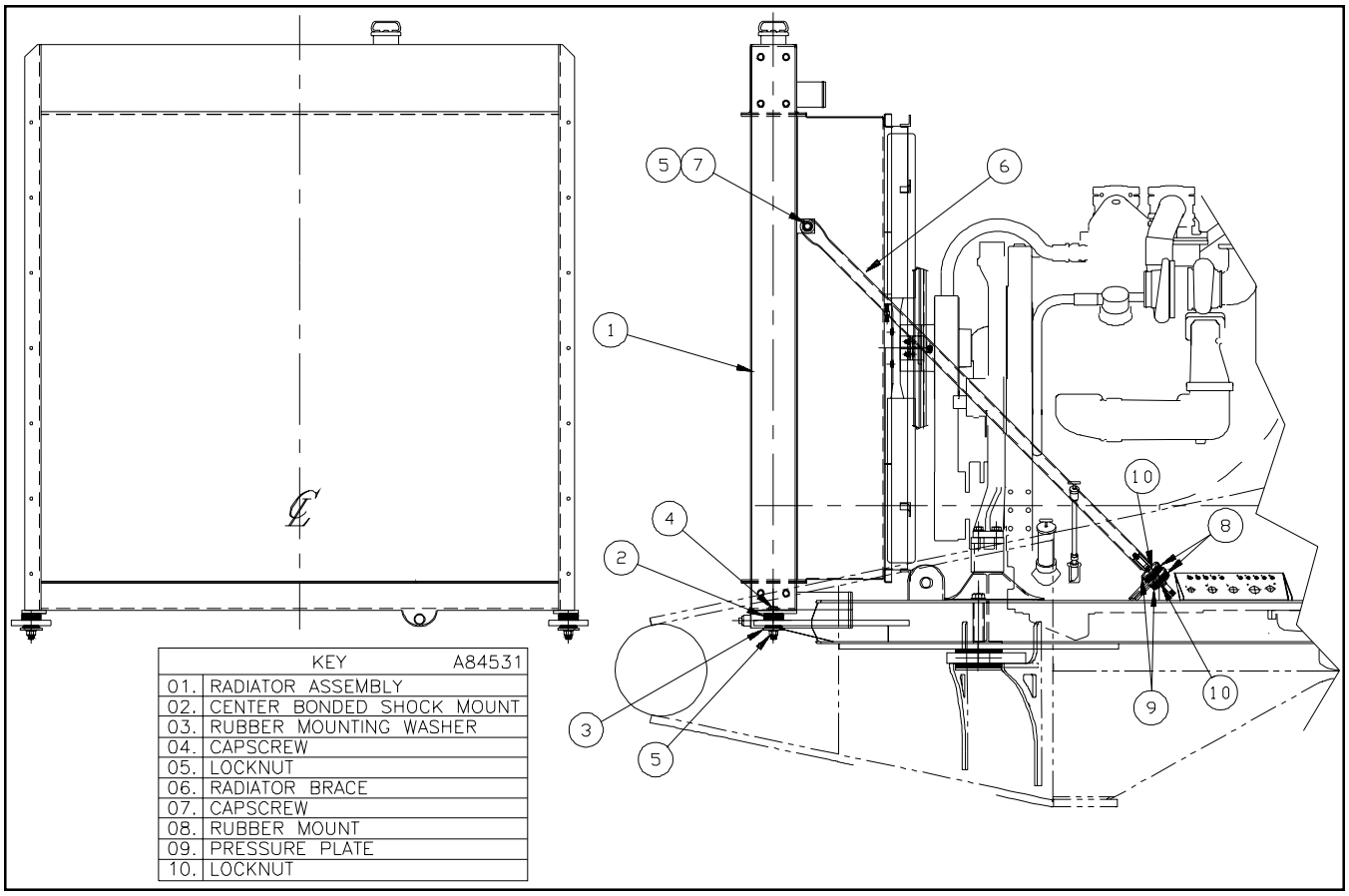
The radiator may be assembled as follows:

1. If the reservoir tanks were removed, reassemble them.

IMPORTANT: *Use only cork neoprene gaskets soaked in light oil. Do not use any cement type sealers such as Permatex or Instant Gasket.*

2. Tighten the assembled bolts until the gasket protrudes slightly. Trim off the excess gasket material.

3. Install the reservoir tanks as directed in steps 1 and 2.



KEY	A84531
01.	RADIATOR ASSEMBLY
02.	CENTER BONDED SHOCK MOUNT
03.	RUBBER MOUNTING WASHER
04.	CAPSCREW
05.	LOCKNUT
06.	RADIATOR BRACE
07.	CAPSCREW
08.	RUBBER MOUNT
09.	PRESSURE PLATE
10.	LOCKNUT

FIGURE 2 - TYPICAL RADIATOR INSTALLATION ASSEMBLY

4. Secure all components to the side members.

5. Install cross-brace members. Tighten each in small, 1 ft-lb. (1.5 Nm), increments to an approximate torque of 5 ft-lbs. (7 Nm).

6. Install fan shroud and guards and other accessory parts.

INSTALLATION

The radiator may be installed as follows: (Figure 2, unless otherwise specified.)

1. Using a suitable lifting device attached to the radiator lifting brackets, position the radiator assembly on the radiator support brackets located on the front of the main frame structure.

2. Securely install the radiator with the shock mounts (2), snubbing washers (3), capscrews (4), and locknuts (5).

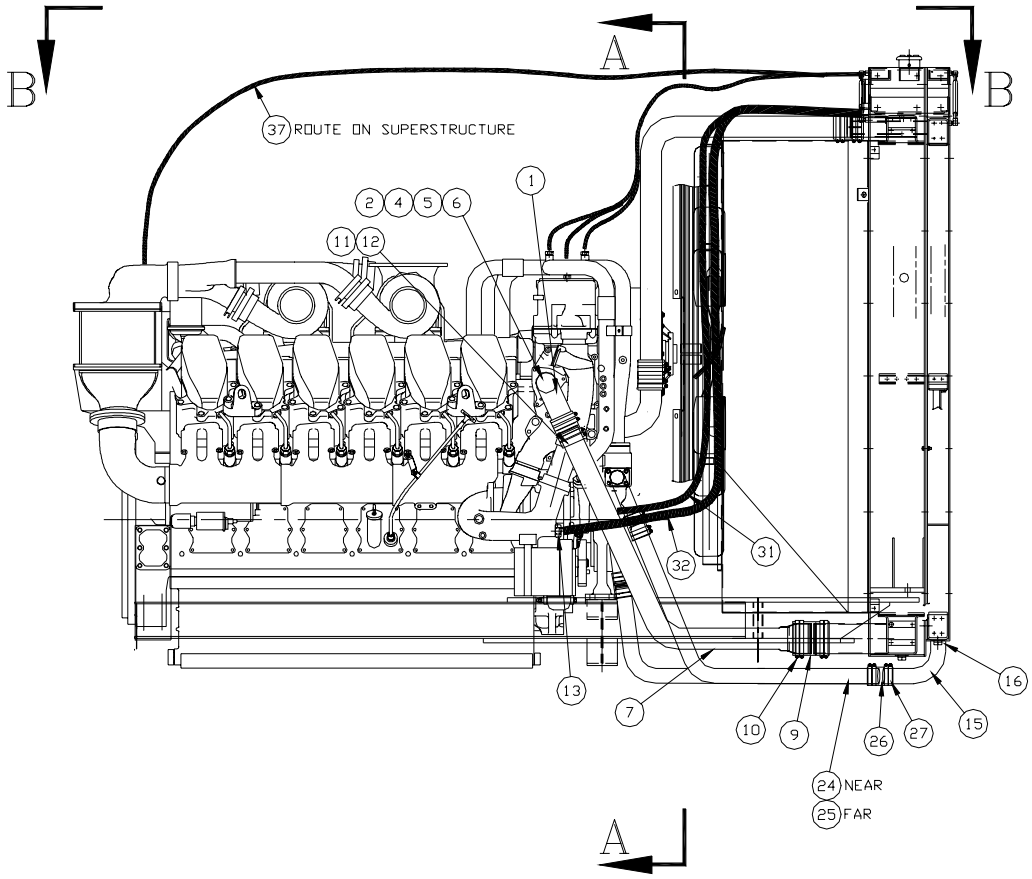
NOTE: *Use the snubbing washers to shim the radiator assembly as required to prevent the module from twisting or leaning. Do not over-tighten the locknuts to extrude or damage the rubber shock mounts.*

3. Install and secure the radiator braces (6) on each side of the radiator.

4. Install the radiator piping as outlined in Figure 3.

5. Install the hood assembly as outlined in the instructions in Section 2 - Structure.

6. Close all cooling system drain cocks and refill the cooling system. Check the cooling system for leaks. Follow the instructions in Section 4 - Power Package.



KEY A85561

01.	Elbow	22.	LTC Gasket
02.	Coolant Outlet Flange	23.	Capscrew (Metric)
03.	Not Used	24.	LTC Engine Outlet Radiator Pipe
04.	O-Ring	25.	LTC Engine Inlet Radiator Pipe
05.	Capscrew (Metric)	26.	Radiator Hose
06.	Lockwasher	27.	Clamp
07.	Lower HTC Radiator Pipe	28.	Not Used
08.	Upper HTC Radiator Pipe	29.	Adapter Fitting
09.	Radiator Hose	30.	Adapter Fitting
10.	Clamp	31.	Hose Assembly
11.	Radiator Hose	32.	Hose Assembly
12.	Clamp	33.	Adapter Fitting
13.	Adapter Fitting (Metric)	34.	Not Used
14.	Not Used	35.	Adapter Fitting
15.	Pipe Fitting	36.	Adapter Fitting
16.	Flange Kit Assembly	37.	Hose Assembly
17.	Adapter Fitting	38.	Not Used
18.	O-Ring	39.	Hose Assembly
19.	Not Used	40.	Hose Assembly
20.	Not Used	41.	Hose Assembly
21.	LTC Outlet Fitting	42.	Hose Assembly

FIGURE 3 - TYPICAL RADIATOR PIPING
4000 SERIES DETROIT DIESEL ENGINE INSTALLATION SHOWN (A85561)

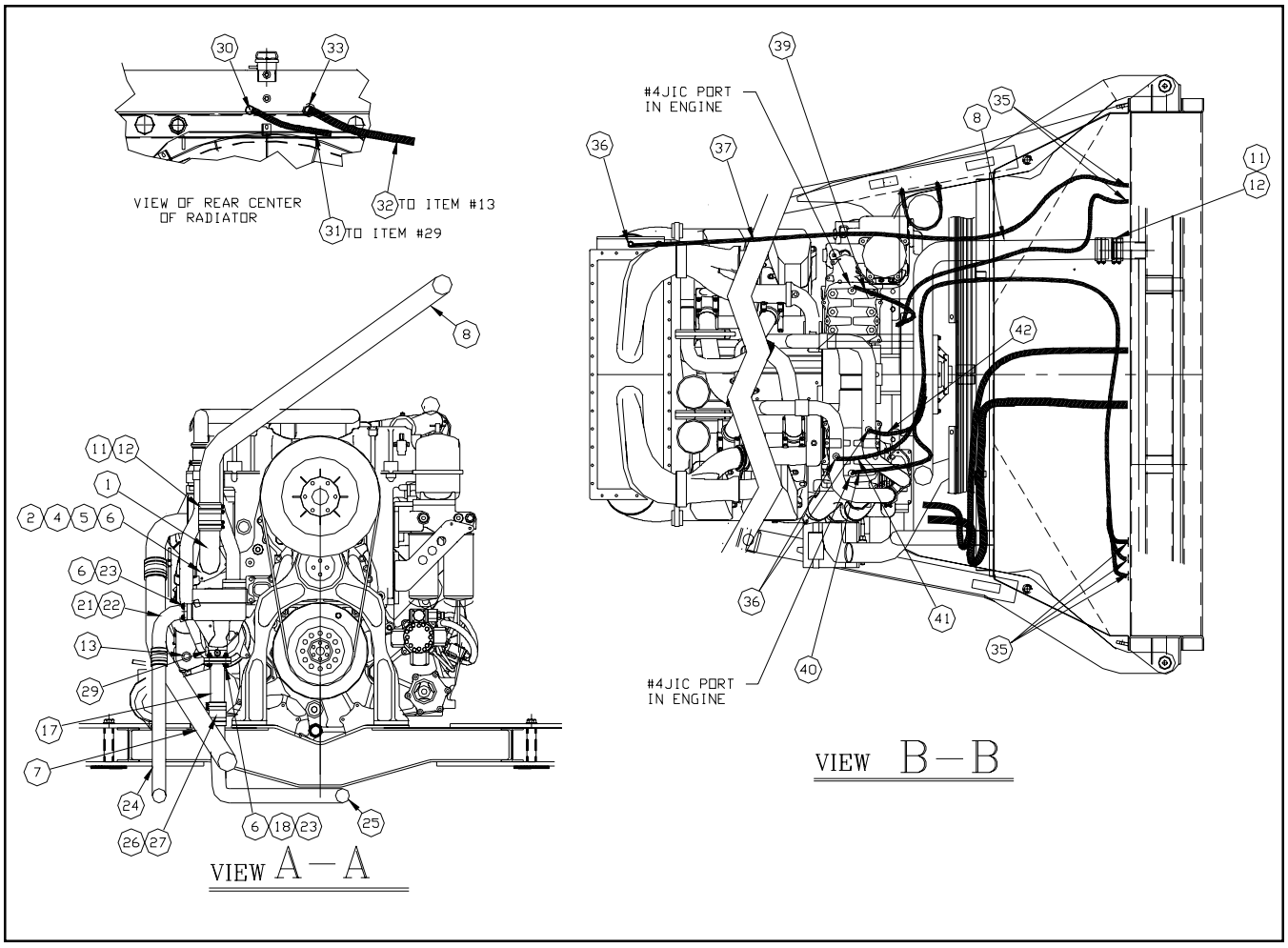


FIGURE 3 - TYPICAL RADIATOR PIPING (CONTINUED)
4000 SERIES DETROIT DIESEL ENGINE INSTALLATION SHOWN (A85561)

ALTERNATOR AND WHEELMOTOR COOLING

DESCRIPTION AND LOCATION

The alternator and wheelmotor cooling system provides a flow of air to the alternator and the wheelmotors. Important components include:

1. Air blower - dual impeller in-line blower mounted on the rear of the traction alternator. The impellers are mounted on a hub heat shrink and taper fitted to the rear of the rotor shaft. A two-piece fiberglass housing completes the assembly.

2. Ducting:

a. From the control box to the blower inlet.

b. From the blower outlet to axlebox and on to the wheelmotors.

c. From the blower housing outlet to the control box for pressurization and component cooling.

OPERATION

The blower provides a supply of cooling air to the main traction alternator and the electrical portion of the wheelmotors.

Air is drawn into the system through silencer assembly in the large opening in the electrical components control box assembly and is drawn into the blower inlet. Several electrical system components are mounted so that their heat exchanger fins extend into the air path to aid in their cooling.

On some trucks, an auxiliary cleaning system is available to assist in pre-cleaning this airflow to minimize the ingestion of contamination into the electrical system components. In this system, a panel of Donaldson Dynaclone ducts, similar to those used in the Donaldson engine air cleaner assemblies, is installed behind the control box. As the air is pulled through these ducts, it is forced to swirl and the resulting centrifugal force causes much of the debris and dirt particles to be separated from the airflow. An independent "scavenger blower" draws a separate airflow along the tube area and exhausts the separated material out through its blower output.

The blower fan is directly coupled to the traction alternator rotor shaft. As the impeller turns, it pressurizes the air to relatively low pressure and passes it onto cooling ducts. One set of these ducts directs the air internally to the alternator itself and through the desired areas. It exits through specially designed outlet screens in the alternator housing perimeter. Another air duct routes the air into the external ductwork to the rear axlebox. There it is routed through the electrical wheelmotors, exiting through the opening in the external hub cap assemblies.

A separate flow of the pressurized air is routed to the electrical control box assembly. The resulting airflow through the control box is designed to:

1. Provide cooling for several system components, and

2. Pressurize the box to minimize dust and contamination ingestion and the build up of heat and other by-products to the system operation.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance includes the following:

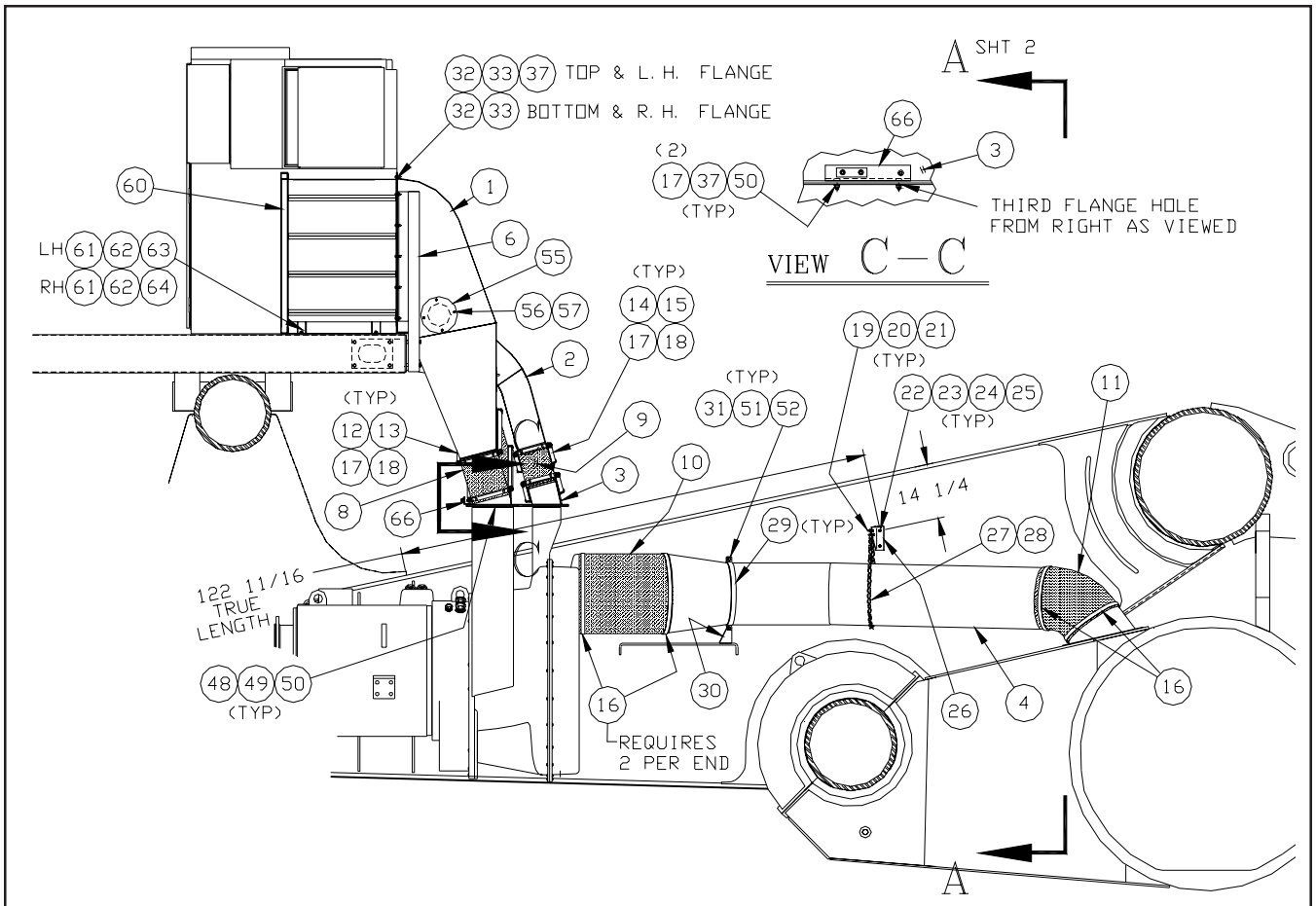
1. Inspect the blower housing for loose or missing hardware. Repair or replace as required.

2. Inspect the blower housing for evidence of damage or cracks. Repair or replace as outlined in the instructions in the electrical system manufacturers maintenance manuals.

3. Inspect all ducting to be free of damage or leakage. Repair or replace as required. RTV sealant should be used around the perimeters of all ducting connections to ensure proper sealing.

4. Verify that the 1/2 inch (12 mm) diameter drain hole at the bottom of the rear blower housing is open.

NOTE: *It is important to remember that the proper and adequate flow of air through the system is required at all times to provide the desired cooling effects. Failure to maintain these flows will result in decreased component service life.*



KEY A85921

01.	Air Intake Duct	22.	Bolting Pad	43.	Bolting Pad
02.	Inverter Cooling Duct	23.	Capscrew	44.	Capscrew
03.	Alternator/Inverter Transition Duct	24.	Flatwasher	45.	Flatwasher
04.	Air Transition Duct	25.	Lockwasher	46.	Lockwasher
05.	Duct Support Bracket	26.	Air Duct Support	47.	Nut
06.	Alternator Duct Mounting Bracket	27.	Chain	48.	Capscrew
07.	Adjusting Bracket	28.	Heat Shrink	49.	Flatwasher
08.	Flexible Rectangular Duct	29.	Tube Support	50.	Nut
09.	Flexible Rectangular Duct	30.	Air Duct Support Plate	51.	Flatwasher
10.	Flexible Hose	31.	Capscrew	52.	Nut
11.	Flexible Hose	32.	Flatwasher	55.	Cover Plate
12.	Duct Clamp	33.	Nut	56.	Capscrew
13.	Duct Clamp	34.	Neoprene Webbing	57.	Flatwasher
14.	Duct Clamp	35.	Capscrew	60.	Silencer Assembly
15.	Duct Clamp	36.	Adhesive Rubber	61.	Capscrew
16.	Heavy Duty Hose Clamp	37.	Capscrew	62.	Flatwasher
17.	Hardened Flatwasher	38.	Lockwasher	63.	Locknut
18.	Capscrew	39.	Capscrew	64.	Lockwasher
19.	Capscrew	40.	Flatwasher	66.	Air Duct Bracket Clamp
20.	Locknut	41.	Lockwasher		
21.	Flatwasher	42.	RTV Rubber Silicone		

FIGURE 1 - ALTERNATOR AND WHEELMOTOR COOLING SYSTEM – GTO BASED SYSTEMS (A85921, SHEET 1 OF 2)

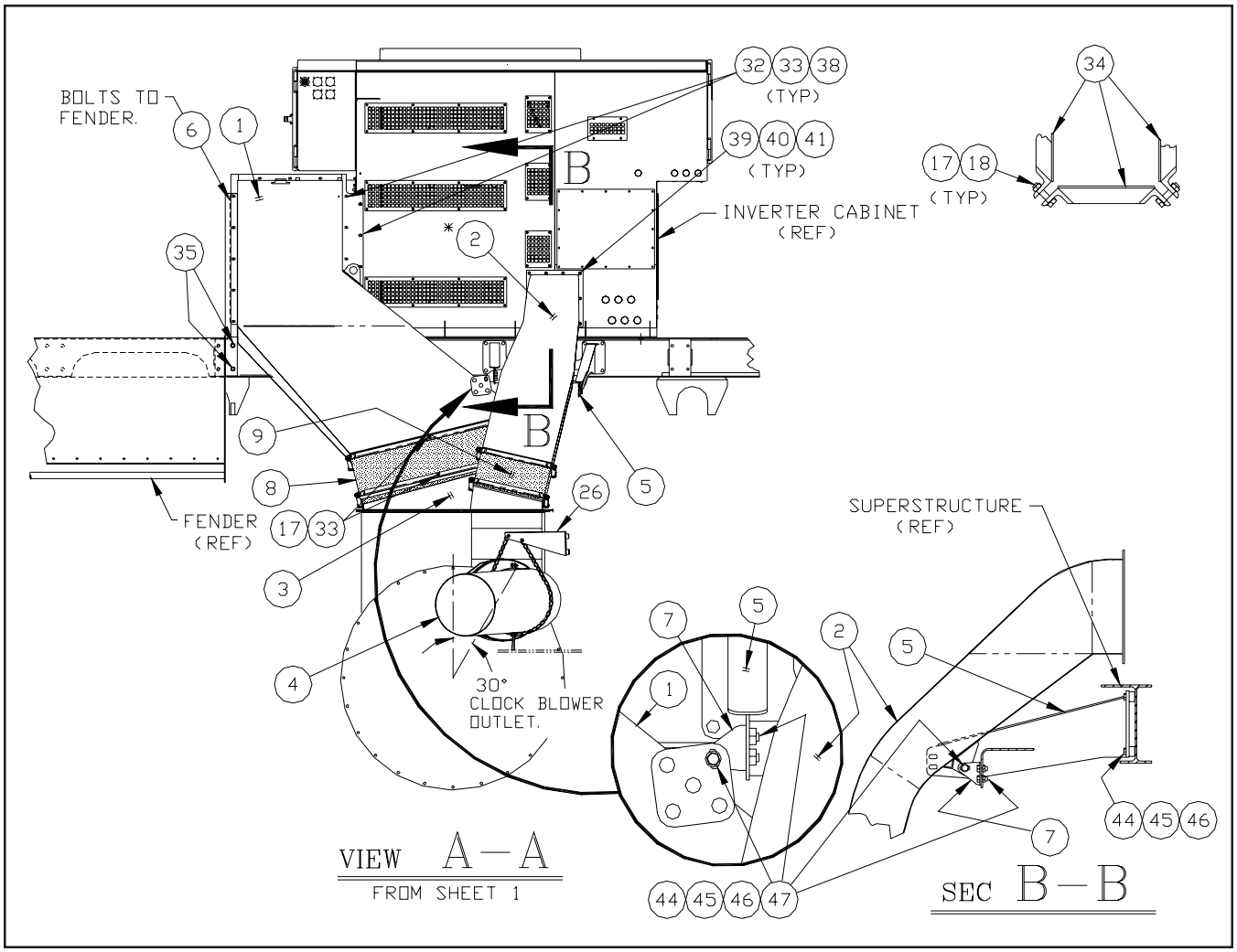
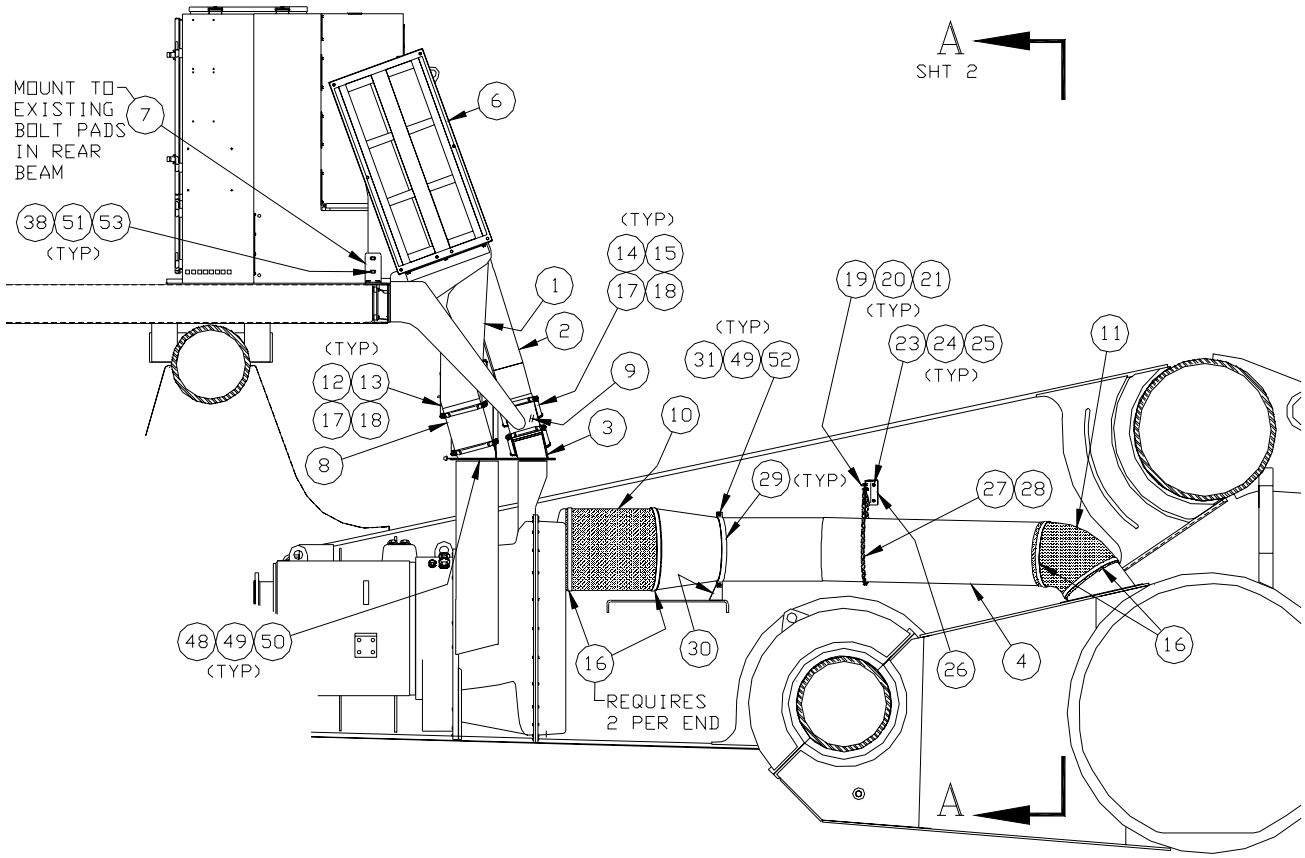


FIGURE 1 - ALTERNATOR AND WHEELMOTOR COOLING SYSTEM – GTO BASED SYSTEMS (A85921, SHEET 2 OF 2)



KEY A86242

01.	Air Intake Duct	19.	Capscrew	39.	Capscrew
02.	Cabinet Cooling Duct	20.	Locknut	40.	Flatwasher
03.	Alternator/Cabinet Transition Duct	21.	Flatwasher	41.	Lockwasher
04.	Air Transition Duct	23.	Capscrew	42.	RTV Rubber Silicone
05.	Duct Support Bracket	24.	Flatwasher	44.	Capscrew
06.	Alternator Inlet Silencer	25.	Lockwasher	45.	Flatwasher
07.	Duct Mounting Bracket	26.	Alternator Duct Support	46.	Lockwasher
08.	Flexible Rectangular Duct	27.	Chain	47.	Nut
09.	Flexible Rectangular Duct	28.	Heat Shrink	48.	Capscrew
10.	Flexible Hose	29.	Tube Support	49.	Flatwasher
11.	Flexible Hose	30.	Air Duct Support Plate	50.	Nut
12.	Duct Clamp	31.	Capscrew	51.	Flatwasher
13.	Duct Clamp	32.	Flatwasher	52.	Nut
14.	Duct Clamp	33.	Locknut	53.	Nut
15.	Duct Clamp	34.	Neoprene Webbing	54.	Adjusting Bracket
16.	Heavy Duty Hose Clamp	36.	Adhesive Rubber	61.	Capscrew
17.	Hardened Flatwasher	37.	Capscrew	62.	Flatwasher
18.	Capscrew	38.	Capscrew		

FIGURE 2 - ALTERNATOR AND WHEELMOTOR COOLING SYSTEM – IGBT BASED SYSTEMS (A86242, SHEET 1 OF 3)

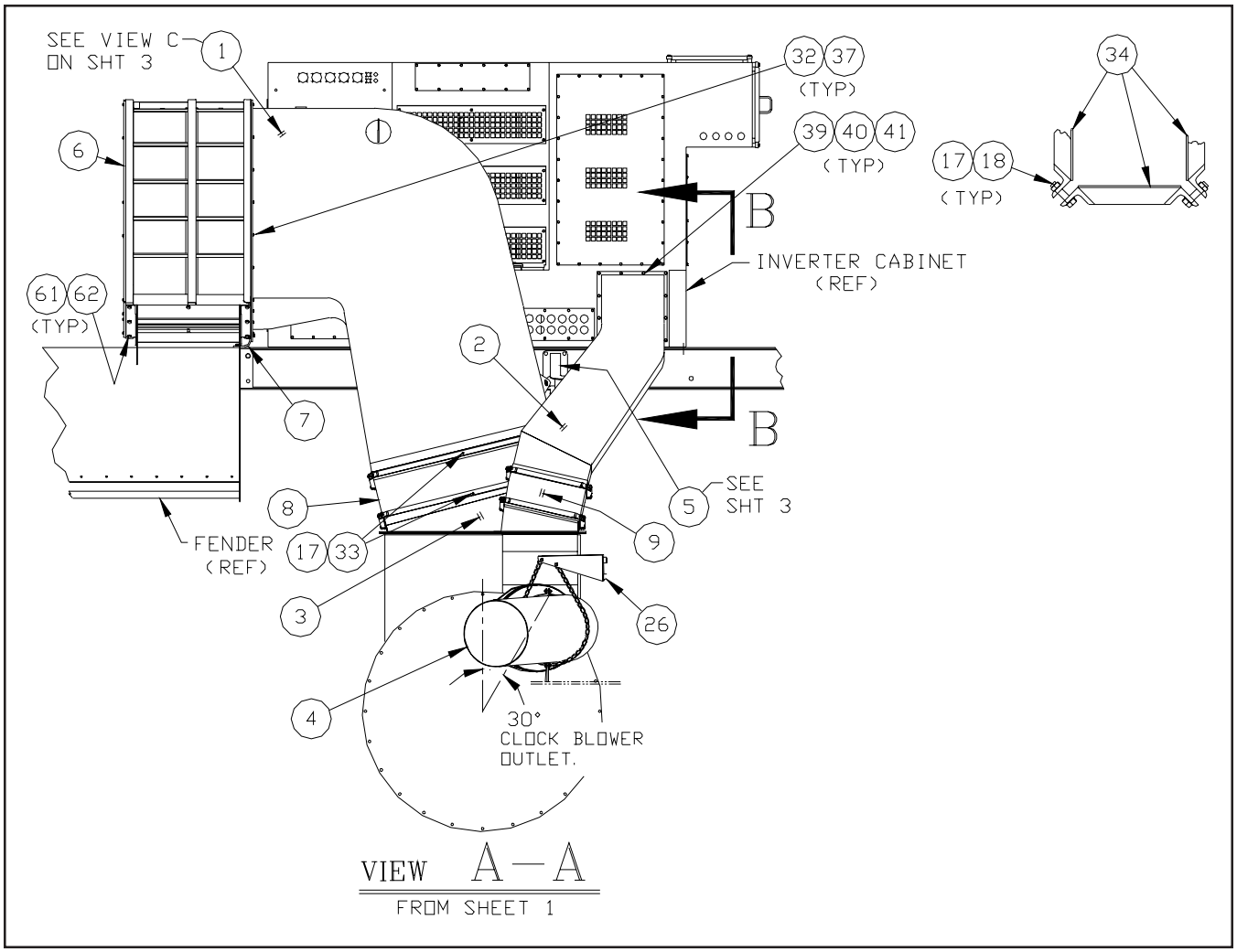


FIGURE 2 - ALTERNATOR AND WHEELMOTOR COOLING SYSTEM – IGBT BASED SYSTEMS (A86242, SHEET 2 OF 3)

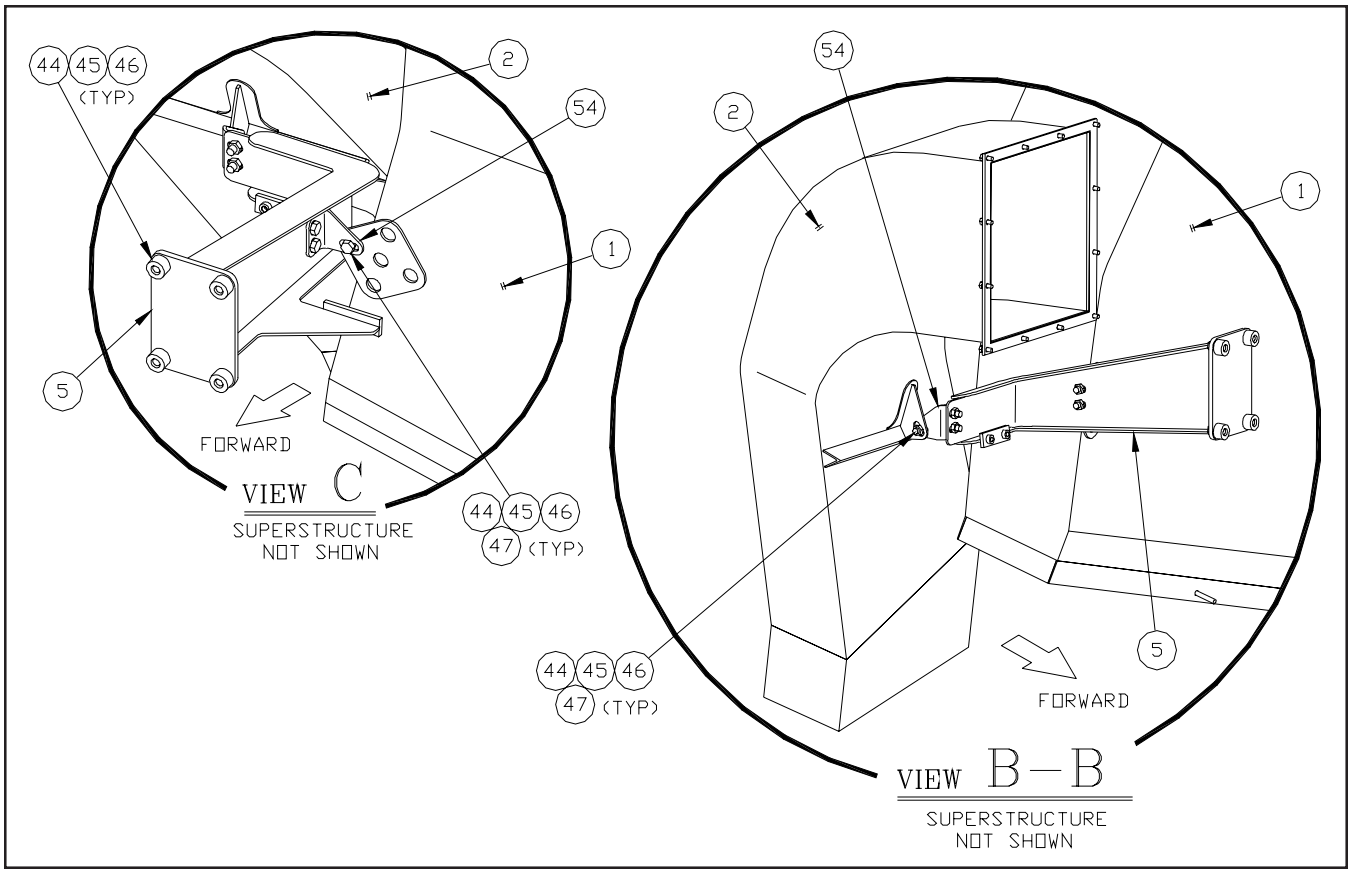


FIGURE 2 - ALTERNATOR AND WHEELMOTOR COOLING SYSTEM – IGBT BASED SYSTEMS (A86242, SHEET 3 OF 3)

HYDRAULIC SYSTEM

DESCRIPTION AND LOCATION

The hydraulic system provides power and assist for the steering, dumping, and brake systems as well as a number of lesser systems. Refer to the individual systems or component modules for detailed information.

OPERATION

The hydraulic oil supply is drawn from the hydraulic reservoir (tank) to the pump assembly. The pumps develop the pressure and flow demanded by the individual systems. The oil is routed back to the reservoir after it completes the cycle in the system.

The reservoir is maintained at a relatively constant pressure of 5 to 10 psi (35 to 70 kPa) at all times during normal operation using the internal pressure created through the operation of the truck's hydraulic system. A relief valve preset at 10 psi (70 kPa) prevents the pressure from exceeding this level.

A hydraulic oil cooler system is included to assist in maintenance of cooler temperatures in the hydraulic system. Detailed information on this system, its operation, maintenance, and testing is included in the information on the Dump System in Section 5 – Hydraulic System of the appropriate Mechanical Manual.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the hydraulic system should include the following:

1. Test the operation of the dump, steering, brake, and any other hydraulic systems as outlined in the instructions in Section 5 - Hydraulic System.

2. Inspect the systems and each of the components for evidence of leakage, wear, or damage. Refer to the individual system or component modules in Section 5 - Hydraulic System for detailed information.

3. Check the oil level in the hydraulic tank. To verify the proper operating level it should be checked as follows:

a. With the engine and Master Switch both Off, check the oil level in the sight plugs.

(1) At a minimum, it should be above the level indicated by the bottom or low level plug.

(2) If not at this minimum level, add sufficient amounts of the oil through the quick disconnect/prefiltering system on the truck to obtain this level.

b. Start the engine and allow to run at low idle speed.

c. Allow all system accumulators in the steering and brake systems to fully reach operating pressure.

d. Recheck the oil level. If it has disappeared below the lower sight plug (with the dump body in the fully lowered position) it may be necessary to refill as outlined previously prior to continuing this procedure.

NOTE: *This is especially true if the operating systems have been drained or not refilled since previous servicing.*

e. Operate each of the systems through sufficient cycles so that all air is bled from each system.

f. With the dump body fully lowered and resting on the truck frame, the steering in straight ahead position and all brakes released, stop the engine, but leave the Master Switch ON.

g. Recheck the oil level sight plugs. If the level is not to the full level, refill as outlined previously in these instructions. Be sure to leave the Master Switch ON for the entire filling process.

NOTES:
1. Since a relief valve assembly regulates the pressure in the tank, it is not necessary to relieve entrapped pressure in the tank before adding hydraulic oil.
2. Operation of the truck with the oil level between the full and low levels when measured as indicated is permissible, but filling fully at this time will provide increased system capacity.
3. Do not overfill the tank above the full tank sight plug.

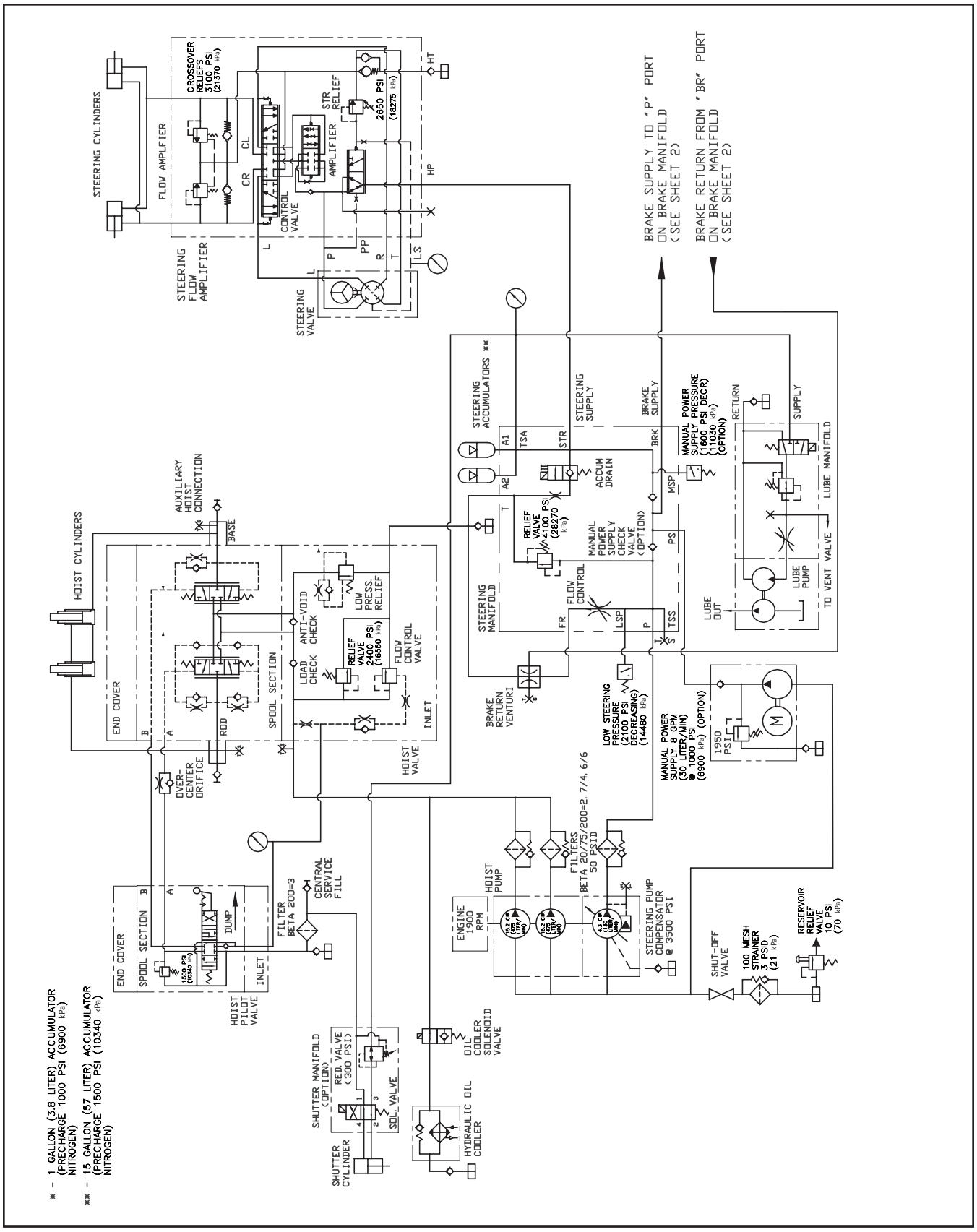


FIGURE 1 - HYDRAULIC SYSTEM SCHEMATIC (S1132) - SHEET 1 OF 2

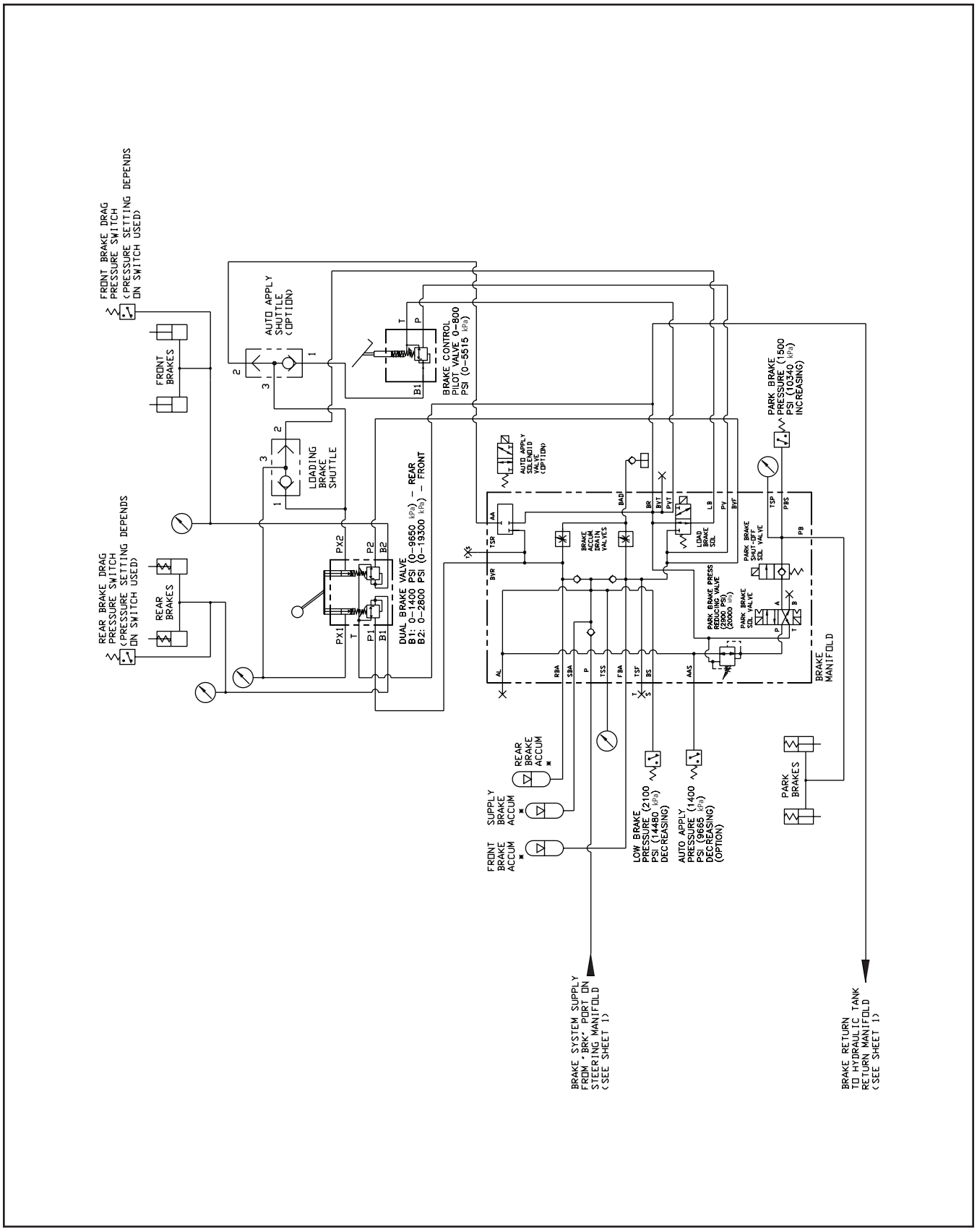


FIGURE 2 - HYDRAULIC SYSTEM SCHEMATIC (S1132) - SHEET 2 OF 2

HYDRAULIC FILTERS

DESCRIPTION AND LOCATION

(Figure 1)

Several high pressure filters are included in the truck's hydraulic systems to remove contamination and improve the operation and service life of the system components.

1. Dump System - two filter assemblies (one on the outlet supply from each section of the dump pump assembly) and are located on the left side of the main frame in front of the hydraulic tank.

2. Steering System - single assembly (on the outlet supply from the steering pump assembly) located on the left side of the main frame with the dump filters.

OPERATION

Pressurized oil from the pump assemblies enters the filter inlet and is routed through the inlet, into the center of the element. After passing through the element, it exits through the outlet port.

A relief or by-pass, valve is installed in each filter assembly that limits the maximum differential pressure through the element to 50 +/- 5 psi (345 +/- 35 kPa) in conditions such as with cold oil or a plugged to over-restrictive filter element.

A separate by-pass indicator is included that monitors the differential pressure through the element and reports it. Standard is a mechanical indicator that is "read" on the exterior of the filter assembly head. Also available as an option is an electoral switch that operates a cab mounted warning indicator system. Both of these systems are designed to activate when the differential pressure through the element has reached a level which soon will allow the by-pass valve to open.

⚠ CAUTION

Continued operation of the filters with the differential indicators activated can allow unfiltered oil to flow around the element and through the remainder of the system. This will result in damage to the system and its components.

MAINTENANCE AND ADJUSTMENT

(Figure 1)

Periodic maintenance should include the following:

1. Inspect the filter assemblies, connections, and hoses for leakage or damage. Repair or replace as required.

NOTES:

1. The filters do not normally require special attention between servicing intervals except for periodic monitoring of the differential warning devices.
2. If external leakage is noted, replace the seals at the location of the leak. For bowl seal leaks, replace the O-ring (7) and back-up ring (8), with the back-up ring (8) as shown in the illustration.
3. If the leakage persists, check the sealing surfaces for scratches or cracks. Replace any damaged or defective components.

2. With the hydraulic oil at operating temperature (e.g. greater than 120° F (49° C)) and all controls in their "neutral" position (e.g. steering and brakes released, Dump Controller lever in "Float" position).

a. Check the position of the mechanical indicator. Depress the red indicator button if extended.

b. Start the engine.

c. Accelerate the engine to rated speed and hold.

d. Verify that:

TROUBLE SHOOTING

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Excess bypassing of oil	Oil cold	Oil will bypass more at low temperature. Check when at normal operating temperatures.
	Element plugged or damaged	Repair or replace as required.

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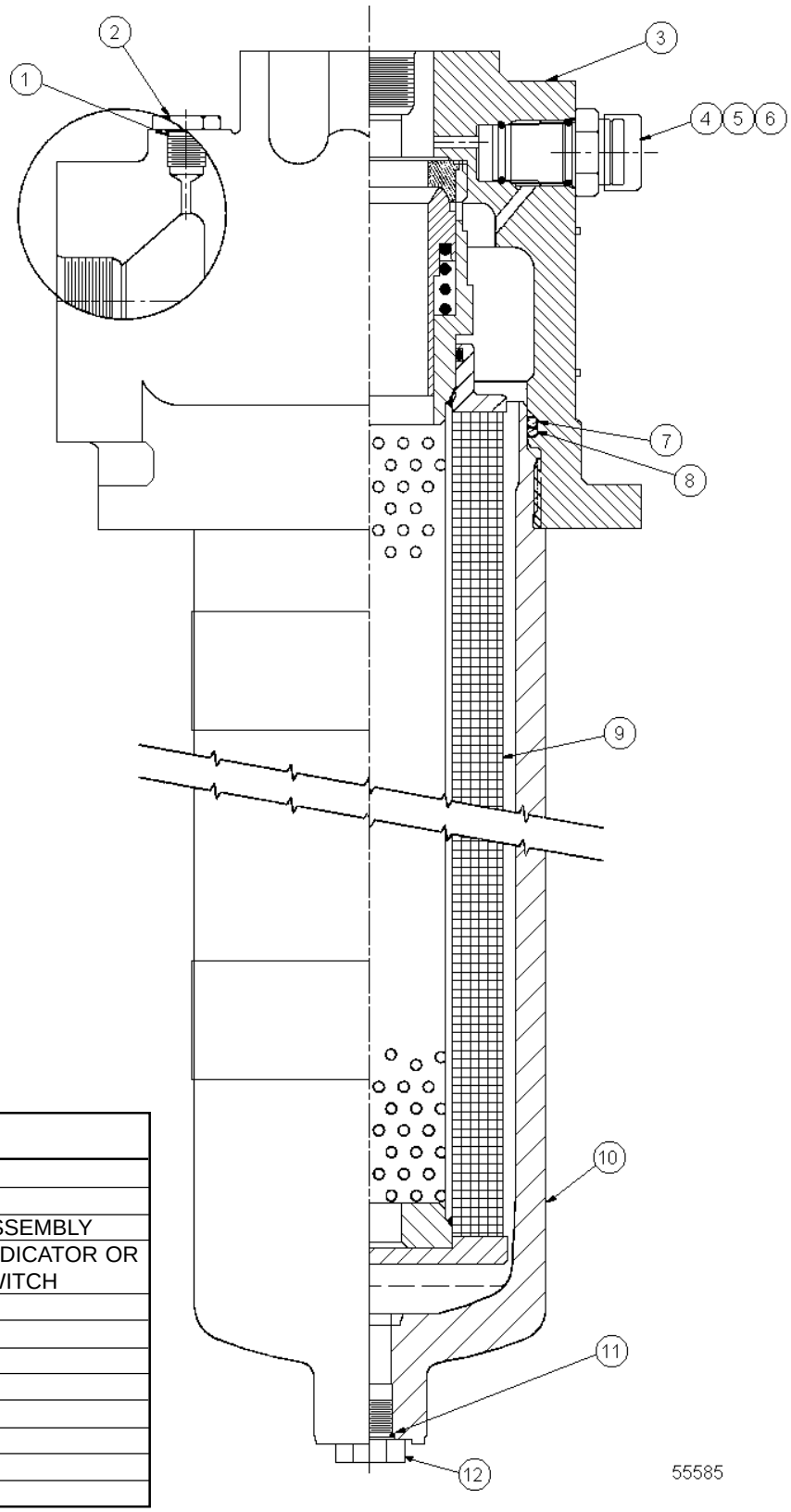


KEY	
1.	O-RING
2.	PLUG
3.	FILTER HEAD ASSEMBLY
4.	MECHANICAL INDICATOR OR ELECTRICAL SWITCH
5.	O-RING
6.	O-RING
7.	O-RING
8.	BACK-UP RING
9.	ELEMENT
10.	BOWL
11.	O-RING
12.	DRAIN PLUG

FIGURE 1 - FILTER ASSEMBLY

(1) On filters equipped with the mechanical indicators, the indicator remains in the depressed state.

(2) On filters equipped with the electrical indicators, the indicator light remains off.

NOTE: *These indicators are designed to show that the differential pressure through the element has reached a level that has or will soon allow the oil to by-pass the filtering medium and not properly filter the impurities.*

e. Slow the engine to low idle speed and stop.

CHANGING THE FILTER ELEMENT

The filter elements may be changed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Drain all hydraulic pressure from the truck's accumulators and release the pressure in the hydraulic reservoir as outlined in the instruction for operating those systems.

⚠WARNING

Failure to release all stored pressure in the system before beginning to service the filter assembly could result in explosive loss of fluid, damage to the equipment, and possible personal injury.

⚠WARNING

The oil in the hydraulic system typically operates at a high temperature. Extra care should be taken when draining this oil to avoid contact with the skin or clothing.

3. Install a drain pan securely under the filter assembly being serviced.

4. Open the filter bleed plug (2) 1-1/2 turns and allow any entrapped pressure to escape.

5. Remove the drain plug (12), and allow the oil to drain completely from the bowl (10).

6. Temporarily reinstall and tighten the drain plug (12) and bleed plug (2). Do not over tighten.

7. Unscrew (counter-clockwise) the bowl (10) from the head assembly (3) and remove.

NOTE: *It may be necessary to use a correct size wrench on the hexagon at the base of the filter bowl (10) to loosen the bowl initially.*

8. Remove the element (9) and seal rings (7 and 8).

9. Carefully inspect the surface for visible contamination or damage. Normally no contamination or particles should be seen, but if there are some present it may be an early warning of system component breakdown and can indicate potential failures.

10. Discard the filter element (9) and its seal rings (7 and 8). The filter element is not cleanable. Any attempt to clean the element can result in degradation of the filtering medium and allow contaminated fluid to flow through the filter element.

⚠WARNING

Do not attempt to clean or re-use any element or seal.

11. Inspect and remove all remaining O-rings and back-up rings including those on the plugs.

12. Clean the bowl (10) and filter head assembly (3) with clean solvent. Inspect for evidence of wear, leakage, or damage. Repair or replace as required.

13. Lubricate all new O-rings, back-up rings, and threads on the filter bowl (10) with clean hydraulic oil of the same specification of that in the truck's hydraulic system. Install all of these seal rings in their proper position as shown in the illustration.

14. Lubricate the element O-ring with clean hydraulic oil of the same specification of that in the truck's hydraulic system. Install a new element (9) straight onto the nipple in the head assembly (3).

NOTE: *While pushing up on the bottom of the element with sufficient force, a definite slight sudden movement of the element should be felt as the seals properly "seat" over the relief valve in the head assembly. If this is not felt, check to make sure that the element is properly seated.*

IMPORTANT: *Failure to seat will allow hydraulic fluid to by-pass the filter element and not be adequately filtered to assist in properly protecting the system and its components.*

15. Install the bowl (10) onto the head assembly (3).

Screw the bowl onto the head assembly until it bottoms out. Do not over tighten, as O-ring sealing is not improved.

⚠WARNING

Do not use a pipe wrench, hammer, or any tool other than a suitable wrench to tighten the bowl to the head assembly.

16. Install the drain plug (12) with a new O-ring (11).

17. Start the engine, and allow the hydraulic system to operate and check for leaks.

18. If air is entrapped in the system, bleed as instructed in Section 5 - Hydraulic System.

19. Once the hydraulic oil is again at operating temperatures, verify the condition of the filter as outlined previously in these instructions.

IMPORTANT: *A contaminated system can quickly plug a new filter element, especially when equipped with silt removal grade media. It may require one or two initial element changes to stabilize element life.*

SERVICE

Normal service requirements other than the periodic replacement of filter elements include the replacement of leaky seals, or the repair of damaged components, or connections.

NOTE: *When replacing a mechanical indicator or electrical differential pressure switch (4), new O-rings (5 and 6) should be installed and the switch tightened to a final torque of 40 ft-lbs (54 Nm).*

HYDRAULIC TANK

DESCRIPTION AND LOCATION

The hydraulic tank is the round, vertically mounted tank mounted on the left side of the trucks main frame between the front and rear tires.

OPERATION

The hydraulic tank holds approximately 175 gallons (620 liters) of hydraulic oil. Glass plugs allow the relative fluid level to be seen externally without removing any covering. A separate pressurization system uses externally provided air pressure to maintain a constant 10 psi (70 kPa) pressure as the fluid level in the tank changes. A pressure regulator is installed to prevent the build up of excessive pressure during normal operation.

NOTE: *Most tank systems are also equipped with a pull drain valve that allows the remote release of the pressure in the tank, typically from ground level.*

Filling of the tank is through a remote mounted central service or quick fill assembly and passes the fluid through either a separate remote mounted service filter assembly or the truck's dump system filters before routing to the tank.

NOTE: *The tank is grounded to the truck frame to add additional safety and durability.*

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following:

1. Inspect the exterior of the tank for evidence of damage or leakage. Repair or replace as required.

2. Inspect the mounts and brackets. They should be secure and in general good repair. Adjust, repair, or replace as required.

3. Inspect the cap on the fill ports. It should seal sufficiently to prevent contamination from entering. Repair or replace as required.

4. Inspect the inlet strainers on the fill port. It should be free of contamination and in general good repair. Repair or replace as required.

5. Inspect all inlet and outlet lines and ports. They should be free of damage and in general good repair. Repair or replace as required.

6. Periodically inspect the inside of the tank for evidence of rust, dust, or other contamination. Flush the tanks and clean as required if evidence of contamination is found.

7. Periodically test the operation of the vacuum release and pull drain valves as outlined the procedures in Section 5 – Hydraulic System in this manual.

REMOVAL

The hydraulic tank may be removed as follows:

1. Empty the contents of the tank into the appropriate cleaned containers. This may be accomplished by use of a transfer pump or other suitable device. Plugs and/or drain cocks are provided in the bottom of each tank to allow for final draining.

IMPORTANT: *Check the fluid level in the tank prior to beginning the emptying procedure and make the appropriate provisions for the large volumes of hydraulic oil that is being `transferred.*

2. Disconnect and cap or plug all lines attached to the tank. Label all hoses removed to assist in later reconnection.

3. Disconnect all wires connected to the tank.

4. Disconnect the ground strap.

5. Support the tank so the weight is removed from the mounting brackets. Secure so that it cannot move when the brackets are released.

6. Remove all remaining capscrews, etc. securing the straps around the tank. Separate the straps.

7. Remove the tank from the truck.

8. If necessary, remove the mounting bracket and strap assembly from the main frame.

DISASSEMBLY

The tank assembly may be disassembled as follows:

1. Remove all fill ports and strainer assemblies.

2. Remove all clean-out port covers.

3. Remove all internal strainers, filters, and other material.

INSPECTION AND REPAIR

The disassembled tank may be inspected as follows:

1. Inspect all threads on ports or plugs for damage. Repair or replace as required.

2. Inspect all exterior and interior surfaces for evidence of corrosion, or damage. Clean, repair, or replace as required.

3. Inspect all welds and mounting brackets for evidence of damage. Repair or replace as required.

4. Inspect the mounted brackets for evidence of wear or damage. Repair or replace as required.

5. Inspect the mounting pads for evidence of wear, damage, and hardening or other deterioration. Replace as required.

ASSEMBLY

The tank may be assembled as follows:

IMPORTANT: *Always use new gaskets and gasket sealer during assembly.*

1. Verify that the internal surfaces and components are free of contamination.

2. Install all switches, valves, and other miscellaneous equipment removed.

3. Install the clean out port covers using care to tighten and torque all of the capscrews sequentially and evenly in small stages to ensure proper sealing.

4. Install the inlet and outlet manifolds and attached hardware.

NOTES:
1. Install the check valve assembly (5) in the return manifold (4) with the slotted screws located vertically.
2. Install the diffuser (9) in the return manifold with the open area toward the outside of the tank.
3. Install the butterfly valve in the suction manifold assembly with the external pivot mounted vertically at the bottom.

4. Install both the suction and return manifolds (10 and 4) securely with the capscrews (2) and flatwashers (3) following the tightening sequence shown in the illustration. The capscrews shown are to be tightened in this sequence to torques of 8, then 15, and finally 23 ft-lb (11, 20, and 31 Nm).

5. Install the fill port/strainer assemblies and tighten sufficiently to form a firm seal. Verify that the rubber seal material on the cover forms a good seal.

NOTE: *It is recommended that thread sealant be applied to all pipe threads.*

INSTALLATION

The hydraulic tank may be installed as follows:

1. If removed, install the brackets and securing straps on the frame mounts using the appropriate mounting hardware.

NOTES:
1. It is generally considered easier to install the brackets, straps, and tank separately.
2. The tank saddle must be completely flush with the mounting bracket saddle.

2. Separate the straps as required.

3. Lift the tank carefully and position on the straps. Verify that the ports are properly oriented.

4. Move the straps around the tank and secure with the capscrews and mounting hardware. Use self-locking nuts to secure.

NOTE: *Tighten the capscrews sufficiently to secure the tanks. Do not over-tighten, as damage to the tank or straps may result.*

5. Connect all wiring to the tank.

6. Connect all hoses removed from the tank.

7. Connect the ground strap making sure to make solid connections at both ends.

8. Fill the tank with the appropriate filtered hydraulic oil using the required filtering transfer device.

9. Test all systems as outlined in the instructions in Section 5 - Hydraulic System.

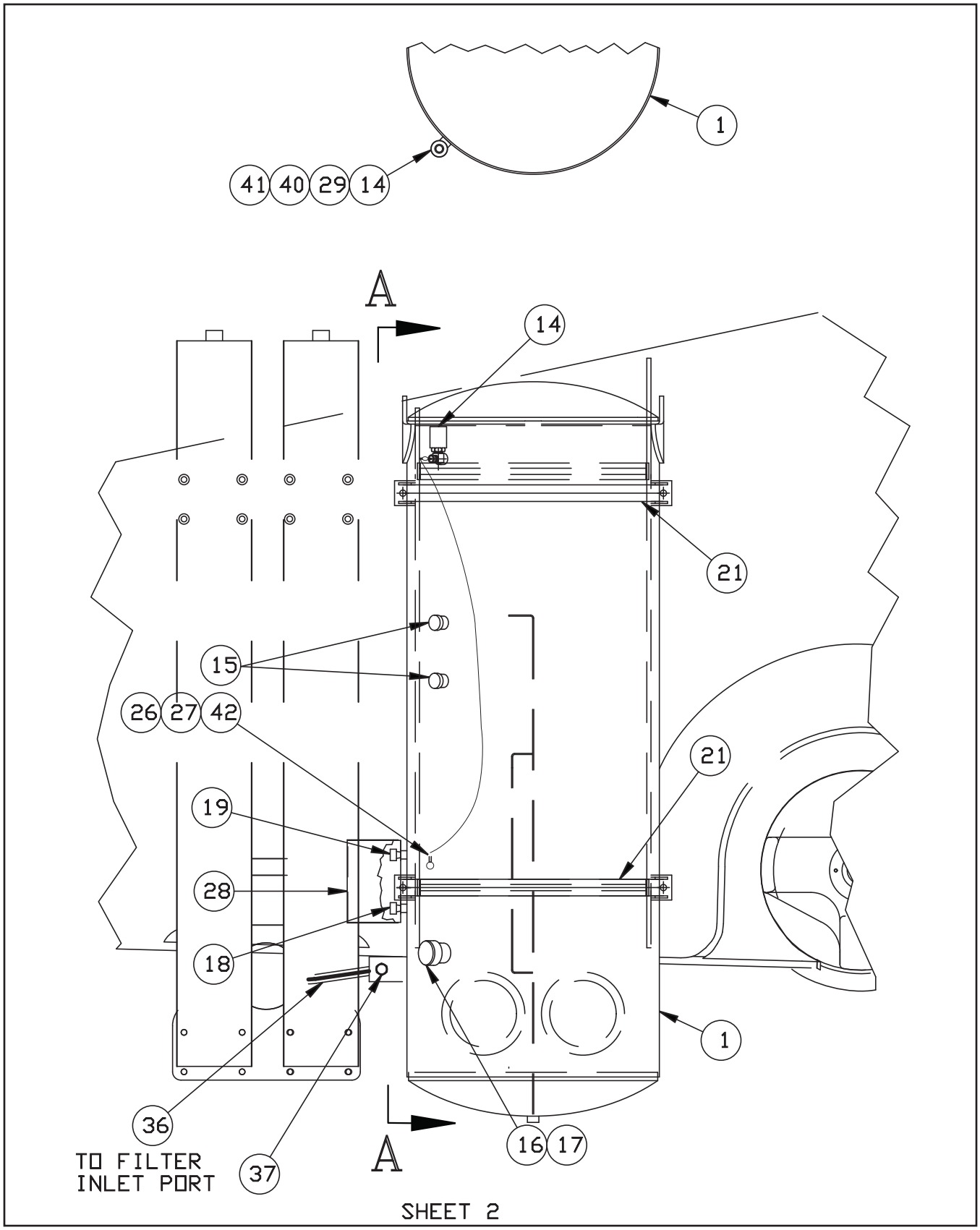


FIGURE 1 - HYDRAULIC TANK ASSEMBLY A85185

KEY			A85185
01.	Hydraulic Tank	23.	Flatwasher
02.	Capscrew	24.	Lockwasher
03.	Flatwasher	25.	Nut
04.	Return Manifold	26.	Capscrew
05.	Check Valve Insert	27.	Flatwasher
06.	Manifold Spacer	28.	Switch Cover
07.	Flange Gasket	29.	Adapter Fitting
08.	Pipe Nipple	30.	Spin On Filter
09.	Return Diffuser	31.	Capscrew
10.	Suction Manifold	32.	Lockwasher
11.	Butterfly Valve	33.	Hose Assembly
12.	Manifold Spacer	34.	Adapter Fitting
13.	Suction Strainer	35.	Adapter Fitting
14.	Vacuum Release Valve	36.	Hose Assembly
15.	Liquid Level Sight Plug	37.	Cushion Clamp
16.	Pipe Cap	38.	Adapter Fitting
17.	Drain Cock	39.	Locknut
18.	Temperature Switch	40.	Adapter Fitting
19.	Oil Level Sensor	41.	Pull Drain Valve
20.	Pipe Plug	42.	Cushion Clamp
21.	Tank Strap	43.	Capscrew
22.	Neoprene Rubber		

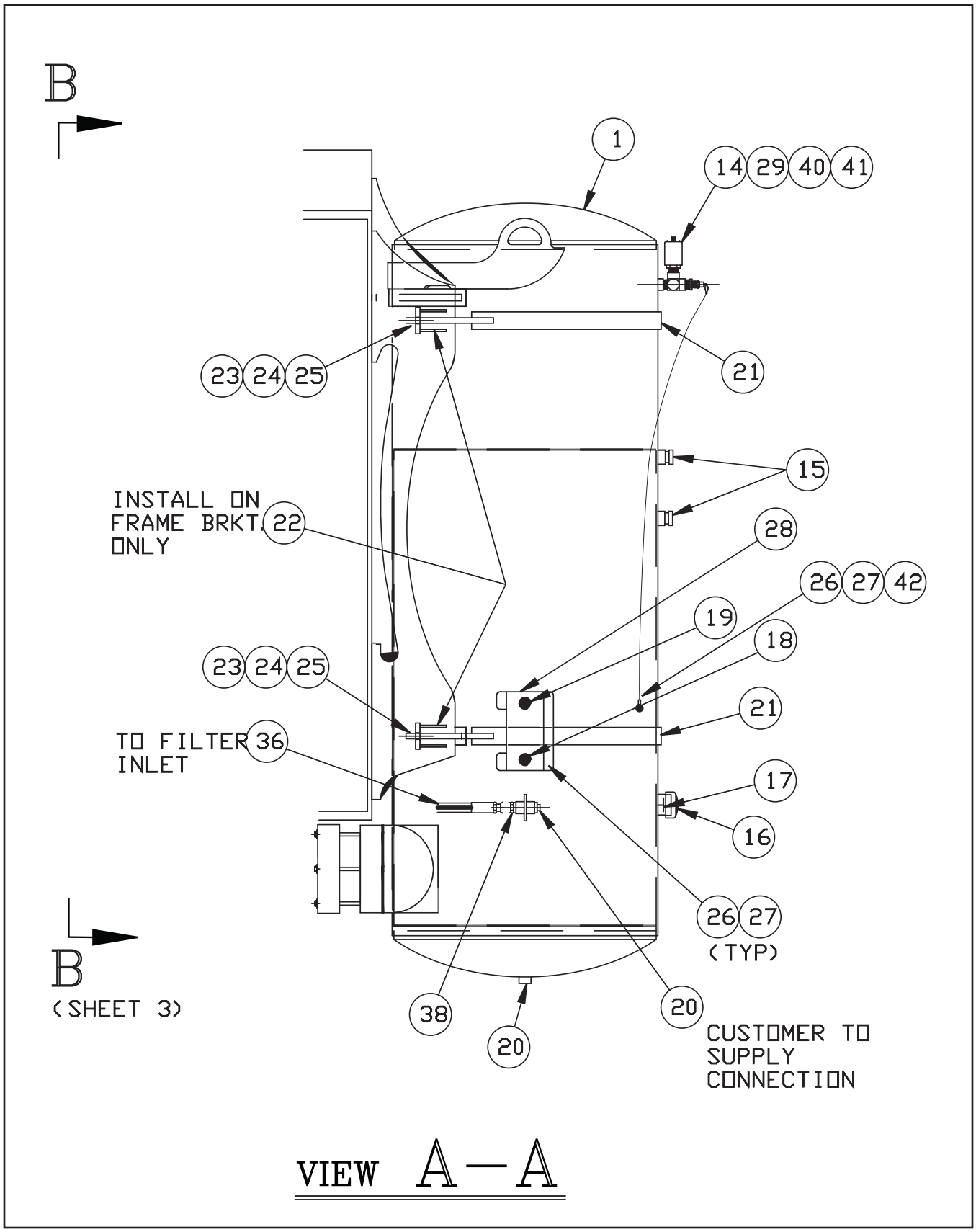


FIGURE 1 - HYDRAULIC TANK ASSEMBLY - CONTINUED

A85185

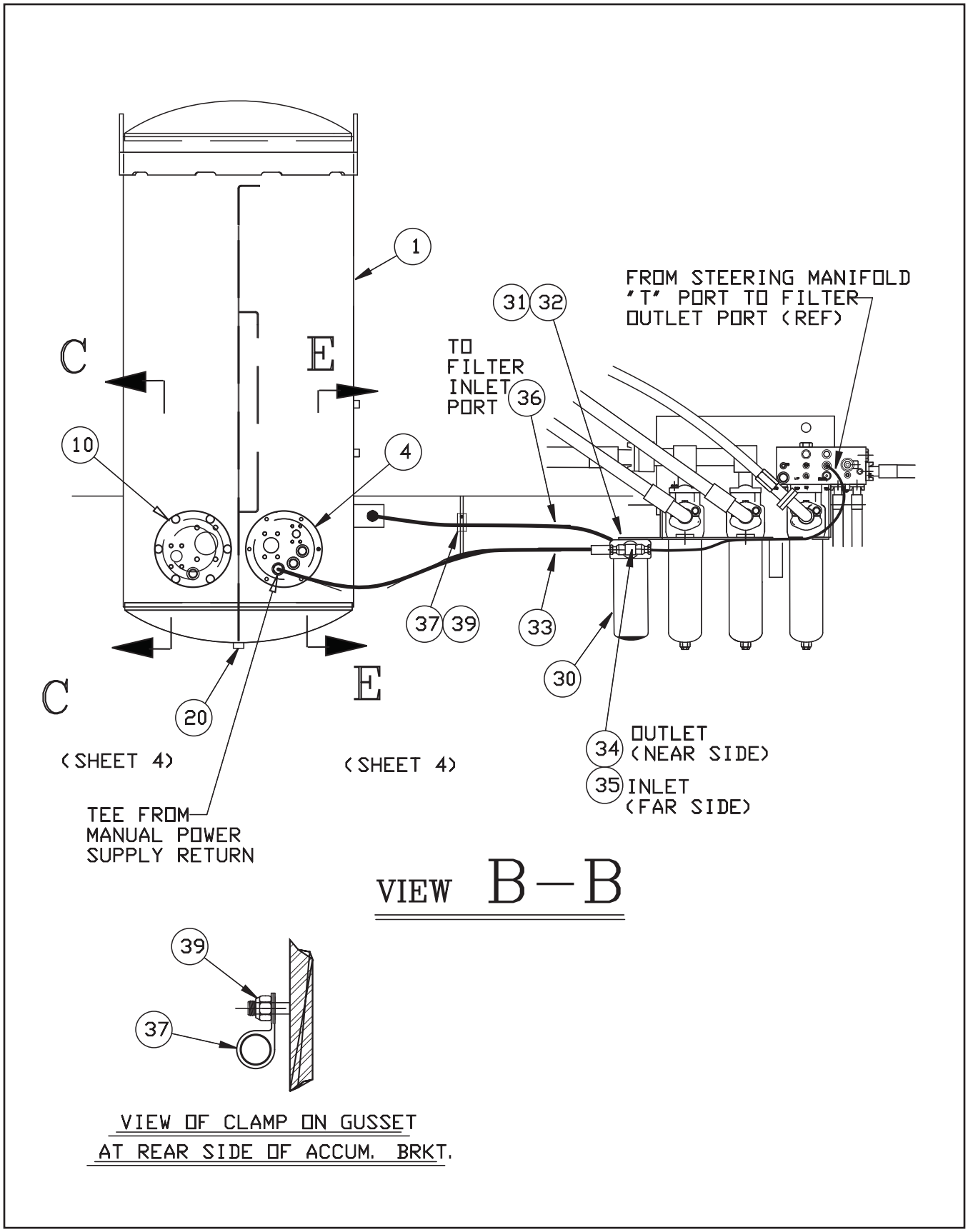
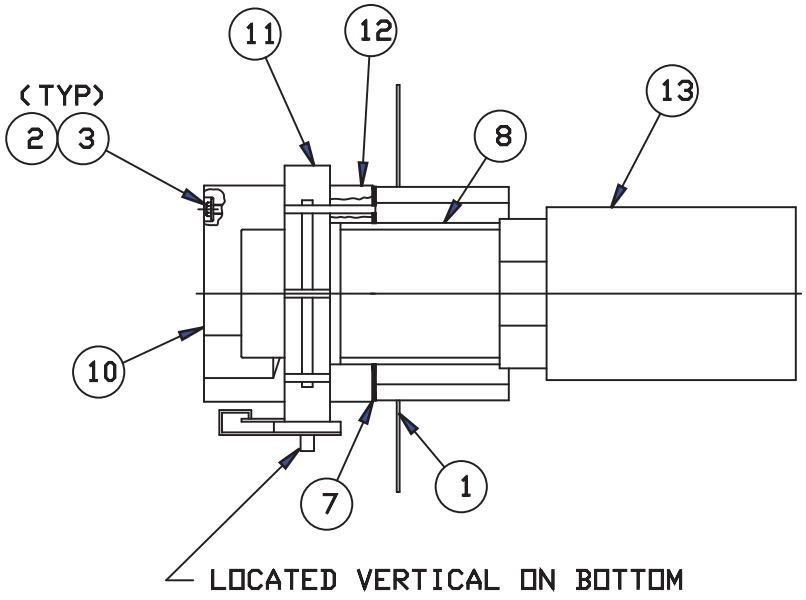


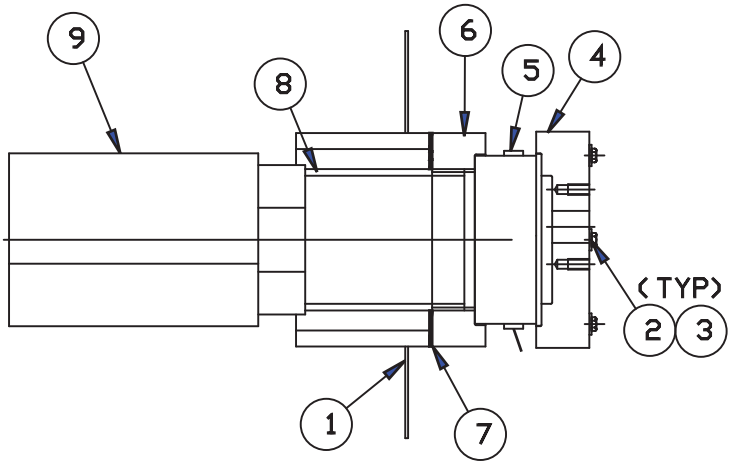
FIGURE 1 - HYDRAULIC TANK ASSEMBLY - CONTINUED

A85185



VIEW C—C

OUTLET PORT



VIEW E—E

RETURN PORT

FIGURE 1 - HYDRAULIC TANK ASSEMBLY - CONTINUED

A85185

HYDRAULIC PUMP DRIVE ASSEMBLY

DESCRIPTION AND LOCATION

The hydraulic pump drive assembly is the propeller shaft device mounted from the rear of the main traction alternator to the hydraulic pump assembly.

OPERATION

The assembly transfers the power required to operate the hydraulic dump and steering pump assembly from the output shaft adapter on the rear of the main traction alternator.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Verify that all components are secure and all mounting bolts are tight.

2. Visually inspect that the universal joint bearings remain lubricated as required to maintain smooth operation. Repair or replace as required.

3. Visually inspect the large pump mounting bracket, especially the isolation mounting pads for guidance or looseness, deterioration, or damage. Repair or replace as required.

4. Verify that the proper dimension between the pump bracket front surface (non pump mounting face) and the face of the pump drive adapter (on the rear of the main traction alternator) is maintained. If not, adjust all brackets as outlined in the Installation instructions at the end of this module.

5. Measure the vertical distance between the horizontal centerlines of the driveshaft's front and rear bearings. It should be 3/16 inch (4.6 mm). If not, adjust as outlined in the Installation instructions at the end of this module.

REMOVAL (Figure 2)

The driveshaft may be removed from the unit (without removing the pump) as follows:

1. Loosen (but do not remove) the capscrews and hardened flatwashers (15 and 17) securing the pump mounting bracket (8) to the pump platform (7).

2. Slide the pump assembly rearwards slowly (while still supporting the driveshaft (4)) until the pump drive splines are clear of the driveshaft.

3. Remove the capscrews securing the driveshaft to the alternator.

4. Remove the driveshaft and scavenger blower drive sheave (if so equipped).

DISASSEMBLY (Figure 1)

The driveshaft may be disassembled as follows:

1. Remove the capscrews (6, Figure 2) securing the splined slip yoke (5, Figure 2) to the driveshaft.

2. Remove the internal snap rings that secure the individual bearing crosses on the universal joint to be replaced.

3. Following normal shop safety practices and using the appropriate presses, remove the bearing caps from the shaft and yoke assemblies.

IMPORTANT: *It is recommended to support the driveshaft components to prevent distortion during the removal process. If the bearings are difficult to remove, use extra care not to distort or damage the shaft components.*

4. Remove the center cross assembly.

INSPECTION AND REPAIR

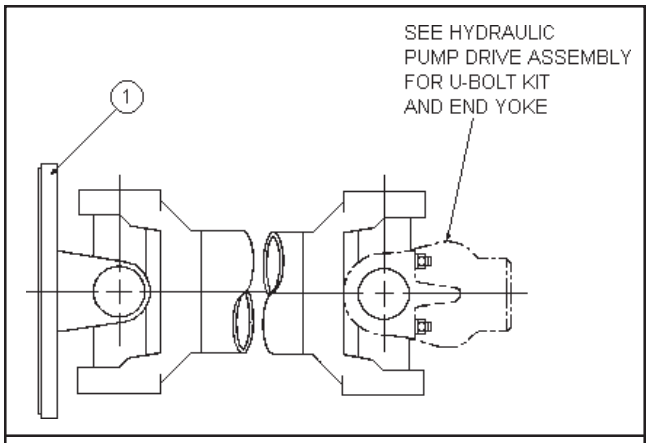
The disassembled driveshaft may be inspected as follows:

1. Clean all metal parts in solvent and dry with compressed air.

2. Inspect for evidence of wear, damage, or leakage. Repair or replace as required.

NOTE: *If the base shaft assembly is damaged, it should be repaired, straightened, or replaced, then rebalanced.*

3. Review the removed bearing assemblies to determine their probable cause of malfunctioning. If other than normal wear over an extended period of time, repair or replace other components as required.



KEY	
01.	Yoke Flange

FIGURE 1 - DRIVESHAFT ASSEMBLY (84202A)

ASSEMBLY

The driveshaft may be assembled as follows:

1. Carefully remove the bearing cap assemblies from the ends to be installed. Use extra care not to allow the bearing needles to become dislodged from their operating position or contaminated.

2. Secure the remaining bearing caps to prevent their unwanted separation from the cross assembly.

3. Following normal shop safety practices and using the appropriate presses, install the bearing caps into the shaft or yoke assembly from the outside, pressing inward until the caps are sufficiently inserted to clear the internal retaining ring groove.

IMPORTANT: *It is recommended to support the driveshaft components to prevent distortion during the installation process. If the bearings are difficult to install, use extra care not to distort or damage the shaft components.*

4. Secure the caps with the retaining rings provided.

5. Repeat steps 1 through 3 on the remaining bearing cap assemblies.

6. Install the splined slip yoke (5, Figure 2) to the driveshaft, securing with capscrews (6, Figure 2). Tighten to 32 to 27 ft.-lbs. (43 to 50 Nm).

INSTALLATION

The driveshaft may be installed as follows:

1. Verify the following are smooth and free of knicks and in general good repair:

a. Alternator shaft drive face and/or sheave mounting surfaces on units equipped with a belt driven cooling system air scavenger blower.

b. Flange end of driveshaft.

c. Splined end of driveshaft.

d. Pump drive splines.

2. Grease the pump shaft and yoke spline to improve installation ease.

3. Verify the lip seal (3) is installed in the pump bracket (8).

4. Install the flanged end on the driveshaft (with the sheave, if so equipped) onto the alternator drive face on the rotor shaft. Torque the capscrews to 32 to 37 ft-lbs (43 to 50 Nm).

5. If not already done, loosen the capscrews (15) and slide the pump assembly as far rearward on the platform (7) as possible.

6. Slide the pump assembly forward and align the splines on the pump with those on the driveshaft yoke.

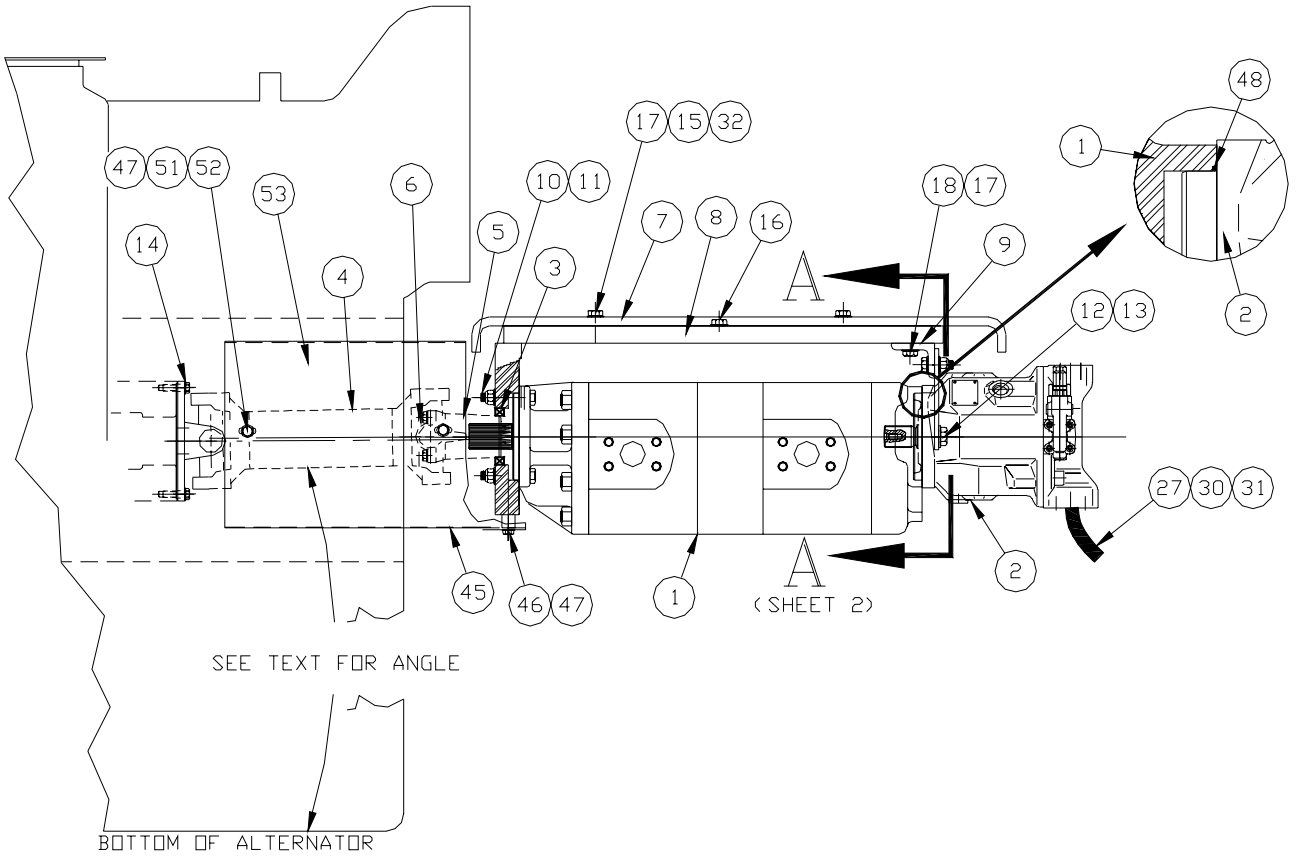
7. Once aligned, gently slide the pumps forward until the pumps will not move. Then move the pumps rearward 3/16 inch (4.6 mm).

NOTE: *When properly adjusted there should be approximately 3/16 inch (4.6 mm) forward and 2-1/2 inch (64 mm) aft adjustment.*

8. Check the angle of the driveshaft relative to parallel with the bottom of the alternator and compare it to the data in Table 1 (+/- 1/2°) and instructions outlined in Figure 1.

TABLE 1 - DRIVESHAFT ALIGNMENT	
MODEL	**ANGLE**
MT3600B/3700B (with smaller steering pump)	1-1/2°
MT3600B/3700B (with larger steering pump)	2°
MT4400/260AC	2°

13872



KEY A85186

01.	Double Dump Pump Assembly	18.	Capscrew	35.	Hose Clamp Bracket
02.	Steering Piston Pump	19.	Capscrew (Grade 8)	36.	Clamp Halves
03.	Seal	20.	Support Bracket	37.	Clamp Cap Plate
04.	Pump Driveshaft	21.	Capscrew	38.	Capscrew
05.	Slip Yoke	22.	Locknut	39.	Clamp Halves or Clamp Plate Assy.
06.	Strap and Bolt Kit	23.	Rubber Mounting Block	40.	Through Item 44. - Not Used
07.	Pump Platform	24.	Bushing	45.	Driveline Guard
08.	Pump Bracket	25.	Mounting Washer	46.	Capscrew (Grade 8)
09.	Pump Tail Support Bracket	26.	Hardened Flatwasher	47.	Flatwasher
10.	Locknut	27.	Hose Assembly	48.	O-ring
11.	Capscrew (Grade 8)	28.	Hose Assembly	49.	Capscrew
12.	Capscrew (Grade 8)	29.	Hose Assembly	50.	Clamp Halves
13.	Lockwasher	30.	Flange Kit	51.	Locknut
14.	Capscrew (Grade 8)	31.	Flange Kit	52.	Capscrew
15.	Capscrew (Grade 8)	32.	(Cab) Mounting Washer	53.	Upper Driveline Guard
16.	Capscrew	33.	Not Used		
17.	Hardened Flatwasher	34.	Not Used		

FIGURE 2 - HYDRAULIC PUMP DRIVE ASSEMBLY (A85186, SHEET 1 OF 3)

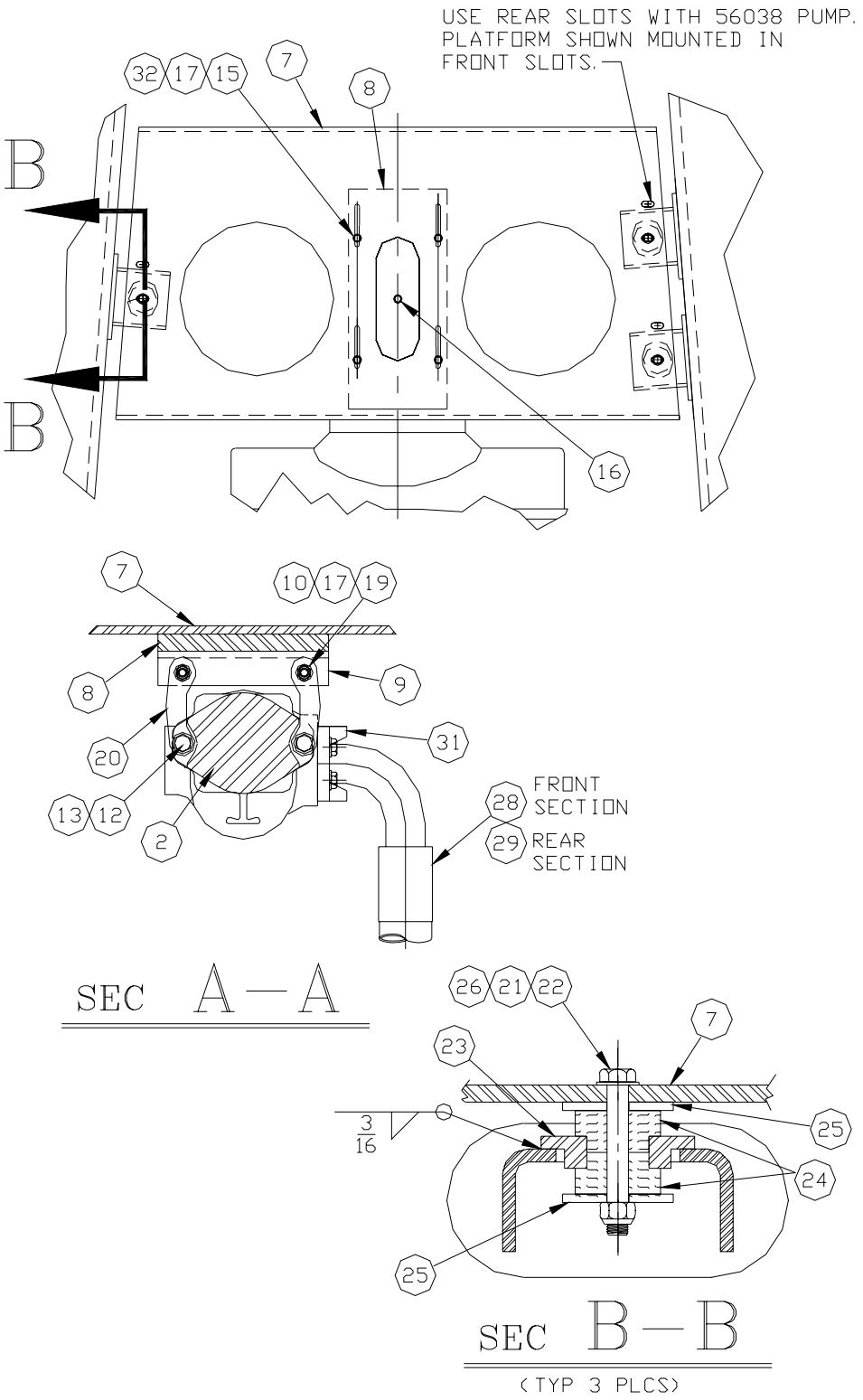


FIGURE 2 - HYDRAULIC PUMP DRIVE ASSEMBLY (A85186, SHEET 2 OF 3)

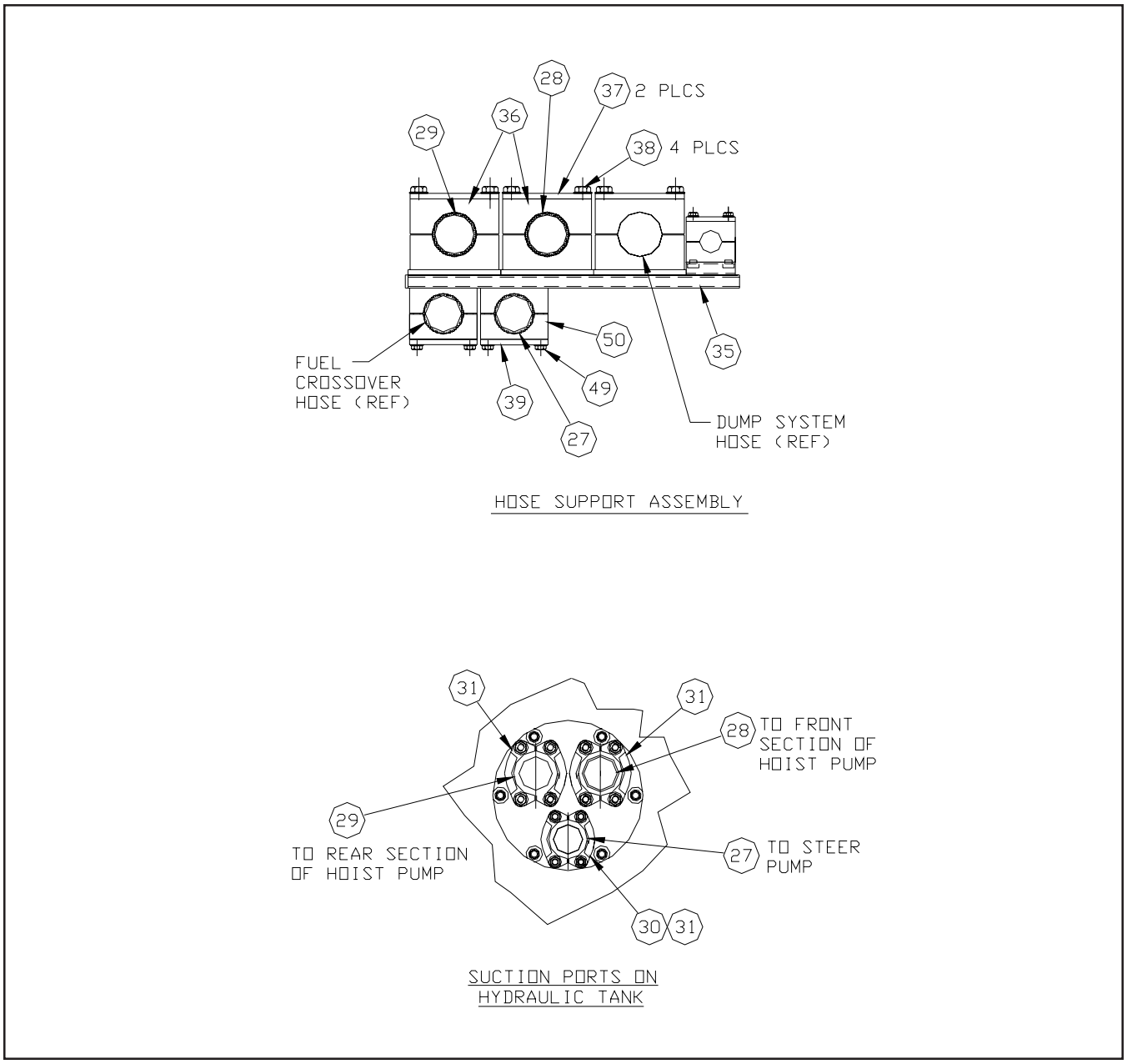


FIGURE 2 - HYDRAULIC PUMP DRIVE ASSEMBLY (A85186, SHEET 3 OF 3)

NOTES: *The use of an electronic or precision protractor or equivalent is recommended to obtain this dimension.*

9. Secure the pump assembly with the capscrews (15) and hardened flatwashers (17).

10. Fill the grease cavity, using the grease fitting inside of the driveshaft U-joint.

NOTE: *When properly installed, there should be approximately 3/8 inch (9.5 mm) forward adjustment and approximately 2-1/2 inches (64 mm) aft adjustment.*

HYDRAULIC DUMP SYSTEM

DESCRIPTION AND LOCATION

Components in the dump system include:

1. Dump pump - one dump pump with two gear sections mounted on the pump mounting platform, part of a multiple pump assembly.

2. Dump cylinders - one mounted on each side of the truck.

3. Dump pilot valve - located in the hydraulic cabinet on the superstructure behind the cab.

4. Dump control valve - mounted on left lower frame assembly.

5. Filters - two separate bowl assemblies located on left inside the lower main frame in dump pump outlet line - one for each dump pump section.

6. Auxiliary dumping connections - quick disconnect style couplings typically mounted on the main dump control valve.

7. Hydraulic oil cooler system – oil-to-air cooling condenser and related control equipment.

a. The oil cooler is mounted in front of the radiator, behind the front grille assembly.

b. The controlling solenoid cartridge valve is mounted above the dump system filters on the left inside of the lower main frame.

c. The controlling electric relay valve is mounted with other relay valves on the moveable panel in the lower right corner of the cab dash.

d. The switches controlling the operation of the relay and cartridge valve are mounted on the dump pilot valve assembly identified previously.

OPERATION

The dump system is used to control operation of the dump body. The pressurized hydraulic oil not only moves the body through the dump cylinders, but also is used to pilot control the dump system components.

PUMP OPERATION

The dump system is used to control the operation of the dump body. Hydraulic pressure, provided by the dump pump, is used to assist in component control as well as the raising of the dump body.

RAISE

To raise the dump body, the operator moves the Dump Control lever to the Raise position and holds. This mechanically positions the pilot valve to the raise position, which in turn hydraulically positions the spools in the main valve.

In the Raise position:

1. Pressurized oil from the pumps (regulated to a maximum of 2400 psi (116 550 kPa) by an internal relief valve in the inlet portion of the main valve) is routed through the load check valves, to the extend ports on the dump cylinders, causing the cylinder to extend.

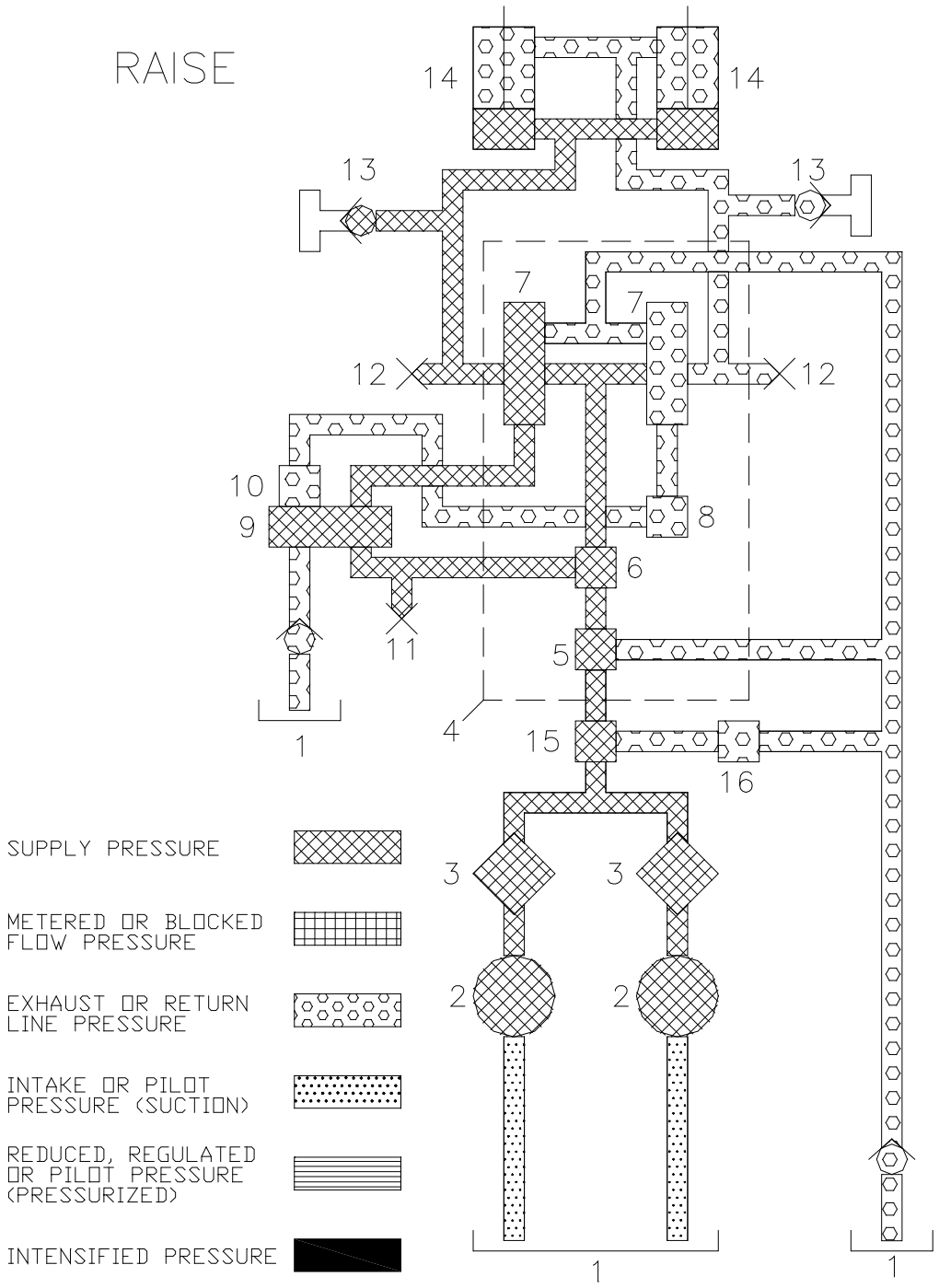
2. Low pressure return oil from the retract ports is routed through the valve back to tank. An anti-void or low pressure relief valve maintains an approximate 40 to 50 psi (275 to 345 kPa) back pressure in this side of the system to maintain some seal pressure and reduce the ingestion of air and other contaminates past the seals.

When the body rises to its overcenter point (at which hydraulic pressure is no longer required to continue raising the body), the main spools begin to try to shift positions. The unidirectional orifice (in the pilot line outlet from the retract side spool) limits this movement, allowing the main spool to move only to a restricted flow position. This control of the return flow allows the now pressurized return flow to control extension of the cylinders.

NOTES:
1. Overcenter provisions are included on these trucks even though the dump bodies themselves do not travel overcenter. This is because movement of the material in the body toward the rear during the dumping cycle causes an "effective overcenter" condition that would result in the dump body reacting just as if it had actually gone overcenter.
2. Oil flow is diverted from the hydraulic oil cooler assembly when the dump controller lever is in the Raise position.

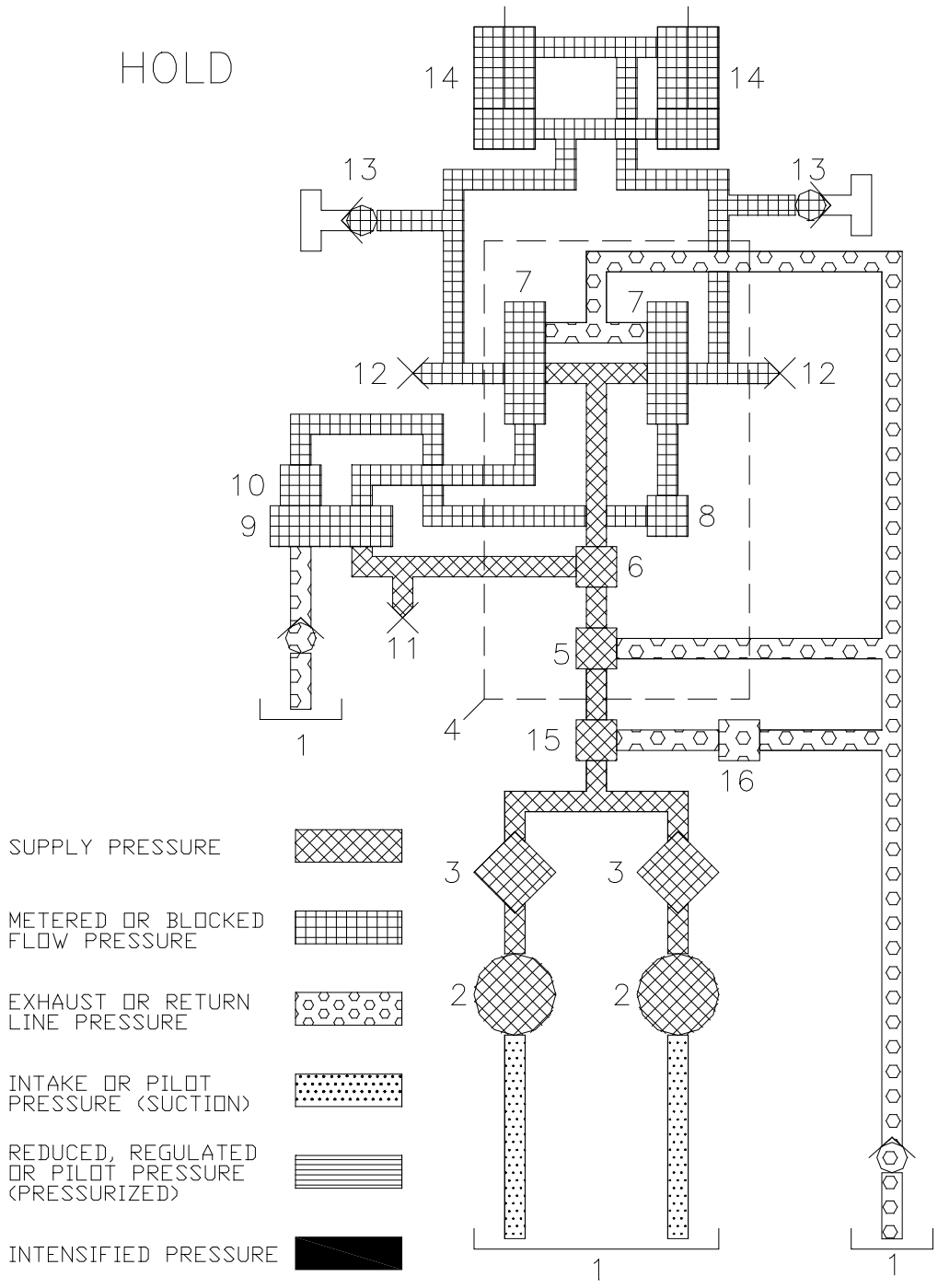
HOLD

To stop movement of the dump body (either raising or lowering) the operator must move the Dump Control lever to the Hold position. The pilot valve flow is detented causing the control valve spools to block flow from both sides of the cylinder pistons. This effectively holds the dump body in the desired position.



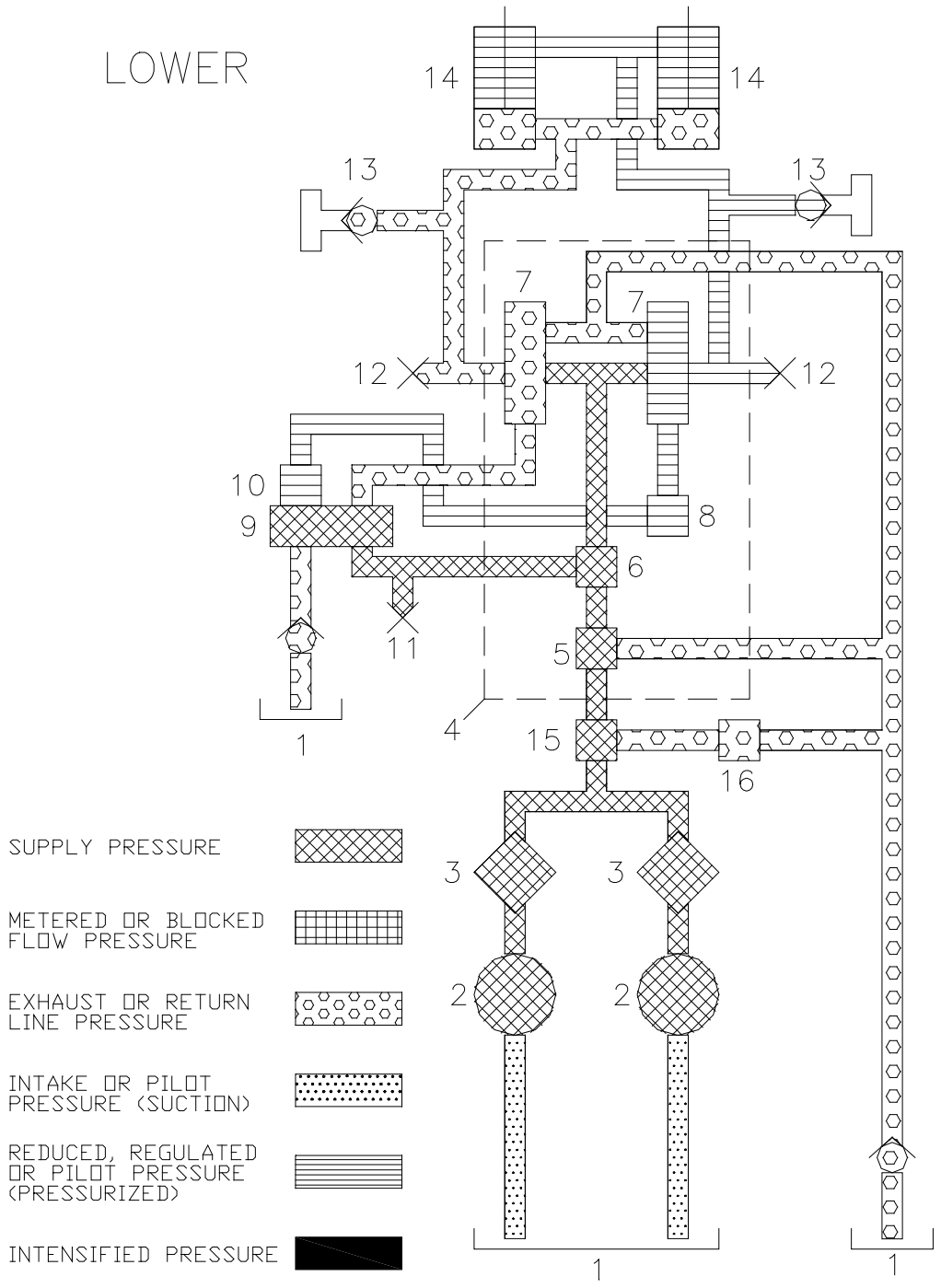
KEY			13642A
01.	HYDRAULIC TANK	09.	DUMP PILOT VALVE
02.	DUMP PUMPS	10.	PRESSURE RELIEF VALVE
03.	HYDRAULIC FILTER	11.	SYSTEM PRESSURE GAUGE
04.	DUMP CONTROL VALVE	12.	TEST PORTS
05.	MAIN PRESSURE RELIEF VALVE	13.	AUXILIARY DUMP CONNECTIONS
06.	FLOW CONTROL RELIEF VALVE	14.	DUMP CYLINDERS
07.	CONTROL SPOOLS	15.	HYDRAULIC OIL COOLER SOLENOID VALVE
08.	OVERCENTER CONTROL ORIFICE	16.	HYDRAULIC OIL COOLER

FIGURE 1 - DUMP SYSTEM OPERATION - RAISE



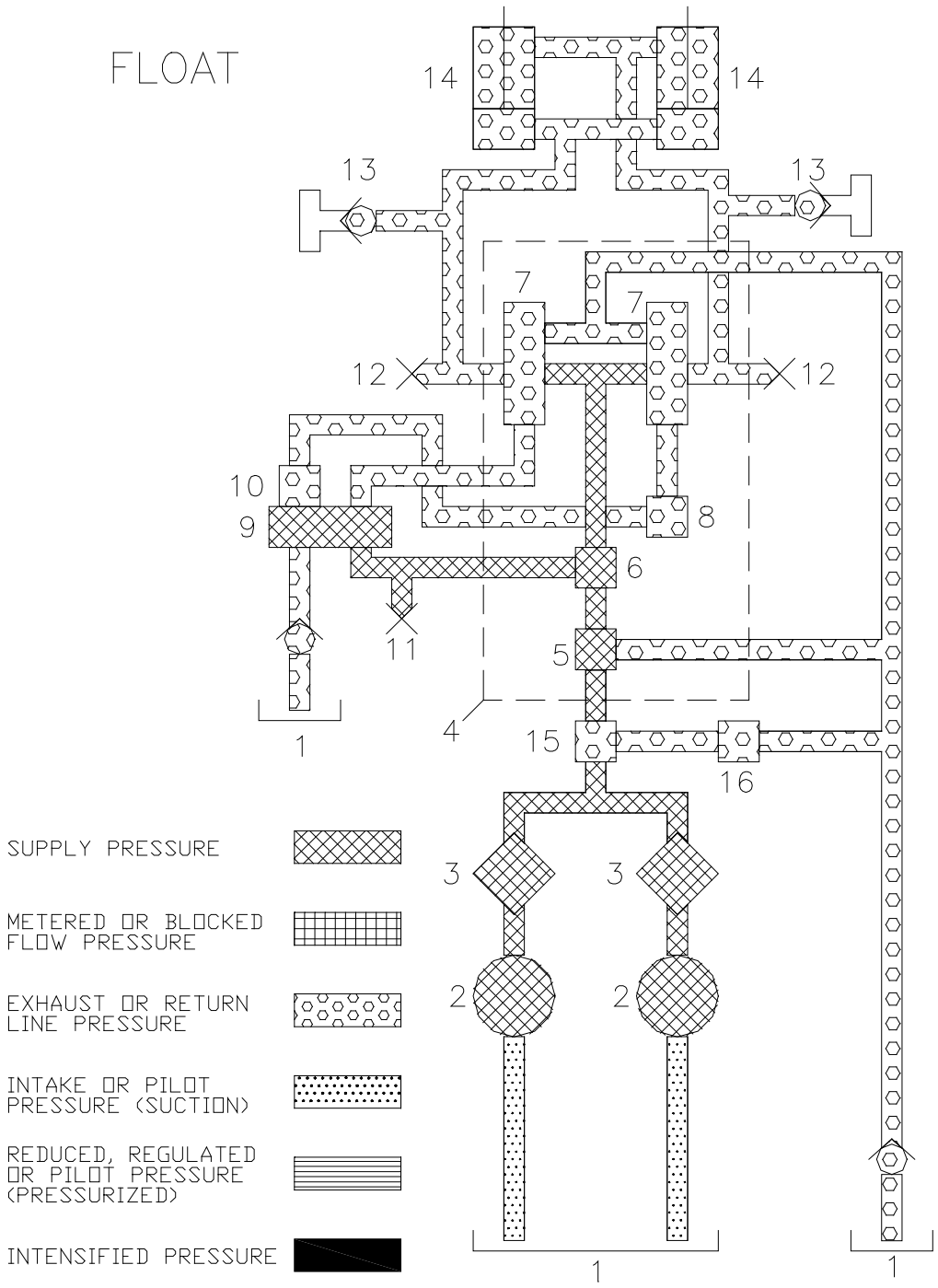
KEY			13642B
01.	HYDRAULIC TANK	09.	DUMP PILOT VALVE
02.	DUMP PUMPS	10.	PRESSURE RELIEF VALVE
03.	HYDRAULIC FILTER	11.	SYSTEM PRESSURE GAUGE
04.	DUMP CONTROL VALVE	12.	TEST PORTS
05.	MAIN PRESSURE RELIEF VALVE	13.	AUXILIARY DUMP CONNECTIONS
06.	FLOW CONTROL RELIEF VALVE	14.	DUMP CYLINDERS
07.	CONTROL SPOOLS	15.	HYDRAULIC OIL COOLER SOLENOID VALVE
08.	OVERCENTER CONTROL ORIFICE	16.	HYDRAULIC OIL COOLER

FIGURE 2 - DUMP SYSTEM OPERATION - HOLD



KEY			13642C
01.	HYDRAULIC TANK	09.	DUMP PILOT VALVE
02.	DUMP PUMPS	10.	PRESSURE RELIEF VALVE
03.	HYDRAULIC FILTER	11.	SYSTEM PRESSURE GAUGE
04.	DUMP CONTROL VALVE	12.	TEST PORTS
05.	MAIN PRESSURE RELIEF VALVE	13.	AUXILIARY DUMP CONNECTIONS
06.	FLOW CONTROL RELIEF VALVE	14.	DUMP CYLINDERS
07.	CONTROL SPOOLS	15.	HYDRAULIC OIL COOLER SOLENOID VALVE
08.	OVERCENTER CONTROL ORIFICE	16.	HYDRAULIC OIL COOLER

FIGURE 3 - DUMP SYSTEM OPERATION - LOWER



KEY			13642D
01.	HYDRAULIC TANK	09.	DUMP PILOT VALVE
02.	DUMP PUMPS	10.	PRESSURE RELIEF VALVE
03.	HYDRAULIC FILTER	11.	SYSTEM PRESSURE GAUGE
04.	DUMP CONTROL VALVE	12.	TEST PORTS
05.	MAIN PRESSURE RELIEF VALVE	13.	AUXILIARY DUMP CONNECTIONS
06.	FLOW CONTROL RELIEF VALVE	14.	DUMP CYLINDERS
07.	CONTROL SPOOLS	15.	HYDRAULIC OIL COOLER SOLENOID VALVE
08.	OVERCENTER CONTROL ORIFICE	16.	HYDRAULIC OIL COOLER

FIGURE 4 – DUMP SYSTEM OPERATION - FLOAT

NOTES:
1. The oil from the dump pump is directed back to the reservoir tank by the pilot and control valves.
2. Oil flow is diverted from the hydraulic oil cooler assembly when the dump controller lever is in the Hold position.

LOWER

To lower the dump body, the operator moves the Dump Control to the Lower position and holds. This mechanically positions the pilot valve to the lower or "power down" position, which in turn hydraulically positions the spools in the main valve.

In the Lower position:

1. Pressurized oil from the pumps (regulated to maximum of 2400 psi (16 550 kPa) by an internal relief valve in the inlet portion of the main valve) is routed through the load check valves, to the retract ports on the dump cylinders, causing the cylinder to retract.

A separate relief valve in the pilot valve assembly limits the maximum pressure in the Lower mode to 1500 psi (10 340 kPa). This is to limit the rate of return of oil from the cylinders to the tank in the power down mode, reducing any possible system problems caused by the potentially high return flow rates.

2. Low pressure return oil from the extend ports is routed through the valve back to tank. An anti-void or low pressure relief valve maintains an approximate 40 to 50 psi (275 to 345 kPa) back pressure in this side of the system to maintain some seal pressure and reduce the ingestion of air and other contaminants past the seals.

NOTE: *Oil flow is diverted from the hydraulic oil cooler assembly when the dump controller lever is in the Lower position.*

FLOAT

Once the dump body is lowered more than approximately 1/2 of its total travel, the operator moves the Dump Control lever to the detented Float position. This resulting valve flow positions the main control spools to direct the flow from the pump and both sides of the cylinder piston. The oil flow rate through the valve regulates the lowering until the dump body is resting on the dump body pads on the frame. At this point, the cylinders are carrying no load and are not pressurized--a desired condition for haulage operation.

⚠ CAUTION

Hold the Dump Control lever in the Lower position only until the dump body is approximately one-half the way down. To continue to power the dump body down will result in the dump body's striking the frame at a relatively high rate of speed. With the control in the Float position, the dump body will settle onto the frame.

IMPORTANT: *The Dump Control lever and dump valve must be in the Float position at all times the truck is in operation. On some trucks a pressure switch will not allow truck propulsion with the valve not in the float position and hydraulic pressure trapped in the lines.*

The Dump Control lever is detented in the Hold and Float positions only. It must be held in the Raise or Lower position. Releasing the Dump Control lever from the Raise position will permit it to move and remain in the Hold position, while releasing the lever from the Lower position to move and remain in the Float position. All other movement must be made manually.

NOTE: *The system is designed to provide infinite positioning of the spool, directly controlled by movement of the Dump Control lever. This enables the operator to maintain precise control of the dump body movement.*

Optional provisions are available which allow the dump body to be raised or lowered by means of an external source, typically another truck's dump system, if the normal pump system is unable to provide required pressure and flow. In this mode, the disabled truck's control valve is placed in the Hold position, blocking off the normal supply and control circuit and the external sources supply controls the operation of the dump cylinders and body.

A dump system/separate loading brake interlock system is available as an option to prevent the raising of the dump body until the truck’s load brake is activated.

NOTE: *The system is designed to provide infinite metering of the dump control valve in the raise and lower modes, which directly controls movement of the dump body. This enables the operator to maintain precise control of dump body movement.*

When the Dump Controller lever is moved to the Float position, a timer is activated. At a preset time interval (typically 45 seconds), the timer activates a cab mounted relay. This causes a solenoid valve to open and to allow the flow of oil, diverted from the dump system, to flow through the oil cooler assembly. The

flow is maintained as long as the Dump Controller lever remains in the Float position.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Inspect all hoses and lines for evidence of damage or leakage. All hoses should be secured properly and properly torqued as outlined in the procedures in Section 10 - Miscellaneous. Repair or replace as required.

2. Inspect each assembly component for evidence of wear, damage, or leakage.

3. Test the operation of the system as outlined in the operation test.

OPERATION TEST

The operation of the system may be tested as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction brake system.

2. Stop the engine and allow the system to release all entrapped pressure. Verify that the Dump Controller lever is in the Float position.

3. Verify that the steering system has been properly tested and adjusted.

4. Verify that all hoses and fittings are tightened per the procedures in Section 10 - Miscellaneous.

5. Verify that the trucks hydraulic tank is filled to the proper level with approved hydraulic oil.

6. If not previously tested, verify that the hydraulic reservoir is properly pressurized as follows:

a. Install a source of clean, dry compressed air, regulated to 10 psi (70 kPa) on the inlet to the hydraulic tank.

b. Install a 0 to 50 psi (0 - 350 kPa) pressure gauge on to the outlet line from the pressure regulator on the hydraulic tank to the tank itself. Fittings may need to be provided.

c. Turn on the air supply to the crossmember, verifying that it does not exceed 10 psi (70 kPa).

d. Verify that the pressure to the hydraulic tank is 10 +/- 1 psi (70 +/- 7 kPa). If not, check the operation of the hydraulic tank relief valve.

e. When complete, remove the equipment installed.

f. Repressurize the hydraulic tank to 10 +/- 1 psi (70 +/- 7 kPa).

7. If the truck has been sitting idle for an extended period of time or the steering pump or system has been drained since the last time the truck was started, fill the case drain on the steering pump with approved hydraulic oil.

8. Using the appropriate means for the electrical propulsion system installed, disable the truck's propulsion system to prevent its operation when the Shifter is moved to the forward or reverse position.

9. Test the high pressure relief valve and hydraulic oil cooler system operation as follows:

a. Verify that the Shifter is in Neutral and the engine is operating at low idle speed.

b. If any work has been done on the dump system or its components or the condition of the system is unknown, raise and lower the dump body through several cycles to bleed all entrapped air from the system. Do not "force" the cylinders at either end of travel.

NOTE: *To improve this process, it is recommended that the:*
1. Dump body is raised in 2 to 3 ft. (0.6 to 0.9 m) increments.
2. Dump Controller lever is held in the Lower or "power-down" position until the dump body is within 2 to 3 ft. (0.6 to 0.9 m) of the frame.

c. During this cycling exercise, verify that the:

(1) LED light on the switch on the dump control pilot valve is on in the Raise, Hold, and Lower positions.

(2) No oil flows through the oil cooler assembly.

c. Raise the dump body to its fully raised position.

d. While holding the Dump Controller lever in the Raise position, verify that:

(1) The dump system pressure (on the cabinet mounted gauge) is 2350 to 2450 psi (16 205 to 16 895 kPa). If not, readjust as outlined in the information on the dump control valve in Section 5 - Hydraulic System.

e. Release the Dump Controller lever, allowing it to return to the detented Hold position.

f. Move the Dump Controller lever to the Lower position and allow the dump body to lower until it is resting on the dump body pads.

g. While holding the Dump Controller lever in the Lower position, verify that:

(1) The dump system pressure (on the cabinet mounted gauge) is 1450 to 1550 psi (10 010 to 10 685 kPa). If not, readjust as outlined in the information on the dump control valve in Section 5 - Hydraulic System.

h. Raise and lower the dump body through its entire operating range (with the engine operating at rated speed) for 5 complete cycles.

10. Test the system circulating pressure and hydraulic oil cooler system operation as follows:

a. Stop the engine.

b. Install a 0 to 200 psi (0 to 1 400 kPa) gauge at the inlet to the dump valve. Additional fittings may be required.

c. Verify that the:

(1) Shifter is in N (Neutral) position.

(2) The Load and/or Park brake is applied or other provisions have been made to ensure that the trucks propulsion system is temporarily disabled, even if the Shifter is in the F (Forward) or R (Reverse) positions.

(3) Verify that the Dump Controller lever is in the detented Float position.

d. Start the truck engine.

e. Verify that the indicated circulation or system pressure at the dump valve inlet does not exceed 40 psi (275 kPa). Record indicated pressure.

f. Accelerate the engine to rated speed and hold.

g. Verify that the indicated circulation or system pressure at the dump valve inlet does not exceed 80 psi (550 kPa). Record indicated pressures.

h. Slow the engine to low idle speed.

i. Verify that on trucks equipped with a hydraulic oil cooler assembly:

(1) LED light on the switch on the dump control pilot valve is off.

(2) After a delay of approximately 45 seconds, oil flows freely through the oil cooler assembly.

NOTES:
1. It may be necessary to move the Dump Controller lever to the Hold or Lower for a moment and then back to the Float position to properly test the delay function.
2. If the pilot-float proximity switch is removed or must be readjusted this may be done as follows:
a. Adjust the top of the switch to 3/32 inch (2.28 mm) from the washer.
b. With the pilot valve in the float position, adjust the top of the washer to align with the centerline of the switch.
c. If necessary, slightly adjust the height of the washer or switch distance to allow the switch to operate as outlined.

j. Stop the engine.

k. Turn the Master Switch off.

11. Reconnect the wires removed to temporarily disable propulsion.

12. Test complete.

a. Remove the pressure gauge at the dump valve inlet.

b. Remove the pressure gauges on the steering manifold and install dust caps on all quick disconnect fittings.

c. Close the cover on the hydraulic components box.

USE OF AUXILIARY DUMP PROVISIONS

If the provisions for raising or lowering the dump body using an external power source are required, they may be used as follows:

NOTES:
1. For purposes of this procedure, it is assumed that the power source is a "helper" truck, configured in a manner similar to the disabled truck. If another supply and control source is used, the procedure must be modified to reflect the changes involved. In either case, it is important that:
a. The hydraulic oil in the two systems be compatible, preferably of the same formulation.
b. The relief pressure settings in the “helper” truck be adjusted to at least the same pressure level as those in the “disabled” truck to allow for maximum lifting requirements.
c. The relief pressure of the relief valve on the pilot control valve of the “helper” truck must be adjusted to the same pressure as the main dump system pressure in the “disabled” truck. Since the “helper” truck is in the Lower position to raise the dump body on the “disabled” truck, not increasing this pressure will not allow full system pressure to be provided to the “disabled” truck, possibly preventing the raising of the dump body. Detailed information is included in the procedures in Maintenance and Adjustment in

this module. Remember to properly reset the pilot valve relief before placing the "helper" truck back into normal operation.
2. To connect the trucks, two jumper hoses, with connectors and dust covers on each end compatible with those on the truck, must be supplied. The hoses should be of sufficient size and pressure ratings to handle the system pressures involved, and of an adequate length to allow ease of connection.

1. Verify that the level of hydraulic oil in the "helper" truck is near full.

2. Move the Dump Controller levers in both the "disabled" and "helper" trucks to the Hold position.

NOTES:
1. It may be necessary to move the Dump Controller lever on the truck to the Float position to relieve any residual pressure remaining on the couplings. Be sure that the dump bodies are resting on the frame or are secured in position to prevent movement before the control is moved to the Float position.
2. If the dump control valves in both trucks are placed in the Float position when the jumper hoses are in place, oil can flow from one truck to the other. If the trucks are parked on a slope, the oil could transfer to the lower truck.

3. Verify the Shifter in both the "disabled" and "helper" trucks is in the N (Neutral) position.

4. Cross connect the two jumper hoses between quick disconnect fittings installed near the dump valves on the "disabled" and "helper" trucks. This means connect the coupling on the extend port side of the dump valve on one truck to the retract port side of the other truck. The remaining hose should be installed on the other two couplings.

NOTE: *This is done so that the dump body on the "helper" truck does not move during movement of the body on the "disabled" truck.*

5. To raise the body, move the Dump Controller lever in the "helper" truck, to the Lower or Power Down position and hold. The rate of lift should be kept at a low, controlled level with the material dumping at a moderate rate.

NOTE: *When the Dump Controller lever is released on the "helper" truck, it will automatically go to the detented Float position. If allowed to remain in this position, the partially loaded dump body may lower at a rapid rate. Therefore, if it is desired to stop the raising of the dump body during the dumping cycle, the Dump Controller lever in the "helper" truck must be moved manually to the Hold position.*

6. To lower the dump body, move the Dump Controller lever on the "helper" truck to the Raise position. The Dump Controller lever should be held in this position until the dump body approaches the frame and then moved to the Float position. The engine on the "helper" truck should remain at low idle and the rate of descent should be maintained at a low, controlled level to minimize impact of the body and cylinders during the movement.

NOTE: *If sufficient pressure is required during the lowering of the "disabled" truck's body, an empty body on the "helper" truck may begin to rise. This movement should be monitored for safety reasons, but is normal.*

7. Because of the possibility that oil might transfer from one truck to the other during this process, the hydraulic oil level in both of the trucks should be checked after both of the bodies are down. Adjust the oil levels as needed before proceeding.

NOTE: *The pressurized hydraulic tank has no external breather provisions, so excess oil cannot escape.*

8. With the dump bodies both completely lowered to the frame, verify that both Dump Controller levers are in the Hold position.
9. Remove the jumper hoses and reinstall the protective caps and plugs. It may be necessary to move one or both Dump Controller levers to the Float position to relieve any residual pressure in the jumper lines or fittings.

10. Readjust the relief valve in the pilot control valve on the "helper" truck as outlined in Maintenance and Adjustment, if it was adjusted previously.

SERVICE

Refer to the modules of the individual components for service information.

KEY					A85183
001.	Dump Valve	047.	Adapter Fitting	097. - 101. Not Used	
002.	Capscrew (Grade 8)	048.	- 053. Not Used	102.	Adapter Fitting
003.	Capscrew	054.	Clamp Cap Plate	103. – 109. Not Used	
004.	Hardened Flatwasher	055.	Capscrew	110.	Clamp Support Assembly
005.	Locknut	056.	Controller Cable	111.	Clamp Support Assembly
006.	Adapter Fitting	057.	Capscrew	112.	Clamp Support Assembly
007.	Tensioner Assembly	058.	Flatwasher	113.	Clamp Bracket
008.	Tie Rod	059.	Cable Control Bracket	114.	Cushion Clamp
009.	Hydraulic Pressure Filter	060.	Not Used	115.	Hardened Flatwasher
010.	Filter Brackets	061.	Capscrew	116.	Chain
011.	Filter Manifold	062.	Not Used	117.	Capscrew
012.	Flatwasher	063.	Adapter Fitting	118.	Flatwasher
013.	Capscrew	064.	Adapter Fitting	119.	Locknut
014.	Lockwasher	065.	- 068. Not Used	120.	Clamp Bracket
015.	Flange Fitting	069.	Adapter Fitting	121.	Clamp Support Assembly
016.	Flange Fitting	070.	Not Used	122.	Clamp Support Assembly
017.	Lockwasher	071.	Adapter Fitting	123.	Clamp Support Assembly
018.	Capscrew	072.	Not Used	124.	Orifice Plate
019.	O-ring	073.	Capscrew	125.	Not Used
020.	Dump Valve Manifold	074.	Lockwasher	126.	Capscrew (Grade 8)
021.	Capscrew (Grade 8)	075.	Pressure Gauge	127.	Solenoid Cartridge Valve with Manifold
022.	Female Quick Coupling	076.	Adapter Fitting	128.	Adapter Fitting
023.	Dust Plug	077.	Control Cable	129.	Capscrew
024.	– 028. Not Used	078.	Harness Seal	130.	Hose Assembly
029.	Flange Fitting	079.	Return Tube	131.	Hose Assembly
030.	Flange Fitting	080.	Hose Assembly	132.	Adapter Fitting
031.	Test Coupling	081.	Hose Assembly	133.	Oil Cooler
032.	Quick Connector	082.	Hose Assembly	134.	Capscrew
033.	Not Used	083.	Hose Assembly	135.	Flatwasher
034.	Adapter Fitting	084.	Hose Assembly	136.	Locknut
035.	Adapter Fitting	085.	Hose Assembly	137.	Cushion Clamp
036.	Not Used	086.	Hose Assembly	138.	Capscrew
037.	Pilot Control Valve	087.	Hose Assembly	139.	Flatwasher
038.	Adapter Fitting	088.	Hose Assembly	140.	Bolting Pad
039.	Clamp Halves	089.	Hose Assembly	141.	Adapter Fitting
040.	Pilot Valve Clevis	090.	Hose Assembly	142.	Socket Head Capscrew
041.	Hex Nut	091.	Nit Used	143.	Lockwasher
042.	Roll Pin	092.	Hose Assembly	144.	O-ring
043.	Proximity Switch Assembly (Oil Cooler)	093.	Not Used	145.	Adapter Fitting
044.	Sensor Bracket	094.	Tube Assembly		
045.	Washer	095.	Not Used		
046.	Locknut	096.	Tube Assembly		

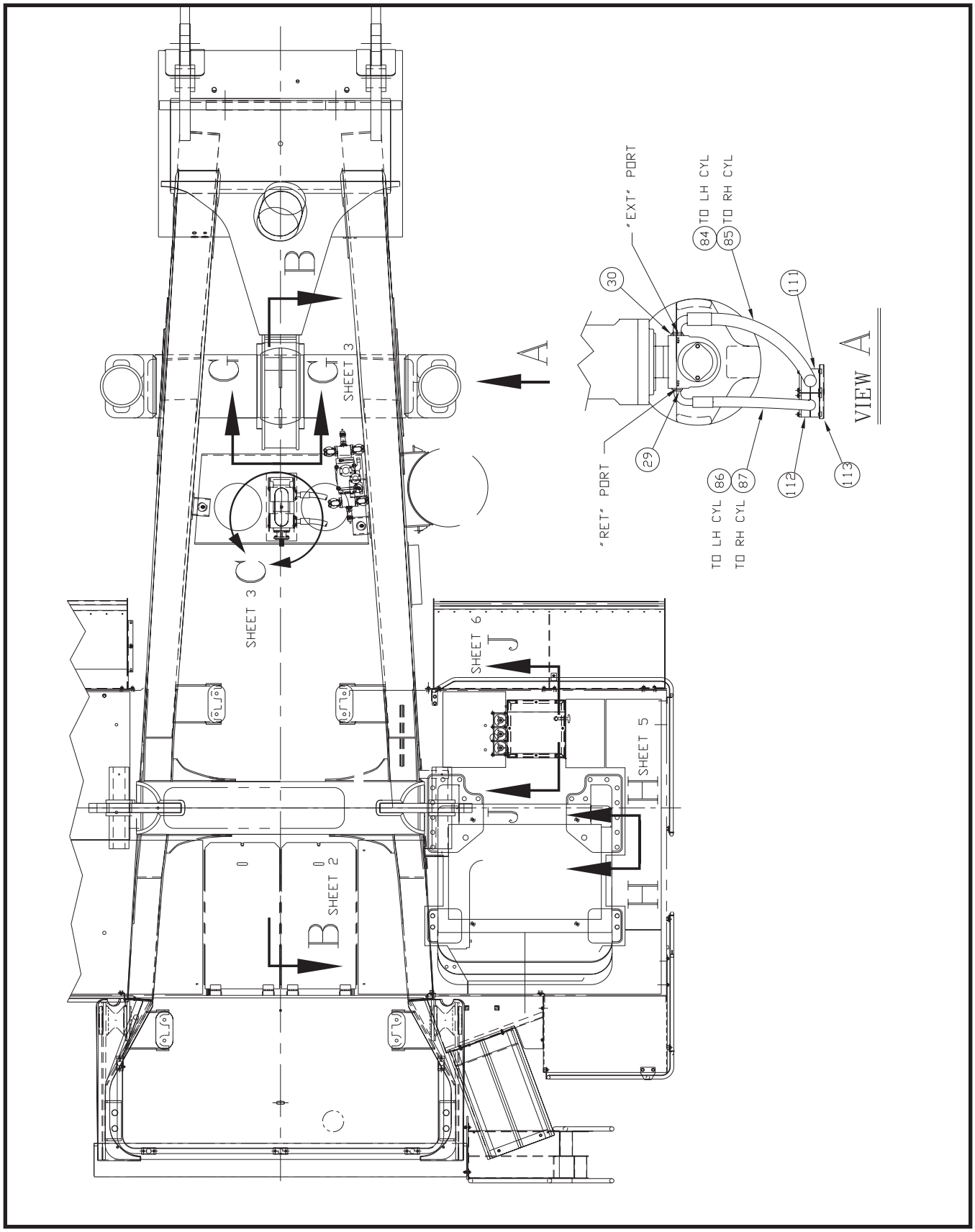


FIGURE 5 - DUMP SYSTEM ASSEMBLY (A85183 SHEET 1 OF 6)

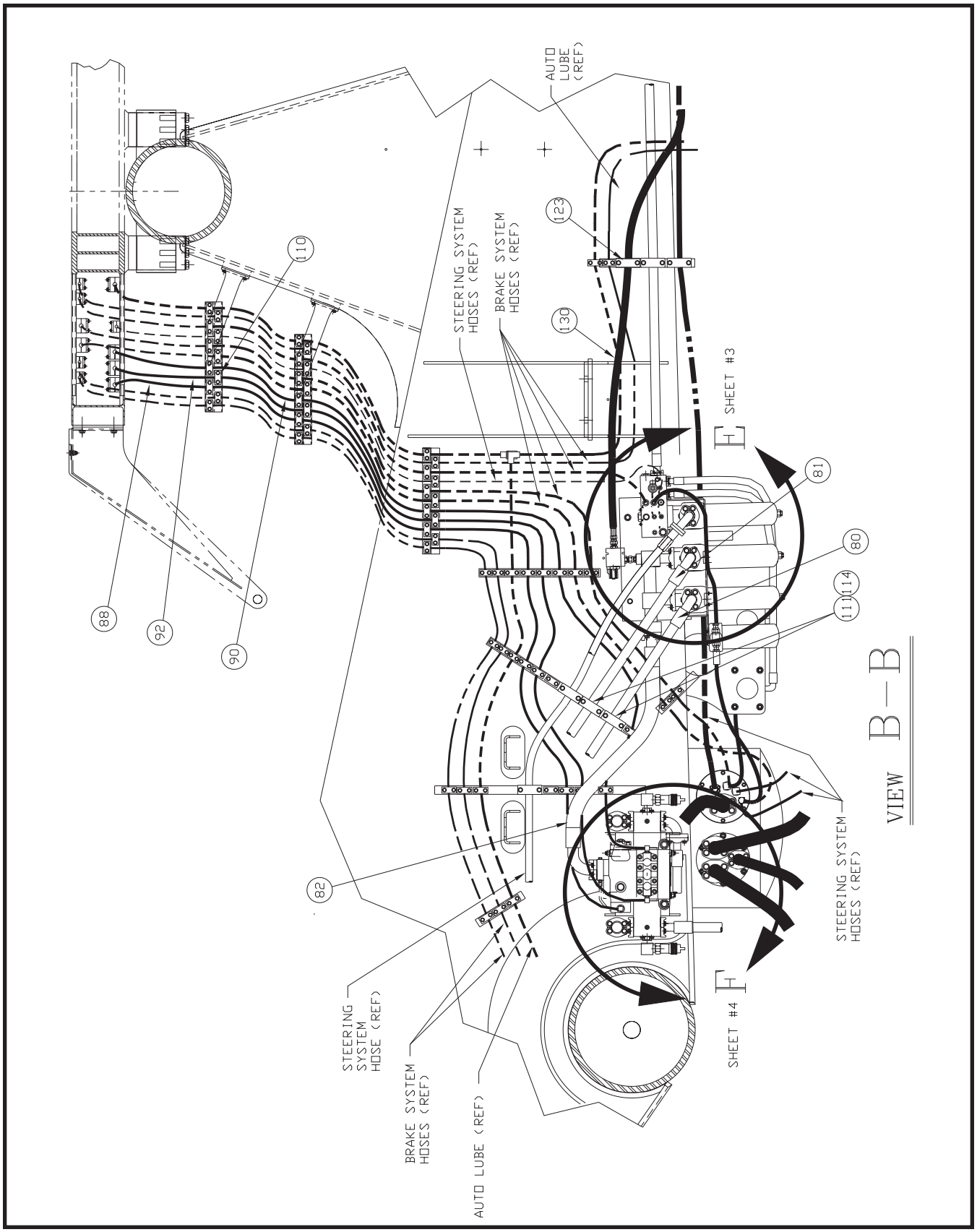


FIGURE 5 - DUMP SYSTEM ASSEMBLY (A85183 SHEET 2 OF 6)

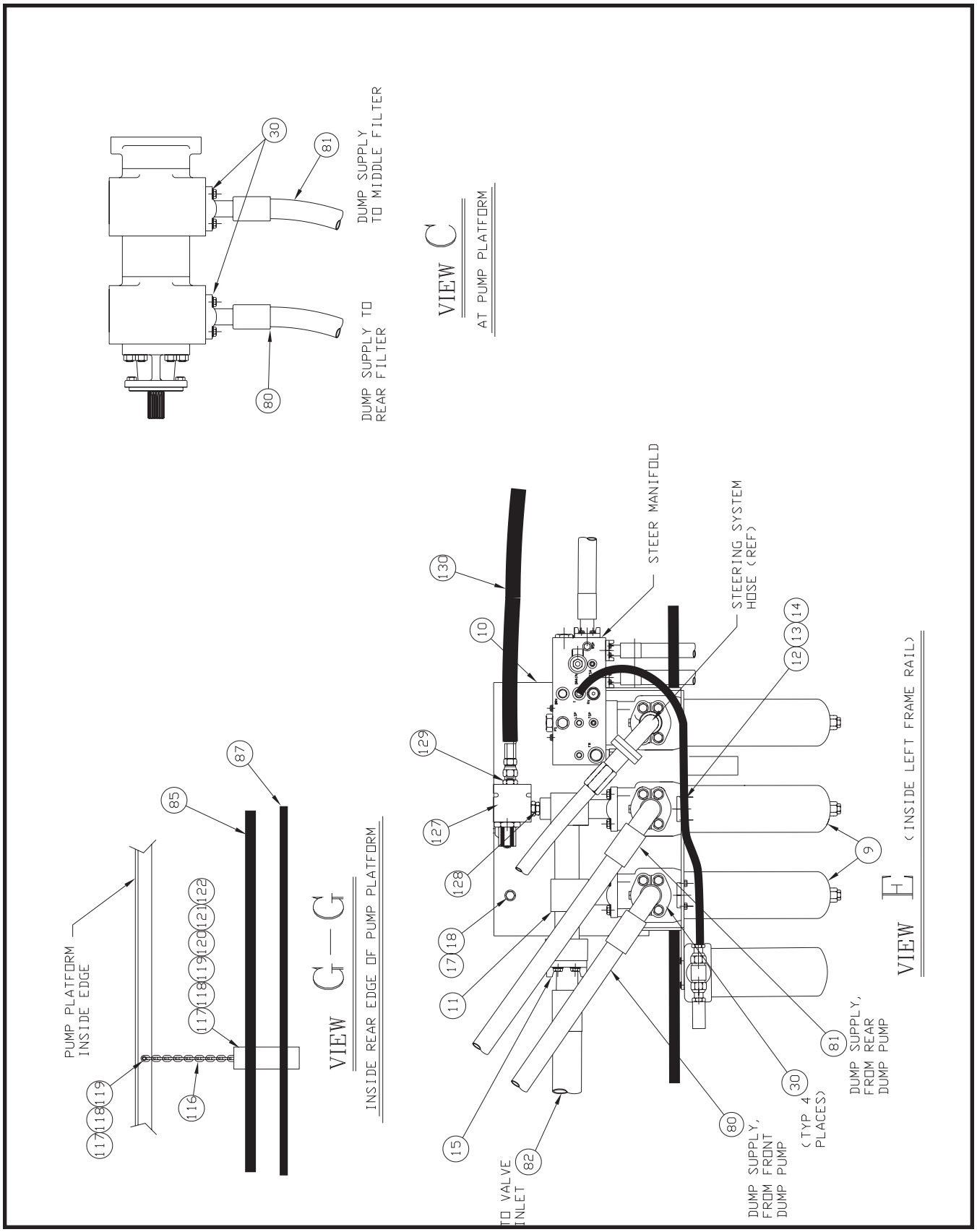


FIGURE 5 - DUMP SYSTEM ASSEMBLY (A85183 SHEET 3 OF 6)

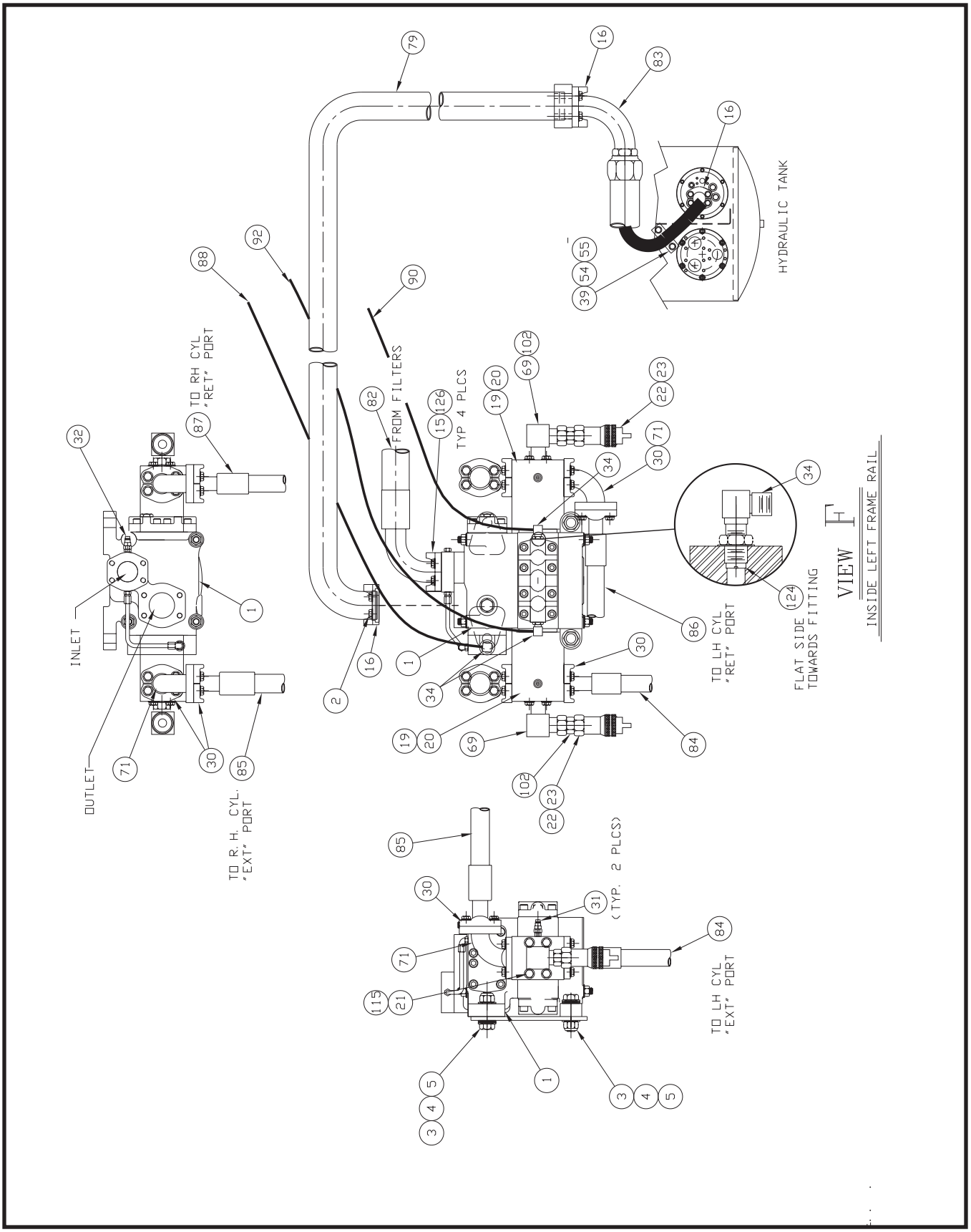


FIGURE 5 - DUMP SYSTEM ASSEMBLY (A85183 SHEET 4 OF 6)

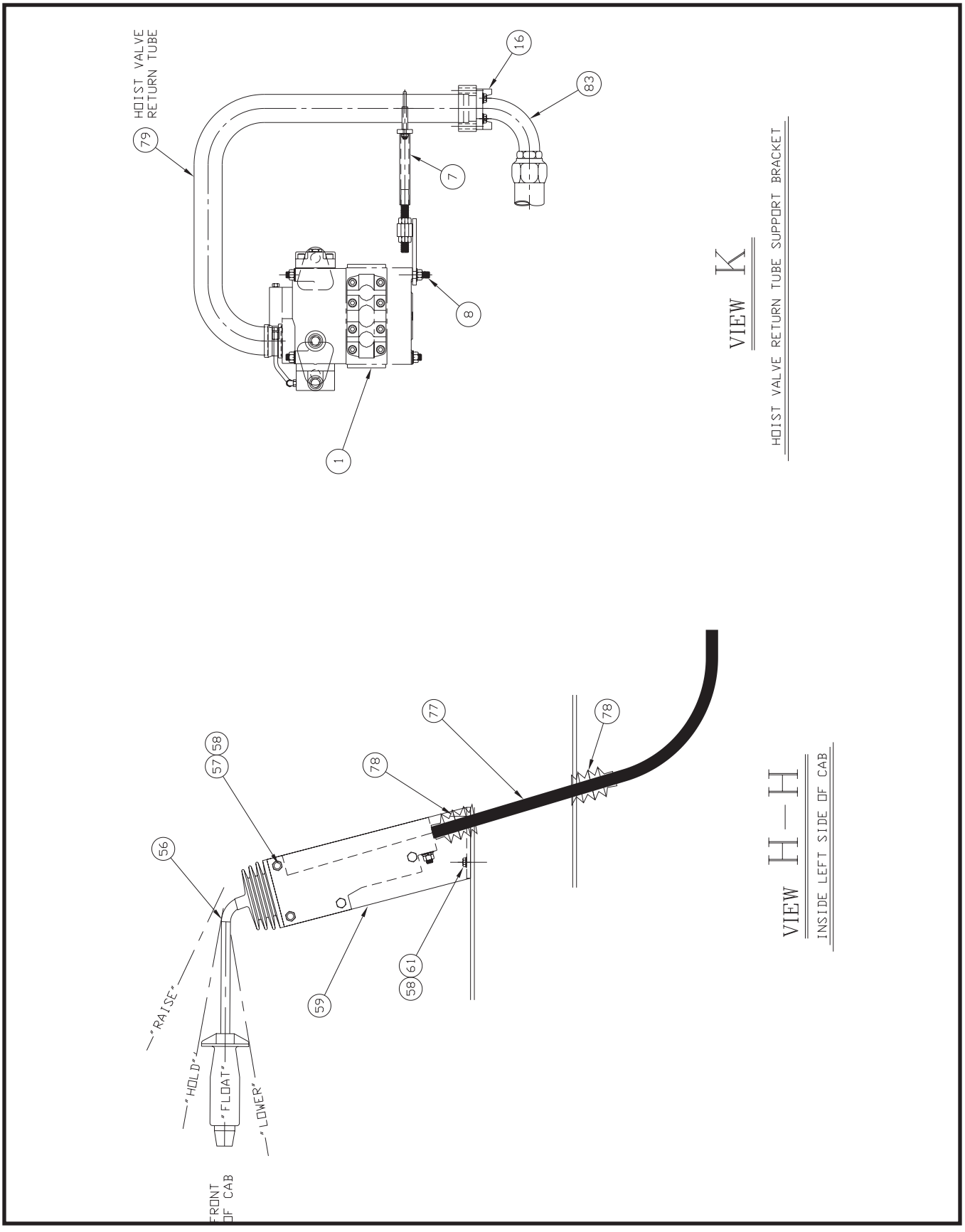


FIGURE 5 - DUMP SYSTEM ASSEMBLY (A85183 SHEET 5 OF 6)

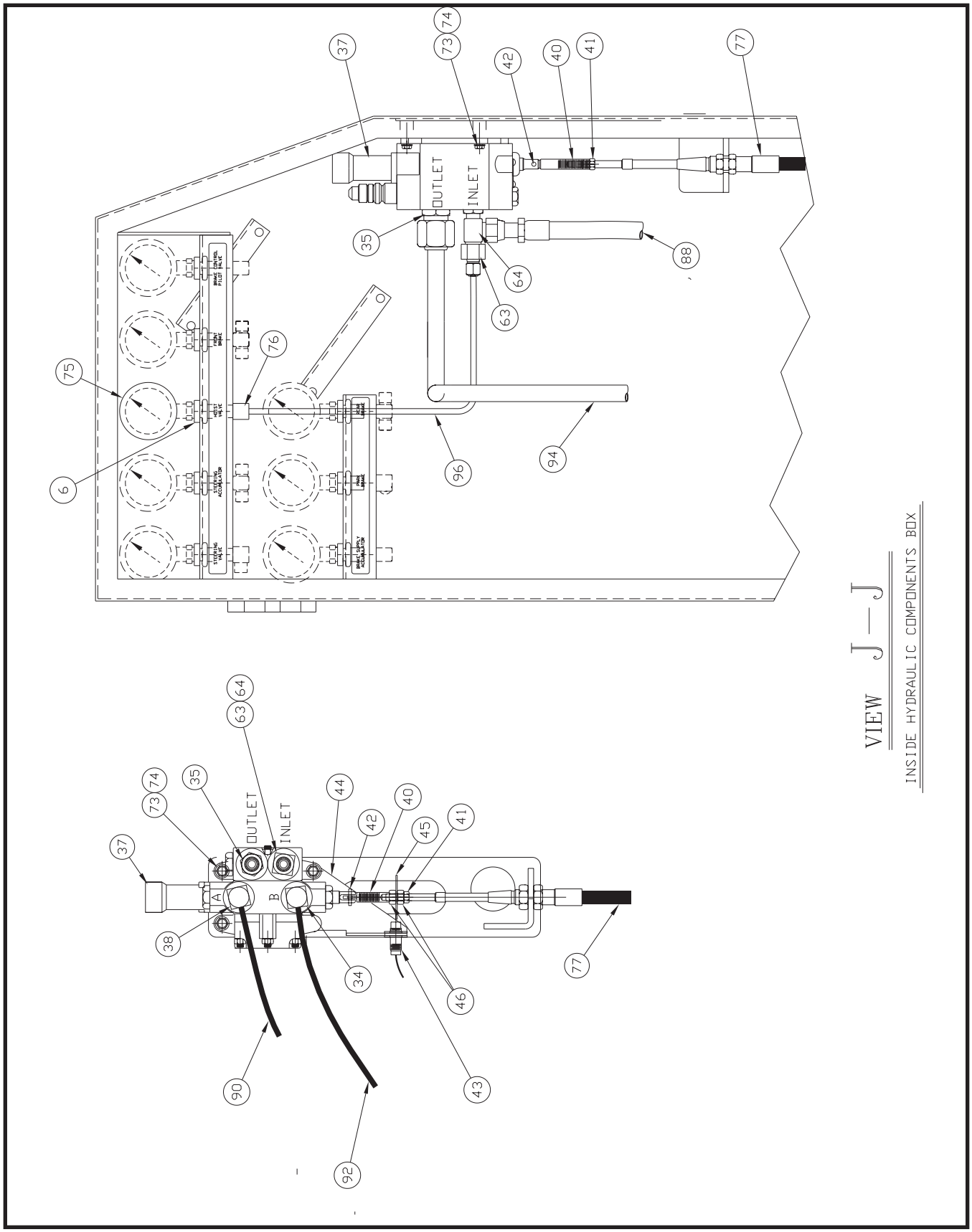


FIGURE 5 - DUMP SYSTEM ASSEMBLY (A85183 SHEET 6 OF 6)

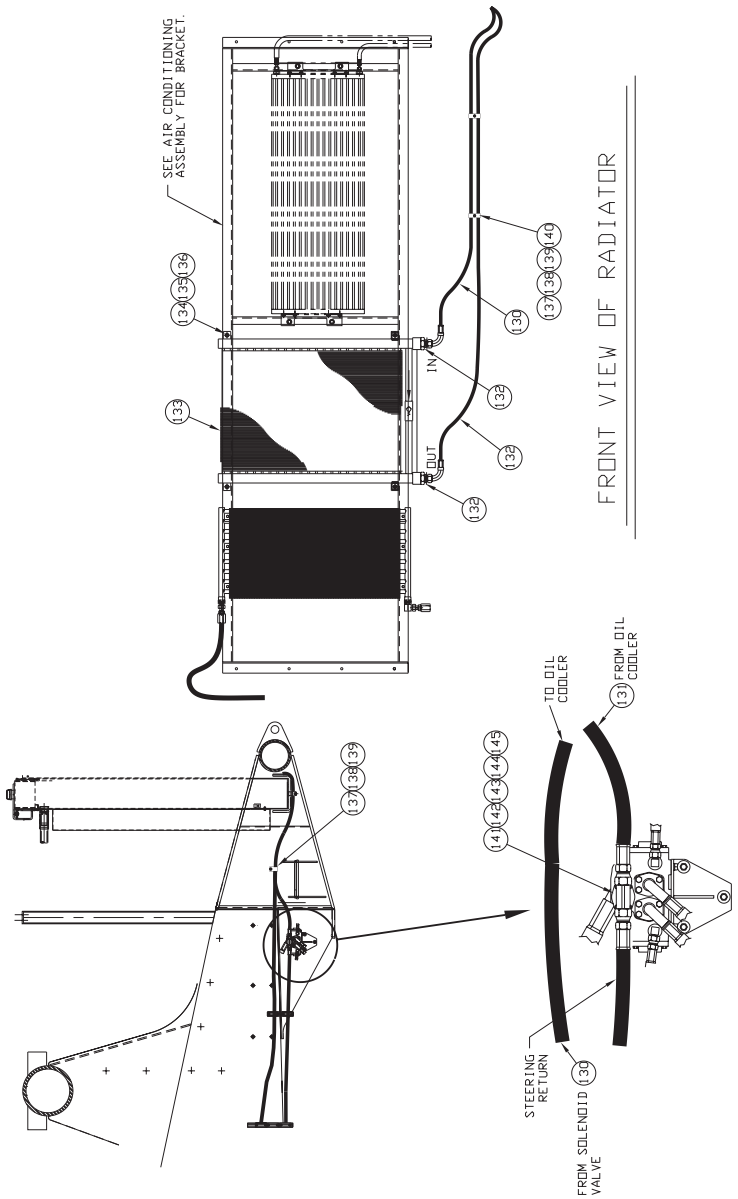


FIGURE 6 – HYDRAULIC OIL COOLER ASSEMBLY (A85399, SHEET 1 OF 2)

DUMP PUMP

DESCRIPTION AND LOCATION

The dump pumps are the larger tandem gear pumps mounted in series with the smaller steering piston pump assembly. The pumps are mounted on a special bracket assembly between the main frame rails, just in front of and above the nose cone receiver.

OPERATION

The pump assembly operates in two basic configurations:

The oil supply for the pumps is drawn through the inlet ports from the reservoir and is routed internally to the pump inlet chambers between the pump gears. As the gears turn, they cause the oil to pressurize and direct it to the outlet chambers. There it exits the pump through the outlet ports. Wear plates are incorporated into the housing to provide increased sealing capacity and rebuilding capability.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

NOTE: *The pumps themselves require no internal maintenance or adjustment beyond periodic verification of the pumps ability to maintain required pressures and flows.*

1. Verify that all components are secure and all mounting bolts are tight.

2. Inspect the pumps for evidence of wear, leakage, or damage. Repair or replace as required.

3. Visually inspect the large pump mounting bracket, especially the isolation mounting pads for evidence of looseness, deterioration, or damage. Repair or replace as required.

4. Verify that the proper distance between the pump bracket front surface (non pump mounting face) and the face of the pump drive adapter (on the rear of the main traction alternator) is maintained. If not, adjust all brackets as outlined in the Installation instructions at the end of this module.

5. Measure the vertical distance between the horizontal centerlines of the driveshaft's front and rear bearings. It should be 3/16 inch (4.6 mm). If not, adjust as outlined in the Installation instructions at the end of this module.

6. Test the operation of the pumps as outlined in the dump system testing instructions in Section 5 - Hydraulic System.

REMOVAL (Figure 2)

The triple pumps assembly may be removed as follows:

1. Park the truck in SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Shut off the oil supply to the pumps by closing the valve on the supply line (near the reservoir tank) or other approved method.

3. Remove the inlet and outlet hoses from the pumps.

4. Install a 1/2 inch NC threaded eye bolt in the threaded hole in the center of the pump bracket accessible through the cut out in the large mounting bracket.

5. Install a suitable lifting point directly above the pumps (e.g. weld eye to dump body, crane, etc.).

6. Install a come-along or equivalent means to the attachment points in steps 4 and 5 and tighten until only a small amount of slack remains in the device.

NOTE: *Provisions should be made for lowering the pumps to the floor, a distance in excess of 6 feet (2 meters). The combined weight of the pumps is approximately 400 lbs. (180 kgs) plus the weight of the mounting bracket.*

7. Remove the capscrews (15) and hardened flatwashers (17) securing the pump mounting bracket (8) to the pump platform (7). Use care to prevent fore and aft movement.

8. Slide the pump assembly rearwards slowly (while supporting the driveshaft) until the pump drive splines are out of the driveshaft.

9. Lower the pump to the ground.

10. Remove the rear or tail pump support bracket (9).

11. Remove the capscrews (11) and locknuts (10) securing the pump assembly to the mounting bracket (8).

12. Remove the pump.

DISASSEMBLY (Figure 1)

Prior to beginning disassembly of the pump:

1. Clean the work area of dirt, grease, foreign material or other items which might contaminate the pump.

2. Clean the unit thoroughly with a solvent. Remove all sharp edges from splines, drill points, keyways and end of shaft. Mark the adapter and cover/housing sections to ensure correct reassembly.

3. To aid in disassembly and reassembly, the pump should be retained in some manner. For example, a steel plate bolted to and extending over the edge of a work bench will suffice. The plate should have a hole large enough for the adapter flange pilot to drop through, and two holes in the adapter flange. The pump can now be firmly fixed to the plate by bolts. This is especially helpful in removal and torquing of capscrews.

The pump may be disassembled as follows:

1. Remove the steering pump section from the rear of the pump assembly as follows: (Figure 2)

a. Remove the capscrews (12) and lockwashers (13) securing the rear piston pump assembly (2) to the dump pump sections (1).

b. Carefully separate the two pump sections, making sure that the splined shafts and couplers are not damaged.

⚠ CAUTION

Do not attempt to pry the pumps apart with a screwdriver or other means. They should be separated by tapping with a soft-faced hammer.

NOTE: *For detailed information on servicing the steering pump assembly, refer to the instructions in Section 5 - Hydraulic System.*

NOTE: *The remaining steps reference Figure 1 unless otherwise indicated.*

2. With a grease pencil, ink marker or other suitable marking tool, mark each housing cover on the parting line in a manner that will allow for reassembly in the same position.

NOTE: *These marks will be used to assist in matching parts for reassembly of the pumps.*

3. Clamp the pump assembly in a vise with the shaft end up.

NOTE: *Use clean wooden blocks or other soft material to protect the machined surfaces (particularly the port faces) from damage.*

4. Clean the driveshaft extension and remove any burrs or other damage. This will prevent damage to the seal lips.

5. Remove the nuts (23) and washers (20) securing flange (1) to the pump body assembly.

6. Remove the flange (1). If the flange does not move easily, use a plastic hammer or wooden mallet and tap the edges of the flange to loosen it.

7. Remove the O-ring (12).

8. Grasp and lift the front drive gear shaft (5) to dislodge the top pressure plate (8) with it while holding the pressure plate face against the gear with your fingers.

NOTE: *If the pressure plate hangs during removal, do not force or bend the plate. Tap lightly with a plastic hammer to drive the plate back down into position and start the removal process over.*

9. Remove the pressure plate from the drive gear. Inspect and discard the seal strips.

NOTE: *Lift the plates straight up off of the shaft.*

NOTE: *When disassembling the pumps sections, the parts should be laid out in a group and in the same order removed.*

10. Lift the idler gear (7) straight up out of the bore of the body.

11. Remove the bottom pressure plate (9) as follows:

a. Insert an expandable bearing puller into the shaft bore of the plate.

b. Tighten until it is secure on the plate.

c. Apply a light forward and back force to the puller handle and dislodge the plate.

NOTE: *If a bearing puller is not available:*
1. Grind a screwdriver shape on the short end of an Allen wrench.

2. Insert the ground end of the wrench into the shaft bore and lift the plate up.
3. Move the wrench to the opposite bore of the plate and lift up.
4. Repeat this action until the plate has been dislodged.

12. Grasping through the bore holes, lift the plate straight up and out.

NOTE: *Use extreme care in removing the plate. Do not pry or attempt to force it out. If the plate binds in place, move it up and down until it is free, then lift it out.*

13. Lift the front body (2) straight up and off of the studs and dowels.

NOTE: *If the body is bound on a dowel, use a plastic hammer or wooden mallet and tap around the body to loosen it.*

14. Remove the splined coupling (21) from the rear driveshaft.

15. Lift the bearing plate (3) off.

NOTE: *It may be necessary to tap the plate lightly with the mallet to loosen it from the dowels.*

16. Repeat steps 6 through 16 for the bottom section of the pump.

17. Repeat again for the removal of the adapter plate (4) if required.

18. Remove the capscrews (29), and O-ring (14).

19. Inspect and remove all remaining seals and components.

INSPECTION AND REPAIR

The disassembled pump may be serviced as follows:

1. Clean all metal parts in solvent and dry with compressed air. Inspect for evidence of wear, damage, cracks, or leakage. Repair or replace as required.

2. Inspect gear bores. Normal gear track-in on the suction side of the body is approximately 0.005 inch (0.127 mm) but should not exceed 0.015 inches (0.38 mm).

a. If the track-in burr rolled over the OD of the bottom pressure plate, remove the burr using a sharp knife. Blow clear with compressed air to remove all loose chips and other material.

b. Replace the body if the groove is too deep or the gear bores look as if they had been sand blasted.

NOTE: *Due to the hydraulic loading of the gears, the cut will start on the suction side of the body and will continue about one-third of the way around the gear bore. It should be smooth and with no deep grooves or scratches.*

3. Discard any pressure or wear plates that show excessive wear on the bronze side. Also discard the plates if deep, curved wear marks or evidence of contamination abrasive wear, cavitation damage, or heat discoloration are visible.

4. Discard the gear assemblies if:

a. The shaft journals show excessive wear or pitting, especially on the journals, sides, or face of the gear, or at the point where the drive gear rotates on the lip seal.

NOTE: *Journal wear is excessive if contamination has caused the journal surface to lose their mirror "finish" and appear as a "sanded" or scratched surface.*

b. The gear OD is under 3.177 inches (80.7 mm).

c. The gear teeth show excessive wear.

d. The gear face is scored or cracked.

e. The driveshaft spines or keyways are badly worn.

5. If the bearings are worn beyond the gray Teflon into the bronze material, it is recommended that the complete flange or housing be replaced. Replacing a bearing in an old component is not recommended.

NOTE: *In the event of bearing failure, verify that the gears have not cut a track in the housing deeper than 0.015 inches (0.38 mm). If they have the housing must also be replaced, typically causing replacement of the entire pump.*

If, however, a bearing must be replaced, it may be done as follows:

a. Place the body in a vise. Clamp on the sides of the body using cardboard to prevent marring by the vise.

b. Using a 3/8 inch end mill on a Bridgeport or drill press,

(1) Align and center the body to allow the cutting to begin at the center of the bearing opposite the split in the bushing.

(2) Move into the bearing wall and make cuts until through the bearing shell.

IMPORTANT: *Do not cut into the bore wall.*

c. Grip the bearing with vise grips and remove by squeezing the parts together and using a twisting motion.

d. After removal, wash the parts in solvent and remove any burrs that may have occurred.

e. Coating the bearing OD and bore ID with Loctite 609 or equivalent.

f. Using a suitable press and tooling, press the bearing into place until they protrude above the surface 0.220 to 0.230 inches (5.6 to 5.8 mm).

IMPORTANT:
1. The split in the bearing must point toward the dowel of the vertical centerline.
2. Use extreme care not to tilt the bearing relative to the bore.

g. Remove all residue from the bearing area.

6. Replace the seals in the pump flange as follows:

a. Lay the flange plate on a work bench or other suitable work surface. Face the pilot down and protect the machined surfaces from dents or scratches by using a piece of clean wood, heavy cardboard, or other suitable material between the plate and the work surface.

b. With a 1/4 inch (7 mm) punch or a screwdriver with the tip bent, insert through the drive bearing and inner seal until against the edge of the outer seal case. Tap at 3 locations around the seal case driving the seal out of the bore.

NOTE: *Use extra caution not to scratch or damage the bore or bearing surfaces or their end projections.*

c. Turn the flange over with the pilot face up, and using a suitable tool, remove the snap ring (16).

d. Remove the inner seal (17) as outlined in step b. above.

e. After the seals are out:

(1) Thoroughly clean the bore with solvent.

(2) Inspect the bore for scratches or gouges that might interfere with the installation of the new seal.

NOTE: *If found, the bore can be smoothed with No. 400 Emery paper (only). Clean the bore after the smoothing process is complete.*

(3) Clean and prepare a suitable seal press ring or plug and two small pieces of wood, 8 to 10 inches (200 to 250 mm) long for use when installing the new seals.

NOTE: *The following procedures are outlined for use with a vise, but they can be adapted to the use of a press if an appropriate one is available.*

(4) Coat the seal OD and flange bore with a light coat of sealant (Permatex No. 3 or equivalent).

(5) Open the vise jaws wide enough to accept the combined thickness dimensions of the flange, wood blocks and the press ring or plug.

(6) Place the two wooden blocks flat against the fixed jaw of the vise.

(7) Place the flange plate against the blocks in such a position that the bearing projections are between the blocks and are clear of the vise jaw.

(8) Position the inner seal (17) so that the garter spring enters the bore first.

(9) Place the press ring in position, centered above the seal.

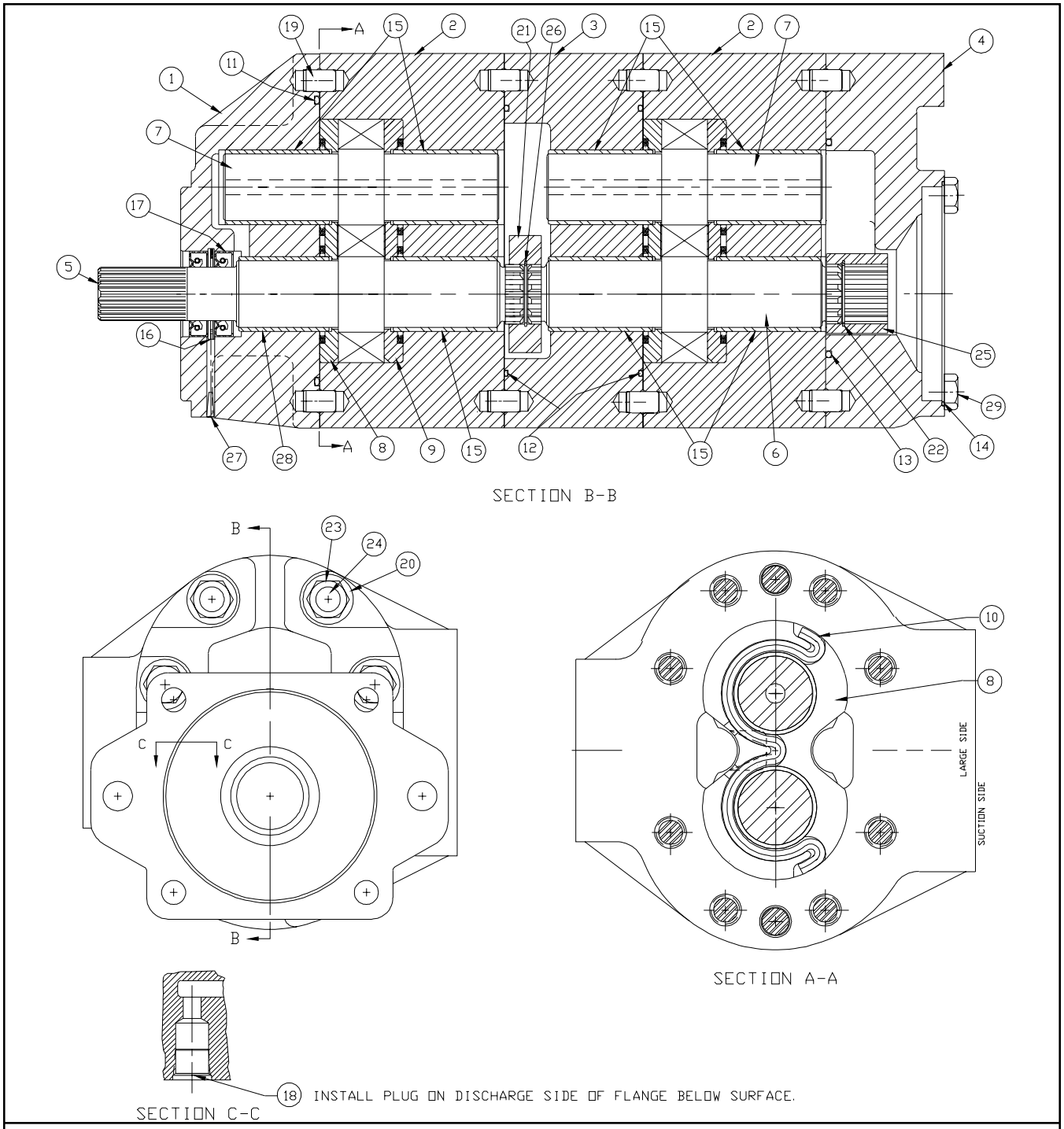
(10) While making sure that the seal stays centered and true with the bore, start applying pressure with the vise. Continue applying the pressure until the seal just clears the snap ring groove in the bore (0.711 inches (18 mm) deep from the pilot face).

(11) Open the vise and remove the press ring.

(12) Install the snap ring (16) in it's groove in the bore so that the weep hole is directly over the gap in the snap ring.

NOTE: *Make sure that the snap ring is seated properly in the groove and is properly oriented before proceeding.*

(13) Repeat steps 5 through 12 with the outer seal (17) to a depth of 0.150 inches (3.8 mm) from the pilot face.



KEY 56090

01.	Flange	09.	Bottom Pressure Plate	17.	Seal	25.	Coupling
02.	Body	10.	Sealing Strip	18.	Plug	26.	Snap Ring
03.	Bearing Plate	11.	O-ring	19.	Dowels	27.	Plug
04.	Adapter Plate	12.	O-ring	20.	Washer	28.	Journal Bearing
05.	Front Drive Gear	13.	O-ring	21.	Coupling	29.	Capscrew
06.	Rear Drive Gear	14.	O-ring	22.	Snap Ring		
07.	Idler Gear	15.	Journal Bearing	23.	Nut		
08.	Top Pressure Plate	16.	Snap Ring	24.	Stud		

FIGURE 1 - DUMP PUMP ASSEMBLY (56090)

(14) Install a new "weep-hole" plug (27) in the 3/16 inch (4.7 mm) drilled hole at the outer surface of the flange.

(15) Remove the flange plate assembly from the vise.

(16) Wash clean in solvent and allow to dry.

ASSEMBLY

IMPORTANT:
1. Prior to reassembly, all parts should be deburred by sanding or stoning; washed in a solvent, wiped with a clean lint free cloth and, if available, dried with compressed air.
2. All seals should be replaced each time the pump is assembled.

The pump may be assembled as follows: (Figure 1)

1. Verify that all parts are clean and dry.

2. Place the rear pump body (2) with the adapter plate (4) installed on the work area, oriented so that the matching marks made during disassembly are facing you.

NOTES:
1. If new components are being installed, make sure that the side facing you is the same as the side marked on the old component.
2. Observe that the body has a wide and a narrow boss. The side having the wide boss is always the suction side.

3. Coat the inner bore of the body with clean hydraulic oil compatible with that in the truck's hydraulic system.

4. Install the bottom pressure plate (9) in the suction side in the bottom of the body with the rounded edge down.

NOTE: *There is a difference in the pressure plates. The one for this location has the radius on the outer edge that mates with the bottom of the gear bore.*

5. Install the new pressure balance seal strips into the grooves in the back of the plates, using heavy grease to hold in place.

NOTE: *There are two strips installed per groove.*

6. With the bronze side facing up and the rounded trap slots toward the discharge side of the body, slide the pressure plate (9) down into the gear bores until it rests firmly on the bottom of the pump body.

NOTE: *Do not force the plate down the gear bores. If the plate binds on the way down, move it back and forth carefully until it slides freely into position.*

7. Coat the rear drive gear journal and faces (6) with clean hydraulic oil compatible with that in the truck's hydraulic system.

8. With the splined end up, install the drive gear in the bore nearest the mark that was made during disassembly.

9. Coat the rear idler gear (7) with clean hydraulic oil compatible with that in the truck's hydraulic system.

10. Install the rear idler gear in the bore opposite the drive gear.

11. Install the dowels in the body.

12. Rotate the rear set of gears until the point of a tooth on the drive gear is in line with the center of the dowel in the body that is nearest the drive gear.

IMPORTANT: *This step establishes the proper timing of these gears with the front set of gears. They must remain in this position until all remaining parts have been assembled.*

13. Install the upper pressure plate (8) with the grooves up.

IMPORTANT: *The pumps have a trap relief on the surface facing the gear. The plate should be assembled so that the trap is off-centered toward the outlet or discharge port side of the pump.*

14. Install the pressure balance seal strips in the plate (9) as outlined previously.

15. Lay the bearing plate so that the side faces upward that has the bearing extending out of the bore.

16. Install the mating O-ring (12) in the surface groove. Use clean, heavy grease to secure it in the groove temporarily.

17. With the O-ring facing down, and the mark made during disassembly facing you, slide the bearing plate down on the shaft until contact is made with the dowels.

18. Keeping the bearing plate oriented properly with the

dowels, tap the plate gently with a plastic hammer or wooden mallet until the O-ring rests firmly against the pump body.

19. Install the spline coupling (21) with snap ring.

20. Lubricate the threads on the studs (24) and screw the studs into place until they are snug.

21. Install the O-ring (12) and dowels (19) in the bearing plate (3).

22. With the gear bores turned up and the matching marks facing you, slide the front pump body (2) down on the studs until it rests firmly on the O-ring in the bearing plate.

23. Install the dowels (19) in the body (2).

24. Coat the inner bore of the body with clean hydraulic oil compatible with that in the truck's hydraulic system.

25. Install the bottom pressure plate (9) in the suction side in the bottom of the body with the rounded edge down.

NOTE: *There is a difference in the pressure plates. The one for this location has the radius on the outer edge that mates with the bottom of the gear bore.*

26. Install the new pressure balance seal strips into the grooves in the back of the plates, using heavy grease to hold in place.

NOTE: *There are two strips installed per groove.*

27. With the bronze side facing up and the rounded trap slots toward the discharge side of the body, slide the pressure plate (9) down into the gear bores until it rests firmly on the bottom of the pump body.

NOTE: *Do not force the plate down the gear bores. If the plate binds on the way down, move it back and forth carefully until it slides freely into position.*

28. With the long end of the front drive gear (5) facing up, slide the gear down into the splined coupling. Before engaging the shaft spline into the coupling, rotate the shaft until the valley between the two gear teeth is lined up with the center of the dowel nearest to the gear.

NOTE: *If the spline will not enter the coupling without the valley being off-center with the dowels, lift the shaft slightly and rotate it to the nearest valley and try again. Continue to do this until the combination of valley and spline are found that will allow the valley to be centered with the dowel. This is to properly time the gears in the front section with those in the rear section.*

29. Install the idler gear (7).

NOTE: *Make sure that the bronze side of the plate faces down and the traps face the discharge side of the body.*

30. Install the pressure balance seal strips in the plate (9) as outlined previously.

31. Install the mating O-ring (11) in the surface groove on the flange plate. Use clean, heavy grease to secure it in the groove temporarily.

32. Coat the splines on the driveshaft extension with heavy grease.

NOTE: *This is to prevent damage to the seal lips as the flange plate and seals are installed. Check the driveshaft for sharp edges. If necessary, use a seal guide or tape to protect the seal lips.*

33. With the O-ring in the flange plate facing down, slide the flange plate (1) down over the studs and shafts until the plate makes contact with the pump body.

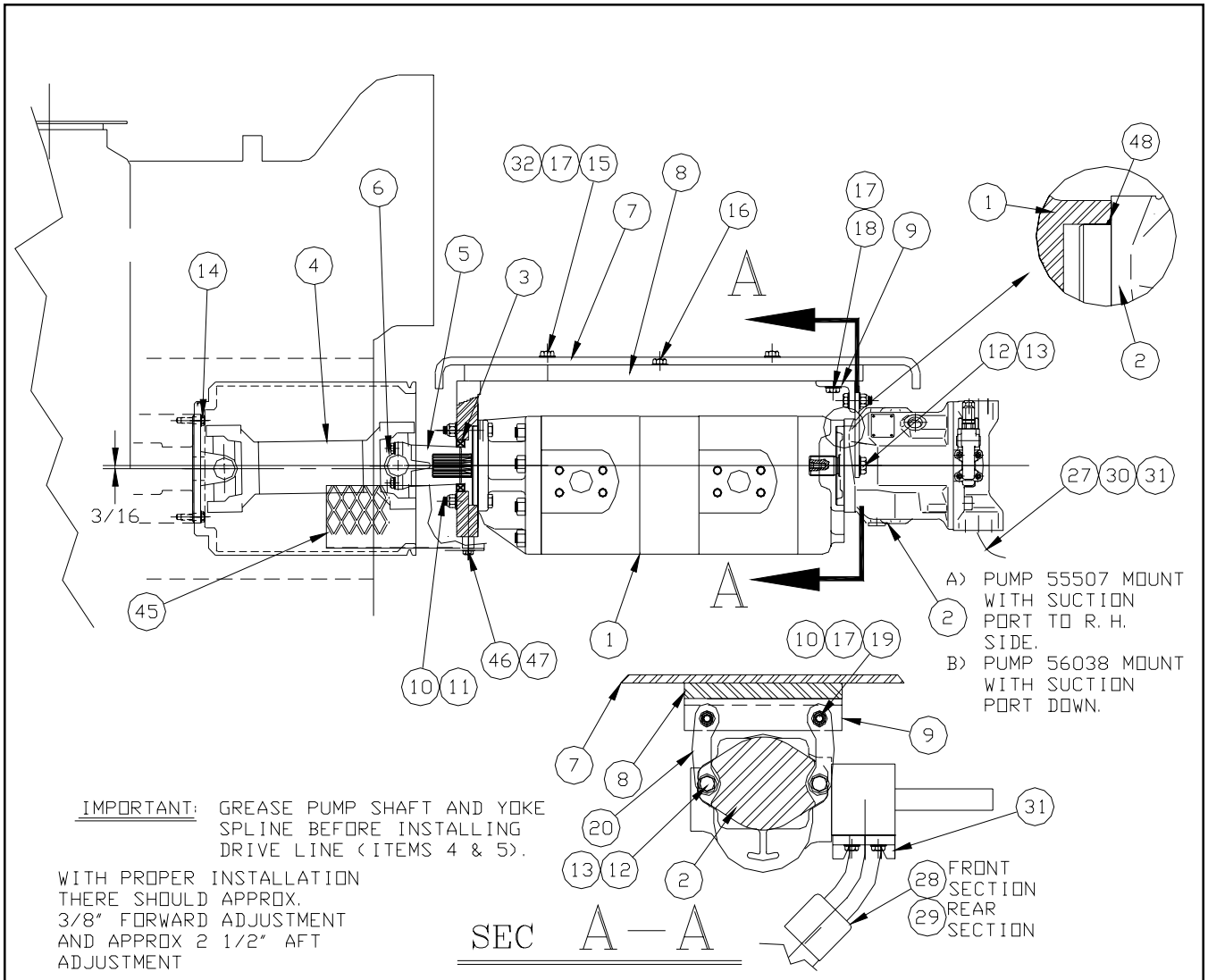
34. Tap gently into place with a plastic hammer or wooden mallet.

IMPORTANT: *If the flange stops approximately 1/8 inch (3.2 mm) short, the journal bearings in the flange may have caught the pressure balance strips. Do not force into position. Lift the flange and position the seal strips away from the journal using a small screwdriver in the middle and ends until the flange drops into place without force. Do not drive the flange on with a hammer or the seal strips may be damaged.*

35. Lubricate the threads and install the washers (20) and nuts (23) on two opposite studs. Tighten in a crossing pattern in even increments to a final torque of 160 to 175 ft-lbs. (215 to 240 Nm).

36. Using an appropriate tool, turn the driveshaft. The movement of the shaft should be tight, but it should turn freely with a maximum of 5 to 10 ft-lbs. (7 to 14 Nm) of torque.

NOTE: *If this does not occur, disassemble the pump and examine the parts for burrs or foreign material causing a build-up or interference between the parts.*



KEY A84203

01.	Tandem Gear Pump Assembly	17.	Hardened Flatwasher	33.	Not Used
02.	Steering Piston Pump	18.	Capscrew	34.	Not Used
03.	Seal Assembly	19.	Capscrew (Grade 8)	35.	Hose Clamp Brackets
04.	Pump Driveshaft	20.	Support Bracket	36.	Clamp Halves
05.	Slip Yoke	21.	Capscrew	37.	Clamp Cap Plate
06.	Strap and Bolt Kit	22.	Locknut	38.	Capscrew
07.	Pump Platform	23.	Rubber Mounting Block	39.	Clamp Halves
08.	Pump Bracket	24.	Bushing	40.	Clamp Cap Plate
09.	Pump Tail Support Bracket	25.	Mounting Washer	41.	Capscrew
10.	Locknut	26.	Hardened Flatwasher	42.	Not Used
11.	Capscrew (Grade 8)	27.	Hose Assembly	43.	Not Used
12.	Capscrew (Grade 8)	28.	Hose Assembly	44.	Not Used
13.	Lockwasher	29.	Hose Assembly	45.	Driveline Guard
14.	Capscrew (Grade 8)	30.	Flange Kit	46.	Capscrew
15.	Capscrew	31.	Flange Kit	47.	Flatwasher
16.	Capscrew	32.	Not Used	48.	O-ring

FIGURE 2 - HYDRAULIC PUMP INSTALLATION (A84203, SHEET 1 OF 2)

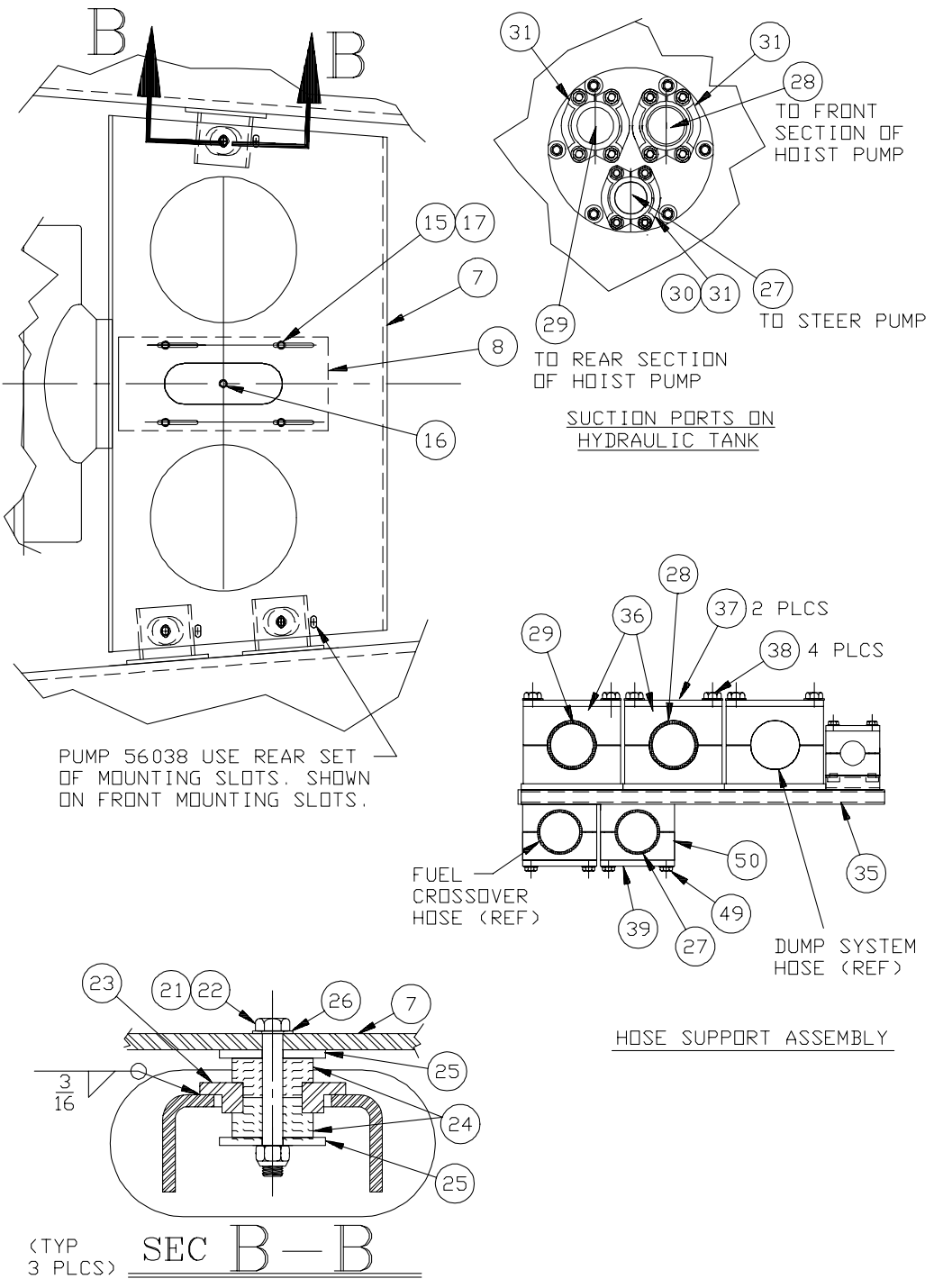


FIGURE 2 - HYDRAULIC PUMP INSTALLATION (A84203, SHEET 2 OF 2)

37. If removed, install plug (18) in the discharge side of the flange, below the surface. (See Figure 1, Section C-C.)

38. Install the steering pump on the rear transition plate as outlined in the instructions in Section 5 - Hydraulic System.

INSTALLATION (Figure 2)

The pumps may be installed as follows:

1. Install the pump assembly on the pump bracket (8) with capscrews (11) and locknuts (10).

2. Install the rear or tail support bracket (9) and supports with the appropriate capscrew on the pumps.

3. Install the lip seal (3) on the front side of the pump bracket.

4. Check the installation of the large pump platform (7). Verify that all mounts are tight and in good repair.

5. Install a 1/2 inch NC threaded eye bolt in the top center of the pump bracket.

6. Position the pump assembly under the truck and route the come-along or other suitable lifting device down through the opening in the center of the upper bracket.

7. Raise the pumps into place and loosely secure with the capscrews and hardened flatwashers.

NOTE: *Do not install the driveshaft at this time.*

8. Slide the bracket fore and aft as required to obtain the required distance between the front edge of the upper bracket and the face of the drive on the rear of the alternator.

If this dimension is not available, it will be necessary to adjust as follows:

a. Remove the mounting hardware securing the bracket to the frame.

b. Remove the weld securing the bushing mounting block to the mount. Grind all surfaces smooth to prevent binding.

c. Repeat steps 4 through 7 adjusting the bushing mounting block fore and aft to obtain the required dimension.

d. Tack weld the block in place.

e. Remove the pump bracket assembly and finish weld the bushing in place.

9. Reinstall the pump bracket assembly.

10. Verify the 3/16 inch (4.6 mm) vertical distance between the horizontal centerlines of the front drive face and the pump drive spline. If not held, use mounting washers to obtain this dimension with the mounting bolts tight.

11. Install the driveshaft as outlined in the instructions in Section 5 - Hydraulic System.

12. Remove the lifting eye bolt from the pump bracket.

13. Install the inlet and outlet hoses on the pumps and secure in place.

14. Re-establish flow from the reservoir to the pumps.

15. Start the engine and let operate at low idle until all air is purged from pumps. Bleed all entrapped air from the system as described in instructions for the individual components.

16. Test pump operation by rechecking individual system operation and test procedures in Section 5 - Hydraulic System.

DUMP CONTROL VALVE

DESCRIPTION AND LOCATION

The dump control valve is a large, multi ported, split spool type hydraulic valve located on or near the dump cylinder cross tube.

The dump valve consists of two main sections:

1. Inlet Section - containing five major components:

    a. Flow Control and Relief Valve Assembly

    b. Dampening Valve Assembly

    c. Load Check Poppet

    d. Anti-Void Poppet

    e. Low Pressure Relief Valve Assembly

2. Spool Section - containing two large, ground and polished spools.

OPERATION-BASIC

The dump valve controls the flow of hydraulic oil between the pump, dump cylinders and the reservoir. Control of this system regulates movement of the dump body, providing a means for dumping payloads.

The dump valve is pilot operated by the dump control pilot valve. This pilot valve receives its oil from the pilot supply caps on the inlet sections of the main dump valve. The pilot valve controls the flow of pilot pressure oil to the spool section of the dump valve by manual movement of the Dump Controller lever in the cab.

OPERATION - INLET SECTION

1. Flow Control Valve and Pilot Dampening Valve

The flow control valve, containing the main relief cartridge, permits the supply oil from the pumps to return to the reservoir when the pilot valve spool is in either the Hold or Float position. With the pilot valve spool in either the Raise (power up) or Lower (power down) position, the flow control valve will shift in its bore, closing a return passage to the reservoir and directing the oil to the spool section by the load check poppet. Supply oil is also directed to the chamber behind the flow control valve to help the spring hold it firmly closed preventing oil loss to the reservoir. The oil, under pressure, enters the chamber behind the flow control valve through the pilot dampening valve enclosed in the pilot supply cap. The pilot supply cap receives oil from the steel tube connected to the main inlet port. The oil directed to the pilot valve and the back side of the flow control valve will be the same pressure as the oil directed to the cylinders. The greater the load in the cylinders, the greater the force behind the valve.

When the pilot valve is released to the Hold or Float position, the oil pressure behind the flow control valve will escape to the reservoir through the pilot dampening valve and the dump control pilot valve. The supply oil, no longer going to the cylinders, will push the flow control valve open and return to the reservoir.

The pilot dampening valve regulates the flow of oil to and from the chamber behind the flow control valve. When the dump control pilot valve is placed in the Raise or Lower position the restriction poppet in the pilot dampening valve will be off of its seat permitting free flow of oil under pressure, to the chamber behind the flow control valve. When the pilot valve is returned to the Hold or Float position, the flow control valve will move off its seat pushing the oil in the chamber out through the small orifice in the poppet of the pilot dampening valve. The combined action of the flow control valve and the pilot dampening valve provide quick response to the operators commands without the pressure surges found in non-dampened valves.

2. Main Relief Valve

The main relief valve, enclosed in the flow control valve, protects the pumps and hydraulic system from excessively high pressure.

The center of the relief poppet is machined to accept a metering piston. Supply oil pressure, present in the inlet chamber, will fill the cavity behind the relief poppet through the small orifice in the metering piston. The oil in the cavity behind the relief poppet will help the spring hold the relief poppet on its seat, preventing oil loss to the reservoir. The oil in the cavity will be the same pressure as the oil delivered to the cylinders. The greater the load on the pumps and cylinders, the greater the force behind the relief poppet.

When main relief pressure is achieved, the oil pressure transmitted to the cavity will push open the pilot poppet and escape to the reservoir. This action causes a pressure drop behind the relief poppet allowing it to move off its seat, opening a passage from the supply cham-

ber to the reservoir. When the relief poppet shifts in its bore, it carries with it the metering piston. The open cavity in the metering piston will seat over the protruding shaft of the pilot poppet to provide additional restriction to the oil flowing into the cavity behind the poppet. The gradual refilling of the cavity gives the main relief the ability to function smoothly and avoid a hammering action which could damage the relief valve components. When the load is released, the cavity will refill and the relief poppet will again be held on its seat preventing oil loss to the reservoir.

The main relief pressure is adjusted by turning the adjusting screw to increase or decrease the spring tension on the pilot poppet.

3. Load Check Poppet

The load check poppet is located directly across from the flow control valve assembly. The cavity behind the load check is referred to as the high pressure supply chamber leading to the spool section. Movement of the dump control pilot valve to the Raise or Lower position causes the two large spools in the spool section to shift providing a path from the high pressure supply chamber to the dump cylinders. The pressure exerted by the load on the dump cylinders is transmitted to the cavity behind the load check and will hold it closed until there is sufficient supply pressure to overcome the load in the cylinders and the load check spring. In doing this the load check poppet prevents the dump body from suddenly decreasing when the pilot valve is initially actuated.

4. Anti-Void Poppet

The anti-void poppet is identical in construction to the load check and is held on its seat by the same spring and hydraulic force that holds the load check closed. When return oil pressure is greater than supply oil pressure, the anti-void poppet will open, allowing the high pressure return oil to join the lower pressure supply oil and flow to the cylinders through the high pressure chamber.

5. Low Pressure Relief Valve

The low pressure relief valve is located next to the main flow control valve. This poppet holds a back pressure against the return oil leaving the cylinders through the low pressure chamber. This back pressure makes the anti-void poppet more effective at preventing cylinder cavitation. The low pressure relief valve is held on its seat by the combined action of hydraulic force and a spring.

OPERATION - SPOOL SECTION

The spool section controls the flow of oil to the dump cylinders. This section contains two large, ground and polished spools. One spool controls the oil flow to the base end of the cylinders, the other spool controls the oil flow to the rod end of the cylinders.

Each spool is held centered in the housing by two centering springs. The spools are hollow with a drilled passage running from end to end and across the middle. The oil pressure present in the cylinder port will also be seen on each end of the spool. When the dump control pilot valve is placed in the Raise position, the pilot oil pressure, in excess of the pressure in the cylinder port, will be directed to the pilot pressure cap to push the rod end spool to index with the high pressure chamber. At this point the high pressure oil flows through the center passage of the spool and is regulated by a small internal restrictor poppet. Oil flowing through the small orifice of the restrictor poppet will create a pressure drop from one side of the spool to the other side. This pressure drop causes the spool to shift. The color coded restrictor poppets are held in the spool by an O-ringed washer.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Inspect all hoses and lines for evidence of damage or leakage. Repair or replace as required.

2. Inspect each assembly component for evidence of wear, damage, or leakage.

3. Test the operation of the valve as outlined in the system test in Section 5 - Hydraulic System.

REMOVAL

The dump valve may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction brake system.

2. Lower the dump body onto the frame. Move the Dump Controller lever to the Float position.

3. Shut the engine off.

4. Verify that all pressure has been relieved from the system.

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Excessive HOLD flow pressure	Restriction in pilot flow	Flush out pilot valve supply line.
	Restriction in pilot return line	Flush out line. Replace if necessary.
	Main flow control poppet stuck in closed position	Remove foreign material until poppet moves freely. Check O-rings and back-up rings. Replace damaged parts.
	Restriction in return line of main control valve	Flush out line. Replace if necessary.
High operating pressures	Main relief is not operating properly	Adjust or replace.
High operating temperature	Main relief is not operating properly	Reset to proper relief valve setting. If trouble persists, disassembly valve.
	Excessive leakage in main control valve or pilot valve	Check spools and bores for excessive wear or scoring. Replace damaged parts.
	Cylinder leaking	Replace cylinder packing.
	Defective pump	Repair or replace.
Loss of power or delay in reaction time	Restriction in the main flow control body pilot hole	Free hole of foreign material.
	Anti-void poppet in inlet section stuck open	Remove foreign material from poppet, poppet seat, and bore. Make sure poppet seats properly and moves freely. Replace return spring if fatigued or distorted.
	Ruptured supply line to pilot valve	Replace supply line.
	Pilot valve spool not positioned properly	Free and clean binding linkage. Check spool and detent balls. Replace if scored or damaged.
	Main relief valve not working properly	Replace.
	Cylinder leaking	Replace cylinder packing.
	Defective pump	Repair or replace.
	Excessive leakage in main control valve or pilot valve	Check spools and bores for excessive wear or scoring. Replace damaged parts.
	Void in system	Verify that the pilot cover is installed properly.

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PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Noticeable voids in dump cylinder when lowering	Pilot cover installed backwards	Probe cross-hole in cover. The cross-hole on the supply side should be about 1/2 the width of the valve.
	Main flow control relief valve poppet stuck open	Replace or see service instructions covering main relief valve.
	Low pressure relief in inlet section stuck open	Remove foreign material from poppet, poppet seat, and bore. Make sure poppet seats properly and moves freely. Replace return spring if fatigued or distorted.
	Anti-void poppet in inlet section stuck closed	
Dump cylinders do not raise or move slowly	Spools binding in main control valve	Clean all foreign material until spool moves freely. Replace damaged or worn parts.
	Restriction in pilot pressure line	Flush out line or replace as required.
	Broken springs in either spool	Replace springs in pairs.
	Ruptured pilot pressure line	Replace pilot pressure line.
	Pilot valve spool not positioned properly	Free and clean binding linkage. Check spool spring and detent balls. Replace if scored or damaged.
	Main relief valve set low or not operating properly	Adjust or replace.
	Cylinder leaking	Replace cylinder packing.
	Defective pump	Repair or replace.
	Restrictor poppet incorrect or out of place	Check assembly print for correct poppet location.
Load drops with lever in Hold position	Spool in pilot control valve not positioned properly	Free and clean binding linkage. Check spool spring and detent balls. Replace if scored or damaged.
	Broken or weak spool return spring in main control valve	Replace spring in pairs.
	Holes in either spool or restrictor poppets plugged	Free holes of foreign material. Replace worn or damaged parts.

12665-2 Sheet 2 of 4

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Load drops with lever in Raise position	Holes in base spool or restrictor poppet plugged	Free holes of foreign material. Replace worn or damaged parts.
	Broken springs in spool	Replace broken springs in pairs.
	Spool binding	Clean all foreign material until spool moves freely. Replace damaged or worn parts.
Slow or loss of float	Pilot valve spool not positioned properly	Free and clean binding linkage. Check spool and detent balls. Replace if scored or damaged. Check detent pin. Screw securely into pilot valve spool.
	Main control valve spools binding	Clean out all foreign material until spool moves freely. Replace damaged or worn parts.
	Float poppet stuck closed	Flush out foreign material until float poppet operates freely.
	Restriction in line between main valve and pilot valve	Flush out line or replace as required.
	Restriction in pilot valve return line	Flush out line or replace as required.
	Restriction in hole of spool	Remove foreign material from hole of spool. Replace damaged or worn parts.
	Restriction in restrictor poppet	Remove foreign material or install new parts as required.
	Low pressure relief in inlet section stuck closed	Remove foreign material until valve operated freely. Replace worn or damaged parts.
	Restriction in main control valve return line	Flush out line or replace as required.
	Restrictor poppet in spools not seating properly	Lap to mating seat or replace.
Noticeable void when lowering dump body	Broken spool spring	Replace spool springs in pairs.
	Hole in restrictor poppet plugged	Free hole of foreign material.
	Restriction in pilot flow or pilot pressure return line	Flush out line. Replace line if necessary.

12665-3 Sheet 3 of 4

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Noticeable void when lowering dump body	Ruptured supply line to pilot valve	Replace supply line.
	Pilot valve spool not positioned properly	Free and clean binding linkage. Check spool and detent balls. Replace if scored or damaged.
	External restrictor	Check external restrictor for dirt and correct poppet seating. Replace if necessary.
Dump body settles down with control in hold position and engine off. Hold.	Cylinder leaking	Replace cylinder packing.
	Spools binding in main control valve	Clean all foreign material until spool moves freely. Replace damaged or worn parts.
	Excessive leakage in valves	Check spools and bores for excessive wear or scoring.
	Spool in pilot valve not centering	Free pilot valve spool. Replace pilot valve if necessary.

12665-4 Sheet 4 of 4

5. Disconnect all hoses and wiring to the valve. Label each to aid during installation. Install clean plugs or caps over all openings.

6. Remove the capscrews that secure the valve.

7. Remove the valve.

DISASSEMBLY (Figure 1)

NOTE: *Note the position and orientation of parts during disassembly. Some parts are not interchangeable. Some parts that appear symmetrical may not be turned around.*

SECTIONS

The main dump control valve may be split into sections as follows:

1. Loosen and remove the locknuts (10), flatwashers (9), and tie bolts (4) securing the sections together.

2. Carefully separate the sections. Inspect all seals between sections.

NOTE: *Do not pry the sections apart with sharp instruments as they may cause damage to mating surfaces.*

INLET SECTION

The inlet section of the dump valve may be disassembled as follows:

1. Mark both covers (17 and 47) to ensure proper reassembly.

2. Remove the eight socket screws from the inlet cover (47). Remove the cover.

3. Remove springs (24 and 31) and tag for proper reassembly.

4. Remove the low pressure relief valve sleeve (25) with subassembly.

5. Remove the main relief valve assembly (32).

6. Remove the eight socket screws (2), poppet cover (17), springs (19), and poppets (20).

7. Remove all O-rings and back-up rings from the inlet housing.

MAIN FLOW CONTROL POPPETS AND RELIEF VALVE

The main flow control poppets and relief valve may be disassembled as follows:

1. Remove the relief valve poppet (37) from the inlet section.

2. Remove the internal retaining ring (41), plug (43) (with associated parts intact), poppet (33), and piston (34).

3. Remove all O-rings and back- up rings.

NOTE: *If associated parts in the plug are removed, the relief pressure setting will be altered. However, to inspect the poppet face and seating surface in the plug, disassembly is necessary.*

4. Remove the locknut (45), adjusting screw (44), spring (42), and poppet (46).

SPOOL SECTION

The spool section of the dump valve may be disassembled as follows:

1. Mark covers (51 and 59) for proper reassembly.

2. Remove the eight socket screws (2), cover (59), and O-rings (61 and 62).

3. Mark both spools (58) with respect to their proper bores and position.

IMPORTANT: *The spools are a select fit. They are not interchangeable, and they cannot be turned around in their bores. Reversing the spools will cause improper operation.*

4. Mark poppets (55 and 65) with respect to their spools.

IMPORTANT: *The poppets are not interchangeable.*

5. Remove the spools (58) with the following:

a. Springs (60).

b. Washers (57), O-rings (52), and poppets (54, 55, and 66).

6. Remove the float poppet subassembly (65) as a unit.

7. Remove the eight socket screws (2), cover (51), O-rings (62), springs (50), washers, and poppet (68).

8. Remove the plug and O-ring from the end cover (if so equipped).

INSPECTION AND REPAIR

INLET SECTIONS

The inlet sections of the dump valve may be serviced as follows:

1. Clean all parts including subassemblies in solvent, and dry with compressed air.

2. Inspect the hole and ball poppet of the low pressure subassemblies for foreign particles, and clean with compressed air.

3. Examine all springs for breaks or distortion.

4. Inspect all poppet seating surfaces for nicks or excessive wear. All seats must be sharp and free of nicks.

5. Inspect all bores and surfaces of sliding parts for nicks, scores, or excessive wear.

6. Insert the poppets into their respective bore and test for fit. The poppets should fit freely, without binding through a complete revolution.

7. Follow the above procedure to check the fit between the low pressure sleeves and low pressure relief valves.

8. Examine all O-rings and back-up rings for damage or wear. Replace as required.

MAIN FLOW CONTROL POPPETS AND RELIEF VALVE

The main flow control poppets and relief valves may be serviced as follows:

1. Clean all parts in solvent and dry with compressed air.

2. Inspect O-ring grooves for contamination.

3. Check springs for breaks or distortion.

4. Examine poppet faces and seating surfaces in poppet and plug for scratches or excessive wear. All seats must be sharp and free of nicks.

5. With the O-rings and back-up rings removed, insert poppets into the poppet subassemblies. Test for fit. The poppet must fit snugly without binding through a complete revolution.

6. Examine all O-rings and back-up rings for damage or deterioration. Replace as required.

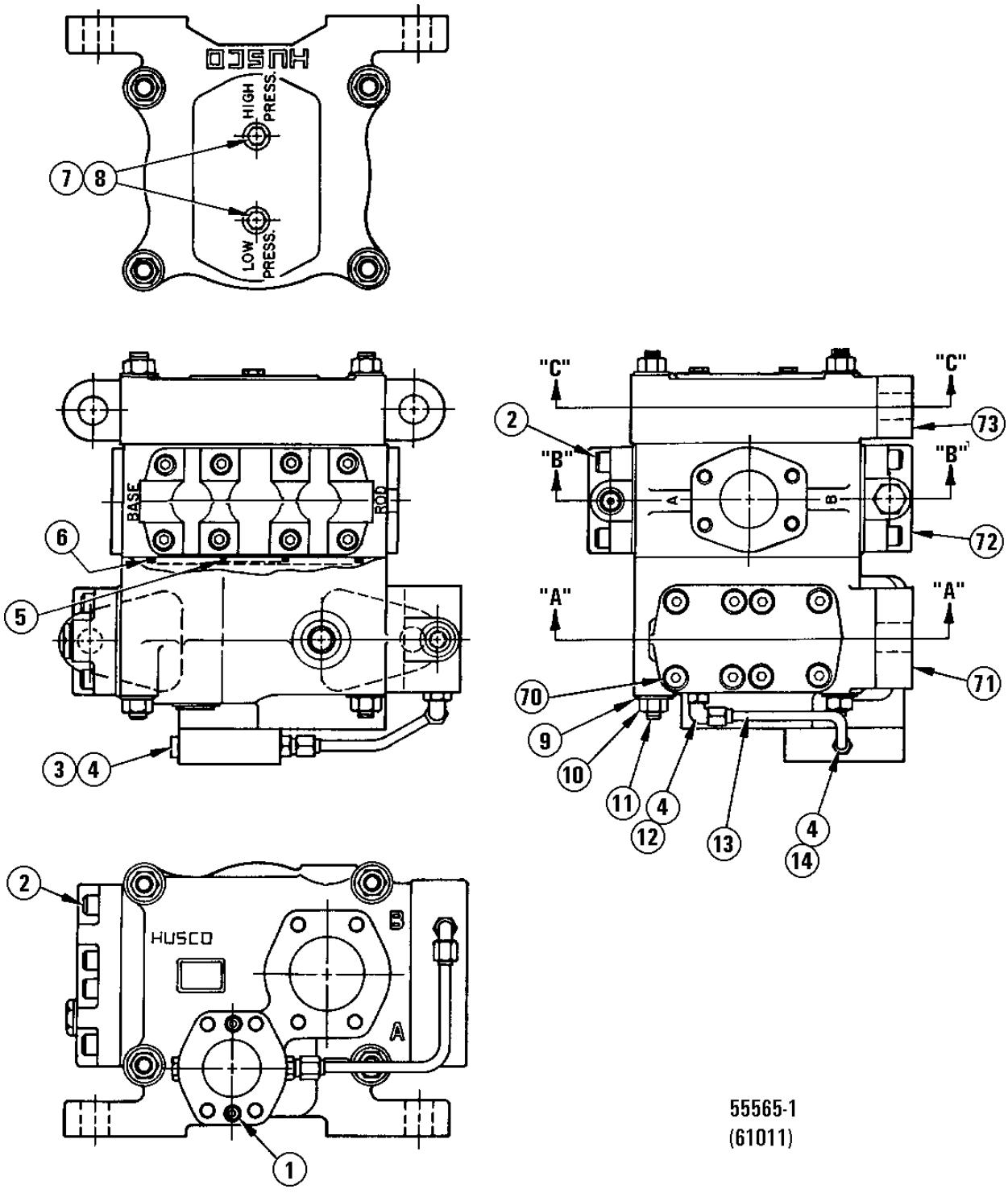


FIGURE 1 - DUMP VALVE ASSEMBLY

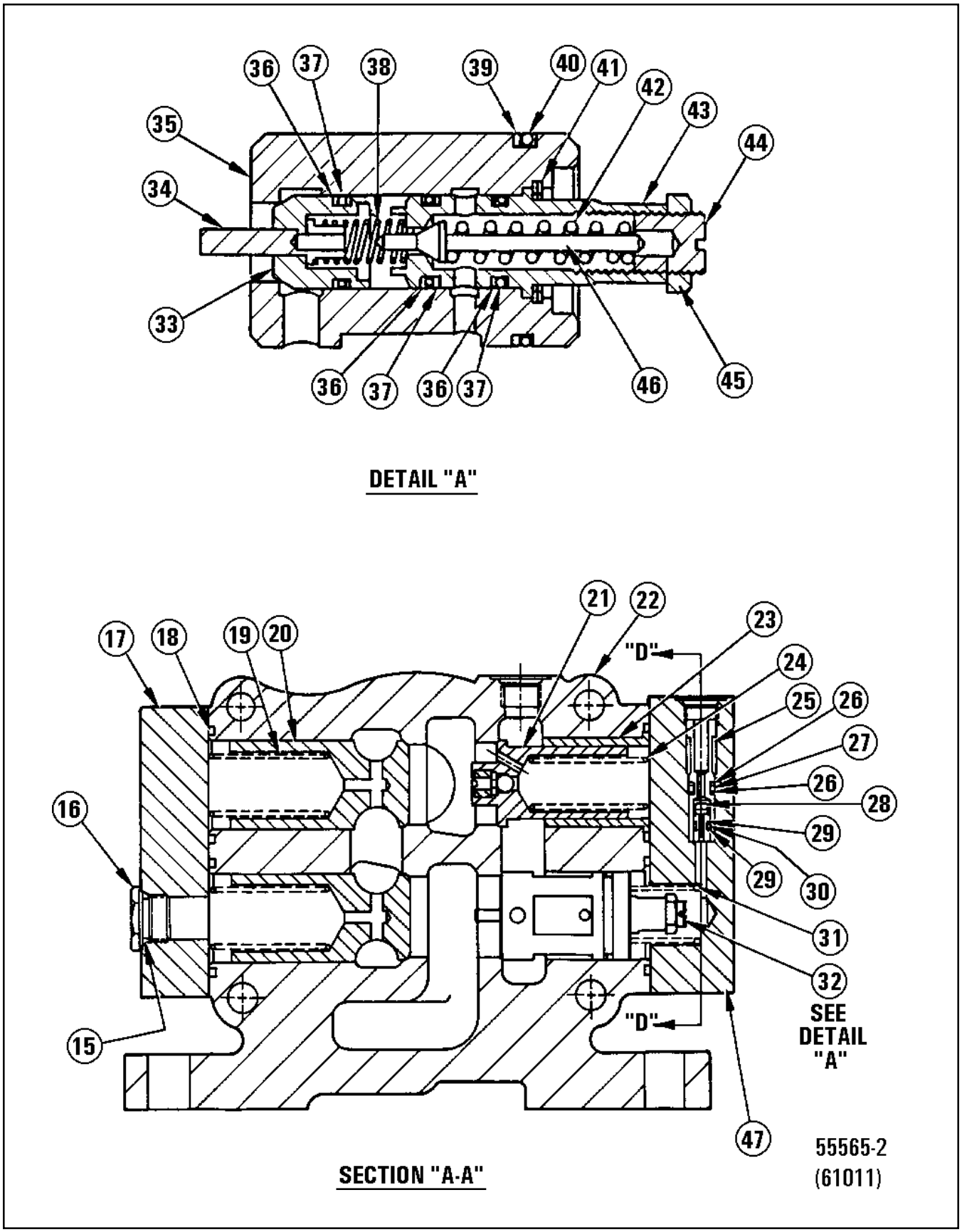


FIGURE 1 - DUMP VALVE ASSEMBLY - CONTINUED

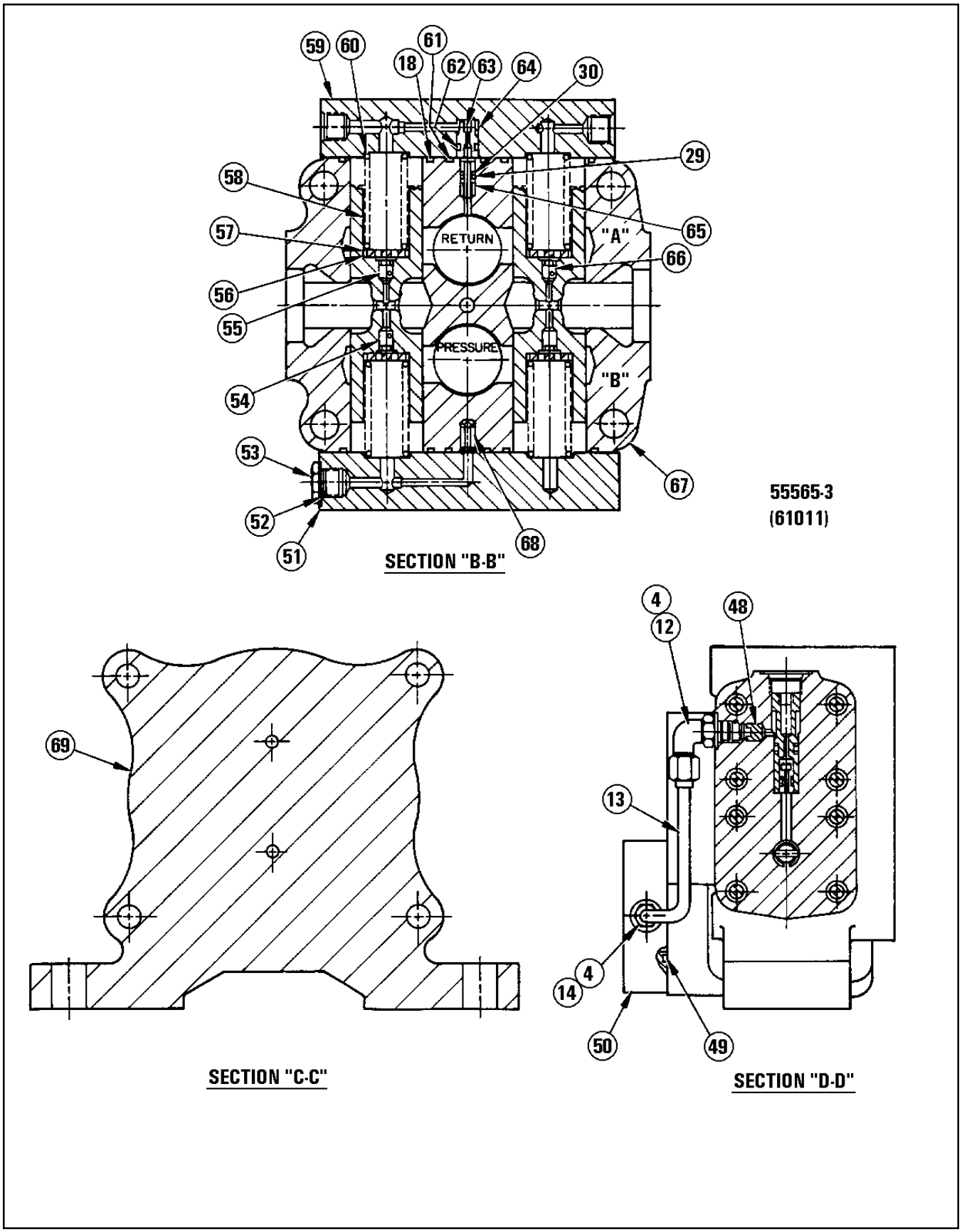


FIGURE 1 - DUMP VALVE ASSEMBLY - CONTINUED

SPOOL SECTION

The spool section of the dump valve may be serviced as follows:

1. Clean all parts in solvent, and dry with compressed air.

2. Inspect the hole and ball poppet of float poppet sub-assembly for foreign particles. Clean with compressed air.

3. Inspect all O-rings for damage or wear.

4. Inspect springs for breaks or distortion.

5. Inspect all poppet faces and seating surfaces in the spools. All seats must be sharp and free of nicks.

6 Inspect the spools and their bores for scratches or scoring. Check the fit of each spool in its bore. They should fit freely, without binding, through a complete revolution.

7. Inspect the flow passages in the spools and both covers. The passages must be clean and free of foreign particles. Clean with compressed air.

KEY			55565
01.	Socket Head Capscrew	38.	Spring
02.	Socket Head Capscrew	39.	Back-up Ring
03.	Plug	40.	O-ring
04.	O-ring	41.	Internal Retaining Ring
05.	O-ring	42.	Spring
06.	O-ring	43.	Relief Valve Plug (Non Serviceable)
07.	Plug	44.	Screw (Non Serviceable)
08.	O-ring	45.	Special Nut
09.	Compression Washer	46.	Relief Valve Poppet (Non Serviceable)
10.	Locknut	47.	Relief Valve Cover
11.	Tie Rod	48.	Restriction Screw
12.	Fitting	49.	O-ring
13.	Tubing	50.	Flange Cap
14.	Fitting	51.	Spool Cover
15.	O-ring	52.	O-ring
16.	Plug	53.	Plug
17.	Poppet Cover	54.	Restriction Poppet (Red)
18.	O-ring	55.	Restriction Poppet (White)
19.	Spring	56.	O-ring
20.	Check Valve Poppet	57.	Spool Washer
21.	Low Pressure Relief Valve Assembly	58.	Spool
22.	Inlet Housing	59.	Spool Cover
23.	Sleeve	60.	Spring (Green)
24.	Low Pressure Spring (White)	61.	O-ring
25.	Sleeve	62.	O-ring
26.	Back-up Ring	63.	Ball
27.	O-ring	64.	Poppet
28.	Restriction Poppet	65.	Restriction Poppet
29.	Back-up Ring	66.	Restriction Poppet
30.	O-ring	67.	Spool Housing
31.	Spring (Orange)	68.	Check Valve Poppet
32.	Relief Valve Assembly	69.	Outlet Housing
33.	Relief Valve Poppet (Non Serviceable)	70.	Socket Head Capscrew
34.	Relief Valve Piston (Non Serviceable)	71.	Inlet Section Assembly
35.	Relief Valve Body (Non Serviceable)	72.	Spool Section Assembly
36.	Back-up Ring	73.	Outlet Section Assembly
37.	O-ring		

ASSEMBLY

PRIMARY INLET SECTION

Main Flow Control Poppets and Relief Valve

Assemble the main flow control and relief valve subassembly as follows:

NOTE: *It is recommended that all O-rings be replaced during assembly. Lightly lubricate all O-rings with a multi-purpose grease. Do not use O-rings other than the manufacturer's, as they are made of special compounds.*

1. Coat all parts with hydraulic oil.

2. Insert poppet (46) and spring (42) into plug (43), and thread in the adjusting screw (44).

NOTE: *When the adjusting screw contacts the spring, an approximate adjustment only can be made. Turn the screw in to raise pressure, and out to lower. 1/4 turn changes the pressure about 150 psi (1 035 kPa). An accurate adjustment can be made when the dump valve is installed.*

3. Make an approximate adjustment with the adjusting screw.

NOTE: *When changing pressure to a lower pressure, perform the following:*

a. Determine how much the adjustment screw must be turned.

b. Turn the screw 1/2 turn beyond the final position.

c. Turn the screw back to the final position and install the locknut. Torque the locknut 20 to 30 ft-lb. (27 to 40 Nm).

4. Assemble O-rings and back-up rings as outlined in the illustration.

5. Insert the piston (34) and spring into the poppet, and install as an assembly into poppet.

IMPORTANT: *The spring is flared on one end. When correctly installed, the flared end will contact the plug.*

6. Insert the plug with associated parts into poppet (43), and install the internal retaining ring (41).

7. Install the relief valve subassembly into the inlet section of the dump valve. The relief valve must fit snugly without binding through a complete revolution.

NOTE: *When checking the main relief valve for freedom of poppet, the poppet may not spring back after being pushed toward the plug. This condition is normal as hydraulic oil on the parts will prevent the poppet from returning. The relief valve should be checked in the main dump valve for proof of proper operation.*

INLET SECTION

Assemble the primary inlet section of the dump valve as follows:

NOTE: *It is recommended that all O-rings be replaced during assembly. Lightly lubricate all O-rings with a multi-purpose grease. Do not use O-rings other than the manufacturer's, as they are made of special compounds.*

1. Coat all parts including the housing bores with hydraulic oil.

2. Insert poppets (20) and springs (19) into their respective bores. Ensure that the poppets are positioned properly.

3. Place O-rings (18) into their corresponding grooves.

4. Attach cover (17) with socket screws, and torque to 60 ft-lb. (80 Nm) in a cross corner sequence.

5. Insert the low pressure relief valve (21) with its sleeve (23) and spring (24) into the proper bore.

6. Insert main flow control/relief valve assembly (32) and springs (31) into its proper bore.

7. Install O-ring.

8. Attach inlet cover (47) with socket screws. Torque to 60 ft-lb. (80 Nm) in a cross corner sequence.

9. Install the pilot control valve assembly as follows:

a. Install O-ring and back-up ring (26 and 27) on sleeve (25).

b. Install O-ring and back-up ring (30 and 25) on the poppet.

c. Install the poppet (28) into the sleeve (25).

d. Install the assembly into the end cover (47) and secure.

SPOOL SECTION

Assemble the spool section of the dump valve as follows:

NOTE: *It is recommended that all O-rings be replaced during assembly. Lightly lubricate all O-rings with a multi-purpose grease. Do not use O-rings other than the manufacturer's, as they are made of special compounds.*

1. Coat all parts, including the housing bores with hydraulic oil.

2. Insert poppets (54, 55, and 66) into spools (58). Ensure that the poppets are installed in proper position.

3. Install washers (57) with O-rings (56) and springs (60) into spools (58).

4. Slide the spools into their respective bores. Ensure that the spools are positioned correctly. The spools cannot be turned around even though they appear symmetrical.

NOTE: *The "V" groove on the end of the spool should always be nearest the cover that the pilot lines connect to.*

5. Place all O-rings and back-up rings into their corresponding grooves.

6. Install the check valve poppet (68) and float poppet subassembly (65).

7. Assemble O-ring to the plug, and install the blank cover.

8. Attach blank cover with socket screws, and torque to 60 ft-lb. (80 Nm) in a cross corner sequence.

NOTE: *The covers are marked to correspond with the section they belong on. Each plunger section has cast webs with an "A" and a "B" designation on it. The number of the section and the nearest web letter is stamped on the cover. The inlet section is always considered section number 1. When the valve is correctly assembled, the stamped letter and number on the cover should match the web letter and section number.*

VALVE SECTIONS

The valve sections may be connected as follows:

1. Install all O-rings between the spool and the two inlet sections.

2. After verifying their respective positioning place the spool and two inlet sections together.

3. Install the tie bolts, lockwashers and nuts. Tighten the nuts as follows:

a. Torque evenly to 20 ft-lb. (27 Nm) in the following pattern :

(1) Top bolt on side opposite side with the cast section designators labeled A and B.

(2) Bottom bolt on side labeled with designator A and B.

(3) Bottom bolt on same side as (1).

(4) Top bolt on same side as (2).

b. Retorque to 50 ft-lb. (67 Nm) in the same sequence.

c. Retorque to 100 ft-lb. (135 Nm) in the same sequence.

d. Retorque to 160 ft-lb. (215 Nm) in the same sequence.

INSTALLATION

The dump valve may be installed as follows:

1. Position the valve on the mounting bracket.

2. Install capscrews and tighten to secure the valve in place.

IMPORTANT: *The dump valve has provisions for four mounting bolts. It is recommended that only three be used. The use of four bolts may cause undue binding or distortion.*

3. Install all hydraulic and electrical connections and secure to the valve.

IMPORTANT: *Remember to install the orifice that controls overcenter operation in the cavity behind the fitting for the Lower pilot inlet line. The orifice should be installed with the flat side toward the fitting. See the information on the dump system in Section 5 - Hydraulic System for more information.*

4. Test the operation of the system as outlined in the testing procedures under system operation in Section 5 - Hydraulic System.

NOTE: *Verify that all relief valves are properly set.*

DUMP PILOT VALVE

DESCRIPTION AND LOCATION

The dump pilot valve is a small multi-ported, spool-type valve mounted in the hydraulic components box behind the left side of the cab.

OPERATION

The dump pilot valve has two functions:

1. It serves as a directional valve, controlling the pilot flow of pressurized fluid to the main spools in the dump valve. This flow directs their operation and thus controls the operation of the entire system.

2. It limits the maximum pressure in the Lower or Power down mode to assist in controlling the rate at which oil is returned to the hydraulic reservoir.

TROUBLESHOOTING

For detailed troubleshooting information, see the chart in the module on the dump valve in Section 5 - Hydraulic System.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Inspect all hoses and lines for evidence of damage or leakage. Repair or replace as required.

2. Inspect each assembly component for evidence of wear, damage, or leakage.

3. Test the operation of the valve as outlined in the system operation test in Section 5 -Hydraulic System.

REMOVAL

The dump pilot valve may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction brake system.

2. Lower the dump body onto the frame. Move the Dump Controller lever to the Float position.

3. Shut the engine off.

4. Verify that all pressure has been relieved from the system.

5. Disconnect all hoses and wiring to the valve. Label each to and during installation. Install clean plugs or caps over all openings.

6. Remove the capscrews that secure the valve.

NOTE: *The Dump Controller cable linkage must be removed to remove the pilot valve assembly.*

7. Remove the valve.

DISASSEMBLY

NOTE: *Note the position and orientation of parts during disassembly. Some parts are not interchangeable. Some parts that appear symmetrical may not be turned around.*

The pilot valve may be disassembled as follows:

1. Separate the inlet (1), spool (2), and outlet (3) sections of the valve as follows:

   a. Loosen and remove the locknuts securing the sections together.

2. Carefully separate the sections. Inspect all seals between sections.

NOTE: *Do not pry the sections apart with sharp instruments as they may cause damage to mating surfaces.*

2. Remove screws (12).

3. Remove the end cover (13), O-ring (30), and wiper ring (29).

4. Remove the detent assembly from the other end of the section.

5. Carefully slide the entire spool assembly out of the main body with the detent section.

6. Remove the O-ring (30), and wiper ring (29) from the detent end of the housing.

7. Unscrew the spool from the detent assembly.

8. Disassemble the detent assembly as follows:

a. Remove internal retaining ring (23) and spacer (22).

b. Remove the internal retainer and balls as required.

c. Remove all remaining seals and components.

9. Remove the relief valve (4) from the side of the spool section.

INSPECTION AND REPAIR

The pilot valve may be serviced as follows:

1. Clean all parts, including the housing, and dry with compressed air.

2. Inspect seal counter-bores. They must be free of nicks and contamination.

3. Inspect the springs for cracks, distortion, or fatigue.

4. Inspect all sliding surfaces for nicks, scores, or excessive wear.

5. Inspect all spools for damage or wear. Test spools for proper fit in their bores. They should turn free through one complete revolution.

6. Examine O-rings for damage or excessive wear.

ASSEMBLY

The pilot valve may be assembled as follows:

1. Coat all parts, including the housing bores, with hydraulic oil.

2. Install the relief valve assembly (4) fitted with new seals (5) on the side of the spool section.

3. Assemble the detent assembly as follows:

a. Assemble the components as shown in the reverse order removed.

NOTE: *It may be desirable to hold the detent balls in place with grease during the assembly process.*

b. Secure with internal retaining ring (23) and spacer (22).

4. Install the spool on the detent assembly and tighten to approximately 5 ft-lbs (7 Nm).

NOTE: *It is recommended that a thread locking compound (Loctite 271 or equivalent) be used to prevent accidental separation of the components during operation. No compound should remain on the outer surface of the spool when assembled.*

6. Install the O-ring (30), and wiper ring (29) on the detent end of the housing.

7. Carefully slide the entire spool assembly into the main body with the detent section.

8. Install the detent assembly onto the end of the spool section.

NOTE: *It is recommended that a mild thread locking compound (Loctite 242 or equivalent) be used to prevent accidental separation of the components during operation. No compound should remain on the outer surface of the spool when assembled.*

INSTALLATION

The dump pilot valve may be installed as follows:

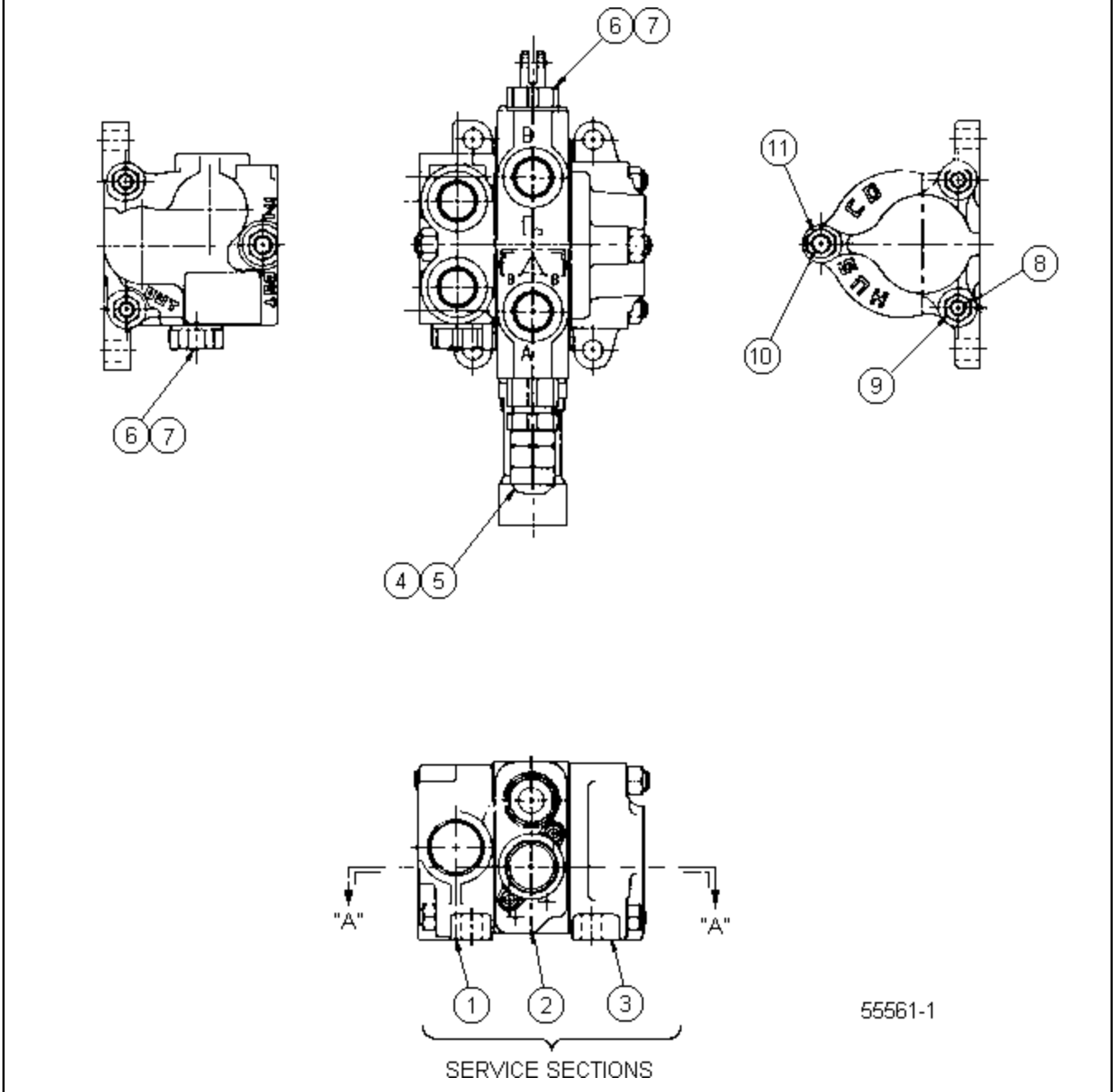
1. Position the valve on the mounting bracket.

2. Install capscrews and tighten to secure the valve in place.

3. Install all hydraulic and electrical connections and secure to the valve.

4. Test the operation of the system as outlined in the testing procedures under system operation in Section 5 - Hydraulic System.

NOTE: *Verify that all relief valves are properly set, particularly the pressure down relief setting controlled by the pilot valve.*



KEY 55561

01.	Inlet Section Assembly	10.	Tie Rod	19.	Spool Cap	28.	Inlet Housing
02.	Spool Section Assembly	11.	Special Nut	20.	Ball	29.	O-ring
03.	Outlet Section Assembly	12.	Machine Screw	21.	Spool End Detent Pin	30.	Wiper
04.	Relief Valve Assembly	13.	Seal Plate	22.	Spacer	31.	Spool
05.	Seal and Spring Repair Kit	14.	Outlet Housing	23.	Internal Retaining Ring	32.	Spool Housing
06.	Shut-off Plug Assembly	15.	O-ring	24.	Ball	33.	Check Valve Poppet
07.	Special Seal	16.	Spring Seat	25.	Spring	34.	Spring
08.	Tie Rod	17.	Spring	26.	Spacer		
09.	Special Nut	18.	Detent Sleeve	27.	Socket Head Capscrew		

FIGURE 1 - DUMP PILOT VALVE

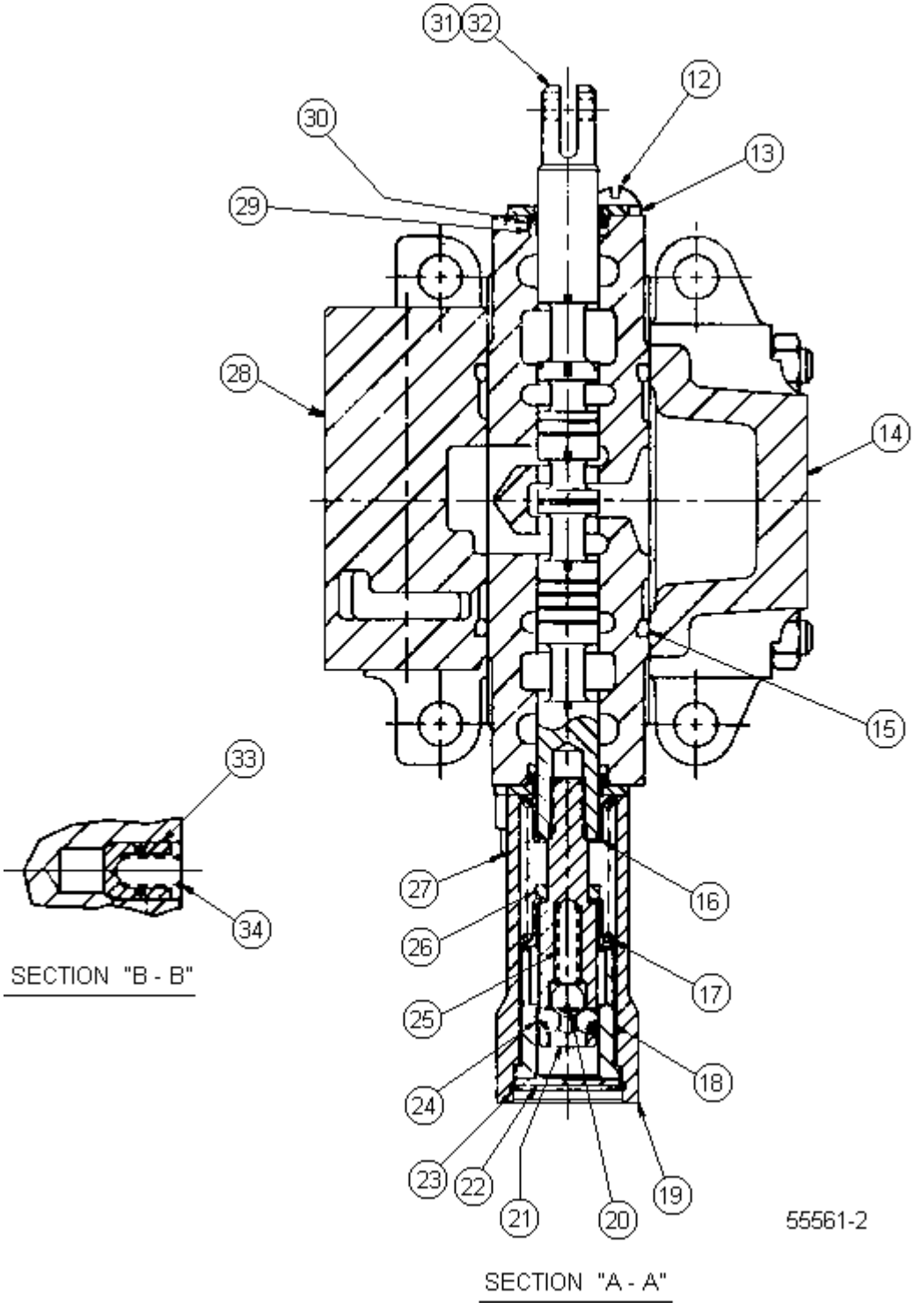


FIGURE 1 - DUMP PILOT VALVE - CONTINUED

DUMP CYLINDERS

DESCRIPTION AND LOCATION

The dump cylinders are two-stage, double-acting, hydraulic cylinders. The cylinders are mounted with the rod end attached to the frame and the base end to the dump body.

OPERATION

The dump cylinders raise and lower the dump body.

The cylinders are positioned so that they lift the front of the dump body, which pivots at the rear. The oil is directed into and out of each cylinder through a pair of ports on the piston rod (lower) end of the cylinder.

To raise the body (extend the cylinders), the hydraulic oil is directed from the dump valve into the extend port of each cylinder. The oil moves up the center tube pressurizing the first and second stage pistons of each cylinder, causing the cylinders to extend. The first and second stages extend together until the first stage bottoms out. The second stage then extends out from the first stage. The oil from the rod end of the cylinder flows out through the retract lines in the center tubes, exits through the retract port, and returns to the hydraulic tank through the dump valve.

In the lower or retraction cycle, the pressurized oil is routed into the cylinders retract ports, up the center tube passage to the rod end of the cylinders. The second stage retracts first, followed by the first stage. The oil from the base end of the cylinder exits through the extend port and to the tank through the dump valve.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps.

1. Clean each dump cylinder, especially any contamination from the rod and cylinder tube.

2. Inspect for wear, leakage, or damage. Repair or replace as required.

3. Verify that the cylinder connections to the frame and dump body are lubricated, secured properly, and free of damage.

4. If the cylinder seals are suspected of bypassing, the by-pass flow may be measured as follows:

a. With the dump body resting on the body pads, park the truck in a SAFE POSITION. It must be secured by means other than the friction brake system.

b. Stop the engine and allow the system to release all entrapped pressure. Verify that the Dump Controller lever is in the Float position.

c. Remove the hose from the extend port side of the cylinder to be tested where it connects to the dump valve.

d. Place the end of the hose in a clean empty container.

e. Start the truck engine and once operating, accelerate to rated speed.

f. Move the Dump Controller lever to the Lower or “Power Down” position and hold. Maintain for 30 seconds.

g. Return the Dump Controller lever to the detented Float position.

h. Measure the fluid captured from the cylinder.

(1) For new cylinders, it should be less than one-half gallon (1.9 liters).

(2) For used cylinders it should be less than one and one-half gallons (5.7 liters).

NOTE: *Flows in excess of these levels (for 30 second test) indicate excessive seal by-pass is occurring and service is recommended.*

i. Reinstall the hose on cylinder.

j. Bleed entrapped air before returning to service.

REMOVAL (Figure 2)

NOTE: *It is recommended that the cylinders be removed and serviced in pairs. Note the direction that the extend and retract ports face on the cylinder, so that the cylinder will be installed in the same position.*

The dump cylinders may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction brake system.

2. Drain the system or relieve all pressure before loosening any lines. Place the Dump Controller lever in the Float position.

⚠ WARNING

Never loosen any pressurized lines or components. Always drain the system, or relieve all pressure first.

3. Close the hydraulic fluid supply valve at the hydraulic tank.

4. Disconnect the hydraulic lines from the cylinder. Label each to ensure proper reassembly. Install clean caps and plugs on all open fittings.

NOTE: *The dump body may have to be blocked up slightly to allow clearance for the dump cylinder to be removed.*

5. Secure the cylinder in place with the shipping brackets, a chain, or equivalent.

6. Remove capscrew assembly (7, 8, and 9), upper plate cap (6), and upper pivot pin (4).

7. Remove capscrew assembly (7, 8, and 9), lower plate cap (6), pin (4), and spacers (5).

NOTE: *It may be necessary to use a puller.*

8. Remove the cylinder.

⚠ CAUTION

Use care to prevent the cylinder from extending during removal.

DISASSEMBLY (Figure 1)

The cylinder may be disassembled as follows:

1. Position the cylinder horizontally in a clean work area of sufficient size to allow for easy access and disassembly.

2. Remove lockwire (23) and drilled head capscrews (21) securing the packing gland (22).

3. Remove the 1st and 2nd stage subassembly from the body tube.

4. Remove the snap ring (4) in the groove on the 1st stage rod.

5. Remove the retainer ring (5).

6. Install the assembly ring tool (not shown) in the snap ring groove.

NOTE: *The assembly ring (tool) is a device used to "fill" the snap ring groove during the installation and removal of the pistons. This ring creates a temporary "smooth surface" with the cylinder bore, which allows the seals to pass over without damage. Failure to use this tool could allow the piston seals to expand in the groove and the cylinder to "seize".*
1. A metal version has been made by modifying a snap or retaining ring of the proper external dimensions, by machining the internal diameter to the internal diameter of the cylinder bore.
2. A alternative method that has been successfully used entails inserting a 2-377 size O-ring (either 90 duro buna or polyurethane) into the grove and coating liberally with an O-ring lubricant or equivalent.

7. Remove the lockwire and socket head capscrews securing the piston assembly (10) to the 1st stage rod (11).

8. Remove the piston assembly (10).

9. Remove the assembly ring (tool).

10. Remove the wear ring (6) and piston seal (7).

11. Remove the second stage rod assembly from first stage.

12. Remove the rod seals (18, 19, and 20) from the first stage assembly.

13. Remove the packing gland (22) from the first stage rod (11).

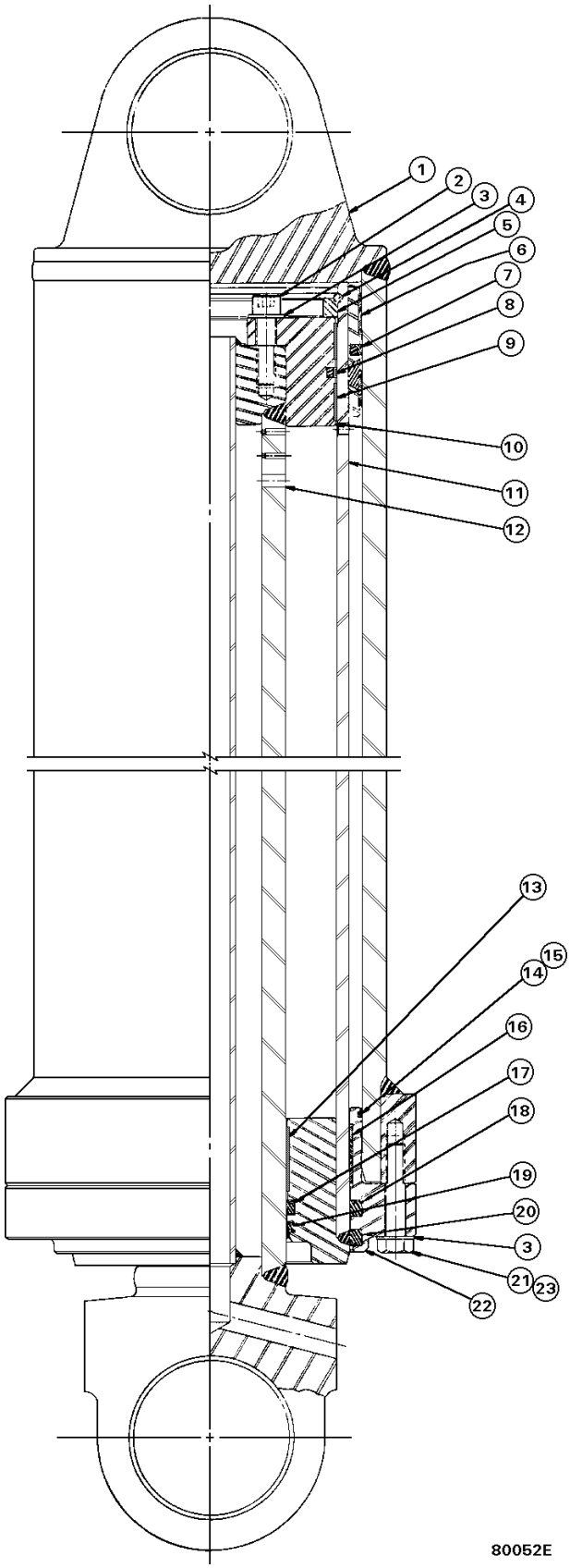
14. Remove the wear rings (13), rod seals (17 and 19), and O-ring seal and back up ring (14 and 15) from the packing gland.

15. Remove any remaining parts.

INSPECTION AND REPAIR

The cylinder may be serviced as follows:

1. Clean all metal components with solvent (especially seat and ring grooves and other passages). Inspect for scoring wear or damage. Repair or replace as required.



KEY 80052E	
01.	Body
02.	Socket Head Capscrew
03.	Hardened Flatwasher
04.	Snap Ring
05.	Retaining Ring
06.	Piston Wear Ring
07.	Piston Seal
08.	Piston Seal
09.	Piston Wear Ring
10.	Piston
11.	1st Stage Rod Assembly
12.	2nd Stage Rod Assembly
13.	Rod Wear Ring
14.	O-ring
15.	Back-up Ring
16.	Rod Wear Ring
17.	Rod Seal
18.	Rod Seal
19.	Rod Seal
20.	Rod Seal
21.	Drilled Head Capscrew
22.	Packing Gland
23.	Safety Wire

FIGURE 1 - DUMP CYLINDER

2. Inspect all seals and wear rings for evidence of damage, then discard.

3. Inspect all threaded components for evidence of damage. Repair or replace as required.

4. Inspect the mounting bushings and retainers for evidence of wear or damage. Repair or replace as required.

ASSEMBLY (Figure 1)

IMPORTANT: *It is recommended that all gasket seals be replaced each time the cylinder is disassembled.*

NOTE: *Prior to assembly coat each surface and/or seal with hydraulic oil compatible with that in the system in which it will operate.*

The cylinder may be assembled as follows:

1. Assemble the packing gland:

a. Install the O-ring seal (14) with back-up ring (15).

b. Install the rod seals (17 and 19) with the sealing lips outward (to act as wiper rings).

c. Install the wear rings (13).

d. Lube the seals and wear rings in the packing gland and the end of the first stage rod (11) with hydraulic oil, or lubricant mixture compatible with the oil to be used in the unit's hydraulic system.

2. Install the packing gland (22) on the first stage rod (11). Slide on several inches (mm) past the end.

NOTE: *The gland should not bind on the rod in any position.*

3. Assemble the first stage rod assembly as follows:

a. Install the rod seals (20) in the rod assembly.

b. Install the rod seal (19).

c. Install the rod seal (18) with the sealing lips outward to act as a wiper ring.

d. Lube the seals and wear rings with hydraulic oil or lubricant mixture compatible with the oil to be used in the truck's hydraulic system.

4. Carefully install the second stage rod assembly into the center of the first stage using care not to damage the components.

5. Assemble the piston as follows:

a. Install the piston seal (7) on the piston (10).

b. Install the wear ring (6).

c. Install the assembly ring (discussed in Disassembly) in the snap ring groove in the first stage rod.

d. Lube the seals and wear rings with the hydraulic oil or lubricant mixture compatible with the oil to be used in the truck's hydraulic system.

6. Install the piston assembly (10) onto the 1st stage rod (11). Use the two of the socket head capscrews (2) and hardened flatwashers (3) (inserted 180° apart) to draw the piston (10) against the second stage rod (12).

NOTE: *Use care not to allow the seals to bind during assembly.*

7. Remove the piston assembly ring from the first stage rod groove.

8. Install the remaining socket head capscrews/hardened flatwashers. Torque to 280-290 ft-lbs (280-290 Nm) in stages of 100, 200 and 280-290 ft-lbs (135, 265, and 380-390 Nm) using a criss-cross or "X" pattern.

9. Lockwire the socket head capscrews in pairs.

10. Install the retainer ring (5) against the piston.

11. Install the snap ring (4) in the groove in the first stage rod.

12. Lube the piston seals in the chamber on tube and the piston seals and bearings and wear rings with the hydraulic oil or lubricant mixture compatible with the oil to be used in the truck's hydraulic system.

13. Install the 1st and 2nd stage subassembly in the body (1).

14. Install the drilled head capscrews (21) and hardened flatwashers (3). Torque to 280-290 ft-lbs (380-390 Nm) in stages of 100, 200, and 280-290 ft-lbs (135, 265, and 380-390 Nm) using a criss-cross or "X" pattern. Lockwire in pairs when complete.

15. If removed, install the self aligning bushings (2, Figure 2) the upper and lower mounting positions and secure with retainer rings (3, Figure 2).

16. If possible, proof test the cylinder to 3000 psi (20 000 kPa) as outlined in the instructions in Maintenance and Adjustment in this module.

17. If the cylinder is not being installed immediately plug all ports with push in split flange plugs or bolted cover plates and coat bearings to prevent corrosion.

INSTALLATION (Figure 2)

The cylinder may be installed as follows:

1. Inspect the upper and lower mounting pins for evidence of wear or damage. Repair or replace as required.

2. Inspect the upper and lower mounting brackets/bushings for evidence of wear or damage. Repair or replace as required.

3. Secure the cylinder with a chain or other suitable means to prevent it from extending when lifted.

4. Lift the cylinder into position on the lower pivot pin with the larger or extend port to rear and the flat side of the body toward the frame.

5. Install the lower pin (4) with spacers (5) on each side. Secure with the capscrews (7), lockwasher (8), flatwasher (9), and plate cap (6).

6. Remove the chain securing the cylinder retracted. Extend the cylinder until the upper yoke is in position between the dump body flanges. Install the pin (4) and secure with capscrew (7), lockwasher (8), flatwasher (9), and cap plate (6).

7. Connect the hydraulic hoses.

8. Bleed the entrapped air from the cylinder as follows:

a. Start the truck and operate at low idle.

b. Move the Dump Controller lever to Lower and hold for several seconds.

c. Move the lever to Raise and allow the body to lift.

d. Move lever to Lower, release and allow the body to float down until it rests on the frame.

e. Repeat steps b through d in 2 ft (0.7 m) increments until all air is purged from the system.

f. Refill the hydraulic reservoir.

9. Test the operation of the dump system as outlined in Section 5 - Hydraulic System.

KEY	A84148
01.	Dump Cylinder
02.	Self Aligning Bushing
03.	Internal Retaining Ring
04.	Pin
05.	Bearing Spacer
06.	Cap Plate
07.	Capscrew
08.	Lockwasher
09.	Flatwasher
10.	Nut *
11.	Locknut *
12.	Flatwasher *
13.	Stud *
14.	Clamp *
15.	Block *

* For shipment and maintenance use only.

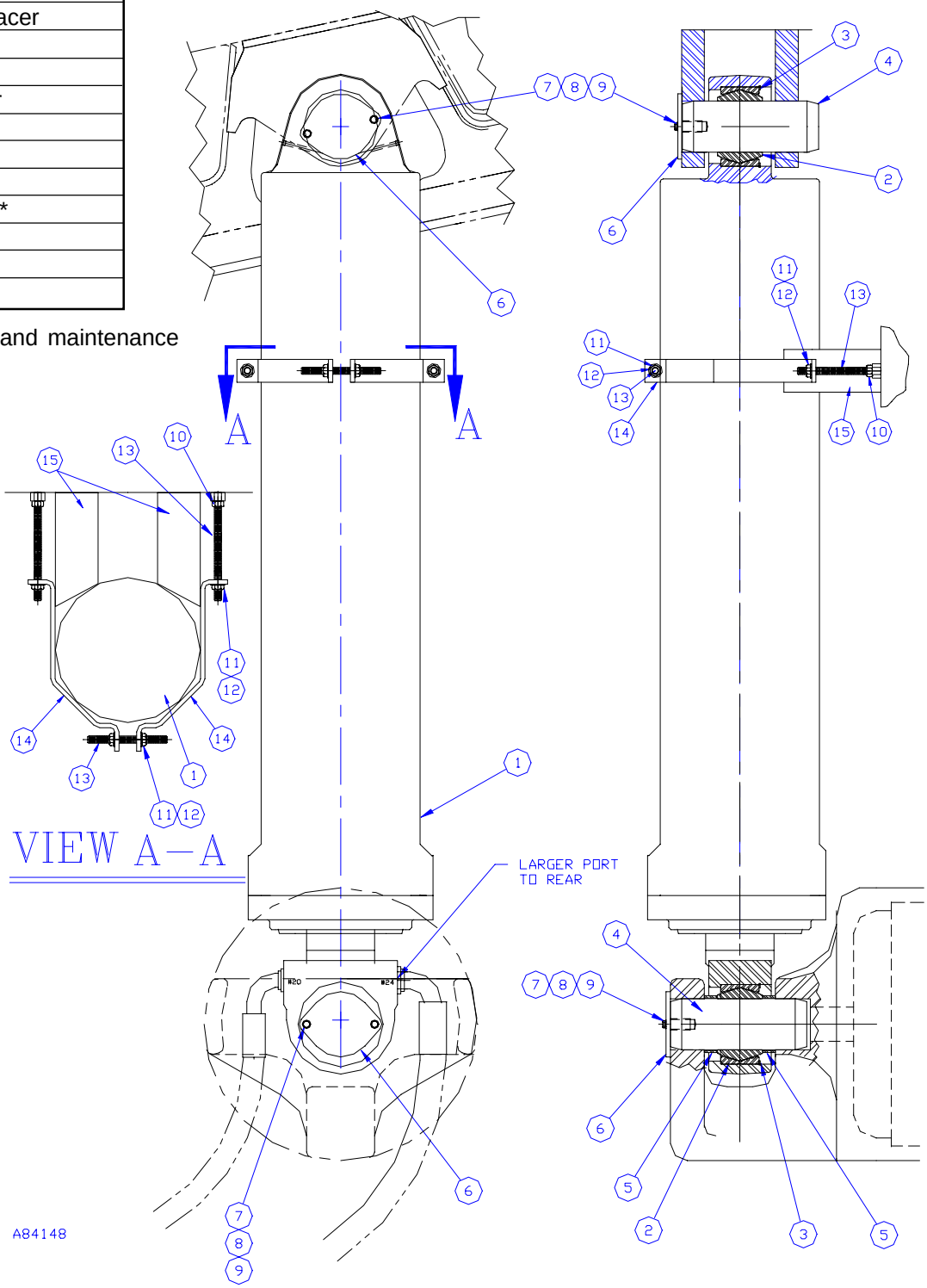


FIGURE 2 - DUMP CYLINDER INSTALLATION

HYDRAULIC STEERING SYSTEM

DESCRIPTION AND LOCATION

Components in the steering system include:

1. Steering pump - variable displacement, pressure compensating piston pump assembly comprising the rear section of the triple hydraulic pump assembly attached to a frame mounted bracket.

2. Hydraulic filter - pressure filter assembly with replaceable cartridge element mounted on the inside of the frame on the driver's side near the hydraulic tank.

3. Steering accumulators - long, slender piston type accumulator mounted in front of the hydraulic tank.

4. Steering orbital valve - cylindrical valve attached to the base end of the steering column behind the access panel in front of the cab.

5. Steering system flow amplifier - rectangular valve mounted inside the front frame rail, in front of the front axle assembly.

6. Steering cylinders - double acting hydraulic cylinders mounted on the front of the front axle assembly.

7. Steering manifold - multi-valve, metal manifold with externally mounted cartridges, mounted on top of the steering system hydraulic filter.

8. Manual power supply pump - 24 Vdc electric motor driven hydraulic pump mounted on the pump mounting platform. It is intended to be used for pressurizing the steering and brake systems during maintenance purposes (such as towing a disabled truck) only.

9. Pressure switches - typically diaphragm type pressure switches located as follows:

a. Low Steering Pressure (LSP) - mounted on the steering manifold. This switch warns the operator of decreased pressure in the steering system that results in diminished steering performance.

b. Manual Power Supply Pressure (MPSP) - mounted on the steering manifold. This switch controls the automatic operation of the manual power supply pump under specific operating conditions.

OPERATION

The hydraulic steering system consists of two subsystems, supply and operation, which perform together to control the operation of the steering system.

SUPPLY

Hydraulic oil to supply the system is drawn from the hydraulic reservoir into the steering pump assembly. The pump is a piston type pump with a moveable swashplate that is controlled in a pressure-compensating mode. In this configuration, the pump swashplate stroke is controlled from 0 to maximum displacement per revolution to provide a flow sufficient to maintain constant pressure of 3500 psi (24 130 kPa) in the system accumulators. The output of the pump is routed to the accumulators through a high pressure oil filter and steering manifold and on to the steering and brake accumulators, which are kept at a “constant state of charge”. The majority of operating time, the steering pump output will equal the steering demands without depleting the accumulator reserves.

OPERATION

The control of the system is based on a principle of flow amplification, in which a limited or pilot flow from the steering valve is used to control the operation of the flow amplifier valve that regulates system flow to the steering cylinders.

When the steering wheel is held stationary (considered the neutral position whether the vehicle is traveling straight or being controlled during a turn):

1. The supply of oil from the steering pump is routed across the integral priority valve in the flow amplifier.

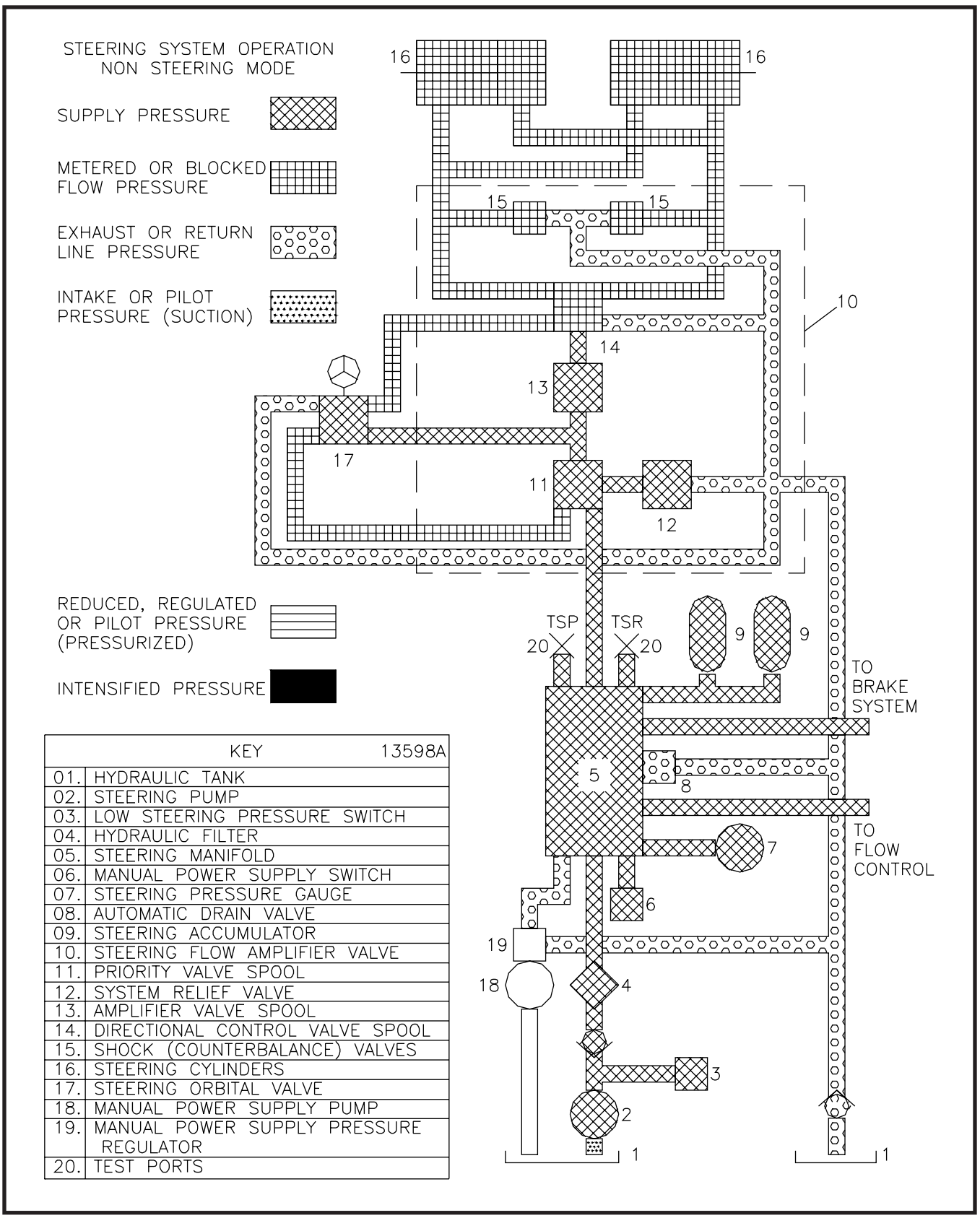
2. The directional control valve remains in the centered position. In this mode, any pressure surges induced by road conditions (e.g. when striking a hole in the road) are absorbed by the integral shock valves in the flow amplifier instead of being transmitted to the steering control unit, non-reactive steering.

When the steering valve is activated (by movement of the steering wheel) to change the position of the vehicle's front wheels:

1. A load sense signal is passed from the steering valve to the flow amplifier's priority valve.

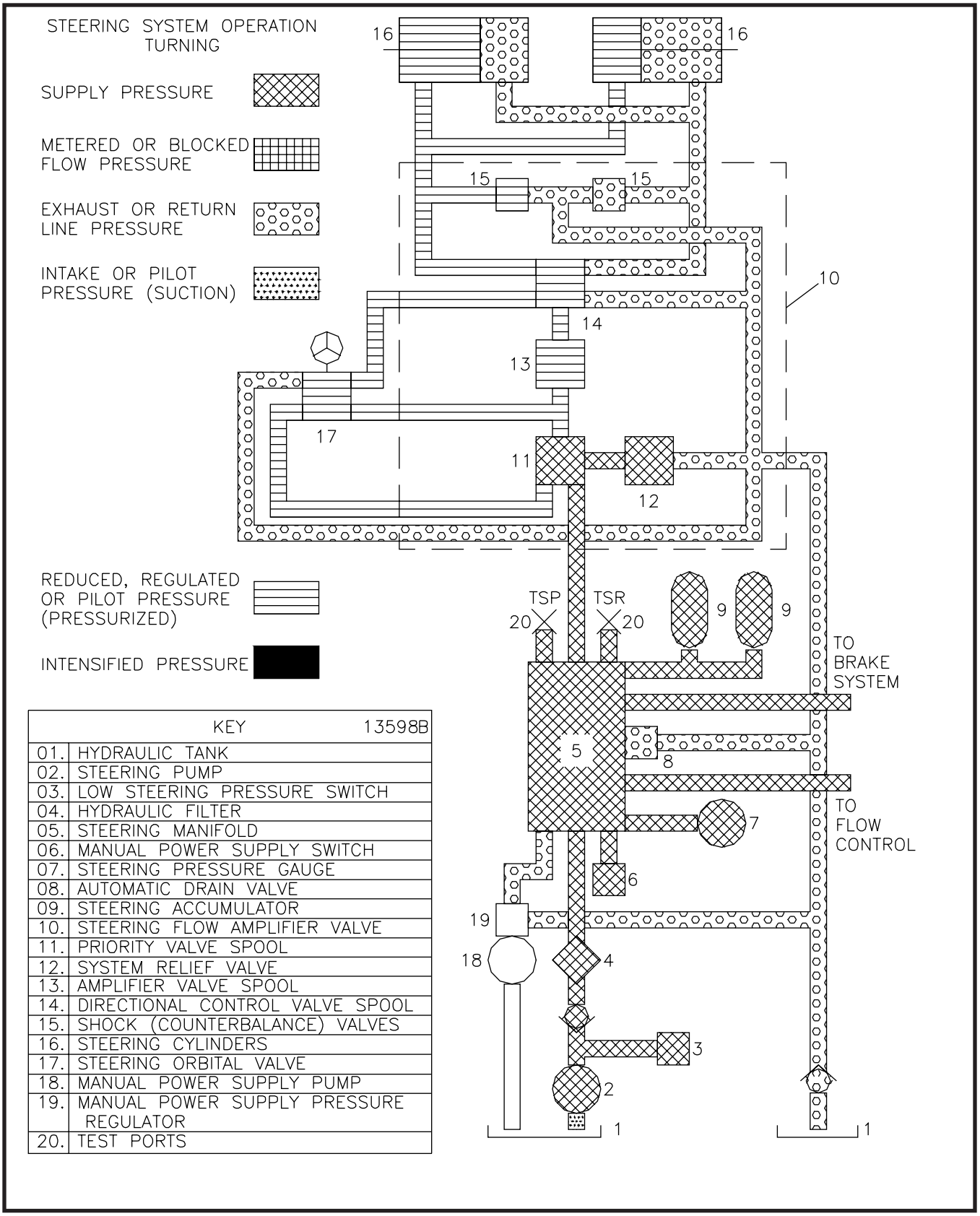
2. The priority valve shifts changing the path of the oil supply to the directional control valve portion of the steering control unit.

3. The directional valve is then shifted allowing the required flow to reach the amplifier valve assembly.



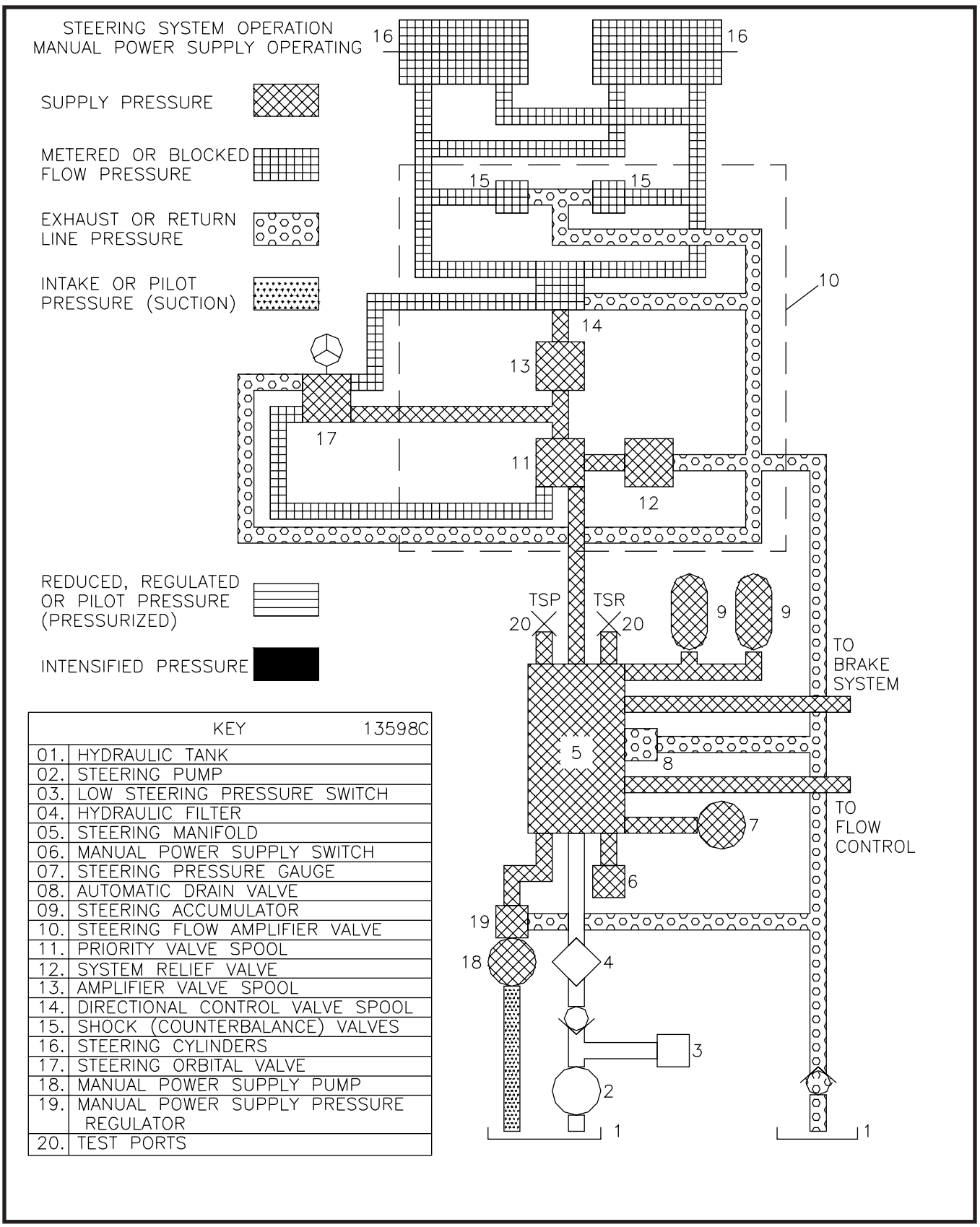
KEY	13598A
01.	HYDRAULIC TANK
02.	STEERING PUMP
03.	LOW STEERING PRESSURE SWITCH
04.	HYDRAULIC FILTER
05.	STEERING MANIFOLD
06.	MANUAL POWER SUPPLY SWITCH
07.	STEERING PRESSURE GAUGE
08.	AUTOMATIC DRAIN VALVE
09.	STEERING ACCUMULATOR
10.	STEERING FLOW AMPLIFIER VALVE
11.	PRIORITY VALVE SPOOL
12.	SYSTEM RELIEF VALVE
13.	AMPLIFIER VALVE SPOOL
14.	DIRECTIONAL CONTROL VALVE SPOOL
15.	SHOCK (COUNTERBALANCE) VALVES
16.	STEERING CYLINDERS
17.	STEERING ORBITAL VALVE
18.	MANUAL POWER SUPPLY PUMP
19.	MANUAL POWER SUPPLY PRESSURE REGULATOR
20.	TEST PORTS

FIGURE 1 - STEERING SYSTEM OPERATION - NONSTEERING MODE(13598A)



KEY	13598B
01.	HYDRAULIC TANK
02.	STEERING PUMP
03.	LOW STEERING PRESSURE SWITCH
04.	HYDRAULIC FILTER
05.	STEERING MANIFOLD
06.	MANUAL POWER SUPPLY SWITCH
07.	STEERING PRESSURE GAUGE
08.	AUTOMATIC DRAIN VALVE
09.	STEERING ACCUMULATOR
10.	STEERING FLOW AMPLIFIER VALVE
11.	PRIORITY VALVE SPOOL
12.	SYSTEM RELIEF VALVE
13.	AMPLIFIER VALVE SPOOL
14.	DIRECTIONAL CONTROL VALVE SPOOL
15.	SHOCK (COUNTERBALANCE) VALVES
16.	STEERING CYLINDERS
17.	STEERING ORBITAL VALVE
18.	MANUAL POWER SUPPLY PUMP
19.	MANUAL POWER SUPPLY PRESSURE REGULATOR
20.	TEST PORTS

FIGURE 1 - STEERING SYSTEM OPERATION - NONSTEERING MODE(13598B)



KEY	13598C
01.	HYDRAULIC TANK
02.	STEERING PUMP
03.	LOW STEERING PRESSURE SWITCH
04.	HYDRAULIC FILTER
05.	STEERING MANIFOLD
06.	MANUAL POWER SUPPLY SWITCH
07.	STEERING PRESSURE GAUGE
08.	AUTOMATIC DRAIN VALVE
09.	STEERING ACCUMULATOR
10.	STEERING FLOW AMPLIFIER VALVE
11.	PRIORITY VALVE SPOOL
12.	SYSTEM RELIEF VALVE
13.	AMPLIFIER VALVE SPOOL
14.	DIRECTIONAL CONTROL VALVE SPOOL
15.	SHOCK (COUNTERBALANCE) VALVES
16.	STEERING CYLINDERS
17.	STEERING ORBITAL VALVE
18.	MANUAL POWER SUPPLY PUMP
19.	MANUAL POWER SUPPLY PRESSURE REGULATOR
20.	TEST PORTS

FIGURE 1 - STEERING SYSTEM OPERATION - NONSTEERING MODE(13598C)

The amount and speed of the input signal controls the magnitude of the spool's movement. The pilot and main flows are then merged and directed to the appropriate ports in the steering cylinders.

Stopping movement of the steering wheel returns the valve to the previously outlined stationary position.

Amplification occurs in the amplifier valve. As the pressure in the chambers increase, flow is regulated in an amount proportionate to the area of the holes in the various portions of the spool.

The directional control valve controls the return oil. In an overrun condition (in which the vehicle wheels try to cause steering movements more severe than the operator's inputs) the directional control valve automatically throttles the flow of this return oil to maintain stable control of the cylinders.

Steering "kick back" is controlled by the system requirement that the pressure in the port chamber of the amplifier valve must exceed that in the main chambers for the movement of the valve.

As in the neutral or stationary mode, the shock valves prevent pressure surges in the cylinders themselves. Suction valve provisions are also incorporated to prevent cavitation. To ensure a constant proper charge to the suction valves, a separate counter pressure valve is provided.

For detailed information of the remaining mechanical components in the steering assembly, refer to the information in Section 7 - Running Gear.

In conditions in which the output of the steering pump is not sufficient to handle the immediate total steering demands, the appropriate accumulators supply the required oil.

A manual power supply is available to provide assistance in steering a disabled truck (e.g. maintenance, engine problems or during towing). In this system, a 24 Vdc motor/pump combination draws fluid from the system reservoir and provides it directly to the steering and brake accumulators. Activation of this system is made either manually by means of a cab dash mounted control switch or automatically if the truck speed is above approximately 3 mph (5 km/hr) and the steering accumulator pressure decreases to less than a preset pressure.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following:

1. Inspect each component in the steering system for evidence of leakage, damage, or wear. Repair or replace as required.

2. Inspect all hydraulic hoses for damage or wear. Verify that they are secure from moving parts and chaffing and that all connections are properly torqued per the instructions in Section 10 - Miscellaneous.

3. Test the operation of the system as outlined in the procedures later in this section.

HYDRAULIC STEERING SYSTEM OPERATIONAL CHECK-OUT

The steering system should be periodically tested as follows:

Prior to Engine Start

1. Verify that the rear wheels are chocked or that the truck is parked in a SAFE POSITION and secured by means other than its friction or park brake system.

2. Verify that the front wheels are not chocked and all equipment and personnel are clear of the area in which the tires will move while turning.

3. Verify that all hose fittings are tightened to the torque specifications contained in Section 10 - Miscellaneous.

4. Verify that the trucks hydraulic tank is filled to the proper level with approved hydraulic oil.

5. Verify that the valve in the pump suction line is open.

6. Verify that all equipment is installed and secured in place in the steering linkage assembly.

7. If the engine is to be operated prior to hydraulic testing:

a. Steering manifold

(1) On manifolds equipped with the automatic or solenoid valve assemblies, this may be done by rotating the manual override button on the solenoid 180° and allowing the button to come out.

(2) On manifolds equipped with the manually operated needle valve assemblies, this may be done by turning the valve counter-clockwise to open and allow the oil to return to the reservoir.

NOTE: *These drain valves must be closed prior to moving the truck or beginning any testing on the steering and/or brake system.*

b. Brake manifold

(1) Remove the manual drain valve from the manifold.

(2) Install an appropriate O-ring boss plug in its place.

NOTE: *This plug must be removed and replaced by the appropriate manual drain valve assembly prior to moving the truck or beginning any testing on the steering and/or brake system.*

8. Verify the nitrogen gas precharge pressures in the accumulators are as follows:

a. Steering (2 large) - 1450 to 1550 psi (9 995 to 10 685 kPa).

b. Brakes (3 smaller) - 950 to 1050 psi (6 555 to 7 245 kPa).

Follow the procedures outlined in the instructions for each style accumulator in Section 5 - Hydraulic System.

NOTE: *The accumulators must be fully drained of all hydraulic pressure prior to checking gas pressure. This may be done by pulling the manual drain valve in the steering and brake manifolds to relieve the pressure in the systems.*

9. Locate the following pressure gauges in the hydraulic component box on the superstructure:

a. Steering accumulator pressure.

b. Steering system or valve pressure.

10. High pressure ("clippard") relief valve adjustment:

NOTE: *The relief valves are shipped from the factory preset. They should not be adjusted unless they have been taken apart for some reason. The internal components are not serviced separately and the valve assembly should be replaced as a complete unit if servicing is required.*

If adjustment is necessary:

a. Loosen the locking nut on the high pressure relief valve.

b. Slowly turn the adjusting screw inward until the screw stops or "bottoms" in its travel.

c. Turn the adjusting screw outward 1 full turn and lock in position with the locking nut.

11. Install a 0 - 5000 psi (0 - 35 000 kPa) pressure gauge on the quick disconnect fittings at the following locations:

a. The TSS or TSP port on the steering manifold.

12. If not previously tested, verify that the hydraulic reservoir is properly pressurized to 10 +/- 1 psi (70 +/- 7 kPa).

13. Verify that the valve in the hydraulic pump suction line is open.

14. If the truck has been sitting idle for an extended period of time or the steering pump or system has been drained since the last time the truck was started, fill the case drain on the steering pump with approved hydraulic oil.

15. Using the appropriate means for the electrical propulsion installed, disable the truck's propulsion system to prevent its operation when the Shifter is moved to the forward or reverse position.

16. Install a voltmeter to monitor the operation of the steering accumulator drain solenoid in the steering manifold.

Main Steering System Test and Adjustment

The steering system may be tested as follows:

1. Reconnect and properly torque all hoses previously removed.

2. Check the pressure in the steering system as follows:

a. Turn the Master Switch On.

b. Start the engine and allow to run at low idle speed.

c. Verify that at approximately 2100 psi (14 480 kPa) the Low Steering Pressure indicator goes out.

NOTE: *This is an approximation test at this point. More detailed final testing will be done later.*

d. Verify that the steering accumulator pressure reading on the gauge in the component box increases slowly to 3450 to 3550 psi (23 790 to 24 480 kPa), then stabilizes.

NOTE: *If the pressure is not correct:*
1. Check all other pressures and determine the cause for the incorrect pressure.
2. Only after determining that the problem is an incorrectly adjusted steering pump compensator, adjust as outlined in the Unit Rig Mechanical Manual.

e. With the engine still at low idle speed, turn the steering wheel back and forth repeatedly. Count the number of revolutions of the steering wheel. The normal is approximately 5-1/2 turns lock-to-lock.

f. Discontinue the steering wheel movement and verify that the steering accumulator pressure returns to 3450 to 3550 psi (23 790 to 24 480 kPa).

g. Verify that the oil level in the hydraulic reservoir remains at normal operating levels. Stop the engine and refill the reservoir if required to obtain this level.

h. Record the pressure reading.

3. Steering system relief valve adjustment:

a. Accelerate the engine to rated speed and hold.

b. Turn the steering wheel for a left or right turn until it "stops".

c. Verify that the pressure on the gauge in the component box marked “Steering Valve” is:

2600 to 2700 psi (17 930 to 18 620 kPa).

d. Release the steering wheel.

e. Verify that the pressure returns to approximately 0 psi (kPa).

f. Slow the engine to low idle speed.

g. If the pressure is not at this level, the flow amplifier valve may be adjusted as follows:

(1) Remove the cover of the top on the relief valve in the steering flow amplifier valve.

(2) Using the appropriate metric hex head "Allen" wrench, turn the adjustment screw inward (to raise the pressure) or outward (to lower the pressure).

NOTE: *One full revolution of the adjustment screw equals approximately 550 psi (3 790 kPa).*

(3) Accelerate the engine to rated speed and read the pressure. Verify that the pressure is:

2600 to 2700 psi (17 930 to 18 620 kPa).

(4) Repeat steps (1) - (3) until the proper pressure is obtained.

(5) Slow the engine to low idle speed.

(6) Secure the adjustment screw and replace the cap.

(7) Record the final pressure.

h. Accelerate the engine to rated speed and cycle the steering by turning back and forth throughout the travel 3 additional times. Slow the engine to low idle speed.

NOTE: *If the steering wheel continues to turn or "freewheel" when turned by the operator with low to moderate force (with the bellcranks against the stops), it is an indication that the pressure setting of the shock valves internal to the flow amplifier is too low. If this occurs, contact Unit Rig for adjustment or replacement information.*

i. Stop the engine.

Low Steering Pressure Switch Operation Test

1. Verify that:

a. The Low Steering indicator is not illuminated.

b. The truck Shifter is in the Neutral position.

c. There is no external speed input signal to the truck propulsion control system.

2. Slowly turn the steering wheel from side to side while monitoring the Low Steering Pressure indicator and steering pressure gauge connected to the test port on the outlet of the steering pump.

3. Verify that the truck’s manual power supply system does not activate.

4. Verify that at 2050 to 2150 psi (14 135 to 14825 kPa) the Low Steering Pressure indicator illuminates.

NOTE: *On some pressure gauge assemblies, it may be difficult to accurately read this low pressure as it is decreasing. The primary intent is to verify that the indicator lights before the pressure decreases to 0 psi (kPa).*

5. Verify that the truck’s manual power supply system does not activate.

6. Stop the movement of the steering wheel.

7. Record the actuation pressure.

Manual Power Supply System Test

Test the operation of the available manual power supply system as follows:

1. If required, raise the truck until the front tires are clear of the floor and block securely in this position.

2. Verify that there is no speed signal input present in the electric drive system’s control panel.

3. With the engine stopped, turn the steering wheel

back and forth until the pressure in the steering accumulators is less than 1750 psi (12 650 kPa).

4. Pull the Manual Steering Pump switch out to activate the system.

5. Verify this pressure increases then stabilizes at 1925 to 1975 psi (13 275 to 13 620 kPa) before the pump stalls or the pump's internal relief valve activates.

a. If the pressure is too high or low, it may be adjusted by means of the adjusting screw on the pump's relief valve. Secure the screw with the locking nut when the adjustment is complete.

b. If the motor stalls prior to obtaining this pressure, check the condition of the batteries, 24 Vdc circuitry, and pump/motor assembly.

6. Push the Manual Supply System Switch in to deactivate the pump assembly.

NOTE: *This is not a continuous duty motor assembly and should not be operated continuously for extended periods of time.*

7. On trucks equipped with the available automatic activation feature for the manual supply system:

a. Provide a condition that will simulate the truck's movement in operation (closing the normally open contacts on the speed relay) by either:

(1) Using a laptop computer, follow the normal control system procedures to cause the anti-reversal (AR) function to activate, or;

(2) Installing a jumper wire on the appropriate contacts on the speed relay that control the signal voltage.

NOTE: *Typically this is from terminal 30 to terminal 87 on the relay, but it is recommended that the proper schematics be reviewed to verify the correct locations.*

b. Turn the steering wheel back and forth slowly while monitoring the steering accumulator pressure.

c. Verify that at 1520 to 1680 psi (10 480 to 11 585 kPa):

(1) The pump activates and begins supplying oil to the system.

(2) The indicator light in the center of the Manual Power Supply Switch is on.

d. Temporarily discontinue turning the steering wheel.

e. Verify that at 1850 +/- 80 psi (12 750 +/- 550 kPa):

(1) The pump stops operating.

(2) The indicator light in the center of the Manual Power Supply Switch is off.

f. Repeat steps b through e as required.

g. Again using a laptop computer, follow the normal control system procedures to cause the anti-reversal (AR) function to deactivate or remove the jumper installed.

NOTE: *This is not a continuous duty motor assembly and should not be operated continuously for extended periods of time.*

Testing Steering Accumulator Drain Systems

Test the steering accumulator automatic pressure drain valve as follows:

1. Turn the Master Switch Off.

2. Verify that the steering accumulator pressure gauge (in the hydraulic component box) pressure reading decreases rapidly as the accumulator drains to the tank through the solenoid valve in the steering manifold.

3. Verify that the steering accumulator pressure decreases to approximately 0 psi (kPa).

4. Verify that the power to the drain valve coil switches off automatically (voltmeter returns to 0 volts) after approximately 150 seconds.

5. Remove the voltmeter.

Test the operation of the steering accumulator manual pressure drain valve as follows:

1. Turn the Master Switch On.

2. Start the engine.

3. Allow the pressure in the accumulator to rise until it exceeds 1500 psi (10 340 kPa), then stop the engine.

4. Pull the manual accumulator drain valve in the steering manifold to open.

5. Verify that the pressure in the steering accumulator decreases to 0 psi (kPa).

6. Release the manual drain valve to close.

Test complete

1. Install all covers removed.

2. Remove all blocking and lower the truck to the ground.

SERVICE

See individual component modules for detailed service information.

Figure 4 - Steering System Assembly A85895 Key					
001.	Steering Flow Amplifier Valve	042.	Flatwasher	112.	Tube Clamp
002.	Steering Orbital Valve	043.	Capscrew	113.	Not Used
003.	Steering Manifold Assembly	044.	Hose Assembly	114.	Not Used
004.	Steering Accumulator	045.	Hose Assembly	115.	Not Used
005.	Hydraulic Filter Assembly	046.	Adapter Fitting	116.	Hose Bracket
006.	Valve Bracket	047.	Hose Assembly	117.	Not Used
007.	Capscrew	048.	Not Used	118.	Not Used
008.	Lockwasher	049.	Hose Assembly	119.	Not Used
009.	Capscrew	050.	Flange Fitting	120.	Clamp Halves
010.	Lockwasher	051.	Not Used	121.	Clamp Cap Plate
011.	Socket Head Capscrew	052.	Adapter Fitting	122.	Capscrew
012.	Lockwasher	053.	Plug	123.	Though Item 141 Not Used
013.	Plug	054 -	059. Not Used	142.	Adapter Fitting
014.	Adapter Fitting	060.	Hose Assembly	143.	– 150 Not Used
015.	Adapter Fitting	061.	Hose Assembly	151.	Locknut
016.	Adapter Fitting	062.	Adapter Fitting	152.	Not Used
017.	Adapter Fitting	063.	Pressure Gauge	153.	Adapter Fitting
018.	Adapter Fitting	064.	Capscrew	154.	Hose Assembly
019.	Clamp Support Assembly	065.	Adapter Fitting	155.	Not Used
020.	Hose Assembly	066.	O-ring	156.	Hose Assembly
021.	Hose Assembly	067.	Capscrew	157.	Clamp Support Assembly
022.	Hose Assembly	068.	Pressure Switch	158.	Not Used
023.	Hose Assembly	069.	Test Coupling	159.	Not Used
024.	Hose Assembly	070.	Quick Connector	160.	Not Used
025.	Hose Assembly	071.	Not Used	161.	Capscrew, Grade 8
026.	Flange Fitting	072.	Nameplate	162.	Tube Clamp
027.	Hose Assembly	073.	Nameplate	163.	Cushion Clamp
028.	Flange Fitting	074.	– 079. Not Used	164.	Clamp Support Assembly
029.	Hose Assembly	080.	Hardened Flatwasher	165.	Adapter Fitting
030.	Hose Assembly	081 Through Item 100 Not Used		166.	Angle Clip
031.	Adapter Fitting	101.	Capscrew	167.	Adapter Fitting
032.	Adapter Fitting	102.	Capscrew	168.	Adapter Fitting
033.	Hose Assembly	103.	Flatwasher	169.	Cushion Clamp
034.	Hose Assembly	104.	Not Used	170.	Adapter Fitting
035.	Hose Assembly	105.	Clamp Support Assembly	171.	Adapter Fitting
036.	Hose Assembly	106.	Not Used	172.	Not Used
037.	Adapter Fitting	107.	Clamp Support Assembly	173.	Adapter Spacer
038.	Flange Fitting	108.	Clamp Support Assembly		
039.	Locknut	109.	Not Used		
040.	Accumulator Mounting Bracket	110.	Not Used		
041.	Adapter Fitting	111.	Tube Clamp		

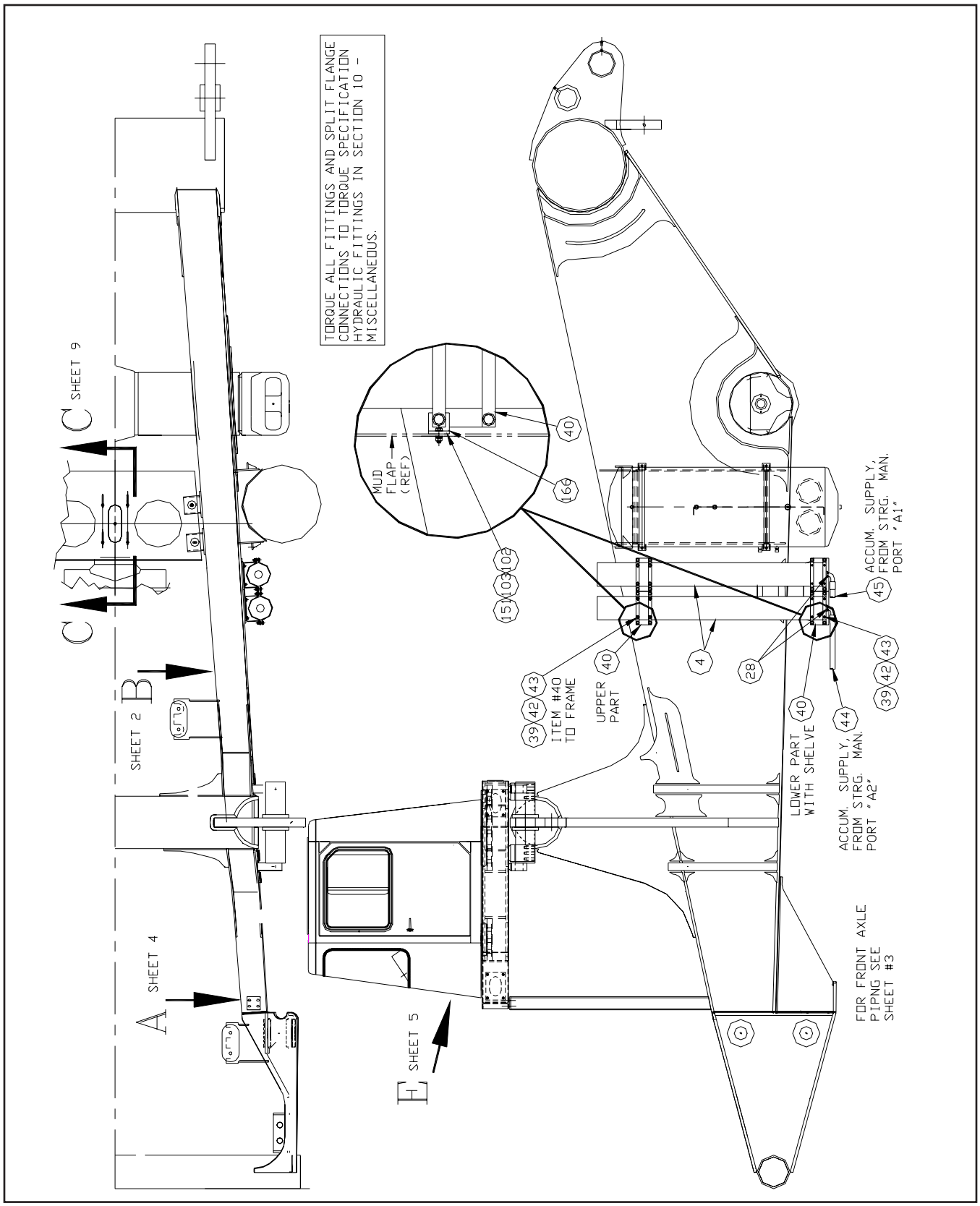


FIGURE 4 - STEERING SYSTEM ASSEMBLY (A85895 - SHEET 1)

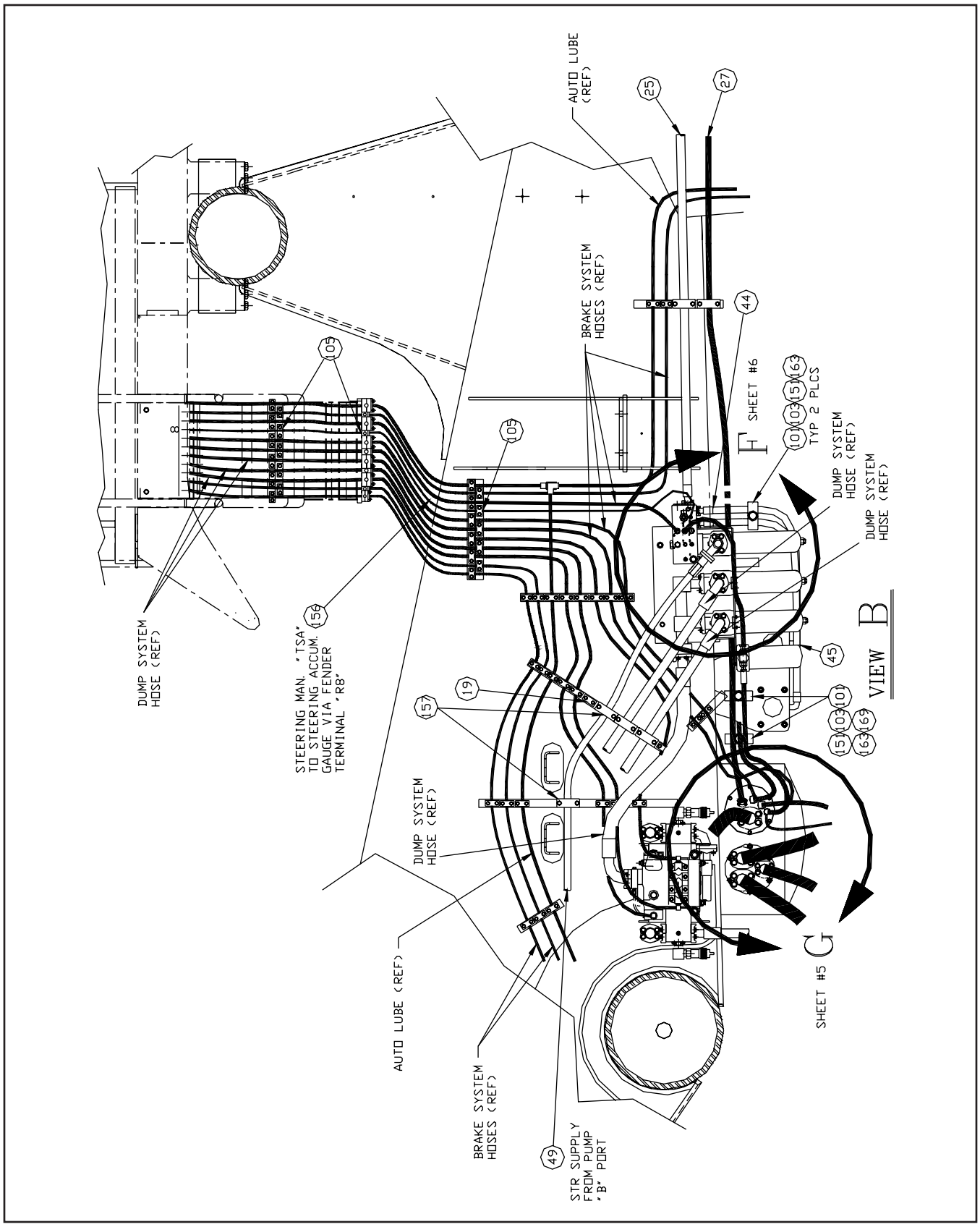


FIGURE 4 - STEERING SYSTEM ASSEMBLY (A85895 - SHEET 2)

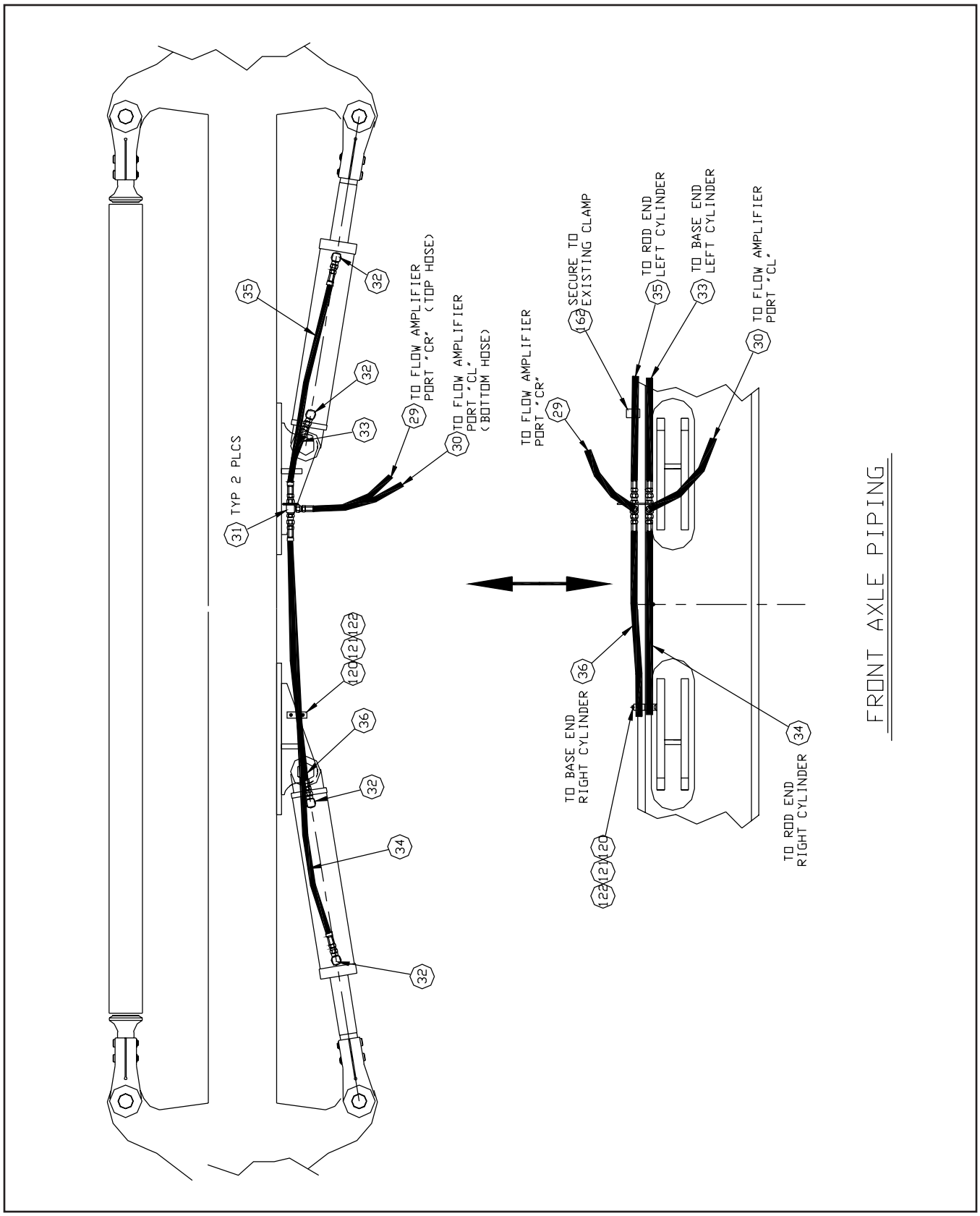


FIGURE 4 - STEERING SYSTEM ASSEMBLY (A85895 - SHEET 3)

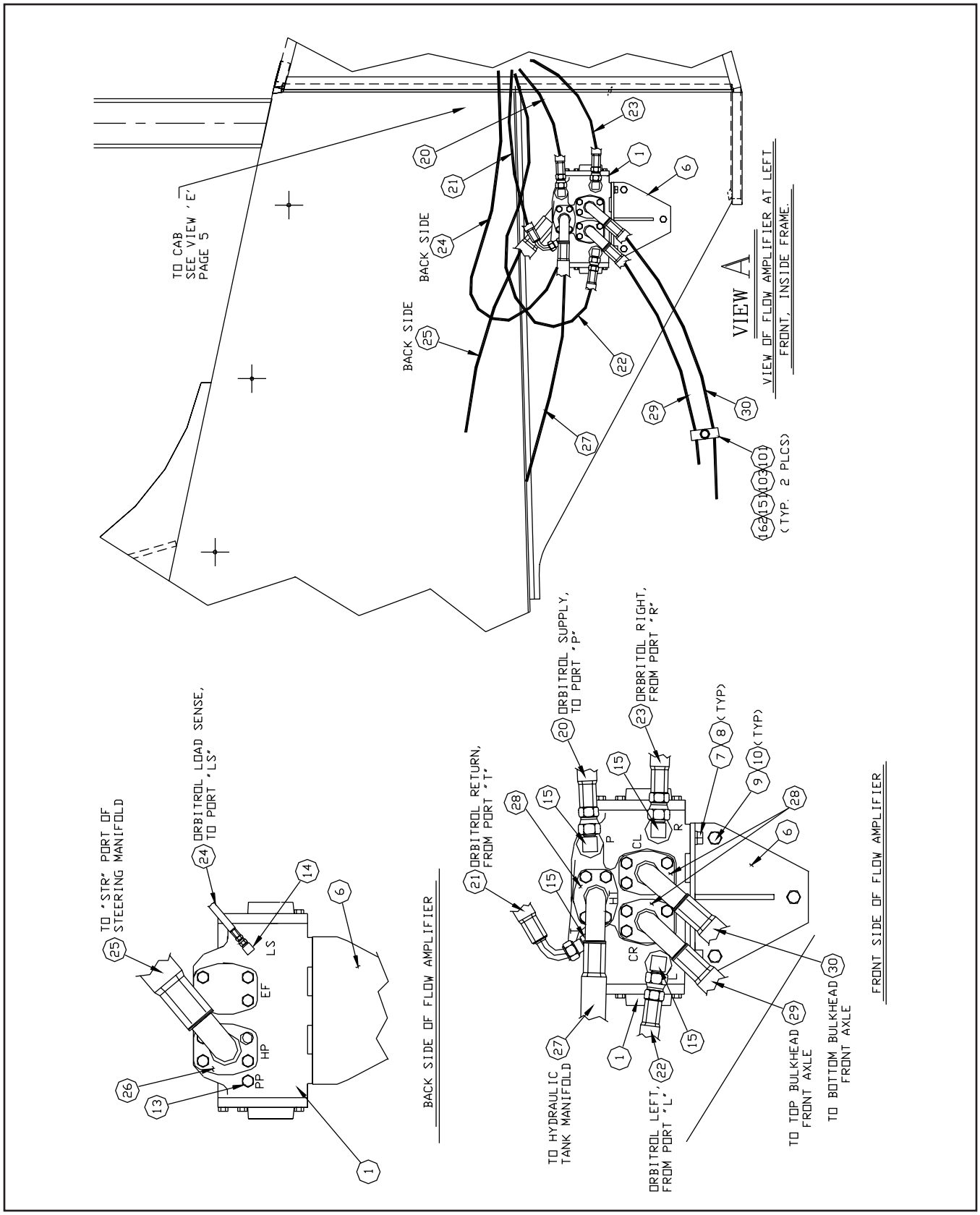


FIGURE 4 - STEERING SYSTEM ASSEMBLY (A85895 - SHEET 4)

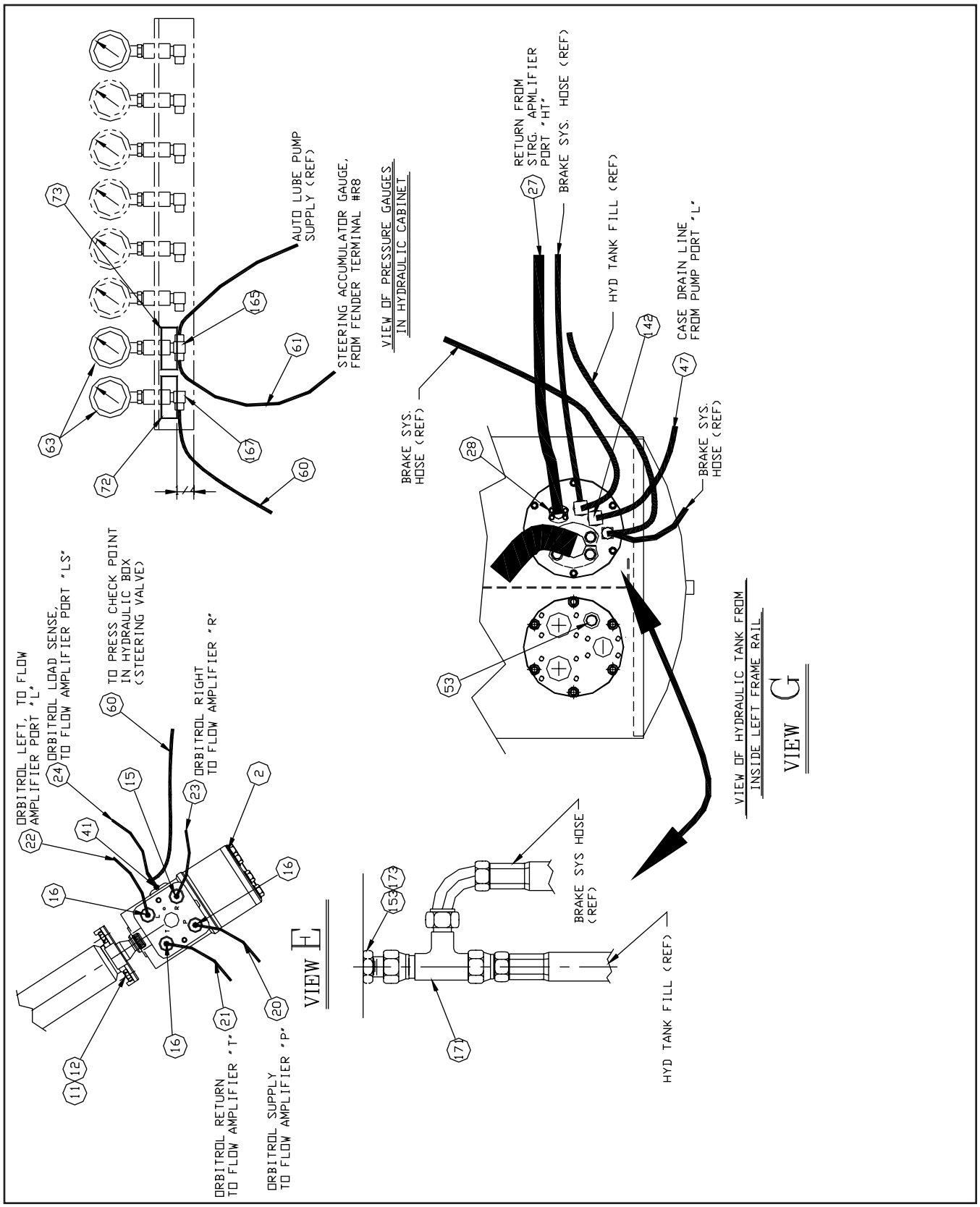


FIGURE 4 - STEERING SYSTEM ASSEMBLY (A85895 - SHEET 5)

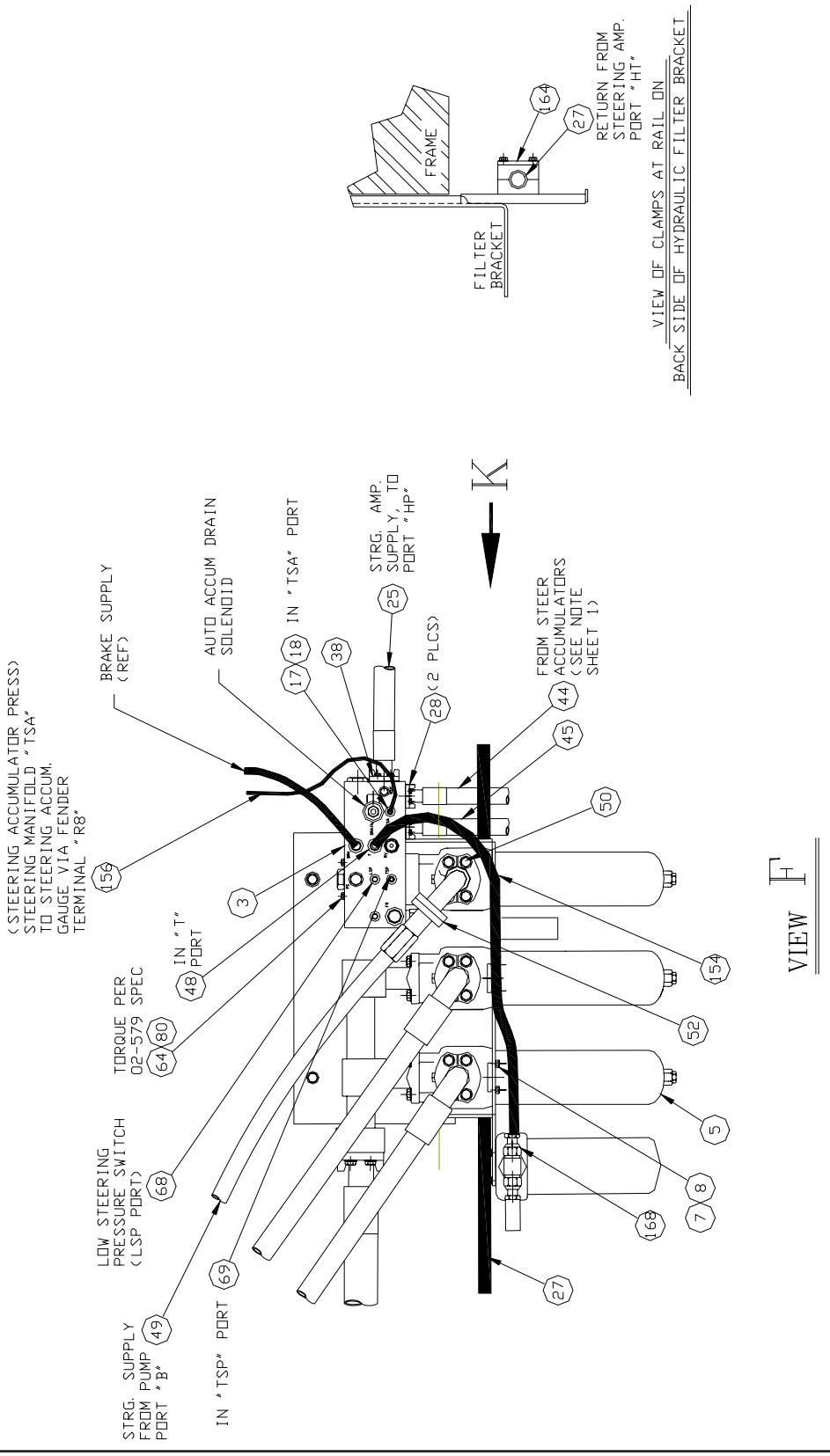


FIGURE 4 - STEERING SYSTEM ASSEMBLY (A85895 - SHEET 6)

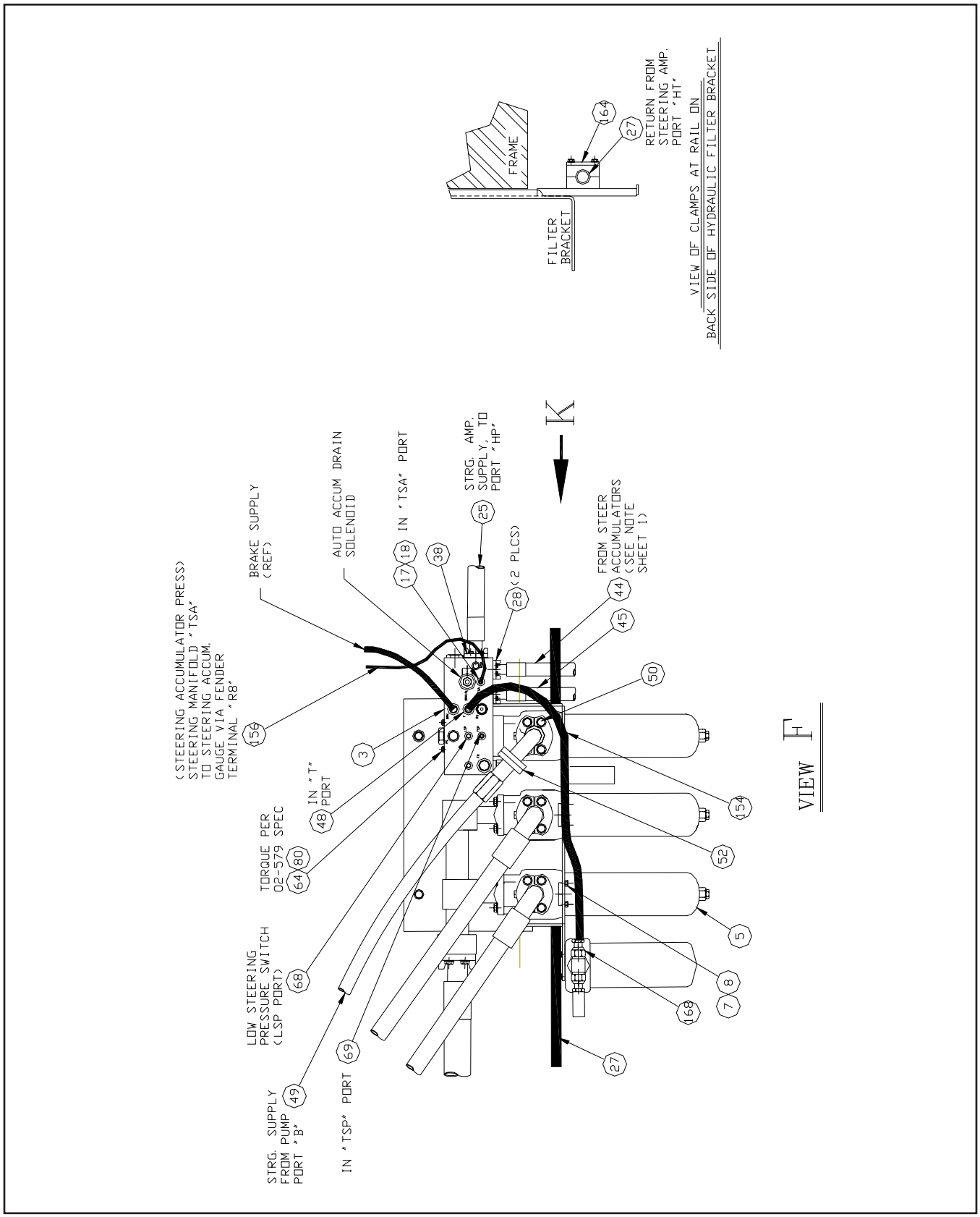


FIGURE 4 - STEERING SYSTEM ASSEMBLY (A85895 - SHEET 7

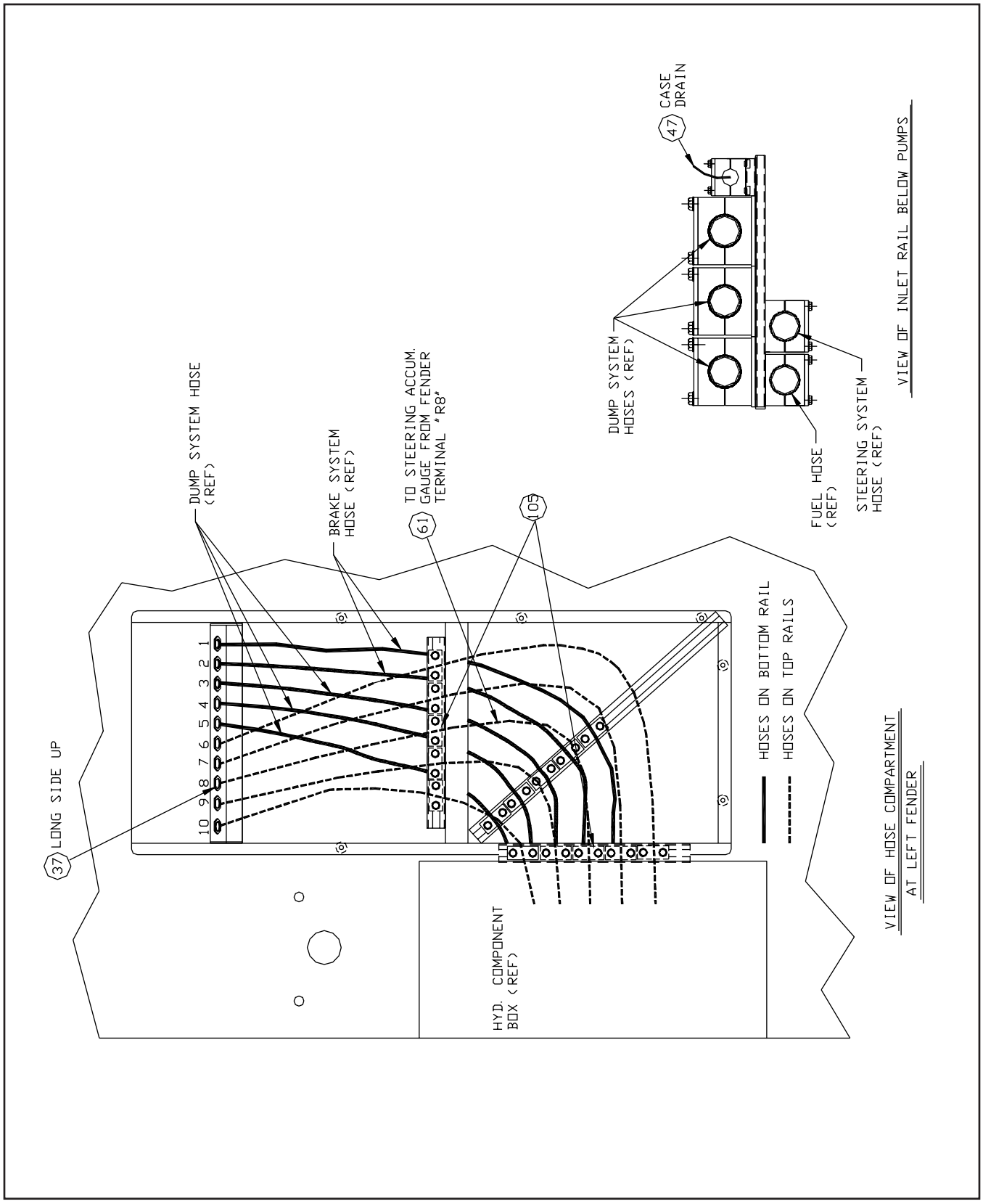


FIGURE 4 - STEERING SYSTEM ASSEMBLY (A85895 - SHEET 8)

STEERING PUMP

DESCRIPTION AND LOCATION

The steering pump is the smaller piston pump assembly mounted on the rear of the tandem section dump pump assemblies. The pumps are mounted on a special bracket assembly between the main frame rails, just in front of and above the nose cone receiver.

OPERATION

The steering pump supplies the pressurized hydraulic oil to operate the steering and brake systems.

The pump is basically a variable swashplate, piston type assembly. The oil supply for the pump enters from the reservoir and is routed internally to the pump piston assembly. As the pistons turn on the angled swashplate, they move up and down in their respective bores. This movement results in the pressurization of the oil and direct it to the outlet chambers. There it exits the pump through the outlet ports.

In this configuration, the pump is set up to operate as a pressure compensating device with self contained, preset, spring loaded piston assemblies controlling the operation of the moveable swashplate. The stroke of the pumping pistons is varied to increase or decrease the output flow to maintain as a constant, the preset pressure in the system.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

NOTE: *The pumps themselves require no internal maintenance or adjustment beyond periodic verification of the pumps ability to maintain required pressures and flows.*

1. Clean the pump assembly and inspect for evidence of wear, leakage or damage. Repair or replace as required.

2. Test the operation of the steering and brake systems as outlined in the appropriate test procedures in Section 5 - Hydraulic System. If adjustment of the pump's output pressure is found to be necessary, it may be made as follows: (Figure 1)

a. Verify that the reason for the incorrect pressure is truly the setting of the pump. Since the systems receiving the flow have a number of components and involve other systems, it is important to eliminate the possibility that the incorrect pressure (especially if too low) is not a symptom of another problem and adjusting the pump is treating the symptom and not the cause.

NOTE: *For example, incorrect operation of the dump solenoid valve in the steering manifold may allow the flow to bypass to the dump system. This would result in a low system pressure reading, even though the pump may be fully stroked and operating properly. Adjusting the pump pressure will not correct the cause only mask it.*

b. Remove the acorn nut and seal washer (35) from the pressure adjustment screw (larger barrel of the two) on the steering pump control valve assembly.

c. While holding the adjusting screw (33) with the appropriate Allen wrench, loosen the locknut (34).

d. Turn the adjusting screw inward (clockwise) to increase the pressure or outward (counter-clockwise) to decrease the pressure. The pressure changes approximately 200 psi (1400 kPa) per turn of the adjusting screw.

NOTE: *The other adjusting screw is turned completely in ("bottomed out") in the installation used.*

e. When the adjustments are complete, secure the adjusting screw with the locknut (34) while holding the adjusting screw to maintain the pressure setting.

f. Install and secure with the acorn nut.

REMOVAL (Figure 2)

The steering pump may be removed from the dump pumps as follows:

NOTE: *It is not necessary to remove the pump assembly to service the steering pump. These procedures are written if the pump is being removed with the pump assembly still on the truck. Modify as required if the pumps have been removed and are on a work bench.*

1. Park the truck in SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Shut the oil supply to the pumps by closing the valve on the supply line (near the reservoir tank) or other ap-

proved method.

3. Remove the inlet and outlet hoses from the pumps. Cap or plug all openings and label to assist in the installation process.

4. Install a suitable lifting device to the pumps to prevent unwanted movement.

NOTE: *Provisions should be made for lowering the pumps to the floor, a distance in excess of 6 feet (2 meters). The approximate weight of the steering pump is 75 lbs. (35 kgs).*

5. Remove the capscrews and washers securing the tail support braces to the pump and the pump bracket.

6. Remove the capscrews (12) and lockwashers (13) securing the rear piston pump assembly (2) to the dump pump sections (1).

7. Carefully separate the two pump sections, making sure that the splined shafts and couplers are not damaged.

⚠ CAUTION

Do not attempt to pry the pumps apart with a screwdriver or other means. They should be separated by tapping with a soft-faced hammer.

8. Lower the pump to the ground.

DISASSEMBLY (Figure 1)

Prior to beginning disassembly of the pump:

1. Clean the work area of dirt, grease, foreign material or other items which might contaminate the pump.

2. Clean the unit thoroughly with a solvent. Remove all sharp edges from splines, drill points, keyways and end of shaft. Mark the adapter and cover/housing sections to ensure correct reassembly.

3. To aid in disassembly and reassembly, the pump should be retained in some manner. For example, a steel plate bolted to and extending over the edge of a work bench will suffice. The plate should have a hole large enough for the adapter flange pilot to drop through, and two holes in the adapter flange. The pump can now be firmly fixed to the plate by bolts. This is especially helpful in removal and torquing of capscrews.

The steering pump may be disassembled as follows:

1. Mark the position of the port block (22) relative to the pump housing (43).

2. Remove the socket head capscrews (23) securing the port block.

3. Remove the port block (22) together with all parts of the controlling valve assembly (26).

4. Remove the tapered roller bearing (19) and shim washer (20) near the port block.

5. Remove the rotary group assembly (Detail A and the driveshaft (36) and bearing (40) assembly) from the housing.

6. Remove the O-ring (39).

7. Remove the bearing shells or cradles (38) and (37).

NOTE: *Make sure to note the orientation of the bore reliefs on the high pressure side. This is important for proper reassembly.*

8. Use an appropriate puller to remove the outer bearing race from the front bearing.

9. Remove the control or lens plate (10).

10. Use an appropriate puller to remove the outer bearing race from the rear bearing.

11. Remove the O-rings (21).

12. Loosen the jam nut on the threaded pin.

13. Remove the threaded pin assembly (16).

14. Disassemble the guide of the control piston (15).

15. Disassemble the guide of the counter piston (14).

16. Pull the driveshaft (36) with the bearing (40) out of the rotary drive assembly.

17. Remove the pistons (2) and retaining plate (3).

18. Remove the retaining ball (4).

19. Compress the center spring (8) in order to allow the removal of the retaining ring (9).

20. Remove the retaining ring (9).

21. Remove the remaining parts of the pump as housing assemblies.

22. Disassemble the control valve assembly as follows:

a. Remove the socket head capscrews (29) securing the valve assembly to the port block.

b. Remove the O-rings (32).

c. Remove the acorn nuts (35) from the adjusting screws.

d. Loosen the locknuts (34) and remove the adjusting screws (33).

e. Remove the plug assemblies (30).

f. Remove the disc or usit ring (31).

g. Remove the springs from the bores.

NOTE: *There are two of them in the smaller flow control bore.*

h. Remove the spring cup.

i. Remove the plug (27).

j. Very carefully remove the piston from the bore.

k. Remove the orifice in the spring area of the pressure control valve.

l. Disassemble the plug or orifice (spring area of the flow control).

INSPECTION AND REPAIR

The disassembled pump may be serviced as follows:

1. Clean all metal parts in solvent and dry with compressed air. Inspect for evidence of wear, damage, cracks, or leakage. Repair or replace as required.

2. Inspect the pistons and piston bores. Replace the body if the groove is too deep or the bores look as if they had been sand blasted.

3. Inspect the piston “shoes” and the swashplate. Replace if wear is noticed or damage or grooves are apparent.

4. Inspect the driveshaft for evidence of damage or wear particularly in the bearing journal and the seal operating areas.

5. Replace the seals in the pump housing as follows:

a. Lay the housing on a work bench or other suitable work surface.

b. Using an appropriate tools, remove the retaining ring (45).

NOTE: *Use extra caution not to scratch or damage the bore or bearing surfaces or their end projections.*

c. Remove the seal (44) from the housing.

d. After the seal is out:

(1) Thoroughly clean the bore.

(2) Inspect the bore for scratches or gouges that might interfere with the installation of the new seal.

NOTE: *If found, the bore can be smoothed with No. 400 Emery paper (only). Clean the bore after the smoothing process is complete.*

(3) Clean and prepare a suitable seal press ring or plug for use when installing the new seal.

(4) Coat the new seal in hydraulic oil or grease compatible with that in the truck’s hydraulic system.

(5) Using the tool listed in step 3, install the new seal (44) in the pump housing (43).

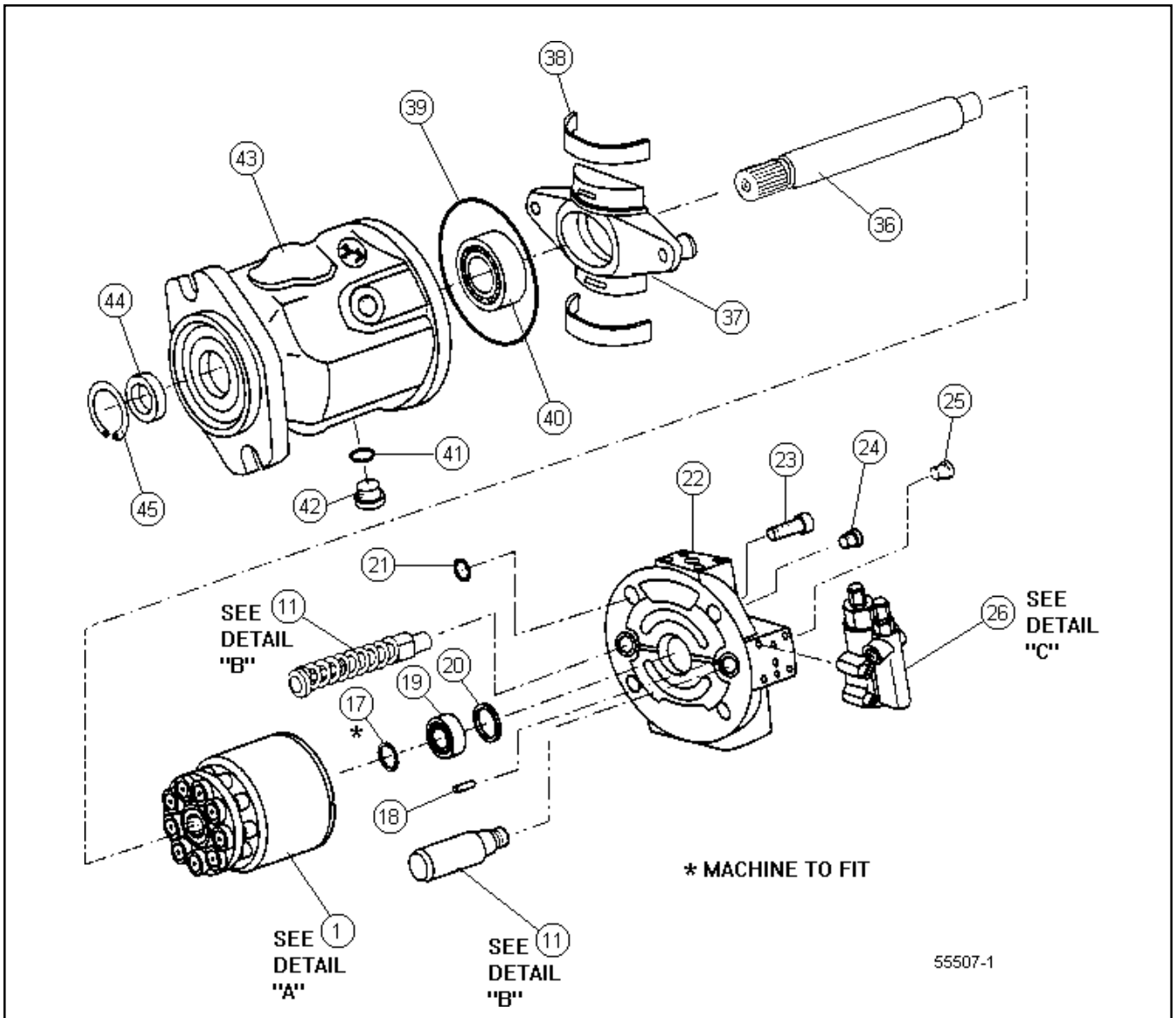
(6) Install and secure the retaining ring (45) into the correct position in the grooves.

ASSEMBLY

Prior to beginning assembly of the pump:

1. Clean the work area of dirt, grease, foreign material or other items which might contaminate the pump.

2. To aid in reassembly, the pump should be retained in some manner. For example, a steel plate bolted to and extending over the edge of a work bench will suffice. The plate should have a hole large enough for the adapter flange pilot to drop through, and two holes in the adapter flange. The pump can now be firmly fixed to the plate by bolts. This is especially helpful in re-



KEY

01.	Rotary Piston Group	16.	Control Piston Guide	31.	Usit Ring
02.	Piston	17.	Adjusting Disc	32.	O-ring
03.	Retaining Plate	18.	Dowel Pin	33.	Adjusting Screw
04.	Retaining Ball	19.	Tapered Roller Bearing	34.	Jam Nut
05.	Barrel	20.	Washer	35.	Acorn Nut
06.	Pressure Pin	21.	O-ring	36.	Driveshaft
07.	Disc Retaining Clip	22.	Port Block	37.	Cradle Assembly
08.	Spring	23.	Socket Head Capscrew	38.	Bearing Cradle
09.	Retaining Ring	24.	Plug	39.	O-ring
10.	Lens Plate	25.	Plug	40.	Tapered Roller Bearing
11.	Piston Control Assembly	26.	Control Valve Assembly	41.	O-ring
12.	Counter Piston	27.	Plug	42.	Plug (with O-ring)
13.	Spring	28.	O-ring	43.	Pump Housing
14.	Counter Piston Guide	29.	Socket Head Capscrew	44.	Shaft Seal
15.	Control Piston	30.	Plug	45.	Seegar V-ring

FIGURE 1 - STEERING PUMP ASSEMBLY - SHEET 1 OF 4

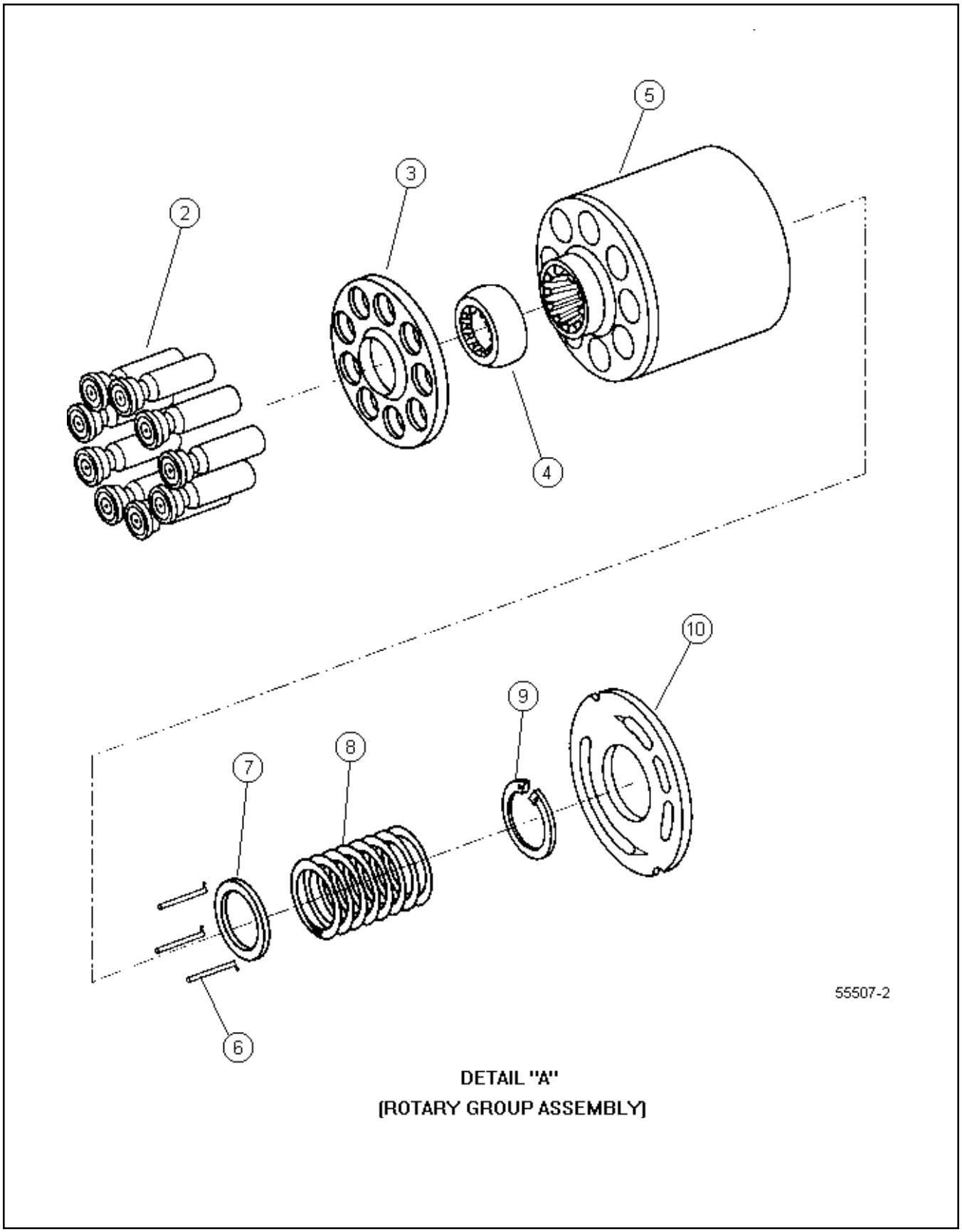
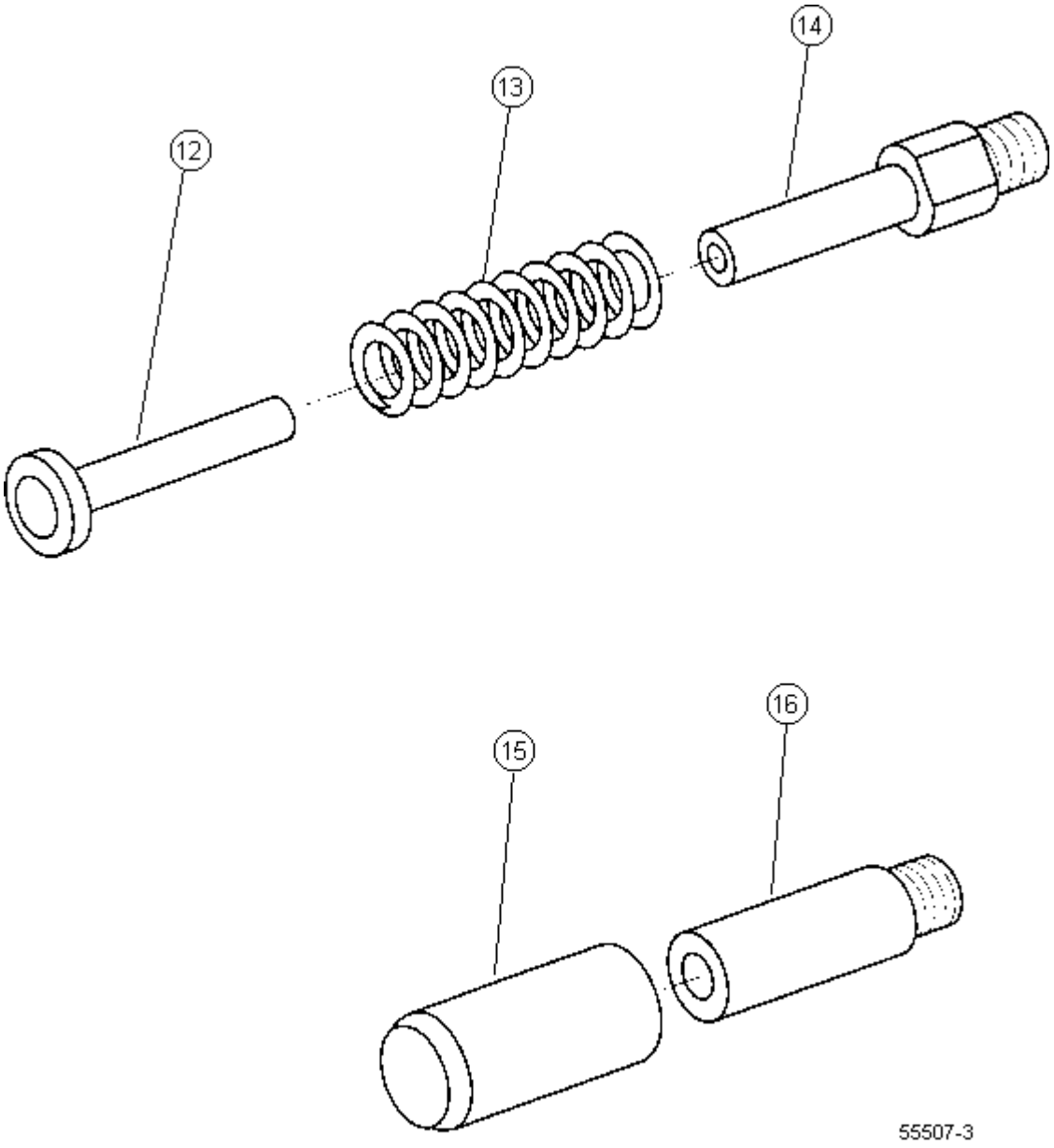
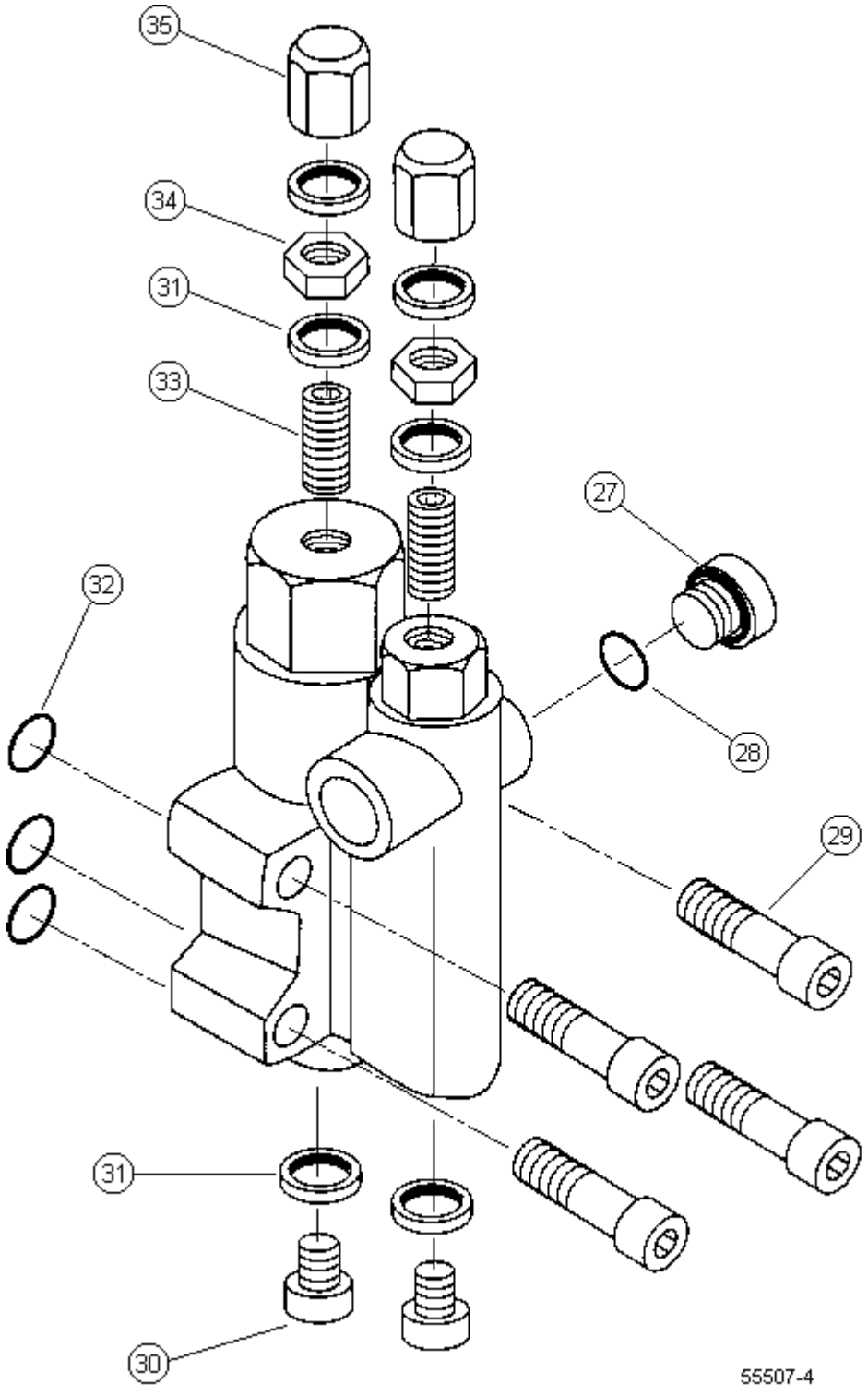


FIGURE 1 - STEERING PUMP ASSEMBLY - SHEET 2 OF 4



DETAIL "B"
CONTROL PISTON ASSEMBLY

FIGURE 1 - STEERING PUMP ASSEMBLY - SHEET 3 OF 4



DETAIL "C"
CONTROL VALVE ASSEMBLY

FIGURE 1 - STEERING PUMP ASSEMBLY - SHEET 4 OF 4

moval and torquing of capscrews.

The steering pump may be assembled as follows:

NOTE: *Coat all seals and parts with hydraulic oil compatible with that in the truck's hydraulic system prior to installation.*

1. Assemble the control valve assembly as follows:

a. Verify that the opening in the center is clear, then install the plug or orifice (spring area of the flow control valve).

NOTE: *Use Loctite 242 or equivalent to secure the orifice in place. Exercise care not to allow excess to escape and cover the opening or other components.*

b. Verify that the opening in the center is clear, then install the orifice in the spring area of the pressure control valve.

NOTE: *Use Loctite 242 or equivalent to secure the orifice in place. Exercise care not to allow excess to escape and cover the opening or other components.*

c. Very carefully install the piston in the bore. Check that it moves freely in its range of motion.

d. Install the plug (27).

e. Install the spring cup.

f. Install the springs in the bores.

NOTE: *There are two of them in the smaller flow control bore.*

g. Install the disc or usit ring (31).

h. Install the plug assemblies (30).

i. Install the adjusting screws (33) and locknuts (34). They will need to be properly adjusted later.

j. Install the acorn nuts (35) on the adjusting screws.

k. Install the O-rings (32).

l. Install the valve assembly on the port block with the socket head capscrews (29)

2. Assemble the rotary group assembly as follows:

a. Install the pressure pins (6) and disc retaining clip (7).

b. Install and compress the center spring (8) in order to install the retaining ring (9).

c. Install the retaining ring (9).

d. Install the retaining ball (4).

e. Remove the pistons (2) and retaining plate (3).

3. Install the bearing (40) and driveshaft (36) into the rotary group assembly.

4. Assemble the control piston assembly as follows:

a. Assemble the guide of the counter piston (14). Check that it moves freely in its range of motion.

b. Assemble the guide of the control piston (15). Check that it moves freely in its range of motion.

c. Install the threaded pin assembly (16).

d. Install the jam nut on the threaded pin.

5. Install the O-rings (21).

6. Use an appropriate installation device to install the outer bearing race for the rear bearing into the pump housing.

7. Install the control or lens plate (10).

8. Use an appropriate installation device to install the outer bearing race for the front bearing into the pump housing.

9. Install the bearing shells or cradles (38) and (37).

NOTE: *Make sure that they are properly oriented in the same configuration as removed.*

10. Install the O-ring (39).

11. Install the rotary group assembly (Detail A) into the housing.

12. Install the tapered roller bearing (19) and shim washer (20) near the port block.

13. Install the control valve spring assembly onto the port block assembly.

NOTE: *It will be necessary to retain the spring tension with a bolt during the assembly process only.*

14. Install the port block (22) together with all parts of the controlling valve assembly (26).

15. Remove the retaining screw on the control valve assemly and install the proper plug.

16. Install the socket head capscrews (23) to secure the port block to the pump housing. Tighten in an even, alternate bolt manner.

17. Cover or block all openings.

INSTALLATION

The steering pump may be installed onto the dump pumps as follows:

NOTE: *It is not necessary to remove the pump assembly to service the steering pump. These procedures are written if the pump is being installed with the pump assembly still on the truck. Modify as required if the pumps have been removed and are on a work bench.*

1. Make sure the O-ring and splined coupler are properly positioned in the rear of the tandem dump pump assembly.

2. Raise the pump into position on the rear of the dump pump assembly.

NOTE: *Provisions should be made for raise the pumps from the floor, a distance in excess of 6 feet (2 meters). The approximate weight of the pump is 75 lbs. (35 kgs).*

3. Carefully align the splines on the pump and coupler in the dump pump and mate the two pump assemblies.

4. Install the capscrews (12) and lockwashers (13) securing the rear piston pump assembly (2) to the dump pump sections (1).

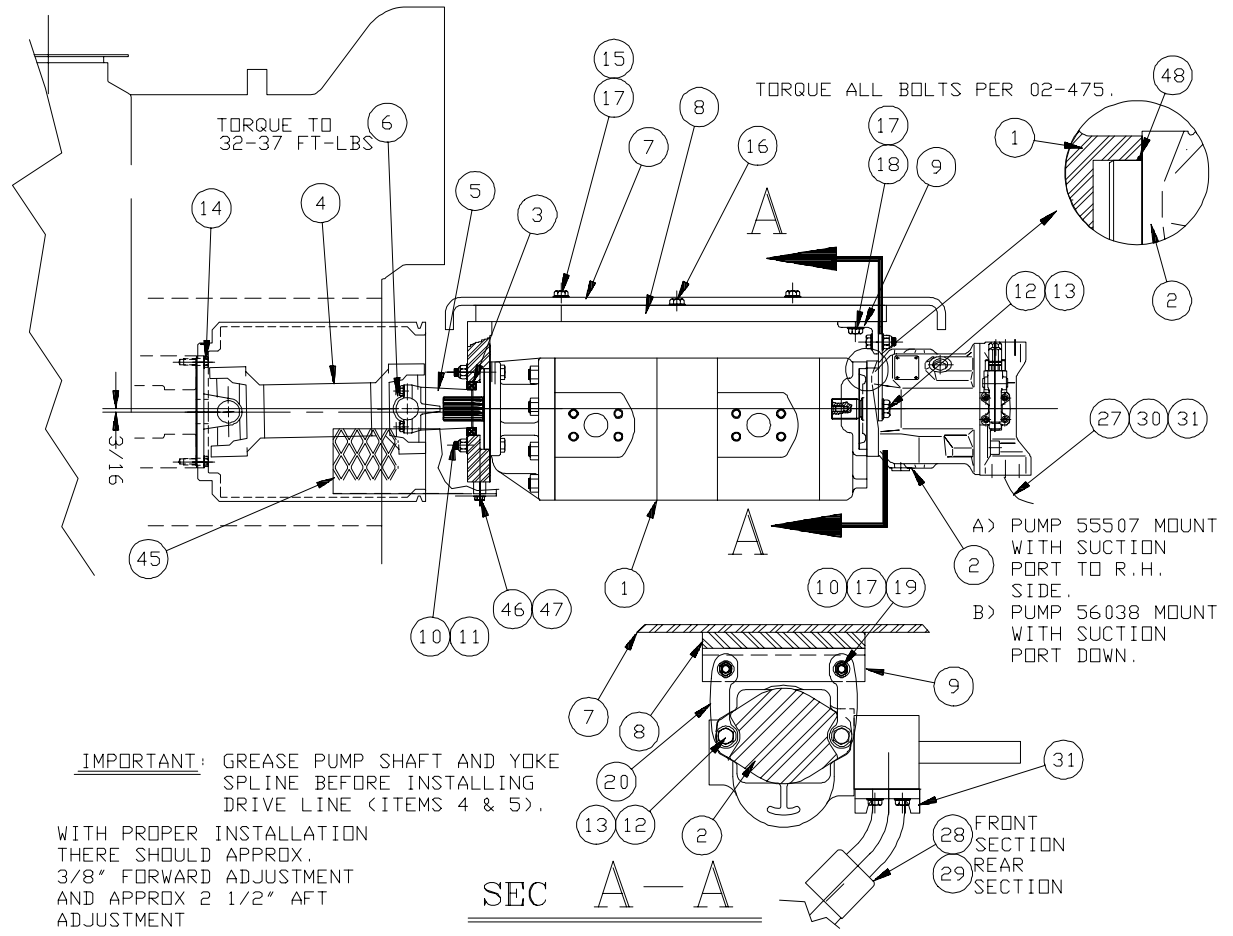
5. Install the tail section supports and braces to the pump and the pump bracket with the appropriate capscrews and washers.

6. Install the inlet and outlet hoses to the pumps.

7. Replenish the oil supply to the pumps by opening the valve on the supply line (near the reservoir tank).

8. Fill the pump by removing the case drain line and filling the pump with hydraulic oil compatible with that in the truck's hydraulic system.

9. Test the operation of the truck's steering and brake systems as outlined in the procedures in Section 5 - Hydraulic System.



KEY					
01.	Double Dump Pump Assembly	17.	Hardened Flatwasher	33.	Not Used
02.	Steering Piston Pump	18.	Capscrew	34.	Not Used
03.	Seal	19.	Capscrew (Grade 8)	35.	Hose Clamp Bracket
04.	Pump Driveshaft	20.	Support Bracket	36.	Clamp Halves
05.	Slip Yoke	21.	Capscrew	37.	Clamp Cap Plate
06.	Strap and Bolt Kit	22.	Locknut	38.	Capscrew
07.	Pump Platform	23.	Rubber Mounting Block	39.	Clamp Halves
08.	Pump Bracket	24.	Bushing	40.	Clamp Cap Plate
09.	Pump Tail Support Bracket	25.	Mounting Washer	41.	Capscrew
10.	Locknut	26.	Hardened Flatwasher	42.	Not Used
11.	Capscrew (Grade 8)	27.	Hose Assembly	43.	Not Used
12.	Capscrew (Grade 8)	28.	Hose Assembly	44.	Not Used
13.	Lockwasher	29.	Hose Assembly	45.	Driveline Guard
14.	Capscrew (Grade 8)	30.	Flange Kit	46.	Capscrew
15.	Capscrew	31.	Flange Kit	47.	Flatwasher
16.	Capscrew	32.	Not Used		

FIGURE 2 - PUMP INSTALLATION

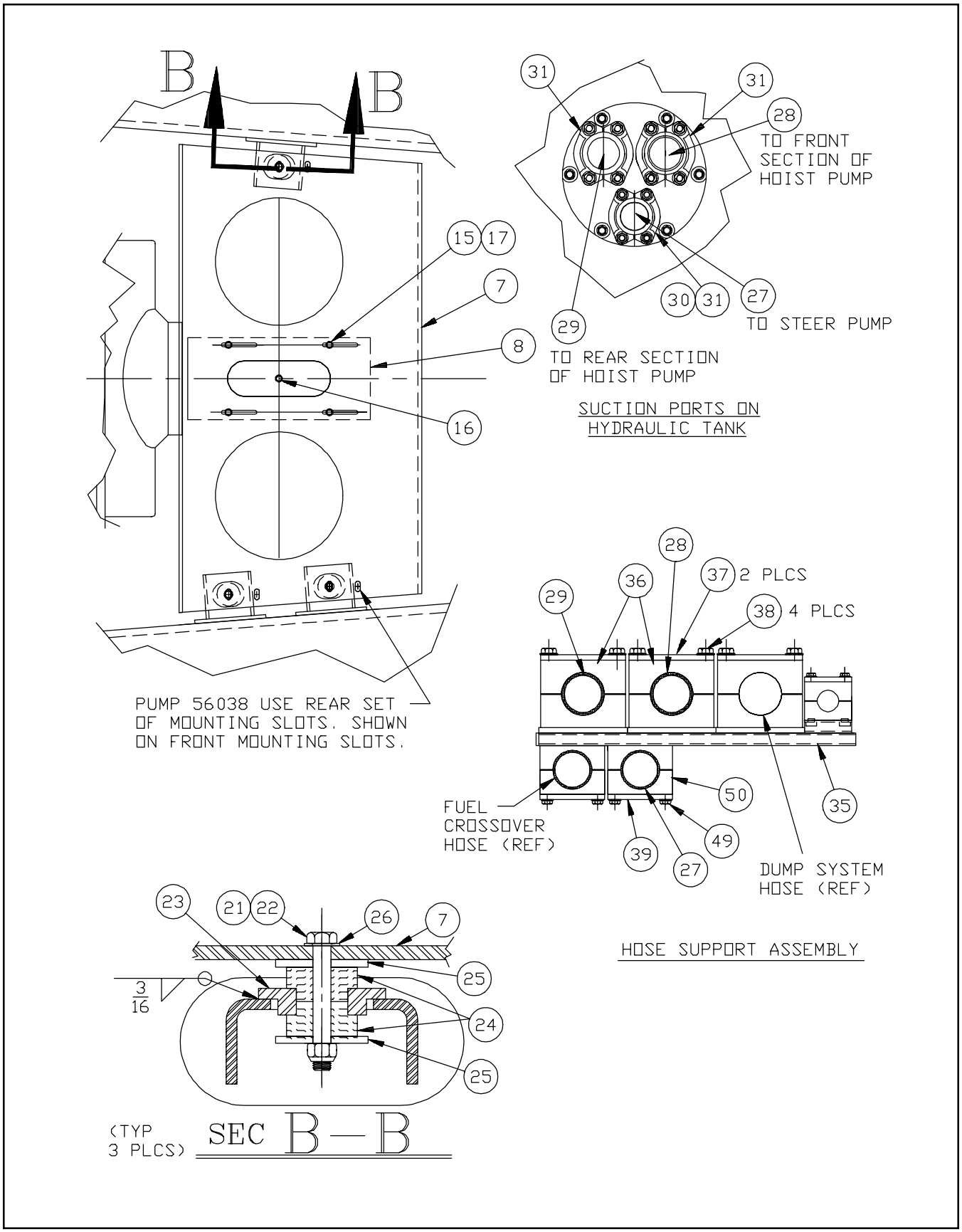


FIGURE 2 - PUMP INSTALLATION - CONTINUED

ACCUMULATORS

DESCRIPTION AND LOCATION

The accumulators are long, heavy metal cylinders with two removable ends or heads.

The accumulators are mounted together on the side of the frame near the hydraulic tank.

OPERATION

The accumulators store energy; oil under pressure. They serve several distinct functions in this application.

1. They act as a ready source of pressurized oil to the system, including a reserve in the case of restricted or inadequate flow from the supplying pumps.

2. They also allow the system to maintain a more constant pressure by absorbing high or low pressure surges.

The accumulator used operates on the sliding piston principle. One end is precharged (pressurized) with dry nitrogen gas. The other end is plumbed directly into the system supply lines. A sliding multi-ringed piston separates the oil from the gas charge.

With no oil in the fluid end, the precharged gas end holds the piston against the fluid end cap. As pressurized oil enters the fluid end, it causes the piston to move, compressing the gas. As oil is removed to assist in meeting the system flow demands, the compressed gas moves the piston back down the cylinder. In this accumulator the pressure in the hydraulic and gas sides are always equal.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Inspect the accumulator cylinders and connecting hardware for evidence of leakage, damage, or wear. Repair or replace as required.

2. Check the precharge pressure level of the gas in the gas end of the accumulator as outlined in the procedure entitled Precharging the Accumulator in these instructions to the pressure defined in the system test procedures in Section 5 - Hydraulic System in this manual.

Recharge as instructed. Frequent recharging indicates the need to service the unit (replace the seals).

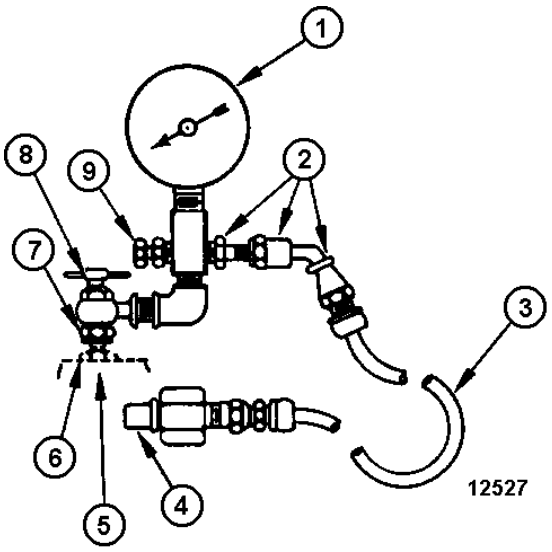
NOTE: *Worn piston seals may allow the gas to enter the hydraulic oil in the system. The addition of this gas to the oil would adversely affect system operation (possibly including spotty or uneven system performance and "spongy" or unsteady operation) similar to operation with air or other gases in the system. If gas does transfer, it is important to properly "bleed" all entrapped contaminants from the oil prior to placing the truck into service.*

PRECHARGING THE ACCUMULATOR (Figures 1 and 2)

The accumulators should be precharged as follows:

IMPORTANT: *The supply cylinder must be of the type that vaporizes the nitrogen when it is withdrawn. Do not charge with liquid nitrogen or any other gas.*

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction and park brake systems.



KEY	12527
1.	PRESSURE GAUGE
2.	HIGH PRESSURE FITTINGS
3.	HOSE ASSEMBLY
4.	CONNECTION TO NITROGEN BOTTLE
5.	ACCUMULATOR
6.	ACCUMULATOR GAS VALVE
7.	SWIVEL NUT
8.	GAS CHECK STEM
9.	BLEEDER VALVE

FIGURE 1 - ACCUMULATOR PRECHARGING EQUIPMENT

2. Drain all hydraulic pressure from each of the accumulators by pulling all valves and holding until indications that all pressure is released are noted (typically the “noise” of the released pressurized oil stops). Release the valve(s).

⚠ DANGER

Never loosen any line or begin any activity without first releasing all pressure from the system.

3. Verify that the accumulator end caps are installed flush with the body and the gas valve is secured tightly.

4. Remove the gas valve guard (14) and cap (11).

5. Turn the gas chuck stem or “T” handle (on the charging assembly) completely out (counter-clockwise).

NOTES:
1. The equipment required for checking or changing system pressure is contained in Figure 1.
2. It is strongly recommended that a regulator be installed on the high pressure nitrogen bottle that is used as a supply source. The regulator should be adjusted to release maximum pressure only slightly above that required by the component or system being charged.

6. Install the gas chuck swivel nut onto the gas valve and, using a suitable wrench, torque to 10 to 15 in-lb. (1.1 to 1.7 Nm).

⚠ CAUTION

Do not loop or twist the hose as it will stiffen when gas pressure is released from the nitrogen bottle.

7. Close the bleeder screw on the charge equipment.

8. Turn the gas chuck “T” handle clockwise until it reaches end of travel. This will depress the core in the accumulator gas valve.

9. Read the pressure indicated on the pressure gauge.

a. If the pressure is less than that listed in the appropriate test procedure, open the nitrogen bottle control valve slightly and allow the accumulator to fill slowly. Shut off the valve when the gauge indicates the desired pressure.

b. If the pressure is greater than that listed in the appropriate test procedure, open the bleeder valve on the charging equipment (typically below the gauge and opposite the gas valve) slightly, for a brief moment, then close to release the extra pressure.

⚠ WARNING

Escaping nitrogen may be cold enough to cause personal injury if it comes into contact with the skin. Care must be taken to avoid direct contact between the gas and any part of the body.

⚠ WARNING

Do not attempt to reduce accumulator precharge pressure by directly depressing the valve core, as high pressure may rupture the rubber valve seat. Instead, use the charging assembly, and use the bleeder screw.

NOTE: *If large quantities of nitrogen are added or removed from the accumulator during this process, it is recommended that the accumulator temperature be allowed to stabilize prior to taking final pressure measurements. This may be done by allowing the system to set idle 10 to 15 minutes after adding or removing gas.*

10. When charging is complete, turn the “T” handle completely out (counter-clockwise) until it reaches the stop. Open the bleeder valve to allow entrapped pressure to escape.

11. Loosen the swivel nut and remove the assembly. Hold the gas valve to prevent it from coming loose.

⚠ WARNING

Never loosen the swivel nut from the gas valve without first turning the “T” handle completely out and opening the bleeder valve.

12. Install the cap (torque to 10 to 15 in.-lb. (1.1 to 1.7 Nm) and gas valve guard.

NOTE: *The procedures are similar for checking or releasing the precharge pressure. The seals should be replaced when a continuing change in the precharge pressure is detected. As the pressure losses are observed, begin a program of frequent checking as a guide to how soon seal replacement must be made. In this manner, maintenance can be planned ahead without the need for any emergency repairs. Do not continue to operate a truck with leaky or damaged accumulators.*

13. Start the truck engine, allow the accumulators to

recharge with hydraulic oil, and check system operation.

14. Remove the charging kit from the supply bottle, cap and store each properly.

REMOVAL

The accumulators may be removed from the truck as follows:

1. Drain all hydraulic pressure from the accumulators and entire system as outlined in system procedures in Section 5 - Hydraulic System.

2. Drain all gas precharge pressure as outlined in the procedures in Maintenance and Adjustment.

3. Remove the precharging assembly from the accumulator.

4. Unscrew the gas valve (part way) until gas begins to escape through the safety hole drilled through the side of the gas valve.

⚠WARNING

Escaping nitrogen may be cold enough to cause personal injury if it comes into contact with the skin. Care must be taken to avoid direct contact between the gas and any part of the body.

5. After all pressure is drained, remove the gas valve.

6. Remove the hydraulic connection to the accumulator. Cap all openings, and label each to aid in installation.

7. Remove the capscrews that secure the accumulators to the mounting bracket.

8. Lift the accumulator(s) clear of the mounting bracket.

NOTE: *The threaded holes in the top end cap may be used as a means of attachment for lifting. An appropriate sling around the body may also be used.*

DISASSEMBLY (Figure 2)

The accumulator may be disassembled as follows:

1. Verify that the gas valve has been removed. If it is still installed, verify that all of the gas has been released as outlined in the procedures in Maintenance and Adjustment.

⚠WARNING

Deep vise marks, scratches, or distortions of the outer tube may cause stress concentrations in the tube under high pressure. Such concentrations may eventually cause component leakage or failure.

2. Set the accumulator horizontal and secure with a strap wrench or vice, gripping over the hydraulic end cap.

3. Install capscrews in the threaded holes in the removable gas end cap (11).

⚠WARNING

Always remove the gas cap, the end cap containing the gas charging valve, first.

4. Remove the cap by using a long bar and carefully “prying” on the capscrews installed for this purpose.

5. Inspect, then remove, the seal ring (3) and back-up ring (2) from the end cap.

6. Remove the hydraulic end cap (1) and rings (2 and 3) in a manner similar to that used to remove the gas end cap.

7. Remove the piston (5) by carefully tapping on the oil end with a wooden dowel as it is guided out of the body. Extra care should be taken to prevent damage to the piston or the seals on the threads.

IMPORTANT: *Never try to remove the piston by applying compressed air to the opposite end.*

8. Inspect, then remove the T seals (6) from the piston (5).

NOTE: To remove the seals from the piston (4), lift the ring with a small, smooth screwdriver or similar tool. Move the tool around the piston several times while using the other hand to work the ring off the piston.

INSPECTION AND REPAIR

The accumulator may be serviced as follows:

1. Thoroughly clean all metal parts in solvent and dry with compressed air.

2. Clean the bore of the body (4) and piston (5) with a

clean lintless cloth soaked in clean solvent.

NOTE: *The bore and piston must be clean of any particles visible, or detectable to the touch.*

3. Inspect the piston for evidence of cracks, burrs (especially around seal ring grooves), for damage. Repair or replace as required.

4. Inspect the condition and check the operation of the two check spring and ball assemblies (7 and 8, respectively) on the piston assembly.

5. Using a light, examine the body bore for scratches or scoring. Inspect the end caps for damaged threads or burrs on O-ring grooves. Minor nicks, scratches or light scoring of the body bore can be removed by using crocus cloth. Dress the bore until all apparent imperfections have been removed.

5. Inspect the seal rings. If damaged, determine the cause and correct before proceeding. They should all be replaced at each disassembly.

NOTE: *The piston "rides" on the seal rings and does not touch the accumulator bore.*

ASSEMBLY

The accumulator may be assembled as follows:

1. Coat all seals and internal parts with clean hydraulic fluid compatible with that used in the truck's hydraulic system.

2. Install the T seals (6) on the piston (5).

NOTE: *The rings may have to be stretched slightly to install. Once installed they should be allowed to relax to their original size for several minutes. This relaxation can be quickened by cooling. However, make sure all moisture residue is removed prior to continuing assembly and that the seals are straight, not twisted.*

3. Install the piston assembly in the bore of the body (1). The hollow side of the piston should be directed toward the gas end.

NOTES:
1. The piston must go into the bore exactly square and very slowly, as the seal ring will move if done slowly, but may be damaged if forced quickly. The piston will fit snug. Do not let the seal rings "drag" on the threads.
2. Use a hammer and a wooden dowel or block to tap the piston into place until all of piston is at least 2 inches (50 mm) below the beginning of the honed bore. Keep force against the piston while tapping the seals through the bore chamfer, otherwise the piston will bounce back, damaging the seals. Cover the port opening to keep out dirt.

4. Install a seal ring (2) and back up ring (3) on the gas end cap (11). Lubricate the seal ring with hydraulic oil. Install onto the body and tighten until the O-ring forms a seal and "tightens".

NOTES:
1. Exercise care not to "drag" the seal rings over the threads when installing.
2. The cap should "bottom out" on the body. Be careful not to over-tighten.

5. Install a new seal ring (2) and back-up ring (3) on the hydraulic end cap (12) and install in a manner similar to the gas end cap.

6. Install the gas valve (13).

8. Install the gas valve cover and guard (14).

INSTALLATION

The accumulators may be installed as follows:

1. Position the accumulator in the mounting bracket.

NOTE: *The threaded holes in the gas end cap may be used as a means of attachment for lifting. An appropriate sling around the body may also be used.*

2. Install the mounting hardware.

3. Secure the unit in place with capscrews and washers.

4. Install the hydraulic connections to the accumulator.

5. Precharge the gas side of the accumulator as outlined in the instructions in the procedures in Maintenance and Adjustment.

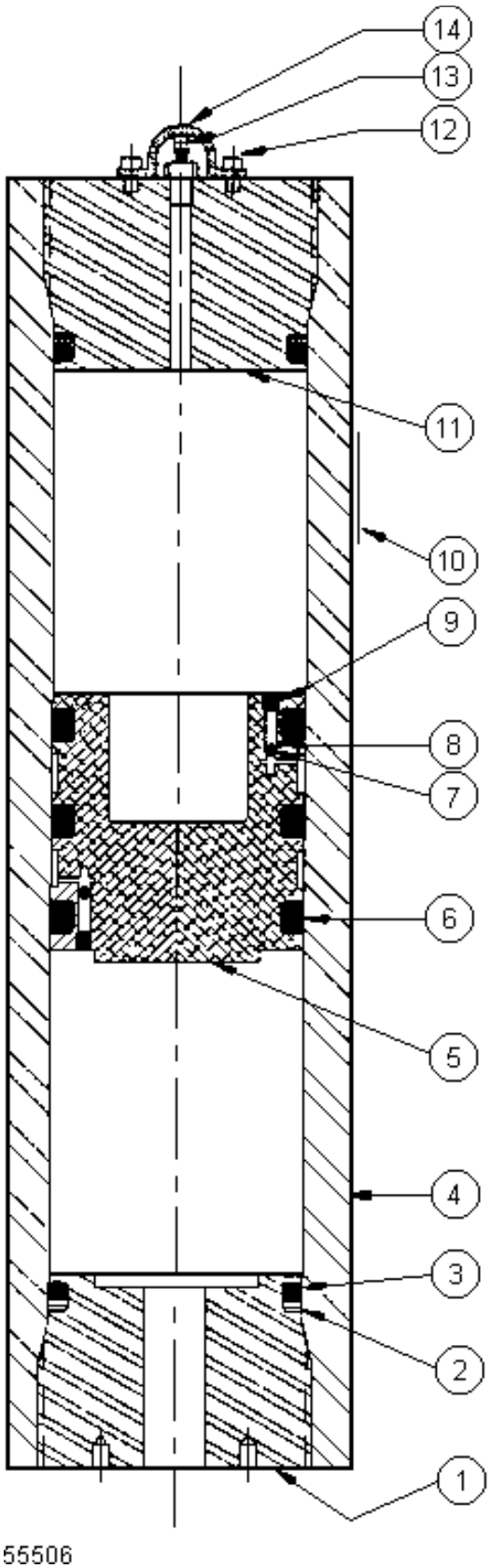
6. Install the gas valve cap.

7. Start the truck engine and allow the systems to pressurize or charge normally. Inspect for evidence of leakage or damage.

8. Bleed all entrapped air or contamination from each

of the systems as outlined in the procedures in Section 5 - Hydraulic System.

9. Test the system operation as outline in the procedures in Section 5 - Hydraulic System.



KEY 55506	
01.	Hydraulic End Cap
02.	Back-up Ring
03.	End Cap Seal
04.	Body
05.	Piston Assembly
06.	Piston T-Seal Rings
07.	Check Valve Ball
08.	Check Valve Spring
09.	Check Valve Screw
10.	Instruction Plate
11.	Gas End Cap
12.	Capscrews
13.	Gas Valve
14.	Gas Valve Guard

FIGURE 2 - ACCUMULATOR ASSEMBLY

STEERING ORBITAL VALVE (HAND PUMP)

DESCRIPTION AND LOCATION

The steering orbital valve is a cylindrical hydraulic device mounted on the lower end of the steering column in front of the cab.

OPERATION

As the steering wheel is turned, the end of the steering shaft turns a splined coupler located in the end of the orbital valve. The turning of the coupler causes the device to act like a pump and directs the flow of the hydraulic fluid. The fluid flows to an amplifier where the pressure is increased and directed along to the steering cylinders. The cylinders react to the pressure changes encountered thereby turning the wheel in the appropriate direction.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Inspect the unit for evidence of wear, leakage, or damage. Repair of replace as required.

2. Check the operation of the unit for evidence of binding or other improper operation. Repair or replace as required.

REMOVAL

The steering orbital valve may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction brake system.

2. Drain or relieve all pressure as outlined in the instructions in Section 5 - Hydraulic System before loosening any lines.

⚠WARNING

Never loosen any pressurized lines or components. Always drain or relieve all pressure first.

3. Disconnect the hydraulic lines from steering valve, making sure to note the routing and orientation of each. Install clean plugs and caps on all openings. Label each to aid in installation.

4. Remove the sets of capscrews, washers, and lockwashers from the valve mounting bracket.

5. Remove the capscrew, etc. securing the valve to the end of the steering column. Remove the valve.

DISASSEMBLY (Figure 1)

The valve may be disassembled as follows:

NOTE: *Cleanliness is extremely important when repairing a steering control unit. Work in a clean area if possible. Before disconnecting the lines, clean port area of unit thoroughly. Use a wire brush to remove foreign material and debris from around exterior joints of the unit. Use a clean solvent, such as Stoddard, to clean entire unit.*

1. Clamp the unit in vise, gerotor or meter end up. Clamp lightly on the edges of the port face side (up to a maximum of 1 inch (25 mm). Use protective material on vise jaws. Do no over tighten the jaws as this could result in distortion of the housing.

2. Remove capscrews (1) from end cap (2).

3. Remove end cap (2).

4. Remove seal (3) from the gerotor or metering section (4).

5. Remove gerotor (4). Be careful not to drop the star like gear in the center.

6. Remove seal (3).

7. Remove the drive spacer assembly (5).

8. Remove drive (7).

9. Remove the housing from the vise.

10. Carefully remove the springs (27), anti-cavitation retaining plug (28), and check ball (26) from the bolt holes by tipping the housing (8).

11. Place the housing, gerotor end down, on a clean soft cloth to protect surface finish.

12. Using a thin bladed screwdriver, carefully pry the retaining ring (19) from the groove. Be careful not to

damage the ring groove.

13. Lift the spool and sleeve assembly up just far enough to free the gland bushing from the housing. Remove the seal assembly.

14. Remove the seals (15, 16, and 17) from the seal gland bushing (18).

15. Use a thin bladed screwdriver to pry dust seal (16) from the seal gland bushing. Be careful not to damage the bushing.

16. Remove the two bearing races (13) and the needle thrust bearing (14) from spool and sleeve assembly.

13. Tip the housing onto the port face. Remove the spool and control sleeve assembly (9) from the fourteen hole end of housing.

NOTE: *Avoid binding the spool and sleeve in the housing. Rotate the spool and sleeve slowly while removing it from the housing.*

14. Push pin (11) from spool and sleeve assembly.

15. Remove centering springs (12) from spool (9) carefully by hand.

INSPECTION AND REPAIR

The unit may be serviced as follows:

1. Clean all mating surfaces.

2. Replace any parts that have scratches or burrs that could cause leakage.

3. Clean all metal parts in clean solvent. Blow dry with air. Do not wipe dry with cloth or paper towel because lint or other matter can get into the hydraulic system and cause damage. Do not use grit, or try to file or grind steering control unit parts.

NOTE: *Lubricate all seals (with exception of new quad ring seal) with a clean petroleum jelly, such as Vaseline. Do not use excessive lubricant on seals for meter section. Replace all old seals with new seals whenever unit is disassembled.*

ASSEMBLY

The unit may be assembled as follows:

1. Assemble the spool and sleeve of the control sleeve assembly (9) carefully so that the centering spring slots line up at the same end. Apply a light film of clean oil to OD of spool. Rotate the spool while sliding the parts together. Because of close tolerances between the spool and sleeve, do not force when rotating the parts together. Be careful not to burr the spool and test for free rotation. The spool should rotate smoothly in the sleeve with finger tip force applied at the spline end.

2. Align the spring slots of the spool and sleeve, then stand the parts on a bench. Insert a spring installation tool (Figure 2) through the spring slots of both ports. Position the centering springs (12) (2 sets of 4 each) on the bench so that the extended edge is down and the center section is together. In this position, insert one end of the entire spring set into the spring installation tool, as shown in Figure 3. If no tool is available, see NOTE below for alternate installation instructions.

3. Compress the expanded end of the centering spring set and push into the spool and sleeve assembly. Keep pressure on the spring ends when withdrawing installation tool, push forward on the springs at the same time.

4. Center the spring set in the spring slots. Seat the springs (12) down evenly and flush with the upper surface of the spring and sleeve.

NOTE: *Carefully follow these instructions when installing center springs without the aid of a spring installation tool.*

a. Insert 1 centering spring, with the extended edge down, in the spring slot of the spool (raise the spool from the sleeve slightly for more spring clearance).

b. Insert 1 centering spring opposite the spring located in the slot of the spool. Make sure center section of both springs are together, and that the extended edge of the springs are down.

c. Push 1 set of 3 centering springs between the 2 springs in the spool, as shown in Figure 3.

d. Push remaining set of 3 centering springs opposite the 4 centering springs in spool.

e. Push the spool into the sleeve until the springs seat is flush the with top and sides of sleeve.

5. Install pin (11) through the spool and sleeve assembly until the pin becomes flush at both sides of sleeve.

KEY	55445
01.	Torx Capscrew
02.	End Cap
03.	Seal
04.	Gerotor
05.	Spacer
06.	Spacer Plate
07.	Drive
08.	Housing
09.	Control Sleeve
10.	Control Spool
11.	Centering Pin
12.	Centering Spring kit
13.	Baring Race
14.	Needle Thrust Bearing
15.	Seal (1.86 in (47.2 mm) ID)
16.	Seal (1 in. (25.4 mm) ID)
17.	Seal (1.46 in. (37.1 mm) ID)
18.	Seal Gland Bushing
19.	Retaining Ring
20.	Check Ball Retainer
21.	Check Ball
22.	Check Ball Seat
23.	Seal (0.30 in. (7.6 mm) ID)
24.	Seal (0.36 in. (9.1 mm) ID)
25.	Set Screw
26.	Check Ball
27.	Spring
28.	Anti Cavitation Retaining Plug

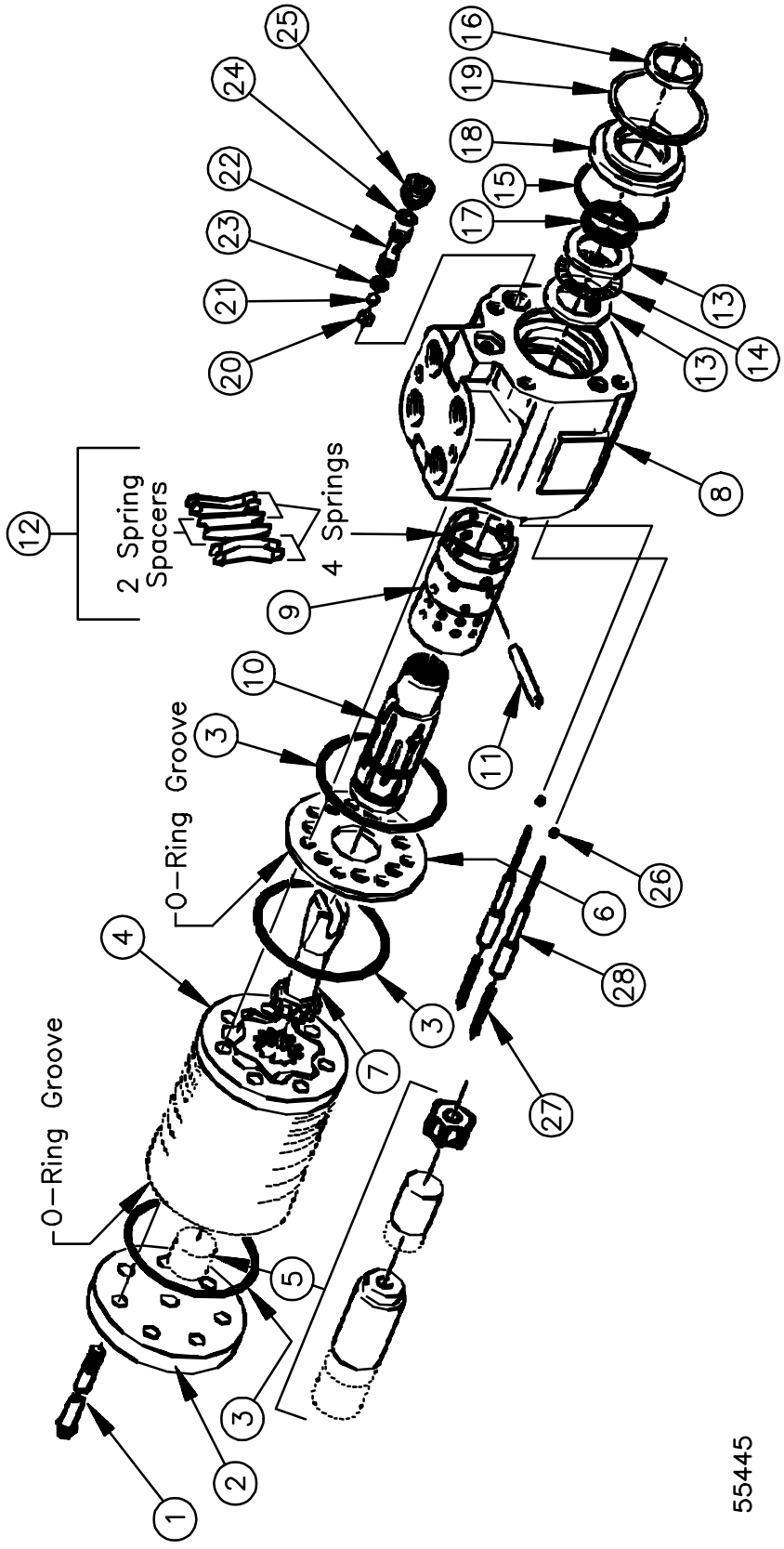


FIGURE 1 - STEERING ORBITAL VALVE ASSEMBLY

Tools required for disassembly and reassembly:

2 Screwdrivers (4" - 6" long, 1/8" flat blade)
1/2 " socket (12 point)
Breaker bar wrench
Torque wrench (90 foot pound capacity)
Plastic hammer or rubber hammer
Tru-Arc Retaining Ring Ratchet Pliers (S-6500)

The following tool isn't necessary for disassembly and reassembly, but is extremely helpful.

Spring installation tool

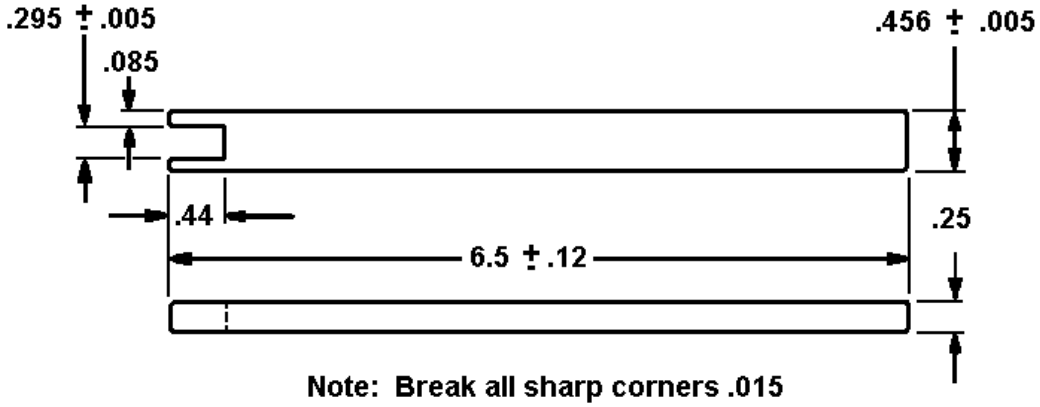


FIGURE 2 - DISASSEMBLY/ASSEMBLY TOOL

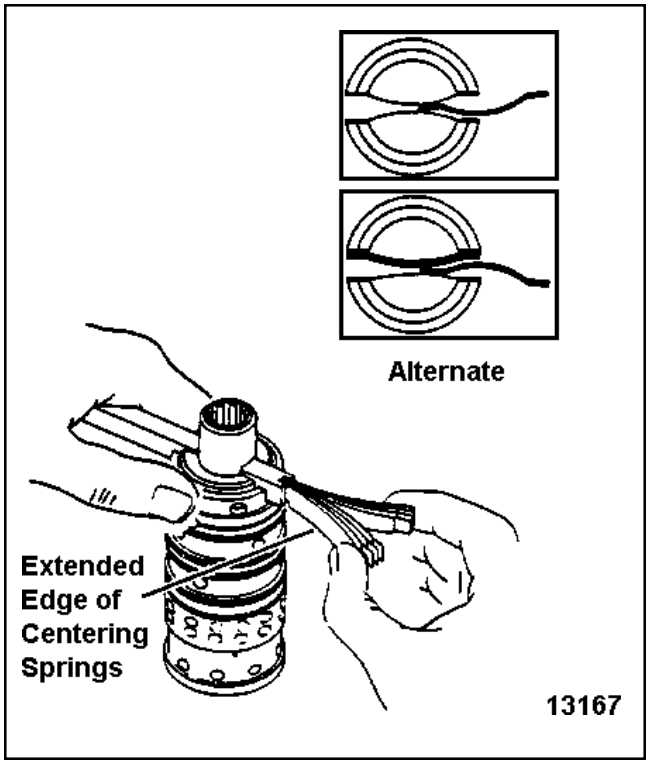


FIGURE 3 - SPRING INSTALLATION

6. Position the spool and sleeve assembly so the splined end of spool enters gerotor (meter) end of housing first.

⚠ CAUTION

Be extremely careful that the spool and sleeve don't tilt out of position while inserting in housing. Lubricate the OD of the sleeve. Push parts gently into place with slight rotation. Keep the pin horizontal. Move the spool assembly entirely within the housing bore until the parts are flush at the meter end of housing. Do not pull the spool assembly beyond this point to prevent the cross pin from dropping into the discharge groove of the housing. With the spool assembly in this flush position, check for free rotation within the housing by turning with light finger force at the splined end.

7. Place housing (8) on a clean lint free cloth. Install 2 bearing races (13) and the needle thrust bearing (14).

8. Install the dust seal (16). The smooth side of dust seal must face down toward seal gland bushing.

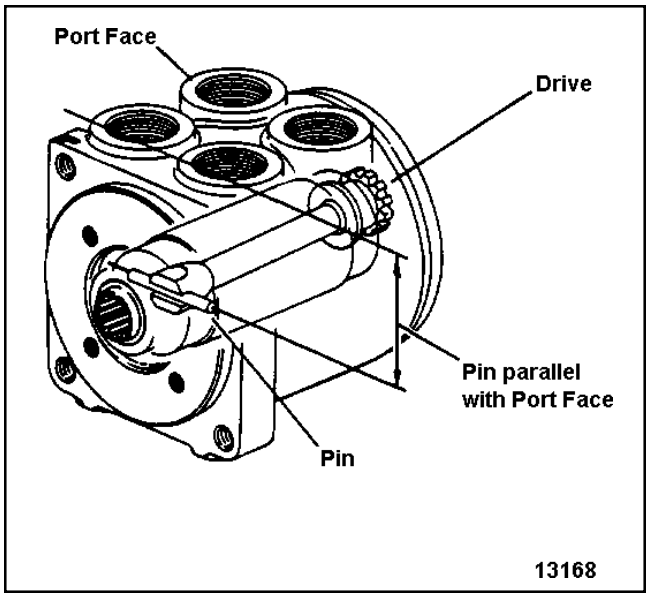


FIGURE 4 - DRIVE INSTALLATION

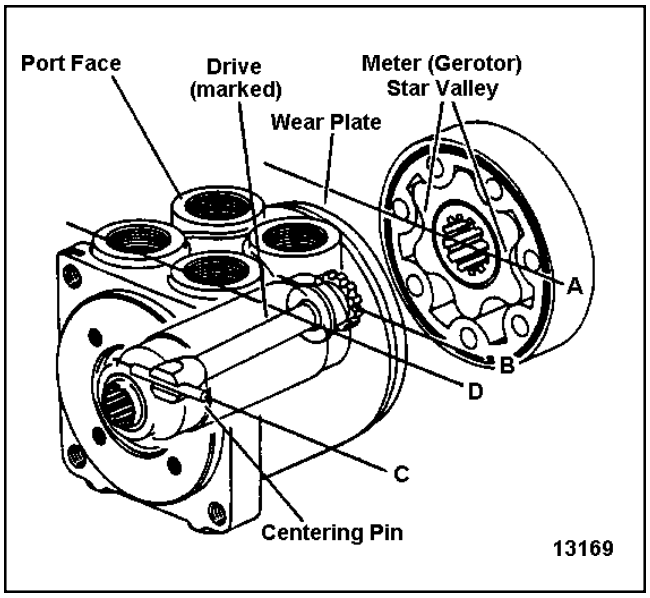


FIGURE 5 - METER INSTALLATION

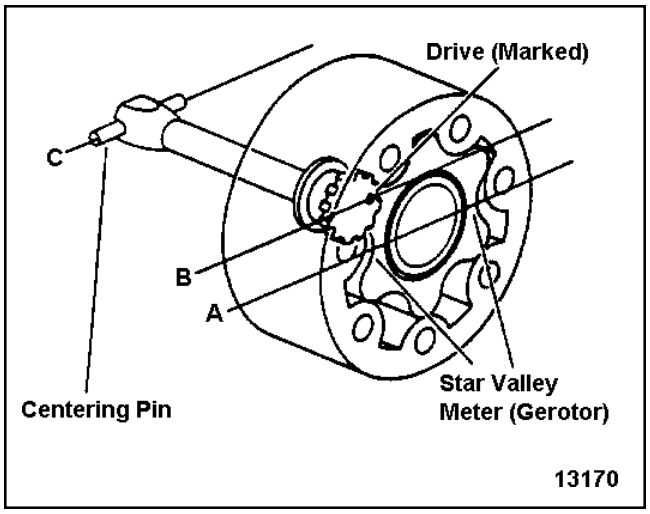


FIGURE 6 - METER HOUSING INSTALLATION

9. Install the dry quad ring seal. Seat the seal in place with your finger. Do not use any seal that falls freely into place.

10. Install 1-13/16 inch (46 mm) diameter O-ring (13) seal.

11. Install seal gland bushing (18) over the spool end with a twisting motion. Tap the bushing into the housing with a rubber hammer. Make sure the bushing is flush against the bearing race.

12. Using a True-Arc retaining ring ratchet pliers (S-6500) or equivalent, install retaining ring (19) in the housing. After installing the ring, tap slightly to properly seat the ring in the groove.

13. Clamp the housing in a vise as before. Clamp lightly on the edges of the mounting area. Do not over-tighten the jaws. Install 4-3/4 in. (120 mm) diameter seals (3) in the housing.

NOTE: *Check to ensure that the spool and sleeve are flush or slightly below the meter end of the housing. Clean the upper surface of the housing by wiping with the palm of clean hand. Clean each of the flat surfaces of the meter end parts in a similar way when ready for reassembly. Do not use a cloth or paper towel to clean surfaces.*

14. Rotate the spool and sleeve assembly until pin is parallel with the port face as shown in Figure 4. Install the drive, making sure to engage the drive with the pin.

To assure proper alignment, mark one of the two drive tooth slots that are parallel with slot in the end of drive as shown in Figure 6.

15. Install the wear plate (6).

16. Install the 2.9 inch (73 mm) diameter O-ring seal (3) on the meter face.

17. With the seal side of meter down, install the meter on the drive. If the star has a counterbore, install the counterbore facing the end cap.

NOTE: *The timing mark you make on the drive must fall on the parallel line between any 2 meter star valleys. Note the parallel relationships of the reference*

lines A, B, C and D in Figures 5 and 6. Align the bolt holes without disengaging the meter from the drive. Be careful when adjusting the meter on the housing, as excessive turning of the meter may disrupt the seal between the meter and the housing.

18. Install 2.9 inch (73 mm) diameter seal in meter.

19. Install end cap on meter and align the holes. Be careful not to disrupt seal from the meter.

20. Install 7 dry capscrews in end cap. Pre-tighten screw to 150 inch pounds (17 Nm), then torque screws to 225 to 275 inch pounds (25 to 30 Nm) as shown in Figure 7.

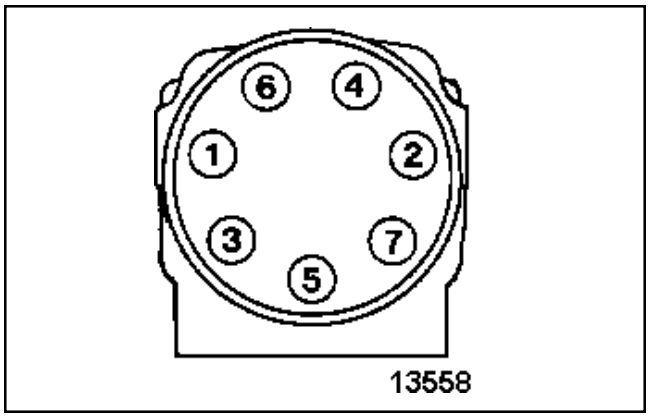


FIGURE 7 - TORQUE SEQUENCE

INSTALLATION

The steering orbital valve may be installed as follows:

1. Install the valve onto the end of the steering column. Do not tighten the mounting capscrews.

2. Install the sets of capscrews, washers, and lockwashers to secure the valve to the mounting bracket. Again do not tighten the capscrews.

3. Turn the steering wheel back and forth several times to allow the components to seek alignment.

4. Tighten the capscrews installed in steps 1 and 2.

5. Repeat step 3, again checking for binding. If noted, loosen the capscrews and repeat steps 3 and 4.

6. Reconnect the hydraulic hoses to the capscrews as removed.

7. Start the engine and test the system operation as outlined in the instructions in Section 5 - Hydraulic System.

STEERING FLOW AMPLIFIER VALVE

DESCRIPTION AND LOCATION

The steering flow amplifier valve increases the amount of flow of the hydraulic fluid in the steering system in order to operate the steering cylinders and turn the wheels of the truck. It is located on the frame in front of the front axle behind the left wheel.

OPERATION

The control of the system is based on a principle of flow amplification, in which a limited, or pilot, flow from the steering control or orbital valve is used to control the operation of a main control or amplifier valve that actually regulates system flow to the steering cylinders.

When the steering wheel is held stationary (considered the neutral position whether the vehicle is traveling straight or being controlled during a turn):

1. The supply of oil from the filters is routed across the integral priority valve in the flow amplifier.

2. The directional valve remains in the centered position. In this mode, any pressure surges induced by road conditions (e.g. when striking a hole in the road) are absorbed by the integral shock valves in the flow amplifier instead of being transmitted to the steering control unit.

When the steering control valve is activated (by movement of the steering wheel) to change the position of the vehicle's front wheels:

1. A pressure signal is passed to the flow amplifier's priority valve.

2. The priory valve shifts changing the path of the oil to the steering control unit.

3. The directional valve is then shifted, allowing the required flow to reach the pressure control/amplifier valve assembly. The amount and speed of the input signals controls the magnitude of the spools' movements. The pilot and main flows are then merged and directed to the appropriate ports in the steering cylinders.

Stopping movement of the steering wheel returns the valve to the previously outlined stationary position.

Amplification occurs in the pressure control/amplifier valve. As the pressure in the chambers increase, flow is regulated in an amount proportionate to the area of the holes in the various portions of the spool.

The return oil is controlled by the directional valve. In an overrun condition (in which the vehicle wheels try to cause steering movements more severe than the operator's inputs) the directional valve automatically throttles the flow of this return oil to maintain stable control of the cylinders.

Steering kick back is controlled by the system requirement that the pressure in the pilot port chamber of the pressure control/amplifier valve must exceed that in the main chambers for the movement of the valve.

As in the neutral or stationary mode, the shock valves prevent pressure surges in the cylinders themselves. Suction valve provisions are also incorporated to prevent cavitation.

On some models, a separate counter pressure valve is provided to ensure a constant proper charge to the suction valves. On others, the normal back pressure in the system handles this function.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the steering flow amplifier valve should include:

1. Visually inspect the unit for leaks from the housing or from the hoses.

2. Verify that the hydraulic oil is clean and of good quality.

3. Test the operation of the system as outlined in the instructions in Section 5 - Hydraulic System.

REMOVAL

The steering flow amplifier valve may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release all hydraulic pressure from the system as outlined in the system procedures in Section 5 - Hydraulic System.

3. Disconnect all hoses, making sure to note their routing and position.

4. Cap or plug all open ports or fittings and keep them as free from contaminants as possible.

5. Remove the capscrews securing the valve to the bracket.

6. Remove the valve from the bracket and move to a suitable working environment.

DISASSEMBLY (Figure 1)

NOTE: *Mark the endplates in a dissimilar manner to properly identify them later during assembly. Note their orientation. Note the characteristics of the springs during removal in order to identify them properly later during assembly. Keep components of the subassemblies separated from one another.*

The steering flow amplifier valve may be disassembled as follows:

NOTE: *Cleanliness is extremely important when working on any steering unit. Work in a clean area if possible. Before beginning disassembly thoroughly clean the exterior of the valve and the repair area. Use a wire brush and clean solvents to remove foreign material and debris.*

1. Clamp in a holding fixture or vice. Use protective material on the jaws and do not over-tighten.

2. Remove the capscrews and washers holding the flanges to the valve. Remove the flanges and the hose adapters.

3. Remove the other hose fittings.

4. Unscrew the top middle plug (38). Then remove the small spring, ball, piston, and large spring which form the counter pressure valve assembly (39) on models so equipped. Note the location and orientation of each as they are removed.

5. Unscrew the other top plug (20). Unscrew the pressure relief valve (19) and take out the washer (6).

6. Moving to the end cover near the PP-connection, unscrew and remove the screws (11 and 13) and washers (12 and 14). Remove the end cover (15).

7. Remove the stop (23) and springs (29 and 30).

8. Remove the spring (40).

9. Remove the plate (18) and 6 O-rings (1 and 2).

10. Remove the spring guide (24).

11. Moving to the end cover near the LS-connection, unscrew and remove the screws (11 and 13) and washers (12 and 14).

12. Remove the end cover (15).

13. Remove the stops (23) and springs (29 and 28).

14. Remove the spring guide (24).

15. Remove the plate (17) and 4 O-rings (1 and 2).

16. Remove the spring guide (24).

17. Remove the directional spool (44) from the housing (9).

18. Remove the amplifier spool (42) from the housing (9).

19. Remove the priority valve spool (43) from the housing (9).

20. Unscrew the orifice (36) in the LS-connection.

21. Pry the throttle check valves (10) out of each end of the housing with a screwdriver.

22. While holding the directional spool (44) with a mandrel, unscrew the orifice (37) from each end of the spool.

23. While holding the amplifier spool (42), carefully remove the spring ring (part of item 42) from the recess with a small screwdriver.

NOTE: *Avoid damage to the spring ring.*

24. Carefully guide the spring ring back.

25. Gently press the pin out holding the plug in the end of the spool.

26. Remove the plug and spring from inside the spool.

27. Using a mandrel in the pin hole, unscrew the check valve.

NOTE: *Avoid damaging the spool surface.*

28. Using a mandrel in the pin hole of the plug, unscrew the orifice (35).

INSPECTION AND REPAIR

The disassembled components of the flow amplifier valve may be serviced as follows:

1. Clean all parts carefully with low aromatic kerosene.

2. Replace all gaskets and sealing washers.

3. Inspect all other parts carefully for evidence of wear or damage. Repair or replace as required.

ASSEMBLY

The flow amplifier valve may be assembled as follows:

1. Install the orifice (35) in the plug of the amplifier spool (42). Torque to 45 +/- 10 in-lb (5 +/- 1 Nm).

2. Install the check valve (10) in the spool. Torque to 175 +/- 25 in-lb (20 +/- 3 Nm). Remember to install the O-ring (8).

3. Assemble the shock/suction valve as follows:

NOTE: *If it is necessary to disassemble the flow amplifier shock valve, a pre-set valve should be ordered from Unit Rig.*

a. Guide the spring with the cone into the housing.

b. Install the adjustment screw.

c. Install the spool.

d. Install the spring.

e. Install the pilot valve with the O-ring. Torque to 175 +/- 45 in-lb (20 +/- 5 Nm).

f. Install the housing.

g. Install the spring.

h. Install the disc.

i. Install the locknut. Torque to 135 +/- 20 in-lb (15 +/-2 Nm).

j. Contact Unit Rig for adjustment.

⚠WARNING

Do not attempt to reassemble a shock valve. Improper adjustment of the shock valve could lead to component damage.

4. The check valve may be assembled as follows:

a. Install the ball.

b. Install the spring and plug. Torque to 45 +/- 10 in-lb (5 +/-1 Nm)

5. The amplifier spool (42) may be assembled as follows:

a. Install the orifice into the plug. Torque to 45 +/- 10 in-lb. (5 +/- 1 Nm).

b. Install the check valve (step 3). Torque to 175 +/ - 25 in-lb (10+/-3 Nm).

c. Install the inner spool in the correct position.

d. Guide the inner spool into place.

e. Install the pin.

f. Install the spring ring with the ring in the recess end away from the pin holes.

g. Install the spring plug and pin at the other end.

h. Push the spring ring into position. Position the ring in the recess end away from the pin holes.

6. Assemble the priority valve spool (43) as follows;

a. Install the throttle check valves.

b. Torque each to 90 +/- 25 in-lb (10 +/- 3 Nm).

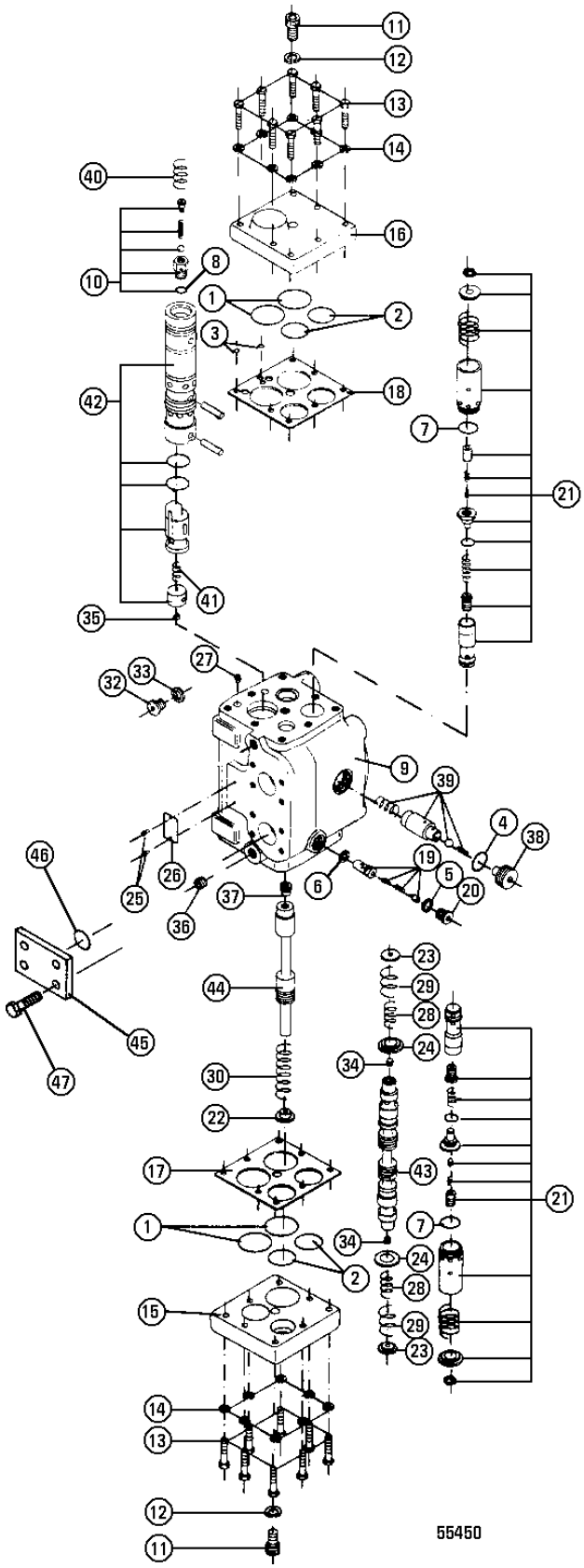
7. Assemble the directional spool assembly (44) as follows:

a. Install the orifices (34).

b. Torque each to 45 +/- 10 in-lb (5 +/- 1 Nm).

8. Install the orifice and throttle check valves as follows:

a. Install the orifice (27) into the housing (9). Torque to 45 +/- 10 in-lb (5 +/- 1 Nm).



KEY	
01.	O-ring
02.	O-ring
03.	O-ring
04.	O-ring
05.	Washer
06.	Washer
07.	O-ring
08.	O-ring
09.	Housing
10.	Check Valve
11.	Screw
12.	Spring Washer
13.	Screw
14.	Spring Washer
15.	End Cover
16.	End Cover
17.	Plate
18.	Plate
19.	Relief Valve
20.	Plug
21.	Shock and Suction Valve
22.	Stop
23.	Stop
24.	Spring Guide
25.	Drive Screw
26.	Nameplate
27.	Orifice
28.	Spring
29.	Spring
30.	Spring
31.	Not Used
32.	Plug
33.	Washer
34.	Orifice
35.	Orifice
36.	Orifice
37.	Orifice
38.	Plug
39.	Counter Pressure Valve (On Models so Equipped)
40.	Spring
41.	Spring
42.	Amplifier Spool Assembly
43.	Priority Valve Spool Assembly
44.	Directional Valve Spool Assembly
45.	Blanking Plate
46.	O-ring
47.	Capscrew

FIGURE 1 - STEERING FLOW AMPLIFIER VALVE

b. Install the orifice (36) into the LS connection. Torque to 90 +/- 25 in-lb (10 +/- 3 Nm).

.

c. Install the throttle check valve into the PP connection. Torque to 90 +/- 25 in-lb (10 +/- 3 Nm).

9. Guide the shock valve (21) with the O-ring in and secure it by hand.

10. Assemble the pressure relief valve as follows:

a. Guide the adjustment screw, spring, and cone up and into the cartridge.

b. Screw the adjusting screw in far enough that the hex key fully engages.

11. Drop the washer (6) in the hole in the top of the housing (9) for the pressure relief valve.

12. Install the pressure relief valve assembly (19) in the housing and torque to 265 +/- 25 in-lb (30 +/- 3 Nm).

13. Install the plug (20) with the washer (5). Torque to 530 +/- 45 in-lb (60 +/- 5 Nm).

14. On models equipped with a counter pressure valve (39):

a. Install the spring in the piston using Vaseline or equivalent to hold in place. Then fit the assembled piston and spring in the housing.

b. Allow the ball to drop down.

c. Install the spring in the plug with Vaseline.

15. Install the assembled plug and spring into the housing and torque to 220 +/- 25 in-lb (25 +/- 3 Nm). Remember to install the O-ring (4).

16. Install the directional (44) and priority valve spools (43).

NOTE: *Spring control must be placed in correct position against LS-connection.*

17. Install the spring on the priority valve spool.

NOTE: *The spring installs in end of the housing located next to the LS-connection.*

18. Install the amplifier spool (42) into the housing. The orifice must be placed in the end nearest the LS-connection.

19. Move to the PP-connection end of the housing and install the spring with Vaseline on the amplifier spool.

20. Install the spring guide (24) on the end of the directional spool (44) lubricated with Vaseline.

21. Install the large and small springs (29 and 28), lubricated with Vaseline, on the end of the directional spool (44).

22. If desired to assist in the assembly process, install the guide screws into the housing.

23. Install the 4 large and 2 small O-rings into the plate (18).

24. Install the smaller stop in the recessed hole, which covers the directional spool, in the endplate with Vaseline.

25. Place plate (18) and endplate (16) in position.

26. Install the center screw (11) with lockwasher (12). Then fit the rest of the screws (13) and washers (14). Torque the center screw to 710 +/- 90 in-lb (80 +/- 10 Nm). Torque the rest of the screws to 220 +/- 45 in-lb (25 +/- 5 Nm).

27. Move to the end of the housing next to the LS-connection. Install the previously used guide screws, if desired.

28. Install the spring guide (24) on end of the directional spool with Vaseline.

29. Install the large and small springs (29 and 28), lubricated with Vaseline, on the end of the directional spool.

30. Install the thicker stop for the priority valve spool (43), lubricated with Vaseline, in the endplate cover.

31. Install the thinner stop for the directional spool with Vaseline in the endplate cover.

32. Install the 4 larger and 2 smaller O-rings in the plate (17). Place the plate and endplate (15) in position.

33. Fit the large center screw (11) with lockwasher (12). Then fit the rest of the screws (13) and washers (14). Torque the center screw to 710 +/- 90 in-lb (80 +/- 10 Nm). Torque the rest of the screws to 220 +/- 45 in-lb (25 +/- 5 Nm).

34. Install the hose fittings, adapters, and flanges on the valve.

INSTALLATION

The assembled flow amplifier valve may be installed as follows:

NOTE: *It may be necessary to fit some of the hoses prior to mounting the valve on the bracket.*

1. Mount the valve to the bracket with the capscrews and washers. Tighten evenly to the proper torque to avoid component damage.

2. Install the hoses to the proper locations. Torque all hoses as outlined in the information in Section 10 - Miscellaneous.

3. Test and adjust the component's and system's operation as outlined in the system's procedure in Section 5 - Hydraulic System.

STEERING CYLINDER

DESCRIPTION AND LOCATION (Figure 2)

The steering cylinders are two-way hydraulic cylinders mounted on the front axle. The base end of the cylinder is attached to the front axle beam through a self-aligning bushing assembly. The rod end is attached to the steering arm on the ends of the axle assembly with a separate clevis assembly through a self-aligning bushing in the steering arm.

NOTES:

1. Several different versions of the cylinder have been built, each with internal improvements over its predecessor. These are outlined in detail in this module. Be sure to properly identify the version that is being serviced and review the updates available whenever servicing the internal components of any cylinder. Externally they all appear the same.

2. Later versions of the system (and earlier trucks so modified) used an expander or segmented pin assembly to secure the base of the steering cylinder to the front axle assembly.

OPERATION

Pressurized oil from the flow amplifier valve enters the steering cylinders through inlet ports at either the base or the rod end. Fluid at the other end is routed back to the steering manifold. The pressure differential on the sides of the piston cause the cylinder to extend or retract. This movement causes the required movement in the steering arm assemblies.

For a detailed description of the steering system, refer to the information in Section 5 - Hydraulic System.

For detailed information on the remainder of the steering linkage components, refer to the information in Section 7 - Running Gear.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Clean both cylinders, associated linkage, and hydraulic hoses. Inspect for wear, leakage and damage. Repair or replace as required.

2. Verify that all cylinder mounting components are installed and in good repair, and are properly lubricated. Repair or replace as required.

a. On trucks equipped with an expander pin, verify that both of the capscrews securing the expanders are properly torqued and that there is no evidence of rotation or wear in the pin assembly or self aligning bushing bore.

(1) If either of the capscrews or the pin assemblies is found to be loose, the assembly should be disassembled, inspected and repaired.

(2) Then the capscrews should be reinstalled and torqued as outlined in the instructions in Installation in this material.

b. On trucks equipped with the straight pins, verify that the pins, nuts, and related hardware are properly installed and secured.

(1) There should be no evidence of rotation or wear in the pin assembly or self-aligning bushing bore.

(2) If found, the assembly should be disassembled, inspected, repaired and then re-assembled as outlined in the instructions for Installation in this material.

3. Bleed any air from the cylinders as follows:

⚠WARNING

Since the truck engine must be running to perform this adjustment, be sure the truck is parked in a SAFE POSITION with the park brakes appropriately set prior to beginning maintenance. Also be sure never to place yourself in a dangerous position near moving parts.

a. Start the engine and allow to fully charge the accumulator system.

b. Rotate the steering wheel from the full right to the full left positions and back until the entire steering system is free of air.

c. Stop the engine.

REMOVAL (Figures 2 and 3)

The steering cylinders may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release steering pressure as outlined in the procedures in Section 5 - Hydraulic System.

NOTE: *Use manual drain valve in the steering manifold to verify that all pressure has been released.*

⚠ DANGER

The steering system is a high pressure system. Release all pressure before disconnecting any lines.

3. Disconnect the hydraulic hoses. Label each to ensure proper installation. Install clean plugs in all openings.

4. Disconnect lubrication lines (if so equipped).

5. Support the cylinder so that it cannot move and will allow for easy removal.

6. Remove the capscrews, hardened flatwashers, pin retainer, grease seals, and pin from the clevis assembly on the rod end of the cylinder.

7. Remove the pin assembly securing the cylinder base to the axle as follows:

a. On trucks equipped with expander pin assemblies (Figure 2):

(1) Remove the capscrew (38), flatwasher (37), and retainer (36) securing the pin assembly (35).

(2) Remove the capscrew (24), expander washer (23), and expander sleeve (22) from the lower portion of the pin assembly (35).

NOTE: *It may be necessary to wait until the pin is removed to remove the expander sleeve (22). If it does not release and must wait to be removed, provide some means of preventing its falling out and becoming damaged.*

(3) Loosen, but do not remove, upper capscrew (24).

(4) Carefully move pin assembly to allow the upper and lower expander sleeves (22) to release, then remove all of the pin assembly components.

(5) Remove the bearing spacer (21).

b. On trucks equipped with the straight pin/nut assembly (Figure 3):

(1) Remove the cotter pin (23), hardened flatwashers (22), slotted nut (20).

(2) Remove the bearing spacers (21) and the steering pin (19).

8. Remove the steering cylinder(s).

DISASSEMBLY (Figures 1A, B, and C unless otherwise indicated)

The steering cylinders may be disassembled as follows:

1. Clamp the body in a bench vise.

2. Remove the yoke from rod end as follows: (Figure 2, this step only)

a. Loosen the capscrews (13) and locknuts (14) to release the locking effect on the yoke assembly.

b. Using an appropriate wrench to keep the piston rod from turning, slowly unscrew the yoke from the rod assembly.

3. Remove the button head capscrews (21) and lockwashers (22).

4. Using a suitable tool, unscrew and remove the retainer (6) from the end of the outer tube assembly (1).

5. Remove the bearing assembly (5) from the outer tube assembly.

6. Remove piston and rod assembly from the outer tube assembly.

7. Remove socket head capscrew (20) from the piston nut (4).

8. Remove the piston nut (4) from the assembly.

9. Remove socket head capscrew (20) from the side of the piston assembly.

10. Unscrew the piston (3) from the rod (2).

11. Inspect and remove all wear rings, seals, and backup rings from various components.

INSPECTION AND REPAIR

The disassembled cylinders may be serviced as follows:

1. Clean all metal components with clean solvent. Dry with compressed air.

2. Inspect the components for excessive wear, scoring, scratches. Repair or replace as required.

Critical dimensions include: (84092A, C, E, and K cylinder components)

Cylinder bore (item 1): 6.000 +0.003/-0.000 inches
Piston OD (item 3): 5.975 +/- 0.001 inches
Piston rod OD (item 2): 3.495/3.4945 inches

3. Inspect the condition of the self-aligning bushing in the end of the outer body tube. If required it may be replaced as follows: (Figures 2 or 3, Section C-C)

a. Remove the internal retaining ring.

b. Remove the self-aligning bushing assembly by a suitable means.

c. Inspect the condition of the bushing bore in the outer tube assembly. It should be free of damage and in good repair. Remove any burrs or nicks.

d. Install the new bushing assembly, securing with internal snap ring.

4. Inspect the removed seals, wiper rings, etc. noting any damage or abnormal appearances. If found, determine the cause and correct prior to beginning the reassembly process.

IMPORTANT: *It is recommended that all seals and O-rings be discarded and replaced with new components during each assembly.*

ASSEMBLY (Figures 1A, B, C, and D)

NOTE: *There are four separate versions of the cylinder assembly that are covered here.*
1. P/N 84092A was the original configuration and is illustrated in Figure 1A.
2. P/N 84092C was an improved configuration and is illustrated in Figure 1B.
3. P/N 84092E (and earlier cylinders modified per UR Engineering Bulletin EB1348 to this configuration) is a further improved configuration and is illustrated in Figure 1C.
4. P/N 84092K is a configuration with integrated seals and a one-piece stuffing box. It is illustrated in Figure 1D.
Always determine the configuration of the cylinder being serviced and verify that the correct parts are available before beginning assembly of the cylinder.

The steering cylinders may be assembled as follows:

1. Clamp outer tube assembly (1) in vise in a manner not to cause distortion or damage.

2. Lubricate all O-rings and seals with hydraulic oil compatible with that in the truck's hydraulic system.

3. Replace the O-ring seal (17) between the piston (3) and the piston rod (2).

4. Using the standard procedures for installing Loctite, cover the threads on the piston (3) and piston rod (2) with Loctite 271 or equivalent. Assemble the two components and torque to 1470 to 1770 ft-lb (1995 to 2400 Nm).

5. Using Loctite 242 or equivalent, install the bronze plug (19) and the socket-head capscrew (20) into the side of the piston (3) to secure on the piston rod (2). Torque to 21 to 25 ft-lb (28 to 34 Nm).

6. Using Loctite 271, install the piston nut (4) onto the piston assembly. Torque to 300 ft-lb (405 Nm), minimum.

7. Using Loctite 242 or equivalent, install the socket-head capscrew (20) into the top of the piston nut (4) to secure the nut on the piston. Torque to 21 to 25 ft-lb (28 to 34 Nm).

8. Install piston wear rings (14) and seal and seal expander (15 and 16) onto the piston (3).

NOTE: *The seal expander is not used with the 89052K configuration.*

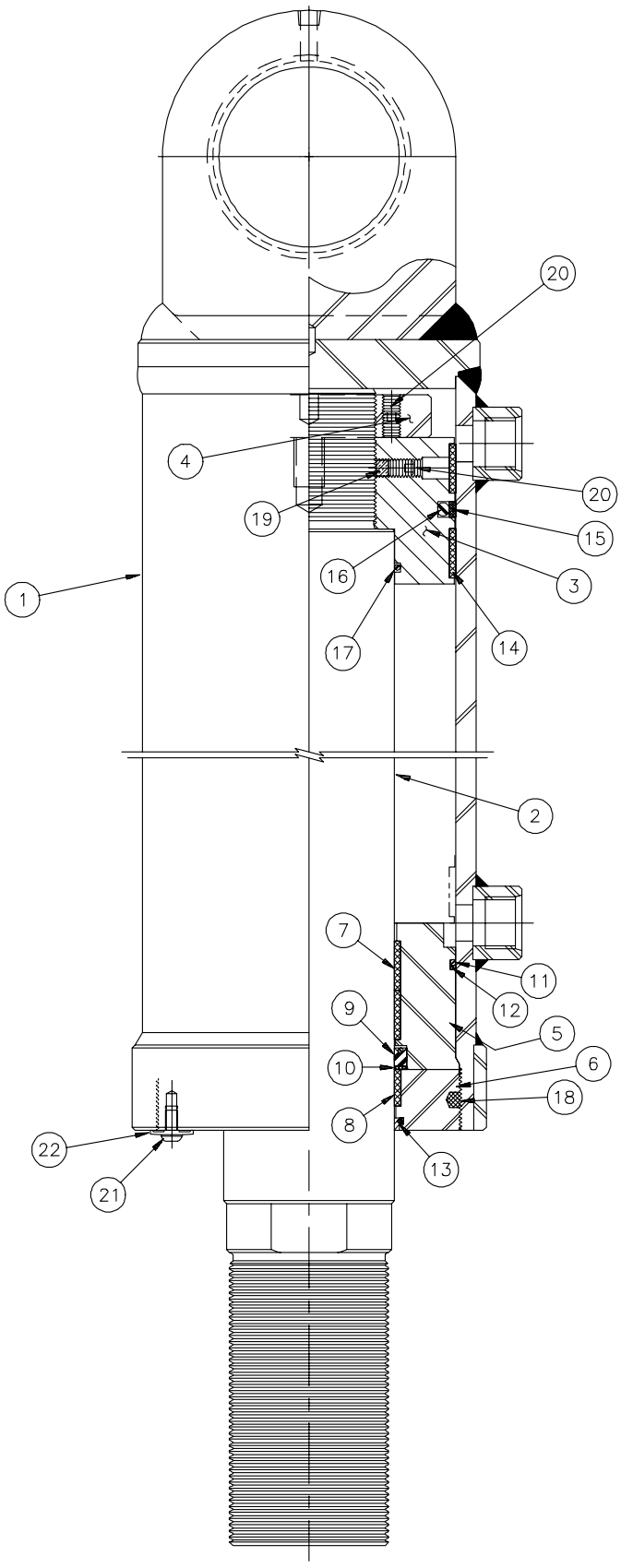
9. Install the rod wear ring (7), U cup seal (9), and back-up ring (10) into the ID of the bearing assembly (5).

NOTE: *On P/N 84092E and P/N 84092K cylinders (Figures 1C and 1D):*
1. Make sure to install item 9 and not item 8. They appear similar, but are different. The seal will not function properly if they are installed in the wrong groove.
2. It is extremely important to have the lip of the seal (9) toward the inside of the cylinder.

10. Install the O-ring (11) and back-up ring (12) into the groove in the OD of the bearing.

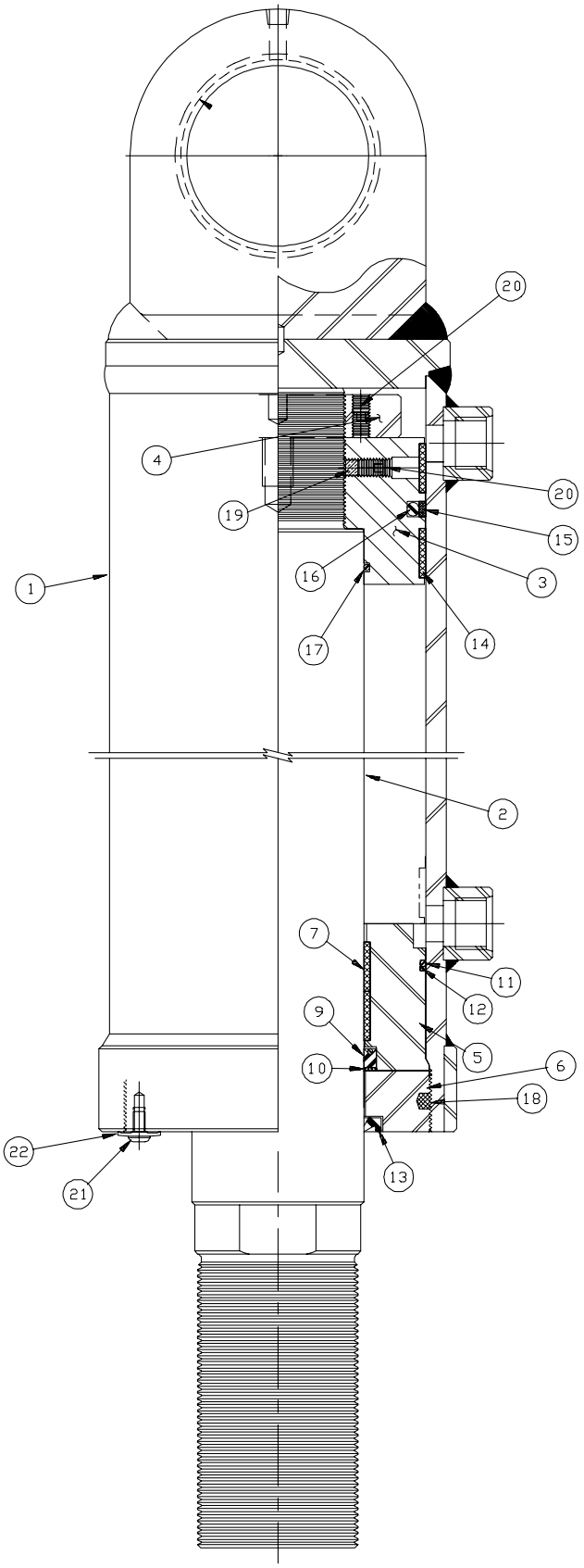
11. Lubricate the cylinder bore and the outside of the piston and bearing assemblies with hydraulic oil compatible with that in the truck's hydraulic system.

12. Using a seal compressor or other suitable tool and



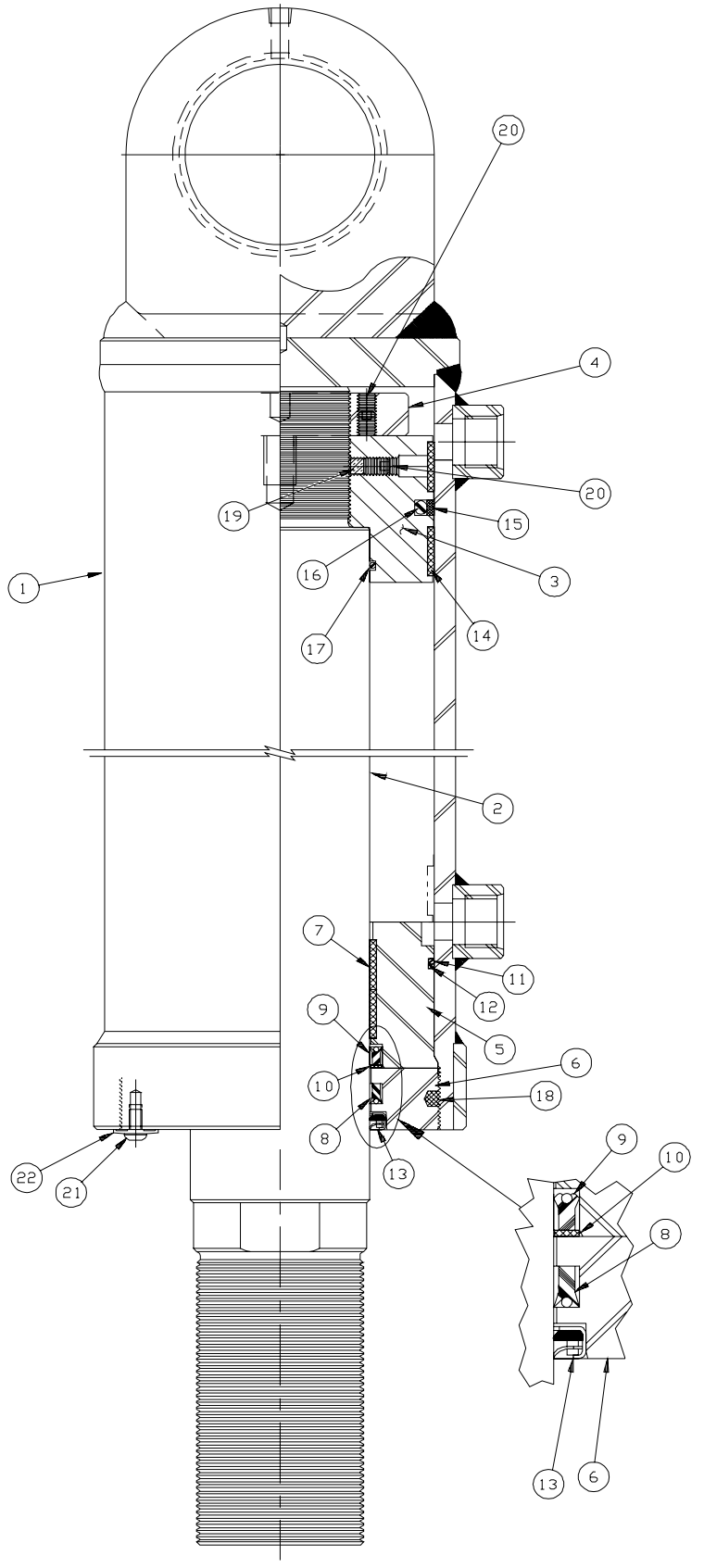
KEY	84092A
01.	Outer Tube Assembly
02.	Piston Rod
03.	Piston
04.	Piston Nut
05.	Bearing
06.	Retainer
07.	Wear Ring
08.	Wear Ring
09.	U-cup Seal
10.	Back-up Ring
11.	O-ring
12.	Back-up Ring
13.	Rod Wiper
14.	Wear Ring
15.	Teflon Piston Seal
16.	Seal Expander
17.	O-ring
18.	Nylon Plug
19.	Bronze Plug
20.	Socket Head Capscrew
21.	Button Head Capscrew
22.	Lockwasher

FIGURE 1A - STEERING CYLINDER ASSEMBLY (PART NUMBER 84092A)



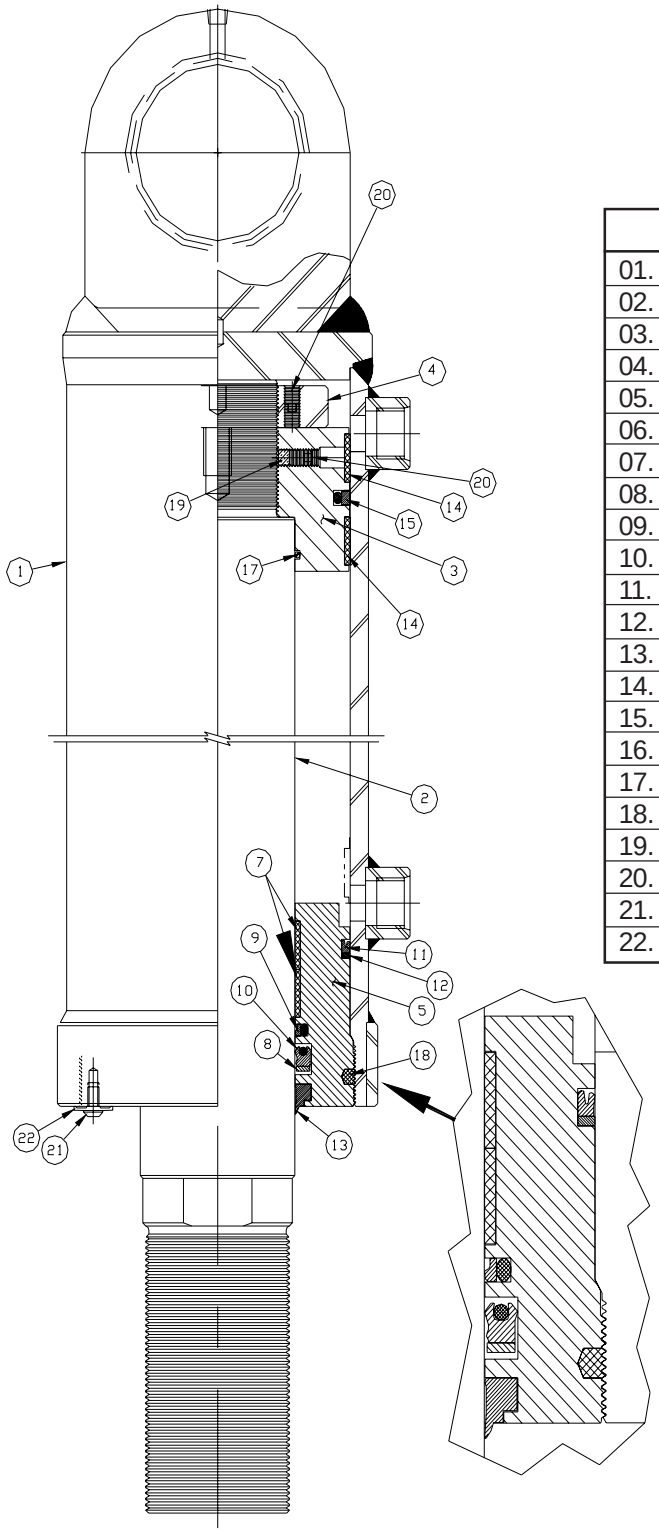
KEY	84092C
01.	Outer Tube Assembly
02.	Piston Rod
03.	Piston
04.	Piston Nut
05.	Bearing
06.	Retainer
07.	Wear Ring
08.	Not Used
09.	U-cup Seal
10.	Back-up Ring
11.	O-ring
12.	Back-up Ring
13.	Rod Wiper
14.	Wear Ring
15.	Teflon Piston Seal
16.	Seal Expander
17.	O-ring
18.	Nylon Plug
19.	Bronze Plug
20.	Socket Head Capscrew
21.	Button Head Capscrew
22.	Lockwasher

FIGURE 1B - STEERING CYLINDER ASSEMBLY (PART NUMBER 84092C)



KEY	84092E
01.	Outer Tube Assembly
02.	Piston Rod
03.	Piston
04.	Piston Nut
05.	Bearing
06.	Retainer
07.	Wear Ring
08.	Secondary Wiper
09.	U-cup Seal
10.	Back-up Ring
11.	O-ring
12.	Back-up Ring
13.	Wiper Scraper
14.	Wear Ring
15.	Teflon Piston Seal
16.	Seal Expander
17.	O-ring
18.	Nylon Plug
19.	Bronze Plug
20.	Socket Head capscrew
21.	Button Head Capscrew
22.	Lockwasher

FIGURE 1C - STEERING CYLINDER ASSEMBLY (PART NUMBER 84092E)



KEY 84092E	
01.	Outer Tube Assembly
02.	Piston Rod
03.	Piston
04.	Piston Nut
05.	Bearing
06.	Not Used
07.	Wear Ring
08.	Secondary Wiper
09.	U-cup Seal
10.	Back-up Ring
11.	O-ring
12.	Back-up Ring
13.	Wiper Scraper
14.	Wear Ring
15.	Teflon Piston Seal
16.	Not Used
17.	O-ring
18.	Nylon Plug
19.	Bronze Plug
20.	Socket Head capscrew
21.	Button Head Capscrew
22.	Lockwasher

FIGURE 1D - STEERING CYLINDER ASSEMBLY (PART NUMBER 84092K)

exercising care not to damage the seals on the threads or other components, carefully install the piston/rod assembly into the tube.

13. Install the secondary wiper seal (8) and wiper scraper seal (13) in the ID of the retainer (5 or 6).

NOTES:
1. This instruction is predominately for P/N 84092E and P/N 84092K cylinders (Figures 1C and 1D). Earlier configurations are installed as shown in Figures 1A and B.
2. On the P/N 84092E and P/N 84092K cylinders (Figures 1C and 1D)
a. Make sure to install item 8 and not item 9. They appear similar, but are different. The seal will not function properly if they are installed in the wrong groove.
3. It is extremely important to have the lip of the secondary wiper seal (8) toward the outside of the cylinder.
4. Install the wiper scraper (13) flush with the edge of the retainer (5 or 6). Do not install into the bottom of the groove.

14. Install the nylon plug into the OD of the retainer (5 or 6).

15. Install the boot assembly (20, 21, and 22) on the cylinder rod (Figure 2).

16. Install the retainer (6) onto the outer tube assembly, tightening until secure. Secure with the button head capscrews (21) and lockwashers (22). Torque to 8 to 12 ft-lb (10 to 16 Nm).

NOTE: *This is not used with the 84092K configuration.*

17. Install the yoke assembly on the rod end as follows: (Figure 2*)*

a. Using an appropriate wrench to keep the piston rod from turning, slowly screw the yoke onto the rod assembly as far as possible.

b. Install and tighten the capscrews (13) and locknuts (14) to secure the locking effect on the yoke assembly.

INSTALLATION (Figures 2 and 3)

The steering cylinders may be installed as follows:

1. Install the cylinder onto the axle with the bearing spacers above and below. Secure in position to allow proper pin installation.

2. Secure the base of the steering cylinder to the axle mounts as follows:

a. On trucks equipped with expander pin assembly (Figure 2):

(1) Lubricate the pin (19) and the expander sleeves (22) with bearing grease to ease installation.

(2) Insert the pin portion of the pin assembly (19) into the bore.

(3) Install the expander sleeves (22) (properly oriented) into the bores and onto the pin.

(4) Install the special expander washers (23) and capscrews (24) onto the upper and lower ends of the pin. Hand tighten each only at this time.

(5) Torque the upper and lower capscrew assemblies in 50 ft-lb (68 Nm) increments to a final torque of 370 ft-lb (500 Nm). This is necessary to maintain an equal clearance between the washers (23) and the mounting lugs on both ends of the pin assembly.

IMPORTANT:
1. The expander washers (23) should never come in contact with the pivot lug. If this does occur, loosen both of the capscrews and repeat the tightening sequence from step (4).
2. If either of the expander washers (23) comes in contact with the lug, the system is out of specification or an incorrect sleeve or component is being used.

NOTE: *A 36 mm socket will be required to tighten the M24 capscrews.*

b. On trucks equipped with conventional pin/nut assembly (Figure 3):

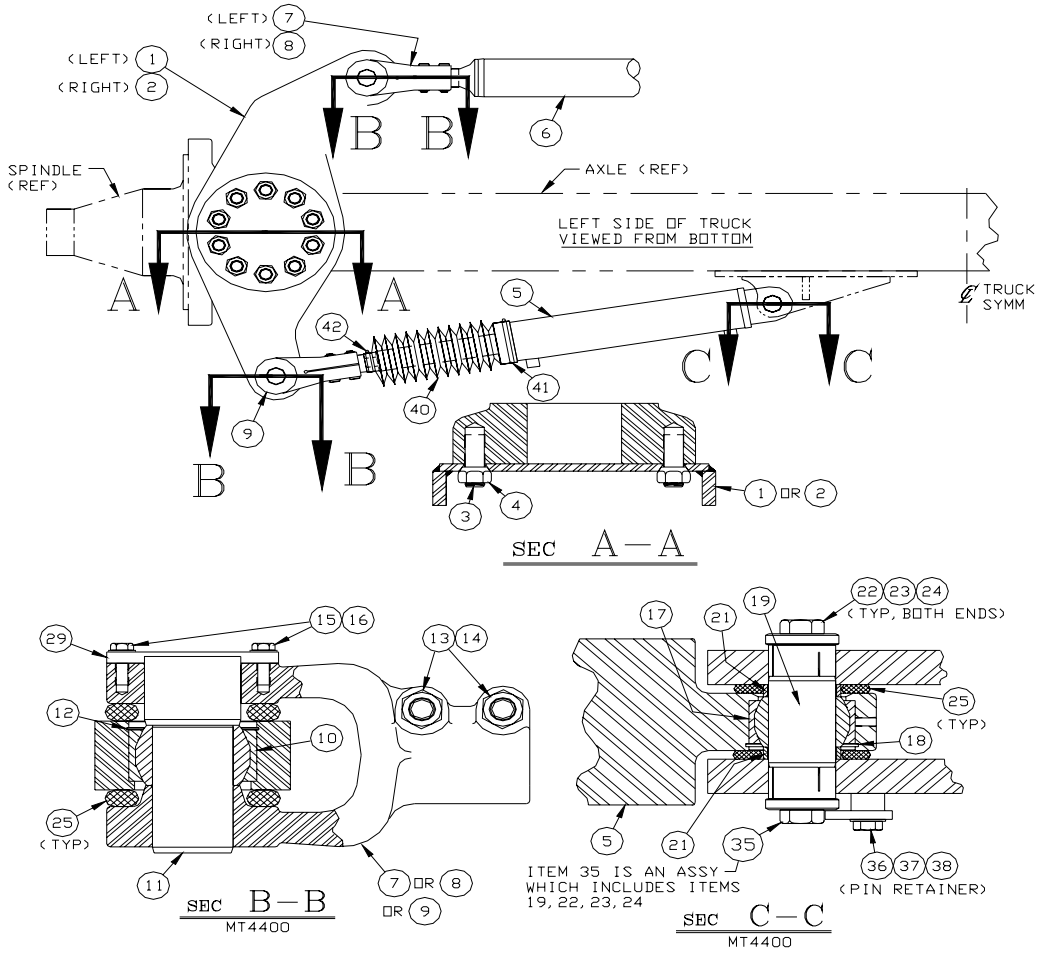
(1) Secure the cylinder assembly to the axle with the steering pin (19), hardened flatwasher (22) and slotted nut (20).

(2) Tighten the nut to secure, but not enough to displace or bend the mounting arms on the axle.

(3) Secure with cotter pin (23) when complete.

3. Install grease seals above and below the bushing.

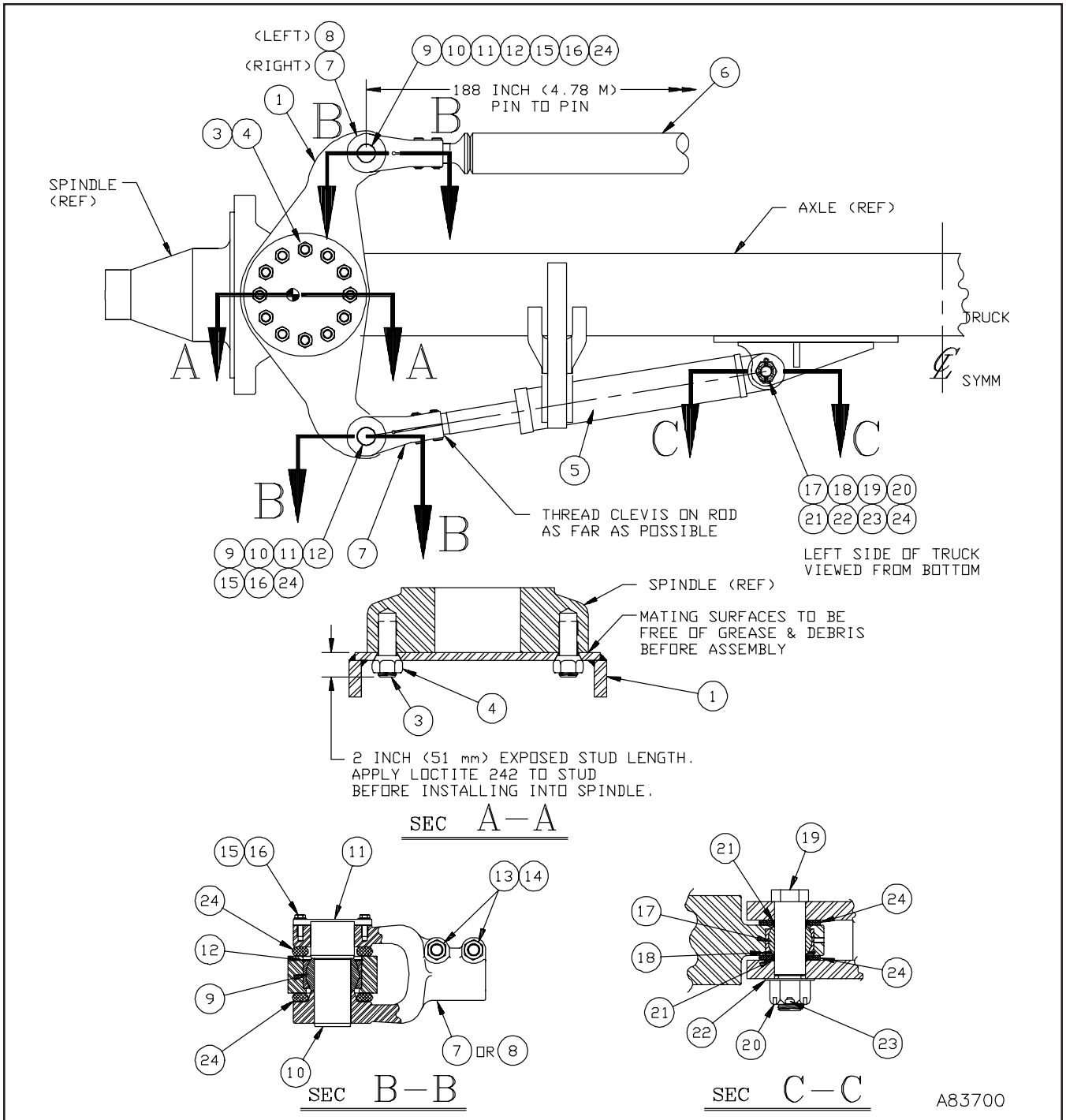
4. Inspect the self-aligning bushing in the steering arm. If worn or damaged, it may be replaced as follows:



KEY MHA86052

01.	Steering Arm	13.	Capscrew	25.	Grease Seal
02.	Steering Arm	14.	Locknut	26.	– 28. Not Used
03.	Stud (Grade 8)	15.	Capscrew	29.	Pin Retainer
04.	Taper Nose Nut (Grade 8)	16.	Hardened Flatwasher	30.	– 34. Not Used
05.	Steering Cylinder	17.	Self-Aligning Bushing	35.	Expander Pin Assembly
06.	Tie Rod	18.	Retaining Ring (Internal)		(Includes items 19, 22, 23, and 24)
07.	Steering Yoke (LH Threads)	19.	Expander Pin	36.	Expander Pin Retainer
08.	Steering Yoke (RH Threads)	20.	Not Used	37.	Flatwasher
09.	Steering Yoke	21.	Bearing Spacer	38.	Capscrew
10.	Self Aligning Bushing	22.	Expander Sleeve	40.	Boot
11.	Expander Pin	23.	Expander Washer	41.	Clamp, Hose
12.	Retaining Ring (Internal)	24.	Capscrew (Metric)	42.	Hose Clamp

FIGURE 2 - STEERING COMPONENT INSTALLATION ASSEMBLY – EXPANDER PIN CONFIGURATION (MHA86052)



KEY					A83700A
1.	STEERING ARM	9.	SELF ALIGNING BUSHING	17.	SELF ALIGNING BUSHING
2.	NOT USED	10.	PIN	18.	RETAINING RING (INTERNAL)
3.	STUD (GRADE 8)	11.	PIN RETAINER	19.	PIN
4.	TAPER NOSE NUT	12.	RETAINING RING (INTERNAL)	20.	SLOTTED NUT
5.	STEERING CYLINDER	13.	CAPSCREW	21.	BEARING SPACER
6.	TIE ROD	14.	LOCKNUT	22.	HARDENED FLATWASHER
7.	STEERING YOKE (R.H. THREADS)	15.	CAPSCREW	23.	COTTER PIN
8.	STEERING YOKE (L.H. THREADS)	16.	HARDENED FLATWASHER	24.	GREASE SEAL

FIGURE 3 - STEERING COMPONENT INSTALLATION ASSEMBLY – STRAIGHT PIN/NUT CONFIGURATION (A83700)

a. Remove the internal retaining ring.

b. Remove the self-aligning bushing assembly by a suitable means.

c. Inspect the condition of the bushing bore in the outer tube assembly. It should be free of damage and in good repair. Remove any burrs or nicks.

d. Install the new bushing assembly, securing with internal snap ring.

5. Install the yoke assembly on the steering arm as follows:

a. Install steering pin, securing with pin retainer. Secure the retainer with capscrews and hardened flatwashers.

b. Install the grease seals above and below the self-aligning bushing.

6. Properly lubricate all steering components before use.

7. Connect all hydraulic hoses and lubrication lines (if so equipped).

8. Bleed entrapped air as outlined under Maintenance and Adjustment in this module.

9. Check the entire system for leaks.

10. Check the front wheel toe-in adjustment as outlined in the instructions in Section 7 - Running Gear in this manual.

11. On trucks equipped with the expander pin assembly:

a. Recheck the upper and lower capscrew torque. Retorque if required.

IMPORTANT: *This retorque is an essential part of the installation.*

b. Install the pin retainer (36), secured with capscrew (38) and flatwasher (37) on the bottom of the pin assembly. The retainer should be as close as possible to the capscrew.

STEERING MANIFOLD ASSEMBLY

DESCRIPTION AND LOCATION

The steering manifold assembly is a rectangular shaped metal valve with several external poppets and multiple hose connection ports. It is generally mounted on a bracket above the steering hydraulic filter.

NOTE: *In later production manifolds, a flow control valve has been installed that regulates the flow to the venturi in the brake return line to reduce the back pressure in that line. On early production manifolds this provision was externally mounted separately.*

OPERATION

The steering manifold serves as a centralized assembly to provide the following provisions:

1. Accumulator drain solenoid - electric solenoid cartridge that automatically causes the remaining hydraulic pressure in the steering accumulator to be released when the Master Switch is switched Off.

2. Manual accumulator drain - cartridge assembly which contains a manual pull-type valve, spring loaded to the closed position that provides a means of manually releasing any pressure remaining in the steering accumulators.

3. Low steering pressure switch - electric switch assembly that monitors the system supply pressure (accumulator pressure) and causes a cab dash Low Steering Pressure indicator to light.

4. Manual power supply pressure switch - electric switch assembly that monitors the system supply pressure (accumulator pressure) and controls the automatic operation of the available manual power supply system's 24 Vdc pump assembly.

5. High pressure or "Clippard" relief valve - mechanical relief valve designed to reduce high pressure surges in the accumulator supply system.

6. Flow control cartridge (where so equipped) - controls the flow of oil through the brake return venturi system to regulate the pressure reduction function of the system.

There are several ports in the manifold including:

1. Steering system (LSP) port - mounting port for the Low Steering Pressure switch.

2. Flow restriction (FR) port (where applicable) - outlet source from the flow control cartridge in the manifold (when installed).

3. Pressure (P) port - inlet source of pressure from the pump filter assembly.

4. Test steering supply (TSP) port - provides a test port location for the steering supply system.

5. Power supply (PS) port - inlet source from the manual power supply assembly.

6. Manual power supply switch (MSP) port - mounting port for the switch that controls the automatic functions of the available manual power supply system.

7. Brake system supply (BRK) port - outlet port to supply pressurized fluid flow to the brake system through the brake manifold.

8. Steering system (TSR) port - outlet port to supply pressure to the flow amplifier valve.

9. Test steering accumulator (TSA) port - outlet port to the pressure gauge in the superstructure mounted hydraulic component box.

10. Accumulator (A1 and A2) ports - outlet ports to the steering accumulators.

11. Tank (T) port - outlet port returning the oil to the reservoir tank.

Pressurized hydraulic oil from the steering pump enters the manifold through the P port. The high pressure (or "clippard") relief valve reduces the pressure surges in the system. Typically these are the result of changes in the outlet flow from the variable displacement, pressure-compensating piston steering pump.

When the truck's Master Switch is turned off, the oil pressure stored in the steering accumulators is allowed to drain back to the hydraulic reservoirs through the accumulator drain solenoid cartridge. A cab mounted delay timer maintains the required 24 Vdc power to the solenoid for a preset period of time to allow the accumulators to drain fully. An orifice is installed to minimize pressure surges in the system during this drain operation.

On later production manifolds, the brake return venturi flow control valve was incorporated into the manifold.

Previously it was installed on its own manifold assembly.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the manifold should include the following:

1. Inspect the valve for evidence of leakage or damage. Repair or replace as required.

2. Test the operation of the functions of the manifold as outlined in the instructions for the dump, steering, and brake systems in Section 5 - Hydraulic System.

REMOVAL

The manifold may be removed from the truck as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Drain all pressure in the system as outlined in the procedures on system operation and testing in Section 5 - Hydraulic System. This includes both the steering and brake system accumulators.

⚠WARNING

Always release all hydraulic pressure in the system before loosening or removing any hydraulic lines.

3. Disconnect all hydraulic fittings from the valve. Cap or plug all openings. Label each to aid in installation.

4. Remove the capscrews that secure the valve to the mounting bracket.

5. Remove the valve.

DISASSEMBLY (Figures 1 and 2)

The manifold may be disassembled as follows:

NOTES:

1. During the disassembly and repair procedures, it is always a recommended practice to carefully note the specific installation and orientation of components before and as they are removed to aid in proper reassembly.
2. Item numbers are the same on both versions unless otherwise noted.

1. Remove check valve cartridge (4).

2. Remove the accumulator drain solenoid cartridge (2) and orifice disk (6, Figure 1).

3. Remove the relief valve cartridge (3)

4. Remove the flow control cartridge (5, Figure 1)

5. Remove the O-ring plugs using care to note the location from which they were removed to aid in the reassembly.

INSPECTION AND REPAIR

The manifold components may be serviced as follows:

1. Inspect, then remove and discard all of the previously used O-rings that have replacements included in the new seal kit. Evidence of damage to the ring should be investigated for cause as it may indicate problems in other areas. It is recommended that all O-rings and seal be replaced each time removed to ensure proper valve sealing and operation.

2. Clean all parts thoroughly with clean solvent and dry with compressed air. Do not use rags or solvents that will leave a residue.

3. Remove any indicated burrs or high spots from any surfaces. Re-clean if required.

4. Inspect the valve body and all other components for evidence of wear or damage. Particular attention should be paid to the bores, mating surfaces, and thread areas. If found to be significant the assembly must be replaced.

5. Test the operation of all solenoid valves by carefully applying 24 Vdc power and ground to the appropriate coil leads. Repair or replace as required. Torque the coils to 4 to 6 ft-lbs. (5 to 8 Nm).

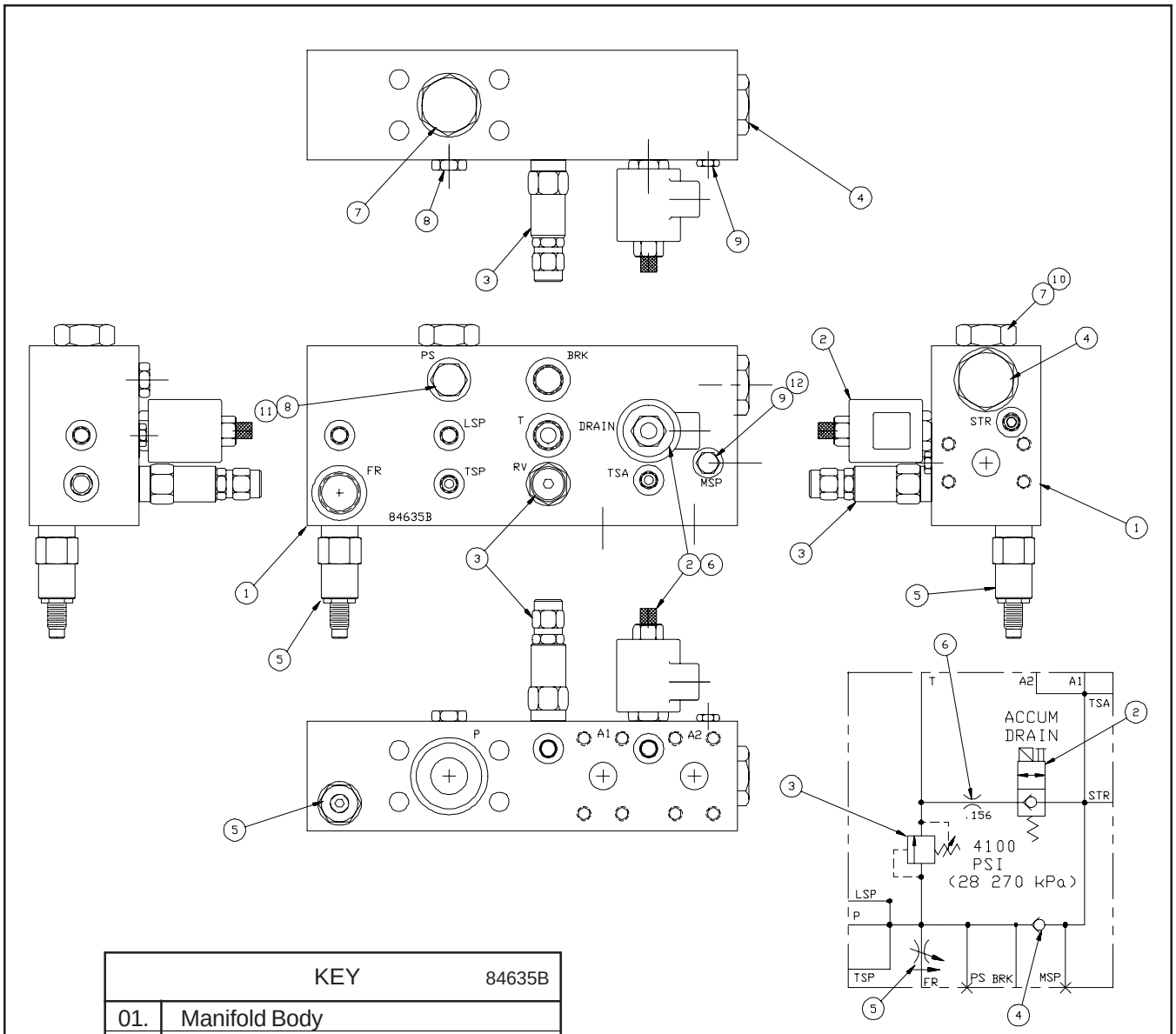
NOTE: *Inspect the electrical connectors for evidence of corrosion or damage. Clean, repair, or replace as required.*

ASSEMBLY (Figures 1 and 2 except where indicated)

The manifold may be assembled as follows:

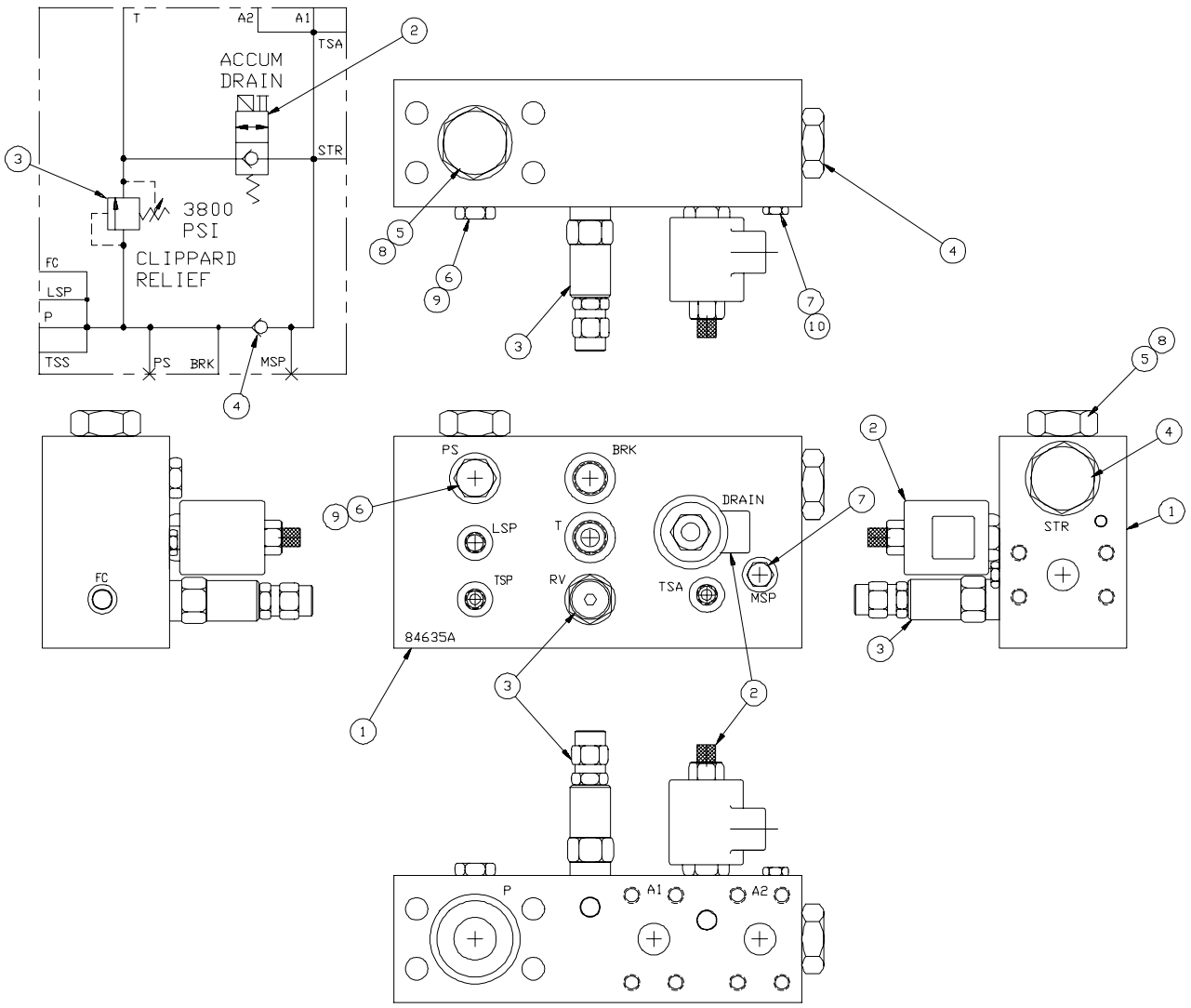
NOTE: *Item numbers are the same on both versions unless otherwise noted.*

1. Check that all parts are clean and free of defects.



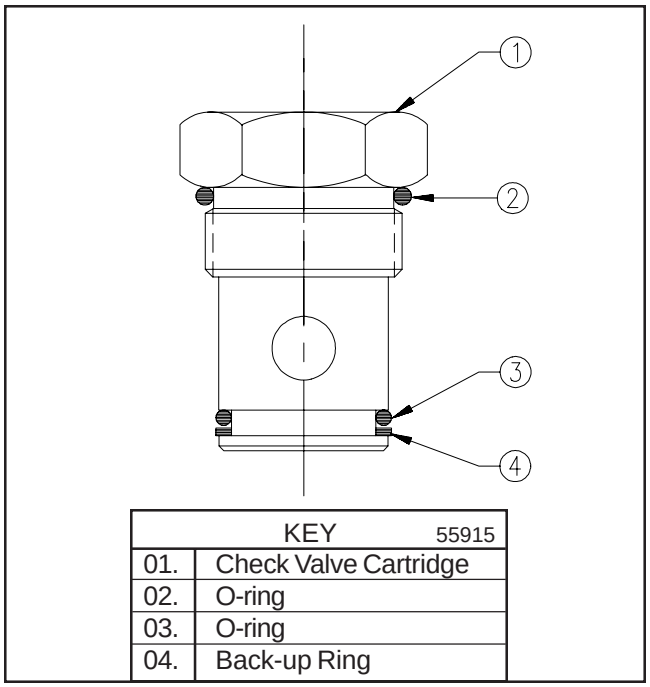
KEY	84635B
01.	Manifold Body
02.	Solenoid Cartridge Valve Assembly
03.	Relief Cartridge Valve Assembly
04.	Check Valve Cartridge Assembly
05.	Flow Control Cartridge Assembly
06.	Orifice Disc (0.156 inch)
07.	#16 O-ring Boss Plug
08.	#8 O-ring Boss Plug
09.	#4 O-ring Boss Plug
10.	#16 O-ring
11.	#8 O-ring
12.	#4 O-ring

FIGURE 1 - STEERING MANIFOLD ASSEMBLY
- LATER PRODUCTION WITH THE INTEGRAL FLOW CONTROL VALVE



KEY	84635A
01.	Manifold Body
02.	Solenoid Cartridge Valve Assembly
03.	Relief Cartridge Valve Assembly
04.	Check Valve Cartridge Assembly
05.	#16 O-ring Boss Plug
06.	#8 O-ring Boss Plug
07.	#4 O-ring Boss Plug
08.	#16 O-ring
09.	#8 O-ring
10.	#4 O-ring

FIGURE 2 - STEERING MANIFOLD ASSEMBLY
- EARLIER PRODUCTION WITHOUT THE INTEGRAL FLOW CONTROL VALVE



KEY 55915	
01.	Check Valve Cartridge
02.	O-ring
03.	O-ring
04.	Back-up Ring

FIGURE 3 - CHECK VALVE CARTRIDGE ASSEMBLY

2. Install the O-rings and back-up rings on all components as shown in the applicable illustrations (Figures 3 through 6).

3. Lubricate all O-rings and bores and threads in the valve body with clean hydraulic fluid compatible with that used in the truck's hydraulic system.

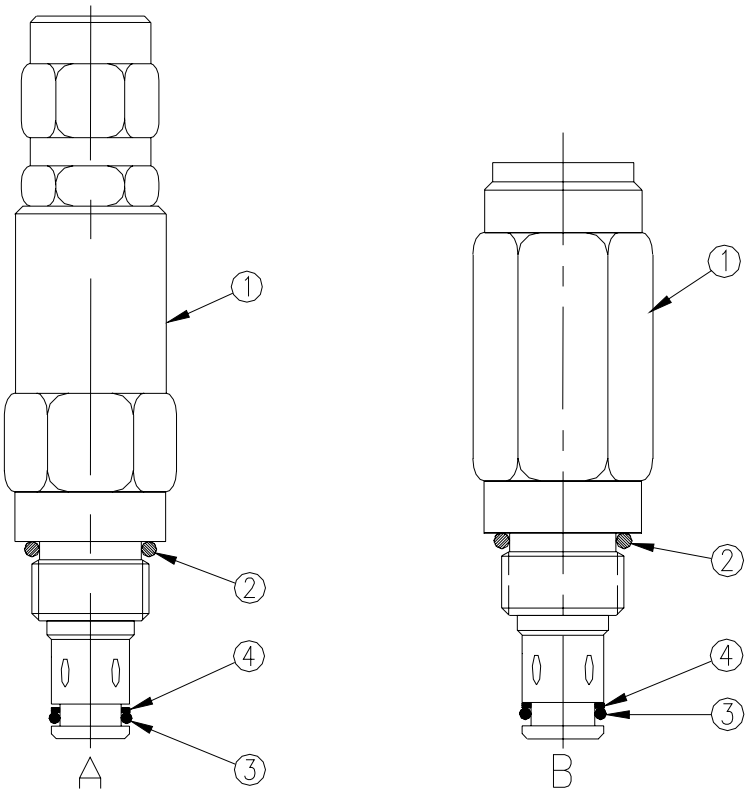
4. Install the O-ring plugs and torque as outlined in the procedures in Section 10 - Miscellaneous.

5. Install the large orifice disk and accumulator drain solenoid cartridge (2). Torque the cartridge to 25 ft-lb (35 Nm).

6. Install the check valve cartridge (4). Torque the cartridge to 50 ft-lb (70 Nm).

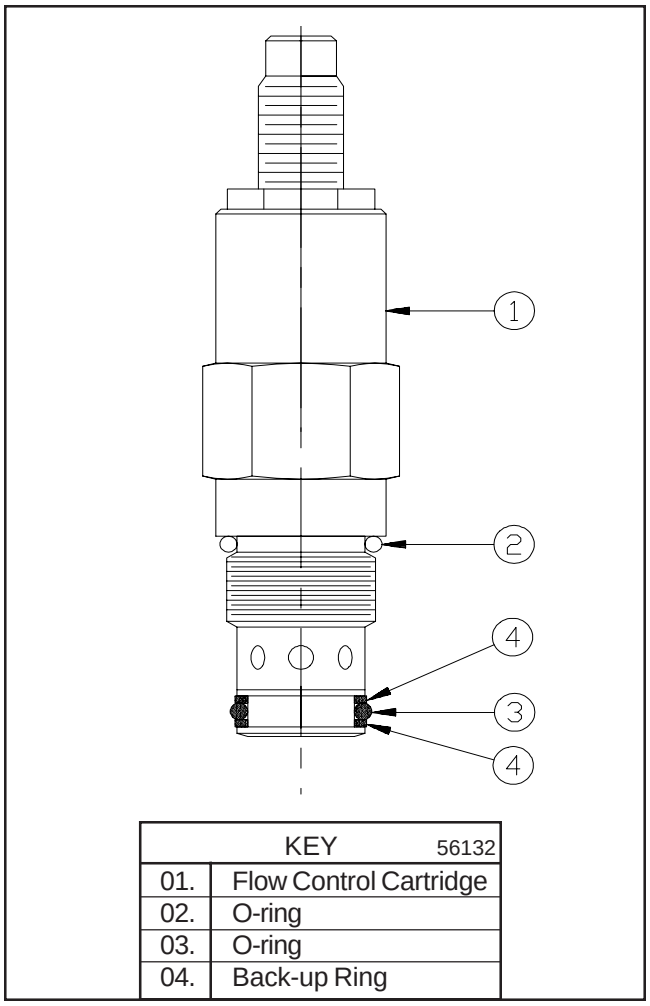
7. Install the relief valve cartridge (3). Torque the cartridge to 20 ft-lb (27 Nm).

KEY 55914	
01.	Relief Valve Cartridge
02.	O-ring
03.	O-ring
04.	Back-up Ring



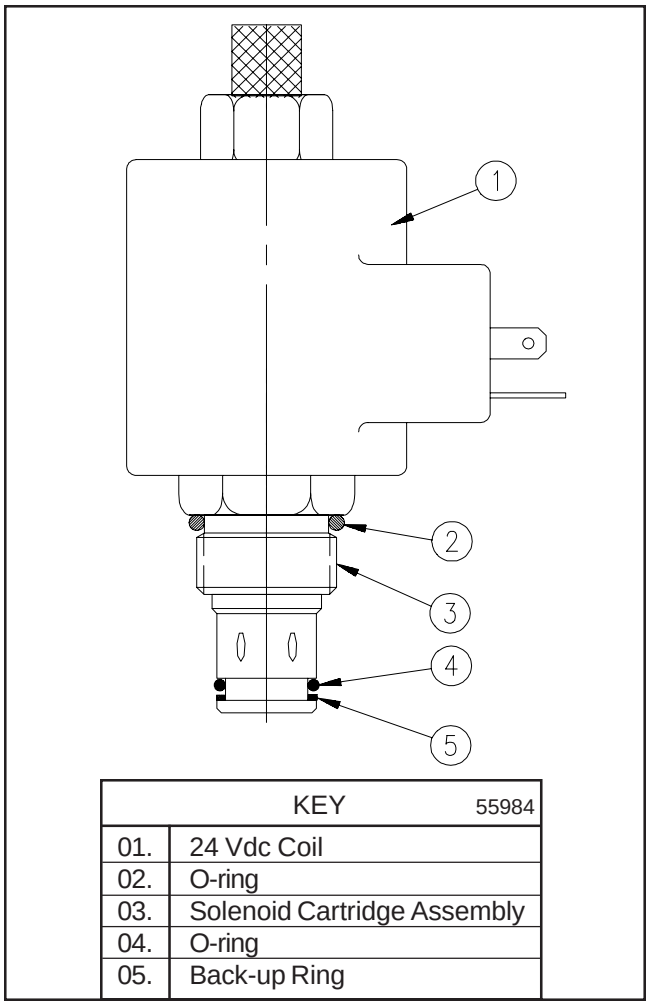
NOTE: Either **A** or **B** version is acceptable.

FIGURE 4 - RELIEF VALVE CARTRIDGE ASSEMBLY



KEY	56132
01.	Flow Control Cartridge
02.	O-ring
03.	O-ring
04.	Back-up Ring

FIGURE 5 - FLOW CONTROL VALVE CARTRIDGE ASSEMBLY



KEY	55984
01.	24 Vdc Coil
02.	O-ring
03.	Solenoid Cartridge Assembly
04.	O-ring
05.	Back-up Ring

FIGURE 6 - ACCUMULATOR DRAIN SOLENOID VALVE CARTRIDGE ASSEMBLY

8. Install the flow control valve cartridge (5, Figure 1) (where equipped). Torque the cartridge to 20 ft-lb (27 Nm).

9. Install caps on all open ports.

INSTALLATION

The manifold may be installed as follows:

1. Install the valve on the mounting brackets. Secure with the appropriate capscrews and related hardware.

2. Connect all hydraulic lines and electrical wires. Torque each connection as outlined in the instructions in Section 10 - Miscellaneous.

NOTE: *Use RTV to seal the electrical connectors to prevent moisture from entering.*

3. Bleed and test all systems as outlined in the procedures for the dump, steering, and brake systems in Section 5 - Hydraulic System.

NOTE: *Entrapped air should be bled from all three systems.*

MANUAL POWER SUPPLY PUMP

DESCRIPTION AND LOCATION

The manual power supply pump is a 24 Vdc electrically operated (motored) hydraulic gear pump. It is typically mounted on the top of the hydraulic pump mounting bracket, inside the frame rails and behind the main traction alternator.

OPERATION

The manual power supply pump is designed to provide flow to the steering and brake systems in place of the main engine driven steering pump if the pump is unable maintain the operating pressure levels in the accumulators. If this condition develops, the electric motors are either manually (using the manual switch) or automatically (pressure switch interlocked through the Shifter) energized, powering the hydraulic pumps.

NOTE: *This supply of pressurized oil for auxiliary steering and braking (for control in the event of the loss of flow while the truck is moving) is from the accumulators in each system. The Manual Power Supply System is designed to partially recharge the accumulators to allow for limited steering and braking as in towing or during maintenance.*

Oil enters the pump from a line direct from the hydraulic reservoir, independent of the main engine driven pumps, with only a coarse suction screen included to minimize ingestion of large contaminants. Inside the pump the oil enters the inlet chamber and is pressurized by the movement of the gears. It then exits through the outlet chamber and port, passing through an integral relief valve (limiting maximum pressures) and independent check valves (which prevent back flow when the pump is not in use). It then is routed to the steering system manifold for distribution to the steering and brake systems.

NOTE: *There are two separate pump assemblies outlined in these procedures:*
1. The early version incorporated a self-contained relief valve assembly.
2. The later version is identified by a cartridge relief valve mounted in separate block assembly on the hydraulic pump assembly.
Always determine the version being worked on before servicing this component.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following:

1. Clean all dirt and other contaminants from the assembly.

2. Inspect for evidence of leakage, wear, or damage to the pump or related components. Especially inspect the condition of the motor brushes, commutator, and related parts. Repair or replace as required.

3. Check the operation of the pump both manually and automatically as outlined in the test instructions in Section 5 - Hydraulic System.

REMOVAL (Figure 2)

The pump may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Stop the hydraulic fluid supply at the reservoir.

3. Disconnect the 24 Vdc power source from the batteries.

4. Disconnect the hydraulic lines to the pumps. Cap or plug all openings. Label each to aid in installation.

⚠WARNING

Release all hydraulic pressure from the system before loosening or removing any lines.

5. Remove any remaining cables or hoses.

6. Remove the capscrews securing the pump to the mount.

7. Remove the pump assembly.

DISASSEMBY (Figures 1A, B and C)

Prior to beginning disassembly of the pump:

NOTE: *There are two separate pump assemblies outlined in these procedures:*
1. The early version incorporated a self-contained relief valve assembly.
2. The later version is identified by a cartridge relief valve mounted in separate block assembly on the hydraulic

pump assembly.
Always determine the version being worked on before servicing this component.

1. Clean the work area of dirt, grease, foreign material or other items that might contaminate the pump.

2. Clean the unit thoroughly with a solvent. Remove all sharp edges from splines, drill points, keyways and end of shaft. Mark the adapter and cover/housing sections to ensure correct reassembly.

3. To aid in disassembly and reassembly, the pump should be retained in some manner. For example, a steel plate bolted to and extending over the edge of a work bench will suffice. The plate should have a hole large enough for the adapter flange pilot to drop through and two holes in the adapter flange. The pump can now be firmly fixed to the plate by bolts. This is especially helpful in removal and installation and checking of the torque of capscrews.

The earlier version pump may be disassembled as follows: (Figure 1A)

1. Remove the capscrews and lockwashers securing the hydraulic pump section to the electric motor and separate.

⚠ CAUTION

Do not attempt to pry the pumps apart with a screwdriver or other means. They should be separated by tapping with a soft-faced hammer.

2. Remove the capscrews (2 and 3) and lockwashers (4 and 5) securing the sections of the pump together.

3. Separate the housing cover (6), gear plate (9), and body assembly (15) by one of the following methods:

a. Use a gear puller.

b. Remove the two capscrews 180° apart, leaving the two engaged approximately three or four threads. Lay the pump on its side and tap the capscrews with a soft head hammer until the housing and adapter separate. Remove the capscrews.

⚠ CAUTION

Do not attempt to pry sections apart with a screwdriver or similar tool, as such action can damage machined sealing surfaces.

NOTE: *Make an index mark before removal to ensure that during reassembly the gears will be in the same position.*

IMPORTANT: *Separate and identify each of the components as removed so that they can be reinstalled in the same location if reused during assembly.*

4. Remove the square key (18) from the driveshaft (17).

5. Remove the drive and driven or idler gear assemblies from the pump assembly.

6. Remove capscrew (26) and plate (25).

7. Remove the seal (24) and O-ring (22).

8. Remove the retaining rings (19), washers (20), and ball bearing (21) from the driveshaft (17).

9. If required, remove the drive gear (12) and woodruff key (13) from the driveshaft (17).

10. If required, remove the retainer rings (10), idler gear (11), and woodruff key (13) from the idler shaft (14).

11. Remove the needle bearing (16) from the body assembly (15) using a suitable puller.

12. Remove the needle bearings (7) from the cover assembly using a suitable puller.

The later version pump may be disassembled as follows: (Figures 1B and C)

1. Remove the nuts and washers securing the electric motor (1, Figure 1B) and hydraulic pump (2, Figure 1C) sections.

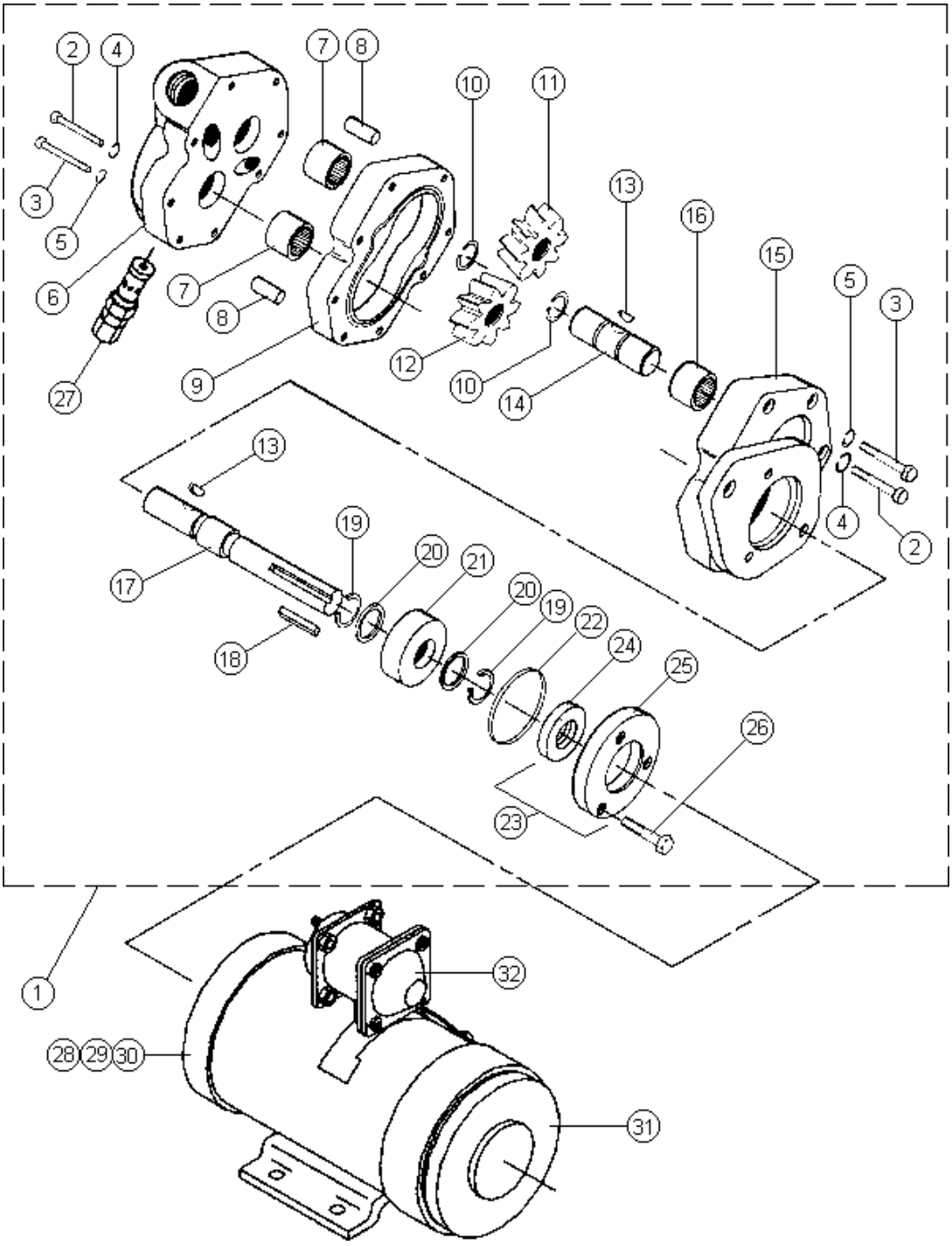
2. Carefully separate the two pump sections, making sure that the splined shafts and couplers are not damaged.

⚠ CAUTION

Do not attempt to pry the pumps apart with a screwdriver or other means. They should be separated by tapping with a soft-faced hammer.

NOTE: *The remaining steps reference Figure 1C unless otherwise indicated.*

3. With a grease pencil, ink marker or other suitable marking tool, mark each housing cover on the parting



KEY 51049

01.	Hydraulic Pump Assembly	09.	Gear Plate	17.	Driveshaft	25.	Plate
02.	Capscrew	10.	Retaining Ring	18.	Square Key	26.	Capscrew
03.	Capscrew	11.	Idler Gear	19.	Retaining Ring	27.	Relief Valve
04.	Lockwasher	12.	Drive Gear	20.	Washer	28.	Adapter Plate
05.	Lockwasher	13.	Woodruff Key	21.	Ball Bearing	29.	Capscrew
06.	Cover Assembly	14.	Idler Shaft	22.	O-ring	30.	Lockwasher
07.	Needle Bearing	15.	Body Assembly	23.	Pilot Plate Assembly	31.	Pump Motor
08.	Dowel Pin	16.	Needle Bearing	24.	Seal	32.	Motor Solenoid

FIGURE 1A - EARLIER VERSION MANUAL POWER SUPPLY PUMP ASSEMBLY

line in a manner that will allow for reassembly in the same position.

NOTE: *These marks will be used to assist in matching parts for reassembly of the pumps.*

4. Clamp the pump assembly in a vise with the shaft end up.

NOTE: *Use clean wooden blocks or other soft material to protect the machined surfaces (particularly the port faces) from damage.*

5. Clean the driveshaft extension and remove any burrs or other damage. This will prevent damage to the seal lips.

6. Remove the capscrews (5) and washers (12) securing flange (1) to the pump body assembly.

7. Remove the flange (1). If the flange does not move easily, use a plastic hammer or wooden mallet and tap the edges of the flange with a plastic hammer to loosen it.

8. Grasp and lift the drive gear shaft (3) to dislodge the top pressure plate (6) with it while holding the pressure plate face against the gear with your fingers.

NOTE: *If the pressure plate hangs during removal, do not force or bend the plate. Tap lightly with a plastic hammer to drive the plate back down into position and start the removal process over.*

9. After noting the installation and orientation, remove the pressure plate from the drive gear. Inspect and discard the seal strips and back up rings.

NOTE: *Lift the plates straight up off of the shaft.*

NOTE: *When disassembling the pump sections, the parts should be laid out in a group and in the same order removed.*

10. Lift the idler gear (4) straight up out of the bore of the body.

11. Remove the bottom pressure plate (7) as follows:

a. Insert an expandable bearing puller into the shaft bore of the plate.

b. Tighten until it is secure on the plate.

c. Apply a light forward and back force to the puller handle and dislodge the plate.

NOTE: *If a bearing puller is not available:*
1. Grind a screwdriver shape on the short end of an Allen wrench.
2. Insert the ground end of the wrench into the shaft bore and lift the plate up.
3. Move the wrench to the opposite bore of the plate and lift up.
4. Repeat this action until the plate has been dislodged.

d. Grasping through the boreholes, lift the plate straight up and out.

NOTE: *Use extreme care in removing the plate. Do not pry or attempt to force it out. If the plate binds in place, move it up and down until it is free, and then lift it out.*

12. Inspect and remove all remaining seals and components.

INSPECTION AND REPAIR

The pump may be serviced as follows:

1. Clean all metal parts in solvent and dry with compressed air. Inspect for evidence of wear, damage, or leakage. Repair or replace as required.

2. Discard any seal plates with score marks, heavy wear pattern, or that show erosion marks.

3. Discard the gear assemblies if:

a. The shaft journals show excessive wear or pitting.

b. The gear teeth show excessive wear.

c. The gear face is scored or cracked.

d. The driveshaft splines or keyways are badly worn.

e. The width of the gears is worn down more than 0.020 inch (0.5 mm).

4. Measure the clearance between the gear housing and gear teeth. This cover/housing and/or gear should be replaced if the clearance exceeds 0.010 inch (0.25 mm).

5. Visually examine the bearings for evidence of spalling of the rollers and fracture of the stamped cages. Check

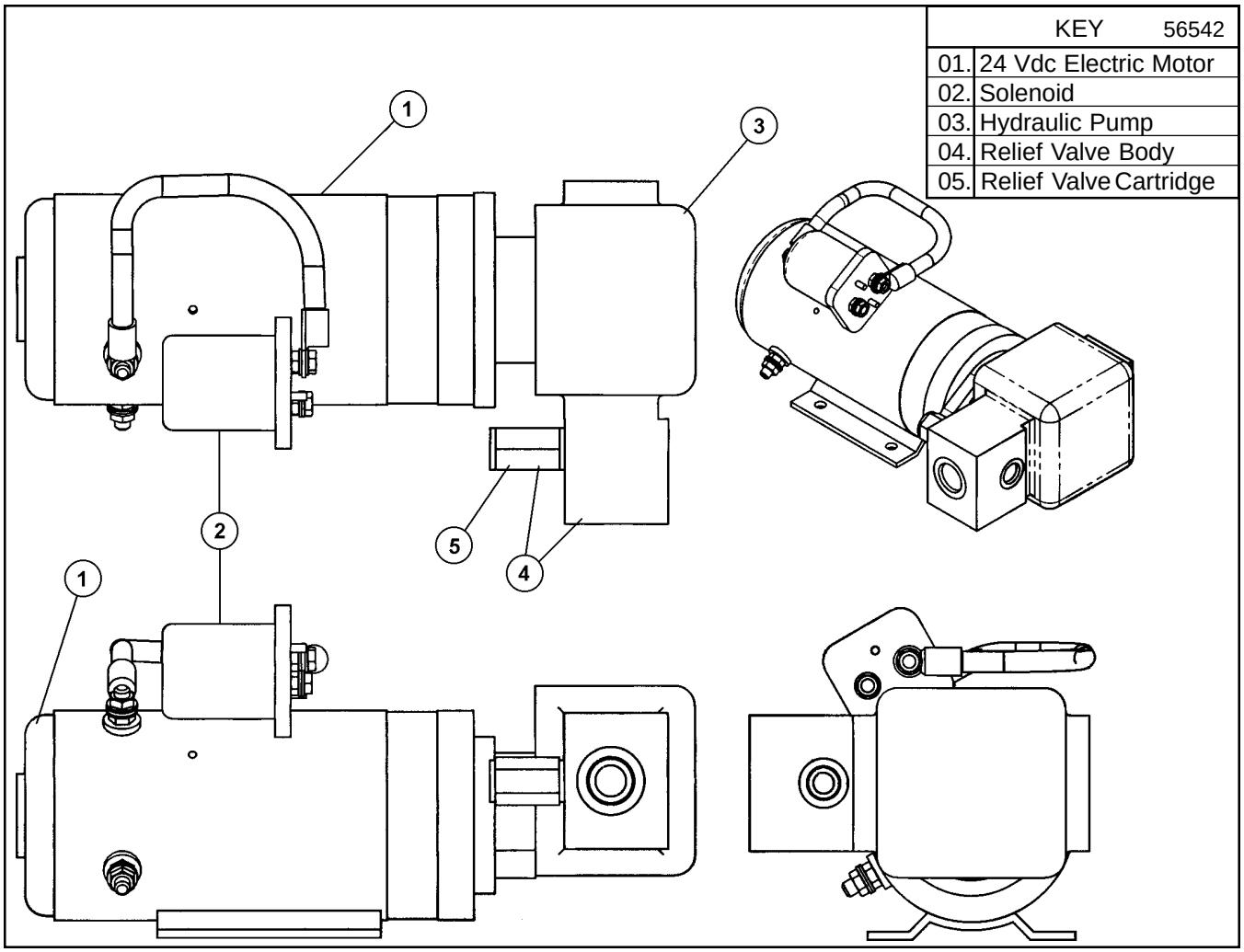


FIGURE 1B – LATER VERSION MANUAL POWER SUPPLY PUMP ASSEMBLY

the roughness of the outer race by sliding the rollers around the periphery of the cage. Any of these defects would be reason for replacement. The bearings should all be replaced at the same time.

6. Remove and inspect the relief valve assembly from the cover or block assembly assembly. Replace if rebuilding the pump assembly.

ASSEMBLY

The earlier version pump may be assembled as follows: (Figure 1A)

1. Install the needle bearings (7) into the cover assembly using a suitable press or driver.

2. Install the needle bearing (16) into the body assembly (15) using a suitable press or driver.

3. If removed, install the retainer rings (10), idler gear (11), and woodruff key (13) onto the idler shaft (14).

4. If removed, install the drive gear (12) and woodruff key (13) onto the driveshaft (17).

5. Install the retaining rings (19), washers (20), and ball bearing (21) onto the driveshaft (17).

6. Install the seal (24) and O-ring (22).

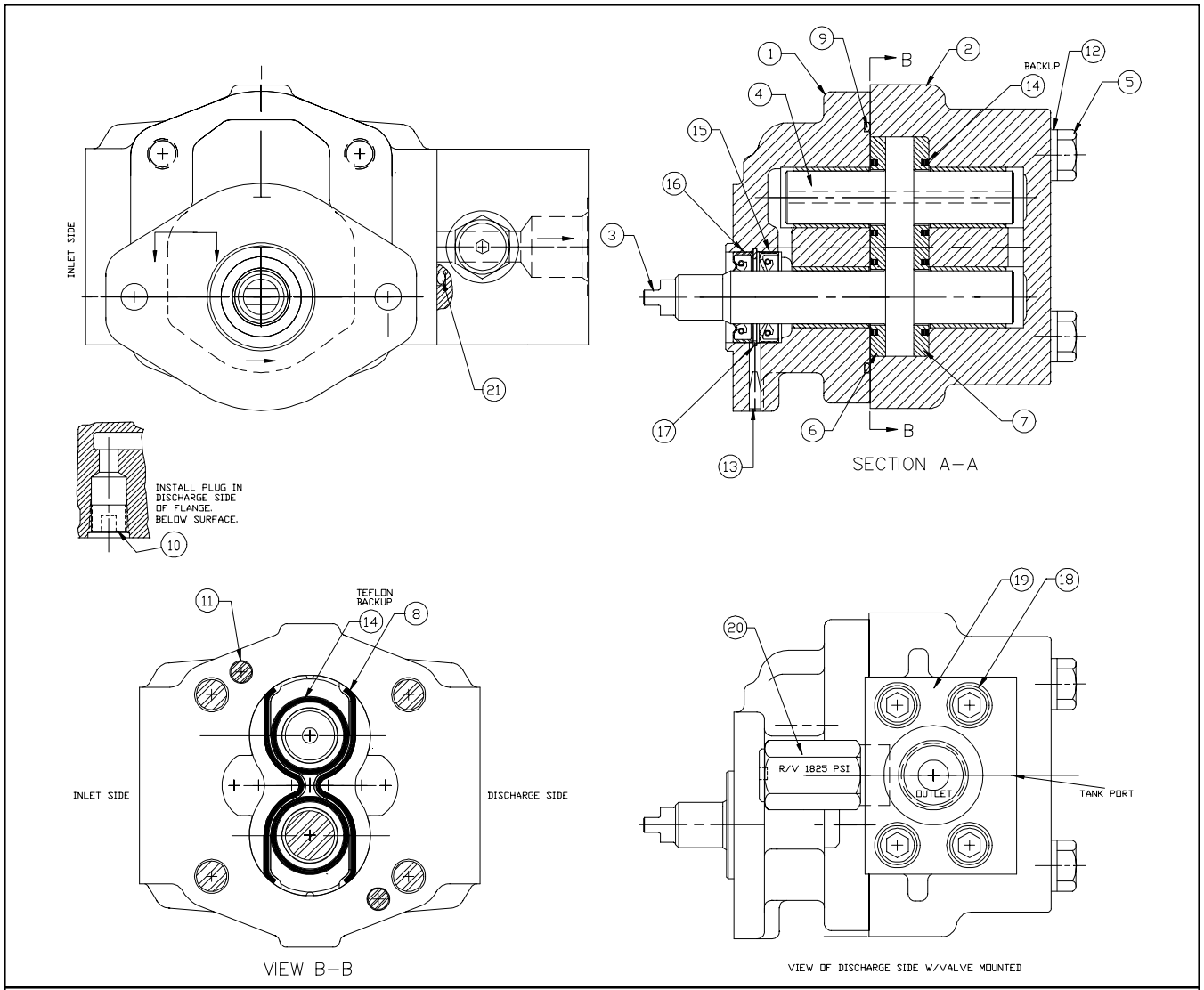
7. Install capscrew (26) and plate (25).

8. Install the drive and driven or idler gear assemblies into the pump assembly.

NOTE: *When the original gears are reused, make sure to align the index marks made during disassembly.*

9. Install the square key (18) onto the driveshaft (17).

10. Align and assemble the housing cover (6), gear



KEY					2003766
01.	Flange	08.	Sealing Strip	15.	Seal
02.	Body	09.	O-ring	16.	Seal
03.	Drive Gear	10.	Plug	17.	Snap Ring
04.	Idler Gear	11.	Dowels	18.	Capscrew
05.	Capscrews	12.	Washer	19.	Relief Valve Block
06.	Top Pressure Plate	13.	Plug	20.	Relief Valve Cartridge
07.	Bottom Pressure Plate	14.	Teflon Back-up Ring	21.	O-ring

FIGURE 1C - HYDRAULIC PUMP ON LATER VERSION ASSEMBLY

plate (9), and body assembly (15).
Secure together with capscrews (2 and 3) and lockwashers (4 and 5).

11. Install the relief valve assembly (27).

12. Mate and secure the hydraulic pump to the electric motor assembly.

The later version manual power supply pumps may be assembled as follows: (Figure 1C)

IMPORTANT:

1. Prior to reassembly, all parts should be deburred by sanding or stoning; washed in a solvent, wiped with a clean lint free cloth and, if available, dried with compressed air.

2. All seals should be replaced each time the pump is assembled.

1. Verify that all parts are clean and dry.

2. Place the body (2) installed on the work area, oriented so that the matching marks made during disassembly are facing you.

NOTES:
1. If new components are being installed, make sure that the side facing you is the same as the side marked on the old component.
2. Observe that the body has a wide and a narrow boss. The side having the wide boss is always the suction side.

3. Coat the inner bore of the body with clean hydraulic oil compatible with that in the truck's hydraulic system.

4. Install the bottom pressure plate (7) in the suction side in the bottom of the body with the rounded edge down.

NOTE: *There is a difference in the pressure plates. The one for this location has the radius on the outer edge that mates with the bottom of the gear bore.*

5. Install the new pressure balance seal strips (8) into the grooves in the back of the plates, using heavy grease to hold in place. Install the Teflon back up rings (14) as shown.

6. With the bronze side facing up and the rounded trap slots toward the discharge side of the body, slide the pressure plate (7) down into the gear bores until it rests firmly on the bottom of the pump body.

NOTE: *Do not force the plate down the gear bores. If the plate binds on the way down, move it back and forth carefully until it slides freely into position.*

7. Coat the drive gear (3) with clean hydraulic oil compatible with that in the truck's hydraulic system.

8. With the long splined end up, install the drive gear (3) into the bore nearest the mark that was made during disassembly.

9. Coat the idler gear (4) with clean hydraulic oil compatible with that in the truck's hydraulic system.

10. Install the idler gear (4) in the bore opposite the drive gear.

11. Install the dowels (11) in the body if removed.

12. Install the top pressure plate (6) with the grooves up.

IMPORTANT: *The pumps have a trap relief on the surface facing the gear. The plate should be assembled so that the trap is off-centered toward the outlet or discharge port side of the pump.*

13. Install the pressure balance seal strips (8) and Teflon back up rings (14) in the plate as outlined previously.

14. Lubricate the threads on the capscrews (5) and install with washers (12) into the body (2).

15. Install the seals (15 and 16) secured by the snap ring (17) into the body.

16. Install the mating O-ring (9) in the surface groove on the flange plate. Use clean, heavy grease to secure it in the groove temporarily.

17. Coat the splines on the driveshaft extension with heavy grease.

NOTE: *This is to prevent damage to the seal lips as the flange plate and seals are installed. Check the driveshaft for sharp edges. If necessary, use a seal guide or tape to protect the seal lips.*

18. With the O-ring in the flange plate facing down, slide the flange plate (1) down over the studs and shafts until the plate makes contact with the pump body.

19. Tap gently into place with a plastic hammer or wooden mallet.

IMPORTANT: *If the flange stops the flange may have caught the pressure balance strips. Do not force into position. Lift the flange and position the seal strips away from the journal using a small screwdriver in the middle and ends until the flange drops into place without force. Do not drive the flange on with a hammer or the seal strips may be damaged.*

20. Tighten the capscrews (5) in a crossing pattern in even increments to a final torque of 75 ft-lbs. (100 Nm).

21. Using an appropriate tool, turn the driveshaft. The movement of the shaft should be tight, but it should turn freely with a maximum of 5 to 10 ft-lbs. (7 to 14 Nm) of torque.

NOTE: *If this does not occur, disassemble the pump and examine the parts for burrs or foreign material caus-*

ing a build-up or interference between the parts.

22. If removed, remount the valve assembly onto the pump assembly.

23. Re-install the hydraulic pump (3, Figure 1B) assembly onto the electric motor assembly (1, Figure 1B) and secure.

INSTALLATION

The manual supply pump assembly may be installed as follows:

1. Place the pump assembly in position and secure with the mounting bolts.

2. Reconnect all hoses to the assembly.

3. Reconnect all 24 Vdc wires/cables.

4. Open the hydraulic fluid supply to the pump.

5. Bleed and test pump/system operation as outlined in the test instructions for the Steering System in Section 5 - Hydraulic System.

6. Install the cover over the pump.

KEY	A85187
01.	Motor Driven Pump
02.	Flatwasher
03.	Capscrew
04.	Locknut
05.	Adapter Fitting
06.	Pipe Coupling
07.	Adapter Fitting
08.	Check Valve
09.	Adapter Fitting
10.	Hose Assembly
11.	Hose Assembly
12.	Hose Assembly
13.	Adapter Fitting
14.	Adapter Fitting
15.	Adapter Fitting
16.	Adapter Fitting
17.	Clamp Halves
18.	Pressure Switch
19.	Connector Fitting
20.	Grip
21.	Gasket
22.	Adapter Fitting
23.	Cartridge Check Valve
24.	Pushbutton Switch
25.	24 Vdc Relay
26.	Diode Assembly*
27.	Electrical Terminal*
28.	Electrical Terminal*
29.	Electrical Terminal*
30.	Electrical Terminal*
31.	Electrical Terminal*
32.	Electrical Wire*
33.	Power Cable*
* Items are not shown on the drawing.	

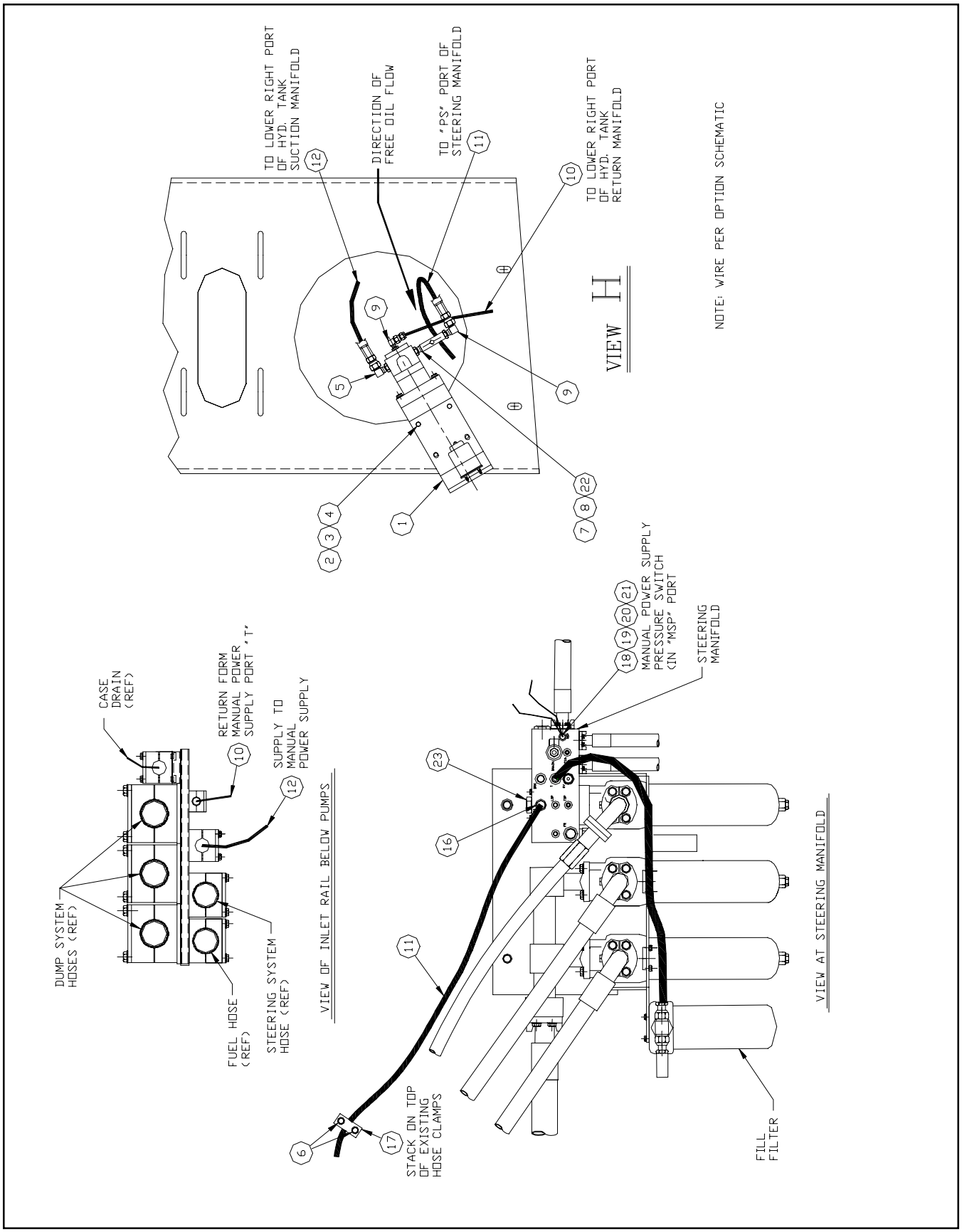


FIGURE 2 – MANUAL POWER SUPPLY PUMP SYSTEM (A85187)

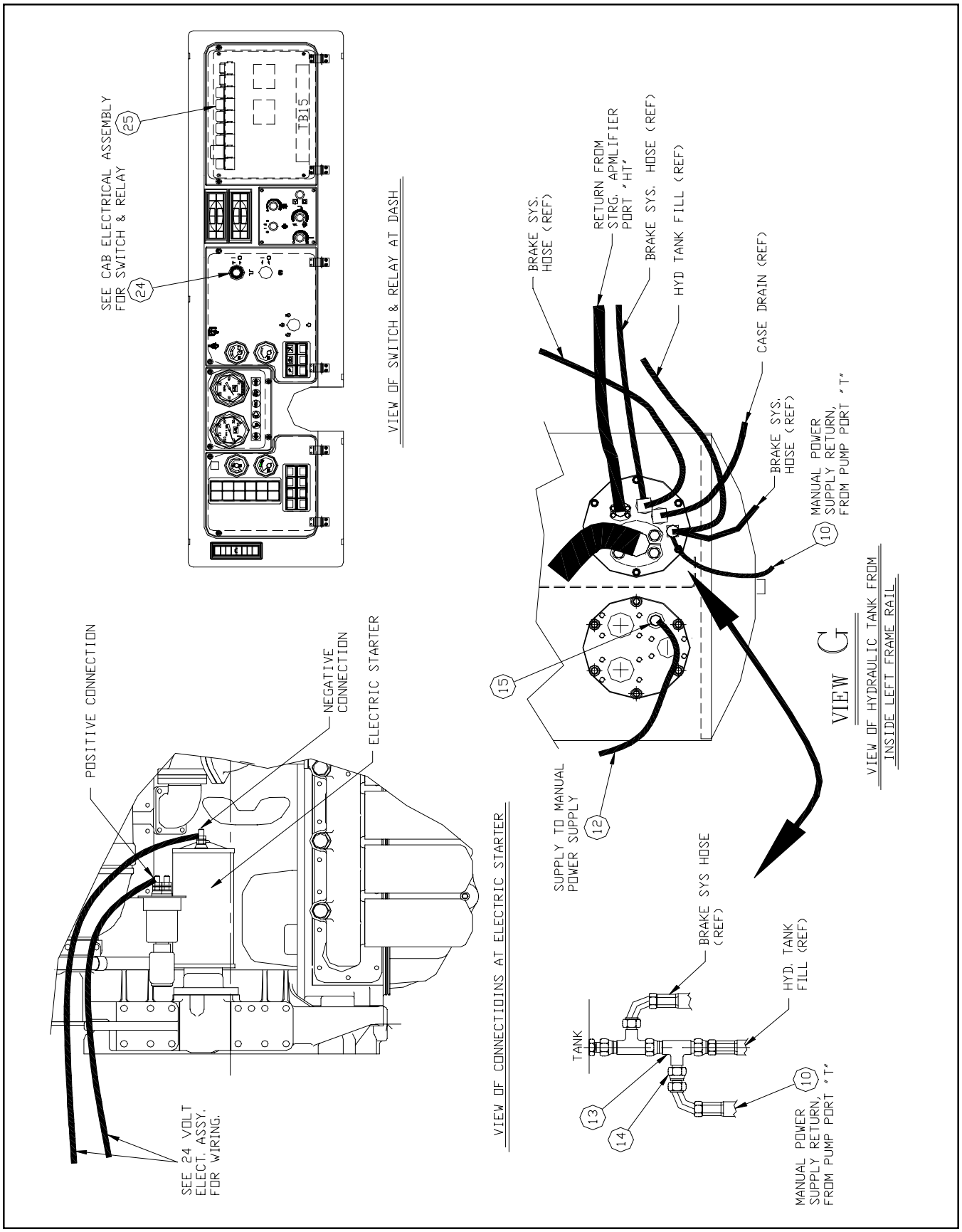


FIGURE 2 – MANUAL POWER SUPPLY PUMP SYSTEM (A85187 CONTINUED)

HYDRAULIC BRAKE SYSTEM

DESCRIPTION AND LOCATION

The hydraulic brake system consists of the following components:

1. Hydraulic fluid supply - the brake system receives its supply of pressurized fluid from the steering system pump and filter.

2. Brake manifold - aluminum manifold installed in the hydraulic component box on the superstructure behind the cab.

3. Accumulator drain valves - located in the brake manifold, which allow hydraulic pressure stored in the brake accumulator system to be released. The valves are for manual operation only.

NOTES: *A needle valve assembly is installed that must be manually opened or closed to release the accumulator pressure.*

4. Accumulators - piston-type storage devices mounted on the rear of the hydraulic components box on the superstructure behind the cab.

5. Pressure switches - diaphragm-type switches to monitor various systems.

a. Low brake pressure.

b. Brake drag - front and rear - (optional).

NOTE: *There are 2 different versions of brake drag switches available:*
1. The preset switch (a combination of rectangular and cylindrical) is preset to 35 psi (240 kPa) and is not considered field adjustable.
2. The adjustable switch (cylindrical) has an external adjustment screw and is typically adjusted to approximately 15 psi (105 kPa).

c. Auto (matic) brake application (auto apply) (optional).

d. Park brake pressure.

6. Brake pilot valve - spool type valve mounted on the brake pedal in the cab.

7. Brake control valves - dual spool valve mounted in the hydraulic components box on the superstructure behind the cab.

8. Brake calipers - caliper assemblies mounted on the front axle assemblies and rear wheelmotors.

9. Auto (matic) apply solenoid - solenoid valve cartridge in the brake manifold which applies the brakes automatically, if supply pressure drops below preset level.

10. Load brake solenoid valve - solenoid valve cartridge in the brake manifold which applies the rear brakes only when activated by a cab mounted switch.

11. Park brake solenoid valve - dual coil electric solenoid, detented valve mounted on the brake manifold that control the flow of pressurized oil to and from the park brake system.

NOTE: *Detailed information on this valve is contained in Section 5 - Hydraulic System.*

12. Park brake shut-off valve - electric solenoid operated check valve cartridge in the brake manifold that limits the flow of oil to the park brake calipers except when energized.

13. Park brake pressure reducing valve - A separate mechanical cartridge assembly in the brake system manifold used to limit the maximum pressure to the park brake caliper assemblies.

14. Steering manifold - metal manifold mounted above the steering filter, supplying oil to the brake system.

15. Venturi and flow control assembly - control valve assembly mounted to a port in the side of the steering manifold that creates a reduced pressure on the return flow from the brake assembly to prevent the brakes from “dragging”.

16. Modulated hand brake valve - mechanical lever and cable assembly that operates the brake control valve in the hydraulic components box with a cab center console mounted lever.

17. Load brake switch - cab console mounted electrical switch that controls the operation of the load brake solenoid valve.

18. Park brake switch - cab dash mounted electrical switch that controls the operation of the park brake apply and release solenoid valves.

KEY			13612A
01.	BRAKE MANIFOLD	16.	REAR BRAKE CALIPERS
02.	LOW BRAKE PRESSURE SWITCH	17.	BRAKE DRAG PRESSURE SWITCHES
03.	AUTO APPLY PRESSURE SWITCH	18.	PARK BRAKE PRESSURE REDUCING VALVE/REGULATOR (IF SO EQUIPPED)
04.	BRAKE SYSTEM PRESSURE GAUGE		
05.	BRAKE ACCUMULATORS	A.	EXTERNAL MOUNTED
06.	MANUAL ACCUMULATOR DRAIN VALVES	B.	INTEGRAL (MANIFOLD) MOUNTED
07.	AUTO APPLY SOLENOID VALVE	19.	PARK BRAKE SOLENOID VALVE
08.	LOAD BRAKE SOLENOID VALVE	20.	PARK BRAKE SHUT–OFF VALVE
09.	LOAD BRAKE SHUTTLE VALVE	21.	PARK BRAKE PRESSURE SWITCH
10.	AUTO APPLY SHUTTLE VALVE	22.	PARK BRAKE SYSTEM PRESSURE GAUGE
11.	BRAKE PILOT VALVE	23.	PARK BRAKE CALIPERS
12.	BRAKE CONTROLLER VALVE	24.	HYDRAULIC TANK
13.	FRONT BRAKE PRESSURE GAUGE	25.	BRAKE SYSTEM REAR PILOT PRESSURE GAUGE
14.	REAR BRAKE PRESSURE GAUGE	26.	FLOW CONTROL
15.	FRONT BRAKE CALIPERS	27.	VENTURI

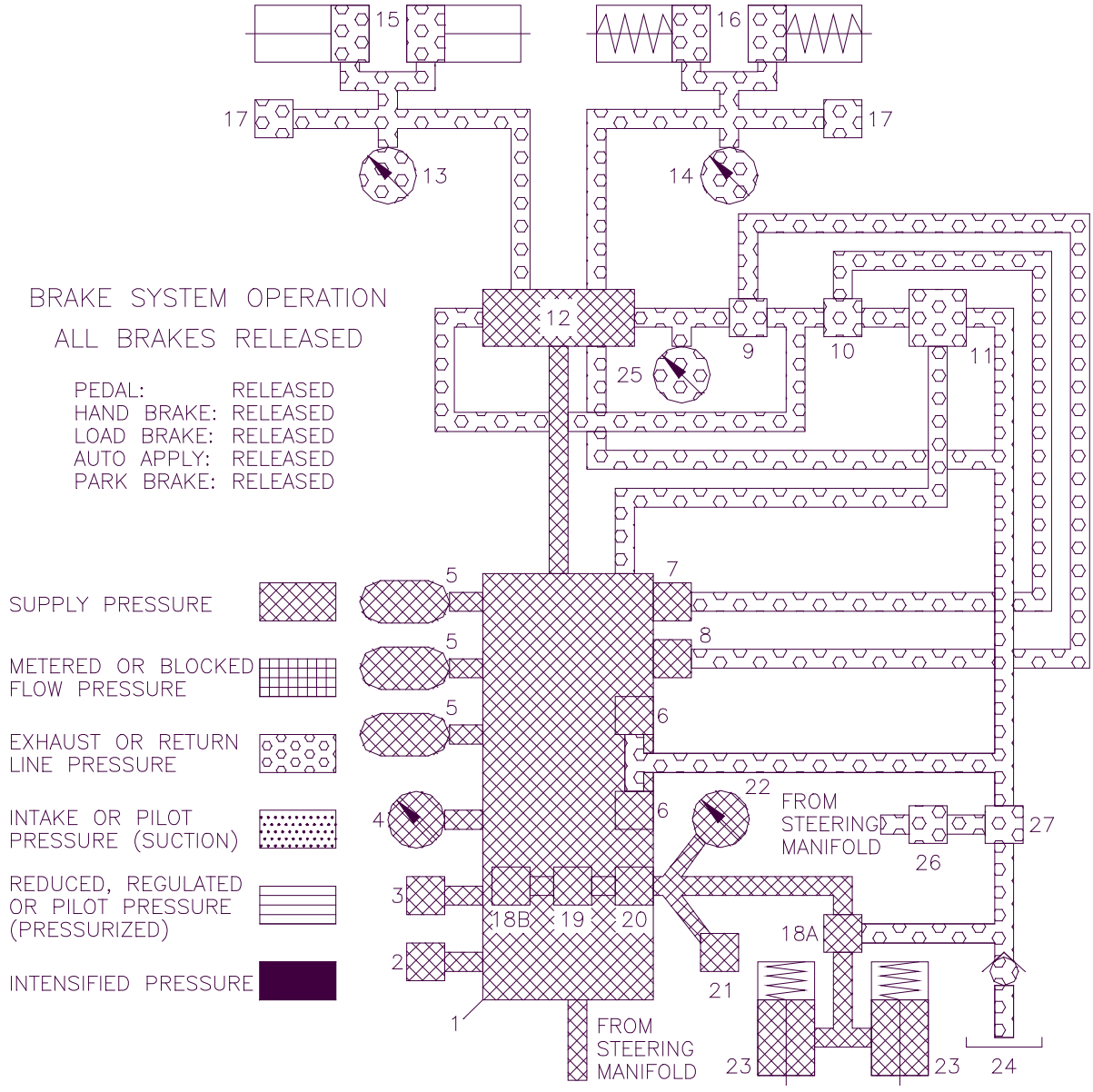


FIGURE 1 - BRAKE SYSTEM OPERATION - ALL BRAKES RELEASED

KEY			13612B
01.	BRAKE MANIFOLD	16.	REAR BRAKE CALIPERS
02.	LOW BRAKE PRESSURE SWITCH	17.	BRAKE DRAG PRESSURE SWITCHES
03.	AUTO APPLY PRESSURE SWITCH	18.	PARK BRAKE PRESSURE REDUCING VALVE/REGULATOR (IF SO EQUIPPED)
04.	BRAKE SYSTEM PRESSURE GAUGE		
05.	BRAKE ACCUMULATORS	A.	EXTERNAL MOUNTED
06.	MANUAL ACCUMULATOR DRAIN VALVES	B.	INTEGRAL (MANIFOLD) MOUNTED
07.	AUTO APPLY SOLENOID VALVE	19.	PARK BRAKE SOLENOID VALVE
08.	LOAD BRAKE SOLENOID VALVE	20.	PARK BRAKE SHUT–OFF VALVE
09.	LOAD BRAKE SHUTTLE VALVE	21.	PARK BRAKE PRESSURE SWITCH
10.	AUTO APPLY SHUTTLE VALVE	22.	PARK BRAKE SYSTEM PRESSURE GAUGE
11.	BRAKE PILOT VALVE	23.	PARK BRAKE CALIPERS
12.	BRAKE CONTROLLER VALVE	24.	HYDRAULIC TANK
13.	FRONT BRAKE PRESSURE GAUGE	25.	BRAKE SYSTEM REAR PILOT PRESSURE GAUGE
14.	REAR BRAKE PRESSURE GAUGE	26.	FLOW CONTROL
15.	FRONT BRAKE CALIPERS	27.	VENTURI

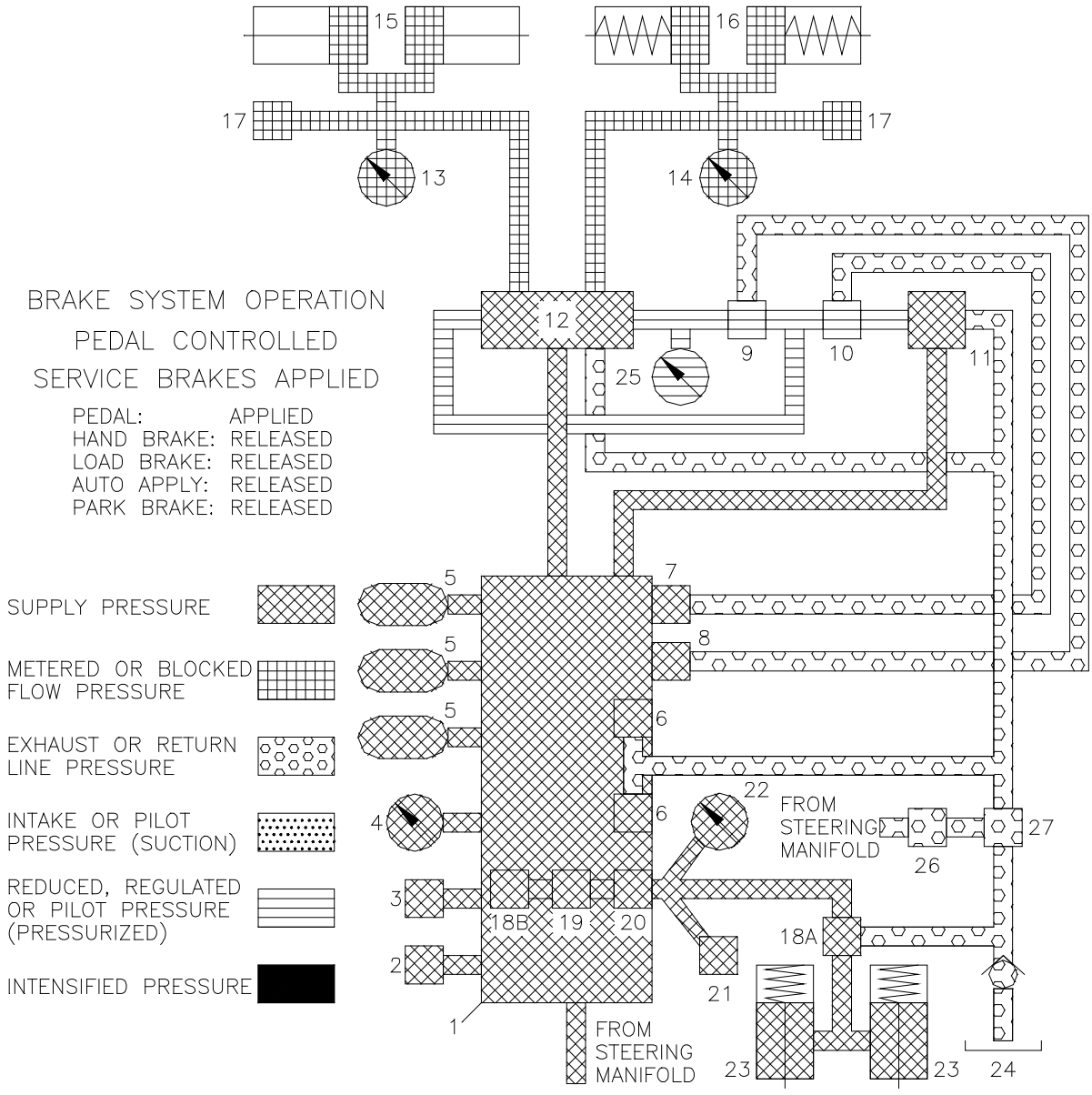


FIGURE 2 - BRAKE SYSTEM OPERATION - PEDAL CONTROLLED SERVICE BRAKES APPLIED

KEY			13612C
01.	BRAKE MANIFOLD	16.	REAR BRAKE CALIPERS
02.	LOW BRAKE PRESSURE SWITCH	17.	BRAKE DRAG PRESSURE SWITCHES
03.	AUTO APPLY PRESSURE SWITCH	18.	PARK BRAKE PRESSURE REDUCING VALVE/REGULATOR (IF SO EQUIPPED)
04.	BRAKE SYSTEM PRESSURE GAUGE		
05.	BRAKE ACCUMULATORS	A.	EXTERNAL MOUNTED
06.	MANUAL ACCUMULATOR DRAIN VALVES	B.	INTEGRAL (MANIFOLD) MOUNTED
07.	AUTO APPLY SOLENOID VALVE	19.	PARK BRAKE SOLENOID VALVE
08.	LOAD BRAKE SOLENOID VALVE	20.	PARK BRAKE SHUT-OFF VALVE
09.	LOAD BRAKE SHUTTLE VALVE	21.	PARK BRAKE PRESSURE SWITCH
10.	AUTO APPLY SHUTTLE VALVE	22.	PARK BRAKE SYSTEM PRESSURE GAUGE
11.	BRAKE PILOT VALVE	23.	PARK BRAKE CALIPERS
12.	BRAKE CONTROLLER VALVE	24.	HYDRAULIC TANK
13.	FRONT BRAKE PRESSURE GAUGE	25.	BRAKE SYSTEM REAR PILOT PRESSURE GAUGE
14.	REAR BRAKE PRESSURE GAUGE	26.	FLOW CONTROL
15.	FRONT BRAKE CALIPERS	27.	VENTURI

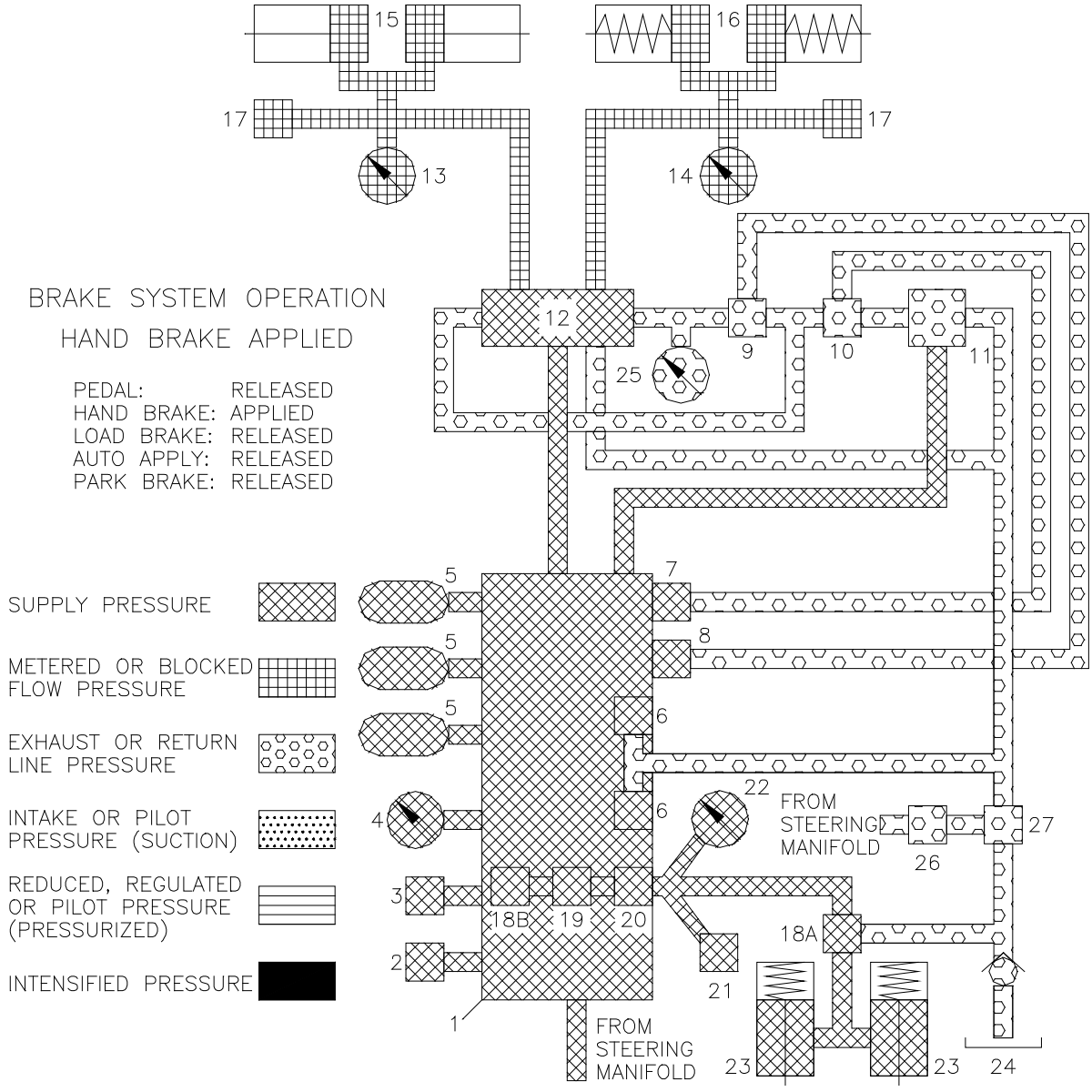


FIGURE 3 - BRAKE SYSTEM OPERATION - HAND BRAKE APPLIED

KEY			13612D
01.	BRAKE MANIFOLD	16.	REAR BRAKE CALIPERS
02.	LOW BRAKE PRESSURE SWITCH	17.	BRAKE DRAG PRESSURE SWITCHES
03.	AUTO APPLY PRESSURE SWITCH	18.	PARK BRAKE PRESSURE REDUCING VALVE/REGULATOR (IF SO EQUIPPED)
04.	BRAKE SYSTEM PRESSURE GAUGE		
05.	BRAKE ACCUMULATORS	A.	EXTERNAL MOUNTED
06.	MANUAL ACCUMULATOR DRAIN VALVES	B.	INTEGRAL (MANIFOLD) MOUNTED
07.	AUTO APPLY SOLENOID VALVE	19.	PARK BRAKE SOLENOID VALVE
08.	LOAD BRAKE SOLENOID VALVE	20.	PARK BRAKE SHUT–OFF VALVE
09.	LOAD BRAKE SHUTTLE VALVE	21.	PARK BRAKE PRESSURE SWITCH
10.	AUTO APPLY SHUTTLE VALVE	22.	PARK BRAKE SYSTEM PRESSURE GAUGE
11.	BRAKE PILOT VALVE	23.	PARK BRAKE CALIPERS
12.	BRAKE CONTROLLER VALVE	24.	HYDRAULIC TANK
13.	FRONT BRAKE PRESSURE GAUGE	25.	BRAKE SYSTEM REAR PILOT PRESSURE GAUGE
14.	REAR BRAKE PRESSURE GAUGE	26.	FLOW CONTROL
15.	FRONT BRAKE CALIPERS	27.	VENTURI

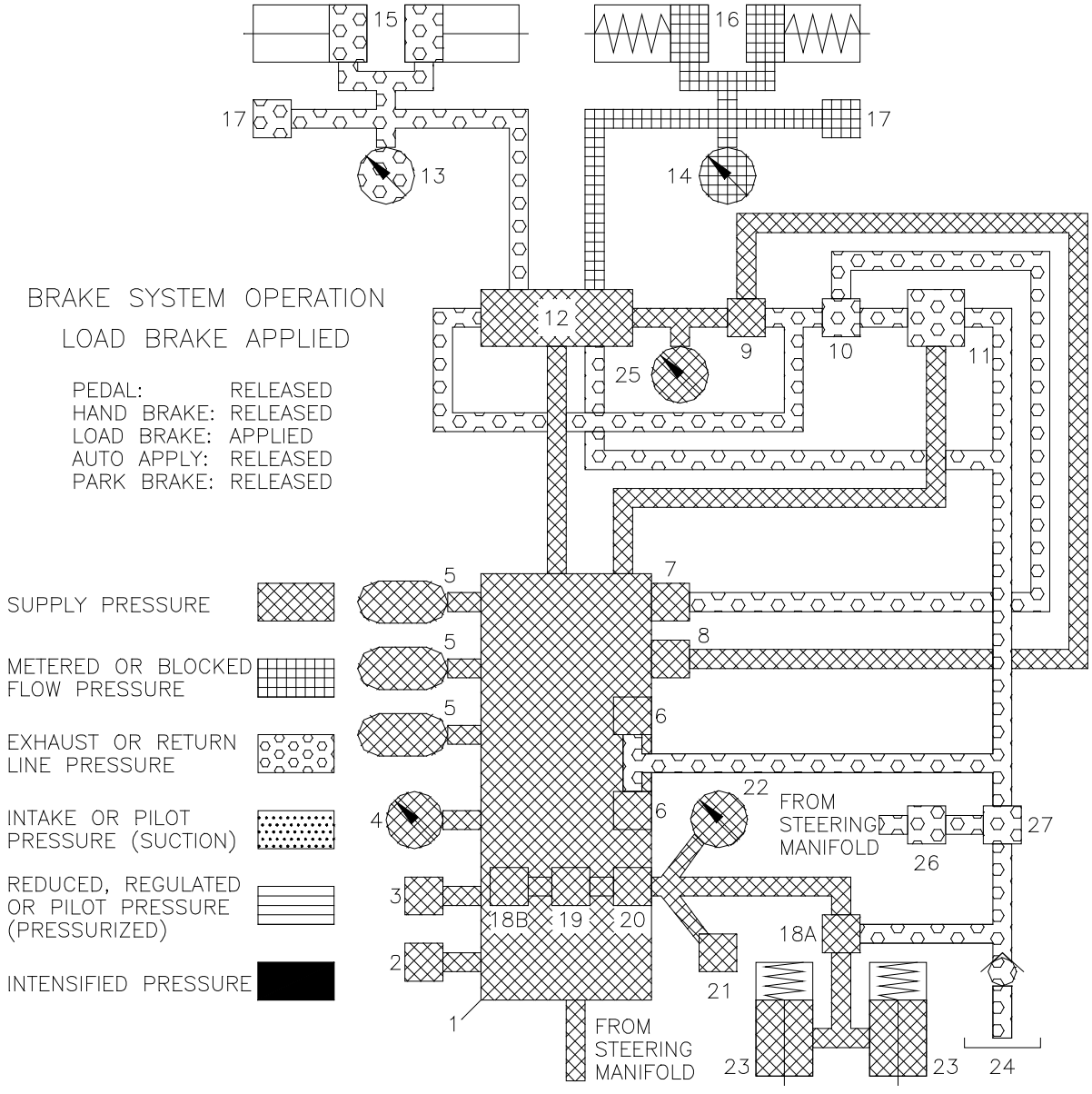


FIGURE 4 - BRAKE SYSTEM OPERATION - LOAD BRAKE APPLIED

KEY			13612E
01.	BRAKE MANIFOLD	16.	REAR BRAKE CALIPERS
02.	LOW BRAKE PRESSURE SWITCH	17.	BRAKE DRAG PRESSURE SWITCHES
03.	AUTO APPLY PRESSURE SWITCH	18.	PARK BRAKE PRESSURE REDUCING VALVE/REGULATOR (IF SO EQUIPPED)
04.	BRAKE SYSTEM PRESSURE GAUGE		
05.	BRAKE ACCUMULATORS	A.	EXTERNAL MOUNTED
06.	MANUAL ACCUMULATOR DRAIN VALVES	B.	INTEGRAL (MANIFOLD) MOUNTED
07.	AUTO APPLY SOLENOID VALVE	19.	PARK BRAKE SOLENOID VALVE
08.	LOAD BRAKE SOLENOID VALVE	20.	PARK BRAKE SHUT-OFF VALVE
09.	LOAD BRAKE SHUTTLE VALVE	21.	PARK BRAKE PRESSURE SWITCH
10.	AUTO APPLY SHUTTLE VALVE	22.	PARK BRAKE SYSTEM PRESSURE GAUGE
11.	BRAKE PILOT VALVE	23.	PARK BRAKE CALIPERS
12.	BRAKE CONTROLLER VALVE	24.	HYDRAULIC TANK
13.	FRONT BRAKE PRESSURE GAUGE	25.	BRAKE SYSTEM REAR PILOT PRESSURE GAUGE
14.	REAR BRAKE PRESSURE GAUGE	26.	FLOW CONTROL
15.	FRONT BRAKE CALIPERS	27.	VENTURI

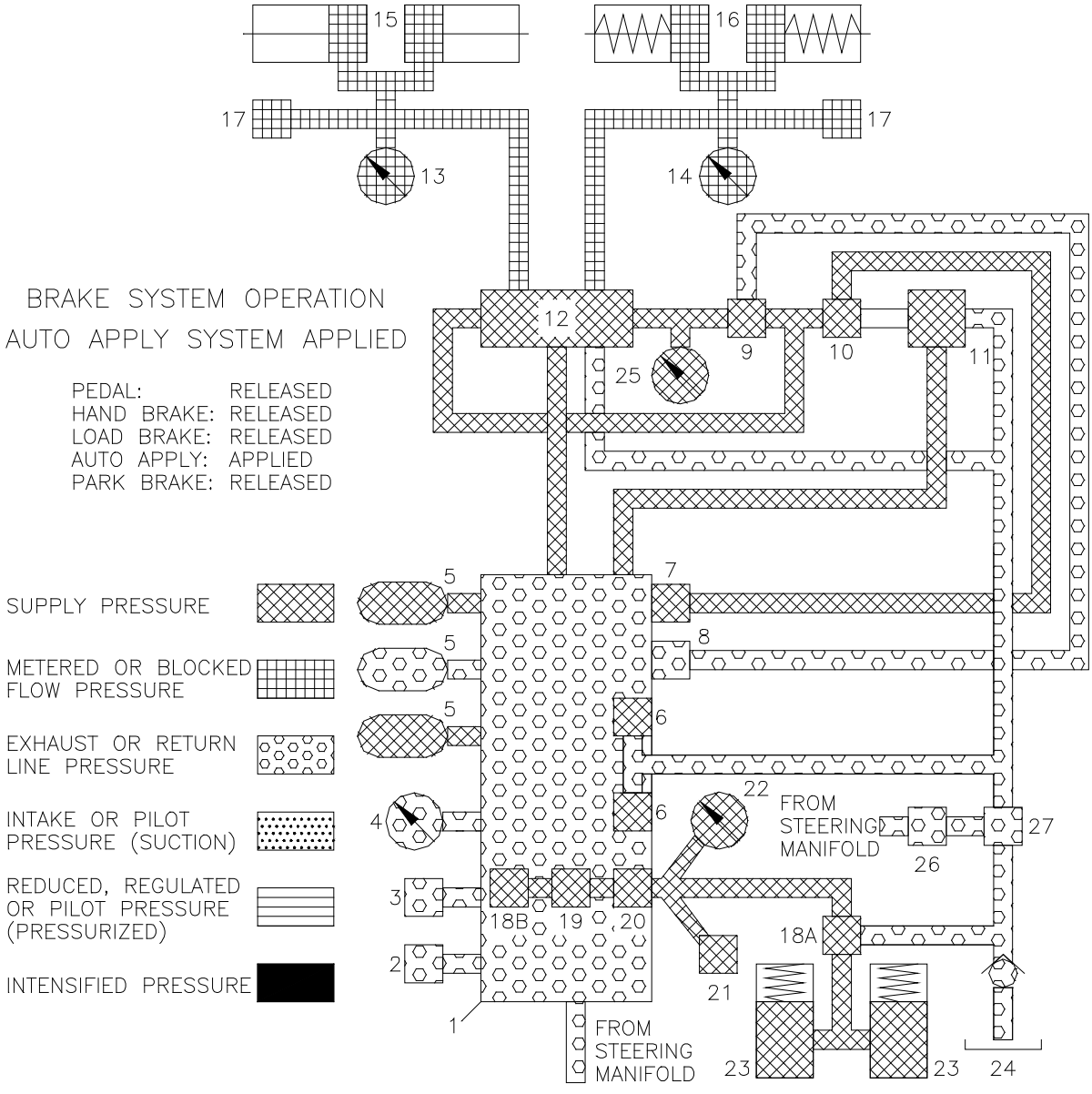


FIGURE 5 - BRAKE SYSTEM OPERATION - AUTO APPLY SYSTEM APPLIED

KEY			13612F
01.	BRAKE MANIFOLD	16.	REAR BRAKE CALIPERS
02.	LOW BRAKE PRESSURE SWITCH	17.	BRAKE DRAG PRESSURE SWITCHES
03.	AUTO APPLY PRESSURE SWITCH	18.	PARK BRAKE PRESSURE REDUCING VALVE/REGULATOR (IF SO EQUIPPED)
04.	BRAKE SYSTEM PRESSURE GAUGE		
05.	BRAKE ACCUMULATORS	A.	EXTERNAL MOUNTED
06.	MANUAL ACCUMULATOR DRAIN VALVES	B.	INTEGRAL (MANIFOLD) MOUNTED
07.	AUTO APPLY SOLENOID VALVE	19.	PARK BRAKE SOLENOID VALVE
08.	LOAD BRAKE SOLENOID VALVE	20.	PARK BRAKE SHUT-OFF VALVE
09.	LOAD BRAKE SHUTTLE VALVE	21.	PARK BRAKE PRESSURE SWITCH
10.	AUTO APPLY SHUTTLE VALVE	22.	PARK BRAKE SYSTEM PRESSURE GAUGE
11.	BRAKE PILOT VALVE	23.	PARK BRAKE CALIPERS
12.	BRAKE CONTROLLER VALVE	24.	HYDRAULIC TANK
13.	FRONT BRAKE PRESSURE GAUGE	25.	BRAKE SYSTEM REAR PILOT PRESSURE GAUGE
14.	REAR BRAKE PRESSURE GAUGE	26.	FLOW CONTROL
15.	FRONT BRAKE CALIPERS	27.	VENTURI

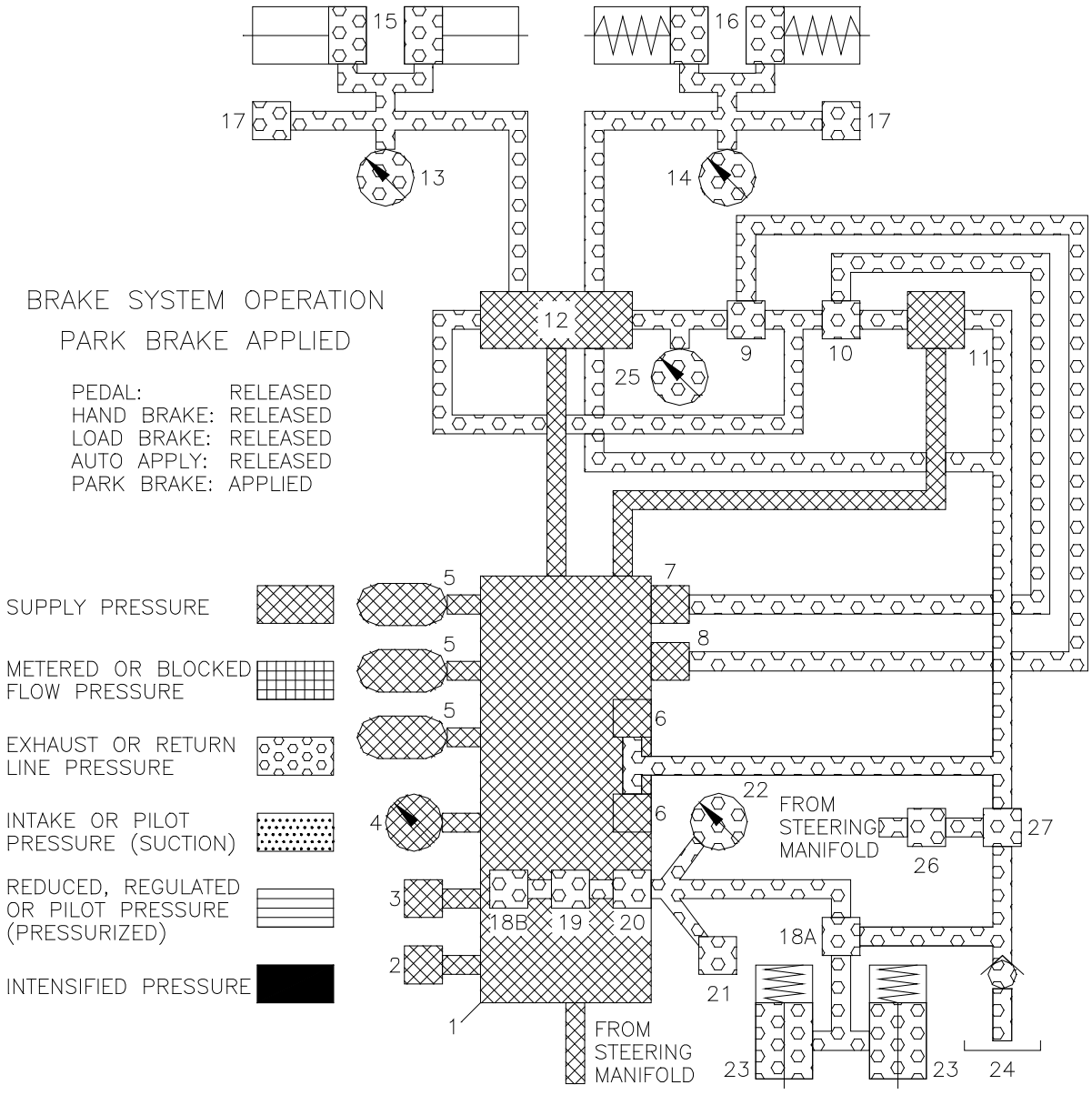


FIGURE 6 - BRAKE SYSTEM OPERATION - PARK BRAKES APPLIED

19. Park brake assembly - separate caliper or piston assembly mounted on the rear disc brakes.

OPERATION (Figures 1 through 6)

The hydraulic brake system consists of two subsystems, supply and operation, which perform together to control the operation of the brake caliper assemblies.

SUPPLY

Hydraulic oil is drawn from the hydraulic reservoir into the steering pump assembly. The pump is a piston type pump with a moveable swashplate that is controlled in a pressure compensating mode. In this configuration, the pump stroke is controlled from 0 to maximum displacement per revolution to provide a flow sufficient to maintain constant pressure of approximately 3500 psi (24 130 kPa) in the system accumulators. The output of the pump is routed through a high pressure oil filter and steering manifold.

It then passes through the brake manifold and on to the brake accumulators, which are kept at a "constant state of charge". The brake manifold splits to the separate front and rear brake accumulators, which supply their respective brake systems.

NOTE: *The three accumulators (supply, front, and rear) are plumbed independently so that the supply accumulator provides support to either the front or rear accumulator.*

A low brake pressure switch is included to activate a cab warning indicator if the pressure in the supply brake accumulator decreases to a predetermined minimum level.

OPERATION

When the operator depresses the Brake pedal a pilot pressure, proportionate to the amount the pedal is depressed, is routed to the front and rear pilot ports on the brake control valve. This pilot pressure causes the spools in the brake control valve to shift, metering the operating pressure allowed to the individual caliper assemblies.

Release of the pedal causes the pilot pressure to decrease to 0 psi (kPa). This releases the caliper operating pressure.

NOTE: *A separate venturi and flow control system is incorporated into the steering manifold that creates a reduced pressure in the brake return line. This reduced pressure allows the return oil to have minimal back pressure, in spite of the 10 psi (70 kPa) pressure maintained in the truck's hydraulic tank.*

A proximity switch on the pilot valve and separate relay assembly is used to operate the truck brake lights.

When the modulated hand brake system is operated, moving the lever in the cab operates a push-pull cable with a lever on the end, which mechanically depresses the spools in the brake control valve. This results in application of the brake calipers in a manner similar to that used in brake pedal operation. Releasing the lever reverses the procedure and releases the brake calipers.

NOTES:

1. The brake control valve outputs are factory preset to regulate the front and rear brake pressure independently.

2. A separate switch and relay system allows for:

a. Operation of a cab warning indicator.

b. Interrupts propulsion enabling circuitry (AS circuit).

c. Operates the truck's stop lights.

3. The modulated hand brake lever is spring loaded to the Release position. The brakes remain applied only when the lever is in the Activated position and held.

A load brake assembly provides a method of applying or releasing the rear brake only. This system is designed to be used during the loading or dumping portions of the cycle, is controlled through a manual switch located on the cab console.

When the Load Brake switch is activated (or moved to the Apply position) pressurized oil is routed from the brake manifold to the pilot port for the rear brake spool in the brake control valve through the Load Brake Shuttle valve. This causes only the rear brakes to apply fully. Moving the switch to the Release position discontinues the pilot pressure and releases the brakes.

An optional auto apply (automatic actuation) feature is available to activate the brakes in conditions where the supply system pressure decreases to a predetermined pressure. At this pressure, a pressure switch activates the auto apply solenoid valve, piloting the brake control valve through the Auto Apply shuttle valve. This causes the brake control valve to provide maximum system pressure to the caliper assemblies,

stopping the truck. This application is not modulated, and should be used in emergency situations only.

A Brake Drag Warning feature included to provide cab warning indications in the event of residual pressure remaining in the brake control circuitry (when all the brakes are fully released), causing the calipers to remain partially applied.

The park brake system is used to assist in securing the truck when parked for long periods of time with the engine shut off, or when the operator leaves the cab or the truck unattended. The basic park brake assembly is mechanically (spring) applied and hydraulically released.

In normal operation, to release the park brakes (supply pressure to the calipers); the operator moves the Park Brake switch to the Release position and holds for a minimum of two (2) seconds. This electrically shifts the park brake release solenoid valve to the open position, allowing oil to flow through. The park brake shut-off valve is also energized at this time, allowing the flow to by-pass the internal check valve portion of the cartridge and to flow to the caliper assemblies.

The pressurized hydraulic fluid from the brake system then goes to the:

1. Calipers - causing them to release.

2. Pressure switch - causing it to switch, which turns the dash mounted indicator light off and completing the AS circuit path through the switch.

When the calipers are released (and the indicator is off) the operator releases the Park Brake switch. This allows the spring loaded park brake shut-off valve to shift to the check position prohibiting further flow to the caliper assemblies.

To apply the park brake, the operator moves Park Brake switch to the Apply position and holds for a minimum of two (2) seconds. This electrically shifts the park brake solenoid valve to the apply position allowing the trapped oil in the system to exhaust to tank. This release of fluid causes:

1. The calipers to apply.

2. The pressure switch to shift which turns the indicator light off and interrupts the AS circuit.

NOTE: *When the park brakes are applied, releasing the Park Brake switch does not affect their status.*

In the event of fluid loss in the system during operation (e.g. hose damage, etc.):

1. The park brake release solenoid valve check feature prevents additional oil to the calipers, preventing undesirable leakage.

2. The system pressure switch interrupts propulsion and provides a warning indicator on the dash to light.

Operation in dynamic retarding will not be affected.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Inspect all hoses and lines for evidence of damage or leakage. All hoses should be secured properly and torqued as per the instructions in Section 10 - Miscellaneous. Repair or replace as required.

2. Inspect each assembly component for evidence of wear, damage, or leakage.

3. Test the operation of the system as outlined in the operation test.

4. Check the operation of the hand brake system. If found difficult to move, adjust as in the indicated procedures.

OPERATION TEST

IMPORTANT: *Prior to beginning this test, the steering system must be properly tested and adjusted.*

Prior to engine start-up:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction brake system. Verify that the front wheels are not chocked and all equipment and personnel are clear of the area in which the tires will move while turning.

2. Release all entrapped pressure in the system.

3. Verify that all hose fittings are torqued per the procedures in Section 10 - Miscellaneous.

4. Verify that the truck's hydraulic tank is filled to the proper level with approved filtered hydraulic oil.

5. Verify that the valve in the hydraulic pump suction line is open.

6. Verify the nitrogen gas precharge pressures in the accumulators are as follows:

a. Brakes (3 smaller) - 950 to 1050 psi (6 555 to 7 245 kPa)

Follow the procedures outlined in the instructions for each style accumulator as outlined in the instructions in Section 5 - Hydraulic System.

NOTE: *The accumulator must be fully drained of all hydraulic pressure prior to checking gas pressure. This may be done by pulling the manual drain valves located on the brake manifold in the hydraulic components box on the superstructure.*

7. Verify that the gauges, mounted in the hydraulic components box on the superstructure are all operational.

8. Pressurize the hydraulic tank to 10 +/- 1 psi (70 +/- 7 kPa).

9. Verify that if the pump has not been previously run, the steering pump case drain has been filled.

10. Using the appropriate means for the electrical propulsion system installed, disable the truck's propulsion system to prevent its operation when the Shifter is moved to the forward or reverse position.

TEST AND ADJUSTMENTS

The operation of the hydraulic brake system may be tested as follows:

Accumulator Supply System

1. Reconnect and torque all hoses previously removed as outlined in the procedures in Section 10 - Miscellaneous.

2. Check the pressure in the brake accumulator supply system as follows:

a. Turn the Master Switch on.

b. Start the engine and allow to run at low idle speed.

c. Verify that at approximately 2100 psi (14 480 kPa) the Low Brake Pressure indicator goes out.

NOTE: *This is an approximation test at this point. More detailed final testing will be done later.*

d. Verify that the Supply Accumulator Pressure increases slowly to 3450 to 3550 psi (23 790 to 24 480 kPa), then stabilizes.

e. With the engine still at low idle speed, fully depress and release the Brake pedal repeatedly.

f. Verify that the supply pressure remains at 3450 to 3550 psi (23 790 to 24 480 kPa).

g. Record the pressure reading.

Bleeding the Service Brake System

Air may be removed from the service brake system as follows:

NOTE: *Prior to beginning the bleeding procedure, consult the appropriate assembly drawings for the correct bleeder port that should be used in this installation, usually the highest points. Also it is recommended that a hose be used to direct oil away from the discs and linings into a catch can.*

1. With the engine still at low idle speed, fully depress the Brake pedal and hold.

2. Verify that the system pressures do not exceed 2500 psi (17 240 kPa) on the front and 1500 psi (10 340 kPa) on the rear brake system gauges. If the pressures do exceed these limits, immediately release the Brake Pedal. Reapply partially and repeat this procedure.

3. Slowly and carefully open each bleeder valve and allow the oil to flow until it is free of air bubbles. Close each valve tightly when complete. Repeat for each service brake caliper assembly both front and rear.

IMPORTANT: *Remember when opening each bleeder valve that considerable pressure may be built up behind it and as a result oil may squirt out rapidly. It is best to open each valve with a slow, steady motion.*

4. Release the Brake pedal when the process is complete.

Bleeding the Park Brake System

Air may be removed from the park brake system as follows:

NOTE: *The instructions for the use of the hose catch can and the opening of the bleeder valves outlined for the service brake calipers also apply for the park brake calipers.*

1. Move the Park Brake switch to the "Released" position and hold.

2. Bleed each park brake assembly in a manner similar to that used on the service brake calipers.

3. Release the Park Brake switch.

4. Move the Load Brake switch to the Release position.

Brake Pedal Control System Adjustment

The service brake pedal may be tested and adjusted as follows:

1. Fully depress the Brake pedal and hold. Verify that the:

a. Foot brake pilot pressure (measured on the Load Brake gauge) is:

675 to 725 psi (4 655 to 5 000 kPa).

b. Front brake pressure is:

2700 to 2900 psi (18 615 to 19 995 kPa).

c. Rear brake caliper pressure is:

1350 to 1450 psi (9 310 to 10 000 kPa)

d. Stop or brake lights are lit.
Rear of truck
On top of the cab (if option installed)

2. Release the Brake pedal. Verify that the:

a. Pilot, front, and rear brake pressures return to 0 psi (kPa).

b. Stop or brake lights are off.

3. If the pressures found are not within the desired range, but are both too high or too low, it will be necessary to adjust the pilot pressure signal to the front and rear brake valve spools. This may be done as follows:

a. Release the Brake pedal.

b. Stop the truck engine.

c. Drain all pressure from the brake accumulators, using the manual accumulator drain valves.

d. Remove the Brake pedal and actuator assembly by loosening the locking nuts and washers securing the U-bolts to the assembly and removing the pivot pin.

e. Loosen the setscrew securing the adjusting collar to the threads on the plunger.

f. Move the adjusting collar counter-clockwise (or toward the ends of the threads) to raise the pressure or clockwise (or to the non-threaded portion of the plunger) to lower the pressure.

NOTE: *Fine adjustments may require turning the valve in increments of as little as 1/8th turn.*

g. Retest the pressure as before. Installing the pivot pin and using a flat screwdriver or equivalent as a lever will allow you to depress the actuator without reinstalling the pedal/cam assembly.

h. Secure the collar by re-tightening the setscrew to 25 to 30 inch-lb. (2.8 to 3.4 Nm).

i. Reinstall the pedal/cam assembly to the spool section.

j. Repeat the above steps until the adjustment is complete.

k. Apply and release the brakes a number of times. Verify that the pressure settings do not change. If they do, repeat the above process as required.

NOTE: *When the assembly is new or has been serviced, it is not uncommon for the pressures to decrease slightly due to the "seating" effect of the components.*

4. Release the Brake pedal. Verify that the:

a. Front and rear brake pressures return to 0 psi (kPa).

b. Stop or brake lights are all off.

5. If the pressure of either the front or rear system

is too high or too low, but the other system and the pilot pressures are within tolerances, the appropriate individual spool on the brake control valve should be adjusted in an manner similar to that used to adjust the brake pilot valve.

6. If pressure remains in the system with the pedal released, adjust the pedal return stop behind the pedal assembly and retest.

7. Record the final pressure found - applied and released.

Brake System Pressure Release System

The front brake release system pressure vacuum may be tested as follows:

1. Stop the engine.

2. Release all pressure in the hydraulic tank.

3. Connect a 0 to 10 psi (0 to 70 kPa) pressure gauge (or equivalent) on the special quick disconnect fitting on the return to the hydraulic tank assembly.

4. Pressurize the hydraulic tank to 10 +/- 1 psi (70 +/- 7 kPa).

5. Start the engine. When acceptable, accelerate the engine to 1900 rpm and hold.

6. Verify that the pressure on the gauge is 1 +/- 0.5 psi (7 +/- 3 kPa). If not adjust the flow controls to obtain this final setting.

NOTE: *This is with the oil at normal operating temperatures. At other oil temperatures, this pressure will vary.*

7. Slow the engine to low idle speed and stop.

8. Release all pressure in the hydraulic tank.

9. Remove the low pressure gauge.

10. Pressurize the hydraulic tank to 10 +/- 1 psi (70 +/- 7 kPa).

Brake Drag System Test

The Brake Drag Monitoring System may be tested as follows:

NOTES:
1. This test is for the system that incorporates a 6 second delay before the indicators light in response to an indicated brake drag condition.
2. In order to test the system in a normal operating mode, the truck must be driven at a speed in excess of the OEM Speed Option in the trucks propulsion system (or a appropriate speed signal introduced into the Propulsion system) and the Brake pedal or Hand Brake applied.

1. Verify that the previous tests are complete and the remainder of the system is operating properly including the:

a. Accumulators are charged to 3450 to 3550 psi (23 790 to 24 475 kPa)

b. Hydraulically operated grease system (if so equipped) is properly operating.

c. The brake venturi system is operating at the proper 1 +/- 0.5 psi (7 +/- 4 kPa)/

2. Verify that the Brake pedal, Hand, and Load brake systems are all released.

3. Connect a 0 to 100 psi (0 to 700 kPa) gauge to the test port adjacent to the Brake Drag switch test port.

NOTE: *Since the pressure at this point can exceed 100 psi (700 kPa) it is important to use hydraulic equipment or use extra care to prevent over pressurization and damage to this gauge while it is installed.*

4. Verify that there is 0 psi (kPa) residual pressure.

5. Remove the front access panel on the cab (under the Master Switch).

6. Set the DIP switches on the Brake Drag Timer (BKDRG TMR) to Off.

NOTE: *This will stop the time delay functions on the Brake Drag alarm.*

7. Open the dash cover on the inside of the passenger side of the cab.

8. Remove the Speed Even Relay (SPD R).

9. Install a jumper between terminals 30 and 87 in the terminal base.

NOTE: *This will apply 24 Vdc power to the Brake Drag switches with the truck parked.*

10. Depress the Brake pedal.

11. Verify that almost immediately both of the Brake Drag indicators light and the alarm sounds.

12. Release the Brake Pedal.

13. Verify that the Brake Drag indicators and the alarm go off.

14. Verify that the Brake pedal, and Hand and Load Brake systems are all released.

15. Replace the 0 to 100 psi (0 to 700 kPa) gauge with a hand held 0 to 50 psi (0 to 345 kPa) gauge.

NOTE: *Since the pressure at this point can exceed 50 psi (345 kPa) it is important to use hydraulic equipment or use extra care to prevent over pressurization and damage to this gauge while it is installed.*

16. Using extra care, very slowly pull the Hand Brake lever back to slightly apply the brakes until the Brake Drag indicator lights and alarm sounds while monitoring the pressure on the gauge. Hold the position of the lever steady.

a. On trucks equipped with the fixed pressure Brake Drag switches, the pressure is 32 to 38 psi (220 to 260 kPa).

b. On trucks equipped with the adjustable pressure Brake Drag switches, the pressure is 14 to 16 psi (95 to 110 kPa).

17. If the pressures are not at these levels:

a. Release the lever and verify that the pressures return to 0 psi (kPa) and the indicators and alarm go off.

b. Repeat step 16 several times to ensure the proper pressure is monitored.

c. On trucks equipped with the fixed pressure switch:

(1) Stop the engine.

(2) Release all pressure in the brake system by methods outlined in this procedure.

(3) Remove and replace the switch.

(4) Prepare to retest.

d. On trucks equipped with the adjustable pressure switch:

(1) Rotate the adjustment clockwise (to increase) or counter-clockwise (to decrease) the actuation pressure.

(2) Prepare to retest.

e. Repeat the above steps until the switch operates at the proper pressure.

18. After releasing all but the Park Brake system, move the pressure gauge to the other pressure switch circuit.

19. Repeat steps 16 and 17 on this circuit.

20. Once both of the switches are determined to be operating properly:

a. Remove the pressure gauge(s).

b. Remove the jumper between terminals 30 and 87 in the Speed Event Relay (SPD R) terminal base.

c. Install the Speed Even Relay.

d. Close the cover in the cab and secure.

e. Set the appropriate DIP switches on the Brake Drag Timer (BKDRG TMR) to On.

NOTE: *Typically for the nominal 6 second delay, this means switches 2 and 3 are on.*

f. Reinstall the previously removed front access panel on the cab (under the Master Switch).

21. Retest the operation of the system as described at the beginning of t his procedure to recheck the settings.

Hand Brake System Adjustment

The operation of the Hand Brake System may be tested as follows:

1. Fully apply the Hand Brake and hold. Verify that the:

a. Front and rear brake system pressures are as follows:

Front: 2700 to 2900 psi (18 615 to 19 995 kPa).
Rear: 1350 to 1450 psi (9 310 to 10 000 kPa)

b. Hand Brake indicator is lit.

2. Release the Hand Brake. Verify that the:

a. Front and rear brake pressures return to 0 psi (kPa).

b. Hand Brake indicator is off.

3. If the pressures found are not within the normal operating ranges:

a. Release the Hand Brake.

b. If both the front and rear systems must be increased or decreased, adjust single adjustment screw on the bracket on the controller valve as required.

c. If only the front or rear system requires adjustment, the individual spools should be adjusted as outlined in the instructions for the brake pedal controlled system earlier in this procedure.

NOTE: *This may affect normal previously adjusted brake pedal system operating pressures and should not be done unless absolutely necessary.*

d. Reapply the Hand Brake and retest.

e. If adjustments are made, retest the pedal controlled system.

f. Secure the adjustment screw with jam nut when the adjustment is completed.

g. Record the final pressures.

4. Verify that the hand brake switch is adjusted to cause the indicator on the control to light as the handle nears the detented "fully applied" position (last 1/3 of the travel) and is off the remainder of lever travel.

Load Brake System Testing

The operation of the load brake system may be tested as follows:

1. Verify that the Brake pedal and Hand Brake system are released.

2. Move the Load Brake switch to the Apply position.

3. Verify that the:

a. Front brake pressure remains a 0 psi (kPa).

b. Rear brake pressure increase to 1350 to 1450 psi (9 310 to 10 000 kPa).

c. Load Brake indicator lights.

4. Move the Load Brake switch to the Release position.

5. Verify that the:

a. Front and rear brake pressures return to 0 psi (kPa).

b. Load Brake indicator turns off.

Park Brake System Testing

The operation of the park brake system may be tested as follows:

1. Verify that the park brake calipers are all in their released position and that the pressure to the system calipers is:

2850 to 2950 psi (19 650 to 20 350 kPa).

2. If the park brake system pressure is not in this operating range, and the truck is equipped with an integral pressure reducing valve in the manifold, it may be adjusted as follows:

a. Apply the park brakes.

b. Verify that the park brake system operating pressure is 0 psi (kPa).

c. Loosen the locking nut securing the adjusting screw on the pressure reducing valve.

d. Turn the adjusting screw inward (to raise the pressure) or outward (to lower the pressure) as required to obtain the desired pressure.

NOTE: *The pressure will increase or decrease approximately 280 psi (1 930 kPa) for each full revolution of the adjusting screw.*

e. Release the park brake calipers and retest as outlined in step 1.

f. Adjust as outlined in step 2 and retest until the proper system pressure is obtained.

g. Once testing and adjustment is complete, secure the valve's adjusting screw with the locknut.

3. With the Hand Brake, Load Brake, and Brake pedal released, move the Park Brake switch to the Apply position, hold for a minimum of two seconds, and then release. Verify that the:

a. Park brake calipers apply.

b. Park brake system pressure is 0 psi (kPa).

c. The Park Brake indicator on the control lights.

4. Move the Park Brake switch to the Release position, hold for a minimum of two seconds, and then release. Verify that the:

a. Park brake calipers are released.

b. Park brake system pressure is again at the pressure outlined in step 1.

c. Park Brake indicator on the control is not lit.

5. Stop the truck engine.

6. Using the same equipment used to bleed the brake calipers, slowly open one of the park brake caliper bleeders. Verify that the:

a. Oil flows briefly then stops, verifying the operation of the Park Brake release solenoid valve.

b. Park Brake indicator comes on when the park brake system pressure decreases to less than 1450 to 1550 psi (10 000 to 10 690 kPa).

7. Close the caliper bleed screw.

8. Record the switch actuation pressure.

9. Start the engine and allow to operate at low idle speed. Bleed any entrapped air from the caliper tested.

10. Release the park brakes.

11. Stop the engine.

Low Brake Pressure Switch Test

The operation of the low brake pressure monitoring system may be tested as follows:

1. Repeatedly apply and release the Brake pedal to decrease the hydraulic pressure in the accumulators.

2. Verify that the Low Brake Pressure indicator lights when the pressure decreases to 2050 to 2150 psi (14 135 to 14 825 kPa) on the gauge monitoring the supply accumulator pressure. Record this pressure.

NOTE: *The brakes must be applied slowly as the accumulator pressure approaches the set point in order to adequately verify the pressure switch setting.*

Optional Auto Apply System Test

The operation of the optional auto-apply system may be tested as follows:

1. Continue to apply and release the Brake pedal while monitoring the Brake Supply Accumulator Pressure and the front and rear brake system delivery pressures.

2. Verify that at 1350 to 1450 psi (9 310 to 10 000 kPa) pressure in the supply accumulator, the auto apply feature activates. This may be documented by the fact that the pressure on the brake systems do not return to "0" psi (kPa) when the pedal is released.

3. Record the actuation pressure.

4. Discontinue the pedal apply and release cycling.

Testing Brake Accumulator Drain Systems

Test the operation of the manual drain valves as follows:

1. Verify that there is pressure in the supply accumulator. If not start the engine and allow the system accumulators to recharge.

2. Open the rear brake accumulator drain valve. This may be done by opening the needle valve assembly or by pulling out the button and holding as applicable to the system.

3. Verify that the pressure in the supply accumulator decreases to 0 psi (kPa).

4. Close the drain valve as required.

5. Restart the engine and allow the accumulator system to recharge.

6. Repeat steps 2 through 5 with the front brake accumulator drain valve.

Propulsion System Interlock Testing

Verify the operation of the propulsion interlocks as follows:

NOTE: *To properly test the system the:*
1. Truck's 24 volt and propulsion electrical systems must be installed and operational.
2. Engine should be off to prevent accidental movement and to ease in determining operation.
3. Brakes should all be released.

IMPORTANT: *It may be necessary to discontinue testing and restart the engine during this test to maintain adequate pressure to operate the brakes.*

1. Move the Shifter to the Forward position.

2. Depress the Throttle pedal. Verify that the contactors pick up and sequence.

3. Release the Throttle pedal. Verify that the contactors drop out.

4. Fully apply the Hand Brake lever and hold.

5. Depress the Throttle pedal. Verify that the contactors do not pick up.

6. Release the Throttle pedal.

7. Apply the Load Brake system.

8. Depress the Throttle pedal. Verify that the contactors do not pick up.

9. Release the Throttle pedal.

10. Release the Load brake system.

11. Apply the Park Brakes.

12. Depress the Throttle pedal. Verify that the contactors do not pick up.

13. Release the Throttle pedal.
14. Install the covers removed on the hydraulic components box.

15. Install the wheelmotor covers.

SERVICE

For detailed service information, refer to the individual component modules in Section 5 - Hydraulic System.

KEY A86509

001.	Brake Pilot Valve	068.	Adapter Fitting	134.	Hose Assembly
002.	Brake Controller Valve	069.	Adapter Fitting	135.	Hose Assembly
003.	Adapter Fitting	070.	Capscrew	136.	Hose Assembly
004.	Not Used	071.	Cushion Clamp	137.	Hose Assembly
005.	Capscrew	072.	- 074. Not Used	138.	Hose Assembly
006.	Flatwasher	075.	Control Cable Clevis	139.	Not Used
007.	Locknut	076.	Not Used	140.	Nameplate
008.	Adapter Fitting	077.	Shuttle Valve	141.	Nameplate
009.	Not Used	078.	Capscrew	142.	- 144. Not Used
010.	Controller Cable	079.	Lockwasher	145.	Adapter Fitting
011.	Capscrew	080.	Adapter Fitting	146.	Not Used
012.	Locknut	081.	Adapter Fitting	147.	Not Used
013.	Adapter Fitting	082.	Adapter Fitting	148.	Adapter Fitting
014.	– 019. Not Used	083.	- 088. Not Used	149.	Adapter Fitting
020.	Grip	089.	Hydraulic Components Box	150.	- 155. Not Used
021.	Adapter Fitting	090.	Accumulator Bracket	156.	Adapter Fitting
022.	Conduit Locknut	091.	Rod	157.	Plug
023.	Not Used	092.	Locknut	158.	Venturi Fitting
024.	Not Used	093.	Adapter Fitting	159.	Test Coupling
025.	Brake Manifold Assembly	094.	Pressure Gauge	160.	O-ring
026.	Low Brake Pressure Switch	095.	Adapter Fitting	161.	O-ring
027.	Not Used	096.	Brake Control Cable Assembly	162.	Adapter Fitting
028.	Adapter Fitting	097.	- 100. Not Used	163.	Plug
029.	Adapter Fitting	101.	Hose Assembly	164.	Adapter Fitting
030.	Lockwasher	102.	Hose Assembly	165.	Not Used
031.	Brake Accumulator	103.	Hose Assembly	166.	Clamp Support Assembly
032.	Flatwasher	104.	Tube Assembly	167.	Not Used
033.	Capscrew	105.	Tube Assembly	168.	Hose Assembly
034.	Flatwasher	106.	Tube Assembly	169.	Venturi Fitting
035.	Park Brake Pressure Switch	107.	Not Used	170.	Quick Coupling
036.	Capscrew	108.	Hose Assembly	171.	Not Used
037.	Clamp Halves	109.	Tube Assembly	172.	Adapter Fitting
038.	- 040. Not Used	110.	Tube Assembly	173.	– 175. Not Used
041.	Adapter Fitting	111.	- 114. Not Used	174.	Adapter Fitting
042.	Not Used	115.	Hose Assembly	175.	Adapter Fitting
043.	Clamp Support Assembly	116.	Not Used	176.	Adapter Fitting
044.	Clamp Halves	117.	Tube Assembly	177.	Adapter Fitting
045.	Capscrew	118.	Tube Assembly	178.	- 183. Not Used
046.	Not Used	119.	Tube Assembly	184.	Hose Assembly
047.	Capscrew	120.	Tube Assembly	185.	- 190. Not Used
048.	- 051. - Not Used	121.	Tube Assembly	191.	Capscrew
052.	Clamp Support Assembly	122.	Not Used	192.	– 195. Not Used
053.	Not Used	123.	Not Used	193.	Adapter Fitting
054.	Capscrew	124.	Tube Assembly	196.	Plug
055.	- 057. Not Used	125.	Hose Assembly	197.	Capscrew
058.	Adapter Fitting	126.	Not Used	198.	Not Used
059.	- 061. Not Used	127.	Tube Assembly	199.	Not Used
062.	Adapter Fitting	128.	Tube Assembly	200.	Rod
063.	Capscrew	129.	Not Used	201.	Not Used
064.	Not Used	130.	Hose Assembly	202.	Not Used
065.	Hose Bracket	131.	Hose Assembly	203.	Brake Drag Pressure Switch
066.	Not Used	132.	Hose Assembly	206.	– 206. Not Used
067.	Adapter Fitting	133.	Hose Assembly	207.	Adapter Fitting

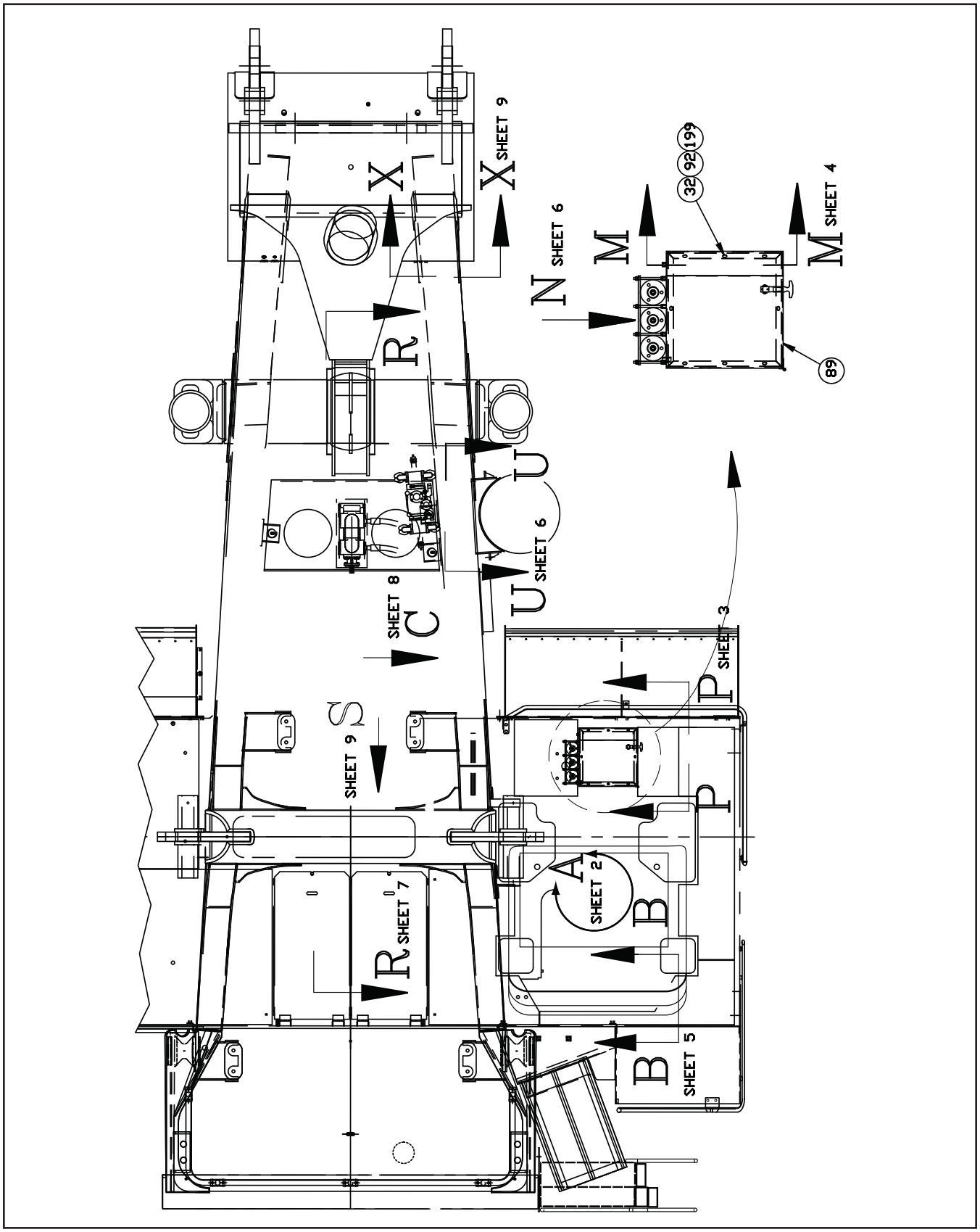
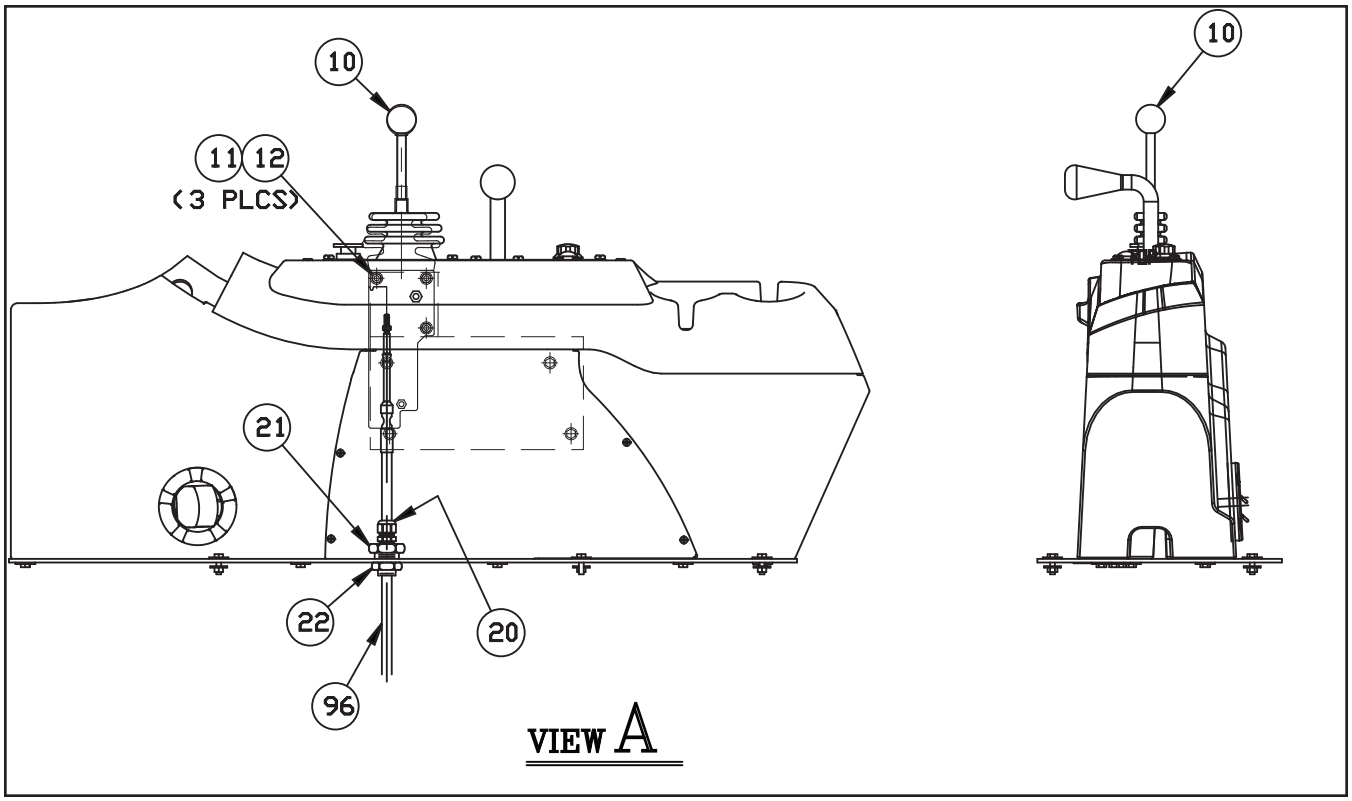


FIGURE 7 - BRAKE SYSTEM ASSEMBLY (A86509 SHEET 1 OF 10)



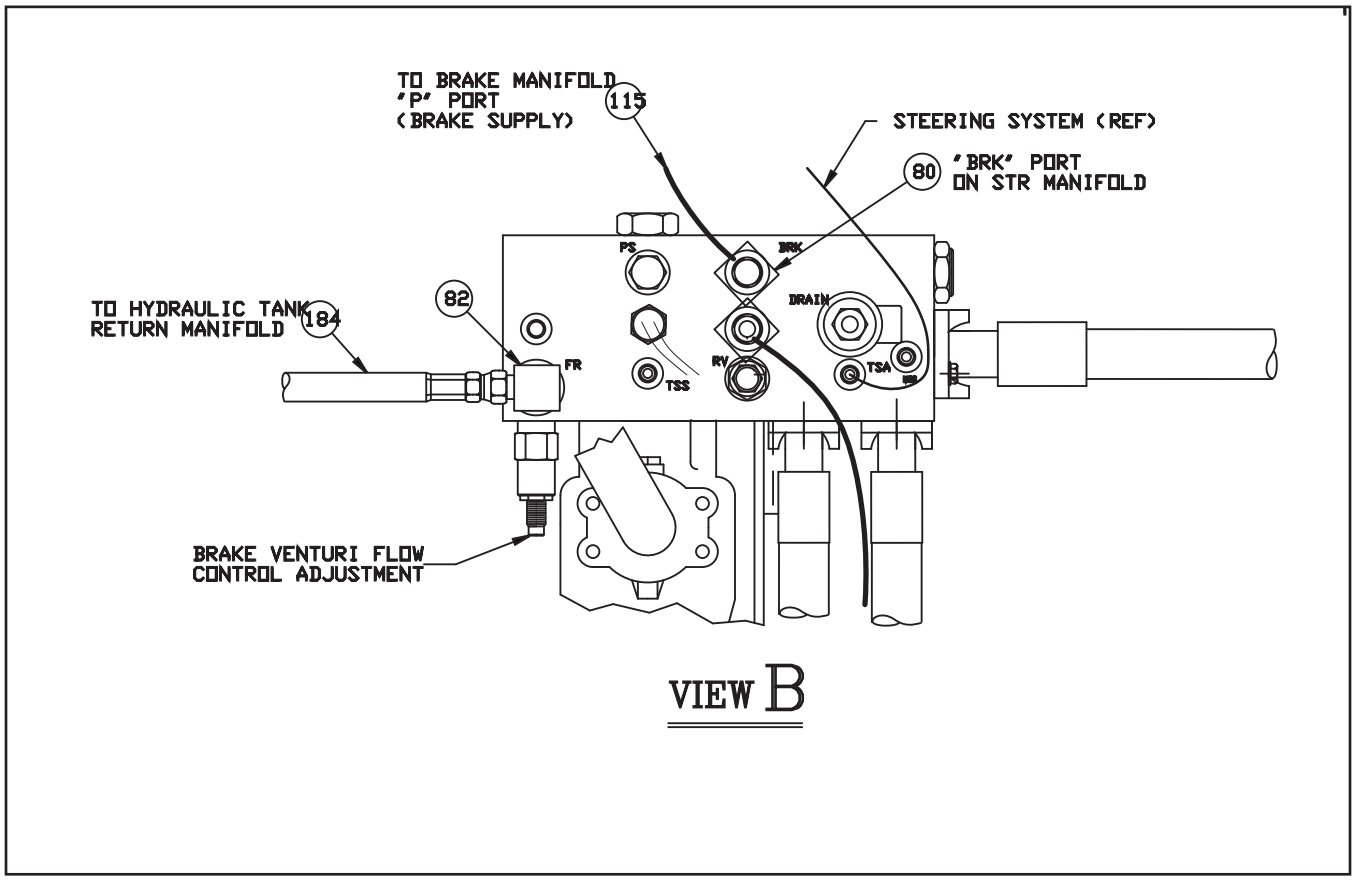


FIGURE 7 - BRAKE SYSTEM ASSEMBLY (A86509, SHEET 2 OF 10)

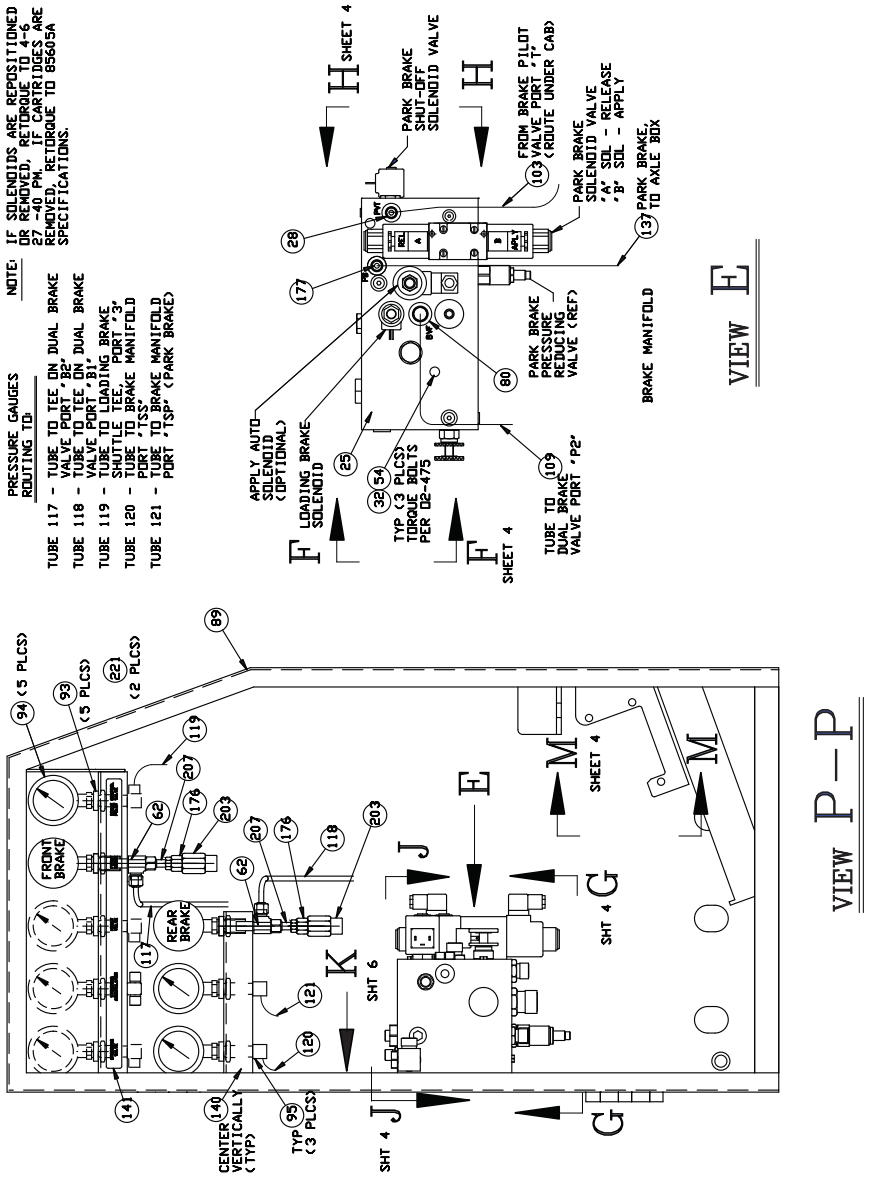


FIGURE 7 - BRAKE SYSTEM ASSEMBLY A86509, SHEET 3 OF 10)

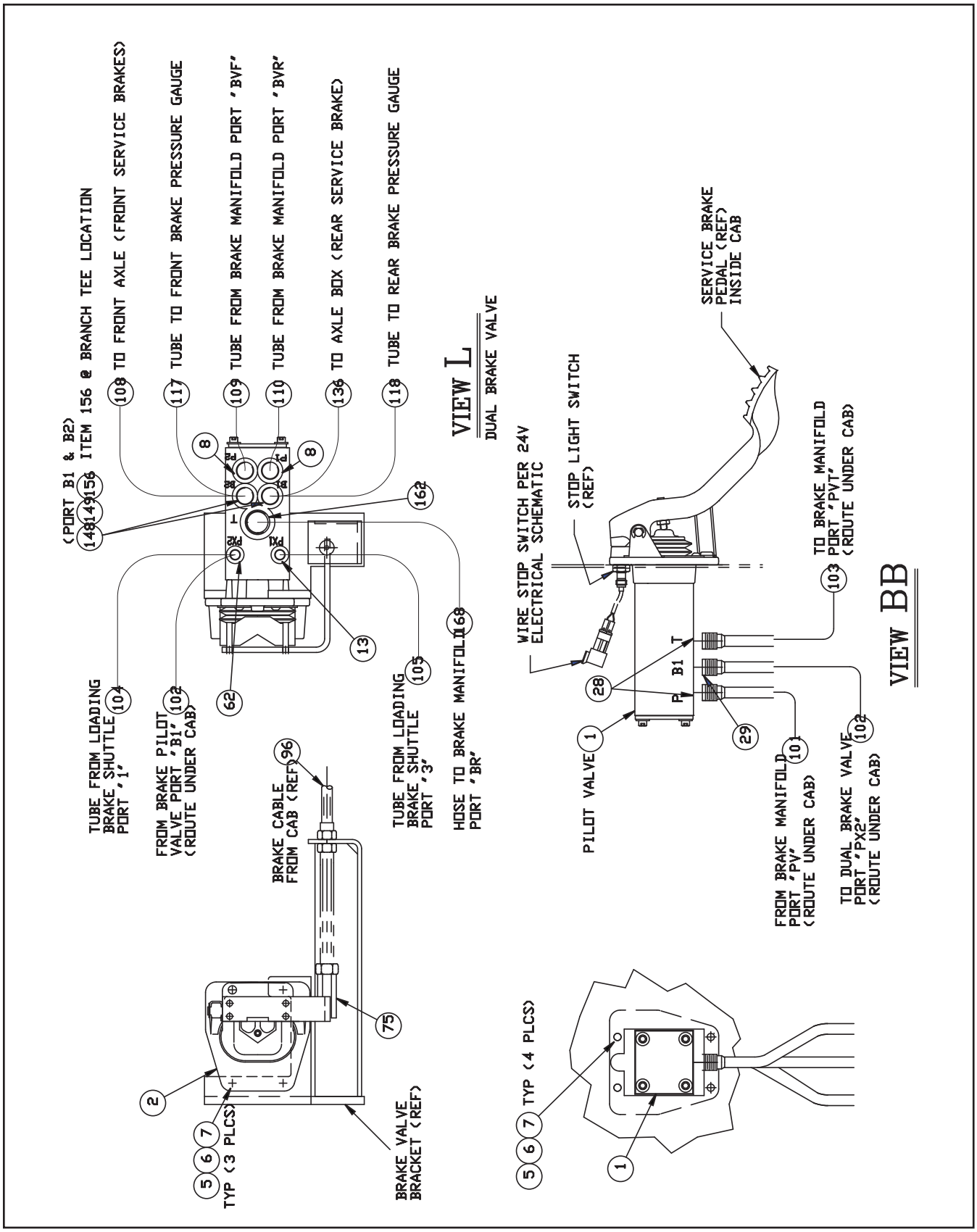


FIGURE 7 - BRAKE SYSTEM ASSEMBLY (A86509, SHEET 4 OF 10)

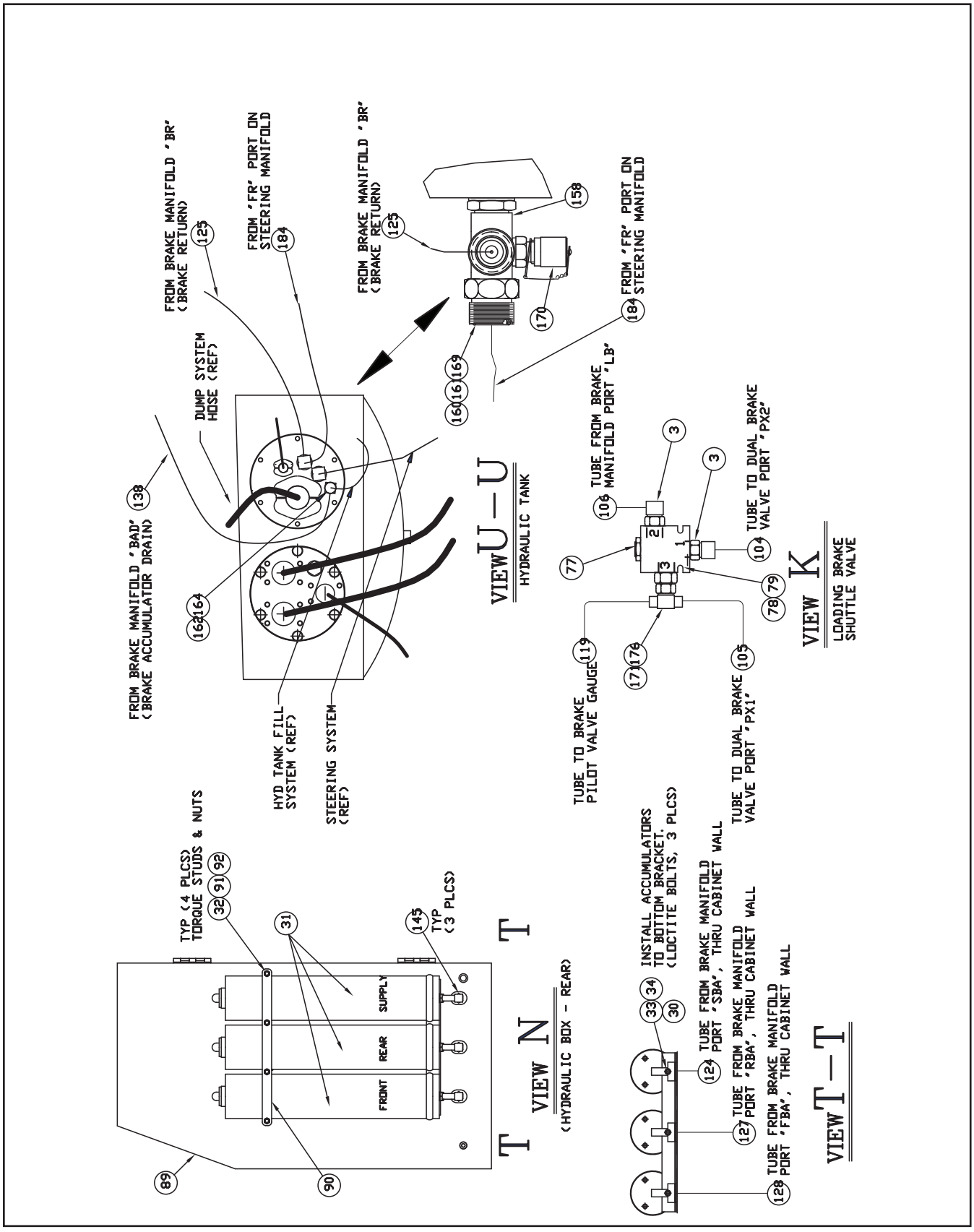


FIGURE 7 - BRAKE SYSTEM ASSEMBLY (A86509, SHEET 5 OF 10)

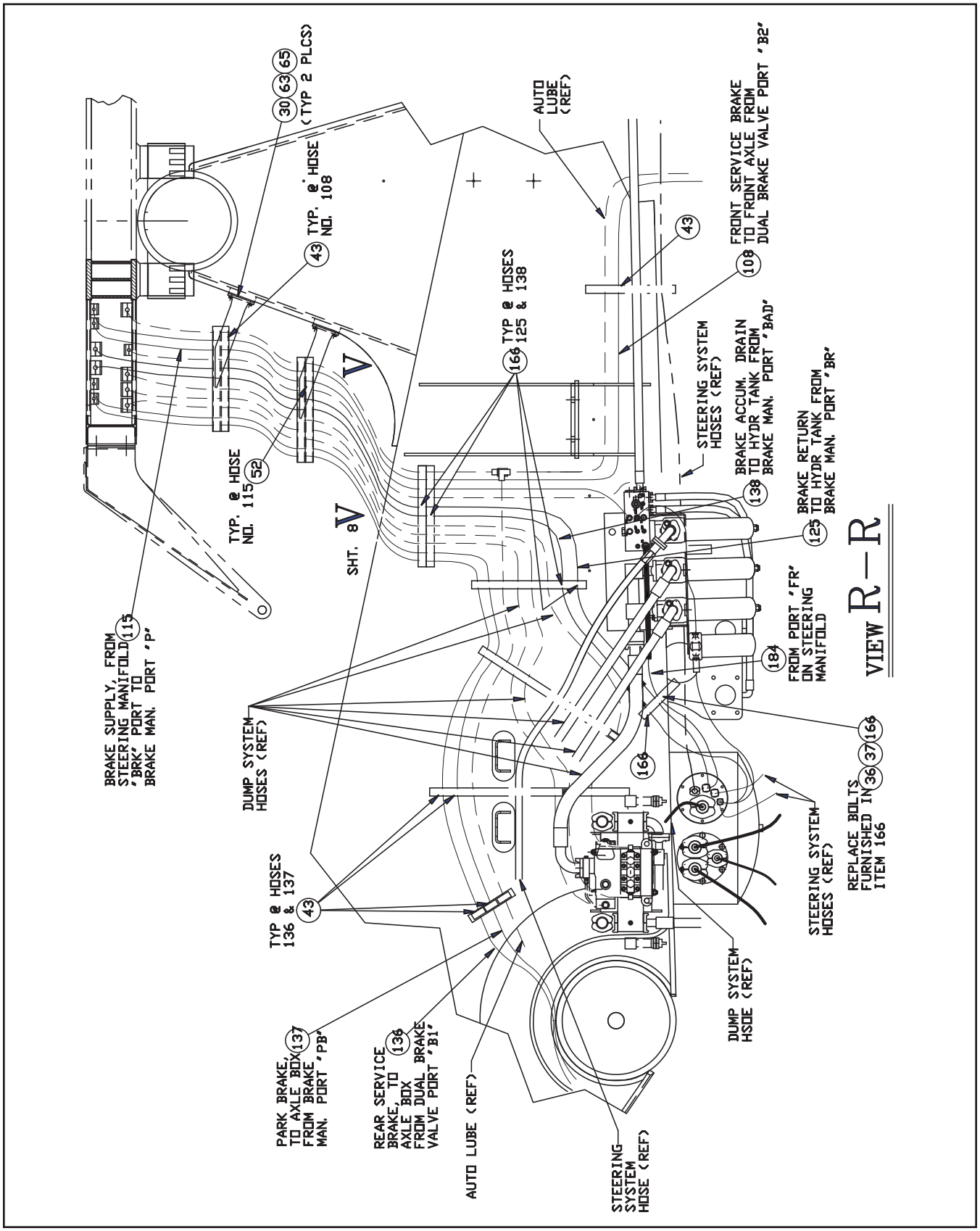


FIGURE 7 - BRAKE SYSTEM ASSEMBLY (A86509, SHEET 6 OF 10)

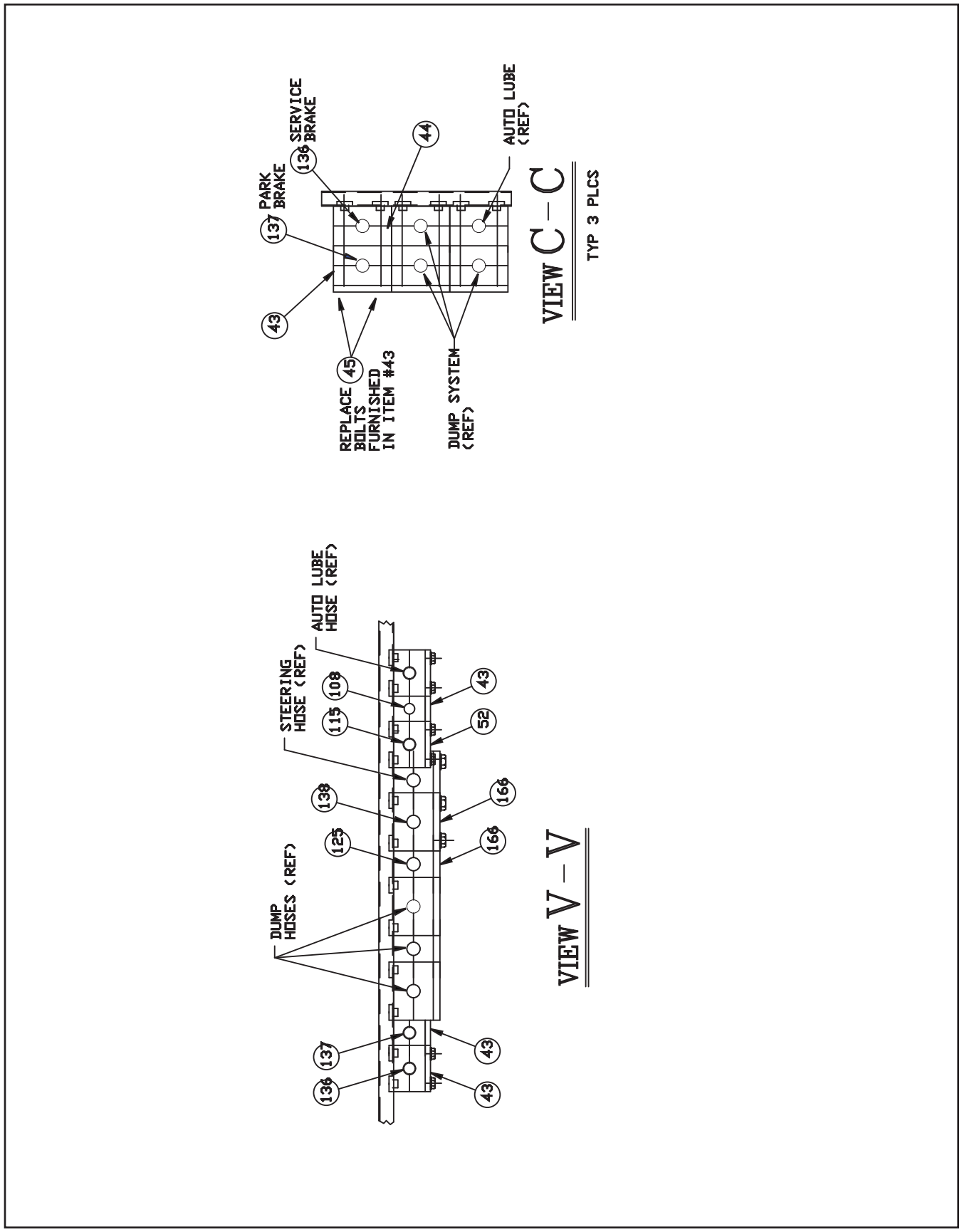


FIGURE 7 - BRAKE SYSTEM ASSEMBLY (A86509, SHEET 7 OF 10)

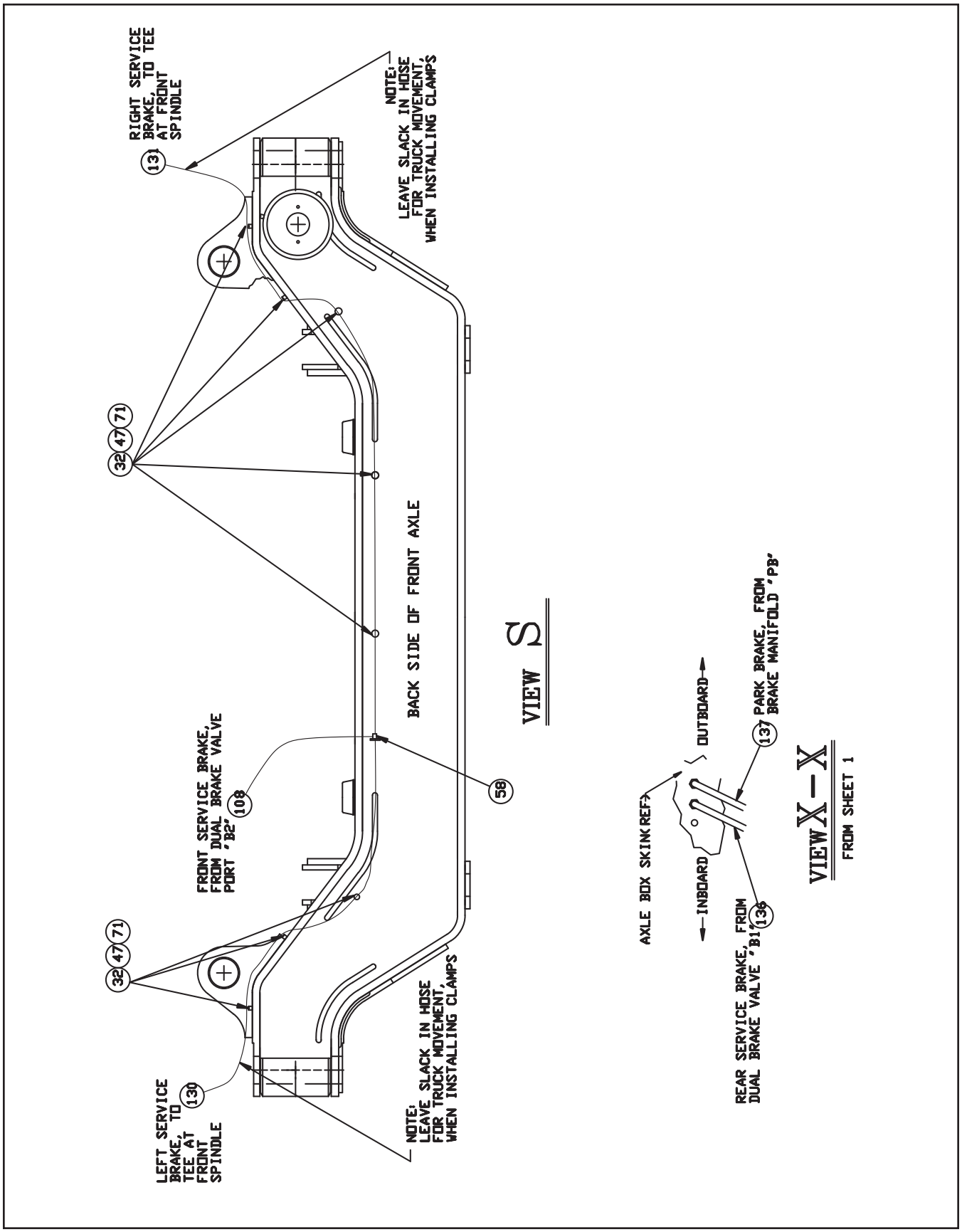


FIGURE 7 - BRAKE SYSTEM ASSEMBLY (A86509, SHEET 8 OF 10)

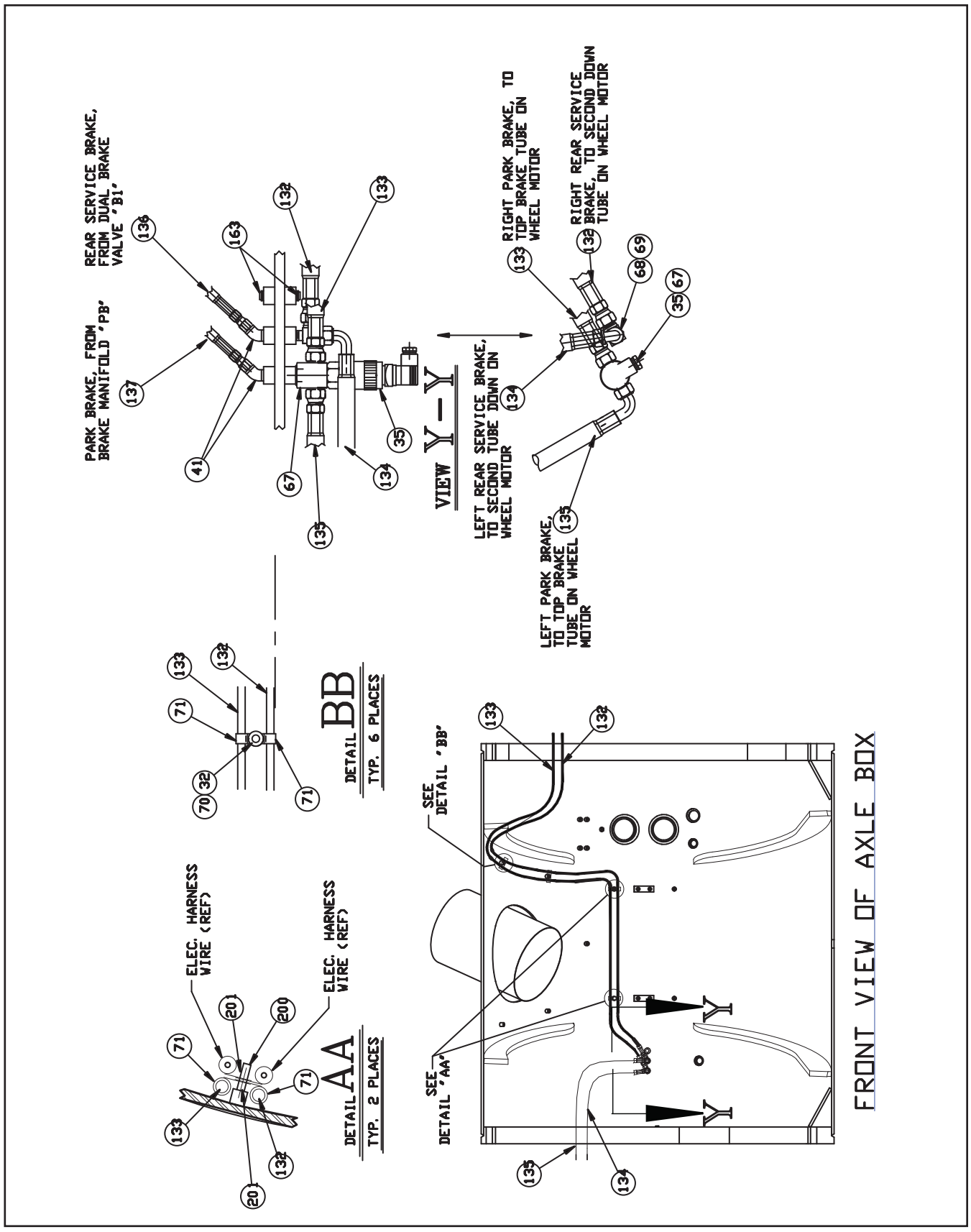


FIGURE 7 - BRAKE SYSTEM ASSEMBLY (A86509, SHEET 9 OF 10)

ACCUMULATORS

DESCRIPTION AND LOCATION

The accumulators are heavy metal cylinders with a combination of removable and fixed or welded ends or heads. They are identified by the large gas valve and protective cover on the lower or gas end.

NOTE: *There are three versions of the accumulators. 1. Earlier versions of the accumulators with fixed hydraulic end caps incorporated wear bands and T-seals as shown in Figure 2. Later versions used a different seal arrangement and a primary seal with two back up rings as shown in Figure 3. Different pistons are required with each type of seal configuration. It is important to determine which configuration the accumulator has and to reinstall the correct type seals.*
2. Accumulators equipped with a removable end cap on the hydraulic end incorporate seals similar to those in the later version of the fixed end version. This is shown in Figure 4.

The accumulators are mounted together on the superstructure near the hydraulic component box.

OPERATION

The accumulators store energy, oil under pressure. They serve several distinct functions in this application.

1. They act as a ready source of pressurized oil to the system, including a reserve in the case of restricted or inadequate flow from the supplying pumps.

2. They also allow the system to maintain a more constant pressure by absorbing high or low pressure surges.

The accumulator used operates on the sliding piston principle. One end is precharged (pressurized) with dry nitrogen gas. The other end is plumbed directly into the system supply lines. A sliding multi-ringed piston separates the oil from the gas charge.

With no oil in the fluid end, the precharged gas end holds the piston against the fluid end cap. As pressurized oil enters the fluid end, it causes the piston to move, compressing the gas. As oil is removed to assist in meeting the system flow demands, the compressed gas moves the piston back down the cylinder. In this accumulator the pressure in the hydraulic and gas sides are always equal.

MAINTENANCE AND ADJUSTMENT

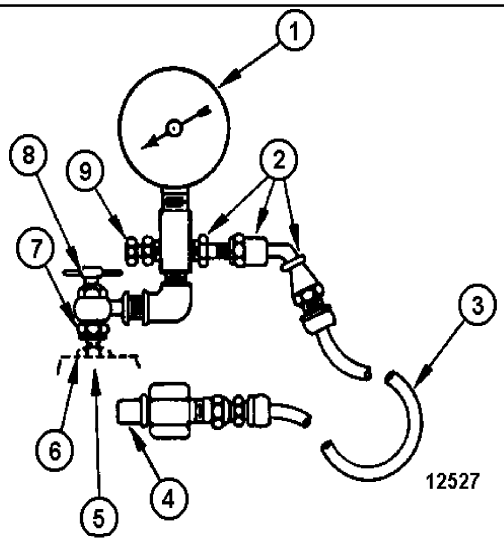
Periodic maintenance should include the following steps:

1. Inspect the accumulator cylinders and connecting hardware for evidence of leakage, damage, or wear. Repair or replace as required.

2. Check the precharge pressure level of the gas in the gas end of the accumulator as outlined in the procedure entitled Precharging the Accumulator in these instructions to the pressure defined in the system test procedures in Section 5 - Hydraulic System in this manual.

Recharge as instructed. Frequent recharging indicates the need to service the unit (replace the seals).

NOTE: *Worn piston seals may allow the gas to enter the hydraulic oil in the system. The addition of this gas to the oil would adversely affect system operation (possibly including spotty or uneven system performance and "spongy" or unsteady operation) similar to operation with air or other gases in the system. If gas does transfer, it is important to properly "bleed" all entrapped contaminants from the oil prior to placing the truck into service.*



KEY	12527
1.	PRESSURE GAUGE
2.	HIGH PRESSURE FITTINGS
3.	HOSE ASSEMBLY
4.	CONNECTION TO NITROGEN BOTTLE
5.	ACCUMULATOR
6.	ACCUMULATOR GAS VALVE
7.	SWIVEL NUT
8.	GAS CHECK STEM
9.	BLEEDER VALVE

FIGURE 1 - ACCUMULATOR PRECHARGING EQUIPMENT

PRECHARGING THE ACCUMULATOR (Figures 1, 2, 3, and 4)

The accumulators should be precharged as follows: (Figure 1 unless otherwise identified.)

IMPORTANT: *The supply cylinder must be of the type that vaporizes the nitrogen when it is withdrawn. Do not charge with liquid nitrogen or any other gas.*

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction and park brake systems.

2. Drain all hydraulic pressure from each of the accumulators by pulling all valves and holding until indications that all pressure is released are noted (typically the "noise" of the released pressurized oil stops). Release the valve(s).

⚠ DANGER

Never loosen any line or begin any activity without first releasing all pressure from the system.

3. Verify that the accumulator end caps are installed flush with the body and the gas valve is secured tightly.

4. Remove the gas valve guard and cap.

5. Turn the gas chuck stem or "T" handle (on the charging assembly) completely out (counter-clockwise).

NOTES:
1. The equipment required for checking or changing system pressure is contained in Figure 1.
2. It is strongly recommended that a regulator be installed on the high pressure nitrogen bottle that is used as a supply source. The regulator should be adjusted to release maximum pressure only slightly above that required by the component or system being charged.

6. Install the gas chuck swivel nut (7) onto the gas valve and, using a suitable wrench, torque to 10 to 15 in-lb (1.1 to 1.7 Nm).

⚠ CAUTION

Do not loop or twist the hose, as it will stiffen when gas pressure is released from the nitrogen bottle.

7. Close the bleeder screw valve (9) on the charge equipment.

8. Turn the gas check stem or "T" handle clockwise until it reaches the end of its travel. This will depress the core in the accumulator gas valve.

9. Read the pressure indicated on the pressure gauge.

a. If the pressure is less than that listed in the appropriate test procedure, open the nitrogen bottle control valve slightly and allow the accumulator to fill slowly. Shut off the valve when the gauge indicates the desired pressure.

b. If the pressure is greater than that listed in the appropriate test procedure, open the bleeder valve on the charging equipment (typically below the gauge and opposite the gas valve) slightly, for a brief moment, then close to release the extra pressure.

⚠ WARNING

Escaping nitrogen may be cold enough to cause personal injury if it comes into contact with the skin. Care must be taken to avoid direct contact between the gas and any part of the body.

⚠ WARNING

Do not attempt to reduce accumulator precharge pressure by directly depressing the valve core, as high pressure may rupture the rubber valve seat. Instead, use the charging assembly, and use the bleeder valve.

NOTE: *If large quantities of nitrogen are added or removed from the accumulator during this process, it is recommended that the accumulator temperature be allowed to stabilize prior to taking final pressure measurements. This may be done by allowing the system to set idle 10 to 15 minutes after adding or removing gas.*

10. When charging is complete, turn the gas check stem or "T" handle (8) completely out (counter-clockwise) until it reaches the stop. Open the bleeder valve (9) to allow entrapped pressure to escape.

11. Loosen the swivel nut (7) and remove the assembly. Hold the accumulator's gas valve to prevent it from coming loose.

⚠ WARNING

Never loosen the swivel nut (7) from the gas valve without first turning the gas check stem or "T"

handle (8) completely out and opening the bleeder valve (9).

12. Install the cap, torqued to 10 to 15 in.-lb (1.1 to 1.7 Nm). Install the gas valve guard.

NOTE: *The procedures are similar for checking or releasing the precharge pressure. The seals should be replaced when a continuing change in the precharge pressure is detected. As the pressure losses are observed, begin a program of frequent checking as a guide to how soon seal replacement must be made. In this manner, maintenance can be planned ahead without the need for any emergency repairs. Do not continue to operate a truck with leaky or damaged accumulators.*

13. Start the truck engine, allow the accumulators to recharge with hydraulic oil, and check system operation.

14. Remove the charging kit from the supply bottle, cap and store each properly.

REMOVAL

The accumulators may be removed from the truck as follows:

1. Drain all hydraulic pressure from the accumulators and entire system as outlined in system procedures in Section 5 - Hydraulic System.

2. Drain all gas precharge pressure as outlined in the procedures in Maintenance and Adjustment.

3. Remove the precharging assembly from the accumulator.

4. Unscrew the gas valve (part way) until any remaining gas begins to escape. Wait until all gas is exhausted before continuing.

Escaping nitrogen may be cold enough to cause personal injury if it comes into contact with the skin. Care must be taken to avoid direct contact between the gas and any part of the body.

5. After all pressure is drained, remove the gas valve.

6. Remove the hydraulic connection to the accumulator. Allow any oil to drain into an appropriate container. Cap all openings, and label each to aid in installation.

7. Remove the capscrews that secure the accumulators to the mounting bracket.

8. Lift the accumulator(s) clear of the mounting bracket.

NOTE: *The threaded holes in the top end cap may be used as a means of attachment for lifting. An appropriate sling around the body may also be used.*

DISASSEMBLY (Figures 2, 3, and 4)

The accumulator may be disassembled as follows:

1. Verify that the gas valve has been removed. If it is still installed, verify that all of the gas and hydraulic oil has been released as outlined in the procedures in Maintenance and Adjustment.

Deep vise marks, scratches, or distortions of the outer tube may cause stress concentrations in the tube under high pressure. Such concentrations may eventually cause component leakage or failure.

2. Set the accumulator horizontal and secure with a strap wrench or vise, gripping over the hydraulic end cap.

3. Install capscrews in the threaded holes in the removable gas end cap.

Always remove the gas cap, the end cap containing the gas charging valve, first.

4. Remove the cap by using a long bar and carefully “prying” on the capscrews installed for this purpose.

5. Inspect, then remove, the seal ring and back up ring from the end cap.

6. On accumulators equipped with removable hydraulic end cap assemblies, they may now be removed by repeating steps 3, 4, and 5 on this end.

7. Remove the piston assembly by carefully tapping on the oil end with a wooden dowel through the oil hole in the fixed end as it is guided out of the body. Extra care should be taken to prevent damage to the piston or the seals on the threads of the cylinder body.

IMPORTANT: *Never try to remove the piston by applying compressed air to the opposite end.*

8. Inspect, then remove, the seals and rings from the piston.

IMPORTANT: *There are two versions of the accumulators with fixed hydraulic end caps. Earlier versions incorporated wear bands and T-seals as shown in Figure 2. Later versions used a different seal arrangement and a primary seal with two back up rings as shown in Figure 3. Different pistons are required with each type of seal configuration. It is important to determine which configuration the accumulator has and to reinstall the correct type seals.*

NOTE: *To remove the seals from the piston, lift the seal ring with a small, smooth screwdriver or similar tool. Move the tool around the piston several times while using the other hand to "work" each of the rings off the piston.*

9. On earlier version accumulators with fixed hydraulic end caps, inspect, then remove the wear bands (3) from the piston (2).

INSPECTION AND REPAIR

The accumulator may be serviced as follows:

1. Thoroughly clean all metal parts in solvent and dry with compressed air.

2. Clean the bore of the cylinder body and piston with a clean, lintless cloth soaked in clean solvent.

NOTE: *The bore and piston must be clean of any particles visible, or detectable to the touch.*

3. Inspect the piston for evidence of cracks, burrs (especially around seal ring grooves), for damage. Also inspect for damage due to "bottoming" on the end cap. Repair or replace as required.

4. Using a light, examine the body bore for scratches or scoring. Inspect the end caps for damaged threads or burrs on O-ring grooves. Minor nicks, scratches or light scoring of the body bore can be removed by using crocus cloth. Dress the bore until all apparent imperfections have been removed.

5. Inspect the seal rings. If damaged, determine the cause and correct before proceeding. They should all be replaced at each disassembly.

IMPORTANT: *There are two versions of the accumulators equipped with fixed hydraulic end cap assemblies. Earlier versions incorporated wear bands and T-seals as shown in Figure 2. Later versions used a different seal arrangement and a primary seal with two back up rings as shown in Figure 3. Different pistons are required with each type of seal configuration. It is important to determine which configuration the accumulator has and to reinstall the correct type seals. The piston must be changed if the later type of seal is to be used in an accumulator originally equipped with the earlier type of seal.*

NOTE: *The piston "rides"' on the seal rings and does not touch the accumulator bore.*

ASSEMBLY

The accumulator may be assembled as follows:

1. Coat all seals and internal parts with clean hydraulic fluid compatible with that used in the truck's hydraulic system.

2. Install the primary seals on the piston as shown in Figures 2, 3 and 4.

IMPORTANT: *There are two versions of the accumulators with fixed accumulator ends. Earlier versions incorporated wear bands and T-seals as shown in Figure 2. Later versions used a different seal arrangement and a primary seal with two back up rings as shown in Figure 3. Different pistons are required with each type of seal configuration. It is important to determine which configuration the accumulator has and to reinstall the correct type seals. The piston must be changed if the later type of seal is to be used in an accumulator originally equipped with the earlier type of seal.*

NOTES:

1. The rings may have to be stretched slightly to install. Once installed they should be allowed to relax to their original size for several minutes. Cooling can quicken this relaxation. However, make sure all moisture residue is removed prior to continuing assembly and that the seals are straight, not twisted.

2. Exercise special care not to "pinch" or distort the back up rings.

3. Install the wear bands or other seals on the piston oriented as shown in Figures 2, 3, and 4.

4. Install the piston assembly in the bore of the cylinder body. The larger hollow side of the piston should be directed toward the gas end.

NOTES:
1. The piston must go into the bore exactly square and very slowly, as the seal ring will move if done slowly, but may be damaged if forced quickly. The piston will fit snug. Do not let the seal rings "drag" on the threads.
2. Use a hammer and a wooden dowel or block to tap the piston into place until all of piston is at least 2 inches (50 mm) below the beginning of the honed bore. Keep force against the piston while tapping the seals through the bore chamfer, otherwise the piston will bounce back, damaging the seals. Cover the port opening to keep out dirt.

5. On accumulators equipped with removable hydraulic end cap assemblies, install a seal ring and back up ring on the hydraulic end cap. Lubricate the seal ring with hydraulic oil. Install onto the body and tighten until the O-ring forms a seal and "tightens". Do not over tighten as this may damage the seal assembly.

6. Install a seal ring and back up ring on the gas end cap. Lubricate the seal ring with hydraulic oil. Install onto the body and tighten until the O-ring forms a seal and "tightens". Do not over tighten as this may damage the seal assembly.

NOTES:
1. Exercise care not to "drag" the seal rings over the threads when installing.
2. The cap should "bottom out" on the body. Be careful not to over-tighten.

7. Install the gas valve.

8. Install the gas valve cover and guard with spacer. Secure with capscrews.

INSTALLATION

The accumulators may be installed as follows:

1. Position the accumulator in the mounting bracket.

NOTE: *The threaded holes in the gas end cap may be used as a means of attachment for lifting. An appropriate sling around the body may also be used.*

2. Install the mounting hardware.

3. Secure the unit in place with capscrews and washers.

4. Install the hydraulic connections to the accumulator.

5. Precharge the gas side of the accumulator as outlined in the instructions in the procedures in Maintenance and Adjustment.

6. Install the gas valve cap.

7. Start the truck engine and allow the systems to pressurize or charge normally. Inspect for evidence of leakage or damage.

8. Bleed all entrapped air or contamination from each of the systems as outlined in the procedures in Section 5 - Hydraulic System.

9. Test the system operation as outlined in the procedures in Section 5 - Hydraulic System.

KEY 56297			
01.	Cylinder Body	07.	End Cap O-ring Seal
02.	Piston	08.	Back-up Ring
03.	Piston Wear Band	09.	Gas Valve Guard Spacer
04.	Piston T-Seal Ring	10.	Capscrews
05.	Instruction Plate	11.	Gas Valve
06.	Gas End Cap	12.	Gas Valve Guard

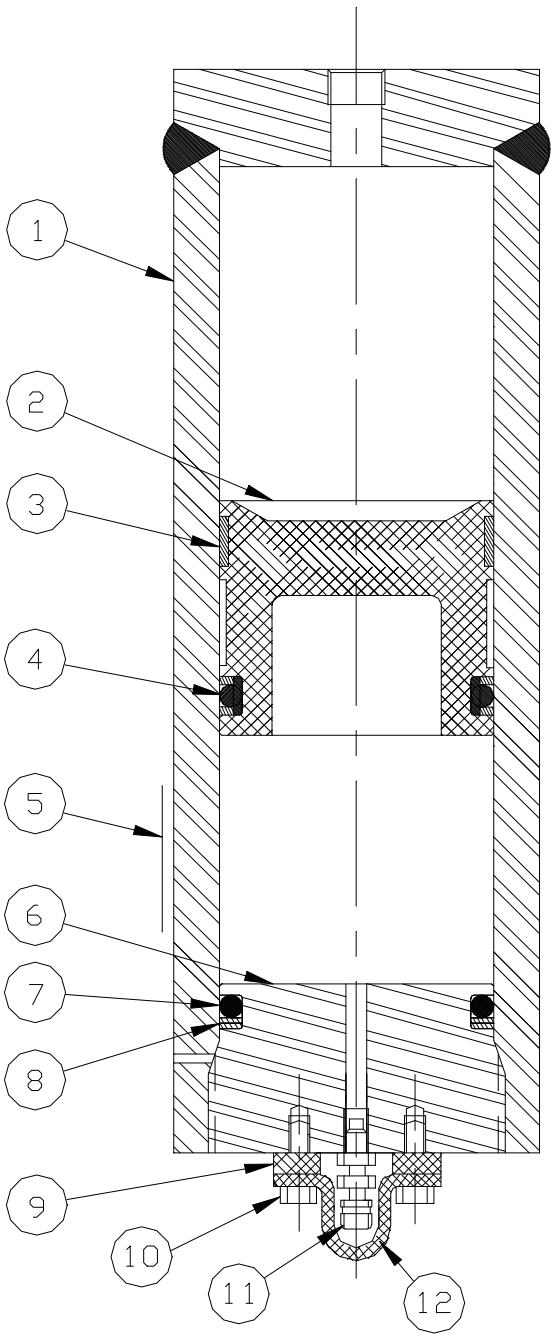


FIGURE 2 - ACCUMULATOR ASSEMBLY – EARLIER VERSION WITH FIXED HYDRAULIC END CAP ASSEMBLY

KEY 56597			
1.	Cylinder Body	07.	End Cap O-ring Seal
2.	Piston	08.	Back-up Ring
3.	Piston Seals	09.	Gas Valve Guard Spacer
4.	Back-up Ring, Piston	10.	Capscrews
5.	Primary Piston Seal	11.	Gas Valve
6.	Gas End Cap	12.	Gas Valve Guard

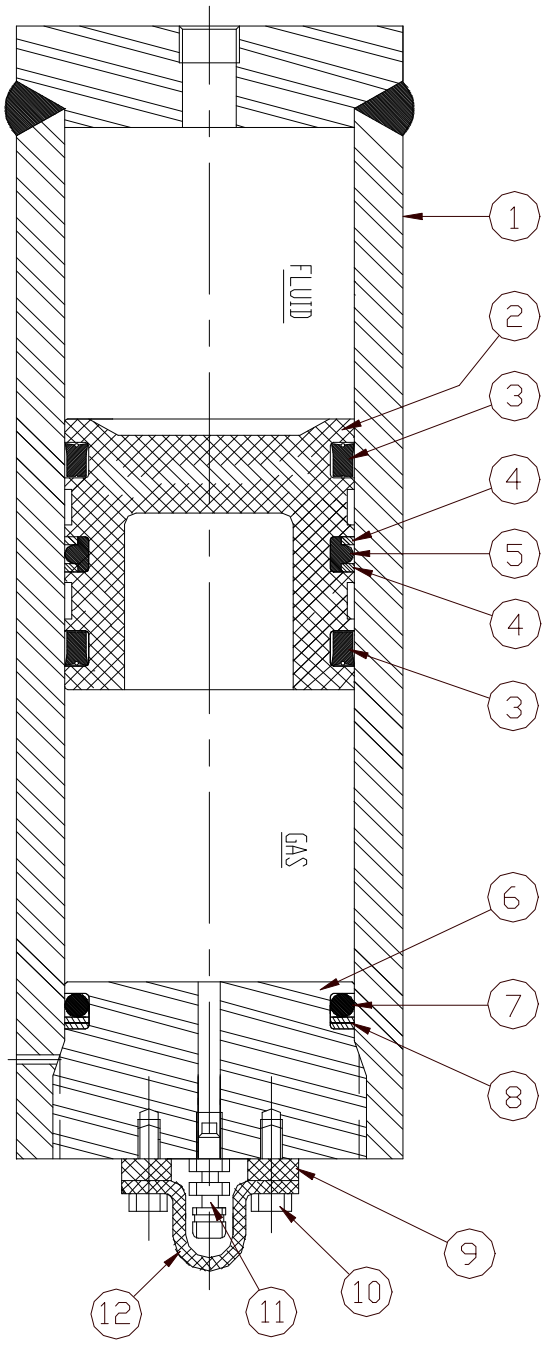


FIGURE 3 - ACCUMULATOR ASSEMBLY – LATER VERSION WITH FIXED HYDRAULIC END CAP ASSEMBLY

KEY			57423
1.	Hyd. End Cap Assy	07.	Ring, Piston Seal Assy
2.	Back-up Ring	08.	Gas End Cap
3.	End Cap O-ring Seal	09.	Gas Valve Guard Spacer
4.	Cylinder Body	10.	Gas Valve Guard
5.	Piston	11.	Gas Valve
6.	Piston PolySeal Assy	12.	Capscrews

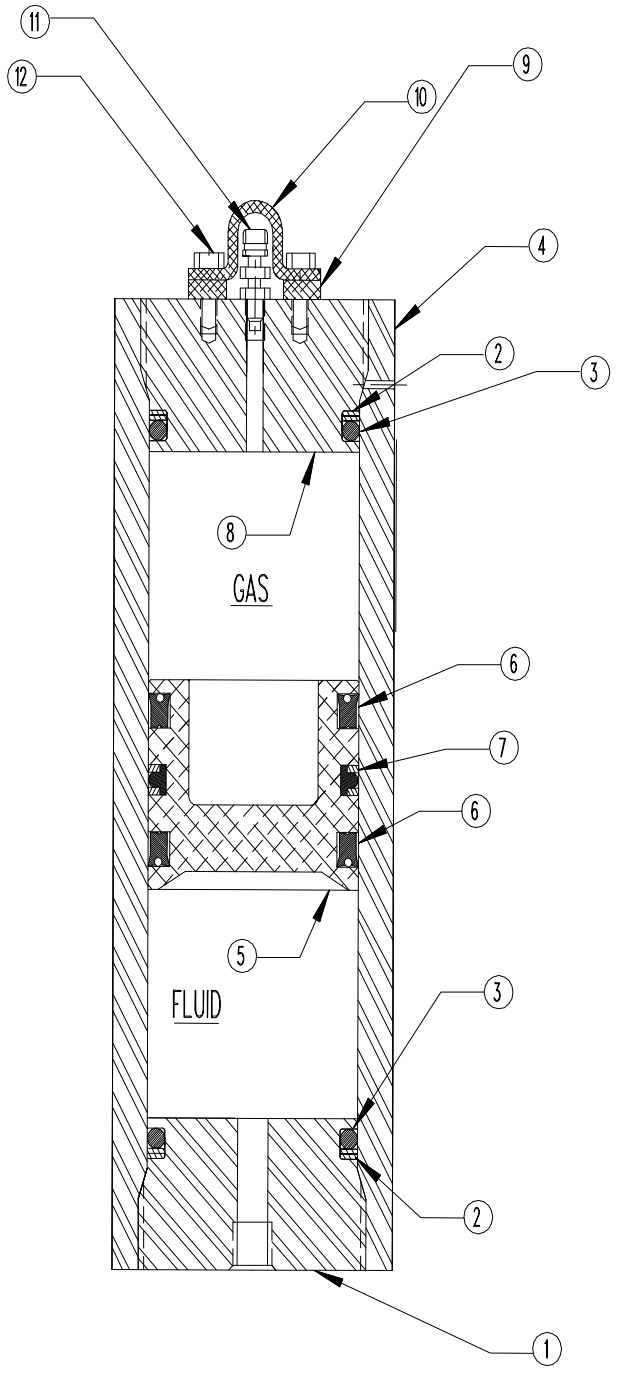


FIGURE 4 - ACCUMULATOR ASSEMBLY – WITH REMOVABLE HYDRAULIC END CAP ASSEMBLY

BRAKE VALVE (PEDAL OPERATED)

DESCRIPTION AND LOCATION

The brake valve is a pedal controlled, spool-type hydraulic valve. It is typically mounted on the front wall/floor of the cab behind/under the operator's control pedal area.

OPERATION (Figure 1)

The primary function of the pedal controlled brake valve is to control hydraulic pressure in the vehicle's brake system either directly or through the control of other components.

In the released position, the pedal is relaxed and the regulator spool is in the up or relaxed position. In this state, the notches near the top of the spool are exposed to the tank cavity in the valve body. The lower portion of the notched area in the spool is exposed to the regulated pressure output port of the valve. This creates a direct link between the tank port and the regulated port of the valve. In this condition, the pressure in the brake equals that in the return lines to the hydraulic tank, approximately 0 psi (kPa). The brakes are released.

When the operator wishes to apply the brakes, the pedal is depressed. As the pedal moves, it pivots on a rod near the rear of the actuator section and moves down on the valve regulator spring. This in turn pushes the regulator spool down. As the spool begins to move down the bore, the metering notches move out of the tank cavity and closes off the return path to the tank. Continued movement downward cause the notches of the lower edge of the spool to enter the inlet pressure port area of the valve body. The pressurized flow of hydraulic oil from the inlet port is then directed to the brake port. As the pressure increases in the brake system, oil flows through the small orifice in the cavity below the spool. As the pressure rises, force builds up on the bottom of the regulator spool and begins to push the spool upward. If the control is not released, the spool moves upward and compresses the spring between the spool and the cam. Once enough pressure is built in the system, it forces the spool up against the spring and closes off the pressurized oil supply to the regulated output port. The spool is now balanced between the outlet pressure and the pressure of the spring generated by the positioning of the lever.

Further movement of the lever causes the cam to increase the pressure on the spring and repeats the above process until the forces are again balanced.

NOTE: *On some valves, the pedal movement to pressure output is a linear function, that is they are directly proportional throughout the operating range.*

On other valves, particularly those used as pilot valves the pressure is staged, that is it rises linearly at one rate to approximately mid-range, then automatically switches to a different, typically increased rate. This is done to provide increased "feel" or limited braking at low braking requirements while still maintaining full maximum braking.

If the operator wishes to release the brakes, releasing the pedal causes the spool assembly to become unbalanced and move upward. This opens the brake port to the tank. At this time, the trapped oil in the system is released, allowing the brakes to release.

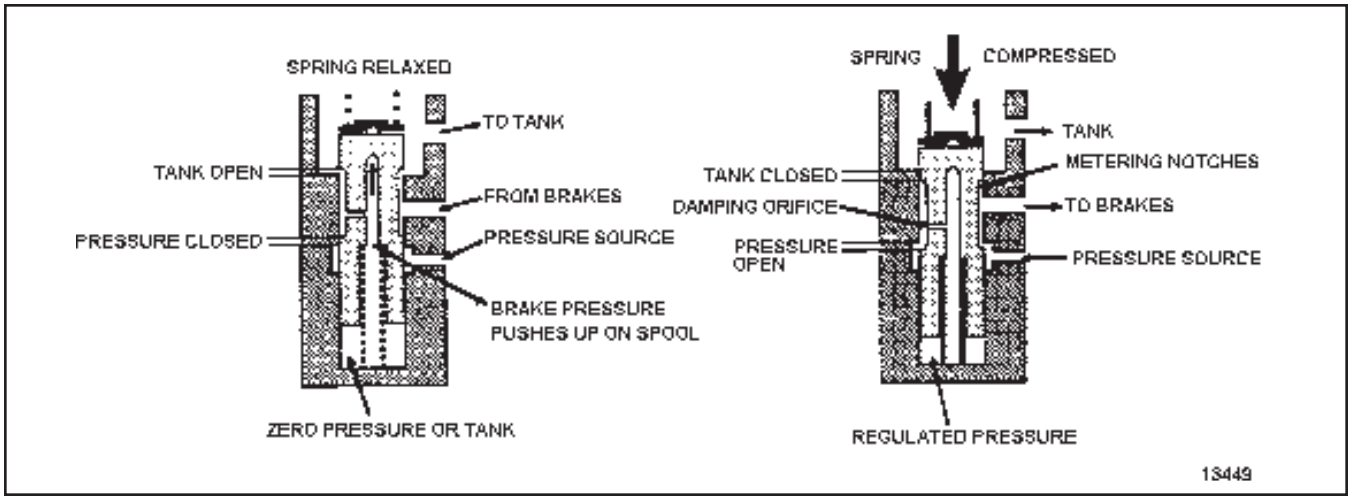


FIGURE 1 - BASIC OPERATION OF THE VALVE

This valve may also be operated by pilot pressure provided by an external source. With no pressure applied to the pilot port, operation is the same as with the pedal released. As the pilot pressure increases, the operation of the valve parallels that during pedal operation until the maximum rated pilot pressure is reached.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the valve should include:

1. Inspect the valve and related components and connections for evidence of damage, wear, or leakage. Repair or replace as required.

2. Check the operation of the valve as outlined in the procedures in Section 5 - Hydraulic System or equivalent. Adjust as required by the method called out in the procedures later in this portion of the module.

ADJUSTING THE VALVE (Figure 4)

Pressure Settings

The maximum outlet pressure of the valve may be adjusted as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the equipment's friction brake system.

2. Check the operation of the valve as outlined in the procedures in Section 5 - Hydraulic System or equivalent.

3. Stop the engine.

4. Drain all pressure from the brake accumulators using the manual accumulator drain valves.

5. Remove the pedal and actuator assembly by loosening the locking nuts (22) and washers (23) securing the U-bolts (38) to the assembly and removing the pivot pin (28).

6. Loosen the set screw securing the adjusting collar (1) to the threads on the plunger (2).

7. Move the adjusting collar counter-clockwise (or toward the ends of the threads) to raise the pressure or clockwise (or to the non-threaded portion of the plunger) to lower the pressure.

NOTE: *Fine adjustments may require turning the valve in increments of as little as 1/8th turn.*

8. Retest the pressure as before. Installing the pivot pin (28) and using a flat screwdriver or equivalent as a lever will allow you to depress the actuator without reinstalling the pedal/cam assembly. (Figure 2)
9. Secure the collar by retightening the set screw to 25 to 30 inch-lbs (2.8 to 3.4 Nm).

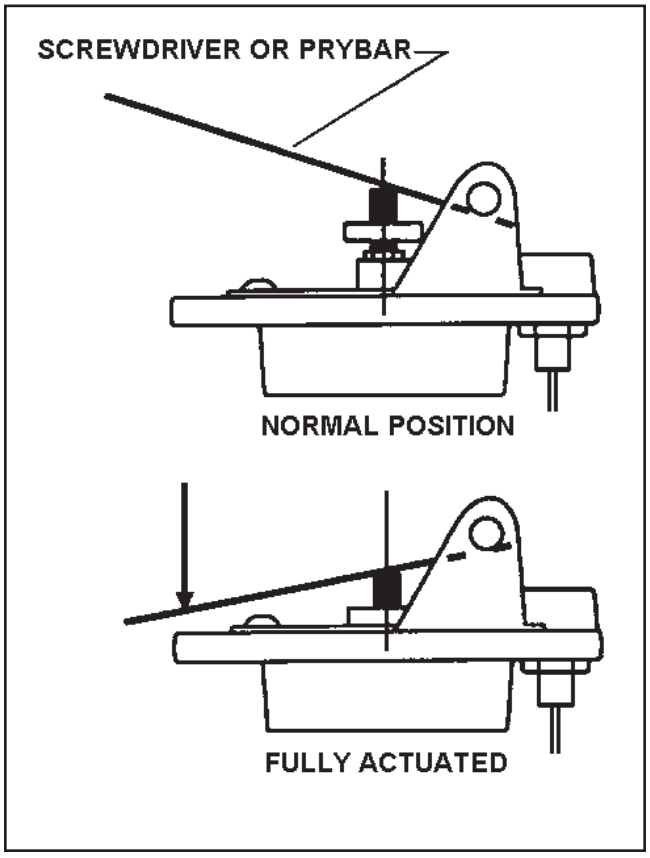


FIGURE 2 - ACTIVATION OF THE VALVE

10. Reinstall the pedal/cam assembly to the spool section.

11. Repeat steps 1 through 10 until the adjustment is complete.

12. Apply and release the brakes a number of times. Verify that the pressure settings do not change. If they do repeat the above process as required.

NOTE: *When the assembly is new or has been serviced, it is not uncommon for the pressures to decrease slightly due to the "seating" effect of the components.*

13. While monitoring the brake pressure and with the engine at low idle speed, depress the pedal as quickly as possible. The pressure should reach maximum within 1 second of the time the pedal was depressed.

14. Release the pedal and reapply slowly. Make sure that the brake pressure increase is smooth and no sticking of the spool is observed.

15. Hold the pedal fully depressed for 20 seconds. Verify that the pressure remains at the proper level at all times the pedal is depressed.

16. Slowly release the pedal. Make sure that the brake pressure decrease is smooth and no sticking of the spool is observed.

17. Verify that the valve has an output of 0 psi (kPa) when fully released.

Deadband Adjustment

The operational deadband of the pedal assembly may be adjusted as follows:

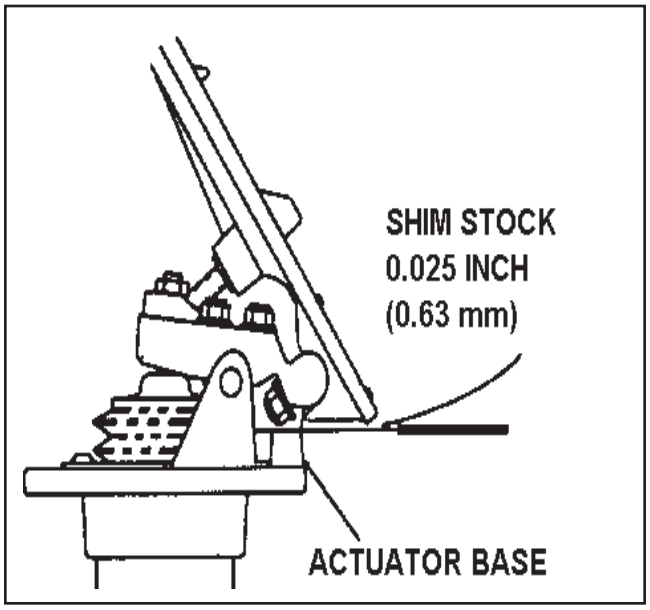


FIGURE 3 - DEADBAND ADJUSTMENT

1. Loosen the deadband adjustment screw (25) by turning counter-clockwise until it is no longer touching the actuator cap.

2. Apply Loctite 242 (or equivalent) to the threads on the adjustment screw.

3. Install a shim between the pedal return stop and the actuator base return stop (Figure 3).

NOTES:
1. On trucks equipped with a treadle pedal, this shim should be 0.025 inches (0.63 mm).
2. On trucks equipped with suspended pedal assemblies operating as pilot valves, this shim should be 0.038 inches (0.96 mm).

4. Turn the deadband adjustment screw down (clockwise) until the adjustment screw (24) is touching the actuator cap.

5. Continue turning the adjusting screw clockwise until a pressure reading is indicated on the gauge.

6. Turn the adjustment screw 1/8 turn counter-clockwise.

7. Apply a few drops of Loctite 242 (or equivalent) to the jam nut (24) and tighten to secure the adjusting screw.

8. Remove the shim stock.

Pedal Angle Adjustments (Treadle Pedal versions only)

The operating angle of the Pedal may be adjusted as follows:

1. Loosen the two nuts (44) at the rear of the pedal cam (26). Do not loosen the four U-bolt nuts (22).

2. Adjust the pedal angle by turning the set screws (40) located in the top face or ribbed side of the pedal. Turning clockwise will increase the angle, counter-clockwise will decrease the angle.

NOTE: *Adjust the screws evenly. When the desired angle is achieved, loosen each slightly, apply Loctite 242 (or equivalent) to the threads and reinstall.*

3. While holding the pedal down, retighten the rear socket head capscrews (41) and nuts (44).

Adjusting the Proximity Switch

The proximity switch may be adjusted as follows:

1. Thread the switch (36) into the base (34) until it contacts the pedal.

2. Turn the outward 1/4 to 1/2 turn. Secure in place with jam nut.

3. Slowly depress the Brake pedal. The switch should actuate as soon as the pedal is depressed, even slightly.

NOTE: *In some applications it may be desirable to*

slightly delay the actuation of the switch in order to increase the system brake pressure when the switch actuates. In these cases, it will require readjusting of the pedal, deadband, and proximity switch settings to obtain the desired pressure levels.

REMOVAL

The valve may be removed from the truck as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Drain all hydraulic pressure from the brake system as outlined in the procedures in Section 5 - Hydraulic System or equivalent.

⚠ DANGER

It is important that all pressure in the hydraulic portion of the brake actuation system be released prior to working on any components or loosening any hydraulic fittings.

3. Remove the access panel near the valve.

4. Disconnect the hydraulic connections to the valve. Cap or plug all openings. Label each to aid during the installation process.

5. Remove any electrical connections. Label each to aid during the installation process.

6. Remove the capscrews and locknuts securing the valve in place.

7. Remove the valve.

DISASSEMBLY (Figure 4)

The brake valve may be disassembled as follows:

1. Drain all oil from all ports of the valve by actuating several times over a suitable container.

2. Secure the valve upright in a table vise, using care not to damage any components.

3. Remove the treadle pedal as follows:

a. Remove the pedal (42) by loosening the two bolts (41) at the pedal heel. The two bolts need not be removed.

b. Remove the proximity switch (36) to prevent damage and set aside.

c. Loosen, but do not remove, the four 1/4 inch locknuts (22) from the two U-bolts (38) securing the actuator pivot pin (28).

d. Remove the pivot pin (28) with a punch and hammer.

e. Remove the cam assembly and inspect for evidence of wear or damage. Set aside for later reassembly.

4. Remove the suspended pedal as follows:

a. Remove the retaining rings (45).

b. Remove the pivot pin (46) using a punch and hammer.

c. Remove the pedal assembly.

5. Remove the four button head capscrews (31) securing the boot retainer plate (32).

6. Remove the boot retainer plate (32), boot (30), and actuator cap (29) as an assembly by grasping the boot and gently lifting from the valve body.

7. Loosen the socket head screw securing the adjusting collar (1) to the threads on the plunger (2).

8. Move the adjusting collar counter-clockwise (or toward the ends of the threads) and remove.

9. Remove the two socket head capscrews (33) that secure the actuator base (34) to the valve body (18). Remove the actuator base.

10. Position the valve upside down in a table vice.

11. Remove the socket head capscrews (21) from the bottom of the valve. Remove the lower end plate (19).

12. Remove the valve from the vise and sit upright on a work bench.

13. Hold the valve in one hand and push the plunger (2) down with the other hand until the regulator sleeve and spool assembly pops loose.

14. Turn the valve on its side on the work bench.

15. Remove the regulator sleeve (13) and spool (7) from the valve body (18).

16. Remove the spool (7) and spool return spring (14) from the regulator sleeve (13).

17. Remove the spring seat (6), regulator springs (4,5), and plunger return spring (3) from the valve body.

18. Position the valve upright on the work bench.

19. Remove the actuator plunger (2) by pushing down (toward the bottom of the valve) on the plunger with your hand until the plunger slides out.

20. Remove the O-rings and Teflon backup rings from the actuator sleeve and discard.

21. Remove the wiper seal (15) and the Poly-Pak seal (17) and the back-up ring (16) from the actuator section and discard.

INSPECTION AND REPAIR

The disassembled valve may be serviced as follows:

1. Clean all metal components in clean solvent and dry with dry compressed air. Do not use rags.

2. Inspect all components for evidence of wear or damage. Repair or replace as required.

3. Inspect the plunger for wear on the sides where it moves through the seals. If axial grooves are seen or any wear is apparent, replace the plunger.

4. Place the regulating spool into its sleeve. Push the spool lightly through the sleeve. The spool must be able to move freely and smoothly the entire length of the sleeve. If it cannot, it must be replaced.

IMPORTANT: *Never replace just the spool or sleeve. They must be replaced as a matched set.*

5. Inspect each spring carefully for evidence of cracks or breakage. Any spring found with a problem must be replaced.

6. Inspect the threaded inserts in the valve. If any of the threads are damaged, the inserts must be replaced. This may be done as follows:

a. Install a bolt with a matching thread into the insert from the side opposite the insert flange.

b. Support the unit around the insert on a small spacer such as a short piece of pipe.

c. Lightly tap the insert free by lightly striking the bolt head with a small hammer.

d. If the inserts were removed from the actuator base:

(1) Position the actuator base upside down on the work bench and support directly under each of the mounting holes.

(2) Install the threaded insert into the base by tapping lightly with a small hammer until the insert flanges are flush with the base.

IMPORTANT: *Be sure that the base is supported to avoid breakage.*

(3) Thoroughly re-clean the assembly.

e. If the insert was removed from the cam:

(1) Place the cam upside down on workbench and support it at the center hole.

(2) Install the insert by tapping lightly with a small hammer until flush with the cam surface.

IMPORTANT: *Be sure that the cam is supported to avoid breakage.*

(3) Thoroughly re-clean the assembly.

8. Inspect the boot (30) for evidence of cracking, tears, or other damage. If damage is evident, the boot must be replaced. This may be done as follows:

a. Remove the boot (30) from the cap (29). Discard the old boot.

b. Thoroughly clean the sides of the cap by scraping the lip where the cap contacts the boot, using a clean knife or other suitable scraper. Clean thoroughly to remove all residual adhesive or other particles from the boot.

c. Apply a thin coat of Loctite Prism 410 (or equivalent) onto the two long sides of the upper side of the cap.

NOTE: *Do not apply the sealant to the rounded sides as these must be free to allow the boot to "breath".*

d. Carefully position the cap into the new boot

groove, wiping off the excess glue.

e. Position the boot such that it conforms to the top of the cap, then set aside. The adhesive requires about 30 minutes to cure.

ASSEMBLY

The valve may be assembled as follows:

NOTE: *During assembly, lightly lubricate the O-rings, seals and other components with hydraulic oil compatible with that in the unit's hydraulic system.*

1. Install the Poly-Pak seal (17) in the seal groove in the valve body first. Position the seal in the groove so that the internal O-ring inside it is facing downward toward the bottom of the valve.

2. After the seal is in the groove, push it down with a smooth O-ring tool to make sure that the internal O-ring is still seated inside the Poly-Pak seal and did not get dislodged during installation.

3. Install the back-up ring (16) on top of the Poly-Pak seal (17). Start by hand and then continue to work into the groove, either by hand or using an O-ring installation tool.

4. Install the wiper seal (15) in the top counterbore. Position in the groove so that the register lip is facing up toward the actuator.

5. Install an O-ring (9) into the smallest groove (on the top) of the regulator sleeve (13).

6. Install O-ring (12) into the largest groove (on the bottom) of the regulator sleeve.

7. Install a split nylon back-up ring (10) into each side of the O-ring (11) located in the middle of the regulator sleeve.

8. Install one split nylon back-up ring (8) above the O-ring (9) located at the top end of the sleeve. Position the back-up ring so that it is next to the top of the regulator sleeve.

NOTES:
1. This O-ring is the smallest of the three 0-rings.
2. The top of the sleeve is the end with the smallest OD.

9. If the cam is being replaced, the split sleeve must be pressed into the counterbore at the rear of the cam. Apply Loctite retaining compound 620 (or equivalent) to the outer diameter of the sleeve and press the sleeve into the counterbore in the cam until the sleeve bottoms in the counterbore.

10. Carefully insert the plunger (2) into the valve body (18). Make sure that the plunger is completely seated and bottomed out in the valve body.

11. With the valve held by a vice in an upside down position, install the plunger return spring (3), regulator springs (4,5), and spring seat (6) into the bore.

NOTE: *If the spring seat (6) does not position itself correctly on top of the regulator spring (5), lightly shake the valve to correctly seat the spring seat.*

12. Install the spring into the open end of the regulator spool (7).

13. Lightly lubricate the regulator spool (7).

14. Install the regulator spool on the regulator sleeve (13). The spherical end of the spool must be at the top of the regulator sleeve.

NOTES:
1. The top of the sleeve is the end with the smallest OD.
2. Check to ensure that the spools will slide smoothly and freely. Replace the entire sleeve assembly and spool if the spool does not slide smoothly and freely.

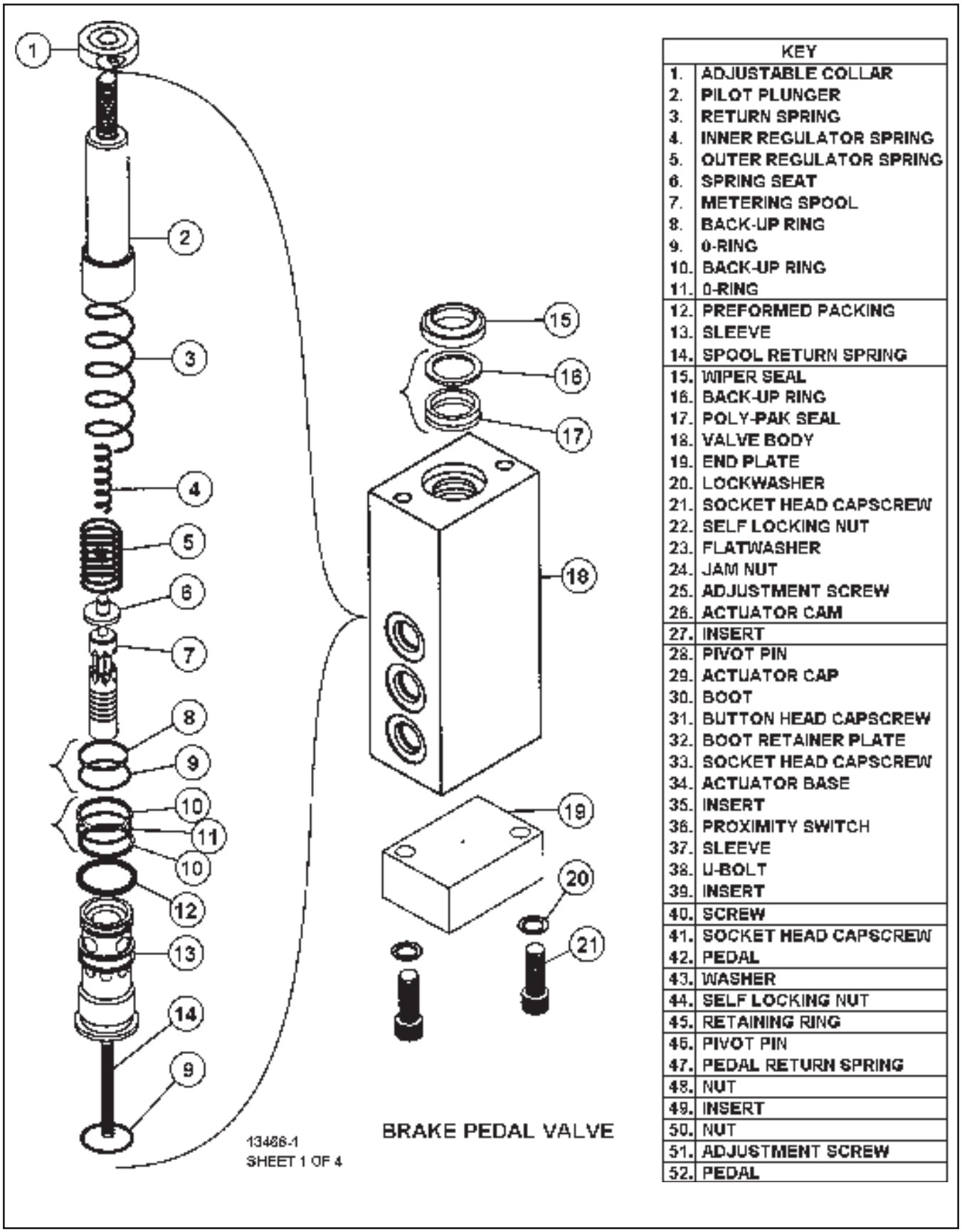
15. Lightly lubricate the O-rings on the regulator sleeve.

16. With the spool temporarily removed from the sleeve, install the regulator sleeve into the valve upside down in a vice. Push the sleeve carefully into the body until the bottom lip of the sleeve contacts the valve body.

17. Lightly lubricate the O-ring (9) and install into the groove at the bottom end of the sleeve.

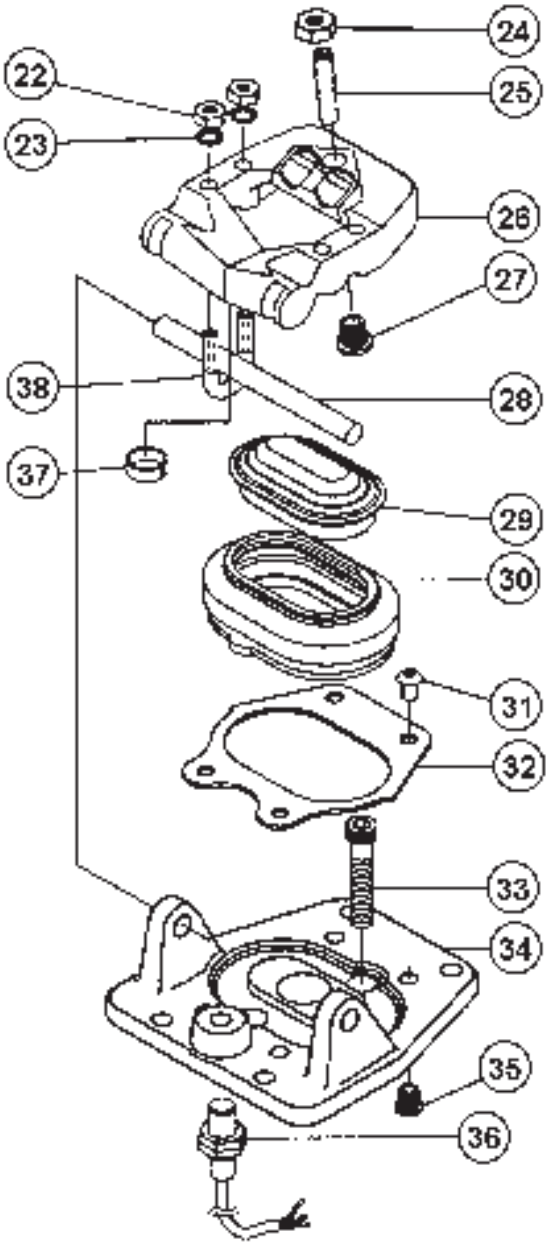
18. Install the spool into the sleeve with the spherical end of the spool toward the top of the valve.

19. Install the end cap (19) on the end of the valve body (18). Secure with the socket head capscrews and washers. Torque to 180 to 190 inch-lbs (20 to 22 Nm).
20. Screw the adjustment collar (1) onto the actuation plunger. Continue to turn it all the way down until it bottoms on the threads.



KEY	
1.	ADJUSTABLE COLLAR
2.	PILOT PLUNGER
3.	RETURN SPRING
4.	INNER REGULATOR SPRING
5.	OUTER REGULATOR SPRING
6.	SPRING SEAT
7.	METERING SPOOL
8.	BACK-UP RING
9.	O-RING
10.	BACK-UP RING
11.	O-RING
12.	PREFORMED PACKING
13.	SLEEVE
14.	SPOOL RETURN SPRING
15.	WIPER SEAL
16.	BACK-UP RING
17.	POLY-PAK SEAL
18.	VALVE BODY
19.	END PLATE
20.	LOCKWASHER
21.	SOCKET HEAD CAPSCREW
22.	SELF LOCKING NUT
23.	FLATWASHER
24.	JAM NUT
25.	ADJUSTMENT SCREW
26.	ACTUATOR CAM
27.	INSERT
28.	PIVOT PIN
29.	ACTUATOR CAP
30.	BOOT
31.	BUTTON HEAD CAPSCREW
32.	BOOT RETAINER PLATE
33.	SOCKET HEAD CAPSCREW
34.	ACTUATOR BASE
35.	INSERT
36.	PROXIMITY SWITCH
37.	SLEEVE
38.	U-BOLT
39.	INSERT
40.	SCREW
41.	SOCKET HEAD CAPSCREW
42.	PEDAL
43.	WASHER
44.	SELF LOCKING NUT
45.	RETAINING RING
46.	PIVOT PIN
47.	PEDAL RETURN SPRING
48.	NUT
49.	INSERT
50.	NUT
51.	ADJUSTMENT SCREW
52.	PEDAL

FIGURE 4 - BRAKE PEDAL VALVE ASSEMBLY

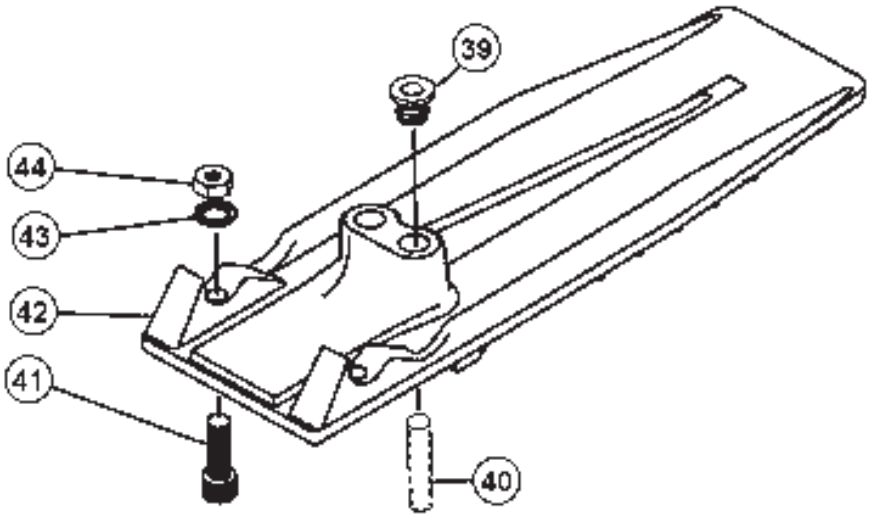


ACTUATOR

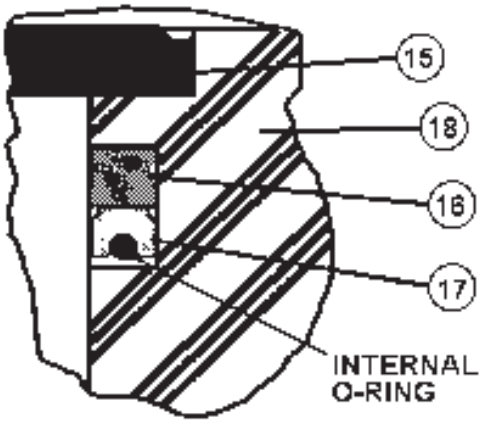
13466-2
SHEET 2 OF 4

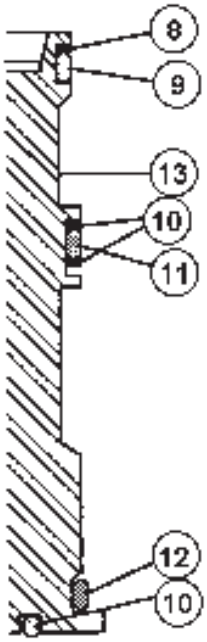
KEY	
1.	ADJUSTABLE COLLAR
2.	PILOT PLUNGER
3.	RETURN SPRING
4.	INNER REGULATOR SPRING
5.	OUTER REGULATOR SPRING
6.	SPRING SEAT
7.	METERING SPOOL
8.	BACK-UP RING
9.	O-RING
10.	BACK-UP RING
11.	O-RING
12.	PREFORMED PACKING
13.	SLEEVE
14.	SPOOL RETURN SPRING
15.	WIPER SEAL
16.	BACK-UP RING
17.	POLY-PAK SEAL
18.	VALVE BODY
19.	END PLATE
20.	LOCKWASHER
21.	SOCKET HEAD CAPSCREW
22.	SELF LOCKING NUT
23.	FLATWASHER
24.	JAM NUT
25.	ADJUSTMENT SCREW
26.	ACTUATOR CAM
27.	INSERT
28.	PIVOT PIN
29.	ACTUATOR CAP
30.	BOOT
31.	BUTTON HEAD CAPSCREW
32.	BOOT RETAINER PLATE
33.	SOCKET HEAD CAPSCREW
34.	ACTUATOR BASE
35.	INSERT
36.	PROXIMITY SWITCH
37.	SLEEVE
38.	U-BOLT
39.	INSERT
40.	SCREW
41.	SOCKET HEAD CAPSCREW
42.	PEDAL
43.	WASHER
44.	SELF LOCKING NUT
45.	RETAINING RING
46.	PIVOT PIN
47.	PEDAL RETURN SPRING
48.	NUT
49.	INSERT
50.	NUT
51.	ADJUSTMENT SCREW
52.	PEDAL

FIGURE 4 - BRAKE PEDAL VALVE ASSEMBLY - CONTINUED



TREADLE PEDAL ASSEMBLY



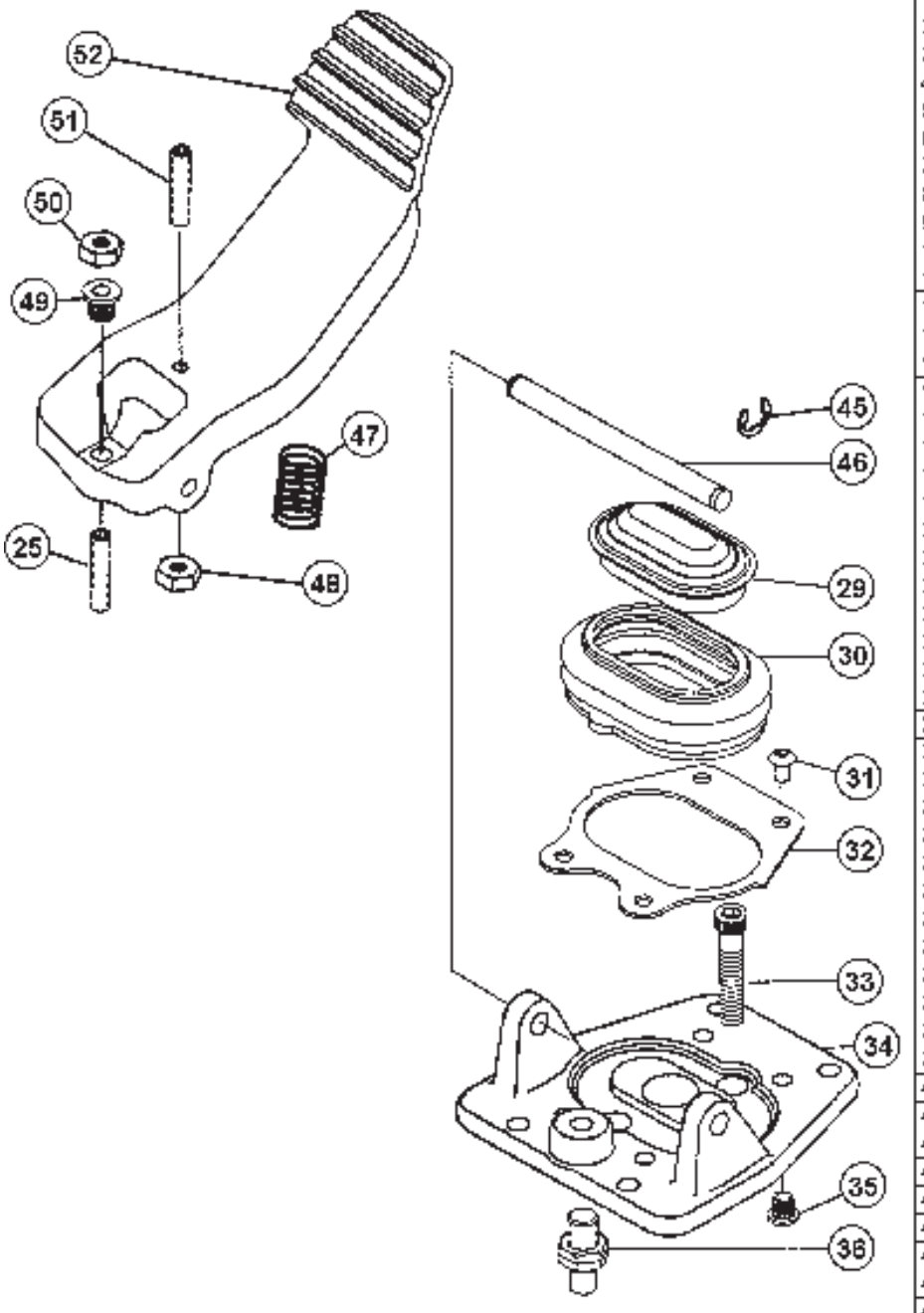


BRAKE PEDAL VALVE

13466-3
SHEET 3 OF 4

KEY	
1.	ADJUSTABLE COLLAR
2.	PILOT PLUNGER
3.	RETURN SPRING
4.	INNER REGULATOR SPRING
5.	OUTER REGULATOR SPRING
6.	SPRING SEAT
7.	METERING SPOOL
8.	BACK-UP RING
9.	O-RING
10.	BACK-UP RING
11.	O-RING
12.	PREFORMED PACKING
13.	SLEEVE
14.	SPOOL RETURN SPRING
15.	WIPER SEAL
16.	BACK-UP RING
17.	POLY-PAK SEAL
18.	VALVE BODY
19.	END PLATE
20.	LOCKWASHER
21.	SOCKET HEAD CAPSCREW
22.	SELF LOCKING NUT
23.	FLATWASHER
24.	JAM NUT
25.	ADJUSTMENT SCREW
26.	ACTUATOR CAM
27.	INSERT
28.	PIVOT PIN
29.	ACTUATOR CAP
30.	BOOT
31.	BUTTON HEAD CAPSCREW
32.	BOOT RETAINER PLATE
33.	SOCKET HEAD CAPSCREW
34.	ACTUATOR BASE
35.	INSERT
36.	PROXIMITY SWITCH
37.	SLEEVE
38.	U-BOLT
39.	INSERT
40.	SCREW
41.	SOCKET HEAD CAPSCREW
42.	PEDAL
43.	WASHER
44.	SELF LOCKING NUT
45.	RETAINING RING
46.	PIVOT PIN
47.	PEDAL RETURN SPRING
48.	NUT
49.	INSERT
50.	NUT
51.	ADJUSTMENT SCREW
52.	PEDAL

FIGURE 4 - BRAKE PEDAL VALVE ASSEMBLY - CONTINUED



SUSPENDED PEDAL ASSEMBLY

13466-4
SHEET 4 OF 4

KEY	
1.	ADJUSTABLE COLLAR
2.	PILOT PLUNGER
3.	RETURN SPRING
4.	INNER REGULATOR SPRING
5.	OUTER REGULATOR SPRING
6.	SPRING SEAT
7.	METERING SPOOL
8.	BACK-UP RING
9.	O-RING
10.	BACK-UP RING
11.	O-RING
12.	PREFORMED PACKING
13.	SLEEVE
14.	SPOOL RETURN SPRING
15.	WIPER SEAL
16.	BACK-UP RING
17.	POLY-PAK SEAL
18.	VALVE BODY
19.	END PLATE
20.	LOCKWASHER
21.	SOCKET HEAD CAPSCREW
22.	SELF LOCKING NUT
23.	FLATWASHER
24.	JAM NUT
25.	ADJUSTMENT SCREW
26.	ACTUATOR CAM
27.	INSERT
28.	PIVOT PIN
29.	ACTUATOR CAP
30.	BOOT
31.	BUTTON HEAD CAPSCREW
32.	BOOT RETAINER PLATE
33.	SOCKET HEAD CAPSCREW
34.	ACTUATOR BASE
35.	INSERT
36.	PROXIMITY SWITCH
37.	SLEEVE
38.	U-BOLT
39.	INSERT
40.	SCREW
41.	SOCKET HEAD CAPSCREW
42.	PEDAL
43.	WASHER
44.	SELF LOCKING NUT
45.	RETAINING RING
46.	PIVOT PIN
47.	PEDAL RETURN SPRING
48.	NUT
49.	INSERT
50.	NUT
51.	ADJUSTMENT SCREW
52.	PEDAL

FIGURE 4 - BRAKE PEDAL VALVE ASSEMBLY - CONTINUED

CAUTION

It is extremely important to bottom the collar on the threads to prevent over-stressing or breaking the springs during the pressure adjustment.

21. Tighten the collar tightening screw, snug only.

22. Install the treadle pedal assembly as follows:

a. Assemble the actuator cap (29), boot (30), boot retainer (32) to the actuator base (34) with the four button head capscrews (31) and tighten.

b. Attach the cam assembly to the actuator base by aligning the pivot holes in the actuator base with the holes in the U-bolts (38).

c. Insert the pivot pin through the hole in the actuator base, through the holes in the U-bolts and through the pivot pin hole in the other side of the actuator base.

d. Center the pivot pin and secure by tightening the four hex nuts (22) and washers (23) on the two U-bolts. Tighten evenly to a final torque of 85 to 95 inch-lbs (9.6 to 10.7 Nm).

e. Install the pedal (42) and secure with Socket head capscrews (41), washers, (43), and nuts (44).

23. Install the suspended pedal assembly as follows:

a. Assemble the actuator cap (29), boot (30) and boot retainer plate (32) to the actuator base with the four button head capscrews (31) and tighten.

b. Insert the pivot pin through the hole in the actuator base through the holes in the suspended pedal (52) and the hole in the other side of the actuator base.

c. Center the pivot pin (46) and secure with retaining rings (45).

d. Install the return spring (47) into the pedal and the boss on the actuator base.

INSTALLATION

The valve may be installed on the truck as follows:

1. Position the valve in the proper mounting location. Secure in place with capscrews and locknuts.

2. Reconnect the hydraulic and electrical connections to the valve assembly.

3. Bleed all entrapped air and contaminates as outlined in the system instructions in Section 5 - Hydraulic System or equivalent.

4. Test and adjust the valve as outlined in the instructions in Maintenance and Adjustment in this module and in the system instructions in Section 5 - Hydraulic System.

5. Install any access panels removed.

BRAKE CONTROLLER VALVE
PILOT AND CABLE OPERATED, DUAL CIRCUIT

DESCRIPTION AND LOCATION

The brake controller valve is a hydraulic pilot and cable controlled multiple spool-type hydraulic valve. It is typically mounted in or above the superstructure platform to the rear of the operator's cab.

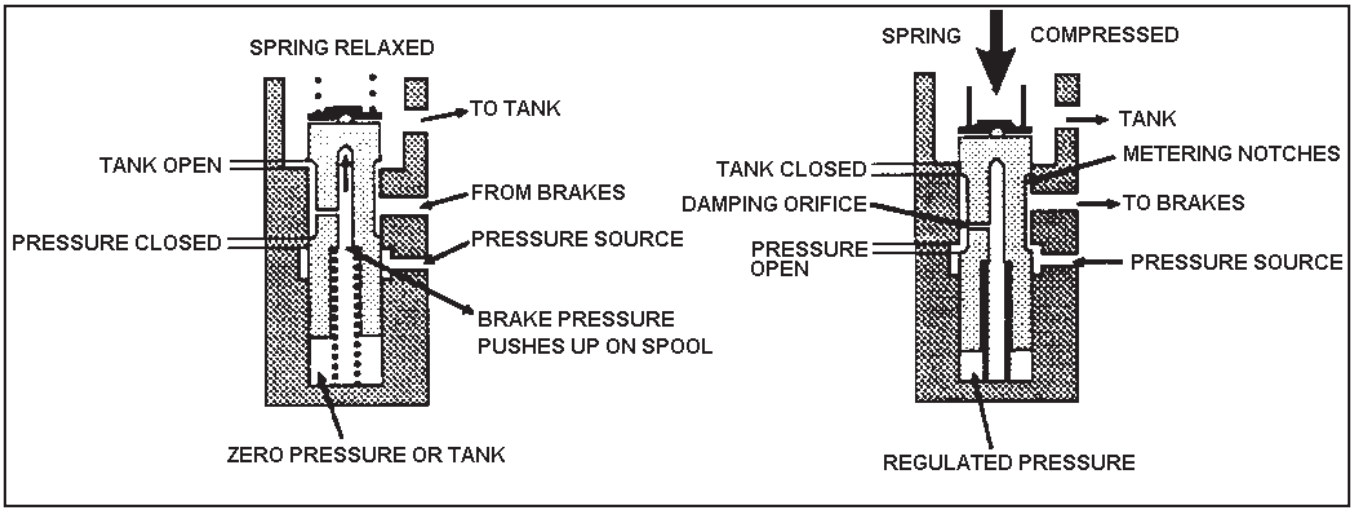


FIGURE 1 - BASIC OPERATION OF VALVE

OPERATION (Figure 1)

The primary function of the brake controller valve is to regulate hydraulic pressure to the truck's friction brake system, either directly or through the control of other components.

In the released position, the valve is relaxed and the regulator spool is in the up or relaxed position. In this state, the notches near the top of the spools are exposed to the tank cavity in the valve body. The lower portions of the notched area in the spools are exposed to the regulated pressure output ports of the valve. This creates a direct link between the tank port and the regulated ports of the valve. In this condition, the pressure in each of the circuits of the brake system equals that in the return lines to the hydraulic tank, approximately 0 psi (kPa) and the brakes are released.

When the operator wishes to apply the brakes, depressing the brake pedal causes pilot "signal" pressures, proportionate to the amount the pedal is depressed, to enter the controller valve through the two pilot or "POX" ports. This pressure on the top of the plungers causes them to move down on the valve regulator springs. This, in turn, pushes the regulator spools down. As the spools begin to move down the bore, the metering notches move out of the tank cavity and closes off the return paths to the tank. Continued movement downward causes the notches of the lower edge of the spools to enter the inlet pressure port areas of the valve body. The pressurized flow of hydraulic oil from the inlet ports is then directed to the brake pressure ports. As the pressure increases in the brake system, oil flows through the small orifices in the cavity below the spools. As the pressure rises, force builds up on the bottom of the regulator spools and begins to push the spools upward. If the control is not released, the spool moves upward and compresses the springs between the spools and the plunger. Once enough pressure is built in the system, it forces the spool up against the spring and closes off the pressurized oil supply to the regulated output ports. The spool is now balanced between the outlet pressure and the pilot pressure.

Further depressing the pedal increases the pilot pressures which, in turn, increases the pressure on the springs and repeats the above process until the forces are again balanced.

If the operator wishes to release the brakes, releasing the pedal causes the loss of the pilot signal. This results in the spool assemblies becoming unbalanced and moving upward, opening the brake ports to the tank. At this time, the trapped oil in the system is released, allowing the brakes to release.

The valve is also designed so that it can be mechanically operated. When lever arm is moved, typically by a push-pull cable assembly, the lever assembly depresses the individual plunger assemblies in a manner similar to that caused by the pilot pressure. Pressure balancing and release also occur in similar manners.

A standard proximity switch is used to control the operation of brake lights and other functions affected by the application and release of the brake controller valve.

On brake valves equipped with the available differential pressure switch, the relative pressure in both the front and rear systems are constantly monitored. If the differential becomes too high or too low the Low/ Differential Brake Pressure indicator is caused to light. If it lights, it will be necessary to apply and release the Brake pedal or Hand Brake actuator (with the Load Brakes released) to cause the indicator light to go out.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the valve should include:

1. Inspect the valve and related components and connections for evidence of damage, wear, or leakage. Repair or replace as required.

NOTE: *Visually inspect the cap and boot assembly to be properly assembled and in good repair. Problems with this assembly could result in improper operation of the valve.*

2. Check the operation of the valve as outlined in the procedures in Section 5 - Hydraulic System. Adjust as required by the method called out in these procedures or those detailed later in this portion of the module.

ADJUSTING THE VALVE (Figure 4)

Pressure Settings

The maximum outlet pressures of the valve may be adjusted as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the vehicle's friction brake system.

2. Check the operation of the valve as outlined in the procedures in Section 5 - Hydraulic System.

NOTES:

1. Adjusting the individual spools as outlined here will affect both the pilot operated service brake and the cable operated hand brake pressures.
2. If the pressure on service (or brake pedal controlled) brake pressure to the front and rear axles are both too high or too low, but still in proper proportion to each other, the adjustment is made by increasing or decreasing the pilot pressure output of the pilot valve.

3. Stop the engine.

4. Drain all pressure from the brake accumulators using the manual accumulator drain valves.

5. Remove the lever arm and actuator assembly as follows:

a. Loosen the locking nuts (27) and washers (28) securing the U-bolts (29) to the assembly and removing the pivot pin (35).

b. Remove the arm/cam assembly.

NOTE: *It is recommended that steps 6 through 10 be completed on one spool at a time to ensure proper adjustment.*

6. Loosen the set screw securing the adjusting collar (1) to the threads on the plunger (2).

7. Move the adjusting collar counter-clockwise (or toward the ends of the threads) to raise the pressure or clockwise (or to the non-threaded portion of the plunger) to lower the pressure.

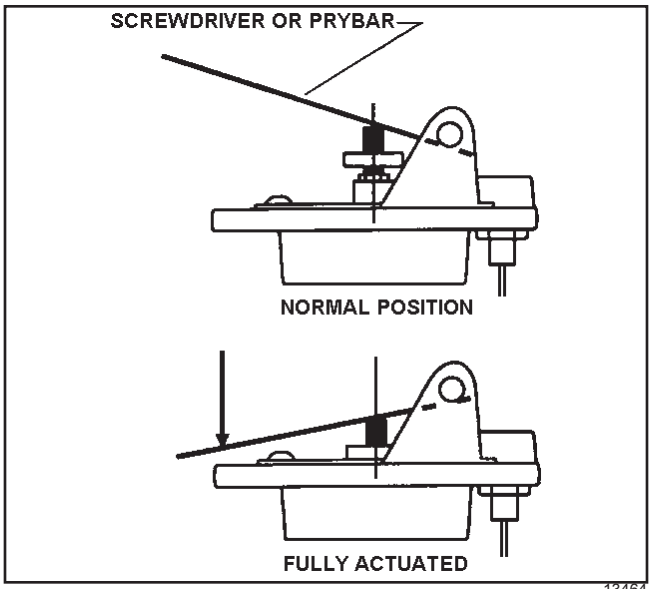


FIGURE 2 - ACTUATION OF THE VALVE

NOTE: *Fine adjustments may require turning the stop in increments of as little as 1/8th turn.*

8. Retest the pressure as before. Installing the pivot pin and using a flat screwdriver or equivalent as a lever this will allow you to depress the actuator without reinstalling the arm/cam assembly (Figure 2).

9. Secure the collar by retightening the set screw to 25 to 30 inch-lb (2.8 to 3.4 Nm). It may be necessary to rotate the entire plunger to properly orient the screws.

10. Repeat the process with the other spool assembly if required.

11. Reinstall the arm/cam assembly to the spool section. Torque the nuts on the U-bolts in even increments a final torque of 140 to 150 inch-lb (16 to 17 Nm).

12. Apply and release the brakes a number of times. Verify that the pressure settings do not change. If they do, repeat the above process as required.

13. Repeat steps 1 through 12 until the adjustment is complete.

NOTE: *When the assembly is new or has been serviced, it is not uncommon for the pressures to decrease slightly due to the "seating" effect of the components.*

14. While monitoring the brake pressure and with the engine at low idle speed, depress the pedal as quickly as possible. The pressures should reach maximum within 1 second of the time the pedal was depressed.

15. Release the pedal and reapply slowly. Make sure that the pressure increase on each circuit is smooth and no sticking of the spool is observed.

16. Hold the pedal fully depressed for 20 seconds. Verify that the pressures remain at the proper level at all times the pedal is depressed.

17. Slowly release the pedal. Make sure that the brake pressure decrease is smooth and no sticking of either spool is observed.

18. Verify that the valve has an output of 0 psi (kPa) when fully released.

Dead Band Adjustment (Figure 3)

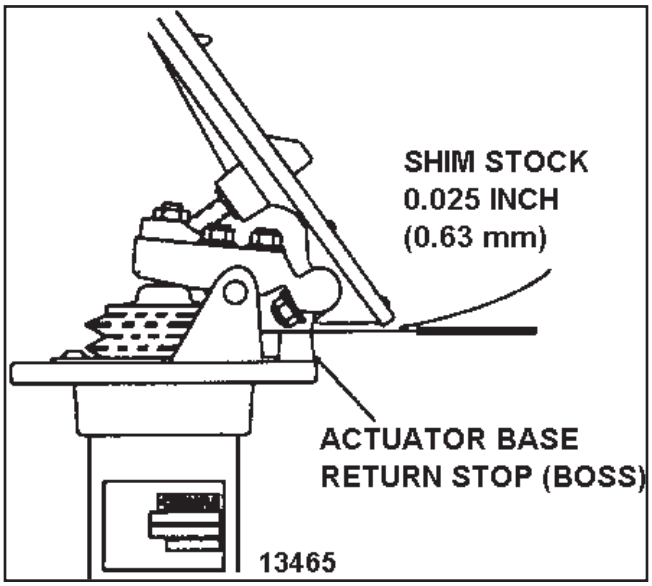


FIGURE 3 - DEAD BAND ADJUSTMENT

The operational dead band of the arm/cam assembly may be adjusted as follows:

1. Loosen the dead band adjustment screw by turning counter-clockwise until it is no longer touching the actuator cap.

2. Apply Loctite 242 (or equivalent) to the threads on the adjustment screw.

3. Install a 0.025 inch (0.63 mm) shim between the pedal return stop and the actuator base return stop (Figure 3).

4. Turn the dead band adjustment screw down (clockwise) until the adjustment screw is touching the actuator cap.

5. Continue turning the adjusting screw clockwise until a pressure reading is indicated on the gauge.

6. Turn the adjustment screw 1/8 turn counter-clockwise.

7. Apply a few drops of Loctite 242 (or equivalent) to the jam nut and tighten to secure the adjusting screw.

8. Remove the shim stock.

Adjusting the Proximity Switch

The proximity switch may be adjusted as follows:

1. Thread the switch into the base until it contacts the arm/cam assembly.

2. Turn the switch outward 1/4 to 1/2 turn. Secure in place with jam nut.

3. Slowly apply the Hand Brake. The switch should actuate as soon as the pedal is depressed, even slightly.

NOTE: *In some applications it may be desirable to slightly delay the actuation of the switch in order to increase the system brake pressure when the switch actuates. In these cases, it will require readjusting of the pedal, dead band, and proximity switch settings to obtain the desired pressure levels.*

REMOVAL

The valve may be removed from the truck as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Drain all hydraulic pressure from the brake system as outlined in the procedures in Section 5 - Hydraulic System or equivalent.

It is important that all pressure in the hydraulic portion of the brake actuation system be released prior to working on any components or loosening any hydraulic fittings.

3. Open the access panel covering the valve.

4. Disconnect the hydraulic connections to the valve. Cap or plug all openings. Label each to aid during the installation process.

5. Remove any electrical connections. Label each to aid during the installation process.

6. Remove the capscrews and locknuts securing the valve in place.

7. Remove the valve.

DISASSEMBLY (Figure 4)

The brake valve may be disassembled as follows:

1. Drain all oil from all ports of the valve by actuating several times over a suitable container.

2. Secure the valve upright in a table vise, using care not to damage any components.

3. Remove the arm/cam assembly as follows:

a. Remove the proximity switch (48) to prevent damage and set aside.

b. Loosen, but do not remove, the four 1/4 inch locknuts (27) and washers (28) from the two U-bolts (29) securing the actuator pivot pin (35).

c. Remove the pivot pin (35) using a punch and hammer if necessary.

d. Remove the arm/cam assembly and inspect for evidence of wear or damage. Set aside for later reassembly.

4. Remove the four button head capscrews (40) securing the boot retainer plate (41).

5. Remove the boot retainer plate (41), boot (39), and actuator cap (38) as an assembly by grasping the boot and gently lifting from the valve body.

NOTE: *In low temperature applications the boot and actuator cap are sub-assembled with special low temperature adhesive and should be replaced as a unit.*

6. Loosen the socket head screw securing the adjusting collar (1) to the threads on the plunger (2).

7. Move the adjusting collar counter-clockwise (or toward the ends of the threads) and remove.

8. Remove the two socket head capscrews that secure the actuator base to the valve body. Remove the actuator base.

9. Position the valve upside down in a table vise.

10. Remove the capscrews (26) and washers (25) from the bottom of the valve. Remove the sleeve retainer (24).

11. Remove the valve from the vise and sit upright on a work bench.

NOTE: *Throughout the following procedures, it is important to keep the individual circuits and circuit components separated and identified as to where they came from. Otherwise varying component "tolerance stack" may cause problems.*

12. With the valve upright, the retaining plug (23) should slide out. If not, lightly tap the plug to dislodge.

13. Remove the O-ring (22) from the counterbore in the base of the valve body. Inspect, and then discard this seal.

14. With the controller still upright on the work bench, hold the valve in one hand and push one of the plungers (2) down with the other hand until the regulator sleeve and spool assembly loosens.

15. Repeat with the other spool assembly.

16. Turn the valve on its side on the work bench.

17. Remove the regulator sleeves and spool assemblies from the valve body.

18. Remove the spools (8), reaction plungers (16), and spool return springs (15) from the regulator sleeve (14).

19. Remove the spring seat (7), regulator springs (5 and 6), and plunger return spring (4) from the valve body.

20. Position the valve upright on the work bench.

21. Remove the actuator plunger (2) by pushing down (toward the bottom of the valve) on the plunger with your hand until the plunger slides out.

22. Remove the O-rings and Teflon back-up rings from the actuator sleeve and discard.

23. Remove the wiper seals (17) and the Poly-Pak seals (19) and the back-up ring (18) from the actuator section. Inspect and discard.

24. On valves equipped with the available differential or unequal pressure switch (50, Figure 5), remove the switch from the valve body (21, Figure 5).

INSPECTION AND REPAIR (Figure 4)

The disassembled valve may be serviced as follows:

1. Clean all metal components in clean solvent and dry with dry compressed air. Do not use rags.

2. Inspect all components for evidence of wear or damage. Repair or replace as required.

3. Inspect the plunger for wear on the sides where it moves through the seals. If axial grooves are seen or any wear is apparent, replace the plunger.

4. Place the regulating spool into its sleeve. Push the spool lightly through the sleeve. The spool must be able to move freely and smoothly the entire length of the sleeve. If it cannot, it must be replaced.

IMPORTANT: *Never replace just the spool or sleeve. They must be replaced as a matched set.*

5. Inspect each spring carefully for evidence of cracks or breakage. Any spring found with a problem must be replaced.

6. Inspect the threaded inserts in the valve. If any of the threads are damaged, the inserts must be replaced. This may be done as follows:

a. Install a bolt with a matching thread into the insert from the side opposite the insert flange.

b. Support the unit around the insert on a small spacer such as a short piece of pipe.

c. Lightly tap the insert free by lightly striking the bolt head with a small hammer.

d. If the inserts were removed from the actuator base:

(1) Position the actuator base upside down on the work bench and support directly under each of the mounting holes.

(2) Install the threaded insert into the base by tapping lightly with a small hammer until the insert flanges are flush with the base.

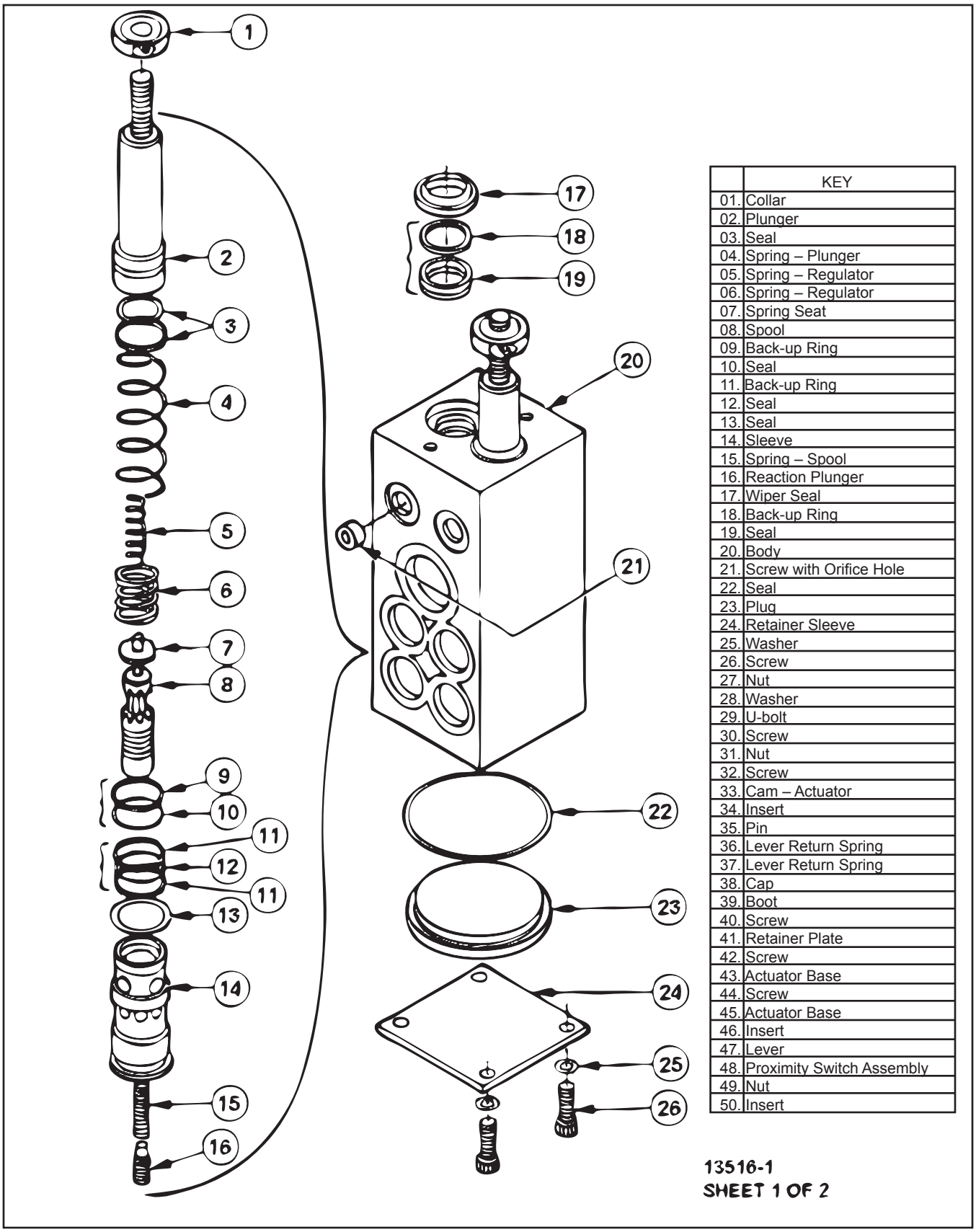
IMPORTANT: *Be sure that the base is supported to avoid breakage.*

(3) Thoroughly re-clean the assembly.

e. If the insert was removed from the cam:

(1) Place the cam upside down on workbench and support it at the center hole.

(2) Install the insert by tapping lightly with a small hammer until flush with the cam surface.



	KEY
01.	Collar
02.	Plunger
03.	Seal
04.	Spring – Plunger
05.	Spring – Regulator
06.	Spring – Regulator
07.	Spring Seat
08.	Spool
09.	Back-up Ring
10.	Seal
11.	Back-up Ring
12.	Seal
13.	Seal
14.	Sleeve
15.	Spring – Spool
16.	Reaction Plunger
17.	Wiper Seal
18.	Back-up Ring
19.	Seal
20.	Body
21.	Screw with Orifice Hole
22.	Seal
23.	Plug
24.	Retainer Sleeve
25.	Washer
26.	Screw
27.	Nut
28.	Washer
29.	U-bolt
30.	Screw
31.	Nut
32.	Screw
33.	Cam – Actuator
34.	Insert
35.	Pin
36.	Lever Return Spring
37.	Lever Return Spring
38.	Cap
39.	Boot
40.	Screw
41.	Retainer Plate
42.	Screw
43.	Actuator Base
44.	Screw
45.	Actuator Base
46.	Insert
47.	Lever
48.	Proximity Switch Assembly
49.	Nut
50.	Insert

FIGURE 4 - BRAKE VALVE ASSEMBLY

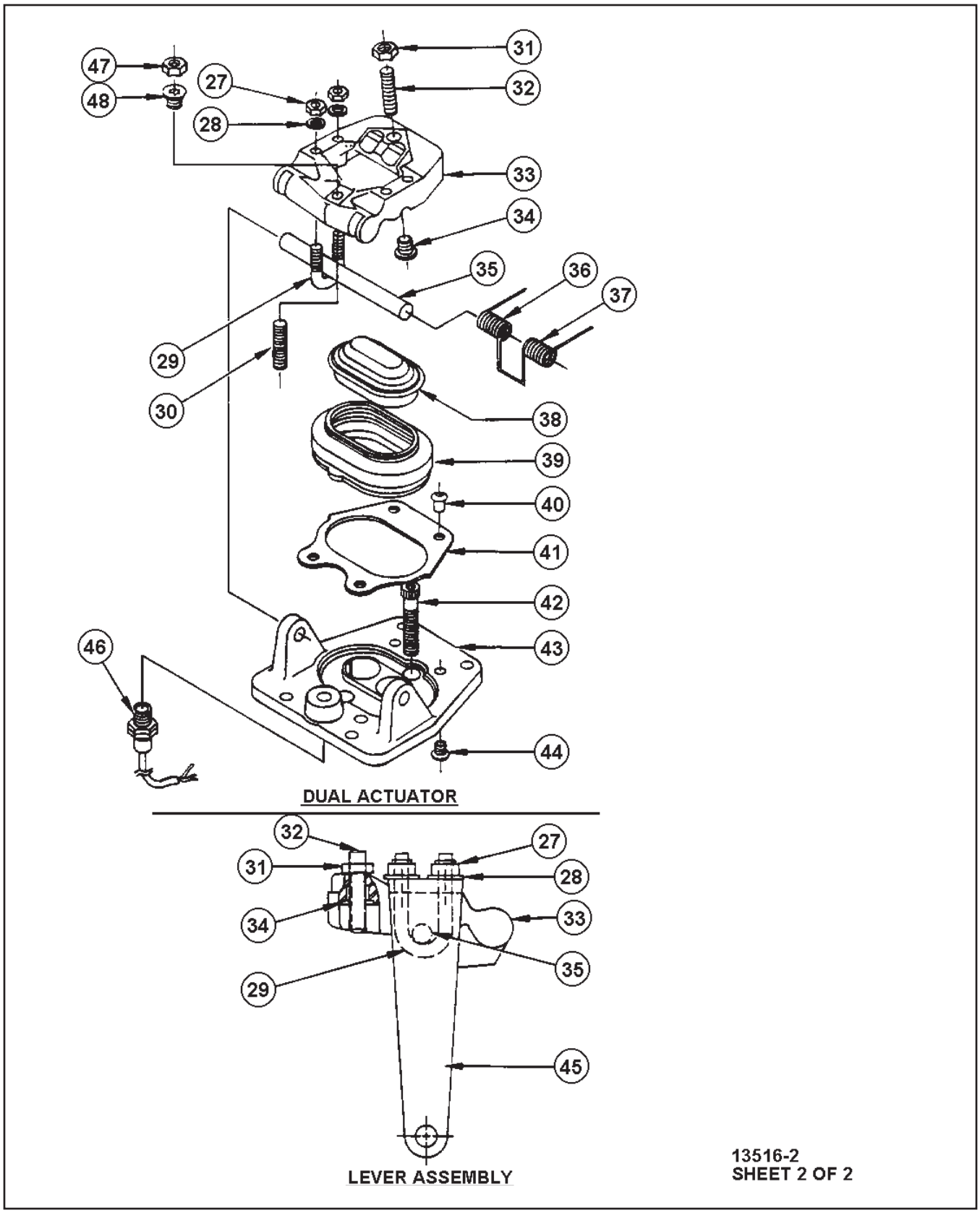
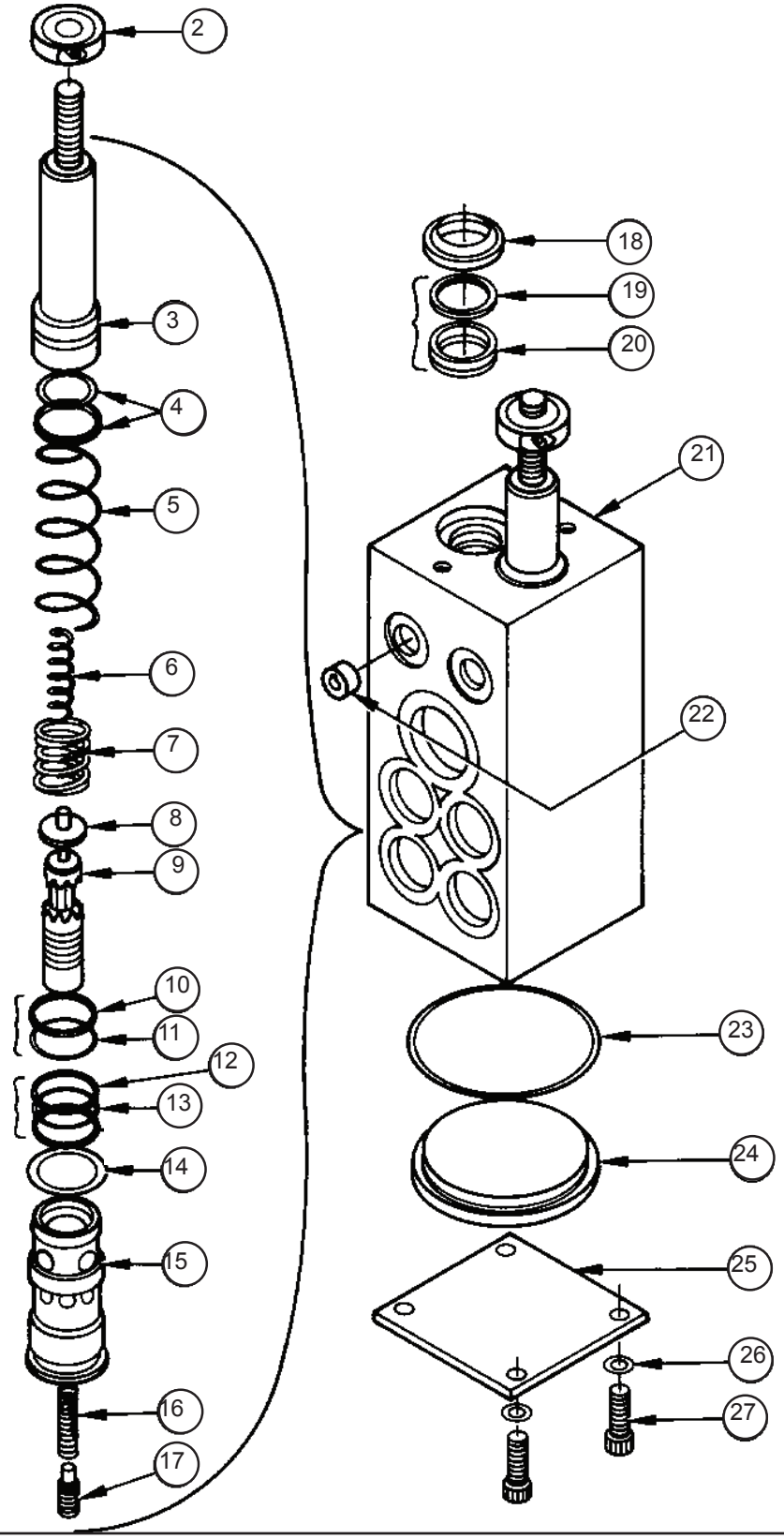


FIGURE 4 cont.- BRAKE VALVE ASSEMBLY



KEY	
01.	Valve Subassembly
02.	Collar
03.	Plunger
04.	Seal
05.	Spring – Plunger
06.	Spring – Regulator
07.	Spring – Regulator
08.	Spring Seat
09.	Spool
10.	Back-up Ring
11.	Seal
12.	Back-up Ring
13.	Seal
14.	Seal
15.	Sleeve
16.	Spring – Spool
17.	Reaction Plunger
18.	Wiper Seal
19.	Back-up Ring
20.	Seal
21.	Body
22.	Screw with Orifice Hole
23.	Seal
24.	Plug
25.	Retainer Sleeve
26.	Washer
27.	Screw
28.	Nut
29.	Washer
30.	U-bolt
31.	Screw
32.	Nut
33.	Screw
34.	Cam – Actuator
35.	Insert
36.	Pin
37.	Lever Return Spring
38.	Lever Return Spring
39.	Cap
40.	Boot
41.	Screw
42.	Retainer Plate
43.	Screw
44.	Actuator Base
45.	Insert
46.	Lever
47.	Proximity Switch Assembly
48.	Nut
49.	Insert
50.	Unequal (Differential) Switch Assembly
51.	Connector Assembly
52.	Label

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FIGURE 5 - BRAKE VALVE ASSEMBLY WITH DIFFERENTIAL PRESSURE SWITCH

IMPORTANT: *Be sure that the cam is supported to avoid breakage.*

(3) Thoroughly re-clean the assembly.

7. Inspect the boot (39) for evidence of cracking, tears, or other damage. If damage is evident, the boot must be replaced. This may be done as follows:

NOTE: *In low temperature installations, a kit is available (and recommended) that bonds the special boot to the actuator cap with a low temperature adhesive.*

a. Remove the boot from the cap (38). Discard the old boot.

b. Thoroughly clean the sides of the cap by scraping the lip where the cap contacts the boot, using a clean knife or other suitable scraper. Clean thoroughly to remove all residual adhesive or other particles from the cap.

c. Apply a thin coat of Loctite Prism 410 (or equivalent) onto the two long sides of the upper side of the cap.

NOTE: *Do not apply the sealant to the rounded sides as these must be free to allow the boot to "breathe".*

d. Carefully position the cap into the new boot groove, wiping off the excess glue.

e. Position the boot such that it conforms to the top of the cap, then set aside. The adhesive requires about 30 minutes curing.

ASSEMBLY (Figure 4)

The valve may be assembled as follows:

NOTES:
1. During assembly, lightly lubricate the O-rings, seals and other components with hydraulic oil compatible with that in the unit's hydraulic system.
2. It is important the components be reinstalled in the same circuits or bores from which they were removed to prevent problems from component tolerance stack.

1. Install the Poly-Pak seal (19) in one of the grooves in the valve body first. Position the seal in the groove so that the internal O-ring inside it is facing downward toward the bottom of the valve (Figure 6).

2. After the seal is in the groove, push it down with a smooth O-ring tool to make sure that the internal O-ring is still seated inside the Poly-Pak seal and did not get dislodged during installation.

3. Install the back-up ring (18) on top of the Poly-Pak seal. Start by hand and then continue to work into the groove, either by hand or using an O-ring installation tool.

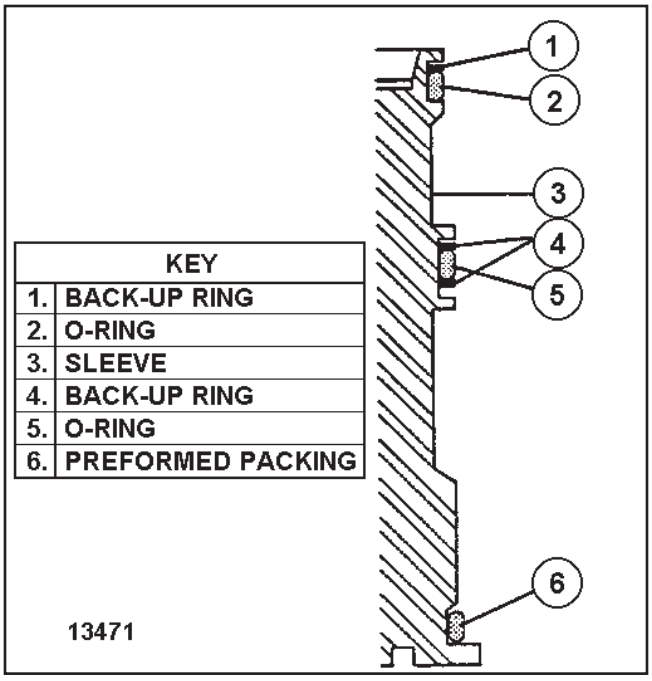


FIGURE 6 - SLEEVE SEAL PLACEMENT

4. Install the wiper seal (17) in the top counterbore. Position in the groove so that the register lip is facing up toward the actuator.

5. Repeat steps 1 through 4 for the other bore.

6. Install an O-ring (10) into the smallest groove (on the top) of the regulator sleeve (14).

7. Install O-ring (12) into the middle groove on the regulator sleeve (14).

8. Install O-ring (13) into the largest groove (on the bottom of the regulator sleeve (14)).

9. Install a split nylon back-up ring (11) into each side of the O-ring (12) located in the middle of the regulator sleeve.

10. Install one split nylon back-up ring (9) above the O-ring (10) located at the top end of the sleeve. Position the back-up ring so that it is next to the top of the regulator sleeve.

NOTES:
1. This O-ring is the smallest of the three o-rings.
2. The top of the sleeve is the end with the smallest OD.

11. Repeat steps 6 through 10 for the second bore or circuit.

12. Install an O-ring (3) into the O-ring groove located at the largest diameter end of the actuation plunger (2).

13. Install a split Glyde Ring (3) over the O-ring.

NOTE: *Twist and squeeze the split Glyde Ring into a small circle before installing to ensure a tight fit over the O-ring.*

14. Repeat steps 12 and 13 for the second bore or circuit.

15. If a new cam is being installed, install the threaded insert as per the instructions in Inspection and Repair.

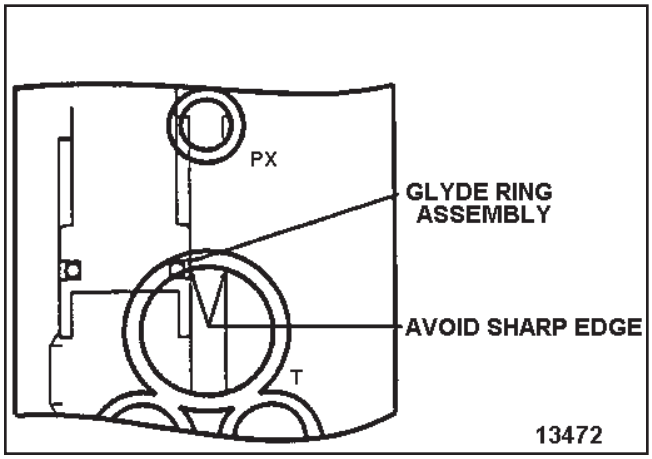
16. Lightly lubricate the actuation plunger Glyde Ring (3).

NOTE: *In the following steps, it is important to remember to install the components in the same bore from which they were removed.*

17. Install one of the actuation plungers (2) into the one of the bores or circuits. Make sure that the actuation plunger is completely seated and bottomed.

NOTE: *Be careful not to damage or cut the Glyde Ring during installation. Observe the Glyde Ring assembly through the tank port as the plunger is being installed. It may be necessary to work the Glyde Ring past the sharp edge in the body to prevent damage to the seal (Figure 7).*

FIGURE 7 - VIEW THROUGH TANK PORT



18. Repeat steps 16 and 17 for the second bore or circuit.

NOTE: *Again, it is recommended that the components in one bore or circuit be installed before beginning the other one.*

19. With the valve held by a vise in an upside down position, install the plunger return spring (4), regulator springs (5 and 6), and spring seat (7) into the correct bore.

NOTE: *If the spring seat (7) does not position itself correctly on top of the regulator spring, lightly shake the valve to correctly seat the spring seat.*

20. Install the spring into the open end of the regulator spool (8).

21. Lightly lubricate the regulator spool (8).

22. Install the regulator spool (8) on the regulator sleeve (14). The spherical end of the spool must be at the top of the regulator sleeve.

NOTES:
1. The top of the sleeve is the end with the smallest OD.
2. Check to ensure that the spools will slide smoothly and freely. Replace the entire sleeve assembly and spool if the spool does not slide smoothly and freely.
23. Remove the spool (8) from the sleeve before installing the sleeve into the body.

24. Lightly lubricate the O-rings (10, 12, and 13) on the regulator sleeve.

25. With the spool (8) temporarily removed from the sleeve, install the regulator sleeve (14) into the correct

valve body bore. Push the sleeve carefully into the body until the sleeve retaining flange at the base of the sleeve contacts the valve body.

26. Install the spool return spring (15) into the correct spool (8).

27. Lightly lubricate and install the reaction plunger (16) into the regulator spool.

28. Install the spool into the sleeve with the spherical end of the spool toward the top of the valve.

29. Repeat steps 19 through 28 for the second bore or circuit.

30. Lightly lubricate the large retainer plate O-ring (22) and install into the counter bore at the base of the regulator sleeve.

31. Install the retainer plug (23) into the counterbore at the bottom of the valve.

NOTE: *Make sure that the steps on the retainer plug are facing the counterbore or toward the top of the valve.*

32. Install the sleeve retainer (24) on top of the retainer plug. Secure with the socket head capscrews (26) and lockwasher (25), tightening alternately diagonally to evenly seat the regulator sleeve assembly. Torque to 140 to 150 inch-lb (16 to 17 Nm).

33. Install the actuator base on top of the valve.

NOTE: *Make sure that it is properly positioned to ensure needed port orientation. Tighten the two socket head capscrews evenly. Torque to 180 to 190 inch-lb (20 to 21 Nm).*

34. Screw the adjustment collars (1) onto the actuation plungers. Screw all the way down until each "bottoms" on the threads.

It is extremely important to "bottom" the collar on the threads to prevent over-stressing or breaking the springs during the pressure adjustment.
35. Tighten the collar tightening screws, snug only.

36. Install the arm/cam assembly follows:

a. Assemble the actuator cap (38), boot (39), boot retainer plate (41) to the actuator base with the four button head capscrews (40) and tighten.

⚠WARNING

NOTE: *In low temperature installations, a kit is available (and recommended) that bonds the special boot to the actuator cap with a low temperature adhesive.*

b. Insert the pivot pin (35) through the hole in the actuator base, through the holes in the U-bolts and through the pivot pin hole in the other side of the actuator base. As it is being inserted, install the two lever return springs (36 and 37).

c. Center the pivot pin and secure by tightening the four hex nuts (27) and washers (28) on the two U-bolts (29). Tighten evenly to a final torque of 140 to 150 inch-lbs (16 to 17 Nm).

37. On valves equipped with the differential or unequal pressure switch assembly, install the switch (50, Figure 5) onto the valve subassembly and secure.

INSTALLATION

The valve may be installed on the truck as follows:

1. Position the valve in the proper mounting location. Secure in place with capscrews and locknuts.

2. If removed, install the proximity switch (48) into the valve and adjust as outlined in the instructions in Maintenance and Adjustment.

3. Reconnect the hydraulic and electrical connections to the valve assembly.

4. Bleed all entrapped air and contaminates as outlined in the system instructions in Section 5 - Hydraulic System or equivalent.
5. Test and adjust the valve as outlined in the instructions in Maintenance and Adjustment in this module and in the system instructions in Section 5 - Hydraulic System.

6. Close or install any access panels removed.

BRAKE MANIFOLD ASSEMBLY

DESCRIPTION AND LOCATION

The brake manifold assembly is a rectangular shaped metal valve with several external poppets and multiple hose connections ports. It is generally mounted inside the hydraulic components box.

OPERATION

The brake manifold serves as a centralized assembly to provide the following provisions:

1. Park brake solenoid valves

a. Park brake solenoid valve - dual coil, latching type, electric solenoid valve that controls the flow of pressurized oil to the park brake system to allow the brakes to be applied or released.

b. Park brake shut-off valve - electric solenoid/check valve assembly that prevents the flow of oil to the system except when the solenoid is energized. The system is wired to allow this only to occur when the operator is holding the Park Brake Switch in the Release position.

2. Load brake solenoid - electric solenoid valve cartridge that control the flow of pressurized oil to the load brake system to allow the rear brake service calipers to be applied or released.

3. Auto apply solenoid (optional) - electric solenoid valve cartridge that control the flow of pressurized oil to the load brake system to cause the rear brake service calipers to apply if the system supply pressure decreases to less than a predetermined level.

4. Accumulator drains

a. Manual - cartridge assembly with either a manual pull type valve assembly (spring loaded to the closed position) or a needle type valve that provide a means of manually releasing any pressure remaining in the brake accumulator.

b. Automatic/Manual - on early production manifolds and trucks, there was an electric solenoid valve cartridge assembly that controlled the flow of oil from the rear brake accumulator system to the tank caused the rear (and thus the supply) accumulators to drain each time the truck's Master Switch was turned Off. An externally controlled manual drain provision was incorporated into this cartridge.

5. Low brake pressure switch - electric switch assembly that monitors the system supply pressure (accumulator pressure) and causes a cab dash Low Brake Pressure indicator to light.

6. Park brake pressure switch - electric switch assembly that monitors the park brake system pressure and causes a cab dash Park Brake indicator to light if the pressure decreases to a level at which the park brake calipers will apply.

7. Auto apply pressure switch – available electric switch assembly that monitors the brake system supply pressure and causes a cab dash auto apply solenoid to shift and automatically apply the trucks rear service brakes if the pressure decreases to the level that the park brakes will apply.

8. Internal pressure reducing valve (if so equipped) – a cartridge assembly installed in an internal port designed to limit the maximum pressure available to the park brake system calipers.

There are a number of ports on the manifold including:

1. (AL) port - not used at this time.

2. Rear brake accumulator (RBA) port - outlet pressure to the rear brake accumulator.

3. Supply brake accumulator (SBA) port - outlet pressure to the supply brake accumulator.

4. Pressure (P) port - inlet pressure from the steering manifold assembly.

5. Test station supply (TSS) port - outlet pressure to the gauge monitoring the supply brake accumulator pressure.

6. Front brake accumulator (FBA) port - outlet pressure to the front brake accumulator.

7. Test station front (TSF) port - mounting port for the quick disconnect fitting that monitors the pressure in the front brake accumulator.

8. Brake switch (BS) port - mounting port for the low brake pressure switch.

9. Auto apply switch (AAS) port - mounting port for the optional auto apply pressure switch.

10. Park brake (PB) port - outlet pressure to the wheelmotor mounted park brake assemblies.

11. Park brake switch (PBS) port - mounting port for the Park Brake Pressure switch.

12. Park brake supply (PBS) port - outlet pressure to the gauge monitoring the pressure in the park brake supply system.

13. Brake valve front (BVF) port - outlet port to the front brake control section of the brake (controller) valve.

14. Pilot valve (PV) port - outlet pressure to the cab mounted brake pilot valve assembly.

15. Load brake (LB) port - outlet pressure to the load brake shuttle valve and the load brake application system.

16. Pilot valve tank (PVT) port - return pressure from the pilot valve assembly.

17. Brake valve tank (BVT) port - return pressure from the brake (controller) valve assembly.

18. Drain (DR) port - outlet port from the manifold assembly to the main hydraulic reservoir. The back pressure of this flow is reduced by the operation of the venturi assembly.

19. Brake accumulator drain (BAD) port - outlet ports for the manifold mounted manual brake accumulator drain valves to the main hydraulic system reservoir.

20. Auto apply (AA) port - outlet port to the optional auto apply shuttle valve and remainder of the control function.

21. Test station rear (TSR) port - mounting port for the quick disconnect fitting that monitors the pressure in the rear brake accumulator.

22. Brake valve rear (BVR) port - outlet port for the rear brake control section of the brake (controller) valve.

Pressurized hydraulic oil from the steering manifold assembly enters the brake manifold through the “P” port.

The pressurized oil is routed to the three brake accumulators, which are plumbed with check valves in the manifold to maintain independence between the front and rear brake systems. Spring loaded, normally closed, drain valves are included to allow the front or rear brake accumulator to be drained of hydraulic pressure during maintenance. The supply accumulator drains through either the front or rear drain system, depending upon their release rates and pressures.

NOTE: *On early production manifolds and trucks, a 24 Vdc solenoid valve (with a manual drain provision) was provided to drain the rear brake accumulator each time the Master Switch was turned Off.*

The low brake pressure switch monitors the pressure in the brake supply accumulator, which will be equal to the front or rear brake accumulators (whichever is lower) and causes a dash mounted indicator to light when the pressure in this accumulator is less than 2100 psi (14 480 kPa).

If so equipped, the auto apply switch also monitors the brake supply accumulator pressure. When it is less than 1400 psi (9 655 kPa), the switch closes to supply power to the auto apply solenoid, which opens and supplies pressurized oil to the automatic brake application system.

The load brake solenoid (controlled by a cab mounted switch) controls the flow of oil to the load brake shuttle valve and then on to the rear service brakes.

The park brake solenoid valve provides a flow of oil to apply and release the wheelmotor mounted park brake calipers. The park brake shut-off valve prevents the flow through the system except when the solenoid is energized, typically when the Park Brake switch is in the Release position.

The pressure regulator or reducing cartridge (if so equipped) limits the maximum pressure available to operate the park brake caliper assemblies, when this is desired or required.

Detailed information on each of these systems is included in the system information in Section 5 - Hydraulic System.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the manifold should include the following:

1. Inspect the valve for evidence of leakage or damage. Repair or replace as required.

2. Test the operation of the functions of the manifold as outlined in the instructions for the dump, steering and brake systems in Section 5 - Hydraulic System.

REMOVAL

The manifold may be removed from the truck as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Drain all pressure in the system as outlined in the procedures on system operation and testing in Section 5 - Hydraulic System. This includes both the steering and brake system accumulators.

⚠WARNING

Always release all hydraulic pressure in the system before loosening or removing any hydraulic lines.

3. Disconnect all hydraulic fittings from the valve. Cap or plug all openings. Label each to aid in installation.

4. Remove the capscrews that secure the valve to the mounting bracket.

5. Remove the valve.

DISASSEMBLY (Figures 1A and B)

NOTE: *Figure 1A represents a brake manifold without an internal park brake pressure regulator or reducing valve that does. Figure 1B represents brake manifolds that incorporate this function with an internal mounted cartridge assembly.*

The manifold may be disassembled as follows:

NOTE: *During the disassembly and repair procedures, it is always a recommended practice to carefully note the specific installation and orientation of components before and as they are removed to aid in proper reassembly.*

1. Remove the load brake solenoid valve cartridge assembly (3).

2. Remove check valve cartridge assemblies (4, 8, and 13).

3. Remove the needle or button manual drain valve cartridge assemblies (5 and 14).

4. Remove the park brake shut-off valve cartridge assembly (6).

5. Remove the park brake solenoid valve assembly (2).

6. Remove the O-ring plugs, using care to note the location from which they were removed to aid in the reassembly.

7. Remove the park brake regulator or pressure reducing cartridge (11. Figure 1B), if so equipped.

8. Remove the plug valve or auto apply solenoid cartridge (if so equipped).

9. Remove the low brake pressure and park brake pressure switches (not shown) and any other remaining hardware.

INSPECTION AND REPAIR

The manifold components may be serviced as follows:

1. Inspect, then remove and discard all used O-rings when new ones are included in the new seal kit. Evidence of damage to the ring should be investigated for cause as it may indicate problems in other areas. It is recommended that all O-rings and seals are replaced each time removed to ensure proper valve sealing and operation.

2. Clean all parts thoroughly with clean solvent and dry with compressed air. Do not use rags or solvents that will leave a residue.

3. Remove any indicated burrs or high spots from any surfaces. Re-clean if required.

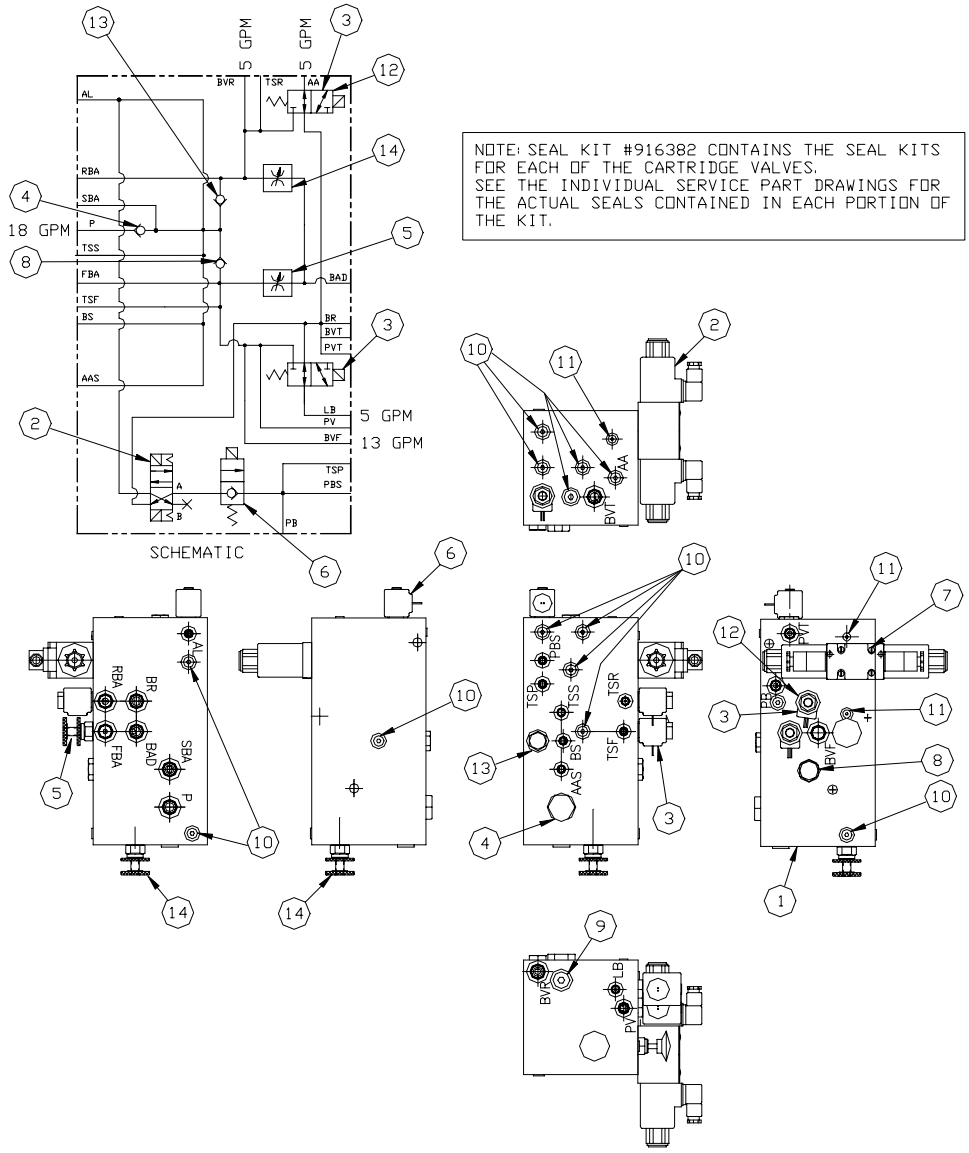
4. Inspect the valve body (1) and all other components for evidence of wear or damage. Particular attention should be paid to the bores, mating surfaces, and thread areas. If found to be significant the assembly must be replaced.

5. Test the operation of all solenoid valves by carefully applying 24 Vdc power and ground to the appropriate coil leads. Repair or replace as required. Torque the new coils to 4 to 6 ft-lbs. (5 - 8 Nm).

NOTE: *Separate instructions on the dual coil park brake solenoid valve are contained in Section 5 - Hydraulic System in this manual.*

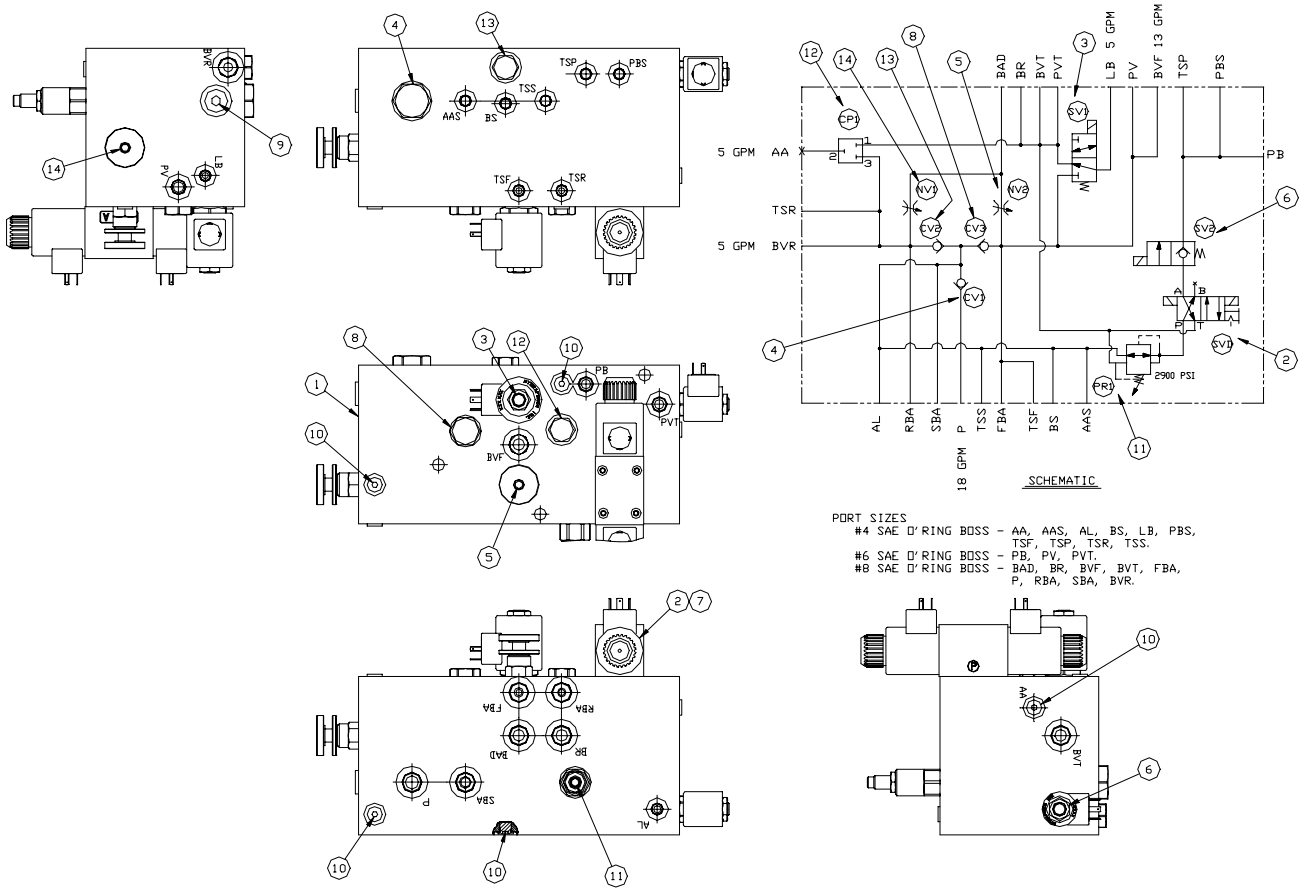
ASSEMBLY (Figure 1 unless listed otherwise)

The manifold may be assembled as follows:



KEY	84767A
01.	Manifold Body
02.	Park Brake Solenoid Valve Assembly
03.	Load Brake Solenoid Valve Cartridge Assembly
04.	Check Valve Cartridge Assembly
05.	Manual Drain Valve Cartridge Assembly
06.	Park Brake Shut-off Solenoid Valve Cartridge Assemblies
07.	Socket Head Capscrew
08.	Check Valve Cartridge Assembly
09.	#8 O-ring Plug
10.	#4 O-ring Plug
11.	#2 O-ring Plug
12.	O-ring Plug Cartridge
13.	Check Valve Cartridge Assembly
14.	Manual Drain Valve Cartridge Assembly (See Note on drawing.)

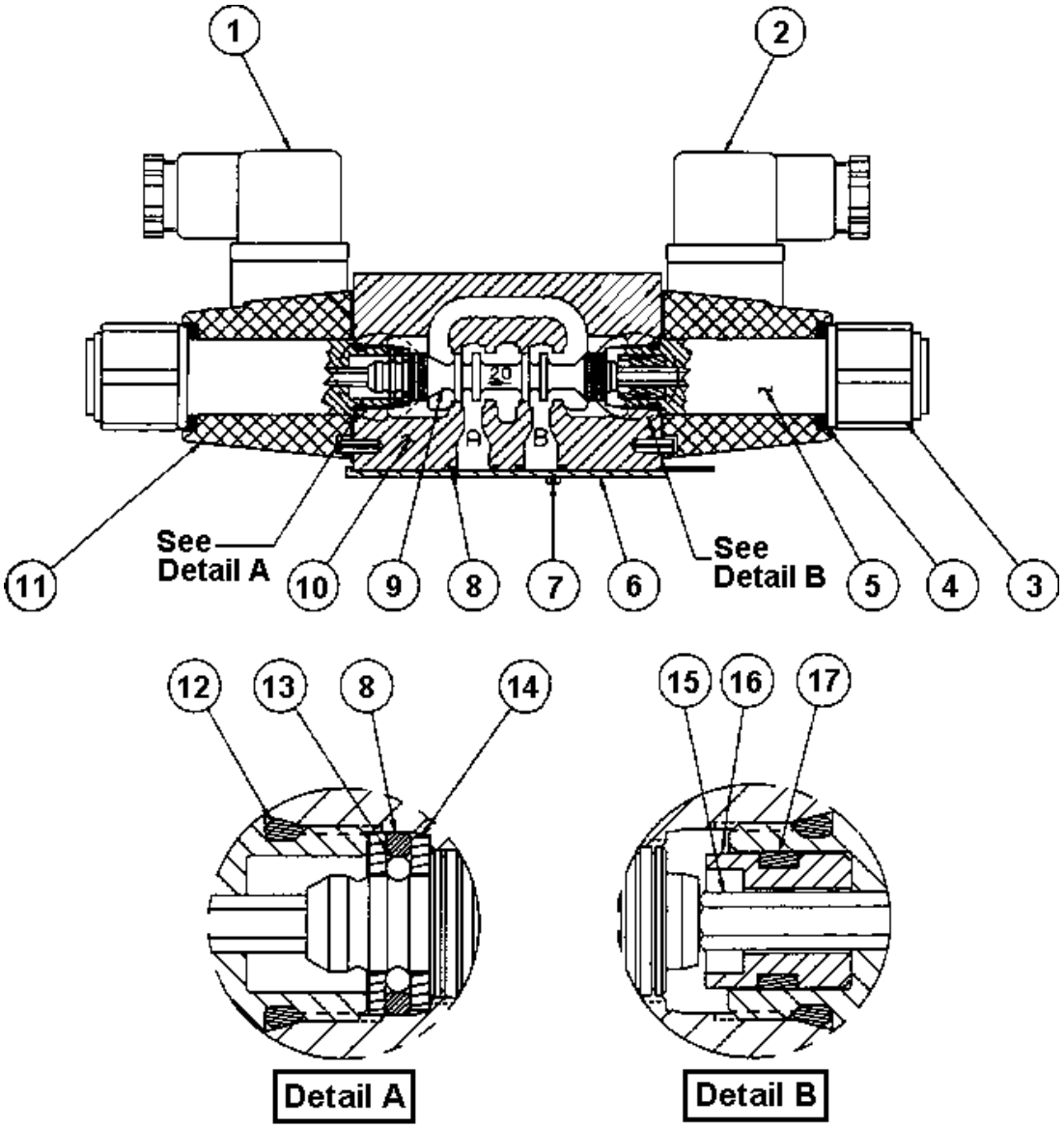
FIGURE 1A - BRAKE MANIFOLD ASSEMBLY – WITHOUT PARK BRAKE PRESSURE REGULATOR



KEY	85605A
01.	Manifold Body
02.	Park Brake Solenoid Valve Assembly
03.	Load Brake Solenoid Valve Cartridge Assembly
04.	Check Valve Cartridge Assembly
05.	Needle Valve Cartridge Drain Assembly
06.	Park Brake Shut-off Solenoid Valve Cartridge Assemblies
07.	Socket Head Capscrew
08.	Check Valve Cartridge Assembly
09.	#8 O-ring Plug
10.	#4 O-ring Plug
11.	Park Brake Pressure Regulator Cartridge Assembly
12.	Valve Plug Cartridge Assembly
13.	Check Valve Cartridge Assembly
14.	Needle Valve Cartridge Drain Assembly

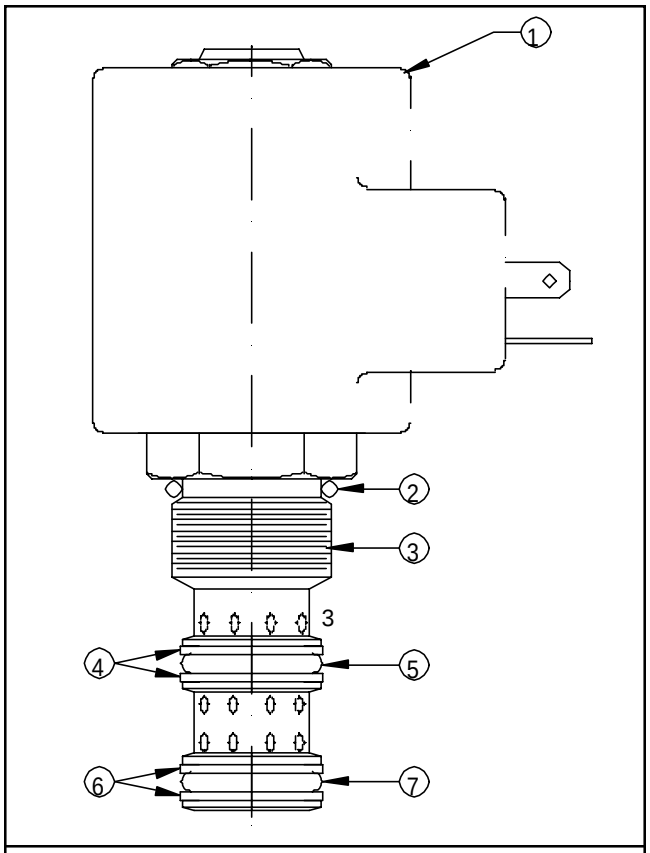
FIGURE 1B - BRAKE MANIFOLD ASSEMBLY – INCORPORATING PARK BRAKE PRESSURE REGULATOR

KEY					56074
01.	Black Plug	07.	Roll Pin	13.	Ball
02.	Gray Plug	08.	O-ring	14.	Ball Clamp
03.	Coil Retainer	09.	Spool	15.	Push Rod
04.	Coil Seal	10.	Body	16.	Spool Stop
05.	Tube	11.	Coil	17.	O-ring
06.	Shipping Plate (Remove for operation)	12.	O-ring		



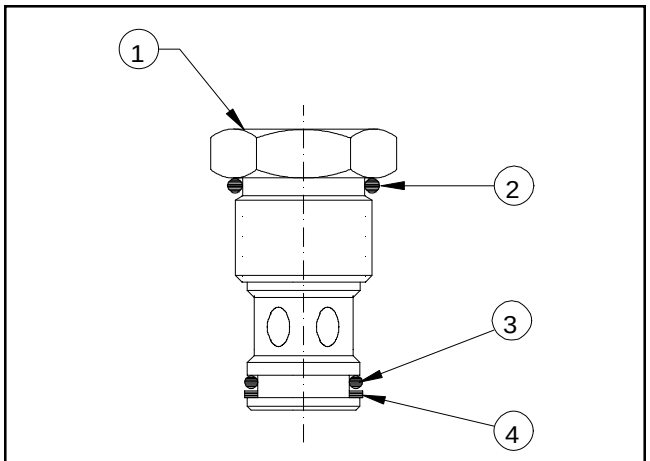
NOTE: There are two coil assemblies included in each valve. The listed quantities of components are per valve not each coil assembly.

FIGURE 2 - PARK BRAKE SOLENOID VALVE ASSEMBLY



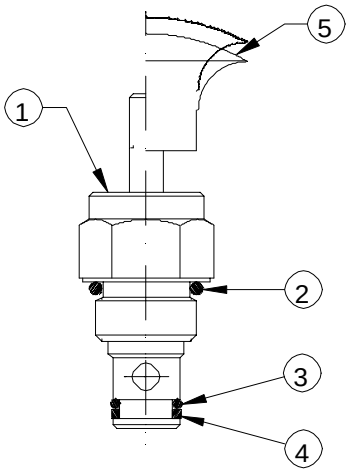
KEY			56081
01.	24 Vdc Coil	05.	O-ring
02.	O-ring	06.	Back-up Ring
03.	Solenoid Valve Cartridge	07.	O-ring
04.	Back-up Ring		

FIGURE 3 - LOAD BRAKE VALVE CARTRIDGE ASSEMBLY



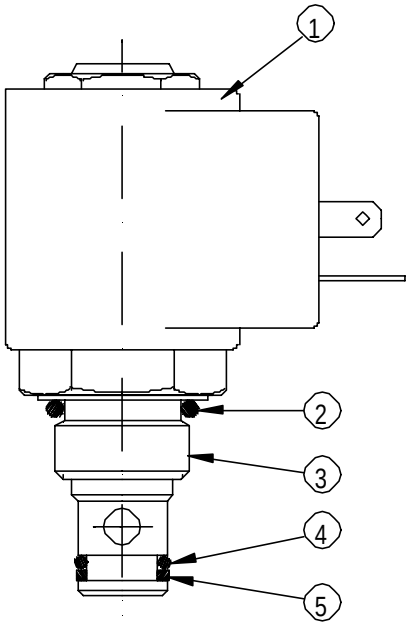
KEY			55644
01.	Check Valve Cartridge	03.	O-ring
02.	O-ring	04.	Back-up Ring

FIGURE 4 - CHECK VALVE CARTRIDGE ASSEMBLY



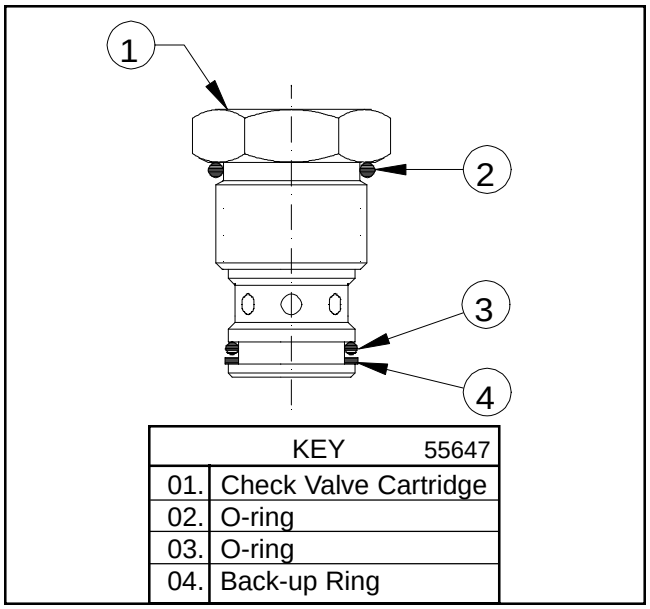
KEY		55656
01.	Manual Drain Valve Cartridge	
02.	O-ring	
03.	O-ring	
04.	Back-up Ring	
05.	Red Knob	

FIGURE 5 - MANUAL DRAIN VALVE CARTRIDGE ASSEMBLY



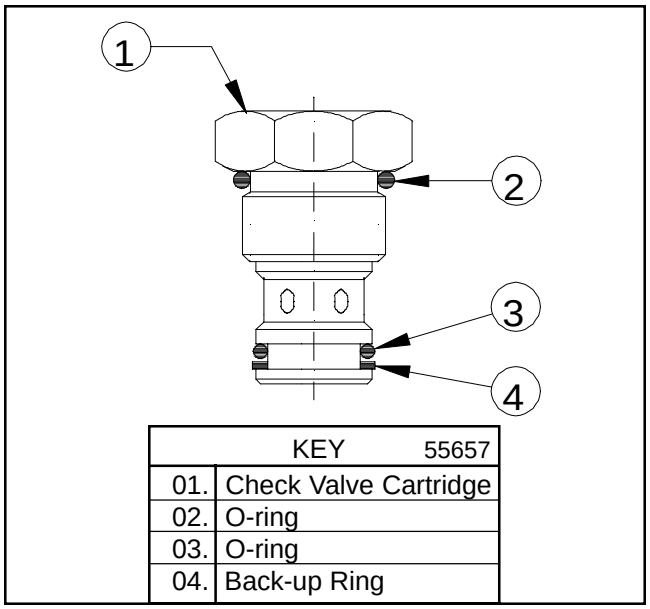
KEY		55918
01.	24 Vdc Coil	
02.	O-ring	
03.	Solenoid Valve Cartridge	
04.	O-ring	
05.	Back-up Ring	

FIGURE 6 - PARK BRAKE SHUT-OFF VALVE CARTRIDGE ASSEMBLY



KEY	55647
01.	Check Valve Cartridge
02.	O-ring
03.	O-ring
04.	Back-up Ring

FIGURE 7 - CHECK VALVE CARTRIDGE



KEY	55657
01.	Check Valve Cartridge
02.	O-ring
03.	O-ring
04.	Back-up Ring

FIGURE 8 - CHECK VALVE CARTRIDGE

NOTE: *If the solenoid coils are removed during their installation process, torque the new coils to 4 to 6 ft-lbs. (5 to 8 Nm).*

1. Check that all parts are clean and free of defects.

2. Install the O-rings and back-up rings on all components as shown in the applicable illustrations (Figures 2 through 10).

NOTE: *Items 11 and 12 in Figure 1B should install in a manner similar to their corresponding items in Figure 1A.*

3. Lubricate all O-rings and bores and threads in the valve body with clean hydraulic fluid compatible with that used in the truck's hydraulic system.

4. Install the O-ring plugs (items 9 through 11). Torque as outlined in the procedures in Section 10 - Miscellaneous.

NOTE: *If the manifold is equipped integral pressure regulating or reducing valve and plug valve cartridges (items 11 and 12, Figure 1B), they should be installed and torqued to 20 ft.-lbs. (27Nm)*

5. Install the cartridge valve plug or auto-apply solenoid cartridge assembly (if so equipped). Torque to 20 ft-lbs. (27 Nm).

6. Install the check valve cartridge assembly (8). Torque to 25 ft-lbs. (33 Nm).

7. Install the check valve cartridge assembly (13). Torque to 20 ft-lbs. (27 Nm).

8. Install the park brake shut-off solenoid cartridge assembly (6). Torque to 20 ft-lbs. (27 Nm).

9. Install the needle or pushbutton manual drain valve cartridge assemblies (5 and 14). Torque to 20 ft-lbs. (27 Nm).

NOTE: *Where applicable, install the automatic/manual accumulator drain solenoid valve assembly (14). Torque to 20 ft-lbs. (27 Nm).*

10. Install the check valve cartridge assembly (4). Torque to 35 ft-lbs. (47 Nm).

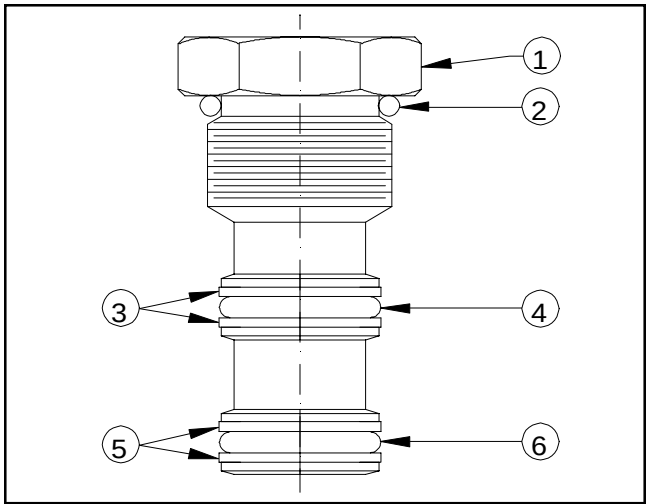
11. Install the load brake solenoid valve cartridge assembly (3). Torque to 25 ft-lbs. (33 Nm).

12. Install the park brake solenoid valve assembly (2). Torque to 20 ft-lbs. (27 Nm).

13. Install the low brake pressure and park brake pressure switches (not shown) and any other remaining hardware. Torque each as outlined in the instructions in Section 10 - Miscellaneous.

14. Install caps on all open ports.

15. Clean and prepare for installation.



KEY			56082
01.	Plug Valve Cartridge	04.	O-ring
02.	O-ring	05.	Back-up Ring
03.	Back-up Ring	06.	O-ring

FIGURE 9 - PLUG VALVE CARTRIDGE

INSTALLATION

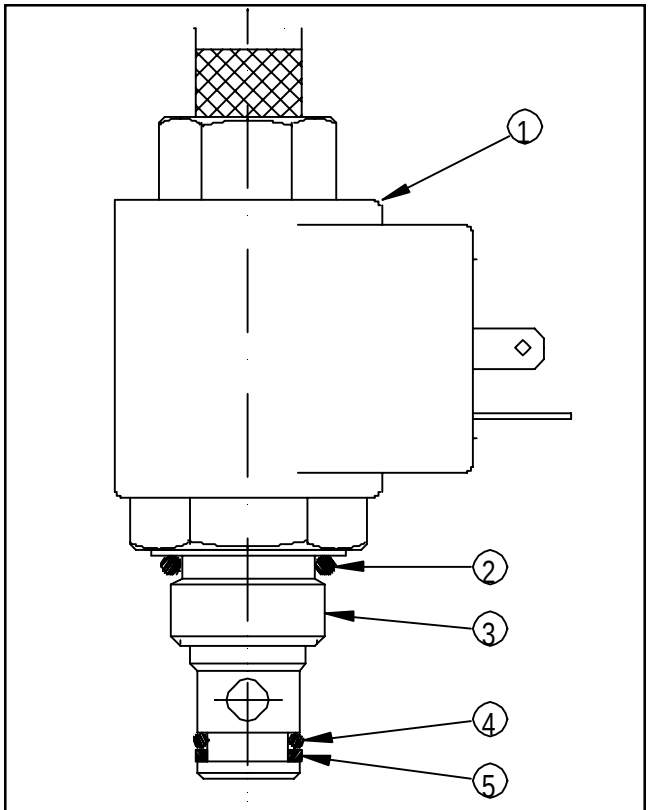
The manifold may be installed as follows:

1. Install the valve on the mounting brackets. Secure with the appropriate capscrews and related hardware.

2. Connect all hydraulic lines and electrical wires. Torque each connection as outlined in the instructions in Section 10 - Miscellaneous.

3. Bleed and test all systems as outlined in the procedures for the dump, steering, and brake systems in Section 5 - Hydraulic System.

NOTE: *Entrapped air should be bled from all three systems.*



KEY			55972
01.	24 Vdc Solenoid Coil	04.	O-ring
02.	O-ring	05.	Back-up Ring
03.	Cartridge Valve		

FIGURE 10 - AUTOMATIC/MANUAL ACCUMULATOR DRAIN ASSEMBLY (WHERE APPLICABLE)

PARK BRAKE SOLENOID VALVE

DESCRIPTION AND LOCATION

The park brake solenoid valve is a double coiled, two position, detented solenoid valve. It is mounted on the brake manifold in the hydraulic components box on the superstructure behind the cab.

There have been two versions of the valve used:

1. In early production installations, the valve can be identified by metal nuts retaining the solenoid coils.

2. On later production versions (and trucks modified with the later production valve), it may be identified by fiber nuts retaining the solenoid coils.

NOTES:
1. The two versions of the valve are fit and functionally interchangeable, but they are from different suppliers and the coils and other operating components are not compatible. Be sure to identify the version in question prior to servicing either form of the valve.
2. The later production valves are of a design that has limited servicing capability outside of cleaning and replacement of the electric coils.

OPERATION

The park brake solenoid valve controls the flow of hydraulic fluid into and out of the park brake system.

The valve is a four-way, two-position, double-coil electric solenoid operated valve. This type of valve is designed to remain in one of two detented positions until the energizing of the coil at the opposite end causes it to shift to the other position.

This provides the control of flow either from the supply source (in the brake manifold) to the caliper assemblies or from the calipers to the hydraulic tank.

NOTE: *Provision has been made to allow the valve to be manually shifted by external means if necessary. This may be done by inserting a punch or similar tool into contact with the push rod assembly in the tube/coil assembly on the appropriate end of the valve, then pushing it to its other detented position. This may take some effort, particularly when the system is pressurized. Make sure that the spool is in one of its detented positions at all times.*

Typically an electric park brake shut-off solenoid valve assembly is installed on the outlet to prevent the flow from continuing should a leak develop downstream of the park brake solenoid valve.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the manifold should include the following:

1. Inspect the valve for evidence of leakage or damage. Repair or replace as required.

2. Test the operation of the valve as outlined in the instructions for the brake systems in Section 5 - Hydraulic System.

REMOVAL

The park brake solenoid valve may be removed from the truck as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Drain all pressure in the system as outlined in the procedures on system operation and testing in Section 5 - Hydraulic System. This includes both the steering and brake system accumulators.

⚠WARNING

Always release all hydraulic pressure in the system before loosening or removing any hydraulic lines.

3. Disconnect all electrical connections from the valve. Cap or plug all openings. Label each to aid in installation.

4. Remove the capscrews which secure the valve to the mounting bracket.

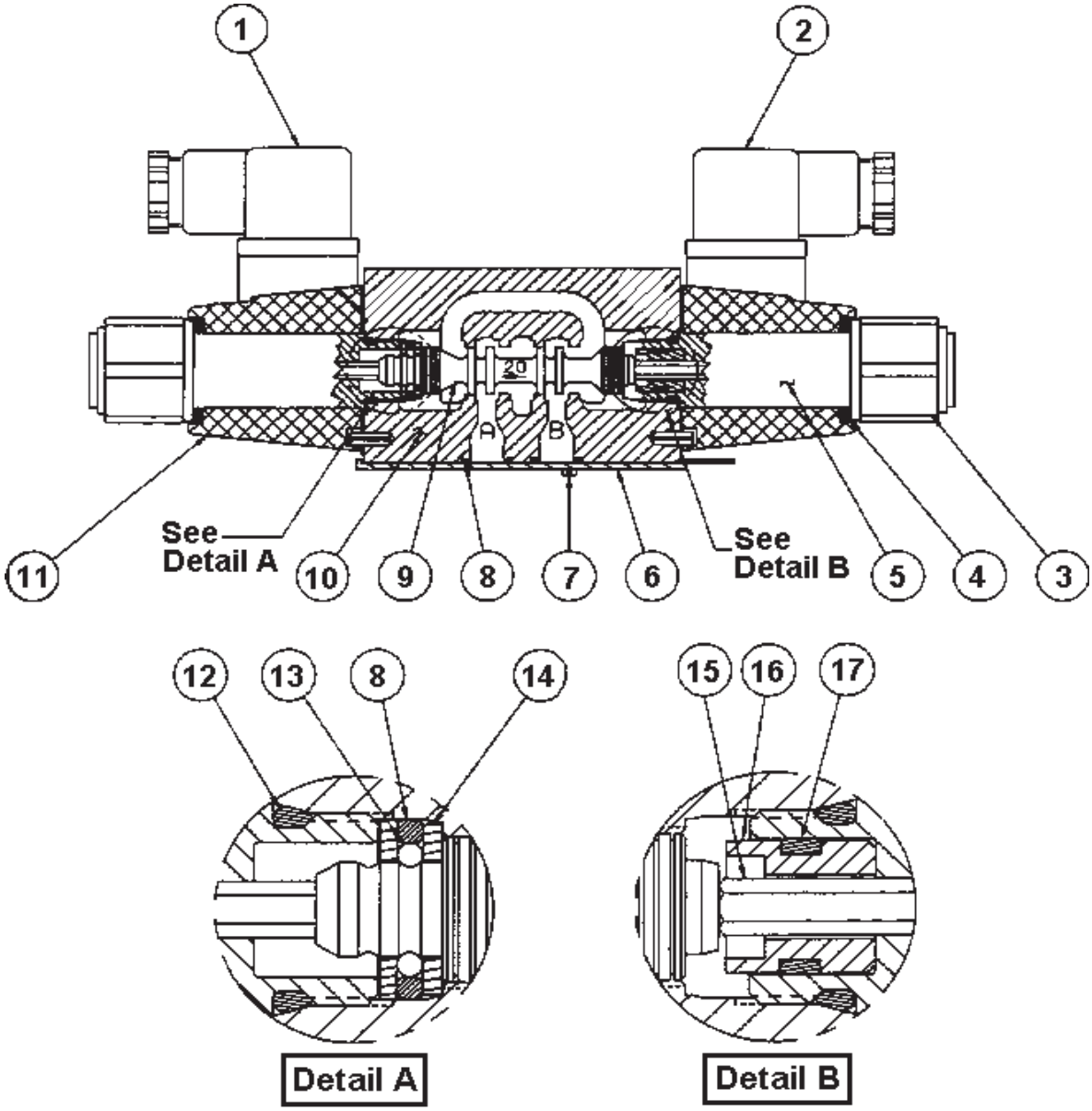
5. Remove the valve.

DISASSEMBLY

The park brake solenoid valve may be disassembled as follows:

1. Early production version valves: (See Figure 1)

a. Remove the two coil retainer nuts (3) from both ends of the valve.



NOTE: There are two coil assemblies included in each valve. The listed quantities of components are per valve not each coil assembly.

KEY 56074

01.	Black Plug	07.	Roll Pin	13.	Ball
02.	Gray Plug	08.	O-ring	14.	Ball Clamp
03.	Coil Retainer	09.	Spool	15.	Push Rod
04.	Coil Seal	10.	Body	16.	Spool Stop
05.	Tube	11.	Coil	17.	O-ring
06.	Shipping Plate (Remove for operation)	12.	O-ring		

FIGURE 1 - PARK BRAKE SOLENOID VALVE ASSEMBLY – EARLY PRODUCTION VERSION (56074)

b. Remove the two coil assemblies (11) from the tube/ body assembly.

c. Remove the two tube and spool stop assemblies from the body.

d. Remove the detent assembly (ball clamps (14), O- ring (8) and ball (13)) from one end of the spool assembly.

e. Remove the spool assembly from the body taking care not to damage the spool or body.

f. Remove the other detent assembly from the spool as outlined in step d.

g. Remove the spool stop (16) from the tube assemblies.

h. Inspect then discard all O-rings and seals.

2. Later production versions: (See Figure 2)

a. Remove the two coil retainer nuts from both ends of the valve.

b. Remove the two coil assemblies (1) from the body assembly (2).

c. Carefully remove the internal spool if required.

INSPECTION AND REPAIR

The disassembled components may be serviced as follows:

1. Inspect, then remove and discard all O-rings that are included in the new seal kit. Evidence of damage to the ring should be investigated for cause as it may indicate problems in other areas. It is recommended that all O-rings and seals be replaced each time removed to ensure proper valve sealing and operation.

2. Clean all parts thoroughly with clean solvent and dry with compressed air. Do not use rags or solvents that will leave a residue.

3. Remove any indicated burrs or high spots from any surfaces. Re-clean if required.

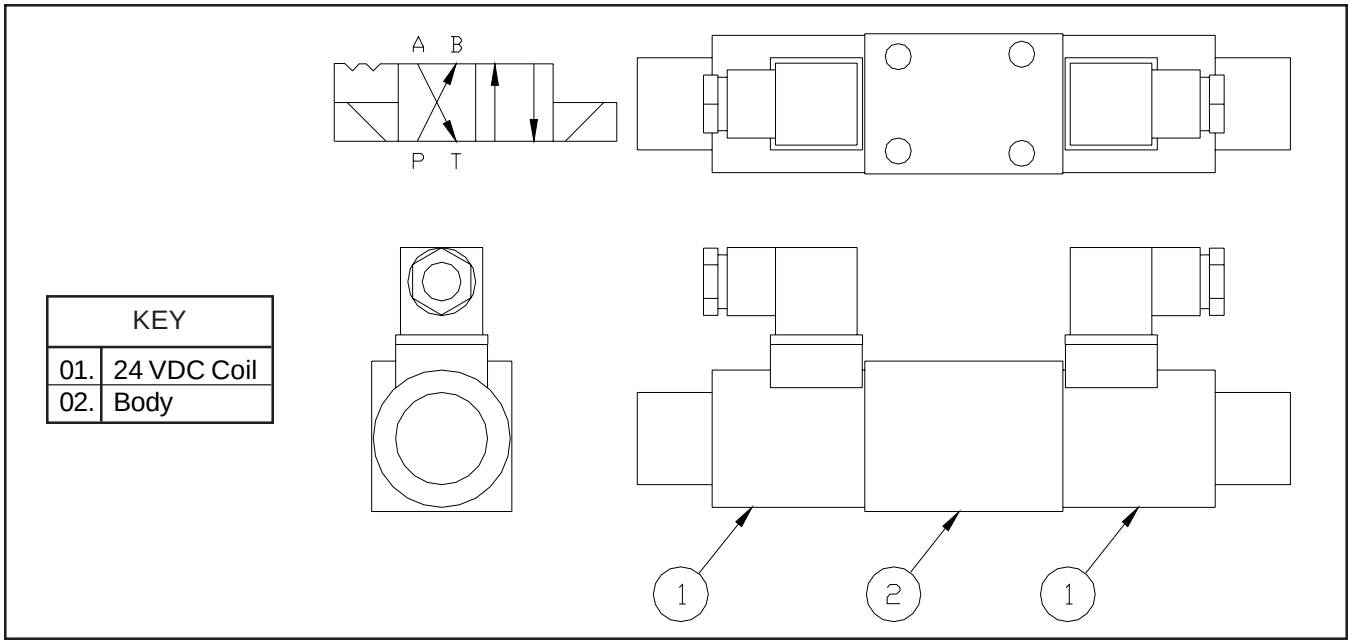
4. Inspect the valve body and all other components for evidence of wear or damage. Particular attention should be paid to the bores, mating surfaces, and thread areas. If found to be significant, the entire assembly must be replaced.

5. Test the operation of all solenoid valves by carefully applying 24 Vdc power and ground to the appropriate coil leads. Repair or replace as required.

ASSEMBLY

The park brake solenoid valve may be assembled as follows:

1. Earlier production versions: (See Figure 1)



KEY	
01.	24 VDC Coil
02.	Body

FIGURE 2 - PARK BRAKE SOLENOID VALVE ASSEMBLY – LATER PRODUCTION VERSION (57060)

a. Check that all parts are clean and free of defects.

b. Lubricate all O-rings, and bores and threads in the valve body with clean hydraulic fluid compatible with that used in the truck's hydraulic system.

c. Install the O-rings (12) on both of the coil assemblies (11).

d. Install the O-rings (17) on and push rod (15) in both of the spool stops (16).

e. Install the spool stop assemblies in each of the tube assemblies (5).

f. Install the spool assembly in to the body (10).

g. Install the ball clamps (14), ball (13), and O-ring (8), as shown on each end of the spool assembly.

NOTE: *Make sure that the inner clamp halves are secure against the shoulder in the bore of the body and that the O-ring (8) and clamp halves (14) secure the ball (13) in position.*

h. Install one of the tube and spool stop assemblies onto the body, making sure that the push rod (15) contacts the end of the spool. Tighten the tube assembly to 180 inch-lbs (20 Nm).

NOTE: *During assembly use care not to allow the detent assembly to move from its installed position.*

i. Install coil (11) on the tube body assembly aligning the alignment pin in the body with the hole in the coil. Secure with coil retainer nut (3), tightened to 27 inch-lbs (3 Nm) final torque.

j. Repeat steps h and i with the other end of the assembly.

k. Using a small punch or similar tool move the spool back and forth within the bore checking the smoothness of operation and the positive locking and releasing of the two detent assemblies.

l. Cap or cover all openings to maintain component cleanliness.

2. Later production valves: (See Figure 2)

a. Check that all parts are clean and free of defects.

b. Lubricate all O-rings, and bores and threads in the valve body with clean hydraulic fluid compatible with that used in the truck's hydraulic system.

c. If removed, carefully reinstall the spool assembly into the body.

d. Install coil assembly (1) on the body assembly (2), aligning as required. Secure with coil retainer nut, tightened as required.

e. Repeat with the coil (1) on the other end.

f. Using a small punch or similar tool move the spool back and forth within the bore checking the smoothness of operation and the positive locking and releasing of the two detent assemblies.

g. Cap or cover all openings to maintain component cleanliness.

INSTALLATION

The park brake solenoid valve may be installed as follows:

1. Install the valve on the brake manifold assembly as shown in the instructions for the manifold in Section 5 - Hydraulic System. Tighten the valve to a final torque of:

a. Early production valves: 20 ft-lb (27 Nm).

b. Later production valves: 5 ft-lb (7 Nm).

2. Connect all electrical wires.

3. Bleed and test all systems as outlined in the procedures for the brake system (particularly the park brake system) in Section 5 - Hydraulic System.

NOTE: *Entrapped air should be bled from all parts of the brake systems.*

SHUTTLE VALVE

DESCRIPTION AND LOCATION (Figure 1)

The shuttle valve is a ball type metal valve used to control the movement of hydraulic fluid.

It is typically mounted in the hydraulic components box on the superstructure behind the cab.

OPERATION (Figure 1)

The shuttle valve provides a means of automatically selecting between two input sources with a single, common output.

The valve consists of a single ball placed between two check seats.

Pressurized fluid enters through both the input ports (identified as 1 and 2). When one of the input lines is pressurized, the internal check ball is forced against the opposite seat, blocking that inlet and providing a flow path to the outlet port.

NOTE: *The outlet flow is always from the source of the highest pressure.*

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following:

1. Inspect the valve, and associated components for evidence of damage or leakage. Repair or replace as required.

2. If problems are noted with the operation of the valve, remove, disassemble, and clean. Replace seals and check the condition of the check ball and seats. Repair or replace as required.

REMOVAL

The shuttle valve may be removed from the truck as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Drain all pressure in the system as outlined in the procedures on system operation and testing in Section 5 - Hydraulic System. This includes both the steering and brake system accumulators.

⚠WARNING

Always release all hydraulic pressure in the system before loosening or removing any hydraulic lines.

3. Disconnect all hydraulic fittings from the valve. Cap or plug all openings. Label each to aid in installation.

4. Remove the capscrews that secure the valve to the mounting bracket.

5. Remove the valve.

DISASSEMBLY (Figure 1)

The shuttle valve may be disassembled as follows:

NOTE: *During the disassembly and repair procedures, it is always a recommended practice to carefully note the specific installation and orientation of components before and as they are removed to aid in proper reassembly.*

1. Clean all oil, dirt and other contamination from the exterior of the valve.

2. Using the appropriate wrench, loosen the lock nut (3) from the body (1).

3. Again using the appropriate tool, loosen and remove the cartridge assembly from the body (1).

4. Remove the O-ring plugs using care to note the location from which they were removed to aid in the reassembly.

INSPECTION AND REPAIR (Figure 1)

The manifold components may be serviced as follows:

1. Inspect, then remove and discard all of the previously used O-rings that have replacements included in the new seal kit. Evidence of damage to the ring should be investigated for cause as it may indicate problems in other areas. It is recommended that all O-rings and seals be replaced each time removed to ensure proper valve sealing and operation.

2. Clean all parts thoroughly with clean solvent and dry with compressed air. Do not use rags or solvents that will leave a residue.

3. Remove any indicated burrs or high spots from any surfaces. This is especially true of the check ball and the “check seats” in the inner portion of the cartridge assembly. Repair, replace, or re-clean as required.

4. Inspect the valve body and all other components for evidence of wear or damage. Particular attention should be paid to the bores, mating surfaces, and thread areas. If found to be significant, the assembly must be replaced.

ASSEMLY (Figure 1)

The shuttle valve may be assembled as follows

1. Check that all parts are clean and free of defects.

2. Install the O-rings and back-up rings on all components as shown.

3. Lubricate all O-rings and bores in the valve body with clean hydraulic fluid compatible with that used in the truck’s hydraulic system.

4. Install the check ball (7) into position in the cartridge.

5. Install the lower portion of the cartridge. Tighten securely, but use care not to over tighten as the seal is provided by the seal rings and not the mating surfaces.

6. Apply thread lock compound to the threads on the upper portion of the cartridge (2) as appropriate.

7. Install the cartridge assembly into the body using care not to damage the seals. . Tighten securely, but use care not to over tighten as the seal provided by the seal rings and not the mating surfaces.

8. Install the lock nut (3). Using the appropriate tools to hold the cartridge assembly and to tighten the lock nut (3), tighten the lock nut to a final torque of 575 inch-lb (65 Nm).

INSTALLATION

The shuttle valve may be installed as follows:

1. Install the valve. Secure as required.

2. Connect all hydraulic lines. Torque each connection as outlined in the instructions in Section 10 - Miscellaneous.

3. Bleed and test all systems as outlined in the procedures for the dump, steering, and brake systems in Section 5 - Hydraulic System.

NOTE: *Entrapped air should be bled from all three systems.*

KEY 56152	
01.	Body
02.	Cartridge
03.	Lock Nut
04.	O-ring
05.	Back-up Ring
06.	O-ring
07.	Check Ball
08.	O-ring
09.	Back-up Ring
10.	Back-up Ring
11.	O-ring

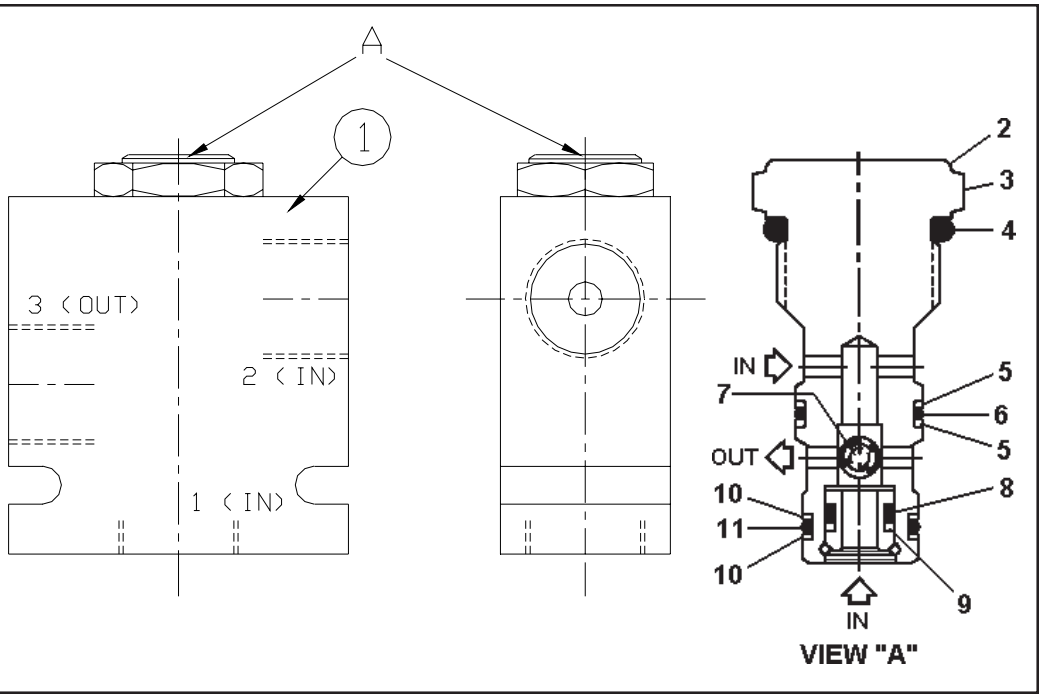


FIGURE 1 – SHUTTLE VALVE (56152)

PNEUMATIC SYSTEM

DESCRIPTION

There is no pneumatic system on the TMT 240,TMT 260AC, or MT 4400 trucks. All controls are handled by the 24 Vdc electrical system, or with hydraulic or mechanical linkages.

Pressurized air, provided by the operation of the dump body through its normal movement is used to pressurize the hydraulic tank. For detailed information, refer to the information on this system in Section 5 - Hydraulic System.

FRONT AXLE

DESCRIPTION AND LOCATION (Figure 1)

The front axle has a long, box configuration curved at each end. It is mounted under the frame and in between the front wheel assemblies.

OPERATION

The front axle is a major structural component of the truck. It provides a:

1. Mounting and pivot point for the spindles in the front wheel assemblies.

2. Series of mounting points for the steering assembly.

3. Connection point for the suspension assemblies.

The front suspension strut assemblies control the oscillation of the axle. Four parallel radius rods are included to control the fore and aft and twisting movements. A transverse radius rod is employed to limit its lateral movement while maintaining its ability to oscillate at various heights.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the front suspension should include the following:

1. Check for cracks in the axle structure and radius rods. Repairs should be made as per the structural welding instructions in Section 10 - Miscellaneous.

2. Check the various pins and other wear points for evidence of proper lubrication. Correct as required.

3. Check the kingpin assembly for evidence of wear, damage, or slack in the kingpin assemblies. At normal inspections this may be done visually. However, at regularly scheduled intervals, (typically 500 hours) a detailed inspection is recommended. This may be done as follows:

NOTE: *This measurement may be taken on each front wheel separately or simultaneously depending upon the availability of measurement and lifting equipment.*

a. Park the empty truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system. The tires should be positioned straight ahead and the engine and Master Switch should both be off.

⚠WARNING

Verify that any residual pressure in the steering accumulators is released before working near the front tire and rim assemblies.

b. Measure the radial run-out of the kingpin assembly as follows:

(1) Install dial indicators on the inside of the top and bottom bosses of the front spindle assembly to measure movement of the spindle bosses relative to the front axle assembly directly toward and away from the center of the truck. See Note A on Section C – C of Figure 1.

NOTES:

1. In this application, dial indicators with a mushroom shaped head, provide more accurate readings. Use of a pointed head tends to read the contour of the surface and not to provide accuracy.

2. The contact area of the pointer must be clean, smooth, and free of irregularities throughout the dial indicator's operating range.

3. The indicator should be adjusted to an initial reading of 0 inches (mm) and set so that they can accurately measure a minimum of 0.040 to 0.075 inches (1.0 to 1.9 mm) movement in either direction.

(2) Using jacks or other suitable means of lifting the frame or front axle without contacting either front tire, wheel or spindle assembly, raise the truck until the tires are clear of the floor. Secure in this position, with the tire, wheel, and spindle assemblies free.

(3) Read and record the measured movement on each of the dial indicators.

(a) If either measurement is between 0.053 to 0.065 inches (1.40 and 1.65 mm), the clearances shown significant wear but if no other problems are noted are still acceptable to be placed back into normal service. However, it is recommended that the operation and wear be more closely monitored.

NOTE: *Typically this would involve a significant decrease in the time between normal inspections. For example, if the normal inspection period is 500 hours, checking at lesser intervals, depending upon the length of time over which the original wear occurred.*

(b) If either measurement exceeds 0.065 inches (1.65mm), the wear is considered excessive and the assemblies should be disassembled and repaired or replaced as required. Detailed service information is included later in this module.

⚠WARNING

Failure to service the component assemblies will result in increased rates of wear and eventually to malfunctioning of the front axle/spindle assemblies.

(4) Repeat the procedure if required on the other side.

(5) After the check is complete:

(a) Remove the dial indicators.

(b) Remove the blocking securing the truck and components.

(c) Lower the truck to the ground.

c. Measure the vertical play of the kingpin assembly as follows:

NOTE: *This measurement serves to provide a means of monitoring the wear condition of the kingpin's bottom thrust washer and related items.*

(1) Using feeler gauges, measure the clearance between the lower face of the top portion of the spindle and the top surface of the upper thrust ring. See Note B on Section C-C in Figure 1.

NOTE: *To obtain the most accurate measurement, the feeler gauges should be carefully inserted to ensure they are on top of the thrust ring and against the kingpin.*

(2) Record the clearance measured, including the date and operating hours.

(3) The kingpin assembly should be disassembled, inspected, and components replaced as required if the measured clearance is greater than the initial clearance plus 0.160 inches (4.05 mm).

NOTES:

1. The wear measurements should be taken at both the front and rear of the assembly, approximately 180° apart.

2. The recorded and monitored measurement should be an average of the two measurements.

3. It is imperative that an initial measurement be taken and recorded whenever kingpin assembly components are serviced or replaced. If not then the extra clearance from the initial assembly cannot be included in the monitoring of wear.

d. After the check is complete:

(1) Remove the dial indicators.

(2) Remove the blocking securing the truck and components.

(3) Lower the truck to the ground.

NOTE: *Trucks with Serial Numbers MH102 and up and earlier trucks modified by Engineering Bulletin EB 1327B are as shown in the illustration. Earlier trucks using different bearing assemblies do not include the roll pins (38) securing the bearing housing (9) and bronze thrust bearing (8) or their installation provisions. Refer to the appropriate BUCYRUS® Parts Manual or Engineering Bulletin for assistance in identifying the configuration installed.*

4. Check the radius rod pins for evidence of slack or damage. Repair or replace as required.

5. Check that the capscrews retaining the radius rod pins are properly tightened.

REMOVAL

The front axle assembly may be removed as follows:

NOTE: *Removal of the front tire and rim, wheel, and/or assemblies is not required to remove the axle. Typically, however, it is desirable for them to be removed to minimize the weight and size of the assembly being handled.*

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Raise the truck and secure the truck frame and front axle with adequate blocking to prevent unwanted movement.

3. Verify that:

a. All brakes are released.

b. All pressure has been released from the steering and brake accumulators and the hydraulic tank systems.

⚠ DANGER

It is important that all pressure in the hydraulic steering and brake systems be released prior to working on any components or loosening any hydraulic fittings.

4. Remove the tire and rim assemblies as outlined in the instructions in Section 7 - Running Gear.

5. Remove the front wheel (and brake assemblies) as outlined in the instructions in Section 7 - Running Gear and Section 8 - Brake System.

NOTE: *Again this may not be absolutely necessary, but it will reduce the weight and mass of the material being moved if handling equipment is limited.*

6. Disconnect and cap the hydraulic hoses from the steering cylinders and brake and automatic or manual lube assemblies.

7. Discharge all nitrogen precharge pressure in the front suspension struts as outlined in the procedure in Section 7 - Running Gear.

8. Raise the truck until the suspension is fully extended. Stop before the axle begins to lift. Secure the suspension in this position.

9. Remove the capscrews, washers, lock, and pin from the suspension lug on the front axle as outlined in the instructions in Section 7 - Running Gear. Secure the suspension out of the way.

10. Resecure the truck frame and front axle assemblies.

11. Remove capscrews, washers, and locks from the radius rod pins. Using air-arc or other suitable means, remove the lock on the upper axle end radius rod pin retainers.

12. Remove the pins and the radius rods marking the positions removed from to aid in installation.

⚠ WARNING

Each large upper radius rod weighs approximately 425 lb (190 kg). Each large lower radius rod weighs approximately 650 lb (230 kg). The smaller transverse radius rod weighs approximately 230 lb (105 kg).

NOTE: *While removing the pins, pay attention to the orientation of the pin removed from each location, particularly the eccentric style pins that are found in the ends of the upper link assemblies. This will also aid in installation*.

13. Remove the axle from under the frame.

14. Remove any material remaining on the axle required to effect repairs as outlined in the instructions in Section 5 - Hydraulic System, Section 7 - Running Gear, or Section 8 - Brake System.

15. If removal of the spindles is required proceed as instructed in the disassembly instructions in this module.

DISASSEMBLY

The spindle/kingpin assembly may be removed as follows:

1. Secure the axle assembly and spindles to prevent undesired movement of any components.

2. Remove the capscrews (12) and washers (13) from the kingpin cover (11). Remove the cover.

3. Remove the setscrew (14) that anchors the kingpin (3) from the side of the axle.

4. While supporting the spindle assembly, pull the kingpin from the axle.

⚠ WARNING

Each spindle weighs approximately 2000 lb (910 kg).

5. Remove the spindle and remaining components from the axle.

INSPECTION AND REPAIR

The assemblies may be serviced as follows:

1. Inspect radius rods, spindle, and axle for cracks, chips, or other abnormalities. Repair or replace as required. Structural field welding procedures are included in Section 10 - Miscellaneous.

NOTE: *Do not attempt to repair or weld on these components without first consulting a* TEREX|UNIT RIG *representative.*

2. Inspect the bearings, bushings, machined surfaces, and kingpins for scratches, wear spots, or other imperfections. Repair or replace as required.

NOTE: *Be careful not to scratch or damage machined surfaces.*

3. Verify that the roll pins (38) used to secure the bronze thrust bearing (8) and bearing housing (9) are properly installed and in good repair. Replace as required.

NOTE: *Trucks with Serial Numbers MH102 and up and earlier trucks modified by Engineering Bulletin EB 1327B are as shown in the illustration. Earlier trucks using different bearing assemblies do not include the roll pins (38) securing the bearing housing (9) and bronze thrust bearing (8) or their installation provisions. Refer to the appropriate* BUCYRUS® *Parts Manual or Engineering Bulletin for assistance in identifying the configuration installed.*

RADIUS ROD BUSHINGS

The self-aligning bushings in the ends of the radius rods may be changed as follows:

1. Using the appropriate tools, remove the retainer rings (30, 32) from the bearing.

2. Remove the old bearing.

3. Inspect the sleeve in the bore. If found damaged, repair if possible. If it must be replaced, this may be done as follows:

a. Using the appropriate cutting and related tools, remove the damaged sleeve from the bore.

b. Inspect the bore's condition and repair as required.

c. Install the new sleeve as follows:

IMPORTANT: *Sleeves with high interference fit may be installed using either of the methods outlined here. The liquid nitrogen method typically provides a more consistent installation.*

(1) Liquid Nitrogen Method

WARNING

Due to the cold temperatures of both the liquid nitrogen cooling medium and the parts being cooled, it is important to take extra precautions that neither comes in contact with skin, clothing, or other items during the entire procedure.

(a) Inspect the new sleeve for evidence of damage, burrs, etc. Repair as required.

(b) Using all of the appropriate precautions because of the cold temperatures of the materials involved, gently immerse the sleeve into a pool of liquid nitrogen.

(c) After allowing sufficient time to fully cool, carefully remove from the liquid nitrogen and install in the appropriate bore properly oriented.

(d) Allow the sleeve to warm slowly and evenly to ambient temperature, making sure that the retaining rings may be properly installed.

IMPORTANT: *The use of externally applied heat to speed up the process may result in uneven cooling and warping of or damage to the sleeve.*

(2) Heating Method

WARNING

Due to the cold temperatures of both the liquid nitrogen cooling medium and the parts being cooled and the heat applied to the receiving component area, it is important to take extra precautions that neither comes in contact with skin, clothing, or other items during the entire procedure.

(a) Inspect the new sleeve for evidence of damage, burrs, etc. Repair as required.

(b) Using all of the appropriate precautions because of the cold temperatures of the materials involved, carefully cool the sleeve to a temperature of -40° to -70° F (-40° to -57° C).

(c) Evenly heat the bore into which the sleeve is to be installed to 300° to 350° F (150° to 175° C).

IMPORTANT: *Heat the massive side of the lug additionally to ensure that the bore is heated and expanded evenly.*

(d) Once both components are at the proper temperatures, carefully remove the sleeve from the cooling medium and install in the appropriate bore properly oriented.

(e) Allow the sleeve to warm slowly and evenly to ambient temperature, making sure that the retaining rings may be properly installed.

IMPORTANT: *The use of externally applied heat to speed up the process may result in uneven cooling and warping of or damage to the sleeve.*

4. Install the new bearings into the sleeves/bores as follows:

IMPORTANT: *Steel spherical bearings should not come in direct contact with dry ice and should not be immersed in liquid nitrogen. Either of these actions could result in the change of the metallurgical character of the bearing affecting subsequent fit and operation.*

⚠WARNING

Due to the cold temperatures of both the dry ice or other cooling medium and the parts being cooled, it is important to take extra precautions that neither comes in contact with skin, clothing, or other items during the entire procedure.

(a) Inspect the new bushing/bearing for evidence of damage, burrs, etc. Repair as required.

(b) Using all of the appropriate precautions because of the cold temperatures of the materials involved, carefully cool the bearing assembly to a temperature of -40° to -70° F (-40° to -57° C).

(c) Once both components are at the proper temperatures, carefully remove the bearing from the cooling medium and install properly oriented into the appropriate bore.

(d) Allow the bearing assembly to warm slowly and evenly to ambient temperature, making sure that the retaining rings may be properly installed.

IMPORTANT: *The use of externally applied heat to speed up the process may result in uneven cooling and warping of or damage to the bearing or bore.*

(e) Install the retaining rings to secure the bearings.

KINGPIN BUSHINGS

The upper and lower bushings in the kingpin assembly may be changed as follows:

1. Verify that the upper bearing (4) is removed.

2. Knock out the old upper and lower bushings (6 and 7) with a long punch taking extra care not to contact or

damage the inner surfaces of the kingpin assembly.

3. Verify that the inner bore surface of the kingpin assembly is free from edges, knicks, or other damage that will interfere with the installation of the new bushings.

4. Freeze the complete new bushings in dry ice or equivalent to shrink the outer diameter.

5. Install the bottom bushing (7), chamfered end first, into the bore (from the bottom) until seated. The end of the bushing should be even with or slightly below the end of the kingpin bore.

6. Install the bearing spacer (34) with the split positioned to clear the socket head setscrew (14).

7. Install the top bushing (6) until the flange is seated on the end of the kingpin housing.

NOTE: *If either of the bushings stick or do not install properly, remove before they have a chance to equalize temperatures and stick in place. Otherwise they may be damaged in the removal/reinstallation phase.*

8. Allow to equalize to room temperature before continuing with the assembly process.

9. Install the relief fitting, if so equipped.

NOTE: *The relief valve is not used on trucks equipped with anti-rotational provisions on the bearing housing and thrust ring.*

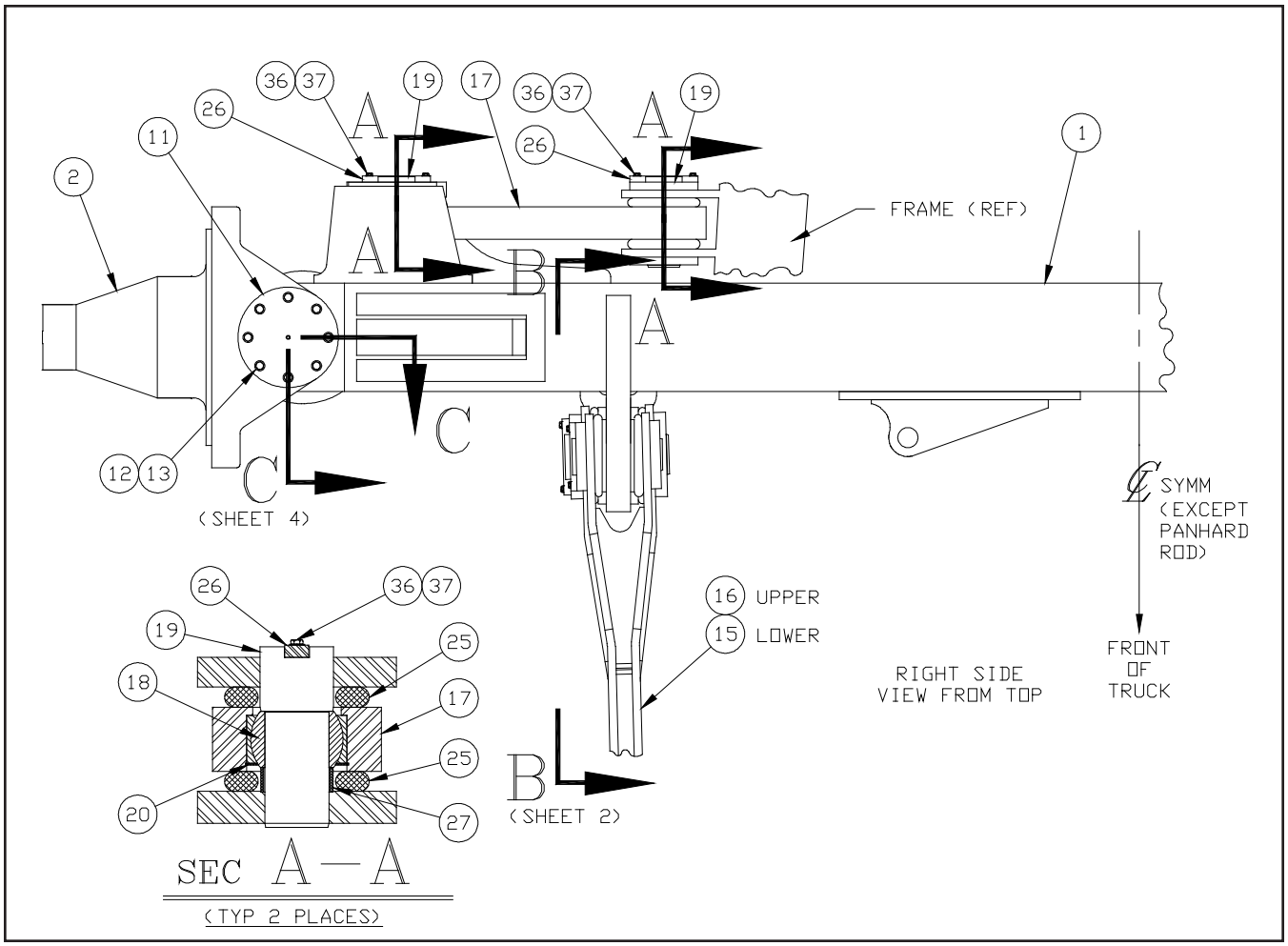


FIGURE 1 - FRONT AXLE ASSEMBLY (A85224, SHEET 1 OF 4)

ASSEMBLY

The spindle/kingpin assembly may be assembled as follows:

1. Fit the bearings in the top (4) and bottom (5) of the spindle.

NOTES:
1. The bottom bearing (5) must be flush with the bottom of the spindle (2).
2. Install the parting split on the top bearing (4) inboard (toward the truck frame). Install the parting split on the bottom bearing (5) outboard (away from the truck frame).

2. Install the thrust washer (10) in position.

3. Install the thrust bearing (8) in the bearing housing (9), securing each with the roll/coil spring pins (38).

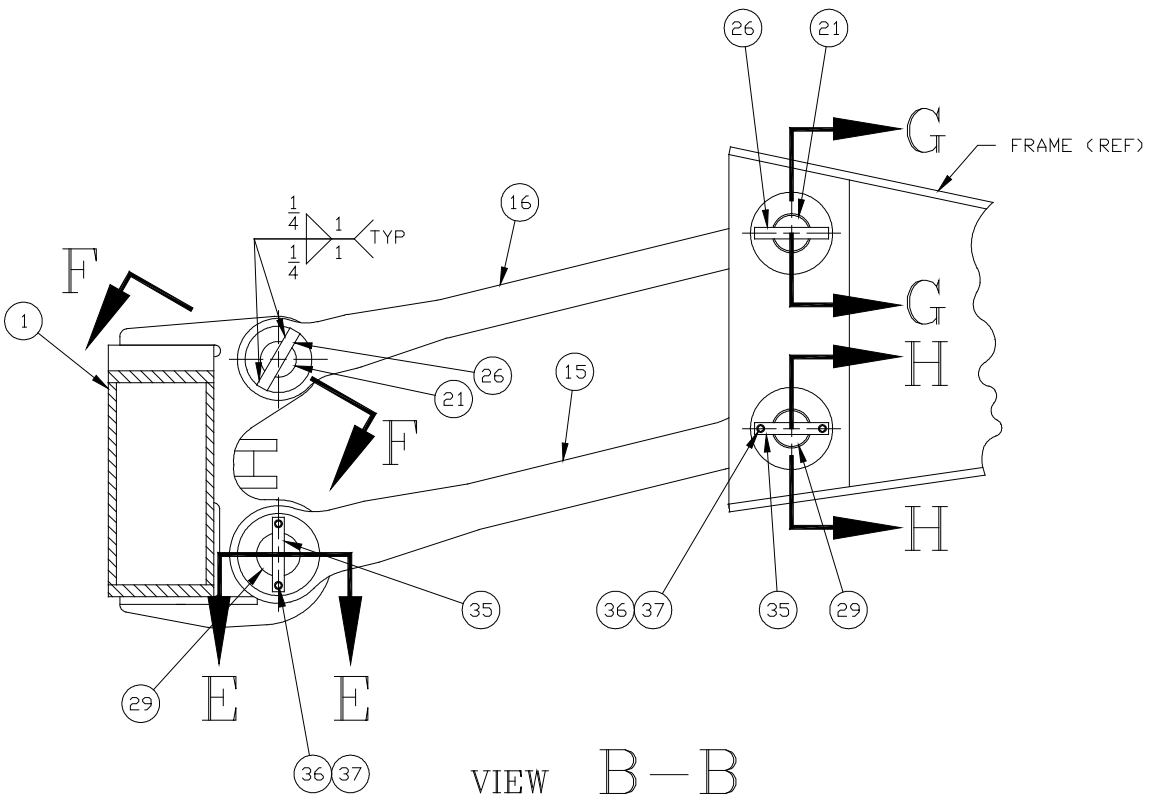
NOTE: *Trucks with Serial Numbers MH102 and up and earlier trucks modified by Engineering Bulletin EB 1327B are as shown in the illustration. Earlier trucks using different bearing assemblies do not include the roll pins (38) securing the bearing housing (9) and bronze thrust bearing (8) or their installation provisions. Refer to the appropriate* BUCYRUS® *Parts Manual or Engineering Bulletin for assistance in identifying the configuration installed.*

4. Align the bearing housing assembly (9), spindle assembly, and axle (1).

5. Align the countersink in the kingpin (3) with the hole in the side of the axle. Insert the kingpin into place.

NOTE: *Be careful not to scratch or damage machined surfaces.*

6. Verify that there is a maximum of 0.065 inches (1.65 mm) clearance between the bottom of the upper kingpin assembly (3) and the top of the upper thrust washer (10). If the clearance exceeds this amount, the axle should



KEY A85224

01.	Front Axle Assembly	14.	Setscrew, Grade 8, Cone Point	27.	Pin Spacer
02.	Front Spindle Assembly	15.	Lower Radius Rod	28.	Self-Aligning Bushing
03.	Kingpin	16.	Upper Radius Rod	29.	Pin
04.	Upper Bearing	17.	Transverse Radius Rod	30.	Internal Retaining Ring
05.	Lower Bearing	18.	Self-Aligning Bushing	31.	Bearing Bore Sleeve
06.	Upper Bushing	19.	Radius Rod Pin	32.	External Retaining Ring
07.	Lower Bushing	20.	Internal Retaining Ring	33.	Bearing Spacer
08.	Bronze Thrust Bearing	21.	Eccentric Pin	34.	Bushing Spacer
09.	Bearing Housing	22.	Bearing Bore Sleeve	35.	Pin Retainer
10.	Thrust Ring	23.	Self-Locking External Retaining Ring	36.	Capscrew
11.	Kingpin Cover	24.	Pin Spacer	37.	Hardened Flatwasher
12.	Capscrew, Grade 8	25.	Dirt Ring	38.	Roll/Coil Spring Pin
13.	Hardened Flatwasher	26.	Pin Retainer		

FIGURE 1 - FRONT AXLE ASSEMBLY (A85224, SHEET 2 OF 4)

be disassembled and the appropriate thicker alternative bearing housing (9) installed. Then repeat the assembly procedure as outlined previously.

NOTES:

1. The alternate bearing housings include 82836M (0.063 inch (1.60 mm)) oversize and 82836N (0.125 inch (3.18 mm)) oversize.

2. If these bearing housings are required on earlier, unmodified trucks, it is recommended that BUCYRUS® *Engineering Bulletin EB 1327B installing roll pins to prevent the rotation of the components also be performed.*

7. Apply Loctite 242 or equivalent to the setscrew (14) and install. Torque to 500 ft-lb (680 Nm).

NOTES:

1. Before installation, coat the outboard ¾ inch (19 mm) of the threads with Loctite 242 (or equivalent).

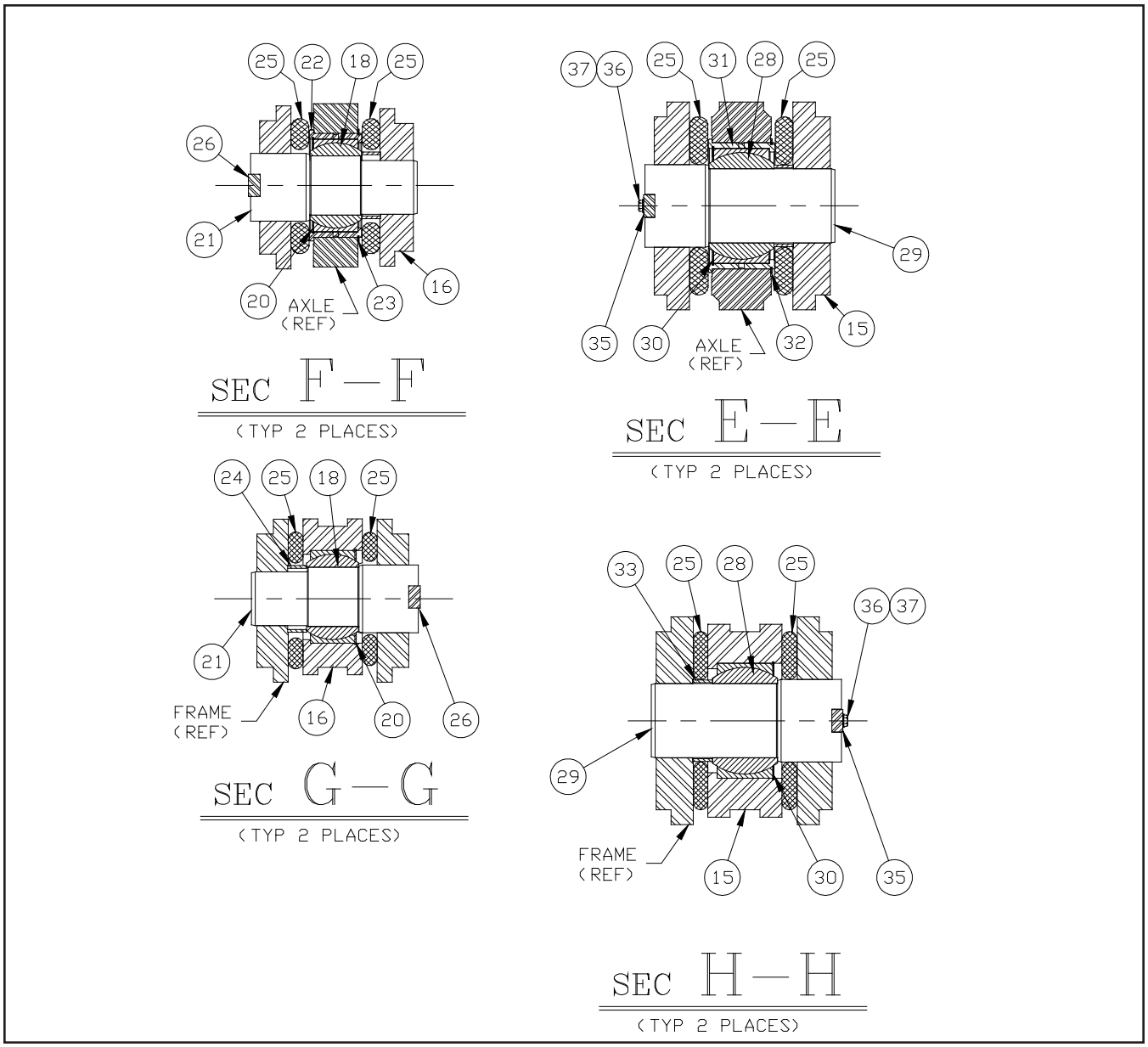


FIGURE 1 - FRONT AXLE ASSEMBLY (A85224, SHEET 3 OF 4)

2. After installation and final torquing, the setscrew should be flush (+/- ¼ inch (6.3 mm)) with the surface of the axle.
3. After the setscrew is installed and properly torqued, apply Loctite 242 (or equivalent) to the perimeter of the setscrew/threads to seal against water and corrosion.

8. Install the kingpin cover (11) and secure it with capscrews (12) and washers (13).

INSTALLATION (Figure 1)

The front axle assembly may be installed as follows:

1. Position the axle assembly under the main frame, perpendicular to the main frame rails.

2. Beginning with either of the lower parallel links, install the radius rods as follows:

a. Position the rod with the double end toward the axle and the lube holes pointed upward.

b. Move the radius rod into position on the axle end.

c. Align the bores and install the radius rod pins (29).

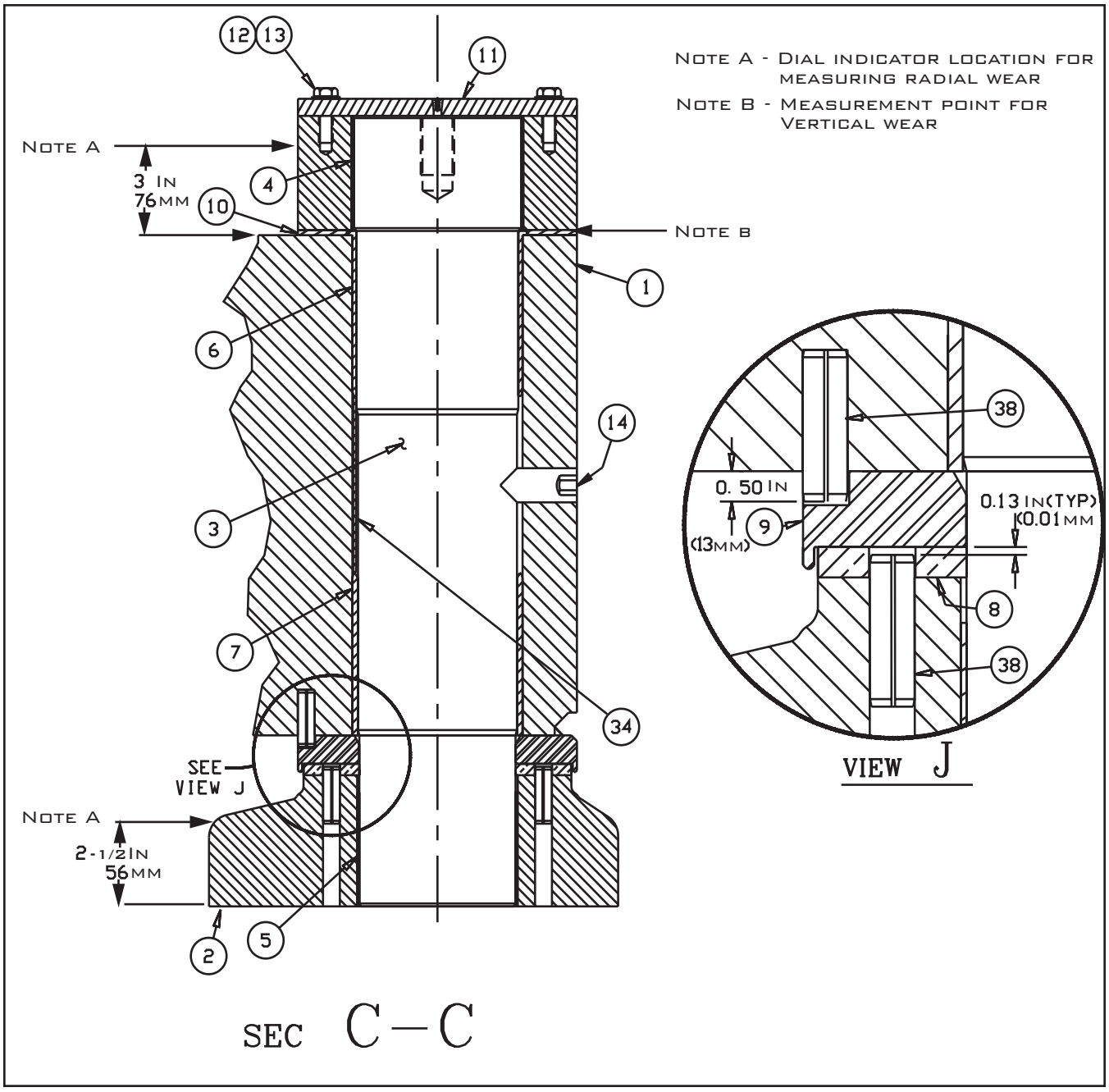


FIGURE 1 - FRONT AXLE ASSEMBLY (A85224, SHEET 4 OF 4)

d. Repeat step c. on the frame end.

NOTE: *Use the standard pins only. The eccentric pins are used only in a designated location and will be installed last.*

e. Install the retainers and secure with the capscrews and washers.

3. Repeat steps 2a. – e. on the other bottom link.

4. Install the left hand upper link as follows:

a. Position the rod with the double end toward the axle and the lube holes pointed downward.

b. Move the radius rod into position on the axle end.

c. Align the bores and install the radius rod pins (29).

d. Install eccentric pins (21) in both ends with the slot vertical and the eccentric portion of the pins up.

IMPORTANT: *Do not install the retainers at this time.*

5. Install the right side upper link as follows:

a. Install the frame end eccentric pin as outlined in steps 4a.-d.

b. Rotate the eccentric pins in the three upper links until the pin bore in the remaining link is aligned with the bore sufficiently to allow installation of the other eccentric pin. Install the pin.

6. Weld the retainers (26) of the eccentric pins to the bosses on all upper pin assemblies with a 1/4 fillet weld 1 inch (25 mm) long on both sides of the retainers.

7. Install the transverse radius rod as outlined in steps 2a.-e.

8. Install the dirt seals (25) on each side of each self-aligning bearing. Secure with the tie-wrap.

9. Install the front suspension strut assemblies as outlined in the instructions in Section 7 - Running Gear.

10. Install the front wheel and brake assemblies (if removed) as outlined in the instructions in Section 7 - Running Gear and Section 8 - Brake System.

11. Install the tire and rim assemblies as outlined in the instructions in Section 7 - Running Gear.

12. Recharge the front suspensions as outlined in the instructions in Section 7 - Running Gear.

13. Service and test the steering and brake systems as outlined in the instructions in Section 5 -Hydraulic System.

14. Remove the blocking and lower the truck to the ground.

15. Complete servicing and testing the truck system.

NOTE: *It is recommended that each time the front axle kingpin assembly has been serviced, particularly when components are repaired or replaced, a recheck of the final amount of clearance be made to serve as a starting point for measuring wear of the components. Detailed instructions are included in the Maintenance and Adjustment instructions in this module.*

16. Check the front wheel alignment as outlined in the procedure on the steering linkage in Section 7 - Running Gear.

FRONT WHEEL ASSEMBLY (GREASE LUBRICATED BEARINGS)

DESCRIPTION AND LOCATION (Figure 1)

The front wheel assembly consists of the large saucer-shaped disc found inside each of the front tire and rim assemblies and the associated bearing and rim mounting hardware.

OPERATION

The front wheel assembly functions as a "connecting link" between the front axle and the tire and rim assembly. The wheel rotates around the rigid front axle on a pair of tapered roller bearings. The tire and rim assembly is secured to the wheel by means of multiple clamps attached to the outer perimeter of the wheel.

A speed sensor system is incorporated to provide "actual" truck ground speed input to the AC drive system to assist in controlling the truck in propulsion and dynamic retarding.

NOTE: *Details of the systems operation and testing is contained in the vendor's maintenance manual for the drive system.*

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Wheel loose	Bearings improperly adjusted - too many shims	Inspect bearing and reshim as outlined in Maintenance and Adjustment.
Wheel dragging or not rotating freely	Brakes dragging (not fully released)	Verify brakes are released. If not, see instructions in Section 8 - Brake System.
	Bearings rough or damaged	Inspect bearings and reshim as outlined in Maintenance and Adjustment.
	Bearings shimmed too tightly - binding the wheel	
Tire not running true (straight)	Rim bent	Inspect tire and rim assembly. Replace as required.
	Rim not properly seated on wheel	Inspect the rim's position on the wheel. Adjust as required.
	Wheel damaged	Inspect the wheel for damage. Replace if necessary.
Short bearing life	Improper lubrication	Follow recommended lubrication practices.
	Bearings improperly adjusted	Shim the bearing as outlined in the procedures in Maintenance and Adjustment.
	Bearing overloaded or damaged in service	Check operating conditions and load. Correct as required.

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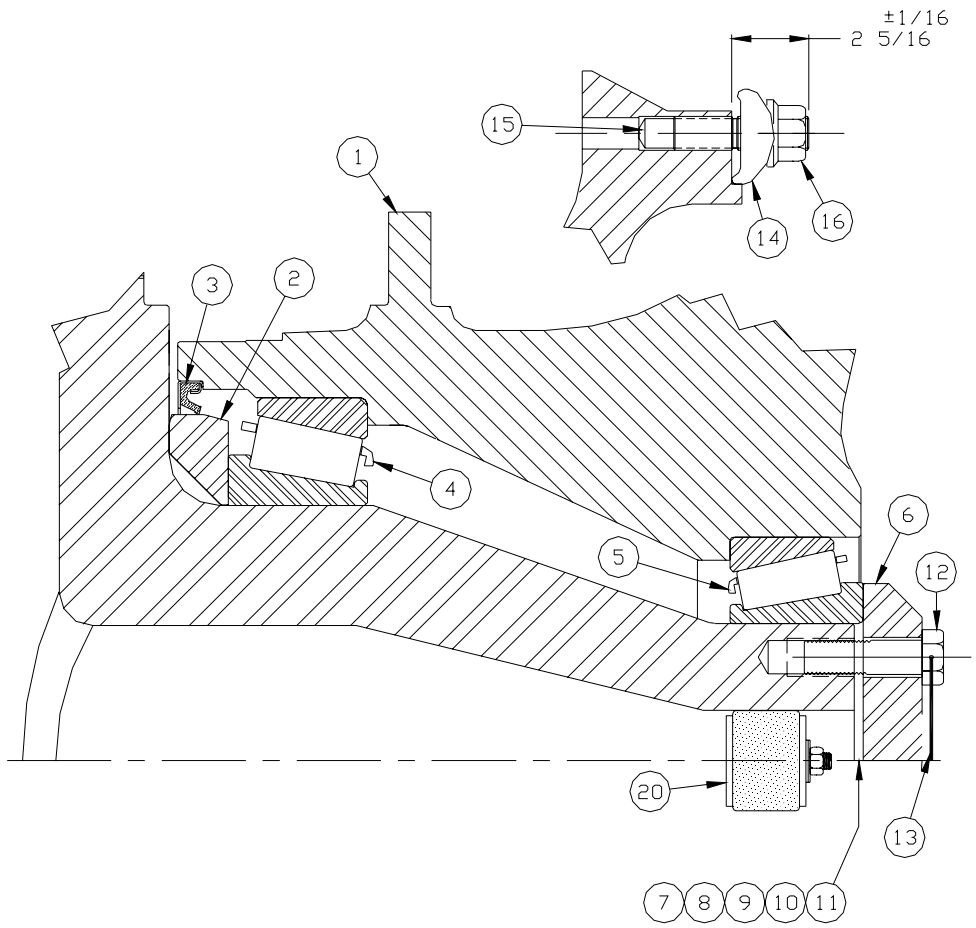


KEY							82559J
01.	FRONT WHEEL	06.	BEARING RETAINER	11.	SHIM	16.	WHEEL NUT
02.	WHEEL BEARING SPACER	07.	SHIM	12.	DRILLED HEAD CAPSCREW	17.	NOT USED
03.	WHEEL SEAL	08.	SHIM	13.	SAFETY WIRE	18.	NOT USED
04.	INNER WHEEL BEARING	09.	SHIM	14.	WHEEL CLAMP	19.	NOT USED
05.	OUTER WHEEL BEARING	10.	SHIM	15.	WHEEL STUD	20.	EXPANSION PLUG

FIGURE 1 - FRONT WHEEL ASSEMBLY

MAINTENANCE AND ADJUSTMENT

Periodic maintenance includes the following steps:

1. Inspect the wheel for evidence of damage. Repair or replace as required.

NOTES:

1. Newer stud assemblies incorporate:

a. A "shoulder" on the threaded area to provide proper installation depth.

b. A hex shape on the open end allowing the direct use of the appropriate tools to assist in the removal and installation of the stud.

2. On older assemblies (without the shoulder or hex):

a. Installation depth is a measurement of the length of the stud that extends out of the wheel casting.

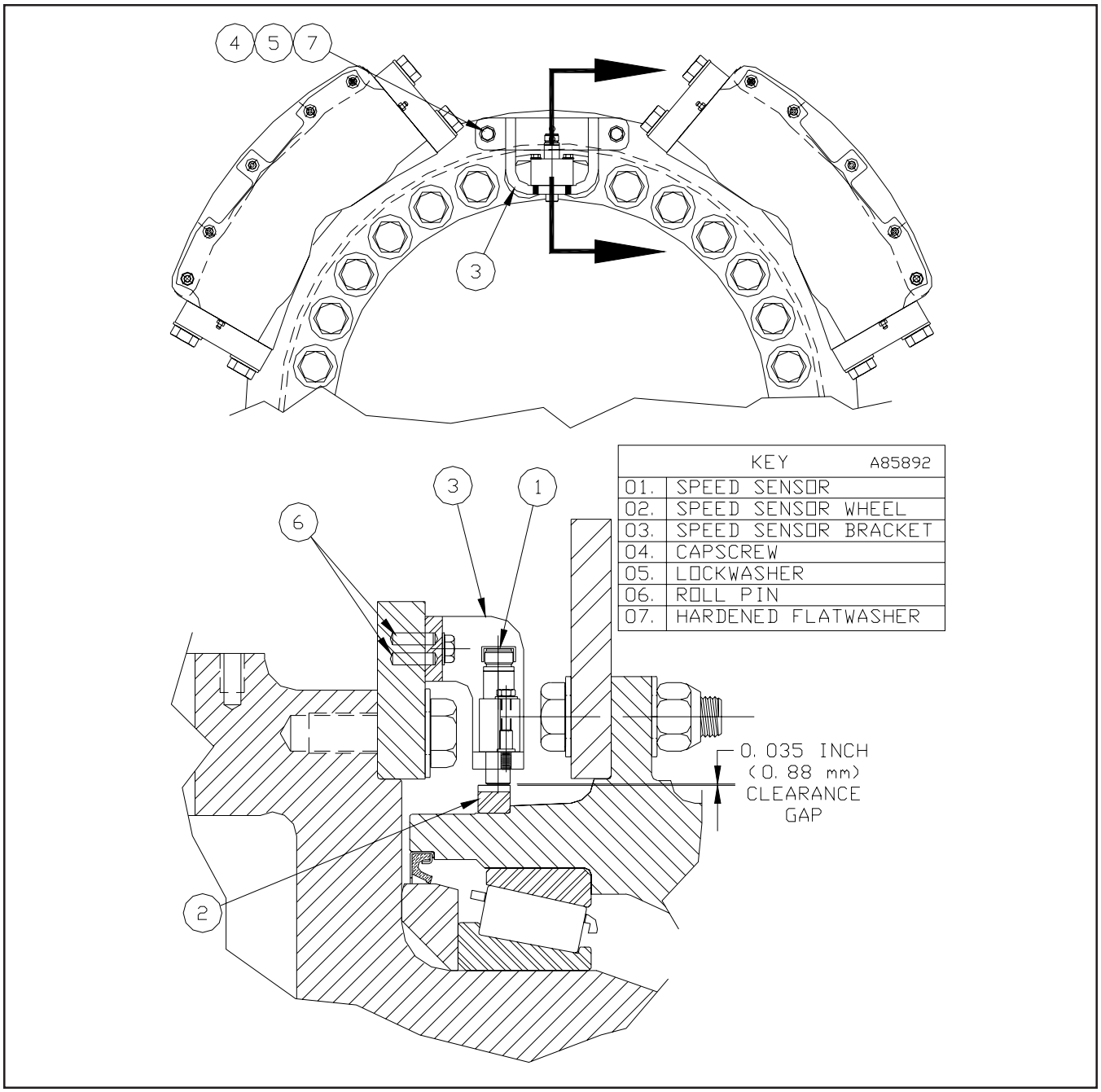
b. A driver or multiple lug nuts tightened onto the stud to function as a driver may be needed to assist in the removal and installation of the wheel studs.

3. In either case, it is recommended that Loctite 242 (liquid), 248 (stick) or equivalent, is applied to the threads to secure in place.

2. At 500 hour intervals:

a. Check that the wheel clamps are properly torqued to 525 to 550 ft-lb (710 to 745 Nm).

b. Test the operation of the speed sensor assembly during normal drive system testing and maintenance as outlined in the procedures in the vendor's maintenance manual. Clean, adjust, repair, or replace as required.



KEY A85892	
01.	SPEED SENSOR
02.	SPEED SENSOR WHEEL
03.	SPEED SENSOR BRACKET
04.	CAPSCREW
05.	LOCKWASHER
06.	ROLL PIN
07.	HARDENED FLATWASHER

FIGURE 2 – SPEED SENSOR INSTALLATION

3. Inspect the front wheel bearings for proper lubrication and preload setting. (See procedure in the information in these procedures.)

FRONT WHEEL BEARING ADJUSTMENT (Figures 1 – 6)

Each time the front axle, wheels, or wheel bearings are removed or replaced, the following procedure should be employed to properly set the bearing preload.

NOTE: *This procedure may be accomplished with tire and rim assemblies either on or off. If removal of the tires is desired, refer to the instructions on tire removal in Section 7 - Running Gear.*

NOTE: *This information is important and will be used in several steps in the following procedure.*

1. Measure retainer (6) thickness using a 1 to 2 inch (25 to 50 mm) micrometer. Stamp this dimension on the retainer for future use.

2. Inspect the inner wheel and hub area for damage and foreign material. It is very important that this area be clean and free of any debris.

3. If the bearing assembly has been replaced, install the bearing cups. Seat the cups against the shoulders in the bearing bores.

NOTES:
1. Check that the cups are fully seated against the shoulders using a 0.002 inch (0.5 mm) feeler gauge. Insert the gauge in between the cup edge and the shoulder in a minimum of three places around the bore. If the gauge will fit in the gap, continue to seat until the gap is gone.
2. Use the proper tools and taking extra care not to damage or contaminate the bearings, seals or other components during the process.

4. If the speed sensor wheel (2) has been removed, it may be reinstalled on the wheel assembly as follows: (All in this step (4) refer to Figure 2.)

a. Inspect the I.D. of the sensor wheel (2) and mating surface of the truck wheel to be free of dirt, grease, or other contamination or other damage or "high spots".

b. Evenly warm the sensor wheel (2) to a final temperature of 300° F (148° C).

c. Install the sensor wheel (2) onto the surface on the truck wheel. Make sure that it is installed straight and is fully seated in place.

5. Install the expansion plug (20) (if it was previously removed). Make sure that there is clearance between the end of the spindle and the end of the stud.

6. Install the seal (3) and fill the cavity between the seal and the inner bearing cup partially with grease.

NOTE: *The seal lip should be facing the rotating wheel assembly.*

7. Pack the inner bearing (4) only with grease. Make sure that the grease is forced between the rollers. Apply a generous coat of grease to the outside of the rollers.

NOTE: *The outer bearings must not be lubricated at this time to ensure proper bearing preload.*

8. Install the cone of the inner bearing (4) on the spindle and seat it against the wheel bearing spacer/rub ring (2).

9. Partially fill the void between the back of the inner bearing (4) and the wheel bearing spacer/rub ring (2) with grease and the cavity from the small diameter of the outer bearing cup to the small diameter of the inner bearing cup.

10. Place the wheel on the front axle, using a forklift truck, crane or other suitable means.

11. Slide the outer bearing (5) onto the spindle.

12. Lubricate the six drilled head capscrews (12) with wheel bearing grease.

13. Install the retainer (6) (with no shims) using the six drilled head retainer capscrews (12).

14. Alternately tighten the retainer capscrews (12) to:

250 ft-lb (340 Nm) in 50 ft-lb (70 Nm) increments.

NOTE: *Rotate the wheel while tightening to properly seat the bearing rollers.*

15. Loosen the four drilled head retainer capscrews (12) to take the preload off the bearing.

16. Remove the retaining capscrews as indicated in Figure 3.

17. Alternately retighten the capscrews to:

110 ft-lb (150 Nm) in 20 ft-lb (25 Nm) increments.

NOTE: *Rotate the wheel while tightening to properly seat the bearing rollers.*

18. Using the depth micrometer, measure the distance from the end of the axle to the outer face of the bearing retainer.

19. To determine the shim requirements, subtract the thickness of the bearing retainer (6) (measured previously) from this latter measurement.

20. Prepare a shim stack equal to the dimension obtained in step 19. Always clean all shims and measure individually.

21. Remove bearing retainer (6) and outer bearing (5).

22. Pack the outer bearing (5) and cavity with grease (as outlined previously) and install shim stack (7, 8, 9, 10, and 11) bearing (5), and bearing retainer (6).

23. Alternately tighten all six drilled head capscrews (12) to:

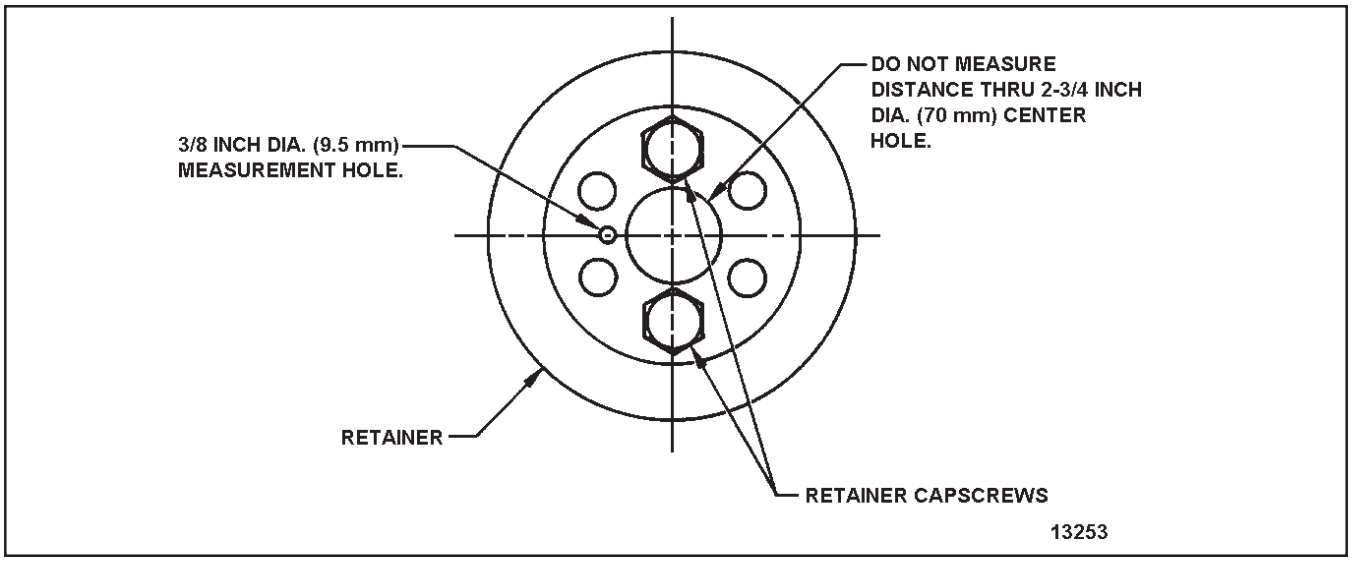


FIGURE 3 - FRONT WHEEL BEARING RETAINERS

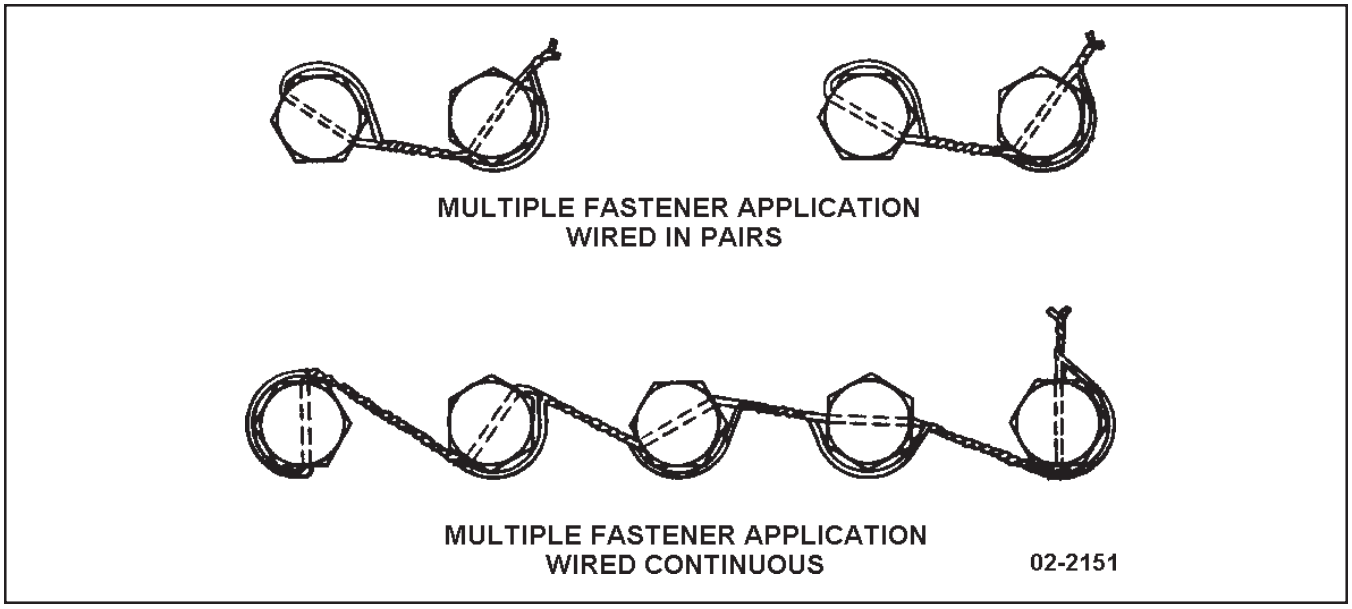


FIGURE 4 – INSTALLATION OF SAFETY WIRE

560 ft-lb (760 Nm) in 100 ft-lb (135 Nm) increments.

NOTE: *Rotate the wheel (1) while tightening to properly seat the bearing rollers.*

24. Lockwire the retainer capscrews in place using safety wire (13).

25. Install the hubcap and secure with capscrews.

NOTE: *To provide an improved seal, first make sure that all mating surfaces are smooth and clean and then apply a thin coat of RTV sealant between the hubcap and the wheel.*

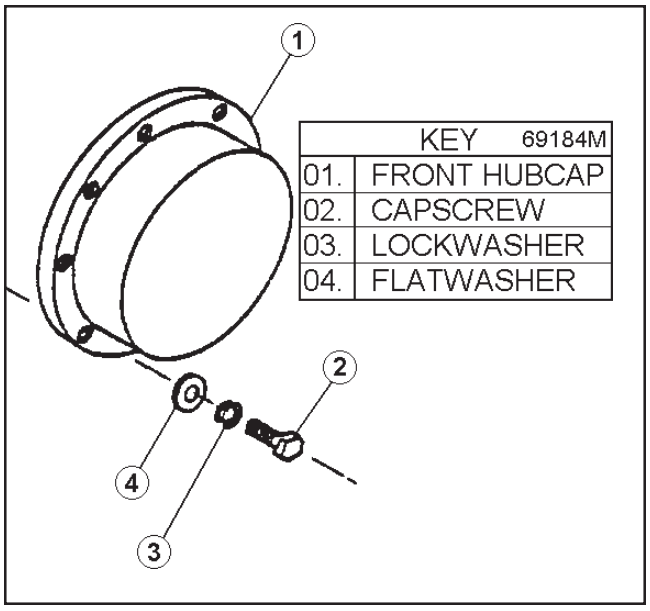
26. Install and adjust the speed sensor assembly as follows: (Refer to Figure 2.)

a. Install the roll pins (6) into the brake spider.

b. Install the speed sensor (1) into the bracket (3).

c. Install the bracket/sensor assembly on the roll pins as illustrated, securing with capscrew (4), lockwasher (5), and hardened flatwasher (7).

NOTE: *Do not fully tighten the mounting hardware at this time.*



KEY	69184M
01.	FRONT HUBCAP
02.	CAPSCREW
03.	LOCKWASHER
04.	FLATWASHER

FIGURE 5 – STANDARD HUBCAP ASSEMBLY

d. Place a 0.035 inch (0.88 mm) feeler gauge between the sensor nose and the sensor wheel, adjusting the position of the bracket to obtain this clearance.

e. Rotate the wheel assembly a complete revolution to verify that this 0.035 inch (0.88 mm) clearance is the minimum clearance at any point.

f. Secure the bracket assembly in place by tightening and torquing the capscrew (4).

NOTE: *Use care to prevent the incidental moving of the bracket. Verify the clearance once the bracket has been secured.*

g. After tightening the hardware, repeat step e to verify the 0.035 inch (0.88 mm) minimum clearance. Readjust and recheck if required.

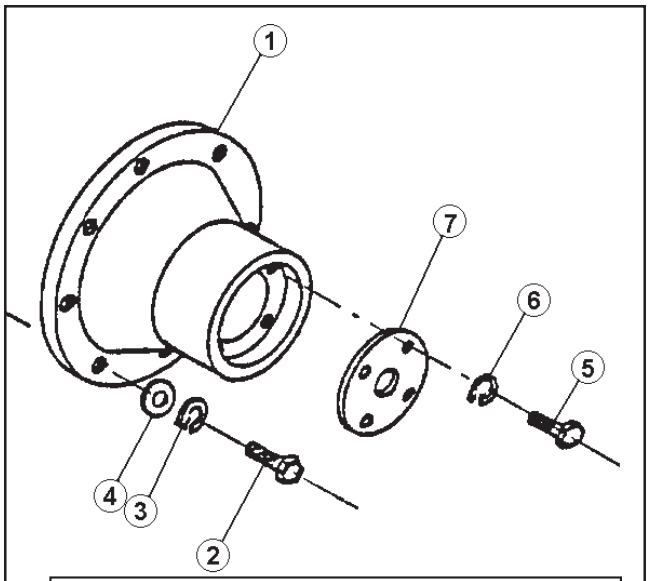
27. If the tire and rim assembly has been removed, install as instructed in the procedures in Section 7 - Running Gear.

REMOVAL (Figure 1)

The front wheel may be removed from the truck as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release all pressure in the steering and brake systems as outlined in the procedures in Section 5 – Hydraulic system.



KEY			69184N
01.	FRONT HUBCAP	05.	CAPSCREW
02.	CAPSCREW	06.	LOCKWASHER
03.	LOCKWASHER	07.	MOUNTING PLATE
04.	FLATWASHER		

FIGURE 6 – HUBODOMETER HUBCAP ASSEMBLY

⚠ DANGER

The hydraulic brake system is a high pressure system. Relieve all pressure before disconnecting any lines.

3. Raise the truck until the tires clear the ground, then securely block in this position.

4. If desired, remove the tire and rim assembly as outlined in the instructions in Section 7 - Running Gear.

5. Disconnect the brake hydraulic supply line at the caliper assemblies. Install a clean plug on the hydraulic lines and a clean cap on each of the calipers.

6. Remove the speed sensor (and if desired the bracket assembly) from the brake "spider" to prevent damage.

7. Remove the hydraulic line between the caliper housings. Install clean plugs and caps on all open fittings.

8. Remove the caliper assemblies as outlined in the procedures in Section 8 - Brake System.

NOTE: *Retain the shims and identify the location removed from. The shims may be reinstalled with the caliper assembly to center the caliper with the disc. If new*

pads, discs, or bearings are installed, it will require re-shimming the caliper assembly.

9. Remove the hubcap as shown in Figures 5 and 6.

10. Support the wheel adequately to prevent accidental movement and remove the capscrews (12), retainer (6), shims (7, 8, 9, 10, and 11), and bearing (5).

11. Slide the wheel off the axle spindle, being careful to protect the inner bearing (4), seal (3), and spacer or rub ring (2).

12. Remove the seal (3) and bearing (4) from the inner portion of the wheel.

13. If necessary, remove the disc by removing the capscrews attaching the disc to the wheel.

INSPECTION AND REPAIR

The disassembled wheel may be serviced as follows:

1. Thoroughly clean the axle spindle, bearing and wheel hub with clean solvent. Dry with clean, dry compressed air.

2. Inspect the inner seal for excessive wear or damage. Repair or replace as required.

3. Inspect the wheel bearing spacer or seal wear ring (2) for evidence of damage or wear. Repair or replace as required.

4. Inspect the inner and outer bearings and races for evidence of damage, spalling, and rough spots. If the bearing races are defective, replace the bearing and races, both inner and outer.

5. Check that the bearing races are properly seated by attempting to force a 0.001 inch (0.03 mm) feeler gauge between the race back face and the wheel shoulder. Reposition as required.

6. Using magnetic particle, dye-check or other suitable methods, check the radius on the base of each side of the disc mounting bolting flange on the inboard side of the wheel for evidence of damage or cracking. If defects are found replace as required. Contact your BUCYRUS® representative for more detailed information.

7. Inspect the wheel studs for proper installation and evidence of wear or damage. If loose or damaged and require replacement, it may be done as follows:

NOTES:
Newer stud assemblies incorporate:
1. A "shoulder" on the threaded area to provide proper installation depth.
2. A hex shape on the open end allowing the direct use of the appropriate tools to assist in the removal and installation of the stud.

Older assemblies (without the shoulder or hex):
1. Stud installation depth is a measurement of the length of the stud that extends out of the wheel casting.
2. A driver or multiple lug nuts tightened onto the stud to function as a driver may be needed to assist in the removal and installation of the wheel studs.

a. Using suitable tooling, remove the old wheel stud.

NOTE: *In instances where hand tools alone will not operate; apply localized heat to the stud or casting to warm to approximately 485° F (250° C). Taking the appropriate measures, remove while hot.*

b. Clean and inspect the threads in the wheel casting. Repair as required.

c. Clean and prepare the threads in the wheel casting and on the stud using the appropriate cleaner/primer for the locking compound to be used.

NOTE: *They both must be free of contamination and oil, wax, paint, rust inhibitor, or any other preservative treatment. It is important to use solvents that do not leave any residual materials or film.*

d. Coat the threads on the stud that will engage the threads in the casting with several drops of Loctite 242 (liquid) or sufficient 248 (stick) material or equivalent.

NOTE: *More detailed instructions on the proper preparation and use of Loctite are contained in Section 7 – Running Gear.*

e. Install the studs:

(1) On trucks equipped with the new stud, insert the threaded end of the stud into the threaded hole. Tighten until the "shoulder" contacts the wheel assembly. A final "light" torque of 15 to 20 ft-lb (20 to 27 Nm) should suffice.

(2) On trucks equipped with the older stud assembly, install the long threaded ending into the casting until the exposed threaded length is 2-5/16 +/- 1/16 inch (59 +/- 1.5 mm) from the machined edge to the wheel.

f. Allow the adhesive to harden per its listed instructions.

NOTE: *Full strength typically requires 24 hours. In some installations, special accelerants may be used to decrease this time, but may adversely affect overall total strength. Check/test before using.*

8. Inspect the wheel speed sensor, sensor mounting bracket, and sensor wheel for evidence of contamination or damage. Clean, repair, or replace as required.

INSTALLATION (Figures 1 and 2)

The wheel may be installed as follows:

1. Pack the interior of the wheel hub one-half to three-fourths full of grease.

2. Pack the inner bearing with grease.

NOTE: *The outer bearing must not be lubricated at this time to ensure proper bearing preload.*

3. Replace brake disc (if removed) and mounting adapter. Torque the bolts as outlined in the instructions in Section 8 - Brake System.

4. Install and shim the wheel assembly (including the speed sensor assembly) as outlined in the instructions in Maintenance and Adjustment.

5. After the wheel has been installed, reinstall and bleed the brake caliper assemblies as outlined in Section 8 - Brake System.

6. Install the tire and rim assembly as outlined in Section 7 - Running Gear.

FRONT WHEEL ASSEMBLY (OIL LUBRICATED WHEEL BEARINGS)

DESCRIPTION AND LOCATION (Figures 1A, 1B, and 2)

The front wheel assembly consists of the large saucer shaped disc found inside each of the front tire and rim assemblies and the associated bearing and rim mounting hardware.

OPERATION

The front wheel assembly functions as a "connecting link" between the front axle and the tire and rim assembly. The wheel rotates around the rigid front axle on a pair of tapered roller bearings, lubricated by a constant bath of gear oil lubricant. The tire and rim assembly is secured to the wheel by means of multiple clamps attached to the outer perimeter of the wheel.

The face type seal consists of two metallic seal rings that have the same geometric contour and are flexibly located in the O-rings. These O-rings act like springs and maintain axial sealing pressure on the rings, providing a static seal between the seal ring and the housing bore and transmit frictional torque.

A speed sensor system is incorporated to provide "actual" truck ground speed input to the AC drive system to assist in controlling the truck in propulsion and dynamic retarding.

NOTE: *Details of the systems operation and testing is contained in the vendor's maintenance manual for the drive system.*

Some versions of the assembly are "non-vented" or "closed". Other versions are "vented" to the atmosphere and may contain filtered breather elements.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance includes the following steps:

1. At least daily:

a. Inspect the wheel especially the inner and outer seal areas for evidence of leakage, wear, or damage. Repair or replace as required.

NOTE: *For proper operation and life of the seal, lubricant is required to maintain proper rotational operation and friction in the sealing gap. The lubricant is admitted to the gap by capillary action and centrifugal force in the normal course of rotation of the wheel assembly. Slight seepage of the seal assembly in this area should be considered normal.*

b. Verify that each wheel lug clamp is in good repair.

NOTE: *Each lug stud should be secured to the wheel using Loctite 242 (liquid), 248 (stick) or equivalent. Refer to the stud installation instructions in Inspection and Repair in this module or the Loctite procedure for wheel studs in Section 7 - Running Gear.*

c. Visually inspect the speed sensor assemblies to be free of damage and contamination.

2. At regular intervals, typically 250 hour lubrication reviews:

a. It is recommended that a lubricant sample be drawn from each of the bearing cavities and spectrochemically analyzed for material content. Corrective actions should be taken if the tests show:

NOTES:
1. The sample should be taken within 15 minutes of the truck being stopped after actual haulage use. The bearing system and lubricant should have reached operating equilibrium (mixing of all of the lubricant and any other materials and including normal temperatures) just before the sample is taken.
2. The sample should be taken from the same depth of the lubricant and the same location in the cavity each time. This may be aided by fabricating a sampling rod indexed from the hubcap port. The rod should have a "stand-off" feature near the inlet to prevent the end of the tube from touching any components inside.

(1) A loss of viscosity or lubricity. Continued operation with the deteriorated lubricant will adversely affect bearing and seal life.

(2) A wear particle analysis with a count of particles greater than 25 microns in size, in units of "particles per milliliter of oil".

IMPORTANT: *Records should be kept. An increase in the metal contents, particularly iron and chromium often indicates bearing wear and continued operation in*

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Wheel loose	Bearings improperly adjusted - too many shims	Inspect bearing and reshim as outlined in Maintenance and Adjustment.
Wheel dragging or not rotating freely	Brakes dragging (not fully released)	Verify brakes are released. If not, see instructions in Section 8 - Brake System.
	Bearings rough or damaged	Inspect bearings and reshim as outlined in Maintenance and Adjustment.
	Bearings shimmed too tightly - binding the wheel	
Tire not running true (straight)	Rim bent	Inspect tire and rim assembly. Replace as required.
	Rim not properly seated on wheel	Inspect the rim's position on the wheel. Adjust as required.
	Wheel damaged	Inspect the wheel for damage. Replace if necessary.
Short bearing life	Improper lubrication	Follow recommended lubrication practices.
	Bearings improperly adjusted	Shim the bearing as outlined in the procedures in Maintenance and Adjustment.
	Bearing overloaded or damaged in service	Check operating conditions and load. Correct as required.

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this condition will also adversely affect bearing and seal life.

NOTES:

1. Particle contamination typically is measured using spectroscopic analysis, a process that can detect microscopic metal particles in lubricant samples. This process can measure concentrations of about twenty different metals and concentrations of particles up to a size to 5 to 10 microns. It can not typically detect larger particles.

2. Wear particle analysis emphasizes particle size in addition to concentration and is a more useful indicator of the condition of a bearing system.

3. While particles of 15 microns in size may cause wear in a hydraulic fluid power systems, particles over 25 microns in size are generally required to cause damage to wheel bearings.

4. Proper and consistent sampling techniques are critical to the success of a lubricant analysis program. It is important that just before any sample is taken, the system should be operating and at normal operating temperatures.

b. Inspect the lubricant level indicated in the front wheel hubcap plug as follows:

(1) Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

(2) Verify that the level checking plug in the hubcap assembly is at approximately the horizontal centerline of the front axle spindle.

NOTE: *It may be necessary to move the truck slowly and slightly to properly orient the plugs on one or both of*

the wheels. It is recommended that the level be checked after the truck has not moved for a minimum of 15 minutes to allow the lubricant to drain from the bearing cavities.

(3) Remove the plug and observe the flow of lubricant out of the opening:

(a) It is a slow, steady trickle, the level is acceptable.

(b) If the flow is heavy or appears contaminated with water or other foreign material, determine the cause and correct before proceeding.

(c) If there is no flow, add the appropriate lubricant until flow just begins through the opening.

NOTES:
1. A complete fill is approximately 3.3 gallons (13 liters) of lubricant. This equates to an approximate 50% fill of the lubricant cavity.
2. If frequent refilling is required, determine the cause and repair.

(4) Reinstall the plug.

3. At 500 hour intervals:

a. Check that the wheel clamps are properly torqued to 525 to 550 ft-lb (710 to 745 Nm).

b. On trucks equipped with replaceable breather elements for wheel bearing reservoir area, inspect the element for indications of contamination. Since this is functioning as a very low pressure breather, replace if they appear contaminated or “oil soaked”.

c. Test the operation of the speed sensor assembly during normal drive system testing and maintenance as outlined in the procedures in the vendor’s maintenance manual. Clean, adjust, repair, or replace as required.

4. At 2,500 hour intervals (or as indicated by the lubricant analysis outlined above), the lubricant should be changed as follows:

a. Sample the oil lubricant as outlined previously.

b. Park the truck in a SAFE POSITION. It must be secured by means other than the truck’s friction brake system.

c. Verify that the drain plug in the wheel assembly is at approximately the vertical centerline of the front axle spindle (bottom of its travel).

TABLE 1 - APPROVED LUBRICANTS	
AMBIENT TEMPERATURE RANGE	**RECOMMENDED VISCOSITY (OR EQUIVALENT)**
-67° to 59° F (-55° to 15° C)	SHC 150
-35° to 77° F (-37° to 25° C)	SHC 220
-29° to 95° F (-34° to 35° C)	SHC 320
-20° to 104° F (-29° to 40° C)	SHC 460
-9° to 122° F (-23° to 50° C)	SHC 680

NOTES:

1. All of the lubricants recommended are fully synthetic. If the use of other lubricants, including mineral based oils, is desired, contact your local BUCYRUS® Representative.

2. The listed recommended viscosity is typical for many brands. For detailed information, refer to the information in Section 10 - Miscellaneous or to your BUCYRUS® Representative for more detailed information.

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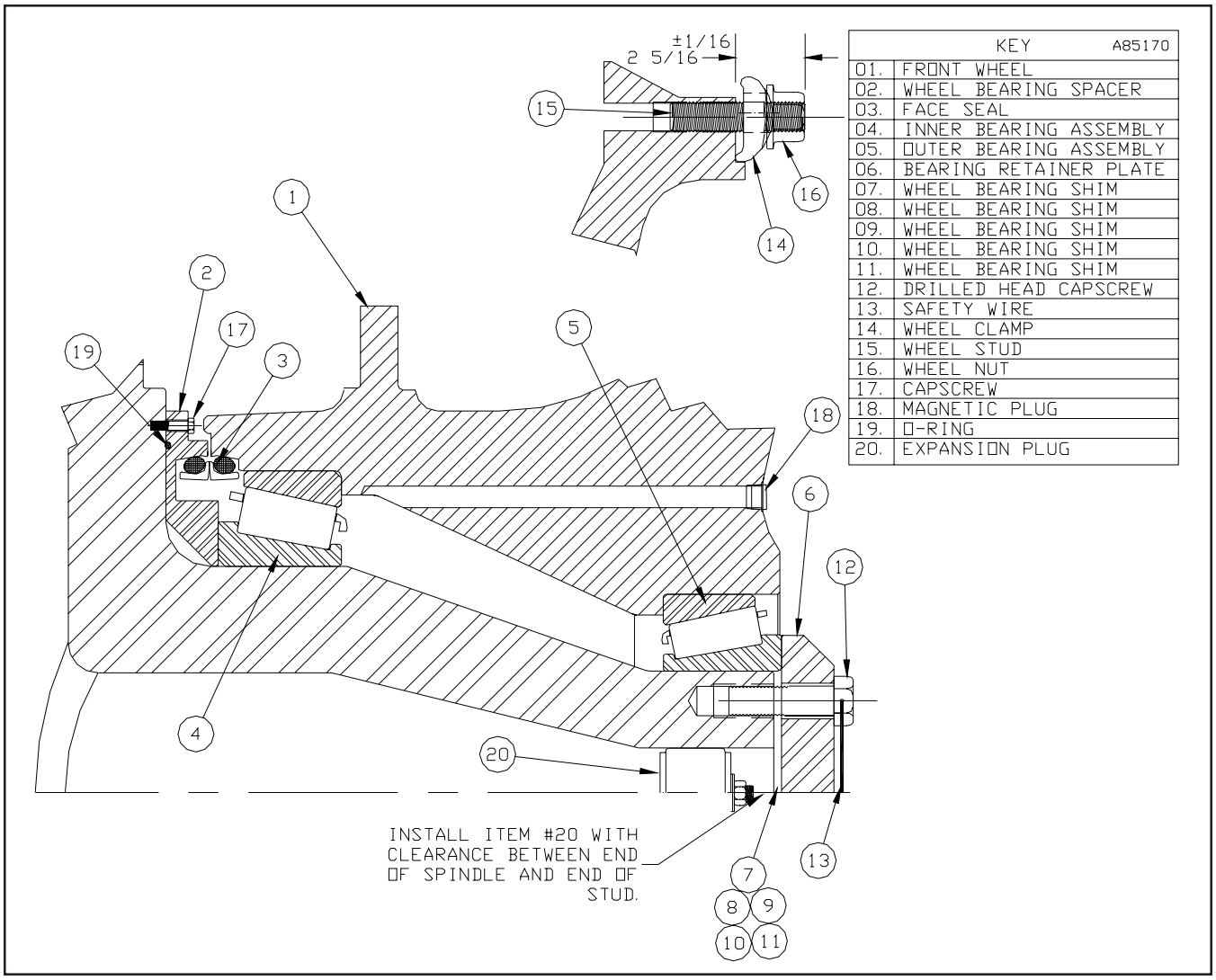
NOTE: *It may be necessary to move the truck slowly and slightly to properly orient the plugs on one or both of the wheels. It is recommended that the wheels be allowed to drain after the truck has not moved for a minimum of 15 minutes to allow the lubricant to drain from the bearing cavities.*

d. Remove the plug and observe the flow of lubricant out of the opening.

NOTE: *If the lubricant appears heavy or appears contaminated with metal particles, water or other foreign material, determine the cause and correct before proceeding.*



KEY	A85170
01.	FRONT WHEEL
02.	WHEEL BEARING SPACER
03.	FACE SEAL
04.	INNER BEARING ASSEMBLY
05.	OUTER BEARING ASSEMBLY
06.	BEARING RETAINER PLATE
07.	WHEEL BEARING SHIM
08.	WHEEL BEARING SHIM
09.	WHEEL BEARING SHIM
10.	WHEEL BEARING SHIM
11.	WHEEL BEARING SHIM
12.	DRILLED HEAD CAPSCREW
13.	SAFETY WIRE
14.	WHEEL CLAMP
15.	WHEEL STUD
16.	WHEEL NUT
17.	CAPSCREW
18.	MAGNETIC PLUG
19.	O-RING
20.	EXPANSION PLUG

FIGURE 1A - FRONT WHEEL ASSEMBLY – NON-VENTED (A85170)

e. Replace the drain plug.

f. Verify that the level checking plug in the hubcap assembly is properly oriented as in step 2.

g. Add the appropriate gear lubricant until flow just begins through the opening.

NOTES:

1. A complete fill is approximately 3.3 gallons (13 liters) of lubricant.

2. For detailed information, refer to the information in Section 10 – Miscellaneous or to your BUCYRUS® *representative for more detailed information.*

h. Reinstall the level checking plug.

5. At 5,000 hour intervals, drain the lubricant as outlined previously. Disassemble and inspect the front wheel bearings for wear, damage, proper preload settings and evidence of proper lubrication. Reassemble and adjust the preload as outlined below.

FRONT WHEEL BEARING ADJUSTMENT

Each time the front axle, wheels, or wheel bearings are removed or replaced, the following procedure should be employed to properly set the bearing preload.

NOTE: *This procedure may be accomplished with tire and rim assemblies either on or off. If removal of the tires is desired, refer to the instructions on tire removal in Section 7 - Running Gear.*

1. Inspect the inner wheel and hub area for damage and foreign material. It is very important that this area be clean and free of any debris.

KEY					A85439
01.	FRONT WHEEL	11.	WHEEL BEARING SHIM	21.	FILTER BRACKET
02.	WHEEL BEARING SPACER	12.	DRILLED HEAD CAPSCREW	22.	PIPE FITTING
03.	FACE SEAL	13.	SAFETY WIRE	23.	ADAPTER FITTING
04.	INNER BEARING ASSEMBLY	14.	WHEEL CLAMP	24.	HOSE ASSEMBLY
05.	OUTER BEARING ASSEMBLY	15.	WHEEL STUD	25.	ADAPTER FITTING
06.	BEARING RETAINER (PLATE)	16.	WHEEL NUT	26.	BREATHER ADAPTER
07.	WHEEL BEARING SHIM	17.	CAPSCREW	27.	SEAL PLATE
08.	WHEEL BEARING SHIM	18.	MAGNETIC PLUG	28.	O-RING
09.	WHEEL BEARING SHIM	19.	O-RING	29.	ADAPTER FITTING
10.	WHEEL BEARING SHIM	20.	SPIN ON AIR FILTER ELEMENT		

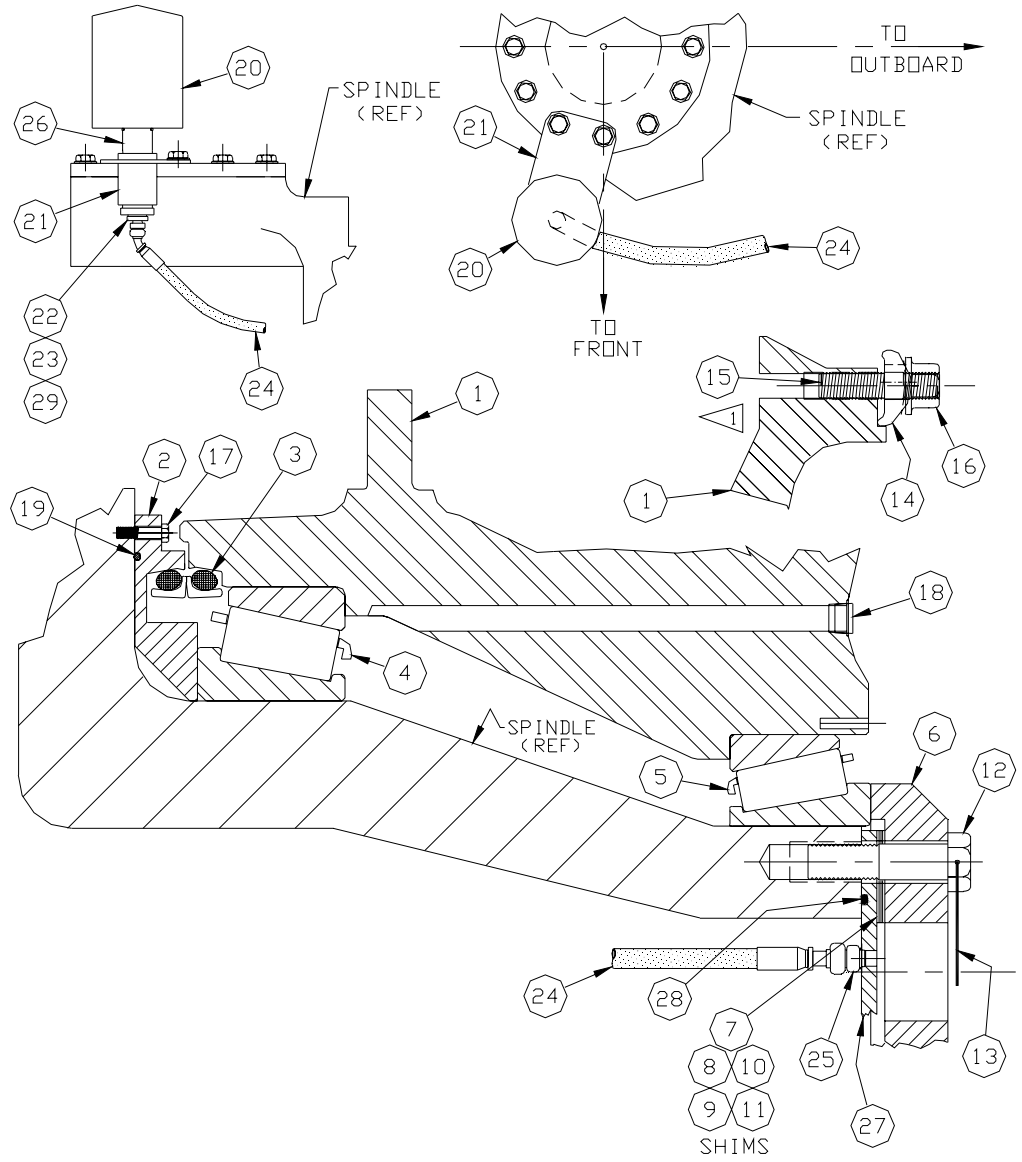


FIGURE 1B - FRONT WHEEL ASSEMBLY – VENTED WITH FILTER (A85439)

2. If the bearing assembly has been replaced, install the bearing cups or races. Seat the cups against the shoulders in the bearing bores.

NOTES:

1. Check that the cups are fully seated against the shoulders using a 0.002 inch (0.5 mm) feeler gauge. Insert the gauge in between the cup edge and the shoulder in a minimum of three places around the bore. If the gauge will fit in the gap, continue to seat until the gap is gone.

2. Use the proper tools and taking extra care not to damage or contaminate the bearings, seals or other components during the process.

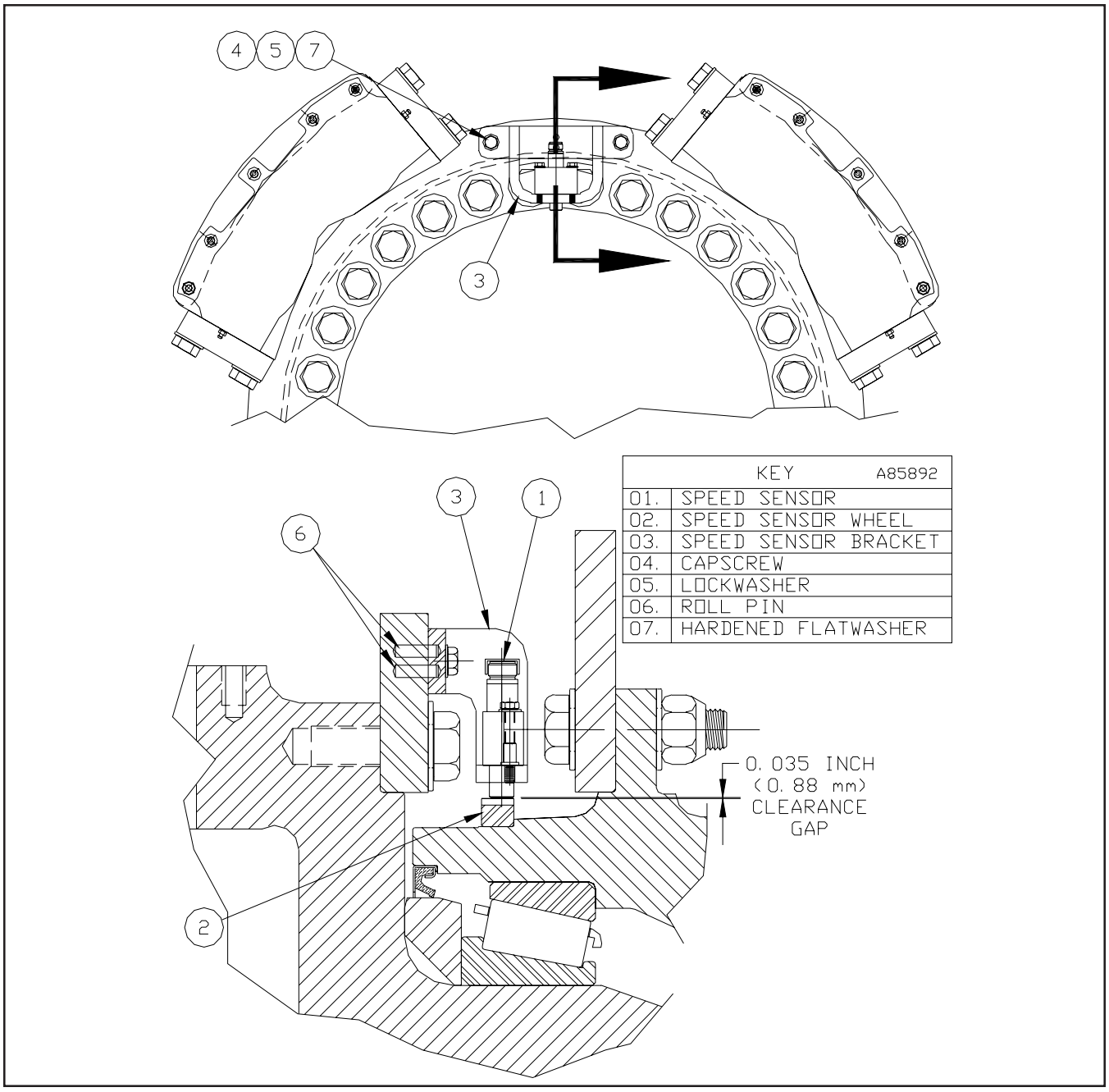


FIGURE 2 – SPEED SENSOR INSTALLATION (A85892)

3. On trucks equipped with spindles for press-fit front wheel bearings, heat the cups or races evenly to 75° F (42° C) above the ambient temperature before installing. Use an appropriate tool to evenly push the cups into their required position and allow to cool before continuing installation.

3. If the speed sensor wheel (2) has been removed, it may be reinstalled on the wheel assembly as follows: (All in this step (3) refer to Figure 2.)

a. Inspect the I.D. of the sensor wheel (2) and mating surface of the truck wheel to be free of dirt, grease, or other contamination or other damage or “high spots”.

b. Evenly warm the sensor wheel (2) to a final temperature of 300° F (148° C).

c. Install the sensor wheel (2) onto the surface on the truck wheel. Make sure that it is installed straight and is fully seated in place.

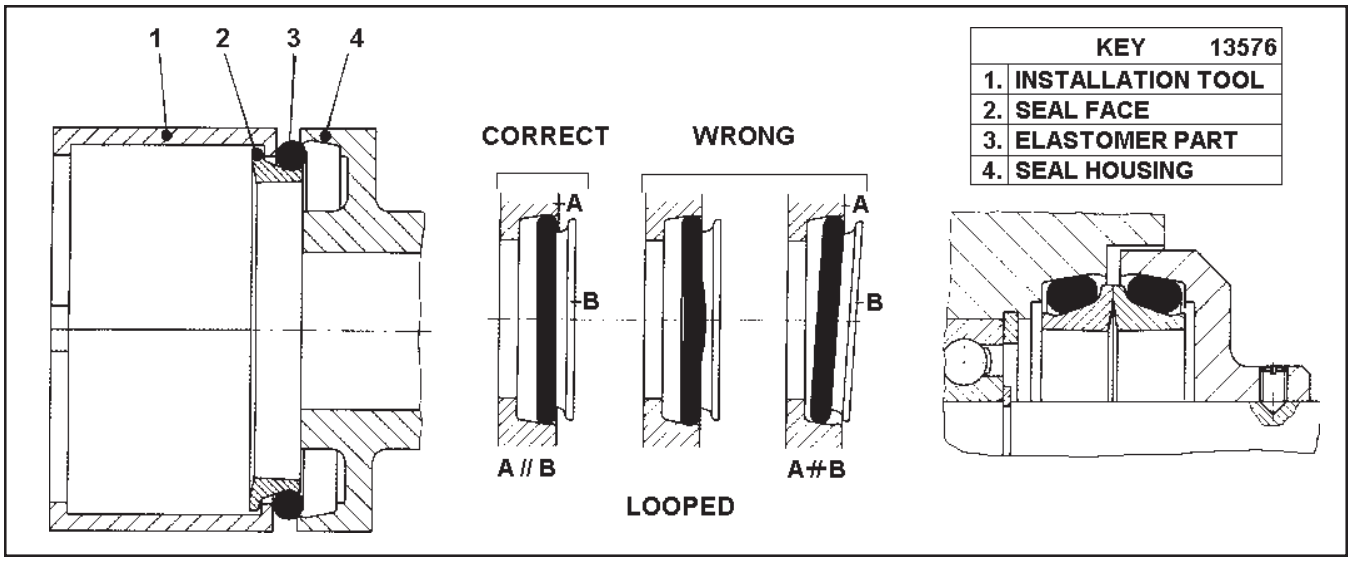


FIGURE 3 - FACE SEAL INSTALLATION (13576)

4. Install the front wheel spacer/seal adapter ring (Figure 1A/B, item 2) onto the spindle.

5. Install the inner bearing cone (Figure 1A/B, part of item 4) into the wheel.

6. Install the seal assembly as follows: (Figure 3 for step 6 only)

a. Remove the seal assembly from the original wrapping material just prior to installation.

b. Verify that the seal housing is free of all grease, metal and other contaminants. Also check again that it is free of all metal.

c. Insert the installation tool or spring onto the seal in preparation. Use extra care not to damage the O-ring or seal face.

NOTE: *Contact your local* BUCYRUS® *representative for information on these special tools.*

d. Install the face seal into the housing with the tool or spring. The pressure must be applied evenly and directly to the elastomer parts.

NOTE: *For easier assembly, moisten the bore and elastomer parts with white spirit.*

e. Press the seal ring like a push button into the housing. Take extra care to ensure that after installation the seal surface A (Figure 3) is parallel to B.

IMPORTANT: *The O-rings must not sit wave like in the housing bore or bulge partially looped out of the bore area.*

f. Wipe the seal face with a lint free cloth and apply a thin film of clean oil (SAE 30 - 40) to the sealing face.

IMPORTANT: *The oil must not wet any other surface. Also do not touch the seal face with your hands or any contaminated source.*

7. With the wheel in a level position and supported by a crane, install the wheel on the spindle. Raise and lower the wheel slightly to fully engage and seat the inner bearing against the bearing spacer.

NOTE: *When installing the wheel onto the spindle, use extreme caution to ensure that it remains centered in relation to the spindle. Damage to the bearing may occur if the wheel is cocked or not centered.*

8. Slide the outer bearing (5) onto the spindle.

9. Lubricate the six drilled head capscrews (12) with wheel bearing lubricant.

10. Install the bearing retainer plate (6) (with no shims) using the six drilled head retainer capscrews (12).

NOTE: *On trucks equipped with vented oil bath wheel bearings, the seal plate (27) and O-ring (28) should be removed from the bearing retainer plate (6) at this time.*

11. Alternately tighten the retainer capscrews to:

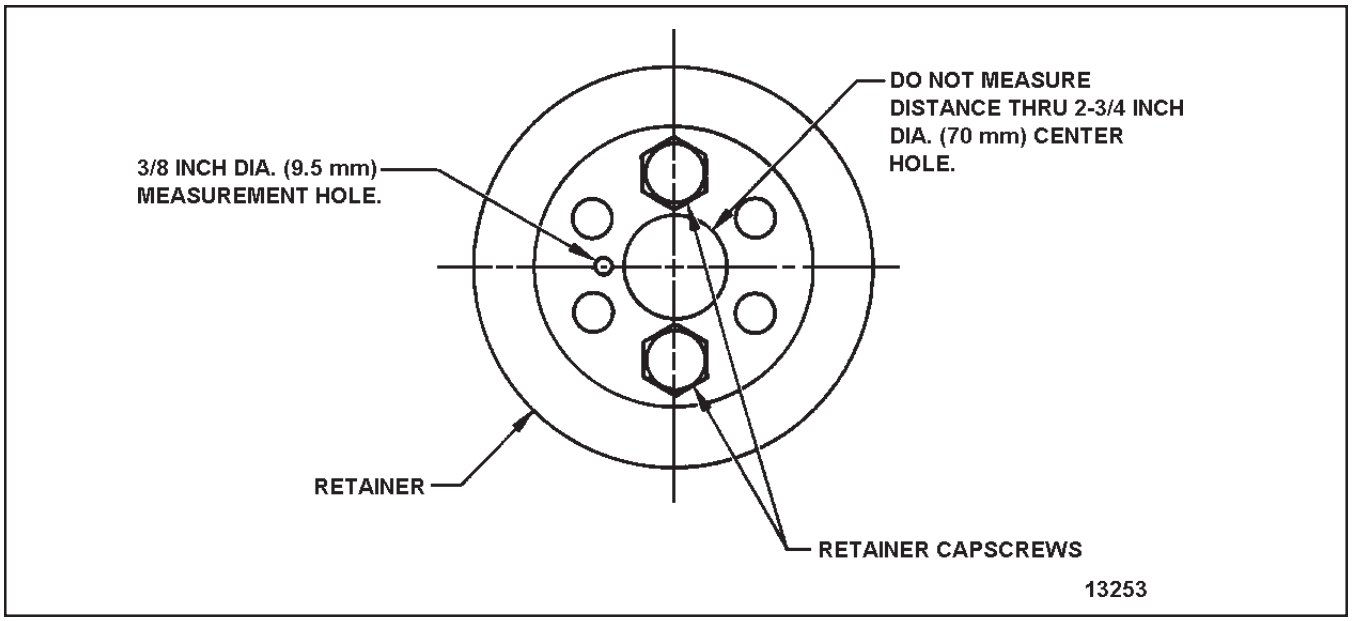


FIGURE 4 - FRONT WHEEL BEARING RETAINERS (13253)

250 ft-lb (340 Nm) in 50 ft-lb (70 Nm) increments.

NOTE: *Rotate the wheel while tightening to properly seat the bearing rollers.*

12. Loosen the retainer capscrews to take the preload off the bearing.

13. Remove the retaining capscrews as indicated in Figure 4.

14. Alternately retighten the two capscrews to:

110 ft-lb (150 Nm) in 20 ft-lb (25 Nm) increments.

NOTE: *Rotate the wheel while tightening to properly seat the bearing rollers.*

15. Using the depth micrometer, measure the distance from the end of the axle to the outer face of the bearing retainer.

16. To determine the shim requirements, subtract the thickness of the retainer (measured previously) from this latter measurement.

17. Prepare a shim stack equal to (within 0.001 inch (0.002 mm)) the dimension obtained in step 16.

NOTES:
1. Always clean all shims and measure individually.
2. On trucks equipped with vented oil bath wheel bearings, measure the thickness of the seal plate (27) and include in the total thickness of the shim stack.

18. Remove bearing retainer (6) and outer bearing (5).

19. Coat the outer bearing (5) with wheel bearing lubricant (as outlined previously) and install shim stack (7, 8, 9, 10, and 11) bearing (5), and bearing retainer (6).

NOTE: *On trucks equipped with vented oil bath bearings, install the hose assembly (24) and adapter fitting (25) to the seal plate (27). Install the seal plate with the marked "UP" orientation.*

20. Alternately tighten all six drilled head capscrews (12) (lubricated) to:

560 ft-lb (760 Nm) in 100 ft-lb (135 Nm) increments.

NOTE: *Rotate the wheel (1) while tightening to properly seat the bearing rollers.*

21. Lockwire the retainer capscrews in place using safety wire (13).

22. Clean the mating surfaces for hubcap mounting on both the hubcap flange and the wheel.

23. Install the hubcap with the proper gasket around the flange and bolt holes. Secure with capscrews.

NOTE: *To provide an improved seal, first make sure that all mating surfaces are smooth and clean and then apply a thin coat of RTV sealant between the hubcap and the wheel.*

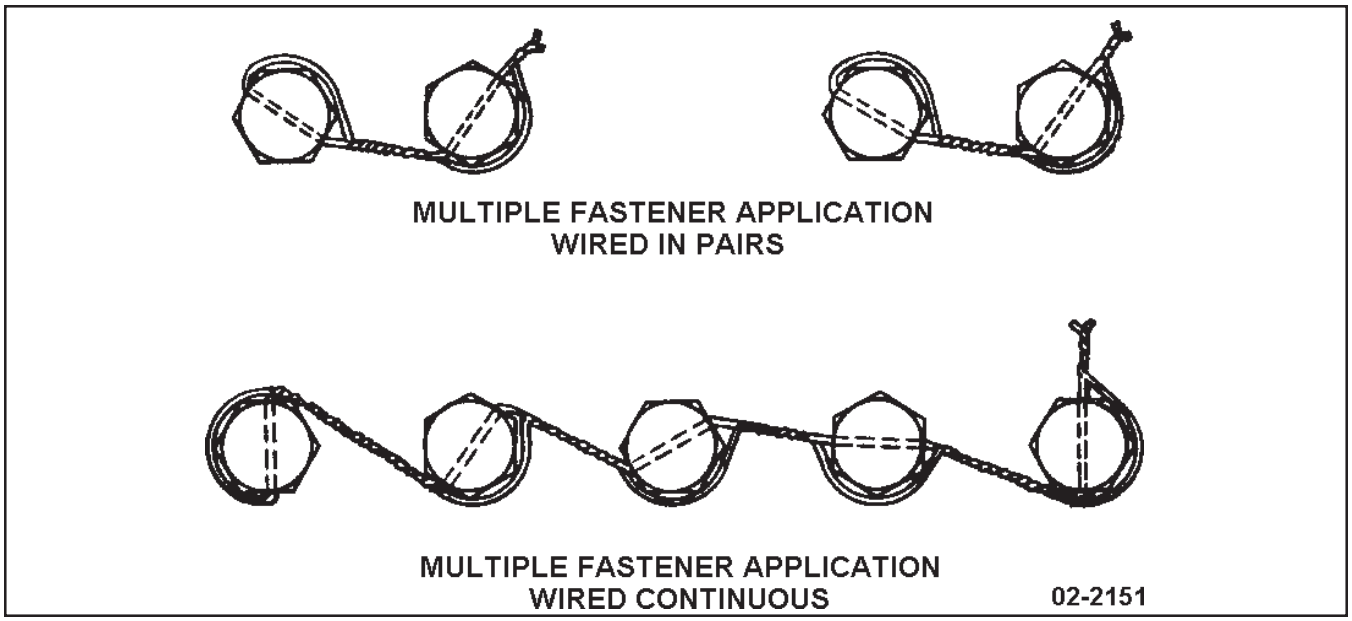


FIGURE 5 – INSTALLATION OF SAFETY WIRE (02-2151)

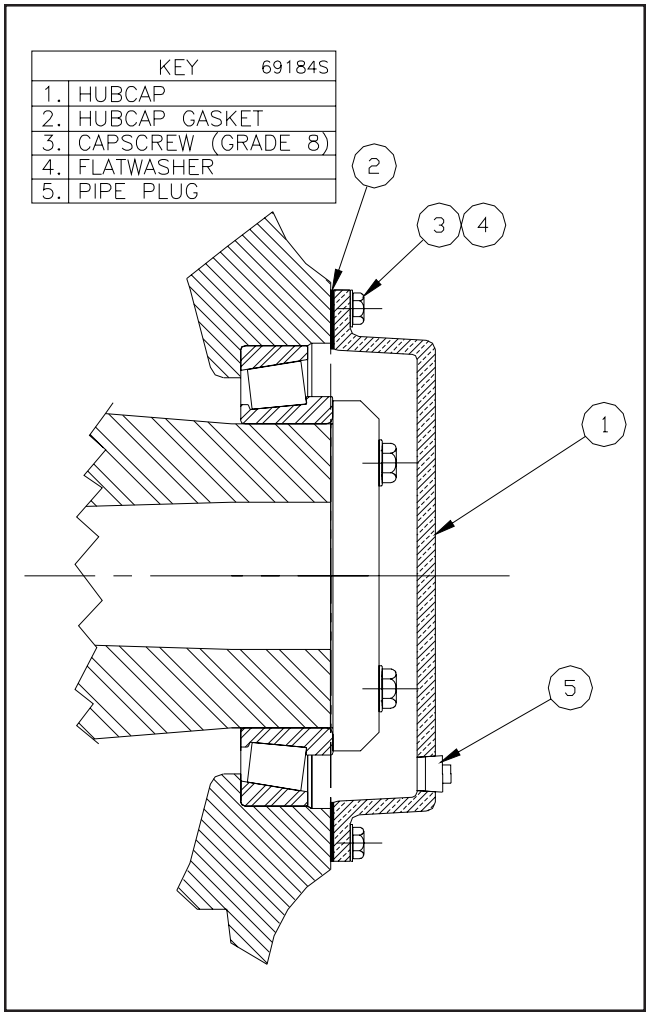


FIGURE 6A - STANDARD HUBCAP ASSEMBLY (69184S)

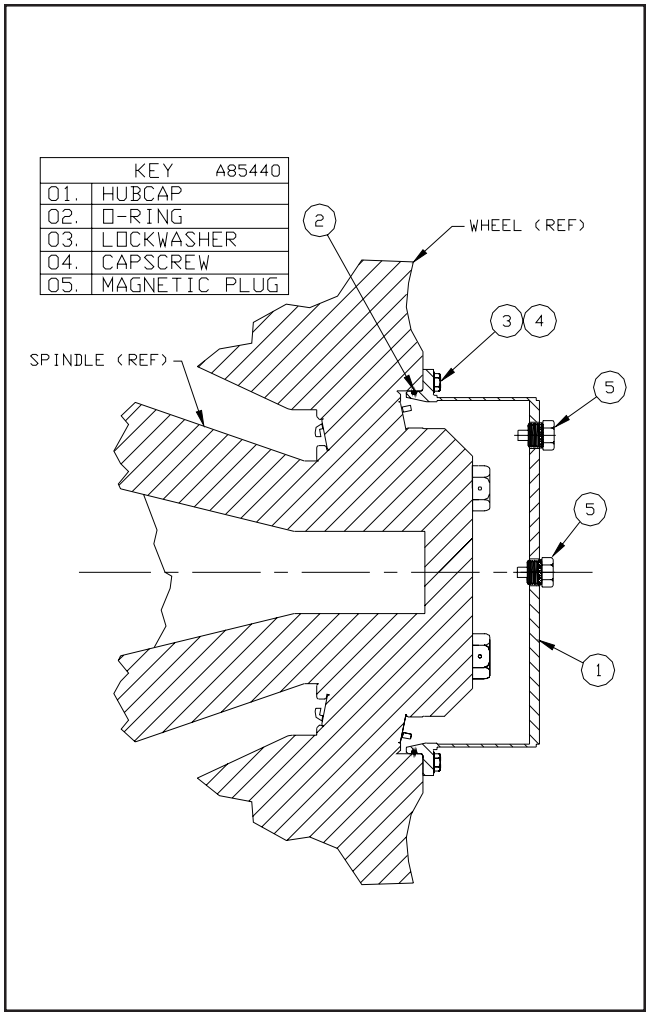


FIGURE 6B – HUBCAP ASSEMBLY WITH VENTED WHEEL BEARINGS (A85440)

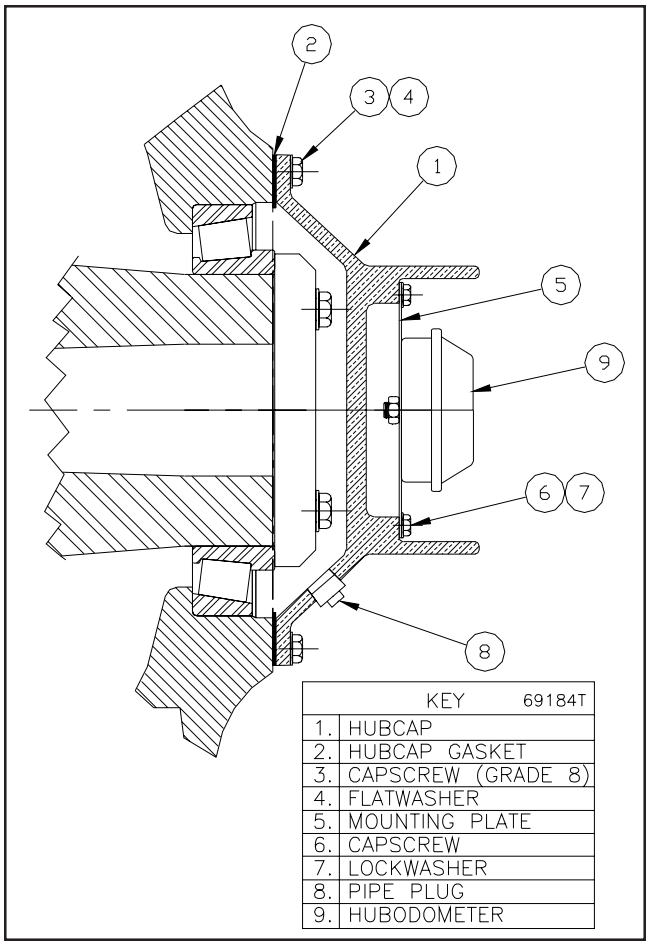


FIGURE 7 - HUBODOMETER HUBCAP ASSEMBLY (69184T)

24. Install and adjust the speed sensor assembly as follows: (Refer to Figure 2.)

a. Install the roll pins (6) into the brake spider.

b. Install the speed sensor (1) into the bracket (3).

c. Install the bracket/sensor assembly on the roll pins as illustrated, securing with capscrew (4), lockwasher (5), and hardened flatwasher (7).

NOTE: *Do not fully tighten the mounting hardware at this time.*

d. Place a 0.035 inch (0.88 mm) feeler gauge between the sensor nose and the sensor wheel, adjusting the position of the bracket to obtain this clearance.

e. Rotate the wheel assembly a complete revolution to verify that this 0.035 inch (0.88 mm) clearance is the minimum clearance at any point.

f. Secure the bracket assembly in place by tightening and torquing the capscrew (4).

NOTE: *Use care to prevent the incidental moving of the bracket. Verify the clearance once the bracket has been secured.*

g. After tightening the hardware, repeat step e. to verify the 0.035 inch (0.88 mm) minimum clearance. Readjust and recheck if required.

25. If the tire and rim assembly has been removed, install as instructed in the procedure in Section 7 - Running Gear.

26. Fill the wheel with approximately 3.3 gallons (13 liters) of the appropriate lubricant through the fill/check port in the side of the hubcap as outlined previously.

REMOVAL (Figures 1A and 1B unless otherwise listed)

The front wheel may be removed from the truck as follows:

NOTE: *This procedure may be accomplished with the tires and rim assemblies either on or off. If removal of the tires is desired, refer to the instruction on tire removal in Section 7 - Running Gear in this manual.*

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release all pressure in the brake and steering systems as outlined in the procedures in Section 5 - Hydraulic System.

⚠ DANGER

The hydraulic brake system is a high pressure system. Relieve all pressure before disconnecting any lines.

3. Raise the truck until the tires clear the ground then securely block in this position.

4. If desired, remove the tire assemblies as outlined in Section 7 - Running Gear.

5. Disconnect the brake hydraulic supply line at the caliper assemblies. Install a clean plug on the hydraulic lines and a clean cap on each of the calipers.

6. Remove the speed sensor (and if desired bracket assembly) from the brake spider to prevent damage.

7. Remove the hydraulic line between the caliper housings. Install clean plugs and caps on all open fittings.

8. Remove the caliper assemblies as outlined in the procedures in Section 8 - Brake System.

NOTE: *Retain the shims and identify the location removed from. The shims may be reinstalled with the caliper assembly to center the caliper with the disc. If new pads, discs, or bearings are installed, it will require reshimming the caliper assembly.*

9. Rotate the wheel assembly until the magnetic drain plug (18) on the wheel hub is pointing down.

10. Remove the plug and allow all lubricant to drain. Observe the draining lubricant and the plug itself for evidence of metal particles, water, or other contamination.

11. Remove the hubcap (Figures 6A and B and 7).

12. Support the wheel adequately to prevent accidental movement and remove the capscrews (12), bearing retainer (6), shims, and outer bearing (5).

NOTE: *On trucks equipped with the vented oil bath wheel bearings, the hose and adapter fittings (24 and 25, respectfully), will need to be removed.*

13. Slide the wheel off the axle spindle, being careful to protect the inner bearing (4), seal (3), and brake disc.

14. Remove the seal (3) and bearing (4) from the inner portion of the wheel.

15. Remove the seal adapter (2) and seal (3). Exercise care not to damage the sealing surfaces or allow to become contaminated.

16. If necessary, remove the disc by removing the capscrews attaching the disc to the wheel.

INSPECTION AND REPAIR

The disassembled wheel may be serviced as follows:

1. Thoroughly clean the axle spindle, bearing and wheel hub with clean solvent. Dry with clean, dry compressed air, but do not cause the bearing to spin freely, driven by the air.

2. Inspect the seals for excessive wear or damage. Repair or replace as required. It is recommended that they be replaced each time the wheel is removed.

3. Inspect the rub or seal wear ring for evidence of damage or wear. Repair or replace as required.

NOTE: *Since the surfaces wear in against each other in normal operation, it is recommended that the face seals be replaced each time the wheel assembly is removed.*

4. Inspect the inner and outer bearing cones and cups for evidence of damage, spalling and rough spots. If the bearing races are defective, replace the bearing cones and cups, both inner and outer.

5. Check that the bearing cups are properly seated by attempting to force a 0.002 inch (0.02 mm) feeler gauge between the cup back face and the wheel shoulder. Reposition as required.

6. Using magnetic particle, dye-check or other suitable methods, check the radius on the base of each side of the disc mounting bolting flange on the inboard side of the wheel for evidence of damage or cracking. If defects are found replace as required. Contact your BUCYRUS® representative for more detailed information.

7. Inspect the wheel studs for proper installation and evidence of wear or damage. If loose or damaged and require replacement, it may be done as follows:

NOTES:
Newer stud assemblies incorporate:
1. A "shoulder" on the threaded area to provide proper installation depth.
2. A hex shape on the open end allowing the direct use of the appropriate tools to assist in the removal and installation of the stud.

Older assemblies (without the shoulder or hex):
1. Stud installation depth is a measurement of the length of the stud that extends out of the wheel casting.
2. A driver or multiple lug nuts tightened onto the stud to function as a driver may be needed to assist in the removal and installation of the wheel studs.

a. Using suitable tooling, remove the old wheel stud.

NOTE: *In instances where hand tools alone will not operate; apply localized heat to the stud or casting to warm to approximately 485° F (250° C). Taking the appropriate measures, remove while hot.*

b. Clean and inspect the threads in the wheel casting and stud. Repair as required.

c. Clean and prepare the threads in the wheel casting and on the stud using the appropriate cleaner/primer for the locking compound to be used.

NOTE: *They both must be free of contamination and oil, wax, paint, rust inhibitor, or any other preservative treatment. It is important to use solvents that do not leave any residual materials or film.*

d. Coat the threads on the stud that will engage the threads in the casting with several drops of Loctite 242 (liquid) or sufficient 248 (stick) material or equivalent.

NOTE: *More detailed instructions on the proper preparation and use of Loctite on the wheel studs are contained in Section 7 – Running Gear.*

e. Install the studs:

(1) On trucks equipped with the new stud, insert the threaded end of the stud into the threaded hole. Tighten until the "shoulder" contacts the wheel assembly. A final "light" torque of 15 to 20 ft-lb (20 to 27 Nm) should suffice.

(2) On trucks equipped with the older stud assembly, install the long threaded ending into the casting until the exposed threaded length is 2-5/16 +/- 1/16 inch (59 +/- 1.5 mm) from the machined edge to the wheel.

f. Allow the adhesive to harden per its listed instructions.

NOTE: *Full strength typically requires 24 hours. In some installations, special accelerants may be used to decrease this time, but may adversely affect overall total strength. Check/test before using.*

8. Inspect the wheel speed sensor, sensor mounting bracket, and sensor wheel for evidence of contamination or damage. Clean, repair, or replace as required.

INSTALLATION

The wheel may be installed as follows:

1. Install the seal adapter onto the spindle assembly.

2. Replace the brake disc (if removed) and mounting adapter. Torque the capscrews as outlined in the information in Section 8 - Brake System, in even increments.

3. Assemble and shim the wheel and bearing assembly (including the speed sensor assembly) as outlined in the instruction on Maintenance and Adjustment in this module.

4. After the wheel has been installed, reinstall and bleed the brake caliper assemblies as outlined in Section 8 - Brake System.

5. Install the tire and rim assembly as outlined in Section 7 - Running Gear.

6. Verify the proper lubricant level in the wheel cavity before operating the truck.

FRONT SUSPENSION - NITROGEN/OIL

DESCRIPTION AND LOCATION (Figure 3)

This version of the BUCYRUS® nitrogen/oil front suspension is identified externally by the location of the charge ports on the side of the outer tube assembly. It is a cylindrical, telescoping unit that suspends the front axle from the main frame assembly. The suspensions are mounted outside of the main frame, between the ends of the superstructure support and directly under the superstructure support frame crossmember and the ends of the front axle assembly.

NOTES:

1. There have been two basic front axle/wheel/ suspension configurations used on the MT 3300AC trucks.

a. Some trucks were equipped with a smaller front axle assembly. These utilized the original design front suspension and wheel assemblies. They can be identified quickly visually by the fact that the two steering arms are symmetrical and interchangeable. Typically these were earlier production trucks and later units built for fleet compatibility and are identified as such in this material.

b. Other trucks used a larger front axle assembly. These utilized new design shorter front suspension and different wheel assemblies that incorporated larger components. They can be identified quickly visually by the fact that the two steering arms are asymmetrical and not interchangeable. Typically these were later production trucks and are identified as such in this material.

2. Later in their evolution, wear bands or guides were added to the piston and stuffing box as product improvements.

It is important to determine which configuration the truck has before beginning servicing the components as there are differences between the two.

OPERATION

The front suspensions consist of two major assemblies that move in relationship to each other. The outer tube assembly is pivoted on the main frame upper crossmember. The inner tube, attached to the axle at its lower end, slides inside the outer tube. The front wheel, steering, and brake assemblies mount on the axle.

The front suspensions serve as both spring and shock absorber. The spring function is provided by the compression of the nitrogen gas. The shock absorber function is handled by controlling the flow of oil between the inner and outer chambers in the suspensions.

In a static condition, compressed nitrogen gas in the internal cavity creates sufficient force to support the truck. When the tire strikes something (a hole, rock, etc.) the resultant forces cause the inner tube to slide upward in the outer tube. This compresses the nitrogen, absorbing the energy. At the same time, oil flows through the passages in the piston rod wall from the main chamber to the dampening chamber (annular volume between the piston rod outside diameter and the outer tube I.D.).

After the impact has been absorbed, the increased gas pressure begins to force the inner tube downward to its original position. As it does, oil flows from the dampening chamber back into the main chamber. However, a portion of the passages are now closed, restricting flow in this direction. This difference in flow characteristics provides dampening/rebound control.

NOTE: *Earlier versions of the suspension incorporated a configuration with two large “check” balls. Later versions were configured with four ½ inch (13 mm) check balls. This earlier/later designation does not necessarily coincide with the earlier/later (longer/ shorter) configuration of the suspension on the MT 3300AC trucks outlined elsewhere in this module.*

MAINTENANCE AND ADJUSTMENT

NOTES:

1. As outlined in Description and Location, MT 3300AC trucks may have either of two distinct suspension configurations:

a. Earlier configurations were longer. They can be visually identified by the vendor part number, (1380 or 1380M, for 2 or 4 check ball configuration, stamped into it) or by the increased length of plunger tube exposed below the bellows.

b. Later configurations are shorter, with the difference in length in the plunger tube. They can be visually identified by the vendor part number, (1380S or 1380SM, for 2 or 4 check ball configuration, stamped into it) or by the decreased length of plunger tube exposed below the bellows.

c. The still later versions with the piston and stuffing box wear bands were the same length and are

identified by the addition of a G to the end of their vendor part number.
2. A more definitive method of identification involves measuring the overall fully extended length - from the center of one mounting pin to the center of the other mounting pin.
a. If the suspension is not mounted, this may be done by extending the suspension manually until it is mechanically stopped.
b. If the suspensions are mounted, this may be done by jacking or lifting the truck by the front points until the tires are lifted from the ground.
c. Overall extended lengths are:
(1) Earlier configuration (longer) suspensions - 68-1/4 inches (1 735 mm)
(2) Later configuration (shorter) suspensions - 64-5/8 inches (1 640 mm)

Periodic maintenance should include the following steps:

1. Clean the unit. Inspect for evidence of wear, damage, or leakage especially in the area of the exposed portion of the inner tube and the charging valves. Repair or replace as required.

NOTE: *An optional split bellows assembly with a zipper is available that allows its replacement without removing the suspension or mounting pins.*

2. Check all retaining screws for evidence of damage or looseness. Repair or replace immediately if found loose, defective, or broken.

⚠WARNING

Prior to loosening any capscrews, always jack and support the truck to remove its weight from the suspension, release all gas pressure and secure the suspension by appropriate means. Under some conditions, these members support the weight of the truck and failure to remove the weight and pressure could result in personal injury or equipment damage.

3. Inspect the exterior of the suspension for evidence of fluid leakage. If there is leakage, repair or replace as required and recharge with oil as outlined in the procedures later in these instructions.

NOTE: *For detailed instructions on checking/charging the suspension oil level, refer to the procedures later in this portion of the module.*

4. Check the relative operating condition of the suspension as follows:

a. Operate the truck for a sufficient period of time to allow both suspensions to equalize at normal operating temperatures.

b. With the empty truck resting on a smooth, flat surface, measure the distance between the center of the upper and lower mounting pins as shown in Figure 1. The measurement should be approximately (+/- 1/2 inch (13 mm)):

MK30B	64-1/4 inches (1 630 mm)
MT 2700/3000	4-1/4 inches (1 630 mm)
MT 3300	64-1/4 inches (1 630 mm)
MT 3300AC	
Earlier configuration (longer)	64-1/4 inches (1 630 mm)
Later configuration (shorter)	60-5/8 inches (1 540 mm)
BD 220	
Earlier configuration (longer)	64-1/4 inches (1 630 mm)
Later configuration (shorter)	60-5/8 inches (1 540 mm)
MT 3600B	58-3/8 inches (1 485 mm)
BD 240 & 270	58-3/8 inches (1 485 mm)
MT 3700B/3700AC	58-3/8 inches (1 485 mm)
MT 4000AC	69-1/8 inches (1 755 mm)
MT 4400/4400AC	69-1/8 inches (1 755 mm)
MT 5500/5500B	69-1/8 inches (1 755 mm)
MT 6300AC	69-1/8 inches (1 755 mm)

If the suspension is not within these limits, check and adjust the nitrogen pre-charge pressure as outlined in the procedures that follow.

Items that may indicate that the suspension may now or will soon require servicing internally include:

(1) Evidence of oil leakage around the suspension.

(2) Frequent changes in ride height requiring recharging with nitrogen gas.

NOTES:
1. A decrease in the ride height usually accompanies a loss of gas. Loss of gas can only occur around the charge valve or BUCYRUS® Weigh or Two-Speed Overspeed System transducers.
2. Increased deflection with a normal ride height indicates a loss of oil.

(3) Harsh or bouncy ride are indications that the suspensions are repeatedly operating at the end of their travel strokes.

5. On trucks equipped with the BUCYRUS® Weigh System, visually inspect all components and wiring for evidence of wear or damage. Repair or replace as

required.

CHARGING PROCEDURE - NITROGEN/OIL FRONT SUSPENSION (Figure 1)

NOTE: *The following procedure describes how to service the suspension with both nitrogen and oil. During factory or rebuild assembly of the suspensions they are to be filled with oil only. They are to be charged with nitrogen only after being installed on a truck. Prior to removing from a truck, the nitrogen charge should be decreased to less than 100 psi (690 kPa) and blocked in the extended position.*

The main bodies of the suspensions are to be charged with dry nitrogen only. Use of oxygen, compressed air or other gases may result in a violent explosion.

The struts contain gas and oil under high pressure. Extra care must be taken when adjusting or servicing the struts. Since internal pressures can exceed 2000 psi (13 800 kPa), it is important to open the charge valves slowly and allow the pressures to be fully released before working on the struts. Also only dry nitrogen gas should be used for charging.

CHARGING WITH OIL (Original or refill after significant servicing)

NOTES:
1. This procedure is recommended if the suspensions have experienced a fluid loss due to some other reason than an external leak. If an external leak develops, the suspension should be removed and replaced. Return the suspensions to BUCYRUS® for repair as unauthorized repair may affect their warranty.
2. To modify or customize ride characteristics, contact your local BUCYRUS® representative for detailed instructions, detailing the suspension part number, mine location, and truck model and serial number.
3. Suspensions are delivered with the proper amount of oil and should not require checking when new or rebuilt.

The oil level of the suspensions mounted on a truck may be checked and adjusted as follows:

NOTE: *During truck operation, the nitrogen precharge in the strut tends to mix with the oil. This appears as an oily froth that comes out of the suspension when the nitrogen pressure is released.*
To accurately measure the oil level, the nitrogen must be removed from the oil. This is done by drawing a vacuum on the gas portion of the suspension assembly or by supporting the frame adequately with blocking and opening and leaving open the upper charge valves for 24 hours. The only time that this need be done is if external leakage is evident (indicating the need for repair) or when the empty to loaded deflection seems excessive.

NOTE: *On trucks equipped with most of the later versions of the suspension, a setscrew/drain plug combination is installed at the bottom to allow the easy draining of the oil if so desired. If the plugs are removed, they should be reinstalled as outlined in the Assembly instructions in this publication.*

NOTE: *The procedure assumes that the suspensions are mounted on a truck. If not, suitable support and means of securing the suspensions should be in place before proceeding.*

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Raise the truck until the suspensions are fully extended. Secure in this position with suitable blocking.

MK30B	68-1/4 inches (1 735 mm)
MT 2700/3000	68-1/4 inches (1 735 mm)
MT 3300	68-1/4 inches (1 735 mm)
MT 3300AC	
Earlier configuration (longer)	68-1/4 inches (1 735 mm)
Later configuration (shorter)	64-5/8 inches (1 640 mm)
BD 220	
Earlier configuration (longer)	68-1/4 inches (1 735 mm)
Later configuration (shorter)	64-5/8 inches (1 640 mm)
MT 3600B	64 inches (1 570 mm)
BD 240 & 270	64 inches (1 570 mm)
MT 3700B/3700AC	64 inches (1 570 mm)
MT 4000AC	72-3/4 inches (1 850 mm)
MT 4400/4400AC	72-3/4 inches (1 850 mm)
MT 5500/5500B	72-3/4 inches (1 850 mm)
MT 6300AC	72-3/4 inches (1 850 mm)

3. Remove the protective covers over the charge valves and carefully open both valves, releasing the gas charge.

4. Connect a vacuum pump to one of the charge valve assemblies to allow a vacuum to be drawn.

NOTE: *To draw this vacuum, special pneumatic valves and electric pump assemblies are available from BUCYRUS®.*

5. Verify that the other charging valve is closed.

6. Start the vacuum process and monitor its progress until all gas has been extracted. This is indicated by the oil in the suspension turning a smoother, darker color.

NOTES:
1. Do not allow liquid oil to be drawn from the suspension.
2. Typically this process will take approximately 15 minutes (with a vacuum of 29 inches Hg (98 kPa)) to 30 minutes (with a vacuum of 10 inches Hg (34 kPa)).

7. Stop the vacuum process.

8. Remove the blocking and slowly lower the truck frame until the distance between the upper and lower mounting pins are approximately (+/- 1/2 inch (13 mm)):

MK30B	58-1/4 inches (1 480 mm)
MT 2700/3000	58-1/4 inches (1 480 mm)
MT 3300	58-1/4 inches (1 480 mm)
MT 3300AC	
Earlier configuration (longer)	58-1/4 inches (1 480 mm)
Later configuration (shorter)	54-5/8 inches (1 390 mm)
BD 220	
Earlier configuration (longer)	58-1/4 inches (1 480 mm)
Later configuration (shorter)	54-5/8 inches (1 390 mm)
MT 3600B	51 inches (1 295 mm
BD 240 & 270	51 inches (1 295 mm)
MT 3700B/3700AC	51 inches (1 295 mm)
MT 4000AC	62-3/4 inches (1 595 mm)
MT 4400/4400AC	62-3/4 inches (1 595 mm)
MT 5500/5500B	62-3/4 inches (1 595 mm)
MT 6300AC	62-3/4 inches (1 595 mm)

9. Release any residual gas pressure in the suspension as outlined previously.

10. Remove the weigh system transducer port adapter fitting near the top of the suspension and replace with the appropriate charging adapter.

11. Open the port and observe if oil flows from the vent hole in the adapter. If not, the oil level is low and charging as outlined below is required.

12. Attach the oil charging kit to this port.

13. Connect the suction line of the charging pump to a supply of clean, good quality transmission fluid (Conoco Hydroclear Power Tran or equivalent).

The approximate volumes of oil required for the initial filling of each suspension is:

MK30B	8.6 gallons (32.6 liters)
MT 2700/3000	8.6 gallons (32.6 liters)
MT 3300	8.6 gallons (32.6 liters)
MT 3300AC	
Earlier configuration (longer)	8.6 gallons (32.6 liters)
Later configuration (shorter)	7.8 gallons (29.5 liters)
BD 220	
Earlier configuration (longer)	8.6 gallons (32.6 liters)
Later configuration (shorter)	7.8 gallons (29.5 liters)
MT 3600B	9.8 gallons (37.1 liters)
BD 240 & 270	9.8 gallons (37.1 liters)
MT 3700B/3700AC	9.8 gallons (37.1 liters)
MT 4000AC	9.7 gallons (36.7 liters)
MT 4400/4400AC	9.7 gallons (36.7 liters)
MT 5500/5500B	9.7 gallons (36.7 liters)
MT 6300AC	9.7 gallons (36.7 liters)

NOTE: *In arctic conditions it is recommended that a synthetic fluid (Conoco Syncon Synthetic R & O or equivalent) be substituted. The fluid should have the properties:*
ISO 46 Viscosity Grade
-70° F (-55° C) Pour Point
PAO Synthetic – May be used with common seals.

14. Connect the charge kit pump to an air supply source, 90 psi (620 kPa) minimum.

15. Start the charging pump and add oil until it comes out of the drain hose. Stop the pump.

NOTE: *During the filling operation, loosen the charge valve body slightly to remove pressure and to check the oil level. Oil and gas under minimum pressure will escape through the vent hole.*

16. When the process is complete, remove the oil charging kit and charging fittings.

17. Reinstall the weigh system transducer port adapter previously removed with new sealing washers. Torque to 14 +/- 1 ft-lb (19 +/- 1 Nm).

18. Charge the suspensions with nitrogen as outlined in the separate procedures.

CHARGING THE SUSPENSION WITH GAS (NITROGEN)

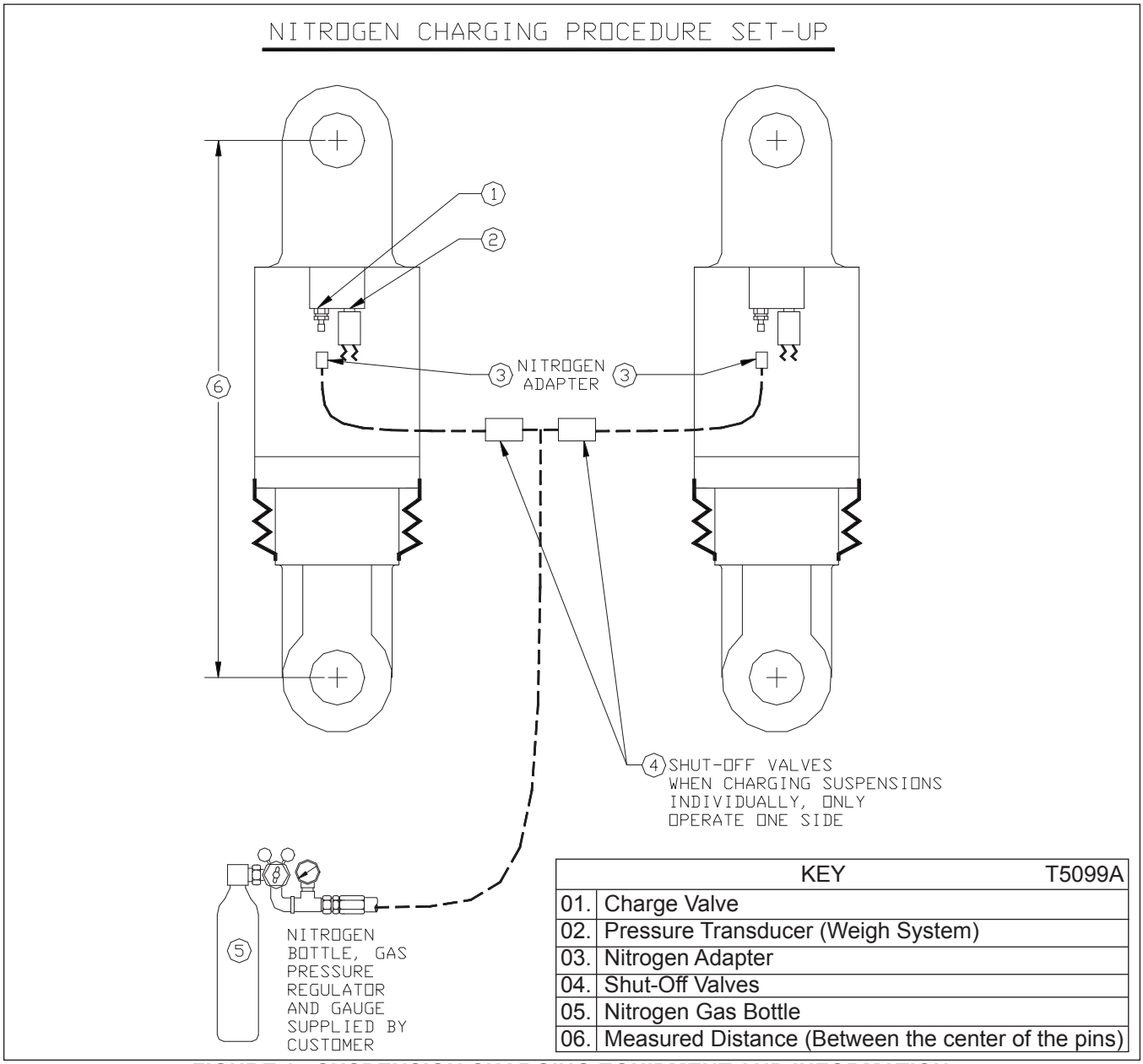
DANGER

The suspensions are only to be charged with nitrogen to a pressure in excess of 100 psi (690 kPa) when mounted on a truck. Use only dry nitrogen. Do not use oxygen or compressed air as their use or other gases may result in a violent explosion.

IMPORTANT: *The supply cylinder must be of the type that vaporizes the nitrogen when it is withdrawn. Do not charge with liquid nitrogen or any other gas.*

NOTE: *Use a gas regulator on the nitrogen bottle (not furnished with the BUCYRUS® charging kit) to protect the pressure gauge. An accurate reliable pressure gauge is essential to proper suspension adjustment.*

NOTE: *When removing the protective caps from the charging valves, allow for the residual gas pressure, if present, to escape before fully removing the cap.*



KEY	T5099A
01.	Charge Valve
02.	Pressure Transducer (Weigh System)
03.	Nitrogen Adapter
04.	Shut-Off Valves
05.	Nitrogen Gas Bottle
06.	Measured Distance (Between the center of the pins)

FIGURE 1 - SUSPENSION CHARGING EQUIPMENT AND INFORMATION

1. Park the truck in a SAFE POSITION in a level place. It must be secured by means other than the truck's friction brake system.

NOTE: *All dirt and other foreign material should be removed from the frame and dump body before charging the suspensions.*

2. Carefully remove the charging valve protective covers, as residual gas pressure may be present.

3. Connect the gas charging kit to the charging valves on the suspensions (with the shut-off valves closed) and to the regulator on the nitrogen supply bottle.

a. Connect the shorter hose assemblies to the two suspensions at the charge valves.

b. Connect the longer supply hose to the nitrogen supply.

4. Adjust the pressure regulator to approximately 600 psi (4 140 kPa).

NOTE: *Use care to protect the pressure gauge against over-pressurization. Pressures in excess of 2000 psi (13 790 kPa) are easily obtainable.*

5. Open the charge valve and charge the suspension until the distance between the centers of the upper and lower mounting pins is approximately (+/- 1/2 inch (13 mm)):

NOTE: *During the filling process, gas should be added slowly enough and the flow stopped periodically to allow the suspensions to equalize. The exact process will vary slightly with equipment, material, and operator.*

MK30B	64-1/4 inches (1 630 mm)
MT 2700/3000	64-1/4 inches (1 630 mm)
MT 3300	64-1/4 inches (1 630 mm)
MT 3300AC	
Earlier configuration (longer)	64-1/4 inches (1 630 mm)
Later configuration (shorter)	60-5/8 inches (1 540 mm)
BD 220	
Earlier configuration (longer)	64-1/4 inches (1 630 mm)
Later configuration (shorter)	60-5/8 inches (1 540 mm)
MT 3600B	58-3/8 inches (1 485 mm)
BD 240 & 270	58-3/8 inches (1 485 mm)
MT 3700B/3700AC	58-3/8 inches (1 485 mm)
MT 4000AC	69-1/8 inches (1 755 mm)
MT 4400/4400AC	69-1/8 inches (1 755 mm)
MT 5500/5500B	69-1/8 inches (1 755 mm)
MT 6300AC	69-1/8 inches (1 755 mm)

NOTES:
1. If the resulting empty ride height is not correct, repeat the above procedure raising or lowering the charge pressure in 20 psi (140 kPa) increments. The important parameter is to charge the suspensions to provide the correct empty ride height.
2. If the truck will be operated in ambient conditions significantly colder than that in the work area, it is recommended that the adjusted empty truck ride height be increased 1/2 to 1 inch (12 to 25 mm) to compensate for the effects to the reduced temperatures.

6. Close the individual shut off valves and then the gas pressure regulator.

7. Remove the charging equipment and check for leaks using a soap solution.

NOTE: *If a leak is found in the charge valve core area:*
1. Check the torque on the valve core. It should be torqued to 3 to 4 in-lb (0.35 to 0.45 Nm).
2. If this does not stop the leak it may be necessary to check the valve core area for damage or contamination or replace the valve core. It is important that all pressure in the suspension be relieved prior to removal of the valve core using the charging unit.

8. Install the protective covers. Torque to 40 to 50 in-lb (4.5 to 5.5 Nm).

9. Remove the blocking and lower the truck to the ground.

10. Operate the truck for approximately 24 hours, and then repeat the empty ride height checking process. Adjust as required.

REMOVAL (Figure 4)

The suspensions may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Raise the front of the truck until both suspensions are at full travel and the tires are clear of the ground. Secure the frame assembly in this position with adequate blocking then lower the truck slightly to remove the load from the suspension and pins. Block the main frame in this position.

3. Release the nitrogen (gas) pressure in both of the

front suspensions to less than 100 psi (690 kPa) as outlined in the instructions in Maintenance and Adjustment in this module.

NOTE: *On trucks equipped with most of the later versions of the suspension, a setscrew/drain plug combination is installed at the bottom to allow the easy draining of the oil if so desired. If the plugs are removed, they should be reinstalled as outlined in the Assembly information in this module.*

4. On trucks equipped with the BUCYRUS® Weigh System, disconnect the wiring from the pressure transducers.

5. Support the suspension adequately before removal of the connecting pins.

⚠WARNING

Each suspension unit weighs in excess of:

MK30B	**1250 lb (565 kg)**
MT 2700/3000	**1250 lb (565 kg)**
MT 3300	**1250 lb (565 kg)**
MT 3300AC	**1250 lb (565 kg)**
BD 220	**1250 lb (565 kg)**
MT 3600B	*1900 lb (860 kg)*
BD 240 & 270	**1900 lb (860 kg)**
MT 3700B/3700AC	**1900 lb (860 kg)**
MT 4000AC	**1900 lb (860 kg)**
MT 4400/4400AC	**1900 lb (860 kg)**
MT 5500/5500B	**1960 lb (890 kg)**
MT 6300AC	**1960 lb (890 kg)**

6. Remove the capscrews (7), flatwashers (8), and pin retainers (5) from both the upper and lower pin assemblies.

7. Using a soft head mallet, tap the end of the pin opposite of the capscrew holes and remove one pin at a time. Slight movement of the suspensions may be required to minimize the forces on the pins. Be cautious when handling the pins. There may be some pressure on the pins caused by supporting the suspension.

⚠WARNING

Take care not to bind the connecting pins in the lugs.

8. Carefully remove the suspension unit from the vehicle.

DISASSEMBLY (Figures 2 and 3)

The suspension may be disassembled as follows:

1. Using the appropriate means, remove the oil from the suspension.

NOTES:

1. On trucks equipped with most of the later versions of the suspension, a setscrew/drain plug combination is installed at the bottom to allow the easy draining of the oil if so desired. If the plugs are removed, they should be reinstalled as outlined in the Assembly information in this module.

2. The expected oil volumes involved are in a chart in the Maintenance and Adjustment information in this module.

2. Remove the guard assembly (3) secured by capscrews (1) and lockwashers (2).

3. Remove the charge valve (23) and plug (26) or transducers, if not removed previously. Temporarily replace with plugs.

4. Using a crane and suitable handling and support fixtures, invert the suspension and secure in place with the outer barrel or tube (5) at the bottom.

5. Remove the bellows (17 or 18).

NOTE: *In some installations, removal of the bellows over the lower mount assembly may not be possible. In those installations, it should be moved and secured to the lower mounting point for later removal.*

6. Remove the Grade 8 capscrews (22) and hardened washers (21) that secure the stuffing box to the outer tube assembly.

7. Carefully raise the lower plunger tube/stuffing box assembly from the outer tube assembly (5) using care not to damage the surfaces on any of the components. This assembly can now be positioned horizontally on a clean work surface for additional disassembly, if desired.

8. Remove the capscrews (6) and hardened washers (7) securing the piston (8) onto the plunger tube assembly. Remove the piston from the plunger tube assembly.

9. Remove the two (or 4) balls (9) from the bores in the plunger tube.

10. Carefully remove the stuffing box (13) from the outer tube assembly (5) using care not to damage the surfaces on any of the components.

11. Inspect, and then remove the O-ring (11) and back-up ring (12) from the grooves on the outer surface area of the stuffing box (13).

12. Inspect then remove the wiper (16), seal (15), buffer (14), and wear bands (31) (if so equipped) from the grooves in the inner bore of the stuffing box (13).

13. Inspect then remove the wear bands (32) from the piston assembly.

14. Drain all oil from the outer barrel or tube assembly and move as required.

INSPECTION AND REPAIR

The disassembled suspension may be serviced as follows:

1. Inspect all component parts both inside and outside. They must be smooth and polished. Remove all nicks, chipped or cracked finishes, and rust spots. Remove all oil and other contamination. If rust is evident in the vicinity of the seals, clean the surface with 400-grit emery cloth.

2. Inspect the self-aligning bearings in the frame and axlebox for evidence of wear and/or damage. They must be free of defects and still properly installed.

If they require replacement, this may be done as follows:

a. Remove the bushing retainers by the appropriate means, exercising special care to prevent damage to the frame/front axle or sleeve bores.

b. If required, use air arc or other appropriate means to split and remove the entire bushing assembly. Again exercise care not to damage the mounting bore and/or sleeve in the frame/front axle.

c. Inspect the inner bore of the sleeve in the frame/front axle for evidence of wear or damage. It must be free of defects and within 0.001 inch (0.025 mm) of round. Small ridges or grooves may be repaired with emery cloth. Otherwise the sleeve should be replaced. This may be done as follows:

(1) If so equipped, carefully remove the damaged sleeve, exercising care not to damage the bore in the frame/front axle.

(2) Inspect the bore in the frame/front axle for evidence of wear or damage. It must be free of defects and within 0.001 inch (0.025 mm) of round. Small ridges or grooves may be repaired with emery cloth.

NOTE: *If defects are found or the bore is not within tolerances, contact the local BUCYRUS® Service Representative for detailed repair recommendations.*

(3) Install the new sleeves as follows:

IMPORTANT: *Sleeves with high interference fit may be installed using either of the methods outlined here. The liquid nitrogen method typically provides a more consistent installation.*

Liquid Nitrogen Method

⚠WARNING

Due to the cold temperatures of both the liquid nitrogen cooling medium and the parts being cooled, it is important to take extra precautions that neither comes in contact with skin, clothing, or other items during the entire procedure.

(a) Using all of the appropriate precautions because of the cold temperatures of the materials involved, gently immerse the sleeve into a pool of liquid nitrogen.

(b) After allowing sufficient time to fully cool, carefully remove from the liquid nitrogen and install in the appropriate bore properly oriented.

(c) Allow the sleeve to warm slowly and evenly to ambient temperature, making sure that the retaining rings may be properly installed.

IMPORTANT: *The use of externally applied heat to speed up the process may result in uneven cooling and warping of or damage to the sleeve.*

Heating Method

WARNING

Due to the cold temperatures of both the liquid nitrogen cooling medium and the parts being cooled and the heat applied to the receiving component area, it is important to take extra precautions that neither comes in contact with skin, clothing, or other items during the entire procedure.

(a) Using all of the appropriate precautions because of the cold temperatures of the materials involved, carefully cool the sleeve to a temperature of -40° to -70° F (-40° to -57° C).

(b) Evenly heat the bore into which the sleeve is to be installed to 300° to 350° F (150° to 175° C).

IMPORTANT: *Heat the massive side of the lug additionally to ensure that the bore is heated and expanded evenly.*

(c) Once both components are at the proper temperatures, carefully remove the sleeve from the cooling medium and install in the appropriate bore properly oriented.

(d) Allow the sleeve to warm slowly and evenly to ambient temperature, making sure that the retaining rings may be properly installed.

IMPORTANT: *The use of externally applied heat to speed up the process may result in uneven cooling and warping of or damage to the sleeve.*

(e) Verify that with the sleeve properly installed, it is within 0.001 inch (0.025 mm) of round. Small ridges or grooves may be repaired with emery cloth.

d. Install the self-aligning bushings as follows:

IMPORTANT: *Steel spherical bearings should not come in direct contact with dry ice and should not be immersed in liquid nitrogen. Either of these actions could result in the change of the metallurgical character of the bearing affecting subsequent fit and operation.*

WARNING

Due to the cold temperatures of both the dry ice or other cooling medium and the parts being cooled, it is important to take extra precautions that neither comes in contact with skin, clothing, or other items during the entire procedure.

(1) Using all of the appropriate precautions because of the cold temperatures of the materials involved, carefully cool the bearing assembly to a temperature of -40° to -70° F (-40° to -57° C).

(2) Once both components are at the proper temperatures, carefully remove the bearing from the cooling medium and install properly oriented into the appropriate bore.

(3) Allow the bearing assembly to warm slowly and evenly to ambient temperature, making sure that the retaining rings may be properly installed.

IMPORTANT: *The use of externally applied heat to speed up the process may result in uneven cooling and warping of or damage to the bearing or bore.*

(4) Secure with the new retainers using care not to contaminate the new bushings.

3. Inspect the bearing spacers (3) on the lower mounting area of the plunger tube assembly (10) for evidence of wear or damage. Repair of replace as required.

ASSEMBLY (Figures 2, 3, and 4)

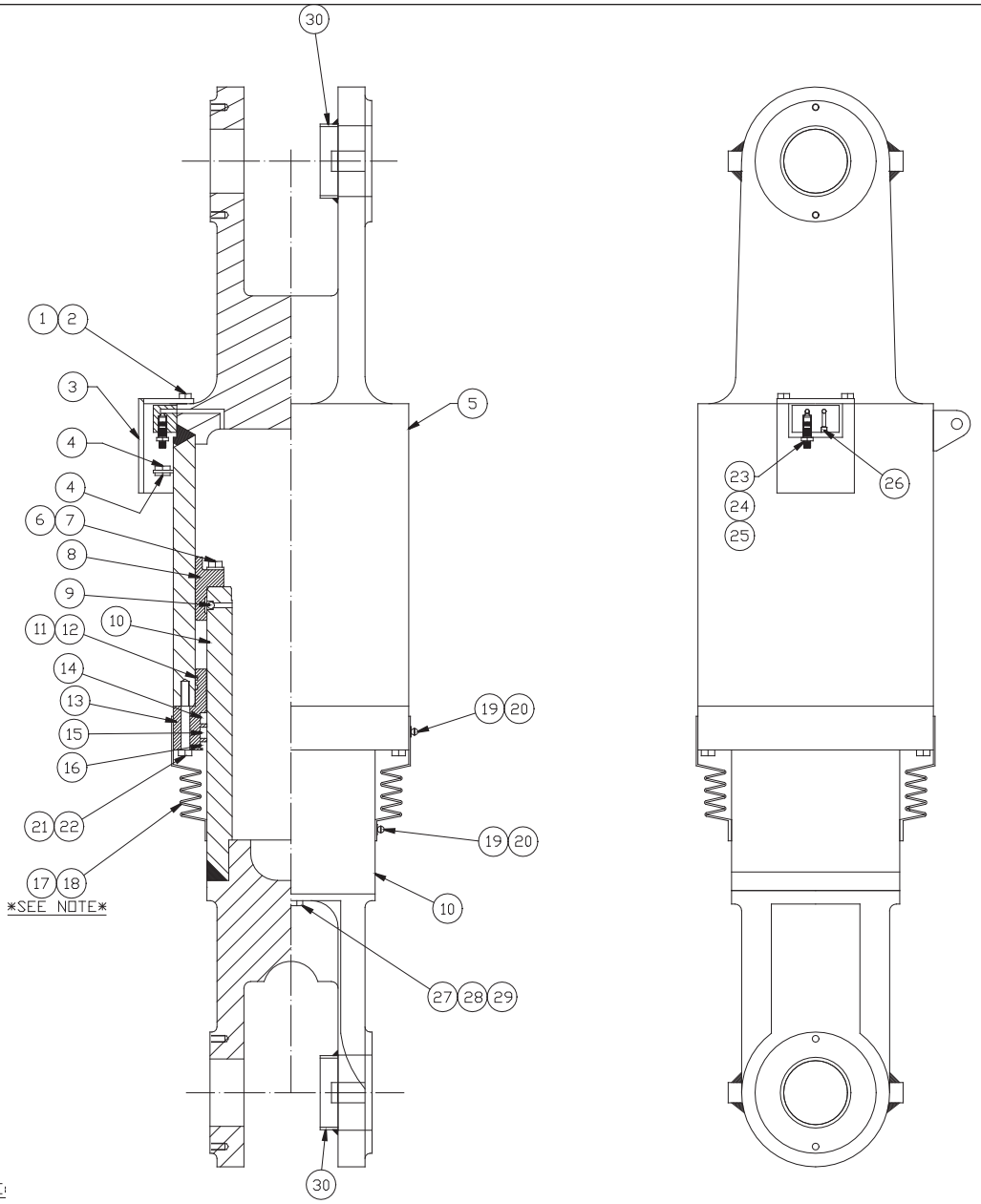
The suspension may be assembled as follows:

1. Lubricate each seal and the OD of the plunger tube (10) and the inner bore of the outer tube assembly (5) with oil compatible with that to be used to fill the suspension assembly.

2. Install wiper (16), primary seal (15), buffer seal (14) and wear bands (31) (if so equipped) into the appropriate grooves in the inner bore of the stuffing box (13).

3. Install the O-ring (11) and back-up ring (12) into the appropriate grooves on the outer surface area of the stuffing box (13).

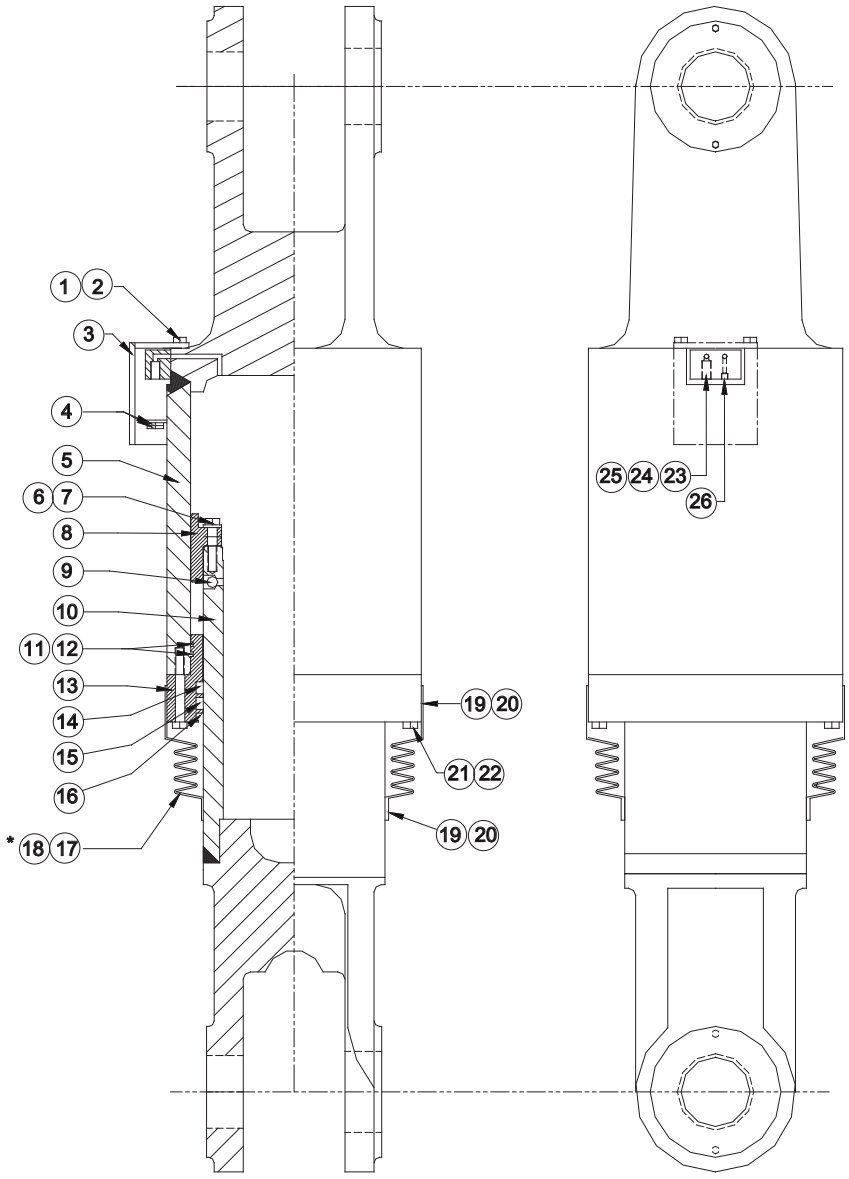
NOTE: *The back-up rings (12) are installed in the groove first, on the side of the groove toward the lower or larger end of the stuffing box. The O-rings (11) are installed toward the smaller, high pressure end of the stuffing box groove.*



*NOTE:
THE OPTIONAL BELLOWS WITH ZIPPER (18) ALLOWS THE BELLOWS TO BE SERVICED WITH THE SUSPENSION MOUNTED ON THE TRUCK.
THE STANDARD BELLOWS (17) REQUIRES THE INSTALLATION OVER THE LOWER MOUNTING PORTION OF THE PLUNGER TUBE ASSEMBLY (10) WHICH MUST BE REMOVED FROM THE TRUCK.

KEY					57110
01.	Capscrew (Grade 8)	11.	O-ring	21.	Hardened Flatwasher
02.	Lockwasher	12.	Back-up Ring	22.	Capscrew (Grade 8)
03.	Valve Guard	13.	Stuffing Box	23.	Charge Valve
04.	Locknut	14.	Buffer Seal	24.	Charge Valve Core
05.	Outer Tube or Barrel Assembly	15.	Primary Seal	25.	Charge Valve Cap
06.	Capscrew (Grade 8)	16.	Wiper	26.	Plug
07.	Hardened Flatwasher	17.	Bellows	27.	O–Ring Boss Drain Plug
08.	Piston	18.	Bellows with Zipper (Optional)	28.	O-ring
09.	Ball	19.	Adjustable Fastener Clamp	29.	Setscrew
10.	Plunger Tube Assembly	20.	Banding Clamp		

FIGURE 2 - FRONT SUSPENSION ASSEMBLY – LATER CONFIGURATION ASSEMBLIES (57110)



*NOTE: The optional bellows with zipper (18) allows the bellows to be serviced with the suspension mounted on the truck.

The standard bellows (17) requires the installation over the lower mounting portion of the plunger tube assembly (10) which must be removed from the truck.

KEY 55895

01.	Capscrew (Grade 8)	10.	Plunger Tube Assembly	19.	Adjustable Fastener Clamp
02.	Lockwasher	11.	O-ring	20.	Banding Clamp
03.	Valve Guard	12.	Back-up Ring	21.	Hardened Flatwasher
04.	Locknut	13.	Stuffing Box	22.	Capscrew (Grade 8)
05.	Outer Tube or Barrel Assembly	14.	Buffer Seal	23.	Charge Valve
06.	Capscrew (Grade 8)	15.	Primary Seal	24.	Charge Valve Core
07.	Hardened Flatwasher	16.	Wiper	25.	Charge Valve Cap
08.	Piston	17.	Bellows	26.	Plug
09.	Ball	18.	Bellows with Zipper (Option)		

FIGURE 3 - FRONT SUSPENSION ASSEMBLY – EARLIER CONFIGURATION ASSEMBLIES (55895)

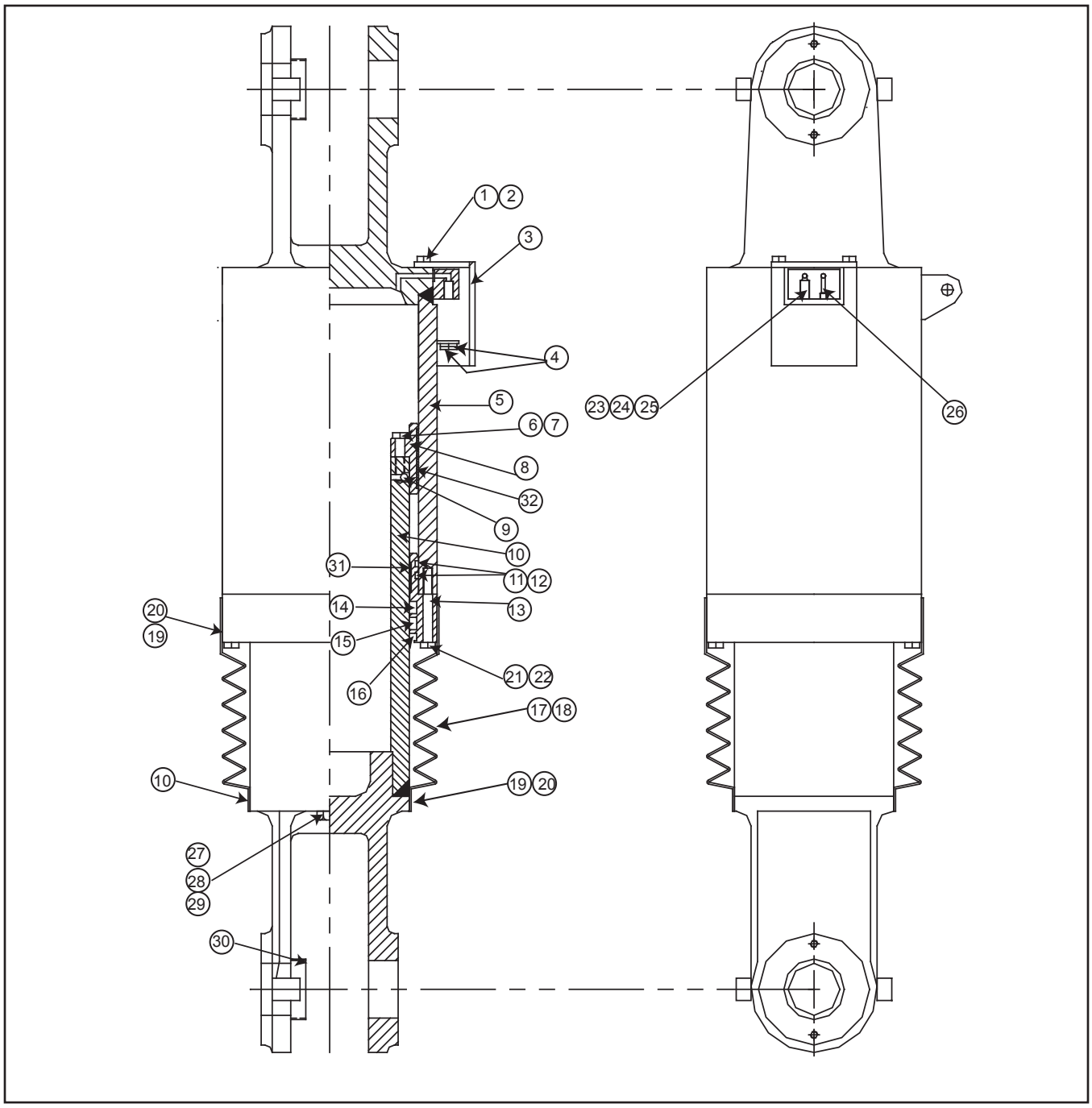


Figure 4 - Front Suspension Assembly – With Wear Bands 57559

Key					
01.	Capscrew (Grade 8)	12.	Back-up Ring	23.	Charge Valve
02.	Lockwasher	13.	Stuffing Box	24.	Charge Valve Core
03.	Valve Guard	14.	Buffer Seal	25.	Charge Valve Cap
04.	Locknut	15.	Primary Seal	26.	Plug
05.	Outer Tube or Barrel Assembly	16.	Wiper	27.	O–Ring Boss Drain Plug
06.	Capscrew (Grade 8)	17.	Bellows	28.	O-ring
07.	Hardened Flatwasher	18.	Bellows with Zipper (Optional)	29.	Setscrew
08.	Piston	19.	Adjustable Fastener Clamp	30.	Bearing Spacer
09.	Ball	20.	Banding Clamp	31.	Wear Ring (Stuffing Box)
10.	Plunger Tube Assembly	21.	Hardened Flatwasher	32.	Wear Ring (Piston)
11.	O-ring	22.	Capscrew (Grade 8)		

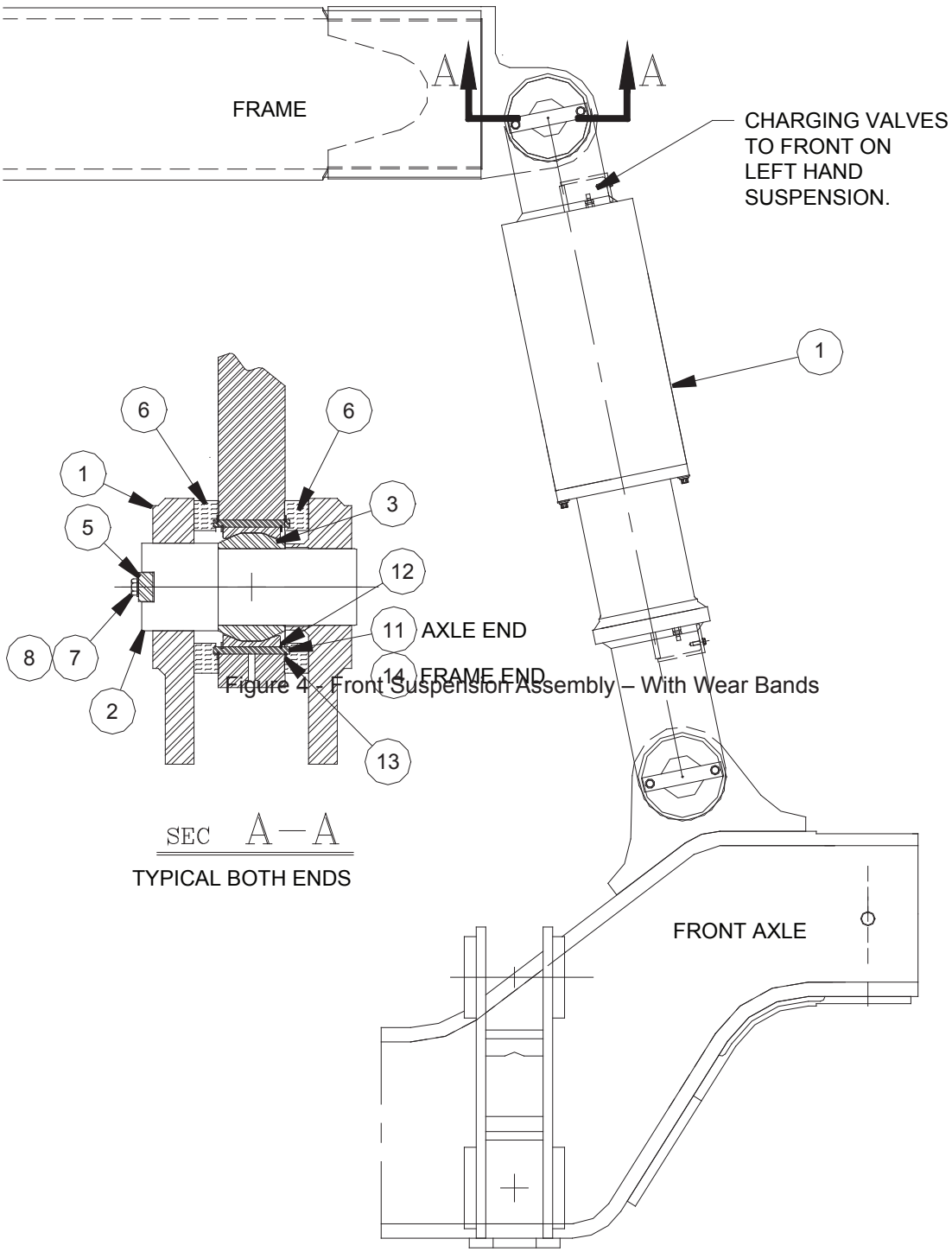


Figure 4 - Front Suspension Assembly – With Wear Bands

KEY					A85225
01.	Front Suspension	06.	Dirt Ring	11.	Sacrificial Sleeve (Axle Assembly)
02.	Mounting Pin	07.	Capscrew	12.	Internal Retaining Ring
03.	Self Aligning Bushing	08.	Hardened Flatwasher	13.	External Retaining Ring
04.	Not Used	09.	Not Used	14.	Sacrificial Sleeve (Frame Assembly)
05.	Pin Retainer	10.	Not Used		

FIGURE 4 - FRONT SUSPENSION MOUNTING ASSEMBLY (A85225)

4. Install the bellows (17), small end first toward the lower mounting clevis, onto the lower plunger tube assembly.

NOTE: *An optional split bellows assembly with a zipper (18) is available that allows its replacement without removing the suspension or mounting pins.*

5. Using the appropriate seal expander or equivalent to prevent damage to the seals, carefully install the stuffing box (13) onto the plunger tube (10), large end first.

6. Install the balls (9) into the bores in the plunger tube.

NOTES:
1. On trucks equipped with the later ½ inch diameter balls; there are four balls per suspension. On earlier versions with larger balls, there are 2 balls per suspension. The correct number and diameter ball for the application must be used.
2. A small amount of clean grease may be used to assist in temporarily holding them in place during the remainder of the assembly process.

7. After installing O-ring (9), install the piston (8) onto the plunger tube assembly, securing with grade 8 capscrews (6) and hardened washers (7). Tighten evenly to the final torque listed below in a crossing pattern in increments of 50 ft-lb (65 Nm).
5/8 - 11NC 160 ft-lb (215 Nm)
3/4 - 10NC 280 ft-lb (380 Nm)

8. On suspensions equipped with wear band (32) on the pistons (8), install and lubricate these for assembly.

9. Using a crane and suitable handling and support fixtures, invert the outer barrel or tube assembly and secure in place with the mounting end at the bottom.

10. Using appropriate tools and precautions, raise the lower plunger tube assembly and install into the outer barrel or tube assembly (5) over the lower plunger tube assembly until it is far enough for the installation of the stuffing box.

11 Using a seal compressor or equivalent to prevent damage to the seals, carefully install the stuffing box (13) into the outer tube assembly with the bolt holes in each properly aligned.

12 Secure the stuffing box to the outer tube assembly, securing with grade 8 capscrews (22) and hardened washers (21). Tighten evenly to the final torque listed below in a crossing pattern in increments of 50 ft-lb (65 Nm).
5/8 - 11NC 160 ft-lb (215 Nm)
3/4 - 10NC 280 ft-lb (380 Nm)

13 Install the bellows (17), securing to the stuffing box and outer tube assembly as needed. Secure with banding clamp (20) and adjustable fastener clamp (19).

NOTE: *An optional split bellows assembly with a zipper (18) is available that allows its replacement without removing the suspension or mounting pins.*

14. Install the charge valve (23) and plug (26) or transducers, if removed previously. Torque the:

a. Pressure transducers to 14 +/- 1 ft-lb (19 +/- 1 Nm).

b. Charge valve to 37 +/- 7 ft-lb (50 +/- 10 Nm) in increments of 10, 20, and 37 ft-lb (14, 27, and 50 Nm).

NOTE: *If removed, reinstall the valve cores and protective covers.*
1. Torque the valve cores to 3 to 5 in-lb (0.35 to 0.45 Nm).
2. Torque the protective covers to 40 to 50 in-lb (4.5 to 5.5 Nm).

15 Install the guard assembly (3) secured by capscrews (1) and lockwashers (2) for protection.

16. On suspensions equipped with the setscrew/drain plug combination:

a. After coating the threads with the appropriate thread sealant, install the setscrew (29, Figure 2). Tighten securely, but do not over-tighten to damage the threads. Make sure that the setscrew is installed to a sufficient depth to allow proper installation of the outer plug.

b. Install the drain plug assembly (27, Figure 2) into the plunger tube assembly. Tighten the special O-ring boss plug until the bosses make metal-to metal contact with the suspension. This should slightly compress the O-ring seal (28), but not cause it to distort.

17. Switch the suspension from the inverted position to a normal vertical operating position.

18. Secure in place and fill with oil as outlined in the procedures in Maintenance and Adjustment in this module.

INSTALLATION (Figure 4)

The front suspensions may be installed as follows:

1. Clean and smooth all mating surfaces on the suspension and the frame.

2. On trucks equipped with pressure transducers, use extra care to prevent damage to system components.

3. Raise the suspension assembly into position making sure the charge valves are located to the outboard side of the suspension.

WARNING

Each suspension unit weighs in excess of:

MK30B	**1250 lb (565 kg)**
MT 2700/3000	**1250 lb (565 kg)**
MT 3300	**1250 lb (565 kg)**
MT 3300AC	**1250 lb (565 kg)**
BD 220	**1250 lb (565 kg)**
MT 3600B	*1900 lb (860 kg)*
BD 240 & 270	**1900 lb (860 kg)**
MT 3700B/3700AC	**1900 lb (860 kg)**
MT 4000AC	**1900 lb (860 kg)**
MT 44004400AC	**1900 lb (860 kg)**
MT 5500/5500B	**1960 lb (890 kg)**
MT 6300AC	**1960 lb (890 kg)**

4. Align the holes in the suspension and in the lugs and insert the suspension pins from the center toward the tires.

5. Install the pin retainers (5) and secure with hardened flatwashers (8) and Grade 8 capscrews (7).

6. Place the neoprene dirt rings (6) in between the suspension and the lugs. Secure with tie wraps.

7. On trucks equipped with the BUCYRUS® Weigh System:

a. Install the pressure transducer if not installed previously. Torque to 14 +/- 1 ft-lb (19 +/- 1 Nm).

KEY			
01.	Suspension	04.	Watertight Joint
02.	Pressure Transducer		
03.	Grip		

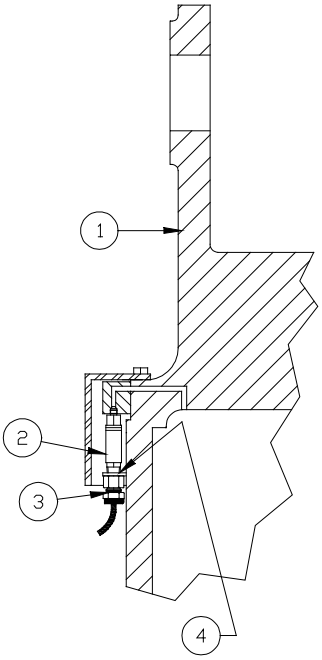


FIGURE 5 – PRESSURE TRANSDUCER INSTALLATION (A84726)

NOTE: *The joint indicated in item 4 of Figure 6must be watertight. It is recommended to use liquid pipe sealant on the threads and apply RTV sealant around the clearance hole to prevent moisture seepage and pooling. Also make sure to install the appropriate sealing grip (3) on the cable end of the transducer, using the body nut as a locknut.*

b. Install all wiring, making sure to allow sufficient freedom for the travel of the suspension.

8. Remove the blocking and lower the truck to the ground.

9. Charge the suspension with dry nitrogen gas as outlined in the instructions in Maintenance and Adjustment in this module.

10. Check operation of the suspension as outlined in Maintenance and Adjustment before placing back into operation.

11. If so equipped, check the operation of the BUCYRUS® Weigh System.

STEERING LINKAGE

DESCRIPTION AND LOCATION (Figures 2 and 3)

The steering linkage consists of the following components:

1. Steering cylinders - double acting hydraulic cylinders (with clevis type ends) with the base end attached to the anchor on the front axle assembly and the rod end attached to the arm on the front spindle assembly.

2. Drag link - adjustable link (turnbuckle style) connected between the arms on the two spindle assemblies.

OPERATION

The function of the mechanical steering linkage assembly is to control the movement of the front axle spindle assemblies and thus steer the truck. Movement of the linkage assemblies is regulated by the steering cylinders. For a detailed explanation of this portion of the system refer to the information in Section 5 - Hydraulic System.

When the steering wheel is moved to make a turn, one steering cylinder extends and the other retracts. This relative motion causes the two spindles to turn on their respective kingpins allowing the tires to “steer”. The drag link ties the relative motion of the two spindle assemblies together to aid in coordination during steering and to maintain the desired toe-in adjustment.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Inspect all components for evidence of wear or damage. Repair or replace as required. Never allow a truck to operate with defective components.

2. Verify that all components are properly lubricated and that all seals are in generally good condition. Repair or replace as required.

3. Check the front wheel toe-in and adjust as outlined below.

ADJUSTING FRONT WHEEL TOE-IN (Figure 1)

The truck’s toe-in (deviation from parallel) should be checked regularly. Proper toe-in adjustment will improve tire and component life, and improve the truck’s steering control. Adjustment should be done as follows:

NOTE: *The truck must be empty and parked on a level surface in an area which will permit both forward movement of at least two truck lengths. The tires should be pointed as straight ahead as possible.*

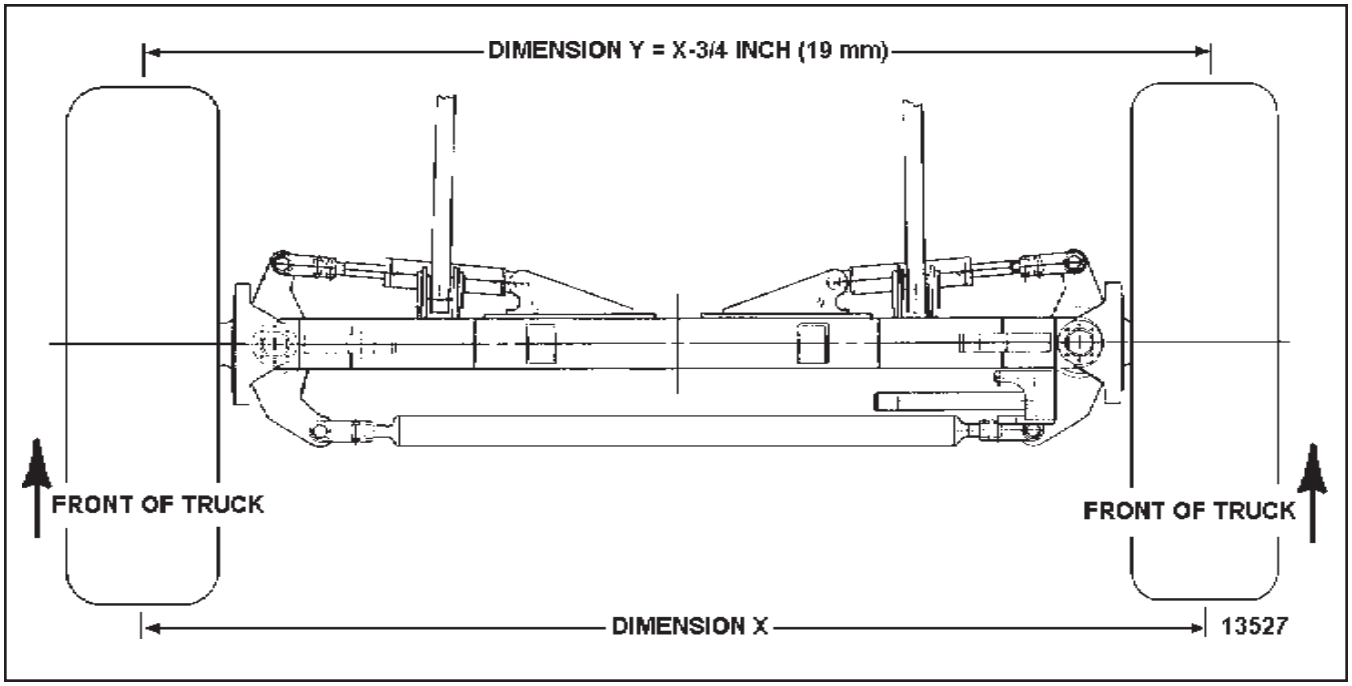


FIGURE 1 - FRONT AXLE TOE-IN ADJUSTMENT

1. Verify that the front wheel bearings are properly adjusted. Refer to the information in Section 7 - Running Gear.

2. Verify that both the front and rear Nitrogen/Oil suspensions are at the proper recommended empty ride height.

3. Adjust the drag link to obtain an initial length of 188 inches (4 775 mm) between the pin centers.

4. Adjust the yokes on the cylinder rods to an initial setting of as few exposed threads as possible on each cylinder assembly.

5. After driving the truck forward on the smooth, level surface, park it in a SAFE POSITION with the front wheels directed straight forward. It must be secured by means other than the truck's friction brake system.

NOTES:
1. There should be sufficient distance in front of the truck to allow it to be moved almost a full tire rotation forward without interference.
2. To ensure the consistency of all measurements the last movement of the truck must always be forward.

6. Place a thumb tack in each tire located as follows:

a. To the rear of the tire;

b. At the center of the tread (side to side);

c. As high and equidistant above the ground level as possible to permit clearance of all truck components by a tape measure or other suitable device strung between the tacks parallel to the ground.

NOTE: *They should be as close to the height of the centerline of the hub as possible.*

7. Record the distance between the tacks (X) and the distance above the ground.

8. Start the truck in a normal manner and drive straight forward until the tacks are low enough to the ground for the tape to clear all components and are about the same distance above the ground in front of the tire as they were to the rear in step 7. Again the final direction of travel must be forward.

9. Secure the truck in a SAFE POSITION. It must be secure by means other than the truck's friction brake system. The final direction of travel must be forward.

10. Record the distance between the tacks (Y).

11. Determine the truck's correct front wheel toe setting as follows:

Y = X - 3/4 inches (19 mm)

12. Adjust the drag links equally as required to obtain the required dimension.

NOTE: *Remember that because of steering geometry the required adjustment will be approximately 1/2 of the calculated change as the opposite side of the tire is moving an equal distance in the opposite direction to that being measured.*

13. When the adjustment is complete, recheck by backing the truck past the original position (step 1 of this procedure) and repeating the measurements and adjustments until correctly completed.

14. Tighten the clamping bolts on the various cylinders and drag links to secure the final settings.

15. Start the truck in a normal manner. Turn the wheels completely in both directions to ensure that the steering cylinders and linkages are reaching the end of their travel. Readjust as required.

NOTE: *To double check the centering of cylinder length adjustments, make left and right turning circles at low speeds (5 mph (8 kph)). They should be within 3 to 5 feet (1 to 1.7 m) of equal if all is adjusted properly. If not, they should be re-centered and re-adjusted as required.*

REMOVAL

The steering linkage components may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. If removal of the steering cylinder is desired, follow the instructions in Section 5 - Hydraulic System.

3. Remove the steering tie rod as follows:

a. Remove the capscrew and hardened flatwasher.

b. Remove the pin retainer.

c. After carefully securing the rod so it will not move until it is lifted, remove the pins from each end of the rod.

d. Lift the rod clear of the steering arms.

4. Remove the steering arm as follows:

a. Remove the steering cylinder and yoke assembly as outlined in the information in Section 5 - Hydraulic System.

b. Remove the steering rod yoke as outlined in step 3 above.

c. Remove the tapered nuts securing to the spindle assembly.

d. Remove the steering arm. Note the side it is removed from to aid in reassembly.

INSPECTION AND REPAIR

The various steering components may be serviced as follows:

1. Inspect and repair all components in and on the steering cylinder as outlined in the information in Section 5 - Hydraulic System.

2. Inspect the self-aligning bushings for evidence of wear or damage. If the bushings need to be replaced:

a. Remove retaining ring and self-aligning bushing.

b. Install new self aligning bushing and retaining ring.

3. Inspect the studs in the spindle of evidence of wear or damage. If they need replacement:

a. Remove the old studs. Applying heat to the assembly should assist in breaking previous adhesive bonds.

b. Apply a coating of Loctite 242 (or equivalent) to the threads of the new stud that are to be installed into the spindle.

c. Install the stud until 2 +/- 1/16 inches (51 +/- 1.7 mm) remains exposed from the spindle assembly.

d. Allow the adhesive to dry before continuing.

4. Inspect all remaining components for evidence of wear or damage. Repair or replace as required.

INSTALLATION

NOTE: *Figure 2 reflects trucks equipped with expander type pins. Figure 3 reflects configurations with the pin/nut assembly.*

The steering linkage components may be installed as follows:

1. Install the steering arm as follows:

a. Select the correct assembly for the side of the axle being assembled, noting that there is a left and a right arm assembly.

b. Verify that the mating surfaces on both the arm and the spindle assembly are clean and free of grease, debris, or other foreign objects.

c. Install the properly oriented steering arm assembly.

d. Secure with the tapered nuts with the taper toward the mounting surface. Torque each sequentially to a final torque listed in the chart in Section 10 - Miscellaneous.

2. Install the steering cylinder on the steering arm as outlined in the instructions in Section 5 - Hydraulic System. Note that there should be a minimal amount of thread showing on the cylinder rod end.

3. Install the steering tie rod assembly as follows:

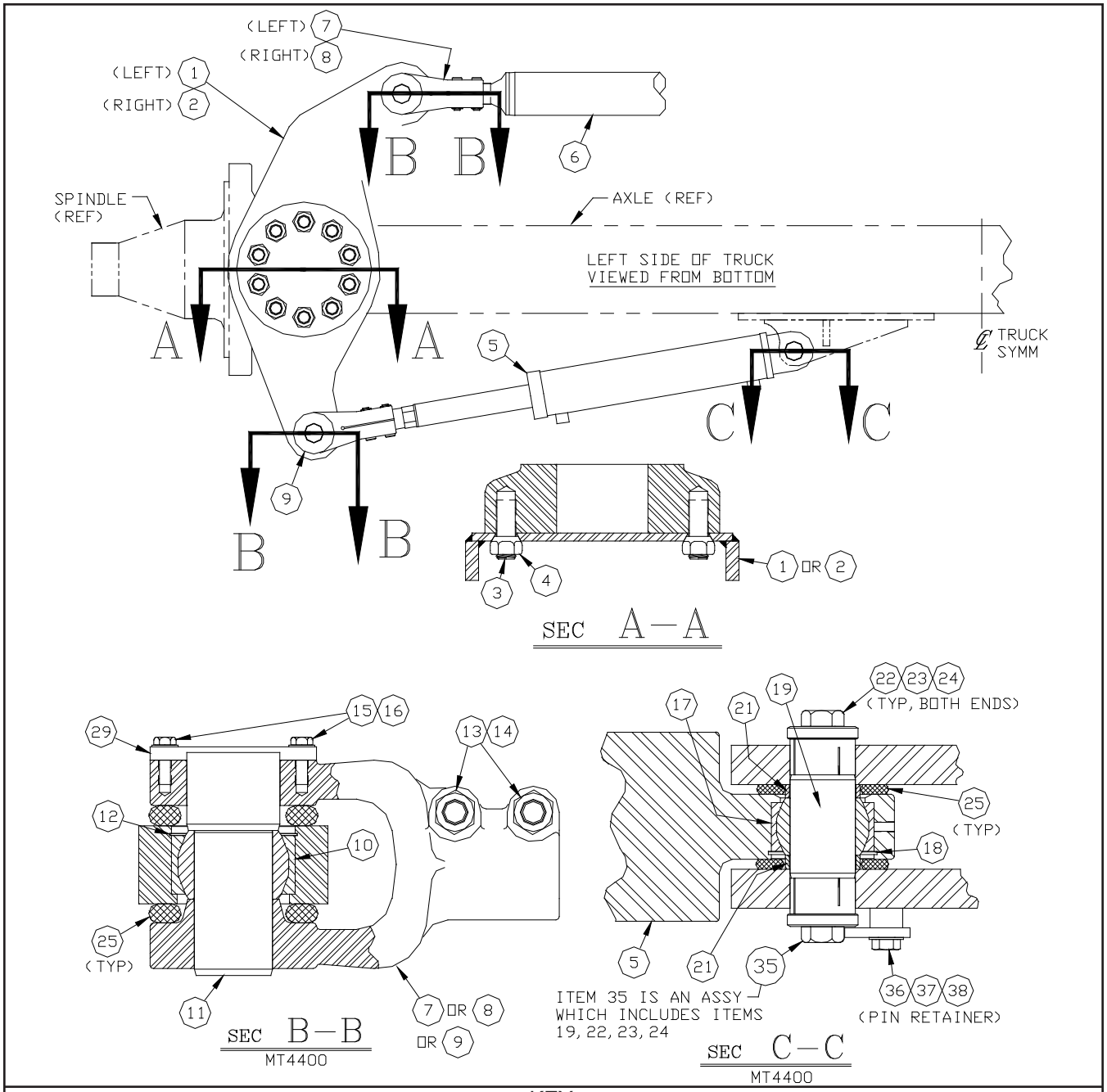
a. Position the yoke assembly over the self-aligning bushing. Note that the larger bore hole is at the top.

b. Install the pin. Secure with pin retainer, capscrews, and hardened flatwashers.

c. Repeat with the other side.

d. Install the grease/dirt seals above and below the self-aligning bushings at each end.

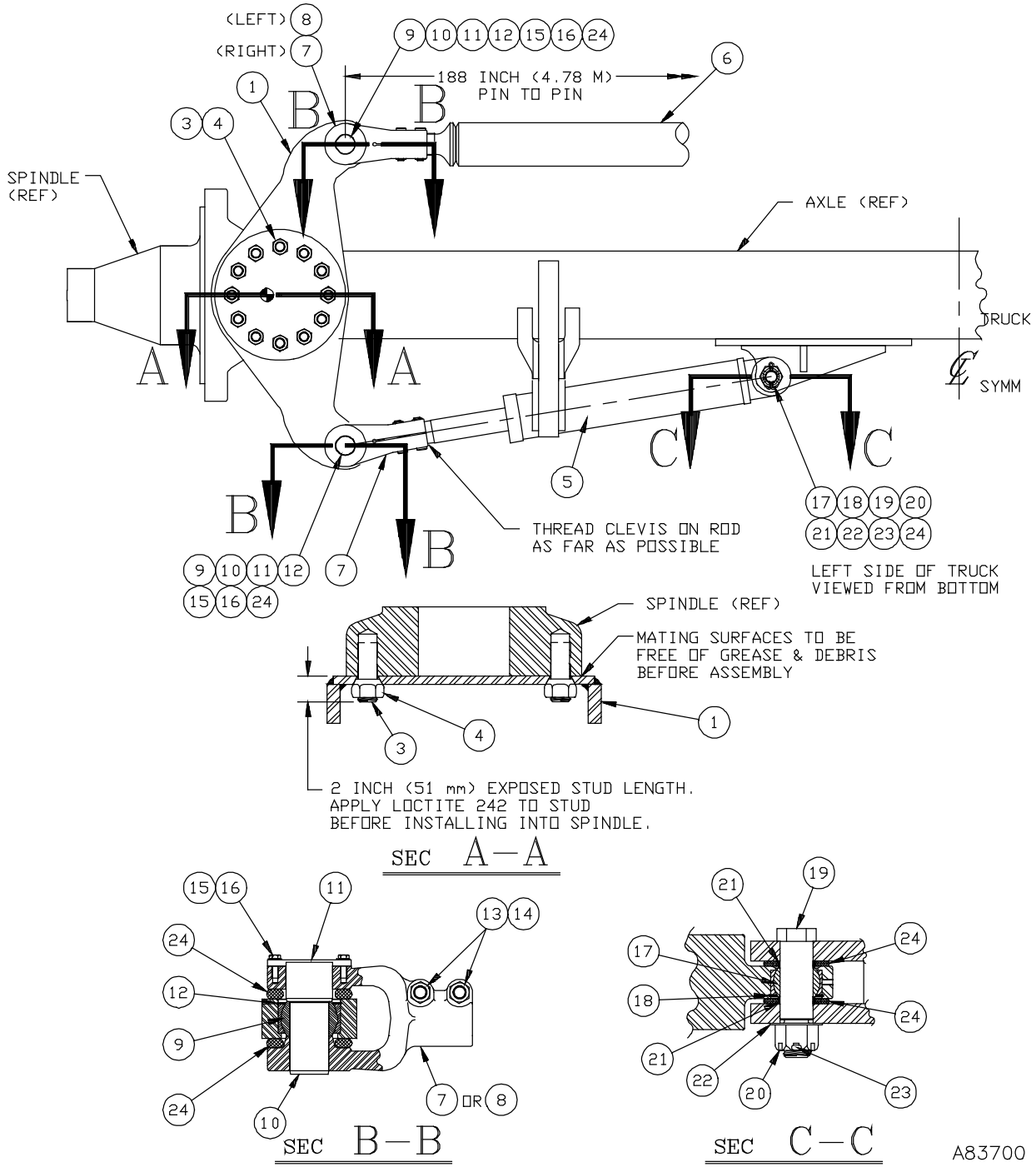
e. Adjust the tire toe-in as outlined in Maintenance and Adjustment. Tighten the clamping bolts on the various cylinders and drag links to secure the final settings.



KEY MHA86052

01.	Steering Arm	12.	Retaining Ring (Internal)	23.	Expander Washer
02.	Steering Arm	13.	Capscrew	24.	Capscrew (Metric)
03.	Stud (Grade 8)	14.	Locknut	25.	Grease Seal
04.	Taper Nose Nut (Grade 8)	15.	Capscrew	26.	– 28. Not Used
05.	Steering Cylinder	16.	Hardened Flatwasher	29.	Pin Retainer
06.	Tie Rod	17.	Self-Aligning Bushing	30.	– 34. Not Used
07.	Steering Yoke (LH Threads)	18.	Retaining Ring (Internal)	35.	Expander Pin Assembly
08.	Steering Yoke (RH Threads)	19.	Expander Pin		(Includes items 19, 22, 23, and 24)
09.	Steering Yoke	20.	Not Used	36.	Expander Pin Retainer
10.	Self Aligning Bushing	21.	Bearing Spacer	37.	Flatwasher
11.	Expander Pin	22.	Expander Sleeve	38.	Capscrew

FIGURE 2 - STEERING COMPONENT INSTALLATION ASSEMBLY – EXPANDER PIN CONFIGURATION (MHA86052)



KEY					A83700A
1.	STEERING ARM	9.	SELF ALIGNING BUSHING	17.	SELF ALIGNING BUSHING
2.	NOT USED	10.	PIN	18.	RETAINING RING (INTERNAL)
3.	STUD (GRADE 8)	11.	PIN RETAINER	19.	PIN
4.	TAPER NOSE NUT	12.	RETAINING RING (INTERNAL)	20.	SLOTTED NUT
5.	STEERING CYLINDER	13.	CAPSCREW	21.	BEARING SPACER
6.	TIE ROD	14.	LOCKNUT	22.	HARDENED FLATWASHER
7.	STEERING YOKE (R.H. THREADS)	15.	CAPSCREW	23.	COTTER PIN
8.	STEERING YOKE (L.H. THREADS)	16.	HARDENED FLATWASHER	24.	GREASE SEAL

FIGURE 3 - STEERING COMPONENT INSTALLATION ASSEMBLY – STRAIGHT PIN/NUT CONFIGURATION

AXLEBOX

DESCRIPTION AND LOCATION (Figure 1)

The axlebox is the large housing located at the rear of the truck directly under the frame and dump body, which serves as the mounting for the wheelmotors. It is made of high strength steel and is attached to the frame at four locations.

The nosecone bearing assembly at the front of the axlebox serves as one attachment point. It consists of a large spherical bearing, which attaches to the lower crossmember on the main frame.

A radius or panhard rod connects the upper axlebox to the frame. Its purpose is to limit lateral movement of the axlebox while permitting vertical movement and oscillation.

The rear of the axlebox connects to the lower portion of the rear suspension assemblies. The upper portion of the rear suspensions attaches to the rear of the main frame.

OPERATION

The axlebox assembly serves as a mounting support for the electric wheelmotor assemblies and rear suspensions, a mounting point and protection for necessary brake and drive system components, and as a plenum chamber for cooling air to the wheelmotor assemblies.

During operation, the acceleration, retarding, and braking forces generated by the rear wheelmotors are transmitted to the truck through the nosecone portion of the axlebox.

The radius or panhard rod allows vertical motion and oscillation of the axlebox especially when the truck is loaded, but limits lateral movement.

The rear suspension axlebox connections limit but allow some vertical movement of the axlebox. Shock caused during vehicle operation is absorbed in the suspension.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction brake system.

2. Clean the assembly.

3. Verify that the axlebox access door is in good condition, and forms a good seal. Repair or replace as required. Use a 3M Rubber Adhesive (or equivalent) to attach the rubber seal to the inside of the door.

4. Inspect axlebox structure for evidence of damage.

5. Every 500 hours visually inspect the following for damage, excessive wear, proper installation and lubrication, and freedom from contamination with dirt or other material.

a. Nosecone bearing cap, capscrews, and washers

b. Radius Rod

c. Suspensions and mounts

d. Grease seals

6. Every 2500 hours check nosecone pivot bearing clearance as follows:

a. Be certain the nosecone bearing cap attaching bolts are properly torqued.

b. Locate the jacks aft of the rear wheel centerline as shown in Figure 1. Jack the truck until the rear tires clear the ground. Secure in place with adequate blocking.

c. Attach two dial indicators to the axlebox as indicated in Figure 1, using magnetic attaching blocks. Orient the indicators to measure vertical clearance.

d. Measure bearing vertical clearance by raising and lowering with a small jack under the nosecone assembly. After determining the clearance, use the jack to center the bearing.

e. Reposition the dial indicators to measure horizontal clearances.

f. Using blocking and a pry bar, port-a-power or other suitable device, move the nosecone from side to side to determine horizontal clearance.

NOTE: *When bearing vertical clearance exceeds 0.125 inch (3.2 mm) or horizontal clearance exceeds 0.437 inch (11.1 mm) the bearing should be replaced as outlined in the instructions later in this module.*

g. Remove all measuring equipment.

h. Remove jacks and blocking and lower to the ground.

REMOVAL (Figure 1)

The axlebox may be removed as follows:

NOTE: *If only the nosecone pivot bearing is being removed or replaced, it is not necessary to remove the radius or panhard rod, suspensions, wheelmotors, or other components. Verify that the D-rings and suspensions do not bind during this procedure.*

NOTE: *The axlebox assembly may be removed with or without the wheelmotors installed. If it is necessary or desirable to remove the wheelmotors, follow the procedures outlined in Section 7 -Running Gear. Additional information on the brakes and other hardware is contained in Section 5 -Hydraulic System, and Section 8 - Brake System.*

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction brakes and rear wheels.

2. Jack or lift the truck until the tires are clear of the ground.

3. Support the frame at the dump cylinder attachment points. Support the axlebox adequately to allow controlled movement, without allowing it to move by itself.

NOTE: *It is recommended that the assembly be lifted at the "D"-rings assembly point with clamps, slings, or other suitable means.*

4. If desired, (if the axlebox is to be removed) remove the tires and wheelmotors as outlined in the instructions in Section 7 - Running Gear.

5. Disconnect all cables and hoses from the axlebox and pull them through their entry holes. Unclamp them from the nose portion of the axlebox.

⚠ DANGER

The hydraulic brake system is a high pressure system. Relieve all pressure before disconnecting any lines.

NOTE: *Label each cable and hose to assist in the assembly procedures. Cap or plug all openings.*

6. Loosen the clamps on the cooling air inlet hose on the axlebox nose. Remove the flexible air coupling.

7. Support the axlebox adequately to hold the weight. Disconnect the rear suspensions as outlined in the instructions in Section 7 - Running Gear.

NOTE: *Total removal of the suspensions will aid in the removal of the axlebox assembly.*

8. Remove the radius or panhard rod assembly by removing the retainers and the pins securing to the frame and axlebox.

NOTE: *The rod must be level when removing.*

9. Remove the capscrews in the bearing cap.

10. Using a come-along on the eye of the bearing cap for support, remove the cap.

NOTE: *Handle the cap with care to prevent the bearing from falling out or being damaged.*

11. Using cables and the come-along, lower the nose of the axlebox, then move the entire axlebox down and rearward out.

NOTE: *If only the nosecone pivot bearing is being replaced, it is necessary to move the axlebox to the rear only enough to gain operating clearance.*

12. Remove all remaining components. Secure the axlebox to prevent movement for safe repair.

INSPECTION AND REPAIR

The axlebox may be inspected/repaired as follows:

1. Inspect all structural components for evidence of wear or damage. Repair or replace as required using the welding procedures outlined in Section 10 - Miscellaneous.

2. Inspect the nosecone pivot bearing surfaces for evidence of wear or damage. Repair or replace as required.

NOTE: *The top and bottom sections of the nosecone pivot bearing are a matched set.*

3. Inspect all remaining seals as required for evidence of wear or damage. Repair or replace as required using 3M Rubber Adhesive (or equivalent) to attach.

4. Inspect the self-aligning bushings in the panhard or radius assembly and the suspension mounting points for evidence of wear or damage. They may be changed as follows:

a. Removing the retainers and bearings using air arc, grinding or other suitable means.

b. Inspect the inner bore of each sleeve in the assemblies for evidence of wear or damage. It must be free of defects and within 0.001 inch (0.025 mm) of round. Small ridges or grooves may be repaired with emery cloth. Otherwise the sleeve should be replaced. This may be done as follows:

(1) If so equipped, carefully remove the damaged sleeve, exercising care not to damage the bore in the frame/front axle.

(2) Inspect the bore in the frame/front axle for evidence of wear or damage. It must be free of defects and within 0.001 inch (0.025 mm) of round. Small ridges or grooves may be repaired with emery cloth.

NOTE: *If defects are found or the bore is not within tolerances, contact the local Unit Rig Service Representative for detailed repair recommendations.*

(3) Install the new sleeves as follows:

IMPORTANT: *Sleeves with high interference fit may be installed using either of the methods outlined here. The liquid nitrogen method typically provides a more consistent installation.*

Liquid Nitrogen Method

⚠WARNING

Due to the cold temperatures of both the liquid nitrogen cooling medium and the parts being cooled, it is important to take extra precautions that neither comes in contact with skin, clothing, or other items during the entire procedure.

(a) Using all of the appropriate precautions because of the cold temperatures of the materials involved, gently immerse the sleeve into a pool of liquid nitrogen.

(b) After allowing sufficient time to fully cool, carefully remove from the liquid nitrogen and install in the appropriate bore properly oriented.

(c) Allow the sleeve to warm slowly and evenly to ambient temperature, making sure that the retaining rings may be properly installed.

IMPORTANT: *The use of externally applied heat to speed up the process may result in uneven cooling and warping of or damage to the sleeve.*

Heating Method

⚠WARNING

Due to the cold temperatures of both the liquid nitrogen cooling medium and the parts being cooled and the heat applied to the receiving component area, it is important to take extra precautions that neither comes in contact with skin, clothing, or other items during the entire procedure.

(a) Using all of the appropriate precautions because of the cold temperatures of the materials involved, carefully cool the sleeve to a temperature of –40° to –70° F (-40° to –57° C).

(b) Evenly heat the bore into which the sleeve is to be installed to 300° to 350° F (150° to 175° C).

IMPORTANT: *Heat the massive side of the lug additionally to ensure that the bore is heated and expanded evenly.*

(c) Once both components are at the proper temperatures, carefully remove the sleeve from the cooling medium and install in the appropriate bore properly oriented.

(d) Allow the sleeve to warm slowly and evenly to ambient temperature, making sure that the retaining rings may be properly installed.

IMPORTANT: *The use of externally applied heat to speed up the process may result in uneven cooling and warping of or damage to the sleeve.*

(e) Verify that with the sleeve properly installed, it is within 0.001 inch (0.025 mm) of round. Small ridges or grooves may be repaired with emery cloth.

c. Install the self-aligning bushings as follows:

IMPORTANT: *Steel spherical bearings should not come in direct contact with dry ice and should not be immersed in liquid nitrogen. Either of these actions could result in the change of the metallurgical character of the bearing affecting subsequent fit and operation.*

⚠WARNING

Due to the cold temperatures of both the dry ice or other cooling medium and the parts being cooled, it is important to take extra precautions that neither comes in contact with skin, clothing, or other items during the entire procedure.

(1) Using all of the appropriate precautions because of the cold temperatures of the materials involved, carefully cool the bearing assembly to a temperature of –40° to –70° F (-40° to –57° C).

(2) Once both components are at the proper temperatures, carefully remove the bearing from the cooling medium and install properly oriented into the appropriate bore.

(3) Allow the bearing assembly to warm slowly and evenly to ambient temperature, making sure that the retaining rings may be properly installed.

IMPORTANT: *The use of externally applied heat to speed up the process may result in uneven cooling and warping of or damage to the bearing or bore.*

(4) Secure with the new retainers (7) using care not to contaminate the new bushings.

INSTALLATION

The axlebox may be installed as follows:

1. Verify that the bearing and threaded surfaces are clean and free of damage or burrs.

2. Install the lower nosecone pivot bearing section in the nosecone.

3. Insert the upper nosecone pivot bearing section in the bearing cap assembly.

4. Liberally coat the surfaces of the spherical inner bearing with clean chassis grease.

5. Move the axlebox into position.

6. Install the upper bearing cap, aligning the two sections with the coiled spring or roll pin (35) (on trucks so equipped).

a. Make sure that on trucks so equipped the bearing is secured with the anti-rotational stop (34).

b. Secure with hardened flatwashers and Grade 8 capscrews coated with Loctite 242 (or equivalent).

c. Tighten in 50 ft-lbs. (68 Nm) increments using a standard cross tightening technique to a final torque of 280 ft-lbs. (380 Nm).

NOTES: *It is recommended that a bead of RTV or equivalent be spread completely around the edges of the mating surfaces on the two halves of the bearing cap to prevent the ingestion of dirt or other contamination. Use care not to allow the material to enter the bearing area so that it might be drawn into the bearing assembly.*

7. Install the nosecone grease seal as shown in Figure 1 using 3M Rubber Adhesive (or equivalent).

a. Make sure to position to the rear of the crosstube:

(1) Splice in the seal.

(2) Screw in the clamp.

b. Make sure that the exposed edge on the rubber seal is oriented downward to avoid the ingress of water and other contamination.

8. Reinstall all hoses, cables, etc. removed previously. Verify all items entering the axlebox are sealed on both the inside and outside.

9. Install the panhard or radius rod as follows:

a. Position the rod in the near horizontal position.

b. Position the axlebox to align the rod assembly with the mounting points in the frame and axlebox.

c. Install the pin on each end of the rod installing the neoprene rings on each side of the self-aligning bushings.

d. Secure each pin with the retainer, capscrews, and flatwashers.

10. Install the rear suspensions as outlined in the instructions in Section 7 - Running Gear.

11. Install the wheelmotors and tires as outlined in the instructions in Section 7 - Running Gear.

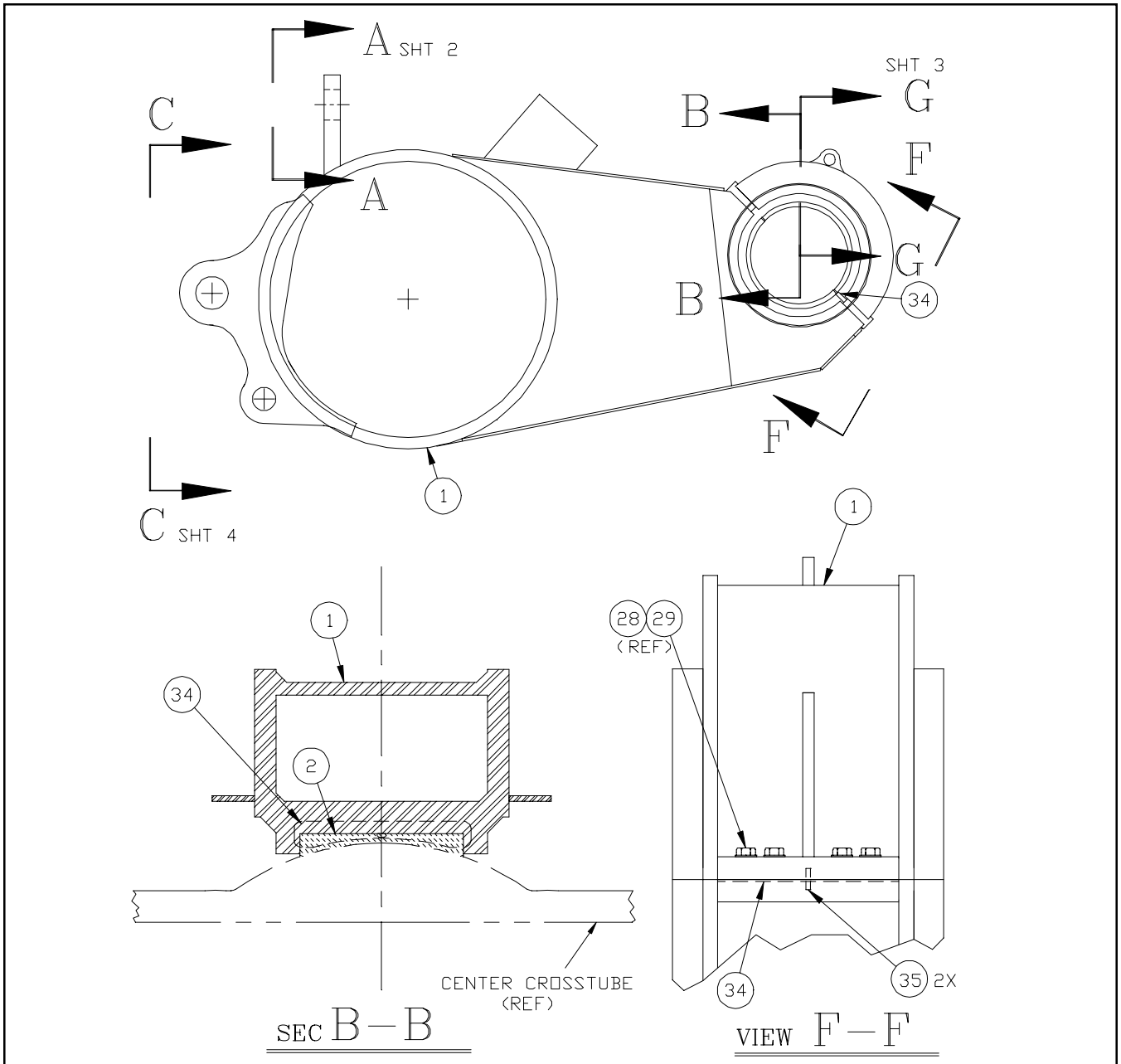
12. Connect all remaining lines.

13. Lubricate all components.

14. Lower the unit to the ground.

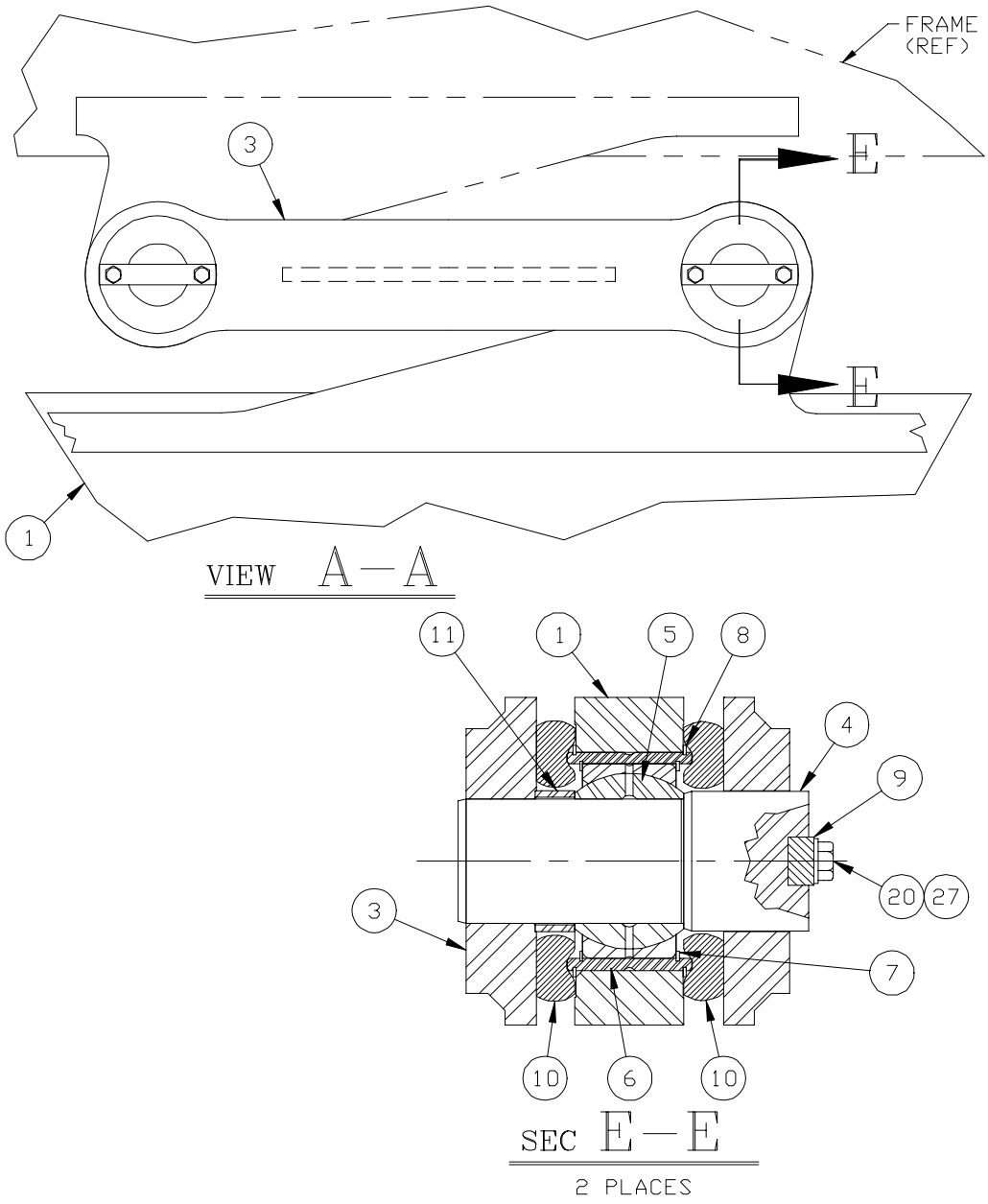
15. Check or test each system as outlined in the appropriate instructions prior to operating the truck.

16. Recheck the torque on the nosecone bearing cap capscrews after the first 125 hours of operation each time the bolts are removed. Then return to the normal 500 hour inspection, 2500 hour retorque routine.



KEY					A85221
01.	Axlebox	13.	Adjustable Clamp	25.	Acorn Nut
02.	Nosecone Pivot Bearing	14.	Banding Clamp	26.	Cellular Rubber Seal
03.	Radius (Panhard) Rod	15.	Rubber Adhesive	27.	Capscrew
04.	Pin	16.	Access Cover Door	28.	Capscrew
05.	Self Aligning Bushing	17.	Hinge Bracket	29.	Hardened Flatwasher
06.	Bearing Bore Sleeve	18.	Capscrew	30.	Not Used
07.	Internal Retaining Ring	19.	Locknut	31.	Not Used
08.	External Retaining Ring	20.	Hardened Flatwasher	32.	Not Used
09.	Pin Retainer	21.	Eye Bolt	33.	Heavy Duty Hose Clamp
10.	Dirt Ring	22.	Eye Bracket	34.	Anti Rotational Key
11.	Bearing Spacer	23.	Clevis Pin	35.	Roll/Coil Spring Pin
12.	Bearing Seal	24.	Speed Ball Handle		

FIGURE 1 - AXLEBOX ASSEMBLY (A85221, SHEET 1 OF 4)



KEY A85221

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02.	Nosecone Pivot Bearing	14.	Banding Clamp	26.	Cellular Rubber Seal
03.	Radius (Panhard) Rod	15.	Rubber Adhesive	27.	Capscrew
04.	Pin	16.	Access Cover Door	28.	Capscrew
05.	Self Aligning Bushing	17.	Hinge Bracket	29.	Hardened Flatwasher
06.	Bearing Bore Sleeve	18.	Capscrew	30.	Not Used
07.	Internal Retaining Ring	19.	Locknut	31.	Not Used
08.	External Retaining Ring	20.	Hardened Flatwasher	32.	Not Used
09.	Pin Retainer	21.	Eye Bolt	33.	Heavy Duty Hose Clamp
10.	Dirt Ring	22.	Eye Bracket	34.	Anti Rotational Key
11.	Bearing Spacer	23.	Clevis Pin	35.	Roll/Coil Spring Pin
12.	Bearing Seal	24.	Speed Ball Handle		

FIGURE 1 - AXLEBOX ASSEMBLY (A85221, SHEET 2 OF 4)

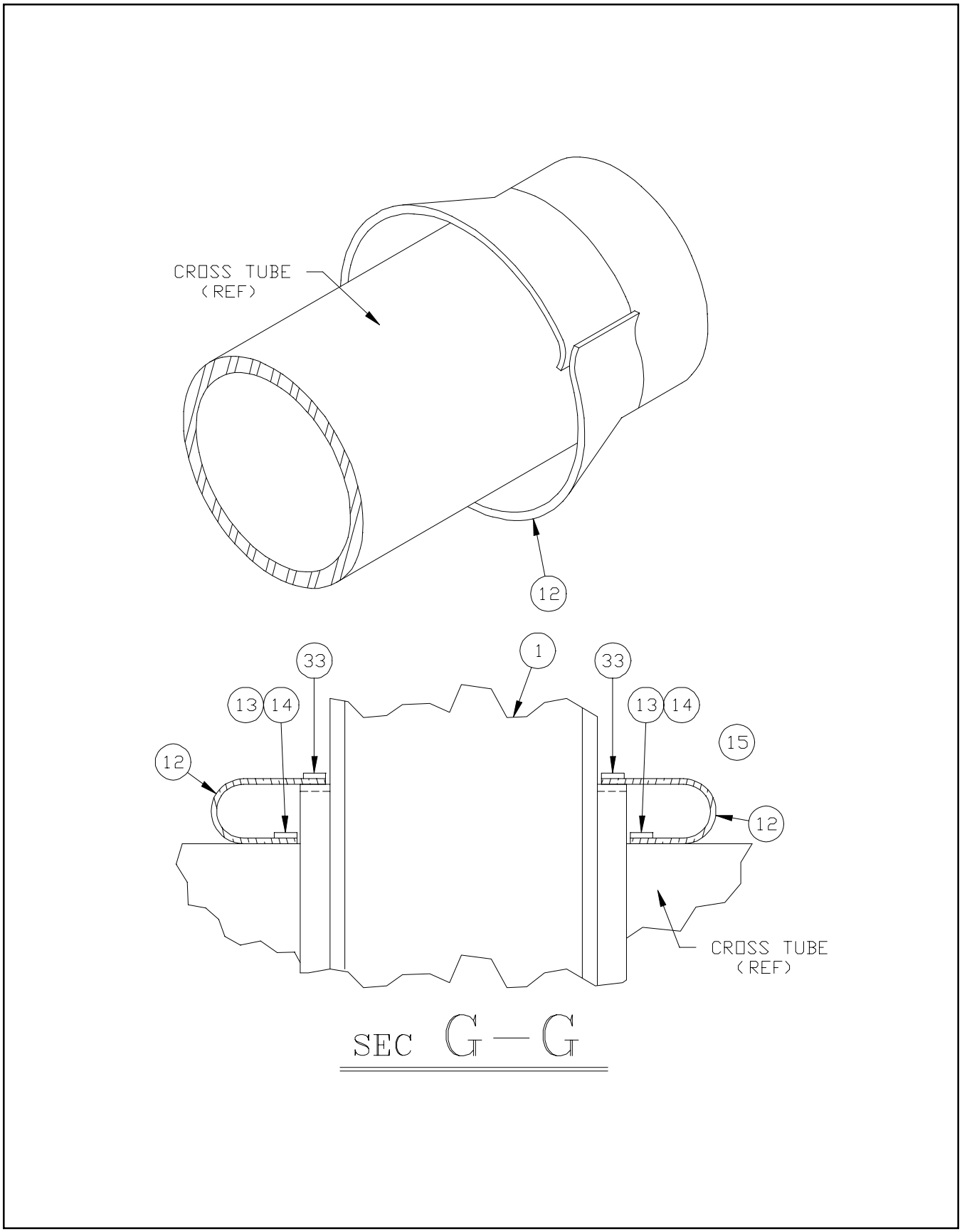
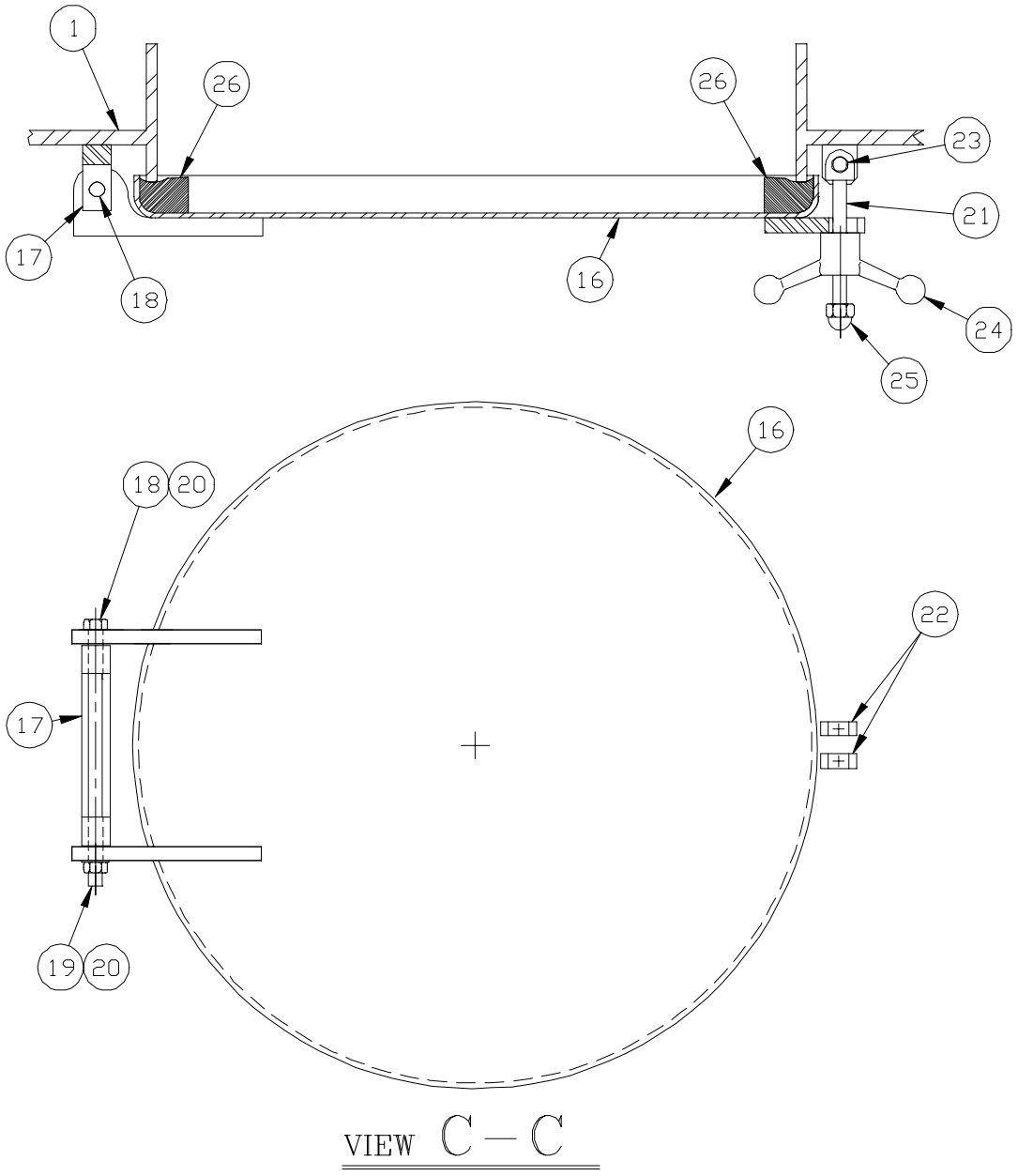


FIGURE 1 - AXLEBOX ASSEMBLY (A85221, SHEET 3 OF 4)



VIEW C – C

KEY A85221

01.	Axlebox	13.	Adjustable Clamp	25.	Acorn Nut
02.	Nosecone Pivot Bearing	14.	Banding Clamp	26.	Cellular Rubber Seal
03.	Radius (Panhard) Rod	15.	Rubber Adhesive	27.	Capscrew
04.	Pin	16.	Access Cover Door	28.	Capscrew
05.	Self Aligning Bushing	17.	Hinge Bracket	29.	Hardened Flatwasher
06.	Bearing Bore Sleeve	18.	Capscrew	30.	Not Used
07.	Internal Retaining Ring	19.	Locknut	31.	Not Used
08.	External Retaining Ring	20.	Hardened Flatwasher	32.	Not Used
09.	Pin Retainer	21.	Eye Bolt	33.	Heavy Duty Hose Clamp
10.	Dirt Ring	22.	Eye Bracket	34.	Anti Rotational Key
11.	Bearing Spacer	23.	Clevis Pin	35.	Roll/Coil Spring Pin
12.	Bearing Seal	24.	Speed Ball Handle		

FIGURE 1 - AXLEBOX ASSEMBLY (A85221, SHEET 4 OF 4)

REAR SUSPENSION - NITROGEN/OIL

DESCRIPTION AND LOCATION (Figure 3)

This version of the BUCYRUS® nitrogen/oil rear suspension is identified externally by the location of the charge ports on the side of the outer tube assembly. It is a cylindrical, telescoping unit that suspends the rear part of the truck. The suspensions are mounted on the rear of each rail of the main frame, directly under the dump body and above the rear of the axlebox assembly.

OPERATION

The rear suspensions consist of two major assemblies that move in relationship to each other. The outer tube assembly is pivoted on the main frame. The inner tube, attached to the axlebox at its lower end, slides inside the outer tube.

The rear suspensions serve two separate functions - spring and shock absorber. The spring function is provided by the compression of the nitrogen gas. The shock absorber function is handled by controlling the flow of oil between the inner and outer chambers in the suspensions.

In a static condition, compressed nitrogen gas in the internal cavity creates sufficient force to support the truck. When the tire strikes something (a hole, rock, etc.) the resultant forces cause the inner tube to slide upward in the outer tube. This compresses the nitrogen, absorbing the impact energy. At the same time, oil flows through the passages in the piston rod wall from the main chamber to the dampening chamber (annular volume between the piston rod outside diameter and the outer tube inner diameter).

After the impact has been absorbed, the increased gas pressure begins to force the inner tube downward to its original position. As it does, oil flows from the dampening chamber back into the main chamber. However, a portion of the passages are now closed, restricting flow in this direction. This difference in flow characteristics provides dampening/rebound control.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Clean the unit. Inspect for evidence of wear, damage, or leakage especially in the area of the exposed portion of the inner tube and charging valves. Repair or replace as required.

NOTE: *An optional split bellows assembly with a zipper is available that allows its replacement without removing the suspension or mounting pins.*

2. Check all retaining hardware for evidence of damage or looseness. Repair or replace immediately if found loose, defective, or broken.

WARNING

Prior to loosening any capscrews, always jack and support the truck to remove its weight from the suspension, release all gas pressure and secure the suspension by appropriate means. Under some conditions, these members support the weight of the truck and failure to remove the weight and pressure could result in personal injury or equipment damage.

3. Inspect the exterior of the suspension for evidence of fluid leakage. If there is leakage, repair or replace as required and recharge with oil as outlined in the procedures later in these instructions.

NOTE: *For detailed instructions on checking and/or charging the suspension oil level, refer to the procedures later in this portion of the module.*

4. Check the relative operating condition of the suspension as follows:

a. Operate the truck for a sufficient period of time to allow both suspensions to equalize at normal operating temperatures.

b. With the empty truck resting on a smooth, flat surface, measure the distance between the center of the upper and lower mounting pins as shown in Figure 1. The measurement should be approximately (+/- 1/2 inch (13 mm)):

MK30B	58-3/4 inches (1 495 mm)
MT 2700/3000	58-3/4 inches (1 495 mm)
MT 3300/3300AC	58-3/4 inches (1 495 mm)
BD 220	58-3/4 inches (1 495 mm)
MT 3600B	67-7/16 inches (1 715 mm)
BD 240/270	67-7/16 inches (1 715 mm)

MT 3700B/3700AC	67-7/16 inches (1 715 mm)
MT 4000	67 inches (1 705 mm)
MT 4000AC	61-7/8 inches (1 570 mm)
MT 4400/4400AC	61-7/8 inches (1 570 mm)
MT 5500/5500B	61-7/8 inches (1 570 mm)
MT 6300AC	61-7/8 inches (1 570 mm)

If the suspension is not within these limits, check and adjust the nitrogen precharge pressure as outlined in the procedures that follow later in this section.

Items that may indicate that the suspension may now or will soon require servicing internally include:

(1) Evidence of oil leakage around the suspension.

(2) Frequent changes in ride height requiring recharging with nitrogen gas.

NOTES:
1. A decrease in the ride height usually accompanies a loss of gas. Loss of gas can only occur around the charge valve or BUCYRUS® Weigh or Two-Speed Overspeed System transducers.
2. Increased deflection with a normal ride height indicates a loss of oil.

(3) Harsh or bouncy ride are indications that the suspensions are repeatedly operating at the end of their travel strokes.

5. On trucks equipped with either or both the *BUCYRUS*® Weigh and Two-Speed Overspeed Systems, visually inspect all components, and wiring for evidence of wear or damage. Repair or replace as required.

CHARGING PROCEDURE - NITROGEN/OIL REAR SUSPENSION

NOTE: *The suspension is to be charged with nitrogen only after being installed on a truck. Prior to removing from a truck, the nitrogen charge should be decreased to less than 100 psi (690 kPa) and blocked in the extended position.*

The main bodies of the suspensions are to be charged with dry nitrogen only. Use of oxygen, compressed air or other gases may result in a violent explosion.

The struts contain gas and oil under high pressure. Extra care must be taken when adjusting or servicing the struts. Since internal pressures can exceed 2000 psi (13 800 kPa), it is important to open the charge valves slowly and allow the pressures to be fully released before working on the struts. Also only dry nitrogen gas should be used for charging.

CHARGING WITH OIL (Original or refill after significant servicing)

NOTES:
1. This procedure is recommended if the suspensions have experienced a fluid loss due to some other reason than an external leak. If an external leak develops, the suspension should be removed and replaced. Return the suspensions to BUCYRUS® for repair as unauthorized repair may affect their warranty.
2. To modify or customize ride characteristics, contact your local BUCYRUS® representative for detailed instructions, detailing the suspension part number, mine location, and truck model and serial number.
3. Suspensions are delivered with the proper amount of oil and should not require checking when new or rebuilt.

The oil level of the suspensions mounted on a truck may be checked and adjusted as follows:

NOTE: *During truck operation, the nitrogen precharge in the strut tends to mix with the oil. This appears as an oily froth that comes out of the suspension when the nitrogen pressure is released. To accurately measure the oil level, the nitrogen must be removed from the oil. This is done by drawing a vacuum on the gas portion of the suspension assembly or by supporting the frame adequately with blocking and opening and leaving open the upper charge valves for 24 hours. The only time that this need be done is if external leakage is evident (indicating the need for repair) or when the empty to loaded deflection seems excessive.*

NOTE: *On trucks equipped with later versions of the suspension, a setscrew/drain plug combination is installed at the bottom to allow the easy draining of*

the oil if so desired. Always release all residual pressure in the system prior to beginning to drain the suspensions by any means. If the plugs are removed, they should be reinstalled as outlined in the Assembly instructions in this publication.

NOTE: *The procedure assumes that the suspensions are mounted on a truck. If not, suitable support and means of securing the suspensions should be in place before proceeding.*

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Raise the truck until the suspensions are fully extended. Secure in this position with suitable blocking.

MK30B	62-3/8 inches (1 585 mm)
MT 2700/3000	62-3/8 inches (1 585 mm)
MT 3300/3300AC	62-3/8 inches (1 585 mm)
BD 220	62-3/8 inches (1 585 mm)
MT 3600B	71-1/8 inches (1 807 mm)
BD 240/270	71-1/8 inches (1 807 mm)
MT 3700B/3700AC	71-1/8 inches (1 807 mm)
MT 4000	72 inches (1 830 inches)
MT 4000AC	64-7/8 inches (1 650 mm)
MT 4400/4400AC	64-7/8 inches (1 650 mm)
MT 5500/5500B	64-7/8 inches (1 650 mm)
MT 6300AC	64-7/8 inches (1 650 mm)

3. Remove the protective covers over the charge valves and carefully open both valves, releasing the gas charge.

4. Connect a vacuum pump to one of the charge valve assemblies to allow a vacuum to be drawn.

NOTE: *To draw this vacuum, special pneumatic valves and electric pump assemblies are available from BUCYRUS®.*

5. Verify that the other charging valve is closed.

6. Start the vacuum process and monitor its progress until all gas has been extracted. This is indicated by the oil in the suspension turning a smoother, darker color.

NOTES:

1. Do not allow liquid oil to be drawn from the suspension.

2. Typically this process will take approximately 15 minutes (with a vacuum of 29 inches Hg (98 kPa)) to 30 minutes (with a vacuum of 10 inches Hg (34 kPa)).

7. Stop the vacuum process.

8. Remove the blocking and slowly lower the truck frame until the distance between the upper and lower mounting pins are approximately (+/- 1/2 inch (13 mm)):

MK30B	56-1/8 inches (1 425 mm)
MT 2700/3000	56-1/8 inches (1 425 mm)
MT 3300/3300AC	56-1/8 inches (1 425 mm)
BD 220	56-1/8 inches (1 425 mm)
MT 3600B	62-5/8 inches (1 590 mm)
BD 240/270	62-5/8 inches (1 590 mm)
MT 3700B/3700AC	62-5/8 inches (1 590 mm)
MT 4000	64-1/2 inches (1 640 mm)
MT 4000AC	59-5/8 inches (1 515 mm)
MT 4400/4400AC	59-5/8 inches (1 515 mm)
MT 5500/5500B	59-5/8 inches (1 515 mm)
MT 6300AC	59-5/8 inches (1 515 mm)

9. Release any residual gas pressure in the suspension as outlined previously.

10. Remove the weigh system transducer port adapter fitting near the top of the suspension and replace with the appropriate charging adapter.

11. Open the port and observe if oil flows from the vent hole in the adapter. If not, the oil level is low and charging as outlined below is required.

12. Attach the oil charging kit to this port.

13. Connect the suction line of the charging pump to a supply of clean, good quality transmission fluid (Conoco Hydroclear Power Tran or equivalent).

The approximate volumes of oil required for the initial filling of each suspension is:

MK30B	7.8 gallons (29.5 liters)
MT 2700/3000	7.8 gallons (29.5 liters)
MT 3300/3300AC	7.8 gallons (29.5 liters)
BD 220	7.8 gallons (29.5 liters)
MT 3600B	10.5 gallons (39.8 liters)
BD 240/270	10.5 gallons (39.8 liters)
MT 3700B/3700AC	10.5 gallons (39.8 liters)
MT 4000AC	8.9 gallons (33.7 liters)
MT 4400/4400AC	8.9 gallons (33.7 liters)
MT 5500/5500B	12.5 gallons (47.3 liters)

MT 6300AC	12.5 gallons (47.3 liters)

NOTE: *In arctic conditions it is recommended that a synthetic fluid (Conoco Syncon Synthetic R & O or equivalent) be substituted. The fluid should have the properties:*

ISO 46 Viscosity Grade

-70° F (-55° C) Pour Point

PAO Synthetic – May be used with common seals.

14. Connect the charge kit pump to an air supply source, 90 psi (620 kPa) minimum.

15. Start the charging pump and add oil until it comes out of the drain hose. Stop the pump.

NOTE: *During the filling operation, loosen the charge valve body slightly to remove pressure and to check the oil level. Oil and gas under minimum pressure will escape through the vent hole.*

16. When the process is complete, remove the oil charging kit and charging fittings.

17. Reinstall the weigh system transducer port adapter previously removed with new sealing washers. Torque to 14 +/- 1 ft-lb (19 +/- 1 Nm).

18. Charge the suspensions with nitrogen as outlined in the separate procedures.

CHARGING THE SUSPENSION WITH GAS (NITROGEN)

The suspensions are only to be charged with nitrogen to a pressure of more than 100 psi (690 kPa) when mounted on a truck. Use only dry nitrogen. Do not use oxygen or compressed air as their use or other gases may result in a violent explosion.

IMPORTANT: *The supply cylinder must be of the type that vaporizes the nitrogen when it is withdrawn. Do not charge with liquid nitrogen or any other gas.*

NOTE: *Use a gas regulator on the nitrogen bottle (not furnished with the BUCYRUS® charging kit) to protect the pressure gauge. An accurate reliable pressure gauge is essential to proper suspension adjustment.*

NOTE: *When removing the protective caps from the charging valves, allow for the residual gas pressure, if present, to escape before fully removing the cap.*

1. Park the truck in a SAFE POSITION in a level place. It must be secured by means other than the truck's friction brake system.

NOTE: *All dirt and other foreign material should be removed from the frame and dump body before charging the suspensions.*

2. Carefully remove the charging valve protective covers, as residual gas pressure may be present.

3. Connect the gas charging kit to the charging valves on the suspensions (with the shut-off valves closed) and to the regulator on the nitrogen supply bottle.

a. Connect the shorter hose assemblies to the two suspensions at the charge valves.

b. Connect the longer supply hose to the nitrogen supply.

4. Adjust the pressure regulator to approximately 600 psi (4 140 kPa).

NOTE: *Use care to protect the pressure gauge against over-pressurization. Pressures in excess of 2000 psi (13 790 kPa) are easily obtainable.*

5. Open the charge valve and charge the suspension until the distance between the centers of the upper and lower mounting pins is approximately (+/- 1/2 inch (15 mm)):

NOTES:

1. During the filling process, gas should be added slowly enough and the flow stopped periodically to allow the suspensions to equalize. The exact process will vary slightly with equipment, material, and operator.

2. If the rear suspensions are being charged together, open the shut off valves first, then the gas pressure regulator.

MK30B	58-3/4 inches (1 495 mm)
MT 2700/3000	58-3/4 inches (1 495 mm)
MT 3300/3300AC	58-3/4 inches (1 495 mm)
BD 220	58-3/4 inches (1 495 mm)
MT 3600B	67-7/16 inches (1 715 mm)
BD 240/270	67-7/16 inches (1 715 mm)

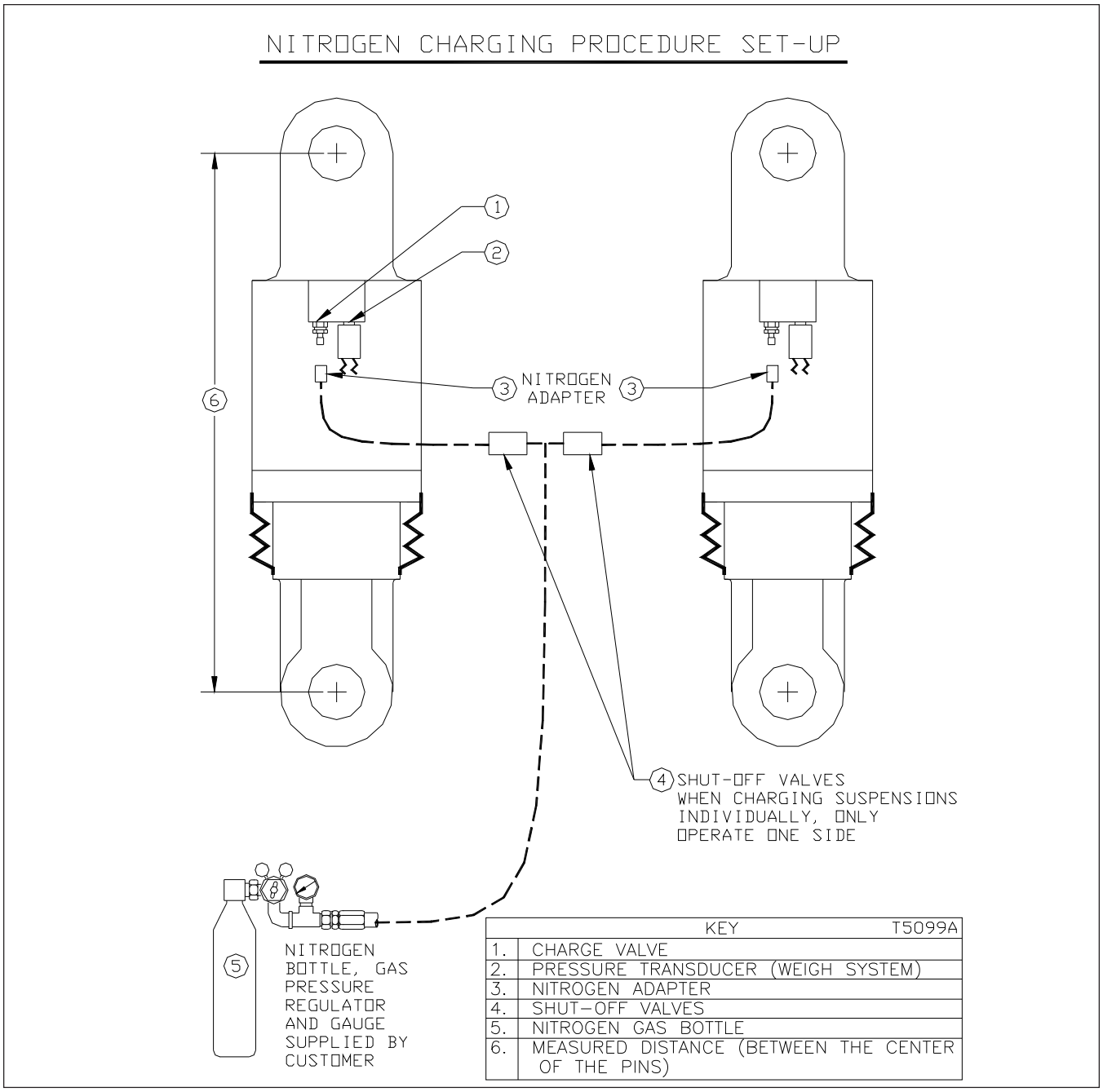


FIGURE 1 - SUSPENSION CHARGING EQUIPMENT AND INFORMATION

MT 3700B/3700AC	67-7/16 inches (1 715 mm)
MT 4000	67 inches (1 705 mm)
MT 4000AC	61-7/8 inches (1 570 mm)
MT 4400/4400AC	61-7/8 inches (1 570 mm)
MT 5500/5500B	61-7/8 inches (1 570 mm)
MT 6300AC	61-7/8 inches (1 570 mm)

NOTES:

1. If the resulting empty ride height is not correct, repeat the above procedure raising or lowering the charge pressure in 20 psi (140 kPa) increments. The important parameter is to charge the suspensions to provide the correct empty ride height.

2. If the truck will be operated in ambient conditions significantly colder than that in the work area, it is recommended that the adjusted empty truck ride height be increased 1/2 to 1 inch (12 to 25 mm) to compensate for the effects to the reduced temperatures.

6. Close the individual shut off valves and then the gas pressure regulator.

7. Remove the charging equipment and check for leaks using a soap solution.

NOTE: *If a leak is found in the charge valve core area:*
1. Check the torque on the valve core. It should be torqued to 3 to 4 in-lb (0.35 to 0.45 Nm).
2. If this does not stop the leak it may be necessary to check the valve core area for damage or contamination or replace the valve core. It is important that all pressure in the suspension be relieved prior to removal of the valve core using the charging unit.

8. Install the protective covers. Torque to 40 to 50 in-lb (4.5 to 5.5 Nm).

9. Remove the blocking and lower the truck to the ground.

10. Operate the truck for approximately 24 hours, and then repeat the empty ride height checking process. Adjust as required.

REMOVAL (Figure 3)

The suspensions may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Raise the rear of the truck until both suspensions are at full travel and the tires are clear of the ground. Secure the axlebox assembly in this position with adequate blocking, and then lower the truck slightly to remove the load from the suspension and pins. Block the main frame in this position.

3. Reduce the nitrogen (gas) pressure in both of the rear suspensions to less than 100 psi (690 kPa) as outlined in the instructions in Maintenance and Adjustment.

4. On trucks equipped with either or both the BUCYRUS® Weigh and Two-Speed Overspeed Systems, disconnect the wiring from the pressure transducers.

5. Support the suspension unit adequately before removal of the

WARNING

Each suspension unit weighs in excess of:

MK30B	**1250 lb (565 kg)**
MT 2700/3000	**1250 lb (565 kg)**
MT 3300/3300AC	**1250 lb (565 kg)**
BD 220	**1250 lb (565 kg)**
MT 3600B	**1650 lb (750 kg)**
BD 240/270	**1650 lb (750 kg)**
MT 3700B/3700AC	**1650 lb (750 kg)**
MT 4000	**1650 lb (750 kg)**
MT 4000AC	**1650 lb (750 kg)**
MT 4400/4400AC	**1650 lb (750 kg)**
MT 5500/5500B	**2320 lb (1 050 kg)**
MT 6300AC	**2320 lb (1 050 kg)**

6. Remove the capscrews (7), lockwashers (8), and pin retainers (5).

7. Using a softhead mallet, tap the end of the pin opposite of the capscrew holes and remove one pin at a time. Slight movement of the suspensions may be required to minimize the forces on the pins. Be cautious when handling the pins. There may be some pressure on the pins caused by supporting the suspension.

WARNING

Take care not to bind the connecting pins in the lugs.

8. Carefully remove the suspension unit from the vehicle.

DISASSEMBLY (Figure 2)

The suspension may be disassembled as follows:

1. Using the appropriate means, remove the oil from the suspension.

NOTES:
1. On trucks equipped with later versions of the suspension, a setscrew/drain plug combination is installed at the bottom to allow the easy draining of the oil if so desired. If the plugs are removed, they should be reinstalled as outlined in the Assembly information in this module.
2. The expected oil volumes involved are in a chart in the Maintenance and Adjustment information in this module.

2. Remove the guard assembly (3) secured by capscrew (1) and lockwasher (2).

3. Remove the charge valve (23) and plug (24) or transducers, if not removed previously. Temporarily replace with plugs.

4. Using a crane and suitable handling and support fixtures, invert the suspension and secure in place with the outer barrel or tube (5) at the bottom.

5. Remove the bellows (17 or 18).

NOTES:
1. In some installations, removal of the bellows over the lower mount assembly may not be possible. In those installations, it should be moved and secured to the lower mounting point for later removal.
2. An optional split bellows assembly with a zipper is available that allows its replacement without removing the suspension or mounting pins.

6. Remove the grade 8 capscrews (22) and hardened washers (21) secure the stuffing box to the outer tube assembly.

7. Carefully raise the lower plunger tube/stuffing box assembly from the outer tube assembly (5) using care not to damage the surfaces on any of the components. This assembly can now be positioned horizontally on a clean work surface for additional disassembly, if desired.

8. Remove the grade 8 capscrews (6) and hardened washers (7) securing the piston (8) onto the plunger tube assembly. Remove the piston from the plunger tube assembly.

NOTE: *In some installations, particularly those with steel piston assemblies, a non-metallic guide bearing is installed in a special groove in the piston. New bearings are provided with the seal kits and these should be inspected, removed and replaced each time the suspension is disassembled and serviced.*

9. Remove the ball or balls (9) from the bore in the plunger tube.

10. Carefully remove the stuffing box (13) from the plunger tube (10), again using care not to damage the surfaces on any of the components.

11. Inspect, and then remove the O-ring (11) and back-up ring (12) from the grooves on the outer surface area of the stuffing box (13).

12. Inspect then remove the wiper (16), seal (15), and buffer (14) from the grooves in the inner bore of the stuffing box (13).

13. Drain all oil from the outer barrel or tube assembly and move as required.

INSPECTION AND REPAIR

The disassembled suspension may be serviced as follows:

1. Inspect all component parts both inside and outside. They must be smooth and polished. Remove all nicks, chipped or cracked finishes, and rust spots. Remove all oil and other contamination. If rust is evident in the vicinity of the seals, clean the surface with 400 grit emery cloth.

2. Inspect the self-aligning bearings in the frame and axlebox for evidence of wear and/or damage. They must be free of defects and still properly installed.

If they require replacement, this may be done as follows: (Figure 3)

a. Remove the bushing retainers by the appropriate means, exercising special care to prevent damage to the frame/axlebox or sleeve bores.

b. If required, use air arc or other appropriate means to split and remove the entire bushing assembly. Again exercise care not to damage the mounting bore and/or sleeve in the frame/axlebox.

c. Inspect the inner bore of the sleeve in the frame/axlebox for evidence of wear or damage. It must be free of defects and within 0.001 inch (0.025 mm) of round. Small ridges or grooves may be repaired with emery cloth. Otherwise the sleeve should be replaced. This may be done as follows:

(1) If so equipped, carefully remove the damaged sleeve, exercising care not to damage the bore in the frame/axlebox.

(2) Inspect the bore in the frame/axlebox for evidence of wear or damage. It must be free of defects and within 0.001 inch (0.025 mm) of round. Small ridges or grooves may be repaired with emery cloth.

NOTE: *If defects are found or the bore is not within tolerances, contact the local BUCYRUS® Service Representative for detailed repair recommendations.*

(3) Install the new sleeves as follows:

IMPORTANT: *Sleeves with high interference fit may be installed using either of the methods outlined here. The liquid nitrogen method typically provides a more consistent installation.*

Liquid Nitrogen Method

WARNING

Due to the cold temperatures of both the liquid nitrogen cooling medium and the parts being cooled, it is important to take extra precautions that neither comes in contact with skin, clothing, or other items during the entire procedure.

(a) Using all of the appropriate precautions because of the cold temperatures of the materials involved, gently immerse the sleeve into a pool of liquid nitrogen.

(b) After allowing sufficient time to fully cool, carefully remove from the liquid nitrogen and install in the appropriate bore properly oriented.

(c) Allow the sleeve to warm slowly and evenly to ambient temperature, making sure that the retaining rings may be properly installed.

IMPORTANT: *The use of externally applied heat to speed up the process may result in uneven cooling and warping of or damage to the sleeve.*

Heating Method

WARNING

Due to the cold temperatures of both the liquid nitrogen cooling medium and the parts being cooled and the heat applied to the receiving component area, it is important to take extra precautions that neither comes in contact with skin, clothing, or other items during the entire procedure.

(a) Using all of the appropriate precautions because of the cold temperatures of the materials involved, carefully cool the sleeve to a temperature of -40° to -70° F (-40° to -57° C).

(b) Evenly heat the bore into which the sleeve is to be installed to 300° to 350° F (150° to 175° C).

IMPORTANT: *Heat the massive side of the lug additionally to ensure that the bore is heated and expanded evenly.*

(c) Once both components are at the proper temperatures, carefully remove the sleeve from the cooling medium and install in the appropriate bore properly oriented.

(d) Allow the sleeve to warm slowly and evenly to ambient temperature, making sure that the retaining rings may be properly installed.

IMPORTANT: *The use of externally applied heat to speed up the process may result in uneven cooling and warping of or damage to the sleeve.*

(e) Verify that with the sleeve properly installed, it is within 0.001 inch (0.025 mm) of round. Small ridges or grooves may be repaired with emery cloth.

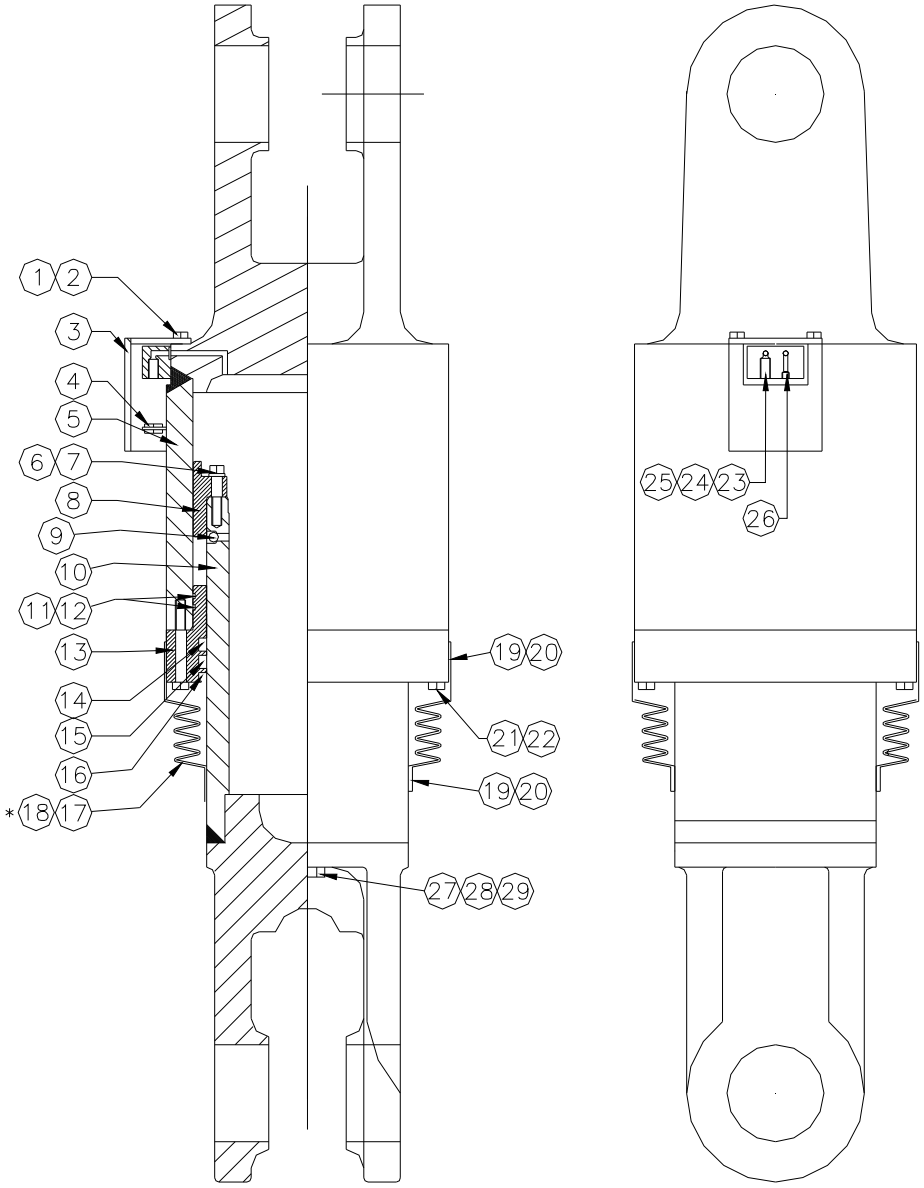
d. Install the self-aligning bushings as follows:

IMPORTANT: *Steel spherical bearings should not come in direct contact with dry ice and should not be immersed in liquid nitrogen. Either of these actions could result in the change of the metallurgical character of the bearing affecting subsequent fit and operation.*

WARNING

Due to the cold temperatures of both the dry ice or other cooling medium and the parts being cooled, it is important to take extra precautions that neither comes in contact with skin, clothing, or other items during the entire procedure.

(1) Using all of the appropriate precautions because of the cold temperatures of the materials involved, carefully cool the bearing assembly to a temperature of -40° to -70° F (-40° to -57° C).



*NOTE: The optional bellows with zipper (18) allows the bellows to be serviced with the suspension mounted on the truck.

The standard bellows (17) requires the installation over the lower mounting portion of the plunger tube assembly (10) which must be removed from the truck.

KEY 55896

01.	Capscrew (Grade 8)	11.	O-ring	21.	Hardened Flatwasher
02.	Lockwasher	12.	Back-up Ring	22.	Capscrew (Grade 8)
03.	Valve Guard	13.	Stuffing Box	23.	Charge Valve
04.	Locknut	14.	Buffer	24.	Charge Valve Core
05.	Outer Tube or Barrel Assembly	15.	Seal	25.	Charge Valve Cap
06.	Capscrew (Grade 8)	16.	Wiper	26.	Plug
07.	Hardened Washer	17.	Bellows	27.	O-ring Boss Plug
08.	Piston	18.	Bellows with Zipper (Option)	28.	O-ring
09.	Ball	19.	Adjustable Fastener Clamp	29.	Setscrew
10.	Plunger Tube Assembly	20.	Banding Clamp		

FIGURE 2 - REAR SUSPENSION ASSEMBLY (55896)

(2) Once both components are at the proper temperatures, carefully remove the bearing from the cooling medium and install properly oriented into the appropriate bore.

(3) Allow the bearing assembly to warm slowly and evenly to ambient temperature, making sure that the retaining rings may be properly installed.

IMPORTANT: *The use of externally applied heat to speed up the process may result in uneven cooling and warping of or damage to the bearing or bore.*

(4) Secure with the new retainers using care not to contaminate the new bushings.

ASSEMBLY (Figure 2)

The suspension may be assembled as follows: (Figure 2)

1. Lubricate each seal and the OD of the plunger tube (10) and the inner bore of the outer tube assembly (5) with oil compatible with that to be used to fill the suspension assembly.

2. Install wiper (16), seal (15), and buffer (14) into the appropriate grooves in the inner bore of the stuffing box (13).

NOTE: *In some seal kits, a special O-ring is provided to assist in properly securing the sealing components in the seal (15) in their proper operating orientation, particularly in unusual operating environments.*

3. Install the O-rings (11) and back-up rings (12) into the appropriate grooves on the outer surface area of the stuffing box (13).

NOTE: *The back-up rings (12) are installed in the groove first, on the side of the groove toward the lower or larger end of the stuffing box. The O-rings (11) are installed toward the smaller, high pressure end of the stuffing box groove.*

4. Install the bellows (17), small end first toward the lower mounting clevis, onto the lower plunger tube assembly.

NOTE: *An optional split bellows assembly with a zipper (18) is available that allows its replacement without removing the suspension or mounting pins.*

5. Using the appropriate seal expander or equivalent to prevent damage to the seals, carefully install the stuffing box (13) onto the plunger tube (10), large end first.

6. Install the ball or balls (9) into the bore in the plunger tube.

NOTE: *A small amount of clean grease may be used to assist in temporarily holding it in place during the remainder of the assembly process.*

7. Install the piston (8) onto the plunger tube assembly, securing with grade 8 capscrews (6) and hardened washers (7). Tighten evenly to the final torque listed below in a crossing pattern in increments of 50 ft-lb (65 Nm).

5/8 - 11NC	160 ft-lb (215 Nm)
3/4 - 10NC	280 ft-lb (380 Nm)

NOTE: *In some installations, particularly those with steel piston assemblies, a non-metallic guide bearing is installed in a special groove in the piston. New bearings are provided with the seal kits and these should be carefully lubricated and installed each time the suspension is disassembled and serviced. An appropriate seal compressor or installation tool will ease the installation process.*

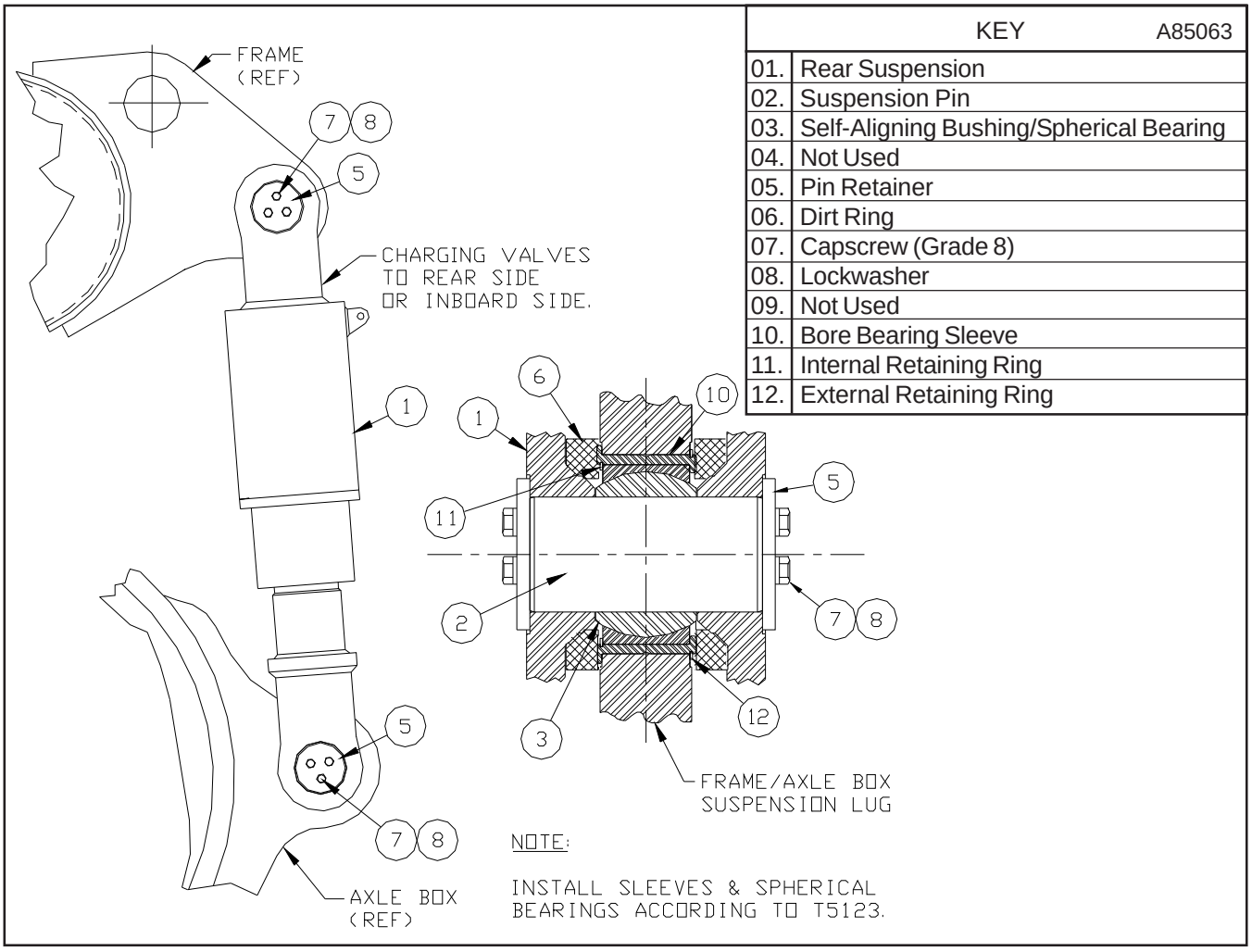
8. Using a crane and suitable handling and support fixtures, invert the outer barrel or tube assembly and secure in place with the mounting end at the bottom.

9. Using appropriate tools and precautions, raise the lower plunger tube assembly and install into the outer barrel or tube assembly (5) over the lower plunger tube assembly until it is far enough for the installation of the stuffing box.

10. Using a seal compressor or equivalent to prevent damage to the seals, carefully install the stuffing box (13) into the outer tube assembly with the bolt holes in each properly aligned.

11. Secure the stuffing box to the outer tube assembly, securing with grade 8 capscrews (22) and hardened washers (21). Tighten evenly to the final torque listed below in a crossing pattern in increments of 50 ft-lb (65 Nm).

5/8 - 11NC	160 ft-lb (215 Nm)
3/4 - 10NC	280 ft-lb (380 Nm)



KEY	A85063
01.	Rear Suspension
02.	Suspension Pin
03.	Self-Aligning Bushing/Spherical Bearing
04.	Not Used
05.	Pin Retainer
06.	Dirt Ring
07.	Capscrew (Grade 8)
08.	Lockwasher
09.	Not Used
10.	Bore Bearing Sleeve
11.	Internal Retaining Ring
12.	External Retaining Ring

FIGURE 3 - REAR SUSPENSION INSTALLATION – ALL EXCEPT MT 5500/5500B/6300AC TRUCKS (A85063)

12. Install the bellows (17), securing to the stuffing box and outer tube assembly as needed.
Secure with banding clamp (20) and adjustable fastener clamp (19).

NOTE: *An optional split bellows assembly with a zipper (18) is available that allows its replacement without removing the suspension or mounting pins.*

13. Install the charge valve (23) and plug (24) or transducers, if removed previously. Torque the:

a. Pressure transducers to 14 +/- 1 ft-lb (19 +/- 1 Nm).

b. Charge valve to 37 +/- 7 ft-lb (50 +/- 10 Nm) in increments of 10, 20, and 37 ft-lb (14, 27, and 50 Nm).

NOTE: *If removed, reinstall the valve cores and protective covers.*
1. Torque the valve cores to 3 to 5 in-lb (0.35 to 0.45 Nm).
2. Torque the protective covers to 40 to 50 in-lb (4.5 to 5.5 Nm).

14. Install the guard assembly (3) secured by capscrew (1) and lockwasher (2) for protection.

15. On suspensions equipped with the setscrew/drain plug combination:

a. After coating the threads with the appropriate thread sealant, install the setscrew (29). Tighten securely, but do not over-tighten to damage the threads. Make sure that the setscrew is installed to a sufficient depth to allow proper installation of the outer plug.

b. Install the drain plug assembly (27) into the plunger tube assembly. Tighten the special O-ring boss plug until the bosses make metal-to metal contact with the suspension. This should slightly compress the O-ring seal (28), but not cause it to distort.

16. Switch the suspension from the inverted position to a normal vertical operating position.

17. Secure in place and fill with oil as outlined in the procedures in Maintenance and Adjustment in this module.

INSTALLATION

The rear suspensions may be installed as follows:

1. Clean and smooth all mating surfaces on the suspension and the frame.

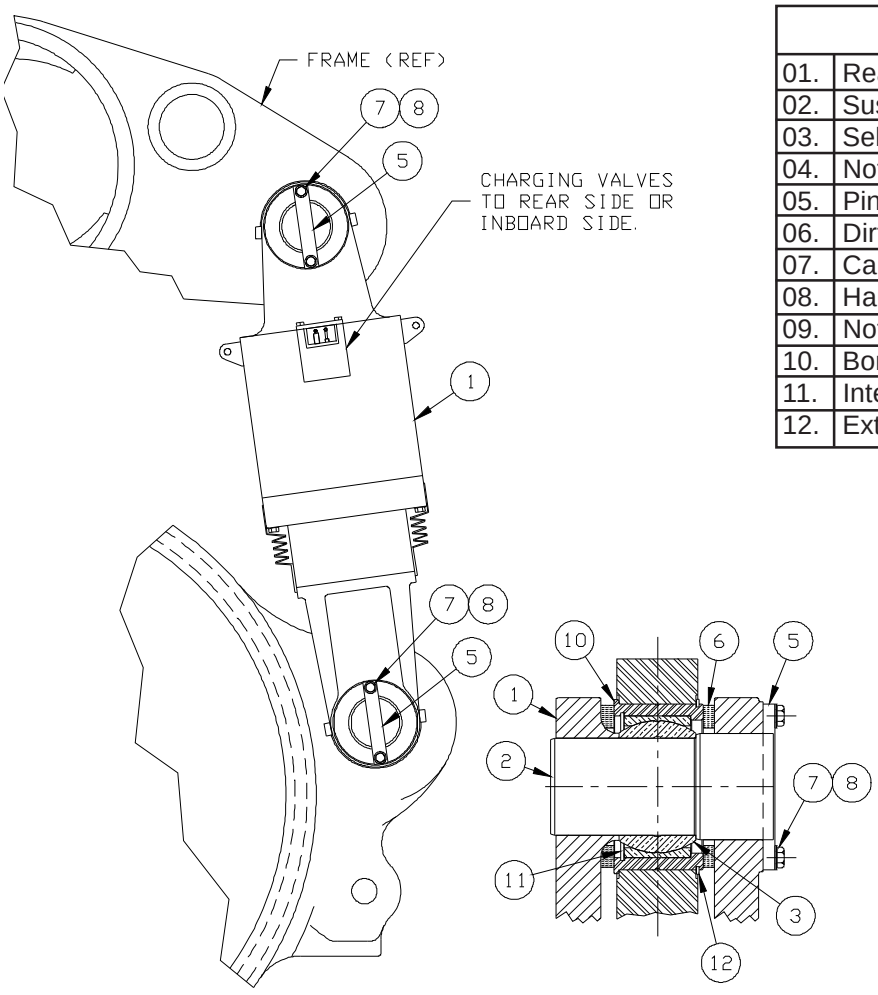
2. On trucks equipped with pressure transducers, use extra care to prevent damage to system components.

3. Raise the suspension assembly into position making sure the charge valves are located to the rear of the truck.

WARNING

Each suspension unit weighs in excess of:

MK30B	**1250 lb (565 kg)**
MT 2700/3000	**1250 lb (565 kg)**
MT 3300/3300AC	**1250 lb (565 kg)**
BD 220	**1250 lb (565 kg)**
MT 3600B	**1650 lb (750 kg)**
BD 240/270	**1650 lb (750 kg)**
MT 3700B/3700AC	**1650 lb (750 kg)**
MT 4000	**1650 lb (750 kg)**
MT 4000AC	**1650 lb (750 kg)**
MT 4400/4400AC	**1650 lb (750 kg)**
MT 5500/5500B	**2320 lb (1 050 kg)**



KEY	A85288
01.	Rear Suspension
02.	Suspension Pin
03.	Self-Aligning Bushing/Spherical Bearing
04.	Not Used
05.	Pin Retainer
06.	Dirt Ring
07.	Capscrew (Grade 8)
08.	Hardened Flatwasher
09.	Not Used
10.	Bore Bearing Sleeve
11.	Internal Retaining Ring
12.	External Retaining Ring

FIGURE 4 - REAR SUSPENSION INSTALLATION – MT 5500/5500B/6300AC TRUCKS (A85288)

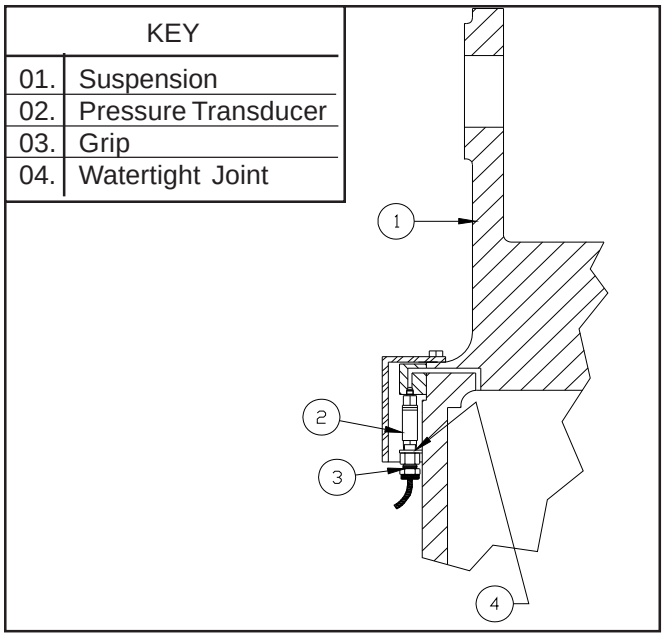


FIGURE 5 – PRESSURE TRANSDUCER INSTALLATION (A84726)

MT 6300AC 2320 lb (1 050 kg)

4. Align the holes in the suspension and in the lugs and install the suspension pins (2).

5. Install the pin retainers (5) and secure with lockwashers (8) and Grade 8 capscrews (7).

6. Install the neoprene dirt rings (6) in between the suspension and the lugs. Secure with tie wraps.

7. On trucks equipped with either or both the BUCYRUS® Weigh and Two-Speed Overspeed System:

a. Install the pressure transducer if not installed previously. Torque to 14 +/- 1 ft-lb (19 +/- 1 Nm).

NOTE: *The joint indicated in item 4 of Figure 5 must be watertight. It is recommended to use liquid pipe sealant on the threads and apply RTV sealant around the clearance hole to prevent moisture seepage and pooling. Also make sure to install the appropriate sealing grip (3) on the cable end of the transducer, using the body nut as a locknut.*

b. Install all wiring, making sure to allow sufficient freedom for the travel of the suspension.

8. Remove the blocking and lower the truck to the ground.

9. Charge the suspension with dry nitrogen gas as outlined in the instructions in Maintenance and Adjustment in this module.

10. Check operation of the suspension as outlined in Maintenance and Adjustment before placing back into operation.

11. If so equipped, check the operation of the BUCYRUS® Weigh or Two-Speed Overspeed System.

WHEELMOTORS

DESCRIPTION AND LOCATION

The wheelmotors are cylindrical shaped electric motor drive power packages attached to the side of the axlebox inside each of the rear dual tire assemblies.

OPERATION

AC electrical power from the alternator and control circuits is converted to mechanical power (torque) in the armature assembly. The torque output of the armature is then multiplied by a compound planetary gear reduction system that is transmitted through the torque tube to the dual rear tires.

For a more complete explanation of the operation of a wheelmotor, refer to the appropriate wheelmotor manufacturer's information.

TROUBLESHOOTING, MAINTENANCE AND ADJUSTMENT

Refer to the appropriate wheelmotor manufacturer's information for detailed troubleshooting and maintenance procedures.

REMOVAL

The wheelmotor may be removed as follows:

1. Park the truck in a SAFE POSITION on level terrain and secure so that it cannot move, even if the brakes are released.

2. Jack the truck and remove the tire and rim assemblies as outlined in Section 7 - Running Gear.

3. Drain all oil from the wheelmotor gearbox sump.

4. Disconnect all cables and hoses connected to the motor inside the axlebox. Label each to aid in reconnection.

5. Remove the dump body mounted tire "rock knockers" or secure them out of the way.

6. Support the wheelmotor by forklift, crane, wheel dolly or other suitable means.

NOTE: *If an overhead crane is to be used either a suitable special fixture must be used or the dump body must be removed. Refer to the instructions in Section 2 - Structure.*

NOTE: *Each wheelmotor assembly weighs* in excess of:*

WHEELMOTOR	*lb**	*kg**
GE GEB23	*15,000*	*6 575*
GE GEB25	*26,800*	*12 155*

**Add approximately 700 to 1000 lb (315 to 455 kg) if brakes are to be left installed.*

Be sure the lifting mechanism is sufficient to safely lift this weight. Also be sure the wheelmotor assembly is supported as recommended by the wheelmotor manufacturer.

7. Remove the capscrews that connect the motor to the axlebox. Move it straight out until the inner edges and equipment are clear of the axlebox before lifting.

8. Set the wheelmotor on blocking as recommended by the manufacturer. Be sure it is sufficient to support the weight and will not damage the wheelmotor.

9. If required, remove the brakes as instructed in Section 8 - Brake System.

SERVICE

Periodic maintenance of the wheelmotors should include the following:

1. Daily, inspect the wheelmotor and attached brakes for evidence of leakage or damage. Repair or replace as required.

2. If the wheel studs are found to be damaged, they may be replaced as followed:

NOTES:
1. Newer stud assemblies incorporate a hex shape on the open end allowing the direct use of the appropriate tools to assist in the removal and installation of the stud.
2. On older assemblies (without the hex), a driver or multiple lug nuts tightened onto the stud to function as a driver may be needed to assist in the removal and installation of the wheel studs.

a. Using suitable tooling, remove the old wheel stud.

NOTE: *In instances where hand tools alone will not operate, apply localized heat to the stud or casting to warm to approximately 485° F (250° C). Taking the appropriate measures, remove while hot.*

b. Clean and inspect the threads in the wheelmotor. Repair as required following the directions in the appropriate manufacturer's service publication.

c. Clean and prepare the threads in the wheelmotor and on the stud using the appropriate cleaner/primer for the locking compound to be used.

d. Coat the threads on the stud that will engage the threads in the casting with several drops of Loctite 242 (liquid) or sufficient 248 (stick) material (or equivalent).

NOTE: *More detailed instructions on the proper preparation and use of Loctite is contained in Section 7 – Running Gear.*

e. Insert the cone end of the stud into the threaded hole. Tighten until the cone end contacts the bottom of the hole. A final "light" torque of 15 to 20 ft-lb (20 to 27 Nm) should suffice.

f. Allow the Loctite to cure as required before installing the tires and rims and tightening the wheel clamps.

NOTE: *Full strength typically requires 24 hours. In some installations, special accelerants may be used to decrease this time, but may adversely affect overall total strength. Check/test before using.*

3. Refer to the appropriate manufacturer's manual for detailed information and service procedure.

INSTALLATION

The wheelmotor may be installed as follows:

1. Lift the assembly and maneuver it into position on the axlebox. Threaded studs, 6 or 8 inches (150 or 200 mm) long, screwed into three of the tapped holes in the axlebox will aid in the assembly process.

IMPORTANT: *Because of the limited clearance between the wheelmotor gear case sump and the axlebox, use care during the mating process.*

2. Install the capscrews and hardened washers that connect the assembly to the axlebox, lubricating the threads and washers. Torque to:

a. 1250 - 1400 ft-lb (1700 - 1900 Nm) on trucks with GEB23 or 25 wheelmotors with 1-1/4 inch capscrews.

3. Connect the hoses and cables to the wheelmotor as marked. Bleed entrapped air and contaminants from the brakes as instructed in Section 8 - Brake System.

NOTE: *If the brakes were removed, reinstall them as instructed in Section 8 - Brake System.*

4. Fill the wheelmotor gear sump to the appropriate level with the required fluid. Refer to the manufacturer's manual for the specific type and amount of lubricant.

5. Reinstall the tire and rim assembly as instructed in Section 7 - Running Gear.

6. Follow the procedure recommended by the manufacturer for testing prior to placing the wheelmotor back into service.

KEY	
01.	Wheelmotor
02.	Stud Bolt
03.	Hardened Flatwasher
04.	Capscrew (Grade 8)
05.	Special Flanged Nut
06.	Wheel Clamp
07.	Dual Spacer
08.	Spin-On Air Filter
09.	Breather Adapter
10.	Pipe Fitting
11.	Adapter Fitting
12.	Pipe Fitting
13.	Pipe Fitting
14.	Hose Clamp
15.	Heater Hose
16.	Drain Valve
17.	Pipe Fitting
18.	Pipe Fitting
19.	Pipe Fitting
20.	Pipe Fitting
21.	Pipe Fitting
22.	Reducer Bushing
23.	Pipe Fitting
24.	Pipe Plug

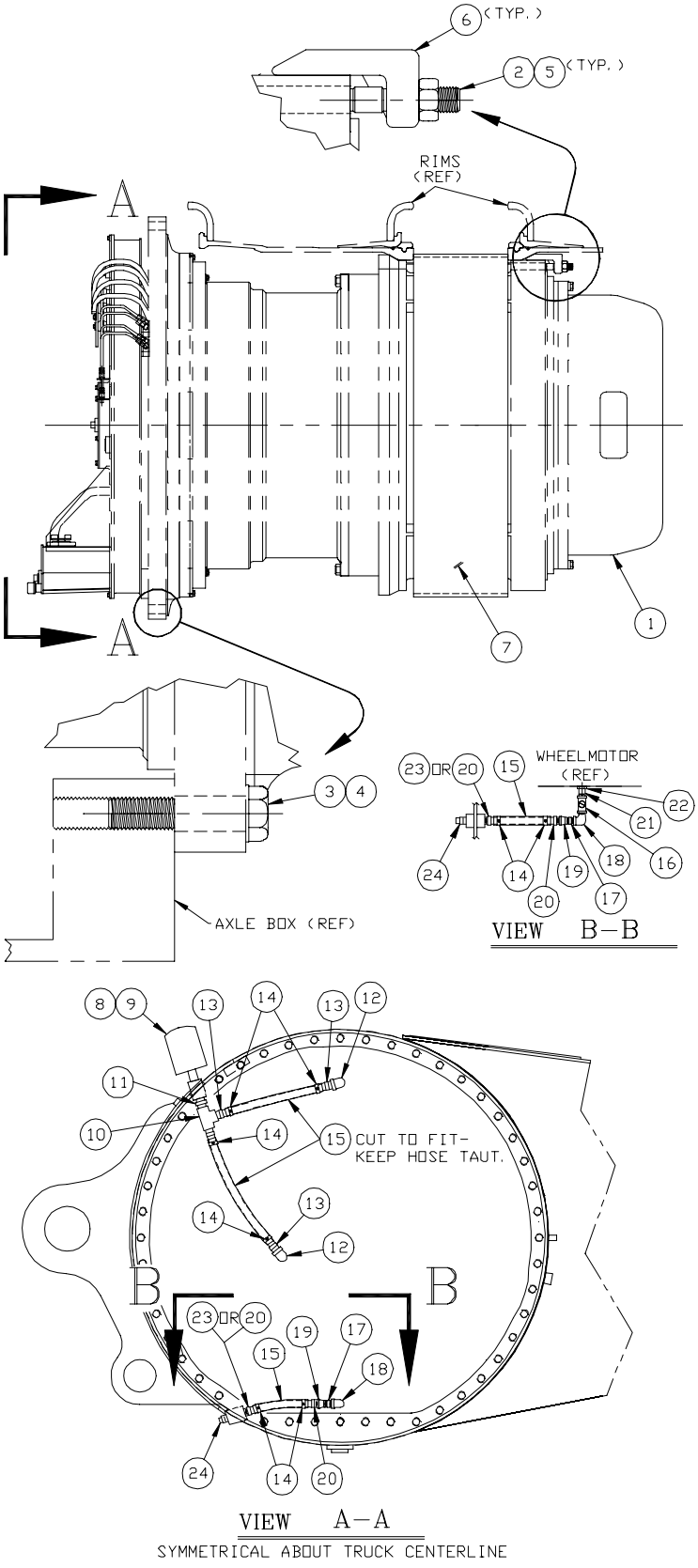


FIGURE 1 - TYPICAL WHEELMOTOR INSTALLATION (A83829)

TIRE AND RIM ASSEMBLY

NOTE: *This module contains information for "5-piece style" rims, available from a variety of sources. For other configurations, refer to Section 9 - Options or the appropriate manufacturer's information.*

DESCRIPTION AND LOCATION

The large rubber tire and metal rim assemblies support the truck. One tire and rim assembly is mounted to each front wheel. Dual tires and rims are mounted to both rear wheelmotors.

OPERATION

Rubber tires support the vehicle weight, and transmit the propulsion, retarding, braking, and steering forces. The tires provide some cushioning due to their construction and hollow, pressurized inner core. Tires are available in several constructions and tread combinations. Refer to the appropriate manufacturer's information for specific details.

The metal rim secures the tire to the wheel, seals the hollow center core, and maintains the basic tire shape. Refer to the appropriate manufacturer for specific information concerning the rim assembly.

NOTE: *Special rim assemblies are now available that allow the tires to be changed without removing the rim assemblies, including the outer dual components, from the truck. If these are installed, the appropriate changes to these instructions must be made. Contact the rim manufacturer or your BUCYRUS® representative for detailed instructions.*

An optional device is available that releases the compressed gas in each of the assemblies if the temperature or pressure exceed preset limits.

NOTE: *One of these devices, known by the proper name "Defuzer", contains a "rupture disc" designed to release the pressure if the pressure exceeds 190 psi (1 310 kPa) or the temperature exceeds 200° F (93° C). See Figure 3.*

TROUBLESHOOTING

For specific details concerning tire and rim assemblies, contact the appropriate component manufacturer or BUCYRUS® representative.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following:

DANGER

Failure to follow all safety precautions when handling a tire and rim assembly could result in an explosion and serious injury.

IMPORTANT: *Tire and rim servicing can be hazardous unless correct procedures are practiced by trained personnel. The use of personal safety equipment such as hard hats, ear protection, safety glasses and shoes, etc., and proper tools and equipment is highly recommended.*

1. Before performing any inspection and maintenance on the tire and rim assemblies, park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Check the tires for cuts, missing pieces, tread depth or other indications of damage. Repair or replace as required.

3. Check the tires for proper inflation pressures. Because these can vary due to a number of factors including load, haul profile, environmental considerations, etc., refer to the appropriate tire manufacturer's recommendations for specific pressure requirements at your location.

NOTES:

1. Always verify that the side or lock rings are fully seated before adding air.
2. Never reinflate a flat tire on a vehicle. Replace the flat tire with spare or repair before continuing operations. Disassemble and inspect the flat tire and rim assembly thoroughly as outlined in the information in Inspection and Repair later in these instructions.
3. Over-inflation results in high cord stresses which reduce resistance to blowouts from impacts and increases the danger of rock cutting. Under-inflated tires are subject to more deflection and flexing. Operation under this condition will result in uneven tread wear, sidewall radial cracks, ply separation, and loose or broken cords inside the tire.
4. Never run a loaded truck on one tire and rim of a dual assembly. The carrying capacity of that single assembly may be greatly exceeded. Operation of a truck in this manner can cause serious damage to the rim and tire and may result in sudden, unexpected failure.

4. Inspect the rim for proper assembly and evidence of damage or wear. Repair or replace as required.

Never try to reseat rings or other components by hammering while the tire is partially or fully inflated. This may cause the assembly to unexpectedly come apart with great force. If misassembled components are found, deflate, inspect, and reassemble following the correct procedures.

IMPORTANT: *Never add or remove any attachment or modify a rim (especially by heating, welding, or brazing), unless the tire has been removed and approval has been received from BUCYRUS® and the rim manufacturer.*

5. On rims equipped with "Defuzer" valves (or equivalent):

a. Inspect the valve for evidence of damage or leakage.

b. Replacement of the valve is recommended at one year intervals when operating under normal conditions. A more frequent replacement may be necessary due to corrosion, fatigue, temperature, or adverse operating conditions. This may need to be determined through actual operating experience.

NOTES:

1. If a rupture disc is not replaced periodically when exposed to these conditions, premature rupturing of the disc may occur, releasing the pressure in the tire.

2. The valves are supplied fully assembled as a sealed unit. They should be replaced as a complete assembly.

6. Verify that the stud/clamp assemblies are properly installed and torqued, typically to 525 to 550 ft-lb (710 to 745 Nm).

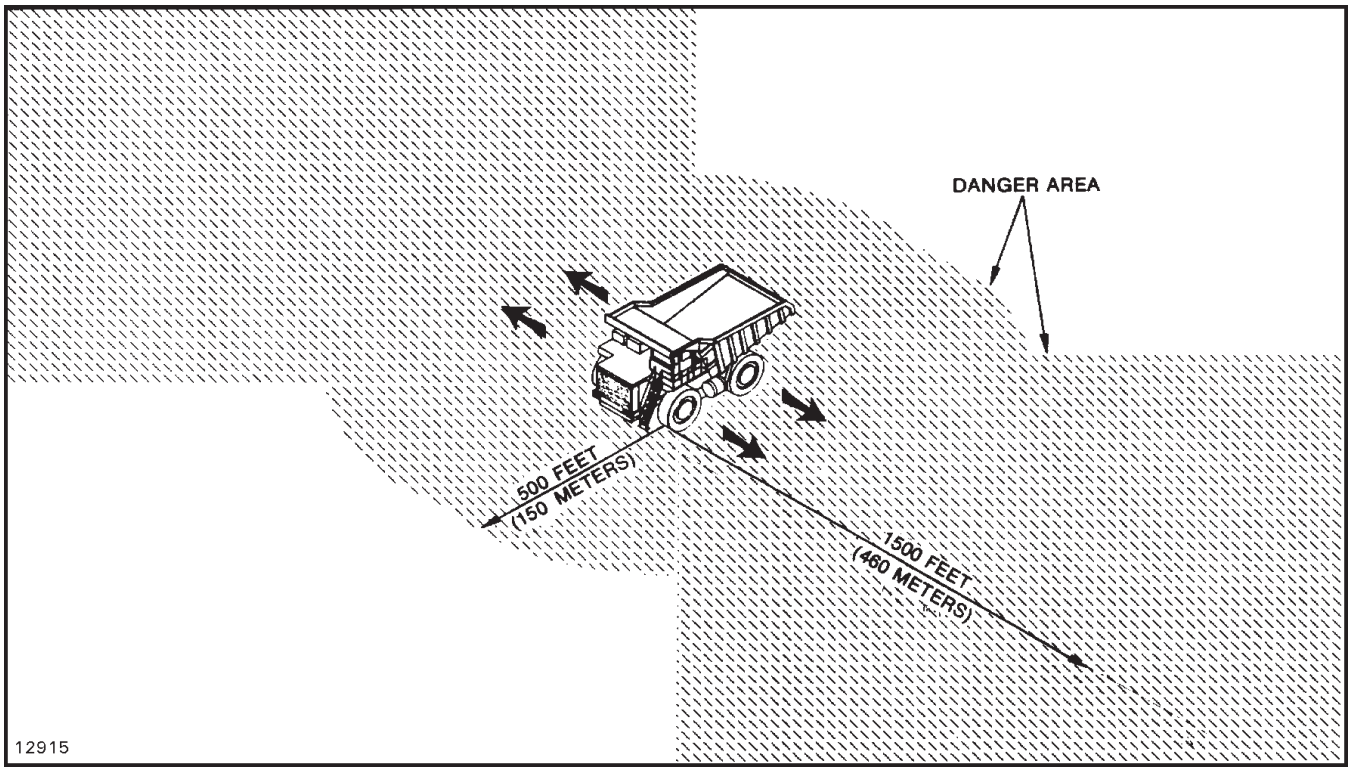
7. Verify that cover caps are installed on each valve stem.

⚠ DANGER

There is danger of tire explosion due to fire/ excessive heat in wheel area.

Whenever the smell of burning rubber or excessively hot brakes is detected on the truck, there could be a distinct possibility of danger of a tire explosion. It could also occur when fire on the truck reaches the tire and wheel area. Under such conditions DO NOT APPROACH THE TRUCK OR ENTER THE DANGER AREA as shown in the illustration. Move the truck to a remote area only if it can be done without endangering the operator or other personnel in the area.

Stay at least 500 feet (150 meters) away from the tread area and 1500 feet (460 meters) from the tire side wall. If it is absolutely necessary to reach the suspect tire, approach from the front or the back of the truck and use a large dozer blade as shield in



front. If there is evidence of brake fire or smell of burning rubber, do not go near the truck. Fight these fires from a distant, remote location. Do not rush to the truck with hand-held fire extinguisher in an effort to control the blaze. Allow at least eight hours for the tire to cool before approaching the truck.

REMOVAL

The tire and rim assembly may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

⚠ DANGER

Failure to follow all safety precautions when handling a tire and rim assembly could result in an explosion and serious injury.

2. Jack the truck until the tire assembly is clear of the ground. Block securely in this position before proceeding.

⚠ CAUTION

When removing the front tires and rims, place a jack under the bottom of front axle assembly (trucks equipped with beam axles) or the lower frame crossmember (trucks with integrated suspension/ axle assemblies) and use a safety block under the front bumper. When removing the tires and rims, place a jack under the axlebox lower rear suspension mount. Always install blocking as a safety precaution.

3. Completely deflate the tire. If it is a rear dual tire, deflate both tires before loosening any clamps.

⚠ WARNING

Always completely deflate the tire (to zero pressure) before loosening the lug nuts. When removing a rear tire and rim, always deflate both tires even if only one tire needs service. A broken or damaged rim or component under pressure may rupture or be propelled by the pressure.

NOTES:
1. When releasing the pressure from the tire assembly, remove the valve core from the valve stem. Stand clear during the deflation to avoid particles in the high speed air flow.

2. If the air flow is trapped, check the valve stem passage for obstruction by carefully running a piece of wire through the stem, taking care that the wire cannot injure you if there is a sudden release of pressure when the obstruction is moved.

4. Support the tire and rim with a forklift, overhead crane, or other suitable means.

IMPORTANT: *If removing dual tire assemblies, make sure to brace both of the tire and rim assemblies so they cannot move until they are to be removed.*

5. Remove the lug nuts and associated clamps.

NOTES:
1. Some clamps contain provisions for using jackscrews to ease removal.
2. If the truck is equipped with the appropriate rim assemblies designed for tire removal on the truck, the clamps securing the rim to the wheel assembly should not be loosened. Always follow the specific instructions available from the rim manufacturer.

6. Remove the tire and rim from the wheel.

⚠ DANGER

If inflated tires are kept in storage, they should be contained in a safety cage.

DISASSEMBLY (Figures 1 and 2)

The tire and rim assembly may be disassembled as follows:

⚠ DANGER

Failure to follow all safety precautions when handling a tire and rim assembly could result in an explosion and serious injury.

NOTE: *Refer to the appropriate manufacturer's publication for specific details on the disassembly and assembly of the tire and rim assembly. Use the following procedure only as a guide.*

1. Verify that the tire is completely deflated, and the valve core removed.

2. Depress the bead seat ring until both the lock ring and O-ring can be removed.

IMPORTANT: *When unseating the tire beads, always use the proper tools, keep fingers clear of any pinch or injury points, and stand to one side. This is especially true when removing the lock ring and O-ring assemblies.*

3. Press the rim base out of the tire.

IMPORTANT: *Always use lifting devices and mechanical aids when handling heavy tires, rims, or components.*

INSPECTION AND REPAIR

Refer to the appropriate manufacturer's information for detailed procedures. These should include instructions to:

1. Always clean the dirt and rust from all wheel parts to ease and improve the inspection process and to aid in proper component reassembly. This is especially important for the interlocking parts of the multi-piece rim components, particularly the gutter section that secures the lock ring in place.

2. Once the parts are clean, thoroughly inspect them for evidence of pitting from corrosion, cracking, bending, wear, or other damage. Replace as required, and then repaint to prevent corrosion.

IMPORTANT: *Never attempt to rework, weld, heat, or braze any rim base or components under any circumstances. If repairable, repairs can be performed by the rim manufacturer or an authorized dealer or distributor of the rim manufacturer. Replace with new parts or parts that are not cracked, broken, or damaged and which are of the same size, type, and manufacturer*.

3. Never reinflate a tire that has been run flat or seriously under-inflated without first disassembling and inspecting the tire and rim assembly.

a. Check the rim for cracks and other damage.

b. Double check the side ring, flange, bead seat band, lock ring, and O-ring for damage.

c. The tire should be inspected by the tire manufacturer before remounting.

d. During reassembly, make certain that all components fit properly and the lock ring is secure in the rim gutter section.

4. On trucks equipped with "Defuzer" valves on the rims:

a. The valve assembly is supplied fully assembled. If the valve disc ruptures, leaks, or requires replacement for any reason, the entire assembly should be replaced.

b. If replacement is required:

(1) Park the truck in SAFE POSITION. It must be secured by means other than the truck's friction brake system.

(2) If the tire and rim assembly remains on the truck, make sure that it is secure so that the assembly cannot move.

(3) Make sure that the tire is completely deflated and the valve core assembly has been removed. There must be no residual pressure in the tire if it is still on the rim assembly.

(4) Using the appropriate wrench on the "flats" on the outside of the valve, remove the valve assembly. Inspect and then discard.

(5) Clean and inspect the threads in the rim assembly. They must be free of grit, dirt, or other foreign material to form a proper seal.

NOTE: *The threads are ¾ Inch NPT.*

(6) Inspect the new valve assembly to be:

(a) Of the correct pressure and temperature rating for the application. This is stamped on the valve body.

(b) Free of damage, especially to the internal rupture disc.

(c) Clean and inspect the threads on the valve. They must be free of grit, dirt, or other foreign material to form a proper seal.

(7) Coat the threads with the appropriate sealing material for the application.

(8) Using the appropriate wrench on the "flats" on the outside of the valve, install the valve assembly. Torque to 75 to 90 ft-lb (100 to 120 Nm).

NOTES:
1. Do not remove the protective cap on the valve. Use the inlet hex only for tightening.
2. Do not attempt to dismantle or replace the rupture disc.

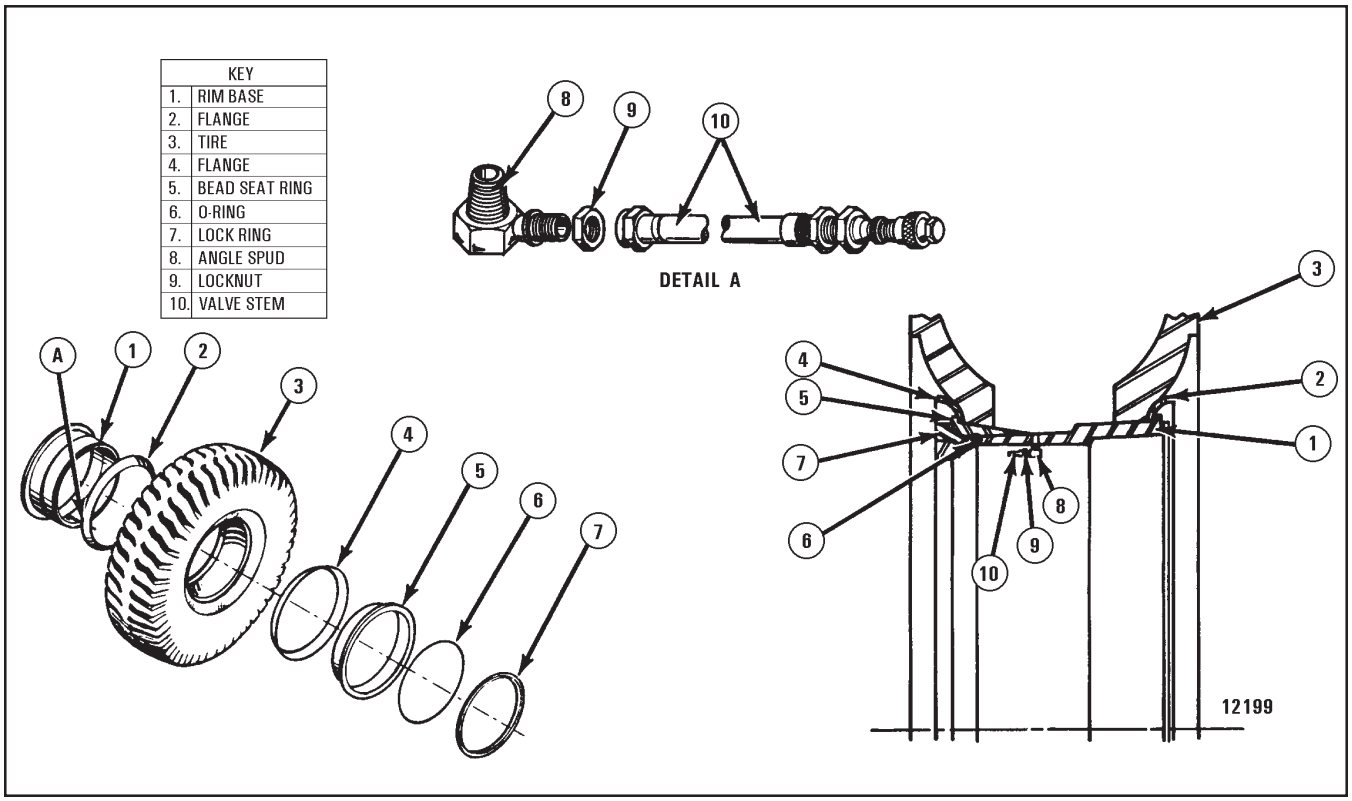


FIGURE 1 - TYPICAL FRONT TIRE AND RIM ASSEMBLY (12199)

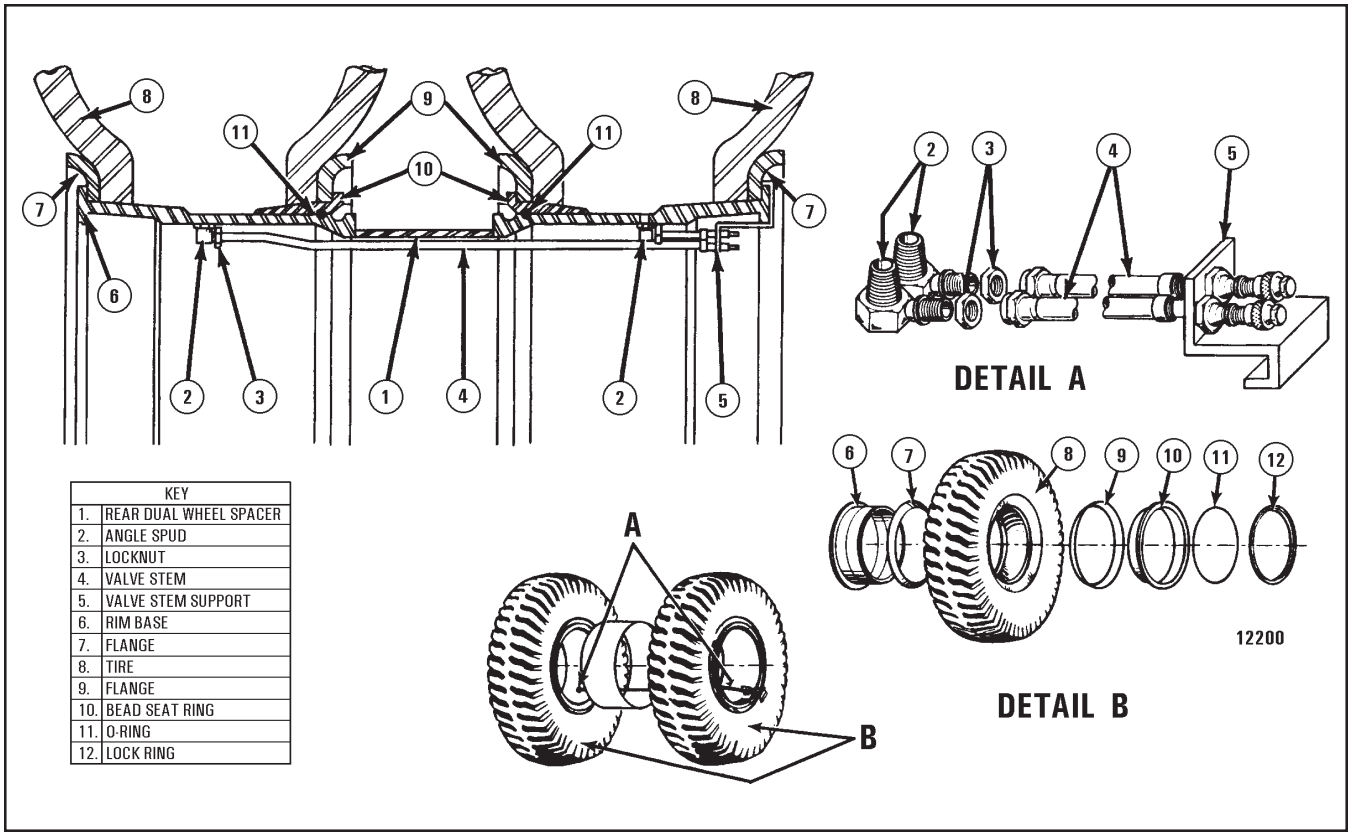
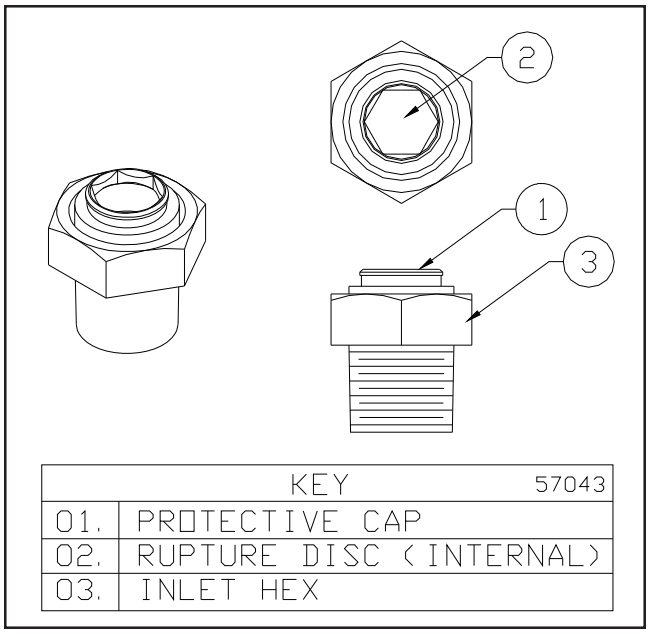


FIGURE 2 - TYPICAL REAR TIRE AND RIM ASSEMBLY (12200)



KEY	57043
01.	PROTECTIVE CAP
02.	RUPTURE DISC (INTERNAL)
03.	INLET HEX

FIGURE 3 – TIRE DEFUZER (57043)

3. Care should be taken during assembly and installation to ensure that nothing sharp protrudes into the inlet or outlet cavities. A rupture disc that has been scratched, dented, or damaged in any way may result in premature failure.

ASSEMBLY (Figures 1 and 2)

The tire and rim assembly may be assembled as follows:

1. Verify that all components are of the correct size, model, and manufacturer of parts for the assembly being worked on.

DANGER

Never intermix components from different manufacturers or even different models from the same manufacturer without the express written permission and instructions of the rim manufacturer and BUCYRUS®.

DANGER

Failure to follow all safety precautions when handling a tire and rim assembly could result in an explosion and serious injury.

2. If the assemblies are equipped with Defuzer valves, inspect and service as outlined in other portions of the information in this module.

3. Place the side ring on the rim base.

4. Place the tire on the rim.

5. Place the bead seat ring and side ring on the tire.

6. Press the bead seat ring down until the O-ring and lock ring can be installed.

IMPORTANT: *Do not hammer on the rim or components with steel hammers. These may damage or distort the rim or components, causing improper fitting of parts or premature failure. If it is necessary to tap uninflated components during assembly, use a rubber, lead, plastic, or brass faced mallet. If the components are correctly matched and assembled as designed, they will seat without tapping during inflation.*

DANGER

Do not pressurize the tire prior to mounting on the truck.

INSTALLATION

The tire and rim assembly may be installed as follows:

DANGER

Failure to follow all safety precautions when handling a tire and rim assembly could result in an explosion and serious injury.

NOTES: *If the truck is equipped with the appropriate rim assemblies designed for tire removal/installation on the truck, the clamps securing the rim to the wheel assembly should not have been loosened. Always follow the specific instructions available from the rim manufacturer.*

1. Using a forklift or crane, lift the tire and rim and install it on the wheel.

2. Install the clamps and lug nuts.

NOTE: *Refer to Loctite procedure for wheel studs, in Section 7 - Running Gear.*

3. Gradually tighten the lug nuts 180° apart from each other in even increments. Do not tighten them to full torque at once.

4. Tighten the nuts to 525 to 550 ft-lb (710 to 750 Nm) final torque.

5. Install the valve core.

6. Install safety cage or equivalent restraining device to the tire and rim assembly.

7. Have specifically trained personnel inflate the tire slightly, typically to 3 psi (21 kPa) then halt the inflation.

IMPORTANT: *It is recommended that:*
1. The inflation equipment have a filter to remove oil, moisture, and dirt from the air source. The moisture can cause corrosion of the rim and components, leading to difficult disassembly or premature failure. The filter should be periodically checked to ensure that it is functioning properly.
2. Always use a remote air valve with a clip-on air chuck and an in-line gauge and pressure regulator assembly to allow the tire mechanic to remain away from the tire during the inflation process. Always stand away from the tire to minimize possible contact should problems develop.
3. All personnel must remain out of potential component trajectories during the inflation process.

8. Recheck that all side or lock rings are properly installed. If an assembly is not fitting as designed, deflate and reassemble. Never attempt to seat rings or components by hammering when the tire is even partially inflated, because it may become dislodged and fly apart.

9. When the installation is okay at the 3 psi (21 kPa) pressure level, fully inflate and seat the tire to the recommended air pressure.

10. Lower the truck to the ground.

11. Fill the tire to the predetermined required pressure for the application and equipment. If not available contact the BUCYRUS® representative for detailed information.

12. Remove inflation equipment.

13. Replace the cover cap on the valve stem.

14. Inspect the tire for evidence of leakage or damage.

15. After the truck has been in operation for one or two loads, recheck the lug bolts and re-torque as required. Repeat several times until the rims remain tight.

NOTE: *When the truck is first driven after changing the tires, it is recommended they be observed to verify that they are properly installed and "running true". If not, repeat the procedures under Removal and Installation and correct the error.*

For other configurations, refer to Section 9 - Options or the appropriate manufacturer's information.

FRONT DISC BRAKES — CARLISLE (GOODRICH)

⚠WARNING

The procedures in this manual for servicing brakes are recommended to reduce exposure to fiber dust, a potential cancer and lung disease hazard. The primary concerns are to avoid creating airborne contamination (such as by blowing material with air) or direct contact with the skin or other organs. Avoid any inhalation of the material and wash hands and other exposed areas of the body after any exposure. Always follow the specific procedures for your work location. Material Safety Data Sheets are available from Unit Rig.

DESCRIPTION AND LOCATION (Figures 5 through 9)

The Carlisle (Goodrich) front brake system is of the caliper and disc design. They are mounted on both front suspension/wheel assemblies. Each wheel uses a single disc with 2 or more calipers.

M85/100/120, MK 24, 30 and 30B, MT 2700/3000 (Std)	2 calipers
MK 36, MT 1900, 2050, 2120, 3300, 3600, 3700	3 calipers
MT 4000, 4400, 5500	4 calipers

OPERATION

Pressurized fluid from the brake actuator and/or control valve assemblies enters through an inlet in the torque plate. This fluid pressure forces the pistons out against the carrier and lining assemblies which in turn are forced against the disc creating a braking action. The reaction to this action is supplied by the thrust plates which retain the carrier and lining assemblies when the pressure is released.

NOTE: *All six piston bores are interconnected by internal passages to allow free flow of fluid between the pistons. This ensures that all pistons push equally on the carrier/lining assemblies to maximize the braking effort.*

MAINTENANCE AND ADJUSTMENT (Figure 2)

Periodic maintenance of each brake assembly should include the following:

1. Inspect all caliper and disc mounting bolts for condition and tightness. Retighten or replace as required.

2. Inspect all boots (15) to ensure they are tight and show no evidence of leakage or deterioration. Repair or replace as required.

3. Bleed the brakes according to proper procedure. Check for moisture or contamination.

4. Inspect the carrier and lining assemblies for wear or damage. Lining assemblies should be replaced if damaged, oil covered or the friction materials are 0.125 inch (3 mm) thickness or less.

⚠DANGER

Never loosen any line or remove any components without first releasing all pressure from the system.

5. Inspect the disc for evidence of wear or damage. Replace if damaged beyond use or if the disc is worn to 0.700 inch (17.2 mm) or less.

⚠WARNING

Failure to replace the lining or disc when worn to the limit will result in loss of braking and possible equipment malfunction.

On trucks equipped with carbon metallic linings, verify that the brake disc:

1. Finish is 125 RMS or smoother.

2. Wear surface run-out is less than 0.010 inch (0.3 mm).

BLEEDING THE BRAKES

Bleeding the brakes is a procedure by which entrapped air and other contamination is removed from the operating fluid in the brake system.

On trucks with a totally hydraulic brake system, this entails applying the brake system and holding by depressing the Brake pedal or applying the Hand Brake. On trucks with an air/hydraulic brake actuation system, typically the system application controls and actuators must be cycled repeatedly to allow for this purging to occur.

Detailed instructions for the procedure required by each system configuration are included in the appropriate system procedure in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

It is important they all be removed from the hydraulic fluid prior to beginning operation.

NOTE: *Direct the fluid away from the brake lining and the disc during the bleeding operation. A piece of hose emptying into a can will prevent fluid contamination of these components.*

⚠ CAUTION

Use only a mineral base hydraulic oil, SAE 10 or equivalent, in the brake system unless another fluid is specified. Do not apply pressure to the brake system unless the caliper assembly is straddled over the disc assembly and the linings and other components are all properly installed.

⚠WARNING

Fluid may cause irritation. Avoid any contact with the eyes or prolonged contact with the skin.

LINING REPLACEMENT (Figure 2)

NOTE: *It is recommended that all linings in all calipers on both front wheels be replaced at the same time.*

The lining may be replaced as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release all service and hand brakes. Apply the park brakes, if so equipped.

3. Release all pressure in the hydraulic brake actuation system as outlined in the system instructions in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

4. Remove capscrews (1), washers (2), and thrust plates (3) from one end of the brake caliper only.

5. Slide the carrier and lining assemblies from the torque head.

NOTE: *Thrust plates are not interchangeable. Mark the location on the plate to ensure correct reassembly.*

6. Open the bleed valve (6) slightly. Do not allow fluid to come in contact with the carrier and lining or disc assemblies.

NOTE: *To prevent fluid from contacting other brake components, it is recommended that the fluid be routed into a container.*

⚠WARNING

Fluid may cause irritation. Avoid any contact with the eyes, or prolonged contact with the skin.

7. Insert a pry bar between the disc and piston. Press each piston back into the torque plate bores as far as possible.

8. Close the bleeder port.

9. Install new carrier and lining assemblies with the friction material facing the disc on each side.

NOTE: *Unit Rig has approved both non-asbestos and carbon metallic lining. For maximum braking efficiency, do not use both types on the same axle of a truck. Identify by part number.*

⚠WARNING

Never mix new and used carrier and lining assembly on the same caliper assembly. Use only the approved linings available from Unit Rig. Use of substitute, non-approved linings may result in loss of braking effectiveness. This may reduce control and lead to ultimate component malfunction.

10. Install the thrust plates (3 and 4) in the same position from which they were removed. (The bolt hole should be farther from the groove in the plate, toward the OD of the disc.) Make sure the groove in the plates engages with the tang on the carrier and lining assemblies.

11. Fasten the thrust plate into place with bolts and washers. Lubricate the threads with SAE 10W or 30W oil and torque 730 to 750 ft-lb (990 to 1020 Nm).

12. Pump (depress and release) the Brake pedal until the new carrier and lining assemblies contact the disc.

13. Bleed all entrapped air and contaminants from the system as outlined in the system instructions in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

14. If removed, reinstall the tires and rim assembly as outlined in Section 7 - Running Gear.

BURNISHING BRAKES

All brakes must be burnished (seated) when new or whenever new discs or linings are installed. The burnishing

procedure should be done prior to placing the truck back into service after brake repair. Failure to follow the proper burnishing procedure may result in reduced braking and increased stopping time.

Smoke and foul odors coming from the brake area during burnishing are considered normal when the temperatures are above 350°F (173°C). At temperatures above 700°F (370°C), heavy smoke and sparks are normal. Flames are possible at temperatures above 900°F (480°C).

IMPORTANT: *If flames are present, take the temperatures as quickly as possible and resume driving the machine as quickly as possible to extinguish the flames. Flames are an acceptable condition only during the burnishing process and should not occur during normal braking.*

The truck should be empty and driven on level ground in an area clear of all obstructions and personnel. Stopping distance required may be greater than normal during burnishing.

NOTE: *Experience has shown that continuing to run the engine at fast idle between burnishing cycles will aid in cooling of the wheelmotors.*

The front brakes may be burnished as follows:

1. On trucks equipped with all linings except the carbon metallic based lining (which are identified by a red stripe):

a. Disconnect the truck's rear brakes.

(1) On trucks equipped with pneumatic actuated brakes this may be done by disconnecting and capping the pneumatic line to each of the actuators in the axlebox assembly.

NOTE: *On trucks equipped with "Spring Brake" actuators, care must be taken to remove the line connected to the "Service Brake" port, not the line to the "Spring Brake" port. Disconnecting the "Spring Brake" supply line will cause the spring brake to actuate and create unnecessary drag and wear.*

⚠ DANGER

Never loosen any line or remove any component without first releasing all pressure from the system.

(2) On trucks equipped with hydraulic brake actuation system, this may be done by removing and capping the supply line to the axlebox.

⚠ CAUTION

It is important to remember that braking distance will be significantly increased with the rear brakes disconnected. Extra precaution must be taken while burnishing. The rear brakes should be reconnected immediately upon the completion of front brake burnishing. Never release the truck for normal operation without all brakes connected and functioning normally.

b. Drive the truck at 5 to 10 mph (8 to 16 km/hr) alternately applying and releasing the brakes until the disc temperature reaches 700 to 750°F (370 to 400°C).

A typical process involves partially depressing the Brake pedal for 50 ft (15 m) then releasing for a period of approximately 10 seconds while still in motion. This process is repeated as required until the proper temperature is achieved.

NOTES:

1. Check the temperature using a surface pyrometer or similar device measuring the temperature on the braking surface of the disc. This should be done after operating for 100 yards (90 m) or as required by ambient temperatures.

2. On trucks equipped with air/hydraulic brakes, the Front Wheel Brake control should be set in the Dry Roads position.

c. Allow the discs to cool to 350°F (173°C).

NOTE: *This may require up to 30 minutes, depending on disc and ambient temperature. It is recommended that the truck be driven slowly during this time to promote even cooling of the brake components. At a minimum, the brakes should be released during all cooling periods.*

d. Repeat step b. with a maximum disc temperature of 800 to 850°F (425 to 455°C).

e. Allow the discs to cool to 350°F (173°C).

f. Repeat step b. with a maximum disc temperature of 900 to 950°F (480 to 510°C).

g. Allow the discs to cool to 350°F (173°C).

h. Repeat step b. with a maximum disc temperature of 1000 to 1050°F (535 to 565°C).

i. Allow the discs to cool to 350°F (173°C).

j. Reconnect the rear brake system supply lines, and allow the discs to cool to 225 to 250°F (107 to 120°C).

k. Bleed all entrapped air from the rear brake system as outlined in the instruction in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

2. On trucks equipped with carbon metallic brake linings (identified by red stripe):

a. With truck empty, make five successive 10 mph (16 km/hr) stops.

b. Make 5 additional successive stops from 25 mph (40/ km/hr) with less than 3 minute intervals between stops.

c. Load truck to rated capacity.

d. Disconnect the rear brakes as outlined in steps 1 a. (1) and (2) above.

e. Make five successive 25 mph (40 km/hr) stops with less than 3 minute intervals between stops.

f. Reconnect the rear brakes and bleed any entrapped air from the system.

g. With the service and hand brakes released allow to cool 1 hour before placing unit in service.

REMOVAL (Figures 5 though 9)

The caliper assembly may be removed from the truck as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release all service brakes and apply the park brakes.

3. Release all pressure in the hydraulic brake actuation system as outlined in the system procedures in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

4. Remove the tire and rim assembly as outlined in Section 7 - Running Gear.

5. Disconnect the hydraulic lines from the caliper assemblies. Cap or plug all openings. Label each to aid in installation.

⚠WARNING

Fluid may cause irritation. Avoid any contact with the eyes, or prolonged contact with the skin.

6. Remove the bolts from the caliper mounting bracket.

7. Remove the caliper assembly.

The disc may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Remove the caliper assemblies as outlined previously.

3. With adequate blocking and jacks, raise the truck front wheel/suspension until the front wheel is free to rotate.

NOTE: *The front wheel assembly can be removed with the tire and rim assembly installed, or the tire and rim can be removed first. If the tire and rim must be removed, refer to the information on tire removal in Section 7 - Running Gear.*

4. Remove the front wheel retainer, capscrews, and shims. Retain the shims for reinstalling the wheel.

5. Remove the outer bearing, and slide the wheel from the spindle being careful to protect the inner bearing, seal, and spindle.

6. Remove the disc mounting bolts and washers, and remove the disc.

DISASSEMBLY (Figure 2)

The caliper assembly may be disassembled as follows:

1. Remove the capscrews (1), washers (2) and thrust plates (3 and 4) from both ends of the caliper assembly.

NOTE: *The thrust plates are not interchangeable. Mark the location of each plate to ensure correct reassembly.*

2. Remove the carrier and lining assemblies (5).

3. Remove the bleeder valve (6).

4. Remove the capscrews (7), washers (8), and caps (9).

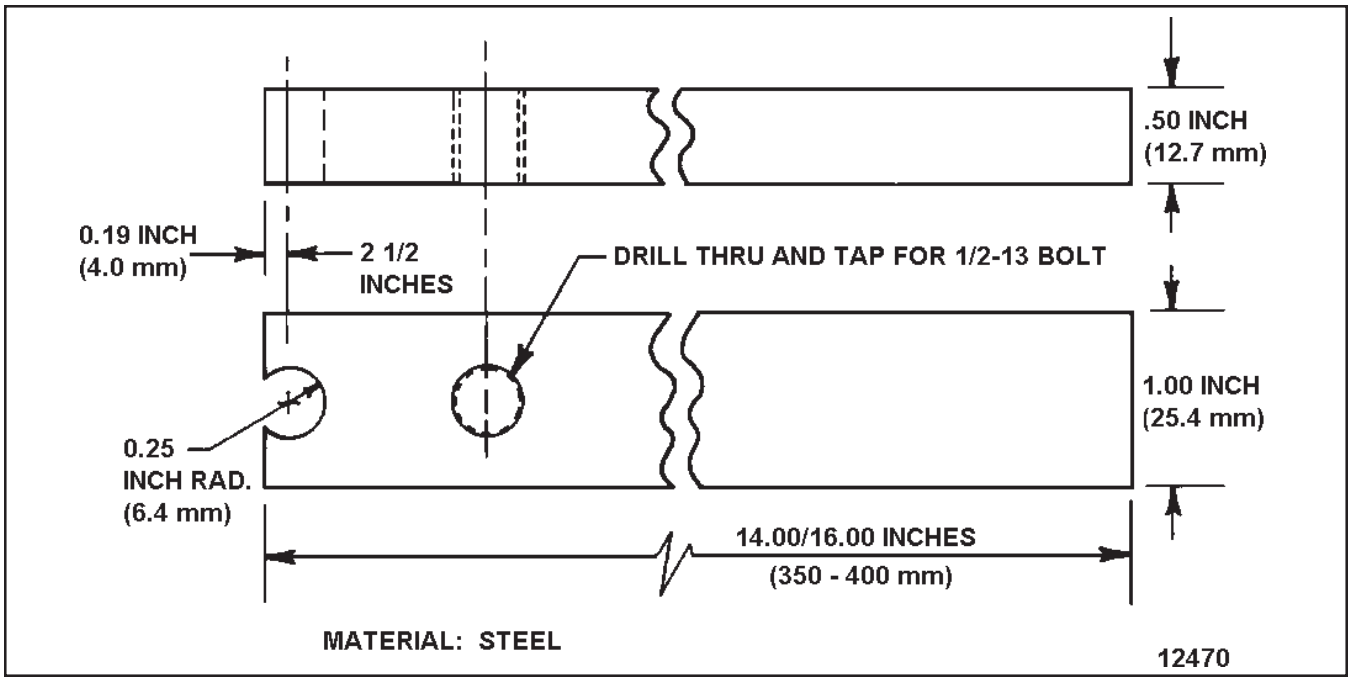


FIGURE 1 - PISTON REMOVAL TOOL

5. Remove the retainer rings (10) and packing rings (11) from the bores.

6. Remove the pistons (14).

NOTE: *The pistons may be removed with the aid of a special tool, shown in Figure 1. Install a 3/8-16 bolt into the threaded end of the piston face. Install a 1/2-13 bolt in the hole in the wrench and pry as required.*

7. Remove the packing assembly (12) and boot (15) from each piston.

INSPECTION AND REPAIR

The disassembled caliper components should be serviced as follows:

1. Inspect all rubber parts, seals, and packing for damage or wear. Normally, all should be replaced during disassembly.

2. Inspect the carrier and lining assemblies for damage, wear, or contamination. The lining should be replaced if damaged or contaminated, or when the friction material is worn to a thickness of 1/8 inch (3 mm) or less.

3. Clean the torque plate with solvent and dry with compressed air. Ensure that no solvent remains in fluid passages or grooves. Inspect dust boots, seal grooves, and metal "land" areas between grooves for damage or cracks. Minor nicks and scratches may be removed with crocus cloth. Replace the torque plate if corrosion is excessive or if the dust boot and seal grooves are damaged.

NOTE: *Replace the torque plate if the diameter of any bore in the plate is greater than 3.505 inches (89.2 mm).*

4. Inspect the pistons for scratches and nicks. Remove fine scratches with crocus cloth. Replace if necessary.

NOTE: *Replace any piston with an outside diameter of less than 3.4945 inches (88.76 mm).*

ASSEMBLY (Figure 2)

The caliper assembly should be reassembled as follows:

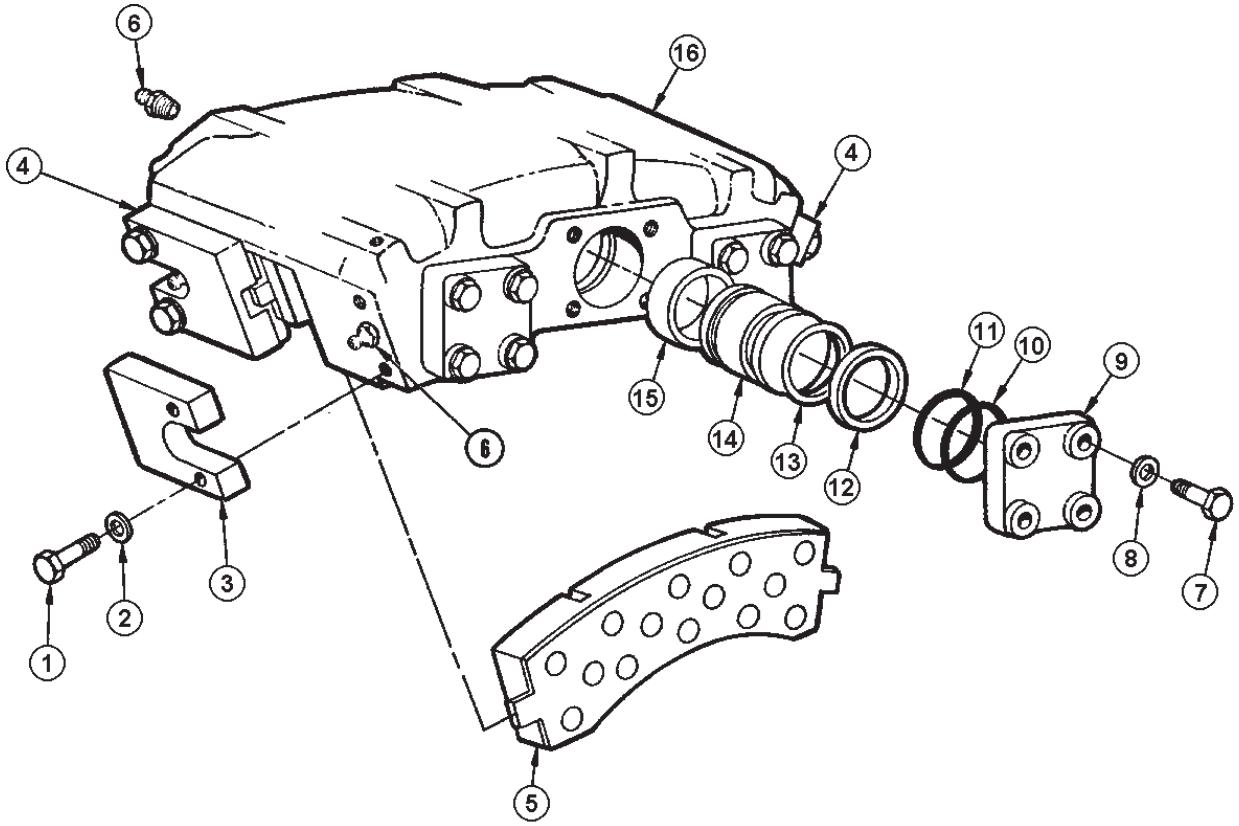
1. Lubricate the packing (12) and pistons (14) with the same fluid used in the brake system.

⚠WARNING

Use only the fluid that is used in the system. Mixture of mineral based hydraulic fluid and non-mineral brake fluid will result in damage to system components.

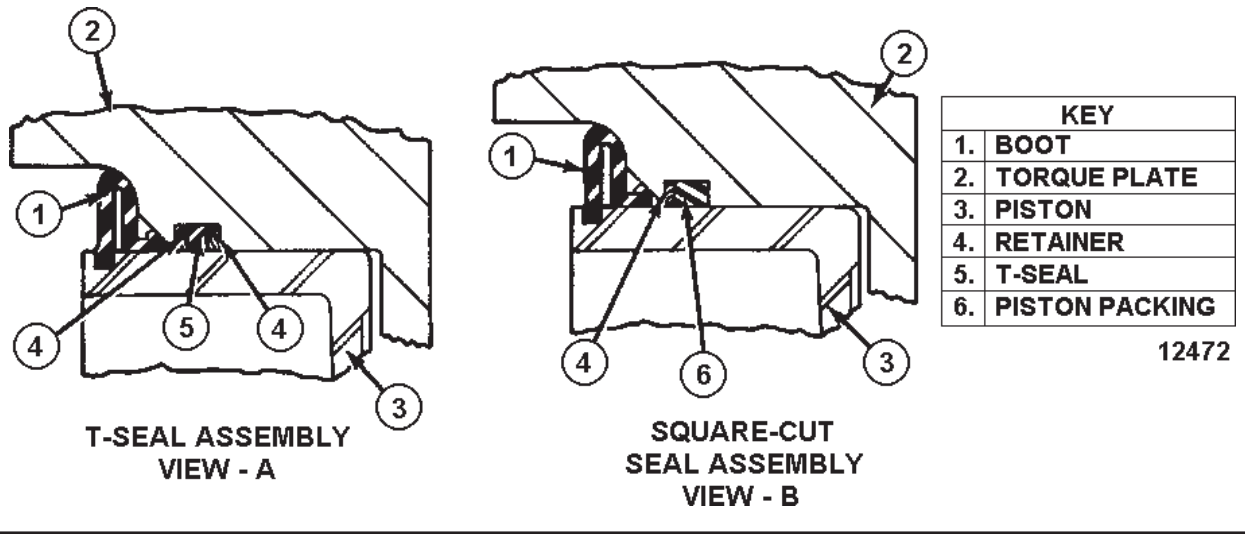
2. Install the packing (11) and retainers into the piston bores.

NOTE: *Packings are T-seals with a retainer installed on each side of the seal, as shown in View A of Figure 3. An alternate seal consisting of a packing and retainer,*



KEY			60872C
1.	CAPSCREW	9.	CAP
2.	WASHER	10.	RETAINER
3.	THRUST PLATE	11.	PACKING
4.	THRUST PLATE	12.	PISTON PACKING
5.	CARRIER AND LINING ASSEMBLY	13.	RETAINER PACKING
6.	BLEEDER VALVE	14.	PISTON
7.	CAPSCREW	15.	BOOT
8.	WASHER	16.	TORQUE PLATE

FIGURE 2 - CALIPER ASSEMBLY



KEY	
1.	BOOT
2.	TORQUE PLATE
3.	PISTON
4.	RETAINER
5.	T-SEAL
6.	PISTON PACKING

12472

FIGURE 3 - SEAL INSTALLATION

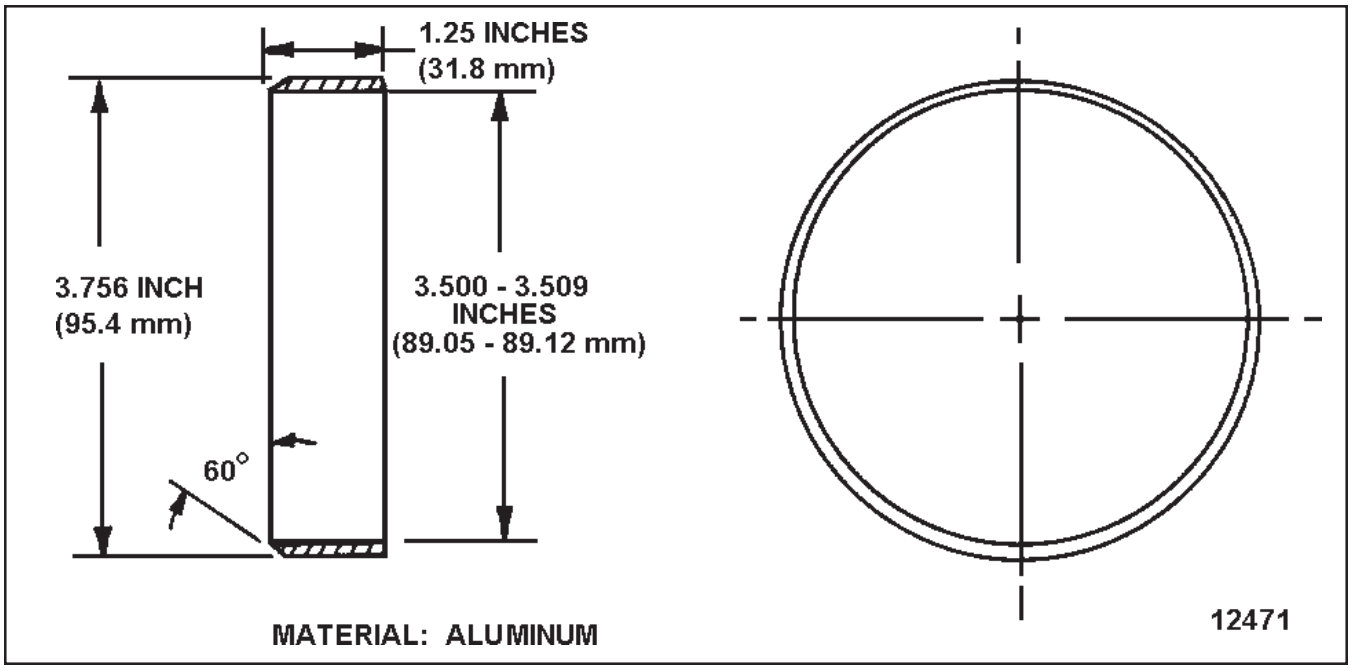


FIGURE 4 - PISTON INSTALLATION SLEEVE

as shown in View B of Figure 3 will eventually replace the T-seals. See View B for correct installation of packing and retainer.

3. Install the dust boots (15) into the grooves of the piston bores as follows:

NOTE: *The recommended method of dust boot installation is to use a sleeve made in accordance with the specifications in Figure 4.*

a. Install the dust boot over the sleeve nearest the beveled end.

b. After the OD lip of dust boot has been installed into groove of the piston bore, check for proper seating of the dust boot lip by reaching through the sleeve with a finger. Lubricate the exposed surfaces of the boot and seals.

c. Insert the piston through the sleeve and dust boot until the piston has seated onto the seal in the piston bore.

d. Remove the sleeve, and press the piston into and through the packing assembly by hand, with a rotating thrusting pressure to the face of the piston.

4. Install the packing and retainers (11 and 10) on the caps (9).

5. Attach the caps to the torque plate with capscrews (7) and washers (8). Dry torque the bolts 135 to 150 ft-lb (185 to 200 Nm).

6. Install the thrust plates (3 and 4) on one side of the torque plate. Secure with capscrews and washers. Lubricate the bolt threads with SAE 10W or 30W oil and torque 730 to 750 ft-lb (990 to 1020 Nm).

NOTE: *Thrust plates are not interchangeable, and must be replaced in the same location from which removed (with bolt hole farthest from groove in plate, toward OD of disc).*

7. Install the carrier and lining assemblies (5), making sure the tangs are engaged in the thrust plates grooves.

8. Install the remaining thrust plates. Secure with bolts and washers. Lubricate threads with SAE 10W or 30W oil, and torque 730 to 750 ft-lb (990 to 1020 Nm).

INSTALLATION (Figures 5 through 9)

The caliper assembly may be installed as follows:

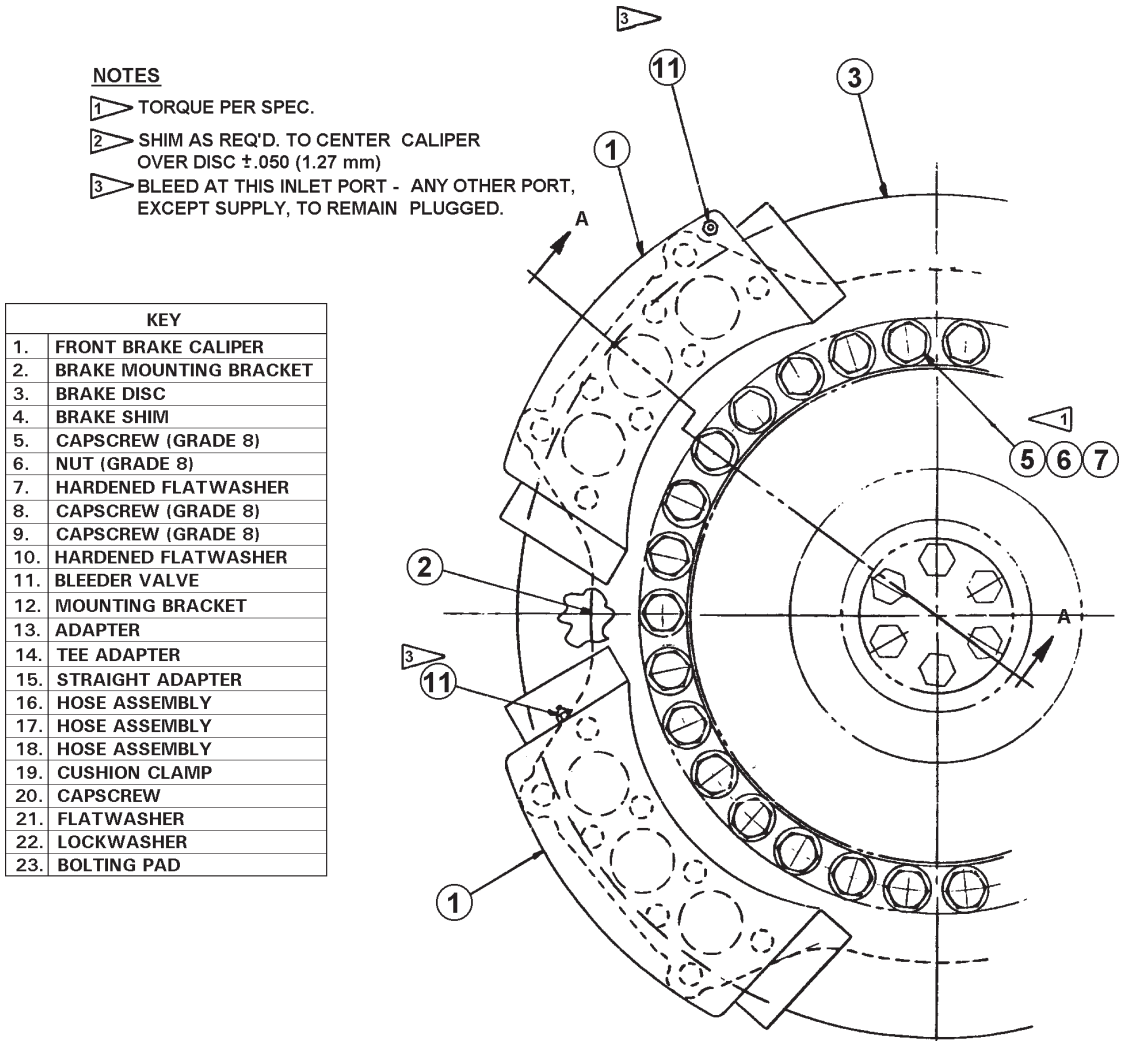
1. If removed, install the brake caliper mounting bracket, oriented as it was removed. Torque each in even increments to the appropriate torque for the fastener used.

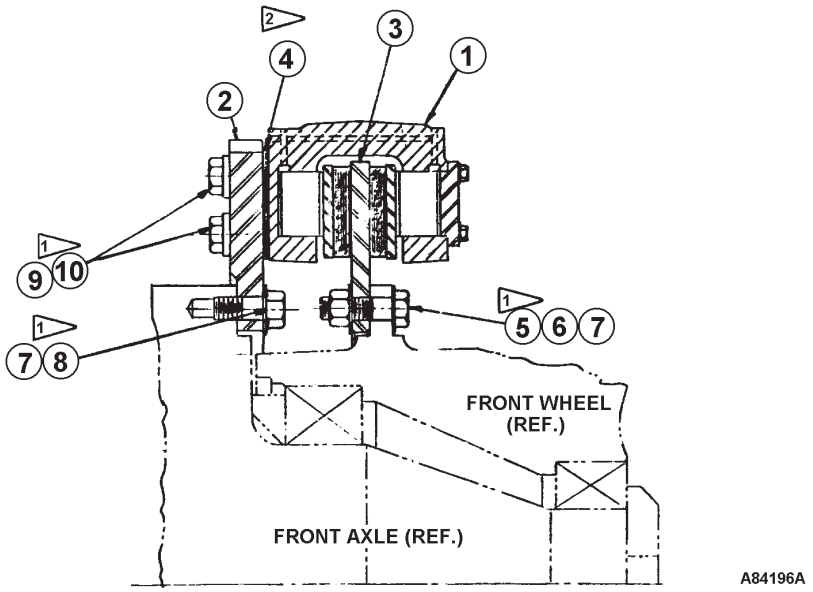
NOTE: *On assemblies in which locknuts are not used, it is recommended that Loctite 266 or equivalent be used on the threads to assist in securing them from loosening.*

NOTES

1. TORQUE PER SPEC.
2. SHIM AS REQ'D. TO CENTER CALIPER OVER DISC ±.050 (1.27 mm)
3. BLEED AT THIS INLET PORT - ANY OTHER PORT, EXCEPT SUPPLY, TO REMAIN PLUGGED.

KEY	
1.	FRONT BRAKE CALIPER
2.	BRAKE MOUNTING BRACKET
3.	BRAKE DISC
4.	BRAKE SHIM
5.	CAPSCREW (GRADE 8)
6.	NUT (GRADE 8)
7.	HARDENED FLATWASHER
8.	CAPSCREW (GRADE 8)
9.	CAPSCREW (GRADE 8)
10.	HARDENED FLATWASHER
11.	BLEEDER VALVE
12.	MOUNTING BRACKET
13.	ADAPTER
14.	TEE ADAPTER
15.	STRAIGHT ADAPTER
16.	HOSE ASSEMBLY
17.	HOSE ASSEMBLY
18.	HOSE ASSEMBLY
19.	CUSHION CLAMP
20.	CAPSCREW
21.	FLATWASHER
22.	LOCKWASHER
23.	BOLTING PAD





SECTION A-A

FIGURE 5 - QUAD FRONT CALIPER INSTALLATION - MT 4400, 5500 (SHEET 1 OF 2)

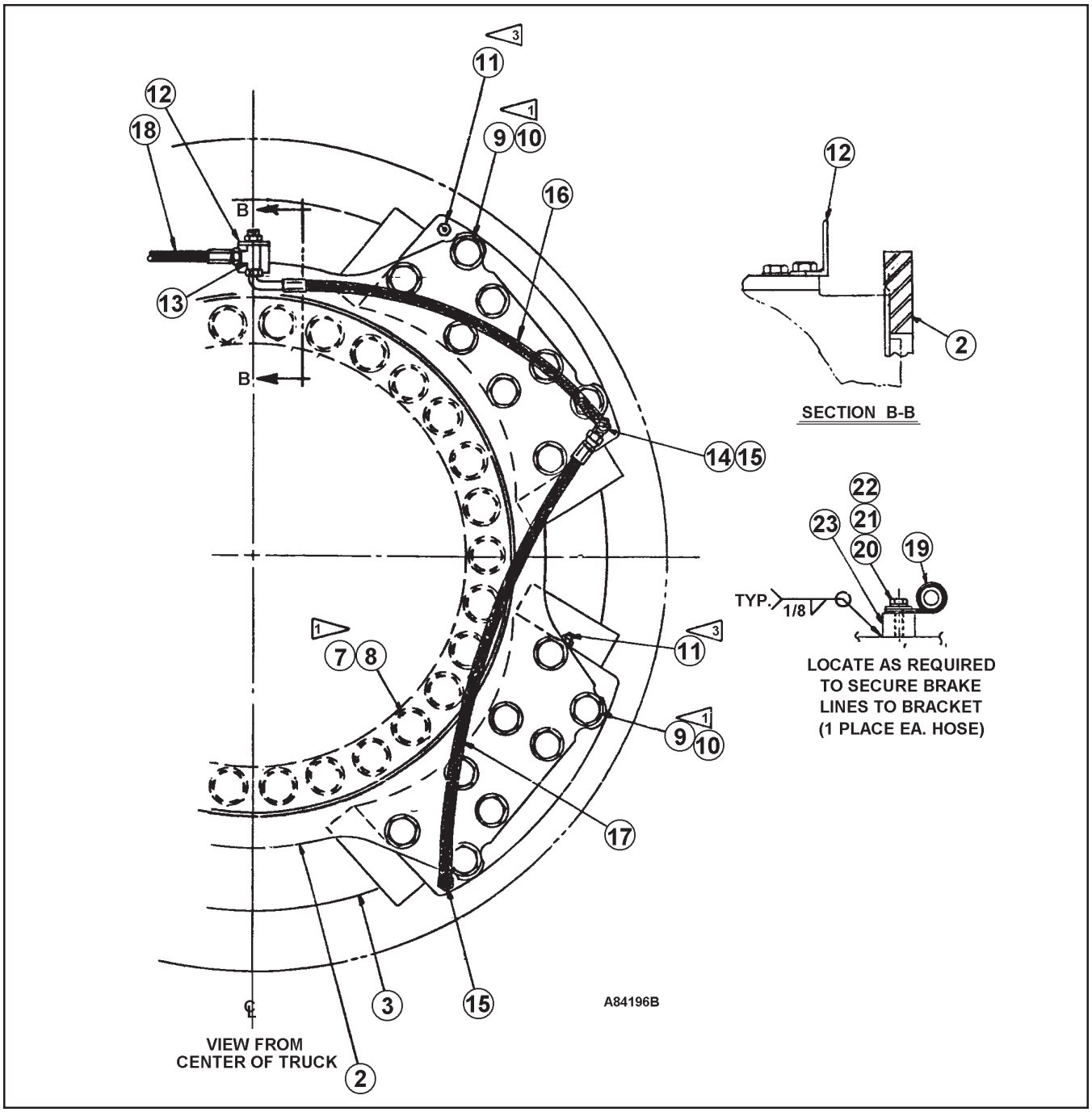


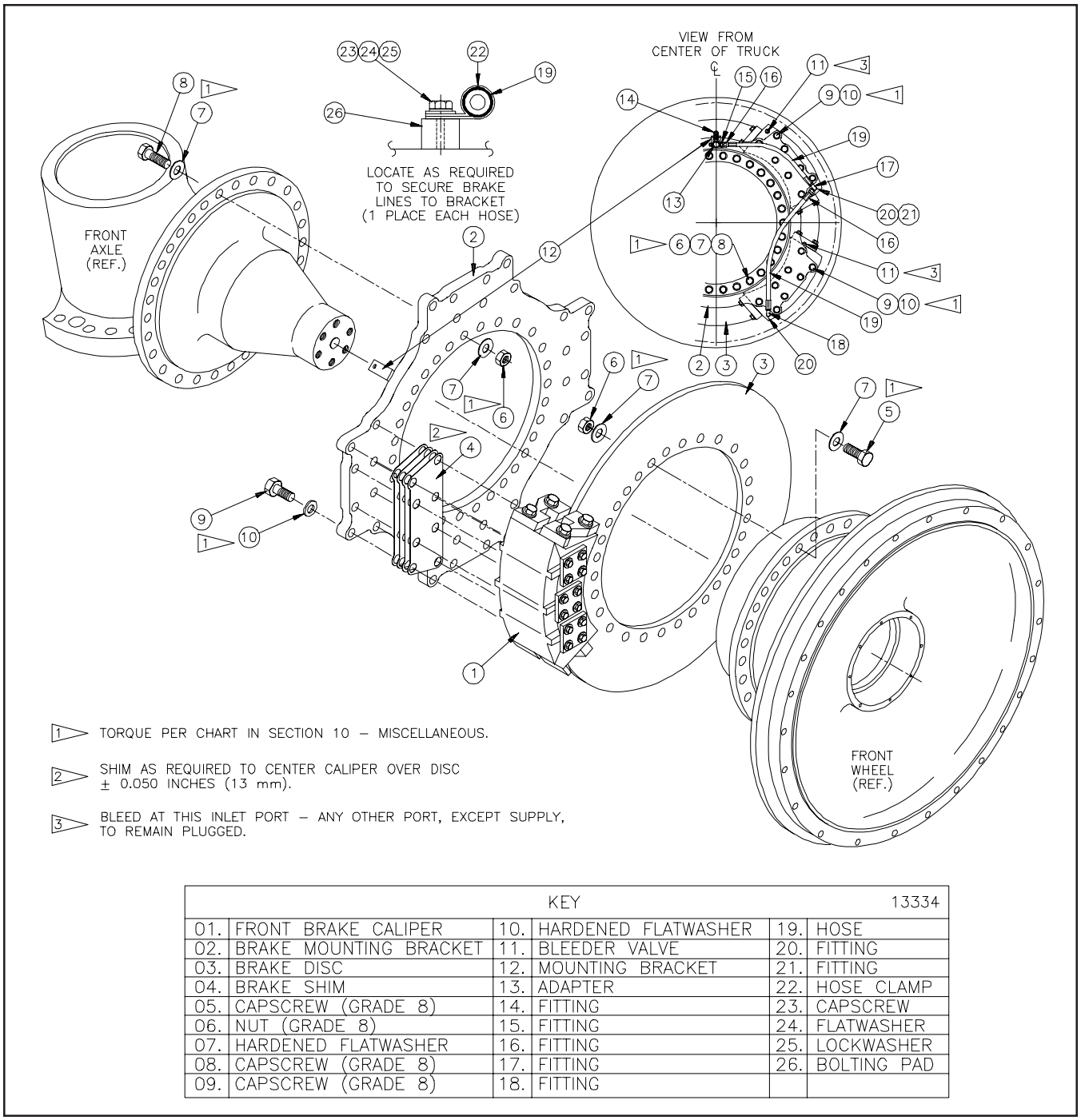
FIGURE 5 - QUAD FRONT CALIPER INSTALLATION - MT 4400, 5500 (SHEET 2 OF 2)

2. Install the brake disc, using hardened flatwashers. Torque as follows:

MK 24, 30, 36	600 ft-lb (815 Nm)
MK 30B	680 ft-lb (922 Nm)
MT 1900/2050/2120	1350 ft-lb (1845 Nm)
MT 2700/3000/3300	680 ft-lb (922 Nm)
MT 3600/3700	1350 ft-lb (1845 Nm)
MT 4000/4400	1350 ft-lb (1845 Nm)
MT 5500	1350 ft-lb (1845 Nm)

NOTE: *On assemblies in which locknuts are not used, it is recommended that Loctite 266 or equivalent be used on the threads to assist in securing them from loosening.*

3. Secure the caliper assembly with the mounting bolts, washers, and nuts. Shim to center the calipers over the disc to within 0.050 inch (1.3 mm). Torque each capscrew to 1500 ft-lb (2050 Nm).



KEY					13334
01.	FRONT BRAKE CALIPER	10.	HARDENED FLATWASHER	19.	HOSE
02.	BRAKE MOUNTING BRACKET	11.	BLEEDER VALVE	20.	FITTING
03.	BRAKE DISC	12.	MOUNTING BRACKET	21.	FITTING
04.	BRAKE SHIM	13.	ADAPTER	22.	HOSE CLAMP
05.	CAPSCREW (GRADE 8)	14.	FITTING	23.	CAPSCREW
06.	NUT (GRADE 8)	15.	FITTING	24.	FLATWASHER
07.	HARDENED FLATWASHER	16.	FITTING	25.	LOCKWASHER
08.	CAPSCREW (GRADE 8)	17.	FITTING	26.	BOLTING PAD
09.	CAPSCREW (GRADE 8)	18.	FITTING		

FIGURE 6 - TYPICAL QUAD FRONT CALIPER ASSEMBLY - MT 4000

4. Install the carrier and lining assemblies, if removed, as outlined elsewhere in this section.

5. Connect the hose from the manifold to the caliper inlet port.

6. Bleed all air from the caliper assemblies as outlined in the instructions in Section 5 - Hydraulic System or Section 6 - Pneumatic System. Be sure to check the assembly for leaks.

7. Install the tire and rim assembly as outlined in Section 7 - Running Gear.

8. Burnish all new linings as outlined in Maintenance and Adjustment.

9. Test the system for proper operation.

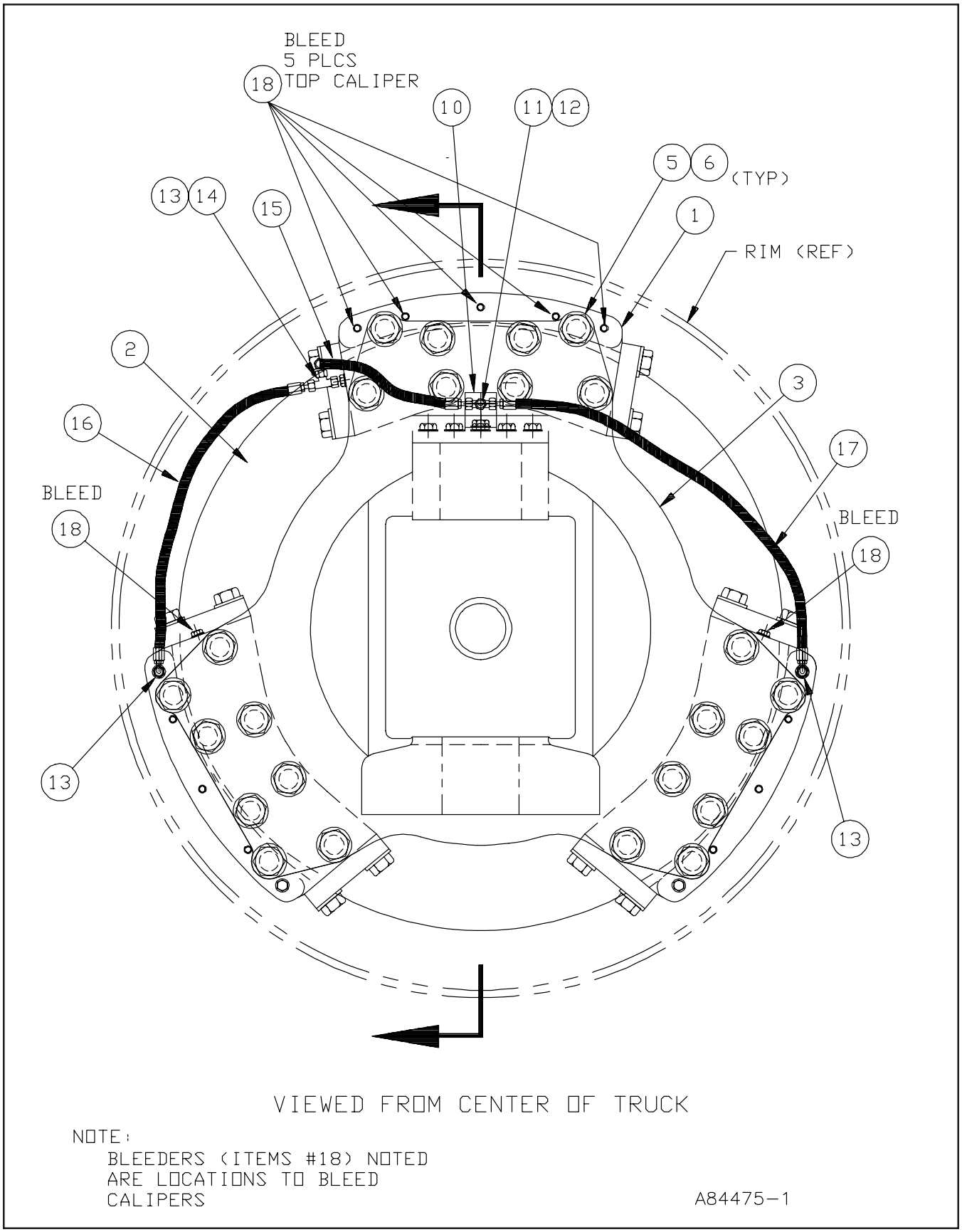
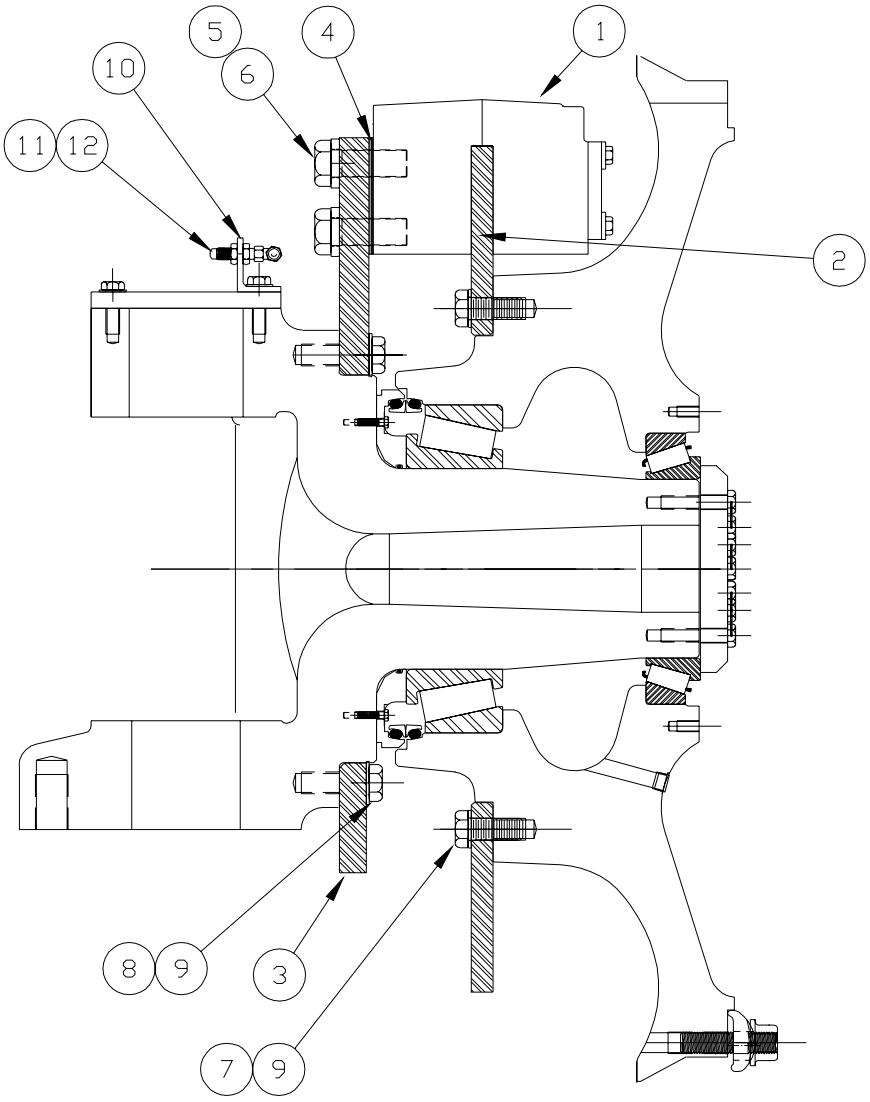


FIGURE 7 - TRIPLE FRONT CALIPER INSTALLATION - MT 3300, 3600, 3700 (SHEET 1 OF 2)

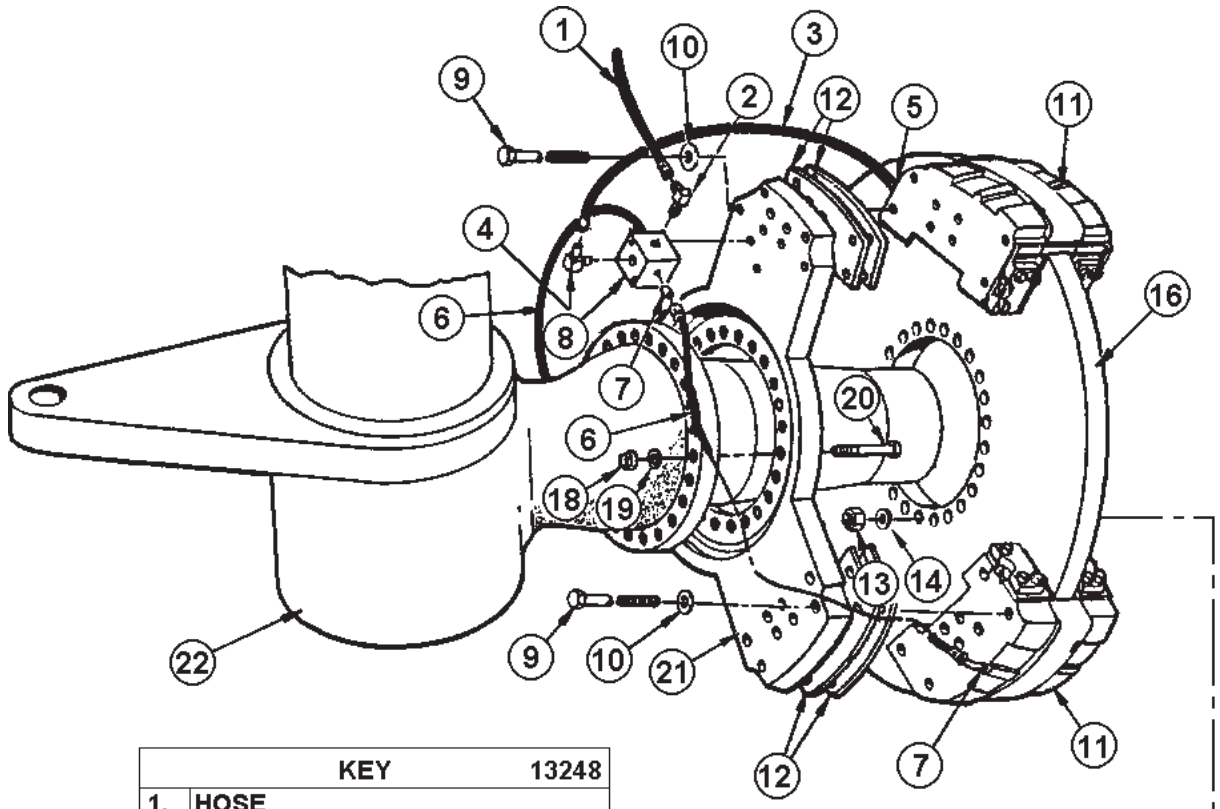
TORQUE ALL FASTENERS PER SPEC.

NOTE:
CENTER CALIPER OVER DISC ±.050 INCH (1.27 mm)



KEY			A84475–2
01.	FRONT BRAKE CALIPER	10.	MOUNTING BRACKET
02.	BRAKE DISC	11.	STRAIGHT ADAPTER
03.	BRAKE MOUNTING BRACKET	12.	TEE ADAPTER
04.	BRAKE SHIM	13.	SHORT STRAIGHT ADAPTER
05.	CAPSCREW (GRADE 8)	14.	TEE ADAPTER
06.	HARDENED FLATWASHER	15.	HOSE ASSEMBLY
07.	CAPSCREW (GRADE 8)	16.	HOSE ASSEMBLY
08.	CAPSCREW (GRADE 8)	17.	HOSE ASSEMBLY
09.	HARDENED FLATWASHER	18.	BLEEDER VALVE

FIGURE 7 - TRIPLE FRONT CALIPER INSTALLATION - MT 3300, 3600, 3700 (SHEET 2 OF 2)



KEY	13248
1.	HOSE
2.	ADAPTER FITTING
3.	HOSE
4.	ADAPTER FITTING
5.	ADAPTER FITTING
6.	HOSE
7.	ADAPTER FITTING
8.	BRAKE MANIFOLD
9.	CAPSCREWS GRADE 8
10.	HARDENED FLATWASHER
11.	BRAKE CALIPER
12.	SHIM
13.	NUT GRADE 8
14.	HARDENED FLATWASHER
15.	CAPSCREW GRADE 8
16.	DISC
17.	FRONT WHEEL
18.	NUT GRADE 8
19.	HARDENED FLATWASHER
20.	CAPSCREW
21.	CALIPER MOUNTING BRACKET
22.	FRONT SUSPENSION

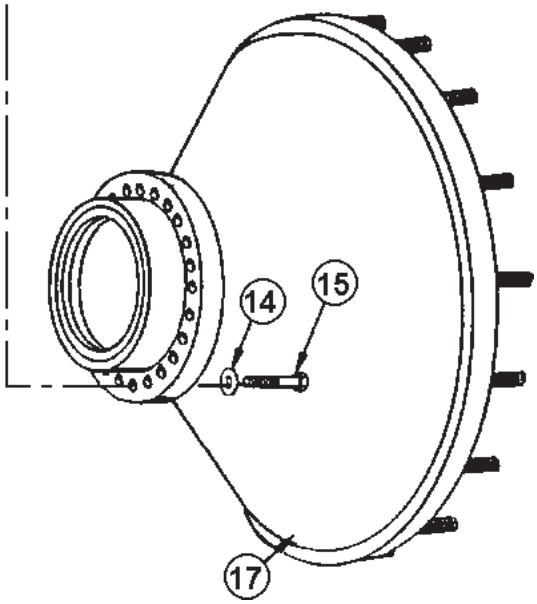
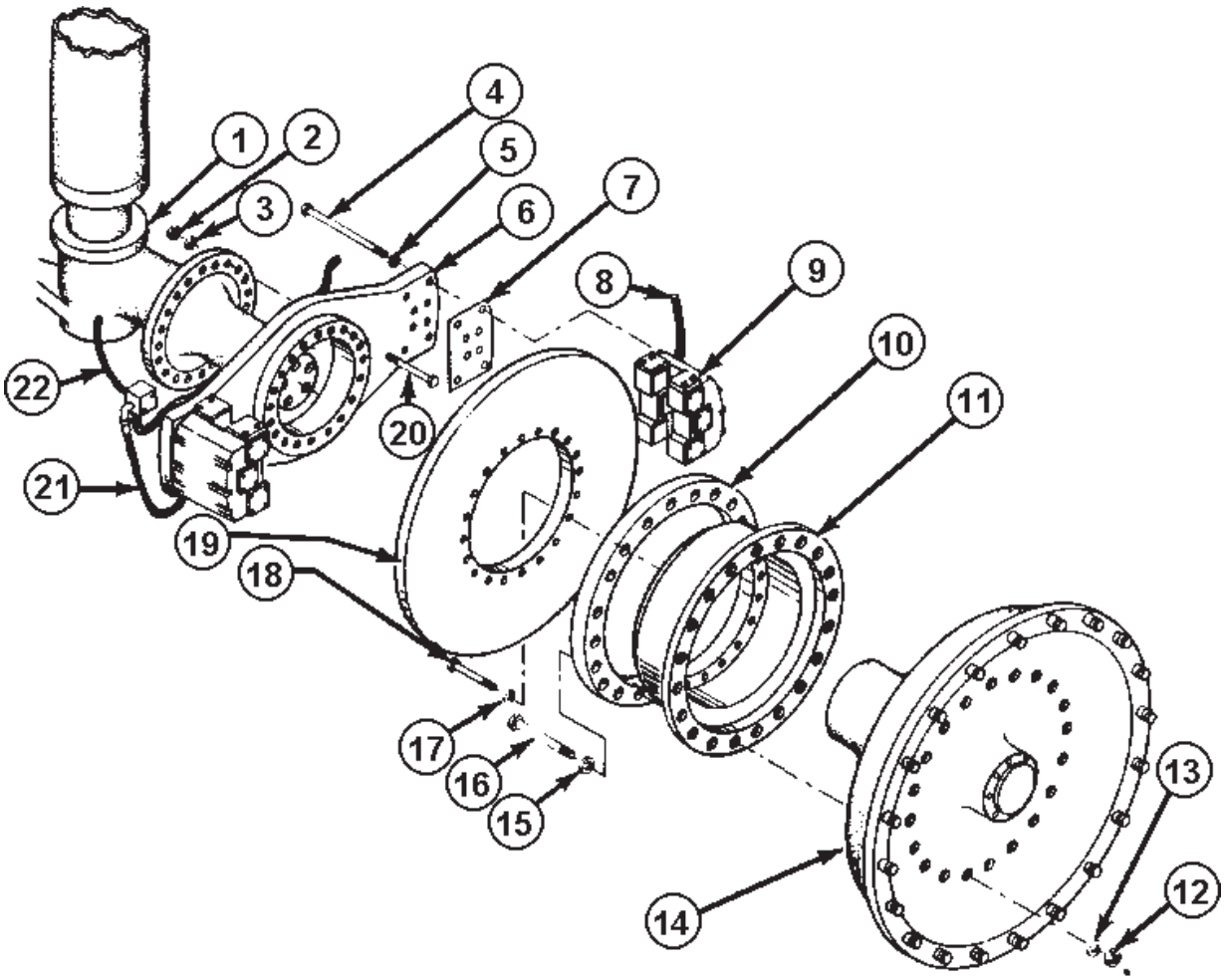


FIGURE 8 - TYPICAL TRIPLE FRONT CALIPER INSTALLATION



KEY			12229
1.	FRONT SUSPENSION ASSEMBLY	12.	NUT GRADE 8
2.	NUT GRADE 8	13.	HARDENED FLATWASHER
3.	HARDENED FLATWASHER	14.	FRONT WHEEL ASSEMBLY
4.	CAPSCREW GRADE 8	15.	HARDENED FLATWASHER
5.	HARDENED FLATWASHER	16.	CAPSCREW GRADE 8
6.	MOUNTING BRACKET ASSEMBLY	17.	HARDENED FLATWASHER
7.	SHIM	18.	CAPSCREW GRADE 8
8.	HOSE ASSEMBLY	19.	BRAKE DISC
9.	CALIPER ASSEMBLY	20.	CAPSCREW GRADE 8
10.	DISC SPACER	21.	HOSE ASSEMBLY
11.	DISC MOUNTING BRACKET	22.	HOSE ASSEMBLY

FIGURE 9 - TYPICAL DUAL FRONT CALIPER INSTALLATION

FRONT DISC BRAKES – ARVINMERITOR (ROCKWELL/GOODYEAR)

⚠WARNING

The procedures in this manual for servicing brakes are recommended to reduce exposure to fiber dust, a potential cancer and lung disease hazard. The primary concerns are to avoid creating airborne contamination (such as by blowing material with air) or direct contact with the skin or other organs. Avoid any inhalation of the material and wash hands and other exposed areas of the body after any exposure. Always follow the specific procedures for your work location. Material Safety Data Sheets are available from BUCYRUS®.

DESCRIPTION AND LOCATION (Figures 2, 3, and 4)

The ArvinMeritor (Rockwell/Goodyear) front brake system is of the caliper and disc design. They are mounted on both front suspension/wheel assemblies. Each front wheel uses a single disc, with 2 or more calipers.

OPERATION

Pressurized fluid from the brake actuator and/or control valve assembly enters through an inlet in the housing. The fluid pressure forces the pistons out against the lining assemblies that in turn are forced against the disc creating a braking action. The induced torque is resisted by the retaining plates.

All the piston bores on each are interconnected to allow free flow of fluid between the piston. This ensures that the pistons push equally on the linings to maximize the braking effort.

MAINTENANCE AND ADJUSTMENT

IMPORTANT: *Park the truck in a SAFE POSITION before performing any maintenance. The truck must be secured by means other than the truck's friction brake system.*

Periodic maintenance of each brake assembly should include the following:

1. Inspect the brake linings for:

a. Lining wear. The linings must be replaced when the thickness of the lining has been worn to a thickness of less than 0.125 inch (3.2 mm) from the backing plate. Follow the instructions on lining replacement in this module.

NOTE: *This thickness is the minimum allowable wear thickness. If experience indicates that the linings may be worn to a thickness less than this prior to the next scheduled brake inspection, it should be replaced at this time to prevent wear to less than this limit.*

b. The thickness of the two linings is significantly different. Determine the cause before repairing to prevent future wear.

c. There is oil or grease on the linings.

d. There are cracks on the lining larger than the normal "heat check" cracks.

⚠ CAUTION

Always replace both linings. If only one lining is replaced possible disc wear can occur.

2. Bleed the brakes according to proper procedure. Check the bled oil for evidence of moisture or contamination. Always discard all oil that is bled from the system.

3. Inspect for evidence of fluid leakage. If present, the brake must be removed for disassembly, inspection, and rebuilding.

4. Inspect the condition of the dust covers. They should be soft and pliable. They should not be hardened or ruptured. If cover replacement is necessary, removal and disassembly is recommended to ensure that dirt has not entered the piston cavity.

5. Inspect the condition of the tubing subassemblies for damage. Inspect the fittings and connections for leakage. Repair or replace as necessary.

6. Wipe the housing subassemblies and lining retaining plates to remove any dirt before installation of new linings. If a petroleum base cleaning fluid is used, such as diesel fuel, use sparingly on the dust covers, and wipe dry.

7. Inspect each front disc for wear. Place a straight edge on each of the worn faces. The disc should be replaced

if this measurement is 0.06 inch (1.5 mm) each side, or if the disc is worn to a minimum total thickness of 1.12 inch (28 mm).

NOTES:
1. This thickness is the minimum allowable wear thickness. If experience indicates that the disc may be worn to a thickness less than this prior to the next scheduled brake inspection, it should be replaced at this time to prevent wear to less than this limit.
2. The amount of waviness of the worn disc face will have the effect of reducing new lining life, because of the lining material used before the lining is completely worn in.

8. Check the linings for freedom to slide back and forth in retaining plates between piston faces and disc.

NOTE: *If a lining is binding, remove it and correct the cause, typically grooves worn in the end plates.*

9. Check the clearance between the disc and retaining plates. If brake installation is done properly, this clearance should be minimally 0.25 inch (6.3 mm), each side of the disc.

10. If it is necessary to replace any tubing subassemblies or break any hydraulic brake line connections, it will be necessary to relieve the brake system pressure.

⚠ DANGER

Never loosen any line or remove any component without first releasing all pressure from the system.

On trucks equipped with carbon metallic linings, verify that the brake disc:

1. Finish is 125 RMS or smoother.

2. Wear surface run-out is less than 0.010 inch (0.3 mm).

BLEEDING THE BRAKES

Bleeding the brakes is a procedure by which entrapped air and other contamination is removed from the operating fluid in the brake system. It is important all contamination be removed from the hydraulic fluid prior to beginning operation.

On trucks with a totally hydraulic brake system, this entails applying the brake system and holding by depressing the Brake pedal or applying the Hand Brake. On trucks with an air/hydraulic brake actuation system, typically the system application controls and actuators must be cycled repeatedly to allow for this purging to occur.

Detailed instructions for the procedure required by each system configuration is included in the appropriate system procedure in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

Tighten the bleeder screw to 100 to 120 inch-lb (11.3 to 13.5 Nm) except when the valve is opened to allow for actual bleeding of the caliper.

NOTE: *Direct the fluid away from the brake lining and the disc during the bleeding operation. A piece of hose emptying into a can will prevent fluid contamination of these components.*

⚠ CAUTION

Use only a mineral base hydraulic oil, SAE 10 or equivalent, in the brake system unless another fluid is specified. Do not apply pressure to the brake system unless the caliper assembly is straddled over the disc assembly and the linings and other components are all properly installed.

⚠ WARNING

Fluid may cause irritation. Avoid any contact with the eyes or prolonged contact with the skin.

LINING REPLACEMENT (Figure 1)

NOTE: *It is recommended that all linings in all calipers on both front wheels be replaced at the same time.*

The linings may be replaced as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction brake system.

2. Release all service and hand brakes. Apply the park brakes, if so equipped.

3. Release all hydraulic pressure in the brake system as outlined in Maintenance and Adjustment.

4. Remove the linings retaining plates (5) on each end of the brake assembly, and remove the worn linings.

5. Inspect the linings (6) for fluid leakage.

6. Open the bleeder valve (12) to relieve fluid pressure.

⚠WARNING

Fluid may cause irritation. Avoid any contact with the eyes, or prolonged contact with the skin.

NOTE: *Direct the fluid away from the brake linings and disc during the lining change and bleeding operation. A piece of hose emptying into a can will prevent fluid contamination of these components.*

7. Using a block of wood or equivalent between the disc and linings, force the pistons and linings back into their respective housing as far as they will go.

8. Close the bleeder valve (12). Tighten the bleeder valve to 100 to 120 inch-lb (11.3 to 13.5 Nm).

9. Remove the worn linings (6).

10. Install the new linings (6).

⚠WARNING

Use only the approved linings available from BUCYRUS®. Use of substitute, non-approved linings may result in loss of braking effectiveness. Do not mix new and used linings in a brake assembly.

11. Install the retaining plates (5). Apply Loctite 271 (liquid), 268 (stick), or equivalent on the threads and torque the bolts to 380 to 460 ft-lb (515 to 625 Nm).

12. Bleed the brakes as outlined in the system procedures in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

13. Check the linings for freedom to slide back and forth in the retaining plates, between the piston faces and disc.

14. Check the clearance between the disc and retaining plates. If the brake installation is done properly, this clearance should be 0.25 inch (6.4 mm) (nominal) each side of disc.

15. Apply and release the brakes several times. The linings should be free from disc, with a slight disc-to-lining clearance.

16. Burnish the brakes as outlined in the procedure in Maintenance and Adjustment in this module.

BURNISHING BRAKES

All brakes must be burnished (seated) when new, or whenever new disc or linings are installed. The burnishing procedure should be done prior to placing the truck back into service after brake repair. Failure to follow the proper burnishing procedure may result in reduced braking and increased stopping time.

Smoke and foul odors coming from the brake area during burnishing are considered normal. The truck should be empty and driven on level ground in an area clear of all obstructions and personnel. Stopping distance required may be greater than normal during burnishing.

NOTE: *Experience has shown that continuing to run the engine at a faster idle between burnishing cycles will aid in cooling of the wheelmotors.*

The front brakes may be burnished as follows:

1. On trucks equipped with all lining materials except carbon metallic based linings (which are identified by a red stripe):

a. Disconnect the truck's rear brakes.

(1) On trucks equipped with pneumatic actuated brakes this may be done by disconnecting and capping the pneumatic line to each of the actuators in the axlebox assembly.

NOTE: *On trucks equipped with "Spring Brake" actuators, care must be taken to remove the line connected to the "Service Brake" port, not the line to the "Spring Brake" port. Disconnecting the "Spring Brake" supply line will cause the spring brake to actuate and create unnecessary drag and wear.*

⚠DANGER

Never loosen any line or remove any component without first releasing all pressure from the system.

(2) Trucks equipped with hydraulic brake actuation system, this may be done by removing and capping the supply line to the axlebox.

⚠ CAUTION

It is important to remember that braking distances will be significantly increased with the rear brakes disconnected. Extra precaution must be taken while burnishing. The rear brakes should be reconnected immediately upon the completion of front brake burnishing. Never release the truck for normal operation without all brakes connected and functioning normally.

b. Drive the truck 5 to 10 mph (8 to 16 km/hr) with the front brakes dragging until the disc temperature reaches 600˚F (315˚C) or more. Check the temperature after 200 yards (185 m). The brake pedal must be used for this operation.

NOTE: *The Front Wheel Brake control (on trucks so equipped) should be set in the Dry Roads position on trucks equipped with pneumatic actuated brakes.*

NOTE: *Do not allow the disc temperatures to exceed 800˚F (425˚C).*

c. Allow the discs to cool to 250˚F (120˚C).

NOTE: *Brakes should be released during all cooling periods.*

d. Repeat steps 2 and 3 a second time.

e. Connect the rear brake system supply lines, and allow the front brakes to cool to 250˚F (120˚C).

f. Bleed the rear brake system of all entrapped air.

2. On trucks equipped with carbon metallic linings (identified by a red stripe):

a. With truck empty make five successive 10 mph (16 km/hr) stops.

b. Make 5 additional successive stops from 25 mph (40 km/hr) with less than 3 minute intervals between stops.

c. Load truck to rated capacity.

d. Reconnect the rear brakes as outlined in steps 1 a (1) and (2) above.

e. Make five successive 25 mph (40 km/hr) stops with less than 3 minute intervals between stops.

f. Reconnect the rear brakes and bleed any entrapped air from the system.

g. With the service and hand brakes released allow to cool 1 hour before placing unit in service.

REMOVAL (Figures 2, 3, and 4)

The caliper assembly may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release all service brakes and apply the park brakes.

3. Release all pressure in the hydraulic actuation system as in the procedures in Section 5 - Hydraulic system or Section 6 - Pneumatic System.

4. Disconnect the hydraulic line at the caliper assembly, and install a clean plug on the hydraulic line and a clean cap on the caliper assembly.

⚠WARNING

Fluid may cause irritation. Avoid any contact with the eyes, or prolonged contact with the skin.

5. Remove the hydraulic line between the calipers.

6. Remove the brake lining retaining plates (one end only), and remove the lining.

NOTE: *To lessen the weight of the caliper, the brake linings can be removed from the caliper before the caliper is removed from the truck.*

7. Remove the brake assembly mounting bolts, taking care to retain any shims between the brake assembly and the brake mounting bracket.

NOTE: *Retain the shims and identify their location. The shims should be reinstalled when the brake assembly is installed, to center the brake assembly with the disc.*

8. Remove the brake caliper assembly and separate the individual caliper assemblies.

⚠WARNING

The housings are very heavy. Make sure that the housings are supported during removal and installation. Serious personal injury or damage to the caliper can occur if the housings are dropped.

The disc may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction brake system.

2. Remove the caliper assemblies as outlined previously.

3. With adequate blocking and jacks, raise the truck

TROUBLESHOOTING CHART		
PROBLEM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
BRAKE DOES NOT APPLY		
No pressure to brake.	Improper operation of the hydraulic system.	Test the operation as outlined in Section 5 - Hydraulic System or Section 6 - Pneumatic System.
Piston does not move.	No pressure applied to the brake caliper.	Test the operation as outlined in Section 5 - Hydraulic System or Section 6 - Pneumatic System.
	Piston cocked in housing bore.	Check the dimensions of the housing and pistons as outlined in Inspection and Repair. Repair or replace as required. Remove any dirt or other material between the lining and the piston.
Brake caliper leaking.	Loose bleeder screw.	Tighten, repair, or replace as required.
	Loose inlet fitting.	Tighten, repair, or replace as required.
	Damaged inlet fitting.	Repair or replace as required.
	Worn or damaged o-rings or back-up rings.	Repair or replace as required.
Damaged lining.	Lining thickness less than 0.125 inches (3 mm).	Replace the linings.
	Lining wear not even.	Inspect the piston. Repair or replace as required. Inspect the end plates. Repair or replace as required.
	Cracked or broken linings.	Replace the linings.
	Oil or grease on linings.	Replace the linings.
BRAKE DOES NOT RELEASE		
Truck does not move.	Parking brake applied.	Release the parking brake.
	Improper operation of the hydraulic system.	Test the operation as outlined in Section 5 - Hydraulic System or Section 6 - Pneumatic System.
Brakes dragging on disc and/or running too hot.	Pressure exceeds 3 psi (20 kPa) when the brakes are released.	Test the operation as outlined in Section 5 - Hydraulic System or Section 6 - Pneumatic System.
	Improper driver operation.	Review operation and correct as required.
	Pistons cocked in the bores.	Test the operation as outlined in Section 5 - Hydraulic System or Section 6 - Pneumatic System.
	Worn or damaged end plates.	Replace worn or damaged end plates. Make sure that the linings move freely between the end plates.

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front wheel/suspension until the front wheel is free to rotate.

NOTE: *The front wheel assembly can be removed with the tire and rim assembly installed, or the tire and rim can be removed first. If the tire and rim must be removed, refer to the information on tire removal in Section 7 - Running Gear.*

4. Remove the front wheel as outlined in the instructions in Section 7 - Running Gear.

5. Remove the disc mounting bolts and washers, and remove the disc.

DISASSEMBLY (Figure 1)

The caliper assembly may be disassembled as follows:

1. Clean the entire unit prior to beginning disassembly:

a. After the brake is removed, the housings (13) should be drained of fluid, and the inlet fittings and openings capped and plugged. The calipers should be given a preliminary cleaning before being moved to the rebuild area for disassembly.

b. Preliminary cleaning can be more effective if the linings are removed. However, retaining plates should be temporarily installed in order to stay with brake assembly through the overhaul cycle.

c. Cleaning may be done by brush or spray, with 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 covers (8) should be wiped dry with a clean cloth.

d. If the brake has not accumulated excessive surface dirt, preliminary cleaning can be done in the rebuilding area. However, it is recommended that preliminary cleaning be done before removal of the pistons. The use of vapor degreasing or steam cleaning is not recommended.

2. Remove the bleeder valves (12) and fitting (3) from the housings (13).

3. Carefully remove the dust covers (8) from behind the grooved lips in the housing and from the lip grooves in the pistons (9).

4. Remove the pistons (9).

⚠ CAUTION

Pistons should not be thrown carelessly into a basket or otherwise allowed to batter each other. The usual cause of nicked piston surfaces is mishandling at this point.

Cleaned and dried parts should not be left exposed for any significant time without a protective coating or lubricant. For short term storage, coat all internal cavities, passages, and bosses with hydraulic fluid. For long term storage, wipe cavities, connector bosses, and threads with protective grease.

5. Remove the seals (10) and back-up ring (11) from the piston cavity seal grooves. Use a small flat tool of wood fiber, etc., with a smooth rounded end. Verify the type of seal that was installed as replacement with the same type of seal is typically recommended.

NOTE: *Under no circumstance should steel tools be used in the piston cavities and seal grooves. Copper, brass, aluminum, wood, etc., are acceptable materials for such purpose.*

a. The standard seal kit incorporates a conventional "round" O-ring and symmetrical back-up ring assembly.

b. The special service kit assembly incorporates a "slant" or specially formed seal and a curved back-up ring assembly.

INSPECTION AND REPAIR (Figure 1)

The disassembled unit may be serviced as follows:

1. Clean all parts of the brake assembly as follows:

a. Use solvent cleaners to clean all metal parts that have ground or polished surfaces, such as pistons and piston bores.

b. Use solvent cleaners or alkaline solutions to clean metal parts with rough surfaces.

c. Use a wire brush to clean the threads of fasteners or fitting.

d. Use soap and water to clean all non-metal parts.

⚠ DANGER

Petroleum base cleaning fluids are volatile. Do not use near an open flame.

⚠ CAUTION

Use only solvent cleaners to clean ground or polished metal parts. Hot solution tanks or water and alkaline solutions will damage these parts. Isopropylene alcohol, kerosene, or diesel fuel can be used for this purpose.

NOTES:
1. Be certain that hydraulic passages in the housing are clean and free from contaminants.
2. Immediately after cleaning, dry all parts with clean paper or rags.

NOTE: *It is recommended that all seals and back-up rings be replaced at disassembly, but if they are reused, clean in a petroleum base hydraulic oil compatible with that used in the truck's hydraulic system.*

2. If brake linings are to be reused, scrape away build-ups of mud and dirt. Replace all linings that have been contaminated with oil or grease.

NOTE: *Linings must be replaced if:*
1. The thickness of the lining has been worn to a thickness of less than 0.125 inch (3.2 mm) from the backing plate. This thickness is the minimum allowable wear thickness. If experience indicates that the linings may be worn to a thickness less than this prior to the next scheduled brake inspection, it should be replaced at this time to prevent wear to less than this limit. Follow the instructions on lining replacement in this module.
2. The thickness of the two linings is significantly different. Determine the cause before repairing to prevent future wear.
3. There is oil or grease on the linings.
4. There are cracks on the lining larger than the normal "heat check" cracks.

3. Inspect the piston for evidence of wear or damage.

a. If any piston has worn too much to be buffed, it should be replaced. Surface quality should be compared with a new piston. The surface roughness of the piston face that contacts the lining back plate is a normal condition.

b. Measure the outer diameter of the piston. Replace the piston if the outer diameter is less than 3.619 inches (91.92 mm).

4. Inspect the dust covers (8) for damage, hardening, cracking, or deterioration. Defective covers can allow contaminants to enter, which may damage the piston, cylinder walls, and seal. If the dust covers are found to be soft and pliable, with no sign of hardening or cracking, they should be wiped clean and set aside for reuse.

5. Inspect the housing for cracks. If any are noted, the housing should not be used, and the manufacturer should be consulted to determine its ability to be repaired. Inspect the dust cover grooves.

6. Inspect the piston cavities for evidence of wear or damage.

a. Inspect the cavities and surfaces for evidence of dirty fluid, particularly if the dust covers were cracked.

b. Inspect the cavities for evidence of varnish formation, caused by excessive heating of brake fluid.

c. Inspect the edges of the seal grooves. They must feel smooth and sharp with no nicks or sharp projections that can damage seals or scratch pistons. The seal groove surfaces must be smooth and free of pits or scratches.

d. The finish of the cylinder wall is not as critical as the surface finish of piston. Surface roughness near the entrance of the cavity should be hand polished very carefully to avoid enlarging the cavity beyond a maximum of 3.629 inches (92.18 mm) inside diameter at the outer edge of the seal groove. Power polishing or honing may be used in cases of extreme surface wear of cavity walls.

NOTES:
1. Care must be taken that a minimum amount of material is removed. Power polishing will not normally be required, and should not be used as a standard rebuilding procedure.
2. The use of a special "3-leg" inside micrometer is recommended for accurate measuring of this bore. It should be measured at several points on the bore to ensure that the dimensions remain consistent.

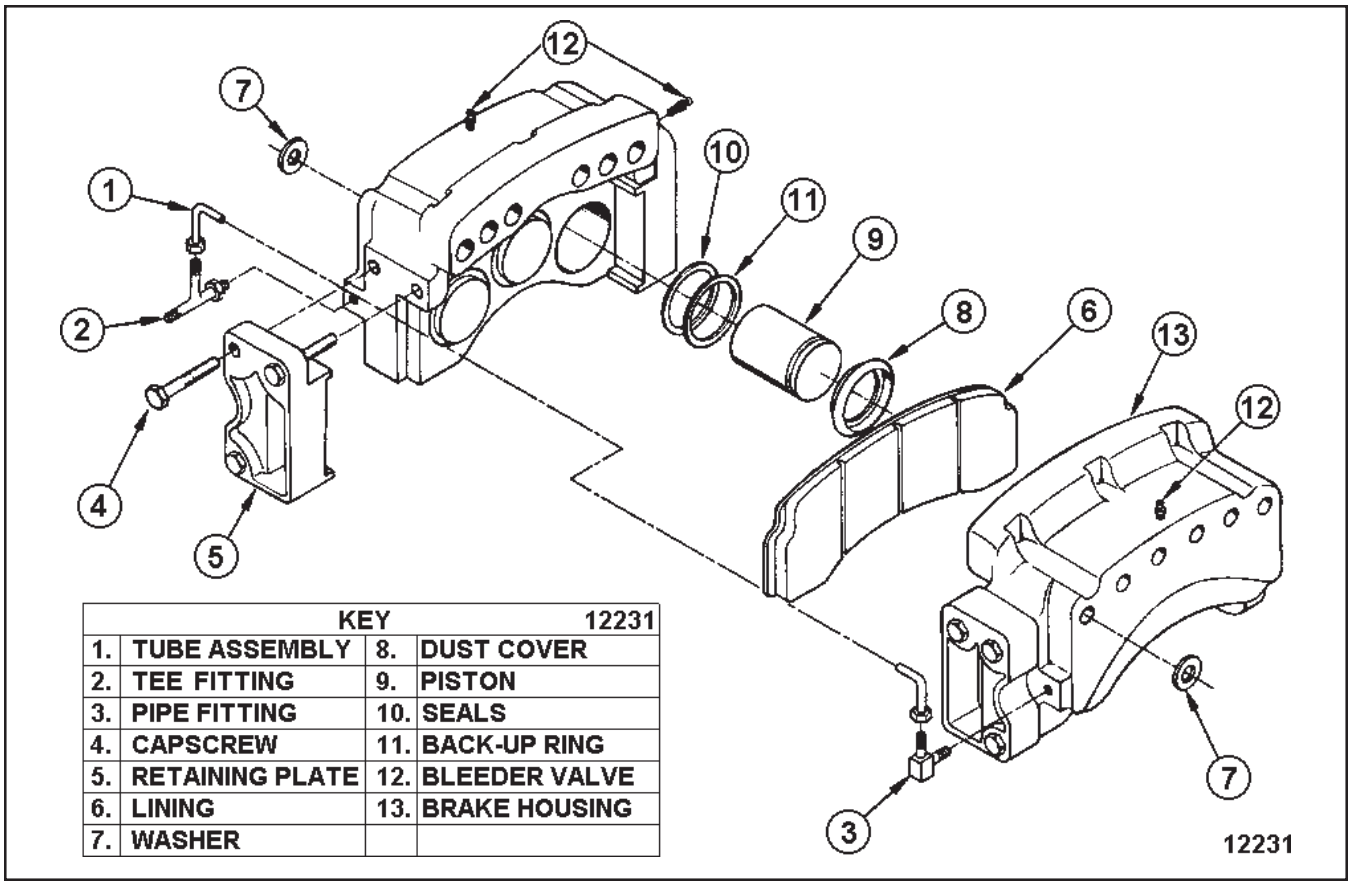
7. Inspect the inlet and bleeder ports in the housings for damage to threads or seal counterbores. Thread damage that cannot be repaired by use of a 0.4375-20 UNF-3B tap will require the housing to be discarded and replaced.

8. Inspect the retainer plates (5) for bent or cracked condition, replace if such damage is found. Inspect the retainer plate bolts and tapped holes in the housing.

NOTE: *These bolts are highly stressed and should be replaced whenever their condition appears questionable. A 3/4-16 UNF-2B tap lubricated with a light oil may be used to inspect tapped holes in housing for thread damage, and to clean up any minor thread roughness.*

ASSEMBLY (Figure 1)

The caliper should be assembled as follows:



KEY			12231
1.	TUBE ASSEMBLY	8.	DUST COVER
2.	TEE FITTING	9.	PISTON
3.	PIPE FITTING	10.	SEALS
4.	CAPSCREW	11.	BACK-UP RING
5.	RETAINING PLATE	12.	BLEEDER VALVE
6.	LINING	13.	BRAKE HOUSING
7.	WASHER		

FIGURE 1 - CALIPER ASSEMBLY

1. Lubricate all cylinder walls, threads, seals, piston seal surfaces, etc. with a silicone grease or equivalent. An adequate assembly lubricant is fluid of the type used in the vehicle brake system.

⚠WARNING

Fluid may cause irritation. Avoid any contact with the eyes, or prolonged contact with the skin.

2. Install the new piston seals (10) and back-up rings (11) in the housings.

a. Install the back-up ring located on the lining side of the seal groove.

b. Install the O-ring into the groove behind the O-ring.

NOTE: *When installing the "slant seal" kit assembly, install the:*
1. Seal with the large end of the seal facing the pressure (inside) of the caliper.
2. Back-up ring with the large radius of the ring facing the rubber seal (still installed on the lining side of the main seal).

3. With the housing positioned on its mounting face, and being careful not to pinch seals (10), gently force and twist each piston past the piston seal until they are seated in bottom of cavities.

4. Install the new or reusable dust covers (8).

⚠ CAUTION

If the dust boots are not completely installed into the housing groove, the pistons will cut and damage the boot when pressure is applied.

NOTE: *Keep these parts as free of lubricant as possible.*

5. Install all fittings and bleeder valves (12) in the correct position in the housings. Install protective plugs for storage protection.

This final assembly of fittings may be postponed until completion of functional test, for which each housing (13) can be temporarily equipped with a bleeder valve and a suitable fitting for connecting to the functional test hydraulic supply.

6. After completing the assembly, a functional test of the unit is recommended to verify that the rebuilt assembly is complete, that the seals are correctly installed, that no leakage occurs, and that the piston retracts properly. A hydraulic supply, capable of varying pressure from zero up to a maximum of 500 to 800 psi (3500 to 5500 kPa) is required. The brake has been designed for a maximum operating pressure of 3000 psi (20 700 kPa) and may be functionally tested to this limit, but is not considered necessary to verify the normal function of the brake. The hydraulic supply should be provided with a reservoir of adequate volume to compensate for fluid loss through the connecting and disconnecting of the brake under test, bleeding, etc. Fluid used should be of the same type the brake will use when installed, generally mineral based hydraulic oil for BUCYRUS® trucks.

The unit may be functionally tested as follows:

NOTE: *Fluid used in test equipment should be clean, and every precaution taken that supply will not be contaminated. The care that has been exercised throughout rebuilding in observing rules of cleanliness can be canceled by using dirty fluid during functional testing.*

NOTE: *A flexible line should be provided for connecting the pressure source to the brake housing assembly under test. In order to minimize fluid loss during bleeding, connecting, and disconnecting brake from supply, the use of a quick disconnecting coupling at the end of the flexible line is recommended. The valve coupling should be installed on the end of the line. The valve nipple should be combined with a test fitting for installation into the housing subassembly that is to be tested.*

1. Assemble the housings with the proper bolt preload, the linings (6), lining retaining plates (5) and the retaining plate bolts (4). Tighten the bolts to a low nominal torque value. Place a 1.250 inch (31.75 mm) spacer between linings.

2. Install a bleeder valve (12) into one inlet of the caliper housing; install a test fitting into the other inlet and connect to the hydraulic supply.

3. Position the housing so the bleed valve is at the highest point.

4. Apply 50 to 100 psi (345 to 690 kPa) hydraulic pressure to the housing.

5. Open the bleeder valve to exhaust air from the housing, then close when all air is released.

NOTE: *Where a limited displacement supply is used, it may be necessary to alternately open and close the bleeder valve while applying and releasing hydraulic pressure. To effectively remove all entrapped air, it may be necessary to place the housing in alternate positions to allow the air to rise toward the bleeder outlet. Let the housing remain in each position for a brief time, to allow the air bubble to rise.*

6. After the housing has been bled, apply and release the hydraulic pressure several times. Observe the extension and retraction of the pistons. With the pressure off, measure the clearance between the piston faces and the test adapter with a feeler gauge. Clearance should be 0.020 inch (0.25 mm).

7. Apply moderate hydraulic pressure to the housing and check for leakage around the pistons. Piston seal leakage cannot be observed directly with the dust covers installed, unless the leakage is significant. If a check is desirable, the pressure can be applied and locked, and pressure drop in the supply line of the brake can be observed over a period of time. Such a leakage check should be made at both the moderate and high pressure limits of the test supply.

8. After testing, unbolt the housings, remove the test fittings and test spacer. Reinstall the lining retainer plates with bolts (with Loctite 271 (liquid), 268 (stick), or equivalent on the threads), and install fittings required. Install protective caps and plugs for storage protection.

NOTE: *Housings subassemblies should be paired with fittings installed accordingly. Linings (6) may be left uninstalled until installation of brake on vehicle.*

INSTALLATION (Figures 2, 3, and 4)

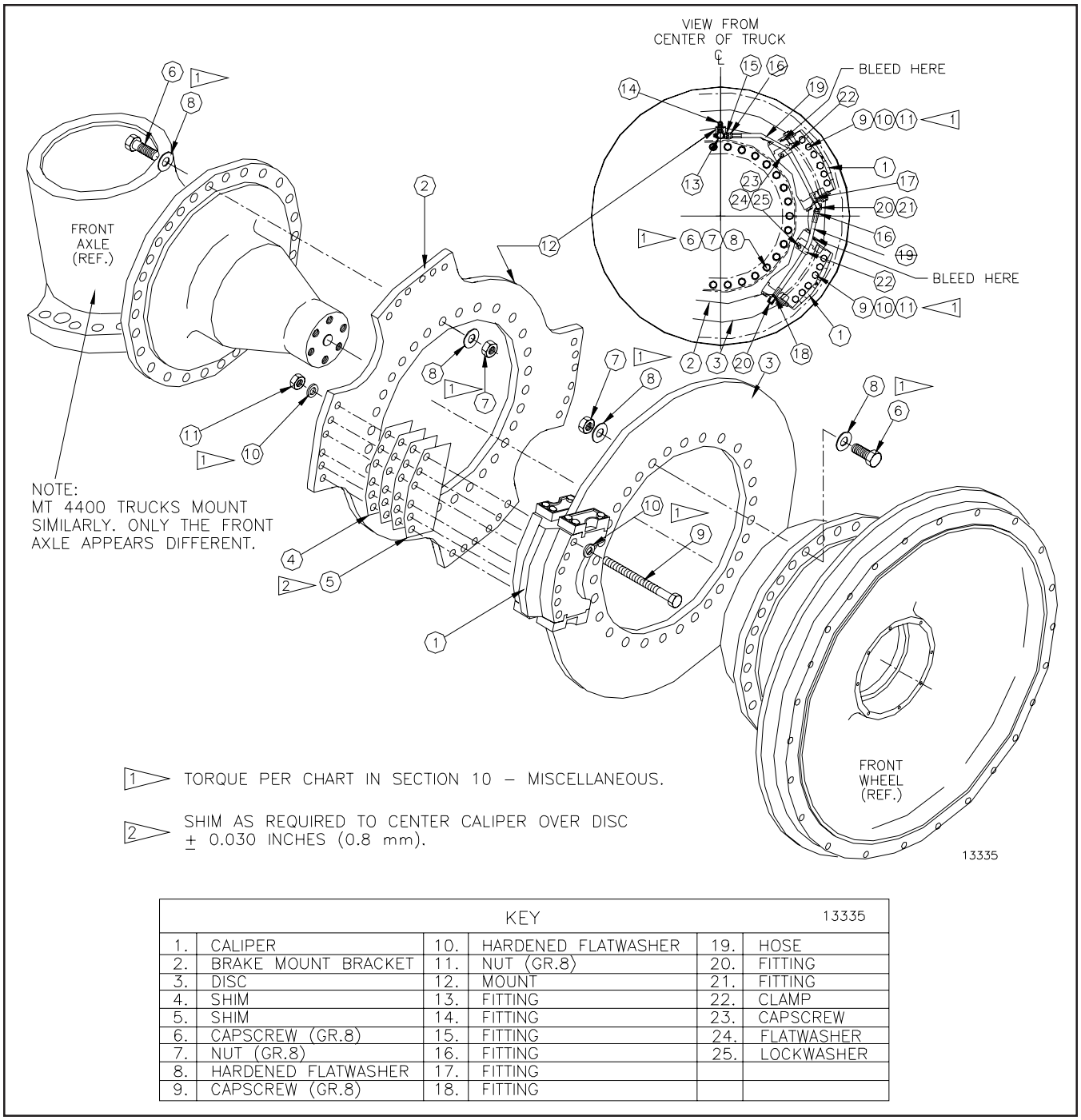
The disc may be installed as follows:

1. If removed, install the brake caliper mounting bracket, oriented as it was removed. Torque each in even increments to the appropriate torque for the fastener used.

NOTE: *On assemblies in which locknuts are not used, it is recommended that Loctite 266 or equivalent be used on the threads to assist in securing them from loosening.*

2. Install the brake disc on the wheel using hardened flatwashers. Torque as follows:

MK 24, 30, 36	600 ft-lb (815 Nm)
MK 30B	1350 ft-lb (1845 Nm)



KEY					13335
1.	CALIPER	10.	HARDENED FLATWASHER	19.	HOSE
2.	BRAKE MOUNT BRACKET	11.	NUT (GR.8)	20.	FITTING
3.	DISC	12.	MOUNT	21.	FITTING
4.	SHIM	13.	FITTING	22.	CLAMP
5.	SHIM	14.	FITTING	23.	CAPSCREW
6.	CAPSCREW (GR.8)	15.	FITTING	24.	FLATWASHER
7.	NUT (GR.8)	16.	FITTING	25.	LOCKWASHER
8.	HARDENED FLATWASHER	17.	FITTING		
9.	CAPSCREW (GR.8)	18.	FITTING		

FIGURE 2 - TYPICAL QUAD CALIPER FRONT DISC BRAKE ASSEMBLY - MT 4000 AND 4400

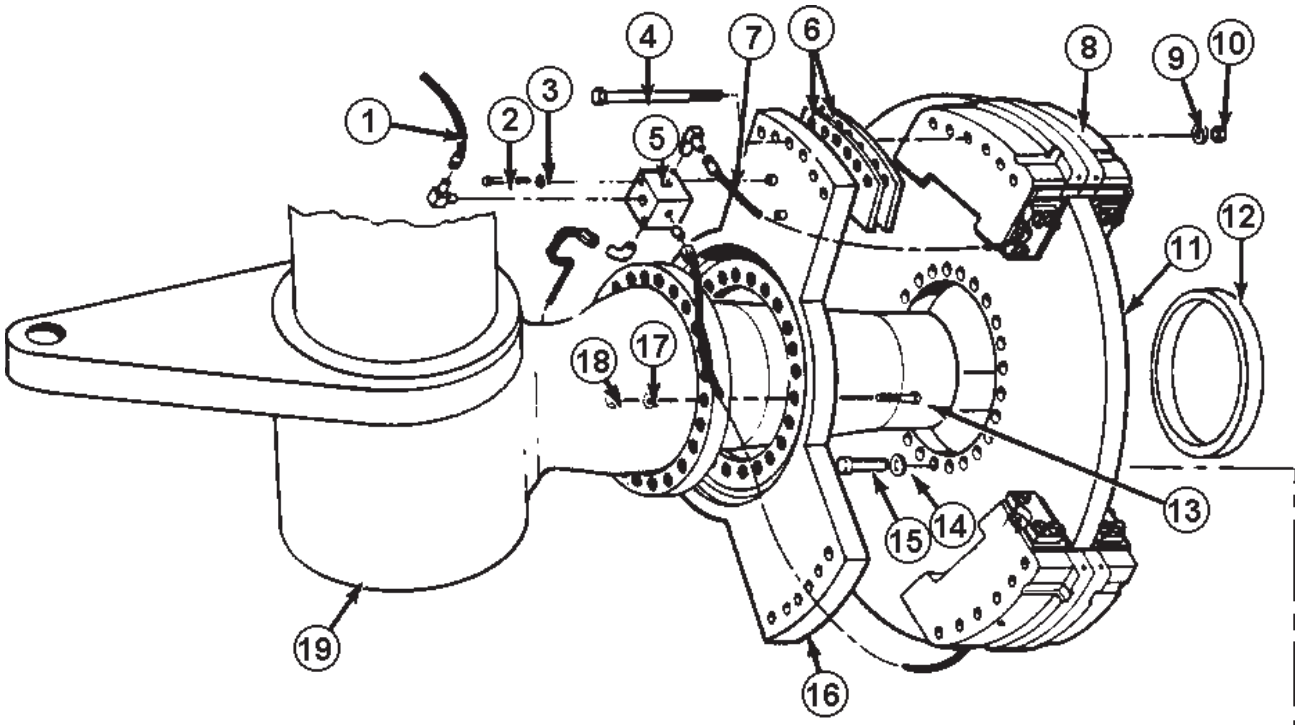
MT 1900/2050/2120	1350 ft-lb (1845 Nm)
MT 2700/3000/3300	1350 ft-lb (1845 Nm)
MT 3600(B)/3700(B)/3700AC	1350 ft-lb (1845 Nm)
MT 4000/4400/4400AC	1350 ft-lb (1845 Nm)

NOTES:

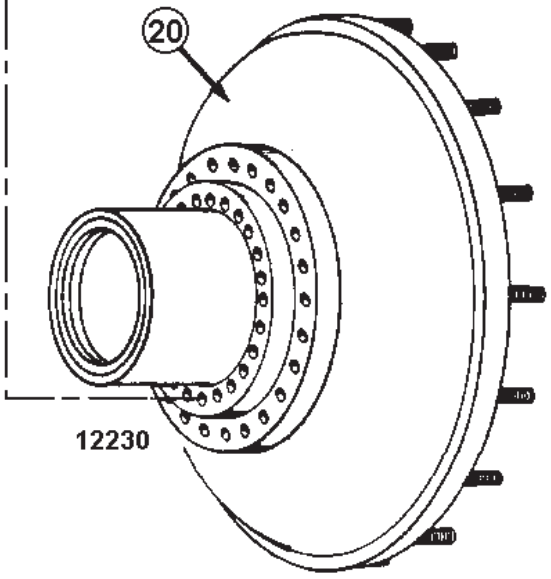
1. On assemblies in which locknuts are not used, it is recommended that Loctite 266 or equivalent be used on the threads to assist in securing them from loosening.

2. In some installations the orientation of the capscrew and nut are reversed to improve clearances with other components and the ability to properly tighten and torque. Refer to the drawings in the appropriate BUCYRUS® *Assembly Parts Manual for the recommended installation.*

3. Install and shim the wheel on the front suspension as outlined in Section 7 - Running Gear.



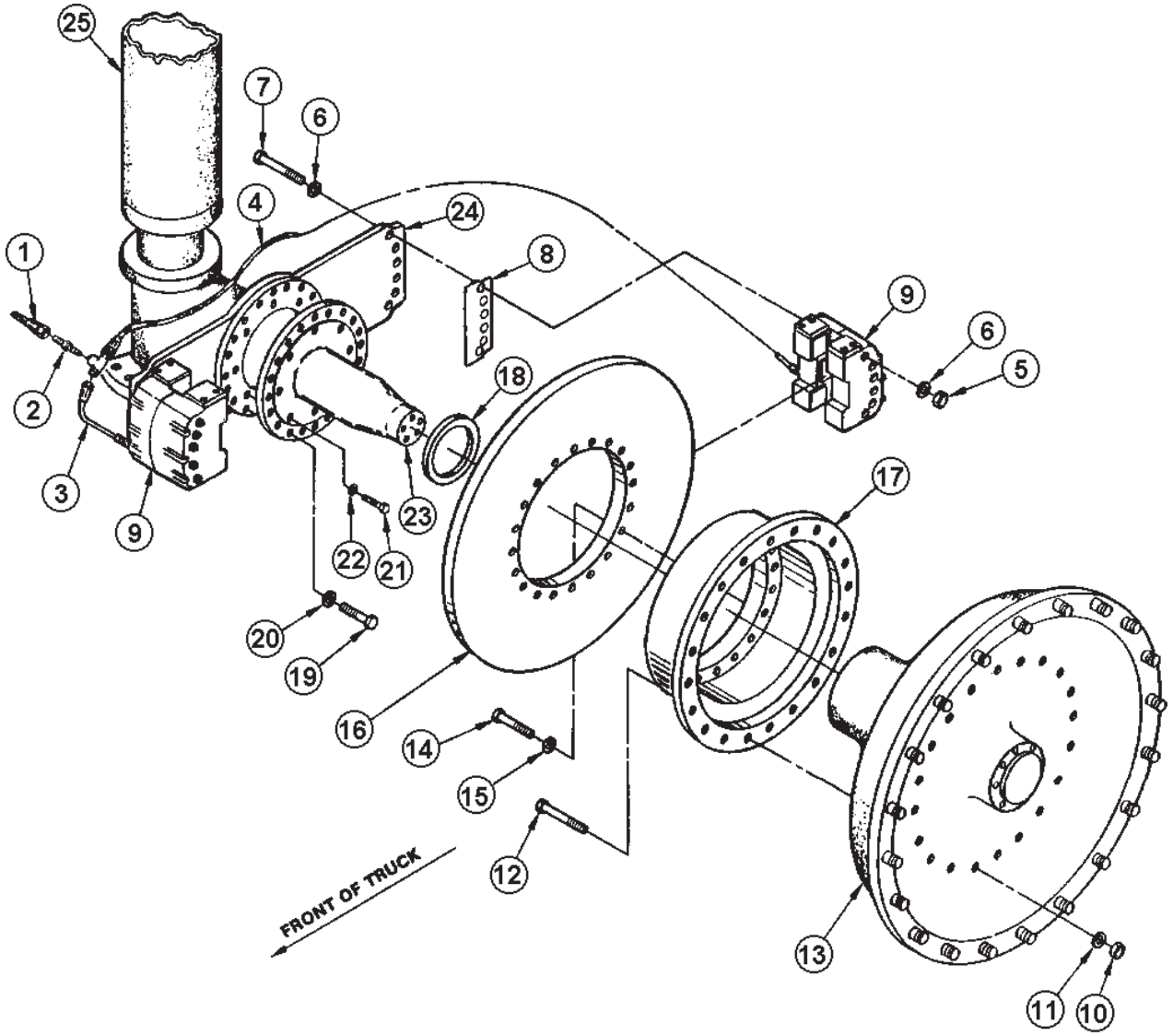
NOTE: This axle is different on trucks equipped with solid front axles.



KEY 12230	
01.	HOSE ASSEMBLY
02.	CAPSCREW
03.	HARDENED FLATWASHER
04.	CAPSCREW (GRADE 8) WITH HARDENED FLATWASHER
05.	MANIFOLD
06.	SHIMS
07.	HOSE ASSEMBLY
08.	CALIPER ASSEMBLY
09.	HARDENED FLATWASHER
10.	NUT (GRADE 8)
11.	BRAKE DISC
12.	RUB RING
13.	CAPSCREW (GRADE 8)
14.	HARDENED FLATWASHER
15.	CAPSCREW (GRADE 8)
16.	CALIPER MOUNTING BRACKET
17.	HARDENED FLATWASHER
18.	NUT (GRADE 8)
19.	FRONT SUSPENSION ASSEMBLY
20.	FRONT WHEEL

NOTE: MT 3300, 3600 and 3700 trucks mount similarly. Only the axle appears different.

FIGURE 3 - TYPICAL TRIPLE CALIPER FRONT DISC BRAKE ASSEMBLY - MK 36, AND MT 3300, 3600(B), AND 3700(B)



KEY					50558F
01.	HOSE	10.	NUT (GRADE 8)	19.	CAPSCREW (GRADE 8)
02.	FITTING	11.	HARDENED FLATWASHER	20.	HARDENED FLATWASHER
03.	HOSE	12.	CAPSCREW (GRADE 8)	21.	CAPSCREW (GRADE 8)
04.	HOSE	13.	WHEEL ASSEMBLY	22.	LOCKWASHER
05.	NUT (GRADE 8)	14.	CAPSCREW (GRADE 8)	23.	FRONT SPINDLE
06.	HARDENED FLATWASHER	15.	HARDENED FLATWASHER	24.	BRACKET
07.	CAPSCREW (GRADE 8)	16.	BRAKE DISC	25.	FRONT SUSPENSION
08.	BRAKE SHIM	17.	DISC MOUNTING BRACKET		
09.	BRAKE CALIPER	18.	RUB RING		

FIGURE 4 - TYPICAL DUAL CALIPER FRONT BRAKE ASSEMBLY

4. Install the caliper assembly as outlined elsewhere in this module.

The caliper assembly may be installed as follows:

1. Install the shims that were removed previously. Install the brake assembly with the mounting bolts. Make sure the shims are in place before tightening bolts. Use the shims to center the caliper over disc within 0.030 inch (0.75 mm).

⚠WARNING

The housings are very heavy. Make sure that the housings are supported during removal and installation. Serious personal injury or damage to the caliper can occur if the housings are dropped.

2. Torque the caliper mounting bolts to 600 ft-lb (825 Nm) using no lubricant.

⚠ CAUTION

The mounting fasteners must be tightened to the specified torque. The torque places preload on the caliper housings. If the fasteners are not tightened to the specified torque, the brake will be damaged if hydraulic pressure is applied.

3. Install the brake linings and lining retainer plates.

4. Apply Loctite 271 (liquid), 268 (stick), or equivalent on the threads and torque the lining retainer plates to 380 to 460 ft-lb (515 to 625 Nm).

NOTE: *With all shims in place and the brake assembly properly torqued, there should be 0.030 inch (76 mm) clearance between the retaining plates and disc. If not, add or remove the appropriate number of shims required to obtain this clearance.*

5. Install the hydraulic line between caliper assemblies.

6. Install the bleeder valves; four on each brake assembly.

7. Connect hydraulic lines from the manifold to each brake assembly.

8. Bleed the brakes as outlined in the procedures in Maintenance and Adjustment.

9. If new linings are installed, they must be burnished as outlined in the procedures in Maintenance and Adjustment.

REAR ARMATURE SPEED DISC BRAKES - CARLISLE (GOODRICH) PHASE III

⚠WARNING

The procedures in this manual for servicing brakes are recommended to reduce exposure to fiber dust, a potential cancer and lung disease hazard. The primary concerns are to avoid creating airborne contamination (such as by blowing material with air) or direct contact with the skin or other organs. Avoid any inhalation of the material and wash hands and other exposed areas of the body after any exposure. Always follow the specific procedures for your work location. Material Safety Data Sheets are available from BUCYRUS®.

DESCRIPTION AND LOCATION (Figure 4 and 5)

The Carlisle (Goodrich) armature speed caliper brakes consist of a single or twin parallel mounted discs, each with a single caliper assembly. The discs are mounted to a flange on the wheelmotor armature. The caliper is attached to the non-rotating portion of the wheelmotor framework.

NOTE: On *General Electric wheelmotors, the brake assemblies are found immediately behind the wheelmotor hub cap. On BUCYRUS® wheelmotors (W-100 and W-200), they are inside the axlebox.*

OPERATION (Figure 3)

Pressurized oil from the control valve/actuator enters the caliper torque plates, and is routed to each of the piston assemblies. This pressure causes the pistons to move the linings against the disc. The resulting friction provides the braking force on the armature shaft.

The caliper assemblies have a self-adjusting feature to maintain a constant clearance between the lining and disc. This clearance is established after the first few brake applications by the adjusting mechanism in the piston and housing assemblies. As pressure builds, the piston (13) moves toward the disc (34), and closes the clearance between the washer (8) and sleeve (10), and compresses the spring. Increased pressure causes the sleeve to slip on the guide (6), at a point of controlled interference. This establishes the adjusting portion of the sleeve. When pressure is released, the spring (9) retracts the piston (13) from the adjusting position of the sleeve (10), allowing the carrier and lining assemblies (29 and 31) to retract. Lining wear or brake deflection, due to increased pressure, will cause the sleeve (10) to slip to a new adjustment position.

MAINTENANCE AND ADJUSTMENT (Figure 3)

Periodic maintenance of the assembly should include the following:

1. Inspect all mounting bolts and hydraulic connections for tightness.

2. Inspect for fluid leakage.

NOTE: *If the bleeder plugs (2) in the piston housing (4) show signs of leakage, remove and clean all threads. Coat the threads with Scotch-Weld No. 2158 adhesive (or equivalent), and reinstall. Allow 12 to 24 hours for the adhesive to set, prior to refilling the brake system with fluid.*

3. Inspect the carrier and lining assemblies (29 and 31) for damage or wear. When worn, the lining carrier end supports approach the wear indicator stop in the center of the spacers (30). If damaged or worn, replace the lining as outlined under Lining Replacement.

NOTE: *If the pads are not worn the same in both caliper assemblies, replace the assembly with the greatest wear. Never mix new and used lining assemblies on the same caliper.*

4. Inspect the discs for damage or wear. Replace the disc if worn less than 0.750 inches (19 mm) thick. Verify that the disc is flat and not grooved or checked. If replacement is required, proceed as outlined under Removal and Installation.

On trucks equipped with carbon metallic linings, verify that the brake disc:

1. Finish is 125 RMS or smoother.

2. Wear surface run-out is less than 0.010 inch (0.3 mm).

BLEEDING THE BRAKES

Bleeding the brakes is a procedure by which entrapped

air and other contamination is removed from the operating fluid in the brake system.

On trucks with a totally hydraulic brake system, this entails applying the brake system and holding by depressing the Brake pedal or applying the Hand Brake. On trucks with an air/hydraulic brake actuation system, typically the system application controls and actuators must be cycled repeatedly to allow for this purging to occur.

Detailed instructions for the procedure required by each system configuration is included in the appropriate system procedure in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

It is important they all be removed from the hydraulic fluid prior to beginning operation.

⚠ CAUTION

Use only mineral base hydraulic oil, SAE 10 or equivalent, in the brake system unless another fluid is specified. Do not apply pressure to the brake system unless the caliper assembly is straddled over the disc assembly and the linings and other components are all properly installed.

⚠WARNING

Fluid may cause irritation. Avoid any contact with the eyes, or prolonged contact with the skin.

LINING REPLACEMENT (Figure 3)

The carrier and lining assemblies should be replaced as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release all pressure from the hydraulic brake system as outlined in the procedures.

3. If required, remove the park brake assemblies as outlined in Section 8 - Brake System.

4. Remove one of the end bolts (33), washer (32), and spacer (30) from either end of the caliper torque plates or brake heads (17 and 22). Slide the carrier and lining assemblies (29 and 31) out of the caliper head assembly.

5. Open the bleed screw (1) to relieve fluid pressure.

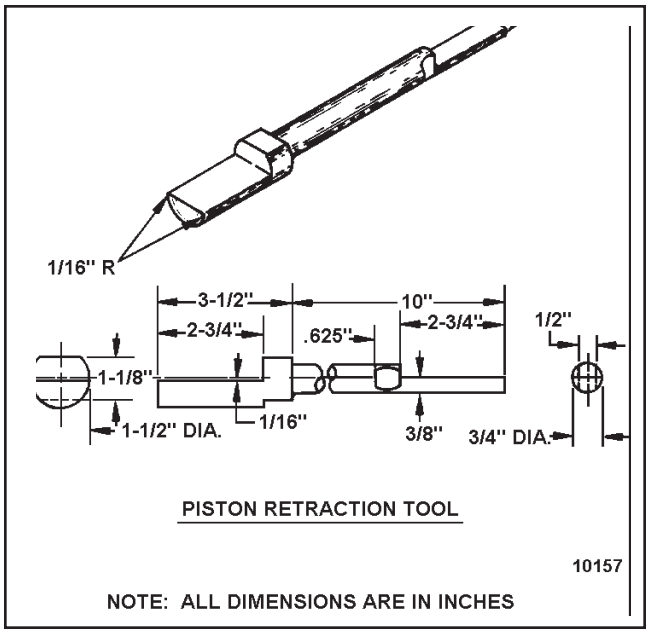


FIGURE 1 - PISTON RETRACTION TOOL

NOTE: *Direct the fluid away from the brake linings and disc during the lining change and bleeding operation. A piece of hose emptying into a can will prevent fluid contamination of these components.*

⚠WARNING

Fluid may cause irritation. Avoid contact with the eyes, or prolonged contact with the skin.

6. Using a special piston retraction tool (Figure 1) placed between the disc (34) and pistons (13), force the pistons back into the fully retracted position.

7. Check the brake discs for minimum thickness. Replace any disc less than 0.750 inch (19 mm) thick.

8. Close the bleed screw (23), and insert new carrier and liner assemblies (29 and 31) into the caliper heads. Ensure that the carrier assembly rests on the spacer (30), on the far end of the assembly.

NOTE: *Do not mix new, used, or different material carrier and liner assemblies on the same caliper assembly or axle.*

⚠WARNING

Use only the approved linings available from Unit Rig. Use of substitute, non-approved linings may result in loss of braking effectiveness. Do not mix new and used, asbestos non asbestos, and/or carbon metallic linings in a brake assembly, or on the same axle.

9. Install the washer (32) on the bolt (33). Install the spacer (30) on the carrier and lining assembly (29 and 31) ends. Insert the bolt through the spacer and caliper assembly. Make sure that the carrier and lining assemblies are interlocked on the two outer spacers (30) before tightening the bolt. Torque the bolts to 600 ft-lb. (815 Nm), lubricated.

10. Install the park brake assemblies (if removed) as outlined in Section 8 - Brake System.

11. Bleed the individual caliper assemblies as required, following the procedures under Bleeding the Brakes.

12. Burnish the brakes per the appropriate procedures.

BURNISHING BRAKES

The disc brakes used on the rear of this truck must be burnished (seated) when new or whenever new discs or linings are installed. The burnishing procedure should be done prior to placing the truck back into service after brake repair. Failure to follow the proper burnishing procedure may result in reduced braking force and an increased stopping time.

Smoke and foul odors coming from the brake area during burnishing are considered normal when the temperatures are above 350°F (173°C). At temperatures above 700°F (370°C) heavy smoke and sparks are normal. Flames are possible at temperatures above 900°F (480°C).

IMPORTANT: *If flames are present, take the temperatures as quickly as possible and resume driving the machine as quickly as possible to extinguish the flames. Flames are an acceptable condition only during the burnishing process and should not occur during normal braking.*

The truck should be empty and driven on level ground in an area clear of all obstructions and personnel. Stopping distance required may be greater than normal during burnishing.

NOTE: *Experience has shown that continuing to run the engine at fast idle between burnishing cycles will aid in cooling of the wheelmotors.*

NOTE: *The front brakes may be left connected during this procedure, but should be checked periodically for heat or other problems.*

1. On trucks equipped with all lining materials except the carbon metallic based linings (which are identified by a red stripe):

a. Drive the truck at 5 to 10 mph (8 to 16 km/hr) alternately applying and releasing the brakes until the disc temperature reaches 700 to 750°F (370 to 400°C).

A typical process involves partially depressing the Brake pedal for 50 ft (15 m) then releasing for a period of approximately 10 seconds while still in motion. This process is repeated as required until the proper temperature is achieved.

NOTES:
1. Check the temperature using a surface pyrometer or similar device measuring the temperature on the braking surface of the disc. This should be done after operating for 100 yards (90 m) or as required by ambient temperatures.

b. Allow the discs to cool to 350°F (173° C).

NOTE: *This may require up to 30 minutes, depending on disc and ambient temperature. It is recommended that the truck be driven slowly during this time to promote even cooling of the brake components. At a minimum, the brakes should be released during all cooling periods.*

c. Repeat step a until the rear brake temperature reaches 800 to 850° F (425 to 450° C). If flames are present, start the machine in motion to extinguish.

NOTE: *The front discs should be checked periodically during this procedure to ensure that disc temperature does not exceed 1000°F (540°C).*

d. Allow the discs to cool to 350° (173° C).

e. Repeat step a until the rear brake temperature reaches 900 to 950° F (480 to 510° C). If flames are present, start the machine in motion to extinguish.

f. Allow the discs to cool to 350°F (173° C).

g. When the brake discs have cooled to 250 to 300° F (120 to 150°C), reinstall the hubcaps and the truck may be placed back into service.

2. On trucks equipped with carbon metallic brake linings (identified by red stripe):

a. With truck empty make five successive 10 mph (16 km/hr) stops.

b. Make 5 additional successive stops from 25 mph (40 km/hr) with less than 3 minute intervals between stops.

c. Load truck to rated capacity.

d. Make five successive 25 mph (40 km/hr) stops with less than 3 minute intervals between stops.

e. With the service and hand brakes released allow to cool 1 hour before placing unit in service.

REMOVAL (Figures 4 and 5)

The brake assemblies may be removed from the wheelmotors as follows:

NOTE: *This procedure is for dual disc brake systems. Single disc systems are done in a similar manner.*

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release all pressure in the hydraulic brake actuation system as outlined in Maintenance and Adjustment.

3. Remove the wheelmotor cover.

4. Open the bleed screws to relieve any residual pressure in the supply lines. Remove all hydraulic lines. Cover all openings with steel plugs.

NOTE: *Direct all fluid away from the brake linings and discs.*

⚠ CAUTION

Fluid may cause irritation. Avoid contact with the eyes, or prolonged contact with the skin.

5. Remove the front portion of the outer caliper assembly.

a. Remove one capscrew and washer from the caliper, and remove the spacer and carrier and lining assembly.

b. Remove the other capscrew, washer, and spacers. Put the brake torque plate in a clean location.

6. Remove the outer disc assembly by removing the capscrews and washers and sliding the disc assembly off of the adapter flange.

7. Remove the torque plate by removing the capscrews and washers that secure it to the adapter spacer. Put the torque plate in a clean location.

8. Remove front torque plate assembly from the inner

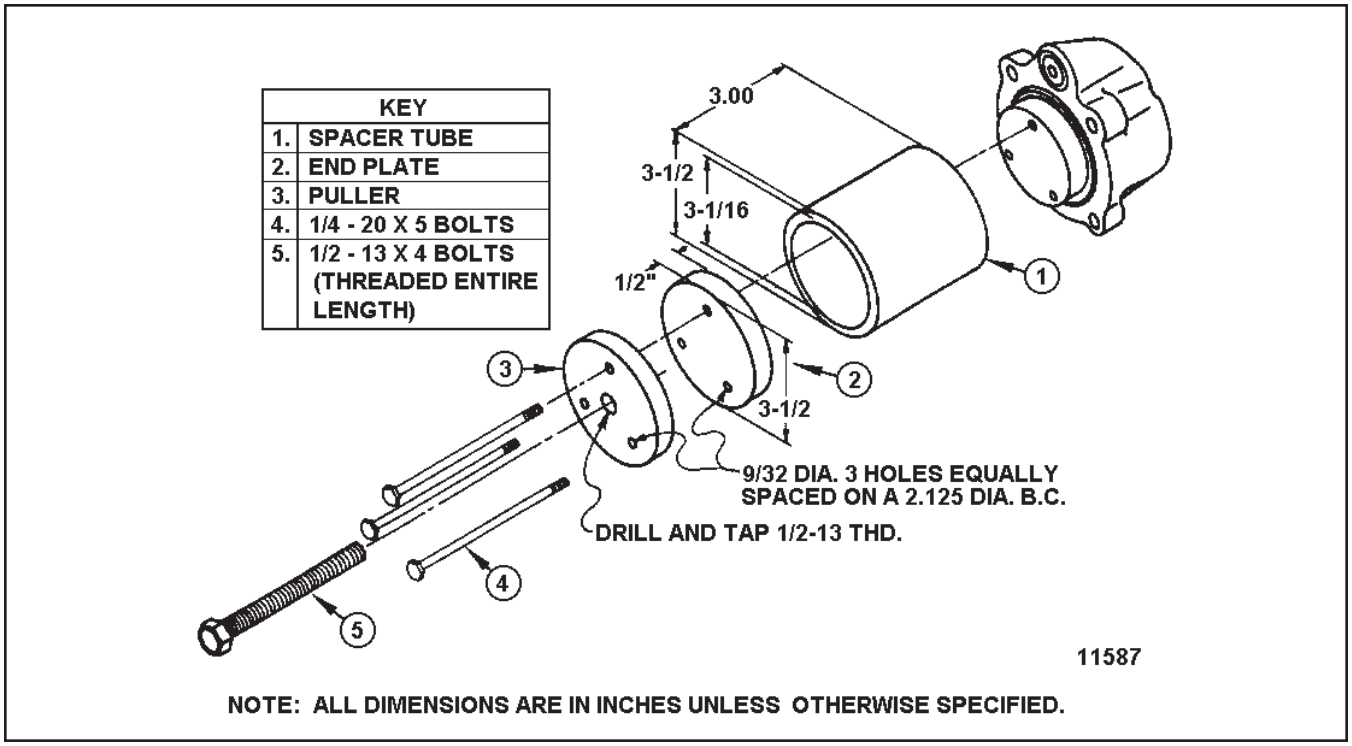


FIGURE 2 - PISTON PULLER TOOL

caliper assembly as outlined in step 5.

9. Remove the adapter flange from the adapter spacer, by removing the capscrews and washers.

10. Remove the inner disc, including the adapter spacer, by removing the capscrews and washers. The disc will slide off of the spacer when all of the capscrews are removed.

NOTE: *In order for the disc to be removed, it may be necessary to remove the large lower brake spacer by removing the capscrews and washers that secure it to the wheelmotor framework.*

11. Remove the back torque plate and spacer from the inner caliper assembly as outlined in step 7.

DISASSEMBLY (Figure 3)

The calipers should be disassembled as follows:

1. Plug one of the 7/16-20 threaded ports in the piston housing, and use the other as an inlet port. Connect this port to a hydraulic pump filled with mineral oil.

2. Pressurize the piston housing to disengage the pistons from the adjuster sleeves (10). It is recommended that a C-clamp be placed over both pistons, tightened, then backed-off slowly as pressure is applied, allowing the pistons to emerge from piston housing slowly and evenly.

NOTE: *The pistons may also be removed by using a piston puller tool (Figure 2). Prior removal of the insulators (15) from the piston, as outlined in step 3 of this procedure, is required if piston puller tool is used.*

3. If the insulators (15) are damaged and require replacement, disassemble from the pistons (13) by removing the three attaching bolts.

NOTE: *The bolts (16) will require more torque to loosen, because locking adhesives have been used on them. Heating the bolts to 375° F (190° C) will facilitate removal with less torque.*

INSPECTION AND REPAIR (Figure 3)

The disassembled components should be serviced as follows:

1. Inspect the carrier and lining assemblies (29 and 31) for wear and damage. Replace the assemblies when the carriers approach the wear indicator stops on the spacers (30).

NOTE: *When the lining carriers approach the wear indicator stops on the spacers (30) it also includes disc wear.*

2. Inspect the disc (34) and bushing (35) for wear and damage. Replace the bushing if it is damaged or badly worn.

3. Replace all packing (5 and 11) whenever the brake head is disassembled.

4. Inspect the adjuster guide (6) for tightness in each piston housing (4). If the guides are loose, remove, clean, and dry the threads. Apply Scotch-Weld No. 2158 adhesive to the threads of guides, and install tightly (145 to 150 inch-lb.) (16 to 17 Nm). Allow 12 to 24 hours for the adhesive to set.

⚠ CAUTION

Do not scratch the adjusting surface of the adjuster sleeve (10). Cracked or damaged Piston housing (4) should be replaced. Be sure the piston housings are completely clean.

5. Scratches, nicks, or other surface damage on the OD of the adjuster sleeve (10) may be smoothed with crocus cloth. Replace any damaged parts that may affect operation of the adjuster.

6. Replace insulators (15) if broken, cracked, or warped.

7. Use crocus cloth to remove small nicks or scratches from the sealing surface of the piston housing (4). Replace any cracked or broken piston housings.

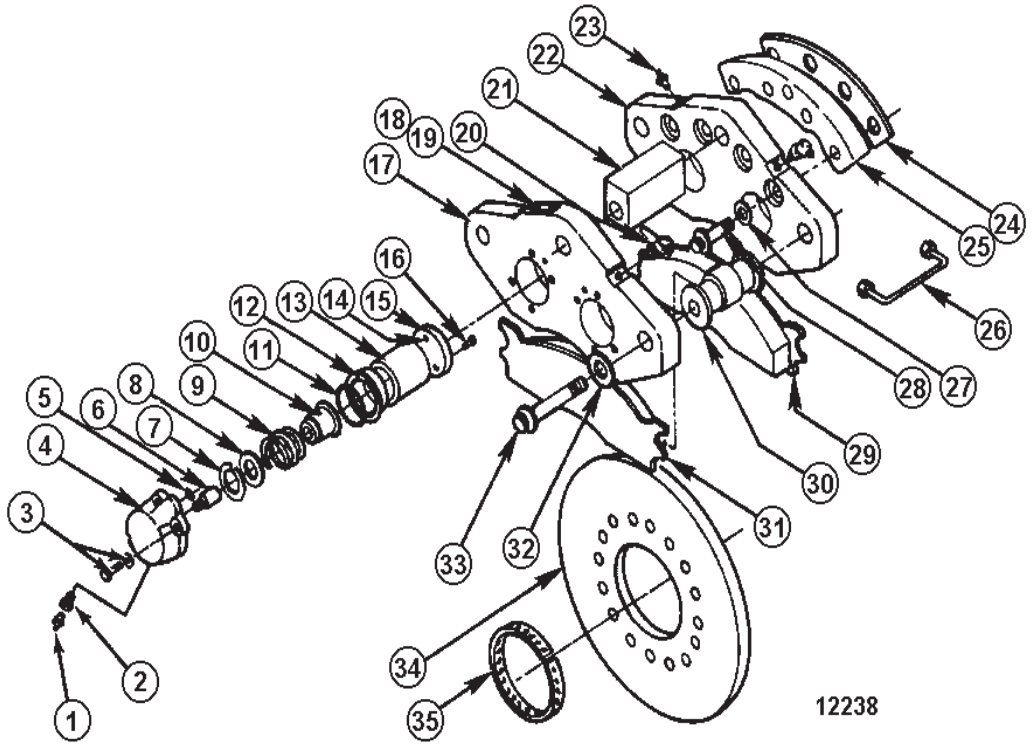
NOTE: *Replace any piston housing with a bore diameter greater than 2.6305 inches (66.8 mm).*

8. Thoroughly clean the brake head, and replace any worn or damaged parts.

9. Remove slight scratches and nicks from pistons with crocus cloth.

NOTE: *Replace any piston with an outside diameter of less than 2.6185 inches (66.5 mm).*

10. Replace all parts damaged or severely worn.



KEY					12238
1.	BLEEDER VALVE	13.	PISTON	25.	SPACER
2.	PLUG	14.	INSERT	26.	CROSSOVER TUBING
3.	CAPSCREW AND LOCKWASHER	15.	INSULATOR	27.	WASHER
4.	PISTON HOUSING	16.	CAPSCREW	28.	CAPSCREW
5.	PACKING	17.	TORQUE PLATE	29.	CARRIER AND LINING ASSEMBLY
6.	ADJUSTER GUIDE	18.	CAPSCREW	30.	SPACER
7.	RETAINING RING	19.	PLATE	31.	CARRIER AND LINING ASSEMBLY
8.	WASHER	20.	PIPE FITTING	32.	WASHER
9.	SPRING	21.	SPACER	33.	CAPSCREW
10.	ADJUSTER SLEEVE	22.	TORQUE PLATE	34.	BRAKE DISC
11.	PACKING	23.	BLEEDER PORT	35.	BUSHING
12.	BOOT	24.	SHIM		

FIGURE 3 - REAR CALIPER ASSEMBLY

11. Remove all old adhesive from the insulator capscrews.

ASSEMBLY (Figure 3)

The caliper assembly should be assembled as follows:

1. Apply a liberal coating of Scotch-Weld No. 2158 B/A adhesive to a minimum of four or five threads on the bolts. Bolt the insulators (15) to the pistons.

NOTE: *Scotch-Weld No. 2158 B/A (a two part epoxy adhesive) is manufactured by Minnesota Mining and Manufacturing Company, St. Paul, Minnesota. Instructions for use are included with the adhesive. Purchase locally from 3M Company Dealers.*

2. Install bolts (16) and tighten securely. The assembled insulator (15) and piston (13) can be put into service immediately if required.

NOTE: *The locking capability of the adhesive is greater if allowed to cure overnight. The adhesive will withstand temperatures up to* 350 °F (175 °C). *Slight softening of adhesive results at higher temperatures. After cool-down, the adhesive resets to original hardness and*

locking capability.

3. If the adjuster mechanism must be reinstalled, apply Scotch-Weld No. 2158 adhesive to the threads of the adjuster guides to 130 to 145 inch-lb. (15 to 16 Nm). Allow adhesive to set 12 to 24 hours.

NOTE: *Lubricate all rubber seals and component parts with the same oil as used in the truck's brake system.*

⚠WARNING

Fluid may cause irritation. Avoid contact with the eyes, or prolonged contact with the skin.

4. Assemble the sleeve (10), spring (9), washer (8), and retaining ring (7) into the piston (13). Using a piece of tubing or similar object, push against the retaining ring compression spring, until the retaining ring snaps in the piston groove.

5. Install the packing in the piston housing groove.

6. Position the piston assembly, (including seal), over the adjuster guide (6) in the piston housing. Use a vise, clamp, or arbor press to bottom the piston (13) in the piston bore.

7. Slide the boot (12) over the piston (13), so the flange faces the piston housing (4). Snap the ID edge of the boot into the OD groove in the piston, and press the ridge of the boot flange into the groove in the piston housing face.

8. Install the packing (5) in the piston housing groove. Make sure it is properly seated.

9. Install the plug (2) and bleeder valve (1) in the bottom part of the housing (4). Coat the plug threads with Scotch-Weld No. 2158 adhesive before installing.

NOTE: *Allow 12 to 24 hours for the adhesive to set before filling the piston housing with brake fluid (mineral oil).*

10. Install the piston housing assemblies on the torque plates (17 and 22). Make sure that the knobs of the piston housings (4) are aligned towards the top center of the torque plates. Secure with screws and washers on each piston and housing assembly. Apply Loctite sealant to the screw threads. Tighten the screws to 24 to 26 ft-lb. (32 to 35 Nm).

INSTALLATION

The brake assembly should be installed as follows:

NOTE: *Steps 1 and 2 refer to Figure 3; the remainder of steps refer to Figures 4 and 5.*

NOTE: *This procedure is for dual disc brake systems. Single disc systems are done in a similar manner.*

1. Prior to installation, the crossover tube assembly (26) and three sets of bolts (33), washers (32), and spacers (21 and 30) should be removed from the brake head assembly. Also, the front and back brake head torque plate assemblies should be separated.

2. Also prior to beginning assembly, make sure the pistons (13) are fully retracted into the piston housing (4). Use a C-clamp to retract pistons that are not fully seated.

NOTE: *The inner and outer brake assemblies are interchangeable. However, when assembling the brakes utilizing used components, it is recommended that the components be installed on the same brake assembly that they were removed from, to ensure a proper fit and wear pattern with the other components.*

⚠ CAUTION

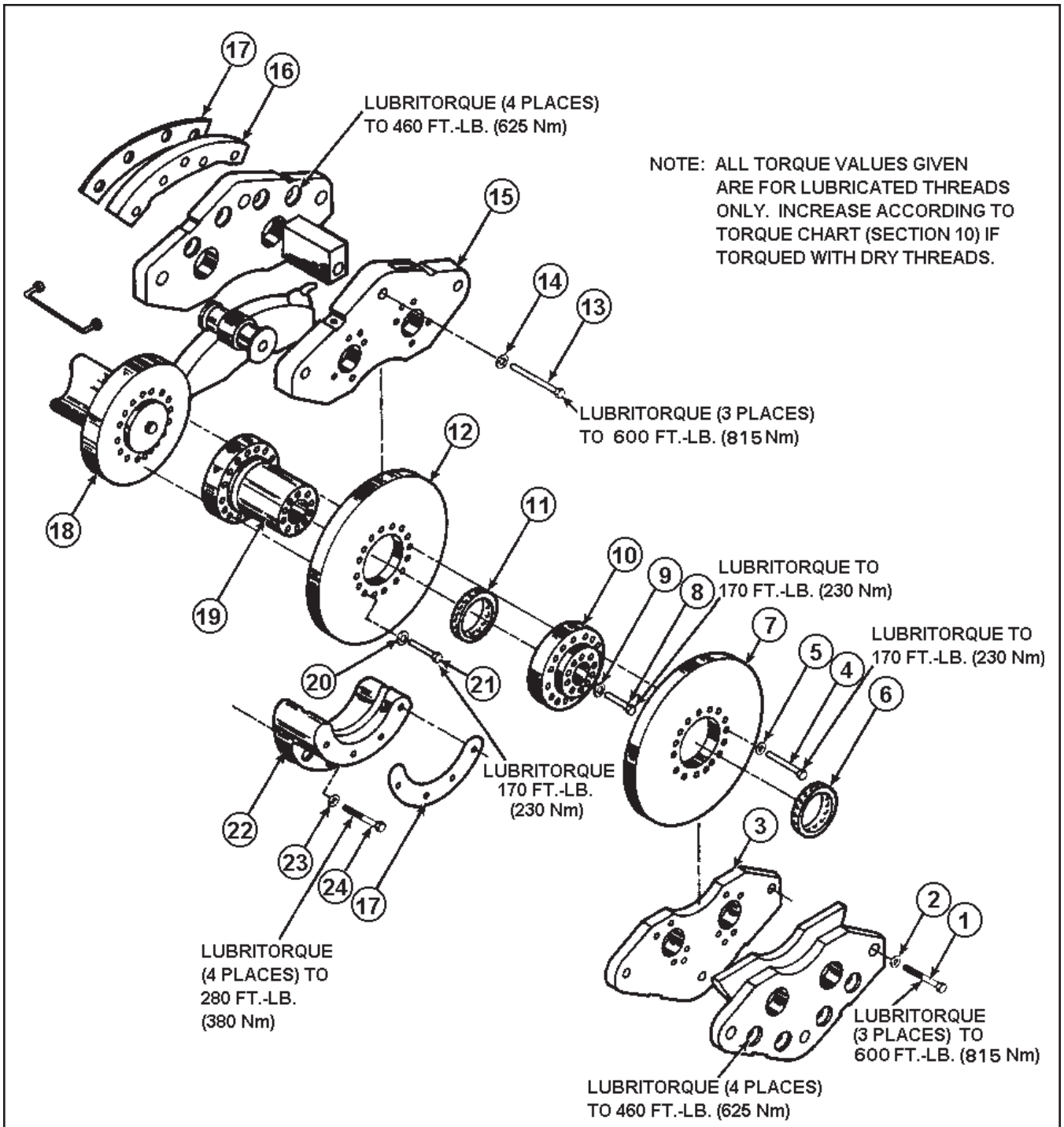
If any capscrew or washer is being replaced in the brake assembly, it is important that it be replaced by one of equivalent or higher strength. All capscrews in these assemblies are to be of SAE Grade 8 (identified by the markings on the head). All washers must be hardened.

NOTE: *The use of guide pins is recommended as an aid during installation and removal of the brake heads. These pins may be either headless bolts or threaded rods of each size: 5/8 NC x 5 1/2, 3/4 NC x 6, and 7/8 NC x 13.*

3. Insert the two 7/8 NC x 13 guide pins into the brake caliper assembly mounting holes in the upper portion of the wheelmotor's framework. Insert the 3/4 NC x 6 guide pins into the brake spacer assembly mounting holes in the lower portion of the wheelmotor framework.

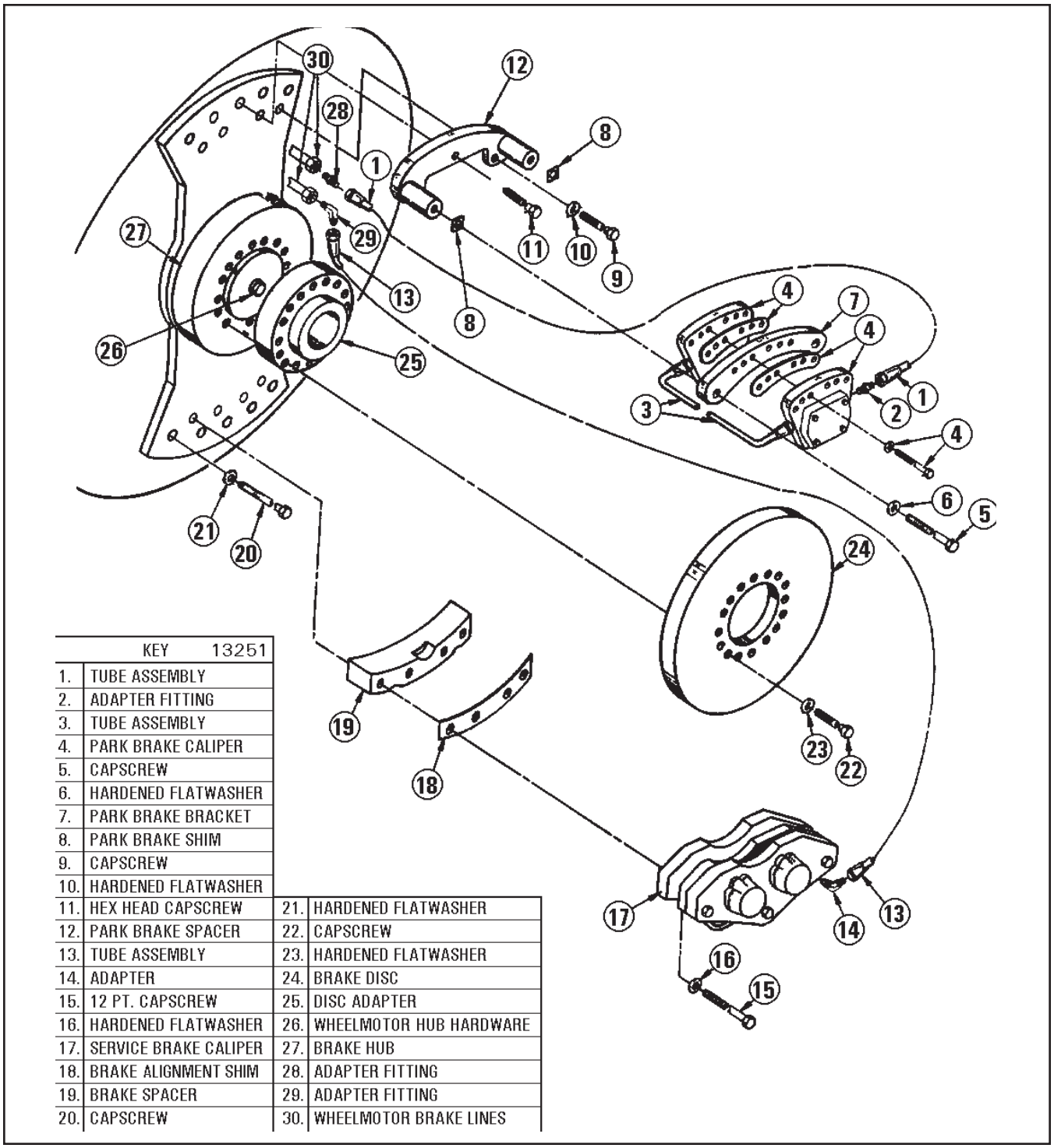
NOTE: *As an additional aid, these pins should be set in the outer pair of holes. Insert the two 5/8 NC x 5 1/2 guide pins into the wheel mounting hub at 180° intervals.*

4. Slide the brake spacer on the upper pair of pins and



KEY					11586
1.	CAPSCREW	9.	WASHER	17.	SHIMS (0.101 INCH)
2.	WASHER	10.	FLANGE ADAPTER	18.	MOUNTING HUB (ON WHEELMOTOR)
3.	OUTER CALIPER	11.	DISC BUSHING	19.	SPACER ADAPTER
4.	CAPSCREW	12.	INNER DISC	20.	WASHER
5.	WASHER	13.	CAPSCREW	21.	CAPSCREW
6.	DISC BUSHING	14.	WASHER	22.	SPACER AND DRIVER ADAPTER
7.	OUTER DISC	15.	INNER CALIPER	23.	WASHER
8.	CAPSCREW	16.	SPACER	24.	CAPSCREW

FIGURE 4 - DUAL DISC REAR BRAKE ASSEMBLY



KEY 13251			
1.	TUBE ASSEMBLY		
2.	ADAPTER FITTING		
3.	TUBE ASSEMBLY		
4.	PARK BRAKE CALIPER		
5.	CAPSCREW		
6.	HARDENED FLATWASHER		
7.	PARK BRAKE BRACKET		
8.	PARK BRAKE SHIM		
9.	CAPSCREW		
10.	HARDENED FLATWASHER		
11.	HEX HEAD CAPSCREW	21.	HARDENED FLATWASHER
12.	PARK BRAKE SPACER	22.	CAPSCREW
13.	TUBE ASSEMBLY	23.	HARDENED FLATWASHER
14.	ADAPTER	24.	BRAKE DISC
15.	12 PT. CAPSCREW	25.	DISC ADAPTER
16.	HARDENED FLATWASHER	26.	WHEELMOTOR HUB HARDWARE
17.	SERVICE BRAKE CALIPER	27.	BRAKE HUB
18.	BRAKE ALIGNMENT SHIM	28.	ADAPTER FITTING
19.	BRAKE SPACER	29.	ADAPTER FITTING
20.	CAPSCREW	30.	WHEELMOTOR BRAKE LINES

FIGURE 5 - SINGLE DISC REAR BRAKE ASSEMBLY

up against the motor framework. Slide the back half of the inner caliper assembly up against the spacer, and install the inside two mounting bolts and washers. Install snugly, but do not tighten.

5. Slide the large brake spacer onto the lower pair of guide pins. Do not position this spacer against the wheelmotor framework; it should be left resting 6 to 8 inches (150 to 200 mm) from the framework.

6. Assemble the disc and bushing, making sure the bushing is securely seated in the disc. Mount the disc and bushing assembly on the disc driver/spacer adapter, taking extra precautions not to damage the bushing. Slide this assembly adapter end first, onto the center guide pins, and position against the wheelmotor ar-

mature mounting hub. While moving the assembly on the guide pins, position the large brake spacer so that the disc rests in the slot in the adapter's inner surface. Position this spacer against the wheelmotor framework. Install the grade 8 capscrews and lockwashers required to mount the disc assembly to the armature flange and torque to 280 ft-lb. (380 Nm) lubricated.

7. The caliper assembly must be centered over the disc assembly to within 0.010 inch (0.25 mm). To check the center, hold a spacer against the rear torque plate. The large diameter center portion of this spacer should be centered over the brake disc.

8. If the spacer is not centered over the disc, measure the off-center distance. Divide this distance by 0.010 inch (0.25 mm) to determine the amount of shims required to center. Loosen the two previously installed bolts (13) holding the back portion of the caliper assembly, and add the required shims between the spacer and the wheelmotor mounting surface. Retighten the bolts (13) and recheck the centering.

NOTE: *The shims may be installed without removing bolts (13) by cutting a slit from the outer edge of the shim into each of the four outer holes. Each shim is 0.010 inch (0.25 mm) thick.*

9. After the caliper assembly is properly centered, remove the two 7/8 inch NC x 13 guide pins, and install the two remaining bolts and washers (13 and 14). Torque all four bolts to 600 ft-lb. (815 Nm) dry or 460 ft-lb. (625 Nm) lubricated.

10. The front portion of the caliper assembly may be installed as follows:

a. Make sure the pistons remain bottomed in their housing as outlined previously.

b. Insert one guide pin into an outer hole of the back torque plate portion of the caliper assembly. Slide a carrier and lining assembly on each side of the disc assembly supported by the spacer (30, Figure 3). Insert the second spacer to support the linings and insert the second guide pin through the spacer and into the guide plate.

c. Position the front torque plate. Install the bolt washers, and rectangular spacer in the top center hole of both torque plates. The spacer should be upright between the torque plates.

d. Remove the guide pins and install the bolts and washers in the outer two holes. Torque the three bolts to 600 ft-lb. (815 Nm) lubricated.

NOTE: *After installation, check for a 0.030 inch (0.76 mm) minimum clearance between the disc and lining assemblies. If this clearance is not present, check the centering of the caliper assembly on the disc and proceed as required.*

11. Install the capscrews and washers to attach the large outer brake spacer to the wheelmotor framework. Remove the guide pins, and install the two additional capscrews. Torque the bolts to 380 ft-lb. (515 Nm) dry or 280 ft-lb. (380 Nm) lubricated in 100 ft-lb (135 Nm) increments. Make sure the slot is centered on the disc assembly.

12. Install the two 7/8 inch NC x 13 guide pins used to install the inner caliper assembly into the large outer brake spacer.

13. Install the outer brake back torque plate as outlined in step 4.

14. Install the flange adapter, bolting the flange to the adapter with capscrews and washers. Torque the capscrews in alternate sequence to 170 ft-lb. (230 Nm) in 60 ft-lb (80 Nm) increments.

15. Assemble the disc and bushing assembly, and install on the adapter flange as outlined in step 6.

16. Center the caliper assembly as outlined in steps 7, 8, and 9.

17. Complete the assembly of the caliper assembly as outlined in steps 10 and 11.

18. Install the bleeder screw, connectors, and tube and not previously assembled, in the appropriate inlet ports on the caliper assemblies as required for right or left hand installations.

19. Install the appropriate fittings and connect the hydraulic lines to the caliper assemblies.

20. Install the park brake assembly as outlined in Section 8 - Brake System.

21. Bleed all air from the brake assemblies as outlined in the procedures in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

22. Burnish all new linings as outlined in Maintenance and Adjustment.

23. Test the system for proper operation.

REAR ARMATURE SPEED DISC BRAKES - MERITOR (ROCKWELL/GOODYEAR) 1425-5 OR LATER SERIES

DESCRIPTION AND LOCATION (Figures 13 and 14)

The Meritor (Rockwell/Goodyear) rear disc brake is a single or dual disc with a single caliper assembly per disc. The discs are mounted to a flange on the wheelmotor armature. The caliper is attached to non-rotating portion of the wheelmotor framework.

NOTE: *General Electric wheelmotors, the brake assemblies are found immediately behind the wheelmotor hub cap. On BUCYRUS® wheelmotors (W-100 and W-200), they are inside the axlebox.*

OPERATION

Pressurized oil from the control valve/actuator enters the caliper housing, and is routed to each of the piston assemblies. This pressure causes the pistons to move the linings against the disc. The resulting friction provides the braking force on the armature shaft.

A constant brake release clearance between pistons and linings, and linings and disc, is maintained by an automatic adjustment feature of the piston subassembly. As the linings wear, the position of the grips on an adjuster or return pin advances to allow maximum piston force to be applied. Upon brake release, the piston is retracted by a return spring to provide running clearance.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the assembly should include the following:

1. Inspect the brake linings for:

a. Lining wear. The linings must be replaced when the thickness of the lining has been worn to a thickness of less than 0.31 inch (7.9 mm) from the backing plate. Follow the instructions on lining replacement in this module.

b. The thickness of the two linings is significantly different. Determine the cause before repairing to prevent future wear.

c. There is oil or grease on the linings.

d. There are cracks on the lining larger than the normal “heat check” cracks.

⚠ CAUTION

Always replace both linings. If only one lining is replaced possible disc wear can occur.

⚠ CAUTION

When replacing linings, never mix new and used linings in a brake assembly.

2. Inspect for evidence of fluid leakage. If present, the brake must be removed for disassembly, inspection, and rebuilding.

3. Inspect the condition of the dust covers or shields. These should be soft and pliable, and show no evidence of hardening, cracking, or damage. If dust cover replacement is necessary, removal and disassembly of the brake for inspection is recommended, to ensure that dirt has not entered piston cavity.

4. Inspect the condition of tubing subassemblies for damage. Inspect fittings and connections for evidence of leakage. Correct or replace where necessary.

5. Wipe the caliper housings and lining retaining plates to remove dirt before installation of new linings. If a petroleum base cleaning fluid is used, such as diesel fuel, use sparingly on dust cover and wipe dry after cleaning.

⚠ DANGER

Do not rub or press on the dust cover directly over the sharp edge of the lip around the piston cavity. This may cause the dust cover to be cut on the underside and cause failure of the boots in service, allowing dirt to contaminate the assembly. Damage to the dust boot can cause loss of braking and serious personal injury.

6. Inspect each disc for wear. Place a straightedge across the disc and measure from straightedge to worn face. The disc should be replaced if this measurement is 0.06 inch (1.5 mm) each side, or if the disc is worn to a minimum total thickness of 0.88 inch (22.3 mm).

NOTE: *When new linings are to be used against a worn disc, the lining life will be shortened by approximately the disc wear depth, since the lining must ad-*

vance this far before the brake begins to be effective. Also, the waviness of the worn disc face will have the effect of reducing lining life, because of the material used before the lining is completely worn in against the disc.

7. Check the clearance between the disc and retaining plates. If brake installation is done properly, this clearance should be 0.13 inch (3 mm), minimum, on each side of the disc.

On trucks equipped with carbon metallic linings, verify that the brake disc:

1. Finish is 125 RMS or smoother.

2. Wear surface run-out is less than 0.010 inch (0.3 mm).

BLEEDING THE BRAKES

Bleeding the brakes is a procedure by which entrapped air and other contamination is removed from the operating fluid in the brake system. It is important all air and other contamination be removed from the hydraulic fluid prior to beginning operation.

On trucks with a totally hydraulic brake system, this entails applying the brake system and holding by depressing the Brake pedal or applying the Hand Brake. On trucks with an air/hydraulic brake actuation system, typically the system application controls and actuators must be cycled repeatedly to allow for this purging to occur.

Detailed instructions for the procedure required by each system configuration is included in the appropriate system procedure in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

Tighten the bleeder screw to 100 to 120 inch-lbs. (11.3 to 13.5 Nm) except when the valve is opened to allow for actual bleeding of the caliper.

NOTE: *Direct the fluid away from the brake lining and the disc during the bleeding operation. A piece of hose emptying into a can will prevent fluid contamination of these components.*

⚠ CAUTION

Use only a mineral base hydraulic oil, SAE 10 or equivalent, in the brake system unless another fluid is specified. Do not apply pressure to the brake system unless the caliper assembly is straddled over the disc assembly and the linings and other components are all properly installed.

⚠ WARNING

Fluid may cause irritation. Avoid any contact with the eyes or prolonged contact with the skin.

LINING REPLACEMENT (Figure 10)

NOTE: *It is recommended that all linings in all calipers on both front wheels be replaced at the same time.*

The linings may be replaced as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release all hydraulic pressure from the brake system as outlined in Maintenance and Adjustment.

3. Remove the lining retaining plates (2 and 20) from one end of the brake assembly, and remove the worn linings (16).

4. Inspect the linings for evidence of fluid leakage.

5. Using a special piston retraction tool (Figure 1) placed between the disc and the face of each piston, force the pistons back into the bores as far as they will go.

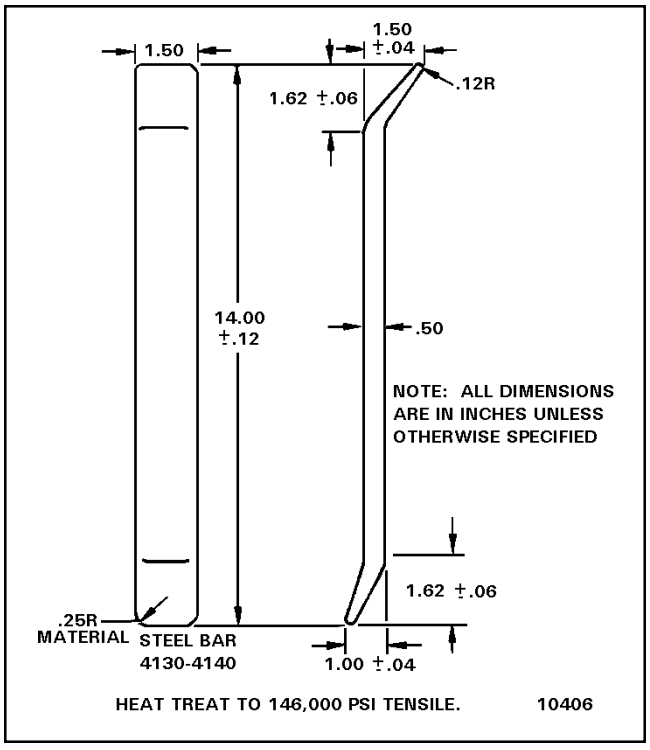


FIGURE 1 - PISTON RETRACTION TOOL

NOTE: *Considerable force will be required to return the pistons. If a piston should move too easily, the brake should be removed and disassembled for inspection of the grip and return pin assembly. When returning pistons to the retracted positions, care must be taken not to damage the dust covers with the retraction tool.*

⚠WARNING

Use only the approved linings available from BUCYRUS®. Use of substitute, non-approved linings may result in loss of braking effectiveness. Do not mix new and used, asbestos non-asbestos, and/or carbon metallic linings in a brake assembly, or on the same axle.

6. Reinstall the retaining plates. Apply Loctite 271 (or equivalent) and torque the end cap bolts to 165 to 210 ft-lb. (225 to 285 Nm).

⚠WARNING

To avoid serious personal injury, be careful when using Loctite or similar products. Follow the manufacturer's instructions for safe use to prevent irritation to the eyes and skin. Wash thoroughly after any skin contact. If the product gets into the eyes, flush with water for 15 minutes and have the eyes checked by a doctor.

7. Bleed the brakes as outlined in the appropriate instructions in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

8. Check the linings for freedom to slide back and forth in the retaining plates between the piston faces and disc.

9. Check the clearance between the disc and retaining plates. If the brake installation is done properly, this clearance should be 0.25 inch (6.3 mm) (nominal) each side of disc.

10. Apply and release the brakes several times. The linings should be free after release, with a minimum of 0.010 inch (0.25 mm) disc-to-lining clearance.

11. Burnish the brakes per the appropriate procedure.

BURNISHING BRAKES

All brakes must be burnished when new or whenever new discs or linings are installed. The burnishing procedure should be done prior to placing the truck back into service after brake repair. Failure to follow the proper burnishing procedure may result in reduced braking and increased stopping time.

Smoke and foul odors coming from the brake area during burnishing are considered normal. The truck should be empty and driven on level ground, in an area clear of all obstructions and personnel. Stopping distance required may be greater than normal during burnishing.

NOTE: *Experience has shown that continuing to run the engine at an increased idle speed between burnishing cycles will aid in cooling of the wheelmotors.*

NOTE: *The front brakes may be left connected during this procedure, but should be checked periodically for heat or other problems.*

1. On trucks equipped with all linings except the carbon metallic based lining (which are identified by a red stripe):

a. Drive the truck 5 to 10 mph (8 to 16 km/hr) with the brakes dragging, until the rear brake disc temperature reaches 600° F (315° C). Check the temperature after 100 yards (90 meters). The brake pedal must be used for this operation.

NOTE: *Check the temperature with a temperature indicating crayon. Make sure that the crayon is for the correct temperature range. Do not allow disc temperatures to exceed 800° F (425° C).*

b. With all brakes released, allow the rear brake disc to cool to 250° F (120° C).

c. Repeat steps a and b a second time.

NOTE: *The front discs should be checked periodically during this procedure to ensure that disc temperature does not exceed 800° F (425° C).*

d. With all brakes released, allow all discs to cool to 250° F (120° C) before placing the truck back in service.

2. On trucks equipped with carbon metallic brake linings (identified by red stripe):

a. With truck empty make five successive 10 mph (16 km/hr) stops.

b. Make 5 additional successive stops from 25 mph (40 km/hr) with less than 3 minute intervals between stops.

c. Load truck to rated capacity.

d. Make five successive 25 mph (40 km/hr) stops with less than 3 minute intervals between stops.

e. With the service and hand brakes released allow to cool 1 hour before placing truck into service.

REMOVAL (Figures 13 and 14)

The rear disc brakes may be removed from the wheelmotors as follows:

NOTE: *This procedure is for dual disc brake systems. Single disc systems are done in a similar manner.*

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release the Brake pedal and Hand Brake. Apply the Park Brake.

IMPORTANT: *On trucks equipped with parking brakes, apply the brakes to remove system pressure, then manually release the assemblies.*

3. Remove the wheelmotor cover to expose the brake assembly. Release all pressure in the system as outlined in the instructions in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

4. Remove the brake linings and end plates from the caliper assemblies.

5. Open the bleed screws to relieve any residual pressure in the supply lines. Remove and cap the supply and cross head tie lines from the actuation system.

⚠WARNING

Fluid may cause irritation. Avoid any contact with the eyes, or prolonged contact with the skin.

NOTE: *Direct all fluid away from the brake linings and discs. If fluid comes into contact with these components, wipe them clean and dry immediately.*

6. Remove the park brake assemblies (if so equipped) as outlined in Section 8 - Brake System.

7. Remove the front portion of the outer caliper assembly as follows:

a. Remove from the caliper assembly the outer two capscrews, and washers. Set the caliper in a clean location.

b. Install two guide pins into these two holes. See the information on the guide pins in the Installation instructions in this module.

c. Remove the inner two capscrews and washers. Place the caliper in a clean location.

8. Remove the outer disc assembly by removing the capscrews and washers, and sliding the disc assembly off the adapter flange.

9. Remove the inner portion of the caliper by sliding it off the guide pin. Place it in a clean location.

10. Remove the outer portion of the assembly as outlined previously.

11. Remove the adapter flange from the adapter spacer by removing the capscrews and washers.

NOTE: *In order for the disc to be removed, it may be necessary to remove the large brake spacer by removing the capscrews and washers, securing it to the wheelmotor framework.*

12. Remove the remaining caliper components by sliding off the pins.

13. Repeat as required for the inner caliper assembly (dual disc systems).

14. Remove remaining brake hardware.

DISASSEMBLY (Figure 10 and 10A unless otherwise specified)

The caliper assembly may be disassembled as follows:

1. Prior to beginning:

a. The caliper housing should be drained of fluid. Cap and plug all openings. Caliper subassemblies should be given a preliminary cleaning, then moved to the rebuilding area for servicing.

NOTE: *The preliminary cleaning can be more effective if linings are first removed. However, retaining plates should be temporarily reinstalled in order to stay with the brake assembly through the rebuilding cycle.*

b. Cleaning may be done by brush or spray, with a petroleum base cleaning solvent. Clean diesel fuel is

TROUBLESHOOTING		
PROBLEM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
BRAKE DOES NOT APPLY		
No pressure to brake.	Improper operation of the hydraulic system.	Test the operation as outlined in Section 5 - Hydraulic System or Section 6 - Pneumatic System.
Piston does not move.	No pressure applied to the brake caliper.	Test the operation as outlined in Section 5 - Hydraulic System or Section 6 - Pneumatic System.
	Piston cocked in housing bore.	Check the dimensions of the housing and pistons as outlined in Inspection and Repair. Repair or replace as required. Remove any dirt or other material between the lining and the piston.
Brake caliper leaking.	Loose bleeder screw.	Tighten, repair, or replace as required.
	Loose inlet fitting.	Tighten, repair, or replace as required.
	Damaged inlet fitting.	Repair or replace as required.
	Worn or damaged o-rings or back-up rings.	Repair or replace as required.
	Loose adjuster pin nut.	Tighten the adjuster pin hex nut to 120 to 150 inch-lbs. (13.6 to 17 Nm).
Damaged lining.	Lining thickness less than 0.31 inches (7.9 mm).	Replace the linings.
	Lining wear not even.	Inspect the piston. Repair or replace as required. Inspect the end plates. Repair or replace as required.
	Cracked or broken linings.	Replace the linings.
	Oil or grease on linings.	Replace the linings.
BRAKE DOES NOT RELEASE		
Truck does not move.	Parking brake applied.	Release the parking brake.
	Improper operation of the hydraulic system.	Test the operation as outlined in Section 5 - Hydraulic System or Section 6 - Pneumatic System.
Brakes dragging on disc and or running too hot.	Pressure exceeds 20 psi (135 kPa) when the brakes are released.	Test the operation as outlined in Section 5 - Hydraulic System or Section 6 - Pneumatic System.
	Improper driver operation.	Review operation and correct as required.
	Pistons cocked in the bores.	Test the operation as outlined in Section 5 - Hydraulic System or Section 6 - Pneumatic System.
	Worn or damaged end plates.	Replace worn or damaged end plates. Make sure that the linings move freely between the end plates.
	Incorrect adjuster assembly.	Check the adjuster as outlined in the instructions on Assembly.

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acceptable for this operation. Cleaning should be thorough enough for preliminary inspection and assembly. Subassemblies should be blown dry with compressed air after cleaning. Dust covers should be wiped dry with a clean cloth.

⚠ CAUTION

Use care in wiping dust covers. Too much pressure on the covers over the sharp lip around the housing cavity may cause dust covers to be cut on the underside and cause failure of the boots in service, allowing dirt to contaminate the assembly. Damage to the dust boot can cause loss of braking and serious personal injury.

NOTE: *If the brake has not accumulated excessive surface dirt, preliminary cleaning can be done in the overhaul area. However, it is recommended that preliminary cleaning be done before removal of pistons from the housing subassemblies. Vapor degreasing or steam cleaning is not recommended for the brake subassemblies or the component parts.*

NOTE: *Keep all parts associated with each housing subassembly separate from other parts, until inspection of the disassembled brake is complete. Usually, when a damaged part or worn condition is noted, such as inlet screw threads, scratched pistons, etc., corresponding defects can be found on mating parts.*

2. Remove all fittings and packing from the inlets of the housing subassembly.

3. Position the housing subassembly on a bench and support with the end of the adjuster or return pins (6) and return pin nuts (23) up. Keep the adjuster or return pins (6) from turning with a narrow-blade screwdriver or a 5/32 inch Allen wrench. Remove nuts (and washers (24), if used) with a box wrench. To drive each piston subassembly out, place the end of a 0.25 inch (6.3 mm) diameter copper or brass drift pin, tap gently with a fiber or plastic mallet. Carefully remove the dust covers (15) from behind the groove lips in the housing and from the lip grooves in the pistons.

NOTE: *Disassembly of the components in a shallow pan is recommended to catch any fluid that will drain from the components.*

4. Remove O-ring and back up seals (3, 1) from the piston cavity seal grooves, with a small flat tool made of wood, fiber, etc., with a smooth, rounded edge.

NOTE: *Under no circumstance should steel tools be used in piston cavities and seal grooves. Copper, brass, aluminum, wood, etc., are acceptable materials for such purpose.*

INSPECTION AND REPAIR (Figure 10 and 10A unless otherwise specified)

The disassembled caliper components may be serviced as follows:

1. Inspect the dust covers (15) for wear or damage. Worn or damaged dust covers can allow dirt into the piston cavity. If dust covers are found to be soft and pliable, with no sign of hardening or cracking, they may be wiped clean and reused. However, it is typically not recommended due to the potential for damage to the brake caliper assemblies if the covers do not last in service.

2. Inspect the piston cavities and piston surfaces for evidence of dirty fluid, particularly if the dust covers are damaged.

3. Inspect the piston cavities for evidence of varnish formation, caused by excessive heating of brake fluid.

4. Thoroughly clean the brake housing and piston assembly. Passages, cavities, and external surfaces should be blown dry with clean, dry compressed air. Piston subassemblies, or parts of disassembled piston subassemblies, should also be cleaned and blown dry.

⚠ CAUTION

The pistons should not be thrown carelessly into a basket or otherwise allowed to contact each other.

NOTE: *Clean parts should be stored with a protective coating of lubricant. For short term storage, coat all internal cavities, passages, and bosses with hydraulic fluid. For long term storage, wipe cavities, connector bosses, and threads with a protective grease, such as petroleum jelly, Dow Corning DC-4, etc.*

5. Examine all seals for evidence of heat distortion, hardening, swelling, wear, or material breakdown.

NOTE: *Damaged piston surfaces from abrasive material or mishandling, excessive operating temperature, damage to piston cavity or seal groove, lack of cleanliness at previous rebuild, dirty hydraulic brake fluid, etc., are all contributing causes to seal damage and reduced seal life, and consequent leakage. It is recommended*

that all seals be replaced each time the caliper is disassembled.

6. Inspect the piston surfaces for damage.

a. Causes of piston damage may result in seal damage and fluid leakage. Piston damage may be a result of mishandling during previous maintenance, or abrasive material in the piston cavity due to a worn or damaged ruptured dust cover. In normal operation, a slow rate of wear should be experienced and is noticeable by the slow disappearance of the black oxide finish.

b. Remove minor nicks and scratches by hand, with 180 grit aluminum oxide or carborundum cloth. Use successively finer grades until a surface comparable to the original surface is obtained. Determination of ideal surface finish can be made by comparison with a new piston. Extensive or power polishing should be avoided.

c. Measure the outer diameter of the piston. The minimum piston diameter is 2.621 inches (66.5 mm). The piston finish is important in providing a proper seal wear life. Where surface finish has worn beyond restoration by moderate power buffing with a fine wire brush, the piston should be replaced.

NOTE: *Surface roughness of the piston face that contacts the lining back plate is a normal condition.*

7. Inspect the piston cavities in the housing for damage.

a. Pay particular attention to the edges of the seal grooves. These must feel smooth and sharp with no nicks or projections that can damage seals or scratch pistons. Seal groove surfaces must be smooth and free of pits or scratches. The cylinder wall finish is not as critical as the surface finish of the piston.

b. Measure the bore of the individual piston cavities. Surface wear near the opening of the cavity should be hand polished very carefully to avoid enlarging the cavity beyond a maximum of 2.630 inches (66.8 mm) ID at the outer edge of the seal groove. Power polishing or honing may be used in cases of extreme surface wear of the cavity walls, but should normally be avoided.

NOTE: *Care must be taken so that a minimum amount of material is removed. Power polishing will not normally be required and should not be used as a standard rebuild procedure.*

8. Inspect the inlet and bleeder ports in the caliper housing for damage to threads or seal counter bores. Thread damage that cannot be repaired by the use of 0.4375-20 UNF-3B tap will require housing replacement.

9. Inspect the housings for cracks.

a. If any are noted, the housing should be inspected to determine its repairability. Inspect the dust cover retainer lips that are machined in the housing around the piston cavities.

b. Care must be taken so that the lips are not damaged through mishandling. If the lip is broken, the dust cover may not seal the cavity properly. Direct impact on the lip may cause piston to close up below the minimum diameter, and require extensive repair. If the lip has been broken, the housing should be replaced.

10. Inspect the retainer plates for damage. Inspect the retainer plate bolts and tapped holes in the housing. Repair or replace as required.

NOTE: *The retainer bolts are highly stressed and should be replaced when their condition appears questionable. A 5/8-11 UNC-3B tap lubricated with a light oil may be used to inspect threaded holes in the housings for damage, and clean up minor roughness.*

SERVICING THE PISTON ASSEMBLY

Disassembly of the piston subassembly at brake overhaul is not mandatory. Inspection of the piston return mechanisms can be made without disassembly by using the appropriate tools and methods. However, piston subassemblies may be disassembled, inspected, and reassembled. Both options are described.

If a piston subassembly can be cleaned thoroughly without disassembly, and if the piston surface is acceptable for reuse, the piston subassembly can be inspected for proper return mechanism operation.

Inspection of the following conditions are required:

1. Return Spring Force—The return spring (10), captured between outer spring guide (11) and spring retainer, exerts a return force, through spring retainer and threaded retaining ring (7) on piston (14). With the brake applied (spring compressed to a minimum height), the return spring force should be between 180 and 250 lbs. (80 and 115 kg).

2. Grip Force—This is the force that is required to make the pair of grip subassemblies slip on return pin and should always be a minimum of about twice the return spring force. For the pair of grips, the slip force re-

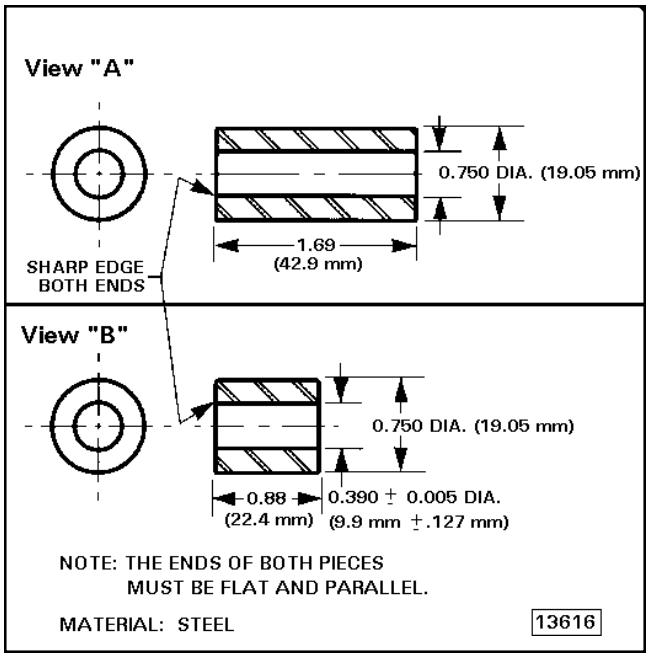


FIGURE 2 - GRIP SPACER AND INSTALLATION SLEEVES

quired will normally measure between 380 and 800 lbs. (175 and 365 kg).

3. Built-in Clearance (BIC)—This is the amount the piston will retract when brake pressure is released. The piston, is retracted by force of piston return spring (10). The normally required dimension is 0.080 to 0.090 inch, (2.03 to 2.29 mm). It is obtained by the adjustment of the threaded retaining ring.

The piston subassembly can be inspected for required return spring force and BIC adjustment at the same time, using the setup on a spring tester as follows:

1. Place the piston sub assembly in a spring tester table.

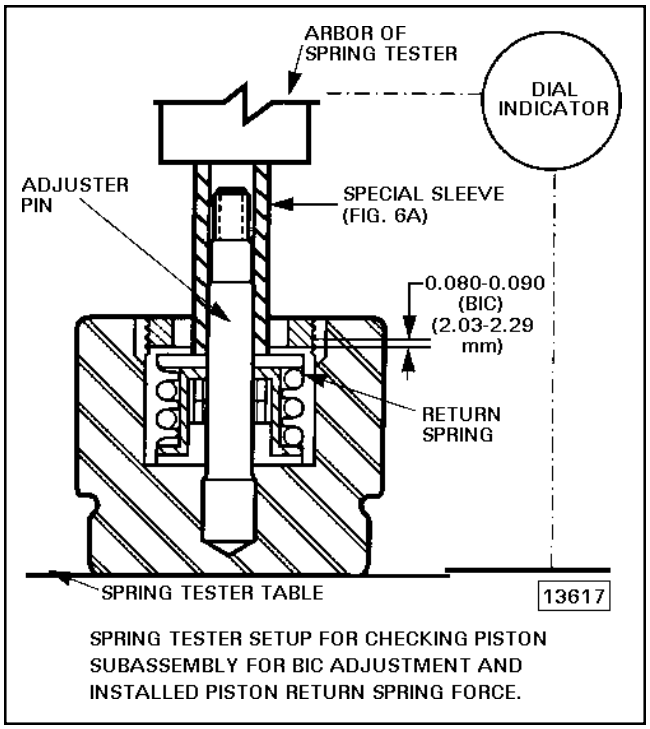
2. Install a special sleeve (Figure 2, View A) over the exposed adjuster or return pin.

3. Set the dial indicator between the tester arbor and table.

NOTE: *Use a dial indicator of plus or minus 0.020 inch (0.51 mm), or 0.025 inch (0.63 mm) scale with 0.0005 inch (0.01 mm) increments, and total range of 0.10 to 0.125 inch (2.5 to 3.2 mm).*

4. Lower the spring tester, and compress the spring to the minimum height. The indicator pointer will stop moving. See Figure 3.

5. Hold the spring compressed and rotate the indicator



SPRING TESTER SETUP FOR CHECKING PISTON SUBASSEMBLY FOR BIC ADJUSTMENT AND INSTALLED PISTON RETURN SPRING FORCE.

FIGURE 3 - SPRING TESTER SET-UP

dial to indicate zero.

6. Raise the spring press arbor slowly, until the indicator again reads zero. The indicator dial reading will be the BIC.

7. Lower the spring press arbor slowly, until the indicator again reads zero; the spring tester force scale will now indicate the return spring force.

8. Slowly raise and lower the arbor several times to verify both the BIC and spring force measurements. The BIC should be between 0.080 and 0.090 inch (2.03 and 2.29 mm). If outside of this range:

a. Remove the lock ring (8).

b. Lower the spring tester arbor until the spring is compressed to its minimum height shown.

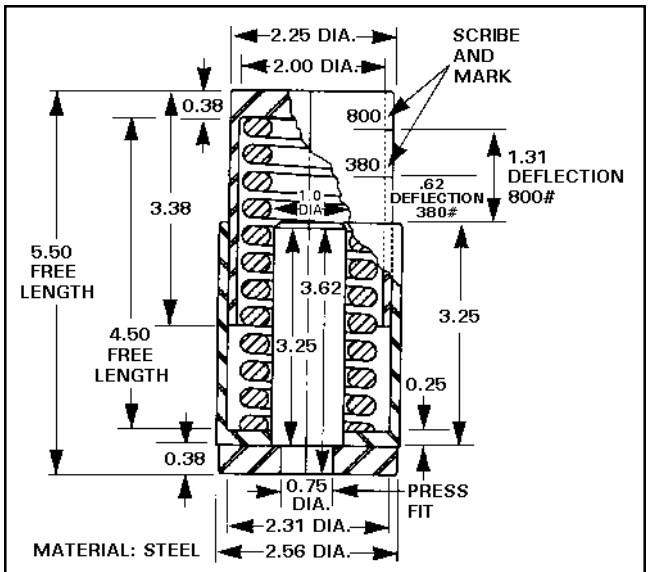
c. Screw in the threaded retaining ring (7) until bottomed.

NOTE: *A spanner wrench is recommended for this.*

d. Back off one full turn (minimum), plus any additional amount to reach the next locking position.

e. Raise the spring press arbor.

f. Reinstall the lock ring (8).



SPRING: Medium-High pressure, 4.50 inch (114.30 mm) free length, 612 lb/in. (10.93 kg/mm), 2.00 inch (50.8 mm) hole, 1.00 inch (25.4 mm) rod (or equivalent).

METRIC CONVERSION			
0.25 in.	6.35 mm	2.56 in.	65.02 mm
0.38 in.	9.7 mm	3.25 in.	82.5 mm
0.62 in.	15.7 mm	3.38 in.	85.9 mm
0.75 in.	19.05 mm	3.62 in.	92.0 mm
1.00 in.	25.4 mm	4.50 in.	114.3 mm
1.31 in.	33.27 mm	5.50 in.	139.7 mm
2.00 in.	50.8 mm	380 lb.	173 kg
2.25 in.	57.15 mm	800 lb.	362 kg
2.31 in.	58.67 mm		

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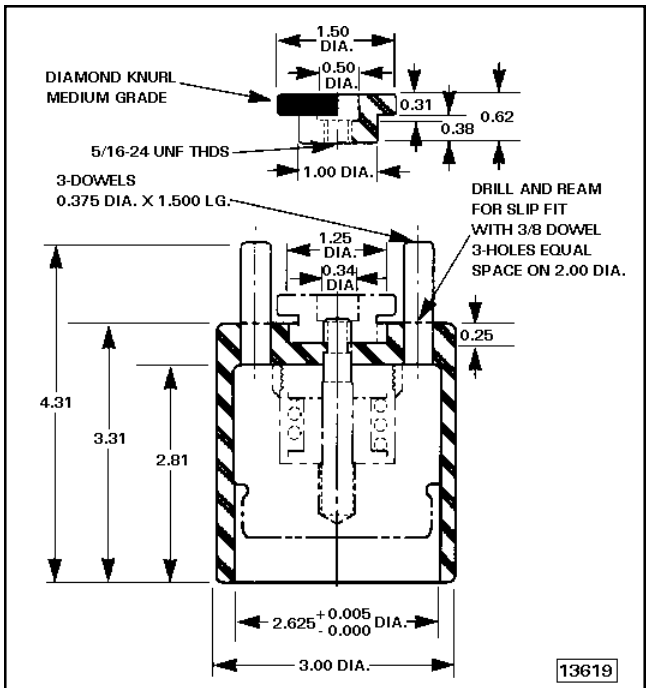
FIGURE 4 - CALIBRATED SPRING POD



METRIC CONVERSION					
0.25	in.	6.35 mm	1.50	in.	38.1 mm
0.31	in.	7.9 mm	2.00	in.	50.8 mm
0.34	in.	8.6 mm	+0.005 (+0.127 mm)		
0.375	in.	9.5 mm	2.625	in.	66.675 mm
0.38	in.	9.7 mm	- 0.000 (- 0.000 mm)		
0.50	in.	12.7 mm	2.81	in.	71.4 mm
0.62	in.	15.7 mm	3.00	in.	76.2 mm
1.00	in.	25.4 mm	3.31	in.	84.1 mm
1.25	in.	31.8 mm	4.31	in.	109.5 mm

FIGURE 5 - ADJUSTER OR RETURN PIN EXTENDER TOOL

g. Recheck for correct BIC adjustment as described in steps 2, 3, and 4.

NOTE: *The return spring force (step 7) should be a minimum of 180 lbs. (82 kg) when fully compressed in the piston subassembly. Replace the spring if the reading is less than 180 lbs. (82 kg).*

⚠ CAUTION

If one defective spring is found, the other return springs in the same brake assembly should also be replaced. Overheating of the brake in service usually causes this condition. Also check for hardening and compression set of the piston seal and back-up rings and for bluing of the steel back plates of the linings, etc. The free height of the return spring should be 1.188 inches (30.16 mm). Springs must not be reinstalled if below a 1.125 (28.58 mm) free height.

GRIP FORCE MEASUREMENT

To make grip force measurement:

1. Assemble the tools shown in Figures 4 and 5.

⚠ CAUTION

Do not use a commercially available spring tester for making grip force measurements. Sudden adjuster grip force release can result in damage to such a tester, requiring repair and re-calibration.

NOTE: *If a hydraulic shop press of suitable requirements is available, the calibration spring pod (Figure 4) is not required. Such a press must have a pressure gauge with a 500 psi (3 500 kPa) range accurately calibrated to read pounds of force exerted by the ram.*

2. Set the calibrated spring pod on the table of the arbor press.

3. Place piston subassembly on top of the spring pod.

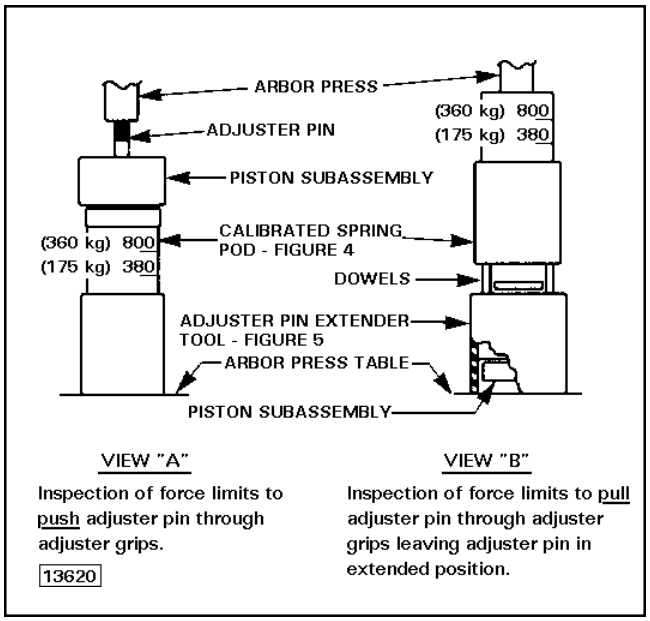


FIGURE 6 - CHECKING ADJUSTER GRIP SPRING FORCE

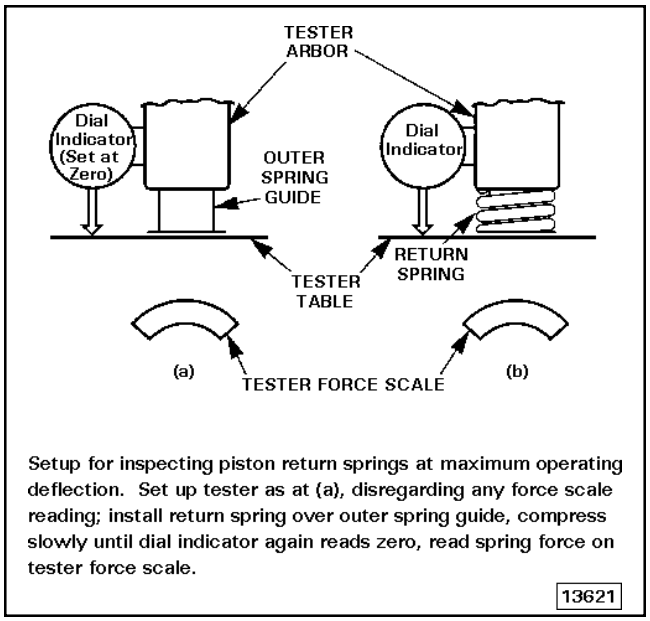


FIGURE 7 - INSPECTING PISTON RETURN SPRING

4. The pin should slip between the 380 and 800 lbs. (175 and 360 kg) marks.

NOTE: *The adjuster or return pin must be returned to its extended position for reassembly in the brake. This is done in the next step, using a special adjuster or return pin extender tool. See Figure 5.*

5. Insert the piston assembly in the adjuster or return pin extender assembly. Secure firmly with the knurled nut.

6. Place the pin return tool and piston subassembly combination on the arbor press table.

7. Drop in three 0.375 inch (9.5 mm) dowel pins as shown in Figure 6. Place the pod tool on top of the dowels.

8. Apply the arbor force slowly to the top of the spring pod and again observe if grip slippage occurs between 380 and 800 lbs. (175 and 360 kg).

9. If slippage occurs below 380 lbs. (175 kg) minimum or above the 800 (360 kg) maximum, the adjuster or return pin should be replaced.

To disassemble the piston subassembly for separate inspection of return spring (10) and return pin and grip assembly (12), proceed as follows:

NOTE: *Disassembly of the piston subassembly during brake overhaul is not mandatory. Clean the piston subassembly thoroughly. If the piston surface passes the functional tests for adjusting force, spring force, and built-in clearance, return the piston subassembly to service.*

1. Remove the O-ring (4) and return pin washer (5) from the adjuster or return pin (6).

2. Remove retaining ring (9).

3. Place the piston subassembly on an arbor press table.

4. Place the special sleeve (Figure 2, View A), or equivalent, over the return pin (6).

5. Lower the arbor and compress the return spring (10) to its minimum height and hold.

6. Back out the threaded retaining ring (9). With compression relieved, the ring can usually be unscrewed by hand. If the threads are burred at the slots, it may be necessary to use a spanner wrench.

7. Slowly raise the arbor until all compression of piston return spring (10) is relieved.

8. Proceed with inspection of disassembled parts.

Inspect return spring (10) as follows:

1. Inspect return spring for a free height dimension of 1.188 inch (30.16 mm). A measured height of less than 1.125 inch (28.58 mm) is an indication that the assembly has been subjected to high temperature operation,

resulting in permanent set of the spring. This causes loss of spring force at working height.

2. Measure the spring force at the maximum service deflection on a spring checker. Use an outer spring guide (11) for test set up purposes. (Figure 7)

3. Set up the dial indicator between the tester arbor and the table.

4. Place the outer spring guide (11) under the test arbor.

5. Lower the arbor firmly on the spring guide. Disregard any tester reading.

6. Hold the arbor in this position and set the indicator dial to zero. See Figure 7, View (b).

7. Raise the arbor.

8. Place the return spring over the spring guide (11) and lower the arbor slowly until the dial indicator again reads zero.

9. Read the spring force on the tester scale.

This value is the spring return force exerted under maximum deflection installed in the position subassembly. Because of manufacturing tolerances, this can be as low as 180 lb. (82 kg), but will usually measure greater than 200 lb. (91 kg). It is recommended that springs measuring a lower force than 180 lb. (82 kg) under these test conditions be replaced.

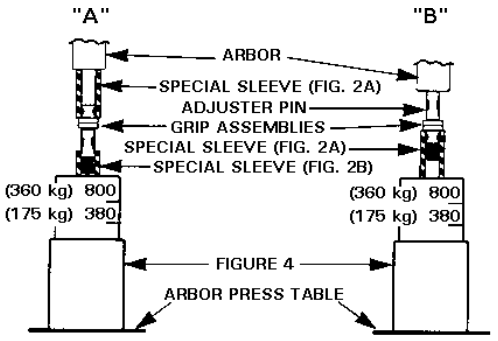
To make grip force measurements of grip subassemblies installed on the adjuster or return pin (6), it is necessary to have available either a force-calibrated hydraulic shop press, or a calibrated spring pod for use with a standard arbor press. Make the force measurements as illustrated in Figure 8.

⚠ CAUTION

Do not use the spring tester checker for making adjuster grip force measurements. Sudden grip force release can destroy calibration and possibly result in damage to the tester.

The force measurements are made as follows (a calibrated spring pod is used to assist in this procedure):

1. Place the spring pod on the arbor press table. Use both of the sleeves (Figure 2) and as shown in Figure 8 to slip the adjuster grips back and forth several times



Use of calibrated spring pod, Figure 4, with an arbor press to check for required grip force slippage between 380 and 800 lb. (175 kg and 360 kg). Slip grips back and forth by alternate use of special sleeves (Figure 2). Leave grips positioned on pin as shown in "B" for installation in piston subassembly.

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FIGURE 8 - CHECKING GRIP FORCE

on the adjuster or return pin.

2. Apply force from the arbor slowly. Observe that slippage occurs between the 380 and 800 lb. (175 and 360 kg) markings on the spring pod.

3. If slippage occurs between the specified force limits, slip the grips to position on the pin as Shown in Figure 2A and reinstall in the piston subassembly.

4. If slippage occurs below the 380 lbs. (175 kg) limit, either the grips, and/or the adjuster or return pin must be replaced.

a. Use the sleeve in Figure 2, View A and the arbor press to slip both grips off the return pin.

b. Inspect the adjuster or return pin for nicks and wear. Any pins with slight nicks that can be polished out by hand can be reused if subsequent slip testing is acceptable. Replace any adjuster or return pin that is bent, battered, or worn to less than 0.374 inches (9.499 mm) diameter. Burred thread can be repaired by use of a 5/16 - 24 UNF-3A thread die.

⚠ CAUTION

The grip subassemblies and adjuster or return pins are critical items in the operation of the piston return mechanism and cannot be mishandled. Under no circumstances should the pin diameter be clamped in a vise or gripped with pliers. In normal use, the surface of the pin will show only a very slow rate of wear. The pins and grips will normally outlast many brake lining changes and brake overhauls.

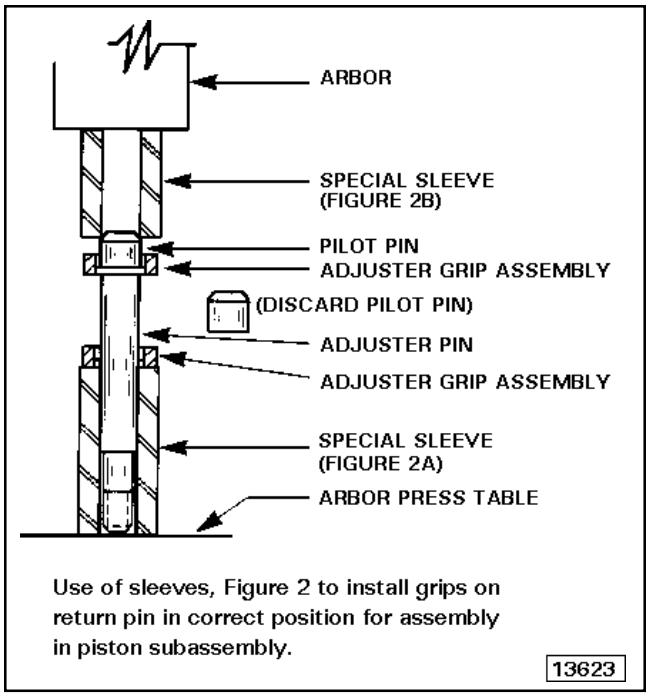


FIGURE 9 - INSTALLING ADJUSTER GRIPS ON ADJUSTER OR RETURN PIN

NOTE: *Any rework of the adjuster or return pin must be avoided unless absolutely necessary.*

5. To install the grips on the adjuster or return pin:

a. Position the adjuster grip and pilot pin (12) on the end of an adjuster or return pin (6).

b. Press the adjuster grip off the expendable pilot pin on to the adjuster or return pin as shown in Figure 9.

c. Press the second grip onto the adjuster or return pin in a similar manner until it is seated firmly against the first.

d. Check the slip force as previously described.

e. After the correct slippage is verified, the position of the grip on the pin should be left untouched for the piston assembly.

6. Reassemble the piston subassembly as follows:

a. Install the inner spring guide (13) in the piston cavity.

b. Install the pilot pin (12) with grip assemblies installed on the adjuster or return pin (6).

c. Install the outer spring guide (11).

d. Install the return spring (10).

e. Install the pin retainer (9).

f. Position the piston assembly on the arbor press table.

g. Place the special sleeve (shown in Figure 2, View A) over the adjuster or return pin (6). Position the threaded spring retainer over the special sleeve.

h. Slowly lower and apply force from an arbor press to compress the return spring to the minimum height and hold compressed.

i. Screw the threaded retaining ring (9) down against the spring retainer. Use a spanner wrench to assure that the threaded ring is bottomed.

j. Holding the spring compressed, back off the threaded retaining ring one full turn minimum, plus an additional amount necessary to install the lock ring in the second available lock ring position.

NOTE: *This provides the necessary built-in clearance adjustment, required for piston retraction, after brake release.*

k. Release and raise the arbor press.

l. Remove the assembly and install the lock ring (8).

ASSEMBLY (Figures 10 and 10A unless otherwise indicated)

The caliper assembly should be assembled as follows:

1. Lubricate all cylinder walls, threads, seals, piston seal surfaces, grooves, etc. with silicone grease. The same hydraulic fluid as used in the truck's hydraulic system is an acceptable substitute lubricant. Do not lubricate the dust boot assemblies.

⚠WARNING

Fluid may cause irritation. Avoid contact with the eyes, or prolonged contact with the skin.

2. Install new piston O-rings (3) into the groove in each of the housing cylinder bores. Push the O-rings to the bottom of the grooves.

3. Install the back-up rings (1) above the O-rings with

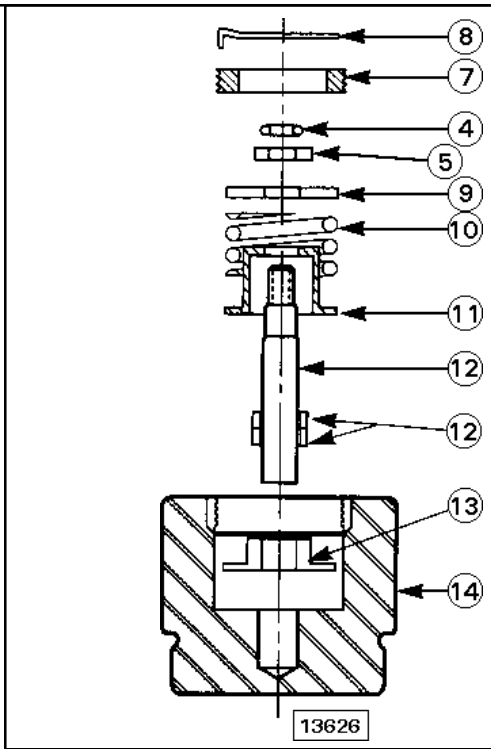
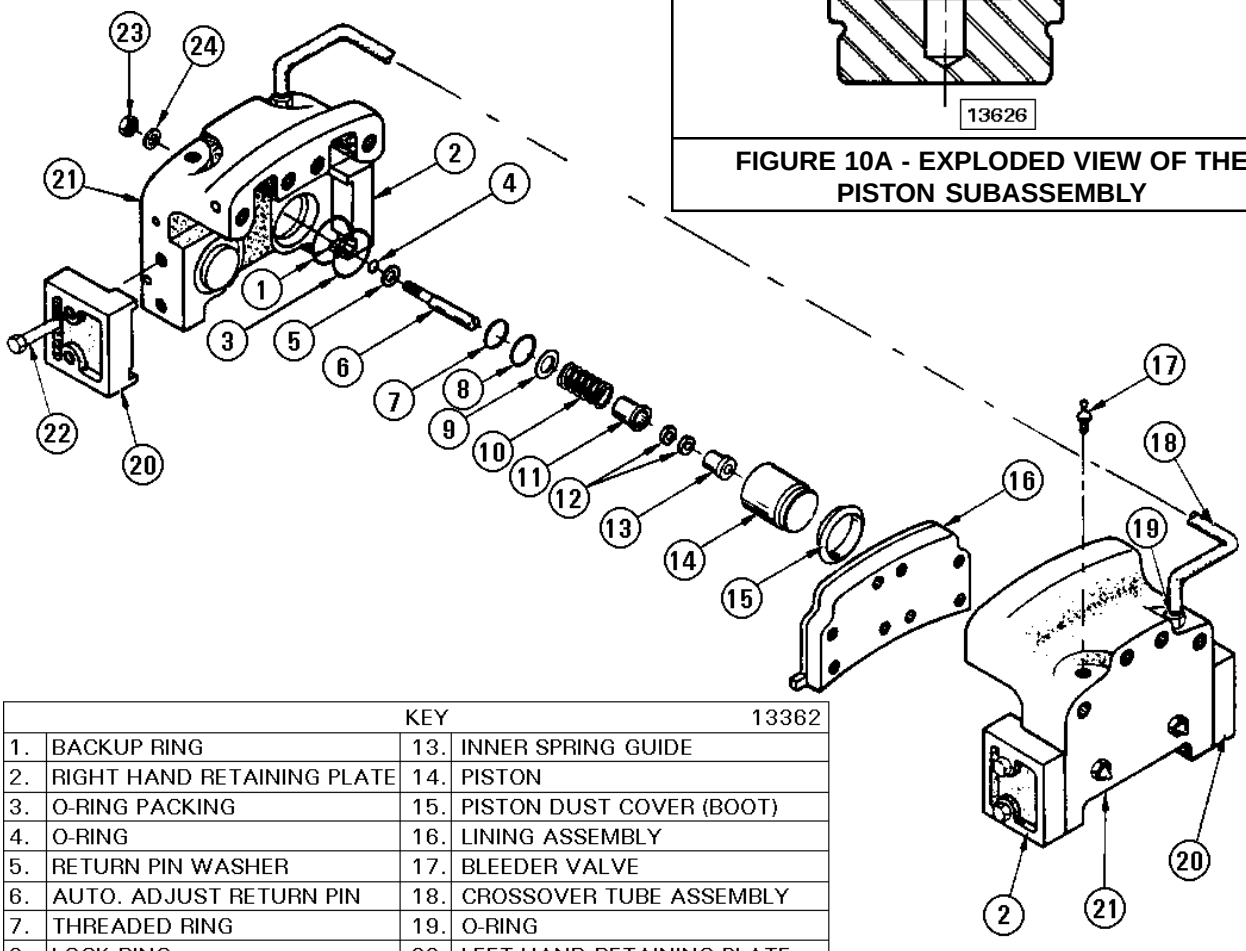


FIGURE 10A - EXPLODED VIEW OF THE PISTON SUBASSEMBLY



KEY			13362
1.	BACKUP RING	13.	INNER SPRING GUIDE
2.	RIGHT HAND RETAINING PLATE	14.	PISTON
3.	O-RING PACKING	15.	PISTON DUST COVER (BOOT)
4.	O-RING	16.	LINING ASSEMBLY
5.	RETURN PIN WASHER	17.	BLEEDER VALVE
6.	AUTO. ADJUST RETURN PIN	18.	CROSSOVER TUBE ASSEMBLY
7.	THREADED RING	19.	O-RING
8.	LOCK RING	20.	LEFT HAND RETAINING PLATE
9.	RETAINING RING	21.	BRAKE HOUSING
10.	COMPRESSION RETURN SPRING	22.	HEX HEAD CAPSCREW
11.	OUTER SPRING GUIDE	23.	HEX NUT
12.	PILOT GRIP AND PIN	24.	INTERNAL TOOTH LOCKWASHER

FIGURE 10 - CALIPER ASSEMBLY

the curved side of the back-up ring against the O-rings.

4. Install the return pin washers (5) on the exposed part of each piston subassembly adjuster or return pin (6). Install a new adjuster or return pin O-ring (4).

5. Position the housing with its mounting face down (cylinder cavities up). Gently force and twist each piston subassembly past the piston seal, until the O-ring and washer are seated in the bottoms of the cavities, being careful not to pinch the seals.

6. Install or reuse the dust covers or boots (15). Keep the covers as free of lubricant as possible.

⚠WARNING

When installing dust cover, avoid applying pressure on the covers over the sharp edge of the shield groove lips. This can cut the underside of covers and cause failure of the boots in service, allowing dirt to contaminate the assembly. Damage to the dust cover can cause loss of braking and serious personal injury.

7. Push the piston assemblies to the bottom of the housing cavity.

8. Position and support the housing subassembly on the bench with the adjuster or return pins up. Install the return pin nuts (23) with washers (24) where required.

9. Hold the adjuster or return pin from turning with a narrow-blade screwdriver or 5/32 Allen wrench. Tighten the nuts to a torque of 120 to 150 inch-lbs. (13.5 to 17.0 Nm).

⚠ CAUTION

When tightening the nuts, avoid turning the adjuster or return pins. This can cause damage to the O-rings and cause the seal to leak.

10. Place the housing on an arbor press. Press the piston assemblies into the fully retracted position.

11. Reinstall all fittings with new packing. Position correctly in the housing subassemblies. Install protective caps and plugs for storage protection.

NOTE: *This final assembly of fittings may be postponed until completion of a functional test. Each housing can be temporarily equipped with a bleed valve and suitable fitting for connecting to a hydraulic supply. Use O-ring packing with the fittings.*

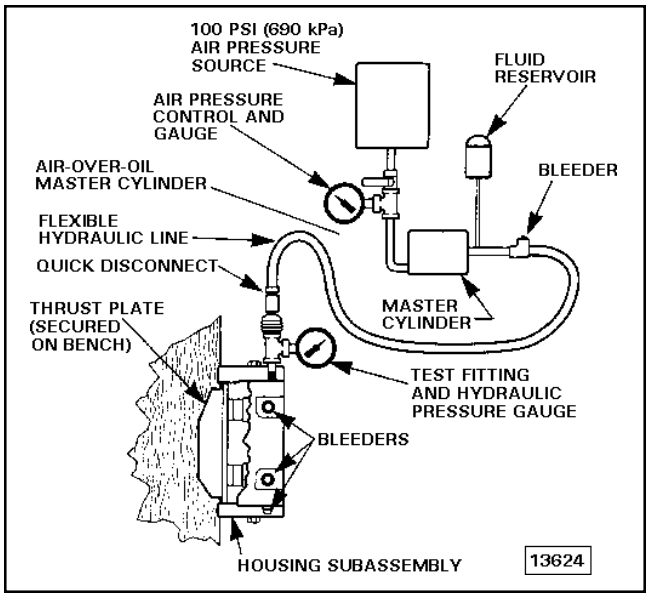


FIGURE 11 - BRAKE FUNCTION TEST SET-UP

FUNCTIONAL TEST

The purpose of the functional test is to verify that the rebuilt brake assembly is correct, seals properly installed, hydraulic leakage is prevented and that the piston retraction mechanism operated properly.

1. Properly set up the required tools including:

a. Hydraulic supply with a pressure range of 0 to 150 psi (1 035 kPa).

NOTE: *An air-over-hydraulic master cylinder if approximately 6 in3 (0.098 liters) of hydraulic displacement with approximately a 6:1 intensification ratio, supplied with 25 psi (170 kPa) line air pressure from a shop source, is adequate. The hydraulic pressure can be controlled by controlling the air pressure.*

b. Reservoir of adequate volume to compensate for fluid loss (bleeding, etc.).

c. Fluid of the same type used in the brake system.

⚠WARNING

Properly discard the hydraulic fluid that is removed from the brake system. Hydraulic fluid that is removed can be contaminated and can cause damage, loss of braking, and serious personal injury. Use only the type of hydraulic fluid specified for the truck. Do not mix different types of hydraulic fluid. The wrong fluid will damage the rubber parts of the caliper and can cause damage, loss of brak-

ing, and serious personal injury.
Use only clean hydraulic fluid during test operations. Contaminated fluid can cause errors in the overhaul, loss of braking, and serious personal injury.

d. Use a flexible line for connecting the pressure source to the brake during testing. Use of a quick disconnect coupling at the end of the flexible line is recommended. The coupling should be used with a test fitting installed in the caliper housing.

e. Feeler gauges

f. Functional test thrust plate as shown in Figure 12.

g. Hydraulic pressure gauge installed at the test fitting.

Test as follows:

1. Assemble the caliper housing with test thrust plate, lining retaining plates (2 and 20), and capscrews (22). Tighten the capscrews to 165 to 210 ft-lbs. (225 to 285 Nm).

2. Install a bleeder valve (17) with an O-ring in one inlet of the housing. Install a test fitting with O-ring in another inlet, and connect this fitting to the hydraulic supply.

3. Position the housing so the bleed valve is at the highest position.

4. Apply 50 to 100 psi (345 to 690 kPa) hydraulic pressure to the housing subassembly.

5. Open the bleed valve to exhaust any entrapped air, then close. If a limited displacement supply is used, it may be necessary to alternately open and close the bleeder, while applying and releasing hydraulic pressure. To effectively remove all entrapped air, it may be necessary to place the housing in alternate positions to allow air to rise toward the bleeder outlet.

NOTE: *Allow the housing to remain in each position for a brief period of time so the air bubbles will rise.*

6. After bleeding all air and other contaminants, apply and release a maximum of 100 psi (690 kPa) hydraulic pressure several times. Observe the extension and retraction of the pistons.

NOTE: *With an air-over-oil intensifier of 6 to 1, this would require about 15 to 20 psi (100 to 140 kPa) air pressure.*

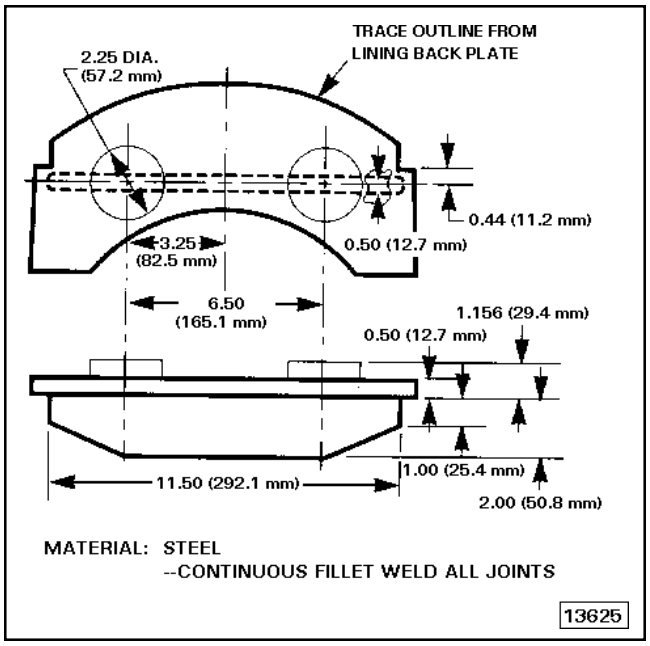


FIGURE 12 - FUNCTION TEST THRUST PLATE

7. With the pressure relieved, a feeler gauge between the piston faces and test adapter will measure the amount of the BIC adjustment, which should be about 0.080 to 0.090 inch (2.03 to 2.29 mm).

8. Apply approximately 30 psi (205 kPa) hydraulic pressure and observe that piston movement begins.

NOTE: *Compression of the piston return spring starts at approximately 30 psi (205 kPa) hydraulic pressure and continues until the built in clearance is used up.*

9. If steps 7 and 8 indicate improper or unsatisfactory piston operation, check for fluid leakage. If leakage is found, repair or replace as required then retest.

10. If the initial clearance between the piston faces and the thrust plate is not within the proper built in clearance, either the built-in clearance was not properly set during piston assembly, or the adjuster grips are out of position on the adjuster return pin (6).

11. Apply 150 psi (1 035 kPa) hydraulic pressure to advance the position of the adjuster grip on the adjuster or return pin (6).

NOTE: *This pressure level corresponds to the grip force limit of 800 lbs. (360 kg) and should reposition the adjuster grips.*

12. Repeat steps 7 and 8. If the required results are not obtained, the piston assembly must be removed from the housing assembly and the built-in clearance reset as outlined in Inspection and Repair. Reassemble and retest.

13. After testing, remove the test fittings and thrust plates. Place the brake half on an arbor press and force each piston to retract until it is completely bottomed in the housing.

14. The linings may be installed at this time or may be installed after the housing assembly has been installed on the truck. Refer to the instructions on Lining Replacement in Maintenance and Adjustment in this module.

NOTE: If the linings are left *un-installed until installation of brake, loosely install the retainer plates and tag the bolts for future reference.*

15. Install the bleeder, caps and plugs as required to store or install the caliper assembly.

INSTALLATION (Figure 10, 13 and 14)

Install the brake assembly as follows:

NOTE: *This procedure is for dual brake systems. Single disc systems are done in a similar manner.*

1. Prior to installation, the crossover tube and nut assembly and three sets of capscrews and washers should be removed from the brake head assembly. Also, the two halves of the caliper assembly should be separated.

2. Before assembly, make sure the pistons are fully retracted. Use a C-clamp to retract pistons that are not fully seated.

NOTE: *The inner and outer caliper assemblies are interchangeable. It is recommended that the components be installed on the same brake assembly that they were removed from to ensure proper fit and wear pattern.*

⚠ CAUTION

If replacement of any capscrew or washer is necessary, it is important that it be replaced by one of equivalent or higher strength. All capscrews in these assemblies are to be SAE Grade 8 (identified by the markings on the head). All washers must be hardened.

NOTE: *The use of guide pins is recommended as an aid during certain steps in installation and removal of the brake heads. These pins may be either headless bolts or threaded rods of each size: 5/8 NC x 5 1/2 inches long, 3/4 NC x 5 inches, and 7/8 NC x 13 inches long.*

3. Insert two 7/8 NC x 13 guide pins into the brake caliper mounting holes on the upper portion of the wheelmotor framework. Insert the 3/4 NC x 6 guide pins into the brake spacer assembly mounting holes in the lower portion of the wheelmotor framework.

NOTE: *As an additional aid, these pins should be set in the outer pair of holes. Insert the two 5/8 NC x 5 1/2 guide pins into the wheel mounting hub at 180° intervals.*

4. Slide the brake spacer on the upper pair of pins and up against the wheelmotor framework. Slide the back half of the inner caliper assembly up against the spacer.

5. Mount the disc and bushing assembly on the disc/spacer adapter.

a. Slide this assembly adapter, end first, onto the center guide pins and position against the wheelmotor armature mounting hub.

b. While moving the assembly on the guide pins, position the large brake spacer so that the disc rests in the adapter slot.

c. Position this spacer against the wheelmotor framework.

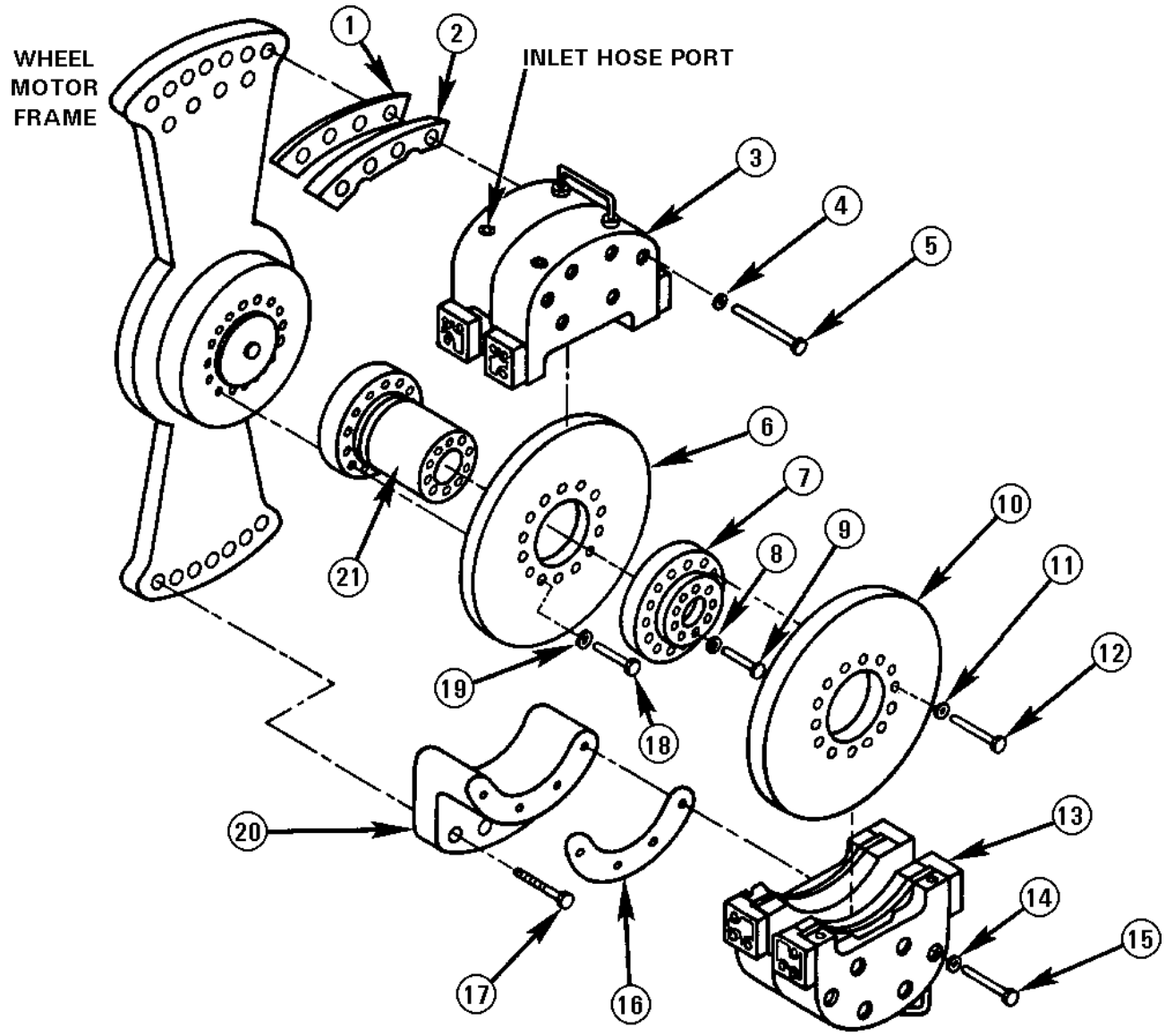
d. Install lubricated Grade 8 capscrews and lockwashers to mount the disc assembly to the armature flange.

e. Torque to 170 ft-lb. (230 Nm) lubricated.

6. Install the other portion of the caliper assembly onto the pins. Install the center two capscrews (9) and washers (10), and tighten.

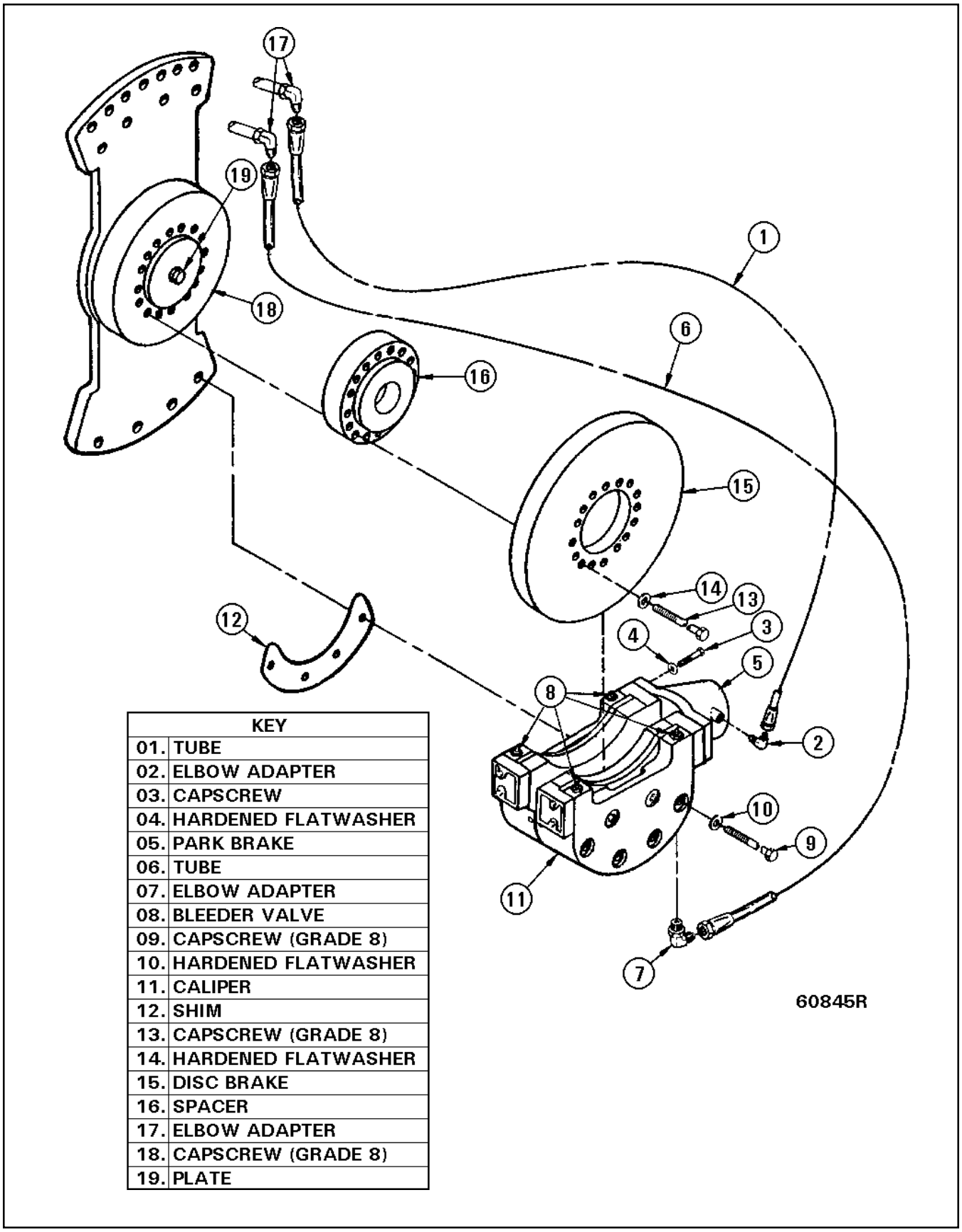
a. Correct installation will center the disc between the retaining plates with approximately 0.13 inch (3.3 mm) clearance between the plates and each side of the disc.

b. If there is not enough clearance between the back face of the disc and the retaining plates of the inner housing it will be necessary to shim behind the disc at the hub.



KEY			11632
1.	CALIPER SHIM	12.	CAPSCREW (GRADE 8)
2.	CALIPER SPACER	13.	OUTER CALIPER ASSEMBLY
3.	CALIPER ASSEMBLY	14.	HARDENED FLATWASHER
4.	HARDENED FLATWASHER	15.	CAPSCREW
5.	CAPSCREW (GRADE 8)	16.	CALIPER SHIM
6.	INNER BRAKE DISC	17.	CAPSCREW (GRADE 8)
7.	ADAPTER FLANGE	18.	CAPSCREW (GRADE 8)
8.	HARDENED FLATWASHER	19.	HARDENED FLATWASHER
9.	CAPSCREW (GRADE 8)	20.	CALIPER SPACER
10.	OUTER BRAKE DISC	21.	DISC ADAPTER SPACER
11.	HARDENED FLATWASHER		

FIGURE 13 - TYPICAL DUAL DISC REAR BRAKE ASSEMBLY



KEY	
01.	TUBE
02.	ELBOW ADAPTER
03.	CAPSCREW
04.	HARDENED FLATWASHER
05.	PARK BRAKE
06.	TUBE
07.	ELBOW ADAPTER
08.	BLEEDER VALVE
09.	CAPSCREW (GRADE 8)
10.	HARDENED FLATWASHER
11.	CALIPER
12.	SHIM
13.	CAPSCREW (GRADE 8)
14.	HARDENED FLATWASHER
15.	DISC BRAKE
16.	SPACER
17.	ELBOW ADAPTER
18.	CAPSCREW (GRADE 8)
19.	PLATE

FIGURE 14 - TYPICAL SINGLE DISC REAR BRAKE ASSEMBLY

c. If the clearance is not enough between the front disc surface and retaining plates of the outer housing it will be necessary to shim behind the inner housing subassembly.

NOTE: *The shims should be steel, ground flat, and should cover the entire mounting area of either the hub or the brake housing.*

NOTE: *The shims may be installed without removing capscrews (5) by cutting a slit from the shim's outer edge into each of the four outer holes.*

7. Once the caliper assembly is properly centered, remove the two 7/8 inch NC x 13 guide pins, and install the two remaining capscrews and washers (10). Torque all four bolts to 465 ft-lb. (630 Nm) lubricated.

NOTE: *After installation, check for 0.030 inch (0.76 mm) minimum clearance between the disc and lining assemblies. If not correct, check the centering of the caliper assembly on the disc.*

8. Install the appropriate fittings and connect hydraulic lines.

9. Install the brake linings as outlined in the procedures on lining replacement in Maintenance and Adjustment. Apply Loctite 271 (or equivalent) and torque the end cap bolt to 165 to 210 ft-lb. (215 to 285 Nm).

⚠WARNING

To avoid serious personal injury, be careful when using Loctite or similar products. Follow the manufacturer's instructions for safe use to prevent irritation to the eyes and skin. Wash thoroughly after any skin contact. If the product gets into the eyes, flush with water for 15 minutes and have the eyes checked by a doctor.

10. Install the park brake assembly and adjust.

11. Bleed air from the brake assemblies as outlined in the procedures in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

12. Apply full brake pressure at least 3 times and release. Check for fluid leaks and correct piston retraction as outlined in Maintenance and Adjustment.

NOTE: *If a piston fails to retract the calipers should be removed and the entire piston subassembly should be replaced.*

PARK BRAKE ASSEMBLY
CARLISLE (GOODRICH) CALIPER TYPE

WARNING

The procedures in this manual for servicing brakes are recommended to reduce exposure to fiber dust, a potential cancer and lung disease hazard. The primary concerns are to avoid creating airborne contamination (such as by blowing material with air) or direct contact with the skin or other organs. Avoid any inhalation of the material and wash hands and other exposed areas of the body after any exposure. Always follow the specific procedures for your work location. Material Safety Data Sheets are available from BUCYRUS®.

DESCRIPTION AND LOCATION (Figures 4 and 5)

The Carlisle (Goodrich) park brake assembly is a caliper/disc type which is mounted on the service brake disc assembly.

OPERATION

The park brakes provide one of the means for securing the truck during parking. Procedures for parking the trucks in a SAFE POSITION should be followed in conjunction with use of the park brakes.

WARNING

Always park in a SAFE POSITION whenever leaving the truck unattended or shutting the engine off. Use the parking brake only as an assist in securing the truck.

The brake discs must be stationary when the park brakes are applied.

Each park brake caliper assembly consists of a pair of piston and housing subassemblies. The calipers are spring applied and hydraulically released. They apply when spring pressure forces the pistons and compresses the springs.

MAINTENANCE AND ADJUSTMENT

IMPORTANT: *Park the truck in a SAFE POSITION before performing any maintenance. The truck must be secured by means other than the truck's friction brake system.*

Periodic maintenance should include the following:

1. Check the individual assemblies, supply hoses, and connections for evidence of leakage or damage. Repair or replace as required.

2. Verify that the disc on which the park brake assembly is located is a minimum of 0.750 inch (19 mm) thick. Replace if worn to less than this thickness.

WARNING

Continued use of disc beyond the minimum thickness may result in loss of braking.

3. Verify that a 0.020 inch (0.51 mm) minimum disc-to-lining clearance exists on each assembly with the brakes released. Adjust as required if this dimension is not correct.

4. Inspect the carrier and lining and disc assemblies as outlined in the procedures on Inspecting Lining and Disc Wear.

WARNING

Always use extra care when working on or around any of the brake assemblies. The service actuation system maintains pressure which must be manually relieved. The park brake actuation system is pressurized when the brakes are released, and relaxed when the brakes are applied. Never remove any pressurized lines without first relieving all pressure.

BLEEDING THE PARK BRAKES

Bleeding the brakes is a procedure by which entrapped air and other contamination is removed from the operating fluid in the brake system.

On trucks with a totally hydraulic brake system, this entails releasing the park brake system and holding by moving the Park Brake switch to the Release position and holding. On trucks with an air/hydraulic brake actuation system, typically the system application controls and actuators must be cycled repeatedly to allow for this purging to occur.

Detailed instructions for the procedure required by each

system configuration are included in the appropriate system procedure in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

It is important they all be removed from the hydraulic fluid prior to beginning operation.

⚠ DANGER

The hydraulic brake system is a high pressure system. Use caution when performing these procedures.

⚠ WARNING

Fluid may cause skin irritation. Avoid any contact with the eyes, or prolonged contact with the skin.

⚠ CAUTION

Pressurizing an improperly adjusted park brake caliper could result in damage to the caliper seals.

INSPECTING LINING AND DISC WEAR

The park brake lining and disc assemblies may be inspected for wear as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction brake system.

2. Verify that the system is properly bled as outlined in the instructions in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

3. Apply the park brakes by moving the Park Brake switch to the Apply position and holding for several seconds (before releasing the switch).

NOTE: *The Load or Hand Brake must be applied before the Park Brake will apply or release.*

4. With the pressure released, measure the clearance between the disc outer edge and the lining carrier with a feeler gauge. (See dimension "A" in Figure 1.) Measure carefully, being sure to include any burr which may exist at the outside of the disc. Also measure the disc thickness at the wear surfaces.

a. If the "A" dimension clearance is greater than 0.040 inch (1.0 mm) and the disc thickness is greater than 0.75 inch (19 mm), proceed to step 6 in this procedure.

NOTE: *If the disc thickness is 0.750 inch or less, it must be replaced before continuing. Procedures for replacing discs are contained in Section 8 - Brake System.*

b. If the "A" dimension clearance is less than 0.040 inch (1.0 mm), either the disc or lining must be replaced. Remove the parking brake and measure the remaining lining thickness.

(1) Replace the disc if:

(a) The disc thickness is less than 0.750 inch (19.0 mm).

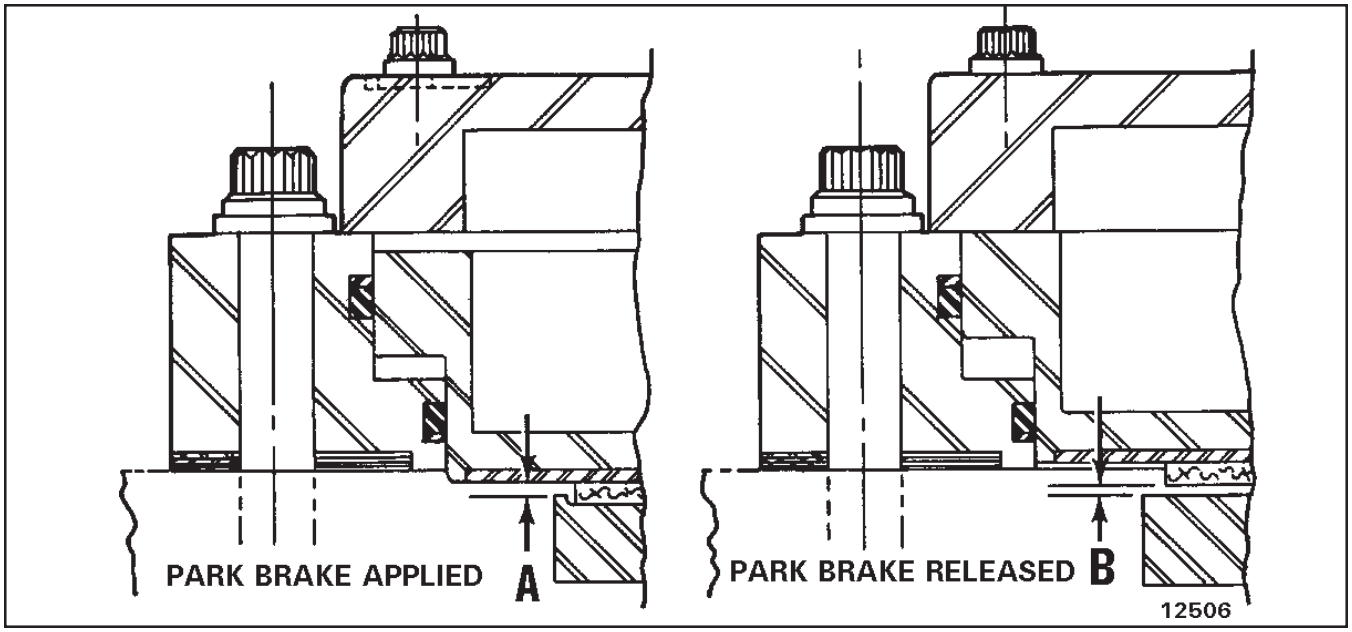


FIGURE 1 - MAINTENANCE MEASUREMENTS (12506)

(b) The disc has no burr on the OD and the remaining material thickness is greater than 0.165 inch (4.2 mm).

(2) Replace the lining and carrier assembly, if:

(a) The disc has no burr on the OD.

(b) The disc has a burr on the OD and the disc thickness is greater than 0.750 inch (19 mm) when measured at the worst worn area.

5. Release the park brake assembly by moving the Park Brake switch to the Release position and holding for several seconds.

NOTE: *The supply accumulator and/or air reservoir must be fully charged, or the truck engine must be running.*

6. With the parking brake released (pressure applied) measure the clearance between the park brake lining and disc with a feeler gauge (see dimension "B" in Figure 1).

NOTE: *Even though the disc and/or lining may have been replaced, the brake may require adjustment under some conditions.*

a. If the "B" dimension clearance is greater than 0.020 inch (0.5 mm) and less than 0.065 inch (1.8 mm), return to service.

b. If the "B" dimension clearance is less than 0.020 inch (0.5 mm) or greater than 0.065 inch (1.8 mm), the brake requires adjustment. Use the shims provided to establish 0.020 to 0.050 inch (0.5 mm to 1.3 mm) clearance. Return to service after completing the reshimming.

⚠WARNING

Failure to adjust the brake when worn below limits may result in hazardous loss of grade holding ability.

CALIPER ADJUSTMENT (Figure 2)

The park brake assembly must be adjusted periodically to compensate for lining and disc wear. This adjustment should be made as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the friction brake system.

2. Bleed all entrapped air and contaminants from the system as outlined in the system instruction in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

3. Release the park brakes by moving the Park Brake switch to the Release position and holding for several seconds before releasing.

NOTE: *The Load or Hand Brake must be applied before the Park Brake will apply or release.*

4. Use a feeler gauge to measure for clearance between carrier and lining assemblies and disc on each side of the disc. Adjust as follows:

a. Shim the mounting bracket to center it over the disc to within 0.010 inch (0.25 mm).

b. Adjust the piston and housing assemblies with shims (3) to provide 0.020 to 0.050 inch (0.5 to 1.3 mm) clearance on each side, between carrier and lining assemblies.

5. Dry torque the mounting bolts (1) to 380 to 390 ft-lb (515 to 530 Nm) and recheck the clearance adjustment. Re-shim if necessary.

NOTE: *If the piston and housing assemblies must be installed without pressurization (brakes applied), the six 3/4 inch bolts (19) must be tightened alternately, one turn at a time, to the required torque.*

PARK BRAKE BURNISHING PROCEDURE

NOTE: *The linings should always be burnished each time the linings or discs are changed. The procedure may be done in conjunction with the burnishing of the rear service brake lining if care is used to obtain the proper disc temperatures.*

The linings may be burnished as follows:

1. Check brake adjustment to assure proper installation and lining as outlined elsewhere in this information.

2. By alternately depressing and releasing the Brake pedal while driving at approximately 5 to 10 mph (8 to 16 km/hr), clean and heat the brake disc to between 700 and 750° F (370 to 400° C).

NOTE: *The temperatures should be taken from an area where the pads or linings have made contact with the disc.*

3. Fully apply the Load or Hand Brake.

4. Apply the Park Brake.

5. Release the Load and/or Hand Brake and Brake pedal.

6. Allow the linings to clamp onto the hot disc until the disc cools to approximately 200° F (94° C) to clean and heat linings.

7. Recheck the parking brake following the instructions in Caliper Adjustment.

8. If testing of the parking capabilities is desired it may be done by parking on steepest hauling grade available not to exceed 15% grade.

⚠WARNING

Make sure that the service brakes operate correctly. If the service brakes do not operate correctly, the truck may not stop and can cause damage and serious personal injury.

REMOVAL (Figures 4 and 5)

Each park brake caliper may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Apply the park brakes by moving the Park Brake switch to the Apply position and holding for several seconds before releasing.

3. Disconnect the hydraulic line at the fitting on the park brake. Cover the line with a metal cap plug, and label to aid installation.

⚠DANGER

Never remove the park brake assembly or hydraulic lines without first verifying that the park brakes are applied and that all hydraulic pressure is released.

4. Pressurize the caliper supply lines to 1300 to 2500 psi (8 965 to 17 248 kPa) to retract the piston. Maintain this pressure during removal.

NOTE: *It is recommended that an external pressure source (i.e., a "port-a-power" or equivalent filled with the same fluid used in the truck's brake system) be used to pressurize the lines during removal and installation.*

5. Remove the capscrews and washers that attach the park brake assembly to the mounting bracket.

6. Remove the park brake assembly.

7. Remove the mounting brackets, shims, etc., if required.

DISASSEMBLY (Figure 2)

The park brake caliper assembly may be disassembled as follows:

⚠WARNING

The brake head components are spring loaded. Use extreme care and follow the disassembly instructions.

1. Loosen the screws (5) one turn at a time, to relieve the spring load on the piston (12).

2. After spring load is completely released, remove screws (5), washers (6) and cap (7).

3. Loosen the screws (10), and secure the carrier and lining assembly (11) to the piston. Remove the screws and carrier and lining assembly.

NOTE: *An epoxy adhesive is used to lock the screws (10) to the pistons (12), which may require more than normal torque to loosen the screws. Heat (350° F (177° C) maximum) applied to the screw heads will facilitate loosening.*

INSPECTION AND REPAIR (Figure 2)

The disassembled caliper may be serviced as follows:

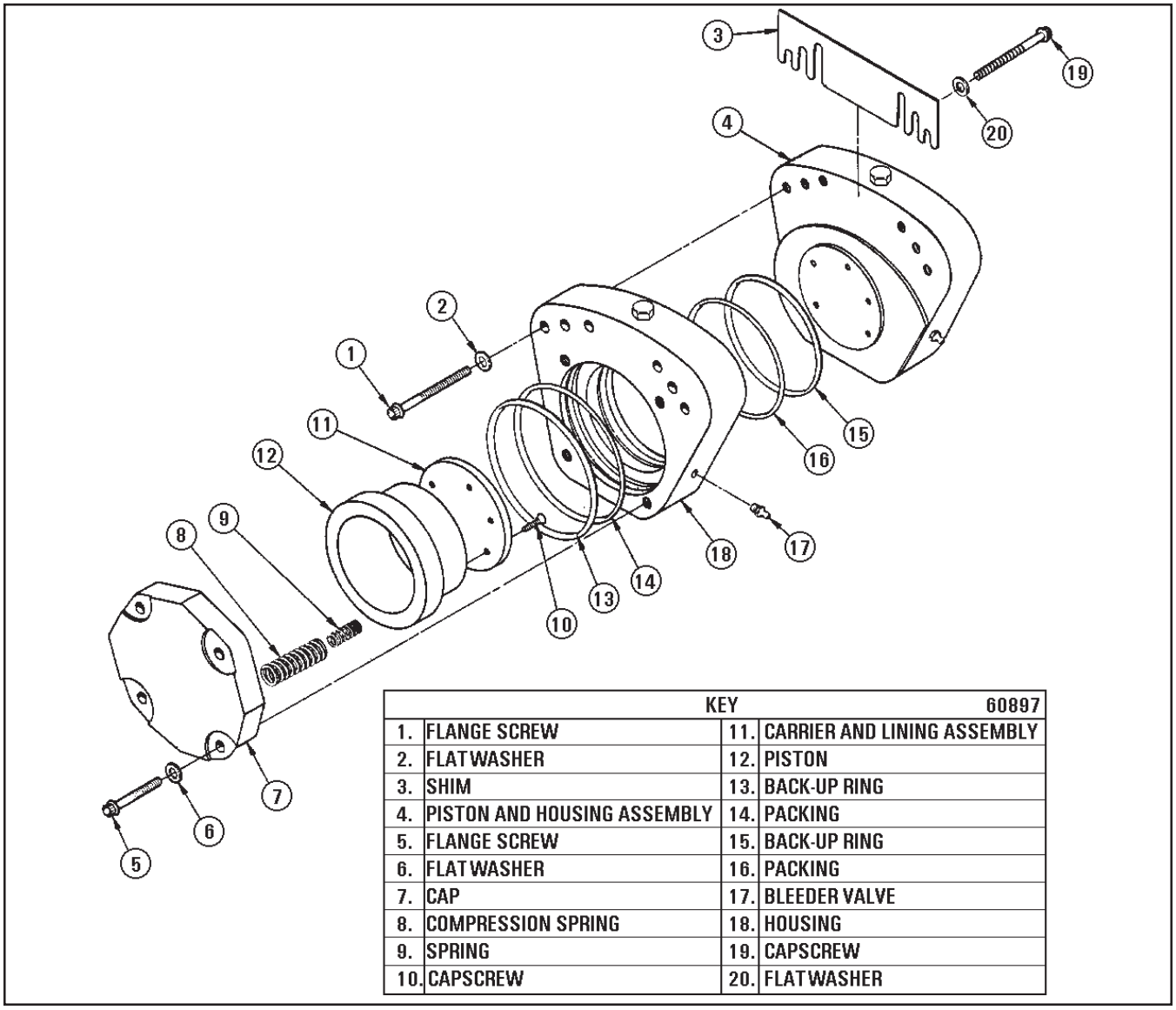
1. Inspect the assembly for evidence of wear, damage or leakage. Repair or replace as required.

2. Inspect the carrier and lining assemblies (11) for wear and damage. Replace when the carrier approaches or contacts the disc.

3. Inspect the piston for scratches, nicks and other slight surface damage. Smooth all surface damage with crocus cloth.

4. Inspect the piston housing (4) for evidence of cracks, breaks, or surface damage. Use crocus cloth to smooth minor surface damage on sealing surfaces. Replace piston housings that are cracked or broken.

5. Check the disc for wear and cracks. Replace if worn to less than 0.750 inch (19 mm). Check all bleeder valves (17) and fittings for thread damage. Replace all damaged threaded parts.



KEY			60897
1.	FLANGE SCREW	11.	CARRIER AND LINING ASSEMBLY
2.	FLATWASHER	12.	PISTON
3.	SHIM	13.	BACK-UP RING
4.	PISTON AND HOUSING ASSEMBLY	14.	PACKING
5.	FLANGE SCREW	15.	BACK-UP RING
6.	FLATWASHER	16.	PACKING
7.	CAP	17.	BLEEDER VALVE
8.	COMPRESSION SPRING	18.	HOUSING
9.	SPRING	19.	CAPSCREW
10.	CAPSCREW	20.	FLATWASHER

FIGURE 2 - PARK BRAKE CALIPER ASSEMBLY (60897)

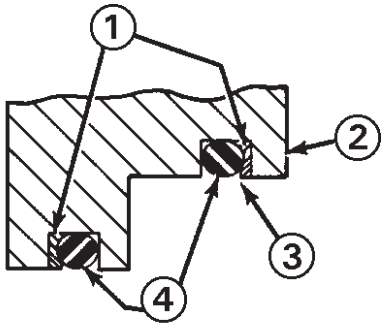
6. Replace all packing and back-up rings each time the assembly is serviced.

ASSEMBLY (Figure 2)

The caliper may be assembled as follows:

1. Lubricate the packing (14 and 16) and back-up rings (13 and 15) with clean fluid (the same fluid used in the system).

2. Install the packing and back-up rings in the ID grooves of the piston housings (4 and 18). Install the rounded surface of the rings against the packing, and the flat surface of the rings facing the outer surfaces of the housing (Figure 3).



KEY	12507
1.	BACK-UP RINGS
2.	PISTON HOUSING
3.	RADIUS SURFACE TOWARD PACKING
4.	PREFORMED PACKINGS

FIGURE 3 - PROPER SEAL INSTALLATION (12507)

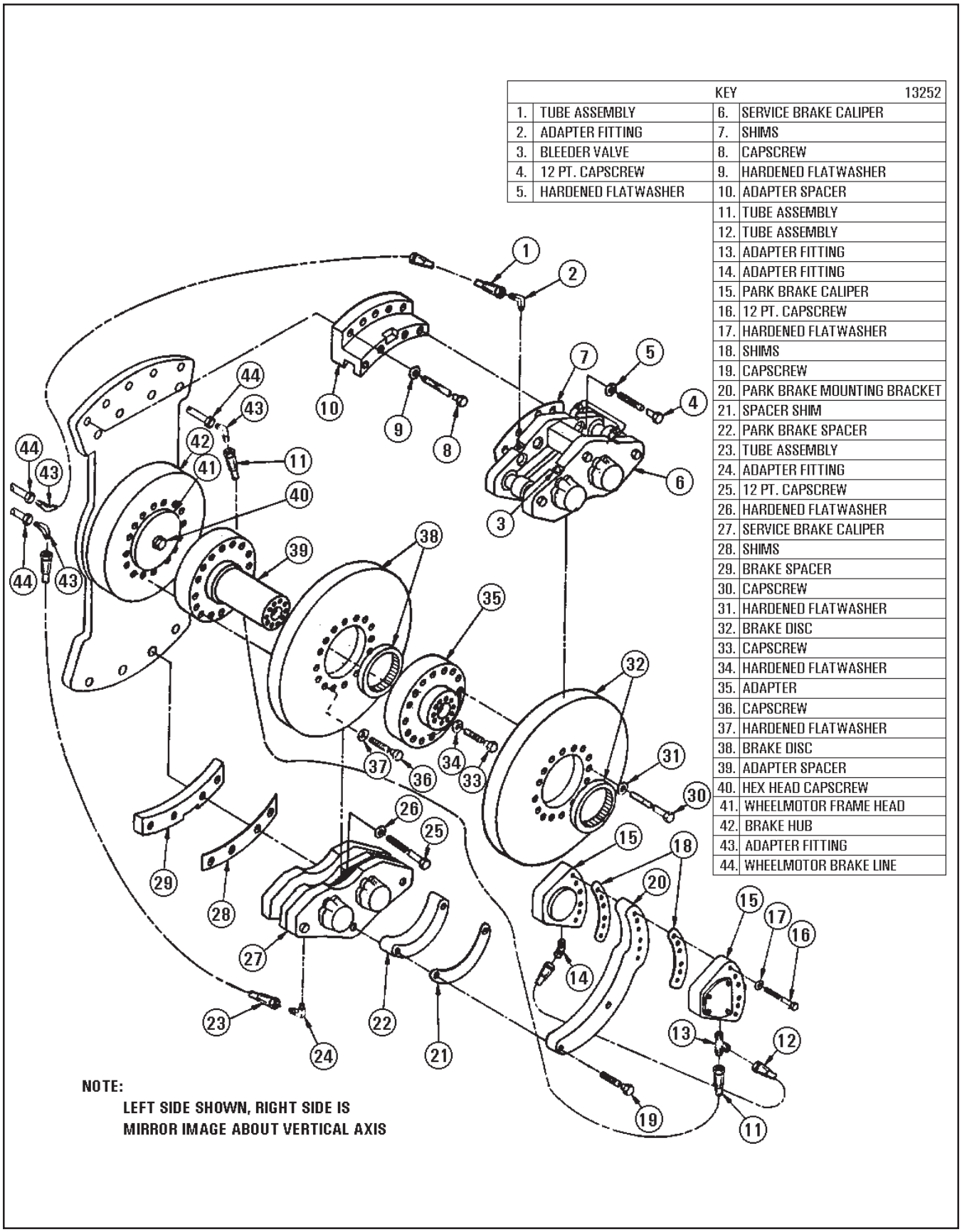
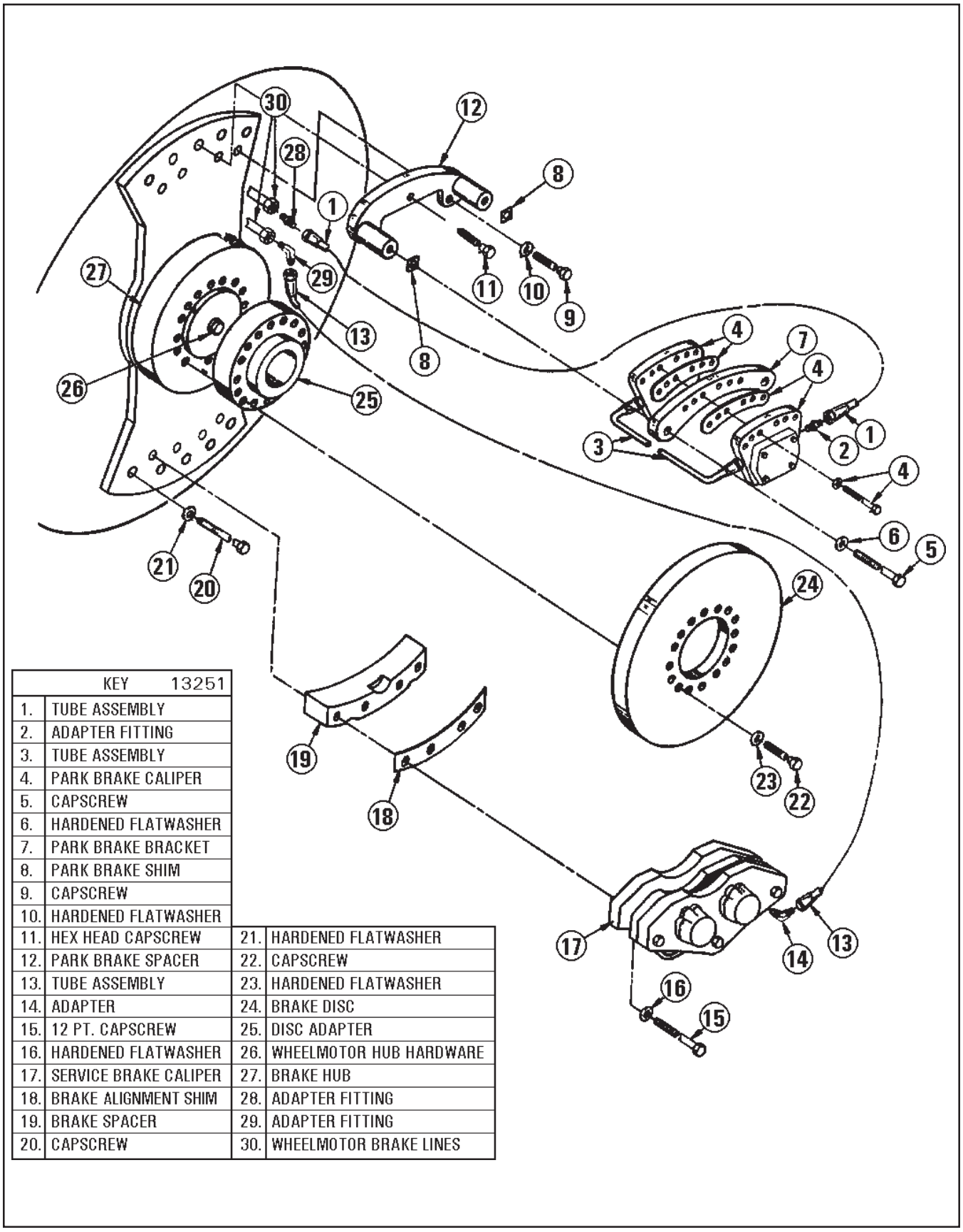


FIGURE 4 - DUAL DISC BRAKE ASSEMBLY WITH PARK BRAKE (13252)



KEY 13251			
1.	TUBE ASSEMBLY	21.	HARDENED FLATWASHER
2.	ADAPTER FITTING	22.	CAPSCREW
3.	TUBE ASSEMBLY	23.	HARDENED FLATWASHER
4.	PARK BRAKE CALIPER	24.	BRAKE DISC
5.	CAPSCREW	25.	DISC ADAPTER
6.	HARDENED FLATWASHER	26.	WHEELMOTOR HUB HARDWARE
7.	PARK BRAKE BRACKET	27.	BRAKE HUB
8.	PARK BRAKE SHIM	28.	ADAPTER FITTING
9.	CAPSCREW	29.	ADAPTER FITTING
10.	HARDENED FLATWASHER	30.	WHEELMOTOR BRAKE LINES
11.	HEX HEAD CAPSCREW		
12.	PARK BRAKE SPACER		
13.	TUBE ASSEMBLY		
14.	ADAPTER		
15.	12 PT. CAPSCREW		
16.	HARDENED FLATWASHER		
17.	SERVICE BRAKE CALIPER		
18.	BRAKE ALIGNMENT SHIM		
19.	BRAKE SPACER		
20.	CAPSCREW		

FIGURE 5 - SINGLE DISC REAR BRAKE ASSEMBLY WITH PARK BRAKE (13251)

NOTE: *Make sure the packing and back-up rings are properly seated in the grooves before continuing assembly.*

3. Assemble the carrier and lining assemblies (11) on the pistons (12), and secure with screws (10). Prior to attaching the new carrier and lining assemblies, clean the screws with solvent to remove old adhesive. Apply a liberal coat of epoxy adhesive (Scotch-Weld Brand Structural Adhesive No. 2158 B/A) to four or five threads.

NOTE: *Scotch-Weld Brand Structural Adhesive No. 2158 B/A is a two-part epoxy adhesive manufactured by Minnesota Mining and Manufacturing Company, St. Paul, Minnesota. Follow manufacturer's instructions for correct use.*

4. Install the piston and lining assembly in the piston housing, taking care not to damage packing and back-up rings.

5. Install the springs (8 and 9) on the threaded end of the screws (10) protruding from the back of the pistons in the piston housings.

6. Install the springs in pairs of small and large over each screw.

7. Install the cap (7) over the springs and secure to the piston housings with screws (5) and washers (6). Dry torque to 110 to 120 ft-lb (150 to 165 Nm).

INSTALLATION (Figures 4 and 5)

The caliper assembly should be installed as follows:

1. Attach the brake fluid supply lines to the 7/16-20 threaded ports of both piston housings. Use bulkhead or O-ring type fittings to prevent fluid leakage.

2. Pressurize the connected supply lines 1300 to 2500 psi (8 965 to 17 240 kPa) to retract pistons. Maintain this pressure during installation.

NOTE: *It is recommended that an external pressure source (i.e., a "port-a-power" or equivalent, filled with the same fluid used in the truck's hydraulic system) be used to pressurize the lines during installation and removal.*

3. Attach the piston and housing assemblies to the mounting bracket with six SAE Grade 8, 3/4 inch diameter bolts and hardened steel washers.

WARNING

SAE Grade 8 bolts with hardened steel flatwashers underneath the bolt heads and nuts must be used to ensure secure mounting of discs and brake heads.

NOTE: *Brake heads must always be installed on the vehicle to allow access to the mounting bolts that attach the piston and housing assemblies to the mounting bracket.*

4. Install the shims on each side of the mounting bracket, between the bracket and housing assemblies. Tighten the two outside mounting bolts. Do not final torque bolts.

5. Shim the assembly as outlined in the adjustment procedures in Maintenance and Adjustment.

6. Dry torque mounting bolts to 380 to 390 ft-lb (515 to 530 Nm).

7. Bleed the assemblies as outlined in Maintenance and Adjustment.

8. Pressurize the system (release the park brakes) and check the clearance between the disc and carrier and lining assemblies. It should be equal on each side of the disc.

WARNING

The clearance between the disc and the carrier and lining assemblies must be maintained during vehicle operation to prevent drag.

9. Check for leaks and proper operation.

10. Before returning the truck into service, burnish the park brakes as outlined in the procedures in Maintenance and Adjustment.

PARK BRAKE ASSEMBLY
ARVIN/MERITOR (ROCKWELL/GOODYEAR) SCL 70

⚠WARNING

The procedures in this manual for servicing brakes are recommended to reduce exposure to fiber dust, a potential cancer and lung disease hazard. The primary concerns are to avoid creating airborne contamination (such as by blowing material with air) or direct contact with the skin or other organs. Avoid any inhalation of the material and wash hands and other exposed areas of the body after any exposure. Always follow the specific procedures for your work location. Material Safety Data Sheets are available from BUCYRUS®.

DESCRIPTION AND LOCATION (Figure 1)

The Arvin/Meritor (Rockwell/Goodyear) SCL 70 is a caliper type mechanical/hydraulic park brake assembly. It contains a dual piston caliper with a yoke installed over the housing. One assembly is mounted over each outboard disc assembly on each wheelmotor.

OPERATION (Figures 1 and 2)

The park brakes provide one of the means for securing the truck during parking. Procedures for parking the trucks in a SAFE POSITION should be followed in conjunction with use of the park brakes.

⚠WARNING

Always park in a SAFE POSITION whenever leaving the truck unattended or shutting the engine off. Use the parking brake only as an assist in securing the truck.

⚠WARNING

The brake discs must be stationary when the park brakes are applied. If the parking brake is used to stop the truck, the brake linings must be replaced. Failure to replace the linings may cause loss of braking and serious personal injury.

When the brake is applied, the hydraulic pressure to the assembly is released. This allows the spring washers to move the pistons, which push the lining assemblies against the disc. The preload on the springs is regulated by an adjusting bolt. The positioning of the lining assembly is regulated by a clamping bolt. To ensure proper adjustment, the procedures outlined in Maintenance and Adjustment must be followed.

When the brake is released, hydraulic pressure is applied against the piston causing it to retract and compress the spring washers. The lining moves away from the disc to a specified clearance, allowing the disc to rotate.

NOTE: *The brakes may be manually released by loosening the clamping bolts and the adjustment bolt to allow the springs to relax.*

⚠ CAUTION

Do not apply hydraulic pressure to the park brake when it is manually released.

MAINTENANCE AND ADJUSTMENT (Figure 2)

IMPORTANT: *Park the truck in a SAFE POSITION before performing any maintenance. The truck must be secured by means other than the friction brake system.*

Periodic maintenance should include the following:

1. Check the individual assemblies, supply hoses, and connections for evidence of leakage or damage. Repair or replace as required.

NOTE: *The covers should be kept clean. A suitable cleaning method is to wipe with a clean cloth covered sparingly with diesel fuel, and drying with a separate clean cloth.*

2. Inspect the boot assemblies (10) for evidence of wear, damage, or leakage. They should be soft and flexible. Repair or replace as required.

3. Verify that the bleeder valves (14) are secure and free of leaks or damage.

4. Verify that the jam nut (13) on the adjusting bolt (12) is tight to 210 ft-lb (285 Nm).

5. Verify that the clamping bolt is torqued to 90 to 125 ft-lb (120 to 170 Nm).

6. Inspect the linings for wear. If the linings are worn to within 0.030 inch (0.8 mm) of the piston, the lining must

be replaced. The linings should also be replaced if:

a. The thickness of the two linings is significantly different. Determine the cause before repairing to prevent future wear.

b. There is oil or grease on the linings.

c. There are cracks on the lining larger than the normal “heat check” cracks.

⚠ CAUTION

Always replace both linings. If only one lining is replaced possible disc wear can occur.

7. Bleed all entrapped air and contaminants from the system as outlined in the procedure in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

8. Check adjustment of the linings as outlined in the procedures on Caliper Adjustment.

CALIPER ADJUSTMENT (Figures 1 and 2)

NOTE: *The item numbers refer to items shown on Figure 2.*

The park brake calipers must be adjusted periodically to compensate for lining and disc wear. This adjustment should be made as follows:

NOTE: *The assembly should have a 0.030 to 0.060 inch (0.762 to 1.524 mm) lining to disc clearance on each side of the disc with the parking brake caliper released.*

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck’s friction brake system.

NOTE: *All calipers should be adjusted at the same time.*

2. Bleed all entrapped air and contaminants from the system as outlined in the procedures Bleeding the Park Brake Calipers in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

3. Fully apply the Load Brake or Hand Brake so that the lever remains detented in the applied position. Verify that the Hand or Load Brake indicator is lit.

4. Apply the park brakes by moving the Park Brake switch to the Apply position, and holding for several seconds before releasing.

5. Cut, remove, and discard the lockwire between the adjusting bolt (12) and the clamping bolt (17).

6. Loosen the clamping bolt (17) on the caliper assembly that secures the yoke to the brake housing.

NOTE: *The parking brake calipers must be applied when the clamping bolt is loosened and the adjusting bolt is turned. Loosen only enough to allow the yoke to slide. Do not remove.*

7. Loosen the jam nut (13) on the adjustment bolt (12) until it does not contact the spring retainer (11).

NOTE: *Verify that there is an anti-seize compound on the threads of the adjustment bolt that will engage the yoke assembly.*

8. Tighten the clamping bolt finger tight until no gap exists between the brake housing and the yoke. Make sure that the yoke is positioned inside of the housing groove.

9. Turn the adjusting bolt (12) until both the inboard and outboard linings just contact the brake disc surface. Use a long feeler gauge to ensure that the linings are contacting the disc surface.

⚠ WARNING

The following adjustment procedure may require 160 to 200 ft-lb (215 to 270 Nm) of torque for proper brake adjustment. Torque over 200 ft-lb (270 Nm) may indicate improper adjustment or improper brake assembly. Continuing adjustment of brakes requiring more than 200 ft-lb (270 Nm) of torque may cause the brake to operate incorrectly and can cause damage to the equipment and serious personal injury.

10. Turn the adjusting bolt (12) in an additional 4 turns. Tighten the clamping bolt (17) to 90 to 125 ft-lb (120 to 170 Nm).

NOTE: *If the adjusting bolt (12) draws up tight before reaching 4 turns, back off and repeat steps 9 and 10.*

11. Back off adjusting bolt (12) by loosening 1/4 turn to obtain the proper brake force and to center the brake over the disc.

12. Hold the adjusting bolt (12) in place and tighten the jam nut (13) against the yoke, torquing to 210 ft-lb (285 Nm).

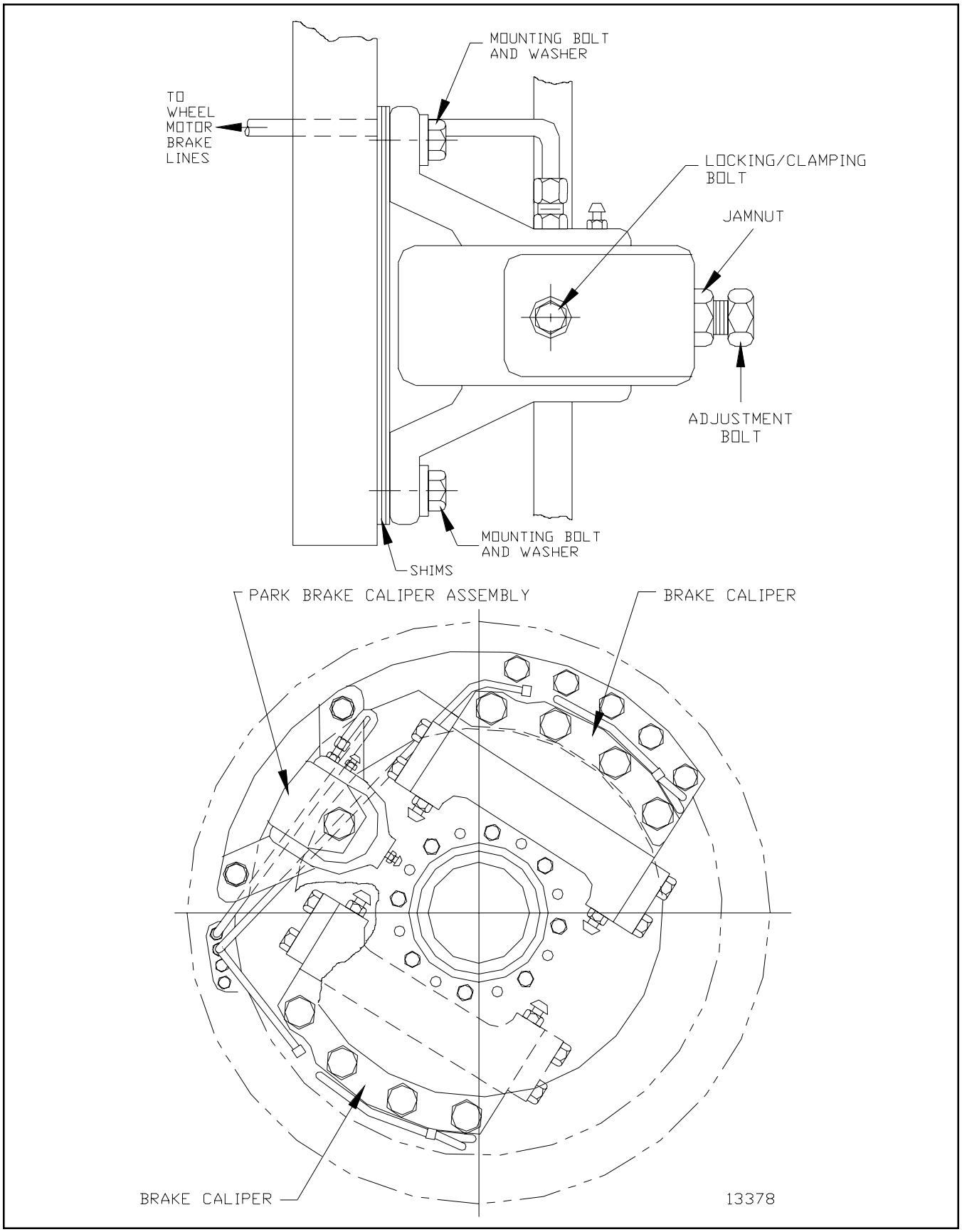


FIGURE 1 - PARK BRAKE CALIPER INSTALLATION AND ADJUSTMENT

13. Repeat steps 5 through 12 for each caliper assembly.

14. Apply and release the parking brakes 3 times. Check for leaks. If the caliper leaks, remove, repair or replace as required.

⚠WARNING

Do not stand near the caliper when the parking brake is applied or released. When the caliper leaks, fluid comes from the caliper at high pressure and can cause serious personal injury.

15. Release the parking brakes by moving the Park Brake switch to the Release position, holding for several seconds, then releasing.

16. With the brakes released, check the inboard lining to disc clearance with a feeler gauge. The clearance should be 0.030 to 0.060 inch (0.762 to 1.524 mm) but should not be less than 0.010 inch (0.254 mm).

NOTE: *The inboard lining to disc clearance must be adjusted before the outboard lining to disc is adjusted.*

17. If the inboard lining to disc clearance is not 0.030 to 0.060 inch (0.762 to 1.524 mm), record the clearance measurement and do the following:

a. Apply the park brakes.

b. Loosen the clamping bolt (17).

c. Hold the adjusting bolt (12) in position and loosen the jam nut (13).

d. Turn the adjusting bolt (12) to obtain the correct 0.030 to 0.060 inch (0.762 to 1.524 mm) inboard disc to lining clearance.

(1) Turn the adjusting bolt left to right or clockwise to decrease the clearance.

(2) Turn the adjusting bolt right to left or counterclockwise to increase the clearance.

NOTE: *Each 1/4 turn of the adjusting bolt changes the lining to disc clearance by approximately 0.009 inch (0.228 mm).*

e. Tighten the clamping bolt (17) to 90 to 125 ft-lb (120 to 170 Nm).

f. Release the parking brakes and check the inboard lining to disc clearance with a feeler gauge. The clearance must be 0.030 to 0.060 inch (0.762 to 1.524 mm). If the inboard clearance is not correct, repeat step 17 (a through e) until the correct inboard clearance is established.

18. Make sure that the clamping bolt (17) is properly torqued to 90 to 125 ft-lb (120 to 170 Nm).

19. With the brakes released, check the outboard lining to disc clearance with a feeler gauge. The clearance should be 0.030 to 0.060 inch (0.762 to 1.524 mm).

20. If the outboard lining to disc clearance is not 0.030 to 0.060 inch (0.762 to 1.524 mm), record the clearance measurement and do the following:

NOTE: *Do not loosen the clamping bolt (17) for this procedure.*

a. Apply the park brakes.

b. Hold the adjusting bolt (12) in position and loosen the jam nut (13).

c. Turn the adjusting bolt (12) to obtain the correct 0.030 to 0.060 inch (0.762 to 1.524 mm) outboard lining to disc clearance.

(1) Turn the adjusting bolt left to right or clockwise to decrease the clearance.

(2) Turn the adjusting bolt right to left or counterclockwise to increase the clearance.

NOTE: *Each 1/8 turn of the adjusting bolt changes outboard lining to disc clearance by approximately 0.009 inch (0.228 mm).*

d. Hold the adjusting bolt (12) in position and tighten the jam nut (13) against the yoke to a final torque of 210 ft-lb (285 Nm).

e. Release the parking brakes and check the outboard lining to disc clearance with a feeler gauge. The clearance must be 0.030 to 0.060 inch (0.762 to 1.524 mm).

f. If the outboard clearance is not correct, repeat step 20 (a through e) until the correct outboard clearance is established.

21. Release the parking brakes.

22. Check the lining to disc clearance of both the inboard and outboard linings with a feeler gauge. The clearance must be 0.030 to 0.060 inch (0.762 to 1.524 mm) for both linings. If either or both clearances are not correct, repeat step 17 through 20 as required.

23. Hold the adjusting bolt (12) in position and tighten the jam nut (13) against the yoke to a final torque of 210 ft-lb (285 Nm).

24. Release the Hand or Load Brake. Verify that the indicator light goes out.

25. After adjustment is complete, install new 0.062 inch (1.57 mm) diameter lockwire between the adjusting bolt (12) and the clamping bolt (17) to secure the adjustments.

26. Burnish the brake linings as outlined in the instructions in this procedure.

BLEEDING THE PARK BRAKE CALIPERS

Bleeding the brakes is a procedure by which entrapped air and other contamination is removed from the operating fluid in the brake system.

On trucks with a totally hydraulic brake system, this entails releasing the park brake system by moving the Park Brake switch to the Release position and holding.

On trucks with an air/hydraulic brake actuation system, typically the system application controls and actuators must be cycled repeatedly to allow for this purging to occur.

Tighten the bleeder screw to 100 to 150 inch-lb (11.3 to 16.9 Nm) when not actually bleeding the assemblies.

Detailed instructions for the procedure required by each system configuration is included in the appropriate system procedure in Section 5 - Hydraulic System or Section 6 - Pneumatic System.

It is important they all be removed from the hydraulic fluid prior to beginning operation.

⚠ DANGER

The hydraulic brake system is a high pressure system. Use caution when performing these procedures.

⚠ WARNING

Fluid may cause skin irritation. Avoid any contact with the eyes or prolonged contact with the skin.

⚠ CAUTION

Pressurizing an improperly adjusted park brake caliper could result in damage to the caliper seals.

PARK BRAKE BURNISHING PROCEDURE

NOTE: *The linings should always be burnished each time the linings or discs are changed.*

The linings may be burnished as follows:

1. Check brake adjustment to assure proper installation and lining to disc clearance of 0.030 to 0.060 inches (0.762 to 1.524 mm).

2. By alternately depressing and releasing the Brake pedal while driving at approximately 5 mph (8 km/hr), clean and heat the brake disc to between 350 and 500° F (175 to 260° C).

3. Fully apply the Hand Brake.

4. Apply the Park Brake.

5. Release the Hand Brake and Brake pedal.

6. Allow the linings to clamp onto the hot disc for 3 to 5 minutes to clean and heat linings.

7. Readjust parking brake following the instructions in Caliper Adjustment.

8. Test the parking capabilities by parking on steepest hauling grade available not to exceed 15% grade.

⚠ WARNING

Make sure that the service brakes operate correctly. If the service brakes do not operate correctly, the truck may not stop and can cause damage and serious personal injury.

9. If parking brake does not hold on grade, allow vehicle to start to roll down grade for approximately 15 feet (4.6 m) before releasing parking brake. Check the disc to lining clearance again, 0.030 to 0.060 inch (0.762 to 1.524 mm).

10. Readjust parking brake as outlined previously.

11. Retest the brake as outlined previously.

RELEASING THE BRAKES MANUALLY (Figures 1 and 2)

NOTE: *The item numbers refer to items shown on Figure 2.*

IMPORTANT: *Use this procedure to release the park brake calipers when the truck must be moved but not operated (i.e. towed, etc.).*

⚠WARNING

If it is necessary to raise the truck to service the parking brake, support the truck with the appropriate stands to secure in place. Never work on trucks supported only by jacks as they can slip and fall over, causing serious personal injury.

1. Park the truck in a SAFE POSITION on a level surface. It must be secured by means other than the truck's friction brake system.

2. Verify that the brakes are fully applied and that all pressure is released from the hydraulic portion of the park brake system.

⚠WARNING

Never try to turn or remove the adjusting bolt while hydraulic pressure is applied to the brake. Turning the adjusting bolt while pressure is applied can damage the seals and the yoke threads. Removing the yoke can cause serious personal injury by the sudden release of hydraulic pressure. Make sure that the nut is tightened to lock the adjusting bolt before putting the truck into service. If the nut is loose, the brake may lose adjustment and become ineffective. Serious personal injury can occur.

3. Cut, remove, and discard the lockwire between the adjusting bolt and the clamping bolt.

4. Loosen the clamping bolt (17) on the top of the housing until the bolt is finger-tight in the housing.

5. Loosen the jam nut (13) on the adjusting bolt (12) on the side of the housing.

6. Loosen the adjusting bolt (12) until the bolt does not touch the spring retainer (11) in the housing. Make sure that the linings do not touch the disc. The brake is now released.

7. Tighten the jam nut (13) to 210 ft-lb (285 Nm).

8. Tighten the clamping bolt (17) to 90 to 125 ft-lb (120 to 170 Nm).

9. The truck is now free to move.

REMOVAL (Figures 1 and 2)

NOTE: *The item numbers refer to items shown on Figure 2.*

Each park brake caliper may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Verify that the park brakes are applied and all pressure is released from the control system.

NOTE: *The park brake calipers must be applied when the clamping bolt (17) is loosened and the adjusting bolt (12) is turned.*

3. Cut, remove, and discard the lockwire between the adjusting bolt (12) and the clamping bolt (17).

4. Loosen the clamping bolt (17) until the bolt is finger tight in the housing.

5. Loosen the jam nut (13) on the adjusting bolt (12) on the side of the housing.

6. Loosen the adjustment bolt (12) until the screw does not touch the spring retainer (11) in the housing. Make sure that the linings do not touch the disc.

7. Disconnect the hydraulic line from brake assembly. Cap the line to prevent contamination of oil.

⚠WARNING

Never remove the park brake assembly or hydraulic lines without first verifying that the park brakes are applied and that all hydraulic pressure is released.

8. Install a plastic inlet plug in the brake inlet port.

9. Remove the capscrews and hardened washers that attach the park brake assembly to the service caliper.

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Brake does not apply.	Brake not adjusted properly.	Adjust as outlined in Maintenance and Adjustment.
	Wrong or damaged spring washers.	Remove and replace the washers.
	Piston does not move.	Check the dimensions of the housing and pistons as outlined in Inspection and Repair. Repair or replace as required.
Brake does not release.	Damaged hydraulic system.	Repair the hydraulic system.
	Piston cocked in bore.	Check the dimensions of the housing and pistons as outlined in Inspection and Repair. Repair or replace as required.
	Hydraulic pressure too low.	Repair the hydraulic system.
	Worn or damaged seals and/or back-up rings.	Replace seals and/or back-up rings.
	Piston does not move.	Check the dimensions of the housing and pistons as outlined in Inspection and Repair. Repair or replace as required.
	Worn or damaged spring washers.	Replace the spring washers.
Brake does not hold on a grade.	Brake pressure not released.	Repair the hydraulic or brake actuation system.
	Brake not adjusted properly.	Adjust the brake as outlined in Maintenance and Adjustment.
	Worn or damaged spring washers.	Replace the spring washers.
	Truck parked on too steep a grade.	Park on a lesser slope and in a SAFE POSITION.
	Brakes not burnished.	Burnish the brakes as outlined in Maintenance and Adjustment.
Cannot attain proper brake adjustment.	Clamp bolt not loose.	Loosen the clamp bolt to finger tight.
	Spring washers not assembled properly.	Assemble the washers correctly.
	Spring washer slipped out of position.	Adjust the spring washers into proper position on the spring retainer.
	Spring washers worn or damaged.	Replace the damaged spring washers. If the brake adjustment produces over 0.060 inches (1.524 mm) lining to disc clearance, the spring washers are worn out and must be replaced.
	Adjust bolt or yoke threads galled or stripped.	Replace the adjusting bolt and/or yoke. Apply anti-seize compound to the threads.

10. If shims are used, mark the position of the shims on the disc.

11. Remove the park brake assembly.

DISASSEMBLY (Figure 2)

The caliper assembly may be disassembled as follows:

1. Remove the bleeder screws (14) and plugs.

2. Drain all oil from the housing and discard.

3. Loosen the clamping bolt (17).

4. Loosen the jam nut (13) on the adjusting bolt (12). Remove the adjusting bolt (12) from the yoke assembly.

5. Remove the clamping bolt (17) and washer (16).

6. Remove the yoke (15) from the housing assembly.

7. Remove, inspect, and discard the dust boots (10) from the spring retainers and the housing.

8. Remove the spring retainers (11) and spring washers (9) from the pistons (6).

9. Push the pistons (6) through the large bores of the caliper housing.

NOTE: *This process may be assisted by connecting a low pressure air or hydraulic system (with fluid compatible with that used in the truck's hydraulic system) to the hydraulic inlet port and gently using the pressure to push the piston out.*

10. Carefully inspect and remove all remaining components from the assemblies.

INSPECTION AND REPAIR (Figure 2)

The park brake assembly may be serviced as follows:

1. Clean all parts of the brake assembly as follows:

a. Use solvent cleaners to clean all metal parts that have ground or polished surfaces, such as pistons and piston bores.

b. Use solvent cleaners or alkaline solutions to clean metal parts with rough surfaces.

c. Use a wire brush to clean the threads of fasteners or fitting.

d. Use soap and water to clean all non-metal parts.

⚠ DANGER

Petroleum base cleaning fluids are volatile. Do not use near an open flame.

⚠ CAUTION

Use only solvent cleaners to clean ground or polished metal parts. Hot solution tanks or water and alkaline solutions will damage these parts. Isopropylene alcohol, kerosene, or diesel fuel can be used for this purpose.

NOTES:
1. Be certain that hydraulic passages in the housing are clean and free from contaminants.
2. Immediately after cleaning, dry all parts with clean paper or rags.

NOTE: *It is recommended that all seals and back-up rings be replaced at disassembly, but if they are reused, clean in a petroleum base hydraulic oil compatible with that used in the truck's hydraulic system.*

2. If brake linings are to be reused, scrape away build-ups of mud and dirt. Replace all linings that have been contaminated with oil or grease. Burnish linings per procedure in this manual. If not, the linings may be replaced as follows:

a. Remove the capscrews (2) securing the lining (3) to the piston (6).

b. Separate the lining (3) and the piston (6).

c. Inspect and clean the piston and capscrews as outlined in this procedure.

d. Apply Loctite 271 (or equivalent) to the threads of the capscrews (2) that fasten the linings (3) to the pistons (6).

⚠ WARNING

To avoid serious personal injury, be careful when using Loctite or similar products. Follow the manufacturer's instructions for safe use to prevent irritation to the eyes and skin. Wash after skin contact. If the material gets into the eyes, flush the eyes with water for 15 minutes and have the eyes checked by a doctor.

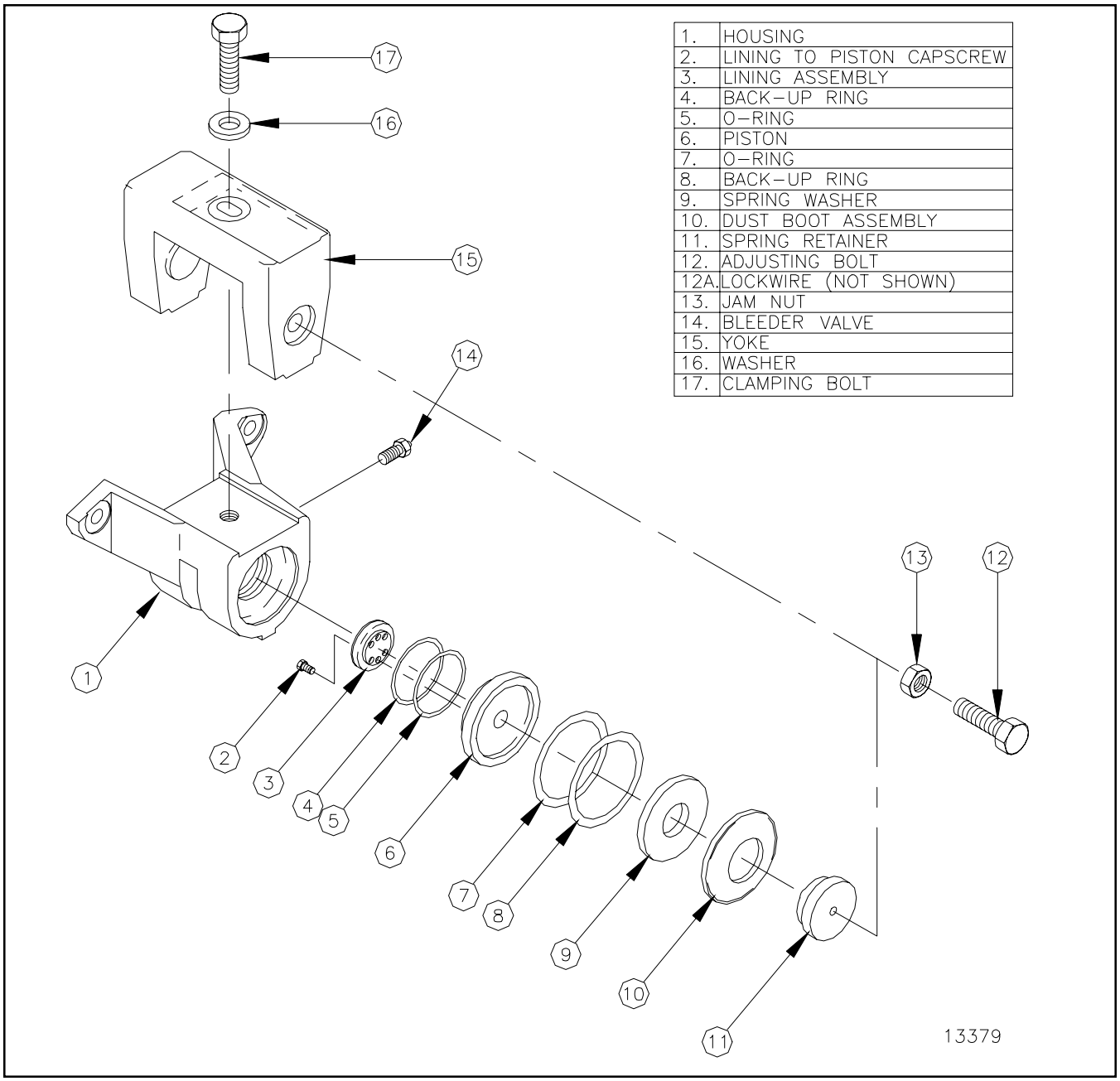


FIGURE 2 - CALIPER ASSEMBLY

e. Install the new lining (3) and secure with the capscrews (2). Evenly tighten all screws to hold the linings against the piston. Do not torque or over-tighten the screws.

3. Inspect all metal parts for cracks or evidence of other damage. Replace any cracked or damaged parts.

NOTE: *It is recommended that springs (9) be replaced as complete sets only.*

4. Check the boot assemblies (10) for evidence of wear or damage. They should still be soft and flexible. Repair or replace as required.

5. Check the inlet and bleeder fittings in the housings for thread damage.

a. Repair any damaged inlet hole threads with a 7/16-20 UNF-2B tap. If threads are not serviceable after repair, replace the housing.

b. Repair any damaged bleeder threads with a 7/16-20 UNF-2B tap. If threads are not serviceable after repair, replace the housing.

⚠WARNING

Make certain that all metal chips and residue are removed from parts and hydraulic passages.

6. Inspect the housing cylinder walls for damage.

a. Scratches or corrosion on the cylinder wall, 0.002 inch (0.05 mm) deep or less, can be blended out with 300 or 400 grit wet or dry sandpaper, or emery cloth.

⚠WARNING

Excessive localized polishing of the cylinder wall or piston surface will result in fluid leakage.

b. Measure inner diameter of the housing bore. Replace the housing if the large end of the bore exceeds 4.503 inches (114.376 mm) or the small end of the bore exceeds 2.504 inches (63.602 mm).

7. Inspect each piston for corrosion and scratches.

a. Scratches or corrosion on the piston surface, 0.002 inch (0.05 mm) deep or less, can be blended out with 300 or 400 grit wet or dry sandpaper, or emery cloth.

⚠WARNING

Excessive localized polishing of the cylinder wall or piston surface will result in fluid leakage.

b. Measure the outer diameter of the piston. Replace the piston if the large end diameter is worn to less than 4.494 inches (114.148 mm) or the small end diameter is worn to less than 2.493 inches (63.322 mm).

8. Inspect spring washers for cracks and corrosion. Replace parts that are cracked or severely corroded.

9. Inspect bolts for cracks, corrosion, and thread damage. Replace bolts that are severely damaged.

10. Inspect the threaded hole for adjustment bolt in the yoke, and the threaded hole for the clamping bolt in the housing.

a. The threaded hole in the yoke for the adjustment bolt can be repaired with a 1-14 UNS-2B tap. If threads are not serviceable after repair, replace the yoke.

b. The threaded hole in the housing for the clamping bolt can be repaired with a 5/8-11 UNC-2B tap. If threads are not serviceable after repair, replace the housing.

ASSEMBLY (Figure 2)

The park brake assembly may be assembled as follows:

1. Lubricate all seals and back-up rings with a coat of silicone grease or the same hydraulic oil used in the hydraulic system. Also, lubricate the cylinder walls with the same oil.

2. Install lubricated seals (7) and back-up rings (8) in the grooves in the caliper housing (1).

a. The back-up rings are installed toward the disc.

b. The lip seals are installed away from the disc.

3. Install lubricated seals (5) and back-up rings (4) on the pistons (6).

a. The lip seals are installed toward the disc.

b. The back-up rings are installed away from the disc.

4. If not done previously, attach the lining (3) to the pistons (6) with screws (2) as outlined in the instruction on Inspection and Repair in this module.

5. Install the pistons in the housing being careful not to damage seals or back-up rings or get oil or grease on the lining assemblies.

6. Lubricate the spring retainers (11) with an anti-seize compound of MIL-T-5544 or equivalent.

7. Assemble the spring retainer assemblies as follows: (See Figure 3 for proper orientation and installation.)

a. Place the spring retainers (11) on a flat surface with the largest diameter on the bottom.

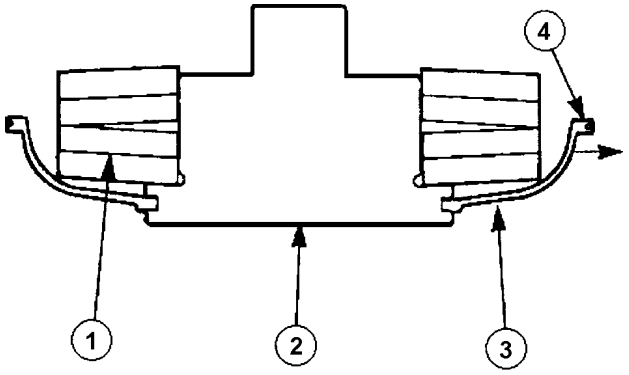
b. Install the piston dust boot assemblies (10) in the grooves in the spring retainers.

c. Place two lubricated spring washers (9) on the spring retainers (11). Install the rounded part of the washer toward the retainer.

d. Place two lubricated spring washers on the washers installed in the retainer. Install the round part of the washers away from the installed washers.

8. Install the spring retainer assemblies with spring washers into the pistons (6).

9. Install the outer edge of the dust boots in the grooves



KEY	13643
01.	Spring Washer (Item 9)
02.	Spring Retainer (Item 11)
03.	Dust Boot (Item 10)
04.	To Housing Groove

NOTE: *Listed item numbers in ( ) refer to Figure 2.*

FIGURE 3 - SPRING AND DUST BOOT INSTALLATION

in the caliper housing as shown in Figure 3.

10. Install the yoke (15) over the caliper housing so that the adjusting bolt is away from the caliper mounting flange. Align the bores in the yoke and the housing.

11. Install the washer (16) on clamping bolt (17) and install the bolt and washer loosely (hand tight), attaching the yoke to the housing.

12. Screw the jam nut (13) all the way on the adjustment bolt (12).

13. Apply an anti-seize compound of MIL-T-5544 or equivalent to end of the adjusting bolt (12). It should be on the threads of the bolt that are opposite the head.

14. Install the bolt in the yoke part way (approximately five turns).

15. Install the bleeder valves (14) in the housing.

NOTE: *The clamping bolt must be loose when the adjusting bolt is tightened.*

16. Install a 1.06 inch (26.94 mm) spacer between the linings. Tighten the adjusting bolt until the linings just touch the spacer.

17. Remove the spacer from between the linings.

INSTALLATION (Figure 2)

The park brake assembly may be installed as follows:

1. Loosen the clamping bolt (17) and adjusting bolt jam nut (13) without turning the adjusting bolt (12).

2. Open the caliper bleed ports on the assembly.

3. Push the linings back to get disc clearance, then tighten the bleeder screws.

4. Install the assembly over the disc, and secure to the wheelmotor. Use shims to center +/- 0.030 inches (0.8 mm).

NOTE: *The shims must be of approved variety, made of steel ground flat and parallel and must cover the entire mounting surface of the hub.*

5. Secure the assembly with capscrews and hardened washers.

6. Check the distance between the mounting surface of the caliper and the mounting surface of the disc. It must be 4.355 to 4.395 inches (110.617 to 111.633 mm). If the distance is not correct, add or remove shims between the housing and mounting bracket or between the hub and the disc.

7. Remove the caps or plugs used for storage.

8. Install the hydraulic line from the brake assembly.

⚠WARNING

Always connect all lines on all assemblies prior to pressurizing any lines. The lines will be pressurized when the truck is running and the Park Brake switch is in the Release position.

9. Repeat for each caliper assembly.

10. Bleed all entrapped air and other contaminants from the system as outlined in the procedure in Section 5 - Hydraulic system or Section 6 - Pneumatic System.

11. Adjust each assembly as outlined in Maintenance and Adjustment.

12. Lockwire the clamping and adjusting bolts as shown on the instruction label on the caliper using the double twist method. Secure the ends with 5 twists and bend the ends back or under to prevent snagging.

13. Inspect the assemblies for leakage.

14. Verify that the assemblies apply and release properly.

15. Verify that the assemblies will secure the vehicle as required.

AUTOMATIC LUBRICATION SYSTEM (WITH ELECTRICALLY (24 VDC) DRIVEN ROTARY GREASE PUMP)

DESCRIPTION AND LOCATION (Figure 1)

The automatic lubrication system provides regular, periodic lubrication to grease points by means of an electrically operated pump, an electric timer, and lubricant injectors. The pump assembly is located on the superstructure and is mounted directly on the lubricant container. The electric timer is labeled with numbers that represent time in minutes, and is mounted inside the cab. The lubricant injectors are connected to the grease lines and are mounted near designated grease points.

For various reasons, not all of the components on the truck can be served by the system. The exact location of the automatic lubrication assemblies and the number of items served vary, depending on the special requirements of the mine.

OPERATION (Figure 1)

The function of the automatic lubrication system is to maintain proper lubrication levels at various bearing points on the truck. Instead of operating continuously, however, the system periodically cycles as follows:

NOTE: *Detailed information about those components contained in the pump assembly and injectors are outlined in their separate information in Section 9 - Options.*

The pump is driven by the rotary motion of the 24 Vdc motor. This rotary motion is converted to reciprocating motion through an eccentric crank mechanism. The reciprocating action causes the pump cylinder to move up and down. The pump is of positive displacement; double acting design with grease output occurring during both the up and down strokes of the pump. The pump motor employs an integral speed control capable of reducing its speed to 10% of its maximum value.

During the down stroke the pump cylinder is extended into the grease. Through the combination of shovel action and vacuum generated in the pump cylinder chamber, the grease is forced into the pump chamber. Simultaneously, grease is discharged through the outlet of the pump. The volume of grease during the intake is twice the amount of grease output during each cycle.

During the upstroke, the inlet check function closes, and one half of the grease taken in during the previous stroke is transferred through the outlet check function to the outlet port.

An electric timer assembly controls the operation of the system relay and the operation of the pump. The pressurization of the grease supply system controls the operation of the individual injectors when it reaches the preset operating level. Setting the motor speed controls the volume of grease flow over the regulated on interval.

Several additional provisions are available for the system.

1. A separate warning indicator to indicate when the system not operating properly (typically if it fails to energize in more than 60 minutes.

2. A separate manual activation switch to allow manual system testing and activation when desired.

3. Remote or ground level central service filling provisions to permit filling the central reservoir from pressurized sources, with and without automatic reservoir level monitoring provisions.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

NOTE: *Preventive maintenance should be performed frequently to ensure proper operation of the system. Damage to bearings and other moving components can be avoided.*

2. Inspect the lubrication system components for evidence of dirt, damage, wear or leaks.

3. Clean and inspect the system components.

4. Check the mounting hardware for tightness.

TROUBLESHOOTING

PROBLEM/ CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
(1) Pump does not run.	**(1) Pump is seized or damaged.**	(1) Disassemble the pump and repair or replace the damaged seized components.
	(2) Incorrect Polarity.	(2) Check that the red motor lead is connected to the battery terminal.
(2) Pump speeds up or runs erratically.	**(1) Follower plate is stuck and separated from the grease.**	(1) Check the follower plate and container for evidence of wear or damage. Repair or replace as required.
	(2) Pump piston or check valves are worn.	(2) Disassemble the pump and repair or replace the damaged or worn components.
(3) Pump runs, but the output of grease is low.	**(1) Pump speed set too low.**	(1) Increase motor speed setting.
	(2) Faulty inlet or discharge check valves.	(2) Repair or replace as required.
(4) Weepage from the housing cover.	**(1) Cup seal or O-ring worn or damaged.**	(1) Check, repair, or replace as required.
(5) Pump becomes noisy.	**(1) No oil in crankcase.**	(1) Add crankcase oil as outlined in the instructions on the hydraulic pump assembly in Section 9 - Options.
	(2) Worn wrist pin bushing.	(2) Disassemble the pump and repair or replace the damaged or worn components.
(6) Pump does not build pressure.	**Foreign material holding lower check assembly open.**	(1) Dismantle, clean, repair or replace as required. Consider installing inlet screen.
		(2) Check grease supply for contamination.

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5. Verify that all connections are tight, clean and free of leaks. All hoses should be secured firmly without kinks and routed away from all moving parts.

6. Maintain an adequate level of lubricant in the reservoir to ensure proper operation of the system, and to avoid priming the system should it run dry.

NOTE: *Do not allow the grease reservoir to run dry. This could result in damage to lubricated parts on the truck, and will require the automatic lubrication system to be primed.*

7. Check the operation and setting of the electric timer setting as follows:

NOTES:
1. The electrical timers are mounted in the cab and are accessed through the dash access panel to the right of the steering wheel.
2. These times are typical and may be adjusted for site and environmental differences.

a. Set the “Off” timer for 5 minutes.

b. Set the “On” timer to 1 minute.

c. Mark the timers and knobs to indicate the settings made.

8. Inspect each injector for the correct discharge adjustment. To adjust an injector for the desired dis-

charge rate, proceed as outlined in the instructions in Section 9 - Options.

9. If it has been determined that there is air in the lines, the air should be removed from the system. Once the air has been removed, the cause should be determined.

NOTE: *Air in the supply and feed lines (injector to bearing) can be a major cause of the lubrication system not to operate properly. Air pockets in the lubricant will prevent the pump from building up lubricant pressure.*

Entrapped air may be removed from the system as follows:

a. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

b. Remove the plug from the tee or injector manifold closest to the pump.

c. Start the pump.

d. When grease flows freely from the plug opening, stop the pump and replace the plug. Repeat this procedure on the next tee or manifold downstream from the pump, and progressively work to the last and longest supply line run.

e. After all air is expelled and all plugs are replaced, the pump will build up lubricant pressure and complete its operating cycle.

10. Check that there is adequate outlet grease flow from the pump has been operated the injectors at once per each On cycle. If not, the speed of the electric motor may be adjusted as follows:

a. Locate the speed adjustment screw on the pump electric motor. It is located under a cover screw 120° away from the power wires on the motor body.

b. Remove the cover by turning it clockwise with a Phillips screwdriver.

NOTE: *There is white plastic seal washer on the cover screw. It will wither come off with the screw or remain wedged in the motor housing. Take care not to lose this seal washer.*

c. The adjustment screw is now exposed and accessible for adjustment.

d. Using an appropriate sized flat bladed screwdriver, insert the screwdriver tip into the slot on the brass adjustment screw.

NOTE: *The slotted brass adjustment screw accepts a flat bladed screwdriver with a tip width of 0.1 inches (2.5 mm) and a tip thickness of 0.025 inches (0.65 mm).*

e. Turn the screw counter-clockwise to reduce the speed, clockwise to increase it.

NOTES:
1. The screw has no stops and a total travel of 15 turns.
2. The minimum motor speed is 170 rpm.
3. Divide the speed by the gear ratio to get the actual pump speed,
4. The adjustment may be made with the pump stopped or running
5. It is often helpful to run the pump with the outlet line detached to monitor pump output as the pump speed is adjusted. If the outlet line is detached for this purpose, make sure to bleed the pressure from the outlet line prior to detaching.

f. When the adjustment is complete, reinstall the cover screw with a Phillips screwdriver. Make sure that the plastic washer is in place before tightening the cover screw.

SERVICE

Servicing of the grease pump and injector assemblies is outlined in their separate instructions contained in Section 9 - Options.

Always relieve pressure from the pump and supply lines before servicing or repairing the pump to reduce the risk of injury from injection, splashing fluid, or moving parts.

KEY FIGURE 1 - AUTOMATIC LUBRICATION SYSTEM A86747					
01.	Grease Pump	69.	Not Used	131.	Hose Assembly
02.	4 Injector Manifold	70.	Not Used	132.	Hose Assembly
03.	3 Injector Manifold	71.	Hose Assembly	133.	Not Used
04.	2 Injector Manifold	72.	Hose Assembly	134.	Hose Assembly
05.	Lube Injector Bracket	73.	– 79. Not Used	135.	Not Used
06.	Capscrew	80.	Adapter Fitting	136.	Hose Assembly
07.	Clamp Halves	81.	Adapter Fitting	137.	Support Clamp Assembly
08.	Adapter Fitting	82.	Not Used	138.	Pipe Plug
09.	Adapter Fitting	83.	Pipe Plug	139.	Adapter Fitting
10.	Capscrew	84.	Not Used	140.	Hose Assembly
11.	Cushion Clamp	85.	Nameplate (Grease)	141.	– 166. Not Used
12.	Adapter Fitting	86.	Drive Screw	167.	Fitting
13.	Adapter Fitting	87.	– 91. Not Used		
14.	Cushion Clamp	92.	Pushbutton Switch		
15.	Cushion Clamp	93.	Not Used		
16.	Angle Clip	94.	Toggle Switch		
17.	Capscrew	95.	Grip		
18.	Flatwasher	96.	Conduit Locknut		
19.	Locknut	97.	Nameplate – Press to Test		
20.	– 23. Not Used	98.	Nameplate – Activation		
24.	Adapter Fitting		Circuit On/Off		
25.	Not Used	99.	Not Used		
26.	Not Used	100.	Not Used		
27.	Reducer Bushing	101.	Cushion Clamp		
28.	Pipe Tee	102.	Not Used		
29.	Not Used	103.	Adapter Fitting		
30.	Pressure Gauge	104.	Not Used		
31.	Not Used	105.	Tie Wrap		
32.	Not Used	106.	Not Used		
33.	Pressure Switch	107.	Hose Assembly		
34.	– 43. Not Used	108.	Hose Assembly		
44.	Pipe Plug	109.	Hose Assembly		
45.	Adapter Fitting	110.	Hose Assembly		
46.	Adapter Fitting	111.	Hose Assembly		
47.	Not Used	112.	Hose Assembly		
48.	Fitting	113.	Hose Assembly		
49.	Cushion Clamp	114.	Hose Assembly		
50.	Not Used	115.	Hose Assembly		
51.	Bolting Pad	116.	Hose Assembly		
52.	– 55. Not Used	117.	Hose Assembly		
56.	Capscrew	118.	Hose Assembly		
57.	Lockwasher	119.	Hose Assembly		
58.	Flatwasher	120.	Hose Assembly		
59.	Capscrew	121.	Hose Assembly		
60.	Locknut	122.	Hose Assembly		
61.	Hose Assembly	123.	Hose Assembly		
62.	Hose Assembly	124.	Hose Assembly		
63.	Hose Assembly	125.	Hose Assembly		
64.	Not Used	126.	Hose Assembly		
65.	Not Used	127.	Hose Assembly		
66.	Not Used	128.	Hose Assembly		
67.	Cap Cover	129.	Hose Assembly		
68.	Not Used	130.	Hose Assembly		

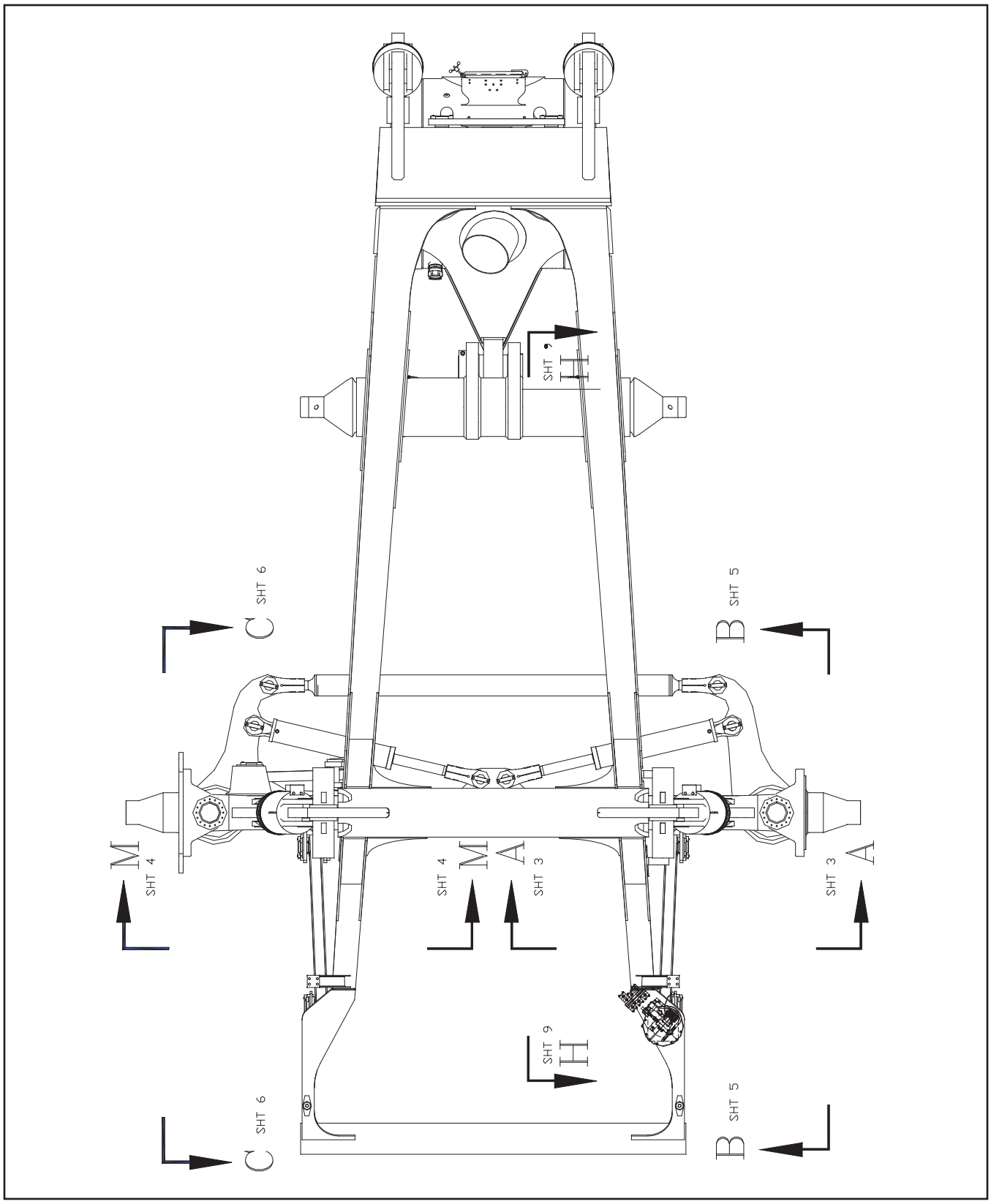

FIGURE 1 - AUTOMATIC LUBRICATION SYSTEM A86747

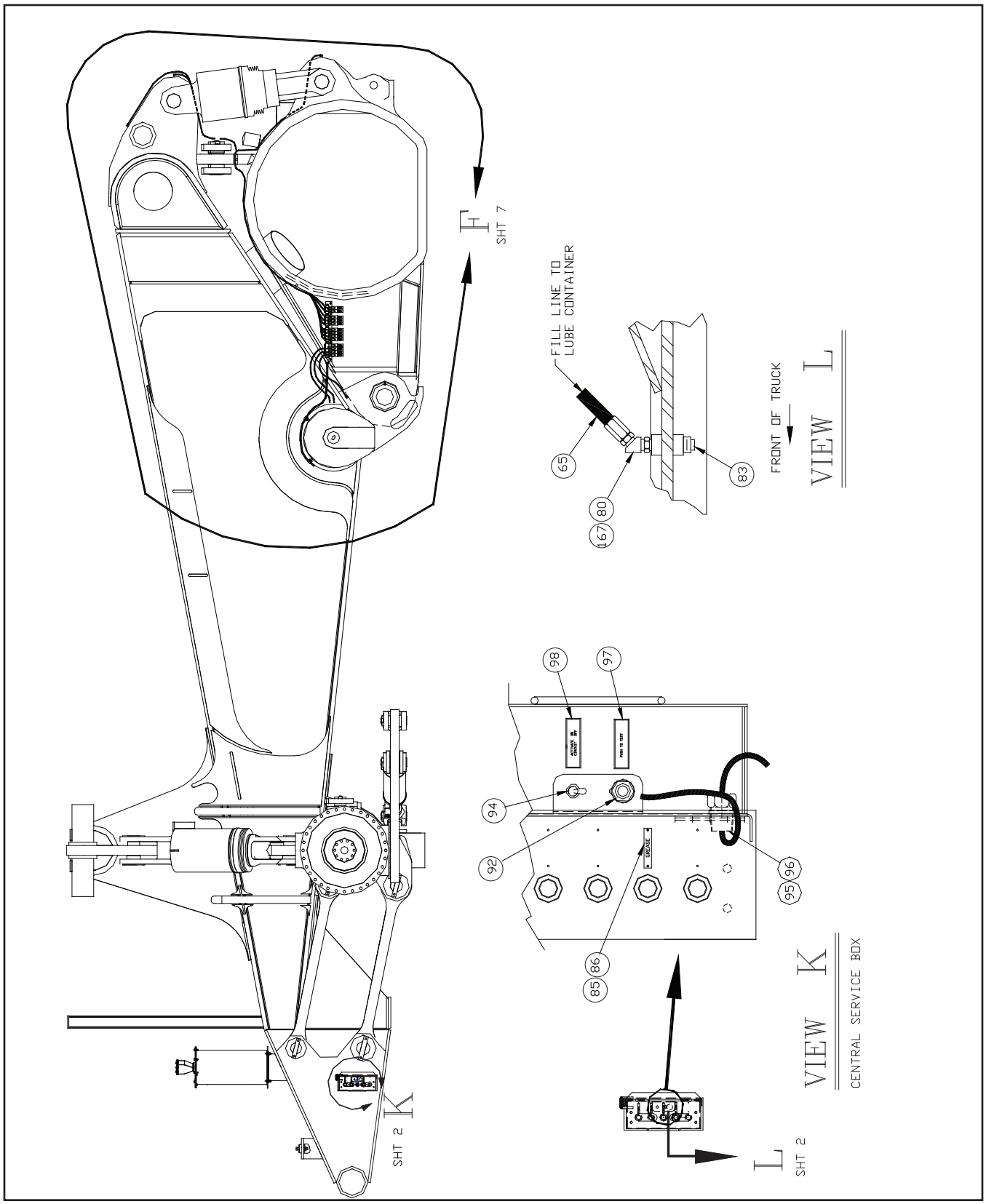

FIGURE 1 CONT. - AUTOMATIC LUBRICATION SYSTEM A86747

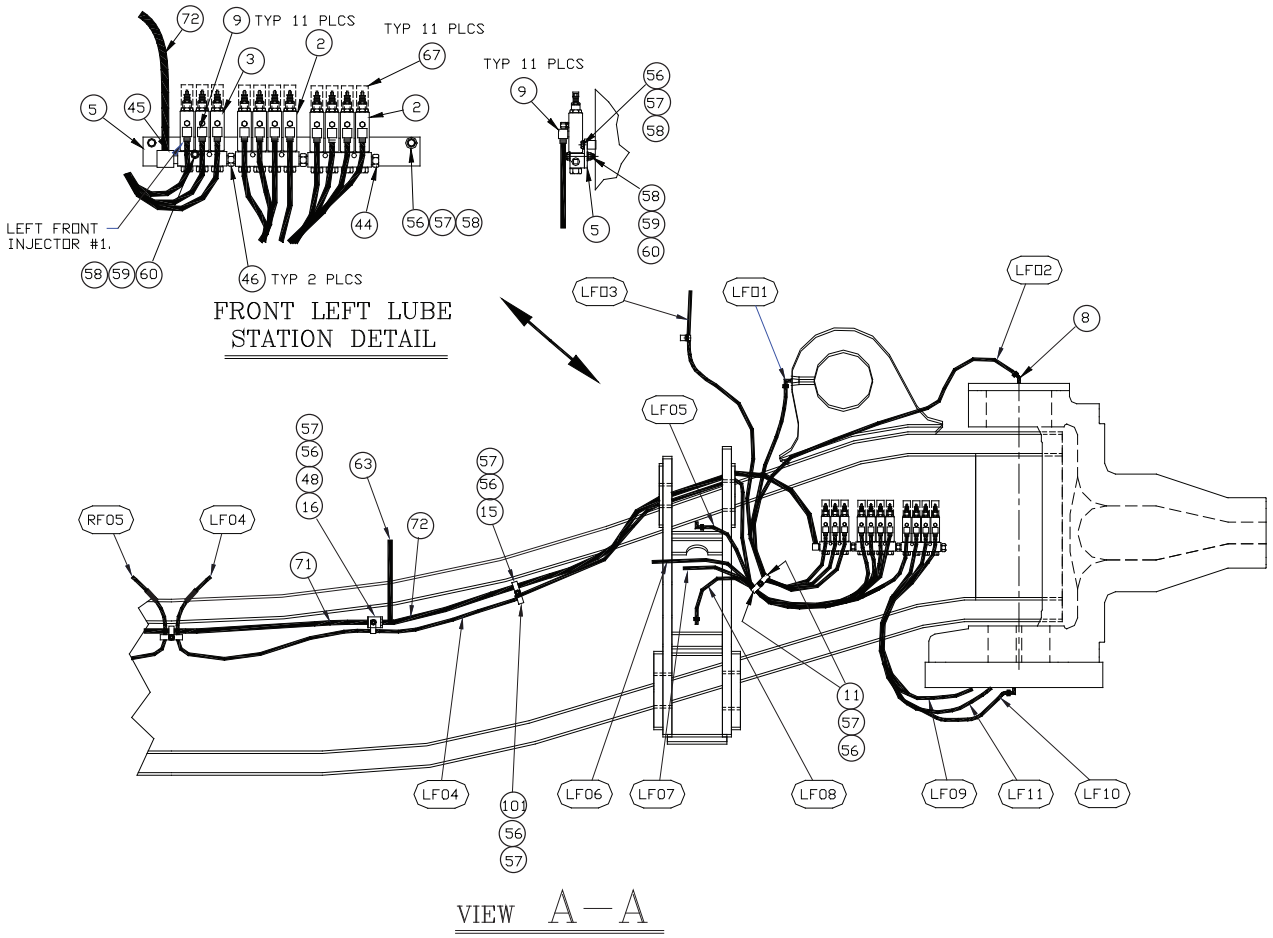

FIGURE 1 CONT. - AUTOMATIC LUBRICATION SYSTEM A86747

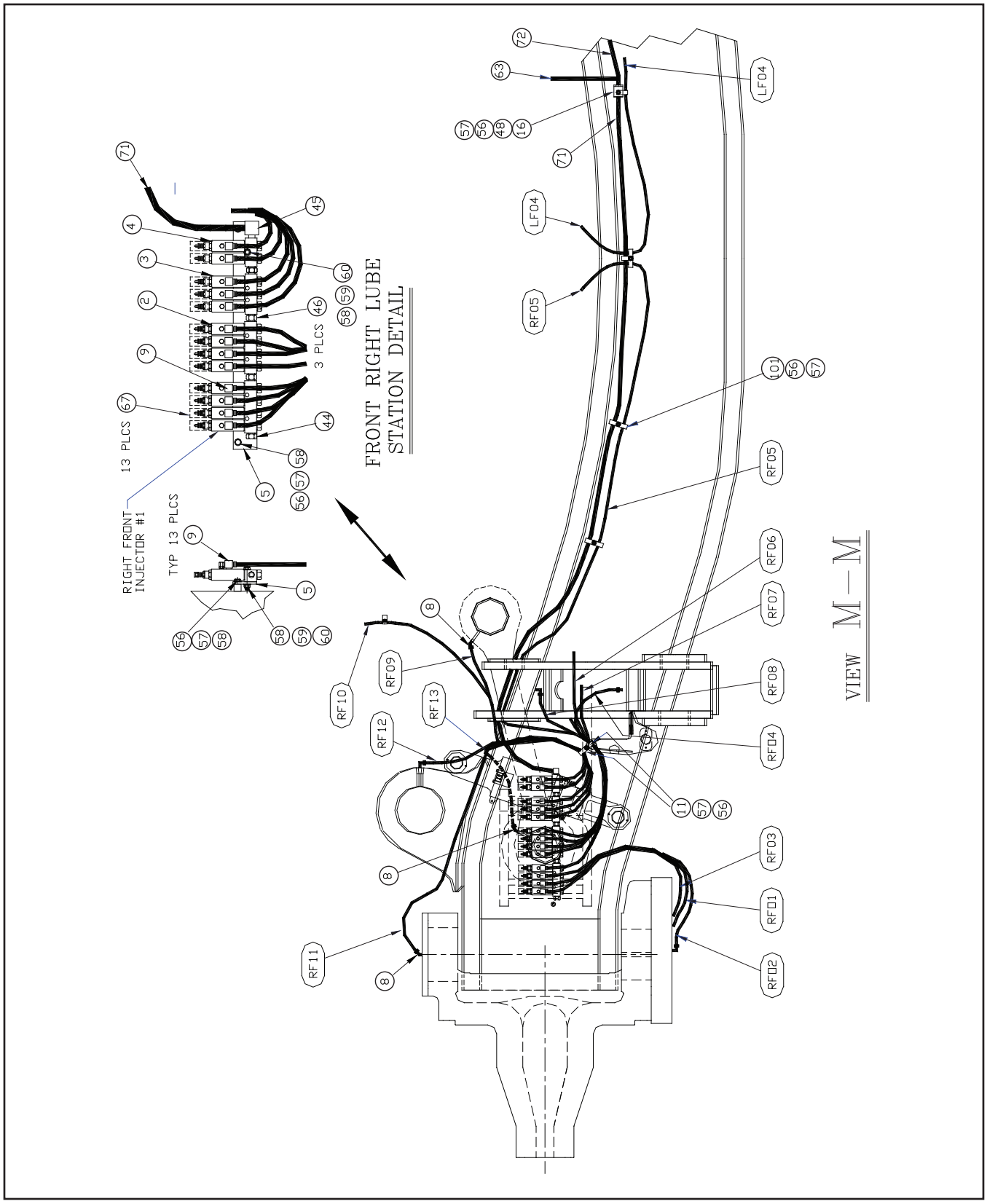

FIGURE 1 CONT. - AUTOMATIC LUBRICATION SYSTEM A86747

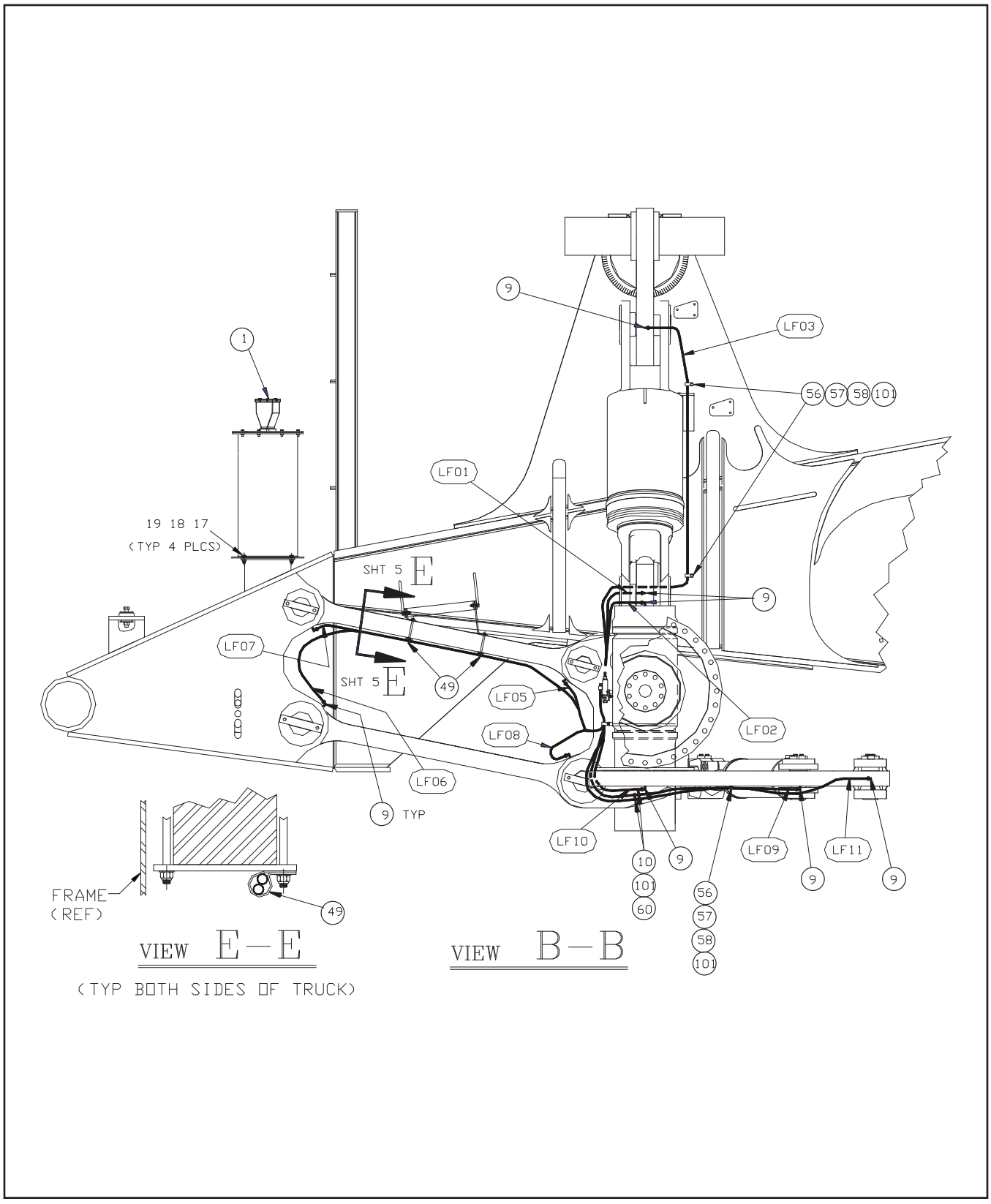

FIGURE 1 CONT. - AUTOMATIC LUBRICATION SYSTEM A86747

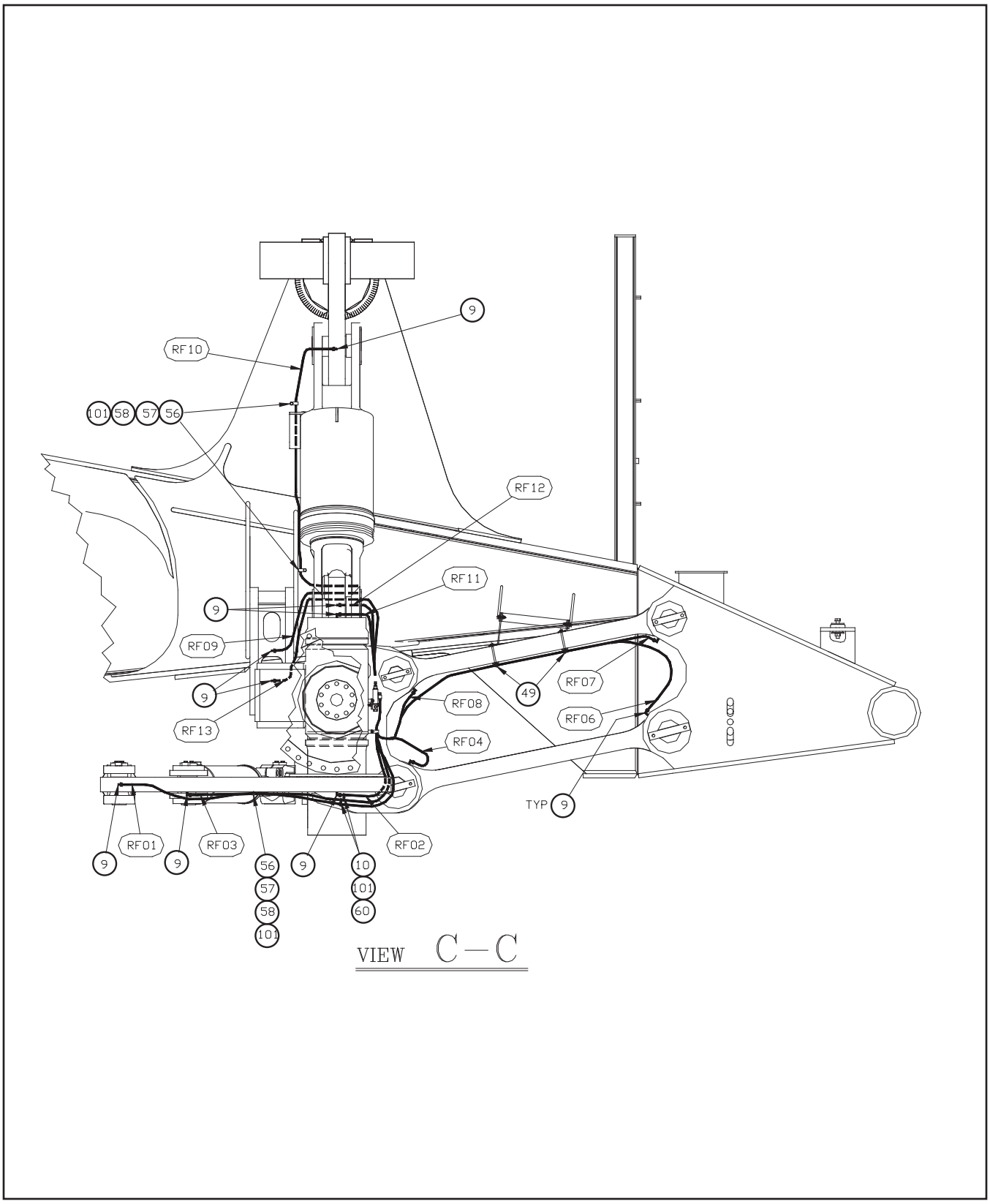

FIGURE 1 CONT. - AUTOMATIC LUBRICATION SYSTEM A86747

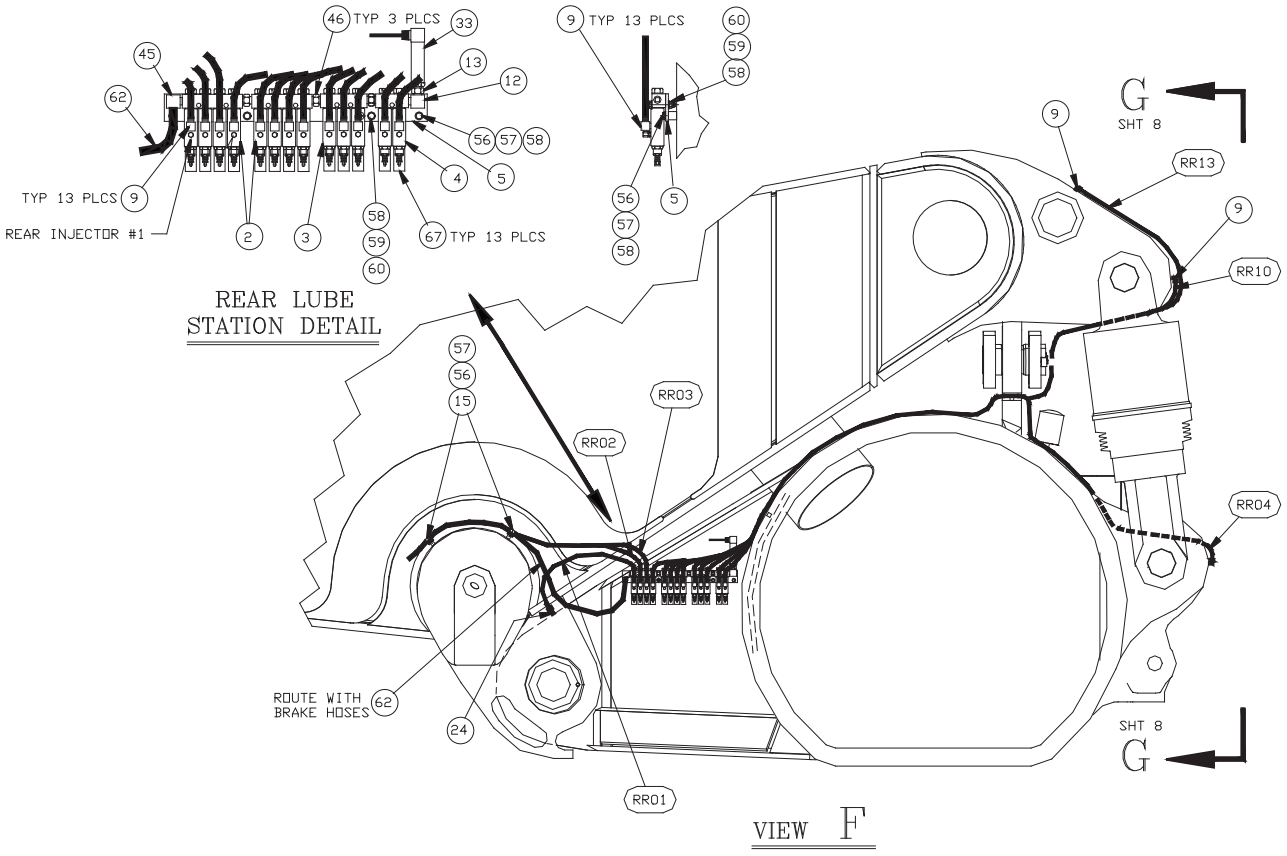

FIGURE 1 CONT. - AUTOMATIC LUBRICATION SYSTEM A86747

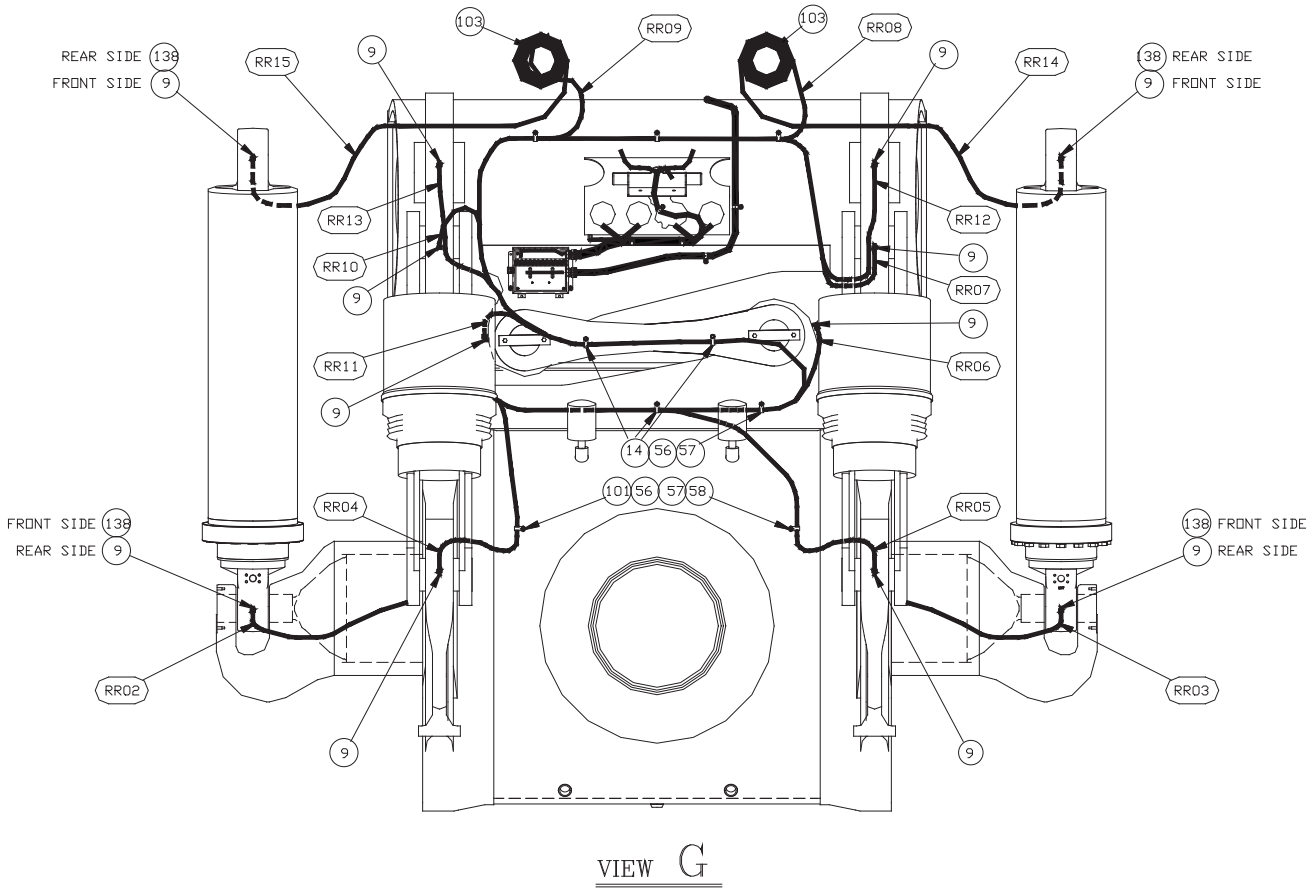

FIGURE 1 CONT. - AUTOMATIC LUBRICATION SYSTEM A86747

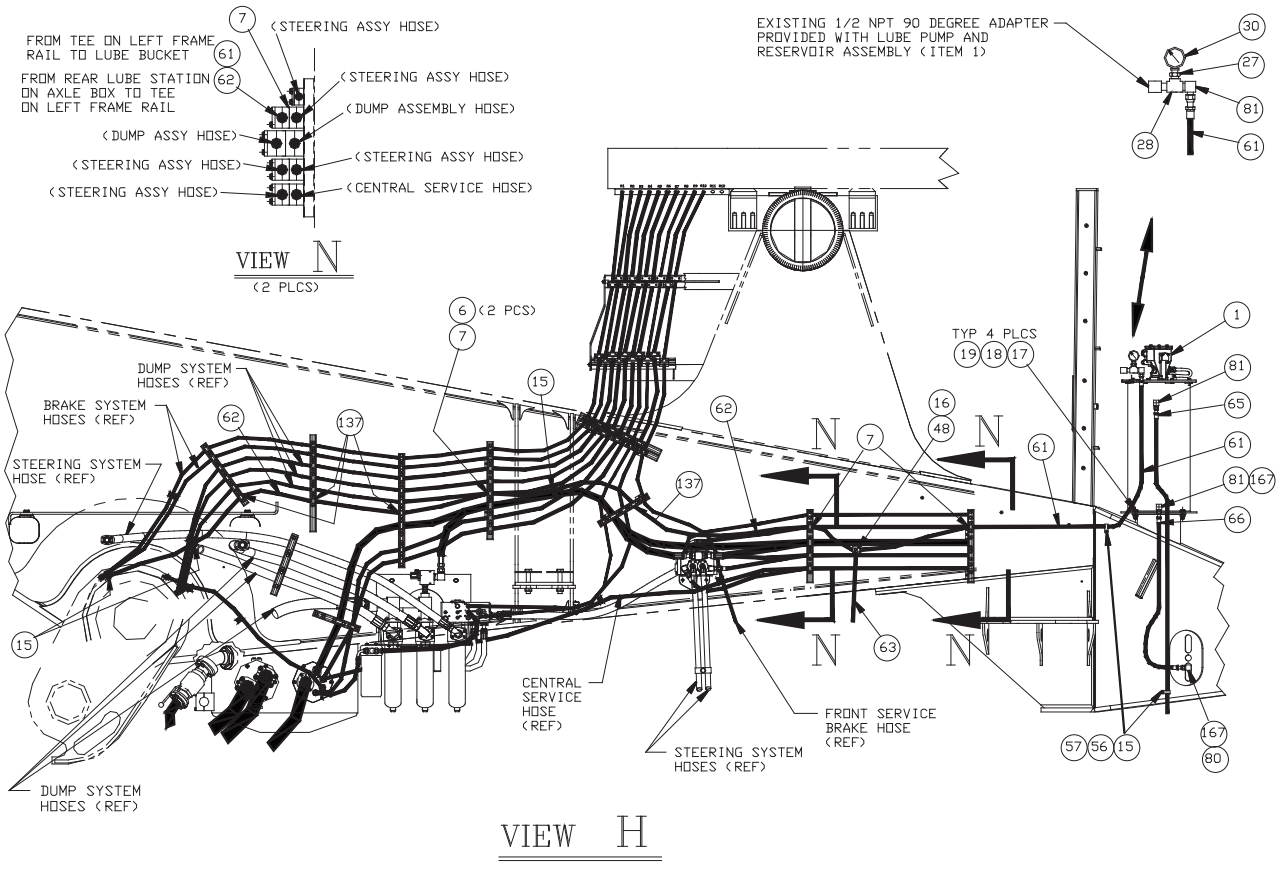

FIGURE 1 CONT. - AUTOMATIC LUBRICATION SYSTEM A86747

HOSE NO	ITEM NO.	LOCATION
LF01	107	FROM LEFT FRONT INJECTOR #1 TO BOTTOM SUSPENSION PIN
LF02	108	FROM LEFT FRONT INJECTOR #2 TO TOP OF KINGPIN
LF03	109	FROM LEFT FRONT INJECTOR #3 TO TOP SUSPENSION PIN
LF04	110	FROM LEFT FRONT INJECTOR #4 TO STEERING CYLINDER PIN (ROD END)
LF05	111	FROM LEFT FRONT INJECTOR #5 TO REAR TOP TRAILING ROD PIN
LF06	112	FROM LEFT FRONT INJECTOR #6 TO FRONT BOTTOM TRAILING ROD PIN
LF07	113	FROM LEFT FRONT INJECTOR #7 TO FRONT TOP TRAILING ROD PIN
LF08	114	FROM LEFT FRONT INJECTOR #8 TO REAR BOTTOM TRAILING ROD PIN
LF09	115	FROM LEFT FRONT INJECTOR #9 TO STEERING CYLINDER PIN (BASE END) AT STEERING ARM
LF10	116	FROM LEFT FRONT INJECTOR #10 TO BOTTOM OF KINGPIN
LF11	117	FROM LEFT FRONT INJECTOR #11 TO TIE ROD PIN

LUBE HOSES ON
LEFT FRONT
LUBE STATION

HOSE NO	ITEM NO.	LOCATION
RF01	117	FROM RIGHT FRONT INJECTOR #1 TO TIE ROD PIN
RF02	116	FROM RIGHT FRONT INJECTOR #2 TO BOTTOM OF KINGPPIN
RF03	115	FROM RIGHT FRONT INJECTOR #3 TO STEERING CYLINDER PIN (BASE END) AT STEERING ARM
RF04	114	FROM RIGHT FRONT INJECTOR #4 TO REAR BOTTOM TRAILING ROD PIN
RF05	139	FROM RIGHT FRONT INJECTOR #5 TO STEERING CYLINDER PIN (ROD END)
RF06	112	FROM RIGHT FRONT INJECTOR #6 TO FRONT BOTTOM TRAILING ROD PIN
RF07	111	FROM RIGHT FRONT INJECTOR #7 TO FRONT TOP TRAILING ROD PIN
RF08	140	FROM RIGHT FRONT INJECTOR #8 TO REAR TOP TRAILING ROD PIN
RF09	118	FROM RIGHT FRONT INJECTOR #9 TO INBOARD PANHARD ROD PIN
RF10	109	FROM RIGHT FRONT INJECTOR #10 TO TOP SUSPENSION PIN
RF11	108	FROM RIGHT FRONT INJECTOR #11 TO TOP OF KINGPIN
RF12	107	FROM RIGHT FRONT INJECTOR #12 TO BOTTOM SUSPENSION PIN
RF13	119	FROM RIGHT FRONT INJECTOR #13 TO OUTBOARD PANHARD ROD PIN

LUBE HOSES ON
RIGHT FRONT
LUBE STATION

HOSE NO	ITEM NO.	LOCATION
RR01	121	FROM REARLUBE INJECTOR #1 TO NOSE CONE BUSHING
RR02	120	FROM REARLUBE INJECTOR #2 TO BOTTOM LEFT DUMP CYLINDER PIN
RR03	134	FROM REARLUBE INJECTOR #3 TO BOTTOM RIGHT DUMP CYLINDER PIN
RR04	122	FROM REARLUBE INJECTOR #4 TO BOTTOM LEFT SUSPENSION PIN
RR05	123	FROM REARLUBE INJECTOR #5 TO BOTTOM RIGHT SUSPENSION PIN
RR06	124	FROM REARLUBE INJECTOR #6 TO RIGHT PANHARD ROD PIN
RR07	127	FROM REARLUBE INJECTOR #7 TO TOP RIGHT SUSPENSION PIN
RR08	125	FROM REARLUBE INJECTOR #8 TO DUMPBODY BULKHEAD RIGHT HOLE
RR09	125	FROM REARLUBE INJECTOR #9 TO DUMPBODY BULKHEAD LEFT HOLE
RR10	128	FROM REARLUBE INJECTOR #10 TO TOP LEFT SUSPENSION PIN
RR11	129	FROM REARLUBE INJECTOR #11 TO LEFT PANHARD ROD PIN
RR12	130	FROM REARLUBE INJECTOR #12 TO RIGHT DUMP BODY PIVOT BUSHING
RR13	131	FROM REARLUBE INJECTOR #13 TO LEFT DUMP BODY PIVOT BUSHING
RR14	126	FROM DUMPBODY BULKHEAD RIGHT HOLE TO TOP RIGHT DUMP CYLINDER PIN
RR15	136	FROM DUMPBODY BULKHEAD LEFT HOLE TO TOP LEFT DUMP CYLINDER PIN

LUBE HOSES ON
REAR LUBE
STATION

AUTOMATIC LUBRICATION SYSTEM (WITH HYDRAULICALLY DRIVEN ROTARY GREASE PUMP)

DESCRIPTION AND LOCATION (Figure 1)

The automatic lubrication system provides regular, periodic lubrication to grease points by means of a hydraulically operated pump, an electric timer, and lubricant injectors. The pump assembly is located on the superstructure and is mounted directly on the lubricant container. The electric timer is labeled with numbers that represent time in minutes, and is generally mounted inside the cab. The lubricant injectors are connected to the grease lines and are mounted near designated grease points.

For various reasons, not all of the components on the truck can be served by the system. The exact location of the automatic lubrication assemblies and the number of items served vary, depending on the special requirements of the mine.

OPERATION (Figure 1)

The function of the automatic lubrication system is to maintain proper lubrication levels at various bearing points on the truck. Instead of operating continuously, however, the system periodically cycles as follows:

NOTE: *Detailed information about those components contained in the pump assembly and injectors are outlined in their separate information in Section 9 - Options.*

The pump is driven by the rotary motion of the hydraulic motor. This rotary motion is converted to reciprocating motion through an eccentric crank mechanism. The reciprocating action causes the pump cylinder to move up and down. The pump is of positive displacement; double acting design with grease output occurring during both the up and down strokes of the pump.

During the down stroke the pump cylinder is extended into the grease. Through the combination of shovel action and vacuum generated in the pump cylinder chamber, the grease is forced into the pump chamber. Simultaneously, grease is discharged through the outlet of the pump. The volume of grease during the intake is twice the amount of grease output during each cycle.

During the upstroke, the inlet check function closes, and one half of the grease taken in during the previous stroke is transferred through the outlet check function to the outlet port.

An integral pump control manifold is incorporated into the motor to control the input flow and pressure of hydraulic oil that provides the operating power.

An electric timer assembly controls the operation of the system solenoid and the operation of the pump. The pressurization of the grease supply system controls the operation of the individual injectors when it reaches the preset operating level.

Several optional alternative and/or additional provisions are available for the system.

1. A separate warning indicator to indicate when the system is operating properly.

2. A separate manual activation switch to allow manual system testing and activation when desired.

3. Remote or ground level central service filling provisions to permit filling the central reservoir from pressurized sources, with and without automatic reservoir level monitoring provisions.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance should include the following steps:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

NOTE: *Preventive maintenance should be performed frequently to ensure proper operation of the system. Damage to bearings and other moving components can be avoided.*

2. Inspect the lubrication system components for evidence of dirt, damage, wear or leaks.

3. Clean and inspect the system components.

4. Check the mounting hardware for tightness.

5. Verify that all connections are tight, clean and free of leaks. All hoses should be secured firmly without kinks and routed away from all moving parts.

6. Maintain an adequate level of lubricant in the reservoir to ensure proper operation of the system, and to avoid

KEY					A85984
01.	Grease Pump	57.	Lockwasher	119.	Hose Assembly
02.	Grease Container	58.	Flatwasher	120.	Hose Assembly
03.	Grease Container Lid	59.	Capscrew	121.	Hose Assembly
04.	Flange Gasket	60.	Locknut	122.	Hose Assembly
05.	4 Injector Manifold	61.	Hose Assembly	123.	Hose Assembly
06.	3 Injector Manifold	62.	Hose Assembly	124.	Hose Assembly
07.	2 Injector Manifold	63.	Hose Assembly	125.	Hose Assembly
08.	Lube Injector Bracket	64.	Not Used	126.	Hose Assembly
09.	Adapter Fitting	65.	Not Used	127.	Hose Assembly
10.	Not Used	66.	Not Used	128.	Hose Assembly
	– Reflects Optional Equipment	67.	Cap Cover	129.	Hose Assembly
11.	Breather	68.	Not Used	130.	Hose Assembly
12.	– 19. Not Used	69.	Not Used	131.	Hose Assembly
	– Reflects Optional Equipment	70.	Not Used	132.	Hose Assembly
20.	Vent Valve	71.	Hose Assembly	133.	Adapter Fitting
21.	Adapter Fitting	72.	Hose Assembly	134.	Not Used
22.	Not Used	73.	Not Used	135.	Hose Assembly
23.	Not Used	74.	Not Used	136.	Hose Assembly
24.	Adapter Fitting	75.	Connector	137.	Support Clamp Assembly
25.	Hose Assembly	76.	Adapter Fitting	138.	Pipe Plug
26.	Hose Assembly	77.	Adapter Fitting	139.	Adapter Fitting
27.	Reducer Bushing	78.	Mounting Clip	140.	Not Used
28.	Pipe Tee	79.	Adapter Fitting	141.	Not Used
29.	Reducer Bushing	80.	Adapter Fitting	142.	Not Used
30.	Pressure Gauge	81.	Not Used	143.	Vent Valve Support
31.	Adapter Fitting	82.	Adapter Fitting	144.	Not Used
32.	Hose Assembly	83.	Pipe Plug	145.	Relay
33.	Pressure Switch	84.	Not Used	146.	Not Used
34.	Adapter Fitting	85.	Nameplate (Grease)	147.	Grease Fitting
35.	Male Quick Coupling	86.	Drive Screw	148.	Not Used
	(Reflects Optional Equipment)	87.	Not Used	149.	Pipe Plug
36.	Female Quick Coupling	88.	Capscrew	150.	Not Used
	(Reflects Optional Equipment)	89.	Locknut	151.	Capscrew
37.	Adapter Fitting	90.	- 100. Reflects Opt. Equipment	152.	Grease Pump Gasket
38.	Hose Assembly		(Not Necessarily Shown)	153.	Cable
39.	Edge Trim	101.	Cushion Clamp	154.	Terminal
40.	Capscrew	102.	Cushion Clamp	155.	Terminal
41.	Flatwasher	103.	Adapter Fitting	156.	Conduit
42.	Locknut	104.	Cushion Clamp	157.	Not Used
43.	Not Used	105.	Tie Wrap	158.	Terminal
44.	Pipe Plug	106.	Tie Wrap	159.	Terminal
45.	Adapter Fitting	107.	Hose Assembly	160.	Not Used
46.	Adapter Fitting	108.	Hose Assembly	161.	Pushbutton Switch
47.	Not Used	109.	Hose Assembly	162.	– 168. Not Used
48.	Fitting	110.	Hose Assembly	169.	Pipe Plug
49.	Tube Clamp	111.	Hose Assembly	170.	Not Used
50.	Not Used	112.	Hose Assembly	171.	Not Used
51.	Bolting Pad	113.	Hose Assembly	172.	Not Used
52.	Not Used	114.	Hose Assembly	173.	Not Used
53.	Not Used	115.	Hose Assembly	174.	Not Used
54.	Not Used	116.	Hose Assembly	175.	Tie Wrap
55.	Not Used	117.	Hose Assembly		
56.	Capscrew	118.	Hose Assembly		

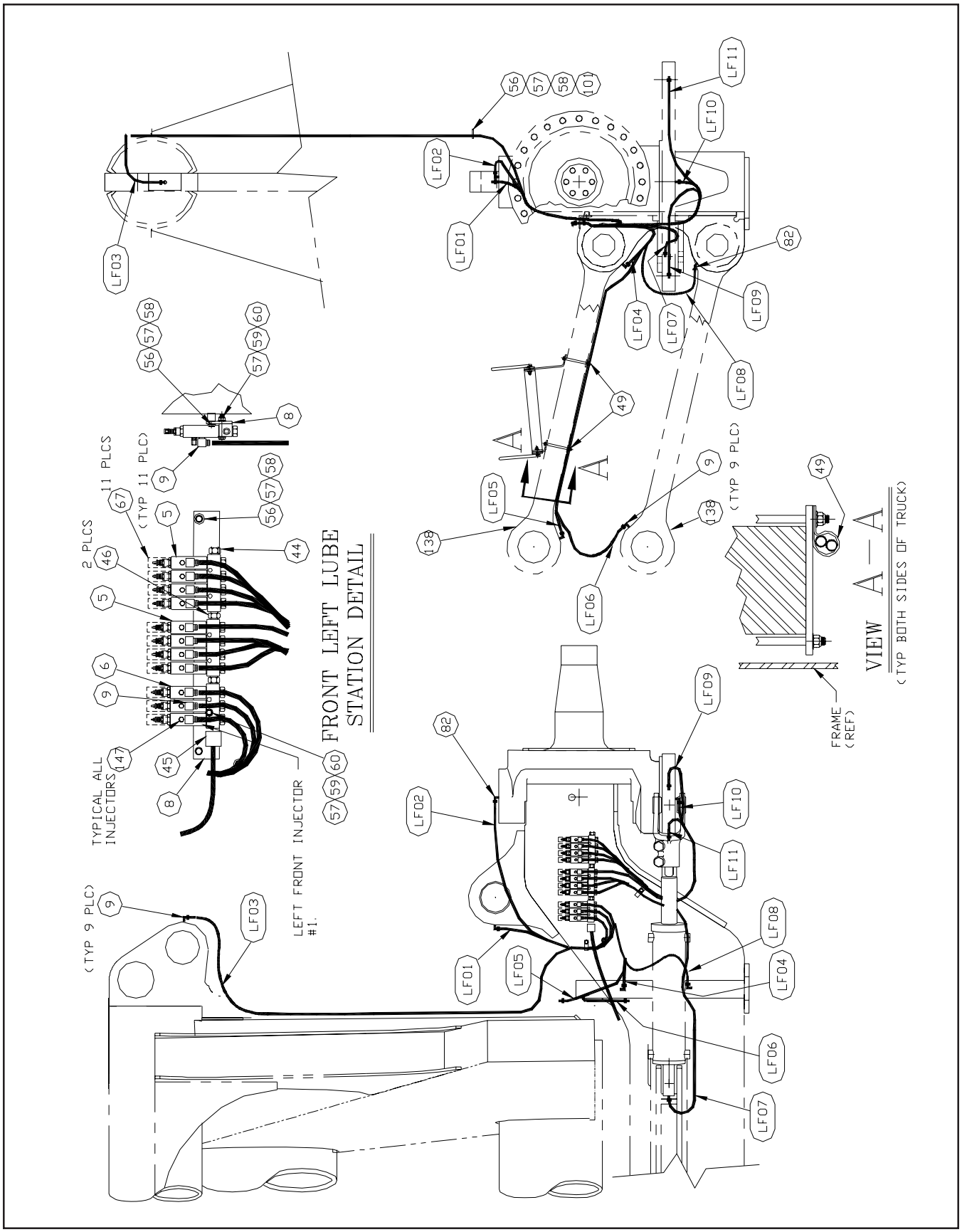

FIGURE 1 - AUTOMATIC LUBRICATION SYSTEM (A85984, SHEET 1 OF 10)

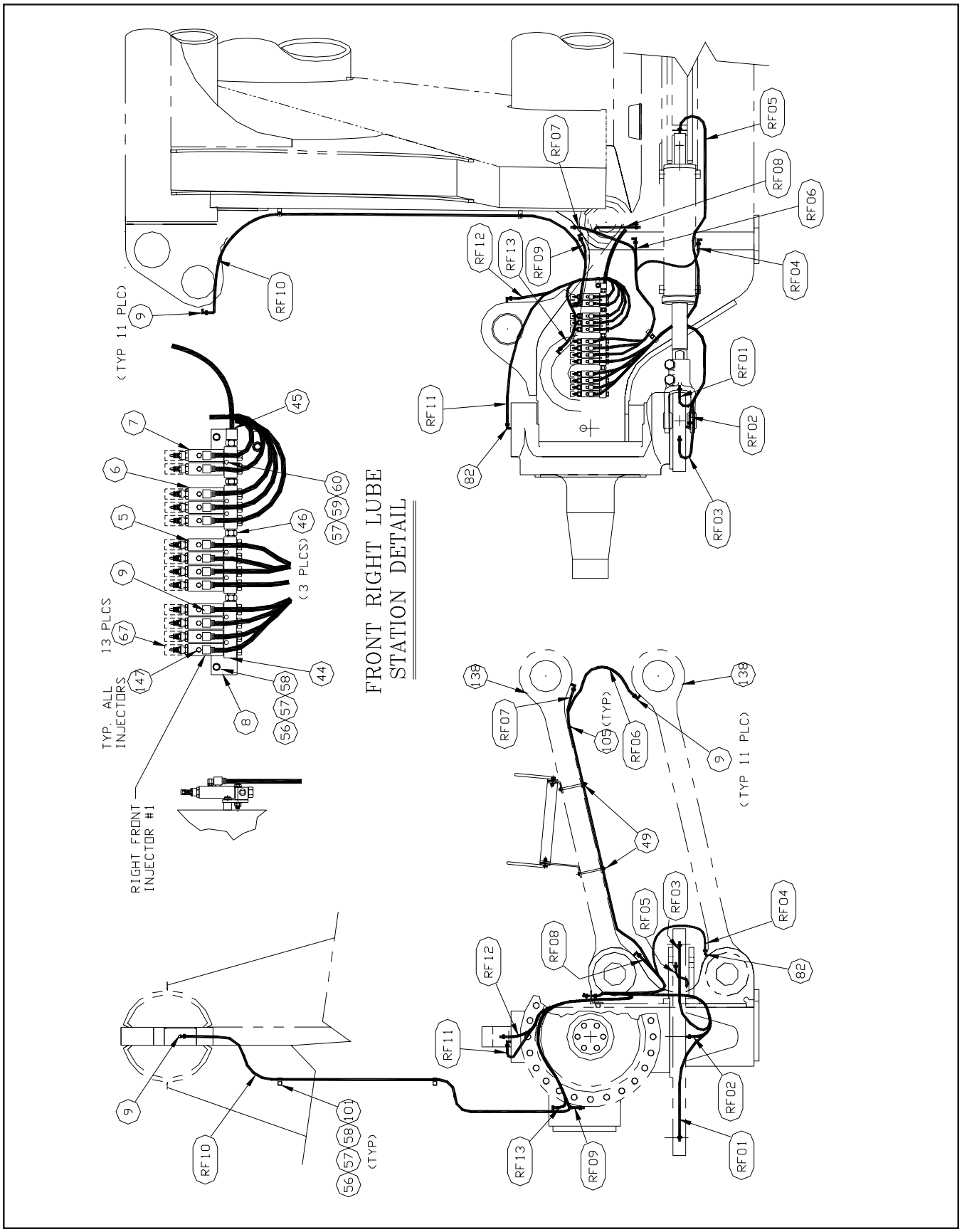

FIGURE 1 - AUTOMATIC LUBRICATION SYSTEM (A85984, SHEET 2 OF 10)

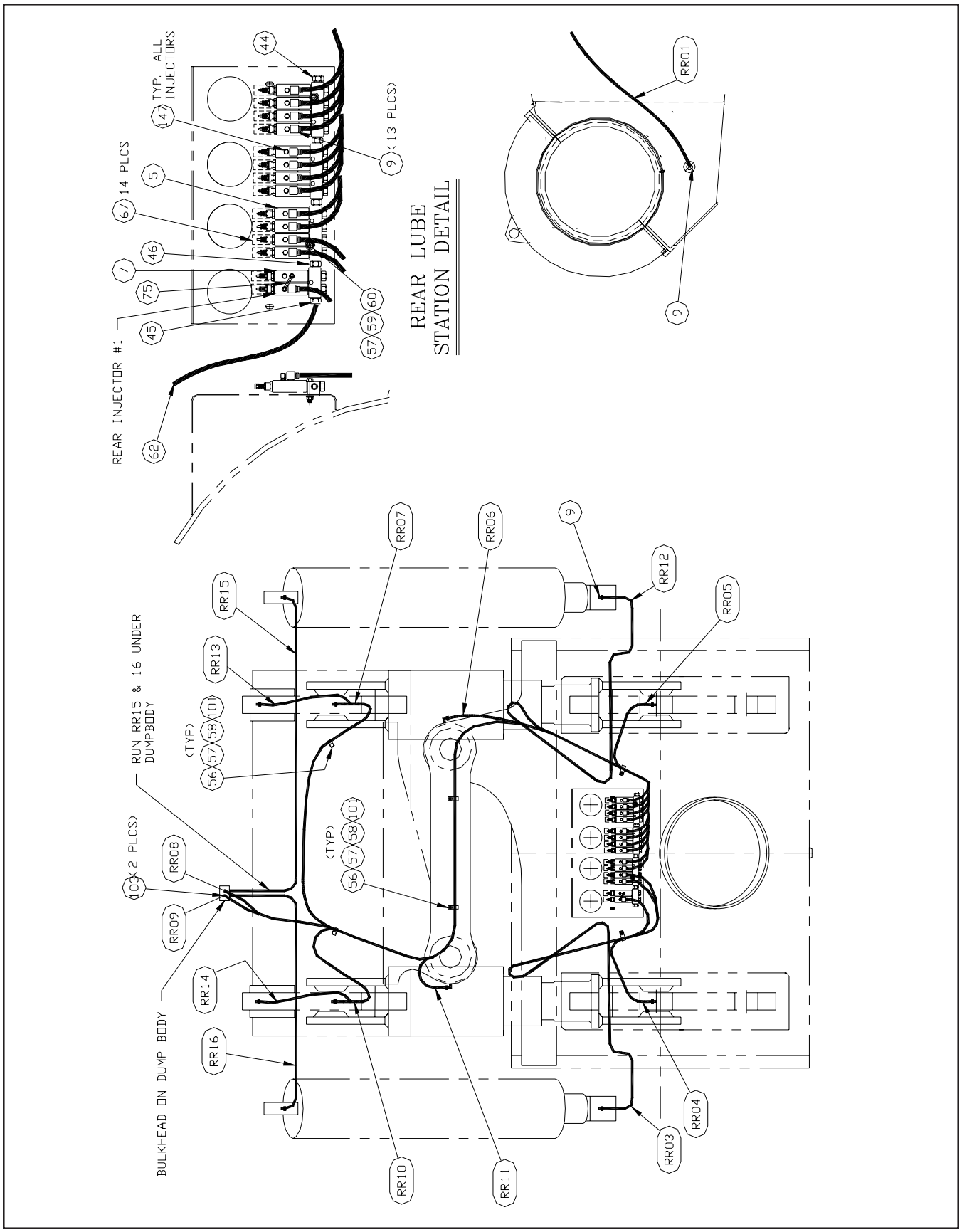

FIGURE 1 - AUTOMATIC LUBRICATION SYSTEM (A85984, SHEET 3 OF 10)

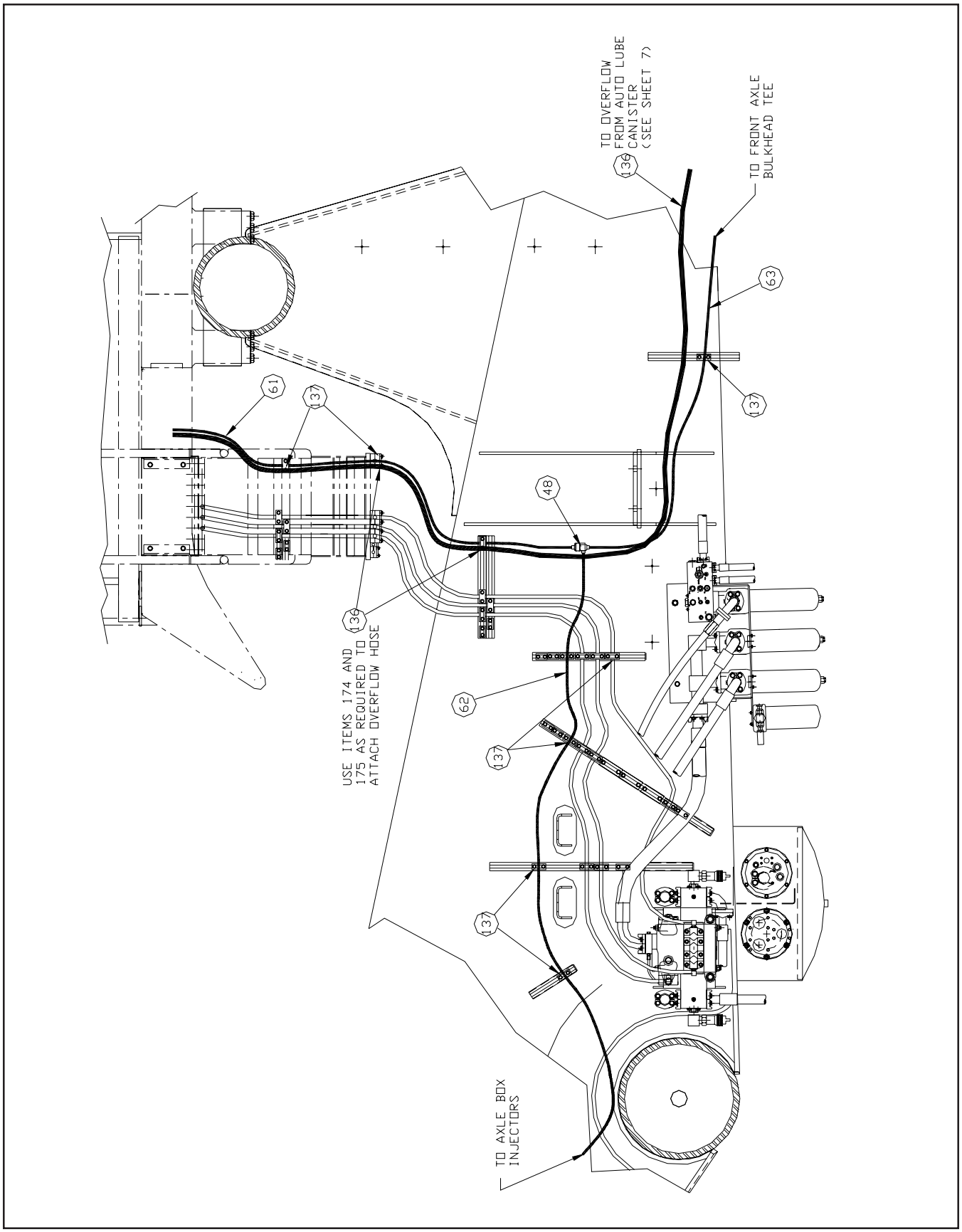

FIGURE 1 - AUTOMATIC LUBRICATION SYSTEM (A85984, SHEET 4 OF 10)

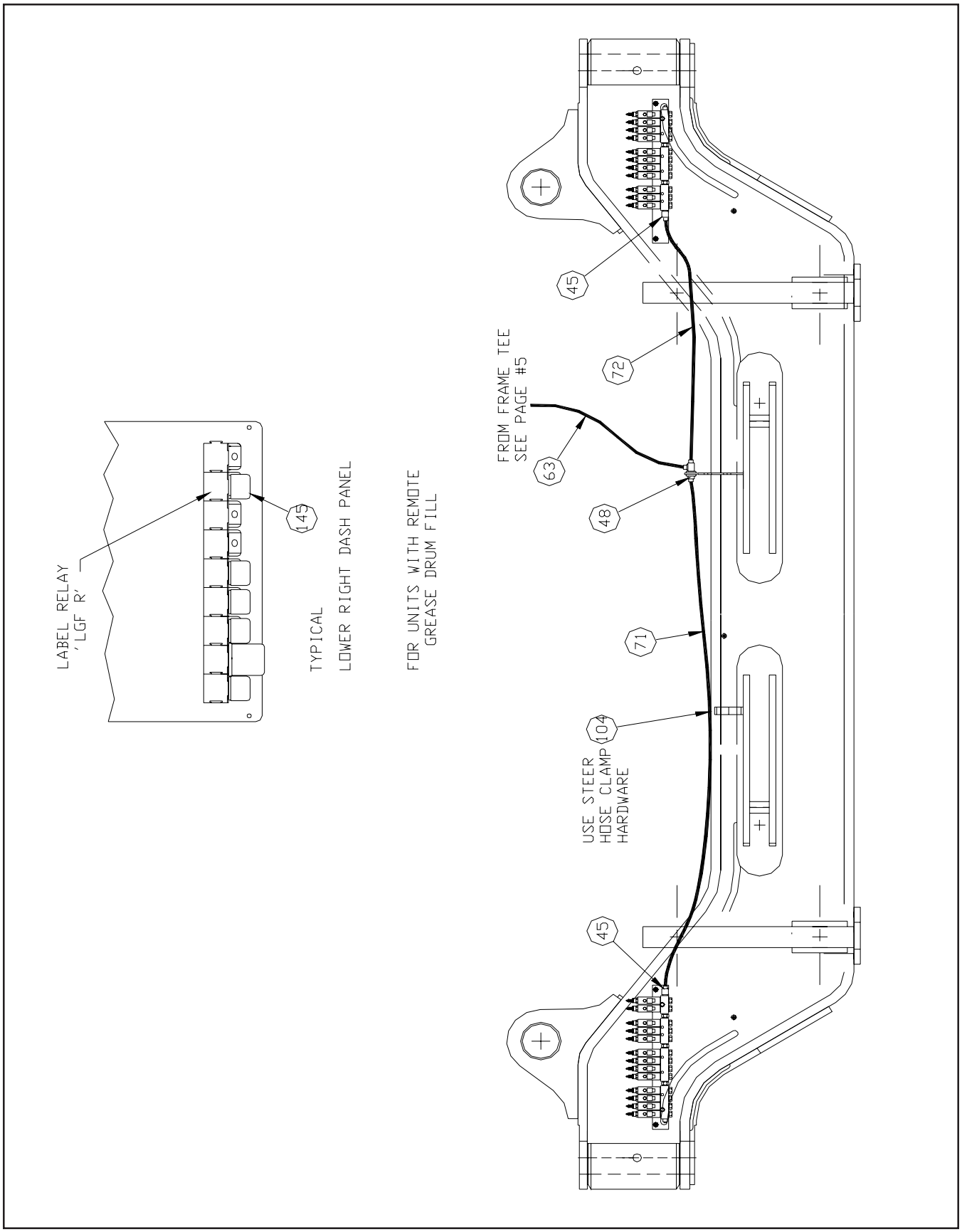

FIGURE 1 - AUTOMATIC LUBRICATION SYSTEM (A85984, SHEET 5 OF 10)

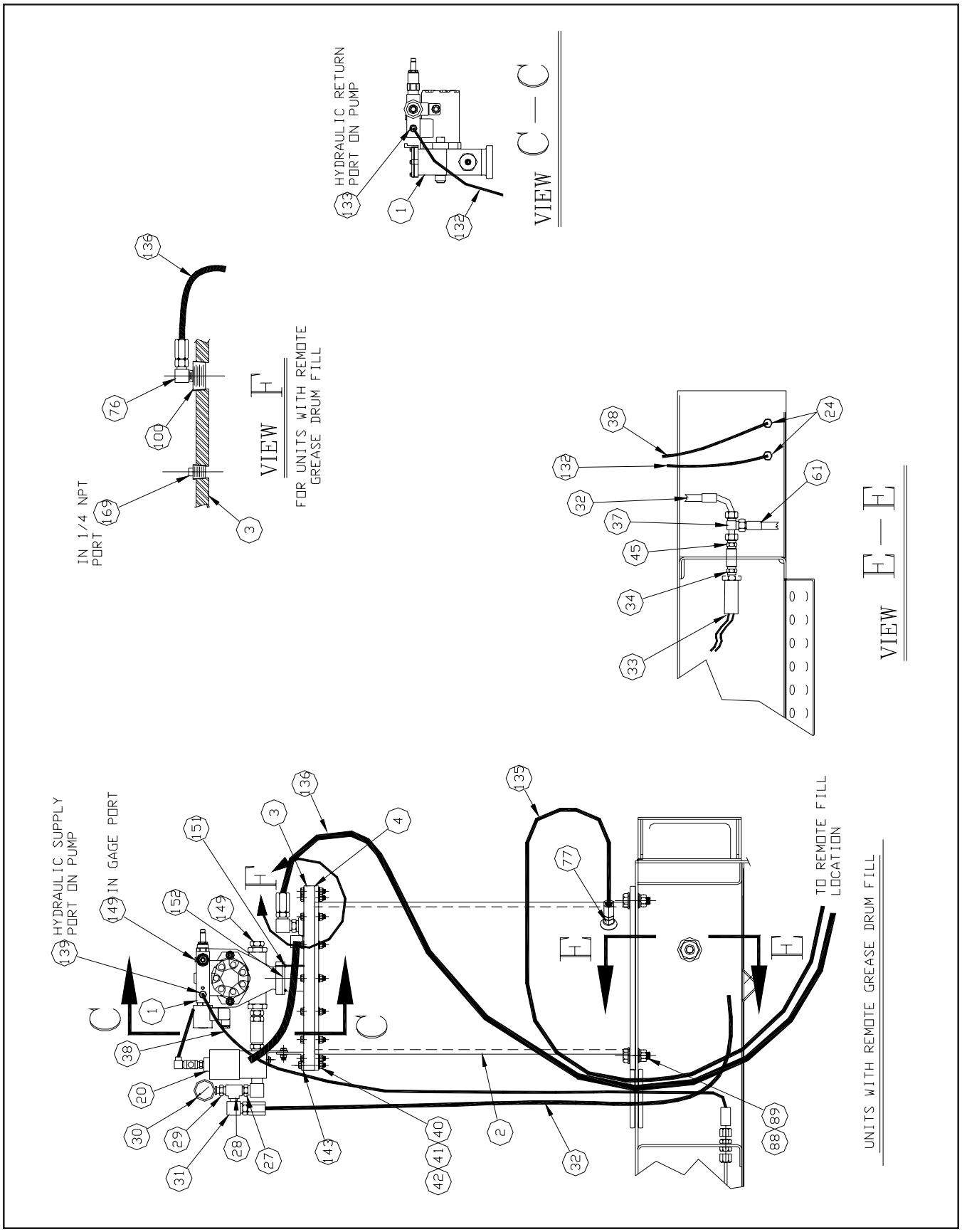

FIGURE 1 - AUTOMATIC LUBRICATION SYSTEM (A85984, SHEET 6 OF 10)

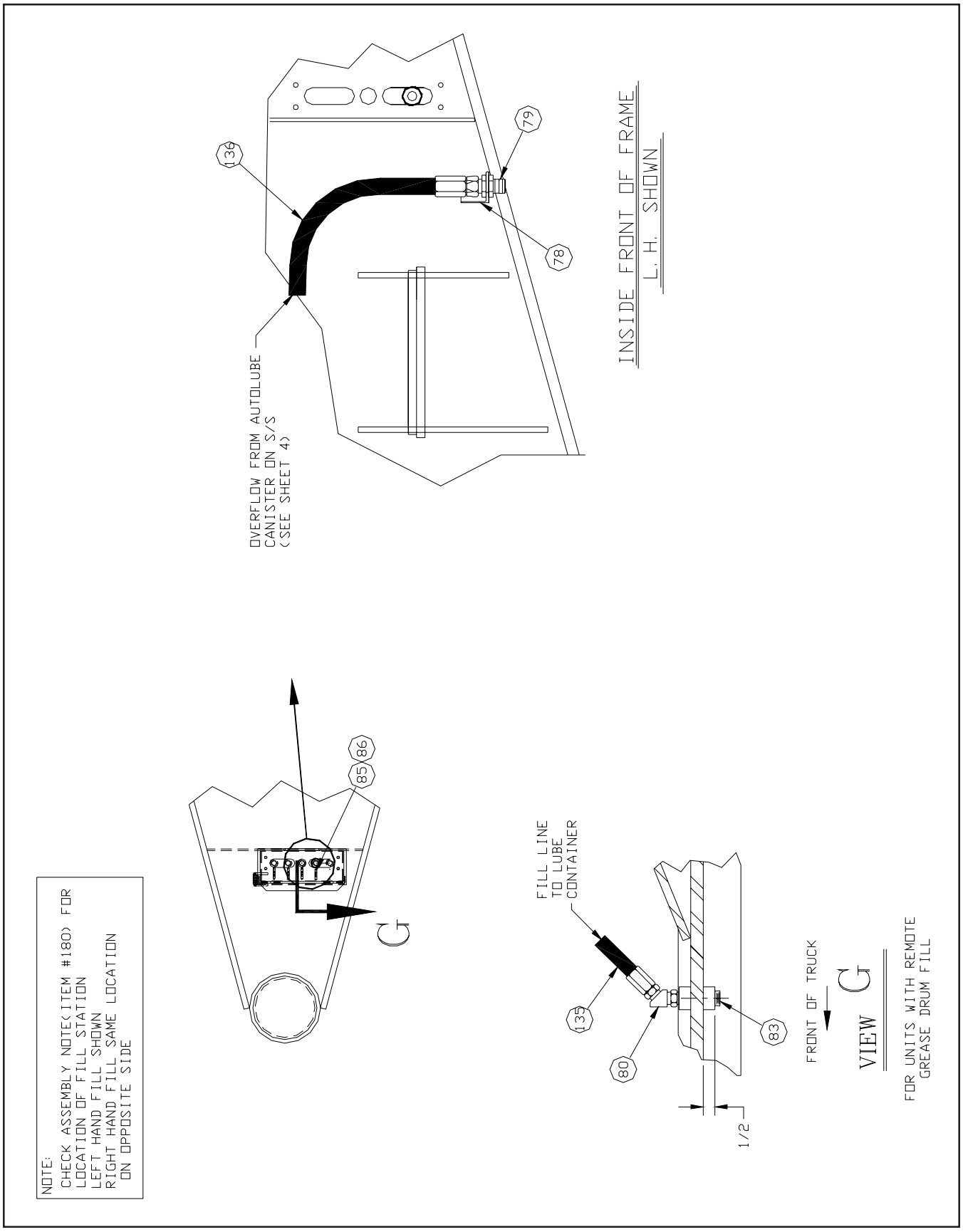

FIGURE 1 - AUTOMATIC LUBRICATION SYSTEM (A85984, SHEET 7 OF 10)

HOSE NO	ITEM NO.	LOCATION
LF01	107	FROM LEFT FRONT INJECTOR #1 TO BOTTOM SUSPENSION PIN
LF02	108	FROM LEFT FRONT INJECTOR #2 TO TOP OF KINGPIN
LF03	109	FROM LEFT FRONT INJECTOR #3 TO TOP SUSPENSION PIN
LF04	110	FROM LEFT FRONT INJECTOR #4 TO REAR TOP TRAILING ROD PIN
LF05	111	FROM LEFT FRONT INJECTOR #5 TO FRONT TOP TRAILING ROD PIN
LF06	112	FROM LEFT FRONT INJECTOR #6 TO FRONT BOTTOM TRAILING ROD PIN
LF07	113	FROM LEFT FRONT INJECTOR #7 TO STEERING CYLINDER PIN AT ANCHOR
LF08	114	FROM LEFT FRONT INJECTOR #8 TO REAR BOTTOM TRAILING ROD PIN
LF09	115	FROM LEFT FRONT INJECTOR #9 TO STEERING CYLINDER PIN AT ARM
LF10	116	FROM LEFT FRONT INJECTOR #10 TO BOTTOM OF KINGPIN
LF11	117	FROM LEFT FRONT INJECTOR #11 TO TIE ROD PIN

LUBE HOSES ON
LEFT FRONT
LUBE STATION

FIGURE 1 - AUTOMATIC LUBRICATION SYSTEM (A85984, SHEET 8 OF 10)

HOSE NO	ITEM NO.	LOCATION
RF01	117	FROM RIGHT FRONT INJECTOR #1 TO TIE ROD PIN
RF02	116	FROM RIGHT FRONT INJECTOR #2 TO BOTTOM OF KINGPPIN
RF03	115	FROM RIGHT FRONT INJECTOR #3 TO STEERING CYLINDER PIN AT ARM
RF04	114	FROM RIGHT FRONT INJECTOR #4 TO REAR BOTTOM TRAILING ROD PIN
RF05	113	FROM RIGHT FRONT INJECTOR #5 TO STEERING CYLINDER PIN AT ANCHOR
RF06	112	FROM RIGHT FRONT INJECTOR #6 TO FRONT BOTTOM TRAILING ROD PIN
RF07	111	FROM RIGHT FRONT INJECTOR #7 TO FRONT TOP TRAILING ROD PIN
RF08	110	FROM RIGHT FRONT INJECTOR #8 TO REAR TOP TRAILING ROD PIN
RF09	118	FROM RIGHT FRONT INJECTOR #9 TO INBOARD PANHARD ROD PIN
RF10	109	FROM RIGHT FRONT INJECTOR #10 TO TOP SUSPENSION PIN
RF11	108	FROM RIGHT FRONT INJECTOR #11 TO TOP OF KINGPIN
RF12	107	FROM RIGHT FRONT INJECTOR #12 TO BOTTOM SUSPENSION PIN
RF13	119	FROM RIGHT FRONT INJECTOR #13 TO OUTBOARD PANHARD ROD PIN

FIGURE 1 - AUTOMATIC LUBRICATION SYSTEM (A85984, SHEET 9 OF 10)

HOSE NO	ITEM NO.	LOCATION
RR01	121	FROM REARLUBE INJECTOR #1 TO NOSE CONE BUSHING
RR02	075	FROM REARLUBE INJECTOR #2 TO REARLUBE INJECTOR #1
RR03	120	FROM REARLUBE INJECTOR #3 TO BOTTOM LEFT DUMP CYLINDER PIN
RR04	122	FROM REARLUBE INJECTOR #4 TO BOTTOM LEFT SUSPENSION PIN
RR05	123	FROM REARLUBE INJECTOR #5 TO BOTTOM RIGHT SUSPENSION PIN
RR06	124	FROM REARLUBE INJECTOR #6 TO RIGHT PANHARD ROD PIN
RR07	127	FROM REARLUBE INJECTOR #7 TO TOP RIGHT SUSPENSION PIN
RR08	125	FROM REARLUBE INJECTOR #8 TO DUMPBODY BULKHEAD RIGHT HOLE
RR09	125	FROM REARLUBE INJECTOR #9 TO DUMPBODY BULKHEAD LEFT HOLE
RR10	128	FROM REARLUBE INJECTOR #10 TO TOP LEFT SUSPENSION PIN
RR11	129	FROM REARLUBE INJECTOR #11 TO LEFT PANHARD ROD PIN
RR12	120	FROM REARLUBE INJECTOR #12 TO BOTTOM RIGHT DUMP CYLINDER PIN
RR13	130	FROM REARLUBE INJECTOR #13 TO RIGHT DUMP BODY PIVOT BUSHING
RR14	131	FROM REARLUBE INJECTOR #14 TO LEFT DUMP BODY PIVOT BUSHING
RR15	126	FROM DUMPBODY BULKHEAD RIGHT HOLE TO TOP RIGHT DUMP CYLINDER PIN
RR16	126	FROM DUMPBODY BULKHEAD LEFT HOLE TO TOP LEFT DUMP CYLINDER PIN

LUBE HOSES ON
REAR LUBE
STATION

FIGURE 1 - AUTOMATIC LUBRICATION SYSTEM (A85984, SHEET 10 OF 10)

TROUBLESHOOTING CHART

PROBLEM/ CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
(1) Pump does not run.	**(1) No pressure indicated on system gauge.**	
	(a) Closed shut off valve in the supply line.	(a) Open the shut off valve.
	(b) No power to the solenoid valve.	(b) Correct the electrical fault.
	(c) Non-operating solenoid valve.	(c) Replace the solenoid.
	(d) System Pressure reducing valve is set too low.	(d) Test, adjust, repair, or replace the pressure reducing valve.
	(e) Hydraulic fluid supply is insufficient.	(e) Test the supply pressure and flow of the hydraulic supply. Repair or replace as required.
	(2) Pressure is indicated on the system gauge.	
	(a) Close hydraulic fluid outlet line.	(a) Check the outlet line for obstruction. Repair or replace as required.
	(b) Flow control valve is fully closed.	(b) Readjust the valve to 3/4 turn open.
	(c) Pump is stalled due to grease backpressure.	(c) Test the operation of the vent valve. Repair or replace as required.
	(3) Pump is seized or damaged.	(3) Disassemble the pump and repair or replace the damaged seized components.
(2) Pump speeds up or runs erratically.	**(1) Low level of grease or reservoir is empty.**	(1) Refill reservoir.
	(2) Follower plate is stuck and separated from the grease.	(2) Check the follower plate and container for evidence of wear or damage. Repair or replace as required.
	(3) Pump piston or check valves are worn.	(3) Disassemble the pump and repair or replace the damaged or worn components.
(3) Pump runs, but the output of grease is low.	**(1) Insufficient hydraulic fluid supply.**	(1) Test the hydraulic supply flow. Adjust the flow control valve to obtain the required flow rate. Repair or replace as required.
	(2) Inlet pressure set too low.	(2) Increase the system operating pressure by adjusting the pressure reducing valve.
	(3) Faulty inlet or discharge check valves.	(3) Repair or replace as required.
(4) Weepage from the housing cover.	**(1) Cup seal or O-ring worn or damaged.**	(1) Check, repair, or replace as required.
(5) Pump becomes noisy.	**(1) No oil in crankcase.**	(1) Add crankcase oil as outlined in the instructions on the hydraulic pump assembly in Section 9 - Options.
	(2) Worn wrist pin bushing.	(2) Disassemble the pump and repair or replace the damaged or worn components.
(6) Pump does not build pressure.	**Foreign material holding lower check assembly open.**	(1) Dismantle, clean, repair or replace as required. Consider installing inlet screen.
		(2) Check grease supply for contamination.

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priming the system should it run dry.

NOTE: *Do not allow the grease reservoir to run dry. This could result in damage to lubricated parts on the truck, and will require the automatic lubrication system to be primed.*

7. Check the operation and setting of the electric timer setting as follows:

NOTES:
1. The electrical timers are mounted in the cab and are accessed through the dash access panel to the right of the steering wheel.
2. These times are typical and may be adjusted for site and environmental differences.

a. Set the “Off” timer for 15 minutes.

b. Set the “On” timer to 1 minute.

c. Mark the timers and knobs to indicate the settings made.

8. Inspect each injector for the correct discharge adjustment. To adjust an injector for the desired discharge rate, proceed as outlined in the instructions in Section 9 - Options.

9. If it has been determined that there is air in the lines, the air should be removed from the system. Once the air has been removed, the cause should be determined.

NOTE: *Air in the supply and feed lines (injector to bearing) can be a major cause of the lubrication system not to operate properly. Air pockets in the lubricant will prevent the pump from building up lubricant pressure.*

Entrapped air may be removed from the system as follows:

a. Park the truck in a SAFE POSITION. It must be secured by means other than the truck’s friction brake system.

b. Remove the plug from the tee or injector manifold closest to the pump.

c. Start the pump.

d. When grease flows freely from the plug opening, stop the pump and replace the plug. Repeat this procedure on the next tee or manifold downstream from the pump, and progressively work to the last and longest supply line run.

e. After all air is expelled and all plugs are replaced, the pump will build up lubricant pressure and complete its operating cycle.

10. Check that the outlet grease flow from the pump has been regulated to 2500 to 2800 psi (17 240 to 19 305 kPa). If not, pressure reducing valve and flow control valve, respectively, can be readjusted as follows:

a. Pressure control valve

(1) Loosen the locknut on the valve by turning counter-clockwise.

(2) Rotate the valve stem counter-clockwise until it no longer turns.

NOTE: *The valve stem will unscrew until it reaches the stop. It will not come off. This is the minimum pressured setting.*

(3) Turn the Master and Battery Isolation switches. Temporarily adjust the timers to allow the system to operate and the pump stalls against the pressure.

(4) Rotate the valve stem clockwise until the grease pressure is 2500 to 2800 psi (17 240 to 19 305 kPa) and the system cycles.

(5) Cause the system to cycle again and verify the operating pressure.

(6) When the adjustment is complete, turn the locknut on the valve stem clockwise to secure.

b. Flow control valve

(1) Loosen the locknut on the flow control valve by turning counter-clockwise.

(2) Adjust the flow rate by turning the valve stem clockwise to reduce the flow and counter-clockwise to increase the flow.

NOTES:
1. There are approximately 2-1/2 turns from the fully opened to the fully closed positions.
2. A typical initial setting is midway, approximately 1-1/4 from the ends of the travel.
3. The valve stem will not come out when fully open as there is a stop in this position.

(3) When the adjustment is complete, turn the locknut on the valve stem clockwise to secure.

When components require replacement, shut off hydraulic pressure to the system, and make sure the truck's Master Switch is Off before doing any work. If a component tubing or hose is removed, the system may have to be primed manually.

NOTE: *When installing the cover on the reservoir:*
1. Apply RTV Sealant to both sides of the gasket.
2. Install the capscrews from the bottom side of the lid. Coat the threads with Loctite 242 (or equivalent) and tighten to 6 ft-lb (8 Nm). Do not over tighten as this may distort the gasket.

SERVICE

Servicing of the grease pump and injector assemblies is outlined in their separate instructions contained in Section 9 - Options.

ELECTRICALLY OPERATED (24 VDC) ROTARY GREASE PUMP

DESCRIPTION AND LOCATION (Figures 1and 2)

The components included in this part of the automatic lubrication assembly are those mounted on the superstructure, including the grease reservoir and the equipment on and around the top of the assembly.

OPERATION

The rotary motion of the 24 Vdc electric motor drives the pump. This rotary motion is converted to reciprocating motion through an eccentric crank mechanism. The reciprocating action causes the pump cylinder to move up and down. The pump is of positive displacement, double acting design with grease output occurring during both the up and down strokes of the pump.

During the down stroke the pump cylinder is extended into the grease. Through the combination of shovel action and vacuum generated in the pump cylinder chamber, the grease is forced into the pump chamber. Simultaneously, grease is discharged through the outlet of the pump. The volume of grease during the intake is twice the amount of grease output during each cycle.

During the upstroke, the inlet check function closes, and one half of the grease taken in during the previous stroke is transferred through the outlet check function to the outlet port.

An integral speed control is incorporated into the 24 Vdc motor to control the motor speed and grease output flow.

TROUBLESHOOTING

The troubleshooting of the components in this portion of the assembly is included in the detailed explanation in the system information in Section 9 - Options.

MAINTENANCE AND ADJUSTMENT (Figures 1 and 2)

Periodic maintenance should include the following steps:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

NOTE: *Preventive maintenance should be performed frequently to ensure proper operation of the system. Damage to bearings and other moving components can be avoided.*

2. Inspect the pump and related lubrication system components for evidence of dirt, damage, wear or leaks.

3. Clean and inspect the system components. Not any material in or on the inlet strainer (63) if so equipped.

4. Check the mounting hardware for tightness.

5. Verify that all connections are tight, clean and free of leaks. All hoses and wires should be secured firmly without kinks and routed away from all moving parts.

6. At regular intervals, (typically approximately 100 hours), check the fluid level in the pump crankcase as follows:

a. Remove pipe plug from the pump housing (73).

b. Verify that the oil level is at the center of the pipe plug opening.

c. If more oil is needed, add SAE 10W-30 motor oil until it reaches the proper level. Do not overfill.

NOTE: *In arctic climate operating conditions, it is recommended that Mobil Aero HFA Low Temperature Hydraulic Fluid (or equivalent) be substituted as the lubricating fluid.*

d. Install the pipe plug into the pump housing (73).

7. At 500 hour intervals, change the in the pump crankcase as follows:

a. Remove pipe plug from the pump housing (73). Allow the oil to drain into an appropriate container.

b. Verify that all the oil is out of the crankcase. Remove any remaining by the necessary means.

c. Refill with SAE 10W-30 motor oil until it reaches the proper level. Do not overfill. Approximately 10 fluid ounces (300 milliliters) will be required.

NOTE: *In arctic climate operating conditions, it is recommended that Mobil Aero HFA Low Temperature Hydraulic Fluid (or equivalent) be substituted as the lubricating fluid.*

d. Install the pipe plug into the pump housing (73).

REMOVAL

The grease pump assembly may be removed as follows:

1. Park the truck in SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Turn off the 24 Vdc power to the autolube assembly and secure so prevent unwanted activation.

3. Release all pressure in the grease inlet and outlet lines prior to their removal.

4. Remove the hardware securing the lid and pump assembly to the top of the reservoir can.

NOTE: *There are a number of variations to the reservoir assembly. See the drawing in the system information in Section 9 - Options for detailed illustrations.*

5. Remove the lid and pump assembly.

DISASSEMBLY (Figure 2)

The grease pump assembly may be disassembled as follows:

1. Remove the electric motor (50) by removing the three jam nuts (42) and unscrewing the mounting screws (51).

2. Remove the gearbox assembly (43, 44, and 45) by removing the four mounting capscrews (40).

3. Remove the 4 screws (48 or 67) and remove the gearset(s) and spacer.

4. Remove the adapter shaft (41) by pulling it straight out of the pump shaft (37).

5. Remove the pump housing cover (30) and gasket (31).

NOTE: *Drain the crankcase oil from the open housing.*

6. Remove the bearing cover (64).

7. Remove the pump shaft snap ring (62).

8. While support against the pump shaft seal (40), press the pump shaft out of the assembly

NOTE: *Be sure to place a support shim under the crank assembly (1 though 7) to prevent binding when the shaft is pushed out.*

9. Remove the two outlet pin nuts (32) from the housing (73).

10. Remove the pump subassembly (1 through 27) from the pump housing (73).

NOTE: *Pushing the subassembly up with a ¾ inch OD wooden or plastic rod against the check seat housing (27) is helpful.*

11. Remove the housing tube (56) from the pump housing (73) by inserting a 3/8 inch (9 mm) diameter rod through the inlet holes on the bottom of the housing tube and unscrewing it.

12. Remove the bronze bearing (52), O-ring (53), and back-up washer (54) from the housing tube (56).

13. Remove the crankrod assembly (1 through 7) from the pump by:

a. Unscrewing the button head screws (11).

b. Pulling out the wrist pin bushings (12).

14. Remove the check seat housing (27) from the reciprocating tube (20).

NOTE: *There is a 3/8-inch Allen head socket in the throat of the check seat housing (27) to ease removal.*

15. Unscrew the wrist pin anchor (13) from the reciprocating tube (20).

16. Pull the plunger assembly (8 through 19) from the reciprocating tube (20).

17. Using a ½ inch (12 mm) wooden or plastic rod, push the cup seal (21) and the pump cylinder (23) from the reciprocating tube (20).

18. Remove the pump plunger (19) from the plunger link rod (16).

NOTE: *A spanner wrench (for 3/8-inch diameter tube with 1/8-inch pins) that uses the holes in the pump plunger is required.*

19. Unscrew the plunger link rod (16) from the plunger tube (10).

20. Slide off the cup seal (15), the back-up washer (14), and the wrist pin anchor (13).

21. Unscrew the plunger tube (10) from the outlet pin (8).

22. To dismantle crank rod assembly (1 through 7), remove the flathead screws (1) and the inner and counter weights (2).

23. Remove the retaining rings (5).

24. Press the crank eccentric (6) out of the ball bearing (7).

NOTE: *Be sure to support the ball bearing (7) on the inner race to prevent damage.*

INSPECTION AND REPAIR

The disassembled pump may be serviced as follows:

1. Clean all metal parts in solvent and dry with compressed air. Inspect for evidence of wear, damage, or leakage. Repair or replace as required.

2. Inspect all seals and gaskets for evidence of leakage or damage. If found, repair or replace the items responsible. Replace all seals during the reassembly process.

3. Inspect the following components and replace if excessive wear is indicated.

a. Ball bearing (7).

b. Crank eccentric (6).

c. Crankrod (4).

d. Wrist pin bushings (12).

e. Plunger Tube (10).

f. Pump plunger and upper check parts (19, 18, and 17).

g. Pump cylinder (23).

h. Check seat housing and lower check ball (27 and 25)

i. Upper Bronze busing (52).

j. Housing tube (56).

k. Shovel Plug (58).

l. Reciprocating tube (20).

m. Shaft seal (40).

ASSEMBLY (Figure 2)

The grease pump assembly may be assembled as follows:

IMPORTANT:
1. Start all fasteners by hand to avoid stripped threads during the assembly process.
2. Use Loctite 242 (or equivalent) on all torqued threaded connections. Extreme care must be exercised to prevent excess compound from flowing into critical areas such as clearance fits, ball checks, etc. Allow a minimum of 30 minutes of cure time before operating the pump.
3. Prior to assembly, verify that all components are clean and free of damage, high spots, or burrs. Coat all items and bores with hydraulic oil compatible with that in the truck's hydraulic system

1. Press the crank eccentric (6) into the ball bearing (7).

NOTE: *Be sure to support the ball bearing (7) on the inner race to prevent damage.*

2. Install the retaining rings (5).

3. To assemble the crank rod assembly (1 through 7), install the flathead screws (1) and the counter weights (2).

4. After coating the threads with Loctite 242 (or equivalent), install the plunger tube (10) onto the outlet pin (8). Torque to 100 to 110 inch-lb (11 to 12 Nm).

5. Install the cup seal (15), the back-up washer (14), and the wrist pin anchor (13).

6. After coating the threads with Loctite 242 (or equivalent), install the plunger link rod (17) onto the plunger tube (10). Torque to 100 to 110 inch-lb (11 to 12 Nm).

7. After coating the threads with Loctite 242 (or equivalent), install the pump plunger (19) onto the plunger link rod (16). Torque to 100 to 110 inch-lb (11 to 12 Nm).

NOTE: *A spanner wrench (for 3/8-inch diameter tube with 1/8-inch pins) that uses the holes in the pump plunger is required.*

8. Using a ½ inch (12 mm) wooden or plastic rod, push the cup seal (21) and the pump cylinder (23) onto the reciprocating tube (20).

9. Install the plunger assembly (8 through 19) into the reciprocating tube (20).

10. After coating the threads with Loctite 242 (or equivalent), install the wrist pin anchor (13) into the reciprocating tube (20). Torque to 20 to 25 ft-lb (27 to 34 Nm).

11. Install the check seat housing (27) into the reciprocating tube (20).

12. Install the crankrod assembly (1 through 7) from the pump by installing the:

a. Wrist pin bushings (12).

b. Button head screws (11), after coating the threads with Loctite 242 (or equivalent). Torque to 100 to 110 inch-lb (11 to 12 Nm).

13. Install the bronze bearing (52), O-ring (53), and back-up washer (54) into the housing tube (56).

14. Install the pump subassembly (1 through 27) into the pump gearbox housing (43).

NOTE: *Pushing the subassembly up with a wooden or plastic rod ¾ inch (19 mm) O. D. against the check seat housing is typically found to be helpful.*

15. After coating the threads with Loctite 242 (or equivalent), install the housing tube (56) from the pump gearbox housing (43) by inserting the ¾ inch (19 mm) rod through the inlet holes on the bottom of the housing tube and tightening it. Torque to 20 to 25 ft-lb (27 to 34 Nm).

16. After coating the threads with Loctite 242 (or equivalent), install the two outlet pin nuts (32) into the pump housing (43). Torque to 30 to 35 ft-lb (41 to 47 Nm).

17. Install the electric motor (50) onto the pump housing (43).

18. Install the two socket head screws (46). Torque to 20 to 25 ft-lb (27 to 34 Nm).

19. Install the shovel plug (58) onto the housing tube (56).

20. Install the retaining ring (59).

21. If so equipped, install and the inlet strainer (74) onto the housing assembly. Secure with the setscrew.

22. Install the housing cover (30) with the cover gasket (31).

23. Install the six self-threading screws (28).

24. Refill the pump crankcase with SAE 10W30 oil as outlined in the instructions in Maintenance and Adjustment.

NOTE: *In arctic climate operating conditions, it is recommended that Mobil Aero HFA Low Temperature Hydraulic Fluid (or equivalent) be substituted as the lubricating fluid.*

25. Install the pipe plug.

INSTALLATION

The pump assembly may be installed as follows:

1. Install the lid and pump assembly onto the top of the reservoir can.

NOTE: *There are a number of variations to the reservoir assembly. See the drawing in the system information in Section 9 - Options for detailed illustrations.*

2. Secure lid with the appropriate hardware for the application.

3. Refill the reservoir as required with the appropriate grease.

4. Purge all air from the pump and remainder of the

system as outlined in the instruction on Maintenance and Adjustment in the information on the system in Section 9 - Options.

5. Test the operation of the system as outlined in the instruction on the system in Section 9 - Options.

KEY			
01.	O-ring	34.	Solenoid Valve Cartridge
02.	Outer Weight	35.	Solenoid Valve Coil (24 Vdc)
03.	Inner Weight	36.	Solenoid Connector
04.	Retainer Ring	37.	Manifold
05.	Crankrod	38.	Pressure Reducing Valve
06.	Retaining Ring	39.	Flow Control Valve
07.	Crank Eccentric	40.	O-ring (Nitrile)
08.	Ball Bearing	41.	Motor Gasket
09.	Outlet Pin	42.	Hydraulic Motor
10.	O-ring (Nitrile)	43.	Washer
11.	Plunger Tube	44.	Socket Head Screw
12.	Button Head Screw	45.	Pipe Plug
13.	Wrist Pin Bushing	46.	Pump Housing
14.	Wrist Pin Anchor	47.	Back-up Ring (Nitrile)
15.	Back-up Washer	48.	O-ring (Nitrile)
16.	Cup Seal (Polyurethane)	49.	O-ring (Nitrile)
17.	Plunger Link Rod	50.	Outlet Pin Nut
18.	Spring	51.	Bronze Bearing
19.	Ball	52.	O-ring (Nitrile)
20.	Pump Plunger	53.	Back-up Washer
21.	Reciprocating Tube	54.	O-ring (Nitrile)
22.	Cup Seal	55.	Housing Tube
23.	O-ring (Polyurethane)	56.	Shovel Plug
24.	Pump Cylinder	57.	Retaining Ring
25.	Ball Cage	58.	Seal Kit
26.	Ball	59.	Seal Kit
27.	O-ring (Nitrile)	60.	Seal Kit
28.	Check Seat	61.	Orifice Fitting
29.	Self Threading Screw (#8-1/2)	62.	Gaskets
30.	Housing Cover	63.	Inlet strainer
31.	Cover Gasket (Nitrile)		
32.	Pressure Gauge		
33.	Socket Head Screw		

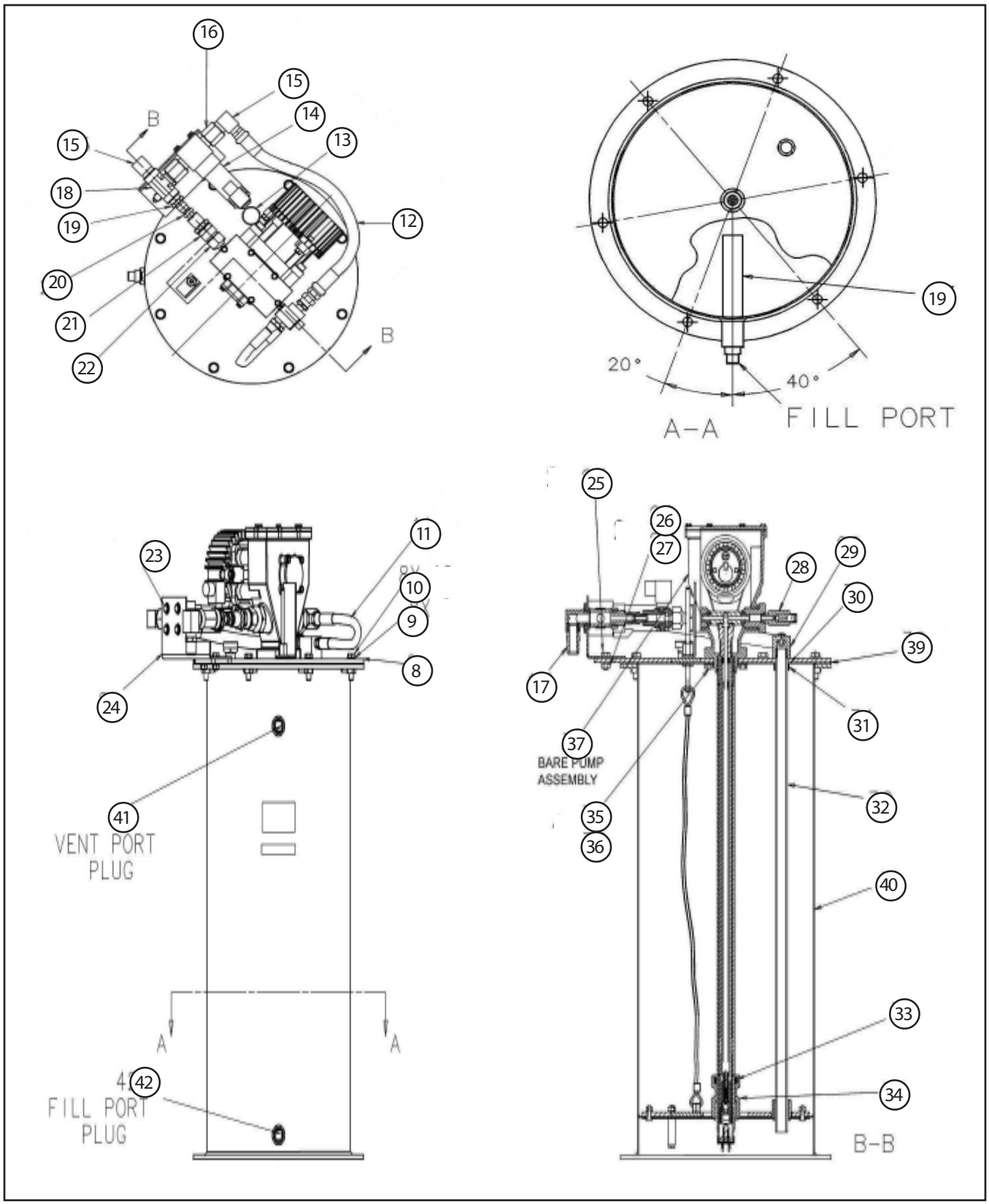


FIGURE 1 – ELECTRICALLY (24 VDC) OPERATED GREASE PUMP 57411

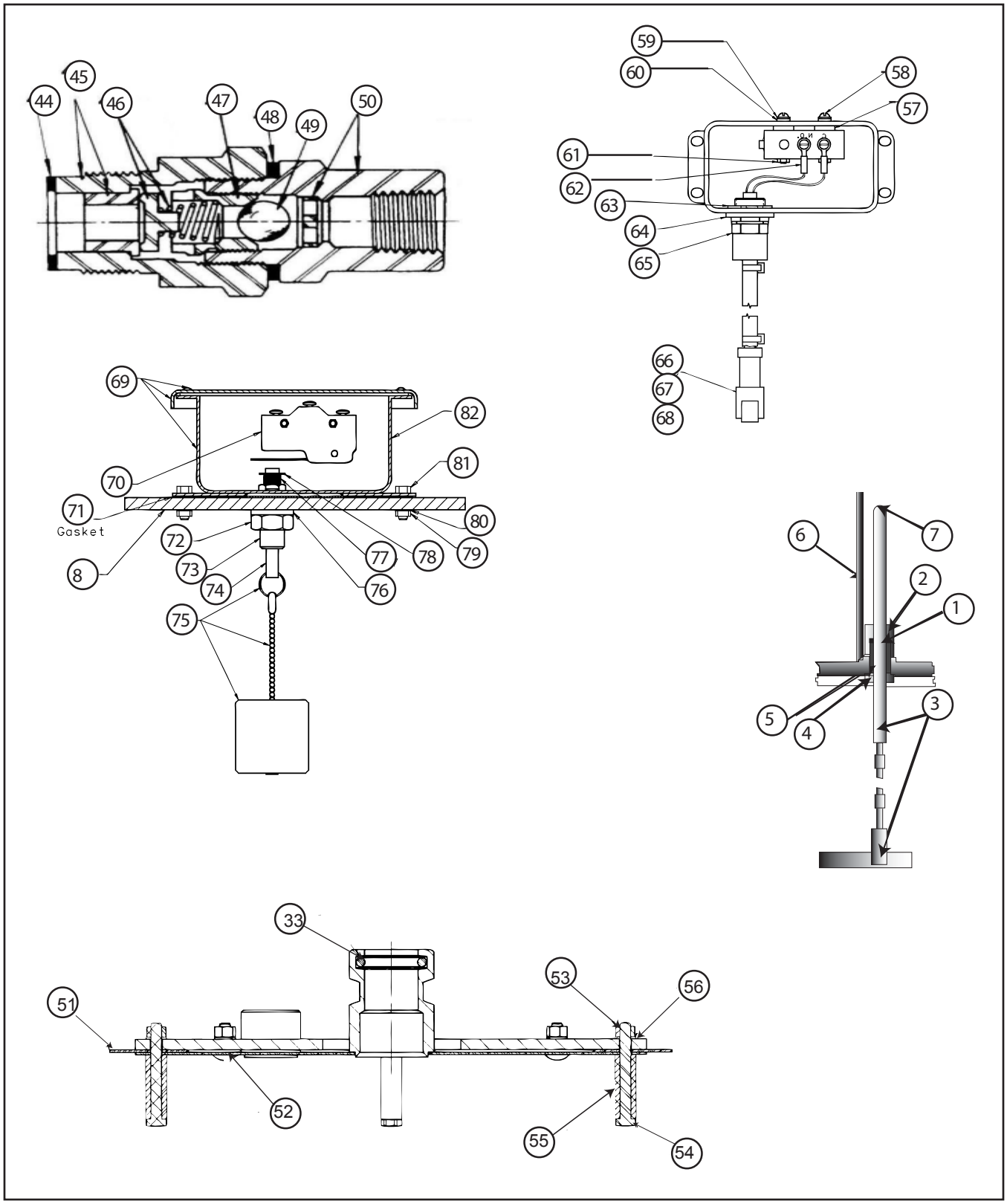


FIGURE 1 CONT. – ELECTRICALLY (24 VDC) OPERATED GREASE PUMP 57411

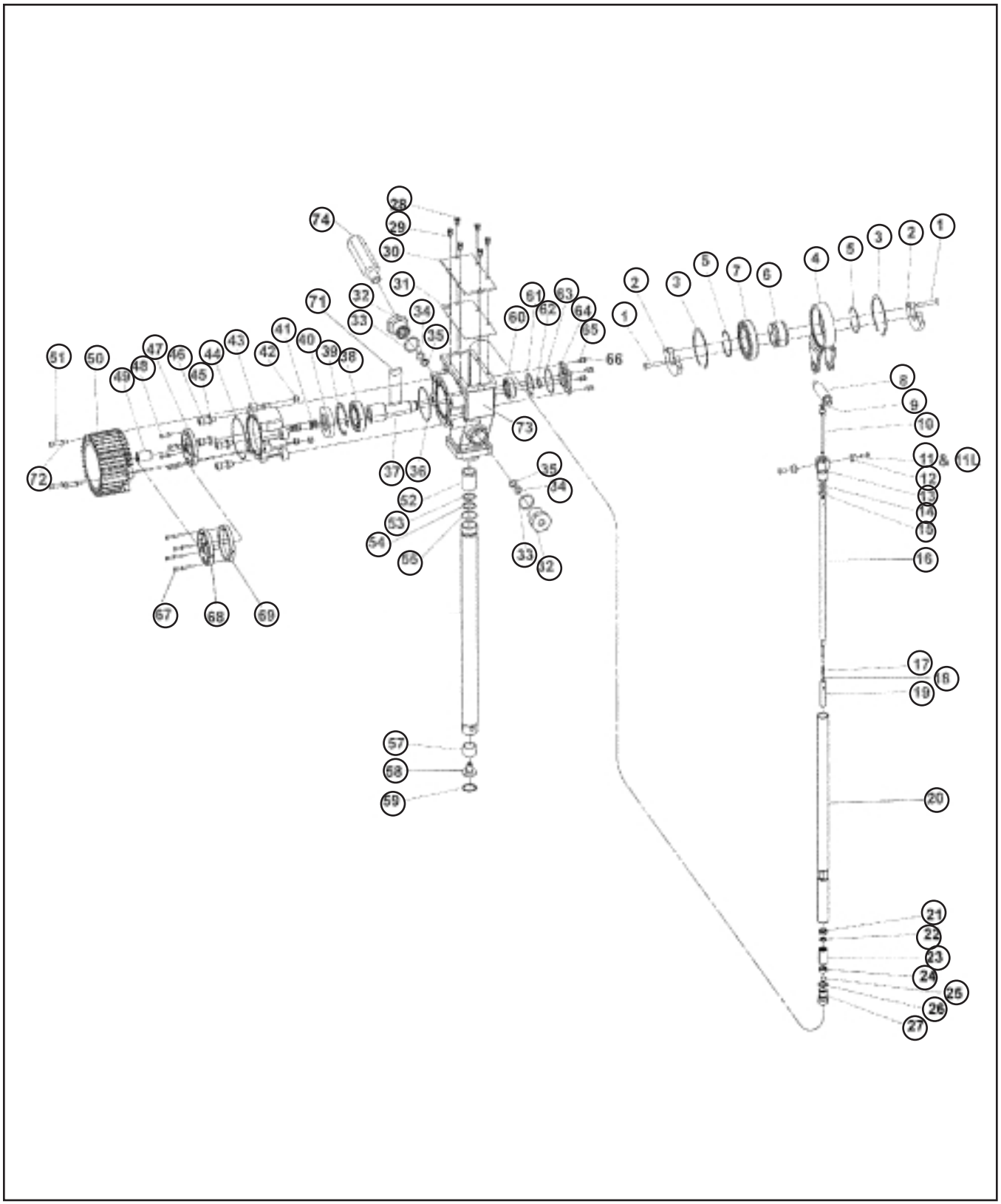


FIGURE 2 – ELECTRICALLY OPERATED GREASE PUMP

KEY			
01.	Flathead Screw	38.	Ball Bearing
02.	Counter Weight	39.	Retaining Ring
03.	Retainer Ring	40.	Shaft Seal
04.	Crankrod	41.	Adapter Shaft
05.	Retaining Ring	42.	Nut
06.	Crank Eccentric	43.	Gearbox Housing
07.	Ball Bearing	44.	O-ring
08.	Outlet Pin	45.	Lockwasher
09.	O-ring (Nitrile)	46.	Screw
10.	Plunger Tube	47.	Gear Set
11.	Button Head Screw	48.	Screw
12.	Wrist Pin Bushing	49.	Motor Coupler
13.	Wrist Pin Anchor	50.	Motor
14.	Back-up Washer	51.	Screw
15.	Cup Seal (Polyurethane)	52.	Bronze Bearing
16.	Plunger Link Rod	53.	O-ring (Polyurethane)
17.	Spring	54.	Back-up Washer
18.	Ball	55.	O-ring (Nitrile)
19.	Pump Plunger	56.	Housing Tube
20.	Reciprocating Tube	57.	Bronze Bushing
21.	Cup Seal	58.	Shovel Plug
22.	O-ring (Polyurethane)	59.	Retaining Ring
23.	Pump Cylinder	60.	Ball bearing
24.	Ball Cage	61.	Retaining Ring
25.	Ball	62.	Retaining Ring
26.	O-ring (Nitrile)	63.	O-ring
27.	Check Seat	64.	Bearing Cover
28.	Self Threading Screw (#8-1/2)	65.	Lockwasher
29.	Gasket (Screw)	66.	Screws
30.	Housing Cover	67.	Screws
31.	Cover Gasket (Nitrile)	68.	Gear Set
32.	Outlet Pin Nut	69.	Gear Set Spacer
33.	O-ring	70.	Not Used
34.	Backup Washer	71.	Woodruff Key
35.	O-ring	72.	Lockwashers
36.	O-ring	73.	Pump Housing
37.	Pump Shaft	74.	Inlet Strainer (Not Shown)

HYDRAULICALLY OPERATED ROTARY GREASE PUMP

DESCRIPTION AND LOCATION (Figure 1)

The components included in this part of the automatic lubrication assembly are those mounted on the superstructure, including the grease reservoir and the equipment on and around the top of the assembly.

OPERATION

The rotary motion of the hydraulic motor drives the pump. This rotary motion is converted to reciprocating motion through an eccentric crank mechanism. The reciprocating action causes the pump cylinder to move up and down. The pump is of positive displacement, double acting design with grease output occurring during both the up and down strokes of the pump.

During the down stroke the pump cylinder is extended into the grease. Through the combination of shovel action and vacuum generated in the pump cylinder chamber, the grease is forced into the pump chamber. Simultaneously, grease is discharged through the outlet of the pump. The volume of grease during the intake is twice the amount of grease output during each cycle.

During the upstroke, the inlet check function closes, and one half of the grease taken in during the previous stroke is transferred through the outlet check function to the outlet port.

An integral pump control manifold is incorporated into the motor to control the input flow and pressure of hydraulic oil that provides the operating power.

TROUBLESHOOTING

The troubleshooting of the components in this portion of the assembly is included in the detailed explanation in the system information in Section 9 - Options.

MAINTENANCE AND ADJUSTMENT (Figure 1)

Periodic maintenance should include the following steps:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

NOTE: *Preventive maintenance should be performed frequently to ensure proper operation of the system. Damage to bearings and other moving components can be avoided.*

2. Inspect the pump and related lubrication system components for evidence of dirt, damage, wear or leaks.

3. Clean and inspect the system components. Not any material in or on the inlet strainer (63) if so equipped.

4. Check the mounting hardware for tightness.

5. Verify that all connections are tight, clean and free of leaks. All hoses should be secured firmly without kinks and routed away from all moving parts.

6. At regular intervals, (typically approximately 100 hours), check the fluid level in the pump crankcase as follows:

a. Remove pipe plug (45) from the pump housing (46).

b. Verify that the oil level is at the center of the pipe plug opening.

c. If more oil is needed, add SAE 10W-30 motor oil until it reaches the proper level. Do not overfill.

NOTE: *In arctic climate operating conditions, it is recommended that Mobil Aero HFA Low Temperature Hydraulic Fluid (or equivalent) be substituted as the lubricating fluid.*

d. Install the pipe plug (45) into the pump housing (46).

7. At 500 hour intervals, change the in the pump crankcase as follows:

a. Remove pipe plug (45) from the pump housing (46). Allow the oil to drain into an appropriate container.

b. Verify that all the oil is out of the crankcase. Remove any remaining by the necessary means.

c. Refill with SAE 10W-30 motor oil until it reaches the proper level. Do not overfill. Approximately 10 fluid ounces (300 milliliters) will be required.

NOTE: *In arctic climate operating conditions, it is recommended that Mobil Aero HFA Low Temperature Hydraulic Fluid (or equivalent) be substituted as the lubricating fluid.*

d. Install the pipe plug (45) into the pump housing (46).

REMOVAL

The grease pump assembly may be removed as follows:

1. Park the truck in SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Remove the hardware securing the lid and pump assembly to the top of the reservoir can.

NOTE: *There are a number of variations to the reservoir assembly. See the drawing in the system information in Section 9 - Options for detailed illustrations.*

3. Remove the lid and pump assembly.

DISASSEMBLY (Figure 1)

The grease pump assembly may be disassembled as follows:

1. Remove the four socket head capscrews (33).

2. Carefully separate the manifold (37) from the hydraulic motor assembly (42). Do not pry the components apart. Use extra care not to damage or mar the mating surfaces.

3. Remove the pipe plug (45) and drain the crankcase oil from the pump housing (46).

4. Remove the six self-threading screws (29).

5. Remove the housing cover (30) and the cover gasket (31).

6. If so equipped, remove the inlet strainer (63) from the tube assembly.

7. Remove the retaining ring (57).

8. Pull the shovel plug (56) from the housing tube (55).

9. Remove the two socket head screws (44).

10. Separate the hydraulic motor (42) from the pump housing (46).

11. Remove the two outlet pin nuts (50) from the pump housing (46).

12. Remove the pump subassembly (1 through 28) from the pump housing (46).

NOTE: *Pushing the subassembly up with a wooden or plastic rod ¾ inch (19 mm) O. D. against the check seat housing is typically found to be helpful.*

13. Remove the housing tube (55) from the pump housing (46) by inserting the ¾ inch (19 mm) rod through the inlet holes on the bottom of the housing tube and unscrewing it.

14. Remove the bronze bearing (51), O-ring (52), and back-up washer (53) from the housing tube (55).

15. Remove the crankrod assembly (1 through 8) from the pump by:

a. Unscrewing the button head screws (12).

b. Pulling out the wrist pin bushings (13).

16. Remove the check seat housing (28) from the reciprocating tube (21).

NOTE: *There is a 3/8-inch Allen head socket in the throat of the check seat housing to ease removal.*

17. Unscrew the wrist pin anchor (14) from the reciprocating tube (21).

18. Pull the plunger assembly (9 through 20) from the reciprocating tube (21).

19. Using a ½ inch (12 mm) wooden or plastic rod, push the cup seal (22) and the pump cylinder (24) from the reciprocating tube (21).

20. Remove the pump plunger (20) from the plunger link rod (17).

NOTE: *A spanner wrench (for 3/8-inch diameter tube with 1/8-inch pins) that uses the holes in the pump plunger is required.*

21. Unscrew the plunger link rod (17) from the plunger tube (11).

22. Slide off the cup seal (16), the back-up washer (15), and the wrist pin anchor (14).

23. Unscrew the plunger tube (11) from the outlet pin (9).

24. To dismantle crank rod assembly (1 through 8), remove the flathead screws (1) and the inner and outer weights (2 and 3).

25. Remove the retaining rings (6).

26. Press the crank eccentric (7) out of the ball bearing (8).

NOTE: *Be sure to support the ball bearing (8) on the inner race to prevent damage.*

INSPECTION AND REPAIR

The disassembled pump may be serviced as follows:

1. Clean all metal parts in solvent and dry with compressed air. Inspect for evidence of wear, damage, or leakage. Repair or replace as required.

2. Inspect all seals and gaskets for evidence of leakage or damage. If found, repair or replace the items responsible. Replace all seals during the reassembly process.

ASSEMBLY (Figure 1)

The grease pump assembly may be assembled as follows:

IMPORTANT:
1. Start all fasteners by hand to avoid stripped threads during the assembly process.
2. Use Loctite 242 (or equivalent) on all torqued threaded connections. Extreme care must be exercised to prevent excess compound from flowing into critical areas such as clearance fits, ball checks, etc. Allow a minimum of 30 minutes of cure time before operating the pump.
3. Prior to assembly, verify that all components are clean and free of damage, high spots, or burrs. Coat all items and bores with hydraulic oil compatible with that in the truck's hydraulic system

1. Press the crank eccentric (7) into the ball bearing (8).

NOTE: *Be sure to support the ball bearing (8) on the inner race to prevent damage.*

2. Install the retaining rings (6).

3. To assemble the crank rod assembly (1 through 8), install the flathead screws (1) and the inner and outer weights (2 and 3).

4. After coating the threads with Loctite 242 (or equivalent), install the plunger tube (11) onto the outlet pin (9). Torque to 100 to 110 inch-lb (11 to 12 Nm).

5. Install the cup seal (16), the back-up washer (15), and the wrist pin anchor (14).

6. After coating the threads with Loctite 242 (or equivalent), install the plunger link rod (17) onto the plunger tube (11). Torque to 100 to 110 inch-lb (11 to 12 Nm).

7. After coating the threads with Loctite 242 (or equivalent), install the pump plunger (20) onto the plunger link rod (17). Torque to 100 to 110 inch-lb (11 to 12 Nm).

NOTE: *A spanner wrench (for 3/8-inch diameter tube with 1/8-inch pins) that uses the holes in the pump plunger is required.*

8. Using a ½ inch (12 mm) wooden or plastic rod, push the cup seal (22) and the pump cylinder (24) onto the reciprocating tube (21).

9. Install the plunger assembly (9 through 20) into the reciprocating tube (21).

10. After coating the threads with Loctite 242 (or equivalent), install the wrist pin anchor (14) into the reciprocating tube (21). Torque to 20 to 25 ft-lb (27 to 34 Nm).

11. Install the check seat housing (28) into the reciprocating tube (21).

12. Install the crankrod assembly (1 through 8) from the pump by installing the:

a. Wrist pin bushings (13).

b. Button head screws (12), after coating the threads with Loctite 242 (or equivalent). Torque to 100 to 110 inch-lb (11 to 12 Nm).

13. Install the bronze bearing (51), O-ring (52), and back-up washer (53) into the housing tube (55).

14. Install the pump subassembly (1 through 28) into the pump housing (46).

NOTE: *Pushing the subassembly up with a wooden or plastic rod ¾ inch (19 mm) O. D. against the check seat housing is typically found to be helpful.*

15. After coating the threads with Loctite 242 (or equivalent), install the housing tube (55) from the pump housing (46) by inserting the ¾ inch (19 mm) rod through the inlet holes on the bottom of the housing tube and tightening it. Torque to 20 to 25 ft-lb (27 to 34 Nm).

16. After coating the threads with Loctite 242 (or equivalent), install the two outlet pin nuts (50) into the pump

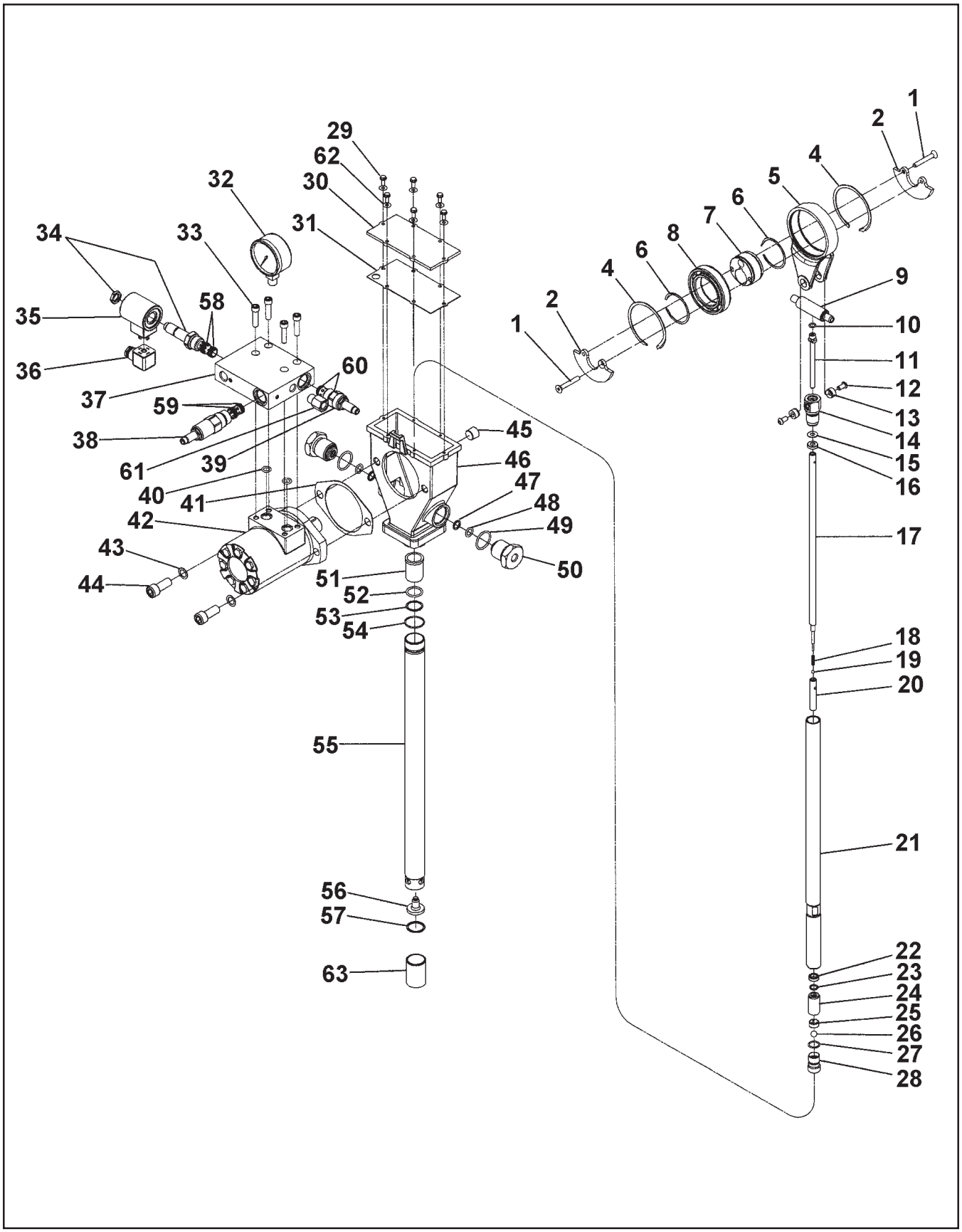


FIGURE 1 - HYDRAULICALLY OPERATED GREASE PUMP (56341)

KEY					56341
01.	Flathead Screw	22.	Cup Seal	43.	Washer
02.	Outer Weight	23.	O-ring (Polyurethane)	44.	Socket Head Screw
03.	Inner Weight	24.	Pump Cylinder	45.	Pipe Plug
04.	Retainer Ring	25.	Ball Cage	46.	Pump Housing
05.	Crankrod	26.	Ball	47.	Back-up Ring (Nitrile)
06.	Retaining Ring	27.	O-ring (Nitrile)	48.	O-ring (Nitrile)
07.	Crank Eccentric	28.	Check Seat	49.	O-ring (Nitrile)
08.	Ball Bearing	29.	Self Threading Screw (#8-1/2)	50.	Outlet Pin Nut
09.	Outlet Pin	30.	Housing Cover	51.	Bronze Bearing
10.	O-ring (Nitrile)	31.	Cover Gasket (Nitrile)	52.	O-ring (Nitrile)
11.	Plunger Tube	32.	Pressure Gauge	53.	Back-up Washer
12.	Button Head Screw	33.	Socket Head Screw	54.	O-ring (Nitrile)
13.	Wrist Pin Bushing	34.	Solenoid Valve Cartridge	55.	Housing Tube
14.	Wrist Pin Anchor	35.	Solenoid Valve Coil (24 Vdc)	56.	Shovel Plug
15.	Back-up Washer	36.	Solenoid Connector	57.	Retaining Ring
16.	Cup Seal (Polyurethane)	37.	Manifold	58.	Seal Kit
17.	Plunger Link Rod	38.	Pressure Reducing Valve	59.	Seal Kit
18.	Spring	39.	Flow Control Valve	60.	Seal Kit
19.	Ball	40.	O-ring (Nitrile)	61.	Orifice Fitting
20.	Pump Plunger	41.	Motor Gasket	62.	Gaskets
21.	Reciprocating Tube	42.	Hydraulic Motor	63.	Inlet strainer

housing (46). Torque to 30 to 35 ft-lb (41 to 47 Nm).

17. Install the hydraulic motor (42) onto the pump housing (46).

18. Install the two socket head screws (44).

19. Install the shovel plug (56) onto the housing tube (55).

20. Install the retaining ring (57).

21. If so equipped, install and the inlet strainer (63) onto the housing assembly. Secure with the setscrew.

22. Install the housing cover (30) with the cover gasket (31).

23. Install the six self-threading screws (29).

24. Refill the pump crankcase with SAE 10W30 oil as outlined in the instructions in Maintenance and Adjustment.

NOTE: *In arctic climate operating conditions, it is recommended that Mobil Aero HFA Low Temperature Hydraulic Fluid (or equivalent) be substituted as the lubricating fluid.*

25. Install the pipe plug (45).

26. Carefully install the manifold (37) to the hydraulic motor assembly (42). Use extra care not to damage or mar the mating surfaces.

27. Install the four socket head capscrews (33).

INSTALLATION

The pump assembly may be installed as follows:

1. Install the lid and pump assembly onto the top of the reservoir can.

NOTE: *There are a number of variations to the reservoir assembly. See the drawing in the system information in Section 9 - Options for detailed illustrations.*

2. Secure lid with the appropriate hardware for the application.

3. Refill the reservoir as required with the appropriate grease.

4. Purge all air from the pump and remainder of the system as outlined in the instruction on Maintenance and Adjustment in the information on the system in Section 9 - Options.

5. Test the operation of the system as outlined in the instruction on the system in Section 9 - Options.

AUTOMATIC LUBRICATION SYSTEM INJECTORS

DESCRIPTION AND LOCATION

The injectors on the automatic lubrication system are the cylindrical assemblies mounted on manifolds at various locations on the truck frame and components.

OPERATION

The function of the injectors is to meter the flow of grease from the central reservoir and pump assembly to the individual points actually being lubricated. The operation of the injector is in four basic stages.

Stage 1

The injector piston is in its normal or rest position. The discharge chamber is filled with lubricant from the previous cycle. Under the pressure of incoming lubricant, the slide valve is about to open the passage leading to injector.

Stage 2

When the slide valve uncovers the passage, lubricant is admitted to the measuring chamber above the injector piston which forces the lubricant from the discharge chamber through the outlet port to the hose leading to the lubricated item.

Stage 3

As the injector completes its stroke, it pushes the slide valve past the passage, stopping further admission of lubricant to the passage and measuring chamber. The injector piston and slide valve remain in this position until the lubricant pressure in the supply line is vented (relieved at the pump).

Stage 4

After venting, the injector spring expands, causing the slide valve to move. This results in the passage and discharge chamber being connected by a valve port. Further expansion of the spring cause the piston to move upward, forcing the lubricant in the measuring chamber through the passage and valve port to refill the discharge chamber.

The injector is now ready for the next cycle.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the injectors should include the following:

NOTE: *Preventive maintenance should be performed frequently to ensure proper operation of the system. Damage to bearings and other moving components can be avoided.*

1. Clean the system components.

2. Inspect the manifolds, injectors, and lubrication lines for evidence of dirt, damage, wear or leaks. Repair or replace as required.

3. Check the mounting hardware for tightness.

4. Inspect each lubricated point for proper lubrication levels. The injector may be adjusted for the correct discharge as follows (as shown in Figure 2):

a. Remove the cover cap and loosen the locknut (3).

b. Increase the lubricant flow by turning the adjustment screw (2) out (counterclockwise). Decrease the flow by turning the adjustment screw in (clockwise).

c. Tighten the locknut and install the cover cap.

REMOVAL (Figure 2)

The injector manifolds may be removed as follows:

1. Park the truck in a SAFE POSITION. It must be secured by means other than the truck's friction brake system.

2. Release all entrapped pressure in the entire automatic lubrication system.

3. Remove the inlet and outlet hoses from all injectors on the manifold. Plug or cap all openings. Label each to aid in installation.

4. Loosen the capscrews and remove the manifold from the mounting surface.

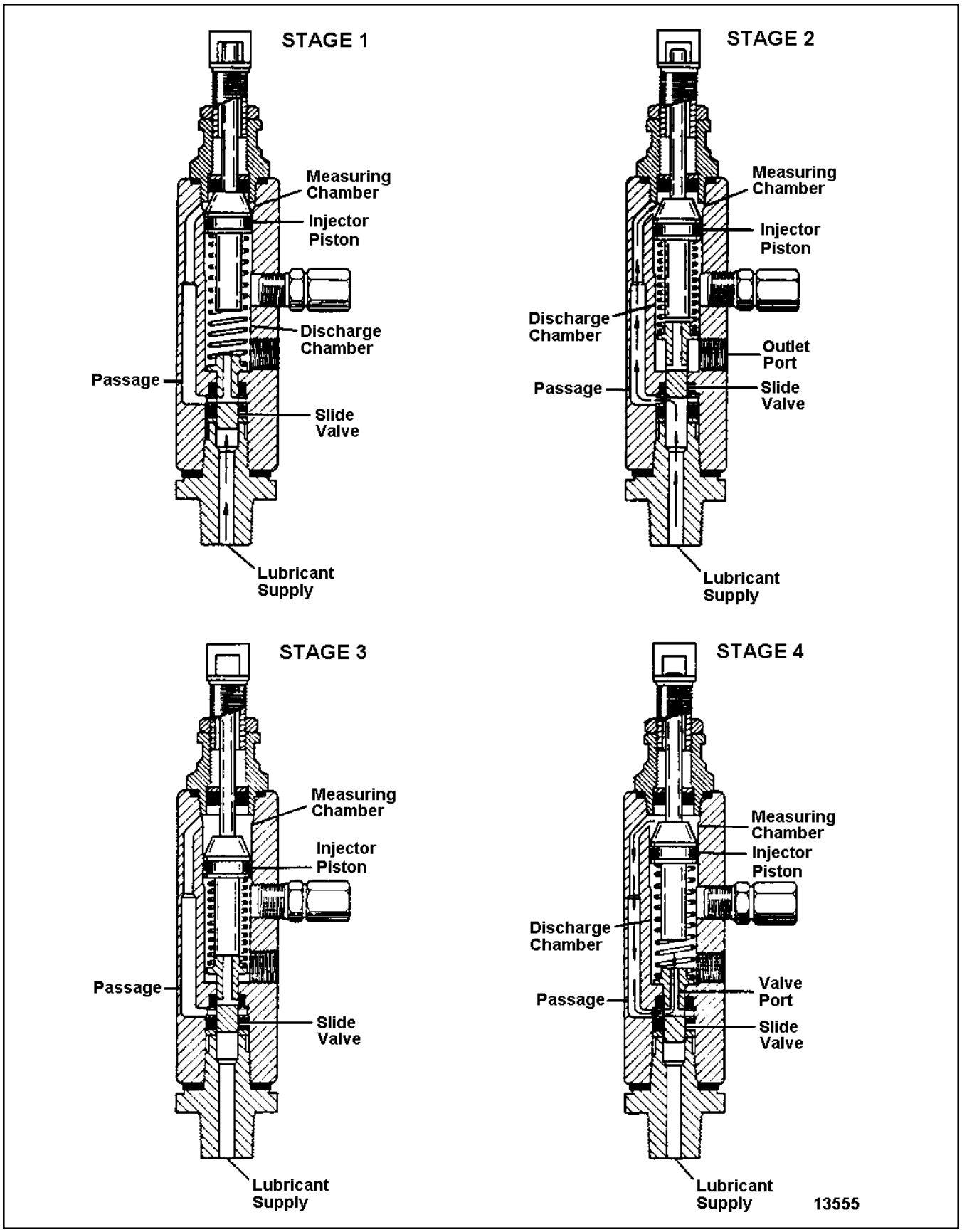


FIGURE 1 - INJECTOR OPERATION

DISASSEMBLY (Figure 2)

The individual injectors may be removed from the manifold and service as follows:

1. Place the manifold assembly in a clean work area.

2. While holding the outer body of the injector (8), loosen and remove the adapter bolt (19) and gasket (5) of the desired injector.

NOTE: *Use extra care during the removal process as other internal components may exit with the adapter bolt.*

3. Remove the locknut (3).

4. Remove the piston stop plug (4) from the top of the injector.

NOTE: *Again, use extra care during the removal process as other internal components may exit with the stop plug.*

5. Remove all remaining internal components.

INSPECTION AND REPAIR (Figure 2)

The injectors and manifold assemblies may be serviced as follows:

1. Clean all metal parts in solvent and dry with compressed air. Inspect for evidence of wear, damage, or leakage. Repair or replace as required.

2. Inspect all seals for evidence of leakage or damage. If found, repair or replace the items responsible. Replace all seals during the reassembly process.

ASSEMBLY

The individual injectors may be reassembled and installed on the manifold as follows:

1. Place the manifold and injector assembly parts in a clean work area.

2. Install the internal components as shown in Figure 2.

3. Install the piston stop plug (4) with a new gasket (5) on the top of the injector. Tighten to 25 to 30 ft-lbs. (35 to 40 Nm).

4. Install the locknut (3).

5. While holding the outer body of the injector (8), install the adapter bolt (19) and gasket (5) of the desired injector. Tighten to 45 to 50 ft.-lbs. (60 to 65 Nm).

NOTE: *Use extra care during the installation process as internal components may attempt to exit the bottom opening.*

INSTALLATION (Figure 2)

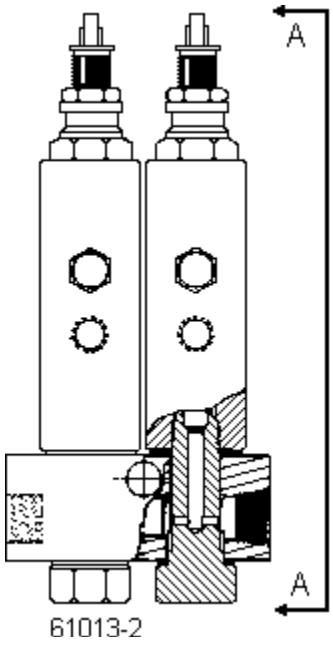
The injector manifold may be installed as follows:

1. Position the manifold on the mounting surface and secure with the appropriate capscrews and washers.

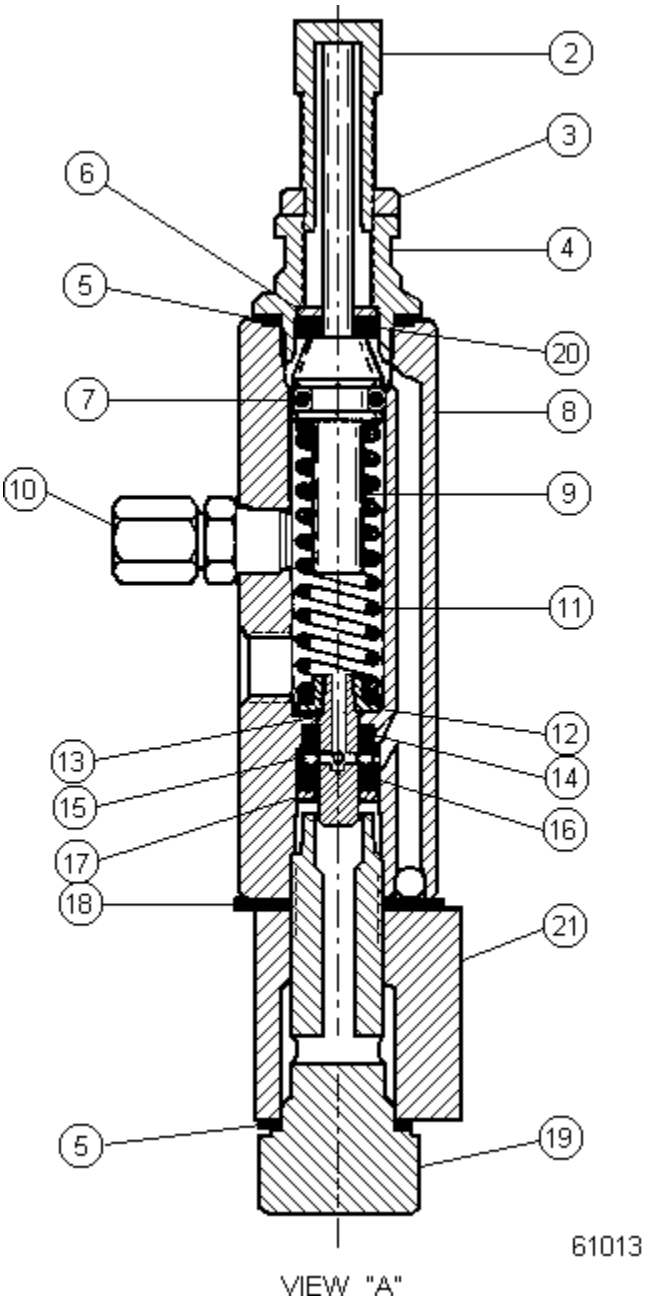
2. Install the inlet and outlet hoses from all injectors on the manifold.

3. Purge all air from the lines and injectors as outlined in the system procedures in Section 9 - Options.

4. Test the operation of the system and adjust the injector output as outlined in the instructions in Maintenance and Adjustment.



KEY	
01.	Injector Assembly
02.	Adjusting Screw
03.	Locknut
04.	Piston Stop Plug
05.	Gasket
06.	Washer
07.	Viton O-ring
08.	Injector Body Assembly
09.	Piston Assembly
10.	Fitting Assembly
11.	Plunger Spring
12.	Spring Seat
13.	Plunger
14.	Viton Packing
15.	Inlet Disc
16.	Viton Packing
17.	Washer
18.	Gasket
19.	Adapter Bolt
20.	Viton Packing
21.	Manifold



NOTE: A typical two injector manifold configuration is shown. The one, three and four injector versions are similar.

FIGURE 2 - INJECTOR MANIFOLD ASSEMBLY

CENTRAL SERVICE SYSTEM

DESCRIPTION AND LOCATION

The central service system is a series of hoses and special fittings designed to provide improved service of various fluids on the truck. Typically the quick disconnect or similar fittings are grouped together at a convenient location on the truck, with each fitting serving a specific function.

OPERATION

The system may contain any combination of couplings or fittings, typically specified by the customer to match the delivery systems in use at the location.

As commonly equipped, the system provides for the filling and/or draining of engine oil and coolant, hydraulic oil, and automatic lubrication system grease. In some applications provisions for fuel filling is also included as is the shop air coupling.

Typically each of the couplings is of a different size or type and is distinctly labeled to minimize the chance of improper coupling.

MAINTENANCE AND ADJUSTMENT

Periodic maintenance of the system should include the following:

1. Before working on any portion of the system, park the truck in a SAFE POSITION, securing by means other than the truck's friction brake system.

2. The central service couplings on both the source and the receiver should be cleaned before, and the appropriate plugs or covers installed immediately after each use.

3. The mating fittings should be checked periodically for proper fit and evidence of damage or leakage. Repair or replace as required.

4. The hose assemblies and fittings should be inspected for evidence of kinks, damage, wear, or other problems. Repair or replace as required.

5. The valve in the radiator fill and drain lines are to be closed when the engine is running. They should be opened only during the drain and refill operations.

SERVICE

Refer to the appropriate vendor's material for more detailed information if required.

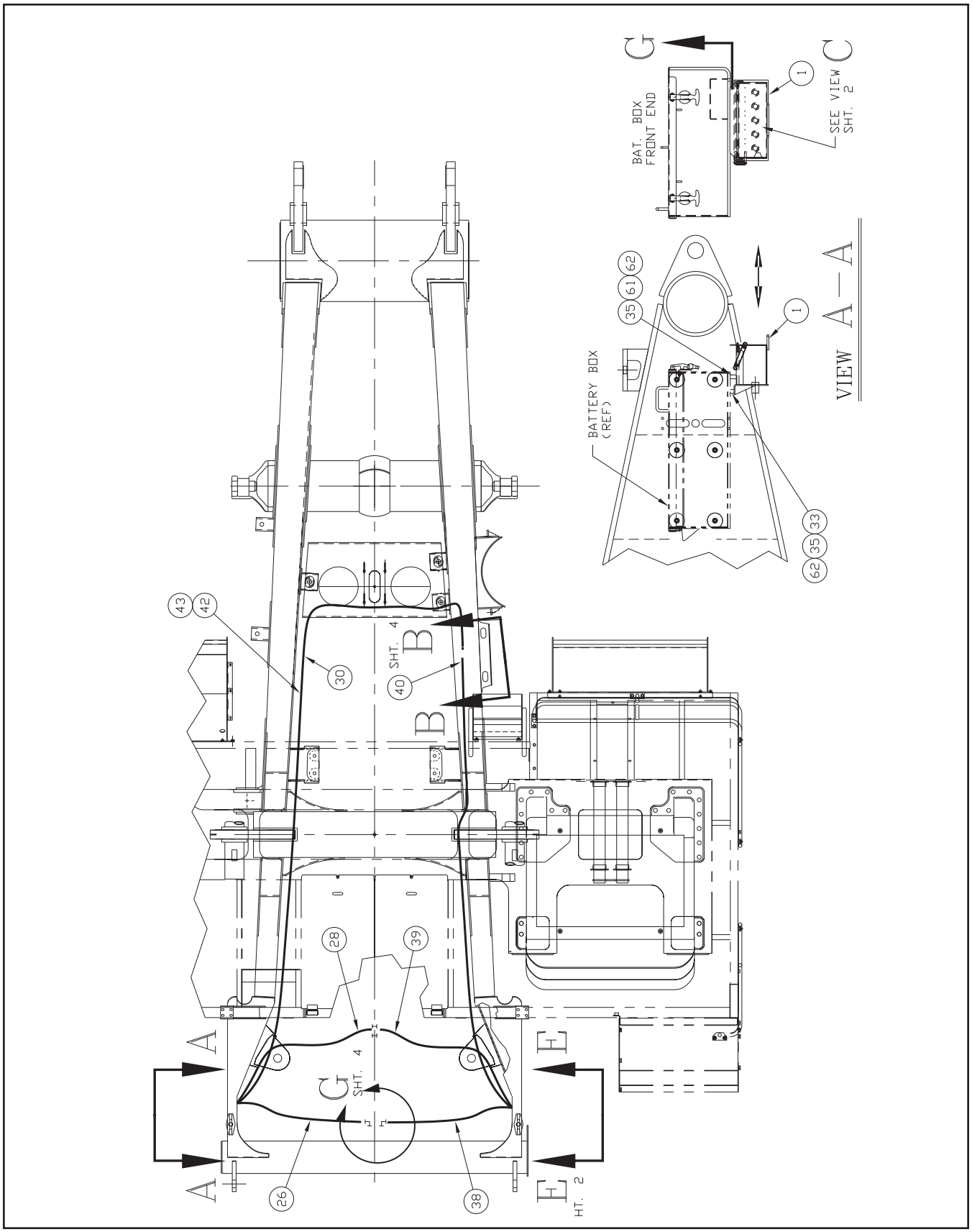
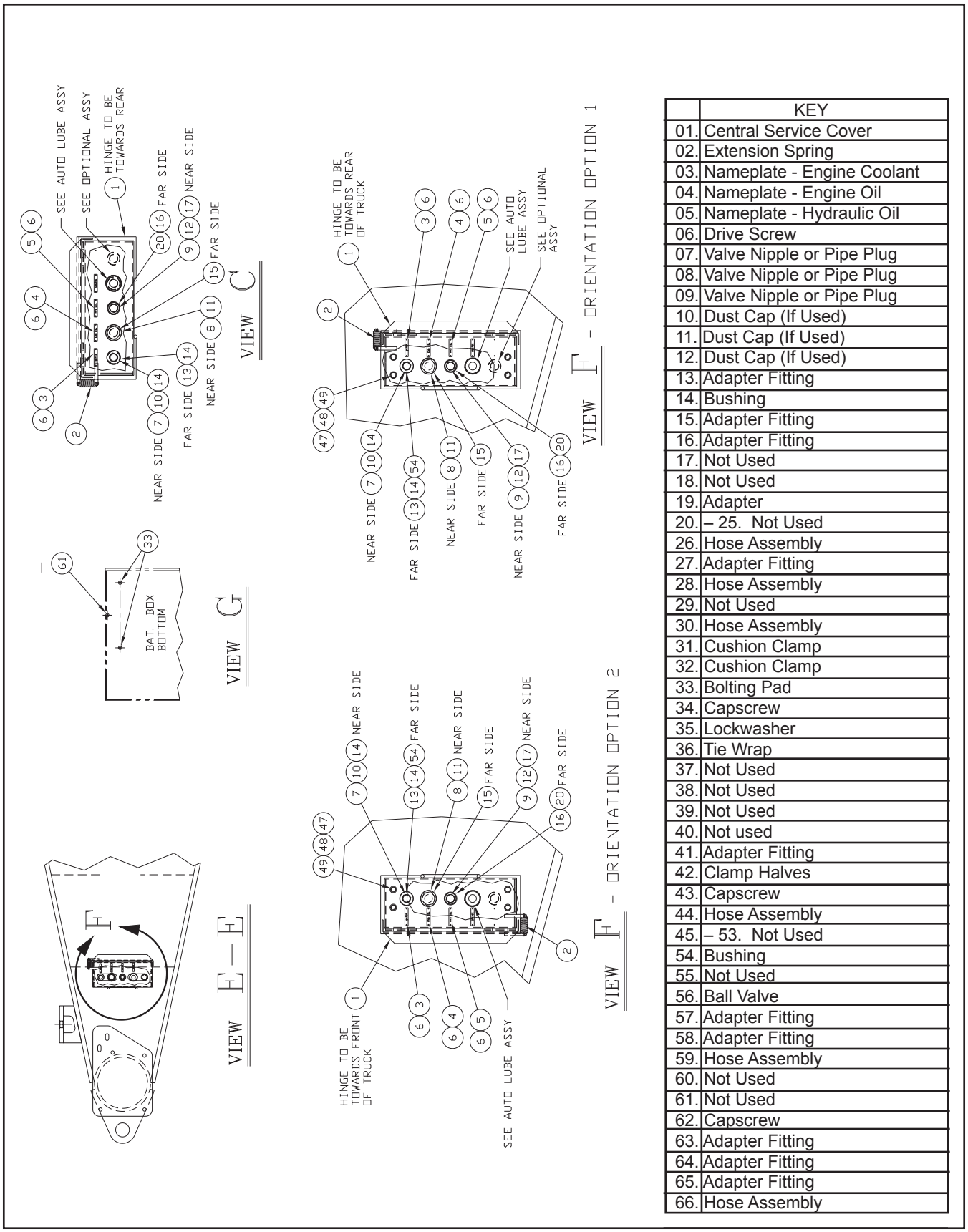
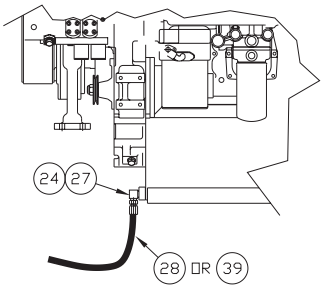


FIGURE 1 - CENTRAL SERVICE SYSTEM (TYPICAL)

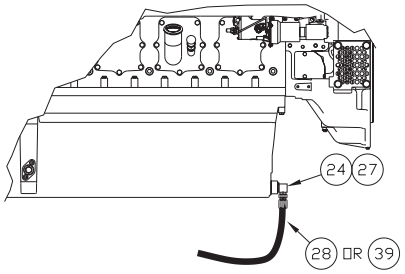


	KEY
01.	Central Service Cover
02.	Extension Spring
03.	Nameplate - Engine Coolant
04.	Nameplate - Engine Oil
05.	Nameplate - Hydraulic Oil
06.	Drive Screw
07.	Valve Nipple or Pipe Plug
08.	Valve Nipple or Pipe Plug
09.	Valve Nipple or Pipe Plug
10.	Dust Cap (If Used)
11.	Dust Cap (If Used)
12.	Dust Cap (If Used)
13.	Adapter Fitting
14.	Bushing
15.	Adapter Fitting
16.	Adapter Fitting
17.	Not Used
18.	Not Used
19.	Adapter
20.	– 25. Not Used
26.	Hose Assembly
27.	Adapter Fitting
28.	Hose Assembly
29.	Not Used
30.	Hose Assembly
31.	Cushion Clamp
32.	Cushion Clamp
33.	Bolting Pad
34.	Capscrew
35.	Lockwasher
36.	Tie Wrap
37.	Not Used
38.	Not Used
39.	Not Used
40.	Not used
41.	Adapter Fitting
42.	Clamp Halves
43.	Capscrew
44.	Hose Assembly
45.	– 53. Not Used
54.	Bushing
55.	Not Used
56.	Ball Valve
57.	Adapter Fitting
58.	Adapter Fitting
59.	Hose Assembly
60.	Not Used
61.	Not Used
62.	Capscrew
63.	Adapter Fitting
64.	Adapter Fitting
65.	Adapter Fitting
66.	Hose Assembly

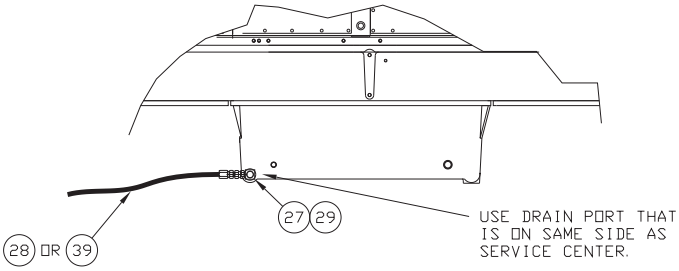
FIGURE 1 - CENTRAL SERVICE SYSTEM (TYPICAL) - CONTINUED



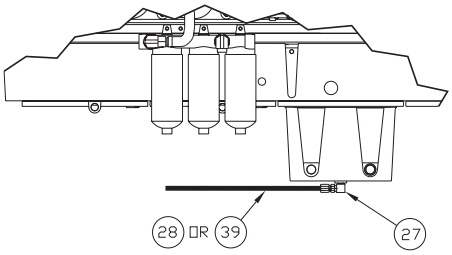
DDC SERIES 4000 T1 ENGINE



DDC SERIES 4000 T2 ENGINE



CUMMINS "K" ENGINE



CUMMINS QSK60 ENGINE

FIGURE 1 - CENTRAL SERVICE SYSTEM (TYPICAL) - CONTINUED

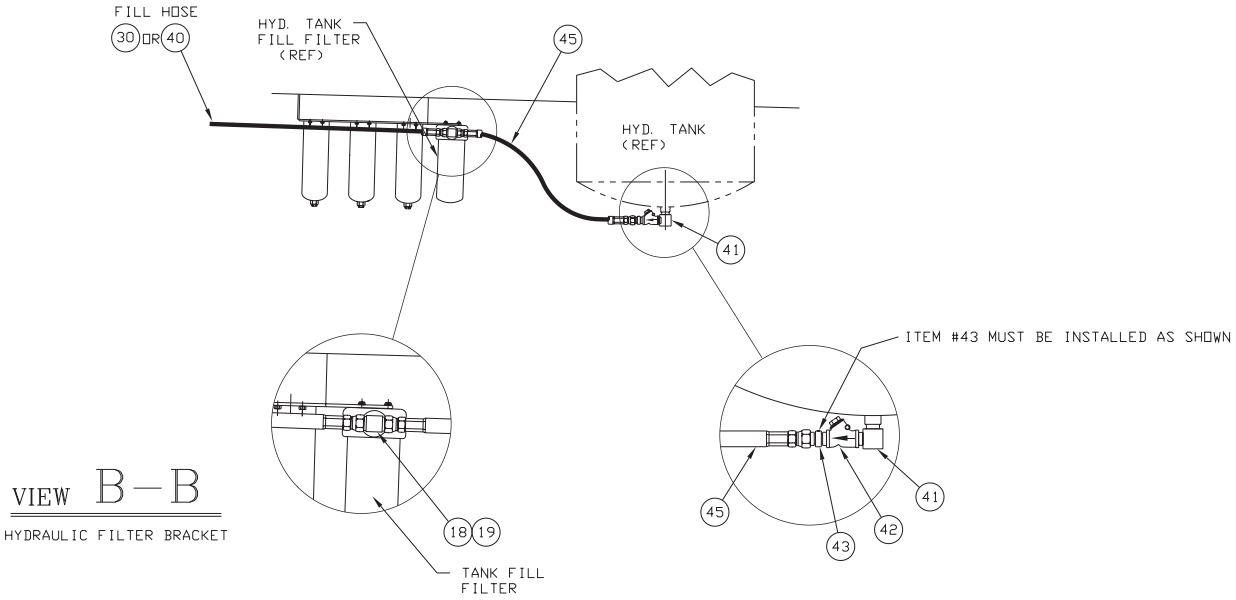


FIGURE 1 - CENTRAL SERVICE SYSTEM (TYPICAL) - CONTINUED

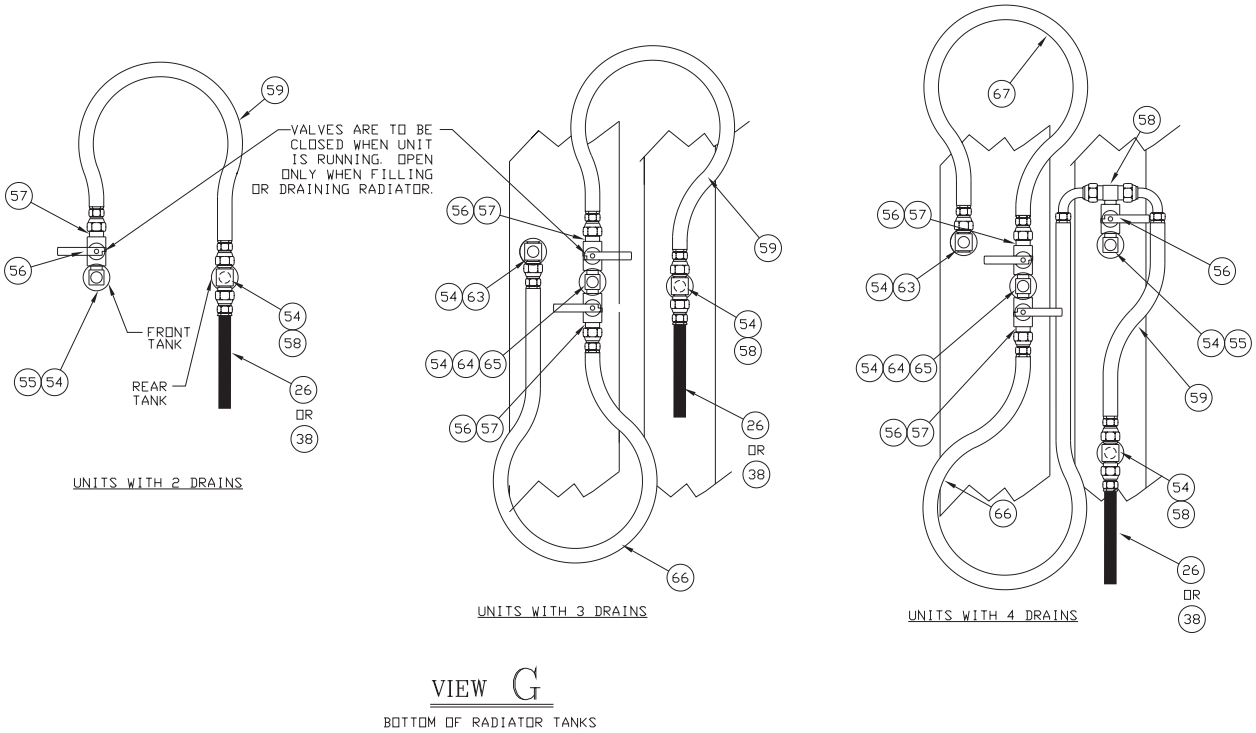


FIGURE 1 - CENTRAL SERVICE SYSTEM (TYPICAL) - CONTINUED

HUBODOMETER

DESCRIPTION AND LOCATION

The hubodometer is a cylindrical device mounted in the center of a front wheel assembly (generally the left front). The device is secured to a special hubcap assembly and has a digital read-out face.

OPERATION

The hubodometer measures the distance the truck travels in miles or kilometers. Since the device measures the distance by the number of revolutions of the tire, the hubodometers are each calibrated by tire size and desired output.

NOTE: *The operation of this device is independent of the direction of rotation. Therefore, hubodometers may be used on either the left or right side of the truck.*

MAINTENANCE AND ADJUSTMENT

The hubodometer requires no maintenance and has no adjustment. Make sure that all mounting hardware is properly installed and tightened and the device is kept clean.

If the device is not operating properly, it must be replaced.

If the tire size is changed, a new, properly specified hubodometer must be installed to maintain proper readings.

REMOVAL

The hubodometer may be removed as follows:

1. Remove the capscrews securing the hubcap to the wheel assembly.

2. Remove the entire hubcap assembly from the wheel assembly.

3. Remove the nut from the stud securing the hubodometer to the attachment bracket.

4. Remove the hubodometer.

SERVICE

The hubodometer is not considered serviceable and should be replaced as an assembly.

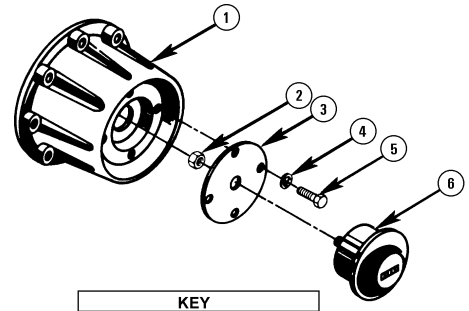
INSTALLATION

The hubodometer may be installed as follows:

1. Position the hubodometer on the attachment bracket in the hubcap assembly.

2. Secure in position with the nut on the stud through the attachment bracket.

3. Install the hubcap assembly on proper wheel assembly, securing with the capscrews and washers.



KEY	
1.	HUBCAP
2.	NUT
3.	ATTACHMENT BRACKET
4.	LOCKWASHER
5.	CAPSCREW
6.	HUBODOMETER

FIGURE 1 - HUBODOMETER ASSEMBLY

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Unit fails to change reading	Unit internally damaged or defective	Replace unit.
Unit obviously inaccurate	Unit not right for tire size	Replace with appropriate hubodometer.
	Unit internally damaged or defective	Replace unit.

PREVENTIVE MAINTENANCE FOR MT 4400AC

GENERAL

Preventive maintenance is a systematic approach to keeping the truck and its components in good condition and operational. This can reduce down time and increase the life of the truck. In addition, a higher level of safety during the truck's operation can be met.

Records of all maintenance should be kept. Information such as pressure readings, condition of components, etc. should be included. Good information can be useful in preventing problems and in determining the causes of improper operation of a system.

USE OF THE PREVENTIVE MAINTENANCE TABLES

Two inter-related tables are included to summarize the recommended practices.

Table 1 - Preventive Maintenance Guidelines - A matrix of service items and the recommended intervals.

Table 2 - Mechanical Preventive Maintenance Schedule - A detailed list of instructions and recommendations on the items listed in Table 1.

TABLE 1

This table is divided into several sections separated by main headings. The sections are of the same title and sequence as the sections in this manual.

To use the table, locate the Hours column that matches the procedure to be scheduled. Look down the column to see what items need attention. The letter or letters appearing in the Hours column and beside the components designate what kind of attention is needed, and are defined in the Key.

If a specific component is to be found, determine the general section in which the component would most likely be included. The components are generally included in the same section that they are covered in the Items column. The main components are in alphabetical order.

TABLE 2

This table is divided into eight levels, each with a preset service interval.

To use this section, determine the service interval (e.g. from Table 1). Use this information to locate the corresponding level. After locating the appropriate level, review the information for detailed instructions.

IMPORTANT NOTES

It should be noted that the Preventive Maintenance Tables do not include all of the components on the truck. However, the entire truck should be checked at intervals based on the operating conditions of the mine. The pre-operational inspection outlined in the Operator's Manual should be performed, as it is a part of preventive maintenance.

Some of the components in the Items columns are optional equipment. They are included to cover the trucks equipped with options.

The hours shown in the table are the maximum recommended hours that preventive maintenance should be scheduled. Preventive maintenance on any part of the truck should be performed more frequently if the conditions of the mine require so.

If a truck is equipped with an automatic lubrication system, its operation should not be taken for granted. Verify that the parts serviced by this system are lubricated.

TABLE 1
PREVENTIVE MAINTENANCE GUIDELINES

KEY	
I	INSPECT
L	LUBRICATE
R	REPLACE
S	SERVICE
T	TEST
V	VISUALLY INSPECT
*****	Refer to the appropriate manufacturer's specific instructions

NOTE: Where L, R, S or T are used, a visual inspection should also be performed.

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TABLE 1 - PREVENTIVE MAINTENANCE GUIDELINES STRUCTURE									
ITEM	HOURLY INTERVAL								REMARK
	Every Shift	Every 250	Every 500	Every 1,000	Every 2,500	Every 3,000	Every 5,000	Every 10,000	
Cab									
Cab Mounts			I						
Controls	V		I						
Defroster	V		I						
Door	V		I						
Gauges	V		I						
Heater	V		I						
Horn	V		I						
Indicators	V		I						
Mirrors	V		I						
Seats and Belts	V		I						
Shifter and Linkage	V		I						
Windows	V		I						
Wipers	V		I						
Dump Body									
Body and Liners	V		I						
Canopy	V		I						
Pads	V		I						
Pivot Pins	V		I						
Rock Ejectors	V		I						
Dump Cylinder									
Attachment Points	V		I						
Frame	V		I						
Fuel and Hydraulic Tanks	V		I, S						
Ladder and Rails	V		I						
Superstructure	V		I						

13579

TABLE 1 - PREVENTIVE MAINTENANCE GUIDELINES
24 V dc ELECTRICAL

ITEM	HOURLY INTERVAL								REMARK
	Every Shift	Every 250	Every 500	Every 1,000	Every 2,500	Every 3,000	Every 5,000	Every 10,000	
Batteries	V		I						
Battery Charging Alternator	V		I						
Clearance Lights	V		I						
Gauges	V		I						
Headlights	V		I						
Indicators	V		I						
Switches	V		I						
Taillights	V		I						
Wiring	V		I						Inspect wiring for damage & loose connections. Secure away from moving parts.

13580

NOTES:

TABLE 1 - PREVENTIVE MAINTENANCE GUIDELINES POWER PACKAGE									
ITEM	HOURLY INTERVAL								REMARK
	Every Shift	Every 250	Every 500	Every 1,000	Every 2,500	Every 3,000	Every 5,000	Every 10,000	
Alternator	V		I						
Blower	V		I						
Blower Ducting	V		I						
Engine Cooling System:	V		I						
Belts (if so equipped)	V		I						
Coolant Filter	V								
Coolant Level	V								
Coolant Lines and Clamps	V		I						
Engine Water Pump	V		I						
Fan Assy., Bushings & Bearings	V		I		L				
Sheave	V		I		L				
Radiator Cap	V								
Radiator Core/Aux. Coolers	V		I						Check for oil in radiator.
Radiator Mounts & Stabilizer	V		I						
Radiator Tanks	V		I						Steam clean if necessary.
Engine	V								* Check engine area for leaks. Check for damaged or loose connections and pipes.
Air Cleaners & Dry Filter Elements	V		I, S						
Air Cleaner Restriction Indicators	V		I						
Starter	V		I						
Emergency Shut-off Device (if so equipped)	V		I						
Engine Speed Control and Actuator	V		T						
Exhaust System	V		I						
Inlet Manifold & Air Piping	V		I						
Mounts	V		I						
Turbocharger	V		I						
Engine Crankcase Breather	V								*
Engine Oil	V								*
Oil Filters & Bypass Filters (if so equipped)	V								*
Fuel Filters (Primary and Secondary)	S								* Drain H2O Daily.

TABLE 1 - PREVENTIVE MAINTENANCE GUIDELINES HYDRAULIC SYSTEM									
ITEM	HOURLY INTERVAL								REMARK
	Every Shift	Every 250	Every 500	Every 1,000	Every 2,500	Every 3,000	Every 5,000	Every 10,000	
Accumulators	V		I, T						
Brake Valves	V		I, T						
Dump Valve/Cylinders	V		I, T						
Hydraulic Lines/Cooler	V		I, T						
Hydraulic Oil	V						R		
Hydraulic Oil Filters			R						
Hydraulic Pump U-Joints & Spline	V		L						Chassis grease
Hydraulic Tank Air Breathers/Relief Valve	V		I, S	R					Clean with solvent and dip in clean oil unless replaceable.
Steering:									
Manual Power Supply (if so equipped)	V		I, T	S					
Cylinders	V		I						
Linkage	V		I						
Manifolds	V		I, T						
Autolube System			I,S,T						

13791

TABLE 1 - PREVENTIVE MAINTENANCE GUIDELINES PNEUMATIC SYSTEM (if so equipped)									
ITEM	HOURLY INTERVAL								REMARK
	Every Shift	Every 250	Every 500	Every 1,000	Every 2,500	Every 3,000	Every 5,000	Every 10,000	
Air Aftercooler (if so equipped)	V		I, T				S		
Air Compressor	V		I, T				S		
Air Governor	V		I, T				S		*
Air Starter and Lubricator	V		I, T				S		
Air Tank(s)	V		I, T				S		

13583

TABLE 1 - PREVENTIVE MAINTENANCE GUIDELINES RUNNING GEAR									
ITEM	HOURLY INTERVAL								REMARK
	Every Shift	Every 250	Every 500	Every 1,000	Every 2,500	Every 3,000	Every 5,000	Every 10,000	
Axlebox:									
Access Door	V		I						
Grease Hoses	V		I						
Nosecone Bushing	V		I		S				
Panhard Bar	V		I						
Suspension Mounts	V		I						
Front Axle Kingpin Assembly	V		I, T						Clearance measurements.
Front Axle Speed Sensor Assy.	V		I, T						
Front Wheel Bearings/Grease Lubricated	V		I				S	R	
Front Wheel Bearings/Oil Lubricated	V	S	S		R				Sample @ 250 Hours. Change @ 2,500 Hours.
Hub Caps	V		I						Ensure hub caps are sealed.
Rims	V		I						
Steering Linkage			I, T						Inspect toe-in. Inspect tightness of linkage.
Suspension (Front):			I						
Mounting Bolts			I						
Ride Height	V		T						
Seals	V								
Tubes	V								
Suspension (Rear):									
Bushings and Mounting Pins			I						
Ride Height	V	T	I, T						
Tires	V		I						
Wheels	V	I	I						
Wheelmotors:									
Dirt Seals	V								*
Gear Box Lubricant	V		S			R			Sample @ 500 Hours (max.). Replace @ 3,000 Hours (max.).
Sump Breathers	V		I						
Mounting			I						
Drive			S						

13807

TABLE 1 - PREVENTIVE MAINTENANCE GUIDELINES
BRAKE SYSTEM

ITEM	HOURLY INTERVAL								REMARK
	Every Shift	Every 250	Every 500	Every 1,000	Every 2,500	Every 3,000	Every 5,000	Every 10,000	
Supply Lines	V		I						
Calipers and Discs	V		I						
Friction Pads	V		I						
Hand, Loading & Park Controls	V		I						
Park Brake System	V		I, T						
Valves	V		I						

13585

TABLE 1 - PREVENTIVE MAINTENANCE GUIDELINES
ACCESSORIES/OPTIONS

ITEM	HOURLY INTERVAL								REMARK
	Every Shift	Every 250	Every 500	Every 1,000	Every 2,500	Every 3,000	Every 5,000	Every 10,000	
Autolube System			I, T						
Fire Suppression System Manual			I, T						
Automatic			I, T						
Weigh System			I, S						

13855

NOTES:

TABLE 2
MECHANICAL PREVENTIVE MAINTENANCE SCHEDULE

RECOMMENDED MINIMUM SERVICE FREQUENCY FOR MT 4400AC	LEVEL 1 Operator Shift/Daily L-1	LEVEL 2 250 HOURS L-2	LEVEL 3 500 HOURS L-3	LEVEL 4 1,000 HOURS L-4	LEVEL 5 2,500 HOURS L-5	LEVEL 6 3,000 HOURS L-6	LEVEL 7 5,000 HOURS L-7	LEVEL 8 10,000 HOURS L-8
PERFORM DURING (PREFERABLY @ THE BEGINNING OF) EACH OPERATOR'S SHIFT.								
PERFORM EACH 250 HOURS OF OPERATION. INCLUDES LEVEL L-1.		L-2						
PERFORM EACH 500 HOURS OF OPERATION. INCLUDES LEVELS L-1 AND L-2.			L-3					
PERFORM EACH 1,000 HOURS OF OPERATION. INCLUDES LEVELS L-1, L-2 AND L-3.				L-4				
PERFORM EACH 2,500 HOURS OF OPERATION. INCLUDES LEVELS L-1, L-2 AND L-3.					L-5			
PERFORM EACH 3,000 HOURS OF OPERATION. INCLUDES LEVELS L-1, L-2, L-3 AND L-4.						L-6		
PERFORM EACH 5,000 HOURS OF OPERATION. INCLUDES LEVELS L-1, L-2, L-3, L-4 AND L-5.							L-7	
PERFORM EACH 10,000 HOURS OF OPERATION. INCLUDES LEVELS L-1, L-2, L-3, L-4, L-5 AND L-7.								L-8
PERFORM PREVIOUS INTERVAL ITEMS AT MULTIPLES OF THE ORIGINAL RECOMMENDATION. FOR EXAMPLE, AT 500 HOURS (LEVEL L-3) OF OPERATION, ALSO PERFORM THOSE ITEMS LISTED UNDER SHIFT INSPECTION (LEVEL L-1) AND 250 HOURS INSPECTION (LEVEL L-2) ETC.								

13819

TABLE 2 - LEVEL 1
MECHANICAL PREVENTIVE MAINTENANCE SCHEDULE

LEVEL 1	TRUCK MODEL **MT 4400AC**, S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT BEGINNING OF EACH OPERATOR'S SHIFT.	OK	REPAIRS NEEDED	PERFORMED BY
1. Perform a walk-around visual inspection as outlined in SECTION 1 - DESCRIPTION AND OPERATION. Check for fuel and hydraulic leaks, damaged, frayed, or improperly secured cables, hoses or components, and the general overall condition of the truck.			
2. Drain water and contaminants from fuel filters daily or each shift.			

13808

TABLE 2 - LEVEL 2
MECHANICAL PREVENTIVE MAINTENANCE SCHEDULE

LEVEL 2	TRUCK MODEL **MT 4400AC,** S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT 250 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
1. Perform any engine maintenance as outlined in the engine manufacturer's recommendations. Typically this includes changing the engine oil and filters. **NOTE:** Refer to the engine manufacturer's manual for detailed instructions.			
2. Check the hydraulic oil level.			
3. Sample the front wheel bearing lubricant (oil lubricated wheel bearings) as outlined in Section 7 - Running Gear.			
4. Inspect the front wheel bearing reservoir breather (if so equipped).			

13810

NOTES:

TABLE 2 - LEVEL 3
MECHANICAL PREVENTIVE MAINTENANCE SCHEDULE

LEVEL 3	TRUCK MODEL **MT 4400AC**, S/N #_____	DATE:_____ HOURS:_____

SCHEDULED MAINTENANCE SERVICES PERFORMED AT 500 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
1. Wash the truck thoroughly. The frame and components must be clean in order to facilitate inspection. Use care to avoid water entering & contaminating the traction alternator, wheelmotors, electrical system cooling ducts, the retarding grid box electrical control cabinet, hydraulic & fuel reservoirs, & any other area adversely affected by water or accumulation. **NOTE:** *Use caution when cleaning in the wheelmotor hubcap & thrust ring area. High pressure should NOT be used here. Refer to GE Tips No. 16 for details.*			
2. Visually inspect the main frame for evidence of damage. Special attention should be paid to weldments. **NOTE:** *Any defects should be repaired promptly & in accordance with recommendations. For applicable welding procedures see the instructions of Field Welding in Section 10 - Miscellaneous in this manual. Use only approved welding rod & practices.*			
3. Inspect all access & service ladders & railings for evidence of wear or damage.			
4. Inspect the engine area components for evidence of improper operation & adjustment, leakage, wear, or damage, particularly the following items: a) All engine inlet & exhaust pipes. b) Air cleaner elements (free of dirt & properly serviced). c) Radiator, fan, fan drives & guards. d) All engine coolant system piping & components. e) Fan & accessory drive belts.			
5. Inspect the front axle assembly comonents for proper lubrication & evidence of wear or damage: (make sure that all grease seals are in place) a) Kingpin assemblies (measure radial & vertical wear clearances). b) Steering cylinders. c) Steering linkage & components including measuring the toe-in of the front tires. d) Trailing & lateral mounting arm assemblies.			
6. Inspect the front brake system components for evidence of leakage, wear or damage.			

LEVEL 3 - Continued next page

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TABLE 2 - LEVEL 3
MECHANICAL PREVENTIVE MAINTENANCE SCHEDULE

LEVEL 3	TRUCK MODEL **MT 4400AC**, S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT 500 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
7. Service the front wheel assembly including: a) Inspecting the wheel clamps & studs for proper installation & torque. b) Inspecting the tires for proper inflation pressure & evidence of wear or damage. c) Inspecting the wheel bearing area for evidence of leakage. d) Inspect the wheel speed system for proper installation & to be in good operating condition.			
8. Inspect the front suspension assemblies for: a) Evidence of proper lubrication & leakage, wear or damage. b) Proper installation of the grease seals. c) Proper empty truck ride height.			
9. Visually inspect the superstructure & support structure for proper mounting & evidence of wear or damage. Special attention should be paid to weldments. **NOTE:** *Any defects should be repaired promptly & in accordance with recommendations. For applicable welding procedures see the instructions of Field Welding in Section 10 - Miscellaneous in this manual. Use only approved welding rod & practices.*			
10. Inspect the hydraulic tank & filter assembly for proper mounting.			
11. Sample the hydraulic oil, then change all filter elements in the hydraulic systems. **NOTE:** *Oil sampling & monitoring of the condition of the filtration system may provide a different filter change interval.*			
12. Inspect the dump cylinders & mounts for evidence of leakage, wear or damage.			
13. Inspect the hydraulic pump driveshaft assembly for evidence of proper lubrication & leakage, wear or damage. If equipped with re-lubable type U-joints or shafts, carefully lubricate with chassis grease. **NOTE:** *Do not over-grease as this can damage the seals.*			
14. Inspect the cooling air blower & ducting for proper installation & evidence of leakage, wear or damage.			
15. Inspect the hydraulic pump assembly for proper mounting & evidence of leakage, wear or damage.			

LEVEL 3 - Continued next page

13811-2

TABLE 2 - LEVEL 3
MECHANICAL PREVENTIVE MAINTENANCE SCHEDULE

LEVEL 3	TRUCK MODEL **MT 4400AC**, S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT 500 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
16. Inspect the axlebox assembly for proper installation, lubrication & evidence of wear or damage. Make sure that all grease seals are in place. a) Nosecone assembly. b) Radius rod assembly. c) Access door assembly & seal.			
17. Inspect the wheelmotor area for proper installation & mounting & evidence of leakage, wear or damage including: a) Inspecting the structure both internally & externally. b) Wheelmotor to axlebox attachment. c) Inspecting the wheel clamps & studs for proper installation & torque. d) Inspecting the tires for proper inflation pressure & evidence of wear or damage. e) Inspecting the wheel bearing & hubcap areas for evidence of leakage. f) Sampling the gear lubricant as outlined in the service requirements from the wheelmotor manufacturer. g. Inspect then clean the magnetic plugs in the wheelmotor gear case sump.			
18. Inspect each of the rear brake assemblies for proper installation & evidence of leakage, wear or damage. Also verify that the hubcaps are properly installed & free of damage.			
19. Inspect the rear suspension assemblies for: a) Evidence of proper lubrication & leakage, wear or damage. b) Proper installation of the grease seals. c) Proper empty truck ride height.			
20. Inspect the dump body pivot pin & bushing assemblies for evidence of wear or damage.			
21. Inspect the dump body assembly for proper installation & evidence of wear or damage including: a) Rock ejectors. b) Structural components. c) Liners. d) Pads. e) Guides on frame.			
22. Inspect the fuel tank assembly for proper mounting. Drain any accumulated moisture or other contaminants.			
23. Inspect the grid box & components for proper installation & evidence of wear or damage. Remove any dirt or other contamination.			

LEVEL 3 - Continued next page

13811-3

TABLE 2 - LEVEL 3
MECHANICAL PREVENTIVE MAINTENANCE SCHEDULE

LEVEL 3	TRUCK MODEL **MT 4400AC**, S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT 500 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
24. Inspect the electrical drive system components box for proper installation & evidence of wear or damage. Remove any dirt or other contamination.			
25. Inspect the cab & all components, plumbing & wiring for proper installation & evidence of wear or damage. Include checking all of: a) Windows & doors. b) Controls & interlocks. c) System operation.			
26. Test the operation of the following systems as outlined in the proper publication: a) Dump system (including the oil cooler system). b) Steering system. c) Brake system. d) 24 Vdc system including the battery charging alternators, batteries & operating components. e) Light system. f) Warning horn systems. g) Engine & propulsion & retarding systems.			
27. Test the operation of the autolube system as outlined in the proper procedures in Section 9. Also, on trucks equipped with the rotary pump configuration, change the lubrication oil in the separate reservoir.			
28. Weigh System: a) Inspect & test the operation system components as outlined in the instructions in the separate manual. Repair or replace as required. b) Download the data stored in the system. Review for problems & correct as required. Keep the data for later reference.			
29. Fire suppressant system: a) Inspect & test the operation of the system components as outlined in the instructions in the publications. Repair or replace as required.			

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NOTES:

TABLE 2 - LEVEL 4
MECHANICAL PREVENTIVE MAINTENANCE SCHEDULE

LEVEL 4	TRUCK MODEL **MT 4400AC**, S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT 1,000 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
1. Inspect the operator's cab filter element. Replace if required.			

13815

TABLE 2 - LEVEL 5
MECHANICAL PREVENTIVE MAINTENANCE SCHEDULE

LEVEL 5	TRUCK MODEL **MT 4400AC**, S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT 2,500 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
1. Recheck the torque on the axlebox nosecone bearing bolts.			
2. Check the allowable movement of the axlebox as outlined in Section 7 - Running Gear.			
3. Sample, then change the front wheel bearing lubricant (oil lubricated bearings).			
4. Recheck the torque on the expander pin retainer bolts in the steering system components.			

13816

TABLE 2 - LEVEL 6
MECHANICAL PREVENTIVE MAINTENANCE SCHEDULE

LEVEL 6	TRUCK MODEL **MT 4400AC**, S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT 3,000 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
1. Sample then change the oil in the wheelmotor gear case sump. **NOTE:** *Change the oil after the first 500 hours of operation of a new or rebuilt wheelmotor. After that, change at the 3,000 hour intervals. The 3,000 hour interval is the maximum. More frequent oil changes may be required, depending upon individual mine or component conditions. An oil sampling & monitoring program should be used in making these determinations.*			
2. Inspect & clean the magnetic plugs in the wheelmotor gear case sump.			

13857

TABLE 2 - LEVEL 7
MECHANICAL PREVENTIVE MAINTENANCE SCHEDULE

LEVEL 7	TRUCK MODEL **MT 4400AC**, S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT 5,000 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
1. Change the hydraulic oil. Clean the internal tank suction screens while the tank is empty. Inspect the tank for indications of damage or contamination or residue. Repair and/or clean prior to refilling. **NOTE:** *Use oil outlined in information on lubricants in Section 10 - Miscellaneous.* **NOTE:** *Oil sampling & monitoring of the condition of the filtration system may provide a different oil change interval.*			
2. Clean, inspect , repack & reshim the front wheel bearings.			
3. Replace the hydraulic tank relief valve.			
4. On Cummins engine equipped trucks; clean, inspect & repack the engine fan hub & drive belt backside idler assemblies (using Areoshell 5 lubricant) or equivalent. **NOTE:** *On Detroit Diesel engine equipped trucks, bearing packing & replacement is recommended at engine overhaul time.*			

13817

TABLE 2 - LEVEL 8
MECHANICAL PREVENTIVE MAINTENANCE SCHEDULE

LEVEL 8	TRUCK MODEL **MT 4400AC**, S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT 10,000 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
1. Replace front wheel bearings. Install & reshim. Install new seals.			

13818

NOTES:

PREVENTIVE MAINTENANCE SCHEDULE - ELECTRICAL DRIVE SYSTEM

GENERAL

Preventive maintenance is the systematic approach to keeping the trucks and related systems and components in good operating condition. Proper implementation of a preventive maintenance program should result in improvements in component life, optimum performance, and maximum availability through reduced, unscheduled downtime and repair.

Records of all maintenance should be kept. Information such as the condition of components, brush lengths, components changed or serviced, etc. should be included. Good information can be useful in preventing problems and in troubleshooting improper operation of a system.

It should be noted that the Preventive Maintenance Table included here does not include all of the components in the system. However, the entire system should be checked at intervals based on the operating conditions of the mine. The Pre-Operational Inspection outlined in the Operator's and Mechanical Manuals should be performed as it is part of a good preventive maintenance program.

Some of the components in the items columns are optional equipment. They are included to cover the trucks so equipped.

The hour intervals shown in the Table reflects the maximum hours that preventive maintenance on any part should be performed. The individual mine operating and environmental conditions may require more frequent inspection and service.

For successful truck operation the mine should provide:

1. Knowledgeable workers and supervision.

2. Adequate maintenance facilities, tools, shop supplies, and proper parts.

3. Lubricating oil and greases equal or superior to those specified.

4. Inspection and maintenance to a regular planned schedule with adequate records kept.

When servicing:

1. Never mix lubricants of different brands or grades.

2. Never overfill lubricants - too much lubricant can be as harmful as too little.

3. Clean equipment covers before removal for maintenance to prevent the ingress of contamination.

4. Use only clean containers to handle lubricants.

5. After servicing, it is recommended that the truck be operated for at least 30 minutes, unloaded and at low speeds (10 mph (16 km/hr)) or less.

The following equipment contains sealed bearings that do not require additional lubrication until the component is overhauled:

1. Wheelmotors

2. Alternator

3. Retarding grid blower motors

⚠WARNING

All checks and inspections should be made with the truck parked in a SAFE POSITON and secured by means other than the truck's friction brake system. Also, the truck's engine and battery power should be off except where indicated and required.

⚠ CAUTION

When performing any of the inspections, extra care must be taken to prevent the ingress of contamination into the gear case or interior or any of the components.

⚠ CAUTION

When welding on the truck:
1. Connect the welding ground as close as possible to the area being welded. Normally this is directly connected to the part being welded.
2. Never connect the welding ground so that the current will pass through the bearings or electrical components of any rotating equipment.
3. Do not pull any cards or remove panel connections. This practice puts unnecessary cycles on connector pins, and may cause loose or dirty pins. These could cause control system problems.

⚠WARNING

Lethal voltages may be present. Before working on the truck and any of the propulsion or retarding systems or components, always:
1. Turn off and remove the key from the Master Switch and install an appropriate Safety or Lock-out Tag.
2. Turn the battery isolation switch off, lock out as required, and install an appropriate Safety or Lock-out Tag.
3. Move the Control Power Switch (CPS) to the Off position.
4. Move the Generator Field Cut-out (GFCO) switch located in the Operator interface Panel in the electrical control system's Main Control Cabinet to the Cut-out position and install an appropriate Safety or Lock-out Tag.
5. Verify that all of the lights on either Capacitor Charge Indicating Light Panel (CCL1 or CCL2) are off.
Failure to comply with these procedures may result in electrocution or death.

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ELECTRICAL PREVENTIVE MAINTENANCE SCHEDULE

RECOMMENDED MINIMUM SERVICE FREQUENCY FOR G.E. 240 TON AC SYSTEM	LEVEL 1 Operator Shift/Daily L-1	LEVEL 2 250 HOURS L-2	LEVEL 3 500 HOURS L-3	LEVEL 4 1,000 HOURS L-4	LEVEL 5 3,000 HOURS L-5	LEVEL 6 5,000 HOURS L-6	LEVEL 7 @ Tire Change Int. L-7
PERFORM DURING (PREFERABLY @ THE BEGINNING OF) EACH OPERATOR'S SHIFT.							
PERFORM EACH 250 HOURS OF OPERATION. INCLUDES LEVEL L-1.		L-2					
PERFORM EACH 500 HOURS OF OPERATION. INCLUDES LEVELS L-1 AND L-2.			L-3				
PERFORM EACH 1,000 HOURS OF OPERATION. INCLUDES LEVELS L-1, L-2 AND L-3.				L-4			
PERFORM EACH 3,000 HOURS OF OPERATION. INCLUDES LEVELS L-1, L-2, L-3 AND L-4.					L-5		
PERFORM EACH 5,000 HOURS OF OPERATION. INCLUDES LEVELS L-1, L-2, L-3, L-4 AND L-5.						L-6	
PERFORM WHENEVER THE DUAL TIRES ARE REMOVED FROM THE MOTOR, EASING ACCESS TO THE AREAS REQUIRED.							L-7

PERFORM PREVIOUS INTERVAL ITEMS AT MULTIPLES OF THE ORIGINAL RECOMMENDATION. FOR EXAMPLE, AT 500 HOURS (LEVEL L-3) OF OPERATION, ALSO PERFORM THOSE ITEMS LISTED UNDER SHIFT INSPECTION (LEVEL L-1) AND 250 HOURS INSPECTION (LEVEL L-2) ETC.

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ELECTRICAL PREVENTIVE MAINTENANCE SCHEDULE L-1

LEVEL 1	TRUCK MODEL GE 240 TON AC, S/N #_____	DATE:_____ HOURS:_____

SCHEDULED MAINTENANCE SERVICES PERFORMED AT BEGINNING OF EACH OPERATOR'S SHIFT.	OK	REPAIRS NEEDED	PERFORMED BY
AXLEBOX/WHEELMOTOR AREA 1. Visually inspect the planetary gear box area for evidence of damage or leakage.			
2. Using the dipstick or other appropriate means, check the level of oil in each of the gearboxes. While the cap is removed, check the condition of the sealing gasket. Add the appropriate fluid as necessary.			
3. Visually inspect the remainder of the wheelmotor for evidence of leakage or damage. This includes: a. Mud or stone build up. b. Damage to the hubcap or restriction to the air outlets.			
TRACTION ALTERNATOR AREA 1. Visually inspect the covers, gaskets, and ductwork for evidence of leakage or damage.			
RETARDING GRID BOX AREA 1. Visually inspect the covers and components for evidence of damage.			
CONTROL BOX AREA 1. Visually inspect the covers, gaskets and ductwork for evidence of leakage or damage.			

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ELECTRICAL PREVENTIVE MAINTENANCE SCHEDULE L-2

LEVEL 2	TRUCK MODEL GE 240 TON AC, S/N #_____	DATE:_____ HOURS:_____

SCHEDULED MAINTENANCE SERVICES PERFORMED AT 250 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
TRACTION ALTERNATOR AREA 1. Check each brush for proper length, condition, and freedom of movement. Record the length and condition for future reference. **NOTE:** *Any brushes worn to near the minimum operating length, or with chipping, broken or eroded carbon, or other damage or with loose or frayed pigtail should be replaced immediately.*			
2. Check the condition of the brush holder, its spacing and brush spring tension.			
3. Check the speed sensor cable connection for tightness and evidence of contamination or damage, particularly the pins.			
4. Check the condition of the collector rings as follows: a. Using the appropriate tools and procedures, blow out the area with clean, dry air (70 psi (485 kPa)) maximum. b. Wipe the area inside clean, including the drain holes. **NOTE:** *When cleaning electrically insulated parts, use a quick drying cleaner which will not leave an oily deposit. Dip a clean, lint free cloth into the cleaner and wipe off the part. Do not dip any insulating material into the cleaner.* c. Check the insulation between collector rings for evidence of physical damage. d. Check the collector ring surfaces for physical signs of damage or distress.			
CONTROL BOX AREA 1. Remove all foreign material from the interior of the control box by vacuuming. **NOTE:** *The use of compressed air to remove the materials is not recommended as it may cause the material to migrate into other areas and components that could adversely affect their operation and service life.*			
2. Check all air intakes and exhaust ports for evidence of blockage.			
3. Check all electrical connections for tightness and damage, particularly that caused by arcing and/or loose connections.			
4. Check the condition of the contactors, interlocks, and relays for tip wear, burning, breakage, over-travel, tip pressure.			
5. Check the shunts for fraying, breakage, or discoloration.			
6. Check the condition of the contactor arc chutes.			
7. Check the cabinet doors and seals for proper operation.			
8. Check the cabinet covers and components for loose or missing hardware.			

ELECTRICAL PREVENTIVE MAINTENANCE SCHEDULE L-3

LEVEL 3	TRUCK MODEL GE 240 TON AC, S/N #_____	DATE:_____ HOURS:_____

SCHEDULED MAINTENANCE SERVICES PERFORMED AT 500 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
AXLEBOX/WHEELMOTOR AREA			
1. Using the appropriate equipment and techniques, take sample of the lubricant from the gear sump and have it analyzed for oil condition and contamination.			
2. Remove, inspect and clean the gear case fill magnetic plugs on the sun pinion cover, noting all material that they have collected.			
3. Check all cable connections for tightness and evidence of discoloration or other damage.			
4. Check the speed sensor cable connection for tightness and evidence of contamination or damage, particularly the pins.			
5. Check the axlebox door to be in good repair. Closely inspect the seal's ability to form a good tight air seal.			
6. Visually inspect the condition of the sump breather filters and related hoses. They should be free of leakage, obstruction, or accumulations of oil or other contaminants. Clean, replace, or repair as required.			
RETARDING GRID BOX AREA			
1. Check the brushes for proper length, condition, and freedom of movement. Record the brush length for future reference.			
2. Check the brush holders for proper installation and condition, spacing, and spring tension.			
3. Visually check the relative condition of the armature and field coils for proper film, cracks, or evidence of damage.			
4. Check all electrical connections for tightness and damage, particularly that caused by arcing and/or loose connections. Check for deterioration, especially that which may be caused by high heat or chaffing.			
5. Check the grid resistors and elements for secure installation, evidence of damage including shorts, overheated or buckled components, cracked insulators, or other like damage.			
6. Using the appropriate tools and procedures, blow out the area and components with clean, dry air (70 psi (485 kPa)) maximum. Mechanically remove any caked on material or debris.			
CONTROL BOX AREA			
1. Review all event codes stored in the system using the D.I.D. panel or the Portable Test Unit (Laptop Computer). Make the appropriate changes and repairs indicated by the codes found.			

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ELECTRICAL PREVENTIVE MAINTENANCE SCHEDULE L-4

LEVEL 4	TRUCK MODEL GE 240 TON AC, S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT 1,000 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
ALTERNATOR 1. Check the air inlet screen. Verify that it is free of obstructions and foreign objects.			
2. Check the brush rings and field leads for evidence of cracked, frayed, or damaged insulation.			
3. Check the field coil connection strap insulation for evidence of cracks or other physical damage.			
VEHICLE OPERATION TESTS 1. Check the battery voltage and supply system. Adjust or repair as required.			
2. Verify operation of the systems' propulsion and retarding systems as outlined in the Vehicle Test Procedures.			

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ELECTRICAL PREVENTIVE MAINTENANCE SCHEDULE L-5

LEVEL 5	TRUCK MODEL GE 240 TON AC, S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT 3,000 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
AXLEBOX/WHEELMOTOR AREA 1. Change the oil in the gear case. **NOTE:** *Change the oil after the first 500 hours of operation of a new or rebuilt wheelmotor. After that, change at the 3,000-hour intervals. The 3,000-hour interval is the maximum. More frequent oil changes may be required, depending upon individual mine or component conditions. An oil sampling and monitoring program should be used in making these determinations.*			

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ELECTRICAL PREVENTIVE MAINTENANCE SCHEDULE L-6			
LEVEL 6	TRUCK MODEL GE 240 TON AC, S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT 5,000 HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
AXLEBOX/WHEELMOTOR AREA 1. Inspect the condition and wear of the sun pinion gear in each wheelmotor.			

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ELECTRICAL PREVENTIVE MAINTENANCE SCHEDULE L-7			
LEVEL 7	TRUCK MODEL GE 240 TON AC, S/N #_____	DATE:_____ HOURS:_____	
SCHEDULED MAINTENANCE SERVICES PERFORMED AT TIRE CHANGE HOUR INTERVALS	OK	REPAIRS NEEDED	PERFORMED BY
AXLEBOX/WHEELMOTOR AREA 1. Verify that all exposed bolts are tight.			

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PREVENTIVE MAINTENANCE

The following checks should be made whenever the truck is in the shop for its normal preventive maintenance (typically at 500 hour intervals).

PRESSURE TRANSDUCERS

The normal readings of the pressure transducers may be tested as follows:

a. Turn the truck's Master Switch On.

b. Depress the MENU switch on the Display in the cab. (See Figures 1 and 3.)

c. Press the UP and DOWN arrows to position the pointer at "Transducer Status", and then depress ENTER switch.

d. Verify that the voltages from all transducers are greater than 1 and less than 5 Vdc. (See Figure 2.)

NOTES:

1. The locations are as follows:
LF refers to Left Front
RF refers to Right Front
LR refers to Left Rear
RR refers to Right Rear

2. The first time these are checked, record the values below. They should be about the same each time they are checked. The rear suspensions will always have a much lower voltage than the front units.

3. Notify the proper personnel if the transducer voltages are not greater than 1 or less than 5Vdc or if they have changed by more then 0.5 Vdc since the first reading.

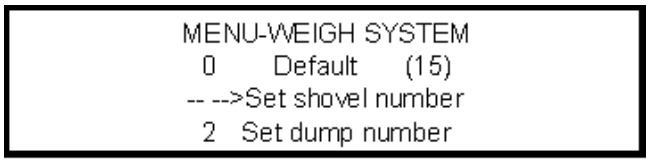
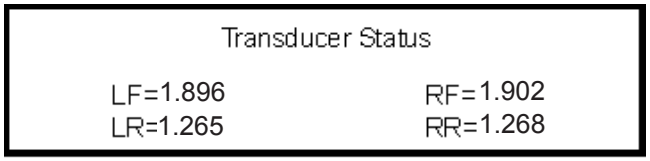


FIGURE 1 – DISPLAY: MENU 13867



200010

FIGURE 2 – DISPLAY: TRANSDUCER STATUS

TRUCK S/N	DATE	LF	RF	LR	RR

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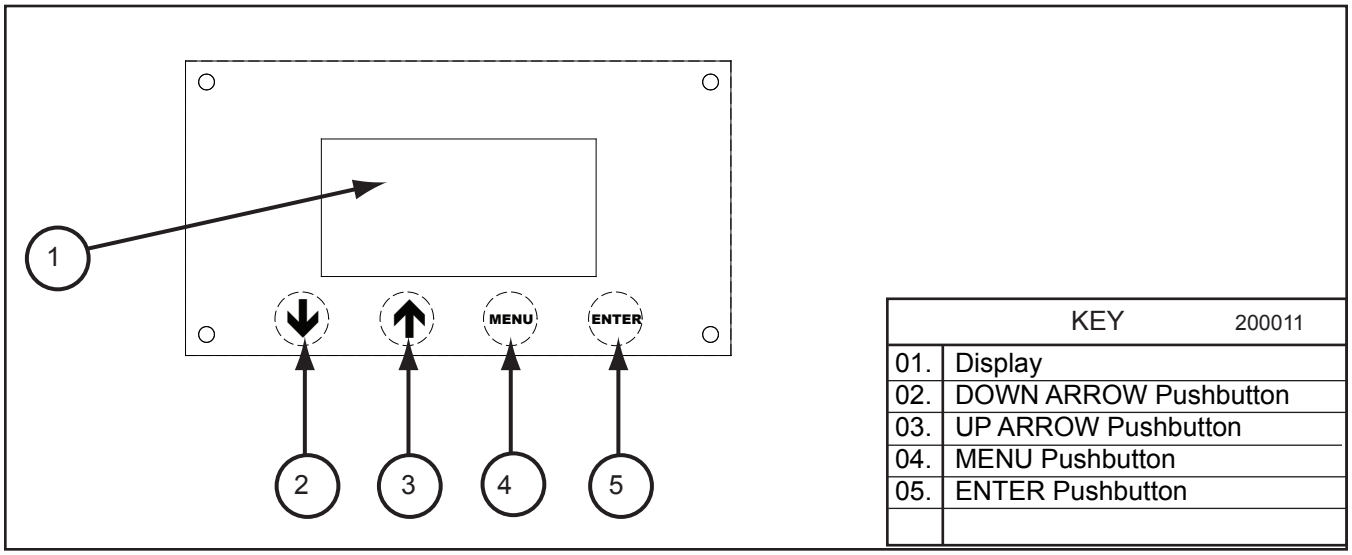
TABLE 1 – TRANSDUCER VOLTAGE READINGS (VDC)



KEY	200011
01.	Display
02.	DOWN ARROW Pushbutton
03.	UP ARROW Pushbutton
04.	MENU Pushbutton
05.	ENTER Pushbutton

FIGURE 3 – WEIGH SYSTEM DISPLAY

e. Turn the Master Switch Off.

LOAD LIGHTS

The load lights may be tested as follows:

NOTE: *There are 2 red and 2 amber lights on left side and the right side of the trucks equipped with load lights. To check these, it is best to have 2 people, one in the cab and one where he can see the load lights and the person in the cab.*

1. Verify that the Master Switch is On.

2. Verfiy that there is sufficient supply pressure in the brake accumulators to release and hold the park brake calipers and pressure switches.

3. While holding the truck in place with the Brake Pedal, release all other brakes (Hand, Park and Load).

4. Apply the Load Brake.

5. Verify that all of the load lights flash enough to show that the lamps are operational.

6. Release and apply the Load Brake to repeat light flashing until the non-operational lamps have been identified.

NOTE: *When the Load Brake is applied, the Display should indicate LOADING mode. When the loading brake is released the Display should show EMPTY mode.*

7. Replace/repair any lamp assemblies that are not operational and retest as required.

DOWNLOAD SYSTEM INFORMATION

The information gathered by the Weigh System should be downloaded and analyzed as follows:

1. Following the procedures outlined in this manual the information gathered and stored by the Weigh System should be downloaded to a laptop computer for analysis.

NOTE: *Care must be take when uploading Weigh System data to ensure the desired effect on the data continuity:*
1. If the data is to remain as it is recorded and stored, select the option entitled "Update Data (Do NOT Reset the Haul Count)".
2. If resetting the haul count recorded on the truck is desired, select the option entitled "Update Data and Reset the Haul Count Since Last Update".

2. Also following one of outlined procedures in this manual the data obtained in step 1 should be reviewed and kept for future reference.

a. Weigh System operational problems, once identified, should be repaired to allow the system to operate properly.

b. The range of truck maximum vehicle weights.

(1) Maximum gross vehicle weight should not exceed truck capacity and allowance.

IMPORTANT: *Exceeding the capacity of the truck systems may adversely affect its operation and ability to perform properly. It may ultimately adversely impact maintenance and warranty considerations.*

(2) The range of the maximum vehicle weights carried should be approximately equal with minimal peaks or valleys. This will ensure the maximum productivity without overloading the truck.

FIELD ASSEMBLY INSTRUCTIONS
MT 4000AC AND MT4400AC

DESCRIPTION

The BUCYRUS® Haul trucks are too massive to usually be shipped in one piece. Typically, the trucks are sub assembled at the factory assembly sites, then shipped to the mine in a modular form for final assembly and testing.

The trucks may be assembled in many ways depending upon many factors including the equipment and manpower available. These instructions focus on what has been found as the most typical assembly process. The remaining versions are but variations on this process.

PREPARATION

Before the components begin arriving at the field assembly site, a plan should be developed for receiving and assembling the trucks. The plan should include several key items:

Personnel requirements
Hand tool requirements
Welding equipment requirements
Site requirements
Safety requirements

PERSONNEL REQUIREMENTS

A typical assembly crew consists of the following:

1 Lead man - to supervise the crew. Should have heavy equipment experience.
1 or more experienced crane operators (quantity dependent upon equipment requirements and availability).
3 experienced journeyman welders - primarily for dump body assembly and final bracket securing.
3 mechanical/electrical laborers - experienced in heavy component assembly.
1 crew member who is experienced in the installation of electrical, mechanical, and hydraulic/pneumatic components, and well versed in the troubleshooting and testing of them.

TOOL REQUIREMENTS (Minimums)

A “Master Mechanics” Tool Box with at least the following:

Special Tools
- Adjustable wrenches: 12, 18, and 24 inch (300, 450, and 600 mm)
- Pipe wenches:
  - Steel: 12 and 18 inch (300 and 450 mm)
  - Aluminum: 24 and 36 inch (600 and 900 mm)
- Sledge hammers: 8, 12, and 16 lb (3.5, 5.5 and 7 kg)
- Air impact wrenches:
  - 1/2 Inch drive with 3/8 to 1-1/2 inch sockets
  - 3/4 or 1 inch drive with sockets up to 2-1/2 inches
- Assortment of line up bars (18 to 24 inches (450 to 600 mm))
- Assortment of heavy duty pry bars
- Torque wrenches:
  - 1/2 inch drive
  - 3/4 or 1 inch drive (500 ft-lb (680 Nm)) Minimum/1000 ft-lb (1 360 Nm) maximum)
- 18:1 Torque multiplier

Welding Equipment

3 300 amp (minimum) dc welding machines with 100 ft (31 m) leads (600 amp dc machines preferred)

2 Carbon air arc attachment
2 Sets cutting/heating torches with assortment of tips

1 Electrode oven
3 Air chipping hammers
2 Heavy duty grinders with assortment of wheels (Typically 5 to 9 inch (125 to 225 mm))
An assortment of wedges and clamps

Lifting Equipment
1 100 ton (90 mt) crane
1 50 ton (45 mt) crane
1 10 ton (9 mt) fork truck/crane
1 Assortment of lifting slings and clevises for above
1 3 ton (3 mt) “come-a-longs”
1 10 ton (9 mt) “port-a-power” or jack assembly

Support Equipment
1 Set front and rear stands
1 Assorted miscellaneous heavy cribbing (may be used instead of stands also)
1 100 scfm (minimum) portable air supply with adequate long hoses

Test Equipment
2 Digital volt-ohmmeters
2 0 - 5000 psi (0 - 35 000 kPa) hydraulic test gauges
1 IBM Windows compatible laptop computer (with GE AC and BUCYRUS® Weigh System programs)
1 1000 V meggar-ohmmeter

COMPONENT WEIGHTS

SHIPPING CONFIGURATION (Typical - including shipping crates)

	lb	kg
Main frame assembly	113,500	51 485
Superstructure (standard)	36,500	16 560
Fuel tank	4,400	1 995
Wheelmotors (GEB 25)	29,000	13 150
Front axle assembly	35,000	15 875
Air cleaner assemblies (with brackets)	1,000	455
Air Ducts/Ladder	2,500	1 135
Tear down (Miscellaneous parts)	5,000	2 270
Rim sets (per pair)	6,800	3 085
Tires		
40R57	7,500	3 400
46/90R57	7.650	3 470
50/80R57	8,270	3 750

NOTE: *These weights are representative only. The actual weight of the tires, rims, and assemblies varies with manufacturer and model.*

COMPONENT INSTALLATION WEIGHTS (Each)

NOTE: *Crating material removed:*

	lb	kg
Main frame assembly	112,000	50 795
Superstructure assembly (standard)	36,000	17 330
Fender assemblies	1,500	680
Air cleaner assemblies	1,000	500
Fuel tank	4,000	1 815
Front axle assembly	34,500	15 650
Tire and rim assemblies		
With 40R57	10,900	4 950
With 46/90R57	11,050	5 010
With 50/80R57 tires	11,670	5 290
Wheelmotor assemblies (each w/brakes)	28,000	12 700

NOTE*: The tire and rim assembly weights are representative only. The actual weight of the tires, rims, and assemblies varies with manufacturer and model.*

Dump body varies with size and liners installed. Refer to BUCYRUS® Service Representative for actual weights.

SITE REQUIREMENTS (Figure 1)

The assembly site should be a clean, dry, relatively flat area with sufficient room to off-load all of the parts around the main frame to minimize later efforts. If more than one truck is to be assembled, arrange the frame locations so that the same tools, equipment, and manpower can be used on them all and they all share easy access to them. Make sure that sufficient room is left to maneuver the cranes and other equipment easily and safely and that no electrical lines or other obstacles are in the working area.

Reserve a level part of the area for the assembly, welding, and installation of the dump bodies. Remember to allow adequate room for the bodies to be turned over during the welding process.

SAFETY REQUIREMENTS

Always review all mine, local, and other safety requirements and practices with all parties prior to beginning any work. This will minimize any problems that may later occur.

DUMP BODY ASSEMBLY

NOTE: *The dump bodies for the haulage trucks are typically fabricated in two or more pieces to facilitate handling and transportation. This procedure will allow assembly of the components in the upside down, horizontal position, typically the configuration in which it is shipped.*

1. Prepare a suitable fabrication/assembly area. It must be flat and of sufficient size to set the sections together and later permit the turning and “rolling” of a complete body.

2. Remove all items tack welded inside of the bed. These are parts that will be used in the field fabrication.

NOTE: *The dump body sections must have the same serial number.*

3. Two types of bodies can be welded by this procedure - center split and off-set split. If the body was shipped in a more disassembled (or “flat pack”) configuration, contact your BUCYRUS® Service Advisor for supplemental detailed information.

4. Check the weight of fabrications and assure correct crane size and cable sizes are utilized. These weights are most likely found on the bill of lading for the dump body or contact the BUCYRUS® Service Advisor.

5. Set each half section on concrete/steel or wood cribbing with steel, with the sections facing one another. Weld on the guide bars furnished top and bottom of floor plate, header plate, and canopy.

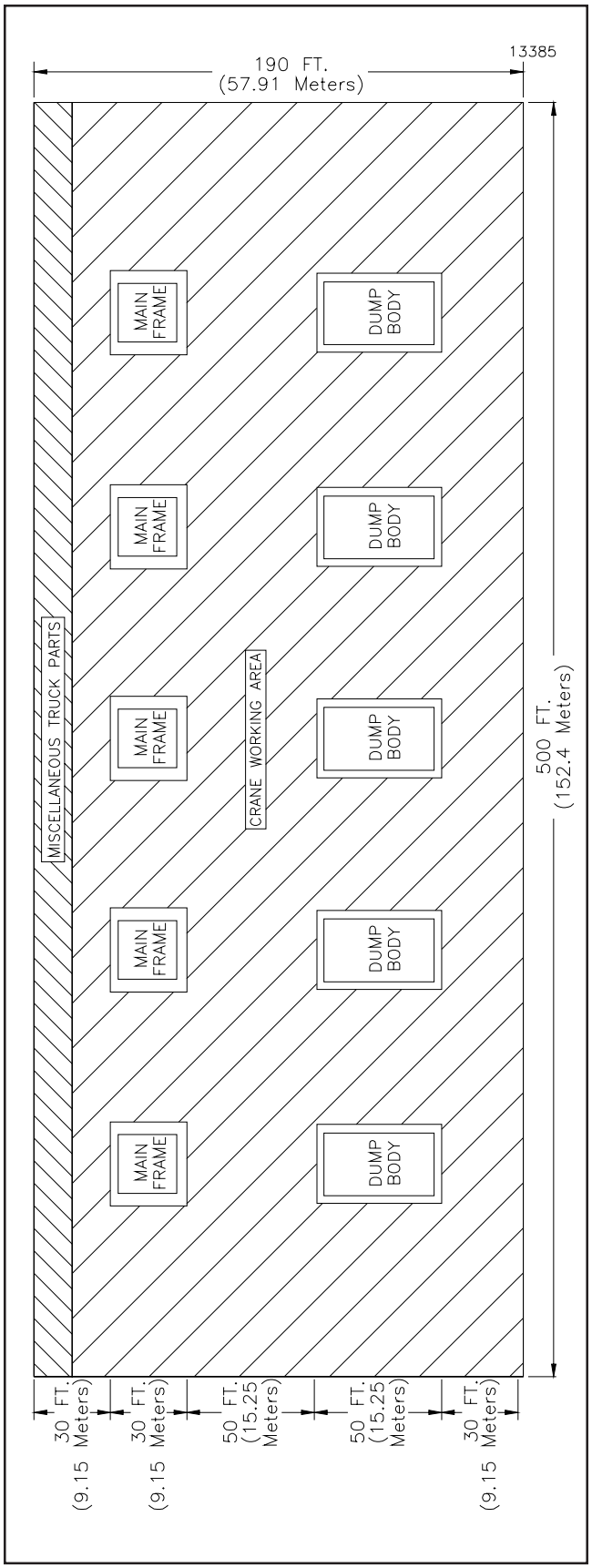


FIGURE 1 - TYPICAL ASSEMBLY SITE

NOTE: *Typically it is found desirable to place pieces of steel under the points at which the body contacts the supports. The steel in the body will slide more easily on this intermediate steel plate, easing the moving of the sections when pulled together.*

6. With the dump body in the inverted position, one side should be positioned into the mating side and all bolts drawn up but not securely tightened. Halves can be pulled together with come-a-longs attached to the inside of the side assemblies.

7. Boards, typically 3 X 12 inch X 4 ft. (75 X 300 mm X 1.2 m), or similar material should be installed under the canopy to reduce the potential for damage during the "rollover". Set the remaining parts on wood or steel to ease their movement during assembly. The dump body should slide across the concrete/steel or wood cribbing/ steel for alignment of the halves.

8. Since proper pivot alignment is essential, refer to the dump body assembly print for the proper alignment information.

NOTES:

1. A pivot alignment tube that passes through all four pivot bosses is required. Typically one is shipped with each truck or dump body order.

2. The bores must be concentric within 1/16 inch (1.5 mm). The above listed tube should be 5.950 inches (151 mm) in diameter and at least 90 inches (2.3 m) in length.

3. Typically the above dimension is 64-1/2 +/- 1/16 inches (1 638 +/- 1.5 mm) from the inside surfaces of the inboard pivot bosses.

9. Pull the sections together to mate the floor sections. Tighten the mating bolts to obtain proper alignment of the "V" groove in the floor plate. As the mating bolts are tightened, make sure that the pivot boss spacing is maintained and that the alignment tube can be turned by hand in the bosses.

NOTE: *Some prying, wedging or "dogging" could be required to obtain this alignment. Even light trimming or grinding could be necessary.*

10. With the bottom tight and the pivots aligned, start aligning the front plate and the canopy sections.

NOTE: *The front plate can have a "V" groove in either side, inside or outside. Later versions are positioned more forward and to the outside. Align the plates so that they are level with each other. The canopy plates should be aligned at the same time.*

11. Pull the front section of the canopy into alignment and skip weld to assure alignment.

NOTE: *If there is a misalignment of the canopy section, this is not uncommon due to handling and tie downs while transporting from fabrication centers to mine sites. This situation can be readily corrected by the use of wedges and similar implements.*

12. With the front section of the canopy aligned, tighten the mating bolts on the canopy and front plates, verifying that the plates are all level with one another.

13. With all of the bolts tight, inside and out, recheck the pivot alignment and pivot boss spacing. Make sure that the pivot alignment tube can still be rotated by hand.

If the pivot is aligned, install a bar (typically 3/4 X 3 inch (19 X 75 mm) between the inside pivot bosses and tack weld in place (to maintain the minimum inside dimensions).

NOTE: *On beds with dump body support beams, check the beams for flatness.*

14. After all bolting clips are tightened and proper alignment secured, install a 3 inch (75 mm) standard spreader pipe welded on the inside of the two halves. This will ensure less stress on welds while turning the dump body, plus it will help keep the sides and runner support beams parallel.

NOTE: *Typically this is supplied with the first dump body shipped with a truck order.*

15. Welding procedures should be followed as per the instructions on Field Welding in Section 10 - Miscellaneous in this manual. All weld sizes should be that specified on the BUCYRUS® Assembly Drawings for the particular body as each body is custom built per customer's request or requirements.

NOTE: *Cold weather welding should be followed after ambient temperature drops below 50° F or 10° C.*

16. All weld areas should be cleaned and free of rust, dirt or paint. The recommended method for cleaning is to burn the paint or use a rotary brush or grinder and clean the metal until it is shiny.

17. Weld the "horseshoes" on all bolsters as required. Weld the center between the bolsters. Use a grinder to grind a "V" or use minor air arc cutting.

NOTES:

1. While welding is in process, make sure that the pivot pin alignment pipe still can be turned by hand.
2. When welding the front plate "V" groove inside - grind a "V", 3/16 inch (4 mm) on the forward side. Weld up this groove completely. Remove the mating bolts and angles as you weld the groove.
3. When welding the canopy, weld the "V" area or flat bar, as called for on the drawings. Remove the mating bolts and angles as you weld the groove. Weld all vertical welds in the canopy header and grind the welds smooth, except the metal letters or logo (per BUCYRUS® Engineering or customer request). Complete all bottom welds prior to rolling the dump body over.

18. If equipped with dump body mounted pads, install the pads. Shimming will be done later.

19. Turn the dump body over.

IMPORTANT: *Due to safety implications, it has been found that turning the body end for end is the safest method. Side to side turning often results in a "humping" or "turtle" effect. Also, provision must be made to secure the body as it goes "overcenter". D-rings have been installed inside of the floor plate to assist in this form of movement.*

A four part cable, sized to carry the appropriate weight, is recommended. Two cables are connected at the pivots. Cut two 3 inch (75 mm) pieces of schedule 40 pipe, approximately the length of the two bosses. Place caps on each end of the pipe as a safety precaution, so that the pipes cannot fall out. Proper judgment is required; always consider the safety aspects and maintain complete control of the body's movement.

The cables attached to the D-rings will lift first (protection against damage when in contact with body parts may be required). As the body reaches the effective overcenter point, the pivot mounted cables begin to be loaded and control movement. These are used to lower the body back to the ground.

20. Block the body so that the floor is level and the canopy is also at some degree of level.

21. Verify that all joints to be welded are free of rust, paint, and other contaminants as outlined previously.

22. Weld the "V" groove in the floor plate. Grinding or air arcing may be required to reach the final desired condition. The bottom weld must be 100% weld. This weld should be kept as flat as possible to the plate surface,

particularly if liners are to be installed, but should not be under-welded.

NOTE: *Preheat of the weld area maybe required. Consult your* BUCYRUS® *representative for further information pertaining to your particular configuration and application.*

23. If dump body liners were added at the factory, there should be center wear bars to be added between the liners in the middle of the body between the existing wear plates. Grinding may be required to allow the bars to lay flat against the bottom plate. These beveled seams should be welded at this time.

NOTE: Preheat of the weld area is required.

24. Grind or air arc out and grind all weld joints made on the canopy and front plate from the opposite side down to good weld to ensure 100% penetration weld.

25. Install the impact cover plate between the canopy and the front plate after the body seam welding is complete.

26. Install the bevel plate at the bottom inside of the center cover plate.

27. Install the rock deflector per drawing specifications. The cab side is considered the primary side and has a standard deflector.

28. Reprimer and paint all welds and other damaged or "skinned" surfaces to match existing colors. Proper paint should be included in the truck ship kits.

TRACTOR ASSEMBLY

ARRIVAL ON SITE

When the components and boxes of loose parts arrive on site:

1. Immediately check their condition and note any shipping damage.

2. Verify their receipt against the shipping or packing lists.

3. As components are unloaded, place them in the vicinity of their installation point:

NOTES:
1. Attach two or more guide ropes to each assembly to assist in preventing unwanted movement in positioning.
2. The crane or cranes should be centered and positioned to allow the frame to be safely lifted and moved onto the awaiting supports/cribbing. Do not lift the frame or any other component higher than is required.
3. If more than one truck is being assembled at one time, be sure that the serial numbers correspond to that on the frame assembly.
4. Never lift a wheelmotor by means of a cable around the outside. Always use suitable lifting brackets as identified in the vendor supplied information with the wheelmotors.

a. Wheelmotors on the correct side and near the axlebox.

b. Front axle assembly properly oriented to the side of where the frame will be set. It should be positioned first to minimize the lifting of the frame and set on stable 12 inch (300 mm) high blocks with a steel cap plate between the blocks and the axle while remaining stable during installation.

c. Fuel and hydraulic tanks (hydraulic - driver' side, fuel - off driver's side) on the correct side and near the center of the frame.

d. Superstructure near the front of the frame (and supported by stands or cribbing to prevent damage to the underside).

NOTE: *Special lifting eyes which mount near the front and rear corners of the superstructure should be used to lift the assembly. Also, a spreader beam or equivalent is recommended to assist in distributing the lifting force through the assembly. If no spreader beam is available, four cable slings of a minimum of 20 ft (6.5 m) in length, may be used.*

4. When unloading the main frame assembly:

a. Measure the frame and prepare to locate the appropriate stands or cribbing to support the frame. This is typically done under the front bumper or front lower frame crossmember and at the bottom of the axle box or the dump cylinder lower mounting support assembly.

NOTE: *The stands or cribbing should not extend out beyond the outside of the frame to interfere in the installation of the remaining components.*

b. Attach the appropriate cables, clevises and other devices to the front lifting eyes on the frame. Install protective covering where required to prevent the cables from marking or damaging any components it contacts.

c. If not already in place, install the rear frame lifting fixtures in the dump body pivot bushings. Secure the pin with a cotter pin or other suitable keeper.

NOTES:
1. Attach guide ropes to each assembly to assist in preventing unwanted movement and in positioning.
2. The crane or cranes should be centered and positioned to allow the frame to be safely lifted and moved onto the awaiting supports/cribbing. Do not lift the frame or any other component higher than is required.

d. Slowly, carefully, and evenly raise the frame off of the carrier, remove the carrier, install the stands or cribbing (following appropriate safety practices), and lower until resting on it. Be sure that the frame is secure enough to be worked on prior to loosening or removing the lifting cables.

ASSEMBLY PROCESS

NOTES:
1. Prior to installing each component, make sure that the mating surfaces on both the component and the frame or other assembly is clean of all dirt, paint, rust, damage or any other contaminant or irregularity.
2. Attach guide ropes to each assembly to assist in preventing unwanted movement and in positioning.
3. The crane or cranes should be centered and positioned to allow the component to be safely lifted and moved as required. Do not lift the frame or any other component higher than is required.

The “tractor” may be assembled as follows:

1. Install the front axle assembly as follows: (See the information in Section 7 - Running Gear for additional information.)

a. Raise the main frame and position squarely over the axle.

b. Install the two bottom radius rods first:

(1) Move the rod end into position and place the neoprene rings into position.

(2) Install the radius rod pins.

NOTE: *Use the standard pins only. The eccentric pins are used only in designated locations and will be used last.*

(3) Install the pin retainer and secure with the capscrews and washers.

c. Install the left side upper radius rod.

d. Install the upper right side radius rod.

NOTE: *Two upper connection points employ eccentric pins to allow for assembly variations. If the axle has not been previously fitted to the truck:*
1. Install the radius rod as before, except use the eccentric pin in the axle end. Rotate the pin until the pin bore in the link is aligned with the frame bore.
2. Weld the pin retainer to the boss with 1/4 inch (26 mm) fillet weld.

2. When the axle installation is complete secure the main frame/axle assembly on cribbing of sufficient height and stability to allow installation of the wheelmotors and all tire and rim assemblies.

3. Have the appropriate trained personnel install the tire and rim assemblies on each of the front wheels as outlined in the instructions in Section 7 - Running Gear. During assembly, make sure that the valve stems are properly installed in the cut-out in the wheel, the rims are properly seated on the hub and closely aligned, and that the clamps are properly torqued.

4. Install the left and right wheelmotor assemblies as outlined in the instructions in Section 7 - Running Gear. During assembly, make sure to use the proper flatwasher and properly torque each of the mounting bolts.

5. Have the appropriately trained personnel install the dual tire and rim assemblies on each of the wheelmotors as outlined in the instructions in Section 7 - Running Gear. During assembly, make sure that the valve stems are properly installed in the cut-out in the wheelmotor hub, the rims are properly seated on the hub and closely aligned, and that the clamps are properly torqued.

6. Have the appropriately trained personnel fill each tire assembly with air to the proper pressure determined for the application and load. If the pressure is not known, contact the tire supplier or the BUCYRUS® Service Advisor.

7. Lift the front and rear ends of the frame as outlined previously, remove the stands or cribbing and allow the assembly to rest on the tires.

NOTE: *Unless two cranes of 75 ton (68 mt) or greater are used, it is typically found that the large crane is used to lift each end of the truck off of the stands or cribbing separately, remove the material, and then lower until the tires rest on the ground.*

8. Install and securely weld the handrails onto the superstructure as outlined in the information in Section 2 - Structure.

9. Install the engine air cleaners as outlined in the instructions in Section 4 - Power Package.

10. Install the fender and mud guard assemblies on the back corners of the superstructure as outlined in the BUCYRUS® As-Built or Assembly Parts Manual.

11. Install the left and right hand side mirror assemblies.

12. Remove the hood and grille assembly as outlined in the information in Section 2 - Structure.

13. Install the superstructure onto the frame as outlined in the information in Section 2 - Structure. During assembly, be sure to install all bolts before tightening any, then properly torque. Routing and connection of all cables, wires and hoses can now begin. Refer to the appropriate BUCYRUS® As-Built or Assembly Parts Manual for details.

14. Reinstall the hood and grille assembly as outlined in the instructions in Section 2 - Structure.

15. Install the superstructure access ladder as outlined in the information in Section 2 - Structure.

16. Install all engine air intake and exhaust ducting as outlined in the BUCYRUS® As-Built or Assembly Parts manual provided with the truck.

17. Install the fuel tank as outlined in the information in Section 2 - Structure. During assembly make sure to properly tension all stabilizers and struts and to connect all plumbing as required.

18. If equipped with frame mounted pads, install the dump body pad assembly as outlined in the information in Section 2 - Structure.

19. Complete and check all plumbing and electrical wiring and cabling.

20. Fill and service all components and reservoirs as outlined in the information of that components or assembly or as defined in the Preventive Maintenance information in Section 10 - Miscellaneous.

a. If not done previously, service the front and rear suspension assemblies as outlined in the information in Section 7 - Running Gear.

b. Purge the manual or automatic lubrication system lines as required and make any initial adjustments.

21. Statically test the electrical system as outlined in the instructions in the appropriate BUCYRUS® Test Instructions.

22. Test the mechanical systems as outlined in the information in the following sections in this manual:

a. Pneumatic - Section 6 - Pneumatic System (on trucks so equipped)

b. Steering - Section 5 - Hydraulic System

c. Dump - Section 5 - Hydraulic System

d. Brakes - Section 5 - Hydraulic System

23. When the tractor assembly and dump body are complete they may be mated as outlined in the information in Section 2 - Structure. After mating, shim the pad assembly as outlined in the same instructions.

NOTE: *If the truck is equipped with dump body heating provisions, the assembly should now be fitted as outlined in Section 7 – Power Package.*

24. Clean, reprise, and repaint any area requiring touch-up.

25. Verify all hoses, wiring, and cabling are secure to prevent movement or chaffing.

26. Assembly of the truck is now complete.

TESTING

The completed truck testing may be done as follows:

1. Complete any testing not done prior to the mounting of the dump body.

NOTE: *Burnish the brake linings as per the instructions for the specific vendor and lining used, as outlined in the information in Section 8 - Brake System, before driving a loaded truck.*

2. Perform a road test as outlined in the instructions in the BUCYRUS® and system vendor's instructions and any other testing required to meet mine, engine, or drive system representative requirements.

3. Check the alignment of the front wheels as outlined on the information on the mechanical steering assembly in Section 7 - Running Gear. Adjust as required.

4. Recheck the wheel clamp torque on both the front and rear wheel assemblies as outlined in Section 7 - Running Gear.

5. Check and shim the dump body pads as outlined in the information on the dump body in Section 2 - Structure.

6. Recheck the empty truck ride height clearance on the suspensions and adjust as required.

RECOMMENDED LUBRICANTS AND FLUIDS MT 4000AC, MT 4400, and MT 4400AC

GENERAL

The items listed here are a compilation of the recommended lubricants and fluids used in specified operating conditions for the listed equipment. Brand names listed are for reference only and do not necessarily constitute an endorsement of the particular product. For detailed recommendations for specific applications, contact your suppliers or your BUCYRUS® representative.

NOTE: These recommendations are subject to change without notice.

LUBRICANTS

1. Engine

NOTE: *These listed items are typical and for reference only. Actual fluid recommendations will vary with a number of factors including engine, duty cycle, fuel content and consumption, lubricant/fluid used, etc. See the appropriate engine manufacturer's instructions and directions for detailed information and specifications, or contact your engine or BUCYRUS® representative.*

a. Engine crankcase oil

(1) Capacity:

(a) 16V4000 (Various ratings): 66 gallons (250 liters) Typical Tier 1

79 gallons (300 liters) Typical Tier 2
(b) Cummins QSK 60 (2700 hp (2 015 kW)) 72 gallons (273 liters)

(2) Recommend service intervals:

(a) Sample: Typically 250 hours. See engine manufacturer's recommendations.
(b) Change: See engine manufacturer's recommendations.

(3) Recommended fluid:

(a) 15W-40 Category 2 Engine Oil (for extended change intervals) that meets current DDC and Cummins criteria.

NOTES:
1. This is the typical oil requirement. Manufacturer, site, and operating environmental considerations may cause alternative oils to be required.
2. For operation in arctic environments, synthetic CE/SF engine oil with adequate low temperature properties such as a 5W-30 is recommended.
3. At other times during the year, other oils may be recommended to maintain proper operation and engine lubrication.
4. Non-synthetic, petroleum based 15W-40 oil is recommended for break in periods and when operating in the non-arctic temperatures.

b. Engine coolant

(1) Capacity:

(a) DDC 4000 Engine (2700 hp (2 015 kW))/Wabtec radiator: 160 gallons (605 liters)
(b) Cummins QSK 60 Engine (2700 hp (2 015 kW))/Wabtec radiator: 150 gallons (568 liters)

(2) Recommended service interval:

(a) Sample: See engine manufacturer's recommendations.
(b) Change: See engine manufacturer's recommendations.

(3) Recommended fluid:

(a) Ethylene glycol based antifreeze that does not require a precharge of supplemental coolant additives to be added before use in heavy duty diesel engines. It is to meet TCM RP-329 (ASTM D6210) with cavitation corrosion additive type "A".

NOTES:
1. A mixture of 50% ethylene glycol and 50% water is recommended in normal climates. It may be used year round.
2. A mixture of 67% ethylene glycol and 33% water is recommended in arctic climates. It may be used year round. It is the maximum recommended mixture.

(b) When mixed 50/50 with water, it is to have the following corrosion inhibitor chemistry:

Boron	125 – 500 ppm
Nitrites	800 – 2400 ppm
Nitrates	200 – 750 ppm
Silicon	50 – 250 ppm
Phosphates	0 ppm
Acidity (pH)	8.0 – 11

The water used with this antifreeze must meet the following requirements:

Chlorides	40 ppm (maximum)
Sulfates	100 ppm (maximum)
Total dissolved solids	340 ppm
Total hardness (Magnesium and Calcium)	170 ppm (maximum)

2. Front wheel bearing

a. Grease lubricant

(1) Capacity: 5.3 gallons (20 liters) or 40 lb (18 kg) each

(2) Recommended service intervals:

(a) Sample: As required
(b) Change/repack: 5,000 hours

(3) Recommended lubricant specifications: Synthetic grease, SHC 460 or equivalent

b. Oil lubricant

(1) Capacity: 3.3 gallons (13 liters) each

(2) Recommended service intervals

(a) Sample: 500 hours
(b) Change: 2,500 hours (or when indicated by sampling)

(3) Recommended lubricant specifications: Synthetic lubricant (ambient temperatures listed).

(a) -67° F to 59° F (-55° C to 15° C): SHC 150 or equivalent
(b) -35° F to 77° F (-37° C to 25° C): SHC 220 or equivalent
(c) -29° F to 95° F (-34° C to 35° C): SHC 320 or equivalent
(d) -20° F to 104° F (-29° C to 40° C): SHC 460 or equivalent
(e) -9° F to 122° F (-23° C to 50° C): SHC 680 or equivalent

3. Hydraulic system

a. Hydraulic fluid

(1) Capacity:

(a) Complete System Fill: 252 gallons (953 liters)

NOTE: *This quantity represents an initial system fill. The actual volume required when draining and refilling the system will be somewhat less, depending upon the amount drained from various components.*

(2) Recommended service intervals:

(a) Sample: 500 hours
(b) Change:
[1] Filters: 500 hours
[2] Oil: 5,000 hours

(3) Recommended fluid:

(a) Petroleum based anti-wear hydraulic oil

NOTE: *Must be approved for use with Mannesmann Rexroth axial pump units.*

(b) The recommended viscosity varies with fluid's operating temperature range, which may not directly correspond with the ambient temperature. See Figure 1 – Selecting Hydraulic Fluid Viscosity for the proper recommendation.

(c) Standard viscosities include:

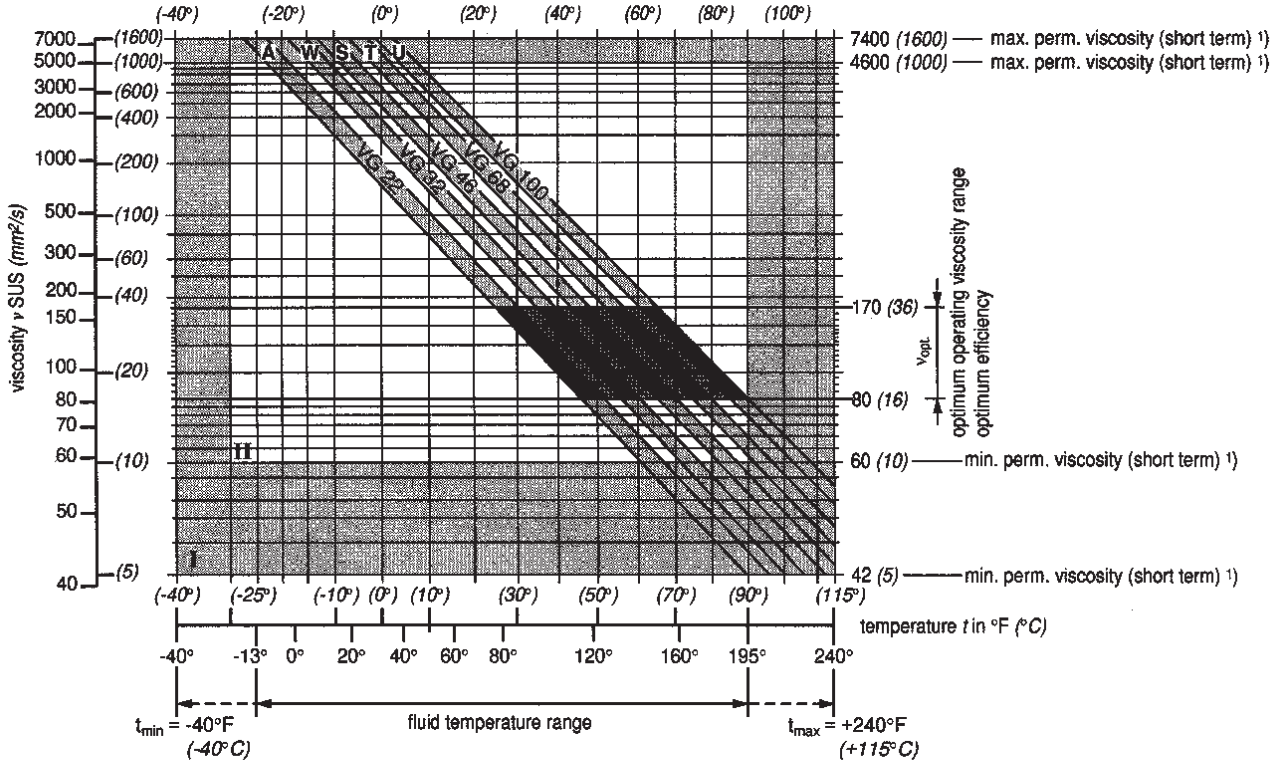
[1] VG 22	Arctic conditions
[2] VG 32	Winter conditions
[3] VG 46	Summer conditions
[4] VG 68	Tropical conditions
[5] VG 100	Excessively high temperatures

NOTES:
1. In severe arctic environments, the use of BUCYRUS® Arctic Hydraulic Oil is recommended. It consists of:
70% Mobil 1 Synthetic ATF
30% Mobil Aero HFA Low Temperature Oil
2. During the warmer months of the year, it is recommended that the normal hydraulic oil be used in the system.

b. System cleanliness recommendation

Selection Diagram

A = for arctic conditions or for extremely long pipelines
W = for winter conditions in Central Europe
S = for summer conditions in Central Europe or for enclosed areas
T = for tropical conditions or for areas with high temperatures
U = for excessively high temperatures (e.g. due to internal combustion engines)



1) Depending on the product resp. the sizes the following viscosity ranges are valid:
I: 42 SUS (t_{max} = +240°F) ... 7400 SUS (t_{min} = -40°F) / 5 mm²/s (t_{max} = +115° C) ... 1600 mm²/s (t_{min} = - 40° C),
II: 60 SUS (t_{max} = +195°F) ... 4600 SUS (t_{min} = -13°F) / 10 mm²/s (t_{max} = +90° C) ... 1000 mm²/s (t_{min} = - 25° C)
(Please find the max. permissible viscosity range in the catalogue sheets of the singular products)

FIGURE 1 - SELECTING HYDRAULIC FLUID VISCOSITY (REXROTH)

(1) To increase component life, it is recommended that the system be sampled at regular intervals and maintained at an ISO Cleanliness Code of 16/15. This code specifies that the oil in the system contain between:

(a) 320 and 640 particles/mL greater than or equal to 4 µm.

(b) 160 and 320 particles/mL greater than or equal to 6 µm.

4. Automatic lubrication system

a. Grease pump reservoir – Lincoln rotary pump

(1) Capacity: 10 fluid ounces (296 ml)

(2) Recommended service intervals:
(a) Check level: 500 hours
(b) Change: 2000 hours

(3) Recommended fluid: VG068 Synthetic Hydraulic Oil

b. Lubricating chassis grease

(1) Capacity: Varies with configuration.

(2) Recommended change interval:
Not applicable.

(3) Grease Specifications

(a) General: Premium Quality EP Grease that meets the following specifications:

Property	Test	Requirement
Base Oil Viscosity @ 40° C (104° F)	ASTM D 445	320 cSt (minimum)
Base Oil Viscosity @ 100° C (212° F)	ASTM D 445	20 cSt (minimum)
Worked Penetration, 60 Stokes @ 25° C (77° F)	ASTM D 217	370 mm (maximum)
Dropping Point	ASTM D 2265	450° F (232° C) (minimum)
Water washout at 175° F (80° C)	ASTM D 1264	8% of weight (maximum)
4-Ball Wear Scar Diameter	ASTM D 2266	0.5 mm (maximum)
4-Ball EP Weld Point	ASTM D 2596	400 kg (885 lb) (minimum)
Timken OK Load	ASTM D 2509	45 lb (20.5 kg) (minimum)
Molybdenum Disulfide Content		5 – 6% by weight
Molybdenum Particle Size		5 microns (maximum)
Graphite Content		None

Minimum Ambient Temperature (Sustained for 48 hours)	Applicable NLGI Grade
-30° F to 0° F (-34° C to –18° C)	0
0° F to 30° F (-18° C to 0° C)	1
Over 30° F (0° C)	2

NOTES:

1. For applications in which the ambient temperature is expected to be sustained at less than –30° F (-34° C) for greater than 48 hours and possibly to as low as –73° F (-58° C), use BUCYRUS® Arctic Grease:

80% Mobiltemp SHC 32
20% Mobil 1 Synthetic ATF

2. During the warmer months of the year, it is recommended that the normal chassis grease be used in the system.

5. Suspensions – Front and rear (Operating Fluid)

a. Capacity:

(1) Front: 9.7 gallons (36.7 liters)
(2) Rear: 8.9 gallons (33.7 liters)

b. Recommended change interval: Not normally required. Change when the assembly is drained for service.

c. Recommended fluid specifications:

(1) Non-arctic ambient temperatures
Automatic transmission fluid (Conoco Hydroclear Power Tran Fluid (or equivalent))

(2) Arctic ambient temperatures
Automatic transmission fluid (Conoco Syncon Synthetic R & O (or equivalent))

NOTES:

1. The arctic fluid should have the properties:
ISO 46 viscosity grade
-70° F (-55° C) pour point
PAO synthetic – May be used with common seals
2. May be used all year.

6. Wheelmotor– GE 787 or GEB 25

a. Gearcase oil

(1) Capacity: 10.5 gallons (39.8 liters)

NOTE: *The use of synthetic lubricants is recommended for all applications. See the appropriate General Electric information for detailed fluid requirements at each of the listed operating temperature ranges and related service information.*

(2) Recommended service intervals:

(a) Sample: 500 hours
(b) Change: (maximum)
[1] GEB 25: 3,000 hours
[2] GE 787: 3,000 hours

NOTES:

1. This represents the maximum number of hours between oil changes. More frequent oil change intervals may be required, depending upon individual mine and wheelmotor conditions. An oil monitoring or sampling program should begin with a base line at the oil change and proceed throughout the operating interval, with any "early" changes dictated by information derived from this system. For more detailed information, see the appropriate General Electric publication.

2. On new or newly overhauled wheelmotors, it is recommend that the oil be changed after the first 500 hours of operation then at the 3,000 hour intervals or when indicated by sampling.

3. Since synthetic oils may be filtered for reuse rather than discarded, they may be monitored to determine whether or not filtering is required, through a particle analysis process. General Electric recommends an ISO Cleanliness Code of 18/13 be used for motorized wheels. Oil that is qualified to be reused must be filtered to 10 microns absolute. For more detailed information, see the detailed information in the appropriate General Electric publication.

4. When the oil is changed or filtered, the magnetic plugs should be removed, inspected, and cleaned.

(3) Recommended fluid specification:
Synthetic lubricant (ambient temperatures listed)

(a) GEB25
[1] -9° F to 122° F (-23° C to 50° C):
SHC 680 or equivalent

NOTE: *If you believe that your site has sustained consecutive daily sub-freezing temperatures that would dictate the use of another viscosity of oil you MUST contact GE and BUCYRUS® for WRITTEN APPROVAL to use other viscosity selections.*

(b) GE 787
[1] -67° F to 59° F (-55o C to 15o C):
SHC 150 or equivalent
[2] -35° F to 77° F (-37° C to 25° C):
SHC 220 or equivalent
[3] -29° F to 95° F (-34° C to 35° C):
SHC 320 or equivalent
[4] -20o F to 104o F (-29° C to 40° C):
SHC 460 or equivalent
[5] -9° F to 122° F (-23° C to 50° C):
SHC 680 or equivalent

RECOMMENDED JACKING AND SUPPORT POINTS

DESCRIPTION AND LOCATION

The recommended jacking and support points on a truck provide a means of lifting the truck and related components to allow effective servicing.

OPERATION (Figure1)

There are two basic sets of jacking and support points at the front and rear of the truck. One set incorporates points on the front beam axle assembly and the axlebox. The other set is on members of the main frame assembly.

MAINTENANCE AND ADJUSTMENT

Prior to beginning jacking, the truck should be:

1. Located in a clear, flat area that will allow access from all sides and angles.

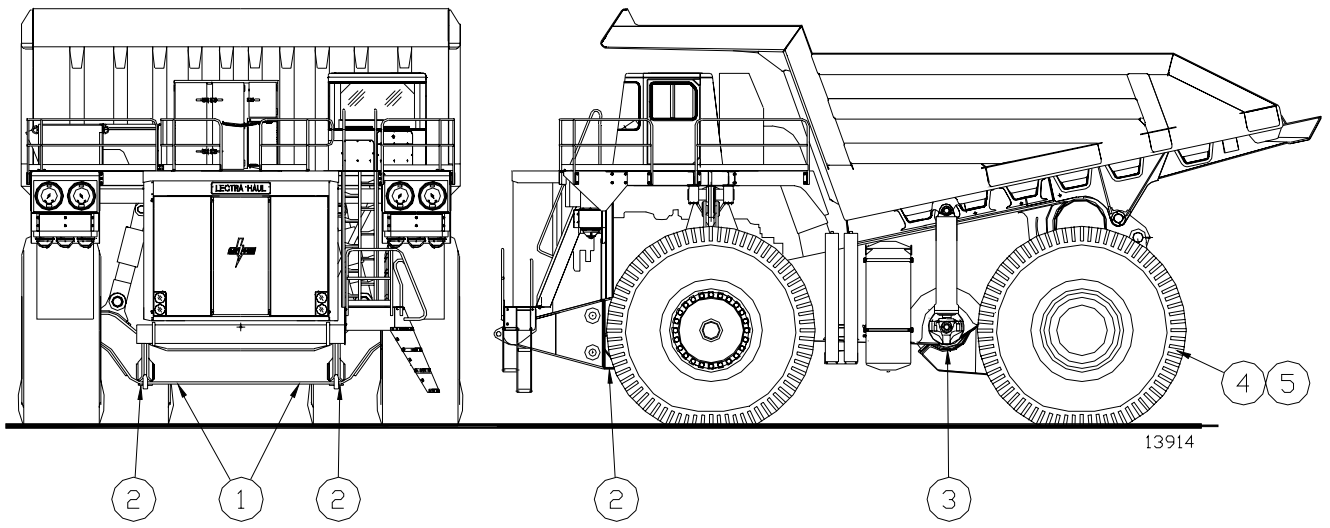
2. Parked in a SAFE POSITION. It must be secured by means other than the trucks friction brake system.

3. Empty of any payload with the dump body fully resting on the main frame. If this is not possible, the dump body must be completely secured to prevent unwanted movement in any direction.

Prior to jacking, the support equipment should be:

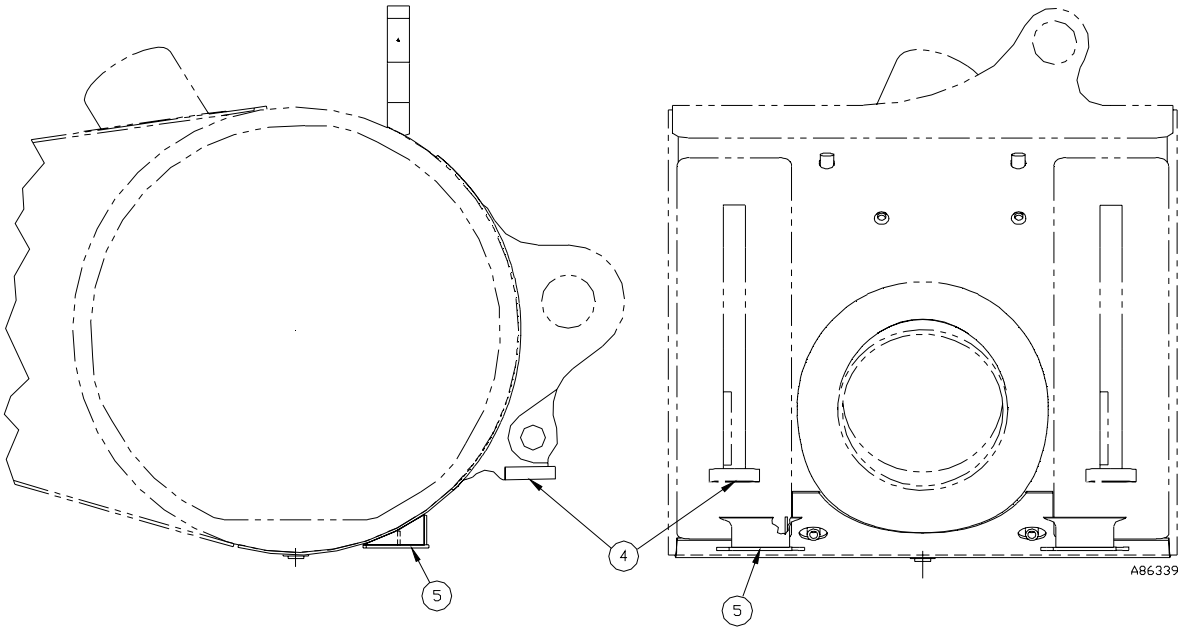
1. Inspected and verified to be of sufficient capacity and in general good repair condition to properly lift and support the weight involved.

2. Securely located on a solid, flat surface, capable of supporting the weights involved.

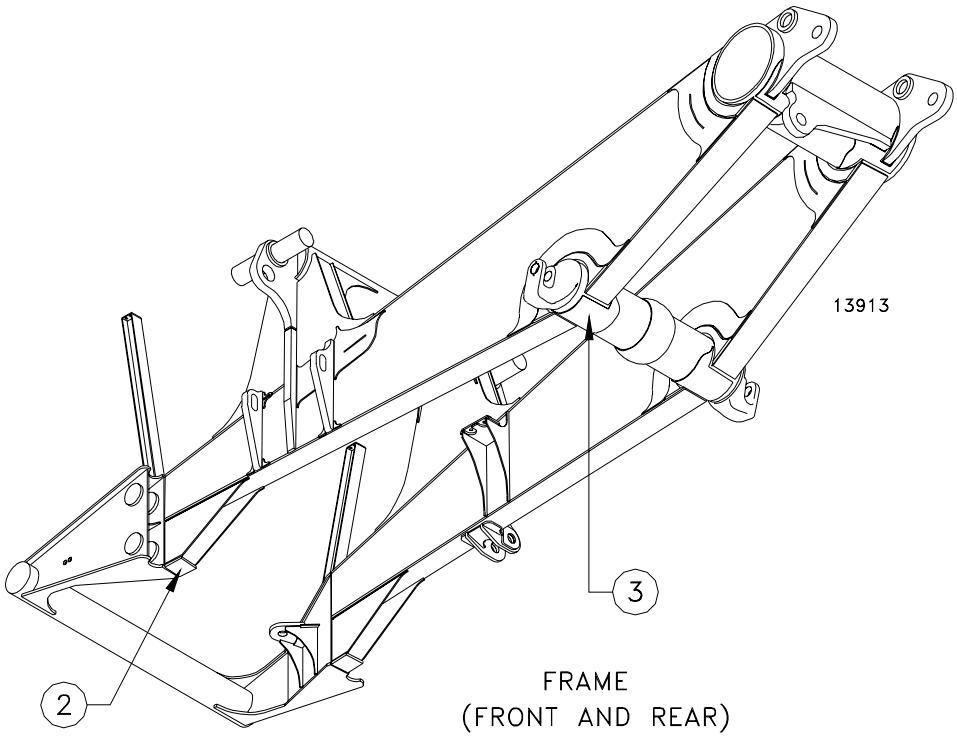


KEY	
01.	Under the lower plate on the front axle beam, just inside the link attachment bracket
02.	On the reinforced flat surface on the bottom of the main frame assembly, near the front edge of the front tires
03.	On the reinforcing plate material on the lower rear main frame crossmember.
04.	On the bottom of the axlebox lower suspension mounting bracket
05.	On trucks equipped with the available jack pad, skid plate assembly, on the flat jacking surface on the bottom of the axlebox, below the suspension lower pointing bracket.

FIGURE 1 - RECOMMENDED JACKING AND SUPPORT POINTS



AXLEBOX



FRAME
(FRONT AND REAR)

KEY	
01.	Under the lower plate on the front axle beam, just inside the link attachment bracket
02.	On the reinforced flat surface on the bottom of the main frame assembly, near the front edge of the front tires
03.	On the reinforcing plate material on the lower rear main frame crossmember.
04.	On the bottom of the axlebox lower suspension mounting bracket
05.	On trucks equipped with the available jack pad, skid plate assembly, on the flat jacking surface on the bottom of the axlebox, below the suspension lower pointing bracket.

FIGURE 1 - RECOMMENDED JACKING AND SUPPORT POINTS (CONTINUED)

FIELD REPAIR WELDING PROCEDURES

These instructions are mandatory guidelines for the field repair and remanufactured processes of Terex|Unit Rig structures. The procedures are based on the shielded metal arc welding process using low hydrogen electrodes and flux cored arc welding. They provide welding guidelines on BUCYRUS® Products – BUCYRUS® and Lectra Haul, Dart, and Payhauler.

REVISION DESCRIPTION

BUCYRUS® makes a constant effort to offer our customer maintenance information to reduce operating costs through increased service life and reduced downtime. BUCYRUS®'s Engineering Department has reviewed the previous welding documentation and the following information has been included in these procedures.

1. Weld Filler Material (SMAW)

The weld filler material considered for weld repairs is AWS E8018C3 (with E7018-1 as an alternative) and is recommended as the primary choice. These both have excellent cold weather impact properties and provide the required tensile strength.

2. Flux Cored Arc Welding (FCAW)

Also known as Dual Shielded Welding is approved using AWS Lincoln 71M or Frontarc 711 (Koby). Shielding is obtained through decomposition of the flux within the tubu-lar wire. Additional shielding is obtained from an exter-nally supplied gas mixture of 75% Argon 25% CO_2.

NOTE: *CO_2 by itself will not meet BUCYRUS® Engineering Charpy requirements*.

3. Roll Over Protective Structure (R.O.P.S.)

To avoid violation of the R.O.P.S. certification, do not weld to or modify the R.O.P.S. in any way without the prior written permission of BUCYRUS®. The R.O.P.S. may not provide sufficient protection if it has been altered, damaged, or previously involved in a roll over. Contact your BUCYRUS® Service Advisor or Service Department for assistance with R.O.P.S. related questions.

4. Tack Welds

We previously allowed tack welds no larger than a rod diameter without preheating. These tack welds, under certain adverse conditions, could produce hydrogen em-brittlement cracking. To eliminate this possibility the information on Welding Application and Tack Weld has been revised.

MATERIAL SPECIFICATIONS

1. All plate material must conform to constructional alloy steel ASTM-A514, Type A.2 on trucks built prior to 1985; after 1985, BUCYRUS® specification 02-560, 561, 562 - similar to Bethstar 80.

NOTE: *Some dump bodies still use 04 - 578 material. Contact a BUCYRUS® representative for material specification.*

2. The main frames of BUCYRUS® (and Lectra Haul) trucks and Dart products plus many of the other major structural components are now being fabricated from a HSLA (High Strength, Low Alloy) steel. This material has a minimum yield strength of 55 to 80 ksi (55 to 80 MPa), depending on thickness and where used, and is very similar to Bethstar 80, except with a lower allowable sulfur content and is produced by the "controlled rolled" process. The result is a superior quality steel with very favorable weld characteristics and good fatigue qualities.

However, in order to take advantage of these characteristics it is still necessary to carefully follow the weld and repair procedures. Further questions should be directed through the BUCYRUS® Engineering or Technical Service Departments or a Service Advisor.

ELECTRODE/WIRE SPECIFICATIONS

1. All shield metal arc welding (stick) electrodes must conform to AWS E8018 C3 or approved equivalent, such as E-7018-1. Welding should be DC, reverse polarity. Alternate electrodes require BUCYRUS® Mining Engineering approval.

NOTE: *The material has excellent cold weather impact properties and provides the required tensile strength.*

2. Flux core arc welding (FCAW) must conform to Lincoln 71M or Frontarc 711 (Koby).

a. The approved wires are Lincoln outer shield 1/16 inch (0.052) and 0.045 - dual shield 1170. Gas flow rate 35 to 45 cfh (1 to 1.3 m^3/hr).

b. External shielding gas shall be CO_2 or a mixture of 75% Argon, 25% CO_2. For further detailed information refer to your electrode supplier or BUCYRUS® Specification 02-150.

NOTE: *CO_2 by itself will not meet BUCYRUS® Engineering Charpy requirements*.

ELECTRODE CARE (STICK)

1. All electrodes must be purchased in hermetically sealed containers. Immediately on opening the container, the electrodes must be removed from container and transferred to a ventilated holding oven at 250 to 300° F (125 to 150° C).

2. If the electrode container has been damaged so as to allow electrode exposure to air, or if it is not of hermetically sealed type, the electrode should be baked at the temperature and for the time as specified by the electrode manufacturer. One to one and a quarter hours at 700 to 800° F (271 to 427° C) is common. They should then be returned to the holding oven as in Step 1.

3. Heating electrodes at a low temperature, 250 to 300° F (125 to 150° C), for several hours is not equivalent to using specified temperatures as outlined in Step 2.

4. Stick electrodes contaminated with oil, grease, water, or with damaged coating must be discarded.

5. No more than a 15 minute supply of electrodes should be removed from oven at one time. Unused electrodes out of oven more than 30 minutes must be discarded or reconditioned as outlined in Step 2.

ELECTRODE CARE (WIRE REELS)

1. Welding wire must be maintained free of dirt, oil and other contaminants.

2. Wire that has been accidentally contaminated must be scrapped.

3. Wire reels should not be removed from shipping box until ready to use.

WELDING PREPARATION

1. Clean the surface prior to making repairs. Use a gas torch, buffer, or grinder to remove paint, rust, oil, and/or dirt.

2. For proper electrode grounding, attach ground cable directly to part being welded. For example, superstructure-to-superstructure, frame-to-frame, and axlebox-to-axlebox. This will avoid current passing through bearings. Grounding leads from the power supply should have good ground clamps.

⚠ CAUTION

During wet weather, when welding leads have bare wire exposed, improper grounding can occur causing damage to truck parts.

3. To protect the truck's electrical system, refer to General Electric TIPS, Issue 34, Oct. 1989, or later information.

DO NOT pull any control cards or remove panel connectors. This practice can cause more damage than it prevents. It puts unnecessary cycles on the connector pins and may result in loose or dirty pins which could result in a control system failure.

4. If the truck has a Detroit Diesel engine equipped with DDEC controls or an Allison transmission with ATEC controls, the ECM power must be disconnected either by a suitable switch or disconnecting the power plug. The Master Switch must be kept in the Off position.

5. Air arcing is required when removing weldment and removing cracks in welds and parent material. The maximum size air arc electrode recommended is 1/4 inch (6.35 mm) in diameter. Scarfing or gas gouging is not permitted. Air arcing should begin 1/2 inch (12 mm) past the propagating end of crack. After air arcing, remove carbon deposits by grinding metal until bright, including all cavities. A die grinder with a carbide burr is recommended for all grinding. Complete removal of crack should be verified by NDT, such as dye penetrant or magnetic particle inspection.

6. An oxygen and gas cutting torch is recommended for web plate cut-outs and preheating. Correct tip size compatible with metal thickness is important to avoid over-heating metal edges. Flame-cut surfaces having burn marks deeper than 1/16 inch (1.6 mm) will require grinding.

WELDING PRECAUTIONS

1. The weld joint plus a three inch (75 mm) area either side must be preheated to 213° F (101° C) (minimum) prior to welding. A temperature crayon, such as tempilstick, can be used for checking the temperature.

2. Interpass temperatures should not exceed 400° F (204° C). Discontinue work until surface cools to approximately 250° F (118° C).

3. All welds must be made with stringer passes. No weaving of welds is acceptable; however, a slight oscillation may be necessary, but movements should never exceed 1/8 inch (3 mm) maximum width or 1/16 inch (1.5 mm) per side of oscillation.

4. When cold weather welding, the overall temperature must be above 50° F (10° C) on the truck or component parts. Cold climates require covering the work piece and using heaters to raise the temperature above 50° F (10° C) and maintaining this temperature control throughout the welding process.

5. Preheat and interpass temperature control are recommended for optimum mechanical properties, crack resistance and hardness control. This is particularly important on multiple pass welds and heavier plate. Job conditions, prevailing codes, high restraint, alloy level and other considerations may also require preheat and interpass temperature control.

WELDING APPLICATION AND TACK WELDS

1. Preheating is required for all tack welds, regardless of size.

2. Cracks that occur in tack (or skip) welds must be removed.

3. Tacks must not leave an uneven finished weld profile on a single or multiple pass welds.

4. Tack welds should be consumed in the final weld or removed by grinding 1/64 inch (1 mm) into the parent material.

5. It is very important that each weld bead be thoroughly cleaned before the following bead is deposited. Pneumatic or hand chipping must be done with a blunt tool after each pass. Wire brushing after chipping is required. Air must never be blown on the weld area.

6. In multiple pass welding all starts and stops must be staggered.

7. Welds must be finish ground as specified in current Terex|Unit Rig T-drawings and blueprints.

WIRE APPLICATIONS

1. All welds should be made with stringer passes.

2. Flux Core Arc Welding (FCAW)

a. Lincoln 71M (or Frontarc 711 (Koby))

These are both all position flux cored wires that display exceptional impact properties in both the as-welded and stress-relieved conditions. Arc characteristics are smooth and splatter level is low. It is recommended for the wide range of low and medium carbon steels used extensively in the construction, shipbuilding, rail car and heavy equipment industries.

Shielding Gas - 75% Argon/25% CO_2

NOTE: *CO_2 by itself will not meet BUCYRUS® Engineering Charpy requirements*.

3. Proper AWS classification of filler material, flux-core can be applied in the vertical-up position. All welds should be made with stringer passes. Flat position is preferred as this improves melted metal flow, bead contour and shielding gas coverage. All starts and stops using multi-pass welding should be staggered wherever possible. A pneumatic chipping hammer is used to clean each weld bead and remove the slag covering.

TIG DRESSING PROCEDURE

1. The surface shall be clean and free of mill scale and slag prior to initial welding. Blasting is the preferred method of cleaning.

2. The completed weld shall be clean and free of slag before TIG dressing.

3. The tip of the electrode shall be kept sharp and clean.

a. Electrode:	Thoriated tungsten, 0.12 to 0.016 inch (0.3 to 0.4 mm) diameter
b. Welding current:	150 to 250 amp range
c. Welding voltage:	10 to 25 V range
d. Welding speed:	4 to 8 inches/minute (101 to 203 mm/minute) range 6 inches/minute (152 mm/minute) target
e. Heat input:	25 to 63 kj/inch (1 to 2.5 kj/mm) range 45 kj/inch (1.8 kj/mm) target

ELECTRODE CHART (out of position welds) ELECTRODE SIZES AND APPLICATIONS				
APPLICATION	DESCRIPTION	STICK ELECTRODE DIAMETER	SHIELDED MANUAL ARC WELDING (SMAW)	
			Primary	Alternate
Flange Repair	1" Plate	3/32" - 1/8"	E-8018-C3	E-7018-1*
Web Plates	Bell Cut-Outs	3/32" - 1/8"	E-8018-C3	E-7018-1*
Tack Welds	All	3/32" - 1/8"	E-8018-C3	E-7018-1*
Original Welds	Under 10" (255 mm) Long	3/32" - 1/8"	E-8018-C3	E-7018-1*
	Over 10" (255 mm) Long	1/8"	E-8018-C3	E-7018-1*
Dump Bodies		1/8" - 5/32"	E-8018-C3	E-7018-1*
APPLICATION	DESCRIPTION	FLUX CORE WIRE DIAMETER	FLUX CORE ARC WELDING (FCAW)	
			Primary	Alternate
Wrapper Repair*	1" Plate	.045 - 1/16"	Lincoln 71M	Fronterc 71
Web Plates	Bell Cut-Outs	.045 - 1/16"	Lincoln 71M	Fronterc 71
Tack Welds	All	.045 - 1/16"	Lincoln 71M	Fronterc 71
Original Welds	Under 10" (255 mm) Long	.045 - 1/16"	Lincoln 71M	Fronterc 71
	Over 10" (255 mm) Long	.045 - 1/16"	Lincoln 71M	Fronterc 71
Dump Bodies		.045 - 1/16"	Lincoln 71M	Fronterc 71
* Lincoln, Esab, Hobart, etc. * (Note: Do not exceed 400° F (205° C) Interpass Temperature				19888

f. Preheat: As required by base material composition

g. Shielding gas: Argon

h. Gas flow: 0.35 to 0.42 cfm (9.85 to 11.83 liters/minute)

4. There shall be no undercut at the resulting dressed profile.

5. Weld parameters:

6. Added weld material is not required, but compatible weld consumable may be used to fill undercut resulting from initial welding.

TIG DRESSING PROCEDURE

PURPOSE: TO IMPROVE THE FATIGUE STRENGTH OF WELDED JOINTS THAT ARE NORMALLY SUSCEPTIBLE TO FATIGUE FAILURE AT THE WELD TOE.

REQUIREMENTS:

1. SURFACE SHALL BE CLEAN AND FREE OF MILLSCALE AND SLAG PRIOR TO INITIAL WELDING. BLASTING IS PREFERRED METHOD.

2. COMPLETED WELD SHALL BE CLEAN AND FREE OF SLAG BEFORE TIG DRESSING.

3. THE TIP OF THE ELECTRODE SHALL BE KEPT SHARP AND CLEAN.

4. THERE SHALL BE NO UNDERCUT AT THE RESULTING DRESSED PROFILE.

5. WELD PARAMETERS:

ELECTRODE	THORIATED TUNGSTEN, 0.12″-0.016″ DIAMETER
WELDING CURRENT	150-250A RANGE
WELDING VOLTAGE	10-25V RANGE
WELDING SPEED	4-8 IN/MIN. RANGE, 6 IN/MIN. TARGET
HEAT INPUT	25-63 KJ/IN RANGE, 45 KJ/IN TARGET
PREHEAT	AS REQ'D BY BASE MAT'L COMPOSITION.
SHIELDING GAS	ARGON
GAS FLOW	0.35-0.42 CFM

6. ADDED WELD METAL IS NOT REQUIRED, BUT COMPATIBLE WELD CONSUMABLE MAY BE USED TO FILL UNDERCUT RESULTING FROM INITIAL WELDING.

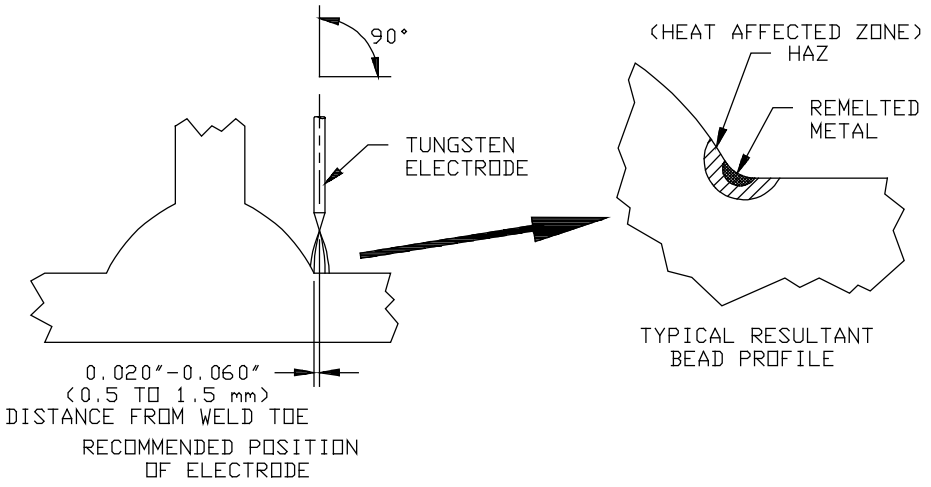


FIGURE 1 - TIG WELD DRESSING RECOMMENDATIONS (T-5089)

STANDARD TORQUE VALUES

BOLTS, STUDS, ETC.

GENERAL INFORMATION

These torque specifications are based on SAE bolt steel classifications. They should be observed in all cases unless directed otherwise by instructions in this manual. If a particular grade of bolt is to be replaced but is not available, only a higher specification bolt should be substituted.

PROCEDURE

When tightening a series of bolts, tighten them alternately and in even torque increments.

Never tighten bolts to the maximum on the first tightening sequence. Alternate the tightening process by tightening bolts directly opposite each other. In some cases, a specific tightening sequence may be outlined in this manual.

GRADE OF CAPSCREWS

The higher the grade of the bolt, the stronger the bolt is - i.e. a Grade 8 or Class 10.9 bolt is stronger than a Grade 5 or Class 8.8 bolt. BUCYRUS® products use Grade 5 or Class 8.8 bolts or stronger.

NOTES:

1. The charts shown in Figures 1 and 2 should be used as guides to torque all fasteners according to size, number of threads per standard length, and grade.
2. These charts are for both assembly and maintenance procedures.
3. The torque values are valid for any of the following lubricants (or equivalents):
a. All plated hardware
b. Thin oil film as received
c. 30 wt. engine oil
d. Hardened washers
4. The use of anti seize compounds is not recommended.
5. Grade 8 and Class 10.9 capscrews shall not be reused. Re-tightening of previously tightened capscrews that may have loosened, as a result of tightening adjacent capscrews shall not be considered a reuse.
6. Class 8.8 is approximately equivalent to SAE Grade 5.
7. Class 9.8 has properties approximately 9% stronger than SAE Grade 5.
8. Class 10.9 is approximately equivalent to SAE Grade 8.
9. It is recommended that to prevent damaging fine thread fasteners:
a. Both sets of threads are cleaned prior to installation.
b. The fastener is installed "hand" tightened sufficiently to ensure proper thread installation.
c. Impact tools are not employed in the tightening and torquing processes.

HYDRAULIC FITTINGS

GENERAL INFORMATION

Proper assembly and torque tightening of hydraulic system fittings will reduce external leakage, service time and requirements and improve overall system integrity and reliability.

NOTES:

1. The assembly torque values in the tables are for steel and stainless steel fittings, adapters, flanges, and hose ends manufactured to SAE specifications and ports manufactured to SAE specifications.
2. The fittings and ports are to be non-lubricated.
3. The O-rings must be lubricated with hydraulic oil or grease compatible with the oil in the hydraulic system.
4. The pipefittings require sealant or Teflon tape on the threads. These sealants should be selected for low hydraulic system contamination.

ASSEMBLY TORQUE METHODS

There are three primary methods of torque tightening the fittings:

1. Torque Method.

a. Uses a standard torque wrench, possibly incorporating "crows foot" or other adapters to allow for proper tightening.

b. Installation involves standard torque procedures used in conjunction with the torque values specified in the appropriate table.

c. Typical installations include the assembly of:

(1) O-ring boss fittings, port fittings, nipples and couplings.

SUGGESTED ASSEMBLY TORQUE VALUES				
SIZE	SAE GRADE 5 ASSEMBLY TORQUE		GRADE 8 ASSEMBLY TORQUE	
	Ft-Lb	Nm	Ft-Lb	Nm
1/4 - 20	6	8	9	12
1/4 - 28	7	9	10	14
5/16 - 18	13	18	18	24
5/16 - 24	14	19	20	27
3/8 - 16	23	31	32	43
3/8 - 24	26	35	37	50
7/16 - 14	37	50	53	72
7/16 - 20	41	56	58	79
1/2 - 13	55	75	80	108
1/2 - 20	65	90	90	122
9/16 - 12	80	108	115	156
9/16 - 18	90	122	130	176
5/8 - 11	115	156	160	217
5/8 - 18	125	170	180	244
3/4 - 10	200	271	280	380
3/4 - 16	225	305	315	427
7/8 - 9	325	441	455	617
7/8 - 14	355	481	500	678
1 - 8	485	658	680	922
1 - 12	530	719	745	1010
1 - 14	440	597	600	814
1 1/8 - 7	590	800	970	1315
1 1/8 - 12	670	900	1080	1465
1 1/4 - 7	835	1132	1360	1844
1 1/4 - 12	935	1268	1510	2048
1 3/8 - 6	1095	1485	1790	2427
1 3/8 - 12	1255	1702	2030	2753
1 1/2 - 6	1455	1973	2380	3228
1 1/2 - 12	1645	2231	2660	3607

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FIGURE 1 - STANDARD CAPSCREW TORQUE VALUES

(2) Tube nuts and swivels (if identical to plating or manufacturer of mating parts).

2. Flats from finger tight method (FFFT) (Figure 3)

a. Uses whatever appropriate wrench is available to tighten fitting.

b. Installation procedure:

SIZE	CLASS 8.8		CLASS 9.8		CLASS 10.9	
	Ft-Lb	Nm	Ft-Lb	Nm	Ft-Lb	Nm
M6.0 - 1.00	-	-	6	9	-	-
M6.3 - 1.00	-	-	8	10	10	13
M6.0 - 0.75	-	-	7	10	9	12
M8.0 - 1.25	-	-	15	21	20	27
M8.0 - 1.00	-	-	17	23	21	29
M10.0 - 1.50	-	-	31	42	39	54
M10.0 - 1.25	-	-	32	45	41	57
M12.0 - 1.75	-	-	53	74	68	94
M12.0 - 1.25	-	-	58	81	74	103
M14.0 - 2.00	-	-	85	118	109	151
M14.0 - 1.50	-	-	92	128	118	163
M16.0 - 2.00	122	169	-	-	169	234
M16.0 - 1.50	130	181	-	-	180	250
M18.0 - 2.50	169	234	-	-	234	323
M18.0 - 1.50	190	263	-	-	262	363
M20.0 - 2.50	239	330	-	-	330	457
M20.0 - 1.50	265	367	-	-	366	507
M22.0 - 2.50	325	451	-	-	450	623
M22.0 - 1.50	357	495	-	-	494	684
M24.0 - 3.00	412	571	-	-	570	790
M24.0 - 2.00	450	623	-	-	622	861
M27.0 - 3.00	605	837	-	-	836	1158
M27.0 - 2.00	652	903	-	-	902	1250
M30.0 - 3.50	820	1135	-	-	1134	1570
M30.0 - 2.00	908	1258	-	-	1256	1740
M30.0 - 1.50	939	1300	-	-	1299	1799
M36.0 - 4.00	1433	1985	-	-	1982	2745
M36.0 - 3.00	1517	2102	-	-	2099	2907

13805

FIGURE 2 – STANDARD CAPSCREW TORQUE VALUES (METRIC FASTENERS)

(1) Tighten the fitting “finger tight” (removing all slack from the fitting components).

NOTE: *If tools or other instruments are used to assist in this initial tightening of the fittings, care must be taken to prevent actually applying clamping torque to the fittings.*

(2) Mark initial corresponding flats on the stationary and swiveling surfaces.

(3) Mark the appropriate position that will indicate proper final torque.

(4) Using the appropriate tools, turn the swivel portion of the fitting the appropriate number of flats to

align the designated marks. Leave in this position.

c. Typical installations include the assembly of:

(1) Tube nuts and swivels (if different or unknown plating or manufacturer of mating parts).

(2) Port fittings, and tube and swivel nuts not accessible with a torque wrench.

3. Turns from finger tight method (TFFT) (Figure 3)

a. Uses whatever appropriate wrench is available to tighten fitting.

b. Installation procedure:

(1) Tighten the fitting “finger tight” (removing all slack from the fitting components).

NOTE: *If tools or other instruments are used to assist in this initial tightening of the fittings, care must be taken to prevent actually applying clamping torque to the fittings.*

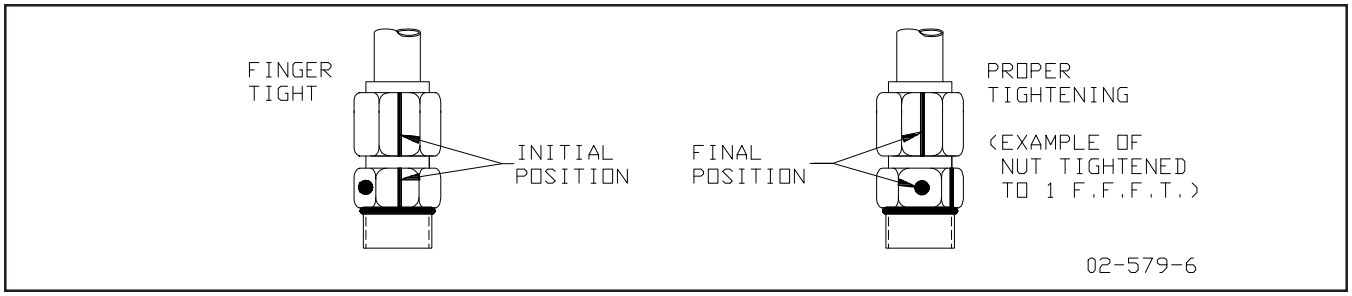

FIGURE 3 - TIGHTENING PROCEDURE FOR FITTINGS

TABLE 1

37 DEGREE FLARE AND FLARELESS NUTS
O'RING BOSS CONNECTORS
ADJUSTABLE O'RING BOSS CONNECTORS
HOSE SWIVEL ENDS
SOCKET/HEX O'RING BOSS PLUGS

DASH SIZE	PORT THREAD SIZE	PORT TORQUE (FT-LB)	PORT TORQUE (NM)	PORT F.F.F.T.	NUT THREAD SIZE	NUT TORQUE (FT-LB)	NUT TORQUE (NM)	TUBE NUT F.F.F.T.	SWIVEL NUT F.F.F.T.
2	5/16-24	5 +/- 1	7 +/- 1	1	5/16-24	3 +/- 1	4 +/- 1	-	-
3	3/8-24	11 +/- 1	15 +/- 1	1	3/8-24	6 +/- 1	8 +/- 1	-	-
4	7/16-20	14 +/- 1	19 +/- 1	1	7/16-20	12 +/- 1	16 +/- 1	2	2
6	9/16-18	27 +/- 2	37 +/- 3	1 1/2	9/16-18	21 +/- 1	29 +/- 1	1 1/2	1 1/4
8	3/4-16	42 +/- 2	57 +/- 3	1 1/2	3/4-16	45 +/- 2	61 +/- 3	1 1/2	1
10	7/8-14	60 +/- 2	82 +/- 3	1 1/2	7/8-14	60 +/- 5	82 +/- 7	1 1/2	1
12	1 1/16-12	80 +/- 5	109 +/- 7	1 1/2	1 1/16-12	85 +/- 5	116 +/- 7	1 1/4	1
14	1 3/16-12	105 +/- 6	143 +/- 8	1 1/2	1 5/16-12	105 +/- 5	143 +/- 7	1	1
16	1 5/16-12	115 +/- 6	156 +/- 8	1 1/2	1 5/16-12	120 +/- 5	163 +/- 7	1	1
20	1 5/8-12	225 +/- 12	306 +/- 16	1 1/2	1 5/8-12	170 +/- 10	231 +/- 14	1	1
24	1 7/8-12	250 +/- 12	340 +/- 16	1 1/2	1 7/8-12	200 +/- 15	272 +/- 20	1	1
32	2-12	325 +/- 15	442 +/- 20	1 1/2	2 1/2-12	270 +/- 20	367 +/- 27	1	1

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TABLE 2

O'RING FACE SEAL FITTINGS

DASH SIZE	PORT THREAD SIZE	PORT TORQUE (FT-LB)	PORT TORQUE (NM)	PORT F.F.F.T.	NUT THREAD SIZE	NUT TORQUE (FT-LB)	NUT TORQUE (NM)	TUBE NUT F.F.F.T.	SWIVEL NUT F.F.F.T.
4	7/16-20	15 +/- 1	20 +/- 1	1 1/2	9/16-18	11 +/- 1	15 +/- 1	2	2
6	9/16-18	25 +/- 1	34 +/- 1	1 1/2	11/16-16	19 +/- 1	26 +/- 2	1 1/2	1 1/4
8	3/4-16	55 +/- 5	73 +/- 5	1 1/2	13/16-16	33 +/- 2	45 +/- 2	1 1/2	1
10	7/8-14	76 +/- 4	104 +/- 6	1 1/2	1-14	48 +/- 2	64 +/- 4	1 1/2	1
12	1 1/16-12	130 +/- 5	177 +/- 7	1 1/2	1 3/16-12	67 +/- 3	93 +/- 2	1	1
16	1 5/16-12	210 +/- 10	285 +/- 15	2	1 7/16-12	96 +/- 4	130 +/- 5	1	1
20	1 5/8-12	245 +/- 35	333 +/- 48	2	1 11/16-12	133 +/- 7	180 +/- 10	1	1
24	1 7/8-12	315 +/- 45	430 +/- 60	2	2-12	157 +/- 7	212 +/- 12	1	1

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TABLE 3

PIPE THREAD FITTINGS

PIPE THREAD SIZE	TORQUE W/ SEALANT (FT-LB)	TORQUE W/O SEALANT (FT-LB)	TORQUE W/ SEALANT (N-M)	TORQUE W/O SEALANT (N-M)	T.F.F.T.
1/16-27	10 +/- 1	15 +/- 1	14 +/- 1	20 +/- 1	2-3
1/8-27	15 +/- 1	20 +/- 1	20 +/- 1	27 +/- 3	2-3
1/4-18	20 +/- 2	25 +/- 2	27 +/- 3	34 +/- 3	1.5-3
3/8-18	25 +/- 2	35 +/- 2	34 +/- 3	48 +/- 3	2-3
1/2-14	35 +/- 2	45 +/- 3	48 +/- 3	61 +/- 4	2-3
3/4-14	45 +/- 3	55 +/- 3	61 +/- 4	75 +/- 4	2-3
1-11 1/2	55 +/- 3	65 +/- 3	75 +/- 4	88 +/- 4	1.5-2.5
1 1/4-11 1/2	70 +/- 4	80 +/- 4	95 +/- 5	109 +/- 5	1.5-2.5
1 1/2-11 1/2	80 +/- 4	95 +/- 5	109 +/- 5	129 +/- 7	1.5-2.5
2-11 1/2	95 +/- 5	120 +/- 5	129 +/- 7	163 +/- 7	1.5-2.5

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TABLE 4

FLANGED FITTING - SCHEDULE 61
4 BOLT SPLIT FLANGE

FLANGE SIZE	BOLT THREAD	BOLT LENGTH	TORQUE (FT-LB)	TORQUE (N M)
1/2	5/16-18	1 1/4	17 +/- 2	22 +/- 2
3/4	3/8-16	1 1/4	25 +/- 4	34 +/- 6
1	3/8-16	1 1/4	31 +/- 4	43 +/- 5
1 1/4	7/16-14	1 1/2	40 +/- 5	56 +/- 6
1 1/2	1/2-13	1 1/2	52 +/- 7	70 +/- 9
2	1/2-13	1 1/2	61 +/- 7	81 +/- 9
2 1/2	1/2-13	1 3/4	86 +/- 7	113 +/- 9
3	5/8-11	1 3/4	145 +/- 7	194 +/- 9
3 1/2	5/8-11	2	125 +/- 8	169 +/- 12
4	5/8-11	2	125 +/- 8	169 +/- 12
5	5/8-11	2 1/4	125 +/- 8	169 +/- 12

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TABLE 5

FLANGED FITTING - SCHEDULE 62
4 BOLT SPLIT FLANGE

FLANGE SIZE	BOLT THREAD	BOLT LENGTH	TORQUE (FT-LB)	TORQUE (NM)
1/2	5/16-18	1 1/4	17 +/- 2	22 +/- 2
3/4	3/8-16	1 1/2	29 +/- 4	40 +/- 5
1	7/16-14	1 3/4	46 +/- 4	62 +/- 6
1 1/4	1/2-13	1 3/4	69 +/- 6	93 +/- 9
1 1/2	5/8-11	2 1/4	125 +/- 7	169 +/- 12
2	3/4-10	2 3/4	208 +/- 8	282 +/- 12

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(2) Mark initial corresponding position on the stationary and swiveling surfaces.

(3) Mark the appropriate position that will indicate proper final torque.

(4) Using the appropriate tools, turn the swiveling portion of the fitting to the appropriate position to align the designated marks. Leave in this position.

c. Typical installations include the assembly of:

(1) Pipe fittings.

(2) Pipe fittings not accessible to torque wrenches.

METRIC CONVERSIONS

GENERAL

Information concerning metric conversions is provided here to aid and supplement the use of dual dimensioning in this manual. Two tables are presented here to show conversions from U.S. Standard units to their metric equivalents.

TABLE 1 - METRIC CONVERSIONS

Table 1 - Metric Conversions, includes some of the most common units and the metric conversions from practical use. Also included are the unit abbreviations used in this manual. Multiply the U.S. standard unit in the left column by the figure shown in the second column to obtain the metric equivalent. Multiply the metric number in the center column by the number in the column to its right to obtain the desired U. S. standard equivalent.

TABLE 2 - DECIMAL EQUIVALENTS

Table 2 - Decimal Equivalents contains fraction of inches with the appropriate decimal equivalents in inches and millimeters. The fractions are shown in intervals of 1/64 inch (0.4 mm).

Multiply:	by:	to get:	Multiply:	by:	to get:
		LINEAR			
inches (in.)	x 25.4	= millimeters (mm)		x 0.03937	= inches
feet (ft.)	x 0.3048	= meters (m)		x 3.281	= feet
yards (yds.)	x 0.9144	= meters (m)		x 1.0936	= yards
miles (mi.)	x 1.6093	= kilometers (km)		x 0.6214	= miles
microinches (μ in.)	x 0.0254	= micrometers (μm)		x 39.37	= microinches
		AREA			
inches^2 (sq. in.)	x 645.16	= millimeters^2 (mm^2)		x 0.000155	= inches^2
feet^2 (sq. ft.)	x 0.0929	= meters^2 (m^2)		x 10.764	= feet^2
yards^2 (sq. yds.)	x 0.8361	= meters^2 (m^2)		x 1.196	= yards^2
acres	x 0.4047	= hectometers (hm^2) [hectares (ha)]		x 2.471	= acres
		VOLUME			
inches^3 (cu. in.)	x 16387	= millimeters^3 (mm^3)		x 0.000061	= inches^3
inches^3 (cu. in.)	x 0.01639	= liters (l)		x 61.024	= inches^3
quarts (qts.)	x 0.94635	= liters (l)		x 1.0567	= quarts
gallons (gal.)	x 3.7854	= liters (l)		x 0.2642	= gallons
feet^3 (cu. ft.)	x 28.317	= liters (l^3)		x 0.03531	= feet^3
feet^3 (cu. ft.)	x 0.02832	= meters^3 (m^3)		x 35.315	= feet^3
fluid oz. (fl. oz.)	x 29.57	= millileters (ml)		x 0.03381	= fluid oz.
yards^3 (cu. yds.)	x 0.7646	= meters^3 (m^3)		x 1.3080	= yards^3
teaspoons (tsp.)	x 4.929	= millileters (ml)		x 0.2029	= teaspoons
cups	x 0.2366	= liters (l)		x 4.227	= cups
		MASS			
ounces (oz.)	x 28.35	= grams (g)		x 0.03527	= ounces
pounds (lbs.)	x 0.4536	= kilograms (kg)		x 2.2046	= pounds
tons (2000 lb.)	x 907.18	= kilograms (kg)		x 0.001102	= tons (2000 lb.)
tons (2000 lb.)	x 0.90718	= metric tons (t)		x 1.1023	= tons (2000 lb.)
tons (long) (2240 lb.)	x 1016.05	= kilograms (kg)		x .000984	= tons (long) (2240 lb.)
		FORCE			
ounces - - f	x 0.278	= newtons (N)		x 3.597	= ounces - - f
pounds - - f	x 4.448	= newtons (N)		x 0.2248	= pounds - - f
kilograms - - f	x 9.807	= newtons (N)		x 0.10197	= kilograms - - f

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SHEET I OF 2

TABLE 1 - METRIC CONVERSION

Multiply:	by:	to get:	Multiply: by:	to get:
ENERGY OR WORK (watt-second = joule = newton-meter)				
foot-pounds (ft.-lbs.)	x 1.3558	= joules (J)	x 0.7376	= foot-pounds
calories (c)	x 4.187	= joules (J)	x 0.2388	= calories
Btu	x 1055	= joules (J)	x 0.000948	= Btu
watt-hours (w-h)	x 3600	= joules (J)	x 0.0002778	= watt-hours
kilowatt-hrs. (kw-h)	x 3.600	= megajoules (MJ)	x 0.2778	= kilowatt-hrs.
PRESSURE OR STRESS (newton sq. meter = pascal)				
inches Hg (60°F)	x 3600	= kilopascals (kPa)	x 0.2961	= inches Hg
pounds/sq. in.	x 6.895	= kilopascals (kPa)	x 0.145	= pounds/sq. in.
inches H_20 (60°F)	x 0.2488	= kilopascals (kPa)	x 4.0193	= inches H_20
bars	x 100	= kilopascals (kPa)	x 0.01	= bars
pounds/sq. ft. (psf)	x 47.88	= pascals (Pa)	x 0.02088	= pounds/sq. ft.
POWER				
horsepower (hp)	x 0.746	= kilowatts (kW)	x 1.34	= horsepower
ft.-lbs./min.	x 0.0226	= watts (W)	x 44.25	= ft.-lbs./min.
TORQUE				
pound-inches (in.-lbs.)	x 0.11298	= newton-meters (Nm)	x 8.851	= pound-inches
pound-feet (ft.-lbs.)	x 1.3558	= newton-meters (Nm)	x 0.7376	= pound-feet
VELOCITY				
miles/hour (mph)	x 1.6093	= kilometers/hour (km/hr)	x 0.6214	= miles/hour
feet/sec (ft./sec.)	x 0.3048	= meters/sec (m/sec)	x 3.281	= feet/sec
kilometers/hr. (km/hr)	x 0.27778	= meters/sec (m/sec)	x 3.600	= kilometers/hr
miles/hour (mph)	x 0.4470	= meters/sec (m/sec)	x 2.237	= miles/hour

TEMPERATURE

°Celsius = 0.556 (F-32) °F = (1.8°C)+32

COMMON METRIC PREFIXES

mega (M)	= 1 000 000	or 10^6	deci (d)	= 0.1	or 10^1
kilo (k)	= 1 000	or 10^3	centi (c)	= 0.01	or 10^2
hecto (h)	= 100	or 10^2	milli (m)	= 0.001	or 10^3
deka (da)	= 10	or 10^1	micro (μ)= 0.000 001	or 10^6	

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TABLE 1 - METRIC CONVERSION - CONTINUED

FRACTION (IN.)	DECIMAL EQUIVALENT (IN.)	DECIMAL EQUIVALENT (MM)	FRACTION (IN.)	DECIMAL EQUIVALENT (IN.)	DECIMAL EQUIVALENT (MM)
1/64	0.015625	0.39688	33/64	0.515625	13.09690
1/32	0.03125	0.79375	17/32	0.53125	13.49378
3/64	0.046875	1.19063	35/64	0.546875	13.89065
1/16	0.0625	1.5875	9/16	0.5625	14.28753
5/64	0.078125	1.98438	37/64	0.578125	14.6844
3/32	0.09375	2.38125	19/32	0.59375	15.08128
7/64	0.109375	2.77813	39/64	0.609375	15.47816
1/8	0.125	3.17501	5/8	0.625	15.87503
9/64	0.140625	3.57188	41/64	0.640625	16.27191
5/32	0.15625	3.96878	21/32	0.65625	16.66878
11/64	0.171875	4.36563	43/64	0.671875	17.06566
3/16	0.1875	4.76251	11/16	0.6875	17.46253
13/64	0.203125	5.15939	45/64	0.703125	17.85941
7/32	0.21875	5.55626	23/32	0.71875	18.25629
15/64	0.234375	5.95314	47/64	0.734375	18.65316
1/4	0.25	6.35001	3/4	0.75	19.05004
17/64	0.265625	6.74689	49/64	0.765625	19.44691
9/32	0.28125	7.14376	25/32	0.78125	19.84379
19/64	0.296875	7.54064	51/64	0.796875	20.24066
5/16	0.3125	7.93752	13/16	0.8125	20.63754
21/64	0.328125	8.33439	53/64	0.828125	21.03442
11/32	0.34375	8.73127	27/32	0.84375	21.43129
23/64	0.359375	9.12814	55/64	0.859375	21.82817
3/8	0.375	9.52502	7/8	0.875	22.22504
25/64	0.390625	9.92189	57/64	0.890625	22.62192
13/32	0.40625	10.31877	29/32	0.90625	23.0188
27/64	0.421875	10.71565	59/64	0.921875	23.41567
7/16	0.4375	11.11252	15/16	0.9375	23.81255
29/64	0.453125	11.50940	61/64	0.953125	24.20942
15/32	0.46875	11.90627	31/32	0.96875	24.6063
31/64	0.484375	12.30315	63/64	0.984375	25.00317
1/2	0.50	12.70002	1	1.0	25.40005

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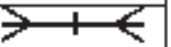
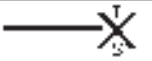
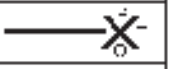
TABLE 2 - DECIMAL EQUIVALENTS

STANDARD GRAPHIC SYMBOLS

GENERAL

Figure 1, Standard Graphic Symbols, represents the standard graphic symbols used on the hydraulic and pneumatic schematics in this manual. For detailed explanations of each schematic, refer to the appropriate information in Section 5 - Hydraulic System, Section 6 - Pneumatic System, Section 9 - Options, or the appropriate manufacturer's information.

LINES AND LINE FUNCTIONS	
LINE, WORKING	
LINE, PILOT (L > 20 W)	
LINE, DRAIN OR EXHAUST (L < 5 W)	
CONNECTOR (DOT TO BE 5X WIDTH OF LINES)	
LINE, FLEXIBLE	
LINE, JOINING	
LINE, PASSING	
DIRECTION OF FLOW: hydraulic	
DIRECTION OF FLOW: pneumatic	
QUICK DISCONNECT: CONNECTED	
QUICK DISCONNECT: DISCONNECTED	
PLUG OR PLUGGED CONNECTION	
TESTING STATION (GAUGE CONNECTION)	
POWER TAKEOFF (HYD.)	
RESTRICTION, FIXED	
RESTRICTION, VARIABLE	

COMPRESSORS OR PUMPS	
COMPRESSOR, FIXED DISPLACEMENT	
PUMP, HYDRAULIC	

MOTORS AND CYLINDERS	
PNEUMATIC MOTOR, UNI-DIRECTIONAL	
PNEUMATIC MOTOR, BI-DIRECTIONAL	
ELECTRIC MOTOR	
CYLINDER, SINGLE ACTING	
Double-acting cylinder in which diameter of rod compared to diameter of bore is significant in circuit function	
PRESSURE INTENSIFIER	

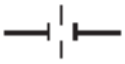
MISCELLANEOUS UNITS	
ROTATING SHAFT (ARROW IN FRONT OF SHAFT)	
COMPONENT ENCLOSURE	
RESERVOIR	
PRESSURE GAUGE	
PRESSURE SWITCH	
MULTIPLE	
ORIFICE PLATE	
TEMPERATURE GAUGE	
INTERNAL-COMBUSTION ENGINE	

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FIGURE 1 - STANDARD GRAPHIC SYMBOLS

VALVES AND BASIC SYMBOLS	
VALVE, CHECK	
VALVE, MANUAL SHUT OFF	
VALVE, MAXIMUM PRESSURE (RELIEF)	
VALVE, BASIC SYMBOL SINGLE FLOW PATHS MODIFIED	
VALVE, BASIC SYMBOL MULTIPLE FLOW PATHS ARE CHANGED	
VALVE, SINGLE FLOW PATH, NORMALLY CLOSED	
VALVE, SINGLE FLOW PATH, NORMALLY OPEN	
VALVE, MULTIPLE FLOW PATHS, BLOCKED INFINITE POSITIONING	
VALVE, MULTIPLE FLOW PATHS, OPEN (ARROWS DENOTE DIRECTION OF FLOW)	
TWO - POSITION, SNAP ACTION WITH TRANSITION	

VALVE EXAMPLES	
VALVE, RELIEF REMOTELY OPERATED (UNLOADING VALVE)	
VALVE, TWO WAY NORMALLY OPEN	
VALVE, PRESSURE PROTECTION	
VALVE, PRESSURE REDUCING	

VALVE EXAMPLES (CONT.)	
PILOT CONTROLLED, SPRING - CENTERED (Simplified / Complete)	
ADJUSTABLE, PRESSURE COMPENSATED FLOW CONTROL, WITH BYPASS	

FLUID CONDITIONERS	
FILTER STRAINER	
COOLER, GASEOUS COOLING MEDIA	
HEATER, GASEOUS HEATING MEDIA	

METHODS OF CONTROL	
SPRING	
PILOT OPERATED	
PILOT OPERATED, DIFFERENTIAL AREA REMOTE SUPPLY - INTERNAL SUPPLY	
MANUAL, PUSH BUTTON	
MANUAL, PUSH-PULL LEVER	
MANUAL, PEDAL OR TREADLE	
MECHANICAL	
OTHER *INSERT APPROPRIATE SYMBOL OR NAME	*

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FIGURE 1 - STANDARD GRAPHIC SYMBOLS, CONTINUED

COMPONENT WEIGHTS

The following represent typical weights for normally serviced truck components. These are representative only and may vary between installations and may change without notice.

Care should be given whenever attempting to lift or move these components to prevent personal injury or damage to these or other equipment.

Component	Identification	Weight	
		lb	kg
Structure			
Cab	—	6,000	2 721
Fuel Tank		1,600	725
Bracket		600	275
Hydraulic Tank		675	305
Electrical			
Electrical Control Box		5,700	2 585
Control Panel	17FL375/386	75	35
Contactor – GF		35	16
Contactor – P1		70	30
Contactor – RP		70	30
Rectifier		60	27
Retarding Grid Box Assembly		5,100	2 315
Blower Motor		950	430
Grids		150	70
Power Package			
Air Cleaner Assembly		275	125
Engine	DDC 16V4000	15,815	7 175
	Cummins	16,610	7 535
Radiator Assembly	Wabtec (Young)	5,100	2 315
High Temperature Core		1,350	615
Low Temperature Core		1,350	615
Traction Alternator	GTA41	9,000	4 085
Hydraulic System			
Brake System			
Accumulator		55	25
Controller Valve Assembly		10	05
Manifold Assembly		35	16
Pedal Valve Assembly		06	03
Dump System			
Control Valve		310	140
Cylinder		2,000	910
Pilot Valve		10	05
Pumps (Double Pump Assembly)		295	135
Steering System			
Accumulator		520	235
Cylinder		300	135
Flow Amplifier		65	35
Hand Pump		20	10
Manifold		35	16
Manual Power Supply Pump		75	35
Pump (Rear Section) - Standard		75	35

Component	Identification	Weight lb	Weight kg
Pneumatic System			
Not available			
Running Gear			
Front Axle Assembly (with brakes)		34,500	15 650
Spindle Assembly		1,925	875
Suspension Assembly - Side charge port		1,900	860
Steering Linkage			
Steering Arms		400	180
Tie Rod Assembly		800	360
Wheel Assembly			
Inner Bearing		190	80
Outer Bearing		75	35
Seal		10	05
Seal Ring		40	18
Wheel		3,700	1 670
Rear Axle Assembly			
Axlebox Assembly		14,000	6 350
Suspension Assembly - Side charge ports		1,750	795
Wheelmotors (w/o brakes)	GE GEB25	27,000	12 245
Wheelmotor (w brakes)		28,000	12 700
Tire and Rim Assemblies			
Assemblies			
50/80 X 57 tires (Titan rims)		11,670	5 290
Rims			
32 X57 (Titan)		3,400	1 540
Tires			
50/80 X 57		8, 270	3 750
Brake System			
Front			
Bracket			
Carlisle		415	188
Rockwell		400	180
Caliper			
Carlisle		260	118
Rockwell		215	98
Discs			
Carlisle		315	145
Rockwell		375	170
Park			
Bracket			
Carlisle		85	38
Rockwell		75	34
Caliper			
Carlisle		125	55
Rockwell		85	40

Component	Identification	Weight lb	Weight kg
Rear			
Caliper			
Carlisle		135	61
Rockwell		155	70
Disc			
Carlisle		110	45
Rockwell		110	45

STANDARD MAN-HOURS FOR COMPONENT REMOVAL AND REPLACEMENT MT 3000/3300/3300AC/3600B/3700B/3700AC/ 4000AC/4400/4400AC

GENERAL

The information in Table 1 reflects the typical man-hours required to remove and replace the listed component.

Assumptions included in these times include:

1. Prior to beginning the task:

a. The work area is clean and free of obstructions and other possible problems.

b. All required parts, tools and tooling, lifting, safety and other equipment is near or at the work area. It must all be available in a timely manner to avoid wasted time.

c. The truck and components are washed and cleaned and are positioned in safe operating conditions.

2. Time for personnel breaks, including travel, meal, “smoke”, etc. are not included.

3. The task hours do not include other tasks that need to be performed prior to or after the listed primary tasks.

4. Time for fluid, oils, lubricants, etc. draining and refilling is included in these hours.

NOTE: *Times are typical only and subject to change without notice.*

TABLE 1 – TYPICAL COMPONENT REMOVE AND REPLACE TIMES

COMPONENTS	REMOVE & REPLACE (TYPICAL MAN-HOURS)	COMPONENTS	REMOVE & REPLACE (TYPICAL MAN-HOURS)
STRUCTURE		**ELECTRICAL**	
Bushing, Dump Body	6	Batteries (1 set)	1
Bushing, Suspension	5	Contactors (each)	1
Cab, R.O.P.S.	24	Dump Body Up Switch	0.5
Door Latch, Cab	1	Grid Blower Motor	3
Door, Cab	3	Master Switch Assembly	0.5
Dump Body	6	Pressure Switch, Axlebox	0.5
Fuel Level Sender	0.5	Switch, Battery Disconnect	0.5
Fuel Tank	4	Switch, Brake Drag	0.5
Gauge, Dash	0.5	Switch, Dash	0.5
Gauge, Hydraulic	0.5	Switch, Electrical	0.5
Heater Blower Motor	1	Switch, Selector	1
Heater Core	4	Turn Signal Flasher	0.5
Pedal, Brake	1		
Pedal, Retard	1	**POWER PACKAGE**	
Pedal, Throttle	1	Air Cleaner	1
Pin, Retaining Dump Body	2	Engine Air Intake Line	4
Seat, Driver	1	Engine Module	48
Seat, Passenger	1	Exhaust Line	4
Steering Column	2	Flex Hose, Wheelmotor Cooling	1
Window, Door	2	Pressure Regulator, Radiator	1
Window, Rear Cab	1	Radiator	7
Windshield	2	Radiator Cap	0.5
Windshield Wiper Motor	1	Sensor, Engine	0.5

COMPONENTS	REMOVE & REPLACE (TYPICAL MAN-HOURS)
HYDRAULIC SYSTEM	
Accumulator, Brake	1
Accumulator, Steering	3
Brake Manifold	6
Brake Pilot Valve	2
Brake System (Dual) Valve	3
Driveshaft	1
Dump Cylinder	3
Dump Lever	2
Dump Pilot Valve	1
Dump Valve	6
Hoses, Hydraulic	1
Hydraulic Tank	5
.Suction Valve	4
Load Brake Shuttle Valve	1
Pump, Manual Power Supply	1.5
Pump, Steering	2
Pump, Hydraulic (Tandem)	4
Sensor, Hydraulic Oil Level	0.5
Sensor, Hydraulic Oil Temperature	0.5
Steering Cylinder	3
Steering Flow Amplifier	2
Steering Hand Pump	1
Steering Manifold	4
RUNNING GEAR	
Axlebox	50
Axlebox Door	0.5
Axlebox Nosecone Bearing	15
Axlebox Nosecone Seal (each side)	1
Front Axle Assembly	14
Front Axle King Pin	6
Front Axle King Pin Bushing	10
Front Axle Spindle (Each)	16
Front Wheel Bearing	6
Pin, Retaining Radius Rod	2
Pin, Retaining Steering Cylinder	1
Pin, Retaining Suspension	2
Radius Rod Arm, Axlebox	4
Radius Rod Arm, Front Axle	3
Steering Yoke	2
Suspension, Front	4
Suspension, Rear	4
Tie Rod	3
Tires (Each position)	
Front	1.5
Rear	2
Wheelmotor	24

COMPONENTS	REMOVE & REPLACE (TYPICAL MAN-HOURS)
BRAKES	
Brake Caliper, Front	3
Brake Caliper Mount, Front	4
Brake Caliper, Park Brake	2
Brake Caliper, Rear Inside	4
Brake Caliper, Rear Outside	2
Brake Disc, Front	8
Brake Disc, Rear	4
OPTIONS	
Autolube Grease Injector	0.5
Autolube System Pump	1
Hoses, Lube	1
Hubodometer	0.5
Weigh System Control Board	1
Weigh System Display	1
Weigh System Transducer	2
MISCELLANEOUS	
A/C Receiver/Dryer	2
Air Compressor, Seat	1
Compressor, Freon	2
Radio	1