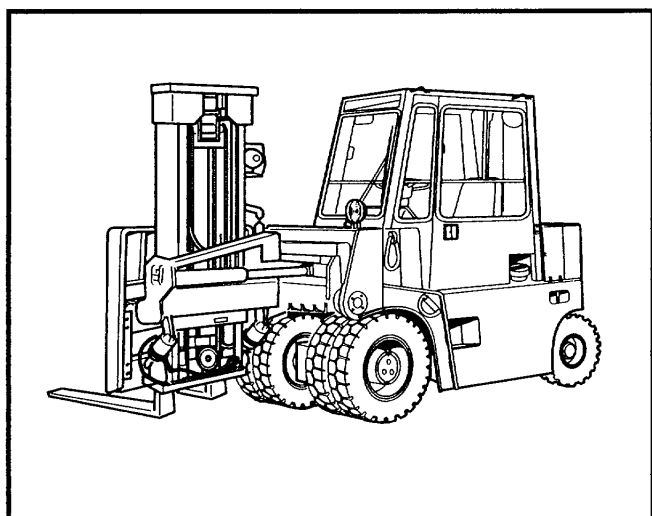


TECHNICAL MANUAL

**DIRECT SUPPORT AND
GENERAL SUPPORT
MAINTENANCE MANUAL**



**TRUCK, LIFT, FORK,
CLEAN BURN DIESEL ,
FRONT/SIDE LOADING**

**6,000 LB CAPACITY
MODEL R60SL-DC**

NSN 3930-01-378-7497

**Approved for public release;
distribution is unlimited.**

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TECHNICAL MANUAL

No. 10-3930-669-34

**HEADQUARTERS
DEPARTMENT OF THE ARMY**
Washington, D.C. 21 JANUARY 1997

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE

**TRUCK, LIFT, FORK, CLEAN BURN DIESEL,
FRONT/SIDE LOADING,
6,000 LB CAPACITY
MODEL R60SL-DC
NSN 3930-01-378-7497**

Approved for public release; distribution is unlimited.

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located at the back of this manual direct to: Commander, US Army Tank-automotive and Armament Command, ATTN: AMSTA-IM-OPIT, Warren, MI 48397-5000. A reply will be furnished to you. You may also provide DA Form 2028-2 information to TACOM via datafax or e-mail. TACOM's datafax number for AMSTA-IM-OPIT is (810) 574-6323 and the e-mail address is: amsta-im-opit @cc.tacom-tech-pubs @ cc.tacom.army.mil.

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HOW TO USE THIS MANUAL

This manual is designed to help maintain the Truck, Lift, Fork NSN 3930-01-378-7497. Listed below are some special features included in this manual to help locate and use the needed information:

- A front cover table of contents is provided for quick reference to chapters and sections that will be used often.
- WARNING, CAUTION, and NOTE headings, subject headings, and other essential information are printed in bold type making them easier to see.
- The maintenance tasks describe what must be done to the forklift before starting the task (Equipment Condition), and what must be done to return the vehicle to operating condition after the task is finished (Follow-On Maintenance).
- The Appendixes are located at the end of the manual. They contain a reference guide to other manuals, a list of expendable supplies and materials, and other material for maintaining the forklift.
- In addition to text, there are exploded-view illustrations showing how to take a component off and put it back on. Cleaning and inspection procedures are also included as required.
- Chapter 2 of this manual covers Direct Support and General Support level Preventive Maintenance Checks and Services (PMCS) and basic troubleshooting, as well as general maintenance.

Follow these guidelines when using this manual:

- Read all WARNINGS and CAUTIONS before performing any procedure.
- The equipment conditions found in the maintenance procedures are of a general nature and the mechanic may be able to perform only certain steps within a procedure to accomplish the equipment condition.

WARNING

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read **NO SMOKING WITHIN 50 FEET (15 m)**.

WARNING

Transmission oil is slippery and can cause falls. To avoid injury, wipe up spilled oil with rags.

WARNING

Engine/Transmission assembly weighs 430 lbs (195 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

WARNING

- Dry-cleaning solvent (P-D-680) is **TOXIC** and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

WARNING

Use care when removing springs. A compressed spring can act as a projectile when released and could cause severe injury.

WARNING

Use care when removing snap ring and retaining rings. Snap ring and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

WARNING

Allow engine to cool before performing maintenance on the muffler, exhaust pipe, exhaust manifold, or turbocharger. If necessary, use insulated pads and gloves.

WARNING

Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

WARNING

Do not touch hot parts with bare hands; injury to personnel will result.

WARNING

Oil will spray from cylinder barrel ports when rod is moved in or out. Cover ports with two cleaning cloths to prevent oil from spraying. Failure to comply may result in injury to personnel.

WARNING

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.). Failure to comply may result in injury or death to personnel.

WARNING

High pressure hydraulics operate this equipment. Refer to vehicle operator and maintenance manuals for hydraulic oil pressure. Never disconnect any hydraulic line or fitting without first dropping pressure to zero. A high pressure oil stream can pierce body and cause severe injury to personnel.

WARNING

All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

WARNING

Applying excessive or uneven pressure to cab glass may cause it to crack or break resulting in injury to personnel and damage to equipment.

WARNING

Hydraulic oil is flammable. Ensure engine is cool to prevent fire. Injury or death to personnel could result.

WARNING

Use extreme care when removing or installing lock wire. Lock wire is under tension and can act as a projectile when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

WARNING

Remove rings, bracelets, wristwatches, and neck chains before working on any vehicle. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.

WARNING

Steam cleaning creates hazardous noise levels and severe burn potential. Eye, skin, and ear protection are required. Failure to comply may result in injury to personnel.

WARNING

Solvents used with a spray gun must be used in a spray booth with filter. Face shield must be used by personnel operating spray gun. Failure to comply may result in injury to personnel.

WARNING

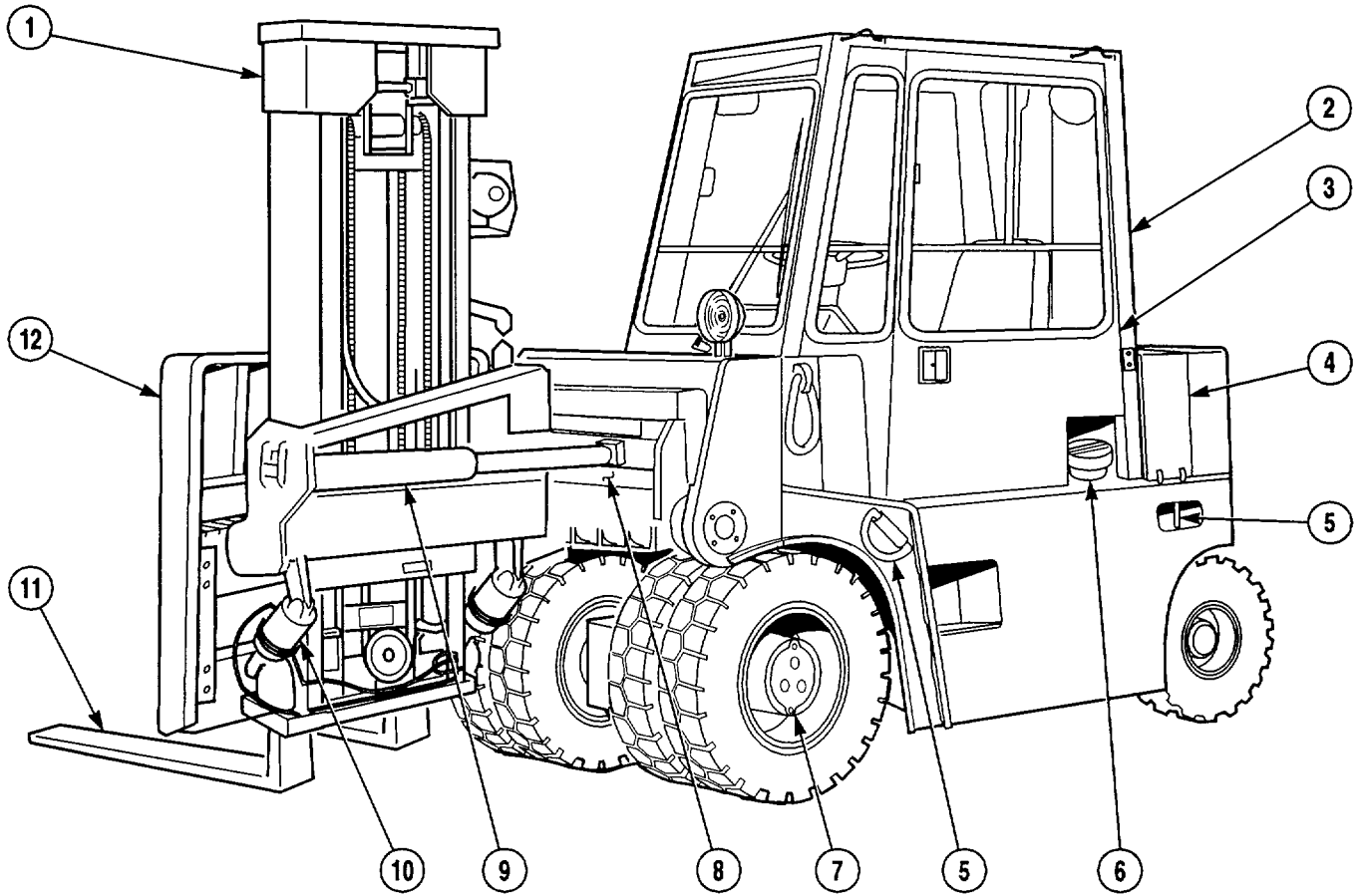
On direct contact, uncured silicon sealant irritates eyes. In case of contact, flush eyes with water and seek medical attention. In case of skin contact, wipe off and flush with water.

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CHAPTER 1
INTRODUCTION

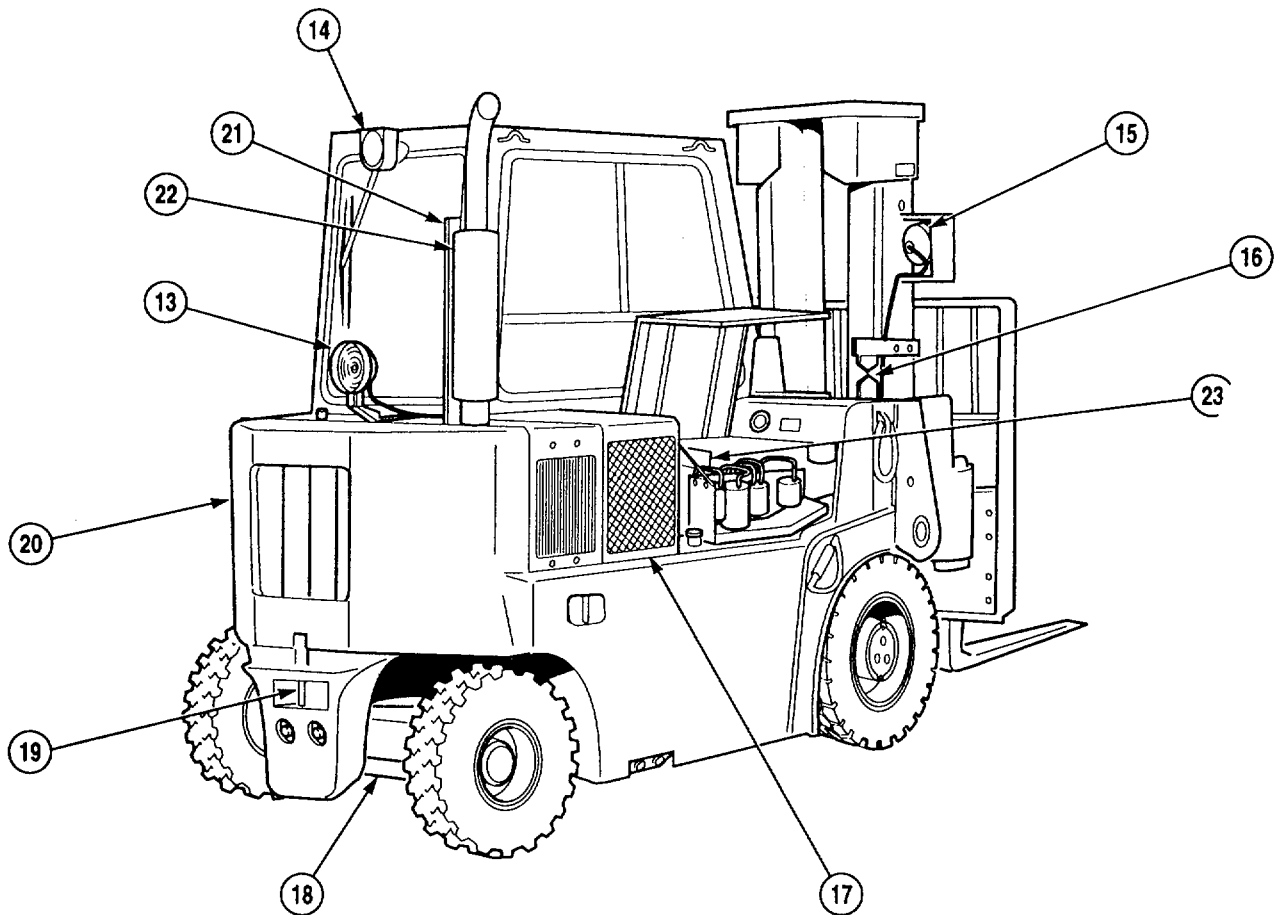
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Section I. GENERAL INFORMATION



- | | |
|-----------------------------|-----------------------|
| 1. Mast Assembly | 7. Drive Axle |
| 2. Cab | 8. Shift Cylinder |
| 3. Cab Door | 9. Pivot Cylinder |
| 4. Rear Engine Access Cover | 10. Tilt Cylinders |
| 5. Tie Down Points | 11. Forks |
| 6. Fuel Tank | 12. Carriage Assembly |

Figure 1-1. Truck, Lift, Fork (Sheet 1 of 2)



- | | |
|--------------------------|---------------------|
| 13. Rear Flood Light | 19. Tow Pin |
| 14. Taillight | 20. Counterweight |
| 15. Front Flood Light | 20. Counterweight |
| 16. Mast Level Indicator | 21. Load Rest |
| 17. Engine Panel | 22. Exhaust Muffler |
| 18. Steer Axle | 23. Battery Box |

Figure 1-1. Truck, Lift, Fork (Sheet 2 of 2)

1-1. SCOPE.

a. Type of Manual. This manual is used for direct support and general support maintenance of the Truck, Lift, Fork.

b. Model Number and Equipment Name. Truck, Lift, Fork, NSN 3930-01-378-7497, produced by Drexel Industries, Inc. of Pennsylvania, Model R60SL-DC. (See Figures 1-1 and 1-2.)

c. Purpose of Equipment. The Truck, Lift, Fork, hereinafter referred to as the forklift, is designed to operate as a conventional, counterbalanced, front-loading forklift with the additional capability of operating as a side-loading forklift.

1-2. MAINTENANCE FORMS, RECORDS, AND REPORTS.

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738-750, The Army Maintenance Management System (TAMMS) (Maintenance Management UPDATE).

1-3. DESTRUCTION OF ARMY MATERIAL TO PREVENT ENEMY USE.

Command decision, according to the tactical situation, will determine when the destruction of the forklift will be accomplished. A destruction plan will be prepared by the using organization unless one has been prepared by a higher authority. For general destruction procedures for this equipment, refer to TM 750-244-6, Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use (U.S. Army Tank-Automotive Command).

1-4. PREPARATION FOR STORAGE OR SHIPMENT.

Refer to Chapter 2, Section VI, of this manual for Preparation for Storage or Shipment.

1-5. OFFICIAL NOMENCLATURE, NAMES, AND DESIGNATIONS.

REFERENCE INFORMATION

This listing includes the nomenclature cross-reference list and list of abbreviations used in this manual.

NOMENCLATURE CROSS-REFERENCE LIST

Common List

Forklift

Official Nomenclature

Truck, Lift, Fork, Clean Burn Diesel,
Front/Side Loading, 6,000 LB. Capacity,
Model R60SL-DC
NSN 3930-01-378-7497

1-6. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR).

If your 6,000 lb forklift needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about our equipment. Let us know why you don't like the design or performance. Put it on an SF368 (Product Quality Deficiency Report). Mail it to us at: Commander, U S Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/MPA, Warren, Michigan 483975000. A reply will be furnished to you.

1-7. WARRANTY INFORMATION.

The warranty starts on the date found in block 23, DA Form 2408-9 in the logbook. Report all defects in material and workmanship to your supervisor, who will take the appropriate action. Warranty information is listed in TM 10-3930-669-20.

1-8. CORROSION PREVENTION AND CONTROL.

Corrosion Prevention and Control (CPC) of Army materials is a continuing concern. It is important that any corrosion problems with the forklift be reported so that the problem can be corrected and improvements can be made to prevent the problem in the future.

While corrosion is typically associated with rusting of metals, corrosion can also include deterioration of other materials, such as rubber and plastic. Unusual cracking, softening, swelling, or breaking of these materials may be a corrosion problem.

If a corrosion problem is identified, it can be reported using Standard Form 368, Product Quality Deficiency Report. Use of key words such as "corrosion, rust, deterioration, and cracking" will ensure that the information is identified as a CPC problem.

The form should be submitted to the address specified in DA PAM 738-750.

1-9. NUCLEAR HARDNESS.

Is not required for this end item.

Section II. EQUIPMENT DESCRIPTION AND DATA**1-10. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES.**

Refer to TM 10-3930-669-10 for Equipment Characteristics, Capabilities, and Features.

1-11. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS.

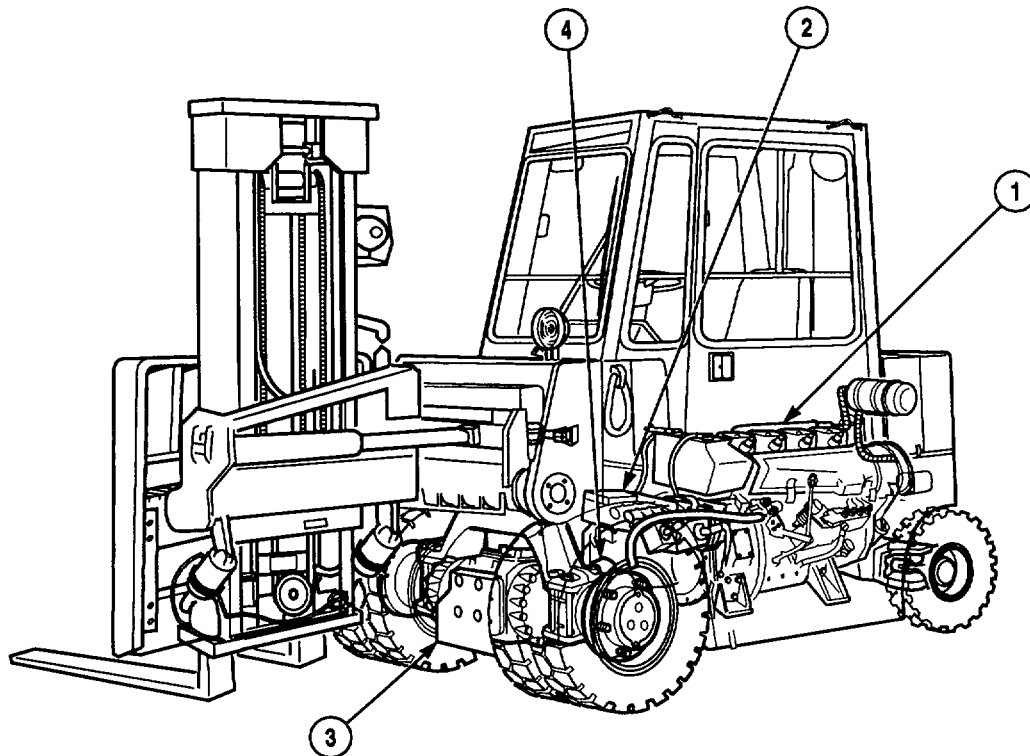
Refer to TM 10-3930-669-10 for Location and Description of Major Components.

1-12. EQUIPMENT DATA.

Refer to TM 10-3930-669-10 for Equipment Data.

Section III. PRINCIPLES OF OPERATION

1-13. POWER TRAIN.



The forklift is powered by an air-cooled diesel engine (1) coupled directly to a semi-automatic transmission (2). Power from the transmission is transferred to the drive axle (3) through a short drive shaft (4) with two universal joints.

a. Engine. The forklift is equipped with a KHD Deutz diesel Model F4L912D/W engine rated at 60 HP (44 kilowatt) at 2,500 RPM. This engine is air cooled.

b. Transmission. The forklift is equipped with a Borg Warner Model PR-2 two-speed, semi-automatic transmission. Forward low range, forward high range, reverse, and neutral functions are controlled by an electric solenoid-controlled valve body. Power is transmitted by constant-mesh helical gears and multiple-disc clutch packs.

(1) The transmission control lever located on the steering column operates two switches sending voltage to the electric solenoids controlling transmission functions.

- (a) To select the forward position for the transmission, move the control lever to the forward position.
- (b) To select the reverse position for the transmission, move the control lever to the rearward position.

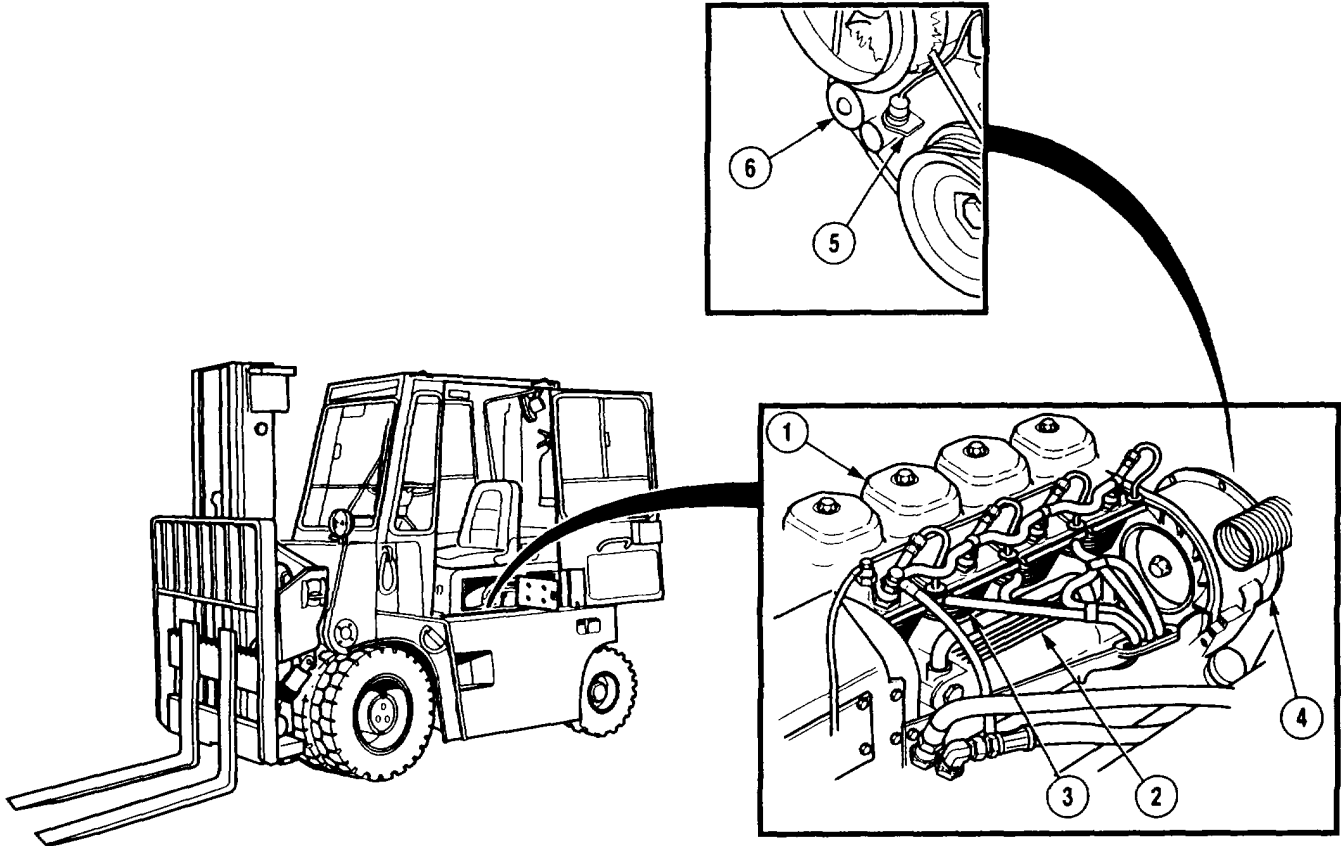
(c) To select the neutral position for the transmission, move the control lever to the center position.

(2) The high/low range selector switch is located on the right side of instrument panel. The electric control rocker switch controls a solenoid in the transmission. This solenoid switches the transmission into high range, when energized. The truck should normally be operated in high range only. Changing from one range to the other is accomplished by pushing the transmission range control button. The high range light will light on the instrument panel when high range is selected.

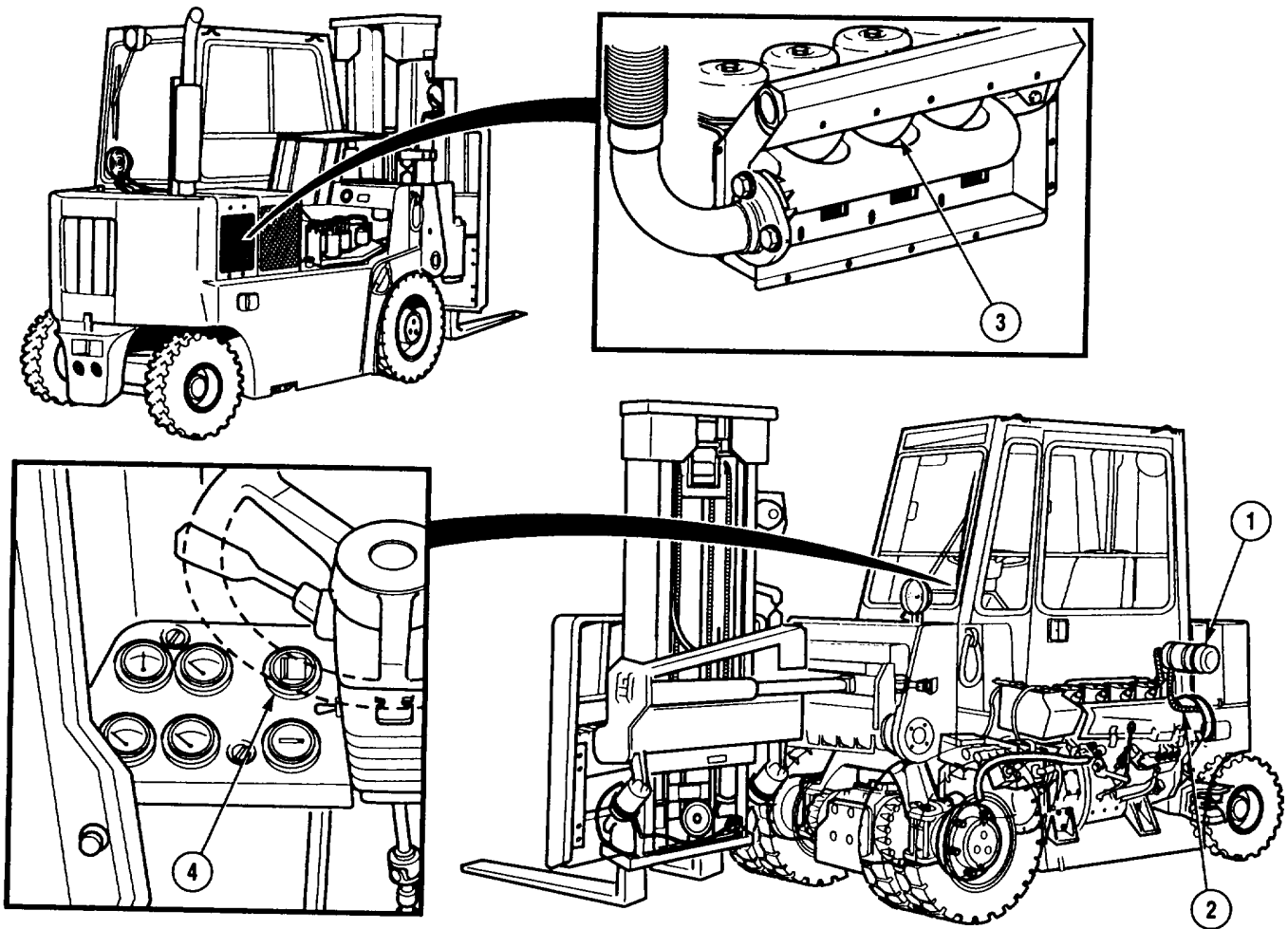
c. Drive Axle. The forklift is equipped with a Clark-Hurth Model 172 drive axle. This drive axle features gear reduction at the wheel ends and is equipped with wet brake discs that serve as the service brakes.

d. Inching System. The inching system works with both the drivetrain and the brake system. The inching system permits extremely slow movement for precise load positioning. Light brake application at slow engine speeds activates the inching solenoid valve. This reduces the hydraulic pressure actuating the hydraulic clutch pack allowing the clutches to slip and the machine to be inched.

1-14. ENGINE SYSTEMS.

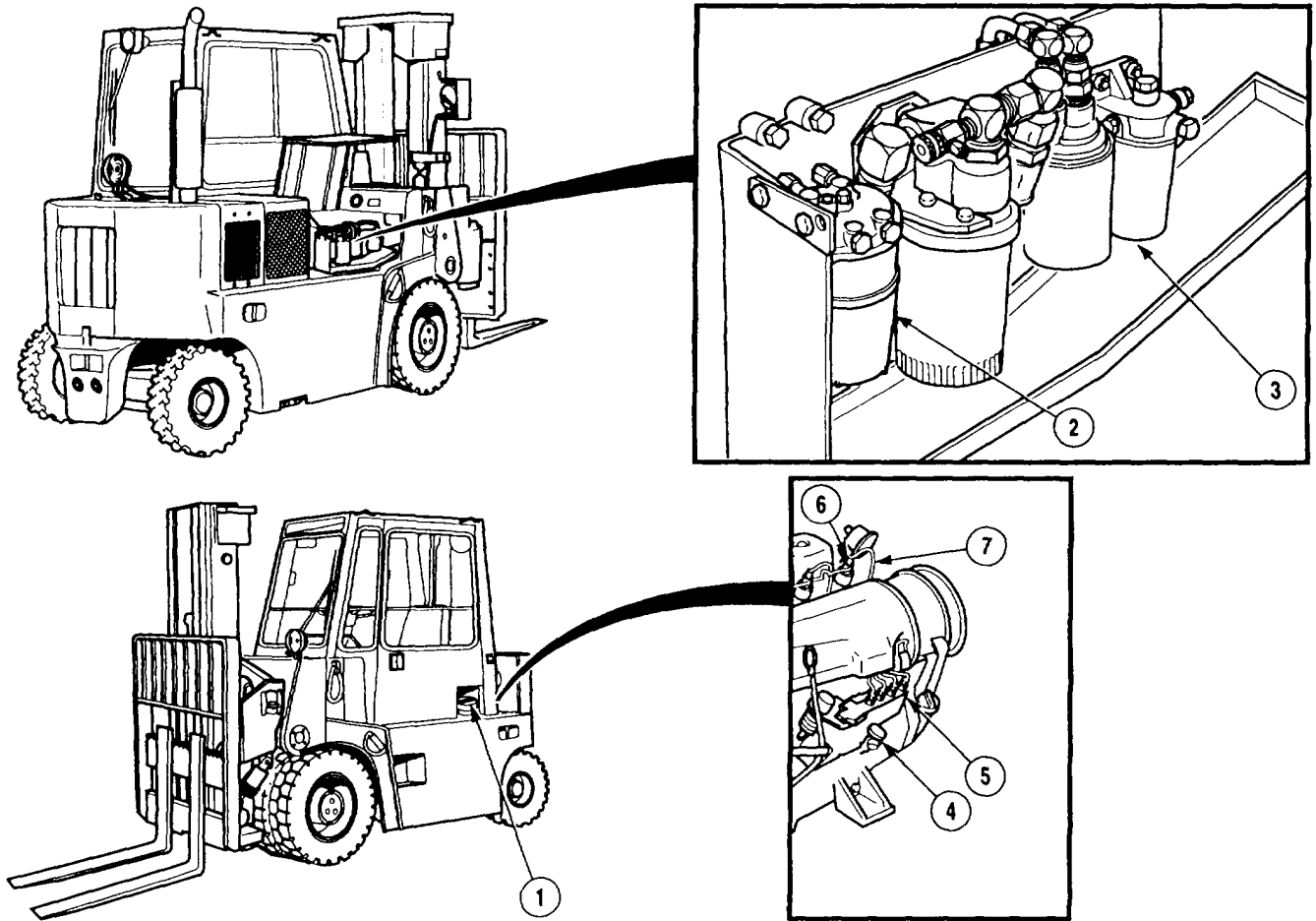


a. Cooling System. The cooling system protects the engine (1) from excess operating temperatures by removing heat generated during the combustion process. Air is drawn through the engine oil-to-air cooler (2) and then past the engine cooling fins (3) by a belt-driven blower (4). A sensor (5) is located on the blower belt tensioner (6). This sensor will send voltage to a warning buzzer and a warning light on the instrument panel when the blower belt breaks or comes off its pulleys.



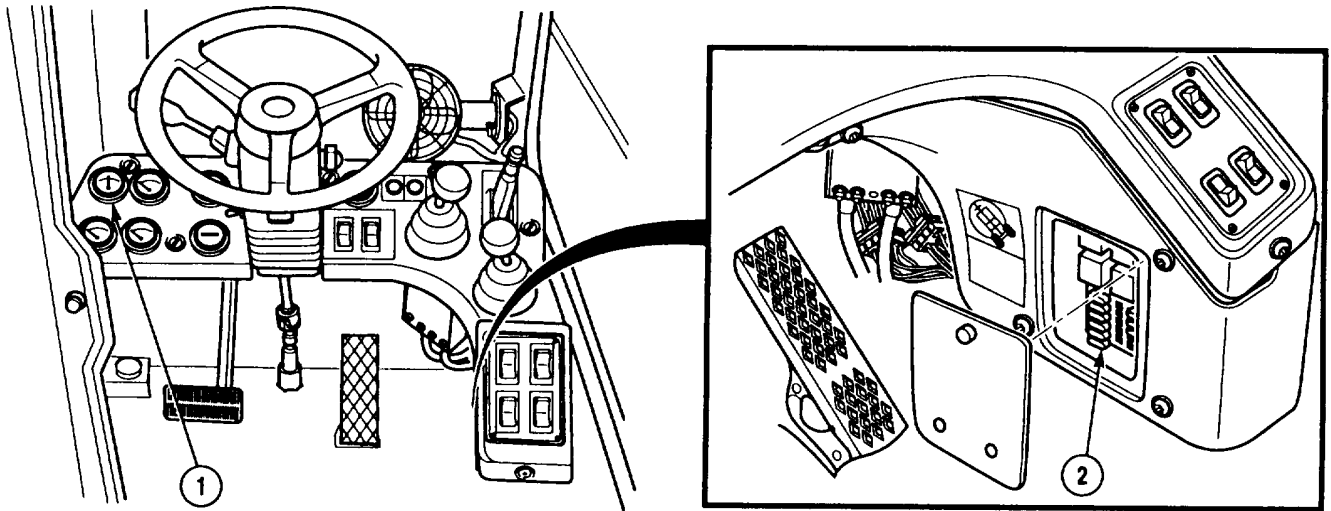
b. Air Intake System. The air intake system consists of a dry-type filter contained in an air cleaner (1), ducting (2), and the engine intake manifold (3). Condition of the air filter is monitored using the air filter indicator (4).

1-14. ENGINE SYSTEMS (CONT).



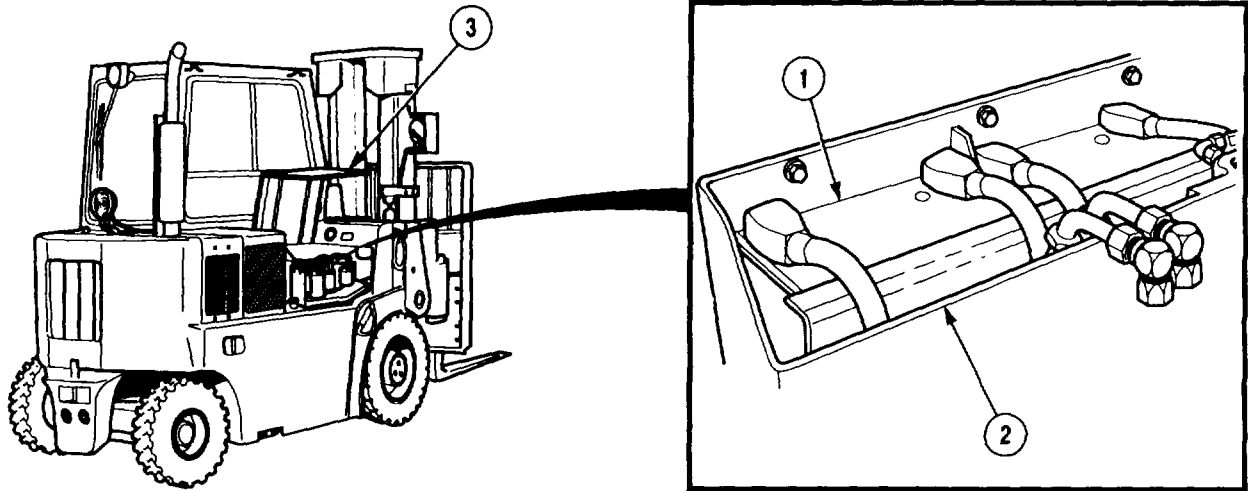
c. Fuel System. The fuel system consists of the fuel tank (1), fuel/water separator (2), fuel filter (3), feed pump (4), injection pump (5), and injectors (6). The fuel tank (1) is located on the LH side of the forklift and has a capacity of 14 gallons. The fuel/water separator (2) removes water and large contaminants from the fuel. Finer contaminants are removed by the fuel filter (3). The feed pump (4) supplies fuel to the injection pump (5) which distributes the fuel to the injectors (6). Surplus fuel is returned to the fuel tank (1) through return lines (7).

1-15. ELECTRICAL SYSTEM.

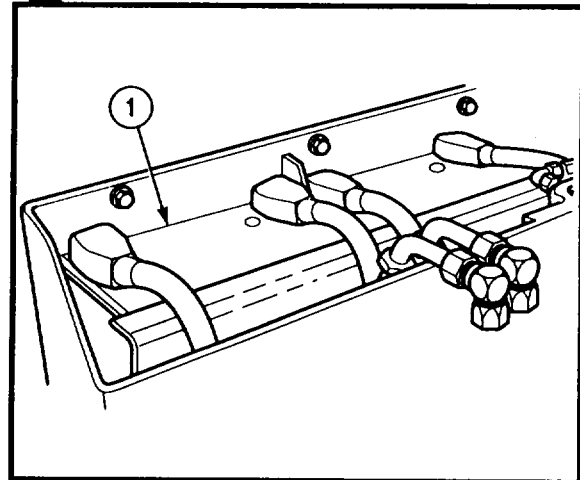
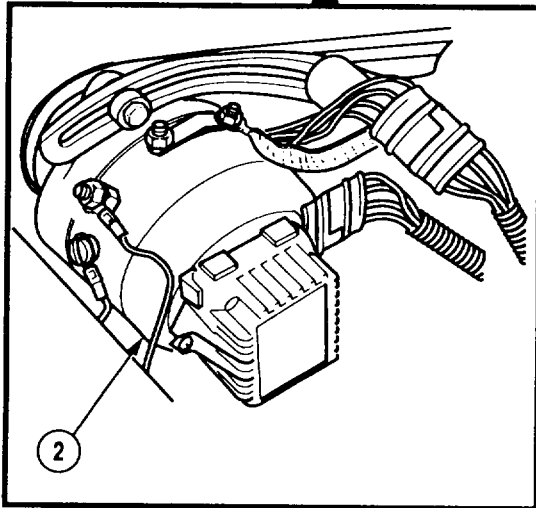
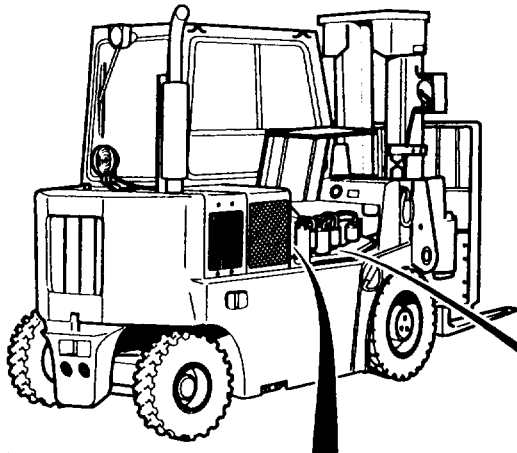


a. Electrical System. The forklift is equipped with a 24-volt electrical system. Status of the electrical system can be monitored by an ammeter gauge (1) located on the dash panel inside the cab. A fuse panel (2) located under the dash panel protects electrical circuits.

1-15. ELECTRICAL SYSTEM (CONT).

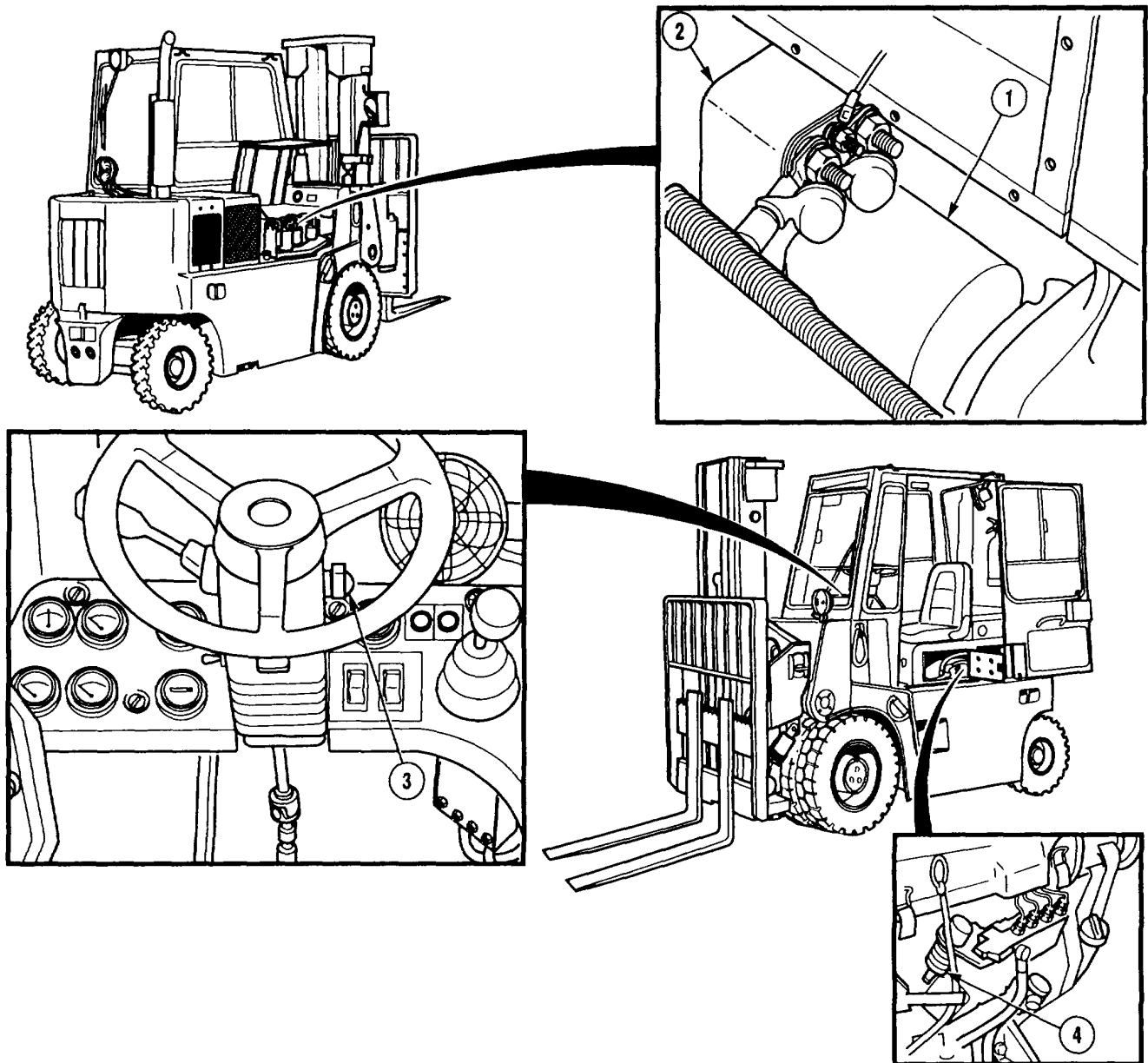


b. Battery. The electrical system is equipped with two 12-volt batteries (1). The batteries are contained in a battery box (2) located on the right-hand side of the forklift under the rear engine access cover (3). This location provides protection from the environment while allowing convenient access for service.

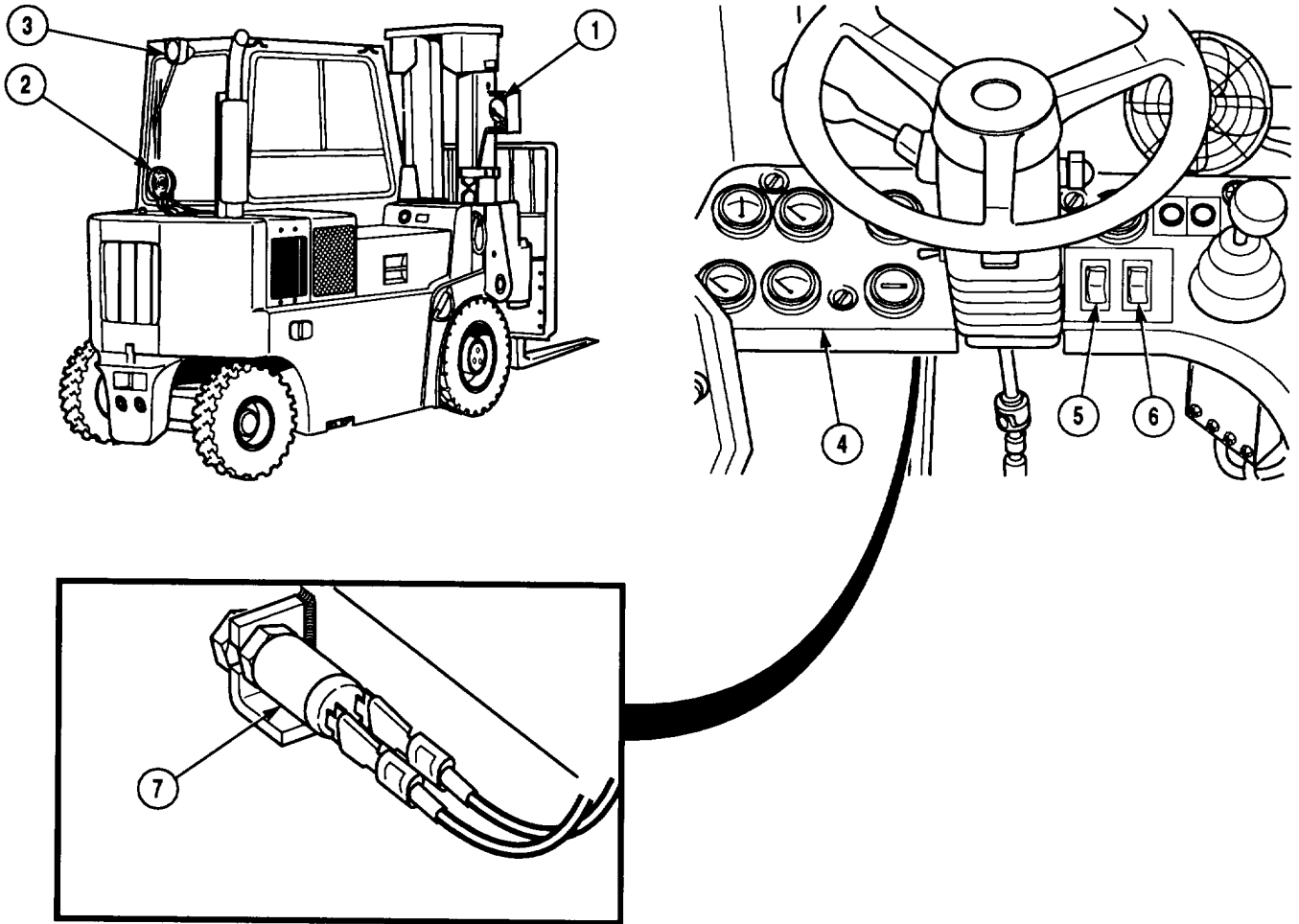


c. Power Storage and Generating. The forklift's 12-volt batteries (1) have the capability of storing electrical power. The batteries can power all of the systems for a limited time while the engine is not running, but its primary purpose is to supply voltage to the engine's starting system. Once the engine is running, the generating system provides the electrical power for all systems. The engine-driven alternator (2) generates alternating current (AC) which is passed through a set of rectifiers that change it into direct current (DC). This direct current is used to charge the battery (1) and is distributed to the other systems of the forklift.

1-15. ELECTRICAL SYSTEM (CONT).

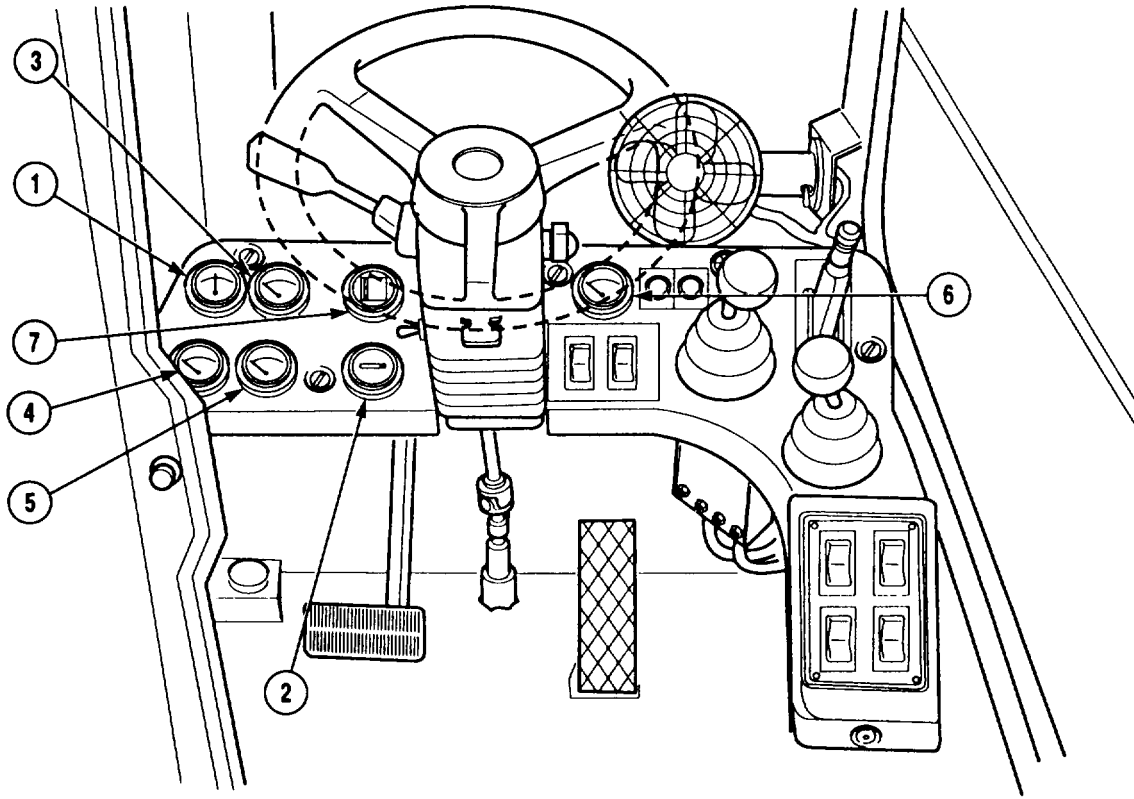


d. Engine Starting and Stopping. The engine starting system consists of a starter motor (1), solenoid (2), neutral start relay (3), and engine switch (4). Battery voltage is used to operate the starter motor (1). The starter motor (1) is mounted on the engine and engages the flywheel only when electrically energized. When the engine switch (4) is turned to the off position, the fuel shutoff solenoid (2) is de-energized causing the injection pump to stop fuel supply to the injectors.



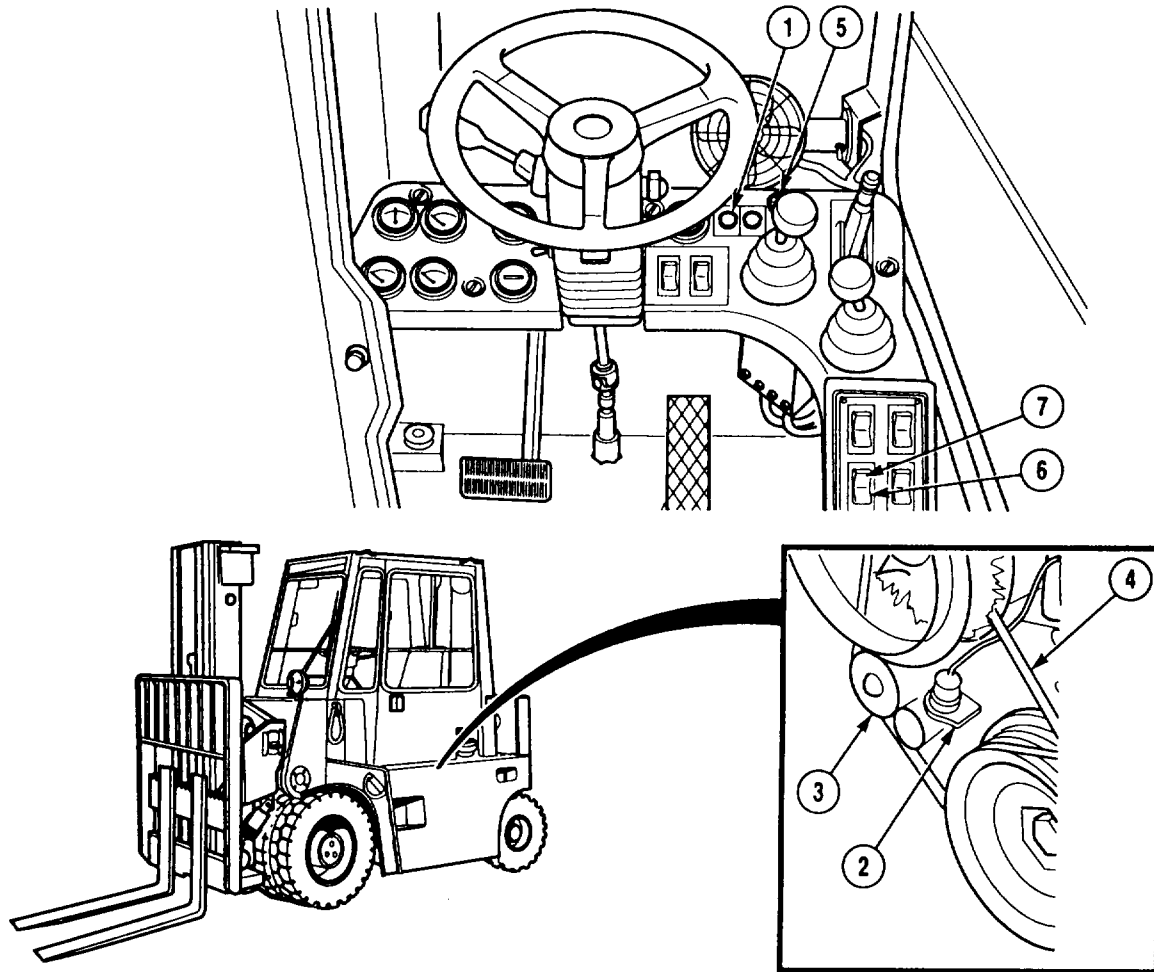
e. Service Lighting. The service lighting includes the front and rear flood lights (1 and 2), one taillight (3), and instrument panel (4) gauge lighting. The front flood light (1), taillight (3), and instrument panel (4) lights are all controlled by the front flood light rocker switch (5). The rear flood light (2) is controlled by the rear flood light rocker switch (6). The taillight is equipped with one dual-filament bulb serving as both the running light and the brake light. The brake light illuminates when it receives voltage from the brake light switch (7) mounted above the brake pedal linkage. Depressing the brake pedal operates the brake light switch (7) and illuminates the brake light.

1-15. ELECTRICAL SYSTEM (CONT).



f. Instruments. All instruments are equipped with individual lamps for illumination and share a common circuit for power of these lamps. A common ground circuit is also shared for all instrument illumination. All instrumentation is fully operable when the main power switch and engine switch are on.

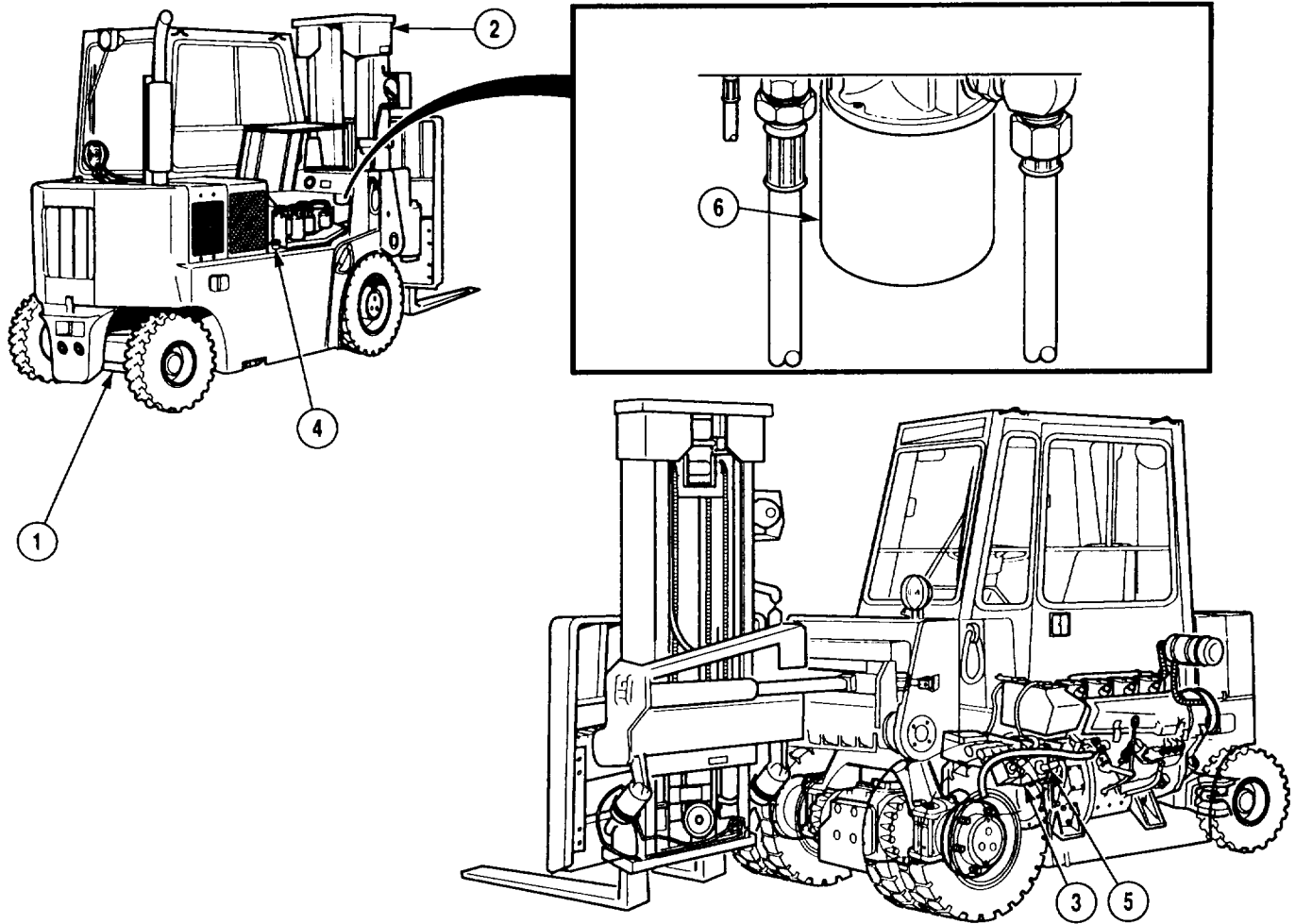
- **Ammeter**(1) receives voltage from the shunt and shares a common ground circuit with other instruments.
- **Hour meter** (2) receives voltage from the fuse panel and shares a common ground circuit with other instruments.
- **Fuel level gauge** (3) receives voltage from the fuse panel and is grounded at the sending unit mounted on the fuel tank.
- **Engine oil pressure gauge** (4) receives voltage from the fuse panel and is grounded at the sending unit mounted on the engine.
- **Engine temperature gauge** (5) receives voltage from the fuse panel and is grounded at the sending unit mounted on the engine.
- **Transmission oil temperature gauge** (6) receives voltage from the fuse panel and is grounded at the sending unit mounted on the transmission.
- **Air restriction indicator gauge** (7) indicates condition of air filter in inches of Hg. Red button is for resetting indicator.



g. Warning Lights, Buzzers, and Indicator Lights.

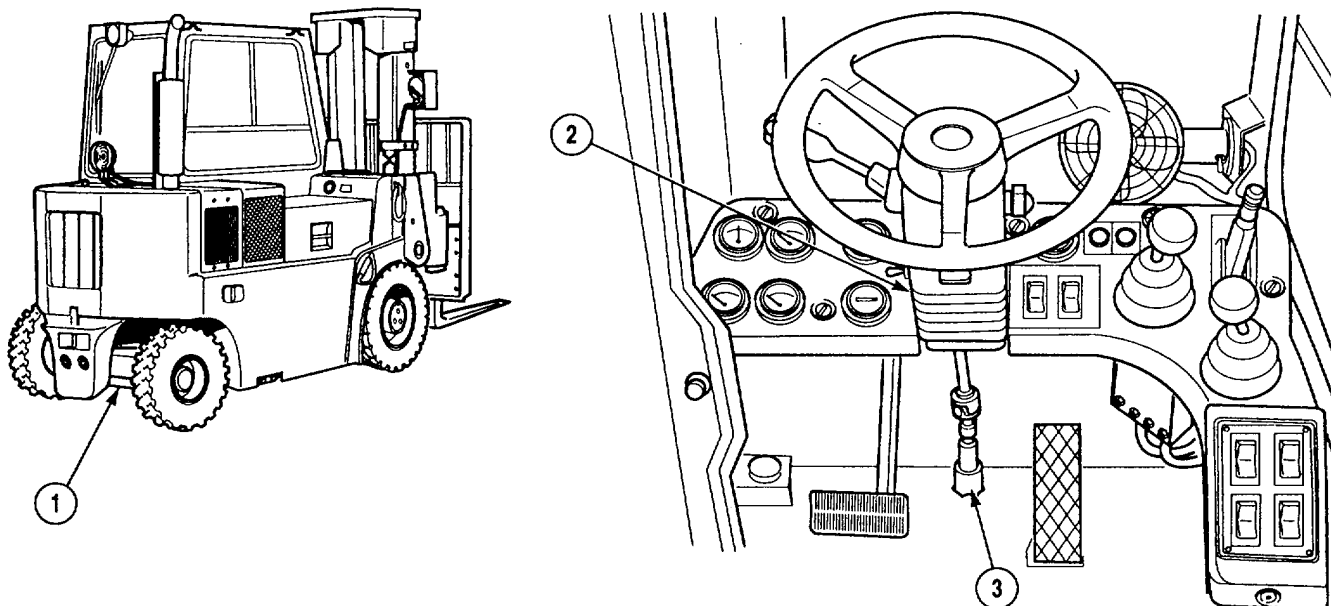
- **Broken belt warning light**(1) is illuminated when the broken belt sensor (2) closes. The broken belt sensor (2) will close any time the blower belt tensioner (3) collapses as a result of the blower belt (4) breaking or coming off its pulleys. The broken belt warning light (1) is on the same electrical circuit as the broken belt warning buzzer (5).
- **Broken belt warning buzzer** (5) sounds when the broken belt sensor (2) closes. The broken belt sensor (2) will close any time the tensioner (3) collapses as a result of the blower belt (4) breaking or coming off its pulleys. The broken belt warning buzzer (5) is on the same electrical circuit as the broken belt warning light (1).
- **Transmission high range indicator light** (6) is illuminated any time the transmission is in high range. The indicator light (6) receives voltage from the high/low range switch (7).

1-16. HYDRAULIC SYSTEM.



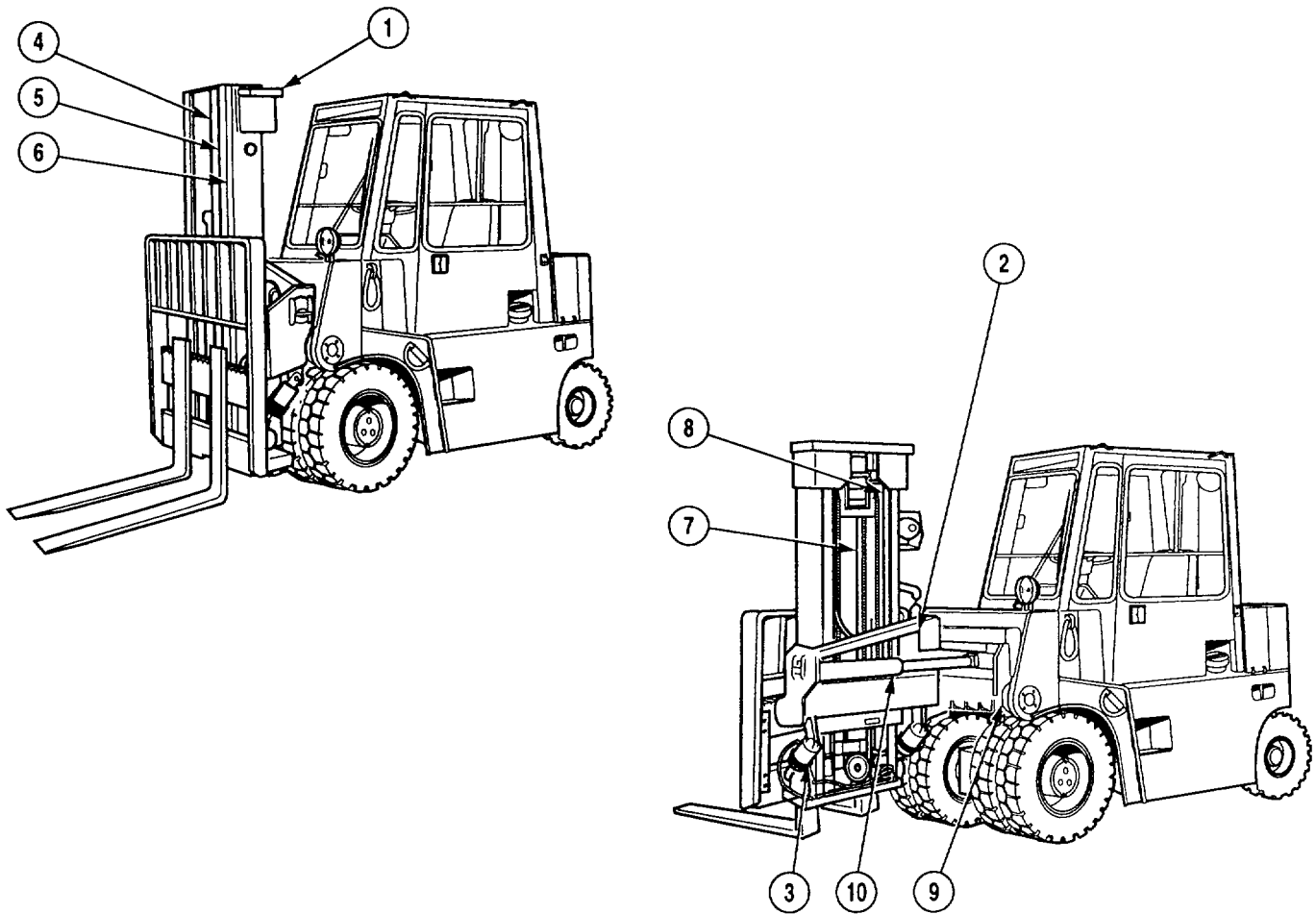
The hydraulic system supplies hydraulic oil pressure for steering (1) and mast (2) operation any time the engine is running. A pump (3) mounted on the transmission draws hydraulic fluid from the hydraulic tank (4) mounted on the RH side of the forklift. A priority valve (5) diverts hydraulic fluid to the mast (2) and steering (1) system by demand. Hydraulic fluid is filtered by a spin-on filter (6) immediately before returning to the hydraulic tank (4).

1-17. STEERING SYSTEM.



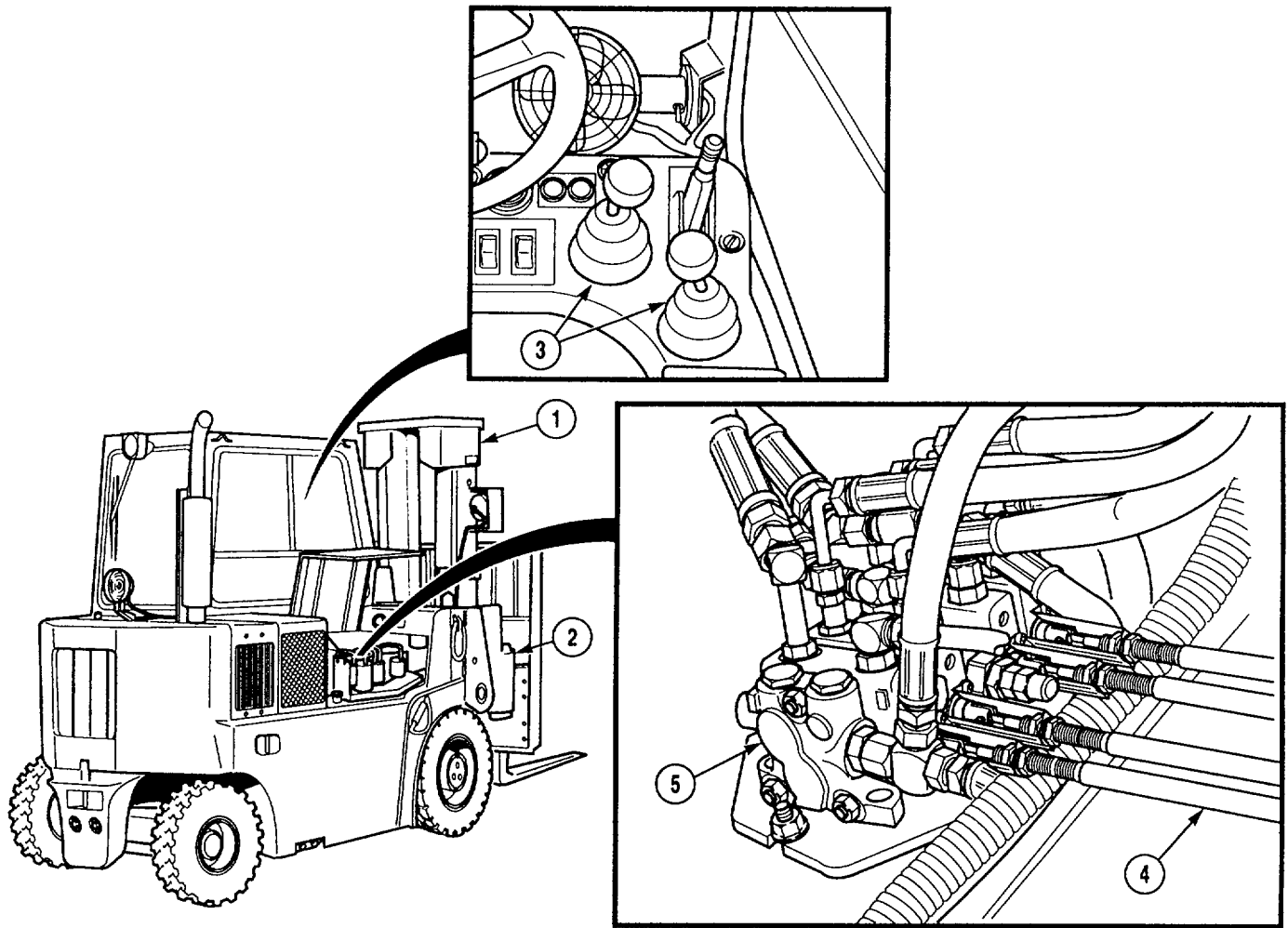
The steer axle (1) is mounted at the rear of the forklift and is hydraulically assisted any time the engine is running. Hydraulic oil pressure is provided by a transmission-mounted pump which is shared by the mast, pivot/shift assembly, and steering system (refer to Para 1-16). No mechanical linkages are used between the steering column (2) and the steer axle (1) for control of the steer axle (1). A valve (3) is connected to the steering column (2) and controls fluid flow from the pump to the steer axle (1).

1-18. MAST AND PIVOT/SHIFT ASSEMBLY.



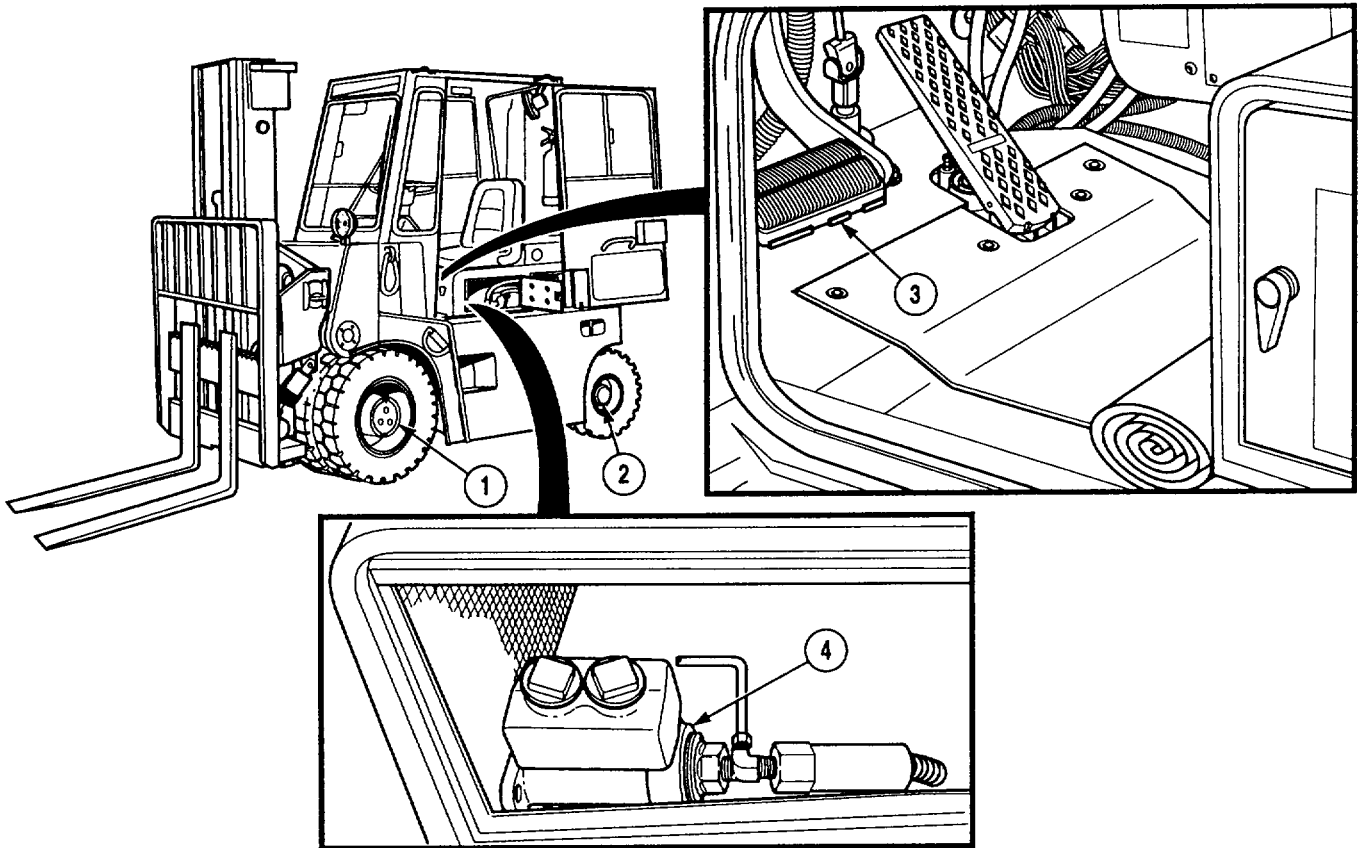
The mast assembly (1) is mounted to the pivot/shift assembly (2) and is capable of a 90 degree pivot to the right. Two tilt cylinders (3) make it possible to tilt the mast assembly (1) six degrees forward or back. The frame of the mast assembly (1) is made up of three separate rails: the inner rail (4), center rail (5), and outer rail (6). The mast assembly (1) is raised and lowered by the primary lift cylinder (7) and secondary lift cylinders (8) using chains and anchors to synchronize the movement of the three rails.

The pivot/shift assembly (2) allows side-to-side movement of the mast assembly (1) using one cylinder located behind the side shift rod (9). Additionally, the pivot cylinder (10) can pivot the mast 90 degrees to the right.

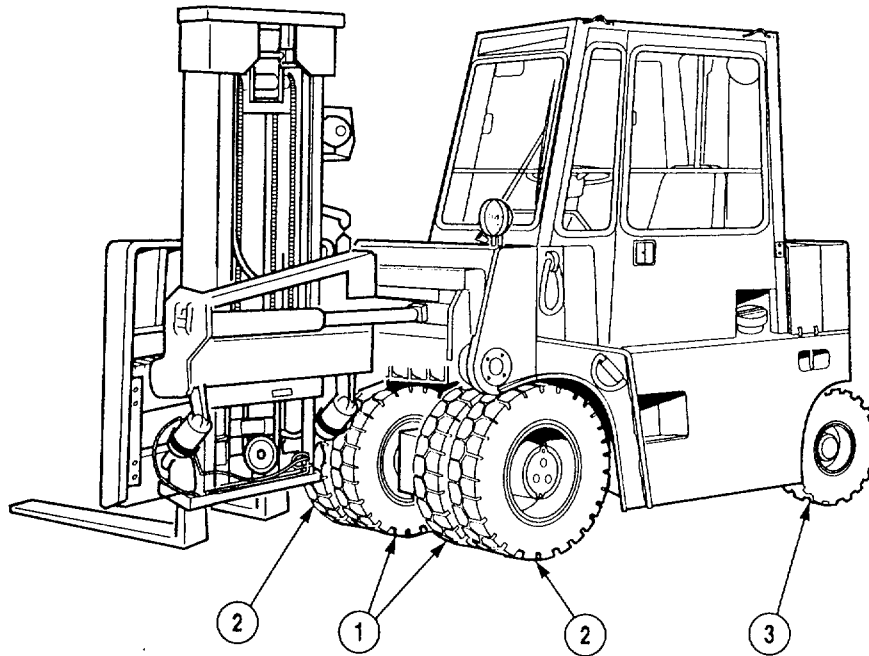


All functions of the mast assembly (1) and the pivot/shift assembly (2) are controlled by two joysticks (3) mounted in the cab. Joysticks (3) are connected by cables (4) to two control valves (5) which direct flow to and from the mast assembly (1) and pivot/shift assembly (2). Hydraulic oil pressure is provided by a transmission-mounted pump which is shared by the steering system, mast assembly, and pivot/shift assembly (refer to Para 1-16).

1-19. BRAKE SYSTEM.



The forklift brakes are located inside the drive axle (1). The steer axle (2) is not equipped with brakes. Braking is controlled by the brake pedal (3) which is connected to the master cylinder (4) by a linkage. Additionally, the brake pedal (3) disengages the transmission automatically as the brakes are being applied.

1-20. WHEELS AND TIRES.

The drive axle is equipped with four wheel-and-tire assemblies (1 and 2), one inner (1) and one outer (2) per side. Inner and outer wheel-and-tire assemblies are not interchangeable because of a difference in wheel depth. The steer axle is equipped with two wheel-and-tire assemblies (3), one per side.

a Drive Axle Wheel-and-Tire Assemblies. A wheel-and-tire assembly (1 or 2) consists of one tire and one wheel. The tire is solid, requiring no air.

b Steer Axle Wheels. A wheel-and-tire assembly (3) consists of one tire and one wheel. The tire is solid, requiring no air.

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CHAPTER 2

VEHICLE MAINTENANCE

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Section I. REPAIR PARTS; SPECIAL TOOLS; TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT

2-1. COMMON TOOLS AND EQUIPMENT.

For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE), CTA 50-970 or CTA 8-100, as applicable to your unit. Table 2-1 lists tool kits required and authorized for use at the Direct/General Support Maintenance level. Reference code numbers listed in the first column correspond to those listed in the same column on the Maintenance Allocation Chart (MAC).

Table 2-1. Authorized Direct/General Support Tool Kits

Tool Or Test Equipment Ref Code	Maintenance Level	Nomenclature	Tool Kit Stock Number
1	O,F,H	Tool kit, general mechanic's: automotive	5180-00-177-7033
2	O,F,H	Shop equipment, automotive maintenance and repair: organizational maintenance common no. 1, less power	4910-00-754-0654
9	O,F,H	Shop equipment, automotive maintenance and repair: organizational maintenance supplemental no. 1, less power	4910-00-754-0653
5	O,F,H	Shop equipment, automotive maintenance and repair: field maintenance, basic	4910-00-754-0705
7	O,F,H	Shop equipment, fuel and electrical system, engine: field maintenance, basic	4910-00-754-0714
10	O,F,H	Shop welding set	3433-00-357-6311
8	F,H	Shop equipment, machine shop	3470-00-754-0708

2-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.

The Maintenance Allocation Chart (MAC) identifies the authority and responsibility for maintenance tasks listed in this manual. Tool kits, test equipment, and diagnostic equipment required for performing maintenance tasks are also identified in the MAC. The forklift Repair Parts and Special Tools List (RPSTL), TM 10-3930-669-24P, lists special tools, TMDE, and support equipment required to perform maintenance procedures contained in this manual. Appendix E lists the tools and test equipment required to perform maintenance procedures contained in this manual.

2-3. REPAIR PARTS.

Repair parts are listed and illustrated in the Repair Parts and Special Tools List, TM 10-3930-669-24P, for maintenance of this equipment.

Section II. SERVICE UPON RECEIPT

2-4. GENERAL SERVICE INSTRUCTIONS.

a. Refer to TM 10-3930-669-10 for operating instructions for the forklift.

b. Upon receipt of a new, used, or reconditioned forklift, the receiving organization must see if it has been properly prepared for service and is in good condition (TM 10-3930-669-10). Inspect all assemblies, subassemblies, and accessories to be sure they are in proper working order. Secure, clean, correctly adjust, and/or lubricate (LO 10-3930-669-12) as needed.

c. Follow general procedures for all services and inspections given in TM 10-3930-669-10.

2-5. INSPECTION AND SERVICING EQUIPMENT.

NOTE

If forklift has been driven to the using organization, most or all of the following work should have been done.

a. When forklift is received, inspect all items for damage that may have occurred during shipping and unloading operations. Pay close attention to any loose or missing nuts, bolts, screws, access plates, drain plugs, draincocks, oil plugs, assemblies, subassemblies, or components that may have been lost or broken in transit.

WARNING

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type 1 dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
- **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**

b. Clean all exterior surfaces coated with rust-preventive compound with dry-cleaning solvent.

2-5. INSPECTION AND SERVICING EQUIPMENT (CONT).

c. Lubricate specific points shown in LO 10-3930-669-12 regardless of interval. Do not lubricate gear cases or engine. Check processing tag for gear case and engine oil. If tag states the oil is good for 500 miles (805 km) of operation and is of the proper grade for local climatic operation, check oil level but do not change oil.

2-6. SPECIAL SERVICE INSTRUCTIONS.**a. Forklift Body and Panel Inspection.**

- (1) Inspect body and panels for evidence of damage during shipment.
- (2) Check doors, latches, and hinges on compartments for proper operation.
- (3) Check mounting hardware and tighten as necessary.

b. Forklift Cab Inspection.

- (1) Inspect cab for evidence of damage during shipment.
- (2) Inspect windshields and window glass for cracks or other damage.
- (3) Check door latches, hinges, and windows for proper operation.
- (4) Check seat and seat belts to ensure they are securely installed and that operator's seat adjustment controls are functioning properly.

c. Engine Inspection.

- (1) Remove any seals, plugs, or tape used to seal air inlets and ports on the engine during shipping.
- (2) Check crankcase oil level with dipstick.
- (3) Examine air cleaner element for dirty or restricted condition.
- (4) Inspect engine and cooling hose connections for evidence of leakage.
- (5) Remove any obstruction of cooling air flow to cooling blower.

d. Transmission Inspection.

- (1) Check fluid level with dipstick.
- (2) Check external hoses and tubes for evidence of leakage.

e. Electrical System Inspection.

- (1) Inspect battery cable connections and clean and tighten as necessary.
- (2) Check lights for burned out lamps, loose connections, and dirty or broken lenses.
- (3) Ensure alternator is charging properly.
- (4) Ensure all electrical equipment functions.

f. Steering System Inspection.

- (1) Examine steering hoses and connections for evidence of leakage.
- (2) Check steering system for proper operation during road test.

g. Tire Inspection.

- (1) Inspect tires for serious cuts, bubbles, cracks, bruises, dry-rot, foreign objects, or exposure of internal cords. Remove foreign objects lodged between treads.
- (2) Check all wheel mounting nuts for proper torque (TM 10-3930-669-20).

h. Fuel System Inspection.

- (1) Check fuel level and add fuel if necessary.
- (2) Inspect fuel hoses, tubes, connections, and filters for evidence of leakage.

i. Hydraulic System Inspection.

- (1) Check all hydraulic hoses, tubes, cylinders, and connections for evidence of leakage.
- (2) Check mast assembly for proper operation (TM 10-3930-669-10).

Section III. TROUBLESHOOTING**2-7. TROUBLESHOOTING INTRODUCTION.**

Troubleshooting contains step-by-step procedures for identifying a specific faulty component that is causing an equipment malfunction (symptom). Not all possible malfunctions can be covered in the troubleshooting. Troubleshooting covers malfunctions that are most likely to occur during the life expectancy of the forklift. Obvious mechanical failures and damage are not covered.

2-8. TROUBLESHOOTING INSTRUCTIONS.**NOTE**

The troubleshooting makes use of the Simplified Test Equipment for Internal Combustion Engines-Reprogrammable (STE/ICE-R) and conventional methods for testing and fault isolation.

a. Simplified Test Equipment for Internal Combustion Engines Reprogrammable (STE/ICE-R). The forklift is equipped with several STE/ICE-R sensors that are used to support troubleshooting procedures. STE/ICE-R tests, employing these sensors, are incorporated into the standard troubleshooting test to aid in fault isolation. The STE/ICE-R acts as a conventional digital multimeter to measure voltage, current, and resistance. It can also measure pressure, speed, compression unbalance, engine power, and some specialized battery and starter evaluations. The STE/ICE-R is powered by the forklift battery using an electrical harness called the Diagnostic Connector Assembly (DCA). The complete system includes a test meter (VTM), cables, transit case, and technical publications. The STE/ICE-R can make TK measurements while connected to the DCA. STE/ICE-R tests are referenced.

b. General Electrical Troubleshooting Procedures.

WARNING

Remove rings, bracelets, wristwatches, neck chains, etc., before working on any vehicle. Jewelry can catch on equipment and cause injury, or may short across an electrical circuit and cause severe burns or electrical shock.

CAUTION

Use proper sized test leads when checking for resistance, continuity, or voltage at connectors or damage to equipment can result.

NOTE

- Multimeter leads must remain in contact with the circuit being tested for a minimum of three seconds to obtain a reading.
- If your multimeter does not operate in the way described in the following steps, learn how it operates before performing troubleshooting.
- The piece of electrical test equipment used will be referred to as the "multimeter." The multimeter's red test lead will be referred to as the "positive (+) multimeter lead." The multimeter's black test lead will be referred to as the "negative (-) multimeter lead."

(1) *Resistance and Continuity Measurements.*

(a) Connect positive (+) multimeter lead to multimeter VOLT-OHM connector. Connect negative (-) multimeter lead to multimeter COM connector. When the multimeter leads are separated or are measuring a circuit with no continuity, the multimeter will indicate "OL" (Over Limit) on its display. When multimeter leads are connected together, multimeter should display "0," indicating a continuous circuit with no (zero) resistance.

(b) Set multimeter function/range switch to the desired ohm position. If the amount of the expected resistance is not known, set the switch to the highest range, then reduce until a satisfactory reading is obtained. If only continuity is to be checked, without regard to resistance, set the multimeter function/range switch to the highest ohm range.

(c) Always turn the main power switch to the OFF position before connecting multimeter leads to a circuit unless instructed to do otherwise in the troubleshooting procedure.

(d) Connect multimeter leads to the circuit being checked. The multimeter leads must only contact the point of measurement to ensure an accurate reading.

(e) Read the resistance value displayed on the multimeter.

(f) Disconnect multimeter leads from circuit.

(g) Turn off multimeter.

(2) *Voltage Measurements.* The forklift is equipped with a 24-volt electrical system. Troubleshooting procedures will reference 24 vdc measurements; however, these values can vary depending on battery conditions and if the engine is running or not. If battery voltages are below 20 vdc, charge batteries.

(a) Connect positive (+) multimeter lead to multimeter VOLT-OHM connector. Connect negative (-) multimeter lead to multimeter COM connector.

(b) Set the function/range switch to the setting closest to, but not below, 24 vdc. If multimeter is equipped with a DC-AC switch, set the switch to the DC position. (c) Always turn the main power switch to the OFF position before connecting multimeter leads to a circuit unless instructed to do otherwise in troubleshooting procedure.

(d) Connect the positive (+) multimeter lead to the circuit being tested. Connect the negative (-) multimeter lead to a known good ground.

(e) Set main power switch to ON position and operate any other controls necessary to energize the circuit being tested.

(f) Read the voltage value displayed on the multimeter.

(g) Set the main power switch to the OFF position. Return other controls to their "at rest" positions.

(h) Disconnect multimeter leads from circuit.

(i) Turn off multimeter.

2-8. TROUBLESHOOTING INSTRUCTIONS (CONT).

(3) *General Relay Troubleshooting Procedure.* The following general relay troubleshooting procedure applies to most relays that are pushed into a receptacle and do not require any attaching hardware.

(a) Pull relay out of receptacle just enough for the relay terminals to make contact with receptacle terminals. Leave about 1/4 to 3/8 in. (6.35 to 9.53 mm) space between the relay and the receptacle to insert a multimeter lead and make contact with the terminal listed in the troubleshooting test.

(b) Perform necessary test.

(4) *General Wiring Harness Short Test.* The following procedure applies to any wiring harness suspected of being shorted. Refer to electrical schematics during this procedure.

(a) Connect positive (+) multimeter lead to multimeter VOLT-OHM connector. Connect negative (-) multimeter lead to multimeter COM connector. When the multimeter leads are separated or are measuring a circuit with no continuity, the multimeter will indicate "OL" (Over Limit) on its display. When multimeter leads are connected together, multimeter should display "0," indicating a continuous circuit with no (zero) resistance. Wires in a harness that are not purposely joined or connected at a component should not have continuity (multimeter indicates "OL").

(b) Set multimeter function/range switch to the highest OHM range.

(c) Disconnect harness connector.

(d) Connect positive (+) multimeter lead to harness connector terminal of suspected wire.

(e) Connect negative (-) multimeter lead to each of the remaining harness connector terminals. If multimeter does not display "OL," and is displaying a resistance value of zero or higher, this indicates a continuous circuit. Refer to the electrical schematic before repairing wires or replacing wiring harness to determine that the wires making a continuous circuit are not purposely joined or are not connected intentionally at a component.

(f) Disconnect multimeter leads from connector.

(g) Turn off multimeter.

2-9. TROUBLESHOOTING SYMPTOMS.

The Troubleshooting Symptom Index (Table 2-3) lists the most common failure symptoms found during operation of the forklift. Find the symptom that is closest to the symptom your forklift has and refer to that paragraph for the troubleshooting procedure.

Table 2-2. Troubleshooting Symptom Index

Para	Description	Page
2-14	Engine System Troubleshooting.....	2-10
2-15	Drive Axle Troubleshooting	2-70

2-10. TROUBLESHOOTING PROCEDURES.

Pages 2-16 through 2-93 contain troubleshooting instructions necessary to identify the faulty component causing the symptom listed in Tables 2-3 and 2-4. Corrective action for repairing or replacing the faulty component is listed in the troubleshooting procedure. Unit Maintenance troubleshooting procedures (TM 103930-669-20) should be completed before performing Direct/General Support Maintenance troubleshooting procedures.

2-11. ENGINE SYSTEM TROUBLESHOOTING.

This paragraph covers Engine System Troubleshooting. The Engine System Fault Index, Table 2-4, lists faults for the engine system of the forklift.

Table 2-3. Engine System Fault Index

Fault No.	Troubleshooting Procedure	Page
1.	Engine Cranks But Will Not Run.....	2-10
2.	Low Engine Oil Pressure (Oil Pressure Gauge Continuously Reads Less Than 30 to 60 psi [207 - 414 kPa] at 625 to 750 rpm)	2-24
3.	Excessive Engine Oil Consumption and/or Blue Smoke	2-32
4.	Excessive Black or Gray Smoke.....	2-38
5.	Engine Overheats (Engine Temp Gauge Reads Over 250°F [121°C])	2-48
6.	Engine Runs Rough or Misfires	2-52
7.	Engine Does Not Develop Full Power.....	2-62

2-11. ENGINE SYSTEM TROUBLESHOOTING (CONT).

1. ENGINE CRANKS BUT WILL NOT RUN.

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Pressure Test Kit (Item 5, Appendix E)
 STE(Optional) (Item 14, Appendix E)
 Gauge, Tester, Injection Pump (Item 5, Appendix E)
 Retainer (Item 13, Appendix E)
 Hand Pump, High Pressure (Item 30, Appendix E)

Materials/Parts

Cap and Plug Set (Item 5, Appendix B)
 Tags, Identification (Item 21, Appendix B)
 Rings, Retaining (2)
 Gasket

References

TM 10-3930-669-10
 TM 10-3930-669-20

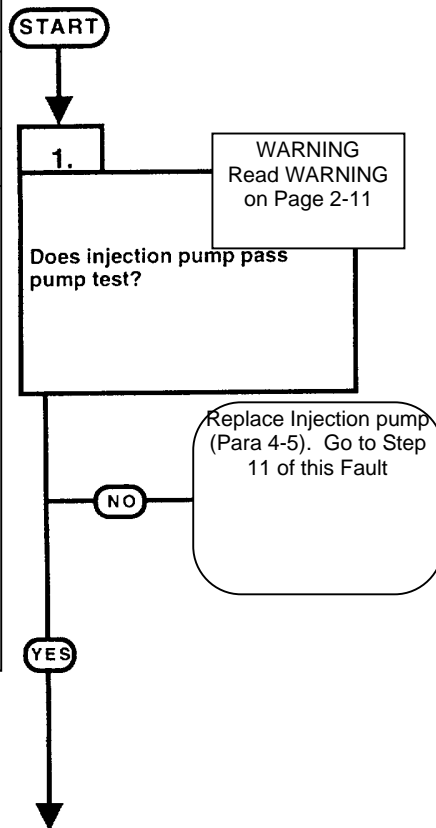
Personnel Required

Two

Equipment Condition

Engine OFF (TM 10-3930-669-10)
 MAIN POWER switch OFF (TM 10-3930-669-10)
 Parking brake applied (TM 10-3930-669-10)
 Wheels chocked (TM 10-3930-669-10)

KNOWN INFO
Nothing.
POSSIBLE PROBLEMS
Injection pump faulty. Injection pump timing incorrect, Camshaft gear alignment incorrect. Low engine compression. Cylinder head(s) or gasket(s) faulty. Piston crown clearance incorrect. Cylinder(s) faulty. Valve(s) or valve spring(s) faulty. Piston(s) faulty. Piston ring(s) faulty.



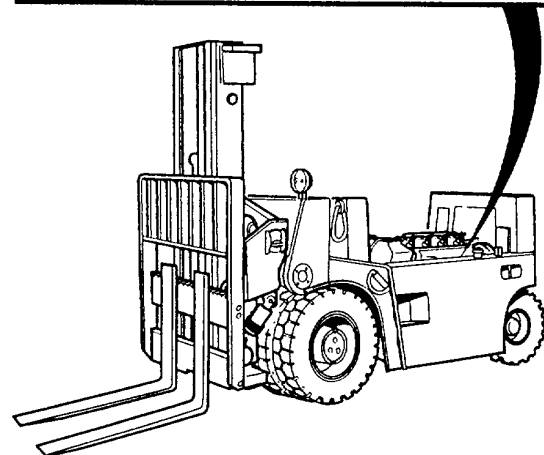
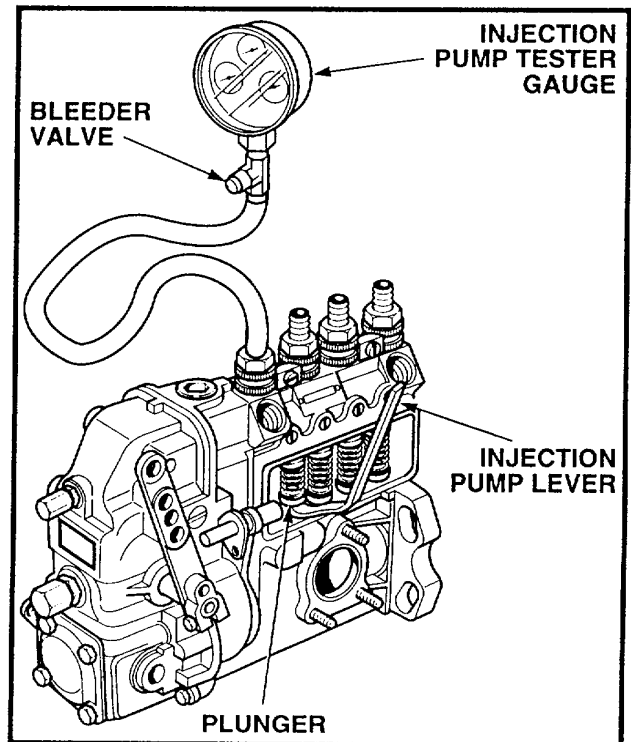
TEST OPTIONS
Injection pump pressure test.
REASON FOR QUESTION
If injection pump is faulty, engine will not run

WARNING

- **Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET (15 m).**
- **Pressure test procedure results in fuel under high pressure. Be sure that pressure test gauge is connected properly and use safety shield during test. Failure to do so may result in injury to personnel.**

INJECTION PUMP PRESSURE TEST

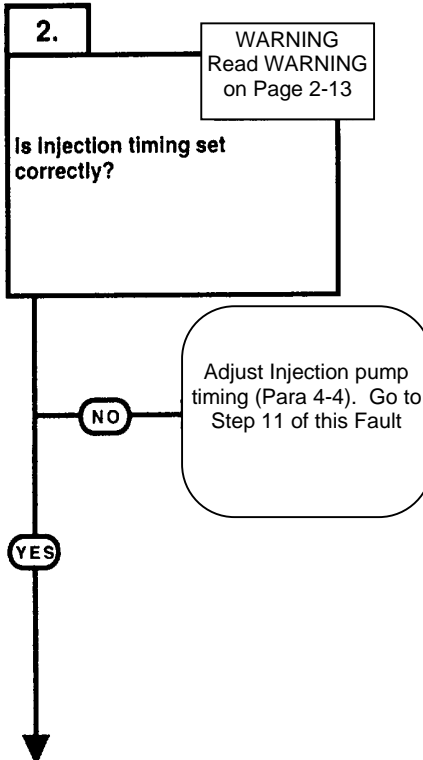
- (1) Remove cab (TM 10-3930-669-20).
- (2) Disconnect throttle cable (TM 10-3930-669-20).
- (3) Position control lever to maximum position.
- (4) Remove pump cover(Para 4-5).
- (5) Tag and disconnect injection pump injector lines one at a time.
- (6) Connect injection pump tester gauge to injection pump port fitting.
- (7) Install pressure plug in No. 1 injector line.
- (8) Open bleeder valve on back of test gauge.
- (9) With aid of an assistant using retainer, turn crankshaft clockwise until pump element to be tested is at the bottom of its stroke.
- (10) Using pump lever, lift plunger to bleed air from pressure gauge. Close bleeder valve.
- (11) Hold shutoff solenoid in open position and pump lever until pressure gauge reads 2,175 psi (14,997 kPa).
- (12) Observe pressure gauge for 60 seconds.
 - (a) If 145 psi (1,000 kPa) or higher is not measured, perform Steps (14) and (15) below and replace injection pump(Para 4-5).
 - (b) If 145 psi (1,000 kPa) or higher is measured, go to step (13) below.
- (13) Hold shutoff solenoid in open position and pump lever until pressure gauge reads 5,075 psi (34,992 kPa).
 - (a) If 5,075 psi (34,992 kPa) cannot be measured, perform Steps (14) and (15) below and replace injection pump(Para 4-5).
 - (b) If 5,075 psi (34,992 kPa) can be measured, repeat steps (5) through (13) above for remaining elements. If all elements are OK, perform Steps (14) and (15) below and go to Step 2 of this Fault.
- (14) Remove injection pump tester gauge from pump port fitting.
- (15) Install pump cover.



1. ENGI

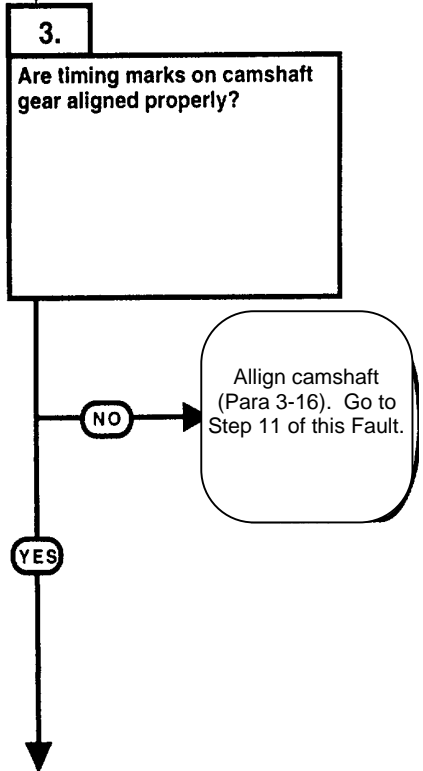
(CONT).

KNOWN INFO
Injection pump OK.
POSSIBLE PROBLEMS
Injection pump timing incorrect. Camshaft gear alignment incorrect. Low engine compression. Cylinder head(s) or gasket(s) faulty. Piston crown clearance incorrect. Cylinder(s) faulty. Valve(s) or valve spring(s) faulty. Piston(s) faulty. Piston ring(s) faulty.



TEST OPTIONS
Injection pump timing check.
REASON FOR QUESTION
If injection pump timing is faulty, engine will not run.

KNOWN INFO
Injection pump OK. Injection pump timing OK.
POSSIBLE PROBLEMS
Camshaft gear alignment incorrect. Low engine compression. Cylinder head(s) or gasket(s) faulty. Piston crown clearance incorrect. Cylinder(s) faulty. Valve(s) or valve spring(s) faulty. Piston(s) faulty. Piston ring(s) faulty.



TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If camshaft alignment is incorrect, engine will not run.

WARNING

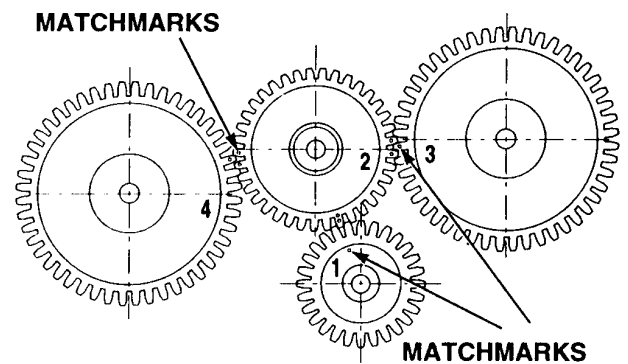
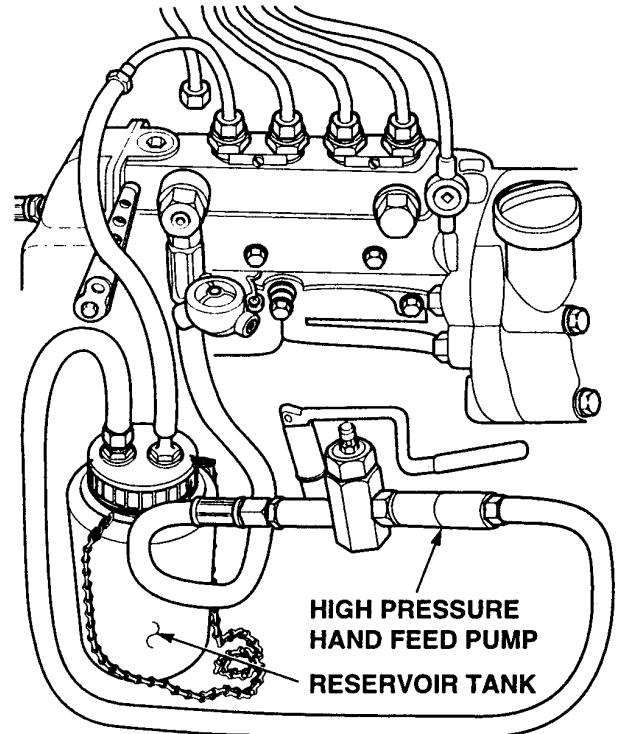
Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read **NO SMOKING WITHIN 50 FEET (15 m)**.

INJECTION PUMP TIMING CHECK

- Check injection pump timing (Para 4-4).
- (a) If injection pump timing is incorrect, reset timing.
 - (b) If injection pump timing is correct, go to Step 3 of this Fault.

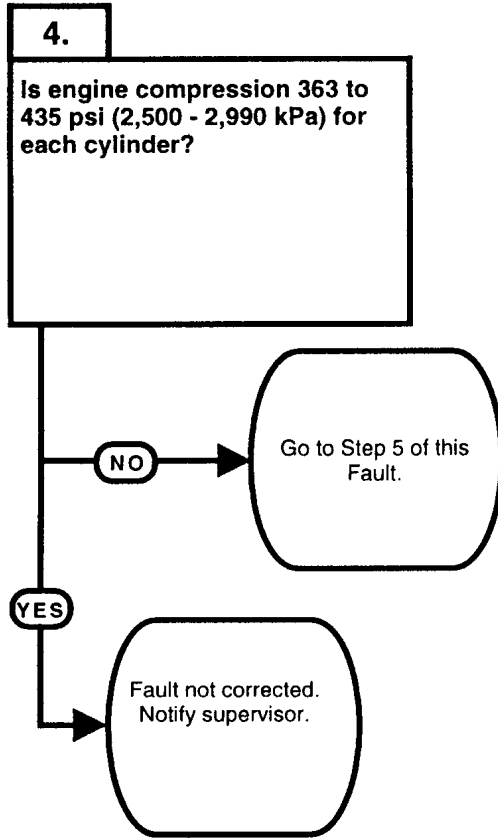
VISUAL INSPECTION

- (1) Remove front cover (Para 3-10).
- (2) Check timing marks on camshaft gear and crankshaft gear.
 - (a) If timing marks are out of alignment, match timing marks (Para 3-14).
 - (b) If timing marks are aligned correctly, camshaft gear alignment is OK.
- (3) Install front cover.



1. ENGINE CRANKS BUT WILL NOT RUN (CONT).

KNOWN INFO
Injection pump OK. Injection pump timing OK. Camshaft gear alignment OK.
POSSIBLE PROBLEMS
Low engine compression. Cylinder head(s) or gasket(s) faulty Piston crown clearance incorrect. Cylinder(s) faulty. Valve(s) or valve spring(s) faulty. Piston(s) faulty. Piston ring(s) faulty.

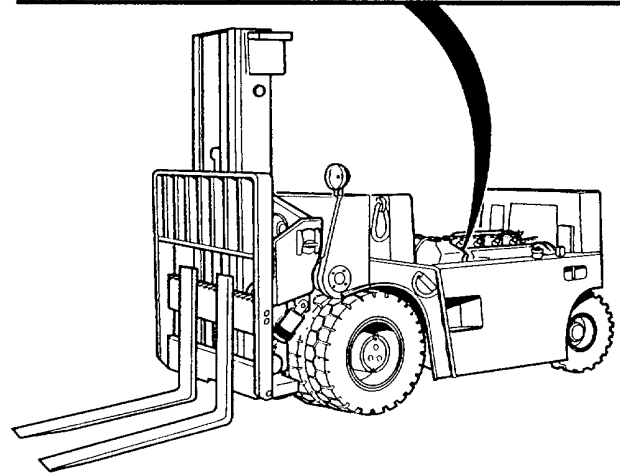
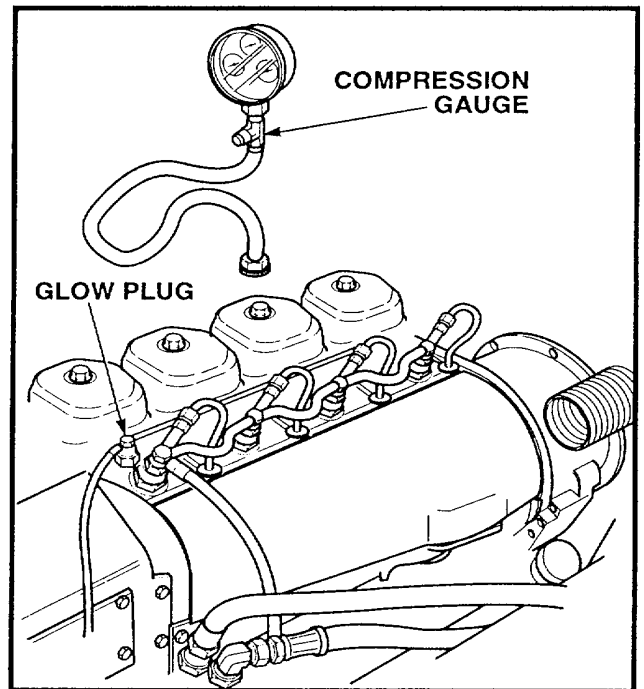


TEST OPTIONS
Compression test. STE/ICE-R #50.
REASON FOR QUESTION
If engine compression is low, engine will not run.



COMPRESSION TEST

- (1) Remove one glow plug at a time in sequence (TM 10-3930-669-20).
- (2) Connect a compression gauge to cylinder.
- (3) With the aid of an assistant using retainer, crank engine and observe pressure gauge.
 - (a) If less than 363 psi (2,500 kPa) is measured, cylinder is faulty. Perform Step (4) and (5) below and go to Step 5 of this Fault.
 - (b) If 363 to 435 psi (2,500 - 2,990 kPa) is measured, repeat Steps (2) and (3) for remaining cylinders. If all cylinders are OK, fault not corrected. Perform Steps (4) through (6) below and notify supervisor.
- (4) Remove compression gauge from cylinder.
- (5) Install glow plug.
- (6) Install cab (TM 10-3930-669-20).



1. ENGI

N (CONT).

KNOWN INFO
Injection pump OK Injection pump timing OK. Camshaft gear alignment OK. Engine compression OK.
POSSIBLE PROBLEMS
Cylinder head(s) or gasket(s) faulty. Piston crown clearance incorrect. Cylinder(s) faulty. Valve(s) or valve spring(s) faulty. Piston(s) faulty. Piston ring(s) faulty.

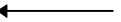
5.
Are suspect cylinder head(s) and gasket(s) free of damage?

NO

Replace cylinder head(s) or gasket(s) (Para 3-5). Go to Step 11 of this Fault.

YES

TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If cylinder head(s) or gasket(s) is faulty, engine will not run.



6.
Is piston crown clearance 0.0040 to 0.0048 in. (1.0 - 1.2 mm)?

NO

Adjust cylinder (Para 3-7). Go to Step 11 of this Fault.

YES

KNOWN INFO
Injection pump OK. Injection pump timing OK. Camshaft gear alignment OK Engine compression OK. Cylinder heads and gaskets OK.
POSSIBLE PROBLEMS
Piston crown clearance incorrect. Piston(s) faulty. Cylinder(s) faulty. Valve(s) or valve spring(s) faulty. Piston(s) faulty. Piston ring(s) faulty.

TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If piston crown clearance is incorrect, engine will not run.



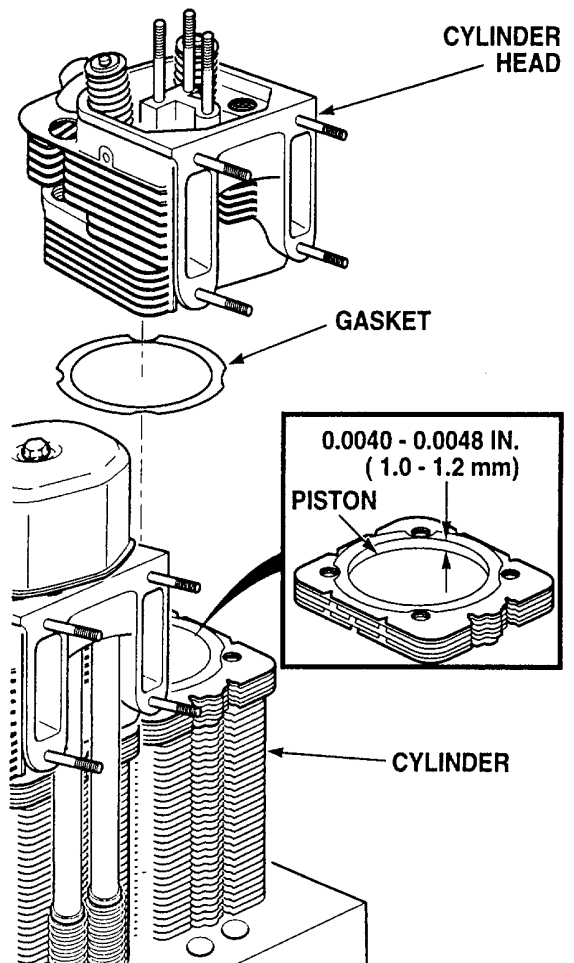
VISUAL INSPECTION

- (1) Inspect suspect cylinder head(s).
 - (a) If leaks or cracks are found, go to Step (2) below.
 - (b) If leaks or cracks are not found, perform Steps (2) and (3) below and go to Step 6 of this Fault.
- (2) Remove cylinder head(s) (Para 3-5).
- (3) Inspect cylinder head(s) and gasket(s).
 - (a) If cylinder head is cracked, replace cylinder head(s).
 - (b) If cylinder head gasket(s) is damaged, replace gasket(s).
 - (c) If cylinder heads and gaskets are not cracked or damaged, cylinder heads and gaskets are OK.

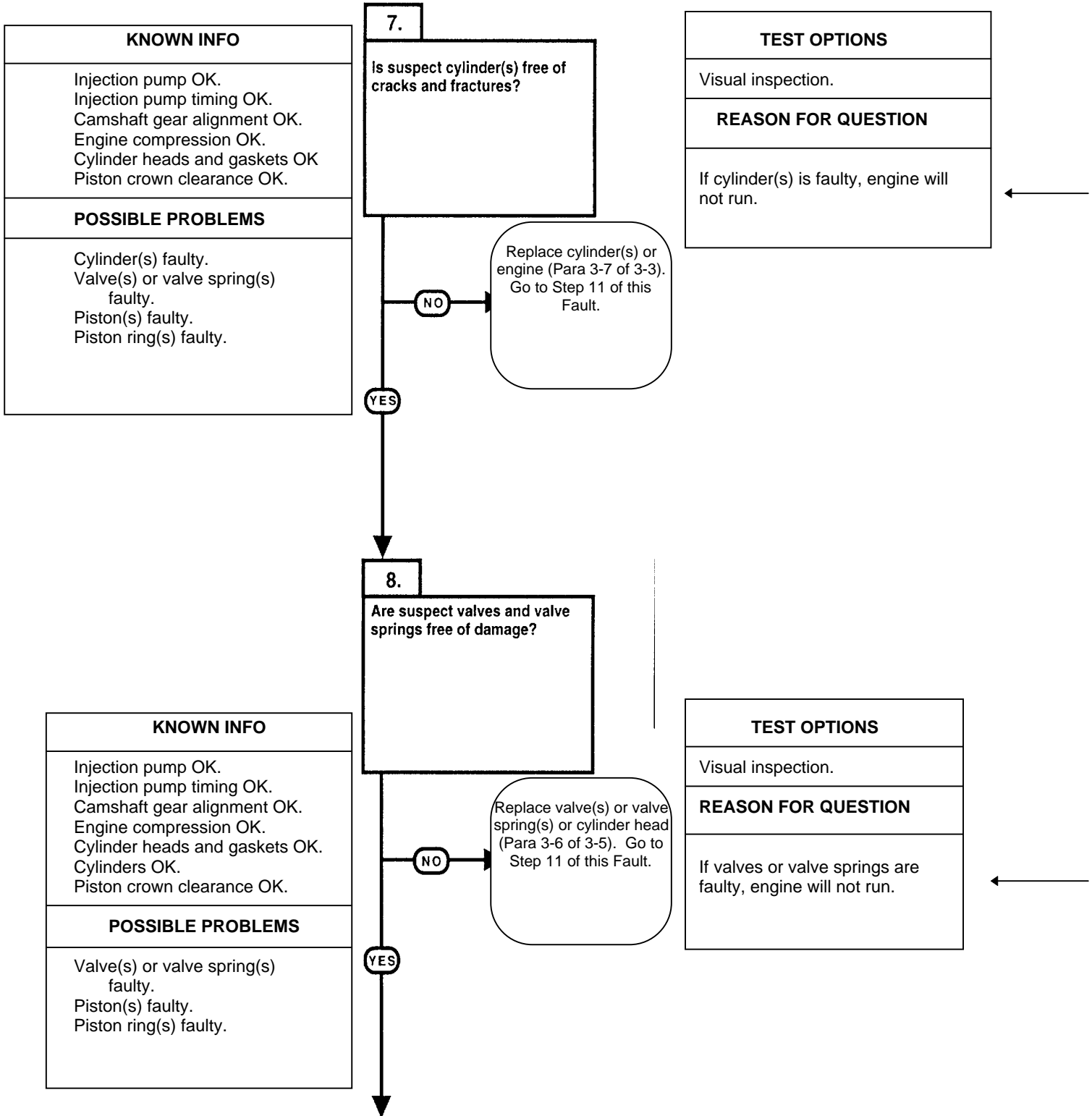
VISUAL INSPECTION

Measure piston crown clearance using a piece of solder.

- (a) If clearance is not 0.0040 to 0.0048 in. (1.0 - 1.2 mm), shim cylinder(s) to correct clearance (Para 3-7).
- (b) If clearance is 0.0040 to 0.048 in. (1 - 1.2 mm), piston crown clearance is OK.



1. ENGINE CRANKS BUT WILL NOT RUN (CONT).



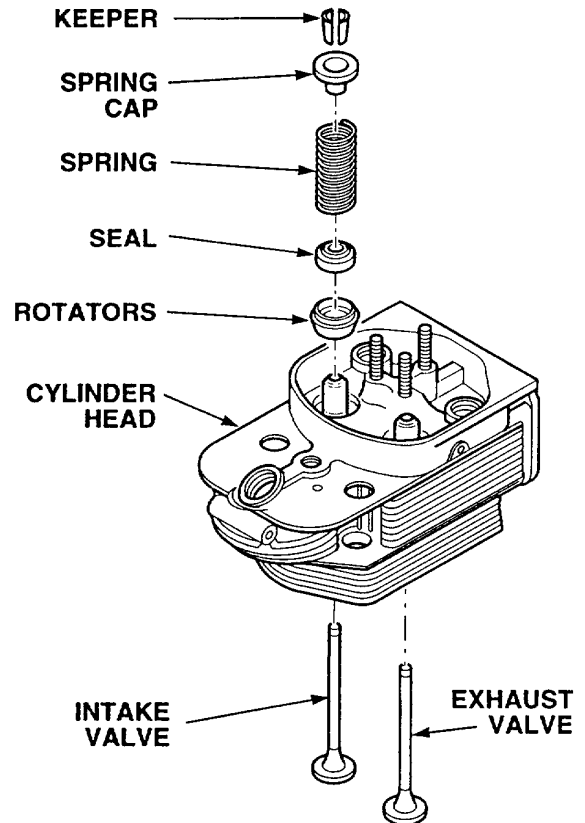
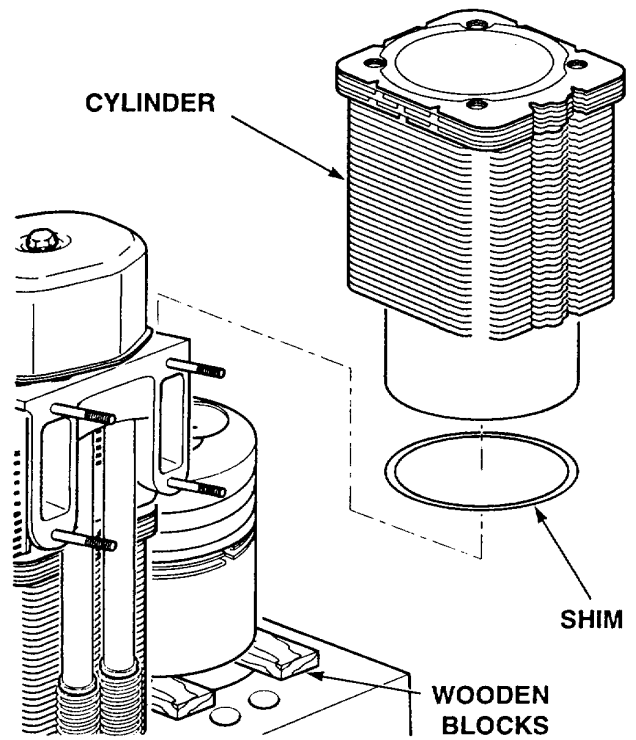
VISUAL INSPECTION

Remove and inspect suspect cylinder(s) (Para 3-7).

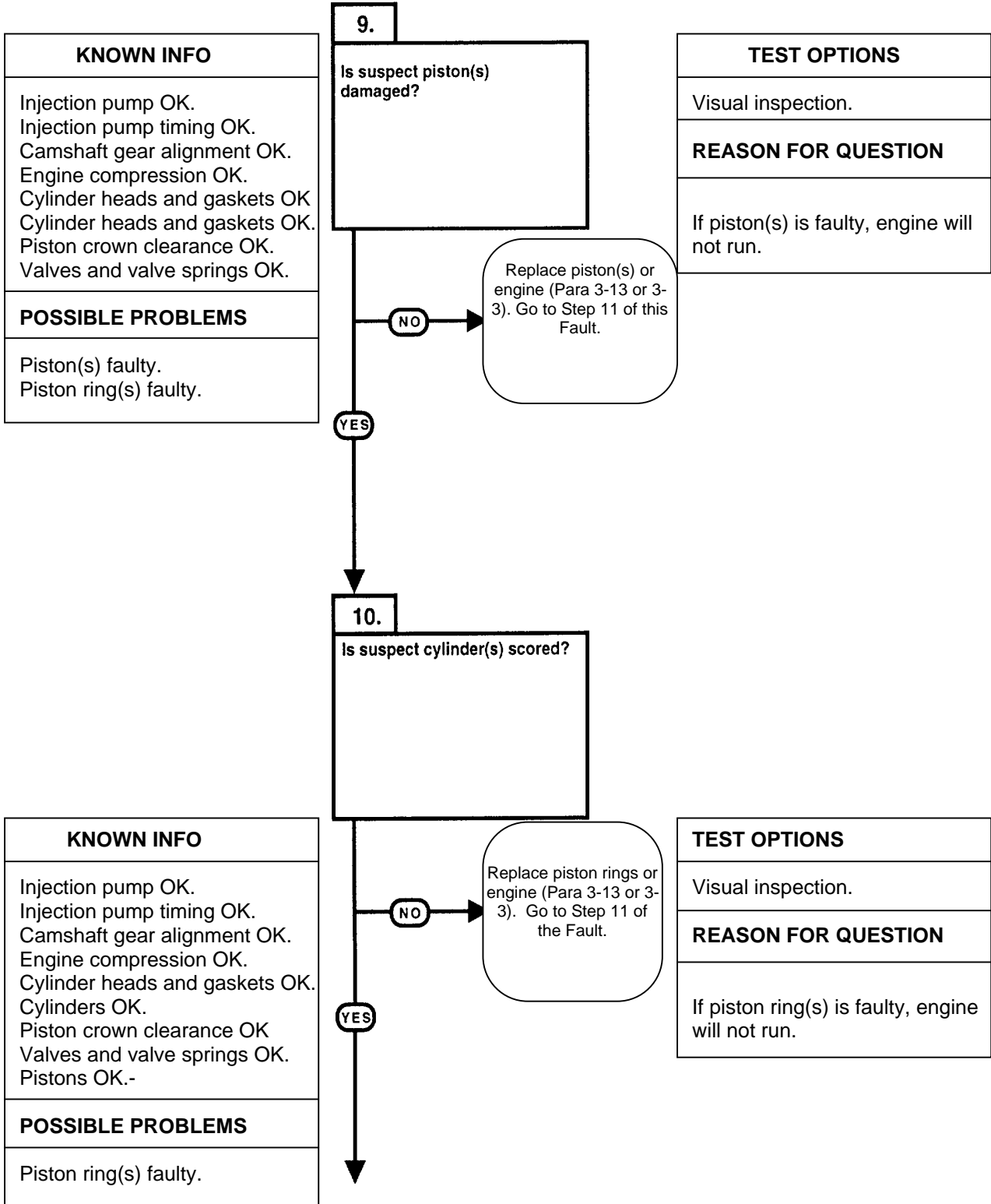
- (a) If cylinder(s) is cracked or fractured, cylinder(s) is faulty. Replace cylinder(s) or engine (Para 3-7 or 3-3).
- (b) If cylinders are not damaged, cylinders are OK.

VISUAL INSPECTION

- (1) Remove valves from suspect cylinder head(s) para 3-6).
- (2) Inspect valves and springs for damage.
 - (a) If valve(s) and/or spring(s) is damaged, replace valve(s) and/or spring(s) or cylinder head(s) (Para 3-6 or 3-5).
 - (b) If valves and springs are not damaged, valves and springs are OK.



1. ENGINE CRANKS BUT WILL NOT RUN (CONT).

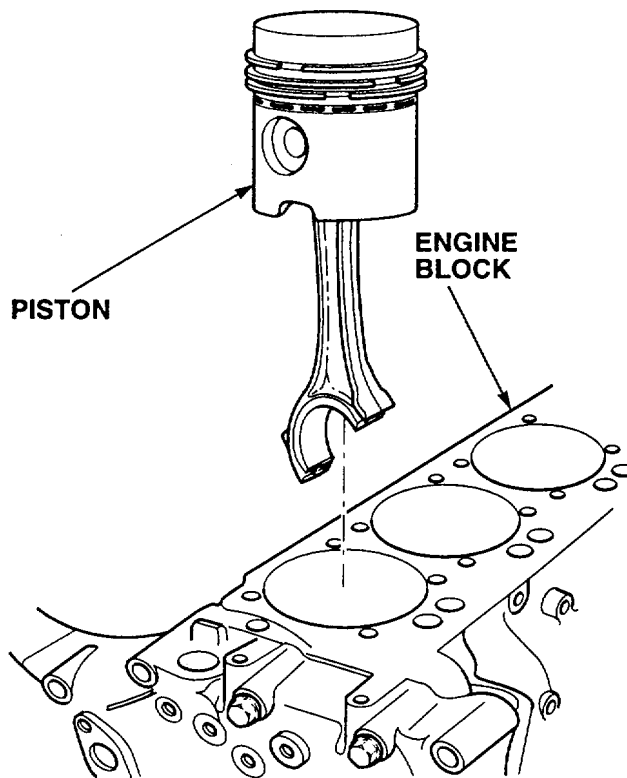


VISUAL INSPECTION

Inspect suspect piston(s) for damage.
 (a) If piston(s) is damaged, replace piston(s) or engine (Para 3-13 or 3-3).
 (b) If pistons are not damaged, pistons are OK

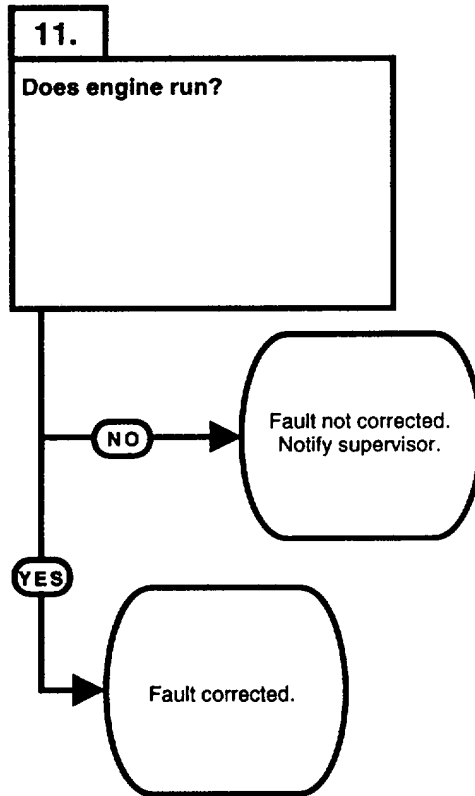
VISUAL INSPECTION

- (1) Inspect inside of suspect cylinder(s) and engine block for scoring.
 - (a) If there is scoring, piston rings are faulty. Replace piston rings (Para 3-13) and hone engine block and cylinder(s) (Para 3-7) or replace engine (Para 3-3).
 - (b) If there is no scoring, piston rings are OK.
- (2) Install cylinder(s) (Para 3-7).
- (3) Install valves and springs (Para 3-6).
- (4) Install cylinder head(s) (Para 3-5).
- (5) Install engine cowling (TM 10-3930-669-10).
- (6) Install cab (TM 10-3930-669-20).



1. ENGINE CRANKS BUT WILL NOT RUN (CONT).

KNOWN INFO
Injection pump OK. Injection pump timing OK. Camshaft gear alignment OK. Engine compression OK. Cylinder heads and gaskets OK. Cylinders OK. Piston crown clearance OK. Valves and valve springs OK. Pistons OK. Piston rings OK.
POSSIBLE PROBLEMS

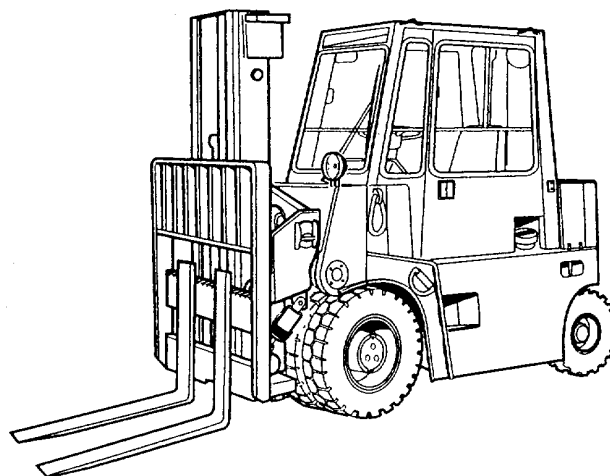


TEST OPTIONS
Verify repair.
REASON FOR QUESTION
If engine runs, fault has been corrected.



VERIFY REPAIR

- (1) Start engine (TM 10-3930-669-10).
 - (a) If engine does not start or is hard to start, fault not corrected. Perform Step (2) below and notify supervisor.
 - (b) If engine starts correctly, fault corrected.
- (2) Shut down engine.



2-11. ENGINE SYSTEM TROUBLESHOOTING (CONT).

2. LOW ENGINE OIL PRESSURE (OIL PRESSURE GAUGE CONTINUOUSLY READS LESS THAN 30 TO 60 PSI [207 - 414 KPA] AT 625 TO 750 RPM).

INITIAL SETUP:

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)

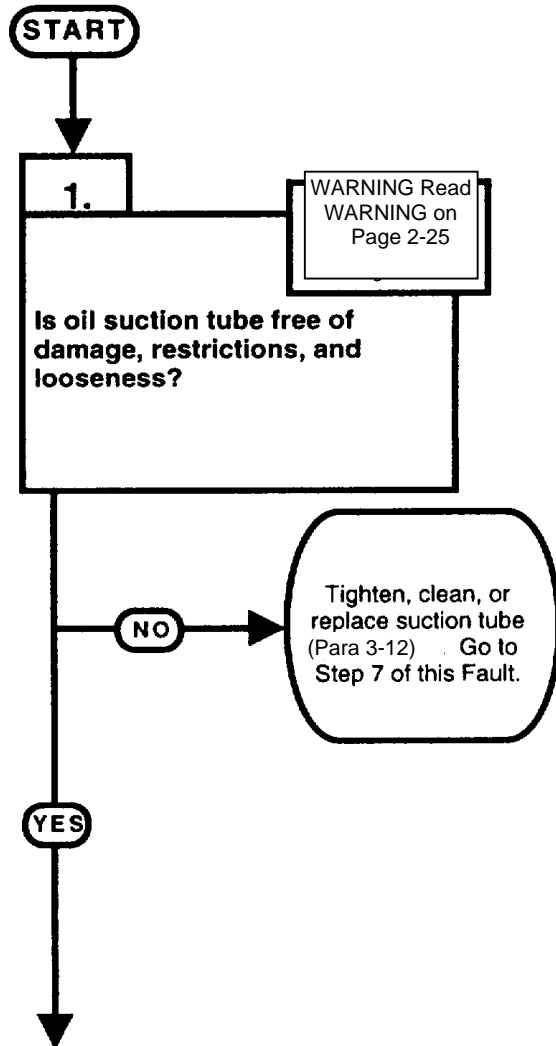
References

TM 10-3930-669-10

Equipment Condition

Engine removed (Para 3-3)

KNOWN INFO
Oil level OK.
POSSIBLE PROBLEMS
Oil suction tube faulty. Oil tube faulty. Oil pump faulty. Oil pump seal faulty. Rod and main bearings faulty. Rifle lines clogged. Oil pump pressure valve faulty.



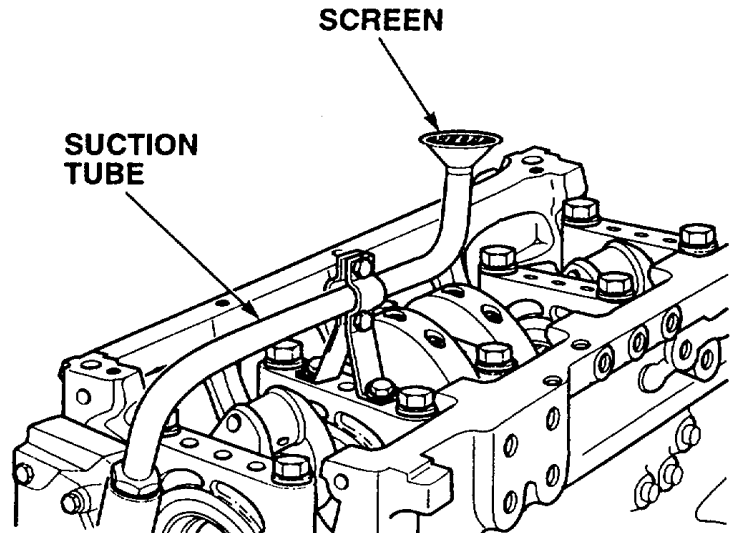
TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If suction tube is faulty, engine oil pressure will be low.

WARNING

Engine retains extreme heat when in operation. Allow time for cooling before performing troubleshooting procedures. Failure to do so may result in injury to personnel.

VISUAL INSPECTION

- (1) Remove oil pan (Para 3-8).
- (2) Inspect oil suction tube, tube screen, and connections.
 - (a) If oil suction tube is loose, tighten connections (Para 3-12).
 - (b) If oil suction tube screen is clogged, clean oil suction tube.
 - (c) If oil suction tube is damaged, replace oil suction tube.
 - (d) If oil suction tube is secured, clean, and not damaged, suction tube is OK.



2. LOW ENGINE OIL PRESSURE (OIL PRESSURE GAUGE CONTINUOUSLY READS LESS THAN 30 TO 60 PSI [207 - 414 KPA] AT 625 TO 750 RPM) (CONT).

KNOWN INFO
Oil level OK. Oil suction tube OK.
POSSIBLE PROBLEMS
Oil tube faulty. Oil pump faulty. Oil pump seal faulty. Rod and main bearings faulty Rifle lines clogged. Oil pump pressure valve faulty

2.
Is oil tube free of damage and looseness?

NO → Tighten or replace oil tube (Para 3-12) . Go to Step 7 of this Fault.

YES

3.
Is oil pump gear backlash 0.0039 to 0.0079 in. (0.1 - 0.2 mm)?

NO → Replace oil pump or engine (Para 3-12 or 3-3). Goo to Step 7 of this Fault

YES



TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If oil tube is faulty, engine oil pressure will be low.

KNOWN INFO
Oil level OK. Oil suction tube OK. Oil tube OK.
POSSIBLE PROBLEMS
Oil pump faulty. Oil pump seal faulty. Rod and main bearings faulty. Rifle lines clogged. Oil pump pressure valve faulty.

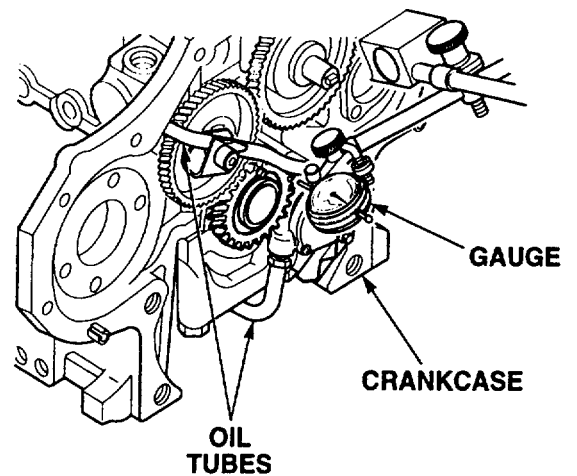
TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If oil pump is faulty, engine oil pressure will be low.

VISUAL INSPECTION

- (1) Remove front cover (Para 3-10).
- (2) Inspect oil tube for damage and looseness.
 - (a) If oil tube is loose or damaged, tighten connections or replace oil tube (Para 3-12).
 - (b) If oil tube is not loose or damaged, oil tube is OK.

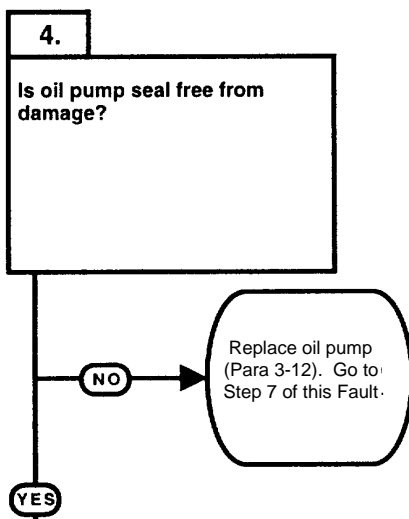
VISUAL INSPECTION

- (1) Set engine No. 1 piston to TDC (TM 10-3930-669-20).
- (3) Install gauge and rotate engine 180° (TM 10-393-669-20) and measure oil pump gear backlash.
 - (a) If gear backlash is not 0.0039 to 0.0079 in. (0.1-0.2 mm), replace oil pump or engine (Para 3-12 or 3-3).
 - (b) If gear backlash is 0.0039 to 0.0079 in. (0.1-0.2 mm), oil lube pump is OK.



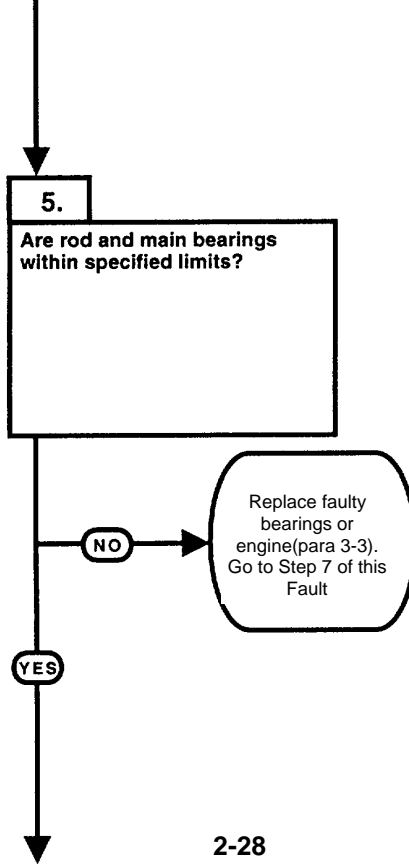
2. LOW ENGINE OIL PRESSURE (OIL PRESSURE GAUGE CONTINUOUSLY READS LESS THAN 30 TO 60 PSI [207 - 414 KPA] AT 625 TO 750 RPM) (CONT).

KNOWN INFO
Oil level OK Oil suction tube OK. Oil tube OK Oil pump OK.
POSSIBLE PROBLEM
Oil pump seal faulty. Rod and main bearings faulty. Rifle lines clogged. Oil pump pressure valve faulty.



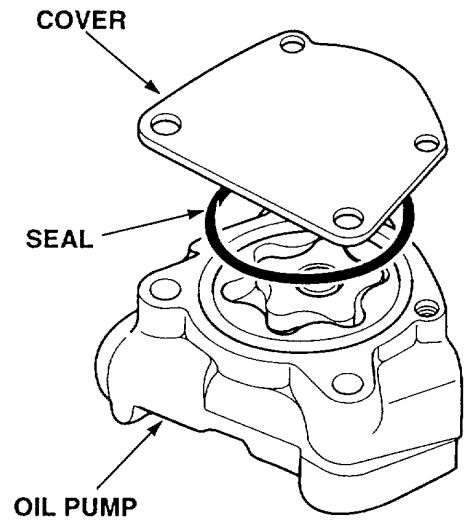
TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If oil pump seal is faulty, engine oil pressure will be below.

KNOWN INFO
Oil level OK. Oil suction tube OK. Oil tube OK. Oil pump OK. Oil pump seal OK.
POSSIBLE PROBLEMS
Red and main bearings faulty. Rifle lines clogged. Oil pump pressure valve faulty.

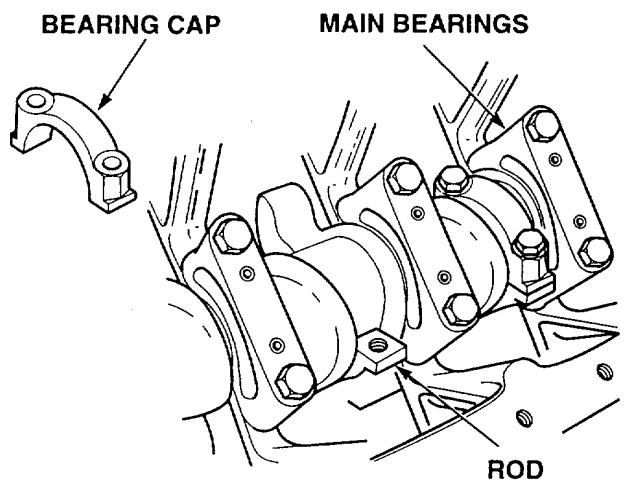


TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If rod or main bearings are faulty, engine oil pressure will be below.

VISUAL INSPECTION
(1) Remove oil pump (Para 3-12). (2) Inspect oil pump seal. (a) If pump seal is damaged, replace pump. (b) If pump seal is not damaged, pump seal is OK.



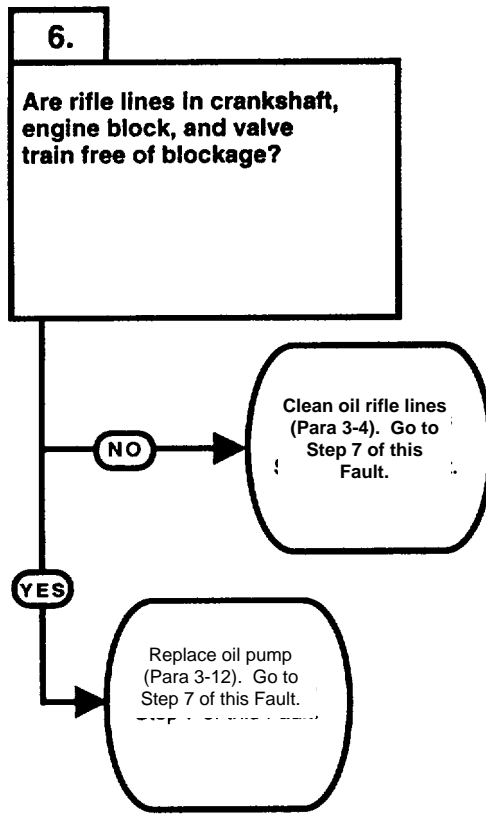
VISUAL INSPECTION
(1) Remove crankshaft (Para 3-14). (2) Inspect rod and main bearings. (a) If rod or main bearings are not within limits, replace damaged bearings or engine (Para 3-3). (b) If rod or main bearings are within limits, rod and main bearings are OK.



2. LOW ENGINE OIL PRESSURE (OIL PRESSURE GAUGE CONTINUOUSLY READS LESS THAN 30 TO 60 PSI [207 - 414 KPA] AT 625 TO 750 RPM) (CONT).

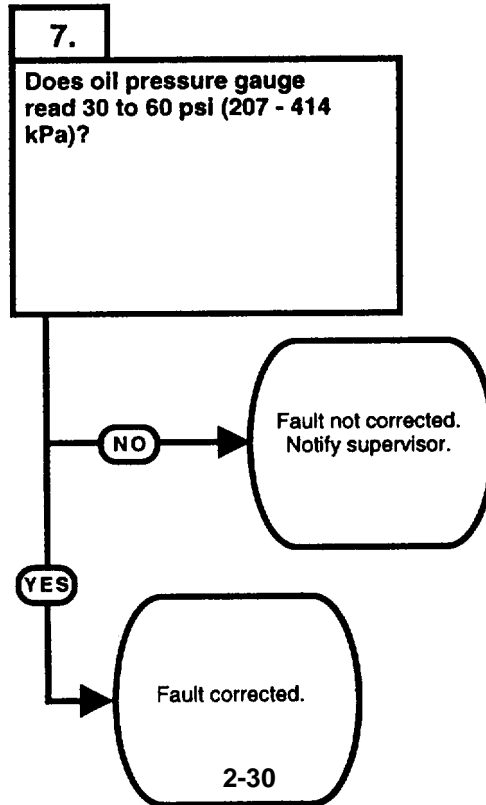
KNOWN INFO
Oil level OK. Oil suction tube OK. Oil tube OK. Oil pump OK. Oil pump seal OK. Rod and main bearings OK.
POSSIBLE PROBLEMS
Rifle lines clogged. Oil pump pressure valve faulty.

TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If rifle lines are blocked, rifle lines are faulty. If rifle lines are not blocked, oil pump pressure valve is faulty.



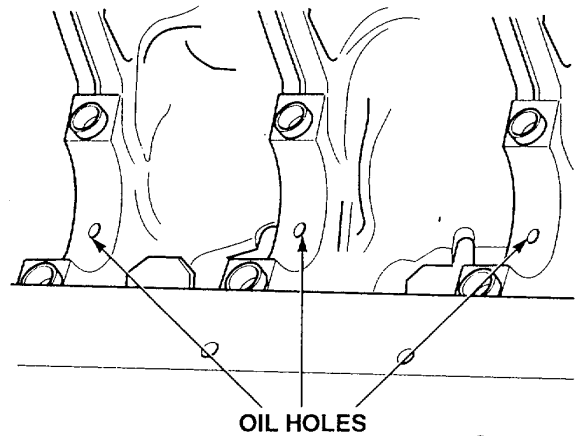
KNOWN INFO
Oil level OK. Oil suction tube OK. Oil tube OK. Oil pump OK. Oil pump seal OK. Rod and main bearings OK. Rifle lines OK. Oil pump pressure valve OK.
POSSIBLE PROBLEMS

TEST OPTIONS
Verify repair.
REASON FOR QUESTION
If oil pressure gauge reads 30 to 60 psi (207 - 414 kPa), fault has been corrected.



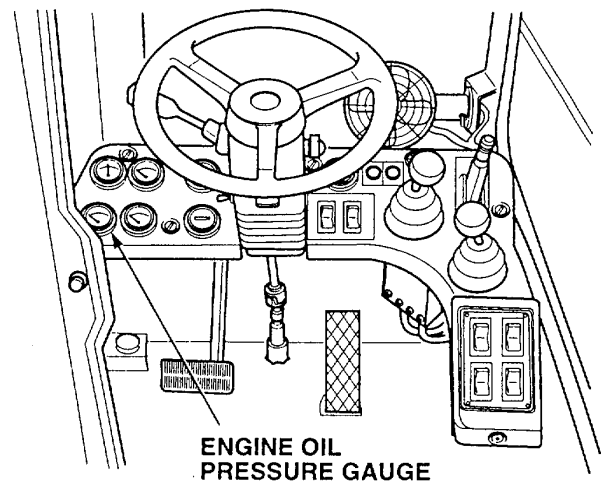
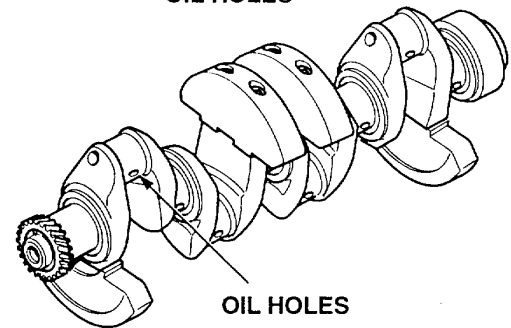
VISUAL INSPECTION

- (1) Inspect oil rifle lines in crankshaft, engine block, and valve train.
 - (a) If oil rifle lines are clogged, clean all rifle lines (Para 3-4).
 - (b) If oil rifle lines are not clogged, replace oil pump (Para 3-12).
- (2) Install crankshaft (Para 3-14).
- (3) Install front cover (Para 3-10).
- (4) Install oil pan (Para 3-8).



VERIFY REPAIR

- (1) Start engine (TM 10-3930-669-10).
- (2) Observe engine oil pressure gauge.
 - (a) If engine oil pressure is not 30 to 60 psi (207 - 414 kPa), fault not corrected. Perform Step (3) below and notify supervisor.
 - (b) If engine oil pressure is 30 and 60 psi (207 - 414 kPa), fault corrected.
- (3) Shut down engine.



2-11. ENGINE SYSTEM TROUBLESHOOTING (CONT).

3. EXCESSIVE ENGINE OIL CONSUMPTION AND/OR BLUE SMOKE.

INITIAL SETUP

Tools and Special Tools

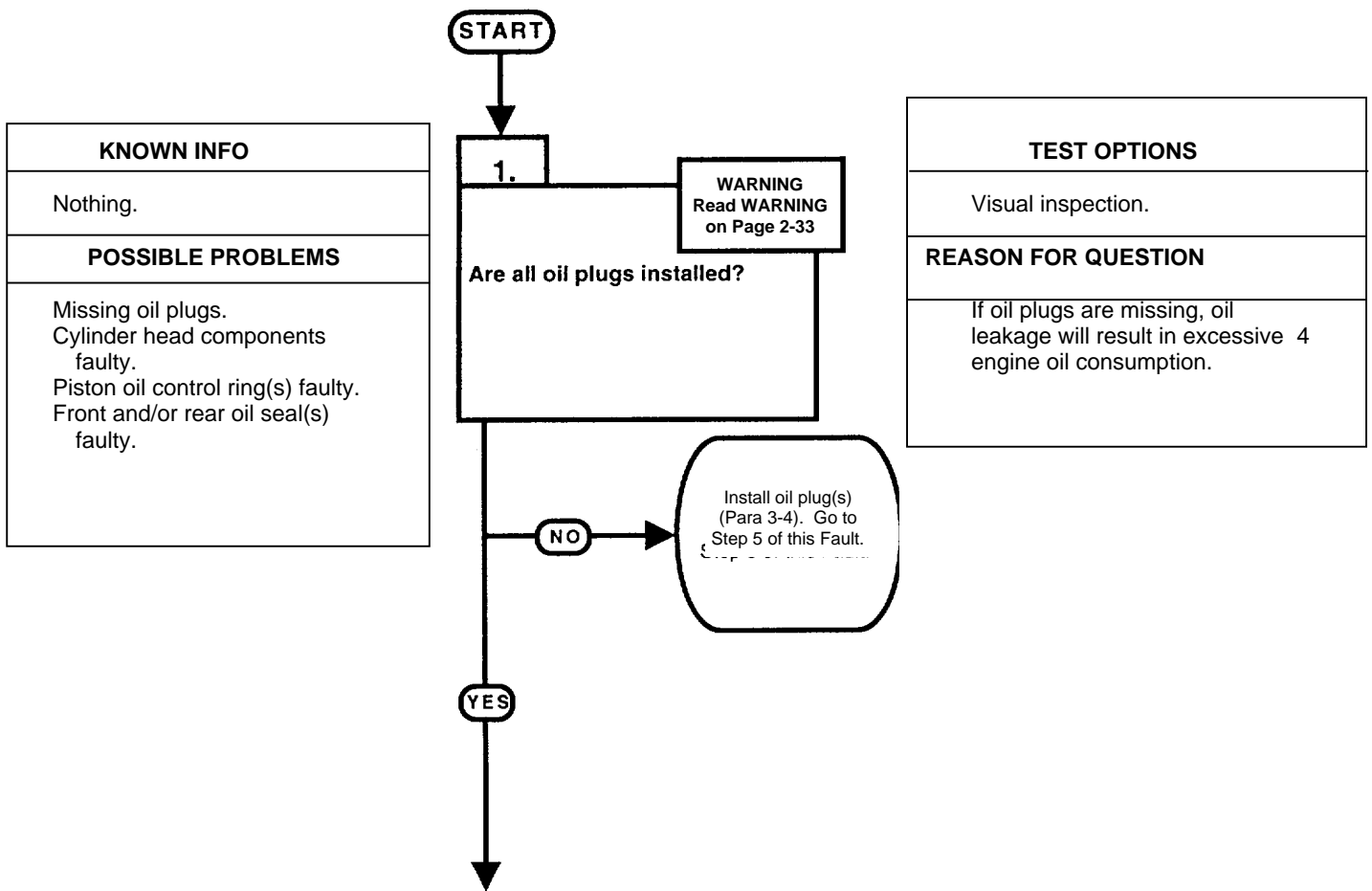
Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)

References

TM 10-3930-669-10
TM 10-3930-669-20

Equipment Condition

Engine OFF (TM 10-3930-669-10)
MAIN POWER switch OFF (TM 10-3930-669-10)
Parking brake applied (TM 10-3930-669-10)
Wheels chocked (TM 10-3930-669-10)

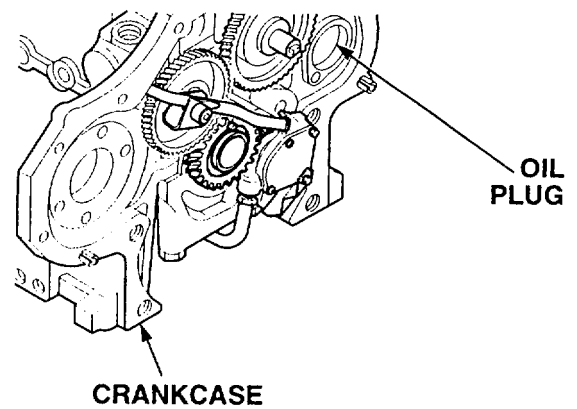


WARNING

Engine retains extreme heat when in operation. Allow time for cooling before performing troubleshooting procedures. Failure to do so may result in injury to personnel.

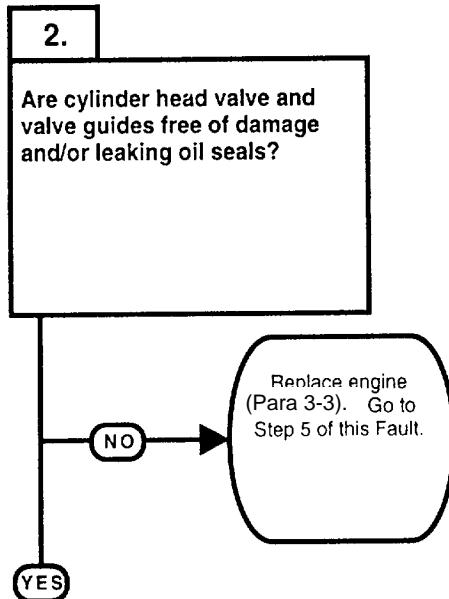
VISUAL INSPECTION

- Inspect engine for missing oil plug.
- (a) If oil plug is missing, replace oil plug (Para 3-4).
 - (b) If oil plug is not missing, oil plug is OK.



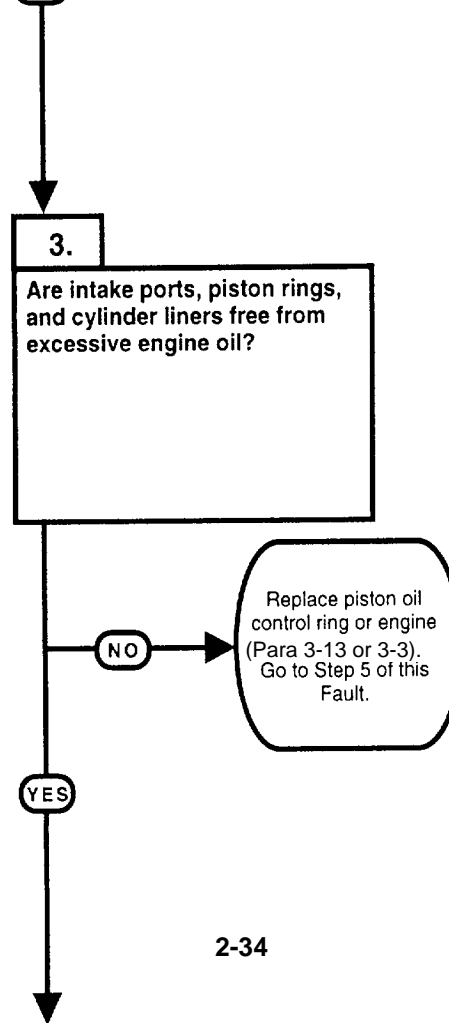
3. EXCESSIVE ENGINE OIL CONSUMPTION AND/OR BLUE SMOKE (CONT).

KNOWN INFO
Missing oil plugs
POSSIBLE PROBLEMS
Cylinder head components faulty. Piston oil control ring(s) faulty Front and/or rear oil seal(s) faulty.



TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If cylinder head, valve, valve guide or seals are faulty, oil leakage will result in excessive engine oil consumption.

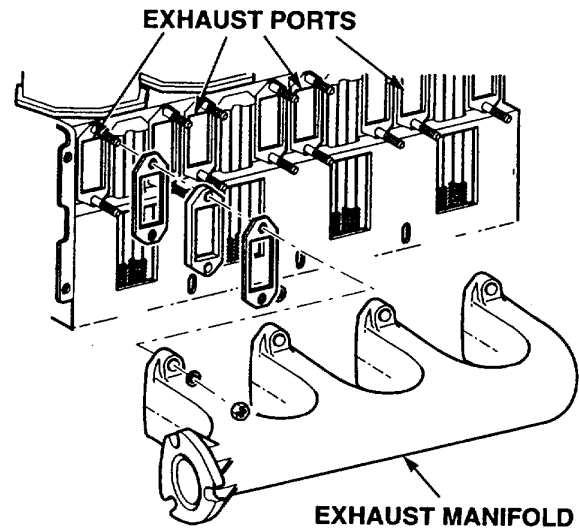
KNOWN INFO
Missing oil plugs. Cylinder head components OK.
POSSIBLE PROBLEMS
Piston oil control ring(s) faulty. Front and/or rear oil seal(s) faulty.



TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If piston oil control ring is faulty, oil leakage will result in excessive engine oil consumption.

VISUAL INSPECTION

- (1) Remove intake and exhaust manifolds (Para 4-2 and 5-2).
- (2) Check inside of exhaust manifolds for leaking oil.
 - (a) If there is oil present inside the exhaust manifolds, go to Step (3) below.
 - (b) If there is no oil inside the exhaust manifold, go to Step 4 of this Fault.
- (3) Remove cylinder head (Para 3-5).
- (4) Check cylinder head, valve, valve guides, and seals for cracks and damage.
 - (a) If cylinder head components are damaged, replace engine (Para 3-3).
 - (b) If cylinder head components are not damaged, components are OK.

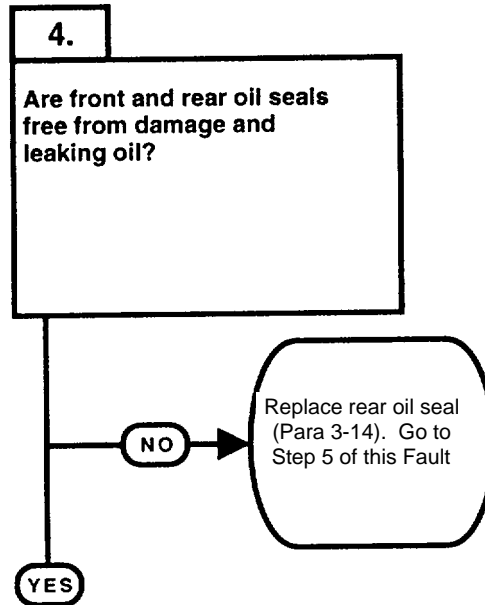


VISUAL INSPECTION

- (1) Check for oil leakage past cylinder ports or piston rings.
 - (a) If oil is leaking past cylinder ports or piston rings, replace engine (Para 3-3).
 - (b) If oil is not leaking past cylinder ports or piston rings, perform Step (2) below and go to Step 4 of this Fault.
- (2) Install intake and exhaust manifolds (Para 4-2 and 5-2).

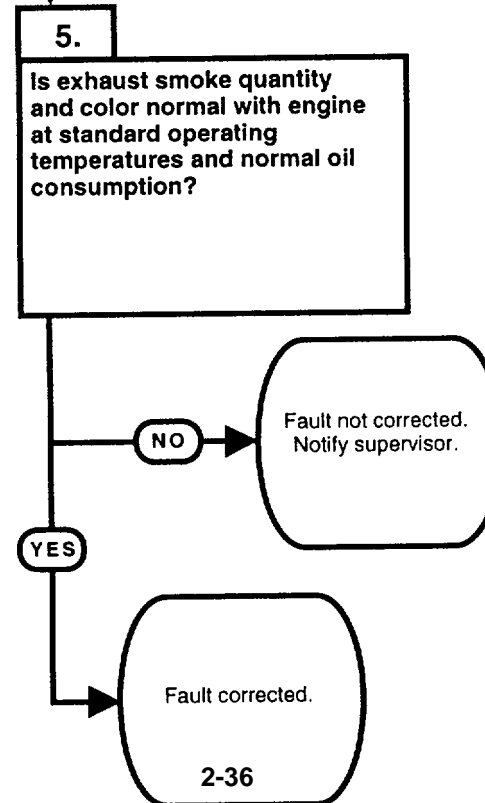
3. EXCESSIVE ENGINE OIL CONSUMPTION AND/OR BLUE SMOKE (CONT).

KNOWN INFO
Missing oil plugs. Cylinder head components OK. Piston oil control rings OK.
POSSIBLE PROBLEMS
Front and/or rear oil seal(s) faulty.



TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If front and/or rear oil seal(s) is faulty, oil leakage will result in excessive engine oil consumption.

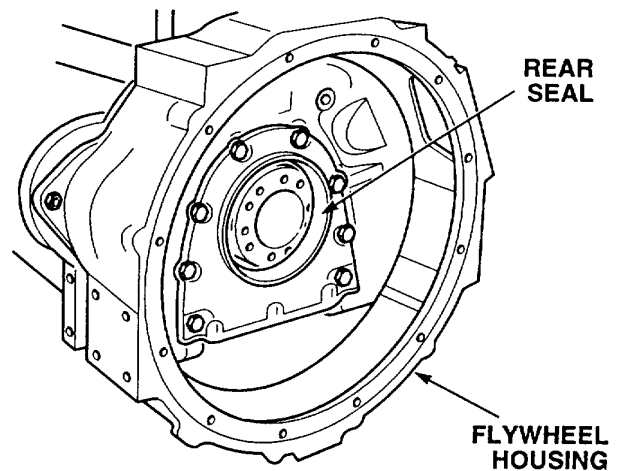
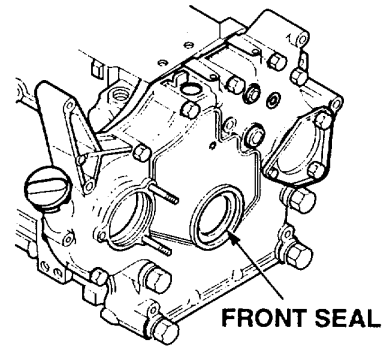
KNOWN INFO
Missing oil plugs. Cylinder head components OK. Piston oil control rings OK. Front and rear oil seals OK.
POSSIBLE PROBLEMS



TEST OPTIONS
Verify repair.
REASON FOR QUESTION
If engine oil consumption is normal, fault has been corrected.

VISUAL INSPECTION

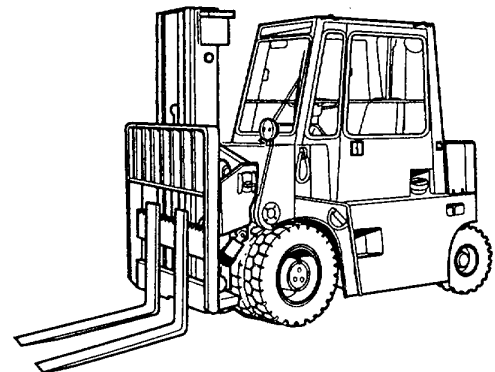
- (1) Open left side rear access cover (TM 10-3930-669-10).
- (2) Inspect front crankshaft cover for oil leakage.
 - (a) If oil leakage is present, replace engine (Para 3-3).
 - (b) If oil leakage is not present, go to Step (3) below.
- (3) Close left side rear access cover.
- (4) Remove fuel/water separator bracket (TM 10-3930-669-20).
- (5) Inspect inside of flywheel housing for oil leakage.
 - (a) If oil leakage is present, replace rear oil seal (Para 3-14).
 - (b) If oil leakage is not present, rear oil seal is OK.
- (6) Install fuel/water separator bracket.



VERIFY REPAIR

Operate engine over the period of time specified in the lubrication order (LO 10-3930-669-12).

- (a) If engine oil consumption exceeds 10 quarts per 250 hours of operation and/or blue smoke is excessive, fault not corrected. Notify supervisor.
- (b) If engine oil consumption does not exceed 10 quarts per 250 hours of operation and blue smoke is not excessive, fault corrected.



2-11. ENGINE SYSTEM TROUBLESHOOTING (CONT).

4. EXCESSIVE BLACK OR GREY SMOKE.

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Pressure Test Kit (Item 5, Appendix E)
 STE/ICE-R (Optional) (Item 14, Appendix E)
 Gauge, Tester, Injection Pump (Item 5, Appendix E)
 Retainer (Item 13, Appendix E)

Materials/Parts

Cap and Plug Set (Item 5, Appendix B)
 Tag, Identification (Item 21, Appendix B)

References

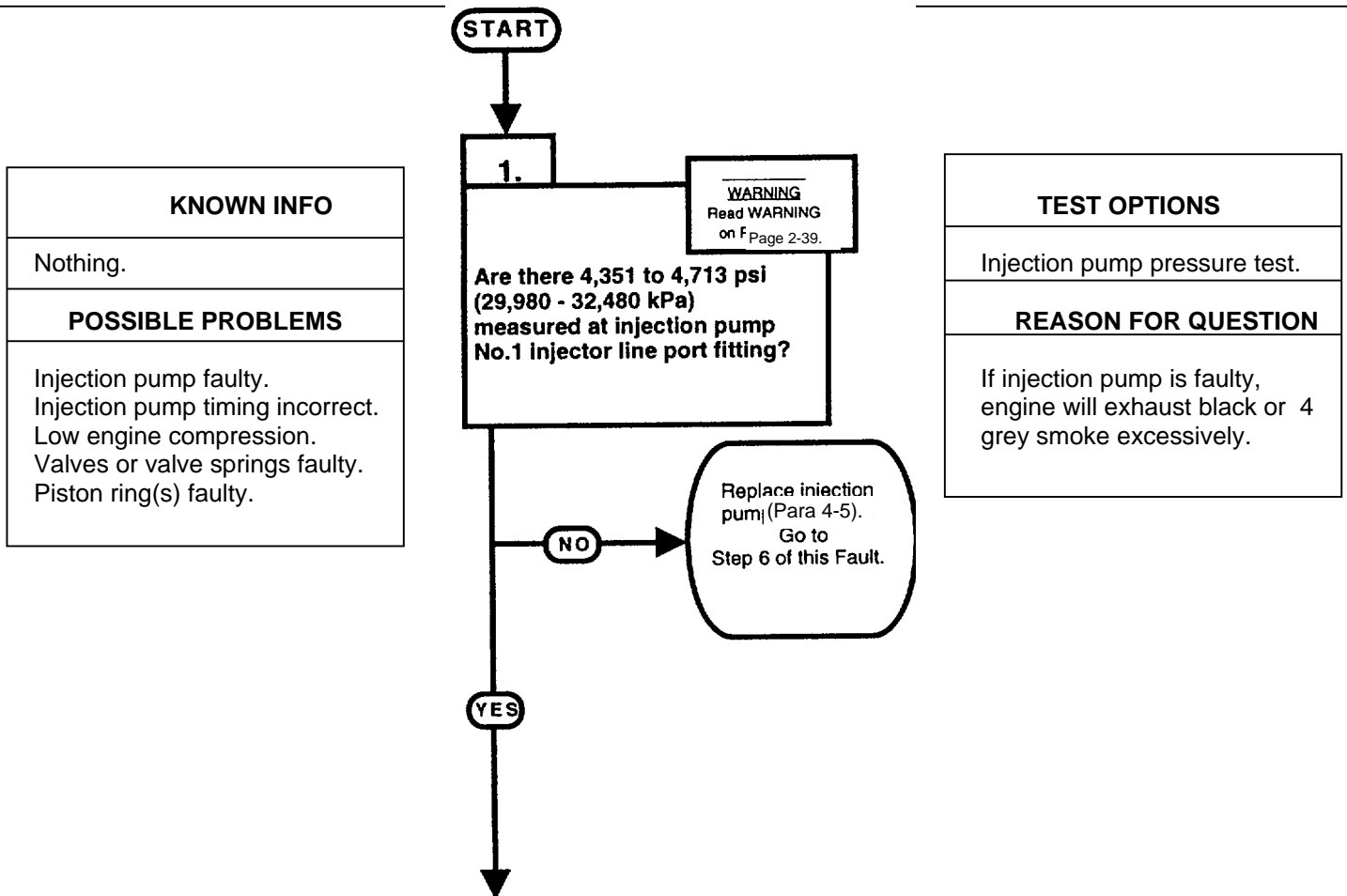
TM 10-3930-669-10
 TM 10-3930-669-20

Personnel Required

Two

Equipment Condition

Engine OFF (TM 10-3930-669-10)
 MAIN POWER switch OFF (TM 10-3930-669-10)
 Parking brake applied (TM 10-3930-669-10)
 Wheels chocked (TM 10-3930-669-10)

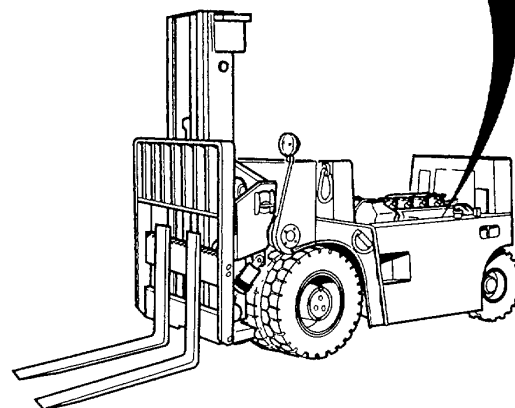
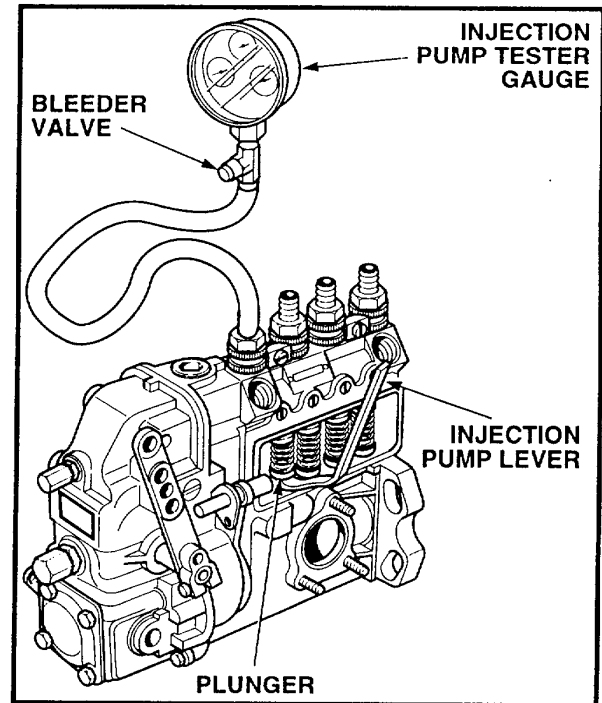


WARNING

- **Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET (15 m).**
- **Pressure test procedure results in fuel under high pressure. Be sure that pressure test gauge is connected properly and use safety shield during test. Failure to do so may result in injury to personnel.**

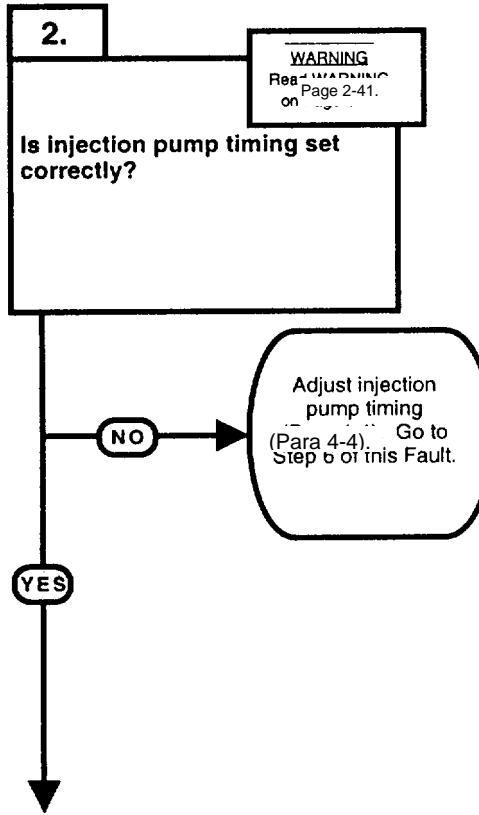
INJECTION PUMP PRESSURE TEST

- | |
|--|
| <ol style="list-style-type: none"> (1) Remove cab (TM 10-3930-669-20). (2) Disconnect throttle cable (TM 10-3930-669-20). (3) Position control lever to maximum position. (4) Remove pump cover (Para 4-5). (5) Tag and disconnect injection pump injector line one at a time. (6) Connect injection pump tester gauge to injection pump port fitting. (7) Install pressure plug in No. 1 injector line. (8) Open bleeder valve on back of test gauge. (9) With aid of an assistant using retainer, turn crankshaft clockwise until pump element to be tested is at the bottom of its stroke. (10) Using pump lever, lift plunger to bleed air from pressure gauge. Close bleeder valve. (11) Hold shutoff solenoid in open position and pump lever until pressure gauge reads 2,175 psi (14,997 kPa). (12) Observe pressure gauge for 60 seconds. <ol style="list-style-type: none"> (a) If 145 psi (1,000 kPa) or higher is not measured, perform Steps (14) and (15) below and replace injection pump (Para 4-5). (b) If 145 psi (1,000 kPa) or higher is measured, go to step (13) below. (13) Hold shutoff solenoid in open position and pump lever until pressure gauge reads 5,075 psi (34,992 kPa). <ol style="list-style-type: none"> (a) If 5,075 psi (34,992 kPa) cannot be measured, perform Steps (14) and (15) below and replace injection pump (Para 4-5). (b) If 5,075 psi (34,992 kPa) can be measured, repeat steps (5) through (13) above for remaining elements. If all elements are OK, perform Steps (14) and (15) below and go to Step 2 of this Fault. (14) Remove injection pump tester gauge from pump port fitting. (15) Install pump cover. |
|--|



4. EXCESSIVE BLACK OR GREY SMOKE (CONT).

KNOWN INFO
Injection pump OK.
POSSIBLE PROBLEMS
Injection pump timing incorrect. Low engine compression. Valves or valve springs faulty. Piston ring(s) faulty.

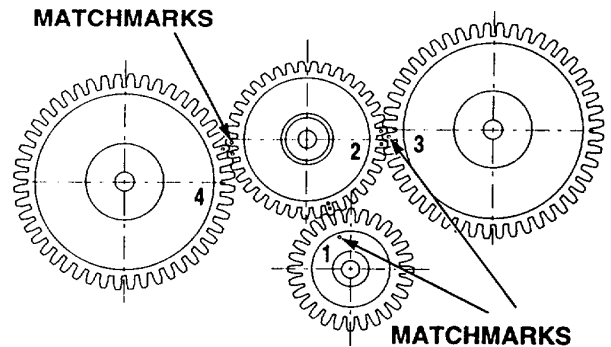
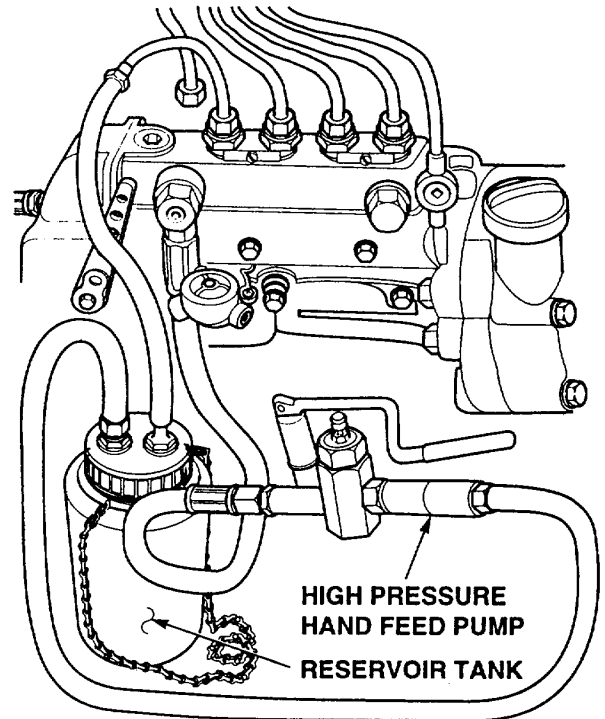


TEST OPTIONS
Injection pump timing check.
REASON FOR QUESTION
If injection pump timing is faulty, engine will exhaust black or grey smoke excessively.

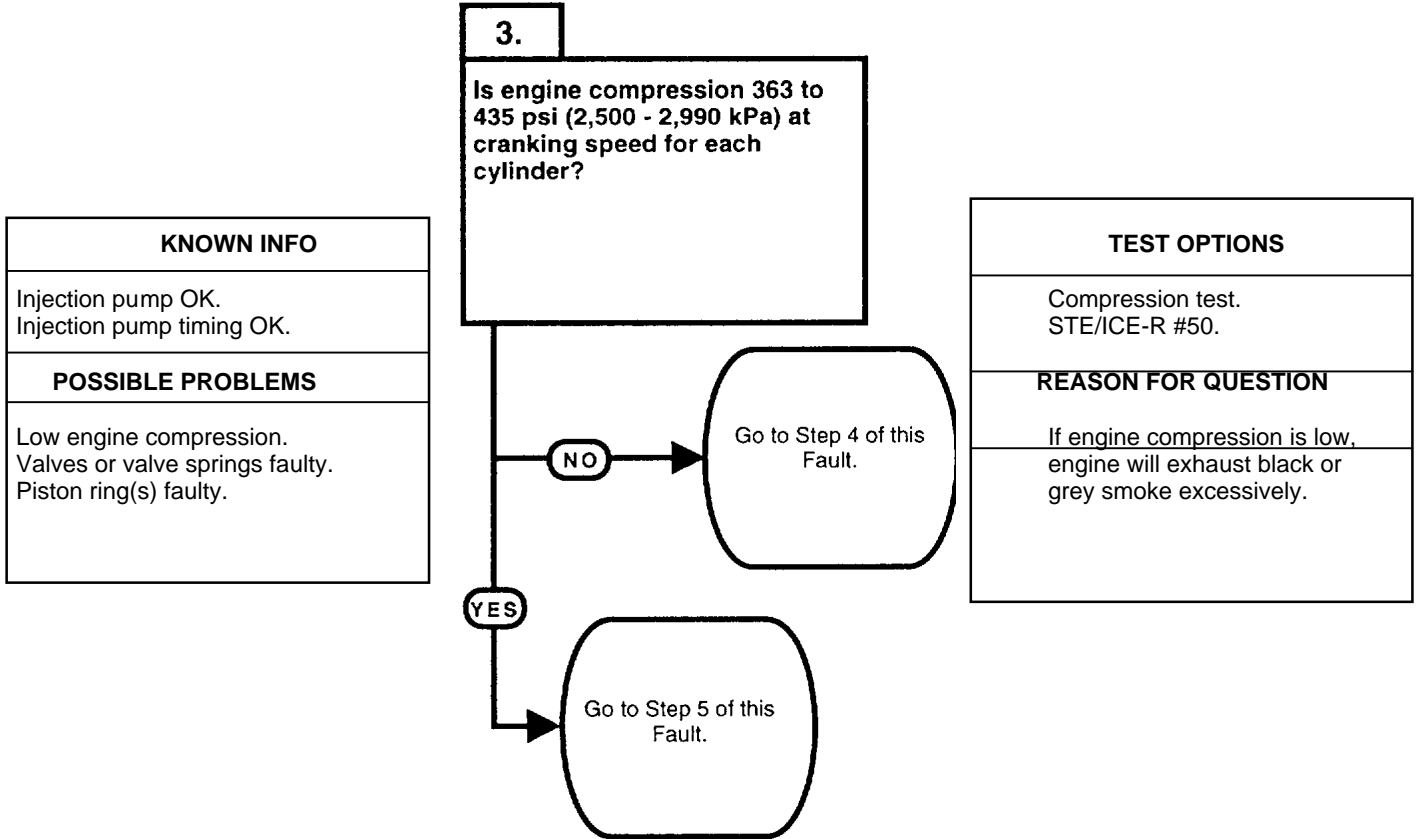
WARNING

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET (15 m).

INJECTION PUMP TIMING CHECK
<p>Check injection pump timing (Para 4-4).</p> <p>(a) If injection pump timing is incorrect, reset timing.</p> <p>(b) If injection pump timing is correct, go to Step 3 of this Fault.</p>

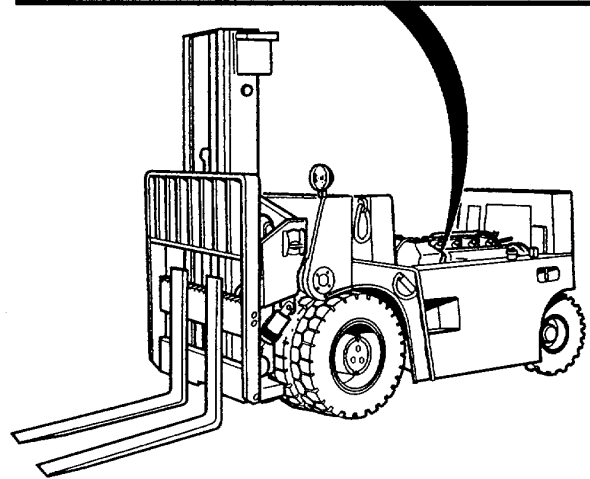
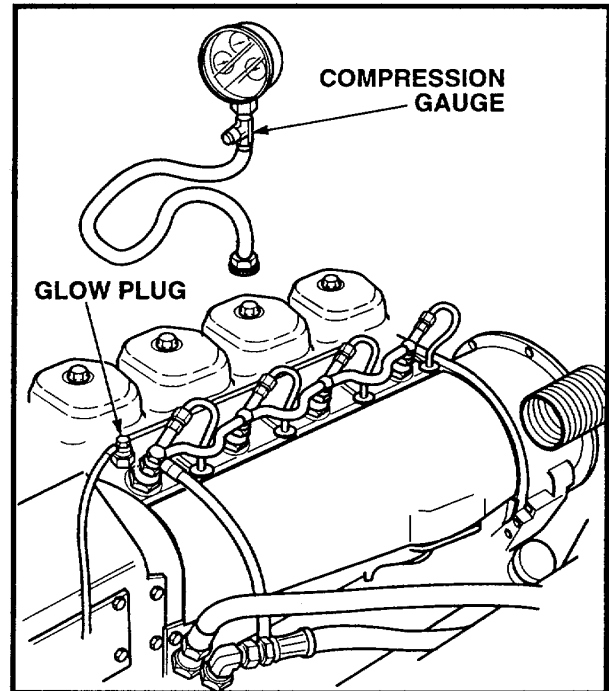


4. EXCESSIVE BLACK OR GREY SMOKE (CONT).



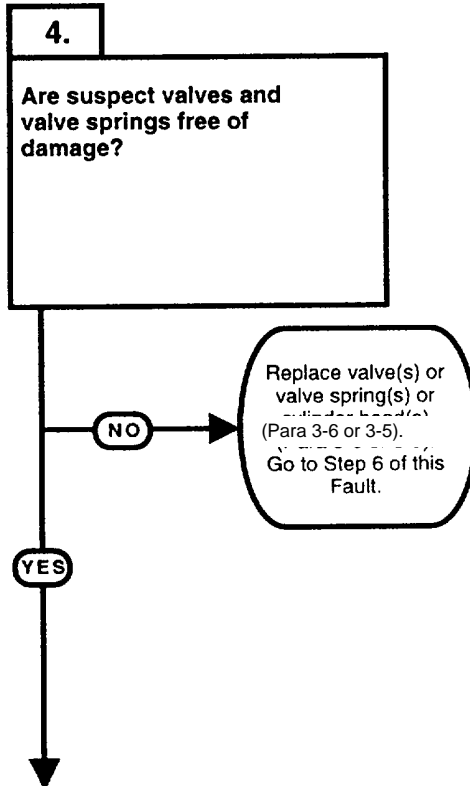
COMPRESSION TEST

- (1) Remove engine blower ducting (Para 6-2).
- (2) Disconnect fuel shutoff solenoid connector P 10.
- (3) Remove glow plug from each cylinder in sequence to perform compression test (TM 10-3930-669-20).
- (4) Install compression test gauge in each cylinder in sequence to perform test.
- (5) With the aid of an assistant, crank engine and observe compression test gauge installed in each cylinder in sequence.
 - (a) If less than 363 psi (2,500 kPa) is measured, cylinder is faulty. Perform Steps (6) through (8) below and go to Step 4 of this Fault.
 - (b) If 363 psi (2,500 kPa) or greater is measured, perform Steps (6) through (8) below and go to Step 5 of this Fault.
- (6) Remove compression test gauge from cylinder when test is complete.
- (7) Install engine glow plugs (TM 10-3930-669-20).
- (8) Connect fuel shutoff solenoid connector P10.



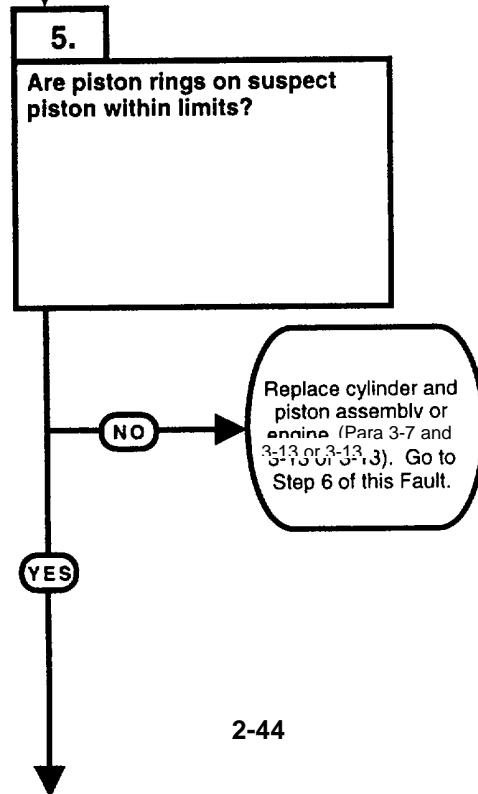
4. EXCESSIVE BLACK OR GREY SMOKE (CONT).

KNOWN INFO
Injection pump OK. Injection pump timing OK. Engine compression OK.
POSSIBLE PROBLEMS
Valves or valve springs faulty. Piston ring(s) faulty.



TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If valves or valve springs are faulty, engine will exhaust black or grey smoke excessively.

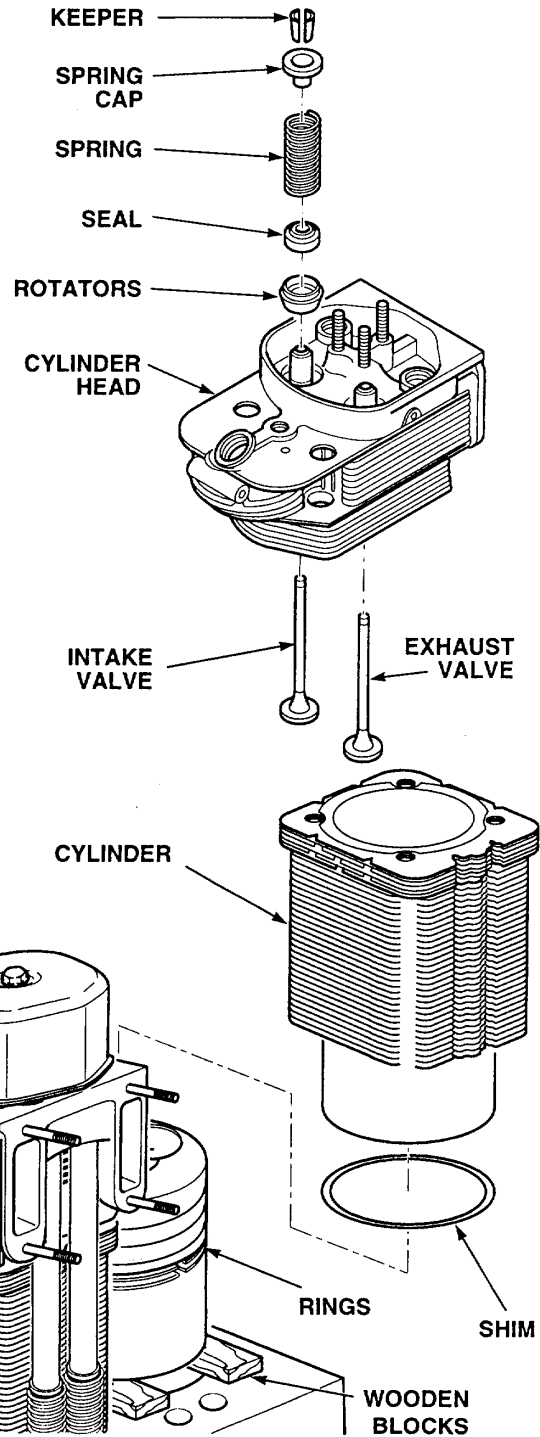
KNOWN INFO
Injection pump OK. Injection pump timing OK. Engine compression OK. Valves and valve springs OK.
Possible problems
Piston ring(s) faulty.



TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If piston ring(s) is faulty, engine will exhaust black or grey smoke excessively.

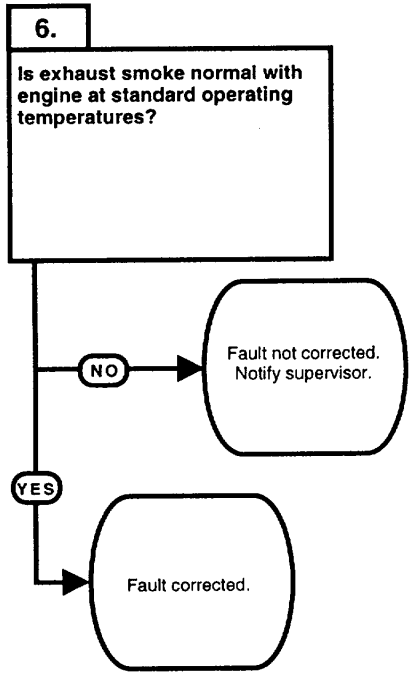
VISUAL INSPECTION	
(1)	Remove valves from suspect cylinder head(s) (Para 3-6).
(2)	Inspect valves and springs for damage. (a) If valve(s) and/or spring(s) is damaged, replace valve(s) and/or spring(s) or cylinder head(s) (Para 3-6 or 3-5). (b) If valves and springs are not damaged, valves and springs are OK.

VISUAL INSPECTION	
(1)	Inspect inside of suspect cylinder(s) and engine block for scoring. (a) If there is scoring, piston rings faulty. Replace piston rings (Para 3-13) and cylinder(s) (Para 3-17) or replace engine (Para 3-3). (b) If there is no scoring, go to Step (2) below.
(2)	Measure trapezoidal, taper-faced, and oil control rings (Table 3-1). (a) If piston ring(s) is not within limits, replace piston ring(s). (b) If piston rings are within limits, piston rings are OK.
(3)	Install cylinder(s) (Para 3-7).
(4)	Install valves and springs (Para 3-6).
(5)	Install cylinder head(s) (Para 3-5).
(6)	Install engine blower ducting (Para 6-2).
(7)	Install cab (TM 10-3930-669-20).



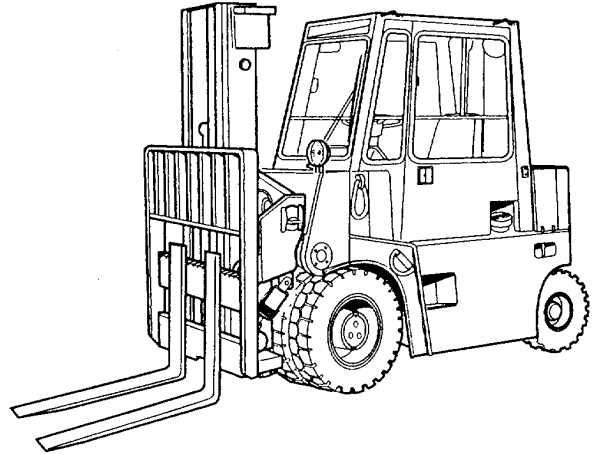
4. EXCESSIVE BLACK OR GREY SMOKE (CONT).

KNOWN INFO
Injection pump OK. injection pump timing OK. Engine compression OK. Valves and valve springs OK. Piston ring(s) OK.
POSSIBLE PROBLEMS



TEST OPTIONS
Verify repair.
REASON FOR QUESTION
If engine does not exhaust black or gray smoke excessively, fault has been corrected.

VERIFY REPAIR	
(1)	Start engine (TM 10-3930-669-10). (a) If exhaust smoke is excessive and black or gray in color, fault not corrected. Perform Step (2) below and notify supervisor. (b) If exhaust smoke is normal in quantity and color, fault has been corrected
(2)	Shut down engine.



2-11. ENGINE SYSTEM TROUBLESHOOTING (CONT).

5. ENGINE OVERHEATS (ENGINE TEMP GAUGE READS OVER 250°F [121°C]).

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Pressure Test Kit (Item 5, Appendix E)
- Gauge, Tester, Injection Pump (Item 5, Appendix E)
- Retainer (Item 13, Appendix E)
- STE/ICE-R (Optional) (Item 14, Appendix E)

Personnel Required

Two

Materials/Parts

Tags, Identification (Item 21, Appendix B)

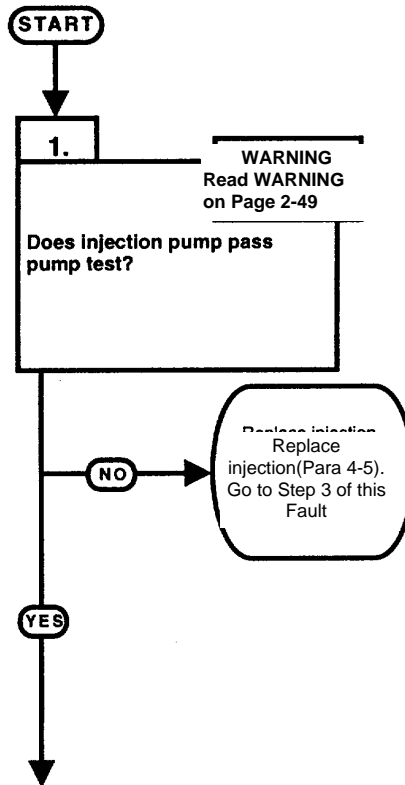
References

- TM 10-3930-669-10
- TM 10-3930-669-20

Equipment Condition

- Engine OFF (TM 10-3930-669-10)
- MAIN POWER switch OFF (TM 10-3930-669-10)
- Parking brake applied (TM 10-3930-669-10)
- Wheels chocked (TM 10-3930-669-10)

KNOWN INFO
Engine oil level OK.
POSSIBLE PROBLEMS
Injection pump faulty. Injection pump timing incorrect.



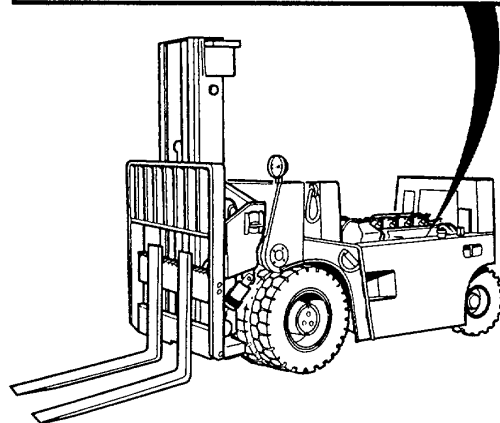
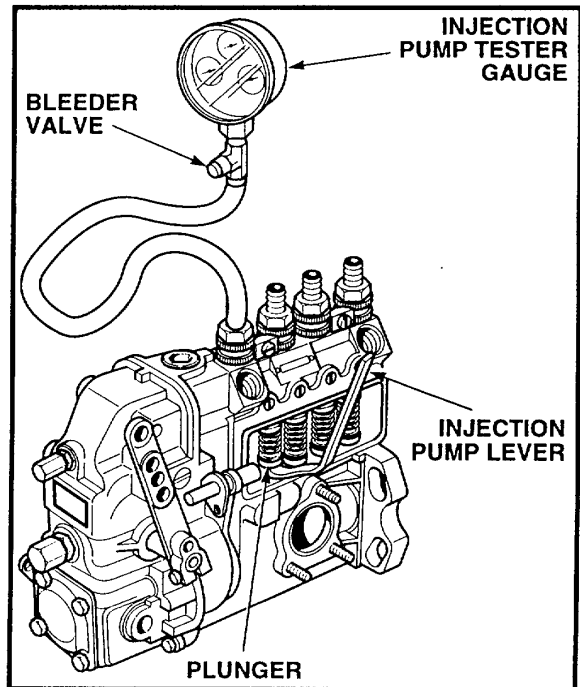
TEST OPTIONS
Injection pump pressure test.
REASON FOR QUESTION
If injection pump is faulty, engine will overheat.

WARNING

- Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET (15 m).
- Pressure test procedure results in fuel under high pressure. Be sure that pressure test gauge is connected properly and use safety shield during test. Failure to do so may result in injury to personnel.

INJECTION PUMP PRESSURE TEST

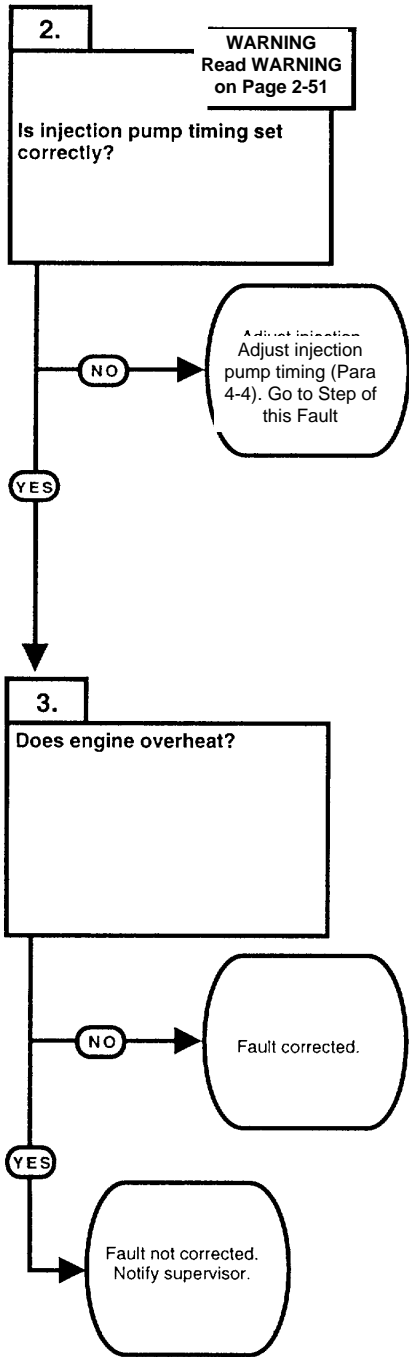
- (1) Remove cab (TM 10-3930-669-20).
- (2) Disconnect throttle cable (TM 10-3930-669-20).
- (3) Position control lever to maximum position (4) Remove pump cover (Para 4-5).
- (5) Tag and disconnect injection pump injector line one at a time.
- (6) Connect injection pump tester gauge to injection pump port fitting.
- (7) Install pressure plug in No. 1 injector line.
- (8) Open bleeder valve on back of test gauge.
- (9) With aid of an assistant using retainer, turn crankshaft clockwise until pump element to be tested is at the bottom of its stroke.
- (10) Using pump lever, lift plunger to bleed air from pressure gauge. Close bleeder valve.
- (11) Hold shutoff solenoid in open position and pump lever until pressure gauge reads 2,175 psi (14,997 kPa).
- (12) Observe pressure gauge for 60 seconds.
 - (a) If 145 psi (1,000 kPa) or higher is not measured, perform Steps (14) and (15) below and replace injection pump (Para 4-5).
 - (b) If 145 psi (1,000 kPa) or higher is measured, go to step (13) below.
- (13) Hold shutoff solenoid in open position and pump lever until pressure gauge reads 5,075 psi (34,992 kPa).
 - (a) If 5,075 psi (34,992 kPa) cannot be measured, perform Steps (14) and (15) below and replace injection pump (Para 4-5).
 - (b) If 5,075 psi (34,992 kPa) can be measured, repeat steps (5) through (13) above for remaining elements. If all elements are OK, perform Steps (14) and (15) below and go to Step 2 of this Fault.
- (14) Remove injection pump tester gauge from pump port fitting.
- (15) Install pump cover.



5. ENGINE OVERHEATS (ENGINE TEMP GAUGE READS OVER 250°F [121°C]) (CONT).

KNOWN INFO
Engine oil level OK Injection pump OK.
POSSIBLE PROBLEMS
Injection pump timing incorrect.

KNOWN INFO
Engine oil level OK. Injection pump OK. Injection pump timing OK
POSSIBLE PROBLEMS



TEST OPTIONS
Injection pump timing check.
REASON FOR QUESTION
If Injection pump timing is faulty, engine will overheat.

TEST OPTIONS
Verify repair.
REASON FOR QUESTION
If engine does not overheat, fault has been corrected.

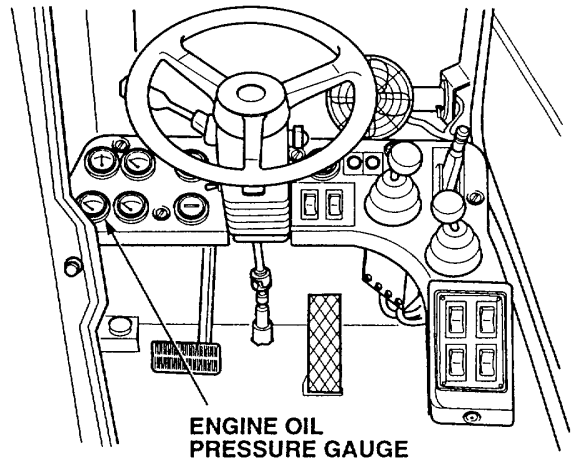
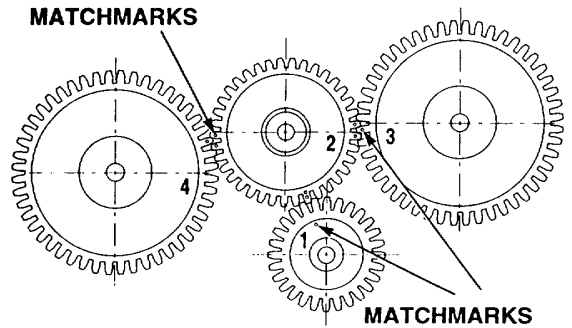
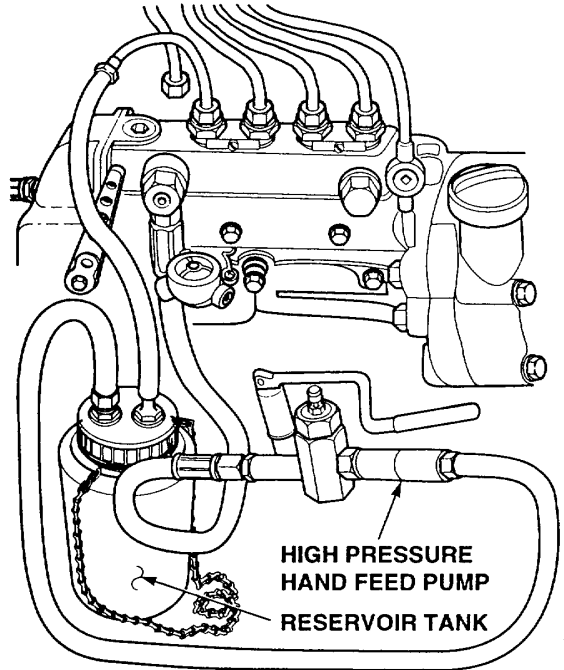
WARNING

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read **NO SMOKING WITHIN 50 FEET (15 m)**.

INJECTION PUMP TIMING CHECK

- Check injection pump timing (Para 4-4).
- (a) If injection pump timing is incorrect, reset timing.
 - (b) If injection pump timing is correct, go to Step 3 of this Fault.

- VERIFY REPAIR**
- (1) Start engine (TM 10-3930-669-10).
 - (2) Operate forklift and observe engine temperature gauge
 - (a) If engine temperature does not go over 250°F (121°C), fault corrected. Perform Step (3) below.
 - (b) If engine temperature goes over 250°F (121 °C), fault not corrected. Perform Step (3) below and notify supervisor.
 - (3) Shut down engine.



2-11. ENGINE SYSTEM TROUBLESHOOTING (CONT).

6. ENGINE RUNS ROUGH OR MISFIRES.

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Pressure Test Kit (Item 5, Appendix E)
 STE(Optional) (Item 14, Appendix E)
 Retainer (Item 13, Appendix E)

References

TM 10-3930-669-10
 TM 10-3930-669-20

Equipment Condition

Engine OFF (TM 10-3930-669-10)
 MAIN POWER switch OFF (TM 10-3930-669-10)
 Parking brake applied (TM 10-3930-669-10)
 Wheels chocked (TM 10-3930-669-10)

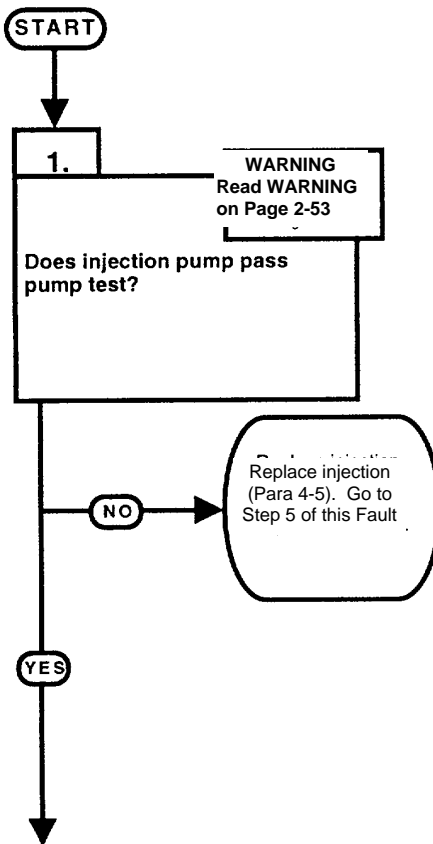
Personnel Required

Two

Materials/Parts

Cap and Plug Set (Item 5, Appendix B)
 Tags, Identification (Item 21, Appendix B)

KNOWN INFO
Nothing.
POSSIBLE PROBLEMS
Injection pump faulty. Injection pump timing incorrect. Low engine compression. Cylinder head(s) or gasket(s) faulty. Camshaft faulty.



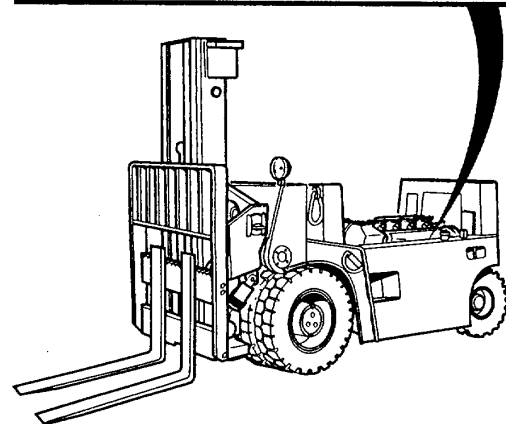
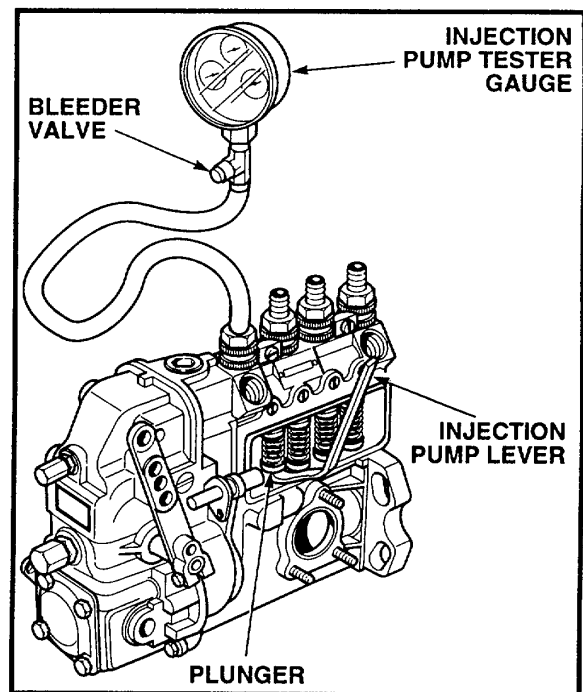
TEST OPTIONS
Injection pump pressure test.
REASON FOR QUESTION
If injection pump is faulty, engine will run rough or misfire

WARNING

- Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET (15 m).
- Pressure test procedure results in fuel under high pressure. Be sure that pressure test gauge is connected properly and use safety shield during test. Failure to do so may result in injury to personnel.

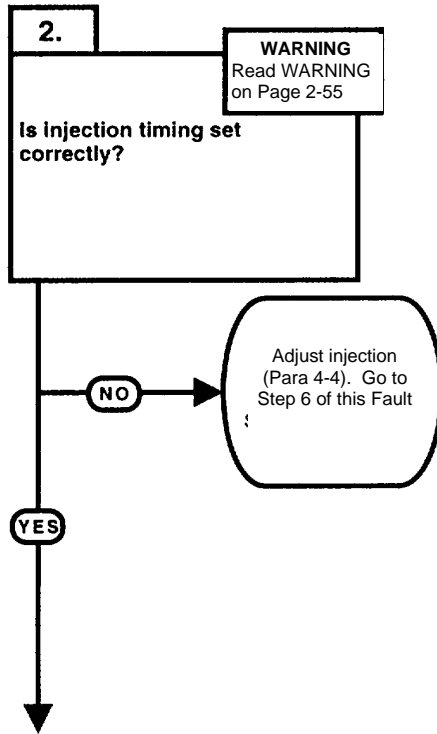
INJECTION PUMP PRESSURE TEST

- (1) Remove cab (TM 10-3930-669-20).
- (2) Disconnect throttle cable (TM 10-3930-669-20).
- (3) Position control lever to maximum position.
- (4) Remove pump cover (Para 4-5).
- (5) Tag and disconnect injection pump injector line one at a time.
- (6) Connect injection pump tester gauge to injection pump port fitting.
- (7) Install pressure plug in No. 1 injector line.
- (8) Open bleeder valve on back of test gauge.
- (9) With aid of an assistant using retainer, turn crankshaft clockwise until pump element to be tested is at the bottom of its stroke.
- (10) Using pump lever, lift plunger to bleed air from pressure gauge. Close bleeder valve.
- (11) Hold shutoff solenoid in open position and pump lever until pressure gauge reads 2,175 psi (14,997 kPa).
- (12) Observe pressure gauge for 60 seconds.
 - (a) If 145 psi (1,000 kPa) or higher is not measured, perform Steps (14) and (15) below and replace injection pump (Para 4-5).
 - (b) If 145 psi (1,000 kPa) or higher is measured, go to step (13) below.
- (13) Hold shutoff solenoid in open position and pump lever until pressure gauge reads 5,075 psi (34,992 kPa).
 - (a) If 5,075 psi (34,992 kPa) cannot be measured, perform Steps (14) and (15) below and replace injection pump (Para 4-5).
 - (b) If 5,075 psi (34,992 kPa) can be measured, repeat steps (5) through (13) above for remaining elements. If all elements are OK, perform Steps (14) and (15) below and go to Step 2 of this Fault,
- (14) Remove injection pump tester gauge from pump port fitting.
- (15) Install pump cover.



6. ENGINE RUNS ROUGH OR MISFIRES (CONT).

KNOWN INFO
Injection pump OK.
POSSIBLE PROBLEMS
Injection pump timing incorrect. Low engine compression. Cylinder head(s) or gasket(s) faulty. Camshaft faulty.



TEST OPTIONS
Injection pump timing check.
REASON FOR QUESTION
If injection pump timing is faulty, engine will run rough or misfire.

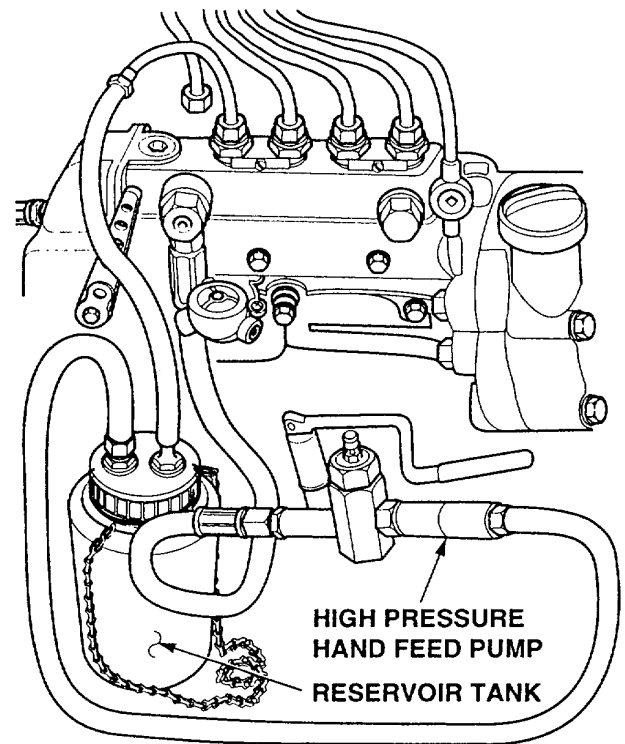
WARNING

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read **NO SMOKING WITHIN 50 FEET (15 m)**.

INJECTION PUMP TIMING CHECK

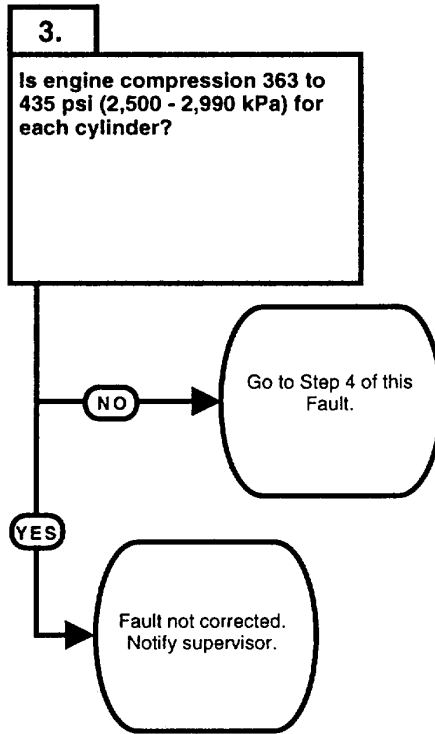
Check injection pump timing (Para 4-4).

- (a) If injection pump timing is incorrect, reset timing.
- (b) If injection pump timing is correct, go to Step 3 of this Fault.



6. ENGINE RUNS ROUGH OR MISFIRES (CONT).

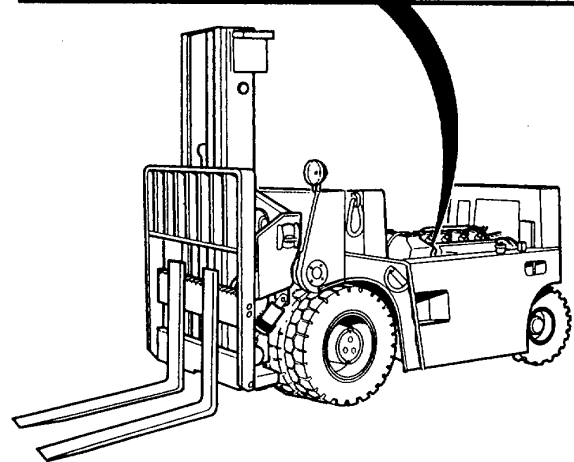
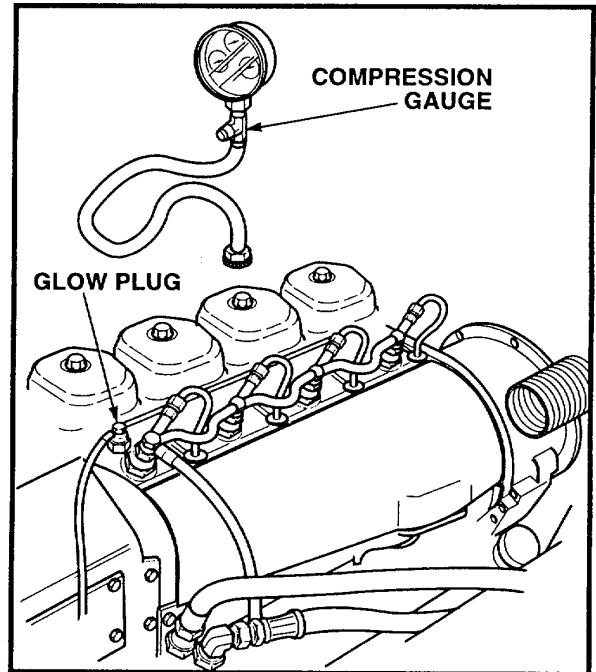
KNOWN INFO
Injection pump OK. Injection pump timing OK.
POSSIBLE PROBLEMS
Low engine compression. Cylinder head(s) or gasket(s) faulty. Camshaft faulty.



TEST OPTIONS
Compression test. STE/ICE-R #50.
REASON FOR QUESTION
If engine compression is low, engine will run rough or misfire.

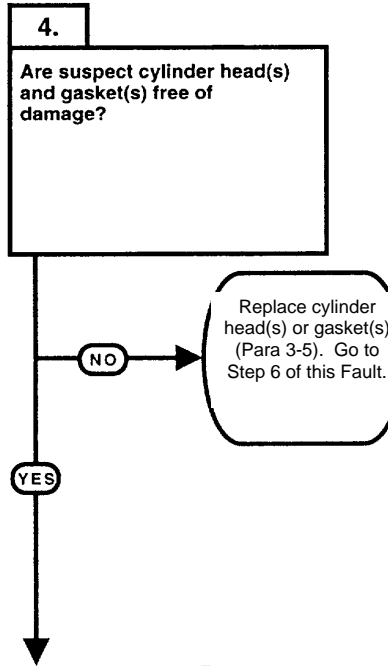
COMPRESSION TEST

- (1) Remove one glow plug at a time in sequence (TM 10-3930-669-20).
- (2) Connect a compression gauge to cylinder.
- (3) With the aid of an assistant using retainer, crank engine and observe pressure gauge.
 - (a) If less than 363 psi (2,500 kPa) is measured, cylinder is faulty. Perform Step (4) and (5) below and go to Step 4 of this Fault.
 - (b) If 363 to 435 psi (2,500 - 2,990 kPa) is measured, repeat Steps (2) through (4) for remaining cylinders. If all cylinders are OK, fault not corrected. Perform Steps (4) through (6) below and notify supervisor.
- (4) Remove compression gauge from cylinder.
- (5) Install glow plug.
- (6) Install cab (TM 10-3930-669-20).



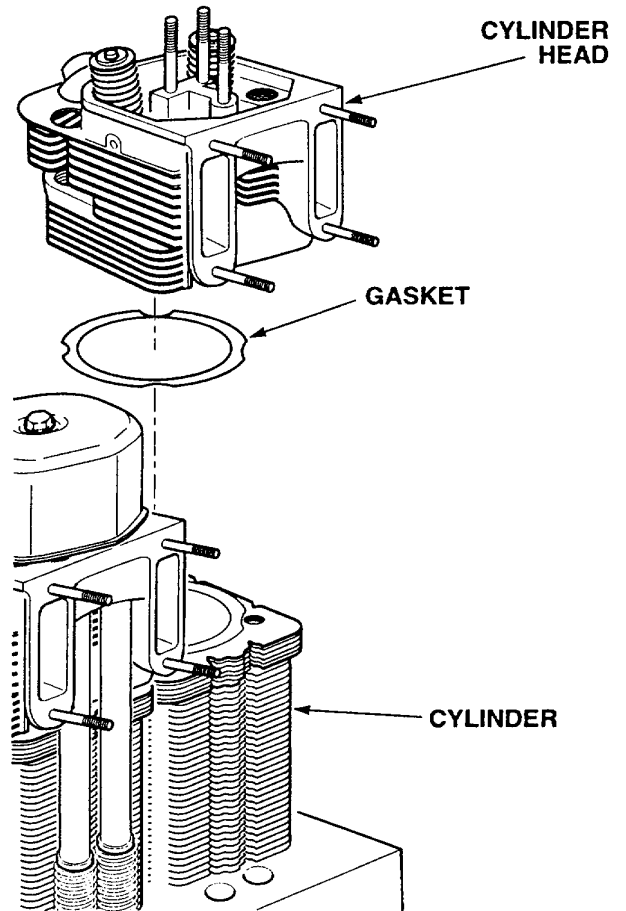
6. ENGINE RUNS ROUGH OR MISFIRES (CONT).

KNOWN INFO
Injection pump OK. Injection pump timing OK. Engine compression OK.
POSSIBLE PROBLEMS
Cylinder head(s) or gasket(s) faulty. Camshaft faulty,



TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If cylinder head(s) or gasket(s) is faulty, engine will not run.

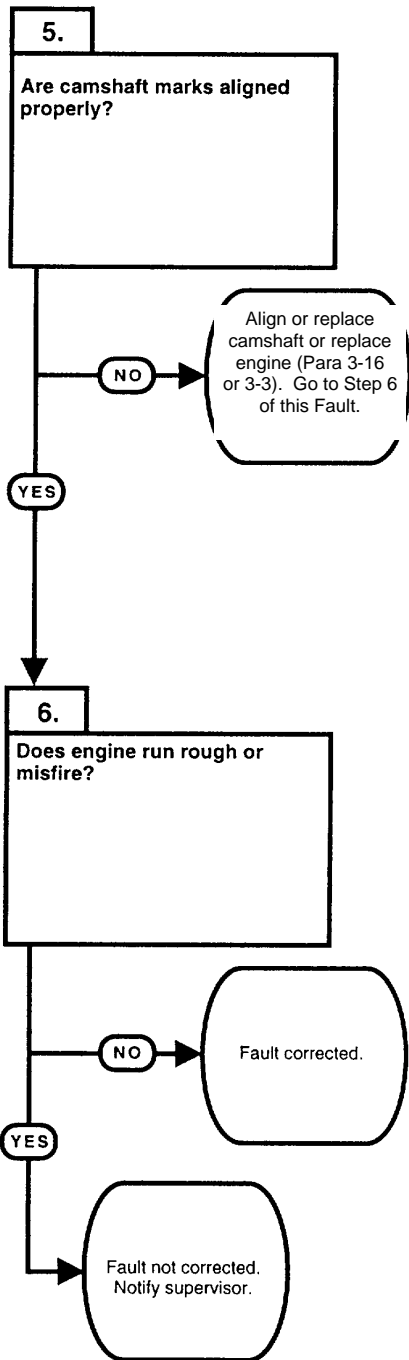
VISUAL INSPECTION	
(1)	Inspect suspect cylinder head(s). <ul style="list-style-type: none"> (a) If leaks or cracks are found, go to Step (2) below. (b) If leaks or cracks are not found, perform Steps (2) and (3) below and go to Step 6 of this Fault.
(2)	Remove cylinder head (s) (Para 3-5).
(3)	Inspect cylinder head(s) and gasket(s). <ul style="list-style-type: none"> (a) If cylinder head is cracked, replace cylinder head(s). (b) If cylinder head gasket(s) is damaged, replace gasket(s).
(c)	If cylinder heads and gaskets are not cracked or damaged, cylinder heads and gaskets are OK.



6. ENGINE RUNS ROUGH OR MISFIRES (CONT).

KNOWN INFO
Injection pump OK. Injection pump timing OK. Engine compression OK. Cylinder head(s) or gasket(s) OK.
POSSIBLE PROBLEMS
Camshaft faulty.

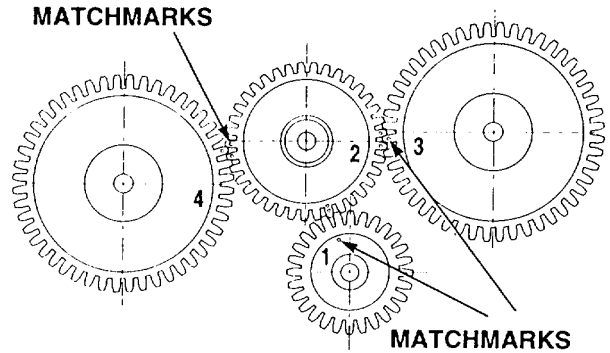
KNOWN INFO
Injection pump OK. Injection pump timing OK. Engine compression OK. Cylinder head(s) and gasket(s) OK. Camshaft OK.
POSSIBLE PROBLEMS



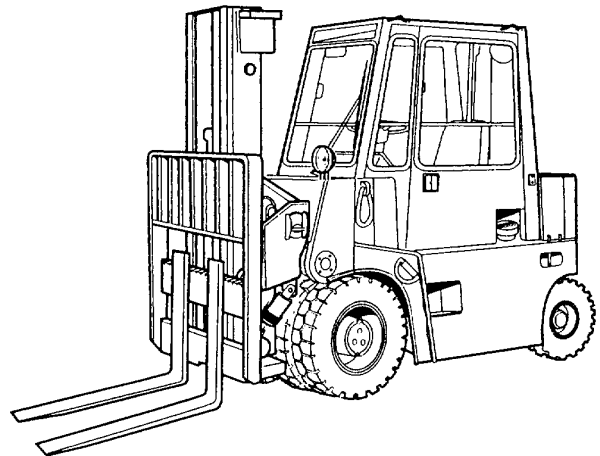
TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If camshaft alignment is incorrect or faulty, engine will run rough or misfire

TEST OPTIONS
Verify repair.
REASON FOR QUESTION
If engine does not run rough or misfire, fault has been corrected.

VISUAL INSPECTION	
(1)	Remove engine front cover (Para 3-10).
(2)	Check timing marks on camshaft gear and crankshaft gear. <ul style="list-style-type: none"> (a) If timing marks are out of alignment, match timing marks (Para 3-16). (b) If timing marks are aligned correctly, go to Step (3) below.
	(3) Measure camshaft limits <ul style="list-style-type: none"> (a) If camshaft is not within limits, replace camshaft or engine (Para 3-16 or 3-3). (b) If camshaft is within limits, camshaft is OK.
(4)	Install engine front cover.



VERIFY REPAIR	
(1)	Start engine (TM 10-3930-669-10).
(2)	Operate forklift and listen to engine operation. <ul style="list-style-type: none"> (a) If engine does not run rough or misfire, fault not corrected. Perform Step (3) below. (b) If engine runs rough or misfires, fault not corrected. Perform Step (3) below and notify supervisor (3) Shut down engine.



2-11. ENGINE SYSTEM TROUBLESHOOTING (CONT).

7. ENGINE DOES NOT DEVELOP FULL POWER.

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Pressure Test Kit (Item 5, Appendix E)
 Gauge, Tester, Injection Pump (Item 5, Appendix E)
 STE(Optional) (Item 14, Appendix E)

Materials/Parts

Cap and Plug Set (Item 5, Appendix B)
 Tags, Identification (Item 21, Appendix B)

References

TM 10-3930-669-10
 TM 10-3930-669-20

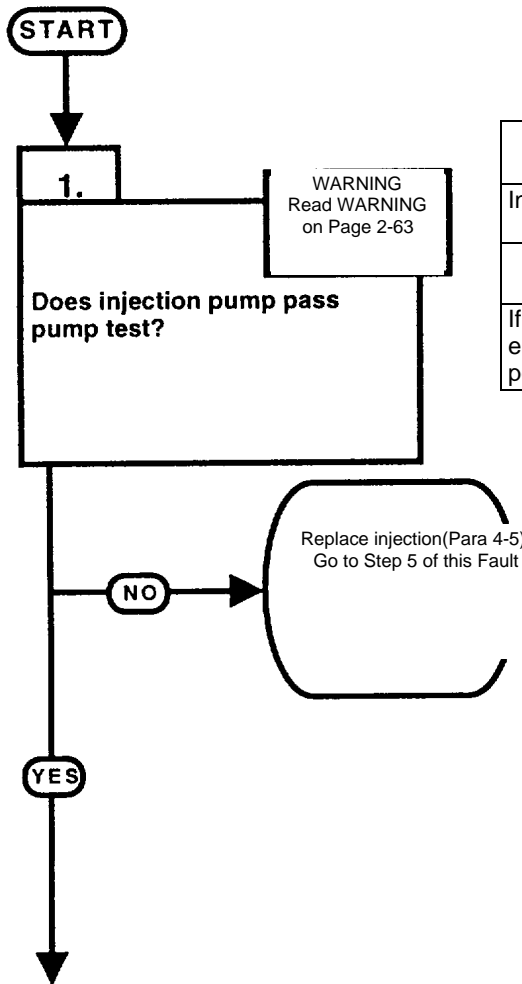
Personnel Required

Two

Equipment Condition

Engine OFF (TM 10-3930-669-10)
 MAIN POWER switch OFF (TM 10-3930-669-10)
 Parking brake applied (TM 10-3930-669-10)
 Wheels chocked (TM 10-3930-669-10)

KNOWN INFO
Nothing.
POSSIBLE PROBLEMS
Injection pump faulty. Low engine compression. Cylinder head(s) or gasket(s) faulty. Valves or valve springs faulty.



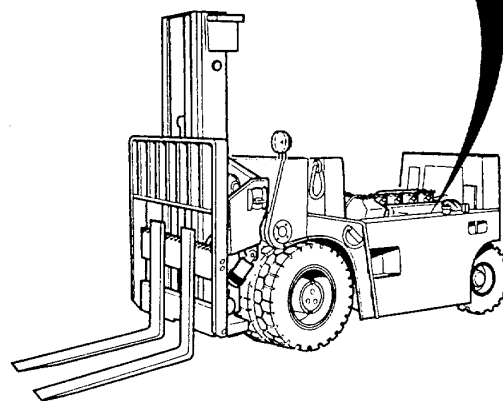
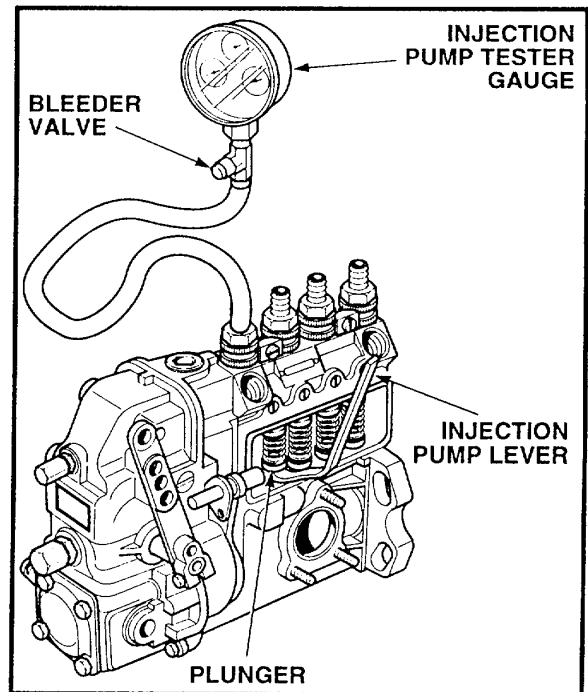
TEST OPTIONS
Injection pump pressure test.
REASON FOR QUESTION
If injection pump is faulty engine will not develop full power.

WARNING

- Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET (15 m).
- Pressure test procedure results in fuel under high pressure. Be sure that pressure test gauge is connected properly and use safety shield during test. Failure to do so may result in injury to personnel.

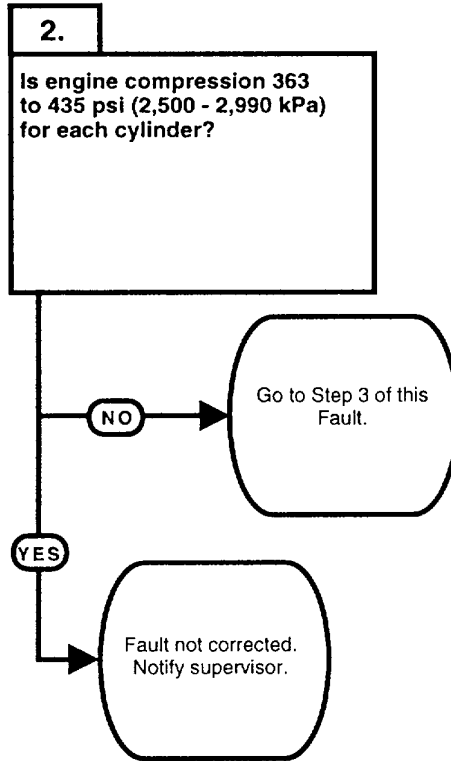
INJECTION PUMP PRESSURE TEST

- (1) Remove cab (TM 10-3930-669-20)
- (2) Disconnect throttle cable (TM 10-3930-669-20).
- (3) Position control lever to maximum position
- (4) Remove pump cover (Para 4-5)
- (5) Tag and disconnect injection pump injector line one at a time.
- (6) Connect injection pump tester gauge to injection pump port fitting.
- (7) Install pressure plug in No. 1 injector line.
- (8) Open bleeder valve on back of test gauge.
- (9) With aid of an assistant using retainer, turn crankshaft clockwise until pump element to be tested is at the bottom of its stroke.
- (10) Using pump lever, lift plunger to bleed air from pressure gauge. Close bleeder valve.
- (11) Hold shutoff solenoid in open position and pump lever until pressure gauge reads 2,175 psi (14,997 kPa).
- (12) Observe pressure gauge for 60 seconds.
 - (a) If 145 psi (1,000 kPa) or higher is not measured, perform Steps (14) and (15) below and replace injection pump (Para 4-5).
 - (b) If 145 psi (1,000 kPa) or higher is measured, go to step (13) below.
- (13) Hold shutoff solenoid in open position and pump lever until pressure gauge reads 5,075 psi (34,992 kPa).
 - (a) If 5,075 psi (34,992 kPa) cannot be measured, perform Steps (14) and (15) below and replace injection pump (Para 4-5).
 - (b) If 5,075 psi (34,992 kPa) can be measured, repeat steps (5) through (13) above for remaining elements. If all elements are OK, perform Steps (14) and (15) below and go to Step 2 of this Fault
- (14) Remove injection pump tester gauge from pump port fitting.
- (15) Install pump cover.



7. ENGINE DOES NOT DEVELOP FULL POWER (CONT).

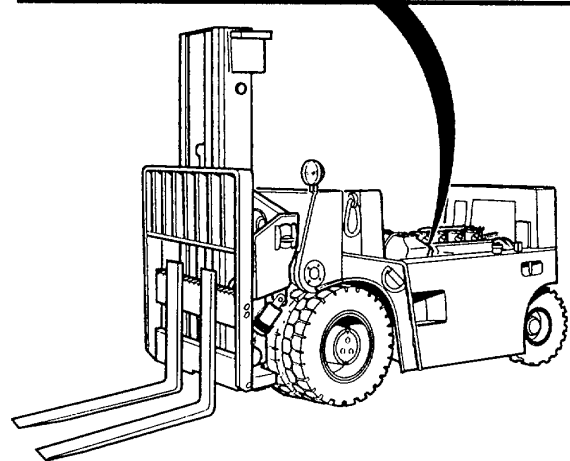
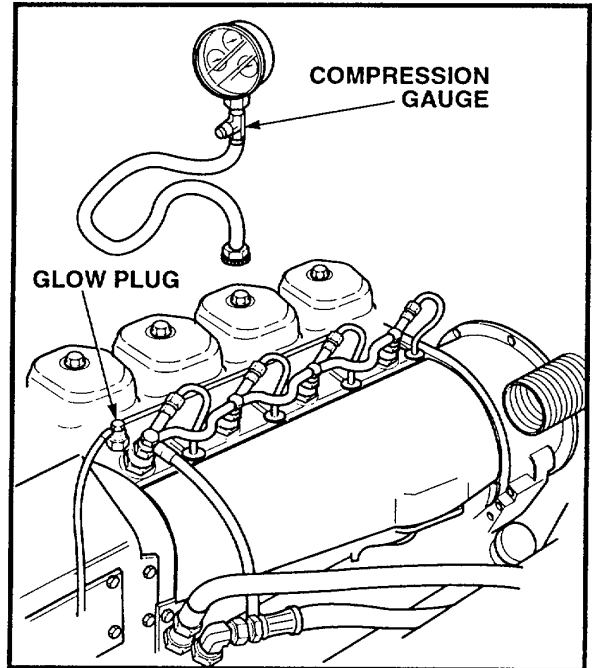
KNOWN INFO
Injection pump OK.
POSSIBLE PROBLEMS
Low engine compression. Cylinder head(s) or gasket(s) faulty. Valves or valve springs faulty.



TEST OPTIONS
Compression test. STE/ICE-R #50.
REASON FOR QUESTION
If engine compression is low, engine will not develop full power.

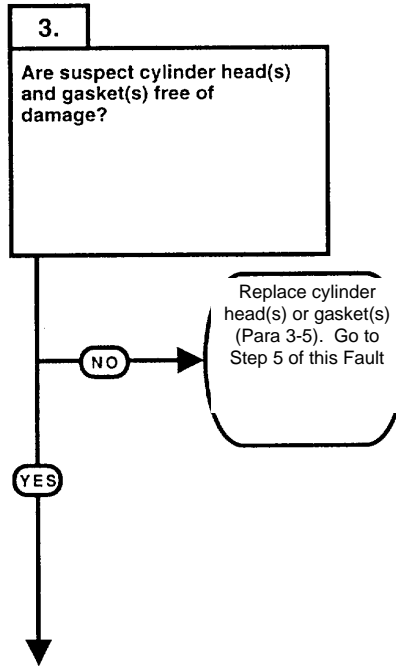
COMPRESSION TEST

- (1) Remove one glow plug at a time in sequence (TM 10-3930-669-20).
- (2) Connect a compression gauge to cylinder.
- (3) With the aid of an assistant using retainer, crank engine and observe pressure gauge.
 - (a) If less than 363 psi (2,500 kPa) is measured, cylinder is faulty. Perform Step (4) and (5) below and go to Step 3 of this Fault.
 - (b) If 363 to 435 psi (2,500 - 2,990 kPa) is measured, repeat Steps (2) through (4) for remaining cylinders. If all cylinders are OK, fault not corrected. Perform Steps (4) through (6) below and notify supervisor.
- (4) Remove compression gauge from cylinder.
- (5) Install glow plug.
- (6) Install cab (TM 10-3930-669-20).



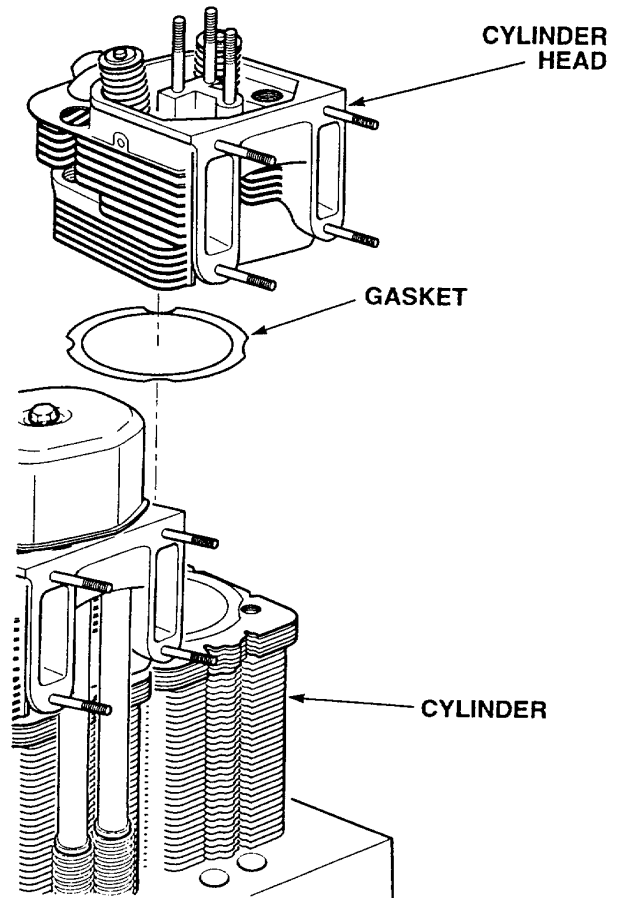
7. ENGINE DOES NOT DEVELOP FULL POWER (CONT).

KNOWN INFO
Injection pump OK. Engine compression OK.
POSSIBLE PROBLEMS
Cylinder head(s) or gasket(s) faulty. Valves or valve springs faulty.



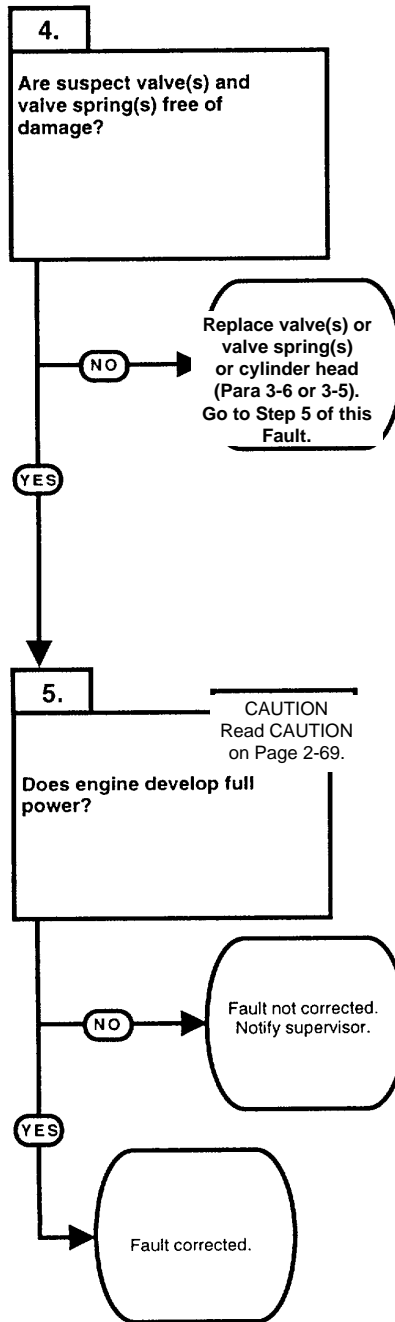
TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If cylinder head(s) or gasket(s) is faulty, engine will not run.

VISUAL INSPECTION	
(1)	<p>Inspect suspect cylinder head(s).</p> <p>(a) If leaks or cracks are found, go to Step (2) below.</p> <p>(b) If leaks or cracks are not found, perform Steps (2) and (3) below and go to Step 6 of this Fault.</p>
(2)	<p>Remove cylinder head(s) Para 3-4 (Para 3-5).</p>
(3)	<p>Inspect cylinder head(s) and gasket(s).</p> <p>(a) If cylinder head is cracked, replace cylinder head(s).</p> <p>(b) If cylinder head gasket(s) is damaged, replace gasket(s).</p> <p>(c) If cylinder heads and gaskets are not cracked or damaged, cylinder heads and gaskets are OK.</p>



7. ENGINE DOES NOT DEVELOP FULL POWER (CONT).

KNOWN INFO
Injection pump OK Engine compression OK. Cylinder heads and gaskets OK.
POSSIBLE PROBLEMS
Valves or valve springs faulty.



TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If valve(s) or valve Spring(s) are faulty, engine will not develop full power.

KNOWN INFO
Injection pump OK. Engine compression OK. Cylinder heads and gaskets OK. Valves and valve springs OK
POSSIBLE PROBLEMS

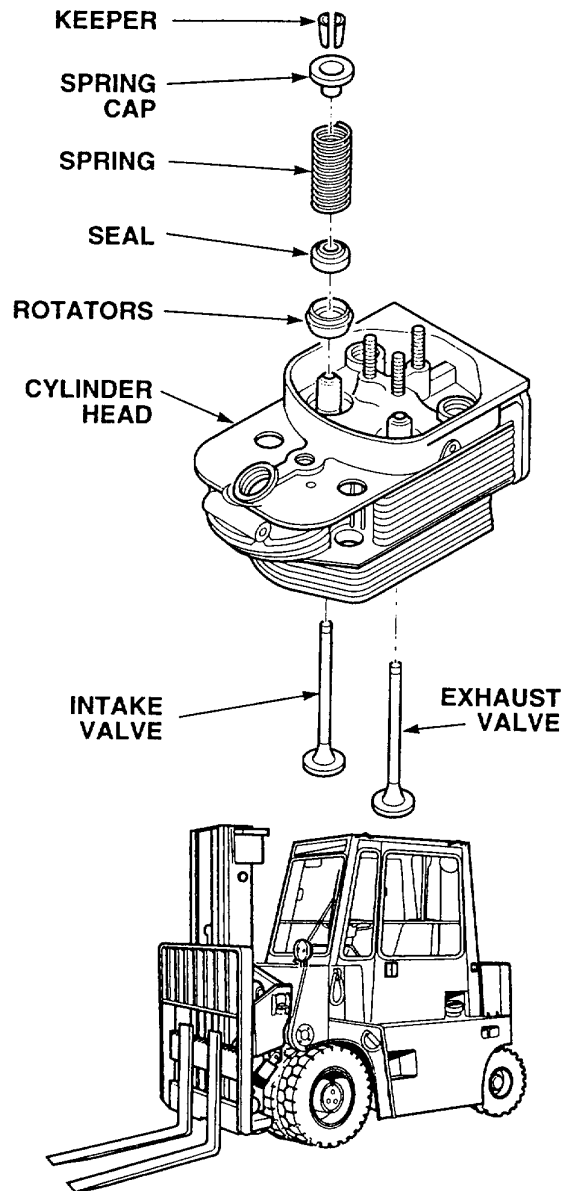
TEST OPTIONS
Verify repair. STE/ICE-R #12.
REASON FOR QUESTION
If engine develops full power. fault has been corrected.

CAUTION

Engine idle speed must be checked prior to performing power test. If idle speed is not within limits specified for vehicle:

- Adjust idle speed to be within proper limits.
- Do not run power test if idle speed cannot be properly adjusted.
- To prevent damage to equipment, allow engine to idle at least two minutes after performing power test.

VISUAL INSPECTION
(1) Remove valves from suspect cylinder head(s) (Para 3-6). (2) Inspect valves and springs for damage. (a) If valve(s) and or spring(s) is damaged, replace valve(s) and/or spring(s) or cylinder head(s) (Para 3-6 or 3-5). (b) If valves and springs are not damaged, valves and springs are OK.



VERIFY REPAIR
(1) Start engine (TM 10-3930-669-10). (2) Operate forklift with a standard load and observe operation. (a) If engine does not develop full power, fault not corrected. Perform Step (3) below and notify supervisor. (b) If engine develops full power, fault corrected. Perform Step (3) below. (3) Shut down engine

2-12. DRIVE AXLE TROUBLESHOOTING.

This paragraph covers the Drive Axle Troubleshooting. The Drive Axle Fault Index, Table 2-5, lists faults for the drive axle of the forklift.

Table 2-5. Drive Axle Fault Index

Fault Number	Troubleshooting Procedure	Page Number
1.	Drive Axle Noise Same Under Power And Coast.....	2-72
2.	Drive Axle Noise Greater Under Power Than During Coast	2-76
3.	Drive Axle Noise Greater During Coast Than Under Power	2-80
4.	Drive Axle Engaging Harshly When Switching Direction	2-84

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2-12. DRIVE AXLE TROUBLESHOOTING (CONT.).

1. DRIVE AXLE NOISE SAME UNDER POWER AND COAST.

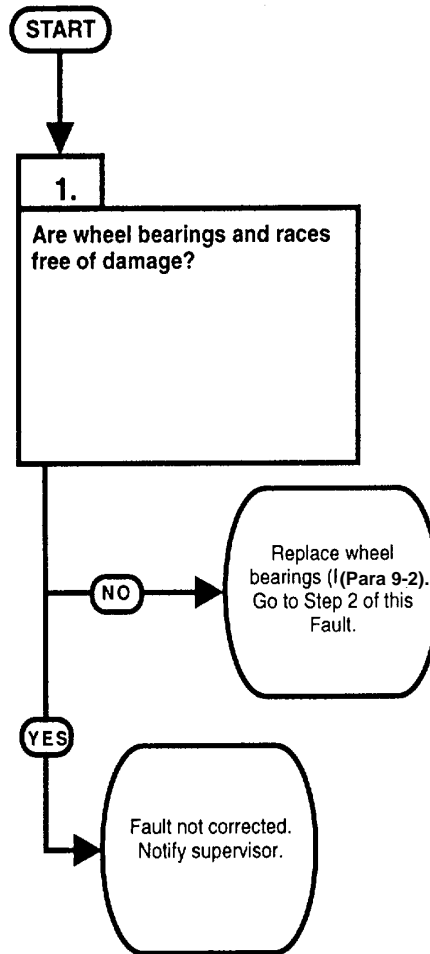
INITIAL SETUP

Tools and Special Tools
 Tool Kit, General Mechanic's: Automotive
 (Item 1, Appendix E)

References
 TM 10-3930-669-10

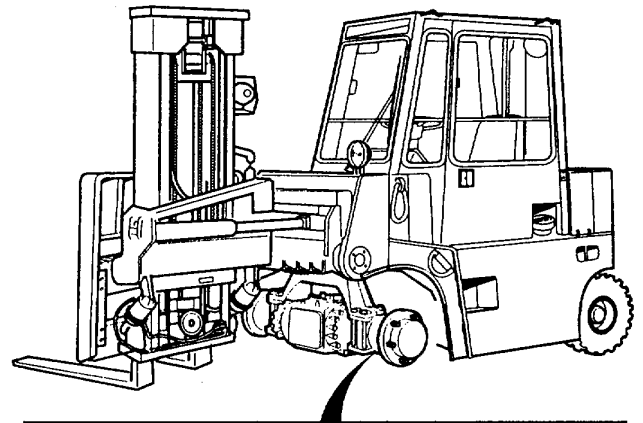
Equipment Condition
 Engine OFF (TM 10-3930-669-10)
 MAIN POWER switch OFF (TM 10-3930-669-10)
 Parking brake applied (TM 10-3930-669-10)
 Wheels choked (TM 10-3930-669-10)

KNOWN INFO
Nothing.
POSSIBLE PROBLEMS
Wheel bearing faulty.



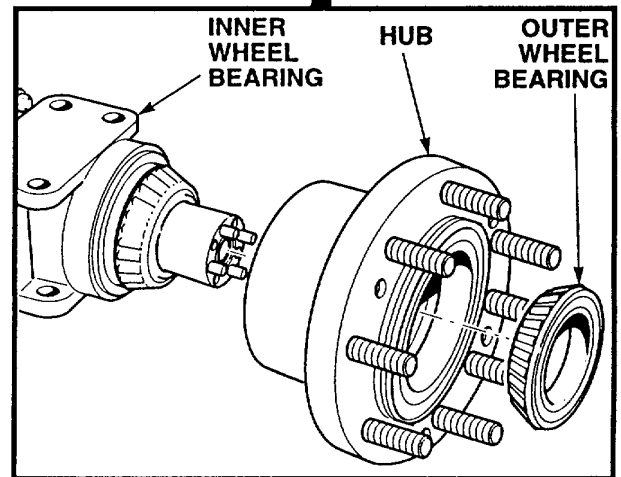
TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If wheel bearing are faulty, drive axle will be unusually noisy under power and during coasting.





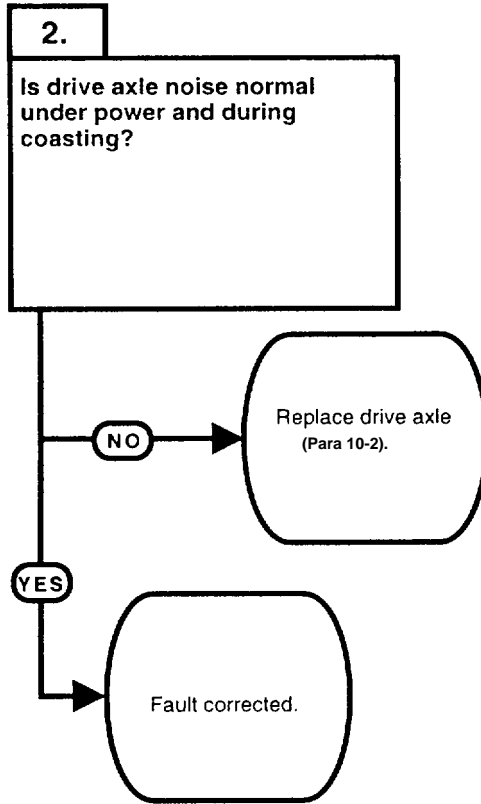
VISUAL INSPECTION

- (1) Remove wheel hub (Para 9-2).
- (2) Remove wheel bearings and races.
- (3) Inspect wheel bearings for pitting and wear. Inspect races for nicks and cracks.
 - (a) If bearings or races are damaged, replace bearings.
 - (b) If bearings and races are not damaged, fault not corrected. Perform Step (4) below and notify supervisor.
- (4) Install wheel hub.



1. DRIVE AXLE NOISE SAME UNDER POWER AND COAST (CONT.).

KNOWN INFO
Wheel bearing OK.
POSSIBLE PROBLEMS

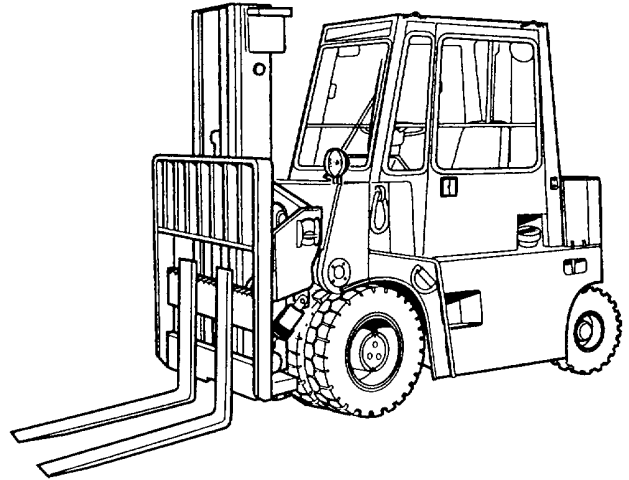


TEST OPTIONS
Verify repair.
REASON FOR QUESTION
If drive axle is not unusually noisy under power and during coasting fault has been corrected.



VERIFY REPAIR

- (1) Start engine (TM 10-3930-669-10).
- (2) Operate forklift and listen for unusual noise from drive axle.
 - (a) If drive axle is unusually noisy under power and during coasting, fault not corrected. Perform Step (3) below and replace drive axle (Para 10-2).
 - (b) If drive axle is not unusually noisy under power and during coasting, fault corrected.
- (3) Shut down engine.

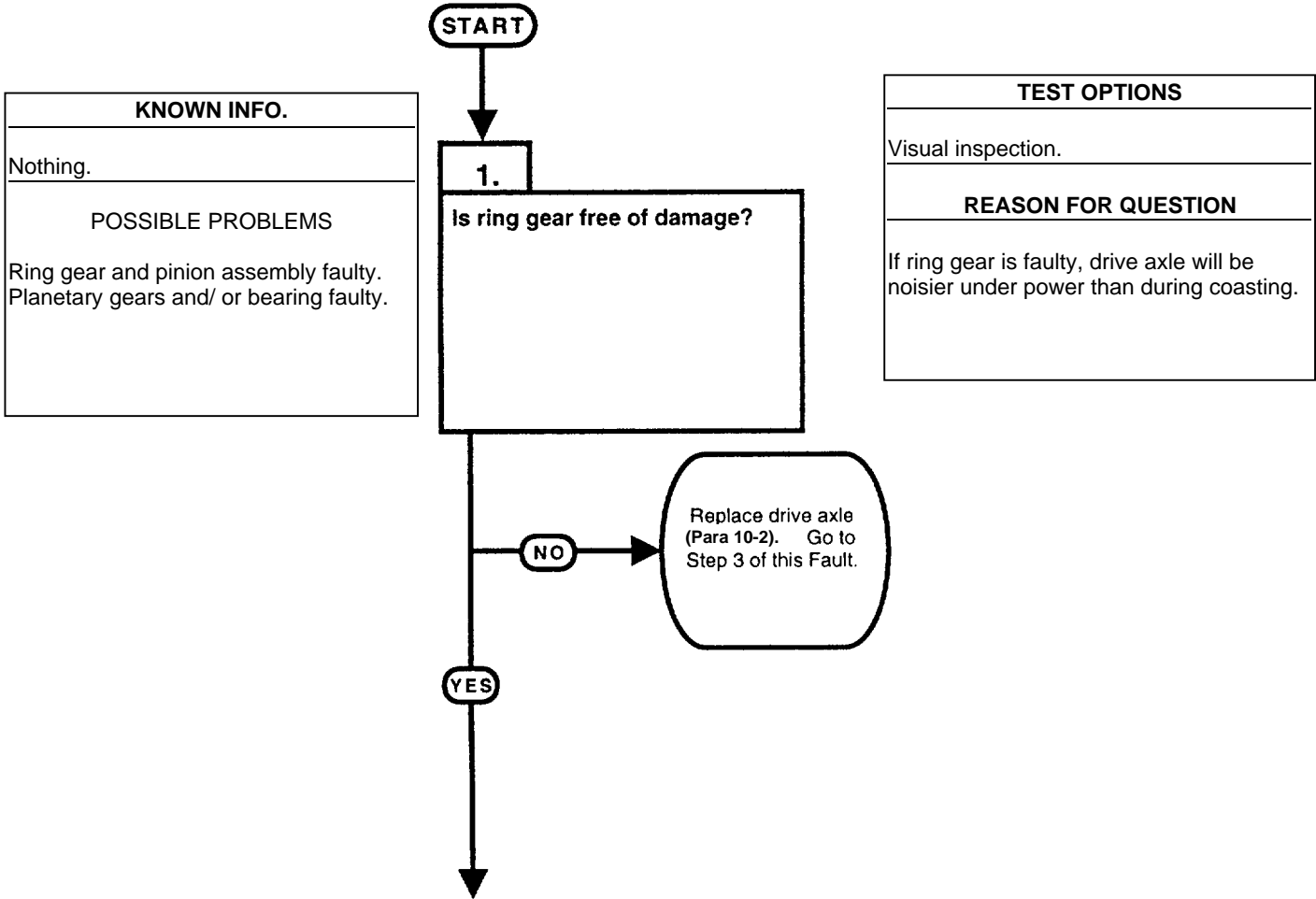


2-12. DRIVE AXLE TROUBLESHOOTING (CONT.).

2. DRIVE AXLE NOISE GREATER UNDER POWER THAN DURING COAST.

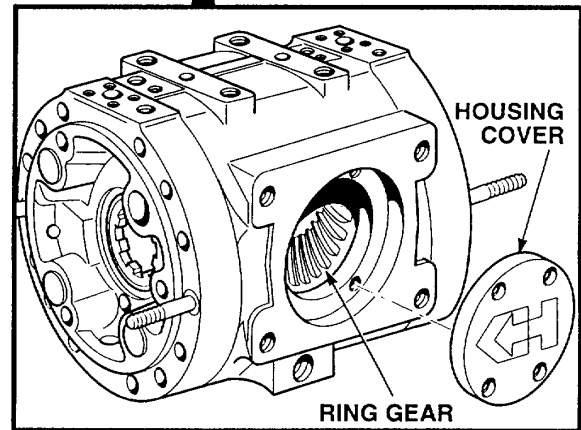
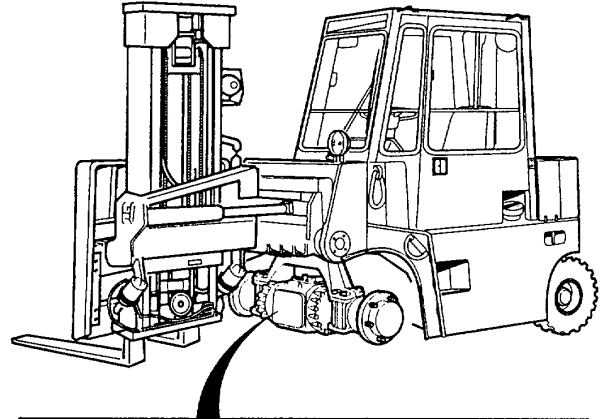
INITIAL SETUP

<p>Tools and Special Tools Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)</p>	<p>References TM 10-3930-669-10</p>
	<p>Equipment Condition Engine OFF (TM 10-3930-669-10) MAIN POWER switch OFF (TM 10-3930-669-10) Parking brake applied (TM 10-3930-669-10) Wheels choked (TM 10-3930-669-10)</p>



VISUAL INSPECTION

- (1) Remove differential housing cover (Para 10-4).
- (2) Inspect ring gear for cracks, chips, and uneven wear.
 - (a) If ring gear is damaged, replace drive axle (Para 10-2).
 - (b) If ring gear is not damaged, ring gear and pinion assembly is OK.
- (3) Install differential housing cover.

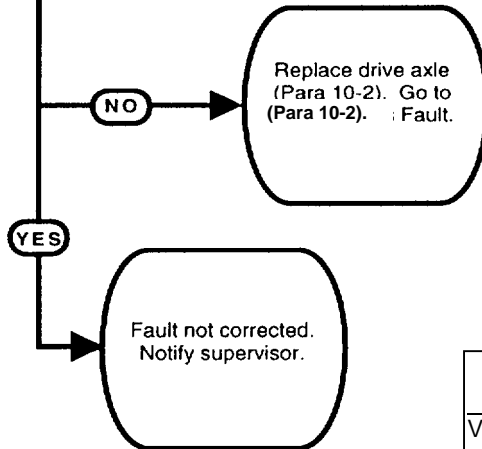


2. DRIVE AXLE NOISE GREATER UNDER POWER THAN DURING COAST (CONT.).

KNOWN INFO
Ring gear and pinion assembly OK.
POSSIBLE PROBLEMS
Planetary gears and/ or bearing faulty

2.
Are planetary gears and bearings free of damage?

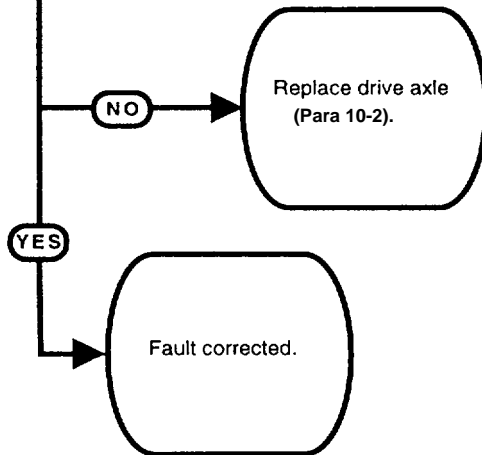
TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If planetary gears for bearings are faulty drive axle will be nosier under power than during coasting.



KNOWN INFO
Ring gear and pinion assembly OK. Planetary gear and bearings OK.
POSSIBLE PROBLEMS

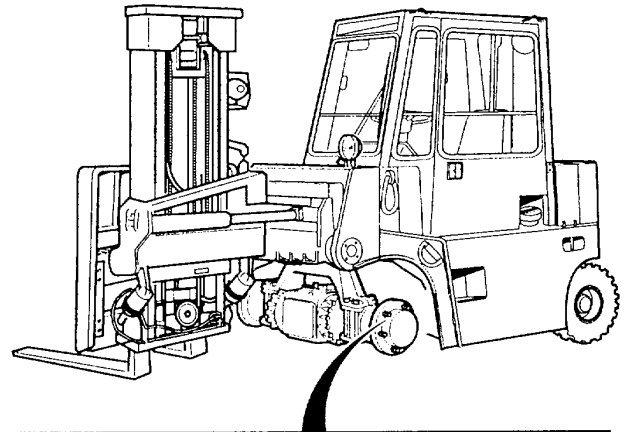
3.
Is drive axle noise normal under power?

TEST OPTIONS
Verify repair.
REASON FOR QUESTION
If drive axle is not nosier under power than during coasting, fault has been corrected.

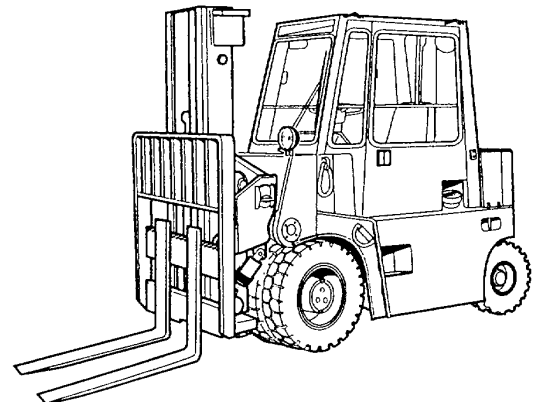
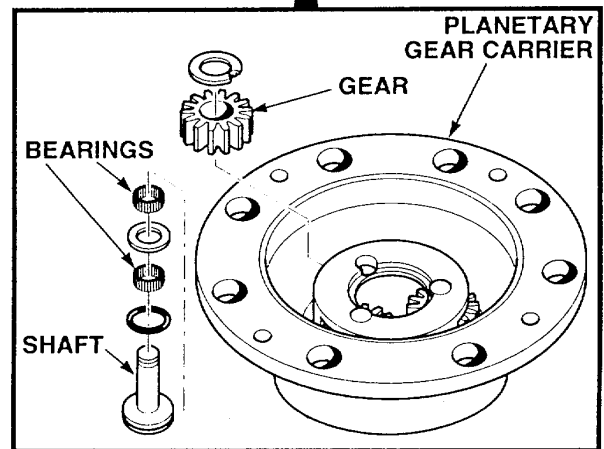


VISUAL INSPECTION

- (1) Remove planetary gears (Para 9-2).
- (2) Inspect planetary gears and bearings for chips, cracks, and uneven wear.
 - (a) If gears or bearings are damaged, replace Drive axle (Para 10-2).
 - (b) If gears and bearings are not damaged, fault not corrected Perform Step (3) below and notify supervisor.
- (3) Install planetary gears.

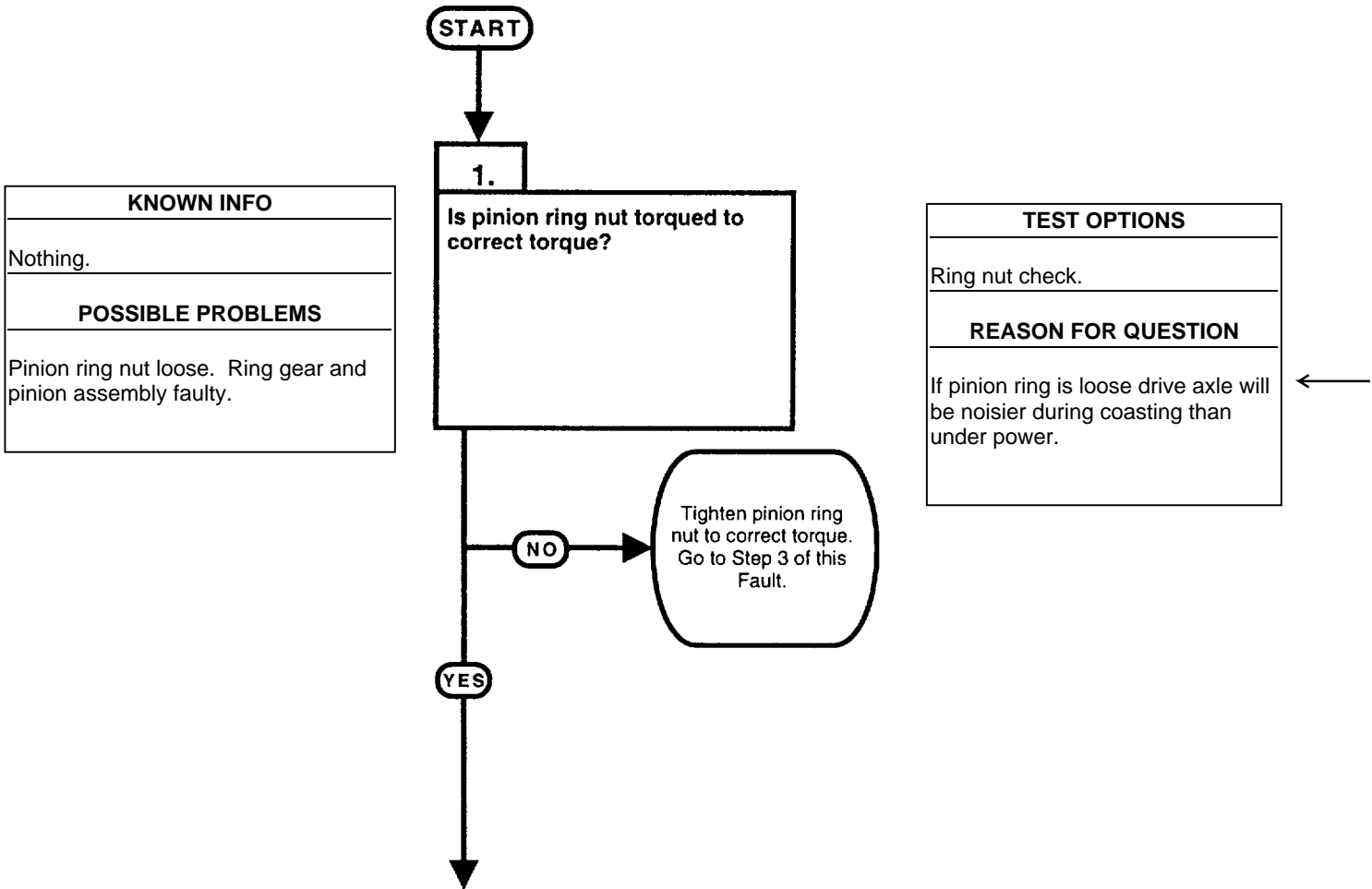


VERIFY REPAIR
<ol style="list-style-type: none"> (1) Start engine (TM 10-3930-669-10). (2) Operate forklift and listen for unusual noise from drive axle. <ol style="list-style-type: none"> (a) If drive axle is noisier under power, fault not corrected. Perform Step (3) below and replace drive axle (Para 10-2). (b) If drive axle is not noisier under power, fault corrected. (3) Shut down engine.



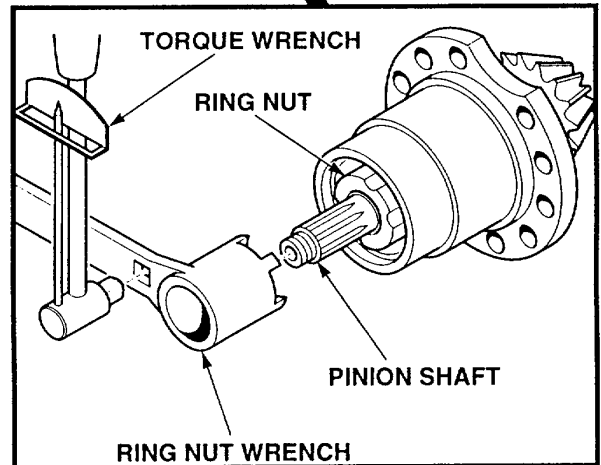
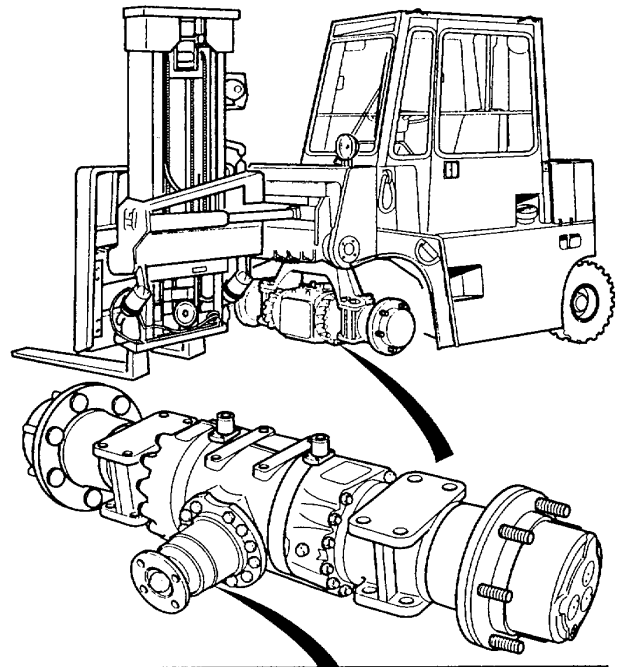
2-12. DRIVE AXLE TROUBLESHOOTING (CONT.).

3. DRIVE AXLE NOISE GREATER DURING COAST THAN UNDER POWER.	
INITIAL SETUP	
<p>Tools and Special Tools Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E) Wrench, Torque (0 to 600 lb-ft [0-814 N.m]) (Item 5, Appendix E)</p>	<p>References TM 10-3930-669-10</p> <p>Equipment Condition Drive axle removed (Para 10-2)</p>



RING NUT CHECK

- (1) Remove pinion gear flange (Para 10-4).
- (2) Check torque on pinion ring nut.
 - (a) If torque is not 443 to 516 lb-ft (600-700 N.m), torque nut.
 - (b) If torque is 443 to 516 lb-ft (600-700 N.m), ring nut torque is OK.
- (3) Install pinion gear flange.

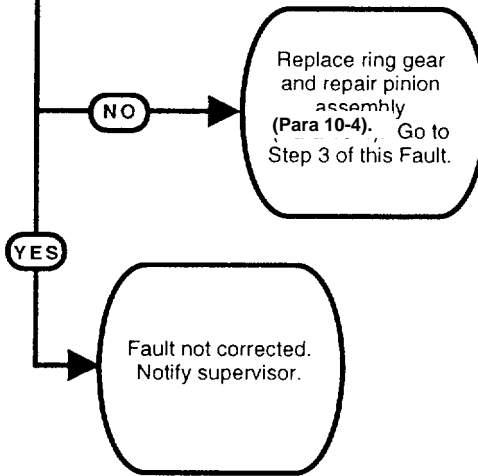


3. DRIVE AXLE NOISE GREATER DURING COAST THAN UNDER POWER (CONT.).

KNOWN INFO
Pinion nut torque OK.
POSSIBLE PROBLEMS
Ring gear and pinion assembly faulty.

2.
Is ring gear free of damage?

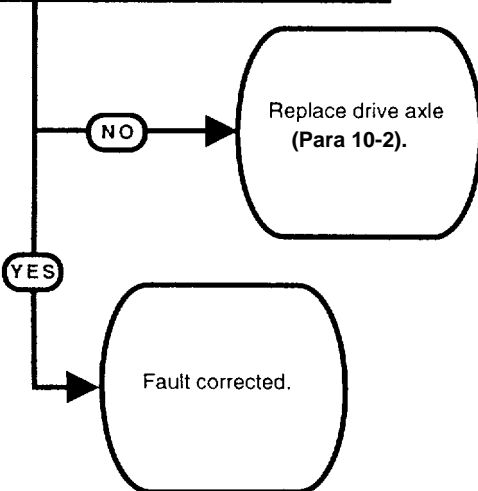
TEST OPTIONS
Visual inspection.
REASON FOR QUESTION
If ring gear is faulty drive axle will be noisier during coasting than under power.



KNOWN INFO
Pinion ring nut torque OK Ring gear and pinion assembly OK.
POSSIBLE PROBLEMS

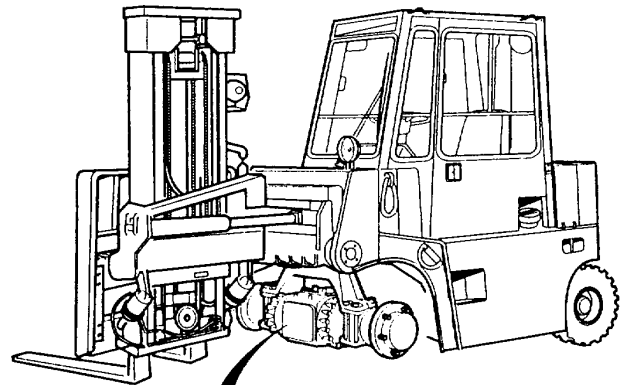
3.
Is drive axle noise normal during coasting?

TEST OPTIONS
Verify repair.
REASON FOR QUESTION
If drive axle is nit noisier during coasting than under power, fault has been corrected.



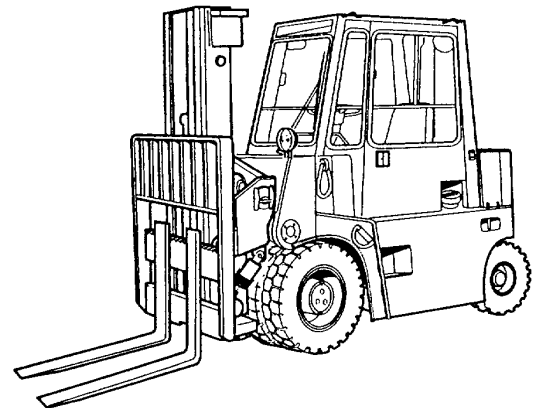
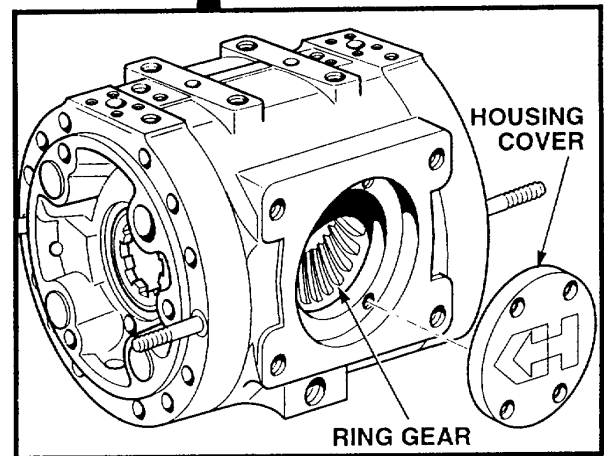
VISUAL INSPECTION

- (1) Remove differential housing cover (Para 10-4).
- (2) Inspect ring gear for cracks, chips, and uneven wear.
 - (a) If ring gear is damaged, replace drive axle (Para 10-2).
 - (b) If ring gear is not damaged, fault not corrected. Perform Step (3) below and replace drive axle (Para 10-2).
- (3) Install differential housing cover.



VERIFY REPAIR

- (1) Start engine (TM 10-3930-669-10).
- (2) Operate forklift and listen for unusual noise from drive axle.
 - (a) If drive axle is noisier during coasting, fault not corrected. Perform Step (3) below and replace drive axle (Para 10-2).
 - (b) If drive axle is not noisier under power, fault corrected.
- (3) Shut down engine.



2-12. DRIVE AXLE TROUBLESHOOTING (CONT.).

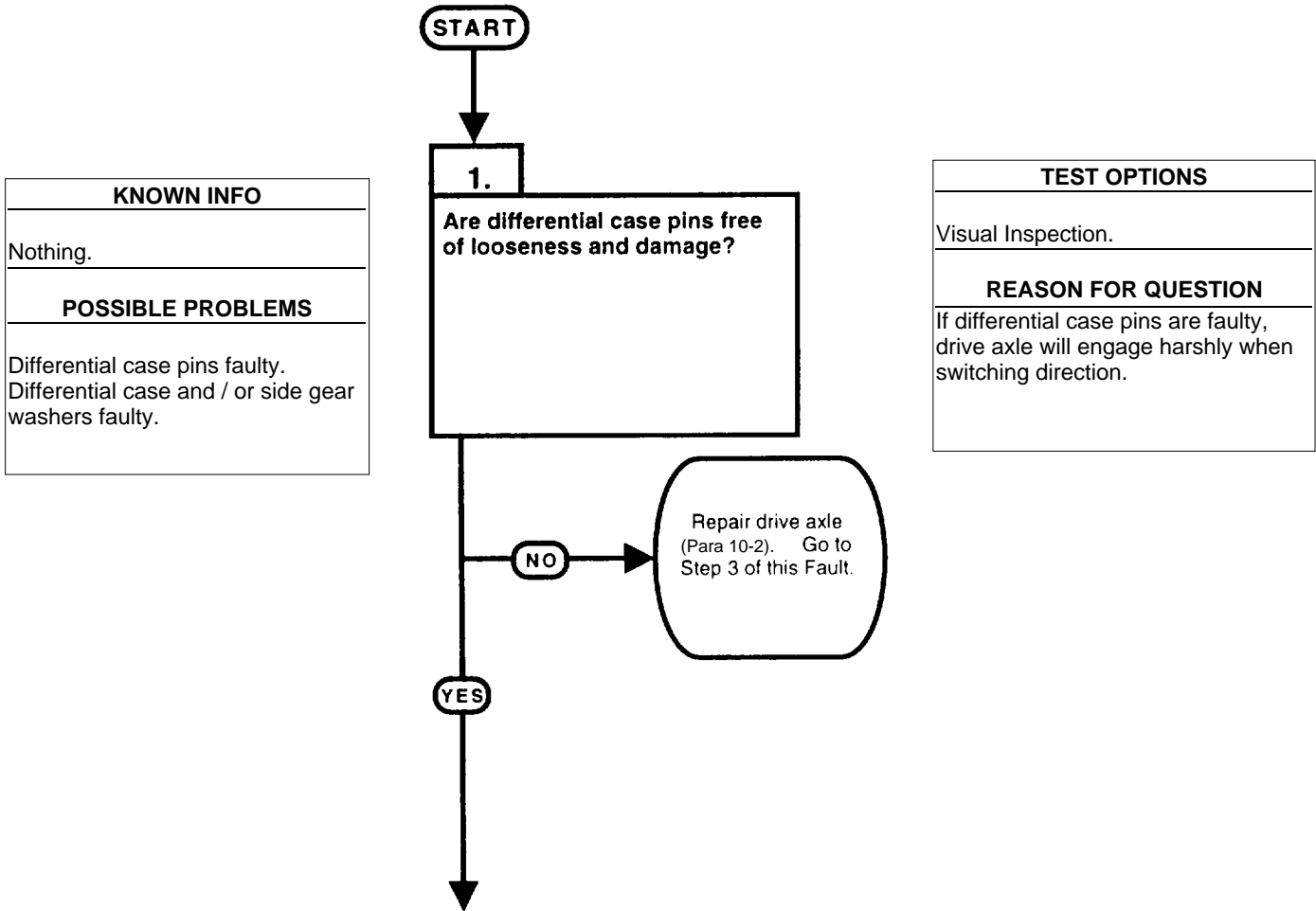
4. DRIVE AXLE ENGAGING HARSHLY WHEN SWITCHING DIRECTION.

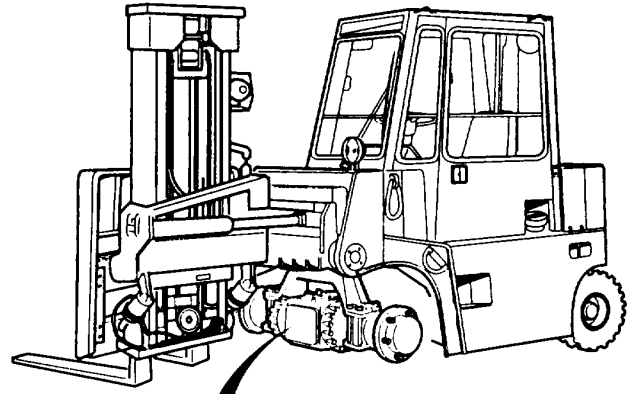
INITIAL SETUP

Tools and Special Tools
 Tool Kit, General Mechanic's: Automotive
 (Item 1. Appendix E)

References
 TM 10-3930-669-10

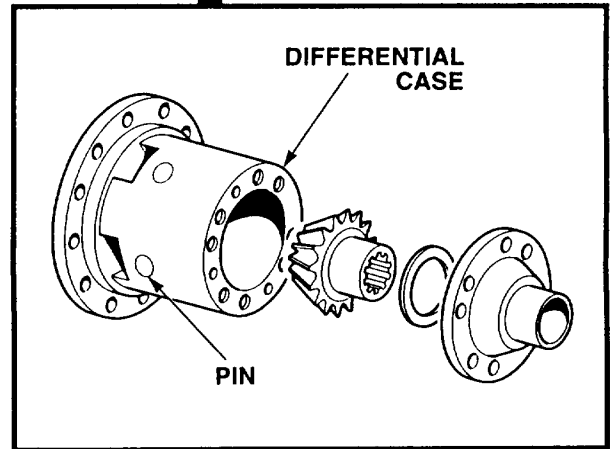
Equipment Condition
 Drive axle removed (Para 10-2)





VISUAL INSPECTION

- (1) Remove differential cover and side gear (Para 10-4).
- (2) Inspect differential case pins for looseness and damage.
 - (a) If differential case pins are missing, loose, or damaged, replace drive axle (Para 10-2).
 - (b) If differential case pins are not missing, loose, or damaged, pins are OK

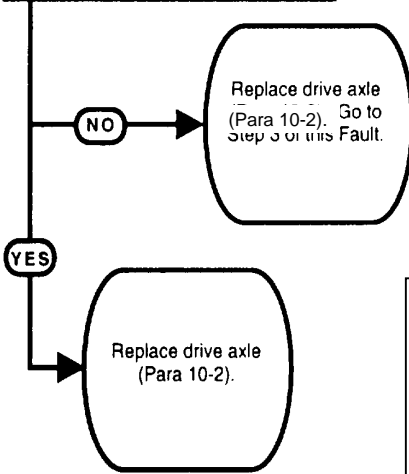


4 DRIVE AXLE ENGAGING HARSHLY WHEN SWITCHING DIRECTION (CONT.).

KNOWN INFO
Differential case pins OK.
POSSIBLE PROBLEMS
Differential case and side gear washers faulty.

2.
Are differential case and side gear washers free of damage?

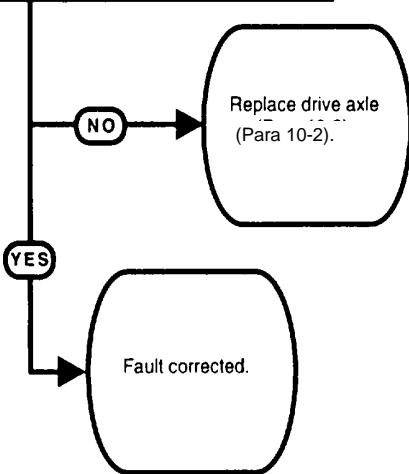
TEST OPTIONS
Visual Inspection.
REASON FOR QUESTION
If differential case shaft retainer, pinion(s) washer(s) and / or side gear washers are faulty, drive axle will engage harshly when switching direction.



KNOWN INFO
Differential case pins OK. Differential case and side gear washers OK.
POSSIBLE PROBLEMS

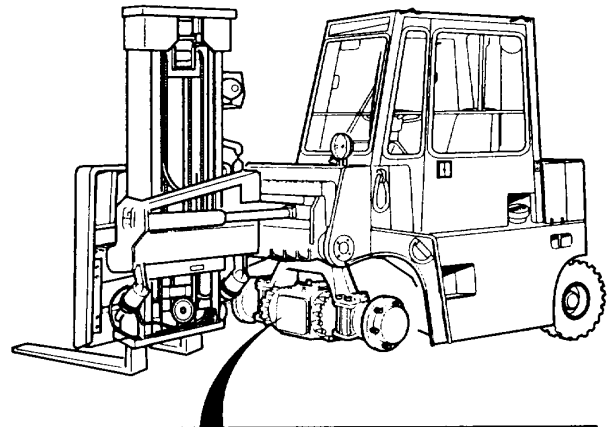
TEST OPTIONS
Verify repair.
REASON FOR QUESTION
If drive axle does not engage harshly when switching direction, fault has been corrected.

3.
Does drive axle engage smoothly when switching direction?



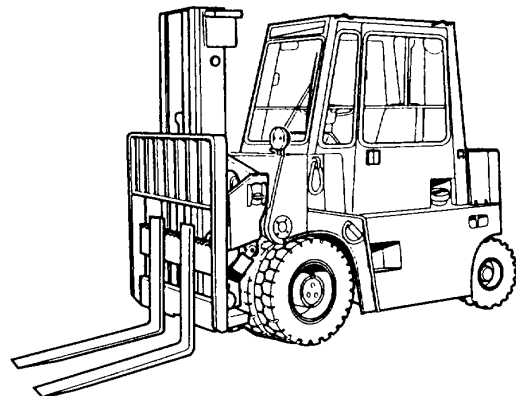
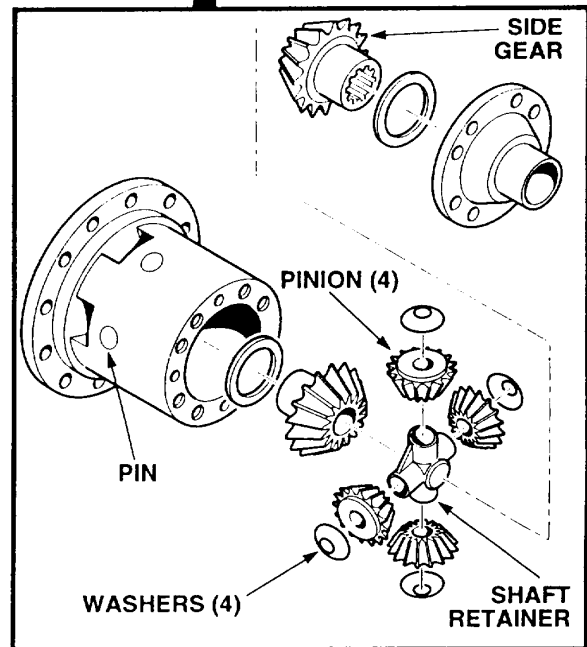
VISUAL INSPECTION

- (1) Remove differential case pins, shaft retainer, pinions, and washers (Para 10-4).
- (2) Inspect washers, shaft retainer, and pinions for cracks and signs of wear
 - (a) If washer(s), shaft retainer, and/or pinion(s) are damaged, replace drive axle (Para 10-2).
 - (b) If washers, shaft retainer, and pinions are not damaged, fault not corrected. Perform Steps (3) and (4) below and replace drive axle (Para 10-2).
- (3) Install washers, shaft retainer, pinions and pins.
- (4) Install side gear, washer, and differential cover.



VERIFY REPAIR

- (1) Start engine (TM 10-3930-669-10)
- (2) Operate forklift forward and reverse and observe drive axle engagement.
 - (a) If drive axle engagement is not smooth, fault not corrected. Perform Step (3) below and replace drive axle (Para 10-2).
 - (b) If drive axle engagement is smooth, fault corrected
- (3) Shut down engine.



Section IV. MAINTENANCE PROCEDURES

2-13. MAINTENANCE INTRODUCTION.

This section provides general maintenance procedures for Direct/General Support Maintenance as specified in the Maintenance Allocation Chart (MAC). When a special procedure is necessary, the detailed procedure will be in the section covering that component.

2-14. GROUND HANDLING.

For Ground Handling information refer to TM 10-3930-669-10.

2-15. GENERAL REMOVAL INSTRUCTIONS.

a. Work Required. Remove parts for repair or replacement as required. Do not disassemble a component any further than needed.

b. Preparation. Before removal of any electrical components, disconnect battery ground cable to ensure that circuits and components are not energized. Before removal of any hydraulic components, relieve hydraulic system pressure. Before removal of fasteners (nuts, screws), remove any paint on threads to ease removal and installation.

c. Identification. To ease assembly and installation, tag and mark shims, connectors, wires, and mating ends of lines before disconnecting them. Identify similar parts to ensure correct assembly.

d. Position of Valves. Before removing valve handles, mark or diagram their positions when opened or closed. This will help during assembly.

e. Tire Removal. Before removing any tires, position wooden blocks under frame. This will secure the forklift for safe tire removal.

f. Location. Before removing cable ties, cushioned clamps, hoses, tubing, wiring, etc., note the location, position, and routing to ensure correct assembly.

2-16. GENERAL DISASSEMBLY INSTRUCTIONS.

a. Cleanliness. Work area must be as clean as possible to prevent contamination of components. Hydraulic components, engines, transmissions, and axles require extremely clean work area when disassembled.

b. Locking Parts. Replace all lock wire, lock washers, cotter pins, and lock nuts at time of disassembly. Self-locking fasteners that are loosened must be replaced, when loosened or removed.

c. Expendable Parts. All gaskets, packings, and seals removed during repair must be discarded and replaced with new parts.

d. Removing Seals. Be sure all traces of oil, gaskets, and sealants are removed from components. When possible, use wood or plastic probes and scrapers to prevent damage to machined surfaces.

CAUTION

Do not use tape to close off fuel or oil openings. Sticky surface of tape can mix with fuel and oil and cause engine malfunctions.

e. Parts Protection. To keep dust, moisture, and other objects out of internal parts of the system or components, cap or tape over tubes, hoses, air lines, fittings, and component openings as soon as part is removed. Wrap all removed parts in clean paper or dip parts in preservation oil.

2-17. GENERAL CLEANING INSTRUCTIONS.**WARNING**

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
- **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**
- **Never use fuel to clean parts. Fuel is highly flammable. Serious personal injury could result if fuel ignites during cleaning.**

a. Cleaning Solvents. Use only approved cleaning solvents to clean parts. Dry-cleaning solvent P-D-680 is commonly used. Always work in a well-ventilated area.

2-17. GENERAL CLEANING INSTRUCTIONS (CONT.).**WARNING**

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

b. Removing Deposits. Soak parts in dry-cleaning solvent and wash away deposits by flushing or spraying. When necessary, brush with a soft-bristle brush (not wire) moistened in solvent. Use compressed air to dry parts, except bearings, after cleaning. Bearings must drip and air dry.

c. Tools. Do not use wire brushes, abrasive wheels, or compounds to clean parts unless specifically approved in the detailed procedures. Parts may be scratched or altered and may be weakened.

d. Ball and Roller Bearings. When cleaning ball or roller bearings, place them in a basket and suspend them in a container of dry-cleaning solvent. If needed, use a brush to remove caked grease, chips, etc. Avoid rotating bearing before solid particles are removed to prevent damage to precision bearing surfaces. When bearings have been cleaned, coat them lightly with lubricating oil to remove solvent.

CAUTION

Do not clean tires, lubricant seals, rubber hoses, or electrical components with solvent mixture.

e. Rubber Parts. Do not clean preformed packings or rubber parts in dry-cleaning solvent. Wipe parts clean with a dry, cleaning cloth.

WARNING

Steam cleaning creates hazardous noise levels and severe burn potential. Eye, skin, and ear protection are required. Failure to comply may result in injury to personnel.

f. Exterior Parts. Steam clean all exterior parts thoroughly before removing. This will make inspection and disassembly easier.

WARNING

Solvents used with a spray gun must be used in a spray booth with filter. Face shield must be used by personnel operating spray gun. Failure to comply may result in injury to personnel.

g. Engine, Cab, and Body. Use a spray gun and solvent mixture for cleaning exterior of engine, cab, and body. Allow mixture to remain on item for ten minutes before rinsing. Rinse with hot water under 80 to 120 pounds of pressure, if available. An ordinary garden hose with nozzle may be used if other equipment is not available. Rinse thoroughly.

CAUTION

To prevent corrosion, parts should be dipped in rust preventive within two hours of degreasing .

h. Degreasing Machine. A degreasing machine may be used to remove heavy grease and oil from metal parts.

WARNING

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
- Never use fuel to clean parts. Fuel is highly flammable. Serious personal injury could result if fuel ignites during cleaning.

i. Passages. After degreasing, check all oil passages and cavities for dirt or blockage before coating with lubricating oil. Run a thin, flexible wire through oil passages to make sure they are not clogged. Use a pressure spray gun and dry-cleaning solvent to clean dirty passages.

j. Electrical Parts. Electrical parts, such as coils, junction blocks, and switches, should not be soaked or sprayed with dry-cleaning solutions. Clean these parts with a cleaning cloth moistened with dry-cleaning solvent.

CAUTION

Do not use soap or alkalies for cleaning tank interiors.

k. Oil and Fuel Tanks. Pay special attention to all warnings and cautions when working on forklift fuel tank. Oil tanks and fuel tanks should be flushed, using a spray gun and dry-cleaning solvent.

l. Battery. Exterior surfaces of the electrical system and battery should be cleaned with a weak solution of baking soda and water. Apply solution with a bristle brush to remove corrosion. Pay special attention to all warnings and cautions when working on the battery.

m. Hydraulic System. When cleaning hydraulic system parts, use dry-cleaning solvent P-D-680. Clean and dry parts thoroughly to make sure no solvent residue remains. If a coating preservative is required before assembly, apply a light film of lubricant. This lubricant must be of the same type used in the forklift's system.

2-18. GENERAL INSPECTION INSTRUCTIONS.

a. Cleaning. Clean all parts before inspection. Check for defects such as physical distortion, wear, cracks, and burrs. If any defect is found, correct it before assembly.

b. Sealing Surfaces. Inspect all surfaces in contact with grease, packings, or seals for nicks and burrs. If , any defect is found, correct it before assembly.

c. Bearings. Inspect bearings for rusting, pitting, rolling, peening, scoring, burning, brinnelling, and fatigue cracking.

d. Gear and Splined Shafts. Inspect gears and splined shafts for wear, pitting, rolling, peening, scoring, burning, brinnelling, and fatigue cracking.

e. Tubing and Hoses. Inspect all hose surfaces for broken or frayed fabric. Check for breaks caused by sharp kinks or contact with other parts of the forklift. Inspect copper tubing lines for kinks. Inspect fitting threads for damage. Replace any defective parts. After assembly and during initial forklift operation period, check for leaks.

f. Electrical Parts. Inspect all wiring harnesses for broken, chafed, or burned wiring. Inspect all terminal connectors for loose or broken parts.

g. Metal Parts. Visually inspect all castings and weldments for cracks. Parts that carry a great load should receive magnetic particle inspection. Critical non-ferrous parts may be inspected with fluorescent penetrate.

h. Drain Plugs. When removing drain plugs from transmission, engine, hydraulic system components, or axle differential and planetary hubs, check amount of sediment on plugs. Accumulations of grit or fine metal particles may indicate actual or potential component failure. A few fine particles are normal. This inspection helps to determine if there are defective parts prior to internal inspection of the component and to predict degradation of the equipment.

2-19. GENERAL REPAIR INSTRUCTIONS.

a. Burrs. Remove burrs from surface with a fine-cut file or crocus cloth.

b. Exterior Parts. Chassis and exterior painted parts may be resurfaced when paint is damaged or where parts have been repaired.

NOTE

Polished or machined steel parts not protected by cadmium, tin, copper, or other plating or surface treatments require protection. Bare metal surfaces must be free of moisture when protective coating is applied.

c. Protecting Parts. Protect bare steel surfaces from rust when not actually undergoing repair work. Dip parts in, or spray them with, corrosion preventive compound. Aluminum parts may require protection in atmospheres having a high salt content.

d. Screws, Nuts, and Fittings. Replace any screw, nut, or fitting with damaged threads. Inspect tapped holes for thread damage. If cross-threading is evident, retap the hole for the next oversize screw or stud. If the retapping will weaken the part, or if the cost of the part makes retapping impractical, replace the part. Chasing the threads with proper size tap or die may be adequate.

e. Stud Installation. When installing studs, use a proper driver. A worn stud driver may damage the end thread and a chasing die must be used before a nut can be installed. This procedure will remove cadmium plating and allow corrosion. Before installing a stud, inspect the hole for chips. Blow out foreign matter and start stud by hand. Before installation, coat thread with a film of antiseize compound. Install stud to proper "setting height", which is the total projecting length.

f. Dents. Straighten minor body dents by bumping with a soft-faced hammer while using a wooden block backing.

g. Sheet Metal Repair. Repair minor skin cracks by installing patches.

2-20. GENERAL ASSEMBLY INSTRUCTIONS.

a. Preparation. Remove protective grease coatings from new parts before installation.

b. Preformed Packing Installation. Clean groove that preformed packing is to be installed in before installation. Lubricate preformed packing, prior to installation, with a clean lubricant. This lubricant must be of the same type used in the component the preformed packing is to be installed in. Do not over-stretch preformed packing during installation. Use care not to cut preformed packing during installation.

c. Pipe Joints and Fittings. Use non-hardening sealing compound or Teflon pipe sealant to join piping and fittings.

d. Oil Seals. Coat oil seals with clean lubricant before installing. This lubricant must be of the same type used in the component the oil seal is to be installed in. Wipe all excess lubricant from side of oil seal that is on the outside of the component (away from lubricant). Install oil seals with seal lip facing toward lubricant, applying an even force to the outer edge of the seal. If oil seals are to be installed over keyed or splined shafts, use a guide to prevent sharp edge of keyway or splines from cutting the seal. Construct guides of very thin gauge sheet metal and shape to the required diameter. Make certain guide edges are not sharp and are bent slightly inward so they do not cut the seal.

e. Bearings and Shafts. When mounting bearings on shafts, always apply force to the inner races. When mounting bearings into housing, always apply the force to the outer race.

f. Bearing Lubrication. Lubricate bearings, before assembly, with clean lubricant. This lubricant must be of the same type used in the component the bearing is to be installed in.

2-20. GENERAL ASSEMBLY INSTRUCTIONS (CONT).**WARNING**

On direct contact, uncured silicon sealant irritates eyes. In case of contact, flush eyes with water and seek medical attention. In case of skin contact, wipe off and flush with water.

g. Silicone Sealant. Silicone sealant is often used instead of a gasket to seal mating parts. The mating parts must be clean, dry, and free of oil or grease for proper adhesion. After silicon sealant has been applied, the mating parts must be assembled immediately. Silicone sealant starts to set-up in 15 minutes and takes 24 hours to completely set. Excess silicone sealant should be removed after assembling the mating parts.

h. Gaskets. Remove all traces of previous gasket and sealant before installing new gasket.

2-21. GENERAL INSTALLATION INSTRUCTIONS.

a. Preparation. When unpacking items, remove all packing material, barrier paper, tape, plastic, plastic bags, protective caps, and protective grease coatings. Handle and store removed components carefully.

CAUTION,

Use sealing compound sparingly and only on threads. Do not apply compound to hose connections. Damage to equipment may result.

b. Sealing Compounds. Use sealing compounds as required in each maintenance task.

c. Torquing. Tighten screws as required in Appendix D or in each maintenance task.

d. Identification Tags. Use identification tags and other identifying markings to ensure hoses, tubes, lines, and electrical wiring are installed and connected correctly.

e. Hoses, Air Lines, and Wiring. After installing hoses, air lines, and wiring, ensure that they do not contact moving parts or components edges. Secure in place, out of the way, with cable ties and cushion clips.

2-22. ADJUSTMENT.

Make changes to equipment pressures, settings, and positions only as required in each maintenance task. Adjustments will bring equipment into proper operating condition.

2-23. PLACING IN SERVICE.

For information on Placing In Service refer to TM 10-3930-669-20.

Section V. PREPARATION FOR STORAGE OR SHIPMENT

2-24. PREPARATION FOR SHIPMENT.

For information about Preparation For Shipment refer to TM 10-3930-669-20.

2-25. STORAGE MAINTENANCE PROCEDURES.

For information about Storage Maintenance Procedures refer to TM 10-3930-669-20.

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CHAPTER 3
ENGINE MAINTENANCE

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3-1. INTRODUCTION.

This chapter contains maintenance instructions for removing, replacing, repairing, installing, adjusting, and testing engine components authorized by the Maintenance Allocation Chart (MAC) at the Direct Support and General Support Maintenance level.

3-2. WEAR LIMITS, FITS, AND TOLERANCES.

Refer to Table 3-1 for wear limits, fits, and tolerances for use throughout this chapter.

Table 3-1. Wear Limits, Fits, and Tolerances

Component	Minimum	Maximum
Intake Valves:		
Head Diameter	1.689 in. (42.900 mm)	1.697 in. (43.100 mm)
Stem Diameter	0.3128 in. (7.9450 mm)	0.3134 in. (7.9600 mm)
Stem-to-guide normal clearance	0.0016 in. (0.0400 mm)	0.0028 in. (0.0700 mm)
Stem-to-guide maximum clearance		0.0059 in. (0.1500 mm)
Seat bore diameter in head nominal	1.7913 in. (45.5000 mm)	1.7923 in. (45.5250 mm)
Seat outside diameter	1.7969 in. (45.6400 mm)	1.7976 in. (45.6600 mm)
Valve seat width	0.0591 in. (1.5000 mm)	0.0787 in. (2.0000 mm)
Seat angle	45°	
Valve rim thickness	0.0197 in. (0.7000 mm)	0.0394 in. (1.0000 mm)
Valve recessed below cylinder head seating surface	0.2000 in. (5.0800 mm)	0.2205 in. (5.6000 mm)
Exhaust Valves:		
Head diameter	1.4527 in. (36.9000 mm)	1.4606 in. (37.1000 mm)
Stem diameter	0.3118 in. (7.9200 mm)	0.3125 in. (7.9400 mm)
Stem-to-guide normal clearance	0.0023 in. (0.0600 mm)	0.0037 in. (0.0950 mm)
Stem-to-guide maximum clearance		0.0079 in. (0.2000 mm)

Table 3-1. Wear Limits, Fits, and Tolerances

Component	Minimum	Maximum
Exhaust Valves - continued:		
Seat bore diameter in head nominal	1.5748 in. (40.0000 mm)	1.5757 in. (40.0250 mm)
Seat outside diameter	1.5803 in. (40.1400 mm)	1.5811 in. (40.1600 mm)
Valve seat width	0.0591 in. (1.5000 mm)	0.0787 in. (2.0000 mm)
Seat angle	45°	
Valve rim thickness	0.0197 in. (0.5000 mm)	0.0591 in. (1.5000 mm)
Valve recessed below cylinder head seating surface	0.2000 in. (5.0800 mm)	0.2205 in. (5.6000 mm)
Valve Guides:		
Outside diameter - nominal	0.5923 in. (15.0450 mm)	0.5927 in. (15.0560 mm)
Bore in cylinder head diameter	0.5905 in. (15.0000 mm)	0.5909 in. (15.0110 mm)
Pressed in inside diameter	0.3149 in. (8.0000 mm)	0.3155 in. (8.0150 mm)
Valve springs:		
Total coils	7	
Normal length	2.3230 in. (59.0000 mm)	2.3976 in. (60.9000 mm)
Minimum length	2.2047 in. (56.0000 mm)	
Cylinder Head:		
Distance between cylinder head bottom and cylinder head joint w/ shim bolts.	0.2323 in. (5.9000 mm)	0.2519 in. (6.4000 mm)
Stud nominal length	8.2870 in. (210.5000 mm)	8.3268 in. (211.5000 mm)

Table 3-1. Wear Limits, Fits, and Tolerances

Component	Minimum	Maximum
Cylinder Head - continued:		
Stud maximum length		8.3661 in. (212.5000 mm)
Cylinders:		
Bore diameter - normal	3.9370 in. (100.0000 mm)	3.9378 in. (100.0220 mm)
Bore wear - maximum		0.0004 in. (0.1000 mm)
Pistons:		
Diameter - normal	3.9331 in. (99.9010 mm)	3.9338 in. (99.9190 mm)
Diameter of bore for connecting rod pin	1.3779 in. (35.0000 mm)	1.3782 in. (35.0060 mm)
Connecting rod pin diameter	1.3777 in. (34.9940 mm)	1.3779 in. (35.0000 mm)
2nd ring groove width	0.0984 in. (2.5000 mm)	0.1020 in. (2.6100 mm)
3rd ring groove width	0.0984 in. (2.5000 mm)	0.1020 in. (2.5900 mm)
4th ring groove width	0.1969 in. (5.0000 mm)	0.1980 in. (5.0300 mm)
Piston Rings:		
2nd ring clearance in groove	0.0039 in. (0.1000 mm)	0.0052 in. (0.1320 mm)
2nd ring maximum clearance in groove		0.0118 in. (0.3000 mm)
3rd ring clearance in groove	0.0039 in. (0.1000 mm)	0.0052 in. (0.1320 mm)
3rd ring maximum clearance in groove		0.0118 in. (0.3000 mm)

Table 3-1. Wear Limits, Fits, and Tolerances

Component	Minimum	Maximum
Piston Rings - continued:		
4th ring clearance in groove	0.0015 in (0.0400 mm)	0.0028 in. (0.0720 mm)
4th ring maximum clearance in groove		0.0059 in. (0.15 mm)
Gap: 1st ring - normal	0.0137 in (0.3500 mm)	0.0216 in. (0.5500 mm)
Gap: 2nd ring - normal	0.0079 in (0.2000 mm)	0.0177 in. (0.4500 mm)
Gap: 3rd ring - normal	0.0098 in (0.2500 mm)	0.0197 in. (0.5000 mm)
Gap: 4th ring - normal	0.0098 in (0.2500 mm)	0.0157 in. (0.4000 mm)
Gap: 1st, 2nd, 3rd, and 4th rings - maximum		0.0315 in. (0.8000 mm)
Connecting Rods:		
Hole for connecting rod pin bushing	1.4961 in (38.0000 mm)	1.4966 in. (38.0160 mm)
Rod bearing bore diameter, less bearing	2.5196 in (64.0000 mm)	2.5204 in. (64.0190 mm)
Rod bearing inside diameter	2.3622 in (60.0000 mm)	2.3637 in. (60.0390 mm)
Rod pin bushing outside diameter	1.4980 in (38.0500 mm)	1.4992 in. (38.0800 mm)
Rod pin bushing inside diameter - pressed in	1.3795 in (35.0400 mm)	1.3813 in. (35.0860 mm)
Rod pin-to-bushing clearance	0.0015 in (0.0400 mm)	0.0035 in. (0.0910 mm)
Rod pin-to-bushing maximum clearance		0.0059 in. (0.1500 mm)
Rod bearing width	0.9763 in (24.8000 mm)	0.9842 in. (25.0000 mm)

Table 3-1. Wear Limits, Fits, and Tolerances

Component	Minimum	Maximum
Connecting Rods - continued:		
Rod width	1.3172 in. (33.5200 mm)	1.3228 in. (33.6000 mm)
Rod bearing-to-crankshaft clearance	0.0015 in. (0.0400 mm)	0.0038 in. (0.0980 mm)
Rod bearing-to-crankshaft maximum clearance		0.0059 in. (0.1500 mm)
Idler Gear and Journal:		
Bearing bushing internal diameter - pressed in	1.5748 in. (40.0000 mm)	1.5757 in. (40.0250 mm)
Journal diameter	1.5744 in. (39.9910 mm)	1.5748 in. (40.0000 mm)
Journal clearance in bushing	0.0013 in. (0.0340 mm)	0.0026 in. (0.0660 mm)
Journal-to-bushing maximum clearance		0.0039 in. (0.10 mm)
Camshaft:		
Camshaft-to-bushing maximum clearance		0.0079 in. (0.20 mm)
Camshaft bushing inside diameter - nominal	1.8890 in. (47.9800 mm)	1.8911 in. (48.0340 mm)
Crankshaft:		
Connecting rod journal diameter - nominal	2.3606 in. (59.9410 mm)	2.3610 in. (59.9700 mm)
Connecting rod journal out-of-round maximum		0.0004 in. (0.0100 mm)
Main bearing journal diameter - normal	2.7555 in. (69.9700 mm)	2.7556 in. (70.0000 mm)

Table 3-1. Wear Limits, Fits, and Tolerances

Component	Minimum	Maximum
Crankshaft - continued:		
Main bearing journal out-of-round		0.001 in. (0.020 mm)
Main bearing journal width	1.4567 in. (37.0000 mm)	1.4606 in. (37.1000 mm)
Main bearings, numbers 2, 3, and 4:		
Main bearing bore diameter - less bearings	2.9330 in. (74.5000 mm)	2.9334 in. (74.5080 mm)
Main bearing inside diameter - normal	2.7574 in. (70.0400 mm)	2.7582 in. (70.0600 mm)
Main bearing inside diameter - minimum	2.6984 in. (68.5400 mm)	2.7001 in. (68.5830 mm)
Main bearing to crankshaft journal clearance - normal	0.0019 in. (0.0500 mm)	0.0043 in. (0.1100 mm)
Main bearing to crankshaft journal clearance - maximum		0.0059 in. (0.1500 mm)
Thrust bearings with stop rings:		
Outside distance of stop rings - nominal	1.4453 in. (36.7110 mm)	1.4508 in. (36.8500 mm)
Outside distance of stop rings - maximum	1.5241 in. (38.7110 mm)	1.5295 in. (38.8500 mm)
Thrust bearing-to-journal - normal clearance	0.0059 in. (0.1500 mm)	0.0123 in. (0.3140 mm)
Thrust bearing-to-journal - maximum clearance		0.0157 in. (0.4000 mm)

3-3. ENGINE/TRANSMISSION ASSEMBLY REPLACEMENT.

This task covers:

- | | | |
|------------------------|-----------------|--------------------------|
| a. TDC Equipment Setup | c. Removal | e. TDC Equipment Removal |
| b. TDC Adjustment | d. Installation | |

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Lifting Eye (2) (Item 16, Appendix E)
- Engine Stand (Item 5 Appendix E)

Materials/Parts

- Cap and Plug Set (Item 5, Appendix B)
- Rags, Wiping (Item 19, Appendix B)
- Tags, Identification (Item 21, Appendix B)
- Washer, Lock (2)

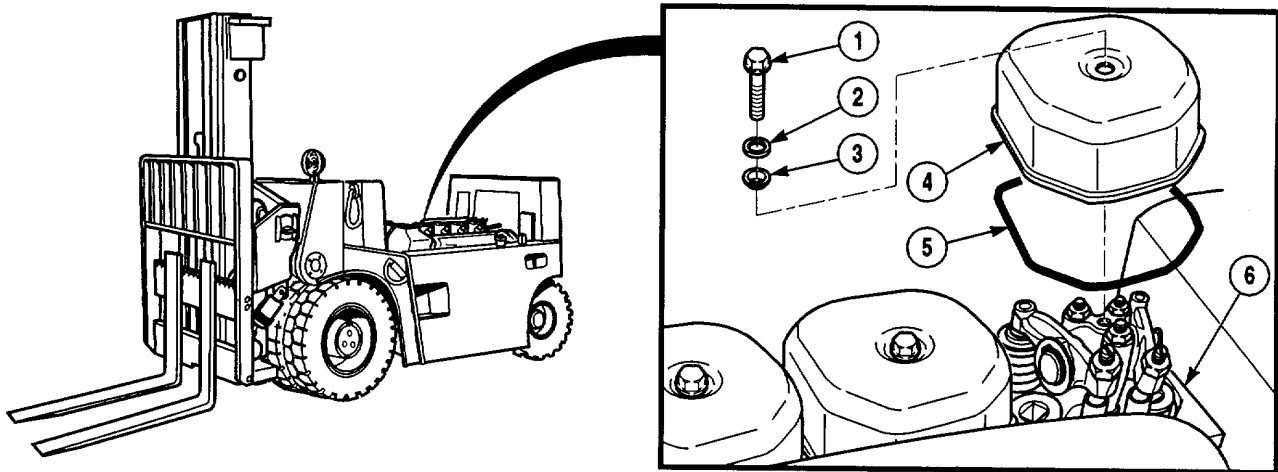
Personnel Required

Two

Equipment Condition

- Wheels chocked (TM 10-3930-669-10)
- Mast pivoted 90 degrees (TM 10-3930-669-10)
- Cab removed (TM 10-3930-669-20)
- Engine oil drained (LO 10-3930-669-12)
- Transmission oil drained (LO 10-3930-669-12)
- Air cleaner assembly removed (TM 10-3930-669-20)
- Throttle cable removed (TM 10-3930-669-20)
- Engine ground strap removed (TM 10-3930-669-20)
- Engine wire harness removed (Para 7-5)

a. TDC Equipment Setup.



WARNING

BURN HAZARD

Allow engine to cool before performing maintenance on the muffler, exhaust pipe, exhaust manifold, or turbocharger. If necessary, use insulated pads and gloves.

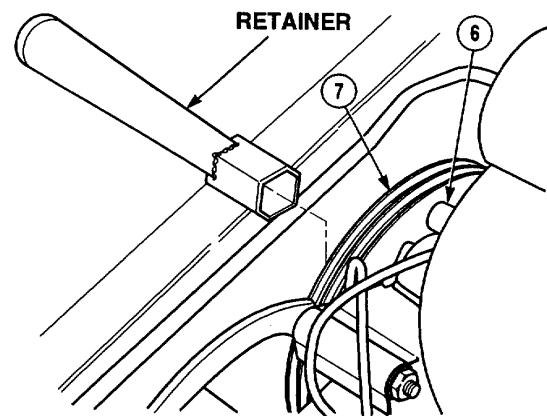
NOTE

Cylinder number designation starts with No. 1 cylinder closest to transmission.

- (1) Remove screw (1), washer (2), washer (3), valve cover (4), and gasket (5) from engine (6) cylinder No. 1. Discard gasket.

NOTE

- All turning of engine will be done with retainer at crankshaft pulley.
 - All turning of engine will be described as if looking at the crankshaft pulley end of engine.
- (2) Using retainer to turn pulley (7), turn engine (6) to the right.

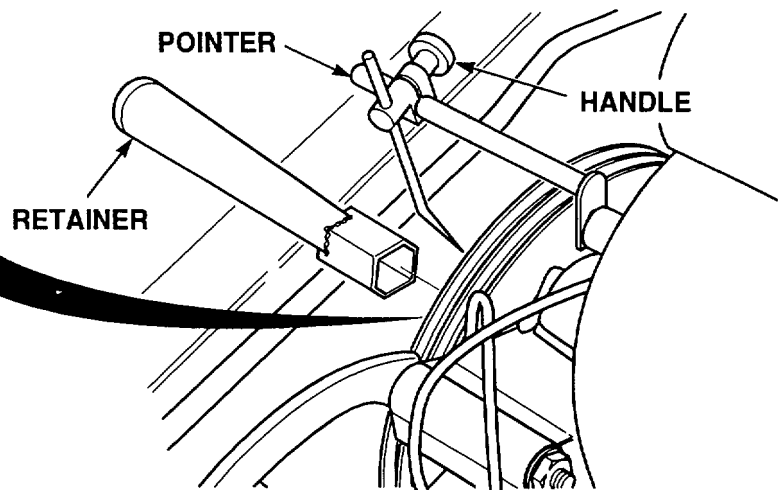
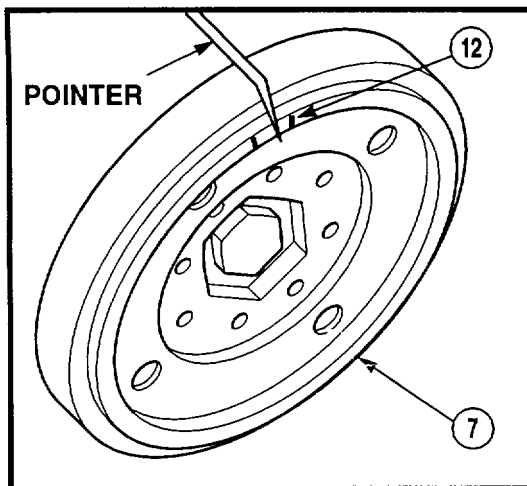
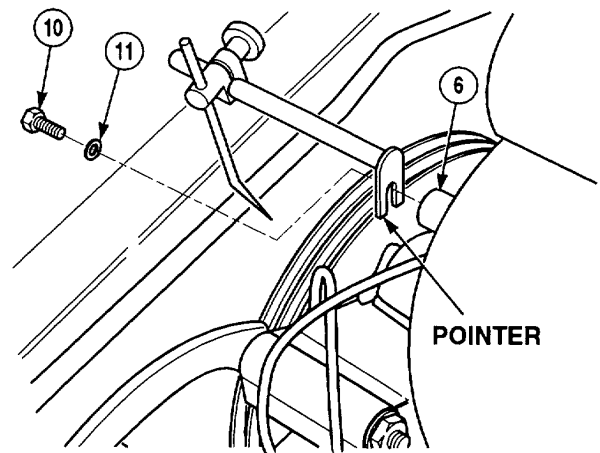
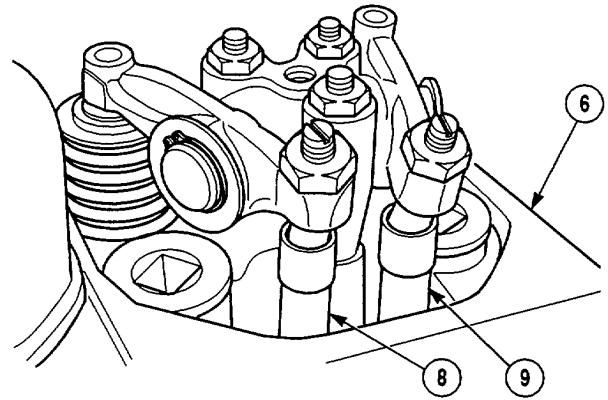


3-3. ENGINE/TRANSMISSION ASSEMBLY REPLACEMENT (CONT).

NOTE

Valve overlapping is when exhaust valve is about to close and inlet valve is about to open. Both pushrods will not rotate.

- (3) As described in Step (2), continue turning engine (6) to the right until exhaust valve pushrod (8) overlaps intake valve pushrod (9).
- (4) Loosen screw (10) and washer (11) on engine (6).
- (5) Mount pointer on engine (6) with screw (10) and washer (11).



- (6) Loosen pointer handle and adjust pointer to middle of two index marks (12) on pulley (7).
- (7) Using retainer, turn pulley (7) 180 degrees to the right.

NOTE

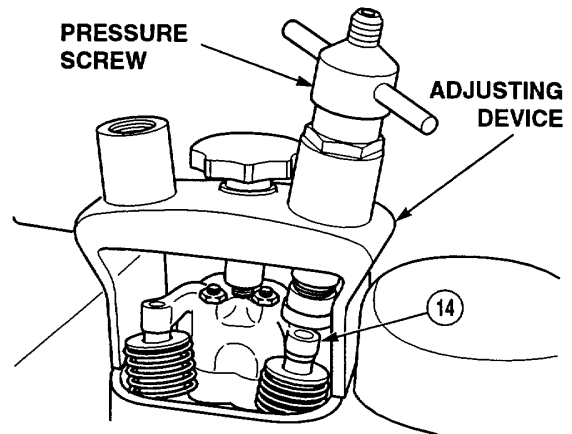
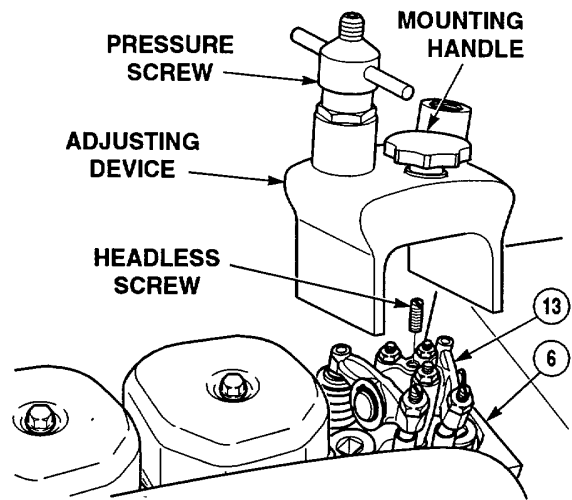
Headless screw is part of adjusting device.

- (8) Mount headless screw in rocker bracket (13).

NOTE

Ensure pressure screw is screwed out so it does not contact engine during adjusting device installation.

- (9) Install mounting handle on headless screw until adjusting device is firmly seated on engine (6).
- (10) Tighten pressure screw of adjusting device until exhaust rocker arm (14) is depressed .20 to .23 in. (5-6 mm).

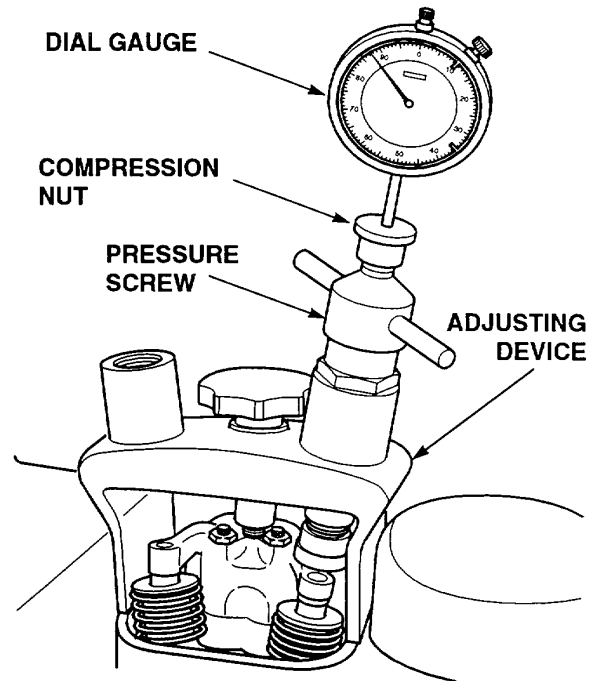


3-3. ENGINE/TRANSMISSION ASSEMBLY REPLACEMENT (CONT).

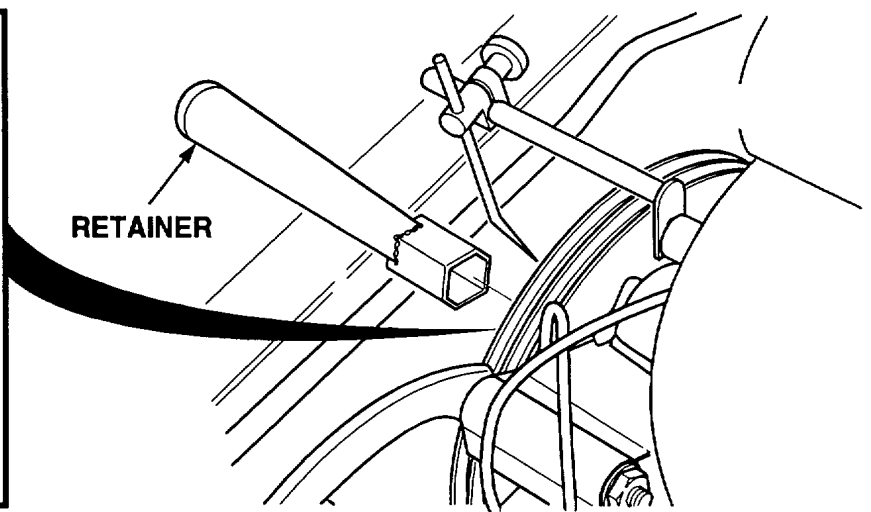
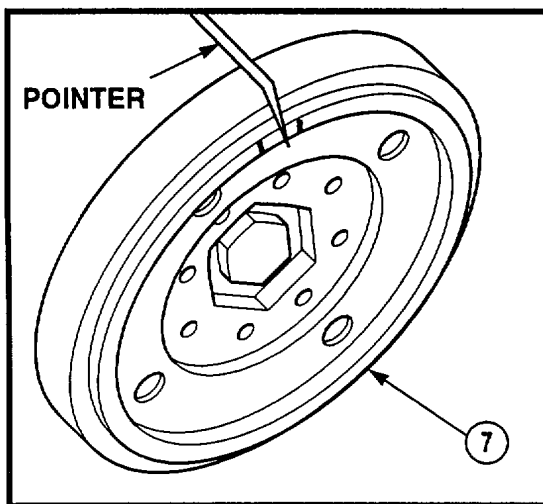
NOTE

Preload is when the plunger of the dial gauge contacts the internal plunger of the pressure screw.

(11) Install the dial gauge in the pressure screw of the adjusting device until the dial gauge pointer moves. Tighten the compression nut.

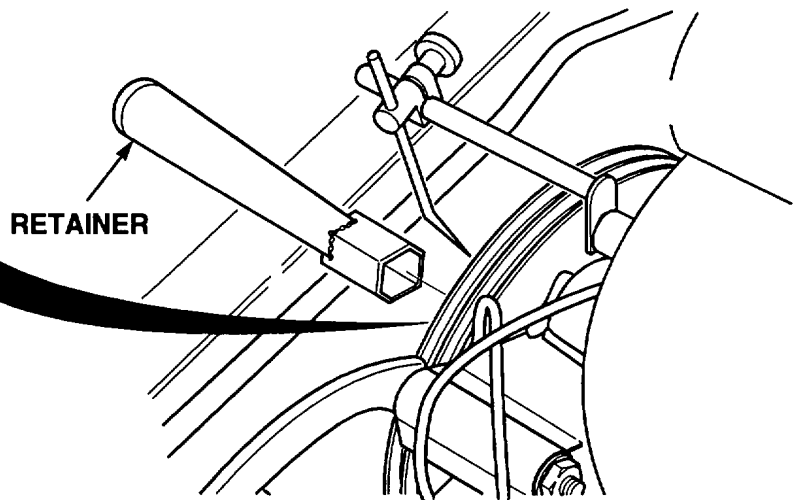
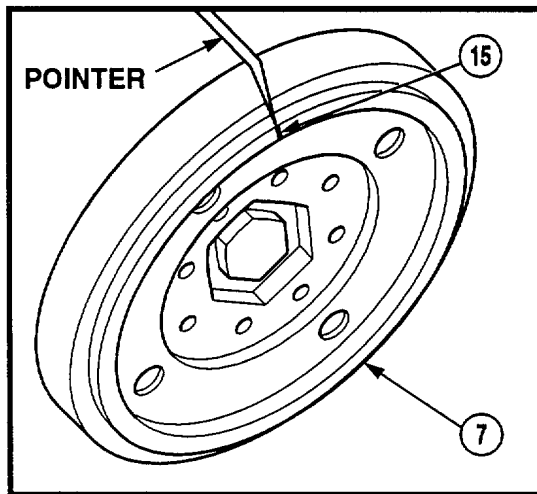
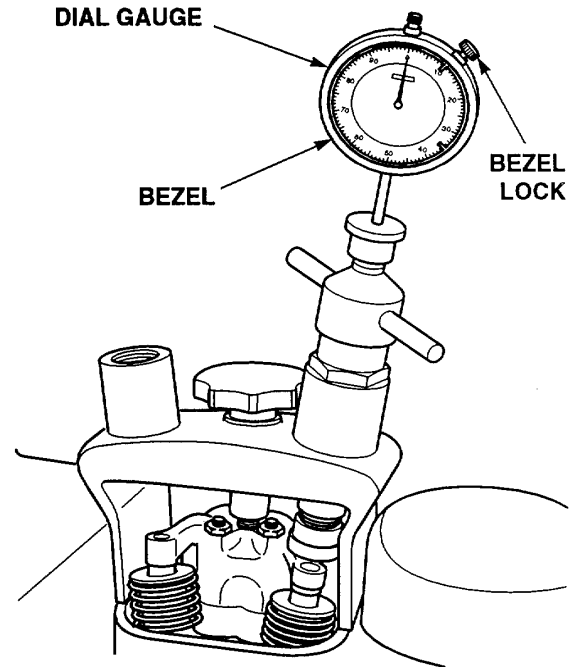


b. TDC Adjustment.



- (1) Using retainer, turn pulley (7) to the right until dial gauge needle begins to move.
- (2) Using retainer, continue turning pulley (7) slowly until dial gauge pointer stops moving in one direction and starts to move in the opposite direction.

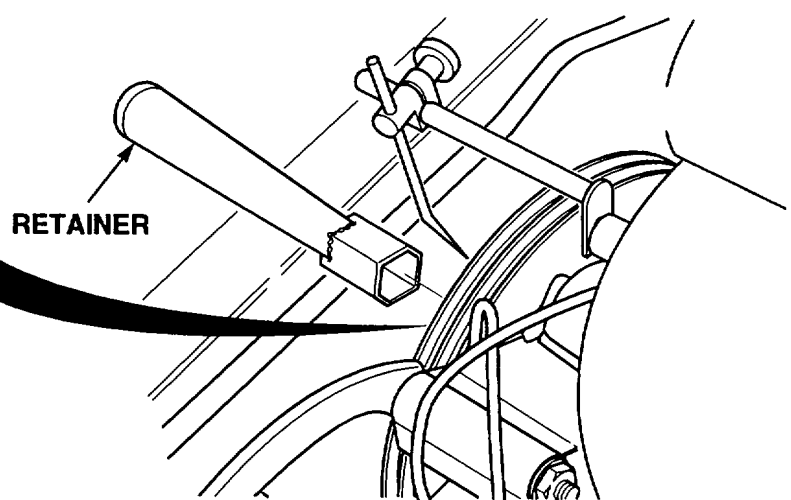
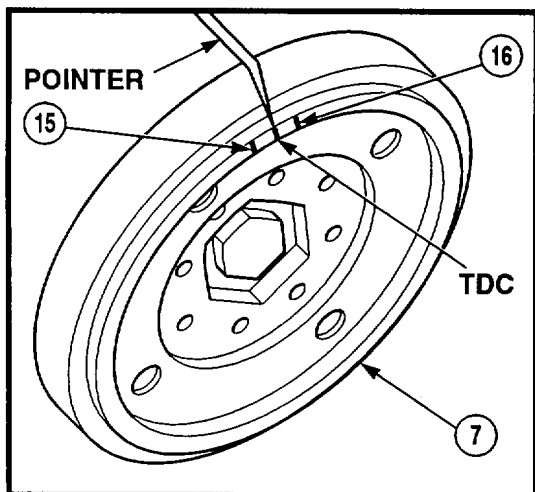
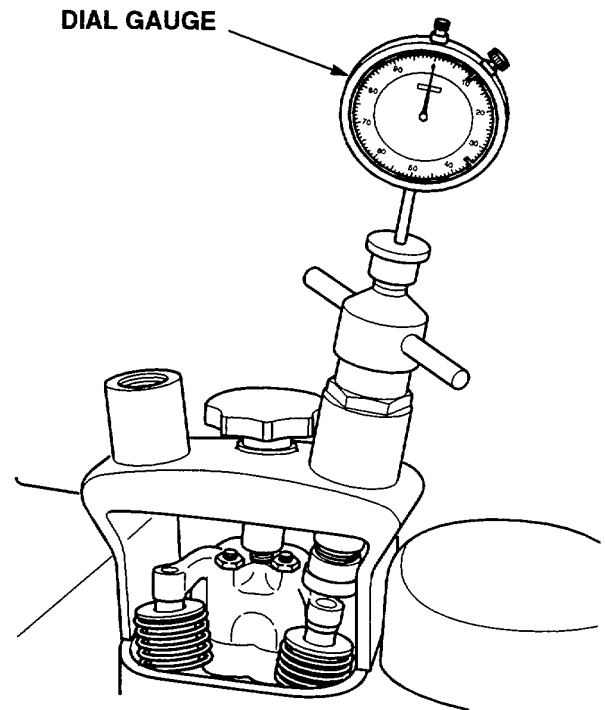
- (3) Loosen bezel lock.
- (4) Turn bezel until zero is aligned with pointer.
Tighten bezel lock.



- (5) Place mark (15) on pulley (7) at the point indicated by the pointer.
- (6) Using retainer, turn pulley (7) to the right one half rotation.
- (7) Using retainer, turn pulley (7) to the left until the dial gauge pointer begins to move.

3-3. ENGINE/TRANSMISSION ASSEMBLY REPLACEMENT (CONT). |'

- (8) Using retainer, continue turning pulley (7) slowly until dial gauge pointer again stops moving in one direction and starts to move in the opposite direction.



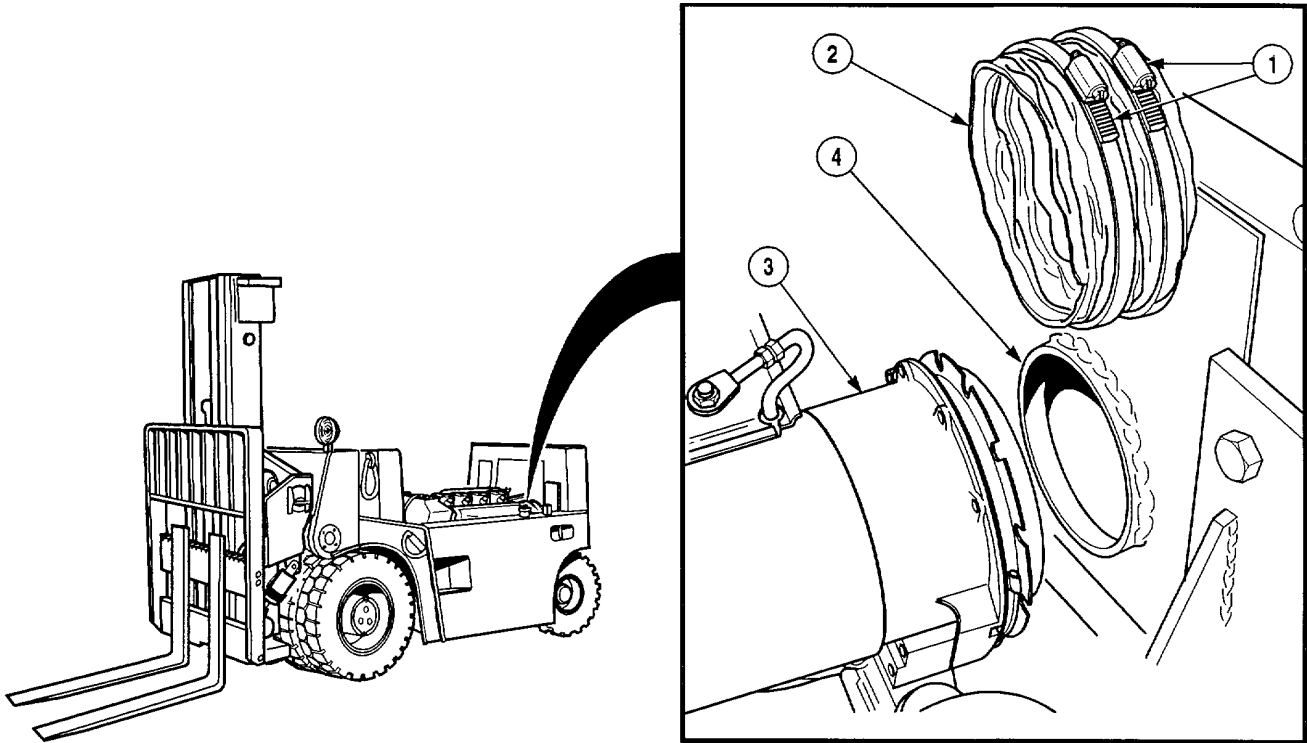
- (9) Place second mark (16) on pulley (7) at point indicated by the pointer.

NOTE

The point halfway between the two pulley marks is top dead center (TDC). If the two pulley marks are the same position, that position becomes top dead center (TDC).

- (10) Determine the point halfway between two marks (15 and 16). Mark this point as top dead center (TDC).

c. Removal



(1) Remove two clamps (1) and hose (2) from blower (3) and plate (4).

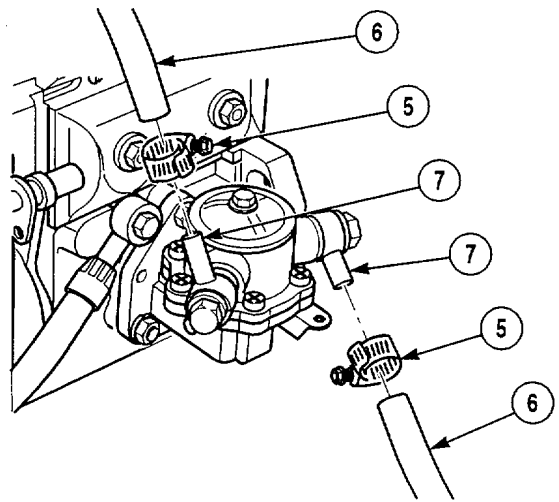
WARNING

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET (15 m).

NOTE

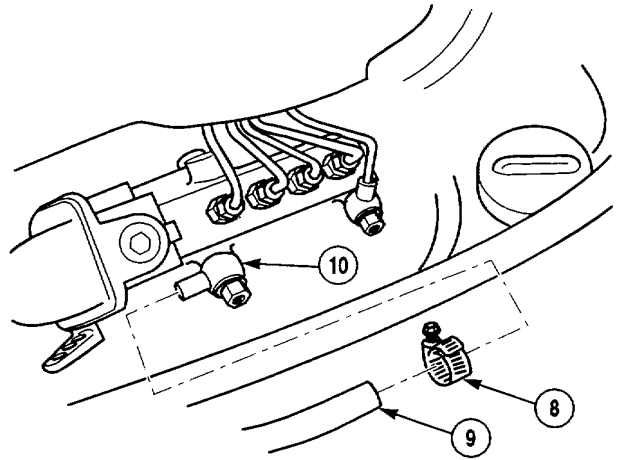
- Inspect all hoses and fittings for cracks, bends, nicks, dents, stripped threads, and cuts. Replace all damaged parts.
- Tag and mark each hose prior to removal.
- Cap and plug all hoses and fittings after removal.

(2) Remove two clamps (5) and hoses (6) from fittings (7).

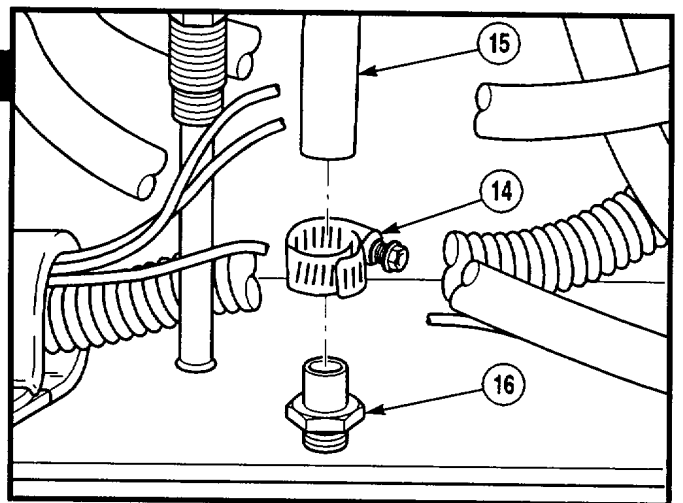
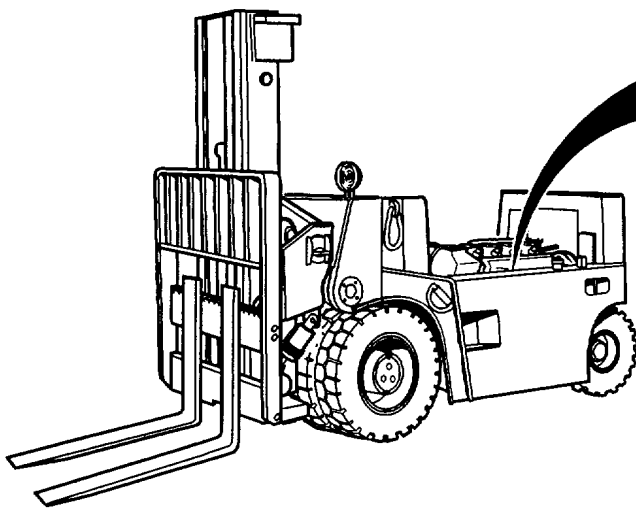
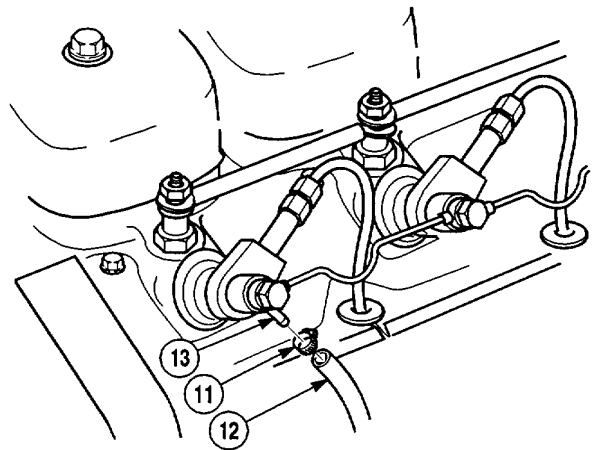


3-3. ENGINE/TRANSMISSION ASSEMBLY REPLACEMENT (CONT).

- (3) Remove clamp (8) and hose (9) from banjo fitting (10).

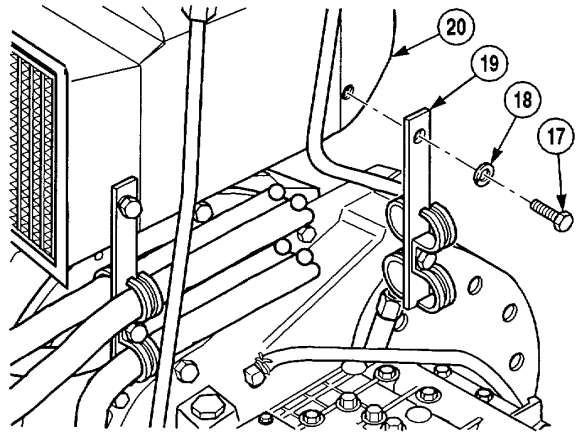


- (4) Remove clamp (11) and overflow hose (12) from fitting (13).

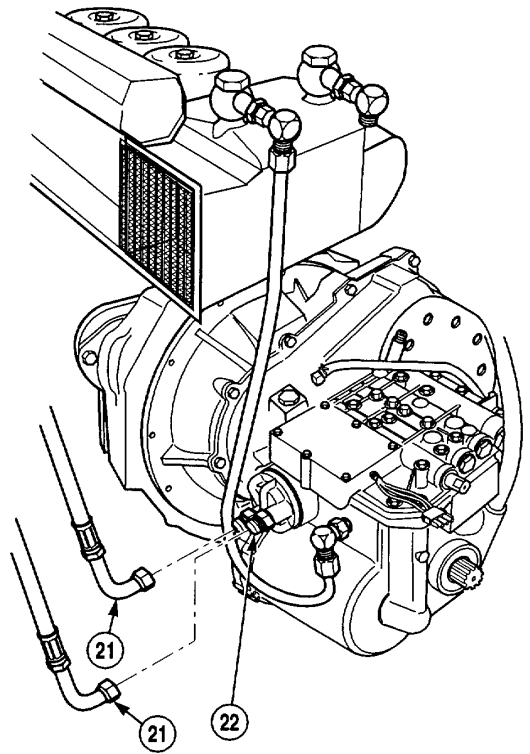


- (5) Remove clamp (14) and fuel return hose (15) from fitting (16).

(6) Remove two screws (17), lock washers (18), and brackets (19) from engine (20). Discard lock washers.



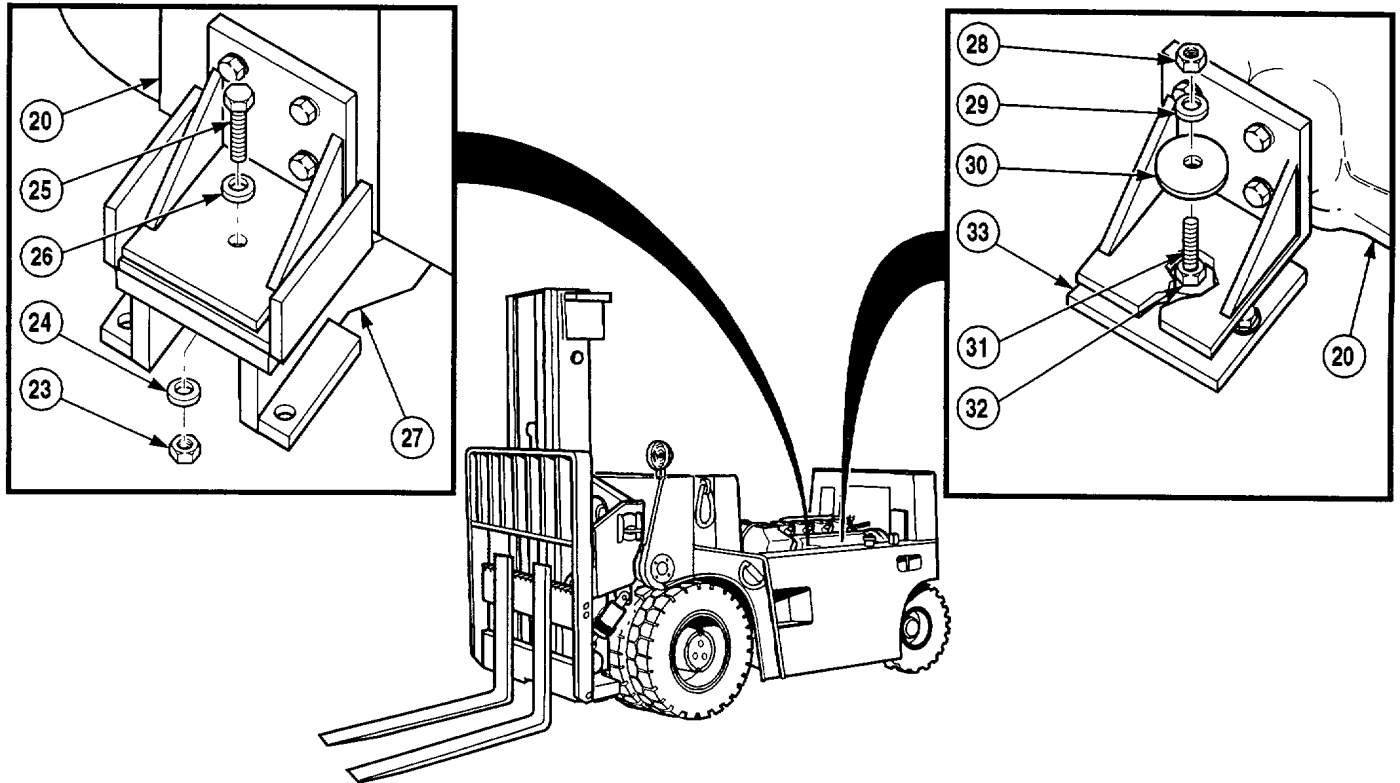
(7) Remove two hoses (21) from fittings (22).



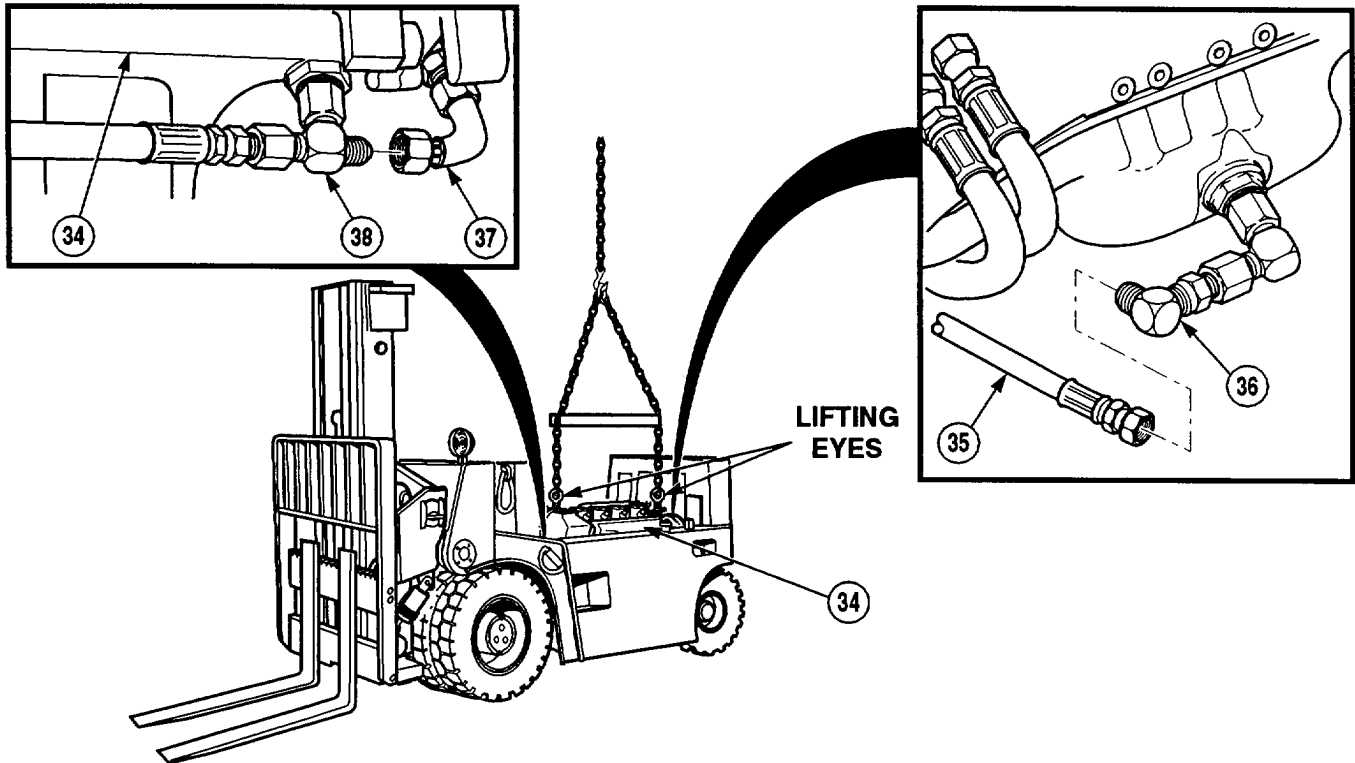
3-3. ENGINE/TRANSMISSION ASSEMBLY REPLACEMENT (CONT)

WARNING

- Engine/Transmission assembly weighs 430 lbs (195 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.
- Exercise extreme caution when working near a cable or chain under tension. A snapped cable or a shifting or swinging load may result in injury or death to personnel.



- (8) Remove two nuts (23), washers (24), screws (25), and washers (26) from engine (20) and front engine mounts (27).
- (9) Remove two nuts (28), washers (29), washers (30) from two screws (31), and nuts (32) on rear engine mounts (33).



- (10) Install two lifting eyes in engine/transmission assembly (34).

WARNING

Engine/Transmission assembly weighs 430 lbs (195.05 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

- (11) With the aid of an assistant, use lifting device to raise engine/transmission assembly (34) 2 ft from engine mounts.
 (12) Position wiping rags under hoses to catch excess oil.
 (13) Disconnect engine drain hose (35) from elbow (36).

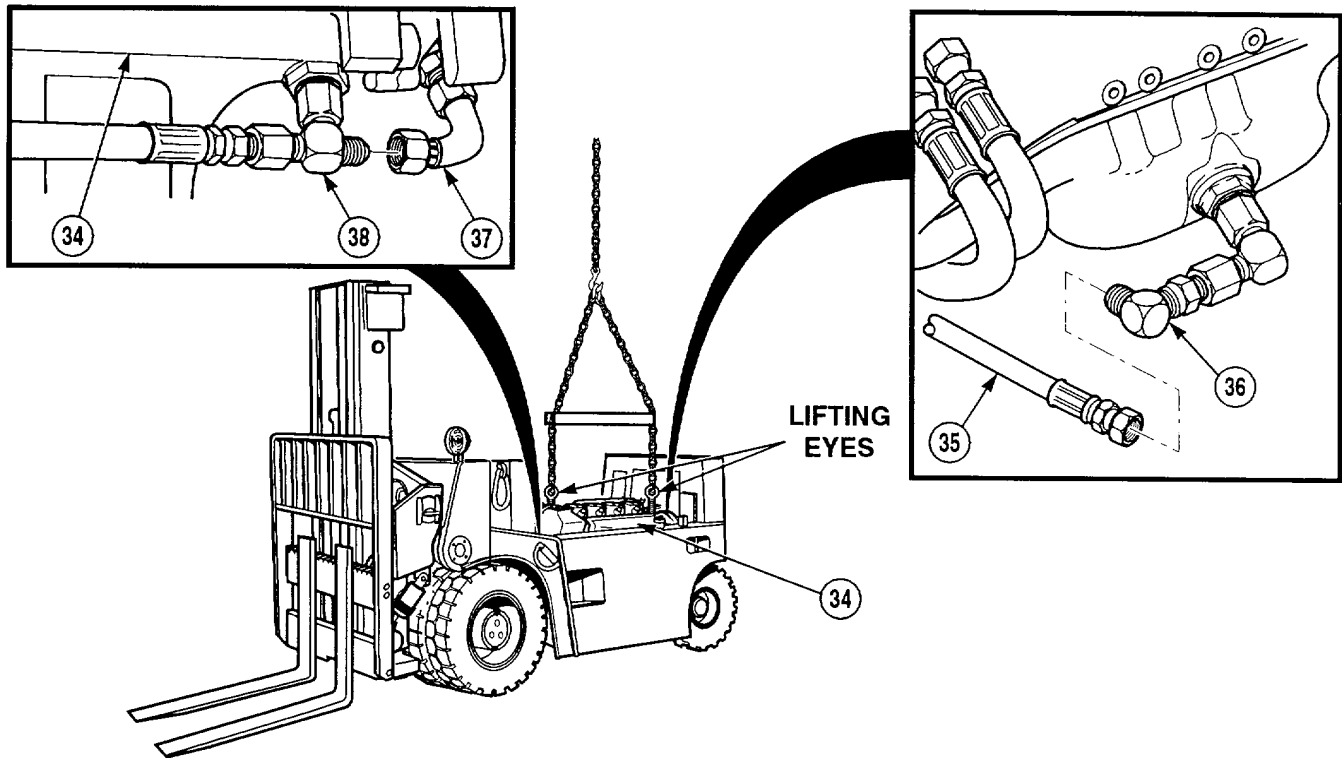
NOTE

- Drive shaft spline must be removed from transmission during removal of engine/transmission assembly.
- Transmission yoke will slide out of transmission.

- (14) Disconnect transmission drain hose (37) from tee (38).
 (15) With the aid of an assistant, use lifting device to remove engine/transmission assembly (34) from forklift.

3-3. ENGINE/TRANSMISSION ASSEMBLY REPLACEMENT (CONT).

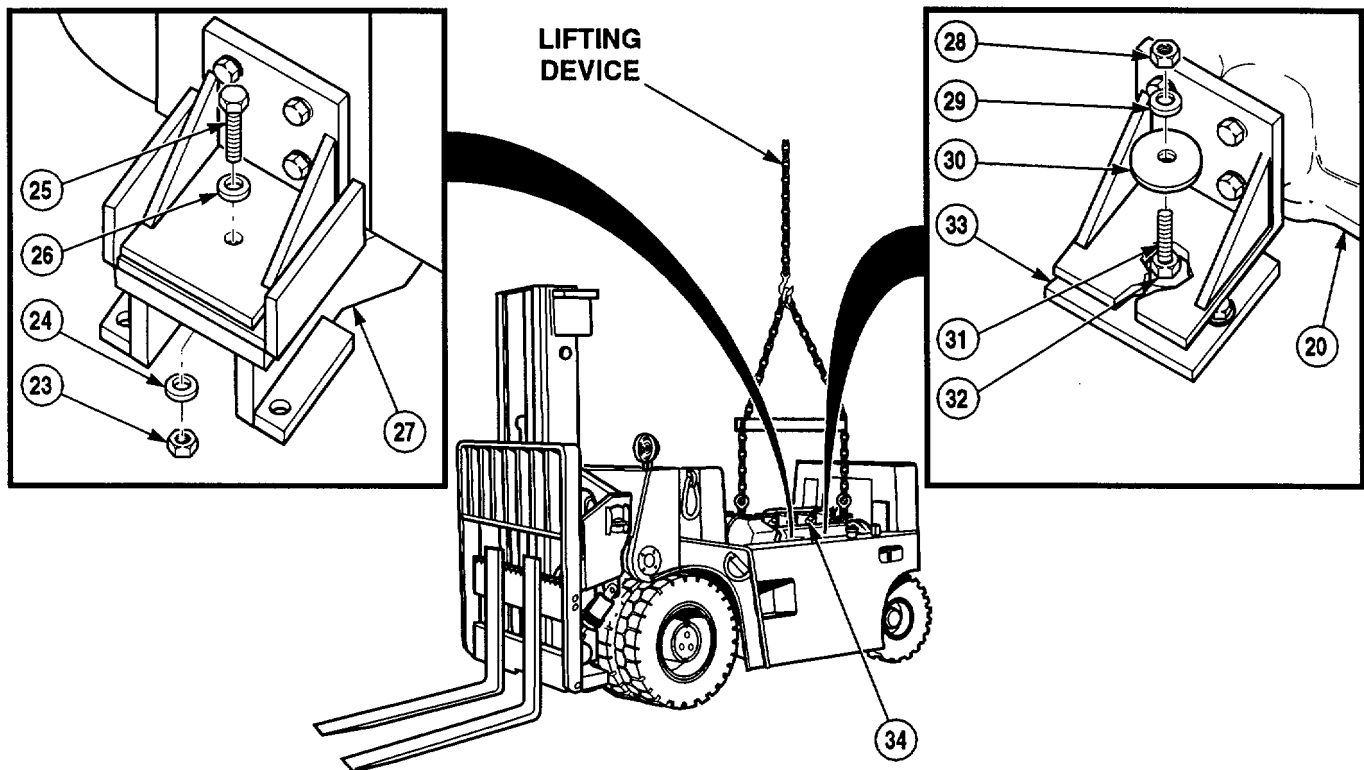
d. Installation.



NOTE

Drive shaft spline must be installed prior to installing engine/transmission assembly.

- (1) With the aid of an assistant, use lifting device to position engine/transmission assembly (34) on forklift 2 ft. above engine mounts.
- (2) Connect transmission drain hose (37) on tee (38).
- (3) Connect engine drain hose (35) on elbow (36).



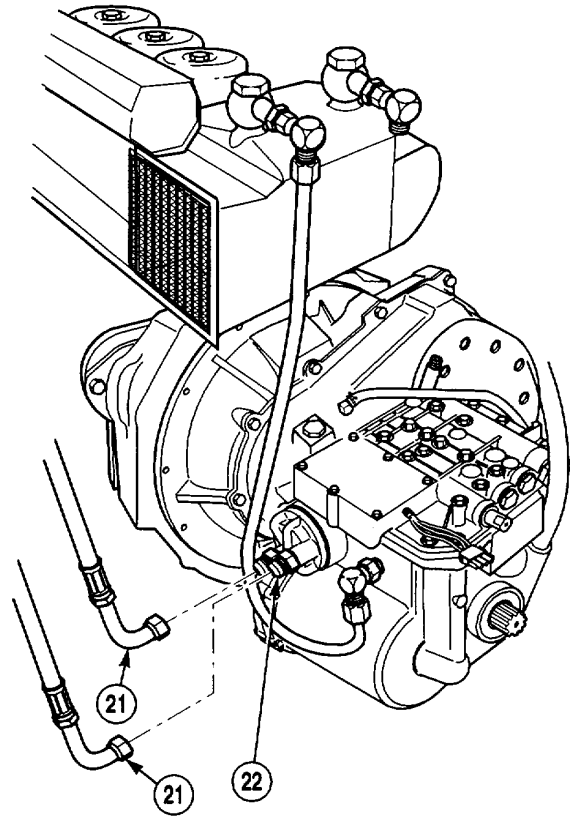
(4) With the aid of an assistant, use lifting device to position engine/transmission assembly (34) on screws (31) and nuts (32) of rear engine mounts (33) and front engine mounts (27).

(5) Install two washers (30) and washers (29) on screws (31) and nuts (32) with two nuts (28) Tighten nuts 45 lb-ft (61 N•m).

(6) Install two washers (26), screws (25), washers (24), and nuts (23) on front engine mounts (27) Tighten nuts 45 lb-ft (61 N•m).

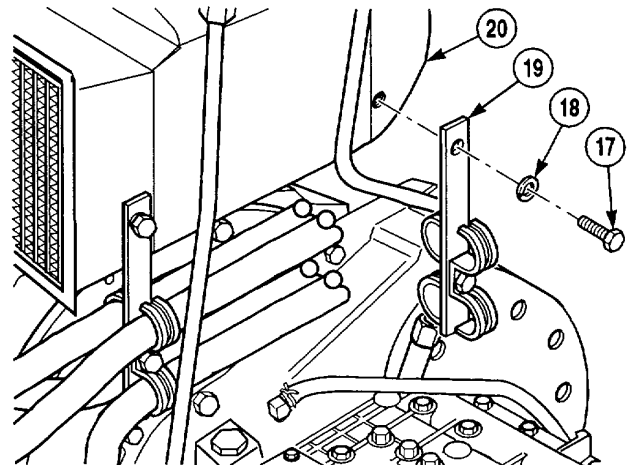
3-3. ENGINE/TRANSMISSION ASSEMBLY REPLACEMENT (CONT)@@@

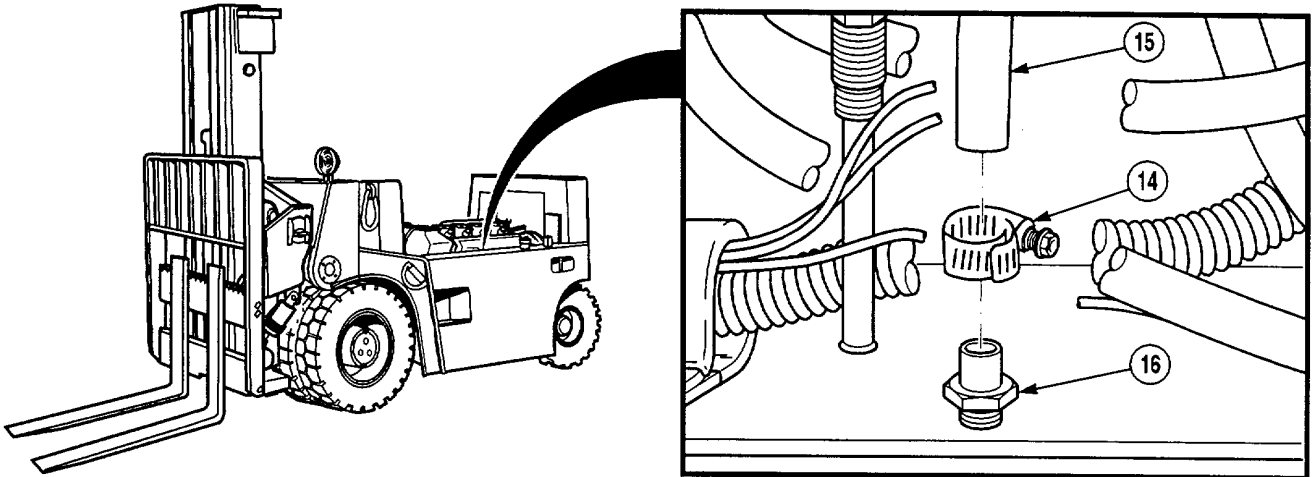
(7) Install two hoses (21) on fittings (22).



(8) Remove lifting device and two lifting eyes.

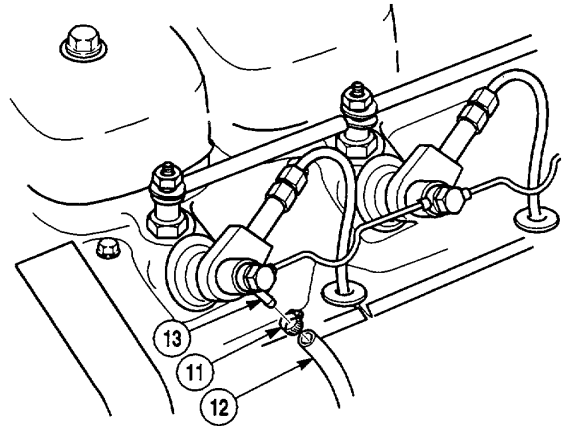
(9) Install two brackets (19) on engine (20) with two lock washers (18) and screws (17).



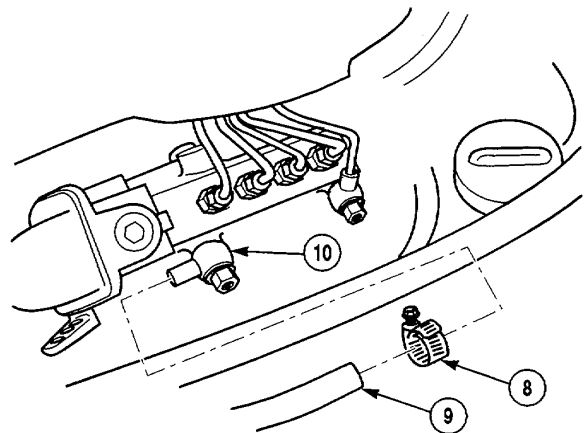


(10) Install fuel return hose (15) on fitting (16) with clamp (14).

(11) Install overflow hose (12) on fitting (13) with clamp (11).

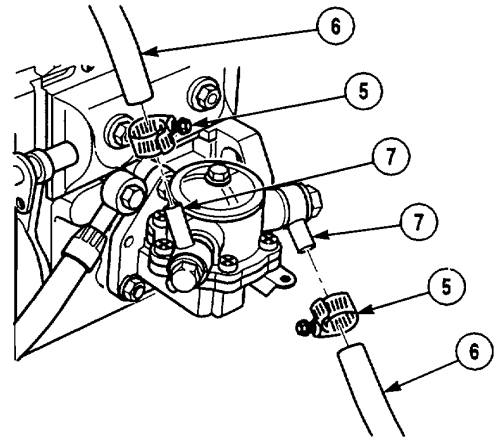


(12) Install hose (9) on banjo fitting (10) with clamp (8).

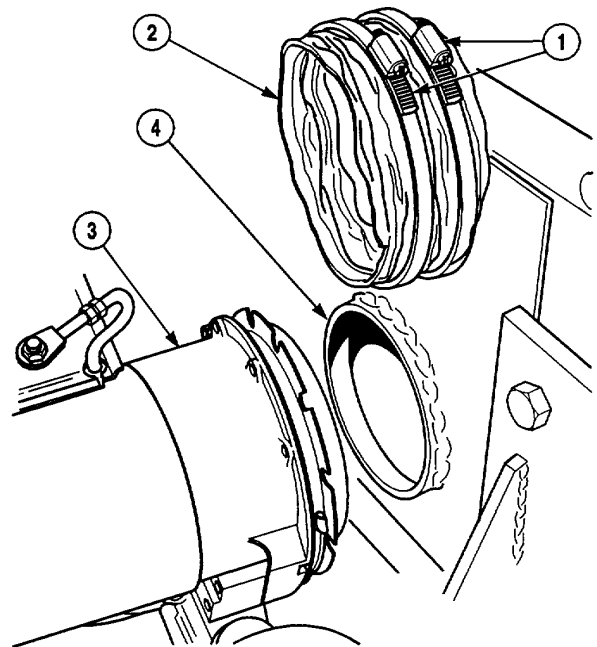


3-3. ENGINE/TRANSMISSION ASSEMBLY REPLACEMENT (CONT).

- (13) Install two hoses (6) on fittings (7) with clamps (5).

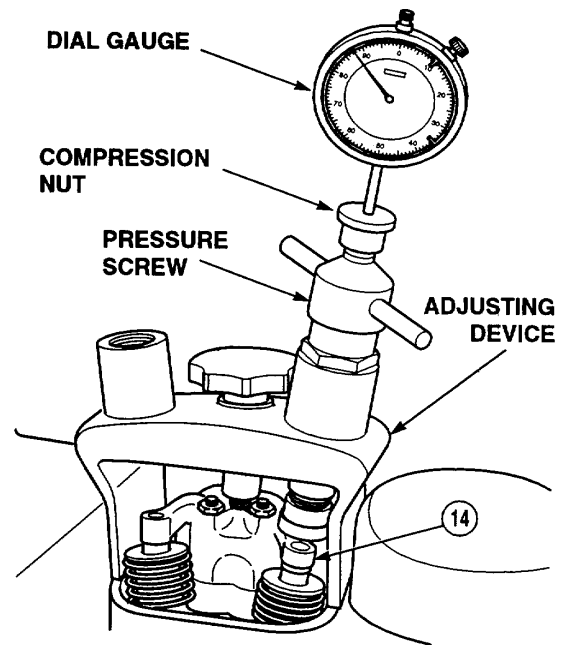


- (14) Install hose (2) on blower (3) and plate (4) with two clamps (1).

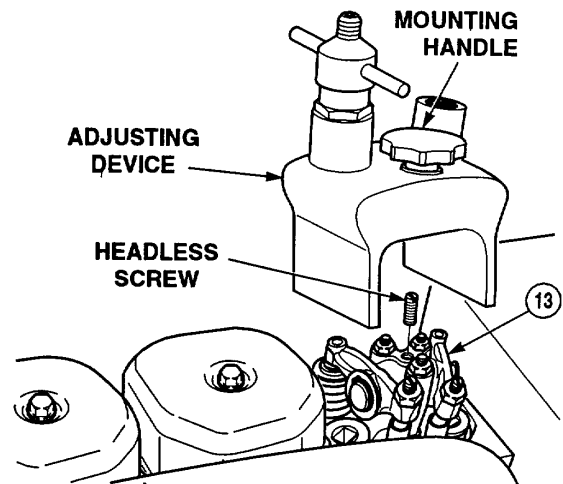


e. TDC Equipment Removal.

- (1) Loosen compression nut on pressure screw of adjusting device.
- (2) Remove dial gauge from pressure screw on adjusting device.
- (3) Turn pressure screw to the left to remove pressure from exhaust rocker arm (14).

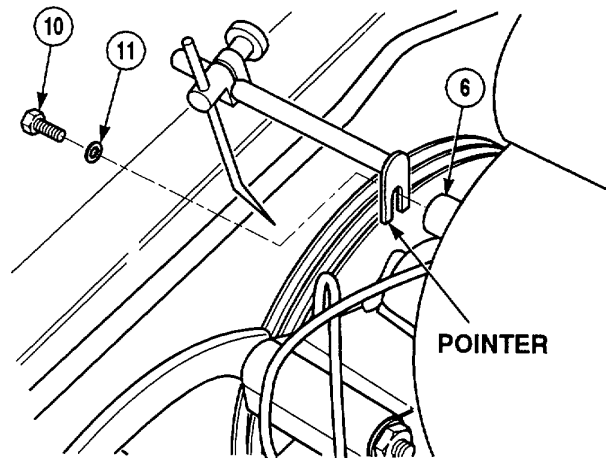


- (4) Remove mounting handle and adjusting device from headless screw.
- (5) Remove headless screw from rocker bracket (13).

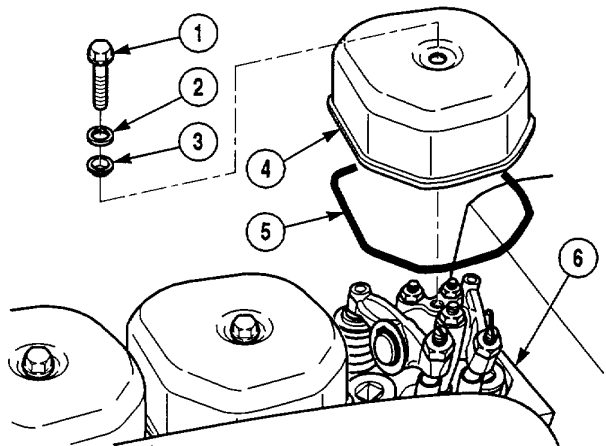


3-3. ENGINE/TRANSMISSION ASSEMBLY REPLACEMENT (CONT).

- (6) Loosen screw (10) and washer (11) from engine (6) and remove pointer.
- (7) Tighten screw (10) to 18 lb-ft (25 N•m).



- (8) Install gasket (5), washer (2), washer (3), and valve cover (4) on engine (6) with screw (1). Tighten screw 5 to 11 lb-ft (7-15 N•m).

**NOTE****Follow-on Maintenance:**

- Install engine wire harness (Para 7-5).
- Install engine ground strap (TM 10-3930-669-20).
- Install throttle cable (TM 10-3930-669-20).
- Install cab (TM 10-3930-669-20).
- Install air cleaner assembly (TM 10-3930-669-20).
- Fill transmission with oil (LO 10-3930-669-12).
- Fill engine with oil (LO 10-3930-669-12).
- Remove wheel chocks (TM 10-3930-669-10).
- Mast pivoted closed (TM 10-3930-669-10).

END OF TASK

3-4. CRANKCASE REPAIR.

This task covers:

- a. Disassembly
- b. Cleaning/Inspection
- c. Repair
- d. Assembly

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Gauge, Dial, Bore, Cylinder (Item 5, Appendix E)
- Gauge, Tightening (Item 22, Appendix E)
- Insert and Remover (Item 32, Appendix E)
- Installing Tool, Oil Nozzle (Item 33, Appendix E)
- Micrometer (Item 5, Appendix E)
- Refacing Device (Item 5, Appendix E)
- C-Clamp (Item 5, Appendix E)

Materials/Parts

- Compound, Sealing (Item 24, Appendix B)
- Rags, Wiping (Item 19, Appendix B)
- Solvent, Drycleaning (Item 20, Appendix B)
- Ink, Marking

Materials/Parts - Continued

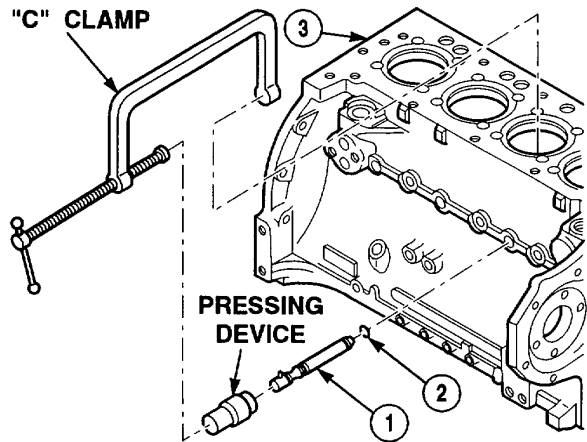
- Nozzles, Oil (4)
- Packing, Preformed (4)
- Plug (2)
- Plug (3)
- Plug (5)
- Washer

Equipment Condition

- Cylinders removed (Para 3-7)
- Oil pan removed (Para 3-8)
- Oil pump removed (Para 3-12)
- Idler gear removed (Para 3-11)
- Pistons and connecting rods removed (Para 3-13)
- Crankshaft removed (Para 3-14)
- Camshaft removed (Para 3-16)

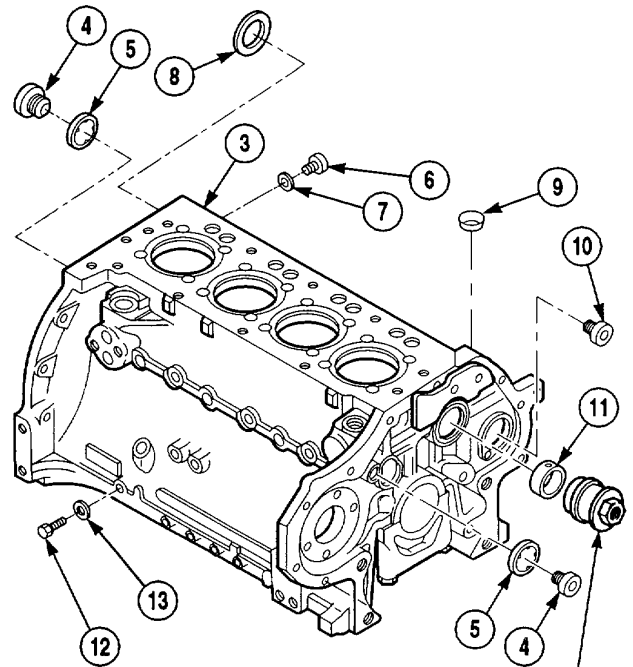
a. Disassembly.

- (1) Remove four oil nozzles (1) and preformed packings (2) from crankcase (3) as follow:
 - (a) Using a 10-inch "C" clamp, position clamp through cylinder port and external crankcase. Turn screw press to slowly remove each oil nozzle and preformed packing.
 - (b) Discard oil nozzles and preformed packings.



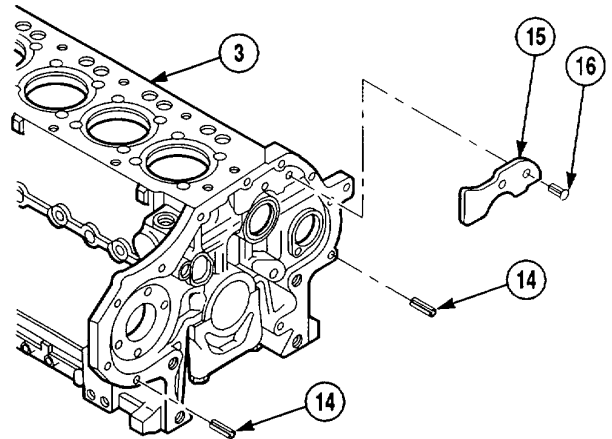
3-4. CRANKCASE REPAIR (CONT).

- (2) Remove two screws (4), washers (5) from crankcase (3). Discard plugs.
- (3) Remove five screws (6) and washers (7) from crankcase (3).
- (4) Remove three plugs (8, 9, and 10) from crankcase (3). Discard plugs.
- (5) Using inserter and remover, remove bearing bushings (11) from crankcase (3).
- (6) Remove plug (12) and washer (13) from crankcase (3). Discard plug and washer.



INSERTER AND REMOVER

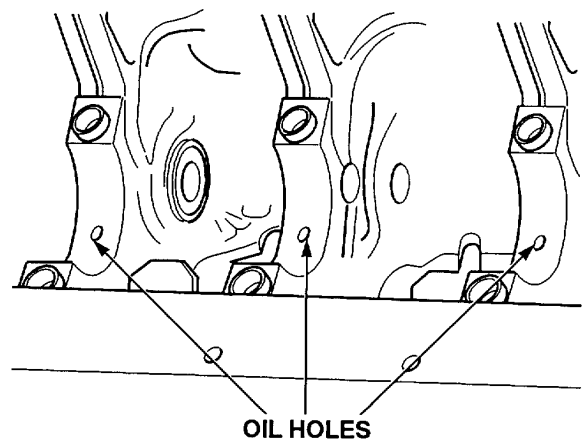
- (7) Remove two dowel sleeves (14), plate (15), and two pins (16) from crankcase (3).



b. Cleaning/Inspection.**WARNING**

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.). Failure to comply may result in injury or death to personnel.

- (1) Clean all parts with dry-cleaning solvent. Thoroughly wash out oil ways. Dry with compressed air.
- (2) Clean tapped holes for lifting eyes and cylinder head screws in crankcase by running down a tap. A greased tap should be used for blind holes.
- (3) Inspect crankcase for cracks. Replace cracked crankcase.
- (4) Blow clean compressed air through oil nozzle and bushing oil holes.



- (5) Clean all tapped holes in crankcase by running down a tap. A greased tap should be used for blind holes.
- (6) Inspect bearing bushings for galling or excessive wear. Replace defective bushings.

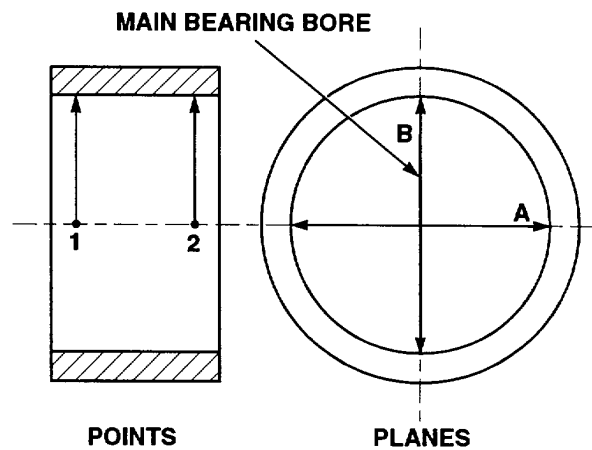
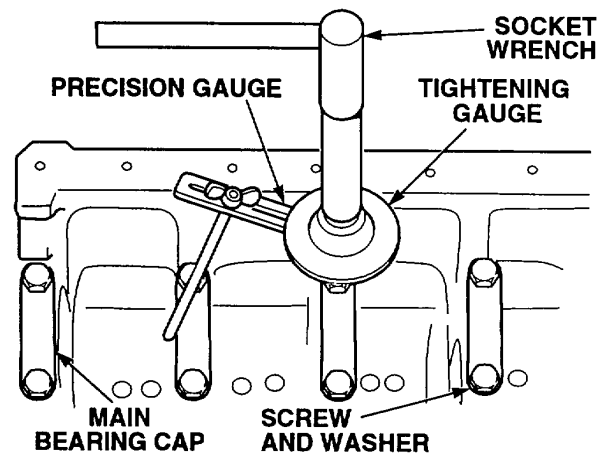
3-4. CRANKCASE REPAIR (CONT).

c. Repair.**NOTE**

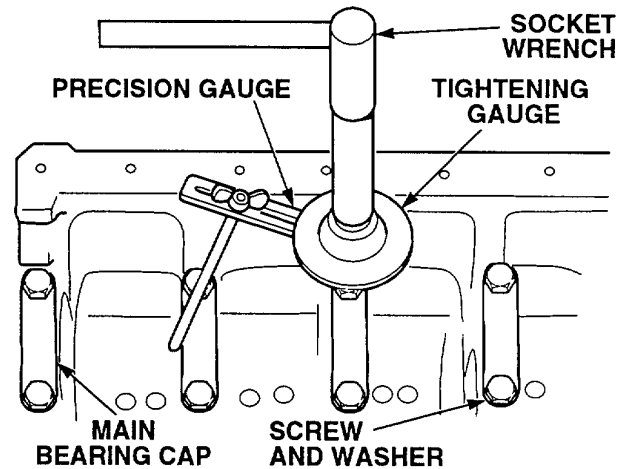
Main bearings are of thin-shell type. Their proper installation requires that webs in crankcase be in alignment and for bearing bores to be preloaded. No attempt should be made to adjust or recondition bearing shells.

(1) Check preloading of bearing bores as follows:

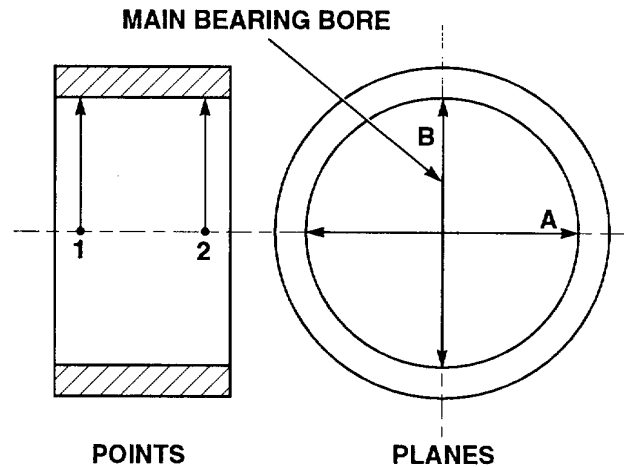
- (a) Position and install main bearing caps, washers, and screws making sure that their identification numbers match with those stamped in crankcase. Using a tightening gauge, torque screws in accordance with instructions given in Appendix D, Table D-1.
- (b) Using a precision gauge, set gauge to 2.933 inches (74.50 mm).
- (c) Measure each main bearing bore at points 1 and 2 in plane "a," and in plane "b" offset by 90 degrees.
- (d) If main bearing bore measurement is between 2.933 inches (74.50 mm) and 2.934 inches (74.519 mm), respective bearing is in acceptable condition and required preload will be obtained when bearing halves are installed.
- (e) If main bearing bore measurement is not between 2.933 inches (74.50 mm) and 2.934 inches (74.519 mm), repeat measurements with new bearing halves installed.
- (f) Insert new main bearings.



- (g) Position and install main bearing caps, washers, and screws. Preload and torque screws in accordance with instructions given in Appendix D, Table D-1.



- (h) Using a precision gauge, set gauge to nominal inside diameter of crankshaft main bearing bore (2.7574 inches (70.0400 mm)).
- (i) Measure each main bearing bore at points 1 and 2 in vertical and horizontal positions "a" and "b."
- (j) If main bearing bore measurements are between 2.7574 inches (70.0400 mm) and 2.7582 inches (70.0600 mm), crankcase is acceptable for further use. If not, notify supervisor.

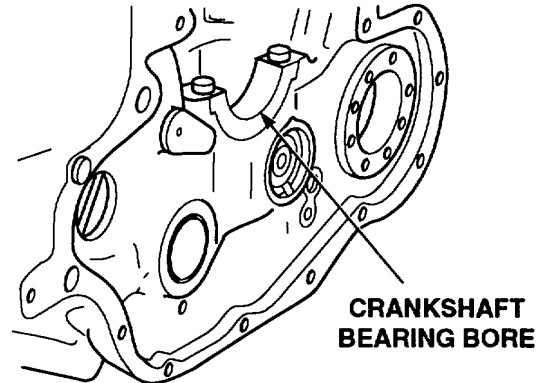


- (2) Check main bearing housing for alignment as follows:
 - (a) Remove main bearing screws, washers, and caps.
 - (b) Coat main crankshaft journals with marking ink.
 - (c) Position crankshaft in crankcase and install main bearing caps, washers, and screws according to numbering. Torque screws in accordance with instructions given in Appendix D, Table D-1.

3-4. CRANKCASE REPAIR (CONT).**NOTE**

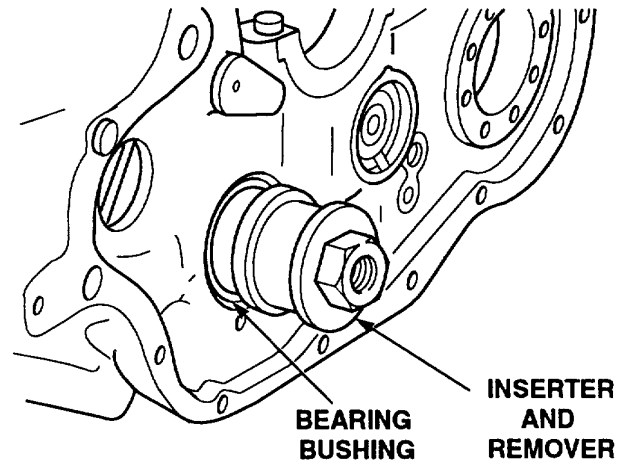
- If all bearings have a uniform contact pattern, bearings are in alignment.
- Do not bore out individual bearings.

- (d) Rotate crankshaft. Remove screws, washers, bearing caps, and crankshaft. If bearing bores are in alignment, there will be an even pattern of marking by crankshaft in all bearing bores. If bearing bores require alignment, bores must be line-bored.



(3) Using an inside micrometer, measure camshaft bearing bores of crankcase. Bore should be 1.8890 to 1.8911 in. (47.9800-48.0340 mm). If bores are more than 1.8890 to 1.8911 in. (47.9800-48.0340 mm), replace camshaft bearings as follows:

- Install shorter, small-diameter thrust piece (part of inserter and remover) on front end of camshaft bore.
- Install end support (part of inserter and remover) at next camshaft bore.
- Pull bearing bushing out towards flywheel end.

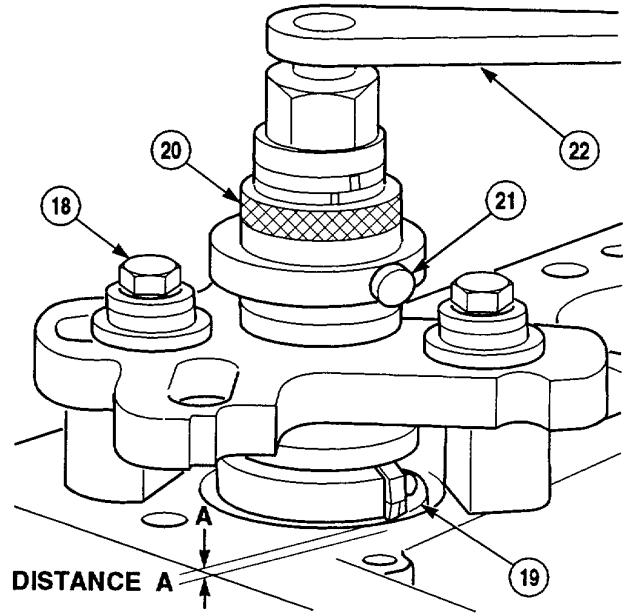
**CAUTION**

Failure to align bearing/bushing oil holes with crankcase oil hole will result in severe damage.

- Align new camshaft bearing bushing so oil holes in bushing coincide with those in crankcase.
- Using inserter and remover, press new bearing bushing into crankcase. Install bushing flush with front end of crankcase.
- Clean crankcase thoroughly.

(4) Check cylinder liner seating on crankcase surface and feel for any evidence of roughness. Seating surface must be level and free from grooves. If cylinder liner seat is not level and free of grooves, repair liner(s) as follows:

- (a) Using a wiping rag, clean seating area and remove paint residues.
- (b) Center refacing device and tighten screws (18).
- (c) Withdraw centering finger and slide tool holder (19) out to diameter of cylinder seating face.



CAUTION

- **DO NOT turn spindle counterclockwise when reworking surface or refacing device will be damaged.**
 - **Adjust feed carefully. A full turn (360°) of knurled nut feeds tool holder 0.059 inch (1.5 mm).**
- (d) Using knurled nut (20), turn spindle of turning device clockwise and adjust tool holder (19) specified amount of liner face to be reworked.
 - (e) Move tool holder (19) toward middle of bore.
 - (f) Using knurled nut (20), set tool over and slightly beyond distance "A" to permit satisfactory refacing.
 - (g) After adjusting tool, tighten setscrew (21).

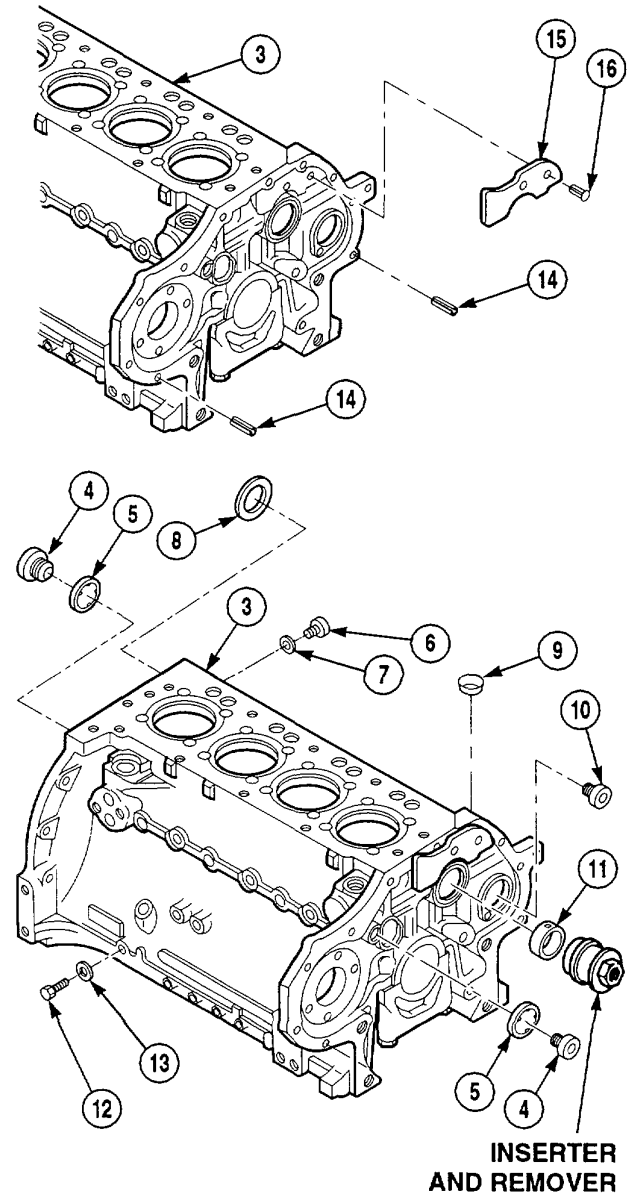
NOTE

- **Selected cutting depth should not exceed 0.008 inch (0.2 mm). This feed corresponds to a 1/8th turn (45°) of knurled nut. Less feed per cut will produce a better surface.**
 - **Resurfacing cut should not exceed the cylinder height of 5.405 in. (137.7 mm).**
- (h) Turn spindle (22) to rework seating area until smooth and/or flush with top of crankcase surface.
 - (i) Set back tool holder and remove refacing device.
 - (j) Clean crankcase thoroughly.

3-4. CRANKCASE REPAIR (CONT).

d. Assembly.

- (1) Install plate (15) in crankcase (3) with two pins (16).
- (2) Install two dowel sleeves (14) in crankcase (3).
- (3) Install washer (13) and plug (12) in crankcase (3).
- (4) If bearing bushings (11) were not replaced, install bushings in crankcase (3) using inserter and remover tool.
- (5) Install plugs (8, 9, and 10) in crankcase (3). Plugs may require using a pressing device.
- (6) Install five washers (7) and screws (6) in crankcase (3).
- (7) Install two washers (5) and plugs (4) in crankcase (3).



- (8) Apply sealing compound to preformed packings (2).

NOTE

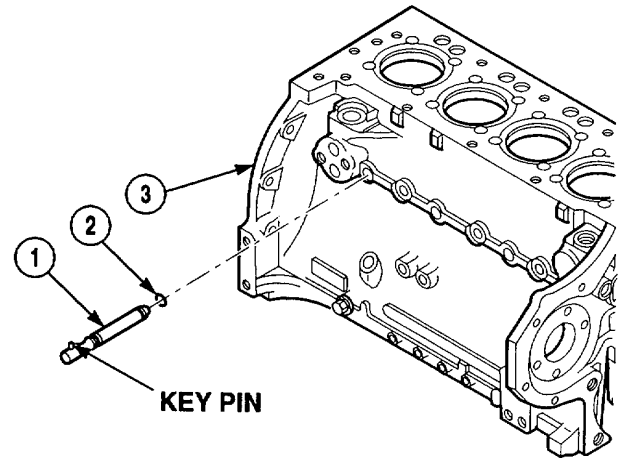
When installing oil nozzles, ensure key pin is facing in the up position.

- (9) Install four oil nozzles (1) and preformed packings (2) in crankcase (3).

NOTE

Follow-on Maintenance:

- Install camshaft (Para 3-16).
- Install crankshaft (Para 3-14).
- Install pistons and connecting rods (Para 3-13).
- Install idler gear (Para 3-11).
- Install oil pump (Para 3-12).
- Install oil pan (Para 3-8).
- Install cylinders (Para 3-7).



END OF TASK

3-5. CYLINDER HEAD ASSEMBLY REPLACEMENT.

This task covers:

- a. Removal
- b. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanics: Automotive
(Item 1, Appendix E)
Spring, Compressor (Item 21, Appendix E)
Wrench, Torque (0-60 N•S)

(Item 5, Appendix E)

Materials/Parts

Wrench, Torque (0 to 175 lb-ft [0-237 N•S])
(Item 5, Appendix E)
Gage Tightening (Item 22, Appendix E)

Fuel lines removed

Compound, Sealing (Item 24, Appendix B)
Grease, Automotive and Artillery,
(Item 13, Appendix B)
Lubricating Oil (Item 15, Appendix B)
Intermediate Ring
Packing, Preformed (2)
Packing, Preformed (4)

Equipment Condition

Engine OFF (TM 10-3930-669-10)
Parking brake applied (TM 10-3930-669-10)
Wheels chocked (TM 10-3930-669-10)
Blower ducting removed (Para 6-2)

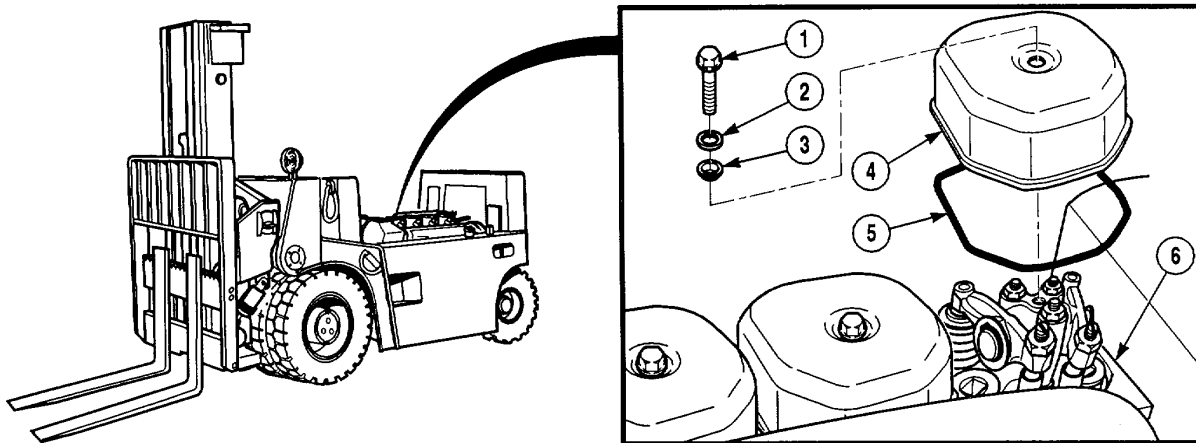
Muffler removed (TM 10-3930-669-20)

Exhaust manifold removed (Para 5-2)
Intake manifold removed (Para 4-2)
Fuel return lines removed (TM 10-3930-669-20)

(TM 10-3930-669-20)

Injector removed (TM 10-3930-669-20)
Glow plug removed (TM 10-3930-669-20)

a. Removal



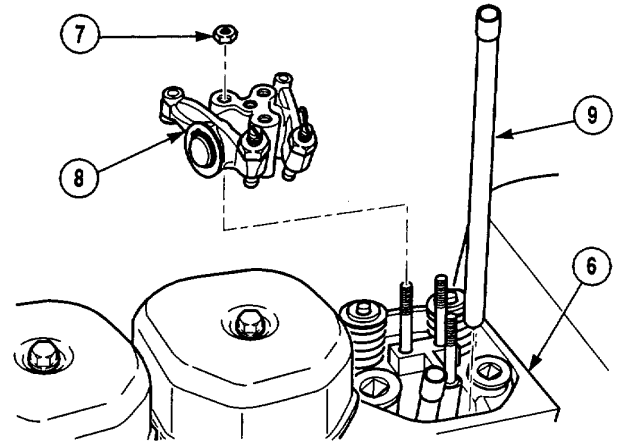
NOTE

Cylinder No. 1 is shown. All cylinders are removed the same way.

- (1) Remove screw (1), washer (2), washer (3), rocker cover (4), and gasket (5) from cylinder head (6). Discard gasket.

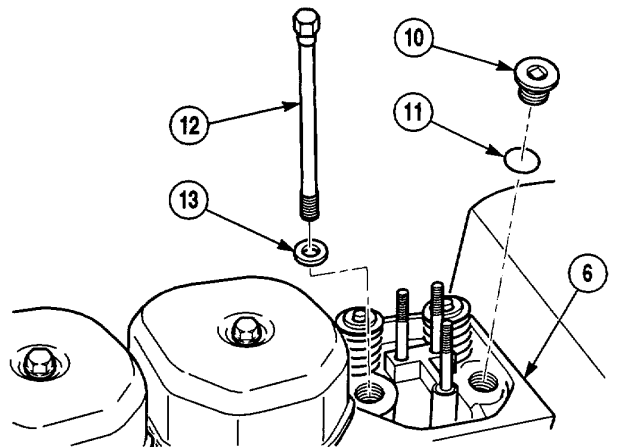
(2) Remove three nuts (7) and rocker arm assembly (8) from cylinder head (6).

(3) Remove two pushrods (9) from cylinder head (6).



(4) Remove two plugs (10) and preformed packings (11) from cylinder head (6). Discard preformed packings.

(5) Remove four screws (12) and washers (13) from cylinder head (6).



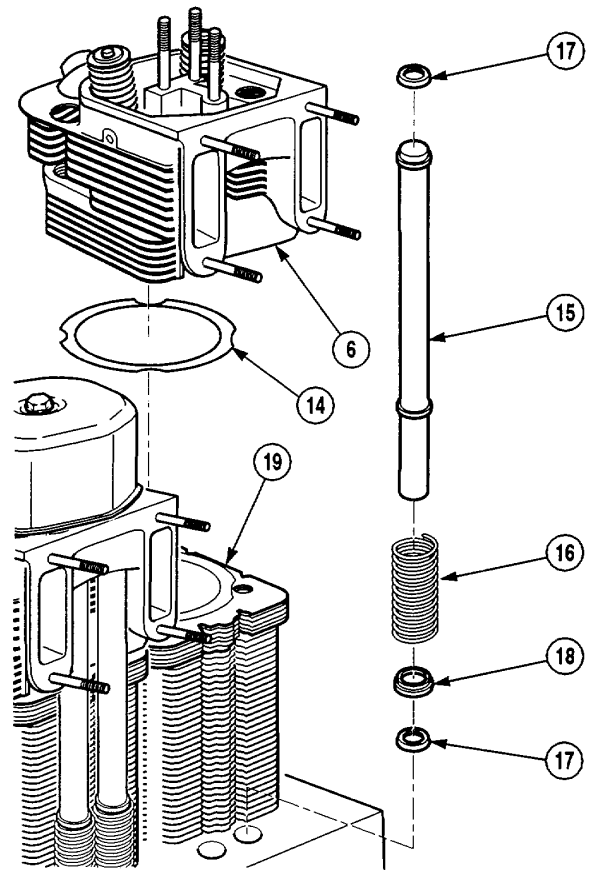
3-5. CYLINDER HEAD ASSEMBLY REPLACEMENT (CONT).**WARNING**

Use care when removing springs. A compressed spring can act as a projectile when released and could cause severe injury.

CAUTION

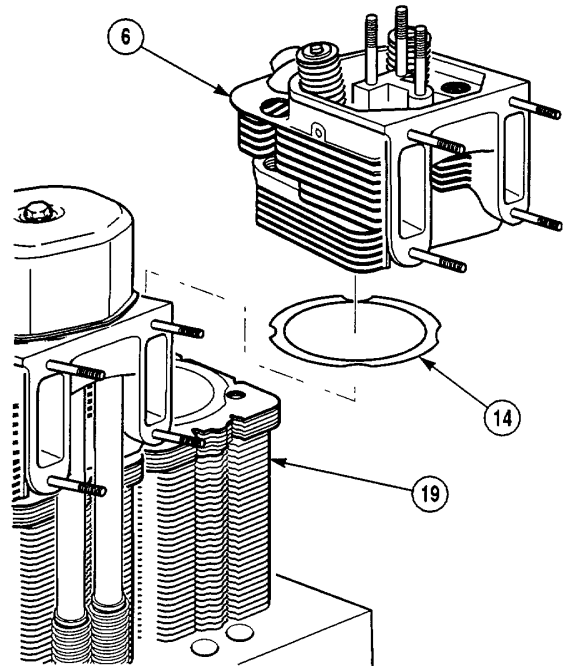
Remove cylinder head slowly to prevent damage to pushrod cover tubes.

- (6) Remove cylinder head (6), intermediate ring (14), two pushrod cover tubes (15), compression springs (16), four preformed packings (17), and two caps (18) from cylinder (19). Discard intermediate ring and preformed packings.

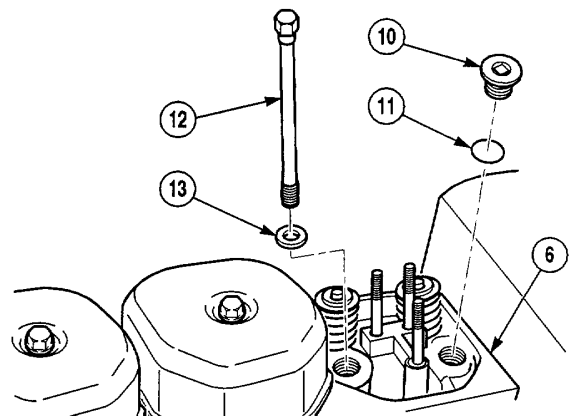


b. Installation.

- (1) Apply a light coat of grease to intermediate ring (14) and position on cylinder head (6).
- (2) Position cylinder head (6) on cylinder (19).



- (3) Apply a light coat of oil to threads of four screws (12) and install screws and washers (13) in cylinder head (6). Preload four screws to 30 lb-ft (40 N•m). Tighten screws (see Appendix D).
- (4) Install two preformed packings (11) and plugs (10) in cylinder head (6). Tighten plugs to 59 to 66 lb-ft (80-90 N•m).



3-5. CYLINDER HEAD ASSEMBLY REPLACEMENT (CONT).

WARNING

Use care when installing springs. Springs are under compression tension and can act as projectiles when released and could cause sever injury.

NOTE

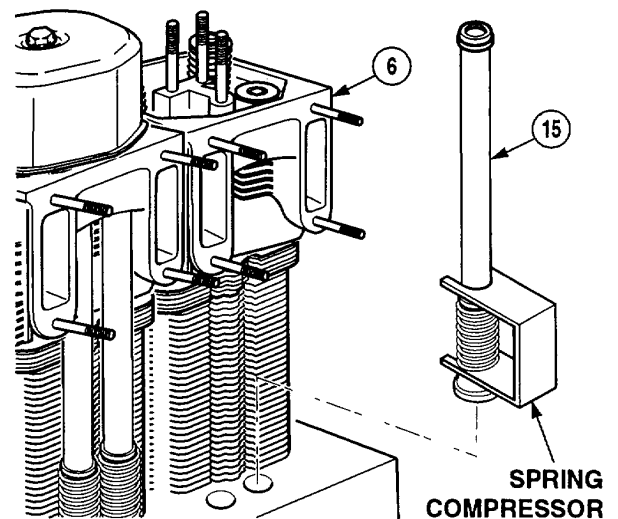
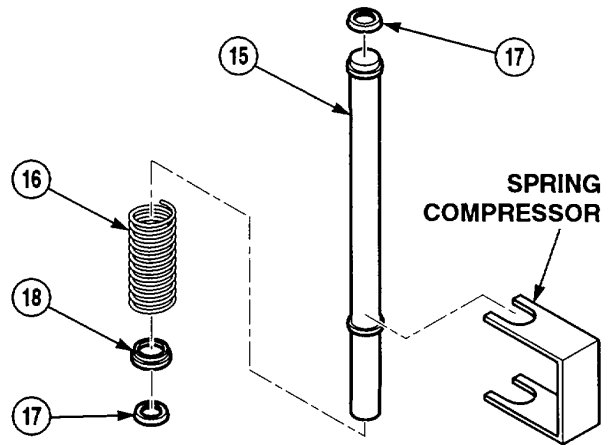
Pushrod cover tubes are installed one at a time. Both are installed the same way.

- (5) Position compression spring (16) on pushrod cover tube (15) and compress spring with spring compressor.
- (6) Position two preformed packings (17) and cap (18) on pushrod cover tube (15).

NOTE

Position pushrod cover tube into the crankcase first, then into the cylinder head for easy installation.

- (7) Install pushrod cover tube (15) in cylinder head (6) and remove spring compressor.



NOTE

Ensure pushrods are properly seated upon installation.

- (8) Position pushrods (9) in cylinder head (6).

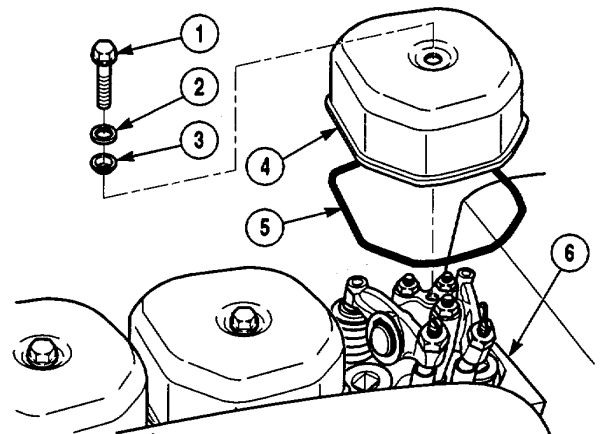
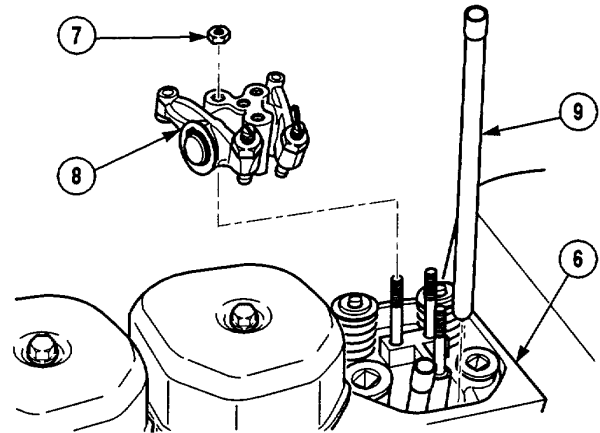
NOTE

After rocker arm assembly is installed, adjust valve clearance (TM-10-3930-669-20), then continue with Step (10) of cylinder head assembly in this paragraph.

- (9) Install rocker arm assembly (8) with three nuts (7) on cylinder head (6). Tighten nuts to 21 lb-ft (28 N•m).
- (10) Apply sealing compound to gasket (5) and position on cylinder head (6).
- (11) Install rocker cover (4) and gasket (5) on cylinder head (6) with washer (3), washer (2), and screw (1). Tighten screw 7 lb-ft (10 N•m).

NOTE**Follow-on Maintenance:**

- Install fuel lines (TM-10-3930-669-20).
- Install fuel return lines (TM-10-3930-669-20).
- * Install intake manifold (Para 4-2).
- Install exhaust manifold (Para 5-2).
- Install muffler (TM-10-3930-669-20).
- Install blower ducting (Para 6-2).
- Install injector (TM 10-3930-669-20).
- Install glow plug (TM 10-3930-669-20).
- Remove wheel chocks (TM- 10-3930-669-10).



END OF TASK

3-6. CYLINDER HEAD REPAIR.

This task covers:

- a. Disassembly
- b. Cleaning/Inspection
- c. Repair
- d. Assembly

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanics: Automotive (Item 1, Appendix E)
- Compressor, Valve Spring (Item 23, Appendix E)
- Depth Gauge (Item 5, Appendix E)
- Drill (Item 5, Appendix E)
- Fixture, Lathe (Item 5, Appendix E)
- Micrometer (Item 5, Appendix E)
- Stud Remover (Item 5, Appendix E)
- Stone, Abrasive (Item 5, Appendix E)
- Mandrel, Exhaust (Item 24, Appendix E)
- Mandrel, Intake (Item 25, Appendix E)

Tools and Special Tools - Continued

- Cutter, Valve Seat (Item 26, Appendix E)
- Reamer, Hand (Item 27, Appendix E)
- Reamer, Hand (Item 28, Appendix E)
- Punch Valve Guide (Item 29, Appendix E)

Material/Parts

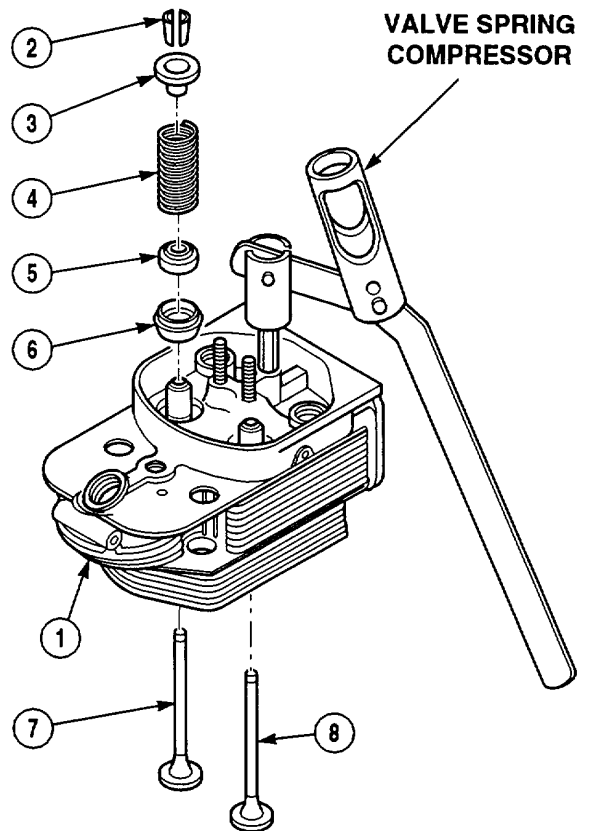
- Rags, Wiping (Item 19, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)
- Seals, Valve Stem (2)

Equipment Condition

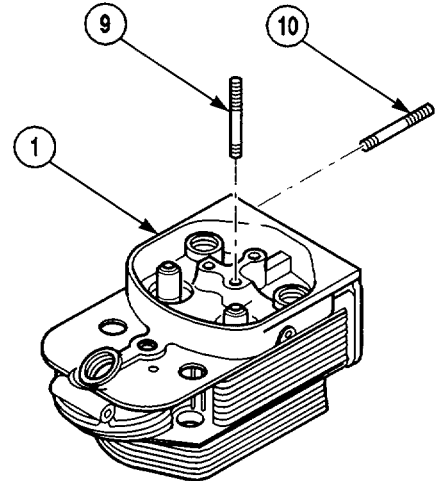
Cylinder head removed (Para 3-5)

a. Disassembly.

- (1) Place cylinder head (1) on clean surface.
- (2) Using valve spring compressor, remove two valve spring keepers (2), spring caps (3), springs (4), valve stem seals (5), valve rotators (6), and inlet and exhaust valves (7 and 8) from cylinder head (1). Discard valve stem seals.



- (3) Remove three studs (9) from cylinder head (1).
- (4) Remove four studs (10) from cylinder head (1).



b. Cleaning/Inspection.

WARNING

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
- **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**

- (1) Clean parts in dry-cleaning solvent. Dry parts using clean wiping rag.
- (2) Inspect cylinder head for external damage or cracks. Replace cylinder head if damaged or cracked.
- (3) Inspect cylinder head parts for defects. Replace defective parts.

3-6. CYLINDER HEAD REPAIR (CONT).

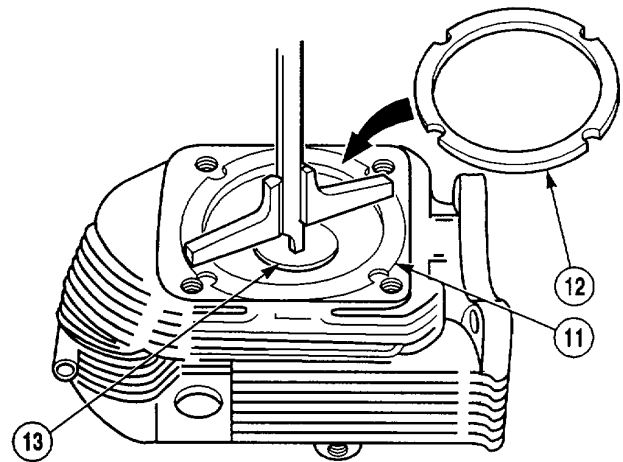
c. Repair.**CAUTION**

Perform all inspections before beginning repairs. Do not reheat cylinder head. Too much heating may warp head.

NOTE

- Use the following procedure to make sure cylinder head seating surface is flat and square.
- Remove as little material as possible to achieve a perfect sealing surface.

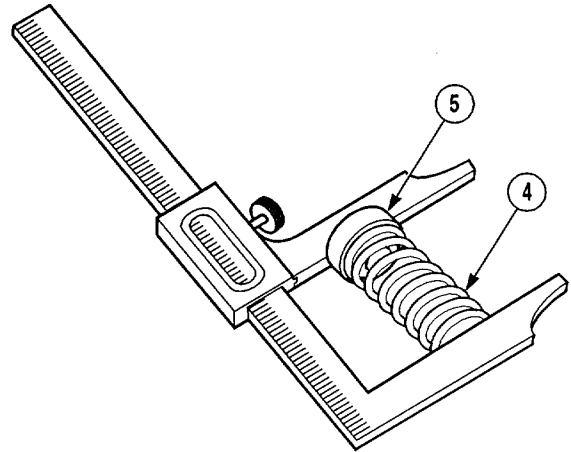
- (1) Check cylinder head seating surface (11). Surface must be flat and square. Minor damage to seating surface can be removed by grinding cylinder head on cylinder with abrasive stone.
- (2) If cylinder head seating surface (11) is more severely damaged, replace cylinder head (Para 3-5).

**NOTE**

- Use the following procedure to make sure valve springs, valve rotators, spring caps, valves, and valve seats are within specification.
- Measurement must be made with intermediate ring inserted.

- (3) Inspect intermediate ring (12). Replace if damaged.
- (4) After refacing cylinder head seating surface (11), measure clearance between cylinder head bottom and cylinder head seating surface. If measured value is not between 0.2323 in. (5.9000 mm) and 0.2519 in. (6.4000 mm), replace valve seats (13).
- (5) Inspect valve seats (13). Measure distance between crown of valve and cylinder head seating surface (11). If measured distance is not between 0.2000 in. (5.0800 mm) and 0.2205 in. (5.6000 mm), replace valve seats.

- (6) Fit valve stem seals (5) and, using a micrometer, measure valve spring (4) length. If measured value is not between 2.2047 inch (56.0000 mm) and 2.3976 inch (60.9000 mm), replace valve springs.

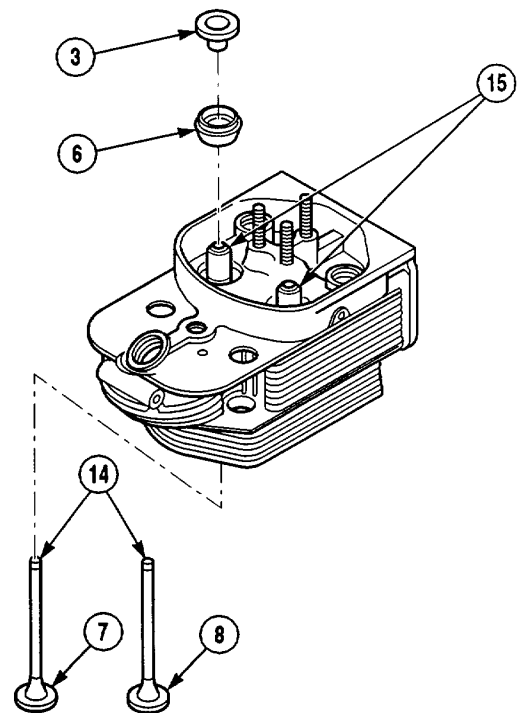


- (7) Inspect valve rotators (6) and spring caps (3) for damage. Make sure valve rotators work freely. Replace valve rotators and spring caps if damaged.

- (8) Inspect inlet and exhaust valves (7 and 8) for cracks and pits. Replace as required. Reface valves if required and inspect to tolerances specified in Table 3-1.

- (9) Check clearance of valve stems (14) in valve guides (15) of inlet and exhaust valves (7 and 8). If clearance exceeds 0.0059 in. (0.1500 mm) for inlet valve or 0.0079 in. (0.2000 mm) for exhaust valve, replace guides.

- (10) Check inner diameter clearance of valve guides (15) (pressed in). If inner diameter clearance exceeds 0.3155 in. (8.0150 mm), replace valve guides.



3-6. CYLINDER HEAD REPAIR (CONT).**NOTE**

- Use the following procedure to replace valve seats and valve guides.
- Mandrels come in two sizes; one to fit exhaust valve seat and the other to fit intake valve seat.

- (11) Place mandrel on valve seat (13) and insert guide through mandrel into valve guide (15). Tighten guide so that mandrel is firmly in place.

CAUTION

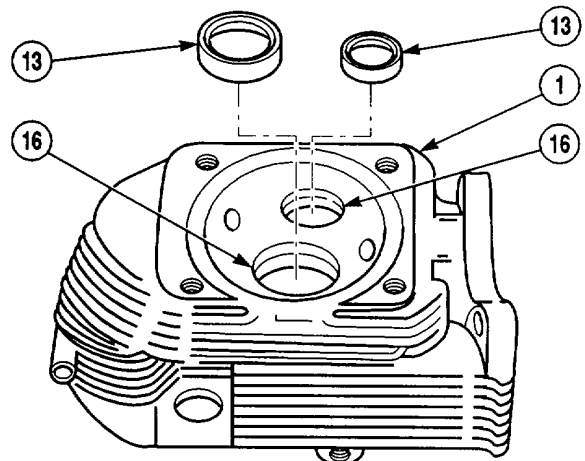
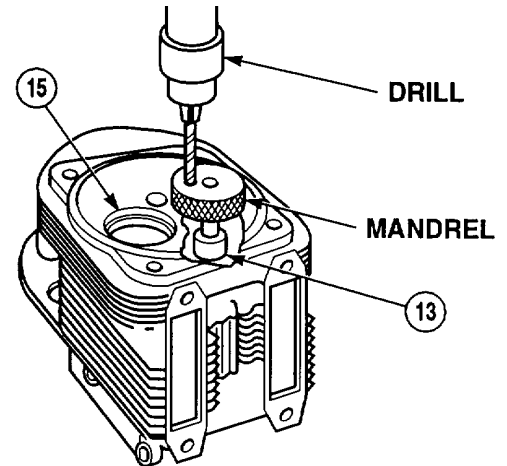
Do not drill into cylinder head.
Damage to equipment may result.

- (12) Insert drill into mandrel and drill through valve seat (13) at two positions 180 degrees apart.
- (13) Remove guide and mandrel.
- (14) Carefully remove and discard drilled seat (13) from cylinder head (1).
- (15) Measure diameter of valve seat bore (16) in cylinder head (1).

NOTE

Intake valve seat has a larger outside diameter than exhaust valve seat.

- (16) Measure outside diameter of new valve seat (13). Subtract diameter of bore (16) from diameter of seat. Difference must not be less than 0.003 inch (0.076 mm).

**CAUTION**

Heating cylinder head for longer than 30 minutes or at a higher temperature than 430°F (220° C) may cause head to warp.

- (17) Heat cylinder head (1) in oven uniformly to a temperature of 430° F (220° C). Do not heat for more than 30 minutes.

WARNING

Exercise care when working around hot cylinder head. Wear gloves. Severe burns can result if protective measures are not taken.

- (18) Remove cylinder head (1) from oven.

NOTE

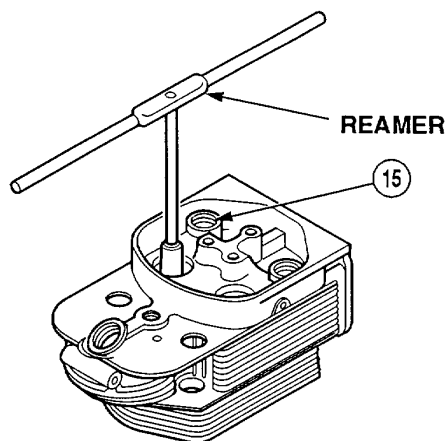
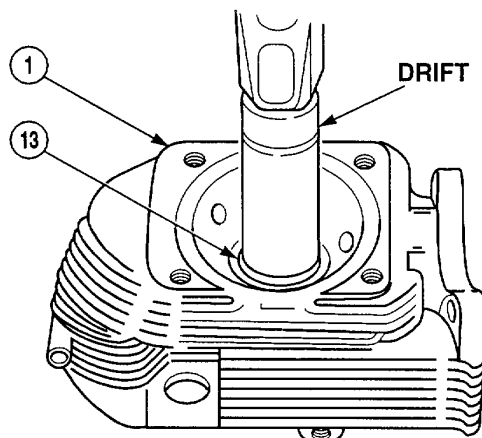
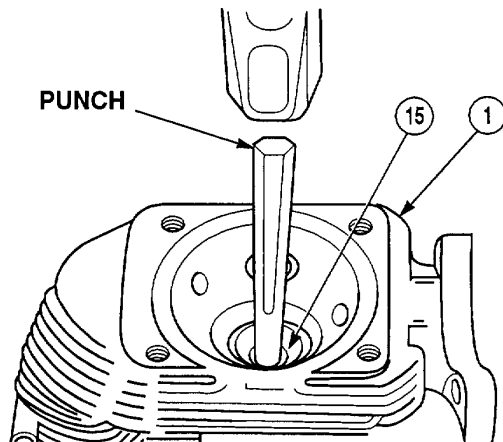
Replace valve guides in need of replacement at this time.

- (19) Insert punch into chamber side of valve guide (15) and drive guide out of cylinder head (1).

- (20) Place new valve seat (13) on drift with chamfered side up and drive seat into recess of cylinder head (1). Ensure that seat is fully inserted.

- (21) Position new locating ring on valve guide (15) and drive longer end of guide into bore from rocker arm side. Drive in until locating ring seats in guide bore.

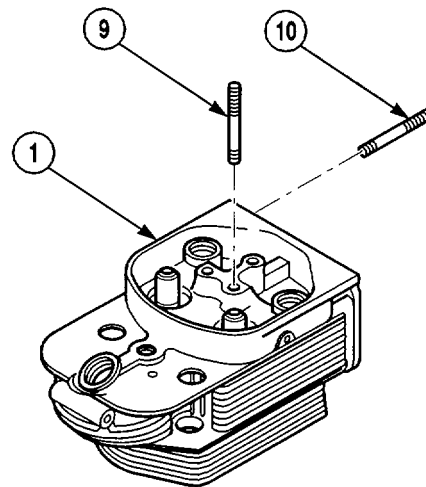
- (22) After head cools, ream valve guides (15) using special 8.0000 mm (0.3149 in.) reamer.



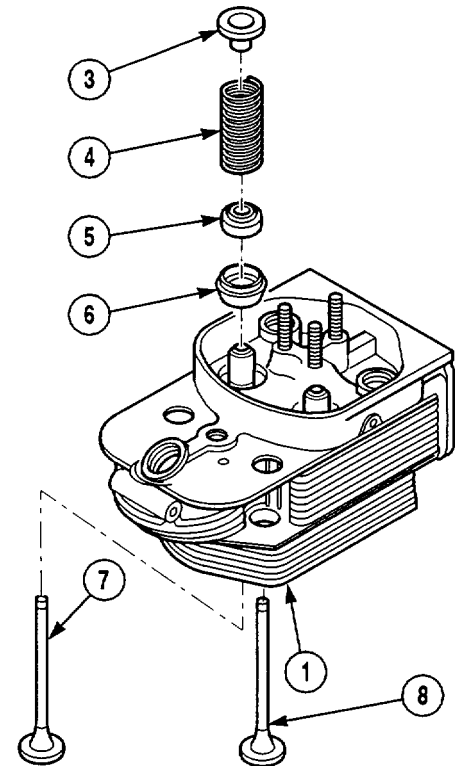
3-6. CYLINDER HEAD REPAIR (CONT).

d. Assembly.

- (1) Install four studs (10) in cylinder head (1).
- (2) Install three studs (9) in cylinder head (1).



- (3) Position inlet and exhaust valves (7 and 8), two valve rotators (6), valve stem seals (5), springs (4), and spring caps (3) in cylinder head (1).



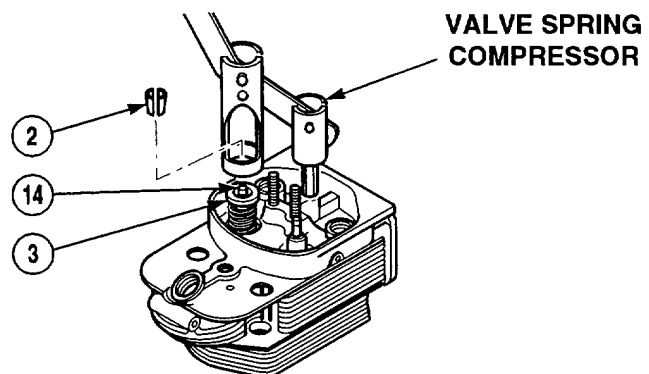
- (4) Using valve spring compressor, install two valve spring keepers (2) in spring caps (3) to lock in valve stems (14).

NOTE

Follow-on Maintenance:

- Install cylinder head (Para 3-5).

END OF TASK



3-7. CYLINDER REPLACEMENT.

This task covers:

- a. Removal b. Installation

INITIAL SETUP*Tools and Special Tools*

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)
Compressor, Piston Ring
(Item 20, Appendix E)

Equipment Condition

Cylinder head removed (Para 3-5)

Materials /Parts

Grease, Automotive and Artillery
(Item 13, Appendix B)
Lubricating Oil (Item 15, Appendix B)
Shim (3)

a. Removal.**CAUTION**

Ensure that piston will not tilt over and hit engine block after removal of cylinder, or damage to piston may occur.

NOTE

All four cylinders are removed the same way. No. 1 cylinder shown.

- (1) Remove cylinder (1) from engine block (2), and place two wooden blocks under piston (3).
- (2) Remove shims (4) from cylinder (1).Discard shims.

b. Installation.

NOTE

- Piston crown clearance is 0.0398 to 0.0472 (1 to 1.2 mm).
- Adjust clearance by shims, 0.2 mm, 0.5 mm, 0.8 mm, or 1.0 mm. Keep the number of shims in the stack to an absolute minimum.

- (1) Apply light coat of grease to shims (4), and install on cylinder (1).
- (2) Apply light coat of oil on piston rings (5).
- (3) Position ring compressor over piston rings (5) on piston (3) and compress rings.

NOTE

Be sure to align cylinder on the engine block so recessed fins on cylinder align with tappet bores.

- (4) Position cylinder (1) on piston (3). Remove ring compressor.

NOTE

After installation of cylinder, be sure to align with adjacent cylinders.

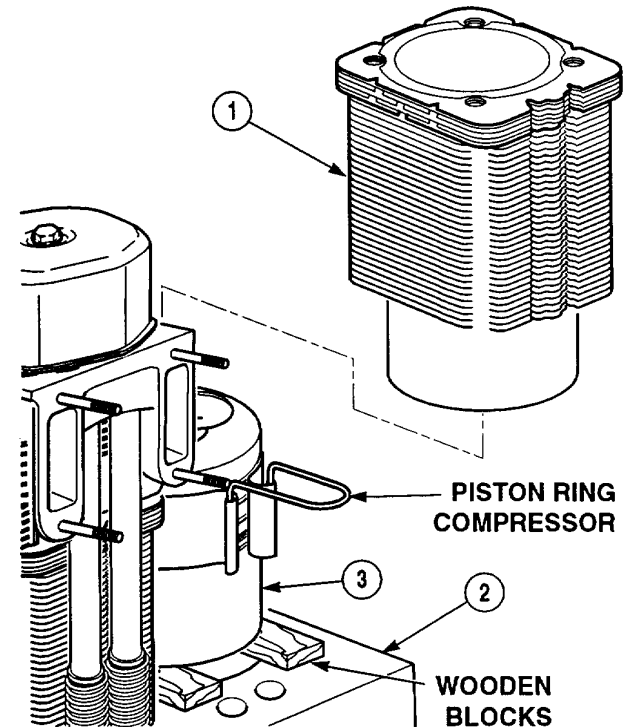
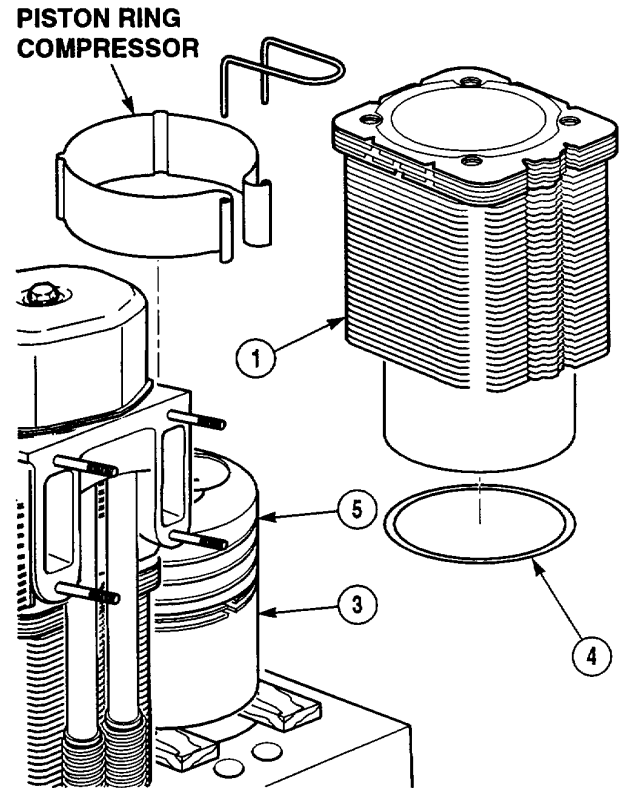
- (5) Remove two wooden blocks from under piston (3) and install cylinder (1) in engine block (2).

NOTE

Follow-on Maintenance:

- Install cylinder head (Para 3-5).

END OF TASK



3-8. ENGINE OIL PAN REPLACEMENT.

This task covers:

- a. Removal b. Cleaning/Inspection c. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)

Equipment Condition

Transmission removed (Para 8-3)

Materials/Parts

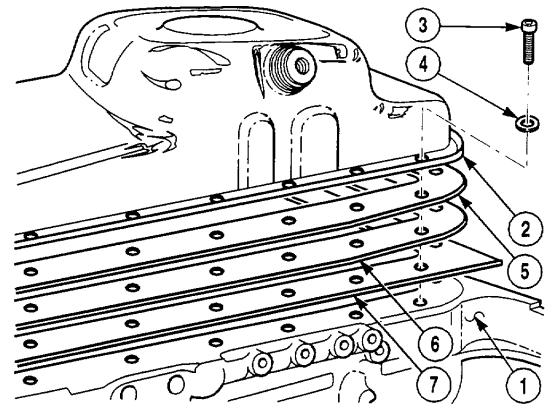
Compound, Sealing (Item 24, Appendix B)
Solvent, Dry-cleaning (Item 20, Appendix B)
Gasket
Gasket

a. Removal.

NOTE

Engine must be attached to stand prior to performing procedure.

- (1) Rotate engine (1) until oil pan (2) is on top.
- (2) Remove twenty-one screws (3) and washers (4) from oil pan (2).
- (3) Remove oil pan (2), gasket (5), intermediate plate (6), and gasket (7) from engine (1). Discard gaskets.



b. Cleaning/Inspection.

WARNING

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.). Failure to comply may result in injury or death to personnel.

- (1) Clean all metal parts with dry-cleaning solvent.
- (2) Inspect all parts for cracks or damage.
- (3) Replace all damaged parts.

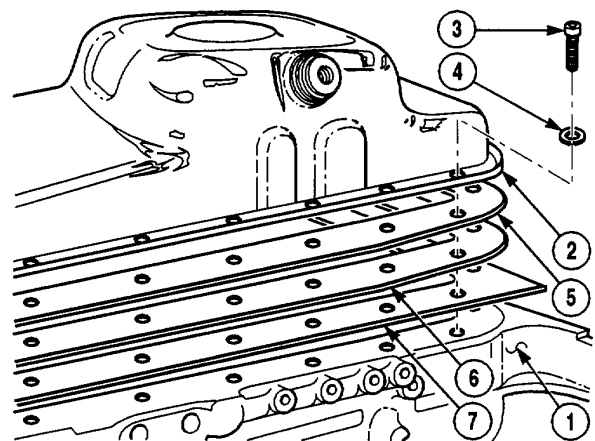
c. **Installation.****WARNING**

Adhesive sealant MIL-S-46163 can damage your eyes. Wear safety goggles/glasses when using; avoid contact with eyes. If sealant contacts eyes, flush eyes with water and get immediate medical attention.

- (1) Apply sealing compound to all gasket mating surfaces and position gasket (7), intermediate plate (6) and gasket (5) on engine (1).
- (2) Install oil pan (2) on engine (1) with twenty-one washers (4) and screws (3).
- (3) Rotate engine (1) until oil pan (2) is on bottom.

NOTE**Follow-on Maintenance:**

- Install transmission (Para 8-3).

END OF TASK

3-9. CRANKSHAFT PULLEY VIBRATION DAMPER REPLACEMENT.

This task covers:

- a. Removal
- b. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit General Mechanic's: Automotive
(Item 1 Appendix E)
Wrench, Torque (0-60 N.m)
(Item 5, Appendix E)
Retainer (Item 13, Appendix E)

Equipment Condition

Engine/Transmission assembly removed
(Para 3-3)
Blower belt tensioner removed
(TM 10-3930-669-20)
Alternator belts removed (TM 3930-669-20)

a. Removal

NOTE

Crankshaft pulley screw has left-hand threads.

- (1) Install retainer No. 030 1107 on crankshaft pulley (1) and remove screw (2) and washer (3).
- (2) Remove crankshaft pulley (1) from front cover (4).
- (3) Remove eight screws (5), washers (6), and vibration damper (7) from crankshaft pulley (1).

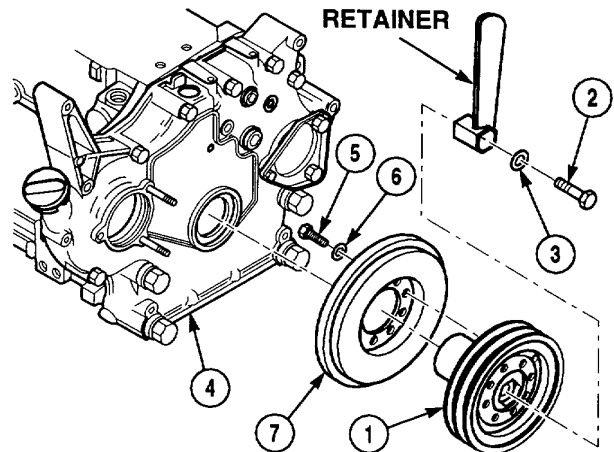
b. Installation.

- (1) Install vibration damper (7) on crankshaft pulley (1) with eight washers (6) and screws (5).
- (2) Install crankshaft pulley (1) on front cover (4) with washer (3) and screw (2). Preload screw 36.9 lb-ft (50 N-m). Tighten screw (see Appendix D).

NOTE

Follow-on Maintenance:

- Install engine/transmission assembly (Para 3-3).
- Install blower belt tensioner (TM 10-3930-669-20).
- Install alternator belts (TM 3930-669-20).



END OF TASK

3-10. ENGINE FRONT COVER REPLACEMENT/REPAIR.

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning/Inspection
- d. Assembly
- e. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)

Materials/Parts

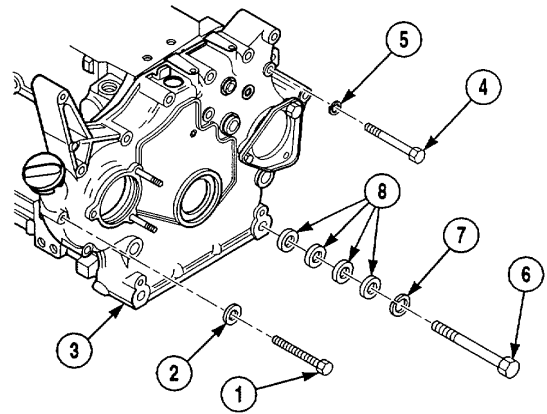
Solvent, Dry-cleaning (Item 20, Appendix B)
Compound, Sealing (Item 24, Appendix B)
Gasket
Packing, Preformed
Packing, Preformed
Packing, Preformed
Packing, Preformed
Washer, Lock (4)
Washer, Lock (4)
Washer, Lock

Equipment Condition

Alternator removed (TM-10-3930-669-20)
Alternator bracket removed
(TM- 10-3930-669-20)
Blower removed (TM-10-3930-669-20)
Crankshaft pulley removed (Para 3-9)
Injection pump removed (Para 4-5)

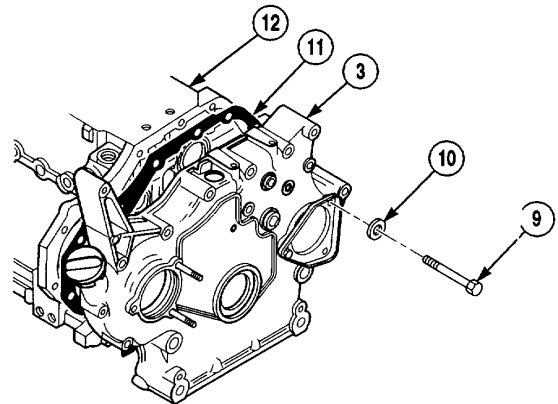
a. Removal.

- (1) Remove screw (1) and washer (2) from front cover (3).
- (2) Remove four screws (4) and lock washers (5) from front cover (3). Discard lock washers.
- (3) Remove four screws (6), lock washers (7), and sixteen spacers (8) from front cover (3). Discard lock washers.



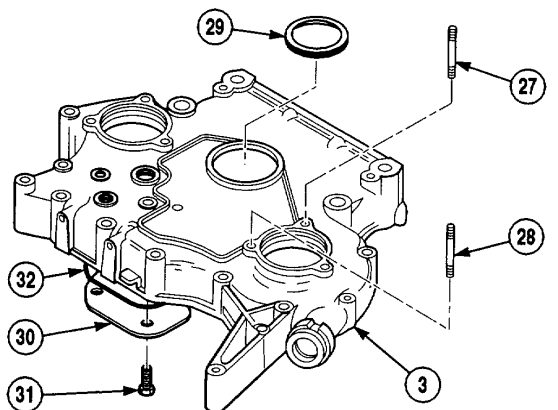
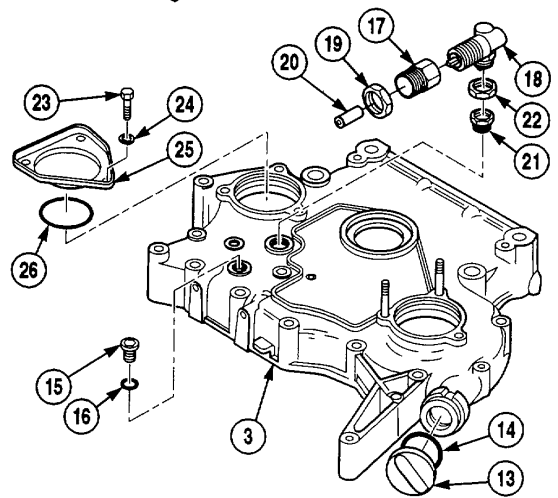
3-10. ENGINE FRONT COVER REPLACEMENT/REPAIR (CONT).

- (4) Remove screw (9) and washer (10) from front cover (3).
- (5) Remove front cover (3) and gasket (11) from crankcase (12). Discard gasket.



b. Disassembly.

- (1) Remove filler cap (13) and spacer ring (14) from front cover (3).
- (2) Remove screw (15) and preformed packing (16) from front cover (3). Discard preformed packing.
- (3) Remove body (17) from angle drive (18).
- (4) Remove tach drive nut (19) and shaft (20) from body (17).
- (5) Remove angle drive (18), adapter (21) and lock nut (22) from front cover (3).
- (6) Remove screw (23), lock washer (24), cover (25), and preformed packing (26) from front cover (3). Discard lock washer and preformed packing.
- (7) Remove two studs (27 and 28) from front cover (3).
- (8) Remove preformed packing (29) from front cover (3). Discard preformed packing.
- (9) Remove plate (30), three screws (31) and gasket (32) from front cover (3).



c. Cleaning/Inspection.

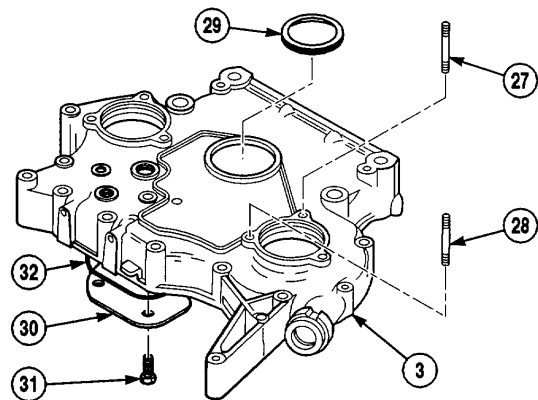
WARNING

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.). Failure to comply may result in injury or death to personnel.

- (1) Clean all metal parts with dry-cleaning solvent.
- (2) Inspect all parts for cracks or damage.
- (3) Replace all damaged parts.

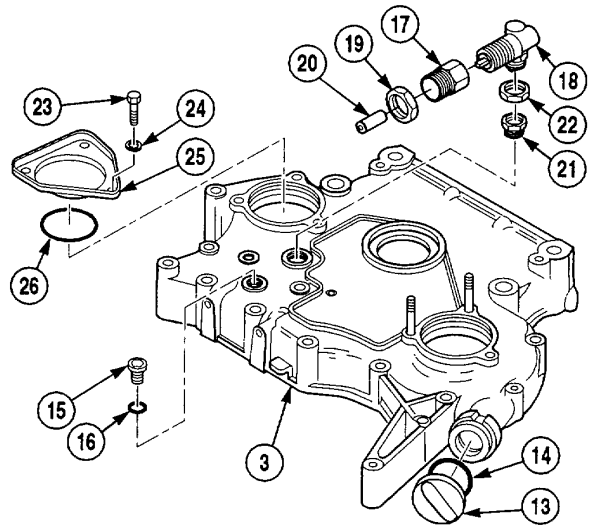
d. Assembly.

- (1) Install gasket (32) and plate (30) on front cover (3) with three screws (31).
- (2) Install preformed packing (29), and two studs (27 and 28) in front cover (3).



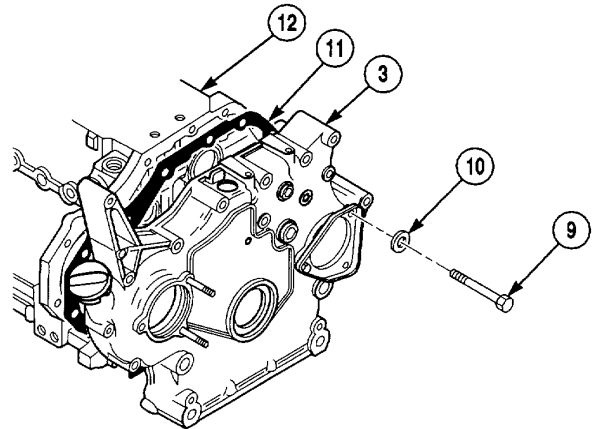
3-10. ENGINE FRONT COVER REPLACEMENT/REPAIR (CONT).

- (3) Install preformed packing (26) and cover (25) on front cover (3) with lock washer (24) and screw (23).
- (4) Install lock nut (22), adapter (21), and angle drive (18) in front cover (3).
- (5) Install body (17) on angle drive (18). Tighten body.
- (6) Install tach drive nut (19) and shaft (20) on body (17).
- (7) Install preformed packing (16) and screw (15) in front cover (3).
- (8) Install filler cap (13) and spacer ring (14) in front cover (3).



e. Installation.

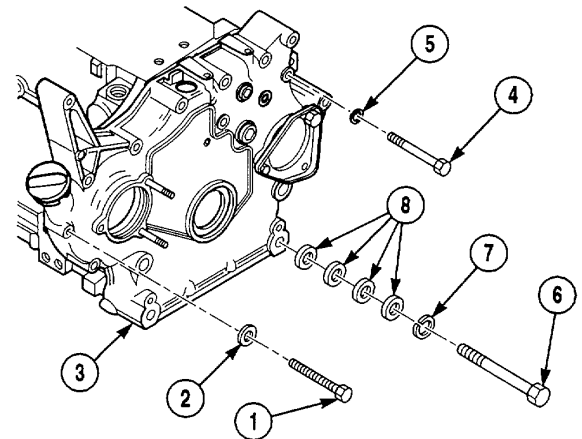
- (1) Apply sealing compound to gasket (11) and position on front cover (3).
- (2) Install front cover (3) on crankcase (12) with two washers (10) and screws (9).
- (3) Install sixteen spacers (8), four lock washers (7), and screws (6) on front cover (3).
- (4) Install four lock washers (5) and screws (4).
- (5) Install washer (2) and screw (1).



NOTE

Follow-on Maintenance:

- Install crankshaft pulley (Para 3-9).
- Install injection pump (Para 4-5).
- Install blower (TM-10-3930-669-20).
- Install alternator bracket (TM- 10-3930-669-20).
- Install alternator (TM-10-3930-669-20).



END OF TASK

3-11. IDLER GEAR REPLACEMENT/REPAIR.

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning/Inspection
- d. Assembly
- e. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Press, 60 Ton (Item 5, Appendix E)
 Wrench, Torque (0-60 N.m) (Item 5, Appendix E)

Equipment Condition

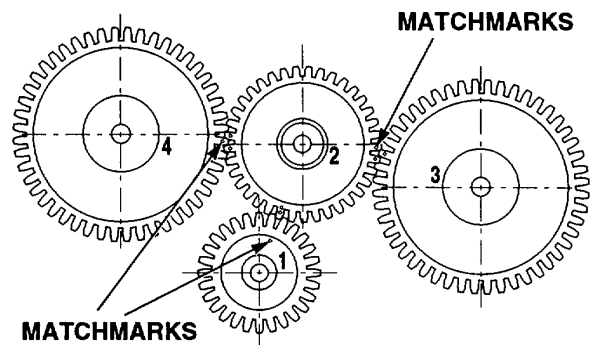
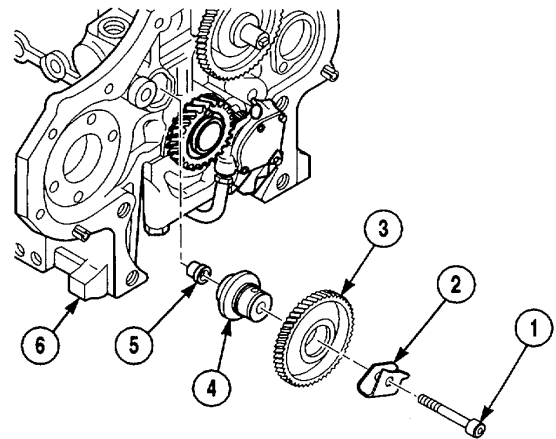
Front cover removed (Para 3-10)
 Oil pump removed (Para 3-12)
 No. 1 piston at top dead center (TDC) (Para 3-3)

Materials/Parts

Solvent, Dry-cleaning (Item 20, Appendix B)
 Gaskets (2)

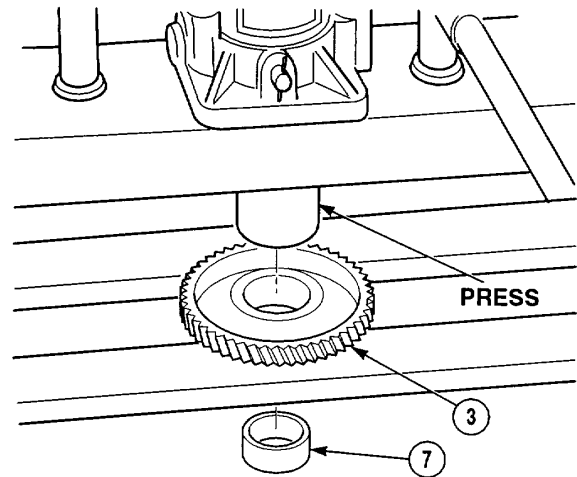
a. Removal

- (1) Remove screw (1) and yoke spring (2) from idler gear (3).
- (2) Matchmark gear timing marks.
- (3) Remove idler gear (3), journal (4), and bushing (5) from crankcase (6).



3-11. IDLER GEAR REPLACEMENT/REPAIR (CONT).

- b. Disassembly.** Using press, remove bushing (7) from idler gear (3).



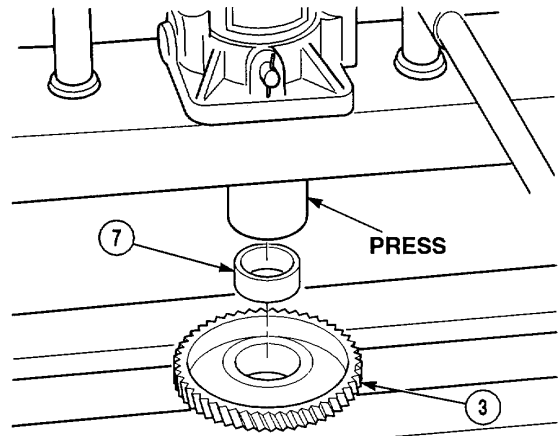
- c. Cleaning/Inspection.**

WARNING

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.). Failure to comply may result in injury or death to personnel.

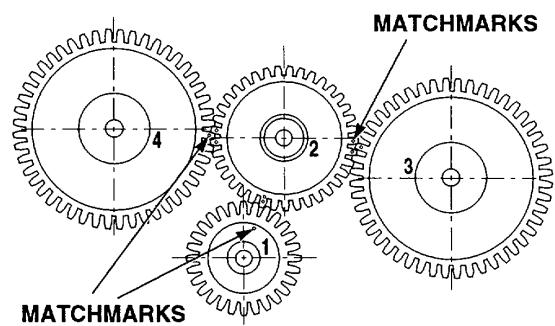
- (1) Clean all metal parts with dry-cleaning solvent. Dry with compressed air.
- (2) Inspect all parts for cracks or damage.
- (3) Replace all damaged parts.

d. *Assembly.* Using press, install bushing (7) in idler gear (3).

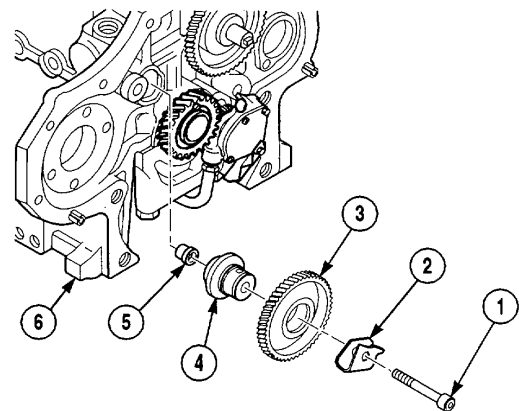


e. *Installation.*

(1) Align gear timing marks.



(2) Install bushing (5), journal (4), and idler gear (3) in crankcase (6) with yoke spring (2) and screw (1). Preload screw (1) to 22 lb-ft (30 N.m). Tighten screw (see Appendix D).



NOTE

Follow-on Maintenance:

- Install oil pump (Para 3-12).
- Install front cover (Para 3-10).

END OF TASK

3-12. OIL PUMP REPLACEMENT.

This task covers:

- a. Removal
- b. Cleaning/Inspection
- c. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive
 (Item 1, Appendix E)
 Wrench, Torque (0 - 60 N.m)
 (Item 5, Appendix E)
 Wrench, Torque (0 to 175 lb-ft [0-237 N-m])
 (Item 5, Appendix E)

Materials Parts

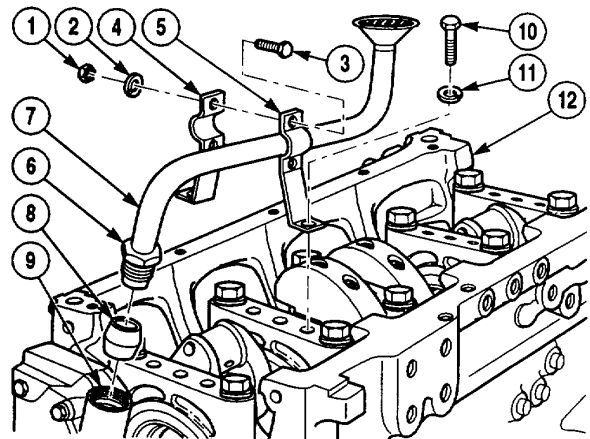
Solvent, Dry-cleaning (Item 20, Appendix B)
 Gasket (2)
 Sleeve, Coupling
 Washer, Lock (2)
 Washer, Lock (2)
 Washer, Lock (2)

Equipment Condition

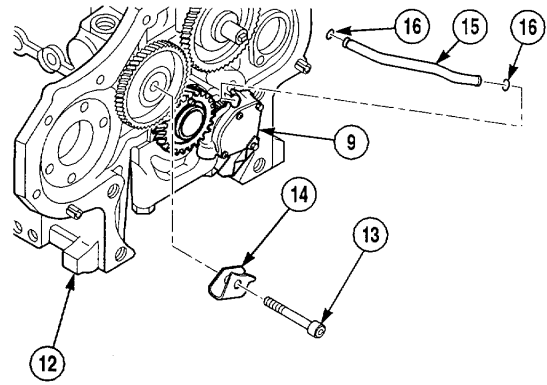
Front cover removed (Para 3-10)
 Oil pan removed (Para 3-8)

a. Removal

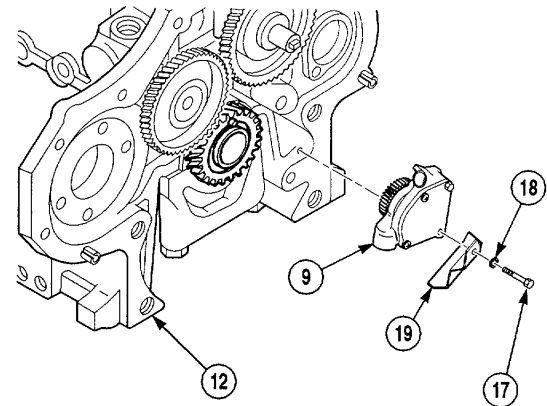
- (1) Remove two nuts (1), lock washers (2), and screws (3) from pipe brackets (4 and 5). Discard lock washers.
- (2) Loosen ferrule nut (6) and remove suction pipe (7) and coupling sleeve (8) from oil pump (9). Discard coupling sleeve.
- (3) Remove two screws (10), lock washers (11), and pipe brackets (4 and 5) from crankcase (12). Discard lock washers.



- (4) Remove screw (13), yoke spring (14), tube (15), and two gaskets (16) from oil pump (9) and crankcase (12). Discard gaskets.



- (5) Remove two screws (17), lock washers (18), baffle (19), and oil pump (9) from crankcase (12). Discard lock washers.



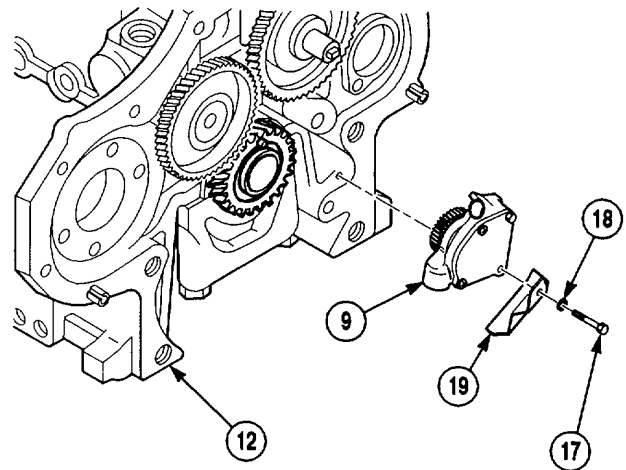
3-12. OIL PUMP REPLACEMENT (CONT).**b. Cleaning/Inspection.****WARNING**

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.). Failure to comply may result in injury or death to personnel.

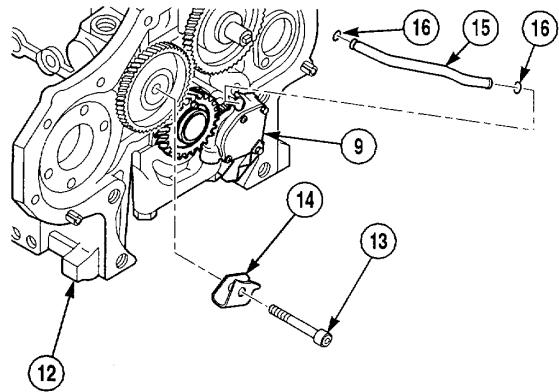
- (1) Clean all metal parts with dry-cleaning solvent. Dry with compressed air.
- (2) Inspect all parts for cracks or damage.
- (3) Replace all damaged parts.

c. Installation.

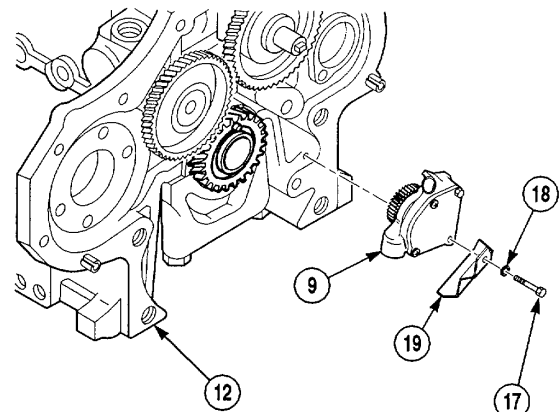
- (1) Install oil pump (9) and baffle (19) on crankcase (12) with two lock washers (18) and screws (17). Tighten screws to 26 lb-ft (35 N.m).



- (2) Install yoke spring (14), tube (15), and two gaskets (16) on oil pump (9) and crankcase (12) with screw (13). Preload screw to 22 lb-ft (30 N.m). Tighten screw (see Appendix D).



- (3) Install pipe brackets (4 and 5) on crankcase (12) with two lock washers (11) and screws (10).
- (4) Position suction pipe (7) between pipe brackets (4 and 5) and install coupling sleeve (8), ferrule nut (6), and suction pipe (7) on oil pump (9). Tighten ferrule nut to 59 to 74 lb-ft (80-100 N.m).
- (5) Install two screws (3), lock washers (2), and nuts (1) on pipe brackets (4 and 5).



NOTE

Follow-on Maintenance:

- Install oil pan (Para 3-8).
- Install front cover (Para 3-10).

END OF TASK

3-13. PISTON AND CONNECTING ROD ASSEMBLY REPLACEMENT/REPAIR.

This task covers:

- a. Removal
- b. Disassembly
- c. Inspection
- d. Assembly
- e. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Gauge, Dial, Bore, Cylinder (Item 5, Appendix E)
 Wrench, Torque (0-60 N.m) (Item 5, Appendix E)
 Heater (Item 5, Appendix E)
 Press, 60 Ton (Item 5, Appendix E)
 Pliers, Snap ring (Item 5, Appendix E)
 Gage, Tightening (Item 22, Appendix E)

Materials Parts

Lubricating Oil (Item 15, Appendix B)
 Rags, Wiping (Item 19, Appendix B)
 Solvent, Dry-cleaning (Item 20, Appendix B)
 Washer, Lock (2)
 Washer, Lock (2)

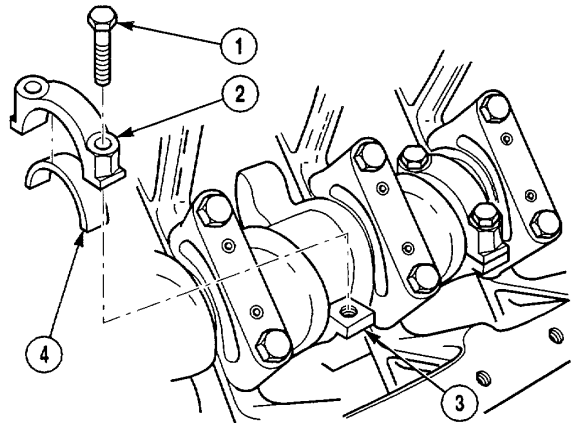
Equipment Condition

Cylinders removed (Para 3-7)
 Oil pump removed (Para 3-12)

a. Removal.

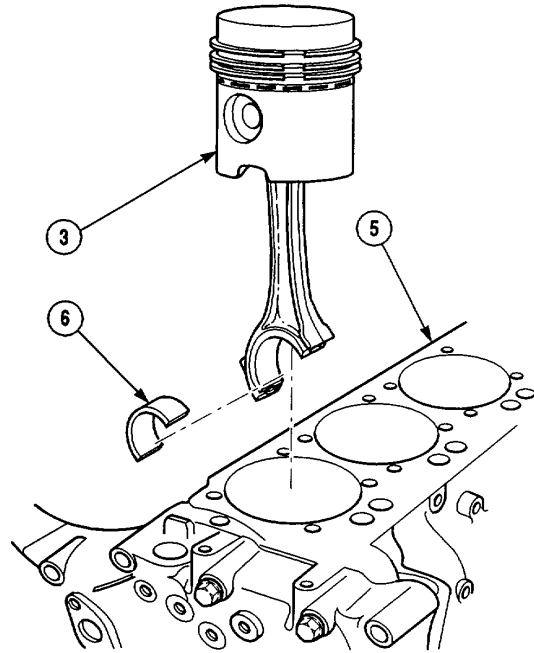
NOTE

- All piston and connecting rod assemblies are removed the same way. Piston and connecting rod assembly No. 4 is shown.
- Do not miss match connecting rod bearing caps.



- (1) Remove two screws (1) and connecting rod bearing cap (2) from piston and connecting rod assembly (3).
- (2) Remove bearing half (4) from connecting rod bearing cap (2).

- (3) Remove piston and connecting rod assembly (3) from crankcase (5).
- (4) Remove bearing half (6) from piston and connecting rod assembly (3).

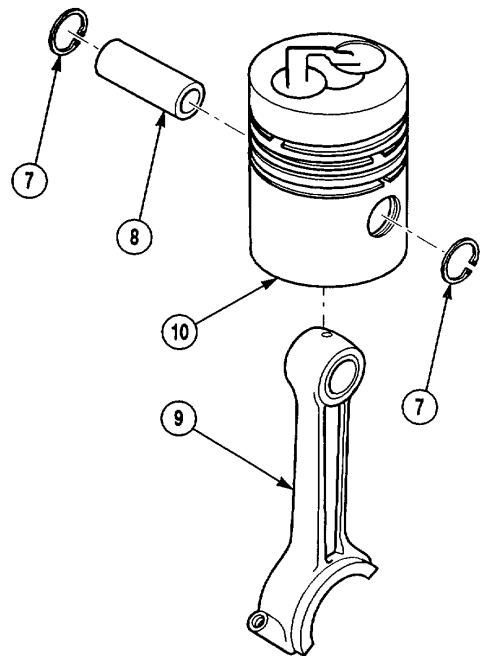


b. Disassembly.

WARNING

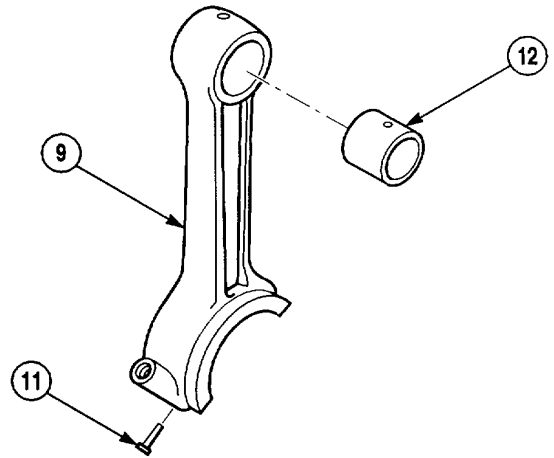
Use care when removing snap ring and retaining rings. Snap ring and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (1) Remove two retaining rings (7), pin (8), and connecting rod (9) from piston (10).

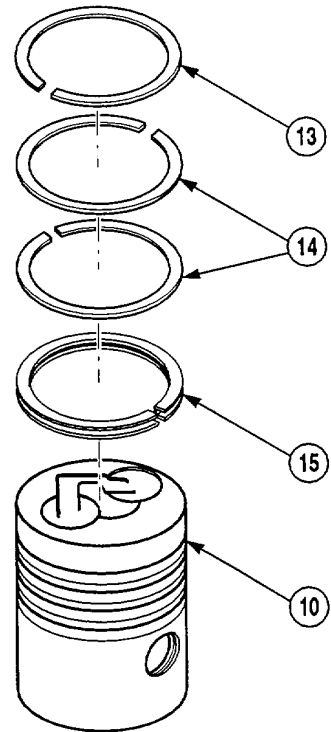


3-13. PISTON AND CONNECTING ROD ASSEMBLY REPLACEMENT/REPAIR (CONT).

- (2) Remove locating pin (11) and sleeve bushing (12) from connecting rod (9).



- (3) Remove trapezoidal ring (13), two taper-faced rings (14), and oil control ring (15) from piston (10).



c. *Cleaning/Inspection.*

WARNING

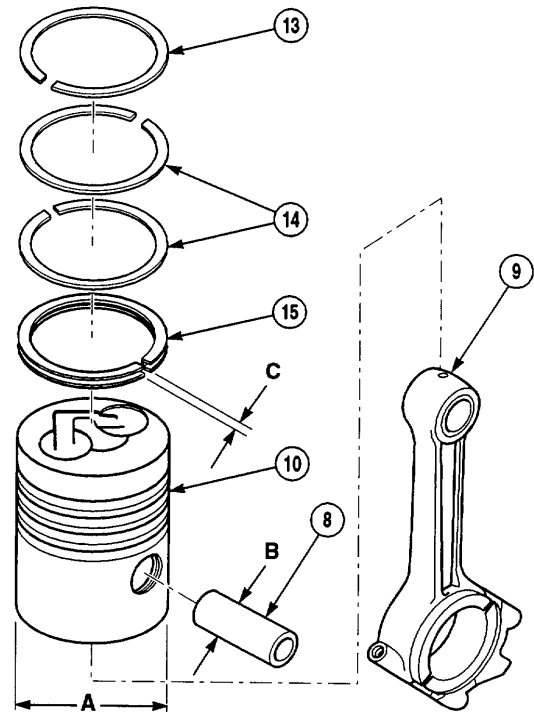
- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

- (1) Clean parts in dry-cleaning solvent. Dry all parts using a clean shop rag.

NOTE

All measurements are according to Table 3-1.

- (2) Inspect piston (10) for damage or visible wear, including bosses. Measure diameter of piston at position A. Normal diameter is between 3.9331 in. (99.9010 mm) to 3.9338 in. (99. mm). If not in range, replace piston.
- (3) Measure outside diameter of pin (8) at position B. Normal diameter is between 1.3777 in. (34.9940 mm) to 1.3779 in. (35.0000 mm). If not in range, replace pin.
- (4) Measure ring grooves on piston (Table 3-1).
- (5) Measure trapezoidal ring (13), taperfaced rings (14), and oil control ring (15) at position C (Table 3-1). Insert each piston ring (one at a time) into cylinder and press down with piston to a distance of 30 mm from cylinder head contacting surface. Measure gap of piston ring and compare with gap clearance in Table 3-1. If measurement is wrong, replace ring.
- (6) Make all necessary measurements of piston (10) and connecting rod (9) assemblies according to Table 3-1.



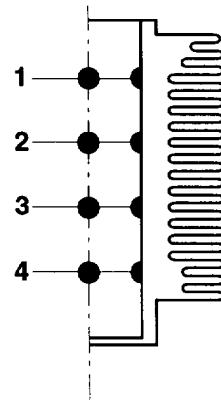
3-13. PISTON AND CONNECTING ROD ASSEMBLY REPLACEMENT/REPAIR (CONT).

(7) Inspect cylinder liner as follows:

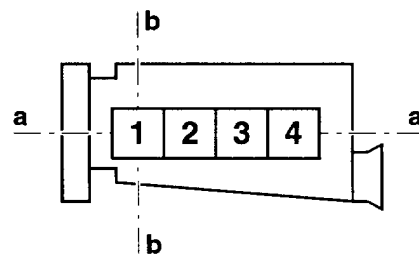
NOTE

If cylinder liner and or piston is worn beyond limits, replace cylinder and piston as a set.

- (a) Set precision gauge to 3.937 in. (100.000 mm).
- (b) Gauge cylinder bore at levels 1 to 4 of engine centerline "a" as well as crossline "b."
- (c) Compare readings with above dimensions. If not within plus 0.0079 in. (0.2200 mm), replace cylinder and piston as a set.



(8) Check that cylinder top and bottom joint faces are flat. Replace cylinders as needed.

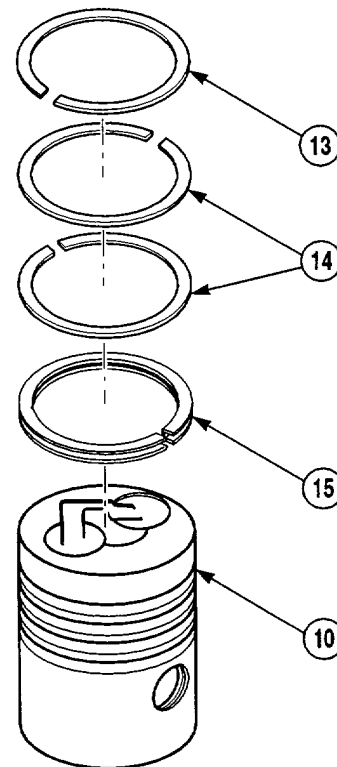


d. Assembly.

NOTE

Ring gaps should be positioned at 90° intervals.

- (1) Install oil control ring (15) on piston (10).
- (2) Install two taper-faced rings (14) on piston (10) with face marked "Top" toward top of piston.
- (3) Install trapezoidal ring (13) on piston (10) with face marked "Top" toward top of piston.



- (4) Install sleeve bushing (12) and locating pin (11) in connecting rod (9).

WARNING

Use care when installing snap ring and retaining rings. Snap ring and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (5) Install one retaining ring (7) in piston (10).

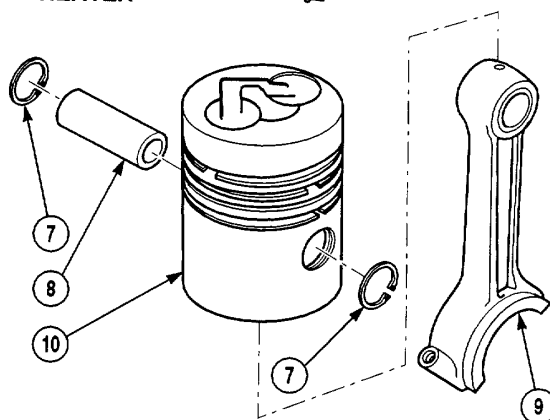
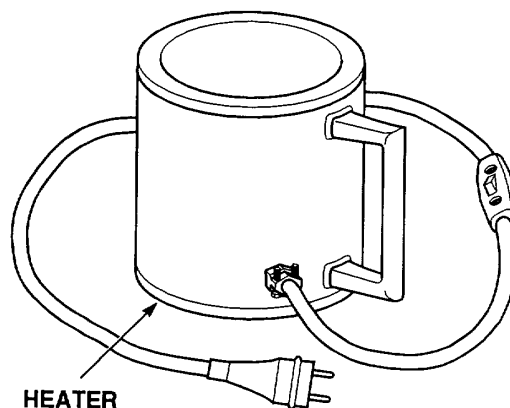
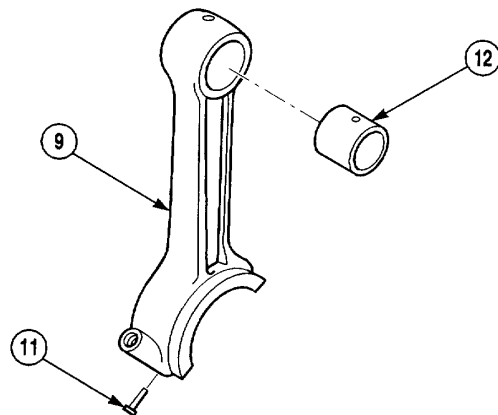
WARNING

Use care when working around hot pistons. Gloves must be worn. Severe burns can result if protective measures are not taken.

NOTE

Step (6) below may not be necessary. Try to perform step (7) below first.

- (6) Using piston heater, heat piston (10) to approximately 176°F (80°C).
- (7) Apply a light coat of oil to pin (8) and install connecting rod (9) in piston (10) with pin (8).
- (8) Install other retaining ring (7) in piston (10).

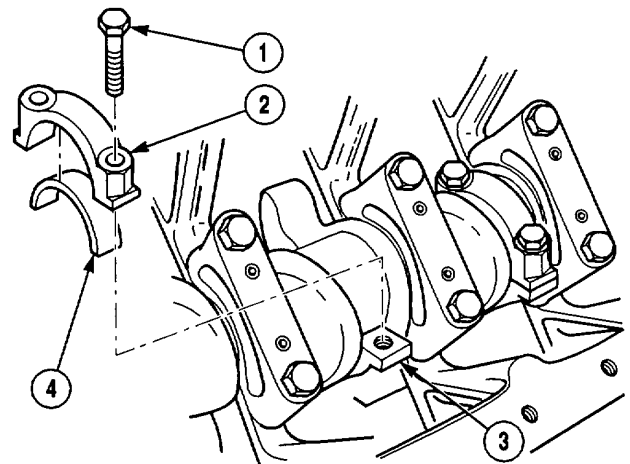
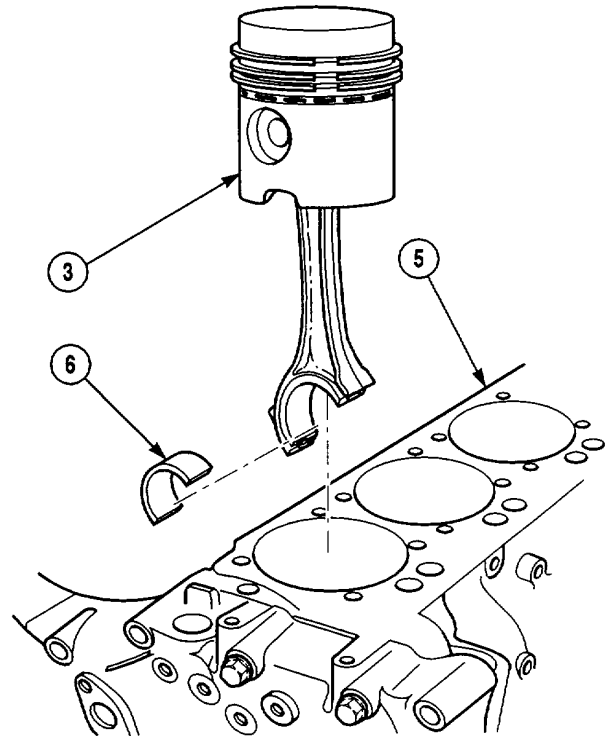


3-13. PISTON AND CONNECTING ROD ASSEMBLY REPLACEMENT/REPAIR (CONT).*e. Installation.*

- (1) Install bearing half (6) in piston and connecting rod assembly (3).
- (2) Position piston and connecting rod assembly (3) in crankcase (5).
- (3) Install bearing half (4) in connecting rod bearing cap (2).
- (4) Install connecting rod bearing cap (2) on piston and connecting rod assembly (3) with two screws (1). Preload screw to 22 lb-ft (30 N•m). Tighten screws (see Appendix D)

NOTE**Follow-on Maintenance:**

- Install oil pump (Para 3-12).
- Install cylinders (Para 3-7).

END OF TASK

3-14. CRANKSHAFT REPLACEMENT/REPAIR.

This task covers:

- | | | |
|----------------|------------------------|-----------------|
| a. Removal | c. Cleaning/Inspection | e. Installation |
| b. Disassembly | d. Assembly | |

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Drill (Item 5, Appendix E)
- Micrometer (Item 5, Appendix E)
- Gauge, Dial, Bore, Cylinder (Item 5, Appendix E)
- Press, 60 Ton (Item 5, Appendix E)
- Puller, Bearing (Item 5, Appendix E)
- Wrench, Torque (0-60 N•m) (Item 5, Appendix E)

Materials /Parts

- Grease, Automotive and Artillery (Item 13, Appendix B)
- Lubricating Oil (Item 15, Appendix B)

Materials/Parts - Continued

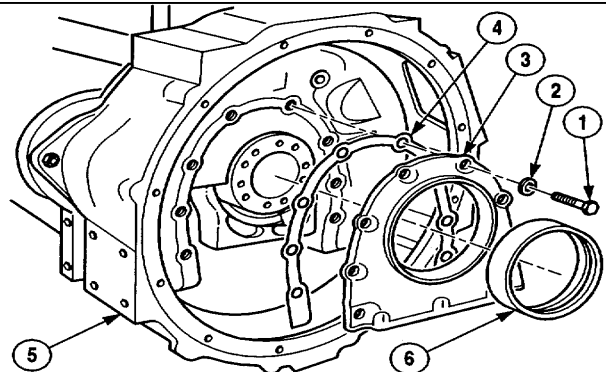
- Solvent, Dry-cleaning (Item 34, Appendix B)
- Magnaflux Penetrant (Item 28, Appendix C)
- Gasket
- Plugs (4)
- Seal
- Washers (4)

Equipment Condition

- Flywheel removed (Para 8-9)
- Piston and connecting rod assemblies removed (Para 3-13)

a. Removal.

- (1) Remove eight screws (1), washers (2), cover (3), and gasket (4) from crankcase (5). Discard gasket.
- (2) Remove seal (6) from cover (3). Discard seal.



3-14. CRANKSHAFT REPLACEMENT/REPAIR (CONT).

NOTE

Matchmark main bearing cap and screws for ease of installation.

- (3) Remove ten bolts (7), washers (8), four bearing caps (9), and bearing cap (10) from crankcase (5).

NOTE

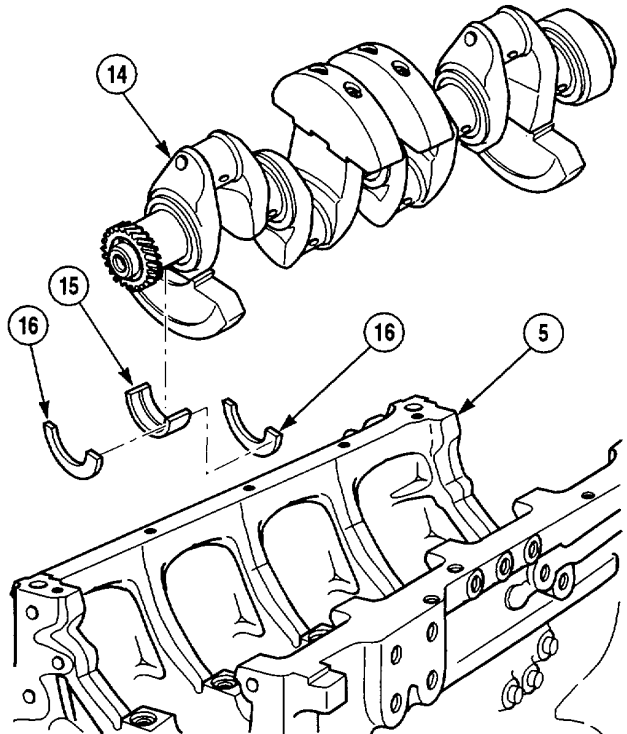
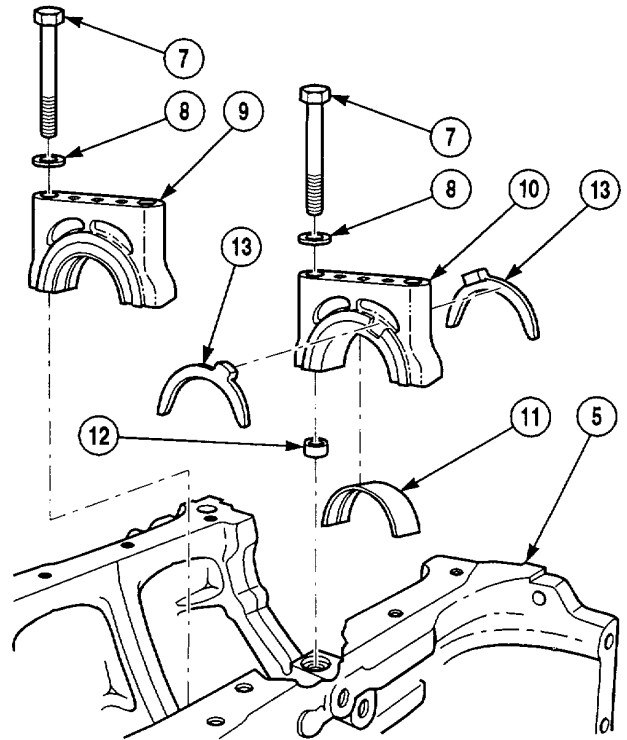
Note location and position of stop rings.

- (4) Remove five bearing halves (11), ten dowel bushings (12), and stop rings (13) from bearing caps (9 and 10).

WARNING

Crankshaft assembly weighs 79 lb (36 kg). Remove with aid of assistant to prevent possible injury to personnel.

- (5) With aid of assistant, remove crankshaft assembly (14), five bearing halves (15), and stop rings (16) from crankcase (5).

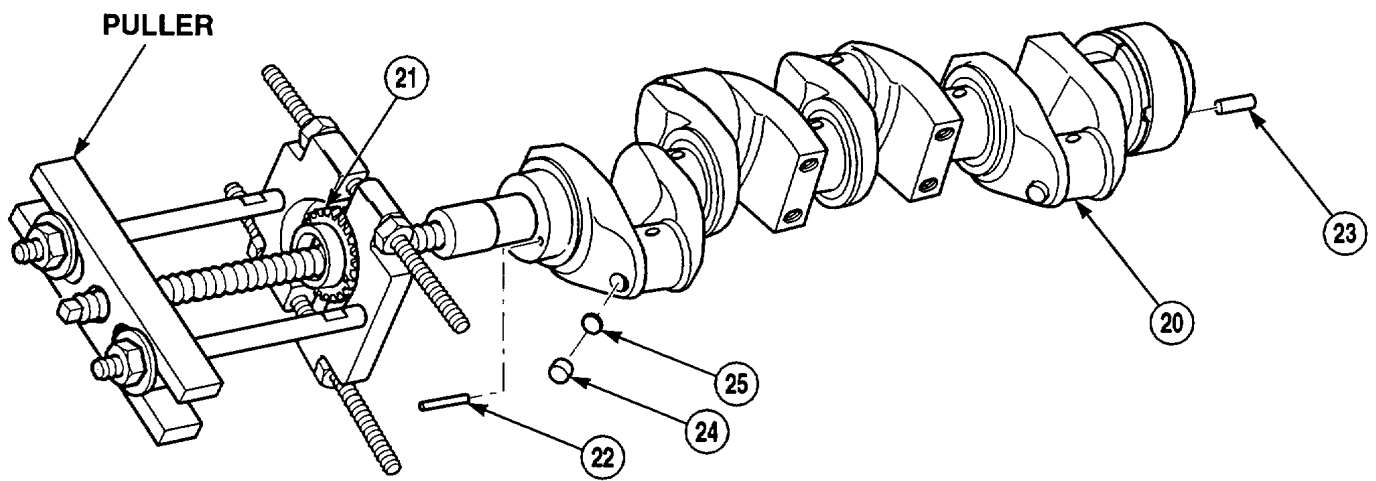
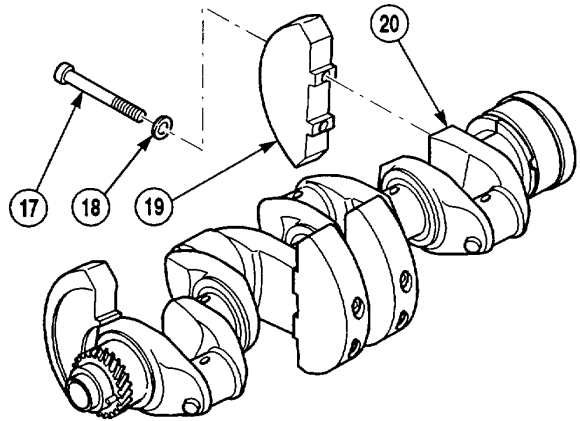


b. Disassembly.

NOTE

Mark position of balancing weights prior to removal.

- (1) Remove eight screws (17), washers (18), and four balancing weights (19) from crankshaft (20).



- (2) Using puller, remove gear (21) and pin (22) from crankshaft (20).
- (3) Remove pin (23) from crankshaft (20).
- (4) Using a drill, remove four plugs (24) and washers (25) from crankshaft (20). Discard plugs and washers.

3-14. CRANKSHAFT REPLACEMENT/REPAIR (CONT)

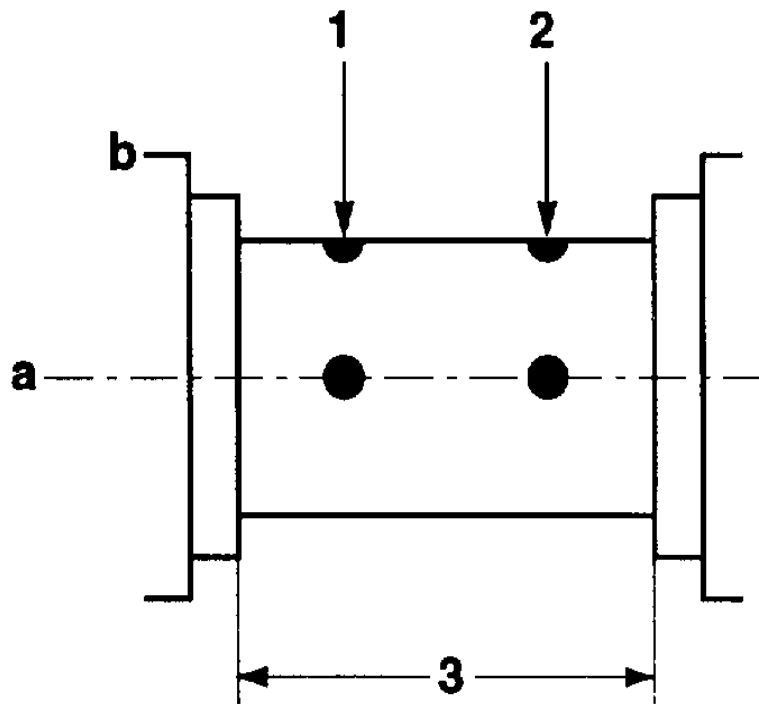
c. Cleaning/Inspection.

WARNING

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
 - **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**
 - **Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).**
- (1) Clean all metal parts in dry-cleaning solvent. Dry thoroughly.
 - (2) Inspect stop rings for defects. Replace if defective.
 - (3) Check locating pin in crankshaft gearwheel. It should project 0.67 inch (17mm) from side opposite that bearing identification mark. If necessary, install a new locating pin.
 - (4) Using magnaflux penetrate, check crankshaft for cracks. Replace crankshaft if cracked.

(5) Measure crankshaft as follows:

(a) Support crankshaft at outer main journals on prism-shaped blocks.



(b) Measure outside diameter of each bearing journal at points "1" and "2," in the vertical and horizontal, as indicated by "a" and "b."

(c) Measure width "3" for a loading bearing.

(d) Note measurements and compare with the following:

- 1 Crankshaft bearing diameter: 2.75 inches (70 mm) maximum.
- 2 Crankshaft center locating bearing: 2.75 inches (70 mm).
- 3 Length of journal: 1.46 inches (37 mm) minimum.

(e) Wear limit for ovality is 0.0008 inch (0.01 mm).

(f) Using a micrometer, check other journals for out-of-round. Refer to Table 3-1 for tolerances.

(g) Check working surface of radial packing ring on flywheel flange. Replace crankshaft if it is defective.

3-14. CRANKSHAFT REPLACEMENT/REPAIR (CONT).



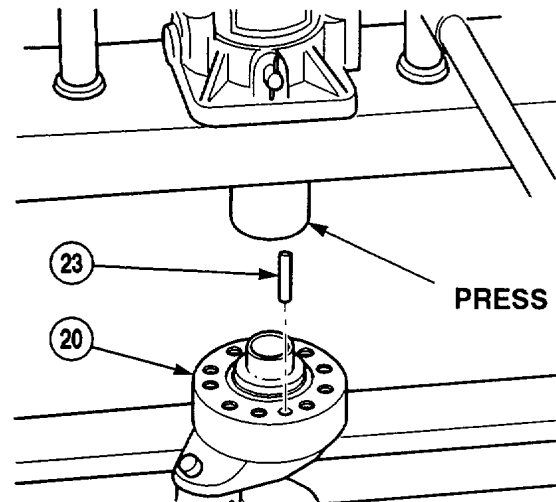
The main bearings are of thin-shell type. Their proper installation requires that webs in crankcase be in alignment and for bearing bores to be preloaded. No attempt should be made to adjust or recondition bearing shells. Severe engine damage may result.

(6) Check preloading of bearing bores as follows:

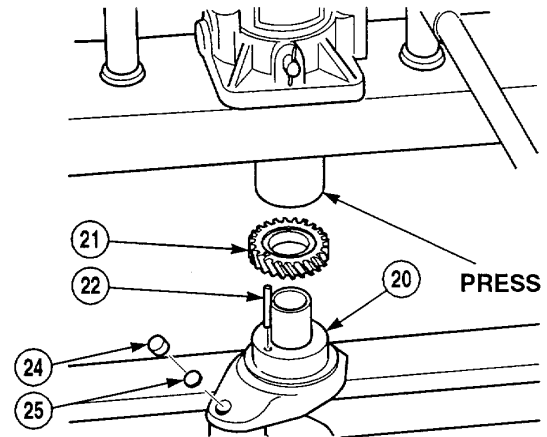
- (a) Position bearing caps, making sure that their identification number match with those stamped in crankcase. Torque bolt in accordance instructions given in Table 3-1.
- (b) Using a micrometer and precision gauge, set gauge to 2.93 inches (74.5 mm).
- (c) Measure each main bearing bore at points 1 and 2 in plane "a," then in the same manner in plane "b" offset by 90 degrees.
- (d) If the recorded value is between 2.933 inches (74.50 mm) and 2.9334 inches (74.508 mm), respective bearing is in acceptable condition and required preload will be obtained when bearing halves are installed.
- (e) If recorded bearing bore diameters differ from the specified values given above, repeat measurements with new bearing halves installed.

d. Assembly.

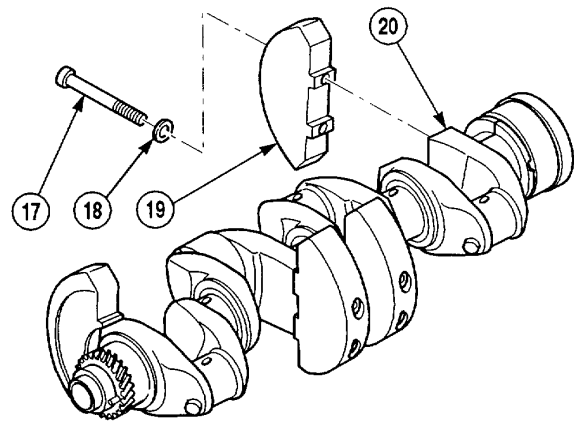
- (1) Using a press, install pin (23) in crankshaft (20).



- (2) Install four washers (25) and plugs (24) in crankshaft (20).
- (3) Using press, install pin (22) and gear (21) with face bearing identification mark directed away from crankshaft.



- (4) Install four balancing weights (19) on crankshaft (20) with eight washers (18) and screws (17). Preload screws to 22 lb-ft (30 N•m). Tighten screws (Appendix D).



3-14. CRANKSHAFT REPLACEMENT/REPAIR (CONT).

e. Installation.

- (1) Apply grease on stop rings (16) and install in matchmarked locations in crankcase (5).
- (2) Install five bearing halves (15) in crankcase (5), making sure that matchmark locations are correct.
- (3) Using oil, lubricate crankshaft assembly (14) journals and install with crankshaft gear (21) matchmark positioned properly.

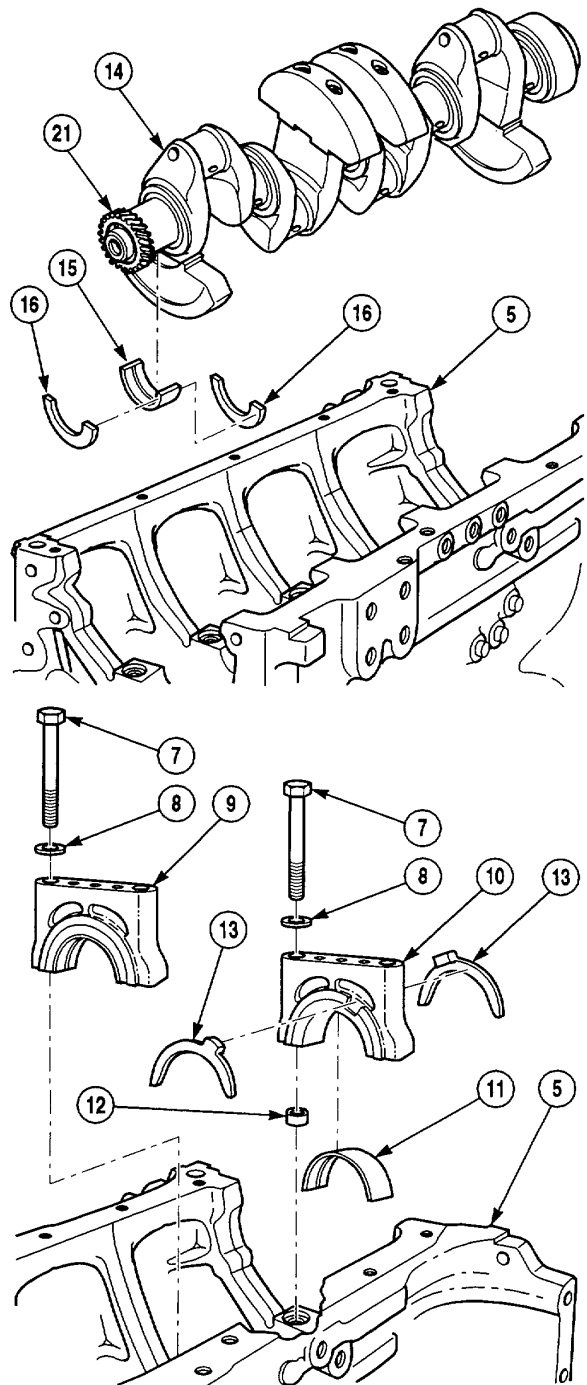
- (4) Apply grease on stop rings (13) and install in matchmarked locations.

- (5) Install ten dowel bushings (12).
- (6) Install five bearing halves (11) in matchmarked locations of bearing caps (9 and 10) making sure they are seated properly.

NOTE

Start by tightening middle bearing caps and finish with bearing caps at ends. The crankshaft must be able to rotate freely.

- (7) Install bearing caps (9 and 10), with their matchmarked locations corresponding to that of crankcase (5), install ten washers (8) and ten screws (7). Preload screws (7) to 22 lb-ft (30 N•m). Tighten screw (7) to 22 lb-ft (30 N•m). Tighten screw (see Appendix D).

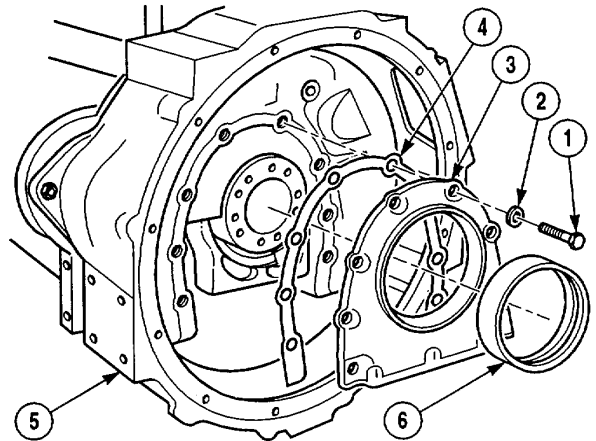


- (8) Using dial indicator, measure the float of the crankshaft.

NOTE

If crankshaft end float requires additional shimming, repeat replacement procedures.

- (9) Crankshaft end float is 0.006 to 0.012 in. (0.15-0.314 mm). Add or subtract shims as required.
- (10) Press seal (6) into cover (3).
- (11) Install gasket (4) and cover (3) and secure with eight washers (2) and eight screws (1).



NOTE

Follow-on Maintenance:

- Install flywheel (Para 8-9).
- Install piston and connecting rod assemblies (Para 3-13).

END OF TASK

3-15. ROCKER ARM AND PUSHROD REPLACEMENT/REPAIR.

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning/Inspection
- d. Assembly
- e. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Wrench, Torque (0-60 N.m) (Item 5, Appendix E)
 Pliers, Snap Ring (Item 5, Appendix E)

Materials/Parts

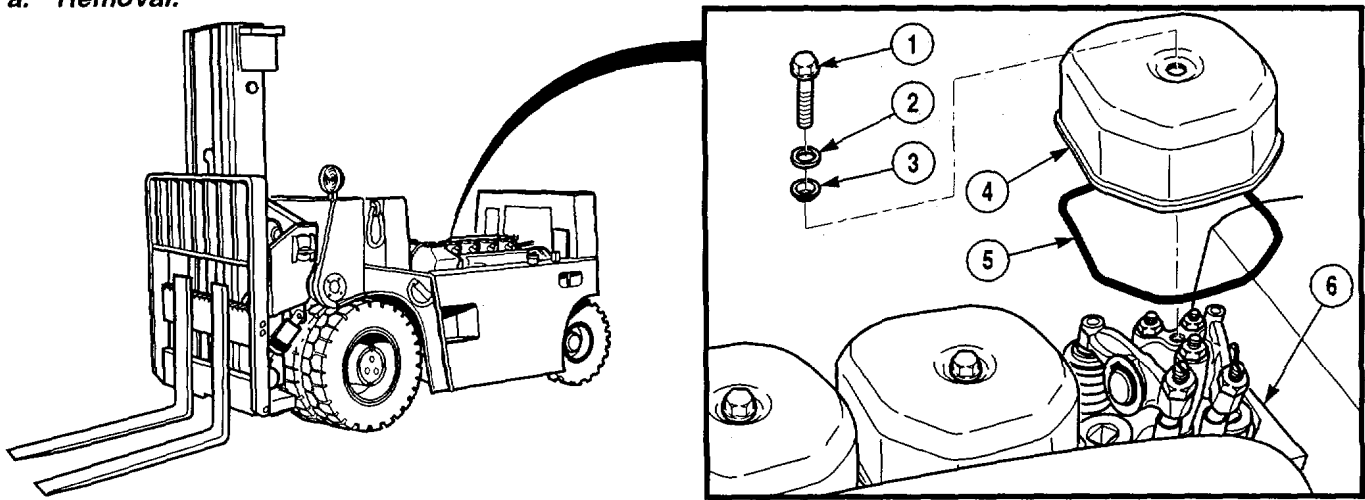
Compound, Sealing (Item 24, Appendix B)
 Gasket

Equipment Condition

Cab removed (TM 10-3930-669-20)

a. Removal

a. Removal.

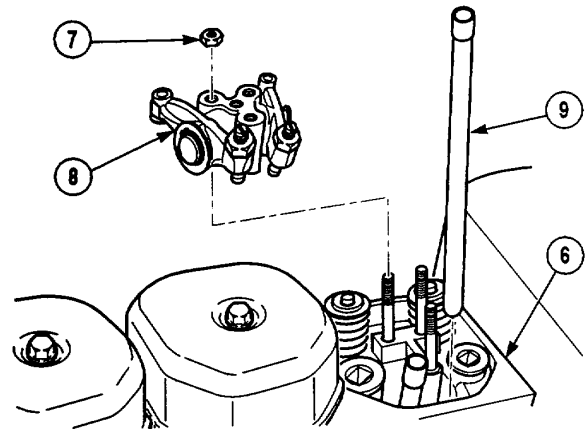


NOTE

All rocker arms and pushrods are removed the same. Cylinder No. 1 is shown.

- (1) Remove screw (1), washer (2), washer (3), valve cover (4), and gasket (5) from cylinder head (6). Discard gasket.

- (2) Remove three nuts (7) and rocker arm assembly (8) from cylinder head (6).
- (3) Remove two pushrods (9) from cylinder head (6).

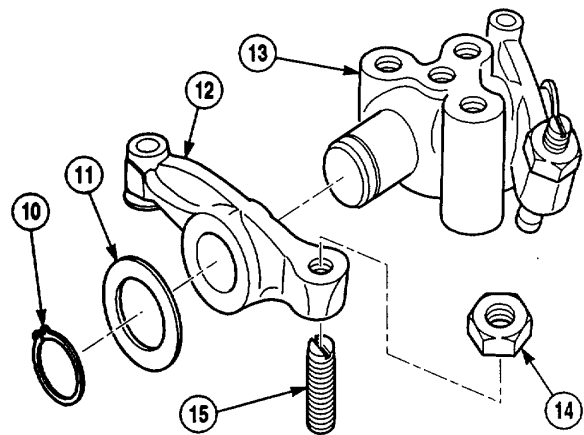


b. Disassembly.

WARNING

Use care when removing snap rings. Snap rings are under compression tension and can act as projectiles when released which could cause severe injury.

- (1) Remove two retaining rings (10), two washers (11), and two rocker arms (12) from rocker bracket (13).
- (2) Remove nut (14) and screw (15) from two rocker arms (12).



3-15. ROCKER ARM AND PUSHROD REPLACEMENT/REPAIR (CONT).

c. Cleaning/Inspection.

WARNING

- Dry-cleaning solvent (P-D-680) is **TOXIC** and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.). Failure to comply may result in injury or death to personnel.

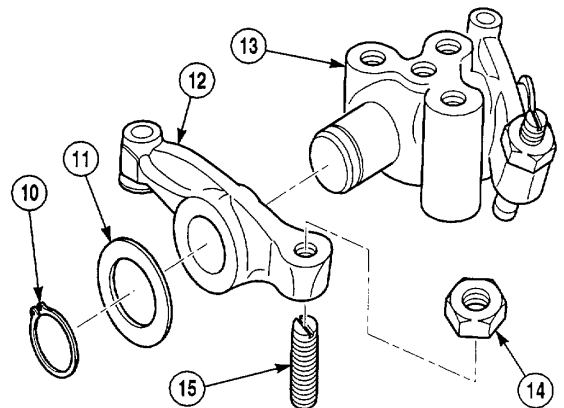
- (1) Clean all metal parts with dry-cleaning solvent. Dry with compressed air.
- (2) Inspect all parts for cracks or damage.
- (3) Replace all damaged parts.

d. Assembly.

WARNING

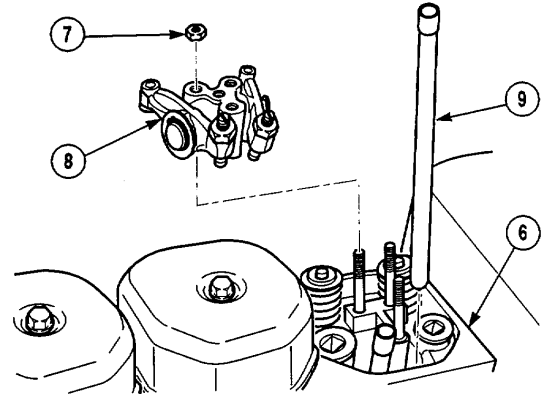
Use care when installing snap rings. Snap rings are under compression tension and can act as projectiles when released which could cause severe injury.

- (1) Install screw (15) and nut (14) on two rocker arms (12).
- (2) Install two rocker arms (12), two washers (11), and two retaining rings (10) on rocker bracket (13).

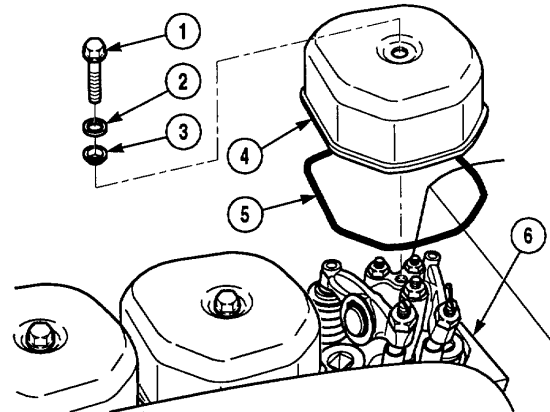


e. Installation.

- (1) Install two pushrods (9) in cylinder head (6).
- (2) Install rocker arm assembly (8) on cylinder head (6) with three nuts (7). Tighten nuts to 21 lb-ft (28 N•m).
- (3) Adjust rocker arms. Refer to (TM 10-3930-669-20) for adjustment.



- (4) Apply sealing compound to gasket (5) and position on cylinder head (6).
- (5) Install washer (2), washer (3), and valve cover (4) on cylinder head (6) with screw (1). Tighten screw to 7 lb-ft (10 N•m)



NOTE

Follow-on Maintenance:

- Install cab (TM 10-3930-669-20).

END OF TASK

3-16. CAMSHAFT REPLACEMENT.

This task covers:

- a. Removal
- b. Cleaning/Inspection
- c. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive
(Item 1 Appendix E)

Materials/Parts

Lubricating Oil (Item 15, Appendix B)
Solvent, Dry-cleaning (Item 20, Appendix B)

Equipment Condition

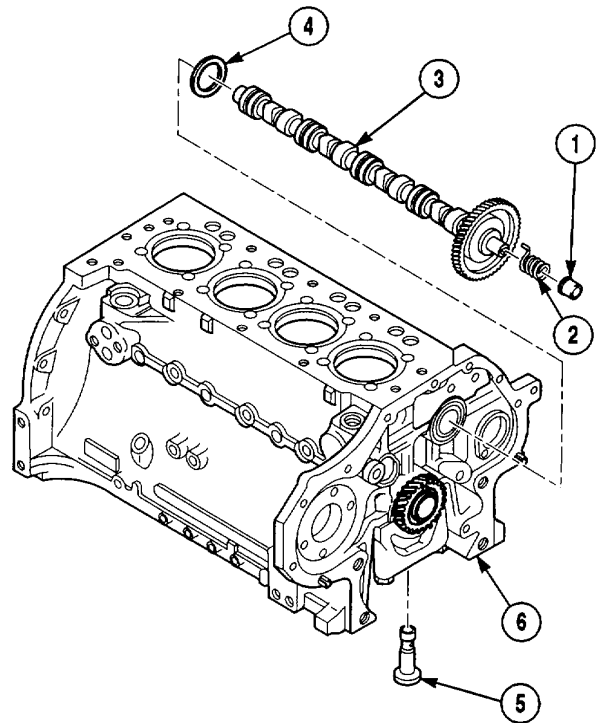
Oil pump removed (Para 3-12)
Idler gear removed (Para 3-11)
Pistons and connecting rods removed
(Para 3-13)

a. Removal

- (1) Remove cap (1) and spring (2) from camshaft (3).

NOTE

- Use care when removing camshaft. If camshaft lobes contact crankcase, damage to camshaft could result.
 - Turn engine upside down before attempting to remove camshaft. Rotate camshaft to clear tappets during removal of camshaft.
- (2) Remove camshaft (3), washer (4), and eight tappets (5) from crankcase (6).



b. Cleaning/Inspection.**WARNING**

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
 - **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**
- (1) Clean all metal parts in dry-cleaning solvent. Dry thoroughly.
 - (2) Check tappets for excessive wear (contacting face must be convex) and oil hole not obstructed.
 - (3) Inspect camshaft for cracks and scores using the magnetic particle method. Replace if defective.
 - (4) Measure camshaft bearing journal outside diameter. Record journal diameter.
 - (5) Measure inside diameter of bearing. Subtract journal diameter from its bearing inside diameter. Replace bearing if difference (clearance) is more than 0.0079 inch (0.20mm).

3-16. CAMSHAFT REPLACEMENT (CONT).

c. Installation.

- (1) Lubricate eight tappets (5) with oil and install in crankcase (6).
- (2) Install washer (4) on camshaft (3).

NOTE

Use care when installing camshaft. If camshaft lobes contact crankcase, damage to camshaft could result.

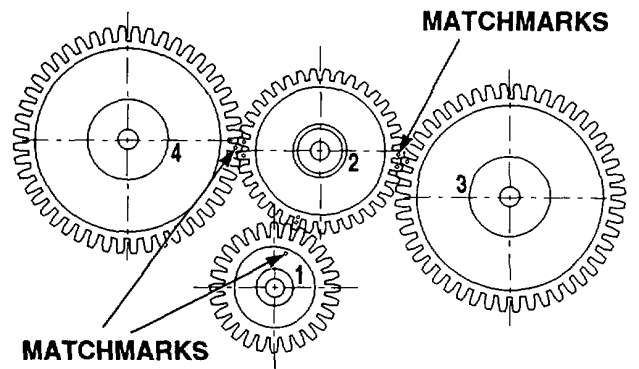
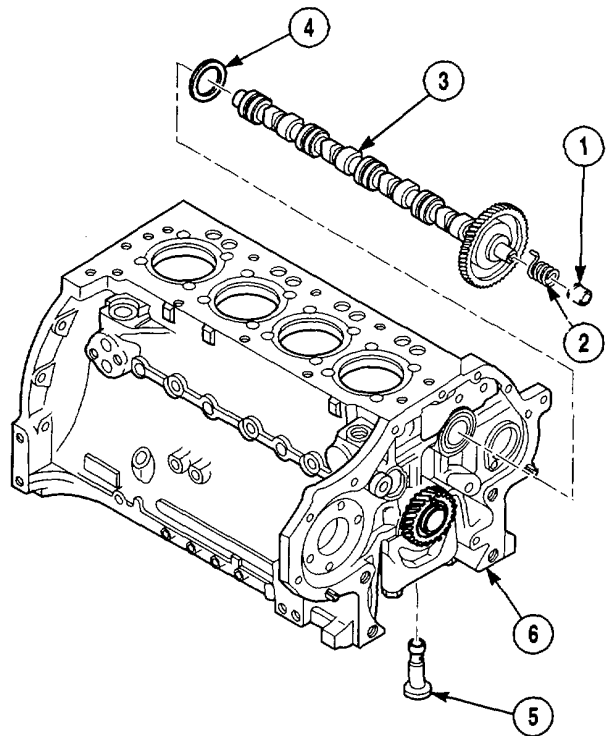
- (3) Lubricate camshaft (3) with oil and install with camshaft gear positioned as shown.
- (4) Check camshaft gear lineup carefully. Dots and characters must match illustration.
- (5) Install spring (2) and cap (1) on camshaft (3) end.

NOTE

Follow-on Maintenance:

- Install idler gear (Para 3-11).
- Install oil pump (Para 3-12).
- Install piston and connecting rod assemblies (Para 3-13).

END OF TASK



3-17. INJECTION PUMP TIMING GEAR REPLACEMENT/REPAIR.

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning/Inspection
- d. Assembly
- e. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Wrench, Torque (0 to 175 lb-ft [0-237 N.m]) (Item 5, Appendix E)
 Puller, Injector Timing Gear (Item 32, Appendix E)

Materials /Parts

Cloth, Lint-free (Item 6, Appendix B)
 Solvent, Dry-cleaning (Item 20, Appendix B)

Equipment Condition

No. 1 piston at top dead center (TDC) (TM 10-3930-669-20)
 Front cover removed (Para 3-10)

a. Removal

NOTE

Ensure that engine timing marks are aligned prior to removal of timing gear.

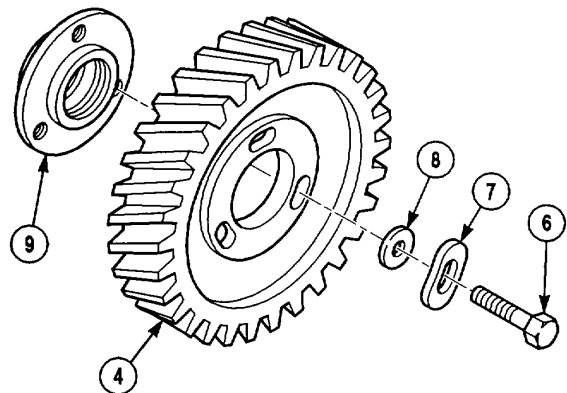
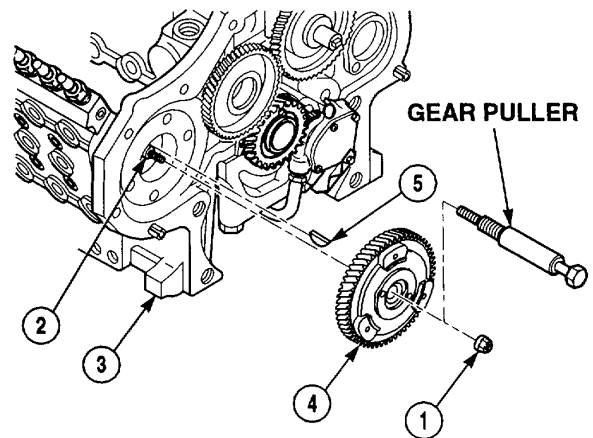
- (1) Remove gear retaining nut (1) from injection pump shaft (2) in crankcase (3).



Use care in removing timing gear. Gear could fall and be damaged.

- (2) Using a gear puller, remove timing gear (4) from injection pump shaft (2).
- (3) Remove key (5) from injection pump shaft (2).

- b. Disassembly.** Remove three screws (6), spring washers (7), washers (8), and hub (9) from timing gear (4).



3-17. INJECTION PUMP TIMING GEAR REPLACEMENT/REPAIR (CONT).

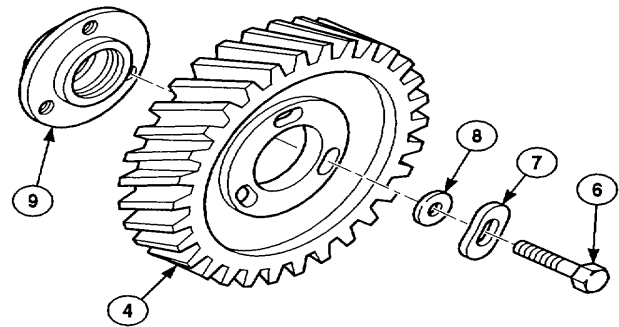
c. Cleaning/Inspection.



- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.). Failure to comply may result in injury or death to personnel.

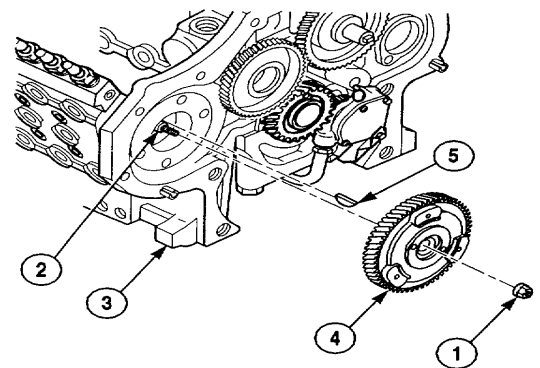
- (1) Clean timing gear with dry-cleaning solvent.
- (2) Inspect timing gear for cracks, wear, or damage.
- (3) Replace damaged timing gear.

d. **Assembly.** Install hub (9) on timing gear (4) with three washers (8), spring washers (7) and screws (6).

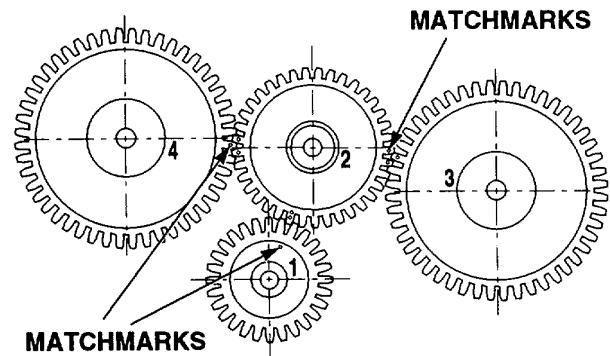


e. **Installation.**

- (1) Install key (5) in fuel injection pump shaft (2) keyway in crankcase (3).



- (4) Check timing gear lineup carefully. Dots and characters must match illustration.

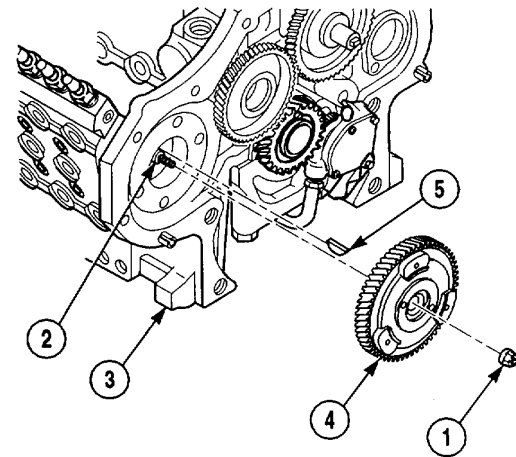


- (5) Align timing gear (4) keyway with pump shaft key and gear/crankcase position mark Install gear.
- (6) Install gear retaining nut (1) on injection pump shaft (2). Tighten nut to 44 to 52 lb-ft (60-70 N•m).

NOTE

Follow-on Maintenance:

- Install front cover (Para 3-10).
- Adjust fuel injection pump timing (Para 4-4).



END OF TASK

3-18. FLYWHEEL HOUSING REPLACEMENT.

This task covers:

- a. Removal
- b. Cleaning/Inspection
- c. Installation

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Wrench, Torque (0 to 175 lb-ft [0-237 N.m]) (Item 5, Appendix E)

Personnel Required

Two

Materials /Parts

- Cloth, Lint-free (Item 6, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)

Equipment Condition

- Engine/transmission assembly removed (Para 3-3)
- Transmission removed (Para 8-3)
- Torque converter removed (Para 8-8)
- Flywheel removed (Para 8-9)

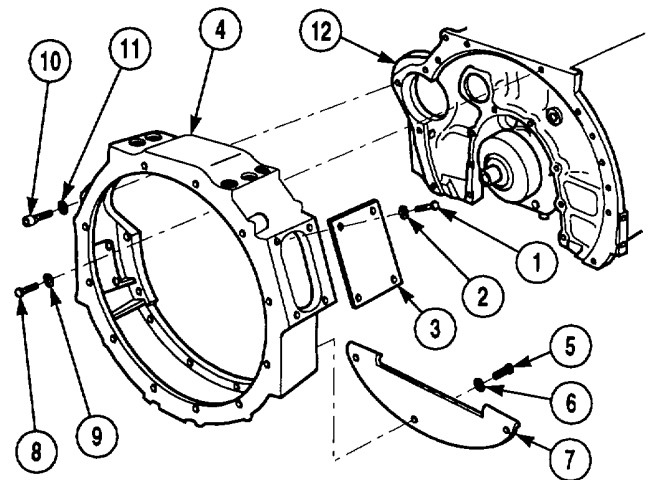
a. Removal

- (1) Remove four screws (1), four lock washers (2), and cover (3) from housing (4).
- (2) Remove three screws (5), three lock washers (6), and plate (7) from housing (4).



Flywheel housing weighs 46 lbs (21 kg). Use the aid of an assistant when removing flywheel housing or injury to personnel can result.

- (3) Remove nine screws (8), nine lockwashers (9), screw (10), lockwasher (11), and housing (4) from crankcase (12).



3-18. FLYWHEEL HOUSING REPLACEMENT (CONT).

b. Cleaning/inspection.

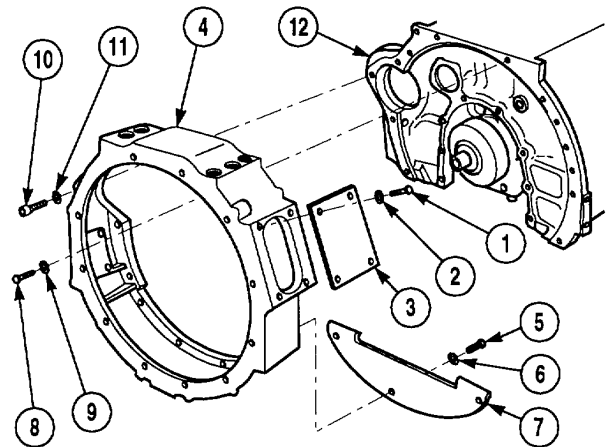
WARNING

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
- Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.). Failure to comply may result in injury or death to personnel.

- (1) Clean flywheel housing with drycleaning solvent.
- (2) Inspect flywheel housing for cracks, wear, or damage.
- (3) Replace damaged flywheel housing.

c. Installation.

- (1) Install housing (4) on crankcase (12) with lockwasher (11), screw (10), nine lockwashers (9), and nine screws (8).
- (2) Install plate (7) on housing (4) with three lockwashers (6), and three screws (5).
- (3) Install cover (3) on housing (4) with four lockwashers (2) and four screws (1).

**NOTE****Follow-on Maintenance:**

- Install flywheel (Para 8-9).
- Install torque converter (Para 8-8).
- Install front cover (Para 3-10).

END OF TASK

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CHAPTER 4
FUEL SYSTEM MAINTENANCE

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4-1. INTRODUCTION.

This chapter contains maintenance instructions for removing, replacing, installing, repairing, and testing fuel components authorized by the Maintenance Allocation Chart (MAC) at the Direct Support and General Support Maintenance level.

4-2. INTAKE MANIFOLD REPLACEMENT.

This task covers:

- a. Removal
- b. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)

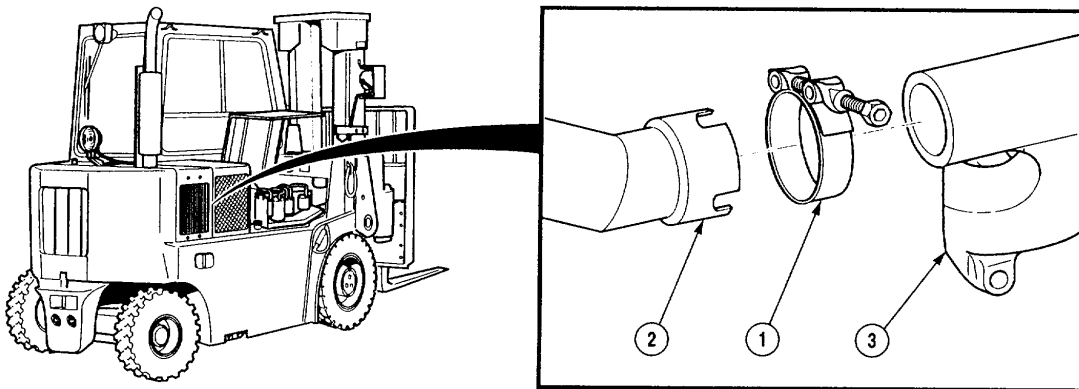
Materials/Parts

Gasket (4)
Washer, Lock
Washer, Lock (6)

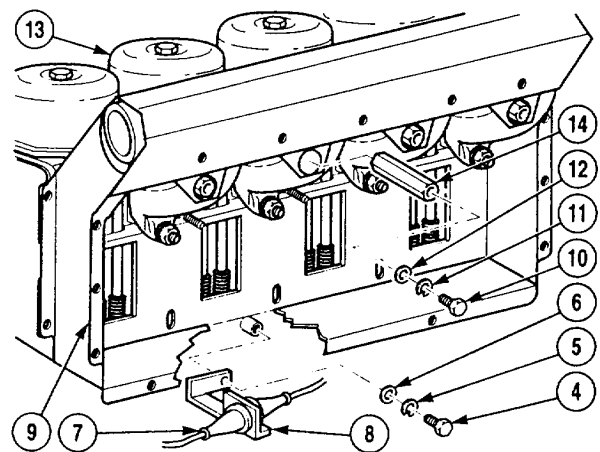
Equipment Condition

Engine OFF (TM 10-3930-669-10)
Parking brake applied (TM 10-3930-669-10)
Wheels chocked (TM 10-3930-669-10)
Right-hand engine access cover open
(TM 10-3930-669-10)
Batteries disconnected (TM 10-3930-669-20)
Blower ducting removed (Para 6-2)

a. Removal.



- (1) Remove clamp (1) and tube (2) from manifold (3).
- (2) Remove screw (4), lock washer (5), washer (6), connector (7), and bracket (8) from manifold ducting (9). Discard lock washer.
- (3) Remove six screws (10), lock washers (11), and washers (12) from manifold ducting (9). Discard lock washers.
- (4) Remove manifold ducting (9) from engine (13).
- (5) Remove four extension nuts (14).



(6) Remove eight nuts (15), washers (16), and manifold (3) from engine (13).

(7) Remove four gaskets (17) from engine (13). Discard gaskets.

b. Installation.

(1) Position four gaskets (17) on engine (13).

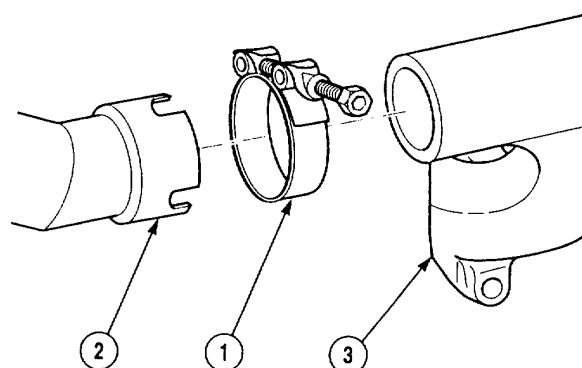
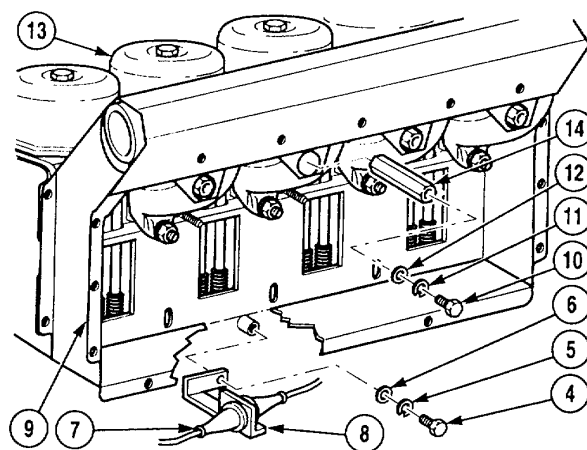
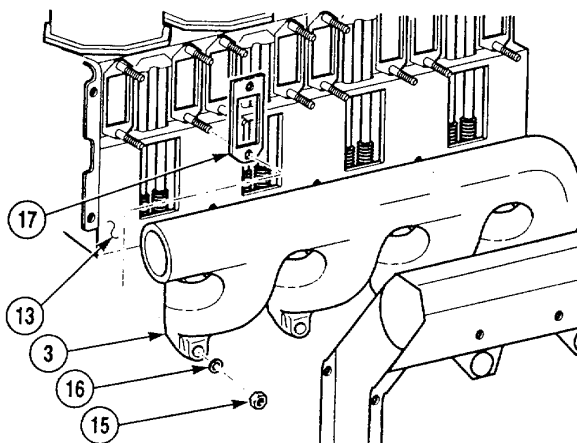
(2) Install manifold (3), eight washers (16), and nuts (15) on engine (13).

(3) Install four extension nuts (14).

(4) Install manifold ducting (9) on engine (13) with six screws (10), lock washers (11), and washers (12).

(5) Install bracket (8) and connector (7) to manifold ducting (9) with screw (4), lock washer (5), and washer (6).

(6) Install tube (2) on manifold (3) with two clamps (1).



NOTE

Follow-on Maintenance:

- **Connect batteries (TM 10-3930-669-20).**
- **Close right-hand engine access cover (TM 10-3930-669-10).**
- **Remove wheel chocks (TM 10-3930-669-10).**
- **Install blower ducting (Para 6-2).**

END OF TASK

END OF TASK

4-3. FUEL TANK REPLACEMENT.**This task covers:****a. Removal****b. Installation****INITIAL SETUP:***Tools and Special Tools*

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)

Materials/Parts

Fuel Oil, Diesel (Item 9, Appendix B)
Tags, Identification (Item 21, Appendix B)

Personnel Required

Two

Equipment Condition

Wheel chocked (TM 10-3930-669-10)
Fuel drained (LO 10-3930-669-12)
Fuel filler tube removed (TM 10-3930-669-20)
Fuel sender removed (TM 10-3930-669-20)
Engine/transmission assembly removed
(Para 3-3)
Counterweight removed (Para 13-4)

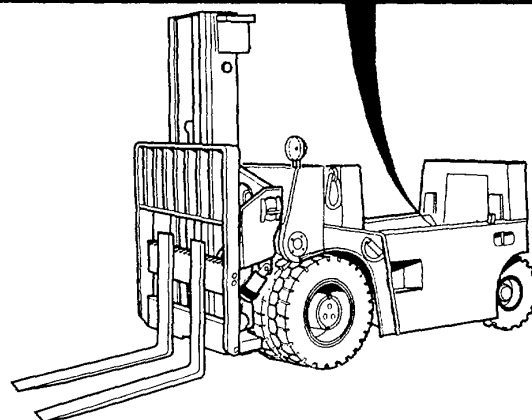
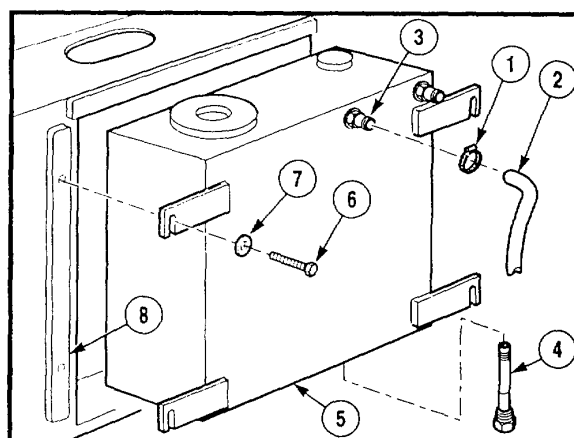
a. Removal.**WARNING**

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep a B-C fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read **NO SMOKING WITHIN 50 FEET (15 m).**

NOTE

Tag and mark all hoses prior to removal.

- (1) Loosen two clamp screws (1) and remove two hoses (2) from two fittings (3).
- (2) Remove extension tube (4) from fuel tank (5).
- (3) Remove four screws (6) and washers (7) from fuel tank (5).
- (4) With the aid of an assistant, remove fuel tank (5) from forklift (8).



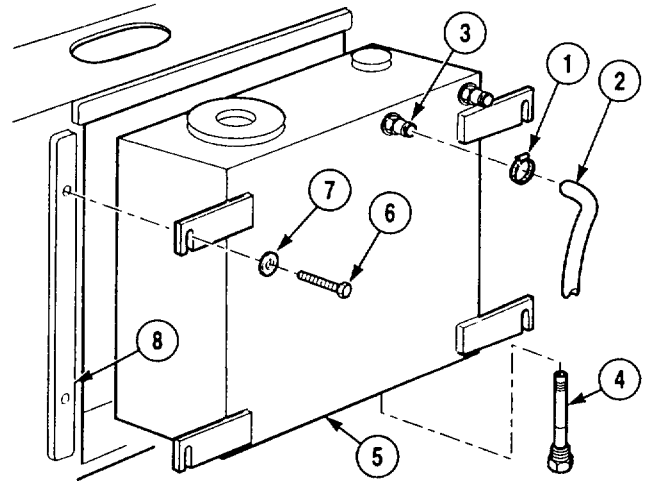
b. Installation.**WARNING**

Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep a B-C fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET (15 m).

- (1) With the aid of an assistant, install fuel tank (5) on forklift (8) with four washers (7) and screws (6).
- (2) Install extension tube (4) on fuel tank (5).
- (3) Install tube (2) on manifold (3) with clamp (1).

NOTE**Follow-on Maintenance:**

- Install counterweight (Para 13-4).
- Install engine/transmission assembly (para 3-3).
- Install fuel filler tube (TM 10-3930-669-20).
- Install fuel sender (TM 10-3930-669-20).
- Install cab (TM 10-3930-669-20).
- Refill fuel tank (TM 10-3930-669-10).
- Remove wheel chocks (TM 10-3930-669-10).

**END OF TASK**

4-4. INJECTION PUMP ADJUSTMENT.

This task covers:

a. Removal

b. Adjustment

c. Removal

INITIAL SETUP:

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Pointer, Dial (Item 5, Appendix E)
 Wrench, Torque (0 to 175 lb-ft [0-237 N•m]) (Item 5, Appendix E)
 High Pressure Pump (Item 30, Appendix E)

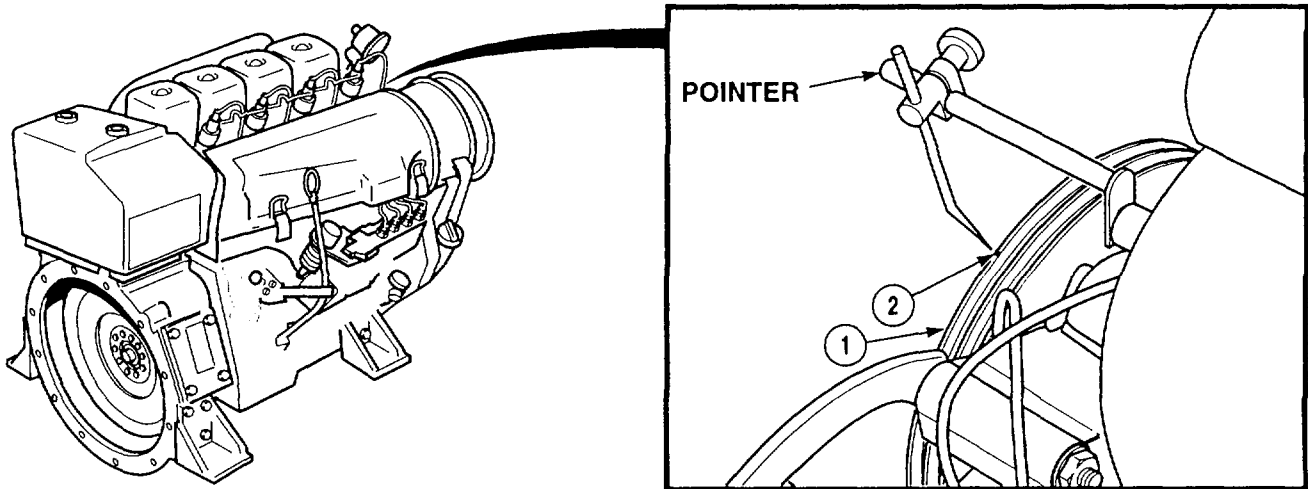
Equipment Condition

Engine OFF (TM 10-3930-669-10)
 Wheels chocked (TM 10-3930-669-10)
 No. 1 piston at top dead center (TDC) (TM 10-3930-669-20)
 Engine/transmission removed (Para 3-3)
 Blower belt tensioner removed (TM 10-39930-669-20)

Materials /Parts

Fuel Oil, Diesel (Item 9, Appendix B)
 Rags, Wiping (Item 19, Appendix B)
 Wire (Item 27, Appendix B)
 Washer (7)

a. Installation.



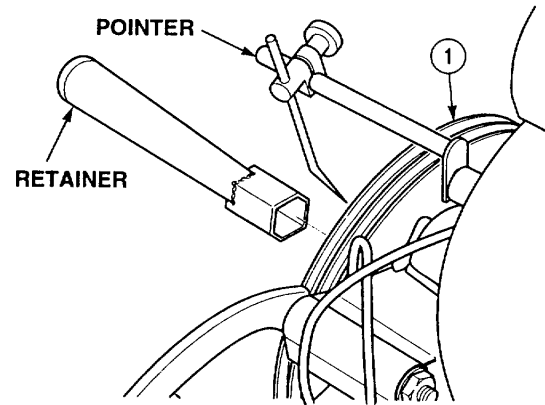
NOTE

The left mark on the crankshaft pulley is the top dead center mark (TDC) and the right mark is the timing mark (18 degrees BTDC).

(1) Position crankshaft pulley (1) with Top Dead Center (TDC) mark (2) at pointer.

NOTE

All directions of engine rotation will be stated as looking at the crankshaft pulley end of the engine.

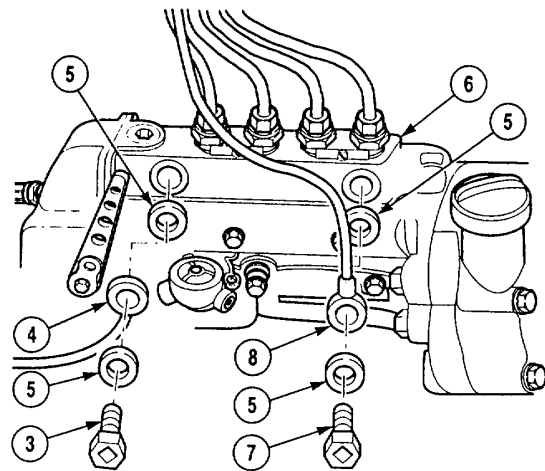


- (2) Using retainer, rotate crankshaft pulley (1) one half turn counter-clockwise.

WARNING

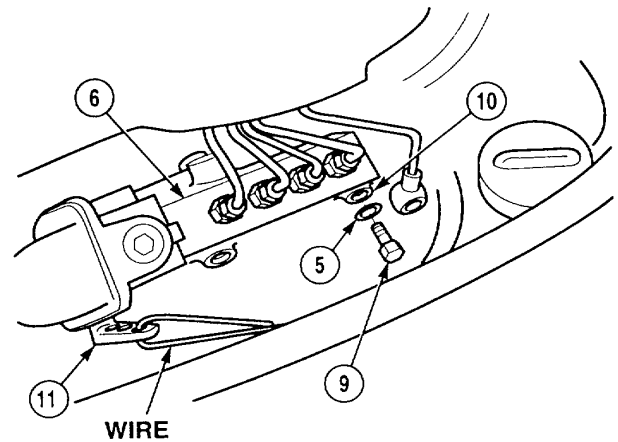
- Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET (15 m).
- Fuel and oil are slippery and can cause falls. To avoid injury, wipe up spilled fuel or oil with rags.

- (3) Remove screw (3), fuel line (4), and two washers (5) from injection pump (6). Discard washers.
- (4) Remove screw (7), overflow line (8), and two washers (5) from injection pump (6). Discard washers.

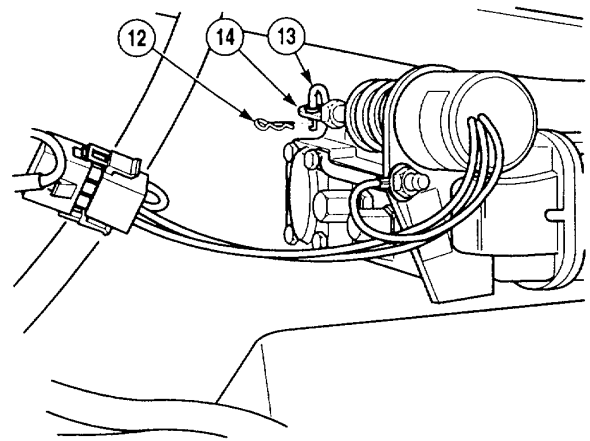


4-4. INJECTION PUMP ADJUSTMENT (CONT).

- (5) Install plug (9) and washer (5) in overflow port (10) of injection pump (6).
- (6) Position control lever (11) to maximum position and attach wire to hold that position.



- (7) Remove retaining clip (12) and plunger (13) from fuel shutoff lever (14).
- (8) Lift fuel shutoff lever (14) to maximum open position.

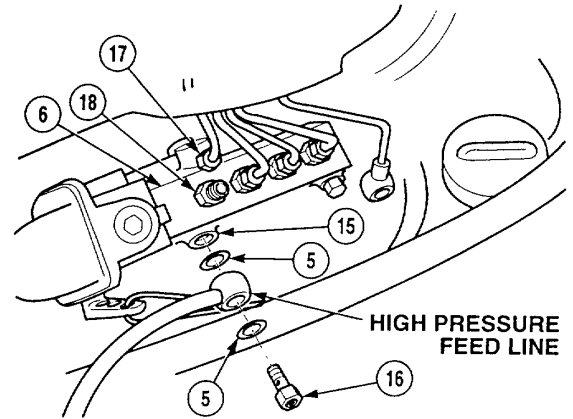


WARNING

- Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read **NO SMOKING WITHIN 50 FEET (15 m)**.
- Fuel and oil are slippery and can cause falls. To avoid injury, wipe up spilled fuel or oil with rags.

NOTE

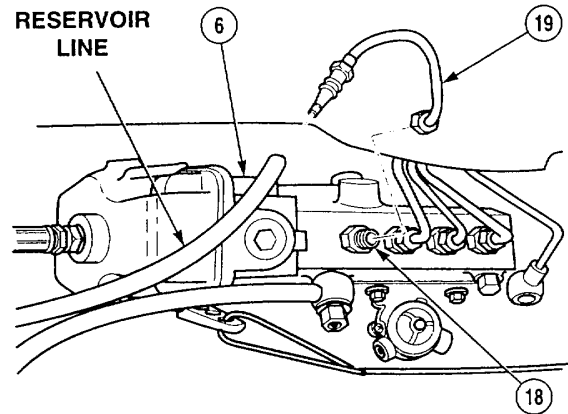
High pressure hand feed pump must be assembled prior to installation.



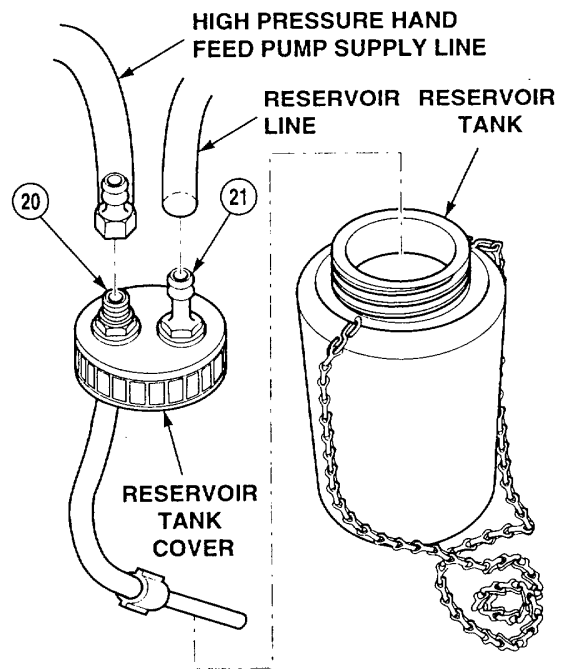
- (9) Install high pressure feed line in fuel line port (15) of injection pump (6) with two washers (5) and screw (16).
- (10) Remove No. 1 injector line (17) from fitting (18) of injection pump (6).

4-4. INJECTION PUMP ADJUSTMENT (CONT).

- (11) Install adapter (19) on fitting (18) of injection pump (6).
- (12) Install reservoir line on adapter (19).



- (13) Install high pressure hand feed pump supply line on fitting (20) of reservoir tank cover.
- (14) Install reservoir line on fitting (21) of reservoir tank cover.
- (15) Fill reservoir tank with clean fuel.
- (16) Install reservoir tank cover on reservoir tank.

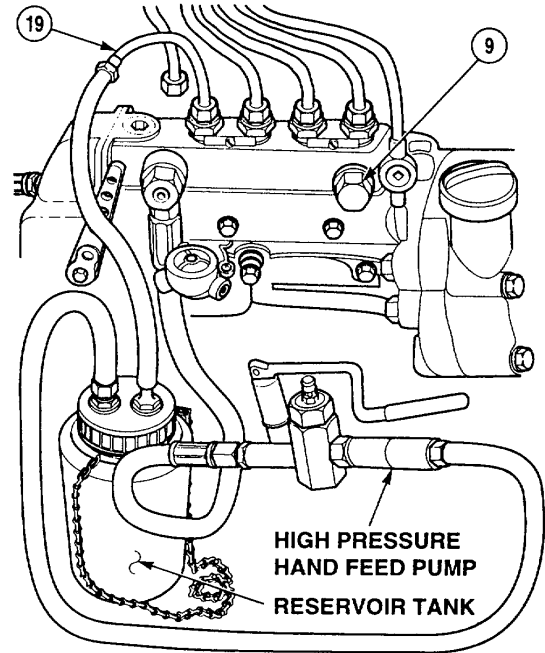


b. Adjustment.**WARNING**

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- Fuel and oil are slippery and can cause falls. To avoid injury, wipe up spilled fuel or oil with rags.

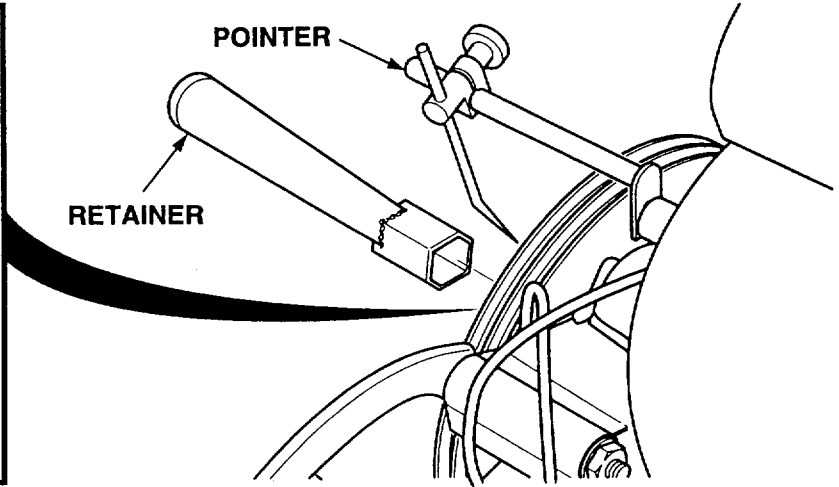
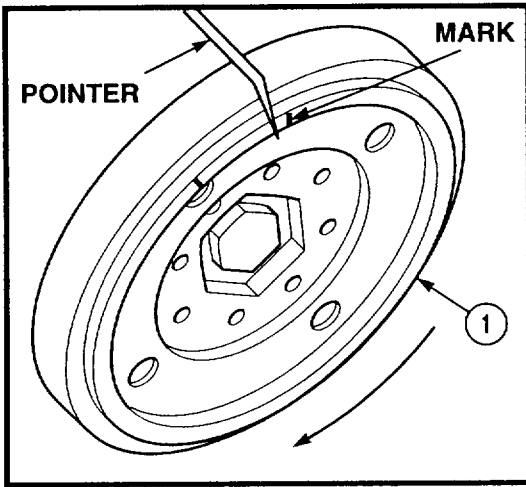
NOTE

Air must be bled from system prior to adjusting injection pump.

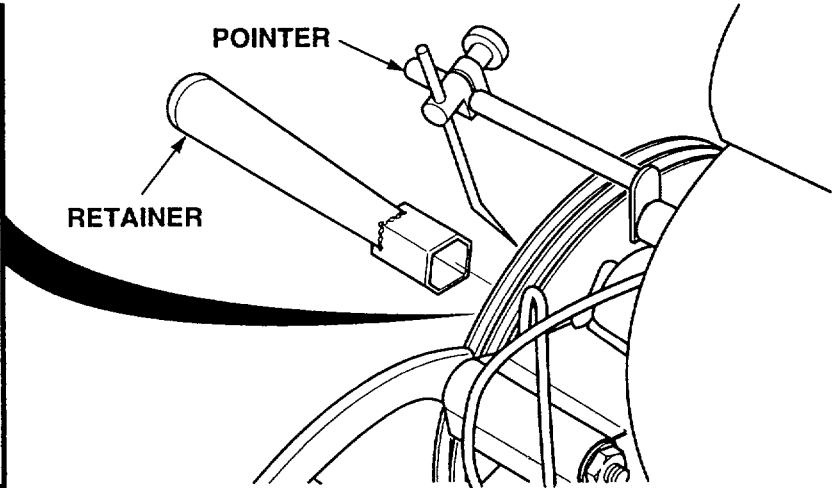
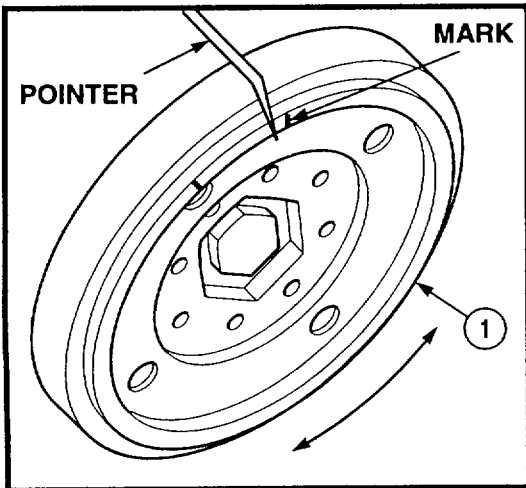


- (1) Loosen plug (9) slightly.
- (2) While holding a container under plug (9), operate high pressure hand feed pump until fuel flows past plug (9).
- (3) Tighten plug (9).
- (4) Actuate high pressure hand feed pump and observe fuel flow from adapter (19).

4-4. INJECTION PUMP ADJUSTMENT (CONT).



(5) With the aid of an assistant and using retainer, rotate pulley (1) slowly clockwise until fuel flow is reduced to droplets.



NOTE

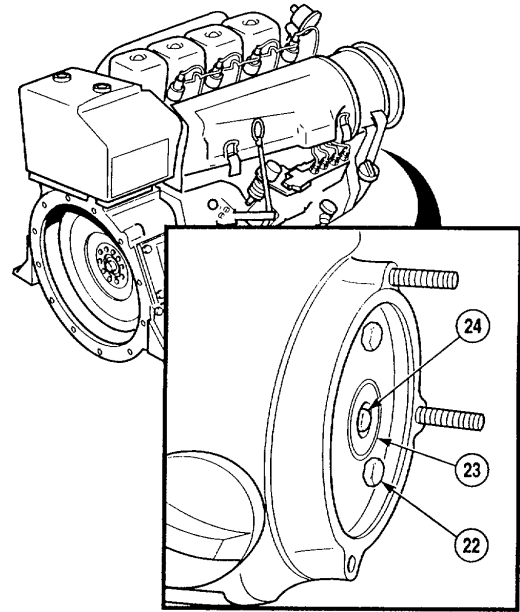
- If the pointer is not pointing at right-hand mark on pulley, proceed to step (6).
- If the pointer is pointing at the right-hand mark on pulley, proceed to removal step (1).

(6) Using retainer, rotate pulley (1) clockwise or counter-clockwise until pointer aligns with right-hand mark on pulley.

CAUTION

Do not remove timing device adjustment screws. Screws can easily fall inside engine resulting in damage to equipment or major engine disassembly.

- (7) Loosen three screws (22) on timing device (23). Do not remove screws.
- (8) With the aid of an assistant, perform adjustment steps (1) through (4).
- (9) Rotate clamping nut (24) until fuel flow is reduced to droplets.
- (10) Tighten three screws (22) on timing device (23).
- (11) Repeat step (4) to verify adjustment.



c. Removal.

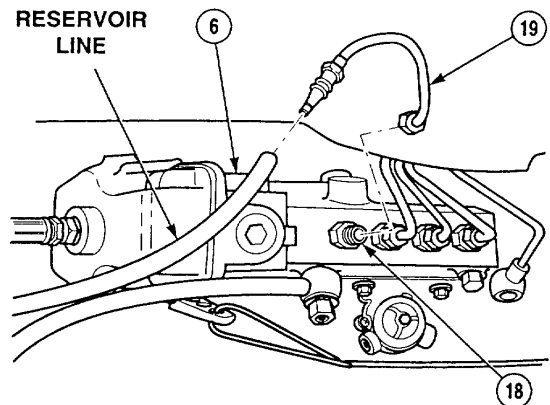
WARNING

- Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET (15 m).
- Fuel and oil are slippery and can cause falls. To avoid injury, wipe up spilled fuel or oil with rags.

NOTE

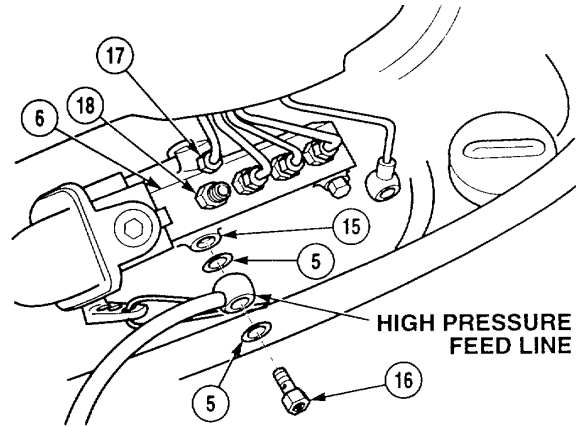
Use wiping rag to wipe up any spilled fuel during removal of adjustment equipment.

- (1) Remove reservoir line from adapter (19).
- (2) Remove adapter (19) from fitting (18) of injection pump (6).

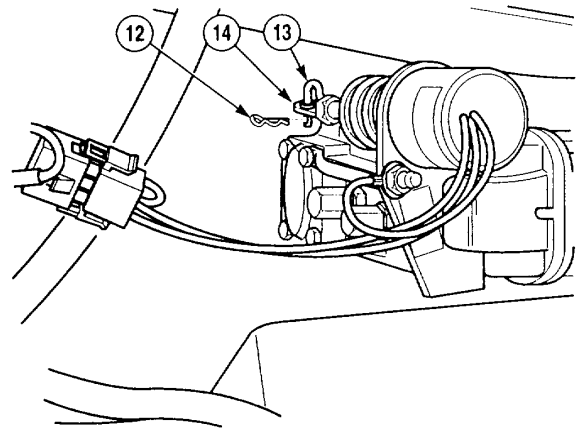


4-4. INJECTION PUMP ADJUSTMENT (CONT).

- (3) Install No. 1 injector line (17) on fitting (18) of injection pump (6).
- (4) Remove screw (16), high pressure feed line, and two washers (5) from fuel line port (15) of injection pump (6). Discard washers.



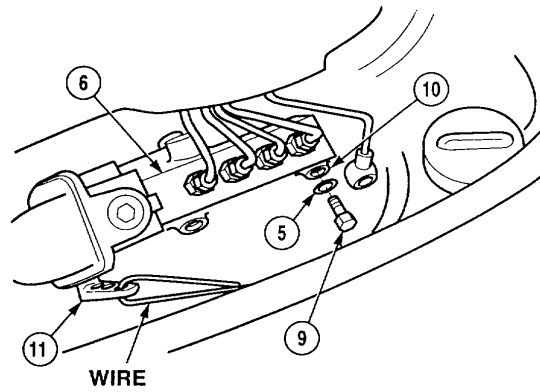
- (5) Install plunger (13) in fuel shutoff lever (14) with retaining clip (12).



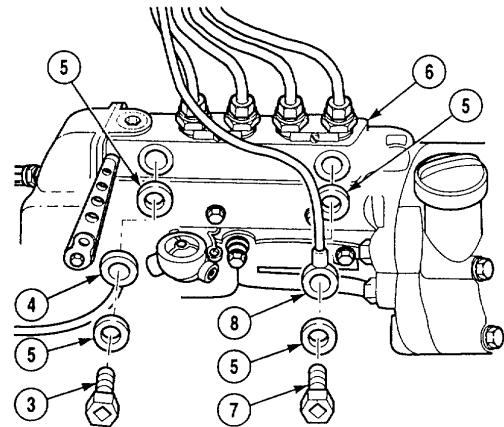
- (6) Remove wire from control lever (11). Discard wire.

WARNING

- Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read NO SMOKING WITHIN 50 FEET (15 m).
- Fuel and oil are slippery and can cause falls. To avoid injury, wipe up spilled fuel or oil with rags.



- (7) Remove plug (9) and washer (5) from overflow port (10) of injection pump (6). Discard washer.
- (8) Install overflow line (8) on injection pump (6) with two washers (5) and screw (7).
- (9) Install fuel line (4) on injection pump (6) with two washers (5) and screw (3).

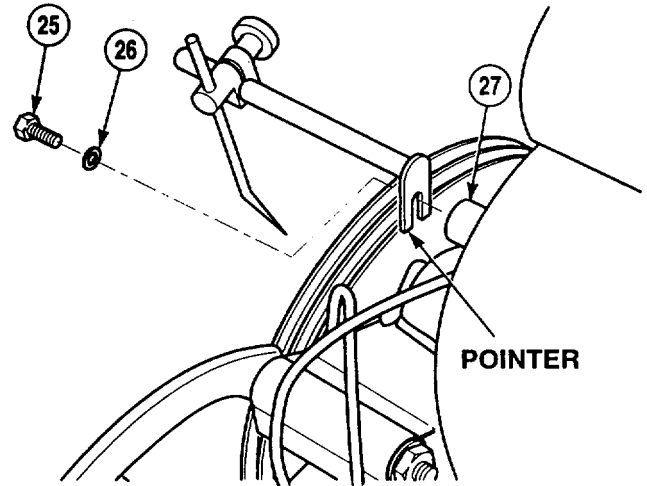


4-4. INJECTION PUMP ADJUSTMENT (CONT).

- (10) Remove screw (25), washer (26), and pointer from engine (27).
- (11) Install washer (26) and screw (25) in engine (27). Tighten to 18 lb-ft (25 N•m).

NOTE**Follow-on Maintenance:**

- Install blower belt tensioner (TM 10-3930-669-20).
- Install engine/transmission (Para 3-3).
- Remove wheel chocks (TM 10-3930-669-10).

**END OF TASK**

4-5. INJECTION PUMP REPLACEMENT.

This task covers:

- a. Removal b. Cleaning/Inspection c. Installation**

INITIAL SETUP:

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Wrench, Torque (0-60 N•m) (Item 5, Appendix E)
- Wrench, Torque (0 to 175 lb-ft [0-237 N•m]) (Item 5, Appendix E)

Materials/Parts

- Cap and Plug Set (Item 5, Appendix B)
- Rags, Wiping (Item 19, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)
- Tags, Identification (Item 21, Appendix B)
- Gasket
- Packing, Preformed
- Seal

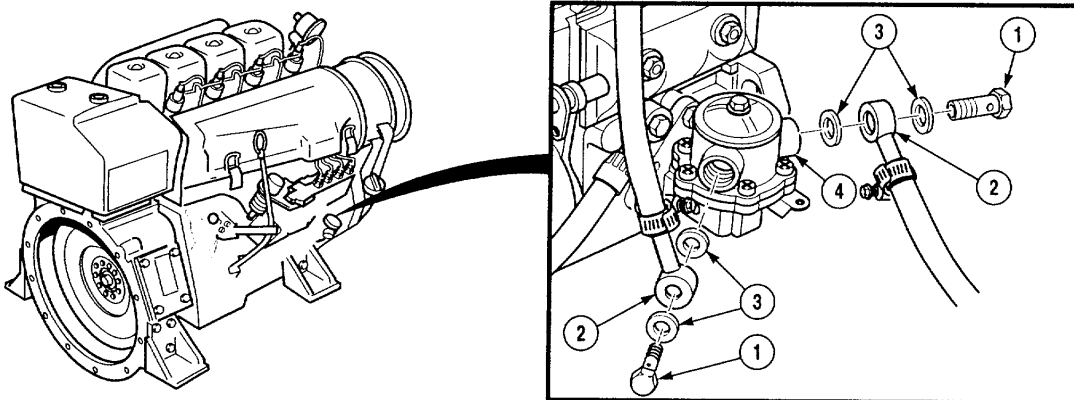
Materials/Parts - Continued

- Seal (2)
- Seal (4)
- Seal (4)
- Washer, Lock (3)

Equipment Condition

- Engine OFF (TM 10-3930-669-10)
- Wheels chocked (TM 10-3930-669-10)
- Engine/transmission removed (Para 3-3)
- No. 1 piston at top dead center (TDC) (TM 10-3930-669-20)
- Fuel pipes removed (TM 10-3930-669-20)
- Fuel shutoff solenoid removed (TM 10-3930-669-20)
- V-Belt tensioner removed (TM 10-3930-669-20)

a. Removal.



WARNING

BURN HAZARD

Allow engine to cool before performing maintenance on the muffler, exhaust pipe, exhaust manifold, or turbocharger. If necessary, use insulated pads and gloves.

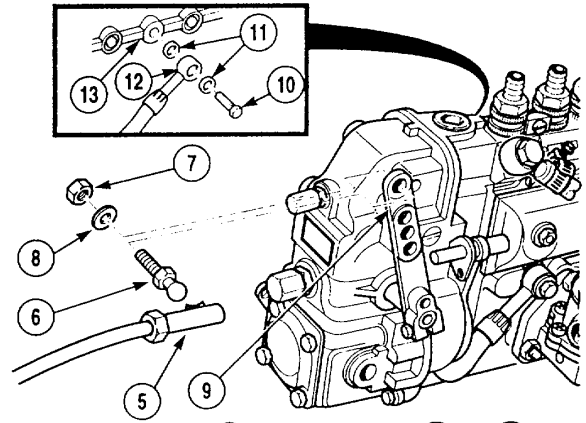
NOTE

- **Tag and mark all lines and fittings prior to removal.**
- **Cap and plug all lines and fittings when disconnected.**

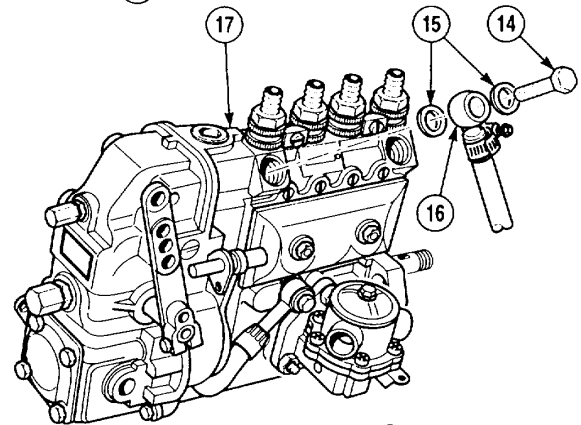
(1) Remove two screws (1), fuel lines (2), and four seals (3) from fuel supply pump (4). Discard seals.

4-5. INJECTION PUMP REPLACEMENT (CONT).

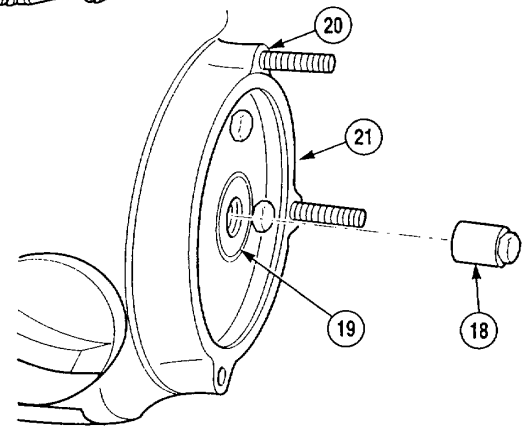
- (2) Remove cable (5) from ball screw (6).
- (3) Remove nut (7), washer (8), and ball screw (6) from lever (9).
- (4) Remove screw (10), two seals (11), and oil line (12) from engine block (13). Discard seals.



- (5) Remove screw (14), two seals (15), and fuel line (16) from injection pump (17). Discard seals.



- (6) Remove clamping nut (18) from timing device (19) at the fan belt tensioner position (20) of front engine cover (21).

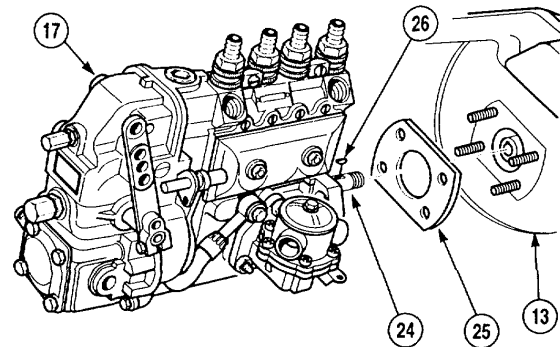
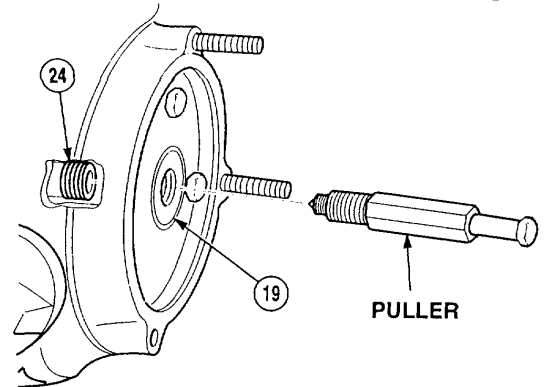
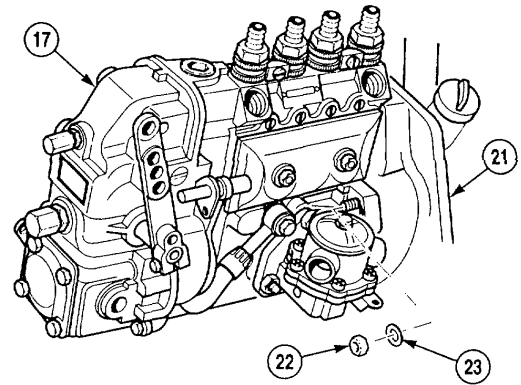


- (7) Remove four nuts (22) and washers (23) from injection pump (17) and front engine cover (21).

CAUTION

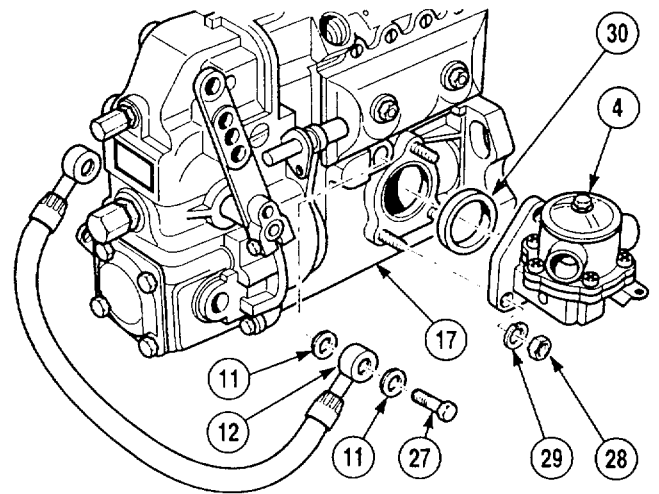
Injection pump may suddenly come free when device is used to press injection pump shaft from timing device. Failure to support injection pump could result in damage to equipment.

- (8) Install puller device in timing device (19).
- (9) Using puller device, remove injection pump shaft (24) from timing device (19).
- (10) Remove injection pump (17) and gasket (25) from engine block (13). Discard gasket.
- (11) Remove key (26) from injection pump shaft (24).
- (12) Place injection pump (17) on clean work surface.



4-5. INJECTION PUMP REPLACEMENT (CONT).

- (13) Remove screw (27), two seals (11), and oil line (12) from injection pump (17). Discard seals.
- (14) Remove three nuts (28), lock washers (29), fuel supply pump (4), and seal (30) from injection pump (17). Discard three lock washers and seal.



b. Cleaning/Inspection.

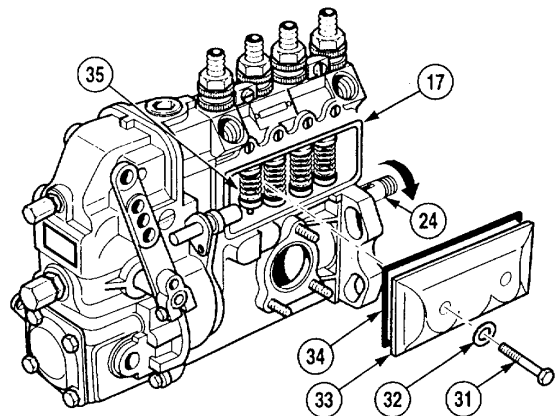
WARNING

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
- **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**

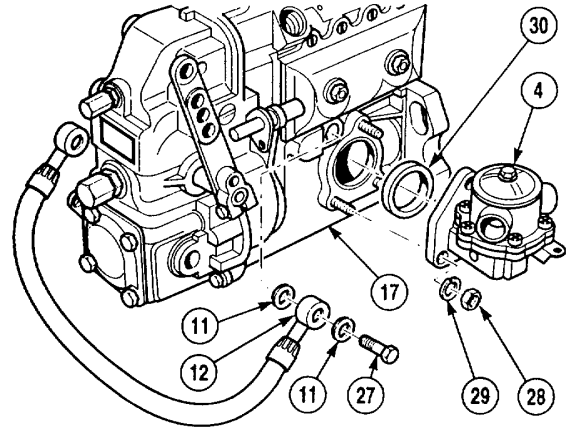
- (1) Clean all metal parts with dry-cleaning solvent and wipe dry with wiping rag.
- (2) Inspect all parts for breaks, cracks, burrs, and sharp edges.
- (3) Replace all damaged parts.

c. Installation.

- (1) Remove two screws (31), preformed packing (32), pump cover (33), and seal (34) from injection pump (17). Discard seal and preformed packings.
- (2) Turn injection pump shaft (24) counter-clockwise until cylinder number one plunger (35) lifts.
- (3) Install pump cover (33) on injection pump (17) with seal (34), two preformed packings (32), and screws (31). Tighten screws to 7 lb-ft (10 N•m).



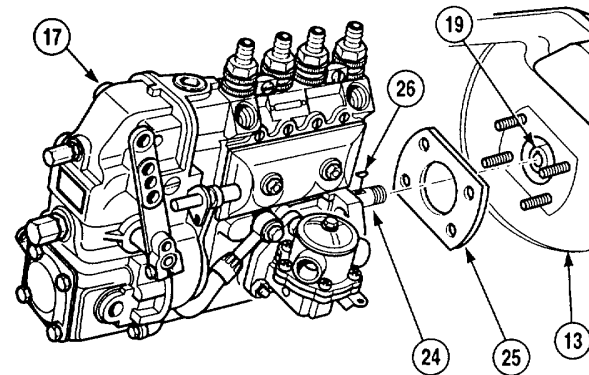
- (4) Install seal (30) and fuel supply pump (4) on injection pump (17) with three lock washers (29) and nuts (28). Tighten nuts to 7 lb-ft (10 N•m).
- (5) Install oil line (12) on injection pump (17) with two seals (11) and screw (27).



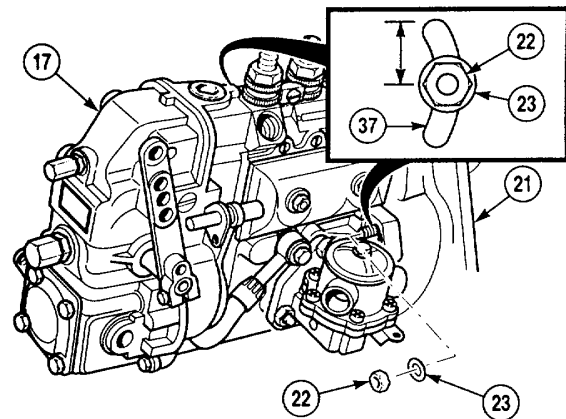
- (6) Install key (26) in injection pump shaft (24).
- (7) Position gasket (25) on engine block (13).

NOTE

Prior to mounting injection pump, align groove in timing device with key on injection pump shaft.

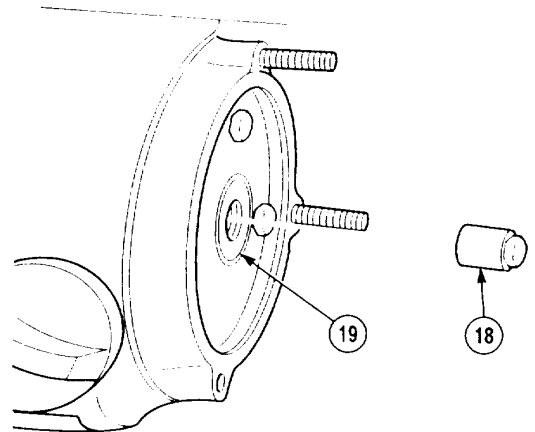


- (8) Mount injection pump (17) on engine block (13) by inserting shaft (24) and key (26) in timing device (19).
- (9) Position injection pump (17) on front engine cover (21) with four washers (23) and nuts (22).
- (10) Turn injection pump, as required, until four washers (23) and nuts (22) are centered in elongated holes (37) of injection pump (17). Tighten nuts 36 lb-ft (49 N•m).

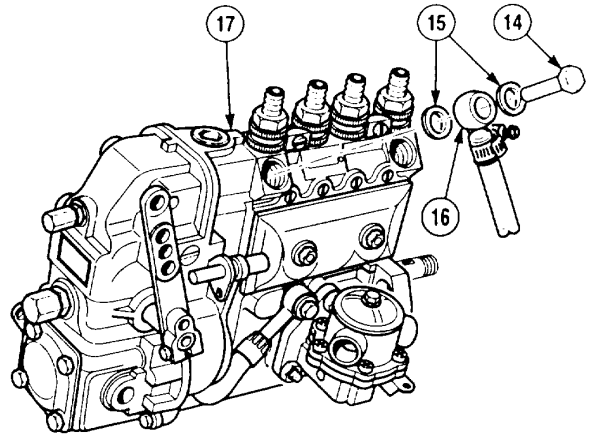


4-5. INJECTION PUMP REPLACEMENT (CONT).

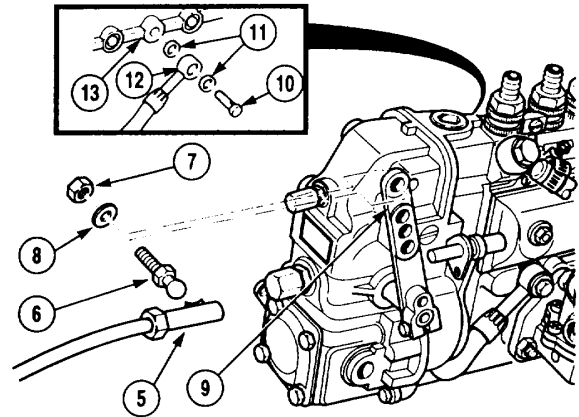
- (11) Install clamping nut (18) at timing device (19).
Tighten clamping nut to 44-52 lb-ft (60-70 N•m).



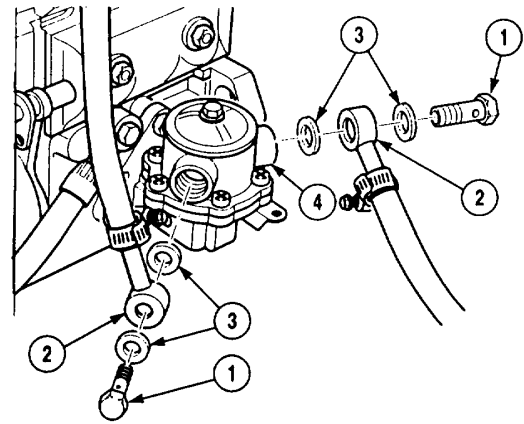
- (12) Install fuel line (16) on injection pump (17) with two seals (15) and screw (14).



- (13) Install oil line (12) on engine block (13) with two seals (11) and screw (10).
- (14) Install ball screw (6), washer (8), and nut (7) on lever (9).
- (15) Install cable (5) on ball screw (6).



- (16) Install two fuel lines (2), as tagged and marked during removal, on fuel supply pump (4) with four seals (3) and two screws (1).



NOTE

Follow-on Maintenance:

- Install V-belt tensioner (TM 10-3930-669-20).
- Install fuel pipes (TM 10-3930-669-20).
- Install fuel shutoff solenoid (TM 10-3930-669-20).
- Check and adjust injection pump (Para 4-4).
- Install engine/transmission (Para 3-3).

END OF TASK

CHAPTER 5
EXHAUST SYSTEM MAINTENANCE

Para	Contents	Page
5-1	Introduction	5-1
5-2	Exhaust Manifold Replacement	5-2

5-1. INTRODUCTION.

This chapter contains maintenance instructions for removing, replacing, installing, repairing, and testing exhaust components authorized by the Maintenance Allocation Chart (MAC) at the Direct Support and General Support Maintenance level.

5-2. EXHAUST MANIFOLD REPLACEMENT. '**This task covers:****a. Removal****b. Installation****INITIAL SETUP:***Tools and Special Tools*

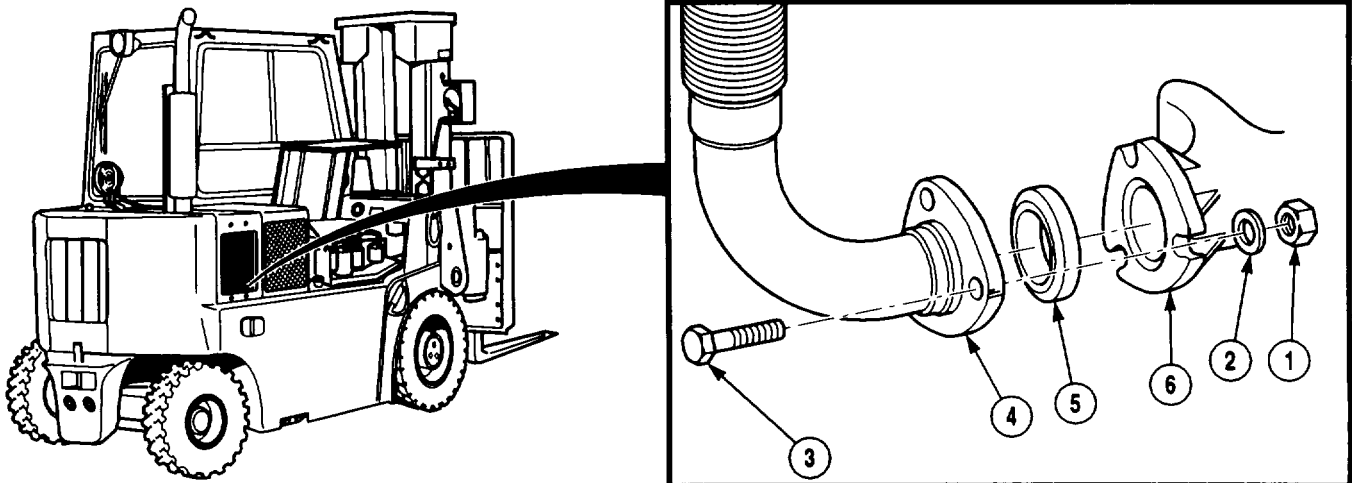
Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)

Materials/Parts

Gasket
Gasket (8)

Equipment Condition

Engine OFF (TM 10-3930-669-10)
Parking brake applied (TM 10-3930-669-1C)
Wheels chocked (TM 10-3930-669-10)
Right-hand engine access cover open
(TM 10-3930-669-10)
Batteries disconnected (TM 10-3930-669-20)
Blower ducting removed (Para 6-2)

a. Removal.**WARNING**

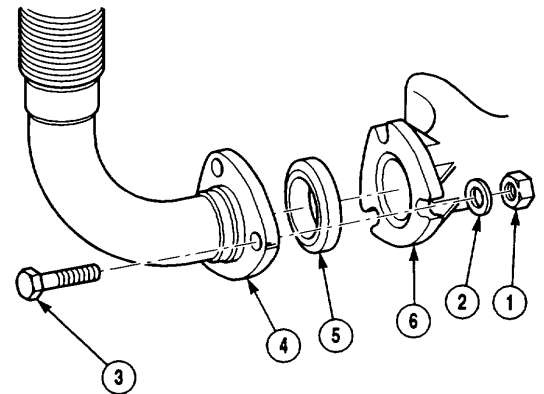
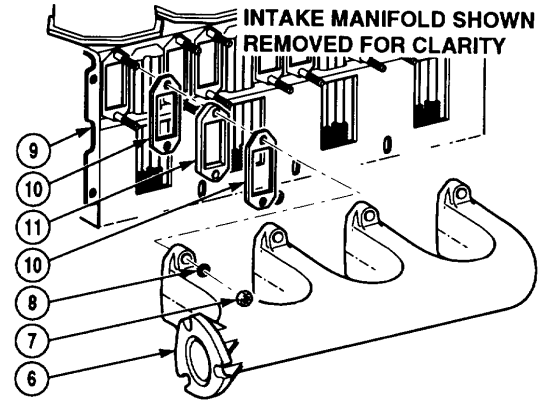
- Allow engine to cool before performing maintenance on the muffler, exhaust pipe, exhaust manifold, or turbocharger. If necessary, use insulated pads and gloves.
- Do not touch hot exhaust system with bare hands; injury to personnel will result.

- (1) Remove three nuts (1), washers (2), and screws (3) from exhaust pipe (4).
- (2) Remove exhaust pipe (4) and gasket (5) from manifold (6). Discard gasket.

- (3) Remove eight nuts (7), washers (8), and manifold (6) from engine (9).
- (4) Remove eight gaskets (10) and four spacers (11) from engine (9). Discard gaskets.

b. Installation.

- (1) Install eight gaskets (10) and four spacers (11) on engine (9).
- (2) Install manifold (6) on engine (9) with eight washers (8) and nuts (7).
- (3) Position gasket (5) and exhaust pipe (4) on manifold (6) and install with three screws (3), washers (2), and nuts (1). Tighten nuts only until gasket is seated.



NOTE

Follow-on Maintenance:

- Install blower ducting (Para 6-2).
- Connect batteries (TM 10-3930-669-20).
- Close right-hand engine access cover (TM 10-3930-669-10).
- Remove wheel chocks (TM 10-3930-669-10).

END OF TASK

CHAPTER 6

COOLING SYSTEM MAINTENANCE

Para	Contents	Page
6-1	Introduction.....	6-1
6-2	Blower Ducting Replacement.....	6-2
6-3	Blower Repair.....	6-10

6-1. INTRODUCTION.

This chapter contains maintenance instructions for removing, replacing, installing, repairing, and testing cooling components authorized by the Maintenance Allocation Chart (MAC) at the Direct Support and General Support Maintenance level.

6-2. BLOWER DUCTING REPLACEMENT.

This task covers:

- a. Removal b. Cleaning/Inspection c. Installation

INITIAL SETUP:

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)

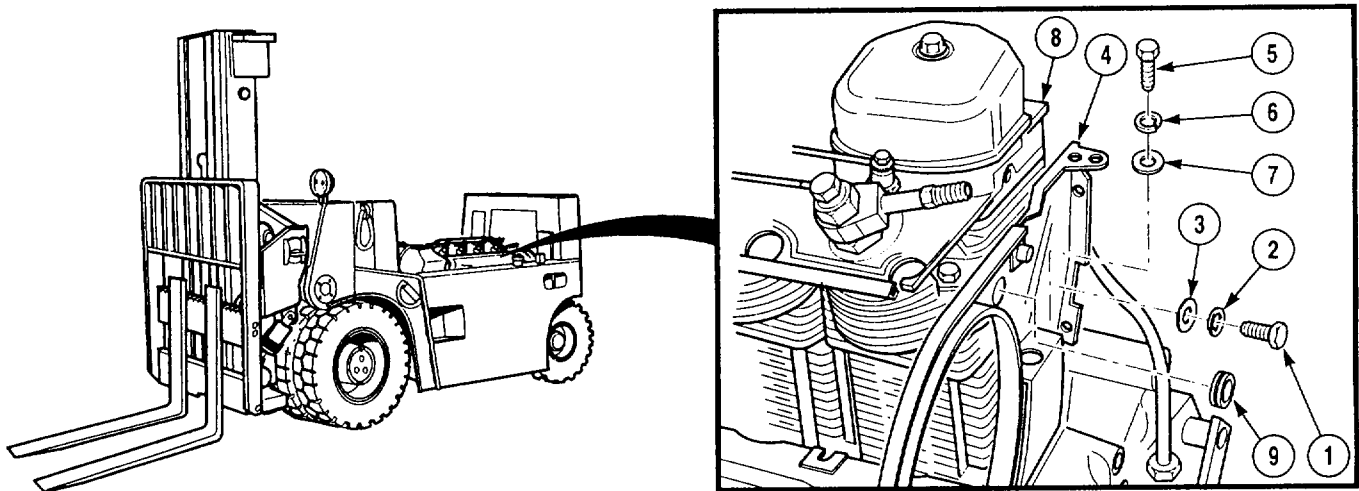
Materials/Parts

- Cable Ties (Item 4, Appendix B)
- Rags, Wiping (Item 19, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)
- Washer, Lock (2)
- Washer, Lock (2)
- Washer, Lock (2)
- Washer, Lock (3)
- Washer, Lock (6)
- Washer, Lock (11)

Equipment Condition

- Wheels chocked (TM 10-3930-669-10)
- Cab removed (TM 10-3930-669-20)
- Fuel pipes removed (TM 10-3930-669-20)
- Blower removed (TM 10-3930-669-20)
- Engine oil breather removed
(TM 10-3930-669-20)
- Engine oil cooler removed
(TM 10-3930-669-20)
- Transmission oil cooler removed
(TM 10-3930-669-20)

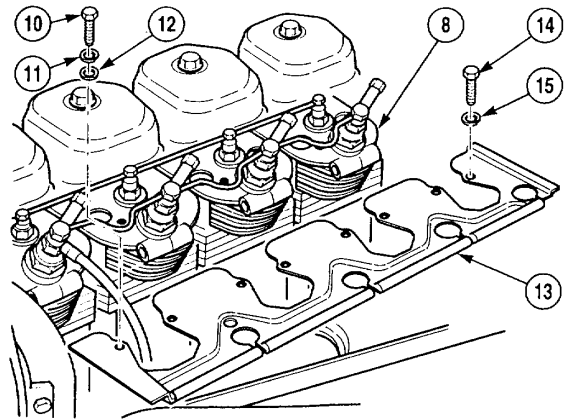
a. Removal.



- (1) Remove two screws (1), lock washers (2), and washers (3) from plate (4). Discard lock washers.
- (2) Remove screw (5), lock washer (6), washer (7), and plate (4) from engine (8). Discard lock washer.
- (3) Remove grommet (9) from plate (4).

(4) Remove screw (10), lock washer (11), and washer (12) from guide rail (13). Discard lock washer.

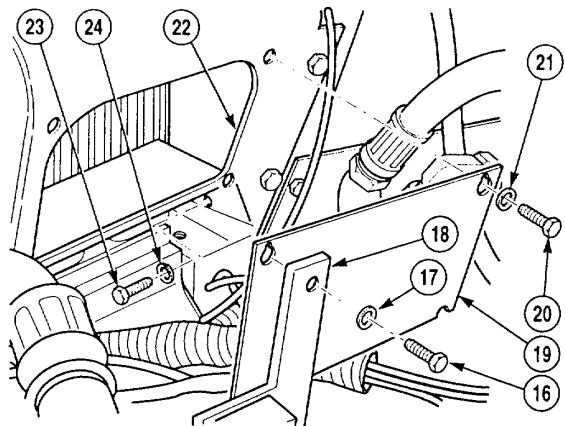
(5) Remove seven screws (14), lock washers (15), and guide rail (13) from engine (8). Discard lock washers.



(6) Remove two screws (16), washers (17), and bracket (18) from cover (19).

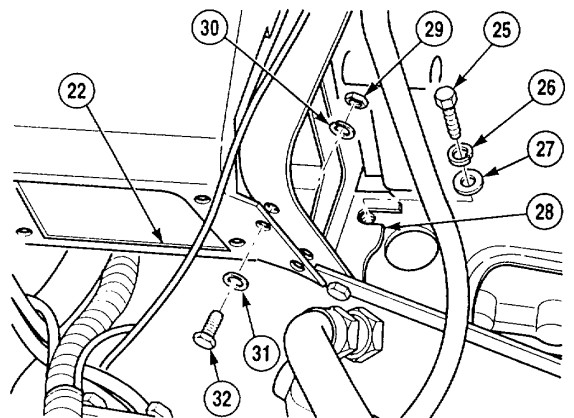
(7) Remove two screws (20), washer (21), and cover (19) from hood (22).

(8) Remove screw (23) and lock washer (24) from hood (22). Discard lock washer.



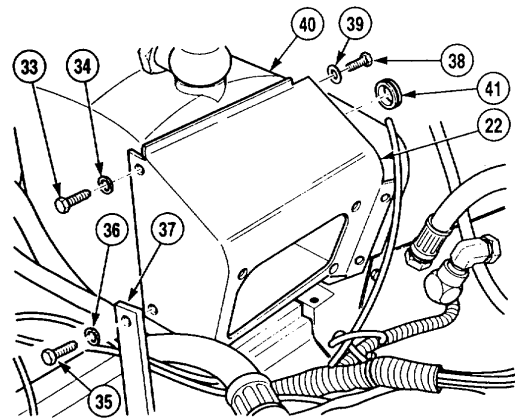
(9) Remove screw (25), lock washer (26), and washer (27) from plate (28).

(10) Remove two nuts (29), lock washers (30), washers (31), and screws (32) from hood (22) and plate (28). Discard lock washers.

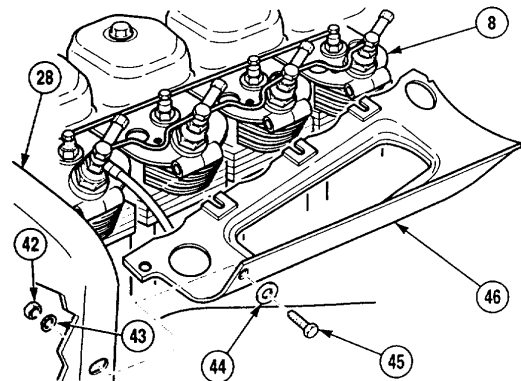


6-2. BLOWER DUCTING REPLACEMENT (CONT).

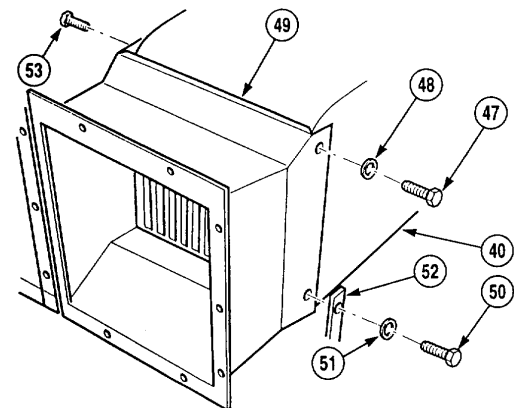
- (11) Remove screw (33) and washer (34) from hood (22).
- (12) Remove screw (35), washer (36), and bracket (37) from hood (22).
- (13) Remove screw (38), washer (39), and hood (22) from transmission oil cooler (40).
- (14) Remove grommet (41) from hood (22).



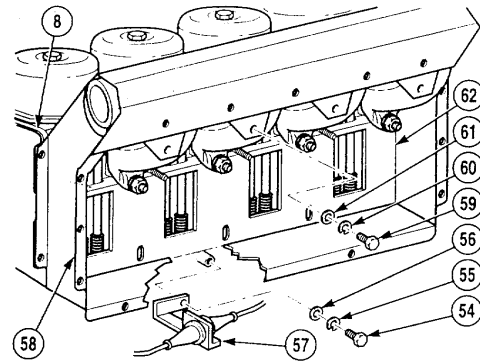
- (15) Remove nut (42), lock washer (43), washer (44), and screw (45) from plate (28) and base ducting (46). Discard lock washer.
- (16) Remove base ducting (46) from engine (8).



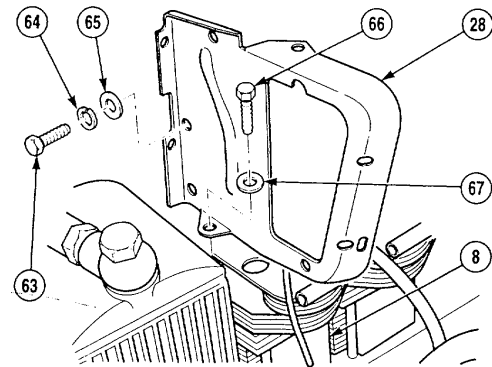
- (17) Remove screw (47) and washer (48) from oil cooler duct (49).
- (18) Remove screw (50), washer (51), and bracket (52) from oil cooler duct (49).
- (19) Remove screw (53) and oil cooler duct (49) from transmission oil cooler (40).



- (20) Remove screw (54), lock washer (55), washer (56), and bracket (57) from engine (8).
- (21) Remove six screws (59), lock washers (60), and washers (61) from manifold ducting (58). Discard lock washers.
- (22) Remove manifold ducting (58) from engine (8).
- (23) Remove baffle (62) from engine (8).



- (24) Remove three screws (63), lock washers (64), and washers (65) from plate (28). Discard lock washers.
- (25) Remove screw (66), washer (67), and plate (28) from engine (8).



6-2. BLOWER DUCTING REPLACEMENT (CONT).

b. *Cleaning/Inspection.*

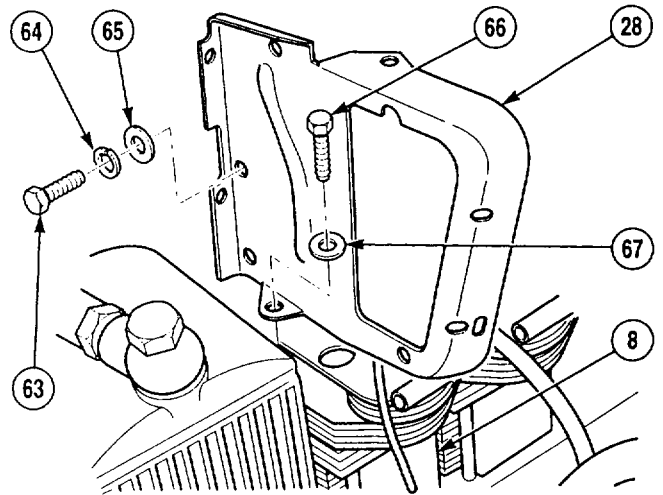
WARNING

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

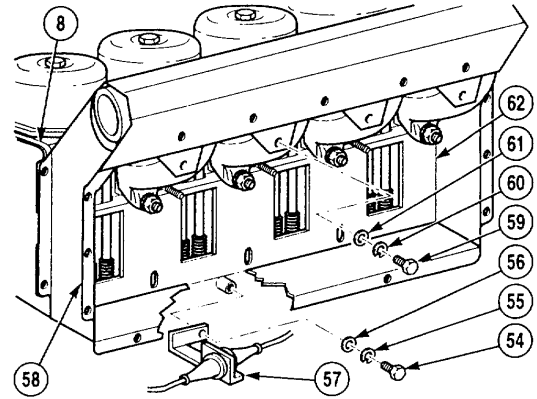
- (1) Clean all metal parts with dry-cleaning solvent.
- (2) Dry all parts with wiping rags.
- (3) Inspect all parts for breaks, cracks, burrs, and sharp edges.
- (4) Replace all damaged parts.

c. *Installation.*

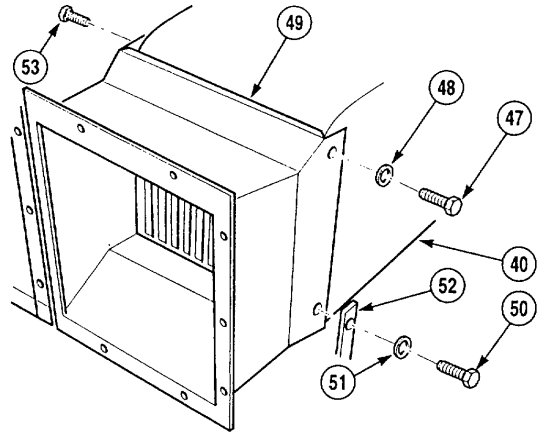
- (1) Install plate (28) on engine (8) with washer (67) and screw (66).
- (2) Install three washers (65), lock washers (64), and screws (63) in plate (28).



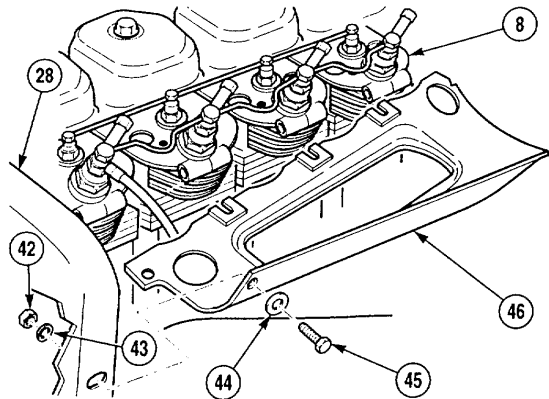
- (3) Position baffle (62) on engine (8).
- (4) Install manifold ducting (58) on engine (8) with six washers (61), lock washers (60), and screws (59).
- (5) Install bracket (57) on manifold ducting (58) with washer (56), lock washer (55), and screw (54).



- (6) Install oil cooler duct (49) on transmission oil cooler (40) with screw (53).
- (7) Install bracket (52) on oil cooler duct (49) with washer (51) and screw (50).
- (8) Install washer (48) and screw (47) in oil cooler duct (49).

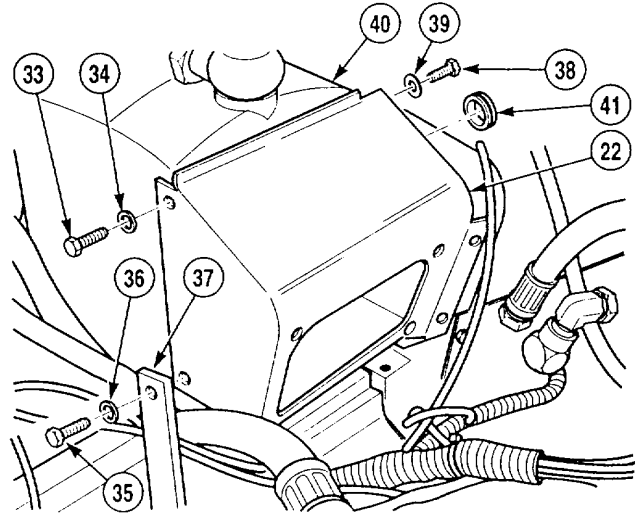


- (9) Position base ducting (46) on engine (8).
- (10) Install screw (45), washer (44), lock washer (43), and nut (42) in base ducting (46) and plate (28).

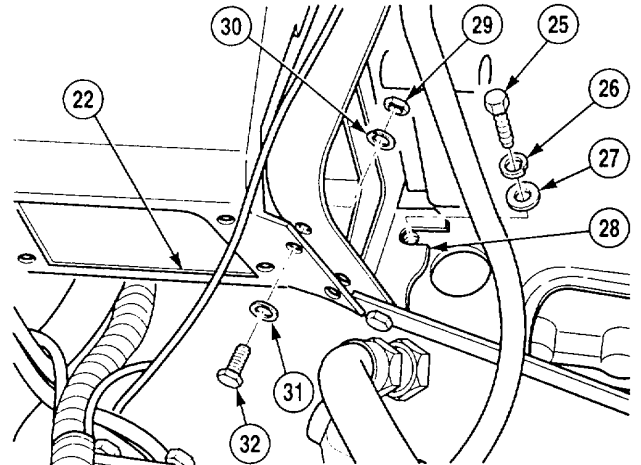


6-2. BLOWER DUCTING REPLACEMENT (CONT.)

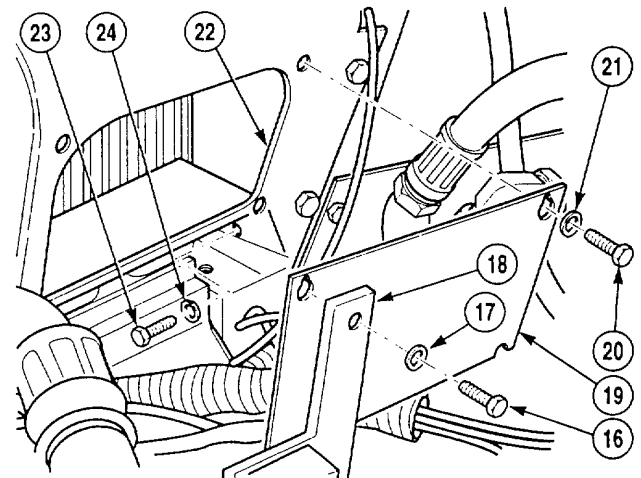
- (11) Install grommet (41) in hood (22).
- (12) Install hood (22) on transmission oil cooler (40) with washer (39) and screw (38).
- (13) Install bracket (37) on hood (22) with washer (36) and screw (35).
- (14) Install washer (34) and screw (33) in hood (22).



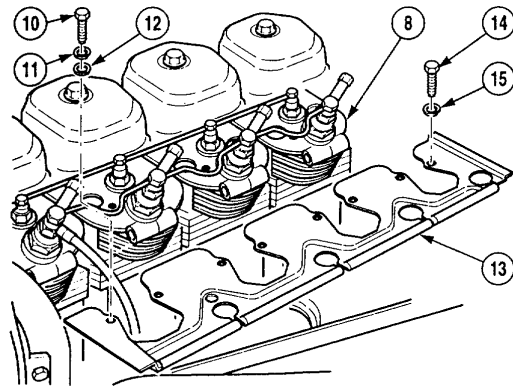
- (15) Install two screws (32), washers (31), lock washers (30), and nuts (29) in hood (22) and plate (28).
- (16) Install washer (27), lock washer (26), and screw (25) in plate (28).



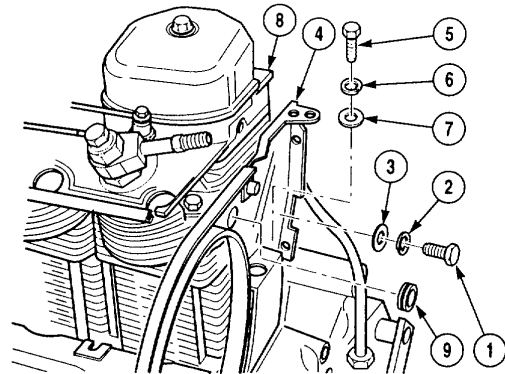
- (17) Install lock washer (24) and screw (23) in hood (22).
- (18) Install cover (19) on hood (22) with two washers (21) and screws (20).
- (19) Install bracket (18) on cover (19) with two washers (17) and screws (16).



- (20) Install guide rail (13) on engine (8) with seven lock washers (15) and screws (14).
- (21) Install washers (12), lock washer (11), and screw (10) in guide rail (13).



- (22) Install grommet (9) in plate (4).
- (23) Install plate (4) on engine (8) with washer (7), lock washer (6), and screw (5).
- (24) Install two washers (3), lock washers (2), and screws (1) in plate (4)



NOTE
Follow-on Maintenance:

- **Install engine oil cooler**
 (TM 10-3930-669-20).
- **Install engine oil breather**
 (TM 10-3930-669-20).
- **Install blower**
 (TM 10-3930-669-20).
- **Install fuel pipes**
 (TM 10-3930-669-20).
- **Install cab**
 (TM 10-3930-669-20).
- **Remove wheel chocks**
 (TM 10-3930-669-10).
- **Install transmission oil cooler**
 (TM 10-3930-669-20).

END OF TASK

6-3. BLOWER REPAIR.

This task covers:

- a. Removal b. Cleaning/Inspection c. Assembly

INITIAL SETUP:

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)
Press, 60 Ton (Item 5, Appendix E)

Materials/Parts - Continued

Washer, Lock
Washer, Lock
Washer, Lock (2)

Materials/Parts

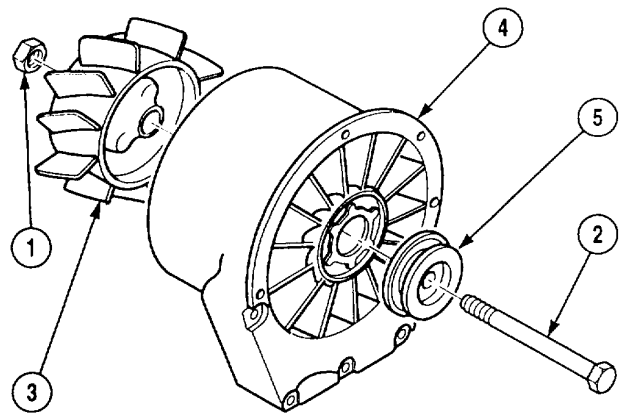
Rags, Wiping (Item 19, Appendix B)
Solvent, Dry-cleaning (Item 20, Appendix B)

Equipment Condition

Blower removed (TM 10-3930-669-20)

a. Disassembly.

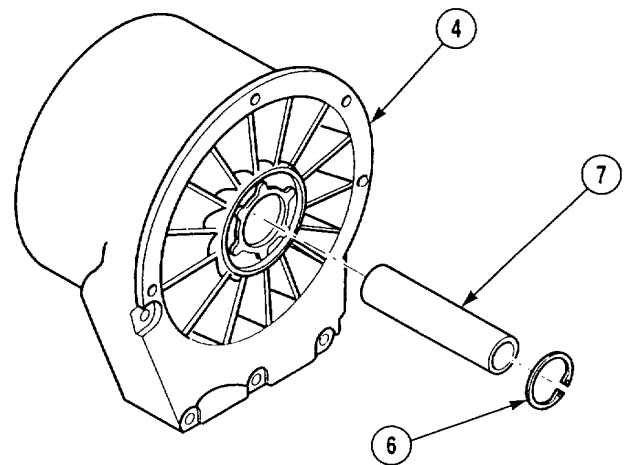
- (1) Remove nut (1), screw (2), and impeller (3) from blower (4).
- (2) Remove pulley (5) from blower (4).



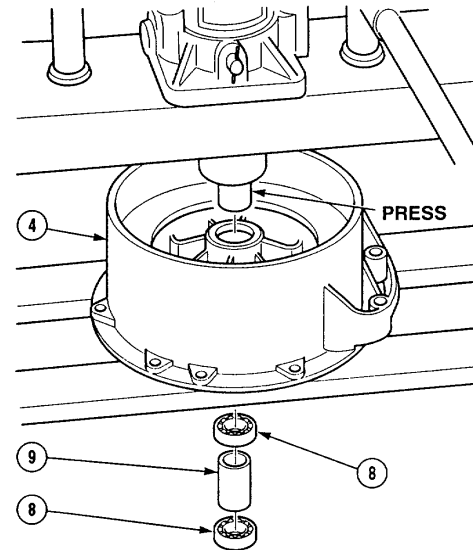
WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (3) Remove snap ring (6) and shaft (7) from blower (4).



- (4) Using a press, remove two bearings (8) and bushing (9) from blower (4).



b. Cleaning/Inspection.

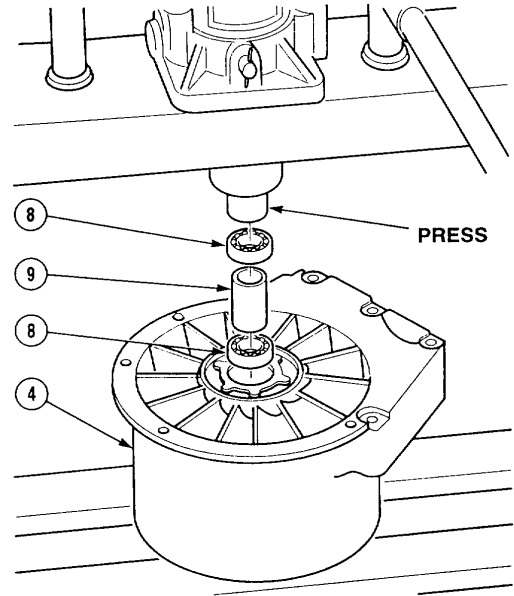
WARNING

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
 - **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**
- (1) Clean all metal parts with dry-cleaning solvent.
 - (2) Dry all parts with wiping rags.
 - (3) Inspect all parts for breaks, cracks, burrs, and sharp edges.
 - (4) Replace all damaged parts.

6-3. BLOWER REPAIR (CONT).

c. Assembly.

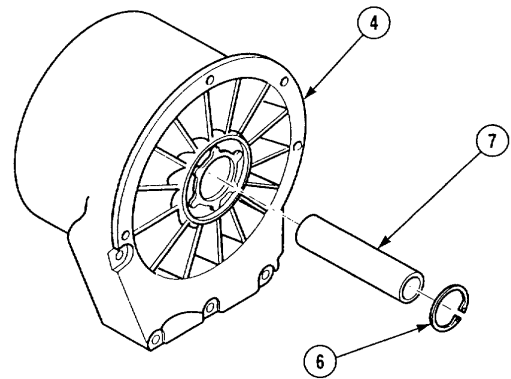
- (1) Using press, install two bearings (8) and bushing (9) in blower (4).



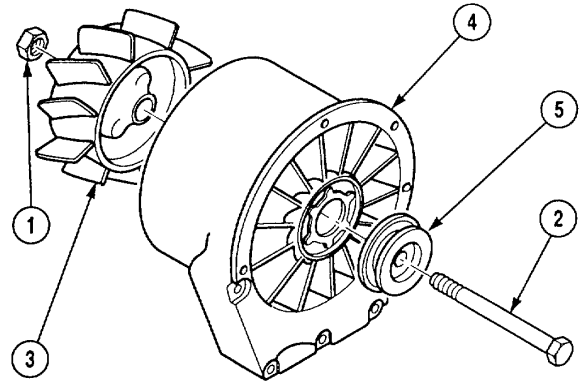
WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (2) Install shaft (7) and snap ring (6) in blower (4).



- (3) Install pulley (5) on blower (4).
- (4) Install impeller (3), screw (2), and nut (1) in blower (4).



NOTE
Follow-on Maintenance:

- Install blower (TM 10-3930-669-20).

END OF TASK

6-13/(6-14 blank)

CHAPTER 7

ELECTRICAL SYSTEM MAINTENANCE

Para	Contents	Page
7-1	Introduction.....	7-1
7-2	Alternator Repair	7-2
7-3	Starter Repair	7-15
7-4	Cab Wire Harness Replacement.....	7-31
7-5	Engine Wire Harness Replacement	7-44

7-1. INTRODUCTION.

This chapter contains maintenance instructions for removing, repairing, installing, and replacing electrical system components as authorized by the Maintenance Allocation Chart (MAC) at the Direct and General Support Maintenance level.

7-2. ALTERNATOR REPAIR.

This task covers:

- a. Removal b. Cleaning/Inspection c. Assembly

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Gun, Soldering (Item 5, Appendix E)
 Press, 60 Ton (Item 5, Appendix E)
 Test Stand, Automotive Generator and Starter (Item 6, Appendix E)

Materials/Parts - Continued

Washer, Lock (5)
 Washer, Lock (5)
 Washer, Plastic
 Washer, Plastic (2)
 Washer, Plastic (3)

Materials /Parts

Solvent, Dry-cleaning (Item 20, Appendix B)
 Tags, Identification (Item 21, Appendix B)
 Nut, Lock
 Nut, Lock (2)
 Nut, Lock (2)
 Nut, Lock (3)
 Nut, Lock (3)

Personnel Required

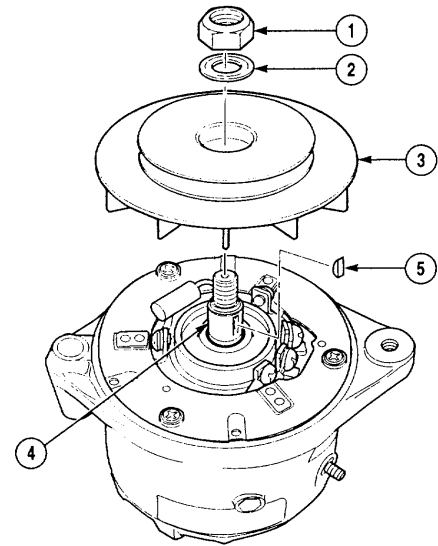
Two

Equipment Condition

Alternator removed (TM 10-3930-669-20)
 Regulator removed (TM 10-3930-669-20)
 Relay removed (TM 10-3930-669-20)

a. Disassembly.

- (1) Remove lock nut (1), washer (2), and pulley assembly (3) from rotor assembly shaft (4). Discard lock nut.
- (2) Remove key (5) from rotor assembly shaft (4).



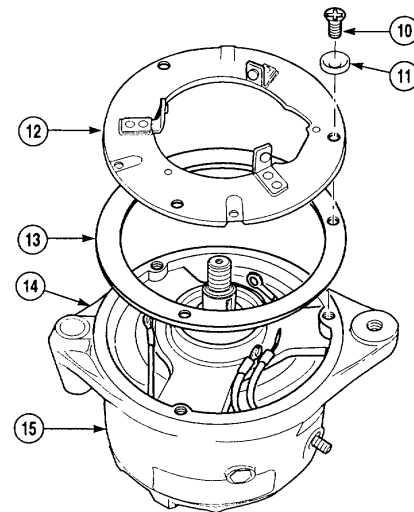
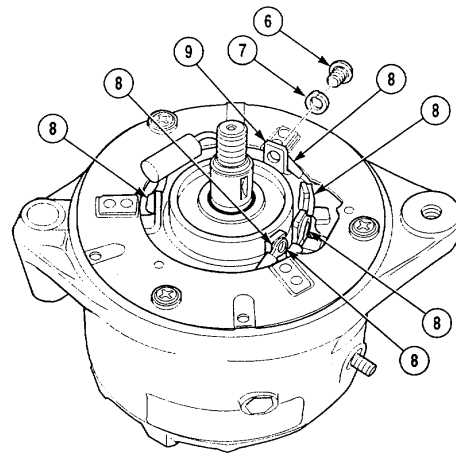
NOTE

Tag and mark all wires prior to removal.

- (3) Remove five screws (6), lock washers (7), and six wires (8) from five terminals (9). Discard lock washers.

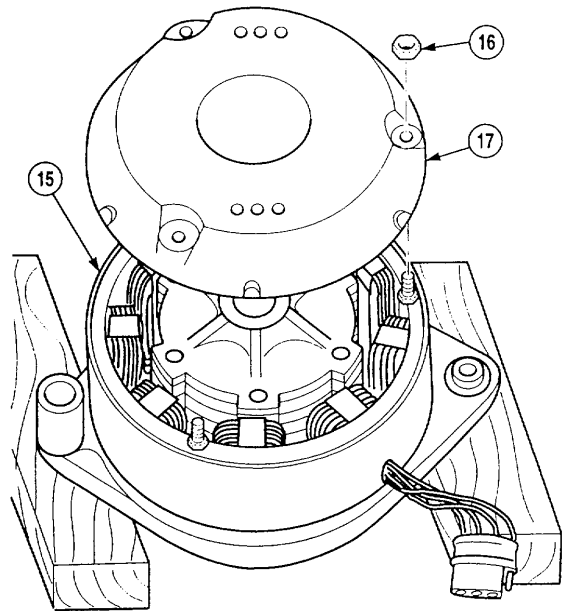
- (4) Remove three screws (10), plastic washers (11), heat sink (12), and insulator (13) from forgings and field coil assembly (14). Discard plastic washers.

- (5) Turn alternator (15) over and place on wooden blocks.



7-2. ALTERNATOR REPAIR (CONT).

- (6) Remove three lock nuts (16) and end cover (17) from alternator (15). Discard lock nuts.

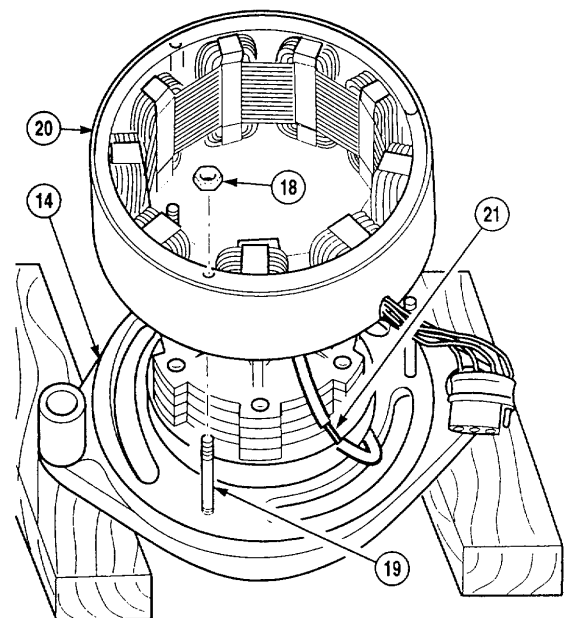


- (7) Remove three nuts (18) from screw shafts (19) in forging and field coil assembly (14).

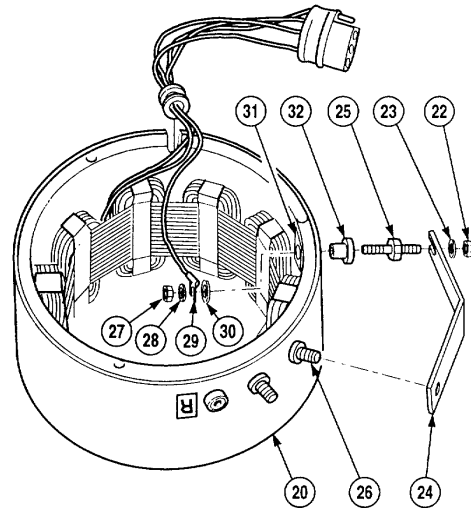
- (8) Separate forging and field coil assembly (14) and stator and shell assembly (20) until soldered connection (21) can be accessed.

- (9) Using a soldering gun, disconnect soldered connection (21).

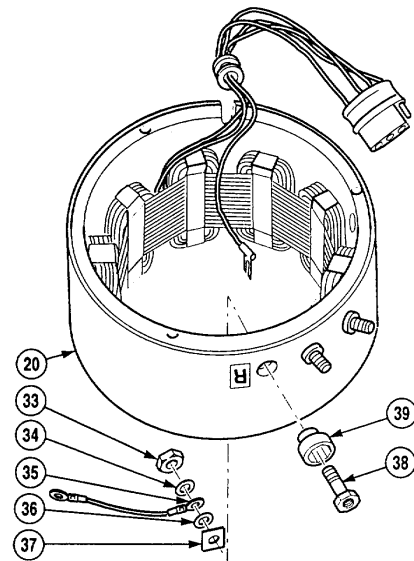
- (10) Remove three screw shafts (19) from forging and field coil assembly (14).



- (11) Remove lock nut (22), washer (23), and strap (24) from stud (25) and stud (26). Discard lock nut.
- (12) Remove lock nut (27), washer (28), connector (29), plastic washer (30), and insulator (31) from stud (25). Discard lock nut and plastic washer.
- (13) Remove stud (25) and collar (32) from stator and shell assembly (20).

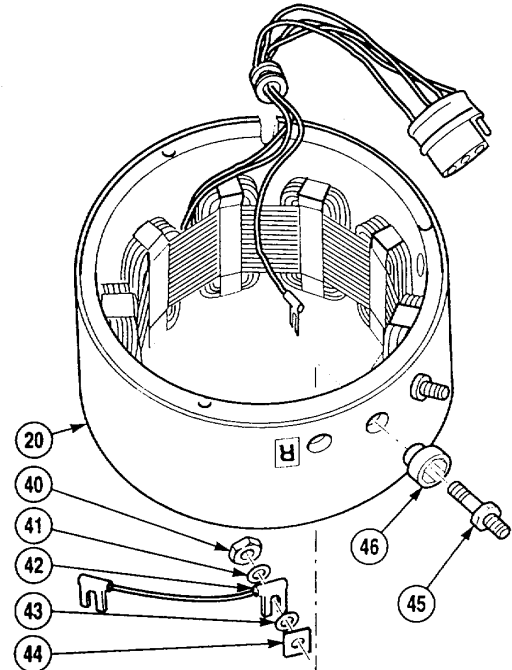


- (14) Remove lock nut (33), washer (34), connector (35) plastic washer (36), and insulator (37) from screw (38). Discard lock nut and plastic washer.
- (15) Remove screw (38) and collar (39) from stator and shell assembly (20)



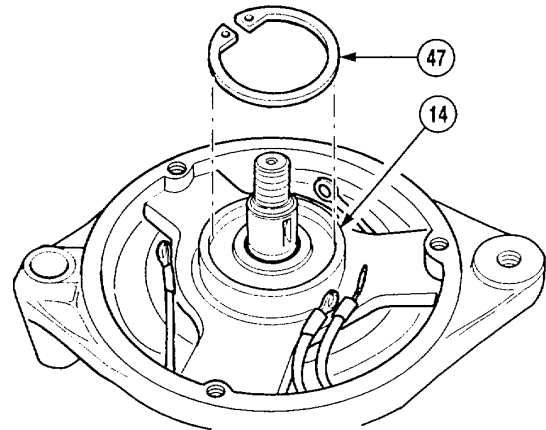
7-2. ALTERNATOR REPAIR (CONT).

- (16) Remove lock nut (40), washer (41), connector (42), plastic washer (43), and insulator (44) from screw (45). Discard lock nut and plastic washer.
- (17) Remove screw (45) and collar (46) from stator and shell assembly (20).

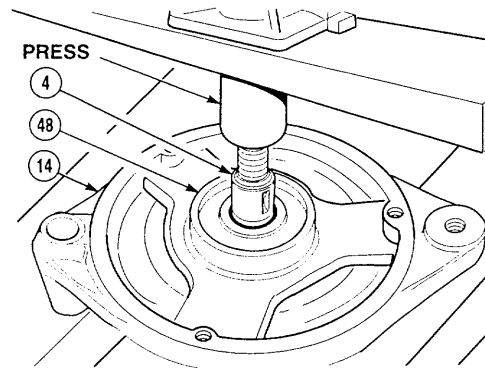
**WARNING**

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (18) Remove retaining ring (47) from forging and field coil assembly (14).



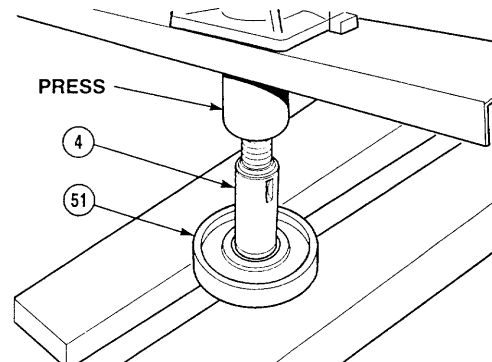
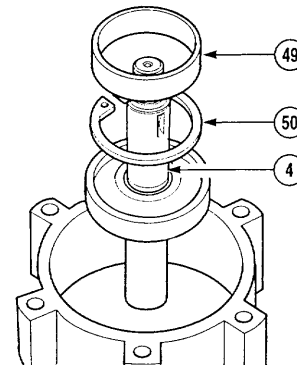
- (19) Using a press, remove rotor assembly shaft (4) from outer bearing (48) in forging and field coil assembly (14).



WARNING

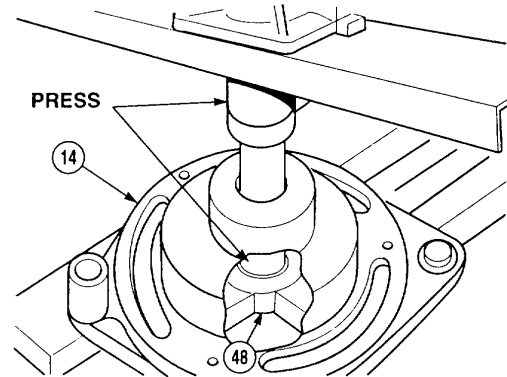
Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (20) Remove retaining cup (49) and retaining ring (50) from rotor assembly shaft (4).
- (21) Using a press, remove rotor assembly shaft (4) from inner bearing (51).



7-2. ALTERNATOR REPAIR (CONT).

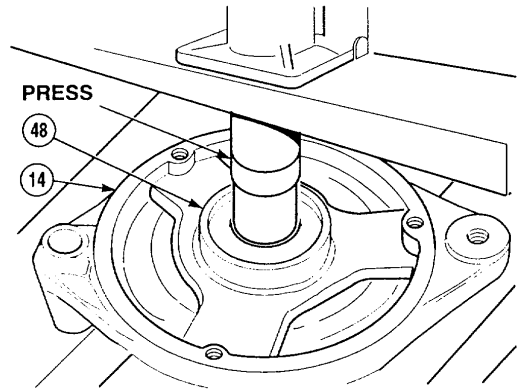
- (22) Using a press, remove outer bearing (48) from forging and field coil assembly (14).

**b. Cleaning/Inspection.****WARNING**

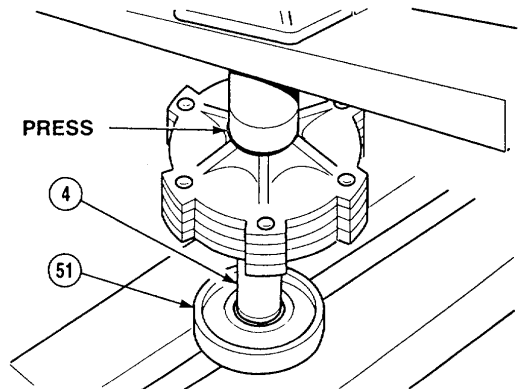
- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
 - If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
- (1) Clean all metal parts with dry-cleaning solvent.
 - (2) Do not allow dry-cleaning solvent to come in contact with rubber wire insulation.
 - (3) Inspect all parts for breaks, cracks, burrs, and sharp edges.
 - (4) Inspect rotor, refer to TM 9-2920-225-34.
 - (5) Replace all damaged parts.

c. Assembly.

- (1) Using a press, install outer bearing (48) in forging and field coil assembly (14).



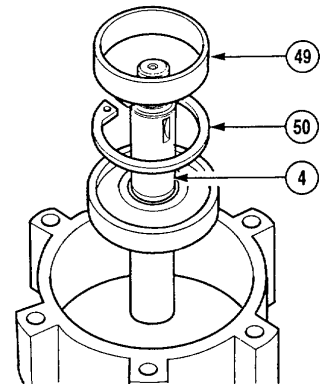
- (2) Using a press, install inner bearing (51) on rotor assembly shaft (4).



WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (3) Install retaining ring (50) and retaining cup (49) on rotor assembly shaft (4).

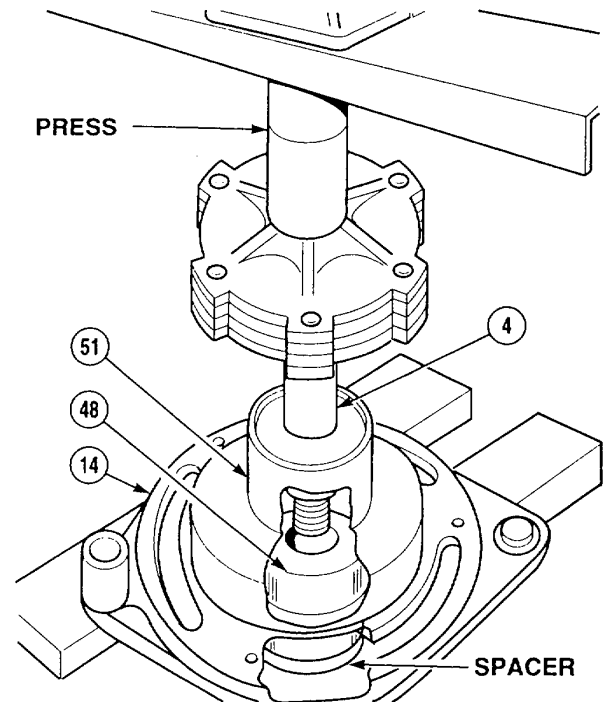


7-2. ALTERNATOR REPAIR (CONT).

NOTE

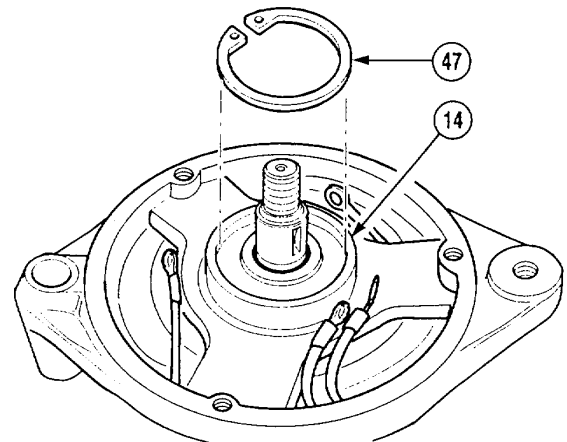
Use suitable spacer to ensure bearing is fully seated in forging and field coil assembly.

- (4) Using a press, install inner bearing (51) in forging and field coil assembly (14) and rotor assembly (4) shaft in outer bearing (48).

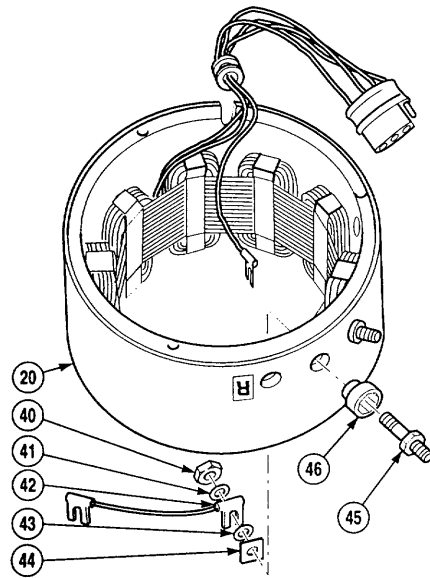
**WARNING**

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

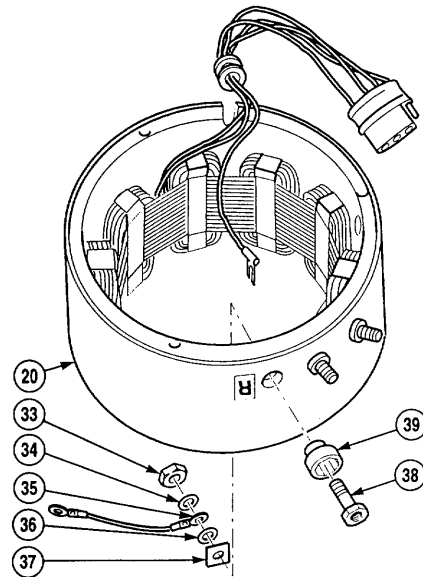
- (5) Install retaining ring (47) in forging and field coil assembly (14).



- (6) Position screw (45) in collar (46).
- (7) Position collar (46) in stator and shell assembly (20).
- (8) Install insulator (44), plastic washer (43), connector (42), and washer (41) on screw (45) with lock nut (40).

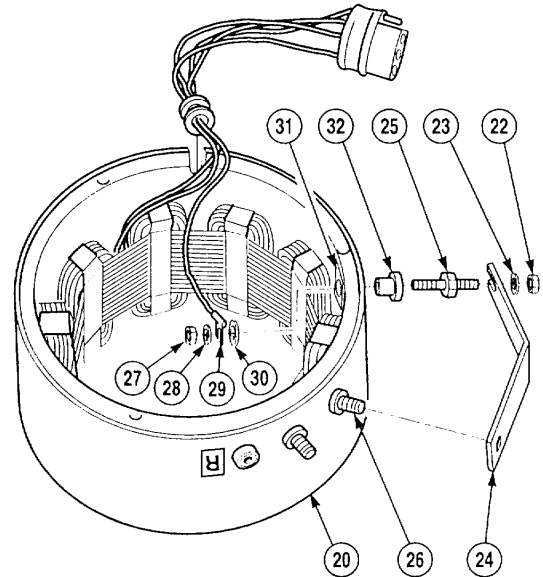


- (9) Position screw (38) in collar (39).
- (10) Position collar (39) in stator and shell assembly (20).
- (11) Install insulator (37), plastic washer (36), connector (35), and washer (34) on screw (38) with lock nut (33).

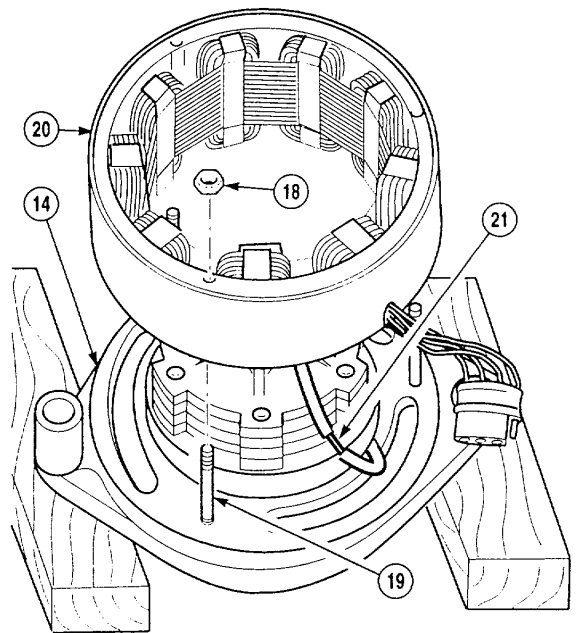


7-2. ALTERNATOR REPAIR (CONT).

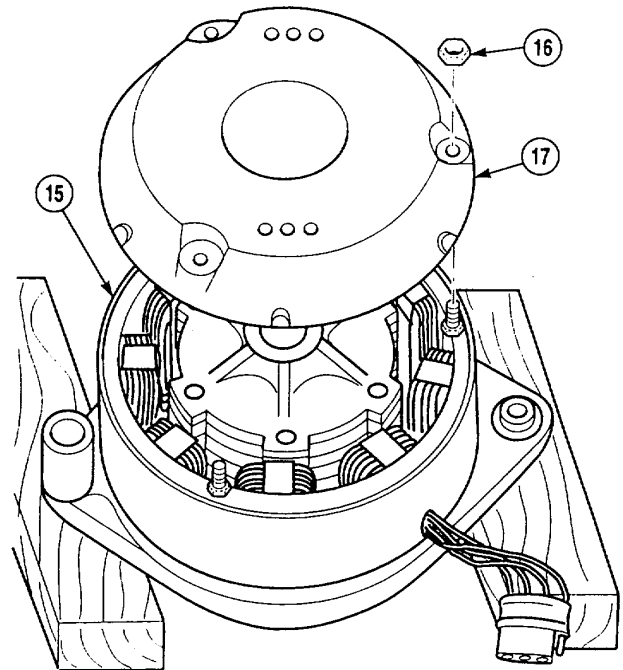
- (12) Position screw (25) in collar (32).
- (13) Position collar (32) in stator and shell assembly (20).
- (14) Install insulator (31), plastic washer (30), connector (29), and washer (28) on screw (25) with lock nut (27).
- (15) Position strap (24) on studs (26 and 25).
- (16) Install strap (24) on stud (25) with washer (23) and lock nut (22).



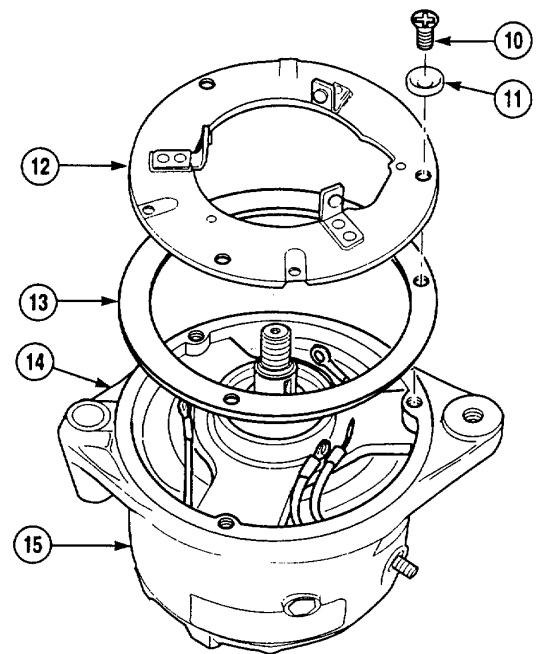
- (17) Position forging and field coil assembly (14) on wooden blocks.
- (18) Install three screw shafts (19) in forging and field coil assembly (14).
- (19) Using a soldering gun and solder, form connection (21) with wires tagged and marked during Disassembly.
- (20) Install stator and shell assembly (20) on three screw shafts (19) and forging and field coil assembly (14) with three nuts (18).



- (21) Install end cover (17) on alternator (15) with three lock nuts (16).
- (22) Turn alternator (15) over and remove wooden blocks.

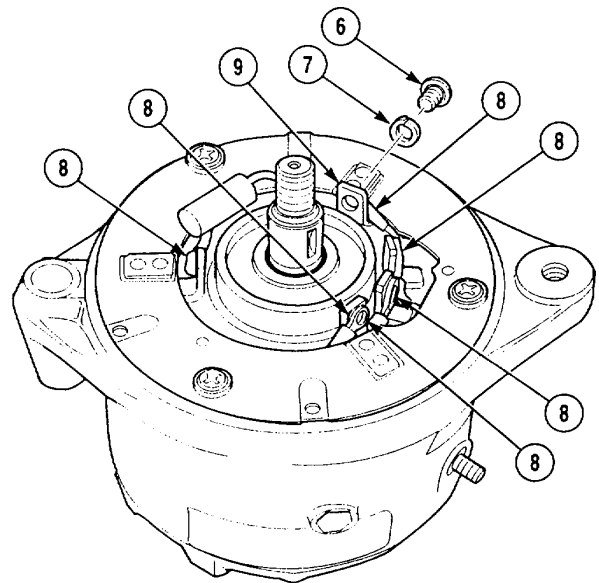


- (23) Install insulator (13) and heat sink (12) on forging and field coil assembly (14) with three plastic washers (11) and screws (10) in alternator (15).



7-2. ALTERNATOR REPAIR (CONT).

(24) Install six wires (8) on five terminals (9) as tagged and marked during Disassembly, with five lock washers (7) and screws (6).



(25) Install key (5) on rotor assembly shaft (4).

(26) Install pulley assembly (3) on rotor assembly shaft (4) with washer (2) and lock nut (1).

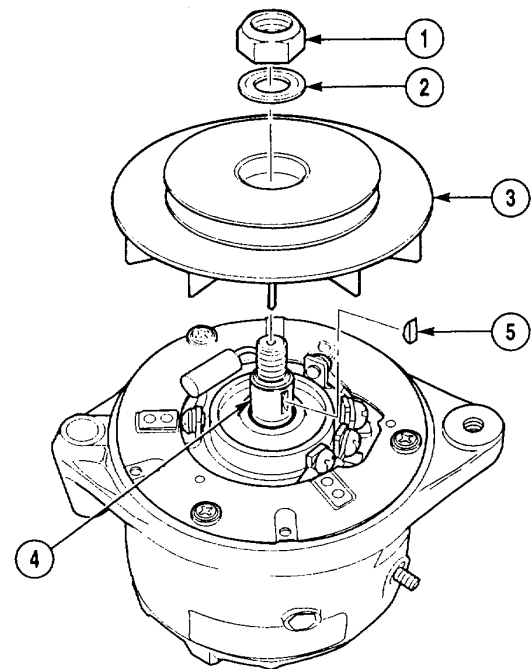
(27) Using test stand, test alternator for proper AMPS and Voltage out-put. With alternator working properly the amps should be LOW to 0 and volts should be 27.0 (36.0 kw) to 29.6 (39.2 kw).

NOTE

Follow-on Maintenance:

- Install regulator (TM 10-3930-669-20)
- Install relay (TM 10-3930-669-20)
- Install alternator (TM 10-3930-669-20)

END OF TASK



7-3. STARTER REPAIR.

This task covers:

- a. Disassembly b. Cleaning/Inspection c. Assembly

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Gun, Soldering (Item 5, Appendix E)
- Press, 60 Ton (Item 5, Appendix E)
- Test Stand, Automotive Generator and Starter (Item 6, Appendix E)
- Test Set, Armature (Item 6, Appendix E)

Materials/Parts

- Solvent, Dry-cleaning (Item 20, Appendix B)
- Tags, Identification (Item 21, Appendix B)
- Grommets (2)
- Nut, Lock
- Packing, Preformed
- Seal
- Washer, Lock

Materials/Parts - Continued

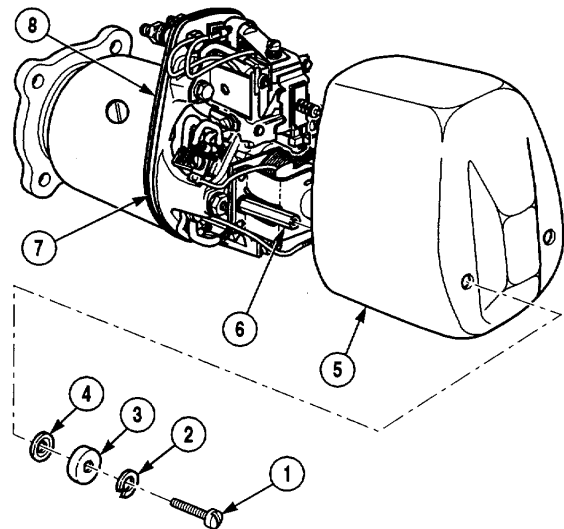
- Washer, Lock
- Washer, Lock
- Washer, Lock
- Washer, Lock
- Washer, Lock
- Washer, Lock
- Washer, Lock (2)
- Washer, Lock (2)
- Washer, Lock (3)

Equipment Condition

Starter removed (TM 10-3930-669-20)

a. Disassembly.

- (1) Remove two screws (1), lock washers (2), grommet covers (3), grommets (4), and cover (5) from studs (6). Discard lock washers and grommets.
- (2) Remove preformed packing (7) from commutator (8). Discard preformed packing.

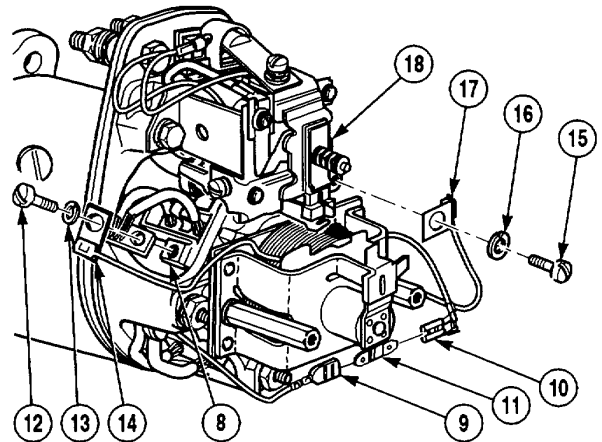


7-3. STARTER REPAIR (CONT).

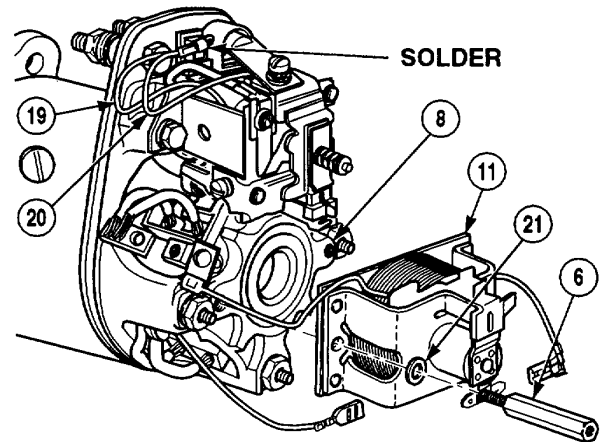
NOTE

Tag and mark all wires and cables prior to removal.

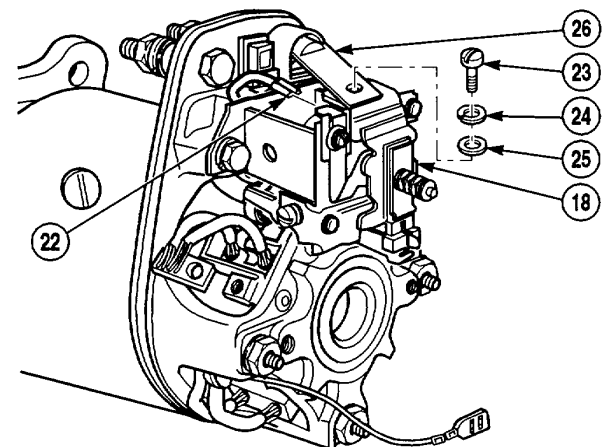
- (3) Disconnect two wires (9 and 10) from magnet (11).
- (4) Remove two screws (12), lock washers (13), and wire (14) from commutator (8). Discard lock washers.
- (5) Remove screw (15), lock washer (16), and wire (17) from switch (18). Discard lock washer.



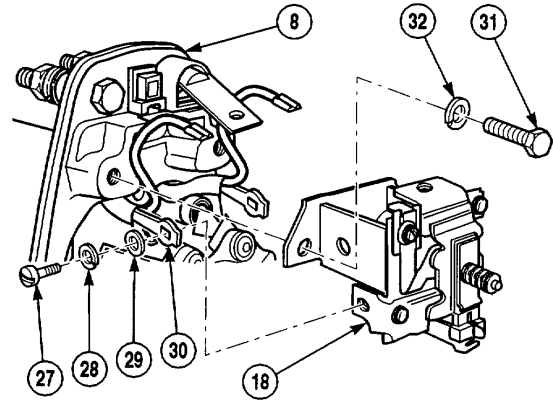
- (6) Using soldering iron, remove two wires (19 and 20) from commutator (8).
- (7) Remove two studs (6), washers (21), and magnet (11) from commutator (8).



- (8) Disconnect wire (22) from switch (18).
- (9) Remove screw (23), lock washer (24), and washer (25) from rail bar (26) and switch (18). Discard lock washer.

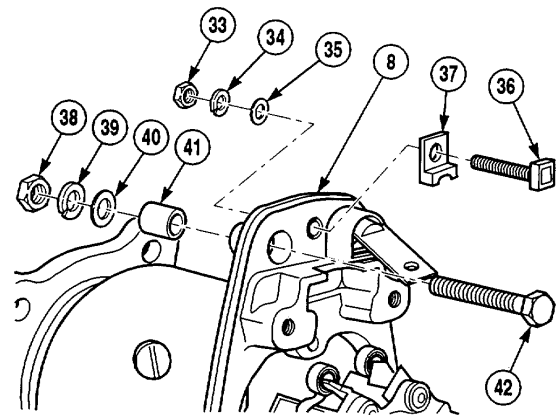


- (10) Remove two screws (27), lock washers (28), washers (29), and copper wires (30) from switch (18). Discard lock washers.

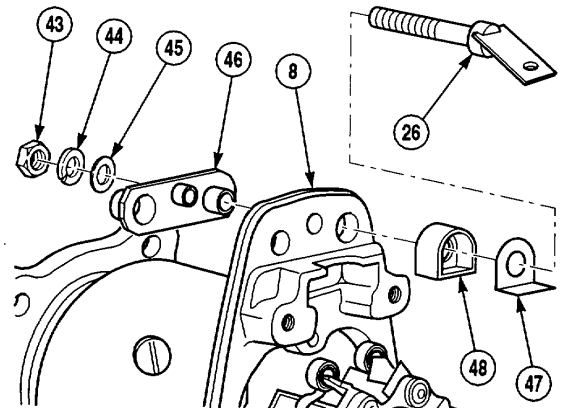


- (11) Remove two screws (31), lock washers (32), and switch (18) from commutator (8). Discard lock washers.

- (12) Remove nut (33), lock washer (34), washer (35), screw (36), and spacer (37) from commutator (8). Discard lock washer.



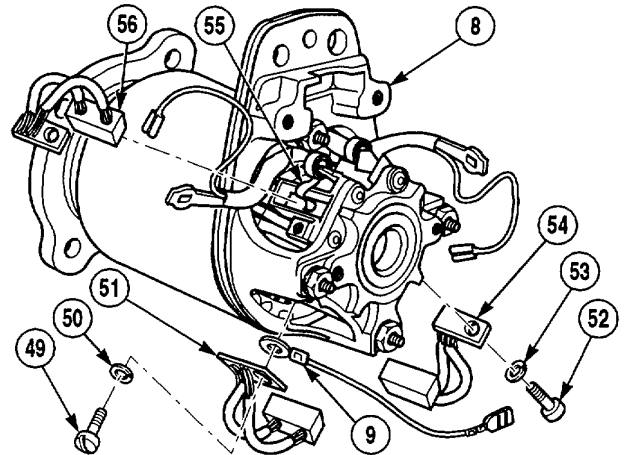
- (13) Remove nut (38), lock washer (39), washer (40), bushing (41), and screw (42) from commutator (8). Discard lock washer.



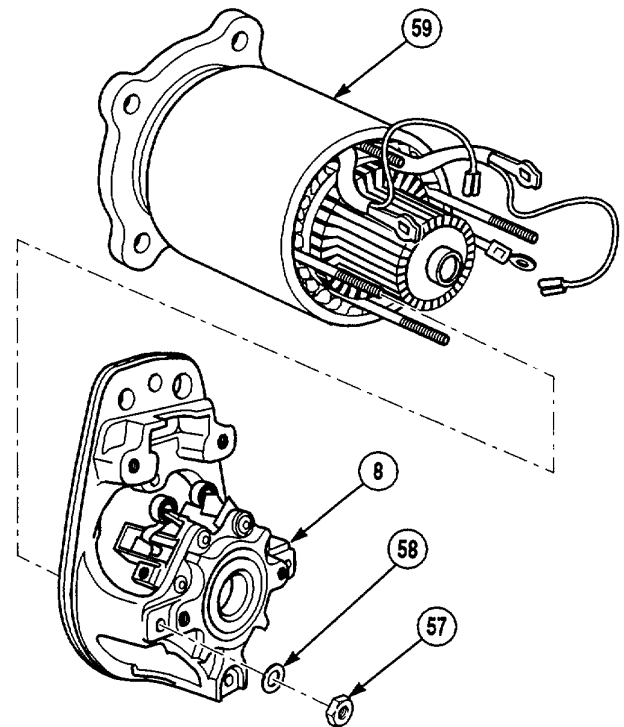
- (14) Remove nut (43), lock washer (44), washer (45), mount (46), rail bar (26), washer (47), and spacer (48) from commutator (8). Discard lock washer.

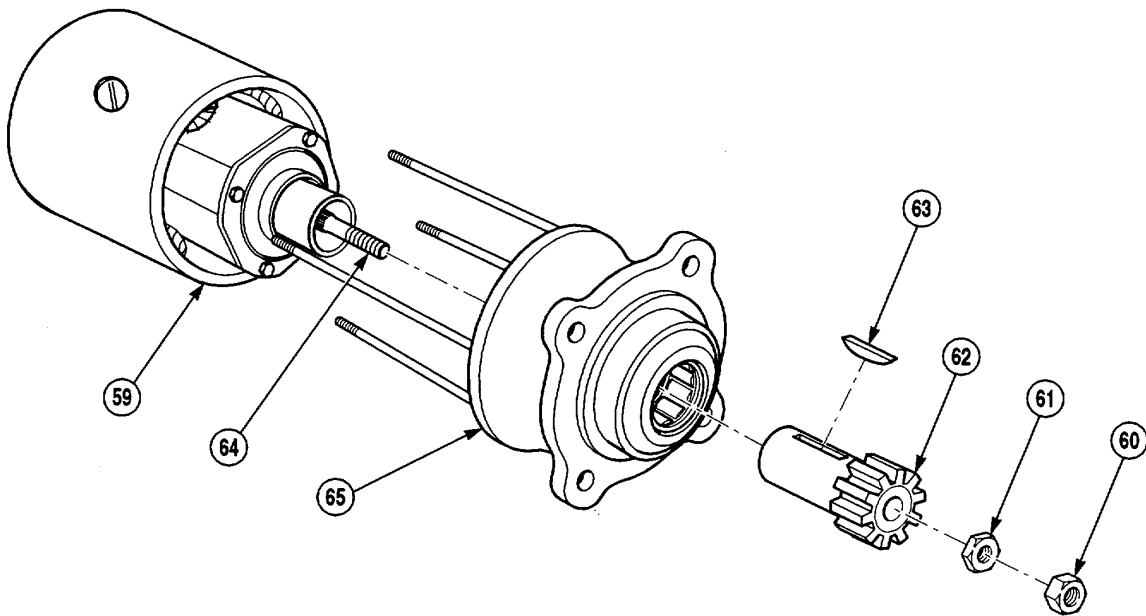
7-3. STARTER REPAIR (CONT).

- (15) Remove screw (49), lock washer (50), brush wire (51), and wire (9) from commutator (8). Discard lock washer.
- (16) Remove screw (52), lock washer (53), and brush wire (54) from commutator (8). Discard lock washer.
- (17) Lift four retainers (55) and remove brushes (56) from commutator (8).



- (18) Remove four nuts (57), washers (58), and commutator (8) from starter housing (59).

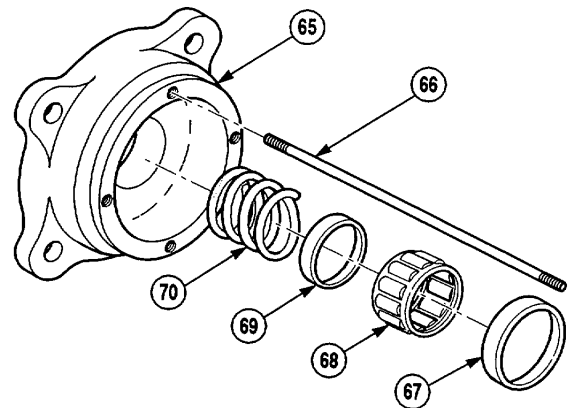




- (19) Remove lock nut (60) and nut (61) from pinion (62). Discard lock nut.
- (20) Remove pinion (62) and parallel key (63) from axle (64).
- (21) Remove drive bearing (65) from starter housing (59).

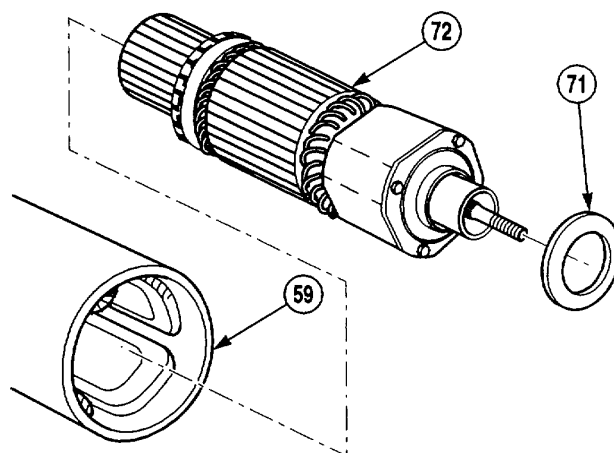
(22) Remove four stud bolts (66) from drive bearing (65).

(23) Remove bushing (67), bearing (68), seal (69), and spring (70) from drive bearing (65). Discard seal.



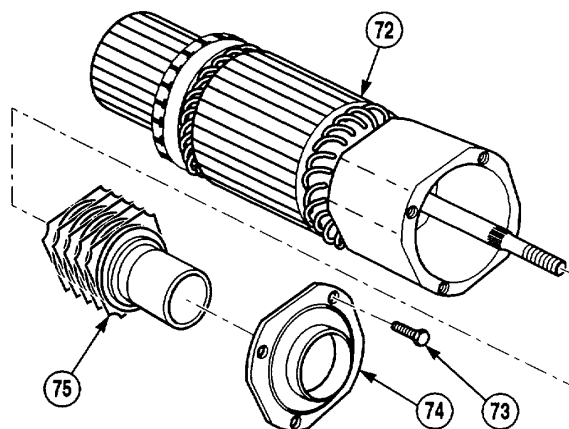
7-3. STARTER REPAIR (CONT).

- (24) Remove shim (71) and armature (72) from starter housing (59).



- (25) Remove four screws (73) and bearing cap (74) from armature (72).

- (26) Remove clutch pack (75) from armature (72).



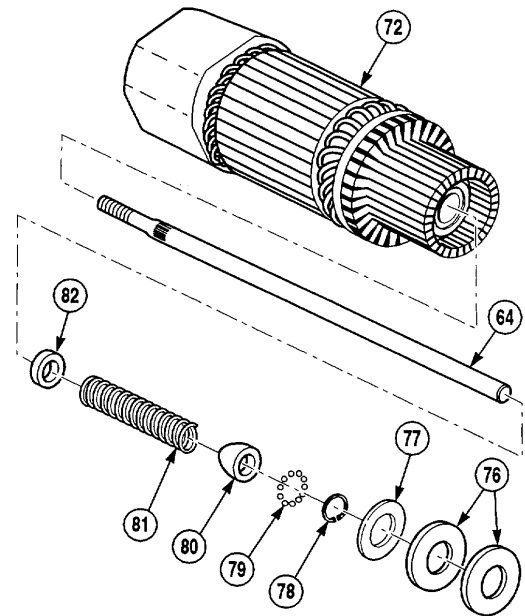
(27) Remove two spacers (76) and washer (77) from armature (72).

WARNING

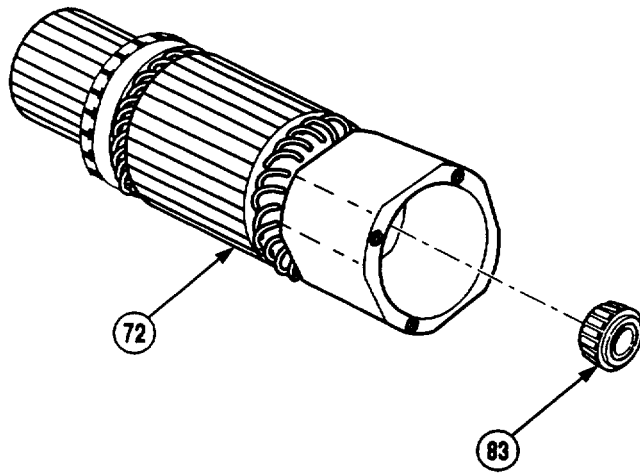
- Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.
- Use care when removing or installing springs. Springs are under spring tension and can act as projectiles when released and could cause severe eye injury.

(28) Remove retaining ring (78), eleven balls (79), stop bush (80), compression spring (81), and ring (82) from axle (64).

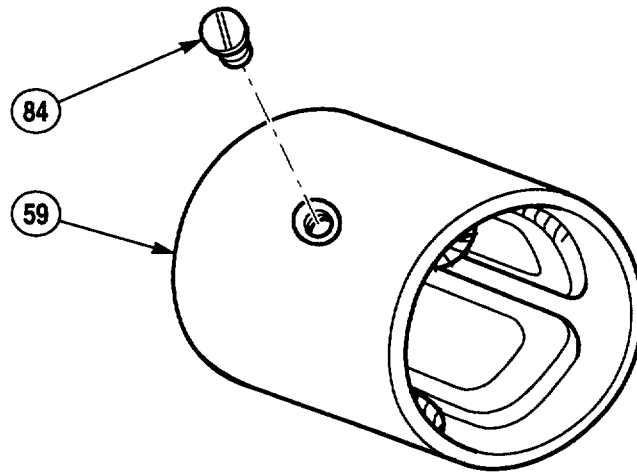
(29) Remove axle (64) from armature (72).



7-3. STARTER REPAIR (CONT).



(30) Remove needle roller bearing (83) from armature (72).

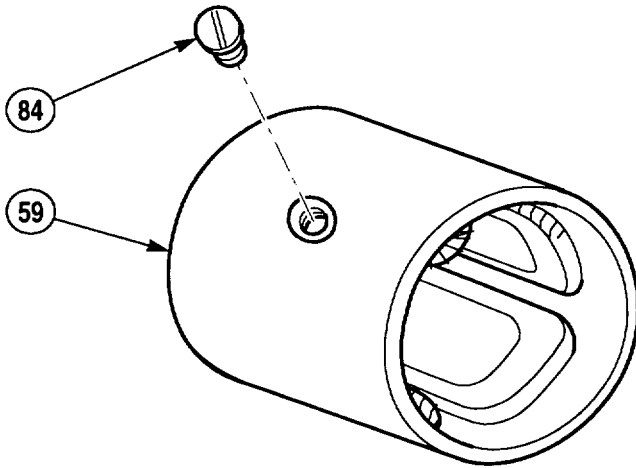


(31) Remove four screws (84) from starter housing (59).

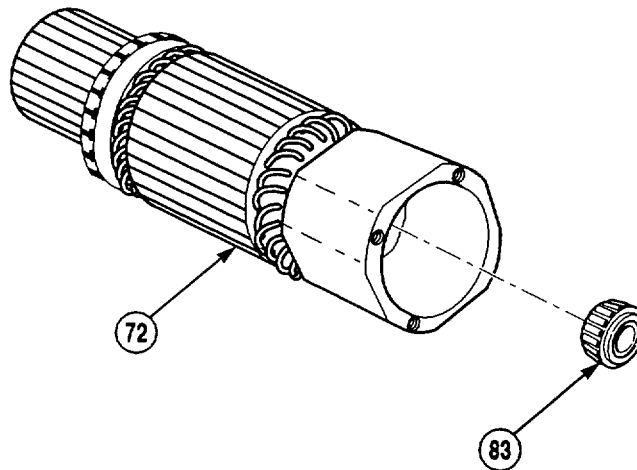
b. Cleaning/Inspection.**WARNING**

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
- **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**
 - (1) Clean all metal parts with dry-cleaning solvent.
 - (2) Do not allow dry-cleaning solvent to come in contact with rubber wire insulation.
 - (3) Inspect all parts for breaks, cracks, burrs, and sharp edges.
 - (4) Replace all damaged parts.

7-3. STARTER REPAIR (CONT).

c. Assembly.

(1) Install four screws (84) in stator housing (59). Tighten screws.



(2) Install needle roller bearing (83) in armature (72).

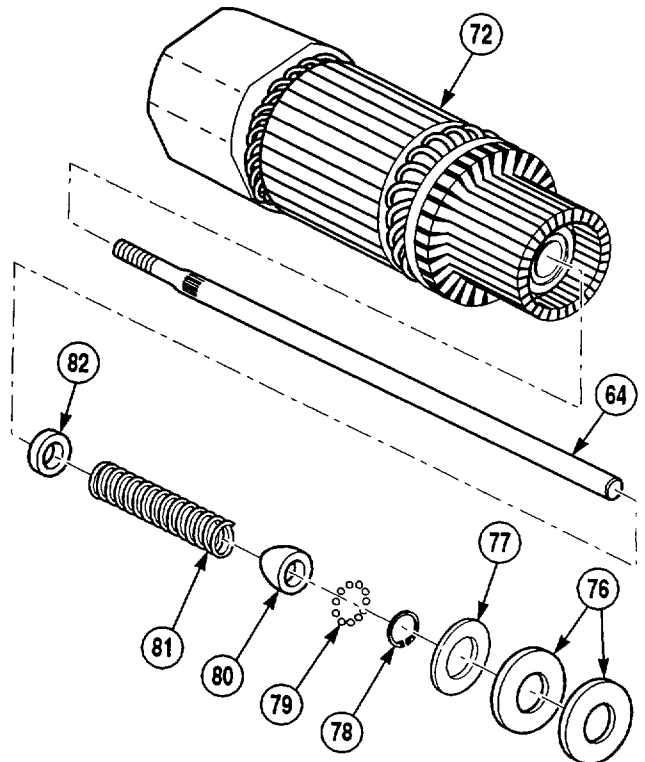
(3) Install axle (64) in armature (72).

WARNING

- Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.
- Use care when removing or installing springs. Springs are under spring tension and can act as projectiles when released and could cause severe eye injury.

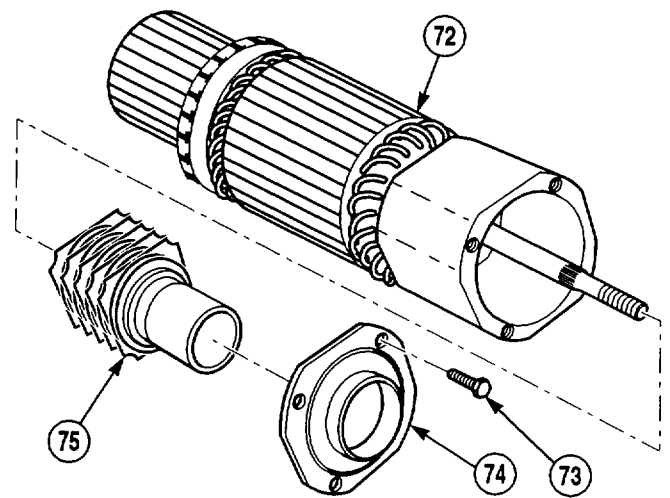
(4) Install ring (82), compression spring (81), stop bush (80), eleven balls (79), and retaining ring (78) on axle (64).

(5) Install two spacers (76) and washer (77) in armature (72).



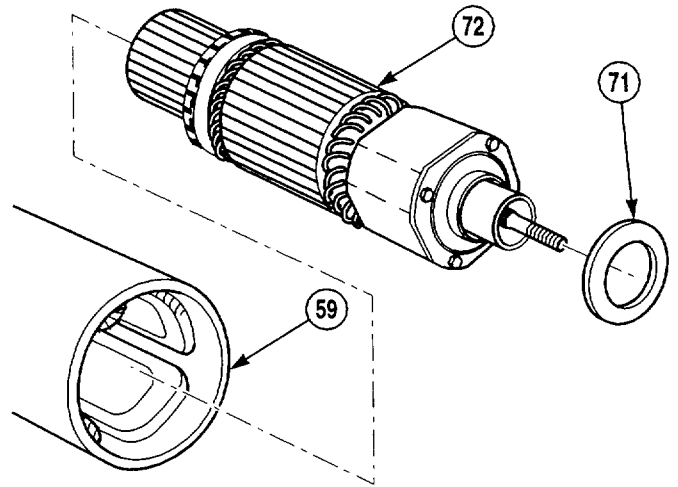
(6) Install clutch pack (75) in armature (72).

(7) Install bearing cap (74) on armature (72) with four screws (73).

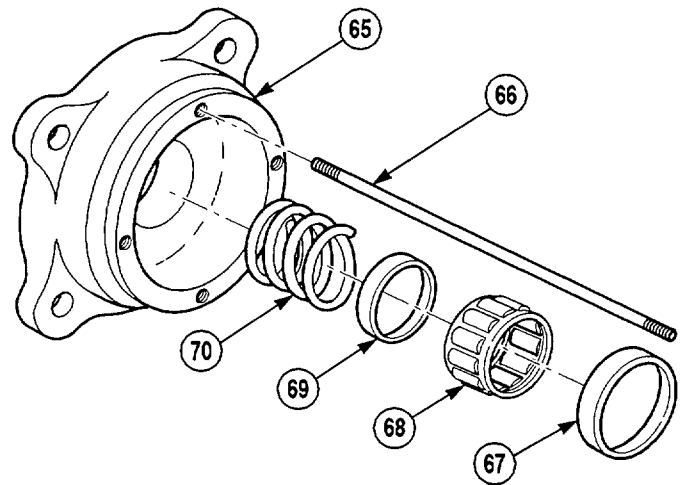


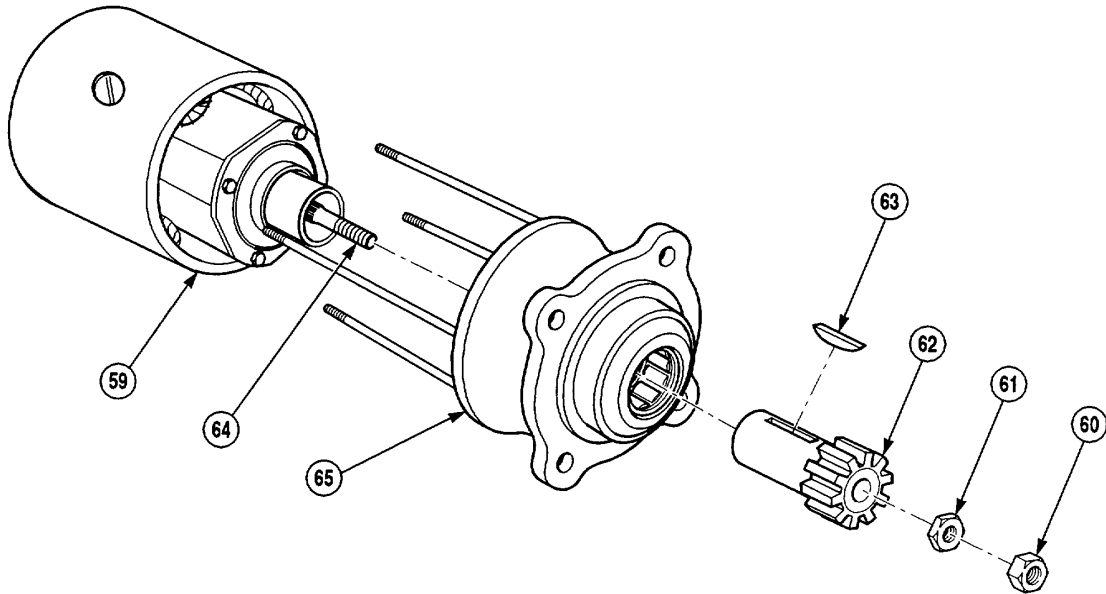
7-3. STARTER REPAIR (CONT).

- (8) Install armature (72) and shim (71) in starter housing (59).

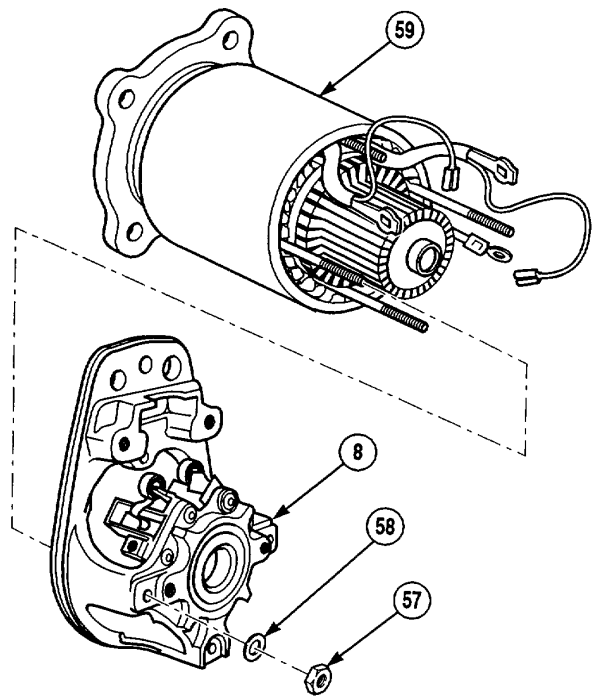


- (9) Install spring (70), seal (69) bearing (68), and bushing (67) in drive bearing (65).
- (10) Install four stud bolts (66) in drive bearing (65).



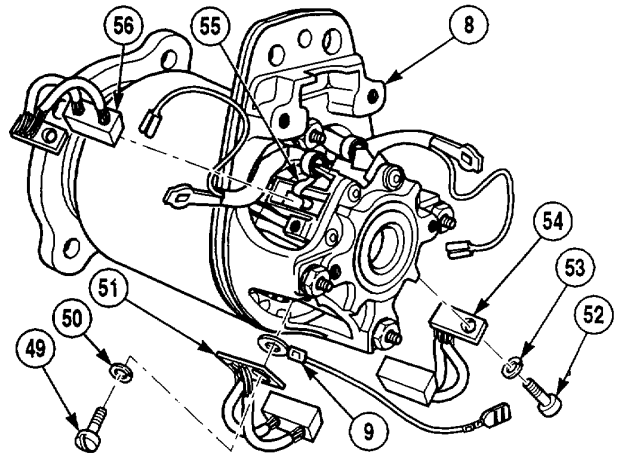


- (11) Install drive bearing (65) in starter housing (59).
- (12) Install parallel key (63) and pinion (62) on axle (64).
- (13) Install nut (61) and lock nut (60) on pinion (62).
- (14) Install commutator (8) on starter housing (59) with four washers (58) and nuts (57).

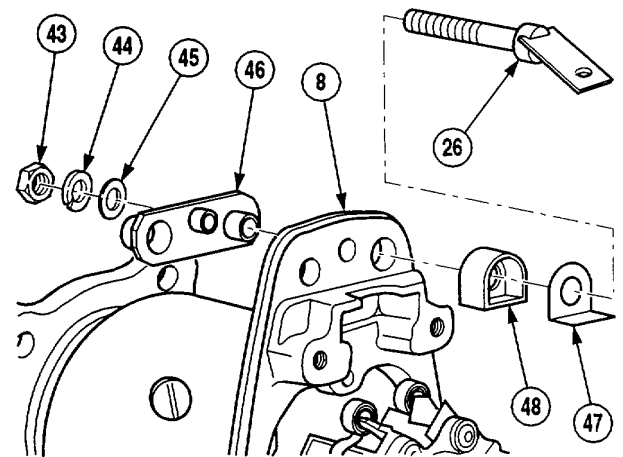


7-3. STARTER REPAIR (CONT).

- (15) Lift four retainers (55) and install four brushes (56) in commutator (8).
- (16) Install brush wire (54) on commutator (8) with lock washer (53) and screw (52).
- (17) Install wire (9) and brush wire (51) on commutator (8) with lock washer (50) and screw (49).

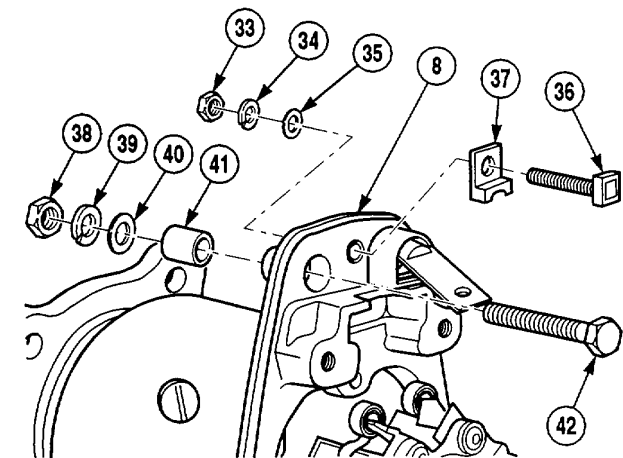


- (18) Install spacer (48), washer (47), rail bar (26), and mount (46) on commutator (8) with washer (45), lock washer (44), and nut (43).

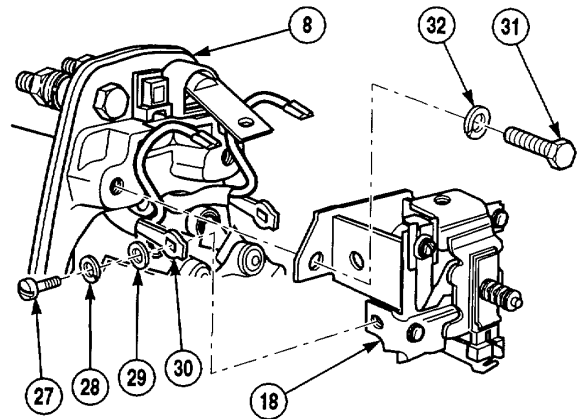


- (19) Install screw (42) and bushing (41) on commutator (8) with washer (40), lock washer (39), and nut (38).

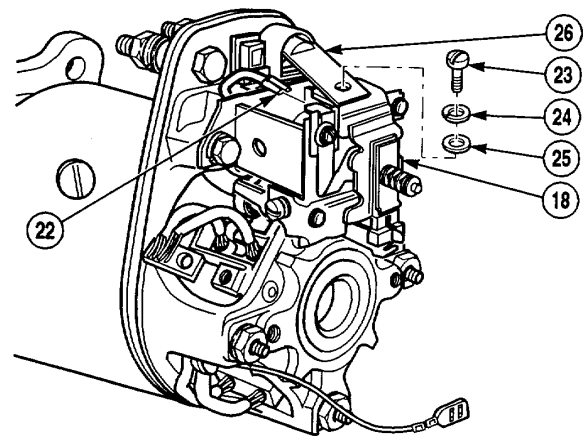
- (20) Install spacer (37) and screw (36) on commutator (8) with washer (35), lock washer (34), and nut (33).



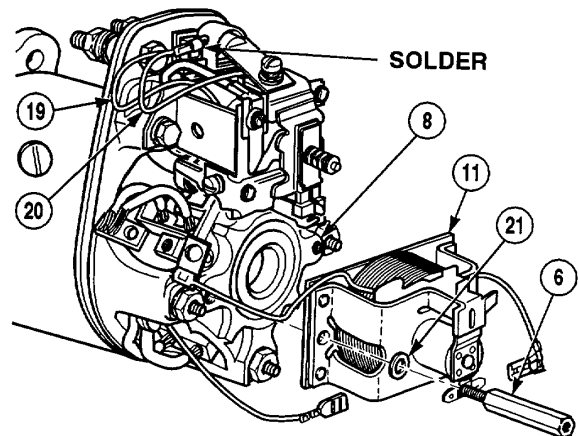
- (21) Install switch (18) on commutator (8) with two lock washers (32) and screws (31).
- (22) Install copper wires (30) on switch (18) with two washers (29), lock washers (28), and screws (27).



- (23) Install rail bar (26) on switch (18) with washer (25), lock washer (24), and screw (23).
- (24) Connect wire (22) on switch (18).

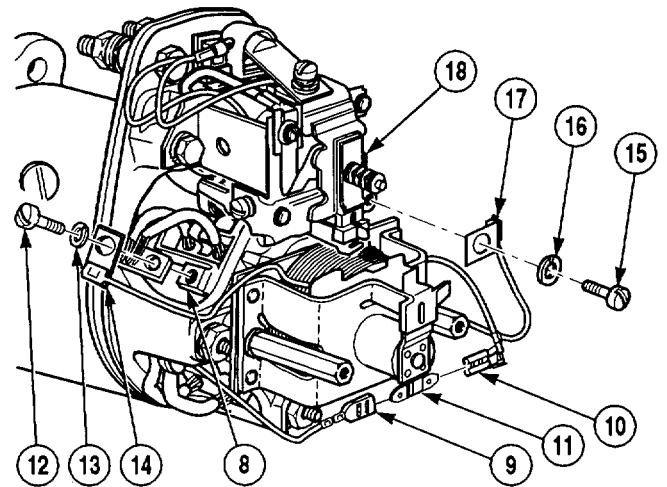


- (25) Install magnet (11) on commutator (8) with two washers (21) and studs (6).
- (26) Using soldering iron, connect two wires (19 and 20) on commutator (8).

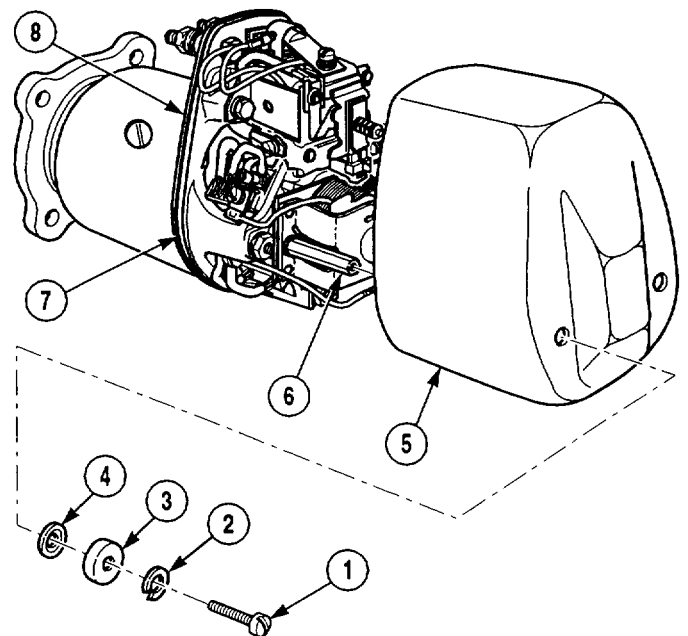


7-3. STARTER REPAIR (CONT).

- (27) Install wire (17) on switch (18) with two lock washers (16) and screws (15).
- (28) Install wire (14) on commutator (8) with two lock washers (13) and screws (12).
- (29) Connect two wires (9 and 10) on magnet (11).



- (30) Install preformed packing (7) on commutator (8).
- (31) Install cover (5) on studs (6) with two grommets (4), grommet covers (3), lock washers (2), and screws (1).
- (32) Using test stand, test starter for voltage loss. Voltage loss must not be higher than 1.6 volts.



NOTE

Follow-on Maintenance:

- Install starter (TM 10-3930-669-20)

END OF TASK

7-4. CAB WIRE HARNESS REPLACEMENT.

This task covers:

- a. Removal b. Installation

INITIAL SETUP*Tools and Special Tools*

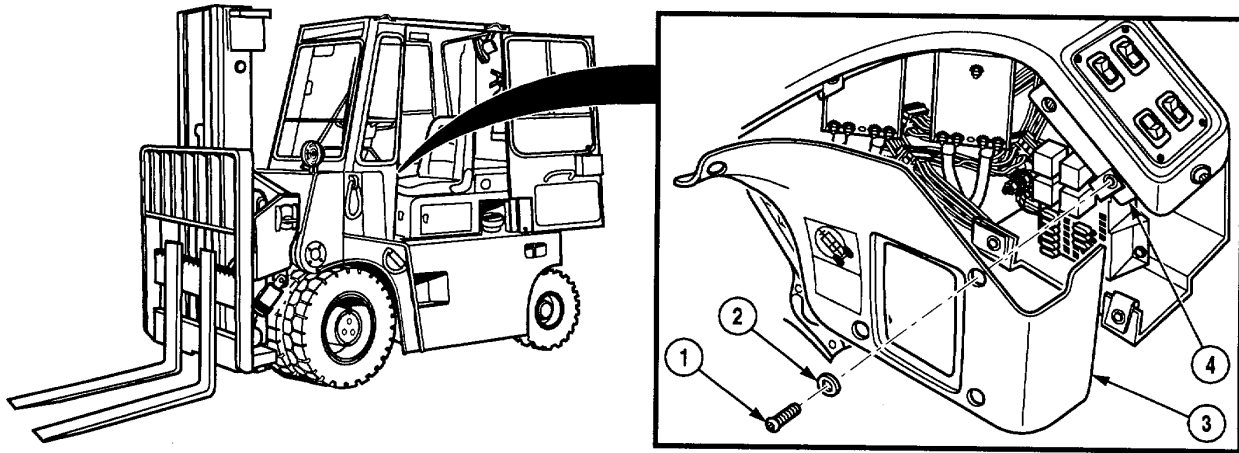
Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)
Tool, Spade Terminal, Removal
(Item 5, Appendix E)

Equipment Condition

Engine OFF (TM 10-3930-669-10)
Parking brake applied (TM 10-3930-669-10)
Wheels chocked (TM 10-3930-669-10)

Materials/Parts

Cable Ties (Item 4, Appendix B)
Tags, Identification (Item 21, Appendix B)

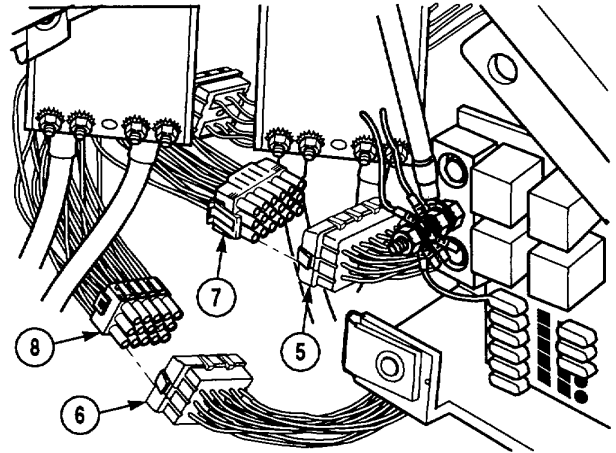
a. Removal.**NOTE**

- **Tag and mark all wires before disconnecting.**
- **Remove plastic ties as necessary.**

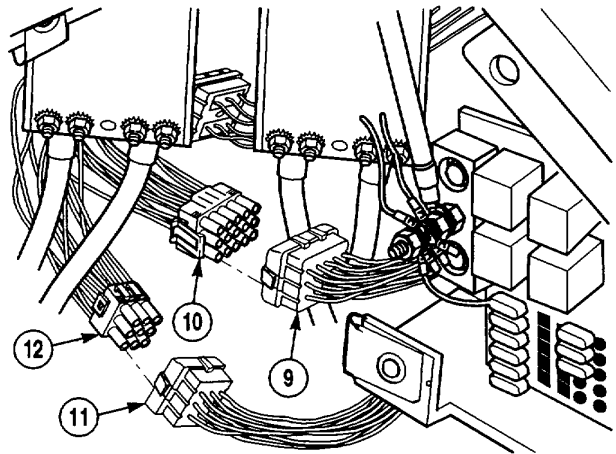
(1) Remove five screws (1), washers (2), and lower dash panel (3) from dash frame (4).

7-4. CAB WIRE HARNESS REPLACEMENT (CONT).

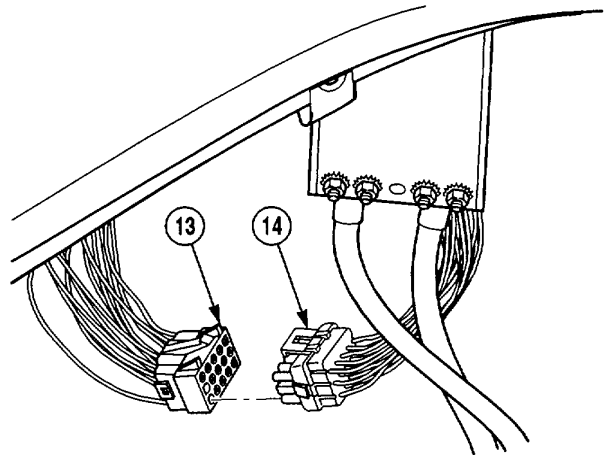
- (2) Disconnect connectors P7 (5) and P6 (6) from connectors J7 (7) and J6 (8).



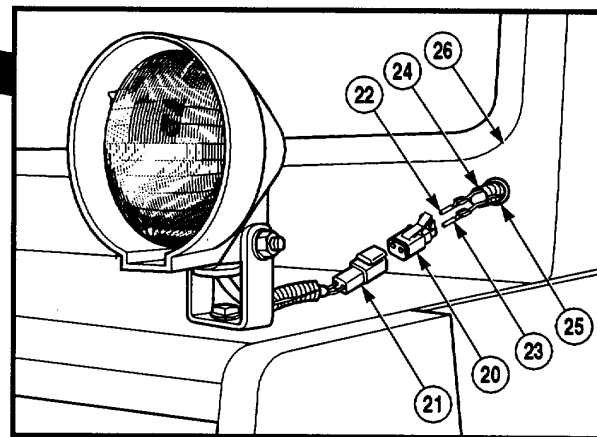
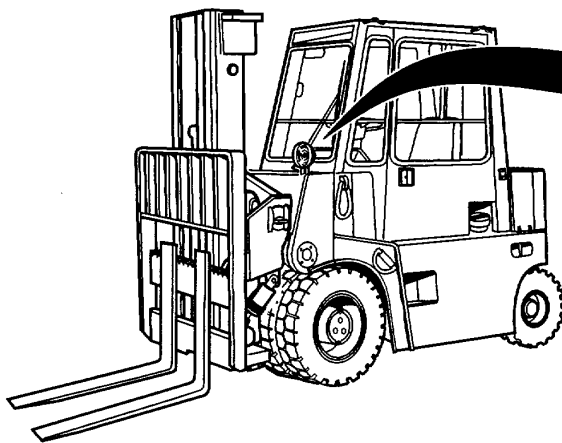
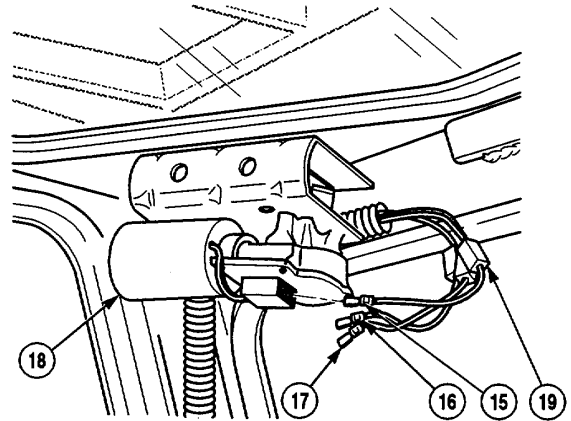
- (3) Disconnect connector J9 (9) from connector P9 (10).
- (4) Disconnect connector J13 (11) from connector P13 (12).



- (5) Disconnect connector J8 (13) from connector P8 (14).



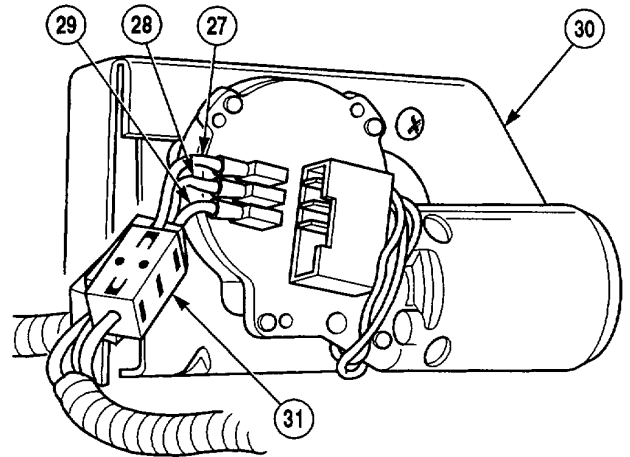
- (6) Disconnect three wires (15, 16, and 17) from top wiper motor assembly (18).
- (7) Remove three EMI filters (19) from three wires (15, 16, and 17).



- (8) Disconnect connector (20) from front worklight connector (21).
- (9) Using terminal removal tool, remove two wires (22 and 23) from connector (20).
- (10) Remove conduit (24) from two wires (22 and 23).
- (11) If damaged, remove grommet (25) from cab (26).

7-4. CAB WIRE HARNESS REPLACEMENT (CONT).

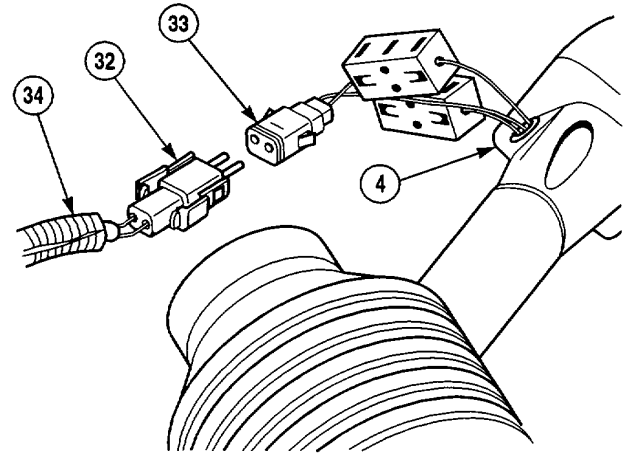
(12) Disconnect three wires (27, 28, and 29) from front wiper motor assembly (30).



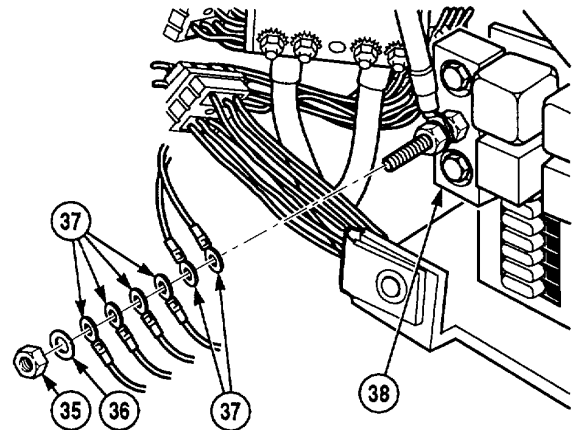
(13) Remove three EMI filters (31) from wires (27, 28, and 29).

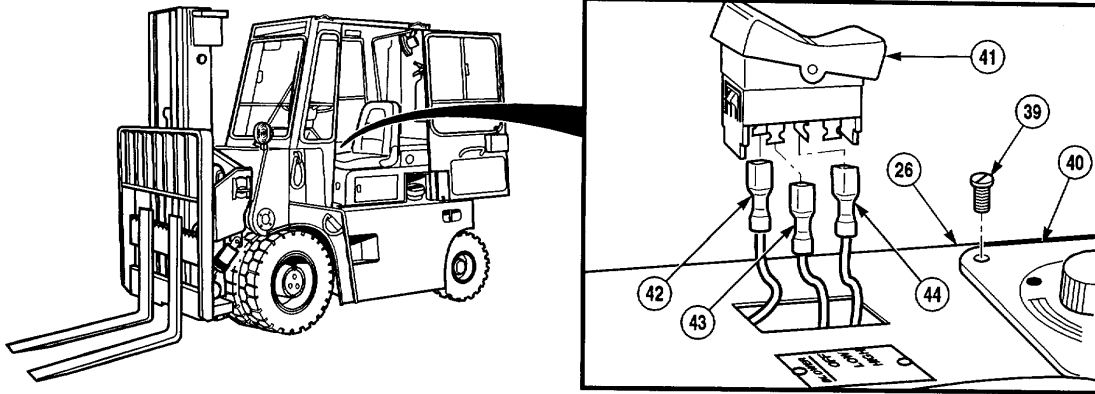
(14) Disconnect connector (32) from front fan motor connector (33).

(15) Remove cab harness (34) from dash frame (4).



(16) Remove nut (35), washer (36), and six wires (37) from cab shunt (38).

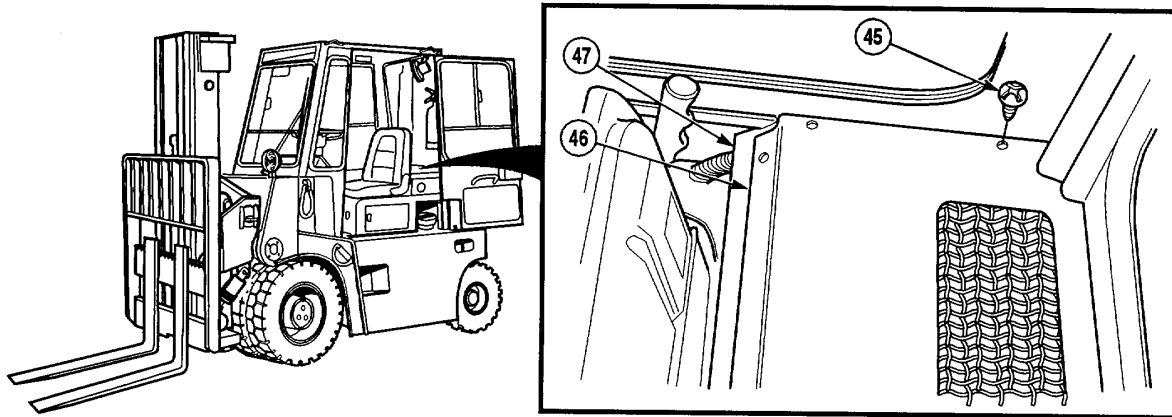




(17) Remove four screws (39) and heater temperature control (40) from cab (26).

(18) Remove switch (41) from cab (26).

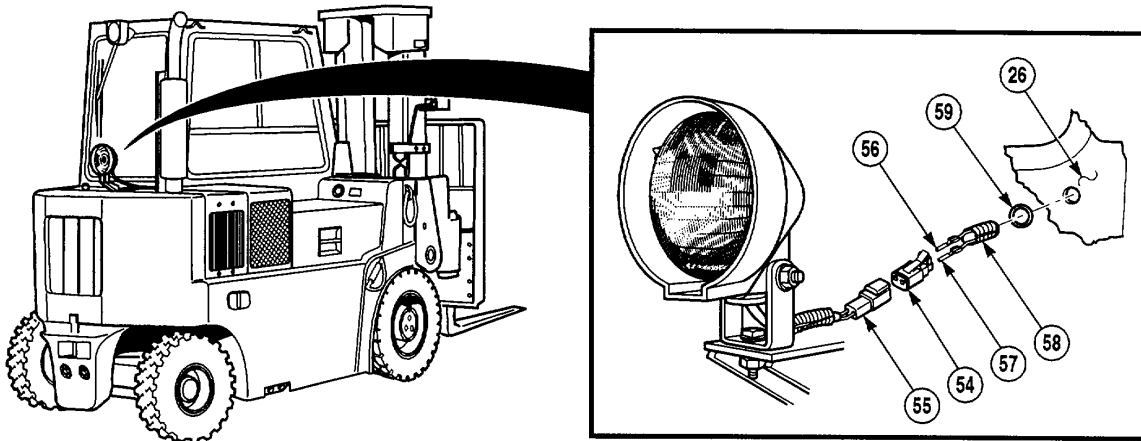
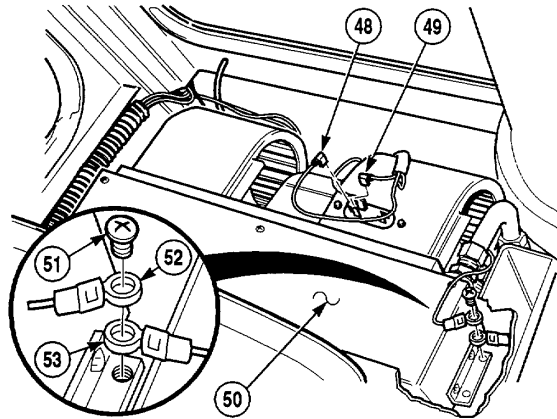
(19) Disconnect three wires (42, 43, and 44) from switch (41).



(20) Remove seven screws (45) and cover (46) from heater housing (47).

7-4. CAB WIRE HARNESS REPLACEMENT (CONT).

- (21) Disconnect two wires (48 and 49) from heater (50).
- (22) Remove screw (51) and two wires (52 and 53) from heater (50).

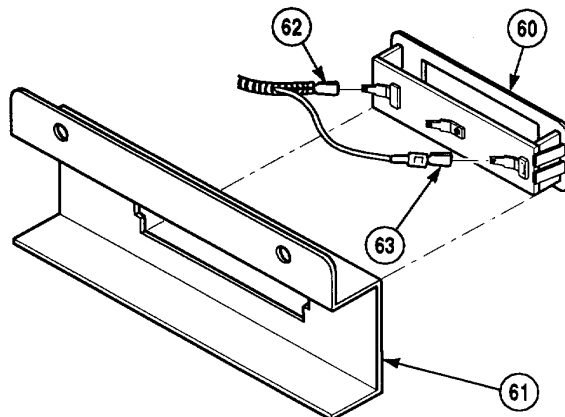


- (23) Disconnect connector (54) from rear worklight connector (55).
- (24) Using terminal removal tool, remove two wires (56 and 57) from connector (54).
- (25) Remove conduit (58) from two wires (56 and 57).
- (26) If damaged, remove grommet (59) from cab (26).

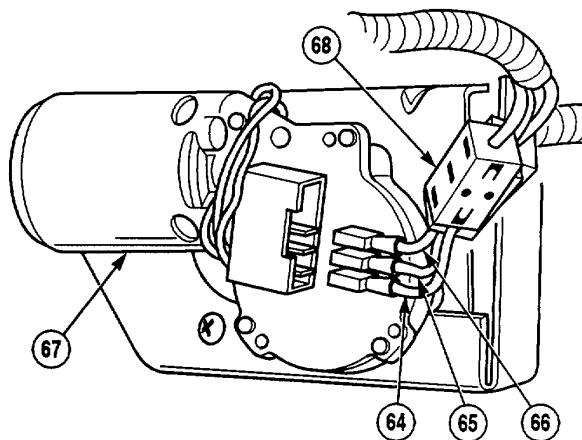
NOTE

Repeat steps (27) and (28) for remaining interior light.

- (27) Remove light (60) from bracket (61).
- (28) Disconnect two wires (62 and 63) from light (60).



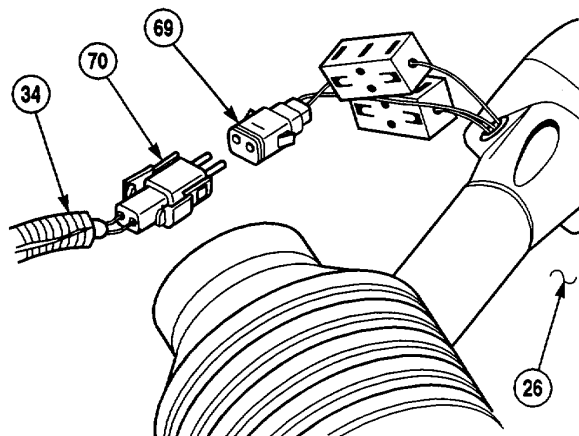
- (29) Disconnect three wires (64, 65, and 66) from rear wiper motor assembly (67).
- (30) Remove three EMI filters (68) from wires (64, 65, and 66).



- (31) Disconnect rear fan motor connector (69) from connector (70).
- (32) Remove cab harness (34) from cab (26).

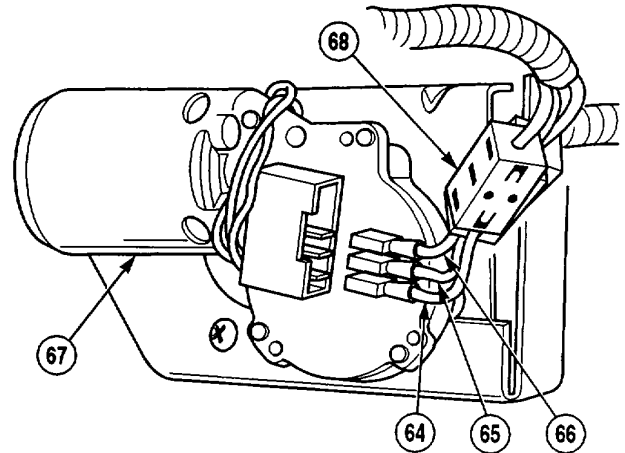
b. Installation.

- (1) Position cab harness (34) in cab (26).
- (2) Connect connector (70) to rear fan motor connector (69).



7-4. CAB WIRE HARNESS REPLACEMENT (CONT).

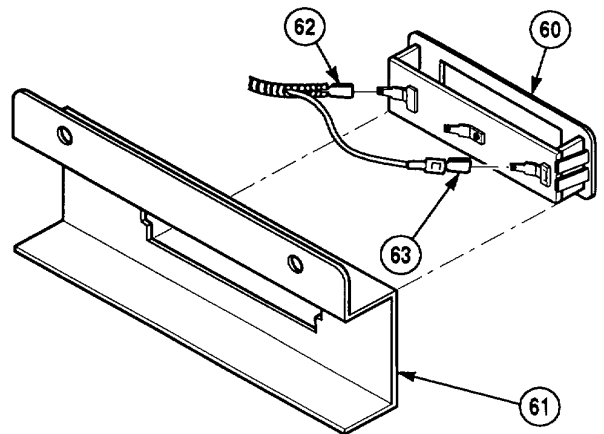
- (3) Install three EMI filters (68) on wires (66, 65, and 64).
- (4) Connect three wires (64, 65, and 66) on rear wiper motor assembly (67).



NOTE

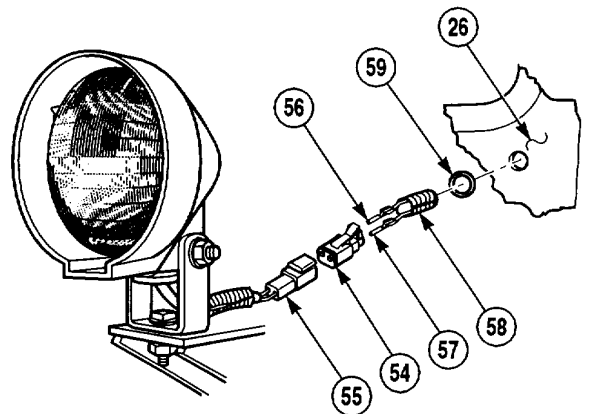
Repeat steps (5) and (6) for remaining interior light.

- (5) Connect two wires (62 and 63) on light (60).
- (6) Install light (60) on bracket (61).



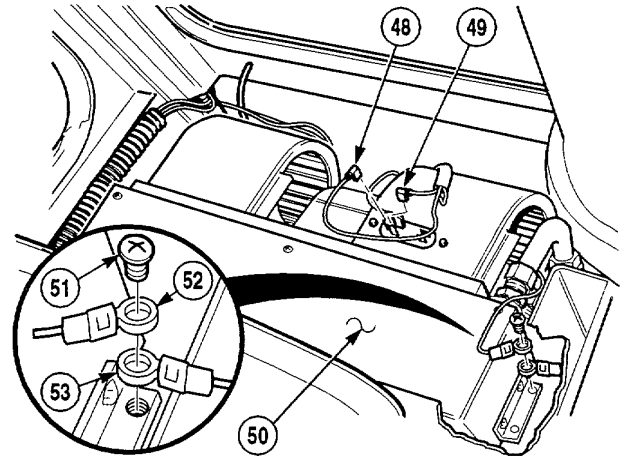
- (7) If removed, install grommet (59) in cab (26).
- (8) Install conduit (58) on two wires (56 and 57).
- (9) Using terminal tool, install two wires (56 and 57) in connector (54).

- (10) Connect rear worklight connector (55) to connector (54).

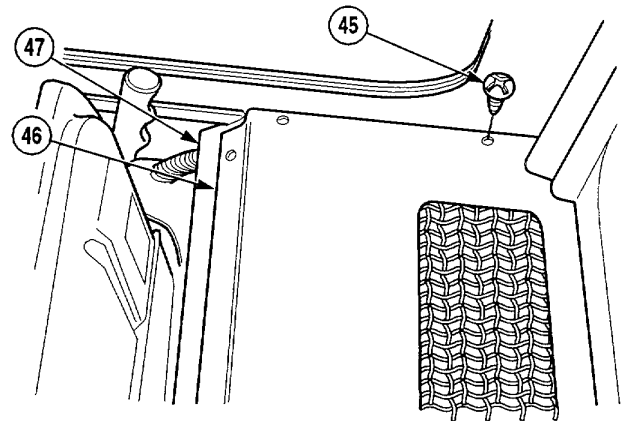


(11) Install two wires (52 and 53) on heater (50) with screw (51).

(12) Connect two wires (48 and 49) on heater (50).



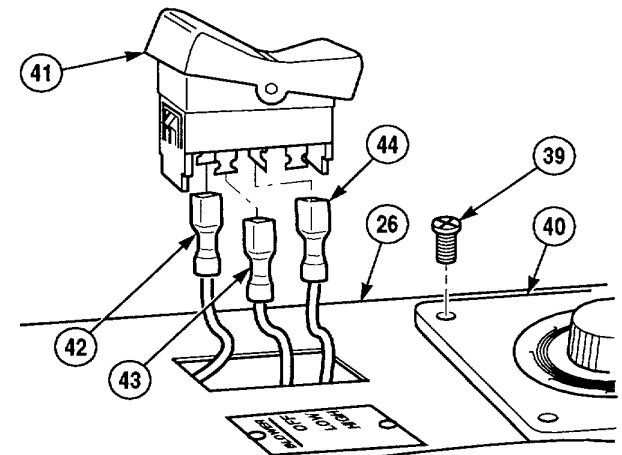
(13) Install cover (46) on heater housing (47) with seven screws (45).



(14) Connect three wires (44, 43, and 42) on switch (41).

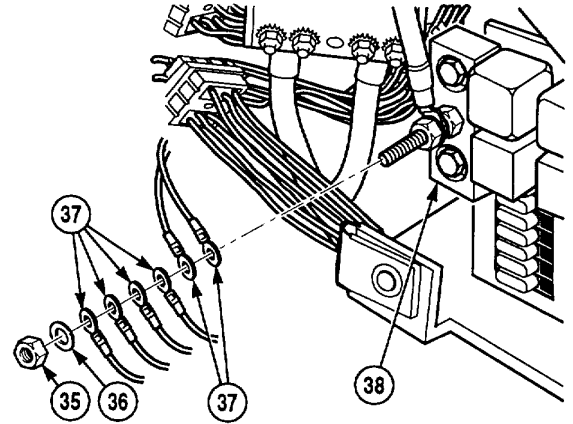
(15) Install switch (41) on cab (26).

(16) Install heater temperature control (40) on cab (26) with four screws (39).



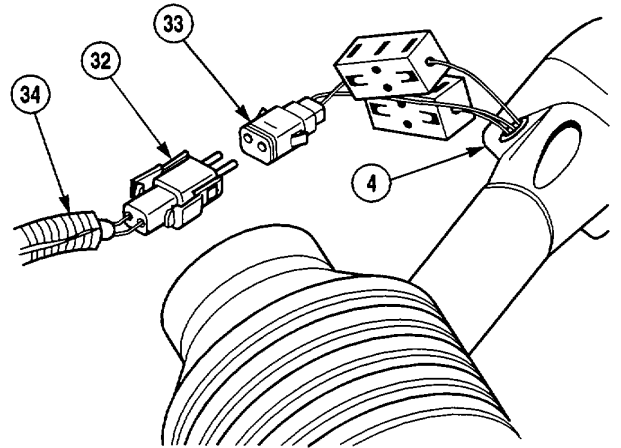
7-4. CAB WIRE HARNESS REPLACEMENT (CONT).

- (17) Install six wires (37) on cab shunt (38) with washer (36) and nut (35).



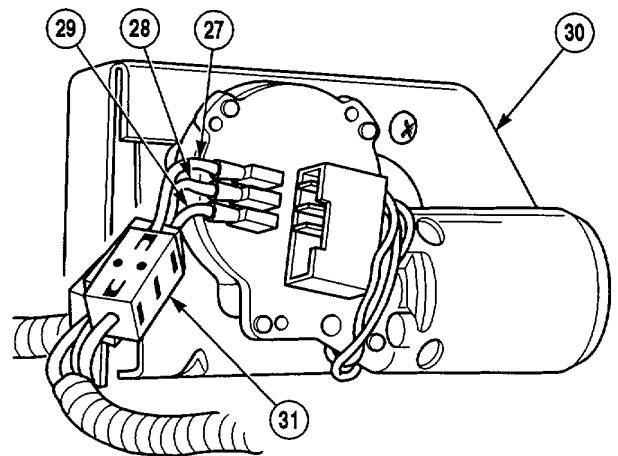
- (18) Position cab harness (34) on dash frame (4).

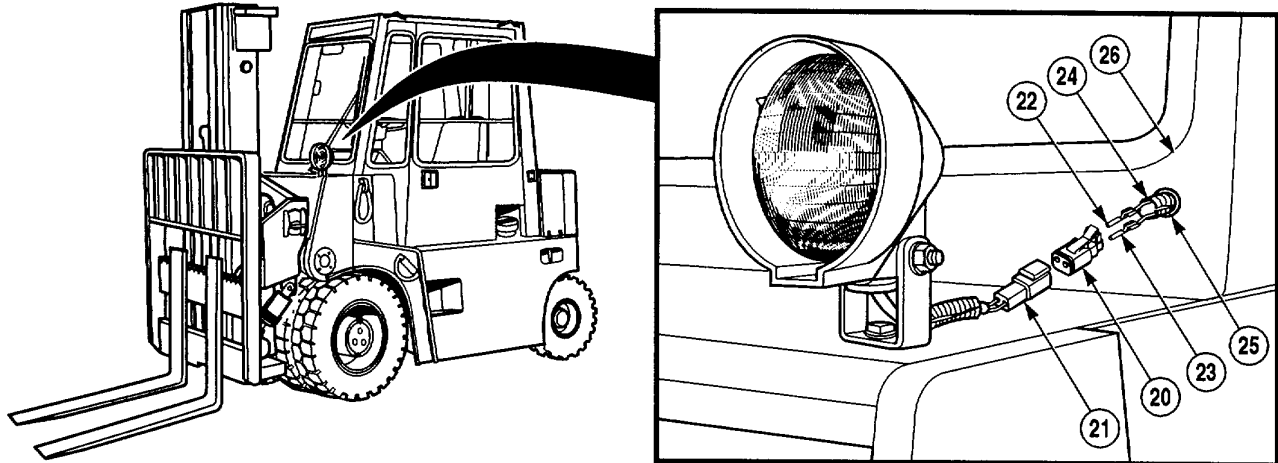
- (19) Connect front fan motor connector (33) on connector (32).



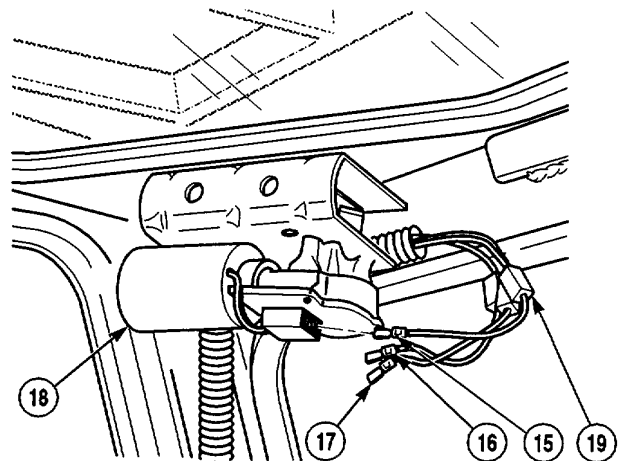
- (20) Install three EMI filters (31) on wires (27, 28, and 29).

- (21) Connect three wires (27, 28, and 29) on front wiper motor assembly (30).



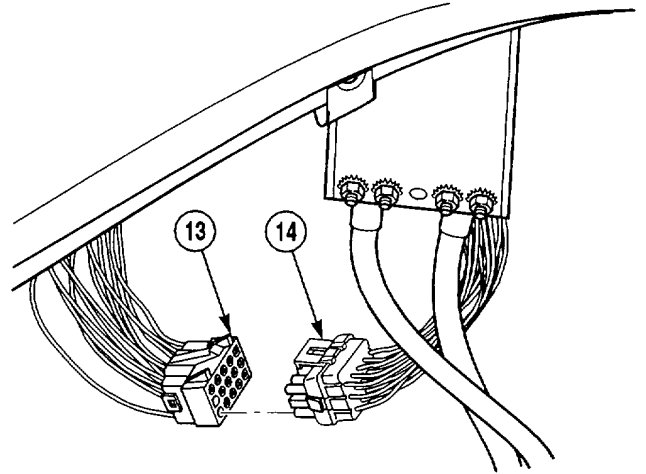


- (22) If removed, install grommet (25) in cab (26).
- (23) Install conduit (24) on two wires (22 and 23).
- (24) Install two wires (22 and 23) in connector (20).
- (25) Connect front worklight connector (21) on connector (20).
- (26) Install three EMI filters (19) on wires (15, 16, and 17).
- (27) Connect three wires (15, 16, and 17) on top wiper motor assembly (18).



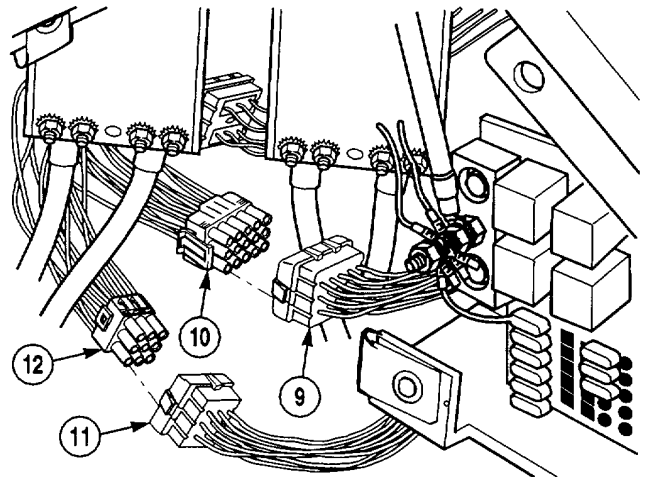
7-4. CAB WIRE HARNESS REPLACEMENT (CONT).

- (28) Connect connector P8 (14) on connector J8 (13).

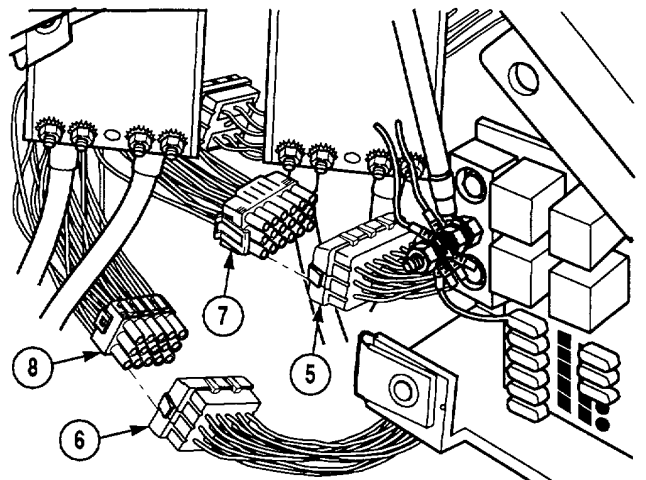


- (29) Connect connector P13 (12) on connector J13 (11).

- (30) Connect connector P9 (10) on connector J9 (9).



- (31) Connect connectors J6 (8) and J7 (7) on connectors P6 (6) and P7 (5).



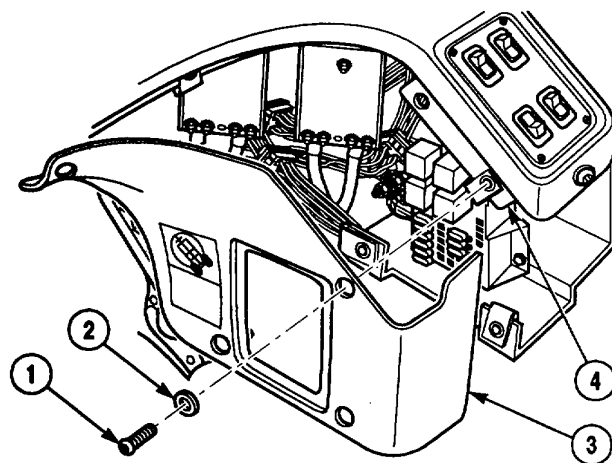
- (32) Install lower dash panel (3) on dash frame (4) with five washers (2) and screws (1).

NOTE

Follow-on Maintenance:

- Remove wheel chocks(TM 10-3930-669-10).

END OF TASK



7-5. ENGINE WIRE HARNESS REPLACEMENT.

This task covers:

- a. Removal
- b. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)

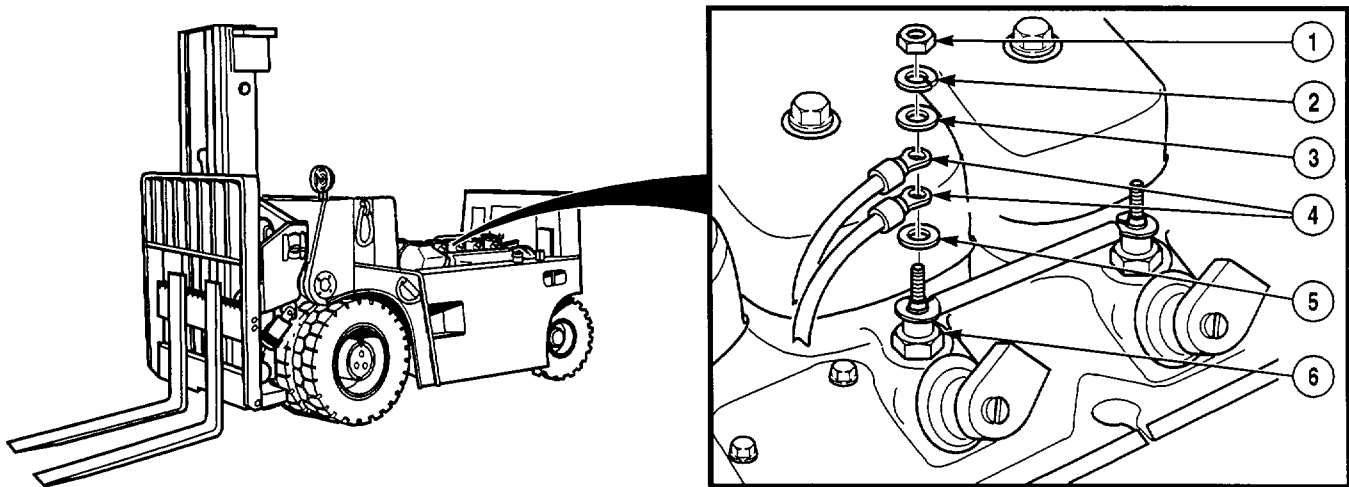
Materials/Parts

Tags, Identification (Item 21, Appendix B)
Washer, Lock
Washer, Lock
Washer, Lock
Washer, Lock
Washer, Lock
Washer, Lock

Equipment Condition

Cab removed (TM 10-3930-669-20)
Relay panel assembly removed
(TM 10-3930-669-20)
Shunt removed (TM 10-3930-669-20)

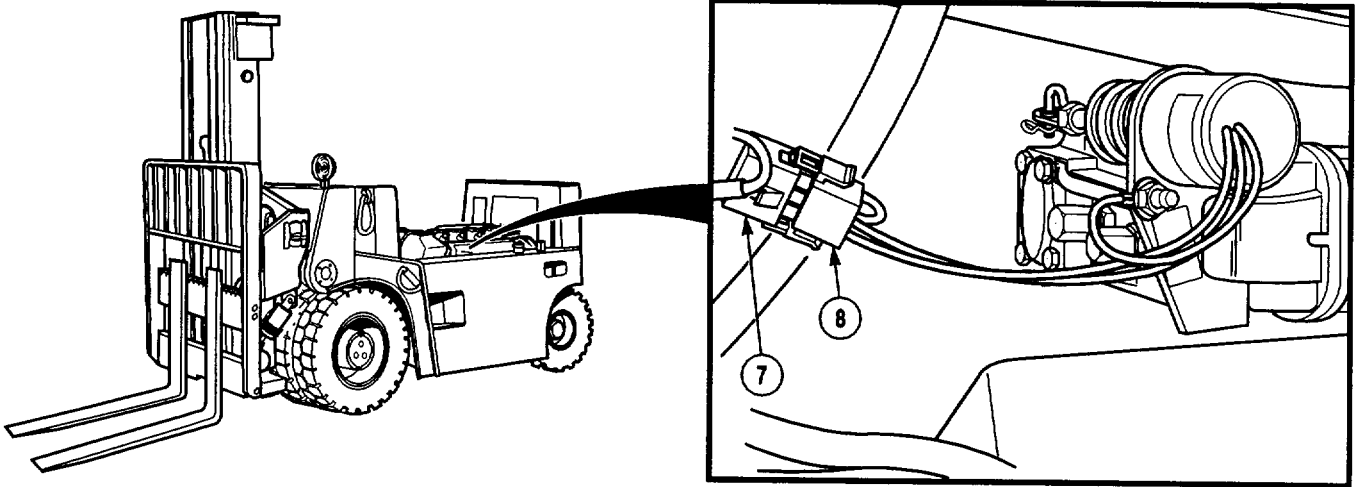
a. Removal.



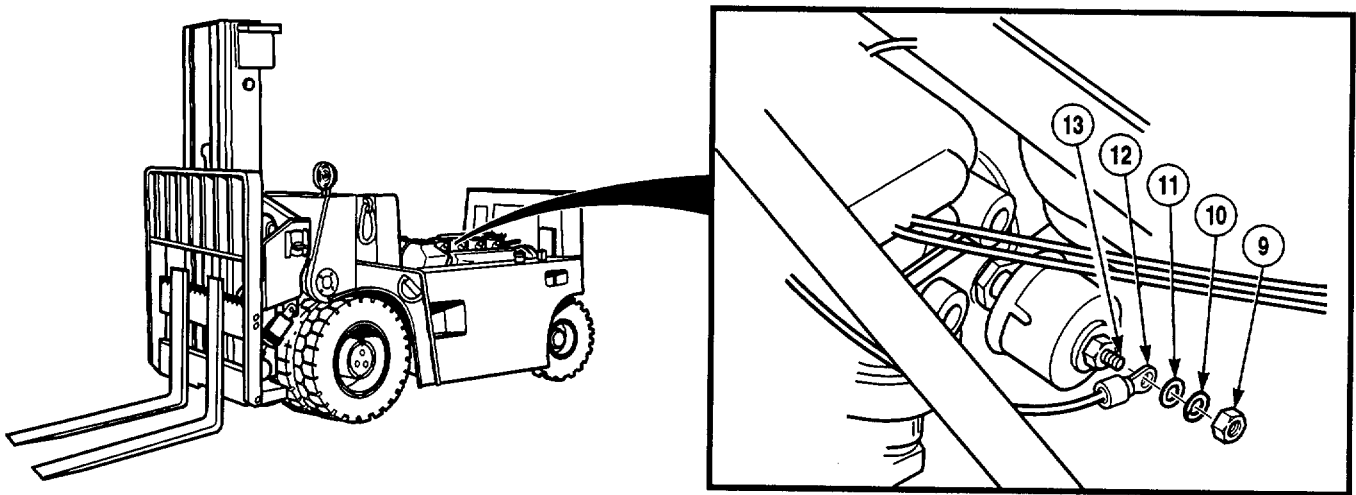
NOTE

- **Tag and mark all wires before disconnecting.**
- **Remove plastic ties as necessary.**

(1) Remove nut (1), lock washer (2), washer (3), two wires (4), and washer (5) from glow plug (6). Discard lock washer.

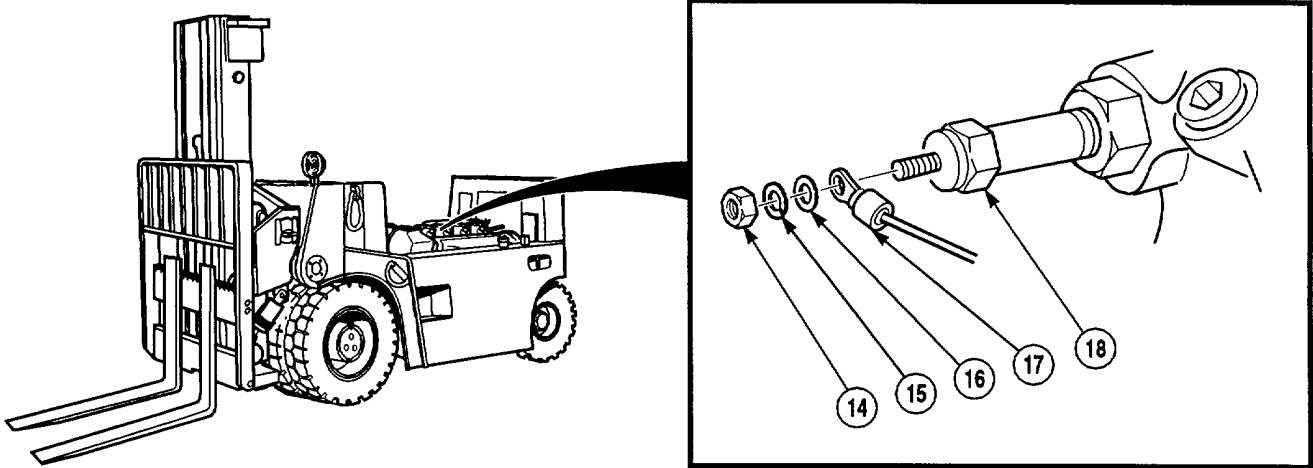


(2) Disconnect connector P10 (7) from fuel shut-off solenoid connector (8).

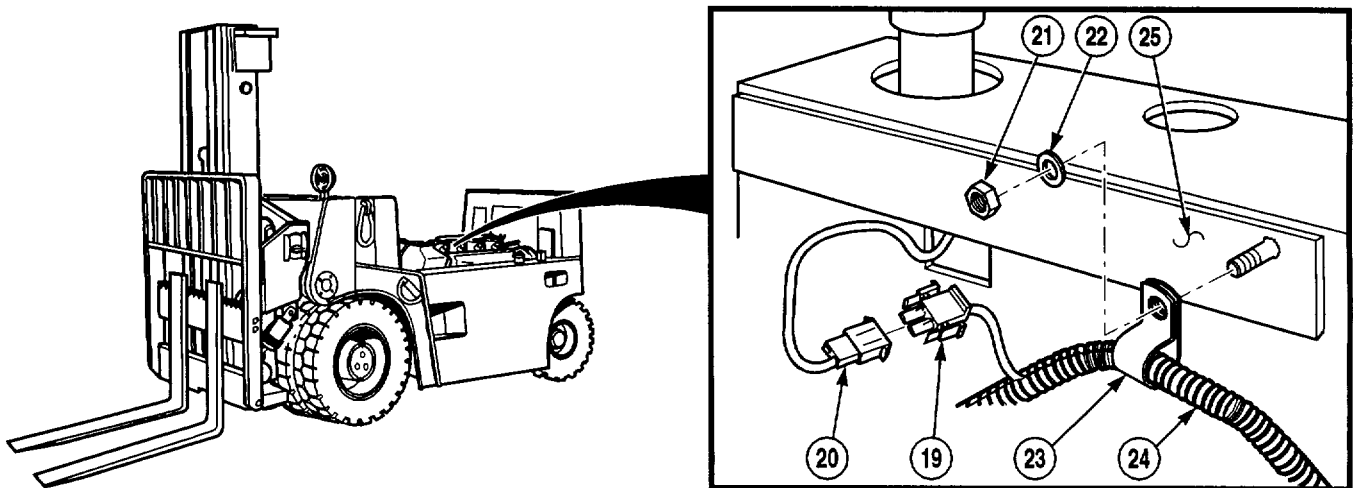


(3) Remove nut (9), lock washer (10), washer (11), and wire (12) from engine oil pressure sensor (13). Discard lock washer.

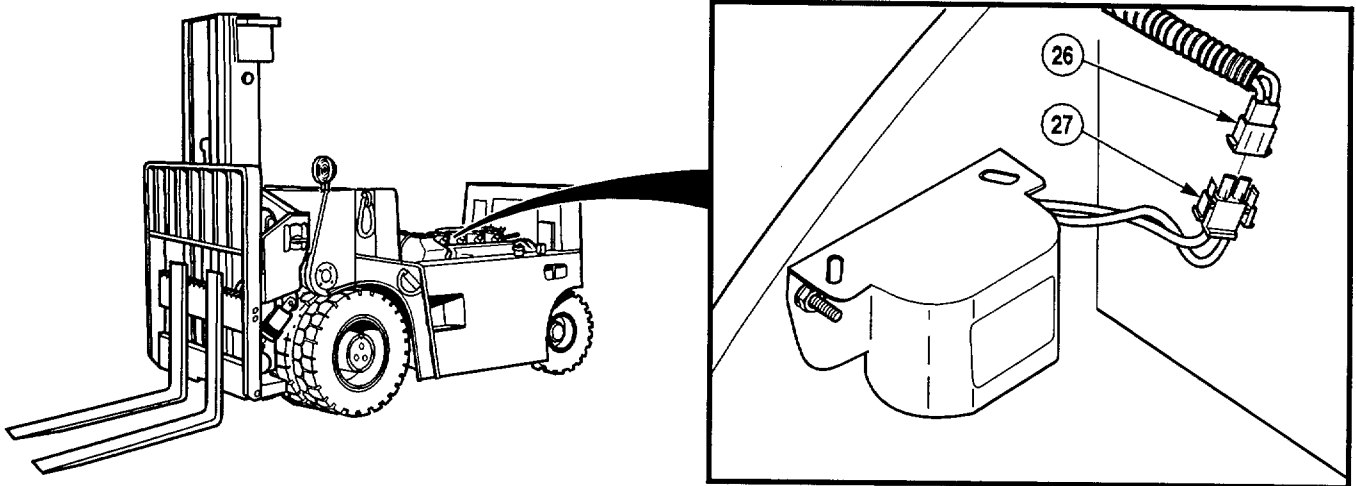
7-5. ENGINE WIRE HARNESS REPLACEMENT (CONT).



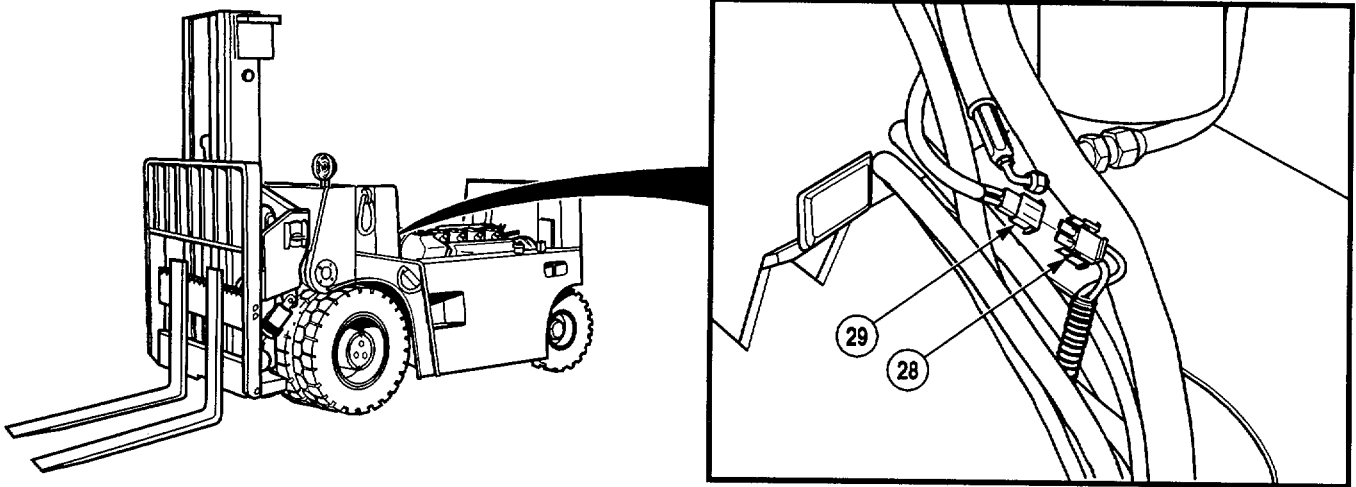
- (4) Remove nut (14), lock washer (15), washer (16), and wire (17) from engine oil temperature sensor (18). Discard lock washer.



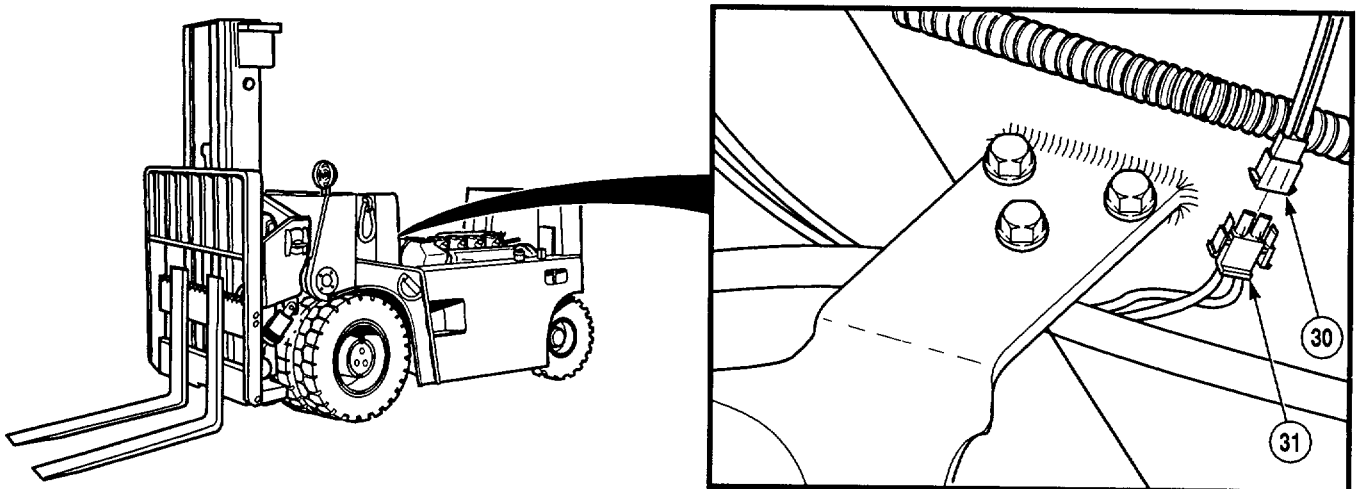
- (5) Disconnect connector P12 (19) from fuel level sender connector (20).
- (6) Remove five nuts (21), washers (22), clamps (23), and wire harness (24) from engine compartment (25).



(7) Disconnect connector P16 (26) from horn connector (27).

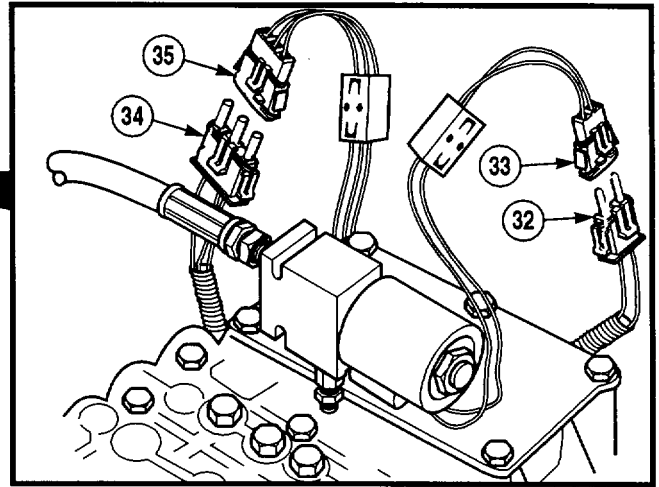
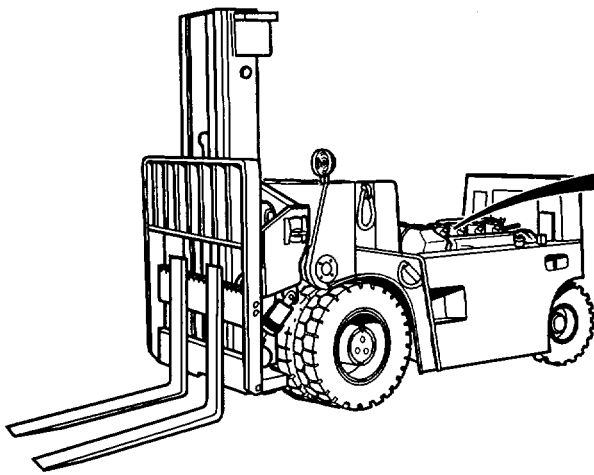


(8) Disconnect connector P14 (28) from connector J14 (29).

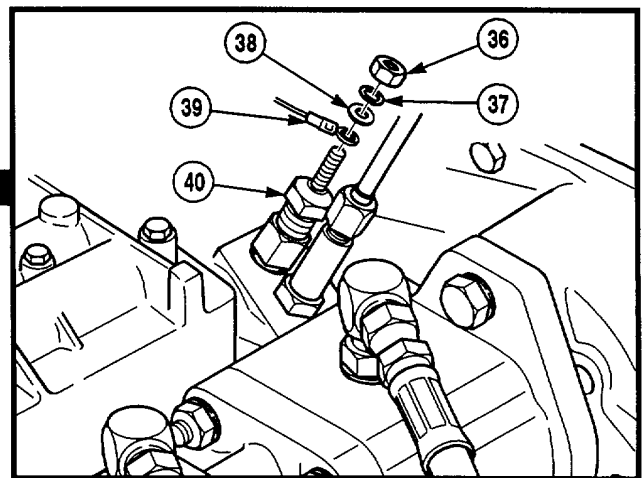
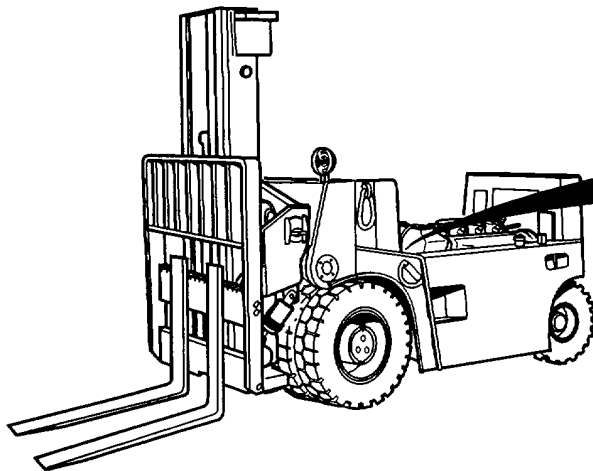


(9) Disconnect connector P18 (30) from axle oil pump connector (31).

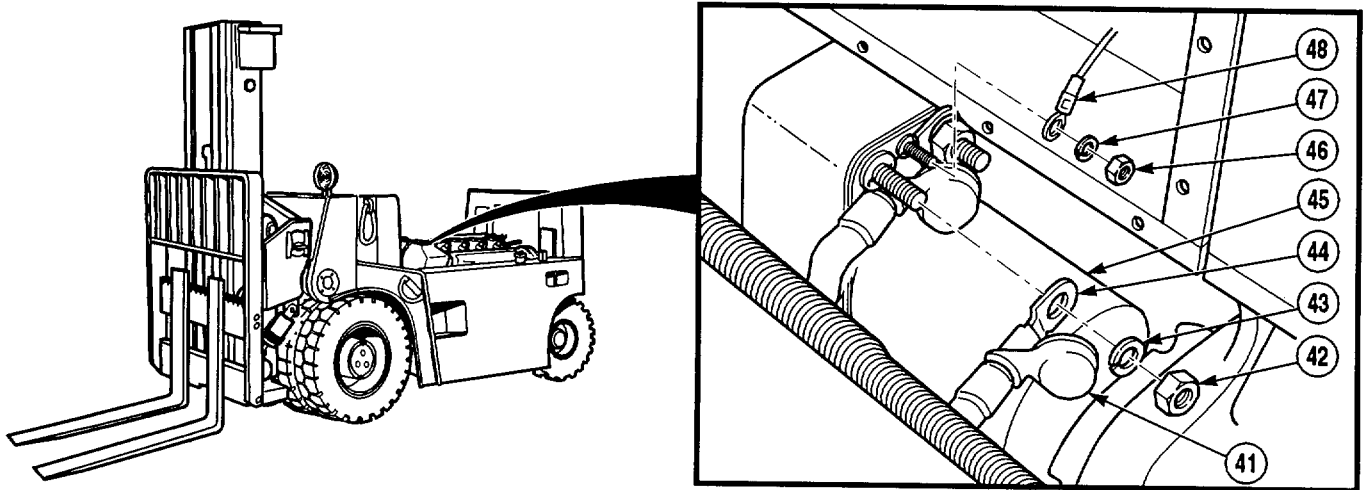
7-5. ENGINE WIRE HARNESS REPLACEMENT (CONT).



- (10) Disconnect connector P19 (32) from inch valve connector (33).
- (11) Disconnect connector P11 (34) from transmission control valve connector (35).

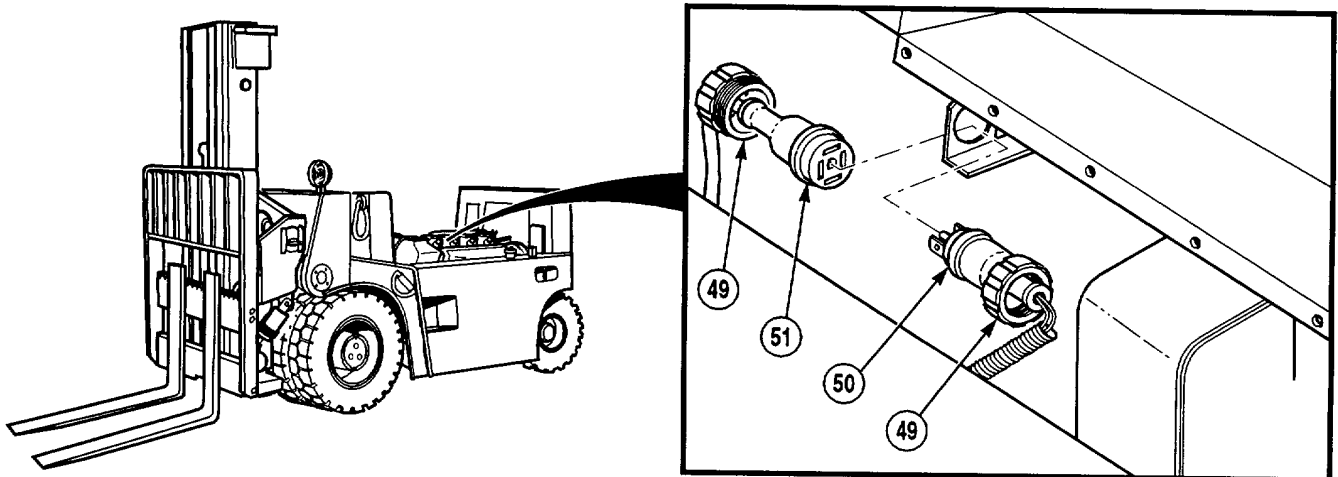


- (12) Remove nut (36), lock washer (37), washer (38), and wire (39) from transmission oil temperature sensor (40). Discard lock washer.



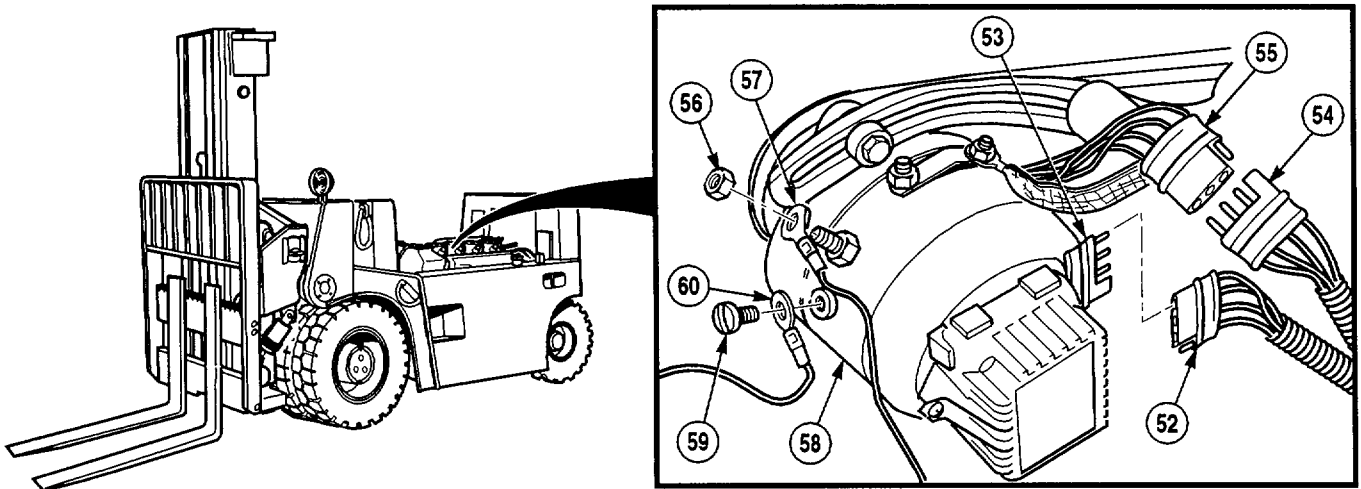
(13) Lift back rubber boot (41) and remove nut (42), lock washer (43), and cable (44) from starter assembly (45). Discard lock washer.

(14) Remove nut (46), lock washer (47), and wire (48) from starter assembly (45). Discard lock washer.



(15) Separate cap nut (49) and disconnect connector P15 (50) from broken belt sensor cable connector (51).

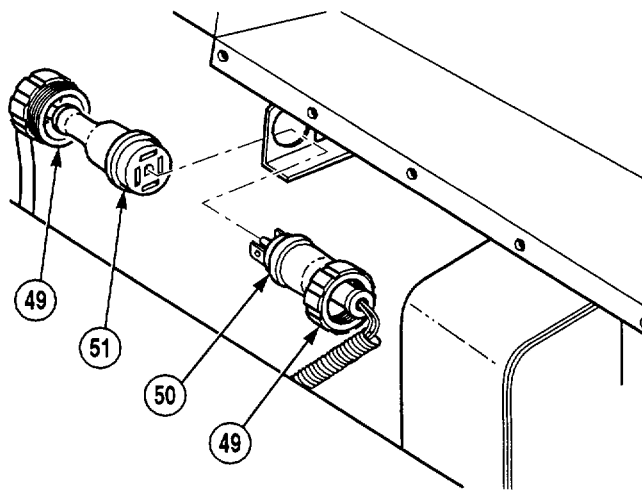
7-5. ENGINE WIRE HARNESS REPLACEMENT (CONT).



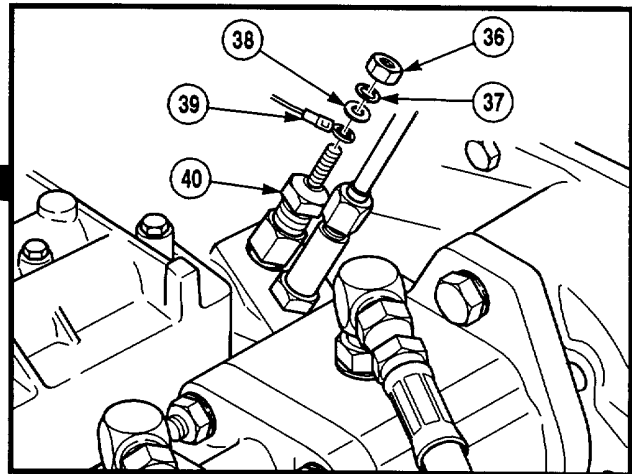
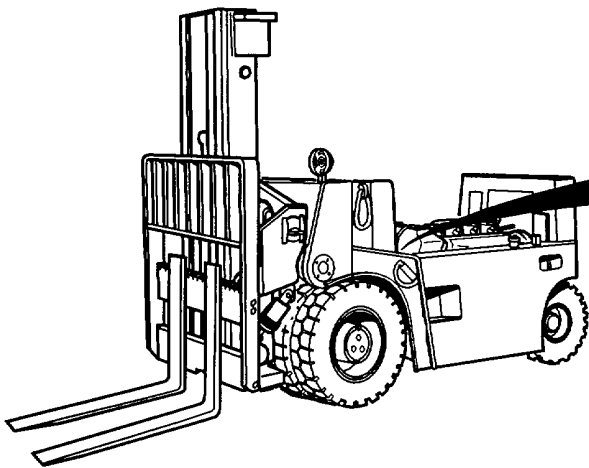
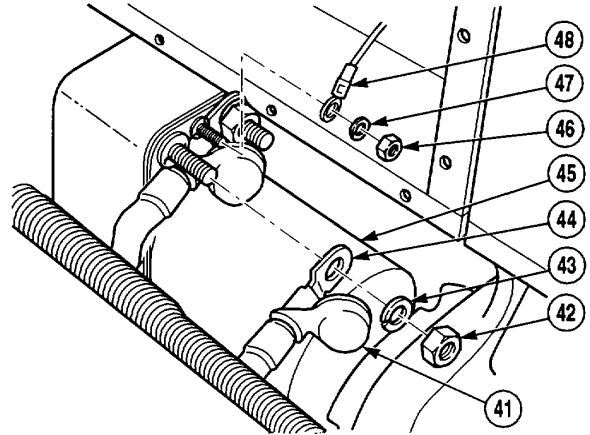
- (16) Disconnect harness connector (52) from voltage regulator (53).
- (17) Disconnect harness connector (54) from alternator connector (55).
- (18) Remove nut (56) and wire (57) from alternator (58).
- (19) Remove screw (59) and wire (60) from alternator (58).

b. Installation.

- (1) Install wire (60) on alternator (58) with screw (59).
- (2) Install wire (57) on alternator (58) with nut (56).
- (3) Connect harness connector (54) on alternator connector (55).
- (4) Connect harness connector (52) on voltage regulator connector (53).
- (5) Connect broken belt sensor cable connector (51) on connector P15 (50). Tighten cap nut (49).



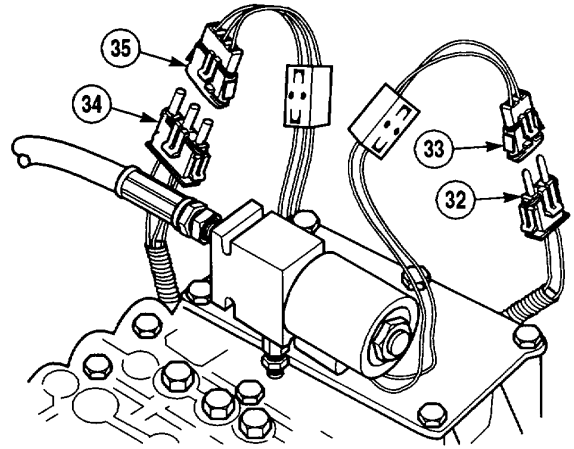
- (6) Install wire (48) on starter assembly (45) with lock washer (47) and nut (46).
- (7) Install cable (44) on starter assembly (45) with lock washer (43) and nut (42). Pull rubber boot (41) down over nut.



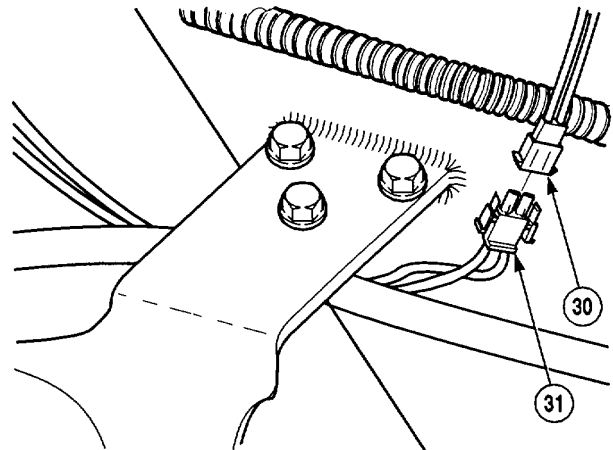
- (8) Install wire (39) on transmission oil temperature sensor (40) with washer (38), lock washer (37), and nut (36).

7-5. ENGINE WIRE HARNESS REPLACEMENT (CONT).

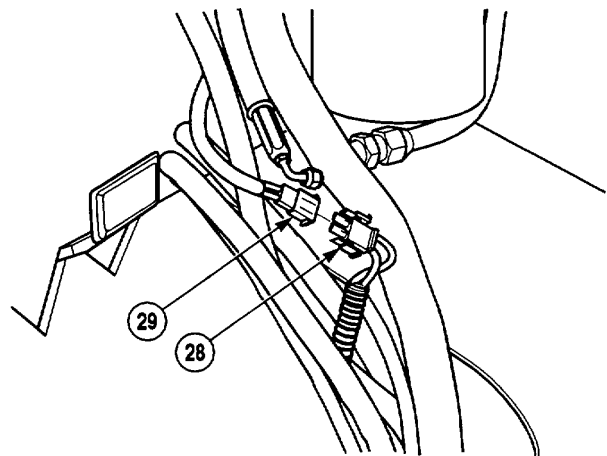
- (9) Connect transmission control valve connector (35) on connector P11 (34).
- (10) Connect inch valve connector (33) on connector P (32).



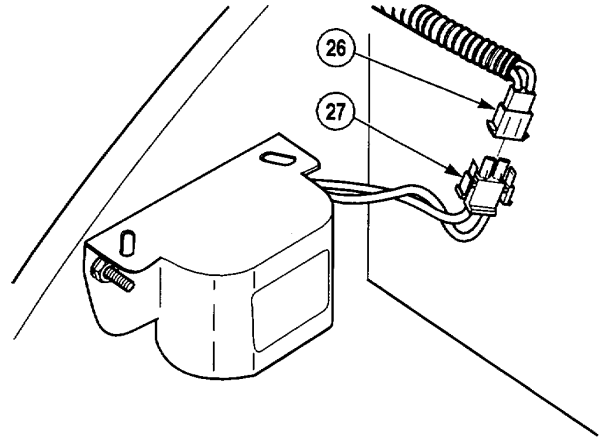
- (11) Connect axle oil pump connector (31) on connector P18 (30).



- (12) Connect connector J14 (29) on connector P14 (28).

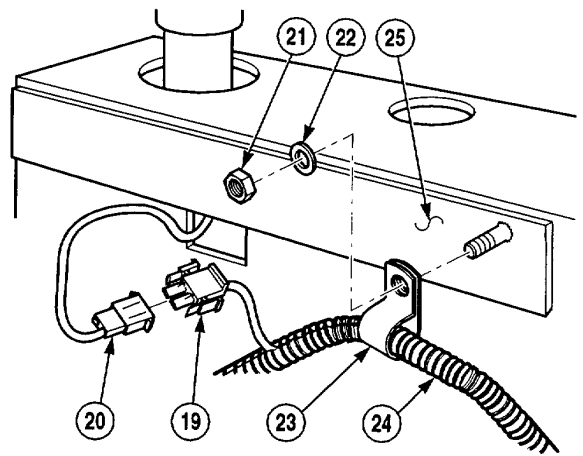


- (13) Install horn connector (27) on connector P16 (26).

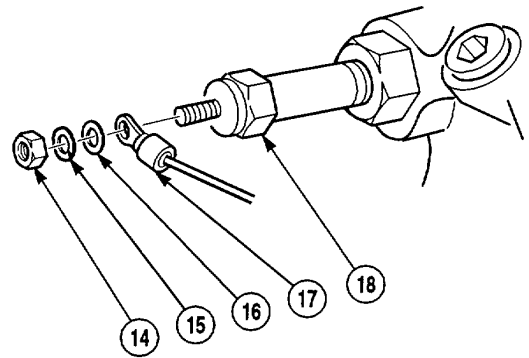


- (14) Install wire harness (24) on engine compartment (25) with five clamps (23), washers (22), and nuts (21).

- (15) Connect fuel level sender connector (20) on connector P12 (19).

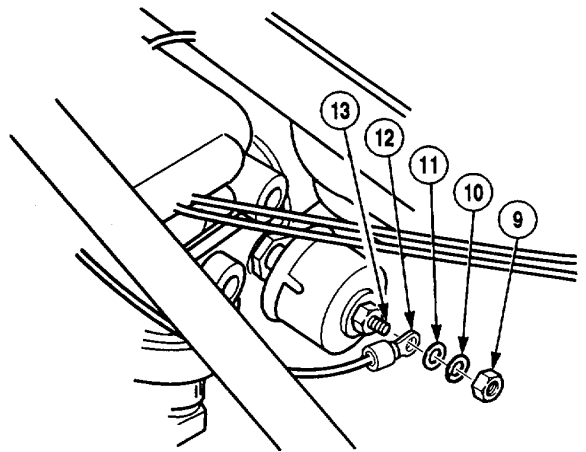


- (16) Install wire (17) on engine oil temperature sensor (18) with washer (16), lock washer (15), and nut (14).

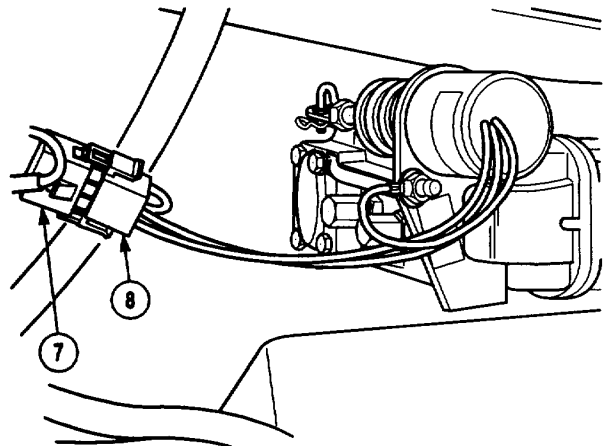


7-5. ENGINE WIRE HARNESS REPLACEMENT (CONT).

- (17) Install wire (12) on engine oil pressure sensor (13) with washer (11), lock washer (10), and nut (9).



- (18) Install fuel shut-off solenoid connector (8) on connector P10 (7).

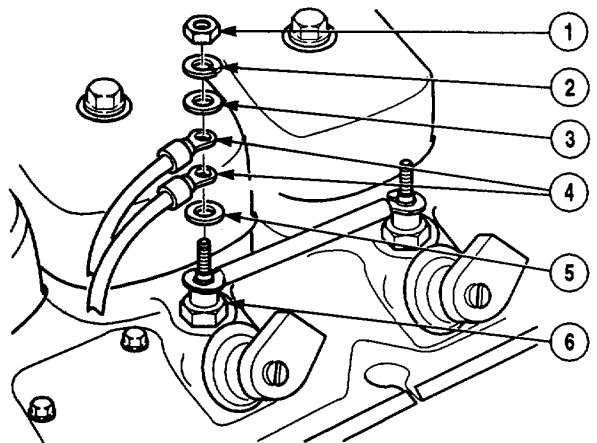


- (19) Install washer (5) and two wires (4) on glow plug (6) with washer (3), lock washer (2), and nut (1).

NOTE

Follow-on Maintenance:

- Install relay panel (TM 10-3930-669-20).
- Install cab (TM 10-3930-669-20).
- Install shunt (TM 10-3930-669-20) **END OF TASK**



CHAPTER 8

TRANSMISSION MAINTENANCE

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8-1. INTRODUCTION.

This chapter contains maintenance instructions for removing, repairing, installing, and replacing transmission system components as authorized by the Maintenance Allocation Chart (MAC) at the Direct Support and General Support Maintenance level.

8-2. TRANSMISSION VALVE BODY REPLACEMENT/REPAIR.

This task covers:

- | | | |
|----------------|------------------------|-----------------|
| a. Removal | c. Cleaning/Inspection | e. Installation |
| b. Disassembly | d. Assembly | f. Adjustment |

INITIAL SETUP:

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive
 (Item 1, Appendix E)
 Wrench, Torque (0-60 N.m)
 (Item 5, Appendix E)

Materials/Parts

Loctite, 242 (Item 22, Appendix B)
 Oil, Transmission (Item 25, Appendix B)
 Solvent, Dry-cleaning (Item 20, Appendix B)
 Tags, Identification (Item 21, Appendix B)
 Gasket
 Gasket
 Gasket

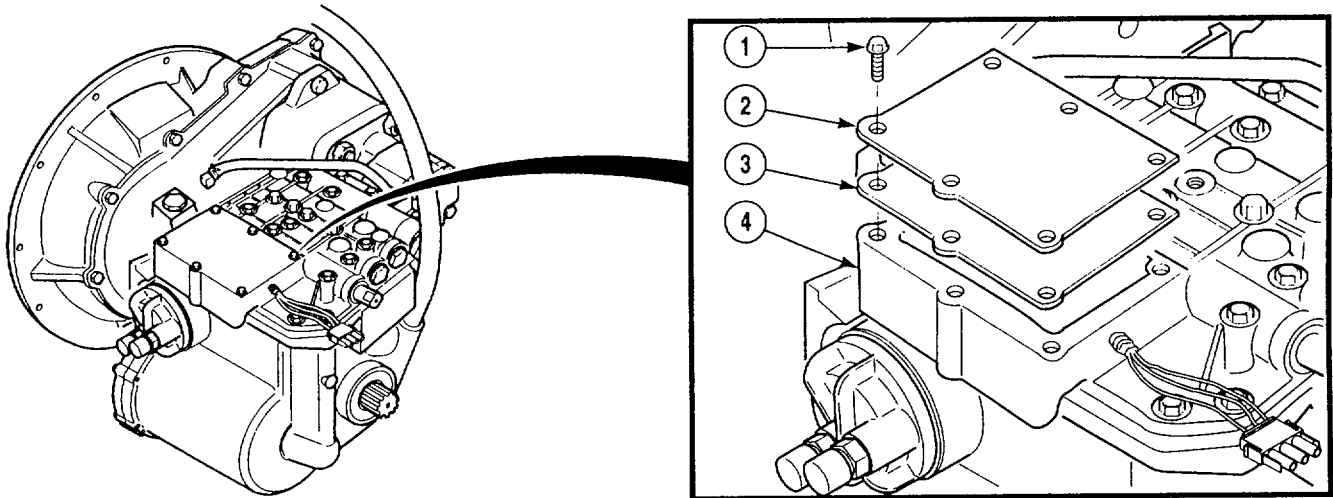
Materials/Parts - Continued

Packing, Preformed
 Packing, Preformed (2)
 Packing, Preformed (3)
 Packing, Preformed (4)
 Screw/Lock Washer Assembly (2)
 Seal

Equipment Condition

Cab removed (TM 10-3930-669-20)
 Transmission inching valve removed
 (TM 10-3930-669-20)

a. Removal.

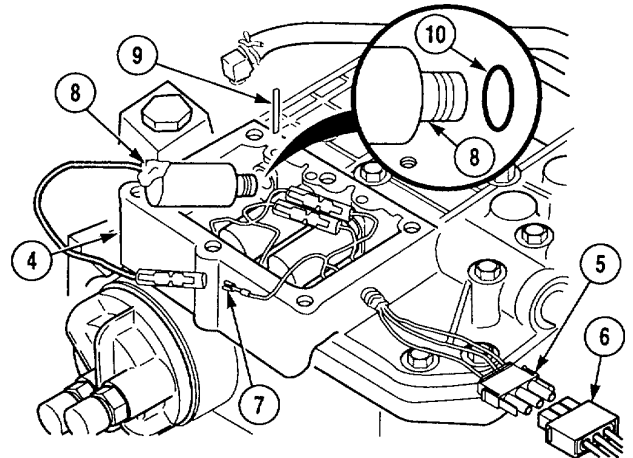


NOTE

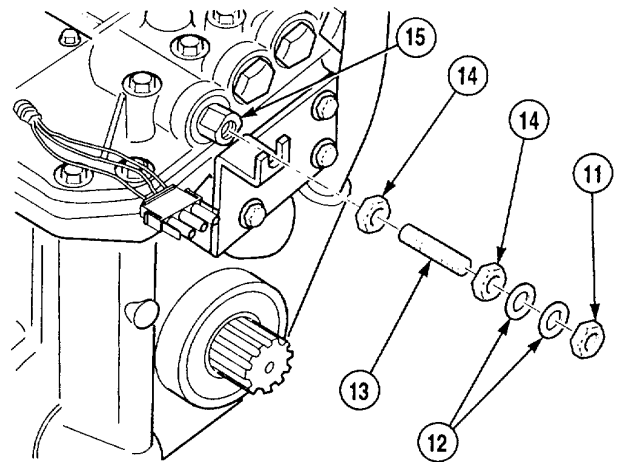
Transmission shown removed for clarity.

- (1) Remove six screws (1), plate (2), and gasket (3) from valve body (4). Discard gasket.

- (2) Disconnect connector P11 (5) from connector S11 (6).
- (3) Disconnect three wires (7) from three solenoids (8).
- (4) Remove three pins (9) and solenoids (8) from valve body (4).
- (5) Remove three preformed packings (10) from solenoids (8). Discard preformed packings.



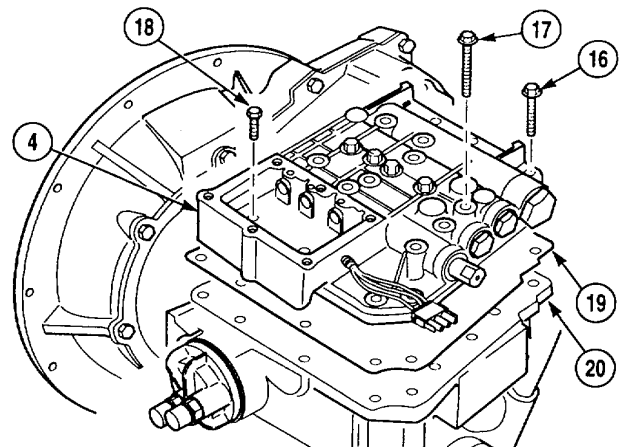
- (6) Remove nut (11) and two washers (12) from adjustment rod (13).
- (7) Loosen two nuts (14) on adjustment rod (13).
- (8) Remove adjustment rod (13) from inching valve plunger (15).



NOTE

- **Mark hole in transmission case that has sealing compound applied to threads of screw to ensure correct installation.**
- **Tag and mark all screws and valve body to ensure correct installation.**

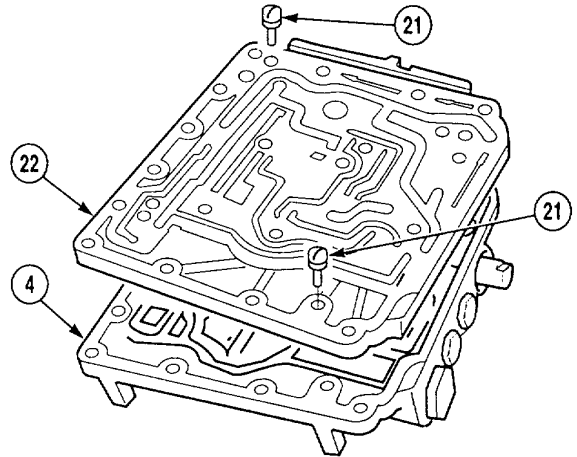
- (9) Remove nine screws (16) from valve body (4).
- (10) Remove six screws (17) from valve body (4).
- (11) Remove two screws (18) from valve body (4).
- (12) Remove valve body (4) and gasket (19) from transmission (20). Discard gasket.



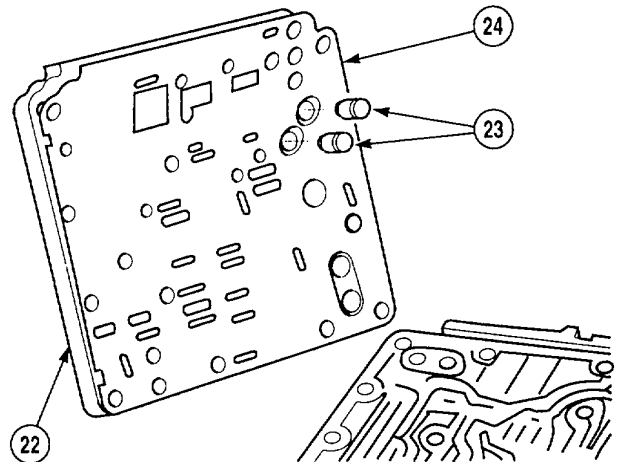
8-2. TRANSMISSION VALVE BODY REPLACEMENT/REPAIR (CONT).

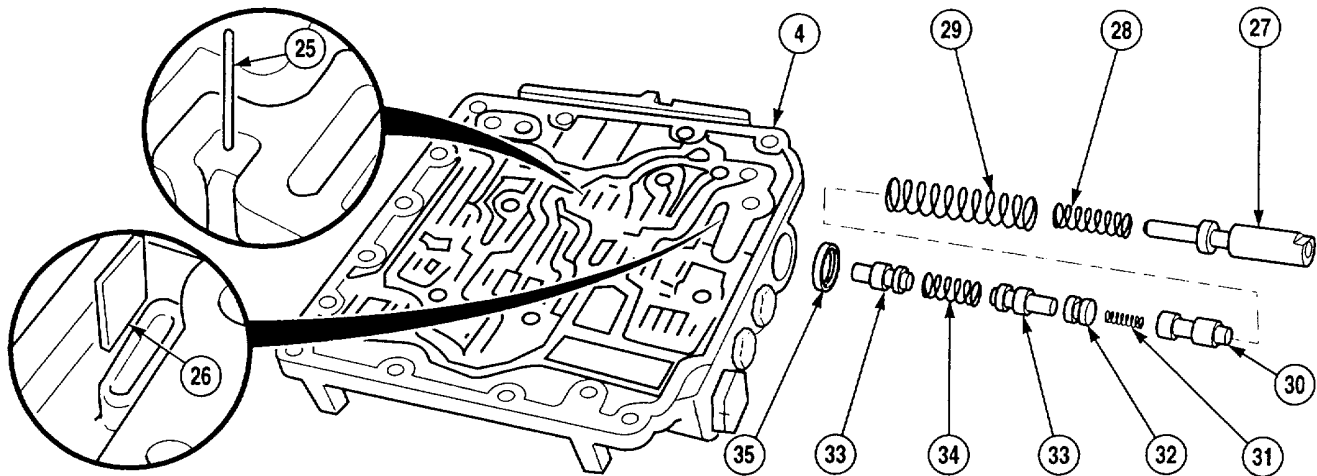
b. Disassembly.

- (1) Remove two screw/lock washer assemblies (21) and distributor plate (22) from valve body (4). Discard screw/lock washers.



- (2) Remove two priority valves (23) and gasket (24) from distributor plate (22). Discard gasket.





(3) Remove pin (25) from valve body (4).

NOTE

- **Note position of parts being removed. Do not reverse or mix them up.**
- **It may be necessary to push in slightly on inching valve plunger prior to removing inching valve stop.**

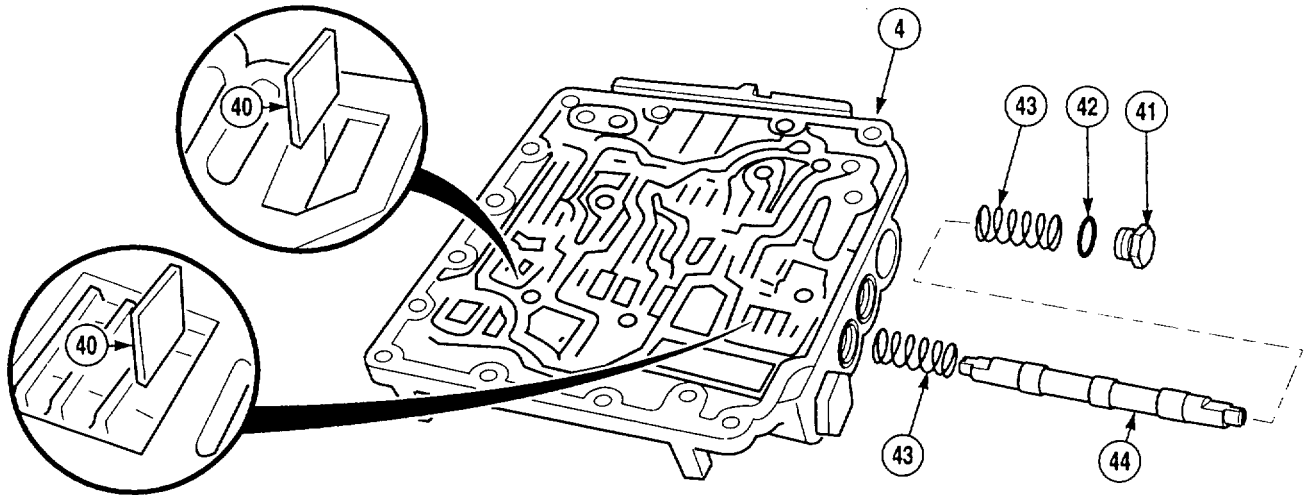
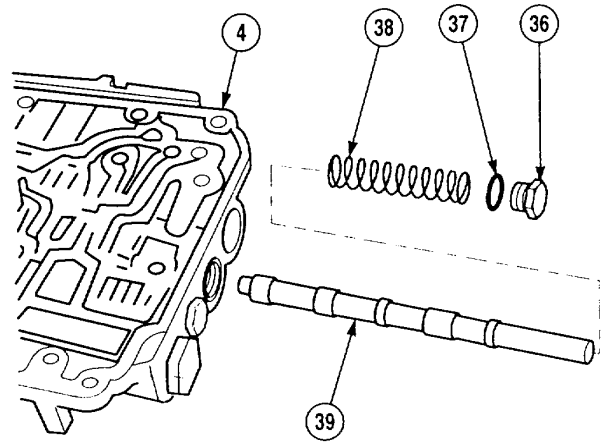
(4) Remove inching valve stop (26) from valve body (4).

(5) Remove inching valve plunger (27), inner spring (28), outer spring (29), inching valve (30), spring (31) stop (32), two accumulator control valves (33), and spring (34) from valve body (4).

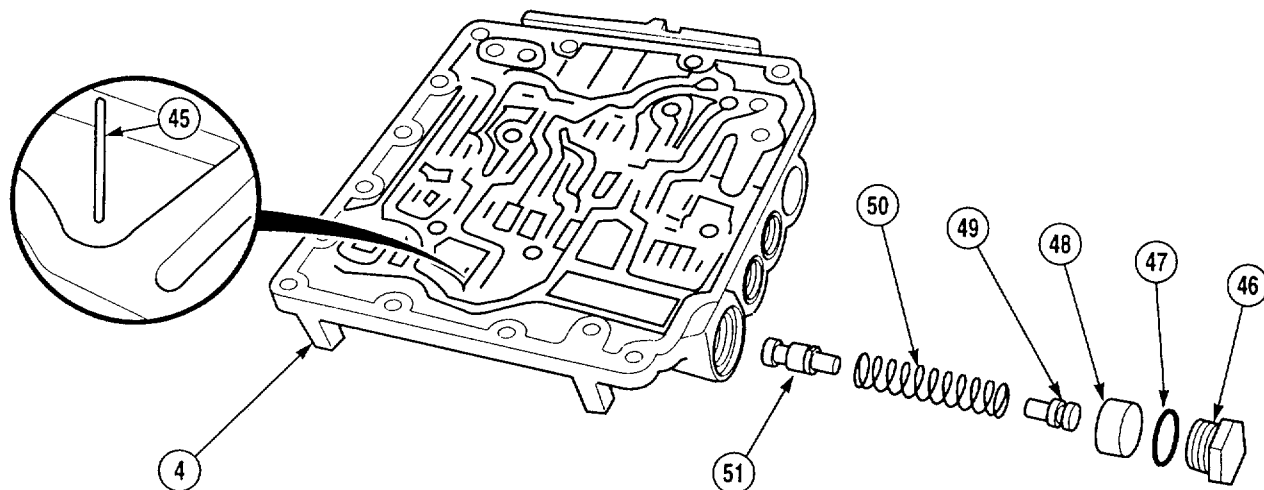
(6) Remove seal (35) from valve body (4). Discard seal.

8-2. TRANSMISSION VALVE BODY REPLACEMENT/REPAIR (CONT).

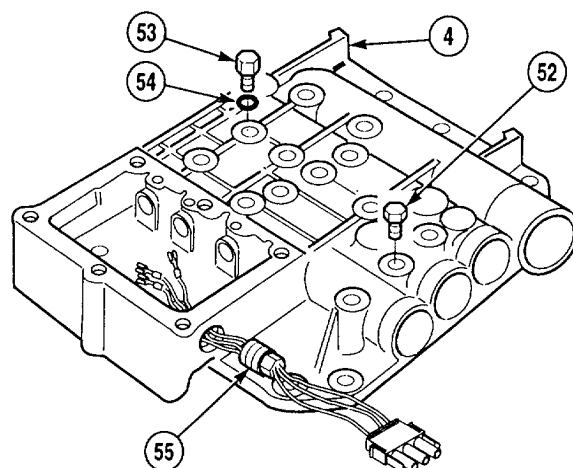
- (7) Remove plug (36), preformed packing (37), spring (38), and valve (39) from valve body (4). Discard preformed packing.



- (8) Remove two inching valve stops (40), plug (41), preformed packing (42), spring (43), selector valve (44), and spring (43) from valve body (4). Discard preformed packing.



- (9) Remove pin (45), plug (46), preformed packing (47), accumulator valve (48), stop (49), spring (50), and regulator valve (51) from valve body (4). Discard preformed packing.
- (10) Remove three plugs (52), four plugs (53), and preformed packings (54) from valve body (4). Discard preformed packings.
- (11) Remove plug and wire assembly (55) from valve body (4).



c. Cleaning/Inspection.

WARNING

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
- **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**

- (1) Rinse all metal parts in dry-cleaning solvent to remove dirt, grease, and transmission oil.
- (2) Take special care to remove all dry-cleaning solvent from oil passages, grooves, and valve bores.

8-2. TRANSMISSION VALVE BODY REPLACEMENT/REPAIR (CONT).

CAUTION

- Do not allow any dirt or lint to enter transmission or valve body or damage to equipment can result.
- Do not use any kind of wiping rag around valve body of transmission where valve body mounts or damage to equipment can result.
- Allow all parts to air dry. Do not use a cloth or shop towel. Lint can get into transmission circuit.

- (3) Inspect valve body and valve surfaces for nicks, scratches, or burrs that can cause leaks.
- (4) Inspect springs for distortion, cracks, or deformation.
- (5) Inspect threaded parts for stripped or damaged threads or burrs.
- (6) Replace any parts that show obvious signs of damage.

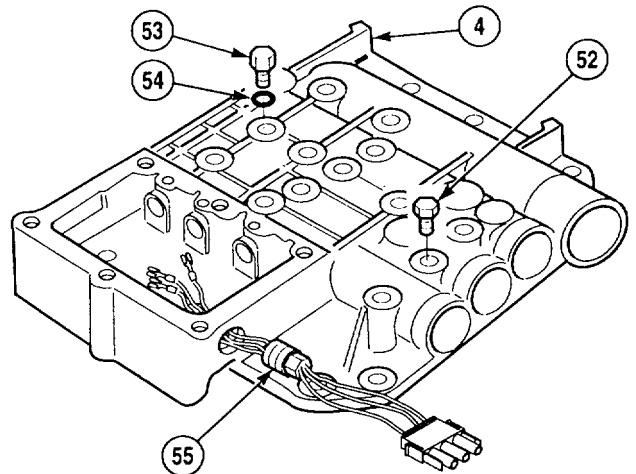
d. Assembly.**CAUTION**

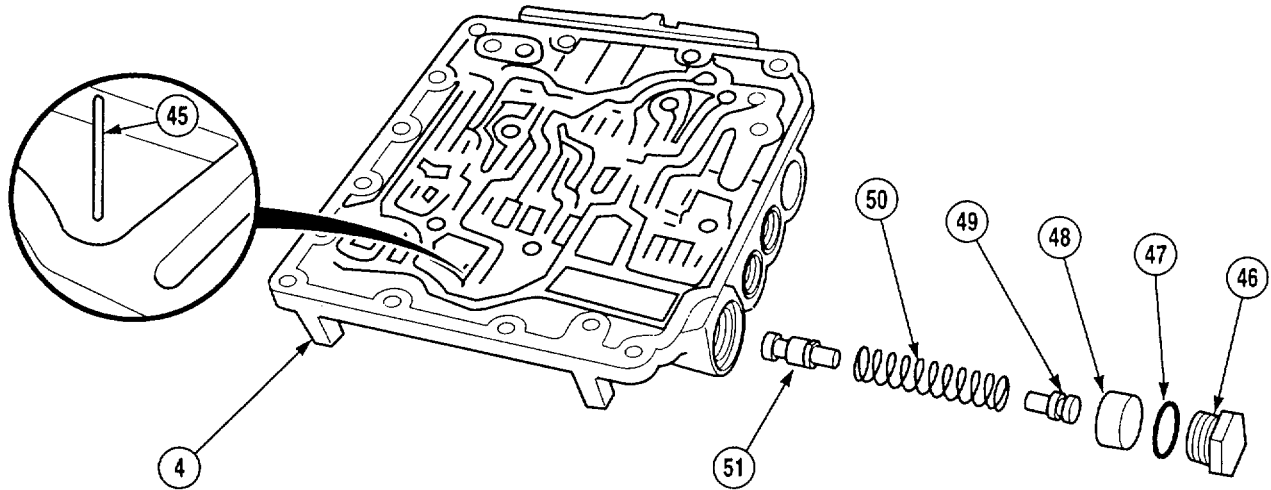
Do not hammer or force pins or stops. They should fit with light to medium hand pressure. Hammering or forcing parts can result in severe damage to valve body.

NOTE

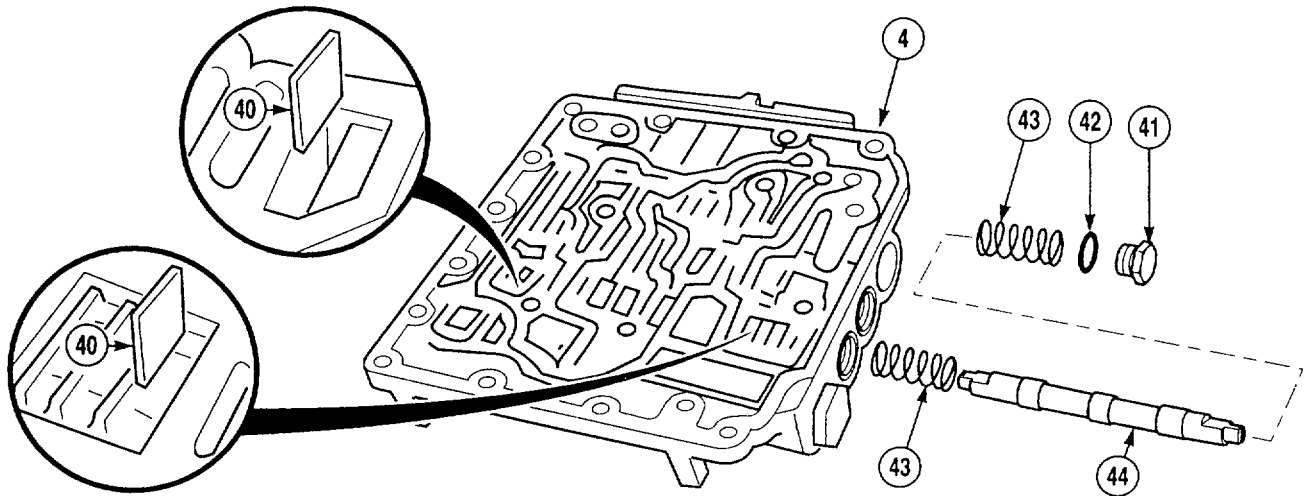
- Place valve body on a clean, lint-free surface.
- Lightly lubricate preformed packings with transmission fluid prior to installation.

- (1) Install plug and wire assembly (55) in valve body (4).
- (2) Install four preformed packings (54) and plugs (53) in valve body (4).
- (3) Install three plugs (52) in valve body (4).





- (4) Install regulator valve (51), spring (50), stop (49), accumulator valve (48), preformed packing (47), and plug (46) in valve body (4).
- (5) Install pin (45) in valve body (4).



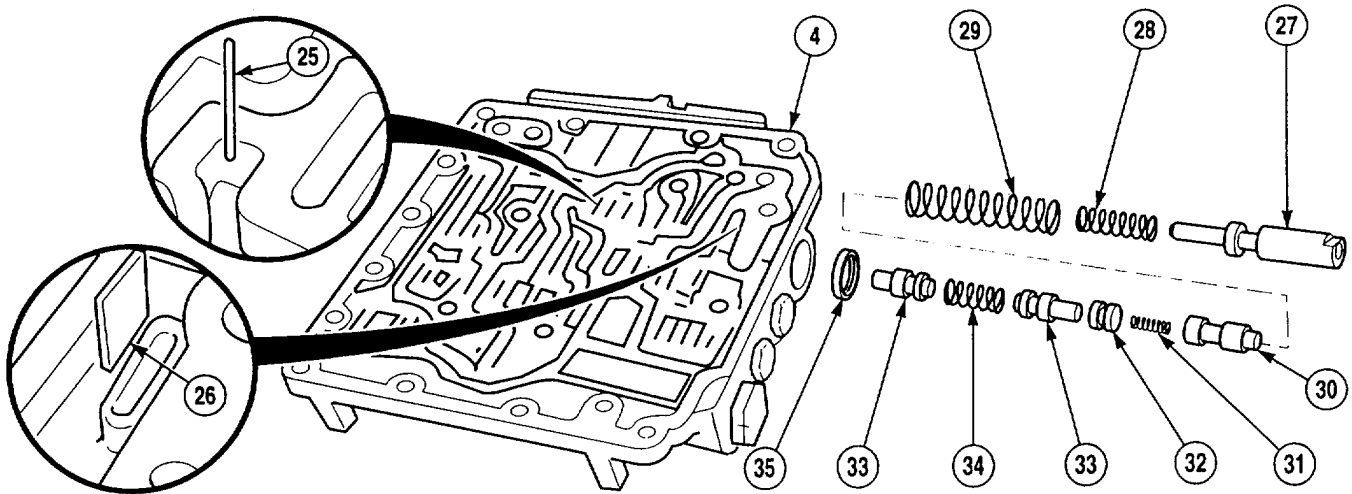
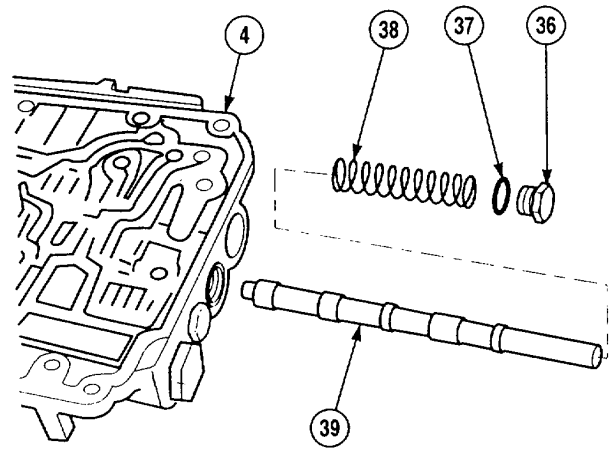
NOTE

Ensure selector valve is aligned properly and inching valve stops are seated properly.

- (6) Install spring (43), selector valve (44), spring (43), preformed packing (42), plug (41), and two inching valve stops (40) in valve body (4). Tighten plug to 25 to 35 lb-ft (34-47 N•m).

8-2. TRANSMISSION VALVE BODY REPLACEMENT/REPAIR (CONT).

- (7) Install valve (39), spring (38), preformed packing (37), and plug (36) in valve body (4). Tighten plug to 25 to 35 lb-ft (34-47 N•m).



NOTE

Ensure small spring is aligned properly prior to installation.

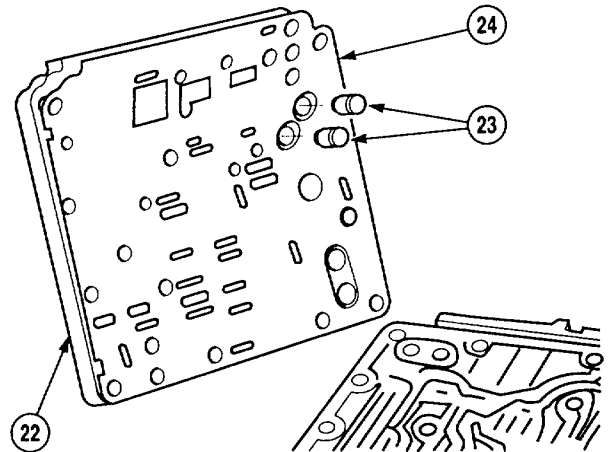
- (8) Install seal (35) in valve body (4).
- (9) Install accumulator control valve (33), spring (34), accumulator control valve (33), stop (32), spring (31), inching valve (30), outer spring (29), inner spring (28), and inching valve plunger (27) in valve body (4).

NOTE

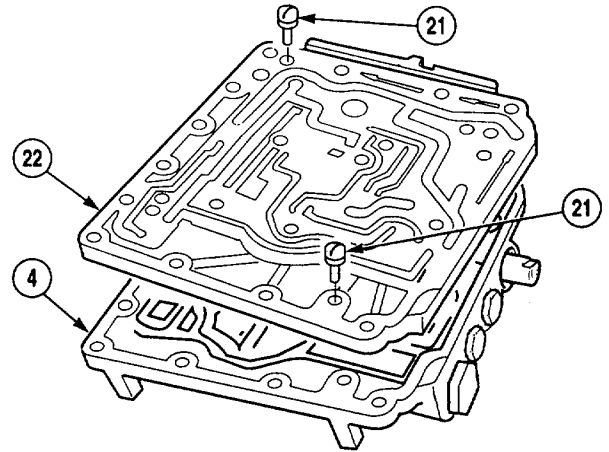
It may be necessary to push in on inching valve plunger slightly prior to installing inching valve stop.

- (10) Install inching valve stop (26) in valve body (4).
- (11) Install pin (25) in valve body (4).

- (12) Install gasket (24) and two priority valves (23) in distributor plate (22).



- (13) Install distributor plate (22) on valve body (4) with two screw a lockwasher assemblies (21).

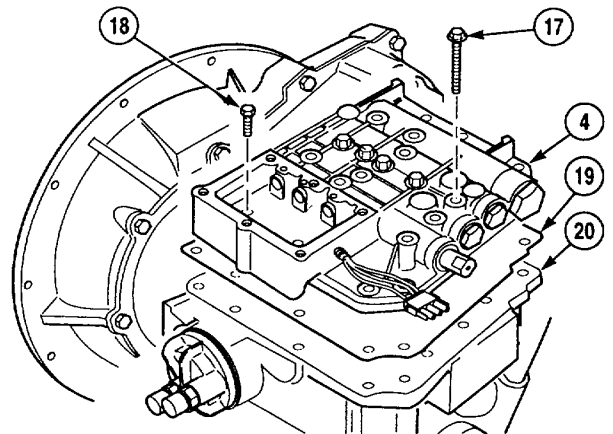


e. Installation.

NOTE

Refer to tags and marks on screws and valve body to ensure correct installation.

- (1) Install gasket (19) and valve body (4) on transmission (20) with two screws (18). Tighten screws to 17 to 22 lb-ft (23-30 N•m).
- (2) Install six screws (17) in valve body (4). Tighten screws to 17 to 22 lb-ft (23-30 N•m).



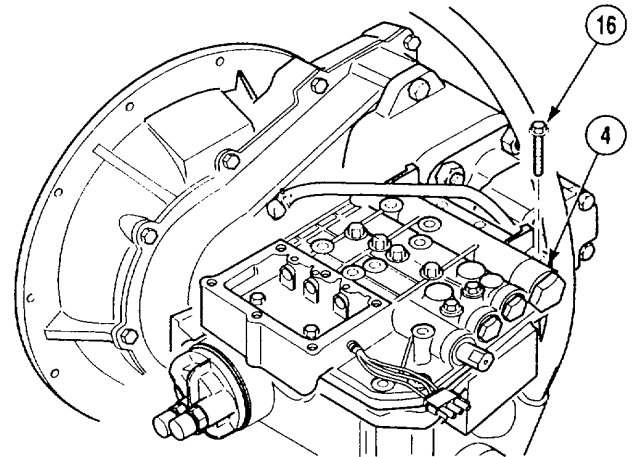
8-2. TRANSMISSION VALVE BODY REPLACEMENT/REPAIR (CONT).**WARNING**

Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

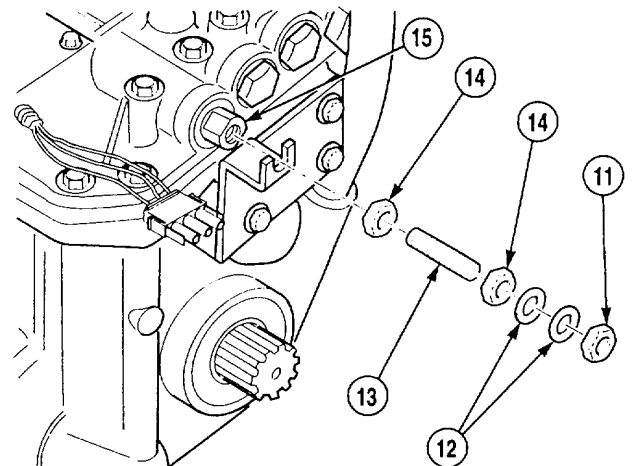
NOTE

Apply sealing compound only to the one screw noted in removal.

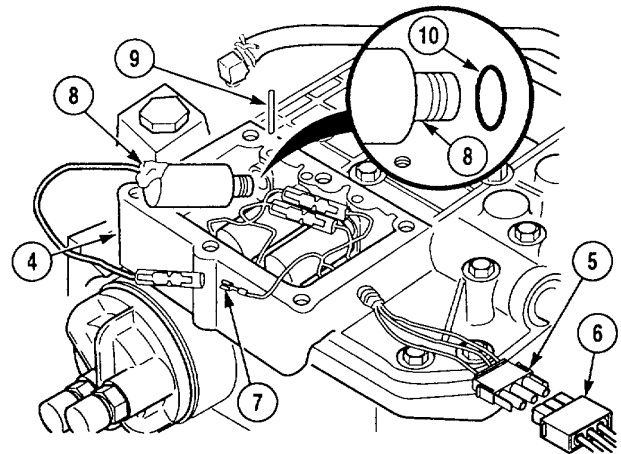
- (3) Apply sealing compound on threads of screw (16).
- (4) Install nine screws (16) in valve body (4). Tighten screws 17 to 22 lb-ft (23-30 N•m).



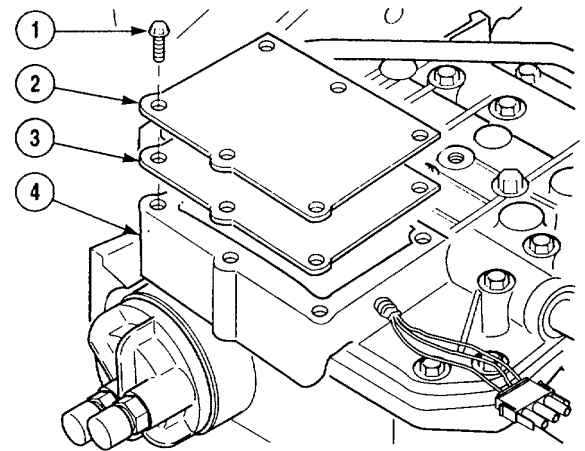
- (5) Position adjustment rod (13) in inching valve plunger (15).
- (6) Position two nuts (14) on adjustment rod (13).
- (7) Position two washers (12) and nut (11) on adjustment rod (13).



- (8) Install three preformed packings (10) on solenoids (8).
- (9) Install three solenoids (8) and pins (9) in valve body (4).
- (10) Connect three wires (7) to solenoids (8).
- (11) Connect connector P11 (5) to connector S11 (6).



- (12) Install gasket (3) and plate (2) on valve body (4) with six screws (1). Tighten six screws 8 to 11 lb-ft (11-15 N•m).



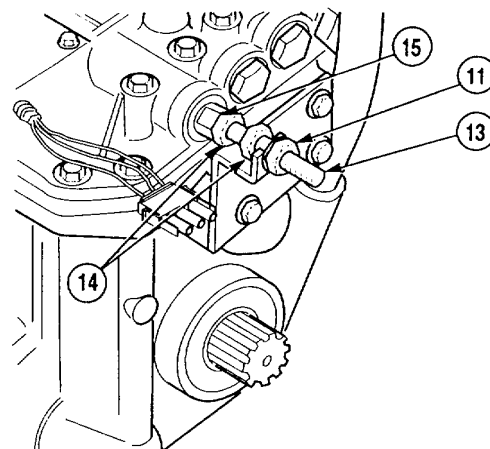
f. Adjustment.

- (1) Tighten nuts (14 and 11) in following order: Thread adjustment rod (13) fully into spool (15). Tighten nut (14 inner). Fully depress spool to bottom and hand tighten nut (14 outer). Turn nut (14 outer) an additional half turn. Tighten nut (11).

NOTE

Follow-on Maintenance:

- Install transmission inching valve (TM 10-3930-669-20).
- Install cab (TM 10-3930-669-20).



END OF TASK

8-3. TRANSMISSION REPLACEMENT.

This task covers:

- a. Removal
- b. Cleaning/Inspection
- c. Installation

INITIAL SETUP:

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Lifting Device
- Wrench, Torque (0 to 175 lb-ft [0 - 237 N•m]) (Item 5, Appendix E)

Personnel Required

Two

Equipment Condition

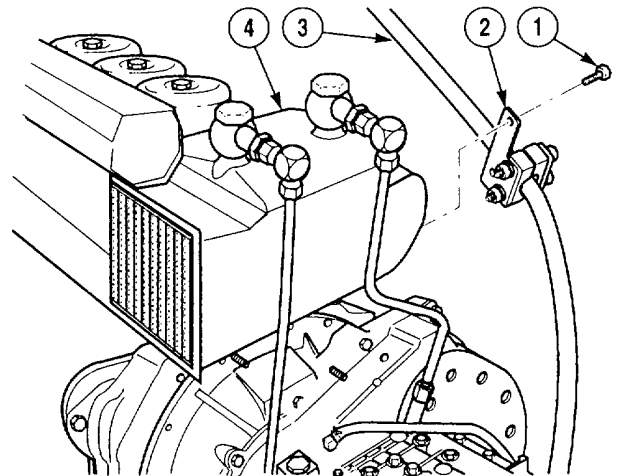
- Inching solenoid removed (TM 10-3930-669-20)
- Engine/transmission assembly removed (Para 3-3)

Materials/Parts

- Cap and Plug Set (Item 5, Appendix B)
- Rags, Wiping (Item 19, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)
- Tags, Identification (Item 21, Appendix B)

a. Removal.

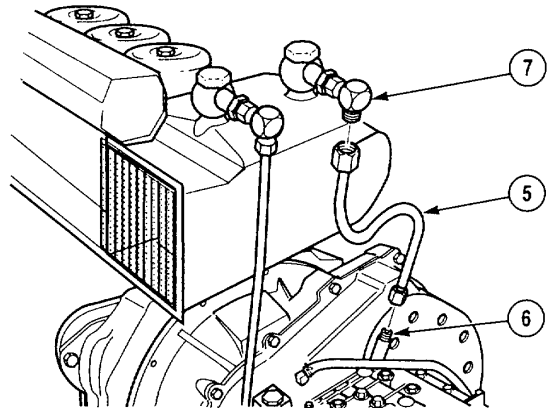
- (1) Remove two screws (1), bracket (2), and transmission oil filter tube (3) from engine (4).



NOTE

- Tag and mark all lines, hoses, and fittings prior to removal.
- Cap and plug all lines, hoses, and fittings when disconnected.

(2) Remove tube (5) from fitting (6) and elbow (7).

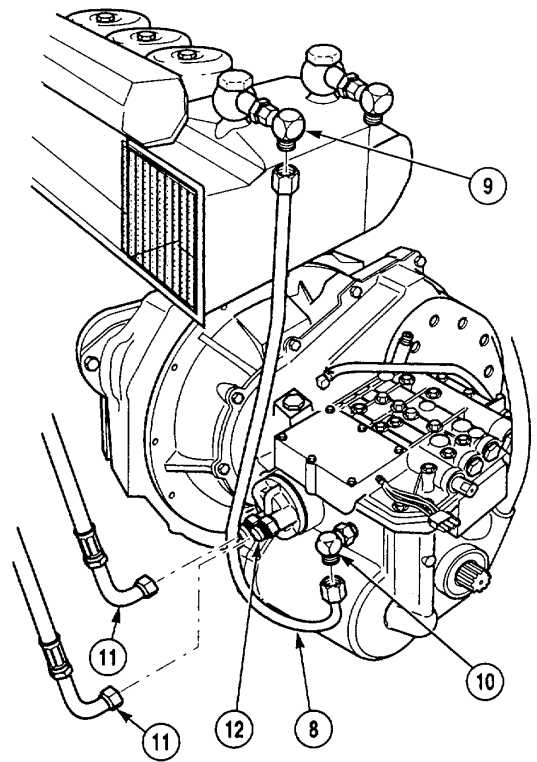


(3) Remove tube (8) from elbows (9 and 10).

NOTE

Tag and mark all hoses and lines prior to removal.

(4) Remove two hoses (11) from fittings (12).



8-3. TRANSMISSION REPLACEMENT (CONT).

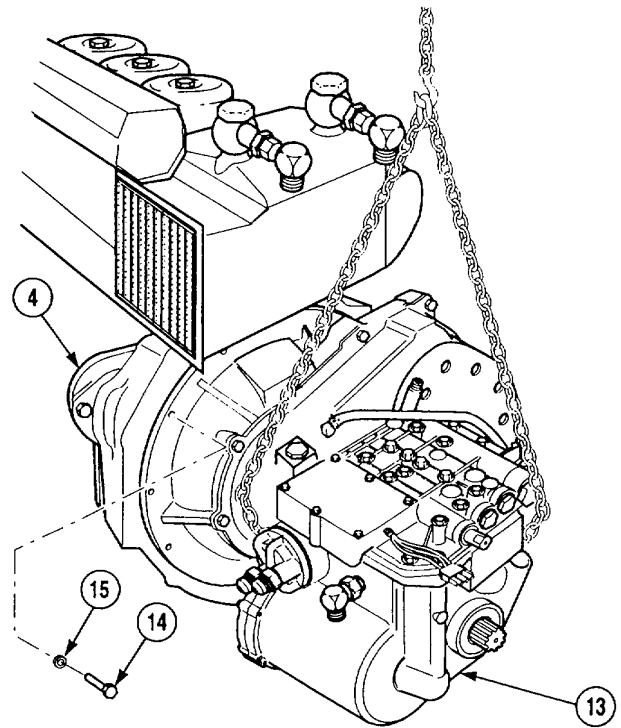
WARNING

Transmission weighs 335 lbs (152 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

CAUTION

Keep transmission straight with engine during removal or damage to transmission can result.

- (5) Support transmission (13) with lifting device.
- (6) Remove twelve screws (14), washers (15), and transmission (13) from engine (4).
- (7) With the aid of an assistant, place transmission (13) in work area as necessary and remove lifting device.



b. Cleaning/Inspection.**WARNING**

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

CAUTION

Do not allow solvent or contaminants to get inside transmission through open ports, fittings, or seals.

- (1) Clean all metal parts with dry-cleaning solvent and wiping rags.
- (2) Inspect all parts for breaks, cracks, burrs, sharp edges, and signs of overheating.

8-3. TRANSMISSION REPLACEMENT (CONT).

c. Installation.**WARNING**

Transmission weighs 319 lbs (145 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

- (1) Attach lifting device to front and rear of transmission (13).

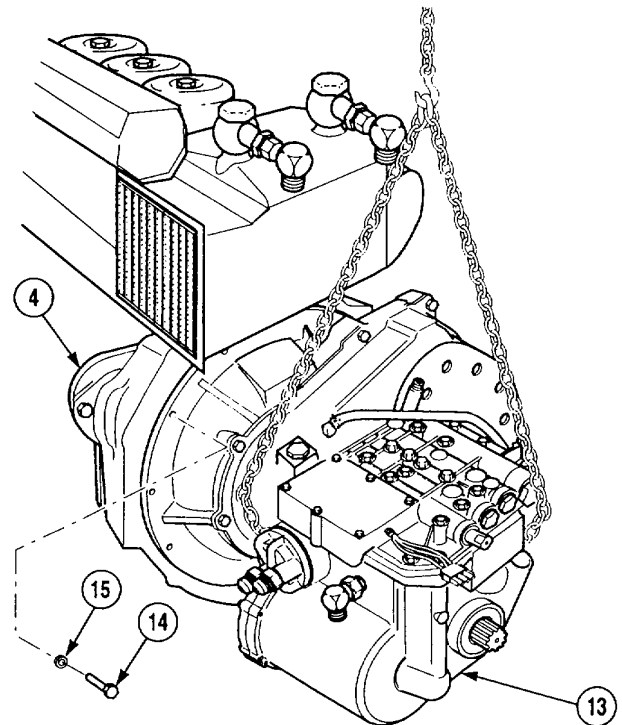
CAUTION

Do not force transmission on engine. Splines of transmission shaft must match up with torque converter splines. When splines are lined up, transmission will install easily. If transmission is forced or handled roughly, damage to transmission may occur.

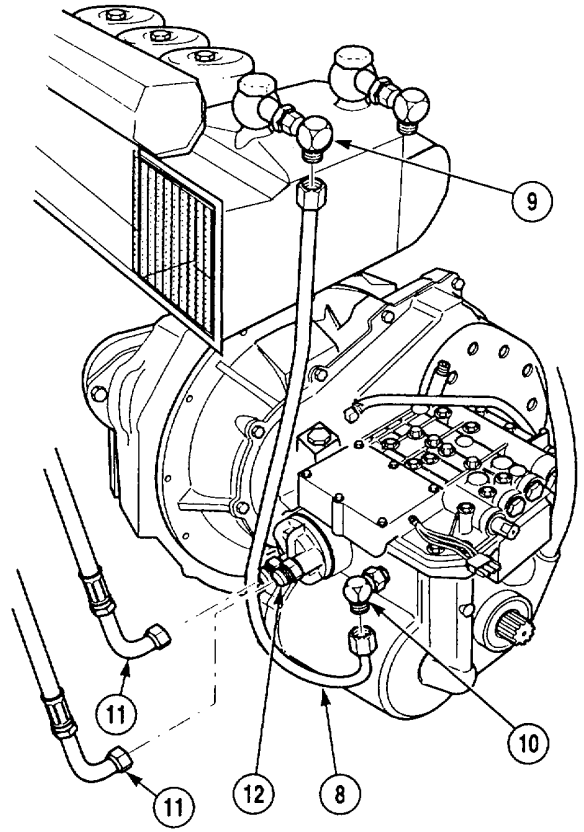
NOTE

It may be necessary to rock transmission during installation to line up splined transmission shafts with splines in torque converter.

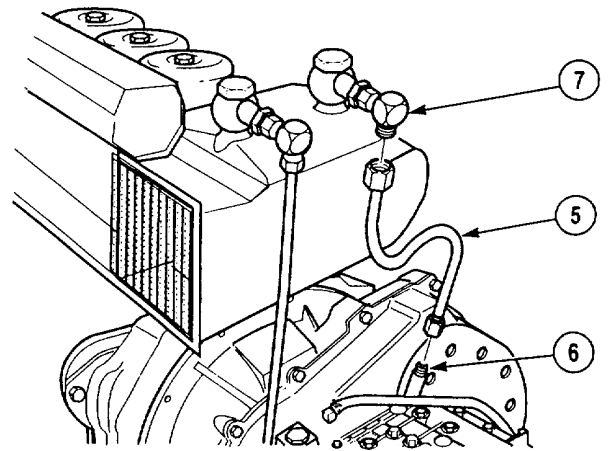
- (2) With the aid of an assistant, install transmission (13) on engine (4) with twelve washers (15) and screws (14). Tighten screws to 49 lb-ft (66 N•m).
- (3) Remove lifting device from transmission (13).



- (4) Install two hoses (11) on fittings (12).
- (5) Install tube (8) on elbows (9 and 10).



- (6) Install tube (5) on elbow (7) and fitting (6).

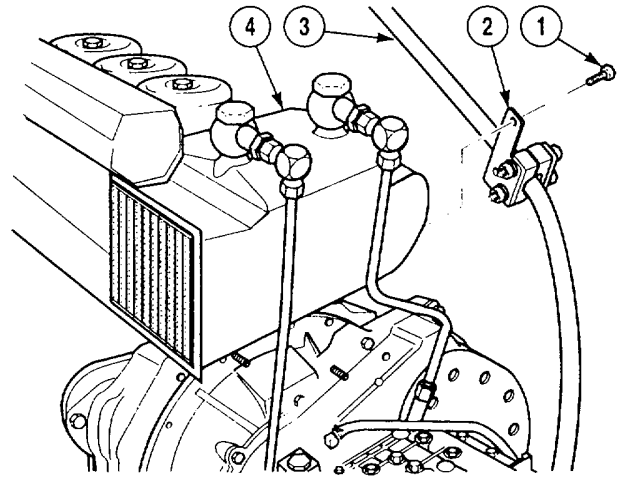


8-3. TRANSMISSION REPLACEMENT (CONT).

- (7) Install transmission oil filler tube (3) and bracket (2) on engine (4) with two screws (1).

NOTE**Follow-on Maintenance:**

- Install engine/transmission assembly (Para 3-3).
- Install inching solenoid (TM 10-3930-669-20).



END OF TASK

8-4. AUXILIARY PUMP DRIVE REPLACEMENT.

This task covers:

- a. Removal
- b. Cleaning/Inspection
- c. Installation

INITIAL SETUP:

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Wrench, Torque (0 to 175 lb-ft [0-237 N•m]) (Item 5, Appendix E)

Materials/Parts

- Oil, Transmission (Item 25, Appendix B)
- Rags, Wiping (Item 19, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)
- Bearing
- Gasket
- Gasket
- Packing, Preformed

Materials/Parts - Continued

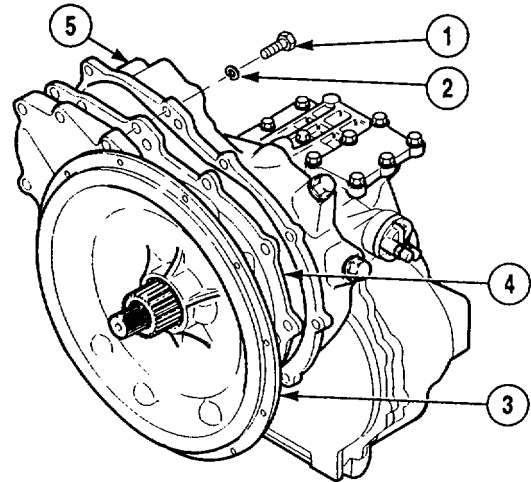
- Packing, Preformed
- Packing, Preformed (2)
- Packing, Preformed (2)
- Seal
- Seal
- Washer, Lock (10)
- Washer, Lock (8)
- Washer, Lock (4)
- Washer, Thrust (2)

Equipment Condition

Transmission removed (Para 8-3)

a. Removal

- (1) Remove 10 screws (1), lock washers (2), converter housing (3), and gasket (4) from cover assembly (5). Discard gasket and lock washers.



8-4. AUXILIARY PUMP DRIVE REPLACEMENT (CONT).

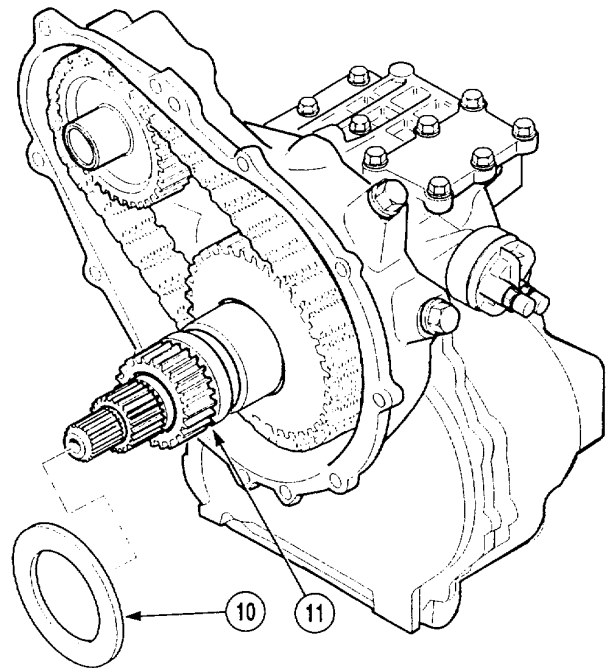
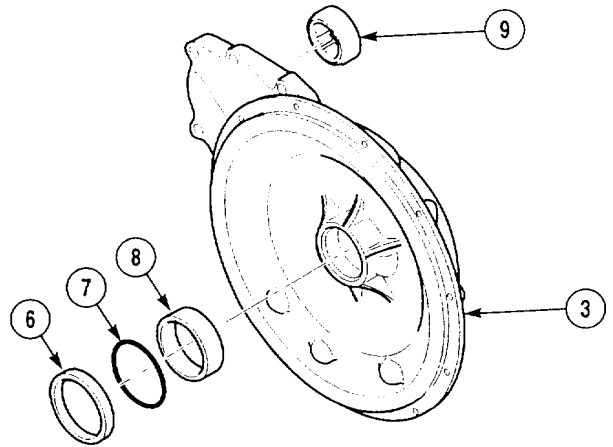
- (2) Remove seal (6), preformed packing (7), and bushing (8) from converter housing (3). Discard seal and preformed packing.

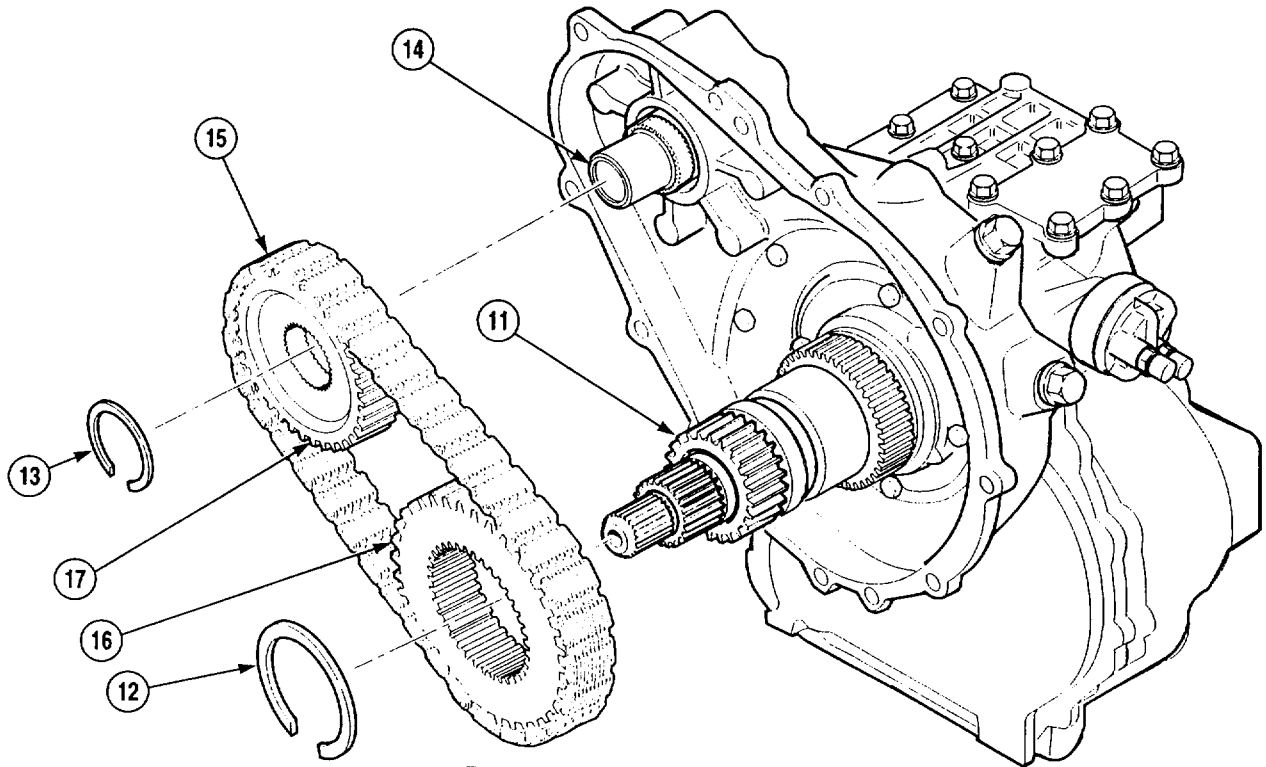
NOTE

Perform Step (3) only if bearing is damaged.

- (3) Remove bearing (9) from converter housing (3). Discard bearing.

- (4) Remove thrust washer (10) from input shaft (11). Discard thrust washer.





WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

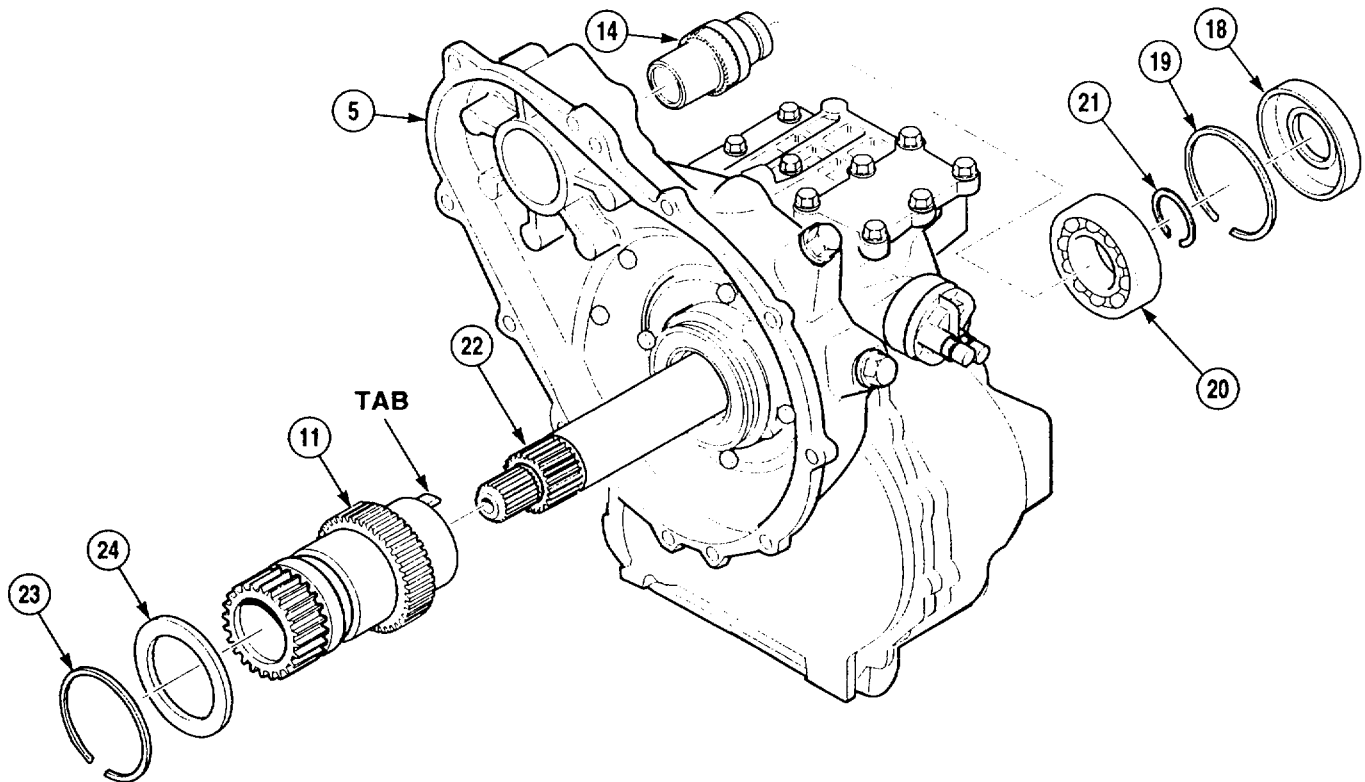
- (5) Remove two retaining rings (12 and 13) from input shaft (11) and shaft (14).

NOTE

Remove chain and sprockets as an assembly.

- (6) Remove chain (15), drive sprocket (16), and driven sprocket (17) from input shaft (11) and shaft (14).

8-4. AUXILIARY PUMP DRIVE REPLACEMENT (CONT).

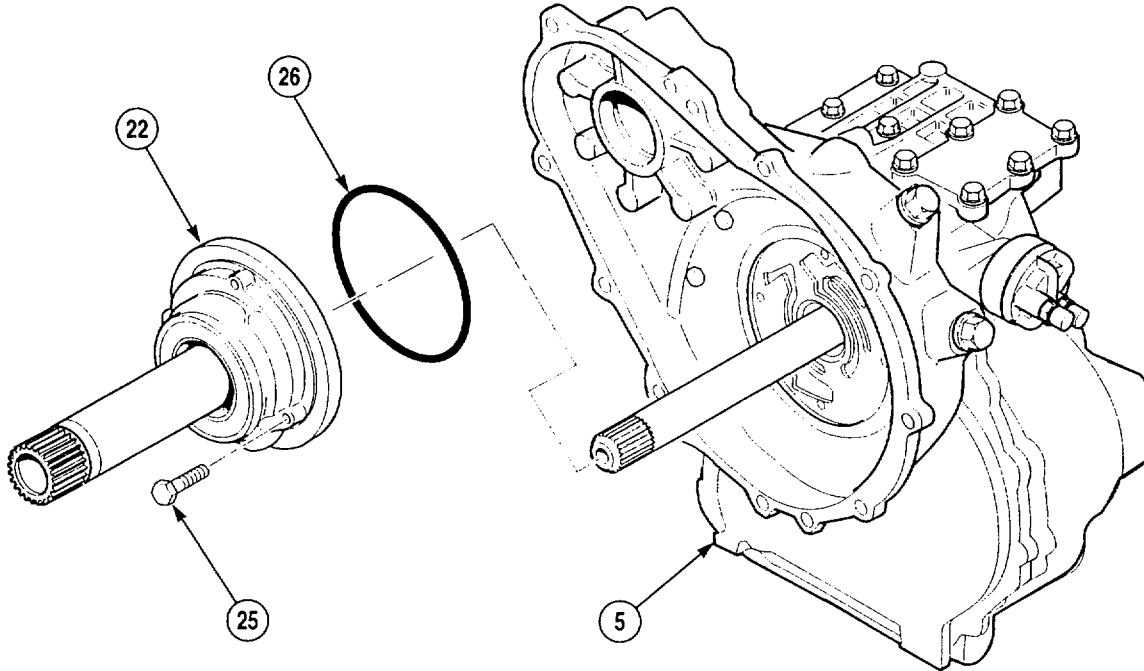


(7) Remove seal (18) from cover assembly (5). Discard seal.

WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

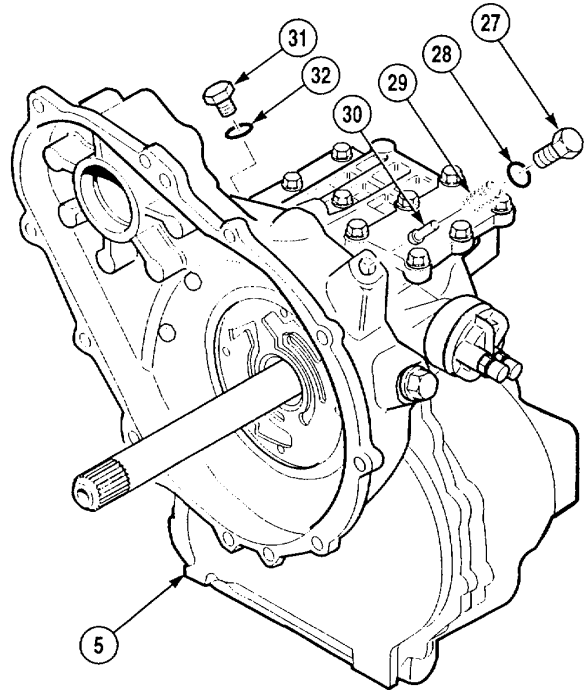
- (8) Remove retaining ring (19) and bearing (20) from cover assembly (5).
- (9) Remove retaining ring (21) and shaft (14) from bearing (20).
- (10) Remove input shaft (11) from pump assembly (22).
- (11) Remove retaining ring (23) and thrust washer (24) from input shaft (11). Discard thrust washer.



NOTE

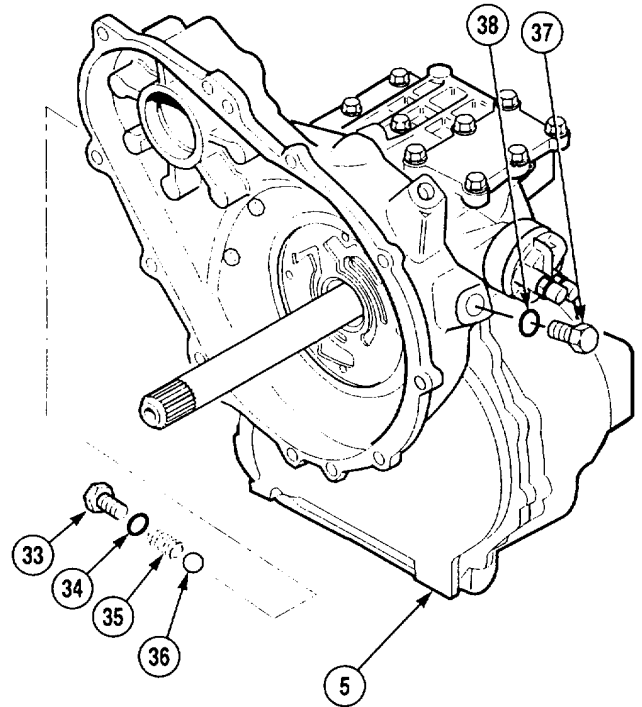
Matchmark pump prior to removal.

- (12) Remove four screws (25), pump assembly (22), and preformed packing (26) from cover assembly (5). Discard preformed packing.
- (13) Remove plug (27), preformed packing (28), spring (29), and valve (30) from cover assembly (5). Discard preformed packing.
- (14) Remove plug (31) and preformed packing (32) from cover assembly (5). Discard preformed packing.

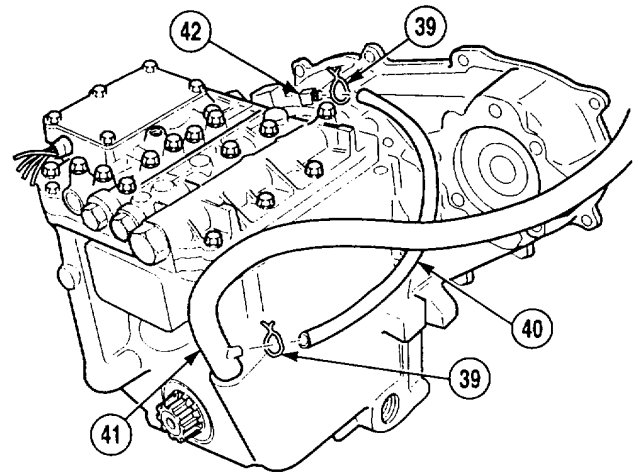


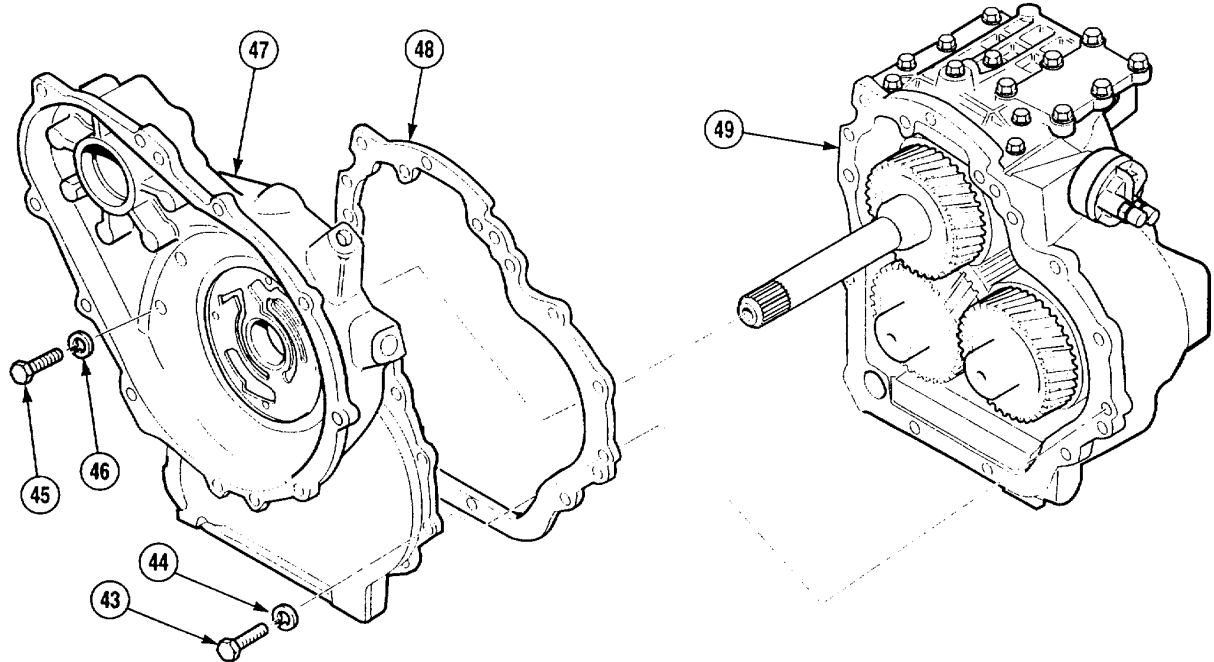
8-4. AUXILIARY PUMP DRIVE REPLACEMENT (CONT).

- (15) Remove plug (33), preformed packing (34), spring (35), and check ball (36) from cover assembly (5). Discard preformed packing.
- (16) Remove plug (37) and preformed packing (38) from cover assembly (5). Discard preformed packing.



- (17) Remove two clamps (39) and hose (40) from dipstick tube (41) and fitting (42).





- (18) Remove eight screws (43), lock washers (44), four screws (45), lock washers (46), cover (47), and gasket (48) from transmission case (49). Discard lock washers and gasket.

b. Cleaning/Inspection.

WARNING

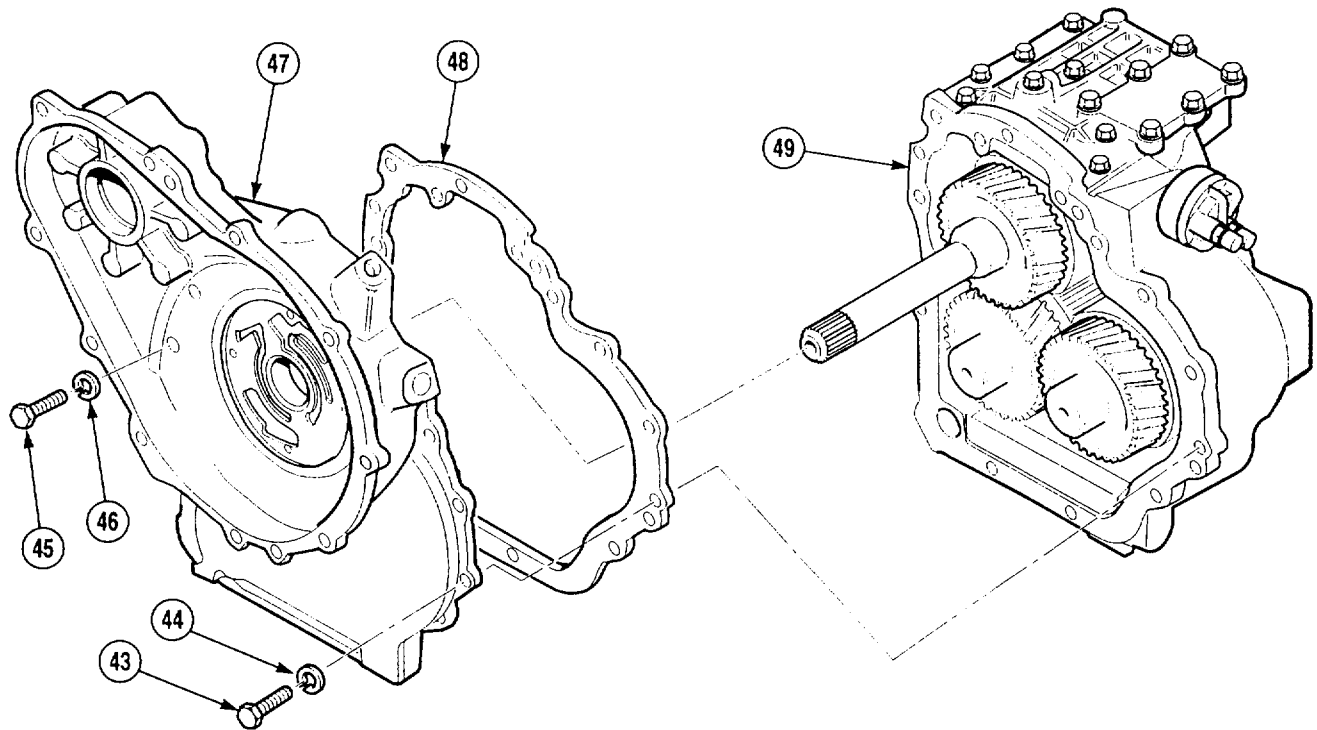
- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
- **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**

CAUTION

Allow all parts to air dry. Do not use a cloth or shop towel. Lint can get into transmission circuit and cause damage.

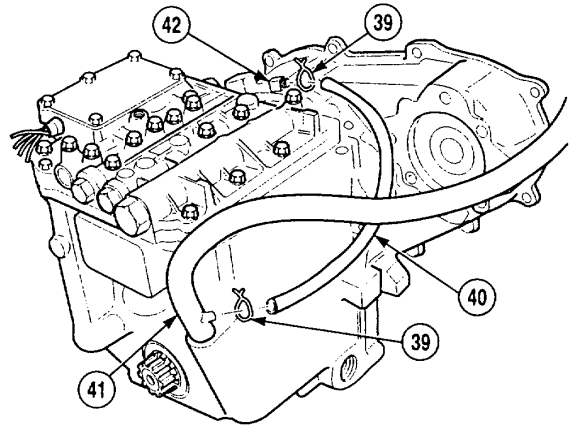
- (1) Clean all metal parts with dry-cleaning solvent and allow parts to air dry.
- (2) Inspect all parts for breaks, cracks, burrs, and sharp edges.
- (3) Inspect gears for chipped, cracked, or broken teeth.
- (4) Replace all damaged parts.

8-4. AUXILIARY PUMP DRIVE REPLACEMENT (CONT).

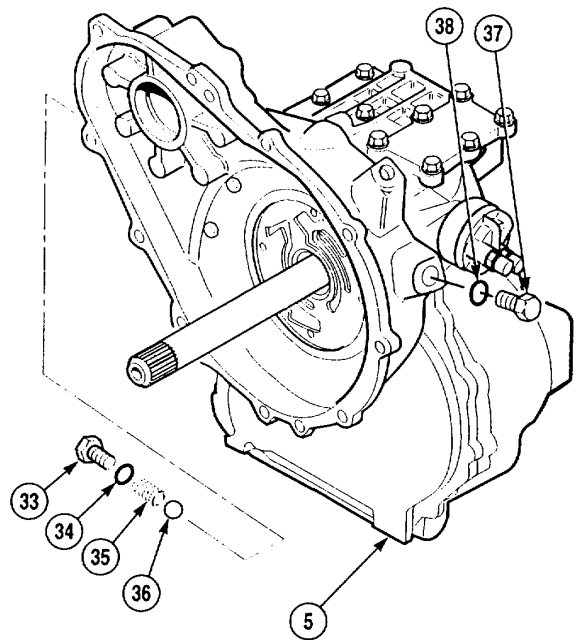
**c. Installation.**

- (1) Position gasket (48), cover, (47), four lock washers (46), screws (45), eight lock washers (44), and screws (43) on transmission (49).
- (2) Tighten four screws (45) to 42 to 50 lb-ft (57-68 N•m).
- (3) Tighten eight screws (43) to 27 to 32 lb-ft (37-43 N•m).

- (4) Install hose (40) on dipstick tube (41) and fitting (42) with two clamps (39).

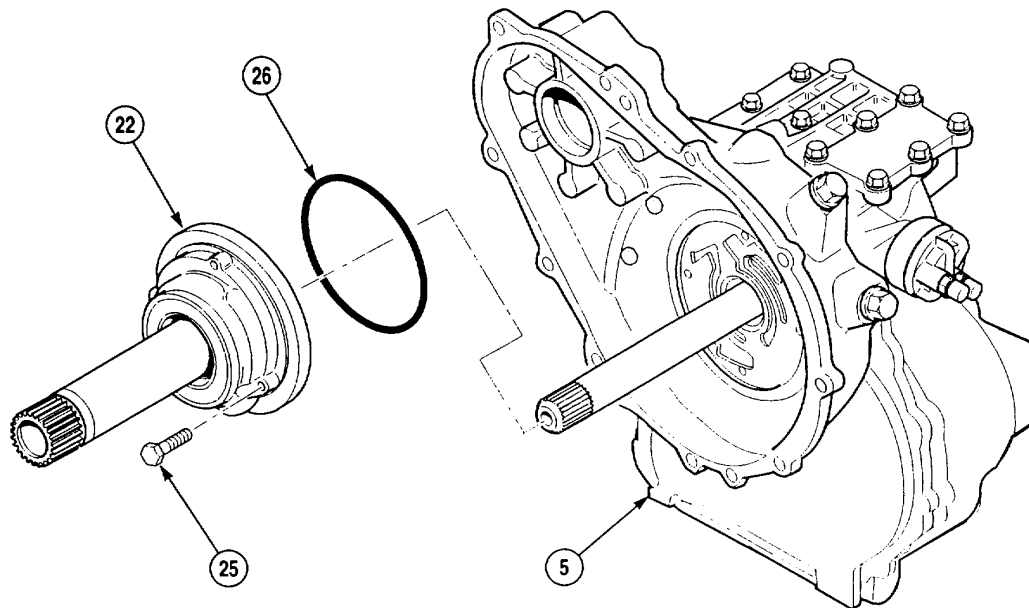
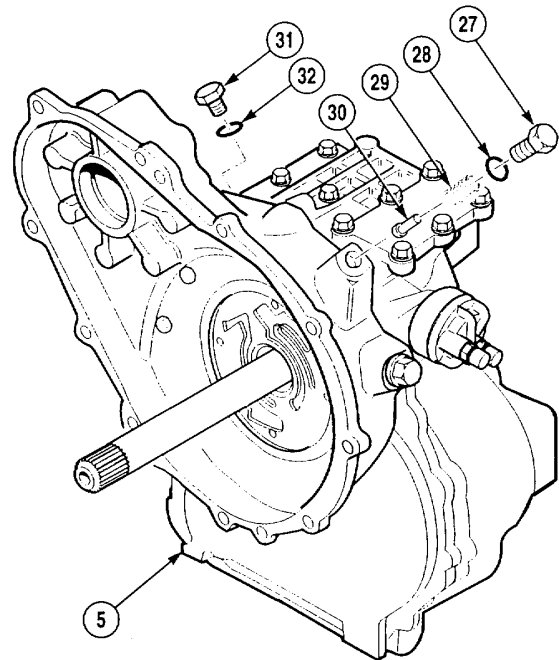


- (5) Coat preformed packing (38) with clean transmission oil.
- (6) Install preformed packing (38) and plug (37) in cover assembly (5). Tighten plug to 17 to 20 lb-ft (23-27 N•m).
- (7) Coat check ball (36), spring (35), and preformed packing (34) with clean transmission oil.
- (8) Install check ball (36), spring (35), preformed packing (34), and plug (33) in cover assembly (5). Tighten plug to 17 to 30 lb-ft (23-41 N•m).



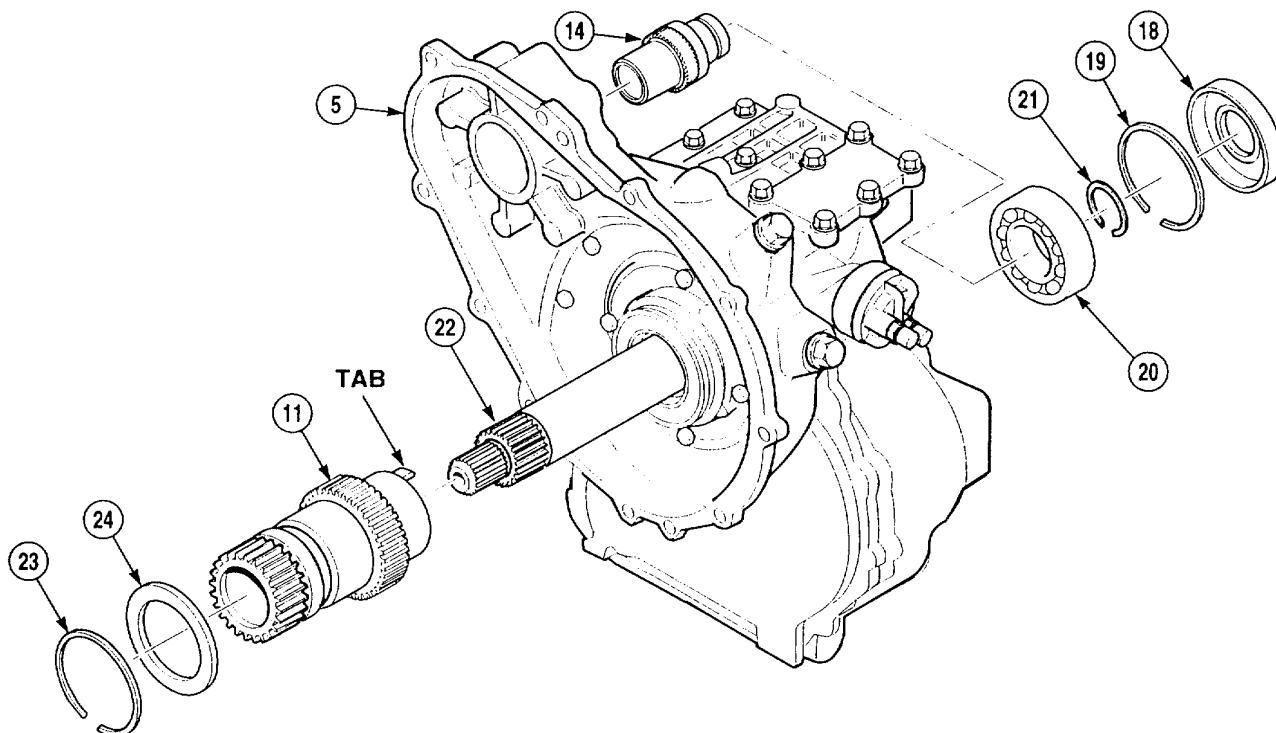
8-4. AUXILIARY PUMP DRIVE REPLACEMENT (CONT).

- (9) Coat preformed packing (32), valve (30), spring (29), and preformed packing (28) with clean transmission oil.
- (10) Install preformed packing (32) and plug (31) in cover assembly (5). Tighten plug to 25 to 35 lb-ft (34-47 N•m).
- (11) Install valve (30), spring (29), preformed packing (28), and plug (27) in cover assembly (5). Tighten plug to 25 to 35 lb-ft (34-47 N•m).

**NOTE**

Align pump assembly to cover assembly as noted during removal.

- (12) Coat preformed packing (26) with clean transmission oil.
- (13) Install preformed packing (26) and pump assembly (22) on cover assembly (5) with four screws (25). Tighten screws to 17 to 22 lb-ft (23-30 N•m).

**WARNING**

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

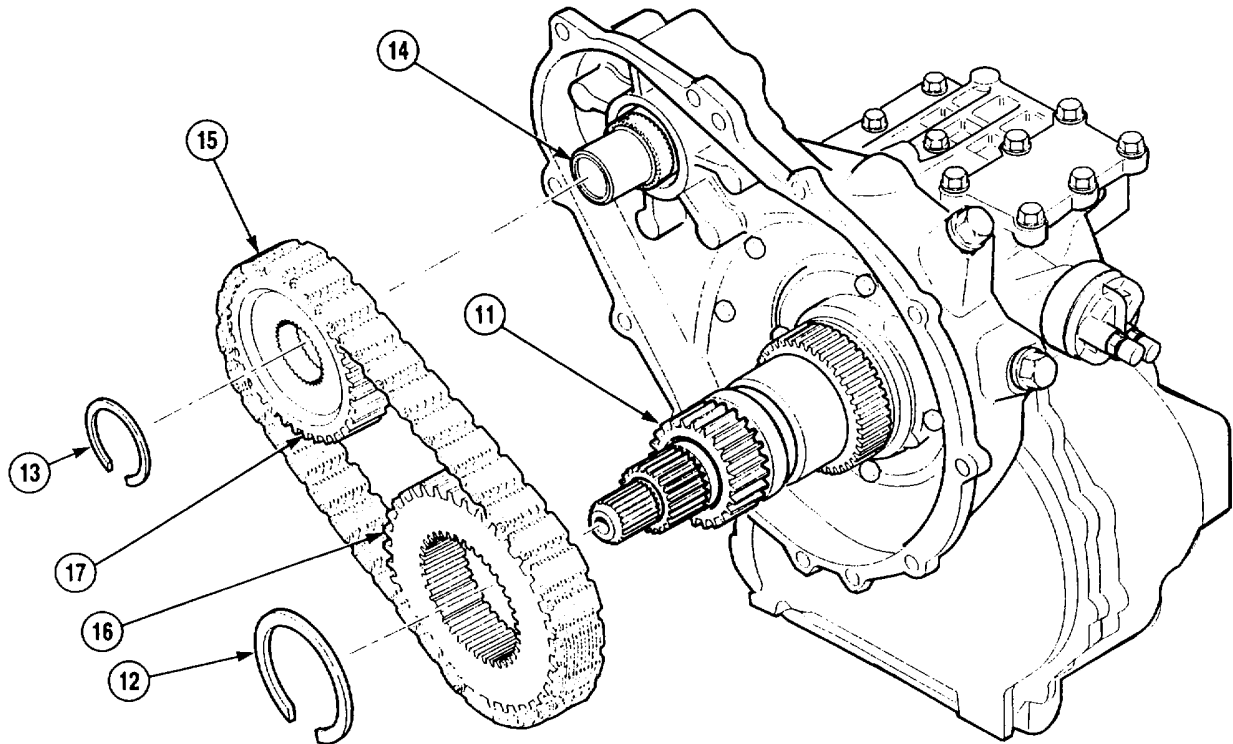
- (14) Coat thrust washer (24) and retaining ring (23) with clean transmission oil.
- (15) Install thrust washer (24) and retaining ring (23) on input shaft (11).
- (16) Coat input shaft (11) with clean transmission oil.

NOTE

Rotate input shaft during installation to ensure that tab drops into pump.

- (17) Install input shaft (11) on pump assembly (22).
- (18) Coat retaining ring (21), bearing (20), retaining ring (19), seal (18), and shaft (14) with clean transmission oil.
- (19) Install shaft (14) in bearing (20) with retaining ring (21).
- (20) Install bearing (20), retaining ring (19), and seal (18) in cover assembly (5).
- (21) Using a wiping rag, clean excess oil from outside surface of seal (18).

8-4. AUXILIARY PUMP DRIVE REPLACEMENT (CONT).

**NOTE**

Install drive sprocket, driven sprocket, and chain on shafts as an assembly.

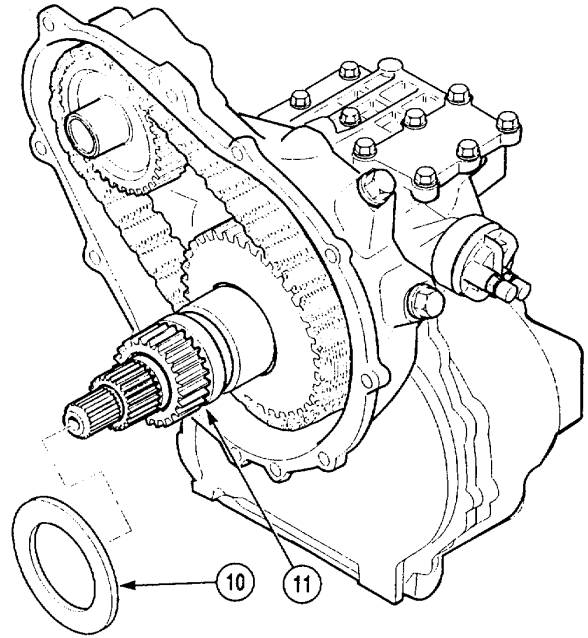
- (22) Coat drive sprocket (16), driven sprocket (17), and chain (15) with clean transmission oil.
- (23) Install drive sprocket (16), driven sprocket (17), and chain (15) on input shaft (11) and shaft (14).

WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (24) Install two retaining rings (12 and 13) on input shaft (11) and shaft (14).

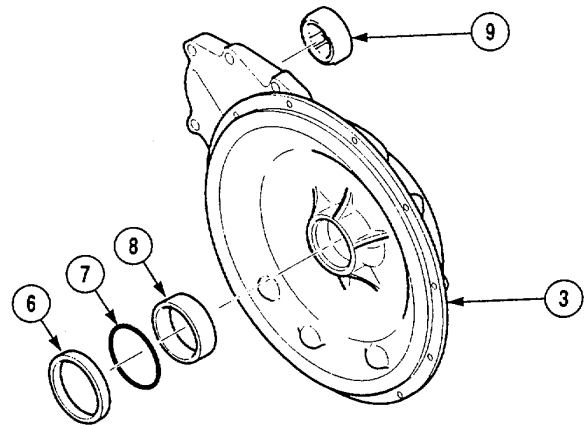
- (25) Coat thrust washer (10) with clean transmission oil.
- (26) Install thrust washer (10) on input shaft (11).



NOTE

Perform Steps (27) and (28) only if bearing was removed in disassembly.

- (27) Coat bearing (9) with clean transmission oil.
- (28) Install bearing (9) in converter housing (3).
- (29) Coat bushing (8), preformed packing (7), and seal (6) with clean transmission oil.
- (30) Install bushing (8), preformed packing (7), and seal (6) in converter housing (3).

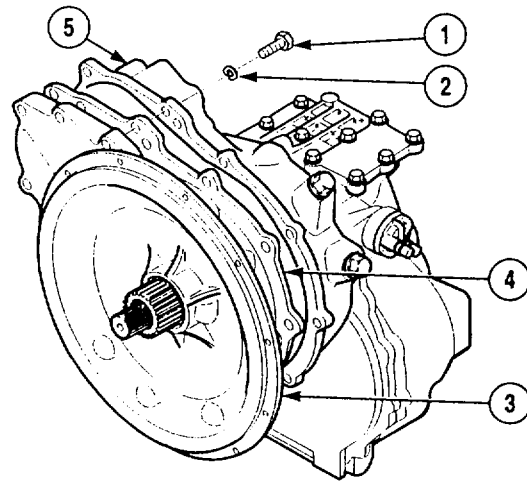


8-4. AUXILIARY PUMP DRIVE REPLACEMENT (CONT).+

- (31) Install gasket (4) and converter housing (3) on cover assembly (5) with 10 lock washers (2) and screws (1). Tighten screws to 27 to 32 lb-ft (37-43 N.m).

NOTE**Follow-on Maintenance:**

- Install transmission (Para 8-3).

**END OF TASK**

8-5. OUTPUT SHAFT REPLACEMENT/REPAIR.

This task covers:

- | | | |
|----------------|------------------------|-----------------|
| a. Removal | c. Cleaning/Inspection | e. Installation |
| b. Disassembly | d. Assembly | |

INITIAL SETUP*Tools and Special Tools*

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)
Press, 60 Ton (Item 5, Appendix E)
Puller (Item 5, Appendix E)

Materials/Parts

Solvent, Dry-cleaning (Item 20, Appendix B)
Oil, Transmission (Item 25, Appendix B)
Seal

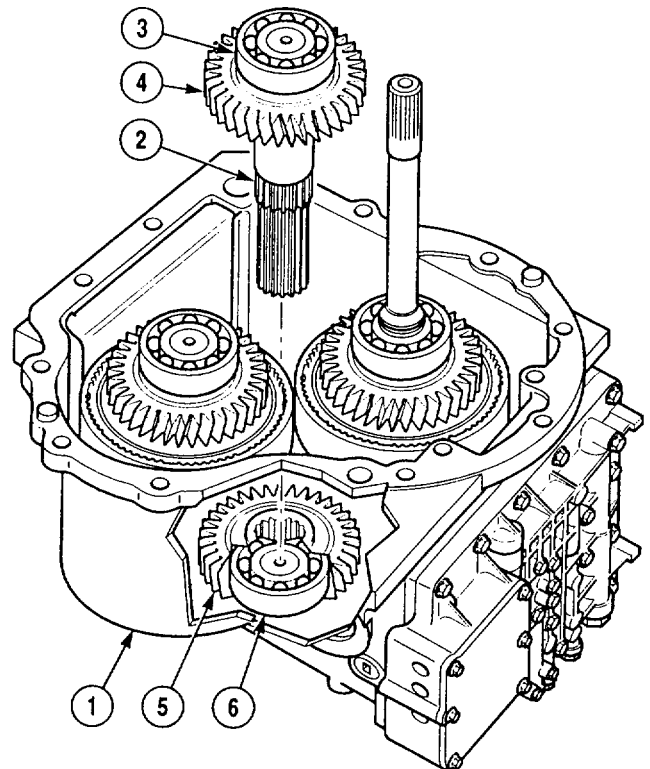
Equipment Condition

Auxiliary pump drive removed (Para 8-4)

a Removal.**WARNING**

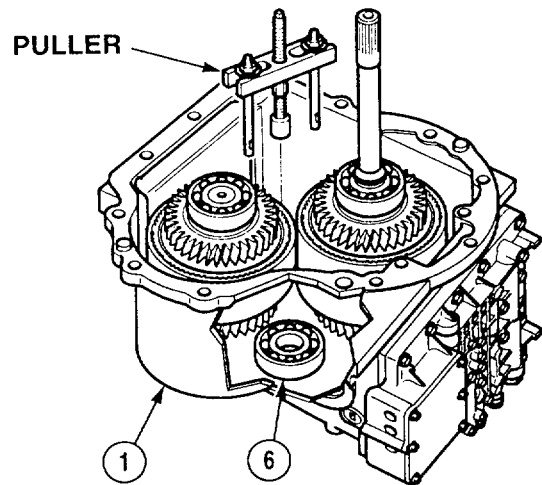
Transmission case weighs 250 lbs (113 kg). Use the aid of an assistant when moving transmission case.

- (1) With the aid of an assistant, place transmission case (1) on wooden blocks with open end facing up.
- (2) Remove output shaft (2) with bearing (3) and gear (4) from gear (5) and bearing (6) in transmission case (1).
- (3) Remove gear (5) from transmission case (1).



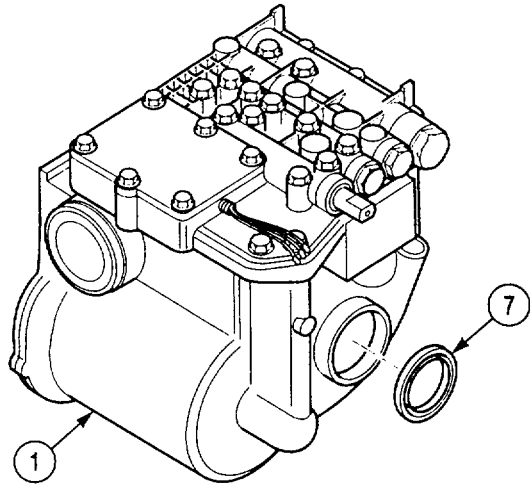
8-5. OUTPUT SHAFT REPLACEMENT/REPAIR (CONT).

- (4) Using a puller, remove bearing (6) from transmission case (1).

**WARNING**

Transmission case weighs 200 lbs (91 kg). Use the aid of an assistant when moving transmission case.

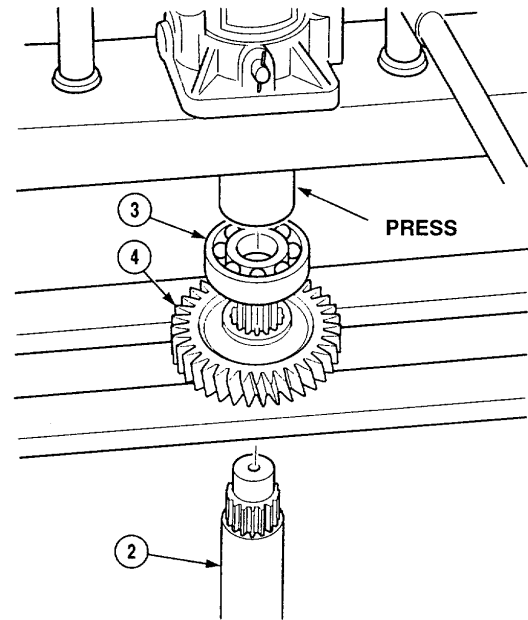
- (5) With the aid of an assistant, place transmission case (1) on side so that oil seal (7) is accessible.
- (6) Remove oil seal (7) from transmission case (1). Discard oil seal.



CAUTION

Gear is held on output shaft by bearing and is not a press fit. Gear will come off output shaft when bearing is removed.

- b. Disassembly.** Press output shaft (2) from bearing (3) and gear (4).



- c. Cleaning/Inspection.**

WARNING

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

CAUTION

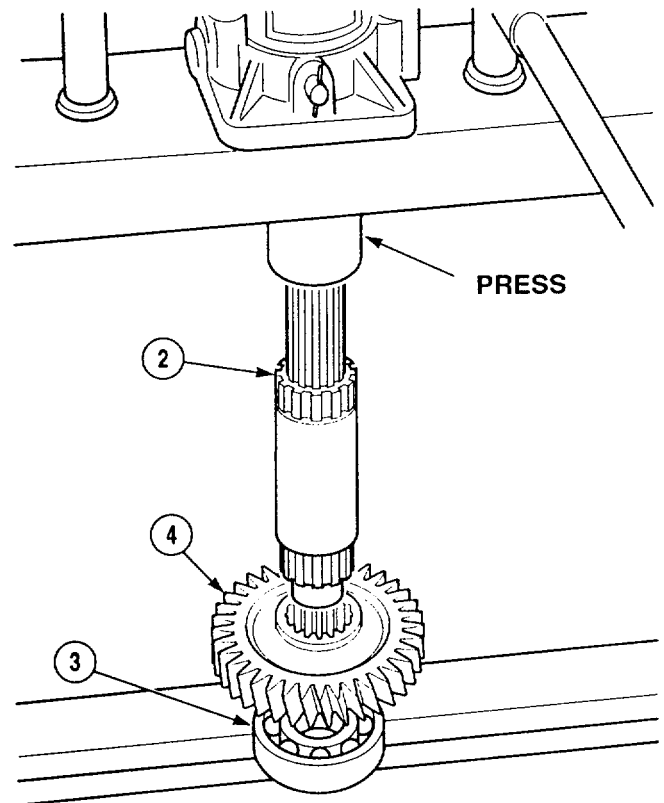
Allow all parts to air dry. Do not use a cloth or shop towel. Lint can get into transmission circuit and cause damage.

- (1) Clean all metal parts with dry-cleaning solvent.
- (2) Allow all parts to air dry.
- (3) Inspect all parts for breaks, cracks, burrs, sharp edges, and signs of overheating.
- (4) Inspect gears for chipped, cracked, or broken teeth.

8-5. OUTPUT SHAFT REPLACEMENT/REPAIR (CONT).

d. Assembly.

- (1) Install gear (4) on output shaft (2).
- (2) Press output shaft (2) in bearing (3) until bearing (3) is snug against gear (4).

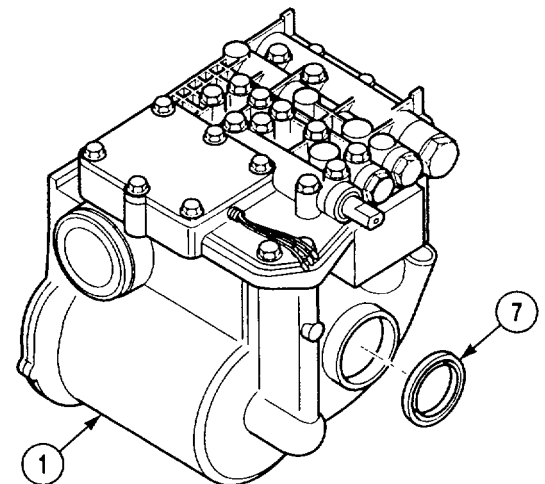


e. Installation.

NOTE

Outside surface of seal (7) should be flush with transmission case.

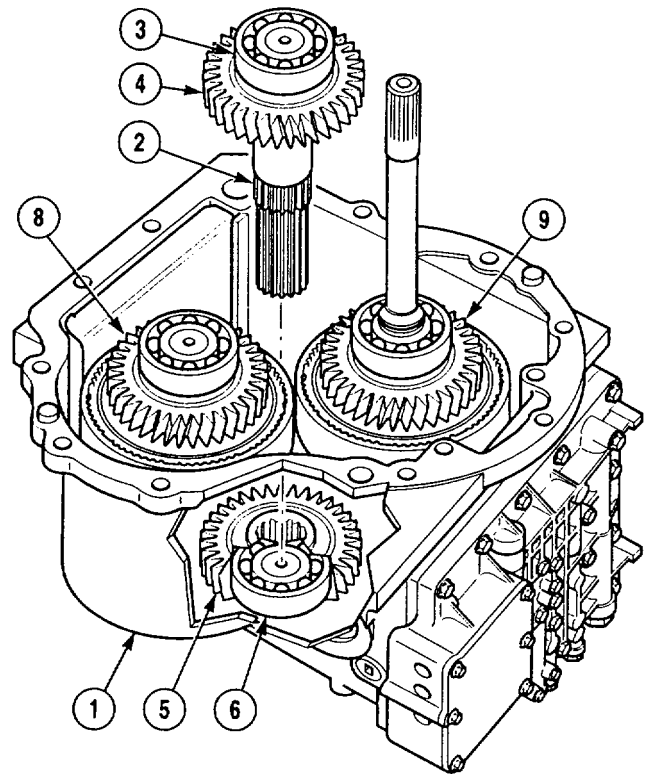
- (1) Coat oil seal (7) with clean transmission oil.
- (2) Install oil seal (7) in transmission case (1).



WARNING

Transmission case weighs 200 lbs (91 kg). Use the aid of an assistant when moving transmission case.

- (3) Place transmission case (1) on wooden blocks in press with open end up.
- (4) Coat bearing (6) with clean transmission oil.
- (5) Using a press, install bearing (6) in transmission case (1).
- (6) Coat gear (5) with clean transmission oil.
- (7) Position gear (5) in transmission case (1) on top of bearing (6). Align centers of gear and bearing.
- (8) Coat output shaft (2), bearing (3), and gear (4) with clean transmission oil.
- (9) While turning output shaft (2) slowly, install output shaft (2) in gear (5) and bearing (6). Gear (4) will mesh with gears (8 and 9).

**NOTE****Follow-on Maintenance:**

- Install auxiliary pump drive (Para 8-4).

END OF TASK

8-6. INPUT SHAFT REPLACEMENT/REPAIR.

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning/Inspection
- d. Assembly
- e. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Press, 60 Ton (Item 5, Appendix E)
 Puller (Item 5, Appendix E)

Materials/Parts - Continued

Packing, Preformed (2)
 Packing, Preformed (2)
 Packing, Preformed (4)

Materials/Parts

Oil, Transmission (Item 25, Appendix B)
 Solvent, Dry-cleaning (Item 20, Appendix B)

Equipment Condition

Output shaft removed (Para 8-5)

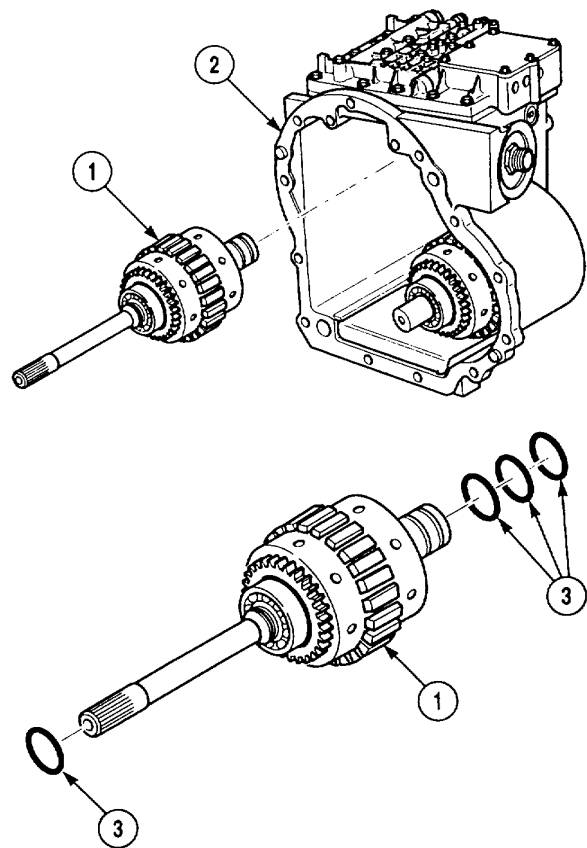
WARNING

Transmission case weighs 200 lbs (91 kg). Use the aid of an assistant when moving transmission case.

a. Removal. Remove assembled input shaft (1) from transmission case (2).

b. Disassembly.

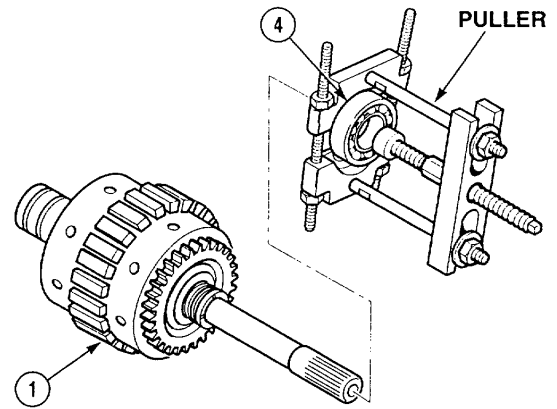
(1) Remove four preformed packings (3) from input shaft (1). Discard preformed packings.



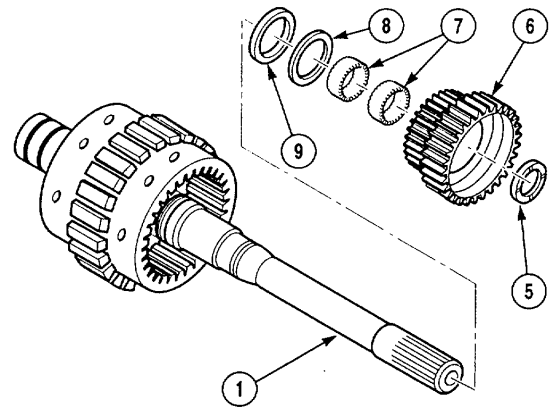
CAUTION

Parts held on input shaft by bearing are not a press fit. These parts will come off input shaft when bearing is removed.

- (2) Using a puller, remove bearing (4) from input shaft (1).



- (3) Remove thrust washer (5) and gear (6) from input shaft (1).
- (4) Remove two bearings (7) and two thrust washers (8 and 9) from input shaft (1).

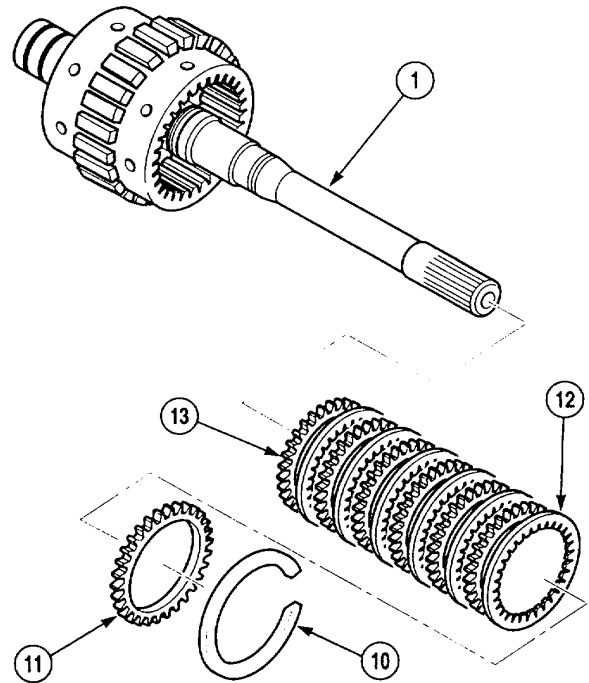


8-6. INPUT SHAFT REPLACEMENT/REPAIR (CONT).

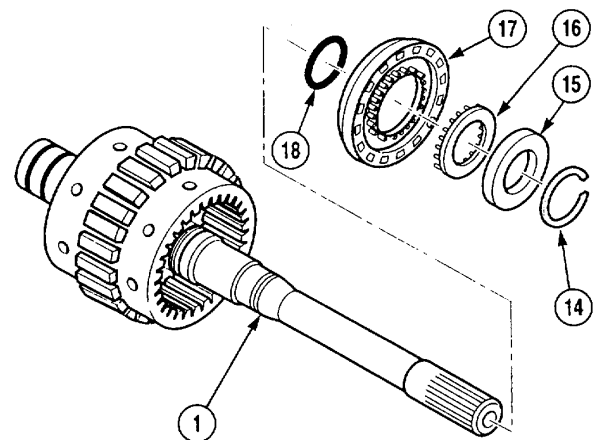
WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

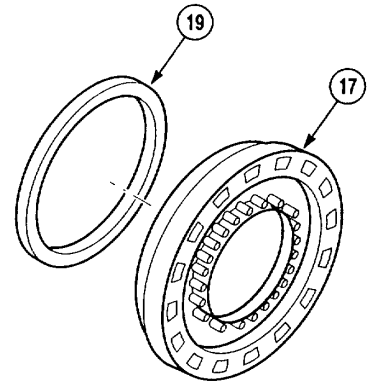
- (5) Remove retaining ring (10) and pressure plate (11) from input shaft (1).
- (6) Remove friction clutch plates (12) and steel clutch plates (13) from input shaft (1).



- (7) Remove retaining ring (14), spring retainers (15 and 16), clutch piston (17), and preformed packing (18) from input shaft (1). Discard preformed packing.



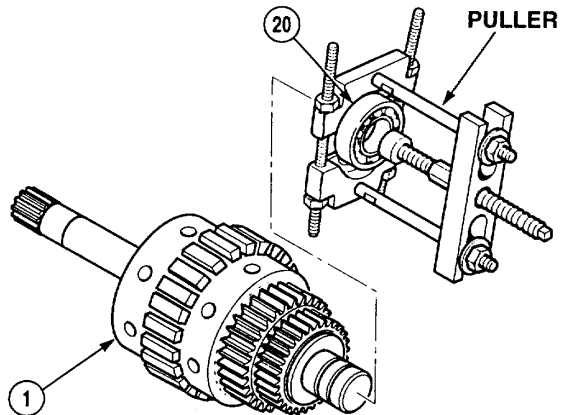
- (8) Remove preformed packing (19) from clutch piston (17). Discard preformed packing.



CAUTION

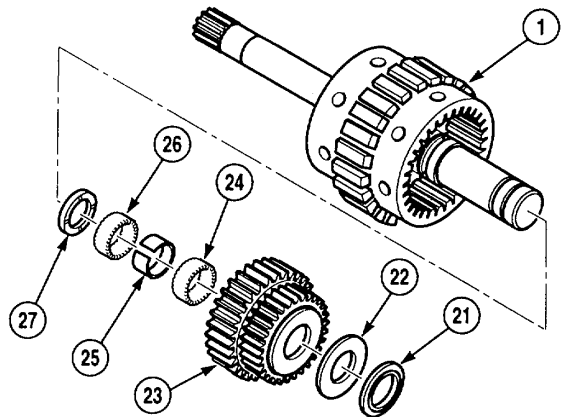
Parts held on input shaft by bearing are not a press fit. These parts will come off shaft when bearing is removed.

- (9) Using a puller, remove bearing (20) from input shaft (1).



- (10) Remove thrust washers (21 and 22) and gear (23) from input shaft (1).

- (11) Remove bearing (24), spacer (25), bearing (26), and thrust washer (27) from input shaft (1).



8-6. INPUT SHAFT REPLACEMENT/REPAIR (CONT).

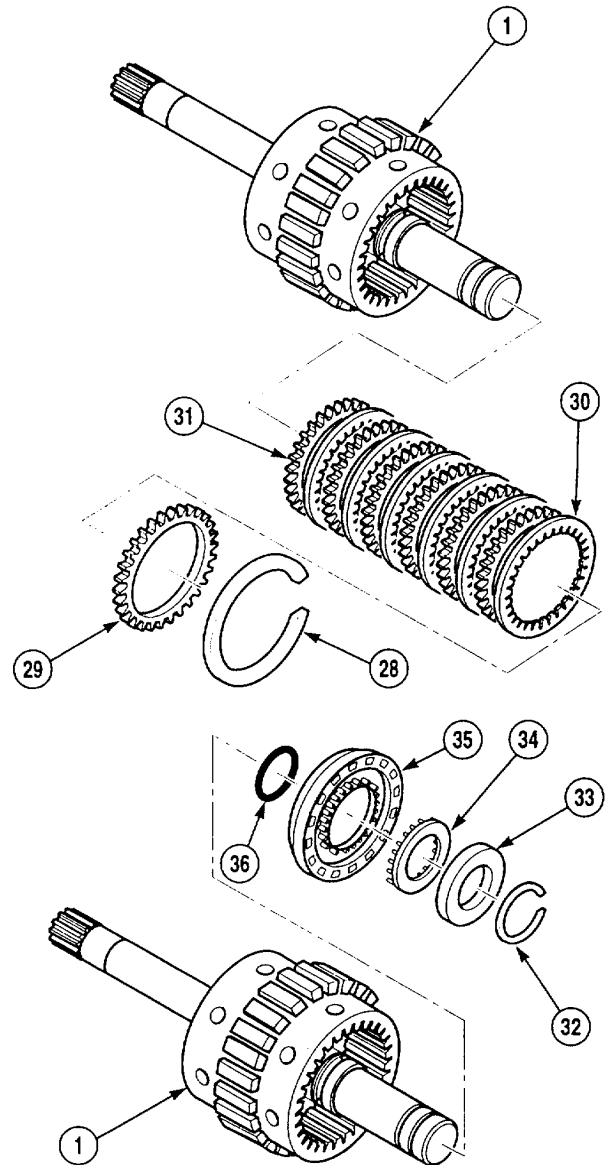
WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

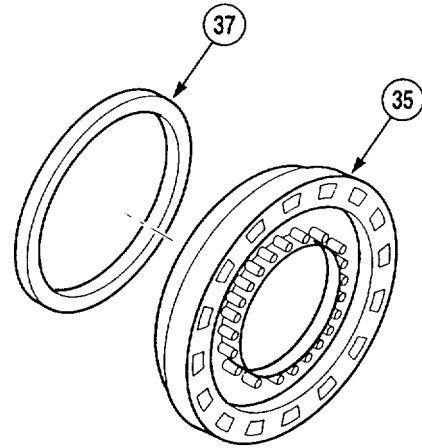
(12) Remove retaining ring (28) and pressure plate (29) from input shaft (1).

(13) Remove friction clutch plates (30) and steel clutch plates (31) from input shaft (1).

(14) Remove retaining ring (32), spring retainers (33 and 34), clutch piston (35), and preformed packing (36) from input shaft (1). Discard preformed packing.



- (15) Remove preformed packing (37) from clutch piston (35). Discard preformed packing.



c. Cleaning/Inspection.

WARNING

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

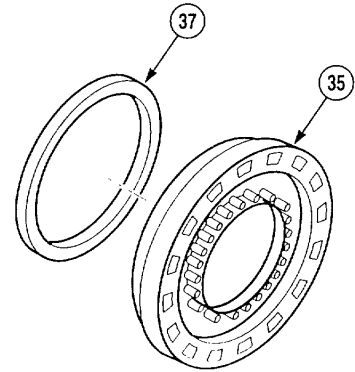
CAUTION

Allow all parts to air dry. Do not use a cloth or shop towel. Lint can get into transmission circuit and cause damage.

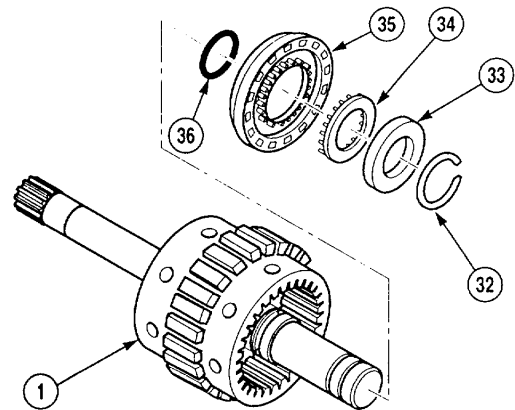
- (1) Clean all metal parts with dry-cleaning solvent and allow parts to air dry.
- (2) Inspect all parts for breaks, cracks, burrs, sharp edges, and signs of overheating.
- (3) Inspect gears for chipped, cracked, or broken teeth.
- (4) Inspect springs for distortion, cracks, and other damage.
- (5) Inspect clutch plates for unusual wear patterns, overheating, and warping.

8-6. INPUT SHAFT REPLACEMENT/REPAIR (CONT).**d. Assembly.**

- (1) Coat preformed packing (37) with clean transmission oil.
- (2) Install preformed packing (37) on clutch piston (35).



- (3) Coat preformed packing (36), clutch piston (35), spring retainers (34 and 33), and retaining ring (32) with clean transmission oil.
- (4) Install preformed packing (36) on input shaft (1).
- (5) Install clutch piston (35) in input shaft (1).
- (6) Install spring retainers (34 and 33) on input shaft (1) and clutch piston (35). Springs of spring retainer (34) should fit in spring bores of clutch piston (35).

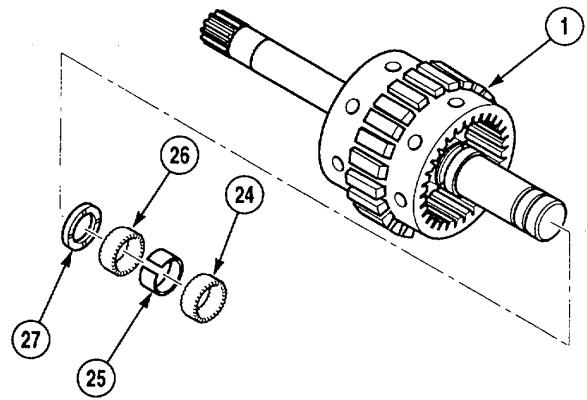
**WARNING**

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (7) Install retaining ring (32) on input shaft (1).

- (8) Coat steel thrust washer (27), bearings (26 and 24), and spacer (25) with clean transmission oil.

- (9) Install thrust washer (27), bearing (26), spacer (25), and bearing (24) on input shaft (1).



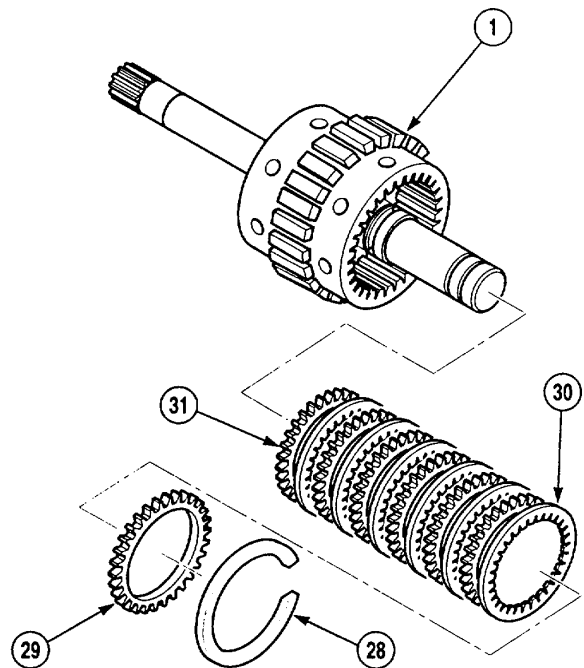
- (10) Coat steel clutch plates (31), friction clutch plates (30), pressure plate (29), and retaining ring (28) with clean transmission oil.

- (11) Install steel clutch plates (31) and friction clutch plates (30) on input shaft (1). Install one steel clutch plate (31) first, then one friction clutch plate (30), then one steel clutch plate (31), then one friction clutch plate (30), until all clutch plates are installed. The last clutch plate to be installed should be a friction clutch plate (30).

WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (12) Install pressure plate (29) and retaining ring (28) on input shaft (1).



8-6. INPUT SHAFT REPLACEMENT/REPAIR (CONT).

- (13) Coat gear (23) and thrust washers (22 and 21) with clean transmission oil.

NOTE

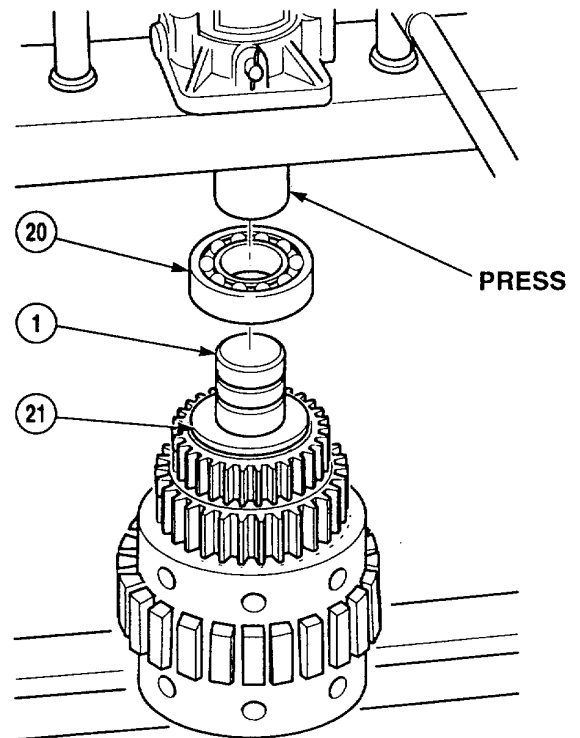
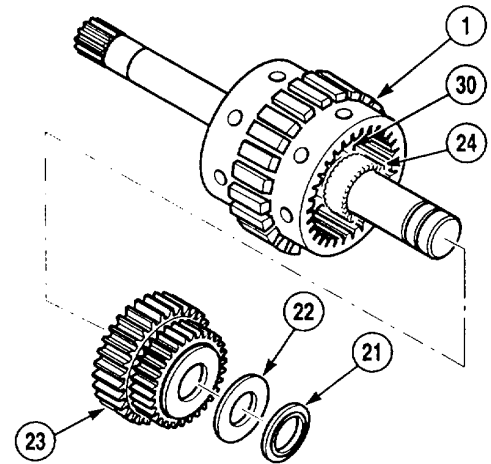
Rotate gear during installation to ensure it has meshed with all friction clutch plates.

- (14) Install gear (23) on bearing (24) and into friction clutch plates (30).
- (15) Install thrust washers (22 and 21) on input shaft (1).
- (16) Coat bearing (20) with clean transmission oil.

NOTE

Components on input shaft, under bearing, should not be loose after bearing is installed.

- (17) Using a press, install bearing (20) on input shaft (1) until it seats firmly against thrust washer (21).



(18) Coat preformed packing (19) with clean transmission oil.

(19) Install preformed packing (19) on clutch piston (17).

(20) Coat preformed packing (18), clutch piston (17), spring retainers (16 and 15), and retaining ring (14) with clean transmission oil.

(21) Install preformed packing (18) on input shaft (1).

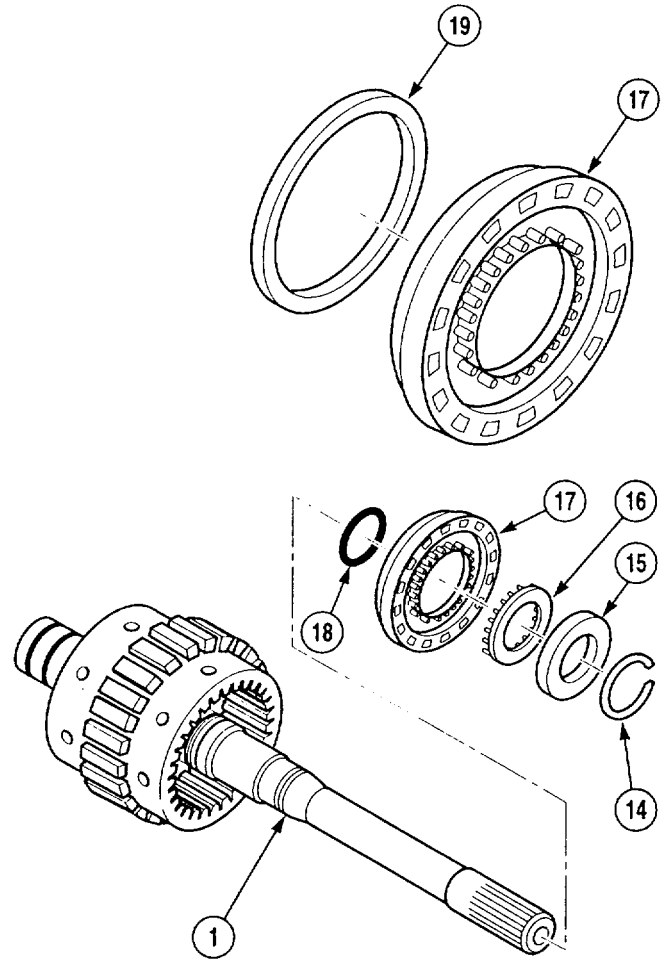
(22) Install clutch piston (17) in input shaft (1).

(23) Install spring retainers (16 and 15) on input shaft (1) and clutch piston (17). Springs of spring retainer (16) should fit in spring bores of clutch piston (17).

WARNING

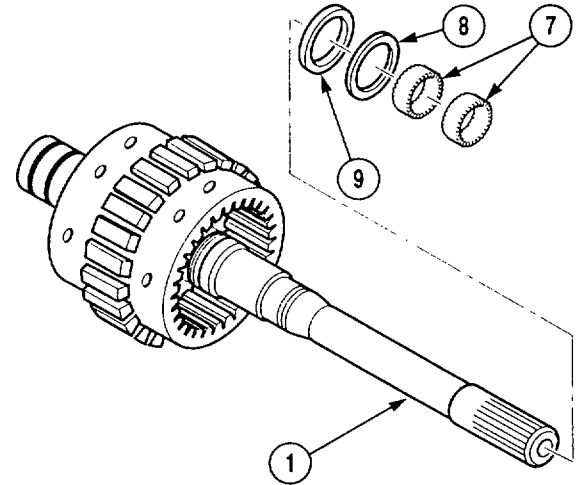
Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

(24) Install retaining ring (14) on input shaft (1).

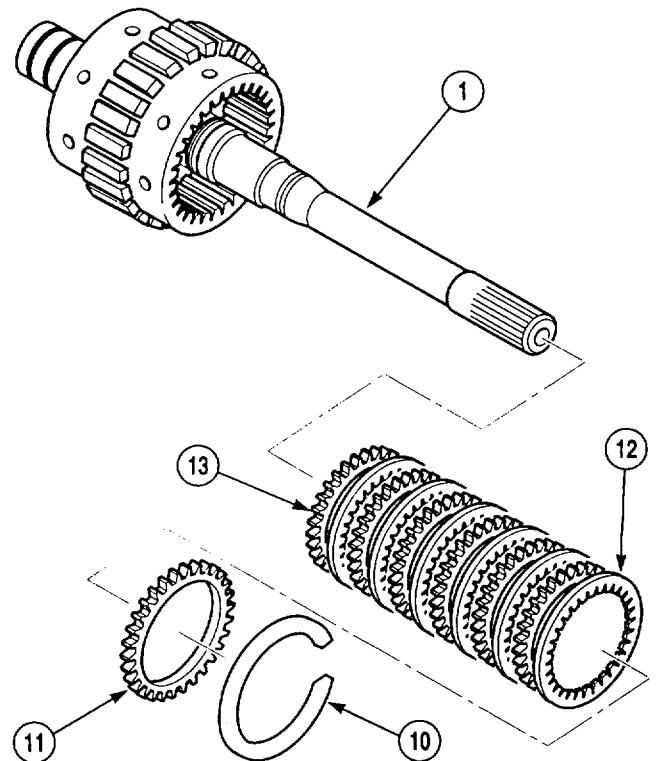


8-6. INPUT SHAFT REPLACEMENT/REPAIR (CONT).

- (25) Coat two thrust washers (9 and 8), and two bearings (7) with clean transmission oil.
- (26) Install two washers (9 and 8) and bearings (7) on input shaft (1).



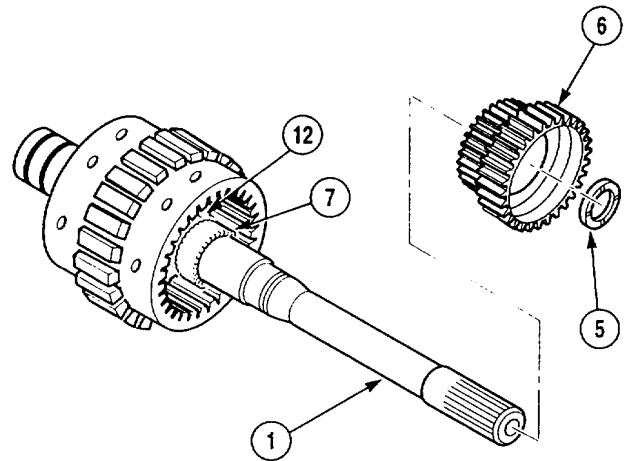
- (27) Coat steel clutch plates (13), friction clutch plates (12), pressure plate (11), and retaining ring (10) with clean transmission oil.
- (28) Install steel clutch plates (13) and friction clutch plates (12) on input shaft (1). Install one steel clutch plate (13) first, then one friction clutch plate (12), then one steel clutch plate (13), then one friction clutch plate (12), until all clutch plates are installed. The last clutch plate to be installed should be a friction clutch plate (12).

**WARNING**

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (29) Install pressure plate (11) and retaining ring (10) on input shaft (1).

- (30) Coat gear (6) and thrust washer (5) with clean transmission oil.
- (31) Install gear (6) on bearings (7) and in friction clutch plates (12).
- (32) Install thrust washer (5) on input shaft (1).

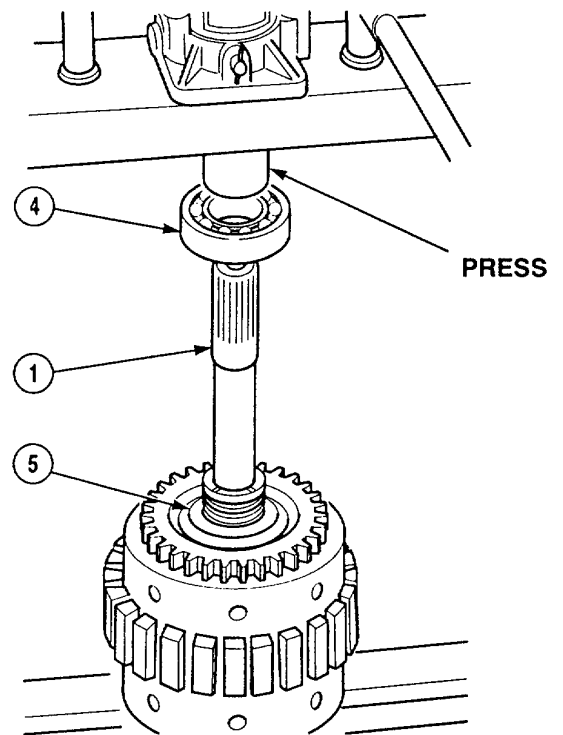


- (33) Coat bearing (4) with clean transmission oil.

NOTE

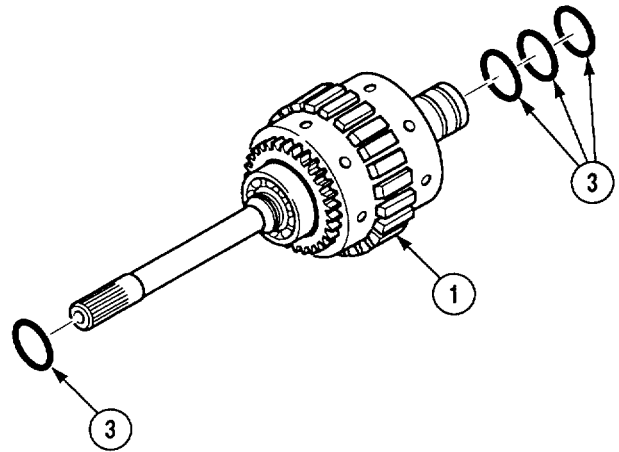
Components on input shaft, under bearing, should not be loose after bearing is installed.

- (34) Using a press, install bearing (4) on input shaft (1) until it seats firmly against thrust washer (5).



8-6. INPUT SHAFT REPLACEMENT/REPAIR (CONT).

- (35) Coat four preformed packings (3) with transmission oil.
- (36) Install four preformed packings (3) on input shaft (1).



NOTE

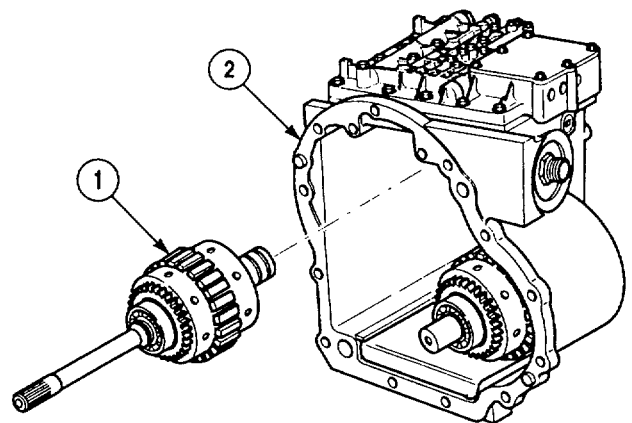
Gears on input shaft should mesh with mating gears.

- e. Installation.* Install input shaft (1) in transmission case (2).

NOTE

Follow-on Maintenance:

- Install output shaft (Para 8-5).



END OF TASK

8-7. FORWARD SHAFT REPLACEMENT/REPAIR.

This task covers:

- | | | |
|----------------|------------------------|-----------------|
| a. Removal | c. Cleaning/Inspection | e. Installation |
| b. Disassembly | d. Assembly | |

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Press, 60 ton (Item 5, Appendix E)
 Puller (Item 5, Appendix E)

Materials/Parts - Continued

Packing, Preformed (2)
 Packing, Preformed (2)
 Packing, Preformed (3)

Materials/Parts

Oil, Transmission (Item 25, Appendix B)
 Solvent, Dry-cleaning (Item 20, Appendix B)

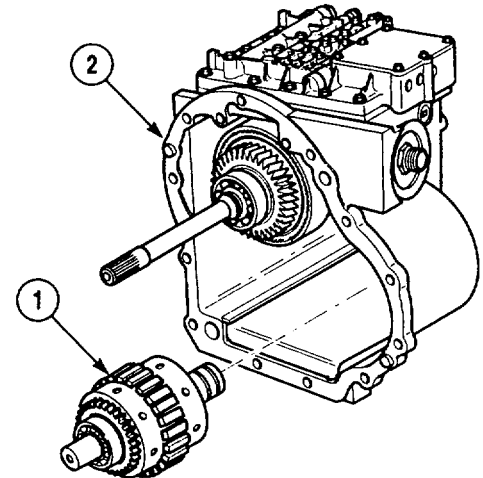
Equipment Condition

Output shaft removed (Para 8-5)

WARNING

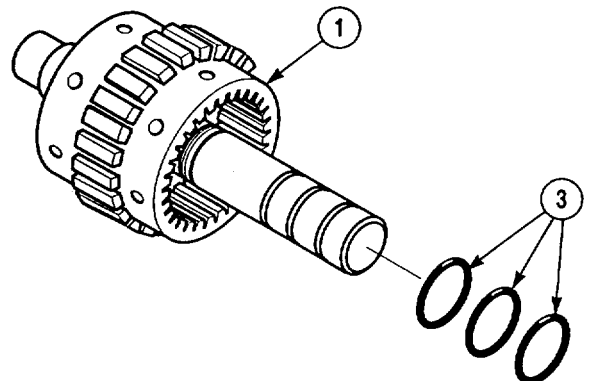
Transmission case weighs 200 lbs (91 kg). Use the aid of an assistant when moving transmission case.

- a. Removal.** Remove assembled forward shaft (1) from transmission case (2).



- b. Disassembly.**

- (1) Remove three preformed packings (3) from forward shaft (1). Discard preformed packings.

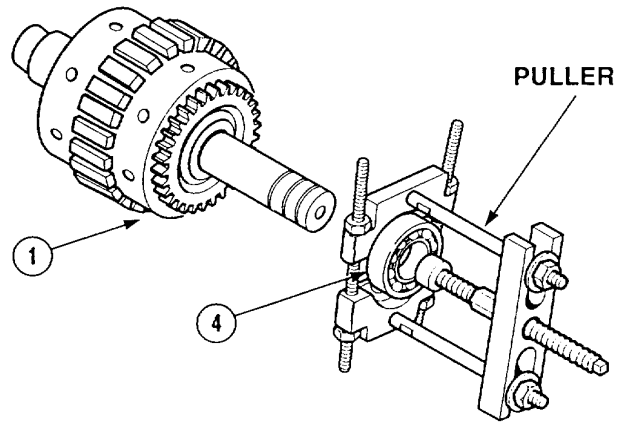


8-7. FORWARD SHAFT REPLACEMENT/REPAIR (CONT).

CAUTION

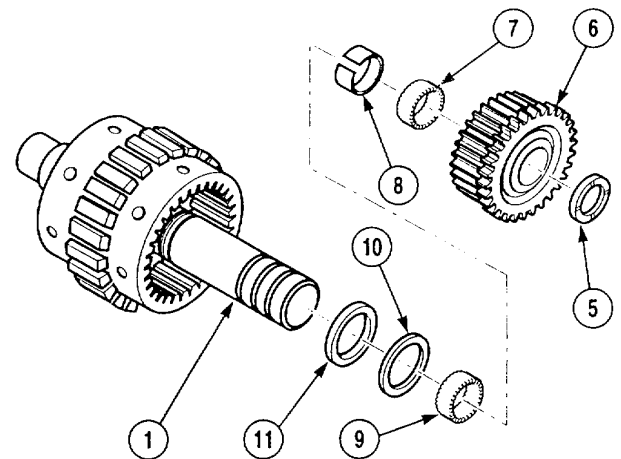
Parts held on forward shaft by bearing are not a press fit. These parts will come off shaft when bearing is removed.

- (2) Using a puller, remove bearing (4) from forward shaft (1).



- (3) Remove thrust washer (5) and gear (6) from forward shaft (1).

- (4) Remove bearing (7), spacer (8), bearing (9), and two thrust washers (10 and 11) from forward shaft (1).

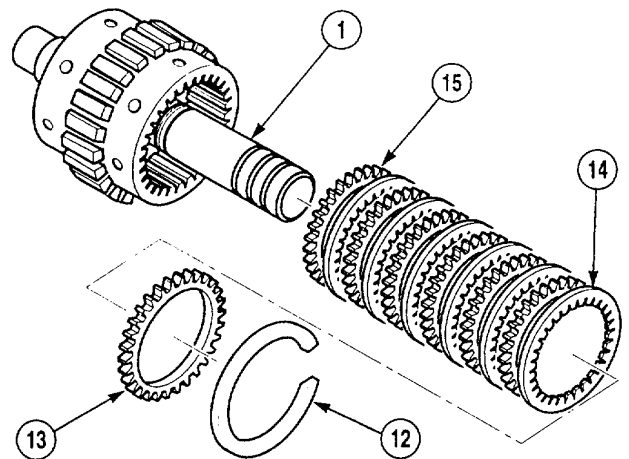


WARNING

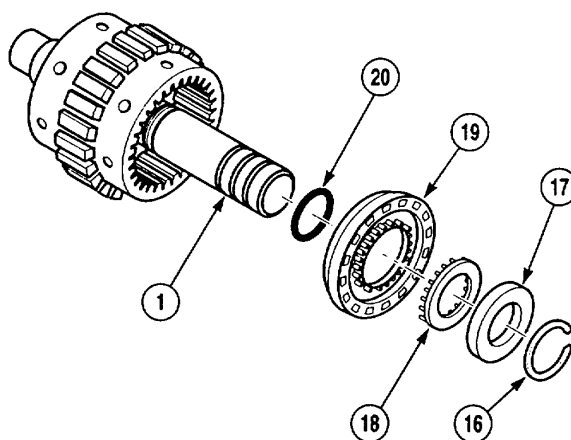
Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (5) Remove retaining ring (12) and pressure plate (13) from forward shaft (1).

- (6) Remove friction clutch plates (14) and steel clutch plates (15) from forward shaft (1).



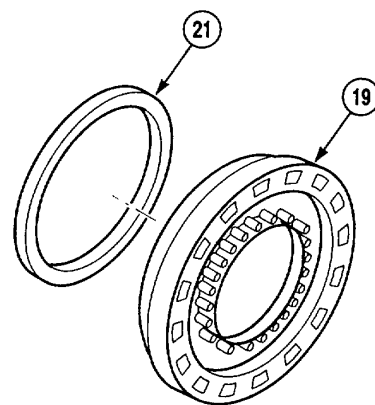
- (7) Remove retaining ring (16), spring retainers (17 and 18), clutch piston (19), and preformed packing (20) from forward shaft (1). Discard preformed packing.



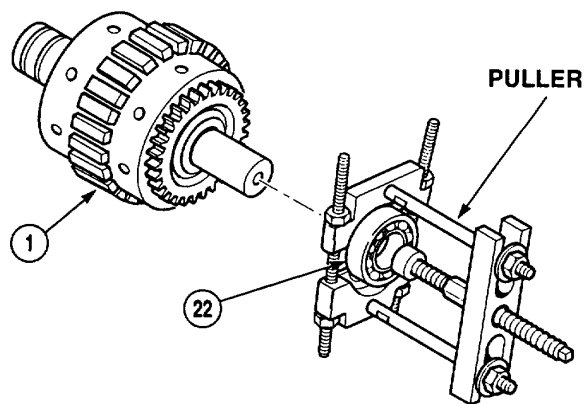
- (8) Remove preformed packing (21) from clutch piston (19). Discard preformed packing.

CAUTION

Parts held on forward shaft by bearing are not a press fit. These parts will come off shaft when bearing is removed.

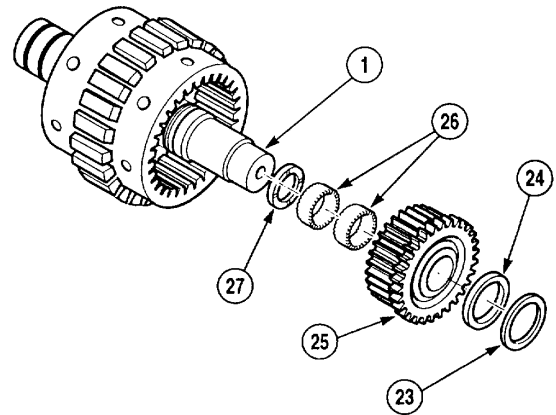


- (9) Using a puller, remove bearing (22) from forward shaft (1).



8-7. FORWARD SHAFT REPLACEMENT/REPAIR (CONT).

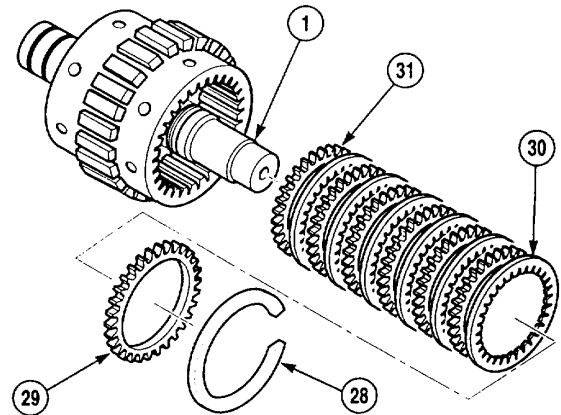
- (10) Remove thrust washers (23 and 24) and gear (25) from forward shaft (1).
- (11) Remove bearings (26) and thrust washer (27) from forward shaft (1).



WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

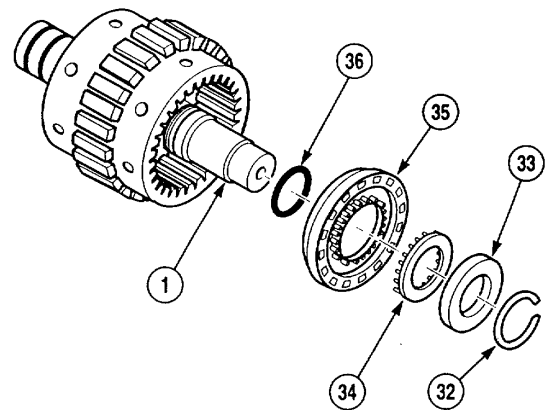
- (12) Remove retaining ring (28) and pressure plate (29) from forward shaft (1).
- (13) Remove friction clutch plates (30) and steel clutch plates (31) from forward shaft (1)



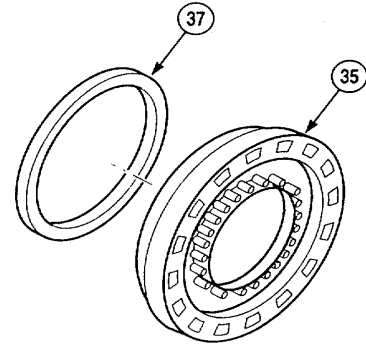
WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (14) Remove retaining ring (32), spring retainers (33 and 34), clutch piston (35), and preformed packing (36) from forward shaft (1). Discard preformed packing.



- (15) Remove preformed packing (37) from clutch piston (35). Discard preformed packing.



c. Cleaning/Inspection.

WARNING

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
- **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**

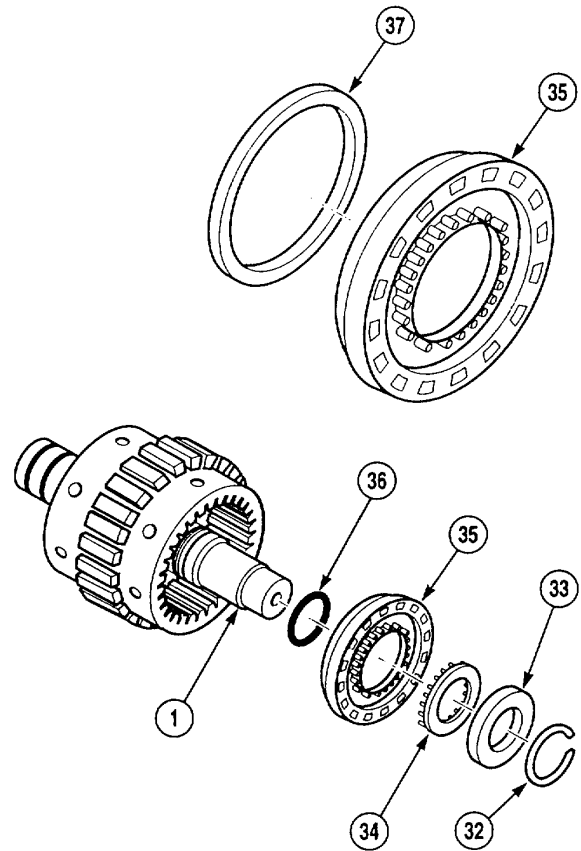
CAUTION

Allow all parts to air dry. Do not use a cloth or shop towel. Lint can get into transmission circuit and cause damage.

- (1) Clean all metal parts with dry-cleaning solvent and allow parts to air dry.
- (2) Inspect all parts for breaks, cracks, burrs, sharp edges, and signs of overheating.
- (3) Inspect gears for chipped, cracked, or broken teeth.
- (4) Inspect springs for distortion, cracks, and other damage.
- (5) Inspect clutch plates for unusual wear patterns, overheating, and warping.
- (6) Measure length of all springs of two spring retainers. Discard spring retainers that have springs measuring less than .96 in (24.38 mm).

8-7. FORWARD SHAFT REPLACEMENT/REPAIR (CONT).**d. Assembly.**

- (1) Coat preformed packing (37) with clean transmission oil.
- (2) Install preformed packing (37) on clutch piston (35).
- (3) Coat preformed packing (36), clutch piston (35), spring retainers (34 and 33), and retaining ring (32) with clean transmission oil.
- (4) Install preformed packing (36) on forward shaft (1).
- (5) Install clutch piston (35) in forward shaft (1).
- (6) Install spring retainers (34 and 33) on forward shaft (1) and clutch piston (35). Springs of spring retainer (34) should fit in spring bores of clutch piston (35).

**WARNING**

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

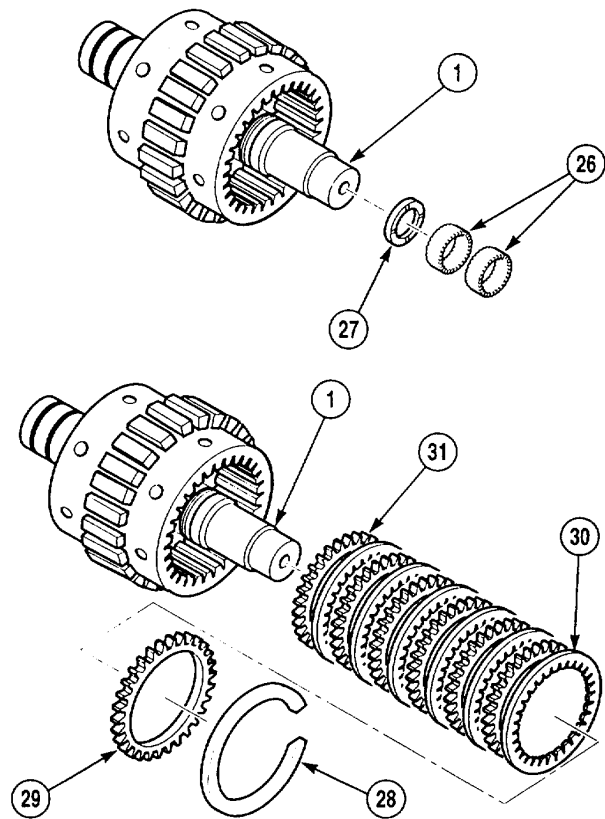
- (7) Install retaining ring (32) on forward shaft (1).

- (8) Coat thrust washer (27) and bearings (26) with clean transmission oil.
- (9) Install thrust washer (27) and bearings (26) on forward shaft (1).
- (10) Coat steel clutch plates (31), friction clutch plates (30), pressure plate (29), and retaining ring (28) with clean transmission oil.
- (11) Install steel clutch plates (31) and friction clutch plates (30) on forward shaft (1). Install one steel clutch plate (31) first, then one friction clutch plate (30), then one steel clutch plate (31), then one friction clutch plate (30), until all clutch plates are installed. The last clutch plate to be installed should be a friction clutch plate (30).

WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (12) Install pressure plate (29) and retaining ring (28) on forward shaft (1).



8-7. FORWARD SHAFT REPLACEMENT/REPAIR (CONT).

- (13) Coat gear (25) and thrust washers (24 and 23) with clean transmission oil.

NOTE

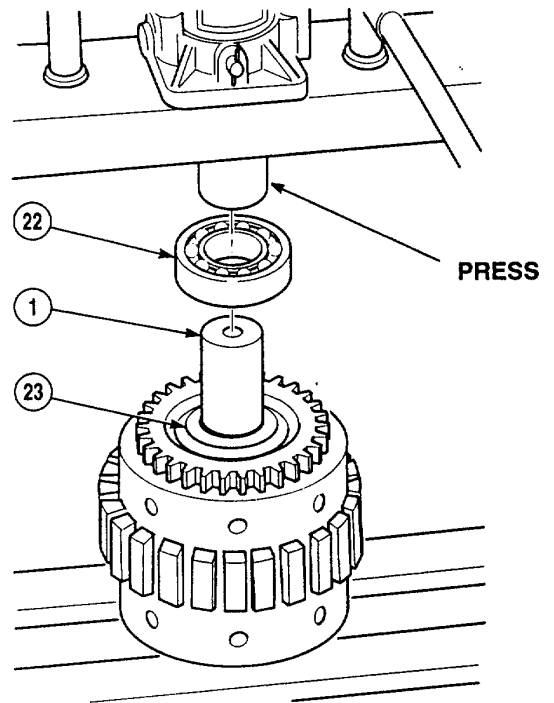
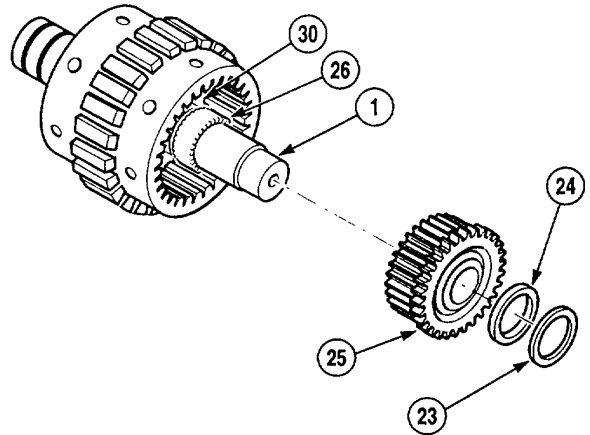
Rotate gear during installation to ensure it has meshed with all friction clutch plates.

- (14) Install gear (25) on bearings (26) and into friction clutch plates (30).
- (15) Install thrust washers (24 and 23) on forward shaft (1).
- (16) Coat bearing (22) with clean transmission oil.

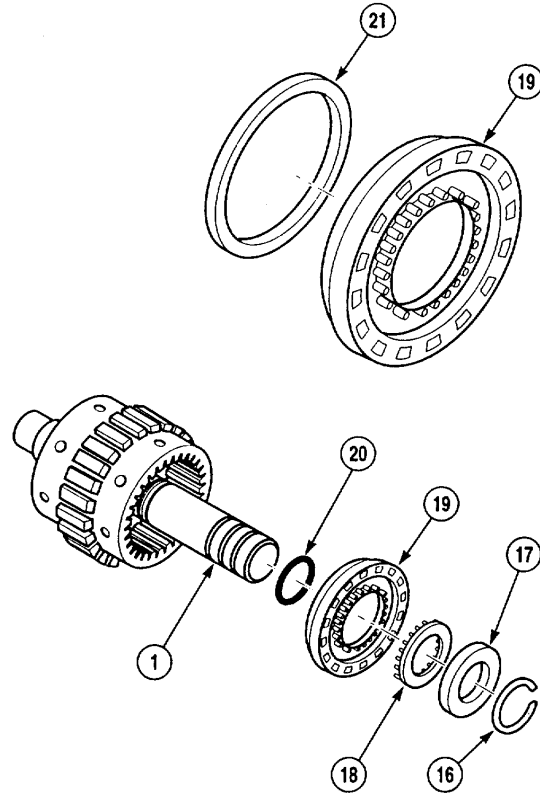
NOTE

Components on forward shaft, under bearing, should not be loose after bearing is installed.

- (17) Using a press, install bearing (22) on forward shaft (1) until it seats firmly against thrust washer (23).



- (18) Coat preformed packing (21) with clean transmission oil.
- (19) Install preformed packing (21) on clutch piston (19).
- (20) Coat preformed packing (20), clutch piston (19), spring retainers (18 and 17), and retaining ring (16) with clean transmission oil.
- (21) Install preformed packing (20) on forward shaft (1).
- (22) Install clutch piston (19) in forward shaft (1).
- (23) Install spring retainers (18 and 17) on forward shaft (1) and clutch piston (19). Springs of spring retainer (18) should fit in spring bores of clutch piston (19).



WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (24) Install retaining ring (16) on forward shaft (1).

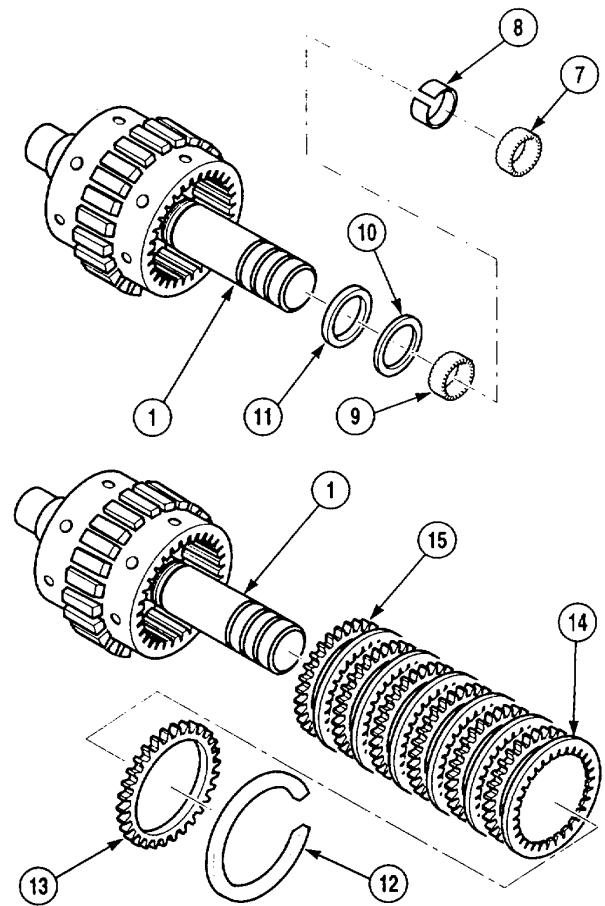
8-7. FORWARD SHAFT REPLACEMENT/REPAIR (CONT).

- (25) Coat two thrust washers (11 and 10), two bearings (9 and 7), and spacer (8) with clean transmission oil.
- (26) Install thrust washer (11), thrust washer (10), bearing (9), spacer (8), and bearing (7) on forward shaft (1).
- (27) Coat steel clutch plates (15), friction clutch plates (14), pressure plate (13), and retaining ring (12) with clean transmission oil.
- (28) Install steel clutch plates (15) and friction clutch plates (14) on forward shaft (1). Install one steel clutch plate (15) first, then one friction clutch plate (14), then one steel clutch plate (15), then one friction clutch plate (14), until all clutch plates are installed. The last clutch plate to be installed should be a friction clutch plate (14).

WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

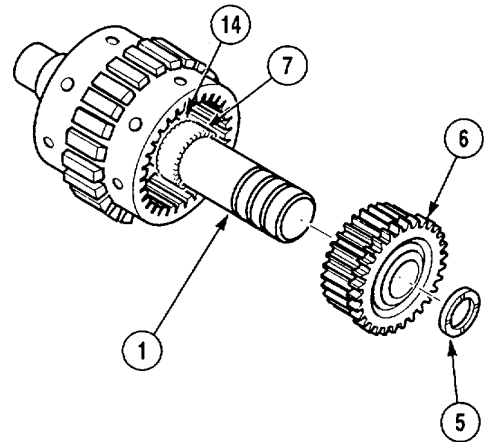
- (2) Install pressure plate (13) and retaining ring (12) on forward shaft (1).



(30) Coat gear (6) and thrust washer (5) with clean transmission oil.

(31) Install gear (6) on bearing (7) and into friction clutch plates (14).

(32) Install thrust washer (5) on forward shaft (1).

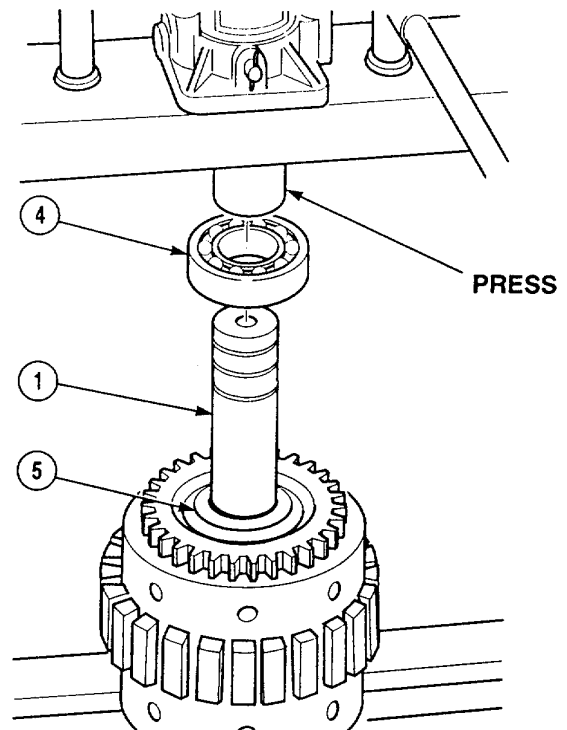


(33) Coat bearing (4) with clean transmission oil.

NOTE

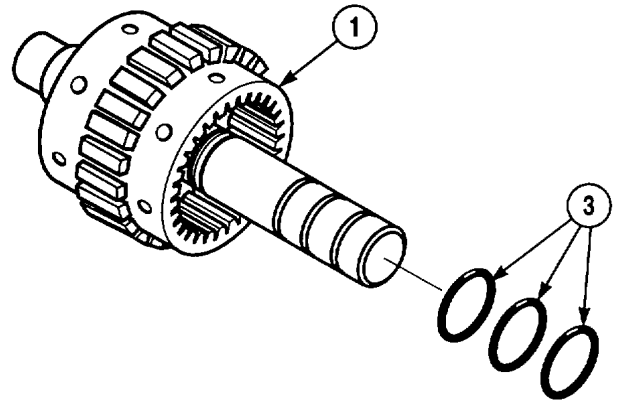
Components on forward shaft, under bearing, should not be loose after bearing is installed.

(34) Using a press, install bearing (4) on forward shaft (1) until it seats firmly against thrust washer (5).



8-7. FORWARD SHAFT REPLACEMENT/REPAIR (CONT)

- (35) Coat three preformed packings (3) with lubricating oil.
- (36) Install three preformed packings (3) on forward shaft (1).



NOTE

Gears on forward shaft should mesh with mating gears.

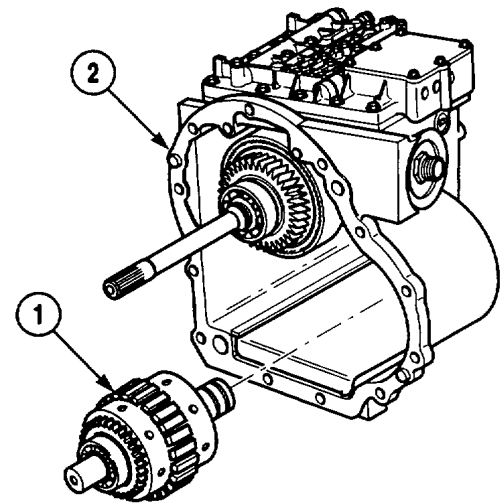
- e. Installation. Install forward shaft (1) in transmission case (2).

NOTE

Follow-on Maintenance:

- Install output shaft (Para 8-5).

END OF TASK



8-8. TORQUE CONVERTER REPLACEMENT/REPAIR.

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning/Inspection
- d. Assembly
- e. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive
 (Item 1, Appendix E)
 Wrench, Torque (0 - 60 N.m)
 (Item 5, Appendix E)

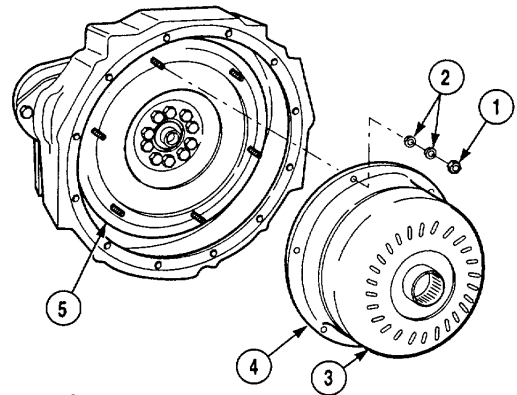
Materials/Parts

Rags, Wiping (Item 19, Appendix B)
 Solvent, Dry-cleaning (Item 20, Appendix B)

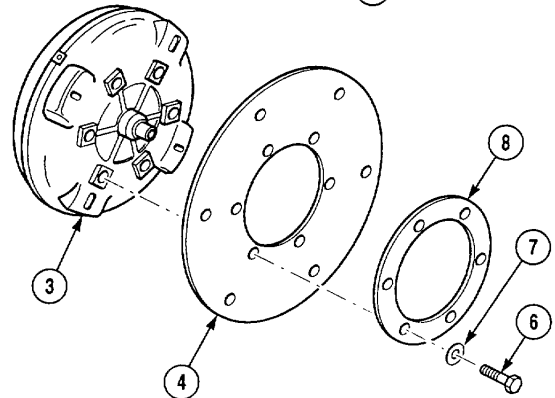
Equipment Condition

Transmission removed (Para 8-3)

a. Removal. Remove six nuts (1), 12 washers (2), torque converter (3), and drive plate (4) from flywheel (5).



b. Disassembly. Remove six screws (6), washers (7), spacer ring (8), and drive plate (4) from torque converter (3).



8-8. TORQUE CONVERTER REPLACEMENT/REPAIR (CONT).

c. Cleaning/Inspection.**WARNING**

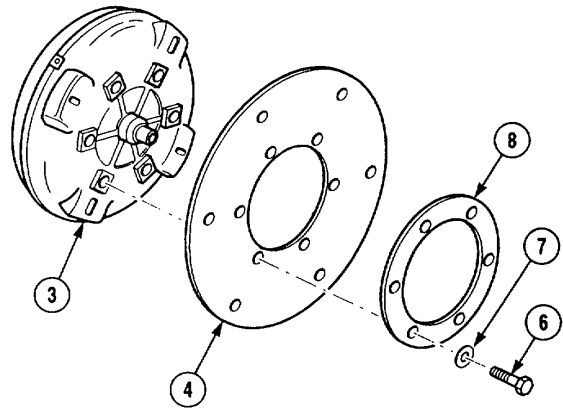
- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

CAUTION

Do not allow solvent or contaminants to enter torque converter; damage to torque converter and transmission can result.

- (1) Clean all metal parts with dry-cleaning solvent and wiping rags.
- (2) Inspect all parts for breaks, cracks, burrs, sharp edges, and signs of overheating.

- d. Assembly.** Install drive plate (4) and spacer ring (8) on torque converter (3) with six washers (7) and screws (6). Tighten screws (6) to 30 lb-ft (41 N•m).



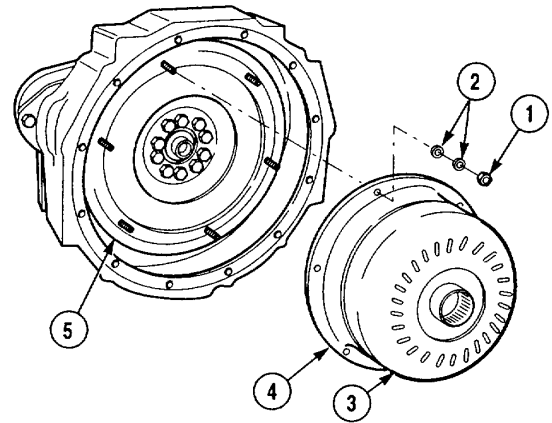
- e. **Installation.** Install drive plate (4) and torque converter (3) on flywheel (5) with 12 washers (2) and six nuts (1). Tighten nuts to 14 lb-ft (19 N•m).

NOTE

Follow-on Maintenance:

- Install transmission (Para 8-3).

END OF TASK



8-9. FLYWHEEL REPLACEMENT/REPAIR.

This task covers:

- | | | |
|----------------|------------------------|-----------------|
| a. Removal | c. Cleaning/Inspection | e. Installation |
| b. Disassembly | d. Assembly | |

INITIAL SETUP*Tools and Special Tools*

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)
Retainer (Item 13, Appendix E)
Wrench, Torque (0 to 175 lb-ft [0-237 N.m])
(Item 5, Appendix E)

Materials/Parts

Rags, Wiping (Item 19, Appendix B)
Solvent, Dry-cleaning (Item 20, Appendix B)

Personnel Required

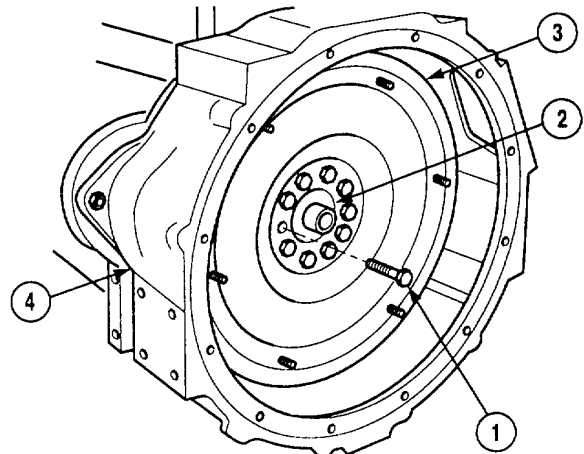
Two

Equipment Condition

Drive plate and torque converter removed
(Para 8-8)
Starter removed (TM 10-3930-669-20)

a. Removal.

- (1) Remove six often screws (1) from crankshaft (2) and flywheel (3).
- (2) Loosen remaining four screws (1) until head of screw (1) is .25 in. (6 mm) from flywheel (3).
- (3) Using a soft-faced mallet, strike flywheel (3) through adapter housing (4) starter hole to loosen flywheel from crankshaft (2). Rock flywheel, if necessary, until it is loose from crankshaft.

**WARNING**

Flywheel weighs 63 lbs. (29 kg). Use the aid of an assistant when removing flywheel or injury to personnel can result.

- (4) With the aid of an assistant, support flywheel (3) with a bar and remove four screws (1) and flywheel from crankshaft (2).

- (5) Remove two washers (5 and 6) and bearing (7) from crankshaft (2).

b. Disassembly.

CAUTION

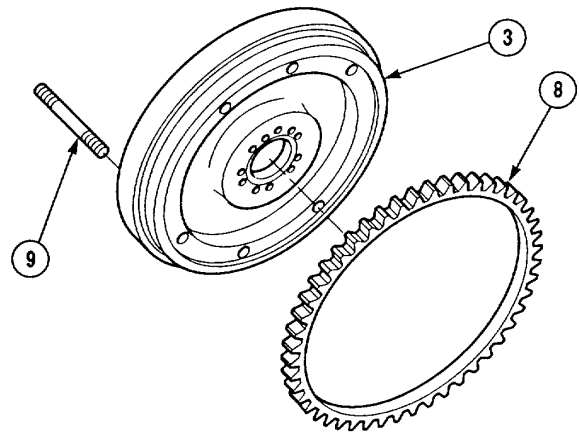
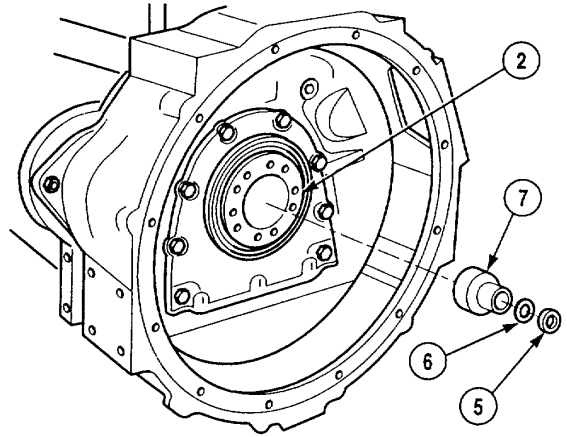
Do not heat ring gear to more than a dull red color. If ring gear is heated to a bright orange color, ring gear will be damaged. Discard ring gear if heated to a bright orange color.

- (1) Heat ring gear (8) in a suitable oven at 248°F (120°C) until ring gear reaches oven temperature.

WARNING

Use care when working around ring gear. Gloves must be worn. Severe burns can result if protective measures are not taken.

- (2) Remove ring gear (8) from flywheel (3).
- (3) Remove six studs (9) from flywheel (3).



8-9. FLYWHEEL REPLACEMENT/REPAIR (CONT).

c. Cleaning/Inspection.**WARNING**

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
 - **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**
- (1) Clean all metal parts with dry-cleaning solvent and wiping rags.
 - (2) Inspect all parts for breaks, cracks, burrs, sharp edges, and signs of overheating.

d. Assembly.

- (1) Install six studs (9) in flywheel (3).

CAUTION

Do not heat ring gear to more than a dull red color. If ring gear is heated to a bright orange color, ring gear will be damaged. Discard ring gear if heated to a bright orange color.

- (2) Heat ring gear (8) in a suitable oven at 248°F (120°C) until ring gear reaches oven temperature.

WARNING

Do not touch hot parts with bare hands; injury to personnel will result.

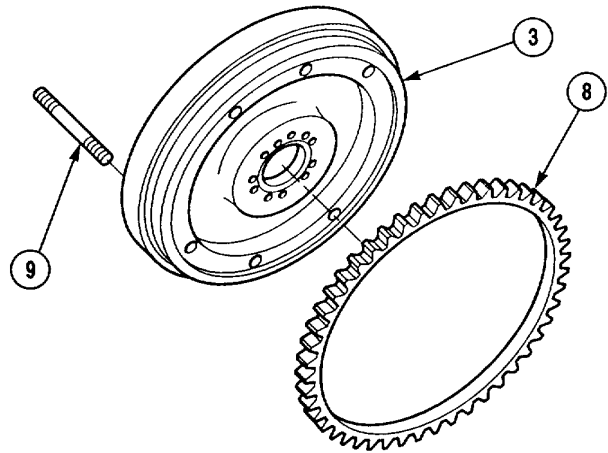
CAUTION

Ring gear must be installed tightly against shoulder of flywheel. If ring gear is not against shoulder, it may not allow starter to operate correctly.

NOTE

Ring gear will drop onto flywheel without force when heated.

- (3) Install ring gear (8) on flywheel (3).



8-9. FLYWHEEL REPLACEMENT/REPAIR (CONT).

e. Installation.

WARNING

- Do not touch hot parts with bare hands. Allow parts to cool before installing or injury to personnel can result.
- Flywheel weighs 63 lbs. (29 kg). Use the aid of an assistant when installing flywheel or injury to personnel can result.

- (1) Install bearing (7) and two washers (5 and 6) in crankshaft (2).
- (2) With the aid of an assistant, install flywheel (3) on crankshaft (2) in adapter housing (4) with ten screws (1). Do not tighten screws.

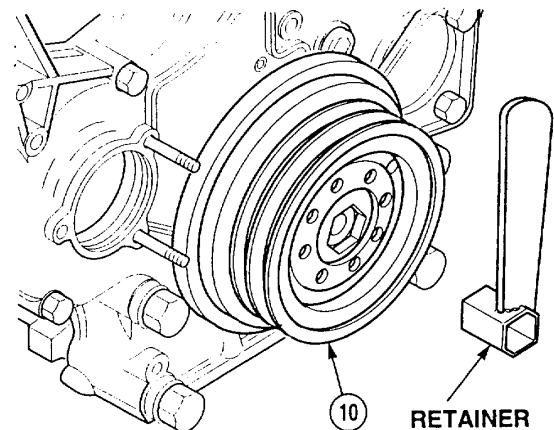
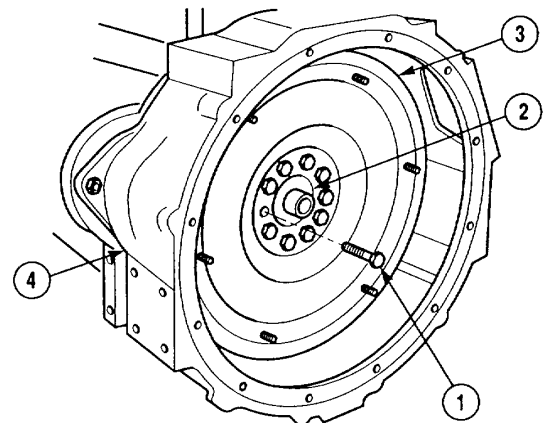
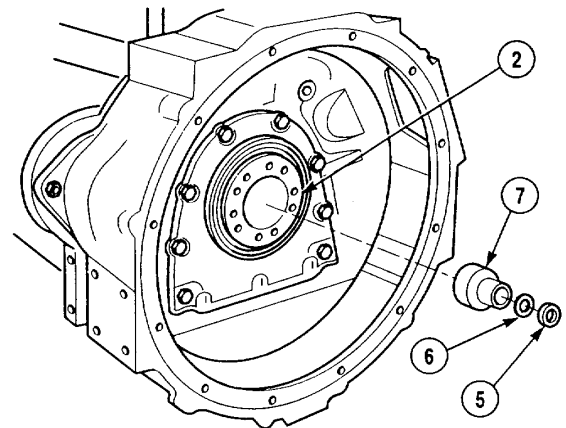
NOTE

Screws are tightened incrementally but there is no tightening sequence.

- (3) With the aid of an assistant, hold crank pulley (10) using retainer. Preload ten screws to 22 lb-ft (30 N•m).
- (4) With the aid of an assistant, hold crank pulley (10) using retainer. Tighten screws (1) to 70 lb-ft (95 N•m).

NOTE**Follow-on Maintenance:**

- Install drive plate and torque converter (Para 8-8).
- Install starter (TM 10-3930-669-20).



END OF TASK

8-10. REAR ENGINE MOUNT REPLACEMENT.

This task covers:

- a. Removal b. Cleaning/Inspection c.. Installation

INITIAL SETUP*Tools and Special*

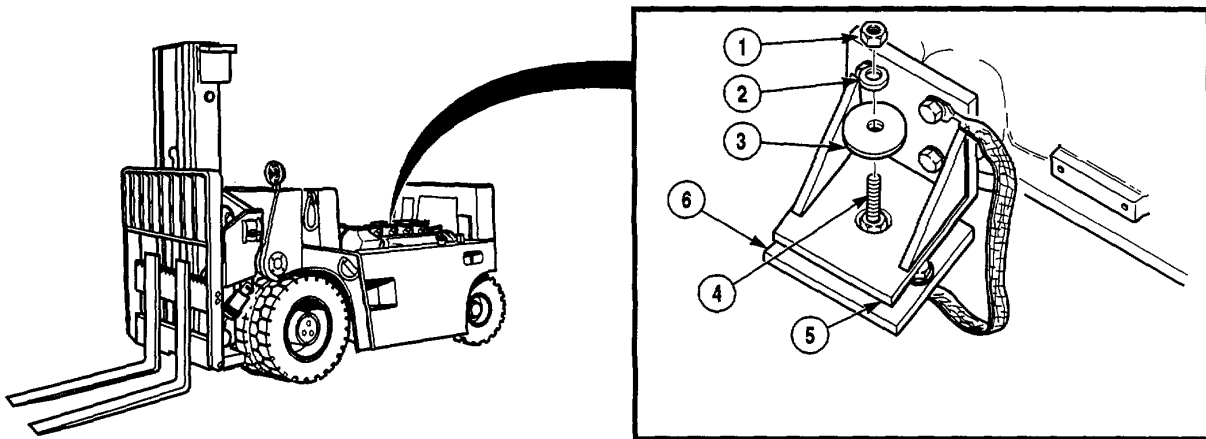
Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)
Wrench, Torque (0 to 175 lb-ft [0-237 N•m])
(Item 5, Appendix E)

Tools Equipment Condition

Cab removed (TM 10-3930-669-20)

Materials/Parts

Rags, Wiping (Item 19, Appendix B)
Solvent, cleaning (Item 20, Appendix B)

a. Removal**WARNING**

Engine/Transmission assembly weighs 430 lbs (195 kg). Attach suitable lifting device prior to any work. Equipment may fall and cause injury or death to personnel.

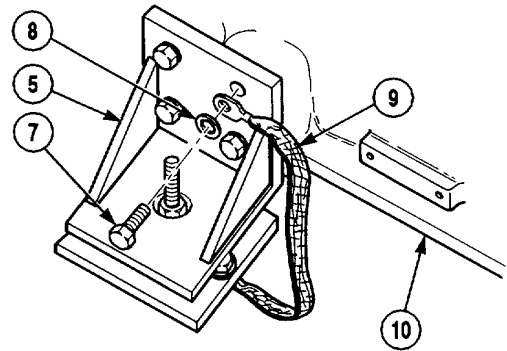
NOTE

- **Left and right rear engine mounts are removed the same way.**
- **Right rear engine mount shown.**
- **Left rear engine mount does not have engine ground strap.**

(1) Remove nut (1), washer (2), and washer (3) from screw (4) of right rear engine mount (5) and frame (6).

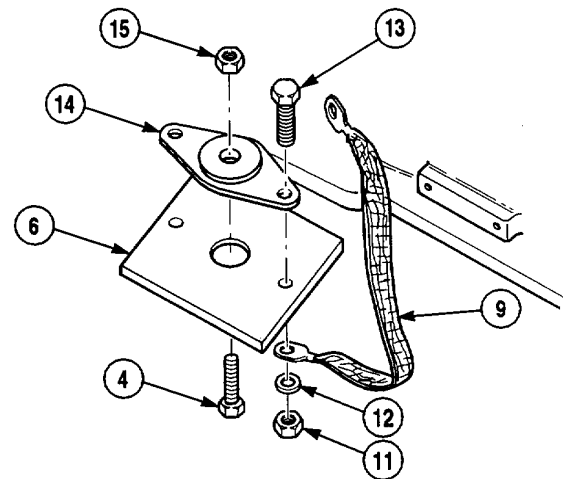
8-10. REAR ENGINE MOUNT REPLACEMENT (CONT).

(2) Remove four screws (7), washers (8), engine ground strap (9), and right rear engine mount (5) from engine (10).



(3) Remove two nuts (11), washers (12) engine ground strap (9), screws (13), and rubber engine mount (14) from frame (6).

(4) Remove nut (15) and screw (4) from rubber engine mount (14).

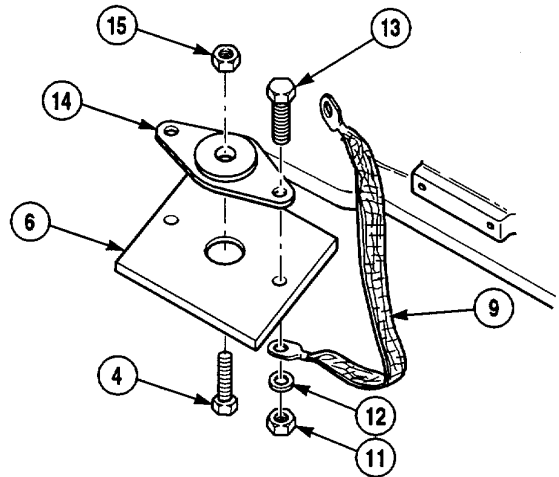
**b. Cleaning/Inspection.****WARNING**

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
- **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**

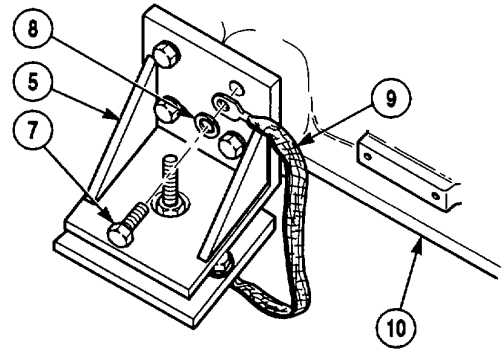
- (1) Clean all parts with dry-cleaning solvent and wiping rags.
- (2) Inspect bracket for cracking. Replace if bracket is cracked.
- (3) Inspect rubber engine mount for cracking, crumbling, and pulling loose from its metal mounting plate. Replace if any of these conditions are present.

c. Installation.

- (1) Install screw (4) on rubber engine mount (14) with nut (15). Tighten screws to 20 lb-ft (27 N•m).
- (2) Install rubber engine mount (14) and engine ground strap (9) on frame (6) with two screws (13), washers (12), and nuts (11). Tighten screws to 69 lb-ft (94 N•m).
- (3) Install right rear engine mount (5) and engine ground strap (9) on engine (10) with washer (8) and screws (7).



- (4) Install right rear engine mount (5) on frame (6) with washer (3), washer (2), and nut (1) on screw (4). Tighten nut to 20 lb-ft (27 N•m).

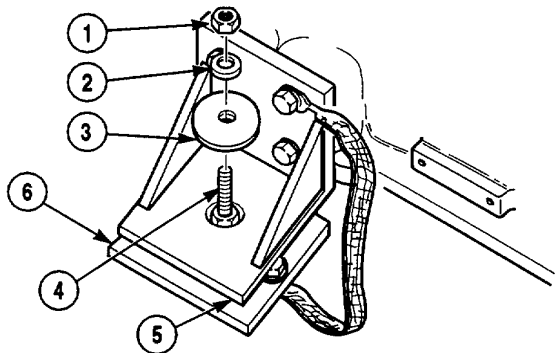


NOTE

Follow-on Maintenance:

Install cab (TM 10-3939-669-20).

END OF TASK



CHAPTER 9
FINAL DRIVE MAINTENANCE

Para	Contents	Page
9-1	Introduction.....	9-1
9-2	Planetary Hub Replacement/Repair.....	9-2

9-1. INTRODUCTION.

This chapter contains maintenance instructions for removing, replacing, installing, and adjusting final drive system components authorized by the Maintenance Allocation Chart (MAC) at the Direct Support and General Support Maintenance level.

9-2. PLANETARY HUB REPLACEMENT/REPAIR.

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning/Inspection
- d. Assembly
- e. Installation

INITIAL SETUP

Tools and Special Tools

- Shop Equipment, Automotive Maint and Repair: Supp. 1 (Item 3, Appendix E)
- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Depth Gauge (Item 5, Appendix E)
- Lifting Device
- Micrometer (Item 5, Appendix E)
- Press, 60 Ton (Item 5, Appendix E)
- Puller (Item 31, Appendix E)
- Wrench, Torque (0 to 175 lb-ft [0-237 N.m]) (Item 5, Appendix E)
- Wrench, Torque (0 to 600 lb-ft [0-814 N.m]) (Item 5, Appendix E)

Materials /Parts

- Base Plate (Item 6, Appendix C)
- Compound, Sealing (Item 24, Appendix B)
- Compound, Corrosion Preventive (Item 7, Appendix B)
- Lubricating Oil (Item 15, Appendix B)
- Rags, Wiping (Item 19, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)
- Seal (3)
- Seal
- Seal
- Seal
- Washer, Seal

Equipment Condition

Drive axle removed (Para 10-2)

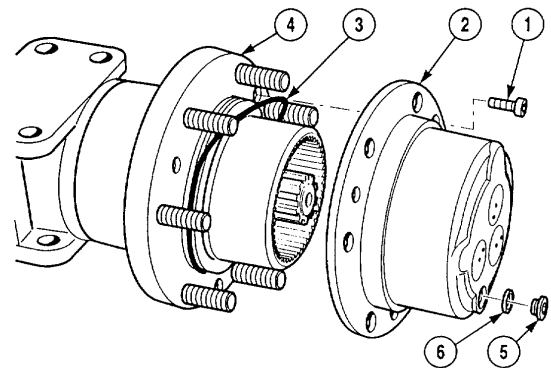
a. Removal.

WARNING

Front axle weighs 608 lbs (276 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

NOTE

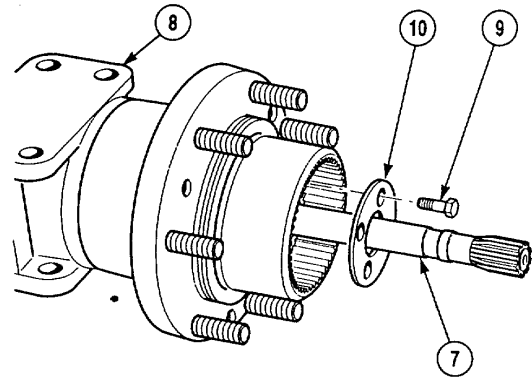
Right planetary gear carrier removal is shown. Left planetary gear carrier removal is similar.



- (1) Remove four screws (1), planetary gear carrier (2), and seal (3) from wheel hub (4). Discard seal.
- (2) Remove plug (5) and seal washer (6) from planetary gear carrier (2). Discard seal washer.

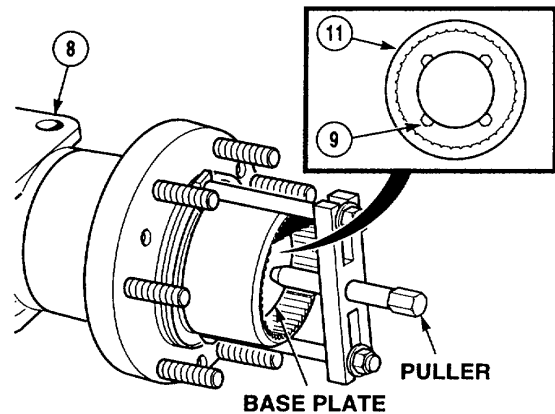
NOTE

- **Right wheel hub removal is shown. Left wheel hub removal is similar.**
- **Prior to axle removal, engage brakes to hold brake disks in alignment with axle.**



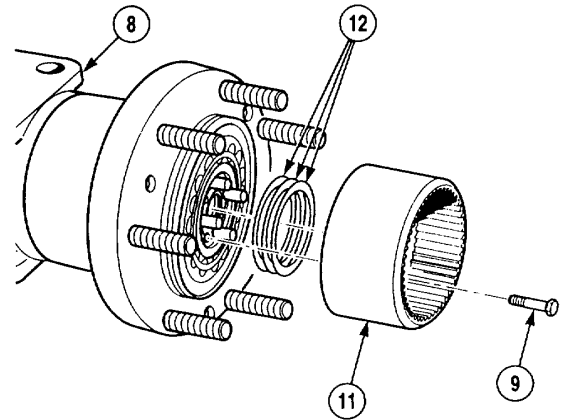
- (3) Remove axle (7) from axle housing (8).
- (4) Remove four screws (9) and locking plate (10) from axle housing (8).
- (5) Place four screws (9) halfway in axle housing (8).

- (6) Place puller with base plate, on four screws (9) and on planetary hub assembly (11).
- (7) Using puller and base plate, pull planetary hub assembly (11) loose from axle housing (8).
- (8) Remove puller, with base plate, from planetary hub assembly (11).



9-2. PLANETARY HUB REPLACEMENT/REPAIR (CONT)

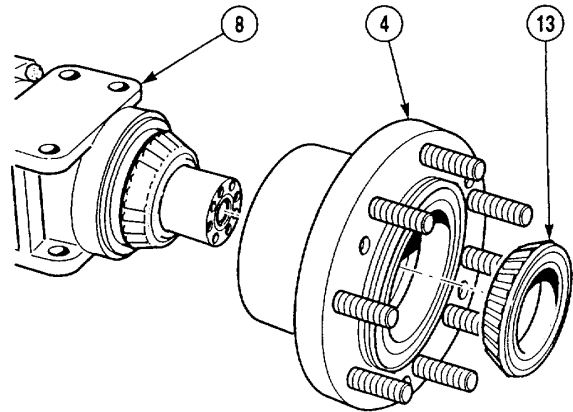
- (9) Remove four screws (9) from axle housing (8).
- (10) Remove planetary hub assembly (11) and shims (12) from axle housing (8).



NOTE

Pulling slightly on wheel hub will free outer wheel bearing on axle housing.

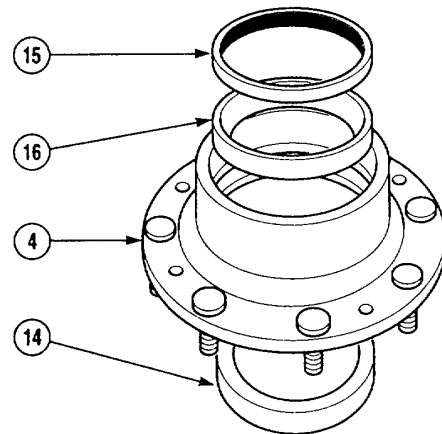
- (11) Remove outer bearing (13) and wheel hub (4) from axle housing (8).



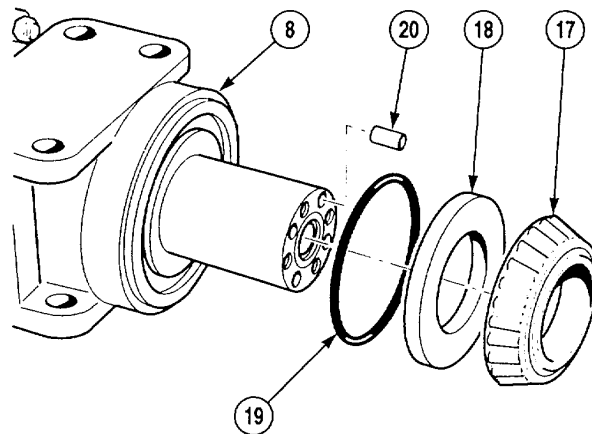
NOTE

Note position of seal prior to removal.

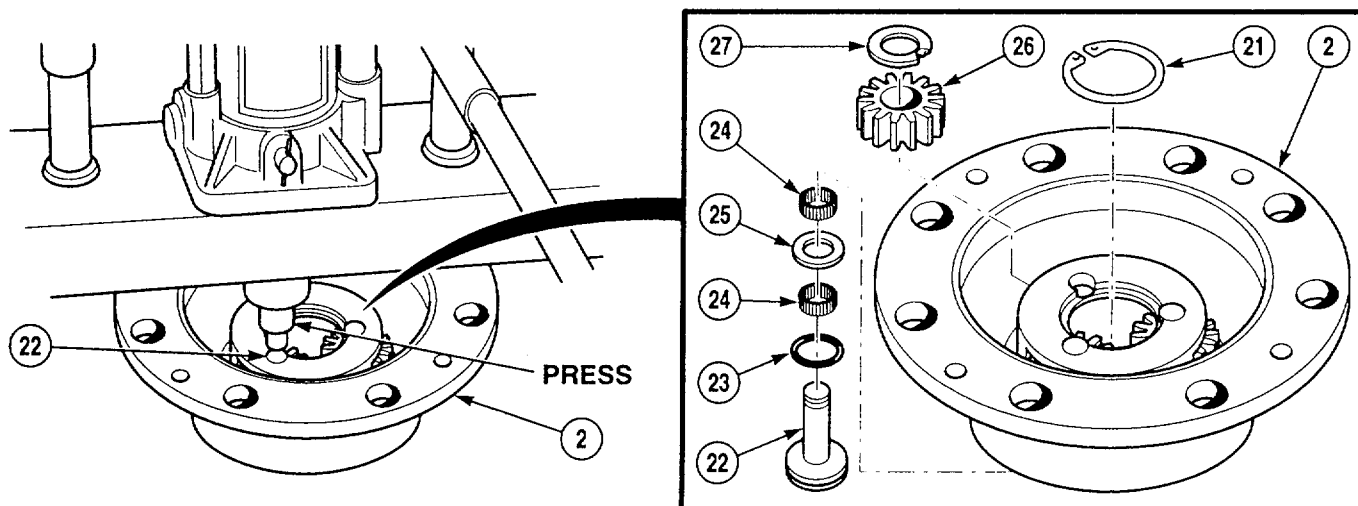
- (12) Remove outer bearing race (14), seal (15), and inner bearing race (16) from wheel hub (4). Discard seal.



- (13) Using puller and base plate, as required, remove inner bearing (17), spacer (18), and seal (19) from axle housing (8). Discard seal.
- (14) Remove four dowels (20) from axle housing (8).



b. Disassembly.



WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (1) Remove retaining ring (21) from planetary gear carrier (2).
- (2) Using a press, remove three planet shafts (22), seals (23), bearings (24), spacers (25), and bearings (24) from planetary gear carrier (2). Discard seals.

NOTE

Note position of spacers prior to removal.

- (3) Remove three planets (26) and spacers (27) from planetary gear carrier (2).

9-2. PLANETARY HUB REPLACEMENT/REPAIR (CONT).

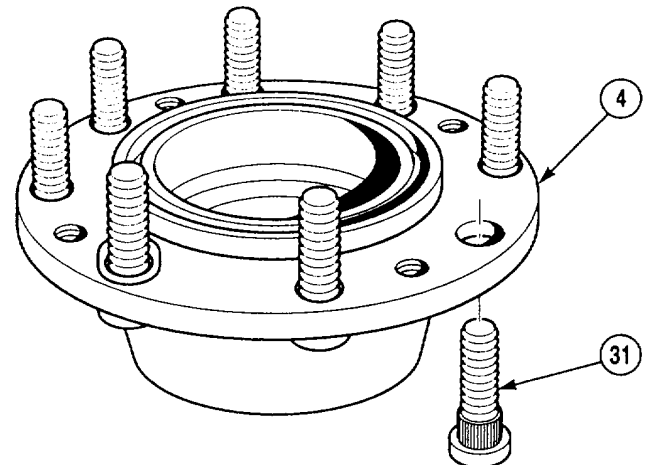
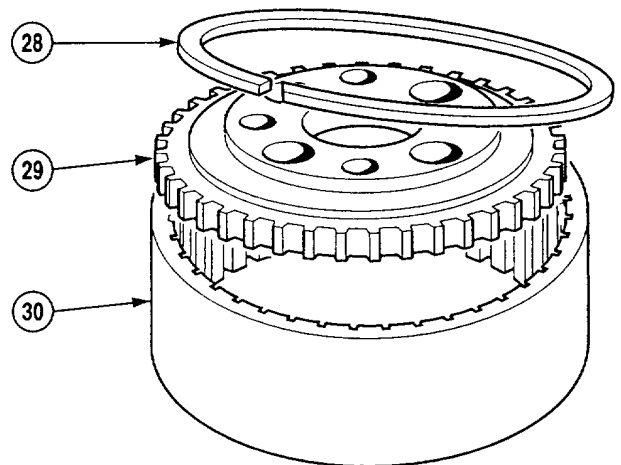
WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (4) Remove retaining ring (28) and backplate (29) from planetary ring gear (30).

NOTE

If wheel studs are damaged, perform Step (5). (5) Use a press to remove damaged stud (31) from wheel hub (4).

**c. Cleaning/Inspection.****WARNING**

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38° C) and for type II is 138°F (50° C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

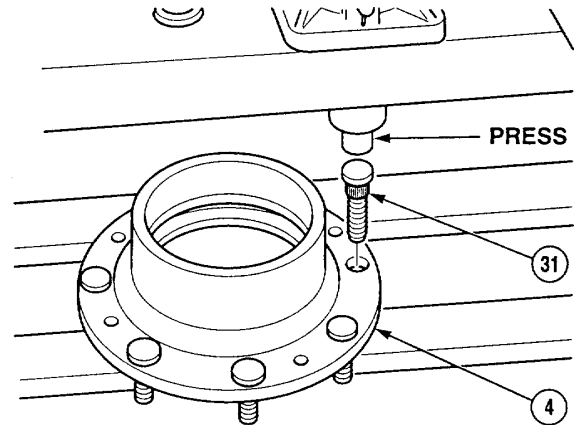
- (1) Clean all metal parts with dry-cleaning solvent.
- (2) Inspect all parts for wear, cracks, nicks, burrs, or scratches.
- (3) Replace all damaged parts.

d. *Assembly.*

NOTE

If damaged wheel studs were removed during Step (5) of Disassembly, perform Step (1). If studs were not removed, proceed to Step (2).

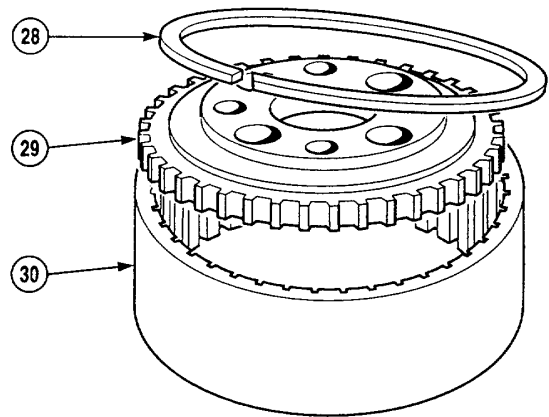
- (1) Using a press, install stud (31) in wheel hub (4).



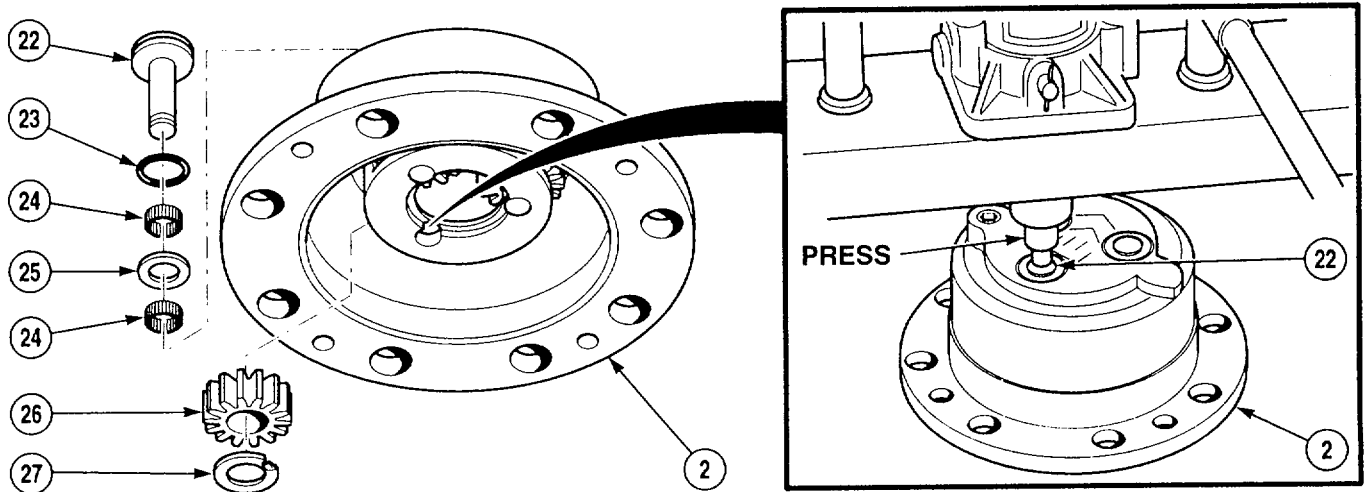
WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (2) Install backplate (29) and retaining ring (28) in planetary ring gear (30).



9-2. PLANETARY HUB REPLACEMENT/REPAIR (CONT).



- (3) Position three planets (26) and spacers (27) in planetary gear carrier (2) as noted during disassembly.
- (4) Coat three seals (23) with lubricating oil.
- (5) Install three seals (23) on planet shafts (22).

NOTE

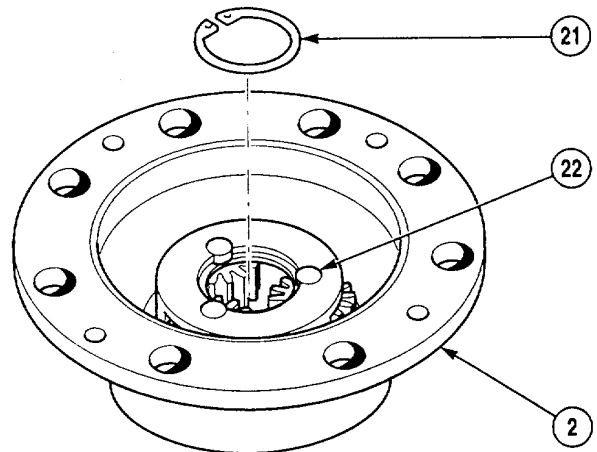
Groove in planet shafts will align with retaining ring groove of planetary gear carrier when properly installed. Planet should move freely.

- (6) Using press, install three bearings (24), spacers (25), bearings (24), and planet shafts (22) in planetary gear carrier (2), planets (26), and spacers (27).

WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (7) Install retaining ring (21) in planetary gear carrier (2) and three planet shafts (22).

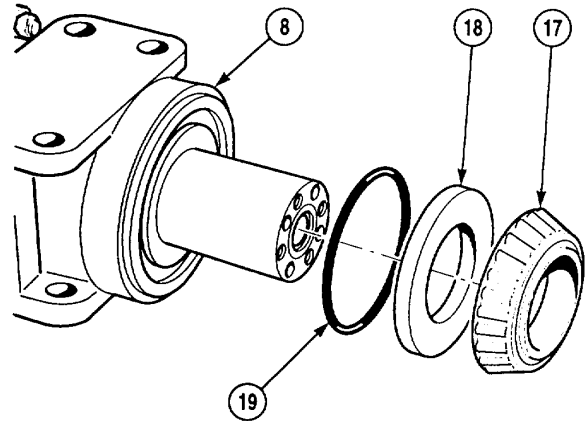


e. Installation.

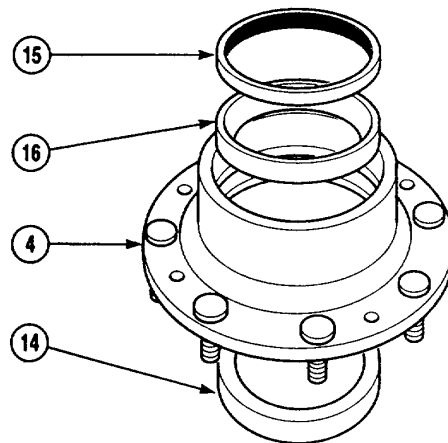
NOTE

Right planetary gear carrier installation is shown. Left planetary gear carrier installation is similar.

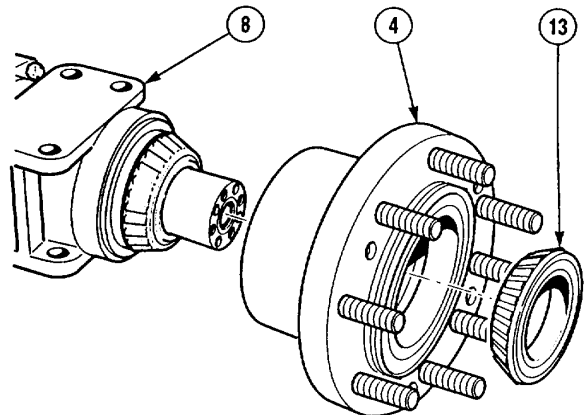
- (1) Install seal (19), spacer (18), and inner bearing (17) on axle housing (8).



- (2) Install outer bearing race (14) and inner bearing race (15) in wheel hub (4).
- (3) Install seal (16) in wheel hub (4) as noted during disassembly.



- (4) Position wheel hub (4) and outer bearing (13) on axle housing (8).

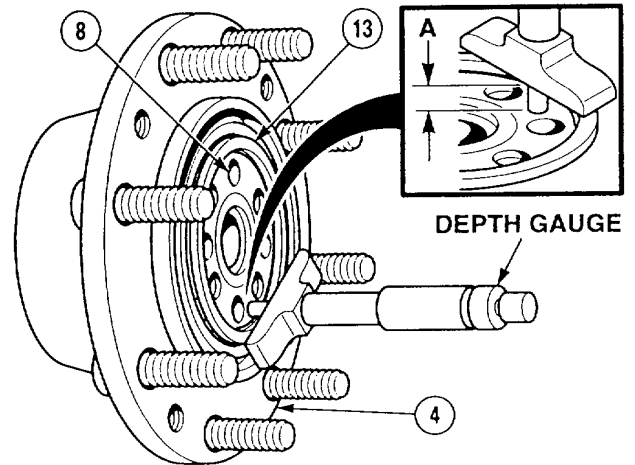


9-2. PLANETARY HUB REPLACEMENT/REPAIR (CONT).

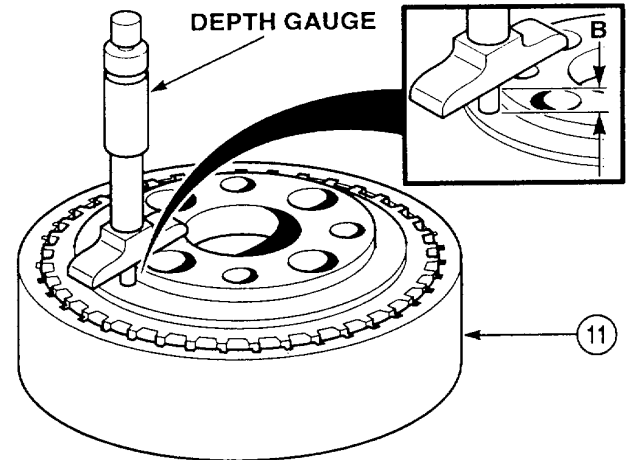
NOTE

The depth difference between the planetary hub assembly and the axle housing must be filled with v shims to within a tolerance of ± 0.0008 in. (± 0.020 mm).

- (5) Using a depth gauge, measure the distance from the face of axle housing (8) to the face of outer bearing (13) of wheel hub (4). Record this measurement as Distance A.

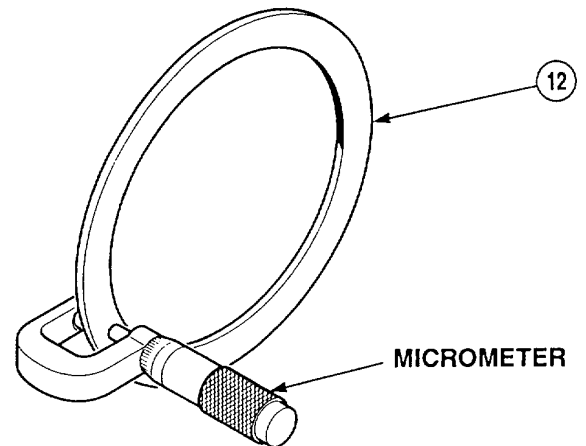


- (6) Using a depth gauge, measure the distance from the face of the planetary hub assembly (11) to the bearing contact surface. Record this measurement as Distance B.



- (7) Subtract Distance B from Distance A to determine the shim thickness required. Record this difference as Distance C.

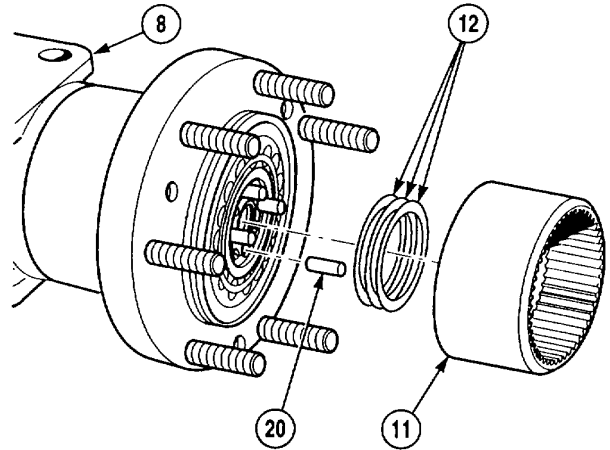
- (8) Using a micrometer to measure each shim (12), add shims together until the combined thickness equals Distance C ± 0.0008 in. (± 0.020 mm).



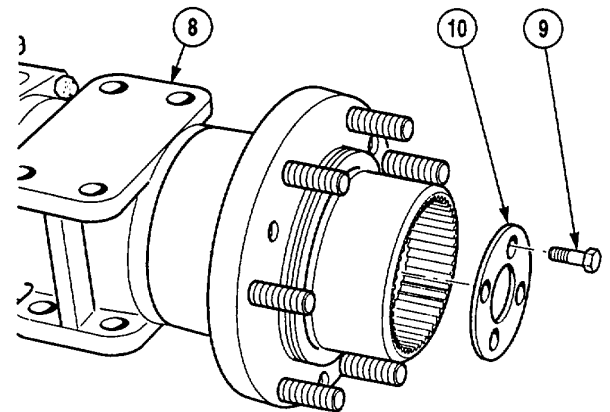
WARNING

Adhesive causes immediate bonding on contact with eyes, skin, or clothing and also gives off harmful vapors. Wear protective goggles and use in well-ventilated area. If adhesive gets in eyes, try to keep eyes open; flush eyes with water for 15 minutes and get immediate medical attention.

- (9) Apply sealing compound to four dowels (20).
- (10) Install four dowels (20) on axle housing (8).
- (11) Install shims (12) and planetary hub assembly (11) on four dowels (20).



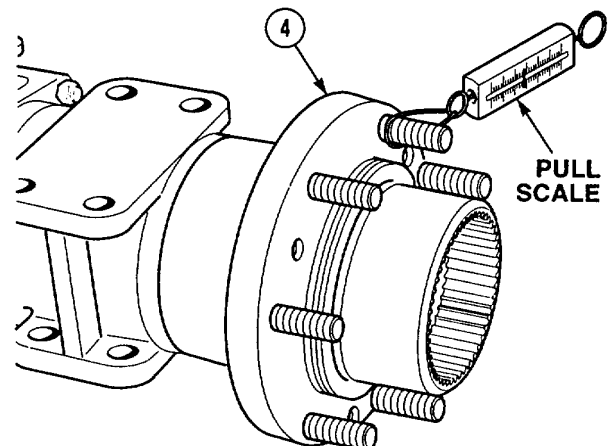
- (12) Apply sealing compound to four screws (9).
- (13) Install locking plate (10) on axle housing (8) with four screws (9). Tighten screws to 184 lb-ft (250 N•m).



NOTE

- The force required to turn the wheel hub must be 9-11.25 lbs (40-50 N).
- Add or remove 0.089 in. (0.02 mm) thickness of shims for each 2.25 lbs (10 N) change desired.

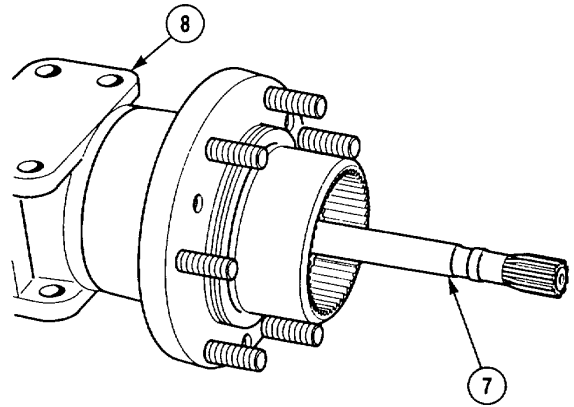
- (14) Attach pull scale to wheel hub (4).
- (15) While observing the scale, pull on pull scale until the wheel hub (4) turns.



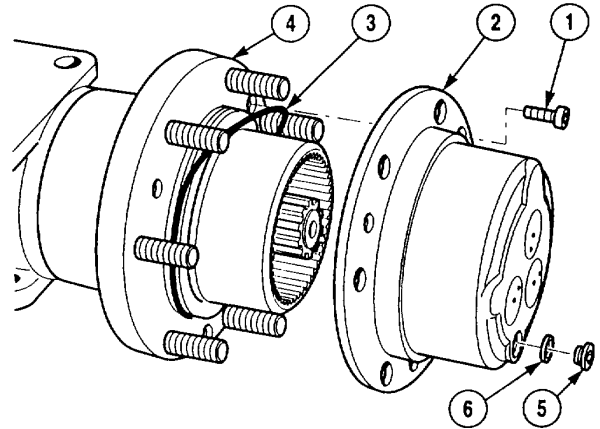
9-2. PLANETARY HUB REPLACEMENT/REPAIR (CONT).

NOTE

- If the force required to turn the wheel hub is not as specified, perform v Removal Steps (5) through (10). Add or subtract shims, as required, and perform Installation Steps (11) through (15).
- If the force required to turn the wheel hub is correct, proceed to Step (16).



- (16) Install axle (8) in axle housing (7).
- (17) Install seal washer (6) and plug (5) in planetary gear carrier (2).
- (18) Coat seal (3) with lubricating oil.
- (19) Install seal (3) on wheel hub (4).



WARNING

Adhesive causes immediate bonding on contact with eyes, skin, or clothing and also gives off harmful vapors. Wear protective goggles and use in well-ventilated area. If adhesive gets in eyes, try to keep eyes open; flush eyes with water for 15 minutes and get immediate medical attention.

- (20) Apply sealing compound to threads of four screws (1).
- (21) Install planetary gear carrier (2) on wheel hub (4) with four screws (1). Tighten to 63 lb-ft (86 N•m).

NOTE

Follow-on Maintenance:

- Install drive axle (Para 10-2).

END OF TASK

CHAPTER 10
AXLE MAINTENANCE

Para	Contents	Page
10-1	Introduction.....	10-1
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10-1. INTRODUCTION.

This chapter contains maintenance instructions for removing, replacing, installing, and adjusting axle components authorized by the Maintenance Allocation Chart (MAC) at the Direct Support and General Support Maintenance level.

10-2. DRIVE AXLE REPLACEMENT.

This task covers:

- a. Removal
- b. Cleaning/Inspection
- c. Installation

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Jack, (Item 17, Appendix E)
- Lifting Device, Minimum Capacity 3000 lbs (1814 kg)
- Wrench Set, Socket, 3/4 in. (Item 5, Appendix E)
- Wrench, Torque (0 to 175 lb-ft [0-237 N•m]) (Item 5, Appendix E)
- Wrench, Torque (0 to 600 lb-ft [0-814 N•m]) (Item 5, Appendix E)

Materials/Parts

- Cap and Plug Set (Item 5, Appendix B)
- Compound, Sealing (Item 23, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)
- Tags, Identification (Item 21, Appendix B) (TM 10-3930-669-20)

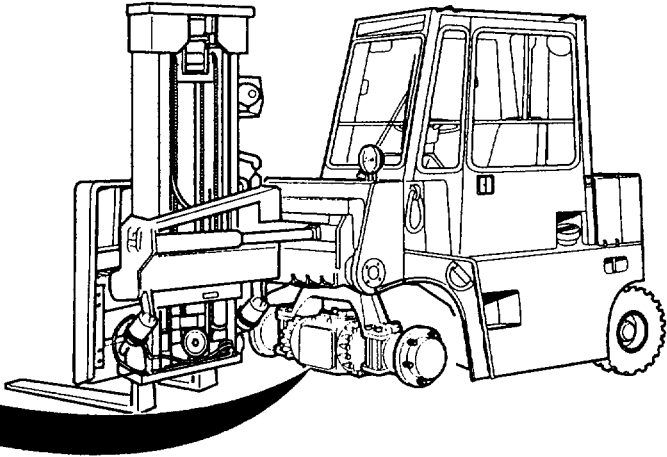
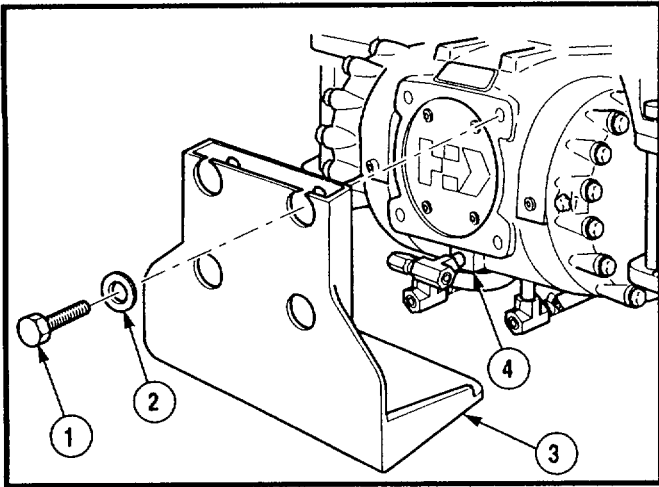
Personnel Required

Two

Equipment Condition

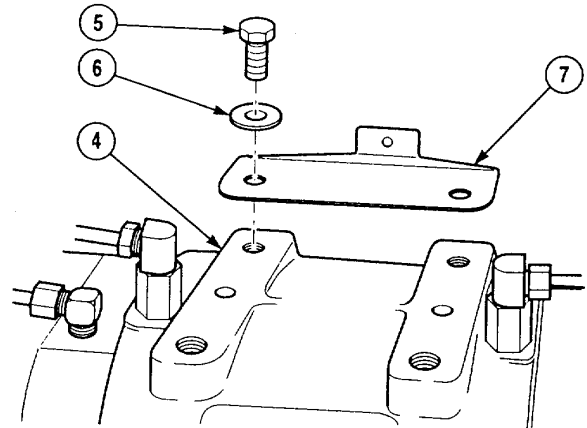
- Engine OFF (TM 10-3930-669-10)
- Wheels chocked (TM 10-3930-669-10)
- Mast assembly pivoted 90 degrees (TM 10-3930-669-10)
- Mast assembly fully side-shifted (TM 10-3930-669-10)
- Batteries disconnected (TM 10-3930-669-20)
- Parking brake assembly removed (TM- 10-3930-669-20)
- Front wheels removed (TM 10-3930-669-20)
- Planetary hub drained (TM 10-3930-669-20)
- Drive axle housing drained (TM 10-3930-669-20)
- Differential housing drained

a. Removal



(1) Remove four screws (1), washers (2), and plate (3) from axle (4).

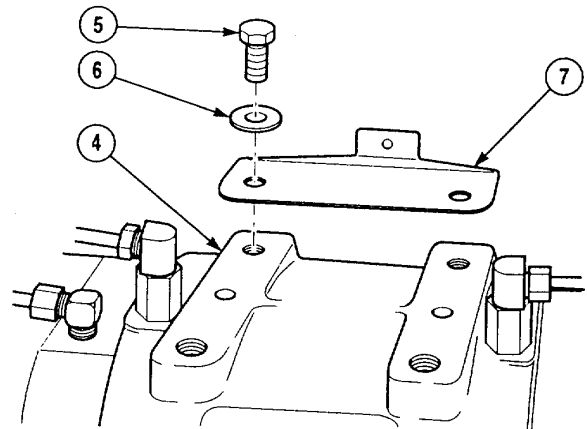
- (2) Remove two screws (5), washers (6), and plate (7) from axle (4).



NOTE

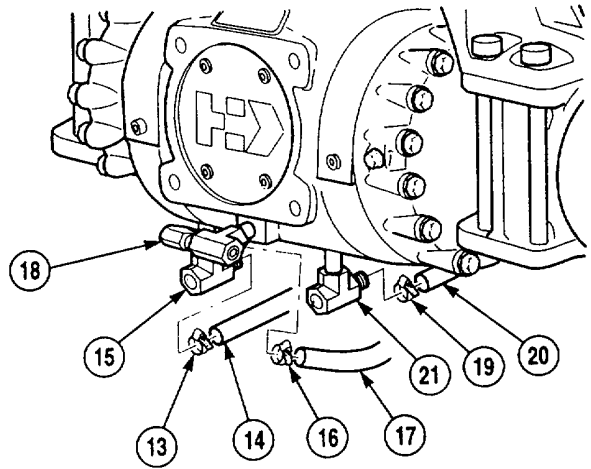
- Tag and mark all hoses and lines prior to removal.
- Inspect all hoses, lines, and fittings for cracks bends, nicks, dents, stripped threads, and cuts. Replace all damaged parts.
- Cap and plug all lines and fittings during removal.

- (3) Remove two brake lines (8) from fittings (9).
 (4) Remove hose (10) from fitting (11).
 (5) Remove bleeder valve (12) from axle (4).

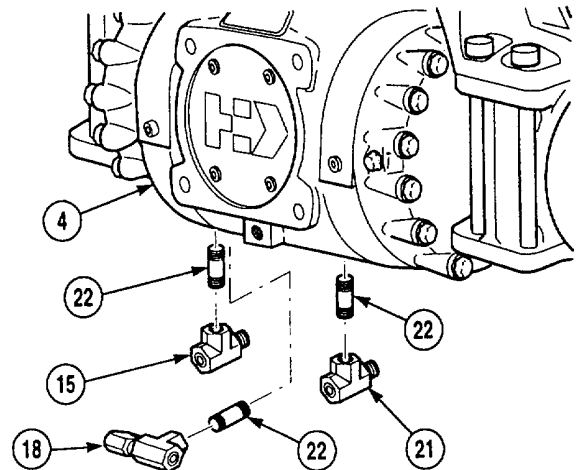


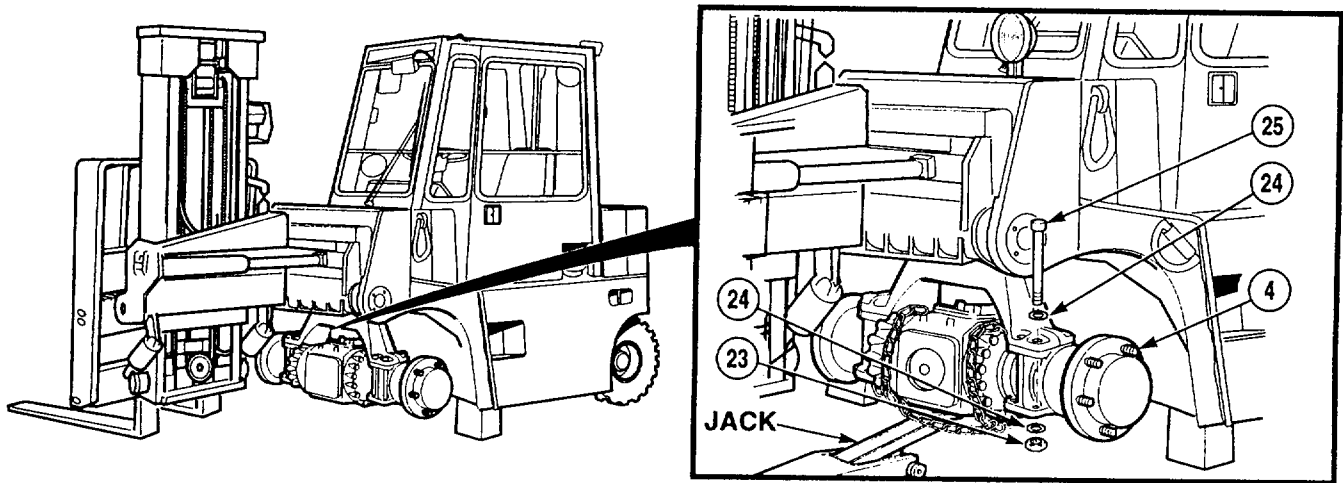
10-2. DRIVE AXLE REPLACEMENT (CONT).

- (6) Remove clamp (13) and hose (14) from fitting (15).
- (7) Remove clamp (16) and hose (17) from fitting (18).
- (8) Remove clamp (19) and hose (20) from fitting (21).



- (9) Remove three fittings (15, 18, and 21) and pipes (22) from axle (4).





WARNING

Front axle weighs 608 lbs (276 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

- (10) Position floor jack under axle (4) and attach to axle with lifting chains.
- (11) Remove eight nuts (23), eight washers (24), eight screws (25), and eight washers (24) from axle (4) and forklift.
- (12) With the aid of an assistant to stabilize axle on floor jack, remove axle (4) from under forklift.
- (13) With the aid of an assistant to stabilize axle on floor jack, remove chains from axle (4).
- (14) With the aid of an assistant to stabilize axle on floor jack, attach lifting device to axle (4).
- (15) With the aid of an assistant, position axle (4) on work surface.
- (16) Remove lifting device from axle (4).

10-2. DRIVE AXLE REPLACEMENT (CONT).

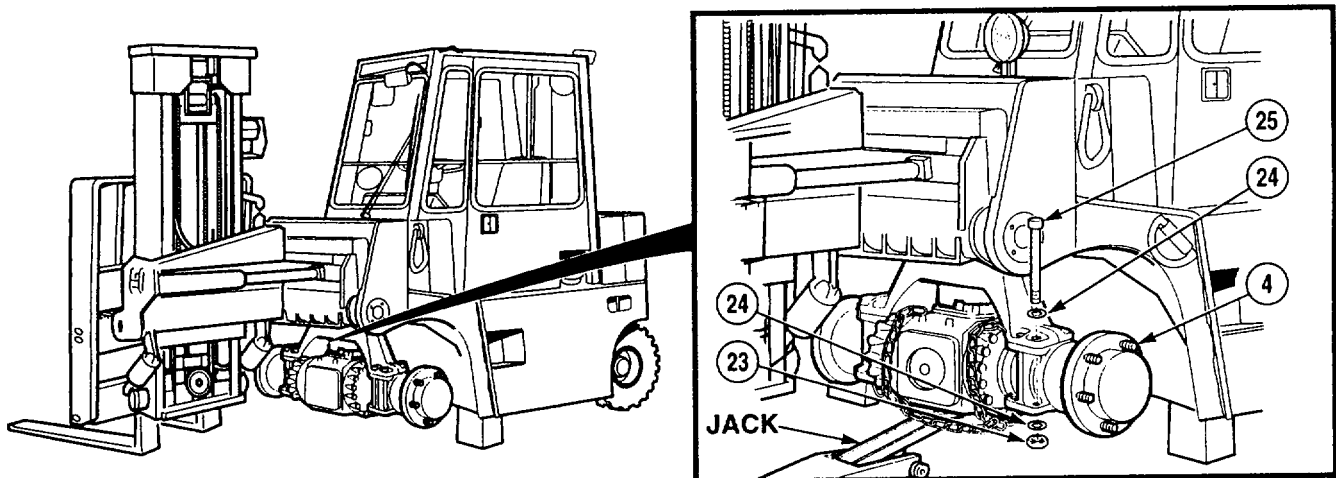
b. *Cleaning/Inspection.*

WARNING

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

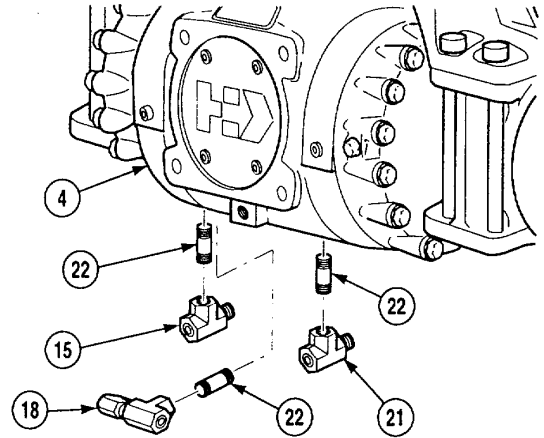
- (1) Clean all metal parts with dry-cleaning solvent.
- (2) Inspect all parts for wear, cracks, nicks, burrs, or scratches.
- (3) Replace all damaged parts.

c. *Installation.*

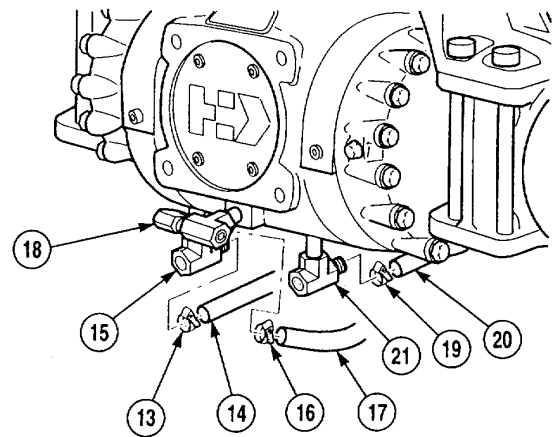


- (1) Attach lifting device to axle (4).
- (2) With the aid of an assistant to stabilize axle on floor jack, position axle (4) on floor jack, remove lifting device, and attach to axle with chains.
- (3) With the aid of an assistant to stabilize axle on floor jack, position axle (4) under forklift.
- (4) Apply sealing compound to threads of eight screws (25).
- (5) Install eight screws (25), eight washers (24), eight nuts (23), and eight washers (22) in forklift and axle (4). Tighten nuts to 230 to 300 lb-ft (311-407 N•m).
- (6) Remove floor jack and chains from axle (4).

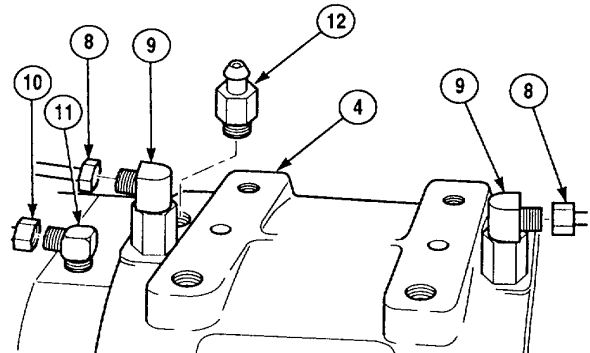
- (7) Install three pipes (22) and fittings (15, 18, and 21) on axle (4).



- (8) Install hose (20) on fitting (21) with clamp (19).
 (9) Install hose (17) on fitting (18) with clamp (16).
 (10) Install hose (14) on fitting (15) with clamp (13).

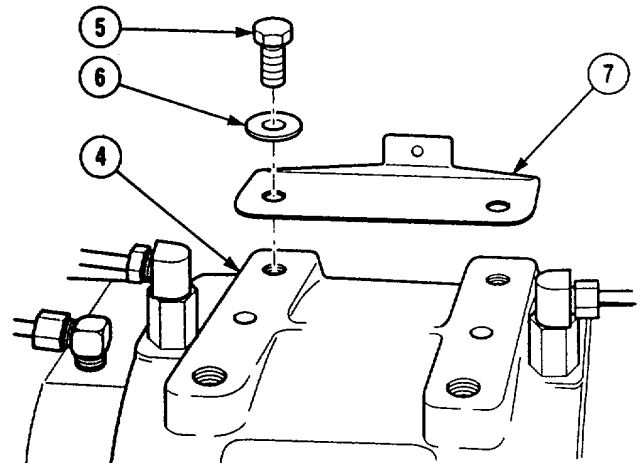


- (11) Install bleeder valve (12) on axle (4).
 (12) Install hose (10) on fitting (11).
 (13) Install two brake lines (8) on fittings (9).



10-2. DRIVE AXLE REPLACEMENT (CONT).

- (14) Install plate (7) on axle (4) with two washers (6) and screws (5). Tighten screws to 155 lb-ft (210 N•m).

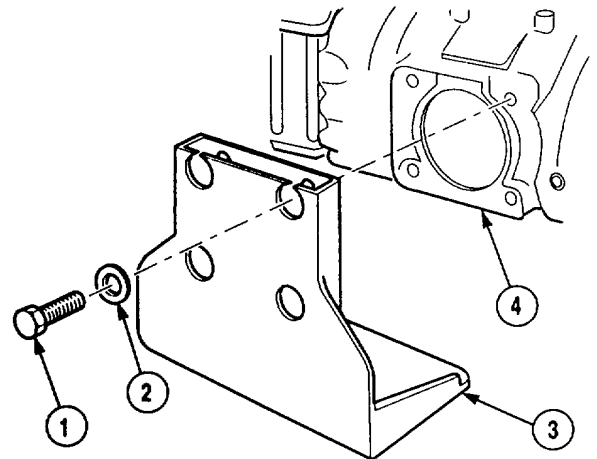


- (15) Install plate (3) on axle (4) with four washers (2) and screws (1).

NOTE

Follow-on Maintenance:

- Install parking brake assembly (TM 10-3930-669-20).
- Fill differential housing with oil (TM 10-3930-669-20).
- Fill drive axle housing with oil (TM 10-3930-669-20).
- Fill planetary hub with oil (TM 10-3930-669-20).
- Bleed service brakes (TM 10-3930-669-20).
- Install front wheels (TM 10-3930-669-20).
- Connect batteries (TM 10-3930-669-20).
- Center mast assembly (TM 10-3930-669-10).
- Pivot mast assembly to front (TM 10-3930-669-10).
- Remove wheel chocks (TM 10-3930-669-10).



END OF TASK

10-3. AXLE HOUSING REPLACEMENT.

This task covers:

- a. Removal b. Cleaning/Inspection c. Installation

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Lifting Device, Minimum Capacity 3000 lbs (1814 kg)
- Wrench, Torque (0 to 175 lb-ft [0-237 N•m]) (Item 5, Appendix E)

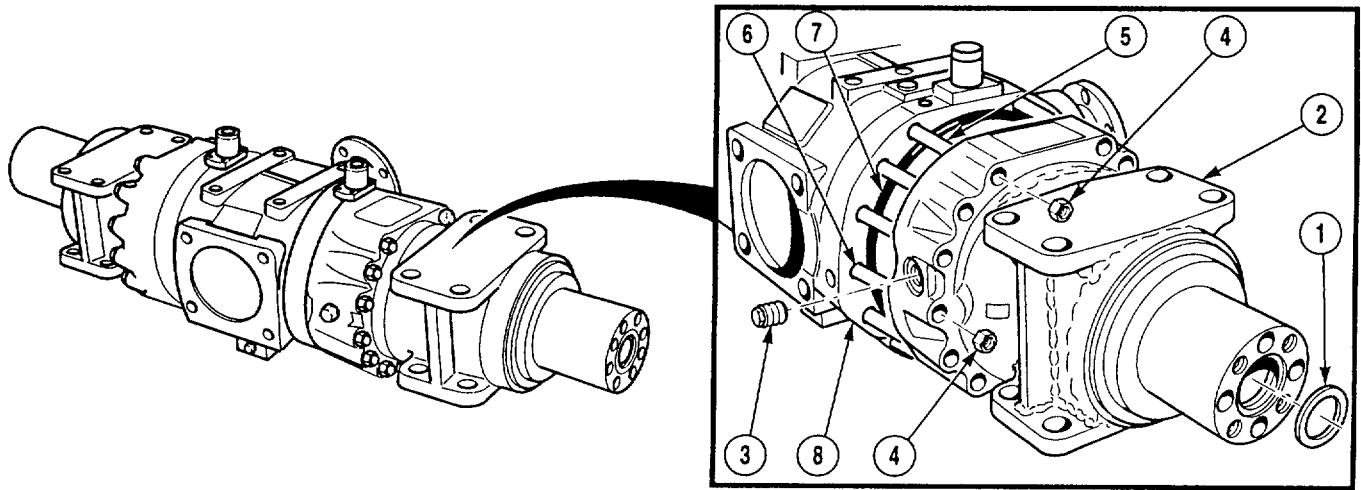
Materials Parts

- Gear Oil, Lubricating (Item 11, Appendix B)
- Loctite (Item 22, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)
- Seal

Equipment Condition

- Planetary hubs removed (Para 9-2)
- Drive axle removed (Para 10-2)

a. Removal



NOTE

Left and right axle housings are removed the same way. Left axle housing shown.

- (1) Remove seal (1) from axle housing assembly (2). Discard seal.
- (2) Remove plug (3) from axle housing assembly (2).

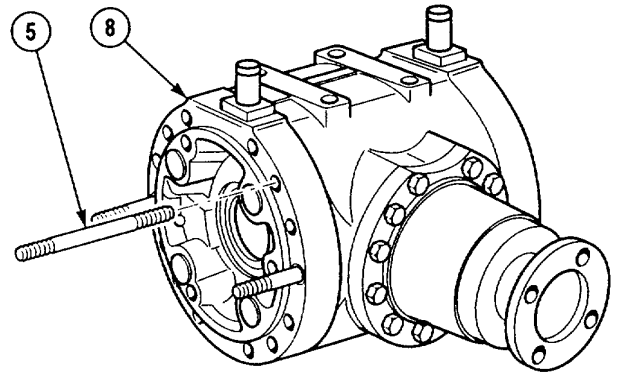
WARNING

Axle housing with brakes weighs 85 lbs (39 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

- (3) Remove fourteen nuts (4) from twelve studs (5) and two studs (6).
- (4) Remove axle housing assembly (2) and seal (7) from differential housing assembly (8). Discard seal.

10-3. AXLE HOUSING REPLACEMENT (CONT).

- (5) Remove twelve studs (5) from differential housing assembly (8).

**b. Cleaning/Inspection.****WARNING**

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (59°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

- (1) Clean all metal parts with dry-cleaning solvent.
- (2) Inspect all parts for wear, cracks, nicks, burrs, or scratches.
- (3) Replace all damaged parts.

c. *Installation.*

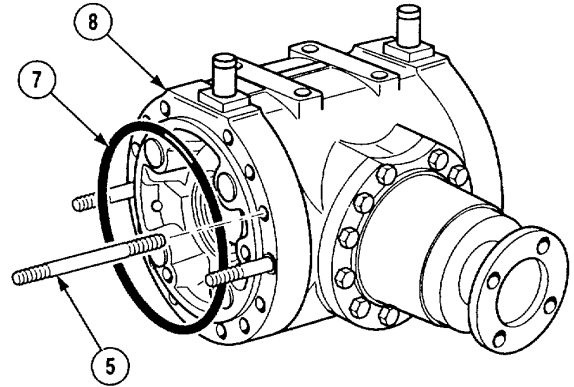
WARNING

Adhesive causes immediate bonding on contact with eyes, skin, or clothing and also gives off harmful vapors. Wear protective goggles and use in well-ventilated area. If adhesive gets in eyes, try to keep eyes open; flush eyes with water for 15 minutes and get immediate medical attention.

NOTE

Left and right axle housings are installed the same way. Left axle housing shown.

- (1) Apply sealing compound to twelve studs (5).
- (2) Install twelve studs (5) in differential housing assembly (8). Tighten to 63 lb-ft (86 N•m).
- (3) Coat seal (7) with lubricating oil.
- (4) Install seal (7) on differential housing assembly (8).



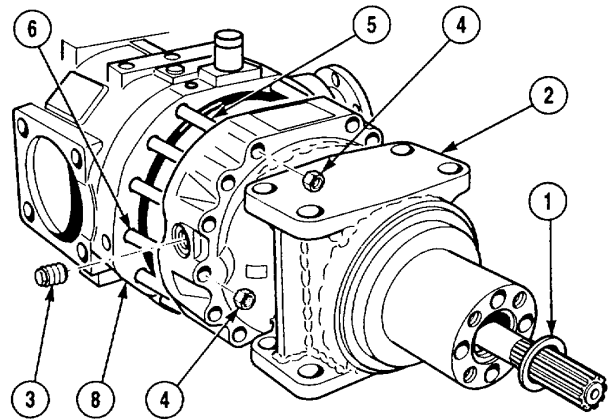
WARNING

Axle housing with brakes weighs 85 lbs (39 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

NOTE

Position axle in housing to align brake disks during assembly.

- (5) Position axle housing assembly (2) on differential housing assembly (8).
- (6) Apply sealing compound to twelve studs (5) and two studs (6).
- (7) Install fourteen nuts (4) on twelve studs (5) and two studs (6). Tighten to 63 lb-ft (86 N•m).
- (8) Install plug (3) in axle housing assembly (2).
- (9) Install seal (1) in axle housing assembly (2).



NOTE

Follow-on Maintenance:

- Install planetary hubs (Para 9-2).
- Install drive axle (Para 10-2).

END OF TASK

10-4. DIFFERENTIAL REPAIR..

This task covers:

- | | | |
|----------------|------------------------|-----------------|
| a. Removal | c. Cleaning/Inspection | e. Installation |
| b. Disassembly | d. Assembly | |

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Lifting, Chain
- Depth Gauge, Micrometer (Item 5, Appendix E)
- Indicator, Dial Set w/Magnetic Base (Item 5, Appendix E)
- Lifting Device, Minimum Capacity 3000 lbs (1814 kg)
- Micrometer, Outside, Caliper, Set (Item 5, Appendix E)
- Press, 60 ton (Item 5, Appendix E)
- Puller (Item 5, Appendix E)
- Puller (Item 5, Appendix E)
- Rule, Steel, Machinist (Item 5, Appendix E)
- Wrench, Spanner (Item 19, Appendix E)
- Wrench, Spanner (Item 34, Appendix E)
- Wrench, Pinion (Item 35, Appendix E)
- Wrench, Torque (0-60 lb-ft) (Item 12, Appendix E)
- Wrench, Torque (0 to 175 lb-ft [0-237 N•m]) (Item 5, Appendix E)
- Wrench, Torque (0 to 600 lb-ft [0-814 N•m]) (Item 5, Appendix E)

Materials/Parts

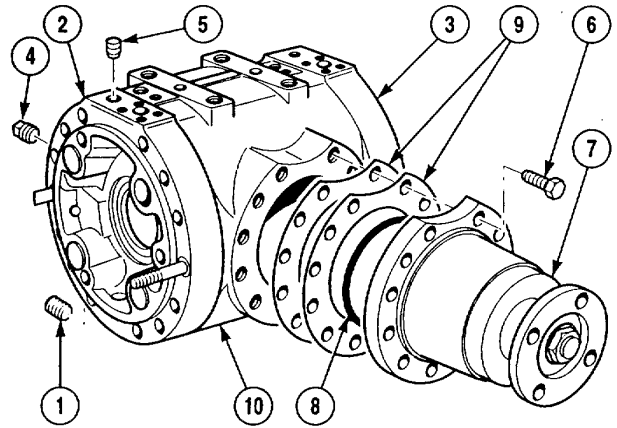
- Loctite (Item 22, Appendix B)
- Oil, Lubricating (Item 15, Appendix B)
- Rags, Wiping (Item 19, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)
- Lock
- Roll Pin (3)
- Seal (2)
- Seal (2)
- Seal
- Seal
- Seal
- Seal
- Shim Kit
- Shim Kit

Equipment Condition

- Drive axle removed (Para 10-2)
- Planetary hubs removed (Para 9-2)
- Axle housing removed (Para 10-3)
- Brakes removed (Para 11-2)

a. Removal.

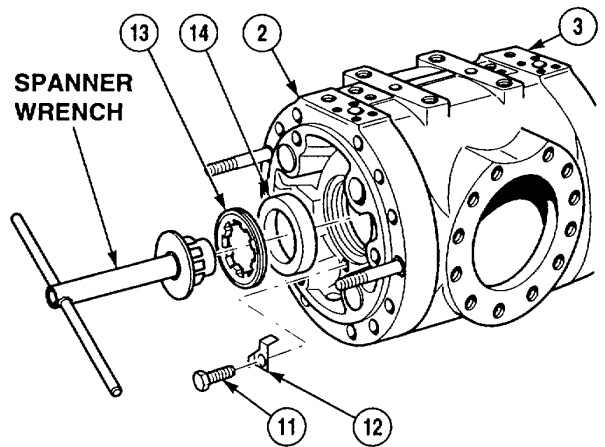
- (1) Remove fill plug (1) from left intermediate cover (2) and right intermediate cover (3).
- (2) Remove fill plug (4) from left intermediate cover (2).
- (3) Remove plug (5) from left intermediate cover (2).
- (4) Remove twelve screws (6), pinion assembly (7), seal (8), and shims (9) from differential housing (10). Discard seal.



NOTE

Note position of ring nuts prior to removal.

- (5) Remove screw (11) and lock (12) from left intermediate cover (2) and right intermediate cover (3). Discard lock.
- (6) Using spanner wrench, remove ring nut (13) and bearing race (14) from left intermediate cover (2) and right intermediate cover (3).

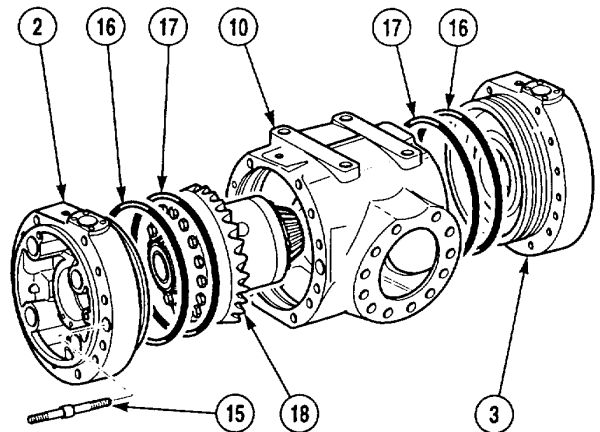


- (7) Remove four screws (15), left intermediate cover (2), right intermediate cover (3), two seals (16), and two seals (17) from differential housing (10). Discard seals.

NOTE

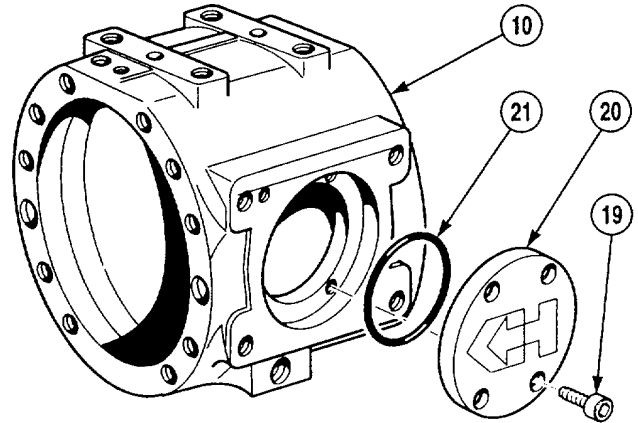
Note position of differential in housing prior to removal.

- (8) Remove differential (18) from differential housing (10).



10-4. DIFFERENTIAL REPAIR (CONT).

- (9) Remove four screws (19), cover (20), and seal (21) from differential housing (10). Discard seal.

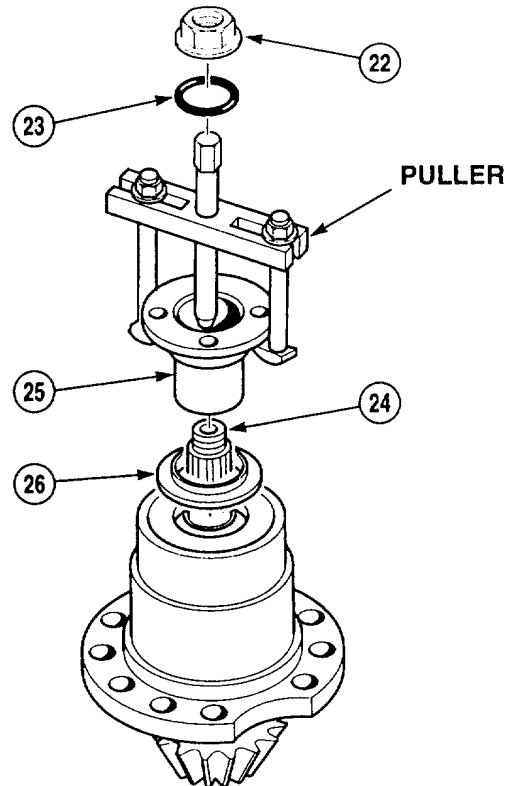


b. Disassembly.

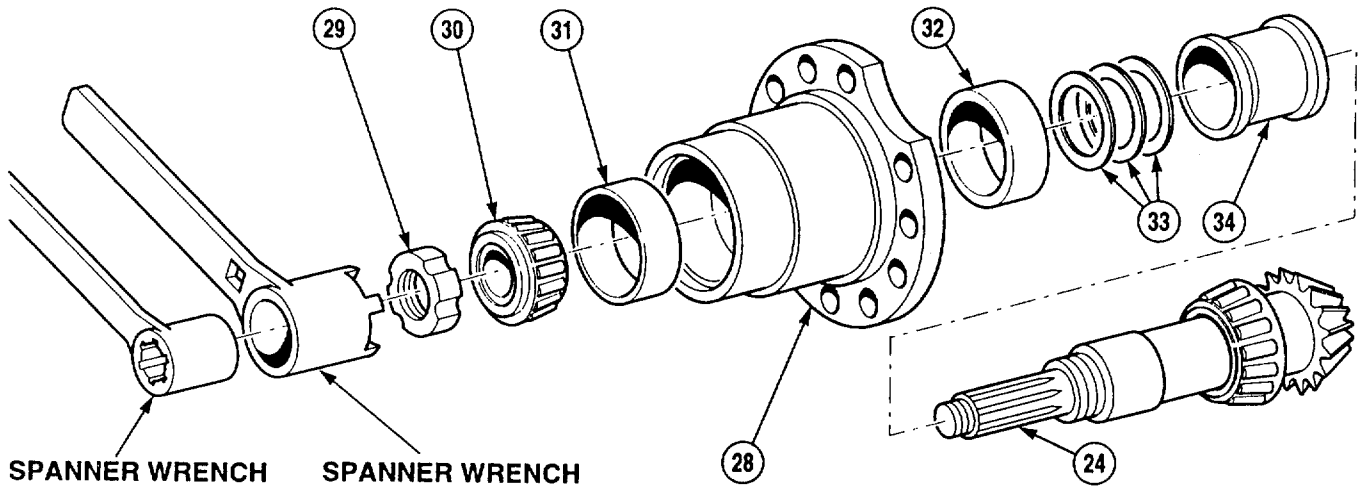
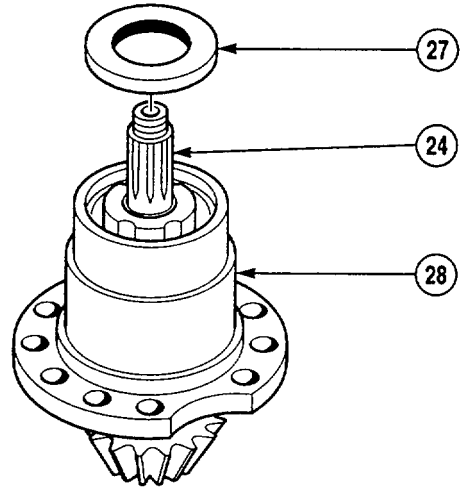
NOTE

Attach pinion assembly flange to work surface to prevent flange from turning during disassembly.

- (1) Remove nut (22) and seal (23) from pinion shaft (24). Discard seal.
- (2) Using a puller, remove flange (25) and cover plate (26) from pinion shaft (24).



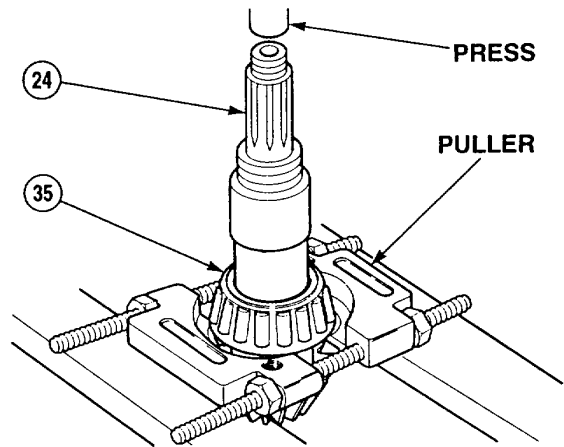
- (3) Remove pinion shaft front seal (27) from pinion shaft (24) and pinion shaft cover (28). Discard seal.



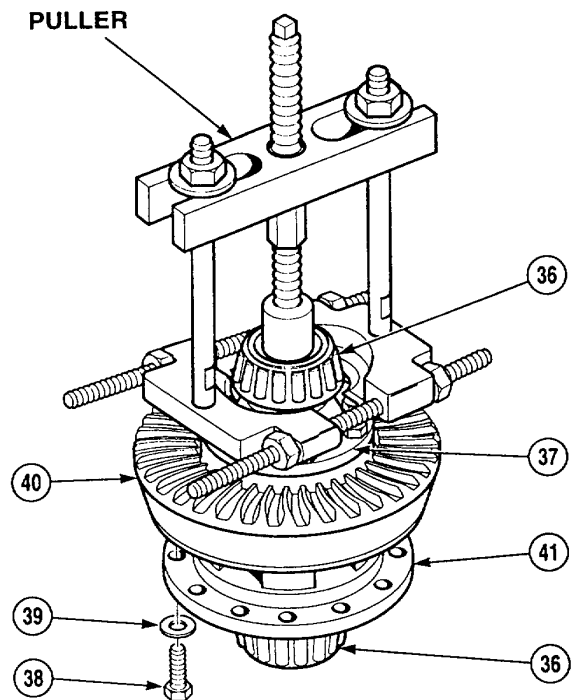
- (4) Using spanner wrenches, remove ring nut (29) from pinion shaft (24).
- (5) Remove pinion shaft cover (28) with bearing (30), bearing race (31), and bearing race (32) from pinion shaft (24).
- (6) Remove bearing (30) and bearing races (31 and 32) from pinion shaft cover (28).
- (7) Remove shims (33) and spacer (34) from pinion shaft (24).

10-4. DIFFERENTIAL REPAIR (CONT).

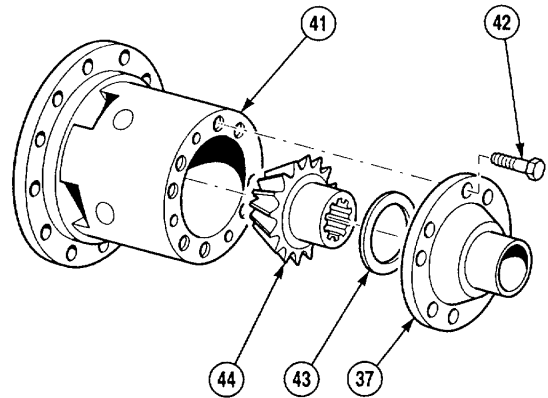
- (8) Using press and puller, remove bearing (35) from pinion shaft (24).



- (9) Using a puller, remove bearing (36) from differential cover (37).
- (10) Remove sixteen screws (38), spring washers (39), and bevel ring gear (40) from differential case (41).
- (11) Using a puller, remove bearing (36) from differential case (41).



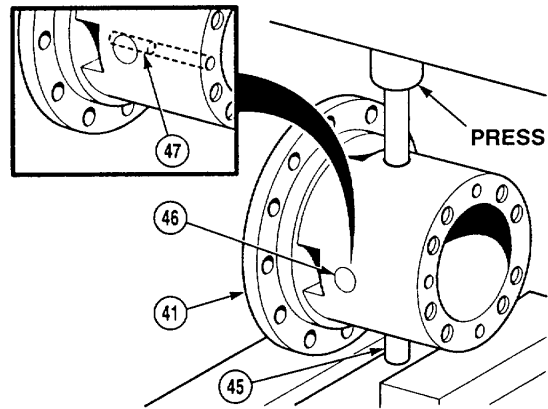
- (12) Remove eight screws (42) and differential cover (37) from differential case (41).
- (13) Remove washer (43) and side gear (44) from differential case (41).



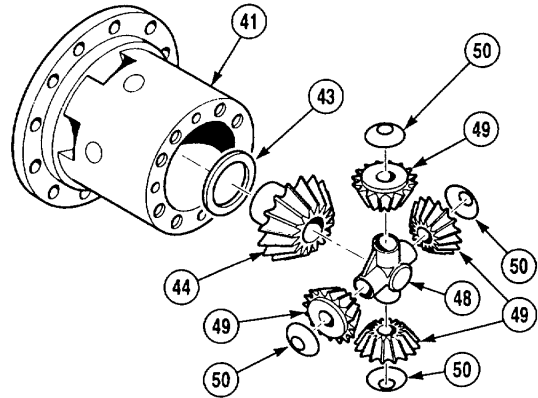
NOTE

Three roll pins will be sheered off during differential pinion pin removal.

- (14) Using press, remove pin (45), two pins (46), and three roll pins (47) from differential case (41).

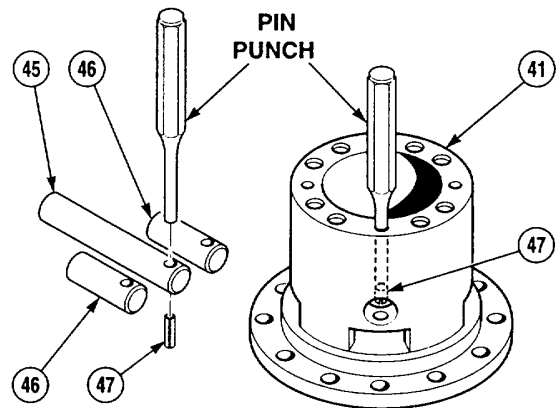


- (15) Remove shaft retainer (48), four differential pinions (49), and friction washers (50) from differential case (41).
- (16) Remove side gear (44) and washer (43) from differential case (41).



10-4. DIFFERENTIAL REPAIR (CONT).

- (17) Using pin punch, remove roll pin (47) pieces from differential case (41), pin (45), and two pins (46). Discard roll pin pieces.

**c. Cleaning/Inspection.****WARNING**

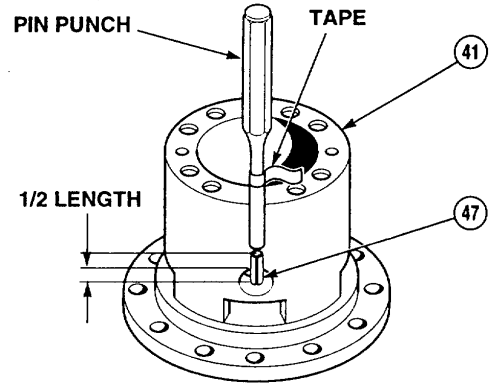
- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
- **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**
 - (1) Clean all metal parts with dry-cleaning solvent.
 - (2) Inspect all parts for breaks, cracks, burrs, and sharp edges.
 - (3) Inspect all bearings for wear, scoring, and cracks.
 - (4) Inspect differential pinions for broken splines and wear.
 - (5) Inspect differential and bevel ring gear for broken splines and wear.
 - (6) Inspect side gears for broken splines and wear.
 - (7) Inspect pinion shaft for broken splines and wear.
 - (8) Replace all damaged parts.

d. Assembly.

NOTE

Prior to assembling components in the differential case, determine roll pin depth so half of roll pin is in differential case and half is in pin. Mark depth on the pin punch with tape.

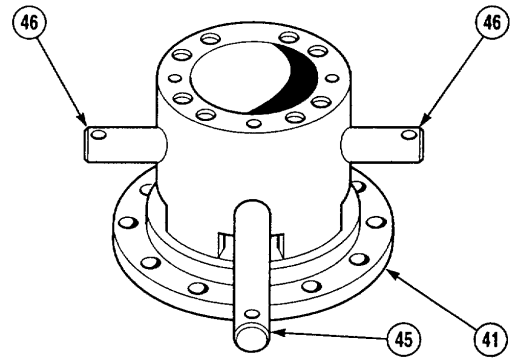
- (1) Mark pin punch at desired depth of roll pins (47) in differential case (41).



NOTE

Ensure that roll pin holes in pins align with those of the differential case during installation.

- (2) Install two pins (46) and pin (45) partially in differential case (41) until flush with inside of differential case (41).



10-4. DIFFERENTIAL REPAIR (CONT).

- (3) Install washer (43) and side gear (44) in differential case (41).

NOTE

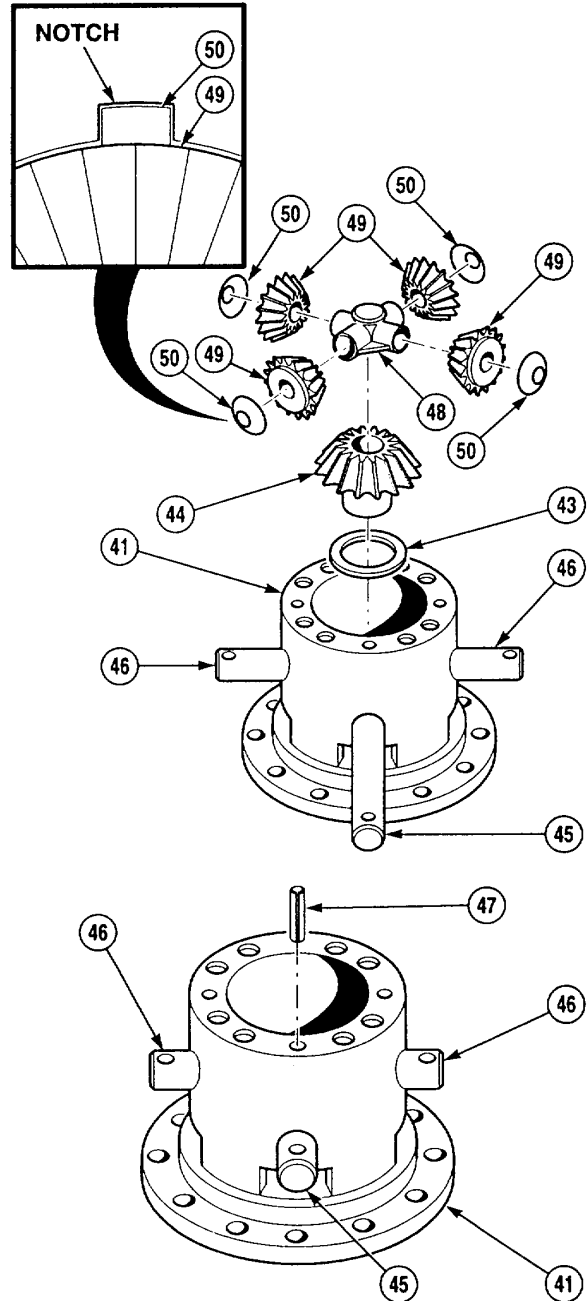
Ensure that the tab on each friction washer is aligned in the differential case notch to prevent it from spinning freely.

- (4) Install two friction washers (50) and differential pinions (49) in differential case (41) with two pins (46) until the end of the pin is flush with inner side of the two differential pinions.
- (5) Install third friction washer (50) and differential pinion (49) in differential case (41) with pin (45) until pin is flush with inner side of third differential pinion.
- (6) Install fourth friction washer (50), differential pinion (49), and shaft retainer (48) in differential case (41) with pin (45) until pin passes through fourth friction washer.

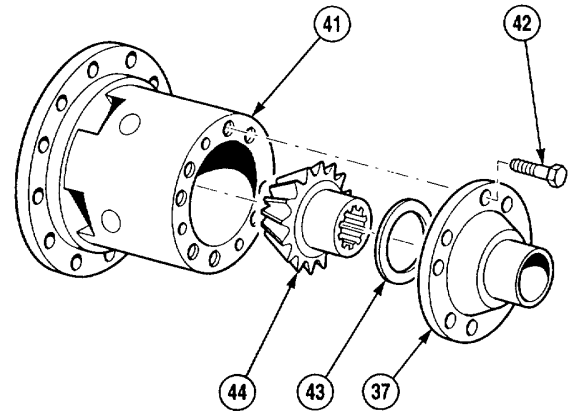
NOTE

Prior to final installation of pins, ensure roll pin holes in pins align with roll pin holes in differential case.

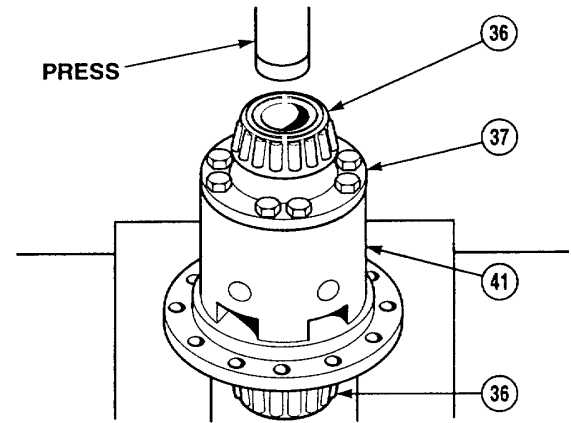
- (7) Install two pins (46) and pin (45) in differential case (41) with three roll pins (47).



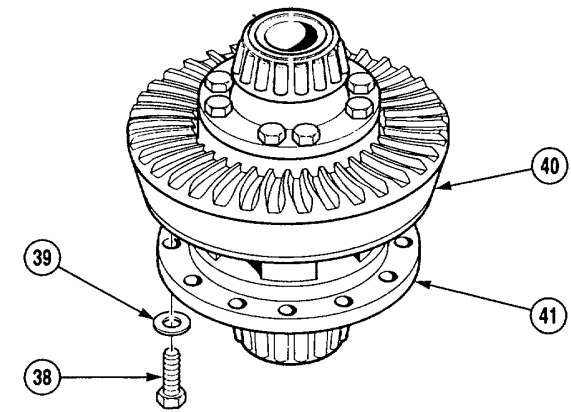
- (8) Install washer (43) and side gear (44) in differential cover (37).
- (9) Apply sealing compound to eight screws (42).
- (10) Install differential cover (37), with side gear (44), and washer (43), on differential case (41) with eight screws (42). Tighten eight screws to 66 lb-ft (89 N•m).



- (11) Using a press, install bearing (36) on differential cover (37).
- (12) Using a press, install bearing (36) on differential case (41).

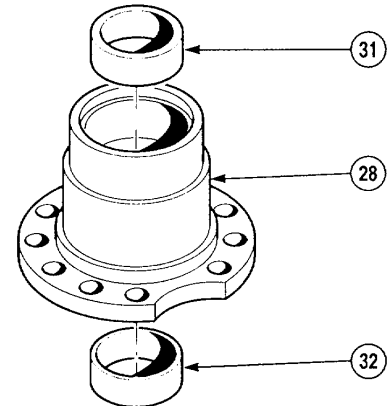


- (13) Apply sealing compound to sixteen screws (38).
- (14) Install bevel ring gear (40) on differential case (41) with sixteen screws (38) and spring washers (39). Tighten sixteen screws to 54 lb-ft (73 N•m).



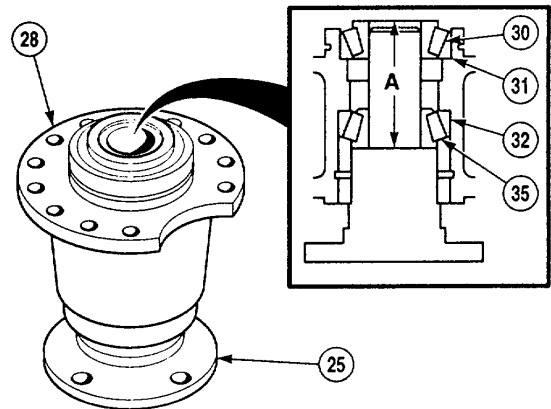
10-4. DIFFERENTIAL REPAIR (CONT).

- (15) Install two bearing races (31 and 32) in pinion shaft cover (28).



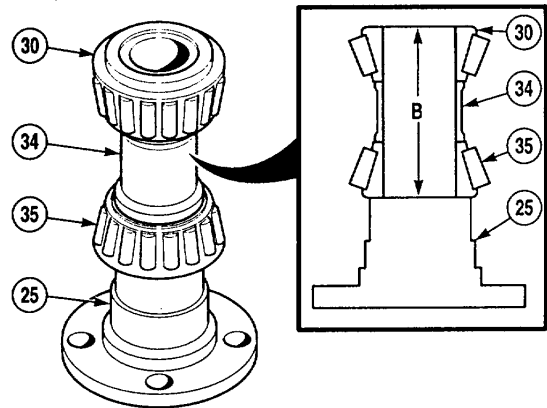
NOTE

The pinion shaft and pinion shaft cover must be assembled with a preload of 0.004-0.005 in. (0.10-0.12 mm). This must be determined prior to assembly of the pinion shaft and pinion shaft cover. Use pinion shaft flange as a support when measuring distances.

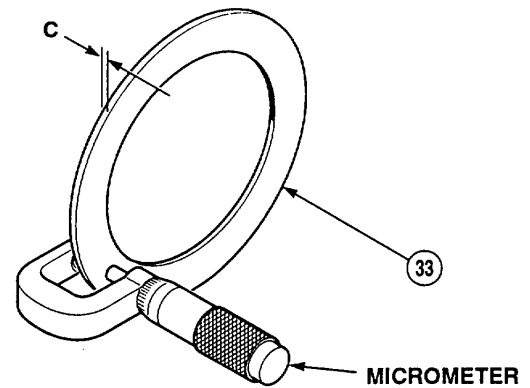


- (16) Position bearing (35), pinion shaft cover (28) with races (32 and 31), and bearing (30) on flange (25).
- (17) Using a depth gauge, measure the distance from the outside edge of bearing (35) to the outside edge of bearing (30). Record this measurement as Distance A.
- (18) Remove bearing (30) and pinion shaft cover (28) with bearing races (31 and 32) from bearing (35) and flange (25).

- (19) Position spacer (34) and bearing (30) on bearing (35) and flange (25).
- (20) Using a depth gauge, measure the distance from the outside edge of bearing (35) to the outside edge of bearing (30). Record this measurement as Distance B.



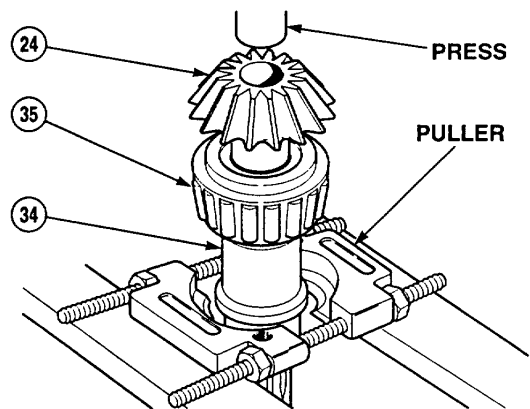
- (21) Subtract Distance B from Distance A to determine the shim thickness required. Record this difference as Distance C.
- (22) Using a micrometer to measure each shim (33), add shims together until the combined thickness equals Distance C \pm .004-.005 in. (\pm 0.10-0.12 mm).



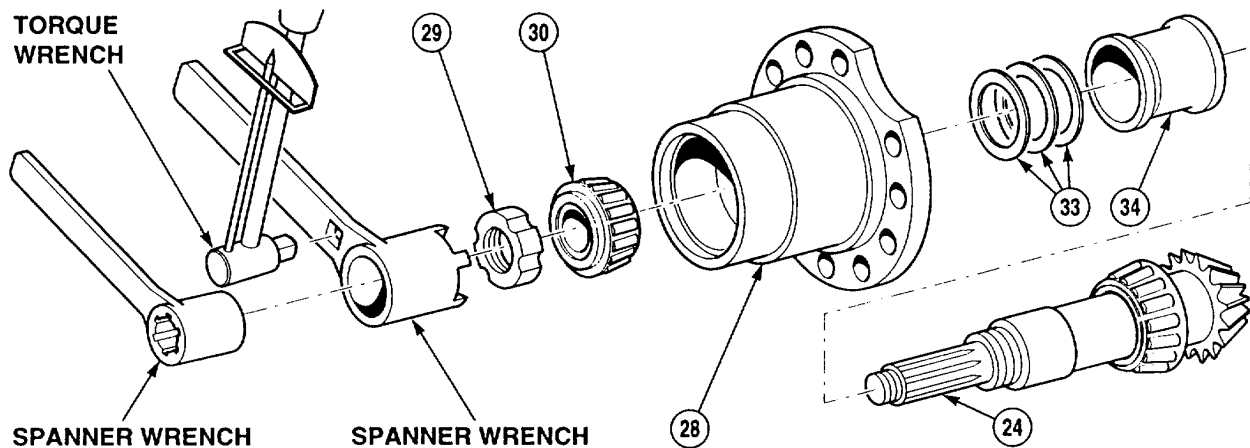
NOTE

Use pinion shaft spacer to direct force of press on inner race of bearing during installation.

- (23) Using press, gear puller, and spacer (34), install bearing (35) on pinion shaft (24).



10-4. DIFFERENTIAL REPAIR (CONT).



NOTE

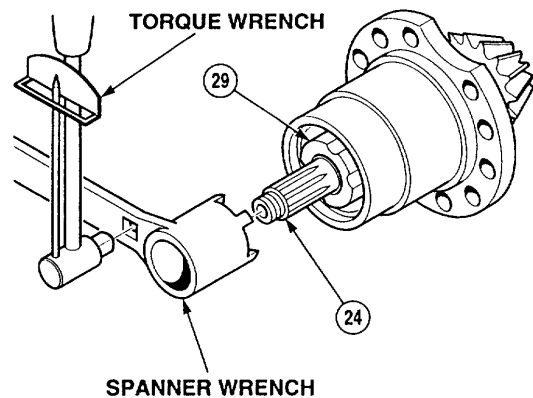
The number of shims to install will be those selected to equal Distance C, ± 0.004 - 0.005 in. (± 0.10 - 0.12 mm), in Step (22).

- (24) Position spacer (34), shims (33), and pinion shaft cover (28) on pinion shaft (24).
- (25) Apply sealing compound to ring nut (29).
- (26) Using spanner wrench, spanner wrench, and torque wrench, install bearing (30) and ring nut (29) on pinion shaft (24). Tighten ring nut to 443 to 516 lb-ft (600-700 N•m).

NOTE

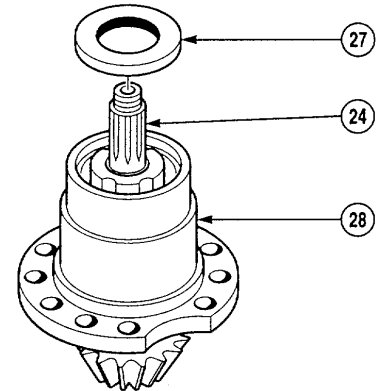
- A rotation torque test will be performed prior to installing the seal. The rotation torque should be 89 to 125 lb-ft (120-170 N•m).
- Attach pinion shaft cover to work surface to prevent movement during rotation torque test.

- (27) Using a torque wrench and spanner wrench on ring nut (29), measure the rotation torque required to turn pinion shaft (24).



NOTE

- If rotation torque measurement is correct, proceed to Step (28).
- If rotation torque measurement is not correct, perform Disassembly Step (4). Add or remove shims, as required, and perform Assembly Steps (24) through (27).

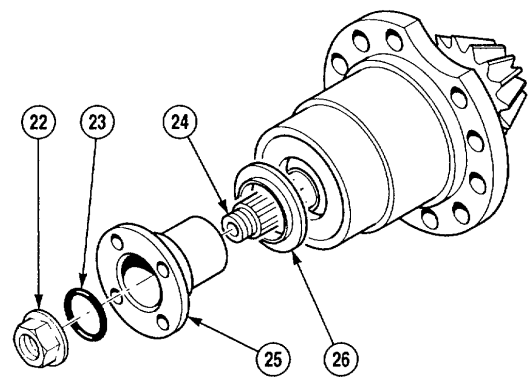


- (28) Install seal (27) on pinion shaft (24) and pinion shaft cover (28).
- (29) Apply sealing compound to nut (22).
- (30) Position cover plate (26), flange (25), seal (23), and nut (22) on pinion shaft (24).

NOTE

Attach pinion assembly and flange to work surface to prevent flange from turning when tightening the nut.

- (31) Tighten nut (22) to 63 to 66 lb-ft (86-89 N•m).



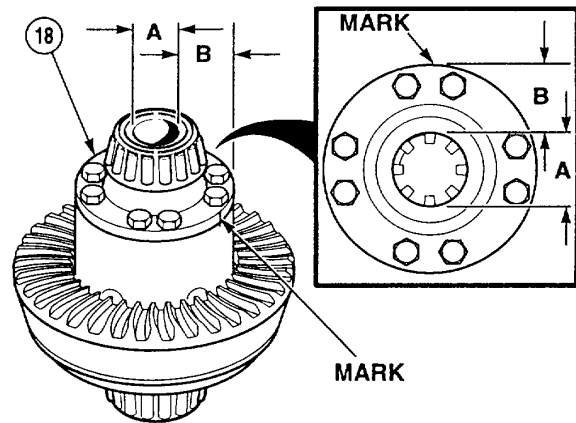
10-4. DIFFERENTIAL REPAIR (CONT).

e. Installation.

NOTE

- Shims will be placed on the pinion shaft assembly during installation to place end of pinion shaft assembly at the correct distance from centerline of the differential. This distance must be 4.4 in. (112 mm).
- Perform all measurements required to determine the shims to be installed with the pinion shaft cover prior to installing components in the differential housing.

- (1) Measure inside shaft diameter of differential (18). Designate this distance as Distance A.
- (2) Mark a point on the outside diameter of differential (18).
- (3) Measure the radius distance from the inside shaft diameter to the mark point on the outside diameter of differential (18). Designate this distance as Distance B.

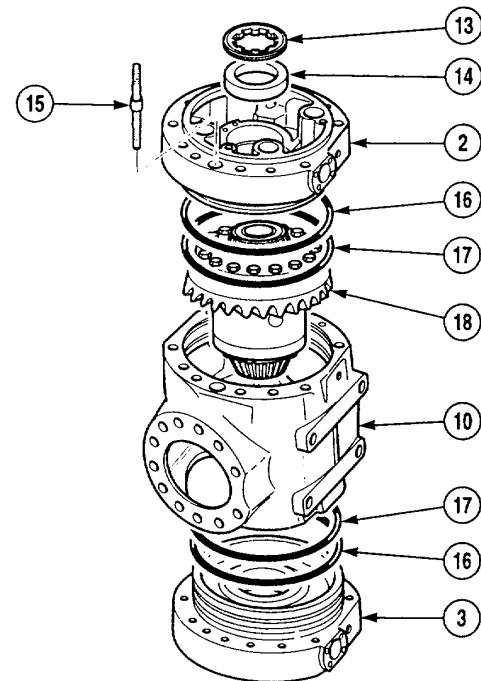


- (4) Apply lubricating oil to two seals (17) and two seals (16).
- (5) Install seal (17) and seal (16) on right intermediate cover (3) and left intermediate cover (2).
- (6) Position bearing race (14) and ring nut (13) in right intermediate cover (3) as noted during removal.

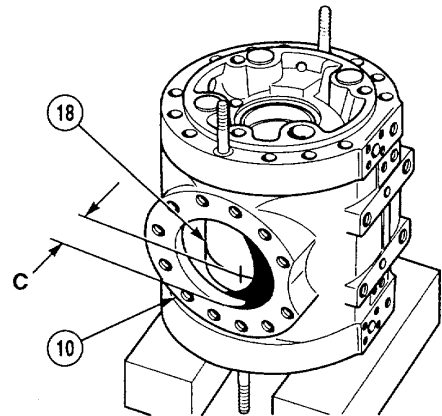
CAUTION

Use care when placing differential inside differential housing or damage to equipment could result.

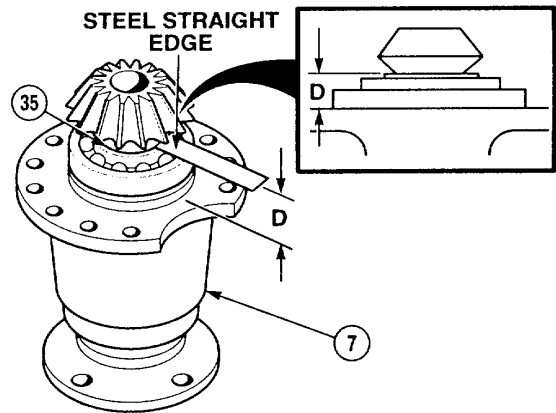
- (7) Install right intermediate cover (3), differential (18), and left intermediate cover (2) on differential housing (10) with four screws (15).
- (8) Position bearing race (14) and ring nut (13) in left intermediate cover (2) as noted during removal.



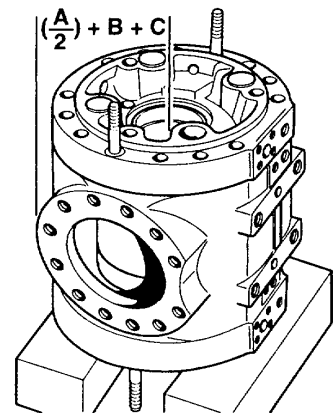
- (9) Measure the closest distance between the point marked on the differential (18) in Step (2) and the machined outside surface of the differential housing (10). Designate this distance as Distance C.



- (10) Place a steel straight edge on the surface of the inner bearing race of bearing (35) and measure the distance from the inner bearing race to the machined surface of the pinion assembly (7). Designate this distance as Distance D.

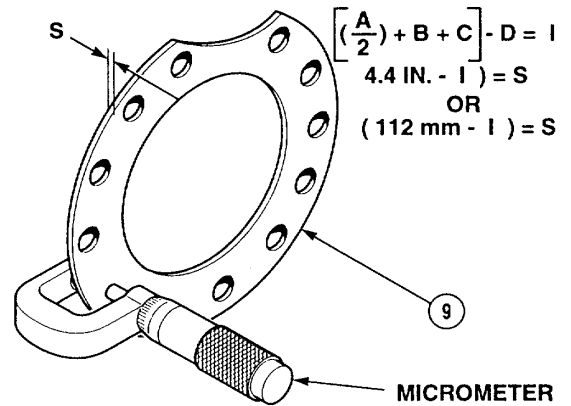


- (11) Divide Distance A by two to determine the inner radius.
- (12) Add the answer to Step (11), Distance B, and Distance C to determine the distance from differential centerline to the machined surface on the differential housing.

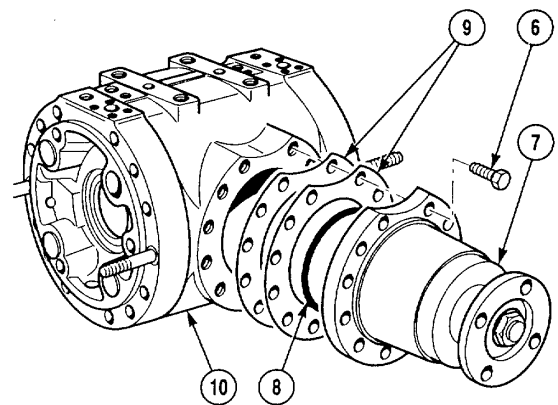


10-4. DIFFERENTIAL REPAIR (CONT).

- (13) Subtract Distance D from the sum determined in Step (12). Record this difference as Distance I.
- (14) Subtract Distance I from 4.4 in. (112 mm) to determine total shim thickness. Record this difference as Distance S.
- (15) Measure and assemble shims (9) until total thickness equals Distance S.



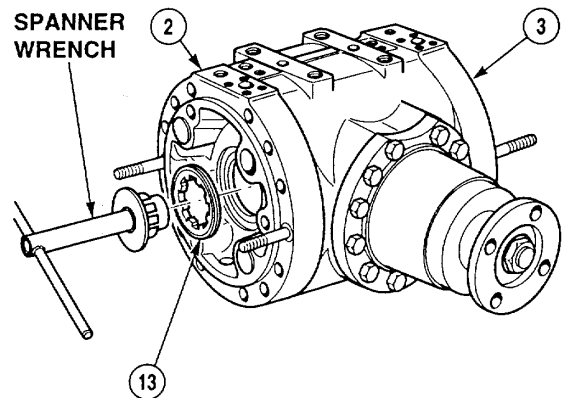
- (16) Apply lubricating oil to seal (8).
- (17) Install seal (8) on pinion assembly (7).
- (18) Apply sealing compound to twelve screws (6).
- (19) Install shims (9) and pinion assembly (7) on differential housing (10) with twelve screws (6). Tighten screws to 63 to 66 lb-ft (86-89 N•m).



NOTE

Left and right bearing race and ring nuts are installed the same way. Left bearing race and ring nut are shown.

- (20) Using a spanner wrench, remove two ring nuts (13) from left intermediate cover (2) and right intermediate cover (3).



- (21) Install magnetic base micrometer on differential housing (10).

NOTE

The sealing compound starts to harden in about 20 minutes.

- (22) Apply sealing compound to two ring nuts (13).

NOTE

Backlash is the distance a tooth of a differential gear moves between two teeth of a stationary pinion shaft gear.

- (23) Using a spanner wrench, install ring nut (13) in left intermediate cover (2) and right intermediate cover (3). Tighten to obtain 0.006 to 0.007 in. (0.15-0.18 mm) backlash.

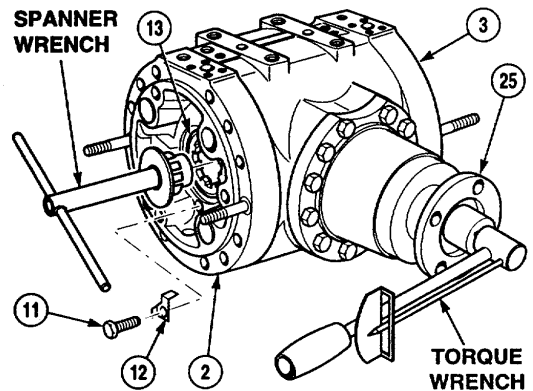
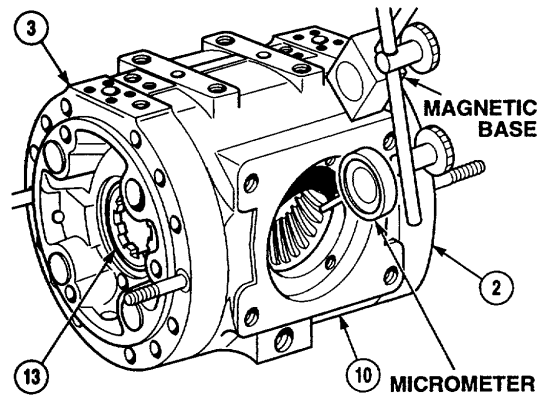
- (24) Measure rotating torque of pinion shaft flange (25). Record measurement.

- (25) Using spanner wrench, tighten ring nut (13) in right intermediate cover (3) until rotating torque rises 3 to 4 lb-in (0.35-0.45 N•m) above the measurement recorded in Step (24).

NOTE

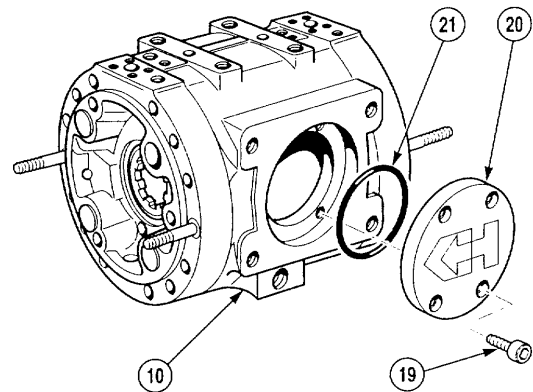
The spanner wrench can be used to adjust ring nuts slightly while installing locks. Rotating torque must remain within torque range given.

- (26) Install lock (12) with screw (11) on intermediate covers (2 and 3), and bend tabs of locks onto ring nuts (13).

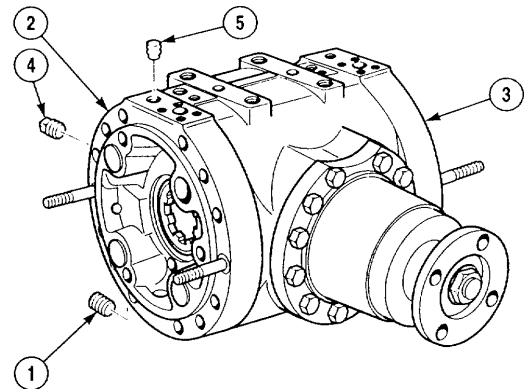


10-4. DIFFERENTIAL REPAIR (CONT).

- (27) Coat seal (21) with lubricating oil.
- (28) Install seal (21) in cover (20).
- (29) Install cover (20) on differential housing (10) with four screws (19). Tighten screws to 18 lb-ft (25 N•m).



- (30) Install plug (5) on left intermediate cover (2).
- (31) Install fill plug (1) in left intermediate cover (2) and right intermediate cover (3).
- (32) Install fill plug (4) in left intermediate cover (2).

**NOTE****Follow-on Maintenance:**

- Install brakes (Para 11-2).
- Install axle housings (Para 10-3).
- Install planetary hubs (Para 9-2).
- Install drive axle (Para 10-2).

END OF TASK

10-5. STEER AXLE ASSEMBLY REPLACEMENT.

This task covers:

- a. Removal b. Cleaning/Inspection c. Assembly

INITIAL SETUP*Tools and Special Tools*

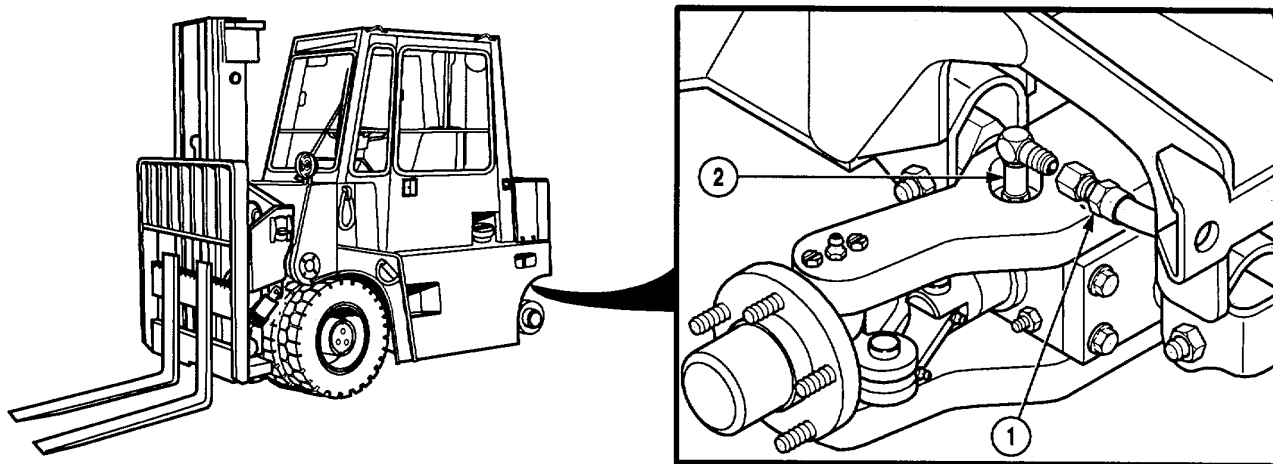
Tool Kit, General Mechanic's: Automotive
 (Item 1, Appendix E)
 Jack (Item 17, Appendix E)
 Lifting Device, Minimum Capacity 3000 lbs
 (1814 kg)
 Press, 60 Ton (Item 5, Appendix E)
 Puller (Item 5, Appendix E)
 Wrench, Torque (0 to 600 lb-ft [0-814 N•m])
 (Item 5, Appendix E)

Materials /Parts

Cap and Plug Set (Item 5, Appendix B)
 Solvent, Dry-cleaning (Item 20, Appendix B)
 Tags, Identification (Item 21, Appendix B)
 Bushing (2)

Equipment Condition

Engine OFF (TM 10-3930-669-10)
 Parking brake applied (TM 10-3930-669-10)
 Wheels chocked (TM 10-3930-669-10)
 Batteries disconnected (TM 10-3930-669-20)
 Wheels removed (TM 10-3930-669-20)

a. Removal**NOTE**

- Tag and mark hoses and fittings prior to removal.
- Cap and plug hoses and fittings during removal.
- Left side and right side hoses are removed the same way. Left side shown.

(1) Disconnect hose (1) from fitting (2).

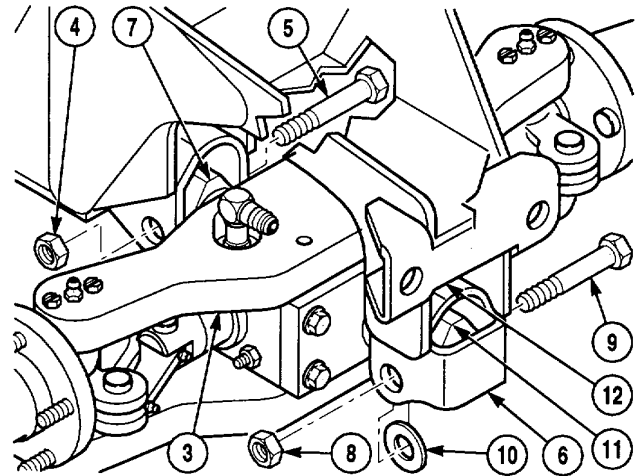
10-5. STEER AXLE ASSEMBLY REPLACEMENT (CONT).**WARNING**

Steer axle weighs 232 lbs (105 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

NOTE

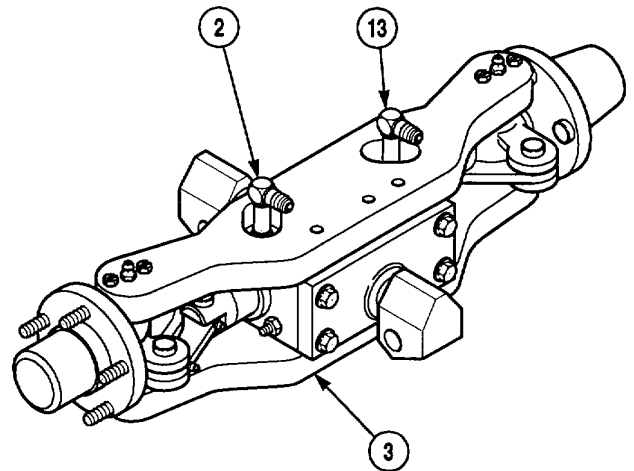
Shims may be present between frame sockets and silent blocks of both front and rear. Note location and number.

- (2) Place floor jack under steer axle (3).
- (3) Remove nut (4) and screw (5) from frame socket (6) and front silent block (7).
- (4) Remove nut (8), screw (9), and shim (10) from frame socket (6) and rear silent block (11).
- (5) Using floor jack, lower steer axle (3) and remove from frame (12).

**WARNING**

Steer axle weighs 232 lbs (105 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

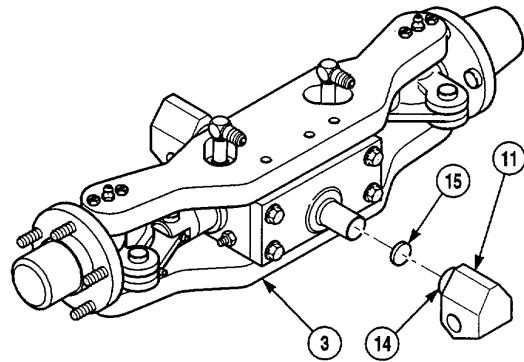
- (6) Attach lifting device to steer axle (3).
- (7) Place steer axle (3) on smooth work surface with fittings (2 and 13) in up position.
- (8) Remove lifting device from steer axle (3).



NOTE

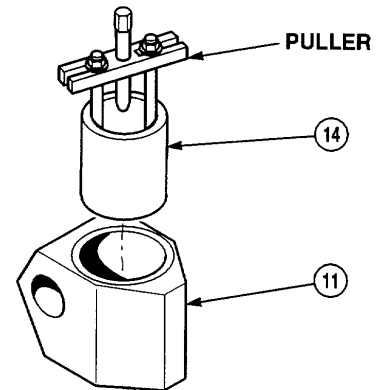
Front and rear silent blocks are removed from steer axle the same way. Rear silent block shown.

- (9) Remove rear silent block (11), with bushing (14) and spacer (15), from steer axle (3).

**NOTE**

Front and rear silent block bushing are removed the same way. Rear silent block shown.

- (10) Using a puller, remove bushing (14) from rear silent block (11). Discard bushing.

**b. Cleaning/Inspection.****WARNING**

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

- (1) Clean all parts in dry-cleaning solvent. Allow to air dry.
- (2) Inspect the bushings for scratches, cracks, glazing, rust pitting, flat spots, and other wear.
- (3) Replace damaged parts or notify supervisor.

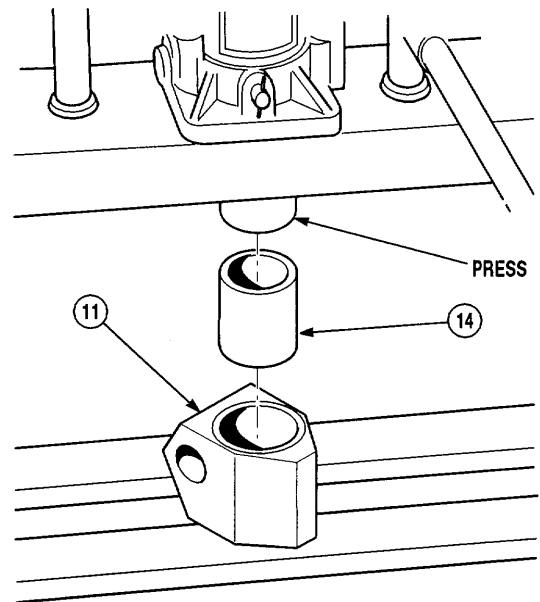
10-5. STEER AXLE ASSEMBLY REPLACEMENT (CONT).

c. Installation.

NOTE

Front and rear silent block bushings are installed the same way. Rear silent block shown.

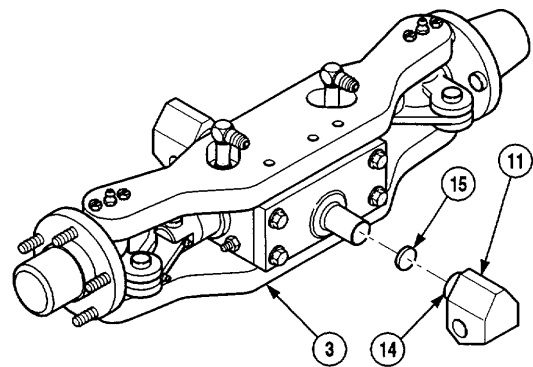
- (1) Using a press, install bushing (14) in rear silent block (11) to .322 in. (8 mm) minimum depth from end of casting.



NOTE

Front and rear silent blocks are installed the same way. Rear silent block shown.

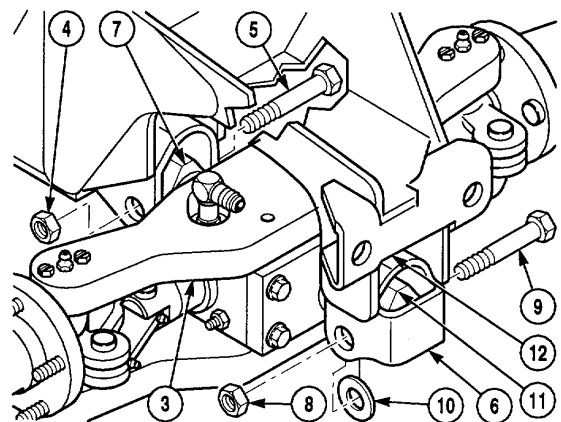
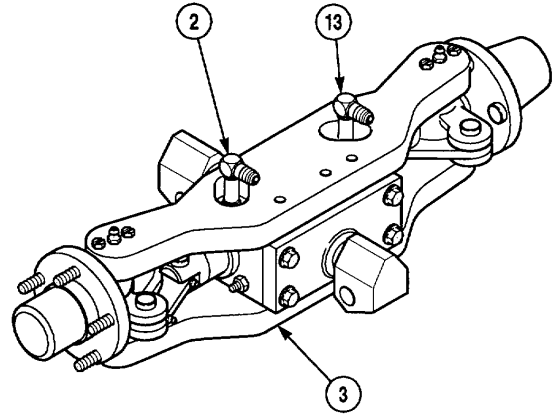
- (2) Install rear silent block (11), with bushing (14) and spacer (15), on steer axle (3).



WARNING

Steer axle weighs 232 lbs (105 kg). Attach lifting device prior to removal or installation to position steer axle on floor jack to prevent possible injury to personnel.

- (3) Attach lifting device to steer axle (3).
- (4) Place steer axle (3) on floor jack with two fittings (2 and 13) in the up position.
- (5) Remove lifting device from steer axle (3).
- (6) Raise the floor jack and position steer axle (3) under frame (12) until the front and rear silent blocks (7 and 11) are aligned with frame sockets (6).
- (7) Install front and rear silent blocks (7 and 11) in frame sockets (6) by slowly raising floor jack.
- (8) Install shim (10) between rear silent block (11) and frame socket (6).
- (9) Install frame socket (6) on rear silent block (11) with screw (9), shim (10), and nut (8).
- (10) Install frame socket (6) on front silent block (7) with screw (5) and nut (4).



NOTE

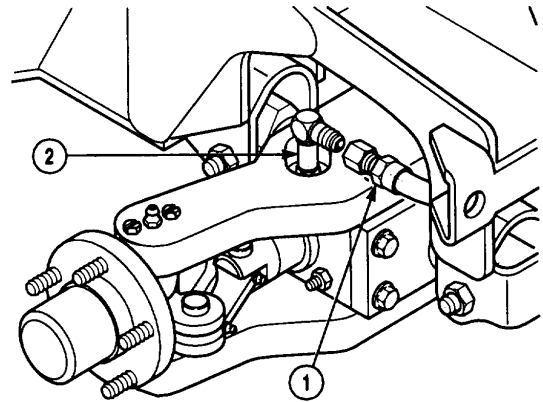
Do not perform Step (11) until all Follow-on Maintenance tasks are completed and normal weight of vehicle is on axle. Front and rear silent blocks are installed the same way. Rear silent block shown.

- (11) Tighten nuts (4 and 8) to 420 to 480 lb-ft (596-651 N•m).
- (12) Remove floor jack from steer axle (3).

10-5. STEER AXLE ASSEMBLY REPLACEMENT (CONT).**NOTE**

Left and right hoses are connected the same way. Left one shown.

(13) Connect hose (1) on fitting (2).

**NOTE****Follow-on Maintenance:**

- Install wheels (TM 10-3930-669-20).
- Connect batteries (TM 10-3930-669-20).
- Remove wheel chocks (TM 10-3930-669-10).
- Connect batteries (TM 10-3930-669-20).
- Perform Step 10-5.C.11 of this task.

END OF TASK

CHAPTER 11

BRAKE SYSTEM MAINTENANCE

Para	Contents	Page
11-1	Introduction.....	11-1
11-2	Brake Repair	11-2

11-1. INTRODUCTION.

This chapter contains maintenance instructions for disassembling and assembling service brake system components authorized by the Maintenance Allocation Chart (MAC) at the Direct Support and General Support Maintenance level.

11-2. BRAKE REPAIR.

This task covers:

- a. Removal b. Cleaning/Inspection c.. Assembly

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Lifting Device, Minimum Capacity 3000 lbs (1814 kg)
 Micrometer, Outside, Caliper, Set (Item 5, Appendix E)
 Wrench, Torque (0-60 N•m) (Item 12, Appendix E)

Materials/Parts

Compound, Sealing (Item 24, Appendix B)
 Oil, Lubricating (Item 15, Appendix B)
 Rags, Wiping (Item 19, Appendix B)

Materials/Parts - Continued

Solvent, Dry-cleaning (Item 20, Appendix B)
 Plug
 Seal
 Seal

Equipment Condition

Drive axle removed (Para 10-2)
 Planetary hubs removed (Para 9-2)
 Axle housings removed (Para 10-3)

a. Disassembly.

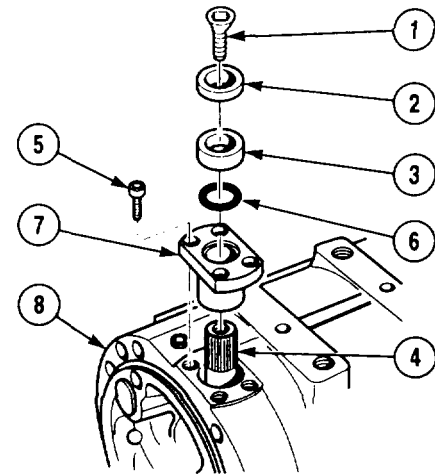
WARNING

Differential weighs 183 lbs (83 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

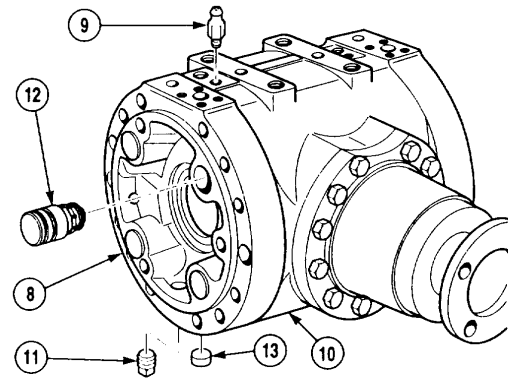
NOTE

- The left and right brakes are disassembled the same way. Left brake is shown.
- Note position of levers prior to removal.

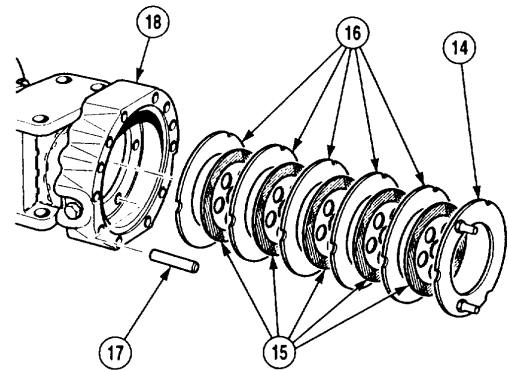
- (1) Remove screw (1), spacer (2), and spacer (3) from brake lever (4).
- (2) Remove four screws (5), seal (6), flange (7), and brake lever (4) from intermediate cover (8). Discard seal.



- (3) Remove brake bleed valve (9) from differential housing (10).
- (4) Remove magnetic plug (11) from intermediate cover (8).
- (5) Remove four pistons (12) from intermediate cover (8).
- (6) Remove plug (13) from intermediate cover (8). Discard plug.



- (7) Remove disk (14), five brake disks (15), and five steel brake disks (16) from three pins (17).
- (8) Remove three pins (17) from axle housing (18).



11-2. BRAKE REPAIR (CONT).

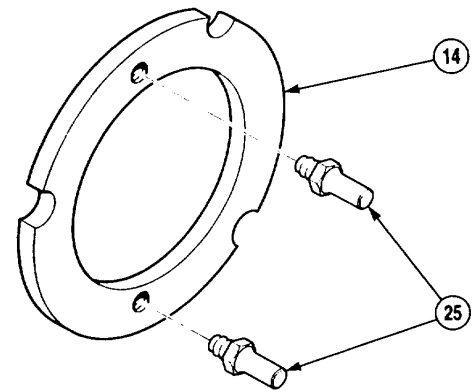
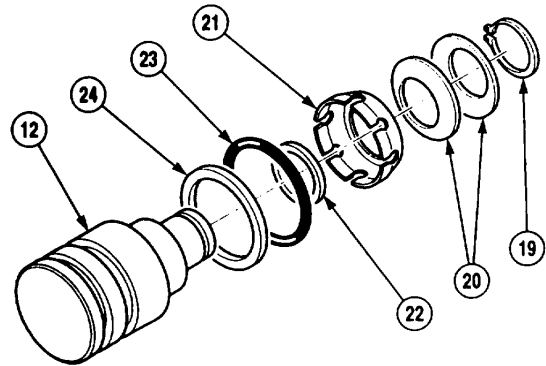
WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

NOTE

There are four piston assemblies in each intermediate cover. They are all disassembled the same way.

- (9) Remove retaining ring (19), two spring washers (20), cup spring (21), and spacer (22) from piston (12).
- (10) Remove seal (23) and backup ring (24) from piston (12). Discard seal.
- (11) Remove two pushers (25) from disk (14).

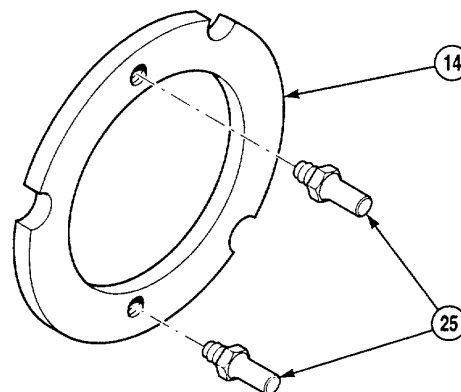


b. Cleaning/Inspection.**WARNING**

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
 - (1) Clean all metal parts with dry-cleaning solvent.
 - (2) Inspect metal parts for breaks, cracks, burrs, and sharp edges.
 - (3) Replace all damaged parts.

c. Assembly.

- (1) Install two pushers (25) on disk (14).
Tighten to 18 lb-ft (25 N•m).



11-2. BRAKE REPAIR (CONT).

NOTE

There are four piston assemblies in each intermediate cover. They are all assembled the same way.

- (2) Coat backup ring (24) and seal (23) with lubricating oil.
- (3) Install backup ring (24) and seal (23) on piston (12).

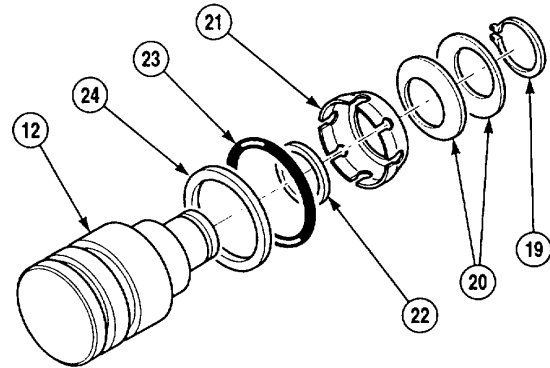
WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

NOTE

Ensure cup spring faces towards spacer.

- (4) Install spacer (22), cup spring (21), two spring washers (20), and retaining ring (19) on piston (12).

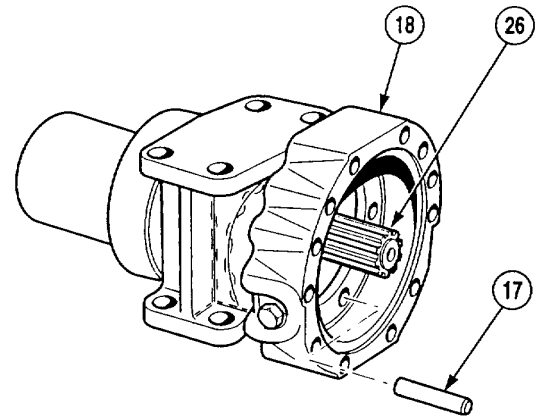


WARNING

Axle housing with brakes weighs 85 lbs (39 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

NOTE

The left and right brake assemblies are installed the same way. Left brake assembly is shown.



- (5) Install three pins (17) in axle housing (18).

NOTE

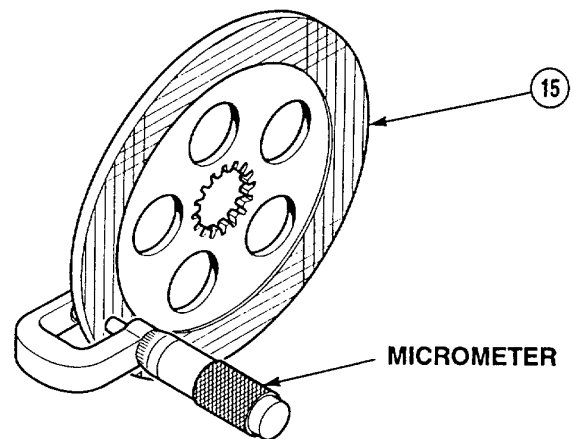
The axle is placed in the axle housing only to hold the brake disks in position during assembly.

- (6) Position axle (26) in axle housing (18).

NOTE

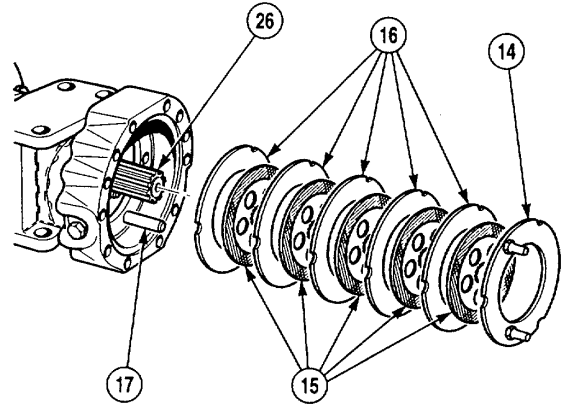
Perform Step (3) only if installing used brake disks. If installing new disks proceed to Step (4).

- (7) Using a micrometer, measure thickness of five brake disks (15). If measurement of any brake disk is less than .177 in. (4.5 mm), replace all five disks.



11-2. BRAKE REPAIR (CONT).

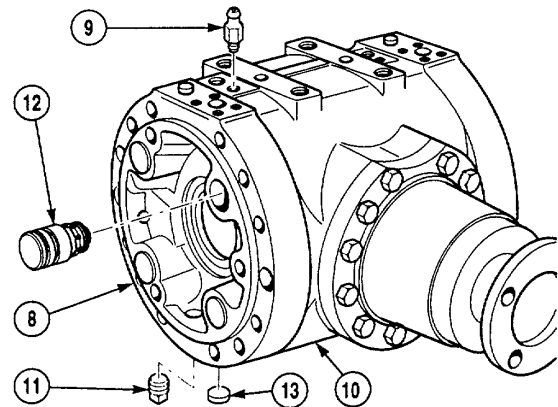
- (8) Install five steel brake disks (16), five brake disks (15), and disk (14) on three pins (17) and axle (26).



WARNING

Differential weighs 183 lbs (83 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

- (9) Install plug (13) in intermediate cover (8).
- (10) Install four piston assemblies (12) in intermediate cover (8).
- (11) Install magnetic plug (11) in intermediate cover (8).
- (12) Install brake bleed valve (9) in differential housing (10).

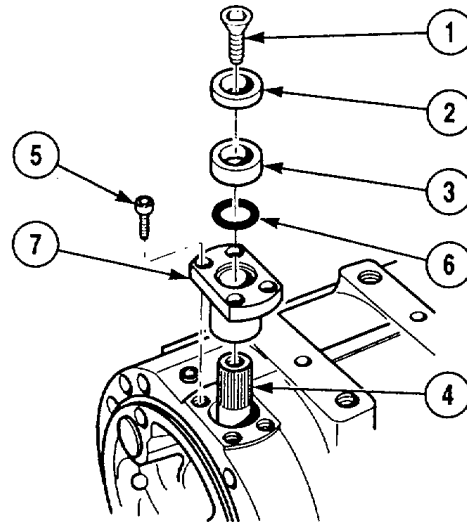


- (13) Install brake lever (4) and flange (7) with four screws (5). Tighten screws to 18 lb-ft (25 N•m).
- (14) Coat seal (6) with lubricating oil.
- (15) Install seal (6) and spacer (3) on brake lever (4).
- (16) Install spacer (2) and screw (1) on brake lever (4). Tighten to 18 lb-ft (25 N•m).

NOTE

Follow-on Maintenance:

- Install axle housing (Para 10-3).
- Install planetary hub (Para 9-2).
- Install drive axle (Para 10-2).
- Bleed service brakes (TM 10-3930-669-20).



END OF TASK

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CHAPTER 12

STEERING SYSTEM MAINTENANCE

Para	Contents	Page
12-1	Introduction.....	12-1
12-2	Tie Rod Arm Replacement.....	12-2
12-3	Steering Cylinder Replacement.....	12-5
12-4	Steering Cylinder Repair	12-9
12-5	Steering Control Pump Repair	12-15
12-6	Hub Repair	12-24

12-1. INTRODUCTION.

This chapter contains maintenance instructions for removing, replacing, repairing, and installing steering components authorized by the Maintenance Allocation Chart (MAC) at the Direct Support and General Support Maintenance level.

12-2. TIE ROD ARM REPLACEMENT.

This task covers:

a. Removal

b. Cleaning/Inspection

c. Installation

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)
Press, Arbor (Item 5, Appendix E)

Materials/Parts

Solvent, Dry-cleaning (Item 20, Appendix B)
Pin, Cotter

Equipment Condition

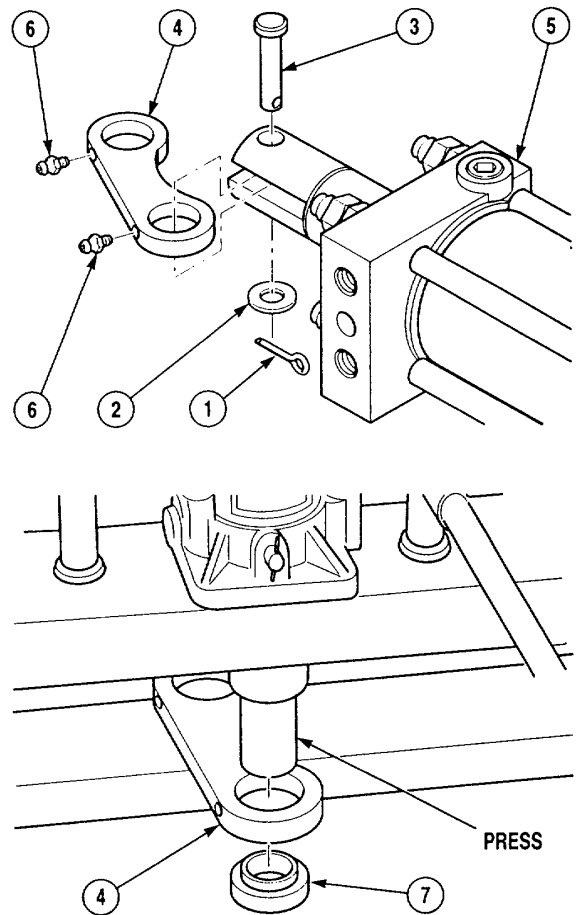
Steering cylinder removed (Para 12-3)

a. Removal

NOTE

Left and right tie rod arms are removed the same way. The left side is shown.

- (1) Remove cotter pin (1), washer (2), pin (3), and tie rod arm (4) from steering cylinder (5). Discard cotter pin.
- (2) Remove two grease fittings (6) from tie rod arm (4).
- (3) Using a press, remove two bearings (7) from tie rod arm (4).

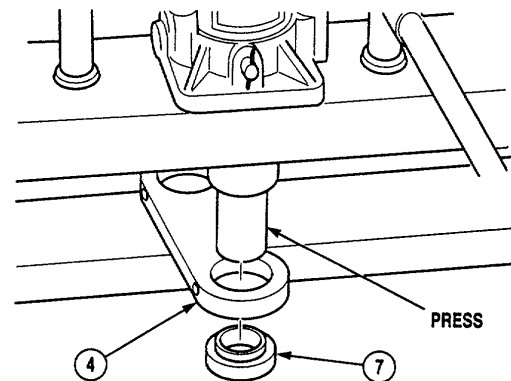


b. Cleaning/Inspection.**WARNING**

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
 - (1) Inspect the bearings for scratches, cracks, glazing, rust pitting, flat spots, and other wear.
 - (2) Inspect the tie rod arm for wear and damage.
 - (3) Replace damaged parts or notify supervisor.

c. Installation.

- (1) Using a press, install two bearings (7) in tie rod arm (4).

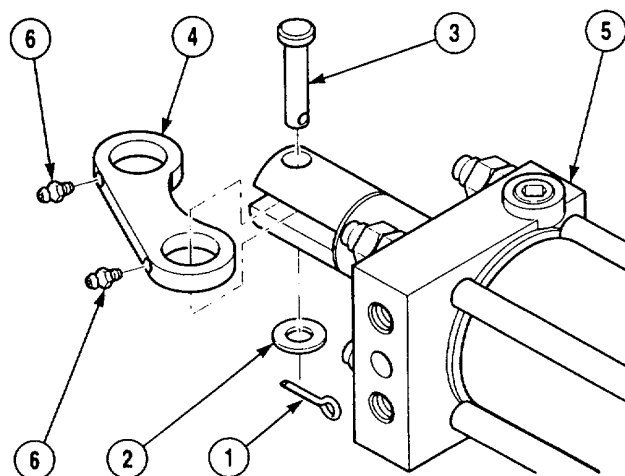


12-2. TIE ROD ARM REPLACEMENT (CONT).

- (2) Install two grease fittings (6) in tie rod arm (4).
- (3) Install tie rod arm (4), pin (3), washer (2), and cotter pin (1) on steering cylinder (5).

NOTE**Follow-on Maintenance:**

- Install steering cylinder (Para 12-3).

**END OF TASK**

12-3. STEERING CYLINDER REPLACEMENT.

This task covers:

- a. Removal b. Cleaning/Inspection c. Installation

INITIAL SETUP*Tools and Special Tools*

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)

Equipment Condition

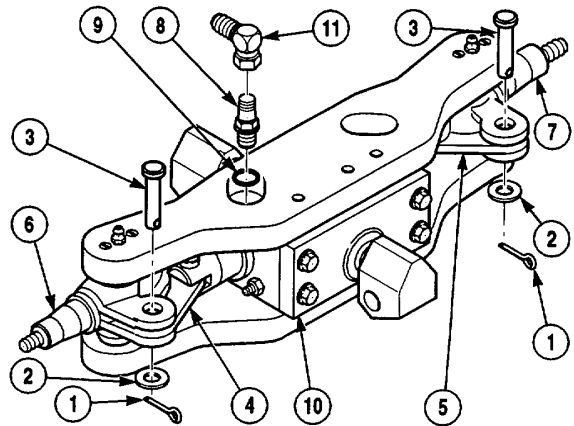
Steer axle assembly removed (Para 10-5)

Materials/Parts

Cap and Plug Set (Item 5, Appendix B)
Oil, Hydraulic (Item 15, Appendix B)
Solvent, Dry-cleaning (Item 20, Appendix B)
Packing, Preformed (2)
Pins, Cotter (4)
1/4 inch X 20 screw

a. Removal

- (1) Remove two cotter pins (1), washers (2), and pins (3) from left and right tie rod arms (4 and 5) and knuckles (6 and 7). Discard cotter pins.

**NOTE**

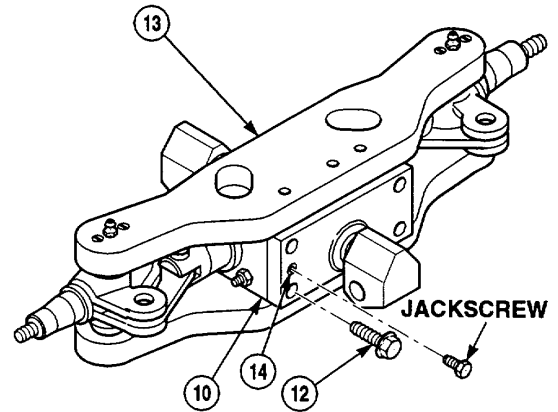
- **Note location and position of elbows prior to removal.**
 - **Oil will drain from steering cylinder upon removal of fittings. Cap and plug steering cylinder immediately upon removal of all fittings.**
- (2) Remove two fittings (8) and preformed packings (9) from steering cylinder (10). Discard preformed packings.
- (3) Remove two elbows (11) from fittings (8).

12-3. STEERING CYLINDER REPLACEMENT (CONT).

NOTE

- **Steering cylinder must be removed from right side of steer axle.**
- **Ensure steering cylinder clears locator pin before removal.**

(4) Remove four screws (12) and steering cylinder (10) from steer axle (13).

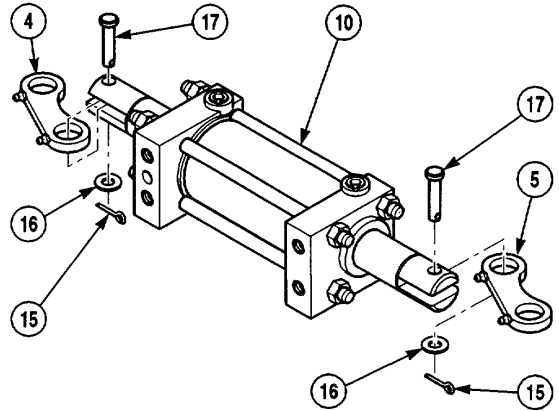


NOTE

Note position of locator pin prior to removal.

(5) Using a 1/4 inch X 20 screw as a jackscrew, install on steer axle (13) and remove locator pin (14) from steering cylinder (10).

(6) Remove two cotter pins (15), washers (16), pins (17), and left and right tie rod arms (4 and 5) from steering cylinder (10). Discard cotter pins.

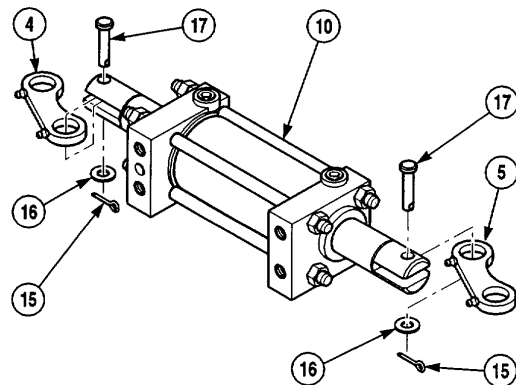


b. Cleaning/Inspection.**WARNING**

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
 - (1) Clean all parts in dry-cleaning solvent. Allow to air dry.
 - (2) Inspect bearings and bearing cups for scratches, cracks, glazing, rust pitting, flat spots, and other wear.
 - (3) Inspect tie rod arm for wear and damage.
 - (4) Inspect steering cylinder for any evidence of external damage.
 - (5) Replace damaged parts or notify supervisor.

c. Installation.

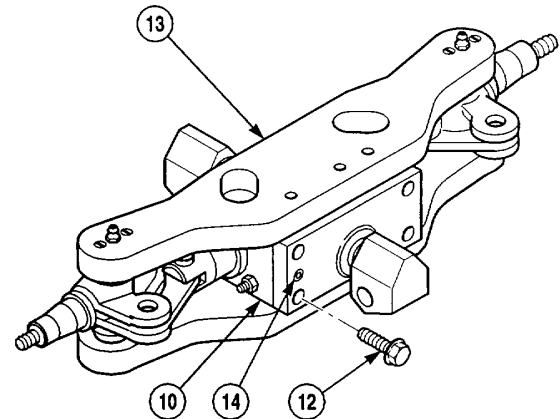
- (1) Install left and right tie rod arms (4 and 5) on steering cylinder (10) with two pins (17), washers (16), and cotter pins (15).



12-3. STEERING CYLINDER REPLACEMENT (CONT).

NOTE

- **Steering cylinder must be installed from right side of steer axle.**
- **Install steering cylinder end with three holes in its gland first.**
- **Ensure steering cylinder is positioned on locator pin before installing screws.**

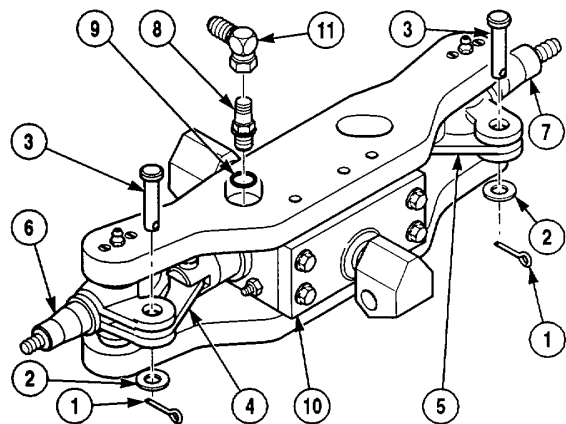


- (2) Positioning steering cylinder (10) in steer axle (13), install dowel (14).
- (3) Install steering cylinder (10) in steer axle (13) with four screws (12).
- (4) Install two preformed packings (9) and fittings (8) in steering cylinder (10).
- (5) Install two elbows (11) on fittings (8).
- (6) Install left and right tie rod arms (4 and 5) on knuckles (6 and 7) with two pins (3), washers (2), and cotter pins (1).

NOTE

Follow-on Maintenance:

Install steer axle assembly (Para 10-5).



END OF TASK

12-4. STEERING CYLINDER REPAIR.

This task covers:

- a. Removal b. Cleaning/Inspection c. Installation

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Pan, Drain (Item 11, Appendix E)
- Caps, Vise Jaw (Item 5, Appendix E)
- Wrench, Torque (0-60 N•m) (Item 12, Appendix E)

Materials/Parts

- Oil, Hydraulic (Item 12, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)
- Tags, Identification (Item 21, Appendix B)

Materials/Parts - Continued

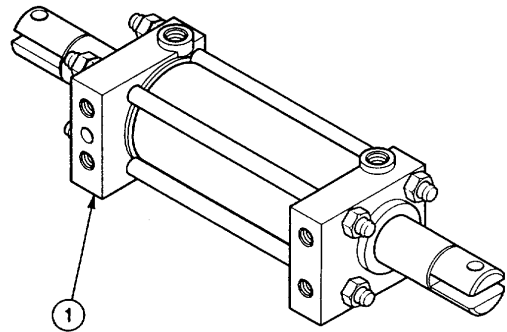
- Expander
- Packing, Preformed (2)
- Seal
- Seal (2)
- Wiper (2)

Equipment Condition

- Steering cylinder removed (Para 12-3)

a. Disassembly.

- (1) Position left-hand gland (1) of steering cylinder in a soft-jawed vise for disassembly.



12-4. STEERING CYLINDER REPAIR (CONT).

WARNING

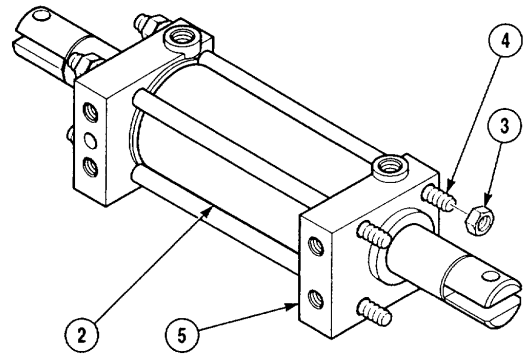
Oil will spray from cylinder barrel ports when rod is moved in or out. Cover ports with two cleaning cloths to prevent oil from spraying. Failure to comply may result in injury to personnel.

CAUTION

Do not allow threaded or machined surfaces to come in contact with other metal surfaces. Clearances between cylinder barrel components are very small, any minor damage done during disassembly could require component replacement or make assembly difficult.

NOTE

- The cylinder barrel has right-hand and left-hand glands.
 - Tag and mark the glands, cylinder barrel, and cylinder rod for installation in the same position at assembly.
- (2) Position drain pan under cylinder barrel (2).
- (3) Remove four nuts (3) from four thru-fasteners (4) on right-gland (5).



- (4) Remove four thru-fasteners (4) from left-hand gland (1) and right-hand gland (5).

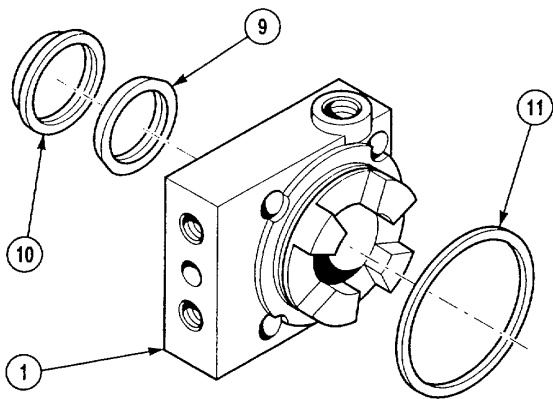
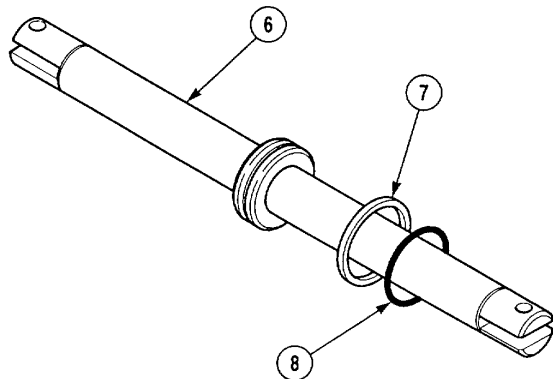
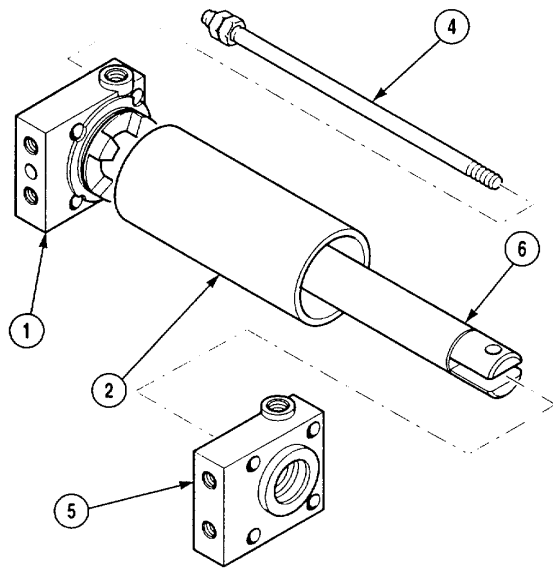
NOTE

Some hydraulic oil may be left in cylinder barrel when removing gland and piston rod.

- (5) Using a soft-faced mallet, remove right-hand gland (5) from cylinder barrel (2) and piston rod (6).
- (6) Remove piston rod (6) from cylinder barrel (2).
- (7) Using a soft-faced mallet, remove cylinder barrel (2) from left-hand gland (1).
- (8) Remove left-hand gland (1) from soft-jawed vise.
- (9) Remove seal (7) and expander (8) from piston rod (6). Discard seal and expander.

NOTE

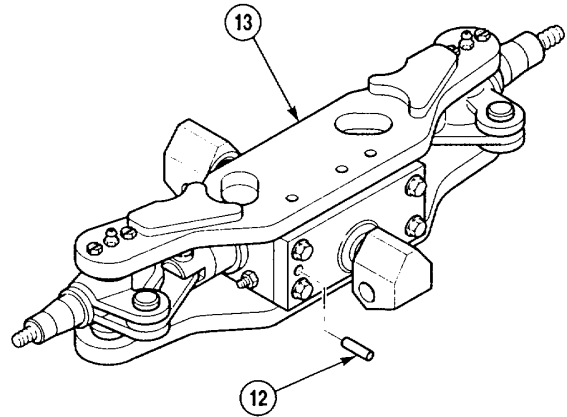
- **Left-hand and right-hand gland preformed packings and seals are installed the same way. Left-hand gland is shown.**
 - **Note position of preformed packings and seal prior to removal.**
- (10) Remove seal (9), wiper (10), and preformed packing (11) from left-hand gland (1). Discard seal, wiper, and preformed packing.



12-4. STEERING CYLINDER REPAIR (CONT).**NOTE**

Perform Step (11) only if locator dowel pin is damaged.

- (11) Remove locator dowel pin (12) from steer axle (13).

**b. Cleaning/Inspection.****WARNING**

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
 - If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
- (1) Clean all components and flush cylinder barrel using dry-cleaning solvent only. Do not use cleaning cloth as any foreign material would contaminate hydraulic system.
 - (2) Inspect barrel bore for any scratches or corrosion. Replace barrel if rusted. Replace barrel and piston rod if either component is scratched.
 - (3) Inspect piston rod for bending. Replace if necessary.
 - (4) Inspect piston rod for scratches or pitting. Remove minor scratches and pitting by using stone and lubrication oil. Stone imperfection just enough to smooth raised part.
 - (5) Inspect the cylinder ports and threads for burrs and stripped threads. Replace or repair as necessary.
 - (6) Inspect thru-fastener threads for burrs and stripped threads. Replace or repair as necessary.

c. *Assembly.*

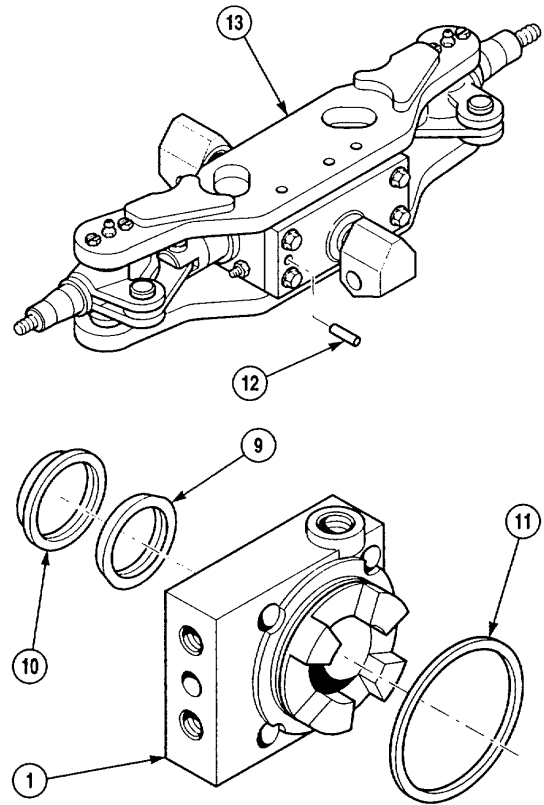
NOTE

Perform Step (1) only if locator dowel pin was removed.

- (1) Install locator dowel pin (12) in steer axle (13) so locator dowel pin is 0.087 in. (0.022 N•m) below outer surface of steer axle.

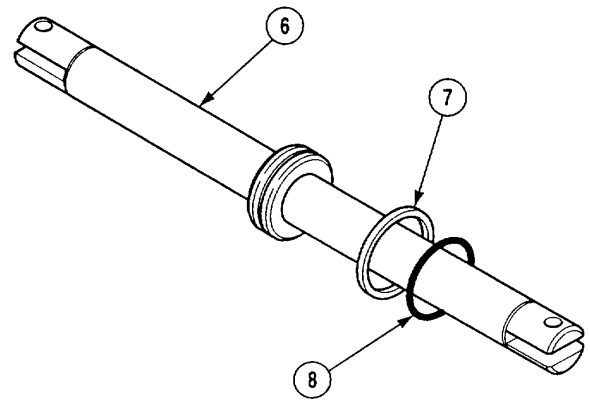
NOTE

- **Left-hand and right-hand gland preformed packings and seals are installed the same way. Left-hand gland is shown.**
 - **Ensure that preformed packings, seals, and wipers are installed in correct direction.**
 - **Coat internal components with hydraulic oil before assembly.**
- (2) Install seal (9), wiper (10), and preformed packing (11) in left-hand gland (1).



12-4. STEERING CYLINDER REPAIR (CONT).

- (3) Install seal (7) and expander (8) on piston rod (6).

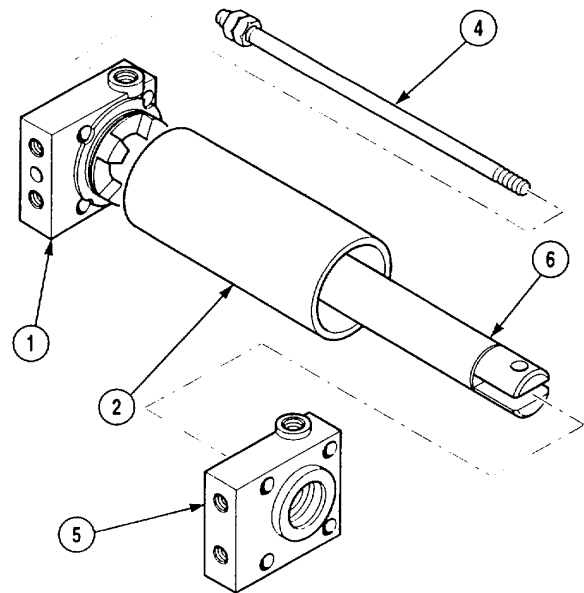


- (4) Install piston rod (6) in cylinder barrel (2).
 (5) Install left-hand gland (1) and right-hand gland (5) on piston rod (6).

NOTE

Note that gland ports are assembled on same side.

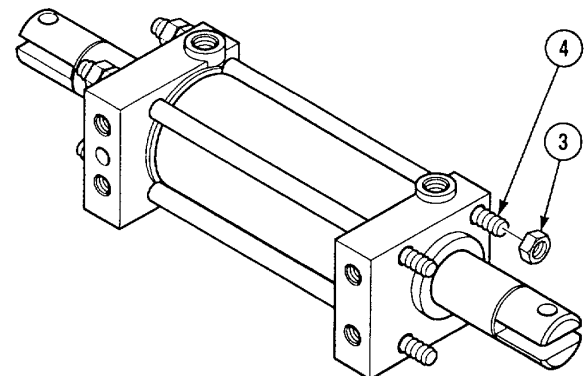
- (6) Install four thru-fasteners (4) in left-hand and right-hand glands (1 and 5).



- (7) Install four nuts (3) on thru-fasteners (4). Tighten nuts to 30 to 33 lb-ft (40-45 N•m).

NOTE**Follow-on Maintenance:**

- Install steering cylinder (Para 12-3).



END OF TASK

12.5 STEERING CONTROL PUMP REPAIR.

This task covers:

- a. Disassembly b. Cleaning/Inspection c. Assembly

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Wrench, Torque (0-60 N•m) (Item 12, Appendix E)
- Vise (Item 5, Appendix E)

Materials/Parts

- Oil, Hydraulic (Item 15, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)

Materials/Parts - Continued

- Packing, Preformed (4)
- Packing, Preformed (2)
- Packing, Preformed (2)

Equipment Condition

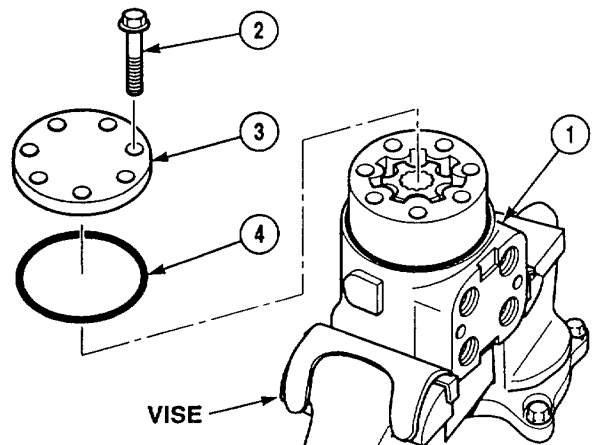
- Steering control pump removed (TM 10-3930-669-20)

a. Disassembly.

CAUTION

Do not overtighten vise as distortion of control pump housing may result in damage to pump.

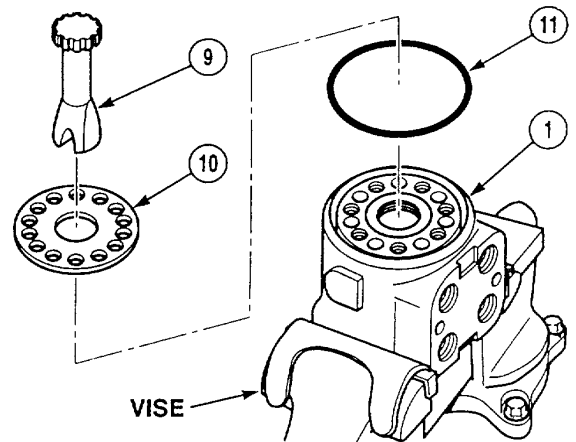
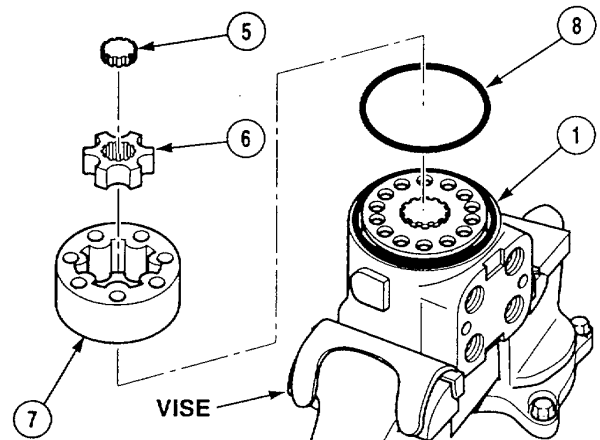
- (1) Place control pump housing (1) in vise.
- (2) Remove seven screws (2), end cap (3), and preformed packing (4) from control pump housing (1). Discard preformed packing.



12-5. STEERING CONTROL PUMP REPAIR (CONT).**CAUTION**

When removing meter, be careful not to drop star, or damage to equipment may result.

- (3) Remove spacer (5), star (6), meter (7), and preformed packing (8) from control pump housing (1). Discard preformed packing.
- (4) Remove drive (9), spacer plate (10), and preformed packing (11) from control pump housing (1). Discard preformed packing.

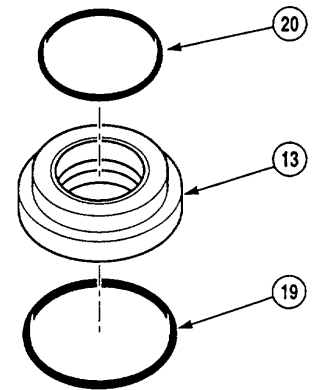
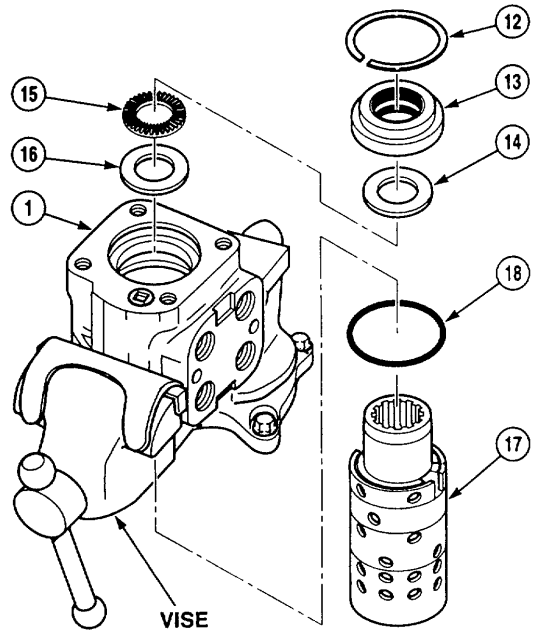


- (5) Turn control pump housing (1) over and remove retaining ring (12) and gland bushing (13).
- (6) Remove bearing race (14), needle thrust bearing (15), and bearing race (16) from spool and sleeve assembly (17).

CAUTION

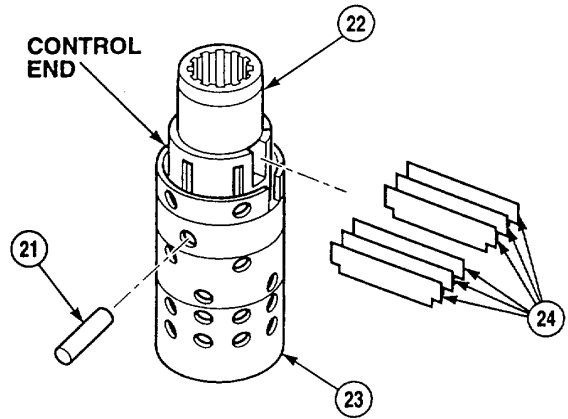
Rotate spool and sleeve assembly slowly when removing to prevent damage that can occur from binding.

- (7) Remove spool and sleeve assembly (17) from control pump housing (1).
- (8) Remove preformed packing (18) from spool and sleeve assembly (17). Discard preformed packing.
- (9) Remove two preformed packings (19 and 20) from gland bushing (13). Discard preformed packings.

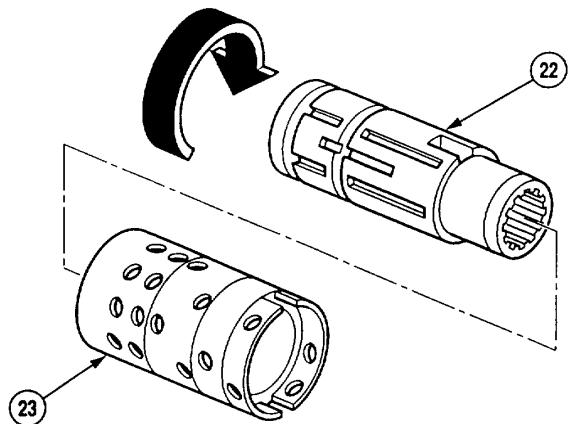


12-5. STEERING CONTROL PUMP REPAIR (CONT).

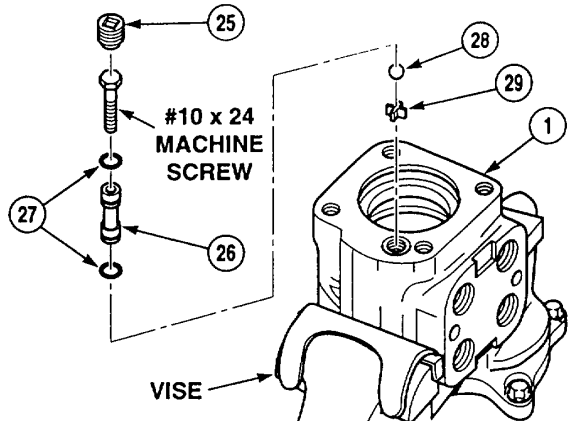
- (10) Remove pin (21) from spool (22).
- (11) Push spool (22) partially from control end of sleeve (23) and carefully remove centering springs (24).



- (12) Push spool (22) back through opposite end of sleeve (23) and remove. Rotate spool slowly when removing from sleeve.



- (13) Remove setscrew (25) from control pump housing (1).
- (14) Install screw into end of check ball seat (26); using screw, pull seat from control pump housing (1).
- (15) Remove and discard two preformed packings (27) from check ball seat (26). Discard preformed packings.
- (16) Tip control pump housing (1) and remove check ball (28) and check ball retainer (29).



b. Cleaning/Inspection.**WARNING**

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
 - If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.
- (1) Clean all metal parts with dry-cleaning solvent.

WARNING

Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.). Failure to comply may result in injury or death to personnel.

- (2) Use compressed air to dry all parts except bearings.
- (3) Allow bearings to air dry.
- (4) Check all mating surfaces for scratches, nicks, or burrs.
- (5) Check all machined surfaces for scratches, nicks, or burrs.
- (6) Check control pump housing for cracks or damage.
- (7) Check all threads for peeled or crossed condition.
- (8) Replace all damaged parts.
- (9) Lubricate all preformed packings with clean hydraulic oil.
- (10) Do not over-lubricate preformed packing on meter section.
- (11) Coat metal parts with light hydraulic oil to aid in assembly.

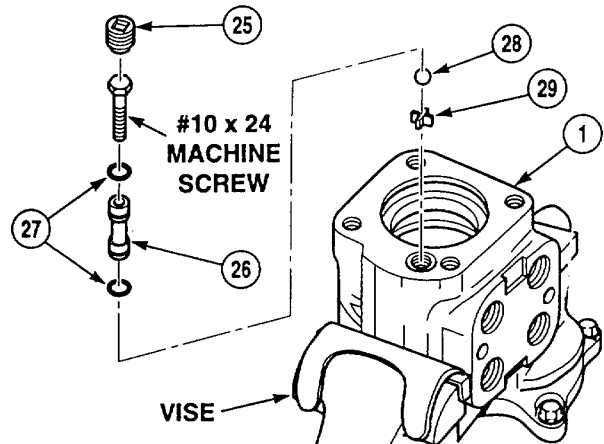
12-5. STEERING CONTROL PUMP REPAIR (CONT).

c. Assembly.

NOTE

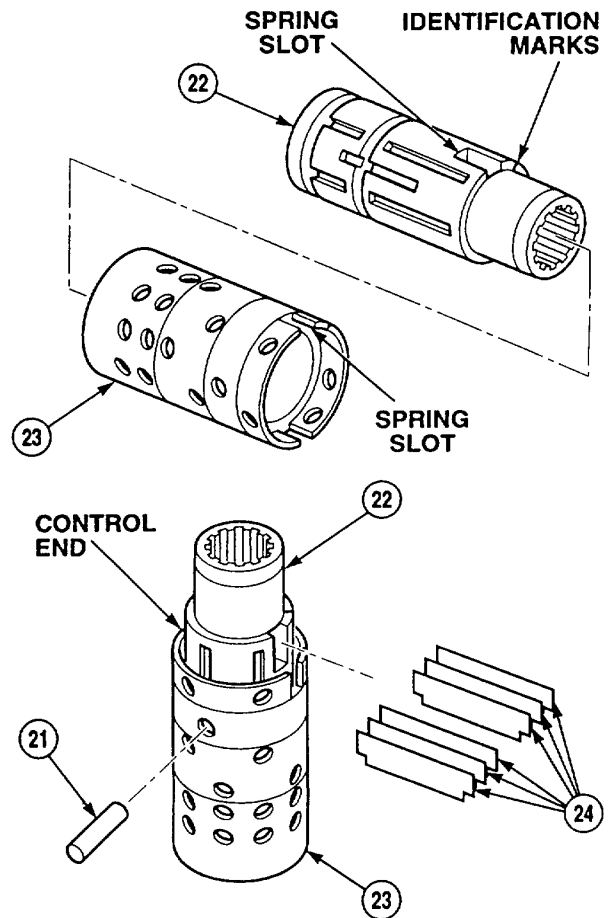
Make sure that check ball retainer sits straight and is not tilted.

- (1) Install check ball retainer (29) and check ball (28) in control pump housing (1).
- (2) Install two preformed packings (27) on check ball seat (26).
- (3) Using a screw, install check ball seat (26) in control pump housing (1) without twisting or damaging preformed packings.
- (4) Install setscrew (25) and tighten setscrew 100 lb-in. (11.3 N•m).



NOTE

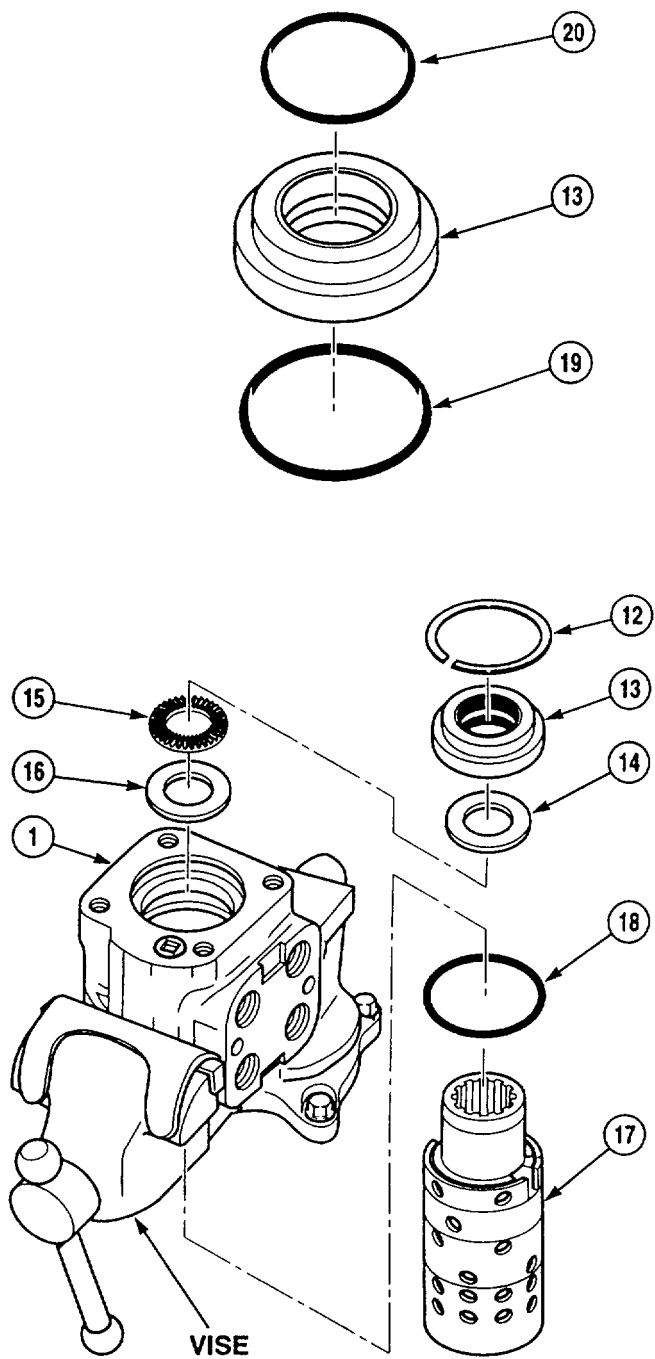
- Some spool and sleeve sets are marked; if present, align marks as shown.
 - Spool should rotate smoothly in sleeve with fingertip force applied at splined end.
- (5) Assemble spool (22) and sleeve (23) carefully so that the spring slots line up at the same end. Rotate spool while sliding parts together.
 - (6) Install two sets of three centering springs (24) with notches facing sleeve (23) and arched centers back-to-back.
 - (7) Center installed springs so that they push down evenly and flush with upper surface of the spool (22) and sleeve (23).
 - (8) Install pin (21) through spool (22) and sleeve (23) until pin is flush on both sides.



CAUTION

Make sure that no parts tilt or slide out of position while installing spool and sleeve assembly. Keep pin in horizontal position. Do not push end of spool and sleeve assembly past end of housing. Damage to spool and sleeve assembly or housing may result if these precautions are not followed.

- (9) Install two preformed packings (20 and 19) in gland bushing (13).
- (10) Install preformed packing (18) on spool and sleeve assembly (17) and carefully install spool and sleeve assembly into control pump housing (1), with a slight rotating movement, until end of assembly is flush with end of housing. Make sure spool rotates freely with slight fingertip pressure at splined end.
- (11) Install bearing race (16), needle thrust bearing (15), and bearing race (14).
- (12) Install gland bushing (13) and retaining ring (12).



12-5. STEERING CONTROL PUMP REPAIR (CONT).

NOTE

Clean upper surface of housing by wiping with palm of clean hand. Clean each flat surface of meter section parts the same way before reassembling.

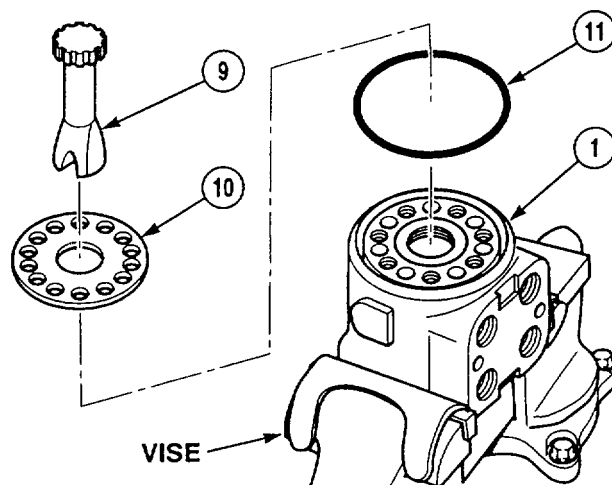
- (13) Install preformed packing (11) and spacer plate (10) on control pump housing (1). Align screw holes in spacer plate with tapped holes in control pump housing.

NOTE

When installing drive in spool and sleeve, make sure drive engages pin.

- (14) Install drive (9) in control pump

housing (1).



CAUTION

When installing meter, be careful not to drop star, or damage may result.

NOTE

Side of star with chamfer on inner splines faces inside of control pump.

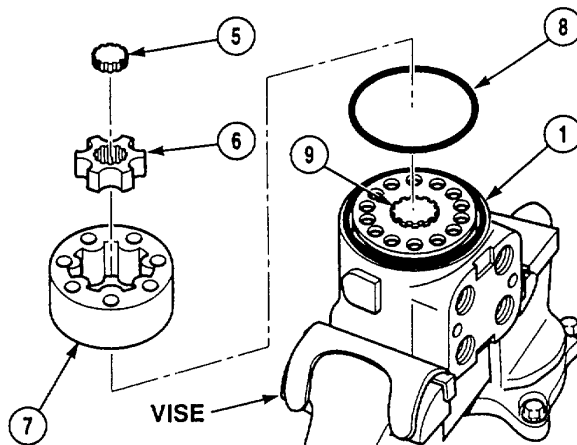
- (15) Install preformed packing (8) and star (6) in meter (7); install assembled meter on control pump housing (1).

NOTE

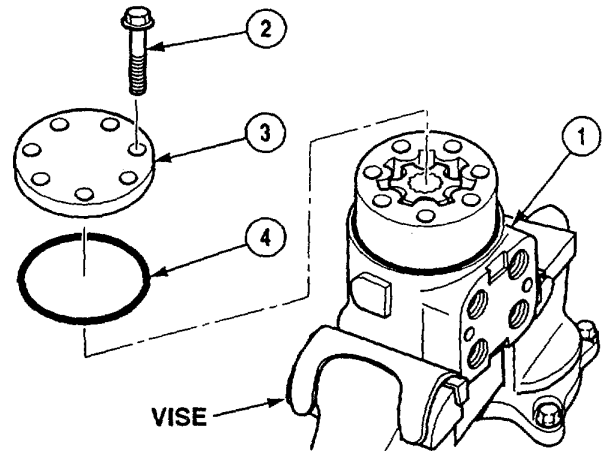
It may be necessary to remove and install meter a few times until holes line up and star fits over drive.

- (16) Align screw holes in meter (7) with tapped holes in control pump housing (1) while fitting star (6) easily over drive (9).

- (17) Install spacer (5) in star (6).



- (18) Install preformed packing (4) and end cap (3) with seven dry screws (2) on control pump housing (1).
- (19) Tighten seven screws (2) 150 lb-in (16.9 N•m), then tighten, in sequence shown, to 275 lb-in (31 N•m).
- (20) Remove control pump housing (1) from vise.

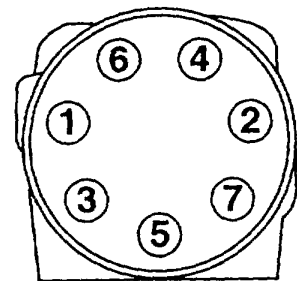


NOTE

Follow-on Maintenance:

- Install steering control pump (TM 10-3930-669-20).

END OF TASK



TIGHTENING SEQUENCE

12-6. HUB REPAIR.

This task covers:

- a. Disassembly c. Cleaning/Inspection d. Assembly

INITIAL SETUP:

Tools and Special tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Puller (Item 5, Appendix E)
 Press, Arbor (Item 5, Appendix E)

Materials/Parts - Continued

Cotter Pin
 Seal, Hub

Materials/ Parts

Grease (Item 14, Appendix B)
 Solvent, Dry-cleaning (Item 20, Appendix B)
 Tags, Identification (Item 21, Appendix B)

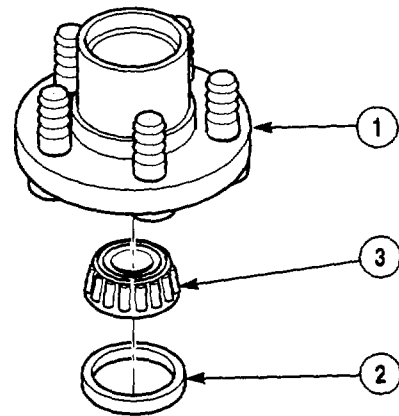
Equipment Condition

Hub removed (TM 10-3930-669-20)

b. Disassembly.

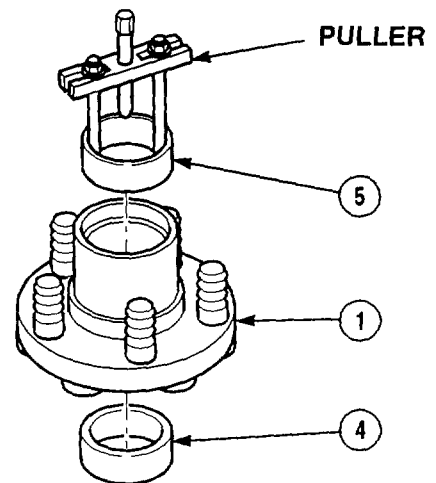
NOTE
 Tag inner bearing cone.

- (1) Position hub (1) on flat surface.
- (2) Using a brass drift, remove hub seal (2) and inner bearing (3) from hub (1). Discard hub seal.



- NOTE**
- Perform Steps (3) and (4) only if inner and outer bearing cups are damaged.
 - Tag and mark inner and outer bearing cups in order of removal.

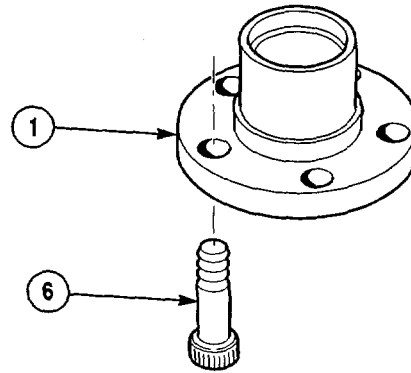
- (3) Using puller, remove inner bearing cup (4) from hub (1).
- (4) Using puller, remove outer bearing cup (5) from hub (1).



NOTE

Perform Step (5) only if fasteners are damaged.

- (5) Remove five wheel fasteners (6) from hub (1).



c. Cleaning/Inspection.

WARNING

- cleaning solvent (P-D-680) is **TOXIC** and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

- (1) Clean all parts in dry-cleaning solvent. Allow to air dry.
- (2) Inspect the bearings and bearing cups for scratches, cracks, glazing, rust pitting, flat spots, and other wear.
- (3) Clean old grease out of center of wheel hub.
- (4) Replace all damaged parts or notify supervisor.

d. Assembly.

NOTE

Perform Step (1) if fasteners were removed.

- (1) Install five wheel fasteners (6) in hub (1).

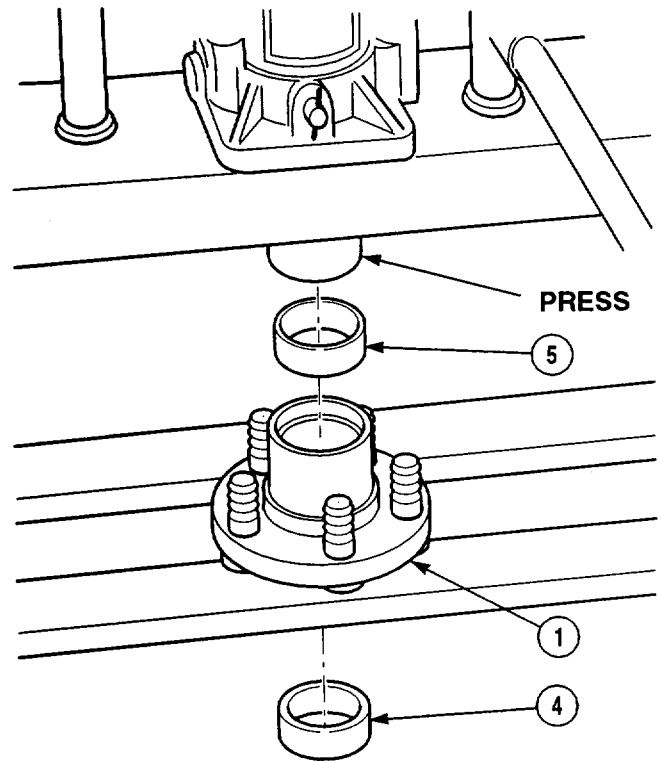
12-6. HUB REPLACEMENT/REPAIR (CONT).

CAUTION

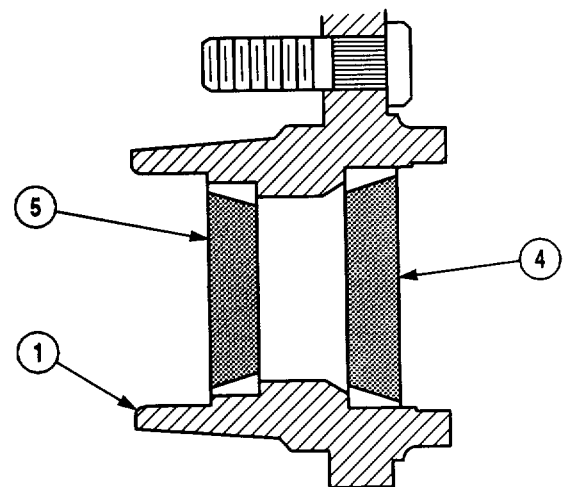
- Apply even force to the bearing cup to prevent cracking during installations.
- Be sure that each bearing cup is fully seated against shoulder in hub bore.

NOTE

- Perform Steps (2) and (3) if inner and outer bearing cups were removed.
- Ensure outer and inner bearing cups and bearings are replaced as a set.



- (2) Using a press, install outer bearing cup (5) in hub (1).
- (3) Using a press, install inner bearing cup (4) in hub (1).
- (4) Pack hub (1) cavity in between inner and outer bearing cups (4 and 5) one-half full with grease.



NOTE

Ensure outer and inner bearing and cones are replaced as a set.

- (5) Pack inner bearing (3) with grease.
- (6) Install inner bearing (3) in hub (1).
- (7) Apply grease to the inside diameter of seal (2).

CAUTION

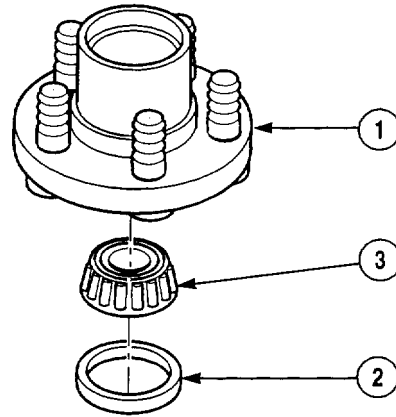
Caution should be taken when pressing or tapping seal into place.

- (8) Using a soft-face mallet, install seal (2) in hub (1) until seal is seated in bottom of hub.

NOTE

Follow-on Maintenance:

- Install hub (TM 10-3930-669-20).



END OF TASK

**CHAPTER 13
FRAME MAINTENANCE**

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13-2	Mast Assembly Replacement/Repair	13-2
13-3	Carriage Replacement/Repair.....	13-27
13-4	Frame Counterweight Replacement.....	13-33
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13-1. INTRODUCTION.

This chapter contains maintenance instructions for removing, replacing, repairing, and installing frame components authorized by the Maintenance Allocation Chart (MAC) at the Direct Support and General Support Maintenance level.

13-2. MAST ASSEMBLY REPLACEMENT/REPAIR.

This task covers:

- | | | |
|-------------|-----------------|------------------------|
| a. Removal | b. Disassembly | c. Cleaning/Inspection |
| d. Assembly | e. Installation | |

INITIAL SETUP:

Tools and Special Tools

- Tool Kit, General Mechanic's (Item 1, Appendix E)
- Lifting Device, Minimum Capacity 3000 lbs (1,814 kg)
- Wrench, Torque (0 to 600 lb-ft [0-814 N-m]) (Item 5, Appendix E)

Personnel Required

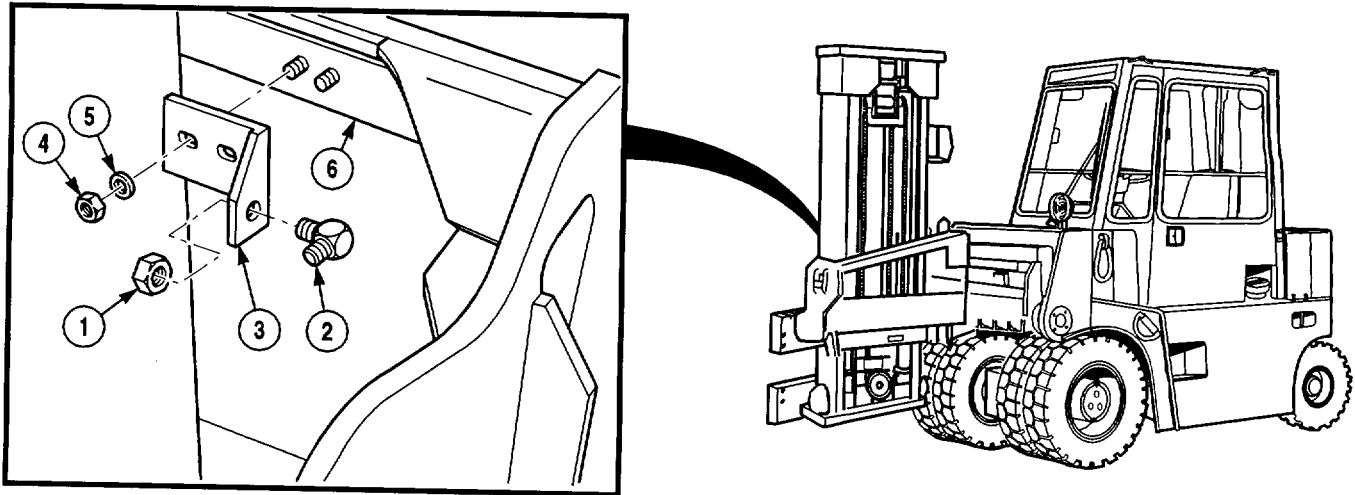
Two

Equipment Condition

- Engine OFF (TM 10-3930-669-10)
- Parking brake applied (TM 10-3930-669-10)
- Wheels chocked (TM 10-3930-669-10)
- Forks removed (TM 10-3930-669-10)
- Mast pivoted 90° (TM 10-3930-669-10)
- Batteries disconnected (TM 10-3930-669-20)
- Mast flood light removed (TM 10-3930-669-20)
- Level indicator removed (TM 10-3930-669-20)
- Backrest removed (TM 10-3930-669-20)
- Mast hydraulic hoses removed (TM 10-3930-669-20)
- Pivot arm hoses and tubes removed (TM 10-3930-669-20)
- Tilt cylinder hoses removed (TM 10-3930-669-20)
- Tilt cylinders removed (TM 10-3930-669-20)

Materials/Parts

- Cable, Ties (Item 4, Appendix B)
- Solvent, Drycleaning (Item 20, Appendix B)
- Tags, Identification (Item 21, Appendix B)
- Nut, Lock
- Nut, Lock
- Nut, Lock
- Nut, Lock
- Nut, Lock
- Nut, Lock (2)
- Nut, Lock (2)
- Nut, Lock (4)
- Pin, Cotter (4)
- Pin, Cotter (4)
- Pin, Cotter (4)
- Pin, Cotter (4)
- Washer, Lock (2)
- Washer, Lock (2)
- Washer, Lock (4)
- Washer, Lock (2)
- Washer, Lock (2)

a. **Removal.****WARNING**

High pressure hydraulics operate this equipment. Refer to vehicle operator and maintenance manuals for hydraulic oil pressure. Never disconnect any hydraulic line or fitting without first dropping pressure to zero. A high pressure oil stream can pierce body and cause severe injury to personnel.

NOTE

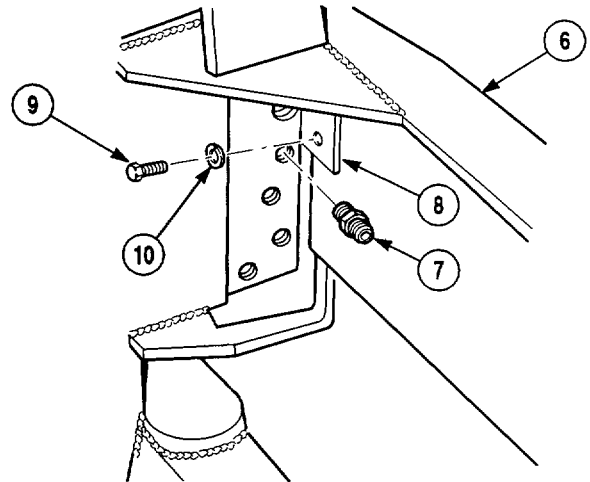
- With main power switch in the off position, operate two hydraulic levers (TM 10-3930-669-10) several strokes to ensure release of any trapped hydraulic oil under pressure.
- Tag and mark all fittings prior to removal.
- Remove cable ties as required.

(1) Remove lock nut (1) and elbow (2) from bracket (3). Discard lock nut.

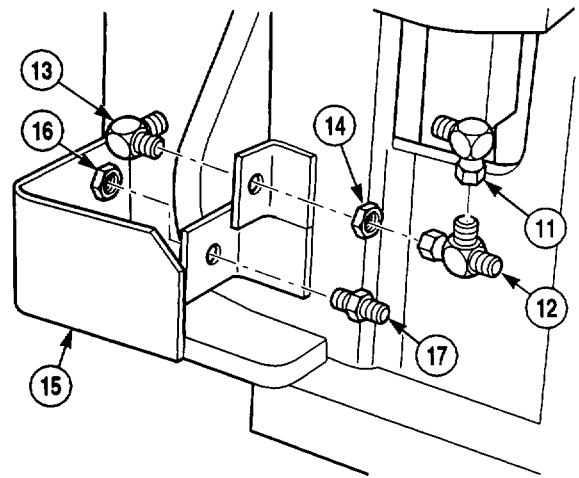
(2) Remove two nuts (4), washers (5), and bracket (3) from pivot arm (6).

13-2. MAST ASSEMBLY REPLACEMENT/REPAIR (CONT).

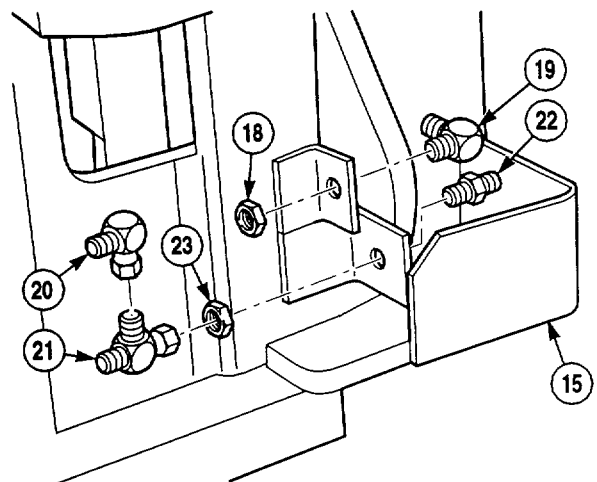
- (3) Remove four fittings (7) from manifold (8).
- (4) Remove two screws (9), lock washers (10), and manifold (8) from pivot arm (6). Discard lock washers.

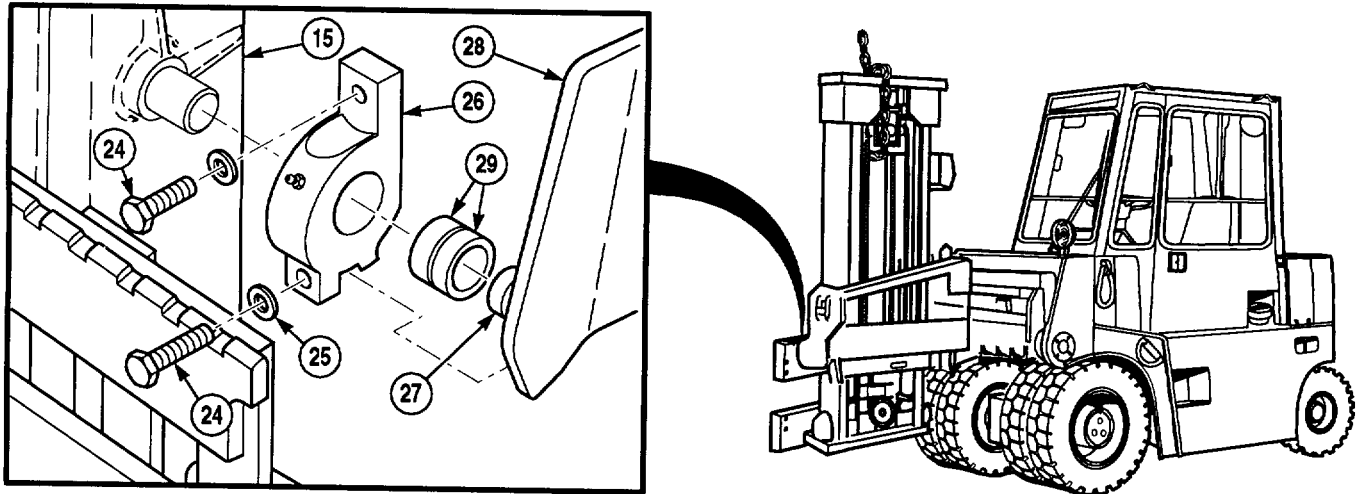


- (5) Remove elbow (11) from tee (12).
- (6) Remove tee (12) from elbow (13).
- (7) Remove lock nut (14) and elbow (13) from mast assembly (15). Discard lock nut.
- (8) Remove lock nut (16) and fitting (17) from mast assembly (15). Discard lock nut.



- (9) Remove lock nut (18) and elbow (19) from mast assembly (15). Discard lock nut.
- (10) Remove elbow (20) from tee (21).
- (11) Remove tee (21) from fitting (22).
- (12) Remove lock nut (23) and fitting (22) from mast assembly (15). Discard lock nut.

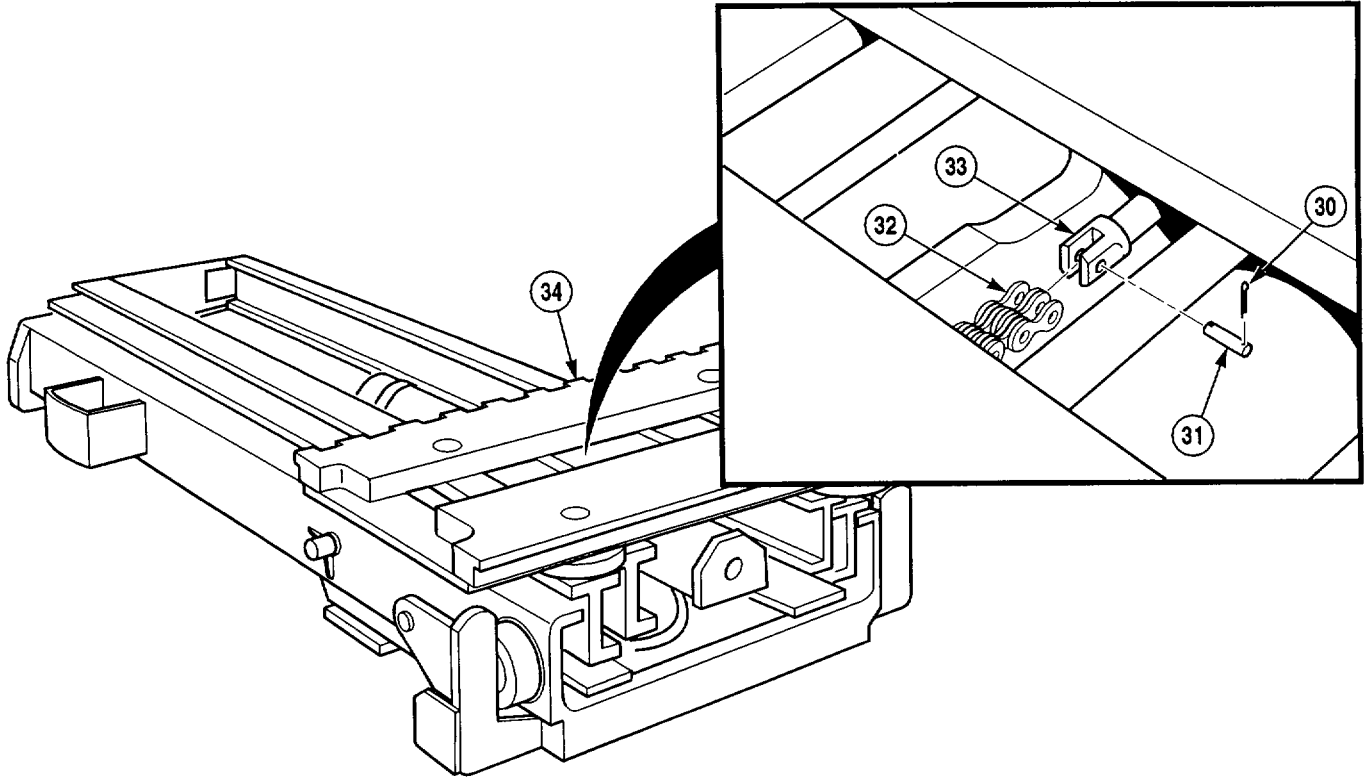




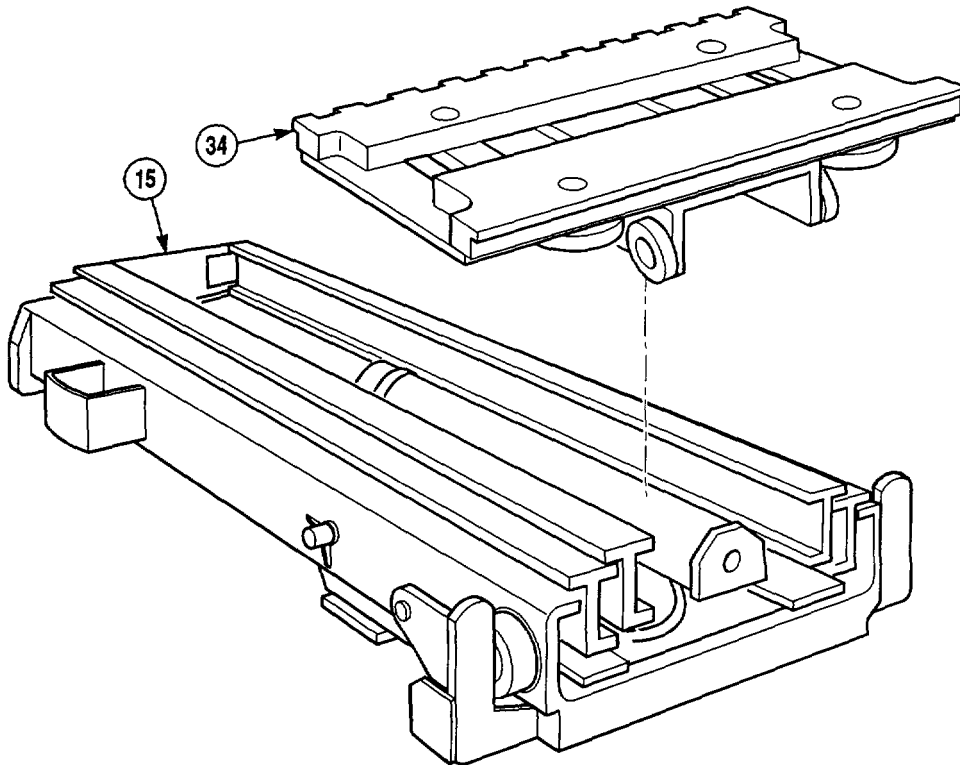
WARNING

- **Mast assembly weighs 4,000 lbs (1,814 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.**
- **All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.**

- (13) Using lifting device, assume weight of mast assembly (15).
- (14) Remove four screws (24) and washers (25) from two bearing clamps (26).
- (15) Remove mast assembly (15) from pivot and shift assembly (28).
- (16) Remove two caps (27) and two bearings (29) from mast assembly (15).
- (17) Using lifting device, lower mast assembly (15) to floor, carriage side up.

13-2. MAST ASSEMBLY REPLACEMENT/REPAIR (CONT).***b. Disassembly.***

- (1) Remove four cotter pins (30), two pins (31), and primary chains (32) from anchors (33). Discard cotter pins.
- (2) Position two primary chains (32) under carriage assembly (34).

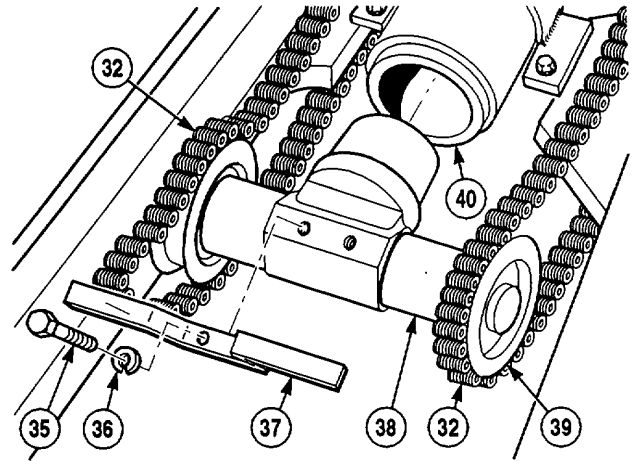
**WARNING**

- Carriage assembly weighs 802 lbs (364 kg). Attach lifting device prior to removal to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

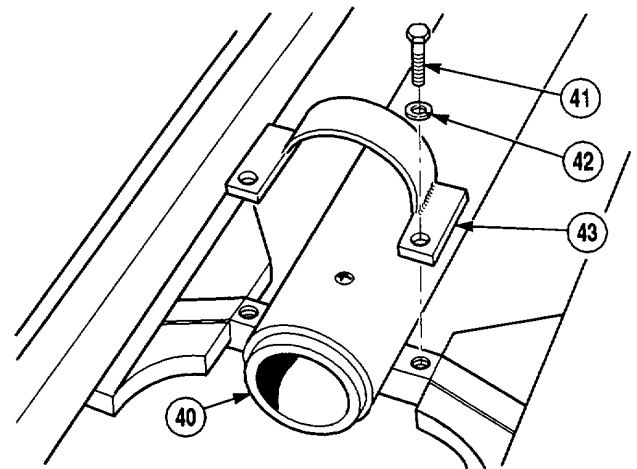
(3) Using lifting device, remove carriage assembly (34) from mast assembly (15).

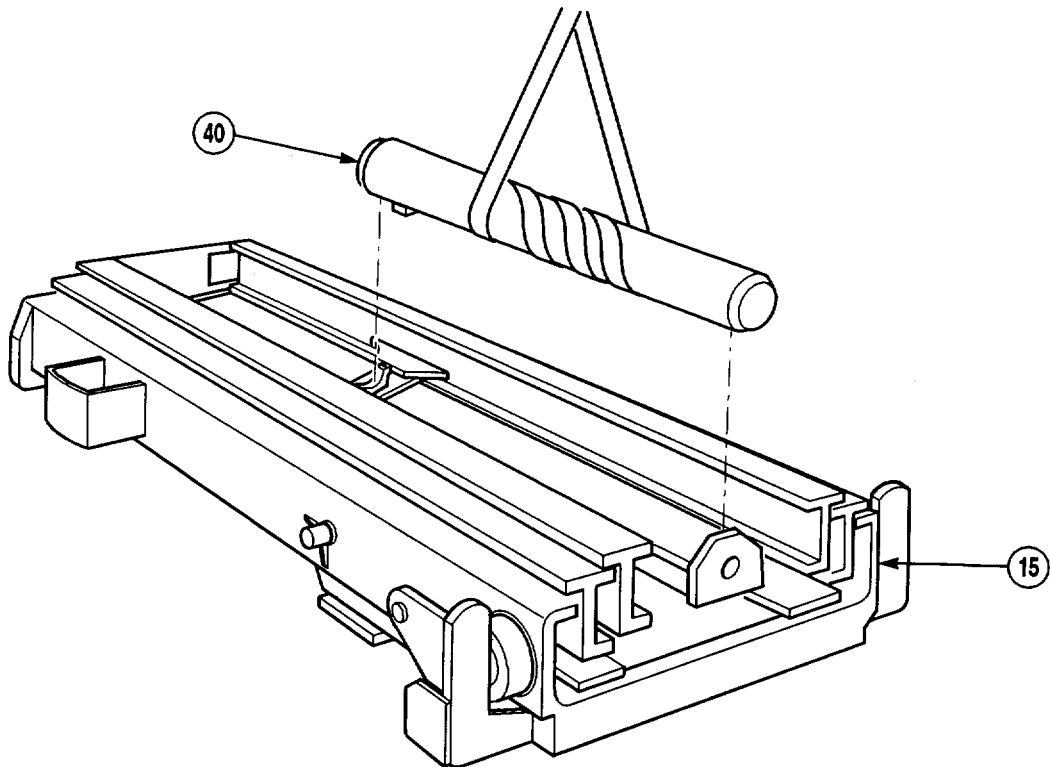
13-2. MAST ASSEMBLY REPLACEMENT/REPAIR (CONT).

- (4) Remove four screws (35), lock washers (36), and two chain retainers (37) from cross head (38). Discard lock washers.
- (5) Remove two primary chains (32) from rollers (39).
- (6) Remove cross head (38) from primary cylinder (40).



- (7) Remove two screws (41), lock washers (42), and cylinder retainer (43) from primary cylinder (40). Discard lock washers.

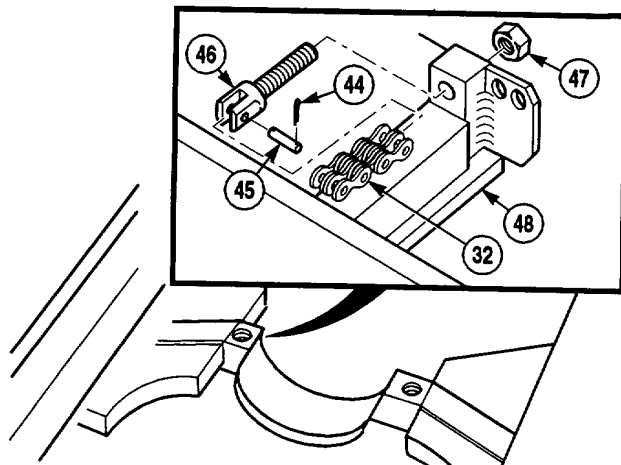




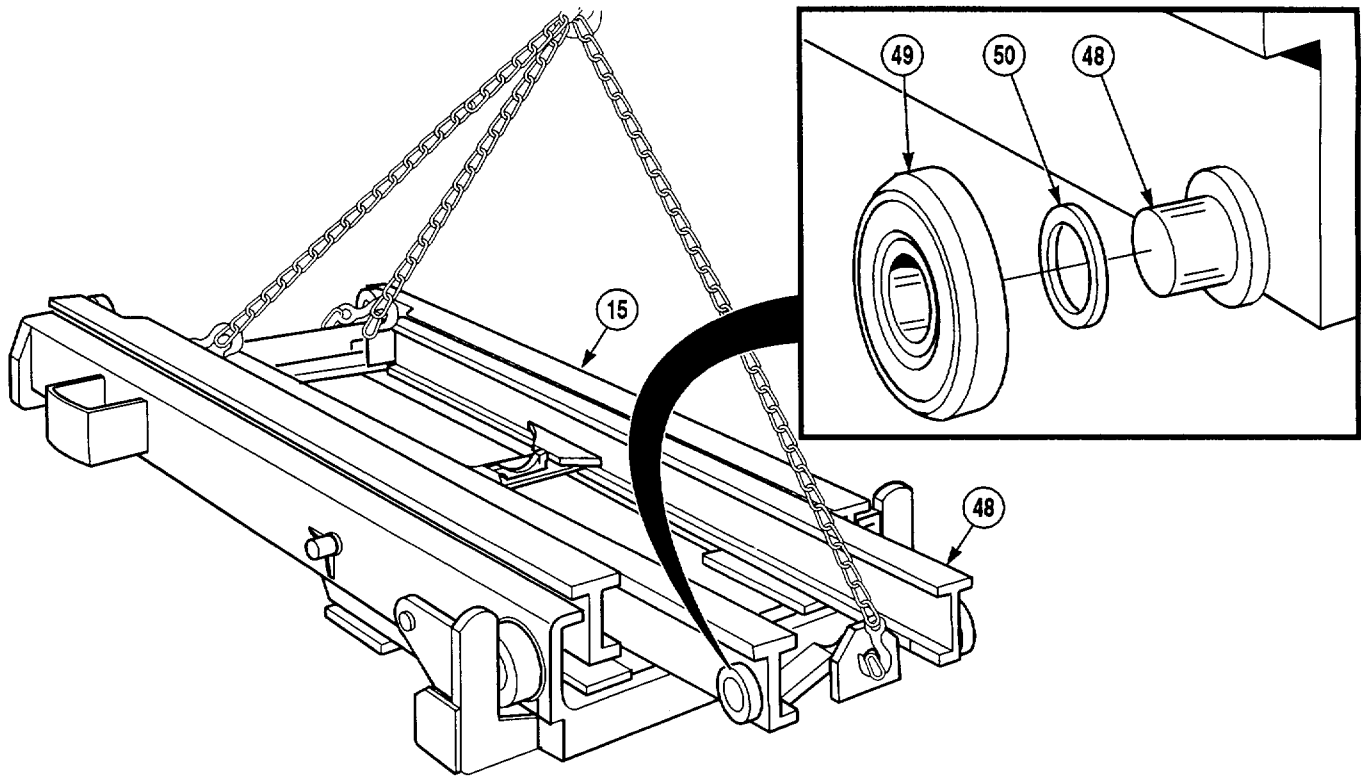
WARNING

- **Primary cylinder assembly weighs 80 lbs (36 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.**
- **All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.**

- (8) Using lifting device, remove primary cylinder (40) from mast assembly (15).
- (9) Remove four cotter pins (44), two pins (45), and primary chains (32) from anchors (46). Discard cotter pins.
- (10) Remove two lock nuts (47) and anchors (46) from inner rail (48). Discard lock nuts.



13-2. MAST ASSEMBLY REPLACEMENT/REPAIR (CONT).

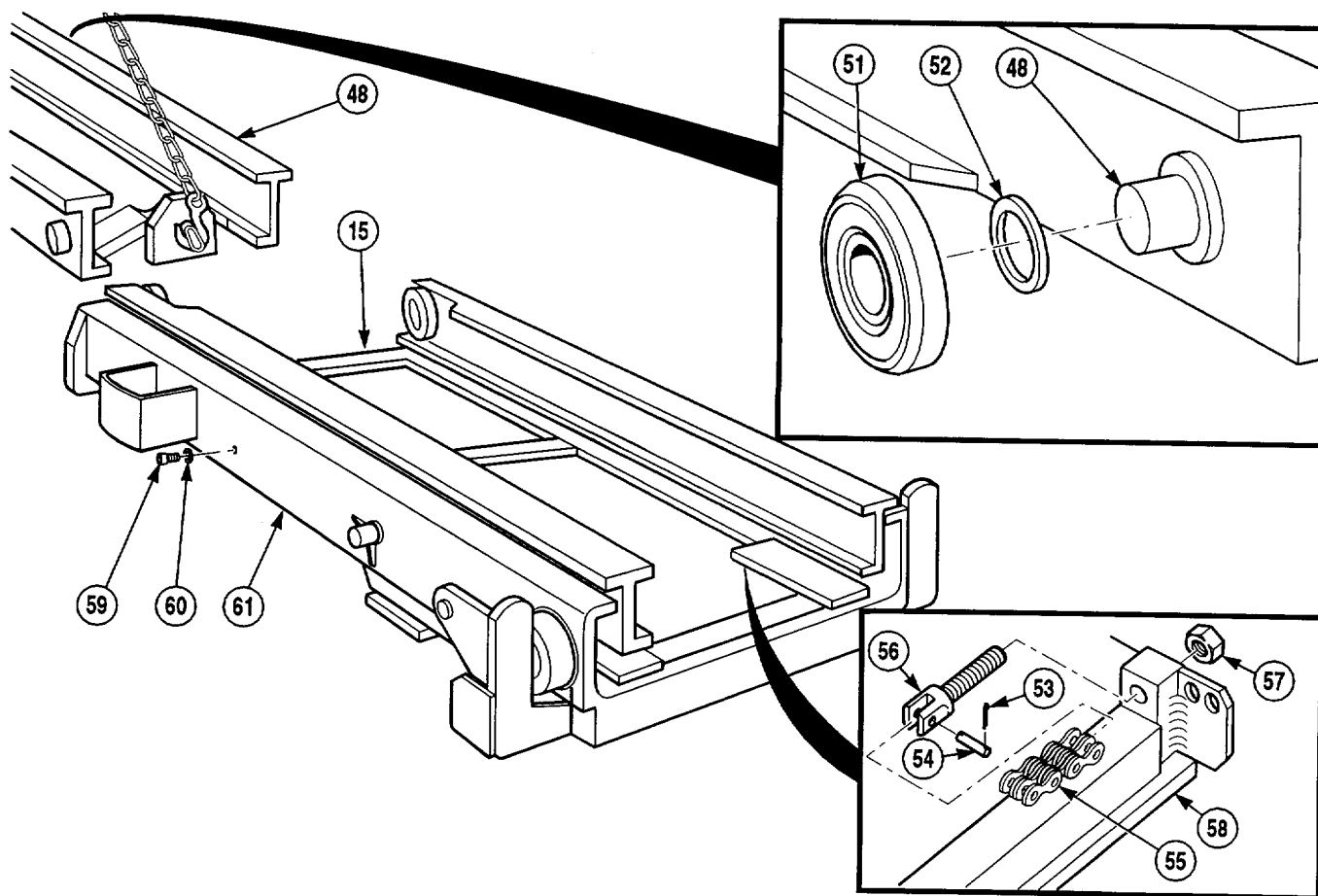
**WARNING**

- Inner rail assembly weighs 330 lbs (150 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

NOTE

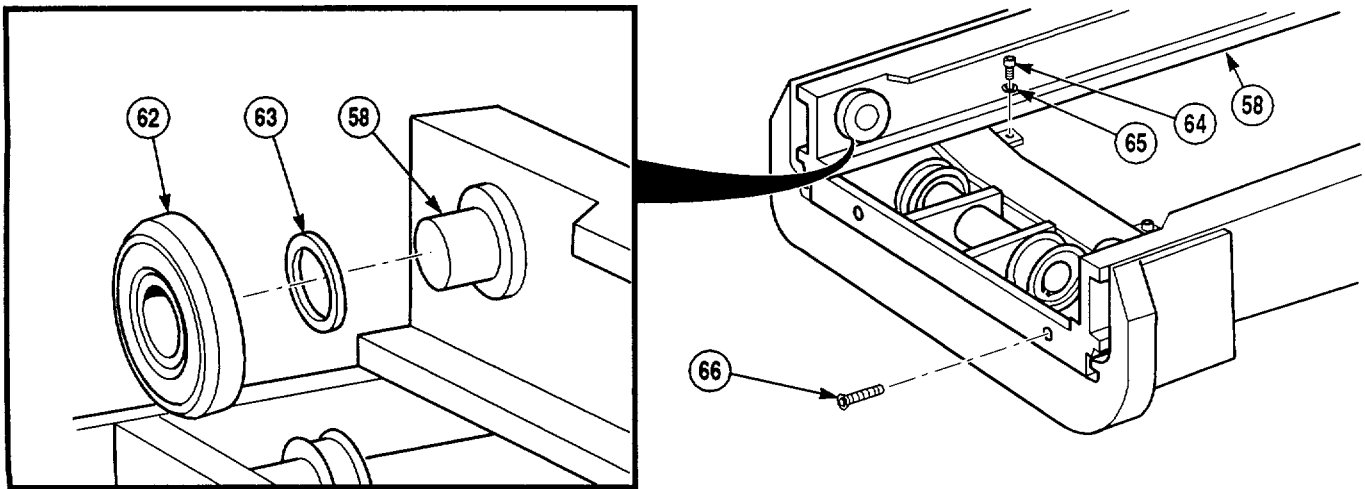
Position secondary chains clear of inner rail prior to removal of inner rail.

- (11) lifting device, roll inner rail (48) toward bottom of mast assembly (15) and remove two rollers (49) and shims (50) from inner rail.



- (12) Remove inner rail (48) from mast assembly (15).
- (13) Remove two rollers (51) and shims (52) from inner rail (48).
- (14) Remove four cotter pins (53), two pins (54), and two secondary chains (55) from two anchors (56). Discard cotter pins.
- (15) Remove two lock nuts (57) and anchors (56) from center rail (58). Discard lock nuts.
- (16) Remove two screws (59) and lock washers (60) from outer rail (61). Discard lock washers.

13-2. MAST ASSEMBLY REPLACEMENT/REPAIR (CONT).

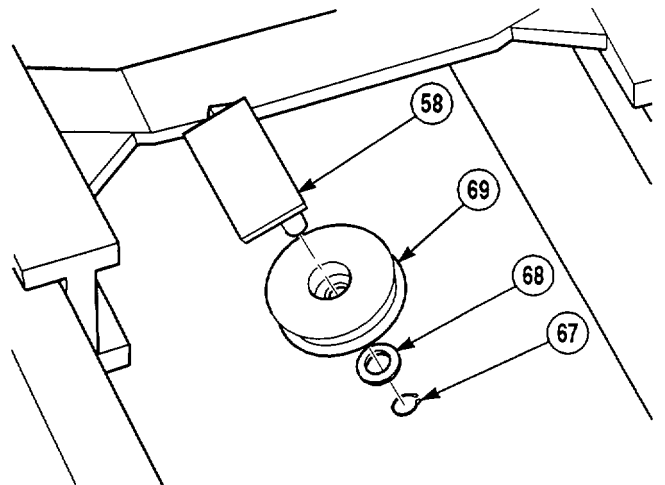


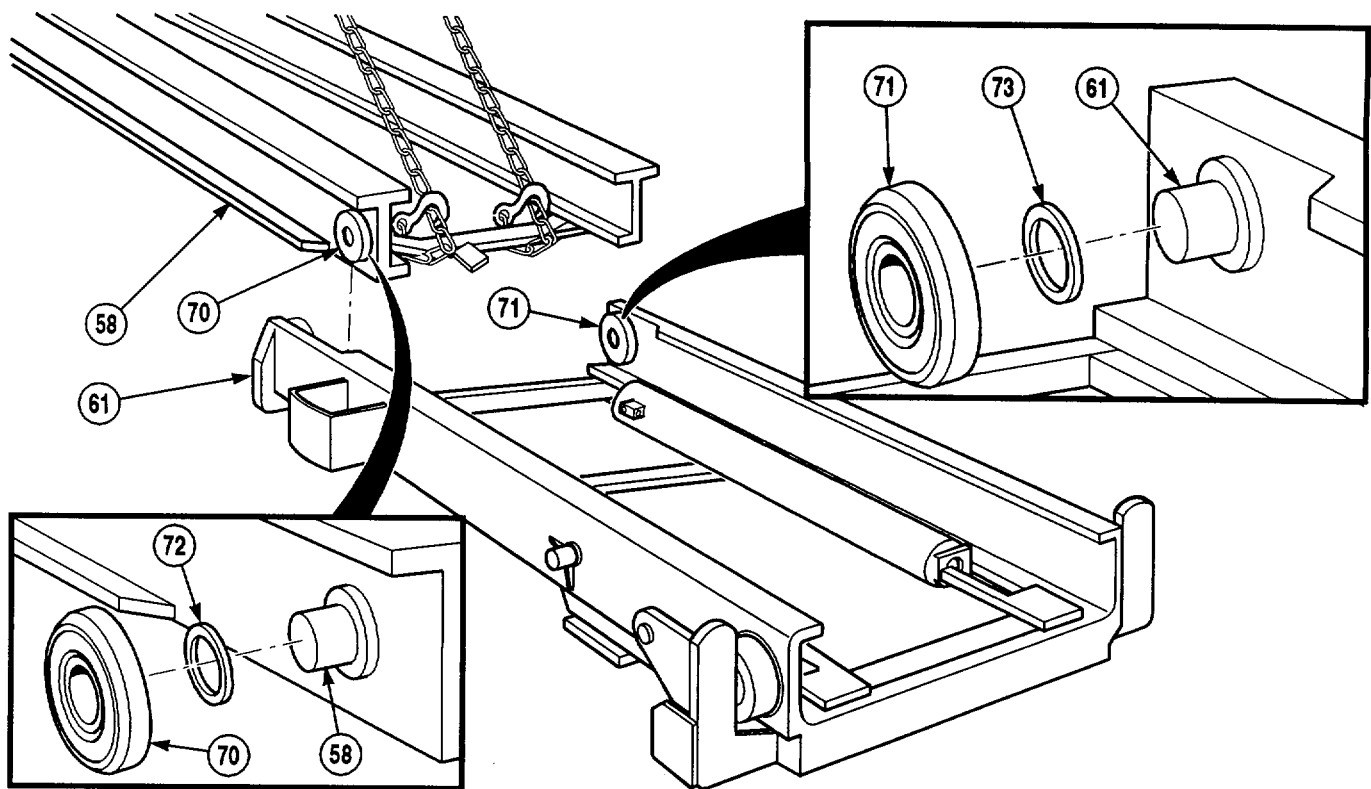
- (17) Remove two rollers (62) and shims (63) from center rail (58).
- (18) Remove two screws (64) and lock washers (65) from center rail (58). Discard lock washers.
- (19) Remove two screws (66) from end of center rail (58).

WARNING

Use care when removing or installing snap and retaining ring. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury,

- (20) Remove retaining ring (67), spacer (68), and roller (69) from center rail (58).





NOTE

- **Position two secondary chains through center rail prior to removal of center rail.**
- **A pry bar may be required to remove center rail from outer rail.**

(21) Using lifting device, roll center rail (58) out top of outer rail (61) until center rail rollers (70) stop at outer rail rollers (71).

WARNING

- **Center rail weighs 361 lbs (164 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.**
- **All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.**

(22) Remove center rail (58) from outer rail (61).

(23) Remove two rollers (70) and shims (72) from center rail (58).

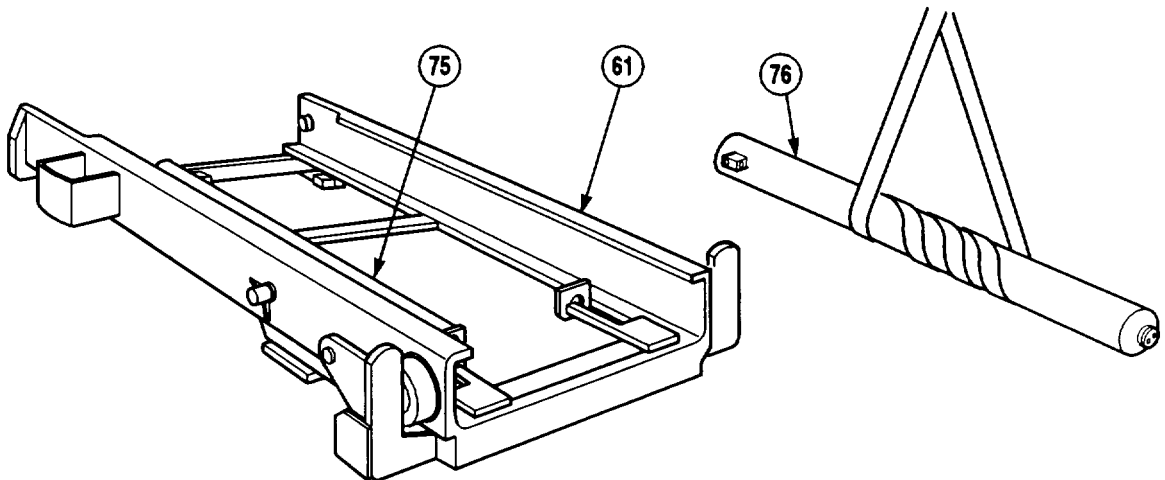
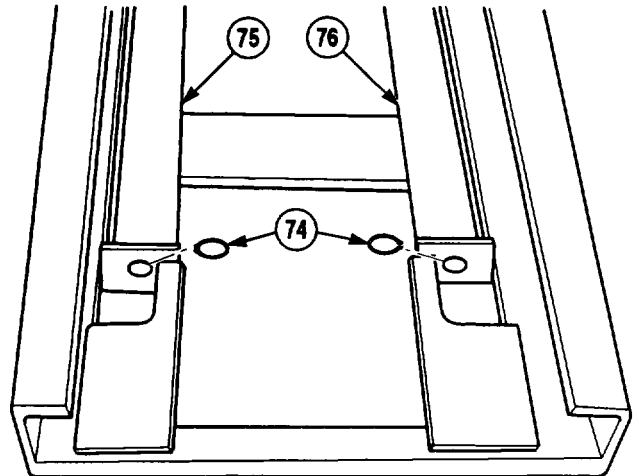
(24) Remove two rollers (71) and shims (73) from outer rail (61).

13-2. MAST ASSEMBLY REPLACEMENT/REPAIR (CONT).

WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

- (25) Remove two retaining rings (74) from secondary cylinders (75 and 76).

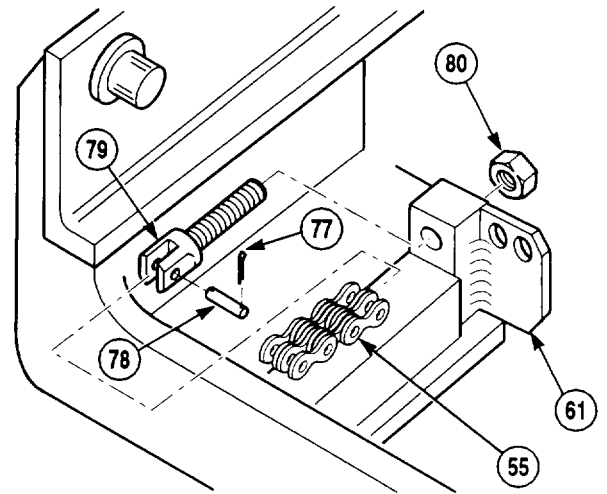


WARNING

- Secondary cylinders weigh 140 lbs (64 kg) each. Attach suitable lifting device prior to removal to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

- (26) Remove two secondary cylinders (75 and 76) from outer rail (61).

- (27) Remove four cotter pins (77), two pins (78), and two secondary chains (55) from anchors (79). Discard cotter pins.
- (28) Remove four lock nuts (80) and anchors (76) from outer rail (61). Discard lock nuts.



c. Cleaning/Inspection.

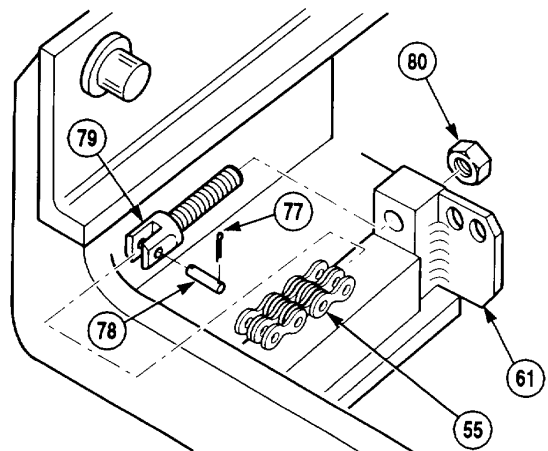
WARNING

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

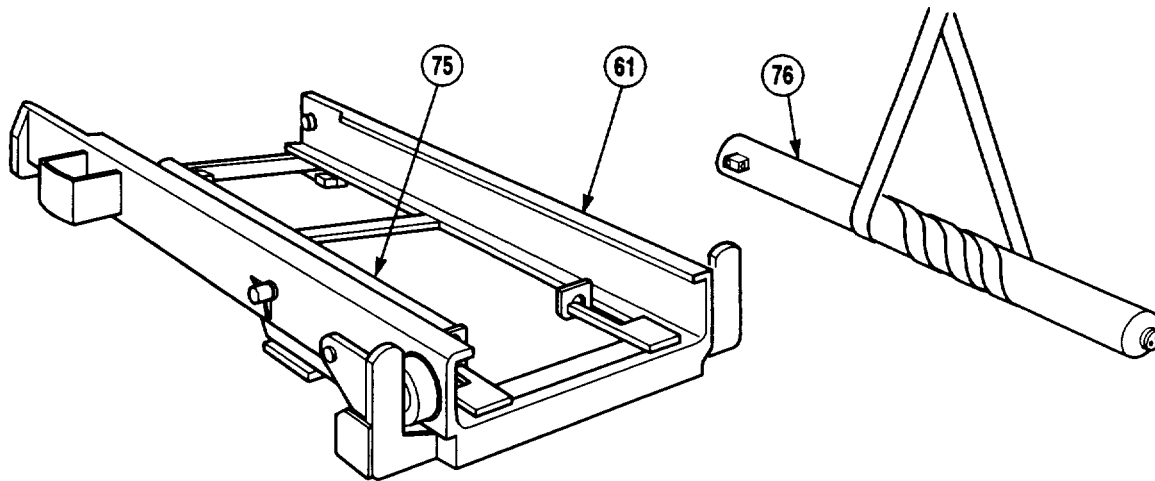
- (1) Clean all metal parts with dry-cleaning solvent.
- (2) Inspect all parts for wear, cracks, nicks, burrs or scratches.
- (3) Replace all damaged parts.

d. Assembly.

- (1) Install anchors (79) on outer rail (61) with lock nuts (80).
- (2) Install two secondary chains (55) on anchors (79) with two pins (78) and four cotter pins (77).



13-2. MAST ASSEMBLY REPLACEMENT/REPAIR (CONT).



WARNING

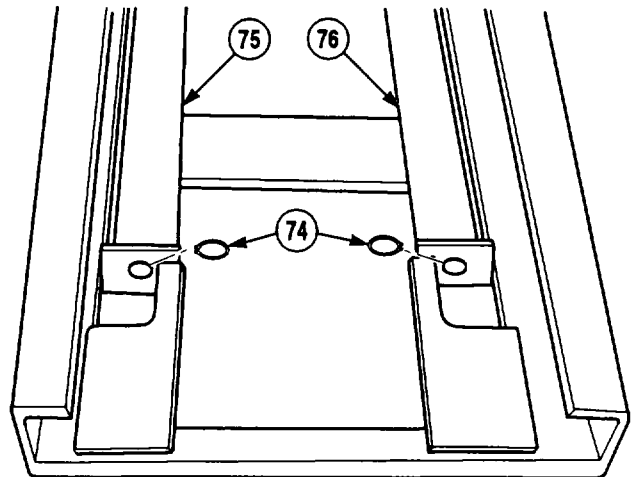
- Secondary cylinders weigh 140 lbs (64 kg) each. Attach suitable lifting device prior to removal to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

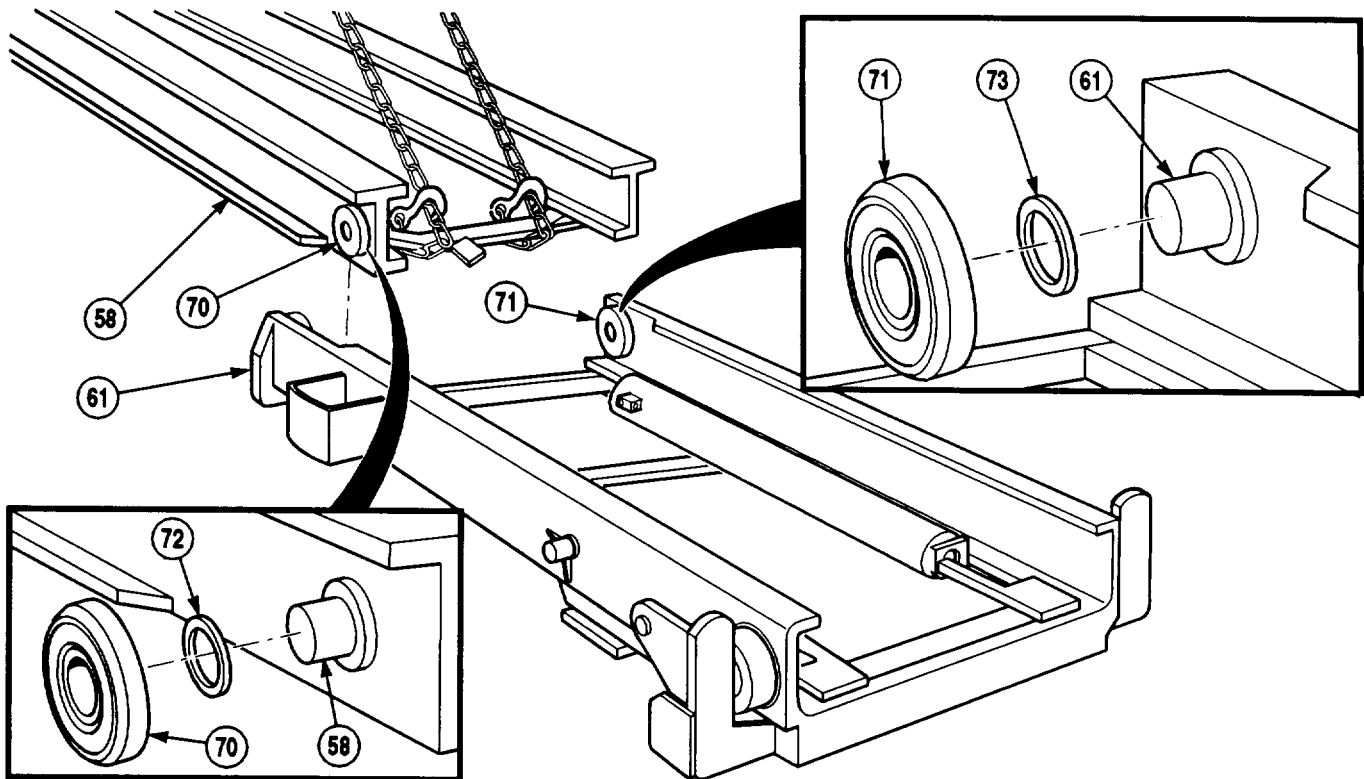
(3) Install two secondary cylinders (75 and 76) on outer rail (61).

WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

(4) Install two retaining rings (74) on secondary cylinders (75 and 76).





NOTE

- **Position two secondary chains through center rail prior to center rail installation.**
- **A pry bar may be required to position center rail in outer rail.**

- (5) Install two shims (73) and rollers (71) on outer rail (61).
- (6) Install two shims (72) and rollers (70) on center rail (58).

WARNING

- **Center rail weighs 361 lbs (164 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.**
- **All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.**

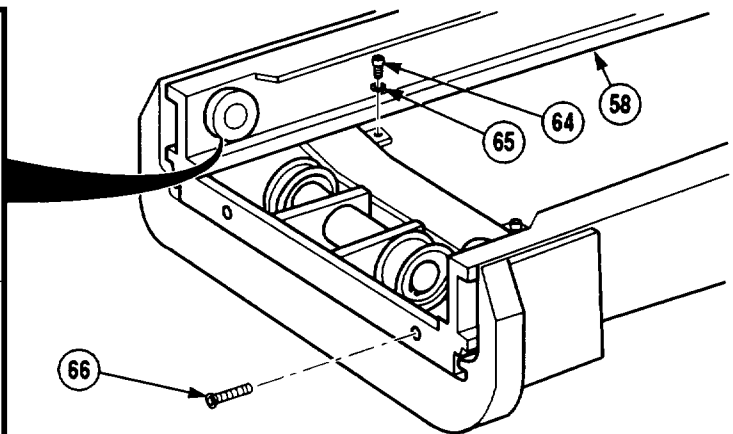
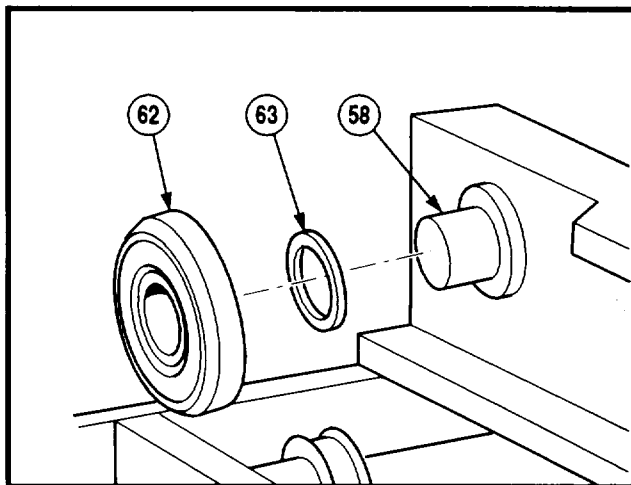
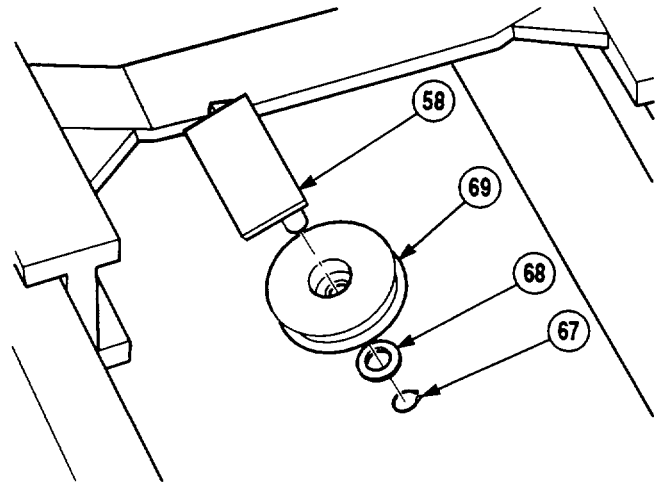
- (7) Install center rail (58) in outer rail (61).

13-2. MAST ASSEMBLY REPLACEMENT/REPAIR (CONT).

WARNING

Use care when removing or installing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

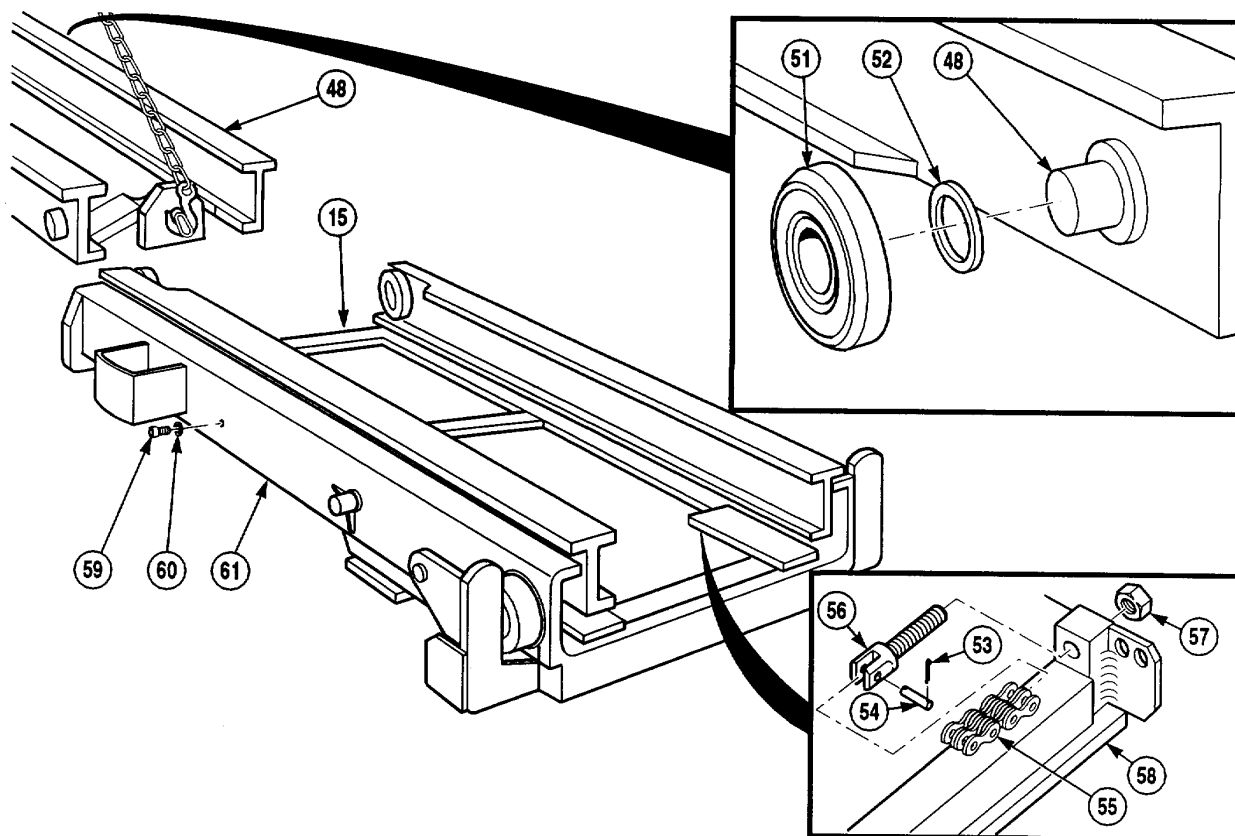
- (8) Install roller (69) on center rail (58) with spacer (68) and retaining ring (67).



WARNING

- **Center rail weighs 361 lbs (164 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.**
- **All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.**

- (9) Install two screws (66) in end of center rail (58).
- (10) Install two lock washers (65) and screws (64) in center rail (58).
- (11) Install two shims (63) and rollers (62) on center rail (58).



WARNING

- Inner rail assembly weighs 330 lbs (150 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

NOTE

- Position secondary chains clear of inner rail prior to installation of inner rail.
- Position two secondary chains through center rail prior to center rail installation.

(12) Install two lock washers (60) and screws (59) in outer rail (61).

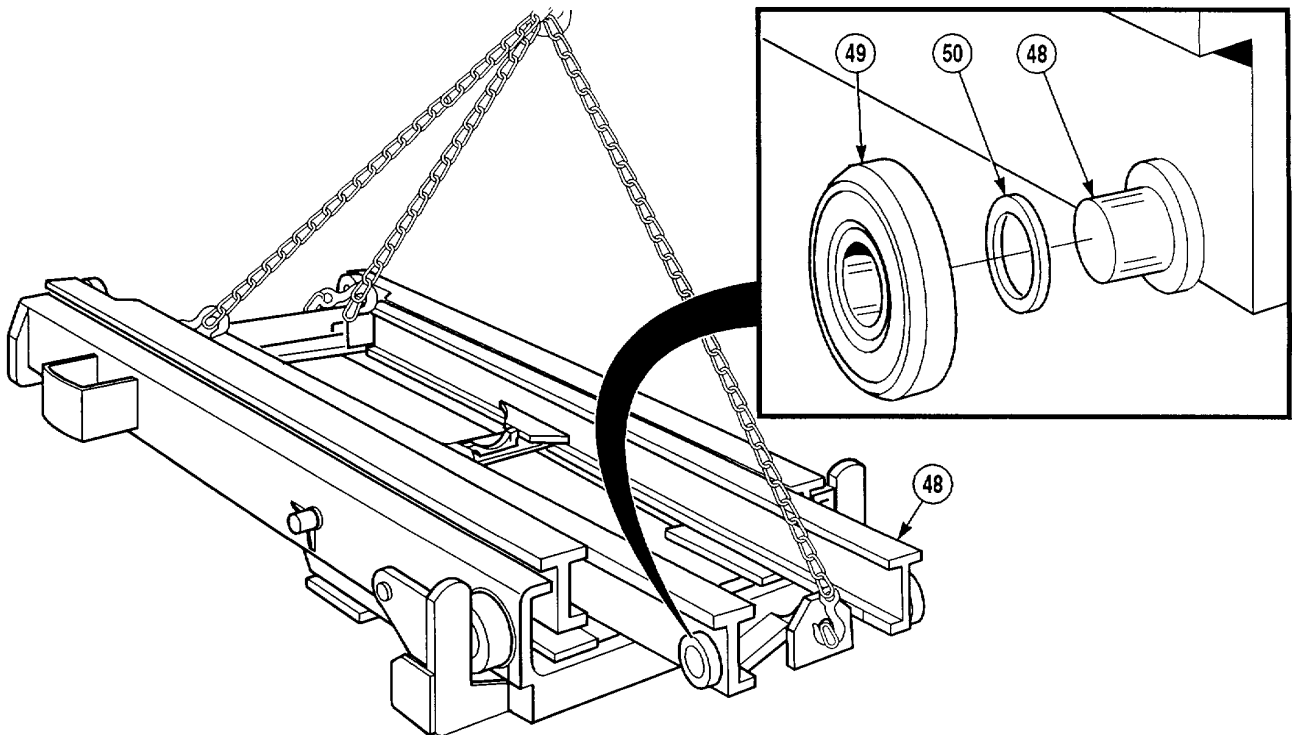
(13) Install two anchors (56) on center rail (58) with lock nuts (57).

(14) Install secondary chains (55) on anchors (56) with two pins (54) and four cotter pins (53).

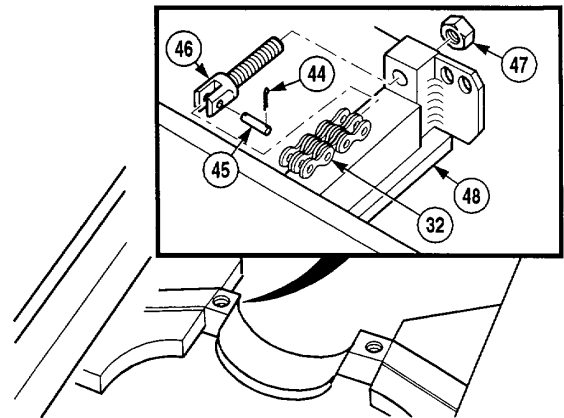
(15) Install two shims (52) and rollers (51) on inner rail (48).

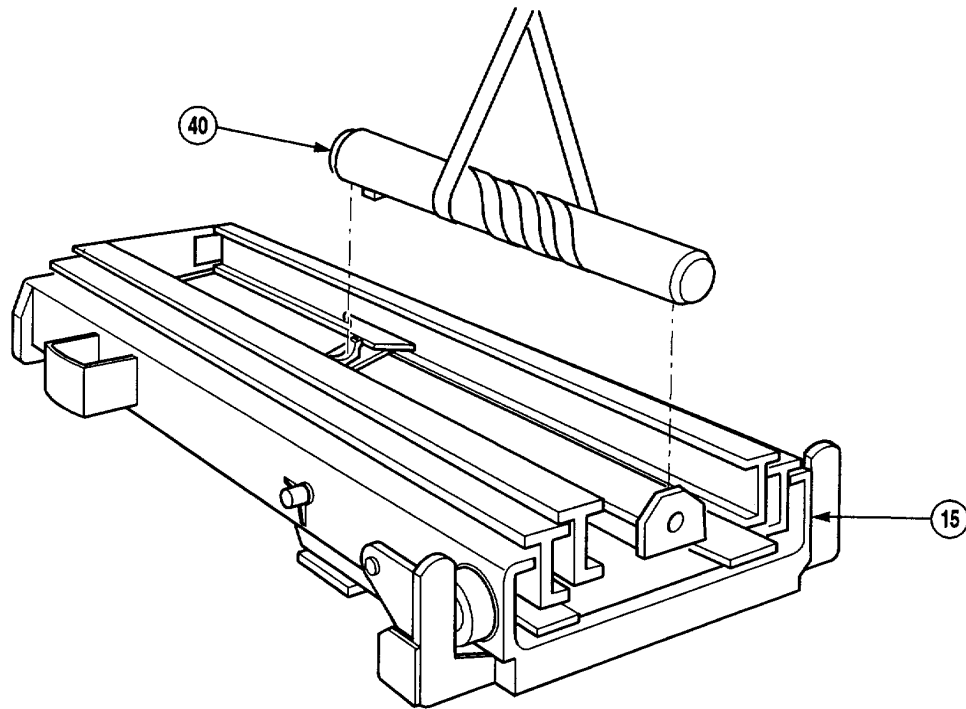
(16) Install inner rail (48) on mast assembly (15).

13-2. MAST ASSEMBLY REPLACEMENT/REPAIR (CONT).



- (17) Install two shims (50) and rollers (49) on inner rail (48).
- (18) Install two anchors (46) on inner rail (48) with lock nuts (47).
- (19) Install primary chains (32) on anchors (46) with two pins (45) and four cotter pins (44).



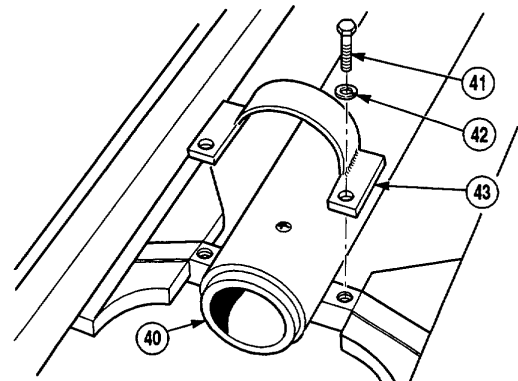


WARNING

- **Primary cylinder assembly weighs 80 lbs (36 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.**
- **All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.**

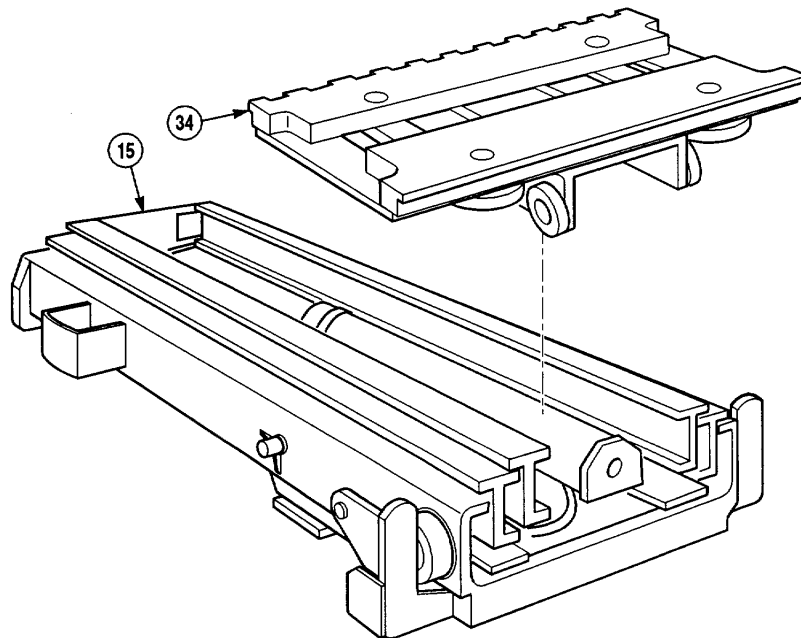
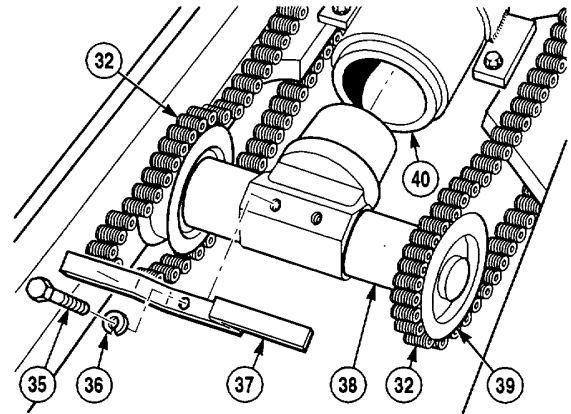
(20) Install primary cylinder (40) on mast assembly (15).

(21) Install cylinder retainer (43) on primary cylinder (40) with two lock washers (42) and screws (41).



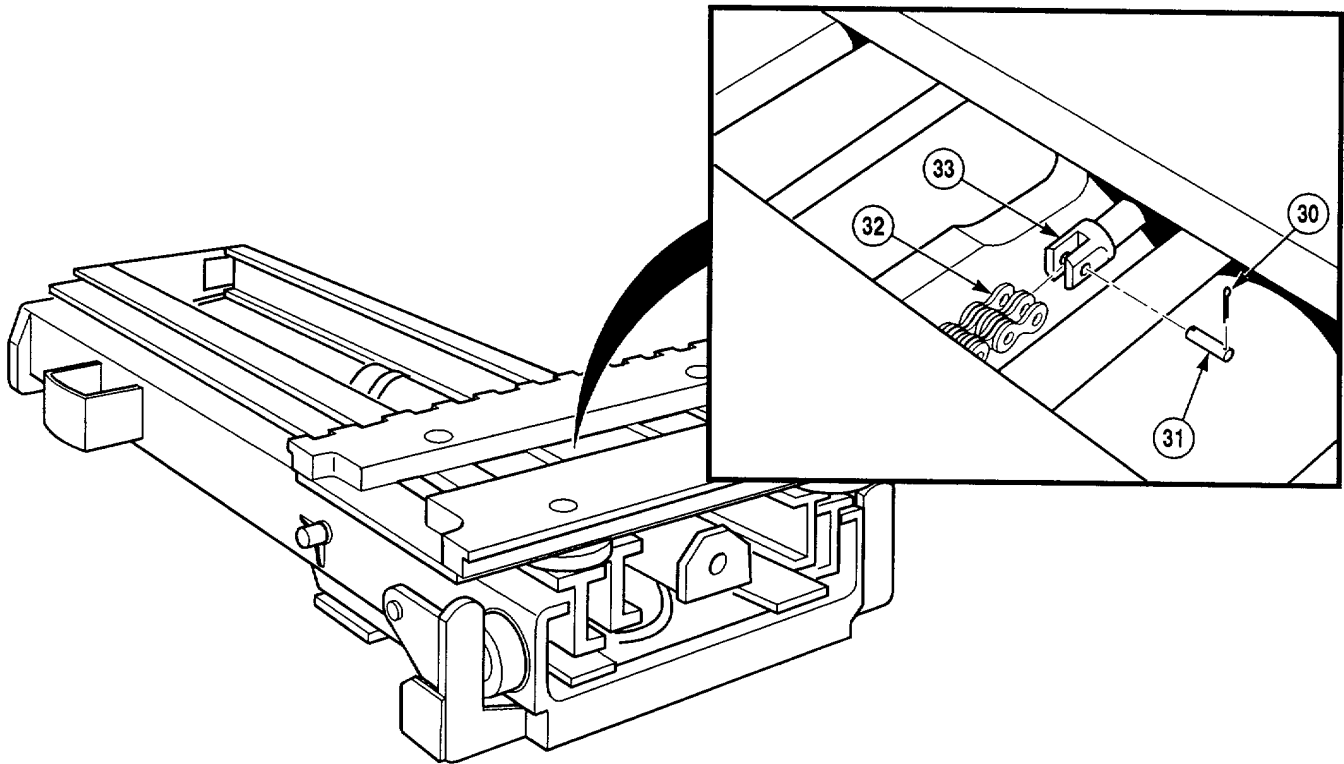
13-2. MAST ASSEMBLY REPLACEMENT/REPAIR (CONT).

- (22) Install cross head (38) on primary cylinder (40).
- (23) Install two primary chains (32) on rollers (39).
- (24) Install two chain retainers (37) on cross head (38) with four lock washers (36) and screws (35).

**WARNING**

- Carriage assembly weighs 802 lbs (364 kg). Attach lifting device prior to installation to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

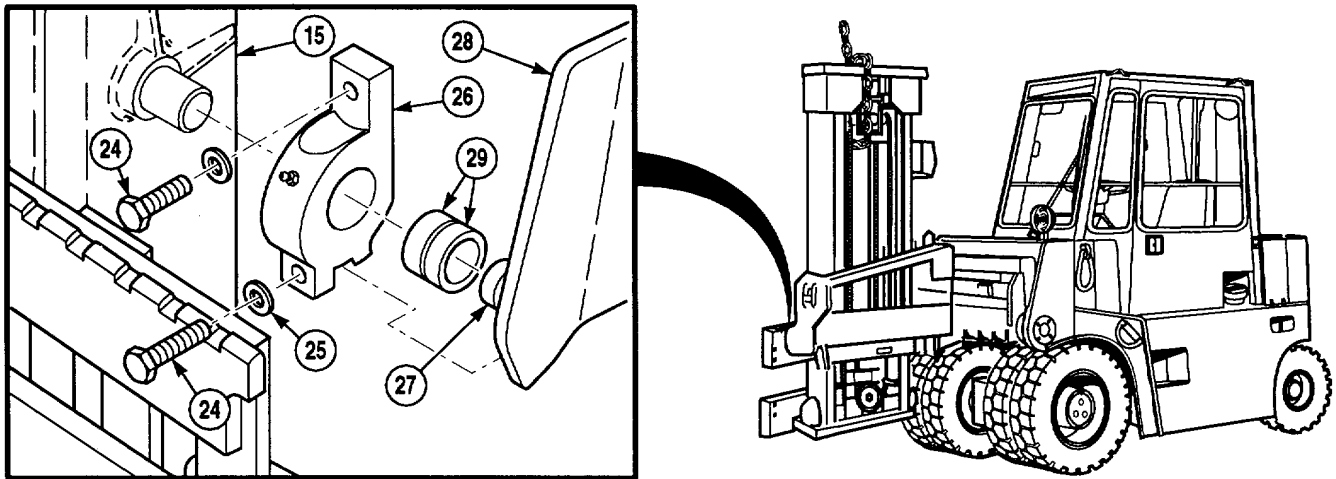
- (25) Using a lifting device, install carriage (34) on mast assembly (15).



(26) Install two primary chains (32) on anchors (33) with two pins (31) four cotter pins (30).

13-2. MAST ASSEMBLY REPLACEMENT/REPAIR (CONT).

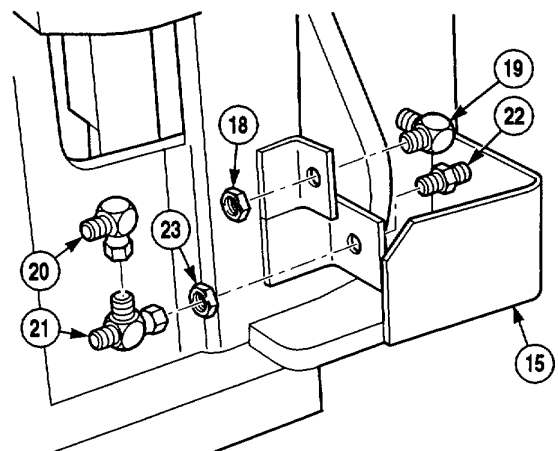
e. Installation.



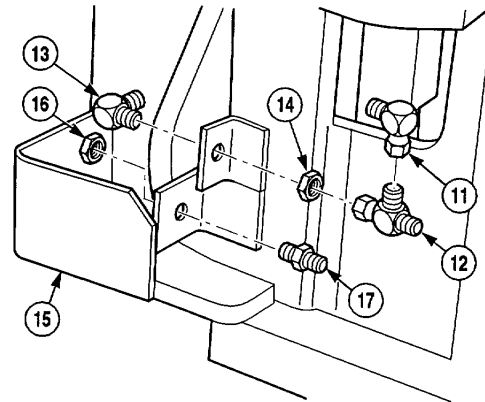
WARNING

- Mast assembly weighs 4,000 lbs (1,814 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

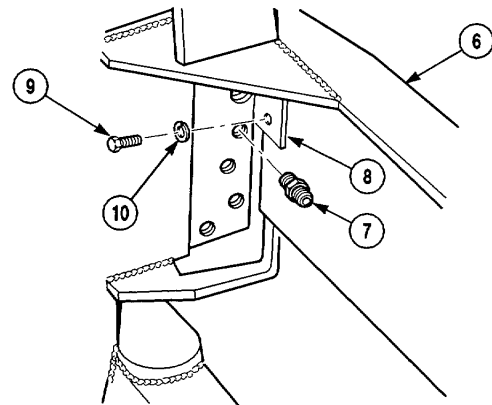
- (1) With the aid of an assistant, using a lifting device, install mast assembly (15) on pivot and shift assembly (28) with two bearings (29), two bearing clamps (26), two caps (27), four washers (25), and screws (24).
- (2) Install fitting (22) on mast assembly (15) with lock nut (23).
- (3) Install tee (21) on fitting (22).
- (4) Install elbow (20) on tee (21).
- (5) Install elbow (19) on mast assembly (15) with lock nut (18).



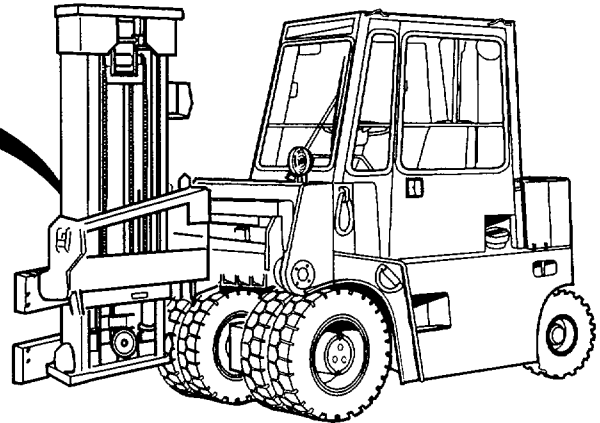
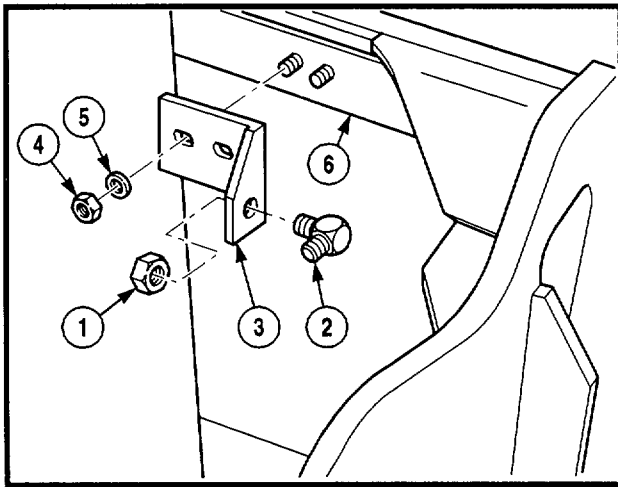
- (6) Install fitting (17) on mast assembly (15) with lock nut (16).
- (7) Install elbow (13) on mast assembly (15) with lock nut (14).
- (8) Install tee (12) on elbow (13).
- (9) Install elbow (11) on tee (12).



- (10) Install manifold (8) on pivot arm (6) with two lock washers (10) and screws (9).
- (11) Install four fittings (7) on manifold (8).



13-2. MAST ASSEMBLY REPLACEMENT/REPAIR (CONT).



(12) Install bracket (3) on pivot arm (6) with two washers (5) and nuts (4).

(13) Install elbow (2) on bracket (3) with lock nut (1).

NOTE**Follow-on Maintenance:**

- Install tilt cylinders (TM 10-3930-669-20).
- Install pivot cylinder (TM 10-3930-669-20).
- Install tilt cylinder hoses (TM 10-3930-669-20).
- Install mast hydraulic hoses (TM 10-3930-669-20).
- Install pivot arm hoses and tubes (TM 10-3930-669-20).
- Install backrest (TM 10-3930-669-20).
- Install level indicator (TM 10-3930-669-20).
- Install mast flood light (TM 10-3930-669-20).
- Connect batteries (TM 10-3930-669-20).
- Install forks (TM 10-3930-669-10).
- Remove wheel chocks (TM 10-3930-669-20).
- Pivot mast to front (TM 10-3930-669-10).

END OF TASK

13-3. CARRIAGE REPLACEMENT/REPAIR.

This task covers:

- | | | |
|----------------|------------------------|-----------------|
| a. Removal | c. Cleaning/Inspection | e. Installation |
| b. Disassembly | d. Assembly | |

INITIAL SETUP*Tools and Special Tools*

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)
Lifting Device, Minimum Capacity 3000 lbs
(1814 kg)

Personnel Required

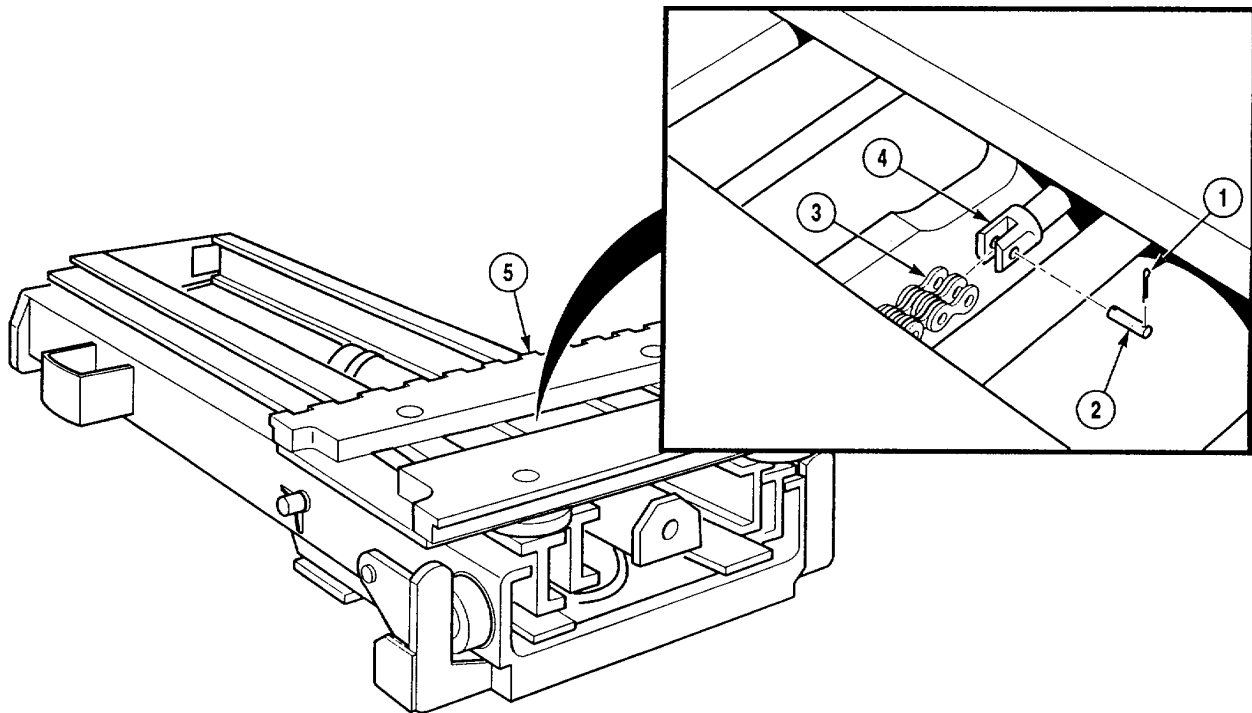
Two

Equipment Condition

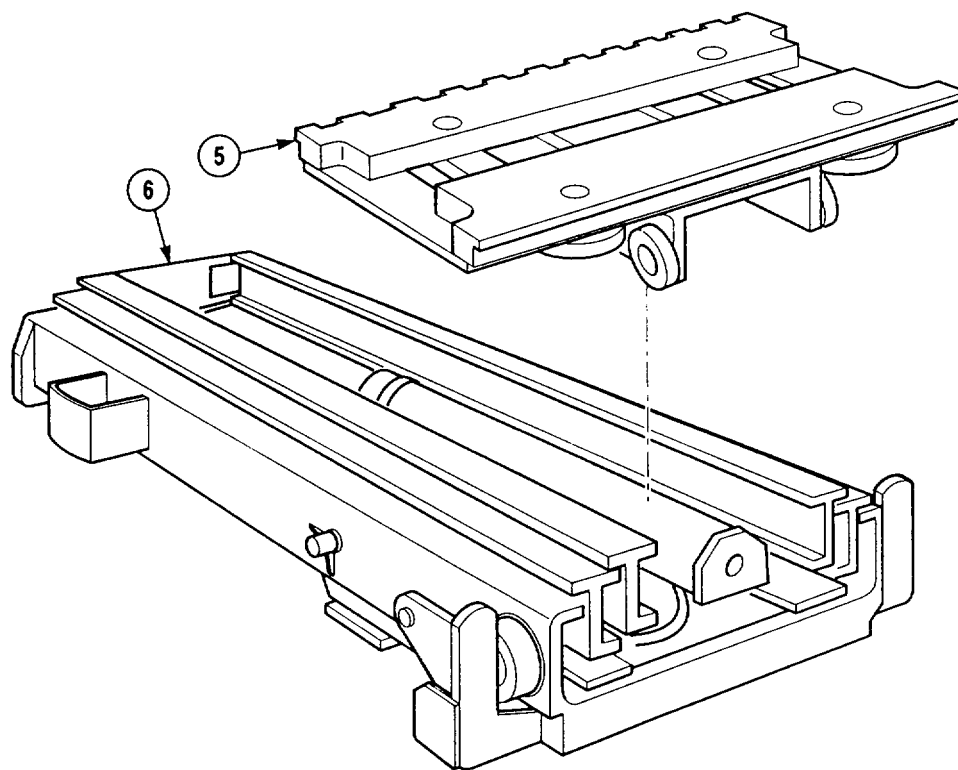
Mast removed (Para 13-2)

Materials /Parts

Solvent, Dry-cleaning (Item 20, Appendix B)
Nut, Lock (2)
Pin, Cotter (4)
Screws, Lock (4)

a. Removal

- (1) Remove four cotter pins (1), two pins (2), and primary chains (3) from anchors (4). Discard cotter pins.
- (2) Position two primary chains (3) under carriage (5).

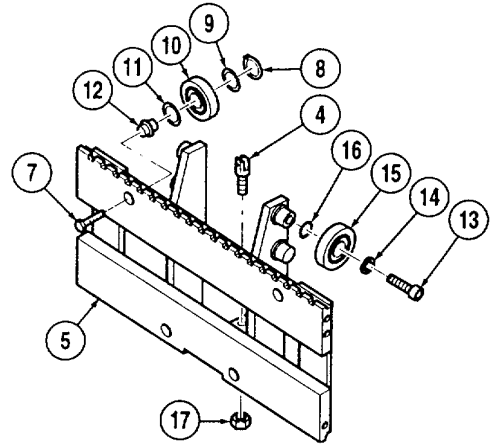
13-3. CARRIAGE REPLACEMENT/REPAIR (CONT).**WARNING**

- Carriage assembly weighs 802 lbs (364 kg). Attach lifting device prior to removal to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

(3) Using lifting device, remove carriage (5) from mast assembly (6).

b. Disassembly**WARNING**

Use care when removing or installing snap and retaining ring. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury,



- (1) Remove four lock screws (7), retaining rings (8), shims (9), rollers (10), shims (11), and shafts (12) from carriage (5). Discard lock screws.
- (2) Remove four screws (13), washers (14), roller bearings (15), and shims (16) from carriage (5).
- (3) Remove two lock nuts (17) and anchors (4) from carriage (5). Discard lock nuts.

c. Cleaning/Inspection.**WARNING**

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

- (1) Clean all metal parts with dry-cleaning solvent.
- (2) Inspect all parts for wear, cracks, nicks, burrs, or scratches.
- (3) Replace all damaged parts.

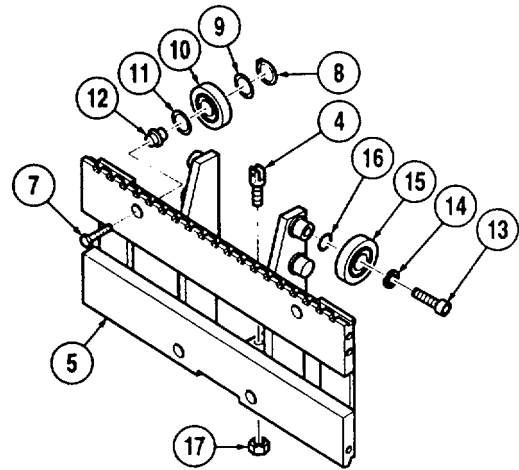
13-3. CARRIAGE REPLACEMENT/REPAIR (CONT).**d. Assembly.**

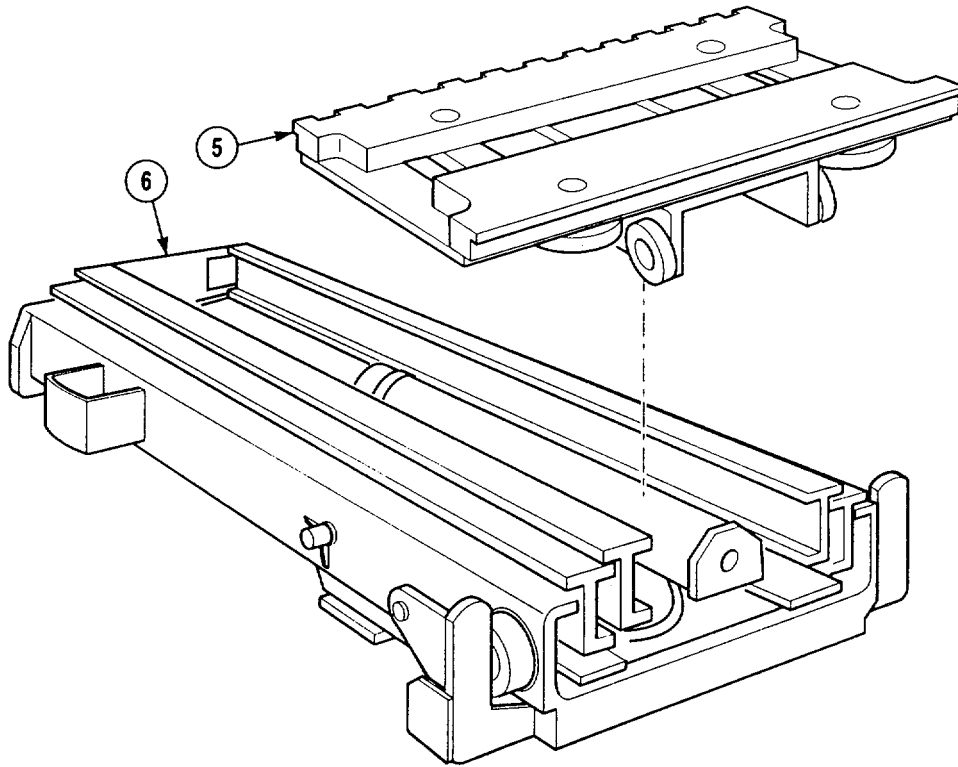
- (1) Install anchor (4) on carriage (5) with two lock nuts (17).
- (2) Install four roller bearings (15) on carriage (5) with shims (16), washers (14), and screws (13).

WARNING

Use care when removing or installing snap and retaining ring. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury,

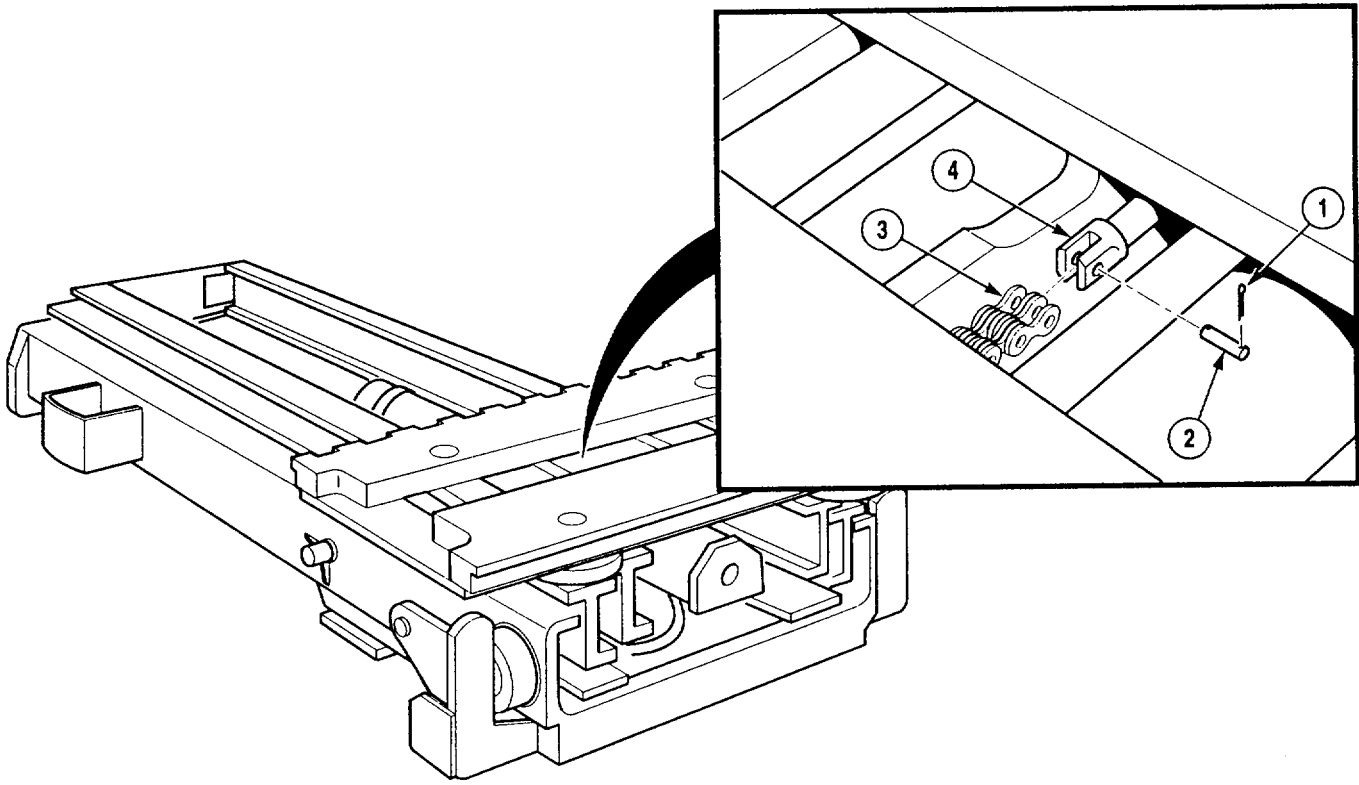
- (3) Install four rollers (10) on carriage (5) with shafts (12), shims (11), shims (9), retaining rings (8), and lock screws (7).



e. Installation.**WARNING**

- Carriage assembly weighs 802 lbs (364 kg). With the aid of an assistant, attach lifting device prior to installation to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

(1) With the aid of an assistant, use lifting device to install carriage (5) on mast assembly (6).

13-3. CARRIAGE REPLACEMENT/REPAIR (CONT).

(27) Install two primary chains (3) on anchors (4) with two pins (2) and four cotter pins (1).

NOTE**Follow-on Maintenance:**

- Install mast (Para 13-2).
- Adjust mast (TM 10-3930-669-20).
- Adjust carriage chains (TM 10-3930-669-20).

END OF TASK

13-4. FRAME COUNTERWEIGHT REPLACEMENT.

This task covers:

- a. Removal b. Cleaning/Inspection c. Installation

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Lifting Device, Minimum Capacity 3000 lbs (1,814 kg)
- Lifting Eye, (Item 16, Appendix E)
- Wrench, Torque (0-60 N.m) (Item 12, Appendix E)
- Wrench, Torque (0 to 175 lb-ft [0-237 N.m]) (Item 5, Appendix E)

Materials/Parts

- Rags, Wiping (Item 19, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)
- Nuts, Lock (4)

Equipment Condition

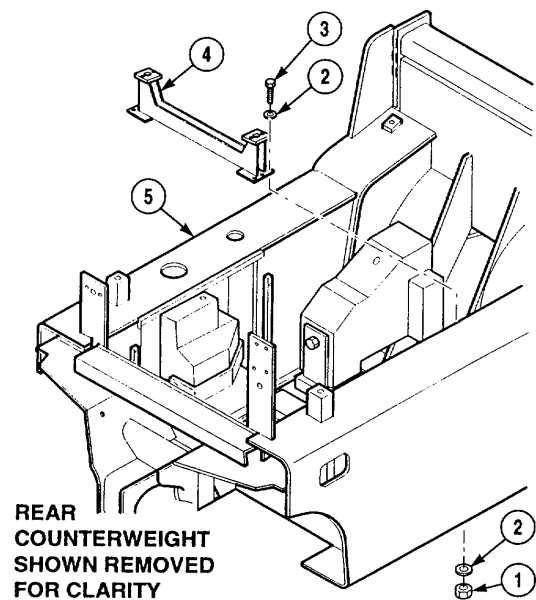
- Priority valve removed (TM 10-3930-669-20)
- Engine/transmission assembly removed (Para 3-3)

a. Removal

WARNING

Front engine mount weighs 60 lbs (27 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (1) Remove six nuts (1), twelve washers (2), and six screws (3) from front engine mount (4) and forklift (5).
- (2) Using lifting device, remove front engine mount (4) from forklift (5).



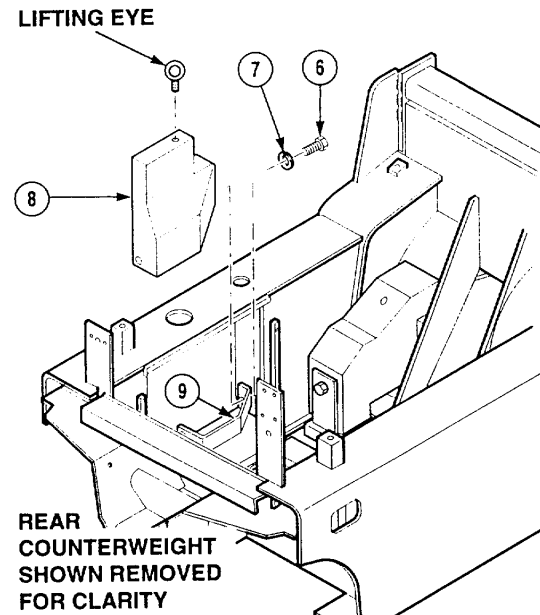
13-4. FRAME COUNTERWEIGHT REPLACEMENT (CONT).

- (3) Remove two screws (6) and washers (7) from rear lead counterweight (8) and rear steel counterweight (9).
- (4) Install lifting eye in rear counterweight (8).

WARNING

Rear lead counterweight weighs 580 lbs (263 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (5) Using lifting device, remove rear lead counterweight (8) from rear steel counterweight (9).
- (6) Remove lifting eye from rear lead counterweight (8).

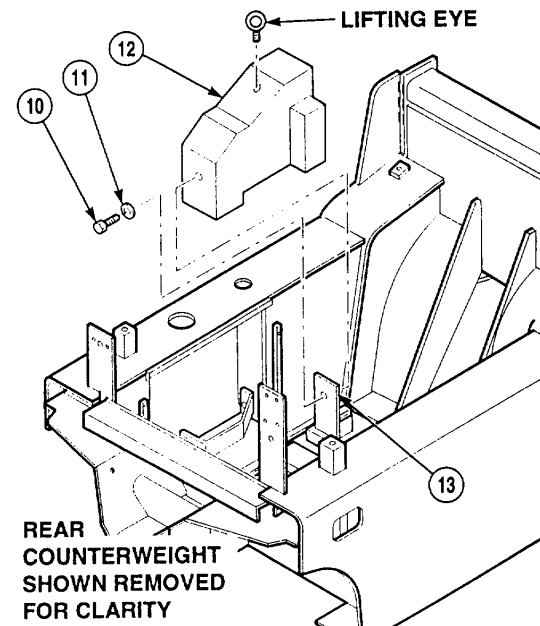


- (7) Remove two screws (10) and washers (11) from front lead counterweight (12) and front steel counterweight (13).
- (8) Install lifting eye in front counterweight (12).

WARNING

Front lead counterweight weighs 530 lbs (240 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

- (9) Using lifting device, remove front lead counterweight (12) from front steel counterweight (13).
- (10) Remove lifting eye from front lead counterweight (12).



- (11) Remove two lock nuts (14), four washers (15), and two screws (16) from front steel counterweight (13) and forklift (5). Discard lock nuts.
- (12) Remove two lock nuts (14), four washers (15), and two screws (16) from rear steel counterweight (9) and forklift (5). Discard lock nuts.

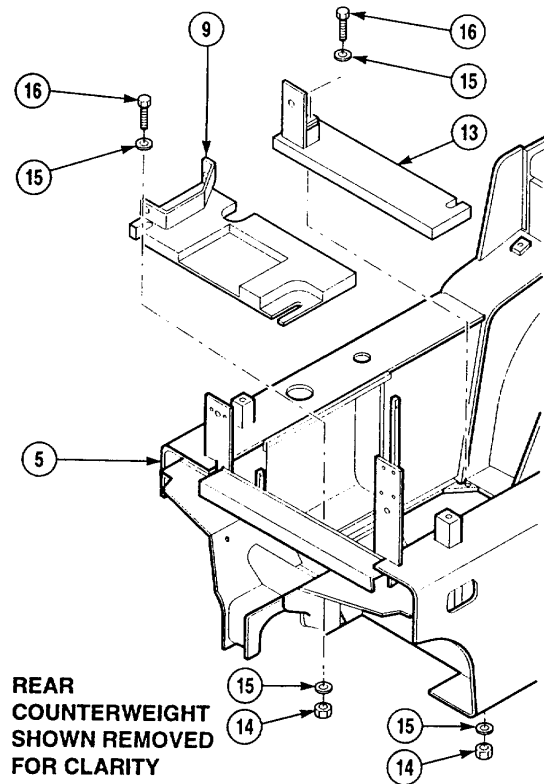
WARNING

Front steel counterweight weighs 170 lbs (77 kg) and rear steel counterweight weighs 110 lbs (50 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

NOTE

Note position of weights prior to removal.

- (13) Using lifting device, remove front steel counterweight (13) from forklift (5).
- (14) Using lifting device, remove rear steel counterweight (9) from forklift (5).



13-4. FRAME COUNTERWEIGHT REPLACEMENT (CONT).

b. Cleaning/Inspection.

WARNING

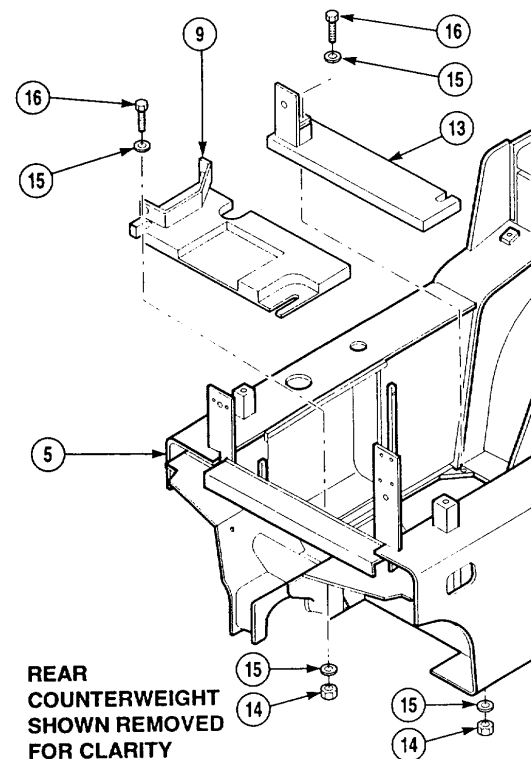
- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

- (1) Clean all parts with dry-cleaning solvent and wipe dry with wiping rag.
- (2) Inspect thread inserts in lead weights for cracks or bulging.
- (3) Replace all damaged parts.

c. *Installation.***WARNING**

Front steel counterweight weighs 170 lbs (77 kg) and rear steel counterweight weighs 110 lbs (50 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- (1) Using lifting device, install rear steel counterweight (9) in forklift (5) with two screws (16), four washers (5), and two lock nuts (14). Tighten lock nuts to 41 lb-ft (55 N.m).
- (2) Using lifting device, install front steel counterweight (13) in forklift (5) with two screws (16), four washers (15) and two lock nuts (14). Tighten lock nuts to 41 lb-ft (55 N.m).

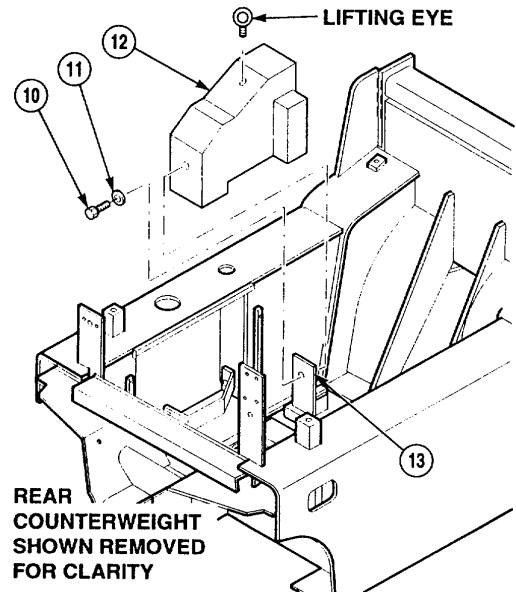


- (3) Install lifting eye in front lead counterweight (12).

WARNING

Front lead counterweight weighs 530 lbs (240 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- (4) Using lifting device, install front lead counterweight (12) in front steel counterweight (13) with two washers (11) and screws (10).
 (5) Remove lifting eye from front lead counterweight (12).

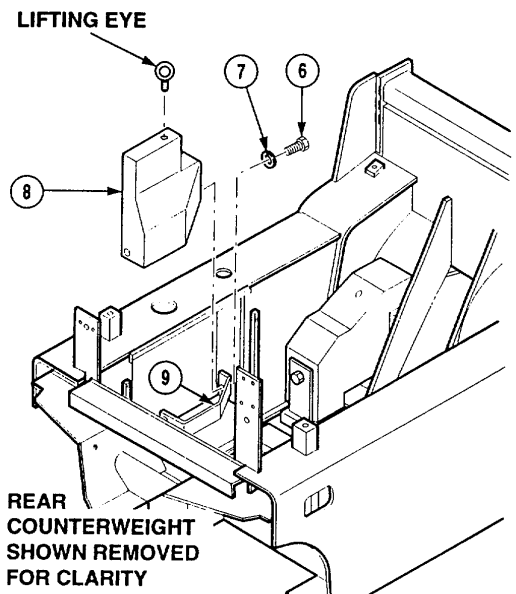


- (6) Install lifting eye in rear lead counterweight (8).

WARNING

Rear lead counterweight weighs 580 lbs (263 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- (7) Using lifting device, install rear lead counterweight (8) in rear steel counterweight (9) with two washers (7) and screws (6).
 (8) Remove lifting eye from rear lead counterweight (8).



13-4. FRAME COUNTERWEIGHT REPLACEMENT (CONT).**WARNING**

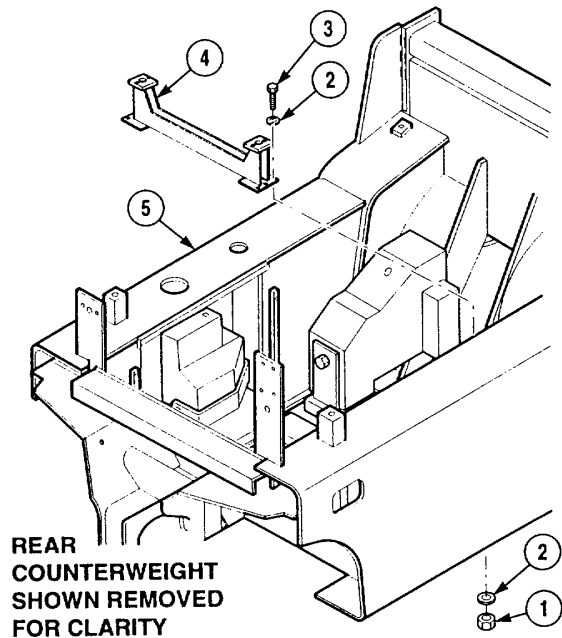
Front engine mount weighs 60 lbs (27 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- (9) Using lifting device, install front engine mount (4) in forklift (5) with six screws (3), twelve washers (2), and six nuts (1). Tighten nuts 63 lb-ft (86 N.m).

NOTE**Follow-on Maintenance:**

- Install engine/transmission assembly (Para 3-3).
- Install priority valve (TM 10-3930-669-20).

END OF TASK



13-5. COUNTERWEIGHT REPLACEMENT.

This task covers:

- a. Removal b. Cleaning/Inspection c. Installation

INITIAL SETUP*Tools and Special Tools*

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix B)
Wrench, Torque (0 to 600 lb-ft [0-813 N•m])
(Item 5, Appendix B)
Lifting Device, Minimum Capacity 3000 lbs
(1814 kg)
(TM 10-3930-669-20)

Equipment Condition

Engine OFF (TM 10-3930-669-10)
Parking brake applied (TM 10-3930-669-10)
Wheels chocked (TM 10-3930-669-10)
Air cleaner assembly removed
(TM 10-3930-669-20)
Muffler assembly removed

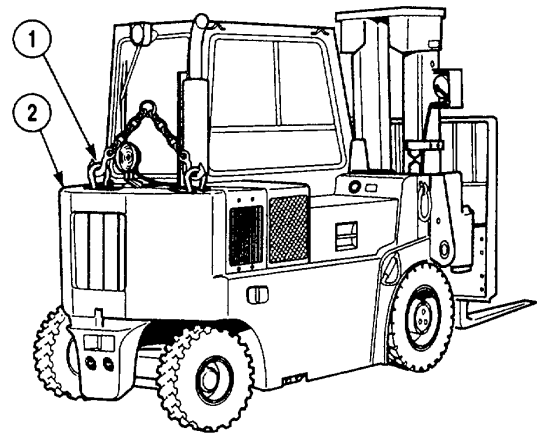
Materials/ Parts

Solvent, Dry-cleaning (Item 20, Appendix B)
Seal

a. Removal.**WARNING**

Counterweight weighs 2,945 lbs (1,336 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

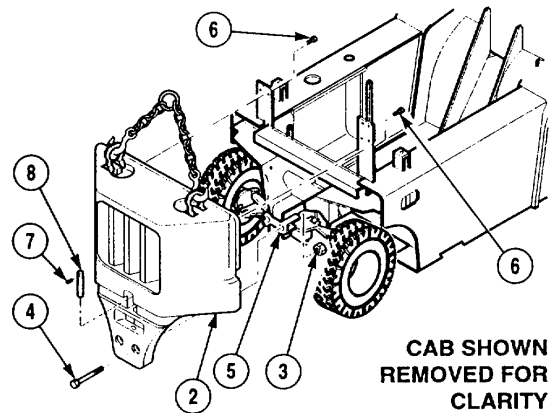
- (1) Attach lifting device to two devices (1) in counterweight (2) and adjust slack out of lifting device.



13-5. COUNTERWEIGHT REPLACEMENT (CONT).**WARNING**

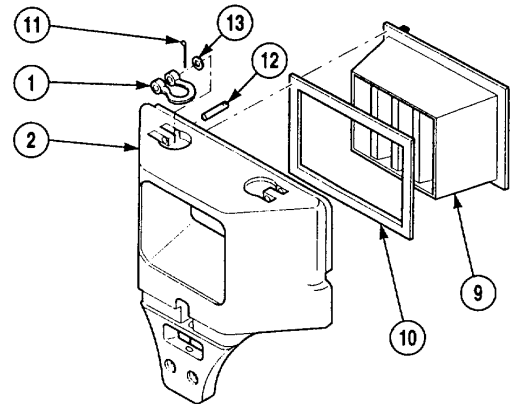
Counterweight weighs 2,945 lbs (1,336 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

- (2) Remove two nuts (3) and screws (4) from counterweight (2) and chassis (5).
- (3) Remove two screws (6) from counterweight (2) and chassis (5).
- (4) Remove counterweight (2) from chassis (5).
- (5) Remove retaining pin (7) and pin (8) from counterweight (2).
- (6) Place counterweight (2) on work surface and remove lifting device.

**WARNING**

Counterweight insert weighs 146 lbs (66 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

- (7) Using a lifting device, remove counterweight insert (9) and seal (10) from counterweight (2). Discard seal.
- (8) Remove two retaining pins (11) from two pins (12).
- (9) Remove two pins (12), washers (13), and devices (1) from counterweight (2).



b. Cleaning/Inspection.

WARNING

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

- (1) Clean all metal parts with dry-cleaning solvent.
- (2) Inspect all parts for breaks, cracks, burrs, and sharp edges.
- (3) Replace all damaged parts.

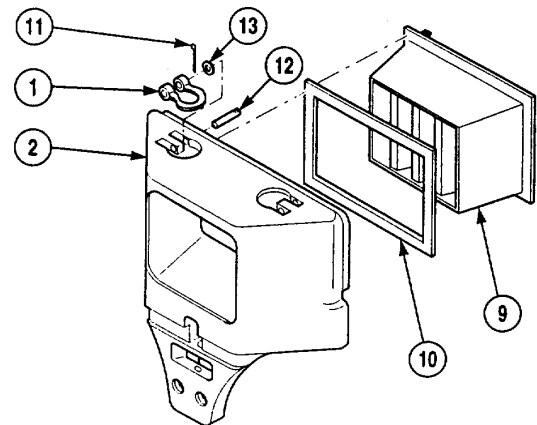
c. Installation.

- (1) Install two devices (1) in counterweight (2) with two washers (13), pins (12), and retaining pins (11).

WARNING

Counterweight insert weighs 146 lbs (66 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

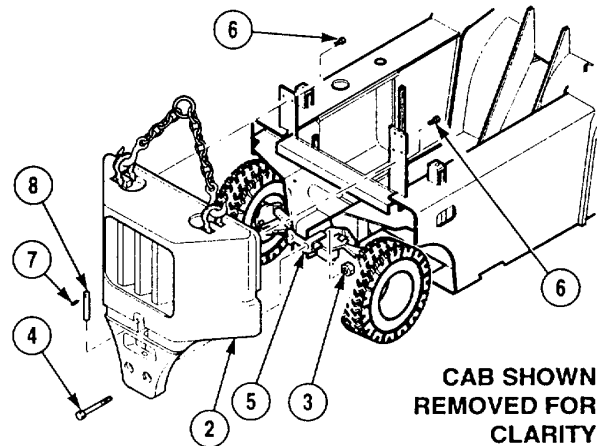
- (2) Using a lifting device, position counterweight insert (9) and seal (10) in counterweight (2).
- (3) Attach lifting device to two devices (1) in counterweight (2).



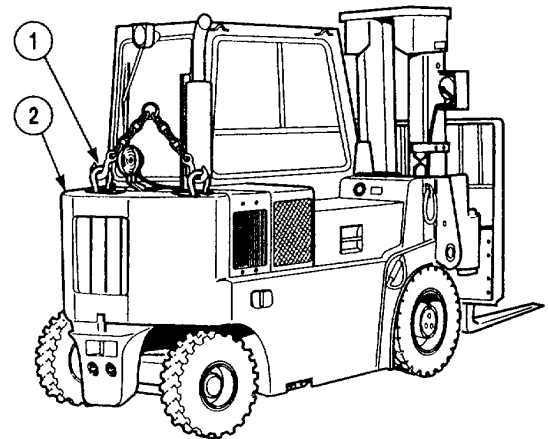
13-5. COUNTERWEIGHT REPLACEMENT (CONT).**WARNING**

Counterweight weighs 2,945 lbs (1,336 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

- (4) Using lifting device, raise counterweight (2) and install pin (8) with retaining pin (7).
- (5) Install counterweight (2) on chassis (5) with two screws (6) and two screws (4) and nuts (3).
- (6) Tighten two screws (6) and two screws (4) 524 lb-ft (710 N.m).
- (7) Remove lifting device from two devices (1) on counterweight (2).

**NOTE****Follow-on Maintenance:**

- **Install muffler assembly (TM 10-3930-669-20).**
- **Install air cleaner assembly (TM 10-3930-669-20).**
- **Remove wheel chocks (TM 10-3930-669-10).**

**END OF TASK**

**CHAPTER 14
CAB AND BODY MAINTENANCE**

Para	Contents	Page
14-1	Introduction.....	14-1
14-2	Cab Glass Replacement	14-2

14-1. INTRODUCTION.

This chapter contains maintenance instructions for removing, replacing, repairing, and installing cab and body components authorized by the Maintenance Allocation Chart (MAC) at the Direct Support and General Support Maintenance level.

14-2. CAB GLASS REPLACEMENT.

This task covers:

a. Removal

b. Cleaning/Inspection

c. Installation

INITIAL SETUP*Tools and Special Tools*

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)
Tool Kit, Glass Cutting: Vehicle
(Item 9, Appendix E)

Materials/Parts

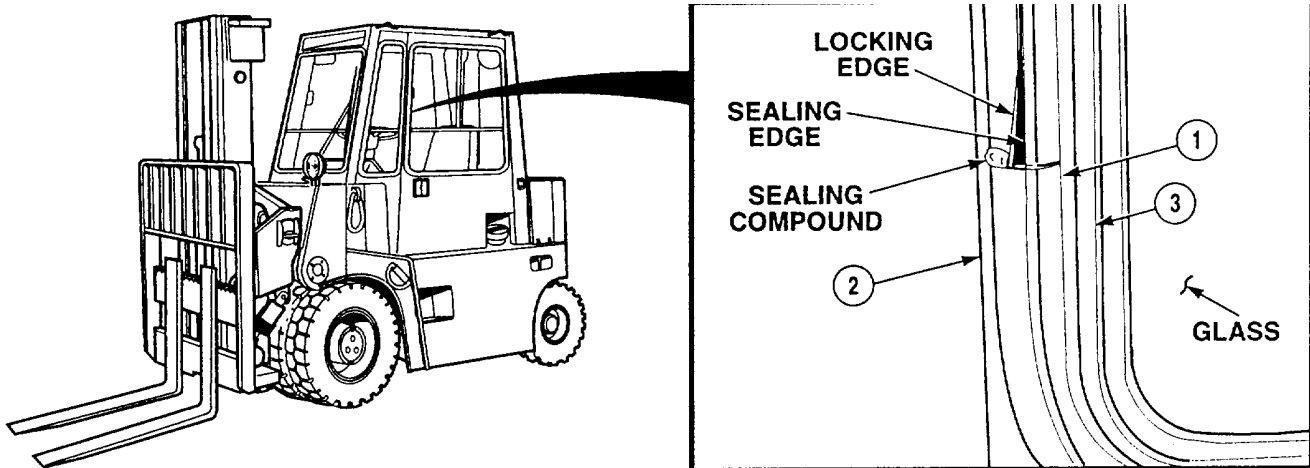
Compound, Sealing (Item 24, Appendix B)
Rags, Wiping (Item 19, Appendix B)

Materials/Parts - Continued

Solvent, Dry-cleaning (Item 20 Appendix B)
Tags, Identification (Item 21, Appendix B)

Equipment Condition

Engine OFF (TM 10-3930-669-10)
Parking brake applied (TM 10-3930-669-10)
Wheels chocked (TM 10-3930-669-10)

a. Removal**NOTE**

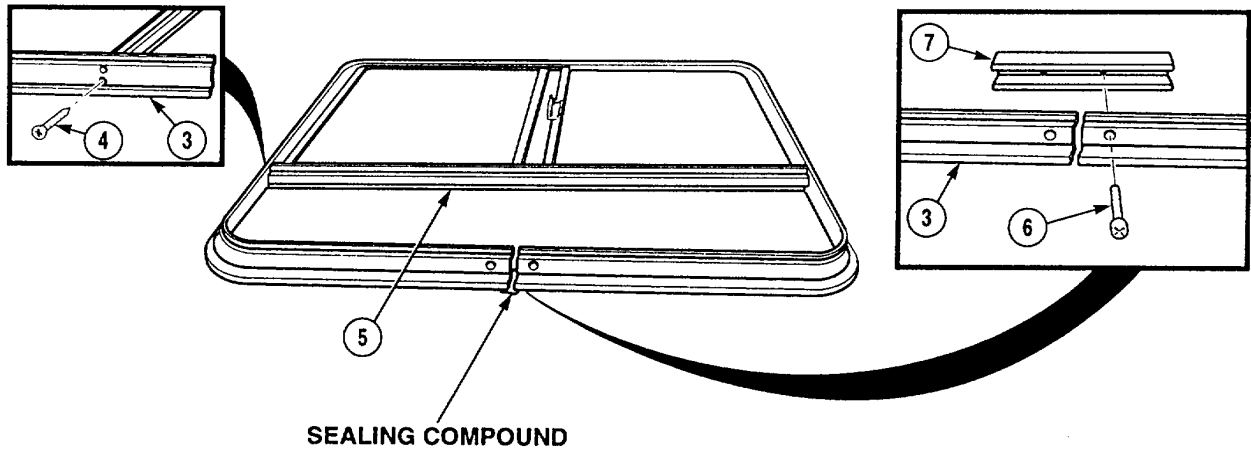
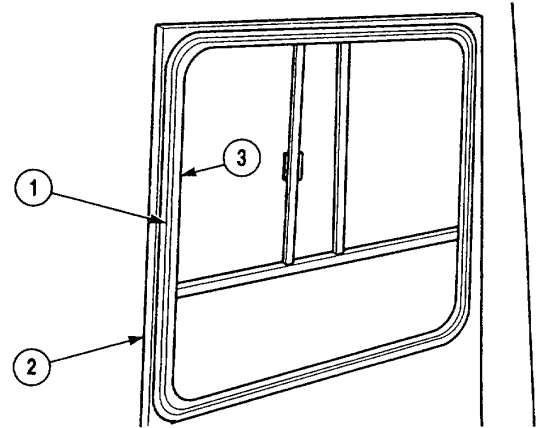
- Door glass replacement procedure is shown. Procedures for replacement of front glass, left side glass, and rear glass are similar.
- Moistening rubber seal contact points will allow rubber to move easier.

- (1) Remove sealing compound from ends of seal (1).
- (2) Move locking edge of seal (1) towards cab (2) to release sealing edge.
- (3) Move sealing edge of seal (1) away from frame assembly (3).

WARNING

Applying excessive or uneven pressure to cab glass may cause it to crack or break resulting in injury to personnel and damage to equipment.

- (4) Repeat Steps (2) and (3) around entire frame assembly (3).
- (5) Remove frame assembly (3) and seal (1) from cab (2).
- (6) Place frame assembly (3) on clean work surface.



NOTE

Frame disassembly procedure for the door is shown. Procedure to disassemble right side glass frame is similar.

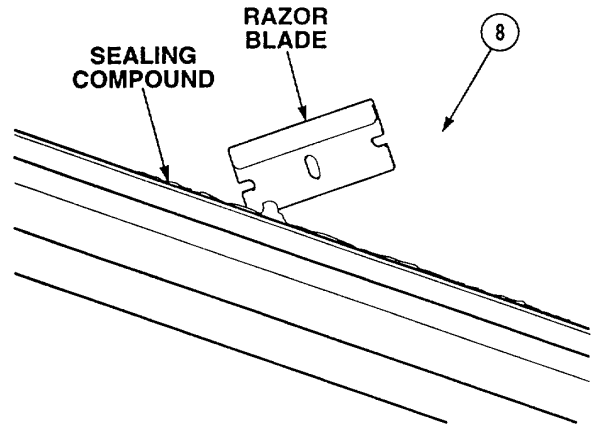
- (7) Remove four screws (4) from frame assembly (3) and frame track (5).
- (8) Remove two screws (6) and bracket (7) from frame assembly (3).
- (9) Remove sealing compound from frame assembly (3) joint.

14-2. CAB GLASS REPLACEMENT (CONT).

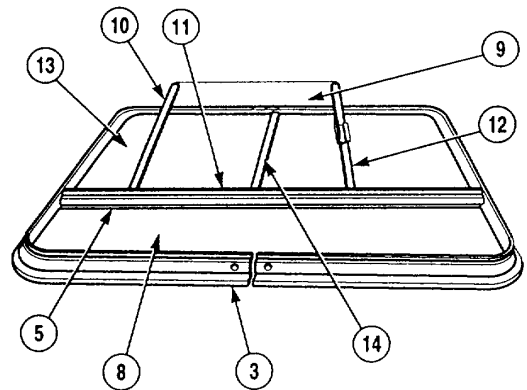
NOTE

The outer edge of each piece of glass is sealed to the frame with sealing compound.

- (10) Using razor blade, cut sealing compound on each framed edge of glass (8).



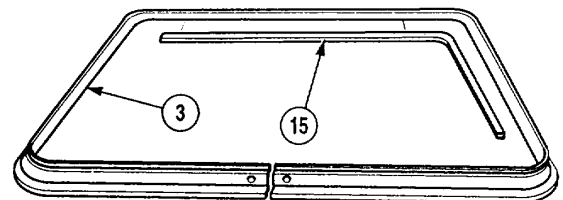
- (11) Separate frame assembly (3) at frame assembly joint.
- (12) Remove glass (9) and three frame edges (10, 11, and 12) from frame assembly (3) and frame track (5).
- (13) Remove glass (13) and frame edge (14) from frame assembly (3) and frame track (5).
- (14) Remove frame track (5) and glass (8) from frame assembly (3).



NOTE

Tag and mark frames prior to removal from glass.

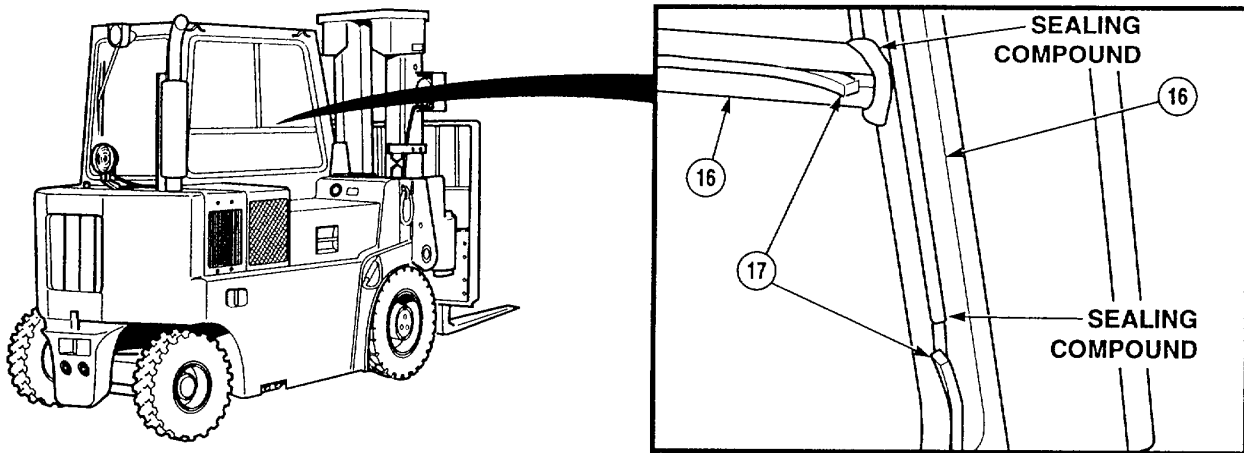
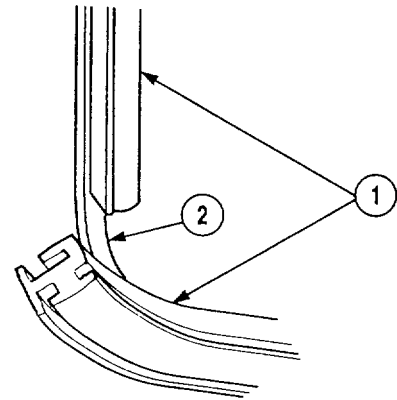
- (15) Remove frame track (5) from glass (8).
- (16) Remove frame edge (14) from glass (13).
- (17) Remove three frame edges (10, 11, and 12) from glass (9).
- (18) Remove channel (15) from frame assembly (3).



NOTE

Perform step (19) only if seal is damaged.

- (19) Remove seal (1) from cab (2).
- (20) Repeat steps (1) through (19), as required, for front glass, left side glass, and rear glass.



NOTE

Procedures for unlocking the seal of the top and right side glass are shown. All other procedures for replacing the top and right side glass are similar to the door glass replacement.

- (21) Remove sealing compound from ends of seal (16) and locking strips (17).
- (22) Repeat steps (3) through (19), as required, for right side and top glass.

14-2. CAB GLASS REPLACEMENT (CONT).**b. Cleaning/Inspection.****WARNING**

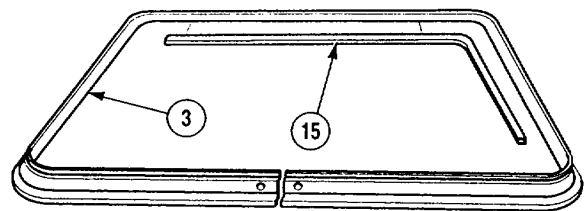
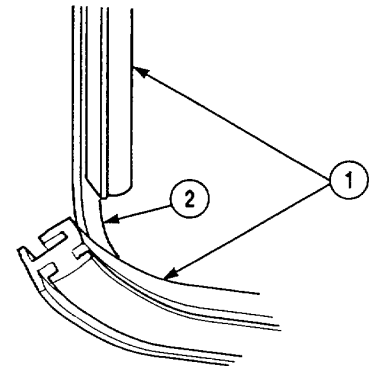
- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

- (1) Clean all metal parts with dry-cleaning solvent and wipe dry with wiping rag.
- (2) Remove all sealing compound residue from glass, seals, and frames.
- (3) Inspect all parts for breaks, cracks, burrs, and sharp edges.
- (4) Replace all damaged parts.

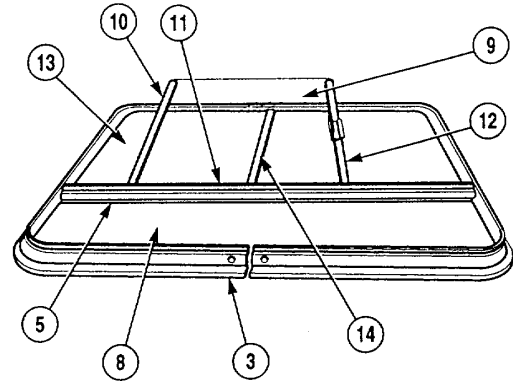
c. Installation.**NOTE**

- If seal was removed during removal, perform step (1).
- If seal was not removed during removal, proceed to step (2).

- (1) Install seal (1) on cab (2).
- (2) Apply sealing compound to outer surface of channel (15).
- (3) Install channel (15) in frame assembly (3).



- (4) Apply sealing compound to three frame edges (10, 11, and 12).
- (5) Install three frame edges (10, 11, and 12) on glass (9) as tagged and marked during removal.
- (6) Apply sealing compound to frame track (5) and frame edge (14).
- (7) Install frame edge (14) on glass (13) as tagged and marked during removal.
- (8) Install frame track (5) on glass (8) as tagged and marked during removal.

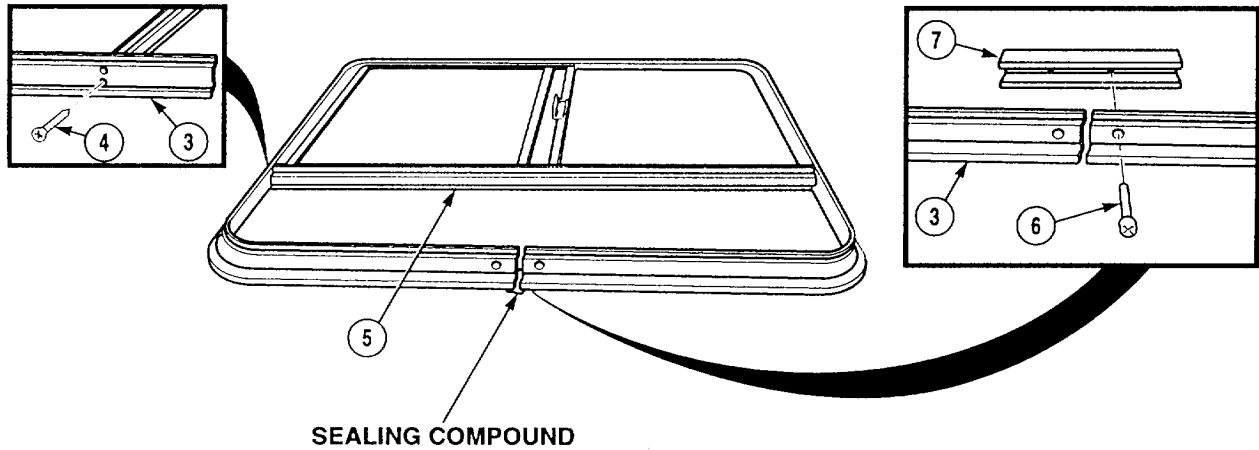


CAUTION

Do not allow sealing compound to get in channel of frame assembly. this will damage channel and not allow window to function properly.

- (9) Apply sealing compound to frame assembly (3).
- (10) Install glass (13) and frame edge (14) in frame assembly (3).
- (11) Install frame track (5) and glass (8) on glass (13) and frame assembly (3).
- (12) Install glass (9) and frame edges (10, 11, and 12) in frame track (5) and frame (3).
- (13) Position ends of frame assembly (3) together.

14-2. CAB GLASS REPLACEMENT (CONT)



SEALING COMPOUND

- (14) Install bracket (7) on frame assembly (3) with two screws (6).
- (15) Install frame track (5) on frame assembly (3) with four screws (4).

CAUTION

Do not allow sealing compound to get in channel of frame assembly. This will damage channel and not allow window to function properly.

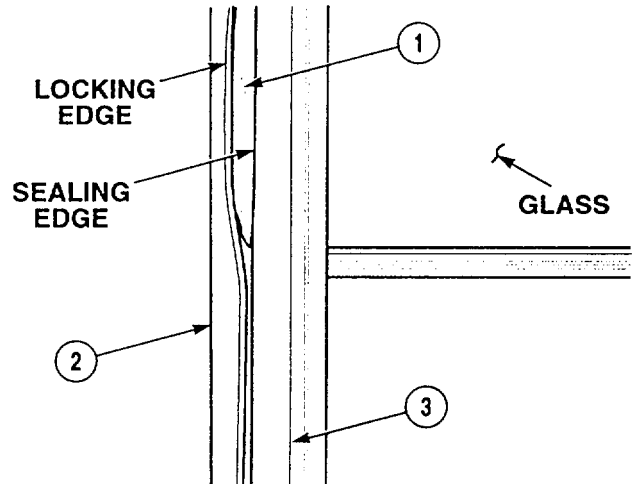
- (16) Apply small bead of sealing compound to the meeting edge of all glass and frame edges and frame assembly.

WARNING

Applying excessive or uneven pressure to cab glass may cause glass to crack or break resulting in injury to personnel and damage to equipment.

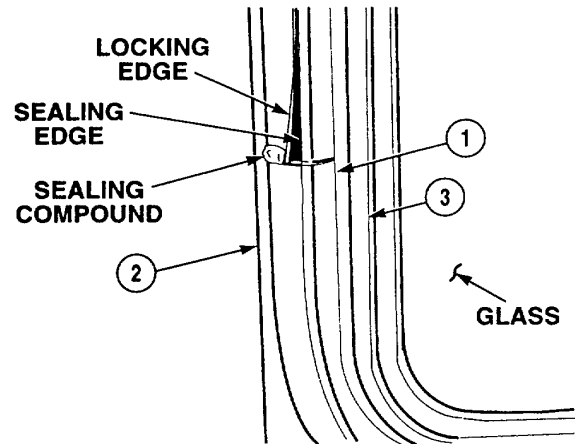
NOTE

- Moistening rubber seal contact points will allow rubber to move easier.
- Allow sealing edge of seal to move under locking edge when installing frame.



- (17) Install frame assembly (3) under sealing edge of seal (1) on cab (2).

- (18) Install sealing edge of seal (1) under locking edge of seal to lock frame assembly (3) to cab (2).
- (19) Apply sealing compound to meeting point of seal (1).
- (20) Use wiping rag to remove excess sealing compound.



NOTE

Procedures for locking the seal of the top and right side glass are shown. All other procedures for replacing the top and right side glass are similar to the door glass replacement.

- (21) Install locking strip (17) in seal (16) of right side glass and top glass.
- (22) Apply sealing compound to meeting points of seals (16).
- (23) Use wiping rag to remove excess sealing compound.

NOTE

Follow-on Maintenance:

- Remove wheel chocks (TM 10-3930-669-10)

END OF TASK

CHAPTER 15
HYDRAULIC SYSTEM MAINTENANCE

Para	Contents	Page
15-1	Introduction.....	15-1
15-2	Hydraulic Pump Replacement/Repair	15-2
15-3	Stack Valve Replacement/Repair.....	15-12
15-4	Priority Valve Repair.....	15-28
15-5	Tilt Cylinder Repair.....	15-30
15-6	Pivot Cylinder Repair.....	15-38
15-7	Mast Primary Cylinder Repair.....	15-45
15-8	Mast Secondary Cylinder Repair.....	15-51
15-9	Pivot and Shift Assembly Replacement/Repair.....	15-55
15-10	Hydraulic Reservoir Replacement.....	15-69
15-11	Side Shift Cylinder Replacement/Repair	15-73

15-1. INTRODUCTION.

This chapter contains maintenance instructions for removing, replacing, repairing, and installing hydraulic system components authorized by the Maintenance Allocation Chart (MAC) at the Direct Support and General Support Maintenance level.

15-2. HYDRAULIC PUMP REPLACEMENT/REPAIR.

This task covers:

- | | | |
|----------------|------------------------|-----------------|
| a. Removal | c. Cleaning/Inspection | e. Installation |
| b. Disassembly | d. Assembly | |

INITIAL SETUP*Tools and Special Tools*

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)
Pan, Drain (Item 11, Appendix E)
Wrench, Torque (0-60 N.m)
(Item 12, Appendix E)
Wrench, Torque (0 to 175 lb-ft [0-237 N.m])
(Item 5, Appendix E)
Wrench Set, Box and Open End Line
(Item 5, Appendix E)

Materials/Parts

Oil, Hydraulic (Item 15, Appendix B)
Rags, Wiping (Item 19, Appendix B)
Solvent, Dry-cleaning (Item 20, Appendix B)
Tags, Identification (Item 21, Appendix B)
Packing, Preformed
Packing, Preformed
Packing, Preformed

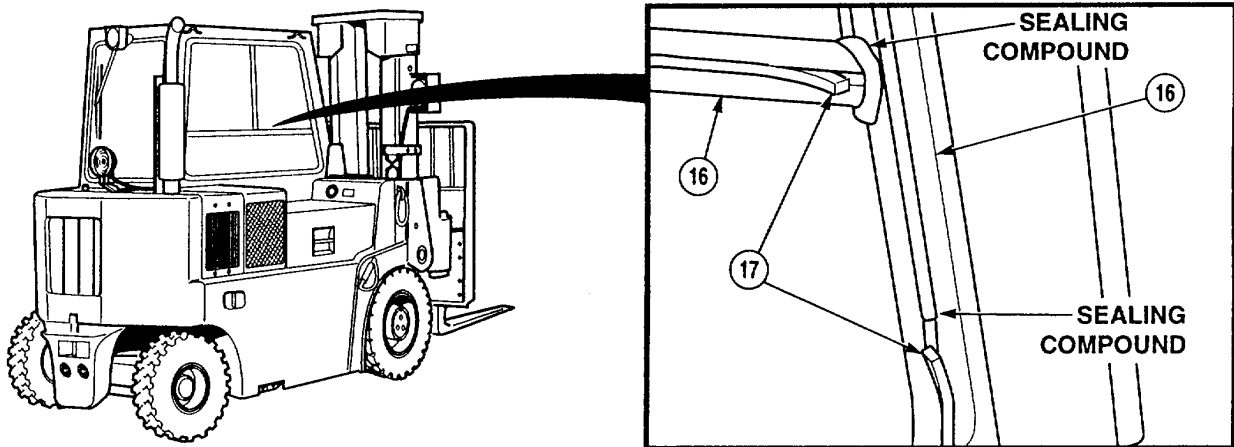
Materials/Parts - Continued

Packing, Preformed (2)
Packing, Preformed (2)
Seal, Backup (2)
Seal, Backup (2)
Seal, Bush (2)
Seal, Bush (2)
Seal, Shaft
Washer, Lock (4)
Washer, Lock (4)

Equipment Condition

Hydraulic fluid drained
(TM 10-3930-669-10)
Cab removed (TM 10-3930-669-20)

a. Removal.



WARNING

- Hydraulic oil is flammable. Ensure engine is cool to prevent fire. Injury or death to personnel could result.
- Oil is slippery and can cause falls. To avoid injury, place drain pan under hydraulic pump before removal. Wipe up spilled oil with wiping rags.

NOTE

Tag and mark each hose prior to removal.

- (1) Remove hose (1) from elbow (2).
- (2) Remove hose (3) from elbow (4).
- (3) Remove hose (5) from 45° elbow (6).

15-2. HYDRAULIC PUMP REPLACEMENT/REPAIR (CONT).

- (4) Loosen screw (7) until approximately 1 1/2 in. of thread can be seen. Do not remove.

NOTE

Screw will stay with pump.

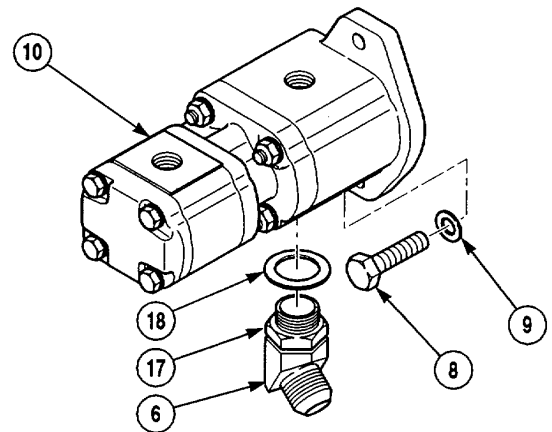
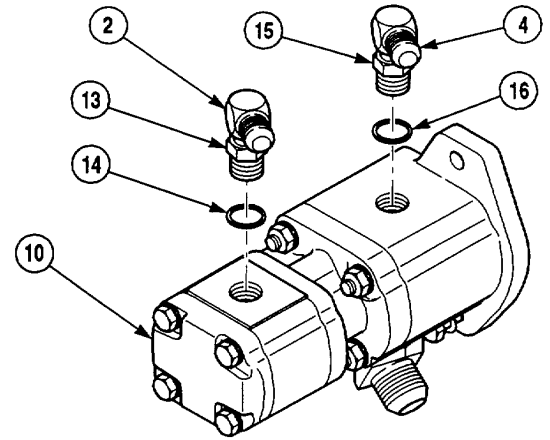
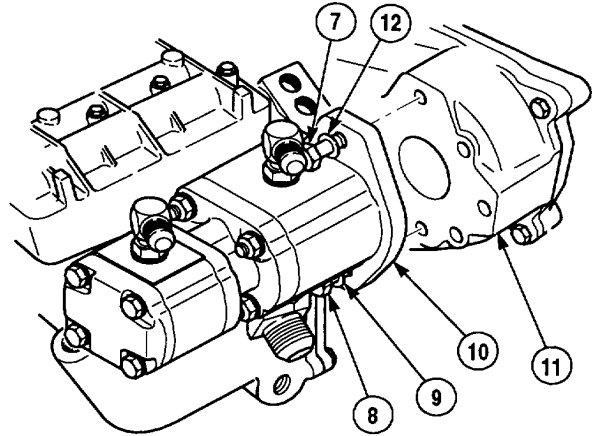
- (5) Remove screw (8) and washer (9) from hydraulic pump (10) and transmission housing (11).
- (6) Hold hydraulic pump (10) and remove screw (8), washer (9), pump (10), screw (7), and washer (12) from transmission housing (11).

b. Disassembly.

NOTE

- **Mark positions of elbows before removal.**
- **Hydraulic pump disassembly can be facilitated by placing pump in a vise with soft jaws.**

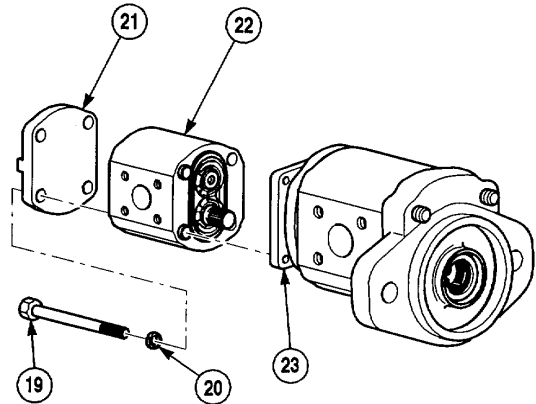
- (1) Loosen nut (13) and remove elbow (2) and preformed packing (14) from hydraulic pump (10). Discard preformed packing.
- (2) Loosen nut (15) and remove elbow (4) and preformed packing (16) from hydraulic pump (10). Discard preformed packing.
- (3) Loosen nut (17) and remove 45° elbow (6) and preformed packing (18) from hydraulic pump (10). Discard preformed packing.
- (4) Remove screw (8) and washer (9) from hydraulic pump (10).



WARNING

Oil is slippery and can cause falls. To avoid injury, wipe up spilled oil with wiping rags.

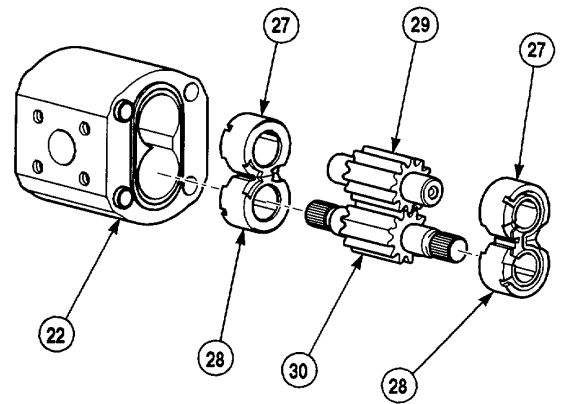
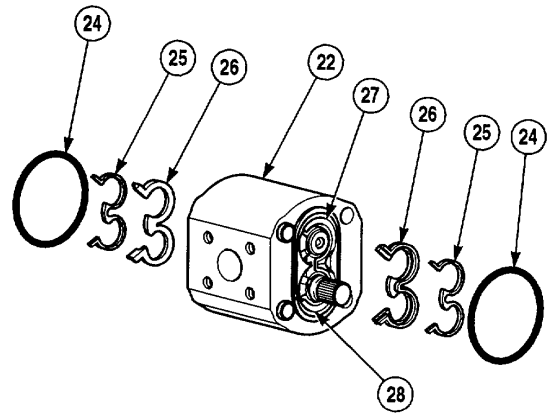
- (5) Remove four screws (19), lock washers (20), and end cover (21) from rear pump body (22).
- (6) Separate rear pump body (22) from spacer plate (23).



NOTE

Tag and mark shafts and bushings before removal.

- (7) Remove two preformed packings (24) from rear pump body (22). Discard preformed packings.
- (8) Remove two backup seals (25) and bushing seals (26) from four bushings (27 and 28). Discard backup and bushing seals.
- (9) Remove four bushings (27 and 28), rear driven gear (29), and rear driveshaft (30) from rear pump body (22) as a unit.
- (10) Separate four bushings (27 and 28), rear driven gear (29), and rear driveshaft (30).



15-2. HYDRAULIC PUMP REPLACEMENT/REPAIR (CONT)

NOTE

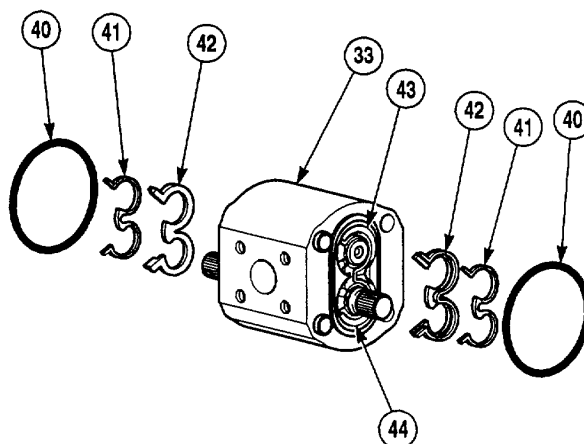
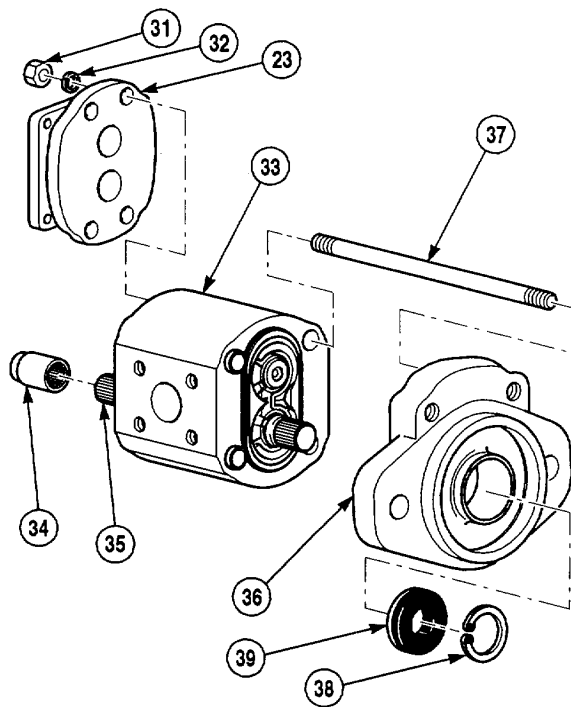
Splined coupling may come off with spacer plate or stay on front driveshaft.

- (11) Remove four nuts (31), lock washers (32), and spacer plate (23) from front pump body (33). Discard lock washers.
- (12) Remove splined coupling (34) from front driveshaft (35).
- (13) Remove flange (36) from front pump body (33).

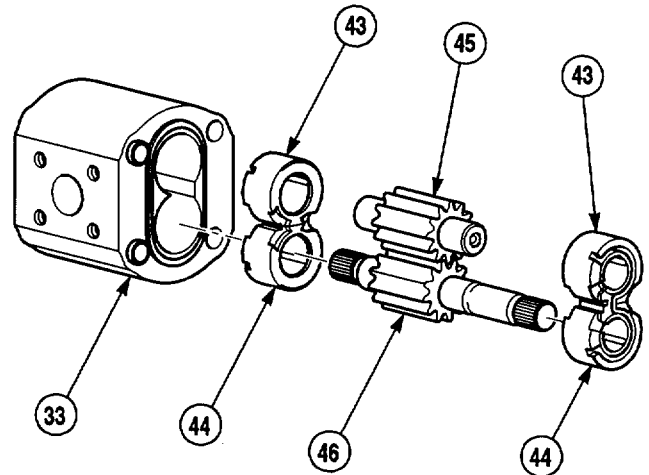
WARNING

Use extreme care when removing or installing springs and retaining rings. Springs and retaining rings are under tension and can act as projectiles when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

- (14) Remove four studs (37), retaining ring (38), and shaft seal (39) from flange (36). Discard shaft seal.
- (15) Remove two preformed packings (40) from front pump body (33). Discard preformed packings.
- (16) Remove two backup seals (41) and bushing seals (42) from four bushings (43 and 44). Discard backup and bushing seals.



- (17) Remove four bushings (43 and 44), front driven gear (45), and front driveshaft (46) from front pump body (33) as a unit.
- (18) Separate four bushings (43 and 44), front driven gear (45), and front driveshaft (46).



c. Cleaning/Inspection.

WARNING

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

NOTE

Inspect all hoses, lines, and fittings for cracks, bends, nicks, dents, stripping threads, and cuts. Replace all damaged parts.

- (1) Clean all metal parts with dry-cleaning solvent.
- (2) Inspect all parts for breaks, cracks, burrs, and sharp edges.

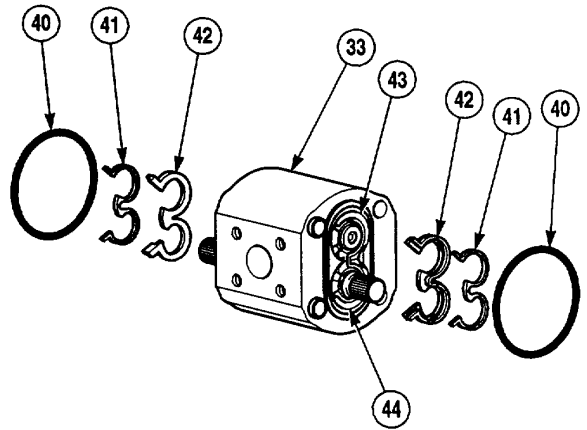
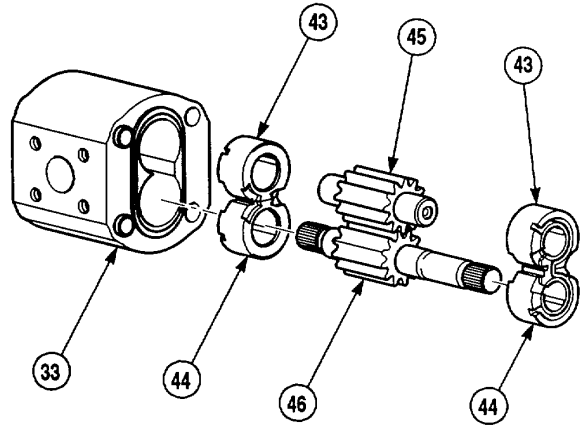
15-2. HYDRAULIC PUMP REPLACEMENT/REPAIR (CONT).

d. Assembly.

NOTE

Coat all internal pump parts with hydraulic oil before assembly.

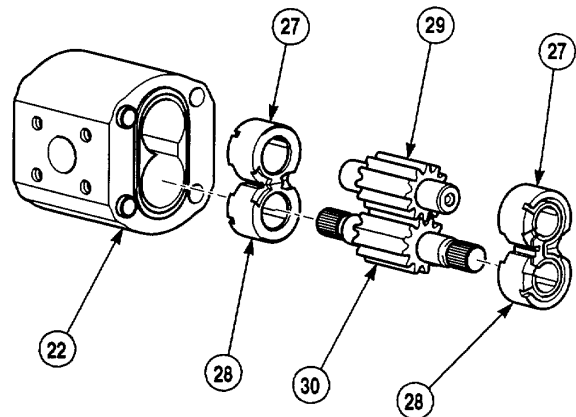
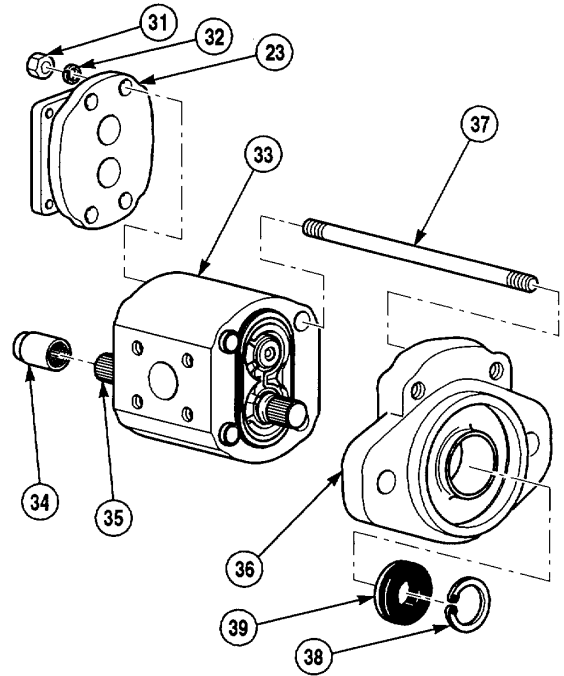
- (1) Install two bushings (43 and 44) in front pump body (33).
- (2) Install front driven gear (45) and front driveshaft (46) in two bushings (43 and 44).
- (3) Install remaining two bushings (43 and 44) in front pump body (33).
- (4) Install two bushing seals (42) and backup seals (41) on four bushings (43 and 44).
- (5) Install two preformed packings (40) on front pump body (33).



WARNING

Use extreme care when removing or installing springs and retaining rings. Springs and retaining rings are under tension and can act as projectiles when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

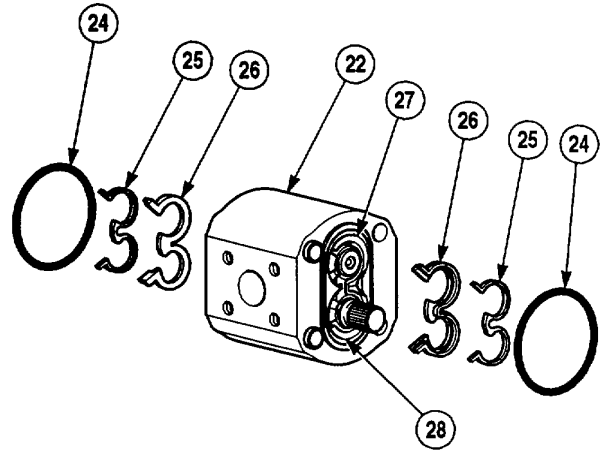
- (6) Install shaft seal (39), retaining ring (38), and four studs (37) in flange (36).
- (7) Install front pump body (33) on four studs (37) and flange (36).
- (8) Install splined coupling (34) on front driveshaft (35).
- (9) Install spacer plate (23) on front pump body (33) with four lock washers (32) and nuts (31). Tighten nuts to 65 to 75 lb-ft (88-102 N.m) in a crisscross pattern.
- (10) Install two bushings (27 and 28) in rear pump body (22).
- (11) Install rear driven gear (29) and rear driveshaft (30) in two bushings (27 and 28).
- (12) Install remaining two bushings (27 and 28) in rear pump body (22).



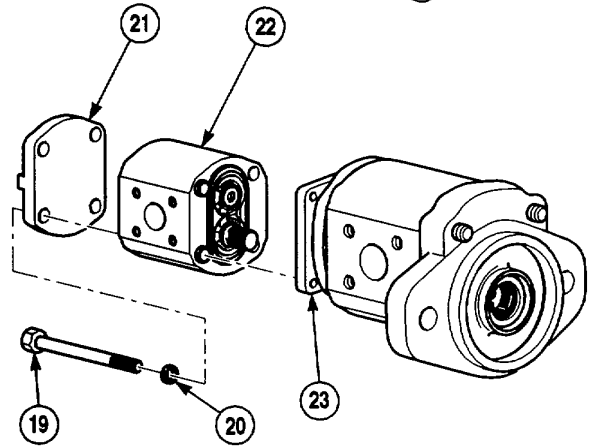
15-2. HYDRAULIC PUMP REPLACEMENT/REPAIR (CONT).

(13) Install two bushing seals (26) and backup seals (25) on four bushings (27 and 28).

(14) Install two preformed packings (24) on rear pump body (22).

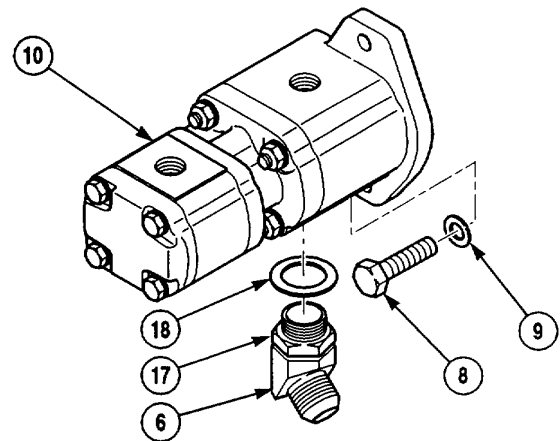


(15) Install rear pump body (22) and end cover (21) on spacer plate (23) with four lock washers (20) and screws (19). Tighten screws to 34-38 lb-ft (46-51 N.m).



(16) Position washer (9) and screw (8) in hydraulic pump (10).

(17) Install preformed packing (18) and 45° elbow (6) in hydraulic pump (10). Tighten nut (17).



(18) Install preformed packing (16) and elbow (4) in hydraulic pump (10). Tighten nut (15).

(19) Install preformed packing (14) and elbow (2) in hydraulic pump (10). Tighten nut (13).

e. Installation.

(1) Install hydraulic pump (10) on transmission housing (11) with two washers (9 and 12) and screws (7 and 8). Tighten screws to 75 lb-ft (102 N.m).

(2) Install hose (5) on 45° elbow (6).

(3) Install hose (3) on elbow (4).

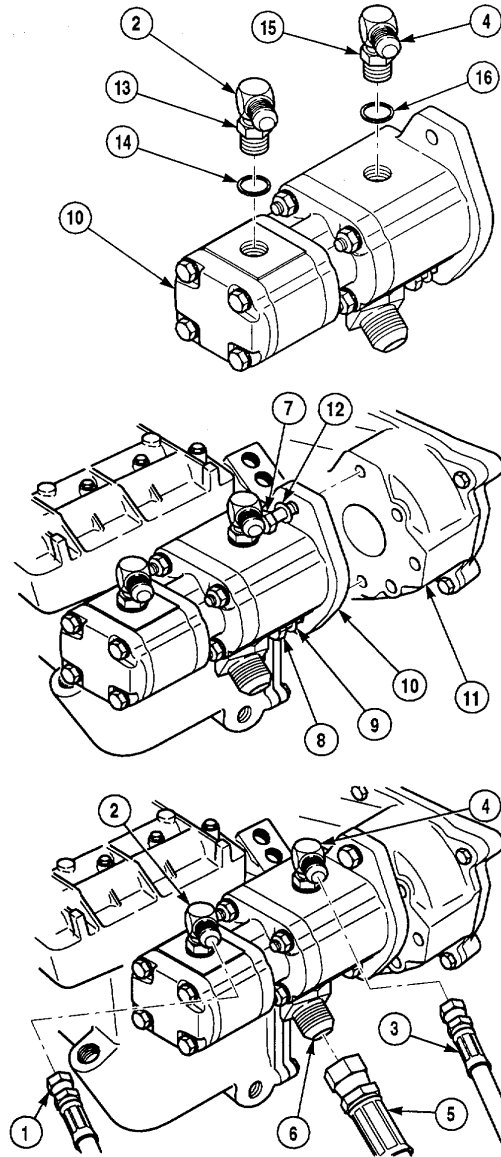
(4) Install hose (1) on elbow (2).

NOTE

Follow-on Maintenance:

- Fill hydraulic reservoir (TM 10-3930-669-10)
- Install cab (TM 10-3930-669-20)

END OF TASK



15-3. STACK VALVE REPLACEMENT/REPAIR.

This task covers:

- | | | |
|----------------|------------------------|-----------------|
| a. Removal | c. Cleaning/Inspection | e. Installation |
| b. Disassembly | d. Assembly | |

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Pan, Drain (Item 11, Appendix E)
- Packing, Preformed (2)

Materials/Parts

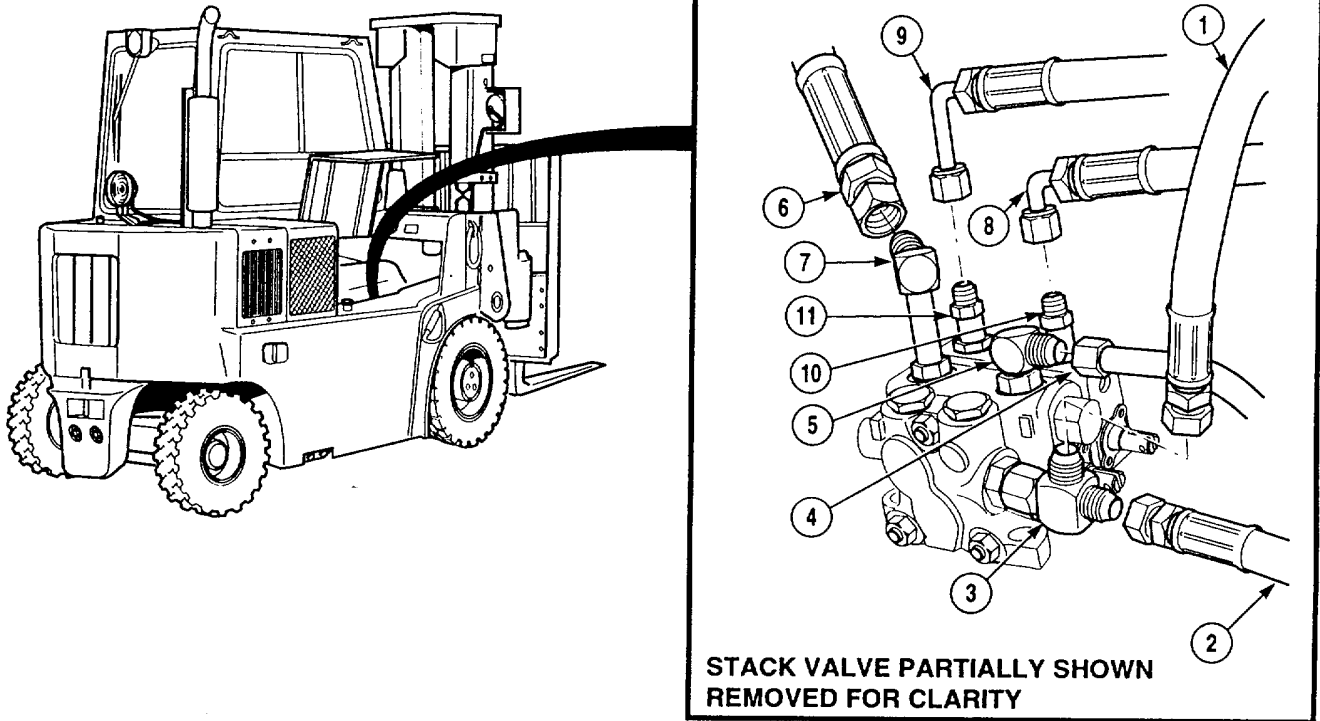
- Cloth, Lint-free (Item 6, Appendix B)
- Oil, Hydraulic (Item 15, Appendix B)
- Rags, Wiping (Item 19, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)
- Tags, Identification (Item 21, Appendix B)
- Packing, Preformed
- Packing, Preformed
- Packing, Preformed
- Packing, Preformed
- Packing, Preformed
- Packing, Preformed
- Packing, Preformed
- Packing, Preformed
- Packing, Preformed
- Packing, Preformed

Materials/Parts - Continued

- Packing, Preformed
- Packing, Preformed
- Packing, Preformed
- Packing, Preformed (2)
- Packing, Preformed (2)
- Packing, Preformed (6)
- Packing, Preformed (8)

Equipment Condition

- Engine OFF (TM 10-3930-669-10)
- Parking brake applied (TM 10-3930-669-10)
- Wheels chocked (TM 10-3930-669-10)
- Batteries removed (TM 10-3930-669-20)
- Battery tray removed (TM 10-3930-669-20)
- Filter tray removed (TM 10-3930-669-20)
- Hydraulic pressure relieved (TM 10-3930-669-20)
- Hydraulic reservoir drained (TM 10-3930-669-20)



a. Removal.

WARNING

- Hydraulic oil is flammable. Ensure engine is cool to prevent fire. Injury or death to personnel could result.
- Oil is slippery and can cause falls. To avoid injury, place drain pan under stack valve before removal. Wipe up spilled oil with wiping rags.

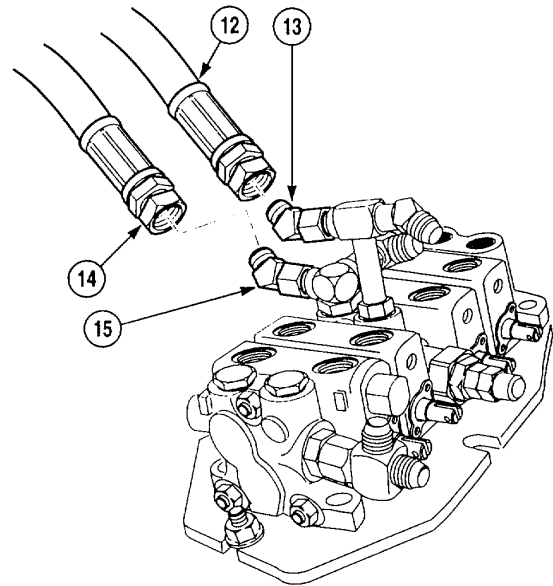
NOTE

- Inspect all hoses, lines, and fittings for cracks, bends, nicks, dents, stripped threads, and cuts. Replace all damaged parts.
- Tag and mark each hose prior to removal.

- (1) Remove two hoses (1 and 2) from 90° tee (3).
- (2) Remove tube (4) from elbow (5).
- (3) Remove hose (6) from elbow (7).
- (4) Remove two hoses (8 and 9) from fittings (10 and 11).

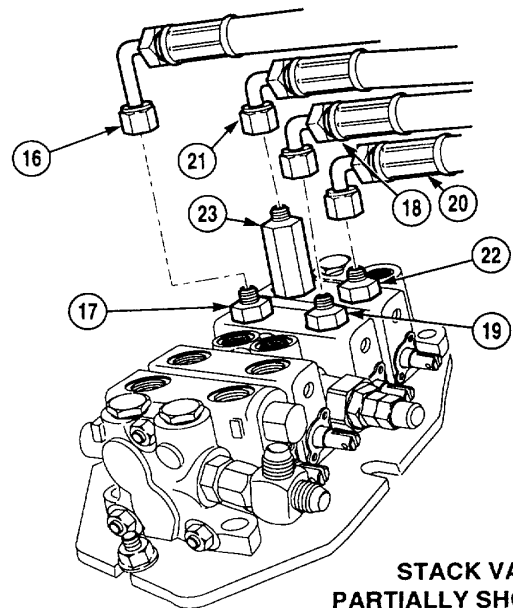
15-3. STACK VALVE REPLACEMENT/REPAIR (CONT).

- (5) Remove hose (12) from 45° elbow (13).
- (6) Remove hose (14) from 45° elbow (15).



**STACK VALVE PARTIALLY SHOWN
REMOVED FOR CLARITY**

- (7) Remove hose (16) from fitting (17).
- (8) Remove hose (18) from fitting (19).
- (9) Remove two hoses (20 and 21) from adapters (22 and 23).



**STACK VALVE
PARTIALLY SHOWN
REMOVED FOR CLARITY**

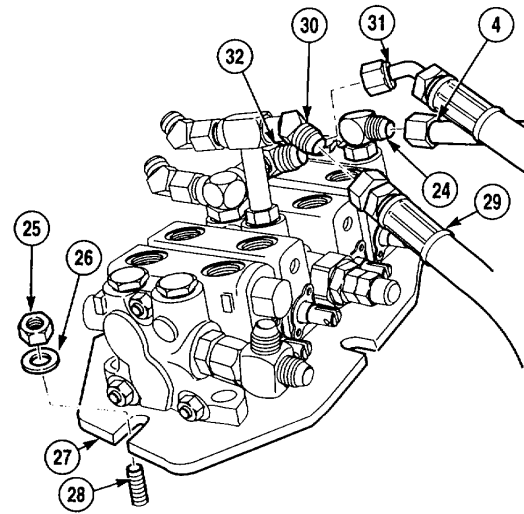
- (10) Remove tube (4) from elbow (24).
- (11) Remove three nuts (25), washers (26), and stack valve (27) from forklift (28).
- (12) Remove hose (29) from 45° elbow (30).
- (13) Remove hose (31) from elbow (32).

b. Disassembly.

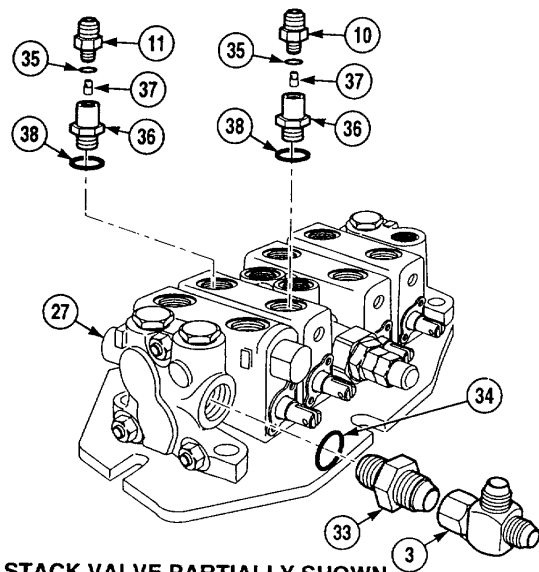
NOTE

Tag and mark positions of elbows and fittings before removal.

- (1) Remove 90° tee (3), adapter (33), and preformed packing (34) from stack valve (27). Discard preformed packing.
- (2) Remove two fittings (10 and 11), preformed packings (35), poppet bodies (36), poppets (37), and preformed packings (38). Discard preformed packings.



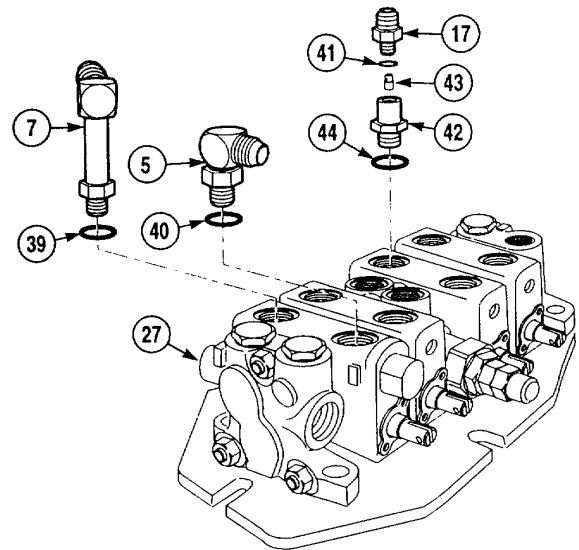
**STACK VALVE PARTIALLY SHOWN
REMOVED FOR CLARITY**



**STACK VALVE PARTIALLY SHOWN
REMOVED FOR CLARITY**

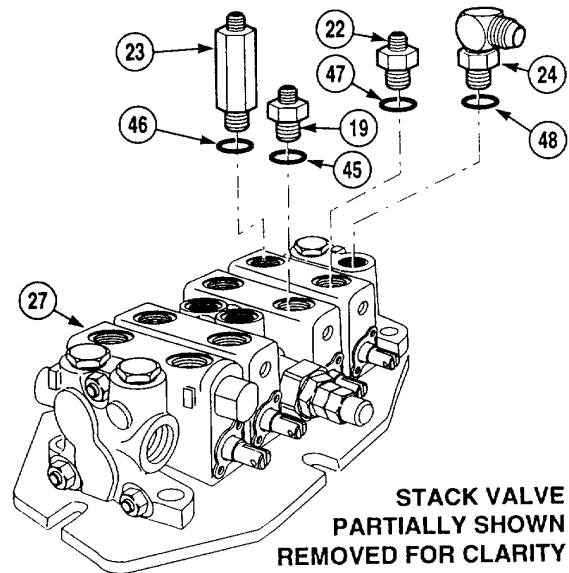
15-3. STACK VALVE REPLACEMENT/REPAIR (CONT).

- (3) Remove elbow (7) and preformed packing (39) from stack valve (27). Discard preformed packing.
- (4) Remove elbow (5) and preformed packing (40). Discard preformed packing.
- (5) Remove fitting (17), preformed packing (41), poppet body (42), poppet (43), and preformed packing (44). Discard preformed packings.



**STACK VALVE PARTIALLY SHOWN
REMOVED FOR CLARITY**

- (6) Remove fitting (19) and preformed packing (45) from stack valve (27). Discard preformed packing.
- (7) Remove fitting (23) and preformed packing (46). Discard preformed packing.
- (8) Remove fitting (22) and preformed packing (47). Discard preformed packing.
- (9) Remove elbow (24) and preformed packing (48). Discard preformed packing.

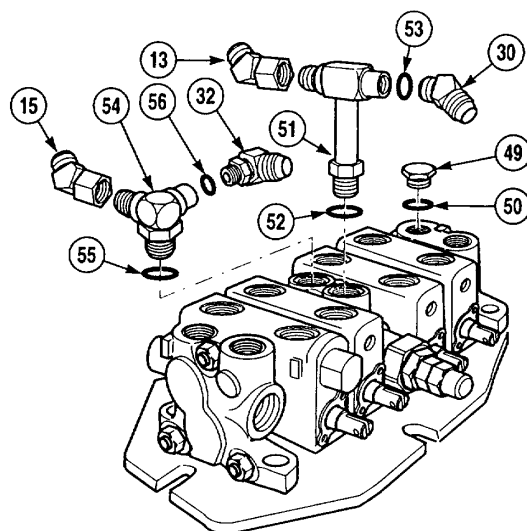


**STACK VALVE
PARTIALLY SHOWN
REMOVED FOR CLARITY**

(10) Remove three plugs (49) and preformed packings (50). Discard preformed packings.

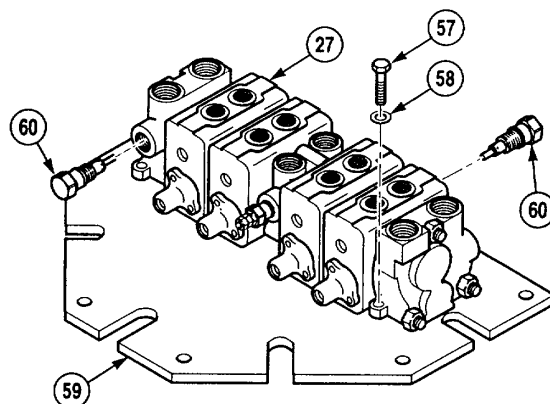
(11) Remove tee (51), preformed packing (52), 45° elbow (13), 45° elbow (30), and preformed packing (53). Discard preformed packings.

(12) Remove 90° tee (54), preformed packing (55), 45° elbow (15), elbow (32), and preformed packing (56). Discard preformed packings.



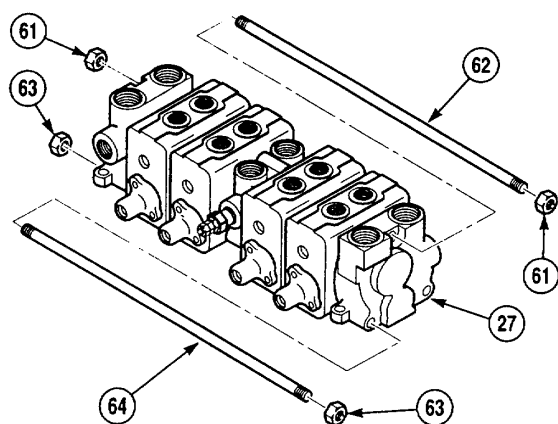
(13) Remove three screws (57), washers (58), and stack valve (27) from mounting plate (59).

(14) Remove two shut-off plugs (60) from stack valve (27).

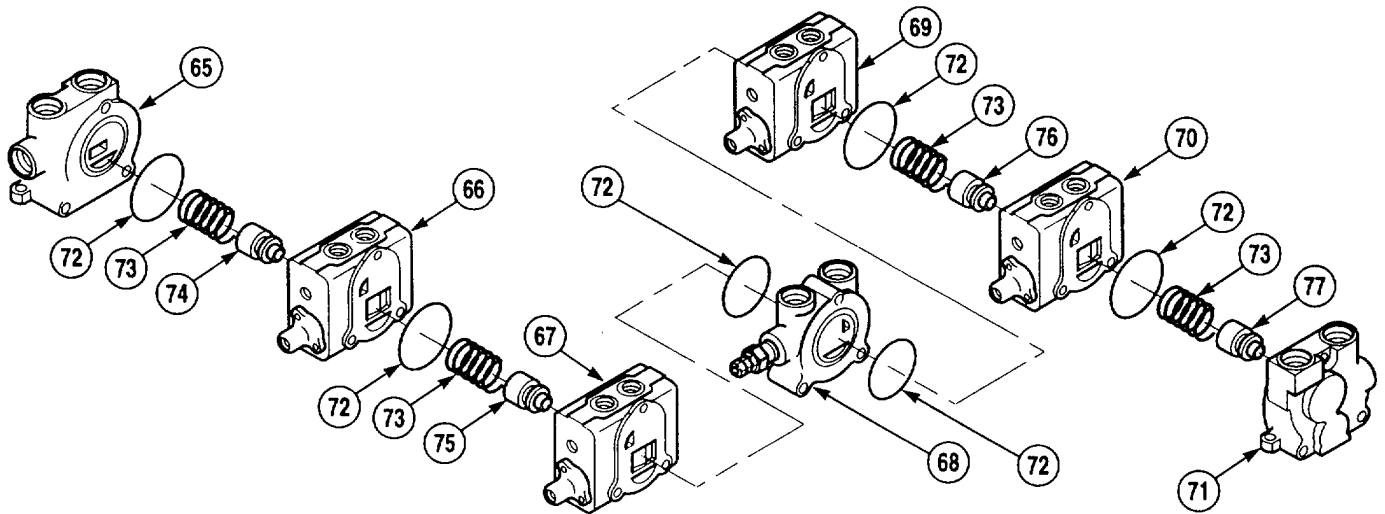


(15) Remove two nuts (61) and tie rod (62) from stack valve (27).

(16) Remove four nuts (63) and two tie rods (64).



15-3. STACK VALVE REPLACEMENT/REPAIR (CONT).



NOTE

Springs may fall when valves are separated.

- (17) Separate inlet (65), pivot valve (66), tilt valve (67), mid-inlet (68), shift valve (69), lift valve (70), and outlet (71).
- (18) Remove six preformed packings (72) from pivot valve (66), tilt valve (67), mid-inlet (68), shift valve (69), and lift valve (70). Discard preformed packings.

NOTE

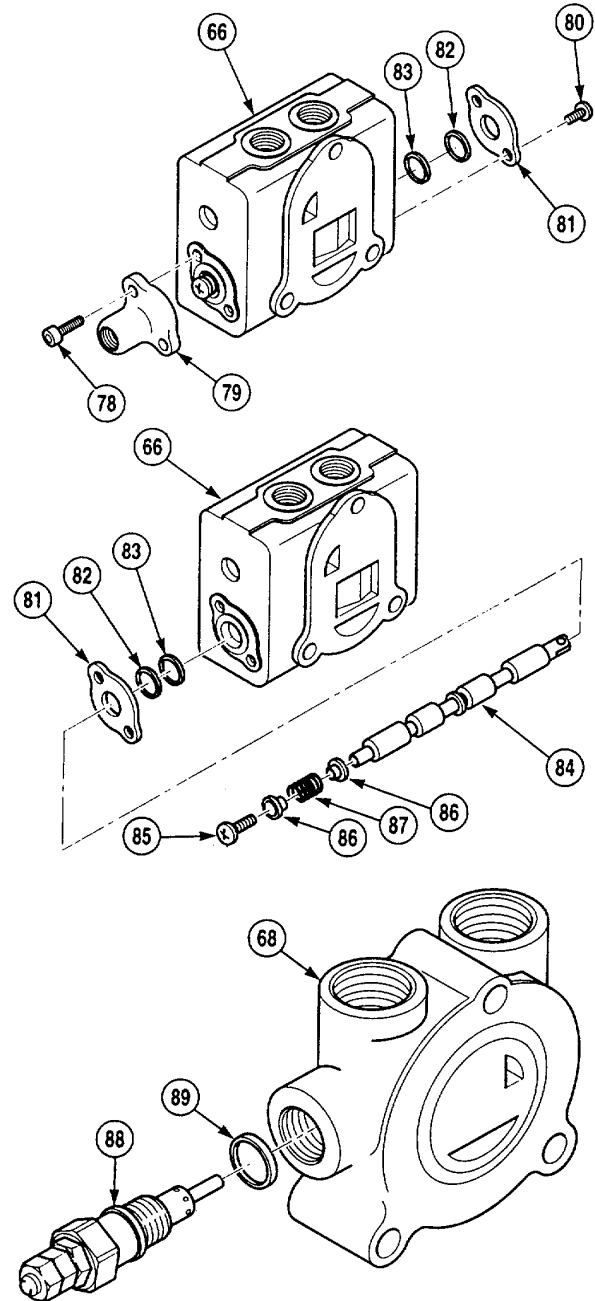
Tag and mark poppet valves upon removal.

- (19) Remove four springs (73) and poppet valves (74, 75, 76, and 77) from pivot valve (66), tilt valve (67), shift valve (69), and lift valve (70).

NOTE

Pivot valve shown. Tilt valve, shift valve, and lift valve are disassembled the same way.

- (20) Remove two screws (78) and spool cap (79) from pivot valve (66).
- (21) Remove two screws (80), seal plate (81), wiper (82), and preformed packing (83) from pivot valve (66). Discard preformed packing.
- (22) Remove spool (84), other seal plate (81), wiper (82), and preformed packing (83) from pivot valve (66). Discard preformed packing.
- (23) Remove screw (85), spring seat (86), spring (87), and other spring seat (86) from spool (84).
- (24) Remove two check valves (88) and preformed packings (89) from midinlet (68). Discard preformed packings.



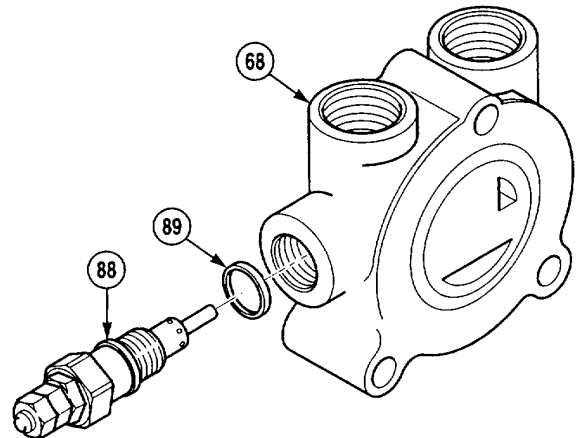
15-3. STACK VALVE REPLACEMENT/REPAIR (CONT).**c. Cleaning/Inspection.****WARNING**

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
 - **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**
- (1) Clean all metal parts with dry-cleaning solvent and wipe dry with wiping rags.
 - (2) Do not allow Dry-cleaning solvent to come in contact with rubber components.
 - (3) Inspect all parts for breaks, cracks, burrs, and sharp edges.
 - (4) Replace all damaged parts.

d. Assembly.**NOTE**

Coat all components with hydraulic oil before assembly.

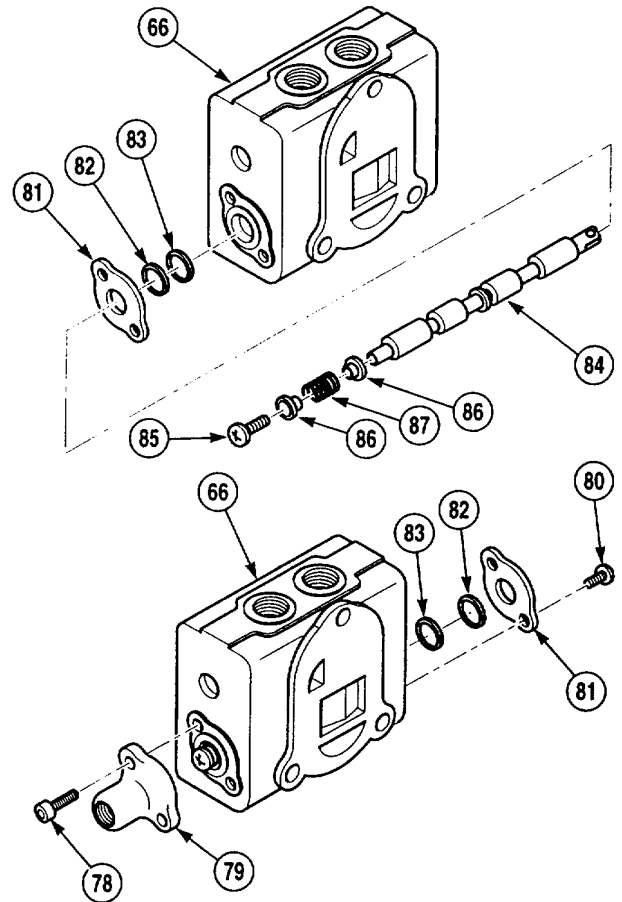
- (1) Install two preformed packings (89) and check valves (88) in mid-inlet (68).



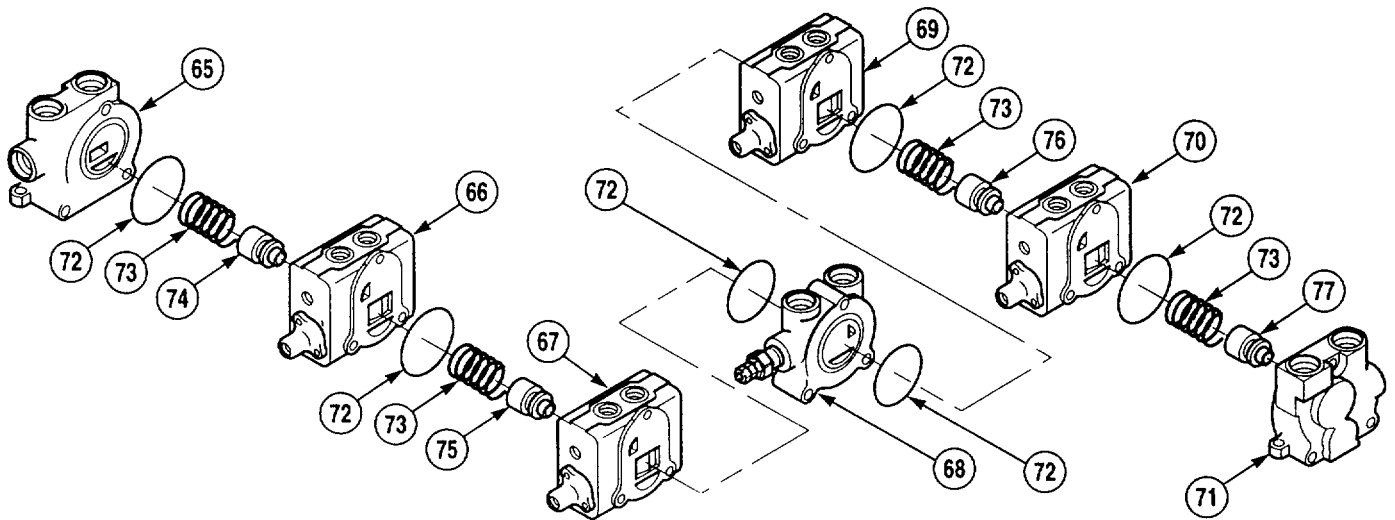
NOTE

Pivot valve shown. Tilt valve, shift valve, and lift valve are assembled the same way.

- (2) Install spring seat (86), spring (87), and spring seat (86) on spool (84) with screw (85).
- (3) Install spool (84), preformed packing (83), wiper (82), and seal plate (81) in pivot valve (66).
- (4) Install spool cap (79) with two screws (78) on pivot valve (66).
- (5) Install preformed packing (83), wiper (82), and seal plate (81) with two screws (80) on pivot valve (66).



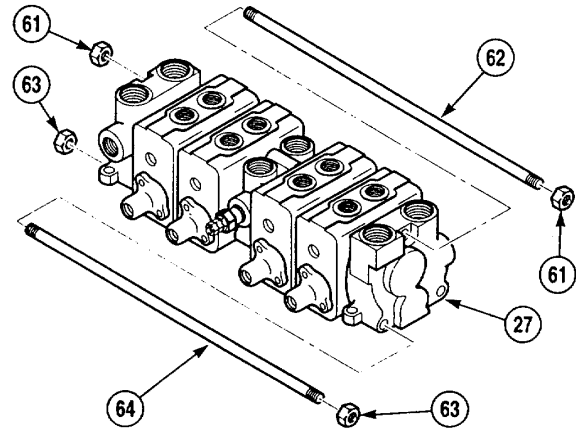
15-3. STACK VALVE REPLACEMENT/REPAIR (CONT).



- (6) Install four poppet valves (74, 75, 76, and 77) and springs (73) in pivot valve (66), tilt valve (67), shift valve (69), and lift valve (70).
- (7) Install six preformed packings (72) in pivot valve (66), tilt valve (67), shift valve (69), and lift valve (70).
- (8) Position inlet (65), pivot valve (66), tilt valve (67), mid-inlet (68), shift valve (69), lift valve (70), and outlet (71).

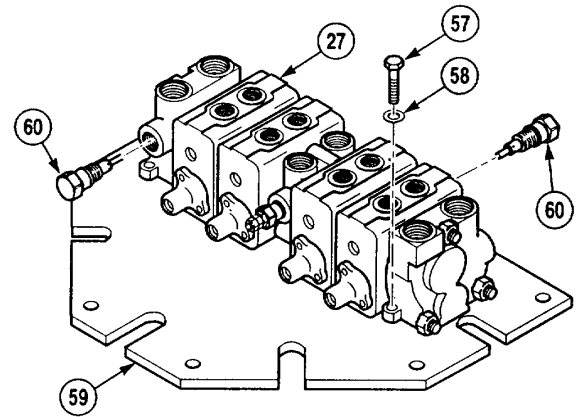
(9) Install two tie rods (64) in stack valve (27) with four nuts (63). Do not tighten.

(10) Install tie rod (62) in stack valve (27) with two nuts (61). Tighten nuts in a crisscross pattern.



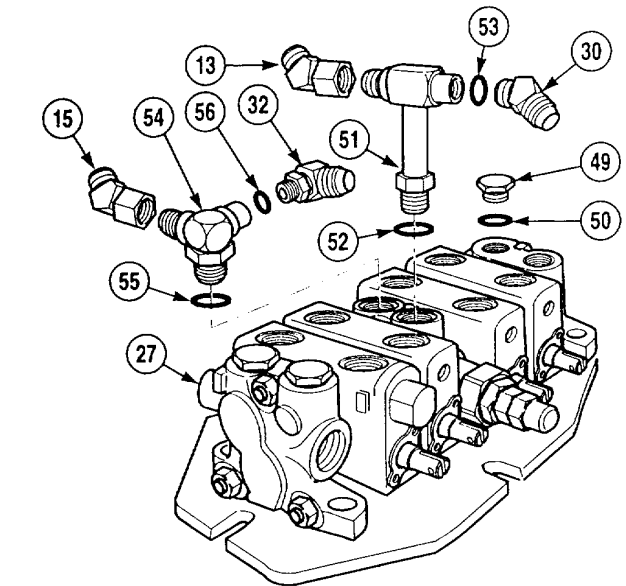
(11) Install two shut-off plugs (60) in stack valve (27).

(12) Install stack valve (27) on mounting plate (59) with three washers (58) and screws (57).

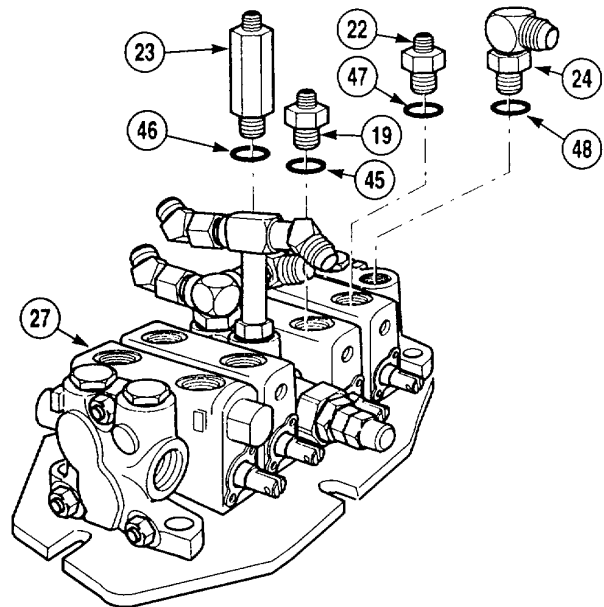


15-3. STACK VALVE REPLACEMENT/REPAIR (CONT).

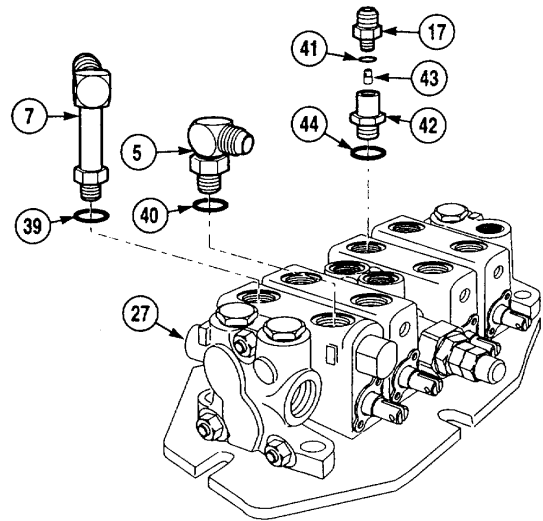
- (13) Install preformed packing (56), elbow (32), and 45° elbow (15) on 90° tee (54).
- (14) Install preformed packing (55) and 90° tee (54) in stack valve (27).
- (15) Install preformed packing (53), 45° elbow (30), and 45° elbow (13) on tee (51).
- (16) Install preformed packing (52) and tee (51).
- (17) Install three preformed packings (50) and plugs (49).



- (18) Install preformed packing (48) and elbow (24) in stack valve (27).
- (19) Install preformed packing (47) and fitting (22).
- (20) Install preformed packing (46) and fitting (23).
- (21) Install preformed packing (45) and fitting (19).

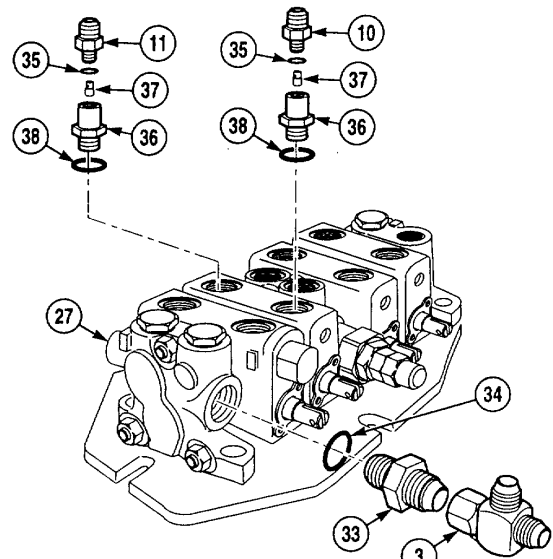


- (22) Install poppet (43), preformed packing (41), and fitting (17) in poppet body (42).
- (23) Install preformed packing (44) and poppet body (42) in stack valve (27).
- (24) Install preformed packing (40) and elbow (5).
- (25) Install preformed packing (39) and elbow (7).



**STACK VALVE PARTIALLY SHOWN
REMOVED FOR CLARITY**

- (26) Install two poppets (37), preformed packings (35), and fittings (10 and 11) in poppet bodies (36).
- (27) Install two preformed packings (38) and poppet bodies (36) in stack valve (27).
- (28) Install 90' tee (3) on adapter (33).
- (29) Install preformed packing (34) and adapter (33) in stack valve (27).

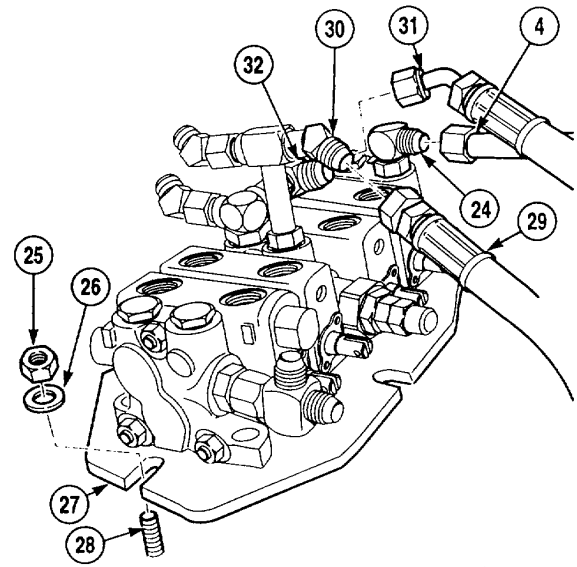


**STACK VALVE PARTIALLY SHOWN
REMOVED FOR CLARITY**

15-3. STACK VALVE REPLACEMENT/REPAIR (CONT).

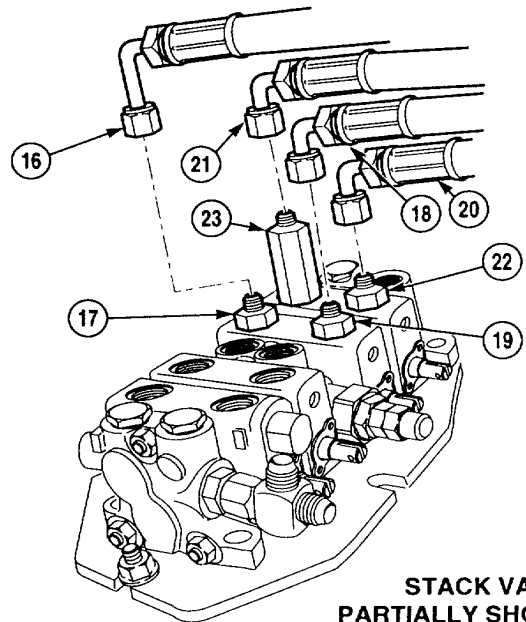
e. Installation.

- (1) Install hose (31) on elbow (32).
- (2) Install hose (29) on 45° elbow (30).
- (3) Install stack valve (27) on bulkhead (28) with three washers (26) and nuts (25).
- (4) Install tube (4) on elbow (24).



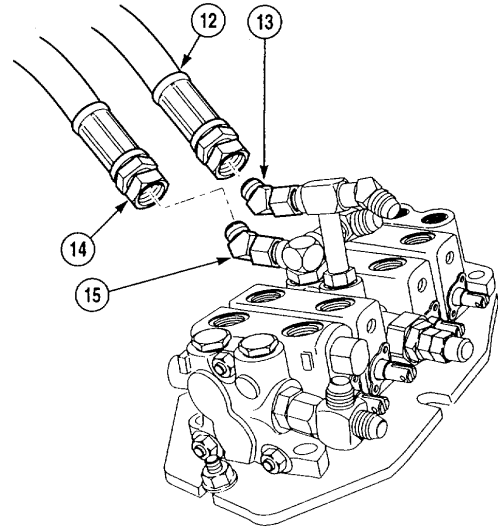
**STACK VALVE PARTIALLY SHOWN
REMOVED FOR CLARITY**

- (5) Install two hoses (20 and 21) on adapters (22 and 23).
- (6) Install hose (18) on fitting (19).
- (7) Install hose (16) on fitting (17).



**STACK VALVE
PARTIALLY SHOWN
REMOVED FOR CLARITY**

- (8) Install hose (14) on 45° elbow (15).
- (9) Install hose (12) on 45° elbow (13).



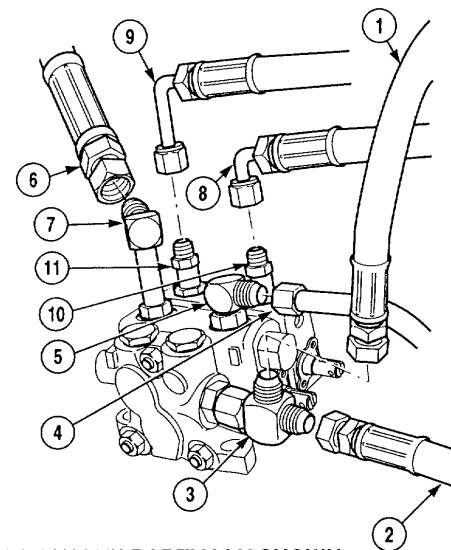
STACK VALVE PARTIALLY SHOWN
REMOVED FOR CLARITY

- (10) Install two hoses (8 and 9) on fittings (10 and 11).
- (11) Install hose (6) on elbow (7).
- (12) Install hose (4) on elbow (5).
- (13) Install two hoses (1 and 2) on 90° tee (3).

NOTE

Follow-on Maintenance:

- Install batteries (TM 10-3930-669-20).
- Install battery tray (TM 10-3930-669-20).
- Install filter tray (TM 10-3930-669-20).
- Fill hydraulic reservoir (TM 10-3930-669-20).
- Remove wheel chocks (TM 10-3930-669-10).



STACK VALVE PARTIALLY SHOWN
REMOVED FOR CLARITY

END OF TASK

15-4. PRIORITY VALVE REPAIR.

This task covers:

- a. Disassembly b. Cleaning/Inspection c. Assembly

INITIAL SETUP*Tools and Special Tools*

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)
Wrench, Torque (0 to 175 lb-ft [0-237 N-m])
(Item 5, Appendix E)

Equipment Condition

Priority valve removed (TM 10-3930-669-20)

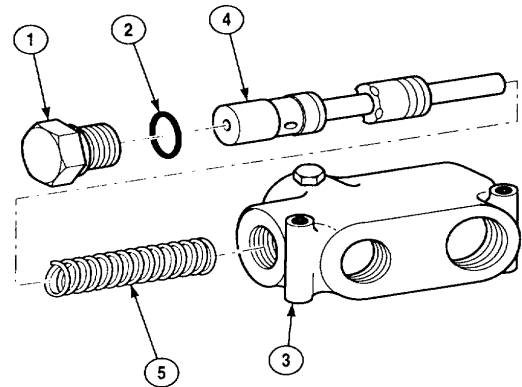
Materials /Parts

Rags, Wiping (Item 19, Appendix B)
Solvent, Dry-cleaning (Item 20, Appendix B)
Packing, Preformed

a. Disassembly.**WARNING**

- **Hydraulic oil is flammable. Ensure engine is cool to prevent fire. Injury or death to personnel could result.**
- **Oil is slippery and can cause falls. To avoid injury, wipe up spilled oil with wiping rags.**

- (1) Remove plug (1) and preformed packing (2) from priority valve (3). Discard preformed packing.
- (2) Remove check valve (4) and spring (5) from priority valve (3).



b. Cleaning/Inspection.

WARNING

- Dry-cleaning solvent (P-D-680) is **TOXIC** and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

- (1) Clean all metal parts with dry-cleaning solvent and wipe dry with wiping rags.
- (2) Inspect all parts for breaks, cracks, burrs, and sharp edges.
- (3) Replace all damaged parts.

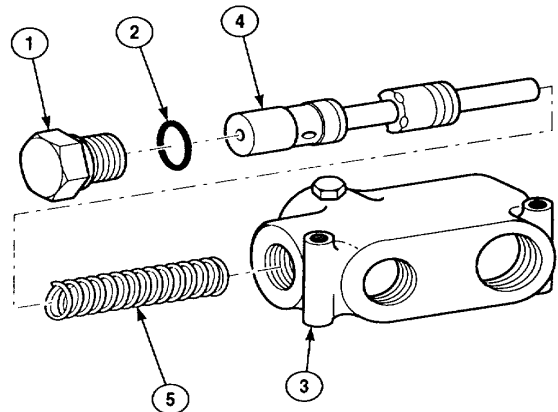
c. Assembly.

- (1) Install spring (5) and check valve (4) in priority valve (3).
- (2) Install preformed packing (2) and plug (1) in priority valve (3).

NOTE

Follow-on Maintenance:

- Install priority valve (TM 10-3930-669-20).



END OF TASK

15-5. TILT CYLINDER REPAIR.

This task covers:

- a. Disassembly b. Cleaning/Inspection c. Assembly

INITIAL SETUP

Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Pan, Drain (Item 11, Appendix E)
- Vise, Pipe, Chain (Item 5, Appendix E)
- Wrench, Torque (0 to 600 lb-ft [0-814 N.m]) (Item 5, Appendix E)
- Pliers, Snap Ring (Item 5, Appendix E)

Materials /Parts

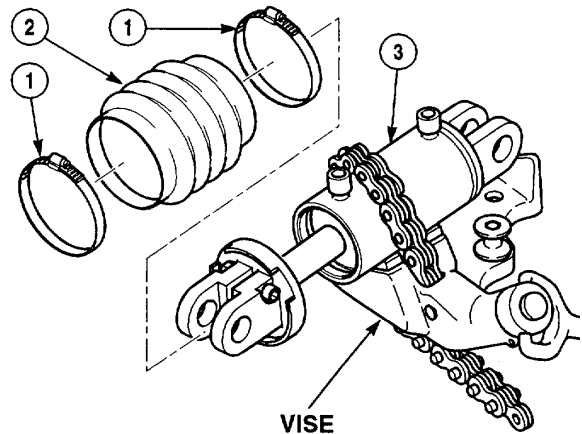
- Oil, Hydraulic (Item 15, Appendix B)
- Solvent, Dry-cleaning (Item 20, Appendix B)
- Kit, Seal
- Nut, Lock

Equipment Condition

Tilt cylinder removed (TM 10-3930-669-20)

a. Disassembly.

- (1) Remove two clamps (1) and boot (2) from tilt cylinder (3).
- (2) Position tilt cylinder (3) in chain vise.



WARNING

Oil will spray from cylinder ports when rod is moved in or out. Cover ports with two cleaning cloths to prevent oil from spraying. Failure to comply may result in injury to personnel.

CAUTION

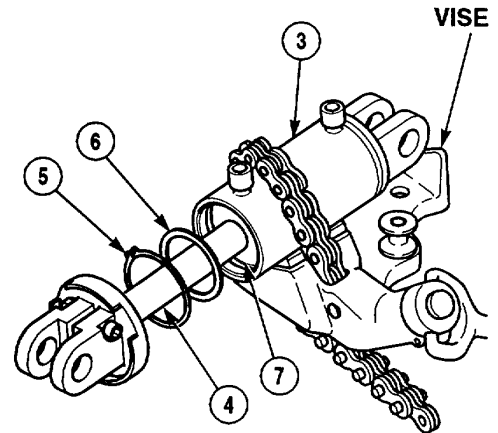
Do not allow threaded or machined surfaces to come in contact with other metal surfaces. Clearances between cylinder components are very small, any minor damage done during disassembly could require component replacement or make assembly difficult.

- (3) Position drain pan under tilt cylinder (3).
- (4) Move rod (4) out of cylinder (3) 1 in. (3 cm).

WARNING

Use extreme care when removing or installing springs and retaining rings. Springs and retaining rings are under tension and can act as projectiles when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

- (5) Remove retaining ring (5) and spacer (6) from cylinder (3) and head (7).



15-5. TILT CYLINDER REPAIR (CONT).

NOTE

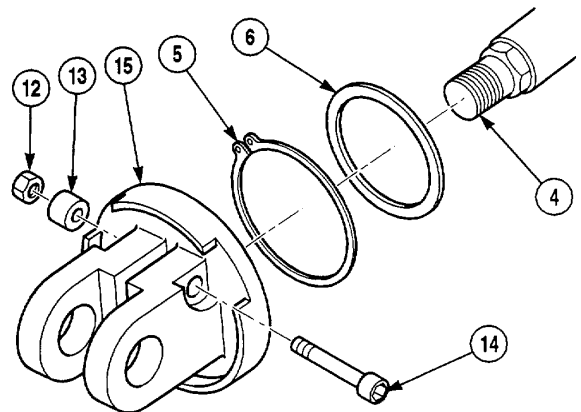
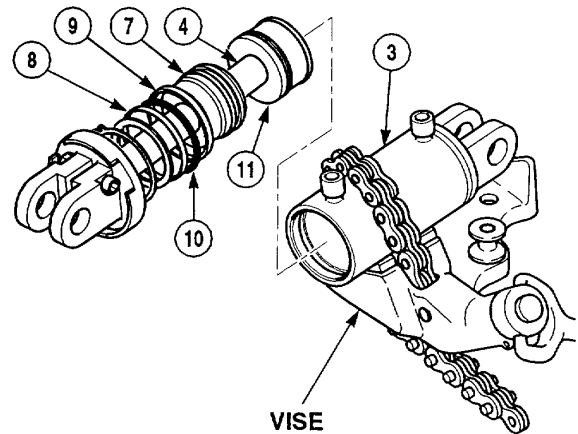
Backup ring and preformed packing may come off during this step.

- (6) Push head (7) into cylinder (3) until shear ring (8) is seen.

CAUTION

Keep rod straight and concentric in cylinder. Do not allow piston to become wedged in cylinder or damage to cylinder or piston may occur.

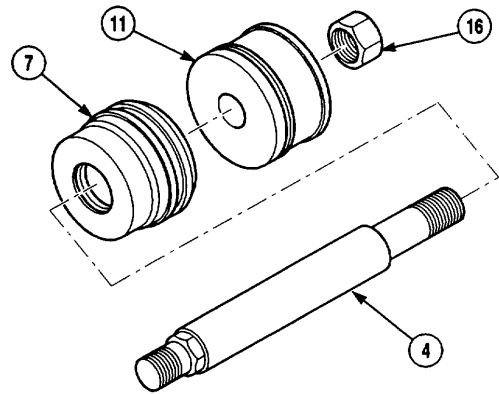
- (7) Remove backup ring (9), preformed packing (10), and shear ring (8) from inside of cylinder (3). Discard backup ring and preformed packing.
- (8) Remove rod (4), head (7), and piston (11) from cylinder (3).
- (9) Remove cylinder (3) from chain vise.
- (10) Remove nut (12), spacer (13), and screw (14) from clevis (15).
- (11) Remove clevis (15), retaining ring (5), and spacer (6) from rod (4).



CAUTION

Do not damage rod surface. Cylinder will leak if rod surface is damaged.

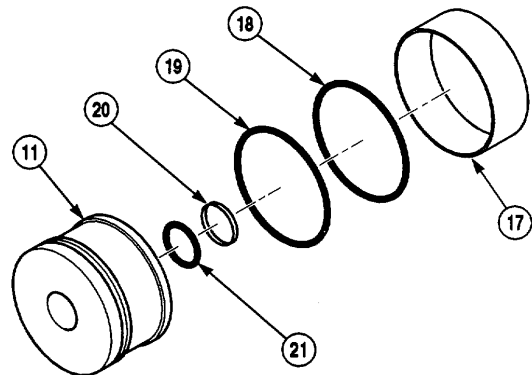
- (12) Remove lock nut (16), piston (11), and head (7) from rod (4). Discard lock nut.



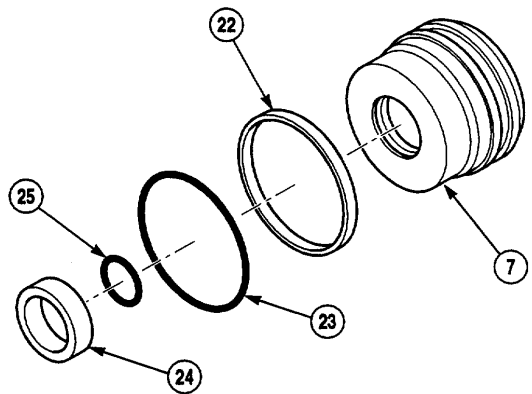
NOTE

Note location and position of packing, expansion ring, wiper, and seal prior to removal.

- (13) Remove bearing strip (17), seal (18), preformed packing (19), expansion ring (20), and preformed packing (21) from piston (11). Discard preformed packings, expansion ring, and seal.



- (14) Remove backup seal (22), preformed packing (23), rod wiper (24), and rod packing (25) from head (7). Discard seal, wiper, rod packing, and preformed packing.



15-5. TILT CYLINDER REPAIR (CONT).

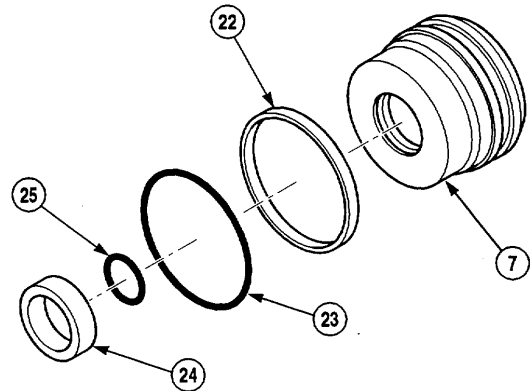
b. Cleaning/Inspection.**WARNING**

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
 - **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**
- (1) Clean all components and flush cylinder barrel using dry-cleaning solvent only. Do not use cleaning cloth as any foreign material would contaminate hydraulic system.
 - (2) Inspect barrel bore for any scratches or corrosion. Replace barrel if rusted. Replace barrel and piston if either component is scratched.
 - (3) Inspect rod for bending. Replace if necessary.
 - (4) Inspect rod for scratches or pitting. Remove minor scratches and pitting by using stone and lubrication oil.
 - (5) Inspect component threads for burrs and stripped threads. Replace or repair as necessary.

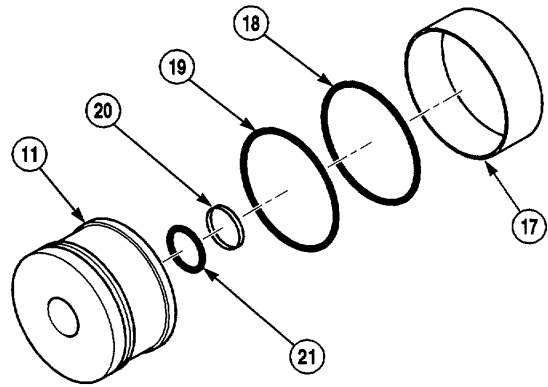
c. Assembly.**NOTE**

Coat all internal parts with hydraulic oil prior to assembly.

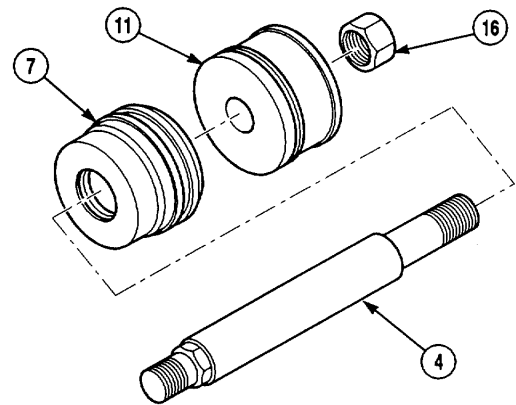
- (1) Install rod packing (25) and rod wiper (24) in head (7).
- (2) Install preformed packing (23) and backup seal (22) on head (7).



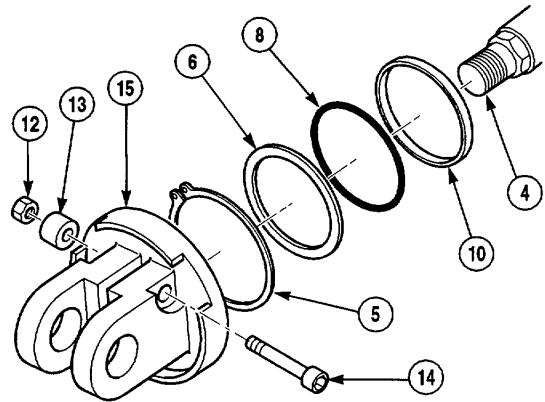
- (3) Install preformed packing (21), expansion ring (20), preformed packing (19), seal (18), and bearing strip (17) on piston (11).



- (4) Install head (7) on rod (4).
- (5) Install piston (11) and lock nut (16) on rod (4). Tighten nut to 250 to 300 lb-ft (339-407 N.m).



- (6) Install preformed packing (10), shear ring (8), spacer (6), and retaining ring (5) on rod (4).
- (7) Install clevis (15) on rod (4).
- (8) Install screw (14), spacer (13), and nut (12) on clevis (15). Do not tighten screw and nut.



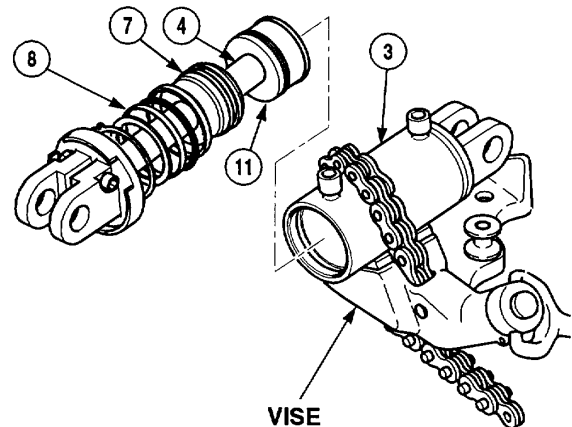
15-5. TILT CYLINDER REPAIR (CONT).

- (9) Position cylinder (3) in chain vise.

CAUTION

Keep rod straight and concentric in cylinder. Do not allow piston to become wedged in cylinder or damage to cylinder or piston may occur.

- (10) Install piston (11), rod (4), and head (7) in cylinder (3).
- (11) Push head (7) back in cylinder (3) until shear ring groove is seen.
- (12) Install shear ring (8) in cylinder (3).

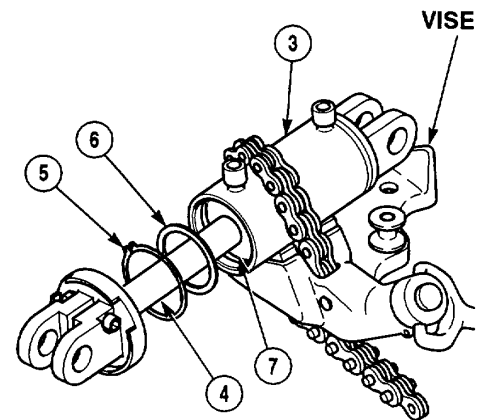
**WARNING**

Use extreme care when removing or installing springs and retaining rings. Springs and retaining rings are under tension and can act as projectiles when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

NOTE

Shear ring will prevent head from coming out of cylinder.

- (13) Pull rod (4) out of cylinder (3) until retaining ring groove of head (7) is seen.
- (14) Install spacer (6) and retaining ring (5) in cylinder (3) and head (7).



(15) Remove cylinder (3) from chain vise.

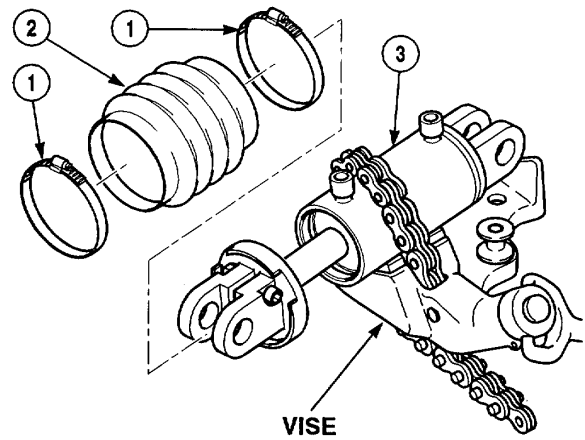
(16) Install boot (2) on cylinder (3) with two clamps (1).

NOTE

Follow-on Maintenance:

- Install tilt cylinder (TM 10-3930-669-20).

END OF TASK



15-6. PIVOT CYLINDER REPAIR.

This task covers:

- a. Disassembly b. Cleaning/Inspection c. Assembly

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Pan, Drain (Item 11, Appendix E)
- Vise, Pipe, Chain (Item 5, Appendix E)
- Wrench, Torque (0 to 600 lb-ft [0-813 N-m]) (Item 5, Appendix E)
- Pliers, Snap Ring (Item 5, Appendix E)

Materials/Parts - Continued

- Solvent, Dry-cleaning (Item 20, Appendix B)
- Kit, Seal
- Nut, Lock
- Packing, Preformed
- Ring, Expansion
- Ring, Shear
- Wiper

Materials/Parts

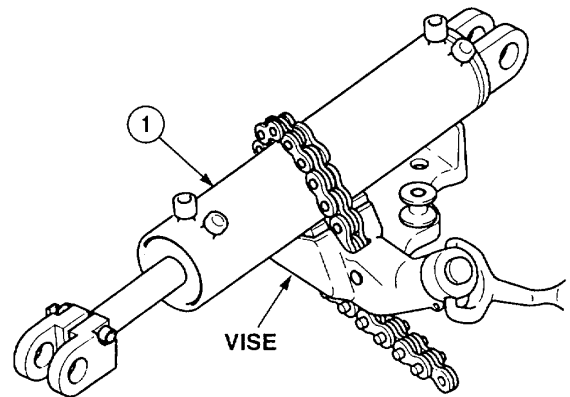
- Cloth, Lint-free (Item 6, Appendix B)
- Oil, Hydraulic (Item 15, Appendix B)

Equipment Condition

- Pivot cylinder removed (TM 10-3930-669-20)

a. Disassembly.

- (1) Position pivot cylinder (1) in chain vise.



WARNING

Oil will spray from cylinder ports when rod is moved in or out. Cover ports with two cleaning cloths to prevent oil from spraying. Failure to comply may result in injury to personnel.

CAUTION

Do not allow threaded or machined surfaces to come in contact with other metal surfaces. Clearances between cylinder components are very small, any minor damage done during disassembly could require component replacement or make assembly difficult.

- (2) Position drain pan under pivot cylinder (1).
- (3) Move rod (2) out of cylinder (1) 9 in. (23 cm).

WARNING

Use extreme care when removing or installing springs and retaining rings. Springs and retaining rings are under tension and can act as projectiles when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

- (4) Remove retaining ring (3) and spacer (4) from cylinder (1) and head (5).

NOTE

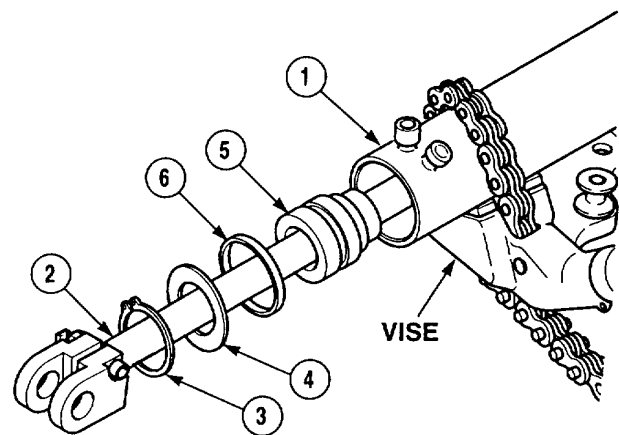
Backup seals may come off during this step.

- (5) Push head (5) into cylinder (1) until shear ring (6) is exposed.

CAUTION

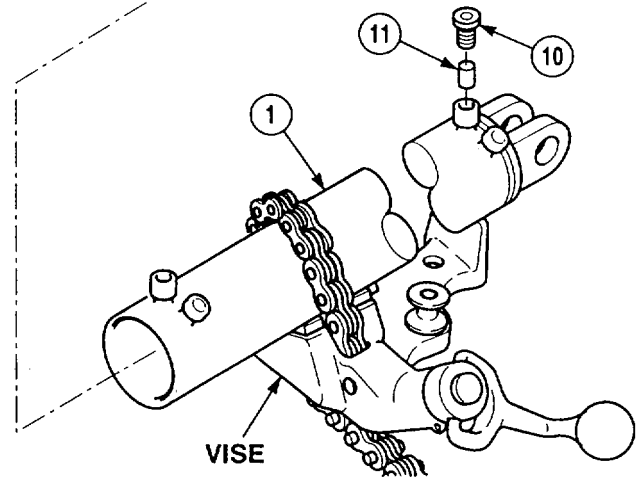
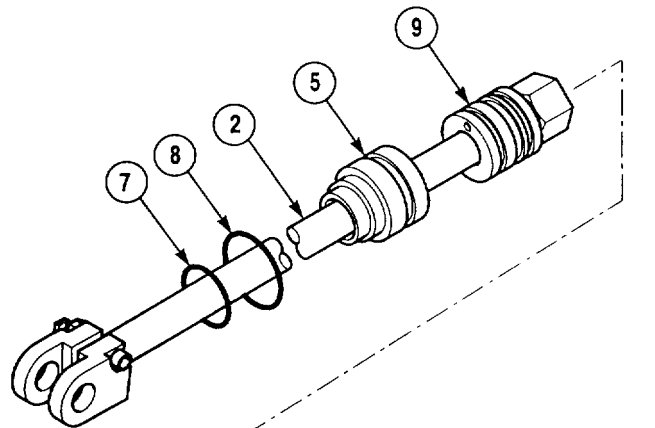
Keep rod straight and concentric in cylinder. Do not allow piston to become wedged in cylinder or damage to cylinder or piston may occur.

- (6) Remove shear ring (6) from inside of cylinder (1). Discard shear ring.

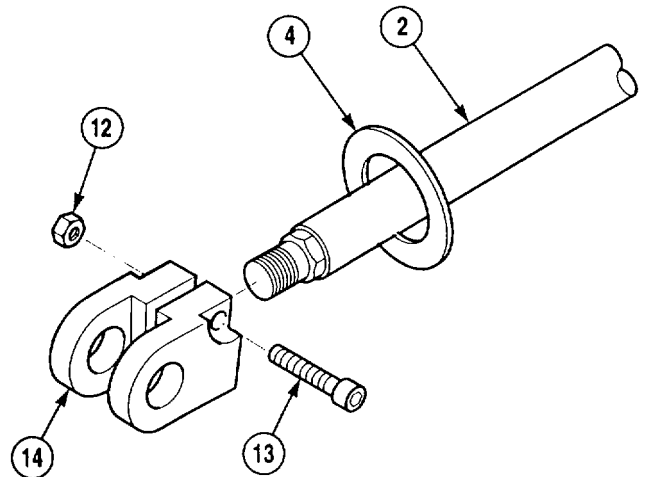


15-6. PIVOT CYLINDER REPAIR (CONT).

- (7) Remove backup seal (7), seal (8), rod (2), head (5), and piston (9) from cylinder (1). Discard backup seal and seal.
- (8) Remove two plugs (10) and preformed packings (11) from cylinder (1). Discard preformed packings.
- (9) Remove cylinder (1) from chain vise.



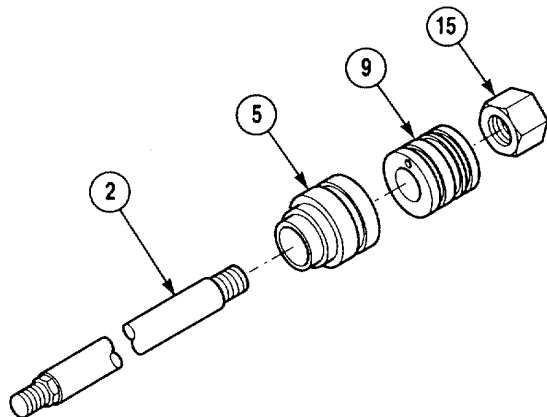
- (10) Remove nut (12) and screw (13) from clevis (14).
- (11) Remove clevis (14) and spacer (4) from rod (2).



CAUTION

Do not damage rod surface. Cylinder will leak if rod surface is damaged.

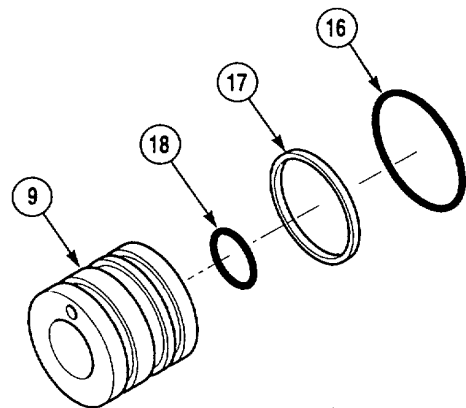
- (12) Remove lock nut (15), piston (9), and head (5) from rod (2). Discard lock nut.



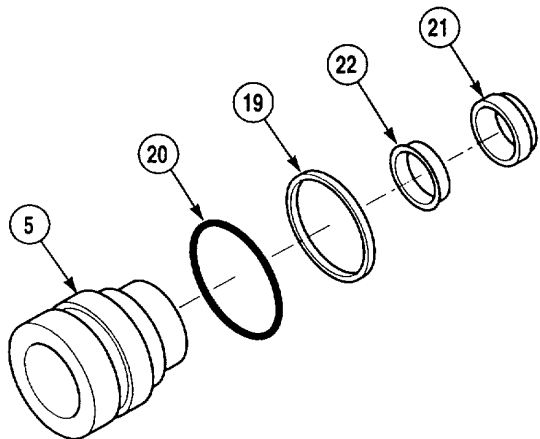
NOTE

Note location and position of packing, expansion ring, wiper, and seal prior to removal.

- (13) Remove preformed packing (16), expansion ring (17), and preformed packing (18) from piston (9). Discard preformed packings and expansion ring.



- (14) Remove backup seal (19), preformed packing (20), rod wiper (21), and rod packing (22) from head (5). Discard seals, wiper and preformed packing.



15-6. PIVOT CYLINDER REPAIR (CONT).

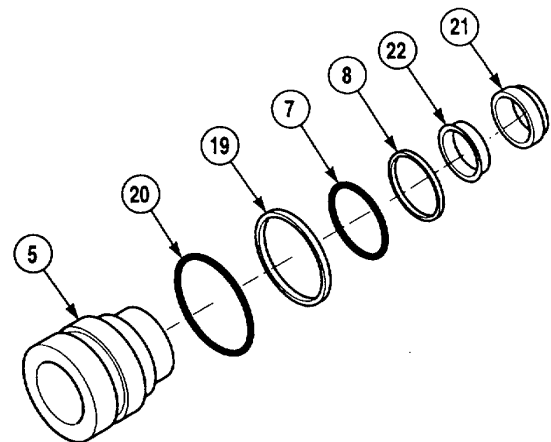
b. Cleaning/Inspection.**WARNING**

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
 - **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**
- (1) Clean all components and flush cylinder barrel using dry-cleaning solvent only. Do not use cleaning cloth as any foreign material would contaminate hydraulic system.
 - (2) Inspect barrel bore for any scratches or corrosion. Replace barrel if rusted. Replace barrel and piston if either component is scratched.
 - (3) Inspect rod for bending. Replace if necessary.
 - (4) Inspect rod for scratches or pitting. Remove minor scratches and pitting by using stone and lubrication oil.
 - (5) Inspect component threads for burrs and stripped threads. Replace or repair as necessary.

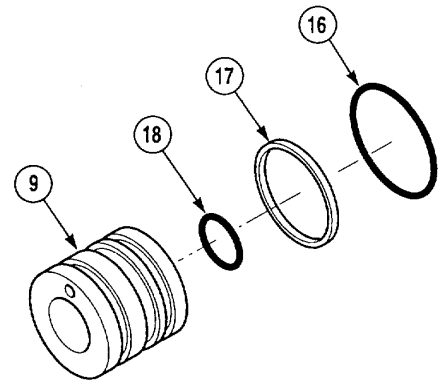
c. Installation.**NOTE**

Coat all internal components with hydraulic oil before assembly.

- (1) Install rod packing (22) and rod wiper (21) in head (5).
- (2) Install seal (20) and backup seal (19) on head (5).
- (3) Install backup seal (8) and seal (7) on head (5).



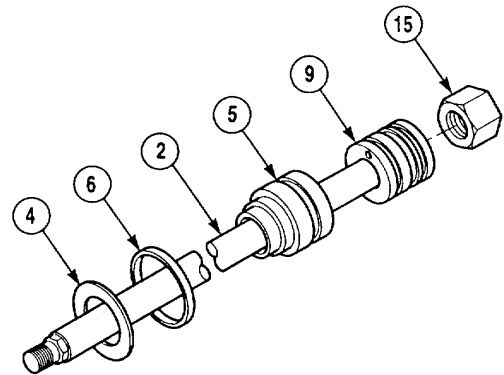
- (4) Install preformed packing (18), expansion ring (17), and preformed packing (16) on piston (9).



- (5) Install spacer (4) and shear ring (6) on rod (2).

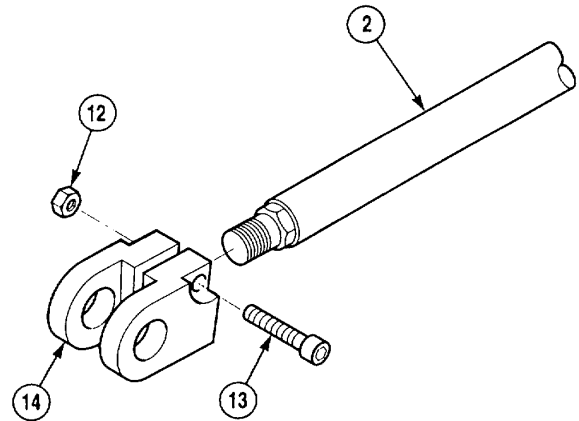
- (6) Install head (5) on rod (2).

- (7) Install piston (9) and lock nut (15) on rod (2). Tighten lock nut to 250 to 300 lb-ft (339-407 N•m).



- (8) Install clevis (14) on rod (2).

- (9) Install screw (13) and nut (12) in clevis (14). Do not tighten nut and screw.



15-6. PIVOT CYLINDER REPAIR (CONT).

- (10) Position cylinder (1) in chain vise.

CAUTION

Keep rod straight and concentric in cylinder. Do not allow piston to become wedged in cylinder or damage to cylinder or piston may occur.

- (11) Install two preformed packings (11) and plugs (10) in cylinder (1).
- (12) Install piston (9), rod (2), and head (5) in cylinder (1).
- (13) Push head (5) back in cylinder (1) until shear ring groove is exposed.
- (14) Install shear ring (6) in cylinder (1).

WARNING

Use extreme care when removing or installing springs and retaining rings. Springs and retaining rings are under tension and can act as projectiles when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

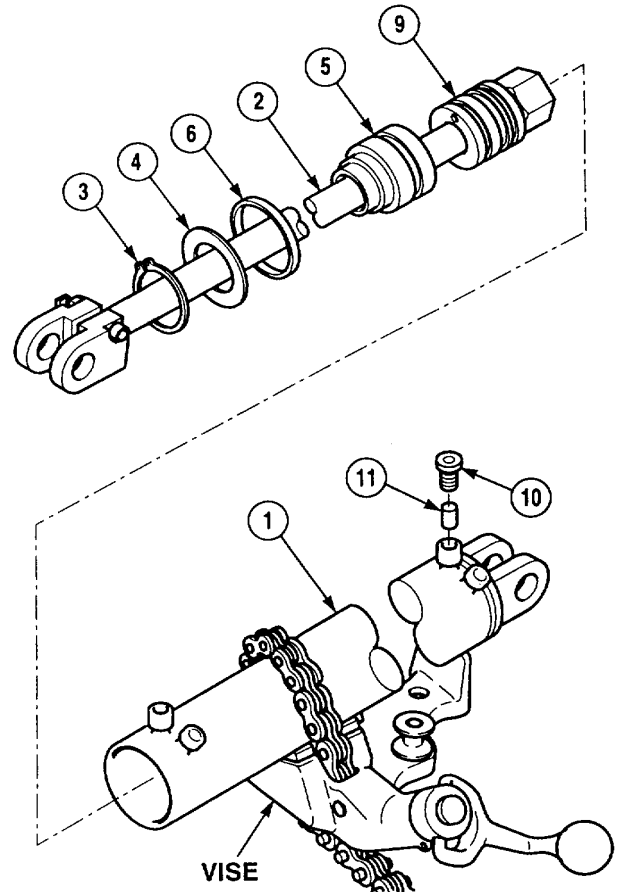
NOTE

Shear ring will prevent head from coming out of cylinder.

- (15) Pull rod (2) out of cylinder (1) until retaining ring groove of head (5) is exposed.
- (16) Install spacer (4) and retaining ring (3) on cylinder (1) and head (5).
- (17) Remove pivot cylinder (1) from chain vise.

NOTE**Follow-on Maintenance:**

- **Install pivot cylinder (TM 10-3930-669-20).**



END OF TASK

15-7. MAST PRIMARY CYLINDER REPAIR.

This task covers:

- a. Disassembly b. Cleaning/Inspection c. Assembly

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
 Vise, Pipe, Chain (Item 5, Appendix E)
 Pan, Drain (Item 11, Appendix E)

Materials /Parts

Oil, Hydraulic (Item 15, Appendix B)
 Solvent, Dry-cleaning (Item 20, Appendix B)
 Cartridge, Flow
 Ring, Backup
 Ring, Wear (2)

Materials/Parts - Continued

Ring, Wear
 Packing, Preformed
 Wire, Lock
 Wiper
 Seal
 Seal
 Screw, Removal (2)

Equipment Condition

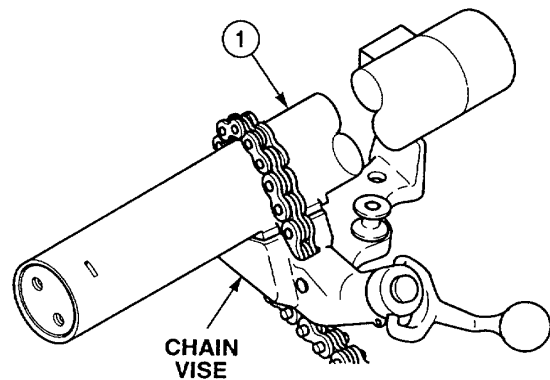
Mast primary cylinder removed (Para 13-2)

a. Disassembly.

CAUTION

Do not allow threaded or machined surfaces to come in contact with other metal surfaces. Clearances between cylinder components are very small, any minor damage done during disassembly could require component replacement or make assembly difficult.

- (1) Position mast primary cylinder (1) in chain vise.



15-7. MAST PRIMARY CYLINDER REPAIR (CONT).

- (2) Position drain pan under mast primary cylinder (1).
- (3) Install two screws (2) in end of base (3).

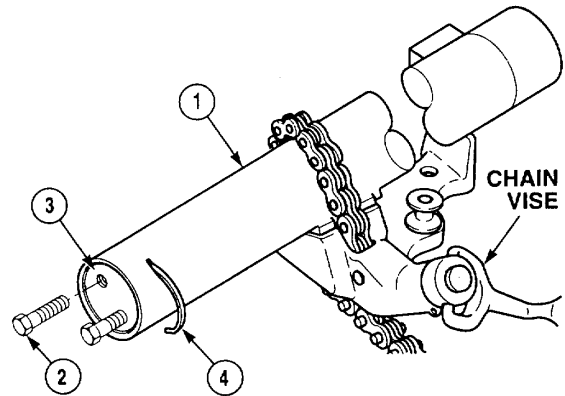
WARNING

Use extreme care when removing or installing lock wire. Lock wire is under tension and can act as a projectile when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

NOTE

A bar may be used to rotate base left or right until end of lock wire appears in slot on cylinder. Lift up lock wire end, rotate base and position lock wire end on outside of cylinder, rotating base until hook end of lock wire is exposed in hole of base.

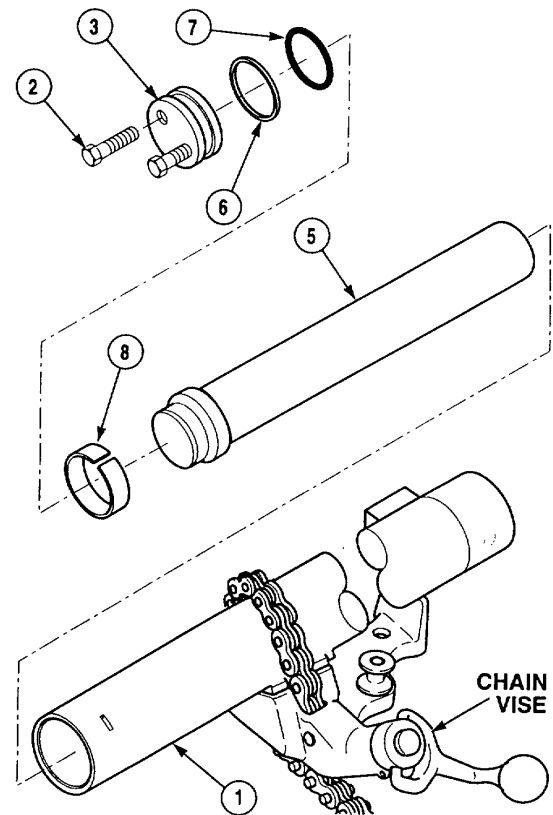
- (4) Remove lock wire (4) from base (3) and cylinder (1). Discard lock wire.



CAUTION

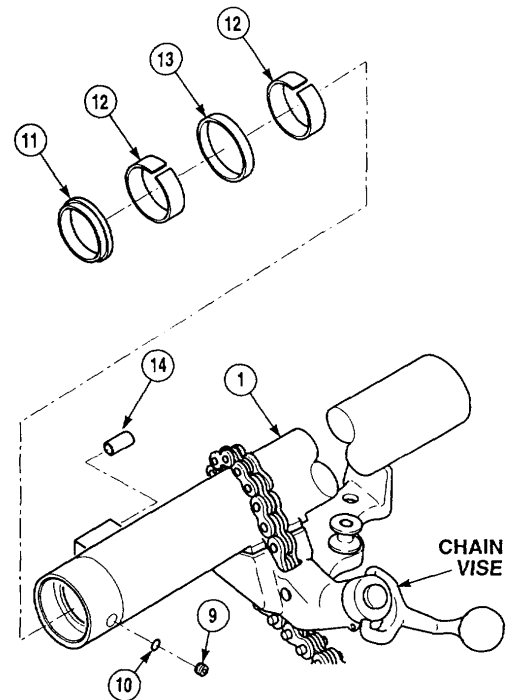
Keep piston straight and concentric in cylinder. Do not allow piston to become wedged in cylinder or damage to cylinder or piston may occur.

- (5) Remove base (3) from cylinder (1).
- (6) Remove piston (5) from cylinder (1).
- (7) Remove two screws (2) from base (3).
- (8) Remove backup ring (6) and preformed packing (7). Discard backup ring and preformed packing.
- (9) Remove wear ring (8) from piston (5). Discard wear ring.



15-7. MAST PRIMARY CYLINDER REPAIR (CONT).

- (10) Remove cylinder (1) from chain vise, rotate 180 degrees, and position cylinder in chain vise.
- (11) Remove button screw (9) and seal (10) from cylinder (1). Discard seal.
- (12) Remove wiper (11), two wear rings (12), and seal (13) from cylinder (1). Discard wiper, wear rings, and seal.
- (13) Remove flow cartridge (14) from cylinder (1). Discard flow cartridge.
- (14) Remove cylinder (1) from chain vise.

**b. Cleaning/Inspection.****WARNING**

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
- **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**

- (1) Clean all components and flush cylinder barrel using dry-cleaning solvent only. Do not use cleaning cloth as any foreign material would contaminate hydraulic system.
- (2) Inspect barrel bore for any scratches or corrosion. Replace barrel if rusted. Replace barrel and piston if either component is scratched.
- (3) Inspect rod for bending. Replace if necessary.

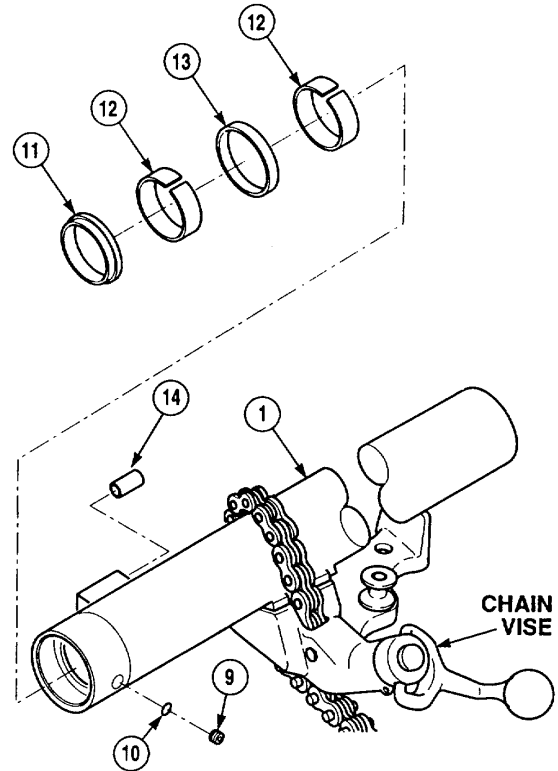
- (4) Inspect rod for scratches or pitting. Remove minor scratches and pitting by using stone and lubrication oil.
- (5) Inspect component threads for burrs and stripped threads. Replace or repair as necessary.

c. Assembly.

NOTE

Coat all internal parts with hydraulic oil before assembly.

- (1) Position mast primary cylinder (1) in chain vise.
- (2) Install flow cartridge (14) in cylinder (1).
- (3) Install seal (13), two wear rings (12), and wiper (11) in cylinder (1).
- (4) Install seal (10) and button screw (9) in cylinder (1).



15-7. MAST PRIMARY CYLINDER REPAIR (CONT).

- (5) Remove cylinder (1) from chain vise, rotate 180 degrees, and position cylinder in chain vise.

CAUTION

Keep piston straight and concentric in cylinder. Do not allow piston to become wedged in cylinder or damage to cylinder or piston may occur.

- (6) Install wear ring (8) on piston (5).
 (7) Install piston (5) in cylinder (1).
 (8) Install preformed packing (7) on base (3).
 (9) Install backup ring (6) on base (3).
 (10) Install two screws (2) in base (3).
 (11) Position base (3) in cylinder (1) with hole in base visible in slot of cylinder.

WARNING

Use extreme care when removing or installing lock wire. Lock wire is under tension and can act as a projectile when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

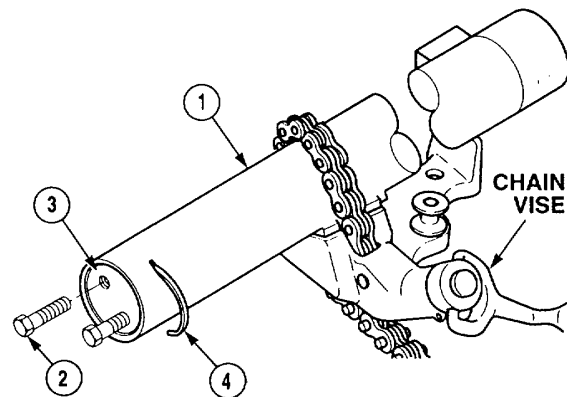
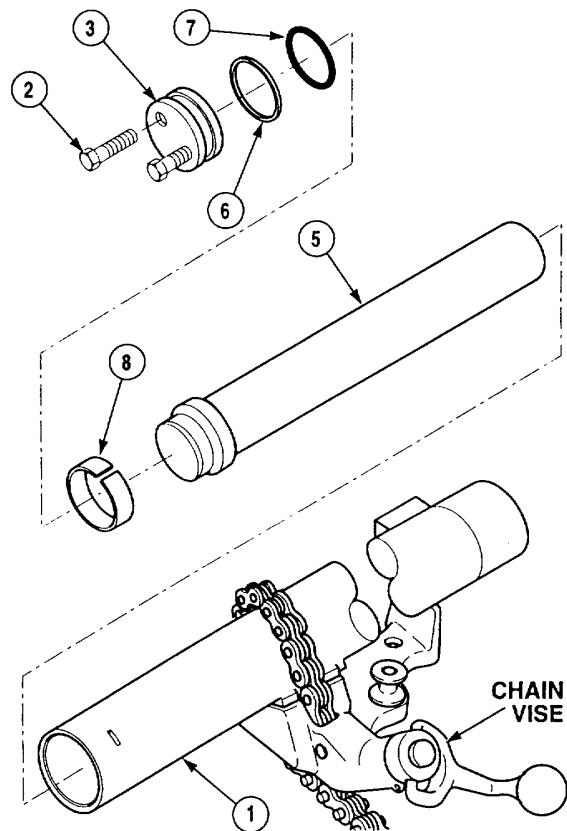
- (12) Install lock wire (4) in hole of base (3) rotating base until lock wire locks into groove of base.
 (13) Remove two screws (2) from base (3).
 (14) Remove mast primary cylinder (1) from chain vise.

NOTE

Follow-on Maintenance:

- **Install mast primary cylinder (Para 13-2).**

END OF TASK



15-8. MAST SECONDARY CYLINDER REPAIR.

This task covers:

- a. Disassembly b. Cleaning/Inspection c. Assembly

INITIAL SETUP

Tools and Special Tools

Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
Vise, Pipe, Chain (Item 5, Appendix E)
Pan, Drain (Item 11, Appendix E)

Equipment Condition

Mast secondary cylinder removed (Para 13-2)

Materials/Parts

Oil, Hydraulic (Item 15, Appendix B)
Solvent, Dry-cleaning (Item 20, Appendix B)
Ring, Wear
Ring, Wear (2)
Kit, Seal

a. Disassembly.

NOTE

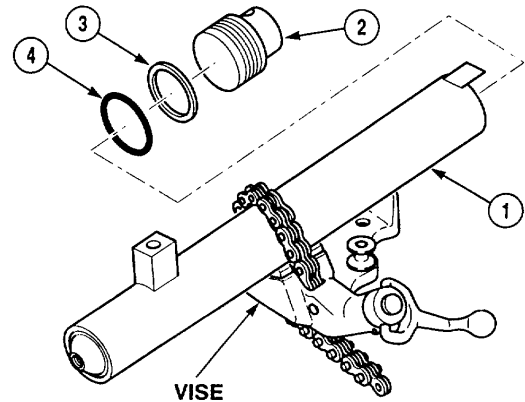
There are two mast secondary cylinders. Both are repaired the same way.

- (1) Position mast secondary cylinder (1) in chain vise.

CAUTION

Do not allow threaded or machined surfaces to come in contact with other metal surfaces. Clearances between cylinder components is very small, any minor damage done during disassembly could require component replacement or make assembly difficult.

- (2) Position drain pan under mast secondary cylinder (1).
(3) Remove base (2) from cylinder (1).
(4) Remove backup ring (3) and preformed packing (4) from base (2). Discard backup ring and preformed packing.

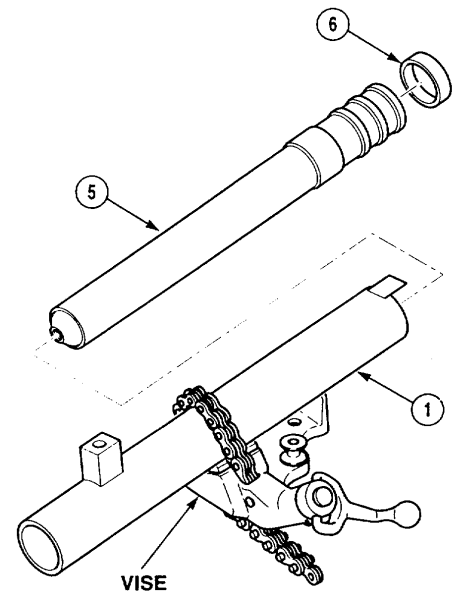


15-8. MAST SECONDARY CYLINDER REPAIR (CONT).

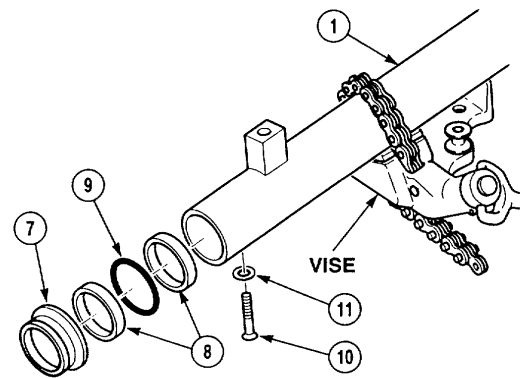
CAUTION

Keep rod straight and concentric in cylinder. Do not allow rod to become wedged in cylinder or damage to cylinder or rod may occur.

- (5) Remove rod (5) from cylinder (1).
- (6) Remove wear ring (6) from rod (5). Discard wear ring.



- (7) Remove wiper (7) from cylinder (1). Discard wiper.
- (8) Remove two wear rings (8) and seal (9) from cylinder (1). Discard wear rings and seal.
- (9) Remove screw (10) and seal (11) from cylinder (1). Discard seal.
- (10) Remove cylinder (1) from chain vise.



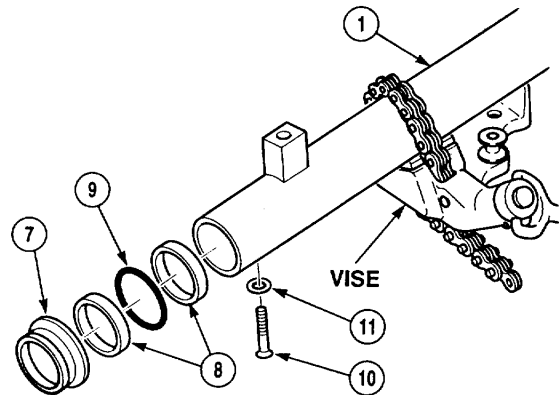
b. Cleaning/Inspection.**WARNING**

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
 - **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**
- (1) Clean all components and flush cylinder barrel using dry-cleaning solvent only. Do not use cleaning cloth as any foreign material would contaminate hydraulic system.
 - (2) Inspect barrel bore for any scratches or corrosion. Replace barrel if rusted. Replace barrel and piston if either component is scratched.
 - (3) Inspect rod for bending. Replace if necessary.
 - (4) Inspect rod for scratches or pitting. Remove minor scratches and pitting by using stone and lubrication oil.
 - (5) Inspect component threads for burrs and stripped threads. Replace or repair as necessary.

c. Assembly.**NOTE**

Coat all internal parts with hydraulic oil before assembly.

- (1) Position mast secondary cylinder (1) in chain vise.
- (2) Install seal (9) and two wear rings (8) in cylinder (1).
- (3) Install wiper (7) in cylinder (1).
- (4) Install seal (11) and screw (10) in cylinder (1).



15-8. MAST SECONDARY CYLINDER REPAIR (CONT).

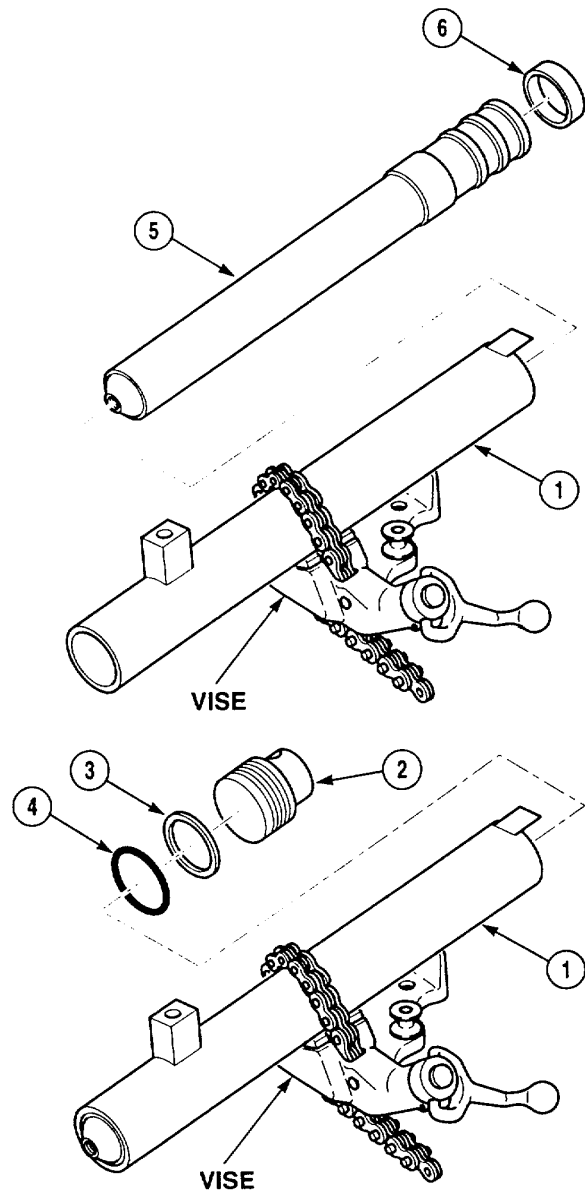
- (5) Install wear ring (6) on rod (5).

CAUTION

Keep rod straight and concentric in cylinder. Do not allow rod to become wedged in cylinder or damage to cylinder or rod may occur.

- (6) Install rod (5) in cylinder (1).

- (7) Install preformed packing (3) and backup ring (4) on base (2).
 (8) Install base (2) in cylinder (1).
 (9) Remove mast secondary cylinder (1) from chain vise.



NOTE

Follow-on Maintenance:

- Install mast secondary cylinder (Para 13-2).

END OF TASK

15-9. PIVOT AND SHIFT ASSEMBLY REPLACEMENT/REPAIR.

This task covers:

- | | | |
|----------------|------------------------|-----------------|
| a. Removal | c. Cleaning/Inspection | e. Installation |
| b. Disassembly | d. Reassembly | |

INITIAL SETUP

Tools and Special Tools

- Tool Kit, General Mechanic's: Automotive (Item 1, Appendix E)
- Lifting Chain, (Item 5, Appendix E)
- Jack Kit, Hydraulic 20 Ton (Item 5, Appendix E)
- Jack, Hydraulic 50 Ton (Item 5, Appendix E)
- Wrench Set, Socket 3/4 "dr" (Item 5, Appendix E)
- Torque Wrench 0-600 lb ft (Item 5, Appendix E)
- Portable Grinder/Sander (Item 5, Appendix E)
- Lubricant Packer Bearing (Item 5, Appendix E)
- Arc Welding Machine (Item 6, Appendix E)
- Spanner Wrench (Item 19, Appendix E)
- Lifting Device, Minimum Capacity 4,000 lbs (1814 kg)

Materials/Parts

- Nut (2) (Item 37, Appendix B)
- Gasket (2)

Personal Required

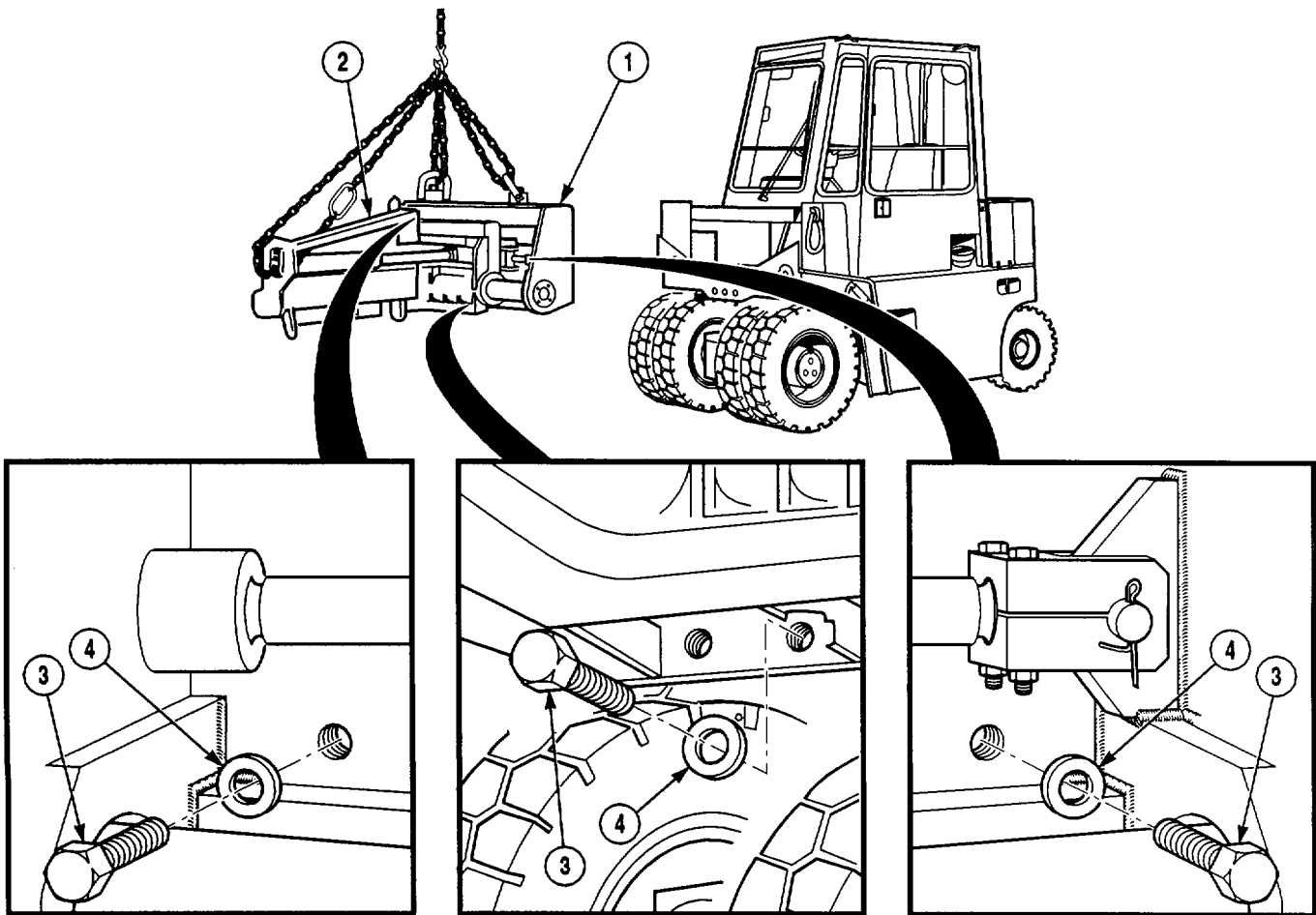
- Two

Equipment Condition

- Engine OFF (TM 10-3930-669-10)
- Parking brake applied (TM 10-3930-669-10)
- Wheels chocked (TM 10-3930-669-10)
- Shift assembly centered on vehicle (TM 10-3930-669-10)
- Side shift rod scraper removed (TM 10-3930-669-20)
- Batteries disconnected (TM 10-3930-669-20)
- Pivot cylinder removed (TM 10-3930-669-20)
- Mast removed (Para 13-2)

15-9. PIVOT AND SHIFT ASSEMBLY REPLACEMENT/REPAIR (CONT).**a. Removal.**

- (1) Install two lifting eyes on side shift housing (1).
- (2) Position blocking in pivot and shift assembly (2).
- (3) Attach suitable three-point sling to pivot and shift assembly (2) and side shift housing (1).

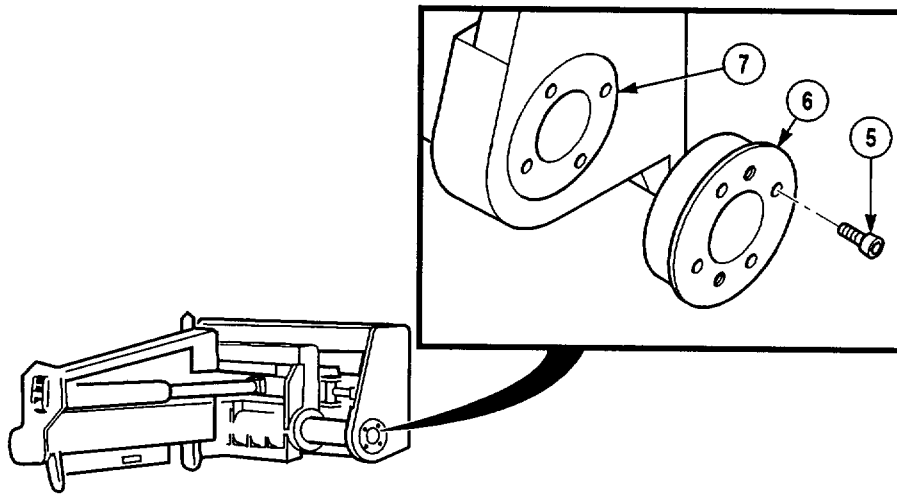
**WARNING**

Pivot and shift assembly weighs 1870 lbs (848 kg). Attach lifting device prior to removal to prevent possible injury to personnel.

- **All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.**

- (4) Remove four screws (3) and washers (4) from side shift housing (1).
- (5) Using suitable lifting device, remove side shift housing (1) and pivot and shift assembly (2) and position on flat surface.

b. Disassembly.



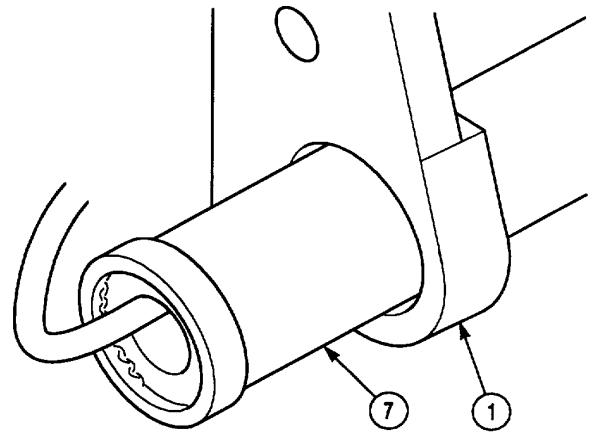
NOTE

The side shift shaft will need to be pulled out two inches in order to be removed from the end cap.

- (1) Remove four screws (5) from plate (6) and shaft (7).

WARNING

- Side shift shaft weighs 295 lbs (134 kg). Attach lifting device prior to removal to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.



- (2) Using a lifting device and suitable press, drive shaft (7) to right side of side shift housing.

15-9. PIVOT AND SHIFT ASSEMBLY REPLACEMENT/REPAIR (CONT).**WARNING**

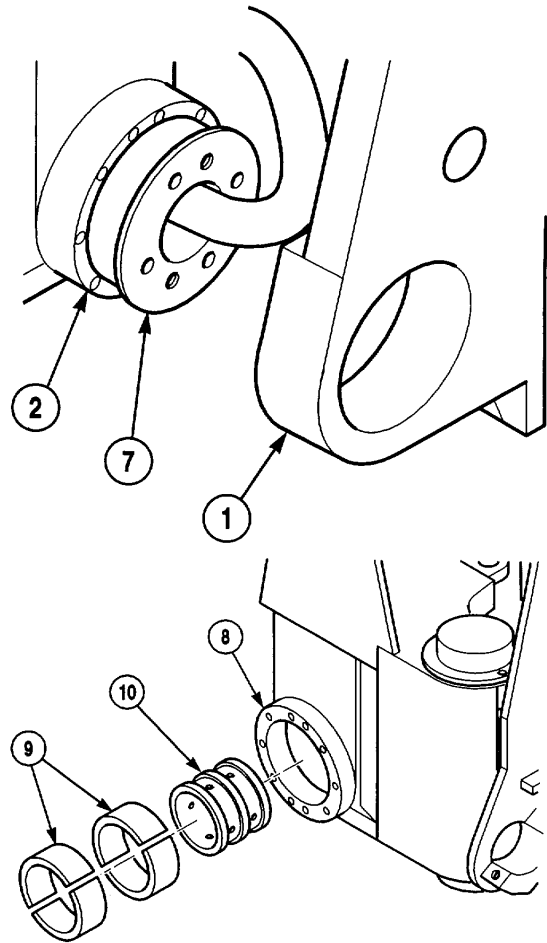
- **Side shift shaft weighs 295 lbs (134 kg). Attach lifting device prior to removal to prevent possible injury to personnel.**
- **All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.**

- (3) Using a suitable lifting device, remove shaft (7) from pivot and shift assembly (2) and side shift housing (1).

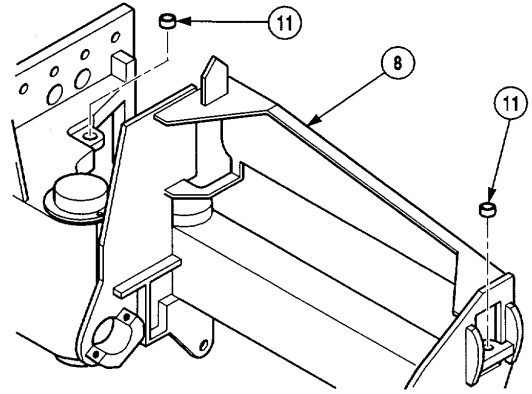
WARNING

- **Pivot arm assembly weighs 875 lbs (397 kg). Attach lifting device prior to removal to prevent possible injury to personnel.**
- **All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.**

- (4) Position pivot assembly (8) on flat surface.
- (5) Using bearing tool, remove four bearing halves (9) and spacer (10) from pivot assembly (8).
- (6) Repeat Step (5) to remove four bearing halves (9) from opposite end of pivot assembly (8).



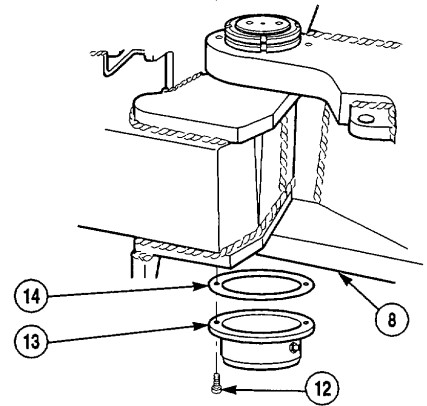
- (7) Remove two radial bushings (11) from pivot assembly (8).



NOTE

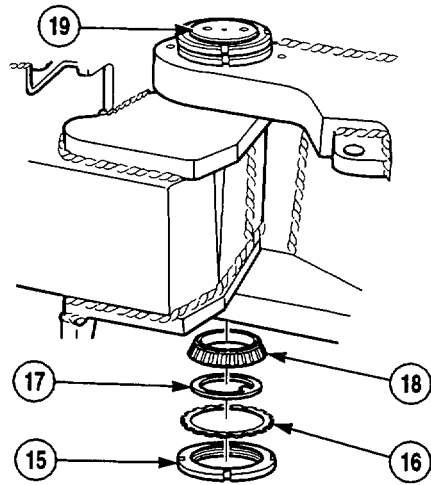
One side shown but both bearing caps removed the same way.

- (8) Remove four screws (12), bearing cap (13), and preformed packing (14) from pivot assembly (8). Discard preformed packing.

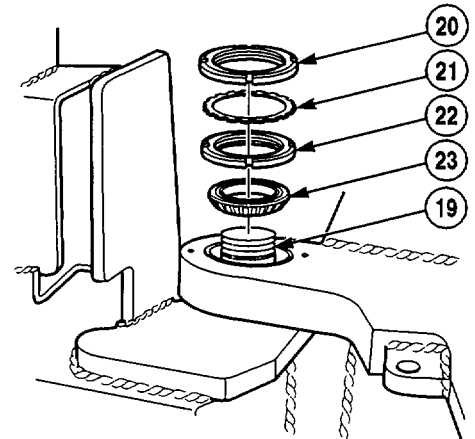


15-9. PIVOT AND SHIFT ASSEMBLY REPLACEMENT/REPAIR (CONT).

- (9) Remove nut (15), lock ring (16), ring (17), and bearing (18) from pivot pin (19).



- (10) Remove nut (20), lock ring (21), nut (22), and bearing (23) from pivot pin (19).

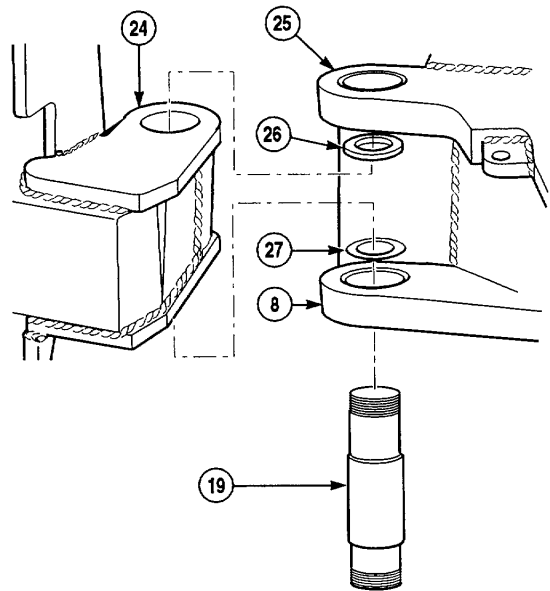


WARNING

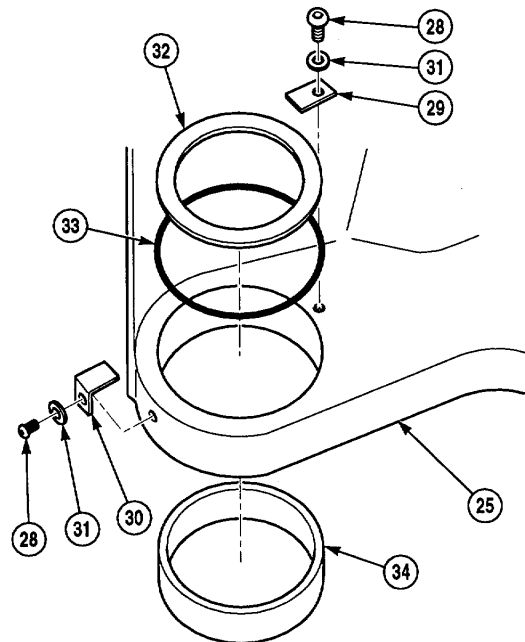
- **Pivot arm weighs 335 lbs (152 kg). Attach lifting device prior to removal to prevent possible injury to personnel.**
- **All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.**

NOTE

Pivot pin can only be removed from the bottom.



- (11) Remove pivot pin (19) from pivot assembly (8) and pivot arm (24).
- (12) Remove pivot arm (24) from side shift assembly (25).
- (13) Remove spacer (26) and preformed packing (27) from side shift assembly (25).
- (14) Remove two screws (28), clips (29 and 30), washers (31), seal (32), and preformed packing (33) from side shift assembly (25).
- (15) Remove two bearing races (34) from side shift assembly (25).



15-9. PIVOT AND SHIFT ASSEMBLY REPLACEMENT/REPAIR (CONT).

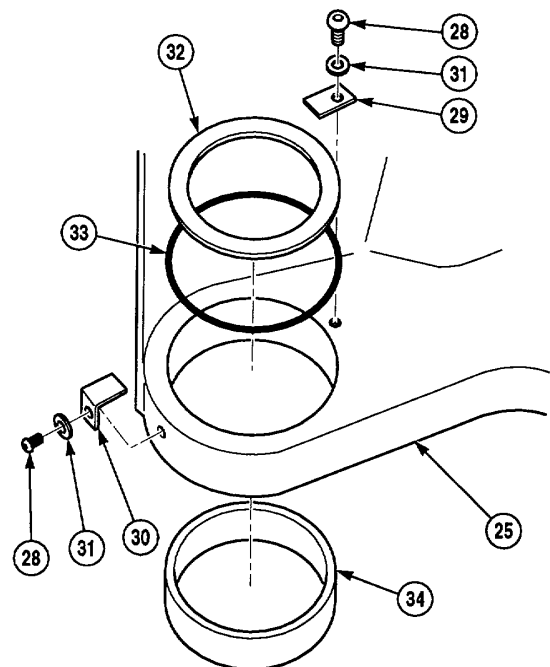
c. Cleaning/Inspection.**WARNING**

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**
- **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**

- (1) Clean all components and flush cylinder barrel using dry-cleaning solvent only. Do not use cleaning cloth as any foreign material would contaminate hydraulic system.
- (2) Inspect barrel bore for any scratches or corrosion. Replace barrel if rusted. Replace barrel and piston if either component is scratched.
- (3) Inspect rod for bending. Replace if necessary.
- (4) Inspect rod for scratches or pitting. Remove minor scratches and pitting by using stone and lubrication oil.
- (5) Inspect component threads for burrs and stripped threads. Replace or repair as necessary.

d. Assembly.

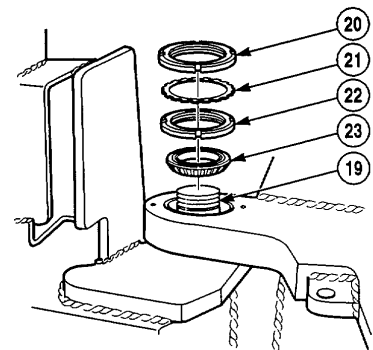
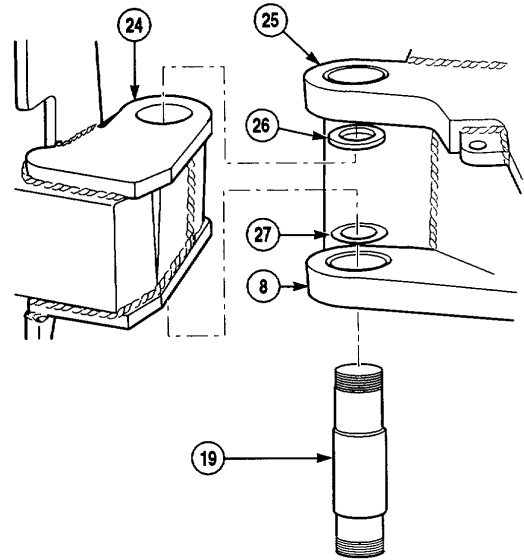
- (1) Install two bearing races (34) in shift assembly (25).
- (2) Position preformed packing (33) and seal (32) into side shift housing (1).
- (3) Install two clips (29 and 30) on side shift assembly (25) with two washers (31) and screws (28). Tighten screw to 10 lb-ft (13.56 N.m)



WARNING

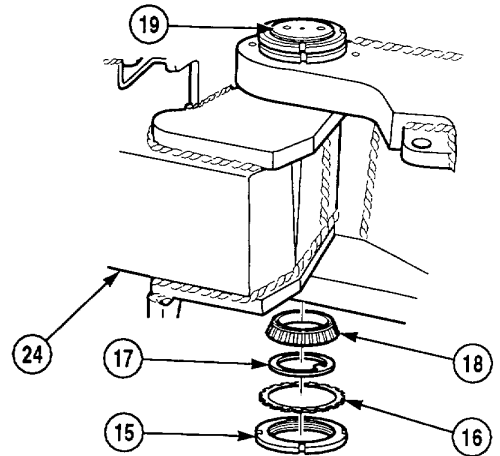
- **Pivot arm weighs 335 lbs (152 kg). Attach lifting device prior to removal to prevent possible injury to personnel.**
- **All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.**

- (4) Position spacer (26) and spacer (27) in side shift assembly (25).
- (5) Using suitable lifting device position pivot arm (24) in side shift assembly (25).
- (6) Position pivot pin (19) in pivot assembly (8) and pivot arm (24) from the bottom.
- (7) Position bearing (23), nut (22), lock ring (21), and nut (20) on pivot pin (19). Do not tighten.
- (8) Using spanner wrench, tighten top nut (20) to 260 lb-ft (352.51 N.m).
- (9) Using spanner wrench, tighten bottom nut (22) to 540 lb-ft (732.14 N.m).



15-9. PIVOT AND SHIFT ASSEMBLY REPLACEMENT/REPAIR (CONT).

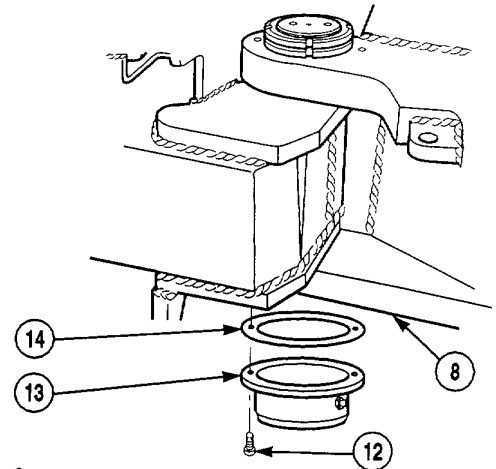
- (10) Check pivot arm (24) for freedom of movement.
- (11) Install bearing (18), ring (17), and lock ring (16) on pivot pin (19) with nut (15). Tighten nut to 20 lb-ft (27.12 N•m).



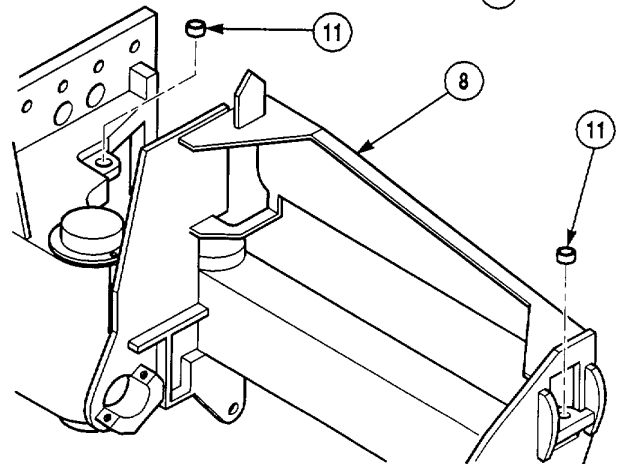
NOTE

One side shown but both bearing caps installed the same way.

- (12) Install preformed packing (14) and bearing cap (13) on pivot assembly (8) with four screws (12).



- (13) Install two radial bushings (11) in pivot assembly (8).



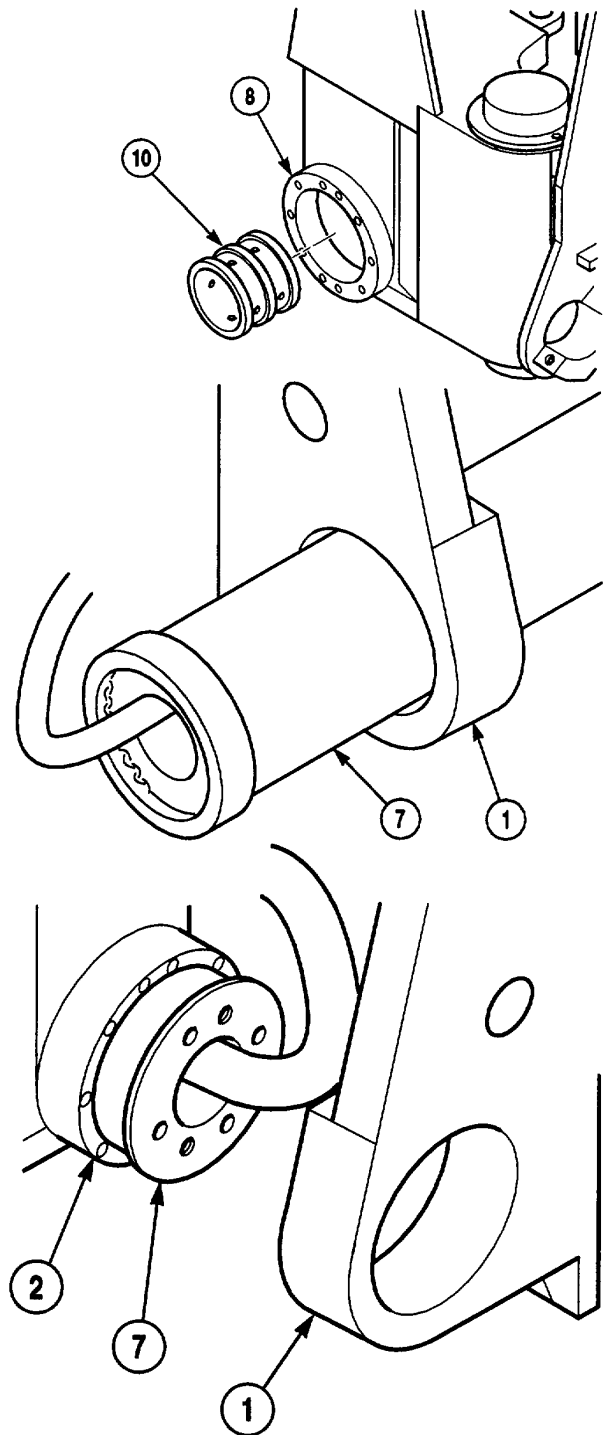
- (14) Apply lithium grease to inside of pivot assembly (8) and position spacer (10) into left side of pivot assembly.

WARNING

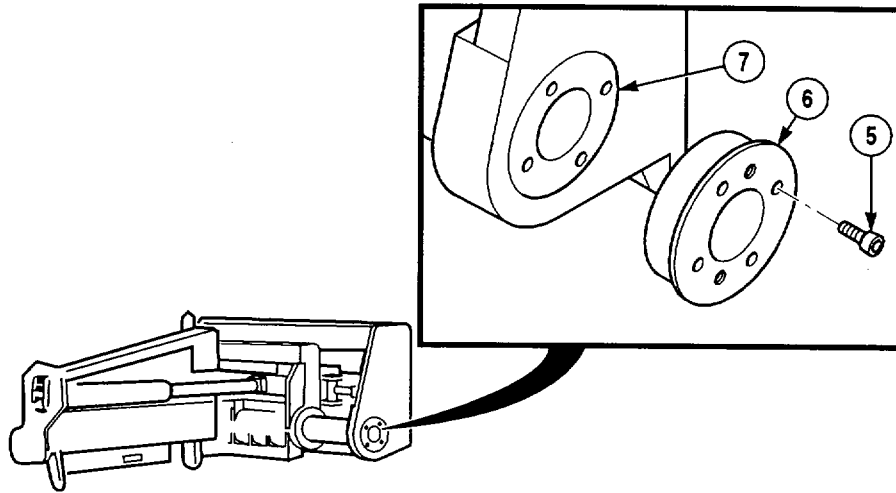
- **Side shift shaft weighs 295 lbs (134 kg) Attach lifting device prior to removal to prevent possible injury to personnel.**

- **All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.**

- (15) Using a lifting device and a suitable press, position shaft (7) in side shift housing (1).
- (16) Using a suitable lifting device, install shaft (7) on pivot and shift assembly (2) and side shift housing (1).



15-9. PIVOT AND SHIFT ASSEMBLY REPLACEMENT/REPAIR (CONT).



(17) Using 30 ton ram, press side shift shaft (7) main end cap (6) and bearing cap (5) into side shift housing (1).

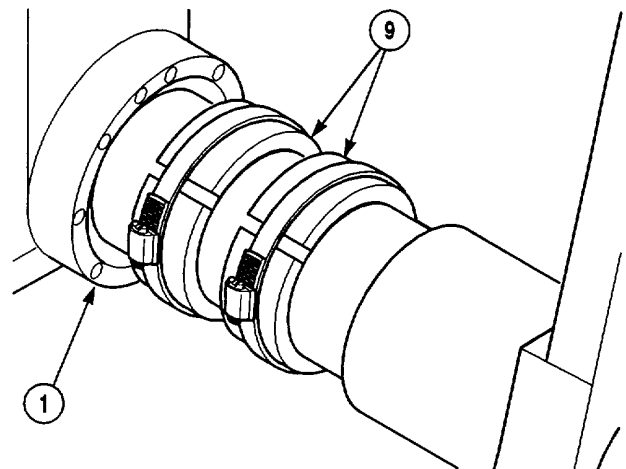
(18) Install main end cap (6) on shaft (7) with four screws (8). Tighten screws to 105 lb-ft (142.36 N.m).

NOTE

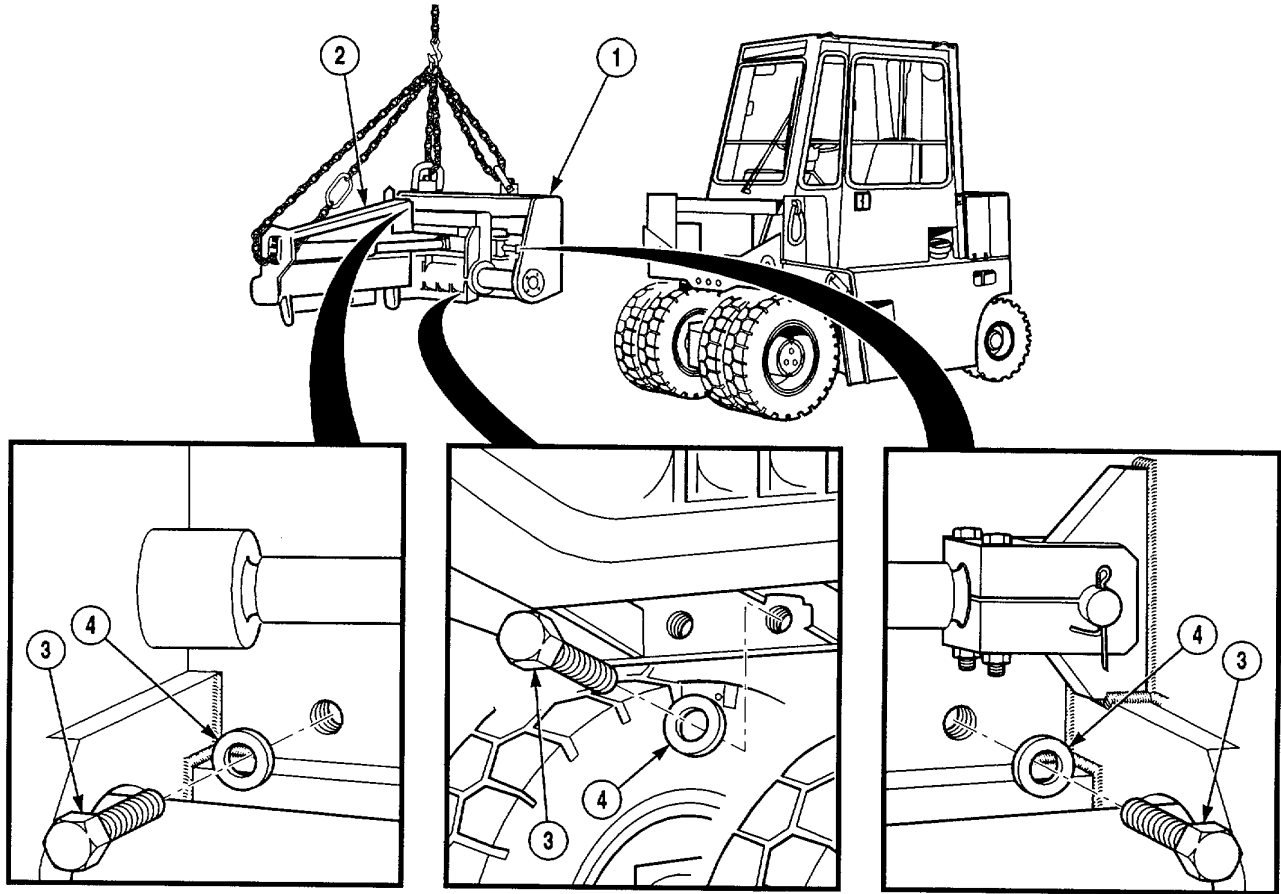
- **Left side bearing halves shown but both sides installed the same way.**

- **Using 50 ton jack, slide the pivot and shift assembly over the bearing halves.**

(19) Using bearing tool and four clamps, install eight bearing halves (9) into side shift housing (1).



e. Installation.



WARNING

- **Pivot and shift assembly weighs 1870 lbs (848 kg). Attach lifting device prior to installation to prevent possible injury to personnel.**
- **All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.**

- (1) Using suitable lifting device, position pivot and shift assembly (2) approximately 12 inches (305 mm) from side shift housing (1).
- (2) Install shift cylinder/umbilical hoses (TM 10-3930-669-20).

NOTE

- **Make sure pivot and shift assembly is positioned securely in weldments on bulkhead.**
 - **Pivot and shift assembly may need to be moved to install bottom screws.**
- (3) Install pivot and shift assembly (2) on side shift housing (1) with four washers (4) and screws (3).

15-9. PIVOT AND SHIFT ASSEMBLY REPLACEMENT/REPAIR (CONT).

NOTE

Follow-on Maintenance:

- **Install mast (Para 13-2).**
- **Install pivot cylinder (TM 10-3930-669-20).**
- **Install side shift rod scraper (TM 10-3930-669-20).**
- **Lube pivot and side shift Assembly (LO 10 3930-669-12).**
- **Connect batteries (TM 10-3930-669-20).**
- **Remove wheel chocks (TM 10-3930-669-20).**

END OF TASK

15-10. HYDRAULIC RESERVOIR REPLACEMENT.

This task covers:

- a. Removal b. Cleaning/Inspection c. Installation

INITIAL SETUP*Tools and Special Tools*

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)
Wrench, Torque (0 to 175 lb-ft [0-237 N-m])
(Item 5, Appendix E)
Wrench, Torque (0-60 N.m)
(Item 12, Appendix E)

Materials/Parts

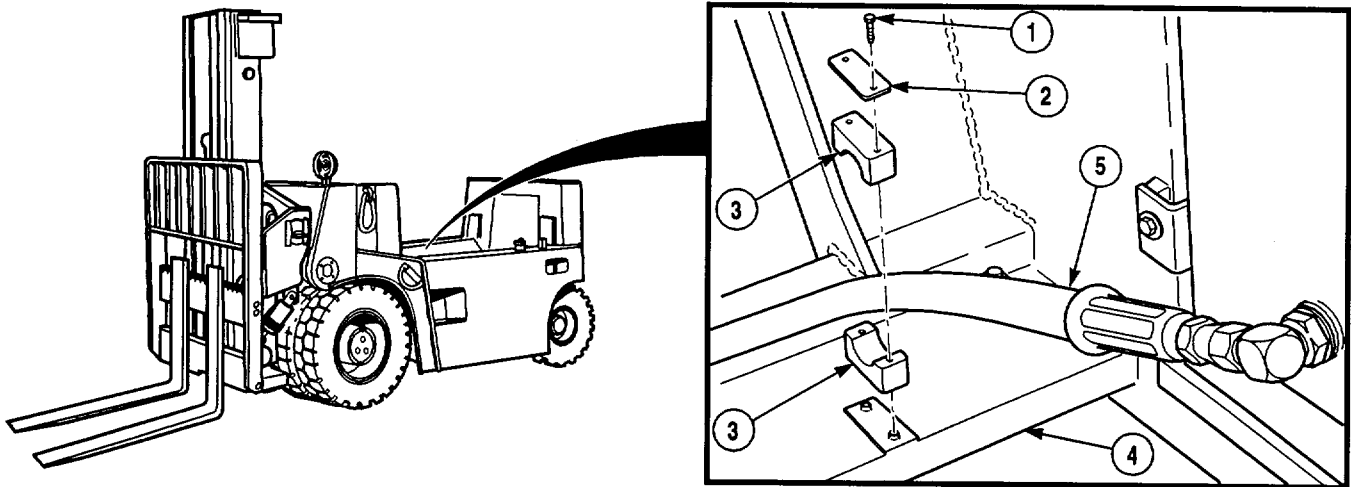
Cap and Plug Set (Item 5, Appendix B)
Rags, Wiping (Item 19, Appendix E)
Solvent, Dry-cleaning (Item 20, Appendix E)
Tags, Identification (Item 21, Appendix E)
Packing, Preformed (3)

Personnel Required

Two

Equipment Condition

Wheels chocked (TM 10-3930-669-10)
Hydraulic reservoir drained
(TM 10-3930-669-10)
Remove shunt (TM 10-3930-669-20)
Engine/transmission assembly removed
(Para 3-3)

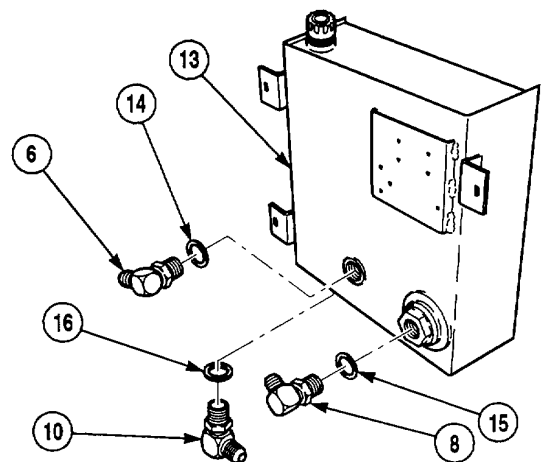
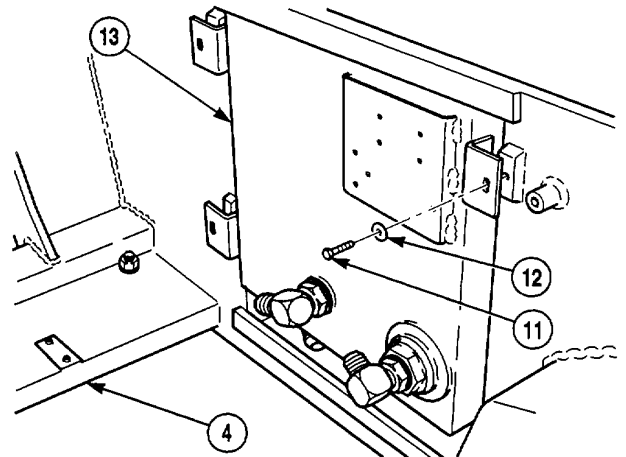
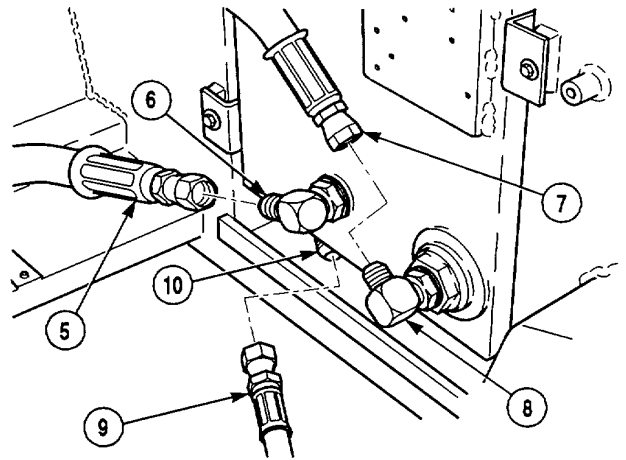
a. Removal.**NOTE**

- Tag and mark all lines, hoses, and fittings prior to removal.
- Cap and plug all lines, hoses, and fittings when disconnected.

(1) Remove two screws (1), cover plate (2), and clamp (3) from frame (4) and hose (5).

15-10. HYDRAULIC RESERVOIR REPLACEMENT (CONT).

- (2) Disconnect hose (5) from elbow (6).
- (3) Disconnect hose (7) from elbow (8).
- (4) Disconnect hose (9) from elbow (10).
- (5) Remove three screws (11) and washers (12) from hydraulic reservoir (13).
- (6) With aid of assistant, remove hydraulic reservoir (13) from frame (4).
- (7) Remove elbow (6) and preformed packing (14) from hydraulic reservoir (13). Discard preformed packing.
- (8) Remove elbow (8) and preformed packing (15) from hydraulic reservoir (13). Discard preformed packing.
- (9) Remove elbow (10) and preformed packing (16) from hydraulic reservoir (13). Discard preformed packing.



b. **Cleaning/Inspection.****WARNING**

- Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes; and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flashpoint for type I dry-cleaning solvent is 100°F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.

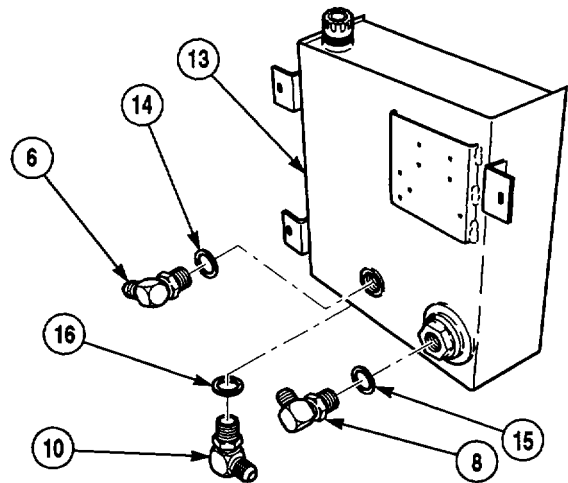
- If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

- (1) Clean all metal parts with dry-cleaning solvent and wipe dry with wiping rag.
- (2) Flush reservoir with dry-cleaning solvent and allow to air dry.
- (3) Inspect all parts for breaks, cracks, burrs, and sharp edges. Inspect all hoses, lines, and fittings for cracks, bends, nicks, dents, stripped threads, and cuts. Replace all damaged parts.

C **Installation.****NOTE**

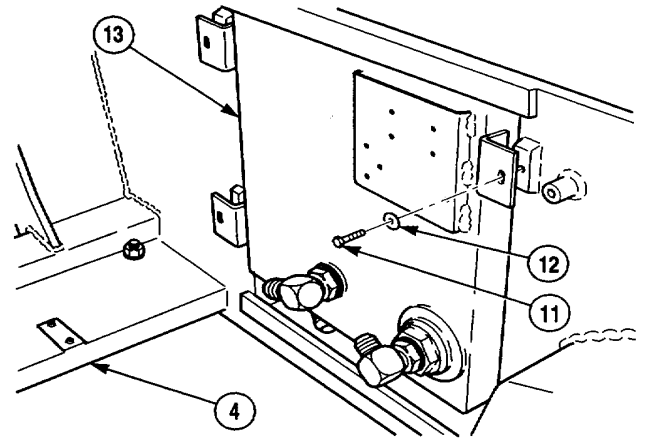
Coat preformed packings with hydraulic fluid prior to installation.

- (1) Install preformed packing (16) and elbow (10) in hydraulic reservoir (13).
- (2) Install preformed packing (15) and elbow (8) in hydraulic reservoir (13).
- (3) Install preformed packing (14) and elbow (6) in hydraulic reservoir (13).

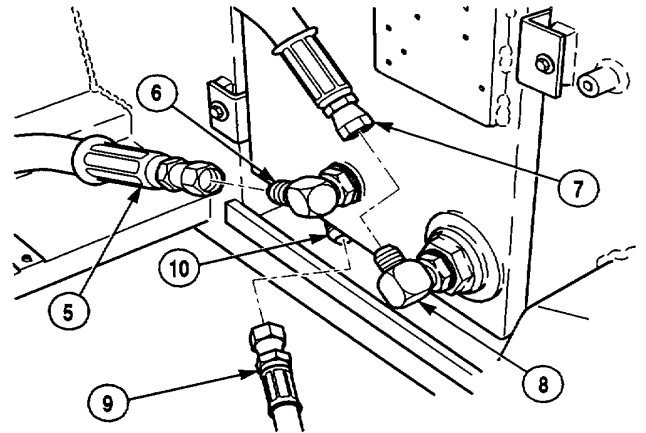


15-10. HYDRAULIC RESERVOIR REPLACEMENT (CONT).

- (4) With aid of assistant, position hydraulic reservoir (13) in frame (4).
- (5) Install hydraulic reservoir (13) in frame (4) with three washers (12) and screws (11).
- (6) Connect hose (9) on elbow (10).
- (7) Connect hose (7) on elbow (8).
- (8) Connect hose (5) on elbow (6).



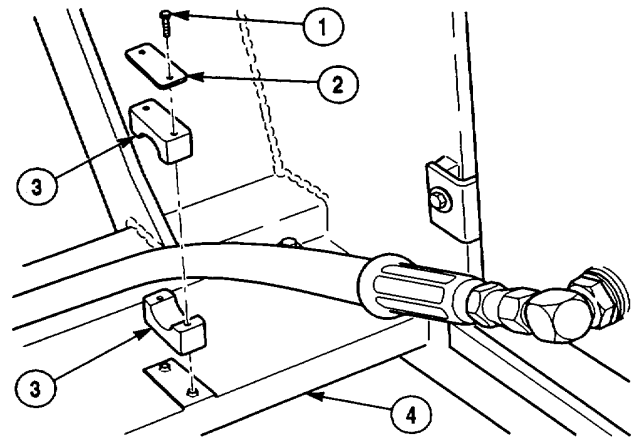
- (9) Install clamp (3) on frame (4) and hose (5) with cover plate (2) and two screws (1).



NOTE

Follow-on Maintenance:

- Install engine/transmission assembly (Para 3-3).
- Install shunt (TM 10-3930-669-20).
- Fill hydraulic reservoir (TM 10-3930-669-10).
- Remove wheel chocks (TM 10-3930-669-10).



END OF TASK

15-11. SIDE SHIFT CYLINDER REPLACEMENT/REPAIR.

This task covers:

- | | | |
|----------------|------------------------|-----------------|
| a. Removal | c. Cleaning/Inspection | e. Installation |
| b. Disassembly | d. Assembly | |

INITIAL SETUP*Tools and Special Tools*

Tool Kit, General Mechanic's: Automotive
(Item 1, Appendix E)
Sander, Disk, Electrical
(Item 5, Appendix E)
Jack, Kit, Hydraulic, 20 Ton Cap
(Item 5, Appendix E)
Wrench, Set, Combination
(Item 5, Appendix E)
Wrench, Set, Socket 1 in dr.
(Item 5, Appendix E)
Jack Kit, 30 Ton
(Item 17, Appendix E)
Bearing Installer
(Item 18, Appendix E)
Wrench, Spanner (Item 19, Appendix E)
Lifting Device, Minimum Capacity 4,000 lbs
(1814 kg)

Material/Parts

Nut, Hex (2)

Personnel Required

Two

Equipment Condition

Engine OFF (TM 10-3930-669-10)
Parking brake applied (TM 10-3930-669-10)
Wheels choked (TM 10-3930-669-10)
Mast assembly side shifted and
pivoted 90 deg. (TM 10-3930-669-10)

15-11. SIDE SHIFT CYLINDER REPLACEMENT/REPAIR (CONT).

a. *Removal.*

NOTE

Tag and mark all lines, hoses, and fittings prior to removal.

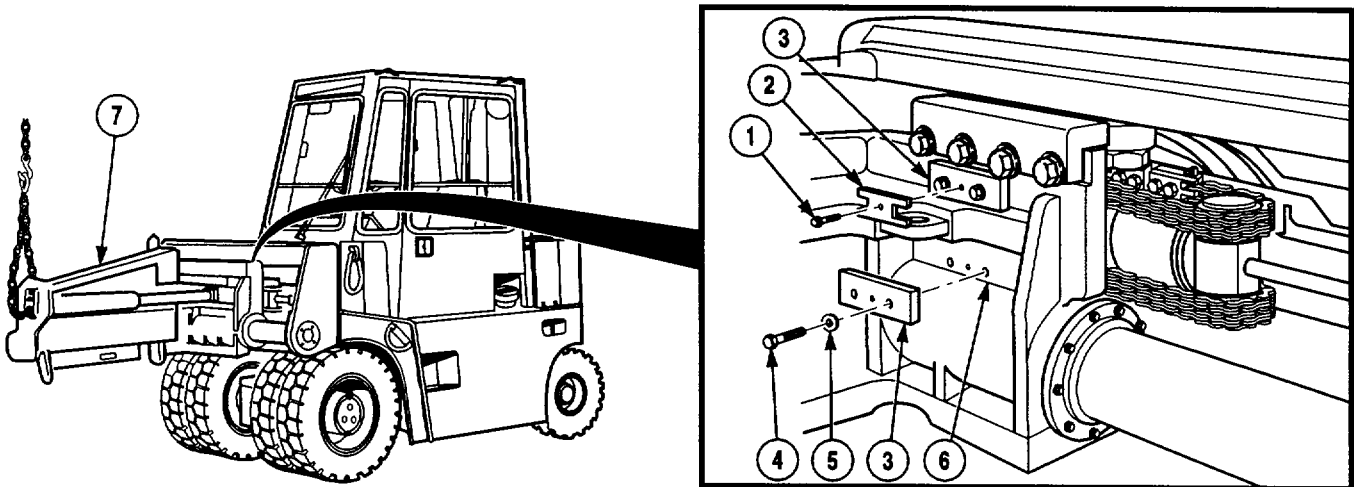
- (1) Remove screw (1) and locking plate (2) from plate assembly (3)

WARNING

- Pivot and shift assembly weighs 1870 lbs (848 kg). Attach lifting device prior to installation to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

- (2) Remove two screws (4), washers (5) and plate assembly (3) from support (6).

- (3) Attach suitable lifting device to support side shift assembly (7).

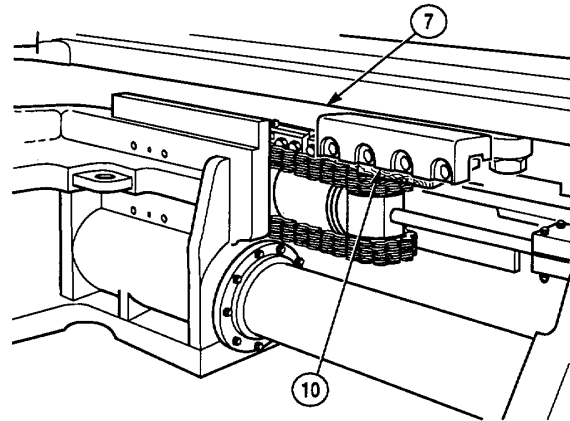
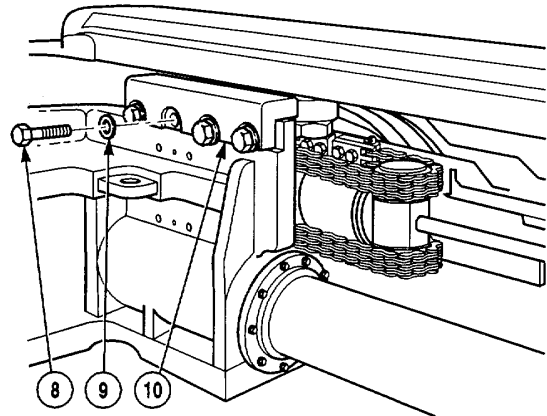


WARNING

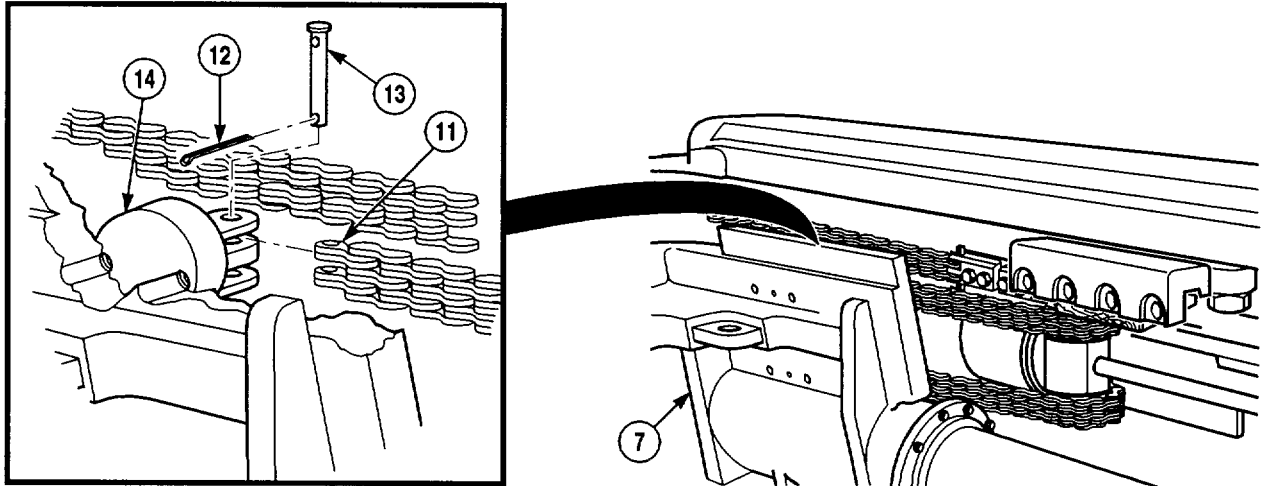
- Side shift assembly weighs 105 lbs (47.63 kg). Attach lifting device prior to installation to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

(4) Remove four screws (8), and washers (9) from support bearing assembly (10).

(5) Position and block support bearing assembly (10) to far right of side shift assembly (7).



15-11. SIDE SHIFT CYLINDER REPLACEMENT/REPAIR (CONT).

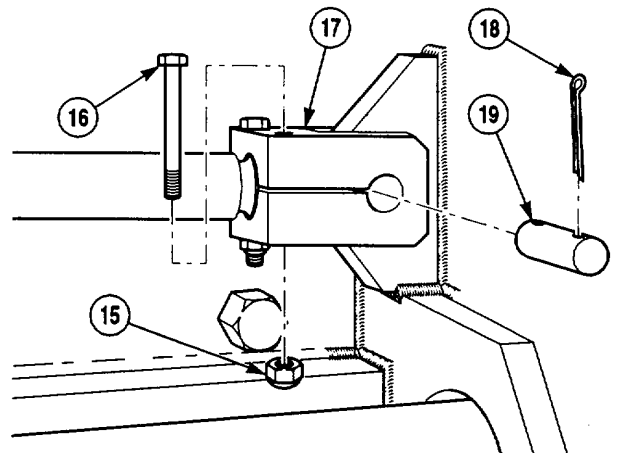


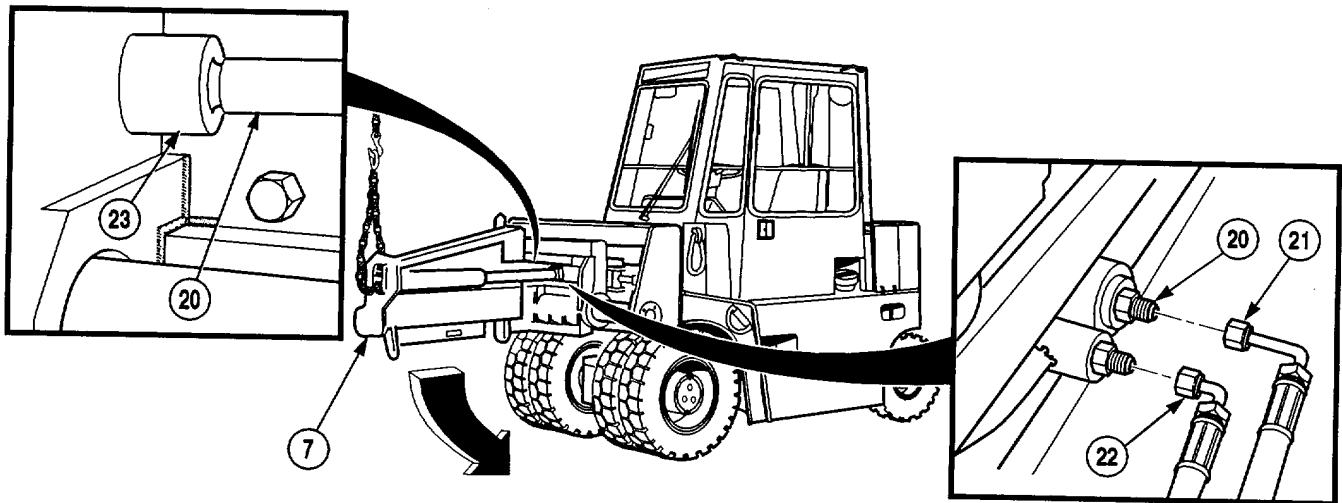
- (6) Lower side shift assembly (7) until access to side shift chains (11) can be achieved.

NOTE

One clevis shown, all chains removed the same way.

- (7) Remove four cotter pins (12), pins (13), and side lift chains (11) from clevis (14).
- (8) Remove two lock nuts (15) and screws (16) from side shift yoke (17).
- (9) Remove two cotter pins (18) and pin (19) from side shift yoke (17).

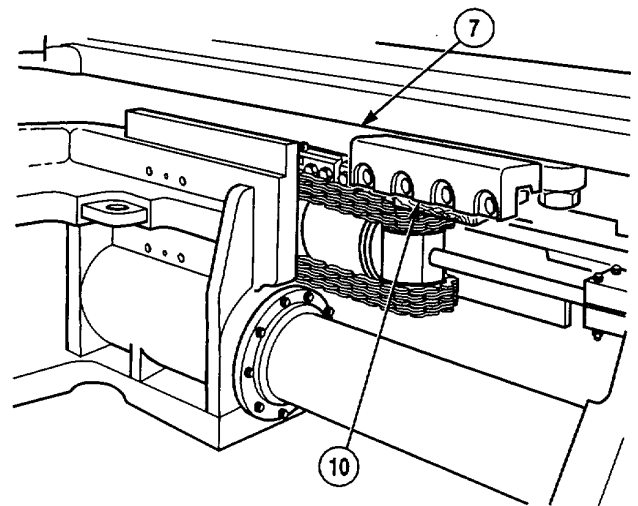




WARNING

- Side shift cylinder weighs 105 lbs (47.63 kg). Attach lifting device prior to installation to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

- (10) Lower side shift assembly (7) completely down.
- (11) Position side shift cylinder (20) to gain access to hydraulic hoses (21 and 22).
- (12) Remove two hoses (21 and 22) from side shift cylinder (20).
- (13) With the aid of an assistant, remove side shift cylinder (20) from cone roller bearing (23) and side shift assembly (7)
- (14) With the aid of an assistant, remove support bearing assembly (10) and blocking from side shift assembly (7).

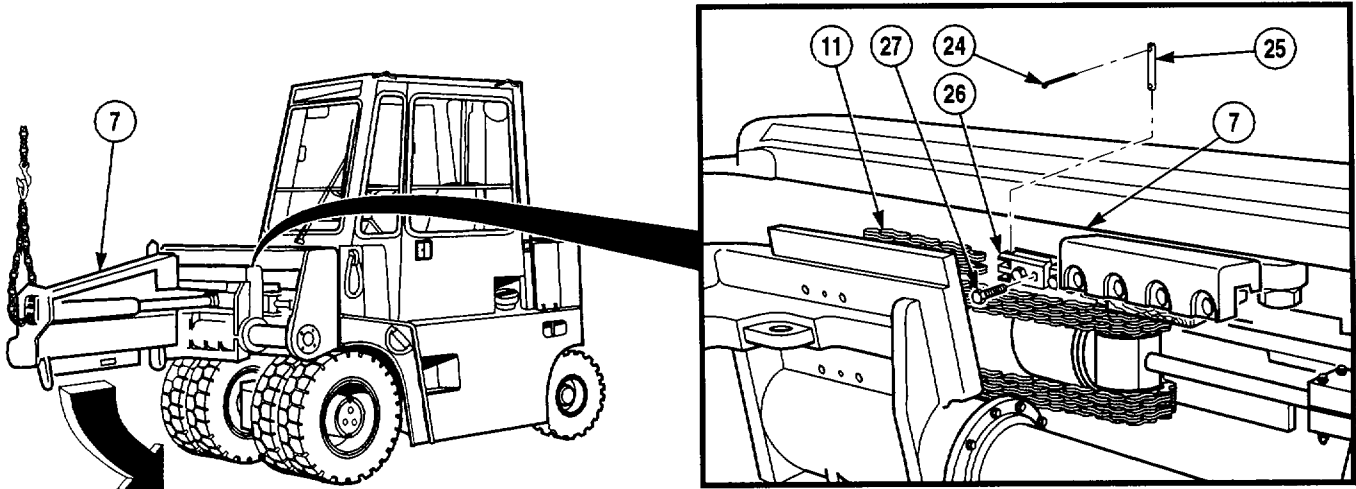


15-11. SIDE SHIFT CYLINDER REPLACEMENT/REPAIR (CONT).

NOTE

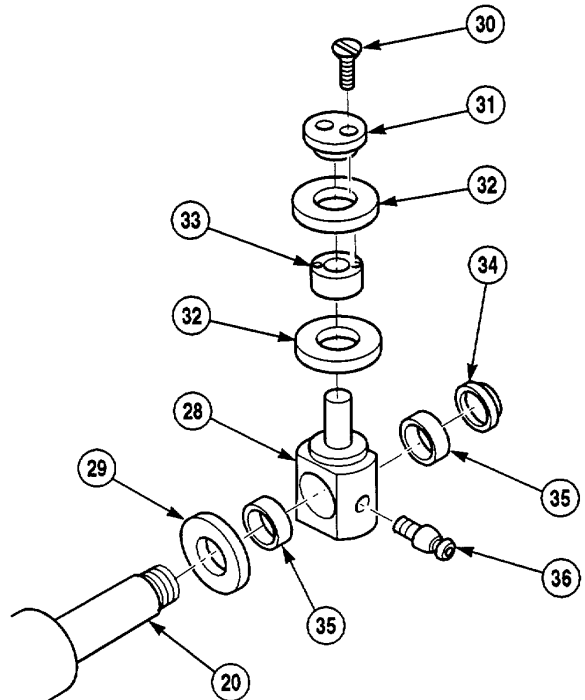
One anchor shown, all removed the same way.

- (15) Remove cotter pin (24), pin (25), and side shift chains (11) from anchors (26).
- (16) Remove two screws (27) and anchor (26) from side shift assembly (7).



b. Disassembly.

- (1) Remove yoke sheave (28) and spacer (29) from side shift cylinder (20).
- (2) Remove four screws (30), two bearing covers (31), chain guides (32), bearings (33), and chain guides (32) from yoke sheave (28).
- (3) Remove rod wiper (34) and two bearings (35) from yoke sheave (28).
- (4) Remove fitting (36) from yoke sheave (28).



CAUTION

Transfer tube is mounted along axis of cylinder. Use blocks to protect transfer tube when clamping cylinder in a chain vise or damage to equipment may result.

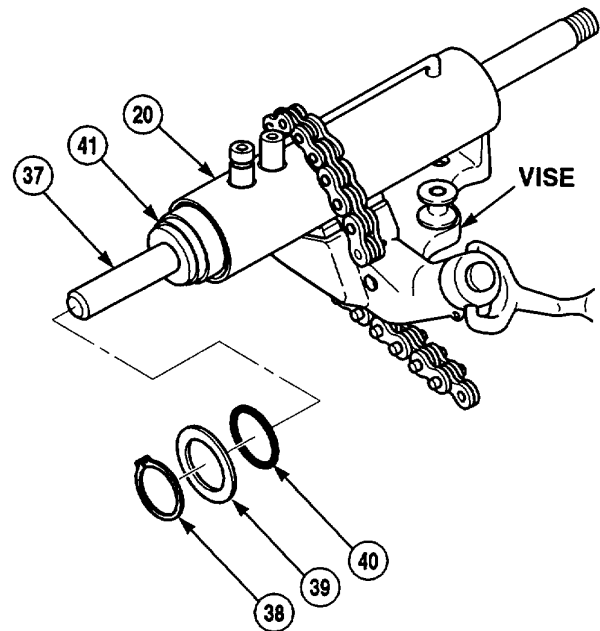
- (5) Position side shift cylinder (20) in chain vise using rubber stripping to protect cylinder surface. Use wooden block to protect transfer tube.

CAUTION

Do not allow threaded or machined surfaces to come in contact with other metal surfaces. Clearances between cylinder components are very small, any minor damage done during disassembly could require component replacement or make assembly difficult.

NOTE

The left head of the side shift cylinder and right head of the side shift cylinder are removed the same way. Right side is shown.



- (6) Position drain pan under side shift cylinder (20).
 (7) Position piston rod (37) out of side shift cylinder (20) 4 in. (10.16 cm).

WARNING

Use extreme care when removing or installing spring retaining rings. Spring retaining rings are under tension and can act as projectiles when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

- (8) Remove retaining ring (38), spacer (39), and preformed packing (40) from side shift cylinder (20) and head (41).

15-11. SIDE SHIFT CYLINDER REPLACEMENT/REPAIR (CONT).

NOTE

Backup seals may come off during the step.

- (9) Push head (41) into the side shift cylinder (20) until shear ring (42) is exposed.
- (10) Remove shear ring (42) from inside of side shift cylinder (20). Discard shear ring.

CAUTION

Keep piston rod straight and concentric in cylinder. Do not allow piston rod to become wedged in cylinder or damage to cylinder or piston rod may occur.

- (11) Remove shear ring (43) backup seal (44), preformed packing (45), head (41), and piston rod (37) from side shift cylinder (20). Discard preformed packing and backup seal.

NOTE

If the left head of the shift cylinder is to be removed repeat Steps (1 through 7), if not go on to step (8).

- (12) Remove side shift cylinder (20) from chain vise.

CAUTION

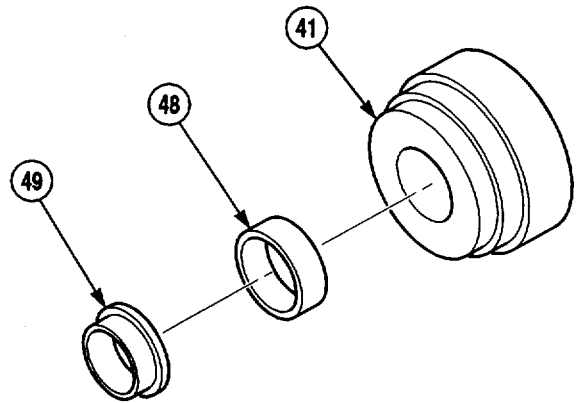
Do not damage piston rod surface. Cylinder will leak if piston rod surface is damaged.

NOTE

Note location and position of preformed packing, gasket, backup seal, and wiper rod prior to removal.

- (13) Remove gasket (46), preformed packing (47) from piston rod (37). Discard gasket and preformed packing.

- (14) Remove rod packing (48), wiper rod (49), from head (41). Discard rod packing and wiper rod.



c. Cleaning/Inspection.

WARNING

- **Dry-cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes, and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flame flash point for type I dry-cleaning solvent is 100F (38°C) and for type II is 138°F (50°C). Failure to do so may result in injury or death to personnel.**

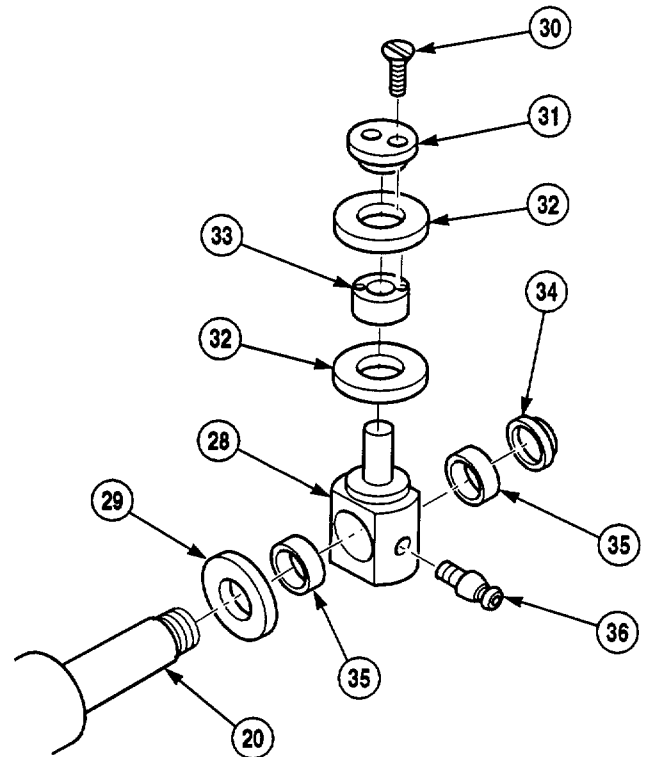
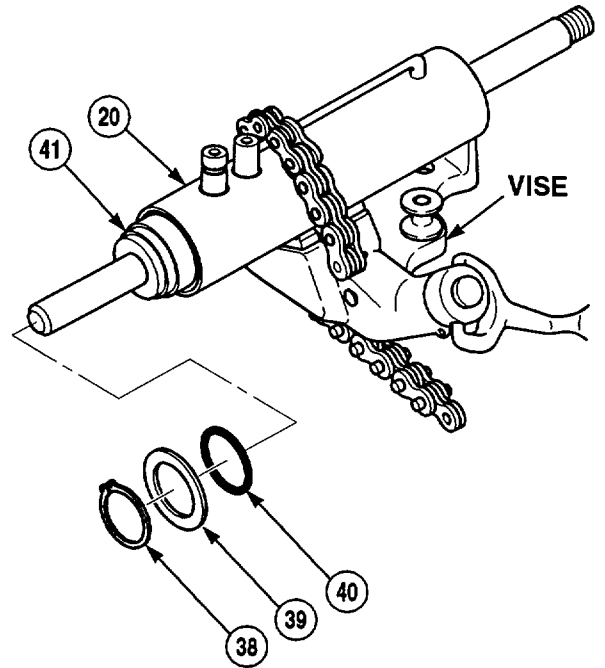
- **If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.**

- (1) Clean all components and flush cylinder barrel using dry-cleaning solvent only. Do not use cleaning cloth as any foreign material would contaminate hydraulic system.
- (2) Inspect barrel bore for any scratches or corrosion. Replace barrel if rusted. Replace barrel and piston if either component is scratched.
- (3) Inspect rod for bending. Replace if necessary.
- (4) Inspect rod for scratches or pitting. Remove minor scratches and pitting by using stone and lubrication oil.
- (5) Inspect component threads for burrs and stripped threads. Replace or repair as necessary.

15-11. SIDE SHIFT CYLINDER REPLACEMENT/REPAIR (CONT).

d. *Assembly.*

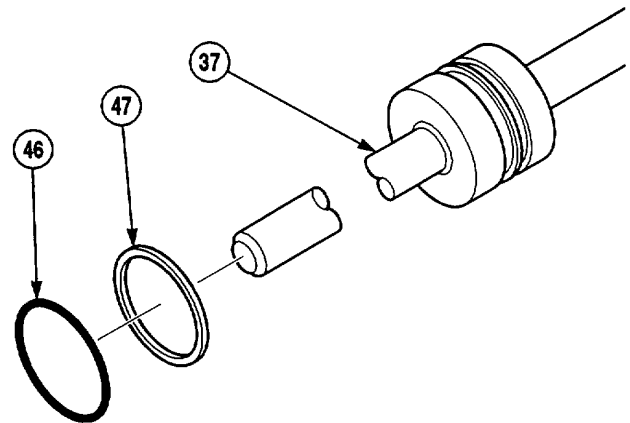
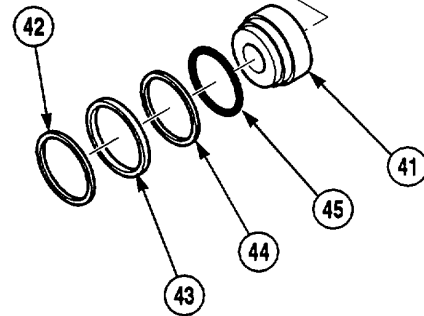
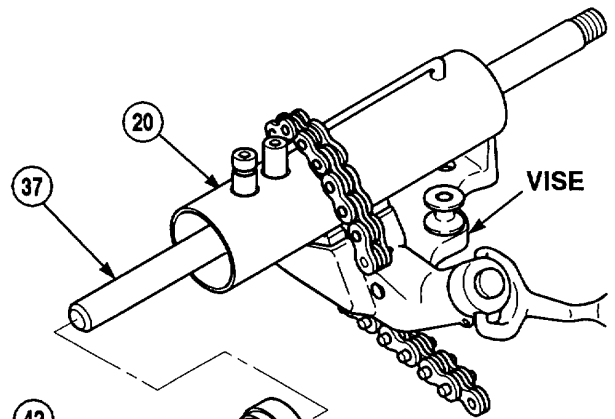
- (1) Coat wiper rod (49), rod packing (48) and head (41) with lubricating oil.
- (2) Install wiper rod (49) and rod packing (48) in head (41).
- (3) Coat preformed packing (47), gasket (46), with lubricating oil.
- (4) Install preformed packing (47) and gasket (46) on piston rod (37).
- (5) Coat preformed packing (45), backup seal (44), and head (41) with lubricating oil.
- (6) Install piston rod (37), head (41), preformed packing (45), backup seal (44) and shear rings (43 and 42) in side shift cylinder (20).



WARNING

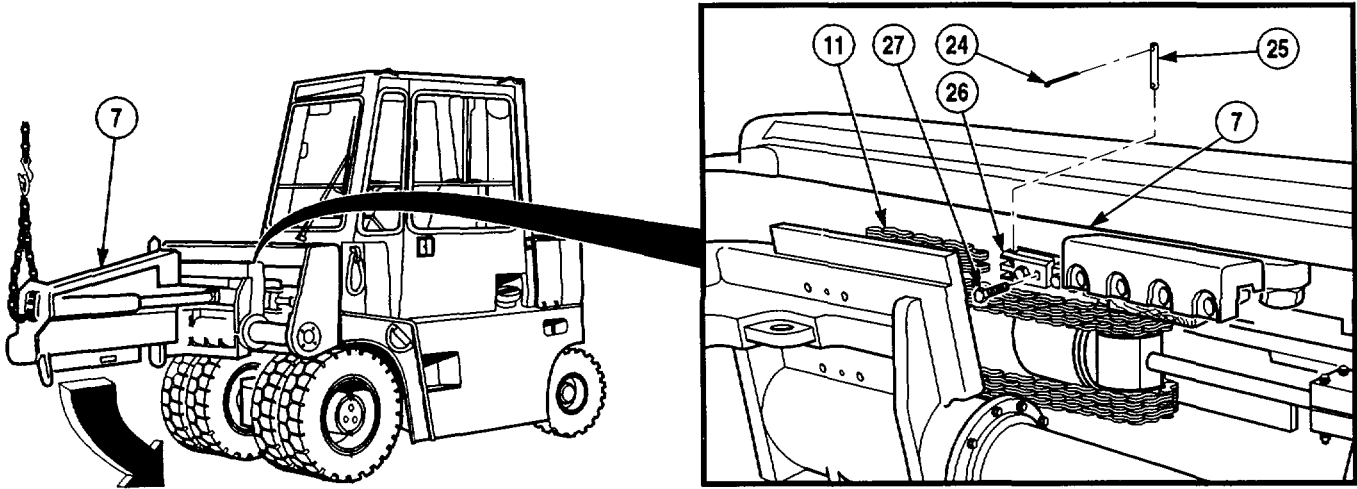
Use extreme care when removing or installing spring retaining rings. Spring retaining rings are under tension and can act as projectiles when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

- (7) Install preformed packing (40), spacer (39), and retaining ring (38) in side shift cylinder (20) and head (41).
- (8) Install fitting (36) on yoke sheave (28).
- (9) Install two bearings (35) and rod wiper (34) on yoke sheave (28).
- (10) Install chain guides (32), bearings (33), chain guides (32), and two bearings (31) on yoke sheave (28) with four screws (30).
- (11) Install spacer (29) and yoke sheave (28) on side shift cylinder (20).



15-11. SIDE SHIFT CYLINDER REPLACEMENT/REPAIR (CONT).

e. *Installation.*



- (1) Install anchor (26) on side shift assembly (7) with two screws (27).

NOTE

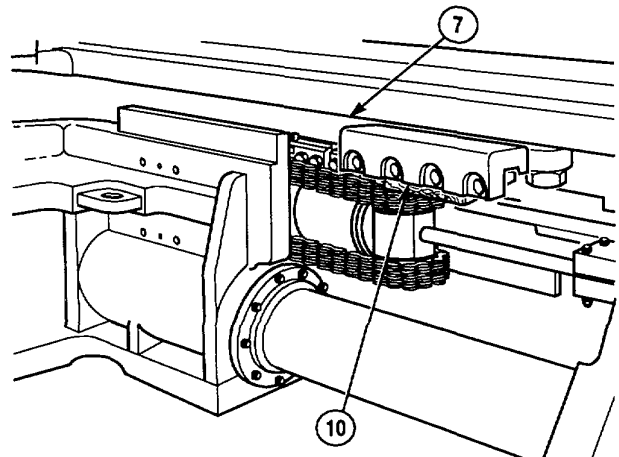
One anchor shown, all installed the same way.

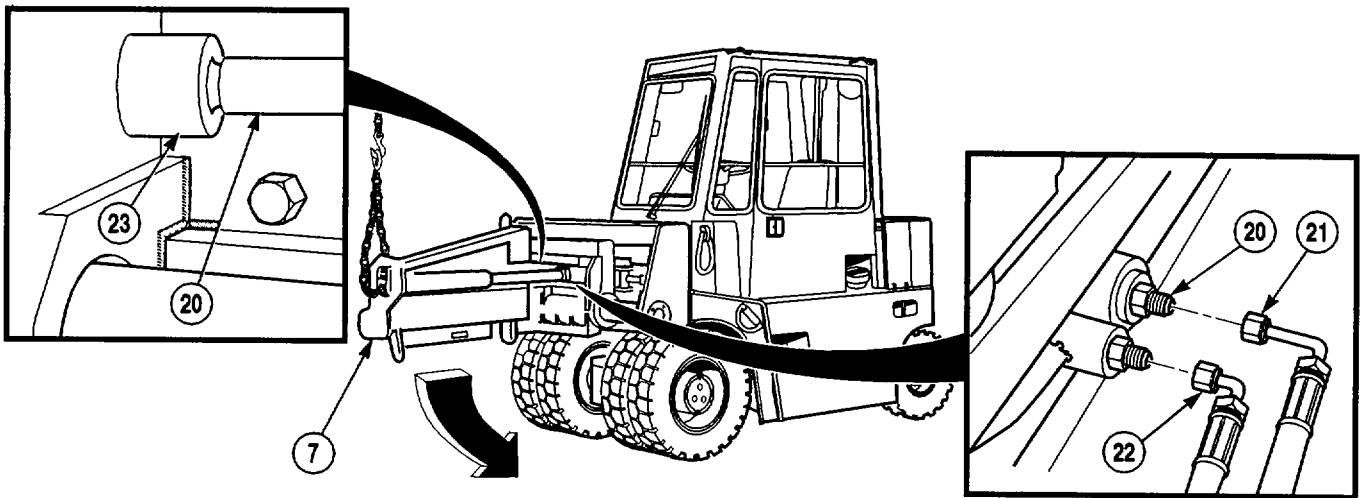
- (2) Install four side shift chains (11) on anchors (26) with four pins (25) and cotter pins (24).

WARNING

- Side shift assembly weighs 105 lbs (47.63 kg). Attach lifting device prior to installation to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

- (3) With the aid of an assistant, install support bearing assembly (10) on side shift assembly (7).

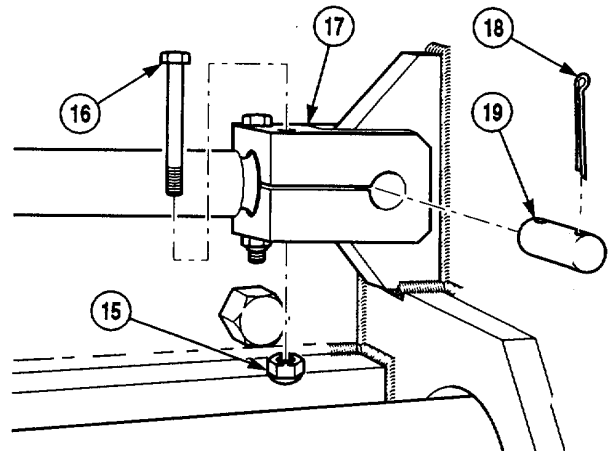




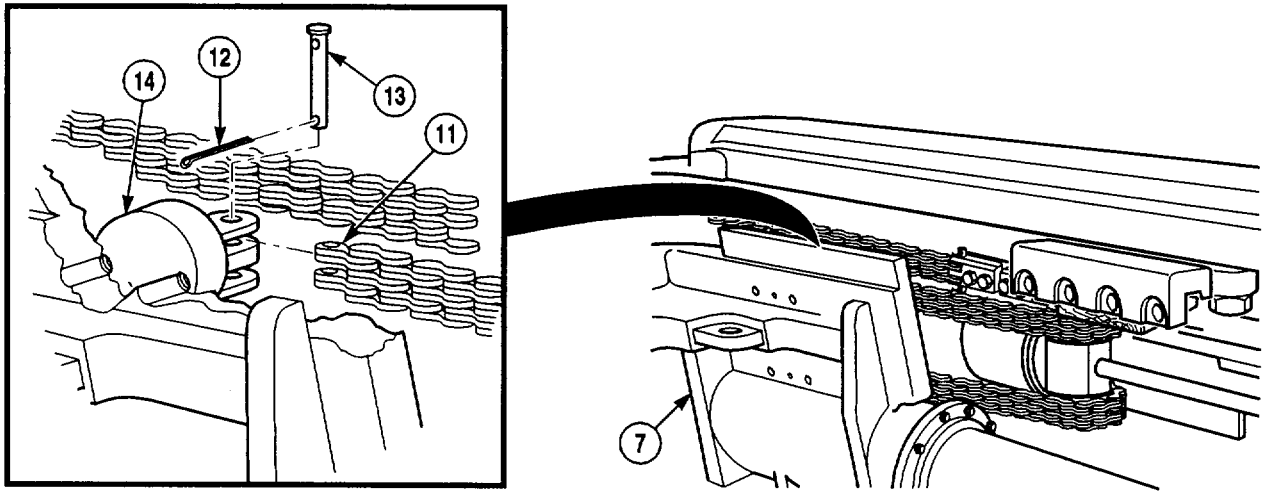
WARNING

- Side shift assembly weighs 105 lbs (47.63 kg). Attach lifting device prior to installation to prevent possible injury to personnel.
- All personnel must stand clear during lifting operations. A swinging or shifting load may cause injury or death to personnel.

- (4) With the aid of an assistant, install side shift cylinder (20) on cone roller bearing (23) and side shift assembly (7).
- (5) Install two hoses (22 and 21) on side shift cylinder (20).
- (6) Install pin (19) on side shift yoke (17) with two cotter pins (18).
- (7) Install two screws (16) on side shift yoke (17) with two lock nuts (15).



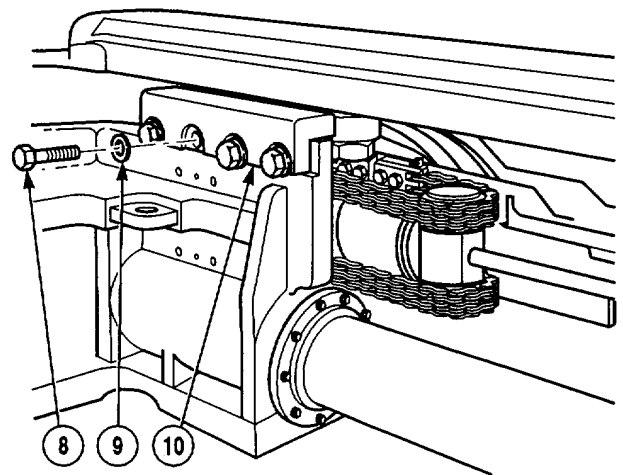
15-11. SIDE SHIFT CYLINDER REPLACEMENT/REPAIR (CONT).

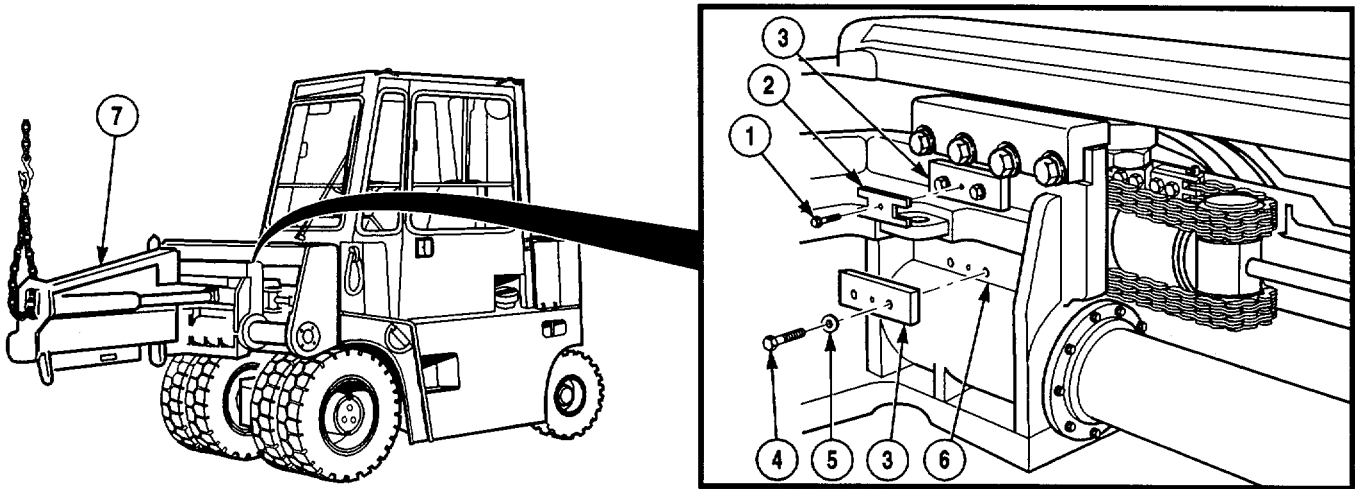


NOTE

One clevis shown, all installed the same way.

- (8) Install clevis (14) on side lift chains (11) with four pins (13) and cotter pins (12).
- (9) Install four washers (9) and screws (8) on support bearing assembly (10).





- (10) Install plate assembly (3) on support (6) with two washers (5) and screws (4).
- (11) Install locking plate (2) on plate assembly (3) with screw (1).
- (12) Remove lifting device from side shift assembly (7).

NOTE

Follow-on Maintenance:

- **Close mast assembly (TM 10-3930-669-10).**
- **Remove wheel chocks (TM 10-3930-669-10).**

END OF TASK

APPENDIX A

REFERENCES

A-1. SCOPE.

Indexes should be consulted frequently for latest changes or revisions given in this appendix and for new publications relating to material covered in this publication.

Military Publication Indexes.

Consolidated of Army Publications and Forms DA PAM 310-1

A-2. FORMS.

Refer to DA PAM 738-750, of the Army Maintenance Management System (TAMMS), for instructions on the use of maintenance forms pertaining to the forklift.

A-3. FIELD MANUALS.

The following publications contain information pertinent to the forklift material.

Camouflage	FM 5-20
Basic Cold Weather Manual	FM 31-70
Manual for Wheel Vehicle Driver	FM 21-305
Army Motor Transport Units and Operations.....	FM 55-30
Northern Operations	FM 31-71
Operation and Maintenance of Ordnance Material in Cold Weather 0°F to -65°F ,	FM 9-207
Nuclear, Biological, and Chemical Defense	FM 21-40
Nuclear, Biological, and Chemical (NBC) Reconnaissance and Decontamination Operations (How to Fight)	FM 3-87 (HTF)

A-4. TECHNICAL MANUALS.

Administrative Storage of Equipment	TM 740-90-1
Chemical, Biological, and Radiological (CBR) Decontamination	TM 3-220
Inspection, Care, and Maintenance of Anti-friction Bearings	TM 9-214

A-4. TECHNICAL MANUALS (CONT).

Painting Instructions TM 43-0139

Materials Used for Cleaning, Preserving, Abrading, and Cementing

Ordnance Material and Related Materials Including ChemicalsTM 9-247

Operator's Manual for Welding Theory and Application TM 9-237

Procedures for Destruction of Tank Automotive to Prevent

Enemy Use (U.S. Army Tank-Automotive Command)TM 750-244-6

Maintenance and Repair for Lead-Acid Storage BatteriesTM 9-6140-200-14

General Shop Practice Requirements for Repair, Maintenance, and

Test of Electronic EquipmentTM 43-0158

A-5. MISCELLANEOUS PUBLICATIONS.

Description, Use, Bonding, and Properties of Adhesives.....TB ORD1032

**APPENDIX B
EXPENDABLE/DURABLE SUPPLIES AND MATERIALS**

Section I. INTRODUCTION

B-1. SCOPE.

This appendix lists expendable/durable supplies and materials you will need to operate and maintain the Pumping Assembly. This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items), or CTA 8-100, Army Medical Department Expendable/Durable Items.

B-2. EXPLANATION OF COLUMNS.

a. Column (1) -- Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Compound, Sealing, Pipe Thread(item 9, Appendix E)").

b. Column (2) -- Level. This column identifies the lowest level of maintenance that requires the listed item.

- C - Operator/Crew
- O - Organizational Maintenance
- F - Direct Support Maintenance
- H - General Support Maintenance

c. Column (3) - National Stock Number. This is the National Stock Number assigned to the item; use it to request or requisition the item.

d. Column (4) - Description. Indicates the Federal item name, and, if required, a description to identify the item. The last line for each item indicates the part number followed by Commercial And Government Entity (CAGE) Code in parentheses.

e. Column (5) - Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by two-character alphabetical abbreviations (e.g., ea., in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

SECTION II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) UNIT OF MEAS.
1	O,F,H	8040-00-843-0802	Adhesive, Sealant, Silicone, RTV, General Purpose	OZ
2	O,F,H	8030-00-009-5023	Sealant, Teflon Thread	RO
3	O	8950-01-144-4822	Baking Soda	BX
4	O,F,H	5975-01-273-8133	Cable Ties 12 inches long, 100 per package	
5	O,F,H	5340-00-450-5718	Cap and Plug Set ST	
6	O,F,H	5330-01-083-0081	Cloth, Lint -Free	
7	O	8030-00-062-6950	Compound, Corrosion Preventive	
8	O,F,H	9150-01-102-9455	Fluid, Brake, (BFS) Silicone	GL
9	O,F,H	9410-00-286-5294	Fuel, Oil, Diesel, Bulk	GL
10	O,F,H	7930-00-177-5217	Detergent, General Purpose	
11	C,O	9150-01-035-5390 9150-01-035-5391	Gear Oil, Lubricating, GO 75 (MIL-L-2105) 1-qt can 5-gal can	QT GL
12	C,O	9150-01-035-5392 9150-01-035-5393 9150-01-035-5394	Gear Oil, Lubricating, GO 80/90 (MIL-L-2105) 1-qt can 5-gal can 55-gal drum	QT GL GL
13	C,H	9150-00-190-0904 9150-00-190-0905 9150-00-190-0907	Grease, Automotive and Artillery, MIL-L-10924 1 lb can 5 lb can 35 lb can	LB LB LB
14	C	9150-00-754-2595	Grease, Ball and Roller Bearing, MIL-G-18709	LB
15	C	9150-00-189-6727	Lubricating Oil, Internal Combustion Engine, Tactical Service, MIL-L-2104C (OE/HDO 10)	GL
16	C	9150-00-186-6681	Lubricating Oil, Internal Combustion Engine, Tactical Service, MIL-L-2104C (OE/HDO 30)	GL

SECTION II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) UNIT OF MEAS.
17	O,F,H	9150-00-402-4478 9150-00-402-2372 9150-00-491-7197	Oil, Lubricating, OEA, MIL-L-46167 (81349)	1 QT 5 GL 55 GL
18	O	9150-00-153-0207	Oil, Preservation, Grade 30, Type II, MIL-L-21260	QT
19	O,F,H	7920-00-306-1711	Rags, Wiping (58536) A-A-531 50 Pound Bale	LB
20	O,F,H	6850-00-274-5241	Solvent, Drycleaning, P-D-680, Type II	GL
21	O,F,H	8135-00-178-9200	Tags, Identification (MIL-S-2910) 1,000 count	CT
22	F,H		Loctite #242 (80244) MIL-S-461463A Type 2 Grade N	
		8030-01-104-5392	10 milliliter bottle	BT
		8030-01-025-1692	250 milliliter bottle	BT
23	F,H	8030-01-158-6070	Loctite #271 (80244) MIL-S-461463 Type I Grade L	BT
24	F	8040-01-010-8753	Compound, Sealing RTV-732 Clear (77247)	TU
25	O,F	9150-01-177-3988	Oil, Transmission (MIL-2104)	QT
26	O,F	7519-00-663-3732	Tape, Packaging, Waterproof	RL
27	O,F,H	9505-00-293-4208	Wire, Safety	LB
28	H	8010-00-652-3626	Magnaflux, Penetrate	OZ

Section III. REMARKS

REFERENCE CODE	REMARKS
A	In the "O" category repair is limited to splicing of wires, taping of the harness or wires, and the replacement of wire ends.
B	At the "F" level the entire wire harness is replaced.
C	High pressure hoses are non-repairable.
D	Repair of the M-13 decontamination unit is covered in TM 3-4230-214-12&P.
E	Ensure pivot arm is blocked in outward position.

APPENDIX C

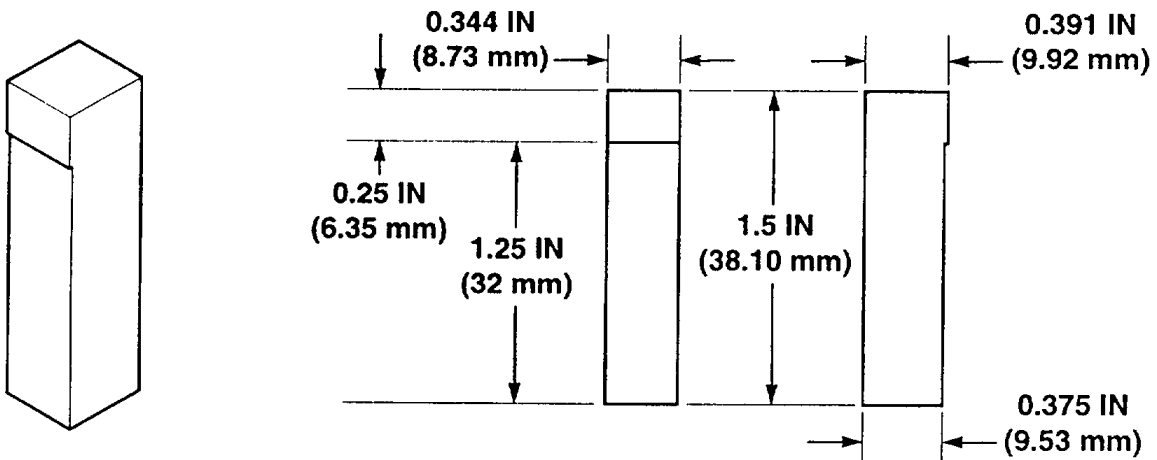
ILLUSTRATED LIST OF MANUFACTURED ITEMS

Section I. INTRODUCTION

C-1. INTRODUCTION.

This appendix includes complete instructions for manufacturing or fabricating items for Direct Support Maintenance.

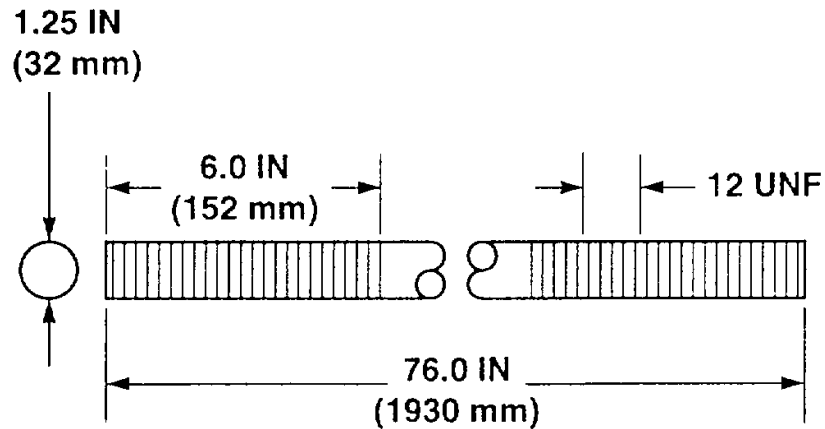
C-2. SPANNER WRENCH POST FABRICATION.



NOTES:

1. Make 4 each from stock steel.
2. Cut to dimensions as shown above.
3. To be used with Spanner Wrench PN 12268039, NSN 5120-01-095-7451.

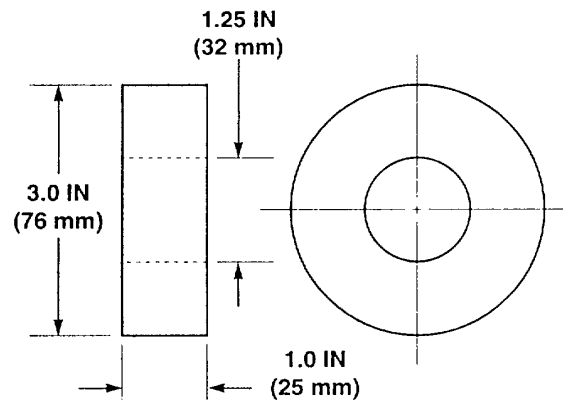
C-3. SIDE SHIFT BAR FABRICATION.



NOTES:

1. Make from stock steel.
2. Cut to dimensions as shown above.
3. Use two 12 universal fine (UNF) nuts with this bar, refer to (Item 37, Appendix E).
4. To be used with Jack, Hydraulic, 30 Ton, NSN 5120-00-188-1790.

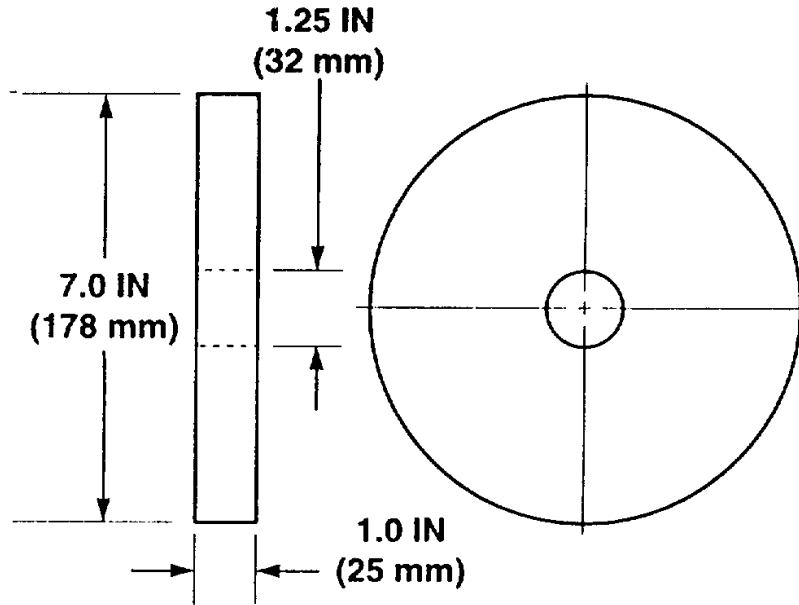
C-4. INSTALLER DISK FABRICATION.



NOTES:

1. Make 2 each from stock steel.
2. Cut to dimensions as shown above.
3. To be used with Jack, Hydraulic, 30 Ton, NSN 5120-00-188-1790.

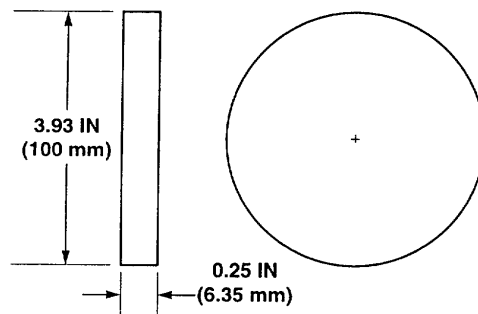
C-5. WASHER, FLAT FABRICATION.



NOTES:

1. Make 2 each from stock steel.
2. Cut to dimensions as shown above.
3. To be used with Jack, Hydraulic, 30 Ton, NSN 5120-00-188-1790.

C-6. BASE PLATE FABRICATION.



NOTES:

1. Make from stock steel.
2. Cut to dimensions as shown above.
3. Using center punch, mark center of base plate.

C-3/(C-4 blank)

APPENDIX D

TORQUE LIMITS

Section I. INTRODUCTION

D-1. SCOPE.

This appendix lists torque specifications and torquing instructions for specific engine nuts and screws.

D-2. GENERAL.

Preloading and angle torques are applied.

Section II. TORQUE SPECIFICATIONS

D-3. TORQUE SPECIFICATIONS.

The application, preloading, and torque angles in degrees are listed in Table D-1.

D-4. TORQUE INSTRUCTIONS.

Preloading is applied with a torque wrench that is calibrated in foot pounds (lb-ft) or newton meters (N•m). Preloading is applied before angle torques. All angle torques listed in Table D-1 are accomplished by turning the screw/nut a specific number of degrees from a zero reference point as shown. The tightening angle is obtained by turning the handle of the wrench being used to the desired angle selected from a clock face you mentally superimpose over the screw head. Torquing of two or more screws securing one assembly should be accomplished in an alternating fashion to ensure assembly seating and equal load distribution. For example, if angle torque specified is 30° initial then 30° final, proceed as follows:

- a. Coat screw and surface under screw head with engine oil, MIL-L-2104.
- b. Set screws squarely to ensure assembly seating.
- c. Apply specified preload with torque wrench.
- d. Using angle torque meter and socket wrench, apply 30° initial torque to screw 1.
- e. Apply 30° initial torque to screw 2.
- f. Apply 30° final torque to screw 1.
- g. Apply 30° final torque to screw 2.

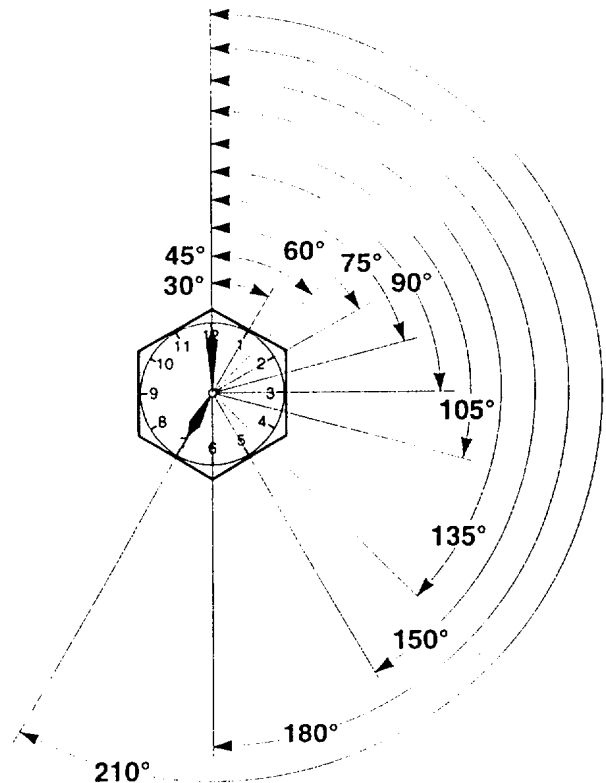


Table D-1. Torque Specifications

Application	Preloading		Angle in Degrees or Torque Values				Total		
	lb-ft	N•m	Stage 1	Stage 2	Stage 3	Stage 4	Degree	lb-ft	N•m
Cylinder head	29.5	40	45°	45°	45°	30	165°	-	-
Cylinder head screw plug	-	-	-	-	-	-	-	59-66	80-90
Rocker arm bracket nut	-	-	-	-	-	-	-	21	28
Rocker chamber cover screw	-	-	-	-	-	-	-	7 (+4; 2)	10 (+5;3)

Table D-1. Torque Specifications - CONT.

Application	Preloading		Angle in Degrees or Torque Values				Total		
	lb-ft	N•m	Stage 1	Stage 2	Stage 3	Stage 4	Degree	lb-ft	N•m
Connecting rod	22	30	60°	30°	-	-	90°	-	-
Bearing cap	22	30	60°	45°	-	-	105°	-	-
Idler gear	22	30	60°	-	-	-	60°	-	-
Flywheel screws	22	30	30°	30°	-	-	60°	-	-
Balance weight	22	30	30°	30°	-	-	60°	-	-
Flywheel nuts	37	50	90°	90°	-	-	180°	-	-
Injection nozzle	-	-	-	-	-	-	-	18.5-22	25-30
Fuel injection pump drive nut	-	-	-	-	-	-	-	44-52	60-70
Fuel injector cap nut	-	-	-	-	-	-	-	44-59	60-80
V-belt pulley	37	50	210°	-	-	-	210°	-	-
Cooling blower	22	30	90°	-	-	-	90°	-	-
Filter carrier	18.5	25	30°	60°	60°	-	150°	-	-
Oil pump retaining screw	-	-	-	-	-	-	-	26	35
Oil connecting pipe) (+20) union screw	80	-	-	-	-	-	-	59 (+15)	80
Alternator	22	30	180°	-	-	-	180°	-	-
Idler pulley	22	30	45°	-	-	-	45°	-	-
Engine suspension	22	30	45°	60°	-	-	105°	-	-
Pump stud nuts 3/8-16	-	-	-	-	-	-	-	17-19	23-26
Pump stud nuts 1/2-13	-	-	-	-	-	-	-	40-42	54-57
Discharge and suction valve fasteners	-	-	-	-	-	-	-	44-48	60-65
Impeller bearing cap screws	-	-	-	-	-	-	-	21	28
Impeller shaft bushing set screw	-	-	-	-	-	-	-	12	16
Intermediate bracket seal plate nuts	-	-	-	-	-	-	-	21	28
Exhaust pipe locking nuts	15	20	26 lb-ft (35 N•m)	37 lb-ft (50 N•m)	-	-	-	37	50

D-5. U.S. STANDARD TORQUE VALUES.

Table D-2. U.S. Standard Torque Values

Thread Size	Minimum Breakaway Torque Value S.A.E. Grade 2		Minimum Breakaway Torque Value S.A.E. Grade 5		Minimum Breakaway Torque Value S.A.E. Grade 8	
	U.S.	Metric	U.S.	Metric	U.S.	Metric
	1/4-20 1/4-28	5 lb-ft 6 lb-ft	7 N•m 8 N•m	8 lb-ft 10 lb-ft	11 N•m 14 N•m	12 lb-ft 14 lb-ft
5/16-18 5/16-24	11 lb-ft 13 lb-ft	15 N•m 18 N•m	17 lb-ft 19 lb-ft	23 N•m 26 N•m	24 lb-ft 27 lb-ft	33 N•m 37 N•m
3/8-16 3/8-24	20 lb-ft 22 lb-ft	27 N•m 30 N•m	30 lb-ft 35 lb-ft	41 N•m 47 N•m	45 lb-ft 50 lb-ft	61 N•m 68 N•m
7/16-14 7/16-20	30 lb-ft 35 lb-ft	41 N•m 47 N•m	50 lb-ft 55 lb-ft	68 N•m 75 N•m	70 lb-ft 80 lb-ft	95 N•m 108 N•m
1/2-13 1/2-20	50 lb-ft 55 lb-ft	68 N•m 75 N•m	75 lb-ft 85 lb-ft	102 N•m 115 N•m	105 lb-ft 120 lb-ft	142 N•m 163 N•m
9/16-12 9/16-18	70 lb-ft 80 lb-ft	95 N•m 108 N•m	110 lb-ft 120 lb-ft	149 N•m 163 N•m	155 lb-ft 170 lb-ft	210 N•m 230 N•m
5/8-11 5/8-17	100 lb-ft 110 lb-ft	136 N•m 149 N•m	150 lb-ft 170 lb-ft	203 N•m 230 N•m	210 lb-ft 240 lb-ft	285 N•m 325 N•m
3/4-10 3/4-16	170 lb-ft 190 lb-ft	230 N•m 258 N•m	270 lb-ft 300 lb-ft	366 N•m 407 N•m	375 lb-ft 420 lb-ft	508 N•m 569 N•m
7/8-9 7/8-14	165 lb-ft 180 lb-ft	224 N•m 244 N•m	430 lb-ft 475 lb-ft	583 N•m 644 N•m	610 lb-ft 670 lb-ft	827 N•m 908 N•m
1-8 1-12 1-14	250 lb-ft 270 lb-ft 280 lb-ft	339 N•m 366 N•m 380 N•m	645 lb-ft 705 lb-ft 720 lb-ft	875 N•m 956 N•m 976 N•m	910 lb-ft 1,000 lb-ft 1,015 lb-ft	1,234 N•m 1,356 N•m 1,376 N•m

D-6. METRIC TORQUE VALUES. 1/2

Table D-3. Metric Torque Values

Thread Size	Minimum Breakaway Torque Value Grade 8.8		Minimum Breakaway Torque Value Grade R10		Minimum Breakaway Torque Value Grade 12	
	U.S.	Metric	U.S.	Metric	U.S.	Metric
4 mm	3 lb-ft	4 N•m	4 lb-ft	5 N•m	5 lb-ft	7 N•m
5 mm	5 lb-ft	7 N•m	7 lb-ft	9 N•m	9 lb-ft	12 N•m
6 mm	9 lb-ft	12 N•m	13 lb-ft	18 N•m	15 lb-ft	20 N•m
7 mm	15 lb-ft	20 N•m	21 lb-ft	28 N•m	25 lb-ft	34 N•m
8 mm	22 lb-ft	30 N•m	31 lb-ft	42 N•m	37 lb-ft	50 N•m
9 mm	28 lb-ft	38 N•m	40 lb-ft	54 N•m	47 lb-ft	64 N•m
10 mm	39 lb-ft	53 N•m	55 lb-ft	75 N•m	66 lb-ft	89 N•m
12 mm	66 lb-ft	89 N•m	93 lb-ft	126 N•m	111 lb-ft	150 N•m
14 mm	100 lb-ft	136 N•m	140 lb-ft	190 N•m	169 lb-ft	229 N•m
16 mm	152 lb-ft	206 N•m	214 lb-ft	290 N•m	256 lb-ft	347 N•m
18 mm	190 lb-ft	258 N•m	228 lb-ft	363 N•m	321 lb-ft	435 N•m
20 mm	265 lb-ft	359 N•m	372 lb-ft	504 N•m	447 lb-ft	606 N•m
22 mm	321 lb-ft	435 N•m	451 lb-ft	611 N•m	542 lb-ft	735 N•m
24 mm	412 lb-ft	559 N•m	578 lb-ft	784 N•m	695 lb-ft	942 N•m

D-5/(D-6 blank)

APPENDIX E

TOOL IDENTIFICATION LIST

Section I. INTRODUCTION

E-1. SCOPE.

This appendix identifies all the tools and special tools you will need to operate and maintain the Fork Lift.

E-2. EXPLANATION OF COLUMNS.

Maintenance functions will be limited to and defined as follows:

a. Column (1) - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Tool Kit, General Mechanics: Automotive (Item x, Appendix E)").

b. Column (2) - Nomenclature. Indicates the item name, if required, a description to identify the item.

c. Column (3) - National/NATO Stock Number. This is the National Stock Number assigned to the item; use it to request or requisition the item.

d. Column (4) - Tool Number. Identifies the part number of the item.

Section II. TOOLS AND TEST EQUIPMENT REQUIREMENTS

Tool or Test Equipment Ref Code	Maintenance Category	Nomenclature	National/NATO Stock Number	Tool Number
1	O,F,H	TOOL KIT, General Mechanic's: Automotive	5180-00-177-7033	SC5180-90-CL-N26
2	O,F,H	SHOP EQUIPMENT, Automotive Maint and Repair: Common No. 1	4910-00-754-0654	SC4910-95-CL-A74
3	O,F,H	SHOP EQUIPMENT, Automotive Maintenance and Repair: Supp. 1	4910-00-754-0653	SC4910-95-CL-A73
4	F,H	SHOP EQUIPMENT, Automotive Maintenance and Repair: Supp. 1	4910-00-754-0706	SC4910-95-A62
5	F	SIOP EQUIPMENT, Automotive Maintenance and Repair: Field Maintenance, Basic	4910-00-754-0705	SC4910-95-CL-A31
6	F,H	SHOP EQUIPMENT, Fuel and Electrical System, Engine: Field Maintenance, Basic	4910-00-754-7791	SC4910-95-CL-A66
7	F	SHOP EQUIPMENT, Fuel and Electrical System, Engine: Field Maintenance, Basic	4910-00-754-0714	SC4910-95-CL-A01
8	F,H	SHOP EQUIPMENT, Machine Shop CL-A02	3470-00-754-0708	SC3470-95-
9	F	Tool Kit, Glass Cutting: Vehicle	4940-00-357-7737	SC 4910-95 CL-18
10	O,F,H	Shop Welding Set	3433-00-357-6311	SC3433-90-CL-N01
11	O,F,H	Pan, drain, 12 qt.	4910-00-287-2944	
12	O,F,H	Wrench, Torque, 0-60 N(m	5120-01-112-9531	
13	O,F,H	Retainer, Crankshaft Pulley		030 1107
14	O,F,H	System Test Equipment Internal Combustion Engine- Reprogrammable (STE/ICE-R)	4910-01-222-6589	12259266
15	O	Square, Combination	5210-00-078-8949	

Tool or Test Equipment Ref Code	Maintenance Category	Nomenclature	National/NATO Stock Number	Tool Number
16	F,H	Lifting Eye		27-0935
17	F,H	Jack, Kit 30 Ton	5120-00-188-1790	
18	F,H	Bearing, Installer		1400154
19	F,H	Wrench, Spanner	5120-01-095-7451	12268039
20	H	Compressor, Piston Ring	5120-01-247-6128	003-0430
21	H	Spring, Compressor		125300
22	O,F,H	Gage, Tightening	5120-10-212-9224	0031102
23	F,H	Compressor, Valve Spring	5120-01-208-7036	J-33345
24	F,H	Mandrel, Exhaust	3460-01-203-7946	003-0441
25	F,H	Mandrel, Intake	3460-01-203-7947	003-0620
26	H	Cutter, Valve Seat		003-0784
27	H	Reamer, Hand	5110-01-203-7945	003-0452
28	H	Reamer, Hand	5110-01-204-5070	003-0652
29	H	Punch, Valve Guide	5120-01-202-5073	003-0453
30	F,H	Hand Pump, High Pressure		003-0714
31	F,H	Puller, Gear		003-0762
32	H	Insertor and Remover	5120-01-280-0077	003-0433
33	H	Installing Tool	5120-01-189-5221	003-0789
34	H	Spanner, Wrench		003-1078
35	H	Wrench, Pinion		1401499
36	H	Wrench, Socket	5120-01-248-1797	003-1043
37	H	Nut	5310-00-761-6869	

Section IV. REMARKS

REFERENCE CODE	REMARKS
A	In the "O" category repair is limited to splicing of wires, taping of the harness or wires, and the replacement of wire ends.
B	At the "F" level the entire wire harness is replaced.
C	High pressure hoses are non-repairable.
D	Repair of the M-13 decontamination unit is covered in TM 3-4230-214-12&P.
E	Ensure pivot arm is blocked in outward position.
F	Refer to Appendix C for fabricated items.
G	End cap on side shift rod must be welded by certified welder.
H	Check for serviceability.
I	Limited welding.
J	Function performed by Specialized Repair Activity (SRA).
K	Repair by piece parts only.

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General, United States Army
Chief of Staff

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THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
 1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
 1 Kilometer = 1000 Meters = 0.621 Miles

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches
 1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet
 1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
 1 Kilogram = 1000 Grams = 2.2 Lb
 1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.06 Cu Inches
 1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
 1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

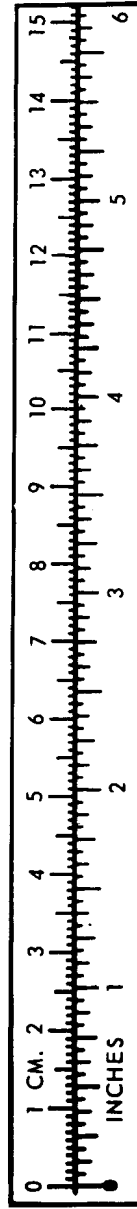
TEMPERATURE

$5.9 (^{\circ}\text{F} - 32) = ^{\circ}\text{C}$
 $212^{\circ}\text{ Fahrenheit is equivalent to } 100^{\circ}\text{ Celsius}$
 $90^{\circ}\text{ Fahrenheit is equivalent to } 32.2^{\circ}\text{ Celsius}$
 $32^{\circ}\text{ Fahrenheit is equivalent to } 0^{\circ}\text{ Celsius}$
 $9 \text{ } ^{\circ}\text{C} + 32 = \text{ } ^{\circ}\text{F}$

APPROXIMATE CONVERSION FACTORS

<u>TO CHANGE</u>	<u>TO</u>	<u>MULTIPLY BY</u>
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

<u>TO CHANGE</u>	<u>TO</u>	<u>MULTIPLY BY</u>
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621



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