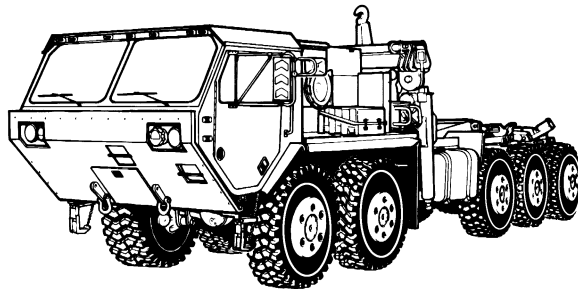


## TECHNICAL MANUAL

# DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE VOLUME IV

## PALLETIZED LOAD SYSTEM



**MODEL M1074/M1075**

**NSN 2320-01-304-2277**  
**NSN 2320-01-304-2278**

ENGINE MAINTENANCE	20-1
FUEL SYSTEM MAINTENANCE	21-1
COOLING SYSTEM MAINTENANCE	22-1
TRANSMISSION MAINTENANCE	23-1
TRANSFER CASE MAINTENANCE	24-1
AXLE MAINTENANCE	25-1
BRAKE MAINTENANCE	26-1
STEERING SYSTEM MAINTENANCE	27-1
MATERIAL HANDLING CRANE AND SELF-RECOVERY WINCH MAINTENANCE	28-1
REFERENCES	A-1
EXPENDABLE SUPPLIES AND MATERIALS	B-1
MANUFACTURED ITEMS LIST	C-1
TORQUE LIMITS	D-1
MANDATORY REPLACEMENT PARTS	E-1
TOOL IDENTIFICATION LIST	F-1

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

**WARNING****CARBON MONOXIDE (EXHAUST GAS) CAN KILL YOU**

Carbon monoxide is a colorless, odorless, DEADLY POISONOUS gas and when breathed deprives body of oxygen and causes SUFFOCATION. Breathing air with carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, a sleepy feeling, and coma. Permanent BRAIN DAMAGE or DEATH can result from severe exposure.

The following precautions MUST be followed to ensure personnel are safe whenever personnel heater or main or auxiliary engine is operated for any purpose.

- DO NOT operate personnel heater or engine of vehicle in enclosed area without adequate ventilation.
- DO NOT idle engine for long periods without ventilator blower operation. If tactical situation permits, open hatches.
- DO NOT drive any vehicle with inspection plates, cover plates, or engine compartment doors removed unless necessary for maintenance purposes.
- NEVER sleep in a vehicle when the heater is operating or the engine is idling.
- BE ALERT at all times during vehicle operation for exhaust odors and exposure symptoms. If either are present, IMMEDIATELY EVACUATE AND VENTILATE the area. Affected personnel treatment shall be: expose to fresh air; keep warm, DO NOT PERMIT PHYSICAL EXERCISE; if necessary, give artificial respiration as described in FM 12-11 and get medical attention.
- BE AWARE; neither the gas particulate filter unit nor field protection mask for nuclear-biological-chemical protection will protect you from carbon monoxide poisoning.

**THE BEST DEFENSE AGAINST CARBON MONOXIDE POISONING IS GOOD VENTILATION****WARNING**

Remove all jewelry such as rings, dog tags, bracelets, etc. If jewelry or tools contact positive electrical circuits, a direct short may result. Damage to equipment, injury or death to personnel may occur.

**WARNING**

Blowing transmission oil can cause injury to eyes. Safety goggles must be worn when testing transmission oil pressure switch.

**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.

**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**

During pressure tests, ensure air pressure is drained to 0 psi (0 kPa) before taking off air compressor line or taking off any cover plates. If pressure is not released, plates or line could blow off and harm personnel. Air tanks have greater than 30 psi (207 kPa) in them. Do not drain air tanks with any part of body in air spray path. Skin embolisms and/or debris in eyes can occur from released pressure.

**WARNING**

Allow engine to cool before performing troubleshooting maintenance. If necessary use insulated pads and gloves. Hot engine components will burn and cause 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**

High pressure hydraulics [oil under 3675 psi (25,339 kPa) pressure] 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. Failure to comply may result in injury to personnel.

**WARNING**

Fuel and oil are slippery and can cause falls. To avoid injury, wipe up spilled fuel or oil with rags.

**WARNING**

Do not get under LHS when disconnecting or connecting connectors and hoses. A hydraulic malfunction could cause LHS to lower causing serious injury or death.

**WARNING**

The LHS hydraulic system operates at oil pressures up to 3625 psi (24,994 kPa). Never disconnect any hydraulic line or fitting without first dropping pressure to zero. Failure to comply may result in serious injury or death to personnel.

**WARNING**

Middle frame and hook arm combined weight is 2100 lbs (953 kg). Hook arm cylinders weigh 210 lbs (95 kg) each. Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

High pressure hydraulics [oil under 3000 psi (20,685 kPa) pressure] 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. Failure to comply may result in injury to personnel.

**WARNING**

Do not stand under crane. Mechanical failure and operator error can cause injury or death to personnel.

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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**

If matchmarks are not aligned during installation of yoke, erratic steering will result. Erratic steering can cause serious injury or death to personnel.



**WARNING**

Use care when disconnecting intergear link. If it falls, it will cause injury to personnel.

**WARNING**

The truck steering operates with 3000 psi (20,685 kPa) hydraulic pressure. A high pressure hydraulic oil stream can pierce a body and cause severe injury to personnel. Never disconnect any high pressure hydraulic oil line or fitting without first dropping pressure to zero.

**WARNING**

Do not stand in front of vehicle when testing air box pressure. Brakes could fail and vehicle could move forward causing injury or death.

**WARNING**

Do not remove the radiator cap when the engine is hot; steam and hot coolant can escape and burn personnel.

**WARNING**

Use a clean thick waste cloth or like material to remove the cap. Avoid using gloves. If hot water soaks through gloves, personnel could be burned.

**WARNING**

Moving engine components can cause severe injury. Keep away from alternator belts and pulleys while engine is running.

**WARNING**

Never use fuel to clean parts. Fuel is highly flammable. Serious injury to personnel could result if fuel ignites during cleaning.

**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 to personnel.

**WARNING**

Steam cleaning creates hazardous noise levels and severe burn potential. Eye, skin, and ear protection is 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**

CARC paint contains isocyanate (HDI) which is highly irritating to skin and respiratory system. High concentrations of HDI can produce symptoms of itching and reddening of skin, a burning sensation in throat and nose and watering of the eyes. In extreme concentrations, HDI can cause cough, shortness of breath, pain during respiration, increased sputum production, and chest tightness. The following precautions must be taken whenever using CARC paint:

- ALWAYS use air line respirators when using CARC paint unless air sampling shows exposure to be below standards. Use chemical cartridge respirator if air sampling is below standards.
- DO NOT let skin or eyes come in contact with CARC paint. Always wear protective equipment (gloves, ventilation mask, safety goggles, etc.).
- DO NOT use CARC paint without adequate ventilation.
- NEVER weld or cut CARC-coated materials.
- DO NOT grind or sand painted equipment without high-efficiency air purifying respirators in use.
- BE AWARE of CARC paint exposure symptoms; symptoms can occur a few days after initial exposure. Seek medical help immediately if symptoms are detected.

**WARNING**

Unsafe welding practices can cause serious injury from fire, explosions, or harmful agents. Allow only authorized personnel to weld or cut metals, and follow safety precautions in TC 9-237. Protective clothing and goggles must be worn; adequate protective equipment used, a suitable fire extinguisher kept nearby, and requirements of TC 9-237 strictly followed.

**WARNING**

On direct contact, uncured silicone 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.

**WARNING**

Engine/transmission assembly weighs 3946 lbs (1791 kg). Attach suitable lifting device of adequate capacity for removal or installation to prevent possible injury to personnel.

**WARNING**

Use extreme care when installing engine/transmission assembly. Ensure engine/transmission assembly does not swing and damage equipment.

**WARNING**

Air compressor weighs 115 lbs (52 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Ensure cradle is fully supported upon removal of four screws and lockwashers or cradle may fall and cause injury to personnel.

**WARNING**

Transmission weighs 1050 lbs (477 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Transmission weighs 1023 lbs (477 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Cylinder head weighs 182 lbs (83 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Use extreme care when removing or installing spring retainers. Spring retainers are under tension and can act as projectiles when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

**WARNING**

Use extreme care when compressing, releasing, removing, or installing springs. Springs are under tension and can act as projectiles when released. Ensure proper eye protection is worn to prevent injury to personnel.

**WARNING**

Vibration damper may fall from crankshaft and may cause injury to personnel.

**WARNING**

Ensure there are no personnel working under truck while performing this task. Engine will be supported by lifting device. If lifting device fails, engine may fall and cause severe injury or death to personnel.

**WARNING**

Lifting device is attached to support engine. Ensure lifting device is positioned snug to engine lifting bracket to prevent engine from falling. Failure to comply may result in injury or death to personnel.

**WARNING**

Lifting device must remain in place and truck must be properly tagged until after installation of this task is performed. Failure to comply may result in engine falling causing severe injury or death to personnel.

**WARNING**

Driveshafts can weigh up to 100 lbs (45kg). Properly support driveshafts when removing screws. After screws and brackets are removed, driveshafts can fall and may cause injury to personnel.

**WARNING**

Use extreme care when removing spring from oil cooler adapter plate. Spring is under tension and can act as a projectile when released. Ensure all personnel wear proper eye protection to prevent possible injury to personnel.

**WARNING**

Ensure all debris is kept clear of blower during removal. Failure to comply may result in damage to equipment.

**WARNING**

Blower lobes turn freely. Ensure fingers, jewelry, and hair are kept clear of rotors in blower. Failure to comply may result in severe injury to personnel.

**WARNING**

Blower weighs 71 lbs (32 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Gloves must be used when handling turbocharger insulation blanket. Turbocharger insulation blanket is made of fiberglass and may cause skin irritation. Failure to comply may result in injury to personnel.

**WARNING**

Gloves must be used when handling insulation blanket. Insulation blanket is made of fiberglass and may cause skin irritation. Failure to comply may result in injury to personnel.

**WARNING**

Turbocharger weighs 57 lbs (26 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Use extreme care when turning rotating assembly. Rotating assembly is sharp and injury to personnel may result.

**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.

**WARNING**

Bottom tank assembly weighs 82 lbs (37 kg). Ensure bottom tank is fully supported prior to removal or installation. Failure to comply may result in injury to personnel or damage to equipment.

**WARNING**

Top tank assembly weighs 76 lbs (35 kg). Ensure top tank assembly is fully supported prior to removal or installation. Failure to comply may result in injury to personnel or damage to equipment.

**WARNING**

Use extreme care when removing tester. Sudden release of pressure can cause injury to personnel.

**WARNING**

Allow engine to cool before removing harness to avoid injury to personnel.

**WARNING**

Corrosion compound contains alkali. Do not get in eyes; wear safety goggles/glasses when using. Avoid contact with skin. In case of contact, immediately wash area with soap and water. If eyes are contacted, flush with large amounts of water for at least 15 minutes and get immediate medical attention.

**WARNING**

Middle frame weighs 2500 lbs (1135 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

After removing wires and cables from battery terminals, ensure no contact is made with battery terminals, other wires, cables or any metal surface to prevent damage to parts, personal injury, or death.

**WARNING**

Battery acid (electrolyte) is extremely harmful. Always wear safety goggles and rubber gloves, and do not smoke when performing maintenance on batteries. Injury will result if acid contacts skin or eyes. Wear rubber apron to prevent clothing being damaged.

**WARNING**

Upon installation of all wires and cables, ensure no contact is made with battery terminals or other wires and cables. Strap wires and cables away from battery terminals and other wires and cables as required to prevent damage to parts, personal injury, or death.

**WARNING**

Do not drain transmission fluid while transmission is hot. Injury to personnel may result.

**WARNING**

Driveshaft weighs 90 lbs (41 kg). The aid of an assistant is required to prevent possible injury to personnel.

**WARNING**

Ensure one screw is left in place behind lifting bracket in flywheel. Screw is intended to secure flywheel until lifting device is in place. Failure to comply may result in serious injury to personnel and damage to equipment.

**WARNING**

Flywheel weighs 175 lbs (79 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

During flywheel removal, torque converter turbine can remain attached to flywheel or remain on transmission. Use care to prevent torque converter turbine from falling. If torque converter turbine stays attached to flywheel, lockup clutch may fall out of transmission. Use care to prevent lockup clutch from falling. Failure to comply may result in serious injury to personnel and damage to equipment may occur.

**WARNING**

Flywheel weighs 175 lbs (79 kg). Use extreme caution when dropping flywheel. Keep feet and hands out from under flywheel to avoid injury to personnel.

**WARNING**

Transfer case weighs 1500 lbs (681 kg). Attach lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Remove and install one transfer case support bracket at a time. Removing both transfer case support brackets at same time will cause transfer case to fall causing damage to parts or severe injury or death to personnel.

**WARNING**

Axle No. 1 and No. 2 weighs 1,950 lbs (885 kg). Use jackstands to support axles. Failure to do so could result in injury to personnel.



**WARNING**

Torque rod is under extreme pressure when being pressed from axle. Torque rod can be dangerous when it breaks loose and could cause injury to personnel.

**WARNING**

Axle No. 1 weighs 1950 lbs (885 kg). Attach a transmission jack prior to removal or installation. The axle must be chained to the transmission jack or an out of balance condition may result. Failure to comply may result in serious injury or death to personnel.

**WARNING**

Keep fingers out of beam holes. Failure to comply could result in serious injury to personnel.

**WARNING**

Axle No. 2 weighs 1907 lbs (866 kg) (without brake drums). Attach a transmission jack prior to removal or installation. The axle must be chained to the transmission jack or an out of balance condition may result. Failure to comply may result in serious injury or death to personnel.

**WARNING**

Pivot and spindle assembly weighs 90 lbs (41 kg). Support pivot and spindle assembly prior to removal to prevent possible injury to personnel.

**WARNING**

Trailing beam assembly weighs 150 lbs (68 kg). Attach a suitable lifting device to axle end of trailing beam assembly prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Main fuel tank weighs between 50 to 700 lbs (23-318 kg) depending on the quantity of fuel inside. Support main fuel tank with suitable lifting device prior to removing mounting hardware to prevent possible injury to personnel.

**WARNING**

Axle No. 3 weighs 1780 lbs (808 kg). Attach a suitable lifting device prior to removal or installation to prevent possible injury to personnel. Axle housing must be chained to lifting device to prevent an out of balance condition when longitudinal torque rod is removed. Axle could roll out of control causing serious injury or death to personnel.

**WARNING**

Ensure axle is fully supported by jackstands prior to removing hydraulic jack from trailing beam assembly. Failure to comply may result in injury to personnel.

**WARNING**

Keep hands and feet clear of Axle No. 3 until Axle No. 3 is secured by longitudinal torque rod. Failure to comply may result in injury to personnel.

**WARNING**

Axle No. 4 weighs 1925 lbs (874 kg). Attach a transmission jack prior to removal or installation. The axle housing must be chained to transmission jack or an out-of-balance condition may result. Failure to comply may result in serious injury or death to personnel.

**WARNING**

The truck end of torque rod must not be removed. Axle No. 4 and 5 share mounting hardware for longitudinal torque rod. If hardware is removed from crossmember, an out-of-balance condition for both axles will result. Any personnel under axle No. 5, which is not secured at this time, could be seriously injured or killed.

**WARNING**

Axle No. 5 weighs 1905 lbs (865 kg). Attach a transmission jack prior to removal or installation. The axle housing must be chained to transmission jack or an out-of-balance condition may result. Failure to comply may result in serious injury or death to personnel.

**WARNING**

Brake shoes may be coated with dust. Breathing this dust may be harmful to your health. Do not use compressed air to clean brake shoes. Wear a filter mask approved for use against brake dust. Failure to comply may result in injury or death to personnel.

**WARNING**

Brake assembly weighs 80 lbs (36 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Brake assembly will swing out on Axles No. 1 and 2 when overhead lifting device is used and screws are removed. Support brake assembly during removal or injury to personnel may result.

**WARNING**

Use care when removing or installing brake springs. Brake springs are under spring tension and can act as projectiles when released and could cause severe injury to personnel.

**WARNING**

Ensure braided hose is cool prior to removal or injury to personal may result.

**WARNING**

Wheel hub assembly weight 115 lbs (52 kg). Support wheel hub assembly with suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

The steering hydraulic system operates at oil pressures up to 3000 psi (20,685 kPa). Never disconnect any hydraulic line or fitting without first dropping pressure to zero. Failure to comply may result in serious injury or death to personnel.

**WARNING**

Do not remove castle nut from drag link before applying upward pressure on drag link. Serious injury to personnel or damage to equipment may result.

**WARNING**

Stand clear of tires while turning them. Failure to do so may result in injury or death to personnel.

**WARNING**

Do not turn relief plunger out more than flush with end of steering gear cover. Plunger could blow out and spray hydraulic oil, causing serious injury to personnel.

**WARNING**

Steering gear weighs 190 lbs (86 kg). Ensure steering gear is properly supported upon removal from truck. Failure to comply may result in severe injury to personnel.

**WARNING**

Front steering gear needs to be supported on transmission jack with two wooden blocks located in front of front steering gear. Wooden blocks should be 4 by 6 by 11 in. and 2 by 4 by 11 in. and should be positioned as shown. Failure to comply may result in steering gear falling from transmission jack and causing injury to personnel.

**WARNING**

Pitman arm is under pressure. Parts can act as projectiles when released and could cause severe eye injury to personnel.

**WARNING**

Intermediate steering gear weighs 170 lbs (77 kg). Attach lifting device prior to removal to prevent injury to personnel.

**WARNING**

Steering gear weighs 165 lbs (75 kg). Attach lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Cab weighs 1700 lbs (772 kg). Attach suitable lifting device prior to removal or installation of cab support to prevent possible injury to personnel.

**WARNING**

Rear crossmember weighs 220 lbs (100 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Power module frame weighs 275 lbs. (125 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Ensure truck frame is securely supported before removing spring assembly. If truck falls, serious injury to personnel or death may result.

**WARNING**

Do not stick fingers in pin holes. Injury to personnel may result.

**WARNING**

Front spring assembly weighs 208 lbs (94 kg). Rear spring assembly weighs 175 lbs (79 kg). Attach a suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Air bags may still be pressurized even though air pressure gauge reads 0 psi. Remove air line slowly to allow air to escape. Failure to comply may result in air line blowing off causing serious injury to personnel.

**WARNING**

Ensure truck is securely supported before removing equalizer beams. If truck falls, serious personal injury or death may result.

**WARNING**

Two equalizer beams and cross tube weigh 445 lbs (202 kg) assembled. Each equalizer beam weighs 212 lbs (96 kg). Attach a suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Equalizer beam weighs 212 lbs (96 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Force required to remove beam end bushings and beam center bushing may exceed 30 tons (27 metric tons). Use of a press of 60-ton (54 metric tons) capacity or more is required to remove and install bushings. Use care when pressing out bushings to prevent serious personal injury or death. Always wear eye protection to prevent injury when operating press.

**WARNING**

Rust preventive contains alkali. Do not get in eyes; wear goggles/safety glasses when using. Avoid contact with skin. In case of contact, immediately wash area with soap and water. If eyes are contacted, flush eyes with large amounts of water for at least 15 minutes and get immediate medical attention.

**WARNING**

Trailing beam bracket weighs 83 lbs. (38 kg). Attach a suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Do not drain coolant if water temperature gage reads above 180 degrees F (82 degrees C). Contact with steam or hot coolant will result in serious injury to personnel.

**WARNING**

Always wear eye protection and protective clothing when handling glass. Failure to comply may result in injury to personnel.

**WARNING**

Fender weighs 74 lbs (34 kg). Use an assistant to remove to prevent possible injury to personnel.

**WARNING**

LHS control box weighs 200 lbs (91 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

The crane hydraulic system operates at oil pressures up to 3100 psi (21,375 kPa). Never disconnect any hydraulic line or fitting without first dropping pressure to zero. Failure to comply may result in serious injury or death to personnel.

**WARNING**

Crane weighs 4,700 lbs (2,134 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Boom weighs 2100 lbs (953 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Erection cylinder weight 78 lbs (35 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

One pin secures erection cylinder, tension cylinder, and mast. Be careful to drive out pin only as far as needed to remove erection cylinder, or other components may fall, causing injury to personnel.

**WARNING**

Lift cylinder weighs 122 lbs (55 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

One pin secures both lift cylinders and mast. Be careful to drive out pin only as far as needed to remove selected cylinder and prevent possible injury to personnel.

**WARNING**

Ensure boom is fully supported by the LHS hook. Failure to support boom with LHS hook will cause boom to drop and may result in serious injury or death to personnel.

**WARNING**

Long pin also holds in mast and erection cylinder. Be careful to drive out pin only as far as needed to remove tension cylinder to prevent possible injury to personnel.

**WARNING**

Mast weighs 109 lbs (49 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Telescope cylinder weighs 70 lbs (32 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.



**WARNING**

Hoist assembly weighs 210 lbs (95 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

When second spring is released, cable follower may fly up against bracket. Keep hands and face away from this area, or injury to personnel may result.

**WARNING**

Turntable weighs 150 lbs (68 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Gear weighs 135 lbs (61 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Subframe weighs 1420 lbs (645 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Swing drive gear reducer weighs 140 lbs (64 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Four valve bank weighs 75 lbs (34 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Outrigger cylinder weighs 115 lbs (52 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Using HOIST control lever, crane should lift test weight a maximum of 1 in. (2.5 cm) before Overload Sensing System (OSS) disables hoist. If hoist lifts test load higher than 1 in. (2.5 cm), OSS is not functioning correctly and crane has failed load test. Perform Follow-On Maintenance and notify GS Maintenance.

**WARNING**

The winch hydraulic system operates at oil pressures up to 3675 psi (25,339 kPa). Never disconnect any hydraulic line or fitting without first dropping the pressure to zero. Failure to comply may result in serious injury or death to personnel.

**WARNING**

Hook weighs 200 lbs (91 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Hook arm weighs 1100 lbs (499 kg). Attach suitable lifting device prior to installation prevent possible injury to personnel.

**WARNING**

The LHS hydraulics system operates at oil pressures up to 3675 psi (25,339 kPa). Never disconnect any hydraulic line or fitting without first dropping pressure to zero. Failure to comply may result in serious injury to personnel.

**WARNING**

Middle frame weighs 1000 lbs (454 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Main cylinder weighs 325 lbs (148 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Compression frame weighs 4200 lbs (1907 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

LHS main manifold bracket assembly weighs 120 lbs (54 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Main hydraulic pump weighs 215 lbs (98 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Never stand in front of main hydraulic pump during lifting. Hydraulic pump can swing out of door and cause serious injury to personnel.

**WARNING**

Prolonged contact with lubricating oil, MIL-L-7808 may causes skin rash. Skin and clothing that come in contact with lubricating oil should be thoroughly washed immediately. Saturated clothing should be removed immediately. Areas in which lubricating oil is used should be well ventilated to keep fumes to a minimum.

**WARNING**

Hook arm cylinders weighs 210 lbs. (95 kg). Attach suitable lifting device prior to removal, installation, or lifting to prevent possible injury to personnel.

**WARNING**

Ensure hook arm assembly is supported with wooden block prior to removal to prevent possible injury to personnel.

**WARNING**

Middle frame, hook arm and hook have a combined weight of 2,300 lbs. (1,044 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Oil will spray from cylinder manifold 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**

Sharp edges of exhaust pipe could cause injury to personnel.

**WARNING**

Sharp edges of exhaust tube could cause injury to personnel.

**WARNING**

Battery box weighs 75 lbs (34 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

**WARNING**

Upon installation of all wires and cables, ensure No contact is made with battery terminals or other wires and cables. Strap wires as required to prevent injury or death to personnel or damage to equipment.

**WARNING**

200 AMP alternator weight 75 lbs (34 kg) Use an assistant to prevent possible injury.

**WARNING**

Always disconnect battery ground cable or power source before working on electrical components or injury to personnel may result. Discharge capacitors as noted. If personnel receive an electrical shock, get immediate medical attention.

**WARNING**

Machine gun ring front support weighs 55 lbs (25 kg). Attach suitable lifting device prior to installation to prevent injury to personnel.

**WARNING**

Machine gun ring weighs 295 lbs (134 kg). Attach suitable lifting device prior to installation to prevent injury to personnel.

**WARNING**

Starter weighs 73 lbs. (33 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Engine weighs 2600 lbs (1180 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Keep out from under engine when lifting. If engine slips, sways, or falls, serious injury or death may result.

**WARNING**

Diesel fuel is flammable. Do not perform this procedure near fire, flame or sparks. Injury or death to personnel could result.

**WARNING**

When installing lifting device, keep hands clear of rotors to prevent injury to personnel.

**WARNING**

Cylinder head with lifting device weighs 182 lbs (83 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Flywheel housing weighs 187 lbs (85 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Keep hands clear of gears when loosening nuts to prevent injury to personnel.

**WARNING**

Vibration damper may drop off crankshaft and may cause injury to personnel.

**WARNING**

Crankshaft weighs 185 lbs (84 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Control valve cover is under spring tension. Use extreme care when removing cover. Control valve cover may project when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

**WARNING**

Slave piston is retained by spring under compression. Ensure proper eye protection is worn to avoid injury to personnel.

**WARNING**

Spring is under extreme tension. Wear proper eye protection. Spring may shoot out and cause injury to personnel.

**WARNING**

Avoid contact with steam. Steam can cause burns, blindness, and other serious injury. Ensure the wearing of protective aprons, gloves, and safety goggles when using live steam or injury to personnel may result.

**WARNING**

When making this pressure test, make sure personnel are protected against pressurized air and oil from possible rupture or leak in hose or fitting on cylinder head or injury to personnel may result.

**WARNING**

Some chemical agents (detergents, solvents, alkalis, etc.) may irritate skin or be harmful to the eyes. Others must only be used with adequate ventilation. When working with potentially harmful chemical substances, read and heed the warnings on the product labels and follow prescribed safety precautions. When working with any potentially harmful substance - including live steam, hot water, and compressed air - wear appropriate safety equipment (face shield, gloves, apron, etc.) if required, and use extreme care to avoid injury to personnel.

**WARNING**

Wear proper eye protection to protect against stream of pressurized water from leak or rupture of fitting, hose, or oil cooler core to prevent injury to personnel.

**WARNING**

Use care when removing or installing piston rings. Piston rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

**WARNING**

High pressure steam can blow particles into eyes, can cause severe burns, and creates hazardous noise levels. Eye, skin, and hearing protection is required.

**WARNING**

Engine block weighs 732 lbs (332 kg). Attach suitable lifting device before removal to prevent possible injury or death to personnel.

**WARNING**

Be careful when using high air pressure. Ensure connections and seals are tight before applying pressure. High air pressure can blow out parts, hoses or debris with force. Explosive force can damage equipment and cause injury to personnel.

**WARNING**

Keep out from under engine when lifting. If engine slips, sways or falls, serious injury or death may result.

**WARNING**

Keep hands and fingers clear of rotors. If rotors turn, fingers may get caught between rotors and result in injury to personnel.

**WARNING**

Use care when removing retaining pin. Spring behind plug is under tension. Wear proper eye protection to avoid personal injury.

**WARNING**

Use care when replacing valve plug. Spring behind plug is under tension. Wear proper eye protection to avoid personal injury.

**WARNING**

Use care when replacing valve stop. Spring behind stop is under tension. Wear proper eye protection to avoid injury to personnel.

**WARNING**

Cover is under spring pressure. Wear proper eye protection to avoid personal injury.

**WARNING**

Washer is under spring tension. Wear proper eye protection to avoid injury to personnel.



**WARNING**

Torque converter housing weighs 100 lbs (45 kg). Attach suitable lifting device for removal or installation to prevent possible injury to personnel.

**WARNING**

When screws are removed, oil pump will fall. Make sure that assistant firmly supports oil pump inside torque converter housing to prevent personal injury or damage to parts.

**WARNING**

Forward clutch and turbine shaft assembly weighs 67 lbs (30 kg). Attach suitable lifting device for removal or installation to prevent possible injury to personnel.

**WARNING**

Use extreme caution when dropping forward clutch assembly. Keep feet and hands out from under parts to avoid personal injury.

**WARNING**

Ensure personnel wear heat resistant gloves prior to heating PTO gear with propane torch. Failure to comply may result in severe injury or death to personnel.

**WARNING**

Use extreme caution when dropping fifth clutch housing. Keep feet and hands out from under fifth clutch housing to avoid injury to personnel.

**WARNING**

Make sure all personnel stand clear when releasing pressure on spring compressor. Retaining ring can cause personal injury if not properly seated in retaining ring groove.

**WARNING**

Front planetary carrier assembly weighs 54 lbs (25 kg). Attach suitable lifting device for removal to prevent possible injury to personnel.

**WARNING**

Use extreme care when removing lifting bracket. Sun gear shaft, main shaft and gear fit loosely and may fall out and cause injury to personnel or damage to parts.

**WARNING**

Do not lift rear planetary assembly by ball bearing on rear end. Bearing may come off and planetary may fall resulting in personal injury or damage to equipment.

**WARNING**

Keep fingers away from inside of transmission housing while installing rear carrier assembly or injury to personnel may result.

**WARNING**

Planetary differential assembly weighs 160 lbs (73 kg). Use suitable lifting device to prevent possible injury to personnel.

**WARNING**

Planetary carrier assembly weighs 85 lbs (39 kg). Use the aid of an assistant to turn differential case over to prevent injury to personnel.

**WARNING**

Rear shaft assembly weighs 100 lbs (45 kg). Attach suitable lifting device to prevent possible injury to personnel.

**WARNING**

Rear housing weighs 210 lbs (95 kg). Attach suitable lifting device before removal or installation to prevent possible injury to personnel.

**WARNING**

Center shaft assembly weighs 145 lbs (66 kg). Attach suitable lifting device before removal or installation to prevent possible injury to personnel.

**WARNING**

Upper shaft assembly weighs 115 lbs (52 kg). Attach suitable lifting device before removal or installation to prevent possible injury to personnel.

**WARNING**

Differential shaft assembly weighs 100 lbs (45 kg). Use an assistant during removal or installation to prevent possible injury to personnel.

**WARNING**

Differential housing weighs 90 lbs (41 kg). Attach suitable lifting device before removal or installation to prevent possible injury to personnel.

**WARNING**

Front housing weighs 200 lbs (91 kg). Attach suitable lifting device before removal to prevent possible injury to personnel.

**WARNING**

To prevent injury to personnel or equipment damage, make sure chains will not slip off shaft assembly during lifting operation.

**WARNING**

Assembled portion of upper shaft assembly weighs 100 lbs (45 kg). Use an assistant to prevent possible injury to personnel.

**WARNING**

Axle No. 3 weighs 1780 lbs (807 kg). Attach a suitable lifting device prior to removal to prevent possible injury to personnel. Chains must be attached to axle housing to prevent an out of balance condition when axle is lifted. Axle could roll out of control causing serious injury or death to personnel.

**WARNING**

Brake drum weighs 132 lbs (60 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Spring in air brake chamber is very powerful and is under tension. Failure to cage air brake chamber before removal will release tension of spring abruptly and could result in injury to personnel.

**WARNING**

Air brake chamber can only be unscrewed a maximum of one turn. Otherwise, incorrect brake operation could result.

**WARNING**

Wheel hub assembly weighs 115 lbs (52 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Brake assembly weighs 80 lbs (36 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Seal race is extremely hot. Do not touch seal race without protective gloves or severe burns to hands could result.

**WARNING**

Pivot and spindle assembly weighs 90 lbs (41 kg). Use the aid of an assistant to prevent possible injury to personnel.

**WARNING**

Differential assembly weighs 198 lbs (90 kg). Attach a suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Differential and bevel gear weighs 70 lbs (32 kg). Attach a suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Prussian Blue Dye is poisonous and can burn skin on contact. Over exposure to dye can cause heart and skin problems, dizziness and unconsciousness.

**WARNING**

Differential assembly weighs 450 lbs (204 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Split torque weighs 62 lbs (28 kg). The aid of an assistant is required to prevent possible injury to personnel.

**WARNING**

Split torque weighs 62 lbs (28 kg) without flange assembly and 75 lbs (34 kg) with flange assembly. The aid of an assistant is required to prevent possible injury to personnel.

**WARNING**

Properly support spindle during removal. Failure to comply may result in injury to personnel.

**WARNING**

Differential assembly weighs 500 lbs (227 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Front housing weighs 90 lbs (41 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Ring and pinion assembly weighs 60 lbs (27 kg). Attach a suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Self-recovery winch weighs 980 lbs (445 kg). Attach suitable lifting device prior to removal or installation to prevent injury to personnel.

**WARNING**

Left side and right side mount weigh 48 lbs (22 kg). Ensure hands and fingers are kept clear of left side and right side mounts during removal. Failure to comply may result in serious injury to personnel.

**WARNING**

Ensure fingers do not get caught between secondary planetary carrier and ring gear or injury to personnel may result.

**WARNING**

Wheel end assembly weighs 200 lbs (91 kg). Support wheel end assembly with suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Internal pistons are under moderate spring tension. Keep pistons compressed when installing locknut. Failure to comply may result in injury to personnel.

**WARNING**

Exhaust manifolds and engine parts are hot. Use care to prevent personal injury.

**WARNING**

Use care when removing or installing springs. Springs are under tension and can act as projectiles when released and could cause severe eye injury.

**WARNING**

Alternator weighs 75 lbs (34 kg). Use the aid of an assistant to prevent possible injury to personnel.

**WARNING**

Engine weighs 2,600 lbs (1,180 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Keep out from under engine when lifting. If engine slips, sways, or falls, serious injury or death may result.

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

**WARNING**

Accumulator testing and charging can expose personnel to high pressure nitrogen. Use of proper safety equipment is required to prevent serious injury or death.

**WARNING**

Accumulator testing and servicing can expose personnel to high pressure nitrogen. Use of proper safety equipment is required to prevent serious injury or death.

**WARNING**

High pressure hydraulics [oil under 3700 psi (25,512 kPa) pressure] operate this equipment. Refer to truck operator and maintenance manuals for hydraulic oil pressure. Never disconnect any hydraulic line or fitting without first dropping pressure to zero. Failure to comply may result in injury to personnel.

**WARNING**

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

**WARNING**

Approved hearing protection devices and protective goggles must be worn when performing tasks. Failure to comply may result in injury to personnel.

**WARNING**

Fan may engage without warning. do not place any part of body in area of fan operation. Failure to do so may result in injury or death to personnel.

**WARNING**

Use care when removing or installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

**WARNING**

Release air pressure prior to opening container or injury to personnel could result.

**WARNING**

Upper container weighs 222 lbs (101 kg). Attach lifting device prior to removal or installation to prevent injury to personnel.



**WARNING**

Transmission assembly weighs 1,061 lbs (482 kg). Attach lifting device prior to removal or installation to prevent injury to personnel.

**WARNING**

Protective goggles must be worn when drilling holes. Failure to comply may result in injury to personnel.

**WARNING**

Upper container weighs 250 lbs (114 kg). Attach lifting device prior to removal or installation to prevent injury to personnel.

**WARNING**

Transfer case weighs 1,388 lbs (630 kg). Attach lifting device prior to removal or installation to prevent injury to personnel.

**WARNING**

Axle No. 3 weighs 1,780 lbs (807 kg) and Axle No. 4 weighs 1,925 lbs (873 kg). Use jackstands to support axles. Failure to do so could result in injury to personnel.

**WARNING**

Driveshafts can weigh up to 100 lbs (45 kg). Properly support driveshafts when removing screws. After screws and brackets are removed, driveshaft can fall and cause injury to personnel.

**WARNING**

Pivot and spindle assembly weighs 90 lbs (41 kg). Use the aid of an assistant to prevent possible injury to personnel.

**WARNING**

Wheel end assembly weighs 300 lbs (136 kg). Support wheel end assembly with suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

The trailing beam assembly weighs 150 lbs (68 kg). Attach a suitable lifting device to truck end of trailing beam assembly prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Axle No. 3 weighs 1780 lbs (808 kg). Attach a suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Keep fingers out of trailing beam assembly holes. Failure to comply could result in serious injury to personnel.

**WARNING**

Trailing beam assembly weighs 150 lbs (68 kg). Attach a hydraulic jack to axle end of air suspension beam assembly prior to installation to prevent possible injury to personnel.

**WARNING**

Main fuel tank weighs 50 to 700 lbs (23 to 318 kg) depending on the quantity of fuel inside. Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**WARNING**

Axle No. 4 and Axle No. 5 share mounting hardware for longitudinal torque rods. Both axles must be supported during removal of screws and locknuts or axles may fall. Failure to comply may result in injury or death to personnel.

**WARNING**

Spindle is heavy. Properly support spindle during disassembly or serious injury to personnel may occur.

**WARNING**

Seal race is extremely hot. Do not touch seal race without protective gloves or severe burns to hands could result.

**WARNING**

Ensure crankcase cover is fully supported before removing screws. Failure to comply may result in crankcase cover falling causing injury to personnel.

**WARNING**

Upper container weighs 480 lbs (218 kg). Attach lifting device prior to removal to prevent injury to personnel.

**WARNING**

Allow cable to slowly retract. Cable is under tension and can snap back rapidly. Ensure that proper eye protection is used. Failure to comply may result in serious injury to personnel.

**WARNING**

Allow engine to cool before performing this procedure or injury to personnel may occur.

**WARNING**

Engine must be cool before performing maintenance. Failure to comply may result in injury to personnel.

**WARNING**

Use care when removing 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.

**WARNING**

Mounts weigh 48 lbs (22 kg). Ensure hands and fingers are kept clear of left side and right side mounts during removal and installation. Failure to comply may result in serious injury to personnel.

**WARNING**

Do not use brake drum that exceeds maximum wear specification. Failure to comply may result in brake failure and serious injury or death to personnel.

**WARNING**

Brake drum weighs 134 lbs (61 kg). Use lifting device or aid of an assistant to lift drum. Failure to comply may result in injury to personnel.

**WARNING**

Do not loosen locknuts more than one full turn. Failure to do so may cause steering gear to fall and cause injury or death to personnel.

**WARNING**

All personnel must stay clear of cab when lifting is in progress. Failure to comply may result in injury or death to personnel.

**WARNING**

Inner-mid section weighs 1,000 lbs (454 kg). Attach suitable lifting device prior to removal to prevent injury to personnel.

**WARNING**

Do not stick fingers under section to remove wear pads, or injury to hands may result.

**WARNING**

Outer-mid section weighs 800 lbs (363 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

- Fly section weighs 450 lbs (204 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.
- Keep fly section level or structural section will fall out. Move fly section slowly. Keep assembly as level as possible during removal. Failure to comply may cause injury to personnel.

**WARNING**

Structural section weighs 175 lbs (79 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Unsafe torching practices can cause serious injury from fire, explosions, or harmful agents. Allow only authorized personnel to heat metals. Protective clothing, gloves, and goggles must be worn; adequate protective equipment used; and a suitable fire extinguishers kept nearby. Failure to comply may result in severe injury to personnel.

**WARNING**

At least 0.06 in. (1.5 mm) of clearance is required between highest spot on fly section and bottom of wear pad or section may not operate properly. Damage to equipment may result.

**WARNING**

Boom weighs 2,100 lbs (953 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

**WARNING**

Ensure charging cylinder contains dry nitrogen. Dry nitrogen tanks are marked with one or two black bands. Certain other gasses can cause accumulator to explode. Failure to comply may result in injury to personnel.

**WARNING**

Compression frame weighs 800 lbs (363 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**WARNING**

Screws are extremely hot. Do not touch screws without protective gloves or severe burns to hands could result.

**WARNING**

The main hydraulic system operates at oil pressures up to 3,675 psi (25,339 kPa). Never disconnect any hydraulic line or fitting without first dropping pressure to zero. Failure to comply may result in serious injury or death to personnel.

**WARNING**

Cylinder weighs in excess of 210 lbs (95 kg). Attach suitable lifting device prior to lifting to prevent possible injury to personnel.

**WARNING**

Left front support bracket weighs 98 lbs (44 kg). Attach suitable lifting device to prevent possible injury to personnel.

**WARNING**

Box assembly weighs 92 lbs (42 kg). Ensure box assembly is properly supported prior to removal to prevent possible injury to personnel.

**WARNING**

Right front support bracket weighs 98 lbs (44 kg). Attach suitable lifting device to prevent possible injury to personnel.

**WARNING**

Front support assembly weighs 660 lbs (300 kg). Attach suitable lifting device to prevent possible injury to personnel.

**WARNING**

Stow weldment weighs 410 lbs (186 kg). Attach suitable lifting device to prevent possible injury to personnel.

**WARNING**

Rear guide assembly weighs 70 lbs (32 kg). Attach suitable lifting device to prevent possible injury to personnel.

**WARNING**

Rear roller bracket weighs 155 lbs (70 kg). Attach suitable lifting device to prevent possible injury to personnel.

**WARNING**

Rear roller brackets weigh 150 lbs (68 kg). Attach suitable lifting device to prevent possible injury to personnel.

**WARNING**

Right strut bracket assembly weighs 80 lbs (36 kg). Attach suitable lifting device to prevent possible injury to personnel.

**WARNING**

Horizontal roller weighs 75 lbs. (34 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

**WARNING**

Lifting frame weighs 1,600 lbs (704 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

**WARNING**

Container lock could drop suddenly if not supported. Failure to comply may result in injury to personnel.

**WARNING**

Tip of removal tool is very sharp. Use caution when using tool. Failure to comply may result in injury to personnel.

**WARNING**

Gloves must be used when handling turbocharger cover. Turbocharger cover is made of fiberglass and may cause skin irritation. Failure to comply may result in injury to personnel.

**WARNING**

Components in each valve bore are spring-loaded and must be compressed while removing retaining pin. Ensure proper eye protection is worn to avoid injury to personnel.

**WARNING**

Rear planetary carrier assembly weighs 86 lbs (39 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.



**WARNING**

Rear cover weighs 98 lbs (44 kg). Attach suitable lifting device for removal or installation to prevent possible injury to personnel.

**WARNING**

Ensure that upward lifting force is applied to the holding fixture before screws are removed or transfer case may shift downward causing personal injury or damage to equipment.

**WARNING**

Press on inner diameter of bearing or equipment damage may result.

**WARNING**

Parts of the brake assembly may be coated with brake dust; breathing this dust can harm personnel.

- Use a filter mask approved for use against asbestos dust.
- Never use compressed air or dry brush to clean these assemblies.
- Use an industrial type vacuum cleaner with a high-efficiency filter system to remove dust.
- Use water and a soft bristle brush or cloth to remove dirt or mud.

**WARNING**

Differential gear weighs 70 lbs (32 kg). Attach a suitable lifting device prior to installation to prevent possible injury to personnel.

**WARNING**

Axle No. 3 weighs 2,048 lbs (808 kg). Attach a suitable lifting device prior to removal or installation to prevent possible injury to personnel. Axle housing must be chained to lifting device to prevent an out of balance condition when longitudinal torque rod is removed. Axle could roll out of control causing serious injury or death to personnel.

**LIST OF EFFECTIVE PAGES**

Insert latest changed pages. Destroy superseded pages.

**NOTE**

The portion of the text effected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by a shadowed or screened areas, or by miniature pointing hands.

Dates of issue for original and changed pages are:

Original ..... 0 ... 1 August 1999

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 1278 CONSISTING OF THE FOLLOWING:

Page No.	*Change No.	Page No.	*Change No.	Page No.	*Change No.
Title .....	0	A-1 - A-2 .....	0		
Blank .....	0	B-1 - B-7 .....	0		
a - ar .....	0	B-8 Blank .....	0		
A .....	0	C-1 - C-35 .....	0		
B Blank .....	0	C-36 Blank .....	0		
i - iii .....	0	D-1 - D-7 .....	0		
iv Blank .....	0	D-8 Blank .....	0		
20-1 - 20-363 .....	0	E-1 - E-18 .....	0		
20-364 Blank .....	0	F-1 - F-9 .....	0		
21-1 - 21-34 .....	0	F-10 Blank .....	0		
22-1 - 22-10 .....	0	Index -1 - Index 14 .....	0		
23-1 - 23-137 .....	0				
23-138 Blank .....	0				
24-1 - 24-91 .....	0				
24-92 Blank .....	0				
25-1 - 25-211 .....	0				
25-212 Blank .....	0				
26-1 - 26-14 .....	0				
27-1 - 27-33 .....	0				
27-34 Blank .....	0				
28-1 - 28-92 .....	0				

\* Zero In This Column Indicates An Original Page.



TECHNICAL MANUAL

No. 9-2320-364-34

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
Washington, D.C. 01 August 1999

## Direct Support and General Support Maintenance Manual

# PALLETIZED LOAD SYSTEM

MODEL M1074/M1075  
NSN 2320-01-304-2277  
NSN 2320-01-304-2278

Current as of 01 August 1999

### REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (Recommended Changes to Publications and Blank Forms), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is <http://aeprs.ria.army.mil>. If you need a password, scroll down and click on "ACCESS REQUEST FORM." The DA Form 2028 is located in the ONLINE FORMS PROCESSING section of the AEPS. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or email your letter, DA Form 2028, or DA Form 2028-2, located at the back of this manual direct to: Commander, U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-AC-NML, Rock Island, IL 61299-7630. The email address is [amsta-ac-nml@ria.army.mil](mailto:amsta-ac-nml@ria.army.mil). The fax number is DSN 793-0726 or Commercial (309) 782-0726. A reply will be furnished to you.

## TABLE OF CONTENTS

	<b>Page</b>
CHAPTER 20 ENGINE MAINTENANCE .....	20-1
CHAPTER 21 FUEL SYSTEM MAINTENANCE .....	21-1
CHAPTER 22 COOLING SYSTEM MAINTENANCE .....	22-1
CHAPTER 23 TRANSMISSION MAINTENANCE .....	23-1
CHAPTER 24 TRANSFER CASE MAINTENANCE .....	24-1
CHAPTER 25 AXLE MAINTENANCE .....	25-1
CHAPTER 26 BRAKE SYSTEM MAINTENANCE .....	26-1
CHAPTER 27 WHEELS AND TIRES MAINTENANCE .....	27-1

## TABLE OF CONTENTS (CONT).

CHAPTER 28 .....	MATERIAL HANDLING CRANE AND SELF-RECOVERY WINCH MAINTENANCE .....	28-1
Section I	Introduction .....	28-1
Section II	Material Handling Crane Maintenance .....	28-2
Section III	Self-Recovery Winch Maintenance .....	28-71
APPENDIX A	REFERENCES .....	A-1
APPENDIX B	EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST .....	B-1
APPENDIX C	ILLUSTRATED LIST OF MANUFACTURED ITEMS .....	C-1
APPENDIX D	TORQUE LIMITS .....	D-1
APPENDIX E	MANDATORY REPLACEMENT PARTS .....	E-1
APPENDIX F	TOOL IDENTIFICATION LIST .....	F-1
INDEX	.....	INDEX-1
SCHEMATICS	.....	SCHMTC-1
Section I	145 Amp Alternator and DDEC II Engine	
Section II	200 Amp Alternator and DDEC III Engine	

## HOW TO USE THIS MANUAL

This manual is designed to help maintain the Model M1074/M1075 Palletized Load System (PLS) truck. 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 truck 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 PLS truck.
- 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.
- Chapters 20 through 28 of this manual cover General Support Maintenance for each PLS truck system.

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.



## CHAPTER 20

### ENGINE MAINTENANCE

Para	Contents	Page
20-1	General Support Engine Maintenance Introduction .....	20-3
20-2	Installing Engine On Stand .....	20-4
20-3	Exhaust Manifold Removal .....	20-13
20-4	Electronic Control Module (ECM) Removal .....	20-14
20-5	Turbocharger And Air Inlet Housing Removal .....	20-30
20-6	Engine Lifting Brackets Removal .....	20-34
20-7	Left Side Thermostat Housing Removal .....	20-35
20-8	Right Side Thermostat Housing Removal .....	20-37
20-9	Secondary Fuel Filter, Head And Fuel Hoses Removal .....	20-39
20-10	Fuel Pump Removal .....	20-44
20-11	Rocker Cover And Gasket Removal .....	20-45
20-12	Tachometer Drive Assembly Removal .....	20-46
20-13	Blower Assembly Removal .....	20-47
20-14	Engine Brake Retarder Removal .....	20-49
20-15	Fuel Injector Removal .....	20-51
20-16	Timing and Synchronous Reference Sensor (TRS/SRS) Removal .....	20-53
20-17	Air Box Covers Removal .....	20-54
20-18	Air Box Drain Removal .....	20-55
20-19	Cylinder Head Removal .....	20-56
20-20	Blower Drive Assembly Removal .....	20-58
20-21	Aftercooler Removal .....	20-59
20-22	Water Pump Assembly Removal .....	20-60
20-23	Engine Oil Filter And Spin-On Adapter Housing And Remote Engine Oil Filter Manifold Removal .....	20-61
20-24	Engine Oil Cooler Assembly Removal .....	20-63
20-25	Vibration Damper And Front Balance Cover Removal .....	20-66
20-26	Flex Plate Removal .....	20-69
20-27	Engine Oil Pan Removal .....	20-70
20-28	Engine Oil Pressure Regulator Valve Removal .....	20-73
20-29	Engine Oil Pressure Relief Valve Removal .....	20-74
20-30	Engine Oil Pump Assembly Removal .....	20-75
20-31	Flywheel Housing And Rear Oil Seal Removal .....	20-76
20-32	Idler Gear Removal .....	20-80
20-33	Crankshaft Timing Gear Removal .....	20-81
20-34	Camshaft Assembly Removal .....	20-82
20-35	Rear Cylinder Block Plate Removal .....	20-86
20-36	Front Cylinder Block Plate Removal .....	20-87
20-37	Crankshaft Pulley Removal .....	20-88
20-38	Vibration Damper Removal .....	20-90
20-39	Crankshaft Front Cover and Seal Removal .....	20-92
20-40	Piston, Connecting Rod And Liner Removal .....	20-94
20-41	Engine Oil Pump Drive Gear Removal .....	20-97
20-42	Main Bearing And Crankshaft Removal .....	20-98



Para	Contents	Page
20-43	Rocker Cover Repair .....	20-104
20-44	Engine Brake Retarder Repair .....	20-107
20-45	Rocker Arm Repair .....	20-114
20-46	Exhaust Valve Bridge Repair .....	20-117
20-47	Cam Follower/Push Rod Repair .....	20-120
20-48	Exhaust Valve Repair .....	20-125
20-49	Cylinder Head Repair .....	20-130
20-50	Valve Guide Repair .....	20-145
20-51	Valve Bridge Guide Repair .....	20-146
20-52	Valve Seat Insert Repair .....	20-149
20-53	Injector Tube Repair .....	20-152
20-54	Water Nozzle Repair .....	20-157
20-55	Blower Drive Assembly Repair .....	20-159
20-56	Aftercooler Inspection .....	20-163
20-57	Engine Oil Cooler Assembly Testing .....	20-165
20-58	Idler Gear Repair .....	20-167
20-59	Engine Oil Pump Drive Gear Inspection .....	20-173
20-60	Piston And Connecting Rod Repair .....	20-175
20-61	Cylinder Liner Repair .....	20-188
20-62	Camshaft Repair .....	20-193
20-63	Main Bearing And Crankshaft Repair .....	20-199
20-64	Engine Cylinder Block Repair .....	20-204
20-65	Main Bearing And Crankshaft Installation .....	20-228
20-66	Engine Oil Pump Drive Gear Installation .....	20-234
20-67	Piston, Connecting Rod And Liner Installation .....	20-235
20-68	Crankshaft Front Cover And Seal Installation .....	20-240
20-69	Vibration Damper Installation .....	20-243
20-70	Crankshaft Pulley Installation .....	20-245
20-71	Front Cylinder Block Plate Installation .....	20-247
20-72	Rear Cylinder Block Plate Installation .....	20-249
20-73	Camshaft Assembly Installation .....	20-251
20-74	Crankshaft Timing Gear Installation .....	20-256
20-75	Idler Gear Installation .....	20-257
20-76	Flywheel Housing And Rear Oil Seal Installation .....	20-259
20-77	Engine Oil Pump Assembly Installation .....	20-266
20-78	Engine Oil Pressure Relief Valve Installation .....	20-268
20-79	Engine Oil Pressure Regulator Valve Installation .....	20-269
20-80	Engine Oil Pan Installation .....	20-270
20-81	Flex Plate Installation .....	20-273
20-82	Vibration Damper And Front Balance Cover Installation .....	20-275
20-83	Engine Oil Cooler Assembly Installation .....	20-278
20-84	Engine Oil Filter And Spin-on Adapter Housing And Remote Engine Oil Filter Manifold Installation .....	20-281
20-85	Water Pump Assembly Installation .....	20-284
20-86	Aftercooler Installation .....	20-287
20-87	Blower Drive Assembly Installation .....	20-288
20-88	Cylinder Head Installation .....	20-290
20-89	Air Box Drain Installation .....	20-295
20-90	Air Box Covers Installation .....	20-296
20-91	Timing And Synchronous Reference Sensor (TRS/SRS) Installation .....	20-297

<b>Para</b>	<b>Contents</b>	<b>Page</b>
20-92	Fuel Injector Installation .....	20-302
20-93	Engine Brake Retarder Installation .....	20-304
20-94	Engine Tune-up Adjustments .....	20-306
20-95	Blower Assembly Installation .....	20-310
20-96	Tachometer Drive Assembly Installation .....	20-313
20-97	Rocker Cover Installation .....	20-314
20-98	Fuel Pump Assembly Installation .....	20-315
20-99	Secondary Fuel Filter, Head And Fuel Hoses Installation .....	20-316
20-100	Right Thermostat Housing Installation .....	20-321
20-101	Left Thermostat Housing Installation .....	20-323
20-102	Engine Lifting Brackets Installation .....	20-325
20-103	Turbocharger And Air Inlet Housing Installation .....	20-327
20-104	Electronic Control Module (ECM) Installation .....	20-331
20-105	Exhaust Manifold Installation .....	20-351
20-106	Removing Engine From Stand .....	20-353

## **Section I. INTRODUCTION**

### **20-1. GENERAL SUPPORT ENGINE MAINTENANCE INTRODUCTION.**

This chapter contains maintenance instructions for removing, replacing, installing, repairing and testing engine components authorized by the Maintenance Allocation Chart (MAC) at the General Support level. Section II consists of a top-down breakdown of engine components with the engine on a maintenance stand.

## Section II. ENGINE REPAIR (ON-STAND)

### 20-2. INSTALLING ENGINE ON STAND.

This task covers:

- a. Installing Engine on Engine Stand
- b. Follow-On Maintenance

#### INITIAL SETUP

##### *Tools and Special Tools*

Tool Kit General Mechanic's  
(Item 240, Appendix F)  
Adapter, Engine Stand (Item 1, Appendix F)  
Jackstand (4) (Item 132, Appendix F)  
Socket Set, 3/8 in. (Item 204, Appendix F)  
Stand, Maintenance, Engine  
(Item 226, Appendix F)  
Wrench, Combination 1-7/16 in.  
(Item 259, Appendix F)  
Wrench, Combination 1-1/2 in.  
(Item 260, Appendix F)  
Wrench, Torque (0-175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Lifting Device, Minimum Capacity  
2600 lbs (1180 kg)

##### *Materials/Parts*

Tags, Identification (Item 72, Appendix B)

##### *Personnel Required*

Two

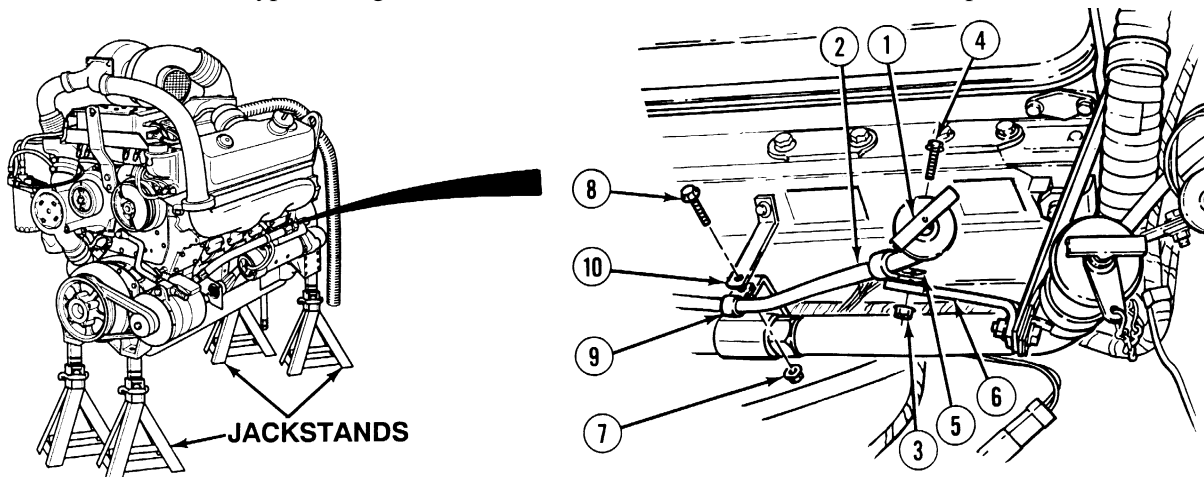
##### *Equipment Condition*

Engine removed from container, (Para 3-23)  
Left hand air box covers removed, (Para 20-17)  
Left hand exhaust manifold removed,  
(Para 20-3)  
Left hand air box drain removed, (Para 20-18)  
Remote engine oil filter manifold hoses  
and adapter removed, (TM 9-2320-364-20)

#### a. *Installing Engine on Engine Stand.*

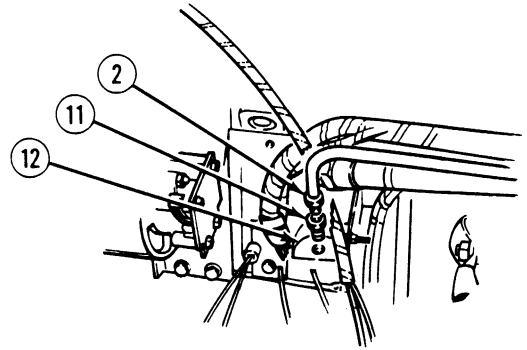
#### NOTE

PLS has two types of engines, DDEC II and DDEC III. Both are same, except where noted.

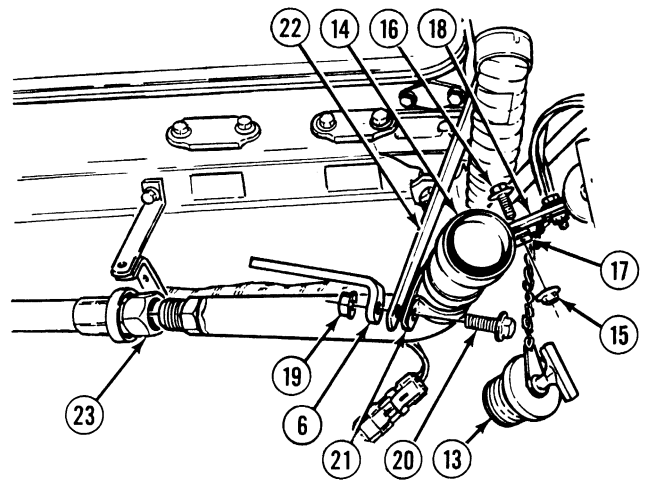


- (1) Remove engine oil dipstick (1) from filler neck (2).
- (2) Remove locknut (3), screw (4) and clamp (5) from bracket (6). Discard locknut.
- (3) Remove locknut (7), screw (8) and clamp (9) from bracket (10). Discard locknut.
- (4) Remove two clamps (5) and (9) from filler neck (2).

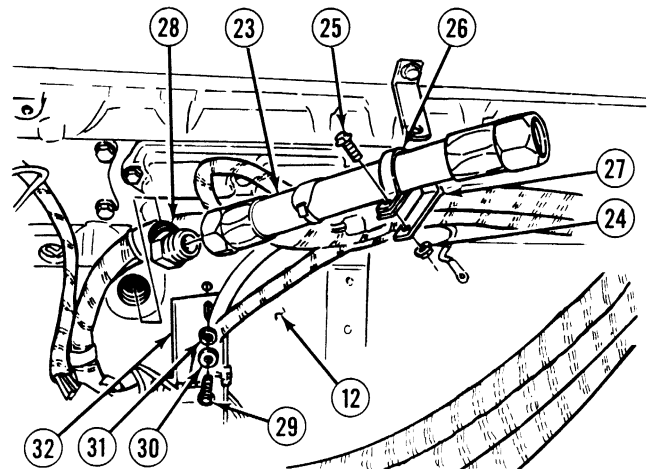
- (5) Remove filler neck (2) from adapter (11).
- (6) Remove adapter (11) from engine block (12).



- (7) Remove filler cap (13) from filler tube (14).
- (8) Remove locknut (15), screw (16) and clamp (17) from bracket (18). Discard locknut.
- (9) Remove locknut (19), screw (20), clamp (21) and bracket (6) from bracket (22). Discard locknut.
- (10) Remove filler tube (14) and two clamps (17) and (21) from filler hose 2999 (23).
- (11) Remove two clamps (17) and (21) from filler tube (14).



- (12) Remove locknut (24), screw (25) and clamp (26) from bracket (27). Discard locknut.
- (13) Remove clamp (26) from filler hose 2999 (23).
- (14) Remove filler hose 2999 (23) from elbow (28).
- (15) Remove two screws (29), lockwashers (30), washers (31) and bracket (32) from engine block (12). Discard lockwashers.



**NOTE**

Mark position of elbow prior to removal.

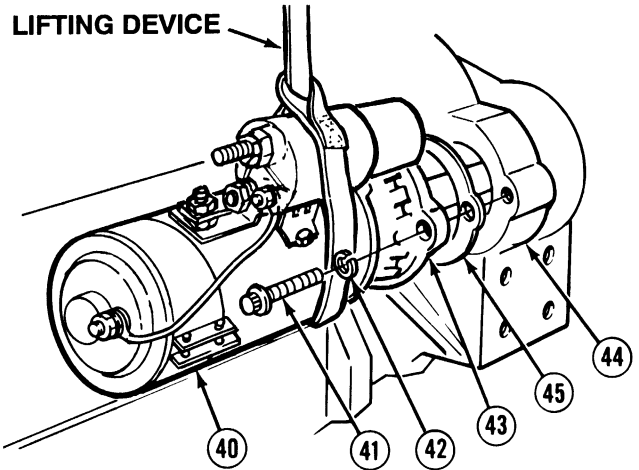
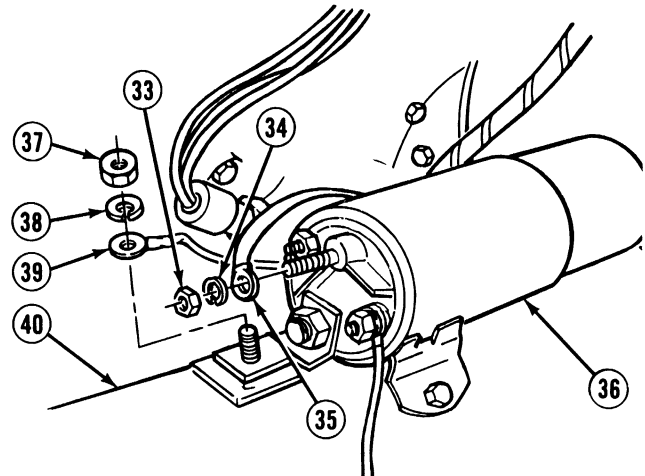
- (16) Remove elbow (28) from engine block (12).

**20-2. INSTALLING ENGINE ON STAND (CONT).**

**NOTE**

Tag and mark wires prior to removal.

- (17) Remove nut (33), lockwasher (34) and wire 1816 (35) from starter solenoid (36). Reinstall nut (33) on starter solenoid (36). Discard lockwasher.
- (18) Remove nut (37), lockwasher (38) and wire 1818 (39) from starter (40). Reinstall nut (37) on starter (40). Discard lockwasher.
- (19) Remove two of three screws (41) and lockwashers (42) from starter mounting bracket (43). Discard lockwashers.



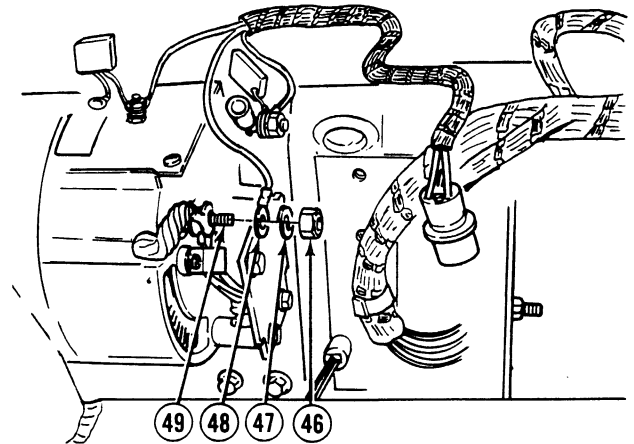
**WARNING**

Starter weighs 73 lbs (33 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (20) Install lifting device on starter (40).
- (21) With the aid of an assistant, remove remaining screw (41) and lockwasher (42) from starter mounting bracket (43). Discard lockwasher.
- (22) Remove starter (40) from flywheel housing (44).
- (23) Remove gasket (45) from starter (40) and flywheel housing (44). Discard gasket.
- (24) Remove lifting device from starter (40).

**NOTE**

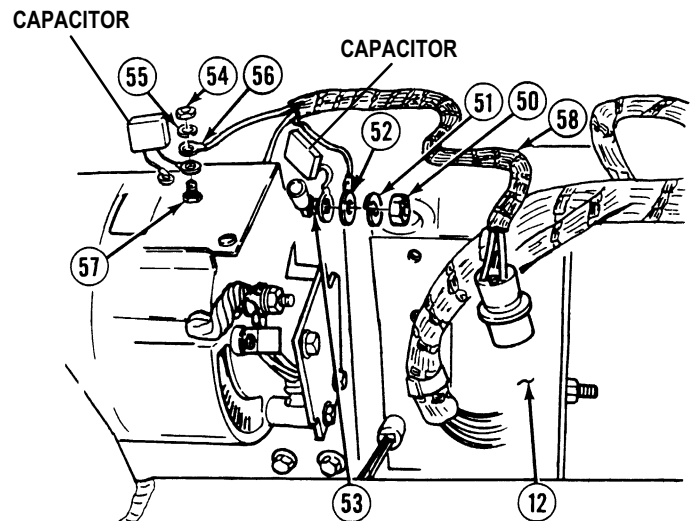
- If equipped with a 145 AMP alternator perform Steps (25) through (36).
- If equipped with a 200 AMP alternator, perform Steps (37) through (52).
- There may be more than one wire located on negative terminal. Remove only wire 1815 and position remaining wires back on negative terminal.



- (25) Remove nut (46), lockwasher (47) and wire 1815 (48) from negative terminal (49). Reinstall nut (46) on negative terminal (49). Discard lockwasher.

**NOTE**

There is a capacitor and possibly more than one wire located on positive terminal. Remove only wire 1820 and position remaining capacitor and/or wire back on positive terminal.



- (26) Remove nut (50), lockwasher (51) and wire 1820 (52) from positive terminal (53). Reinstall nut (50) on positive terminal (53). Discard lockwasher.

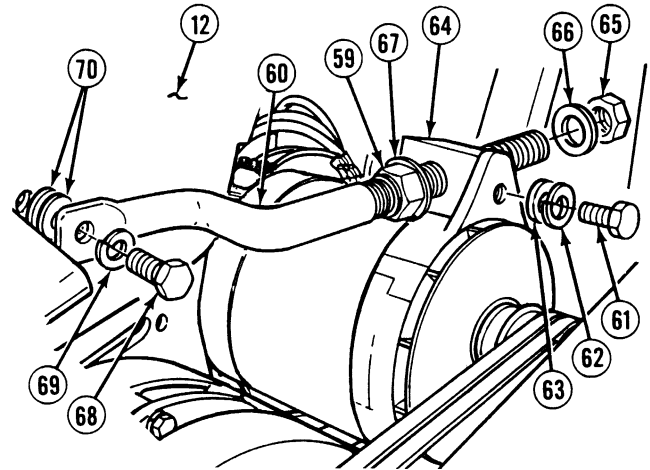
**NOTE**

There is a capacitor and possibly more than one wire located on F-positive terminal. Remove only wire 1953 and position remaining capacitor and/or wire back on F-positive terminal.

- (27) Remove nut (54), lockwasher (55) and wire 1953 (56) from F-positive terminal (57). Reinstall nut (54) on F-positive terminal (57). Discard lockwasher.
- (28) Remove STE/ICE-R alternator harness (58) from engine block (12).

**20-2. INSTALLING ENGINE ON STAND (CONT).**

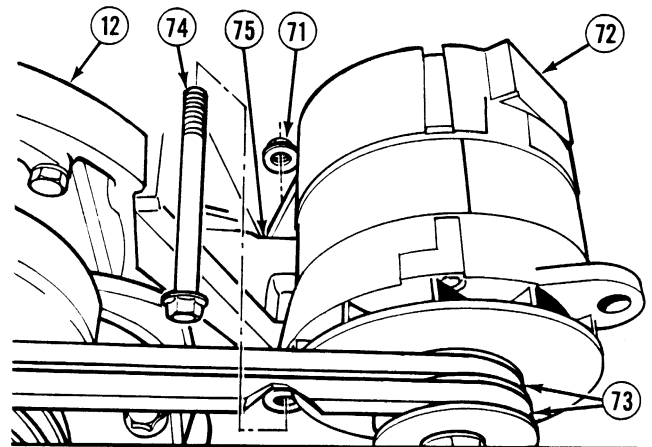
- (29) Loosen locknut (59) on alternator support arm (60).
- (30) Remove screw (61), lockwasher (62) and washer (63) from eye rod end (64) on alternator support arm (60). Discard lockwasher.
- (31) Remove locknut (65), washer (66), eye rod end (64), washer (67) and locknut (59) from alternator support arm (60). Discard locknuts.



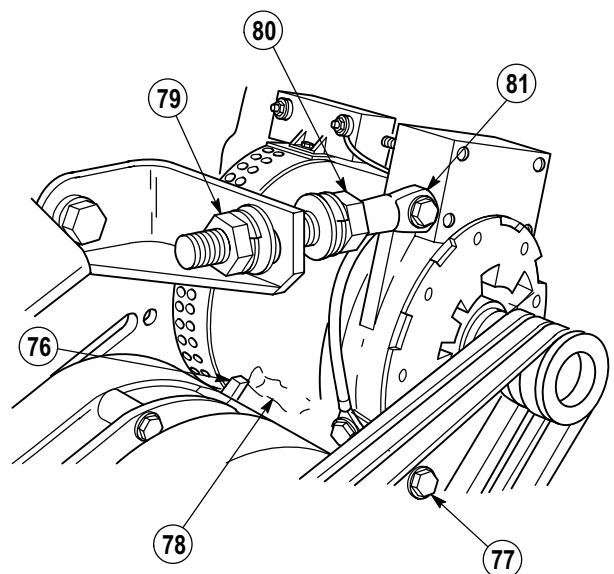
**NOTE**

Note number of washers prior to removal.

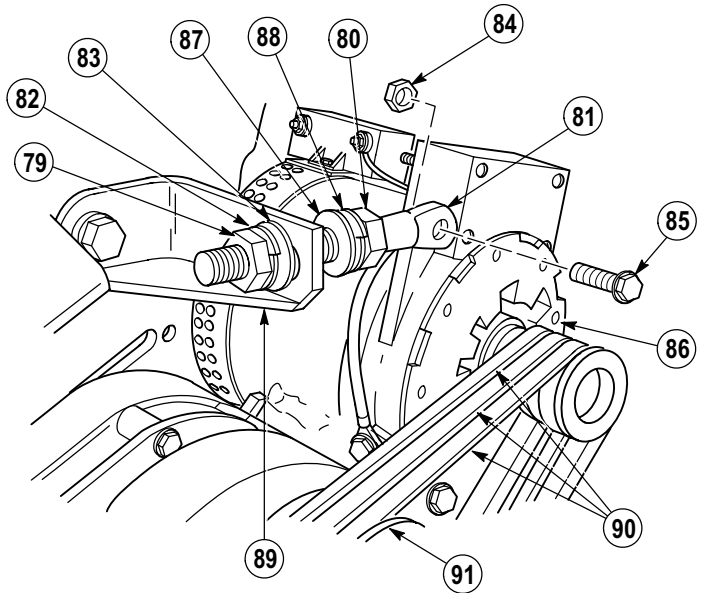
- (32) Remove screw (68), lockwasher (69), alternator support arm (60) and washer (70) from engine (12). Discard lockwasher.
- (33) Remove locknut (71) from bottom of alternator (72). Discard locknut.
- (34) Rotate alternator (72) towards center of engine (12) and remove two belts (73).
- (35) Remove screw (74) from bottom of alternator. (72).
- (36) Remove alternator (72) from alternator mounting bracket (75).



- (37) Loosen nut (76) and screw (77) on bottom of alternator mounting bracket (78).
- (38) Loosen nuts (79) and (80) on alternator support arm (81).



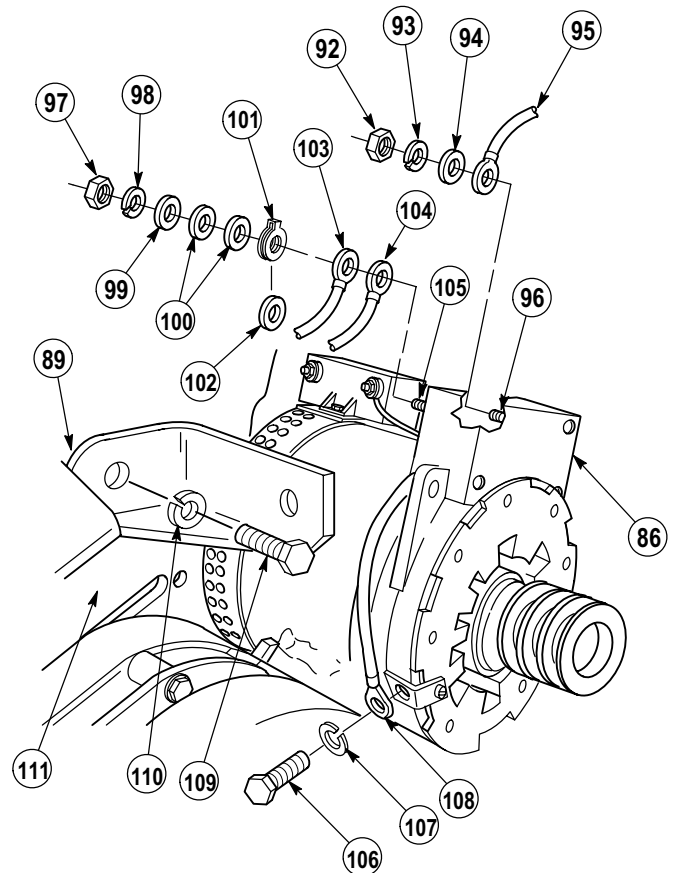
- (39) Remove nut (79), lockwasher (82) and washer (83) from alternator support arm (81). Discard lockwashers.
- (40) Remove locknut (84), screw (85) and alternator support arm (81) from alternator (86). Discard locknut.
- (41) Remove washer (87), lockwasher (88), nut (80) and alternator support arm (81) from bracket (89). Discard lockwasher.
- (42) Remove three alternator belts (90) from alternator (86) and engine pulley (91).



**NOTE**

Tag and mark all wire connectors prior to removal.

- (43) Remove nut (92), lockwasher (93), washer (94), and wire 1860 (95) from 12 volt terminal (96). Discard lockwasher.
- (44) Position washer (94) and nut (92) on 12 volt terminal (96).
- (45) Remove nut (97), lockwasher (98), washer (99), washer(s) (if present) (100), fuse link (101), insulator washer (102), wire 1820 (103), and wire 1953 (104) from 24 volt terminal (105). Discard lockwasher.
- (46) Position fuse link (101), insulator washer (102), washer(s) (if removed) (100), washer (99) and nut (97) on 24 volt terminal (105).
- (47) Remove screw (106), lockwasher (107), and wire 1815 (108) from alternator (86). Discard lockwasher.
- (48) Remove screw (109), lockwasher (110) and bracket (89) from engine (111). Discard lockwasher.





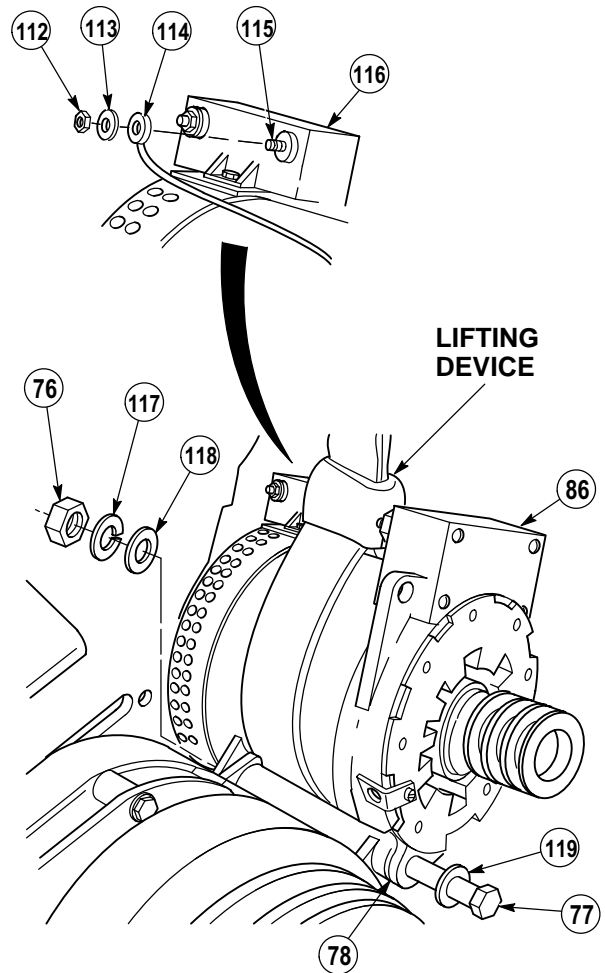
## 20-2. INSTALLING ENGINE ON STAND (CONT).

- (49) Remove locknut (112), washer (113), and wire 1020B (114) from terminal (115) of regulator (116). Discard locknut.
- (50) Remove nut (76), lockwasher (117), washer (118), screw (77) and washer (119) from alternator (86) and alternator mounting bracket (78). Discard lockwasher.

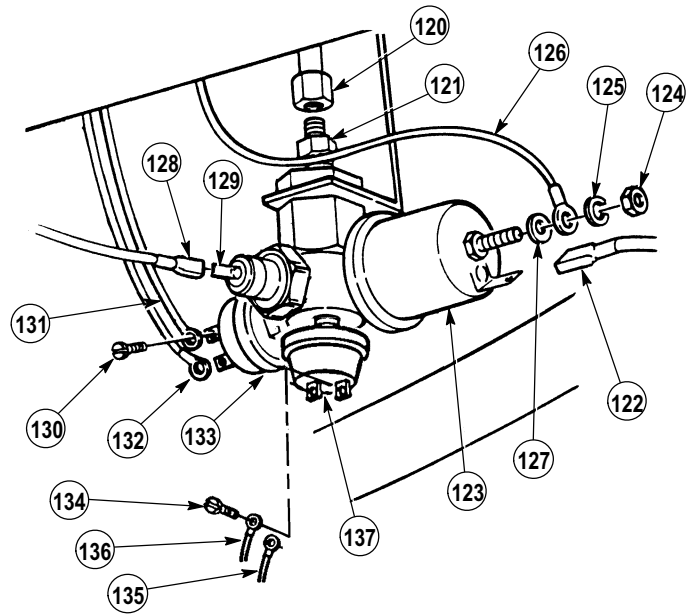
### **WARNING**

Alternator weighs 75 lbs (34 kg).  
Use the aid of an assistant to  
prevent possible injury to  
personnel.

- (51) With the aid of an assistant, install lifting device onto alternator and remove alternator (86) from alternator mounting bracket (78).
- (52) Remove lifting device from alternator (86).



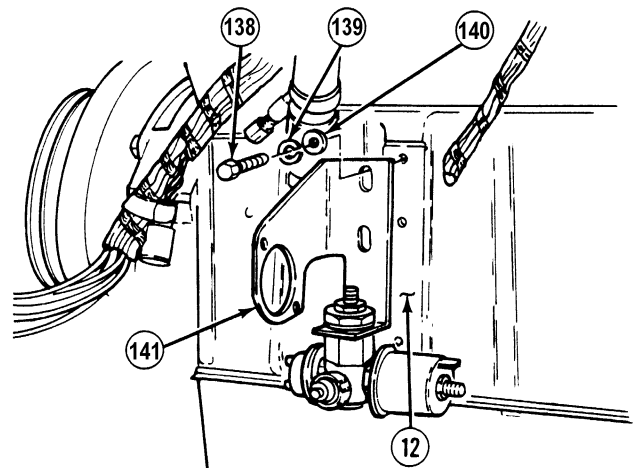
- (53) Disconnect hose 2682 (120) from adapter (121).
- (54) Remove wire 1435 (122) from oil pressure sending unit (123).
- (55) Remove nut (124), lockwasher (125), wire 1113 (126) and washer (127) from oil pressure sending unit (123). Discard lockwasher.
- (56) Position washer (127) and nut (124) on oil pressure sending unit (123).
- (57) Remove wire 1032 (128) from oil pressure switch (129).
- (58) Remove two screws (130) and wire 1517 (131) and wire 1871 (132) from oil pressure switch (133).
- (59) Position two screws (130) in oil pressure switch (133).



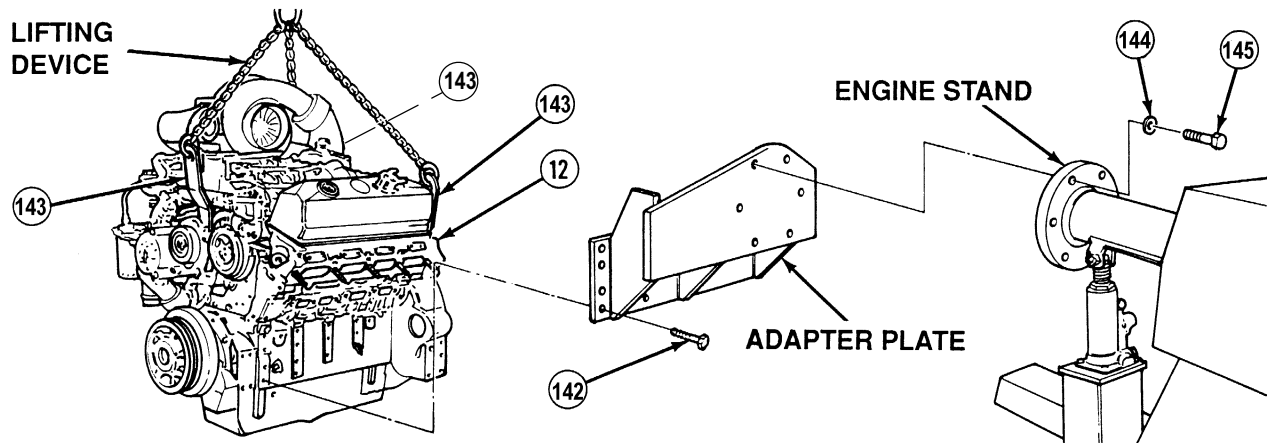
**NOTE**

Perform Step (60) and (61) if truck is equipped with 200 AMP alternator.

- (60) Remove two screws (134) and wire 1020A (135) and 1020B (136) from oil pressure switch (137).
- (61) Position two screws (134) in oil pressure switch (137).
- (62) Remove two screws (138), lockwashers (139), washers (140) and switch bracket assembly (141) from engine block (12).



**20-2. INSTALLING ENGINE ON STAND (CONT).**



(63) With the aid of an assistant, install adapter plate with 13 screws (142) on engine (12). Tighten screws 35 lb-ft (47 N·m).

**WARNING**

- Engine weighs 2,600 lbs (1,180 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.
- Keep out from under engine when lifting. If engine slips, sways, or falls, serious injury or death may result.

**CAUTION**

- Ensure lifting device is not resting on turbocharger air inlet when lifting engine to prevent damage to inlet or turbocharger.
- Ensure loose wires and hoses are secure and moved out of way so they do not snag and cause damage when engine is lifted.
- Install lifting hooks as shown. Before lifting engine completely off supports, test by lifting slightly to see if balanced. If engine starts to tilt, lower and adjust chain lengths. Unbalanced engine can swing causing damage.

(64) Install lifting device on engine (12) at lift points (143).

(65) With the aid of an assistant, install adapter plate to engine stand with six lockwashers (144) and screws (145). Tighten screws 147 lb-ft (199 N·m).

(66) Remove lifting device from engine (12).

**b. Follow-On Maintenance:**

- Remove exhaust manifolds, (Para 20-3).

**END OF TASK**

## 20-3. EXHAUST MANIFOLD REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)

#### *Equipment Condition*

Engine installed on stand, (Para 20-2)

#### a. **Removal.**

#### **NOTE**

Right and left exhaust manifolds are removed the same way. Right side shown.

- (1) Remove two clamps (1) and exhaust tube (2) from turbocharger adapter tee (3) and exhaust manifold (4).
- (2) Loosen five locknuts (5) and remove exhaust manifold (4) from cylinder head (6).

#### **NOTE**

Center locknut on left side has a bracket.

- (3) Remove five locknuts (5), three washers (7) and two crabs (8) from cylinder head (6). Discard locknuts.
- (4) Remove two gaskets (9) from cylinder head (6). Discard gaskets.

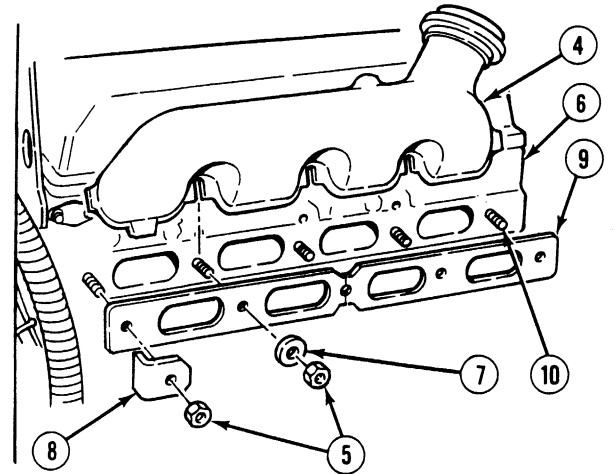
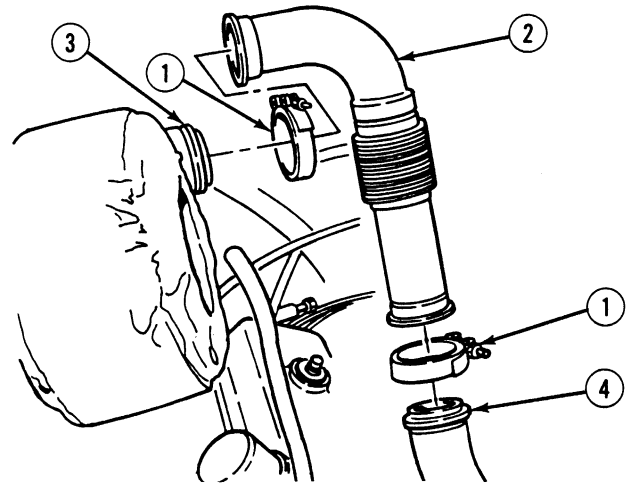
#### **NOTE**

Perform Step (5) only if studs are damaged.

- (5) Remove studs (10) from cylinder head (6). Discard studs.

#### b. **Follow-On Maintenance:**

- Remove Electronic Control Module (ECM), (Para 20-4).



**END OF TASK**

## 20-4. ELECTRONIC CONTROL MODULE (ECM) REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

- Tool Kit, General Mechanic's  
(Item 240, Appendix F)
- Connector Remover (Item 42, Appendix F)
- Pan, Drain 4 gal (Item 144, Appendix F)
- Wrench, Combination 1-1/8 in.  
(Item 255, Appendix F)
- Wrench, Combination 1-1/4 in.  
(Item 256, Appendix F)
- Wrench, Combination 1-1/2 in.  
(Item 260, Appendix F)

#### *Tools and Special Tools - Continued*

- Wrench, Combination 1-3/4 in.  
(Item 263, Appendix F)

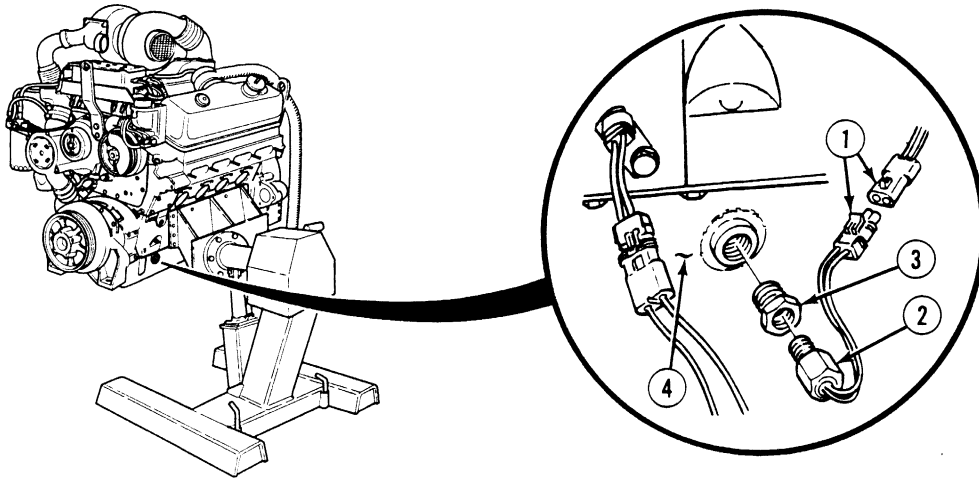
#### *Materials/Parts*

- Tags, Identification (Item 72, Appendix B)

#### *Equipment Condition*

- Exhaust manifolds removed, (Para 20-3)

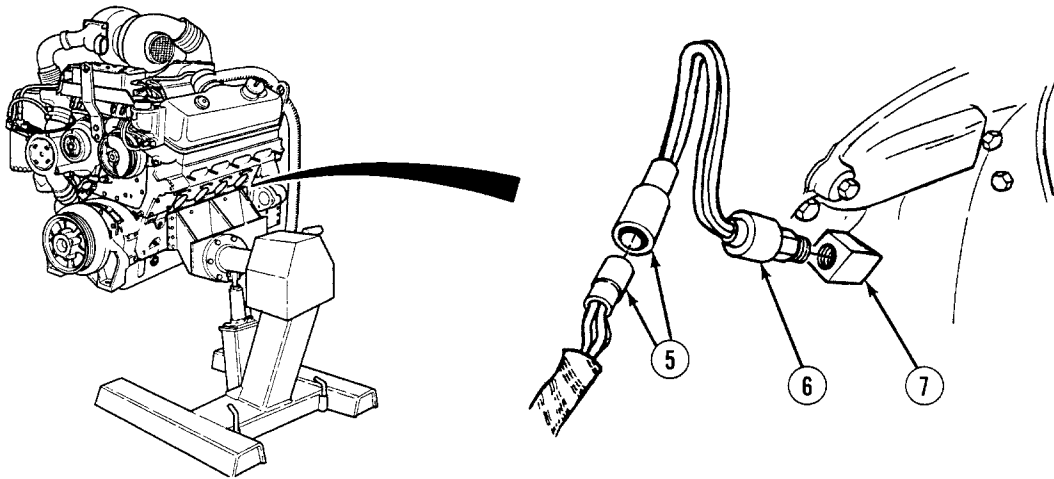
### a. Removal.



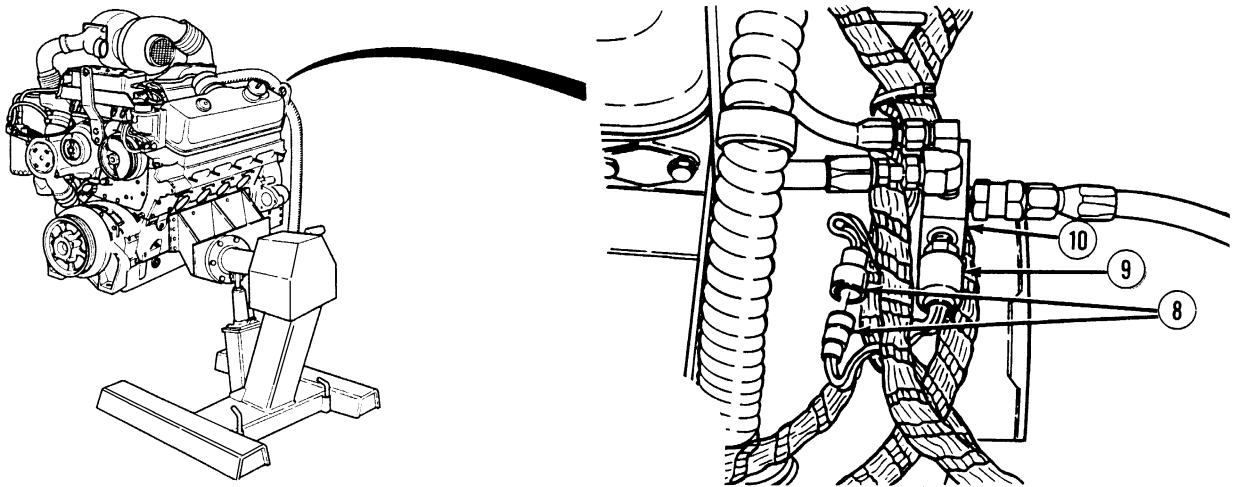
### NOTE

- PLS has two types of engines, DDEC II and DDEC III. Both are same, except where noted.
- DDEC II ECM has all multiple connectors on right side.
- DDEC III ECM has multiple connectors on both sides.
- Remove cable ties as required.
- Tag and mark wires and connectors prior to removal.

- (1) Disconnect MC70 connector (1).
- (2) Remove engine oil temperature sensor (2) from adapter (3).
- (3) Remove adapter (3) from oil pan (4).



- (4) Disconnect MC68 connector (5).
- (5) Remove air box pressure transducer (6) from tee (7).

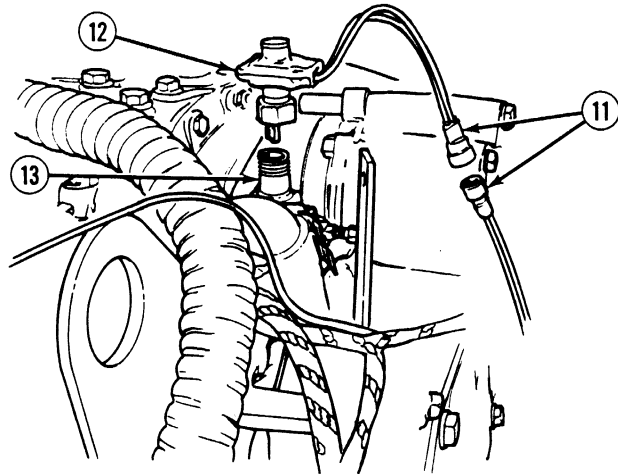
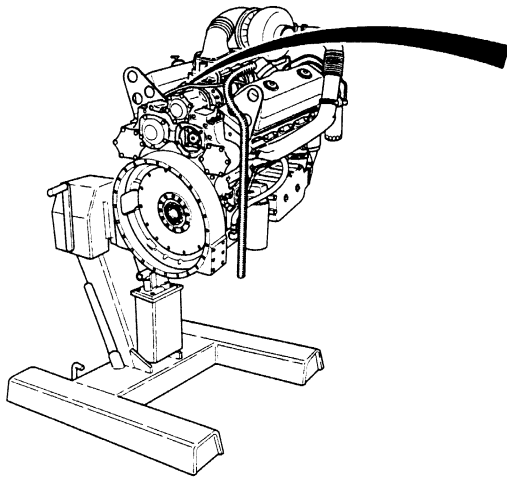


**WARNING**

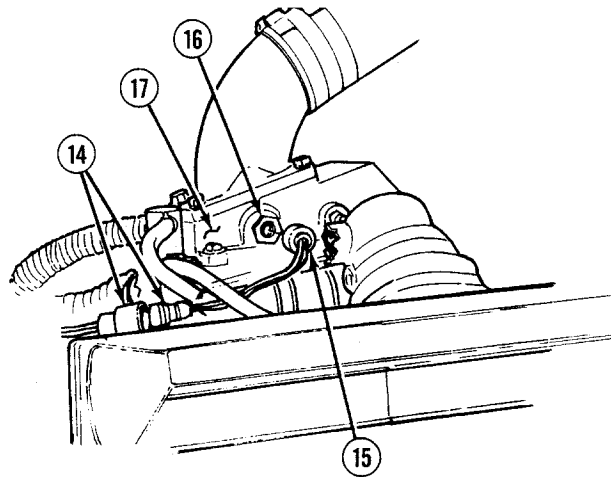
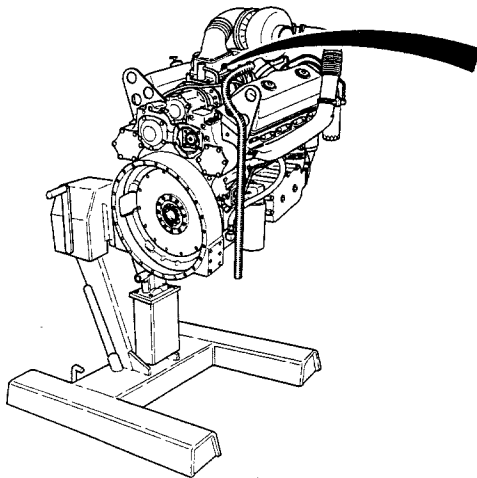
Diesel fuel is flammable. Do not perform this procedure near fire, flame or sparks. Injury or death to personnel could result.

- (6) Disconnect MC69 connector (8).
- (7) Position drain pan under fuel pressure transducer (9) and remove fuel pressure transducer (9) from manifold (10).

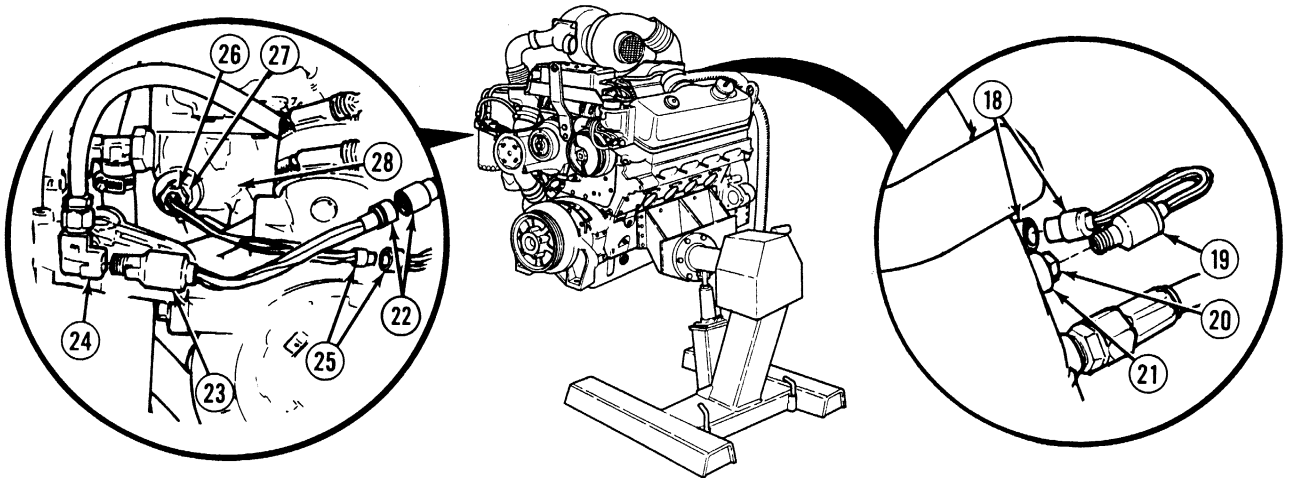
**20-4. ELECTRONIC CONTROL MODULE (ECM) REMOVAL (CONT).**



- (8) Disconnect MC41 connector (11).
- (9) Remove tachometer drive sending unit (12) from tachometer drive housing (13).



- (10) Disconnect MC66 connector (14).
- (11) Remove turbocharger outlet pressure transducer (15) from reducer (16).
- (12) Remove reducer (16) from turbocharger housing (17).



- (13) Disconnect MC67 connector (18).
- (14) Remove air cleaner pressure transducer (19) from reducer (20).
- (15) Remove reducer (20) from air inlet tube (21).
- (16) Disconnect MC43 connector (22).
- (17) Remove fuel pressure sensor (23) from tee (24).

**NOTE**

Connector is removed by gently prying up on tab and pulling connector out.

- (18) Disconnect MC71 connector (25).

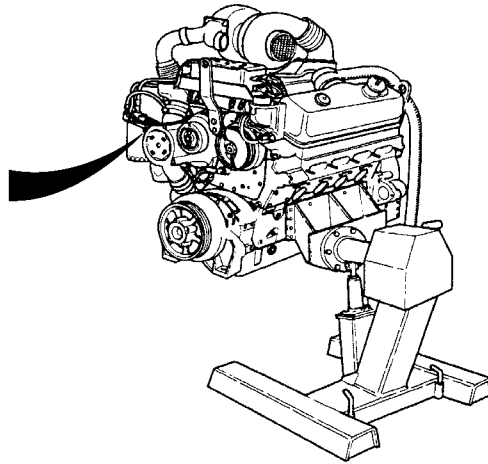
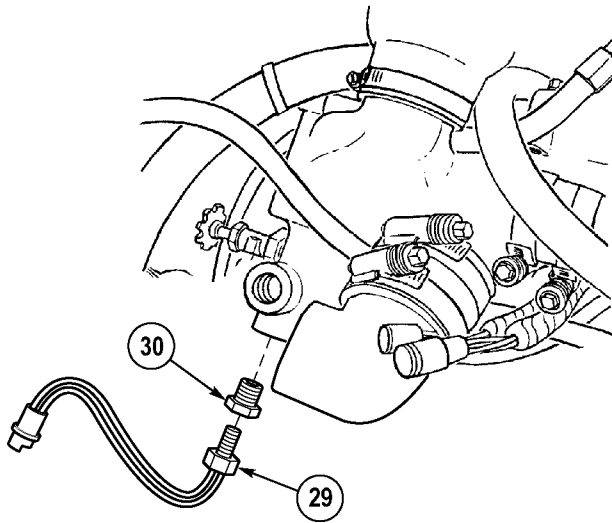
**NOTE**

Perform Steps (19) and (20) for DDEC II engines.

- (19) Remove water temperature sensor (26) from reducer (27).
- (20) Remove reducer (27) from right thermostat housing (28).



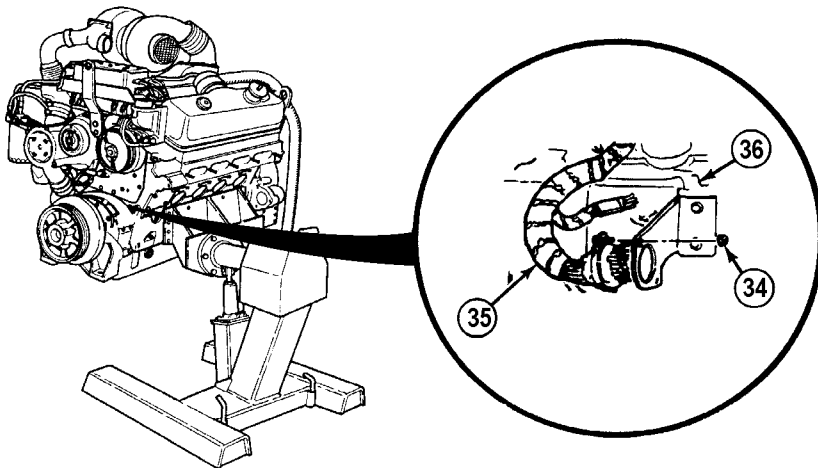
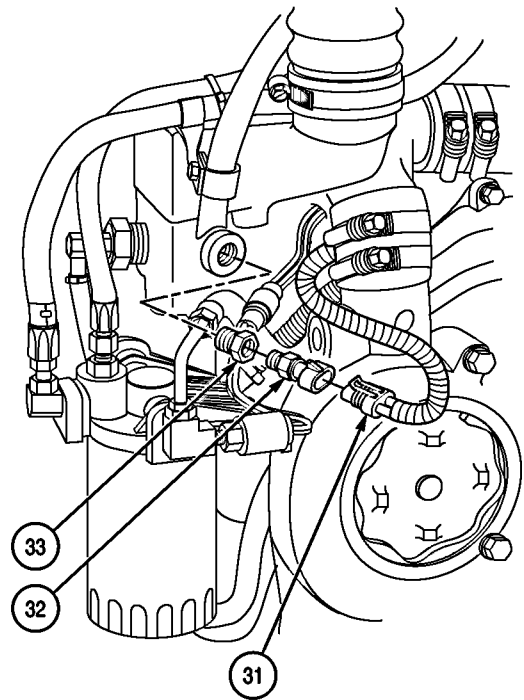
**20-4. ELECTRONIC CONTROL MODULE (ECM) REMOVAL (CONT).**



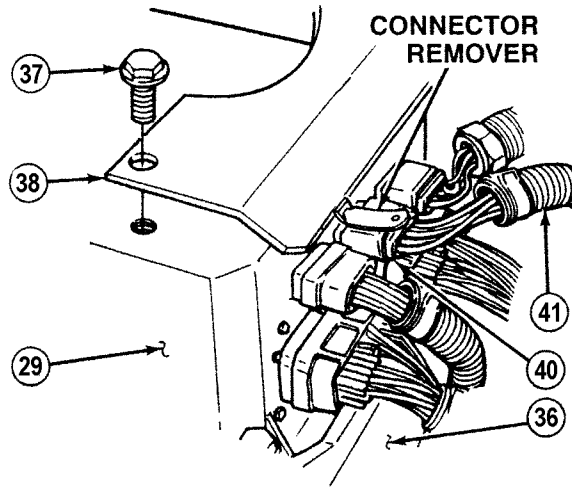
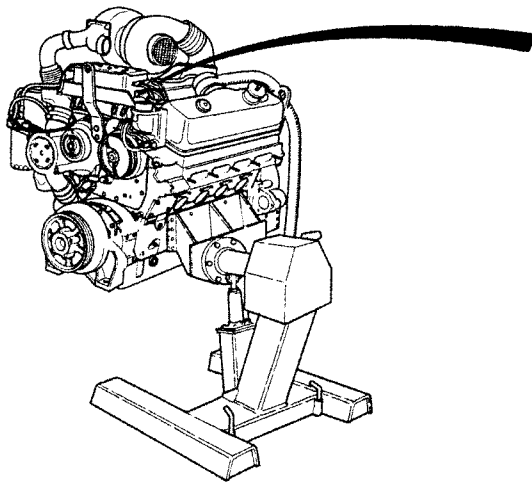
**NOTE**

Perform Steps (21) thru (23) for DDEC III engines.

- (21) Remove STE/ICE sensor (29) and bushing reducer (30).
- (22) Disconnect coolant temperature harness (31) from coolant temperature sensor (32).
- (23) Remove coolant temperature sensor (32) and fitting (33).



- (24) Remove two nuts (34) and STE/ICE-R wire harness (35) from engine (36).



**NOTE**

- Perform Steps (25) thru (27) for DDEC II engines.
- Perform Steps (28) and (29) for DDEC III engines.

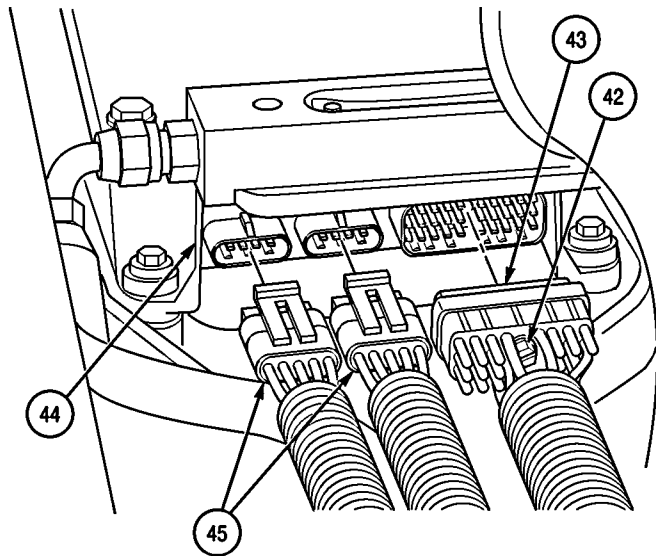
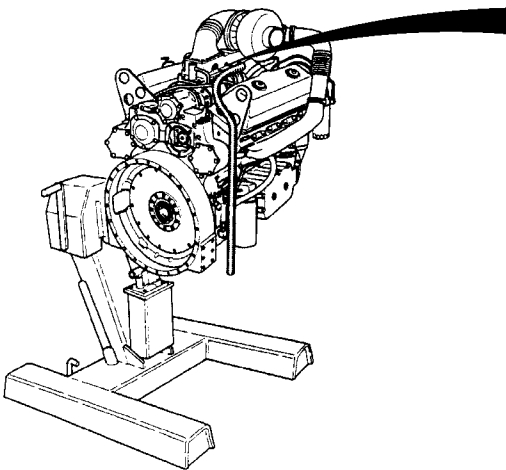
(25) Remove two lockscrews (37) and cover plate (38) from ECM (39). Discard lockscrews.

**CAUTION**

Use caution when removing connectors from ECM. The ECM has plastic retainers that may break if connectors are improperly removed.

(26) Using connector remover, disconnect MC17 connector (40) from ECM (39).

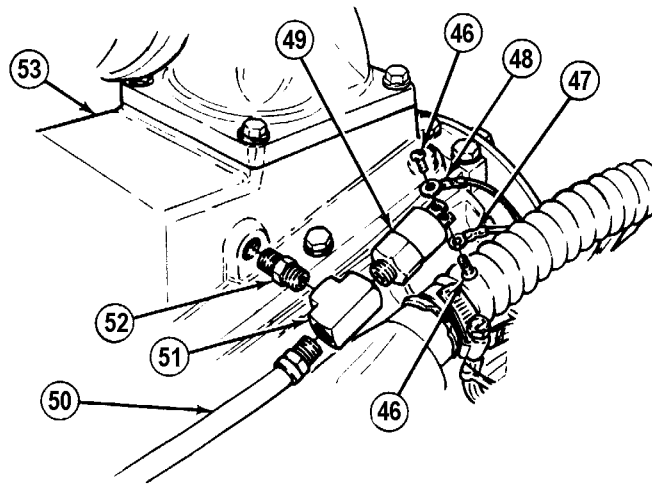
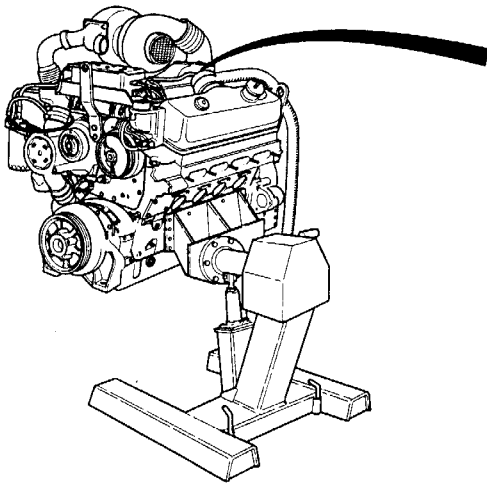
(27) Remove DDEC engine power wire harness (41) from engine (36).



(28) Loosen screw (42) and remove engine wiring harness connector (43) from right side of ECM (44).

(29) Disconnect two injector wiring harness connectors (45) from right side of ECM (44).

**20-4. ELECTRONIC CONTROL MODULE (ECM) REMOVAL (CONT).**

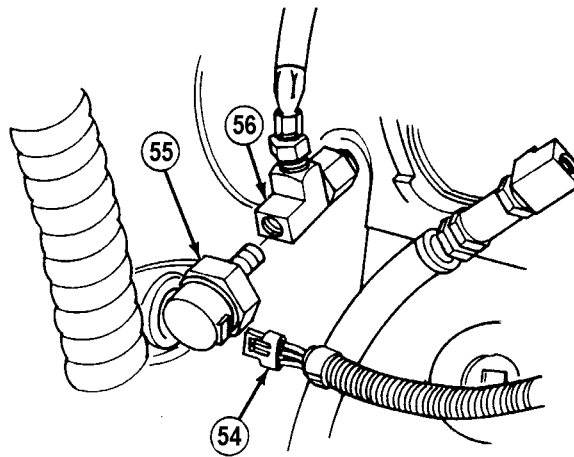
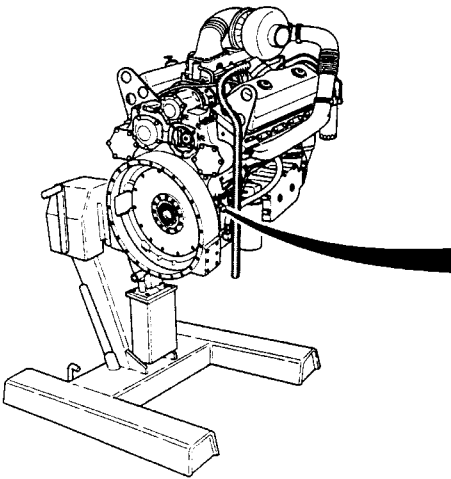


- (30) Remove two screws (46), wire 1955 (47) and wire 1957 (48) from turbo boost pressure switch (49).
- (31) Remove air line (50) and turbo boost pressure switch (49) from tee (51).

**NOTE**

Note position of tee prior to removal.

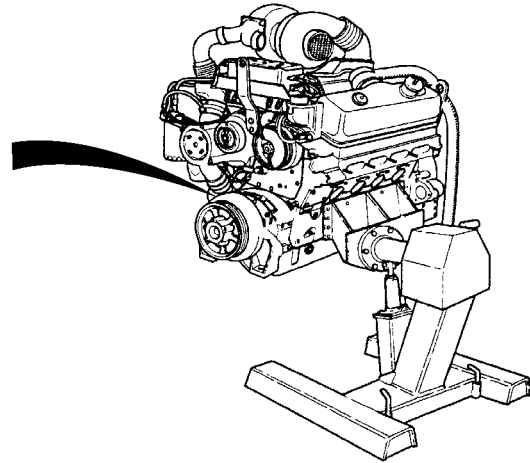
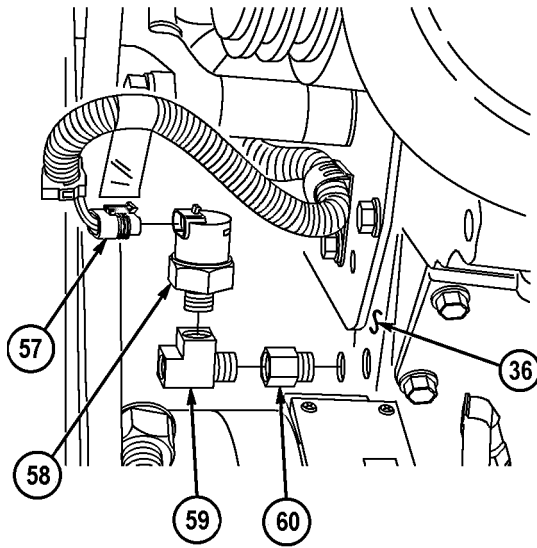
- (32) Remove tee (51) from adapter (52).
- (33) Remove adapter (52) from air inlet housing (53).



**NOTE**

- Connector is removed by gently prying up on tab and pulling connector out.
- Perform Steps (34) and (35) for DDEC II engines.

- (34) Disconnect connector (54) from DDEC engine pressure sensor (55).
- (35) Remove DDEC engine oil pressure sensor (55) from tee (56).

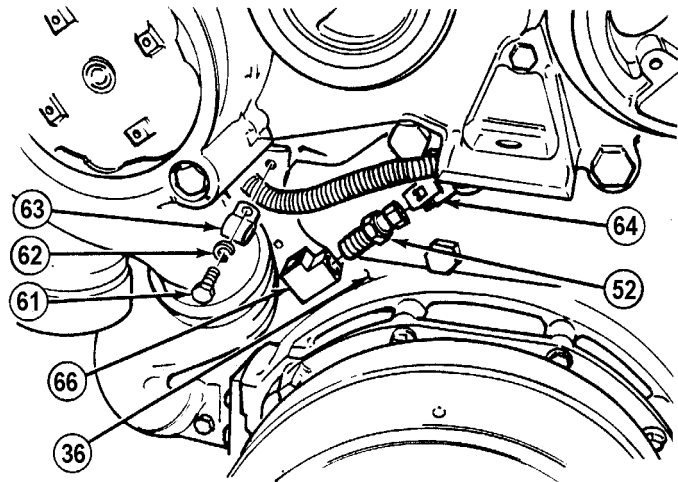
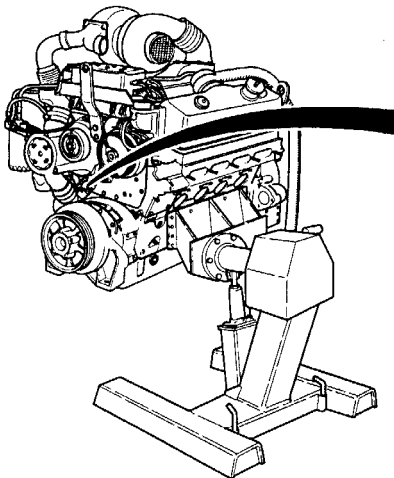


**NOTE**

- Connector is removed by gently prying up on tab and pulling connector out.
- Perform Steps (36) and (37) for DDEC III engines.

(36) Disconnect connector (57).

(37) Remove DDEC engine oil pressure sensor (58), tee (59) and reducer (60) from engine (36).

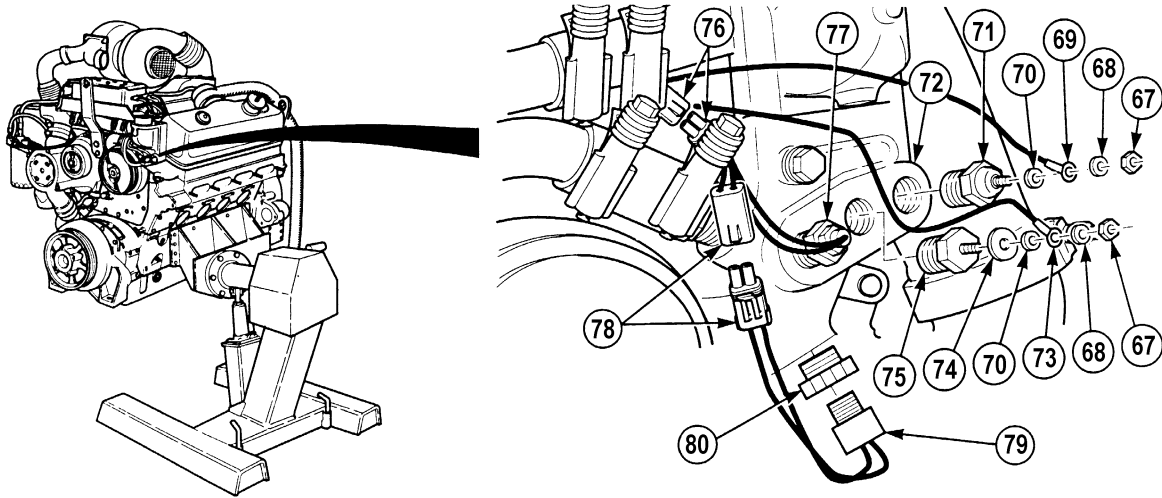


(38) Remove screw (61), lockwasher (62) and clip (63) from engine (36). Discard lockwasher.

(39) Disconnect connector (64) from DDEC oil temperature sensor (65).

(40) Remove DDEC oil temperature sensor (65) from tee (66).

**20-4. ELECTRONIC CONTROL MODULE (ECM) REMOVAL (CONT).**

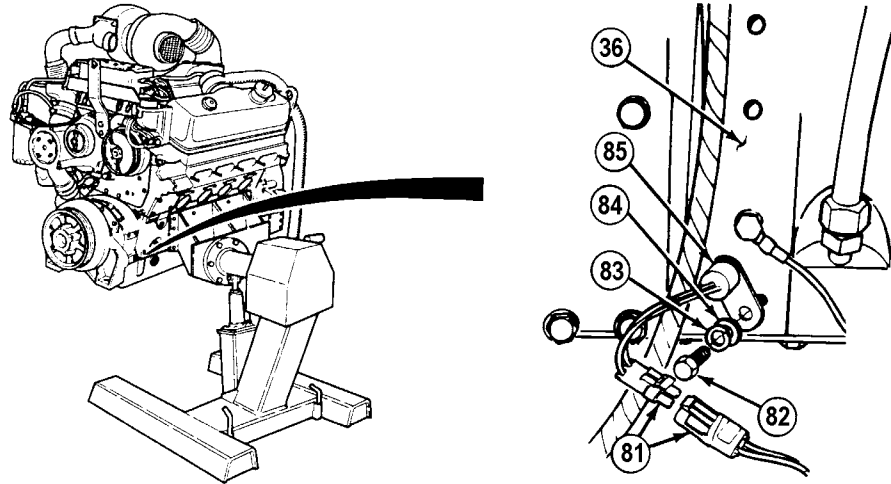


- (41) Remove nut (67), lockwasher (68), wire 1147 (69) and washer (70) from water temperature sending unit (71). Reinstall washer (70) and nut (67) on water temperature sending unit (71). Discard lockwasher.
- (42) Remove water temperature sending unit (71) from left thermostat housing (72).
- (43) Remove nut (67), lockwasher (68), wire 1320 (73), washer (70) and washer (74) from water temperature gage sensor (75). Reinstall washer (74), washer (70) and nut (67) on water temperature gage sensor (75). Discard lockwasher.

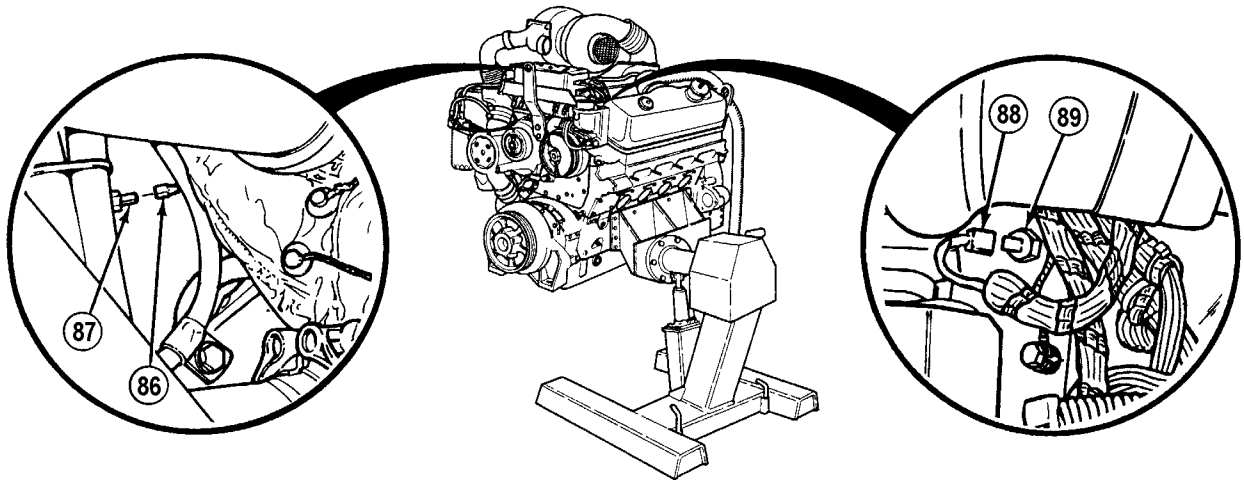
**NOTE**

Connector is removed by gently prying up on tab and pulling connector out.

- (44) Disconnect MC61 connector (76).
- (45) Remove water temperature gage sensor (75) and fan control sensor (77) from left thermostat housing (72).
- (46) Disconnect MC128 connector (78).
- (47) Remove temperature switch (79) from reducer bushing (80).
- (48) Remove reducer bushing (80) from left thermostat housing (72).



- (49) Disconnect MC56 connector (81).
- (50) Remove screw (82), lockwasher (83), washer (84) and ether start aid thermostat (85) from engine block (36). Discard lockwasher.



- (51) Disconnect wire 1715 (86) from terminal on right cylinder head (87).
- (52) Disconnect wire 1716 (88) from terminal on left cylinder head (89).

**20-4. ELECTRONIC CONTROL MODULE (ECM) REMOVAL (CONT).**

**CAUTION**

Remove connectors from ECM. The ECM has plastic retainers that may break if connectors are improperly removed.

**NOTE**

Perform Steps (53) thru (60) for DDEC II engines.

- (53) Using connector remover, disconnect two injector harness connectors (90), engine harness connector (91) and vehicle harness connector MC18 (92) from ECM (39).

**CAUTION**

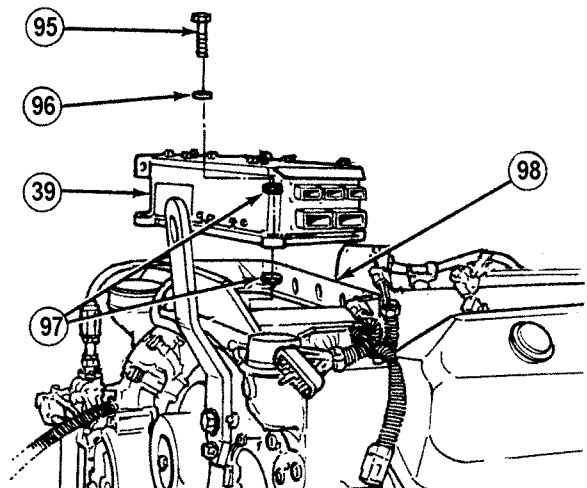
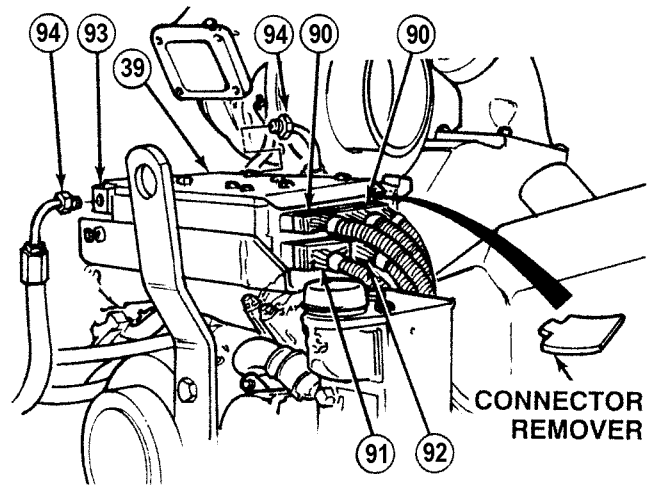
When removing fuel hoses, hold DDEC fitting (93) and disconnect two fuel hose assemblies (94).

- (54) Hold DDEC fitting (93) and disconnect two fuel hose assemblies (94).

**NOTE**

- Washer may or may not be present in Step (55).
- If mounts are damaged, mounts and screws must be replaced.

- (55) Remove four screws (95), washers (96), eight mount cushions (97) and ECM (39) from ECM bracket (98).



- (56) Loosen clamp (99) and disconnect hose (100) from turbo boost pressure sensor (101).

**NOTE**

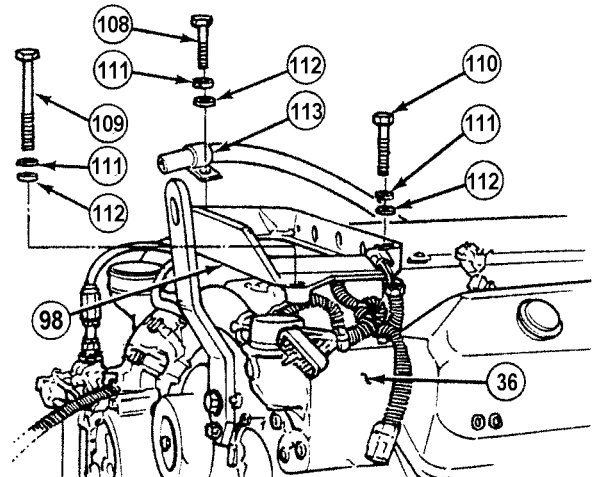
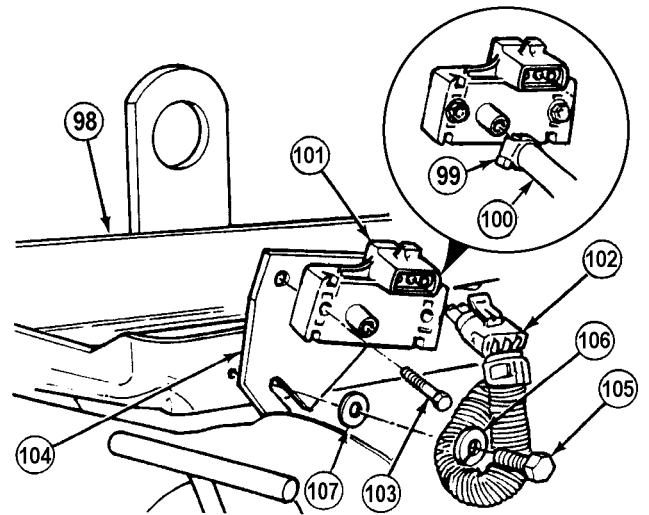
Connector is removed by gently prying up on tab and pulling connector out.

- (57) Disconnect connector (102) from turbo boost pressure sensor (101).
- (58) Remove two screws (103) and turbo boost pressure sensor (101) from turbo boost sensor bracket (104).
- (59) Remove screw (105), lockwasher (106), washer (107) and turbo boost sensor bracket (104) from ECM bracket (98). Discard lockwasher.

**NOTE**

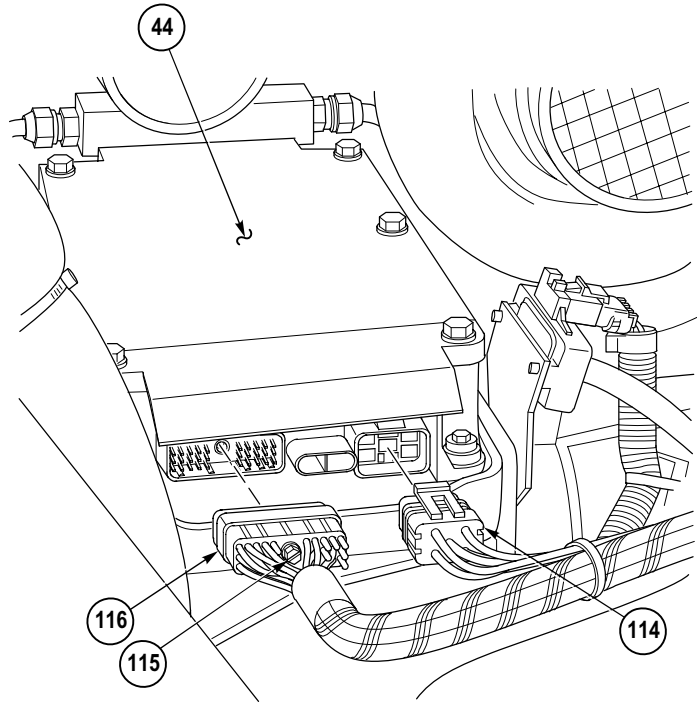
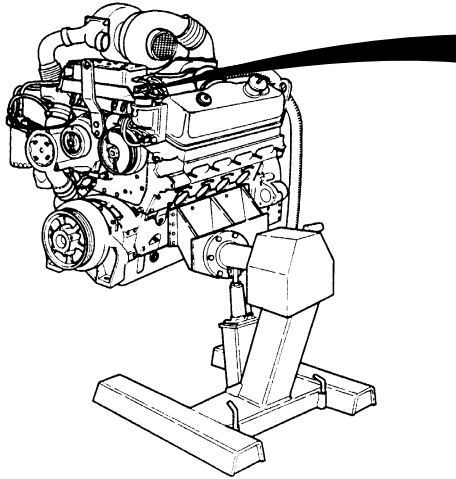
Tag and mark screws prior to removal.

- (60) Remove screws (108), (109) and (110), three lockwashers (111), washers (112), clip (113) and ECM bracket (98) from engine block (36). Discard lockwashers.





**20-4. ELECTRONIC CONTROL MODULE (ECM) REMOVAL (CONT).**



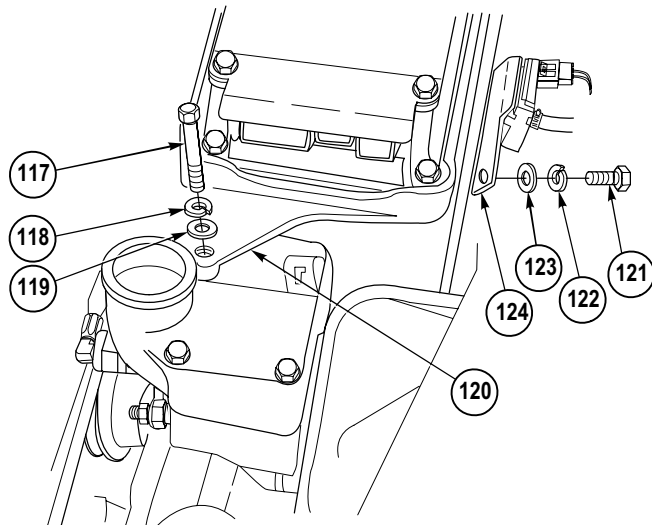
**CAUTION**

Remove connectors from ECM. The ECM has plastic retainers that may break if connectors are improperly removed.

**NOTE**

Perform Steps (61) through (69) for DDEC III engines.

- (61) Remove 5-way power wiring harness connector MC17 (114) from left side of ECM (44).
- (62) Loosen screw (115) and remove vehicle wiring harness connector MC18 (116) from left side of ECM (44).
- (63) Remove screw (117), lockwasher (118) and washer (119) from ECM bracket (120). Discard lockwasher.
- (64) Remove screw (121), lockwasher (122), washer (123) and turbo boost sensor bracket (124) from ECM bracket (120). Discard lockwasher.

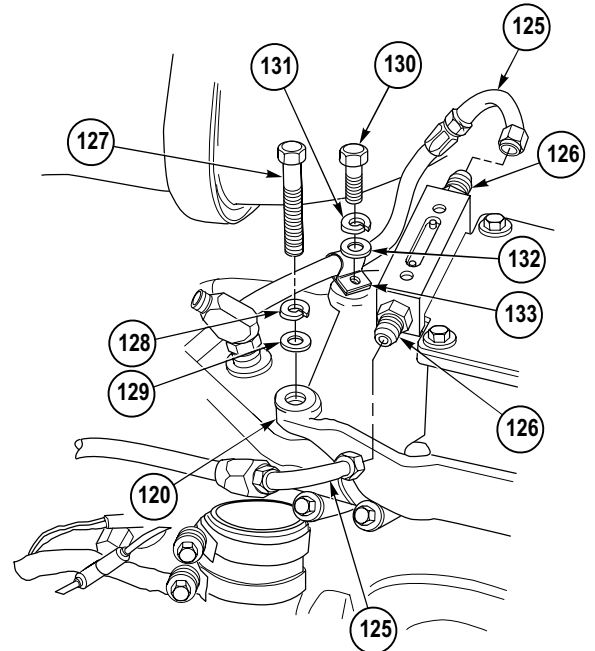


**WARNING**

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.

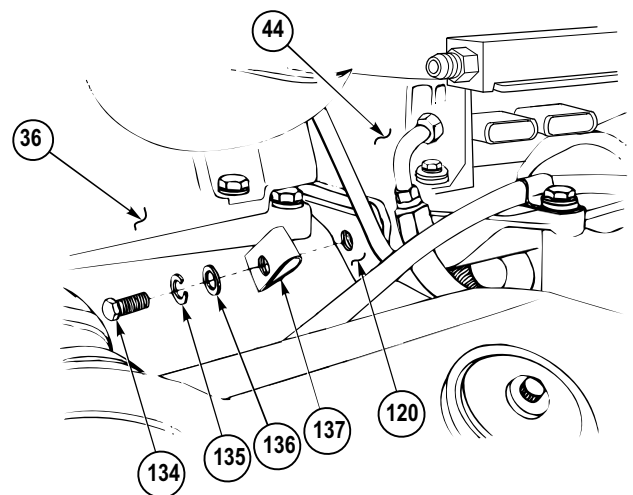
**CAUTION**

Cover exhaust manifold to prevent foreign material from entering turbocharger and causing damage.

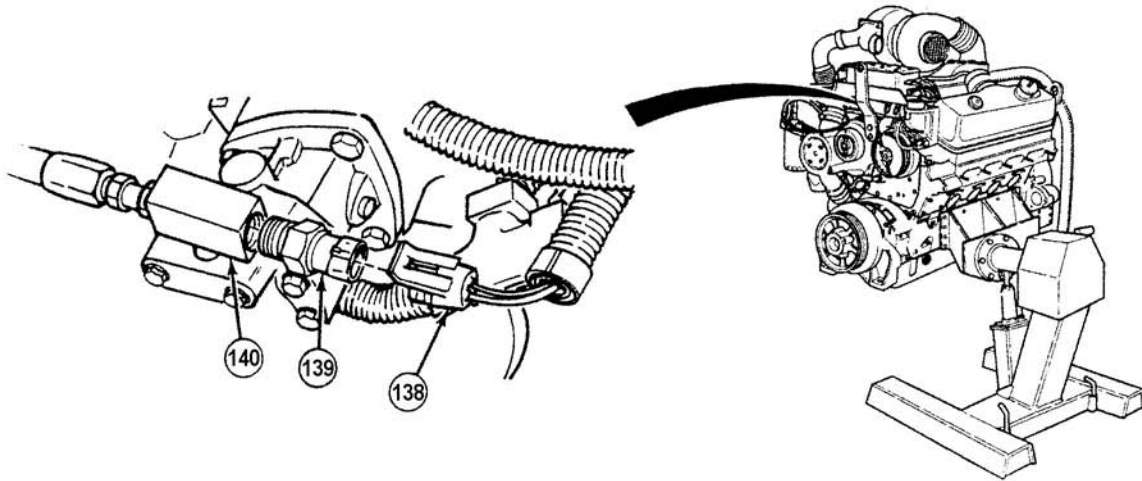


- (65) Remove two fuel lines (125) from fittings (126).
- (66) Remove screw (127), lockwasher (128) and washer (129) from ECM bracket (120). Discard lockwasher.
- (67) Remove screw (130), lockwasher (131), washer (132) and clip (133) from ECM bracket (120). Discard lockwasher.

- (68) Remove screw (134), lockwasher (135), washer (136) and clip (137) from ECM bracket (120). Discard lockwasher.
- (69) Remove ECM bracket (120) and ECM (44) from engine (36) and place on clean work surface.



**20-4. ELECTRONIC CONTROL MODULE (ECM) REMOVAL (CONT).**



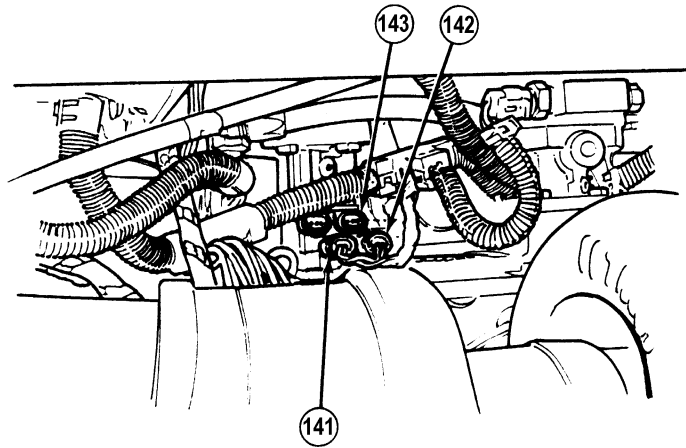
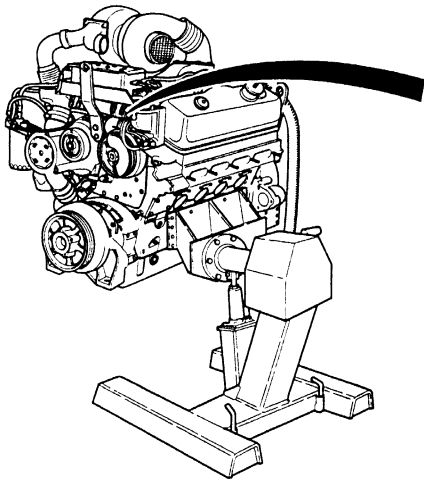
**WARNING**

Diesel fuel is flammable. Do not perform this procedure near fire, flame or sparks. Injury or death to personnel could result.

**NOTE**

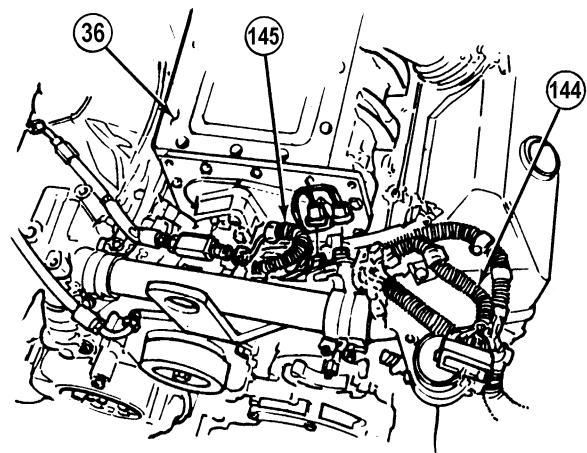
Connector is removed by gently prying up on tab and pulling connector out.

- (70) Disconnect connector (138) from fuel temperature sensor (139).
- (71) Remove fuel temperature sensor (139) from tee (140).



(72) Disconnect connectors (141) and (142) from timing and synchronous reference sensors (SRS/TRS) (143).

(73) Remove DDEC engine harness (144) and engine wiring harness (145) from engine (36).



**b. Follow-On Maintenance:**

- Remove turbocharger, (Para 20-5).

**END OF TASK**

## 20-5. TURBOCHARGER AND AIR INLET HOUSING REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

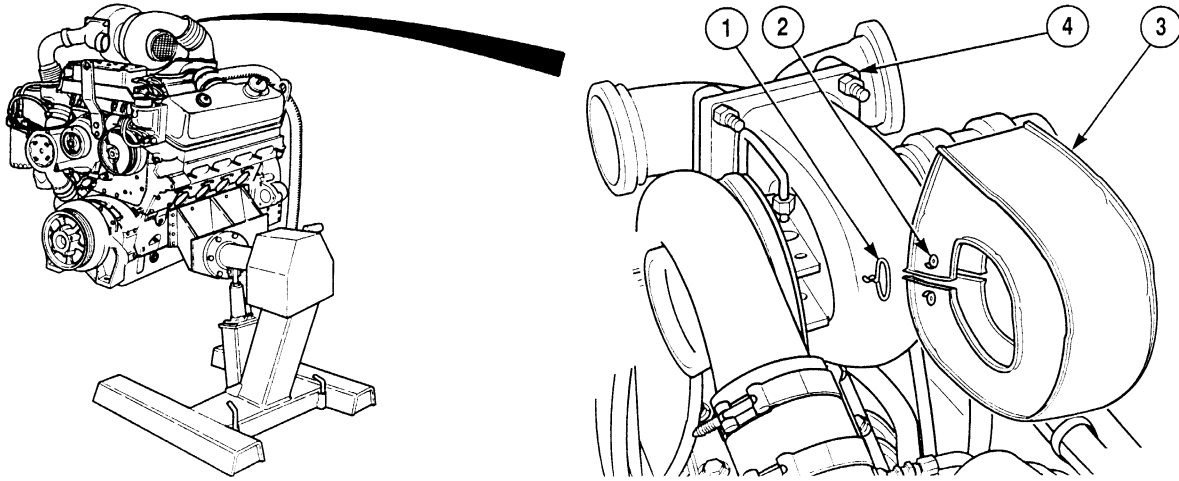
#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Gloves, Heavy Duty (Item 82, Appendix F)

#### *Equipment Condition*

ECM removed, (Para 20-4)

#### a. Removal.

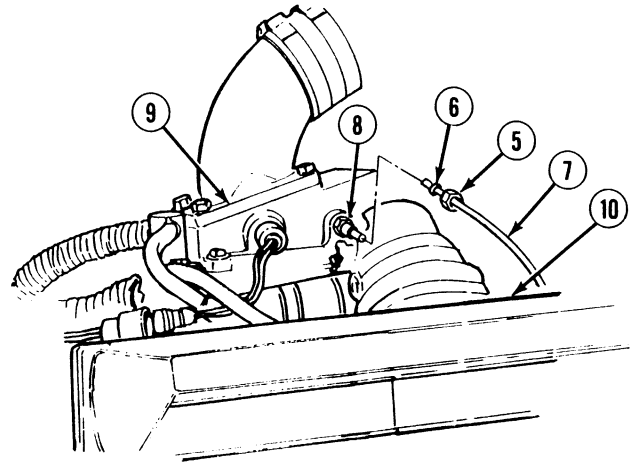


### **WARNING**

Gloves must be used when handling turbocharger insulation blanket. Turbocharger insulation blanket is made of fiberglass and may cause skin irritation. Failure to comply may result in injury to personnel.

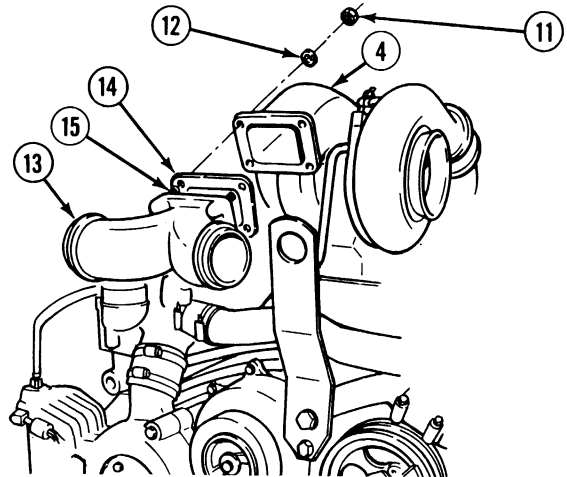
- (1) Cut two wires (1) on tabs (2) and insulation blanket (3) from turbocharger assembly (4). Discard wires.

- (2) Remove nut (5), ferrule (6) and ether tube (7) from atomizer (8).
- (3) Remove atomizer (8) from air inlet housing (9).
- (4) Remove ether tube (7) from engine (10). Discard nut, ferrule and tube, if cut.



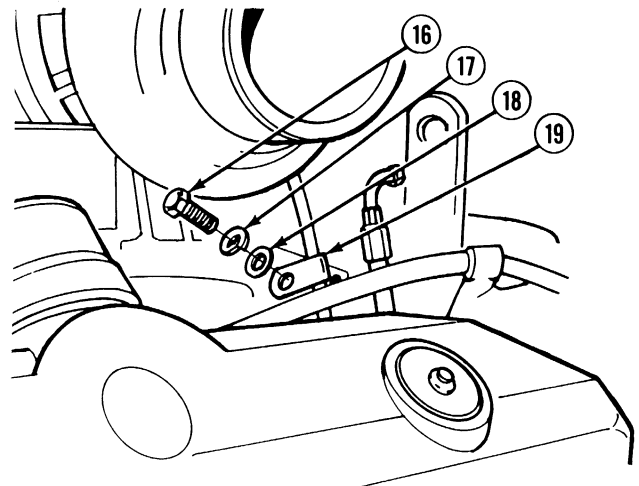
**NOTE**

- Studs may come out with locknuts.
  - If stud stays with bottom right locknut, clamp on turbocharger may have to be moved to remove stud.
- (5) Remove four locknuts (11), washers (12), adapter tee (13) and gasket (14) from turbocharger assembly (4). Discard gasket and locknuts.



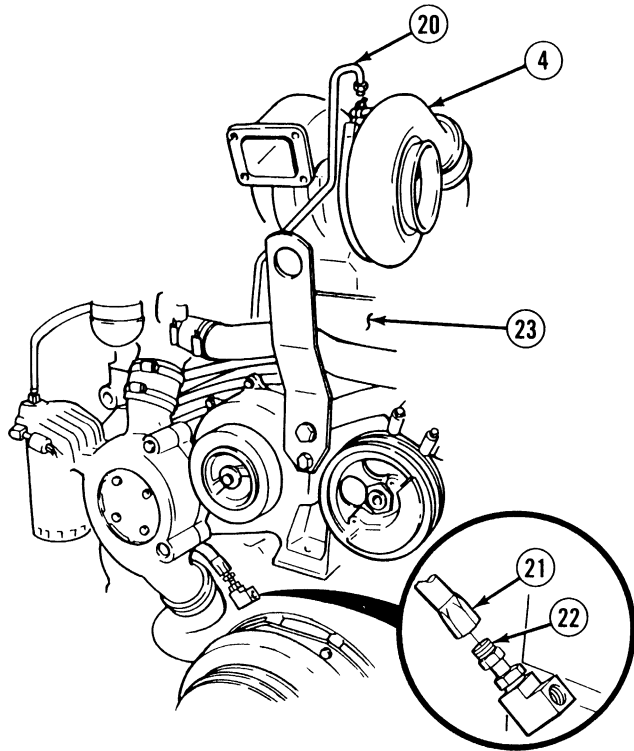
**NOTE**

- Perform Step (6) to remove studs only if studs are damaged.
- (6) Remove studs (15) from adapter (13) or turbocharger assembly (4).
  - (7) Remove screw (16) lockwasher (17), washer (18) and clip (19). Discard lockwasher.

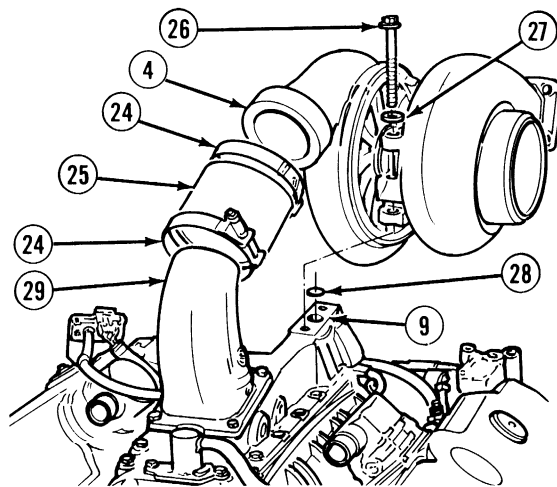


**20-5. TURBOCHARGER AND AIR INLET HOUSING REMOVAL (CONT.)**

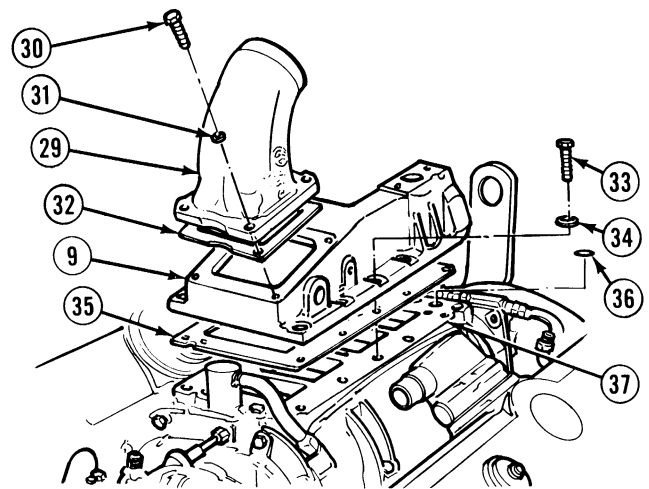
- (8) Remove tube assembly (20) from turbocharger assembly (4).
- (9) Disconnect hose assembly (21) from pipe coupling (22).
- (10) Remove turbocharger tube assembly (20) from engine (23).



- (11) Remove two clamps (24) on turbocharger compressor hose (25).
- (12) Remove two screws (26) and lockwashers (27) from turbocharger assembly (4). Discard lockwashers.
- (13) Remove turbocharger assembly (4) and gasket (28) from air inlet housing (9). Discard gasket.
- (14) Remove turbocharger compressor hose (25) from air inlet housing adapter (29).



- (15) Remove four screws (30), lockwashers (31), air inlet housing adapter (29) and gasket (32). Discard lockwashers and gasket.
- (16) Remove ten screws (33) and lockwashers (34) from air inlet housing (9). Discard lockwashers.
- (17) Remove air inlet housing (9), gasket (35) and two preformed packings (36) from blower assembly housing (37). Discard gasket and preformed packings.



**b. Follow-On Maintenance:**

- Repair turbocharger, (Para 21-3).
- Remove engine lifting brackets, (Para 20-6).

**END OF TASK**



## 20-6. ENGINE LIFTING BRACKETS REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)

#### *Equipment Condition*

Turbocharger and air inlet housing removed,  
(Para 20-5)

#### a. **Removal.**

- (1) Remove screws (1) and (2), lockwashers (3) and (4) and front lifting bracket (5) from front balance cover (6). Discard lockwashers.

#### **NOTE**

Left and right rear lifting brackets are removed the same way. Right side shown.

- (2) Remove two screws (7), lockwashers (8) and washers (9). Discard lockwashers.

#### **NOTE**

Washer in Step (3) is located on right side only.

- (3) Remove screw (10) and lockwasher (11) from rear lifting bracket (12). Discard lockwasher.

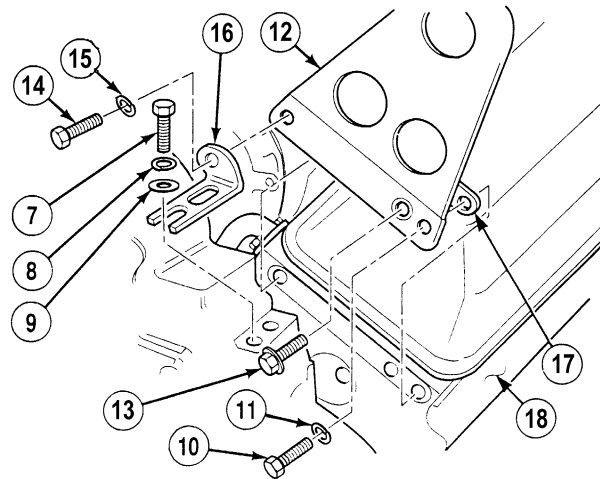
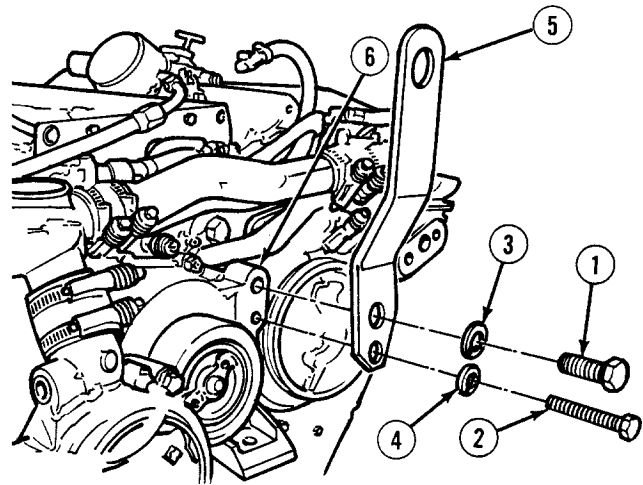
#### **NOTE**

Perform Step (4) for left side only.

- (4) Remove screw (13) from rear lifting bracket (12).
- (5) Remove screw (14), lockwasher (15), bracket (16), rear lifting bracket (12) and gasket (17) from cylinder head (18). Discard gasket and lockwasher.
- (6) Repeat Steps (2) through (5) for left rear lifting bracket.

#### b. **Follow-On Maintenance:**

- Remove left thermostat housing, (Para 20-7).

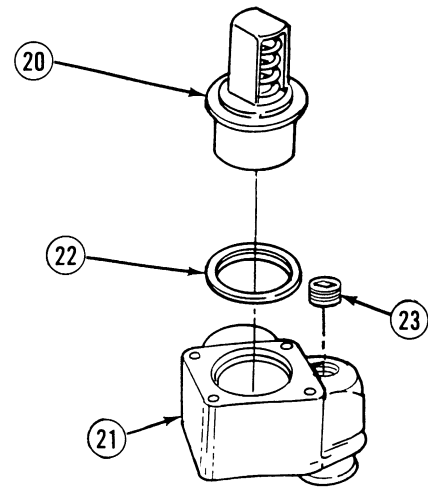


END OF TASK



**20-7. LEFT SIDE THERMOSTAT HOUSING REMOVAL (CONT).**

- (9) Remove thermostat (20) from bottom of left thermostat cover (21).
- (10) Remove seal ring (22) from bottom of left thermostat cover (21). Discard seal ring.
- (11) Remove plug (23) from bottom of left thermostat cover (21).



**b. Follow-On Maintenance:**

- Remove right side thermostat housing, (Para 20-28).

**END OF TASK**

## 20-8. RIGHT SIDE THERMOSTAT HOUSING REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

*Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)

*Equipment Condition*

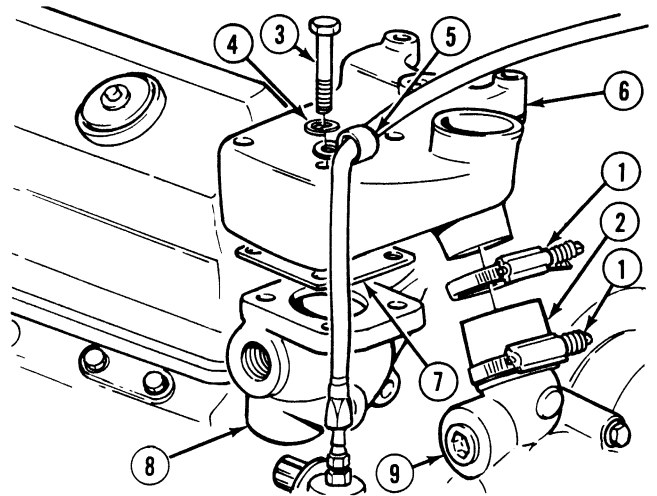
Left side thermostat housing removed,  
(Para 20-7)

#### a. Removal.

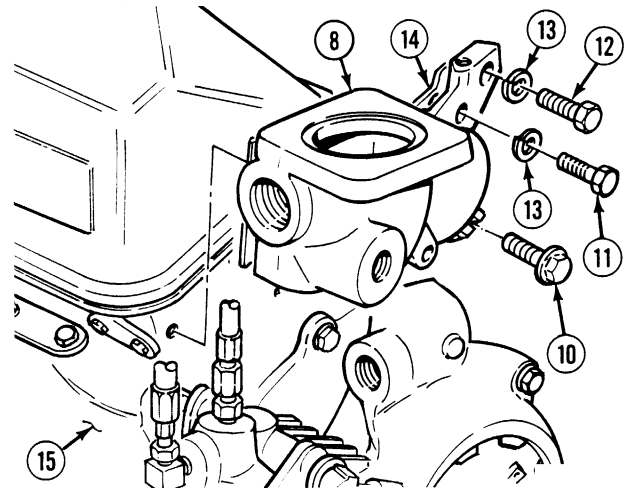
#### NOTE

Remove cable ties as necessary.

- (1) Loosen two clamps (1) on hose (2).
- (2) Remove four screws (3), lockwashers (4), clip (5), right thermostat cover (6) and gasket (7) from right thermostat housing (8). Discard lockwashers and gasket.
- (3) Remove hose (2) and two clamps (1) from right thermostat cover (6) and water pump (9).

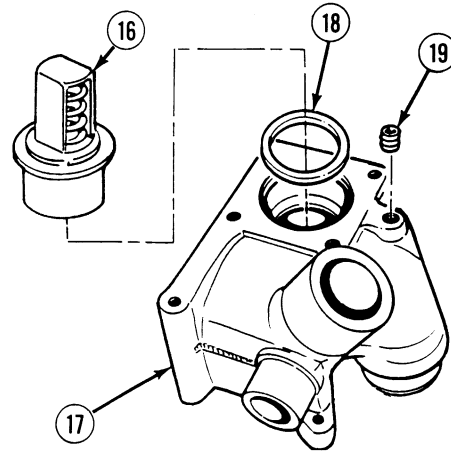


- (4) Loosen screw (10) on right thermostat housing (8).
- (5) Remove screws (11) and (12), two lockwashers (13), right thermostat housing (8) and gasket (14) from cylinder head (15). Discard lockwashers and gasket.
- (6) Remove screw (10) from cylinder head (15).



**20-8. RIGHT SIDE THERMOSTAT HOUSING REMOVAL (CONT).**

- (7) Remove thermostat (16) from bottom of right thermostat cover (17).
- (8) Remove seal ring (18) from bottom of right thermostat cover (17). Discard seal ring.
- (9) Remove plug (19) from bottom of right thermostat cover (17).



**b. Follow-On Maintenance:**

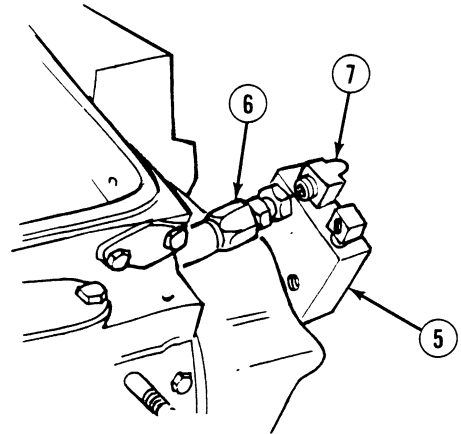
- Remove secondary fuel filter, (Para 20-9).

**END OF TASK**



**20-9. SECONDARY FUEL FILTER, HEAD AND FUEL HOSES REMOVAL (CONT).**

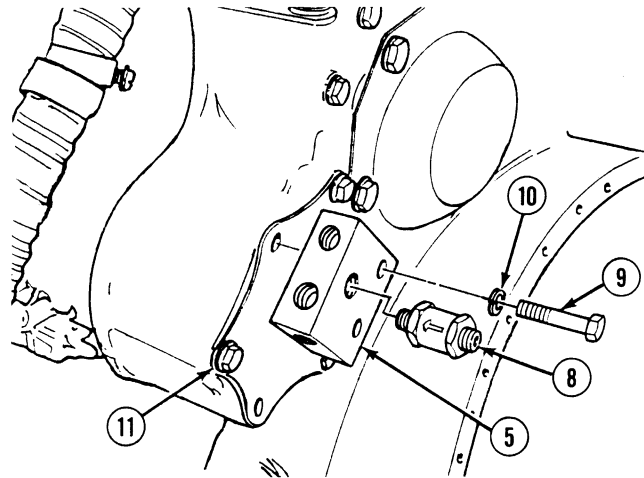
- (5) Remove hose (6) from elbow (7).
- (6) Remove elbow (7) from fuel block (5).

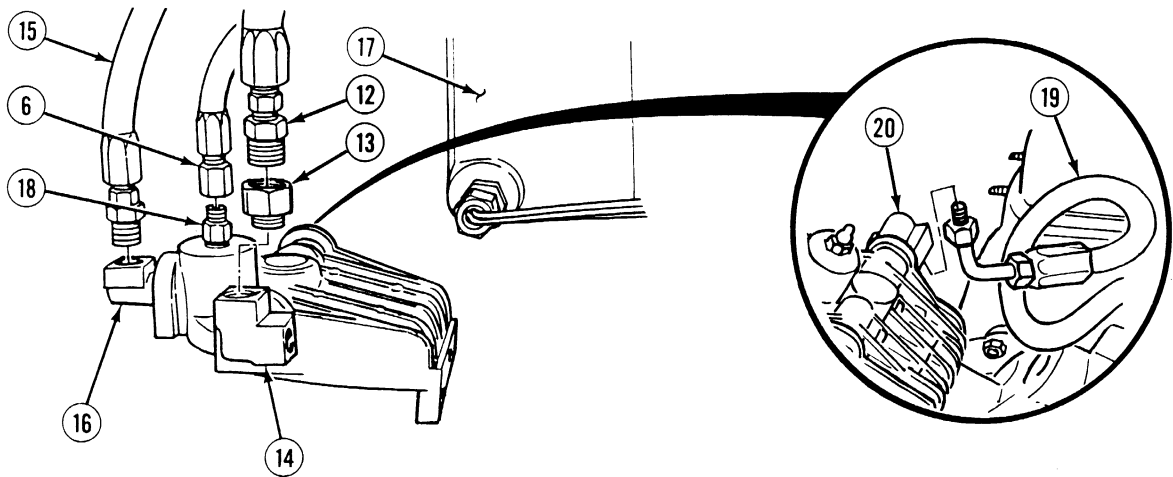


**NOTE**

Note position and direction of arrow on check valve prior to removal.

- (7) Remove check valve (8) from fuel block (5).
- (8) Remove screw (9), lockwasher (10) and fuel block (5) from rear end plate (11). Discard lockwasher.

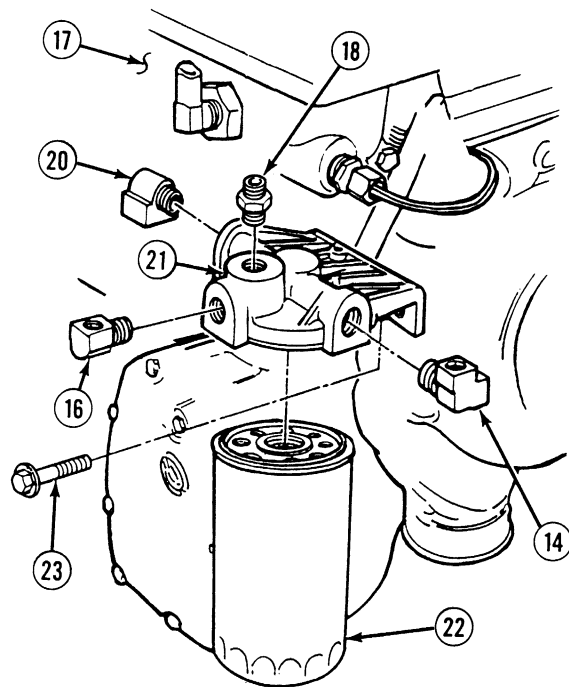




**WARNING**

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.

- (9) Remove hose (12) from reducer (13).
- (10) Remove reducer (13) from tee (14).
- (11) Remove hose (15) from elbow (16) and engine (17).
- (12) Remove hose (6) from fitting (18).
- (13) Remove hose (19) from elbow (20).
- (14) Remove fitting (18), tee (14) and elbows (16) and (20) from filter head (21).
- (15) Position drain pan under filter (22).
- (16) Remove filter (22) from filter head (21). Discard filter.
- (17) Remove two screws (23) and filter head (21) from engine (17).



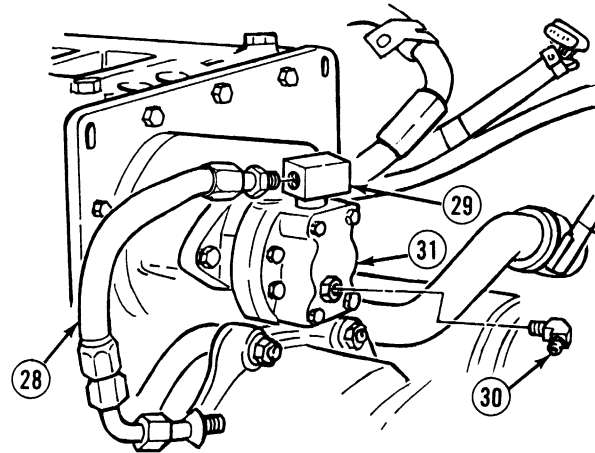
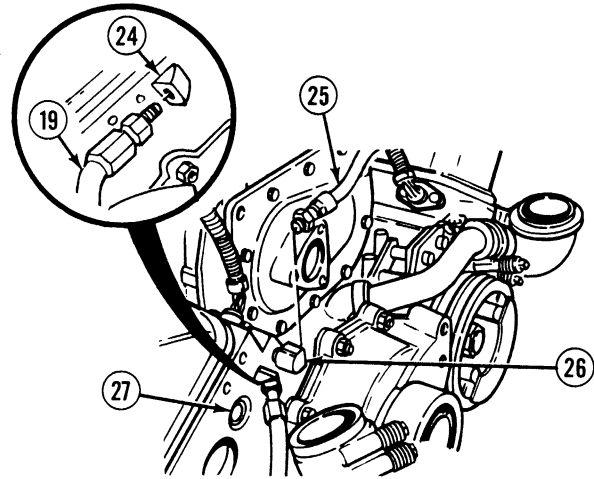


**20-9. SECONDARY FUEL FILTER, HEAD AND FUEL HOSES REMOVAL (CONT).**

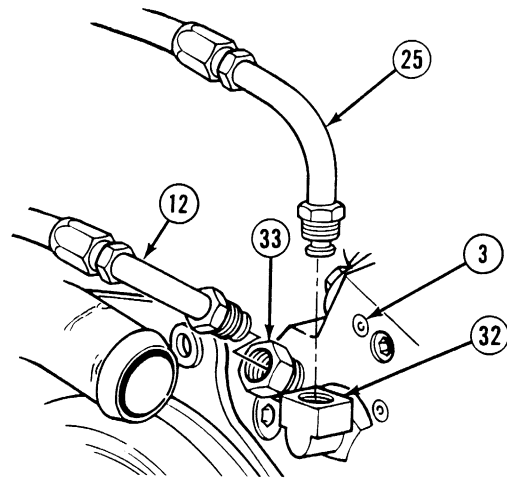
**WARNING**

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.

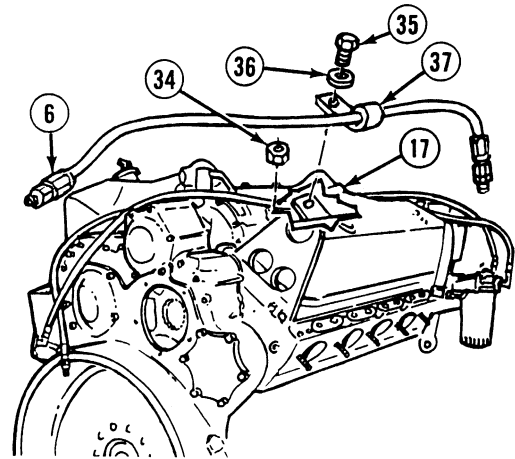
- (18) Remove hose (19) from elbow (24).
- (19) Remove hose (25) from elbow (26).
- (20) Remove elbows (24) and (26) from right cylinder head (27).
- (21) Remove hose (28) from tee (29).
- (22) Remove elbow (30) from fuel pump (31).



- (23) Remove hose (25) from elbow (32).
- (24) Remove hose (12) from fitting (33).
- (25) Remove elbow (32) and fitting (33) from left cylinder head (3).



- (26) Remove nut (34), screw (35), lockwasher (36), cushion clip (37) and hose (6) from engine (17). Discard lockwasher.



**b. Follow-On Maintenance:**

- Remove fuel pump, (Para 20-10).

**END OF TASK**

## 20-10. FUEL PUMP REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

*Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)

*Equipment Condition*

Secondary fuel filter, head, and fuel hoses removed, (Para 20-9)

**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 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.

**NOTE**

Note position and location of tee prior to removal.

- (1) Remove tee (1) from fuel pipe bushing (2).
- (2) Remove pipe bushing (2) from fuel pump (3).

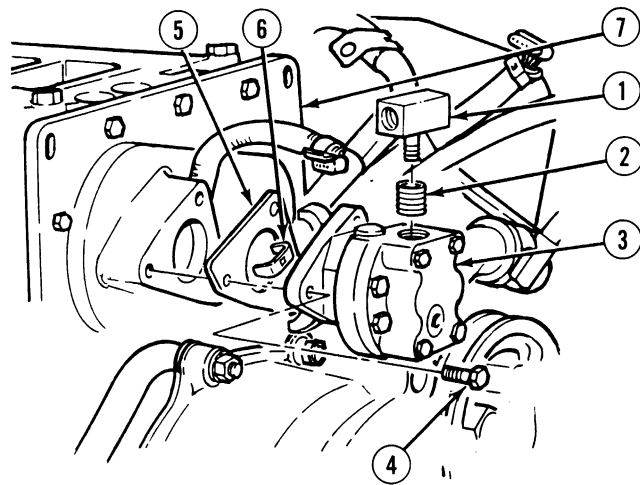
**NOTE**

Drive coupling fork may come off with pump or may stay with engine.

- (3) Remove three screws (4), fuel pump (3), gasket (5) and drive coupling fork (6) from blower housing (7). Discard gasket.

**b. Follow-On Maintenance:**

- Remove rocker covers, (Para 20-11).



**END OF TASK**



## 20-12. TACHOMETER DRIVE ASSEMBLY REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

*Tools and Special Tools*

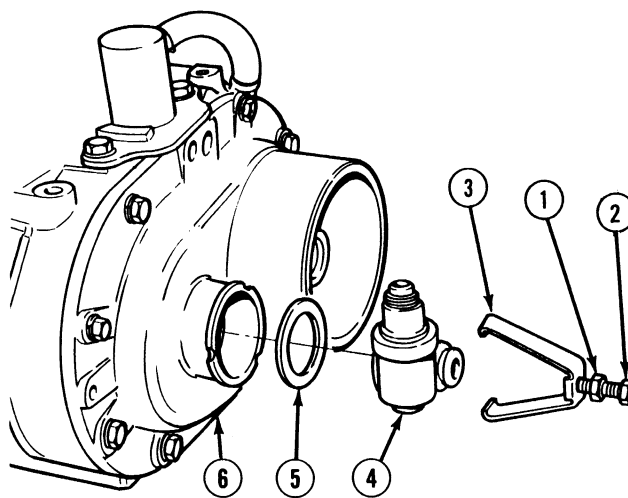
Tool Kit, General Mechanic's  
(Item 240, Appendix F)

*Equipment Condition*

Rocker covers removed, (Para 20-11)

#### a. Removal.

- (1) Loosen jam nut (1) on screw (2).
- (2) Loosen screw (2) and remove clamp (3), tachometer drive housing (4) and gasket (5) from blower (6). Discard gasket.



#### b. Follow-On Maintenance:

- Remove blower assembly, (Para 20-13).

**END OF TASK**

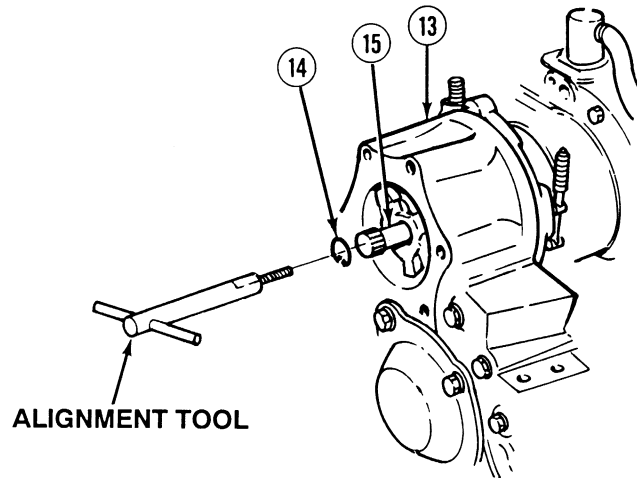


**20-13. BLOWER ASSEMBLY REMOVAL (CONT).**

**WARNING**

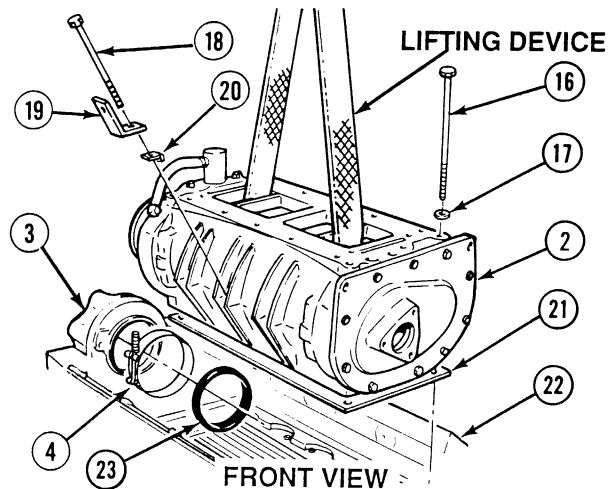
Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (6) Install alignment tool and remove retaining ring (14) from blower drive shaft (15). Discard retaining ring.
- (7) Remove blower drive shaft (15) from flywheel housing (13).
- (8) Remove four screws (16) and washers (17) from blower (2).
- (9) Remove six screws (18), bracket (19) and retainers (20) from blower (2).



**WARNING**

- Blower weighs 71 lbs (32 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.
- When installing lifting device, keep hands clear of rotors to prevent injury to personnel.



**CAUTION**

Lift blower straight up or damage to equipment may occur.

- (10) Using a lifting device and the aid of an assistant, remove blower (2) and gasket (21) from engine (22). Discard gasket.
- (11) Remove clamp (4) and seal (23) from blower drive assembly (3). Discard seal.

**b. Follow-On Maintenance:**

- Repair blower assembly, (Para 21-2).
- Remove engine brake retarder, (Para 20-14).

**END OF TASK**

## 20-14. ENGINE BRAKE RETARDER REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

*Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)

*Equipment Condition*

Blower assembly removed, (Para 20-13)

*Materials/Parts*

Cable Ties (Item 9, Appendix B)  
Tags, Identification (Item 72, Appendix B)

#### a. Removal.

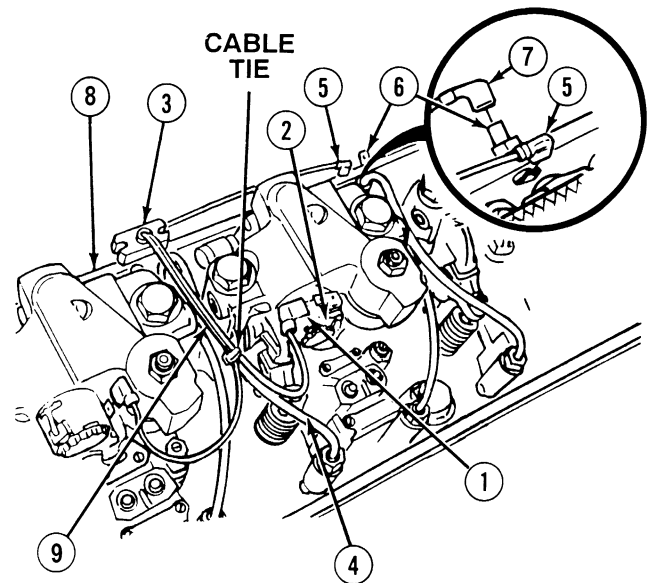
**CAUTION**

Pull back protective sleeve on positive lock connectors prior to removing positive lock connectors. Do not pull on wires of harness to remove positive lock connectors. Failure to comply may result in damage to solenoid and/or harness.

**NOTE**

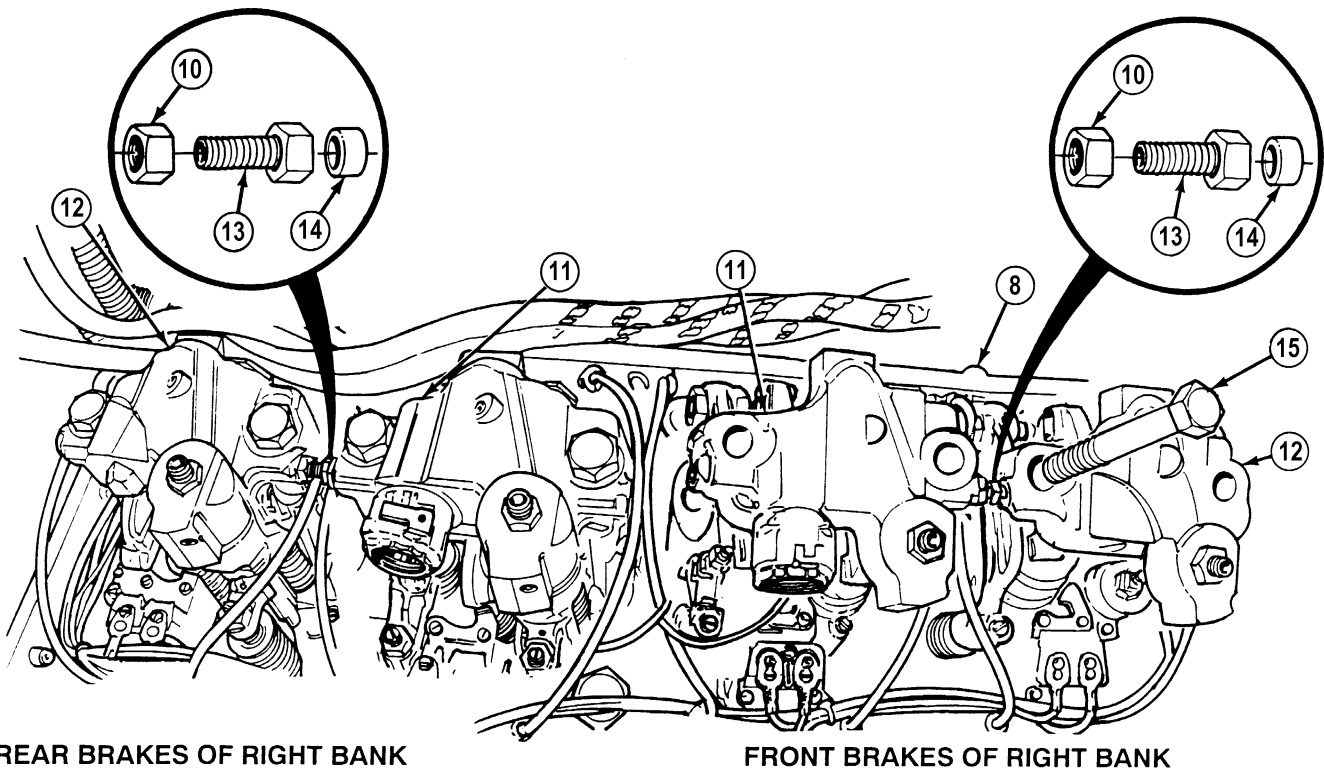
- There are two supply brakes and two drones on each cylinder bank. All supply brakes and drones are removed the same way. Right cylinder bank shown.
- Note location of cable ties and remove as required.
- Tag and mark wires prior to removal.

- (1) Disconnect positive lock connectors (1) from engine brake solenoids (2).
- (2) Remove rubber harness support (3) from injector lines (4).
- (3) Disconnect spade connector (5) from terminal assembly (6).
- (4) Disconnect spade connector (7) from terminal assembly (6).
- (5) Remove terminal assembly (6) from cylinder head (8).
- (6) Remove engine brake harness (9) from cylinder head (8).





**20-14 ENGINE BRAKE RETARDER REMOVAL (CONT).**



**REAR BRAKES OF RIGHT BANK**

**FRONT BRAKES OF RIGHT BANK**

- (7) Loosen nut (10) between supply brake (11) and drone (12).

**NOTE**

Perform Step (8) for front brakes of left bank and rear brakes of right bank. Perform Step (9) for front brakes of right bank and rear brakes of left bank.

- (8) Thread connector (13) into drone (12) to clear preformed packing (14) from connector (13).
- (9) Thread connector (13) into supply brake (11) to clear preformed packing (14) from connector (13).
- (10) Remove four screws (15) from supply brake (11) and drone (12).
- (11) Remove supply brake (11) and drone (12) from cylinder head (8).
- (12) Repeat Steps (1) through (11) for other supply brakes and drones.

**b. Follow-On Maintenance:**

- Repair engine brake retarder, (Para 20-44).
- Remove fuel injectors, (Para 20-15).

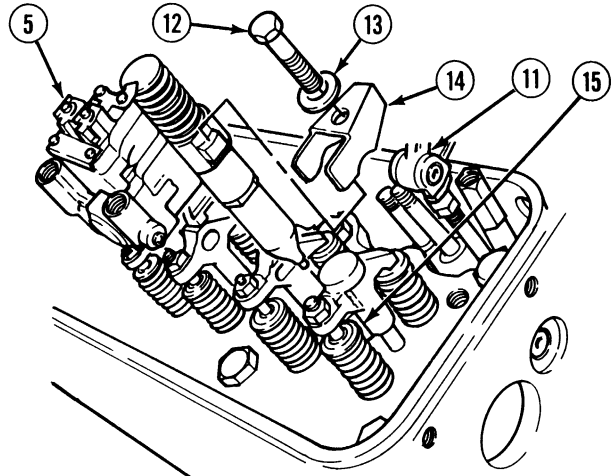
**END OF TASK**



**20-15 FUEL INJECTOR REMOVAL (CONT).**

**CAUTION**

- When removing fuel injectors, caution should be taken not to damage fuel injector tips.
  - Do not force rocker arms all the way back with shaft in place. Only position rocker arm back far enough to access fuel injector. Failure to comply may result in damage to push rods.
- (4) Lift rocker arms (11) up and remove screw (12), washer (13), clamp (14) and fuel injector (5) as a unit from injector tube hole (15).



**b. Follow-On Maintenance:**

- Remove Timing and Synchronous Reference Sensor (TRS/SRS), (Para 20-16).

**END OF TASK**



## 20-17. AIR BOX COVERS REMOVAL

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

*Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)

*Equipment Condition*

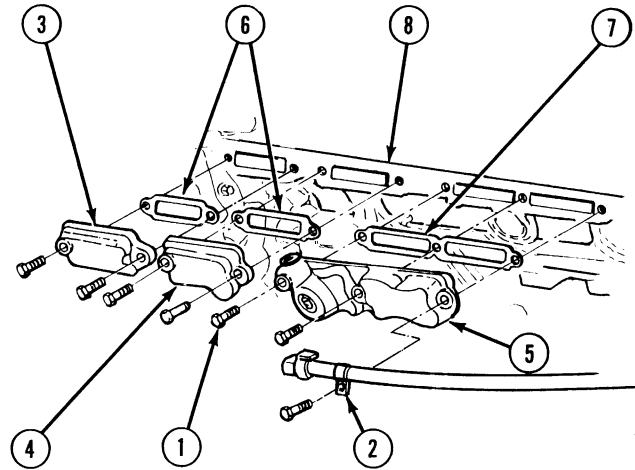
Timing and synchronous reference  
sensor removed, (Para 20-16)

**a. Removal.**

**NOTE**

- Remove left air box covers only to install engine on stand.
- Right and left air box covers are removed the same way. Right side shown.

- (1) Remove seven screws (1) and cushion clips (2) from air box covers (3), (4) and (5).
- (2) Remove air box covers (3), (4) and (5), two gaskets (6) and gasket (7) from engine block (8). Discard gaskets.



**b. Follow-On Maintenance:**

- Remove air box drains, (Para 20-18).

**END OF TASK**



## 20-19. CYLINDER HEAD REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit General Mechanic's  
(Item 240, Appendix F)  
Lifting Tee (2) (Appendix C)  
Wooden Block (2) (Appendix C)

#### *Equipment Condition*

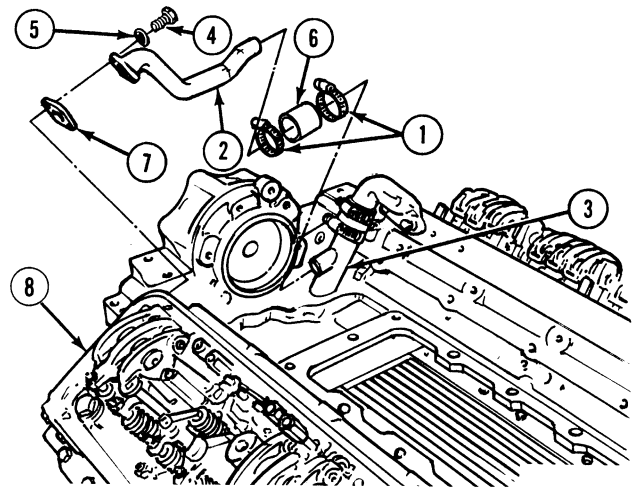
Air box drains removed, (Para 20-18)

### a. Removal.

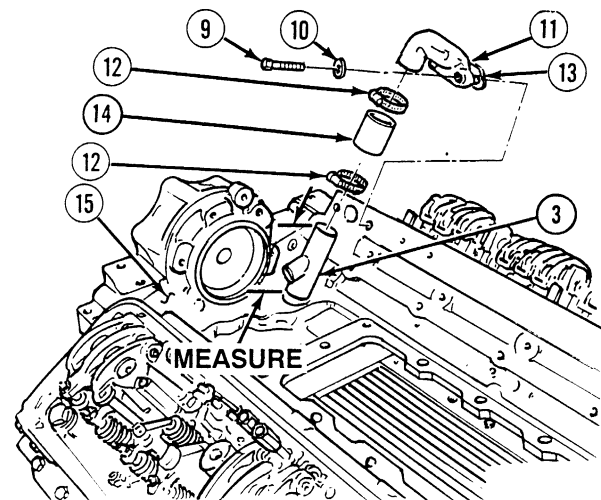
#### NOTE

Both cylinder heads are removed the same way. Right side shown.

- (1) Loosen two clamps (1) on breather tubes (2) and (3).
- (2) Remove two screws (4), washers (5), breather tube (2), hose (6), clamps (1) and gasket (7) from cylinder head (8). Discard gasket.



- (3) Remove two screws (9) and washers (10) from breather tube (11).
- (4) Loosen two clamps (12) on breather tubes (3) and (11).
- (5) Remove breather tube (11), gasket (13), hose (14) and clamps (12) from breather tube (3). Discard gasket.



#### NOTE

Perform Steps (6) and (7) only if breather tube is damaged.

- (6) Measure and record height of breather tube (3) extending from engine block.
- (7) Remove breather tube (3) from engine block (15).

**NOTE**

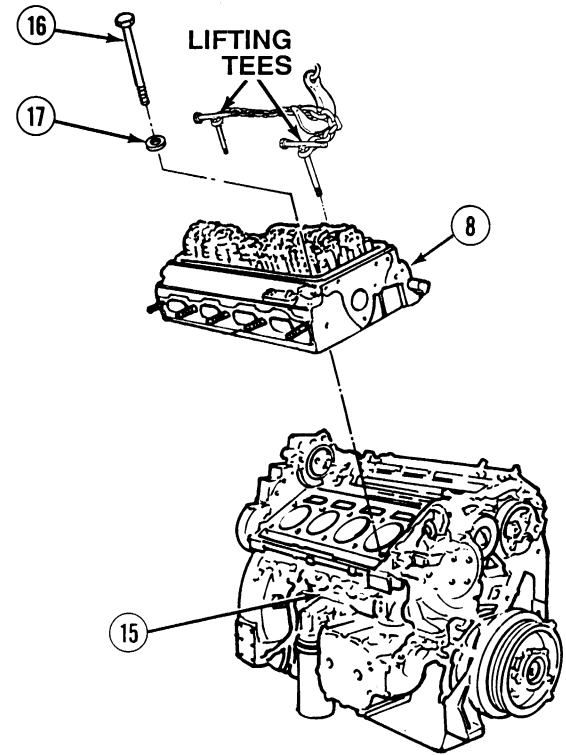
Leave upper right and left screws installed at this time.

- (8) Remove eight screws (16) and washers (17) from cylinder head (8).
- (9) Install two lifting tees on cylinder head (8).

**WARNING**

Cylinder head with lifting tees weighs 182 lbs (83 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (10) Remove two screws (16) and washers (17) from cylinder head (8).
- (11) Lift cylinder head (8) from engine block (15) and position on wooden blocks.

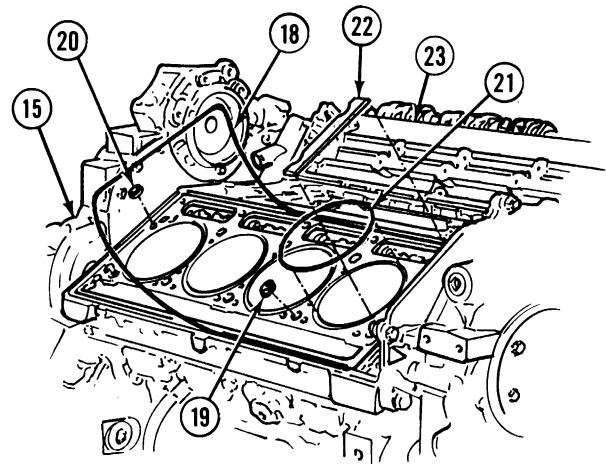


- (12) Remove and discard seal strip gasket (18), 16 water seals (19), oil seal (20) and four compression gaskets (21) from engine block (15).

**NOTE**

Note position and location of shims prior to removal.

- (13) Remove two support shims (22) from engine block (15). Discard shims.
- (14) Remove two lifting tees from cylinder head (8).
- (15) Repeat Steps (8) through (14) for other cylinder head (23).

**b. Follow-On Maintenance:**

- Repair cylinder head, (Para 20-49).
- Remove blower drive assembly, (Para 20-20).

**END OF TASK**



**20-20. BLOWER DRIVE ASSEMBLY REMOVAL.**

This task covers:

- a. Removal
- b. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

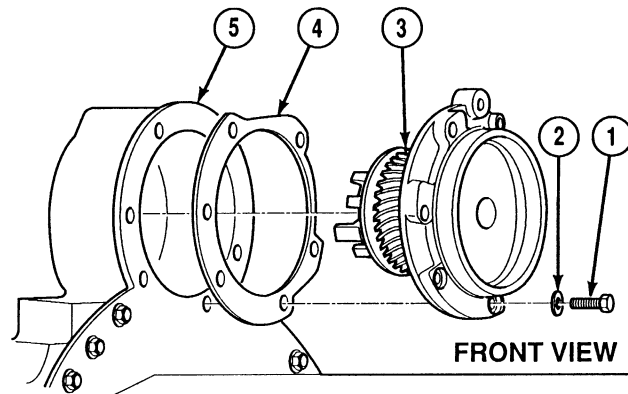
Tool Kit, General Mechanic's  
(Item 240, Appendix F)

*Equipment Condition*

Cylinder heads removed, (Para 20-19)

**a. Removal.**

- (1) Remove two screws (1) and copper washers (2) from blower drive assembly (3). Discard washers.
- (2) Remove blower drive assembly (3) and gasket (4) from rear end plate (5). Discard gasket.



**b. Follow-On Maintenance:**

- Repair blower drive assembly, (Para 20-55).
- Remove aftercooler, (Para 20-21).

**END OF TASK**





**20-23. ENGINE OIL FILTER AND SPIN-ON ADAPTER HOUSING AND REMOTE ENGINE OIL FILTER MANIFOLD REMOVAL.**

This task covers:

- a. Removal
- b. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

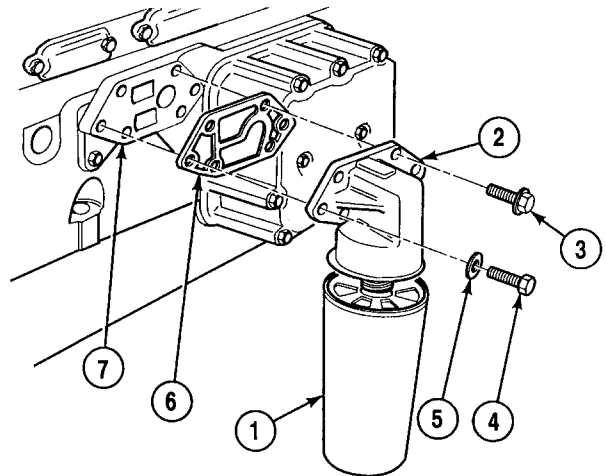
Tool Kit, General Mechanic's  
 (Item 240, Appendix F)  
 Pan, Drain 4 gal (Item 144, Appendix F)

*Equipment Condition*

Water pump assembly removed, (Para 20-22)

**a. Removal.**

- (1) Position drain pan under oil filter (1).
- (2) Remove oil filter (1) from adapter housing (2). Discard oil filter.
- (3) Remove four screws (3) from adapter housing (2).
- (4) Remove two screws (4), lockwashers (5), adapter housing (2) and gasket (6) from oil cooler adapter cover (7). Discard lockwashers and gasket.

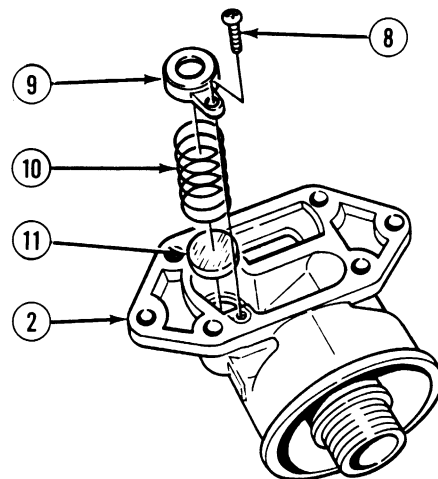


**WARNING**

Use care when removing springs. Springs are under tension and can act as projectiles when released and could cause injury to personnel.

**NOTE**

- Perform Step (5) if truck is not equipped with remote engine oil filter manifold.
- Perform Steps (6) through (8) if truck is equipped with remote engine oil filter manifold.



- (5) Remove screw (8), retainer (9), spring (10) and bypass disk (11) from adapter housing (2). Discard spring.

**20-23. ENGINE OIL FILTER AND SPIN-ON ADAPTER HOUSING AND REMOTE ENGINE OIL FILTER MANIFOLD REMOVAL (CONT).**

- (6) Remove two screws (12), screws (13), screws (14), four lockwashers (15), remote engine oil filter manifold (16) and gasket (17) from oil cooler adapter cover (18). Discard lockwashers and gasket.

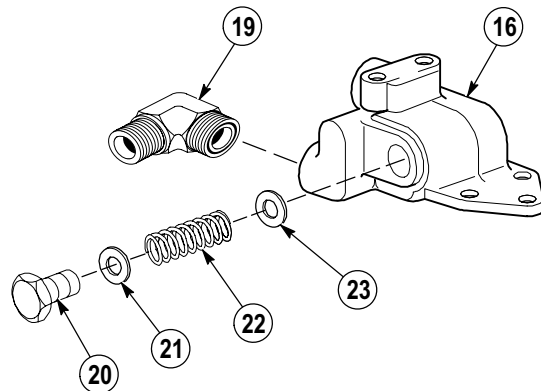
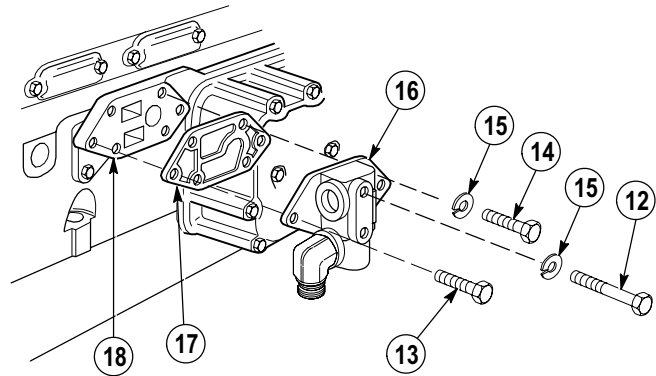
**WARNING**

Use care when removing springs. Springs are under tension and can act as projectiles when released and could cause injury to personnel.

**NOTE**

Note location and position of adapter prior to removal.

- (7) Remove adapter (19) from remote engine oil filter manifold (16).
- (8) Remove plug (20), washer (21), spring (22) and valve disk (23) from remote engine oil filter manifold (16). Discard spring.



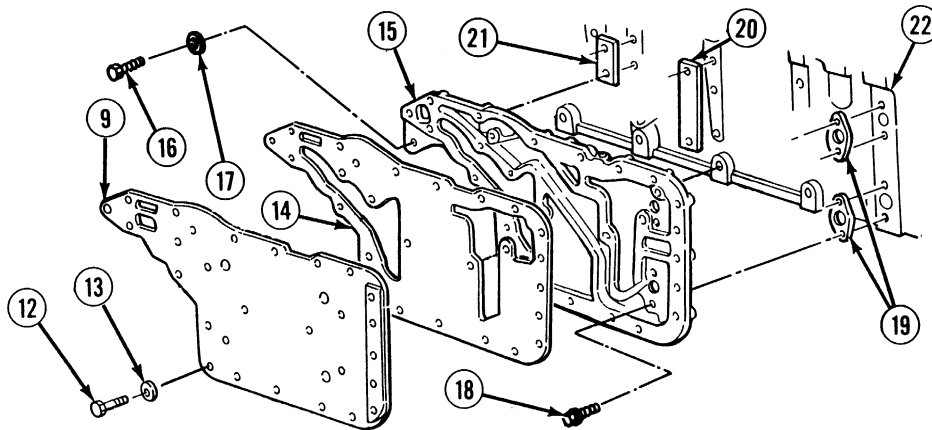
**b. Follow-On Maintenance:**

- Remove engine oil cooler assembly, (Para 20-24).

**END OF TASK**



**20-24. ENGINE OIL COOLER ASSEMBLY REMOVAL (CONT).**

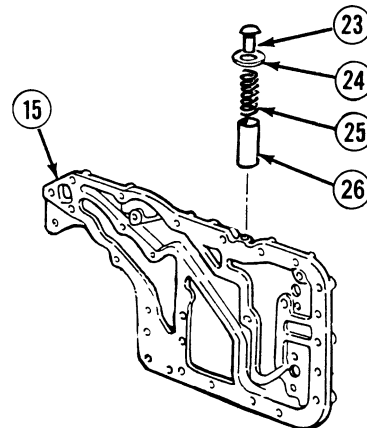


- (6) Remove eight screws (12), lockwashers (13), oil cooler adapter cover (9) and gasket (14) from oil cooler adapter (15). Discard gasket and lockwashers.
- (7) Remove three screws (16) and washers (17) from oil cooler adapter (15).

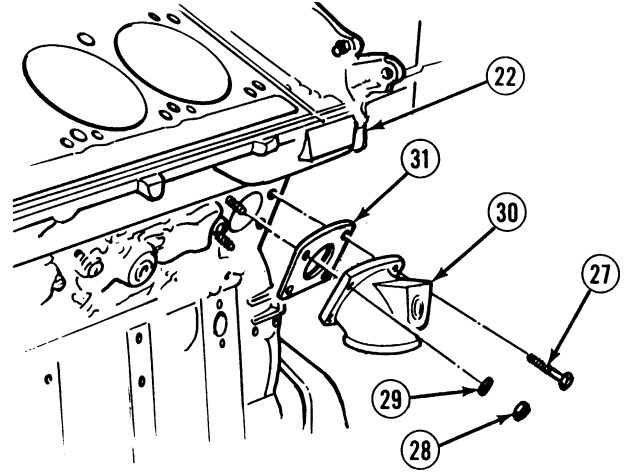
**NOTE**

Note and record size and thickness of shims.

- (8) Remove three screws (18), oil cooler adapter (15), two gaskets (19) and two shims (20) and (21) from engine block (22). Discard gaskets.
- (9) Remove plug (23), copper washer (24), spring (25) and valve (26) from oil cooler adapter (15). Discard washer and spring.



- (10) Remove two screws (27), nuts (28) and lockwashers (29) from elbow (30). Discard lockwashers.
- (11) Remove elbow (30) and gasket (31) from engine block (22). Discard gasket.



**b. Follow-On Maintenance:**

- Perform engine oil cooler assembly test, (Para 20-57).
- Remove vibration damper and front balance cover, (Para 20-25).

**END OF TASK**



## 20-25. VIBRATION DAMPER AND FRONT BALANCE COVER REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Puller Kit, Universal Slide Hammer  
(Item 175, Appendix F)

#### *Equipment Condition*

Engine oil cooler assembly removed,  
(Para 20-24)

#### *Materials/Parts*

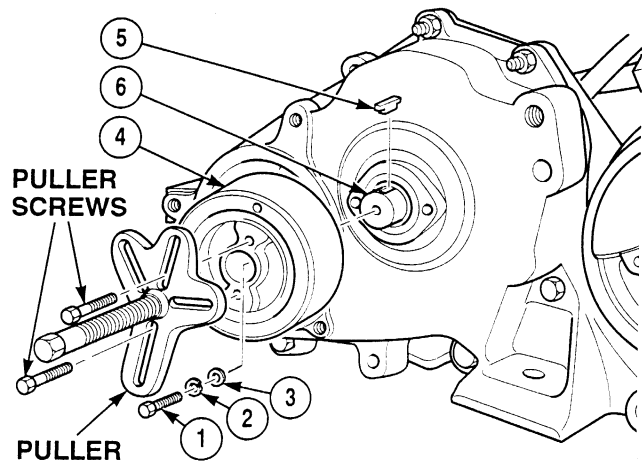
Tags, Identification (Item 72, Appendix B)

### a. Removal.

#### NOTE

Tag and mark screws and washers upon removal.

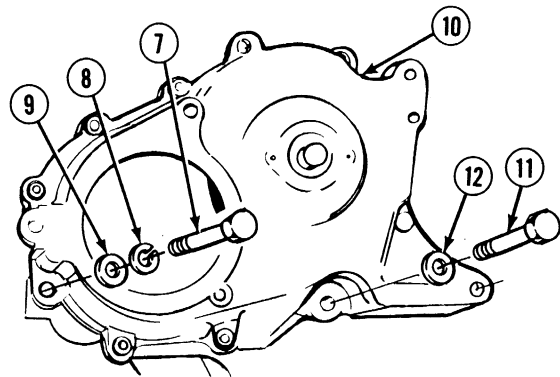
- (1) Remove screw (1), lockwasher (2) and washer (3) from vibration damper (4). Discard lockwasher.
- (2) Install puller with puller screws in vibration damper (4).
- (3) Using puller remove vibration damper (4) and key (5) from vibration damper shaft (6). Discard key.
- (4) Remove puller and puller screws from vibration damper (4).
- (5) Remove screw (7), lockwasher (8) and washer (9) from front balance cover (10). Discard lockwasher.



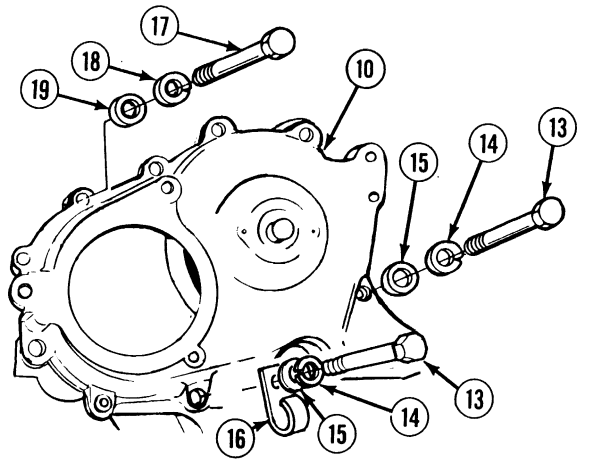
#### NOTE

Other screw and washer removed with lift point.

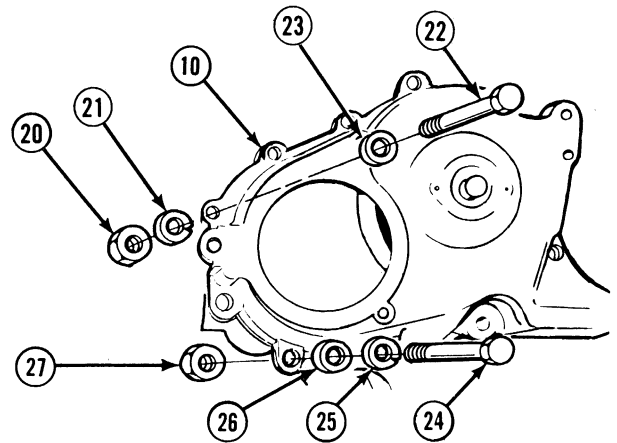
- (6) Remove screw (11) and washer (12) from front balance cover (10).



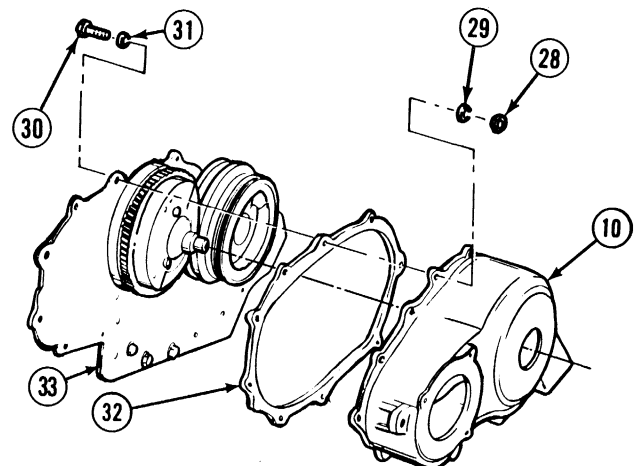
- (7) Remove two screws (13), lockwashers (14), washers (15) and clip (16) from front balance cover (10). Discard lockwashers.
- (8) Remove screw (17), lockwasher (18) and washer (19) from front balance cover (10). Discard lockwasher.



- (9) Remove nut (20), lockwasher (21), screw (22) and washer (23) from front balance cover (10). Discard lockwasher.
- (10) Remove screw (24), lockwasher (25), washer (26) and nut (27) from front balance cover (10). Discard lockwasher.



- (11) Remove three nuts (28), lockwashers (29), screws (30) and washers (31) from front balance cover (10). Discard lockwashers.
- (12) Remove front balance cover (10) and gasket (32) from end plate (33). Discard gasket.



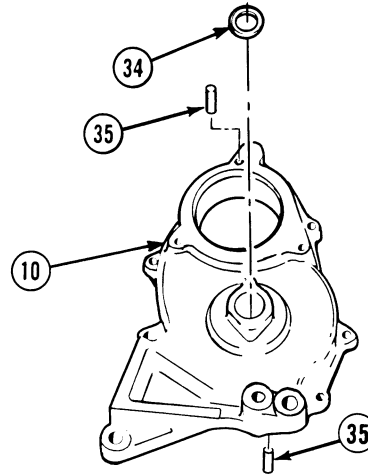
**20-25. VIBRATION DAMPER AND FRONT BALANCE COVER REMOVAL (CONT).**

- (13) Remove oil seal (34) from front balance cover (10). Discard oil seal.

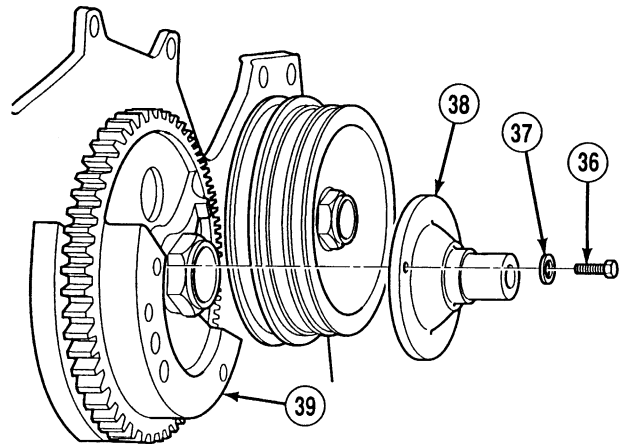
**NOTE**

Perform Step (14) if dowels are damaged.

- (14) Remove two dowels (35) from front balance cover (10).



- (15) Remove three screws (36), lockwashers (37) and vibration damper shaft (38) from gear (39). Discard lockwashers.



**b. Follow-On Maintenance:**

- Remove flex plate, (Para 20-26).

**END OF TASK**



## 20-27. ENGINE OIL PAN REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

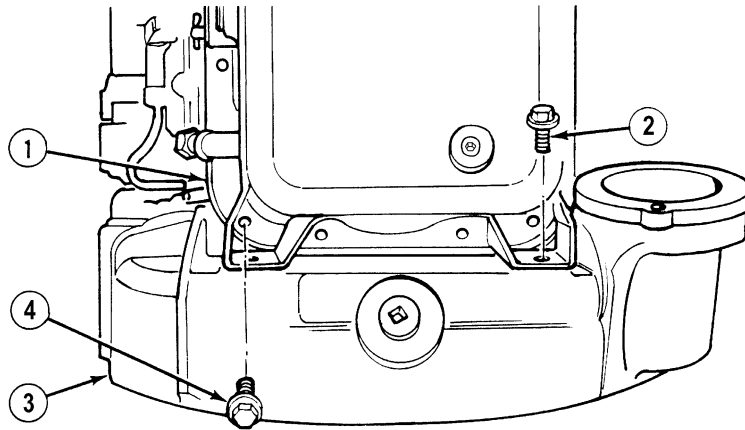
#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Pan, Drain 4 gal (Item 144, Appendix F)

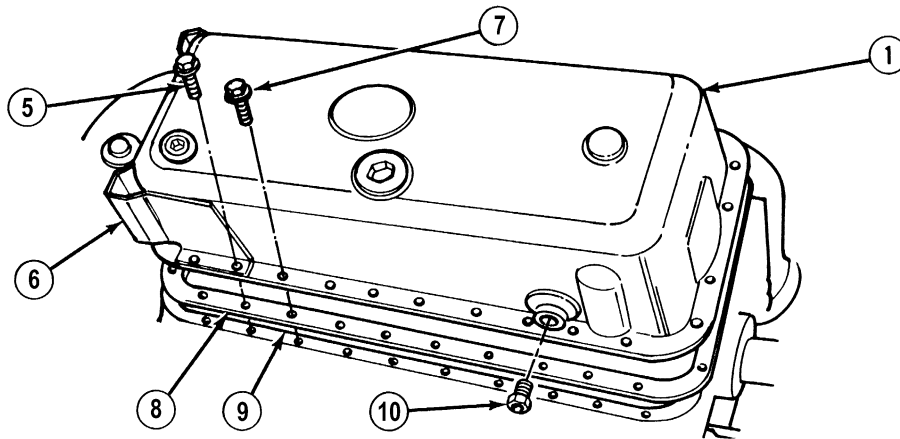
#### *Equipment Condition*

Flex plate removed, (Para 20-26)

#### **a. Removal.**



- (1) Position drain pan under engine.
- (2) Rotate engine until oil pan (1) is on top.
- (3) Remove two screws (2) from flywheel housing (3).
- (4) Remove four screws (4) from rear end of oil pan (1).

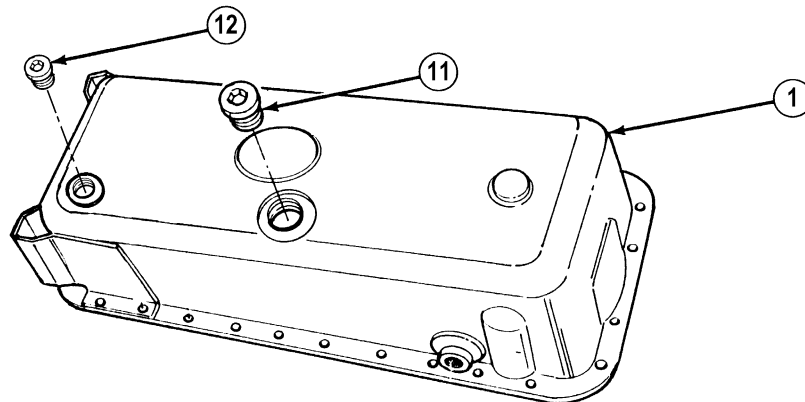


- (5) Remove four screws (5) from support bracket (6) and oil pan (1).
- (6) Remove 20 screws (7) from oil pan (1).
- (7) Remove oil pan (1) and gasket (8) from engine block (9). Discard gasket.

**NOTE**

Perform Step (8) if adapter is damaged.

- (8) Remove adapter (10) from oil pan (1).



**NOTE**

Perform Step (9) if plugs are damaged.

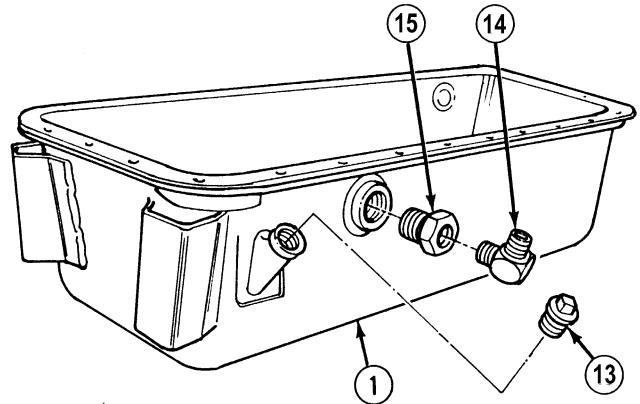
- (9) Remove plug (11) and plug (12) from oil pan (1).

**20-27. ENGINE OIL PAN REMOVAL (CONT).**

**NOTE**

Perform Step (10), (11) or (12) if plug, elbow or adapter is damaged.

- (10) Remove plug (13) from oil pan (1).
- (11) Remove elbow (14) from adapter (15).
- (12) Remove adapter (15) from oil pan (1).



**b. Follow-On Maintenance:**

- Remove oil pressure regulator valve, (Para 20-28).

**END OF TASK**





**20-29. ENGINE OIL PRESSURE RELIEF VALVE REMOVAL.**

This task covers:

- a. Removal
- b. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

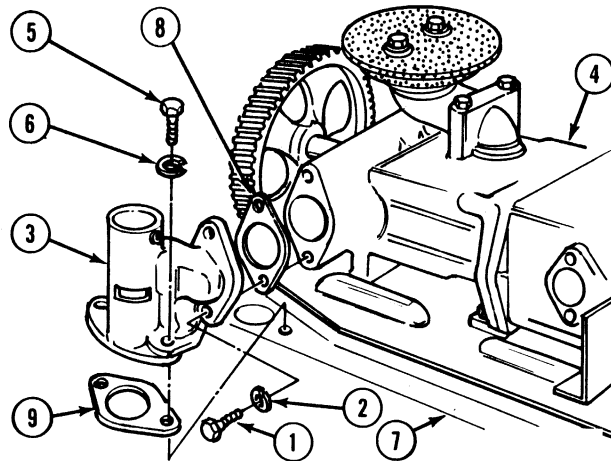
Tool Kit, General Mechanic's  
(Item 240, Appendix F)

*Equipment Condition*

Engine oil pressure regulator valve removed,  
(Para 20-28)

**a. Removal.**

- (1) Remove two screws (1) and lockwashers (2) from pressure relief valve (3) and oil pump (4). Discard lockwashers.
- (2) Remove two screws (5) and lockwashers (6) from pressure relief valve (3) and engine block (7). Discard lockwashers.
- (3) Remove pressure relief valve (3) and gaskets (8) and (9). Discard gaskets.



**b. Follow-On Maintenance:**

- Remove engine oil pump assembly, (Para 20-30).

**END OF TASK**



## 20-31. FLYWHEEL HOUSING AND REAR OIL SEAL REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

*Tools and Special Tools*

Tool Kit, General Mechanic's  
 (Item 240, Appendix F)  
 Eyes, Lifting (Appendix C)  
 Lifting Device, Minimum Capacity  
 200 lbs (91 kg)

*Materials/Parts*

Tags, Identification (Item 72, Appendix B)

*Equipment Condition*

Engine oil pump assembly removed,  
 (Para 20-30)

**a. Removal.**

**NOTE**

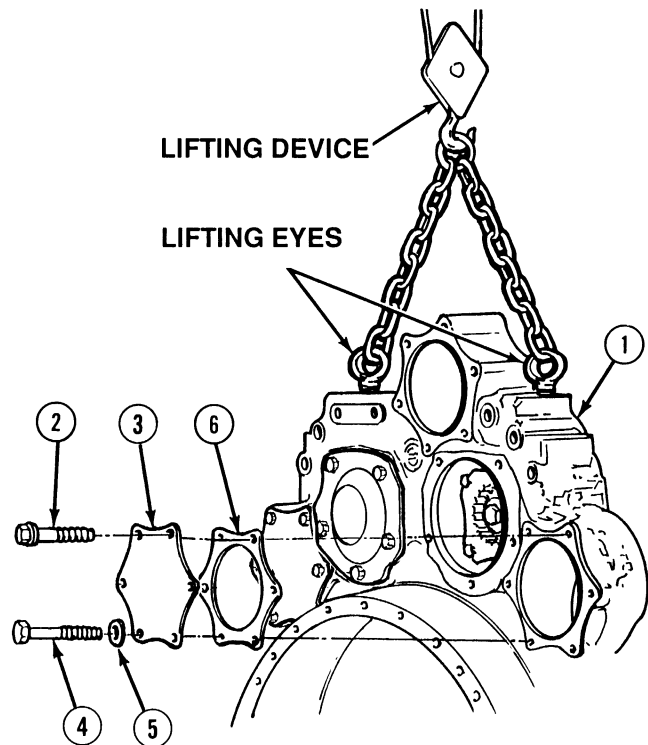
- Tag and mark screws and washers during removal.
- Two screws are removed with air governor.

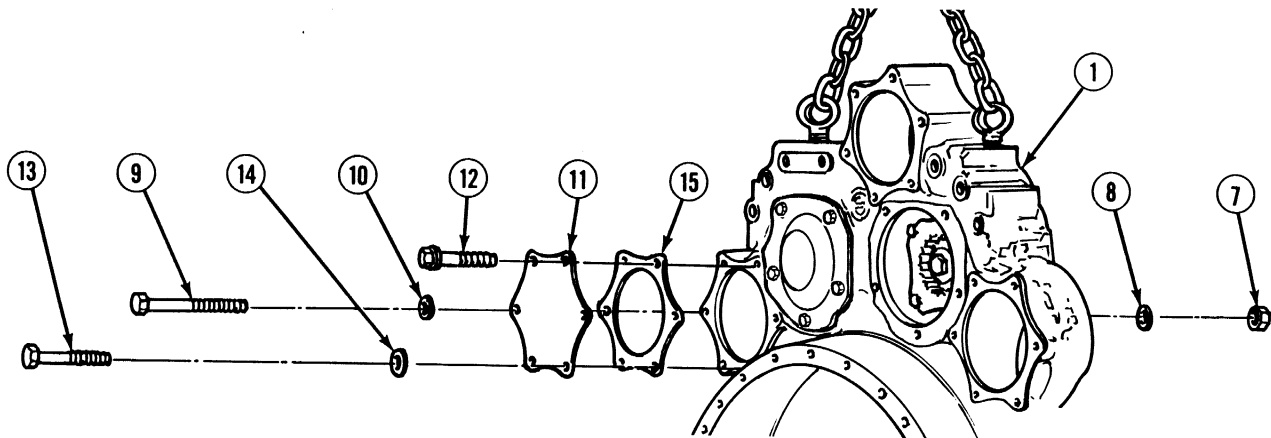
- (1) Install two lifting eyes in flywheel housing (1).

**WARNING**

Flywheel housing weighs 187 lbs (85 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (2) Attach lifting device to support flywheel housing (1).
- (3) Remove three screws (2) from access cover (3).
- (4) Remove screw (4) and copper washer (5) from access cover (3). Discard copper washer.
- (5) Remove access cover (3) and gasket (6) from flywheel housing (1). Discard gasket.

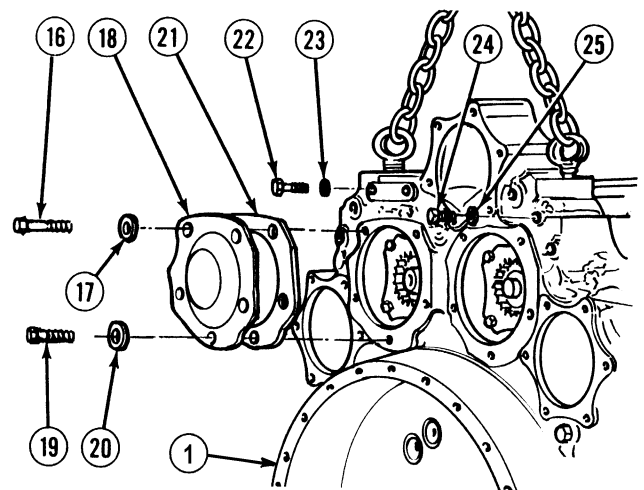




**NOTE**

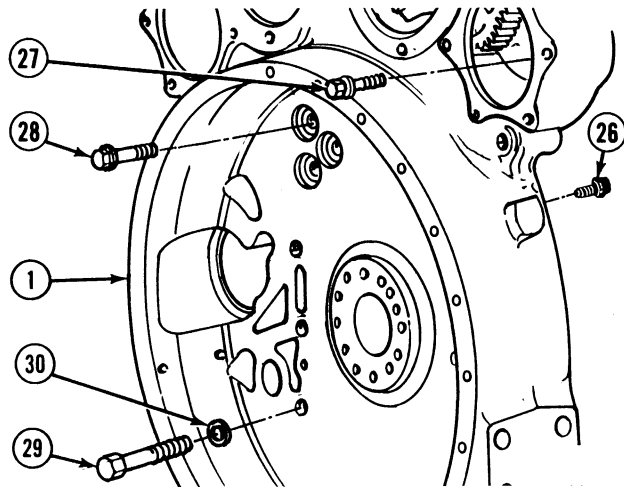
One screw removed with fuel block.

- (6) Remove two nuts (7), lockwashers (8), screws (9) and washers (10) from access cover (11). Discard lockwashers.
- (7) Remove two screws (12) from access cover (11).
- (8) Remove screw (13) and washer (14) from access cover (11).
- (9) Remove access cover (11) and gasket (15) from flywheel housing (1). Discard gasket.
- (10) Remove four screws (16) and lockwashers (17) from access cover (18). Discard lockwashers.
- (11) Remove screw (19) and washer (20) from access cover (18).
- (12) Remove access cover (18) and gasket (21) from flywheel housing (1). Discard gasket.
- (13) Remove four screws (22) and washers (23) from flywheel housing (1).
- (14) Remove three screws (24) and washers (25) from flywheel housing (1). Discard screws.



**20-31. FLYWHEEL HOUSING AND REAR OIL SEAL REMOVAL (CONT).**

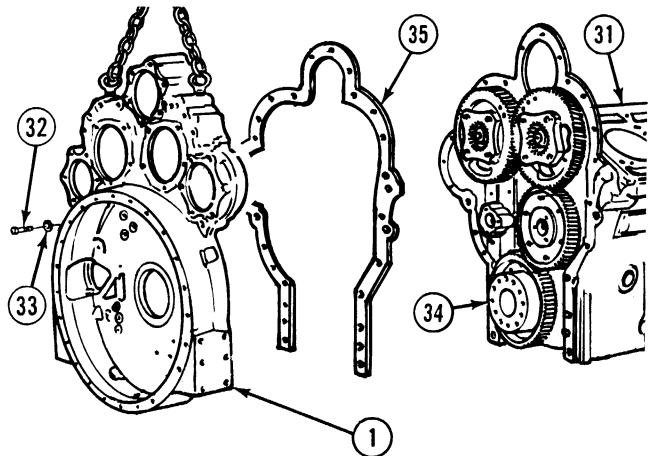
- (15) Remove two screws (26) from flywheel housing (1).
- (16) Remove screw (27) through access hole from flywheel housing (1). Discard screw.
- (17) Remove six screws (28) from flywheel housing (1).
- (18) Remove six screws (29) and washers (30) from flywheel housing (1) on engine (31).



**WARNING**

Flywheel housing weighs 187 lbs (85 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

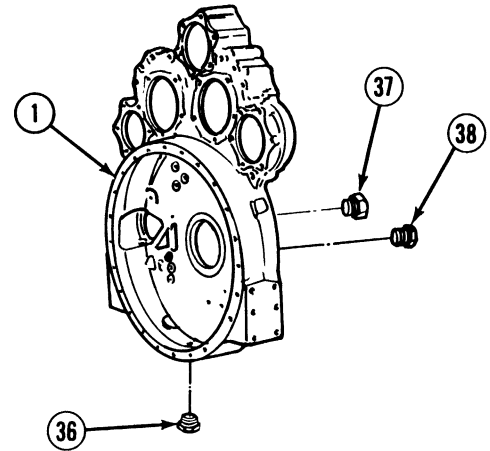
- (19) Remove two screws (32), washers (33) and flywheel housing (1) from cylinder block plate (34) and position on clean work surface.
- (20) Remove gasket (35) from cylinder block plate (34) and flywheel housing (1). Discard gasket.
- (21) Remove lifting device and lifting eyes from flywheel housing (1).



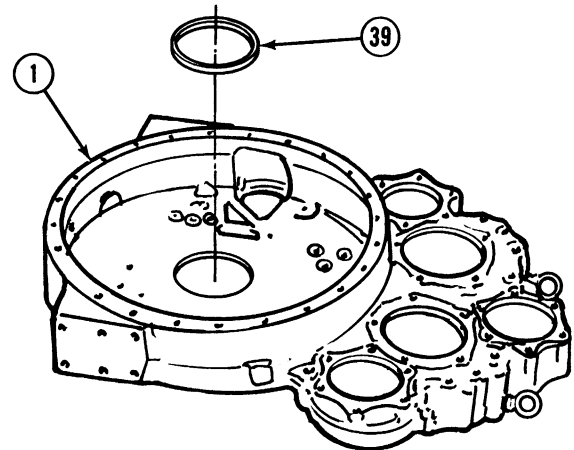
**NOTE**

Perform Steps (22) and/or (23) if plugs are damaged.

- (22) Remove plug (36) from flywheel housing (1).
- (23) Remove plugs (37) and (38) from flywheel housing (1).



- (24) Remove crankshaft rear oil seal (39) from flywheel housing (1). Discard seal.

**b. Follow-On Maintenance:**

- Remove idler gear, (Para 20-32).

**END OF TASK**

## 20-32. IDLER GEAR REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

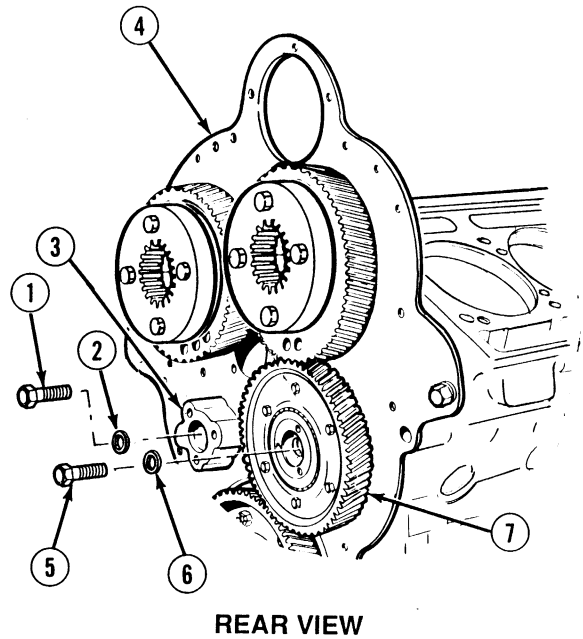
Tool Kit, General Mechanic's  
(Item 240, Appendix F)

#### *Equipment Condition*

Flywheel housing and rear oil seal removed,  
(Para 20-31)

#### **a. Removal.**

- (1) Remove screw (1), washer (2) and hub (3) from end plate (4).
- (2) Remove screw (5) and washer (6) from idler gear (7).
- (3) Remove idler gear (7) from end plate (4).



#### **b. Follow-On Maintenance:**

- Repair idler gear, (Para 20-58).
- Remove crankshaft timing gear, (Para 20-33).

END OF TASK





## 20-34. CAMSHAFT ASSEMBLY REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Adapter, Mechanical Puller (Item 4, Appendix F)
- Puller, Mechanical (Item 173, Appendix F)
- Puller Kit, Universal (Item 174, Appendix F)

*Equipment Condition*

Crankshaft timing gear removed, (Para 20-33)

*Materials/Parts*

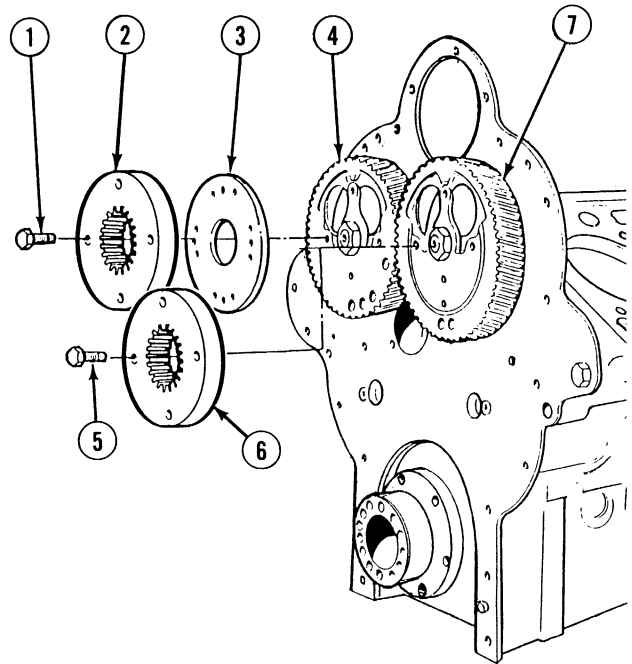
- Cloth, Cleaning (Item 11, Appendix B)
- Tags, Identification (Item 72, Appendix B)

**a. Removal.**

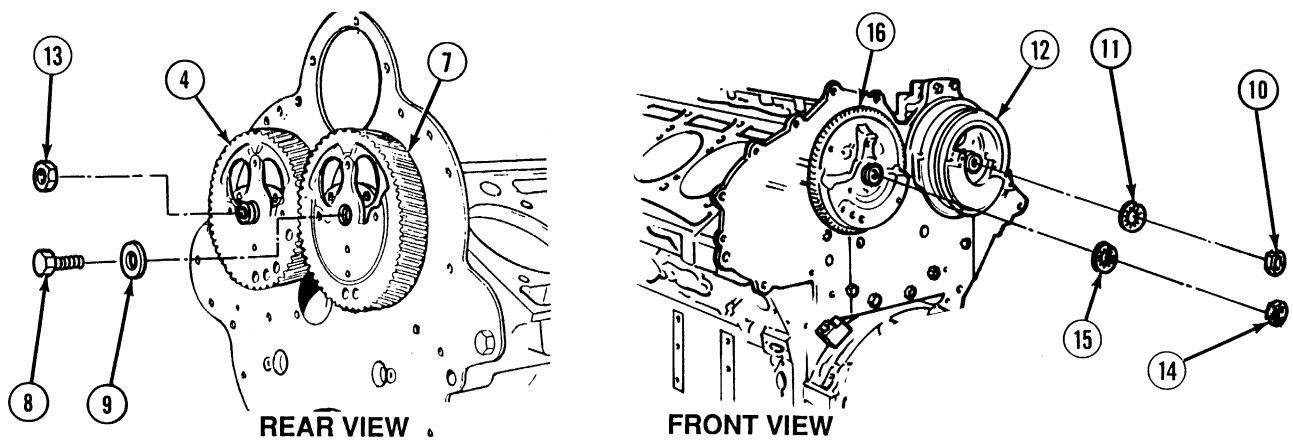
**NOTE**

Tag and mark parts prior to removal.

- (1) Remove four screws (1), left accessory drive hub (2) and camshaft nut lock plate (3) from left rear camshaft gear (4).
- (2) Remove four screws (5) and right accessory drive hub (6) from right rear camshaft gear (7).



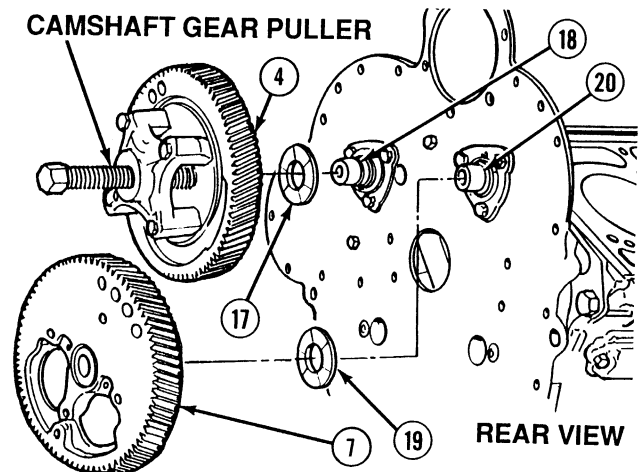
**REAR VIEW**



**WARNING**

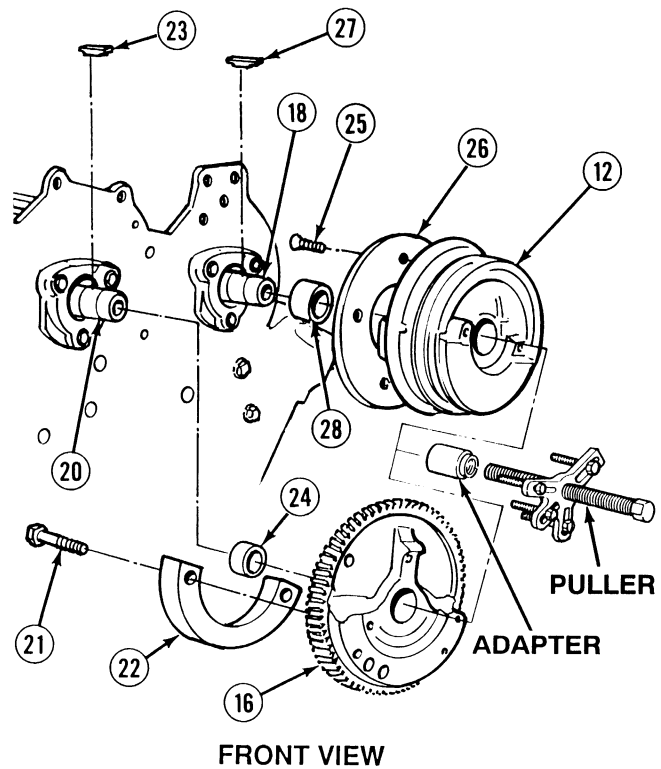
Keep hands clear of gears when loosening nuts to prevent injury to personnel.

- (3) Place a clean cloth between top of left and right rear camshaft gears (4) and (7).
- (4) Remove screw (8) and spacer (9) from right rear camshaft gear (7).
- (5) Remove nut (10) and lockwasher (11) from camshaft front balance pulley (12). Discard lockwasher.
- (6) Place clean cloth between bottom of left and right rear camshaft gears (4) and (7).
- (7) Remove nut (13) from left rear camshaft gear (4).
- (8) Remove nut (14) and lockwasher (15) from water pump drive gear (16). Discard lockwasher.
- (9) Using camshaft gear puller, remove left rear camshaft gear (4) and thrust washer (17) from left camshaft (18).
- (10) Using camshaft gear puller, remove right rear camshaft gear (7) and thrust washer (19) from right camshaft (20).



**20-34. CAMSHAFT ASSEMBLY REMOVAL (CONT).**

- (11) Using mechanical puller and adapter, remove water pump drive gear (16) from right camshaft (20).
- (12) Remove two lockscrews (21) and balance weight (22) from water pump drive gear (16). Discard lockscrews.
- (13) Remove key (23) and spacer (24) from front end of right camshaft (20). Discard key.
- (14) Using mechanical puller and adapter, remove camshaft front balance pulley (12) from left camshaft (18).
- (15) Remove four screws (25) and speed sensor wheel (26) from front balance pulley (12).
- (16) Remove key (27) and spacer (28) from front end of left camshaft (18). Discard key.

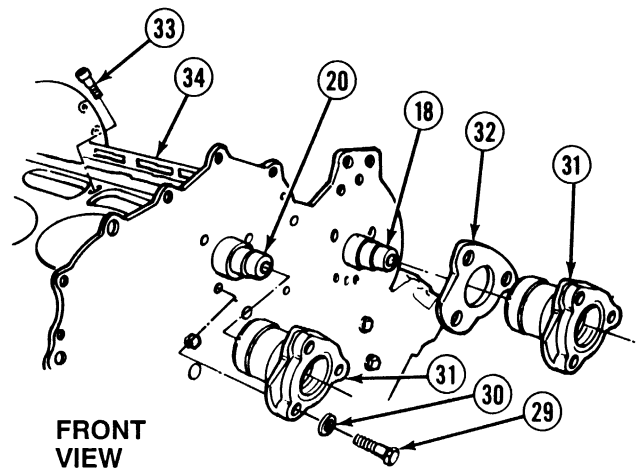


- (17) Remove three screws (29) and lockwashers (30) from two bearings (31). Discard lockwashers.

**NOTE**

Gasket is on left hand bearing only.

- (18) Remove two bearings (31) and gasket (32) from right camshaft (20) and left camshaft (18). Discard gasket.
- (19) Remove six intermediate bearing setscrews (33) from engine block (34). Discard setscrews.

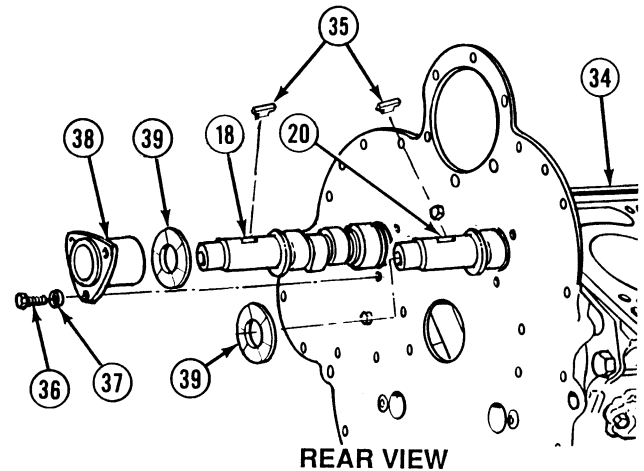


- (20) Remove two keys (35) from right camshaft (20) and left camshaft (18).  
Discard keys.
- (21) Remove three screws (36), lockwashers (37) and two rear bearing sleeves (38) from right camshaft (20) and left camshaft (18).  
Discard lockwashers.
- (22) Remove two thrust washers (39) from right camshaft (20) and left camshaft (18).



Use care when removing camshafts. Camshafts can be damaged by scraping or hitting engine block or hard surface.

- (23) Remove right camshaft (20) from engine block (34).
- (24) Remove left camshaft (18) from engine block (34).



**b. Follow-On Maintenance:**

- Repair camshaft, (Para 20-62).
- Remove rear cylinder block plate, (Para 20-35).

**END OF TASK**

## 20-35. REAR CYLINDER BLOCK PLATE REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)

#### *Equipment Condition*

Camshaft assemblies removed, (Para 20-34)

#### a. Removal.

- (1) Remove screw (1) and lockwasher (2) from end plate (3). Discard lockwasher.
- (2) Remove four screws (4) from end plate (3).
- (3) Remove end plate (3) and gasket (5) from engine block (6). Discard gasket.

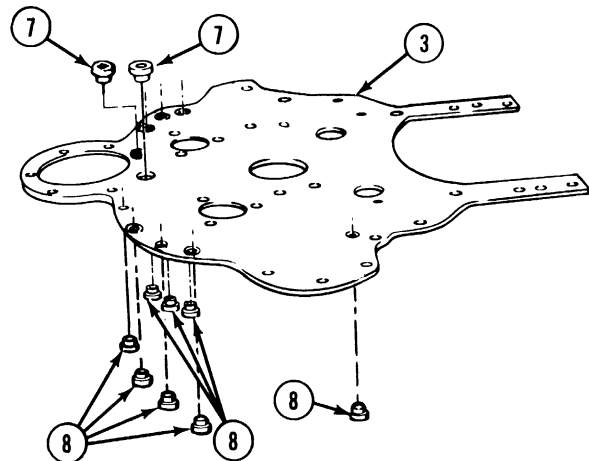
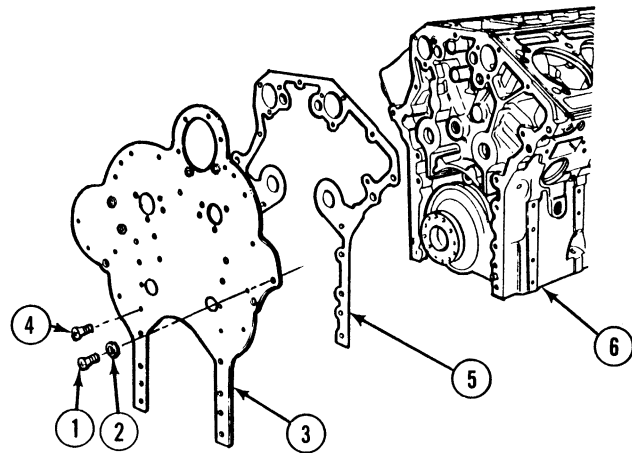


Support rear end plate on flat, even surface when removing screw inserts to prevent warping or bending of end plate.

#### NOTE

Perform Steps (4) and (5) only if screw inserts are damaged.

- (4) Remove two screw inserts (7) from end plate (3). Discard inserts.
- (5) Remove eight screw inserts (8) from end plate (3). Discard inserts.



#### b. Follow-On Maintenance:

- Remove front cylinder block plate, (Para 20-36).

END OF TASK

**20-36. FRONT CYLINDER BLOCK PLATE REMOVAL.**

This task covers:

- a. Removal
- b. Follow-On Maintenance

**INITIAL SETUP**

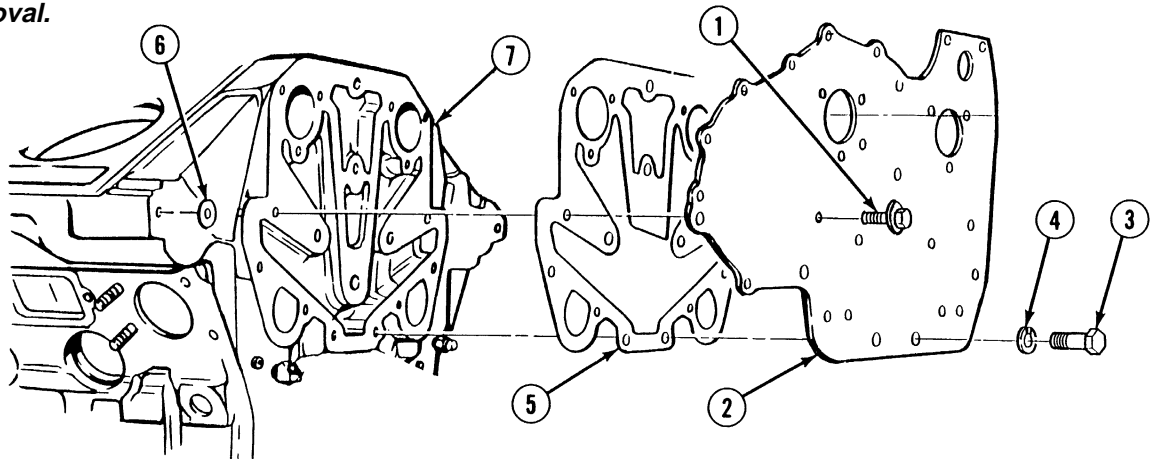
*Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)

*Equipment Condition*

Rear cylinder block plate removed, (Para 20-35)

**a. Removal.**



- (1) Remove five screws (1) from front end plate (2).
- (2) Remove two screws (3) and lockwashers (4) from front end plate (2). Discard lockwashers.
- (3) Remove front end plate (2) and gaskets (5) and (6) from engine block (7). Discard gaskets.

**CAUTION**

Support front end plate on flat, even surface when removing screw inserts to prevent warping or bending end plate.

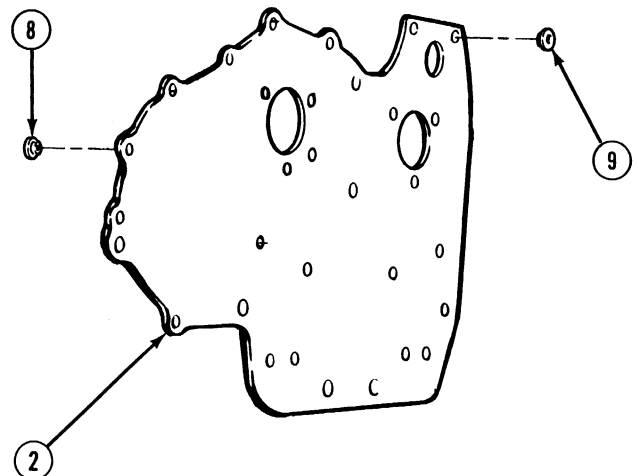
**NOTE**

Perform Steps (4) and (5) only if screw inserts are damaged.

- (4) Remove screw insert (8) from front end plate (2). Discard inserts.
- (5) Remove two screw inserts (9) from front end plate (2). Discard inserts.

**b. Follow-On Maintenance:**

- Remove crankshaft pulley, (Para 20-37).



**END OF TASK**

## 20-37. CRANKSHAFT PULLEY REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

*Tools and Special Tools*

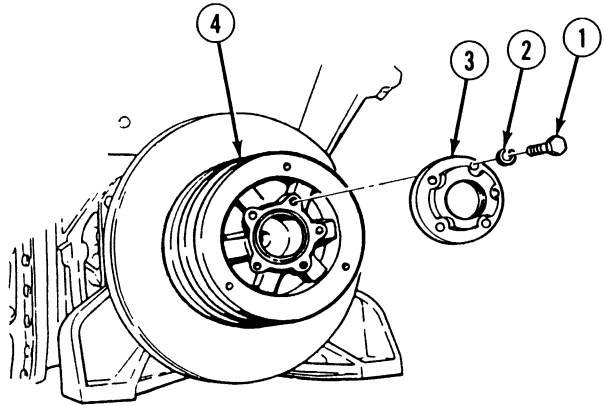
Tool Kit, General Mechanic's  
 (Item 240, Appendix F)  
 Pulley Remover (Item 177, Appendix F)

*Equipment Condition*

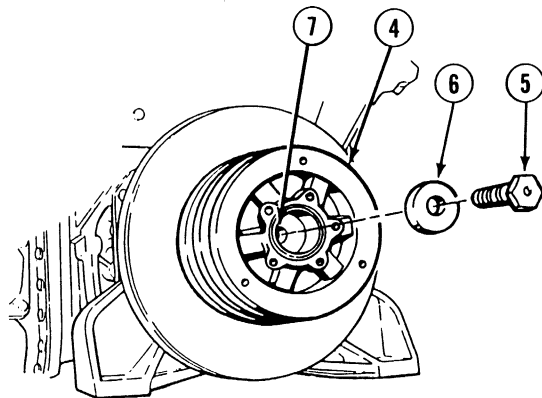
Front cylinder block plate removed, (Para 20-36)

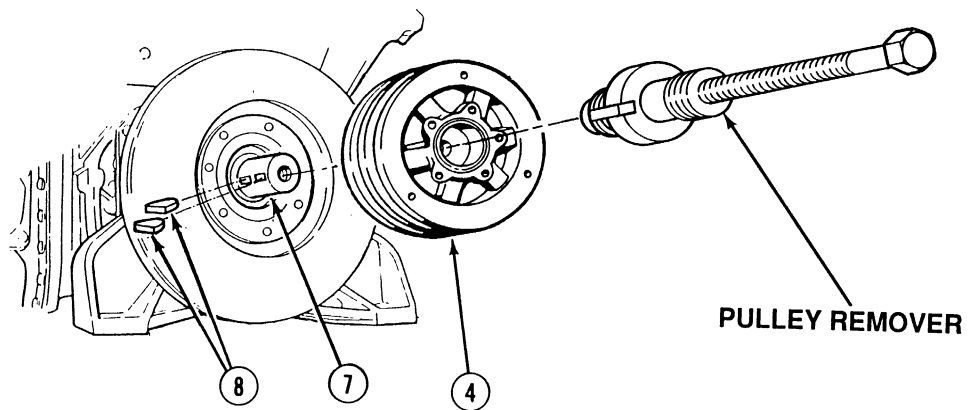
**a. Removal.**

- (1) Remove five screws (1) and lockwashers (2) from PTO adapter (3). Discard lockwashers.
- (2) Remove PTO adapter (3) from crankshaft pulley (4).



- (3) Remove screw (5) and washer (6) from crankshaft pulley (4).
- (4) Install screw (5) in crankshaft (7).

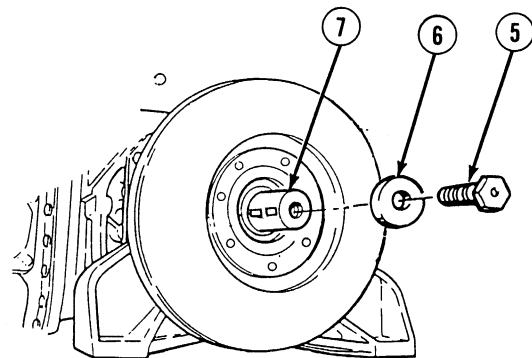




**CAUTION**

Use care when removing crankshaft pulley. Do not pry on vibration damper or damage to equipment may result.

- (5) Using crankshaft pulley remover, remove crankshaft pulley (4) and two keys (8) from crankshaft (7). Discard keys.
- (6) Remove screw (5) from crankshaft (7).
- (7) Install washer (6) and screw (5) in crankshaft (7).



**b. Follow-On Maintenance:**

- Remove vibration damper, (Para 20-38).

**END OF TASK**



## 20-38. VIBRATION DAMPER REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Puller Kit, Universal (Item 174, Appendix F)

#### *Equipment Condition*

Crankshaft pulley removed, (Para 20-37)

#### a. Removal.

### WARNING

Vibration damper may drop off crankshaft and may cause injury to personnel.

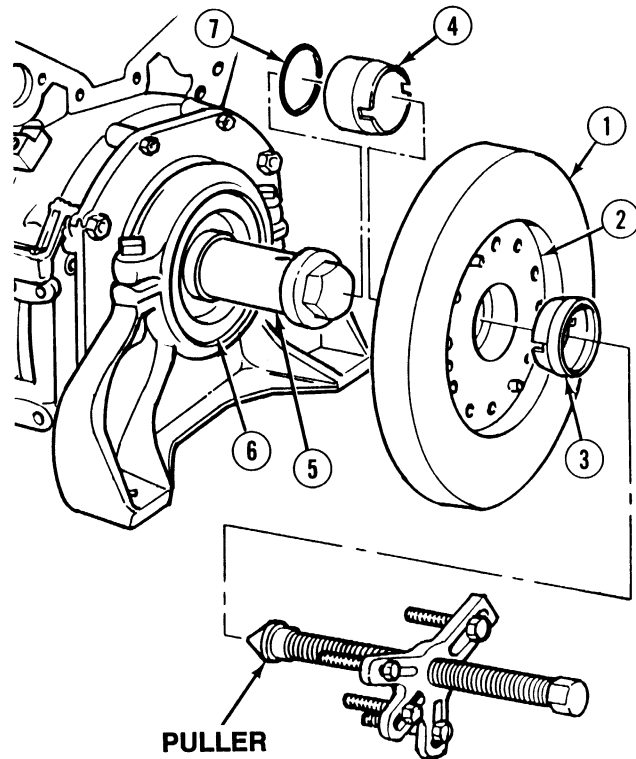
### CAUTION

Use care when removing vibration damper. Pounding, prying or dropping can dent and cause damage to equipment.

### NOTE

If puller does not free damper, use punch in split of cone to pop cone out.

- (1) Using puller, loosen vibration damper (1), hub assembly (2) and front cone (3).
- (2) Turn rear cone (4) clockwise and remove from crankshaft (5) and inside trunnion support (6).
- (3) Remove preformed packing (7) from rear cone (4). Discard preformed packing.



**NOTE**

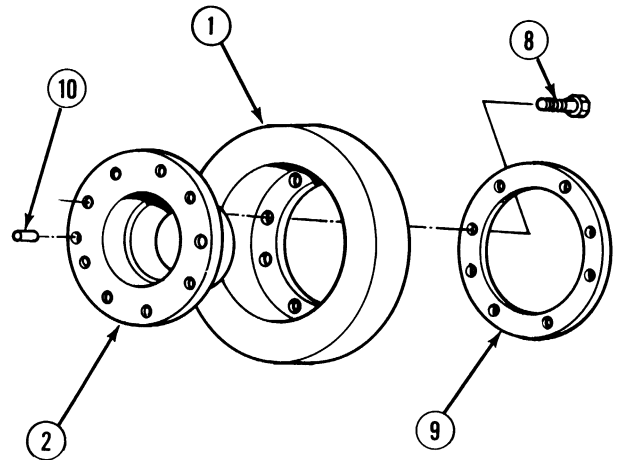
Note location of screws prior to removal.

- (4) Remove eight lockscrews (8), mounting plate (9) and hub assembly (2) from vibration damper (1). Discard lockscrews.

**NOTE**

Perform Step (5) only if dowels are damaged.

- (5) Remove two dowels (10) from hub assembly (2). Discard dowels.

**b. Follow-On Maintenance:**

- Remove crankshaft front cover and seal, (Para 20-39).

**END OF TASK**

## 20-39. CRANKSHAFT FRONT COVER AND SEAL REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

*Tools and Special Tools*

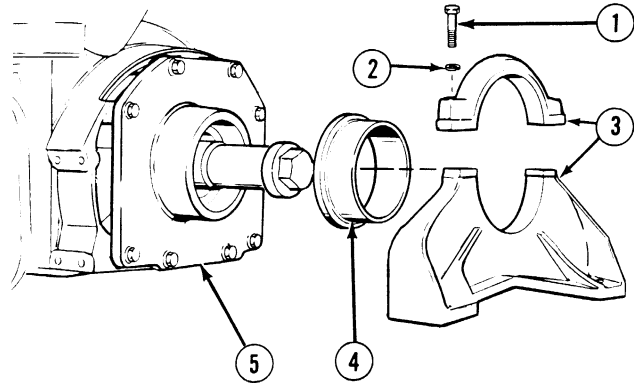
Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Wooden Block (2) (Appendix C)

*Equipment Condition*

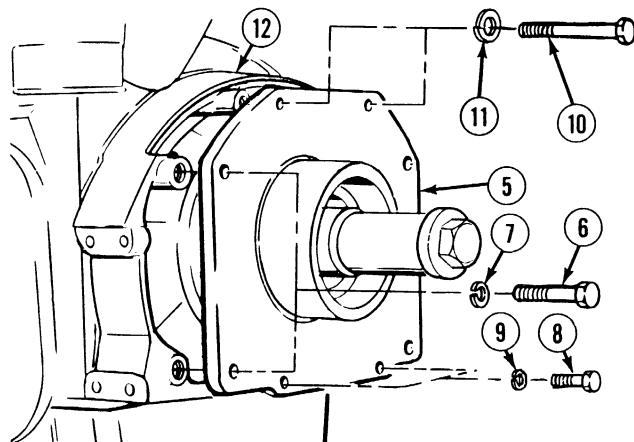
Vibration damper removed, (Para 20-38)

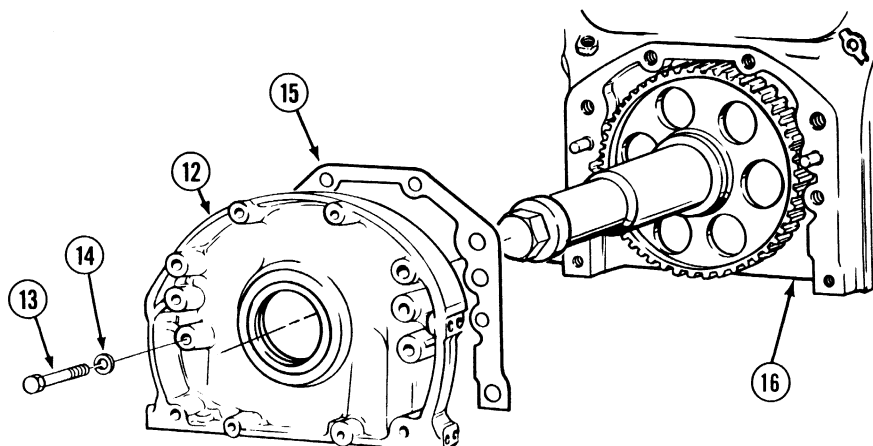
**a. Removal.**

- (1) Remove two screws (1) and lockwashers (2) from supports (3). Discard lockwashers.
- (2) Remove supports (3) and rubber ring (4) from trunnion (5).

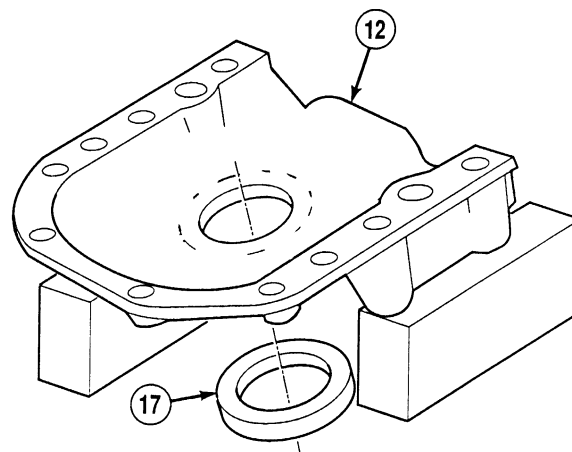


- (3) Remove four screws (6) and lockwashers (7) from trunnion (5). Discard lockwashers.
- (4) Remove two screws (8) and lockwashers (9) from trunnion (5). Discard lockwashers.
- (5) Remove two screws (10) and lockwashers (11) from trunnion (5). Discard lockwashers.
- (6) Remove trunnion (5) from flywheel cover (12).





- (7) Remove two screws (13) and lockwashers (14) from inside flywheel cover (12). Discard lockwashers.
- (8) Remove flywheel cover (12) and gasket (15) from engine block (16). Discard gasket.
- (9) Support flywheel cover (12) outer face on wooden blocks and drive front seal (17) out front side of flywheel cover (12). Discard seal.



**b. Follow-On Maintenance:**

- Remove piston, connecting rod and liner, (Para 20-40).

**END OF TASK**

## 20-40. PISTON, CONNECTING ROD AND LINER REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Remover Assembly (Item 184, Appendix F)

#### *Equipment Condition*

Crankshaft front cover and seal removed,  
(Para 20-39)

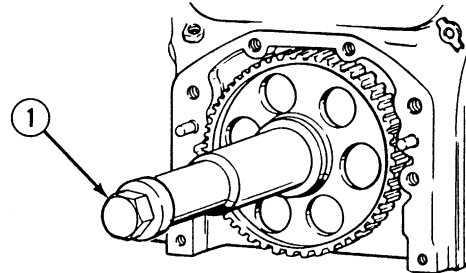
#### *Materials/Parts*

Cloth, Cleaning (Item 11, Appendix B)  
Tags, Identification (Item 72, Appendix B)

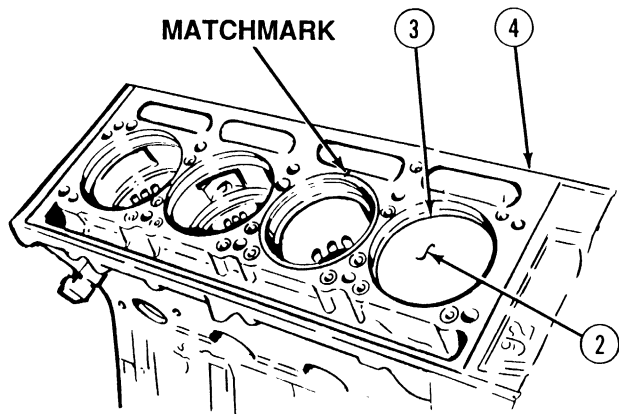
### a. Removal.

#### NOTE

- There are eight pistons, connecting rods, and liners. All eight are removed the same way.
- Matchmark cylinder liner and engine block prior to removal.



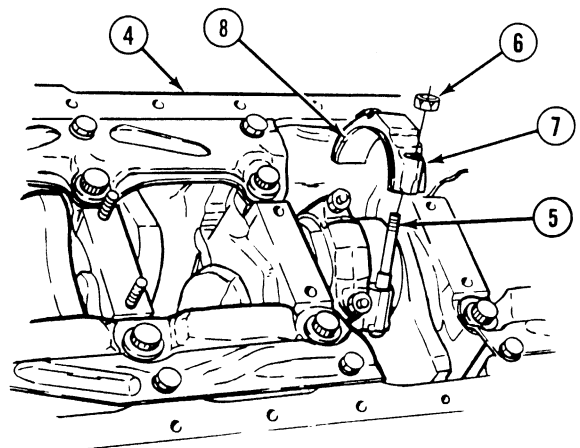
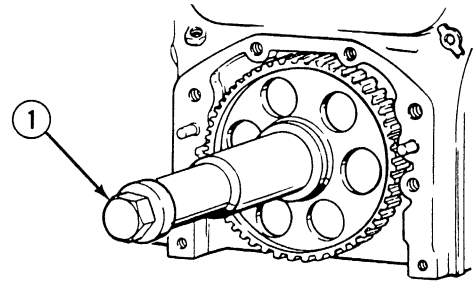
- (1) Turn screw (1) clockwise to move piston (2) so top is just above air inlet ports in cylinder liner (3).
- (2) Place cleaning cloth on top of piston (2) to catch carbon deposits as they are removed from cylinder liner (3).
- (3) Scrape carbon ridge from top of cylinder liner (3).
- (4) Remove rag and carbon residue from cylinder liner (3).
- (5) Perform Steps (1) through (4) for remaining seven cylinders.



**NOTE**

Tag and mark position and location of each connecting rod and piston prior to removal.

- (6) Position engine block (4) in stand with bottom facing up.
- (7) Turn screw (1) to allow access to bearing cap screws (5).
- (8) Remove two nuts (6) from bearing cap screws (5).
- (9) Remove connecting rod bearing cap (7) and lower bearing shell (8).



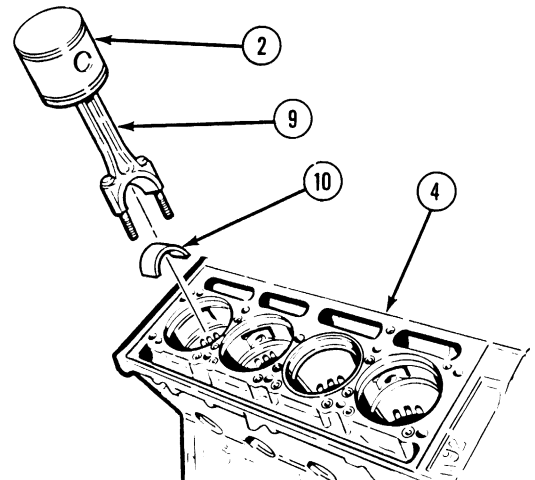
**CAUTION**

- Ensure connecting rod does not catch on lip of liner or damage to liner may result.
- Ensure connecting rod does not strike inside edge of piston or damage to piston may result.

**NOTE**

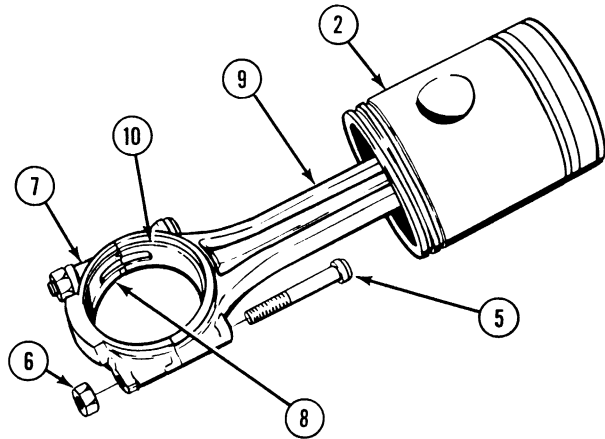
Cylinder liner may come out with piston.

- (10) Position engine block (4) in stand with bottom facing down.
- (11) With aid of assistant remove piston (2), connecting rod (9) and upper bearing shell (10) as an assembly from engine block (4).



**20-40. PISTON, CONNECTING ROD AND LINER REMOVAL (CONT).**

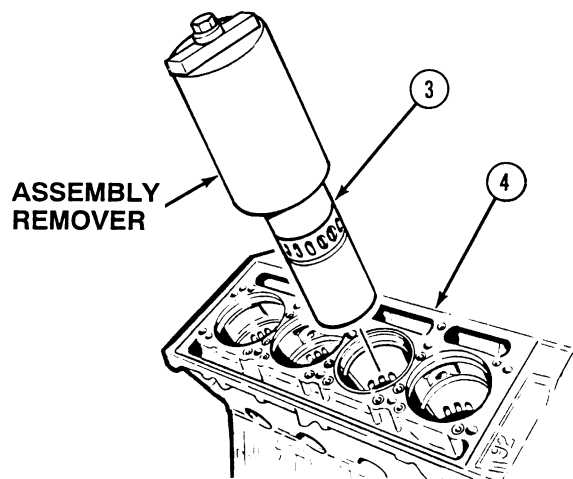
- (12) Position bearing cap (7), upper bearing shell (10), lower bearing shell (8) and two nuts (6) and bearing cap screws (5) on connecting rod (9).
- (13) Perform Steps (6) through (12) to remove seven remaining pistons (2) and connecting rods (9).



**NOTE**

Crankshaft may have to be turned to allow for clearance of removal tool.

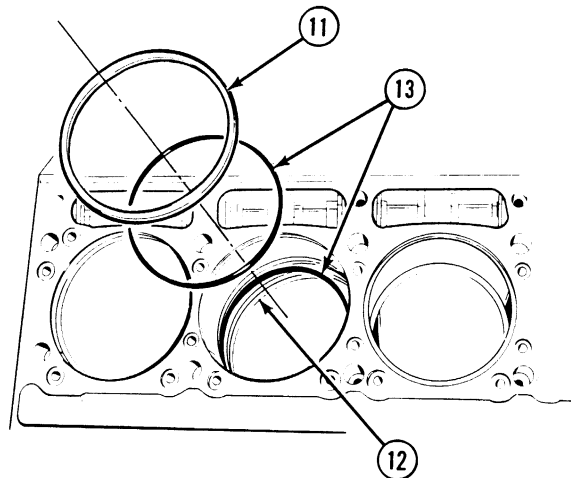
- (14) Using assembly remover, remove liner (3) from engine block (4).
- (15) Remove cylinder liner insert (11) from cylinder bore (12).



- (16) Remove and discard two cylinder liner seal rings (13) from cylinder bore (12).
- (17) Repeat Steps (14) through (17) to remove seven remaining cylinder liners.

**b. Follow-On Maintenance:**

- Repair piston and connecting rod, (Para 20-60).
- Remove engine oil pump drive gear, (Para 20-41).



**END OF TASK**





## 20-42. MAIN BEARING AND CRANKSHAFT REMOVAL.

This task covers:

- a. Removal
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Hammer, Hand, Soft Plastic  
(Item 88, Appendix F)  
Indicator, Dial, Set w/Magnetic Base  
(Item 98, Appendix F)  
Micrometer, Outside, Caliper, Set  
(Item 139, Appendix F)  
Wrench, Torque (0-600 lb-ft [0-814 N·m])  
(Item 278, Appendix F)  
Remover, Bearing Shell  
(Appendix C)

#### *Materials/Parts*

Oil, Lubricating (Item 36, Appendix B)  
Tags, Identification (Item 72, Appendix B)

#### *Personnel Required*

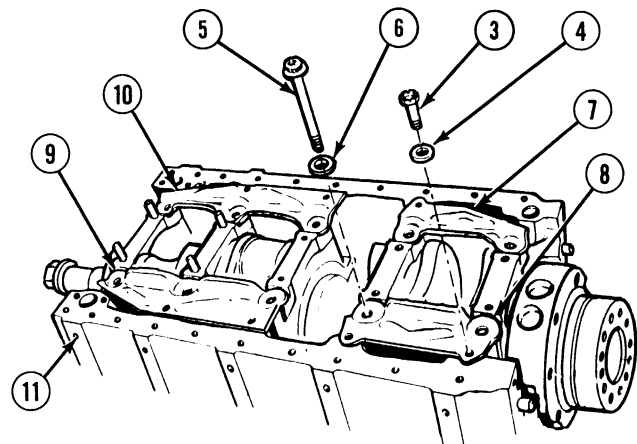
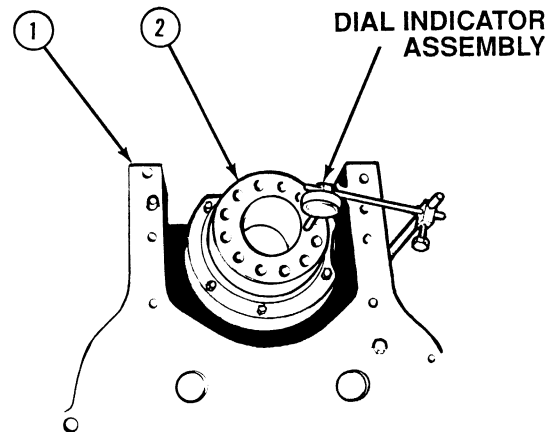
Two

#### *Equipment Condition*

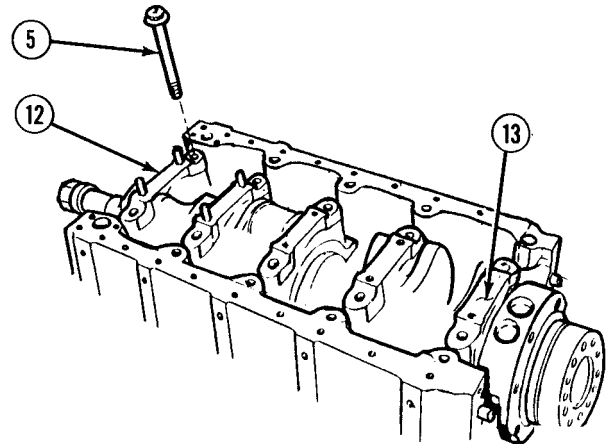
Engine oil pump drive gear removed,  
(Para 20-41)

### a. Removal.

- (1) Position dial indicator on engine block (1) and pry crankshaft (2) toward gage with pry bar. Adjust dial indicator to zero.
- (2) Note end play after repositioning pry bar and prying crankshaft (2) in opposite direction.
- (3) Record end play measurement observed on dial indicator.<sup>77</sup>
- (4) Remove seven lockscrews (3), washers (4), 10 screws (5) and washers (6) from bearing cap stabilizers (7), (8), (9) and (10). Discard lockscrews.
- (5) Remove bearing cap stabilizers (7), (8), (9) and (10) from engine block (11).



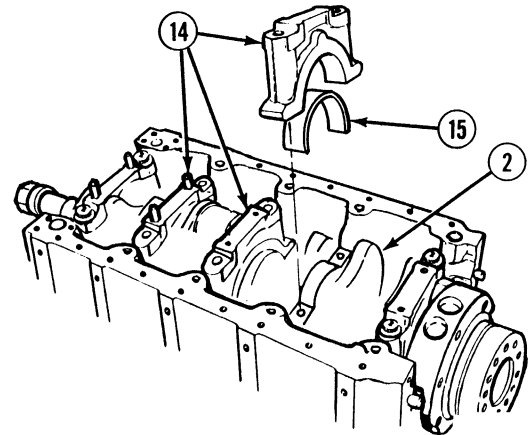
- (6) Install four screws (5) in front main bearing cap (12) and rear main bearing cap (13).
- (7) Tighten four screws (5) on bearing caps (12) and (13) to 50 lb-ft (68 N·m).
- (8) Strike front main bearing cap (12) and rear main bearing cap (13) with soft plastic hammer.
- (9) Tighten four screws (5) on bearing caps (12) and (13) 110 lb-ft (149 N·m).
- (10) Strike front main bearing cap (12) and rear main bearing cap (13) with soft plastic hammer.
- (11) Tighten four screws (5) on bearing caps (12) and (13) 250 to 260 lb-ft (339 to 353 N·m).



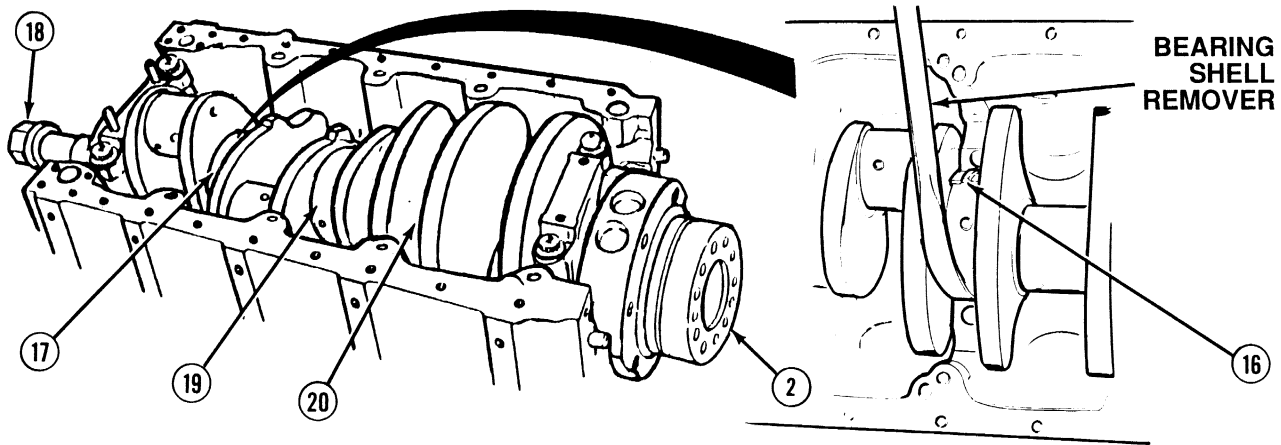
**NOTE**

Bearing caps are numbered from one to five for later installation.

- (12) Remove three center bearing caps (14) from crankshaft (2).
- (13) Remove lower bearing shells (15) from three center bearing caps (14).



**20-42. MAIN BEARING AND CRANKSHAFT REMOVAL (CONT).**



**NOTE**

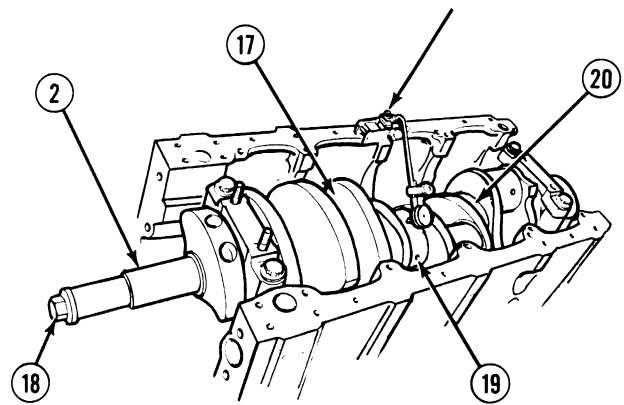
Turn crankshaft to aid in removing bearing shell from under bearing journal.

- (14) With the aid of an assistant, push upper bearing shell (16) out from under crankshaft (2) main bearing journal No. 2 (17) with bearing shell remover while turning screw (18) to turn crankshaft. Remove and discard bearing shell.
- (15) Repeat Step (14) for crankshaft main bearing journals No. 3 (19) and No. 4 (20).
- (16) Position dial indicator on engine block (11) and main bearing journal No. 2 (17).

**NOTE**

Maximum allowable runout for journals No. 2 and No. 4 is 0.002 in. (0.05 mm). Maximum allowable runout for journal No. 3 is 0.004 in. (0.102 mm). Difference between runout measurements for two adjacent journals must not exceed 0.003 in. (0.076 mm). When runout high spots are at right angles to each other, sum of their runout measurements must not exceed 0.004 in. (0.102 mm). Crankshaft must be replaced.

**DIAL INDICATOR ASSEMBLY**



- (17) Turn screw (18) to turn crankshaft (2), and read runout of main bearing journal No. 2 (17), No. 3 (19) and No. 4 (20) with dial indicator.

- (18) Remove four screws (5) and bearing caps (12) and (13) from crankshaft (2).
- (19) Remove lower bearing shells (15) from bearing caps (12) and (13).
- (20) Remove two thrust washers (21) from bearing cap (13). Measure and note thrust washer thickness. Discard thrust washers.

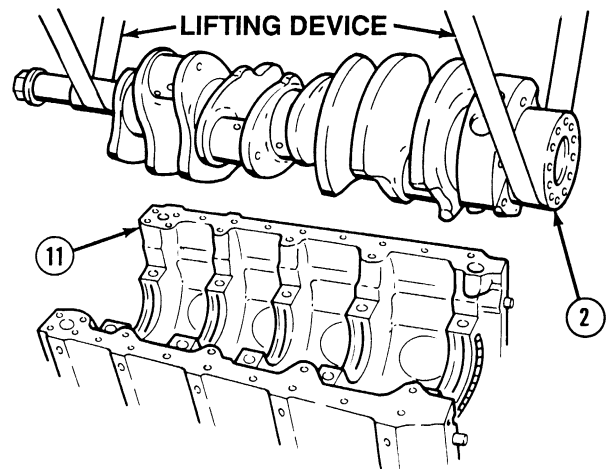
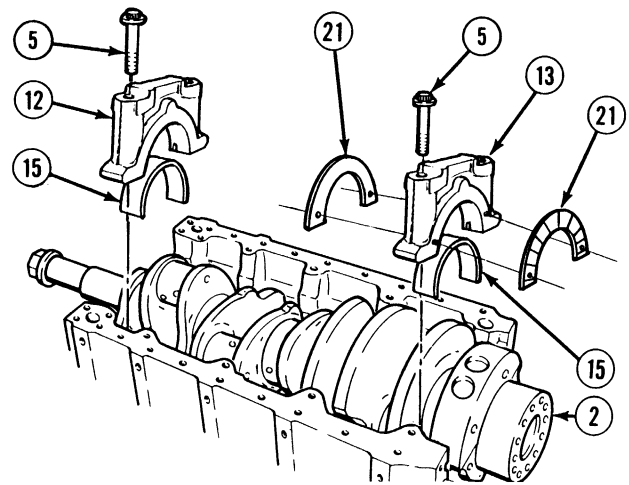
**WARNING**

Crankshaft weighs 185 lbs (84 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**CAUTION**

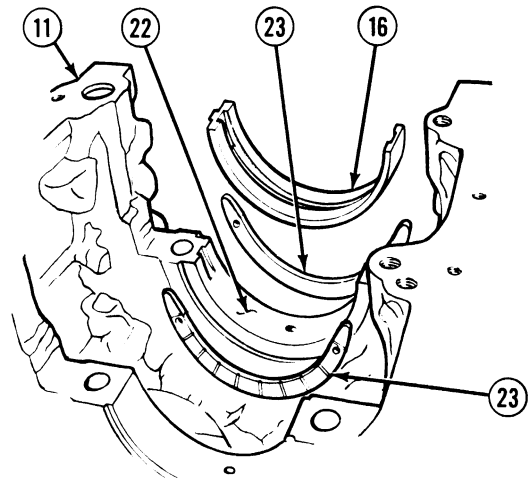
Crankshaft may be bent if stored on side. Store crankshaft on end or damage to crankshaft may result.

- (21) Attach lifting device to crankshaft (2).
- (22) With the aid of an assistant, remove crankshaft (2) from engine block (11) and position on clean work surface.



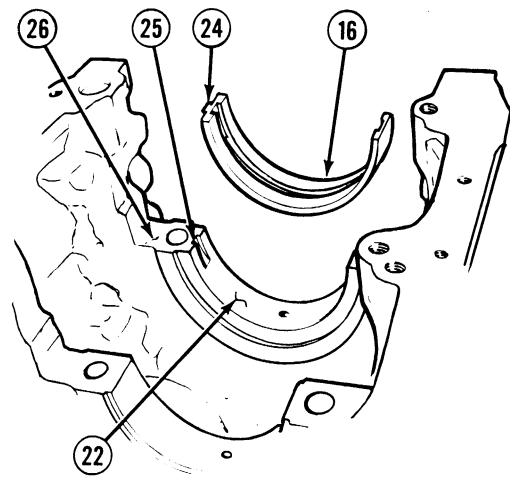
**20-42. MAIN BEARING AND CRANKSHAFT REMOVAL (CONT).**

- (23) Remove two remaining upper bearing shells (16) from bearing surfaces (22) at front and rear of engine block (11).
- (24) Remove two thrust washers (23) from bearing surface (22). Measure and note thrust washer thickness. Discard thrust washers.

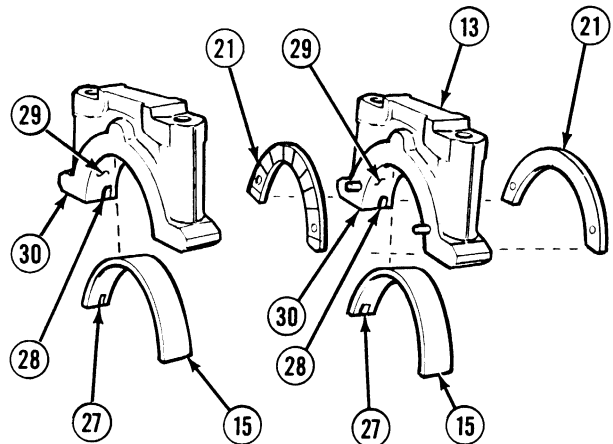


**NOTE**

- If runout measured in Step (17) is not within limits, perform Steps (25) through (35) to see if bearing shell caused crankshaft runout.
- Upper bearing shells have a through slot for lubrication.
- Use new bearing shells for second runout test.



- (25) Align tab (24) on upper bearing shell (16) with slot (25) on engine block rear bearing surface (22).
- (26) Install bearing shell (16) on bearing surface (22). Insure both ends of bearing shell are flush with bearing cap mounting surfaces (26).
- (27) Align tabs (27) with slots (28) and install lower bearing shells (15) on bearing cap mounting surfaces (29). Ensure both ends of bearing shells are flush with bearing cap mounting surfaces (30).
- (28) Install two thrust washers (21) on rear bearing cap (13) with grooved sides of thrust washers facing away from bearing cap.

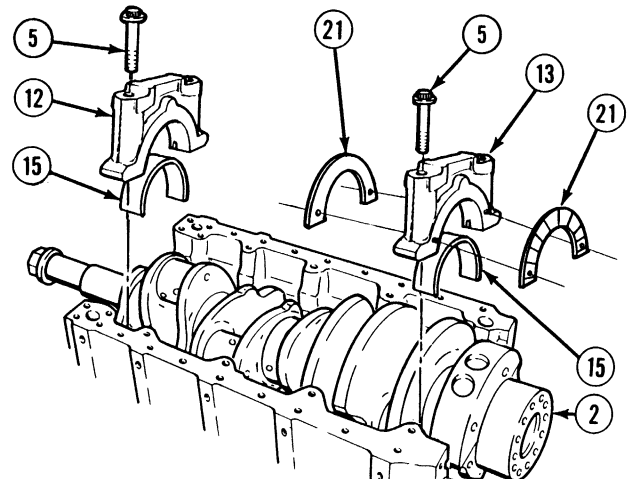
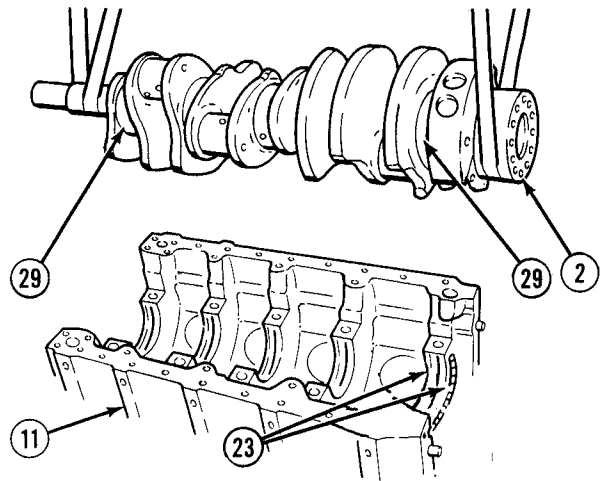


- (29) Apply lubricating oil to crankshaft front and rear main bearing journals (29).

**WARNING**

Crankshaft weighs 185 lbs (84 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (30) Attach lifting device to crankshaft (2).
- (31) With the aid of an assistant and a lifting device, install crankshaft (2) in engine block (11).
- (32) Push crankshaft (2) to front and install thrust washer (23). Push crankshaft (2) to rear and install remaining thrust washer (23).
- (33) Install two bearing caps (12) and (13) and bearing shells (15) on crankshaft (2).
- (34) Perform Steps (6) through (11).
- (35) Perform Steps (16) and (17). If crankshaft runout is still too high, replace crankshaft (2).
- (36) Perform Steps (18) through (35).



**b. Follow-On Maintenance:**

- Repair main bearing and crankshaft, (Para 20-63).
- Repair cylinder block, (Para 20-64).

**END OF TASK**

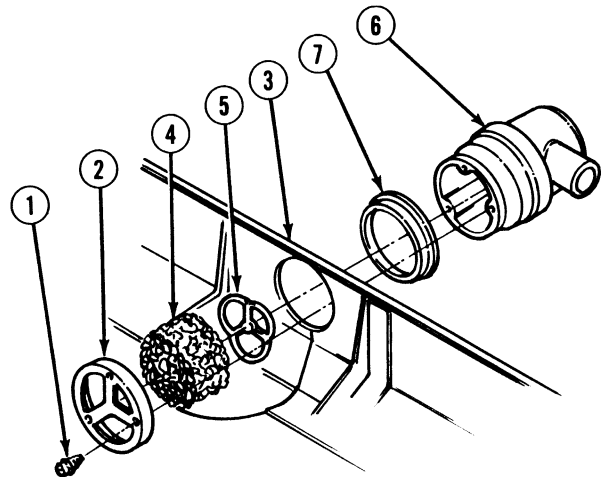


**b. Cleaning/Inspection.****WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
  - (2) Dry all parts with compressed air.
  - (3) Blow out groove in rocker cover with compressed air.
  - (4) Inspect all parts for nicks, burrs, scratches or dents. Replace damaged parts.

**c. Assembly.**

- (1) Install seal (7) in rocker cover (3).
- (2) Install breather shell (6) in seal (7) with breather tube toward rear of rocker cover (3).
- (3) Install breather retainer (5) and element (4) in breather shell (6).
- (4) Position rocker cover retainer (2) over element (4) and install three screws (1) in rocker cover (3).



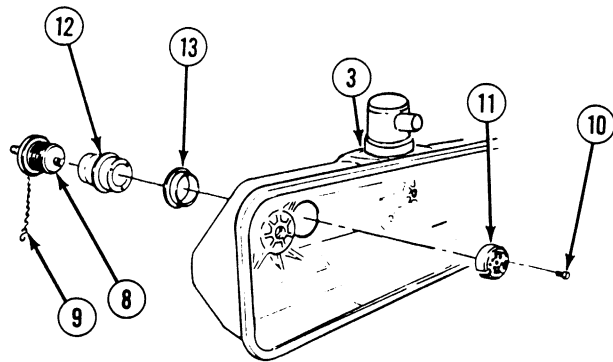


**20-43. ROCKER COVER REPAIR (CONT).**

**NOTE**

- Filler cap located on left rocker cover only.
- Ensure chain hook slides through rocker cover to outside of cover before installing screws.

- (5) Install gasket (13), filler cap tube (12) and strainer (11) in rocker cover (3) with three screws (10).
- (6) Install chain hook (9) on filler cap (8).
- (7) Install filler cap (8) in rocker cover (3).



**END OF TASK**

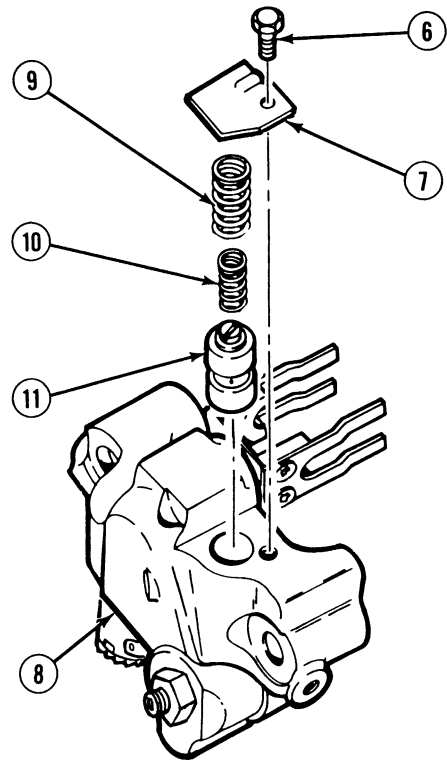


**20-44. ENGINE BRAKE RETARDER REPAIR (CONT).**

**WARNING**

Control valve cover is under spring tension. Use extreme care when removing cover. Control valve cover may project when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

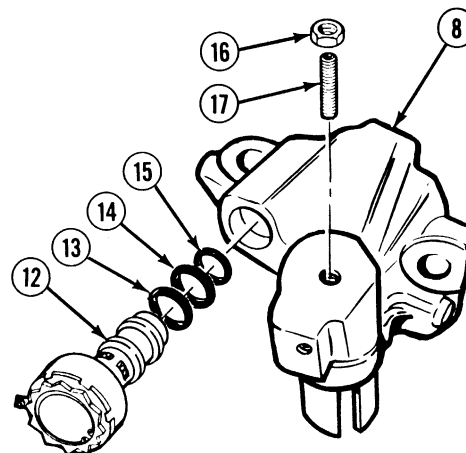
- (3) Remove screw (6) and control valve cover (7) from supply housing (8).
- (4) Remove springs (9) and (10) and valve (11) from supply housing (8). Discard springs.



**NOTE**

Solenoid valve is used on supply housing only.

- (5) Remove solenoid valve (12) from supply housing (8).
- (6) Remove and discard preformed packings (13) and (14) from solenoid valve (12).
- (7) Remove and discard preformed packing (15) from supply housing (8).
- (8) Remove nut (16) and setscrew (17) from supply housing (8).



**WARNING**

Slave piston is retained by spring under compression. Ensure proper eye protection is worn to avoid injury to personnel.

- (9) Position supply housing (8) in press.
- (10) Compress slave piston spring (18) and spring retainer (19) in supply housing (18).

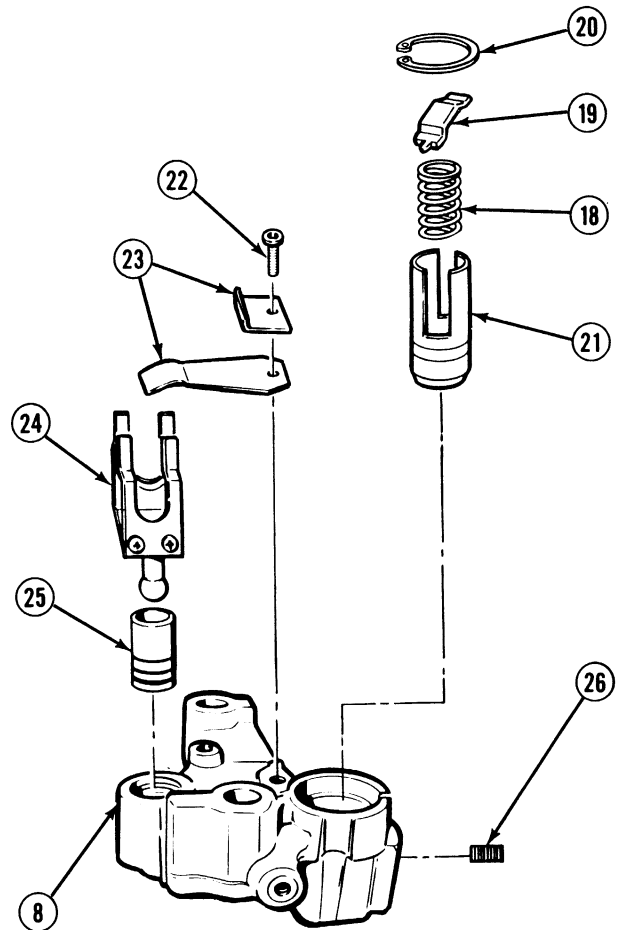
**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (11) Remove retaining ring (20) from supply housing (8). Discard retaining ring.
- (12) Slowly release pressure from spring retainer (19).
- (13) Remove spring retainer (19), spring (18) and slave piston (21) from supply housing (8). Discard spring.
- (14) Remove screw (22), valve spring and retainer assembly (23) and piston fork assembly (24) from supply housing (8).
- (15) Remove pump piston (25) from supply housing (8).

**NOTE**

- Note location of pipe plugs before removal.
  - Perform Step (16) only if plugs are damaged.
- (16) Remove two plugs (26) from supply housing (8).



**20-44. ENGINE BRAKE RETARDER REPAIR (CONT).**

**b. Cleaning/Inspection.**

**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.
- 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 housings and parts with diesel fuel.
- (2) Dry parts with compressed air.
- (3) Inspect all parts for nicks, burrs, scratches or dents. Replace damaged parts.

**c. Assembly.**

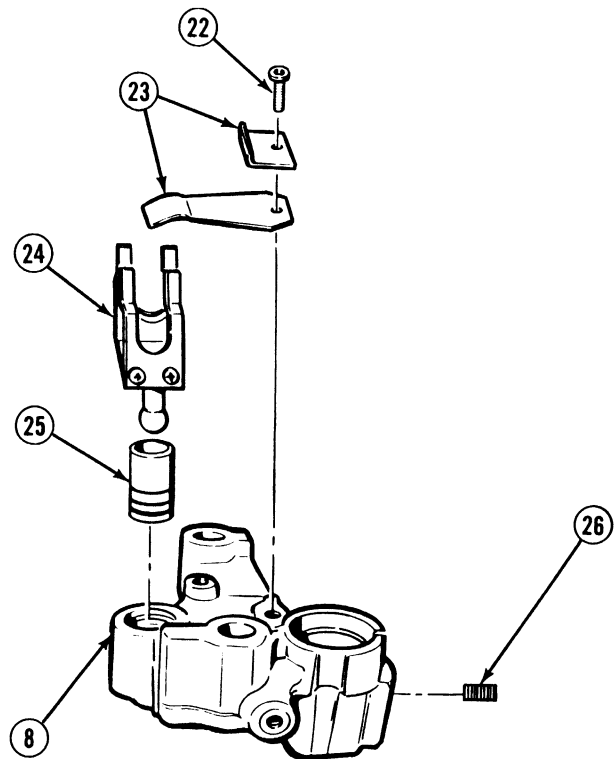
**WARNING**

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**

- All eight engine brake retarders are assembled the same way.
- Perform Step (1) only if plugs were removed.

- (1) Coat threads on two plugs (26) with sealing compound and install in supply housing (8).
- (2) Apply lubricating oil to pump piston (25).
- (3) Install pump piston (25) and piston fork assembly (24) in supply housing (8).
- (4) Apply sealing compound to threads of screw (22).
- (5) Install valve spring and retainer assembly (23) in supply housing (8) with screw (22). Tighten screw to 50 lb-in (6 N·m).

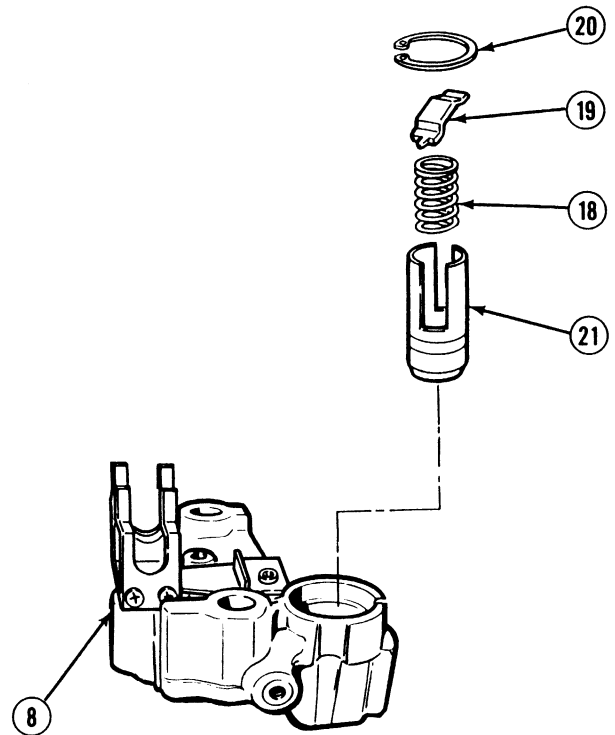


- (6) Apply lubricating oil to slave piston (21) and slave piston spring (18).
- (7) Install slave piston (21) and slave piston spring (18) in supply housing (8).
- (8) Align tab on spring retainer (19) with slot in supply housing (8).
- (9) Position supply housing (8) in press.

**WARNING**

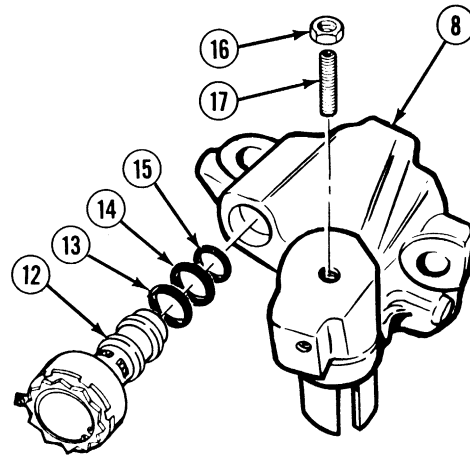
Spring is under extreme tension.  
Wear proper eye protection.  
Spring may shoot out and cause injury to personnel.

- (10) Compress spring (18) and spring retainer (19) in supply housing (8), just below retaining ring groove, and install retaining ring (20) in supply housing (8).
- (11) Remove supply housing (8) from press.



**20-44. ENGINE BRAKE RETARDER REPAIR (CONT).**

- (12) Apply lubricating oil to preformed packing (15).
- (13) Install preformed packing (15) in supply housing (8).
- (14) Apply lubricating oil to preformed packings (13) and (14).
- (15) Install preformed packings (13) and (14) on solenoid valve (12).



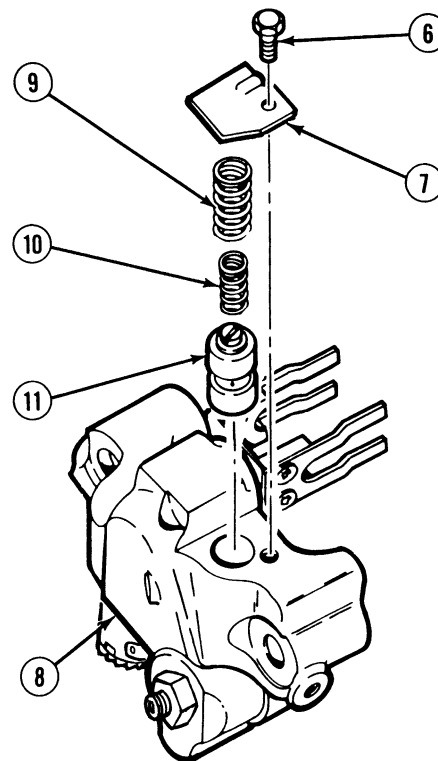
**NOTE**

Solenoid is used on supply housing only.

- (16) Install solenoid valve (12) in supply housing (8). Tighten to 50 lb-in (6 N·m).
- (17) Install setscrew (17) with nut (16) in supply housing (8).
- (18) Apply lubricating oil to control valve (11).
- (19) Install control valve (11), springs (10) and (9) in supply housing (8).

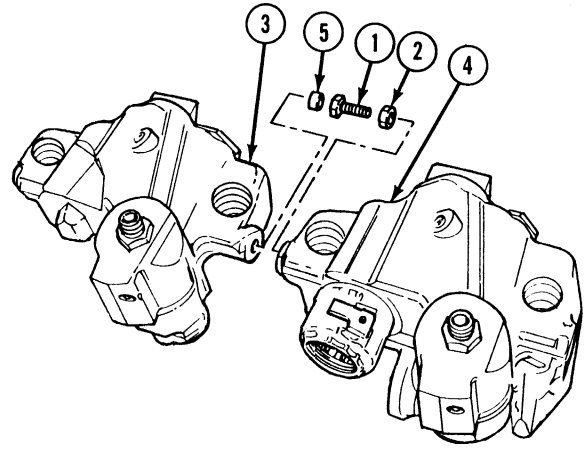
**WARNING**

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.



- (20) Apply sealing compound to screw (6).
- (21) Install control valve cover (7) with screw (6) in supply housing (8). Tighten screw to 110 lb-in (12 N·m).

- (22) Install preformed packing (5) in drone (3).
- (23) Install connector (1) with nut (2) in drone (3) or brake (4).
- (24) Screw connector (1) in about 1/2 in. (13 mm).



**END OF TASK**



## 20-45. ROCKER ARM REPAIR.

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/Inspection | d. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
 (Item 240, Appendix F)  
 Compressor, Unit, Air (Item 35, Appendix F)  
 Gage Set, Feeler (Item 66, Appendix F)  
 Gloves, Chemical Oil Protective  
 (Item 81, Appendix F)  
 Goggles, Industrial (Item 83, Appendix F)  
 Gun, Airblow (Item 86, Appendix F)  
 Press, Arbor, Hand Operated  
 (Item 162, Appendix F)  
 Reamer Set, Hand (Item 181, Appendix F)

#### *Materials/Parts*

Oil, Lubricating (Item 36, Appendix B)  
 Solvent, Drycleaning (Item 68, Appendix B)  
 Tags, Identification (Item 72, Appendix B)  
 Bushing (Item 21, Appendix E)

#### *Equipment Condition*

Engine brake retarder removed, (Para 20-14)

### a. *Disassembly.*

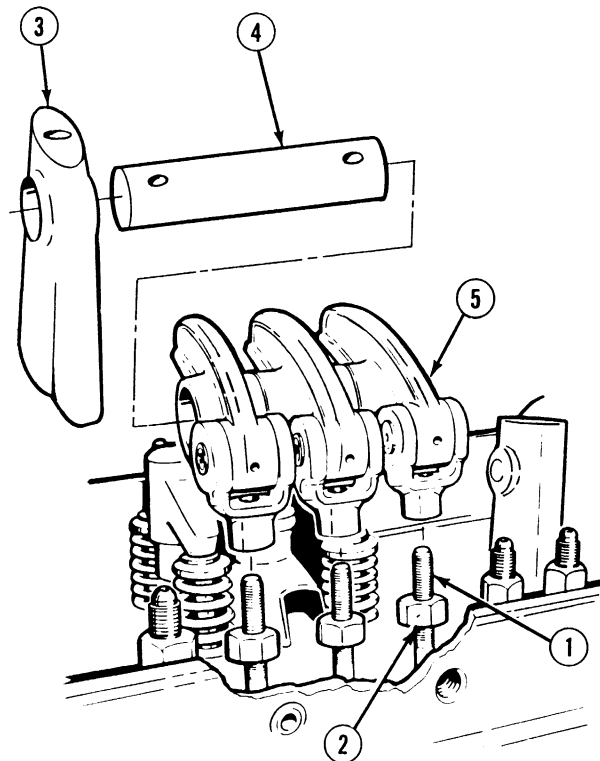
#### NOTE

All 24 rocker arms are removed the same way.

- (1) Hold three push rods (1) and loosen three locknuts (2).
- (2) Remove two brackets (3) from rocker shaft (4).

#### CAUTION

- Do not force rocker arms all the way back with shaft in place. Failure to comply could result in damage to push rods.
  - Rocker arms need to be raised and moved toward center of engine to permit removal of shaft or damage to parts may occur.
- (3) Raise three rocker arms (5) and shaft (4) slightly.



**NOTE**

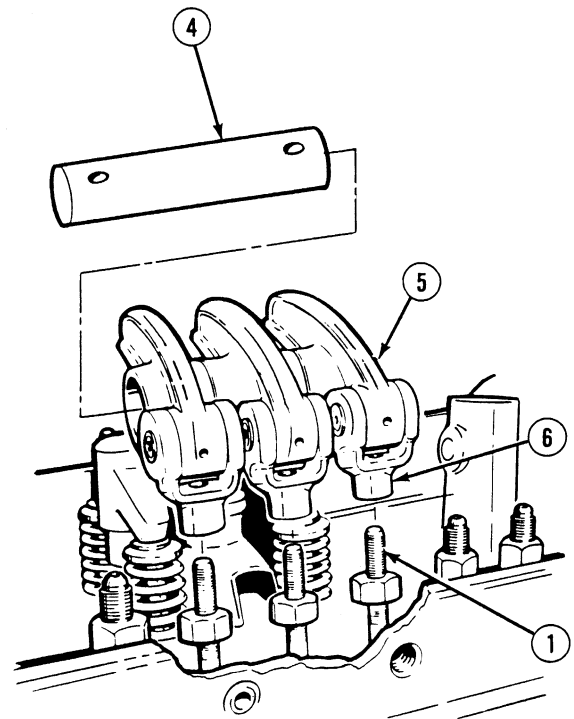
Tag and mark shaft prior to removal.

- (4) Remove shaft (4) from rocker arms (5).

**NOTE**

Tag and mark rocker arms before removal.

- (5) Remove three rocker arms (5) and clevis yoke (6) from push rods (1).



**b. Cleaning/Inspection.**

**WARNING**

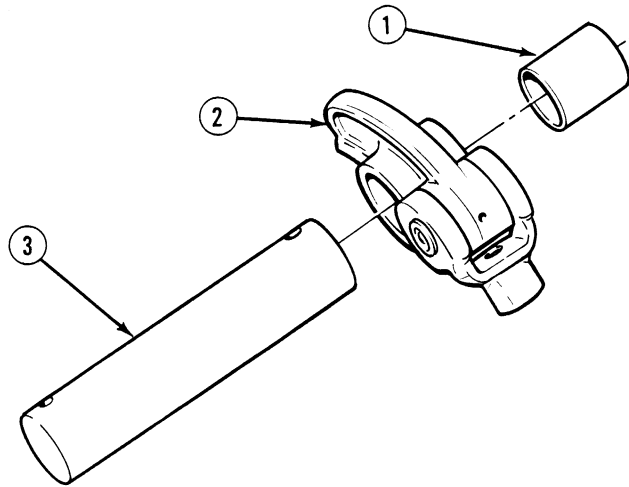
- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes, and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent. The flashpoint for Type II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
  - (2) Dry all metal parts with compressed air.
  - (3) Inspect rocker arm assembly and brackets for cracks, nicks, burrs or scratches. Replace damaged parts.

**20-45. ROCKER ARM REPAIR (CONT).**

**NOTE**

- Clearance between bushing and shaft must not exceed 0.004 in. (0.102 mm).
- If bushing is not within specified clearance, perform Steps (5) through (8).

- (4) Measure inside diameter of bushing (1) in rocker arms (2) and outside diameter of shaft (3).
- (5) Position rocker arm (2) in press.
- (6) Press bushing (1) from rocker arm (2). Discard bushing.
- (7) Press bushing (1) in rocker arm (2).
- (8) Ream replacement bushing (1) to 0.875 in. (22 mm).

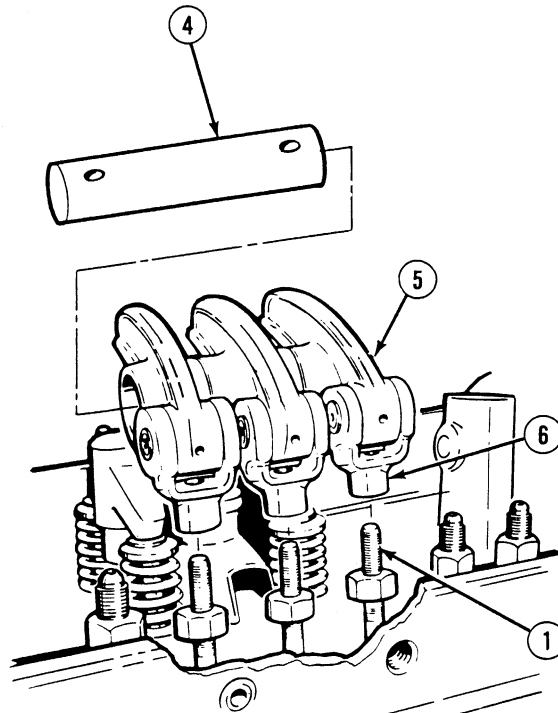


**c. Assembly.**

**NOTE**

- All 24 rocker arms are installed the same way.
- Assemble rocker arms as noted during removal.

- (1) Thread three rocker arms (5) on push rods (1) until top of each push rod (1) is flush with or above threaded area of each clevis yoke (6).
- (2) Coat shaft (4) with lubricating oil.
- (3) Slide shaft (4) through three rocker arms (5).
- (4) Position two brackets (3), one over each end of shaft (4), with finished face toward rocker arms (5).



**d. Follow-On Maintenance:**

- Install engine brake retarders, (Para 20-93).

**END OF TASK**

**20-46. EXHAUST VALVE BRIDGE REPAIR.**

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/Inspection | d. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Caps, Vise Jaw (Item 27, Appendix F)  
Compressor, Unit, Air (Item 35, Appendix F)  
Gage Set, Feeler (Item 66, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Vise, Machinist's (Item 248, Appendix F)  
Wrench, Torque (0-175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

*Materials/Parts*

Oil, Lubricating (Item 36, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Tags, Identification (Item 72, Appendix B)  
Locknut (16) (Item 187, Appendix E)

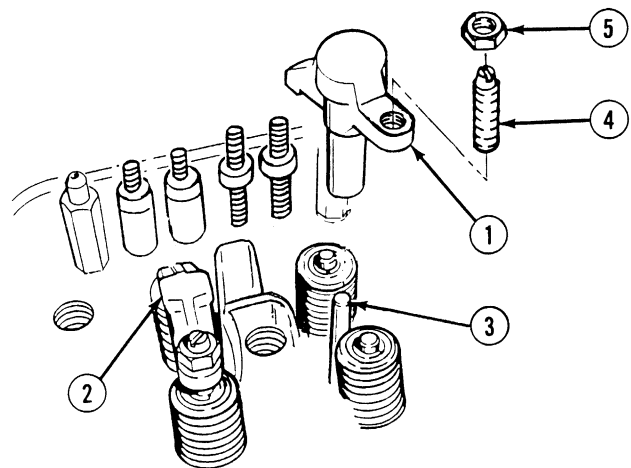
*Equipment Condition*

Rocker arms removed, (Para 20-45)

**a. Disassembly.****NOTE**

- Tag valve bridges when removed so bridges may be installed in original locations.
- All 16 valve bridges are removed the same way.

- (1) Remove valve bridges (1) and (2) from valve bridge guides (3).
- (2) Position valve bridges (1) and (2) in soft jawed vise.
- (3) Remove screw (4) and locknut (5) from valve bridge (1) and (2). Discard locknut.



**20-46. EXHAUST VALVE BRIDGE REPAIR (CONT).**

**b. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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.

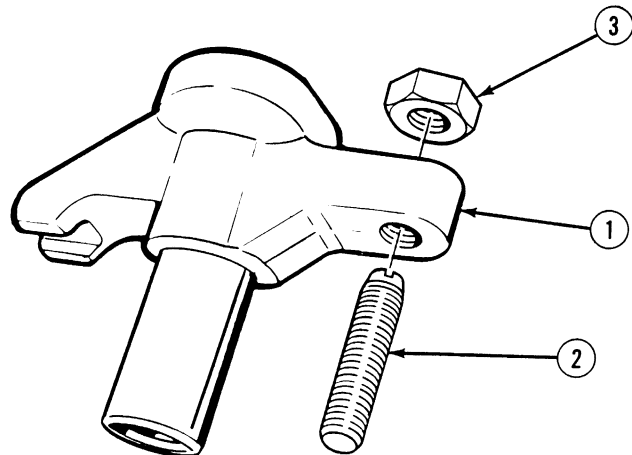
- (1) Clean all parts in drycleaning solvent.
- (2) Dry all parts with compressed air.
- (3) Inspect exhaust valve bridges for cracks, chipping, scoring, or excessive wear. Replace defective bridges.

**c. Assembly.**

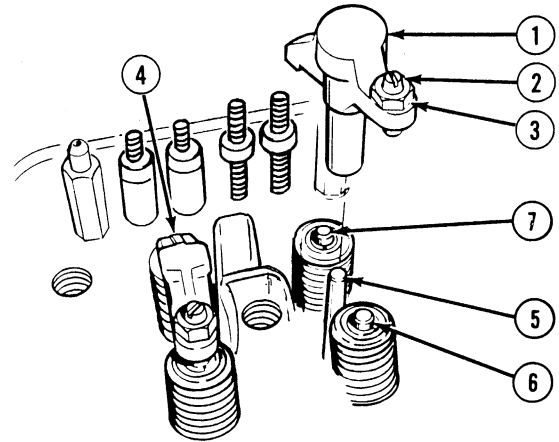
**NOTE**

All 16 exhaust valve bridges are installed the same way.

- (1) Position valve bridge (1) in soft-jawed vise.
- (2) Install screw (2) slotted end up in valve bridge (1).
- (3) Position nut (3) on screw (2).
- (4) Remove valve bridge (1) from vise.



- (5) Install valve bridges (1) and (4) on valve bridge guides (5), making sure grooves in valve bridges fit over top of valve stem (7).
- (6) Push down on top of valve bridges (1) and (4) and turn adjusting screw (2) until adjusting screw (2) just touches valve stem (6).
- (7) Tighten screw (2) an additional 1/4-turn and tighten nut (3).
- (8) Remove valve bridges (1) and (4) from valve bridge guides (5) and position in soft-jawed vise.
- (9) Hold screw (2) and tighten nut (3) to 20 to 25 lb-ft (27 to 34 N·m).
- (10) Remove valve bridges (1) and (4) from soft jawed vise.
- (11) Coat valve bridges (1) and (4) and valve bridge guides (5) with lubricating oil.
- (12) Install valve bridges (1) and (4) on valve bridge guides (5) making sure grooves in valve bridges fit over top of valve stem (7).
- (13) Insert 0.0015 in. (0.0381 mm) feeler gage between end of valve bridges (1) and (4) and exhaust valve stem (6).
- (14) Press down on top surface of valve bridges (1) and (4). Feeler gage must be tight.
- (15) Repeat Steps (13) and (14) for other end of valve bridges (1) and (4).



**d. Follow-On Maintenance:**

- Install rocker arms, (Para 20-45).

**END OF TASK**

## 20-47. CAM FOLLOWER/PUSH ROD REPAIR.

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/Inspection | d. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Caps, Vise Jaw (Item 27, Appendix F)  
Compressor, Unit, Air (Item 35, Appendix F)  
Gage Set, Feeler (Item 66, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Hammer, Hand, Soft Plastic  
(Item 88, Appendix F)  
Indicator, Dial, Set w/Magnetic Base  
(Item 98, Appendix F)  
Pan, Drain 4 gal (Item 144, Appendix F)  
Pliers, Retaining Ring (Item 154, Appendix F)  
Vise, Machinist's (Item 248, Appendix F)  
Wrench Set, Socket 3/8 in. Drive  
(Item 273, Appendix F)

#### *Tools and Special Tools - Continued*

Wrench, Torque (0-60 N·m)  
(Item 276, Appendix F)  
Wooden Block (2) (Appendix C)

#### *Materials/Parts*

Cloth, Cleaning (Item 11, Appendix B)  
Oil, Diesel, Fuel (Item 32, Appendix B)  
Oil, Lubricating (Item 36, Appendix B)  
Rags, Wiping (Item 47, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Tags, Identification (Item 72, Appendix B)  
Locknut (24) (Item 187, Appendix E)  
Lockwasher (24) (Item 290, Appendix E)  
Spring (24) (Item 658, Appendix E)

#### *Equipment Condition*

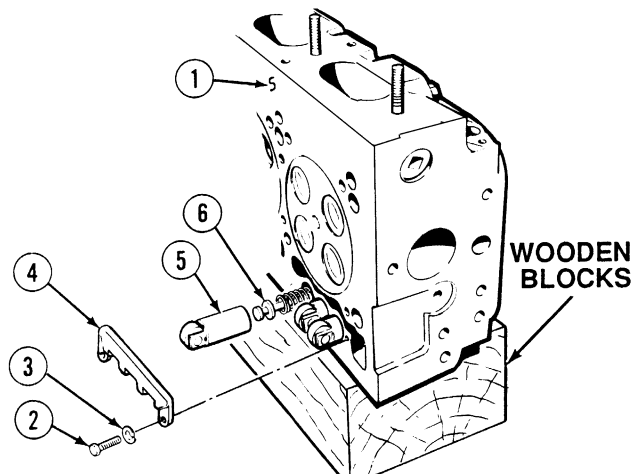
Exhaust valve bridges removed, (Para 20-46)

### a. *Disassembly.*

#### NOTE

- Tag cam follower and associated parts so they may be installed in original location.
- All 24 cam followers are removed the same way.

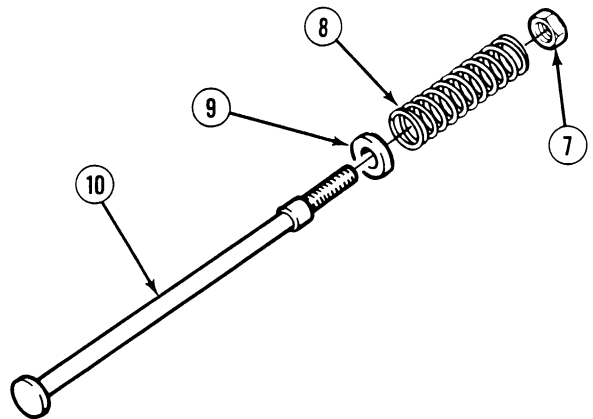
- (1) Position cylinder head (1) on side on wooden blocks.
- (2) Remove two screws (2), lockwashers (3) and cam follower guide (4) from cylinder head (1). Discard lockwashers.
- (3) Remove cam follower (5) from cylinder head (1).
- (4) Remove push rod assembly (6) from cylinder head (1).



**WARNING**

Spring is under extreme tension.  
Wear proper eye protection.  
Spring may shoot out and cause injury to personnel.

- (5) Remove locknut (7), spring (8) and lower spring seat (9) from push rod (10). Discard locknut and spring.



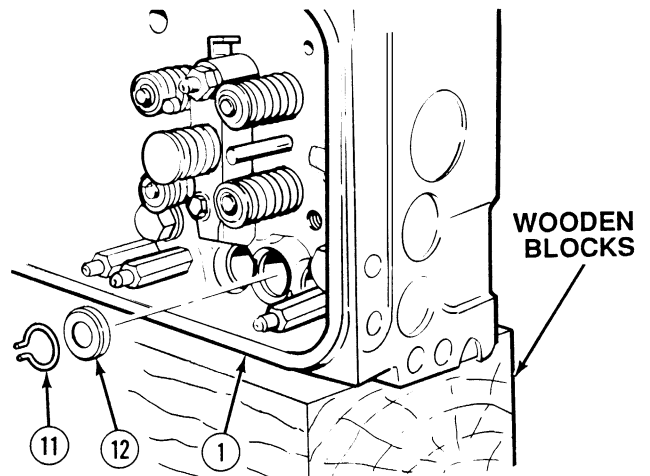
**WARNING**

Use extreme care when removing spring retainers. Spring retainers are under tension and can act as projectiles when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

**NOTE**

Spring retainer must point in proper direction when installed. Mark direction of spring retainer prior to installation.

- (6) Remove spring retainer (11) from top side of cylinder head (1).
- (7) Remove upper spring seat (12) from cylinder head (1).





**20-47. CAM FOLLOWER/PUSH ROD REPAIR (CONT).**

**b. Cleaning/Inspection.**

**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.
- 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) Wash all parts except cam followers in diesel fuel.
- (2) Dry all parts except cam followers with compressed air.
- (3) Wash cam followers in lubricating oil and wipe dry with cleaning cloth.
- (4) Inspect cam follower rollers for scoring, pitting, or flat spots. Replace cam follower if damaged.
- (5) Inspect cam follower (2) for nicks, burrs, scratches or dents.
- (6) Replace all damaged parts.
- (7) Position cam follower (2) in soft jawed vise.

**NOTE**

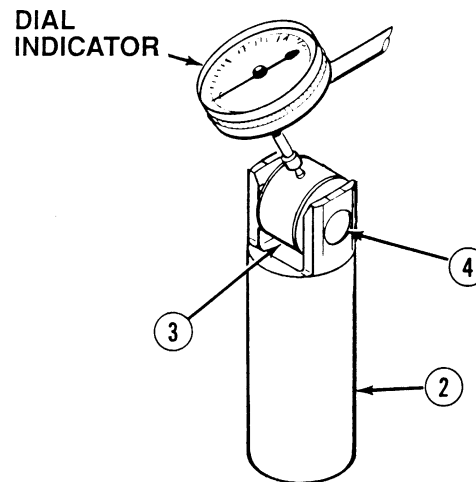
If clearance is more than 0.023 in. (0.58 mm), replace cam follower.

- (8) Check that side clearance between cam follower (2) and roller (3) is not more than 0.023 in. (0.58 mm).

**NOTE**

If clearance is more than 0.010 in. (0.25 mm), replace cam follower.

- (9) Using dial indicator, check for more than 0.010 in. (0.25 mm) pin (4) to bushing clearance.
- (10) Remove cam follower (2) from soft jawed vise.



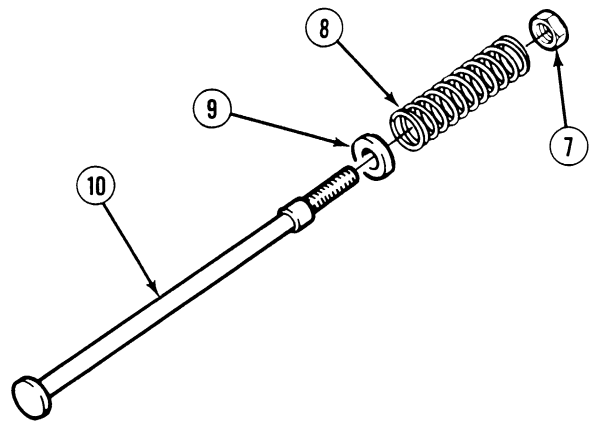
- (11) Rotate cam followers during soaking.
- (12) Remove cam followers from pail and allow to air dry.

**c. Assembly.**

**NOTE**

- Apply lubricating oil to all parts before installation.
- All 24 cam followers are installed the same way.

- (1) Install lower spring seat (9), spring (8) and locknut (7) on push rod (10).



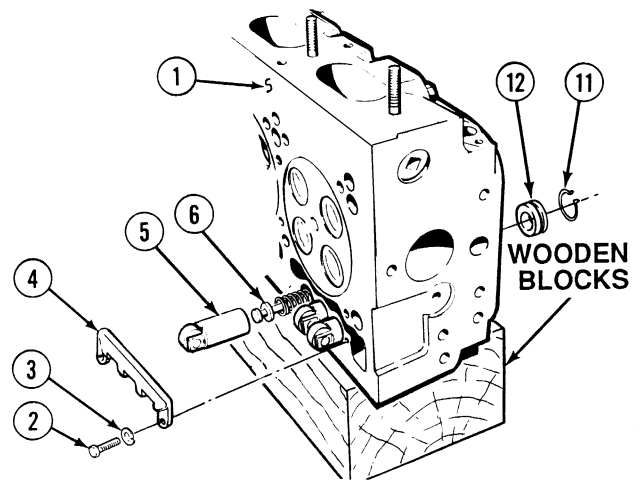
**WARNING**

Use extreme care when installing spring retainers. Spring retainers are under tension and can act as projectiles when released suddenly. Ensure proper eye protection is worn to prevent injury to personnel.

**NOTE**

Ensure spring retainers are installed same as marked during removal.

- (2) Install upper spring seat (12) and spring retainer (11) in topside of cam follower bore of cylinder head (1).
- (3) Install push rod assembly (6) in cylinder head (1).



**NOTE**

Cam follower should be positioned so oil hole points away from exhaust valves.

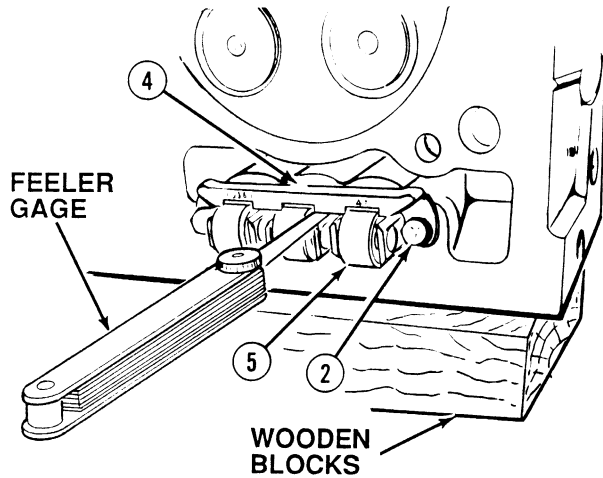
- (4) Install cam follower (5) over push rod assembly (6) and in cylinder head (1).
- (5) Install cam follower guide (4), two lockwashers (3) and screws (2) in cylinder head (1).

**20-47. CAM FOLLOWER/PUSH ROD REPAIR (CONT).**

**NOTE**

There must be 0.005 in. (0.13 mm), but not more than 0.010 in. (0.25 mm), clearance between cam follower guide and cam follower.

- (6) Insert 0.005 in. (0.13 mm) feeler gage between cam follower guide (4) and legs of cam followers (5).
- (7) Tap cam follower guide (4) lightly with brass hammer until feeler gage is snug.
- (8) Tighten screws (2) to 180 lb-in (20 N·m).
- (9) Remove feeler gage from cam follower guide (4) and legs of cam followers (5).
- (10) Check clearance again as in Step (6).



**NOTE**

If proper clearance cannot be obtained, replace cam follower guide.

- (11) If not enough clearance, loosen screws (2) and move guide (4) and repeat Steps (6) through (9) until proper clearance is obtained.

**d. Follow-On Maintenance:**

- Install exhaust valve bridges, (Para 20-46).

**END OF TASK**

**20-48. EXHAUST VALVE REPAIR.**

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/Inspection | d. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Caliper, Dial, 0-6 in. w/Dial  
(Item 25, Appendix F)  
Compressor, Unit, Air (Item 35, Appendix F)  
Compressor, Spring, Valve (Item 41, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Grinding Machine, Valve Face  
(Item 85, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Hammer, Hand, Soft Plastic  
(Item 88, Appendix F)  
Inserter, Seal (Item 104, Appendix F)  
Installer, Seal (Item 117, Appendix F)  
Stone, Abrasive, Cylinder (Item 228, Appendix F)  
Wooden Block (2) (Appendix C)

*Materials/Parts*

Oil, Diesel, Fuel (Item 32, Appendix B)  
Oil, Lubricating (Item 36, Appendix B)  
Tags, Identification (Item 72, Appendix B)  
Tape, Masking (Item 74, Appendix B)  
Lock, Valve (32) (Item 162, Appendix E)  
Seal, Oil (32) (Item 595, Appendix E)  
Spring (32) (Item 667, Appendix E)

*Equipment Condition*

Cam followers/push rods removed,  
(Para 20-47)

**20-48. EXHAUST VALVE REPAIR (CONT).**

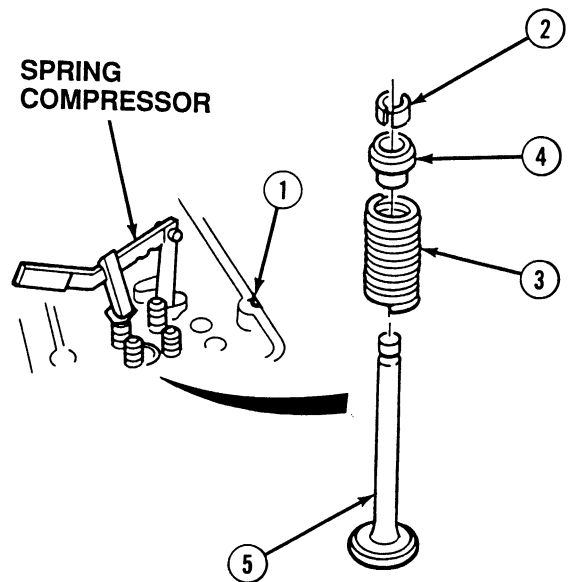
*a. Disassembly.*

**WARNING**

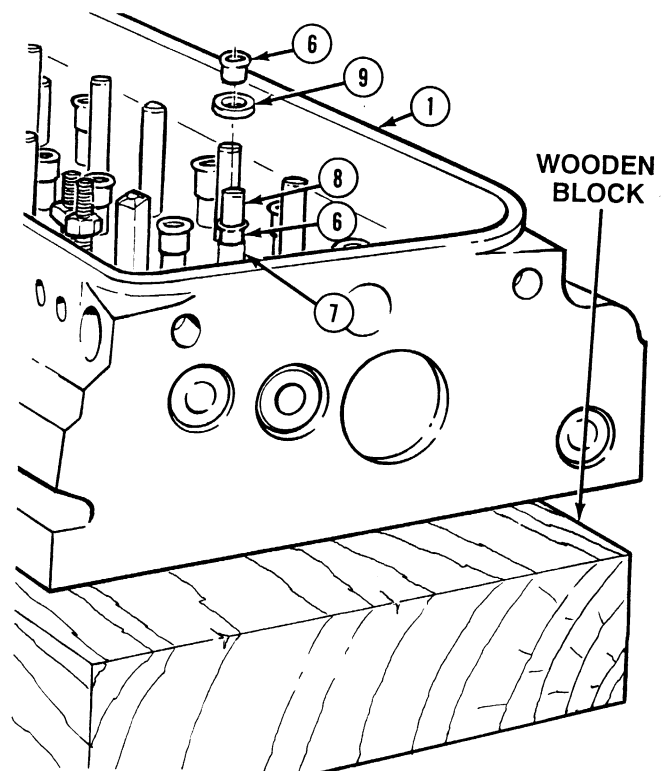
Use extreme care when compressing spring. Spring is under tension and can act as a projectile when released and could cause severe eye injury.

**NOTE**

- All 32 exhaust valves are removed the same way.
- Number and tag each valve upon removal to ensure installation in same location.
- Position cylinder head on wooden blocks. Wooden block under valve will support valve while two-piece valve lock is being removed.



- (1) Install spring compressor on cylinder head (1).
- (2) Remove and discard two-piece valve lock (2) by compressing spring (3) on spring cap (4).
- (3) Release pressure on spring (3).
- (4) Remove spring cap (4) and valve spring (3) from exhaust valve (5). Discard spring.
- (5) Repeat Steps (1) through (4) for each valve being removed.
- (6) Remove spring compressor from cylinder head (1).
- (7) Remove valve guide seal (6) from valve guide (7). Discard seal.
- (8) Turn cylinder head (1) on side and remove valve (8) from bottom of cylinder head (1).
- (9) Remove valve seat (9) from valve guide (7).

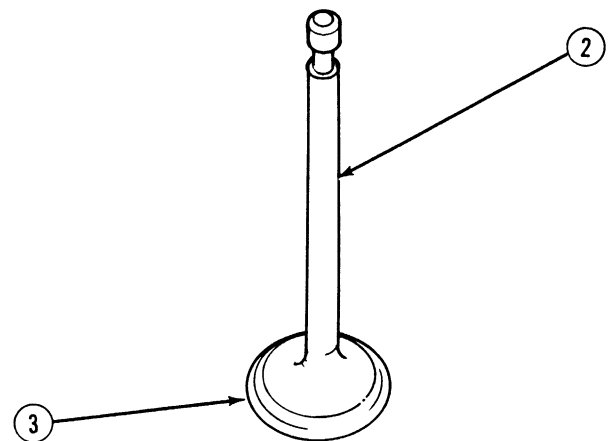


**b. Cleaning/Inspection.**

**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.
- 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.

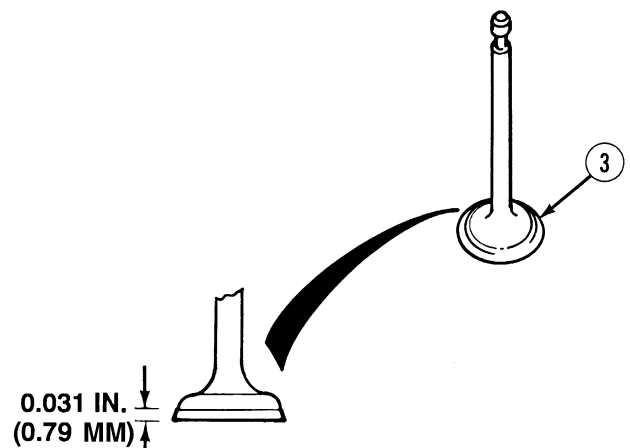
- (1) Clean parts with fuel oil.
- (2) Dry all parts with compressed air.
- (3) Inspect spring seat and spring caps for wear, nicks, burrs or scratches. Replace damaged parts.
- (4) Inspect valve stem (2) and valve face (3) for cracks, pitting, and warpage. Replace if damaged.
- (5) Inspect outer diameter of valve face (3) for scoring or galling. Replace if damaged.



**NOTE**

Perform Steps (6) through (9) only if exhaust valve is being reused.

- (6) Grind exhaust valve face (3) using 31 degree grinding stone.
- (7) Edge of valve face (3) must not be less than 0.031 in. (0.79 mm) thick after grinding. If edge of valve face is less than 0.031 in. (0.79 mm) after grinding, discard valve.
- (8) Clean valve with diesel fuel.
- (9) Dry with compressed air.

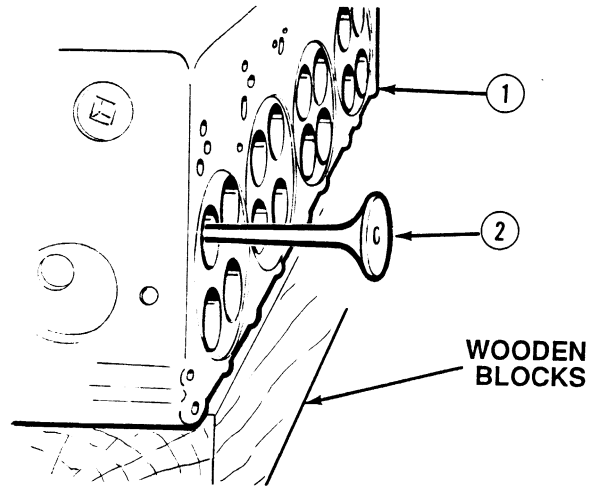


**c. Assembly.**

**NOTE**

- All 32 exhaust valves are installed the same way.
- Repeat Steps (2) through (4) for each valve.

- (1) Position cylinder head (1) on side on wooden blocks.
- (2) Lubricate valve (2) with lubricating oil.
- (3) Install valve (2) in cylinder head (1).
- (4) Secure valve (2) with tape to keep from falling out of cylinder head (1).



**NOTE**

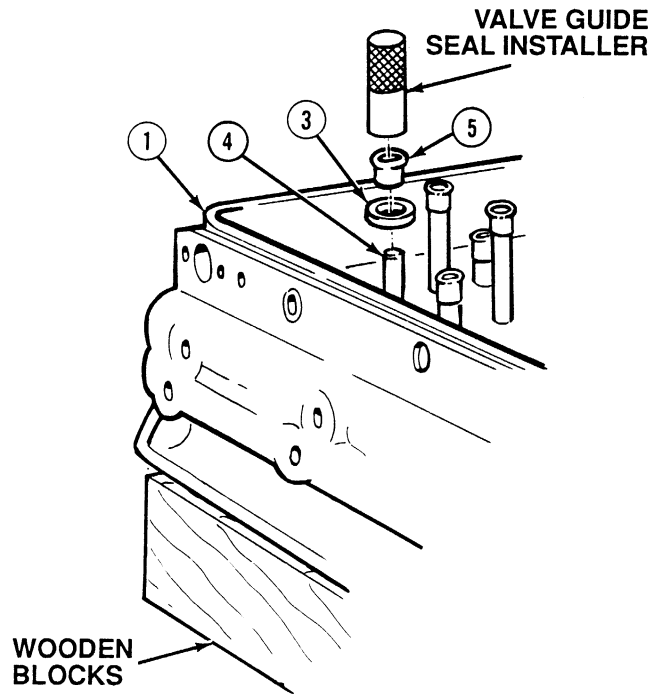
Wooden blocks must be high enough to keep exhaust valves from touching work surface while installing spring locks.

- (5) Position cylinder head (1) right side up on wooden blocks.
- (6) Install valve seat (3) over valve guide (4).

**NOTE**

Plastic cap which comes with oil seal may be placed over exhaust valve to protect exhaust valve from being scratched upon installation of oil seal. Ensure plastic cap is removed after installation of oil seal.

- (7) Using valve guide seal installer, install oil seal (5) on valve guide (4).



**WARNING**

Use extreme care when compressing spring. Spring is under tension and can act as a projectile when released and could cause severe eye injury.

- (8) Install valve spring (6) and spring cap (7) in cylinder head (1).
- (9) Install spring compressor on cylinder head (1).

**CAUTION**

Compress spring only enough to permit installation of two-piece valve lock. If spring is compressed farther than needed, damage may result to valve guide oil seal.

- (10) Compress valve spring (6) using valve spring compressor on spring cap (7).
- (11) Install two-piece valve lock (8) on spring cap (7) and valve stem (9).
- (12) Release pressure on valve spring (6) and remove spring compressor from cylinder head (1).
- (13) Tap end of valve stem (9) with plastic hammer to properly seat two-piece valve locks (8).

**NOTE**

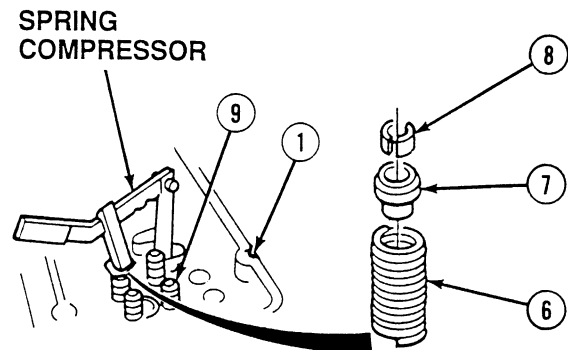
Repeat Steps (5) through (14) for each valve being installed.

- (14) Remove tape from bottom of cylinder head (1).

**d. Follow-On Maintenance:**

- Install cam followers/push rods, (Para 20-47).

**END OF TASK**





## 20-49. CYLINDER HEAD REPAIR.

This task covers:

- |                        |                     |                          |
|------------------------|---------------------|--------------------------|
| a. Disassembly         | c. Pressure Testing | e. Follow-On Maintenance |
| b. Cleaning/Inspection | d. Assembly         |                          |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Brush, Wire, Valve Cylinder  
(Item 24, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Fixture, Test, Head (Item 64, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Mag Ins Unit, Stat (Item 138, Appendix F)  
Micrometer, Outside, Caliper, Set  
(Item 139, Appendix F)  
Steam Cleaner (Item 227, Appendix F)  
Straight Edge (Item 230, Appendix F)  
Wrench Set, Socket 3/8 in. Drive  
(Item 273, Appendix F)  
Wrench, Torque (0-60 N·m)  
(Item 276, Appendix F)  
Wrench, Torque (0-175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Wooden Block (2) (Appendix C)

#### *Materials/Parts*

Cloth, Crocus (Item 12, Appendix B)  
Oil, Diesel, Fuel (Item 32, Appendix B)  
Oil, Lubricating (Item 37, Appendix B)  
Sealing Compound (Item 53, Appendix B)  
Sealing Compound (Item 56, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Adapter, Fuel (8) (Item 1, Appendix E)  
Gasket (4) (Item 93, Appendix E)  
Gasket (8) (Item 122, Appendix E)  
Washer (8) (Item 691, Appendix E)

#### *Equipment Condition*

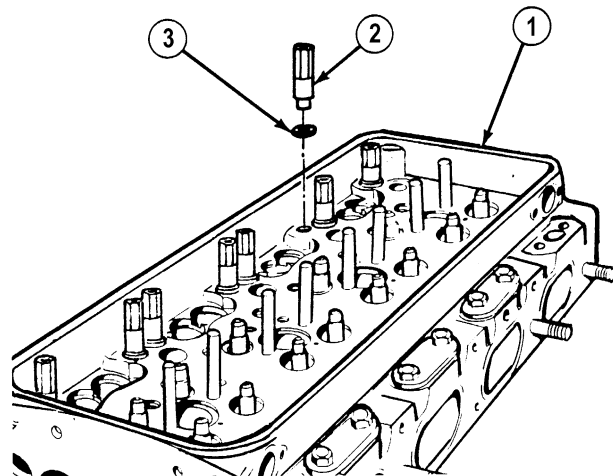
Exhaust valves removed, 20-48)

### a. *Disassembly.*

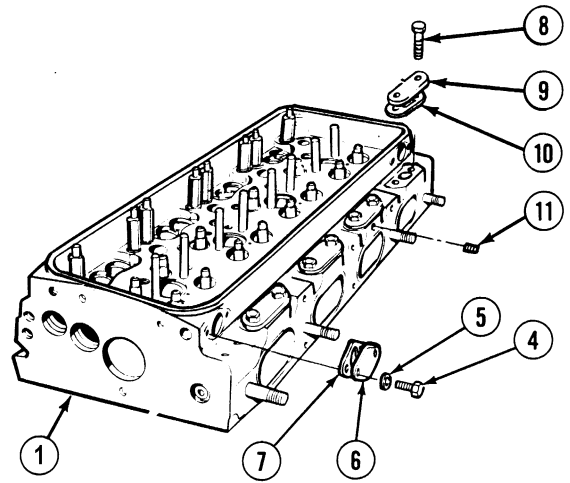
#### **NOTE**

Both cylinder heads are disassembled the same way.

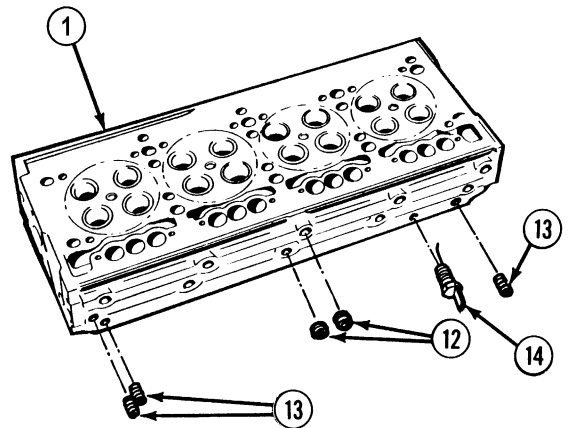
- (1) Position cylinder head (1), machined surface side down, on wooden blocks.
- (2) Remove and discard eight fuel pipe adapters (2) and washers (3) from cylinder head (1).



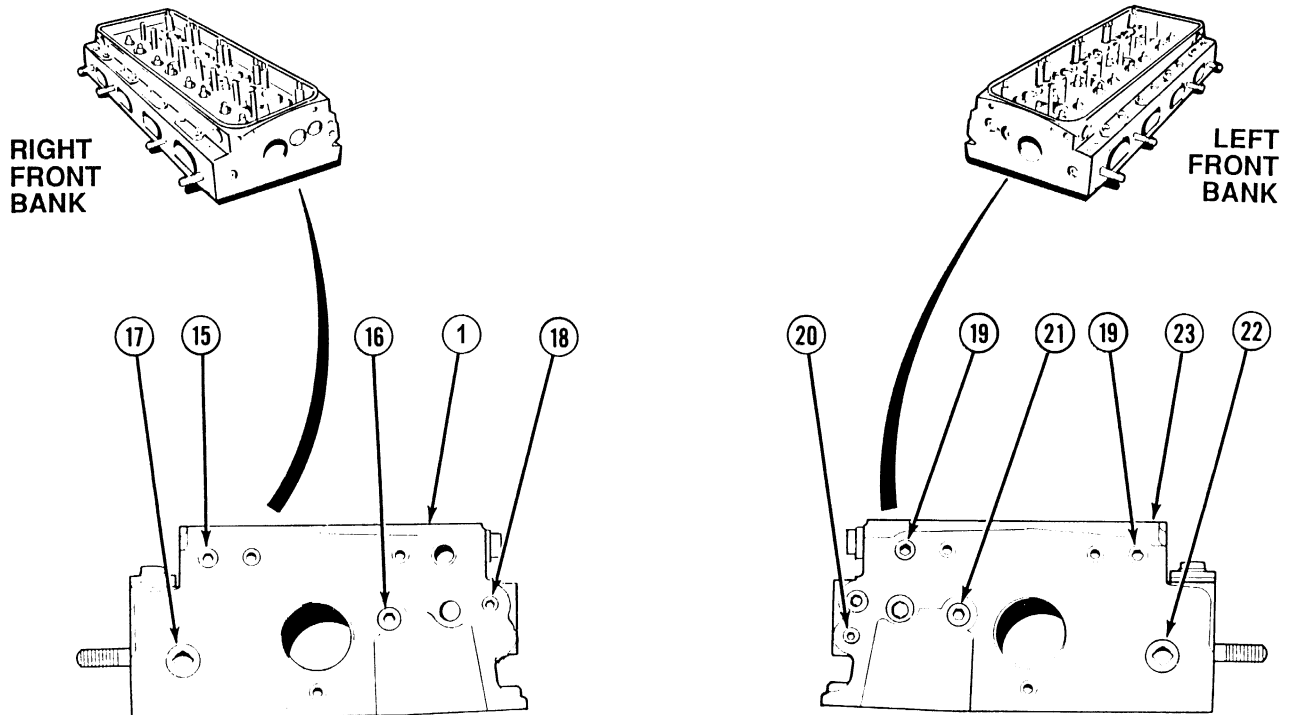
- (3) Remove four screws (4), washers (5), two cover plates (6) and gaskets (7) from cylinder head (1). Discard gaskets.
- (4) Remove eight screws (8), four covers (9) and gaskets (10) from cylinder head (1). Discard gaskets.
- (5) Remove plug (11) from cylinder head (1).



- (6) Remove nine pipe plugs (12) from cylinder head (1).
- (7) Remove three plugs (13) from cylinder head (1).
- (8) Remove connector (14) from cylinder head (1).



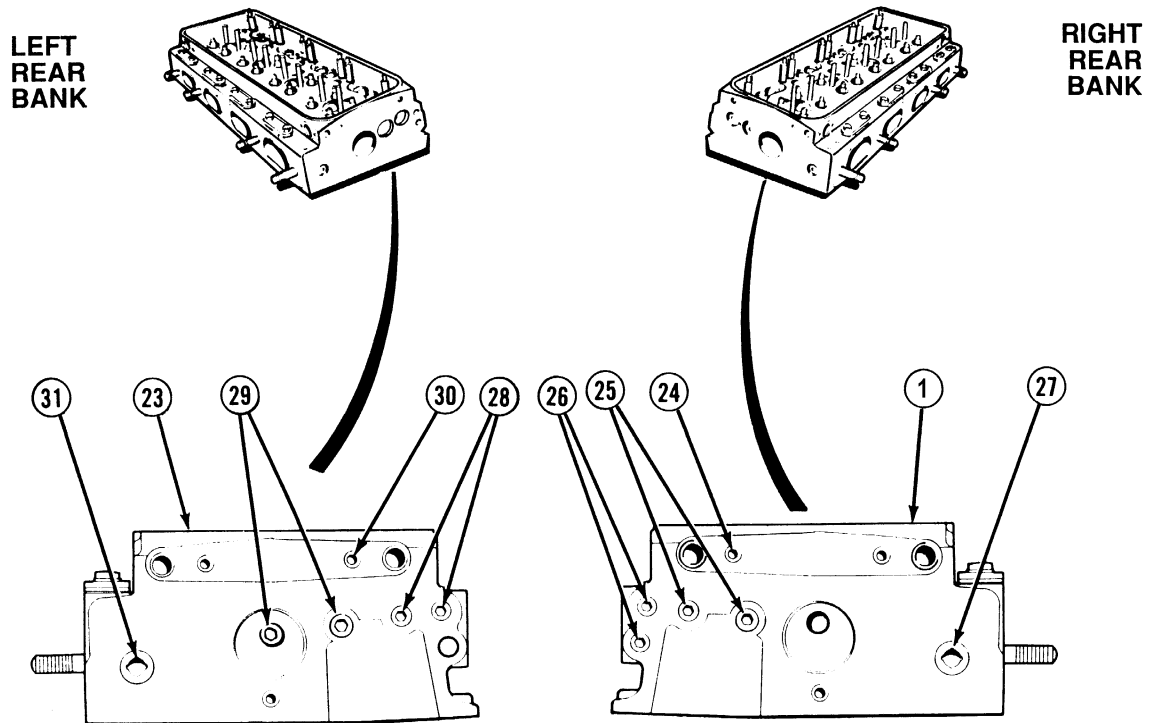
**20-49. CYLINDER HEAD REPAIR (CONT).**



**NOTE**

Perform Steps (9) and (11) for right cylinder head. Perform Steps (10) and (11) for left cylinder head.

- (9) Remove plug (15), plug (16), plug (17) and plug (18) from front of right cylinder head (1).
- (10) Remove two plugs (19), plug (20), plug (21) and plug (22) from front of left cylinder head (23).



- (11) Remove plug (24), two plugs (25), plugs (26) and plug (27) from rear of right cylinder head (1).
- (12) Remove two plugs (28), plugs (29), plug (30) and plug (31) from rear of left cylinder head (23).

**20-49. CYLINDER HEAD REPAIR (CONT).**

**b. Cleaning/Inspection.**

**WARNING**

- Avoid contact with steam. Steam can cause burns, blindness, and other serious injury. Ensure the wearing of protective aprons, gloves, and safety goggles when using live steam or injury to personnel may result.
- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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.

**CAUTION**

Use extreme caution not to scratch or nick cylinder head or damage may result to cylinder head.

- (1) Scrape excess gasket material from cylinder head.
- (2) Thoroughly steam clean cylinder head.
- (3) Clean cylinder head with drycleaning solvent.
- (4) Dry cylinder head with compressed air.

**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.

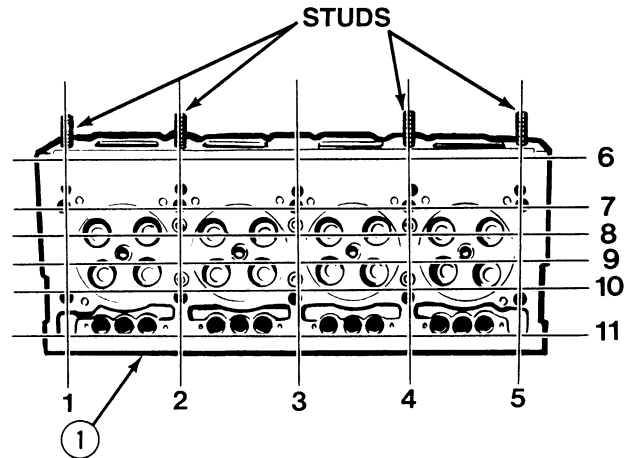
- (5) Clean all cylinder head components with diesel fuel and dry with compressed air.

**NOTE**

If cracks are visible in cylinder head, do not use Pressure Test Method.

- (6) Inspect cylinder head for cracks using magnetic particle and fluorescent penetrate inspections (located in General Inspection) before pressure testing. These inspections will locate exterior cracks. Replace cylinder head if any cracks are detected.

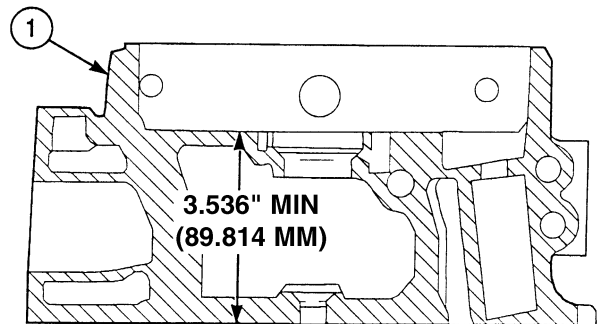
- (7) Inspect studs in cylinder head for cracks or looseness. Replace if damaged.
- (8) Inspect bottom of cylinder head (1) for flatness with accurate straight edge and feeler gage.
  - (a) At points (1) through (5), maximum warpage is 0.004 in. (0.102 mm).
  - (b) At points (6) through (11), maximum warpage is 0.005 in. (0.127 mm).
  - (c) If excessively warped, cylinder head must be replaced.



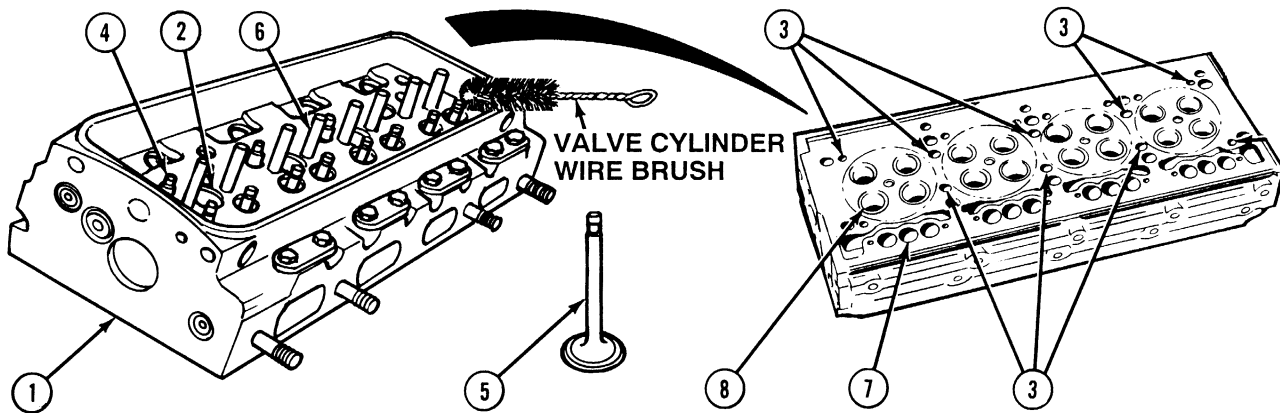
**NOTE**

Cylinder head must have minimum cylinder head height of 3.536 in. (89.814 mm). If cylinder head is not within specifications, replace cylinder head.

- (9) Measure distance between top and bottom faces of cylinder head (1).



**20-49. CYLINDER HEAD REPAIR (CONT).**



- (10) Inspect eight injector tubes (2) for scoring, cracking, and leaks. If injector tubes fail inspection, replace injector tubes.
- (11) Inspect eight water nozzles (3) for looseness or damage. Replace water nozzles failing inspection or leakage during pressure testing.
- (12) Inspect 16 valve guides (4) for cracks, chipping, scoring, or excessive wear.
- (13) Using valve cylinder wire brush, clean valve guides (4).

**NOTE**

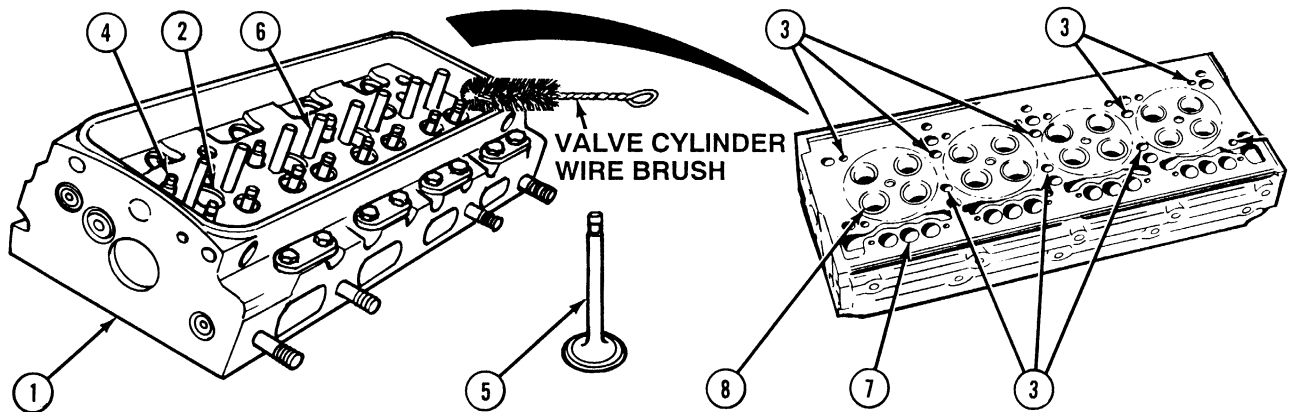
- Inside diameter of valve guide must be minimum of 0.3125 in. (7.938 mm) and maximum of 0.3140 in. (7.9756 mm).
- Outside diameter of valve stem must be minimum of 0.310 in. (7.874 mm) and maximum of 0.309 in. (7.849 mm).

- (14) Measure inside diameter of valve guide (4).
- (15) Measure outside diameter of corresponding valve stem (5).

**NOTE**

To obtain valve guide clearance, subtract valve stem diameter from valve guide inside diameter measurement. Clearance should be between minimum of 0.0017 in. (0.0432 mm) and maximum of 0.0035 in. (0.0889 mm), with limit of 0.0050 in. (0.1270 mm).

- (16) Determine valve guide clearance. If valve guide has excessive clearance or inside diameter, replace valve guide.
- (17) Inspect valve bridge guides (6) for cracks, chipping, scoring, or excessive wear. If valve bridge guides fail inspection, replace valve bridge guides.



**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.

- (18) Inspect cam follower bores (7) in cylinder head (1) for scoring or wear.
- (a) If light score marks are found, clean up with crocus cloth moistened with diesel oil.
  - (b) Measure inside diameter of cam follower bore (7). Diameter must be between minimum 1.062 in. (26.975 mm) and maximum of 1.063 in. (27.000 mm).
  - (c) Replace all parts failing inspection.
- (19) Inspect 16 valve seat inserts (8) for cracks, pitting, chipping, scoring, or excessive wear. If valve seat insert fails inspection, replace valve seat insert.



**20-49. CYLINDER HEAD REPAIR (CONT).**

**c. Pressure Testing.**

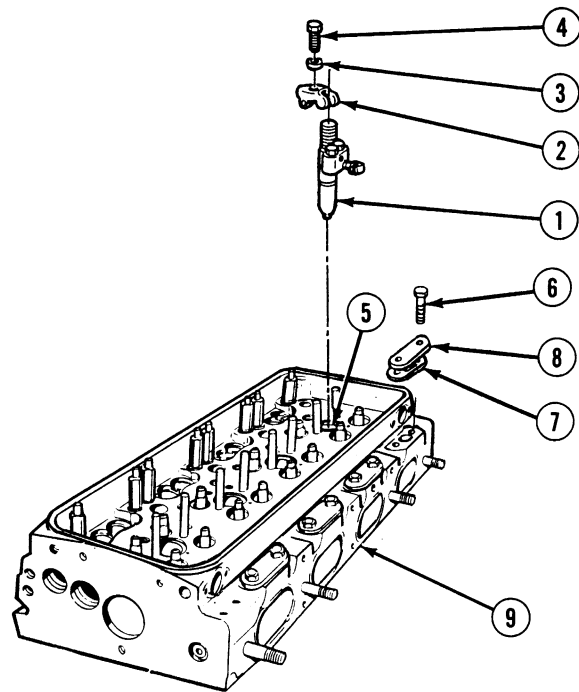
**NOTE**

Perform magnetic particle and fluorescent penetrant inspections before pressure testing. These inspections will locate exterior cracks. Replace cylinder head if cracks are detected.

- (1) Install four injectors (1) (removed in Para 4-2) with clamps (2), washers (3) and screws (4) in injector tubes (5). Tighten screws 20 to 25 lb-ft (27 to 34 N·m).

**WARNING**

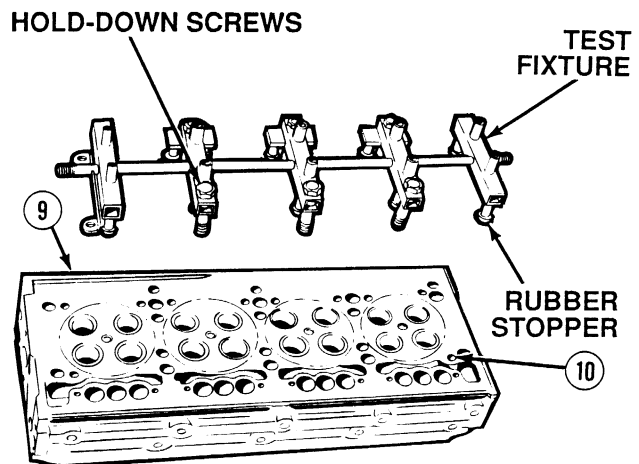
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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



- (2) Apply coat of sealing compound to threads of eight screws (6).
- (3) Install four gaskets (7) and covers (8) on cylinder head (9) with eight screws (6). Tighten to 26 to 29 lb-ft (35 to 39 N·m).
- (4) Align test fixture on top of bottom face of cylinder head (9) so rubber stoppers cover water inlets (10).

**CAUTION**

Do not overtighten hold-down cap screws. Rubber stopper could distort enough to seal off outer diameter of water nozzle. Leak would not be detected from outer diameter.

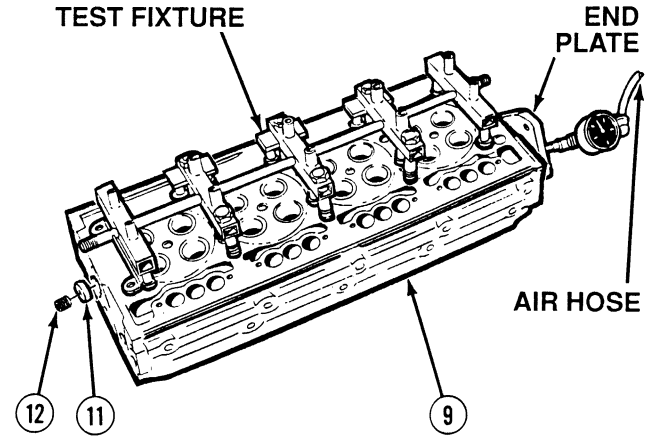


- (5) Install and tighten six hold down screws on test fixture until rubber stoppers start to flatten out.

- (6) Install end plate on thermostat end of cylinder head (9).
- (7) Install plug (11) and plug (12) in rear of cylinder head (9).

**WARNING**

When making this pressure test, make sure personnel are protected against pressurized air and oil from possible rupture or leak in hose or fitting on cylinder head or injury to personnel may result.



- (8) Install air hose to end plate and apply 40 psi (276 kPa) to cylinder head (9).

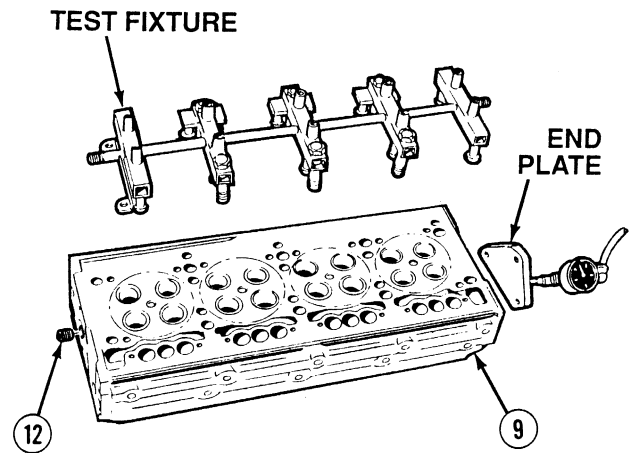
**NOTE**

If cylinder head leaks, replace seals or injector tubes as required.

- (9) Apply coat of lubricating oil to cylinder head (9) around seal and injector tube areas.
- (10) If leak is found in cylinder head (9), check test assembly for proper seating. Repeat Steps (8) and (9).

**NOTE**

If cylinder head (9) leaks when Steps (8) and (9) are repeated, replace cylinder head (9).



- (11) Slowly relieve air pressure.
- (12) Remove test fixture, plug (12) and end plate from cylinder head (9).

**20-49. CYLINDER HEAD REPAIR (CONT).**

- (13) Remove four screws (4), washers (3), clamps (2) and injectors (1) from injector tubes (5).

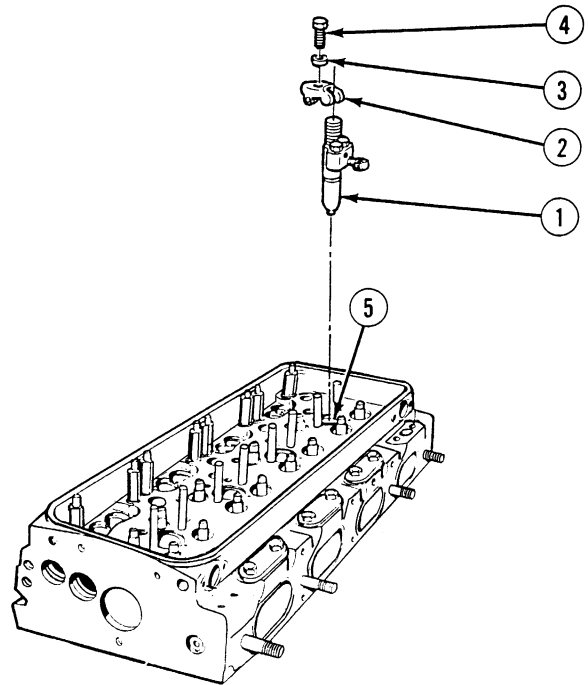
**WARNING**

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.

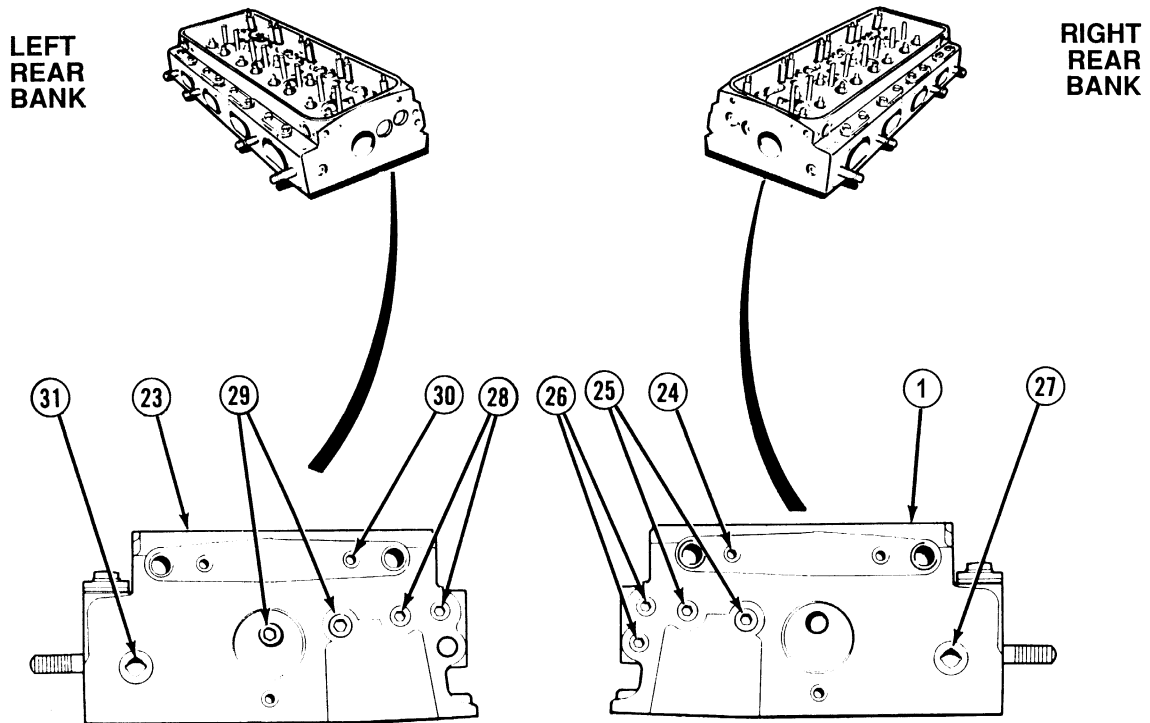
- (14) Dry cylinder head with compressed air.

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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.



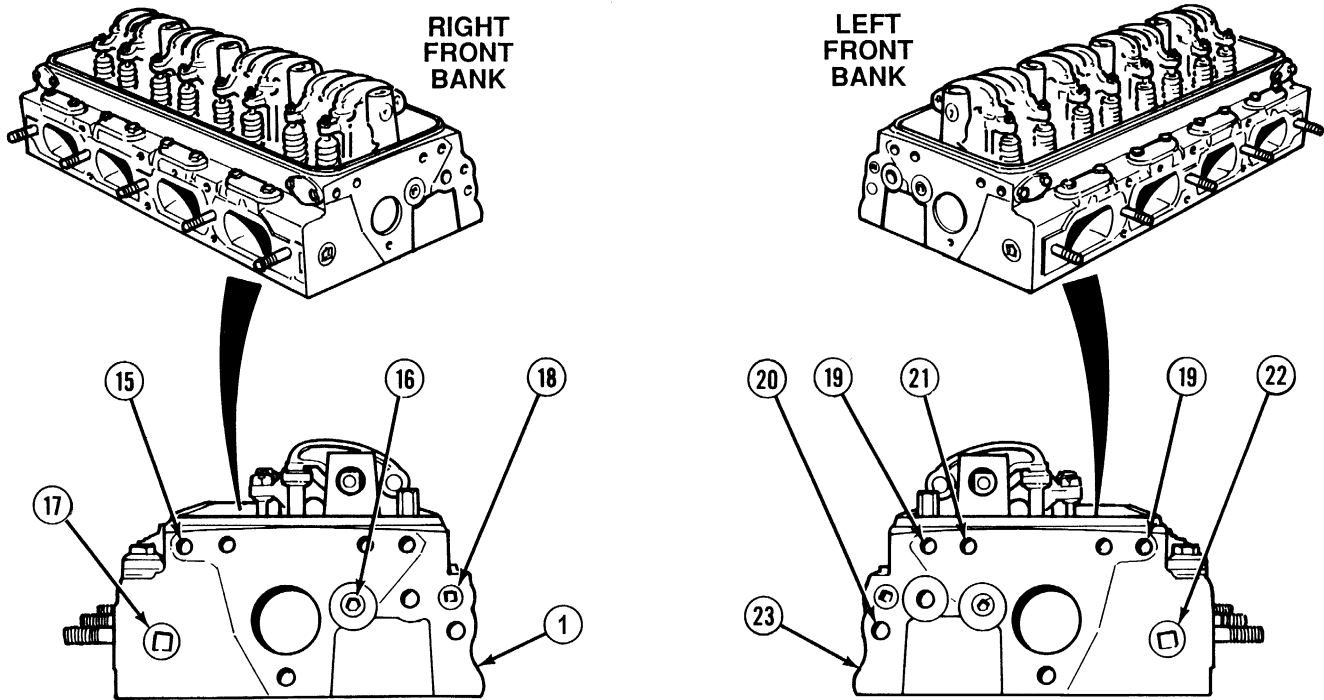
- (15) Clean cylinder head with drycleaning solvent.
- (16) Dry cylinder head with compressed air.

**d. Assembly.****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.

- (1) Apply coat of sealing compound to plugs (24), (25), (26), (27), (28), (29), (30) and (31).
- (2) Install plug (24) in rear right cylinder head (1). Tighten plug 168 to 192 lb-in (19 to 22 N·m).
- (3) Install two plugs (25) in rear right cylinder head (1). Tighten 23 to 27 lb-ft (31 to 37 N·m).
- (4) Install two plugs (26) in rear right cylinder head (1). Tighten 216 to 264 lb-in (24 to 30 N·m).
- (5) Install plug (27) in rear right cylinder head (1). Tighten 33 to 37 lb-ft (45 to 50 N·m).
- (6) Install two plugs (28) in rear left cylinder head (23). Tighten 216 to 264 lb-in (24 to 30 N·m).
- (7) Install two plugs (29) in rear left cylinder head (23). Tighten 23 to 27 lb-ft (31 to 37 N·m).
- (8) Install plug (30) in rear left cylinder head (23). Tighten 168 to 192 lb-in (19 to 22 N·m).
- (9) Install plug (31) in rear left cylinder head (23). Tighten 33 to 37 lb-ft (45 to 50 N·m).

**20-49. CYLINDER HEAD 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.

- (10) Apply coat of sealing compound to plugs (15), (16), (17), (18), (19), (20), (21) and (22).
- (11) Install plug (15) in front right cylinder head (1) until flush with cylinder head.
- (12) Install plug (18) in front right cylinder head (1). Tighten 168 to 192 lb-in (19 to 22 N·m).
- (13) Install plug (16) in front right cylinder head (1). Tighten 23 to 27 lb-ft (31 to 37 N·m).
- (14) Install plug (17) in front right cylinder head (1). Tighten 33 to 37 lb-ft (45 to 50 N·m).
- (15) Install two plugs (19) and plug (20) in front left cylinder head (23). Tighten 14 to 16 lb-ft (19 to 22 N·m).
- (16) Install plug (21) in front left cylinder head (23). Tighten 23 to 27 lb-ft (31 to 37 N·m).
- (17) Install plug (22) in front left cylinder head (23). Tighten 33 to 37 lb-ft (45 to 50 N·m).

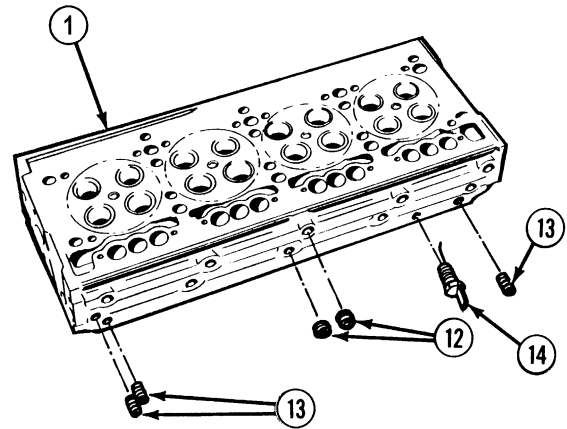
**WARNING**

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.

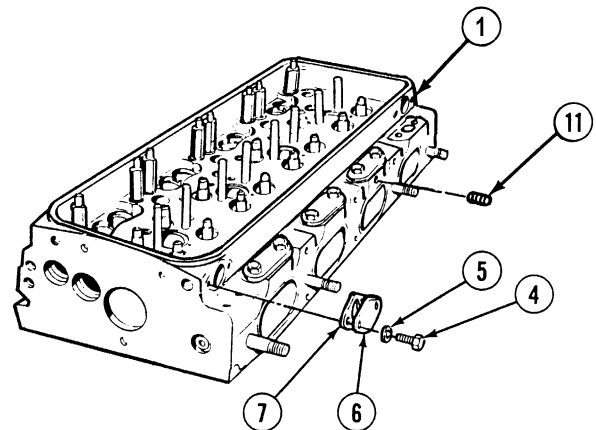
**NOTE**

Both cylinder heads are assembled the same way.

- (18) Apply coat of sealing compound to three plugs (13).
- (19) Install three plugs (13) in cylinder head (1) until flush.
- (20) Apply coat of sealing compound to nine plugs (12).
- (21) Install nine plugs (12) in cylinder head (1). Tighten plugs 18 to 22 lb-ft (24 to 30 N·m).
- (22) Install connector (14) in cylinder head (1).

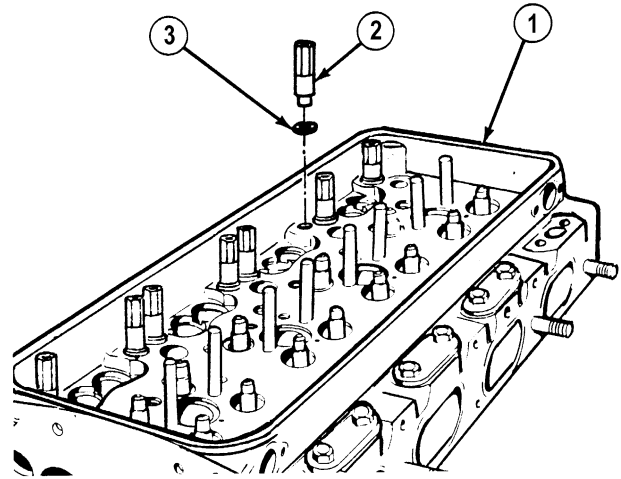


- (23) Apply coat of sealing compound to plug (11).
- (24) Install plug (11) in cylinder head (1).
- (25) Apply sealing compound to threads of four screws (4).
- (26) Install two gaskets (7), cover plates (6), four washers (5) and screws (4) on cylinder head (1). Tighten screws to 26 to 29 lb-ft (35 to 39 N·m).



**20-49. CYLINDER HEAD REPAIR (CONT).**

- (27) Install eight washers (3) on fuel pipe adapters (2).
- (28) Install eight fuel adapters (2) in cylinder head (1). Tighten adapters to 40 to 45 lb-ft (54 to 61 N·m).



**e. Follow-On Maintenance:**

- Install exhaust valves, (Para 20-48).

**END OF TASK**





**20-51. VALVE BRIDGE GUIDE REPAIR.**

This task covers:

- a. Disassembly
- b. Assembly
- c. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Drill Set, Twist (Item 48, Appendix F)
- Drill, Electric, Portable, 1/4 in. (Item 49, Appendix F)
- Hammer, Slide (Item 89, Appendix F)
- Installer, Valve Bridge (Item 121, Appendix F)
- Remover Set, Valve Bridge (Item 185, Appendix F)

*Tools and Special Tools - Continued*

- Remover, Valve Bridge (Item 192, Appendix F)

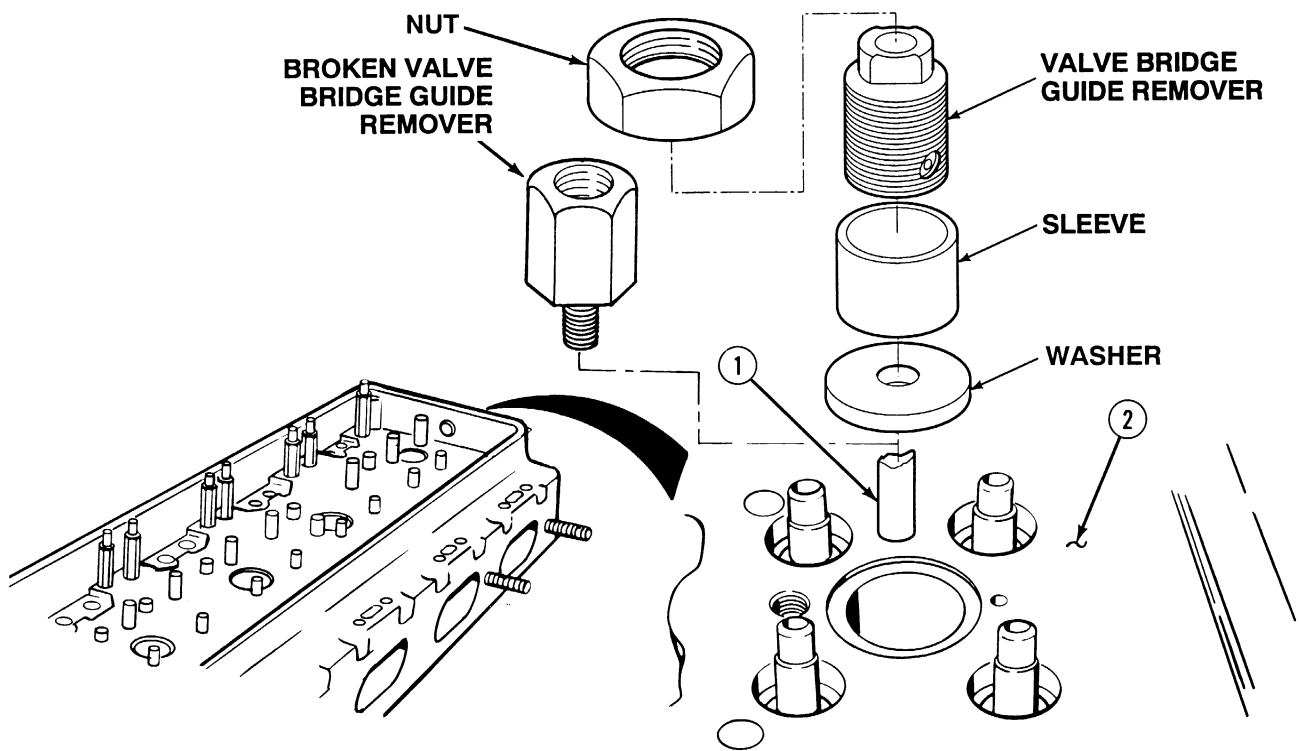
*Materials/Parts*

- Compound, International No. 2 (Item 16, Appendix B)

*Equipment Condition*

- Cylinder head disassembled, (Para 20-49)

a. *Disassembly.*



**NOTE**

- All 16 valve bridge guides are removed the same way.
- If valve bridge guide is not broken, perform Steps (1) through (3). If valve bridge guide is broken, perform Steps (4) through (6).

- (1) File or grind two opposite notches 1/16 in. (1.6 mm) deep in side of valve bridge guide (1), approximately 1-1/4 in. to 1-1/2 in. (31.8 to 38.1 mm) from upper end.
- (2) Position washer over valve bridge guide (1) and slide guide remover over valve bridge guide (1). Align screws with notches in guide and tighten to hold tool securely.
- (3) Position sleeve over valve bridge guide remover. Thread nut on valve bridge guide remover and tighten to remove valve bridge guide (1) from cylinder head (2).
- (4) Drill hole 1/2 in. (12.7 mm) deep in end of valve bridge guide (1) using No. 3, 0.213 in. drill bit.
- (5) Tap valve bridge guide (1) with 1/4 in. (6.4 mm) bottoming tap.
- (6) Thread broken valve bridge guide remover in valve bridge guide (1) and attach slide hammer to remover. After one or two sharp blows with slide hammer, remove broken valve bridge guide.

**20-51. VALVE BRIDGE GUIDE REPAIR (CONT).**

**b. Assembly.**

**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**

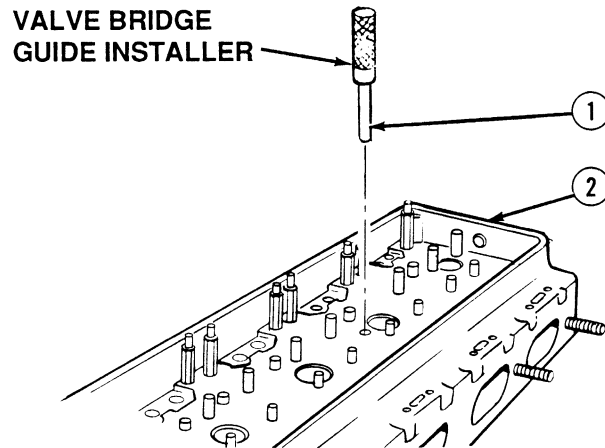
All 16 valve bridge guides are installed the same way.

- (1) Apply International No. 2 compound to valve bridge guide (1).

**NOTE**

Bridge guide is positioned in cylinder head with undercut edge of bridge guide installed in hole in cylinder head.

- (2) Position bridge guide (1) in hole in cylinder head (2).
- (3) Using valve bridge guide installer, install bridge guide (1) straight into cylinder head (2) until seated.



**c. Follow-On Maintenance:**

- Assemble cylinder head, (Para 20-49).

**END OF TASK**

**20-52. VALVE SEAT INSERT REPAIR.**

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/Inspection | d. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Gage, Dial (Item 74, Appendix F)  
Grinding Kit, Valve Seat (Item 84, Appendix F)  
Installing Tool, Valve (Item 125, Appendix F)  
Remover, Valve Seat (Item 194, Appendix F)

*Tools and Special Tools - Continued*

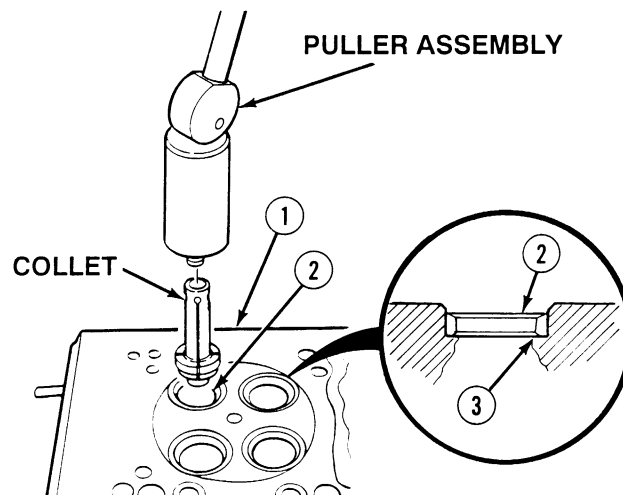
Wooden Block (2) (Appendix C)

*Materials/Parts*

Valve, Seat (Item 687, Appendix E)

*Equipment Condition*

Cylinder head disassembled, (Para 20-49)

**a. Disassembly.****NOTE**

There are 16 valve seat inserts in each cylinder head. All valve seat inserts are removed the same way.

- (1) Position cylinder head (1), machined side up, on wooden blocks.
- (2) Using collet and puller assembly, remove and discard valve seat insert (2) from counterbore (3) of cylinder head (1).

**20-52. VALVE SEAT INSERT REPAIR (CONT).**

*b. Cleaning/Inspection.*

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
  - (2) Dry all parts with compressed air.
  - (3) Inspect valve seat insert counterbore for cleanliness, concentricity, flatness and cracks.
  - (4) Inspect valve seat insert counterbore for diameter of 1.440 to 1.441 in. (3.658 to 3.660 cm) and a depth of 0.3395 to 0.3505 in. (0.862 to 0.890 cm).

**c. Assembly.**

**CAUTION**

Cylinder head must be preheated in hot water to a temperature of 180 to 200 degrees F (82 to 93 degrees C) or damage to the valve seat insert would result. Do not use propane torch to preheat.

**NOTE**

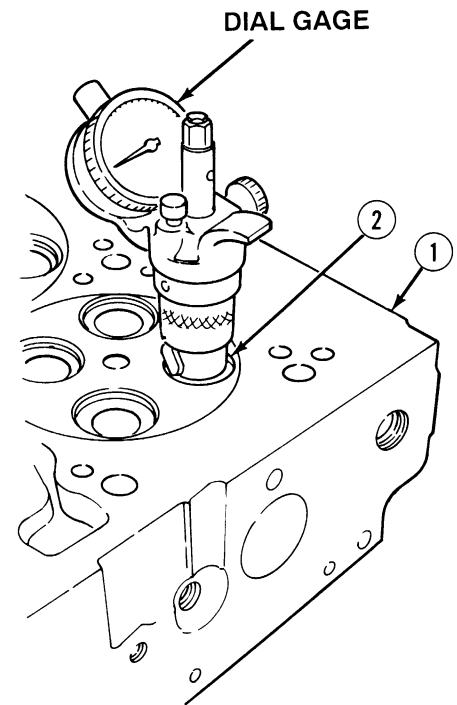
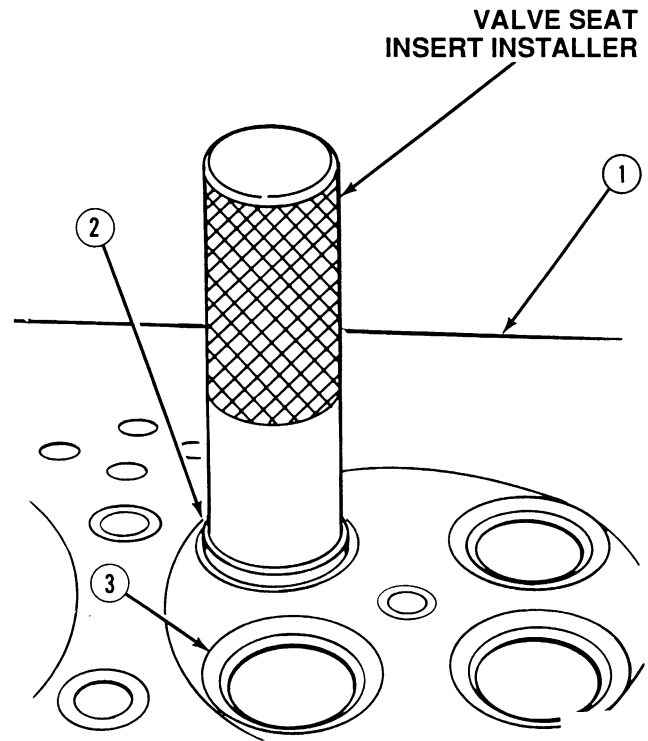
- All inserts are installed the same way.
- Install inserts while cylinder head is still hot.

- (1) Position cylinder head (1), machined side up, on wooden blocks.
- (2) Position valve seat insert (2), seat side up, in counterbore (3).
- (3) Using valve seat insert installer, drive valve seat insert (2) until fully seated in cylinder head (1).

**NOTE**

If runout exceeds 0.002 in. (0.05 mm), regrind valve seat.

- (4) Set dial gage on cylinder head (1) and check roundness of each valve seat insert (2) relative to valve guide. Total runout must not exceed 0.002 in. (0.05 mm).



**d. Follow-On Maintenance:**

- Assemble cylinder head, (Para 20-49).

**END OF TASK**

## 20-53. INJECTOR TUBE REPAIR.

This task covers:

- a. Disassembly
- b. Assembly
- c. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Compressor Unit, Air (Item 35, Appendix F)
- Gage, Depth (Item 71, Appendix F)
- Gloves, Chemical Oil Protective (Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Gun, Airblow (Item 86, Appendix F)
- Reconditioning Set, Injector Tube (Item 182, Appendix F)
- Wrench, Torque (0-175 lb-ft [0-237 N·m]) (Item 277, Appendix F)
- Wooden Block (2) (Appendix C)

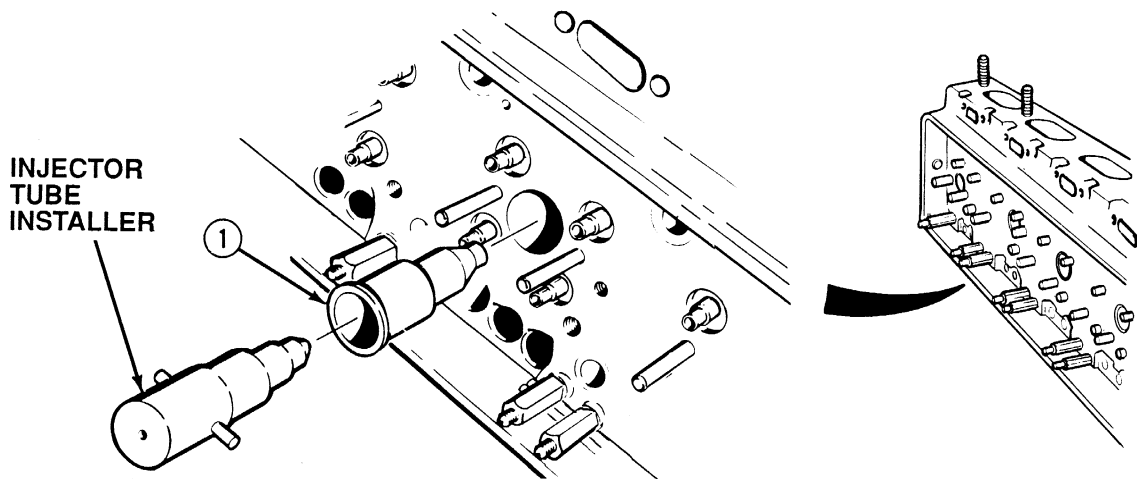
#### *Materials/Parts*

- Cloth, Cleaning (Item 11, Appendix B)
- Oil, Lubricating (Item 36, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)
- Kit, Repair (Item 147, Appendix E)

#### *Equipment Condition*

- Cylinder head disassembled, (Para 20-49)

### a. *Disassembly.*

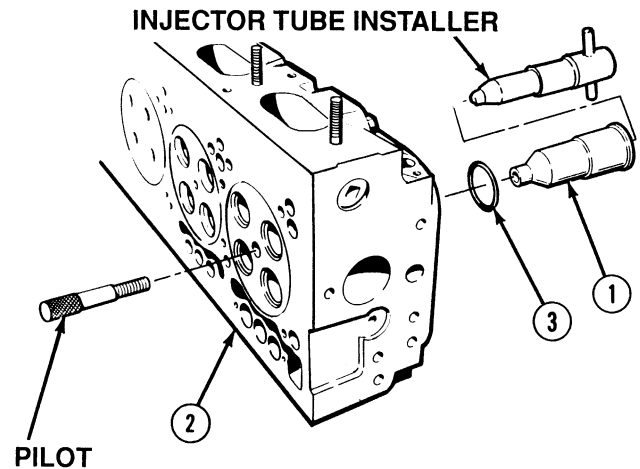


### NOTE

All eight injector tubes are removed the same way.

- (1) Insert injector tube installer in injector tube (1).

- (2) Install pilot in injector tube installer through bottom of cylinder head (2).
- (3) Tap pilot to loosen injector tube (1) from cylinder head (2).
- (4) Remove injector tube (1), preformed packing (3), pilot, and installer from cylinder head (2). Discard injector tube and preformed packing.

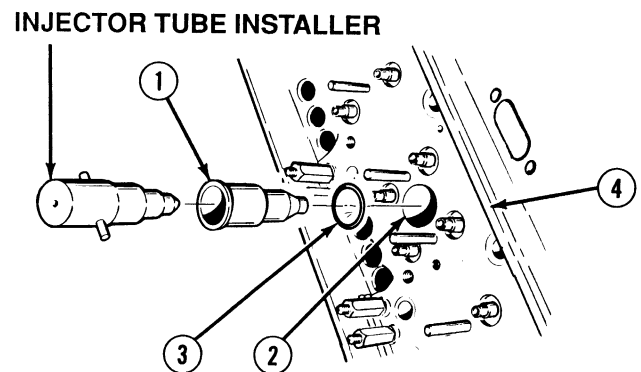


**b. Assembly.**

**NOTE**

- All eight injector tubes are installed the same way.
- Injector tube must be reamed before injectors can be installed.

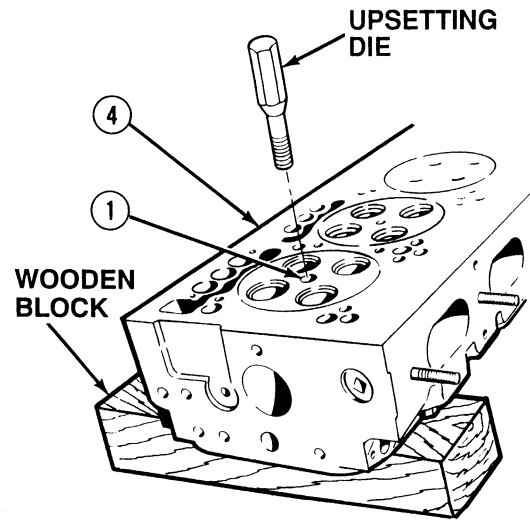
- (1) Wipe debris from injector tube (1) and cylinder head counterbore (2) with cleaning cloth.
- (2) Install preformed packing (3) into cylinder head counterbore (2).
- (3) Using injector tube installer, tap injector tube (1) into cylinder head counterbore (2) until bottom rim of installer is flush with cylinder head (4).





**20-53. INJECTOR TUBE REPAIR (CONT).**

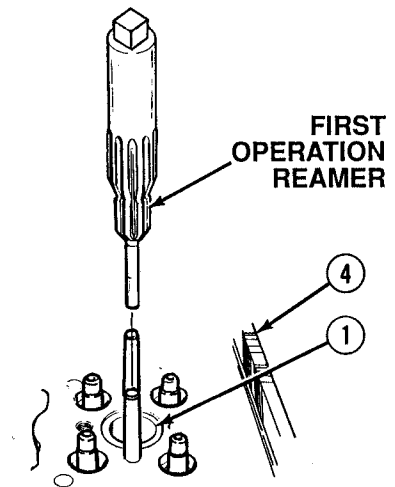
- (4) Position cylinder head (4), machined side up, on two wooden blocks.
- (5) Using upsetting die, seat injector tube (1) in cylinder head (4). Tighten to 30 lb-ft (41 N·m) and remove upsetting die.
- (6) Position cylinder head (4) on side on wooden blocks.



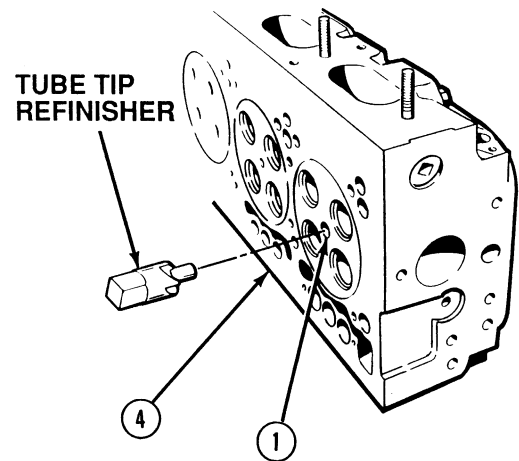
**CAUTION**

Turn reamer to the right only.  
Turning reamer to the left will damage reamer and injector tube.

- (7) Lubricate reamer blades with lubricating oil.
- (8) Ream injector tube (1) with first operation reamer.
- (9) Wipe metal filings from injector tube (1) with cleaning cloth.
- (10) Repeat Steps (7) through (9) until shoulder of reamer touches top of injector tube (1).



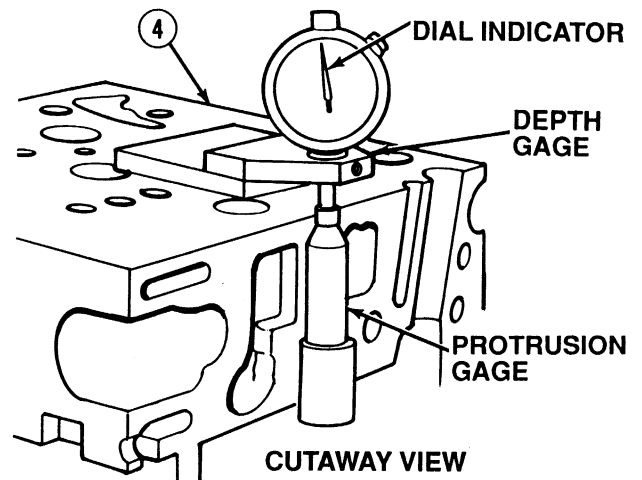
- (11) Using tube tip refinisher, remove excess material from tip of injector tube (1) until finisher contacts bottom of cylinder head (4).
- (12) Clean metal filings from inside of injector tube (1).
- (13) Position cylinder head (4) on wooden blocks with machined side up.
- (14) Install protrusion gage in top of cylinder head (4) through injector tube (1).



**NOTE**

Measurement must be  $0 \pm 0.014$  in. (0.36 mm). If measurement is within tolerance, perform Steps (21) and (22). If measurement is more than 0.014 above 0 reading, replace tube and perform Steps (16) through (20).

- (15) Using depth gage, measure distance to protrusion gage in cylinder head (4).
- (16) Set cylinder head (4) machined side down on wooden blocks.



**20-53. INJECTOR TUBE REPAIR (CONT).**

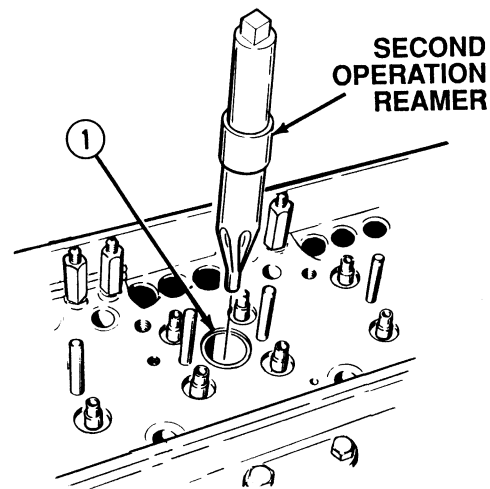
**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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.

- (17) Clean injector tube (1) with drycleaning solvent.

**CAUTION**

Reaming injector tube to the left will damage reamer blades and injector tube.



- (18) Lubricate reamer blades with lubricating oil while reaming injector tubes (1) with second operation reamer.
- (19) Ream injector tube (1) to the right with second operation reamer.
- (20) Clean filings from injector tube (1).
- (21) Repeat Steps (17) through (20) until protrusion gage is flush  $\pm 0.014$  in. (0.36 mm).
- (22) Clean injector tube (1) with drycleaning 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.

- (23) Dry with compressed air.

**c. Follow-On Maintenance:**

- Assemble cylinder head, (Para 20-49).

**END OF TASK**

**20-54. WATER NOZZLE REPAIR.**

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/Inspection | d. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Tap and Die Set (Item 234, Appendix F)  
Screw (1/2 in. by 4 in.)

*Equipment Condition*

Cylinder head disassembled, (Para 20-49)

**a. Disassembly.****NOTE**

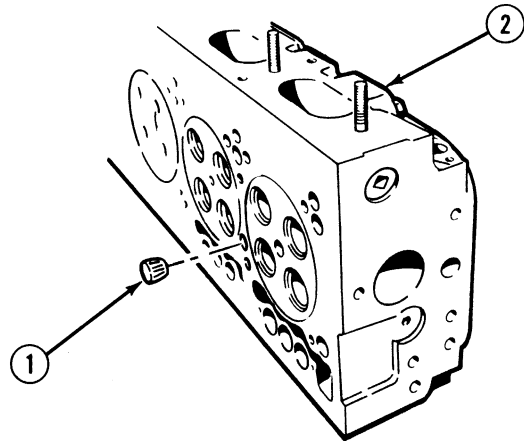
All water nozzles are removed the same way.

- (1) Start 1/2 in. tap in water nozzle (1) in cylinder head (2).

**NOTE**

If water nozzle is not removed in Step (2), go on to Step (3).

- (2) Thread water nozzle (1) 1/2 in. (12.7 mm) deep in cylinder head (2). Remove tap.
- (3) Thread 1/2 in. screw in water nozzle (1).
- (4) Pull on screw and remove water nozzle (1) from cylinder head (2).

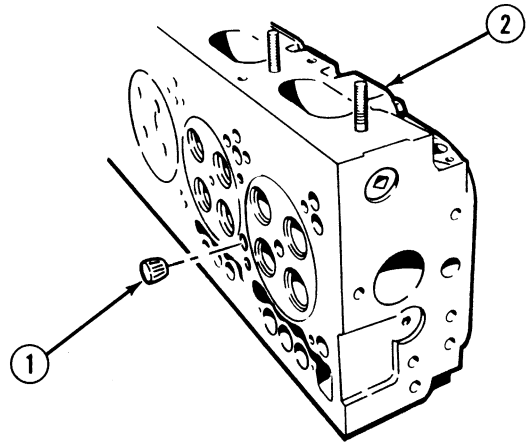


**b. Cleaning/Inspection.**

**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.

- (1) Clean shavings from cylinder head (2) with compressed air.
- (2) Inspect water nozzle holes for cracks and damage. If damaged, replace cylinder head (2).
- (3) Inspect water inlet ports for cleanliness and deposit buildup.



**c. Assembly.**

**NOTE**

- All water nozzles are installed the same way.
  - Water nozzles are installed until flush or recessed less than 0.015 in. (0.38 mm) below cylinder head surface.
- (1) Install water nozzle (1) in cylinder head (2).

**d. Follow-On Maintenance:**

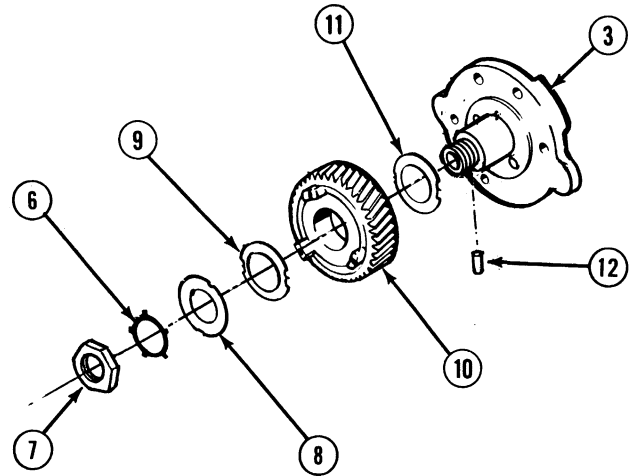
- Assemble cylinder head, (Para 20-49).

**END OF TASK**



**20-55. BLOWER DRIVE ASSEMBLY REPAIR (CONT).**

- (5) Remove nut (7), lockwasher (6), thrust washer bearing (8), thrust bearing (9), drive gear (10) and thrust bearing (11) from blower drive assembly (3). Discard lockwasher.
- (6) Remove and discard pin (12) from blower drive assembly (3).
- (7) Remove blower drive assembly (3) from vise.



**b. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
  - (2) Dry parts, except bearings, with compressed air. Let bearings air dry.
  - (3) Inspect oil passages to ensure all passages are free of debris.
  - (4) Inspect all threads for stripped or crossed condition. Replace damaged parts.

**NOTE**

If thrust washer is not within specification, replace thrust washer.

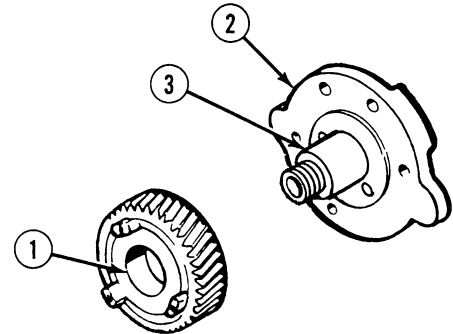
- (5) Using a micrometer, check to ensure that thrust washer thickness is between 0.2350 and 0.2450 in. (5.97 and 6.223 mm).

**NOTE**

If thrust bearings are not within specification or show signs of scoring, replace thrust bearing.

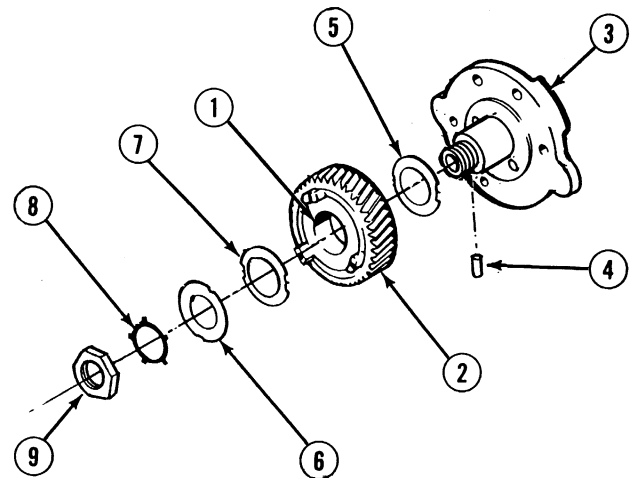
- (6) Using a micrometer, check to ensure that thrust bearing thickness is between 0.0590 and 0.0610 in. (1.499 and 1.549 mm). Inspect thrust bearings for scoring.

- (7) Inspect drive gear teeth for scoring, pitting, and burning (blue or dark spots). Replace if teeth are damaged.
- (8) Inspect accessory drive hub for cracks, breaks, stripped threads or worn-out splines in bore. Replace if damaged.
- (9) Inspect both flex spring plates for cracks, distortion, or other damage. Replace if damaged.
- (10) Using a telescoping gage and micrometer, check that inside diameter of drive gear bushings (1) is between 1.6260 and 1.6265 in. (41.300 and 41.313 mm). Record diameter.
- (11) Using a micrometer, check diameter of blower drive support (2) at base of shaft (3). Diameter must be between 1.6240 and 1.6265 in. (41.250 and 41.313 mm). Record diameter.
- (12) Subtract diameter recorded in Step (10) from diameter recorded in Step (11). Clearance between blower drive support (2) and support bushing (1) is between 0.0010 and 0.0025 in. (0.025 and 0.064 mm) when parts are new. Limit is 0.0050 in. (0.127 mm) for used parts.



**c. Assembly.**

- (1) Apply lubricating oil to support bushings (1) in drive gear (2).
- (2) Place blower drive assembly (3) in vise with soft jaws.
- (3) Install pin (4) in blower drive assembly (3).
- (4) Apply light coat of lubricating oil to blower drive assembly (3), thrust washer bearing (5) and thrust washer bearing (6).
- (5) Install thrust washer bearing (5) on blower drive assembly (3).
- (6) Install drive gear (2) with flat side towards blower drive assembly (3).
- (7) Install thrust washer bearing (7) and thrust washer bearing (6) with tang of thrust washer bearing fitting in thrust washer bearing notch on blower drive assembly (3).
- (8) Install lockwasher (8) and nut (9), with lockwasher tang fitting in thrust washer bearing (7) notch on blower drive assembly (3). Tighten nut 50 to 60 lb-ft (68 to 81 N·m).



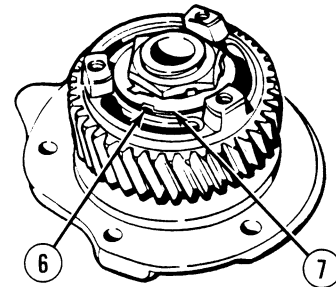


**20-55. BLOWER DRIVE ASSEMBLY REPAIR (CONT).**

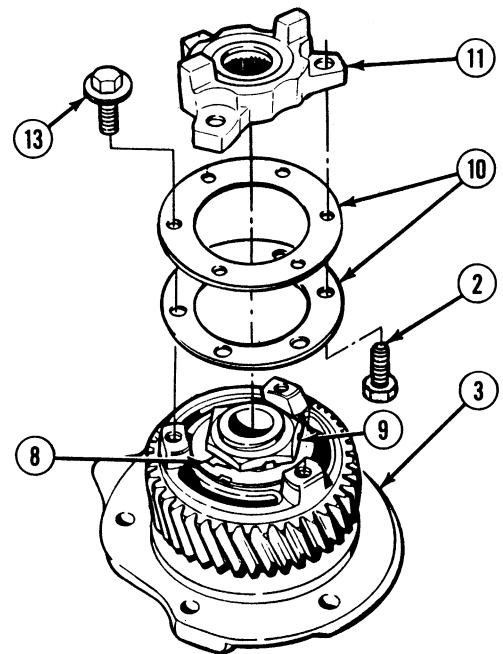
**NOTE**

If clearance is less than 0.005 in. or more than 0.012 in. (0.127 mm or 0.31 mm), discard blower drive assembly.

- (9) Using feeler gage, measure clearance between thrust washer bearing (6) and thrust washer bearing (7).



- (10) Bend tangs of lockwasher (8) against sides of nut (9).
- (11) Install two spring plates (10) on camshaft hub (11) with three screws (2). Tighten screws 35 to 39 lb-ft (47 to 53 N·m).
- (12) Install camshaft hub (11) on blower drive assembly (3) with three screws (13). Tighten screws 35 to 39 lb-ft (47 to 53 N·m).



**END OF TASK**

**20-56. AFTERCOOLER INSPECTION.**

This task covers:

- a. Cleaning/Inspection

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Steam Cleaner (Item 227, Appendix F)

*Materials/Parts*

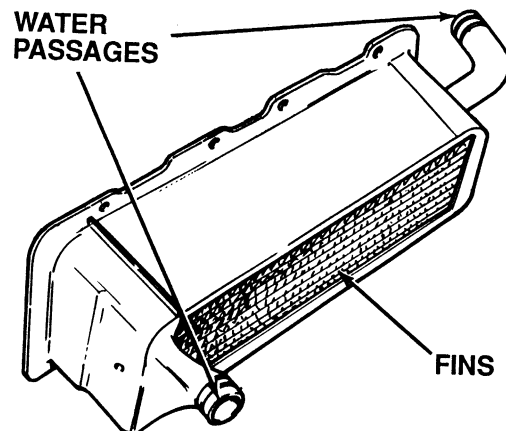
Solvent, Drycleaning (Item 68, Appendix B)

*Equipment Condition*

Aftercooler on clean work surface.

**a. Cleaning/Inspection.**

- (1) Inspect all cooler fins and air and water passages for plugging, bent, broken, leaking, or other obvious damage. Replace damaged parts.
- (2) Clean fins of dirt or any other foreign obstructions with a small brush.

**WARNING**

- Some chemical agents (detergents, solvents, alkalis, etc.) may irritate skin or be harmful to the eyes. Others must only be used with adequate ventilation. When working with potentially harmful chemical substances, read and heed the warnings on the product labels and follow-prescribed safety precautions. When working with any potentially harmful substance - including live steam, hot water, and compressed air - wear appropriate safety equipment (face shield, gloves, apron, etc.) if required, and use extreme care to avoid injury to personnel.
  - Avoid contact with steam. Steam can cause burns, blindness, and other serious injury. Ensure the wearing of protective aprons, gloves, and safety goggles when using live steam.
- (3) Using steam cleaner or high pressure hot water rinse, clean outside of core to remove any loose deposits or debris.

**20-56. AFTERCOOLER INSPECTION (CONT).**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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**

Ensure water connections are open so cleaning solution can penetrate both water and air sides of core.

- (4) Soak aftercooler core in tank filled with a solution of drycleaning solvent for 12 hours.
- (5) Remove core from tank and rinse thoroughly with steam cleaner or high pressure hot water rinse.

**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.

**NOTE**

To ensure debris is not forced farther into fins, direct stream of air opposite direction of normal coolant and air flow.

- (6) Blow out air and water sides of core using compressed air.
- (7) Rinse core with clean drycleaning solvent to remove any excess oil or grease.
- (8) Remove drycleaning solvent from core using steam cleaner or high pressure hot water rinse.
- (9) Blow dry air and water sides of core using compressed air.
- (10) Visually inspect aftercooler core tubes and fins to ensure cleaning process has completely removed all contamination. If contamination still exists, repeat cleaning procedure and inspection.

**END OF TASK**

**20-57. ENGINE OIL COOLER ASSEMBLY TESTING.**

This task covers:

- a. Pressure Testing

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Heavy Duty (Item 82, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Pump, Force (Item 178, Appendix F)  
Plate, Oil Cooler Test (Appendix C)

*Materials/Parts*

Oil, Lubricating (Item 36, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Gasket (1) (Item 65, Appendix E)

*Equipment Condition*

Oil cooler on clean work surface.

**a. Pressure Testing.****NOTE**

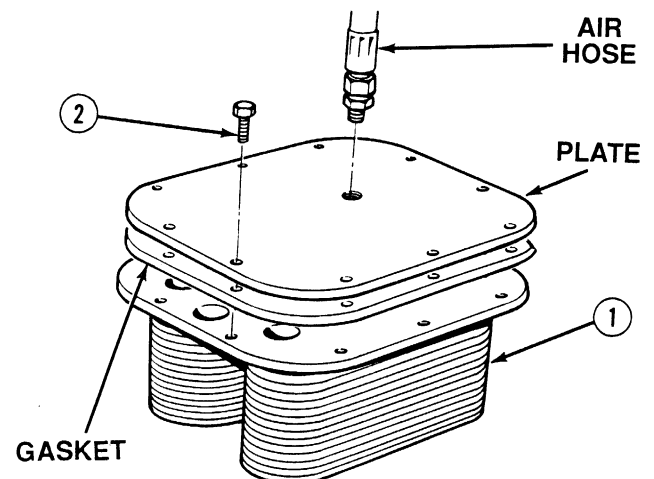
Use rubber gasket with plate to ensure tight seal.

- (1) Attach gasket and plate to flanged side of oil cooler core (1) with ten screws (2).

**WARNING**

Wear proper eye protection to protect against stream of pressurized water from leak or rupture of fitting, hose, or oil cooler core to prevent injury to personnel.

- (2) Attach air hose to oil cooler core (1) and apply 75 to 150 psi (517 to 1034 kPa) air pressure.
- (3) Submerge oil cooler core (1) in tank of hot water.
- (4) Check for air bubbles which would indicate leak in oil cooler core (1).
- (5) Remove oil cooler core (1) from water.
- (6) Relieve air pressure and remove air hose from oil cooler core (1).
- (7) Remove ten screws (2), plate and gasket from oil cooler core (1).

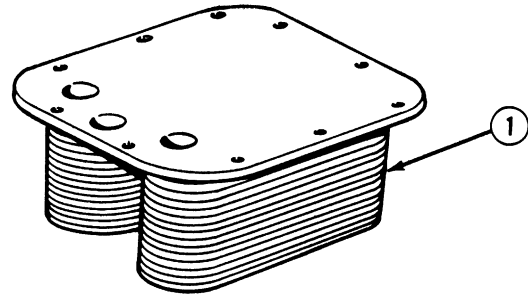


**20-57. AFTERCOOLER INSPECTION (CONT).**

**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). Failure to comply may result in injury or death to personnel.

- (8) Dry oil cooler core (1) with compressed air.
- (9) Replace oil cooler core (1) if any leaks are detected.
- (10) Apply lubricating oil to oil cooler core (1).



**END OF TASK**



**20-58. IDLER GEAR REPAIR (CONT).**

**CAUTION**

Use extreme care when handling idler gear bearings. Ensure bearings do not get scratched or damaged.

- (3) Position idler gear (3) in press with inner bearing cone (4) supported on steel blocks.

**CAUTION**

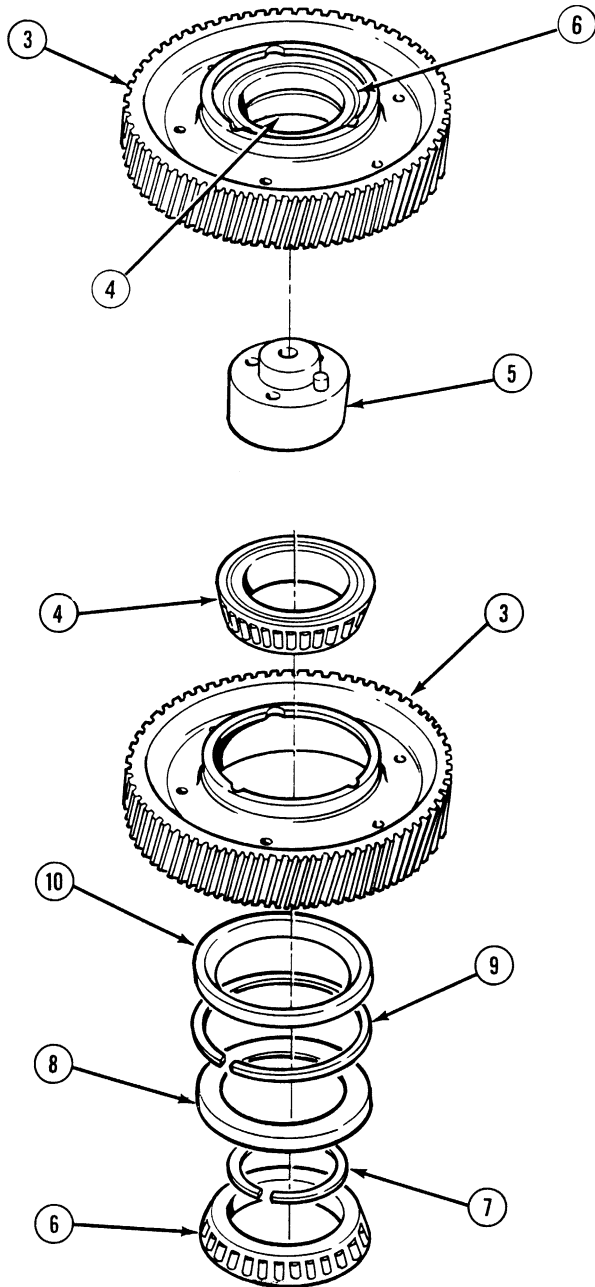
Idler gear must be rotated during removal to prevent damage to bearing cones.

- (4) Rotate idler gear (3) while pressing idler gear hub (5) out of bearing cones (4) and (6).
- (5) Remove idler gear (3) as a unit from press.
- (6) Remove outer bearing cone (6), inner spacer ring (7) and inner bearing cone (4) from idler gear (3).

**NOTE**

Perform Step (7) only if bearing cups are damaged.

- (7) Remove outer bearing cup (8), outer spacer ring (9) and inner bearing cup (10) from idler gear (3).



**b. Cleaning/Inspection.****WARNING**

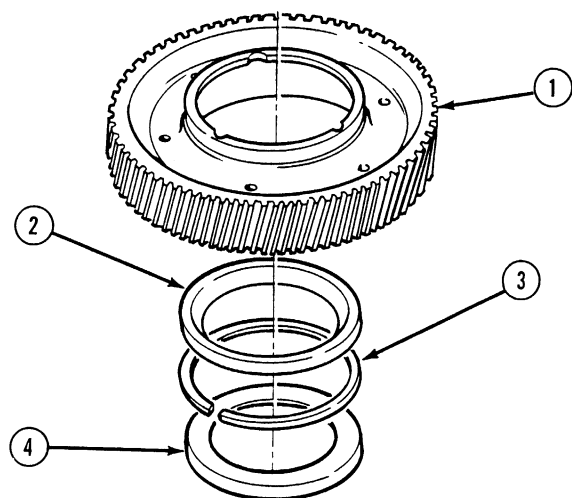
- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes, and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent. The flashpoint for Type II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
- (2) Dry all parts, except bearings, with compressed air. Allow bearings to air dry.
- (3) Inspect bearing for scoring, pitting, or flat spots on rollers or cones.
- (4) Examine gear teeth for scoring, pitting, and chips.
- (5) Replace all damaged parts.

**c. Assembly.****NOTE**

- Perform Steps (1) through (6) only if bearing cups were removed.
- The idler gear bearing is a matched assembly. Do not mix the components with another bearing assembly.

- (1) Support idler gear (1), shoulder down, on bed of press.
- (2) Apply lubricating oil to inner bearing cup (2) and position inner bearing cup, numbered side up, into bore of gear (1).
- (3) Press inner bearing cup (2) to seat against shoulder of idler gear (1).
- (4) Install outer spacer ring (3) on inner bearing cup (2).
- (5) Apply lubricating oil to outer bearing cup (4) and position outer bearing cup, numbered side down, into bore of idler gear (1).
- (6) Press outer bearing cup (4) against outer spacer ring (3).





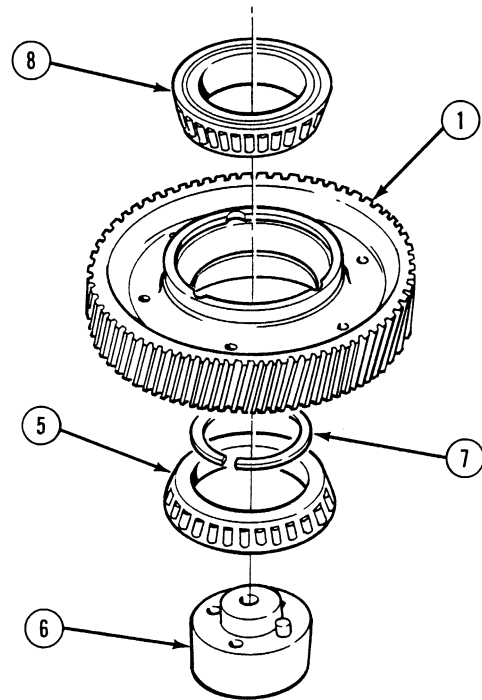
**20-58. IDLER GEAR REPAIR (CONT).**

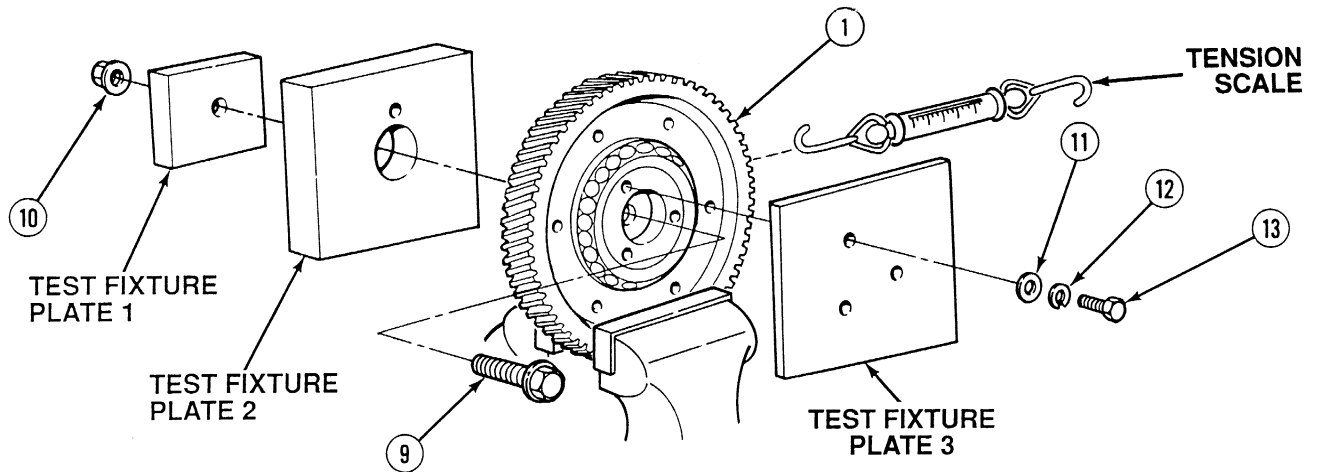
- (7) Apply lubricating oil to all parts. Place outer bearing cone (5) numbered side down on bed of press.
- (8) Press idler gear hub (6) into outer bearing cone (5) until bottom of idler gear hub is flush with bottom of cone.
- (9) Install inner spacer ring (7) on idler gear hub (6).
- (10) Position gap in inner spacer ring (7) on side opposite of oil hole in idler gear hub (6).
- (11) Support outer bearing cone (5) and idler gear hub (6).
- (12) Install idler gear (1) on idler gear hub (6).

**CAUTION**

Turn gear while installing bearing cone on idler gear hub to prevent damage to bearing cups.

- (13) Turn idler gear (1) while pressing inner bearing cone (8), numbered side up, over idler gear hub (6).
- (14) Hold idler gear hub (6) and turn idler gear (1) to see if binding occurs.





- (15) Position idler gear (1) in vise with soft jaws.
- (16) Mount test fixture plate 1 and test fixture plate 2 on idler gear (1) with screw (9) and nut (10). Tighten to 90 lb-ft (122 N·m).
- (17) Mount test fixture plate 3 on idler gear (1) with three washers (11), lockwashers (12) and screws (13). Tighten to 40 lb-ft (54 N·m).
- (18) Position test fixture plate 1 in vise so test fixture plate 3 faces upward.

**NOTE**

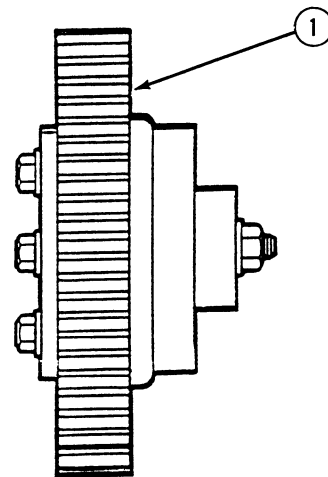
Pull to start gear moving must not be less than 0.5 lb (0.23 kg) or more than 4.0 lbs (1.8 kg).

- (19) Wrap rope several times around idler gear (1).
- (20) Attach tension scale to rope.

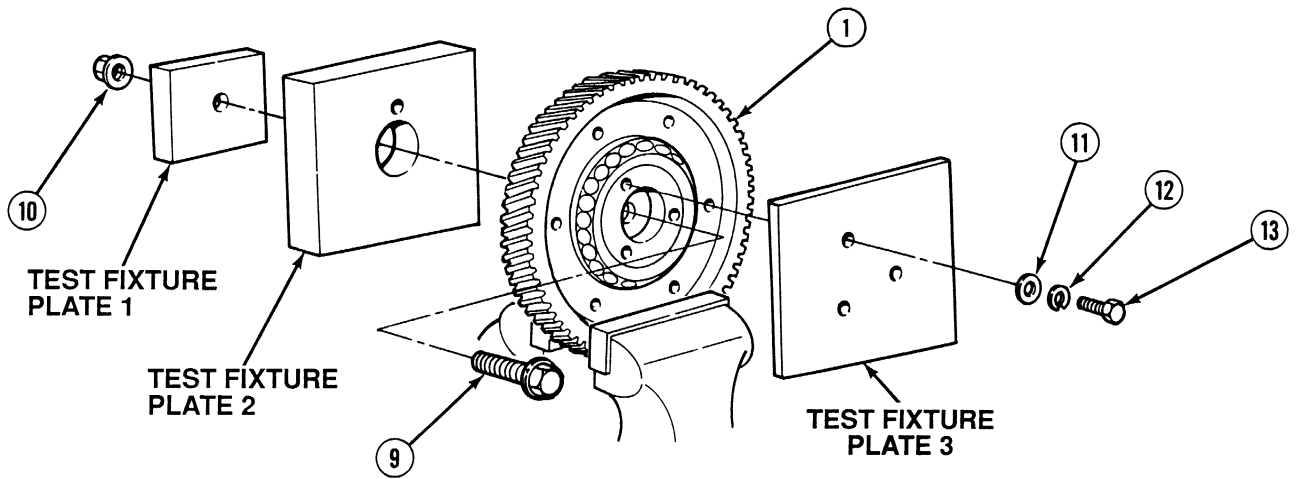
**NOTE**

Maximum difference between pulls in Step (21) is 2 lbs, 11 ounces (1.22 kg). If difference between pulls does not meet specifications, replace bearings.

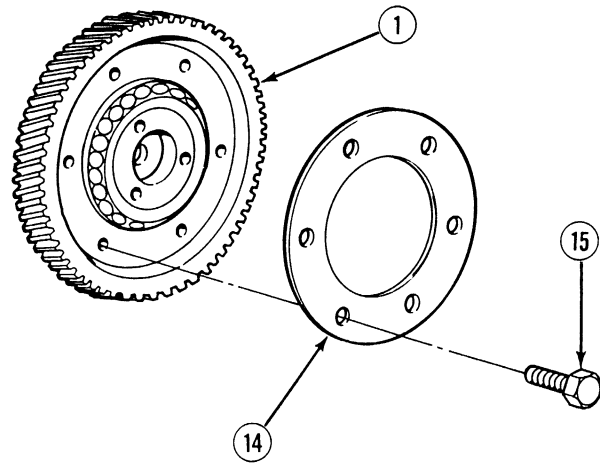
- (21) Pull idler rope several times and record pull required to start gear turning.



**20-58. IDLER GEAR REPAIR (CONT).**



- (22) Position idler gear (1) in vise with soft jaws.
- (23) Remove three screws (13), lockwashers (12), washers (11) and test fixture plate 3 from idler gear (1).
- (24) Remove nut (10), screw (9) and two test fixture plates 2 and 1.
- (25) Remove idler gear (1) from vise.
- (26) Install retainer (14) on idler gear (1) with six screws (15). Tighten screws 24 to 29 lb-ft (33 to 39 N·m).



**END OF TASK**

**20-59. ENGINE OIL PUMP DRIVE GEAR INSPECTION.**

This task covers:

- a. Cleaning/Inspection

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gage Set, Telescoping (Item 69, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Micrometer, Outside, Caliper, Set  
(Item 139, Appendix F)

*Materials/Parts*

Oil, Diesel, Fuel (Item 32, Appendix B)

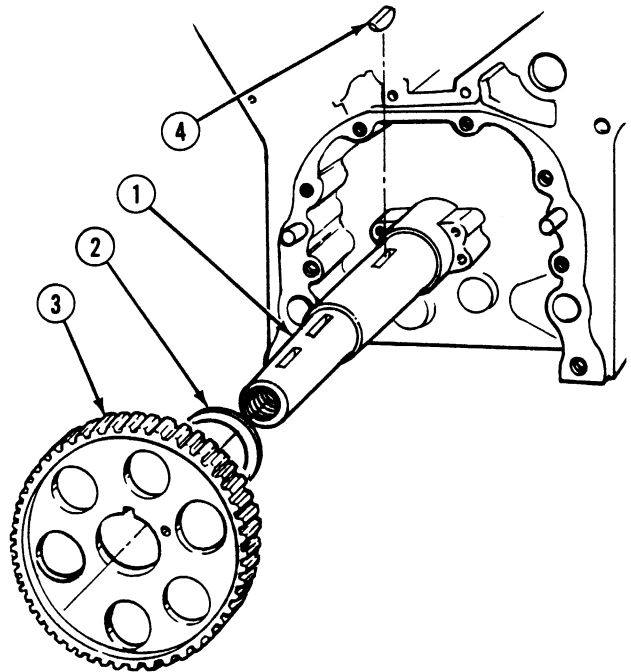
*Equipment Condition*

Oil pump drive gear on clean work surface.

**a. Cleaning/Inspection.****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.

- (1) Clean crankshaft (1), spacer (2), gear (3) and key (4) with diesel fuel.



**20-59. ENGINE OIL PUMP DRIVE GEAR INSPECTION (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). Failure to comply may result in injury or death to personnel.

- (2) Dry parts with compressed air.

**NOTE**

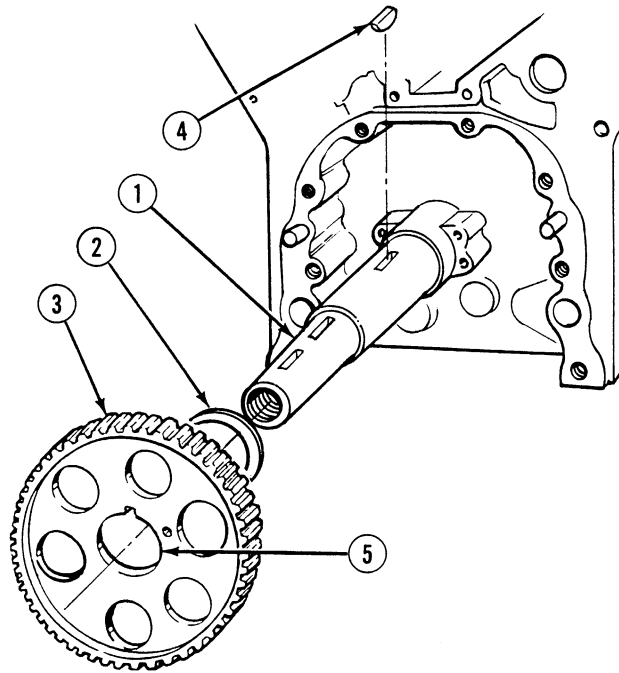
Diameter must be minimum of 2.498 in. (63.45 mm) and maximum of 2.500 in. (63.50 mm).

- (3) Measure crankshaft (1) diameter. Replace crankshaft if not within specifications.

**NOTE**

Diameter must be minimum of 2.5005 in. (63.51 mm) and maximum of 2.5010 in. (63.53 mm).

- (4) Measure oil pump drive gear bore (5). Replace oil pump drive gear if not within specifications.
- (5) If gear teeth are broken, worn, or scored, replace gear.



**END OF TASK**



**20-60. PISTON AND CONNECTING ROD REPAIR (CONT).**

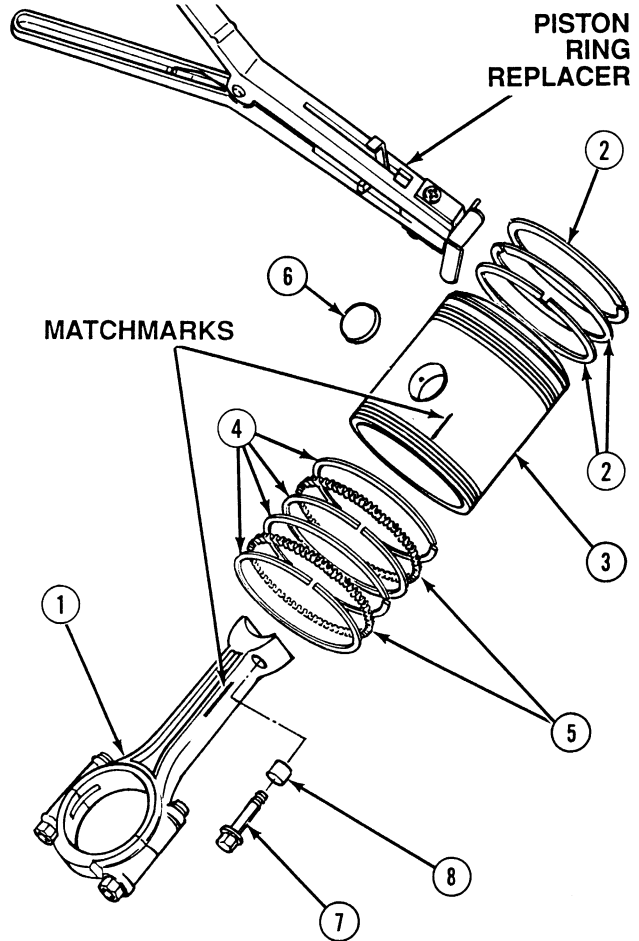
**a. Disassembly.**

- (1) Position connecting rod (1) in soft jawed vise.

**WARNING**

Use care when removing piston rings. Piston rings are under tension and can act as projectiles when released and could cause severe eye injury.

- (2) Using piston ring replacer, remove and discard three upper piston rings (2) from piston (3).
- (3) Using piston ring replacer, remove and discard four lower piston rings (4) from piston (3).
- (4) Remove and discard two oil ring expanders (5) from lower piston ring grooves in piston (3).
- (5) Punch hole in two piston pin retainers (6) and remove piston pin retainers from piston (3). Discard piston pin retainers.
- (6) Loosen two screws (7) in connecting rod (1).
- (7) Remove connecting rod (1) and piston (3) from vise.



**NOTE**

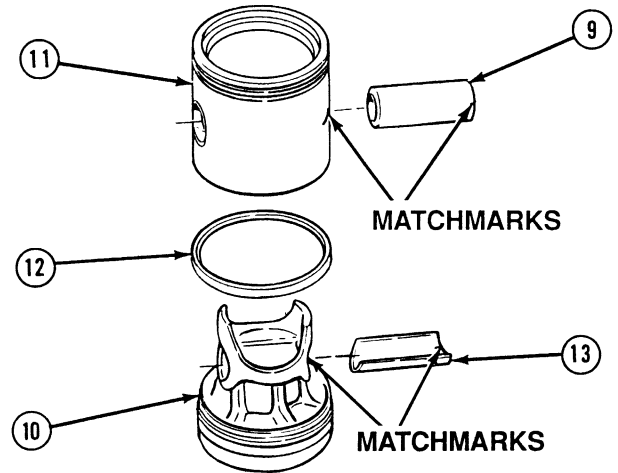
Matchmark connecting rod prior to removal.

- (8) Remove two screws (7) and spacers (8) from connecting rod (1).
- (9) Remove connecting rod (1) from piston (3).

**NOTE**

Matchmark piston pin, piston crown, piston skirt and piston pin bearing prior to removal.

- (10) Remove piston pin (9) from piston crown (10).
- (11) Separate piston crown (10) from piston skirt (11).
- (12) Remove seal (12) from piston crown (10).
- (13) Remove piston pin bearing (13) from piston crown (10).

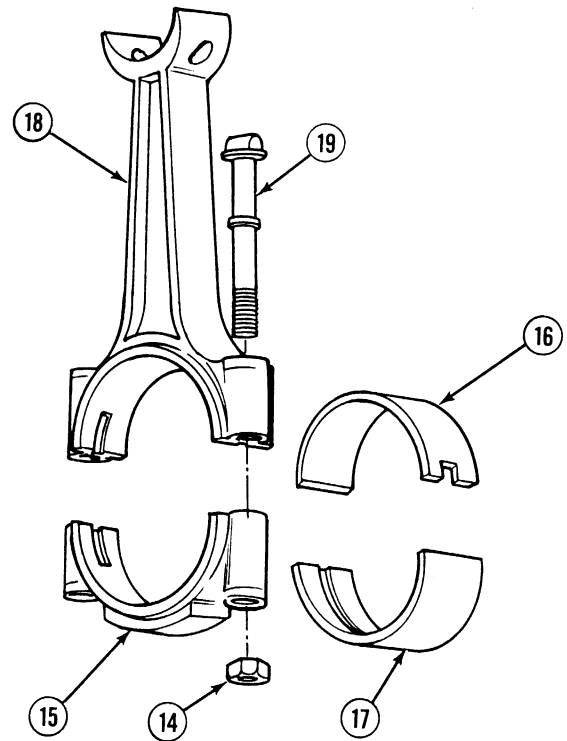


- (14) Remove two nuts (14), bearing cap (15) and bearing shells (16) and (17) from connecting rod (18). Discard bearing shells.

**NOTE**

Perform Step (15) only if connecting rod is damaged.

- (15) Remove two connecting rod bolts (19) from connecting rod (18).





**20-60. PISTON AND CONNECTING ROD REPAIR (CONT).**

***b. Cleaning/Inspection.***

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 sandblast or use wire brush to clean carbon deposits from piston skirt. Damage to parts may occur.

- (1) Clean carbon deposits from all ring grooves using soft bristle brush and drycleaning solvent.
- (2) Clean oil drain holes in piston skirt using brush and drycleaning solvent.
- (3) Clean all metal parts, except connecting rod and piston pin with drycleaning solvent.

**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.

- (4) Clean connecting rod and piston pin with diesel fuel.

**WARNING**

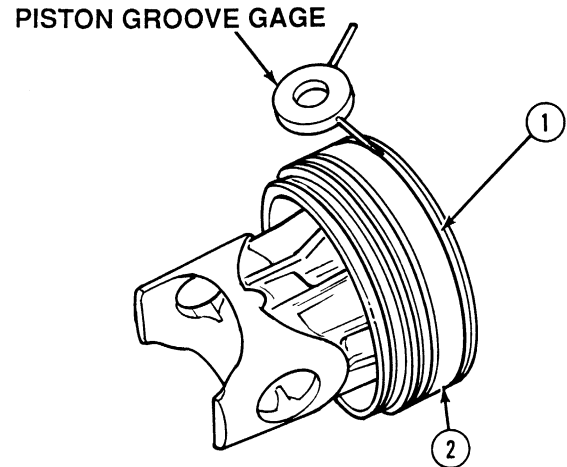
Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc). Failure to comply may result in injury or death to personnel.

- (5) Dry all parts with compressed air.
- (6) Inspect all parts for nicks, burrs or scratches. Replace all damaged parts.
- (7) Inspect piston skirt and piston crown for score marks, cracks, or damaged ring grooves.

**NOTE**

- Piston crown, bearing, and pin must be replaced as an assembly.
- If wire is not flush or protrudes slightly from fire ring groove, replace crown, bearing and pin.

- (8) Insert 0.100 in. (2.54 mm) “GO” wire in piston groove gage completely around fire ring groove (1).
- (9) Insert 0.106 in. (2.692 mm) “NO-GO” wire in piston groove gage completely around fire ring groove (1).



**NOTE**

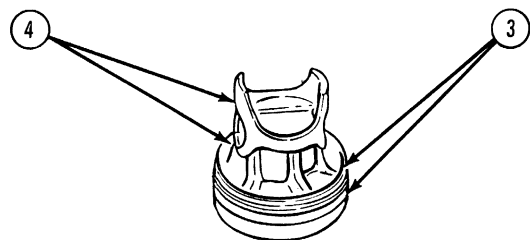
If diameter is not between minimum of 4.8104 in. (12.218 cm) and maximum of 4.8134 in. (12.226 cm), replace piston crown, bearing and pin.

- (10) Measure piston crown (2) diameter above fire ring groove (1).

**NOTE**

If diameter is not between minimum of 4.4650 in. (11.341 cm) and maximum of 4.4750 in. (11.367 cm), replace piston crown, bearing and pin.

- (11) Measure diameter above and below seal ring groove (3).



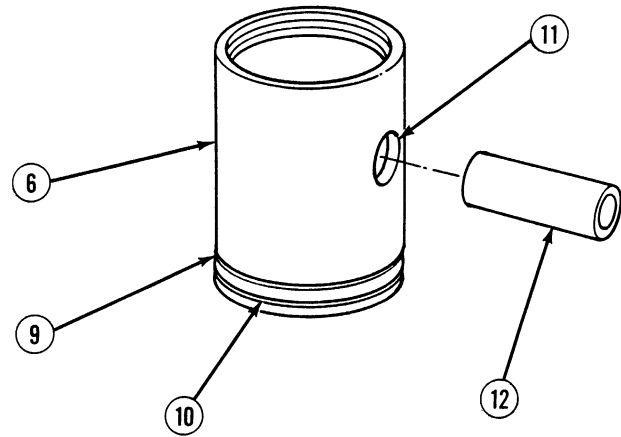
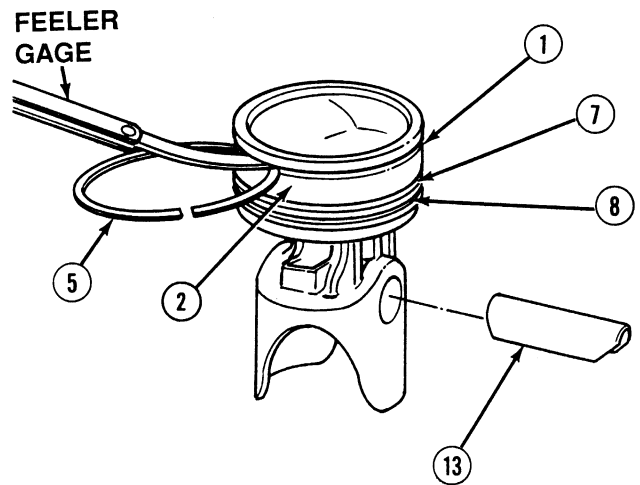
**NOTE**

If diameter is not between minimum of 3.2360 in. (8.219 cm) and maximum of 3.2370 in. (8.222 cm), replace piston crown, bearing and pin.

- (12) Measure diameter above and below bearing bore (4).

**20-60. PISTON AND CONNECTING ROD REPAIR (CONT).**

- (13) Using feeler gage and piston ring (5), measure ring to groove clearance in piston crown (2) and piston skirt (6).
- (14) Fire ring groove (1) clearance must be between minimum of 0.0010 in. (0.0254 mm) and maximum of 0.0070 in. (0.178 mm).
- (15) Top compression groove (7) clearance must be between minimum of 0.0100 in. (0.2540 mm) and maximum of 0.0220 in. (0.5588 mm).
- (16) Bottom compression groove (8) clearance must be between minimum of 0.0040 in. (0.1016 mm) and maximum of 0.0130 in. (0.3302 mm).
- (17) Using two piston rings, measure oil control grooves (9) and (10). Clearance must be between minimum of 0.0015 in. (0.0381 mm) and maximum of 0.0080 in (0.2032 mm).
- (18) Measure diameter of piston skirt (6). Diameter must be minimum of 4.8318 in. (12.2728 cm) and maximum of 4.8340 in. (12.2784 cm).
- (19) Using telescoping gage and micrometer, measure piston pin bore (11) in piston skirt (6). Diameter must be between minimum of 1.5025 in. (3.8164 cm) and maximum of 1.5040 in. (3.8202 cm).
- (20) Measure piston pin (12) diameter. Diameter must be between minimum of 1.4980 in. (3.8049 cm) and maximum of 1.5000 in. (3.8100 cm).
- (21) Inspect pin bearing (13) for scoring or wear. Bearing thickness must be between minimum of 0.0860 in. (2.1844 mm) and maximum of 0.0880 in. (2.2352 mm).



**NOTE**

Piston crown, bearing and pin must be replaced as an assembly.

- (22) Replace parts that are not within specification.

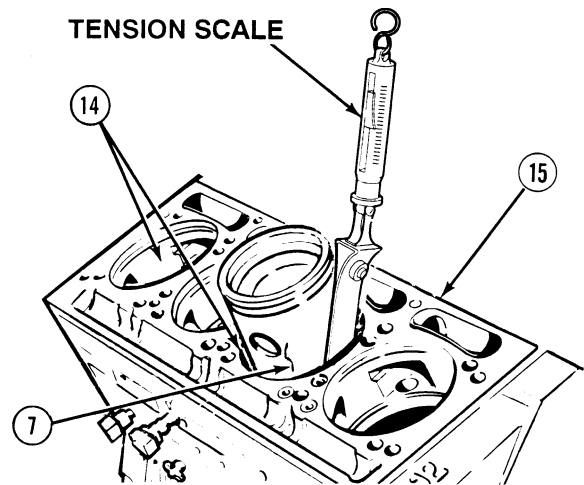
**NOTE**

Ensure to match piston to proper cylinder liner. Pistons being reinstalled were marked during removal. Match markings.

- (23) With cylinder liner (14) installed in engine block (15) and with the aid of an assistant hold piston skirt (7) upside down in cylinder liner (14) and attach tension scale to feeler gage set and check clearance in four places 90 degrees apart.

**NOTE**

- Feeler gage must be down inside cylinder liner approximately 3 in. (7.62 cm).
  - Clearance will be 0.001 in. (0.025 mm) greater than feeler gage thickness when it is withdrawn with pull of 6 lbs (2.7 kg). If clearance is not between minimum of 0.0051 in. (0.1295 mm) and maximum of 0.0120 in. (0.3048 mm), replace piston skirt.
- (24) Select feeler gage thickness requiring a pull of 6 lbs (2.7 kg).
- (25) If any binding between piston skirt and liner is noted, remove burrs with honing stone and repeat step (24).

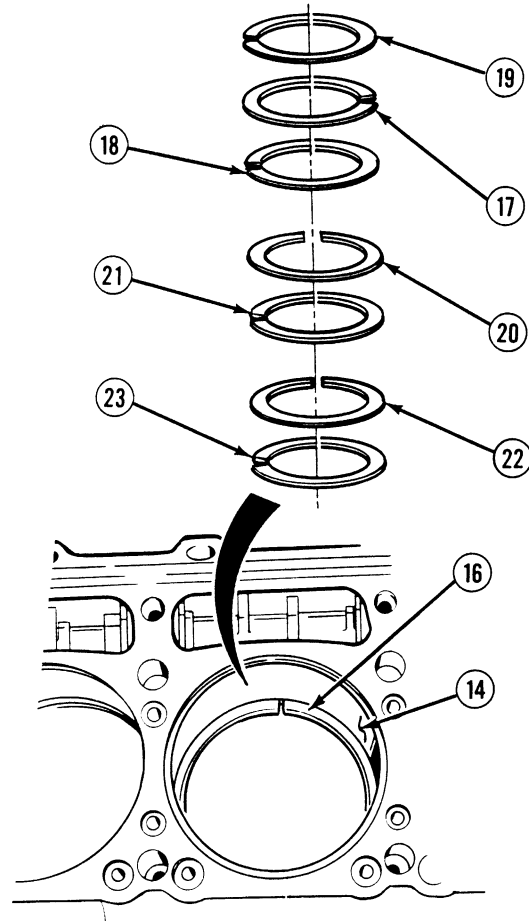


**20-60. PISTON AND CONNECTING ROD REPAIR (CONT).**

**NOTE**

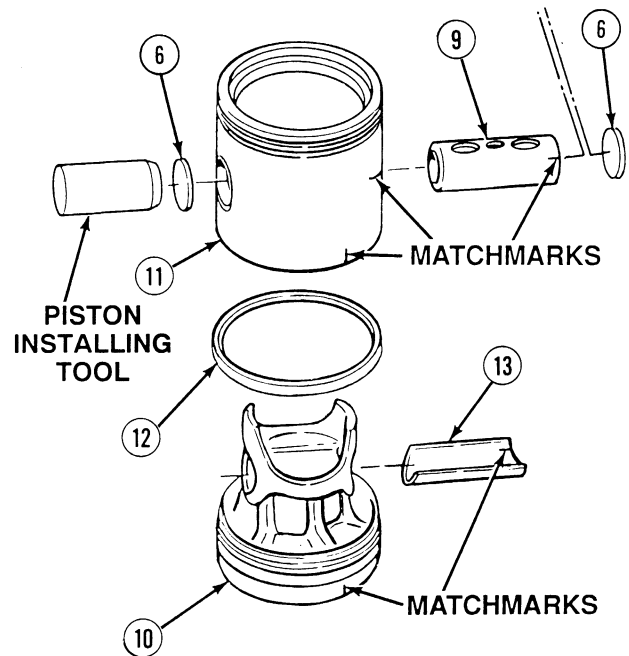
- Fire ring has two identification marks, top compression ring has no identification marks, and bottom compression ring has no identification marks. Upper oil control rings have orange stripe and lower oil control rings are black rings.
- Use piston skirt to position ring parallel with top of cylinder liner.

- (26) Insert and measure piston rings (16) one at a time inside cylinder liner (14) far enough to be in area of ring travel 2.0 to 3.0 in. (5.1 to 7.6 cm) deep.
- (27) Top compression ring (17), bottom compression ring (18) and fire ring (19) must have minimum gap of 0.0250 in. (0.6350 mm) and maximum gap of 0.0600 in. (1.524 mm).
- (28) Upper oil control rings (20) and (21) must have gap between minimum of 0.0070 in. (0.1778 mm) and maximum of 0.0350 in. (0.8890 mm).
- (29) Lower oil control rings (22) and (23) must have gap between minimum of 0.0100 in. (0.2540 mm) and maximum of 0.0430 in. (1.0922 mm).
- (30) If any rings are below minimum clearance, replace rings.
- (31) Replace all parts failing inspection.



**c. Assembly.**

- (1) Place piston crown (10), top end down, on work bench.
- (2) Install piston pin bearing (13) in piston crown (10).
- (3) Coat seal (12) with lubricating oil.
- (4) Install seal (12) on piston crown (10).
- (5) Position piston skirt (11) on piston crown (10).
- (6) Coat piston pin (9) with lubricating oil.
- (7) Align hole in piston skirt (11) with hole in piston crown (10).
- (8) Install piston pin (9) with threaded holes toward bottom of piston skirt (11).



**NOTE**

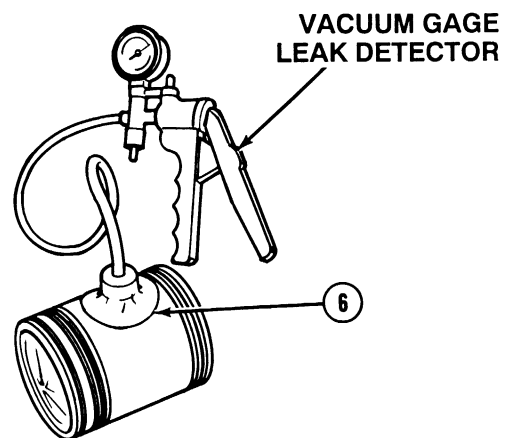
Retainers must be seated fully and evenly in piston skirt.

- (9) Using piston pin retainer installer, install piston pin retainers (6) in piston skirt (11) on each side of piston pin (9) until retainers bottom out.

**NOTE**

If loss of pressure of piston pin retainers is noted, replace piston pin retainers.

- (10) Using leak detector, apply 10 in. (254 mm) of vacuum to each piston pin retainer (6). There should be no loss of pressure.



**20-60. PISTON AND CONNECTING ROD REPAIR (CONT).**

**NOTE**

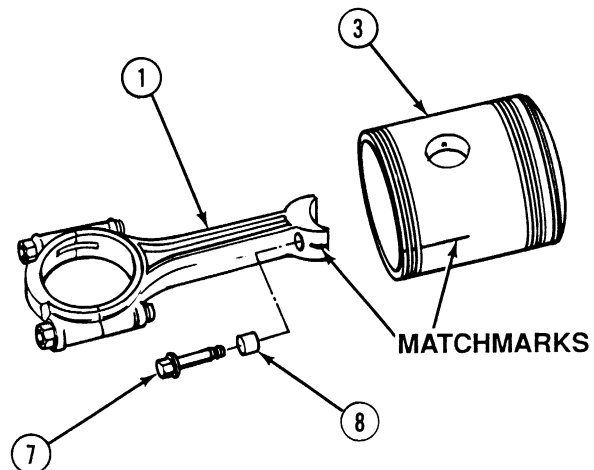
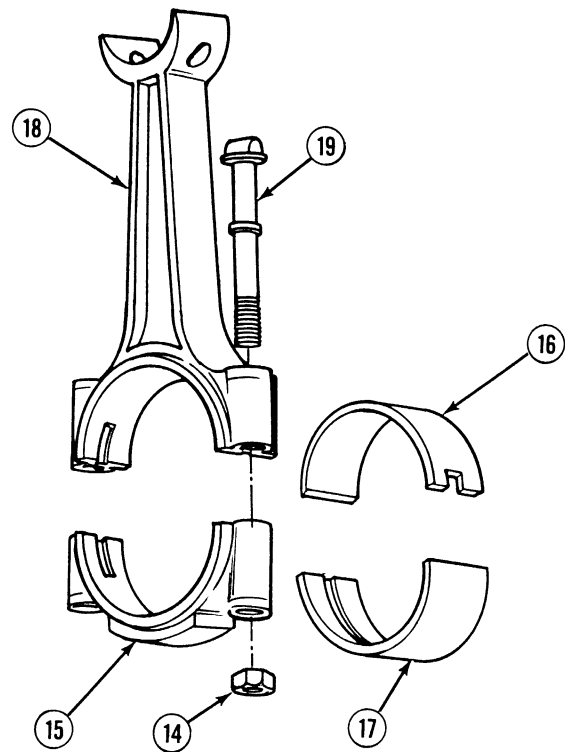
Perform Step (11) only if connecting rod bolts were removed.

- (11) Install two connecting rod bolts (19) in connecting rod (18).
- (12) Position two bearing shells (16) and (17), bearing cap (15) and two nuts (14) in connecting rod (18).
- (13) Install two spacers (8) on screws (7) in connecting rod (1).

**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.

- (14) Apply small amount of International Compound No. 2 to threads and head contact surface of two screws (7).
- (15) Align matchmarks and position connecting rod (1) into piston skirt (3) with two screws (7).
- (16) Position connecting rod (1) in vise with soft jaws.
- (17) Tighten screws (7) in connecting rod (1) 55 to 60 lb-ft (75 to 81 N·m).



**NOTE**

Replace piston rings in sets only.

- (18) Coat piston crown (10) and piston skirt (3) with lubricating oil.

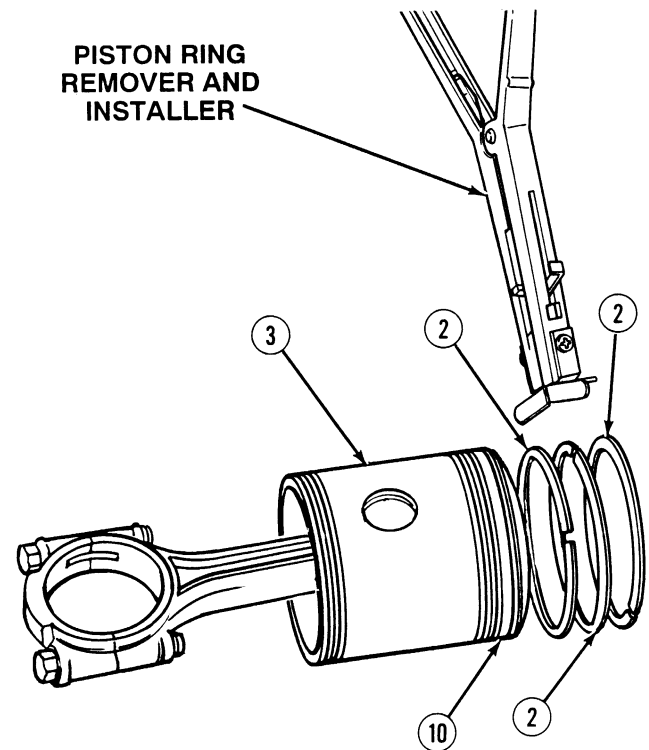
**WARNING**

Use care when installing piston rings. Piston rings are under tension and can act as projectiles when released and could cause severe eye injury.

**NOTE**

- Position gaps 120 degrees apart, around piston crown.
- Lower piston ring is piston ring without identification marks.

- (19) Lubricate lower piston ring (2) with lubricating oil.
- (20) Using piston ring remover and installer, install lower piston ring (2) in piston crown (10).

**NOTE**

Middle piston ring is piston ring without identification marks.

- (21) Lubricate middle piston ring (2) with lubricating oil.
- (22) Using piston ring remover and installer, install middle piston ring (2) in piston crown (10).

**NOTE**

Top piston ring is piston ring with two identification marks.

- (23) Lubricate upper piston ring (2) with lubricating oil.
- (24) Using piston ring remover and installer, install upper piston ring (2) in piston crown (10).



**20-60. PISTON AND CONNECTING ROD REPAIR (CONT).**

**CAUTION**

To prevent damage to oil rings when piston is installed in ring compressor, make sure ends of expander rings do not overlap.

- (25) Lubricate two oil ring expanders (5) with lubricating oil.

**NOTE**

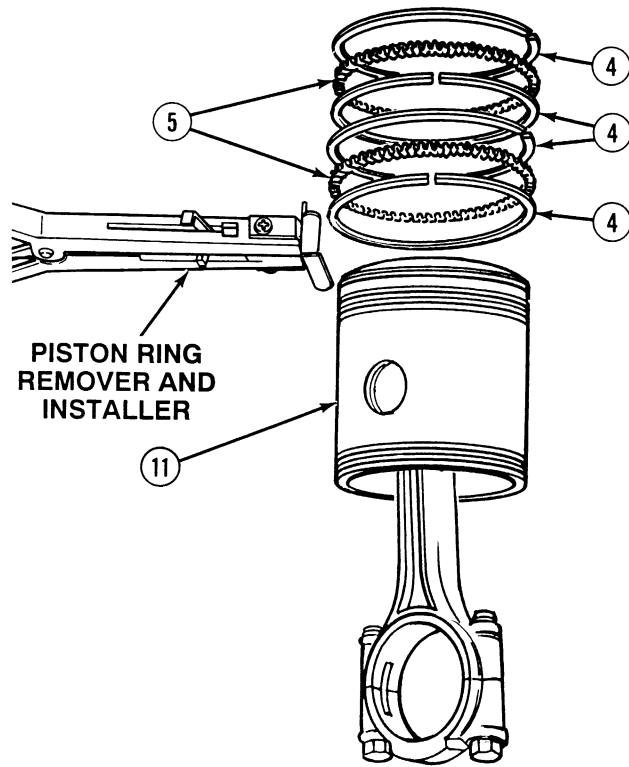
Two oil ring expanders are installed with ends pointing upward and are positioned 180 degrees apart.

- (26) Install two oil ring expanders (5) on piston skirt (11).

**NOTE**

Install oil rings with beveled edge facing upward.

- (27) Lubricate chrome, non-slotted oil ring (4) with lubricating oil.



**WARNING**

Use care when installing piston rings. Piston rings are under tension and can act as projectiles when released and could cause severe eye injury.

**NOTE**

Chrome, non-slotted oil ring is installed with gap position 180 degrees from gap in oil ring expanders installed in Step (26).

- (28) Using piston ring remover and installer, install chrome, non-slotted oil ring (4) in piston skirt (11).
- (29) Lubricate non-slotted oil ring (4) with lubricating oil.

**NOTE**

Non-slotted oil ring is installed with gap positioned 90 degrees from gap in oil ring installed in Step (28).

- (30) Using piston ring remover and installer, install non-slotted oil ring (4) in piston skirt (11).
- (31) Lubricate oil ring (4) with lubricating oil.

**NOTE**

Oil ring is installed with black-slotted bottom down and gap positioned 180 degrees from gap in expander ring installed in Step (26).

- (32) Using piston ring remover and installer, install oil ring (4) in piston skirt (11).

- (33) Lubricate oil ring (4) with lubricating oil.

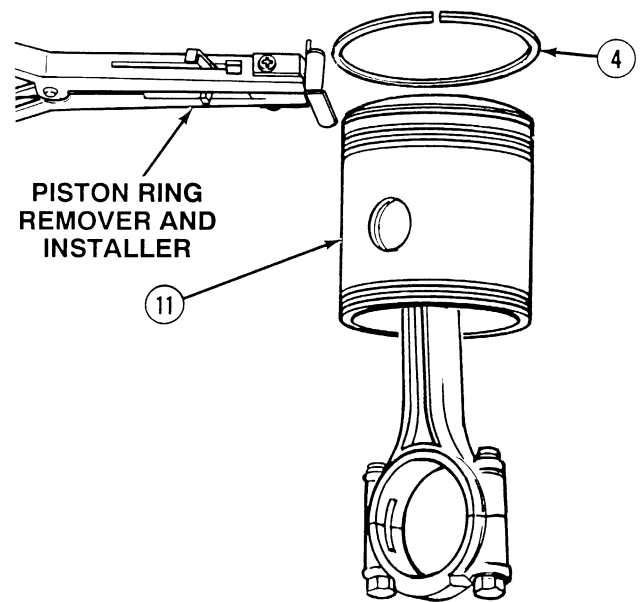
**WARNING**

Use care when installing piston rings. Piston rings are under tension and can act as projectiles when released and could cause severe eye injury.

**NOTE**

Oil ring is installed with black slotted bottom down and gap positioned 90 degrees from gap in oil ring installed in Step (32).

- (34) Install oil ring (4) in piston skirt (11).



**END OF TASK**

**20-61. CYLINDER LINER REPAIR.**

This task covers:

- a. Cleaning/Inspection                      b. Honing                                      c. Cylinder Liner Protrusion

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's  
(Item 240, Appendix F)
- Bracket, Mounting, Cylinder Liner  
(Item 22, Appendix F)
- Compressor Unit, Air (Item 35, Appendix F)
- Gage, Depth, Cylinder Liner  
(Item 72, Appendix F)
- Gage, Dial, Bore, Cylinder (Item 75, Appendix F)
- Gloves, Chemical Oil Protective  
(Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Gun, Airblow (Item 86, Appendix F)
- Honing Unit, Cylindrical Bore, Portable  
(Item 96, Appendix F)

*Tools and Special Tools - Continued*

- Micrometer, Outside, Caliper, Set  
(Item 139, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

*Materials/Parts*

- Oil, Honing (Item 33, Appendix B)
- Oil, Lubricating (Item 36, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)

*Equipment Condition*

Cylinder liner on clean work surface.

**a. Cleaning/Inspection.**



- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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**

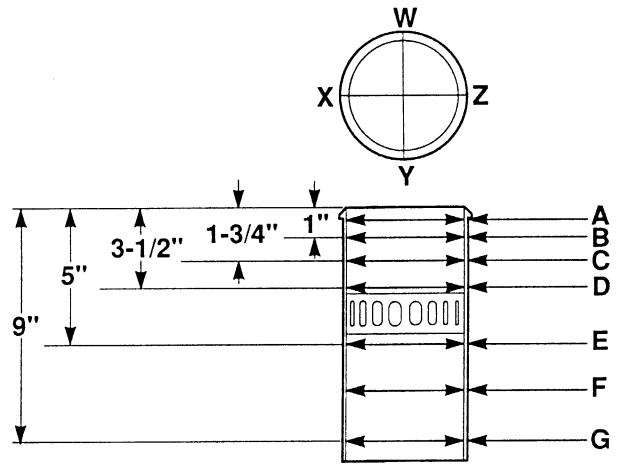
All eight cylinder liners are cleaned, inspected, and repaired the same way.

- (1) Clean all parts with drycleaning solvent.
- (2) Inspect cylinder liner for cracks and scoring. A slightly scored cylinder liner may be honed and reused. If cracked or excessively scored, replace cylinder liner.
- (3) Inspect cylinder liner area above port holes for pitting. If pitting is noted, replace cylinder liner.
- (4) Inspect inside surface of cylinder liner at top for ridge. If ridge is not excessive it may be honed.

- (5) If cylinder liner is glazed, it must be honed.

**NOTE**

- Inside diameter must be maximum of 4.8415 in. (12.297 cm) and minimum of 4.8390 in. (12.291 cm).
- Cylinder liner out-of-round may be maximum of 0.0025 in. (0.0635 mm).
- Cylinder liner taper may be maximum of 0.0025 in. (0.0635 mm).
- If cylinder liner does not meet specifications, replace cylinder liner.



- (6) Measure and record inside diameter of cylinder liner. Measure points A through G and make two measurements (X, Z and W, Y) at each point.

**NOTE**

- Top diameter, just below flange, should be minimum of 5.3577 in. (13.6086 cm). Maximum of 5.3595 in. (13.6131 cm) is acceptable.
- Middle diameter should be minimum of 5.3347 in. (13.5501 cm) and maximum of 5.3365 in. (13.5547 cm).
- Lower diameter must be minimum of 5.2142 in. (13.2441 cm) and maximum of 5.2160 in. (13.2486 cm).
- Replace cylinder liner if any measurement exceeds specifications.

- (7) Measure and record outside diameter of cylinder liner.

**20-61. CYLINDER LINER REPAIR (CONT).**

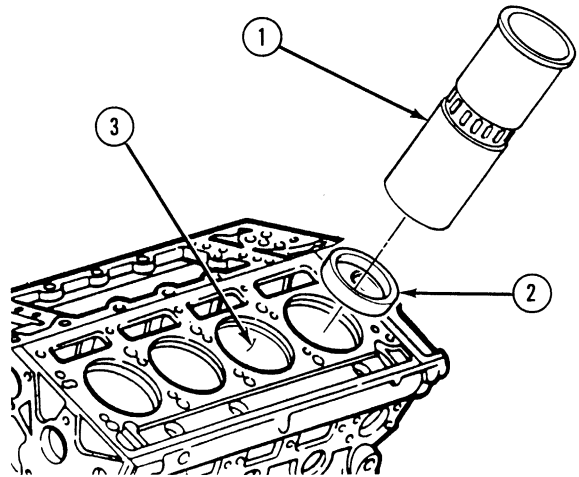
**CAUTION**

Do not drop cylinder liner into cylinder bore. Damage to cylinder liner will result.

**NOTE**

- Cylinder liners must be installed in their original bores.
- Cylinder liner is installed when liner flange rests on insert.

- (8) Install cylinder liners (1) and inserts (2) in cylinder bore (3).

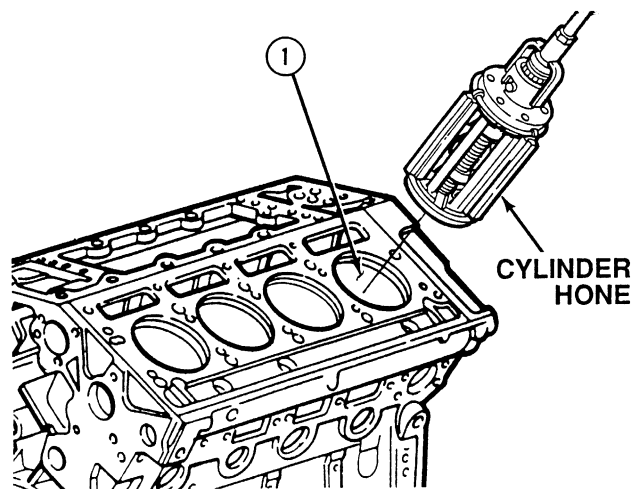


**b. Honing.**

**CAUTION**

Do not hone new cylinder liner. New liners are factory finished and honing could affect seating of piston rings. Hone the liner if glazed, ridged, out of round, or tapered.

- (1) Coat inside of cylinder liner (1) with honing oil.
- (2) Install hone with 120 grit stones, into cylinder liner (1).
- (3) Work hone up and down in cylinder liner (1) at 300 to 400 rpm. Move hone full length of cylinder liner (1) so hone produces marks in crisscross pattern at a 45 degrees angle.
- (4) Remove hone after glaze has been removed from cylinder liner (1).

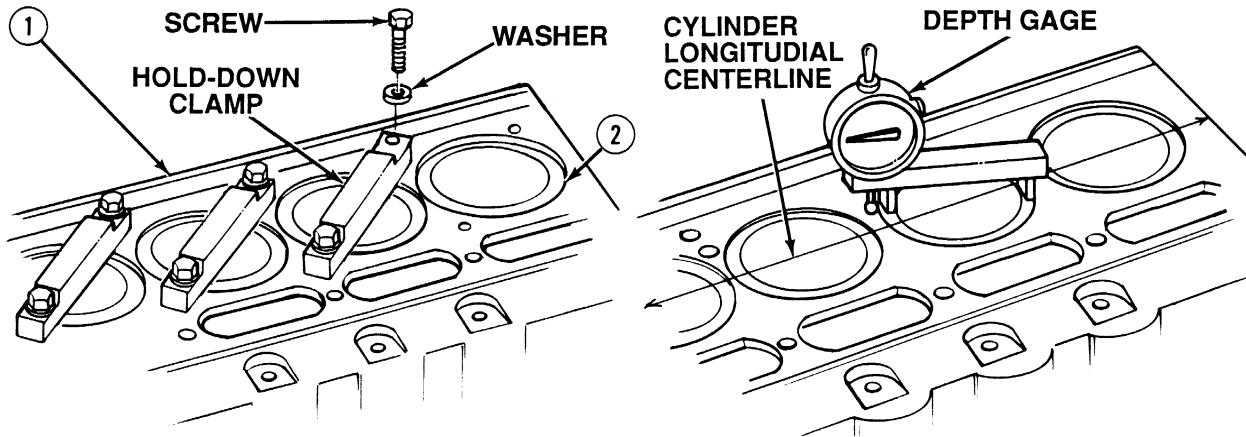


**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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.
- (5) Clean cylinder liner with drycleaning .
  - (6) Dry cylinder liner with compressed air.
  - (7) Check cylinder liner for burrs.
  - (8) Recheck cylinder liner for taper and out-of-round (Step (6) of **a. Cleaning/Inspection**).

**20-61. CYLINDER LINER REPAIR (CONT).**

*c. Cylinder Liner Protrusion.*



- (1) Install eight hold-down clamps on engine block with 16 washers and screws. Tighten screws to 50 lb-ft (68 N·m).
- (2) Place depth gage on engine block (1) and set to zero.

**NOTE**

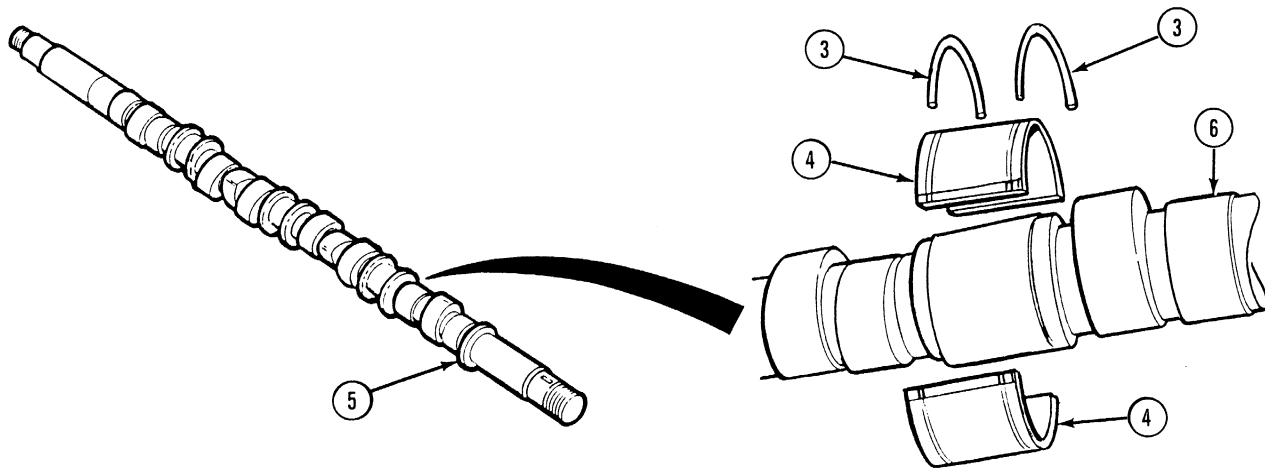
- Although cylinder liners are within specifications, there must not be over 0.0015 in. (0.0381 mm) difference between any two adjacent cylinder liners when measured along cylinder longitudinal centerline.
  - Replace cylinder liner if any measurement exceeds specification.
- (3) Measure distance from top of cylinder liner (2) to top of engine block (1) with depth gage. Depth of flange below engine block (1) must be minimum of 0.0418 in. (1.0617 mm) and maximum of 0.0482 in. (1.2243 mm).
  - (4) Once cylinder liner (2) is within specifications, tag and mark cylinder liner (2) and engine block (1) so liner is installed in correct cylinder block bore.
  - (5) Remove screws, washers, hold down clamps, and liners (2) from engine block (1).

**END OF TASK**





**20-62. CAMSHAFT REPAIR (CONT).**



(2) Remove and discard six lock rings (3) and bearing halves (4) from left and right camshaft (5) and (6).

**b. Cleaning/Inspection.**

**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.
- 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.

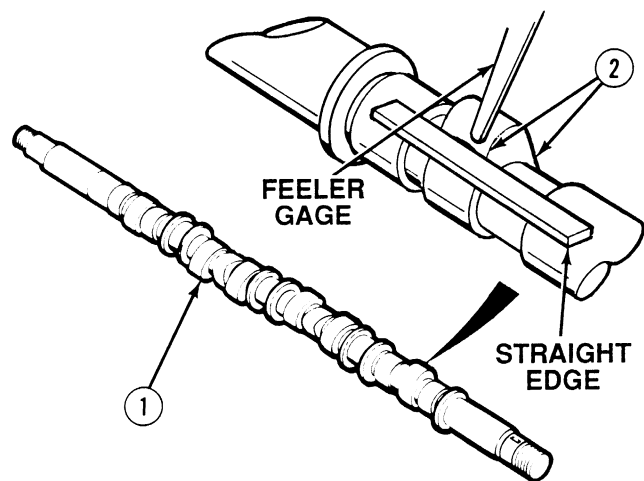
**NOTE**

Both camshafts are cleaned and inspected the same way.

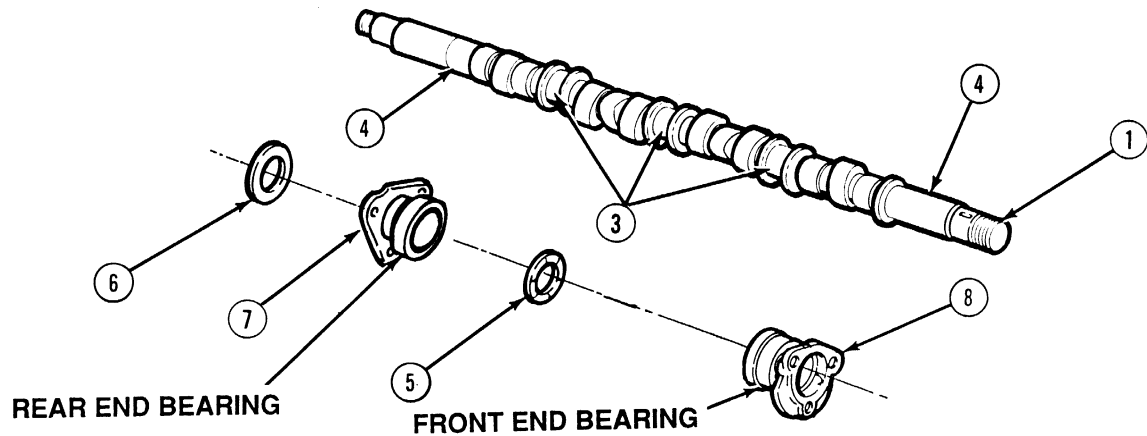
- (1) Clean all parts with diesel fuel.
- (2) Dry all parts with compressed air.
- (3) Inspect camshaft (1) for scratches, gouges, scoring or pitting.
- (4) File burred keyways smooth.
- (5) Retap threaded holes if threads are stripped or dented.

**NOTE**

If feeler gage larger than 0.003 in. (0.076 mm) fits between flat lobe and straight edge, replace camshaft.



(6) Measure flat spots (2) on cam lobes using straight edge and 0.003 in. (0.076 mm) feeler gage.



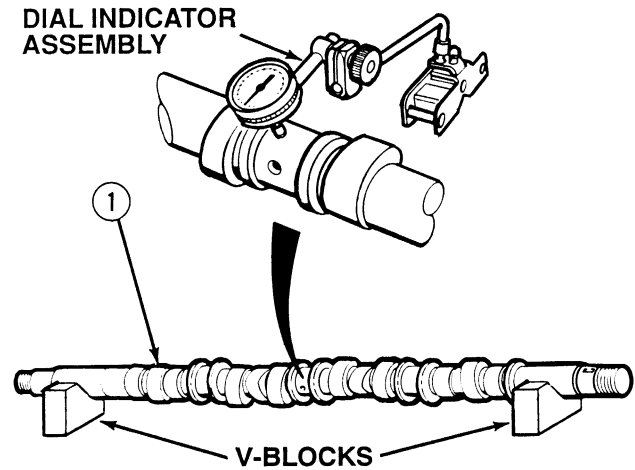
- (7) Measure and note diameters of three bearing journals (3). Replace camshaft (1) if any diameter is less than 1.4980 in. (38.0492 mm).
- (8) Measure and note diameters of two end bearing journals (4). Replace camshaft (1) if any diameter is less than 1.4960 in. (37.9984 mm).
- (9) Measure and note thickness of two rear end bearing thrust washers (5) and (6) for each camshaft and replace if less than 0.119 in. (3.023 mm).
- (10) Measure bushing in end bearings (7) and (8) to shaft clearance. If clearance is more than 0.006 in. (0.152 mm), replace end bearings.
- (11) For each camshaft, subtract end play measurement (measured in Camshaft Removal Para 20-31) and thickness of two thrust washers (measured in Step (9)).
  - (a) If difference is between 0.003 in. (0.076 mm) and 0.018 in. (0.457 mm), use standard size thrust washers 0.119 to 0.122 in. (3.023 to 3.099 mm).
  - (b) If difference is between 0.018 in. (0.457 mm) and 0.023 in. (0.584 mm), use next size thrust washers 0.124 to 0.127 in. (3.150 to 3.226 mm).
  - (c) If difference is between 0.024 in. (0.610 mm) and 0.027 in. (0.686 mm), use largest size thrust washers 0.129 to 0.132 in. (3.277 to 3.353 mm).
  - (d) If difference is greater than 0.027 in. (0.686 mm), replace camshaft.

**20-62. CAMSHAFT REPAIR (CONT).**

**CAUTION**

Protect machined surfaces of camshaft from damage due to contact with V-blocks by folding rags over V block.

- (12) Place camshaft (1) in V-blocks and use dial indicator to check center bearing surface for runout. Runout should not exceed 0.002 in. (0.051 mm).
- (13) If runout exceeds 0.002 in. (0.051 mm), replace camshaft (1).
- (14) Inspect plugs in end of camshaft. Replace camshaft if plugs are damaged.

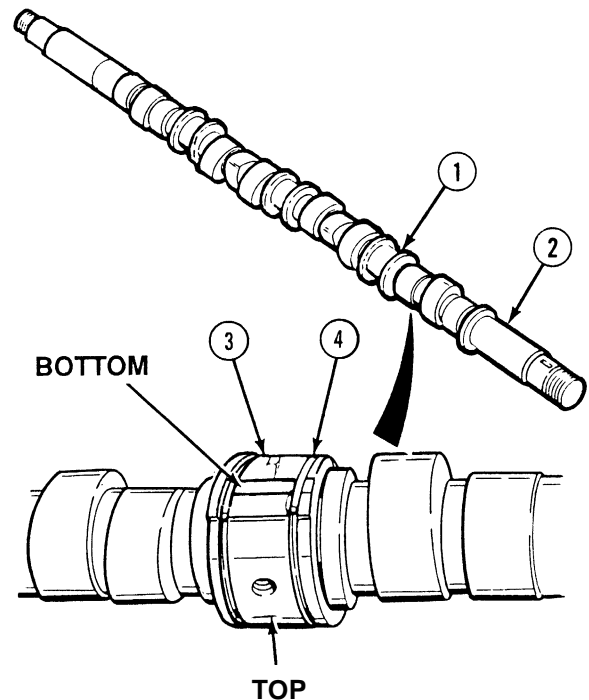


**c. Assembly.**

**NOTE**

- Lower intermediate bearings have an oil groove on mating edge and do not have setscrew hole.
- Left and right camshafts are assembled the same way.

- (1) Apply grease to camshaft intermediate bearing journals (1) of camshaft (2).
- (2) Position top and bottom intermediate bearing halves (3) on camshaft journals (1).

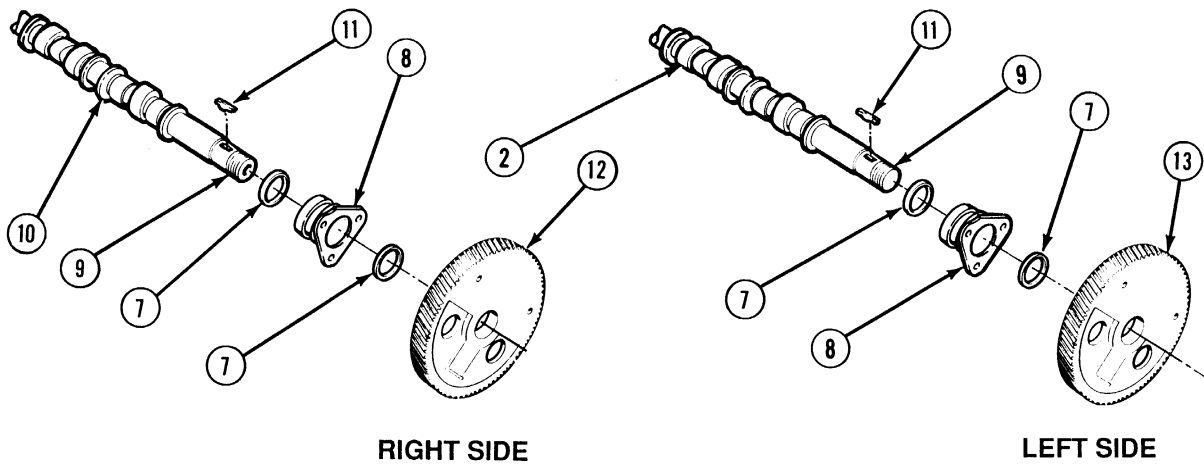
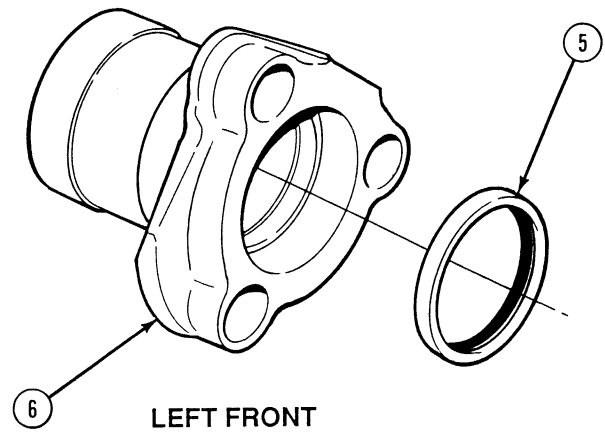


**NOTE**

Both ends of lock ring must cover split line of bearing and be installed over lower half of bearing.

- (3) Install six lock rings (4) over bottom halves of intermediate bearings (3).

- (4) Install oil seal (5) in left front end bearing (6).

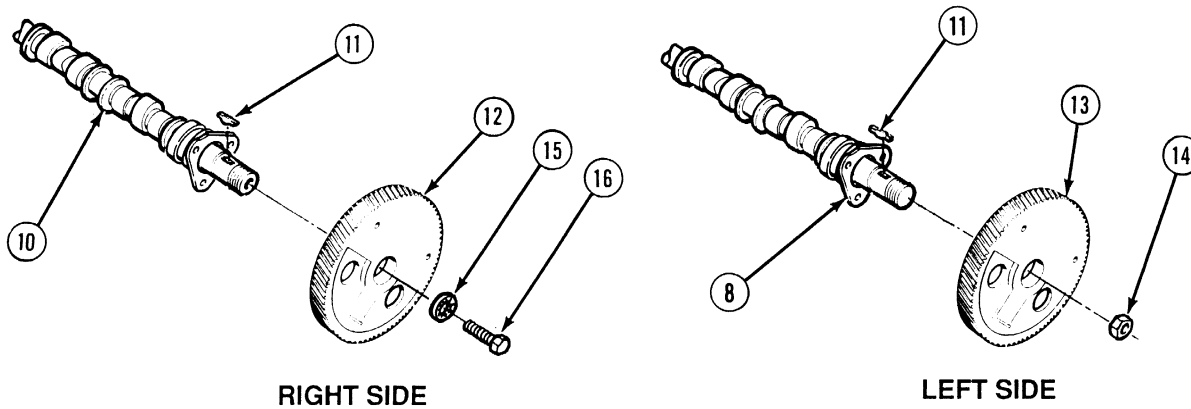


**NOTE**

- Steel faces of thrust washers go next to bearing.
- Gears, thrust washers, nut, screw, washer and spacer were removed during camshaft removal (Para 20-34).

- (5) Apply grease to steel faces of two thrust washers (7).
- (6) Install thrust washers (7) on rear end bearings (8).
- (7) Lubricate rear journals (9) of left and right camshafts (2) and (10) with lubricating oil.
- (8) Install rear end bearings (8) on camshafts (2) and (10) with flange of bearings facing toward gear (12) and (13) end of camshafts.
- (9) Install two woodruff keys (11) in camshafts (2) and (10).

**20-62. CAMSHAFT REPAIR (CONT).**



**NOTE**

Flat side of gear faces away from camshaft.

- (10) Support camshafts (2) and (10) on press.

**NOTE**

Camshaft gears were removed when camshaft was removed from engine.

- (11) Align keyways in two gears (12) and (13) with keys (11) on camshafts (2) and (10).
- (12) Press gears (12) and (13) on camshafts (2) and (10).

**NOTE**

Clearance must be minimum of 0.004 in. (0.102 mm) and not exceed limit of 0.018 in. (0.457 mm). If clearance is not within specifications, replace thrust washers and rear end bearing.

- (13) Measure clearance between thrust washers (7) and rear end bearing (8).
- (14) Install nut (14) on left camshaft (2).
- (15) Position spacer (15) and screw (16) on right camshaft (10).

**END OF TASK**



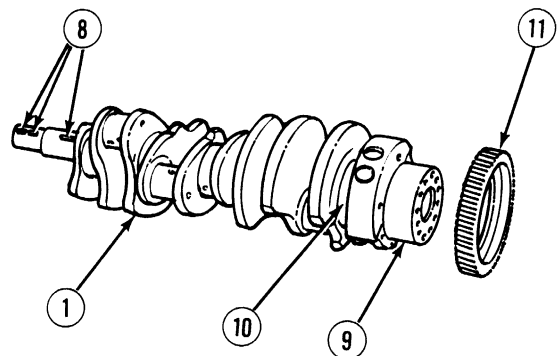
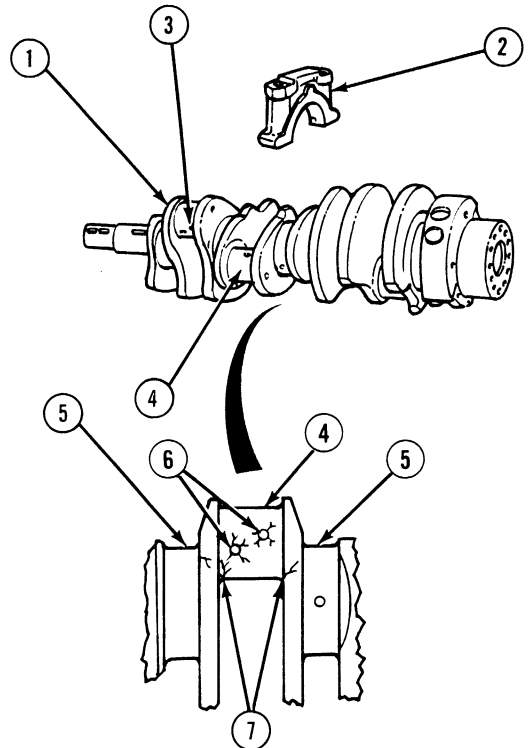
**20-63. MAIN BEARING AND CRANKSHAFT REPAIR (CONT).**

**b. Cleaning/Inspection.**

**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.

- (1) Clean crankshaft (1) and bearing caps (2) with diesel fuel and cleaning cloth.
- (2) Flush oil passages (3) in crankshaft and clean using a stiff wire brush.
- (3) Visually inspect crankshaft (1) for signs of overheating. Replace crankshaft if journals have turned blue from heat.
- (4) Inspect crankshaft connecting rod journals (4) and main bearing journals (5) for deep scratches. Replace crankshaft if damaged.
- (5) Inspect connecting rod journals (4) and main bearing journals (5) for signs of cracks at connecting rod journal oil holes (6) or at joining points (7) of connecting rod journal and main bearing journals. Replace crankshaft if damaged.
- (6) Inspect crankshaft keyways (8) for cracks or gouges. Replace crankshaft (1) if damaged.
- (7) Inspect rear oil seal contact surface (9) for deep scratching. If scratches cannot be smoothed out with crocus cloth, replace crankshaft (1).
- (8) Inspect crankshaft thrust surfaces (10) for grooving. Replace crankshaft (1) if deep grooves have been scratched into thrust surfaces.



**NOTE**

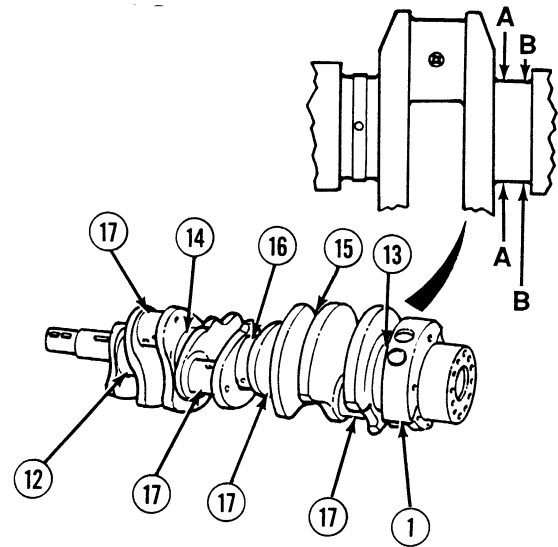
Timing gear was removed from crankshaft during crankshaft removal.

- (9) Inspect timing gear (11) for chipped teeth. Replace if damaged.

**CAUTION**

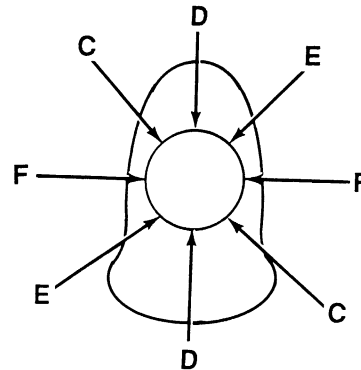
Protect machined surfaces of camshaft from damage due to contact with V blocks by folding rags over V block.

- (10) Support crankshaft on two machined V blocks at the front main journal (12) and rear main journal (13).



**NOTE**

- Maximum runout for journals 2 and 4 is 0.002 in. (0.051 mm).
- Maximum runout for main bearing journal 4 is 0.004 in. (0.102 mm).
- Difference between runout measurements for two adjacent journals must not exceed 0.003 in. (0.076 mm).
- When runout high spots of adjacent journals are at right angles to each other, sum of their runout measurements must not exceed 0.004 in. (0.102 mm).
- Replace crankshaft if runout is not within specifications.



- (11) Using dial indicator, measure crankshaft runout at journals (14), (15), and (16). Rotate crankshaft one complete turn. Record readings and note locations of runout high spots on journals.
- (12) Install two more machined V-blocks under two journals to support crankshaft.

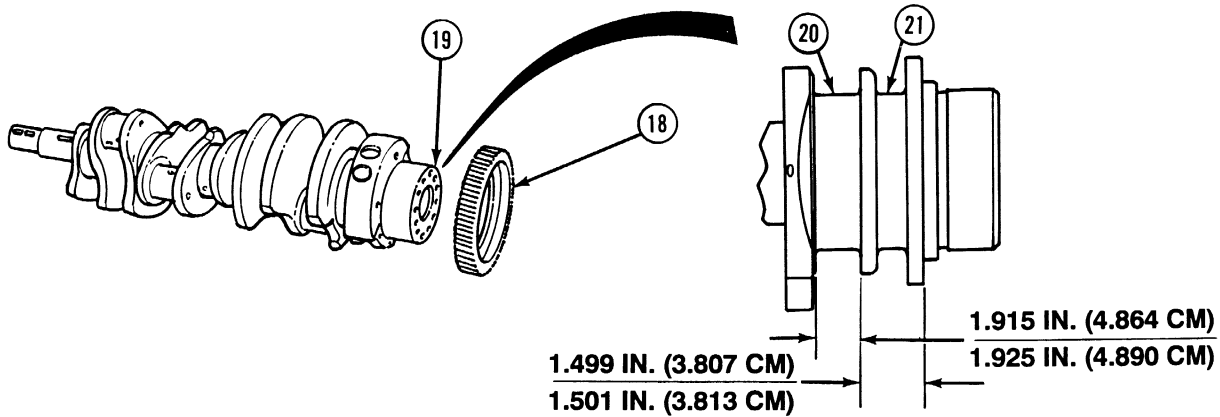
**NOTE**

If any crankshaft journal is not within specification, replace crankshaft.

- (13) Using a micrometer, measure crankshaft journals. At point A measure around shaft at points C through F. At point B measure around the shaft at points C through F. Compare measurements with the following limits.
- (a) Diameter of main bearing journals (12), (13), (14), (15) and (16) must be minimum of 4.4985 in. (11.4262 cm) and maximum of 4.5002 in. (11.4305 cm).
  - (b) Connecting rod journals (17) diameter must be minimum of 2.9985 in. (7.616 cm) and maximum of 3.0002 in. (7.6205 cm).
  - (c) Check main bearing journals (12), (13), (14), (15) and (16) and connecting rod journals (17) for out-of-round. Journal out-of-round must not exceed 0.0005 in. (0.0127 mm).
  - (d) Check main bearing journals (12), (13), (14), (15) and (16) for taper. Taper must not exceed 0.004 in. (0.102 mm).
  - (e) Check connecting rod journals (17) for taper. Taper must not exceed 0.004 in. (0.102 mm) (half width) and 0.008 in. (0.203 mm) (full width).



**20-63. MAIN BEARING AND CRANKSHAFT REPAIR (CONT).**



**NOTE**

If timing gear does not meet specifications, replace timing gear.

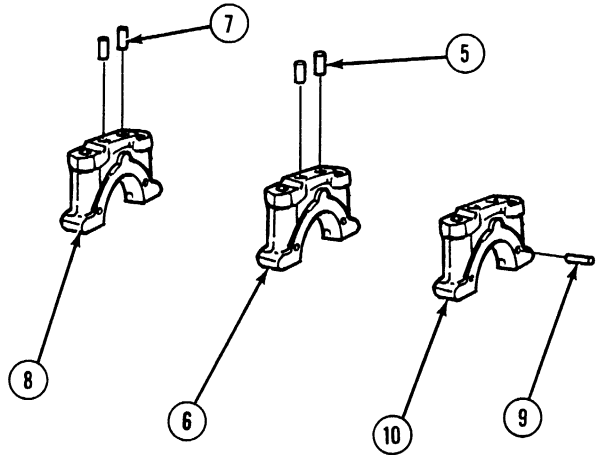
- (14) Using a micrometer and telescoping gage, measure crankshaft to timing gear clearance as follows:
  - (a) Measure timing gear (18) inside diameter. Inside diameter of timing gear should be minimum of 5.2490 in. (13.3325 cm) and maximum of 5.2510 in. (13.3375 cm).
  - (b) Measure diameter of crankshaft at timing gear surface (19). Record measurement.
  - (c) Crankshaft to timing gear clearance must not exceed 0.001 in. (0.025 mm).
  - (d) Replace timing gear (18) if not within specification.
- (15) Using a micrometer and telescoping gage, measure crankshaft thrust washer surface width.
  - (a) Rear main thrust washer surface (20) width must be minimum of 1.499 in. (3.807 cm) and maximum of 1.501 in. (3.813 cm).
  - (b) Counterweight thrust washer surface (21) width must be minimum of 1.915 in. (4.864 cm) and maximum of 1.925 in. (4.890 cm).
- (16) Replace any part failing inspection.

**c. Assembly.**

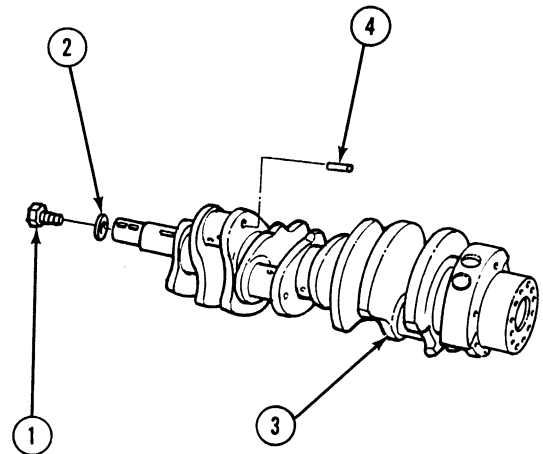
**NOTE**

Perform Steps (1) through (4) if studs, dowel pins and plugs were removed.

- (1) Install two studs (7) in front bearing cap (8).
- (2) Install two studs (5) in second bearing cap (6).
- (3) Install four dowel pins (9) in rear bearing cap (10).



- (4) Install four plugs (4) in crankshaft (3).
- (5) Install spacer (2) and screw (1) in crankshaft (3).



**END OF TASK**

**20-64. ENGINE CYLINDER BLOCK REPAIR.**

This task covers:

- |                        |             |                          |
|------------------------|-------------|--------------------------|
| a. Disassembly         | c. Assembly | e. Follow-On Maintenance |
| b. Cleaning/Inspection | d. Testing  |                          |

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Compressor Unit, Air (Item 35, Appendix F)
- Drill Set, Twist (Item 48, Appendix F)
- Drill, Electric, Portable, 1/4 in. (Item 49, Appendix F)
- Gage Set, Feeler (Item 66, Appendix F)
- Gage, Depth (Item 71, Appendix F)
- Gage, Dial, Bore, Cylinder (Item 75, Appendix F)
- Gloves, Chemical Oil Protective (Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Gun, Airblow (Item 86, Appendix F)
- Hammer, Hand, Soft Plastic (Item 88, Appendix F)
- Handle, Driver (Item 90, Appendix F)
- Installer and Remover (Item 106, Appendix F)
- Installing/Removing Tool (Item 126, Appendix F)
- Pan, Drain 4 gal (Item 144, Appendix F)
- Plug, Cylinder Block (Item 160, Appendix F)
- Press, 60 Ton (Item 164, Appendix F)
- Socket Wrench Attachment, Screwdriver (Item 221, Appendix F)
- Steam Cleaner (Item 227, Appendix F)
- Straight Edge (Item 230, Appendix F)
- Testing Kit, Cylinder Block (Item 238, Appendix F)
- Wrench Set, Socket 3/8 in. Drive (Item 273, Appendix F)
- Wrench Set, Socket 3/4 in. Drive (Item 274, Appendix F)
- Wrench, Torque (0-60 N·m) (Item 276, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

*Tools and Special Tools - Continued*

- Wrench, Torque (0 to 600 lb-ft [0-814 N·m]) (Item 278, Appendix F)
- Lifting Device, Minimum Capacity 800 lbs (363 kg)

*Materials/Parts*

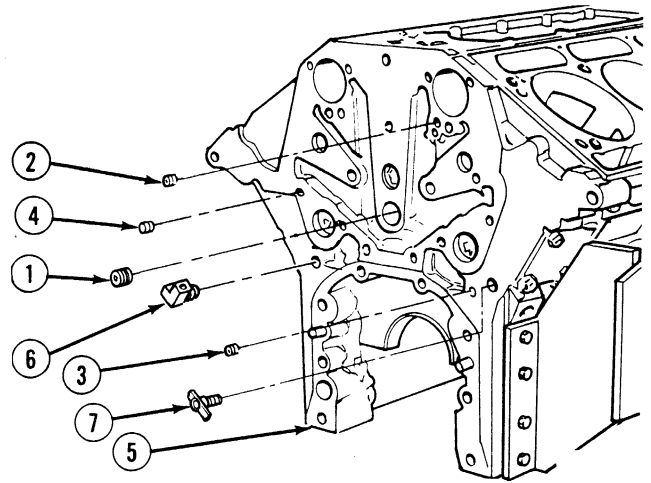
- Antifreeze (Item 6, Appendix B)
- Compound, International, No. 2 (Item 16, Appendix B)
- Oil, Lubricating (Item 36, Appendix B)
- Sealing Compound (Item 53, Appendix B)
- Cover, Access (Item 37, Appendix E)
- Gasket (Item 80, Appendix E)
- Gasket (Item 84, Appendix E)
- Gasket (3) (Item 99, Appendix E)
- Gasket, Compression (8) (Item 123, Appendix E)
- Lockwasher (4) (Item 292, Appendix E)
- Pin, Dowel (4) (Item 426, Appendix E)
- Plug, Expansion (Item 443, Appendix E)
- Ring, Seal, Cylinder Liner (16) (Item 511, Appendix E)
- Seal (2) (Item 570, Appendix E)

*Equipment Condition*

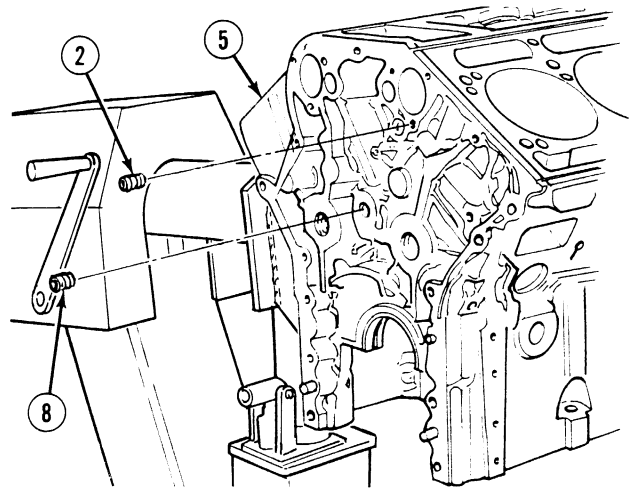
- Main bearing and crankshaft removed from engine, (Para 20-42)

**a. Disassembly.**

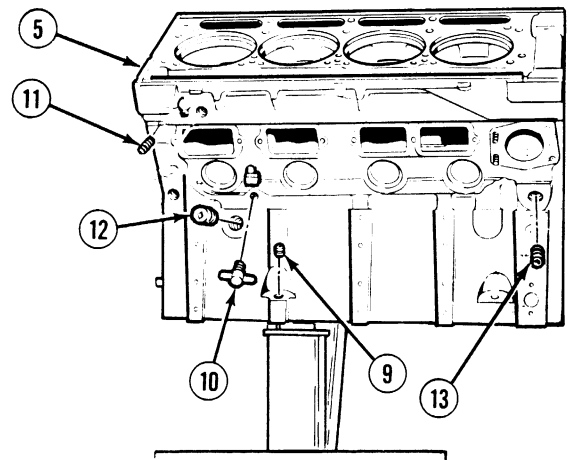
- (1) Remove oil galley plugs (1), (2), and (3) and plug (4) from front of engine block (5).
- (2) Remove three-way oil tee (6) from front of engine block (5).
- (3) Remove drain cock (7) from front of engine block (5).



- (4) Remove oil gallery plugs (2) and (8) from rear end and side of engine block (5).

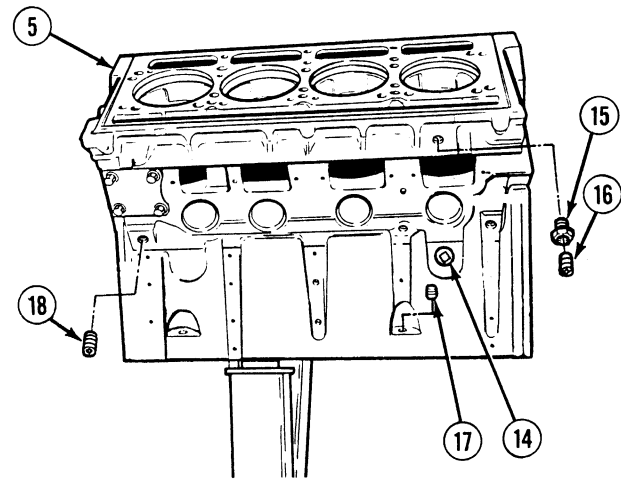


- (5) Remove plug (9) from right side of engine block (5).
- (6) Remove drain cock (10) from right side of engine block (5).
- (7) Remove oil galley plug (11) from right side of engine block (5).
- (8) Remove plugs (12) and (13) from right side of engine block (5).

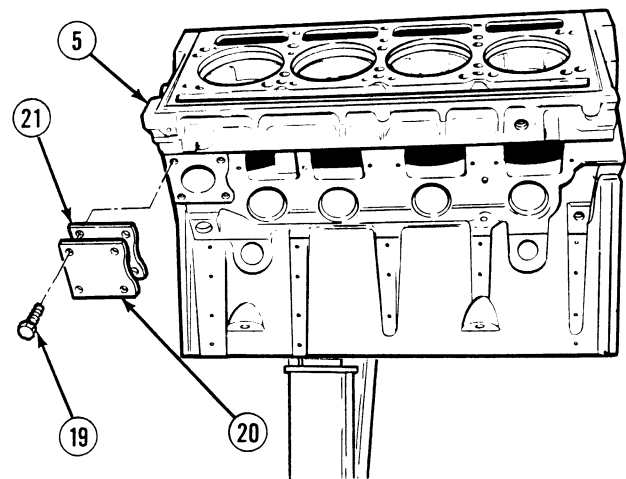


**20-64. ENGINE CYLINDER BLOCK REPAIR (CONT).**

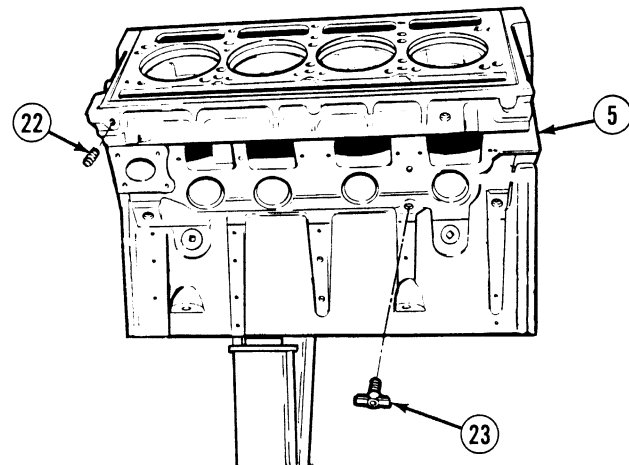
- (9) Remove plug (14) from left side of engine block (5).
- (10) Remove reducer (15) and plug (16) from left side of engine block (5).
- (11) Remove plug (17) from left side of engine block (5).
- (12) Remove plug (18) from engine block (5).

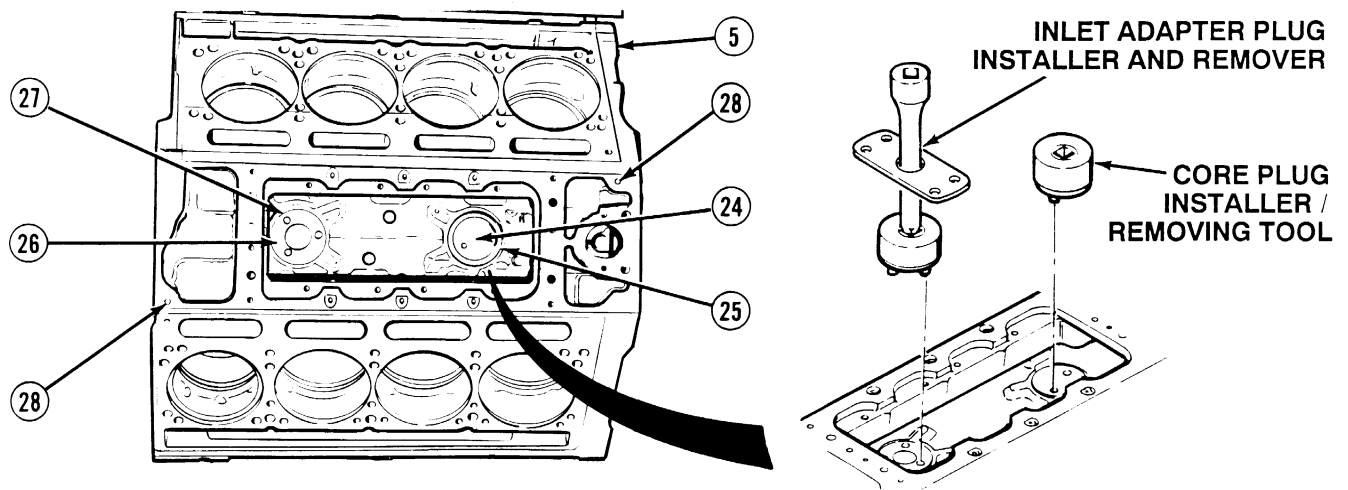


- (13) Remove four screws (19), cover plate (20) and gasket (21) from left side of engine block (5). Discard gasket.

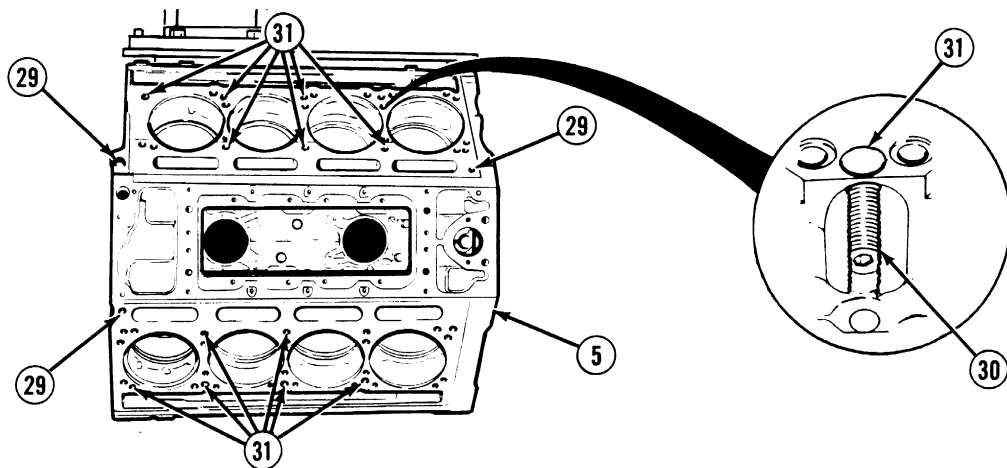


- (14) Remove oil plug (22) from engine block (5).
- (15) Remove drain cock (23) from engine block (5).





- (16) Using installing/removing tool, remove core plug (24) and gasket (25) from top of engine block (5). Discard gasket.
- (17) Using installer and remover, remove aftercooler water inlet adapter (26) and gasket (27) from top of engine block (5). Discard gasket.
- (18) Remove two oil gallery plugs (28) from top of engine block (5).



**NOTE**

Remove plugs and dowels in Steps (19) through (25) only if damaged.

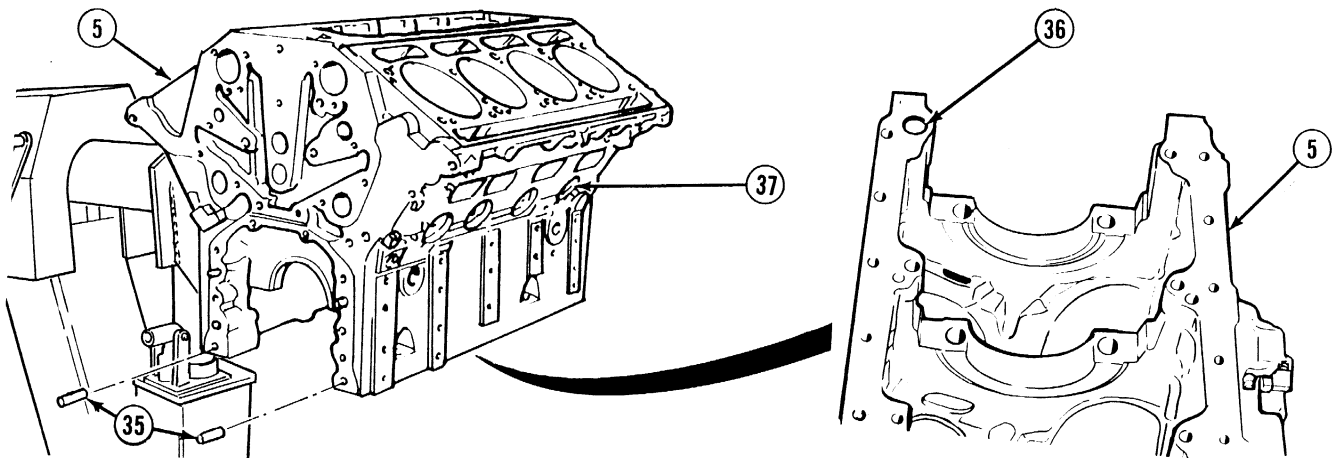
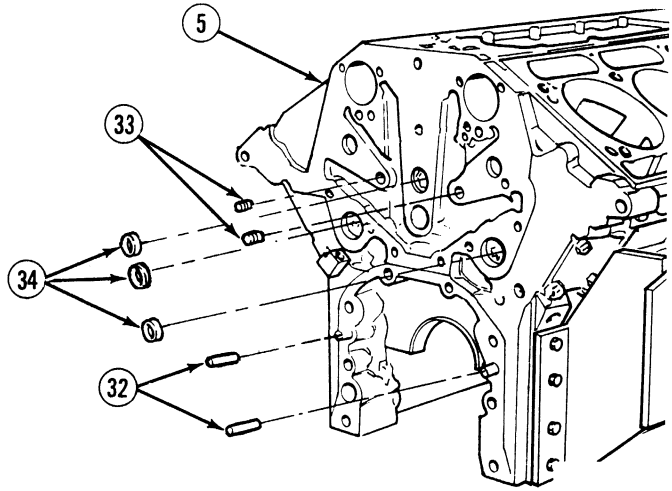
- (19) Remove three dowels (29) from top of engine block (5).
- (20) Remove 14 plugs (30) from bottom of cylinder head screw holes (31).

**20-64. ENGINE CYLINDER BLOCK REPAIR (CONT).**

**NOTE**

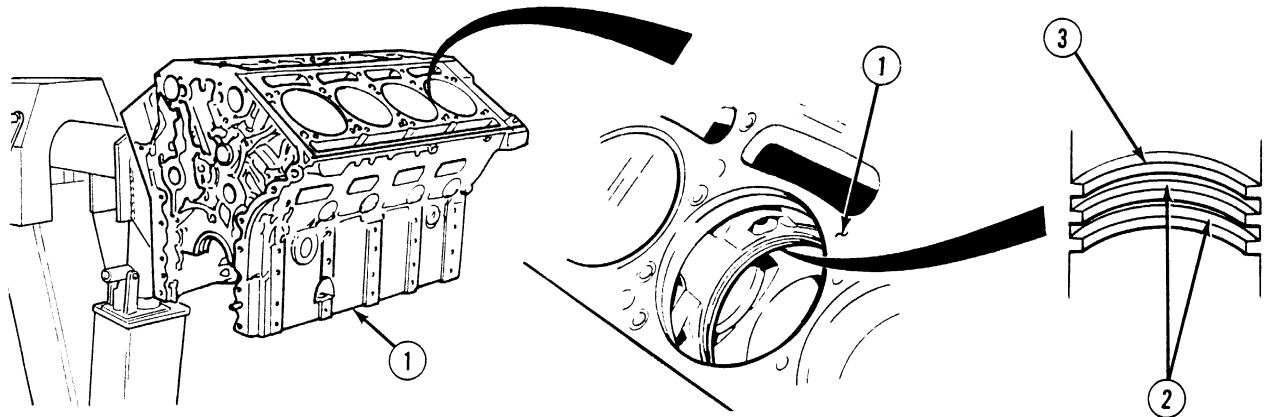
Perform Steps (21) through (25) if plugs or dowels are damaged or leaking.

- (21) Remove two dowels (32) from front of engine block (5).
- (22) Remove two plugs (33) and three plugs (34) from front of engine block (5).



- (23) Remove two dowels (35) from rear of engine block (5).
- (24) Remove cup plug (36) from bottom left rear of engine block (5).
- (25) Remove four cup plugs (37) from both right and left sides of engine block (5).

**b. Cleaning/Inspection.**



- (1) Scrape gasket material and sealant off engine block (1) surfaces.

**WARNING**

- High pressure steam can blow particles into eyes, can cause severe burns, and creates hazardous noise levels. Eye, skin, and hearing protection is required.
- 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) Steam clean engine block (1). Ensure oil and water galleries are cleaned thoroughly.
- (3) Dry engine block (1) with compressed air.

**NOTE**

If pitting or erosion is noted, replace engine block.

- (4) Inspect grooves (2) and lands (3) for pitting and erosion.

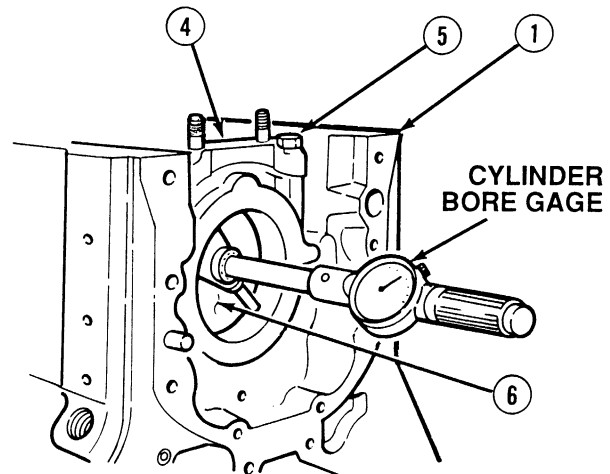
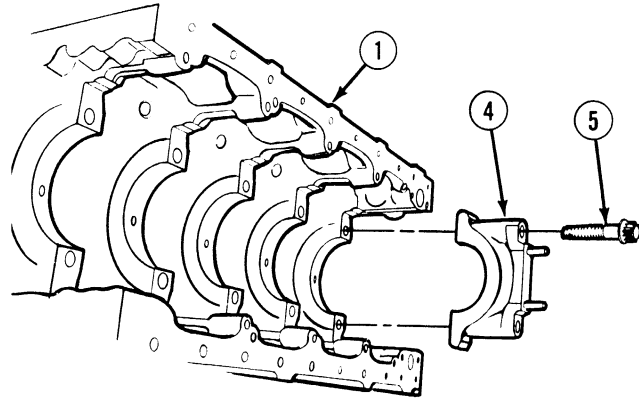


**20-64. ENGINE CYLINDER BLOCK REPAIR (CONT).**

**NOTE**

Main bearing caps must be installed in proper positions in engine block, as marked during removal. Ensure caps are firmly seated in engine block and main bearing shells are removed.

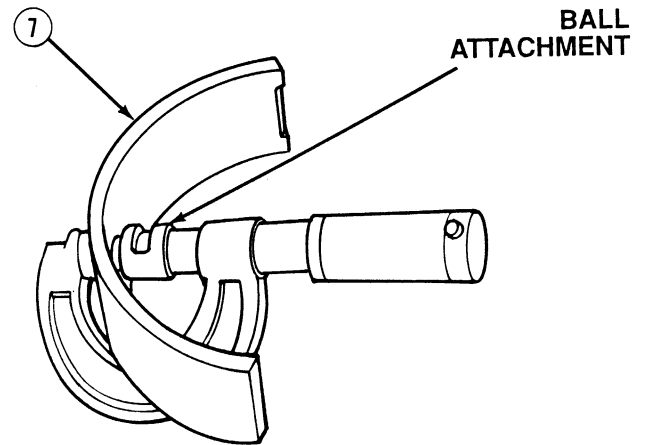
- (5) Position five main bearing caps (4) and ten screws (5) in engine block (1).
- (6) Tighten screws (5) on bearing caps (4).
- (7) Strike caps (4) with soft-face hammer to seat them.
- (8) Tighten screws (5) on bearing caps (4) to 50 lb-ft (68 N·m).
- (9) Tighten screws (5) on bearing caps (4) to 110 lb-ft (149 N·m).
- (10) Tighten screws (5) 250 to 260 lb-ft (339 to 353 N·m).
- (11) Using bore dial gage, measure each main bearing bore (6) diameter. If main bearing bore (6) diameter is less than 4.812 in. (122.225 mm) or is greater than 4.813 in. (122.250 mm), replace engine block (1).
- (12) Remove screws (5) and five main bearing caps (4) from engine block (1).



- (13) Inspect backs of bearings (7) for shiny spots, gouges, cracks, pitting or chipping. Replace any damaged bearings (7).

**NOTE**

- Bearing thickness equals total thickness of bearing and ball attachment, minus diameter of ball.
- If bearings are not within specifications, replace bearings.



- (14) Measure thickness of both halves of bearing (7) at outer edge using micrometer and ball attachment. Compare measurements with table of limits (Table 20-1).

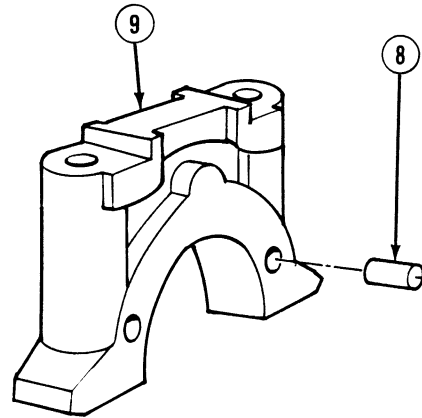
**Table 20-1. Table of Limits**

Bearing Size	Bearing Thickness	
	Minimum/Maximum	Limit
Standard	0.1545 in. / 0.1552 in. 3.9243 mm / 3.9421 mm	0.154 in. 3.911 mm
0.002 in. Undersize	0.1555 in. / 0.1562 in. 3.9497 mm / 3.9675 mm	0.155 in. 3.937 mm
0.010 in. Undersize	0.1595 in. / 0.1602 in. 4.0513 mm / 4.0691 mm	0.159 in. 4.039 mm
0.020 in. Undersize	0.1645 in. / 0.1652 in. 4.1783 mm / 4.1961 mm	0.164 in. 4.166 mm
0.030 in. Undersize	0.1695 in. / 0.1702 in. 4.3053 mm / 4.3231 mm	0.169 in. 4.293 mm

**20-64. ENGINE CYLINDER BLOCK REPAIR (CONT).**

(15) Inspect dowel pins (8) on rear main bearing retainer cap (9) for looseness and extension. Dowel pins (8) must extend minimum of 0.110 in. (2.794 mm) and maximum of 0.120 in. (3.048 mm). If dowel pins (8) are loose, replace with oversized pins.

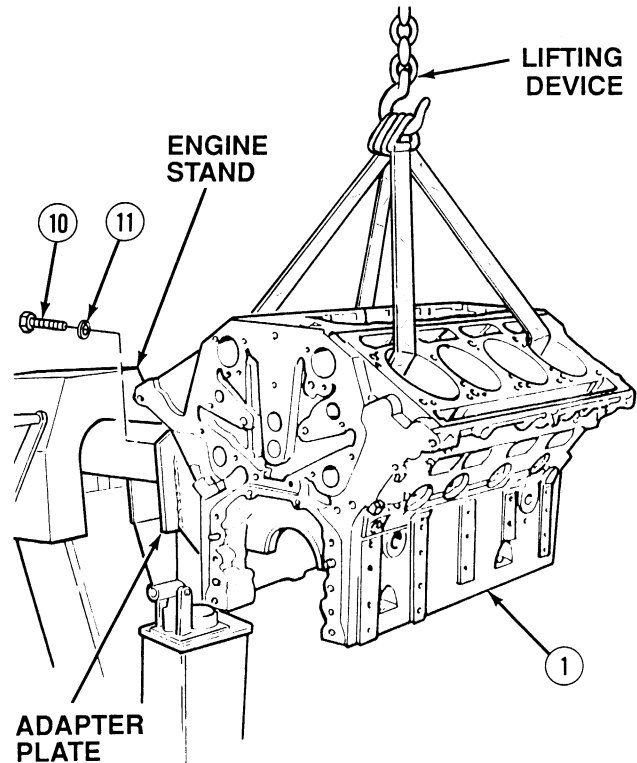
- (a) Remove old dowel pins (8) and drill dowel holes with number 11 drill bit.
- (b) Press in new dowel pins (8) to specified height.
- (c) After pressing in dowel pins (8), remove all burrs from base of dowel pins to permit proper seating of thrust washers.

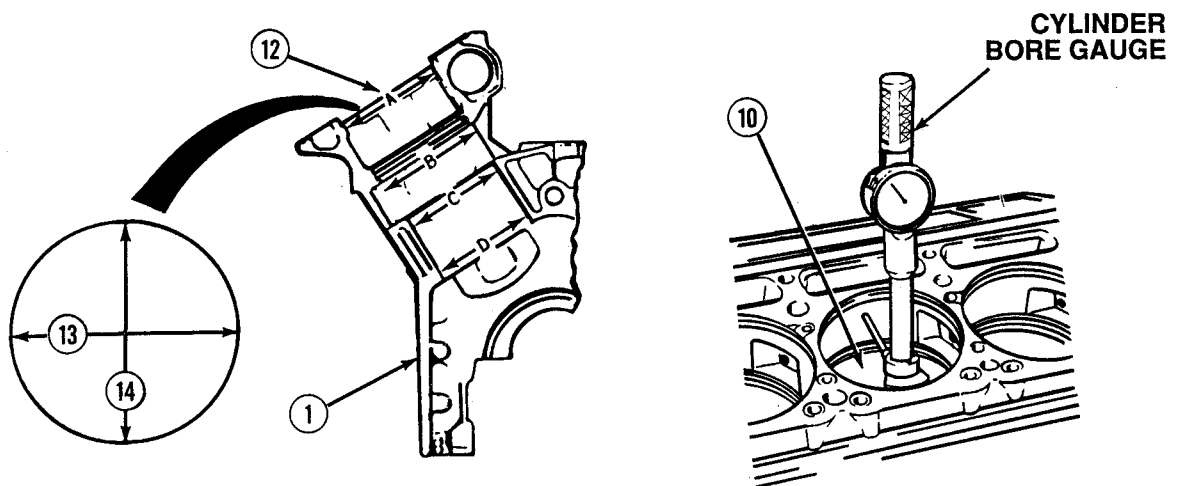


**WARNING**

Engine block weighs 732 lbs (332 kg). Attach suitable lifting device before removal to prevent possible injury or death to personnel.

- (16) Using lifting device, support engine block (1).
- (17) With the aid of an assistant, remove six screws (10), lockwashers (11), and adapter plate from engine stand.
- (18) Using lifting device, lower engine block (1) and position on floor.



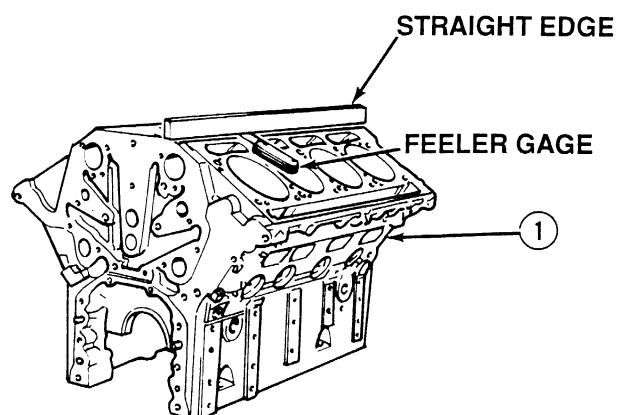


- (19) Make two cylinder bore (12) measurements (13) and (14) with cylinder bore gage in Steps (20) through (23).
- (20) Measure cylinder bore (12) at position A. Measurement cannot be greater than 5.3625 in. (136.2075 mm).
- (21) Measure cylinder bore (12) at position B. Measurement cannot be greater than 5.3395 in. (135.6233 mm).
- (22) Measure cylinder bore (12) at position C. Measurement cannot be greater than 5.2185 in. (132.5499 mm).
- (23) Measure cylinder bore (12) at position D. Measurement cannot be greater than 5.2185 in. (132.5499 mm).
- (24) Maximum out-of-roundness is 0.0010 in. (0.0254 mm).
- (25) Maximum taper is 0.0010 in. (0.0254 mm).

**NOTE**

- Replace engine block (1) if any cylinder bore is not within limits.
- Lengthwise measurements must not exceed 0.007 in. (0.178 mm). Diagonal measurements must not exceed 0.003 in. (0.076 mm).

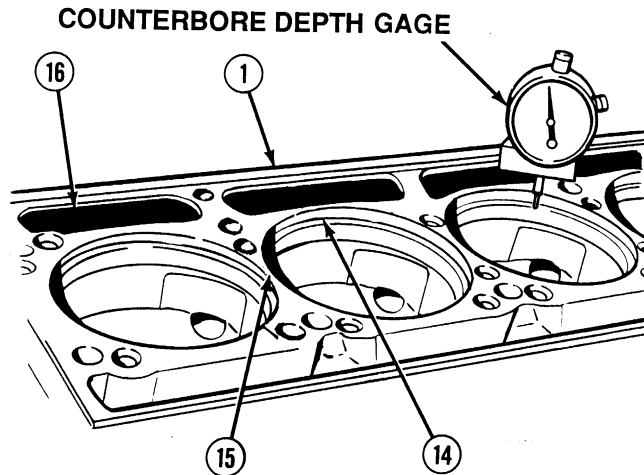
- (26) Measure top of cylinder head surface on engine block (1) lengthwise and diagonally for flatness using a straight edge and feeler gage.



**20-64. ENGINE CYLINDER BLOCK REPAIR (CONT).**

**NOTE**

- Cylinders may be counterbored to either of two depths.
- If depth is not between 0.4755 in. (12.0777 mm) and 0.477 in. (12.116 mm) or between 0.4905 (12.4587 mm) and 0.4920 in. (12.4968 mm) and cannot be brought into limits by installing cylinder liner insert, replace engine block.



- (27) Using depth gage, measure depth of counterbore (14).
- (28) If counterbore (14) varies more than 0.0015 in. (0.0381 mm) around edge of cylinder, replace engine block (1).

**NOTE**

If two adjacent cylinders are in different counterbore depth ranges measured in Step (27) above, perform Step (29).

- (29) If difference between any two adjacent cylinder counterbores (14) measured at their closest point (15) is more than 0.0015 in. (0.0381 mm), replace engine block (1).

**NOTE**

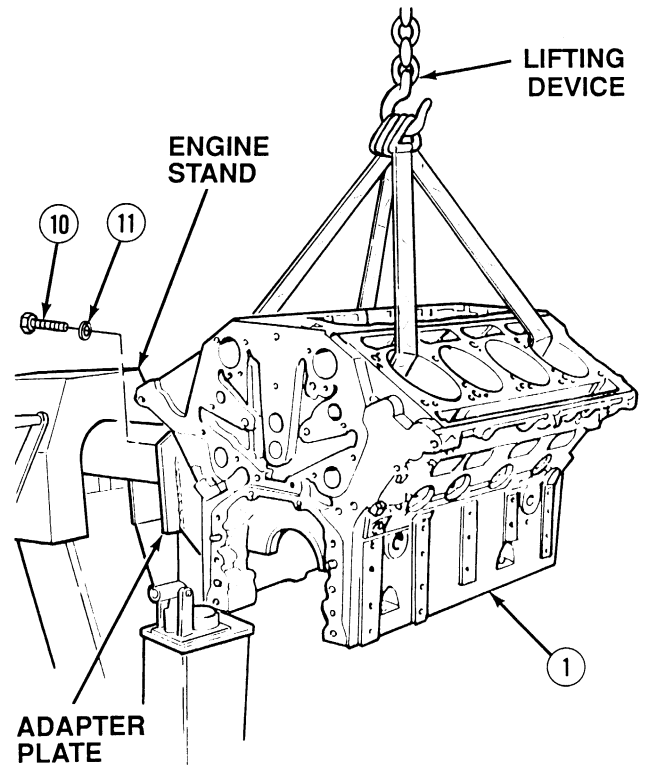
If counterbore diameter or camshaft bearing bores are not within specifications, replace engine block.

- (30) Measure counterbore (14) diameter. Counterbore diameter must be minimum of 5.5550 in. (141.0970 mm) and maximum of 5.5600 in. (141.2240 mm).
- (31) Measure inside diameter of camshaft bearing bores (16). Diameter must be minimum of 2.1875 in. (55.5625 mm) and maximum of 2.1889 in. (55.5981 mm).

**WARNING**

Engine block weighs 732 lbs (332 kg). Attach suitable lifting device before removal to prevent possible injury or death to personnel.

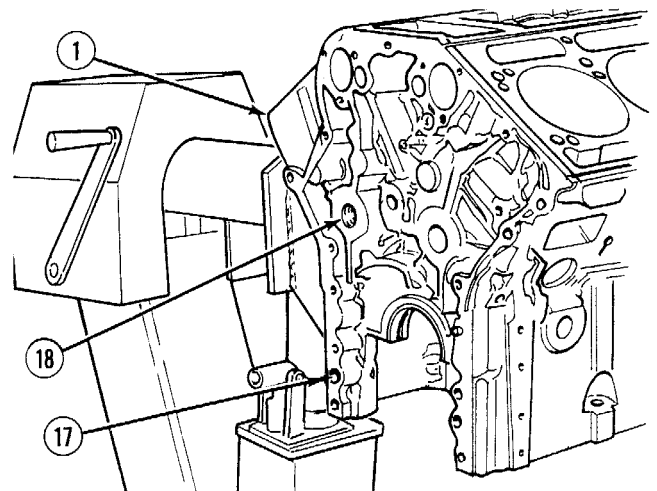
- (32) Using lifting device, raise engine block (1) up to engine stand.
- (33) Install adapter plate on engine stand with six screws (10) and lockwashers (11). Tighten screws to 147 lb-ft (199 N·m).



**WARNING**

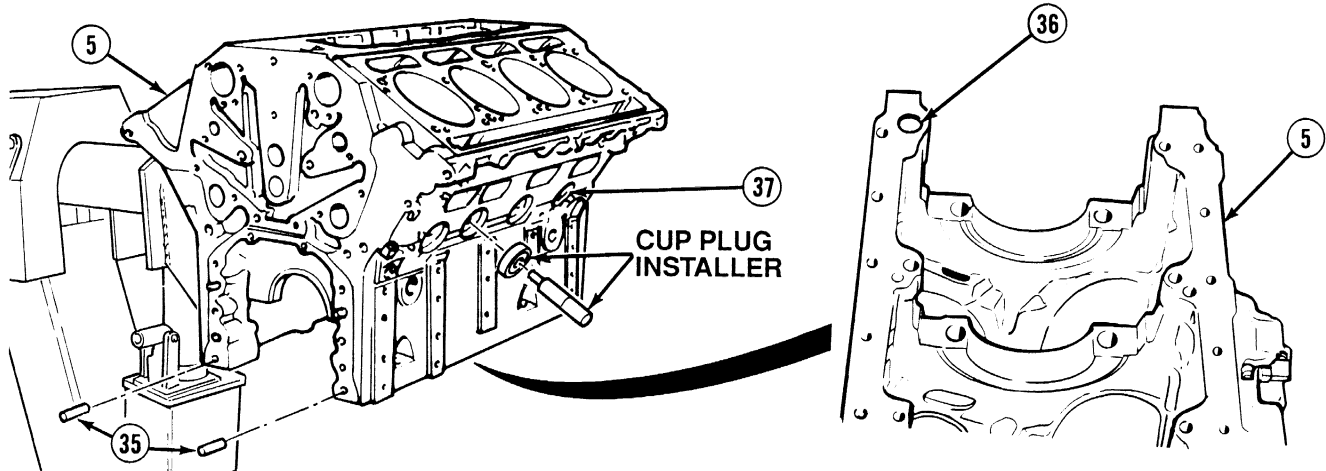
Engine block weighs 732 lbs (332 kg). Attach suitable lifting device before removal to prevent possible injury or death to personnel.

- (34) Inspect dowel holes (17) in engine block (1) for oversize holes or damage. Replace engine block if damaged or oversize.
- (35) Inspect threaded holes (18) for stripped or crossed threads. Use tap to clean threads.



**20-64. ENGINE CYLINDER BLOCK REPAIR (CONT).**

*c. Assembly.*



**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**

Perform Steps (1) through (6) only if removed.

- (1) Coat four cup plugs (37) with sealing compound.
- (2) Using cylinder block plug, install four cup plugs (37) in both right and left sides of engine block (5) until flush.
- (3) Coat cup plug (36) with sealing compound.
- (4) Using cylinder block plug, install cup plug (36) in bottom left rear of engine block (5) to depth of 0.12 in. (3.05 mm).
- (5) Coat dowel pins (35) with sealing compound.
- (6) Install two dowel pins (35) in rear of engine block (5) until they protrude 3/8 in. (9.5 mm).

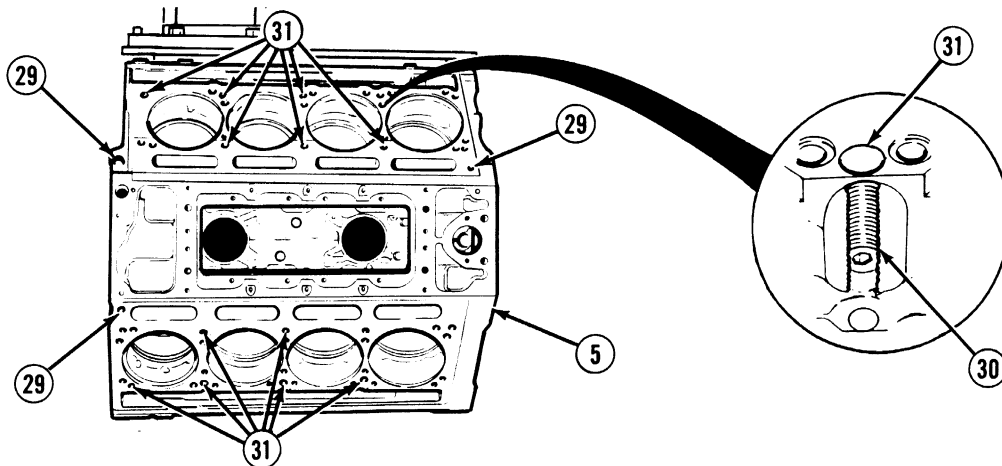
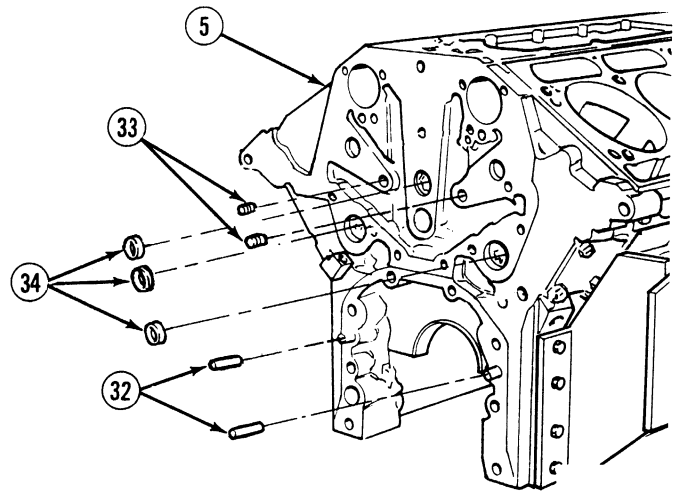
**WARNING**

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**

Perform Steps (7) through (14) if plugs and dowels were removed.

- (7) Coat two plugs (33) and three plugs (34) with sealing compound.
- (8) Install two plugs (33) and three plugs (34) in engine block (5).
- (9) Coat two dowels (32) with sealing compound.
- (10) Install two dowels (32) in front of engine block (5) until they protrude 3/8 in. (9.5 mm).

**NOTE**

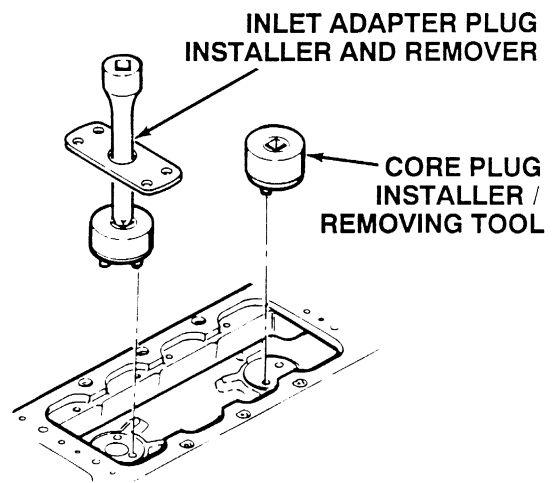
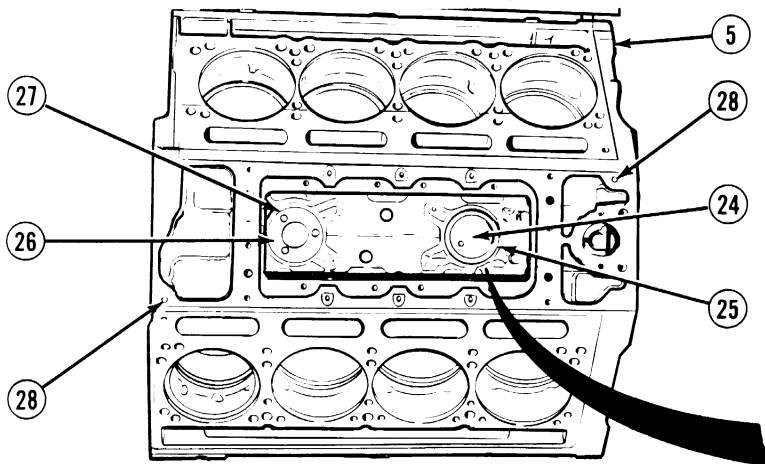
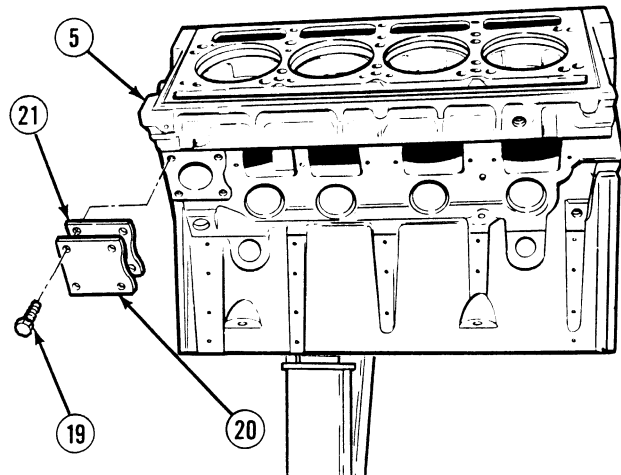
Top of plugs must be 1.960 in. (49.784 mm) below surface of block when installed.

- (11) Coat threads of 14 plugs (30) with sealing compound.
- (12) Install 14 plugs (30) in cylinder head screw holes (31). Tighten to 50 to 60 lb-ft (68 to 81 N·m).
- (13) Coat threads of three dowel pins (29) with sealing compound.
- (14) Install three dowel pins (29) in top of engine block (5) until flush with surface of engine block.



**20-64. ENGINE CYLINDER BLOCK REPAIR (CONT).**

- (15) Install gasket (21), cover plate (20) and four screws (19) in left side of engine block (5).



**WARNING**

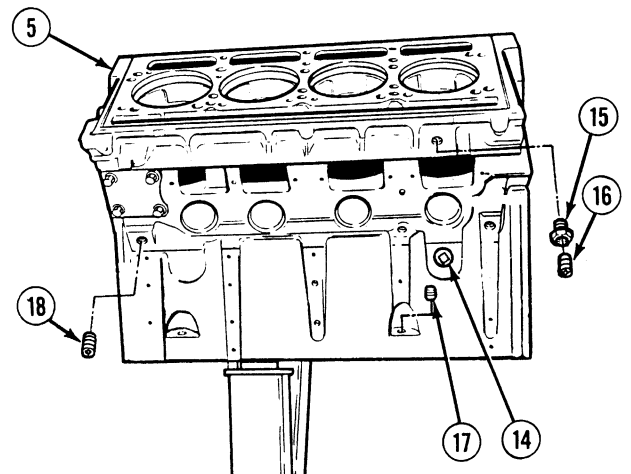
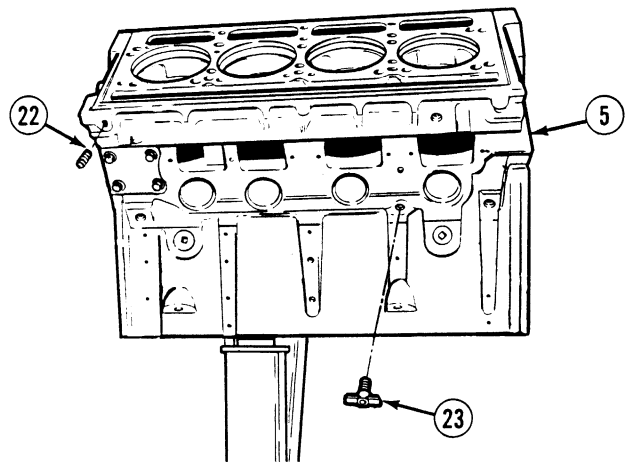
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (16) Coat two oil gallery plugs (28) with sealing compound.
- (17) Install two oil gallery plugs (28) in top of engine block (5). Tighten plugs (28) 168 to 192 lb-in (19 to 22 N·m).
- (18) Coat core plug (24) with sealing compound.
- (19) Using installing/removing tool, install gasket (25) and core plug (24) in top of engine block (5). Tighten plug (24) 230 to 270 lb-ft (312 to 366 N·m).

**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.

- (20) Coat drain cock (23) with sealing compound.
- (21) Install drain cock (23) in left side of engine block (5).
- (22) Coat oil plug (22) with sealing compound.
- (23) Using pipe plug driver, install oil plug (22) in engine block (5). Tighten plug 120 to 144 lb-in (14 to 16 N·m).
- (24) Coat plug (18) with sealing compound.
- (25) Install plug (18) in engine block (5).
- (26) Coat plug (14) with sealing compound.
- (27) Install plug (14) in engine block (5). Tighten plug 75 to 85 lb-ft (102 to 115 N·m).
- (28) Coat plug (16) and reducer bushing (15) with sealing compound.
- (29) Install plug (16) and reducer bushing (15) in engine block (5).
- (30) Coat plug (17) with sealing compound.
- (31) Install one plug (17) in engine block (5). Tighten plug 168 to 192 lb-in (19 to 22 N·m).

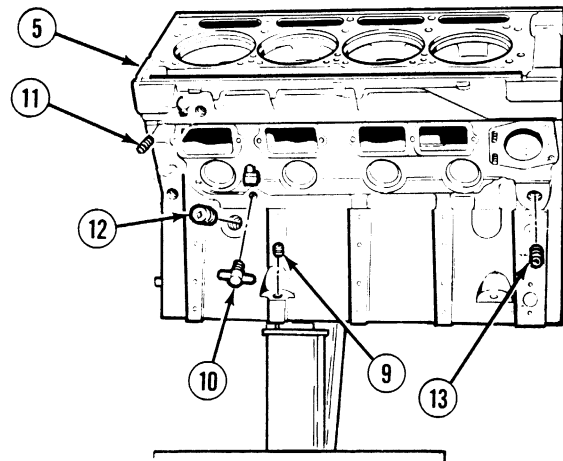


**20-64. ENGINE CYLINDER BLOCK REPAIR (CONT).**

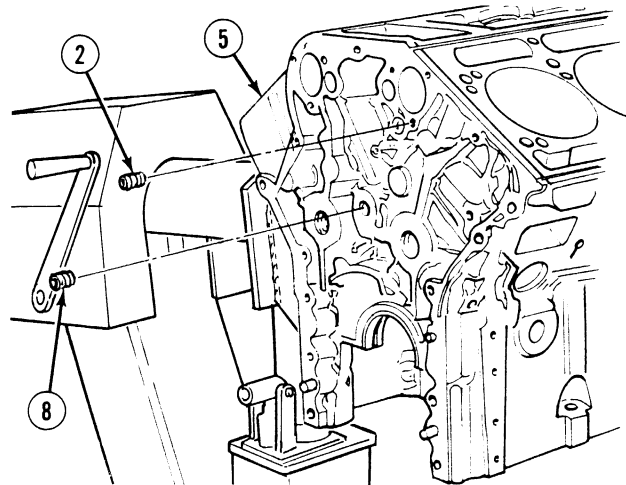
**WARNING**

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.

- (32) Coat plug (9) with sealing compound.
- (33) Install plug (9) in right side of engine block (5). Tighten plug 168 to 192 lb-in (19 to 22 N·m).
- (34) Coat oil gallery plug (11) with sealing compound.
- (35) Using pipe plug driver, install oil gallery plug (11) in engine block (5). Tighten plug 120 to 144 lb-in (14 to 16 N·m).
- (36) Coat drain cock (10) with sealing compound.
- (37) Install drain cock (10) in engine block (5).
- (38) Coat plugs (12) and (13) with sealing compound.
- (39) Install plugs (12) and (13) in right side of engine block (5). Tighten plug 75 to 85 lb-ft (102 to 115 N·m).

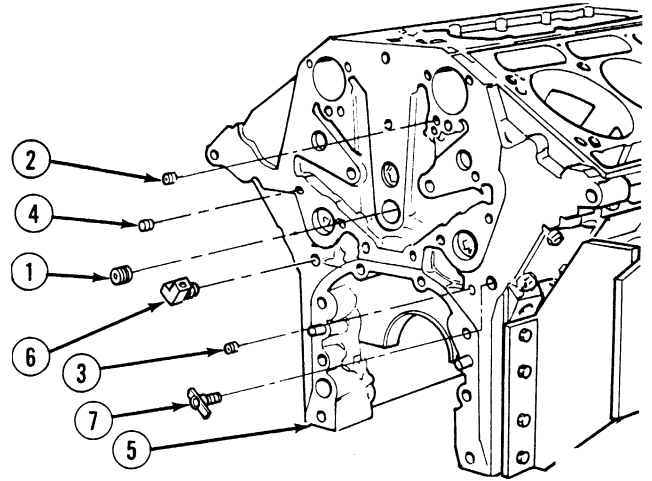


- (40) Coat oil gallery plug (2) with sealing compound.
- (41) Install oil gallery plug (2) in rear end of engine block (5). Tighten plug 23 to 27 lb-ft (31 to 37 N·m).
- (42) Coat oil gallery plug (8) with sealing compound.
- (43) Install oil gallery plug (8) in rear end of engine block (5). Tighten plug 33 to 37 lb-ft (45 to 50 N·m).



**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.



- (44) Coat drain cock (7) with sealing compound.
- (45) Install drain cock (7) in engine block (5).
- (46) Coat three-way oil tee (6) with sealing compound.
- (47) Install three-way oil tee (6) in engine block (5).
- (48) Coat oil gallery plug (1) with sealing compound.
- (49) Install oil gallery plug (1) in front of engine block (5). Tighten plug 33 to 37 lb-ft (45 to 50 N·m).
- (50) Coat oil gallery plug (2) with sealing compound.
- (51) Install oil gallery plug (2) in engine block (5). Tighten plug 23 to 27 lb-ft (31 to 37 N·m).
- (52) Coat oil gallery plug (3) with sealing compound.
- (53) Install oil gallery plug (3) in engine block (5). Tighten plug 168 to 192 lb-in (19 to 22 N·m).
- (54) Coat plug (4) with sealing compound.
- (55) Install plug (4) in engine block (5). Tighten 216 to 264 lb-in (24 to 30 N·m).

**20-64. ENGINE CYLINDER BLOCK REPAIR (CONT).**

**d. Pressure Testing.**

- (1) Coat seal rings (1) with lubricating oil.

**CAUTION**

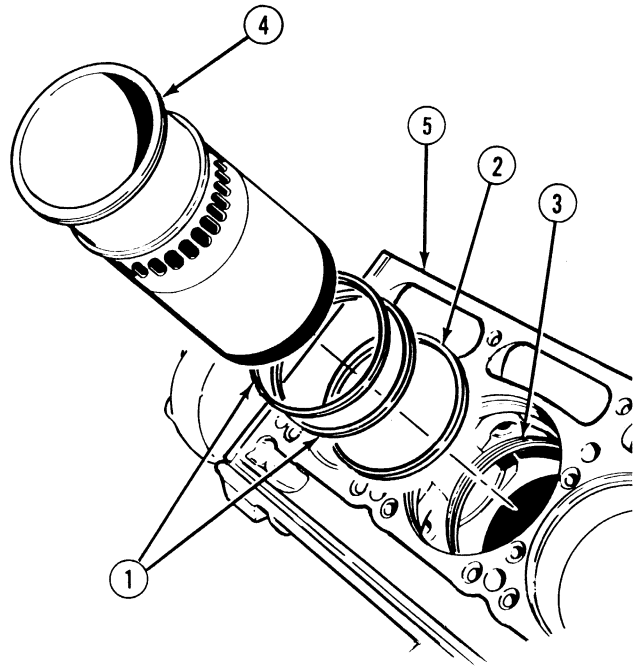
Ensure correct cylinder liners and inserts are installed in the same cylinder bore from which they were removed.

- (2) Install two seal rings (1) and insert (2) in each cylinder bore (3).

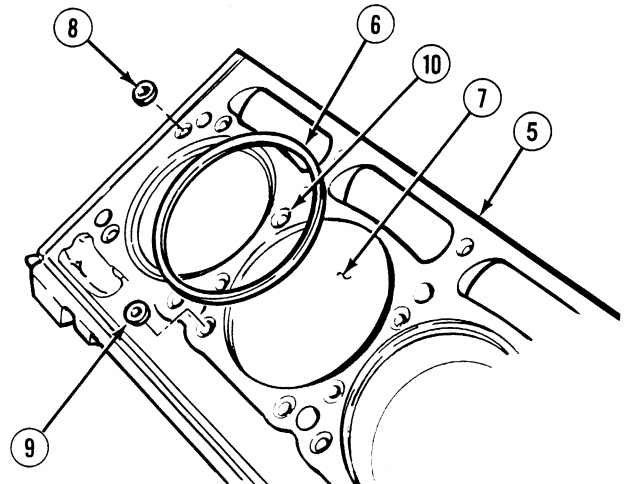
**CAUTION**

Care must be taken when installing cylinder liners in cylinder bores or damage to seal rings will result.

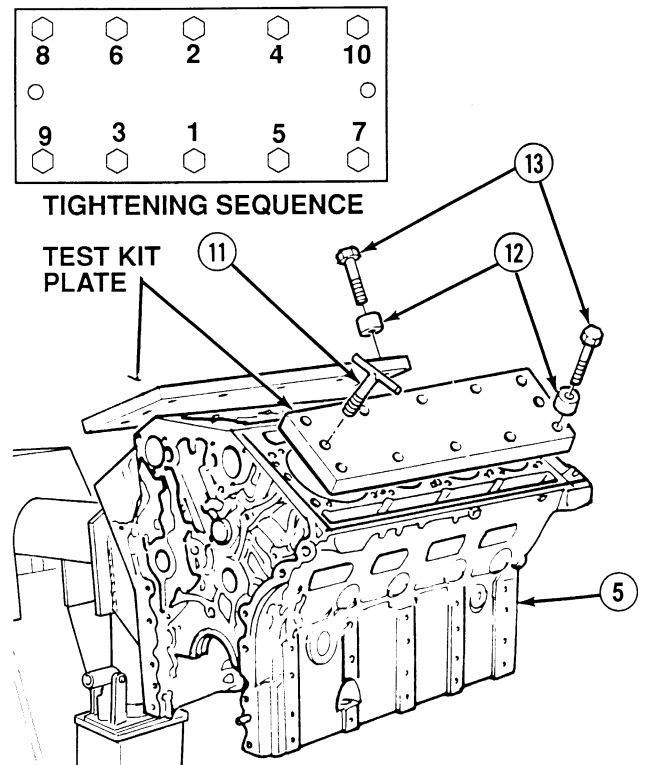
- (3) Install eight cylinder liners (4) in engine block (5).



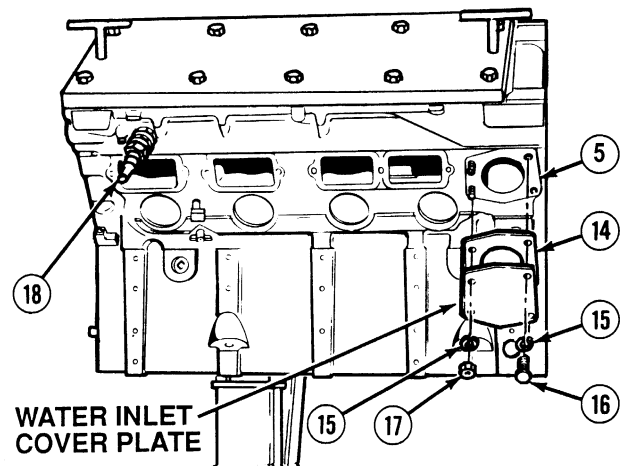
- (4) Install eight compression gaskets (6) in cylinder (7).
- (5) Install two oil seals (8) and 15 water seals (9) in 34 counterbored holes (10) in both sides of engine block (3).



- (6) Install two T-handles (11) in plates.
- (7) Install two plates on right and left cylinder banks of engine block (5) with 20 spacers (12), screws (13).
- (8) Tighten screws (13) to 50 lb-ft (68 N·m). Continue tightening in sequence shown, in increments of 50 lb-ft (68 N·m), until all screws (13) are tightened 250 to 260 lb-ft (339 to 353 N·m).



- (9) Install gasket (14) and water inlet cover plate on right front side of engine block (5) with four lockwashers (15), two screws (16) and nuts (17).
- (10) Install air adapter fitting (18) in right rear of engine block (5).
- (11) Connect air line to fitting (18). Route air line from above engine block (5) to prevent antifreeze solution from draining into hose.

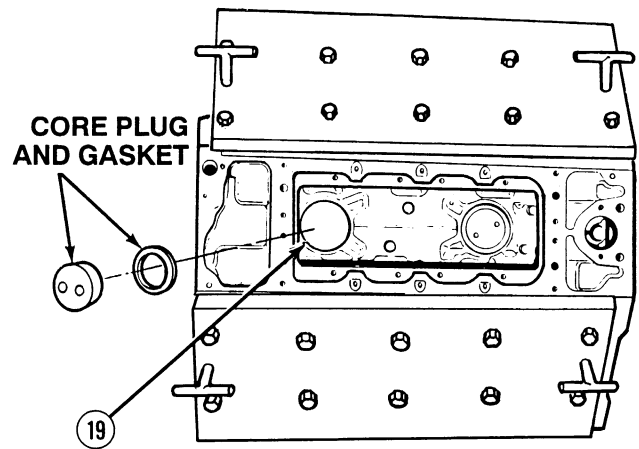


**20-64. ENGINE CYLINDER BLOCK REPAIR (CONT).**

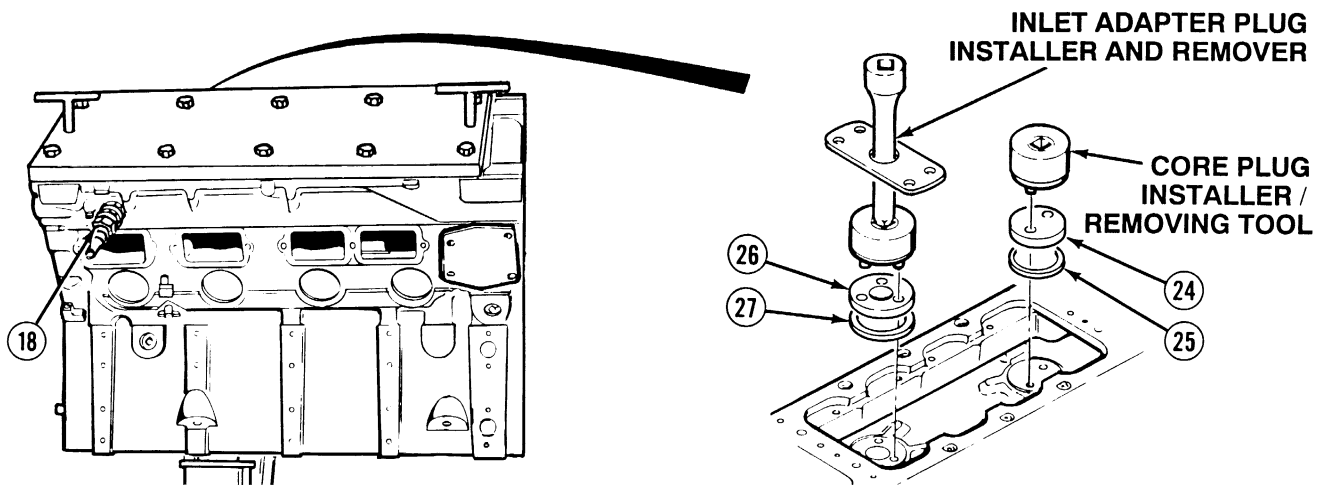
- (12) Pour mixture of one gallon (3.8 l) water and one gallon (3.8 l) of antifreeze in water inlet adapter hole (19). Fill engine block completely.

**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.



- (13) Coat core plug with sealing compound.



- (14) Using installer/remover, install gasket (25) and core plug (24). Tighten core plug 230 to 270 lb-ft (312 to 366 N·m).

**WARNING**

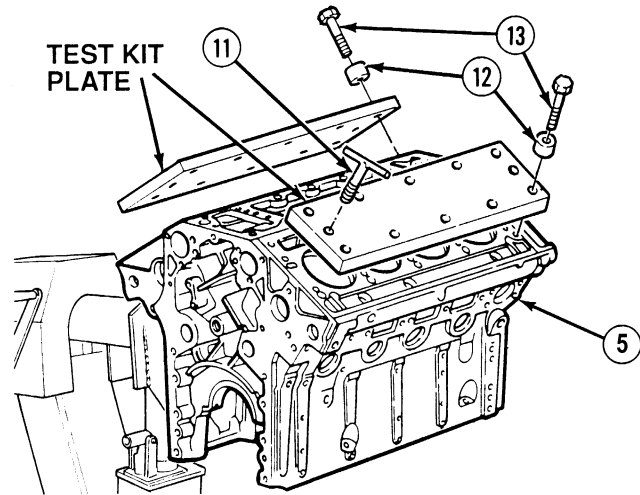
Be careful when using high air pressure. Ensure connections and seals are tight before applying pressure. High air pressure can blow out parts, hoses or debris with force. Explosive force can damage equipment and cause injury to personnel.

- (15) Apply 40 psi (276 kPa) pressure to engine block (5) through fitting (18). Maintain pressure for at least two hours.
- (16) Inspect engine block (5) for leaking antifreeze. If leaks are found, engine block (5) must be replaced.
- (17) Slowly relieve 40 psi (276 kPa) pressure from engine block (5).
- (18) Remove air line and air adapter fitting (18) from engine block (5).
- (19) Drain antifreeze from engine block (5).
- (20) Remove core plug and gasket.
- (21) Coat threads of water inlet adapter (26) with sealing compound.
- (22) Using remover/installer, install gasket (27) and water inlet adapter (26) in engine block (5). Tighten water inlet adapter (26) to 230 to 270 lb-ft (312 to 366 N·m).

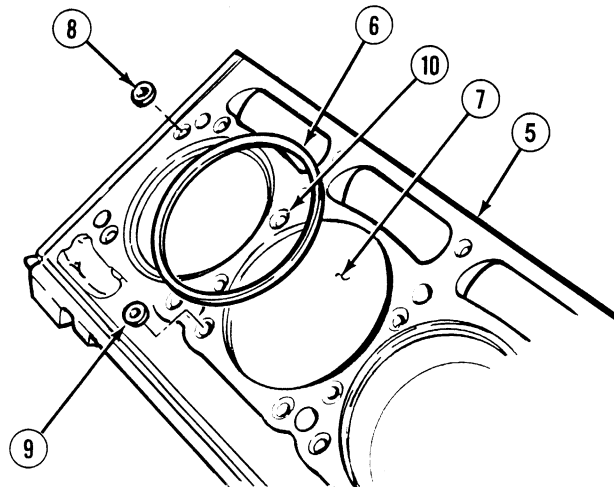


**20-64. ENGINE CYLINDER BLOCK REPAIR (CONT).**

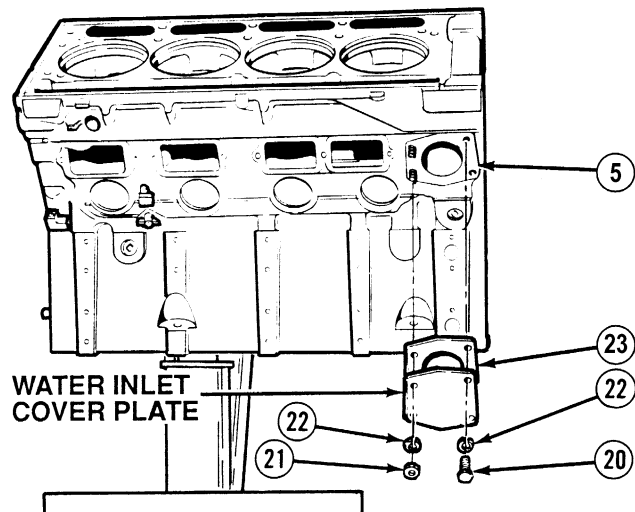
- (23) Remove 20 screws (13), spacers (12) and two plates from engine block (5).
- (24) Remove T-handles (11) from plates.



- (25) Remove two oil seals (8) and 15 water seals (9) from 34 counterbored holes (10) in both sides of engine block (5). Discard two oil seals.
- (26) Remove and discard eight compression gaskets (6) from cylinders (7).



- (27) Remove two screws (20), nuts (21), four lockwashers (22), water inlet cover plate, and gasket (23) from engine block (5). Discard lockwashers and gasket.

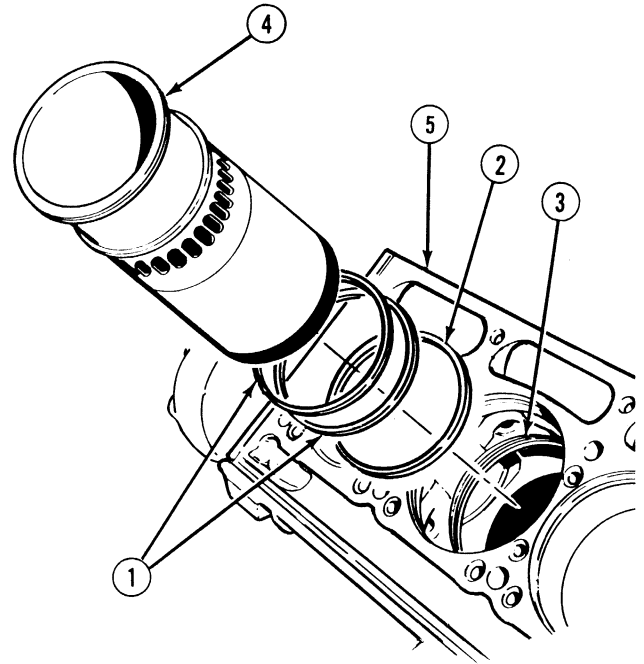


- (28) Remove cylinder liner (4), insert (2) and two seal rings (1) from each cylinder bore (3). Discard seal rings.

**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.

- (29) Dry engine block (5) with compressed air.
- (30) Dry cylinder liners (4) and inserts (2) with compressed air.
- (31) Coat cylinder liners (4) and inserts (2) with lubricating oil.



**e. Follow-On Maintenance:**

- Install main bearing and crankshaft, (Para 20-65).

**END OF TASK**

## 20-65. MAIN BEARING AND CRANKSHAFT INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Indicator, Dial, Set w/Magnetic Base  
(Item 98, Appendix F)  
Wrench Set, Socket 3/4 in. Drive  
(Item 274, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Wrench, Torque (0 to 600 lb-ft [0-814 N·m])  
(Item 278, Appendix F)  
Lifting Device, Minimum Capacity 400 lbs  
(182 kg)

#### *Materials/Parts*

Compound, International, No. 2  
(Item 16, Appendix B)  
Oil, Lubricating (Item 36, Appendix B)  
Plastigage (Item 44, Appendix B)  
Bearing Set (5) (Item 12, Appendix E)  
Lockscrew (7) (Item 223, Appendix E)  
Washer, Thrust (4) (Item 698, Appendix E)

#### *Personnel Required*

Two

#### *Equipment Condition*

Engine cylinder block repaired, (Para 20-64)

### a. **Installation.**

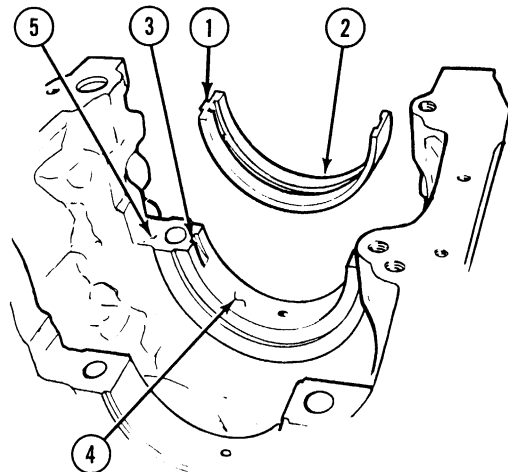
#### CAUTION

- Do not handle bearing shells and thrust washers more than necessary for installation. Sweat from hands can damage bearing shells and thrust washers. Make sure bearing shells and thrust washers are clean before installation.
- Main bearings are a matched set and cannot be interchanged or damage to equipment may result.
- Upper bearing shells have a through - slot for lubrication. Incorrect installation of bearing shells will result in damage to equipment.

#### **NOTE**

Bearing surfaces are numbered one to five from front to rear of engine block.

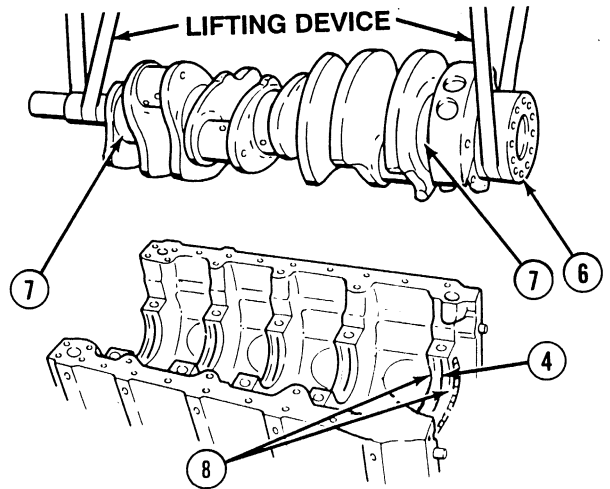
- (1) Align tab (1) on upper bearing shell (2) with slot (3) on engine block bearing surface (4).
- (2) Install shell (2) on bearing mounting surface (5). Make sure both ends of shell are flush with bearing cap mounting surfaces (5).
- (3) Repeat Steps (1) and (2) for four other bearing surfaces.
- (4) Apply lubricating oil to upper bearing shells (2) after installation.



**WARNING**

Crankshaft weighs 185 lbs (84 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- (5) Attach lifting device to crankshaft (6).
- (6) With the aid of an assistant install crankshaft (6) on engine block bearing surface (4).
- (7) Apply lubricating oil to five crankshaft main bearing journals (7).

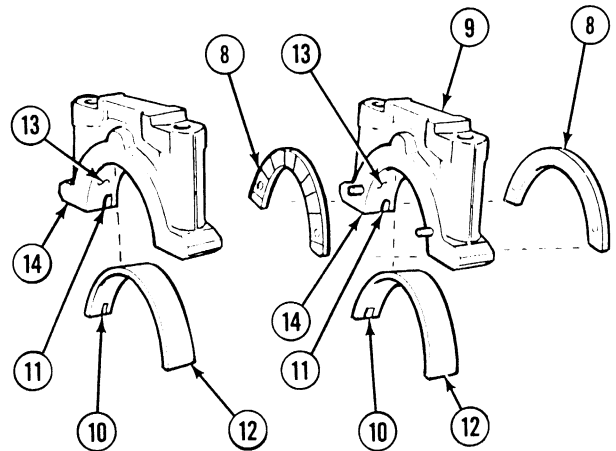


**NOTE**

Upper thrust bearing can be started at top of crankshaft and slid in place around bearing.

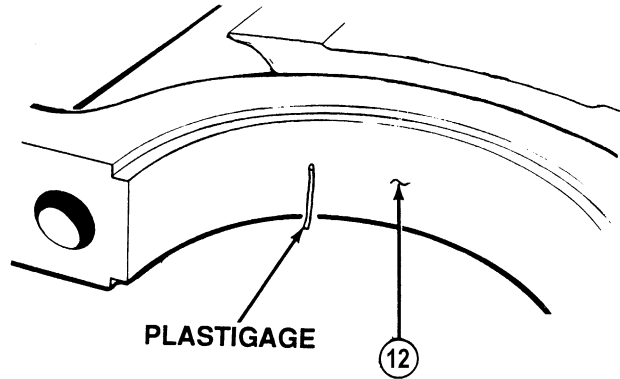
- (8) Push crankshaft (6) to front and install thrust washer (8) on bearing cap (9) with ground sides of thrust washer facing away from bearing. Push crankshaft to rear and install other thrust washer (8).

- (9) Align tab (10) with slot (11) and install lower bearing shell (12) on bearing cap mating surface (13), making sure both ends of bearing shell are flush with bearing cap (14) mounting surfaces .
- (10) Install four other lower bearing shells (12).
- (11) Install two thrust washers (8) on bearing cap (9) with grooved sides of thrust washers facing away from bearing cap.

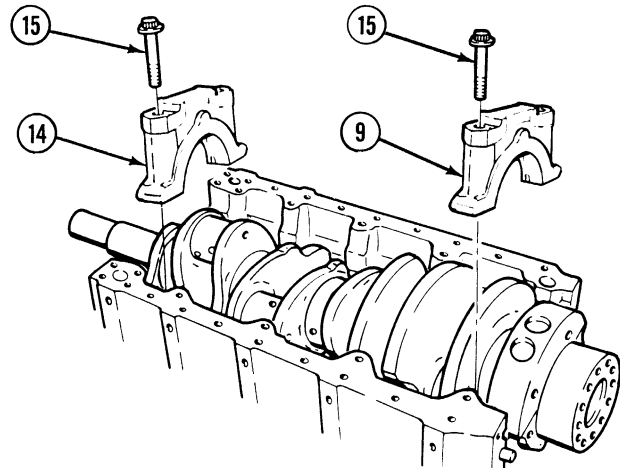


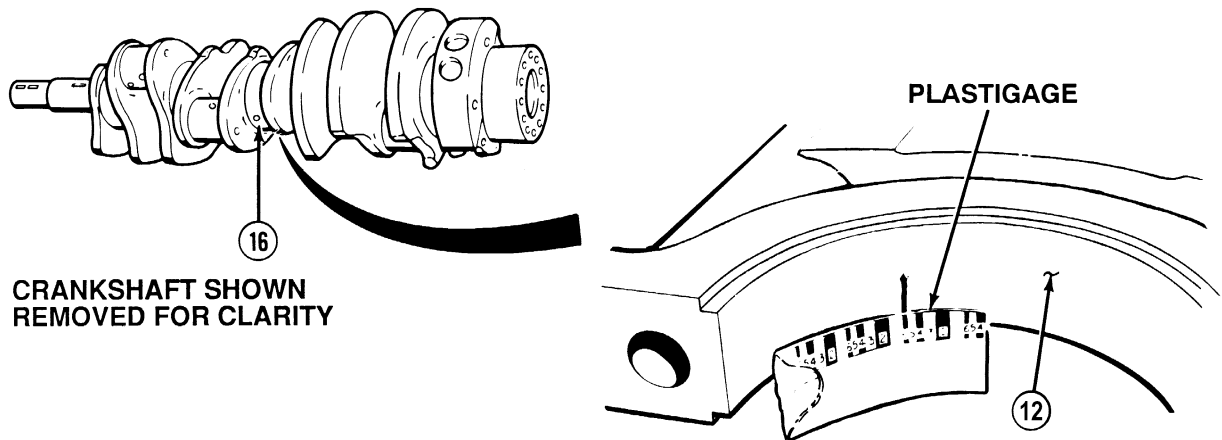
**20-65. MAIN BEARING AND CRANKSHAFT INSTALLATION (CONT).**

- (12) Wipe oil from bearing shells and crankshaft main bearing journals.
- (13) Place strip of plastic gage across width of bearing shell (12) 1/4 in. (6.35 mm) from center.
- (14) Repeat Step (13) for four other bearing caps.

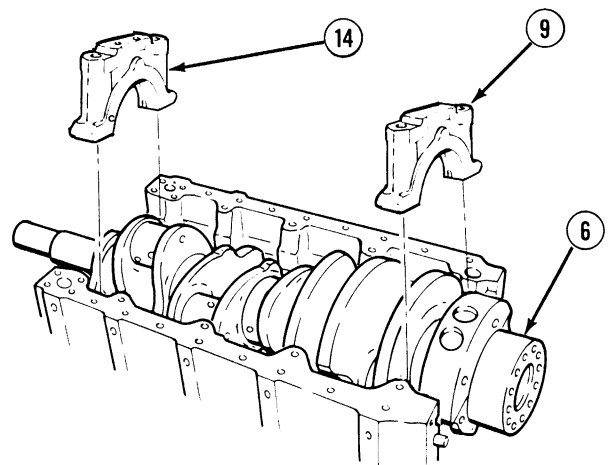


- (15) Install five bearing caps (9) and (14).
- (16) Strike bearing caps (9) and (14) with soft-face hammer.
- (17) Install ten screws (15).
- (18) Tighten ten screws (15) 50 lb-ft (68 N·m).
- (19) Strike bearing caps (9) and (14) with soft-face hammer.
- (20) Tighten ten screws (15) 110 lb-ft (149 N·m).
- (21) Tighten ten screws (15) 230 to 240 lb-ft (312 to 325 N·m).
- (22) Remove ten screws (15) and five bearing caps (9) and (14).



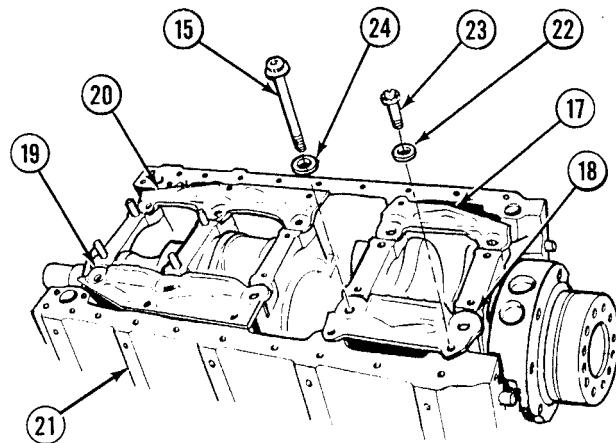


- (23) Measure widest part of plastic gage with measuring strip. Width must be minimum of 0.0014 in. (0.0356 mm) and maximum of 0.0055 in. (0.1397 mm). If greater, replace upper and lower bearing shells (12).
- (24) Wipe plastic gage from five main bearing journals (16) or bearing shells (12) and apply lubricating oil to those surfaces.
- (25) Position five bearing caps (9) and (14) on crankshaft (6).
- (26) Strike bearing caps (9) and (14) with soft-face hammer.



**20-65. MAIN BEARING AND CRANKSHAFT INSTALLATION (CONT.)**

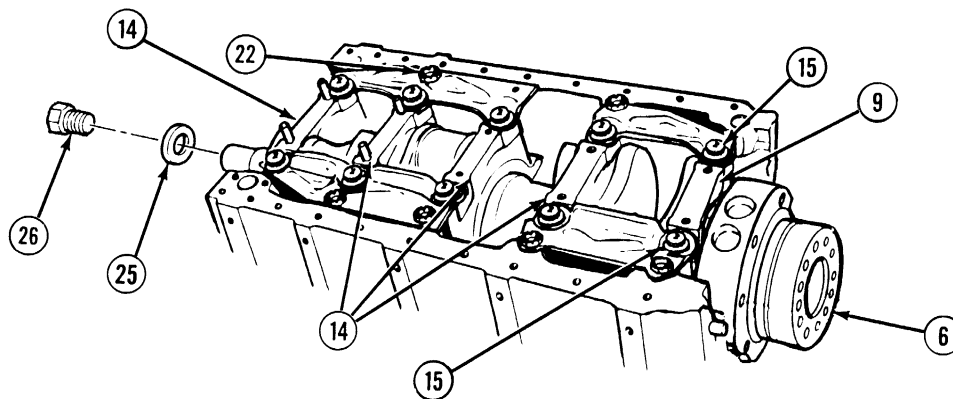
- (27) Position two front bearing cap stabilizers (17) and (18) and two rear bearing cap stabilizers (19) and (20) on engine block (21).
- (28) Position seven washers (22) and lockscrews (23) on bearing cap stabilizers (17) and (18).



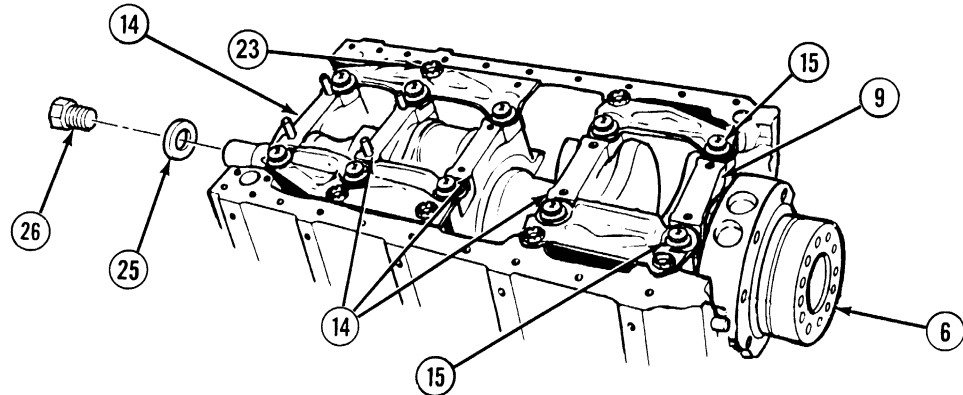
**WARNING**

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.

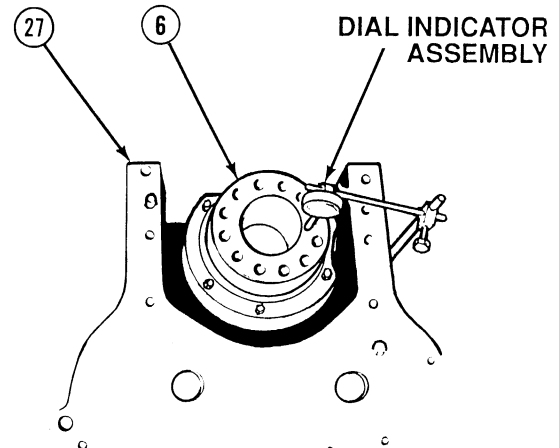
- (29) Apply small amount of International Compound No. 2 to threads of ten screws (15) and surfaces of stabilizers (17), (18), (19) and (20).
- (30) Position ten washers (24) and screws (15) in bearing cap stabilizers (19) and (20).



- (31) Starting with middle two bearing caps (14) of front four bearing caps, tighten eight screws (15) on four bearing caps to 50 lb-ft (68 N·m).
- (32) Strike four front bearing caps (14) with soft-face hammer and tighten eight screws (15) to 110 lb-ft (149 N·m).
- (33) Strike four front bearing caps (14) with soft-face hammer and tighten eight screws (15) to 230 to 240 lb-ft (312 to 325 N·m).



- (34) Tighten two screws (15) on rear bearing cap (9) 50 lb-ft (68 N·m).
- (35) Strike both ends of crankshaft (6) two or three blows with soft-face hammer.
- (36) Strike rear bearing cap (9) with soft-face hammer.
- (37) Tighten two screws (15) on rear bearing cap (9) to 110 lb-ft (149 N·m).
- (38) Strike rear bearing cap (9) with soft-face hammer.
- (39) Tighten two screws (15) on rear bearing cap (9) 230 to 240 lb-ft (312 to 325 N·m).
- (40) Tighten seven lockscrews (23) 70 to 75 lb-ft (95 to 102 N·m).
- (41) Install retainer (25) and screw (26).
- (42) Turn screw (26) clockwise to make sure crankshaft turns freely and smoothly.
- (43) Position dial indicator on engine block (27) and push crankshaft (6) toward gage with pry bar. Adjust dial indicator to zero.
- (44) Read end play after repositioning pry bar and forcing crankshaft (6) in opposite direction. Minimum end play is 0.004 in. (0.102 mm) and maximum end play is 0.018 in. (0.457 mm). If end play is outside limits, replace crankshaft.



**b. Follow-On Maintenance:**

- Install engine oil pump drive gear, (Para 20-66).

**END OF TASK**



## 20-66. ENGINE OIL PUMP DRIVE GEAR INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

*Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)

*Equipment Condition*

Main bearings and crankshaft installed,  
(Para 20-65)

*Materials/Parts*

Compound, Retaining (Item 17, Appendix B)  
Key (Item 144, Appendix E)

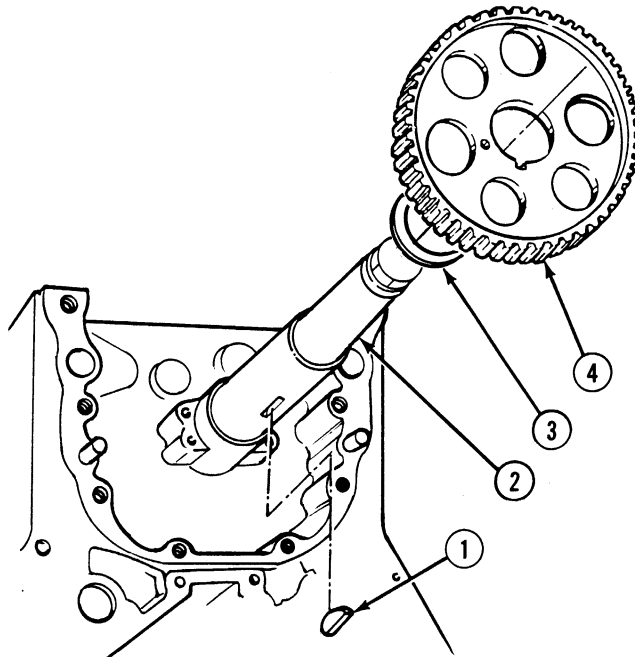
**a. Installation.**

- (1) Install key (1) on crankshaft (2).
- (2) Install spacer (3), finished side facing away from engine.
- (3) Apply retaining compound to gear (4) bore. Remove excess compound from chamfer area of the gear (4), do not wipe dry.
- (4) Apply a thin bead of retaining compound around the outside diameter of the crankshaft (2) approximately 1-1/4 in. in front of spacer (3). Do not spread bead or wipe dry.

**NOTE**

Ensure gear is in final position with key in place, since retaining compound will start to set up almost immediately.

- (5) Install oil pump drive gear (4) on crankshaft (2), flat side of hub facing away from engine and beveled side of hub facing towards engine.



**b. Follow-On Maintenance:**

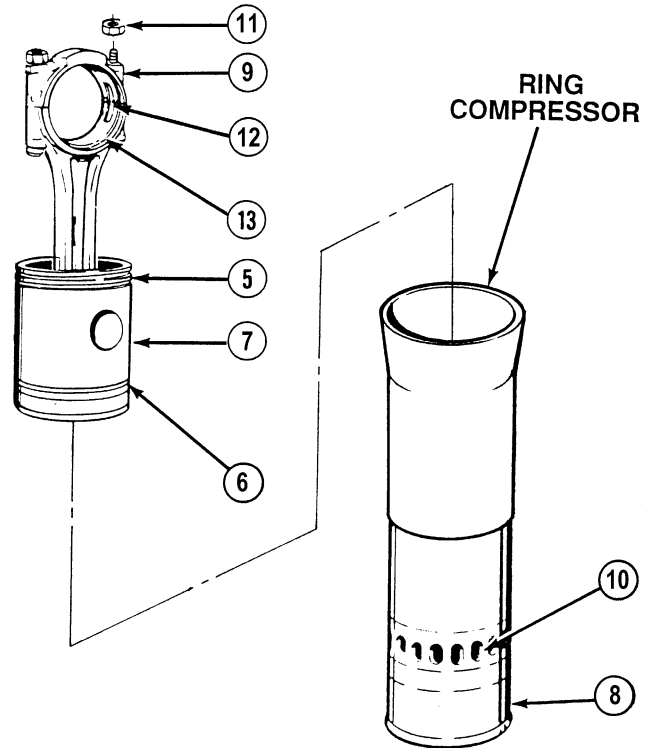
- Install piston, connecting rod and cylinder liner, (Para 20-67).

END OF TASK



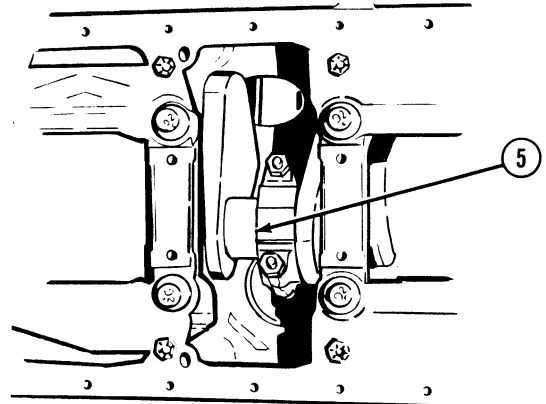
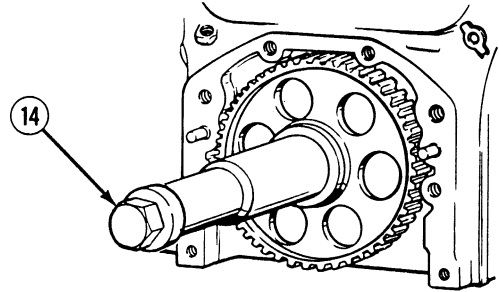
**20-67. PISTON, CONNECTING ROD AND LINER INSTALLATION (CONT).**

- (6) Inspect ring compressor for nicks and burrs. Sand smooth with 1000 grit paper. Replace ring compressor if any nicks or burrs cannot be removed.
- (7) Apply lubricating oil to piston ring set (5) and (6), piston (7) and inside of ring compressor.
- (8) Stagger piston ring (5) gaps and install piston (7) in ring compressor.
- (9) Coat inside of cylinder liner (8) with lubricating oil.
- (10) With aid of assistant, hold cylinder liner (8), flange end down, while placing ring compressor with piston (7) on cylinder liner (8).
- (11) Make sure number on rod bearing cap (9) matches number on cylinder liner (8).
- (12) Align letters on rod bearing cap (9) with letters on cylinder liner (8).
- (13) Push piston (7) into cylinder liner (8) until piston is free from ring compressor. Remove ring compressor.
- (14) Push piston (7) into cylinder liner (8) until compression rings (6) pass cylinder liner ports (10).
- (15) Remove two nuts (11), bearing cap (9) and bearing shell (12).
- (16) Coat connecting rod bearing shells (12) and (13) with lubricating oil.



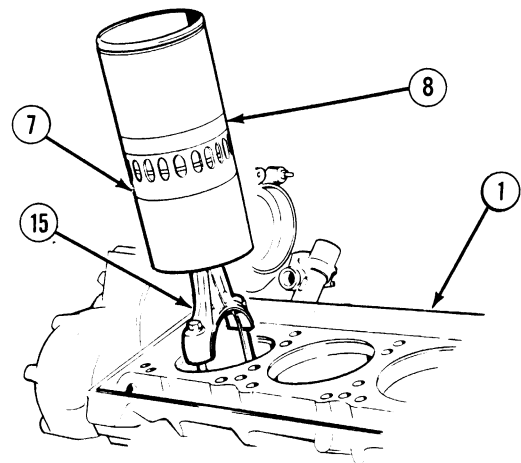
(17) Turn pulley retaining screw (14), to position crankshaft connecting rod journal (5), of cylinder being worked to bottom of its travel.

(18) Coat crankshaft journal (5) with lubricating oil.



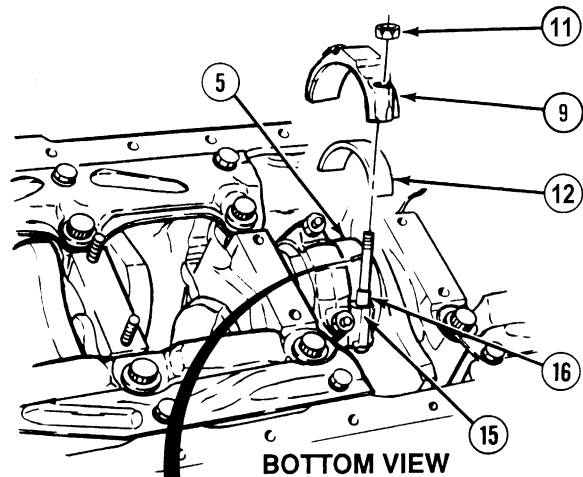
(19) Position liner (8) in front of engine block (1) bore so that identification number and letter on the connecting rod (15) face outer edge of cylinder block and mark on cylinder liner aligns with mark on engine block.

(20) With aid of assistant slide cylinder liner (8) with piston and connecting rod assembly into engine block (1). Continue sliding piston (7) down into cylinder liner while guiding connecting rod (15) over crankshaft journal (5).



**20-67. PISTON, CONNECTING ROD AND LINER INSTALLATION (CONT).**

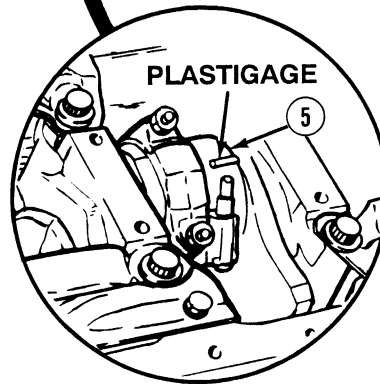
- (21) Seat connecting rod (15) firmly on crankshaft journal (5).
- (22) Wipe oil from bearing shells (12) and crankshaft journals (5).
- (23) Place strip of plastic gage across width of bearing shell (12) 1/4 in. (6.35 mm) from center.
- (24) Install bearing shell (12) and cap (9) over two screws (16).
- (25) Install two nuts (11) and tighten 60 to 70 lb-ft (81 to 95 N·m).
- (26) Remove two nuts (11) from screws (16).
- (27) Remove cap (9) from screws (16).



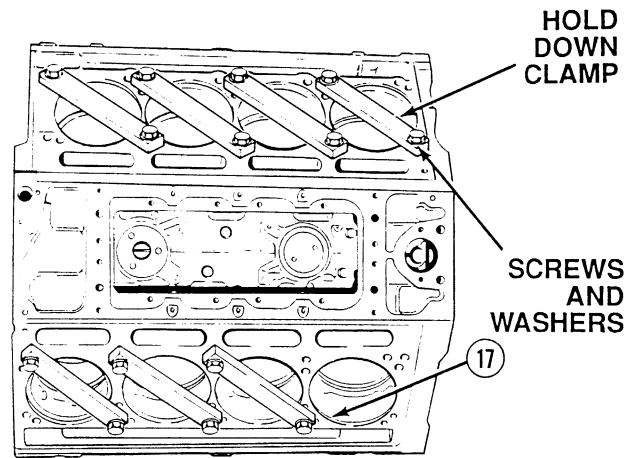
**NOTE**

Width must be minimum of 0.0008 in. (0.0203 mm) and maximum of 0.0056 in. (0.1422 mm). If measurement cannot be obtained, replace upper and lower bearing shells.

- (28) Measure widest part of plastic gage with measuring strip.
- (29) Wipe plastic gage from bearing shells (12) and crankshaft journals (5) and coat with lubricating oil.
- (30) Install bearing shell (12) and cap (9) over two screws (16).
- (31) Install two nuts (11) and tighten 60 to 70 lb-ft (81 to 95 N·m).



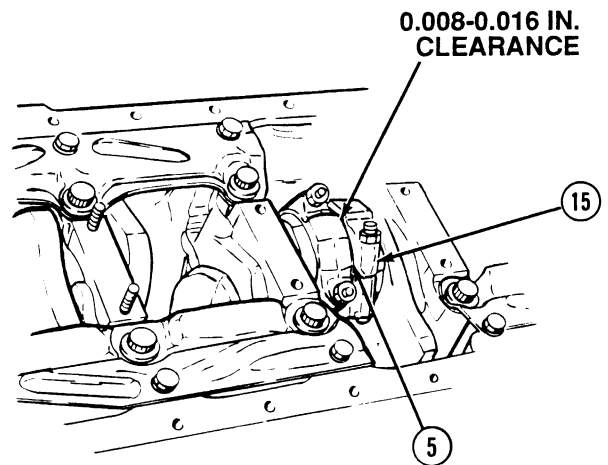
- (32) Install hold down clamp with two screws and washers to hold liner (17) in place.
- (33) Repeat Steps (1) through (31) for remaining cylinders.



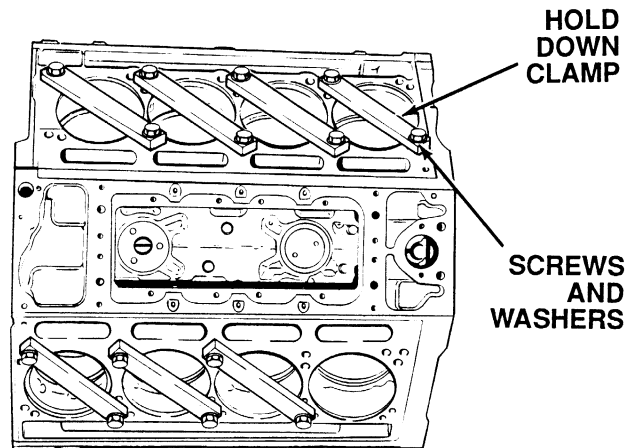
**NOTE**

If clearance between connecting rods are not correct, loosen nuts and reposition connecting rods.

- (34) Check that clearance between each connecting rod (15) installed on same crankshaft journal (5) is 0.008 to 0.016 in. (0.203 to 0.406 mm) at lowest point of travel.



- (35) After all liners and pistons have been installed, remove screws, washers, and hold down clamps.
- (36) Turn engine block over in stand.



**b. Follow-On Maintenance:**

- Install crankshaft front cover and seal, (Para 20-68).

**END OF TASK**

## 20-68. CRANKSHAFT FRONT COVER AND SEAL INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Installer, Seal, Crankshaft, Front  
(Item 114, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

#### *Equipment Condition*

Pistons, connecting rods and liners installed,  
(Para 20-67)

#### *Materials/Parts*

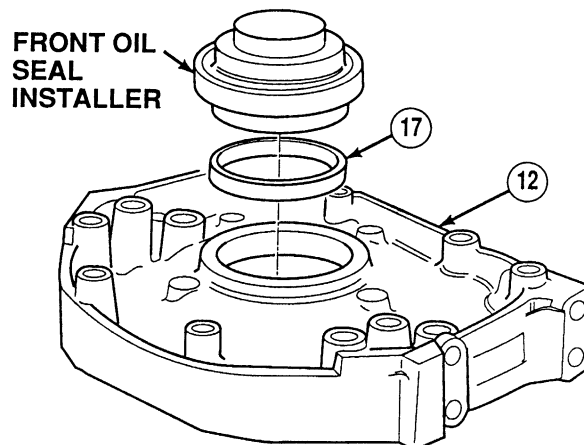
Grease (Item 21, Appendix B)  
Gasket (Item 88, Appendix E)  
Lockwasher (2) (Item 285, Appendix E)  
Lockwasher (6) (Item 286, Appendix E)  
Lockwasher (4) (Item 292, Appendix E)  
Seal (Item 565, Appendix E)

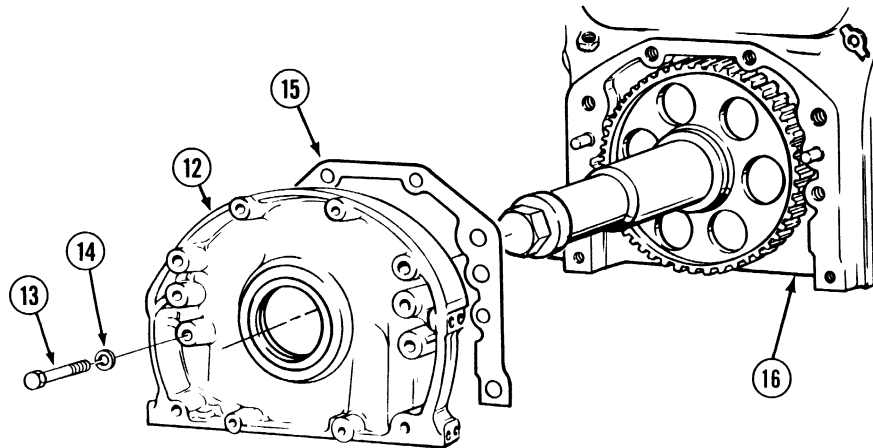
### a. *Installation.*

#### NOTE

Do not remove lubricant or plastic coating on outer surface of front seal.

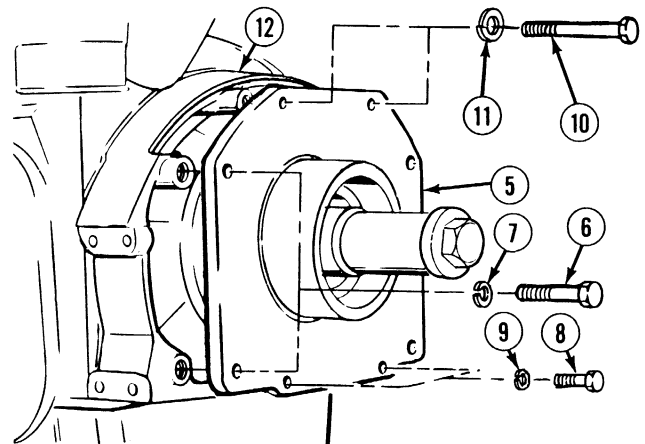
- (1) Coat sealing lip of front seal (17) with grease.
- (2) Position front seal (17) with sealing lip against inner face of flywheel cover (12).
- (3) Using seal installer, drive front seal (17) into flywheel cover (2).





- (4) Coat gasket (15) with grease and position on engine block (16).
- (5) Coat sealing lip with grease and install flywheel cover (12) on engine block (16).
- (6) Install two screws (13) and lockwashers (14).
- (7) Tighten two screws (13) 80 to 90 lb-ft (108 to 122 N·m).
- (8) Position trunnion (5) against flywheel cover (12).

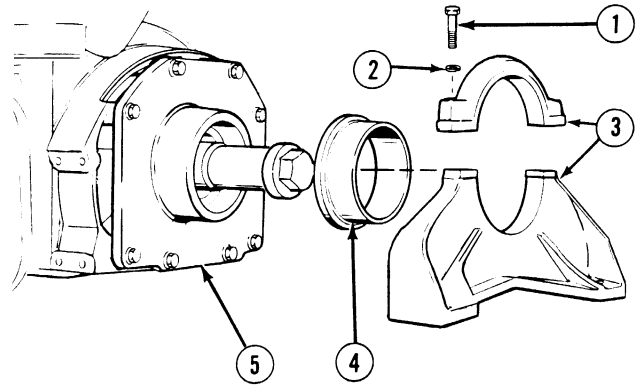
- (9) Install four lockwashers (7) and screws (6) in trunnion (5).
- (10) Position two lockwashers (9) and screws (8) in trunnion (5).
- (11) Position two lockwashers (11) and screws (10) in trunnion (5).
- (12) Tighten screws (8) and (10) 30 to 35 lb-ft (41 to 47 N·m).
- (13) Tighten screws (6) 70 to 75 lb-ft (95 to 102 N·m).





**20-68. CRANKSHAFT FRONT COVER AND SEAL INSTALLATION (CONT).**

- (14) Coat inside of rubber ring (4) with light coat of grease and slide over trunnion (5).
- (15) Install support (3) with two lockwashers (2) and screws (1).
- (16) Tighten screws (1) 45 to 50 lb-ft (61 to 68 N·m).



**b. Follow-On Maintenance:**

- Install vibration damper, (Para 20-69).

**END OF TASK**



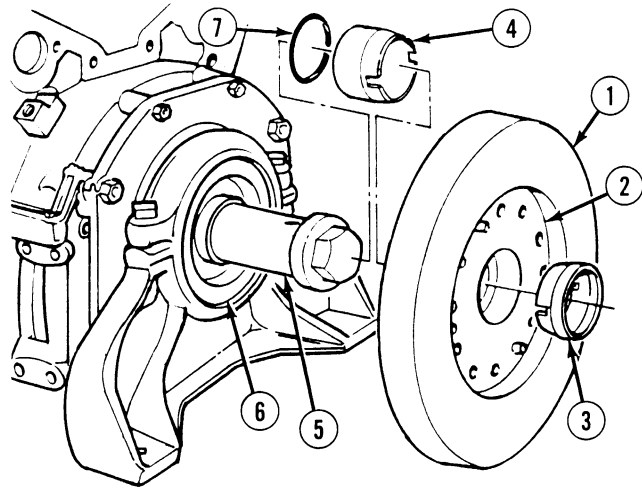
**20-69. VIBRATION DAMPER INSTALLATION (CONT).**

- (5) Apply lubricating oil to preformed packing (7).
- (6) Install preformed packing in rear cone (4).
- (7) Apply lubricating oil to rear cone (4) and crankshaft (5).
- (8) Turn rear cone (4) clockwise to install in trunnion support (6) with tapered end pointing out on crankshaft (5).

**CAUTION**

Use care when installing vibration damper. Pounding or hammering vibration damper can cause damage.

- (9) Install vibration damper (1) and hub assembly (2) on crankshaft (5).
- (10) Apply lubricating oil on front cone (3).
- (11) Install front cone (3) on crankshaft (5) with tapered end pointing toward vibration damper (1).



**b. Follow-On Maintenance:**

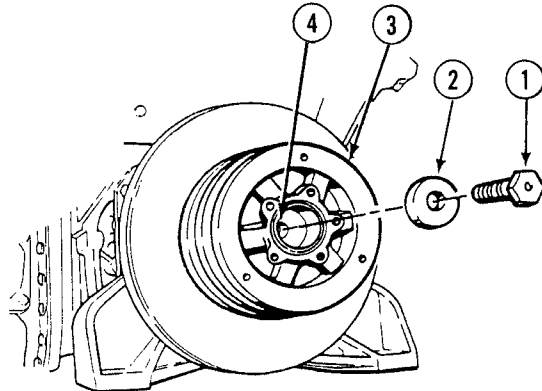
- Install crankshaft pulley, (Para 20-70).

**END OF TASK**

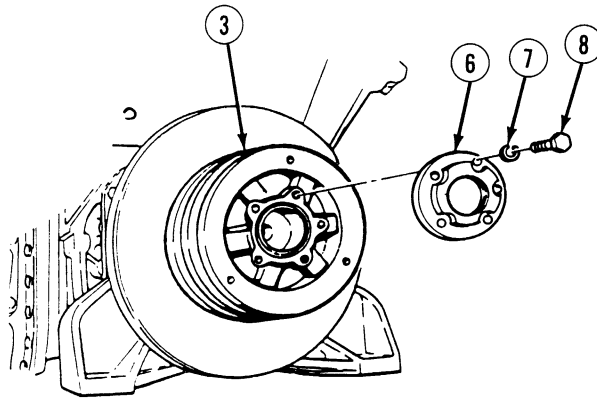


**20-70. CRANKSHAFT PULLEY INSTALLATION (CONT).**

- (5) Install screw (1) and retainer (2) in crankshaft pulley (3) of crankshaft (4).
- (6) Tighten screw (1) 180 lb-ft (244 N·m).
- (7) Strike head of screw (1) with soft face hammer and brass drift.
- (8) Tighten screw (1) 310 lb-ft (420 N·m) and strike screw again.
- (9) Tighten screw (1) 310 lb-ft (420 N·m).



- (10) Install PTO adapter (6) on crankshaft pulley (3) with five lockwashers (7) and screws (8). Tighten screws to 35 lb-ft (47 N·m).



**b. Follow-On Maintenance:**

- Install front cylinder block plate, (Para 20-71).

**END OF TASK**

**20-71. FRONT CYLINDER BLOCK PLATE INSTALLATION.**

This task covers:

- a. Installation
- b. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0 to 237 N·m]) (Item 277, Appendix F)

*Materials/Parts*

- Sealing Compound (Item 63, Appendix B)
- Gasket (Item 89, Appendix E)
- Gasket (Item 101, Appendix E)

*Materials/Parts - Continued*

- Inserts, Screw (3) (Item 133, Appendix E)
- Lockwasher (2) (Item 286, Appendix E)

*Equipment Condition*

- Camshaft pulley installed, (Para 20-70)

**a. Installation.**



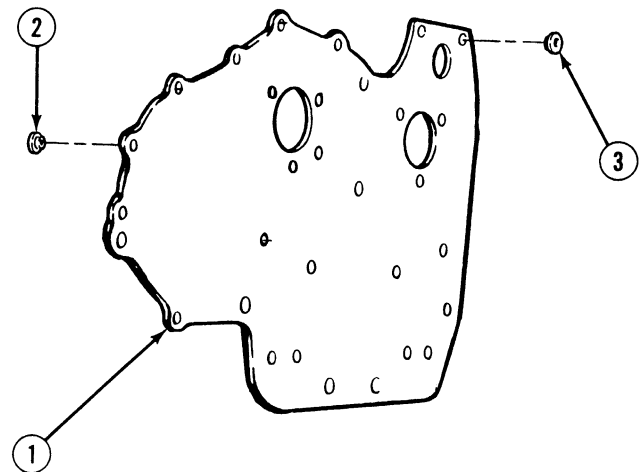
Support front block plate on flat, even surface when installing screw inserts to prevent warping or bending block plate.

- (1) Support front block plate (1).

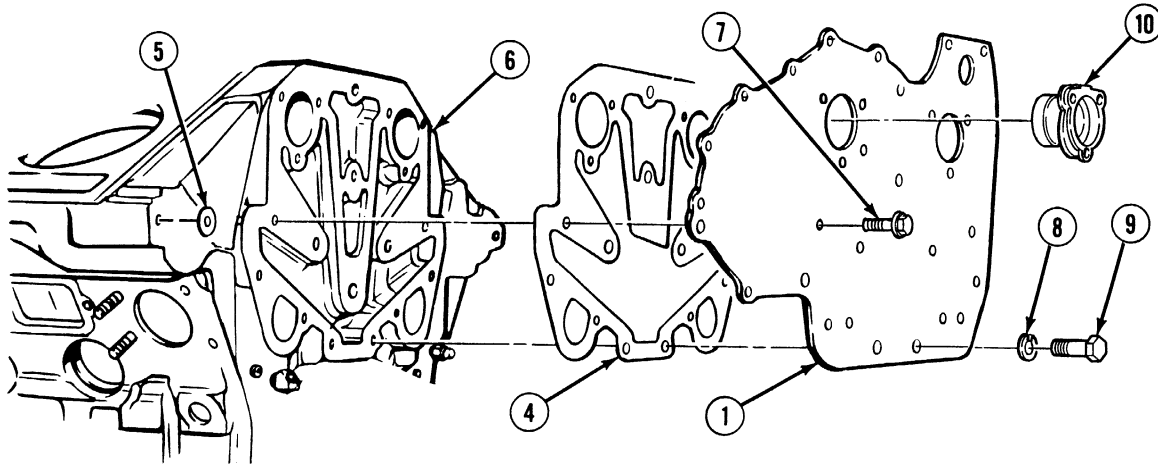
**NOTE**

Perform Step (2) only if inserts were removed.

- (2) Press three screw inserts (2) and (3) into front block plate (1) until heads seat on end plate surface.



**20-71. FRONT CYLINDER BLOCK PLATE INSTALLATION (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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (3) Coat block plate gaskets (4) and (5) with sealing compound and install on engine block (6).
- (4) Position front block plate (1), five screws (7), two lockwashers (8) and screws (9). Tighten screws finger tight.
- (5) Position right bank camshaft end bearing (10) in engine block (6).
- (6) Tighten five screws (7) 30 to 35 lb-ft (41 to 47 N·m).
- (7) Tighten two screws (9) 71 to 75 lb-ft (96 to 102 N·m).
- (8) Remove end bearing (10) from block plate (1).

**b. Follow-On Maintenance:**

- Install rear cylinder block plate, (Para 20-72).

**END OF TASK**

**20-72. REAR CYLINDER BLOCK PLATE INSTALLATION.**

This task covers:

- a. Installation
- b. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

*Materials/Parts*

- Sealing Compound (Item 63, Appendix B)
- Gasket (Item 66, Appendix E)

*Materials/Parts - Continued*

- Inserts, Screw (10) (Item 133, Appendix E)
- Lockwasher (Item 286, Appendix E)

*Equipment Condition*

- Front cylinder block plate installed, (Para 20-71)

**a. Installation.**



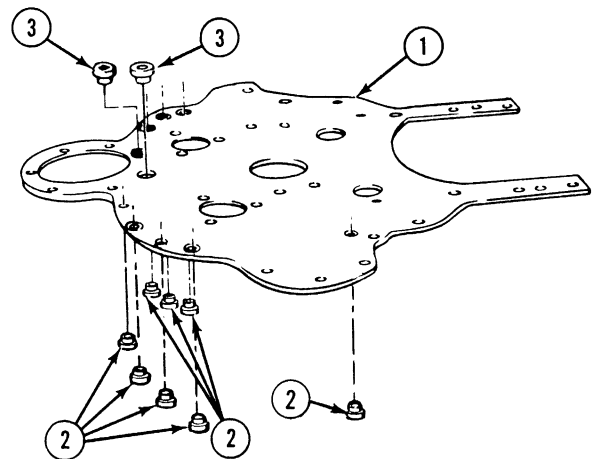
Support rear block plate on flat, even surface when installing screw inserts to prevent warping or bending block plate.

- (1) Support block plate (1).

**NOTE**

Perform Steps (2) and (3) only if removed.

- (2) Press eight screw inserts (2) into back of block plate (1) until head seats on block plate surface.
- (3) Press two screw inserts (3) into front of block plate (1) until heads seat on block plate surface.

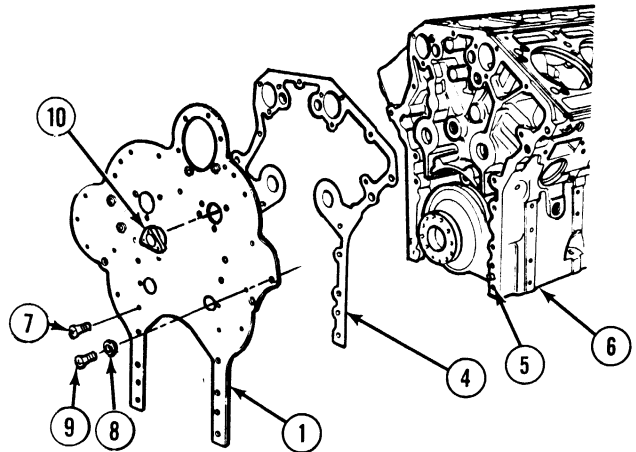




**20-72. REAR CYLINDER BLOCK PLATE INSTALLATION (CONT).****WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (4) Coat block plate gasket (4) with sealing compound and install over dowel pins (5) on engine block (6).
- (5) Position block plate (1) on dowel pins (5).
- (6) Position four screws (7) in block plate (1).
- (7) Position lockwasher (8) and screw (9) in block plate (1).
- (8) Position camshaft front end bearing (10) as a guide in block plate (1).
- (9) Tighten four screws (7) 30 to 35 lb-ft (41 to 47 N·m).
- (10) Tighten screw (9) 103 to 110 lb-ft (140 to 149 N·m).
- (11) Remove camshaft front end bearing (10) from block plate (1).

**b. Follow-On Maintenance:**

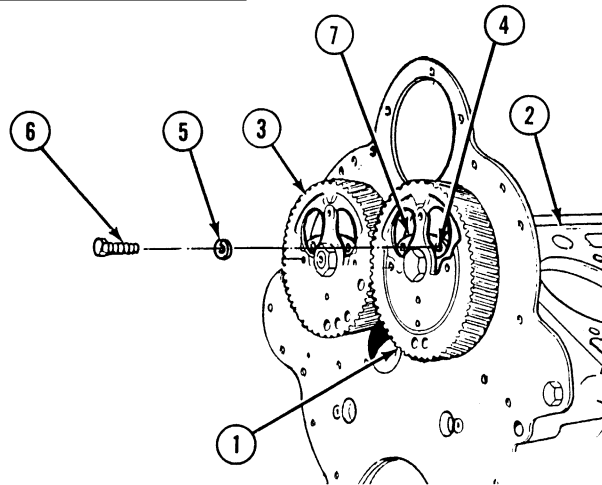
- Install camshaft assembly, (Para 20-73).

**END OF TASK**

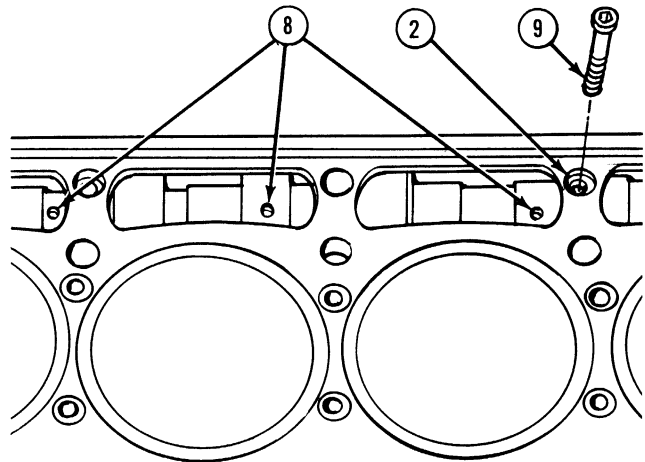


**20-73. CAMSHAFT ASSEMBLY INSTALLATION (CONT).**

- (6) Turn gears (1) and (3) to reach all rear end bearing screw holes (4).
- (7) Install six lockwashers (5) and screws (6) in both camshaft rear end bearings (7) and engine block (2) and tighten screws (6) 35 to 40 lb-ft (47 to 54 N·m).



- (8) Align holes in three intermediate bearings (8) on each camshaft with tapered holes in engine block (2).
- (9) Install six setscrews (9) and tighten to 20 lb-ft (27 N·m).

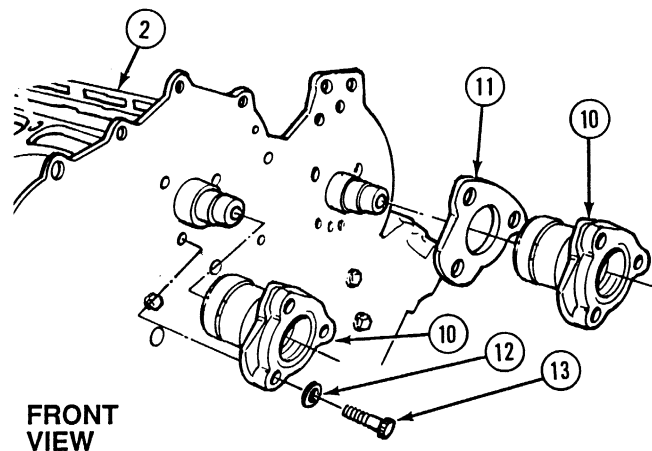


- (10) Apply lubricating oil to camshaft front end bearing journals (10).

**NOTE**

Gasket is on left hand bearing only.

- (11) Install gasket (11) and two end bearings (10) on front of engine block (2).
- (12) Install three lockwashers (12) and screws (13) in each end bearing (10) and tighten screws 35 to 40 lb-ft (47 to 54 N·m).



**NOTE**

Left spacer has polished outside diameter.

- (13) Install spacer (14) on front end of left camshaft assembly (15).

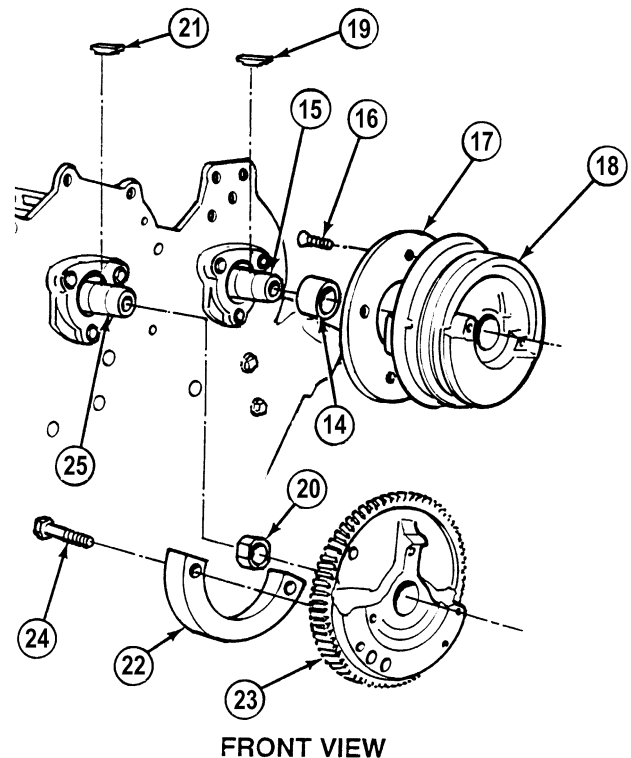
**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

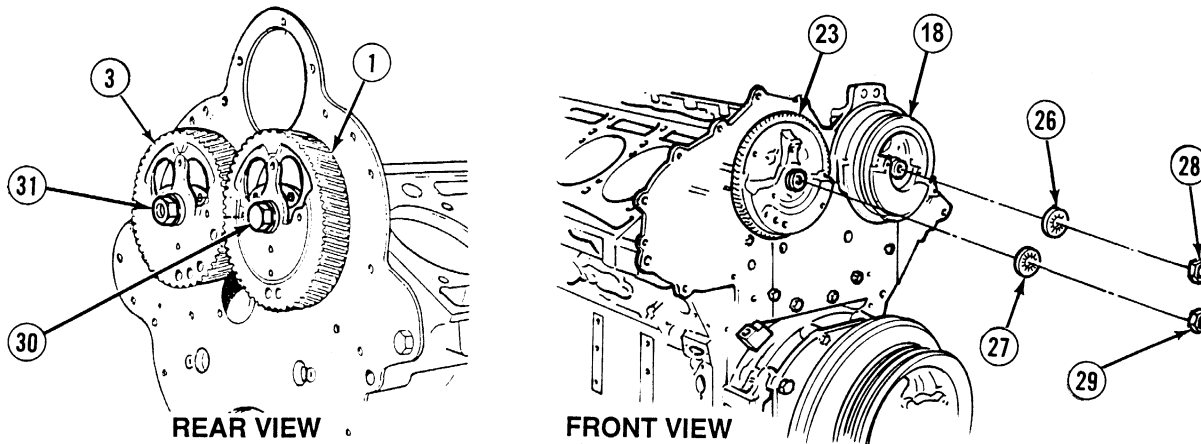
**NOTE**

DDEC II engines have a 13 tooth pulse wheel; DDEC III engines have a 36 tooth pulse wheel.

- (14) Apply retaining compound to threads of screws (16).
- (15) Install screws (16) and pulse wheel (17) on pulley (18). Tighten screws 60 to 84 lb-in (7 to 10 N·m).
- (16) Install key (19).
- (17) Position pulley (18) on front end of left camshaft (15).
- (18) Install right spacer (20) and key (21).
- (19) Install balance weight (22) on gear (23) with two lockscrews (24). Tighten screws 35 to 40 lb-ft (47 to 54 N·m).
- (20) Position gear (23) on right camshaft (25).



**20-73. CAMSHAFT ASSEMBLY INSTALLATION (CONT).**



- (21) Position lockwashers (26) and (27) and nuts (28) and (29) on pulley (18) and gear (23).
- (22) Place clean cloth between bottom of camshaft gears (1) and (3).
- (23) Tighten right rear camshaft screw (30) 180 to 190 lb-ft (244 to 258 N·m).
- (24) Tighten left camshaft front nut (28) 300 to 325 lb-ft (407 to 441 N·m).
- (25) Place cloth between top of camshaft gears (1) and (3).
- (26) Tighten left camshaft rear nut (31) 300 to 325 lb-ft (407 to 441 N·m).
- (27) Tighten right camshaft front nut (29) 300 to 325 lb-ft (407 to 441 N·m).

- (28) Place clean cloth between tops of camshaft gears (1) and (3).
- (29) Install camshaft nut lock plate (32) and accessory drive hub (33) on left camshaft gear (3) with four screws (34). Tighten screws 35 to 39 lb-ft (47 to 53 N·m).
- (30) Place clean cloth between bottom of camshaft gears (1) and (3).
- (31) Install accessory drive hub (35) on right camshaft gear (1) with four screws (36). Tighten screws 35 to 39 lb-ft (47 to 53 N·m).
- (32) Check end play of camshaft assemblies (1) and (3). Install dial indicator on engine block. Push camshaft towards gage and adjust dial indicator to zero. Force camshaft in opposite direction and read end play. If end play is less than 0.003 in. (0.076 mm) or greater than 0.018 in. (0.457 mm), replace camshaft.

#### NOTE

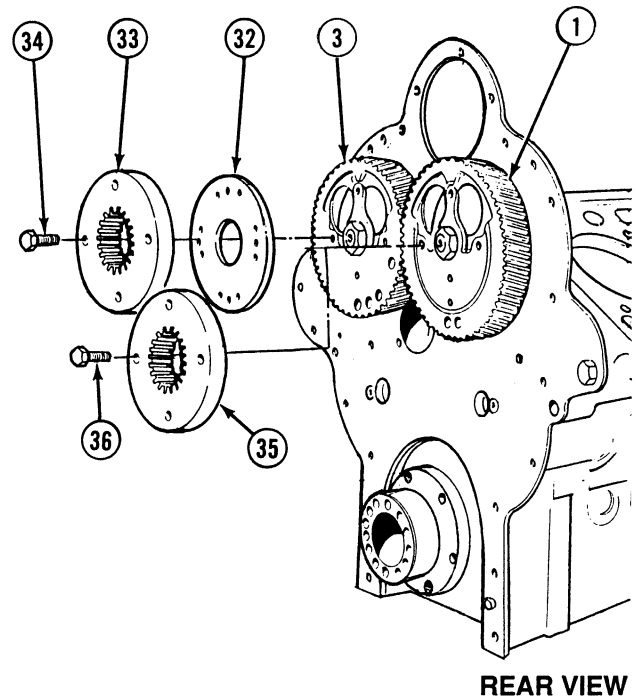
Minimum backlash for new gears is 0.002 to 0.008 in. (0.051 to 0.203 mm). If backlash is greater than 0.010 in. (0.254 mm), replace gears. Maximum backlash for used gears is 0.010 in. (0.254 mm).

- (33) Check backlash between camshaft gears (1) and (3).
- (34) Remove cloth from between bottom of camshaft gears (1) and (3).

#### b. Follow-On Maintenance:

- Install crankcase timing gear, (Para 20-74).

**END OF TASK**



## 20-74. CRANKSHAFT TIMING GEAR INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

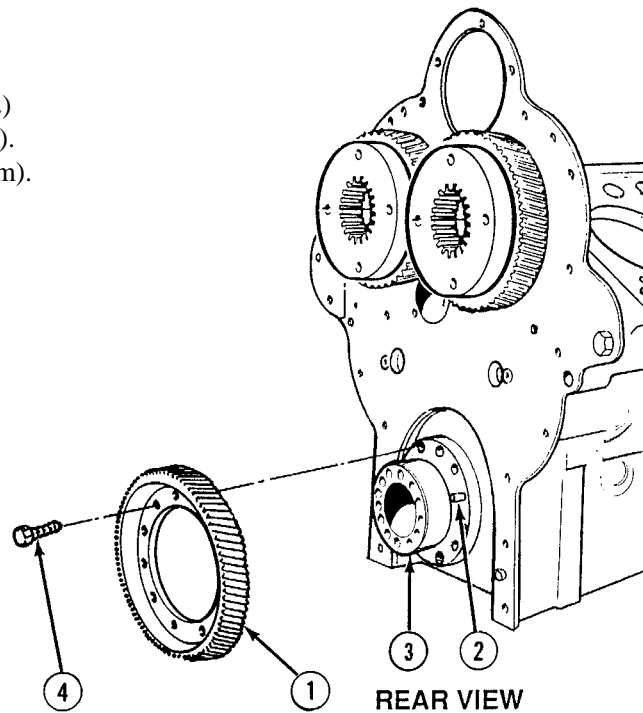
Tool Kit, General Mechanic's  
 (Item 240, Appendix F)  
 Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
 (Item 277, Appendix F)

#### *Equipment Condition*

Camshafts installed, (Para 20-73)

#### a. **Installation.**

- (1) Position timing gear (1) over dowel pin (2) on crankshaft (3) and install six screws (4). Tighten screws 35 to 39 lb-ft (47 to 53 N·m).



#### b. **Follow-On Maintenance:**

- Install idler gear, (Para 20-75).

END OF TASK





**20-75. IDLER GEAR INSTALLATION (CONT).**

- (3) Rotate idler gear (4) hub so dowel (5) aligns with hole in end plate (6).
- (4) Tap hub until it seats against end plate (6).
- (5) Check timing marks again to make sure gears are aligned as shown.
- (6) Install washer (7) and screw (8) tighten screw (8) 80 to 90 lb-ft (108 to 122 N·m).
- (7) Lubricate bearing (9) and idler gear (4) teeth liberally with lubricating oil.

**NOTE**

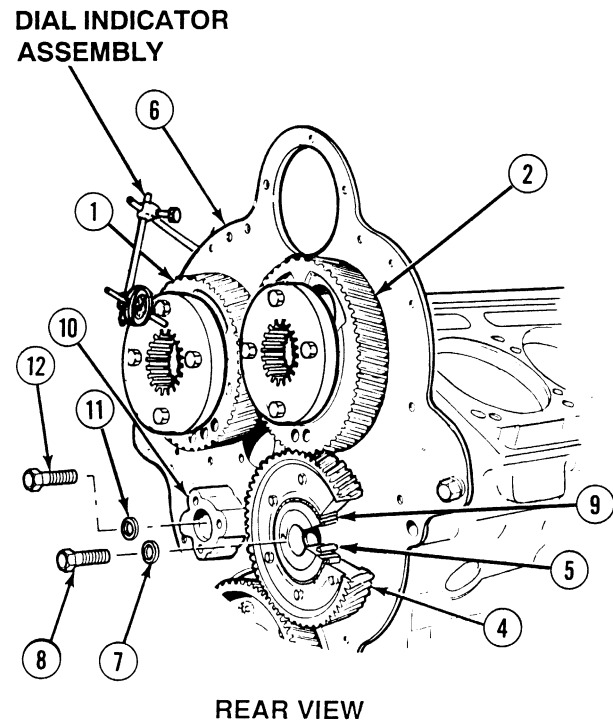
Minimum backlash is 0.002 in. (0.051 mm). Maximum backlash in 0.008 in. (0.203 mm). If backlash is greater than 0.008 in. (0.203 mm) or less than 0.002 in. (0.051) replace idler gear (4).

- (8) Mount dial indicator on end plate and check backlash between gears (2) and (4).
- (9) Install hub (10) with washer (11) and screw (12). Tighten screw 80 to 90 lb-ft (108 to 122 N·m).

**b. Follow-On Maintenance:**

- Install flywheel housing and rear oil seal, (Para 20-76).

**END OF TASK**





**20-76. FLYWHEEL HOUSING AND REAR OIL SEAL INSTALLATION (CONT).**

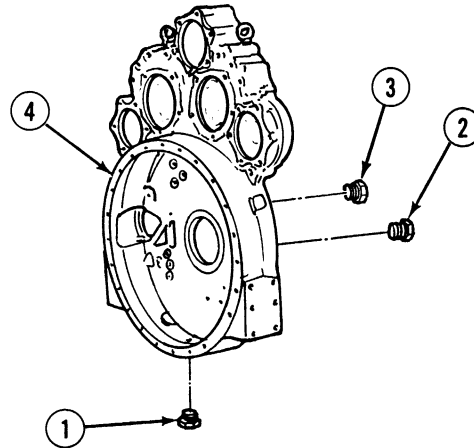
**a. Installation.**

**WARNING**

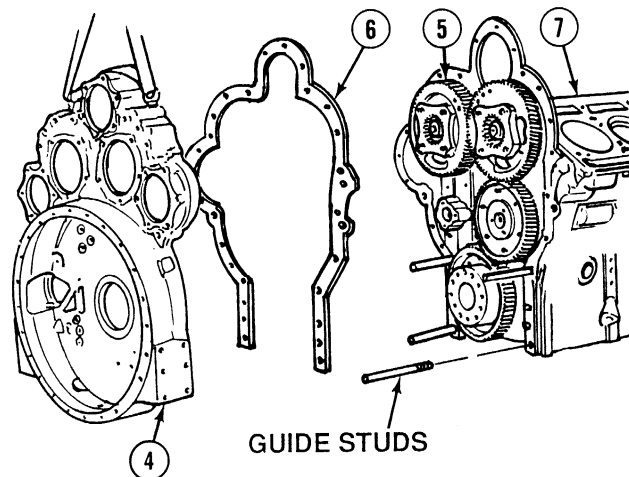
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

**NOTE**

Coat threads of pipe plugs (1), (2) and (3) with sealing compound.



- (1) Install pipe plugs (2) and (3) in back side of flywheel housing (4).
- (2) Install pipe plug (1) in bottom of flywheel housing (4).
- (3) Lubricate gear train (5) with lubricating oil.
- (4) Apply grease to engine side of flywheel housing (4).
- (5) Position gasket (6) on engine side of flywheel housing (4).
- (6) Apply grease to gasket (6).
- (7) Install four guide studs in engine block (7).

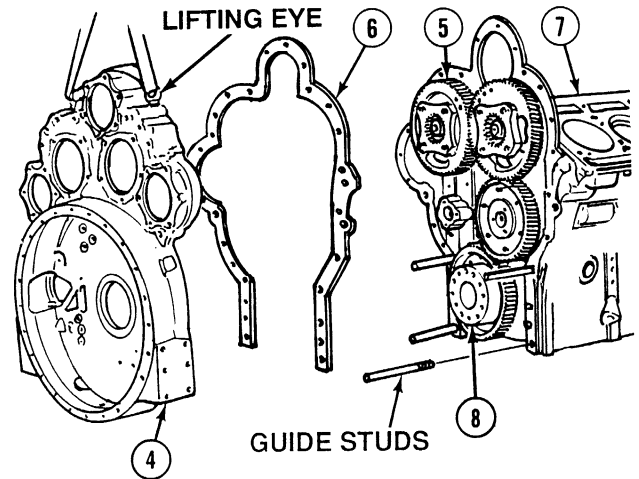


- (8) Install lifting eyes in flywheel housing (4).

**WARNING**

Flywheel housing weighs 187 lbs (85 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

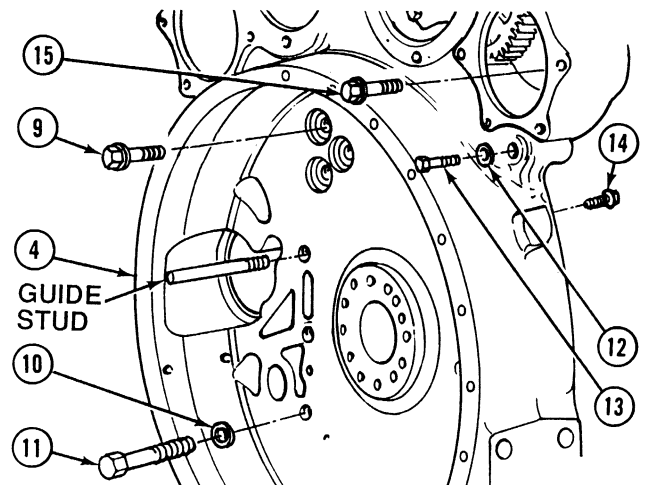
- (9) Install flywheel housing (4) over crankshaft (8) against engine block (7).



**WARNING**

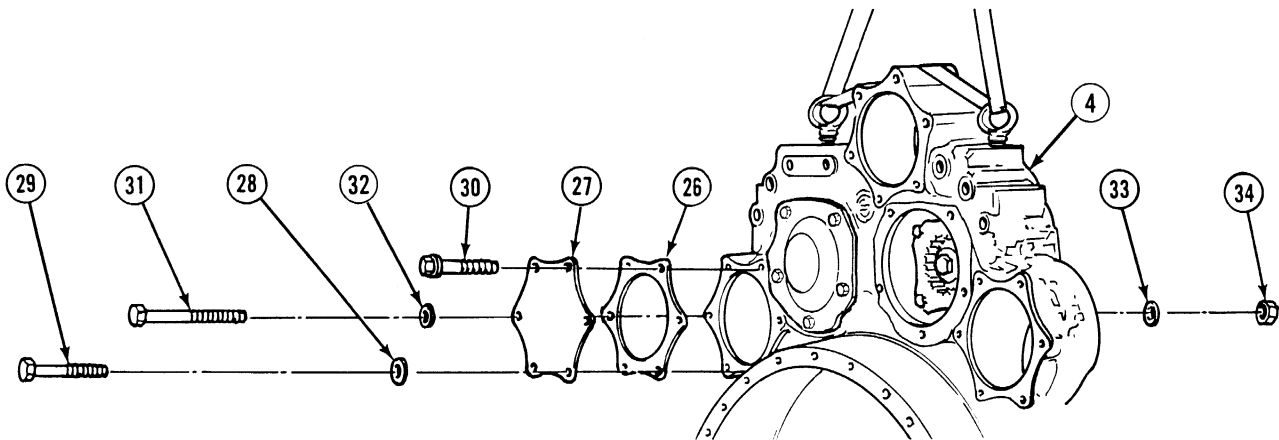
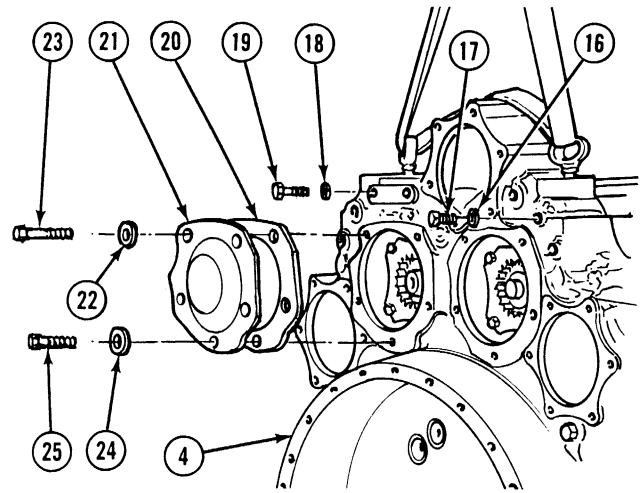
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (10) Coat threads of six screws (9) with sealing compound.
- (11) Position six screws (9) in flywheel housing (4).
- (12) Install two washers (10) and screws (11) in flywheel housing (4).
- (13) Remove guide studs and install remaining four washers (10) and screws (11) in flywheel housing (4).
- (14) Position two washers (12) and screws (13) in flywheel housing (4).
- (15) Position two screws (14) on back side of flywheel housing (4).
- (16) Position screw (15) in flywheel housing (4).



**20-76. FLYWHEEL HOUSING AND REAR OIL SEAL INSTALLATION (CONT).**

- (17) Position three washers (16) and screws (17) in flywheel housing (4).
- (18) Position four lockwashers (18) and screws (19) in flywheel housing (4).
- (19) Apply grease to gasket (20).
- (20) Position gasket (20) and access cover (21) in flywheel housing (4).
- (21) Install four lockwashers (22) and screws (23) in flywheel housing (4).
- (22) Position copper washer (24) and screw (25) in flywheel housing (4).



- (23) Apply grease to gasket (26).
- (24) Position gasket (26), access cover (27), washer (28) and screw (29) in flywheel housing (4).
- (25) Position two screws (30) in flywheel housing (4).

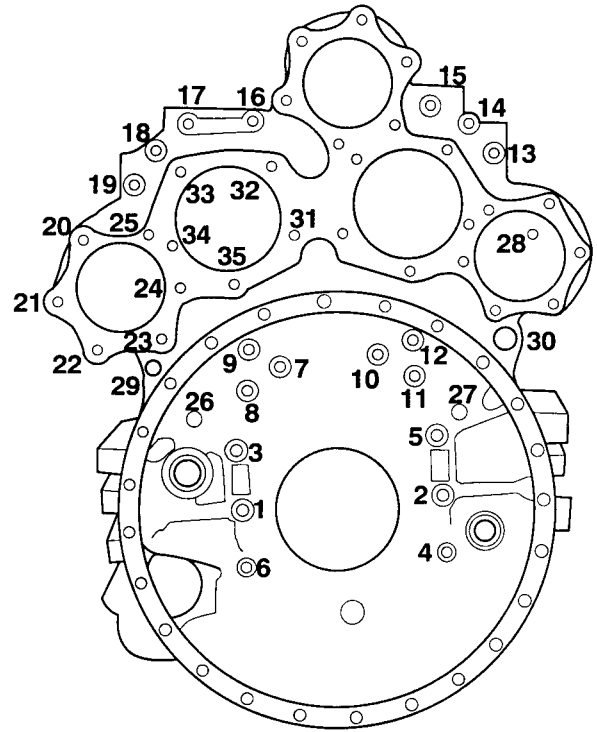
**NOTE**

Top left most screw will be installed with fuel block.

- (26) Position two screws (31), washers (32), lockwashers (33) and nuts (34) in flywheel housing (4).
- (27) Remove lifting device and lifting eyes.

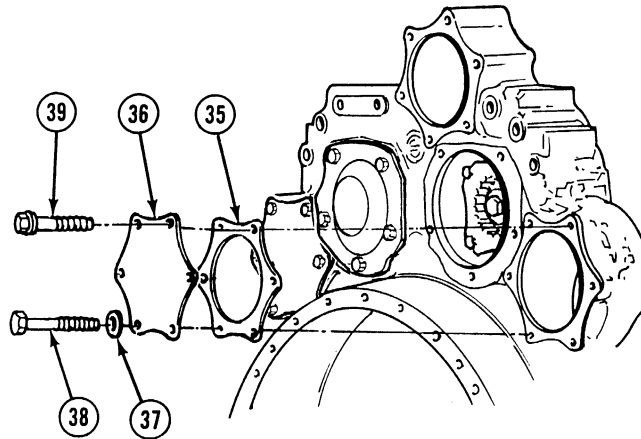
**TIGHTENING SEQUENCE**

SCREW	TORQUE
1-6	90-100 lb-ft (122-136 N·m)
7-12	40-45 lb-ft (54-61 N·m)
13-25*	25-30 lb-ft (34-41 N·m)
26-27**	40-45 lb-ft (54-61 N·m)
28	30-35 lb-ft (41-47 N·m)
29-30	137-147 lb-ft (186-200 N·m)
31-34	53-56 lb-ft (72-76 N·m)
35	35-38 lb-ft (47-51 N·m)



\* 20 to be installed with fuel block.  
 \*\* Behind flywheel housing.

(28) Tighten screws in sequence shown to specified torque.



(29) Apply grease to gasket (35).

(30) Install gasket (35), access cover (36), copper washer (37) and screw (38).

**NOTE**

Middle and bottom right two screws will be installed with air governor.

(31) Install three screws (39).

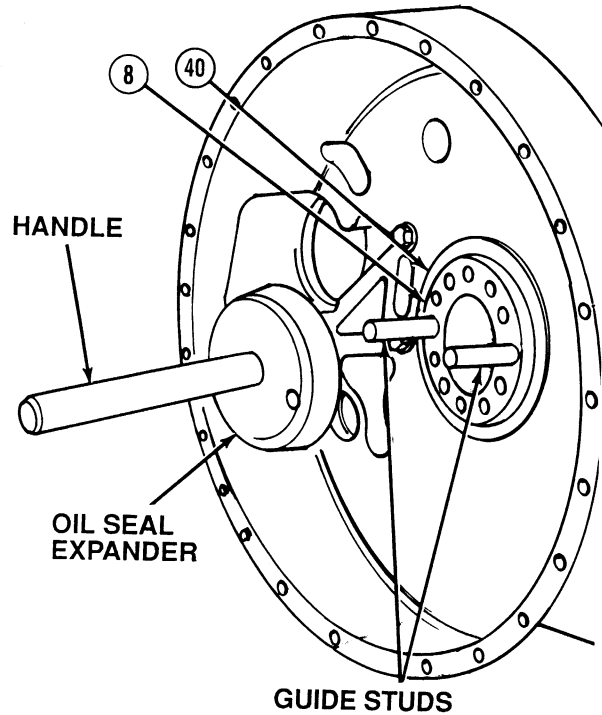
(32) Tighten screws (39) and (38) 30 to 35 lb-ft (41 to 47 N·m).

**20-76. FLYWHEEL HOUSING AND REAR OIL SEAL INSTALLATION (CONT).**

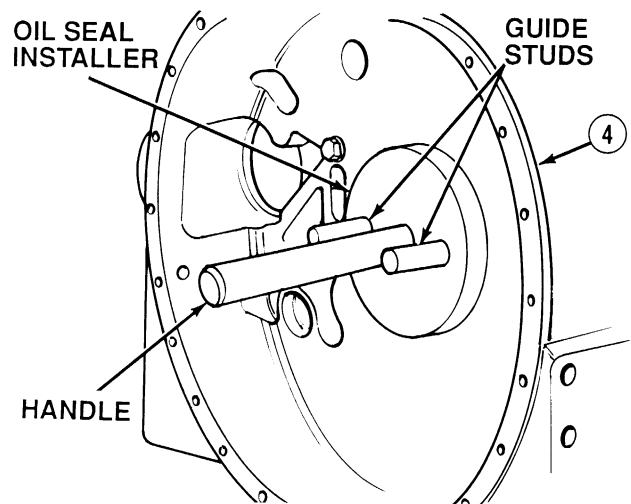
**CAUTION**

Do not lubricate Teflon seal lip or outside diameter of crankshaft before seal installation. Teflon lip seals must be installed dry to allow transfer of Teflon to crankshaft for proper sealing.

- (33) Position guide studs in end of crankshaft (8).
- (34) Install oil seal expander on guide studs using handle.
- (35) Position seal (40) on oil seal expander.
- (36) Slide seal (40) over oil seal expander and onto crankshaft (8).
- (37) Remove oil seal expander and guide studs.
- (38) Position guide studs in end of crankshaft (8).
- (39) Position oil seal installer and handle on guide studs.



- (40) Drive seal (40) with oil seal installer until seal seats squarely in flywheel housing (4).

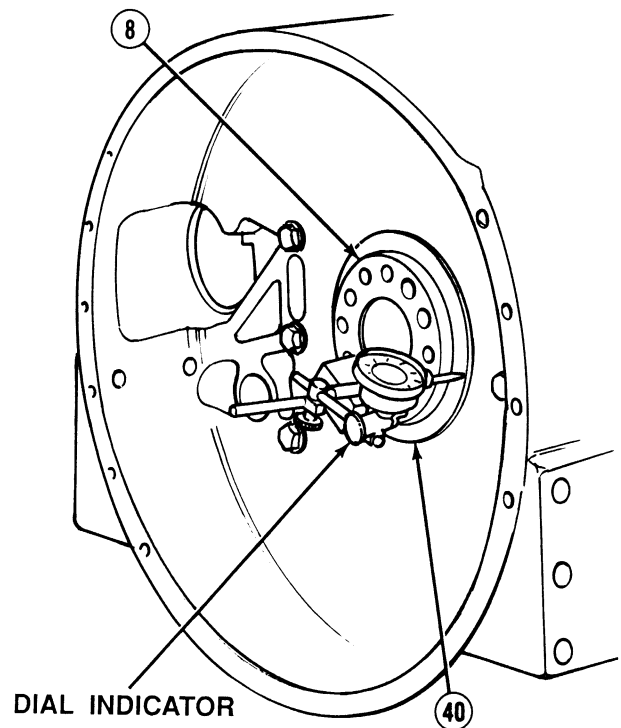


- (41) Attach dial indicator on crankshaft (8).
- (42) Position point of dial indicator on seal (40) face.
- (43) Pry crankshaft (8) toward one end and check to ensure end play is in one direction only.

**CAUTION**

When using front crankshaft capscrew to bar over engine, always turn in a clockwise direction. Turning over in counter-clockwise direction may loosen capscrew and vibration damper. This can cause serious engine damage.

- (44) With the aid of an assistant rotate crankshaft (8) while noting readings at 12, 9, 6, and 3 o'clock positions. Total runout at each position should not exceed 0.015 in. (0.381 mm).
- (45) If any reading is over 0.015 in. (0.38 mm) place seal installer over seal and lightly tap at high points.
- (46) If seal (40) cannot be brought into specification, remove and discard seal and repeat Steps (34) through (43).



**b. Follow-On Maintenance:**

- Install engine oil pump assembly, (Para 20-77).

**END OF TASK**



## 20-77. ENGINE OIL PUMP ASSEMBLY INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Indicator, Dial, Set w/Magnetic Base (Item 98, Appendix F)
- Wrench, Crowsfoot, 9/16 in., 3/8 in. Drive (Item 269, Appendix F)
- Wrench Set, Socket 3/8 in. Drive (Item 273, Appendix F)
- Wrench, Torque (0 to 60 N·m) (Item 276, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

#### *Materials/Parts*

- Lockwasher (6) (Item 292, Appendix E)
- Shim (2) (Item 632, Appendix E)
- Shim (2) (Item 633, Appendix E)
- Shim (2) (Item 634, Appendix E)

#### *Equipment Condition*

- Flywheel housing and rear oil seal installed, (Para 20-76)

#### a. **Installation.**

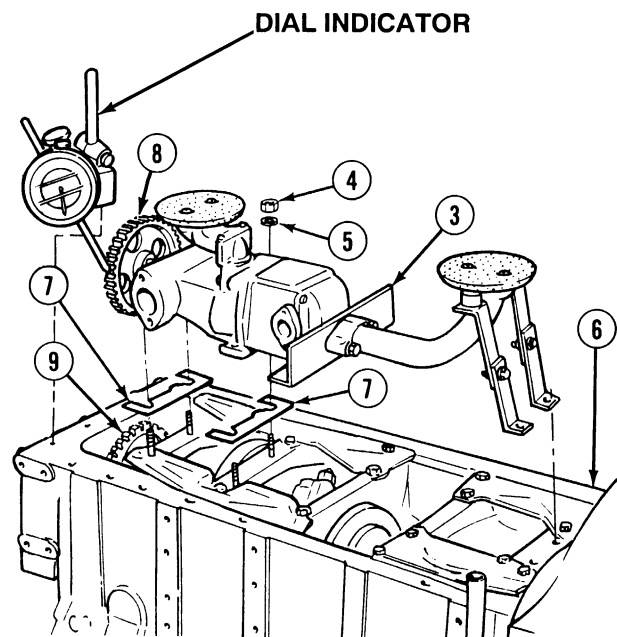
#### **NOTE**

If shims were damaged during removal, ensure shims of same thickness as recorded during removal are used for installation.

- (1) Install shims (7) on studs in engine block (6).
- (2) Position oil pump (3) on engine block (6).
- (3) Install four lockwashers (5) and nuts (4) on studs in engine block (6). Tighten nuts to 27 lb-ft (37 N·m).

#### **NOTE**

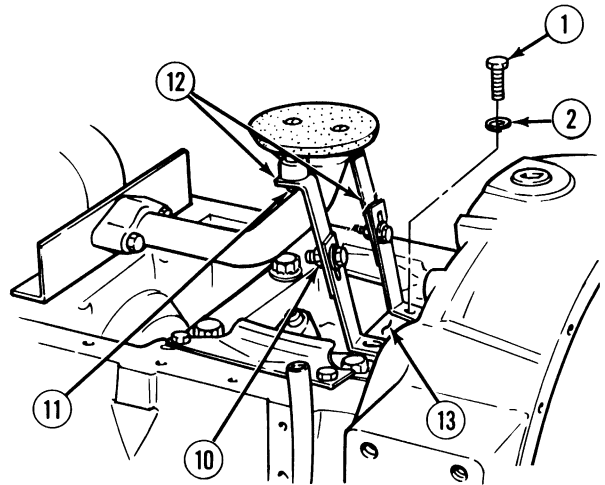
- Each 0.005 in. (0.127 mm) shim changes gear backlash 0.0035 in. (0.088 mm).
  - Backlash should be 0.006 to 0.012 in. (0.152 to 0.30 mm).
- (4) Using a dial indicator, measure backlash between crankshaft oil pump drive gear (8) and oil pump drive gear (9). Add or subtract same thickness of shims (7) under pump to obtain correct backlash.



**NOTE**

Perform Steps (5), (7), (9) and (10) if oil tube brackets do not align with screw holes.

- (5) Loosen four nuts (10) and (11) on oil tube brackets (12).
- (6) Install two lockwashers (2) and screws (1) in oil tube brackets (12) and main bearing cap (13).
- (7) Adjust oil tube brackets (12) to seat firmly against main bearing cap (13).
- (8) Tighten two screws (1) on oil tube brackets (12) to 26 to 29 lb-ft (35 to 39 N·m).
- (9) Tighten two nuts (10) on oil tube brackets (12) to 26 to 29 lb-ft (35 to 39 N·m).
- (10) Tighten two nuts (11) on oil tube brackets (12) to 120 to 156 lb-in (14 to 18 N·m).

**b. Follow-On Maintenance:**

- Install engine oil pressure relief valve, (Para 20-78).

**END OF TASK**

## 20-78. ENGINE OIL PRESSURE RELIEF VALVE INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

#### *Equipment Condition*

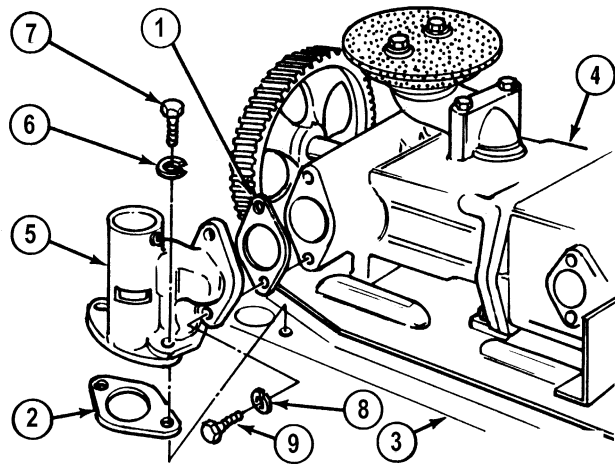
Engine oil pump assembly installed,  
(Para 20-77)

#### *Materials/Parts*

Grease (Item 21, Appendix B)  
Gasket (Item 81, Appendix E)  
Gasket (Item 90, Appendix E)  
Lockwasher (4) (Item 292, Appendix E)

#### **a. Installation.**

- (1) Apply grease to two gaskets (1) and (2)
- (2) Position two gaskets (1) and (2) on engine block (3) and pump (4).
- (3) Position pressure relief valve (5) two lockwashers (6) and screws (7).
- (4) Position two lockwashers (8) and screws (9).
- (5) Tighten screws (7) and (9) 23 to 26 lb-ft (31 to 35 N·m).



#### **b. Follow-On Maintenance:**

- Install oil pressure regulator valve, (Para 20-79).

**END OF TASK**

## 20-79. ENGINE OIL PRESSURE REGULATOR VALVE INSTALLATION.

This task covers:

- a. Installation                                      b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

#### *Materials/Parts*

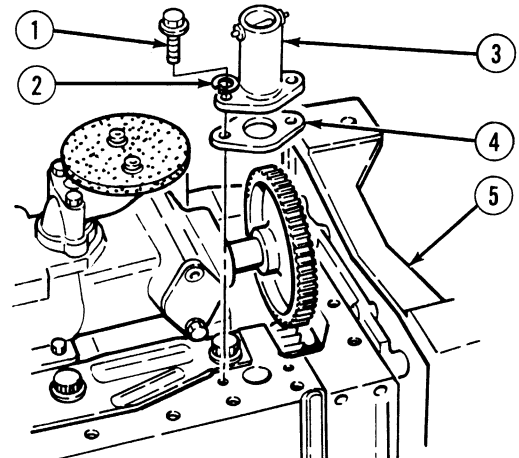
Gasket (Item 81, Appendix E)  
Lockwasher (2) (Item 292, Appendix E)

#### *Equipment Condition*

Engine oil pressure relief valve installed,  
(Para 20-78)

### a. Installation.

- (1) Install gasket (4) and oil pressure regulator (3) on engine (5) with two lockwashers (2) and screws (1).
- (2) Tighten lockscrews (1) 30 to 35 lb-ft (41 to 47 N·m).



### b. Follow-On Maintenance:

- Install engine oil pan, (Para 20-80).

END OF TASK

## 20-80. ENGINE OIL PAN INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Wrench Set, Socket 3/8 in. Drive  
(Item 273, Appendix F)  
Wrench, Torque (0-60 N·m)  
(Item 276, Appendix F)

#### *Equipment Condition*

Engine oil pressure regulator valve installed,  
(Para 20-79)

#### *Materials/Parts*

Sealing Compound (Item 53, Appendix B)  
Sealing Compound (Item 56, Appendix B)  
Gasket (Item 78, Appendix E)

#### a. *Installation.*

### WARNING

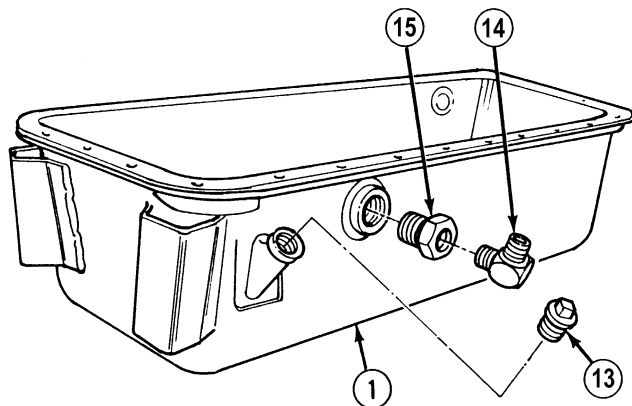
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

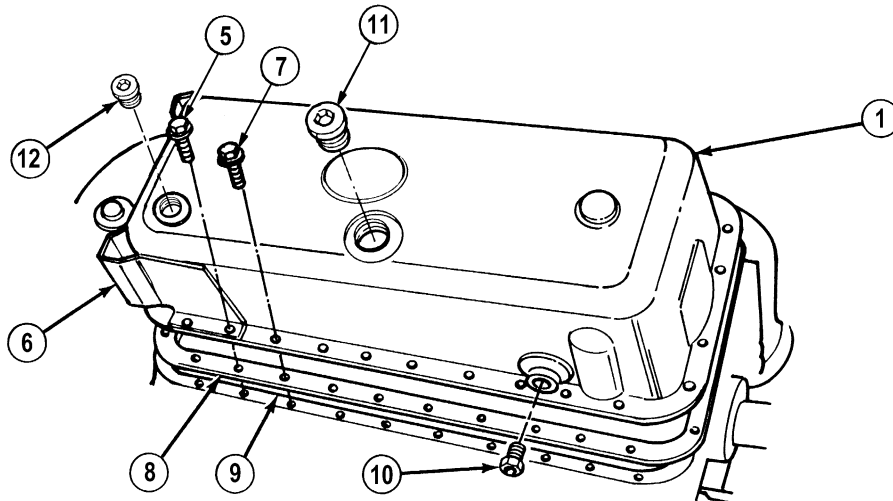
- (1) Coat threads of elbow (14) and adapter (15) with sealing compound.
- (2) Install adapter (15) in oil pan (1).
- (3) Install elbow (14) in adapter (15).

#### **NOTE**

Perform Step (4) only if removed.

- (4) Coat threads of plug (13) with sealing compound.
- (5) Install plug (13) in oil pan (1).





**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

**NOTE**

Perform Steps (6) and (7) if plugs were removed.

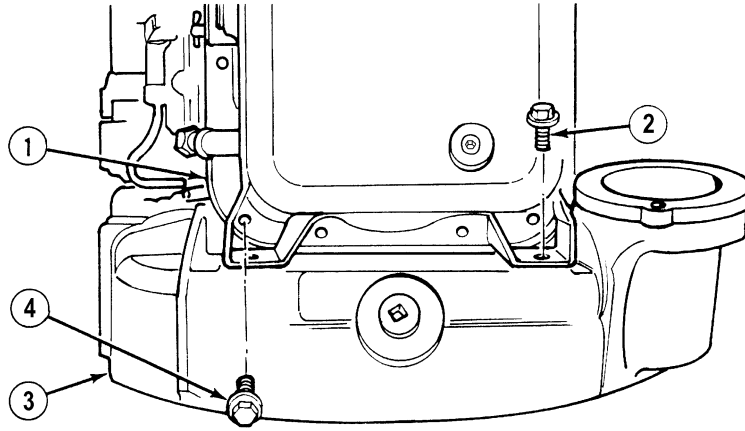
- (6) Coat threads of plug (12) and plug (11) with sealing compound.
- (7) Install plug (12) and plug (11) in oil pan (1).

**NOTE**

Ensure ends of end plate gaskets are trimmed flush with surface of block.

- (8) Coat threads of adapter (10) with sealing compound.
- (9) Install adapter (10) in oil pan (1).
- (10) Apply grease to mating surface of oil pan (1).
- (11) Install gasket (8) on engine block (9).
- (12) Position oil pan (1) on gasket (8).
- (13) Position four screws (5) in support bracket (6).
- (14) Apply sealing compound to threads of 20 oil pan screws (7).
- (15) Position 20 screws (7) in sides and front of oil pan (1).

**20-80. ENGINE OIL PAN INSTALLATION (CONT).**



- (16) Position four screws (4) in rear of oil pan (1).
- (17) Position two screws (2) in flywheel housing (3).
- (18) Starting with center screw on each side and working alternately toward each end of pan (1), tighten all screws 120 to 240 lb-in (14 to 27 N·m).
- (19) Tighten two screws (2) 120 to 240 lb-in (14 to 27 N·m).

**b. Follow-On Maintenance:**

- Install flex plate, (Para 20-81).

**END OF TASK**

## 20-81. FLEX PLATE INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

*Tools and Special Tools*

Tool Kit, General Mechanic's  
 (Item 240, Appendix F)  
 Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
 (Item 277, Appendix F)

*Materials/Parts*

Compound, International, No. 2  
 (Item 16, Appendix B)  
 Lockscrew (12) (Item 224, Appendix E)

*Equipment Condition*

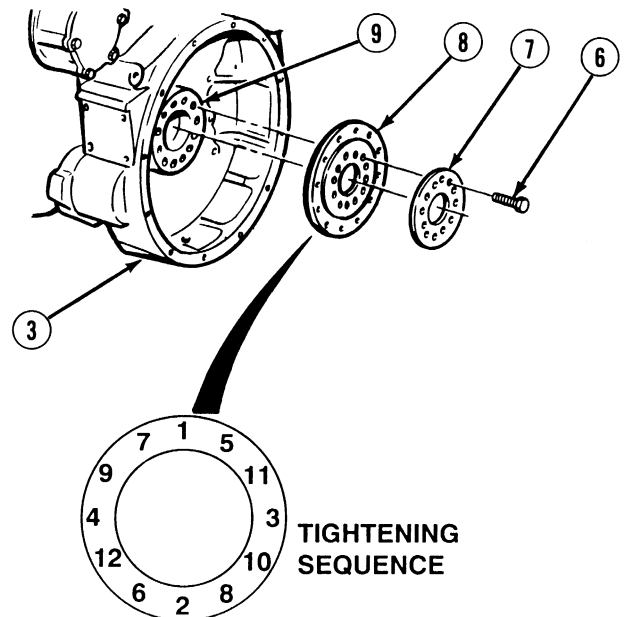
Oil pan installed, (Para 20-80)

**a. Installation.**

**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.

- (1) Apply International Compound No. 2 to threads of 12 screws (6).
- (2) Align screw holes in hub (8) and plate (7) with crankshaft (9) inside flywheel housing (3) and install with 12 lockscrews (6). Tighten lockscrews to 50 lb-ft (68 N·m).
- (3) Mark position of lockscrews (6).
- (4) Tighten lockscrews (6) an additional 90 degrees to 100 degrees in sequence shown.





**20-81. FLEX PLATE INSTALLATION (CONT).**

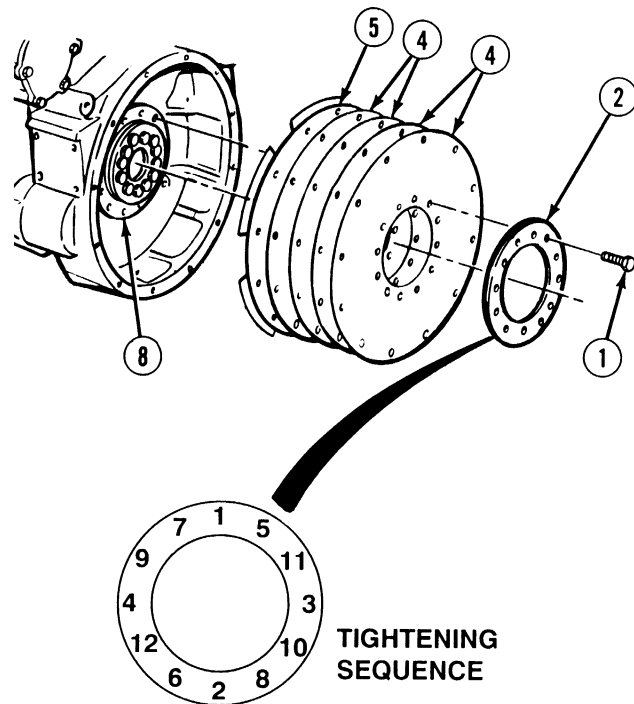
**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (5) Apply International Compound No. 2 to threads of 12 lockscrews (1).

**NOTE**

- Six welded plates on inner most disk face toward engine.
  - Remove cable ties after flex coupling inserts are installed.
- (6) Align screw holes in disk (5), four disks (4) and plate (2) with hub (8).
  - (7) Install five disks (4) and (5) and plate (2) with 12 lockscrews (1). Tighten lockscrews 100 lb-ft (136 N·m) in sequence shown.



**b. Follow-On Maintenance:**

- Install vibration damper and front balance cover, (Para 20-82).

**END OF TASK**

**20-82. VIBRATION DAMPER AND FRONT BALANCE COVER INSTALLATION.**

This task covers:

- a. Installation
- b. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Installer, Seal (Item 115, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

*Materials/Parts*

- Grease (Item 21, Appendix B)

*Materials/Parts - Continued*

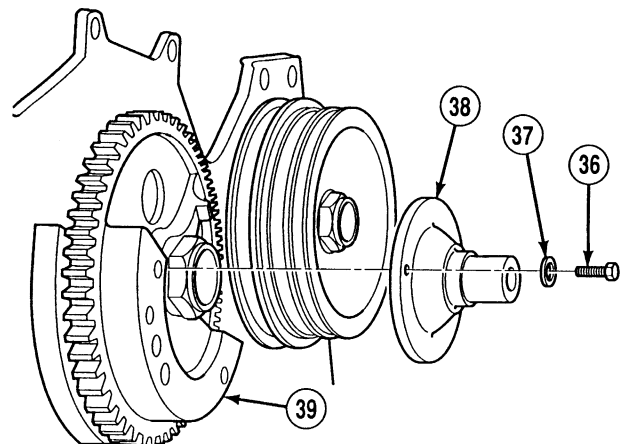
- Gasket (Item 92, Appendix E)
- Key (Item 143, Appendix E)
- Lockwasher (1) (Item 286, Appendix E)
- Lockwasher (3) (Item 291, Appendix E)
- Lockwasher (9) (Item 292, Appendix E)
- Seal, Oil (Item 590, Appendix E)

*Equipment Condition*

- Flex plate installed, (Para 20-81)

**a. Installation.**

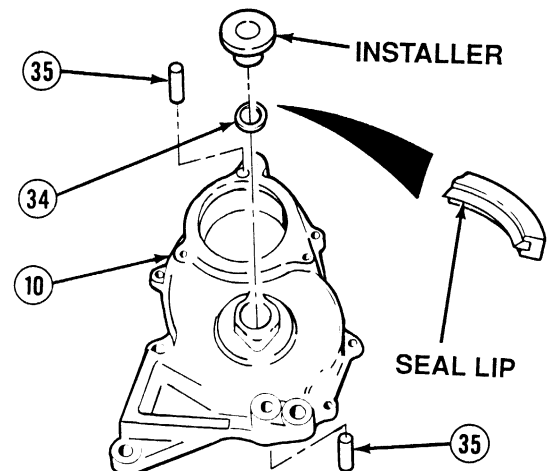
- (1) Install vibration damper shaft (38) on gear (39) with three lockwashers (37) and screws (36). Tighten screws 15 to 19 lb-ft (20 to 26 N·m).



**NOTE**

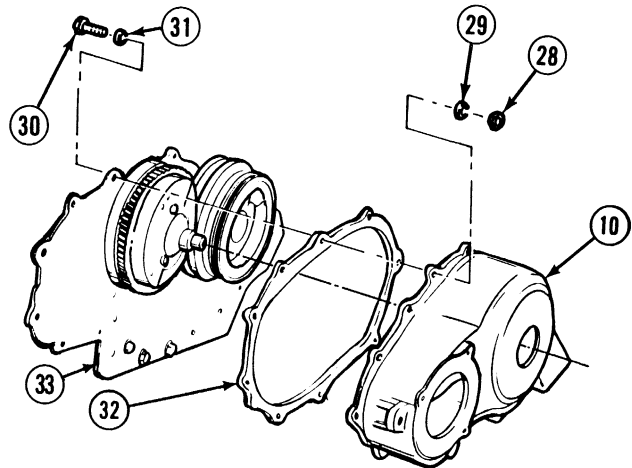
Perform Step (2) only if removed.

- (2) Install two dowels (35), to heights of 3/16 in. to 1/4 in. (4.8 to 6.4 mm) above cover (10).
- (3) Position oil seal (34) with seal lip pointing toward inner side of cover (10).
- (4) Using oil seal installer, install oil seal (34). Coat lip of seal with grease.

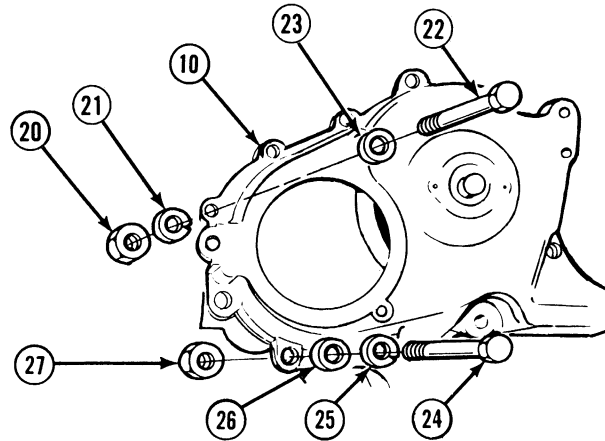


**20-82. VIBRATION DAMPER AND FRONT BALANCE COVER INSTALLATION (CONT.)**

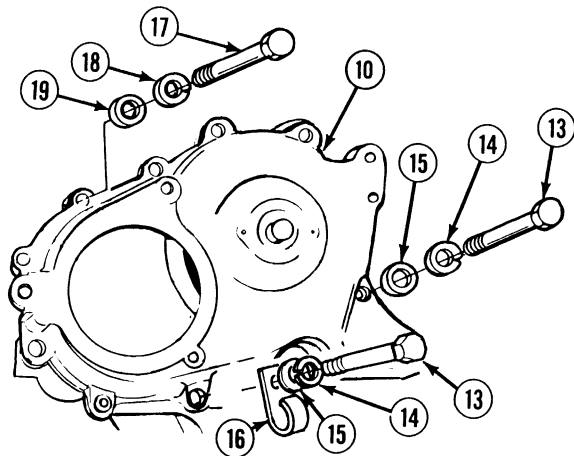
- (5) Coat gasket (32) with grease.
- (6) Position gasket (32) on front cover (10).
- (7) Align holes on front balance cover (10) with holes in end plate (33) and position front balance cover (10) on end plate (33).
- (8) Install three washers (31), screws (30), lockwashers (29) and nuts (28). Tighten nuts 30 to 35 lb-ft (41 to 47 N·m).



- (9) Install screw (22), washer (23), lockwasher (21) and nut (20) in front cover (10). Tighten nut 35 to 39 lb-ft (47 to 53 N·m).
- (10) Install screw (24), lockwasher (25), washer (26) and locknut (27). Tighten locknut 35 to 39 lb-ft (47 to 53 N·m).



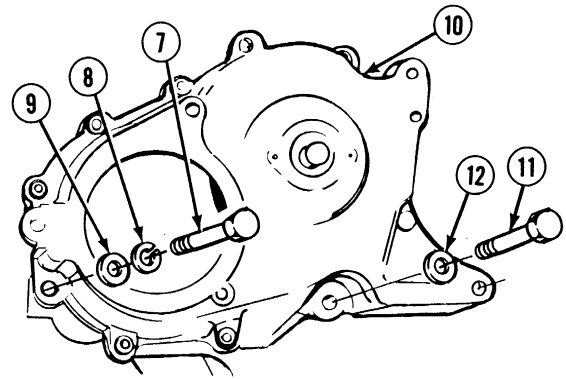
- (11) Install washer (19), lockwasher (18) and screw (17). Tighten screw 35 to 39 lb-ft (47 to 53 N·m).
- (12) Install clip (16), two washers (15), lockwashers (14) and screws (13) in front cover (10). Tighten screws 30 to 35 lb-ft (41 to 47 N·m).



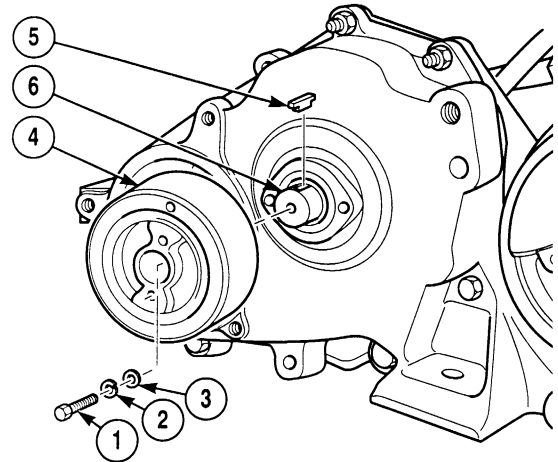
**NOTE**

Other screw and washer installed with front lift bracket.

- (13) Install washer (12) and screw (11). Tighten screw 137 to 147 lb-ft (186 to 199 N·m).
- (14) Install washer (9), lockwasher (8) and screw (7). Tighten screw 71 to 75 lb-ft (96 to 102 N·m).



- (15) Install key (5) on vibration damper shaft (6).
- (16) Position vibration damper (4) on vibration damper shaft (6).
- (17) Install washer (3), lockwasher (2) and screw (1). Tighten screw to 25 lb-ft (34 N·m).



**b. Follow-On Maintenance:**

- Install engine oil cooler, (Para 20-83).

**END OF TASK**

## 20-83. ENGINE OIL COOLER ASSEMBLY INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Bit Set, Screwdriver (Item 20, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Wrench Set, Socket 3/8 in. Drive (Item 273, Appendix F)
- Wrench, Torque (0-60 N·m) (Item 276, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

#### *Materials/Parts*

- Grease (Item 21, Appendix B)
- Sealing Compound (Item 53, Appendix B)
- Sealing Compound (Item 56, Appendix B)

#### *Materials/Parts - Continued*

- Gasket (Item 65, Appendix E)
- Gasket (Item 120, Appendix E)
- Lockwasher (20) (Item 291, Appendix E)
- Lockwasher (2) (Item 292, Appendix E)
- Seal (Item 567, Appendix E)
- Spring (Item 666, Appendix E)
- Washer, Copper (Item 694, Appendix E)

#### *Personnel Required*

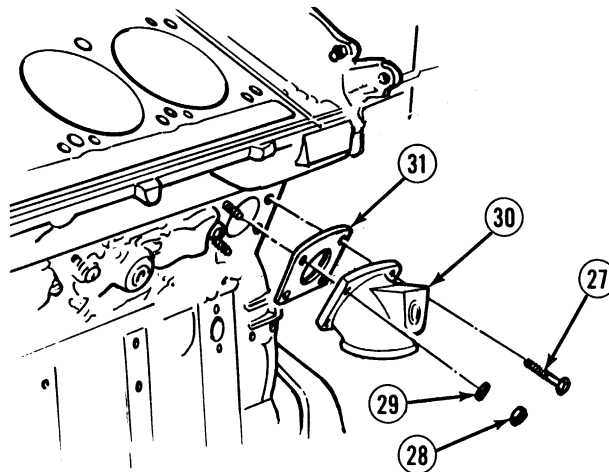
Two

#### *Equipment Condition*

Vibration damper and front balance cover installed, (Para 20-82)

### a. *Installation.*

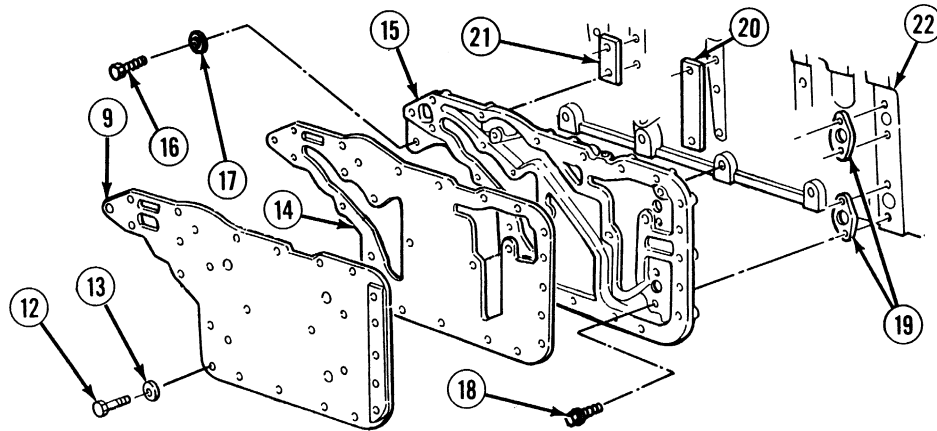
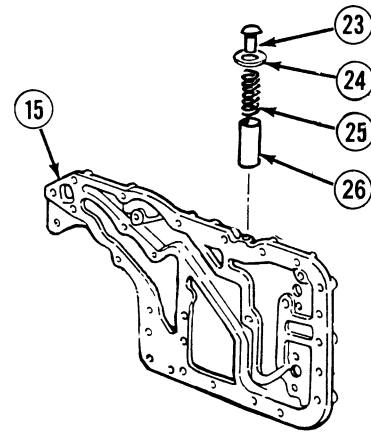
- (1) Install gasket (31) and oil cooler outlet elbow (30) with two screws (27), lockwashers (29) and nuts (28). Tighten screws 30 to 35 lb-ft (41 to 47 N·m).



**WARNING**

Use care when installing spring. Spring is under tension and can act as a projectile if released and could cause severe eye injury.

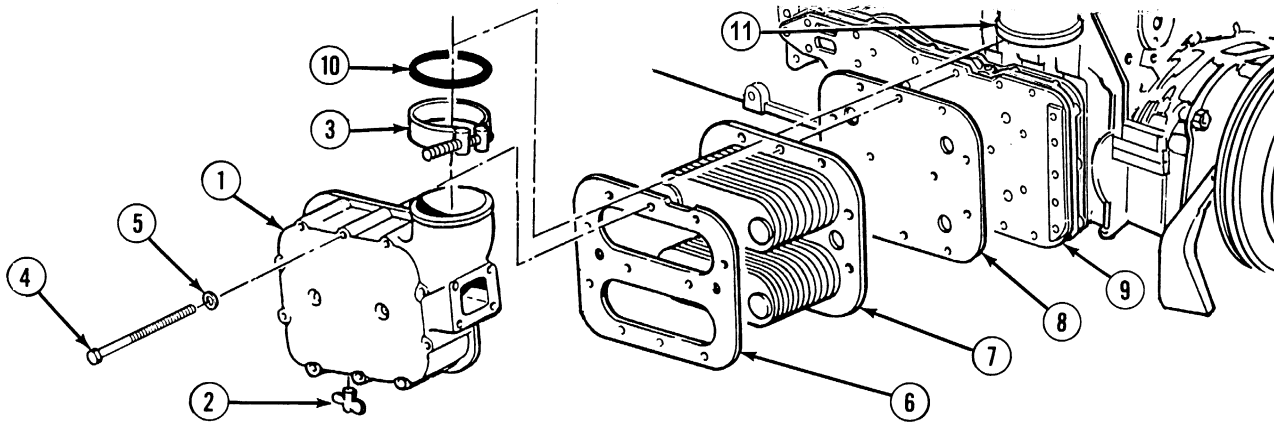
- (2) Install valve (26), spring (25), copper washer (24) and plug (23) in oil cooler adapter (15). Tighten plug 25 to 30 lb-ft (34 to 41 N·m).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (3) Apply sealing compound to threads of 14 screws (16) and (18).
- (4) Install two shims (20) and (21), gaskets (19) and oil cooler adapter (15) with three washers (17) and screws (16). Tighten 30 to 35 lb-ft (41 to 47 N·m).
- (5) Install three screws (18). Tighten 30 to 35 lb-ft (41 to 47 N·m).
- (6) Apply grease to gasket (14).
- (7) Install gasket (14) and oil cooler adapter cover (9), with eight lockwashers (13) and screws (12) on engine block (22). Tighten screws 120 to 156 lb-in (14 to 18 N·m).

**20-83. ENGINE OIL COOLER ASSEMBLY INSTALLATION (CONT).**



**CAUTION**

Inlet and outlet openings in oil cooler core are marked “IN” and “OUT”. Make sure oil cooler is reinstalled in original position to prevent oil flow from being reversed.

- (8) Apply grease to two gaskets (6) and (8).
- (9) Install gasket (8), oil cooler core (7), gasket (6), seal (10) and hose clamp (3) on oil cooler housing (1).
- (10) Apply sealing compound to threads of 12 screws (4).
- (11) With the aid of an assistant, position oil cooler housing (1) and install with 12 lockwashers (5) and screws (4). Tighten screws 120 to 180 lb-in (14 to 20 N·m).
- (12) Tighten hose clamp (3) on hose (11).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (13) Apply sealing compound to threads of draincock (2).
- (14) Install draincock (2) on oil cooler housing (1).

**b. Follow-On Maintenance:**

- Install engine oil filter and spin on adapter housing, (Para 20-84).

**END OF TASK**

**20-84. ENGINE OIL FILTER AND SPIN-ON ADAPTER HOUSING AND REMOTE ENGINE OIL FILTER MANIFOLD INSTALLATION.**

This task covers:

- a. Installation
- b. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

*Materials/Parts - Continued*

- Sealing Compound (Item 56, Appendix B)
- Gasket (Item 112, Appendix E)
- Lockwasher (2) (Item 292, Appendix E)
- Spring (Item 659, Appendix E)

*Materials/Parts*

- Oil, Lubricating (Item 36, Appendix B)

*Equipment Condition*

- Engine oil cooler assembly installed, (Para 20-83)

**a. Installation.**

**WARNING**

Use care when installing spring. Spring is under tension and can act as a projectile if released and could cause severe eye injury.

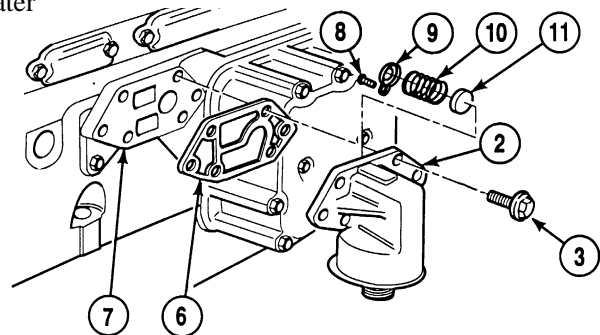
**NOTE**

- Perform Steps (1) through (3) if truck is not equipped with remote engine oil filter manifold.
  - Perform Steps (4) through (8) if truck is equipped with remote engine oil filter manifold.
- (1) Install bypass valve disk (11), spring (10), retainer (9) and screw (8) in housing adapter (2).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water

- (2) Apply sealing compound to threads of four screws (3).
- (3) Install gasket (6) and adapter housing (2) on oil cooler adapter cover (7) with four screws (3). Tighten screws 30 to 35 lb-ft (41 to 47 N·m).



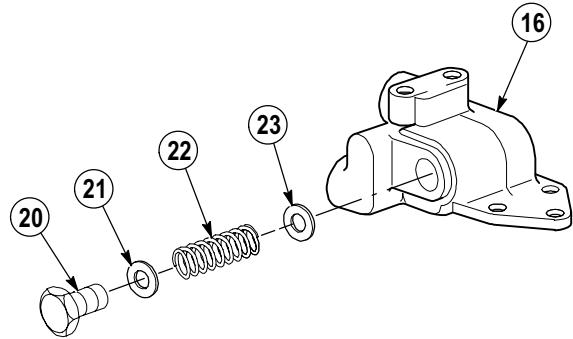


**20-84. ENGINE OIL FILTER AND SPIN-ON ADAPTER HOUSING INSTALLATION (CONT).**

**WARNING**

Use care when installing spring. Spring is under tension and can act as a projectile if released and could cause severe eye injury.

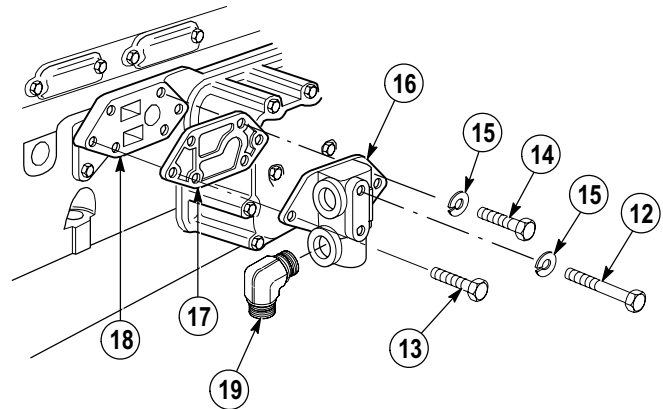
- (4) Install valve disk (23), spring (22), washer (21) and plug (20) in remote engine oil filter manifold (16).



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (5) Apply sealing compound to threads of two screws (14), screws (13) and screws (12).
- (6) Install gasket (17) and engine oil filter manifold (16) on oil cooler adapter cover (18) with two screws (14), screws (13), screws (12) and four lockwashers (15). Tighten screw 30 to 35 lb-ft (41 to 47 N·m).
- (7) Apply sealing compound to threads of adapter (19).



**NOTE**

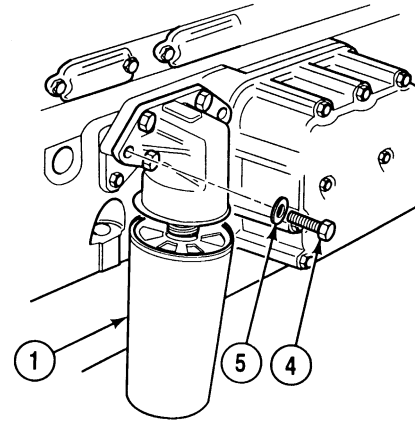
Adapter in Step (8) is installed in bottom port marked "IN" and facing down.

- (8) Install adapter (19) in remote engine oil filter manifold (16).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (9) Apply sealing compound to threads of two screws (4).
- (10) Install two lockwashers (5) and screws (4). Tighten screws 30 to 35 lb-ft (41 to 47 N·m).
- (11) Lightly coat oil filter (1) seal with lubricating oil.
- (12) Fill filter (1) 2/3 full with clean oil and install. Tighten by hand until gasket touches mounting adapter head. Then tighten an additional 2/3 turn.



**b. Follow-On Maintenance:**

- Install water pump assembly, (Para 20-85).

**END OF TASK**

## 20-85. WATER PUMP ASSEMBLY INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Hammer, Hand, Soft Plastic  
(Item 88, Appendix F)  
Indicator, Dial, Set w/Magnetic Base  
(Item 98, Appendix F)  
Pliers, Retaining Ring (Item 157, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Screw (5/16-18 in. by 2 in.)

#### *Materials/Parts*

Sealing Compound (Item 56, Appendix B)  
Gasket (Item 71, Appendix E)  
Lockwasher (3) (Item 285, Appendix E)  
Packing, Preformed (Item 366, Appendix E)  
Ring, Seal (Item 508, Appendix E)

#### *Equipment Condition*

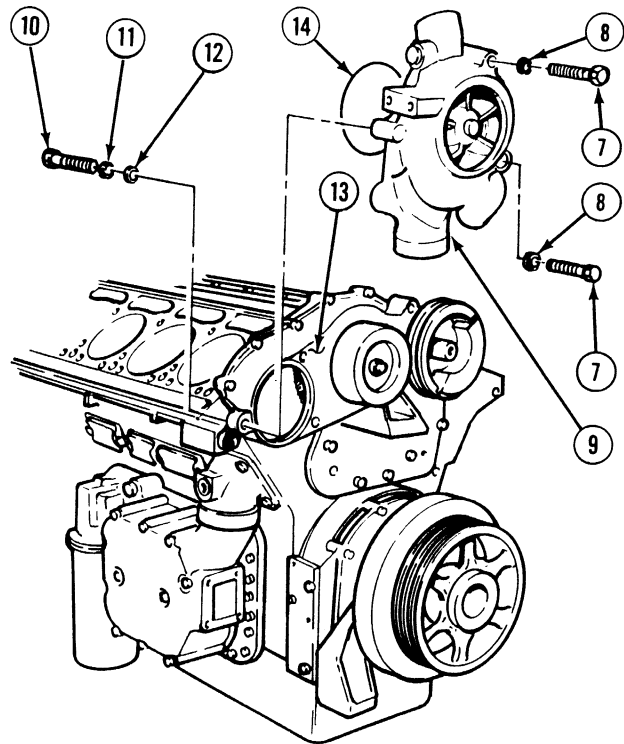
Engine oil filter and spin-on adapter housing  
installed, (Para 20-84)

#### *Materials/Parts*

Oil, Lubricating (Item 36, Appendix B)

### a. *Installation.*

- (1) Apply lubricating oil to seal ring (14) and install on water pump (9).
- (2) Position water pump (9) on front balance cover (13).
- (3) Install washer (12), lockwasher (11) and screw (10) on front balance cover (13) and water pump (9). Tighten screw 45 to 50 lb-ft (61 to 68 N·m).
- (4) Install two lockwashers (8) and screws (7) on water pump (9) and front balance cover (13). Tighten 45 to 50 lb-ft (61 to 68 N·m).

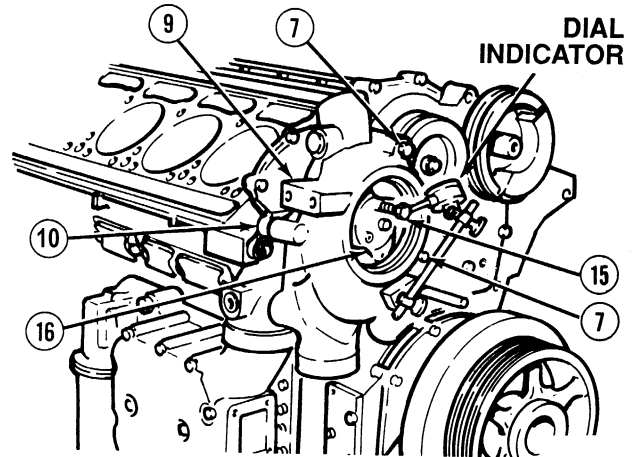


- (5) Install 5/16-18 by 2 in. screw (15) in impeller (16).

**NOTE**

Limits for gear backlash are 0.001 to 0.006 in. (0.025-0.152 mm). If correct backlash cannot be obtained, replace water pump.

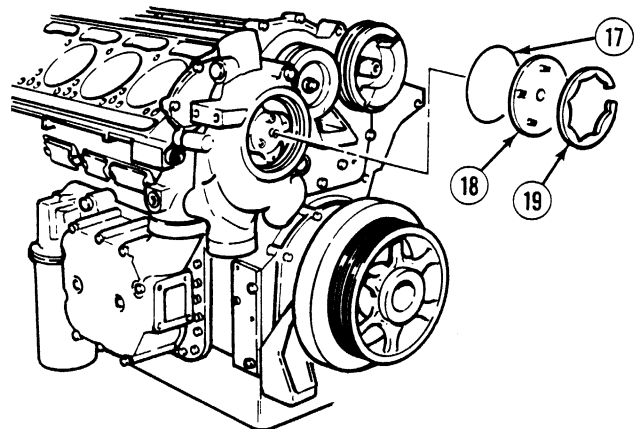
- (6) Place plunger of dial indicator against screw (15). Rotate impeller (16) and read backlash.
- (7) If backlash is less than 0.001 in. (0.025 mm) or greater than 0.006 in. (0.152 mm), loosen two screws (7) and (10) and pivot water pump (9) to obtain proper backlash.
- (8) Remove screw (15) and dial indicator.
- (9) Tighten screws (7) and (10) 45 to 50 lb-ft (61 to 68 N·m).



**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

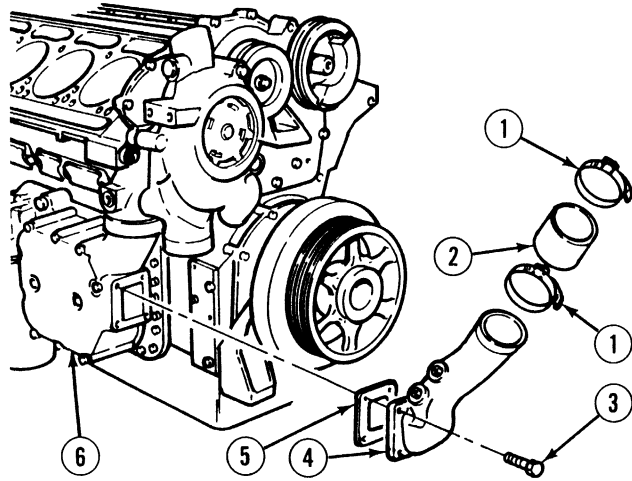
- (10) Apply lubricating oil to preformed packing (17) and install with pump cover (18) and retaining ring (19).
- (11) Using soft face hammer strike retaining ring (19) inward two or three times until ring fully seats in groove.



**20-85. WATER PUMP ASSEMBLY INSTALLATION. (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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (12) Apply sealing compound to threads of four screws (3).
- (13) Position hose (2) and two clamps (1) on adapter (4).
- (14) Install gasket (5) and water pump discharge to adapter (4) on oil cooler housing (6) with four screws (2).
- (15) Tighten screws (2) 30 to 35 lb-ft (41 to 47 N·m).
- (16) Tighten two clamps (1) on hose (2).

**b. Follow-On Maintenance:**

- Install aftercooler, (Para 20-86).

**END OF TASK**



**20-87. BLOWER DRIVE ASSEMBLY INSTALLATION.**

This task covers:

- a. Installation
- b. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Indicator, Dial, Set w/Magnetic Base (Item 98, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

*Materials/Parts*

- Grease (Item 21, Appendix B)
- Sealing Compound (Item 56, Appendix B)
- Copper Washer (Item 34, Appendix E)
- Gasket (Item 103, Appendix E)

*Equipment Condition*

Aftercooler installed, (Para 20-86)

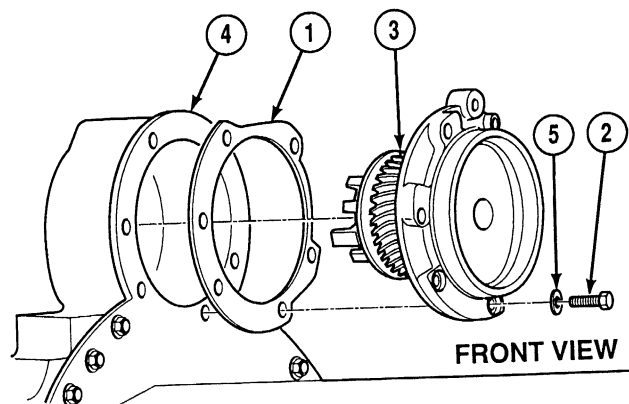
**a. Installation.**

- (1) Apply light coat of grease to both sides of gasket (1).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (2) Coat threads of two screws (2) with sealing compound.
- (3) Install gasket (1) and blower drive assembly (3) in rear end plate (4) with two copper washers (5) and screws (2).
- (4) Tighten two screws (2) 25 to 30 lb-ft (34 to 41 N·m).



**NOTE**

Screw, washer and nut are from blower.

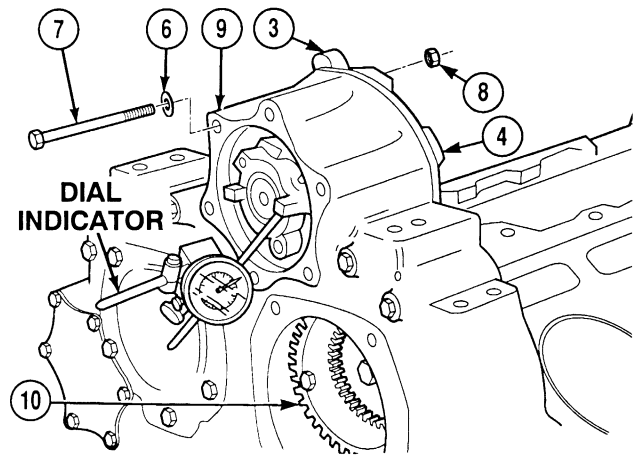
- (5) Install washer (6), screw (7) and nut (8) in rear end plate (4) and flywheel housing (9).

**NOTE**

- If backlash cannot be checked at face of blower drive gear, check at accessory drive hub.
- If gears fit tight, turn crankshaft to free before reading backlash.
- Backlash must be minimum of 0.002 in. (0.051 mm) and maximum of 0.010 in. (0.254 mm).
- If proper backlash cannot be obtained, replace blower drive support.

- (6) Using a dial indicator check backlash between blower drive assembly (3) and right back camshaft gear (10).

- (7) Remove nut (8), screw (7) and washer (6).

**b. Follow-On Maintenance:**

- Install cylinder head, (Para 20-88).

**END OF TASK**



## 20-88. CYLINDER HEAD INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
 (Item 240, Appendix F)  
 Studs, Guide (Item 233, Appendix F)  
 Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
 (Item 277, Appendix F)  
 Lifting Tees (Appendix C)  
 Lifting Device, Minimum Capacity  
 400 lbs (182 kg)

#### *Materials/Parts*

Compound, No. 2, International  
 (Item 17, Appendix B)  
 Gasket (2) (Item 93, Appendix E)  
 Gasket, Seal Strip (Item 129, Appendix E)  
 Seal, Water (2) (Item 622, Appendix E)  
 Shims (Item 645, Appendix E)

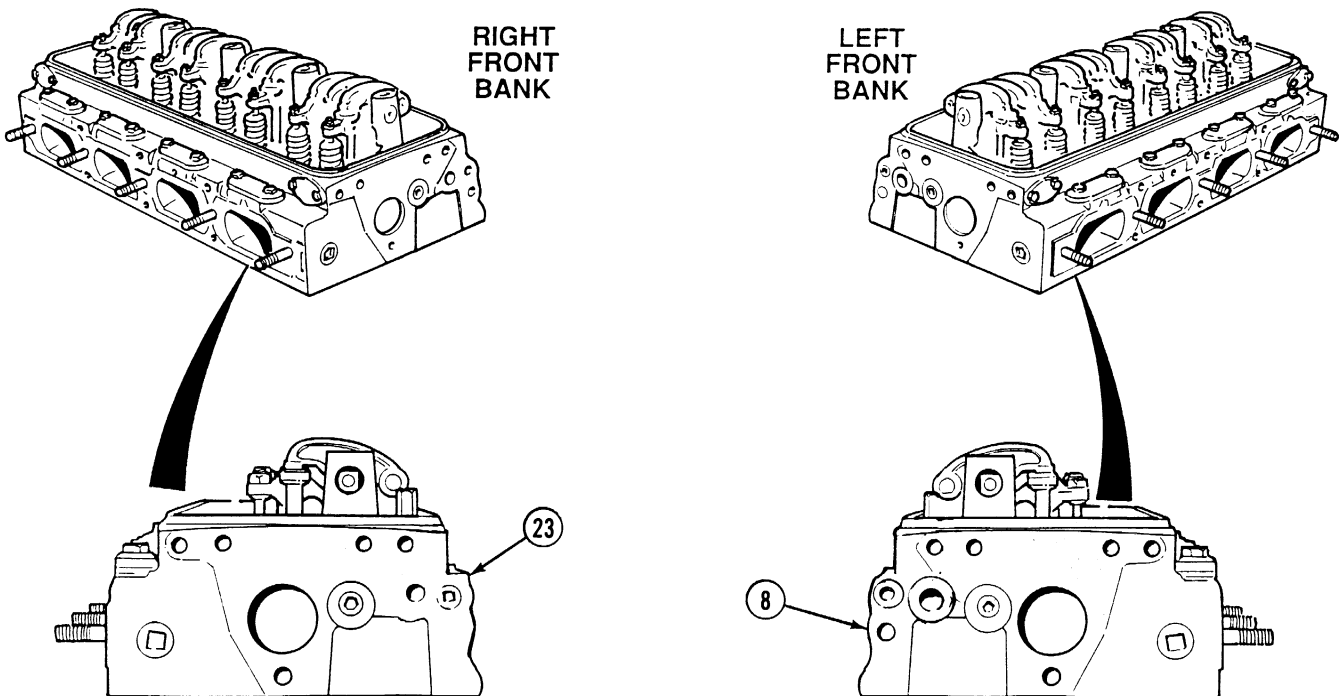
#### *Personnel Required*

Two

#### *Equipment Condition*

Blower drive support installed, (Para 20-87)

### a. Installation.



### NOTE

Both cylinder heads are installed the same way. Make sure to install properly.

- (1) Note differences between left cylinder head (8) and right cylinder head (23).

**CAUTION**

Never install used compression gaskets, they will cause compression leaks.

**NOTE**

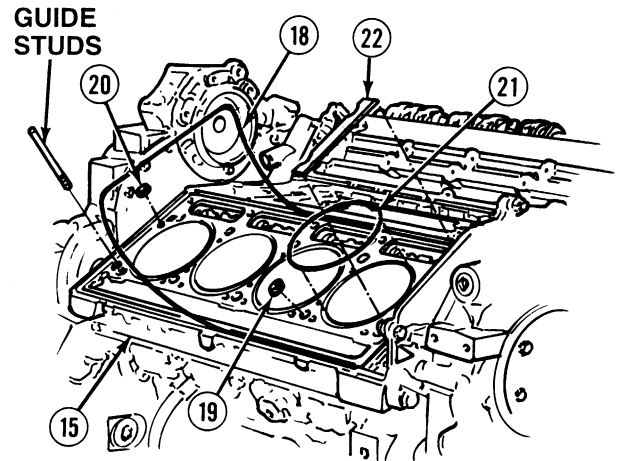
Color side of seal strip is installed facing away from cylinders.

- (2) Install four compression gaskets (21), 16 water seals (19), oil seal (20) and seal strip gasket (18) in engine block (15).

**NOTE**

Shims are installed in same position and location as noted during removal.

- (3) Remove paper covering from back of two support shims (22) and install glued side down on engine block (15).
- (4) Install two cylinder head guide studs into two bottom corners of cylinder block (15).



**20-88. CYLINDER HEAD INSTALLATION (CONT).**

**WARNING**

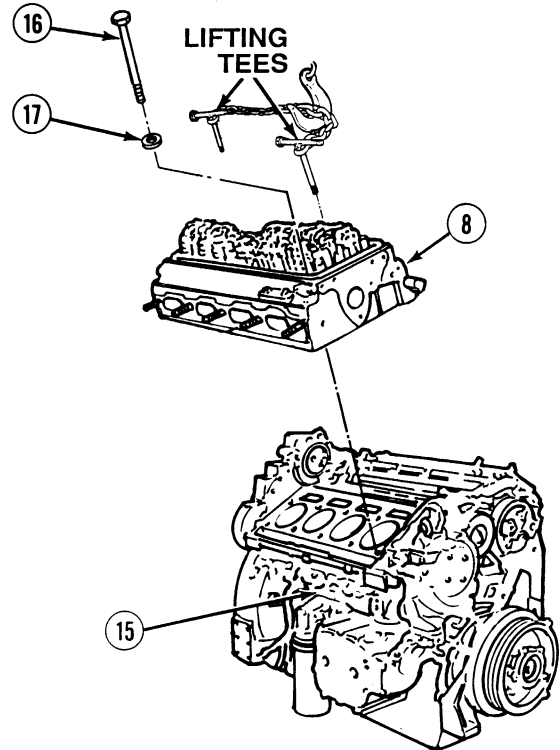
Cylinder head weighs 182 lbs (83 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- (5) Install two lifting tees on left cylinder head (8).

**CAUTION**

Gaskets and seals which are not seated properly will cause leaks and blow-by and result in poor engine performance and damage to engine. Shim strips not in place can result in broken cylinder head bolts.

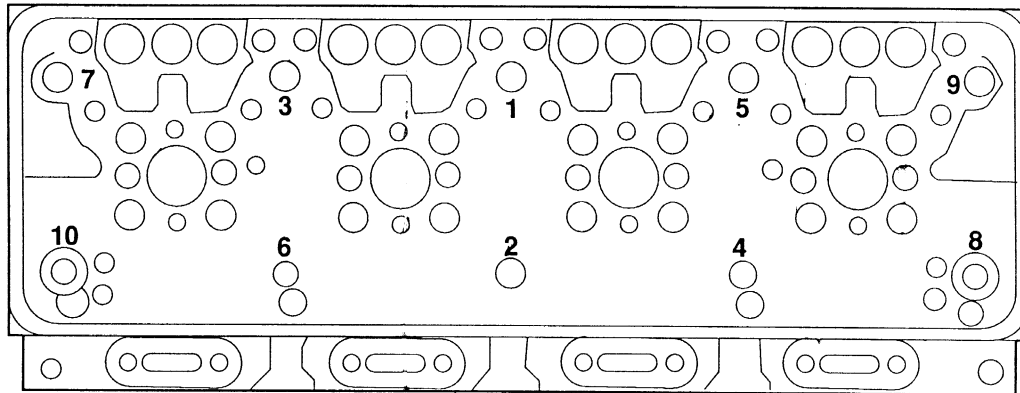
- (6) Make final visual check of compression gaskets, seals and shims to ensure that they are in place before cylinder head is lowered.
- (7) With the aid of an assistant, align left cylinder head (8) with guide studs.
- (8) Lower cylinder head (8) on cylinder block (15).



**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.

- (9) Apply a small amount of International Compound No. 2 to the threads and underside of cylinder head attaching screws (16).
- (10) Install four cylinder head washers (17) and screws (16) in locations (3), (4), (5) and (6) of tightening sequence shown in Step (13). Tighten screws 15 to 20 lb-ft (20 to 27 N·m).
- (11) Remove two lifting tees from cylinder head (8).
- (12) Remove two guide studs and install two remaining cylinder head washers (17) and screws (16). Tighten screws to 15 to 20 lb-ft (20 to 27 N·m).



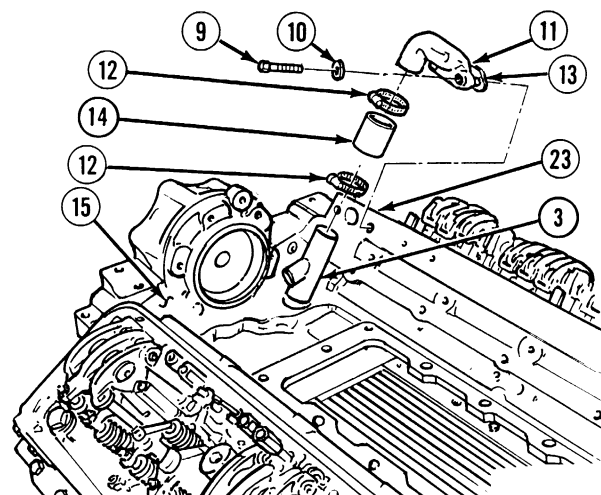
**TIGHTENING SEQUENCE**

- (13) Tighten screws in sequence shown until cylinder head is seated on compression seals and parallel to block face.
- (14) Tighten all screws to 100 lb-ft (136 N·m) in sequence shown. Hold wrench at this torque for two to three seconds to allow screws to turn while compression seals yield to their crushed thickness.
- (15) In same sequence, one screw at a time, perform following Steps:
  - (a) Tighten to 100 lb-ft (136 N·m).
  - (b) Mark position of screw head and turn screw an additional 90 degrees. Try to turn screw in single arc with one pull of wrench.
- (16) Repeat Steps (2) through (15) for right cylinder head (23).

**NOTE**

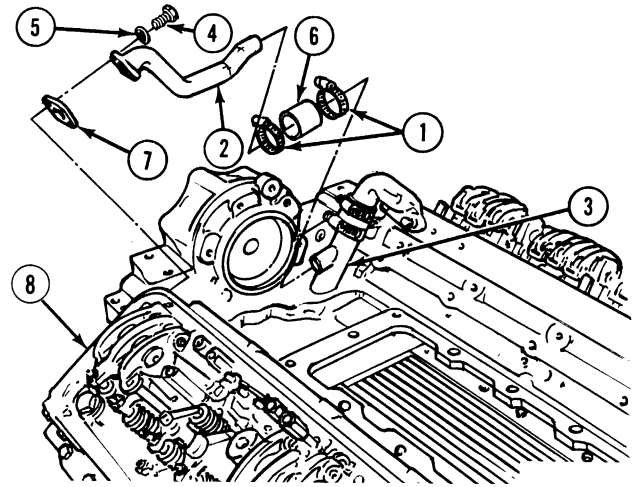
Perform Step (17) only if removed.

- (17) Install breather tube (3) in engine block (15) to height noted in removal.
- (18) Position hose (14), two clamps (12) on breather tube (3) and elbow (11).
- (19) Install gasket (13) and elbow (11) on right cylinder head (23) with two washers (10) and screws (9). Tighten 60 lb-in (7 N·m).



**20-88. CYLINDER HEAD INSTALLATION (CONT).**

- (20) Position hose (6) and two clamps (1) on breather tubes (2) and (3).
- (21) Install gasket (7) and breather tube (2) on left cylinder head (8) with two washers (5) and screws (4). Tighten screws to 60 lb-in (7 N·m).
- (22) Tighten clamps (1) and (12).



**b. Follow-On Maintenance:**

- Install air box drain, (Para 20-89).

**END OF TASK**



## 20-90. AIR BOX COVERS INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Wrench Set, Socket 3/8 in. Drive  
(Item 273, Appendix F)  
Wrench, Torque (0-60 N·m)  
(Item 276, Appendix F)

#### *Materials/Parts*

Grease (Item 21, Appendix B)  
Sealing Compound (Item 56, Appendix B)  
Gasket (2) (Item 115, Appendix E)  
Gasket (Item 116, Appendix E)

#### *Equipment Condition*

Air box drain installed, (Para 20-89)

### a. Installation.

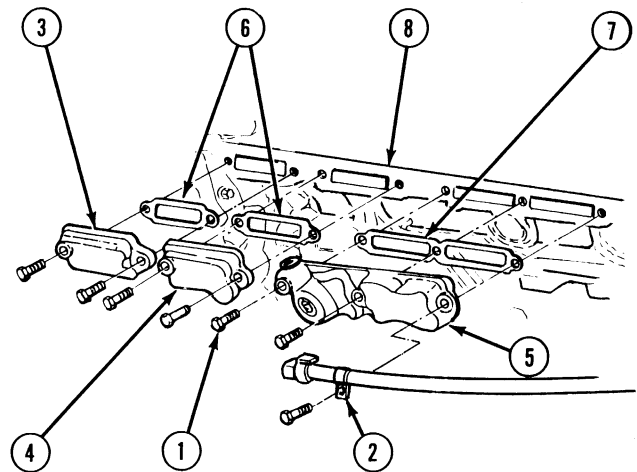
#### WARNING

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

- Right and left air box covers are installed the same way. Right side shown.
- Left side air box cover can not be installed with engine stand installed.

- (1) Coat two gaskets (6) and gasket (7) with grease.
- (2) Position gaskets (6) and (7) on engine block (8).
- (3) Coat threads of seven screws (1) with sealing compound.
- (4) Install air box covers (3), (4) and (5), cushion clip (2) on engine block (8) with seven screws (1). Tighten screws to 96 to 144 lb-in (11 to 16 N·m).



### b. Follow-On Maintenance:

- Install timing and synchronous reference sensor, (Para 20-91).

END OF TASK

**20-91. TIMING AND SYNCHRONOUS REFERENCE SENSOR (TRS/SRS) INSTALLATION.**

This task covers:

- a. Installation

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Hammer, Hand, Soft-faced (Item 88, Appendix F)
- Indicator, Dial, Timing Tool (Item 99, Appendix F)
- Tool, Timing, TRS/SRS (Item 246, Appendix F)

*Tools and Special Tools - Continued*

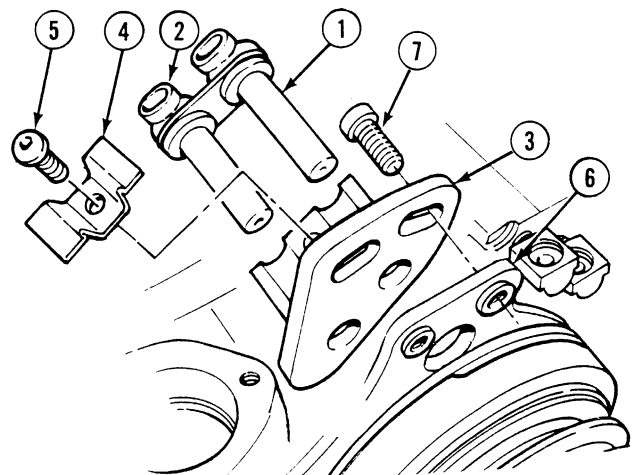
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

*Equipment Condition*

- Air box covers installed, (Para 20-90)

**a. Installation.**

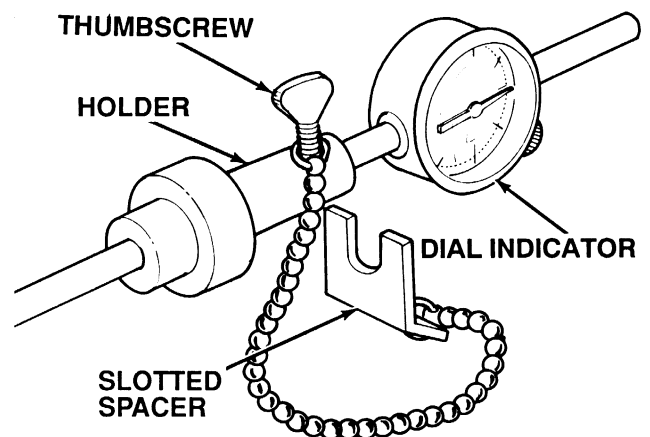
- (1) Position synchronous reference and timing reference sending units (1) and (2) in bracket (3) with bracket (4) and screw (5).
- (2) Position bracket (3) on front plate (6) with two screws (7).



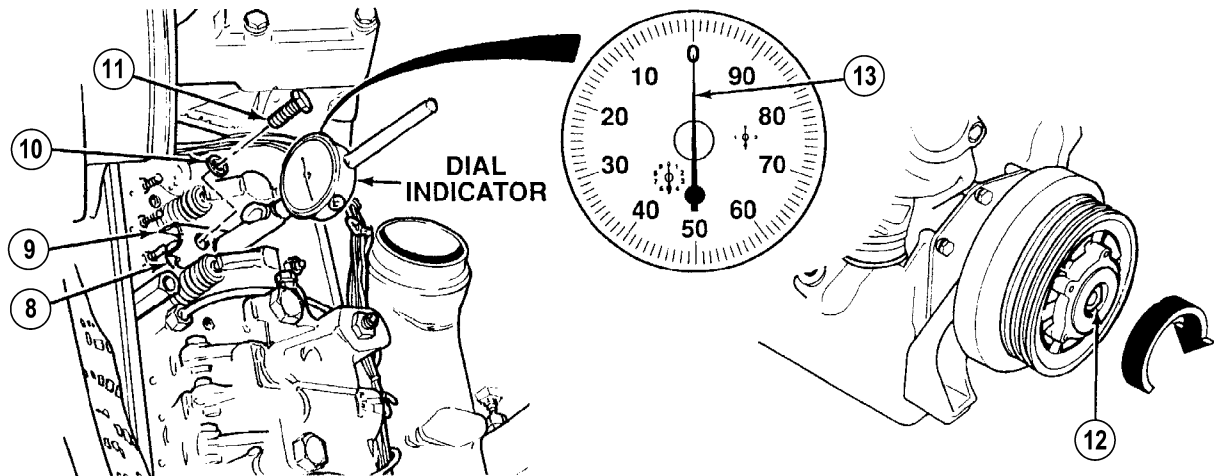
**CAUTION**

Ensure spacer is installed between dial indicator and top of holder. Failure to comply may result in damage to dial indicator if piston is already at top of travel when dial indicator is installed.

- (3) Install slotted spacer on chain between dial indicator and top of holder and tighten thumbscrew.







- (4) Position dial indicator in No. 1 right injector bore (8) and install clamp (9), washer (10) and screw (11) from injector. Tighten screw 20 to 25 lb-ft (27 to 34 N·m).

**NOTE**

Perform Steps (5) and (6) for DDEC II engines.

- (5) Turn crankshaft (12) slowly clockwise and note indicator movement. Stop turning when large dial hand (13) stops moving.

**CAUTION**

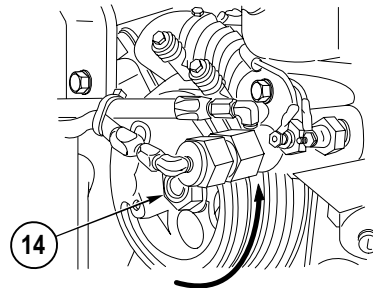
If crankshaft pulley loosens during procedure, tighten to appropriate torque value. Failure to comply may result in loose crankshaft pulley and possible engine damage may occur.

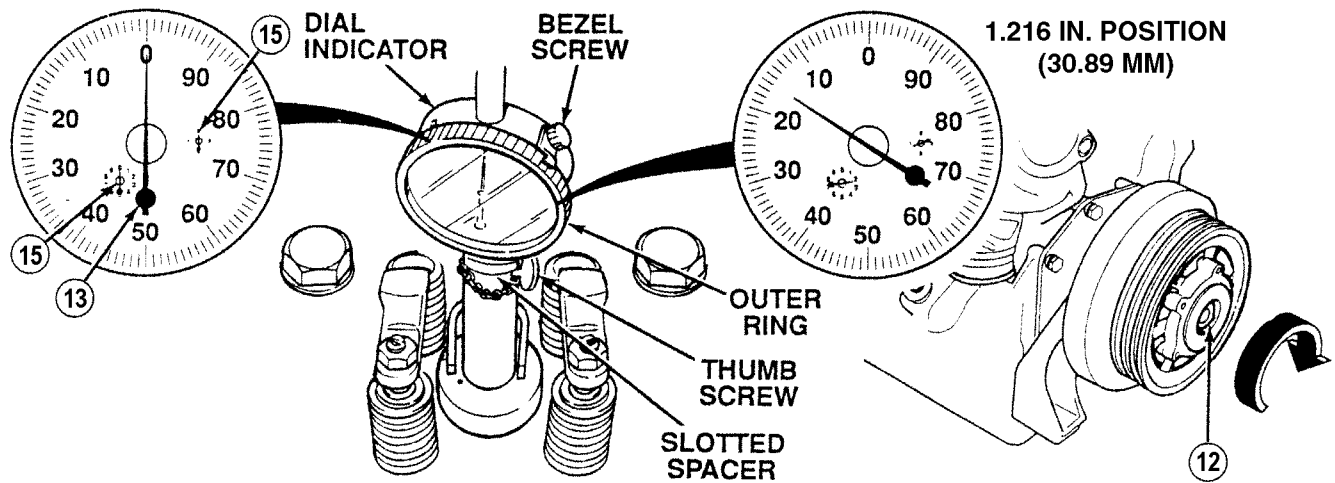
- (6) Turn crankshaft (12) slowly in opposite direction until large dial hand (13) barely starts to move. Piston is now at top-dead-center.

**NOTE**

Perform Steps (7) through (9) for DDEC III engines.

- (7) Turn camshaft (14) slowly counterclockwise until large dial hand (13) starts moving.
- (8) Continue turning camshaft (14) slowly counterclockwise until large dial hand (13) stops moving.
- (9) Turn camshaft (14) slowly in opposite direction until large dial hand (13) barely starts to move. Piston is now at top-dead-center.





**NOTE**

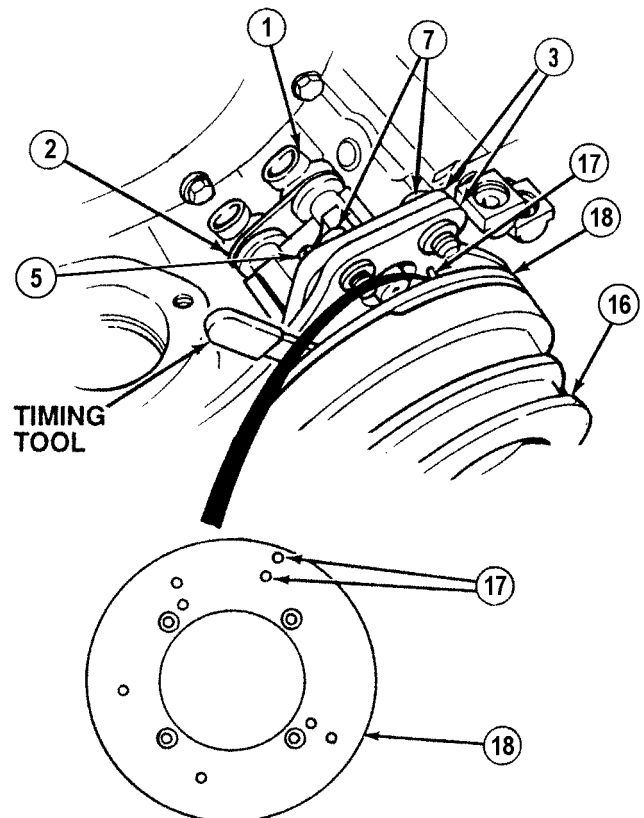
Dial indicator must be zeroed before piston downward travel can be measured. Perform Steps (10) through (12) to measure downward travel.

- (10) Loosen thumbscrew and remove slotted spacer.
- (11) Lower dial indicator until two small dial hands (15) are at zero and large dial hand (13) is near zero. Tighten thumbscrew.
- (12) Loosen bezel screw and rotate outer ring of dial until zero lines up with large dial hand (13). Tighten bezel screw.

**NOTE**

Perform Steps (13) through (19) for DDEC II engines.

- (13) Turn crankshaft (12) slowly clockwise, until dial reads exactly 1.216 in. (30.886 mm).
- (14) Tap end of camshaft pulley (16) to take up end play.
- (15) Insert grooved end of timing tool between TRS (2) and double teeth (17) on pulse wheel (18).
- (16) Move bracket (3) to align end of TRS (2) with groove in timing tool.
- (17) Hold bracket (3) and tighten two screws (7).
- (18) Check that synchronous reference sensor (1) is in place against half moon on rear of timing tool and double teeth on pulse wheel (18) in groove on front of timing tool.
- (19) Tighten screw (5) and remove timing tool.

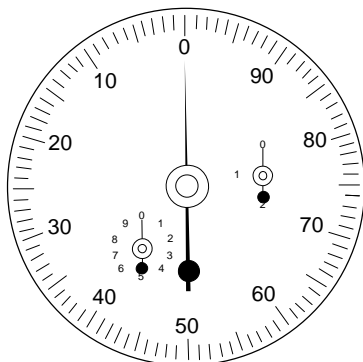
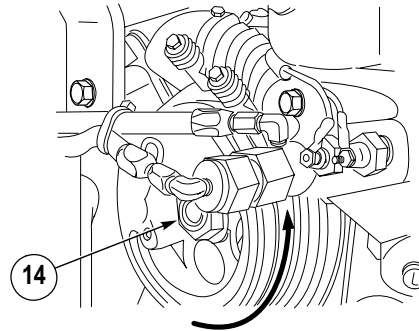


**20-91. TIMING AND SYNCHRONOUS REFERENCE SENSOR (TRS/SRS) INSTALLATION (CONT).**

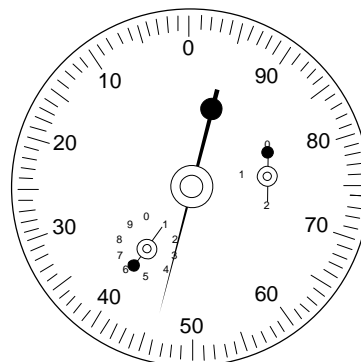
**NOTE**

Preform Steps (20) through (29) for DDEC III engines.

- (20) Zero dial indicator and turn camshaft (14) slowly counterclockwise, until dial indicates exactly 2.146 in. (54.51 mm). (See below).



**ZERO POSITION**



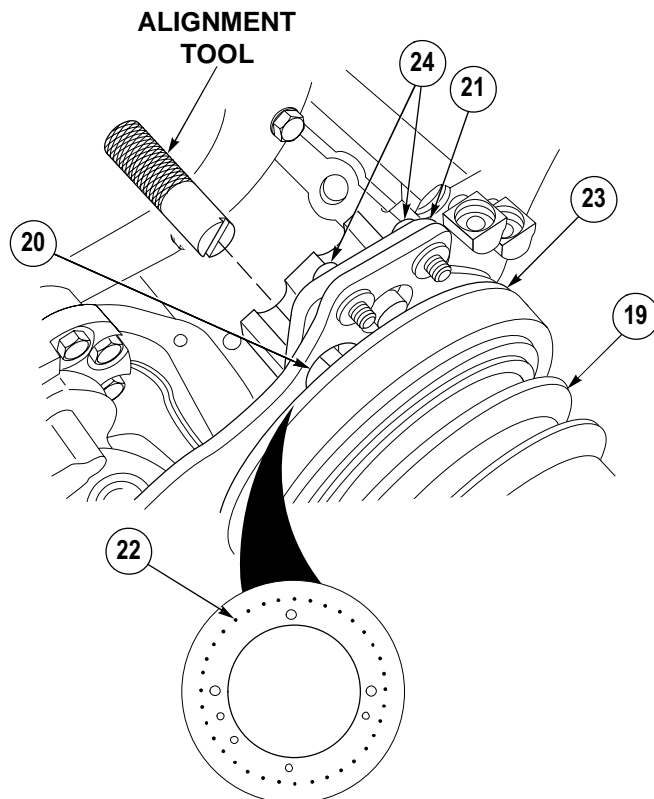
**2.146 IN. POSITION**

- (21) Tap end of camshaft pulley (19) with soft-faced hammer to take up end play.
- (22) Insert alignment tool in TRS hole (20) of bracket (21).

**NOTE**

There is a notch on the edge of the pulse wheel next to the correct TRS timing pin.

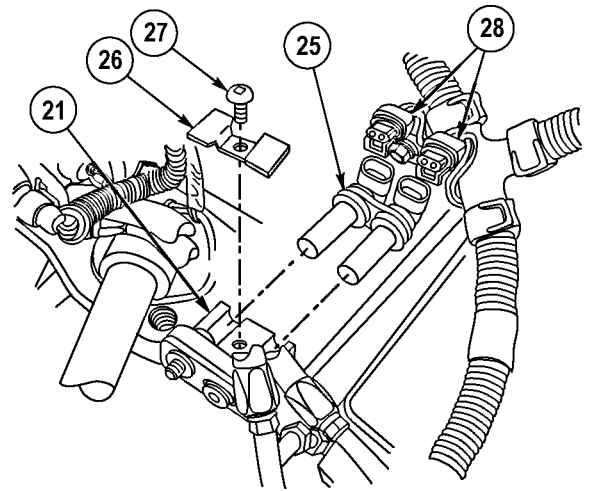
- (23) Move bracket (21) until notch in tool engages with TRS timing pin (22) on pulse wheel (23).
- (24) Tighten two sockethead screws (24) and remove alignment tool.
- (25) Tap end of camshaft pulley (19) again to take up end play.



- (26) Install SRS/TRS (25) in bracket (21) with retaining clip (26) and screw (27). Do not tighten.

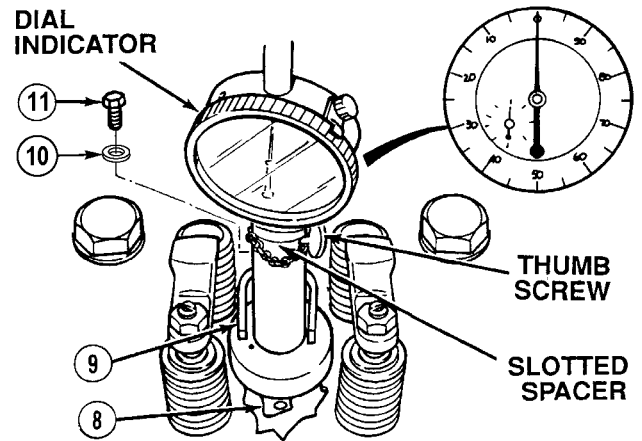
**NOTE**

When properly adjusted, there should be .018 - .022 in. (.46 - .56 mm) between pulse wheel teeth and the end of the sensor.



- (27) Position a .020 in. (.50 mm) feeler gage between TRS (25) and the TRS pin on the pulse wheel (23).
- (28) Slide the SRS/TRS (25) against feeler gage and tighten screw (27).
- (29) Connect two connectors (28) to SRS/TRS (25).

- (30) Remove screw (11), washer (10), clamp (9) and dial indicator from right injector bore (8).



**b. Follow-On Maintenance:**

- Install fuel injector, (Para 20-92).

**END OF TASK**

## 20-92. FUEL INJECTOR INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Wrench, Fuel Line (Item 270, Appendix F)
- Wrench Set, Socket 3/8 in. Drive (Item 273, Appendix F)
- Wrench, Torque (0-60 N·m) (Item 276, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

#### *Materials/Parts*

- Oil, Diesel Fuel (Item 32, Appendix B)
- Oil, Lubricating (Item 36, Appendix B)
- Gasket (Item 93, Appendix E)
- Packing, Preformed (2) (Item 380, Appendix E)

#### *Equipment Condition*

- Timing and Synchronous Reference Sensor installed, (Para 20-91)

### a. *Installation.*

#### NOTE

- There are eight fuel injectors. All fuel injectors are installed the same way. Right side shown.
- Fill injectors with diesel fuel prior to installation.

- (1) Insert injector (5) into injector tube hole (15).

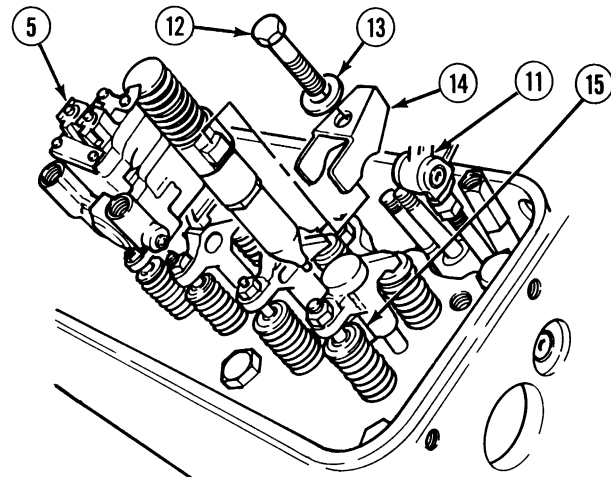
#### CAUTION

- Do not force rocker arms all the way back with shaft in place. Failure to comply could result in damage to push rods.
- Ensure clamp does not interfere with injector spring or valve springs. Interference of clamp with spring travel can cause damage to components.

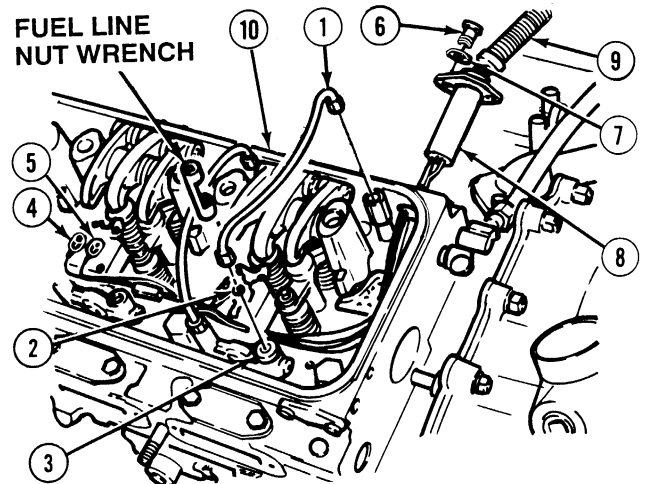
#### NOTE

Curved side of washer is installed facing clamp.

- (2) Lift rocker arms (11) and install clamp (14), washer (13) and screw (12). Tighten screw 20 to 25 lb-ft (27 to 34 N·m).



- (3) Install fuel injector wire harness (9) and flange with gasket (8) on cylinder head (10) with two washers (7) and screws (6).
- (4) Connect wire terminals to fuel inlet block on fuel injector (5) and tighten retaining screws (4).
- (5) Remove caps from four fuel line connectors (3).
- (6) Apply lubricating oil to four preformed packings (2).
- (7) Using fuel line nut wrench, install four preformed packings (2) and two fuel lines (1) on connectors (3). Tighten to 160 lb-in (18 N·m).
- (8) Repeat Steps (1) through (7) for other seven fuel injectors.



**b. Follow-On Maintenance:**

- Install engine brake retarders, (Para 20-93).

**END OF TASK**

## 20-93. ENGINE BRAKE RETARDER INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

*Tools and Special Tools*

Tool Kit, General Mechanic's  
 (Item 240, Appendix F)  
 Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
 (Item 277, Appendix F)

*Materials/Parts*

Cable Ties (Item 9, Appendix B)

*Equipment Condition*

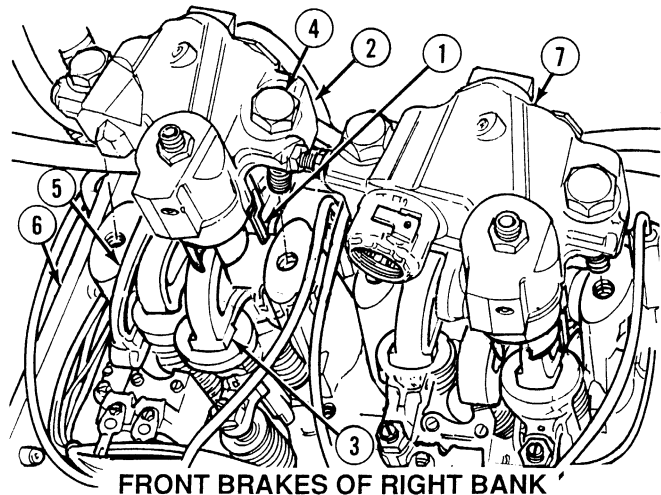
Fuel injectors installed, (Para 20-92)

**a. Installation.**

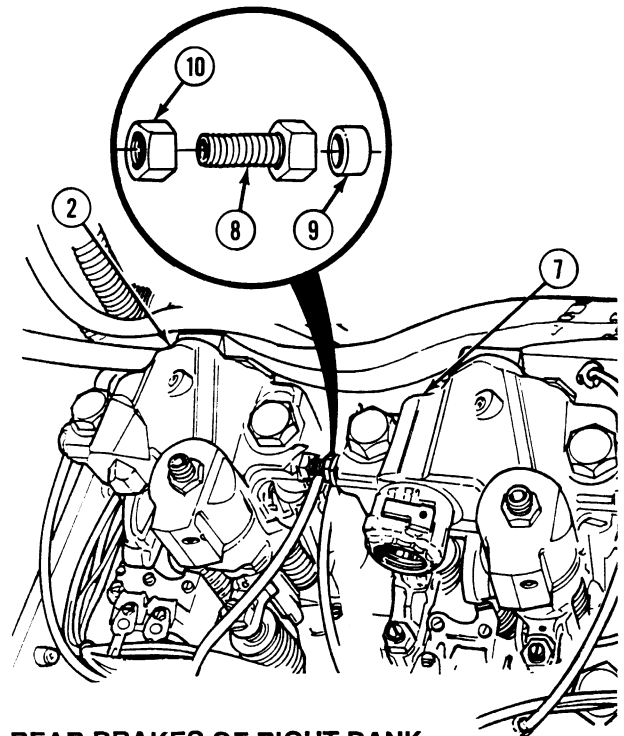
**NOTE**

There are two supply brakes and two drones on each cylinder bank. All supply brakes and drones are installed the same way. Right cylinder bank shown.

- (1) Position master piston fork assembly (1) of drone (2) over injector rocker clevis (3) and install with two screws (4) through rocker arm shaft (5) to cylinder head (6).
- (2) Tighten screws (4) to 45 lb-ft (61 N·m).
- (3) Tighten screws (4) to 88 to 92 lb-ft (119 to 125 N·m).
- (4) Move master piston fork assembly (1) up and down several times to make sure it rides freely on injector rocker clevis (3).
- (5) Repeat Steps (1) through (4) for other supply brakes (7) and drones (2).



- (6) Unscrew connector (8) from drone (2) until connector (8) covers preformed packing (9) and makes contact with service brake (7).
- (7) Back off connector (8) 1/3 turn and hold connector (8) while tightening nut (10) against drone (2).
- (8) Repeat Steps (1) through (7) for remaining brake sets.

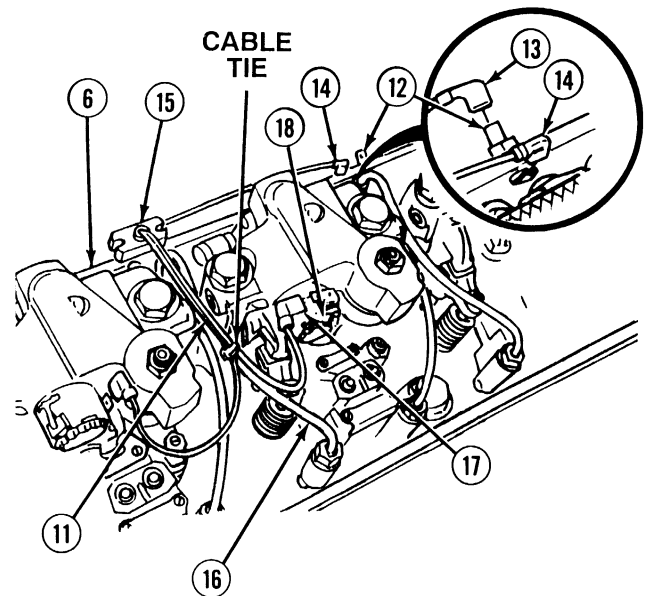


REAR BRAKES OF RIGHT BANK

**NOTE**

- Both engine brake wire harnesses are installed the same way.
- Install cable ties as noted during removal.

- (9) Position engine brake harness (11) in cylinder head (6).
- (10) Install terminal assembly (12) in cylinder head (6).
- (11) Connect spade connector (13) on terminal assembly (12).
- (12) Connect spade connector (14) on terminal assembly (12).
- (13) Install rubber harness support (15) on injector lines (16).
- (14) Connect positive lock connectors (17) on engine brake solenoids (18).



**b. Follow-On Maintenance:**

- Perform engine tune-up adjustments, (Para 20-94).

**END OF TASK**



## 20-94. ENGINE TUNE-UP ADJUSTMENTS.

This task covers:

- |                                       |                                    |
|---------------------------------------|------------------------------------|
| a. Exhaust Valve Clearance Adjustment | c. Fuel Injector Timing Adjustment |
| b. Engine Brake Retarder Adjustment   | d. Follow-On Maintenance           |

### INITIAL SETUP

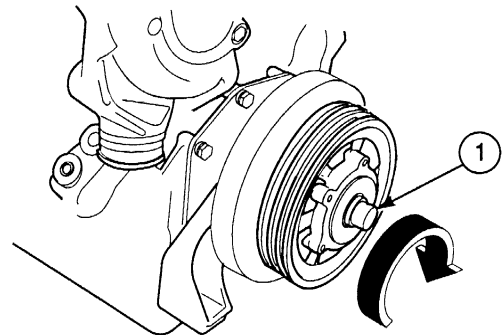
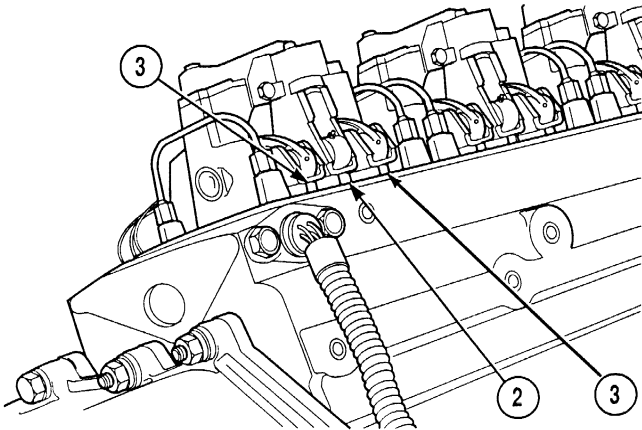
#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Gage, Feeler (Item 77, Appendix F)  
Gage, Feeler, Jacobs Brake  
(Item 78, Appendix F)  
Gage, Timing, Injector (Item 80, Appendix F)  
Wrench Set, Pushrod (Item 272, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

#### *Equipment Condition*

Engine brake retarders installed, (Para 20-93)

#### a. Exhaust Valve Clearance Adjustment.



### CAUTION

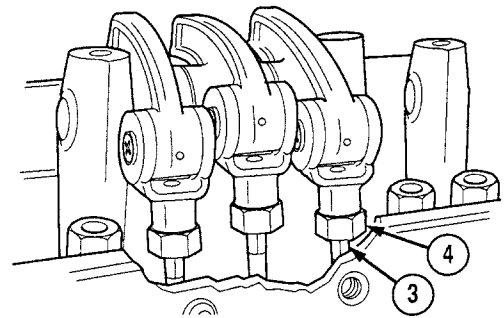
Crankshaft must be turned clockwise only. If crankshaft is turned counterclockwise, crankshaft screw will be loosened resulting in damage to equipment.

### NOTE

Two push rods operate four exhaust valves for each of eight cylinders. All 16 exhaust valve clearance adjustments are made the same way.

- (1) Rotate crankshaft by turning pulley (1) clockwise until engine is on injection stroke. This can be noted when injector push rod (2) is fully up, and exhaust push rods (3) are down.

- (2) Hold push rod (3) and loosen locknut (4).

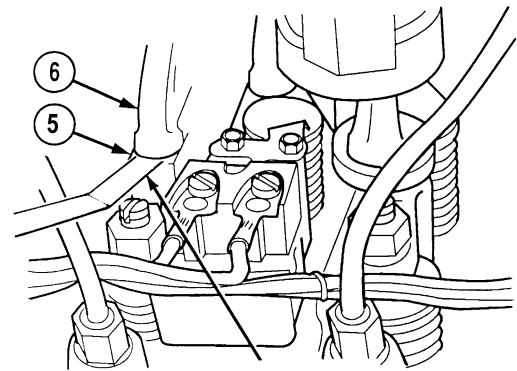


**BRAKE RETARDER AND FUEL LINES REMOVED FOR CLARITY**

**NOTE**

Clearance is 0.016 in. (0.406 mm) for cold or hot setting.

- (3) Insert feeler gage (5) between valve bridge (5) and valve rocker arm (6) to check clearance.



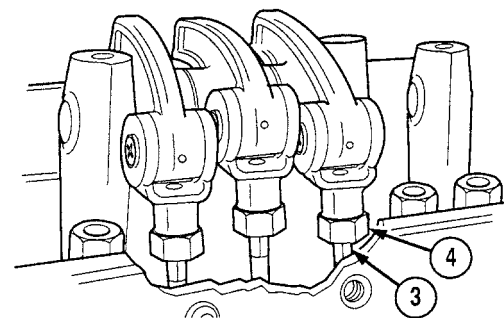
**FEELER GAGE**

- (4) Adjust push rod (3) until slight drag is felt on feeler gage.

**NOTE**

Clearance is correct when 0.015 in. (0.311 mm) feeler gage passes freely between rocker arm and valve bridge, but the 0.017 in. (0.432 mm) feeler gage will not pass through.

- (5) Remove feeler gage, hold push rod (3) and tighten locknut (4). Recheck clearance.  
 (6) Repeat Steps (1) through (5) for other 15 exhaust valves.



**BRAKE RETARDER AND FUEL LINES REMOVED FOR CLARITY**

**20-94. ENGINE TUNE-UP ADJUSTMENTS (CONT).**

**b. Engine Brake Retarder Adjustment.**

**CAUTION**

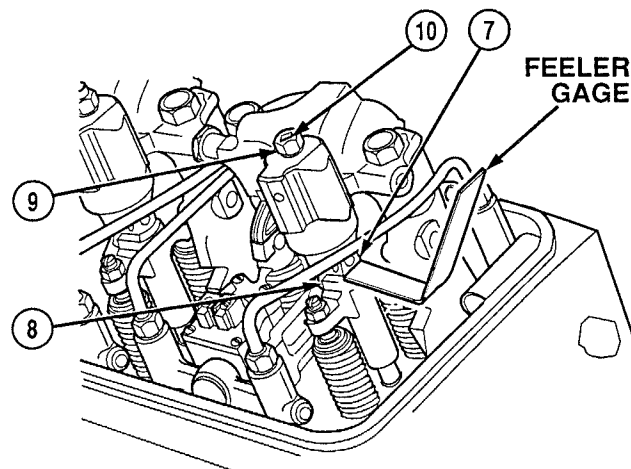
To prevent engine damage make sure exhaust valves are closed and injector follower is fully depressed.

- (1) Verify engine is still on injection stroke as noted in Step (1) of **a. Exhaust Valve Clearance Adjustment.**

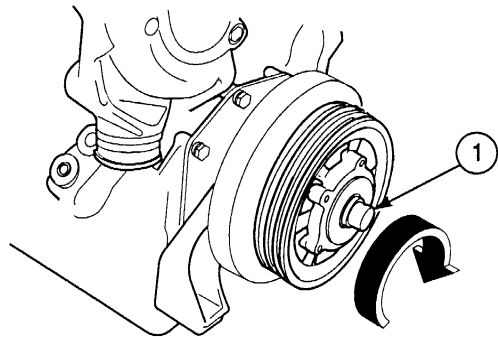
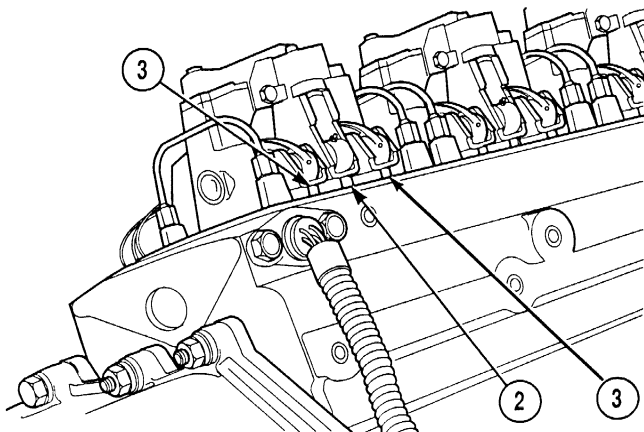
**NOTE**

Use 0.059 in. (1.5 mm) feeler gage for hot or cold setting.

- (2) Insert feeler gage between piston foot (7) and exhaust valve bridge (8).
- (3) Loosen locknut (9) and turn adjusting screw (10) until slight drag is felt on feeler gage.
- (4) Check both feet of piston (7).
- (5) Tighten locknut (9) to 15 to 18 lb-ft (20 to 24 N·m) and recheck clearance.
- (6) Repeat Steps (1) through (5) for other seven brake retarders.



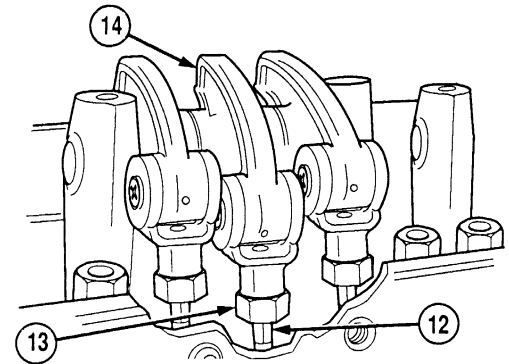
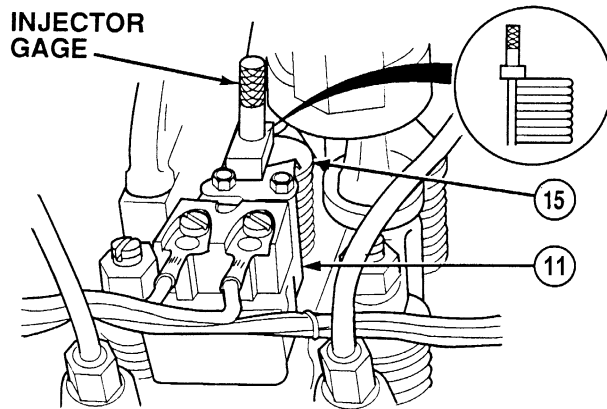
**c. Fuel Injector Timing Adjustment.**



**NOTE**

All eight fuel injector timing adjustments are made the same way.

- (1) Rotate crankshaft by turning pulley (1) clockwise until engine is on exhaust stroke. This can be noted when injector push rod (2) is down, and exhaust push rods (3) are fully up.



**BRAKE RETARDER AND FUEL LINES REMOVED FOR CLARITY**

### NOTE

- Flat side of injector gage faces injector follower.
  - Some supply brake wire harness connectors may have to be removed to adjust fuel injector timing.
- (2) Insert 1.520 in. (38.608 mm) injector gage in hole at top of fuel injector body (11).
  - (3) Hold injector rocker arm push rod (12) and loosen locknut (13).
  - (4) Turn push rod (12) and adjust injector rocker arm (14) so flat side of injector gage passes just over top of injector follower (15).
  - (5) Hold push rod (12) and tighten locknut (13).
  - (6) Put injector gage into fuel injector body (11) and recheck clearance of injector follower (15). If clearance is not correct repeat Steps (2) through (5).
  - (7) Repeat Steps (1) through (6) for other seven fuel injectors.

#### **d. Follow-On Maintenance:**

- Install blower assembly, (Para 20-95).

**END OF TASK**

## 20-95. BLOWER ASSEMBLY INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
 (Item 240, Appendix F)  
 Alignment Tool, Blower (Item 12, Appendix F)  
 Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
 (Item 277, Appendix F)  
 Lifting Device Minimum Capacity  
 100 lbs (45 kg)

#### *Materials/Parts*

Grease (Item 21, Appendix B)  
 Sealing Compound (Item 53, Appendix B)  
 Sealing Compound (Item 56, Appendix B)  
 Gasket (Item 76, Appendix E)  
 Gasket (Item 100, Appendix E)  
 Lockwasher (5) (Item 292, Appendix E)  
 Seal (Item 574, Appendix E)  
 Snap Ring (Item 648, Appendix E)

#### *Equipment Condition*

Engine tune-up adjustments completed,  
 (Para 20-94)

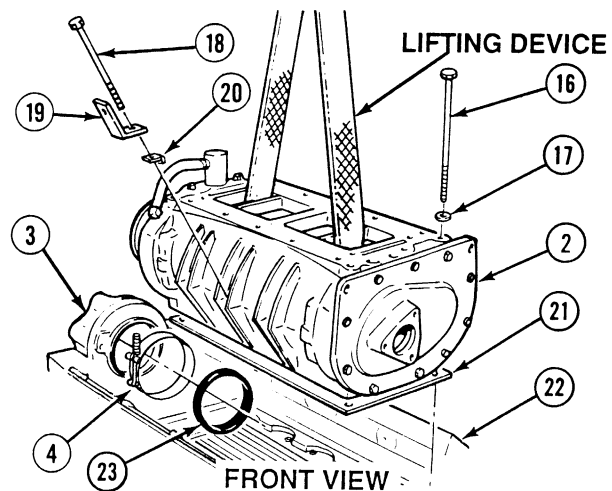
#### a. *Installation.*

- (1) Apply grease to bottom side of gasket (21).
- (2) Position gasket (21) on engine block (22).
- (3) Position seal (23) and clamp (4) on blower drive hub (3).

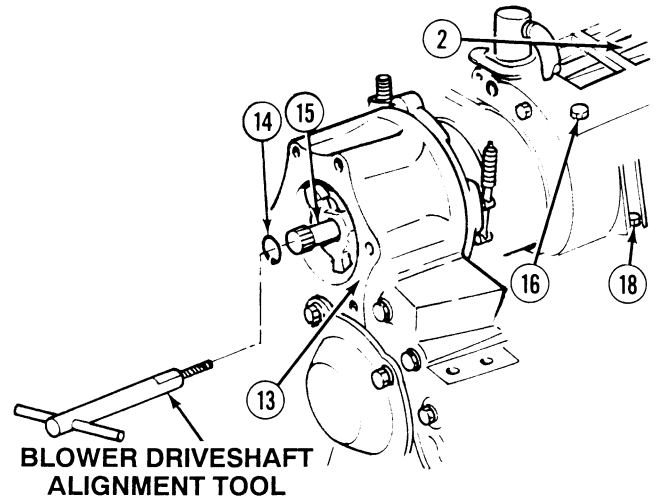
**WARNING**

Blower weighs 71 lbs (32 kg).  
 Attach suitable lifting device for  
 installation to prevent possible  
 injury to personnel.

- (4) Install lifting device on blower assembly (2).
- (5) Position blower assembly (2) on gasket (21).  
 Remove lifting device.
- (6) Position four washers (17) and screws (16)  
 on blower (2).
- (7) Position six retainers (20), bracket (19) and  
 screws (18) on blower (2).



- (8) Install blower driveshaft alignment tool in blower driveshaft (15).
- (9) Rotate blower lobes (2) in 90 degree increments. Check alignment at each stop by making sure blower driveshaft (15) can be moved in and out without binding.
- (10) Tighten four screws (16) to 40 to 45 lb-ft (54 to 61 N·m).
- (11) Tighten six screws (18) to 20 lb-ft (27 N·m) and then tighten in equal five lb-ft increments until tightened 30 to 35 lb-ft (41 to 47 N·m).
- (12) Blower driveshaft (15) should move freely. If not, loosen screws (16) and (18) and repeat Steps (8) through (11).



**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

**CAUTION**

Retaining ring is installed over blower driveshaft alignment tool to keep retaining ring from falling into flywheel housing, causing engine damage.

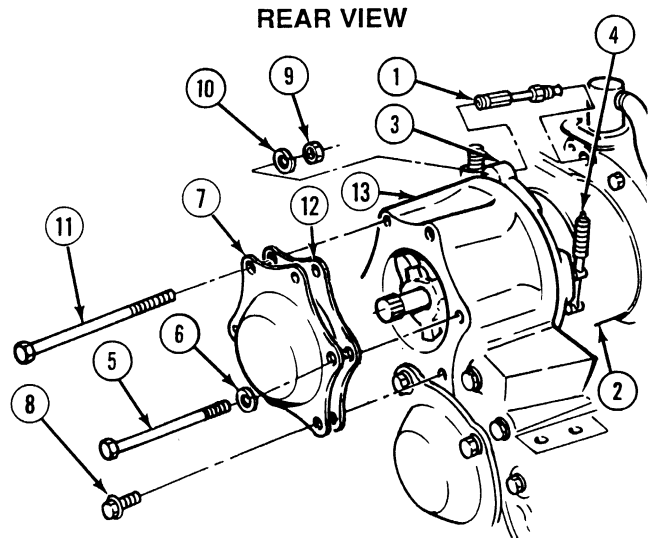
- (13) Install retaining ring (14) on blower driveshaft (15) and remove blower driveshaft alignment tool.

**20-95. BLOWER ASSEMBLY INSTALLATION (CONT).**

- (14) Position gasket (12) and blower drive hub cover (7) on flywheel housing (13).
- (15) Install three lockwashers (6) and screws (5) in blower drive hub cover (7).

**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.



- (16) Coat threads of two screws (8) with sealing compound.
- (17) Install two screws (8) in blower drive hub cover (7). Tighten to 30 to 35 lb-ft (41 to 47 N·m).
- (18) Install screw (11) in blower drive hub cover (7) with lockwasher (10) and nut (9). Tighten screw to 30 to 35 lb-ft (41 to 47 N·m).
- (19) Tighten clamp (4).
- (20) Coat threads of blower lube line (1) with sealing compound and install between blower (2) and blower drive hub (3).

**b. Follow-On Maintenance:**

- Install tachometer drive assembly, (Para 20-96).

**END OF TASK**





## 20-97. ROCKER COVER INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

#### *Materials/Parts*

Oil, Lubricating (Item 36, Appendix B)  
Gasket (Item 74, Appendix E)  
Mount, Resilient (2) (Item 306, Appendix E)

#### *Equipment Condition*

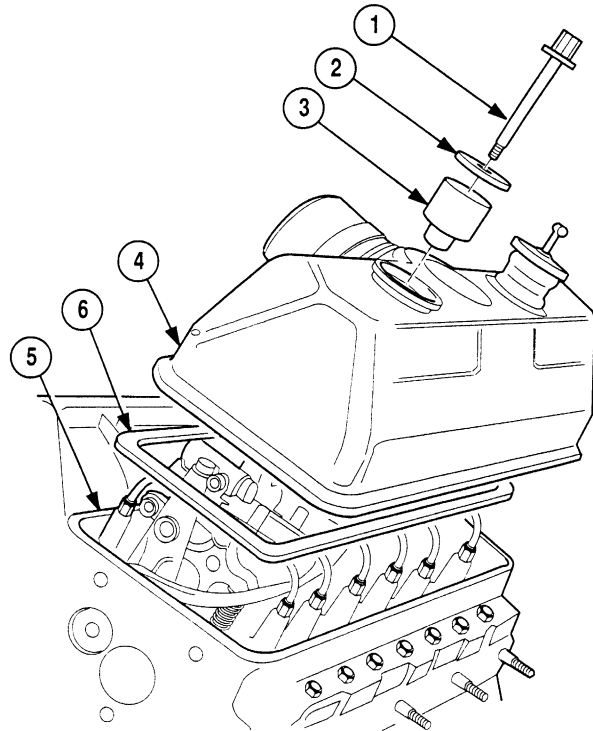
Tachometer drive installed, (Para 20-96)

### a. **Installation.**

#### **NOTE**

Right and left rocker covers are installed in the same way. Left side shown.

- (1) Press stem side of gasket (6) down into groove at four corners of rocker cover (4).
- (2) Press remainder of gasket (6) into place in groove of rocker cover (4). Ensure gasket is seated.
- (3) Lubricate cylinder head (5) rail and flat surface of gasket (6) with light coating of lubricating oil.
- (4) Position rocker cover (4) on cylinder head (5).
- (5) Install two resilient mounts (3), washers (2) and screws (1). Tighten screws to 15 to 21 lb-ft (20 to 28 N·m).



### b. **Follow-On Maintenance:**

- Install fuel pump assembly, (Para 20-98).

**END OF TASK**



## 20-99. SECONDARY FUEL FILTER, HEAD AND FUEL HOSES INSTALLATION.

This task covers:

- a. Installation
- b. Follow-On Maintenance

### INITIAL SETUP

*Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)

*Equipment Condition*

Fuel pump installed, (Para 20-98)

*Materials/Parts*

Oil, Diesel, Fuel (Item 32, Appendix B)  
Sealing Compound (Item 53, Appendix B)  
Lockwasher (2) (Item 292, Appendix E)

**a. Installation.**

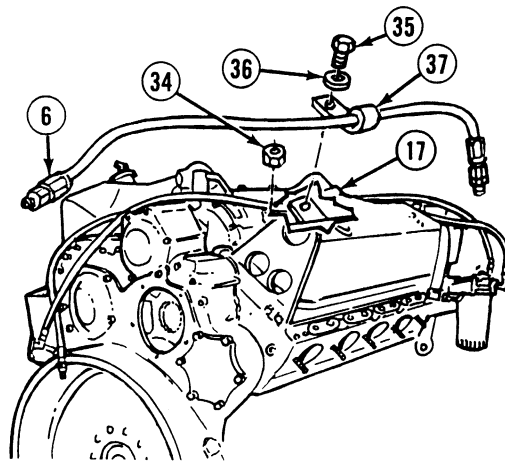
**WARNING**

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.

**NOTE**

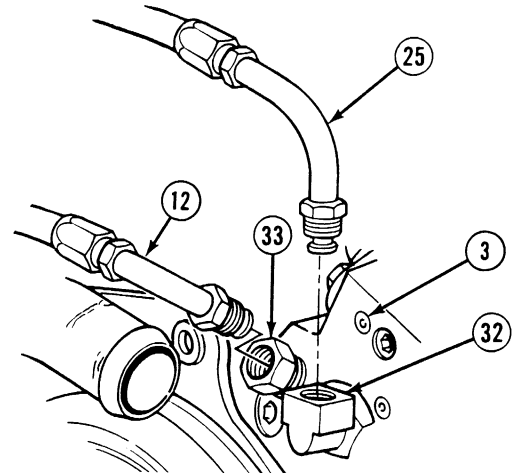
Locate and position fittings, elbows and tees as noted during removal.

- (1) Install hose (6) in cushion clip (37) on engine (17) with lockwasher (36), screw (35) and nut (34).

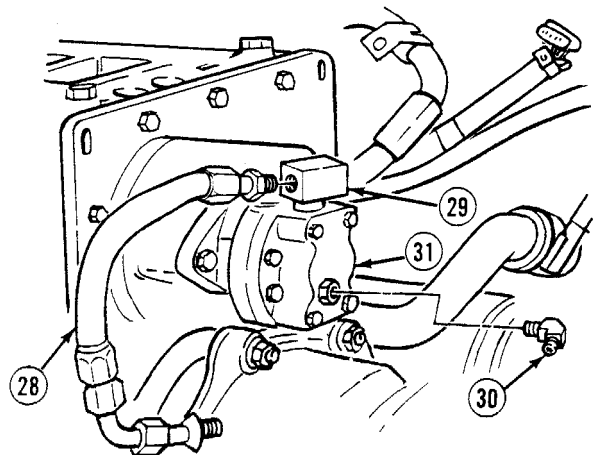


**WARNING**

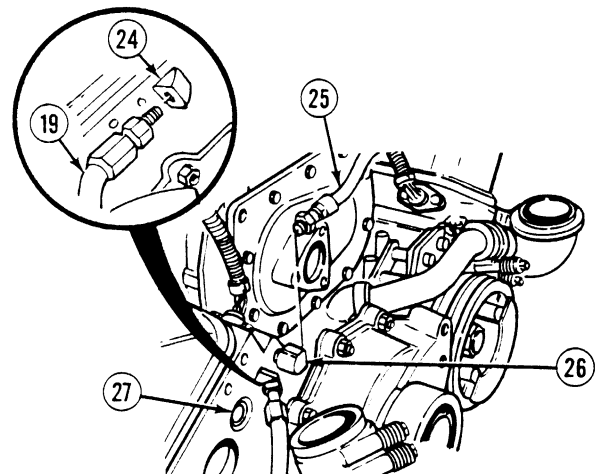
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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



- (2) Coat threads of fitting (33) and elbow (32) with sealing compound.
- (3) Install elbow (32) and fitting (33) in left cylinder head (3).
- (4) Install hose (25) in elbow (32).
- (5) Install hose (12) in fitting (33).
- (6) Coat threads of elbow (30) with sealing compound.
- (7) Install elbow (30) in fuel pump (31).
- (8) Install hose (28) in tee (29).



- (9) Coat threads of elbows (24) and (26) with sealing compound.
- (10) Install elbows (26) and (24) in right cylinder head (27).
- (11) Install hose (25) in elbow (26).
- (12) Install hose (19) in elbow (24).

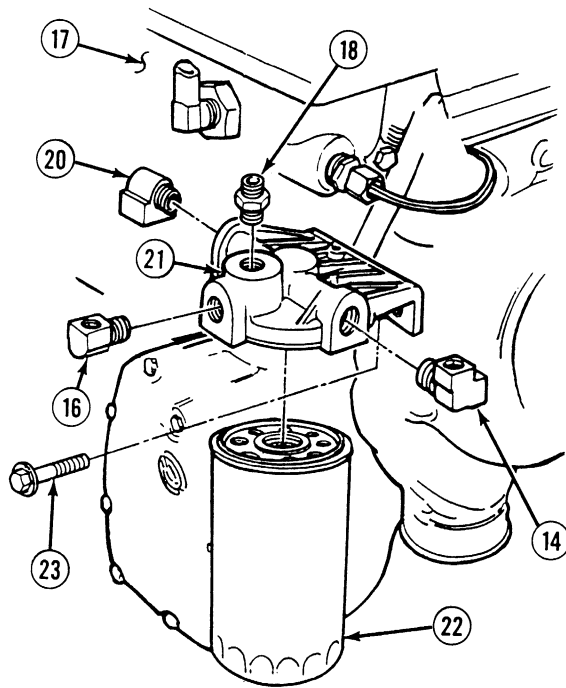


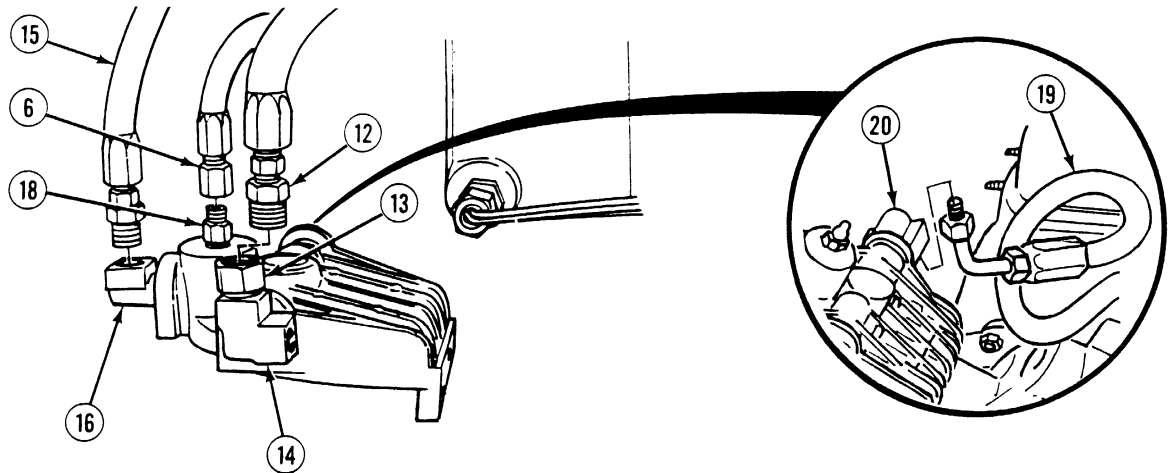
**20-99. SECONDARY FUEL FILTER, BASE AND FUEL HOSES INSTALLATION (CONT).**

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (13) Install filter head (21) on engine (17) with two screws (23).
- (14) Fill filter (22) and moisten filter gasket with diesel fuel.
- (15) Install filter (22) on filter head (21). Hand tighten filter 1/2 turn after gasket contacts filter head.
- (16) Coat threads of elbows (16) and (20), tee (14) and fitting (18) with sealing compound.
- (17) Install elbow (20) in filter head (21).
- (18) Install fitting (18) in filter head (21).
- (19) Install elbow (16) in filter head (21).
- (20) Install tee (14) in filter head (21).





- (21) Install hose (19) in elbow (20).
- (22) Install hose (6) on fitting (18).
- (23) Install hose (15) in elbow (16).

**WARNING**

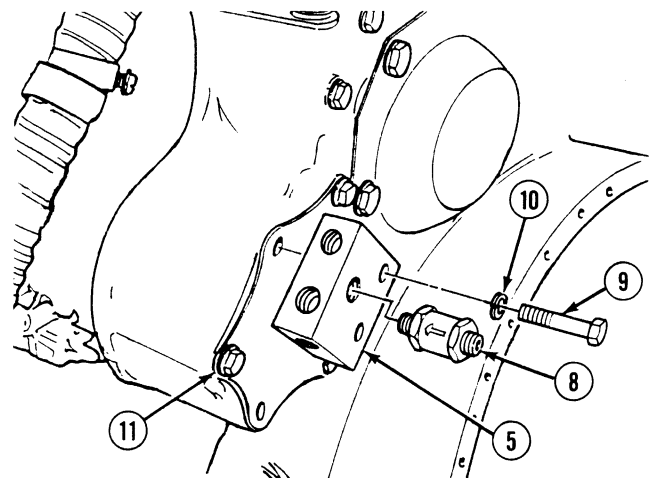
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (24) Coat threads of reducer (13) with sealing compound.
- (25) Install reducer (13) in tee (14).
- (26) Install hose (12) in reducer (13).
- (27) Install fuel block (5) on rear end plate (11) with lockwasher (10) and screw (9).
- (28) Coat threads of check valve (8) with sealing compound.

**NOTE**

Install check valve in direction as noted prior to removal. Arrow must face fuel block.

- (29) Install check valve (8) in fuel block (5).

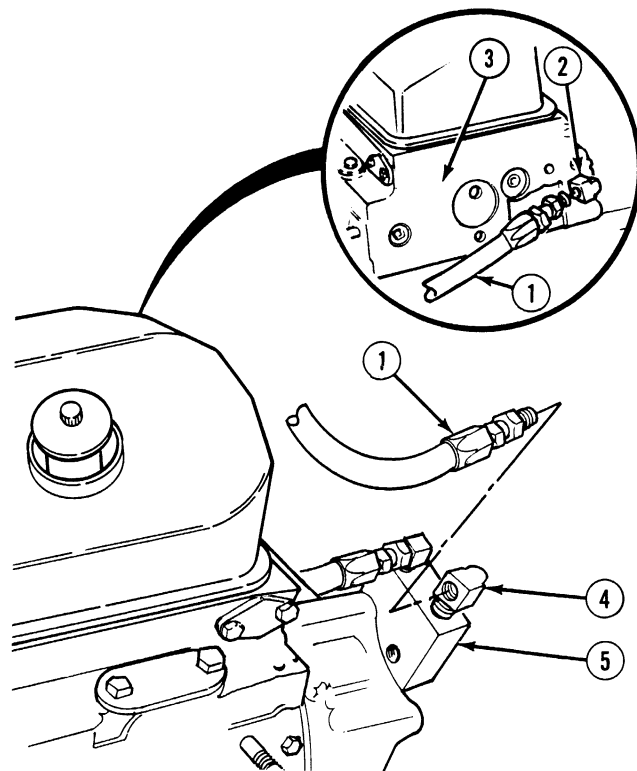
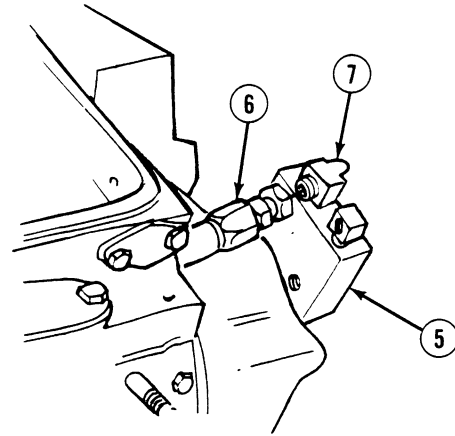


**20-99. SECONDARY FUEL FILTER, BASE AND FUEL HOSES INSTALLATION (CONT).**

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (30) Coat threads of elbow (7) with sealing compound.
- (31) Install elbow (7) in fuel block (5).
- (32) Install hose (6) on elbow (7).
- (33) Coat threads of elbows (4) and (2) with sealing compound.
- (34) Install elbow (4) in fuel block (5).
- (35) Install hose (1) in elbow (4).
- (36) Install elbow (2) in left cylinder head (3).
- (37) Install hose (1) in elbow (2).



**b. Follow-On Maintenance:**

- Install right thermostat housing, (Para 20-100).

**END OF TASK**





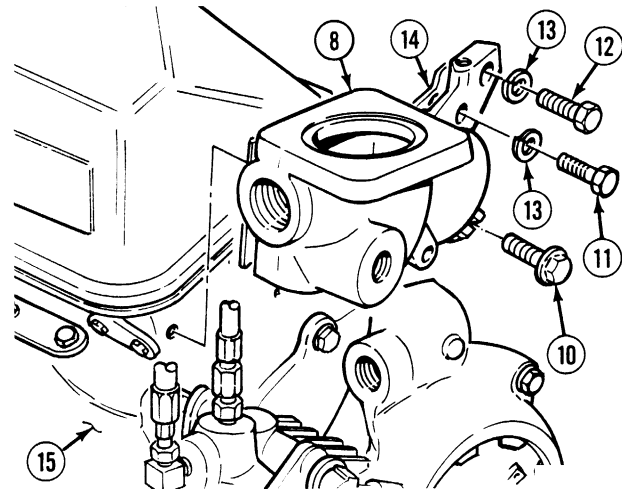
**20-100. RIGHT THERMOSTAT HOUSING INSTALLATION (CONT).**

**b. Installation.**

**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.

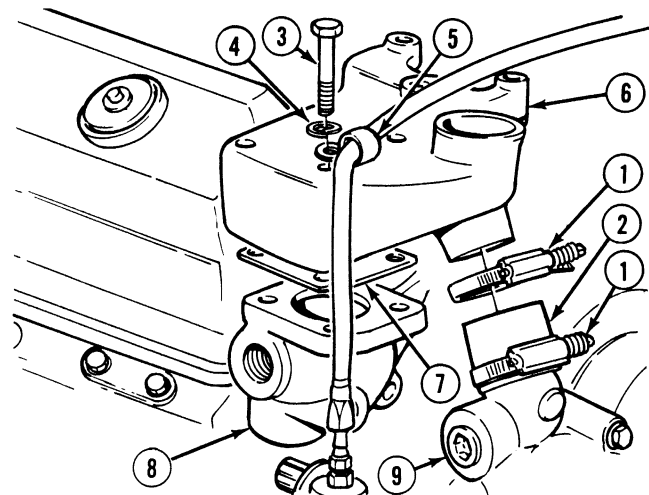
- (1) Coat threads of screw (10) with sealing compound.
- (2) Position screw (10) in cylinder head (15) three turns deep.
- (3) Coat gasket (14) with grease.
- (4) Position gasket (14) on right thermostat housing (8).
- (5) Install gasket (14) and right thermostat housing (8) with two lockwashers (13) and screws (11) and (12).
- (6) Tighten screws (10) and (11) to 23 to 26 lb-ft (31 to 35 N·m).
- (7) Tighten screw (12) to 35 to 38 lb-ft (47 to 52 N·m).



**NOTE**

Long screw, lockwasher, and clip will be installed in turbocharger and air inlet housing installation task.

- (8) Coat gasket (7) with grease.
- (9) Position gasket (7) on thermostat housing cover (6).
- (10) Position two hose clamps (1) on hose (2) and on thermostat housing cover (6).
- (11) Install thermostat housing cover (6) and clip (5) on right thermostat housing (8) with four lockwashers (4) and screws (3). Tighten 23 to 26 lb-ft (31 to 35 N·m).
- (12) Position hose (2) and position hose clamps (1) on water pump (9).
- (13) Tighten two hose clamps (1).



**c. Follow-On Maintenance:**

- Install left thermostat housing, (Para 20-101).

**END OF TASK**

**20-101. LEFT THERMOSTAT HOUSING INSTALLATION.**

This task covers:

a. Assembly

b. Installation

c. Follow-On Maintenance

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Handle, Installer (Item 93, Appendix F)  
Installer, Seal (Item 116, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

*Materials/Parts*

Grease (Item 21, Appendix B)

*Materials/Parts - Continued*

Sealing Compound (Item 53, Appendix B)  
Sealing Compound (Item 56, Appendix B)  
Gasket (Item 85, Appendix E)  
Gasket (Item 86, Appendix E)  
Lockwasher (4) (Item 292, Appendix E)  
Seal (Item 566, Appendix E)

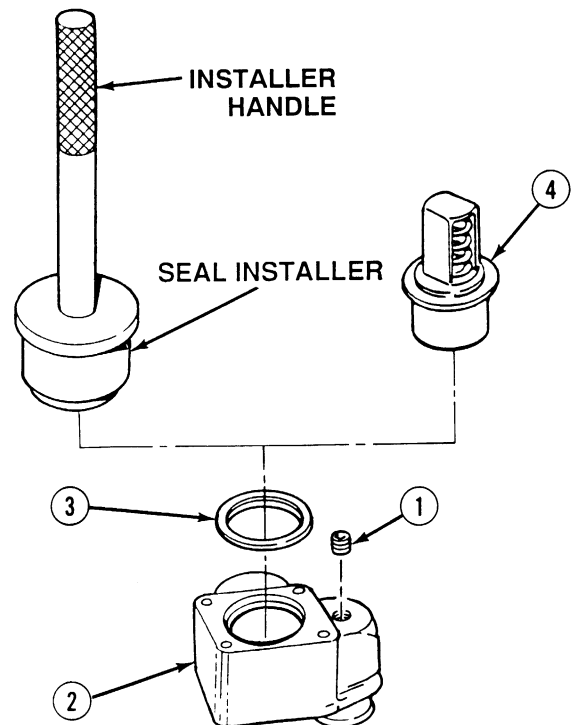
*Equipment Condition*

Right thermostat housing installed, (Para 20-100)

**a. Assembly.****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.

- (1) Coat threads of plug (1) with sealing compound.
- (2) Install plug (1) in left thermostat housing (2).
- (3) Position seal ring (3) on installer and handle and install seal ring (3) in left thermostat housing (2).
- (4) Install thermostat (4) in left thermostat housing (2).



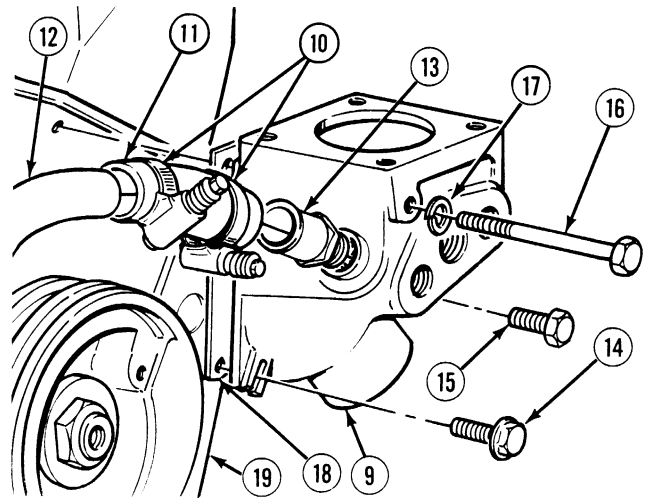
**20-101. LEFT THERMOSTAT HOUSING INSTALLATION (CONT).**

**b. Installation.**

**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.

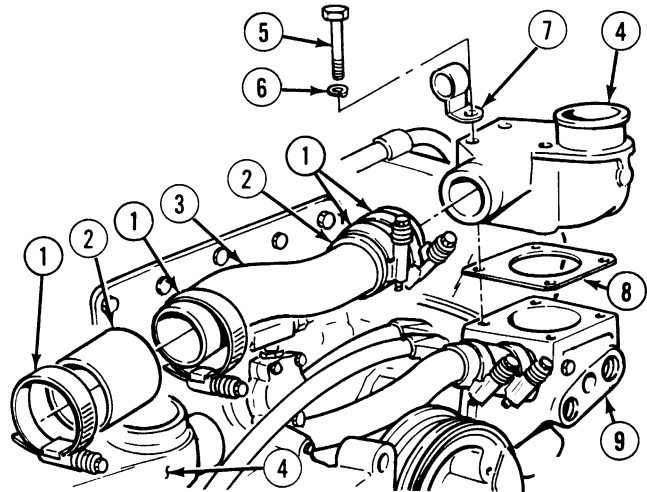
- (1) Coat threads of connector (13) with sealing compound.
- (2) Install connector (13) in left thermostat housing (9).
- (3) Position hose (11) and two clamps (10) on left thermostat housing (9).
- (4) Coat gasket (18) with grease.
- (5) Position gasket (18) and left thermostat housing (9) on engine (19). Line up with hose (11).
- (6) Position hose (11) on tube elbow (12).
- (7) Coat threads of screws (14) and (15) with sealing compound.
- (8) Install two screws (14) and (15) through left thermostat housing (9) into cylinder head (18). Tighten screws 23 to 26 lb-ft (31 to 35 N·m).
- (9) Install lockwasher (17) and screw (16). Tighten screw 23 to 26 lb-ft (31 to 35 N·m).
- (10) Tighten two clamps (10) on hose (11).
- (11) Coat gasket (8) with grease.
- (12) Position gasket (8) on thermostat cover (4).



**NOTE**

Screw for right front holes will be installed with ECM bracket.

- (13) Install thermostat cover (4) and clip (7) with three lockwashers (6) and screws (5). Tighten screws 23 to 26 lb-ft (31 to 35 N·m).
- (14) Install crossover tube (3), two hoses (2) and four clamps (1) on thermostat covers (4).



**c. Follow-On Maintenance:**

- Install engine lifting brackets, (Para 20-102).

**END OF TASK**



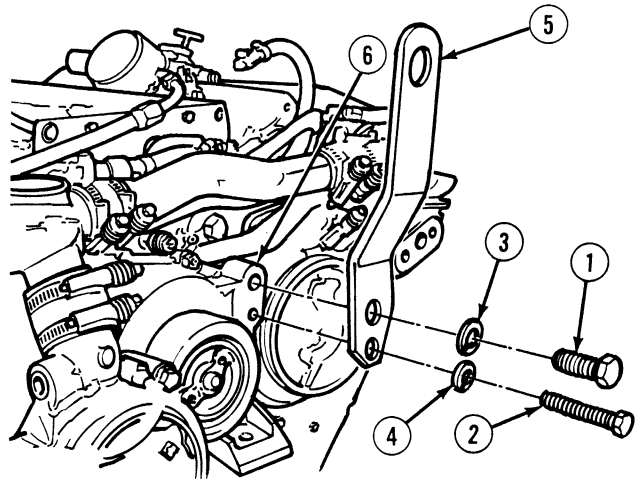
**20-102. ENGINE LIFTING BRACKETS INSTALLATION (CONT).**

- (8) Repeat Steps (1) through (7) for left rear lifting bracket.

**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.

- (9) Coat threads of screws (1) and (2) with sealing compound.
- (10) Position front lifting bracket (5) on front balance cover (6) with lockwashers (3) and (4) and screws (1) and (2).
- (11) Tighten screw (1) to 53 to 56 lb-ft (72 to 76 N·m) and screw (2) to 103 to 106 lb-ft (140 to 144 N·m).
- (12) Tighten screw (1) 71 to 75 lb-ft (96 to 102 N·m).
- (13) Tighten screw (2) 137 to 147 lb-ft (186 to 199 N·m).



**b. Follow-On Maintenance:**

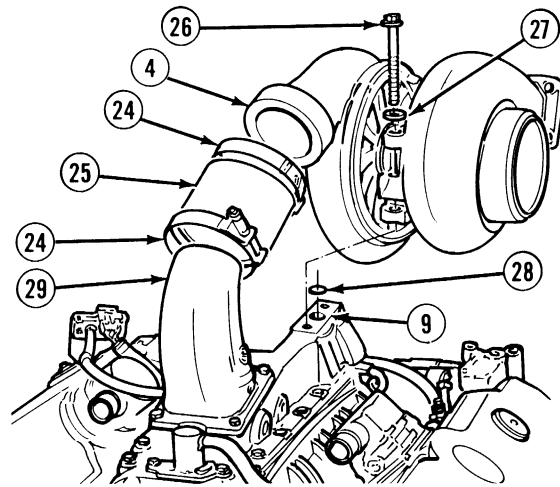
- Install turbocharger and air inlet housing, (Para 20-103).

**END OF TASK**

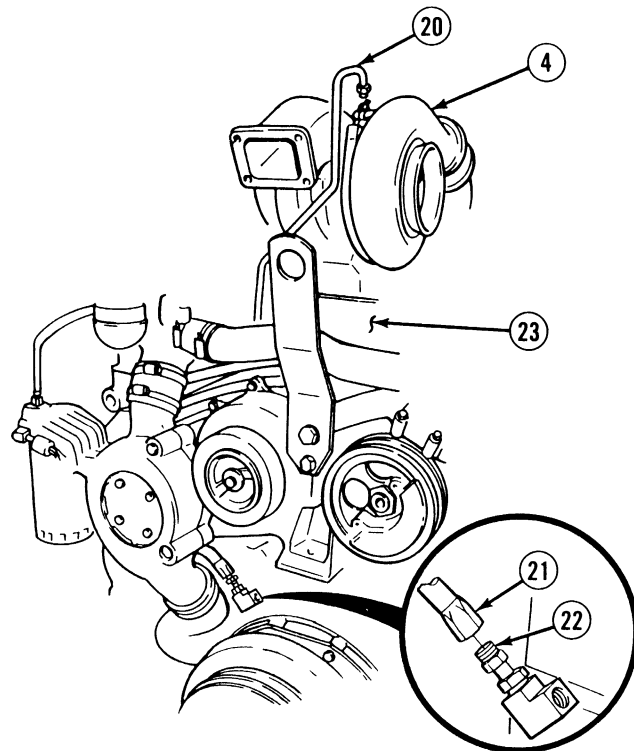


**20-103. TURBOCHARGER AND AIR INLET HOUSING INSTALLATION (CONT).**

- (8) Position hose (25) and two clamps (24) on air inlet housing adapter (29).
- (9) Apply lubricating oil to gasket (28).
- (10) Install gasket (28) on air inlet housing (9).
- (11) Install turbocharger assembly (4) on air inlet housing (9) with two lockwashers (27) and screws (26). Tighten screws to 45 to 50 lb-ft (61 to 68 N·m).
- (12) Align hose (25) and tighten two clamps (24).



- (13) Fill turbocharger assembly (4) with clean engine oil and spin rotor by hand.
- (14) Position turbocharger tube assembly (20) on engine (23).
- (15) Install hose assembly (21) on fitting (22).
- (16) Install tube assembly (20) in turbocharger assembly (4).

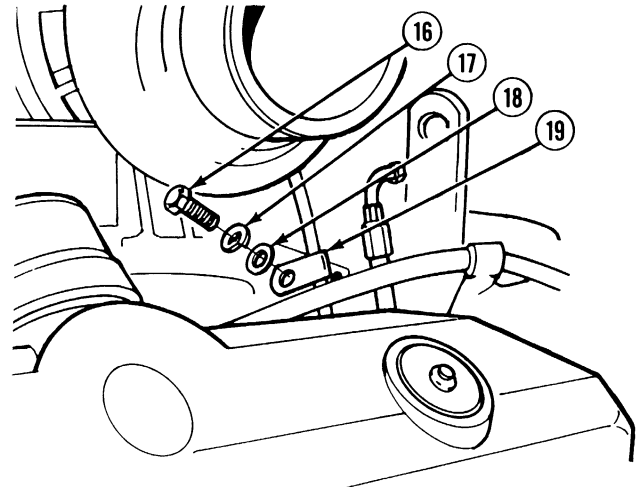


- (17) Install clip (19) with washer, (18), lockwasher (17) and screw (16). Tighten screw to 10 to 31 lb-ft (14 to 42 N·m).

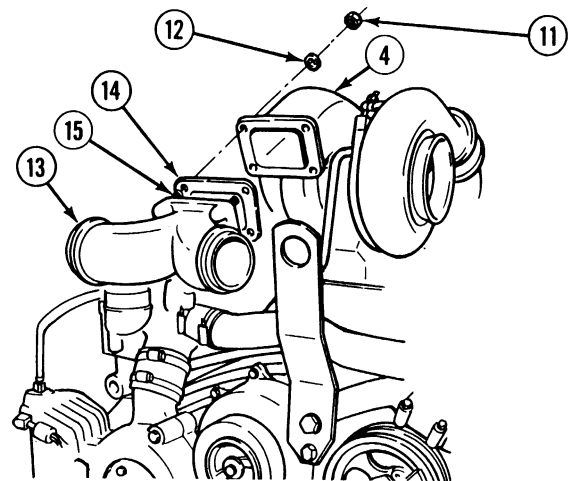
**NOTE**

Perform Step (18) if studs were removed.

- (18) Install studs (15) on adapter tee (13).



- (19) Install gasket (14) and adapter tee (13) on turbocharger assembly (4) with four washers (12) and locknuts (11). Tighten locknuts to 30 to 35 lb-ft (41 to 47 N·m).



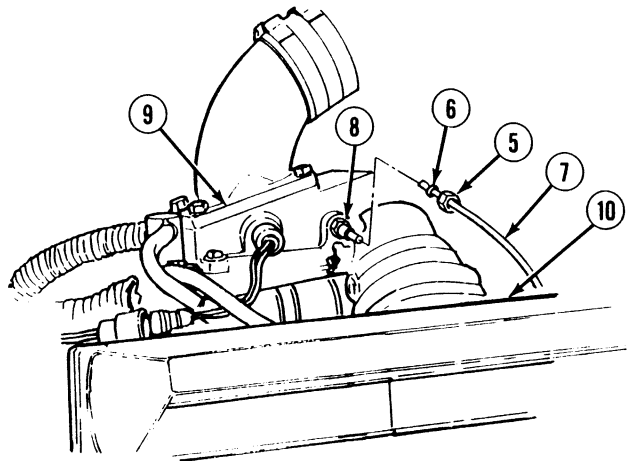


**20-103. TURBOCHARGER AND AIR INLET HOUSING INSTALLATION (CONT).**

- (20) Position ether start tube (7) on engine (10).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

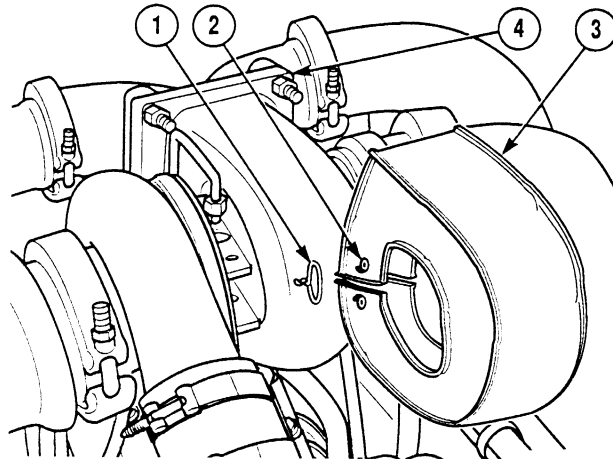


- (21) Coat threads of atomizer (8) with sealing compound.
- (22) Install atomizer (8) in air inlet housing (9).
- (23) Install ferrule (6), ether tube (7) and nut (5) on atomizer (8).

**WARNING**

Gloves must be used when handling turbocharger cover. Turbocharger cover is made of fiberglass and may cause skin irritation. Failure to comply may result in injury to personnel.

- (24) Install cover (3) on turbocharger assembly (4) and secure with two wires (1) through tabs (2).



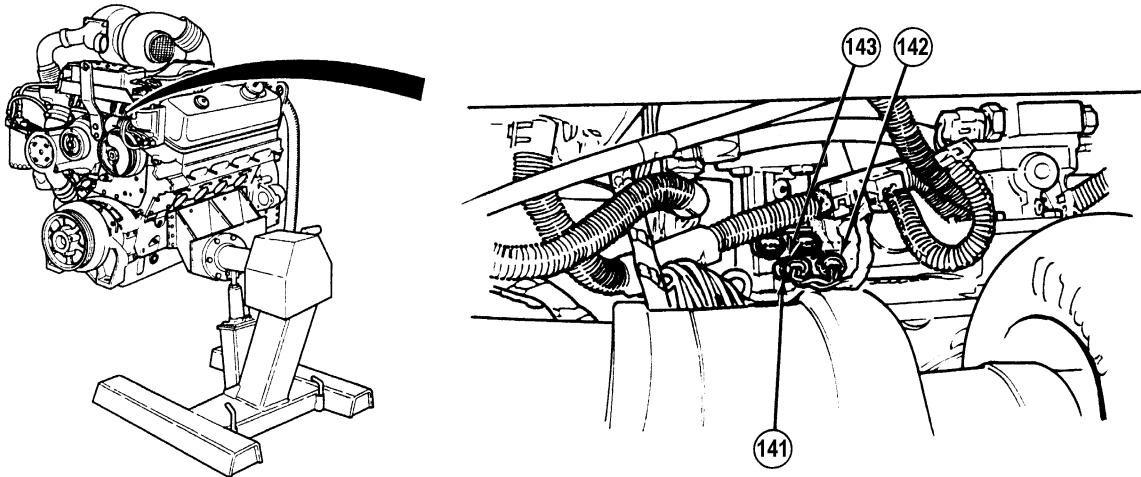
**b. Follow-On Maintenance:**

- Install ECM, (Para 20-104).

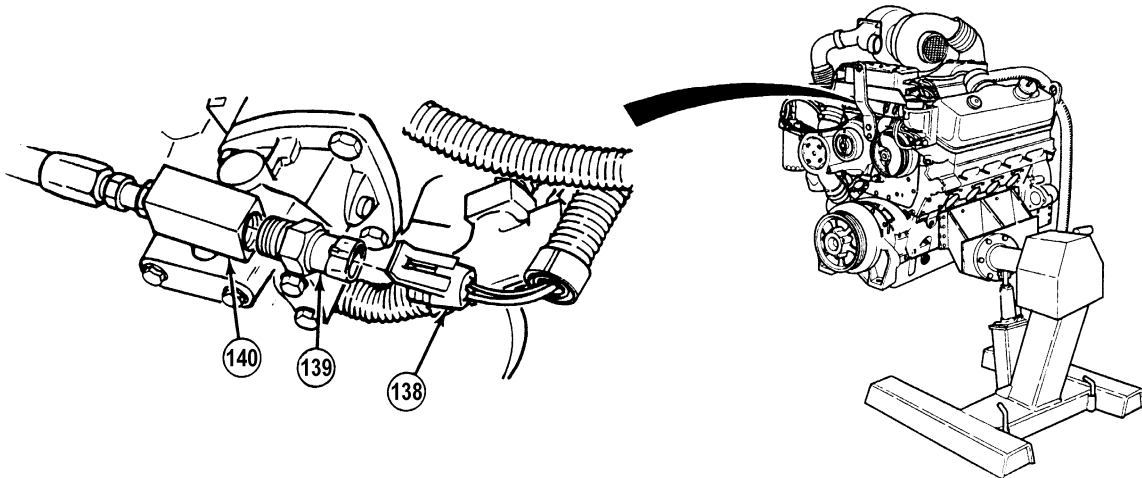
**END OF TASK**



**20-104. ELECTRONIC CONTROL MODULE (ECM) INSTALLATION (CONT).**



- (2) Connect two connectors (141) and (142) to the timing and synchronous reference sensor (TRS/SRS) (143).

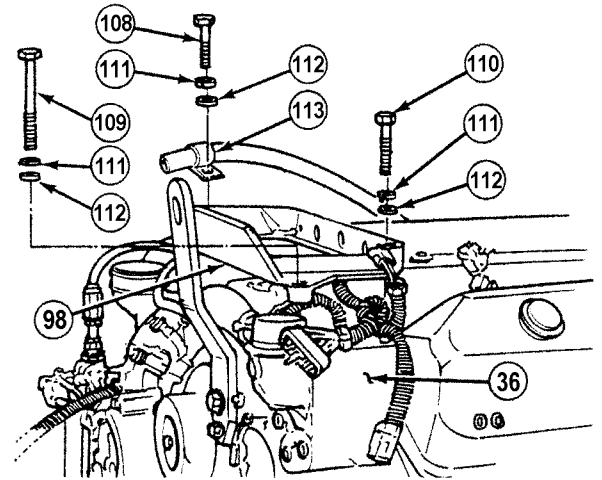


**WARNING**

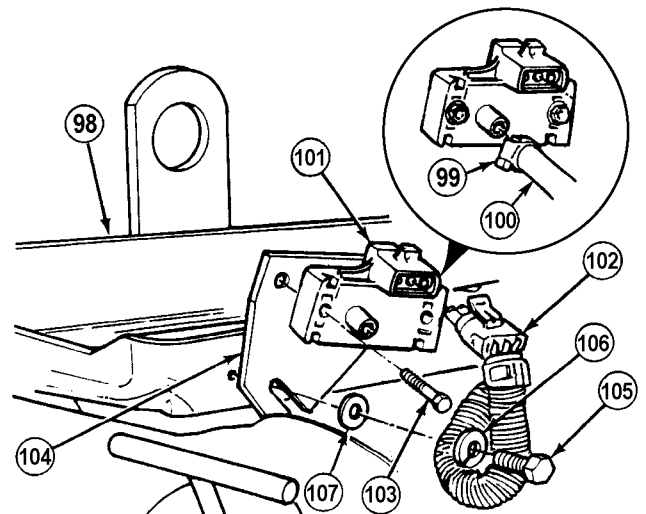
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (3) Coat threads of fuel temperature sensor (139) with sealing compound.  
 (4) Install fuel temperature sensor (139) in tee (140).  
 (5) Connect connector (138) to fuel temperature sensor (139).

- (6) Install ECM bracket (98) and clip (113) on engine block (36) with three washers (112), lockwashers (111) and screws (110), (109) and (108). Tighten screws to 23 to 26 lb-ft (31 to 35 N·m).

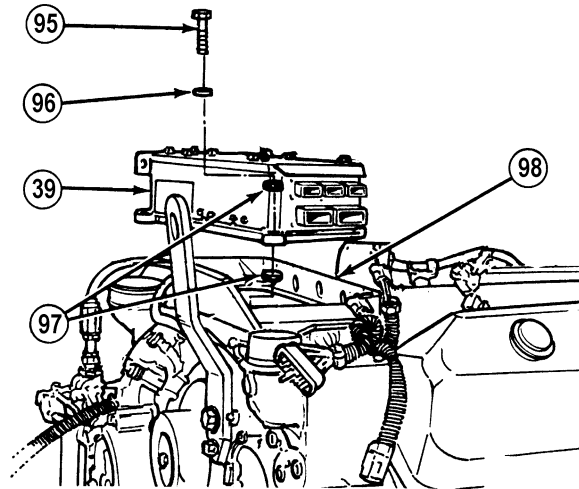


- (7) Install turbo boost pressure sensor bracket (104) on ECM bracket (98) with washer (107), lockwasher (106) and screw (105). Tighten screw to 120 to 156 lb-in (14 to 18 N·m).
- (8) Install turbo boost pressure sensor (101) on turbo boost pressure sensor bracket (104) with two screws (103).
- (9) Connect connector (102) and hose (100) with clamp (99) to turbo boost pressure sensor (101).



**20-104. ELECTRONIC CONTROL MODULE (ECM) INSTALLATION (CONT).**

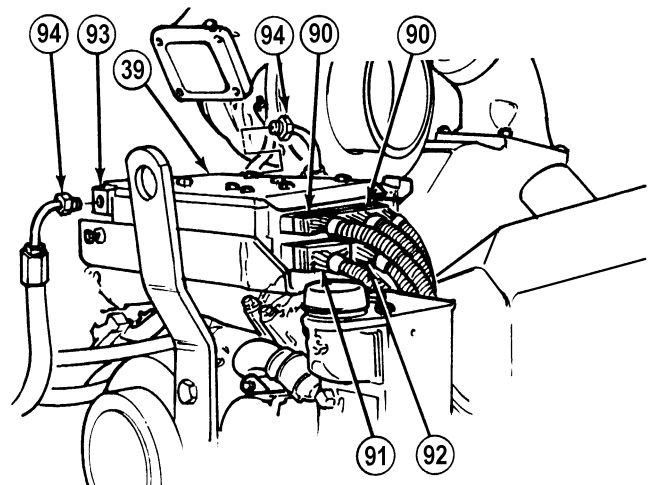
- (10) Install eight mount cushions (97) and ECM (39) on ECM bracket (98) with four washers (96) and screws (95).



**CAUTION**

Hold DDEC fitting block on ECM when installing fuel lines to prevent cracking or damage to equipment may result.

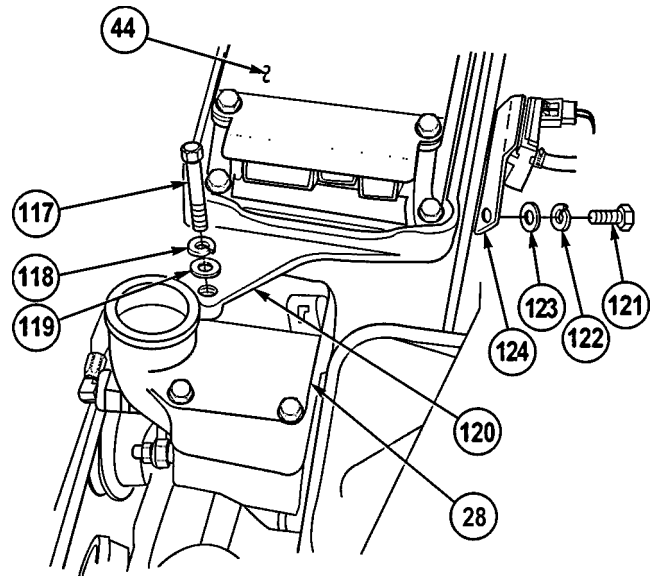
- (11) Install two fuel hose assemblies (94) on DDEC fitting (93).
- (12) Connect vehicle harness connector MC18 (92), engine harness connector (91) and two injector harness connectors (90) to ECM (39).



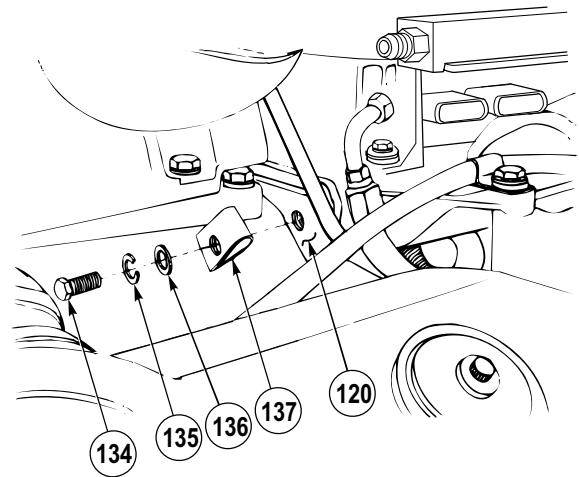
**NOTE**

- Perform Steps (13) through (23) for DDEC III engines.
- Left injector wire harness should be located under ECM bracket.

- (13) Position ECM (44) and ECM bracket (120) on thermostat housing (28).
- (14) Position turbo boost sensor bracket (124) on ECM bracket (120) with washer (123), lockwasher (122) and screw (121). Do not tighten screw.
- (15) Position washer (119), lockwasher (118) and screw (117) on ECM bracket (120). Do not tighten screw.

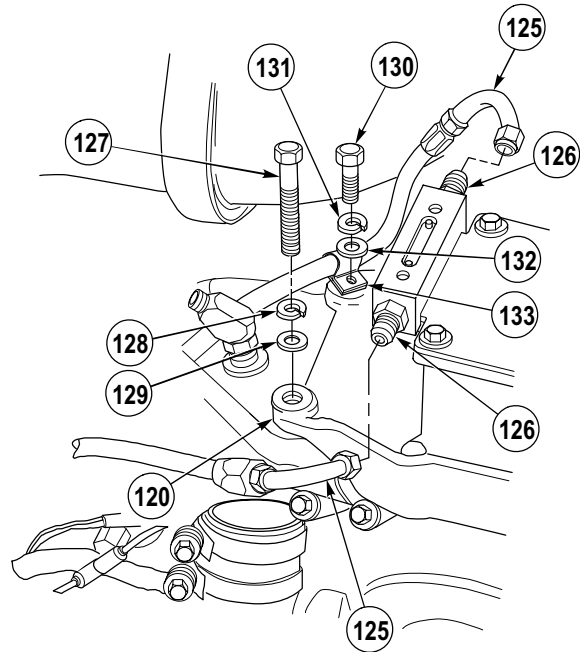


- (16) Position clip (137), washer (136), lockwasher (135) and screw (134) on ECM bracket (120). Do not tighten screw.



**20-104. ELECTRONIC CONTROL MODULE (ECM) INSTALLATION (CONT).**

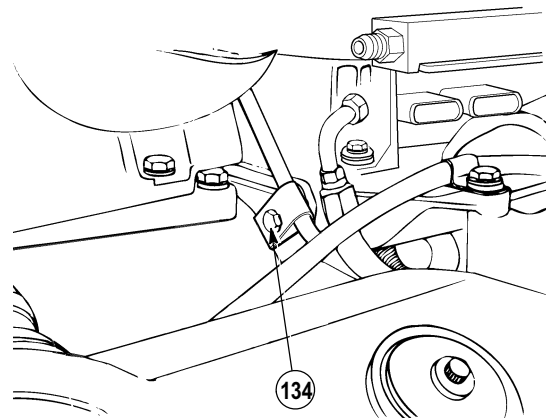
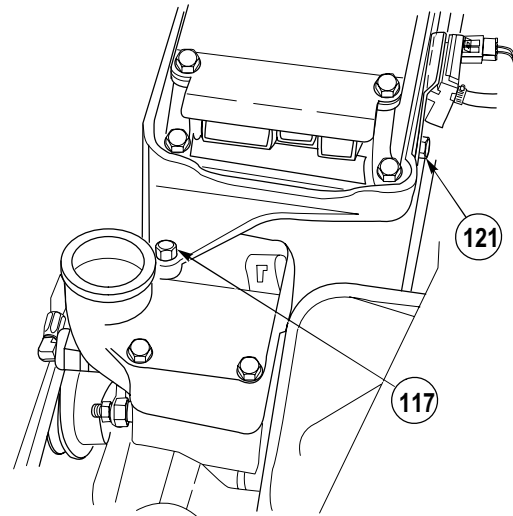
- (17) Position clip (133), washer (132), lockwasher (131) and screw (130) on ECM bracket (120). Do not tighten screw.
- (18) Position washer (129), lockwasher (128) and screw (127) on ECM bracket (120). Do not tighten screw.



**CAUTION**

Screws connecting bracket to blower must be tightened first to prevent damage to housing.

- (19) Tighten two screws (121) and (134) to 120-156 lb-in. (14-18 N·m).
- (20) Tighten three screws (117), (130) and (127) to 17-20 lb-ft (23-27 N·m).
- (21) Install two fuel lines (125) on fittings (126).



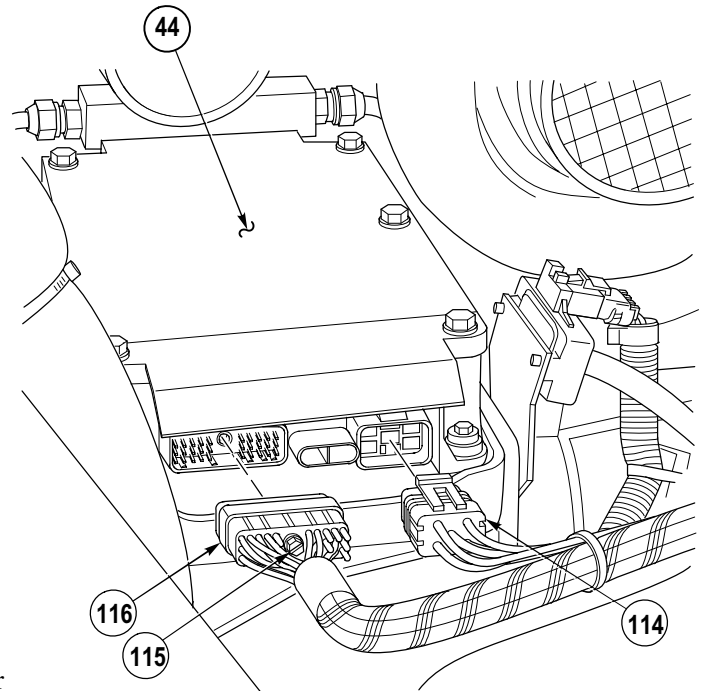
**CAUTION**

Use caution while installing connectors from ECM. The ECM has plastic retainers that may break if connectors are not properly installed.

**NOTE**

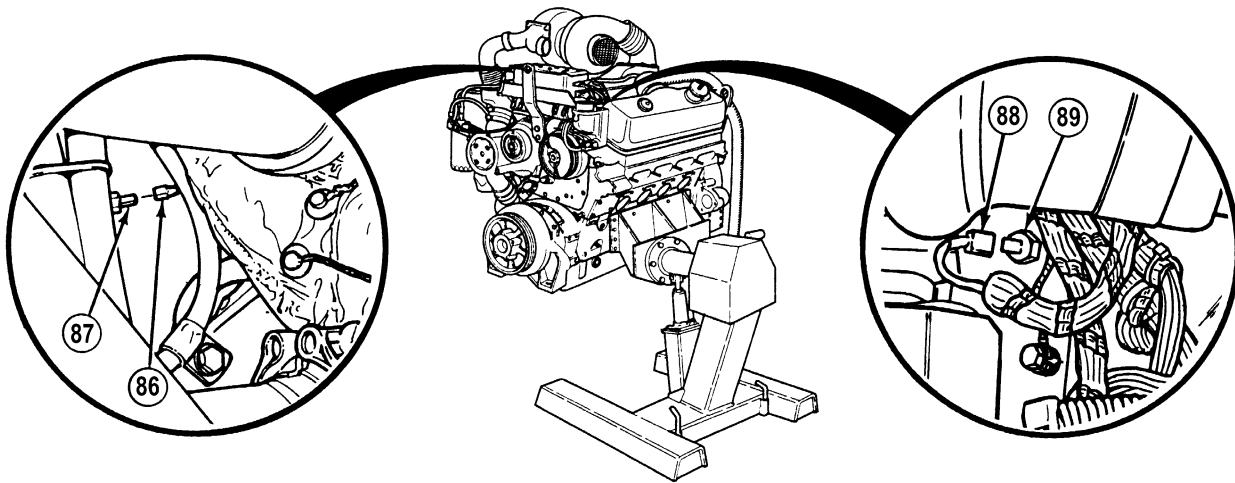
- Ensure locking tangs are locked in place when installing wiring harness connectors.
- ECM wiring harnesses are designed to be installed in only one location.

- (22) Connect vehicle wiring harness connector MC18 (116) to left side of ECM (44) and tighten screw (115).
- (23) Connect 5-way power wiring harness connector MC17 (114) to left side of ECM (44).

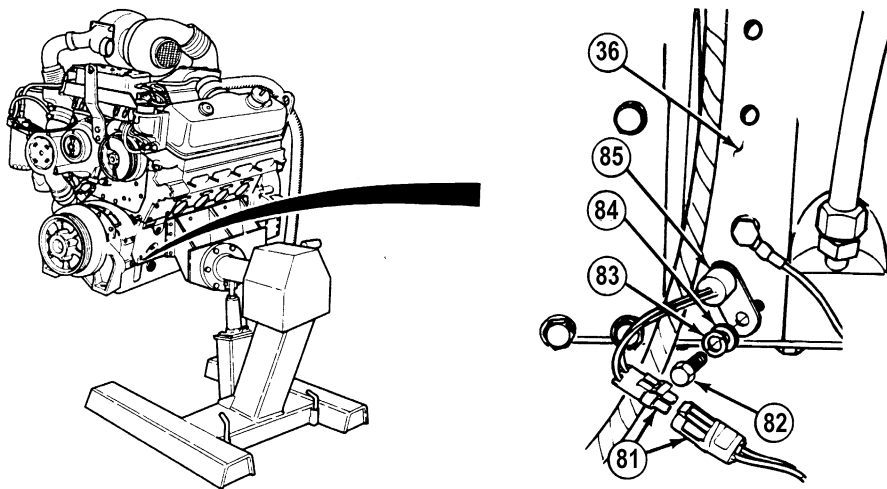




**20-104. ELECTRONIC CONTROL MODULE (ECM) INSTALLATION (CONT).**



- (24) Connect wire 1716 (88) to terminal on left cylinder head (89).
- (25) Connect wire 1715 (86) to terminal on right cylinder head (87).

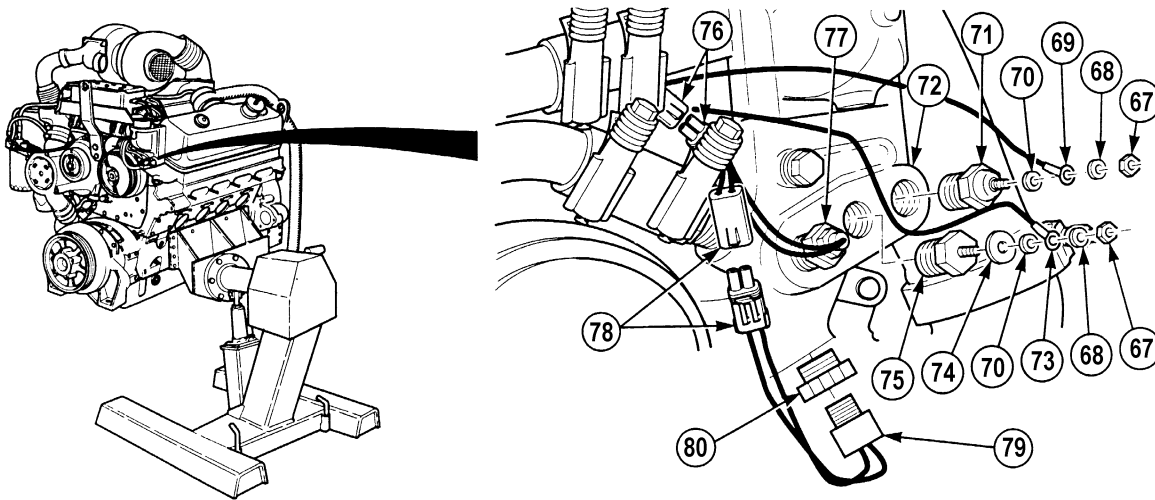


- (26) Install ether start aid thermostat (85) on engine block (36) with washer (84), lockwasher (83) and screw (82).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (27) Apply corrosion preventive compound to screw (82).
- (28) Connect MC56 connector (81).



- (29) Install water temperature gage sensor (75), fan control sensor (77) and water temperature sending unit (71) in left thermostat housing (72).
- (30) Connect MC61 connector (76).
- (31) Remove nut (67) from water temperature sending gage sensor (75).

### NOTE

Ensure remaining washers in above illustration are still on water temperature sending gage sensor and water temperature sending unit.

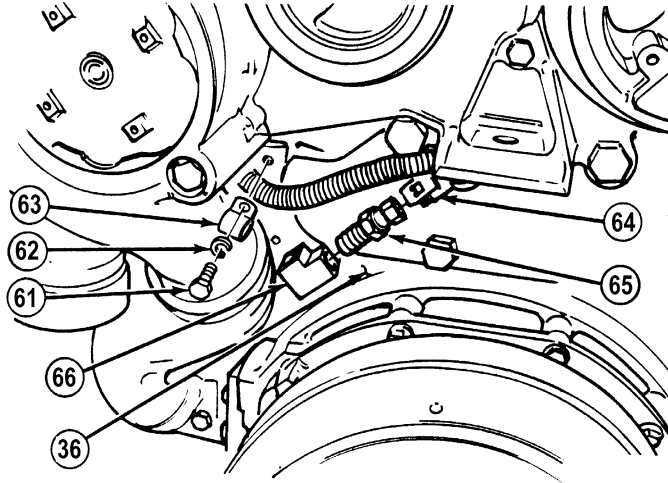
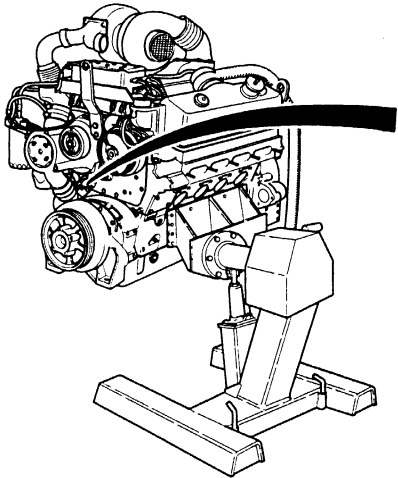
- (32) Install washer (74), washer (70), wire 1320 (73) and lockwasher (68) and nut (67) on water temperature sending gage sensor (75).
- (33) Remove nut (67) from water temperature sending unit (71).
- (34) Install washer (70), wire 1147 (69) and lockwasher (68) and nut (67) on water temperature sending unit (71).

### 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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (35) Coat threads of temperature switch (79) and reducer bushing (80) with sealing compound.
- (36) Install reducer bushing (80) in left thermostat housing (72).
- (37) Install temperature switch (79) in reducer bushing (80).
- (38) Connect MC128 connector (78).

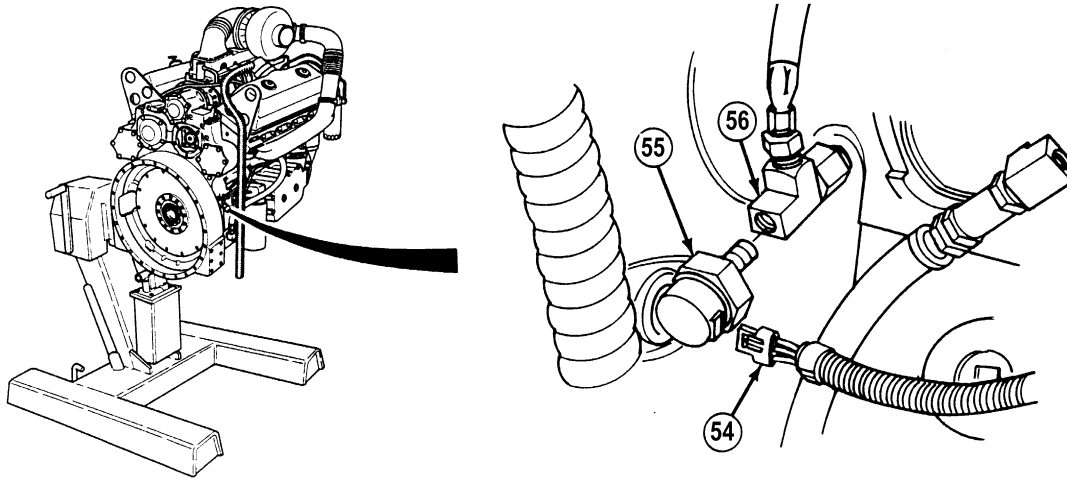
**20-104. ELECTRONIC CONTROL MODULE (ECM) INSTALLATION (CONT).**



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (39) Coat threads of DDEC oil temperature sensor (65) with sealing compound.
- (40) Install DDEC oil temperature sensor (65) in tee (66).
- (41) Connect connector (64) to DDEC oil temperature sensor (65).
- (42) Install clip (63), lockwasher (62) and screw (61) on engine (36).

**WARNING**

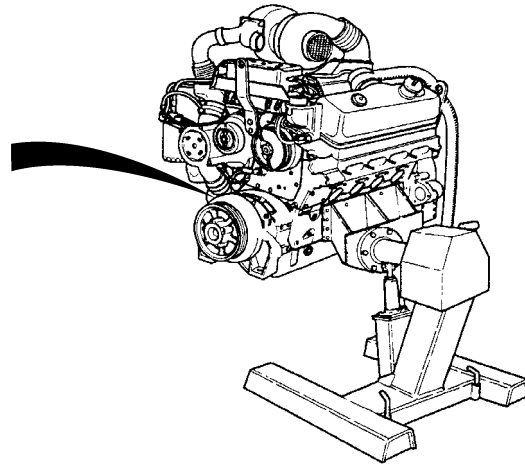
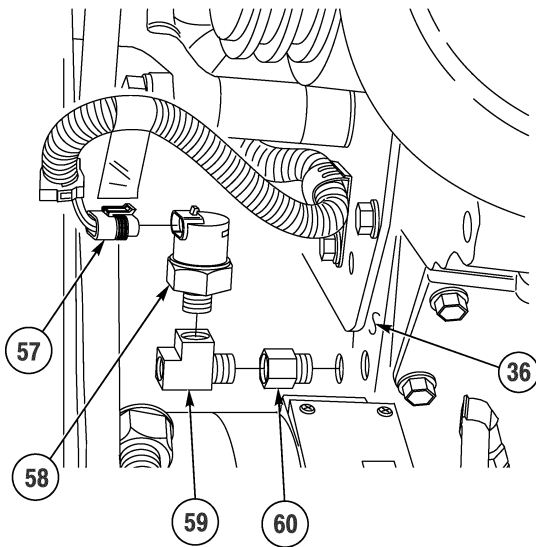
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

**NOTE**

Perform Steps (43) through (45) for DDEC II engines.

- (43) Coat threads of DDEC engine oil pressure sensor (55) with sealing compound.
- (44) Install DDEC engine oil pressure sensor (55) in tee (56).
- (45) Connect connector (54) to DDEC engine oil pressure sensor (55).

**20-104. ELECTRONIC CONTROL MODULE (ECM) INSTALLATION (CONT).**



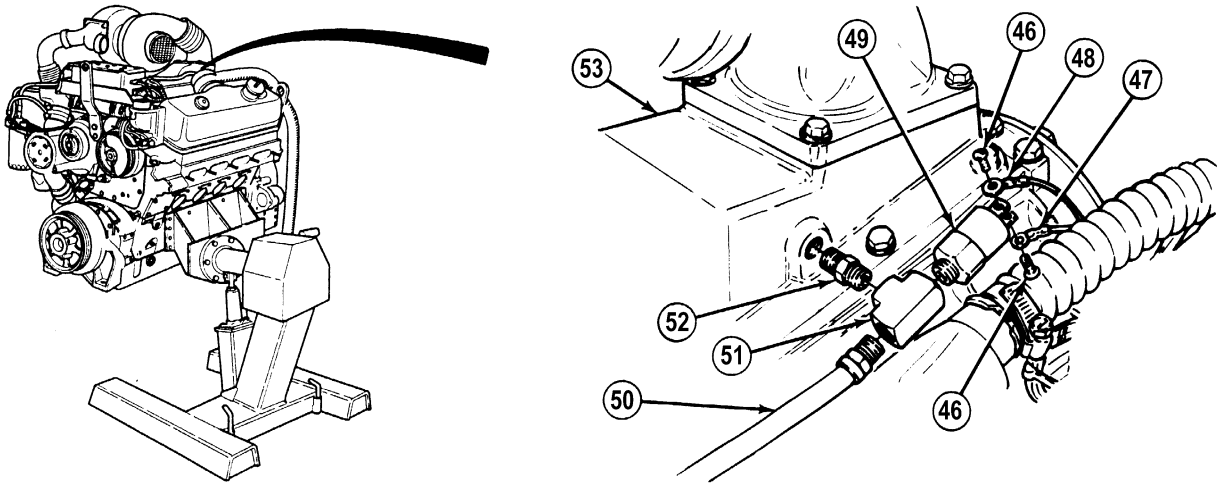
**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

**NOTE**

Perform Steps (46) through (50) for DDEC III engines.

- (46) Apply sealing compound to threads of DDEC engine oil pressure sensor (58), tee (59) and reducer (60).
- (47) Install reducer (60) in engine (36).
- (48) Install tee (59) in reducer (60).
- (49) Install DDEC engine oil pressure sensor (58) on tee (59).
- (50) Connect connector (57).



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

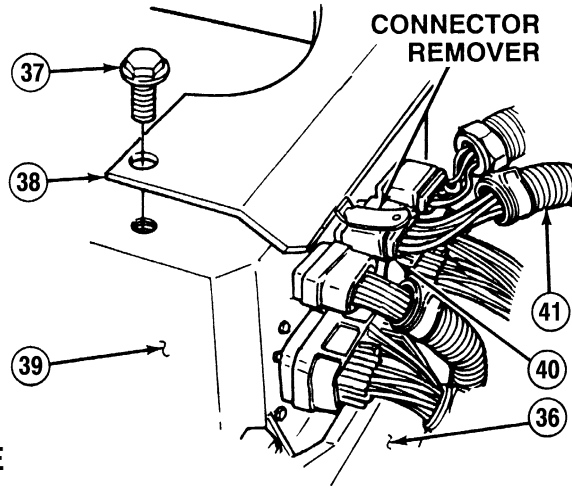
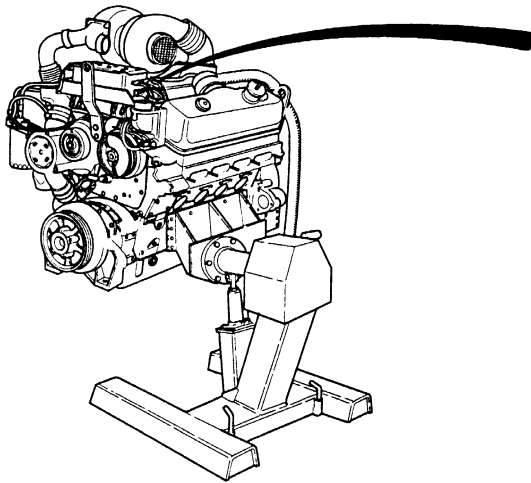
- (51) Coat threads of adapter (52) with sealing compound.
- (52) Install adapter (52) in air inlet housing (53).

**NOTE**

Position of tee should be as noted in removal.

- (53) Install tee (51) on adapter (52).
- (54) Coat threads of turbo boost pressure switch (49) with sealing compound.
- (55) Install air line (50) and turbo boost pressure switch (49) in tee (51).
- (56) Install wire 1957 (48) and wire 1955 (47) on turbo pressure switch (49) with two screws (46).

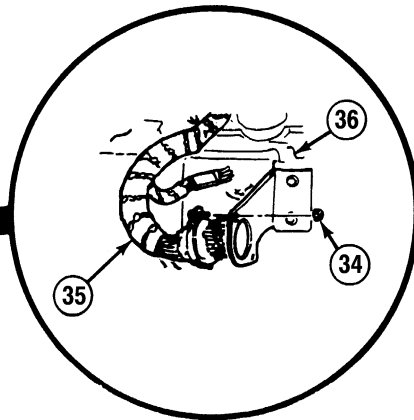
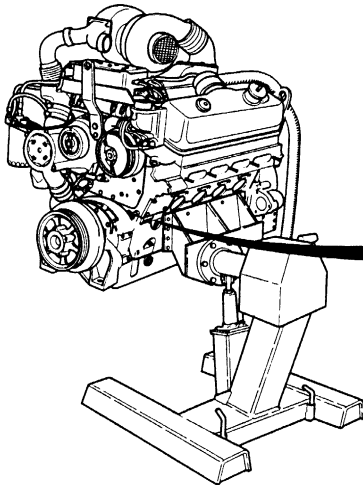
**20-104. ELECTRONIC CONTROL MODULE (ECM) INSTALLATION (CONT).**



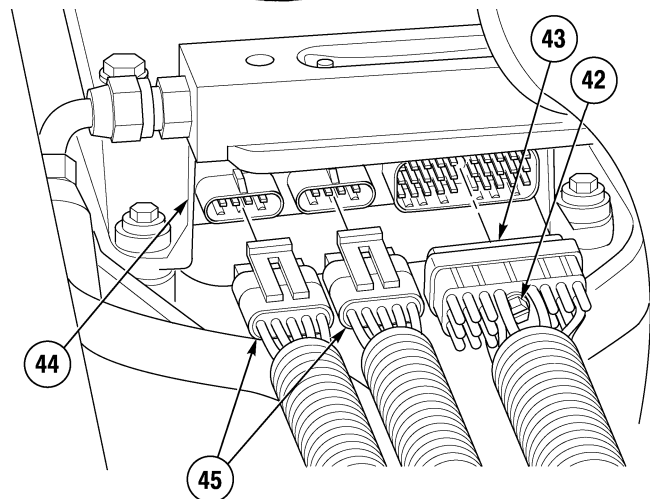
**NOTE**

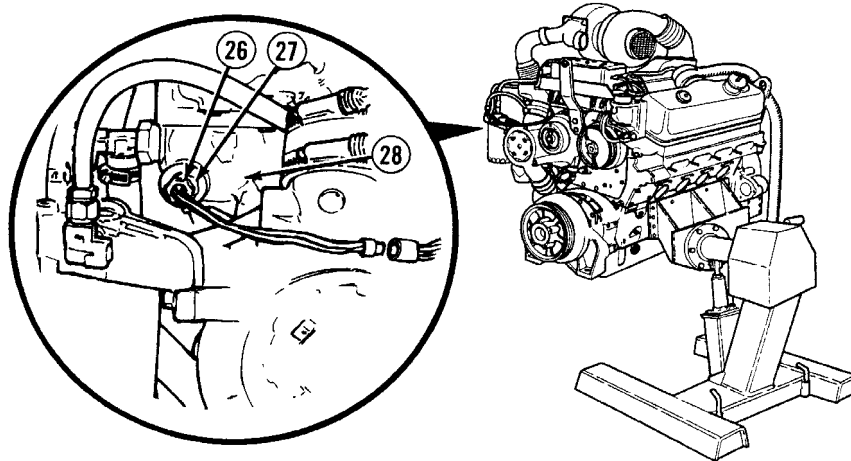
- Perform Steps (57) through (59) for DDEC II engines.
- Perform Steps (60) and (61) for DDEC III engines.

- (57) Position DDEC engine wire harness (41) on engine (36) and connect MC17 connector (40) to ECM (39).
- (58) Install cover plate (38) on ECM (39) with two lock screws (37). Tighten screws to 156 to 204 lb-in (18 to 23 N·m).



- (59) Position STE/ICE-R wire harness (35) on engine (36) with two nuts (34).
- (60) Connect two injector wiring harness connectors (45) to right side of ECM (44).
- (61) Connect engine wiring harness connector (43) to right side of ECM (44) and tighten screw (42).





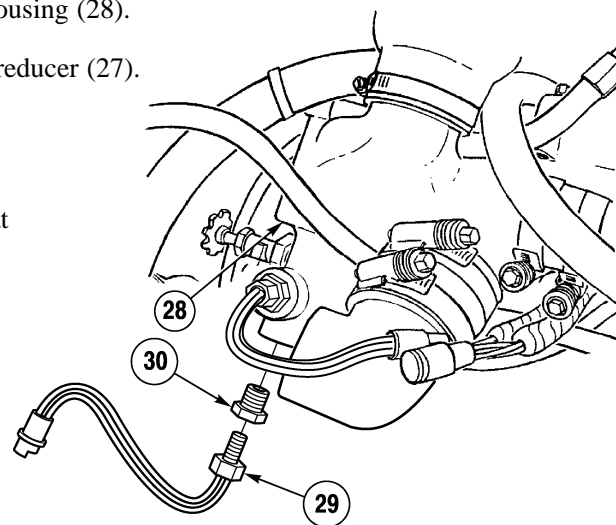
**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

**NOTE**

- Perform Steps (62) through (64) for DDEC II engines.
- Perform Steps (65) through (72) for DDEC III engines.

- (62) Coat threads of reducer (27) and water temperature sensor (26) with sealing compound.
- (63) Install reducer (27) in right thermostat housing (28).
- (64) Install water temperature sensor (26) in reducer (27).
- (65) Apply sealing compound to threads of bushing reducer (30).
- (66) Install bushing reducer (30) in thermostat housing (28).
- (67) Apply sealing compound to threads of STE/ICE sensor (29).
- (68) Install STE/ICE sensor (29) in bushing reducer (30).



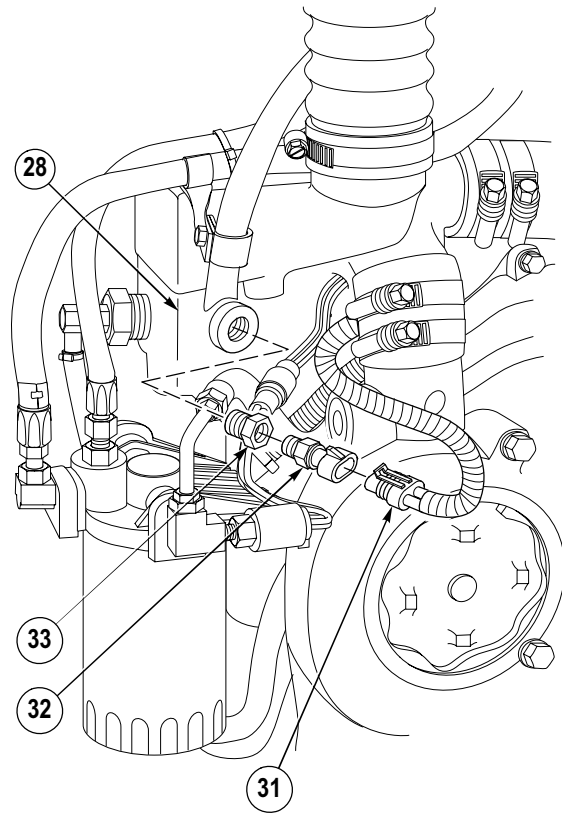


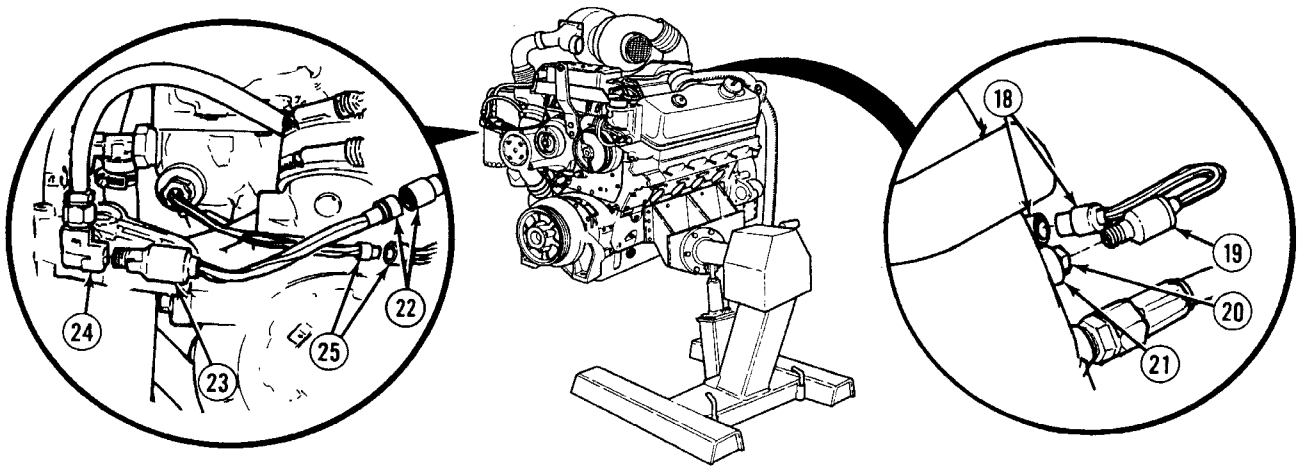
**20-104. ELECTRONIC CONTROL MODULE (ECM) INSTALLATION (CONT).**

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (69) Apply sealing compound to threads of fitting (33) and coolant temperature sensor (32).
- (70) Install fitting (33) in right thermostat housing (28).
- (71) Install coolant temperature sensor (32) in fitting (33).
- (72) Install coolant temperature harness (31) into coolant temperature sensor (32).



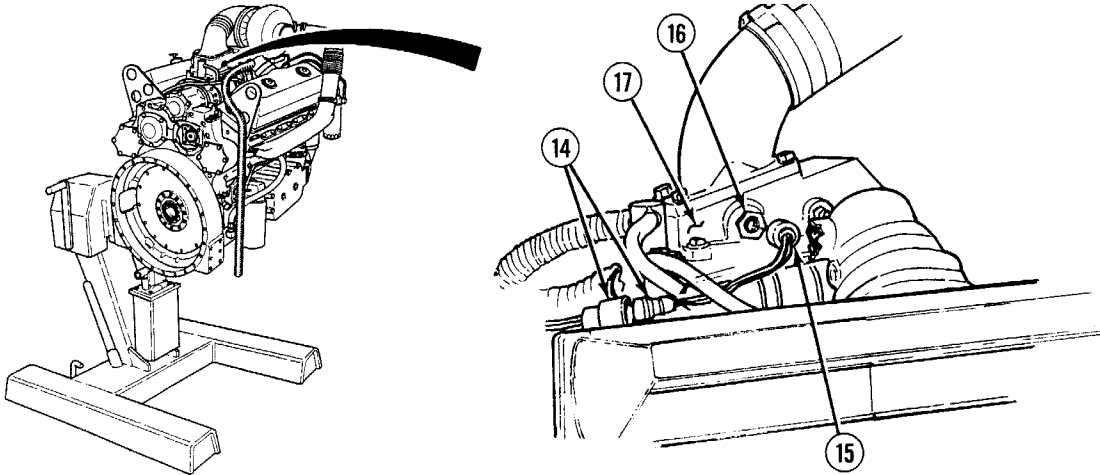


**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (73) Connect MC71 connector (25).
- (74) Coat threads of fuel pressure sensor (23) with sealing compound.
- (75) Install fuel pressure sensor (23) in tee (24).
- (76) Connect MC43 connector (22).
- (77) Coat threads of reducer (20) and air cleaner pressure transducer (19) with sealing compound.
- (78) Install reducer (20) in air inlet tube (21).
- (79) Install air cleaner pressure transducer (19) in reducer (20).
- (80) Connect MC67 connector (18).

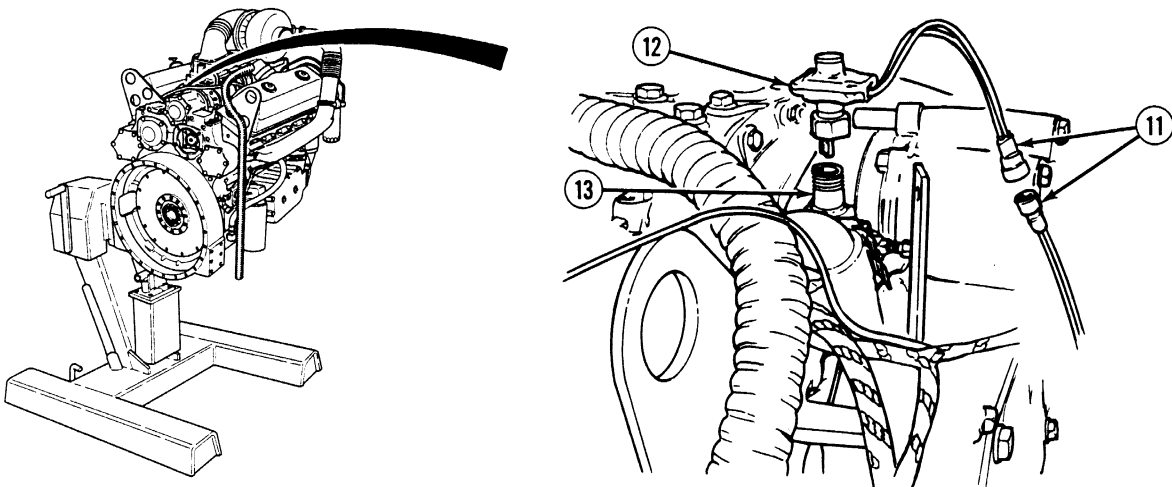
**20-104. ELECTRONIC CONTROL MODULE (ECM) INSTALLATION (CONT).**



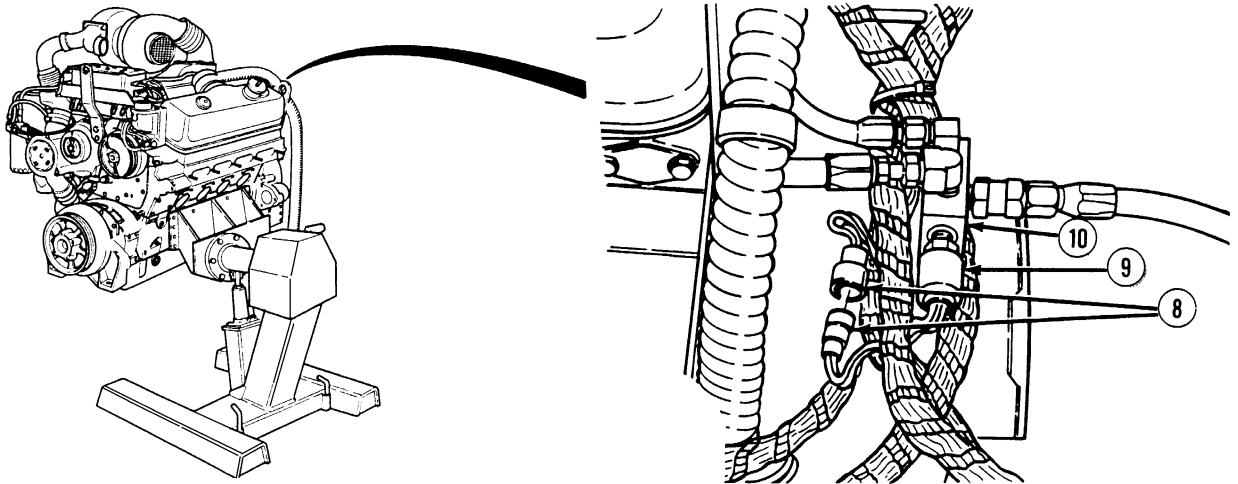
**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (81) Coat threads of reducer (16) and turbocharger outlet pressure transducer (15) with sealing compound.
- (82) Install bushing reducer (16) in turbocharger housing (17).
- (83) Install turbocharger outlet pressure transducer (15) in reducer (16).
- (84) Connect MC66 connector (14).



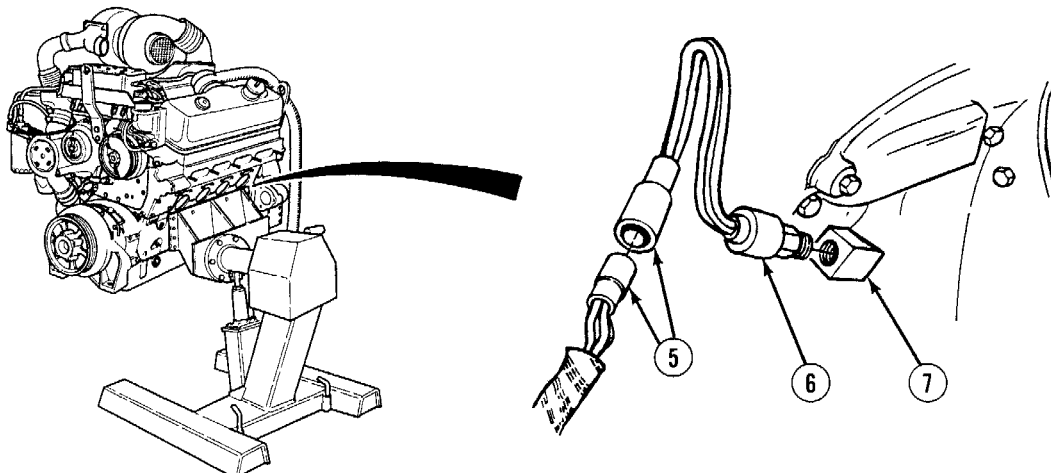
- (85) Install tachometer drive sending unit (12) in tachometer drive housing (13).
- (86) Connect MC41 connector (11).



**WARNING**

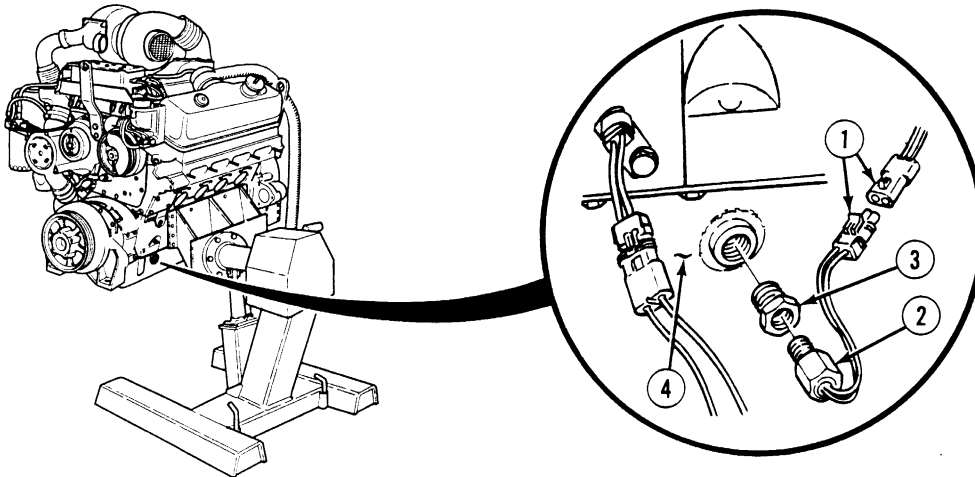
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (87) Coat threads of fuel pressure transducer (9) with sealing compound.
- (88) Install fuel pressure transducer (9) in manifold (10).
- (89) Connect MC69 connector (8).



- (90) Coat threads of air box pressure transducer (6) with sealing compound.
- (91) Install air box pressure transducer (6) in tee (7).
- (92) Connect MC68 connector (5).

**20-104. ELECTRONIC CONTROL MODULE (ECM) INSTALLATION (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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (93) Coat threads of bushing (3) and engine oil temperature sensor (2) with sealing compound.
- (94) Install adapter (3) in oil pan (4).
- (95) Install engine oil temperature sensor (2) in adapter (3).
- (96) Connect MC70 connector (1).

**b. Follow-On Maintenance:**

- Install exhaust manifolds, (Para 20-105).

**END OF TASK**

**20-105. EXHAUST MANIFOLD INSTALLATION.**

This task covers:

- a. Installation
- b. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

Tool Kit, General Mechanic's  
 (Item 240, Appendix F)  
 Stud Remover and Setter (Item 231, Appendix F)  
 Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
 (Item 277, Appendix F)

*Materials/Parts*

Gasket (2) (Item 87, Appendix E)  
 Locknut (5) (Item 191, Appendix E)  
 Stud (8) (Item 677, Appendix E)

*Equipment Condition*

ECM installed, (Para 20-104)

**a. Installation.**

**NOTE**

- Right and left exhaust manifolds are installed the same way. Right side shown.
- Perform Step (1) only if studs were removed.

- (1) Using a stud remover and setter, install studs (10) in cylinder head (6). Tighten studs (10) to 25 to 40 lb-ft (34 to 54 N·m).

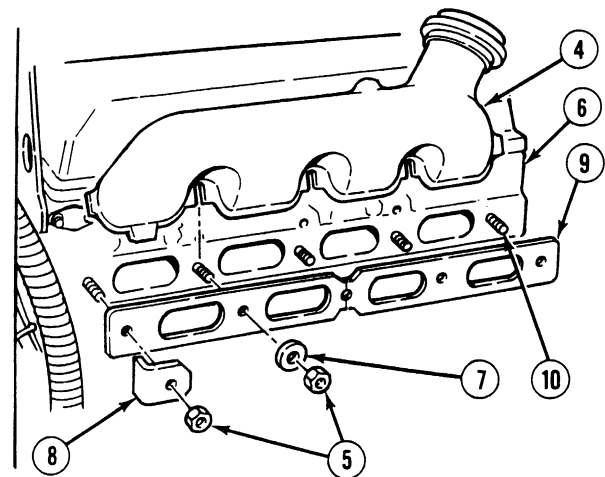
**NOTE**

Gaskets have a crimped side.  
 Crimped side faces the cylinder head.

- (2) Position two gaskets (9) on cylinder head (5).

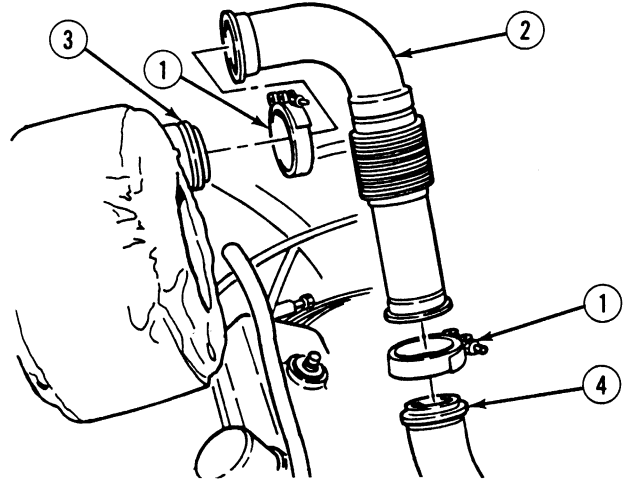
**NOTE**

- Exhaust manifold retaining washers are special curved washers. Curved side must be mounted toward exhaust manifold.
- Center locknut on left side also holds a bracket.



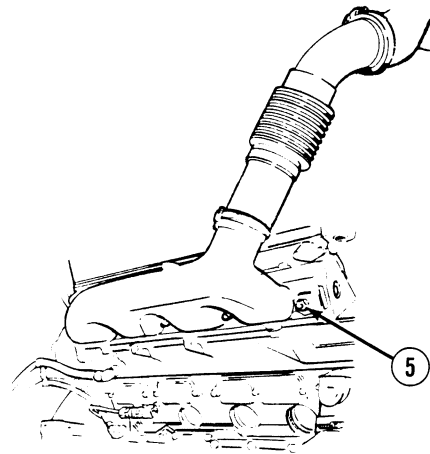
- (3) Position exhaust manifold (4) and three washers (7), two crabs (8) and five locknuts (5) on studs (10).

- (4) Install exhaust tube (2) with two clamps (1) on turbocharger adapter tee (3) and exhaust manifold (4).



**CAUTION**

- Ensure exhaust manifold is seated properly and lies flat on cylinder head without any gaps. Failure to seat properly can crack exhaust manifold when locknuts are tightened.
- Ensure to tighten locknuts from the center, outwards. Tightening outside locknuts first can crack exhaust manifold.



- (5) Tighten five locknuts (5) to 30 to 35 lb-ft (41 to 47 N·m).

**b. Follow-On Maintenance:**

- Remove engine from stand, (Para 20-106).

**END OF TASK**

**20-106. REMOVING ENGINE FROM STAND.**

This task covers:

- a. Remove Engine From Stand      b. Follow-On Maintenance

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Jackstand (4) (Item 132, Appendix F)  
Socket Set, 3/8 in. (200 AMP only)  
(Item 204, Appendix F)  
Tension Gage, Belt  
(Item 236, Appendix F)  
Wrench, Combination 1-7/16 in.  
(Item 259, Appendix F)  
Wrench, Combination 1-1/2 in.  
(Item 260, Appendix F)  
Wrench, Torque (0-60 N·m)  
(Item 276, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Lifting Device, Minimum Capacity  
2,600 lbs (1,180 kg)

*Materials/Parts*

Sealant, Electrical (Item 50, Appendix B)  
Sealing Compound (Item 53, Appendix B)  
Gasket (Item 97, Appendix E)  
Locknut (145 AMP only) (Item 165, Appendix E)  
Locknut (200 AMP only) (Item 169, Appendix E)  
Locknut (3) (145 AMP only)  
(Item 201, Appendix E)  
Locknut (2) (145 AMP only)  
(Item 204, Appendix E)

*Materials/Parts - Continued*

Locknut (200 AMP only) (Item 208, Appendix E)  
Locknut (200 AMP only) (Item 209, Appendix E)  
Locknut (2) (145 AMP only)  
(Item 210, Appendix E)  
Lockwasher (2) (145 AMP only)  
(Item 250, Appendix E)  
Lockwasher (5) (145 AMP only)  
(Item 251, Appendix E)  
Lockwasher (200 AMP only)  
(Item 255, Appendix E)  
Lockwasher (2) (200 AMP only)  
(Item 260, Appendix E)  
Lockwasher (145 AMP only)  
(Item 280, Appendix E)  
Lockwasher (145 AMP only)  
(Item 281, Appendix E)  
Lockwasher (2) (145 AMP only)  
(Item 286, Appendix E)  
Lockwasher (4) (145 AMP only)  
(Item 288, Appendix E)  
Lockwasher (1) (200 AMP only)  
(Item 288, Appendix E)  
Lockwasher (200 AMP only)  
(Item 296, Appendix E)  
Lockwasher (2) (200 AMP only)  
(Item 299, Appendix E)

*Personnel Required*

Two

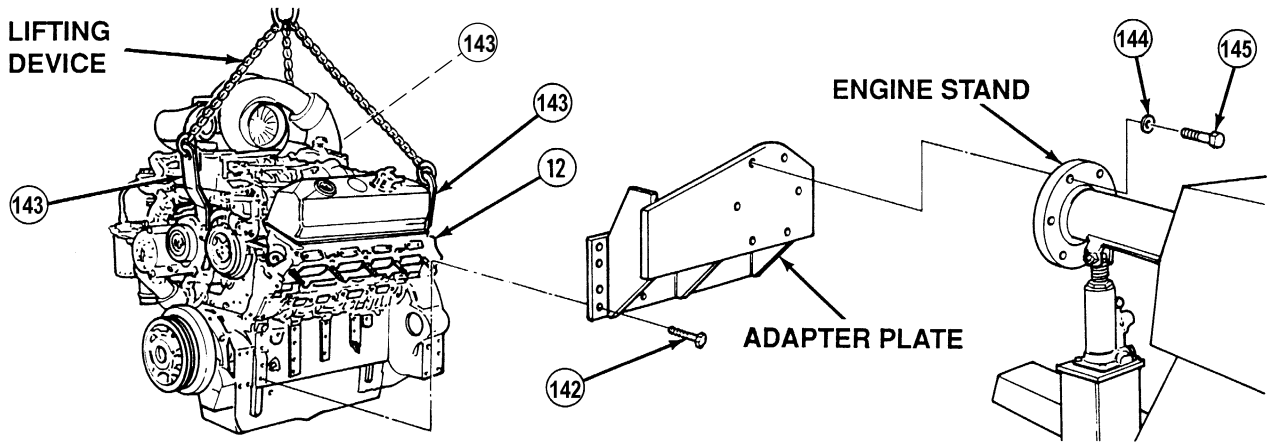
*Equipment Condition*

Right exhaust manifold installed, (Para 20-105)



**20-106. REMOVING ENGINE FROM STAND (CONT).**

**a. Remove Engine From Stand.**



**WARNING**

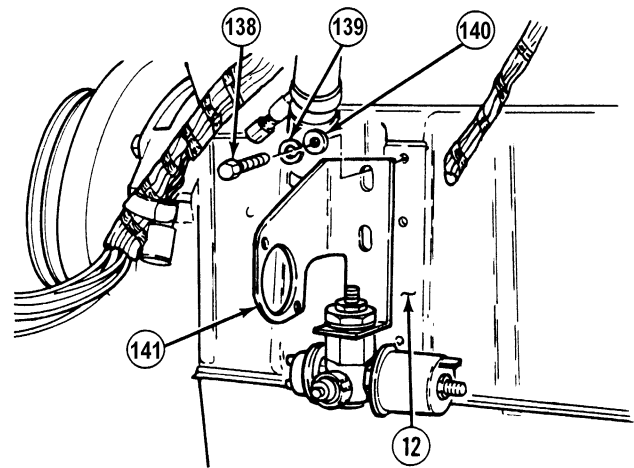
- Engine weighs 2,600 lbs (1,180 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.
- Keep out from under engine when lifting. If engine slips, sways or falls, serious injury or death may result.

**CAUTION**

- Ensure lifting device is not resting on turbo air inlet when lifting engine to prevent damage to inlet or turbocharger.
- Ensure loose wires and hoses are secure and moved out of way so they do not snag and cause damage when engine is lifted.
- Install lifting hooks as shown. Before lifting engine completely off supports, test by lifting slightly to see if balanced. If engine starts to tilt, lower and adjust chain lengths. Unbalanced engine can swing causing damage.

- (1) Install lifting device on engine (12) at lift points (143) and support weight of engine.
- (2) With the aid of an assistant, remove six screws (145) and lockwashers (144) from engine stand. Discard lockwashers.
- (3) Position engine (12) on jackstands.
- (4) Remove 13 screws (142) and adapter plate from engine (12).

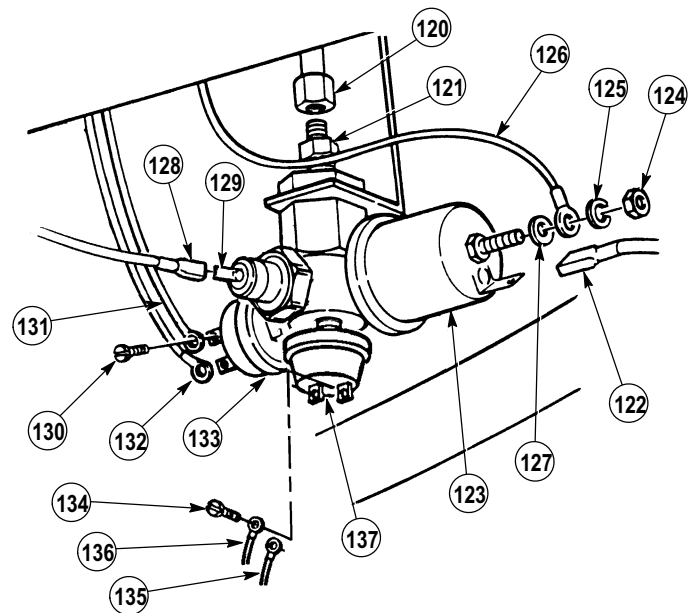
- (5) Install switch bracket assembly (141) on engine block (12) with two washers (140), lockwasher (139) and screws (138).
- (6) Remove two screws (130) from oil pressure switch (133).
- (7) Install wire 1517 (131) and wire 1871 (132) on oil pressure switch (133) with two screws (130).
- (8) Connect wire 1032 (128) to oil pressure switch (129).
- (9) Remove nut (124) and washer (127) from oil pressure sending unit (123).
- (10) Install washer (127), wire 1113 (126), lockwasher (125) and nut (124) on oil pressure sending unit (123).



**NOTE**

If equipped with 200 AMP alternator perform Steps (11) through (13).

- (11) Remove two screws (134) from oil pressure switch (137).
- (12) Install wire 1020B (136) and wire 1020A (135) on oil pressure switch (137) with two screws (134).



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (13) Apply electrical sealant to sending unit (123) terminal and two screws (134).
- (14) Install wire 1435 (122) on oil pressure sending unit (123).
- (15) Connect hose 2682 (120) to adapter (121).

**20-106. REMOVING ENGINE FROM STAND (CONT).**

**NOTE**

- If equipped with 200 AMP alternator, perform Steps (16) through (42).
- If equipped with a 145 AMP alternator, perform Steps (43) through (65).

- (16) Install wire 1020B (114), washer (113) and locknut (112) on terminal (115) of regulator (116). Tighten locknut to 25 lb-in (3 N·m).

**WARNING**

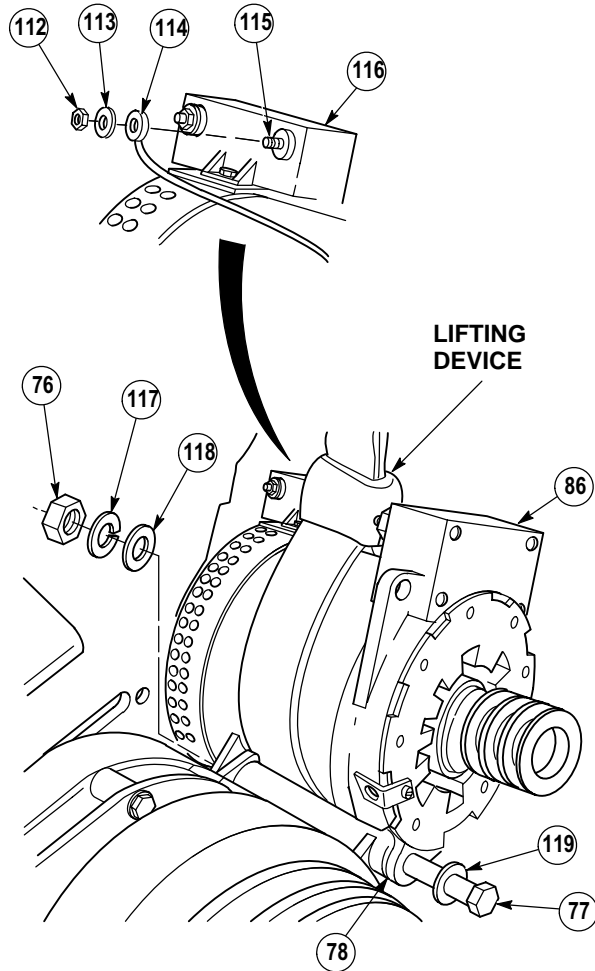
Adhesives, solvents, and sealing compounds can burn easily can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (17) Apply electrical sealant to terminal (115).

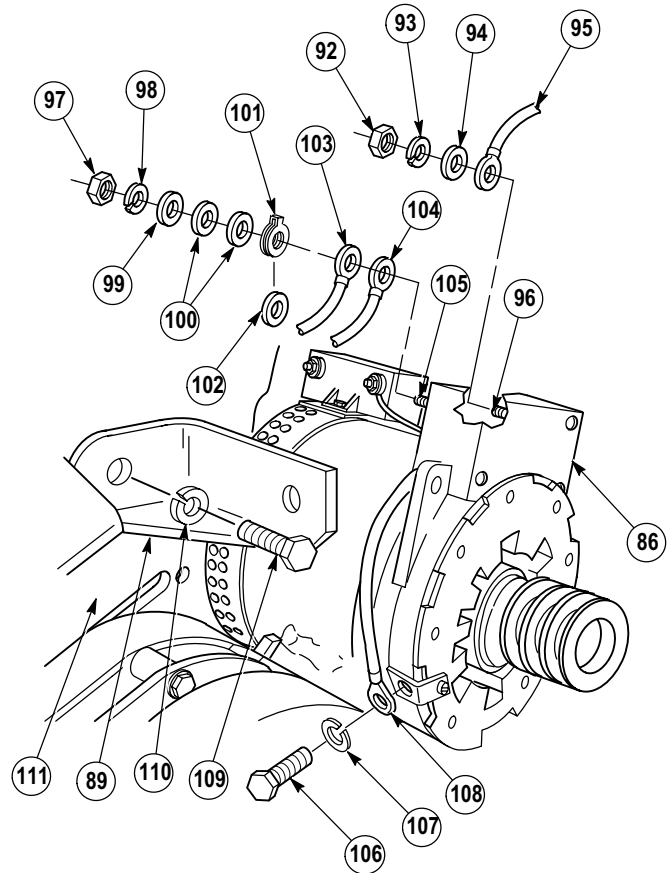
**WARNING**

Alternator weighs 75 lbs. (34 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- (18) With the aid of an assistant, install lifting device onto alternator and install alternator (86) in alternator mounting bracket (78).
- (19) Install screw (77), washer (119), washer (118), lockwasher (117) and nut (76) in alternator mounting bracket (78) and alternator (86).
- (20) Remove lifting device from alternator (86).



- (21) Position alternator bracket (89), lockwasher (110) and screw (109) on engine (111).
- (22) Install wire 1815 (108), lockwasher (107) and screw (106) on alternator (86).
- (23) Tighten screw (106) to 17 lb-ft (23 N·m).
- (24) Remove nut (97), washer (99), washer(s) (if present) (100), and fuse link (101) with insulator washer (102) from 24 volt terminal (105).
- (25) Install wire 1953 (104), wire 1820 (103), fuse link (101) with insulator washer (102), washer(s) (if removed) (100), washer (99), lockwasher (98) and nut (97) on 24 volt terminal (105).
- (26) Tighten nut (97) to 15 lb-ft (20 N·m).
- (27) Remove nut (92) and washer (94) from 12 volt terminal (96).
- (28) Install wire 1860 (95), lockwasher (93), washer (94) and nut (92) on 12 volt terminal (96).
- (29) Tighten nut (92) to 15 lb-ft (20 N·m).



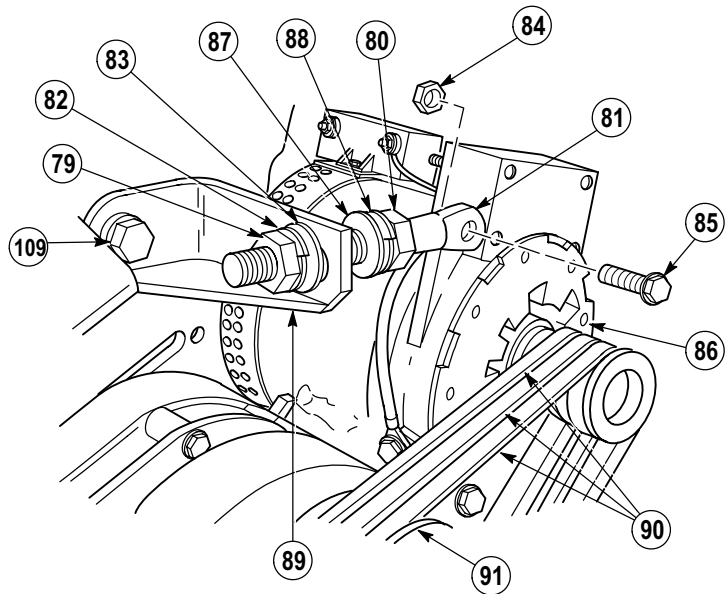
**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

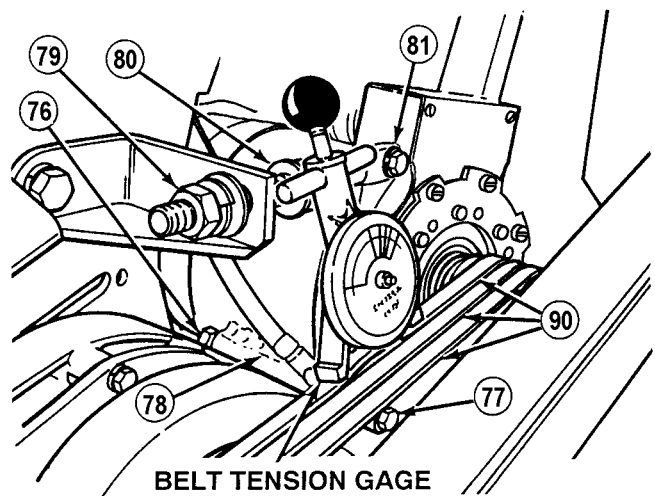
- (30) Apply electrical sealant to 12 volt terminal (96), 24 volt terminal (105) and screw (106).

**20-106. REMOVING ENGINE FROM STAND (CONT).**

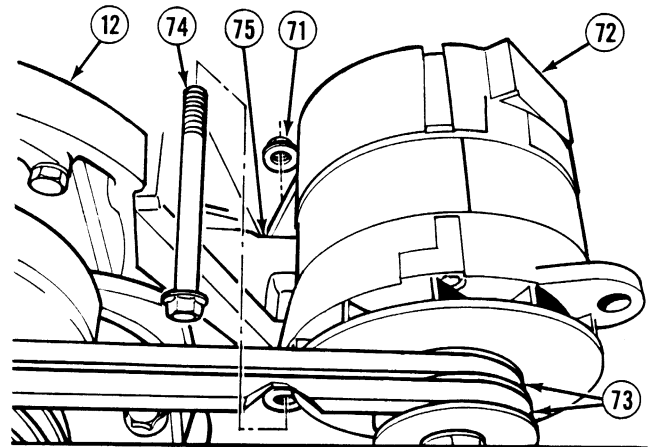
- (31) Position three alternator belts (90) on alternator (86) and engine pulley (91).
- (32) Install nut (80), lockwasher (88) and washer (87) on alternator arm (81).
- (33) Position alternator support arm (81) in bracket (89).
- (34) Tighten screw (109) to 170 lb-ft (23 N·m).
- (35) Position alternator support arm (81) on alternator (86) with screw (85) and locknut (84).
- (36) Position washer (83), lockwasher (82) and nut (79) on alternator support arm (81).



- (37) Install belt tensioning gage on belts (90).
- (38) Tighten locknut (80) on alternator support arm (81) until alternator belts tension reaches 60 to 65 lb-ft (81-88 N·m).
- (39) Tighten locknut (79) on alternator support arm (81).
- (40) Remove belt tensioning gage from belts (90).
- (41) Tighten locknut (84) on screw (85) to 26-30 lb-ft (30-41 N·m).
- (42) Tighten locknut (76) on screw (77) and alternator mounting bracket (78) to 90 lb-ft (122 N·m).



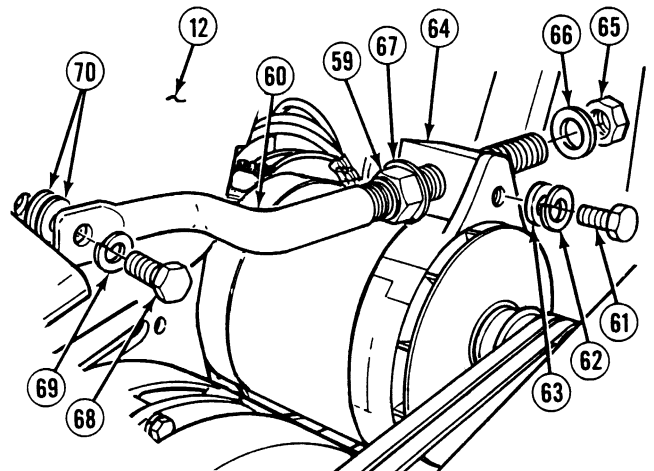
- (43) Position alternator (72) and screw (74) in bottom of alternator bracket (75).
- (44) Rotate alternator (72) towards center of engine (12) and install two belts (73). Slide alternator (72) into original position.
- (45) Position locknuts (71) on screw (74).



**NOTE**

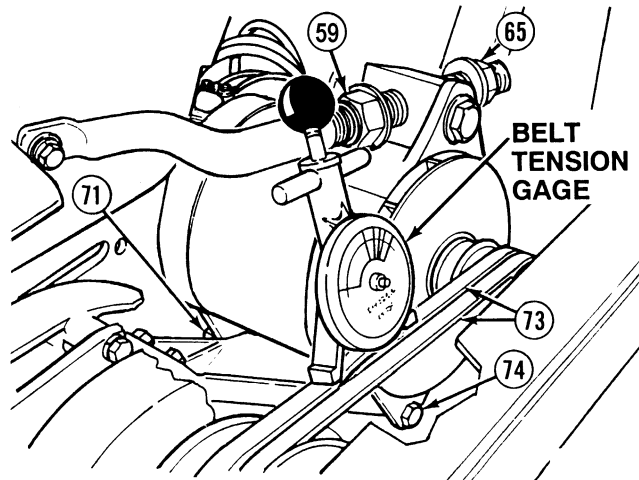
Install same number of washers as removed.

- (46) Position washers (70), alternator support arm (60) on engine (12) with lockwasher (69) and screw (68).
- (47) Position locknut (59), washer (67), eye rod end (64), washer (66) and locknut (65) on alternator support arm (60).
- (48) Position washer (63), lockwasher (62) and screw (61) in eye rod end (64).
- (49) Tighten screw (68) to 137 to 147 lb-ft (186 to 199 N·m).
- (50) Tighten screw (61) to 50 to 55 lb-ft (67 to 75 N·m).



**20-106. REMOVING ENGINE FROM STAND (CONT).**

- (51) Position belt tension gage on belts (73).
- (52) Tighten locknut (59) until alternator belt tension reaches 55 to 65 lb-ft (75 to 88 N·m).
- (53) Tighten locknut (65) to 75 lb-ft (102 N·m).
- (54) Remove belt tension gage from belts (73).
- (55) Tighten locknut (71) on screw (74) to 60 to 70 lb-ft (81 to 95 N·m).
- (56) Position STE/ICE-R alternator harness (58) on engine (12).

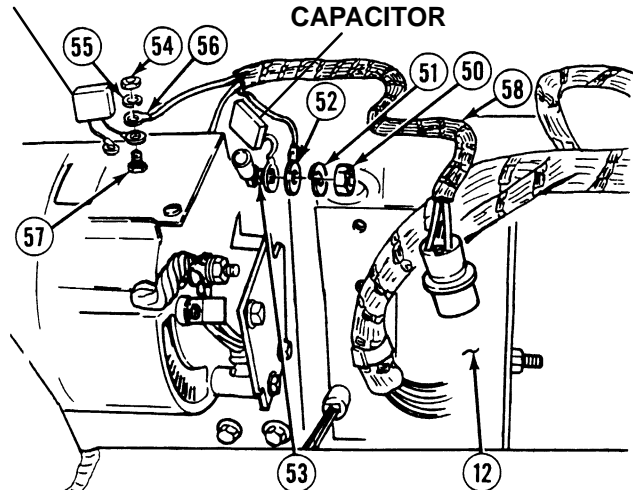


**NOTE**

Any capacitors or wires already mounted on the F-positive terminal must stay on that terminal during installation.

- (57) Remove nut (54) from F-positive terminal (57).
- (58) Install wire 1953 (56), lockwasher (55) and nut (54) on F-positive terminal (57).

**CAPACITOR**



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (59) Coat F-positive terminal (57) with electrical sealant.

**NOTE**

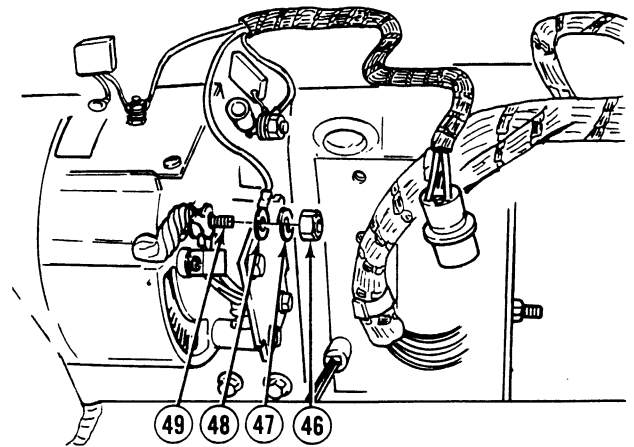
Any capacitors or wires already mounted on the positive terminal must stay on that terminal during installation.

- (60) Remove nut (50) from positive terminal (53).
- (61) Install wire 1820 (52), lockwasher (51) and nut (50) on positive terminal (53).
- (62) Coat positive terminal (53) with electrical sealant.

**NOTE**

Any wires already mounted on the negative terminal must stay on that terminal during installation.

- (63) Remove nut (46) from negative terminal (49).
- (64) Install wire 1815 (48), lockwasher (47) and nut (46) on negative terminal (49).



**WARNING**

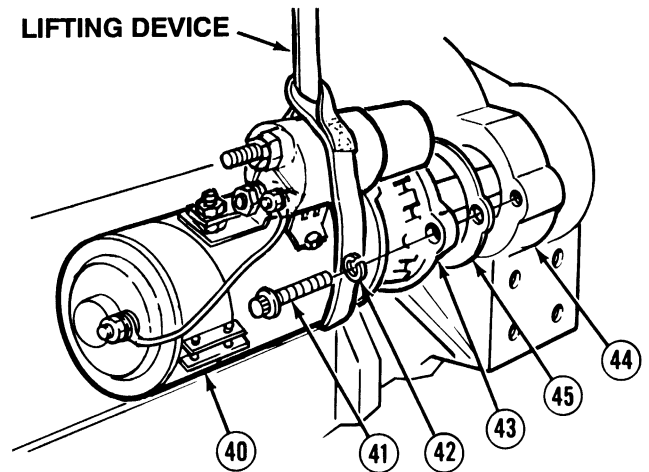
Adhesives, solvents, and sealing compounds can burn easily and give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (65) Coat negative terminal (49) with electrical sealant.

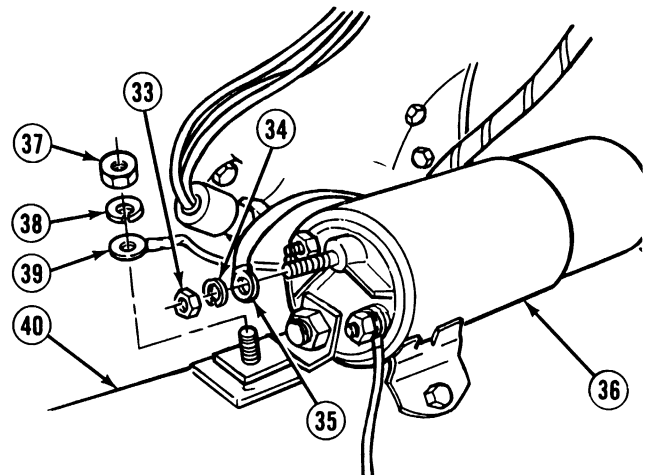
**WARNING**

Starter weighs 73 lbs (33 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

**LIFTING DEVICE**



- (66) Using a lifting device, install gasket (45), starter (40) in flywheel housing (44) with three lockwashers (42) and screws (41) through starter mounting bracket (43). Tighten screws to 137 to 147 lb-ft (186 to 199 N·m).
- (67) Remove lifting device from starter (40).
- (68) Remove nuts (37) and (33) from starter (40).
- (69) Install wire 1818 (39) on starter (40) with lockwasher (38) and nut (33). Tighten nut to 30 lb-ft (41 N·m).
- (70) Install wire 1816 (35) on starter solenoid (36) with lockwasher (34) and nut (33). Coat terminal with electrical sealant.



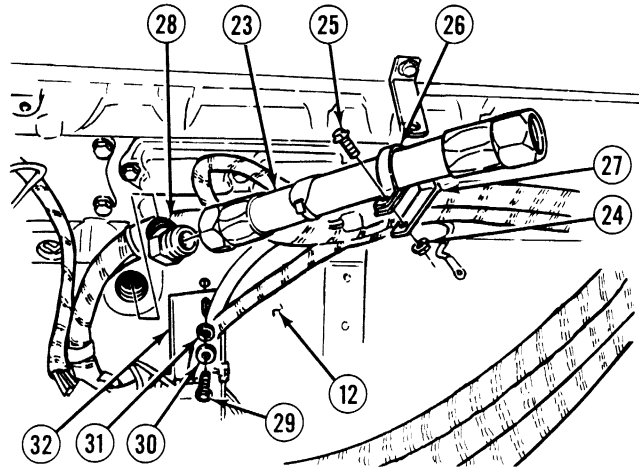


**20-106. REMOVING ENGINE FROM STAND (CONT).**

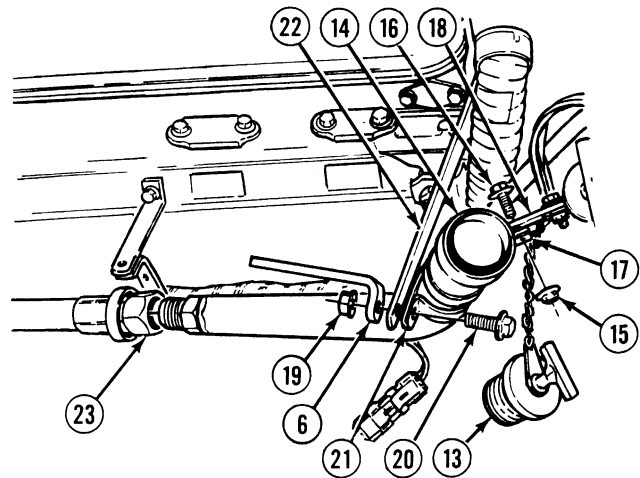
- (71) Install bracket (32) on engine (12) with two washers (31), lockwashers (30) and screws (29).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

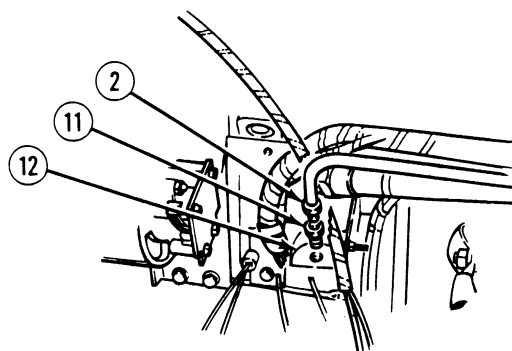


- (72) Apply sealing compound to threads of elbow (28).
- (73) Install elbow (28) in engine block (12).
- (74) Install filler hose 2999 (23) on elbow (28).
- (75) Position clamp (26) on filler hose 2999 (23) and install clamp (26) on bracket (27) with screw (25) and locknut (24).
- (76) Position two clamps (17) and (21) on filler tube (14).
- (77) Position filler tube (14) on filler hose 2999 (23).
- (78) Install bracket (6), clamp (21), screw (20) and locknut (19) to bracket (22).
- (79) Install clamp (17), screw (16) and locknut (15) to bracket (18).
- (80) Install filler cap (13) on filler tube (14).

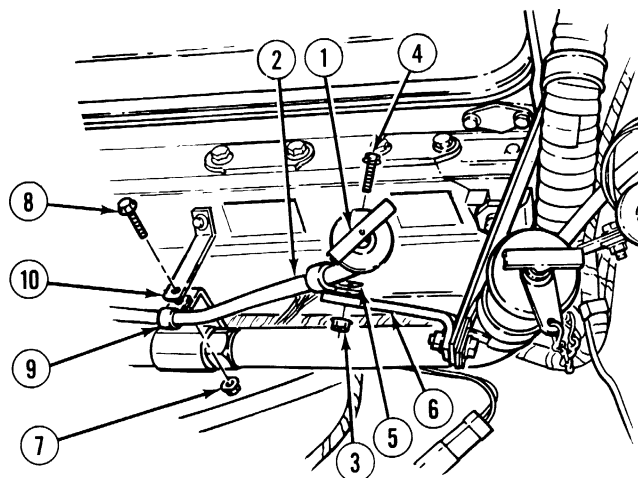
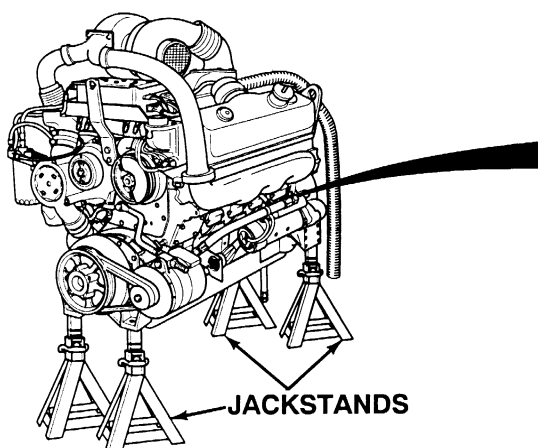


**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.



- (81) Apply sealing compound to threads of adapter (11) and install on engine block (12).
- (82) Apply sealing compound to threads of filler neck tube (2) and install on adapter (11).



- (83) Position two clamps (9) and (5) on filler tube (2).
- (84) Install clamp (9), screw (8) and locknut (7) on bracket (10).
- (85) Install clamp (5), screw (4) and locknut (3) on bracket (6).
- (86) Install engine oil dipstick (1) in filler neck (2).

**b. Follow-On Maintenance:**

- Install left hand air box drain, (Para 20-89).
- Install left hand exhaust manifold, (Para 20-105).
- Install left hand air box covers, (Para 20-90).
- Install engine in container, (Para 3-33).

**END OF TASK**



## CHAPTER 21

### FUEL SYSTEM MAINTENANCE

Para	Contents	Page
21-1	General Support Fuel System Maintenance Introduction .....	21-1
21-2	Blower Assembly Repair .....	21-2
21-3	Turbocharger Assembly Repair .....	21-23

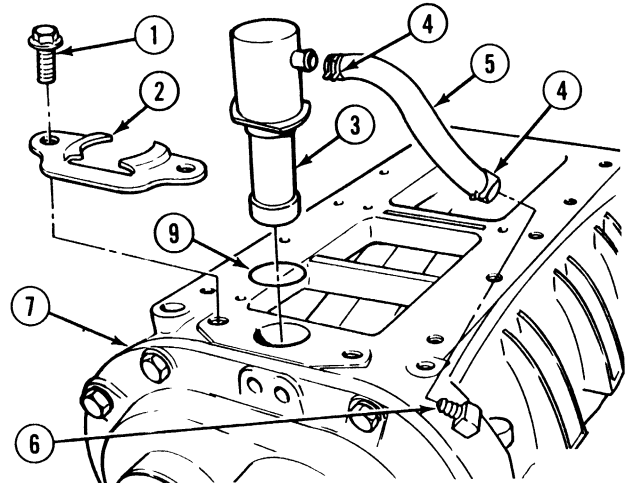
**21-1. GENERAL SUPPORT FUEL SYSTEM MAINTENANCE INTRODUCTION.**

This chapter contains maintenance instructions for repairing fuel system components as authorized by the Maintenance Allocation Chart (MAC) at the General Support Maintenance level.



**a. Disassembly.**

- (1) Remove two screws (1) from pressure clamp (2).
- (2) Remove pressure clamp (2) from bypass valve (3).
- (3) Compress lower clamp (4) and pull hose (5) off of hose fitting (6).
- (4) Remove bypass valve (3) and hose (5) from blower (7).
- (5) Remove two clamps (4) from hose (5).
- (6) Remove hose (5) from bypass valve (3).
- (7) Remove and discard preformed packing (9) from bypass valve (3).
- (8) Note position of hose fitting (6) and remove hose fitting (6) from blower (7).



**WARNING**

Keep hands and fingers clear of rotors. If rotors turn, fingers may get caught between rotors and result in injury to personnel.

**NOTE**

Matchmark rear blower housing cover and blower before removal.

- (9) Position drain pan under blower (7) to catch excess oil.

**NOTE**

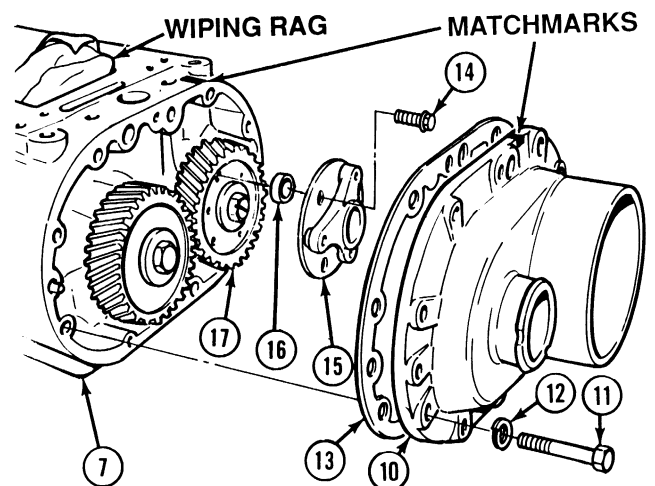
Wiping rag placed in blower will prevent rotors from turning.

- (10) Place wiping rag in blower (7).
- (11) Remove nine screws (11), lockwashers (12), rear blower housing cover (10) and gasket (13) from blower (7). Discard lockwashers and gasket.

**NOTE**

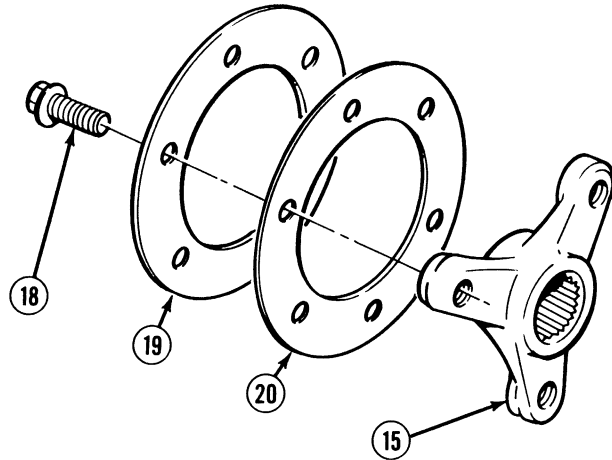
Spacer sleeves are behind hub and will fall out when hub screws are removed.

- (12) Remove three screws (14), hub (15) and three spacer sleeves (16) from gear (17). Discard screws.



**21-2. BLOWER ASSEMBLY REPAIR (CONT).**

- (13) Remove three screws (18) and spacer plates (19) and (20) from hub (15). Discard screws.



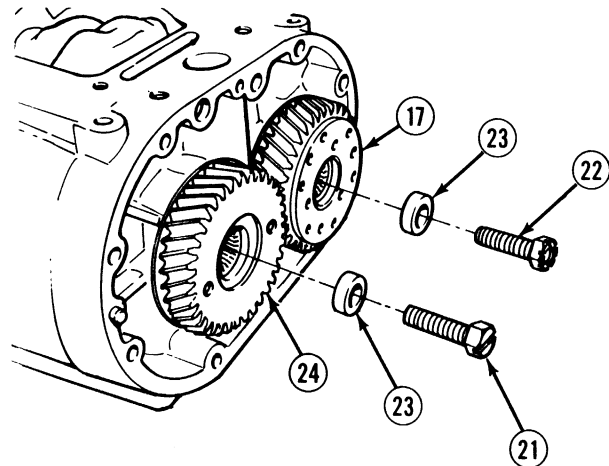
**WARNING**

Keep hands and fingers clear of rotors. If rotors turn, fingers may get caught between rotors and result in injury to personnel.

**NOTE**

Note location of slotted hex screw to left hand helix gear on left rotor.

- (14) Remove screws (21) and (22) and washers (23) from right timing gear (17) and left timing gear (24).



**NOTE**

Use five screws with puller tools on rear end plate. Use 5/16-24 by 1-1/2 in. (38 mm) screws and align with tapped holes in gears.

- (15) Install puller on left timing gear (24) with two screws (25).
- (16) Install puller on right timing gear (17) with three screws (25).

**CAUTION**

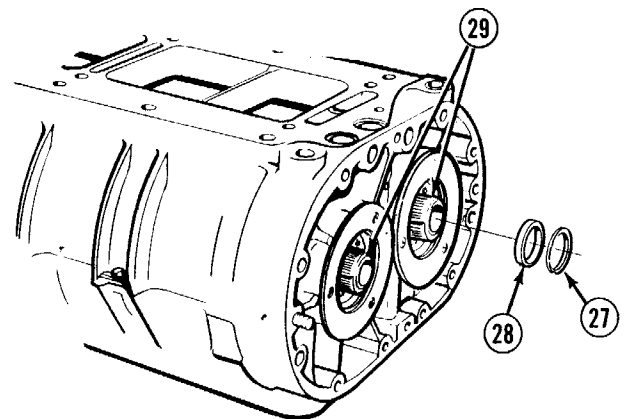
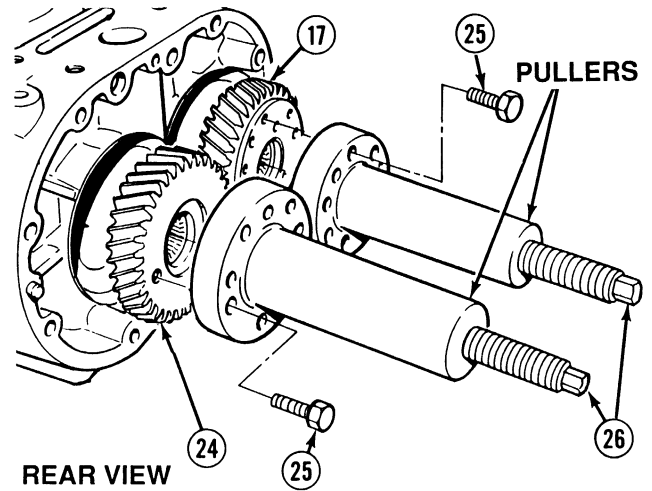
If puller screws are not tightened evenly during removal of timing gears, damage to gears may result.

- (17) Tighten screws (26) on pullers evenly to remove right timing gear (17) and left timing gear (24).
- (18) Remove pullers and five screws (25) from timing gears (17) and (24).

**NOTE**

- Amount of shims may vary on each shaft.
- Tag and mark shims during removal.

- (19) Remove shims (27) and spacer (28) from each rotor shaft (29).



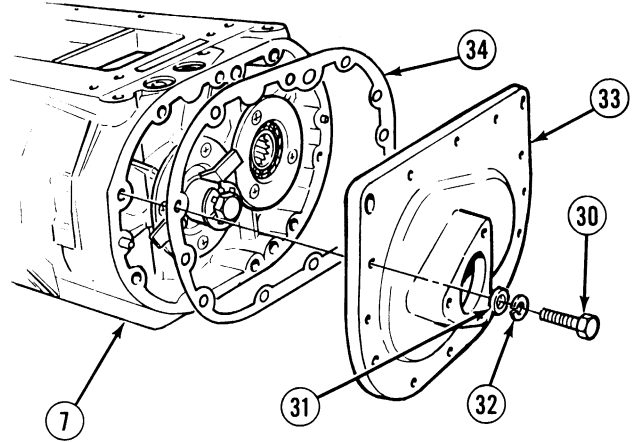


**21-2. BLOWER ASSEMBLY REPAIR (CONT).**

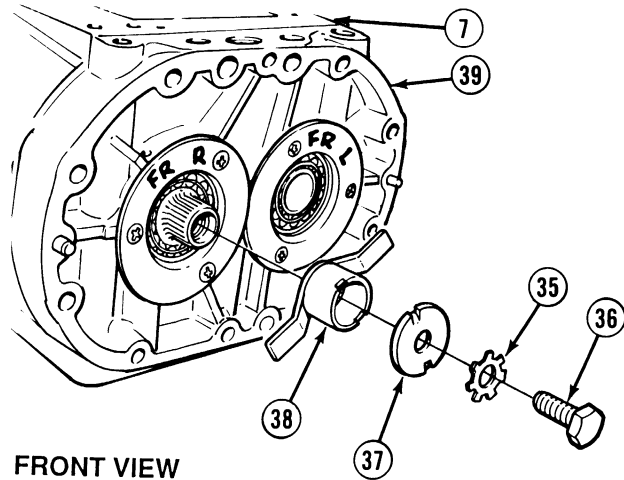
**NOTE**

Position drain pan under front cover.

- (20) Remove ten screws (30), washers (31) and lockwashers (32) from front cover (33). Discard lockwashers.
- (21) Remove front cover (33) and gasket (34) from blower (7). Discard gasket.



- (22) Bend tabs of lockwasher (35) flat.
- (23) Remove screw (36), lockwasher (35), fuel pump disk (37) and oil slinger (38) from front end plate (39). Discard lockwasher.
- (24) Remove wiping rag from blower (7).



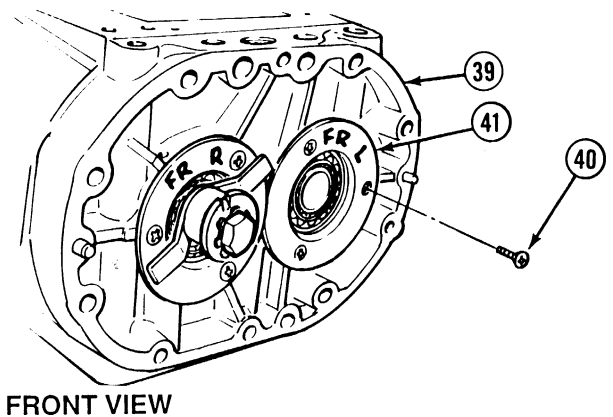
**CAUTION**

All parts to be matchmarked are to be marked as being viewed from rear of blower. Front matchmarks will be different than rear matchmarks. Failure to comply may result in damage to equipment.

**NOTE**

Matchmark front flanged bearing retainers.

- (25) Remove six screws (40) and two flanged bearing retainers (41) from front end plate (39). Discard screws.

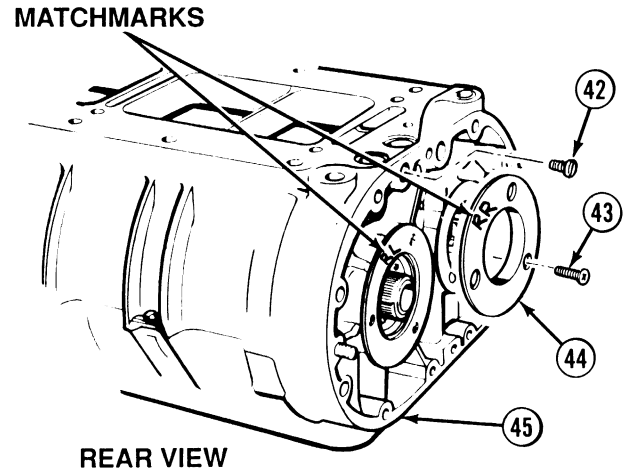


- (26) Loosen two screws (42) three turns.

**NOTE**

Matchmark rear bearing retainers.

- (27) Remove six screws (43) and two flat bearing retainers (44) from rear end plate (45). Discard screws.
- (28) Remove two screws (42) from rear end plate (45).



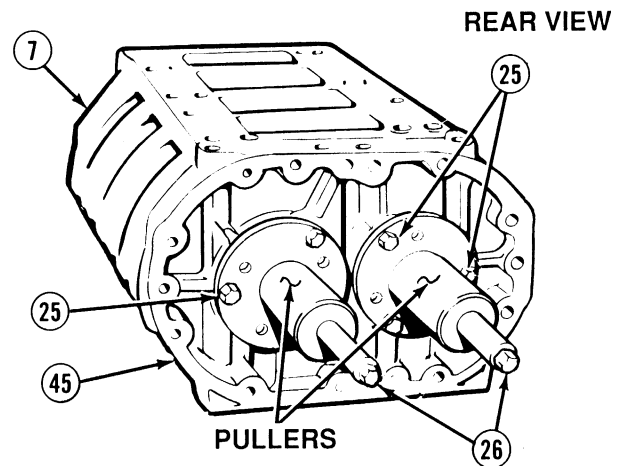
**NOTE**

Six puller screws must be 1/4-20 by 1-1/4 in.

- (29) Install puller on rear end plate (45) with two screws (25).
- (30) Install puller on rear end plate (45) with three screws (25).

**WARNING**

Keep hands and fingers clear of rotors. If rotors turn, fingers may get caught between rotors and result in injury to personnel.



- (31) Turn both puller screws (26) evenly clockwise and remove rear end plate (45) from blower (7).
- (32) Remove pullers and five screws (25) from rear end plate (45).

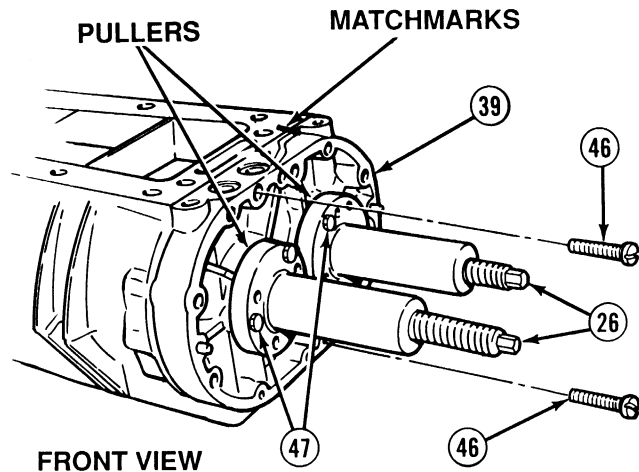
**21-2. BLOWER ASSEMBLY REPAIR (CONT).**

- (33) Remove two screws (46) from front end plate (39).

**NOTE**

- Matchmark front end plate and indicate top. Matchmark front end of blower housing and indicate top.
- Use 1/4-20 by 1 1/4 in. screws on pullers.

- (34) Install two pullers on front end plate (39) with six screws (47).
- (35) Turn both puller screws (26) evenly clockwise and remove front end plate (39).
- (36) Remove two pullers and six screws (47) from front end plate (39).



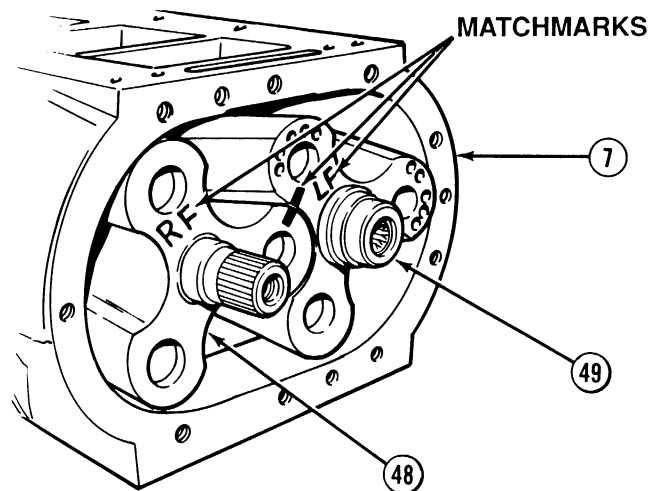
**CAUTION**

Handle rotors with care to avoid scratching surfaces. Scratching surface may cause damage to parts.

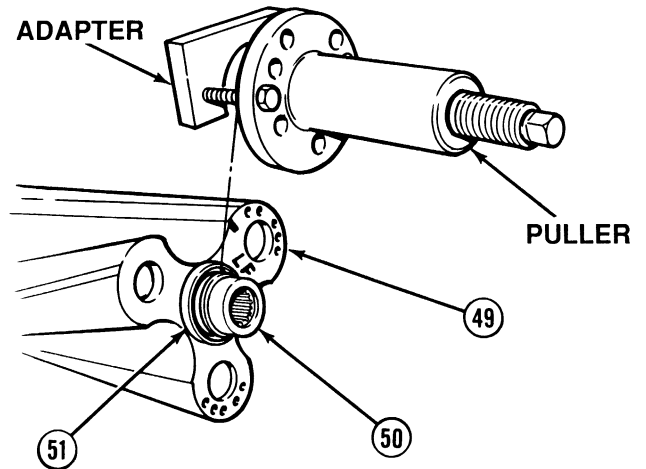
**NOTE**

- Rotors are marked left and right as viewed from rear of blower.
- Both rotors are removed at same time.
- Matchmark front right and front left rotors to each other before removal.

- (37) Remove right rotor (48) and left rotor (49) from blower (7).



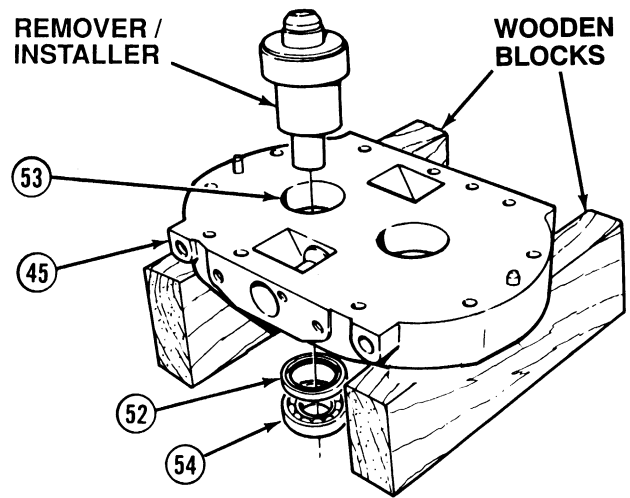
- (38) Install puller and adapter on bearing race (50).
- (39) Remove bearing race (50) from left front rotor (49).
- (40) Remove bearing race (50) from puller.
- (41) Remove and discard oil seal (51) from left front rotor (49).



**NOTE**

Repeat Steps (42) through (44) for left and right bore.

- (42) Position rear end plate (45) on wooden blocks with seal (52) facing upward.
- (43) Place long end of remover and installer tool in bore (53) through seal (52) into ball bearing (54).
- (44) Remove ball bearing (54) and seal (52) from rear end plate (45). Discard seal.

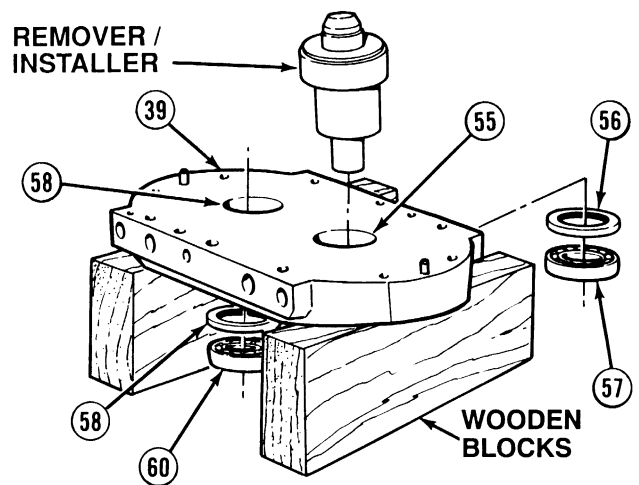


- (45) Place long end of remover and installer tool in right bore (55) of front end plate (39) through seal (56) and in roller bearing (57).
- (46) Remove roller bearing (57) and seal (56) from front end plate (39). Discard seal.

**NOTE**

Inner bearing race, removed in Step (39), may be positioned in left roller bearing for support.

- (47) Install long end of remover and installer tool in left bore (58) of front end plate (39) through seal (59) and in roller bearing (60).
- (48) Remove roller bearing (60) and seal (59) from front end plate (39). Discard seal.



**21-2. BLOWER ASSEMBLY REPAIR (CONT).**

***b. Cleaning/Inspection.***

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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.

**CAUTION**

Do not use compressed air on bearings. Allow bearings to air dry. Compressed air may cause damage to bearings.

- (1) Clean metal parts in drycleaning solvent. Dry parts, except bearings, with compressed air. Allow bearings to air dry.
- (2) Inspect roller and ball bearings for corrosion, scoring, pitting, or other damage.
- (3) Inspect both timing gears at teeth and at bore splines for chips or nicks. If replacement is necessary, both gears must be replaced.
- (4) Inspect oil holes. If clogged, clean with drycleaning solvent.
- (5) Inspect all finished surfaces for burrs and scoring. Use crocus cloth to clean.
- (6) Inspect blower rotors for burrs or scoring. If rotors are slightly scored or burred, they may be cleaned with emery cloth.
- (7) Inspect rotor shaft splines for burrs or peening.
- (8) Inspect inner bearing races for burrs or scoring.
- (9) Inspect inside surface of blower housing for burrs or scoring. If burred or scored, clean with emery cloth.
- (10) Check machined ends of blower housing and end plates for flatness and burrs. If end plates are slightly scored or burred, clean with emery cloth.
- (11) Clean out oil galleries with drycleaning solvent. Dry with compressed air.

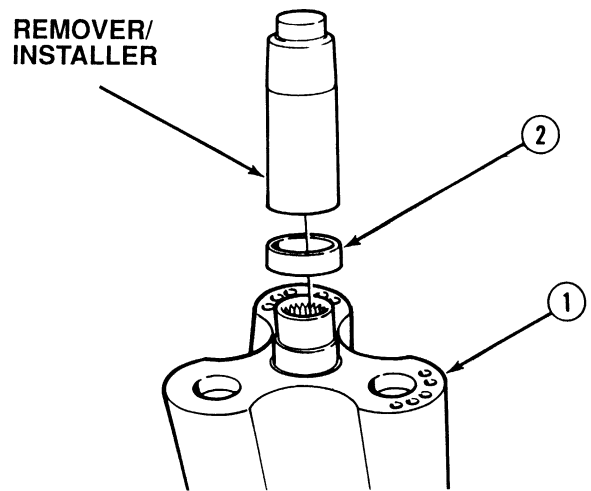
- (12) Check dowel pins in front and rear end plates. Dowel pins must project 0.320 in. (8.1 mm) from flat inner face of end plates.
- (13) Replace all parts failing inspection.

**c. Assembly.**

**NOTE**

Perform Steps (1) and (2) for four oversized seal spacers on both rotors.

- (1) Support rotor (1) on wooden blocks in press.
- (2) Using remover and installer tool, install oversized seal spacer (2) on rotor (1) until fully seated.



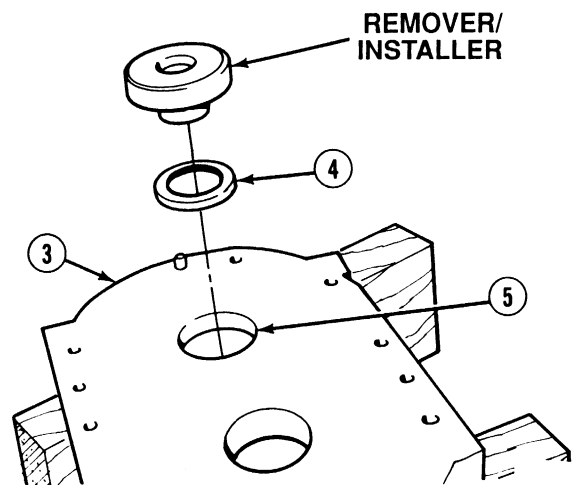
**CAUTION**

- Do not lubricate seals, spacers, or blower rotor shafts prior to seal installation. Teflon seals must be installed dry. Failure to comply will result in improper sealing.
  - Double lipped Teflon seals are packaged around plastic insert which should not be removed prior to installation. Sleeve protects lips of seals during shipment and acts as seal lip expander during blower assembly. Failure to comply could result in damage to parts.
- (3) Place end plate (3) on press on wooden blocks with machined side facing upward.

**NOTE**

Part number on seal should be facing upward.

- (4) Using large end of remover and installer tool, install double lipped Teflon seal (4) in end plate (3).
- (5) Press seal (4) into bore (5) until shoulder of installer contacts end plate (3).
- (6) Repeat Steps (3) through (5) to install remaining three seals (4) in end plates (3).

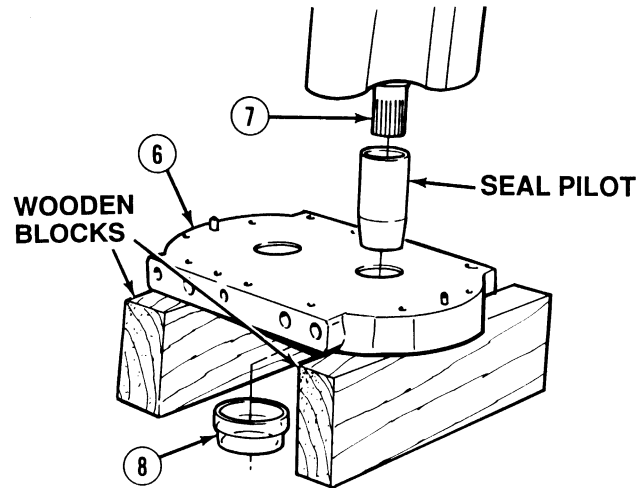


**21-2. BLOWER ASSEMBLY REPAIR (CONT).**

**NOTE**

- Perform Steps (7) and (9) for left and right rotors.
- Ensure matchmarks on rotor shafts are aligned before installation.

- (7) Support front end plate (6) with wooden blocks.



**NOTE**

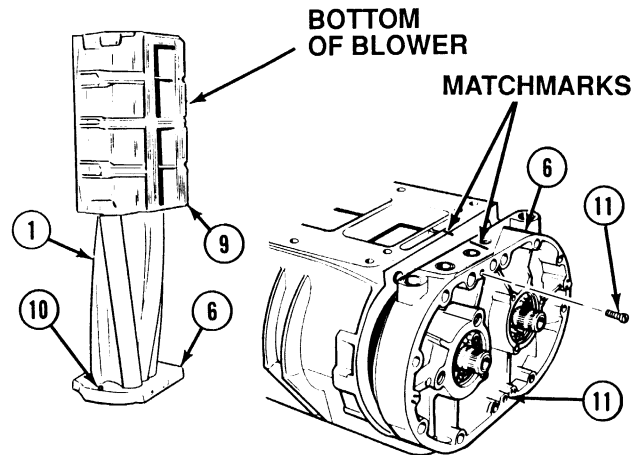
Tool will drive out plastic insert in seal.

- (8) Install seal pilot over rotor shaft (7).
- (9) Install rotor shaft (7) in front end plate (6) and remove plastic insert (8). Discard plastic insert.
- (10) Remove seal pilot from front end plate (6).

**NOTE**

Position blower housing over rotors standing on end.

- (11) Align matchmarks on top of blower housing (9) with top edge of front end plate (6).
- (12) Align dowel pins (10) and position blower housing (9) over rotors (1) onto end plate (6).
- (13) Install two screws (11) in front end plate (6). Tighten 60 to 120 lb-in (7 to 14 N·m).



- (14) Install seal guides on gear end of rotor shaft (7).

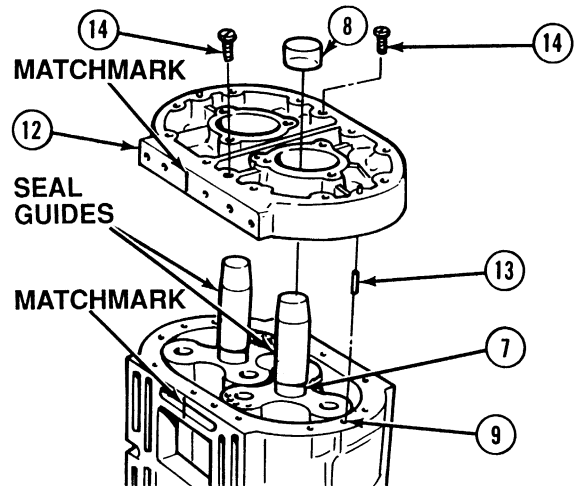
**NOTE**

Plastic inserts in seal will come out with installation of rear end plate.

- (15) Align matchmarks and position rear end plate (12), machined side down, and align dowel pins (13) to holes in blower housing (9).

- (16) Using soft faced hammer, tap rear end plate (12) in blower housing (9) to remove plastic inserts (8). Discard plastic inserts.

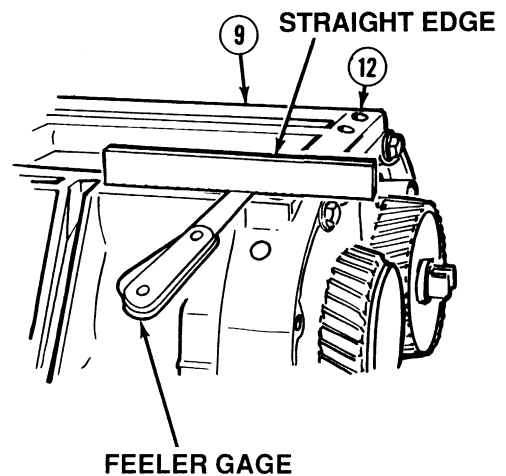
- (17) Install and tighten two screws (14) in rear end plate (12) to 60 to 120 lb-in (7 to 14 N·m).



**NOTE**

- Perform Step (18) for rear and front end plate.
- Two measurements are taken on each end plate. Each measurement should be taken one in. (25 mm) from each end of end plate.
- Protrusion of blower housing to end plates should not be more than 0.0005 in. (0.01270 mm) above to 0.0065 in. (0.1651 mm) below end plate.
- Protrusion in Step (18) is checked at cylinder block side of blower.

- (18) Using feeler gage and straight edge, check blower end plate (12) to blower housing (9).





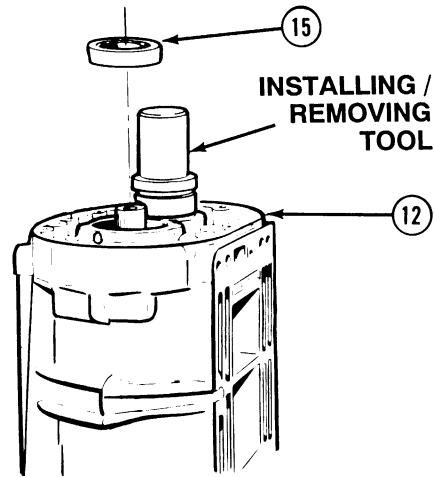
**21-2. BLOWER ASSEMBLY REPAIR (CONT).**

- (19) Apply lubricating oil to two ball bearings (15).

**NOTE**

- Perform Step (20) for left and right bearings.
- Ball bearings are installed with numbered end facing upward.

- (20) Using bearing installer, install two ball bearings (15) in rear end plate (12).



- (21) Turn blower housing (9) so front end plate (6) faces upward.

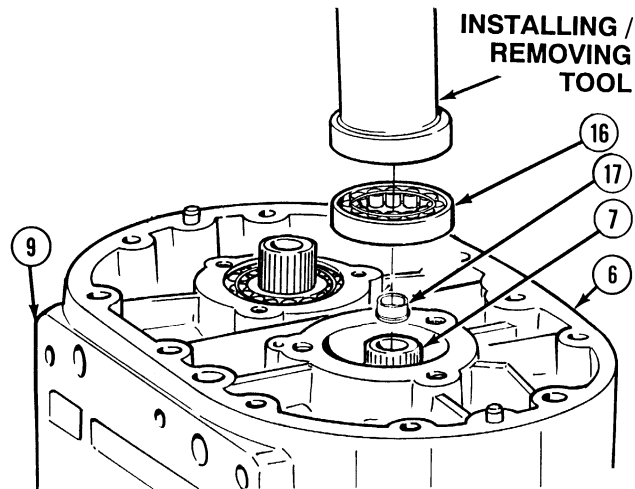
- (22) Apply lubricating oil to two roller bearings (16).

**NOTE**

- Perform Steps (23) through (25) for left and right rotor shafts.
- Bearing race in Step (23) and roller bearings in Step (24) are installed with numbered side facing upward.

- (23) Install bearing race (17) on roller bearing (16).

- (24) Using bearing installer, install roller bearings (16) over rotor shafts (7).



**NOTE**

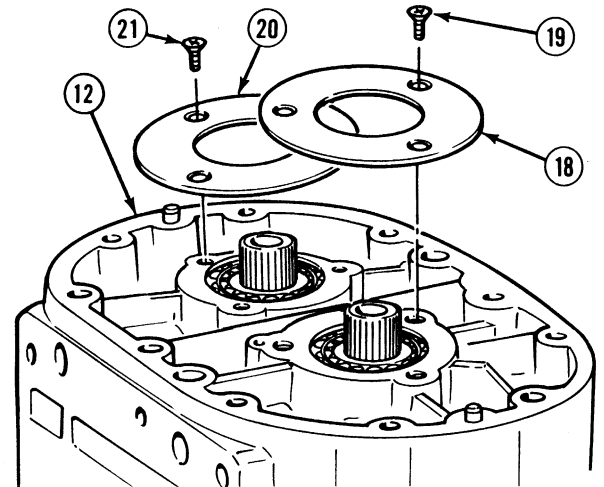
Flat bearing retainers are installed on rear end plate with chamfered holes facing upward.

- (25) Install flat bearing retainer (18) on rear end plate (12) with three screws (19). Tighten screws to 84 to 108 lb-in (9 to 12 N·m).

**NOTE**

Flanges on bearing retainers face front end plate.

- (26) Install flanged bearing retainer (20) with three screws (21) in front end plate (6). Tighten screws 84 to 108 lb-in (9 to 12 N·m).
- (27) Position blower housing (9) on flat surface.



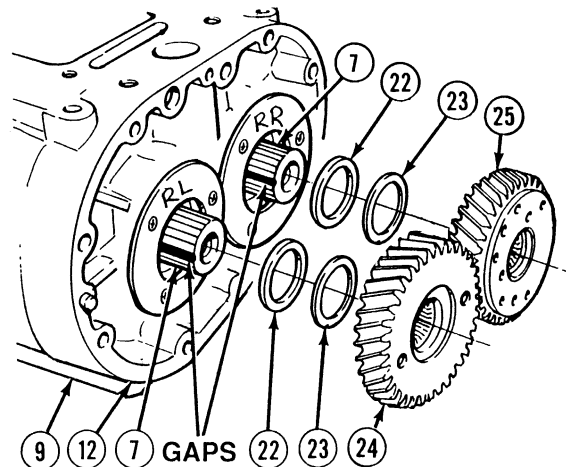
**WARNING**

Keep hands and fingers clear of rotors. If rotors turn, fingers may get caught between rotors and result in injury to personnel.

- (28) Set rotor shafts (7) at rear end plate (12) so that each gap in splines face left side.
- (29) Install spacer (22) and shim (23) on each rotor shaft (7).

**CAUTION**

Ensure right hand gear is installed on right hand rotor and left hand gear is installed on left hand rotor or damage to parts may occur.



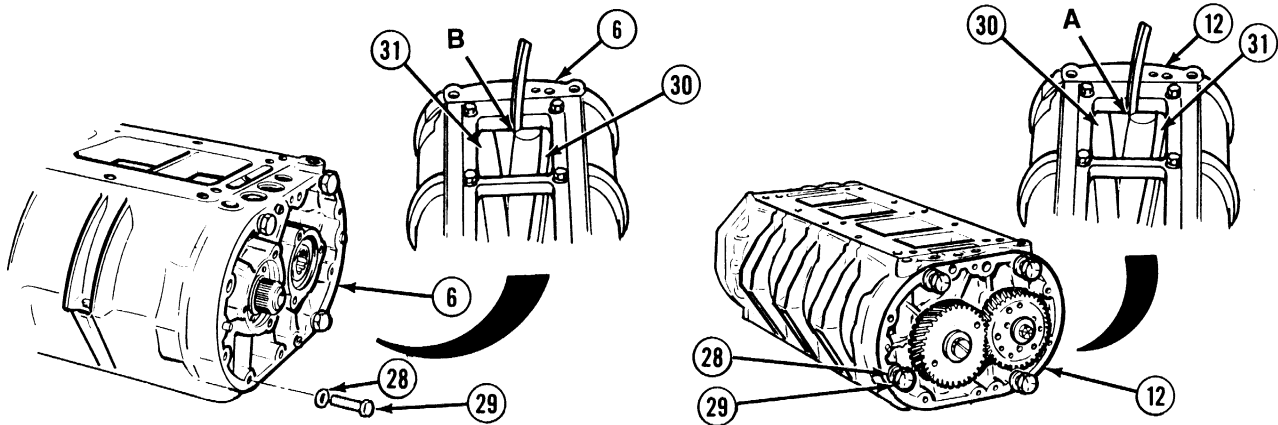
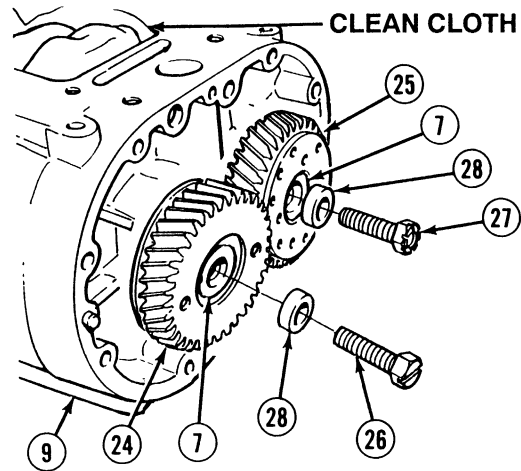
- (30) Lubricate rotor shaft (7) with lubricating oil.
- (31) Start both timing gears (24) and (25) at same time so gap in splines on gears mate with gap in splines on rotor shafts (7).

**21-2. BLOWER ASSEMBLY REPAIR (CONT).**

**NOTE**

Slotted screw from tach drive goes on left hand gear.

- (32) Lubricate threads of screws (26) and (27) with lubricating oil.
- (33) Install two timing gear washers (28) and screws (26) and (27) on rotor shafts (7).
- (34) Place clean cloth in blower housing (9).
- (35) Tighten both timing gear screws (26) and (27) evenly to draw both timing gears (24) and (25) tight to rear end plate (12).
- (36) Tighten timing gear screws (26) and (27) 100 to 110 lb-ft (135 to 149 N·m).



**NOTE**

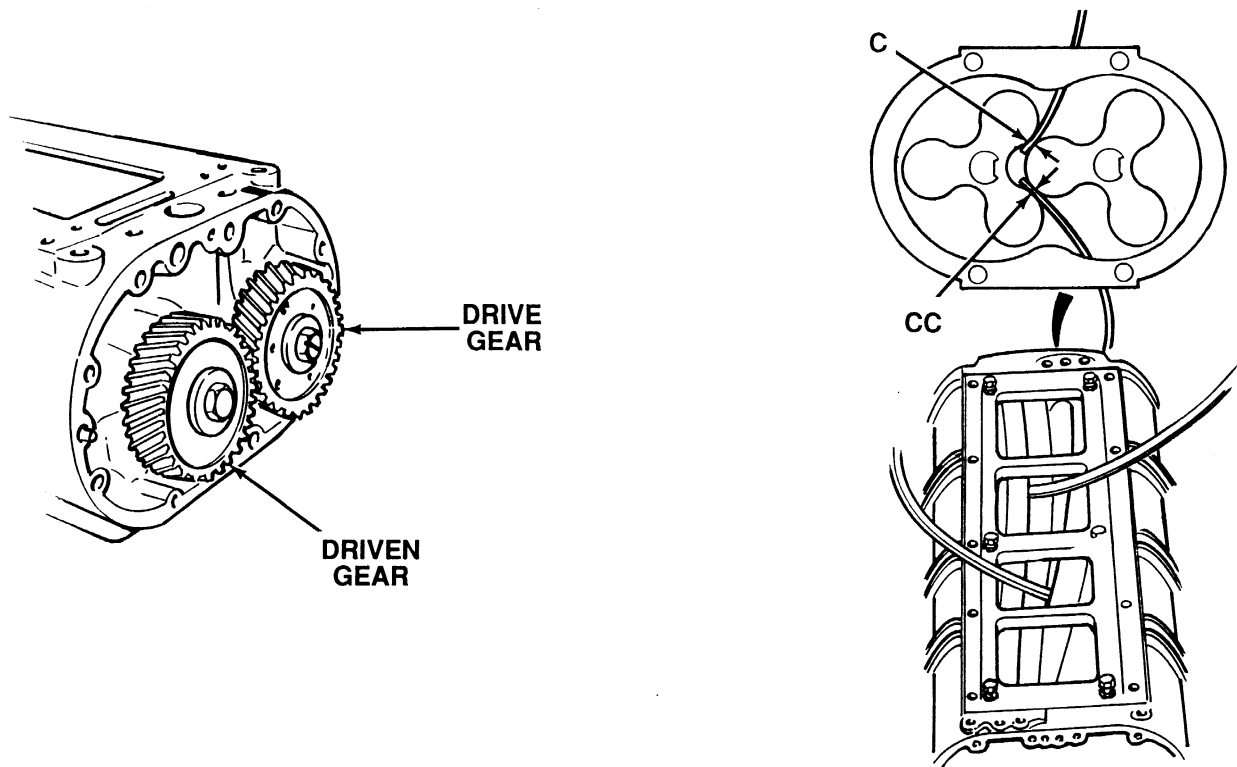
Screws should be 5/16-18 by 1 7/8 in.

- (37) Install four washers (28) and screws (29) in front end plate (6) and four washers (28) and screws (29) in rear end plate (12). Tighten screws (29) 156 to 204 lb-in (18 to 23 N·m).

**NOTE**

- Feeler gage is inserted between end plates and end of rotors. This must be performed at ends of each lobe, making 12 measurements in all.
- If proper clearance cannot be obtained at points (A) and (B), replace blower.

- (38) Check clearances at points A and B, between lobes of rotors (30) and (31) and end plates (6) and (12). Each rotor lobe must be checked. Minimum clearance at point A is 0.007 in. (0.178 mm). Minimum clearance at point B is 0.019 in. (0.482 mm).



**NOTE**

- Rotor to rotor measurements must be measured one in. (2.54 cm) from each end and at center of blower.
- Add shims behind driven gear to increase (C) clearance.

(39) Measure clearances between rotor lobes at points (C). Minimum clearance is 0.013 in. (0.330 mm).

**NOTE**

- Placing 0.003 in. (0.076 mm) shim behind gear rotates rotor 0.001 in. (0.025 mm).
- Add shims behind drive gear to increase (CC) clearance.

(40) Measure clearances at points (CC). Minimum clearance is 0.013 in. (0.330 mm).

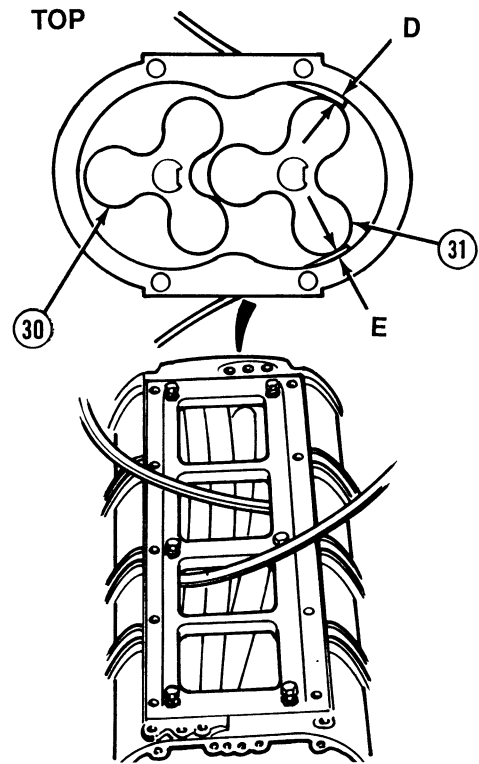
**21-2. BLOWER ASSEMBLY REPAIR (CONT).**

- (41) Rotate rotors (30) and (31) to align lobes with points (D).

**NOTE**

If proper clearance cannot be obtained at points D and E, replace blower.

- (42) Measure clearances at points (D). Minimum clearance is 0.015 in. (0.381 mm).
- (43) Rotate rotors (30) and (31) to align lobes with points (E).
- (44) Measure clearances at points (E). Minimum clearance is 0.009 in. (0.228 mm).



- (45) Rotate rotors (30) and (31) 180 degrees.

**NOTE**

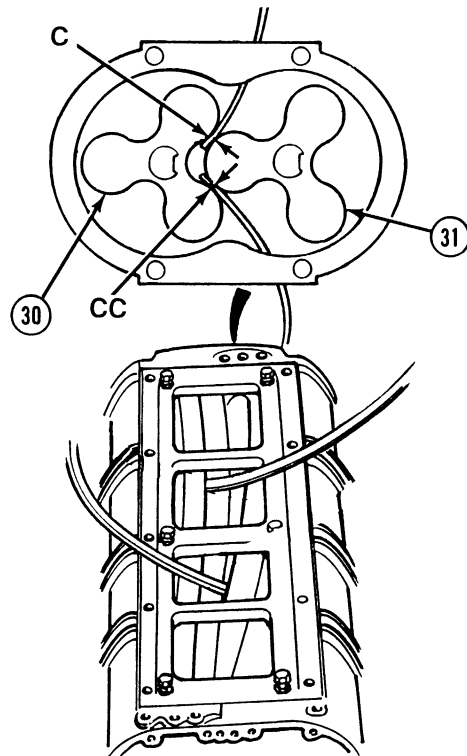
Add shims behind driven gear to increase (C) clearance.

- (46) Measure clearance at points (C). Minimum clearance is 0.013 in. (0.330 mm).

**NOTE**

Add shims behind drive gear to increase (CC) clearance.

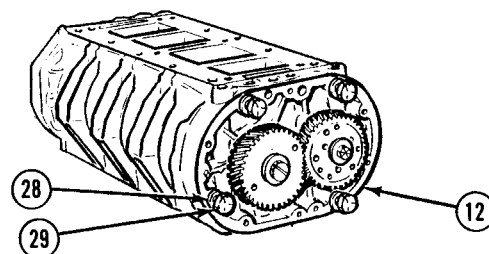
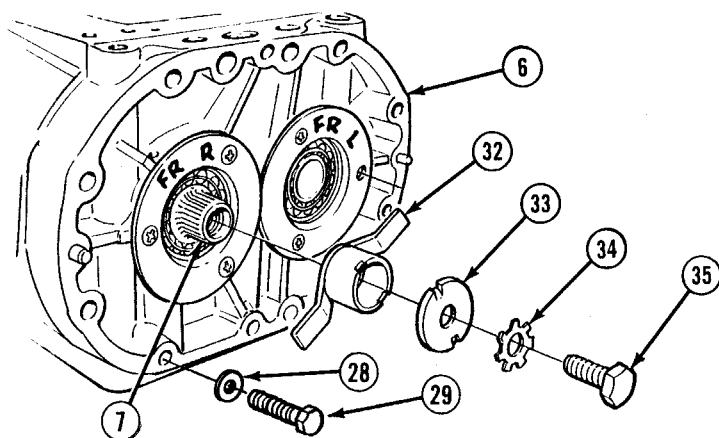
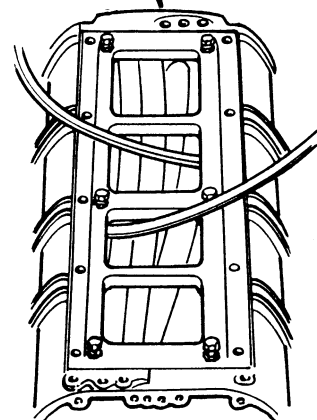
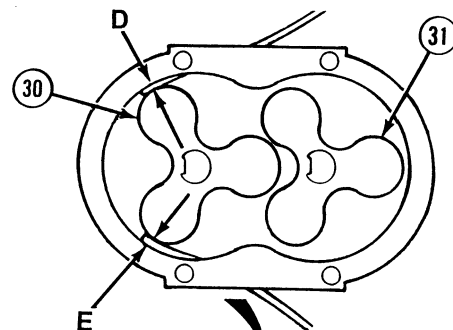
- (47) Measure clearance at point (CC). Minimum clearance is 0.013 in. (0.330 mm).



**NOTE**

If clearance cannot be obtained at points (D) and (E), replace entire blower assembly.

- (48) Rotate rotors (30) and (31) to align lobes with points (D). Measure clearance at points (D). Minimum clearance is 0.015 in. (0.381 mm).
- (49) Measure clearance at points (E). Minimum clearance is 0.009 in. (0.228 mm).



- (50) Remove four screws (29) and washers (28) from front end plate (6) and four screws (29) and washers (28) from rear end plate (12).
- (51) Install oil slinger (32) on rotor shaft (7) at front end plate (6).

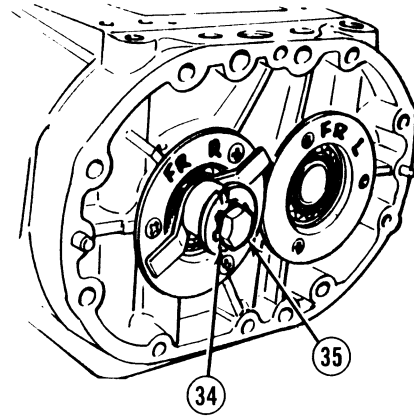
**NOTE**

Ensure tang on fuel pump disk locks into groove in spacer.

- (52) Install fuel pump disk (33), lockwasher (34) and screw (35) on rotor shaft (7).
- (53) Place clean shop towel between two rotors (30) and (31).
- (54) Bend one lockwasher (34) tab in groove of fuel pump disk (33).

**21-2. BLOWER ASSEMBLY REPAIR (CONT).**

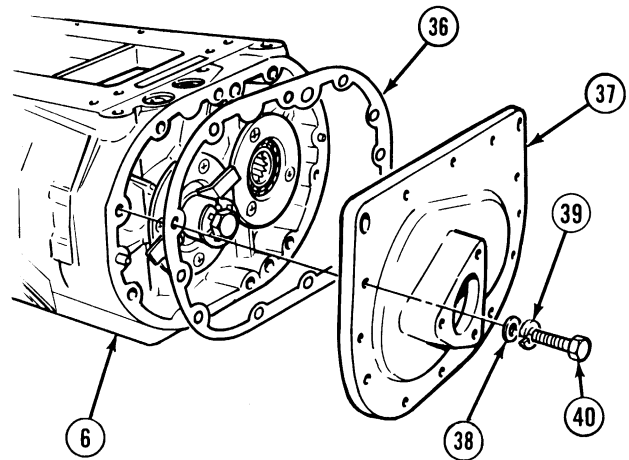
- (55) Tighten screw (35) 55 to 65 lb-ft (74 to 88 N·m).
- (56) Bend two more lockwasher (34) tabs against flat sides of screw (35).



**NOTE**

One screw and washer was removed during removal and nine screws and washers were removed during disassembly.

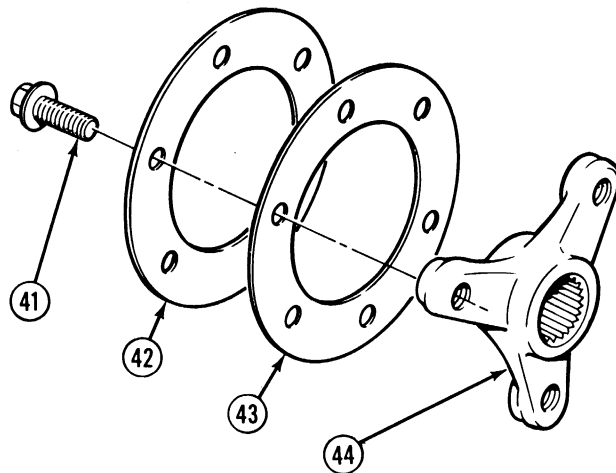
- (57) Install gasket (36) and front cover (37) on front end plate (6) with ten washers (38), lockwashers (39) and screws (40). Tighten 156 to 204 lb-in (18 to 23 N·m).



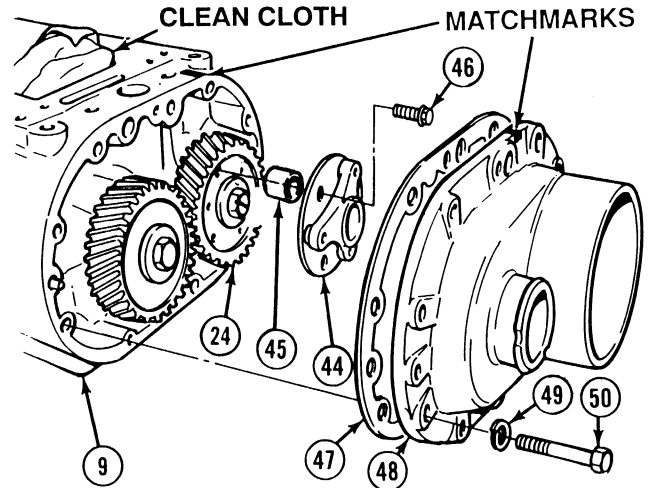
**NOTE**

Machined side of hub faces spring plate.

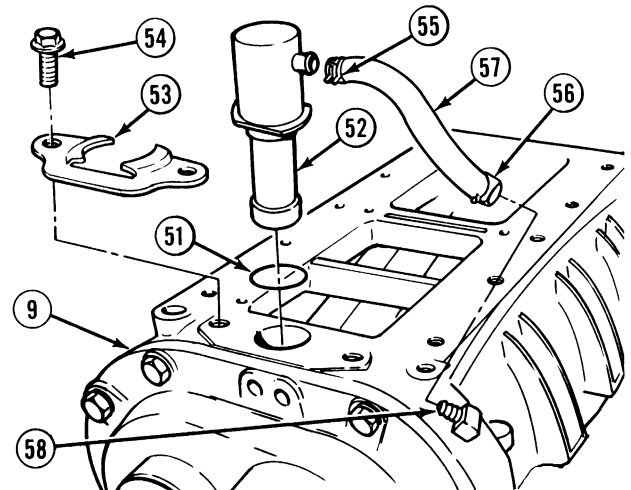
- (58) Install three screws (41) and two spring plates (42) and (43) in hub (44).
- (59) Install hub (44) in vise with soft jaws and tighten three screws (41) 25 to 30 lb-ft (34 to 41 N·m).
- (60) Remove hub (44) from soft-jawed vise.



- (61) Install three spacers (45) and hub (44) with three screws (46) on gear (24). Tighten screws 25 to 30 lb-ft (34 to 41 N·m).
- (62) Remove cleaning cloth from blower housing (9).
- (63) Install gasket (47) and rear end plate cover (48) on blower housing (9).
- (64) Install nine lockwashers (49) and screws (50) on rear end plate cover (48). Tighten screws evenly 156 to 204 lb-in (18 to 23 N·m).



- (65) Install preformed packing (51) on by-pass valve (52).
- (66) Install by-pass valve (52) on blower (9) until fully seated.
- (67) Install pressure clamp (53) on bypass valve (52).
- (68) Install two screws (54) in pressure clamp (53). Tighten screws 23 to 26 lb-ft (31 to 35 N·m).
- (69) Install two clamps (55) and (56) on hose (57).



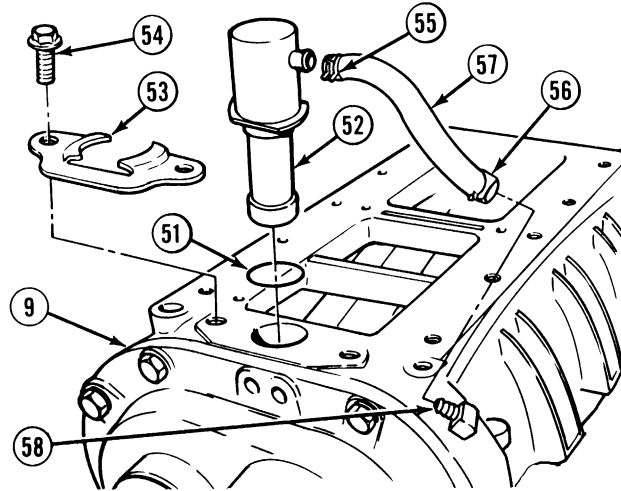


**21-2. BLOWER ASSEMBLY REPAIR (CONT).**

**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.

- (70) Apply sealing compound on threads of hose fitting (58).
- (71) Install hose fitting (58) securely in position as noted during disassembly.
- (72) Install hose (57) on bypass valve (52) and hose fitting (58).
- (73) Position clamps (55) and (56) over hose (57) on bypass valve (52) and hose fitting (58).



**END OF TASK**

## 21-3. TURBOCHARGER ASSEMBLY REPAIR.

This task covers:

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

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Caps, Vise Jaw (Item 27, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gage Set, Telescoping (Item 69, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Hammer, Hand, Soft Plastic  
(Item 88, Appendix F)  
Indicator, Dial, Set w/Magnetic Base  
(Item 98, Appendix F)  
Micrometer, Outside, Caliper, Set  
(Item 139, Appendix F)  
Pliers, Retaining Ring (Item 152, Appendix F)  
Vise, Machinist's (Item 248, Appendix F)  
Wrench Set, Socket 3/8 in. Drive  
(Item 273, Appendix F)  
Wrench, Torque (0-60 N·m)  
(Item 276, Appendix F)  
Torque Wrench (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Fixture, Holding (Appendix C)

#### *Materials/Parts*

Compound, Antiseize (Item 14, Appendix B)  
Grease (Item 21, Appendix B)  
Grease (Item 22, Appendix B)  
Oil, Lubricating (Item 36, Appendix B)  
Sealing Compound (Item 52, Appendix B)

#### *Materials/Parts - Continued*

Solvent, Drycleaning (Item 68, Appendix B)  
Bearing (2) (Item 10, Appendix E)  
Bearing, Thrust (Item 16, Appendix E)  
Collar, Shaft (Item 33, Appendix E)  
Locknut (2) (Item 186, Appendix E)  
Locknut (Item 190, Appendix E)  
Ring, Retaining (2) (Item 471, Appendix E)  
Ring, Retaining (3) (Item 492, Appendix E)  
Ring, Seal (2) (Item 509, Appendix E)  
Ring, Seal (Item 510, Appendix E)  
Washer, Flat (2) (Item 693, Appendix E)

#### *Personnel Required*

Two

#### *Equipment Condition*

Turbocharger on clean work surface.

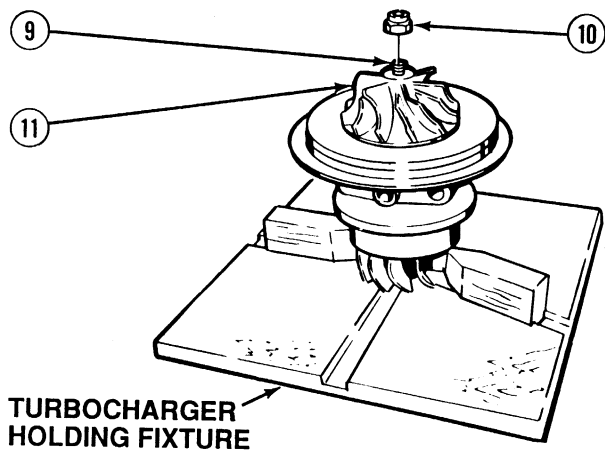
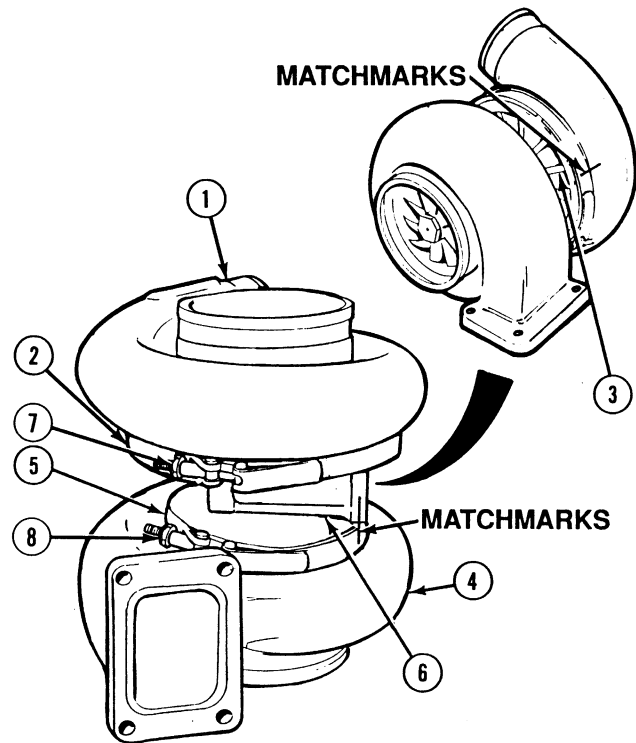
**21-3. TURBOCHARGER ASSEMBLY REPAIR (CONT).**

*a. Disassembly.*

**CAUTION**

Use care when removing turbine housing and compressor housing in order to prevent damage to housing.

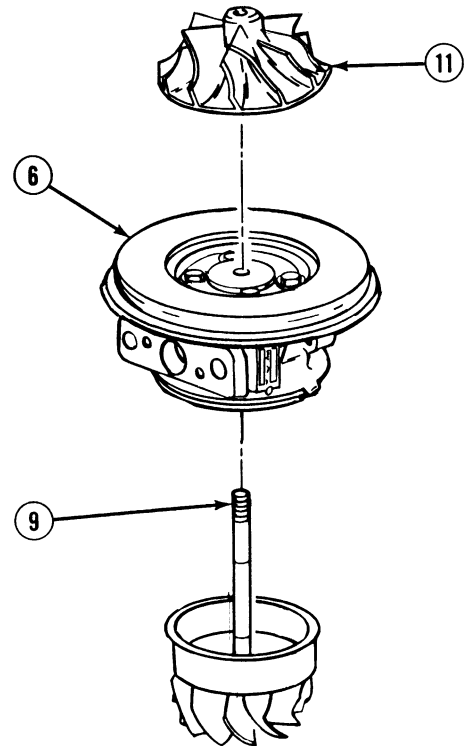
- (1) Matchmark turbo housing (1), clamp (2) and backplate (3).
- (2) Matchmark turbine housing (4), clamp (5) and center housing (6).
- (3) Remove locknut (7) from clamp (2). Discard locknut.
- (4) Remove turbo housing (1) and clamp (2) from center housing (6).
- (5) Remove locknut (8) from clamp (5). Discard locknut.
- (6) Remove center housing (6) and clamp (5) from turbine housing (4).
- (7) With the aid of an assistant, hold turbine wheel assembly shaft (9) in turbocharger holding fixture while removing locknut (10). Discard locknut.
- (8) With the aid of an assistant, hold turbocharger holding fixture while tapping turbine wheel assembly shaft (9) with soft face hammer to loosen impeller (11).



**CAUTION**

Do not pry off impeller or damage to equipment will result.

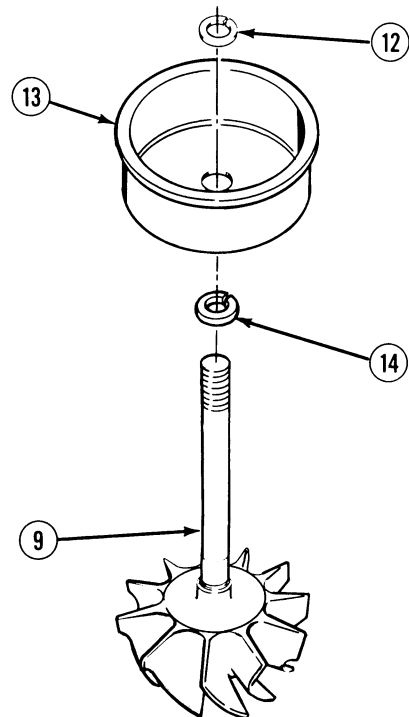
- (9) Remove impeller (11) from turbine wheel assembly shaft (9).
- (10) Remove center housing (6) from turbine wheel assembly shaft (9).



**WARNING**

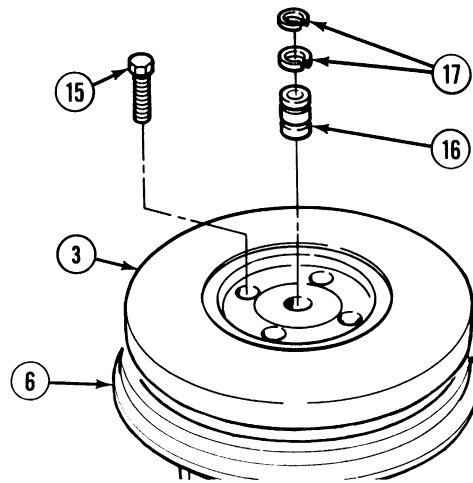
Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (11) Remove and discard retaining ring (12) from turbine wheel assembly shaft (9).
- (12) Remove turbine wheel shroud (13) from turbine wheel assembly shaft (9).
- (13) Remove and discard retaining ring (14) from turbine wheel assembly shaft (9).

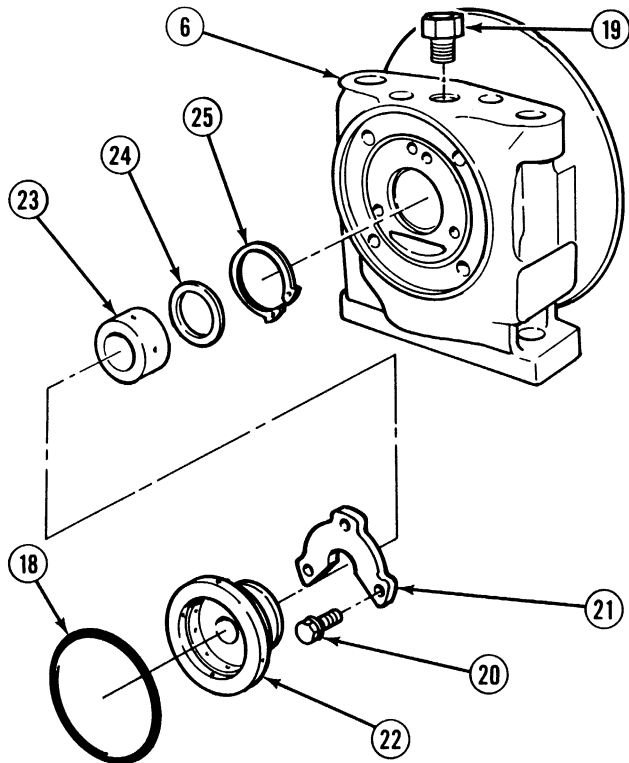


**21-3. TURBOCHARGER ASSEMBLY REPAIR (CONT.)**

- (14) Position center housing (6) in soft-jaw vise and remove four screws (15) from center housing (6).
- (15) Remove backplate (3) from center housing (6).
- (16) Remove sleeve spacer (16) from backplate (3).
- (17) Remove and discard two seal rings (17) from sleeve spacer (16).



- (18) Remove and discard seal ring (18) from center housing (6).
- (19) Remove connector (19) from center housing (6).
- (20) Remove three screws (20) from thrust washer bearing (21).
- (21) Remove and discard shaft collar (22) and thrust washer bearing (21) from center housing (6).
- (22) Remove and discard bearing (23) and washer (24) from center housing (6).



**WARNING**

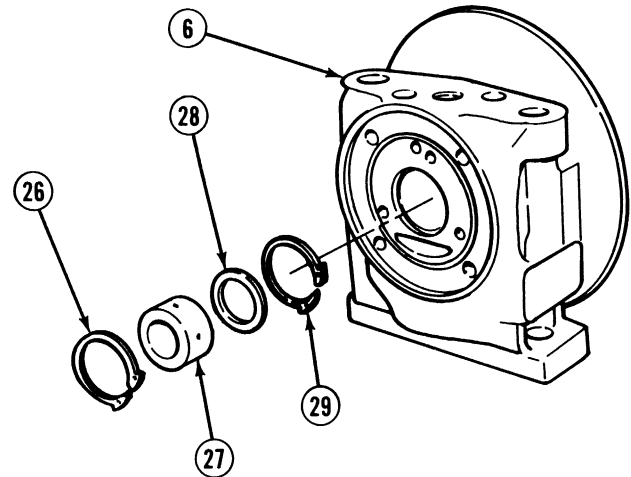
Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (23) Remove and discard retaining ring (25) from center housing (6).

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released and could cause injury to personnel.

- (24) Remove and discard retaining ring (26) and bearing (27) from center housing (6).
- (25) Remove and discard thrust washer (28) from center housing (6).
- (26) Remove and discard retaining ring (29) from center housing (6).
- (27) Remove center housing (6) from vise.

**b. Cleaning/Inspection.****WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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**

If shaft collar is excessively worn, backplate (removed in Step (15) of *a. Disassembly*) must be discarded.

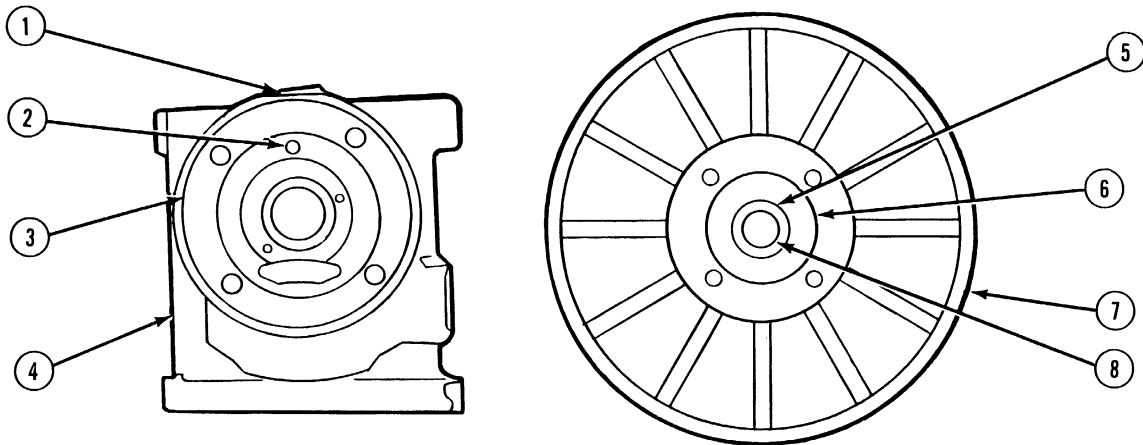
- (1) Soak metal parts in drycleaning solvent for 25 minutes.

**CAUTION**

Do not clean with steel bristle brush. Turbocharger parts can be damaged by steel bristles.

- (2) Clean parts with stiff bristle brush after soaking in drycleaning solvent.

**21-3. TURBOCHARGER ASSEMBLY REPAIR (CONT).**



**WARNING**

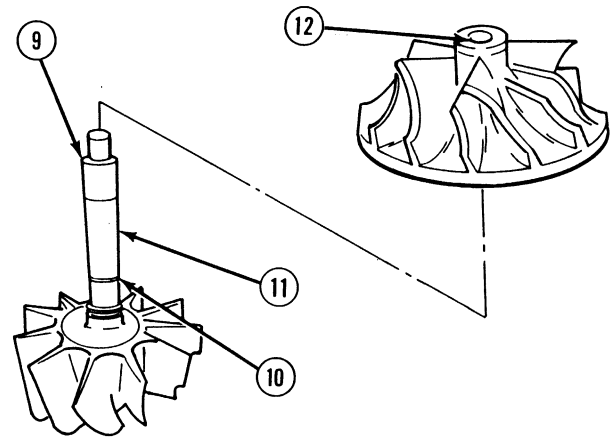
- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes, and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent. The flashpoint for Type II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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.
- (3) Clean oil passages (1), (2) and (3) in center housing (4) and oil passages (5) and (6) in backplate (7) with drycleaning solvent.

**WARNING**

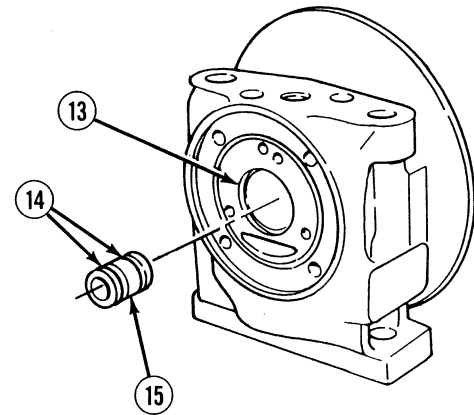
Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc). Failure to comply may result in injury or death to personnel.

- (4) Dry all parts with compressed air.
- (5) Inspect turbocharger parts for nicks, cuts, scratches, scoring or other damage.
- (6) Inspect screw threads for stripping or cross-threading.
- (7) Check diameter of seal bore (8). Seal bore must not be greater than 0.6895 in. (17.513 mm).

- (8) Check diameters of turbine wheel shaft journals (9) and (10) on shaft (11). Journal diameters must be between 0.6250 and 0.6254 in. (15.875 and 15.885 mm).
- (9) Check diameter of impeller bore (12). Inside diameter of impeller bore must not be greater than 0.3749 in. (9.522 mm).



- (10) Check diameter of center housing (13). Inside diameter of center housing must not be greater than 0.9842 in. (24.998 mm).
- (11) Check width of ring groove (14) and outside diameter of sleeve spacer (15). Ring groove width will not be greater than 0.0715 in. (1.816 mm). Sleeve spacer outside diameter must not be less than 0.6705 in. (17.030 mm).
- (12) Replace parts that fail inspection or are damaged.





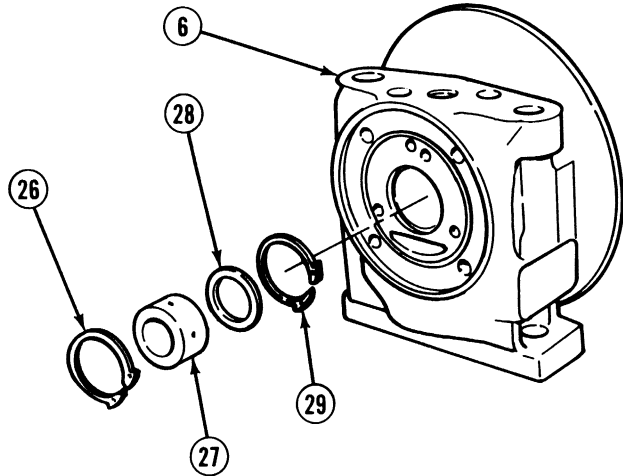
**21-3. TURBOCHARGER ASSEMBLY REPAIR (CONT).**

**c. Assembly.**

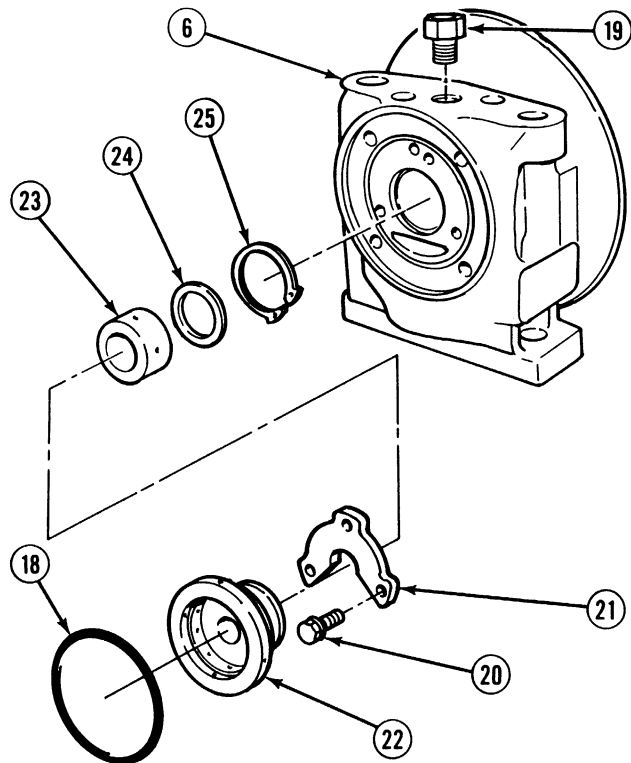
- (1) Position center housing (6) in soft jawed vise.

**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.



- (2) Install retaining ring (29) in center housing (6).
- (3) Install thrust washer (28), bearing (27) and retaining ring (26) in center housing (6).
- (4) Install retaining ring (25), washer (24) and bearing (23) in center housing (6).
- (5) Install shaft collar (22) in thrust washer bearing (21).
- (6) Install center housing (6) in soft-jaw vise and install thrust washer bearing (21) in center housing (6) with three screws (20). Tighten screws to 25 lb-in (3 N·m).
- (7) Install seal ring (18) in center housing (6).

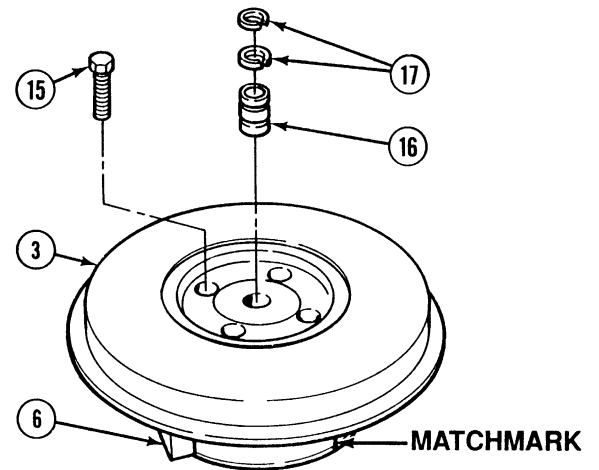


**WARNING**

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.

- (8) Coat threads of connector (19) with sealing compound.
- (9) Install connector (19) in center housing (6). Tighten to 240 lb-in (27 N·m).
- (10) Coat sleeve spacer (16) with grease.

- (11) Install two seal rings (17) on sleeve spacer (16).
- (12) Install sleeve spacer (16) in compressor backplate (3).
- (13) Align matchmark and install backplate (3) in center housing (6).
- (14) Install four screws (15) through backplate (3) into center housing (6). Tighten screws 80 to 100 lb-in (9 to 11 N·m).

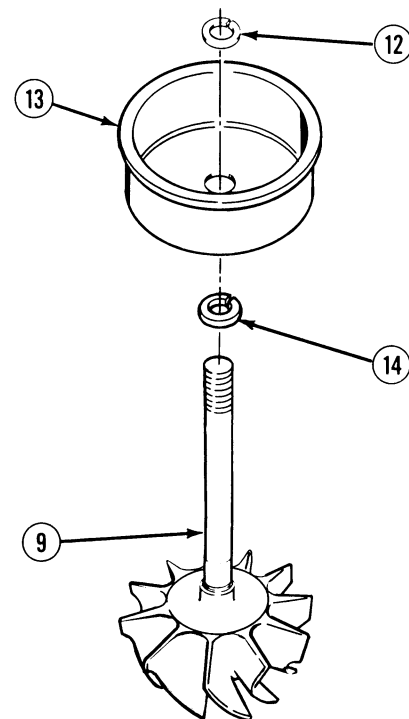


- (15) Remove center housing (6) from soft-jaw vise.
- (16) Install retaining ring (14) on turbine wheel assembly shaft (9).
- (17) Install turbine wheel shroud (13) on turbine wheel shaft (9).

**WARNING**

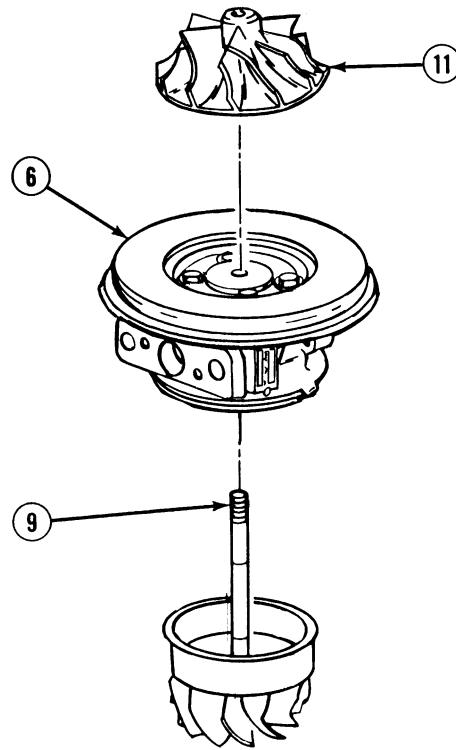
Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (18) Fill ring groove in turbine wheel shroud (13) with grease and install retaining ring (12) in groove.

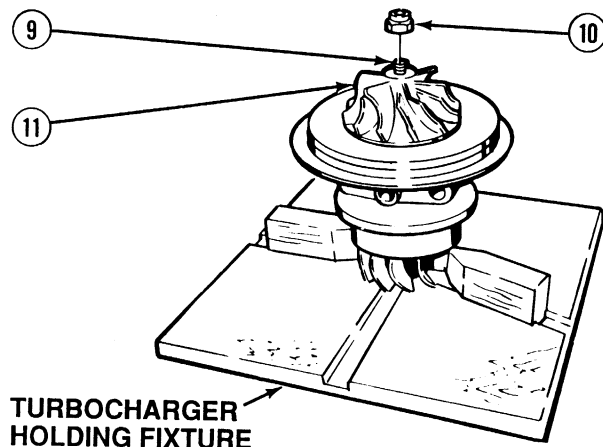


**21-3. TURBOCHARGER ASSEMBLY REPAIR (CONT).**

- (19) Install turbine wheel assembly shaft (9) in center housing (6).
- (20) Install impeller (11) on shaft (9).



- (21) Position locknut (10) on turbine wheel assembly shaft (9).
- (22) Position impeller (11) in holding fixture.
- (23) With the aid of an assistant, hold turbocharger holding fixture while tightening locknut (10) to 135 lb-in (15 N·m).
- (24) With the aid of an assistant, hold turbocharger holding fixture while removing locknut (10).
- (25) Apply grease to threads of turbine wheel assembly shaft (9) and base of locknut (10).
- (26) With the aid of an assistant hold turbocharger holding fixture so turbine wheel assembly shaft (9) does not move, and tighten locknut (10) 35 to 55 lb-in (4 to 6 N·m).
- (27) Tighten locknut (10) on turbine wheel assembly shaft (9) 1/4 turn more.

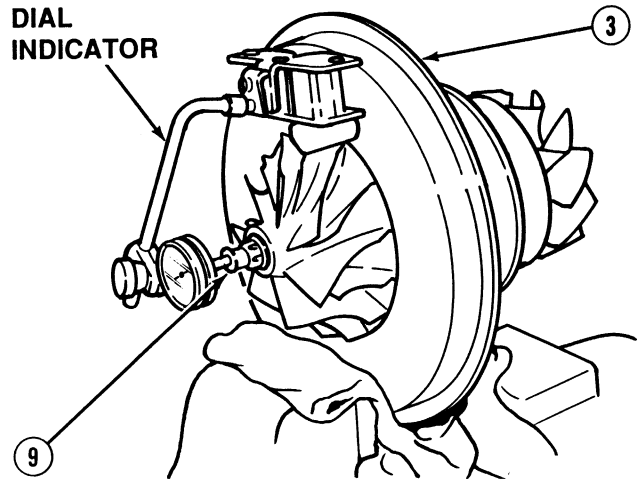


- (28) Position backplate (3) in soft-jawed vise.

**NOTE**

If indicator reading is not within specification, replace thrust collar.

- (29) Check thrust play with dial indicator. Move turbine wheel assembly shaft (9) back and forth in center housing. Indicator reading (thrust float) must be 0.003 to 0.010 in. (0.08 to 0.25 mm).
- (30) Remove backplate (3) from vise.



- (31) Install clamp (5) on turbine housing (4).
- (32) Align matchmarks on center housing (6) with those on turbine housing (4) and install center housing.

**WARNING**

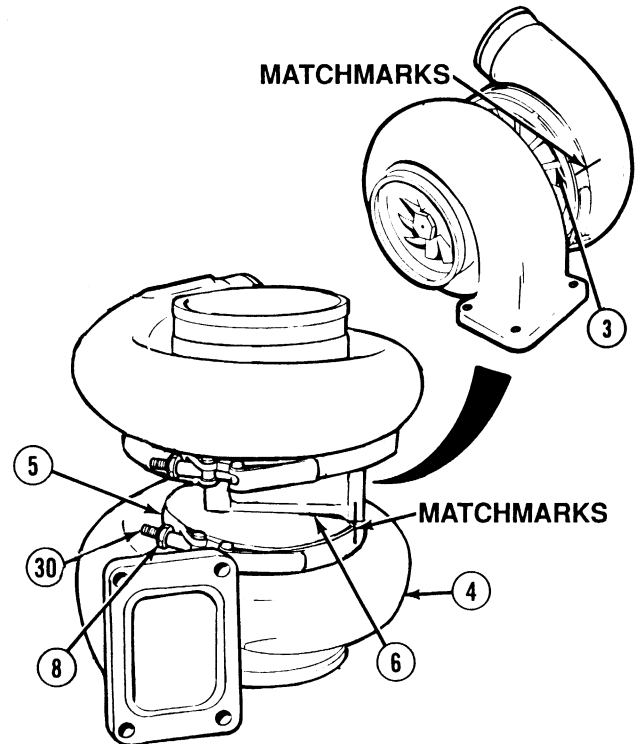
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (33) Apply antiseize compound to threads of screw (30).

**CAUTION**

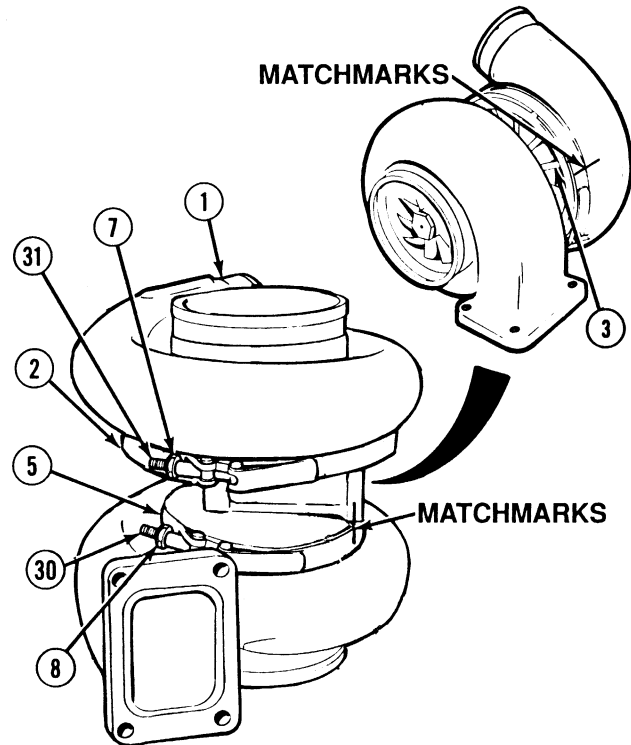
Do not tighten turbine housing clamp until aligned with turbine housing. If parts are not aligned, turbocharger will be damaged.

- (34) Tighten locknut (8) on clamp (5) 160 lb-in (18 N·m).



**21-3. TURBOCHARGER ASSEMBLY REPAIR (CONT).**

- (35) Loosen locknut (8) on clamp (5) and retighten to 50 lb-in (6 N·m).
- (36) Tighten locknut (8) on clamp (5) to 165 lb-in (18.9 N·m).
- (37) Install clamp (2) over center housing (6).
- (38) Align matchmarks on turbo housing (1) and backplate (3) and install turbo housing (1) on backplate (3).
- (39) Apply lubricating oil to threads of screw (31).
- (40) Tighten locknut (7) on screw (31) to 110 to 130 lb-in (12 to 15 N·m).



- (41) Position dial indicator with magnetic base swivel adapter and extension rod, on flat surface of housing inlet flange (32).

**NOTE**

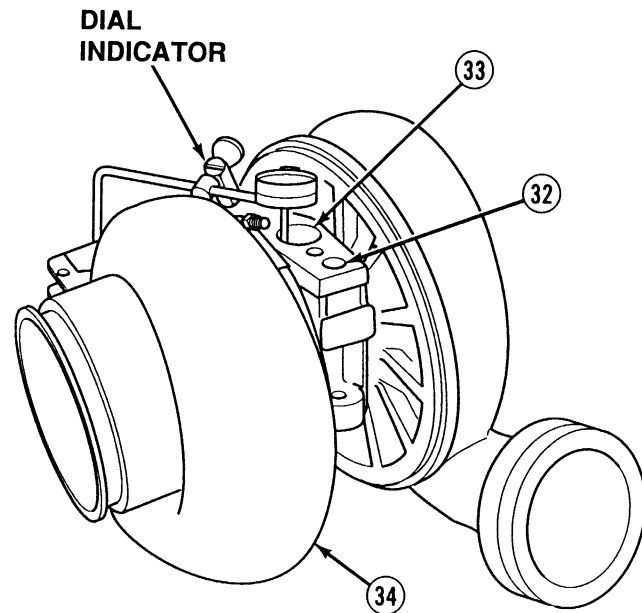
Do not allow extension rod to touch sides of center housing. Inaccurate readings can result in poor fit and damage.

- (42) Position extension rod in oil drain hole (33) so rod is against turbine wheel shaft.

**NOTE**

Disassemble and inspect turbocharger if fit of turbine wheel shaft is not within limits.

- (43) Ensure turbine wheel shaft moves up and down not more than 0.0070 in. (0.177 mm) or less than 0.003 in. (0.076 mm).



**END OF TASK**

## CHAPTER 22

### COOLING SYSTEM MAINTENANCE

Para	Contents	Page
22-1	General Support Cooling System Maintenance Introduction .....	22-1
22-2	Water Pump Assembly Repair .....	22-2

**22-1. GENERAL SUPPORT COOLING SYSTEM MAINTENANCE INTRODUCTION.**

This chapter contains maintenance instructions for repairing and testing cooling system components as authorized by the Maintenance Allocation Chart (MAC) at the General Support Maintenance level.

**22-2. WATER PUMP ASSEMBLY REPAIR.**

This task covers:

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

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Adapter, Slip Test (Item 7, Appendix F)
- Caps, Vise Jaw (Item 27, Appendix F)
- Driver, Bearing, Gear (Item 51, Appendix F)
- Gloves, Chemical Oil Protective (Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Handle, Installer (Item 93, Appendix F)
- Installer, Seal, Oil (Item 118, Appendix F)
- Installer, Water Pump Seal (Item 122, Appendix F)
- Pliers, Retaining Ring (Item 157, Appendix F)
- Press, Arbor, Hand Operated (Item 162, Appendix F)
- Vise, Machinist (Item 248, Appendix F)
- Wrench, Torque (0-175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

*Materials/Parts*

- Adhesive (Item 1, Appendix B)
- Compound, International No. 2 (Item 16, Appendix B)

*Materials/Parts - Continued*

- Oil, Diesel Fuel (Item 32, Appendix B)
- Oil, Lubricating (Item 36, Appendix B)
- Sealing Compound (Item 54, Appendix B)
- Tags, Identification (Item 72, Appendix B)
- Bearing (Item 8, Appendix E)
- Bearing (Item 9, Appendix E)
- Impeller (Item 131, Appendix E)
- Locknut (Item 185, Appendix E)
- Packing, Preformed (Item 366, Appendix E)
- Plug (Item 439, Appendix E)
- Seal, Oil (Item 594, Appendix E)
- Seal, Water (Item 621, Appendix E)
- Shaft (Item 628, Appendix E)

*Personnel Required*

Two

*Equipment Condition*

Water pump on clean work surface.

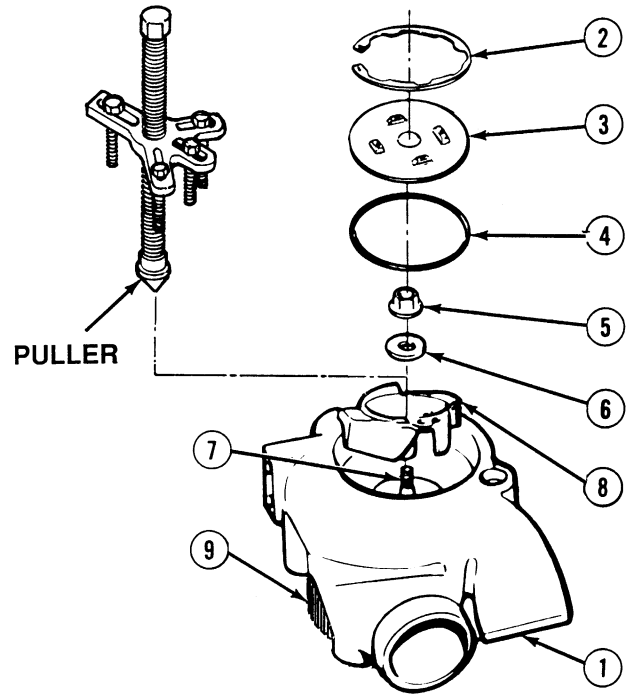
**a. Disassembly.**

- (1) Position pump body (1), gear side down, on clean work surface.

**WARNING**

Use extreme care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released suddenly and could cause severe eye injury.

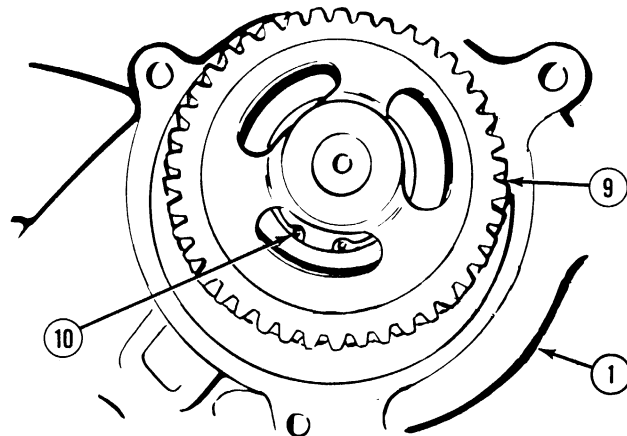
- (2) Remove retaining ring (2), pump cover (3) and preformed packing (4) from pump body (1). Discard preformed packing.
- (3) Remove locknut (5) and washer (6) from shaft (7). Discard locknut.
- (4) Using puller and with the aid of an assistant, hold pump gear (9) and remove impeller (8) from shaft (7). Discard impeller.
- (5) Place pump body (1), gear (9) side up, on work surface.
- (6) Turn pump gear (9) until ends of retaining ring (10) can be seen.



**WARNING**

Use extreme care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released suddenly and could cause severe eye injury.

- (7) Move retaining ring (10) from groove in pump body (1).
- (8) Position pump body (1) in press.



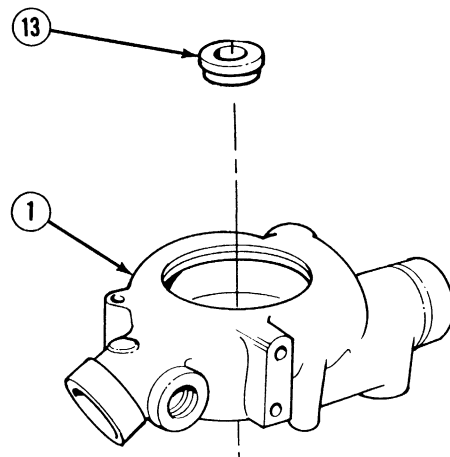
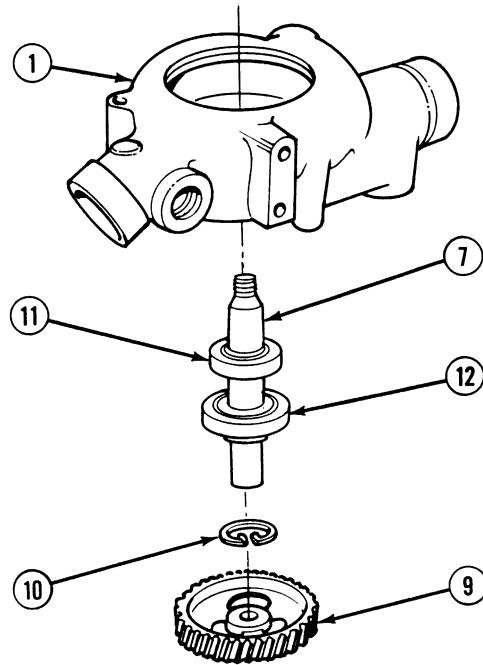


**22-2. WATER PUMP ASSEMBLY REPAIR (CONT).**

**CAUTION**

Pump gear and shaft assembly will fall when pressed from pump body if not supported. Ensure pump gear and shaft assembly is supported to prevent damage to parts.

- (9) Press pump gear (9) and shaft (7) out of pump body (1).
- (10) Press shaft (7) out of pump gear (9). Discard shaft and two bearings (11) and (12).
- (11) Remove retaining ring (10) from pump gear (9).
- (12) Turn water pump body (1) over and tap out water seal (13). Discard water seal.

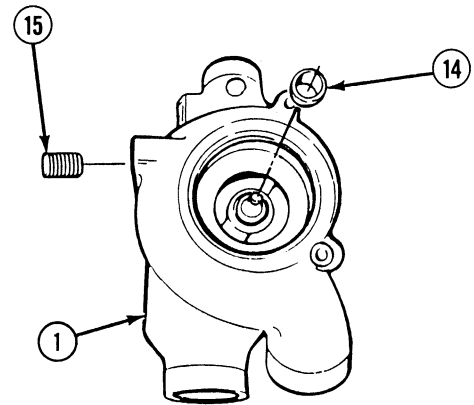


- (13) Remove and discard oil seal (14) from pump body (1).

**NOTE**

Remove plug only if damaged.

- (14) Remove plug (15) from pump body (1).  
Discard plug.



**b. Cleaning/Inspection.**

**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.
  - 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 to personnel.
- (1) Wash all parts in clean diesel fuel.
  - (2) Dry all parts with compressed air.
  - (3) Inspect passages of housing for obstructions, deposits and cracks. Clean out any obstructions or deposits. Replace housing if cracked.
  - (4) Inspect all parts for cracks and wear. Replace damaged or worn parts.

**22-2. WATER PUMP ASSEMBLY REPAIR (CONT).**

**c. Assembly.**

- (1) Lubricate bearings (1) and (2) and shaft (3) with lubricating oil.
- (2) Position shaft (3) in press.

**CAUTION**

Apply pressure to inner races only in Step (3) or damage to parts may occur.

**NOTE**

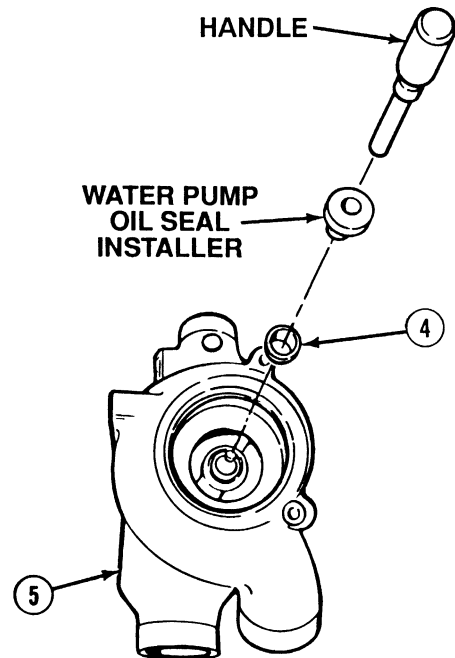
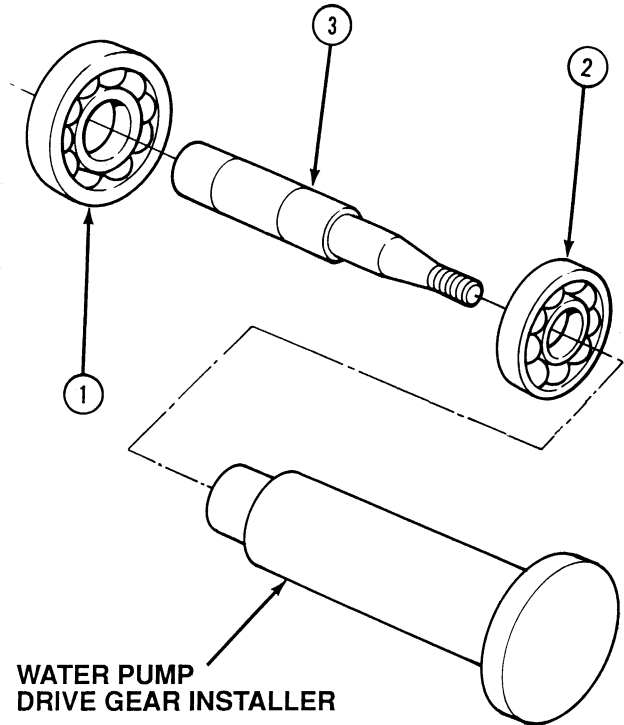
Bearings are installed with numbered side of each bearing facing in toward numbered side of other bearing.

- (3) Using gear bearing driver, press shaft (3), threaded end down, in inner bearing (2).
- (4) Using gear bearing driver to support bearing, press shaft (3), threaded end up, in outer bearing (1).

**CAUTION**

Oil seal must be installed flush with water seal counterbore. Water pump will not operate if oil seal is not properly installed.

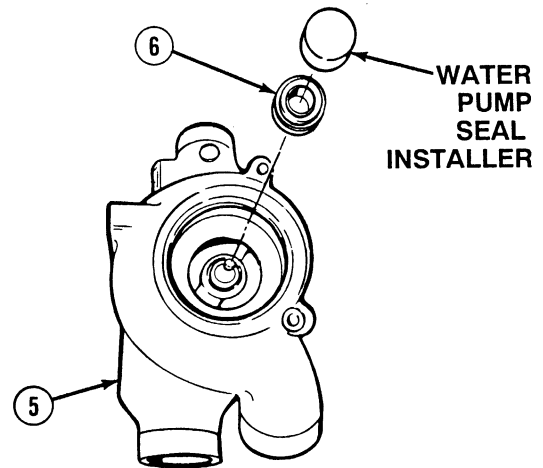
- (5) Apply lubricating oil to oil seal (4).
- (6) Using handle and oil seal installer, install oil seal (4) in pump body (5).
- (7) Remove oil seal installer and handle from pump body (5).



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (8) Coat outside of water seal (6) with adhesive.
- (9) Position water seal (6) small side facing up, in water pump body (5).
- (10) Install water seal (6) in water pump body (5) using water pump installer.



**NOTE**

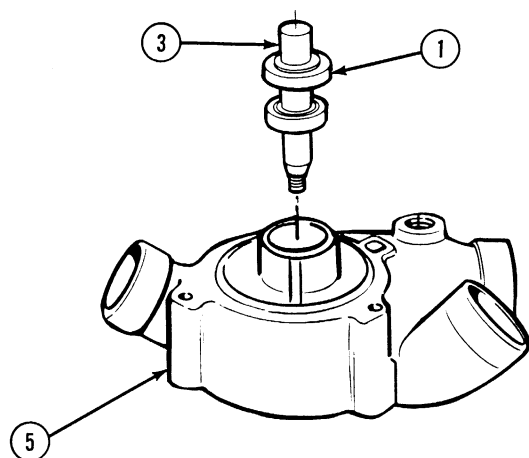
Pump body is positioned in press with larger opening facing down.

- (11) Position pump body (5) in press.

**CAUTION**

When installing shaft, ensure shaft assembly is installed straight in pump body or shaft assembly and pump body may be damaged.

- (12) Install shaft (3) in pump body (5) by pressing on outer race of larger bearing (1).
- (13) Remove pump body (5) from press.

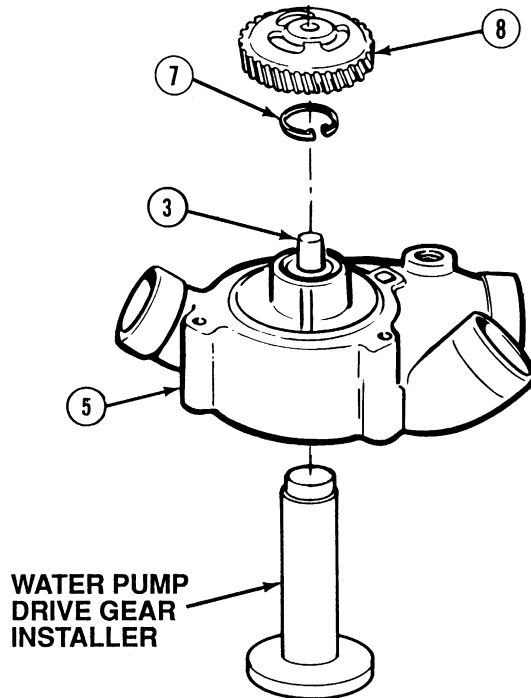


**22-2. WATER PUMP ASSEMBLY REPAIR (CONT).**

**WARNING**

Use extreme care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released suddenly and could cause severe eye injury.

- (14) Install retaining ring (7), beveled side up, in pump body (5).
- (15) Position water pump drive gear installer and pump body (5) in press.
- (16) Using water pump drive gear installer to support shaft assembly from beneath, press pump gear (8) on shaft (3).
- (17) Remove pump body (5) and water pump drive gear installer from press.



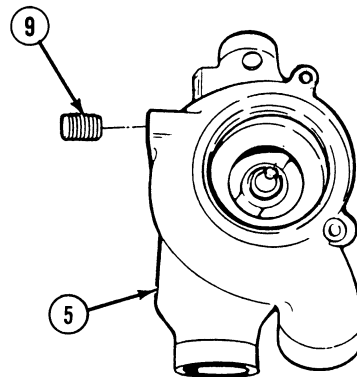
**WARNING**

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**

Perform Steps (18) and (19) if plug was removed.

- (18) Apply sealing compound to threads of plug (9).
- (19) Install plug (9) in pump body (5).



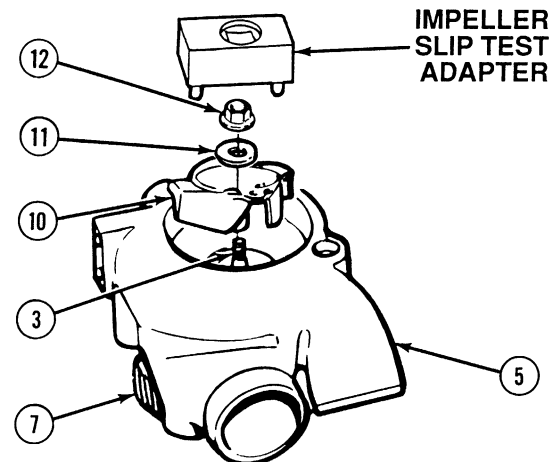
- (20) Position pump body (5) in soft jawed vise.
- (21) Position impeller (10) on shaft (3).

**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.

**CAUTION**

- Ensure International Compound No. 2 is applied only to threads of shaft. Impeller slippage may occur if International Compound No. 2 contacts shaft.
  - Ensure all parts are free of dirt, metal, and oil. If parts are dirty, impeller slippage may occur.
- (22) Apply International Compound No. 2 to threads of shaft (3).
- (23) Install washer (11) and locknut (12) on shaft (3). Tighten locknut to 35 to 40 lb-ft (47 to 54 N·m).
- (24) Mark line across water pump gear (7) and shaft (3).
- (25) Mark second line across impeller (10), locknut (12) and shaft (3).
- (26) Attach water pump impeller slip test adapter on torque wrench.
- (27) Install impeller slip test adapter dowel pins in impeller puller holes, and tighten to 80 lb-ft (108 N·m).
- (28) If slippage is noted, remove pump body (5) from vise and examine scribe marks to determine if gear (7) has moved or if impeller (10) has moved.
- (29) If gear (7) has slipped, replace water pump gear and shaft.
- (30) If impeller (10) has slipped replace shaft.

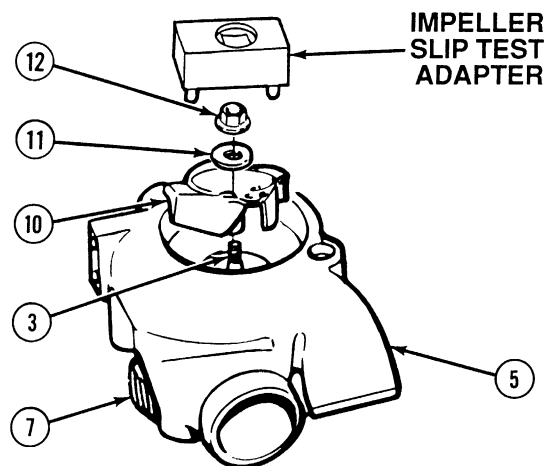


**22-2. WATER PUMP ASSEMBLY REPAIR (CONT).**

**NOTE**

If slippage is detected, perform Step (31) through (33).

- (31) Remove locknut (12), washer (11) and impeller (10) from shaft (3).
- (32) Repeat Steps (20) through (30).
- (33) Install 0.015 in. (0.381 mm) feeler gage between impeller (10) and inside of pump body (5).
- (34) While holding feeler gage in position described in Step (26), turn impeller (10) to check clearance between all blades of impeller and wall of pump body (5).



**NOTE**

Seal, preformed packing, pump cover and retaining ring will be installed during Follow-On Maintenance. Tag parts with water pump.

- (35) If clearance is incorrect, replace housing.

**END OF TASK**

## CHAPTER 23

### TRANSMISSION MAINTENANCE

Para	Contents	Page
23-1	General Support Transmission Maintenance Introduction .....	23-1
23-2	Transmission On Stand Installation/Removal .....	23-2
23-3	Transmission Oil Pan And Gasket Replacement .....	23-7
23-4	Transmission Internal Oil Filter Element Replacement .....	23-10
23-5	Transmission Low Oil Sensor Assembly Replacement .....	23-11
23-6	First Range Trimmer Valve Repair .....	23-13
23-7	First Shift Valve Repair .....	23-17
23-8	Transmission Solenoid Wiring Harness Repair .....	23-21
23-9	Control Valve Assembly Repair .....	23-26
23-10	Torque Converter Stator Repair .....	23-38
23-11	Torque Converter Pump Repair .....	23-42
23-12	Torque Converter Housing Repair .....	23-49
23-13	Forward Clutch And Turbine Shaft Repair .....	23-65
23-14	Fifth Clutch Repair .....	23-78
23-15	Fourth Clutch Repair .....	23-87
23-16	Center Support Repair .....	23-91
23-17	Planetary Gearing, Shafts And Third Clutch Repair .....	23-102
23-18	Rear Transmission Cover Assembly Repair .....	23-116
23-19	First Clutch And Adapter Housing Repair .....	23-128
23-20	Second Clutch Repair .....	23-134

**23-1. GENERAL SUPPORT TRANSMISSION MAINTENANCE INTRODUCTION.**

This chapter contains maintenance instructions for repairing, replacing, installing and servicing transmission components as authorized by the Maintenance Allocation Chart (MAC) at the General Support Maintenance level.

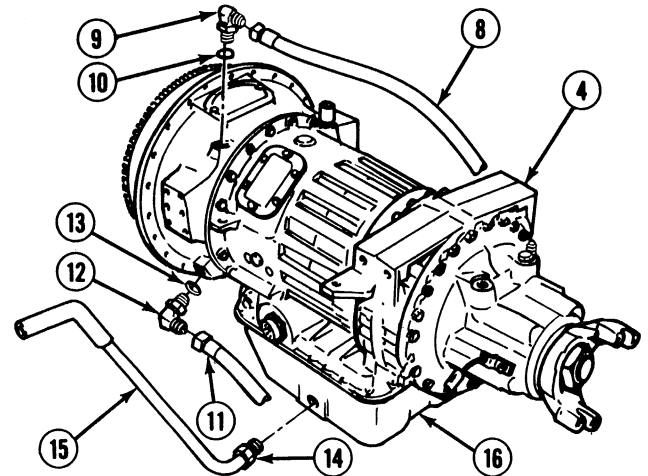




- (3) Remove hose 2310 (8), elbow (9) and preformed packing (10) from transmission (4). Discard preformed packing.
- (4) Remove hose 2311 (11), elbow (12) and preformed packing (13) from transmission (4). Discard preformed packing.

**NOTE**

Position drain pan under transmission oil pan.

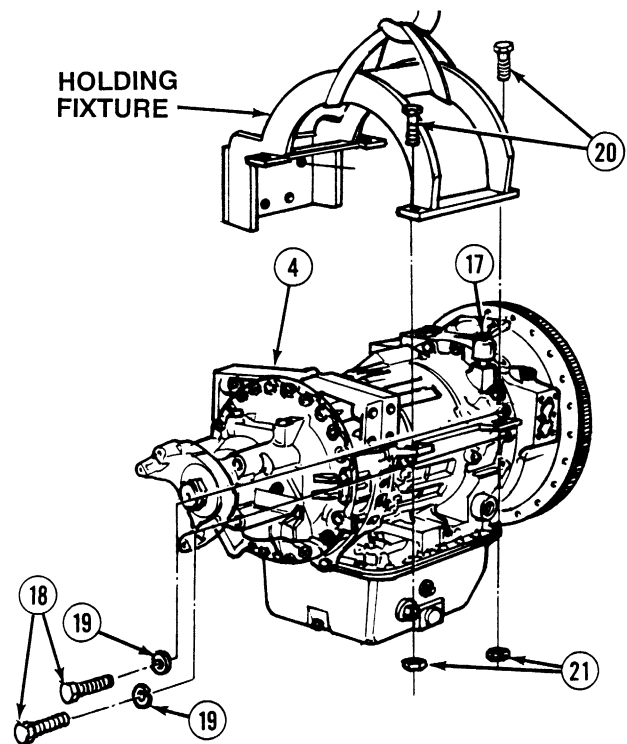


- (5) Loosen flange nut (14) and remove oil dipstick tube assembly (15) from transmission oil pan (16).
- (6) Remove breather assembly (17) from transmission (4).
- (7) Remove four screws (18), two from each side of transmission (4), and four lockwashers (19). Discard lockwashers.

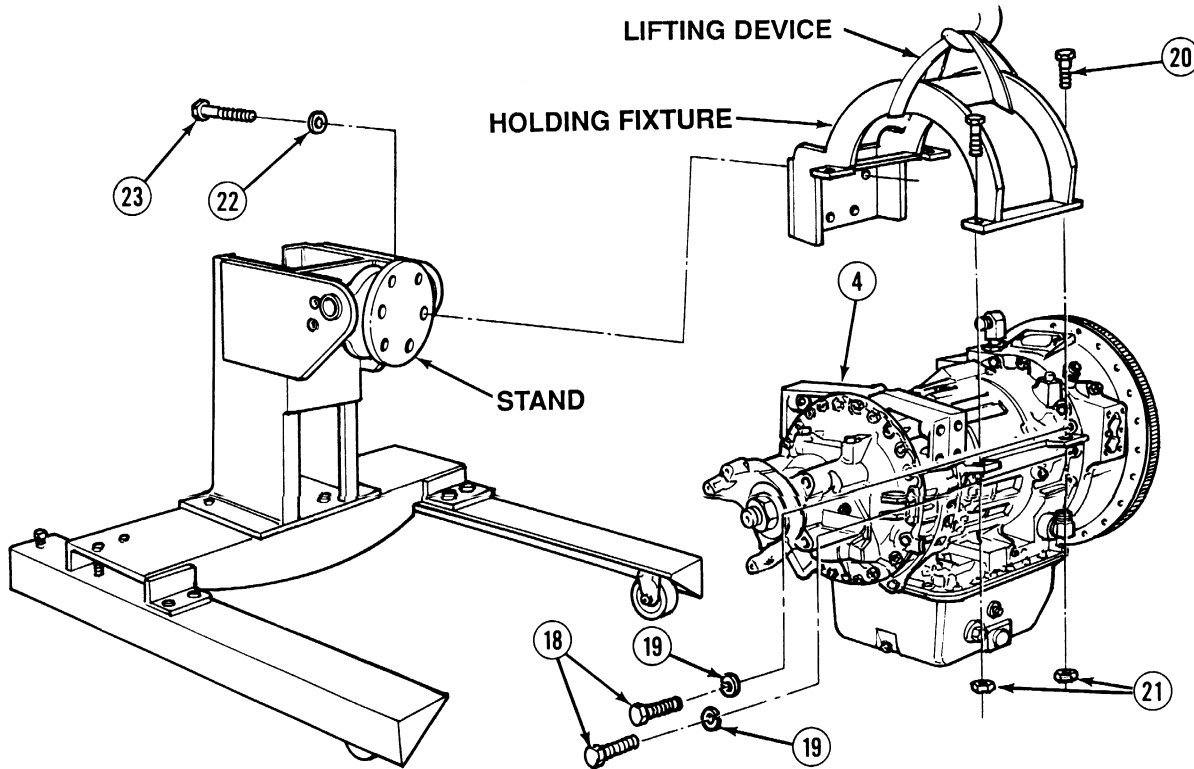
**NOTE**

Screws must be 5/8-11 by 2-1/2 in. and locknuts 5/8-11.

- (8) Install transmission holding fixture on transmission with four screws (20) and nuts (21).



**23-2. TRANSMISSION ON STAND INSTALLATION/REMOVAL (CONT).**



**WARNING**

Transmission weighs 1,023 lbs (464 kg). Attach suitable lifting device for installation to prevent possible injury to personnel.

- (9) Install lifting device on transmission holding fixture.
- (10) With the aid of an assistant, install transmission and holding fixture on stand with four washers (22) and screws (23).
- (11) Remove lifting device from transmission holding fixture.

**b. Removal.**

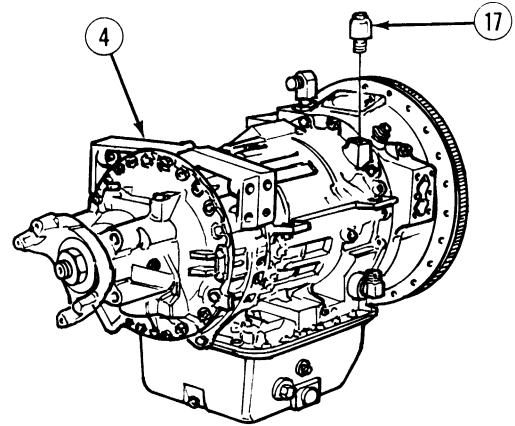
**CAUTION**

Ensure lifting device is supporting transmission securely before removing screws or damage may occur to transmission.

- (1) Install lifting device on transmission holding fixture.
- (2) Remove four screws (23) and washers (22) from stand.
- (3) With the aid of an assistant, remove transmission (4) from stand.
- (4) Remove lifting device, four nuts (21), screws (20) and holding fixture from transmission (4).
- (5) Install four lockwashers (19) and screws (18) in transmission (4). Tighten screws to 67 to 80 lb-ft (91 to 108 N·m).

**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.

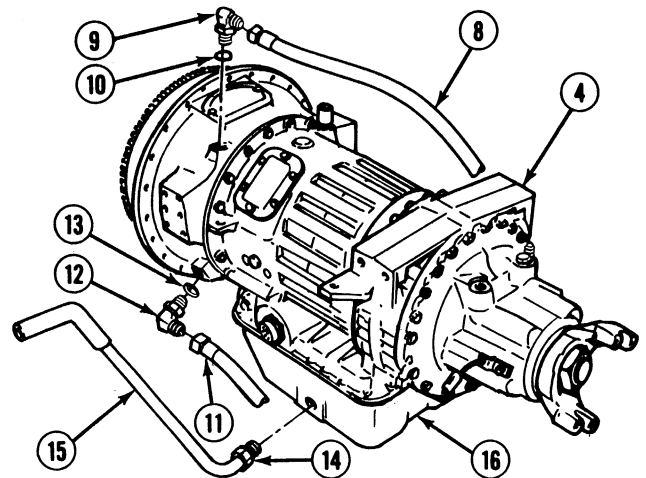


- (6) Coat threads of breather assembly (17) with sealing compound.
- (7) Install breather assembly (17) in transmission (4). Tighten breather assembly to 156 to 192 lb-in (18 to 22 N·m).

**NOTE**

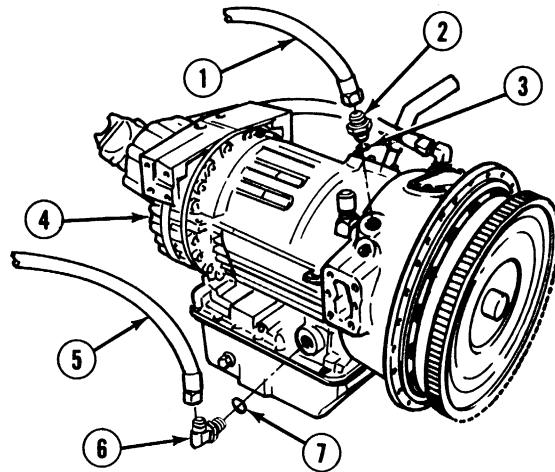
Install cable ties as required.

- (8) Install oil dipstick tube assembly (15) on transmission oil pan (16). Tighten flange nut (14) 90 to 100 lb-ft (122 to 136 N·m).
- (9) Apply hydraulic oil to preformed packing (13).
- (10) Install preformed packing (13), elbow (12) and hose 2311 (11) on transmission (4).
- (11) Apply hydraulic oil to preformed packing (10).
- (12) Install preformed packing (10), elbow (9) and hose 2310 (8) on transmission (4).



**23-2. TRANSMISSION ON STAND INSTALLATION/REMOVAL (CONT).**

- (13) Apply hydraulic oil to preformed packing (7).
- (14) Install preformed packing (7), elbow (6) and hose 2382 (5) on transmission (4).
- (15) Apply hydraulic oil to preformed packing (3).
- (16) Install preformed packing (3), fitting (2) and hose 2279 (1) on transmission (4).



**c. Follow-On Maintenance:**

- Install transmission in container, (Para 7-11).

**END OF TASK**

### 23-3. TRANSMISSION OIL PAN AND GASKET REPLACEMENT.

This task covers:

- a. Removal
- b. Cleaning/Inspection
- c. Installation
- d. Follow-On Maintenance

#### INITIAL SETUP

##### *Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Compressor Unit, Air (Item 35, Appendix F)
- Gloves, Chemical Oil Protective (Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Gun, Airblow (Item 86, Appendix F)
- Wrench Set, Socket 3/8 in. Drive (Item 273, Appendix F)
- Wrench Set, Socket 3/8 in. Drive (Item 274, Appendix F)
- Wrench, Torque (0-175 lb-ft [0-237 N·m]) (Item 276, Appendix F)
- Wrench, Torque (0-60 N·m) (Item 277, Appendix F)

##### *Tools and Special Tools*

- Wrench, Torque (0-600 lb-ft [0-814 N·m]) (Item 278, Appendix F)

##### *Materials/Parts*

- Sealing Compound (Item 53, Appendix B)
- Sealing Compound (Item 56, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)
- Gasket (Item 60, Appendix E)
- Gasket (Item 62, Appendix E)
- Screw (23) (Item 523, Appendix E)

##### *Equipment Condition*

- Transmission installed on stand, (Para 23-2)

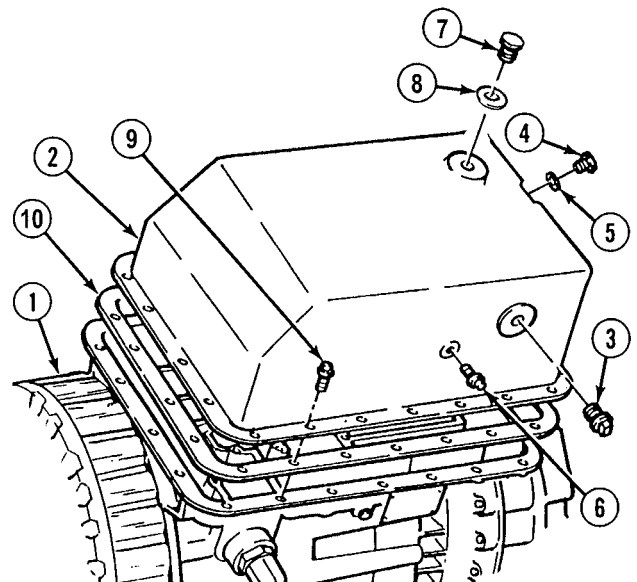
#### a. Removal.

- (1) Position transmission (1) so oil pan (2) faces upward.
- (2) Remove plug (3), plug (4), gasket (5) and plug (6) from oil pan (2). Discard gasket.

#### NOTE

Perform Step (3) if oil pan is equipped with a corner drain plug.

- (3) Remove plug (7) and gasket (8) from oil pan (2). Discard gasket.
- (4) Remove 23 screws (9) and oil pan (2) from transmission (1). Discard screws.
- (5) Remove and discard oil pan gasket (10) from oil pan (2) or transmission (1).



### 23-3. TRANSMISSION OIL PAN AND GASKET REPLACEMENT (CONT).

*b. Cleaning/Inspection.*

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 inside of oil pan with drycleaning solvent.
  - (2) Clean and remove all excess gasket material from oil pan and transmission.

**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.

- (3) Dry oil pan with compressed air.
- (4) Inspect oil pan for cracks and replace if damaged.

**c. Installation.**

- (1) Install gasket (10) on transmission (1).

**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.

- (2) Coat 23 screws (9) with sealing compound.
- (3) Install oil pan (2) on transmission (1) with 23 screws (9). Tighten screws in sequence shown to 120 to 156 lb-in (14 to 18 N·m).
- (4) Coat threads of plugs (3) and (6) with sealing compound.
- (5) Install plugs (3) and (6) in oil pan (2). Tighten plug (3) 75 to 80 lb-ft (102 to 108 N·m). Tighten plug (6) to 120 to 144 lb-in (14 to 16 N·m).
- (6) Install washer (5) and plug (4) in oil pan (2). Tighten plug to 180 to 240 lb-in (20 to 27 N·m).

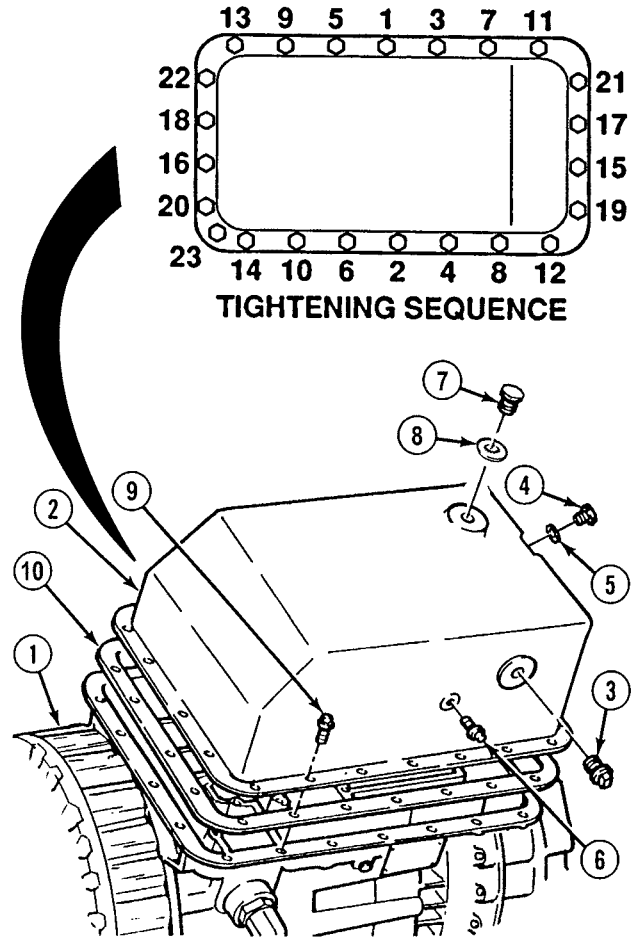
**NOTE**

Perform Step (7) if oil pan is equipped with a corner drain plug.

- (7) Install plug (7) and gasket (8) from oil pan (2). Tighten plug to 180 to 240 lb-in (20 to 27 N·m).

**d. Follow-On Maintenance:**

- Remove transmission from stand, (Para 23-2).



**END OF TASK**





**23-5. TRANSMISSION LOW OIL SENSOR ASSEMBLY REPLACEMENT.**

This task covers:

- a. Removal
- b. Installation
- c. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Wrench Set, Socket 3/8 in. Drive (Item 273, Appendix F)
- Wrench, Torque (0-60 N·m) (Item 276, Appendix F)

*Materials/Parts*

- Tags, Identification (Item 72, Appendix B)

*Equipment Condition*

- Internal oil filter removed, (Para 23-4)

**a. Removal.**

**NOTE**

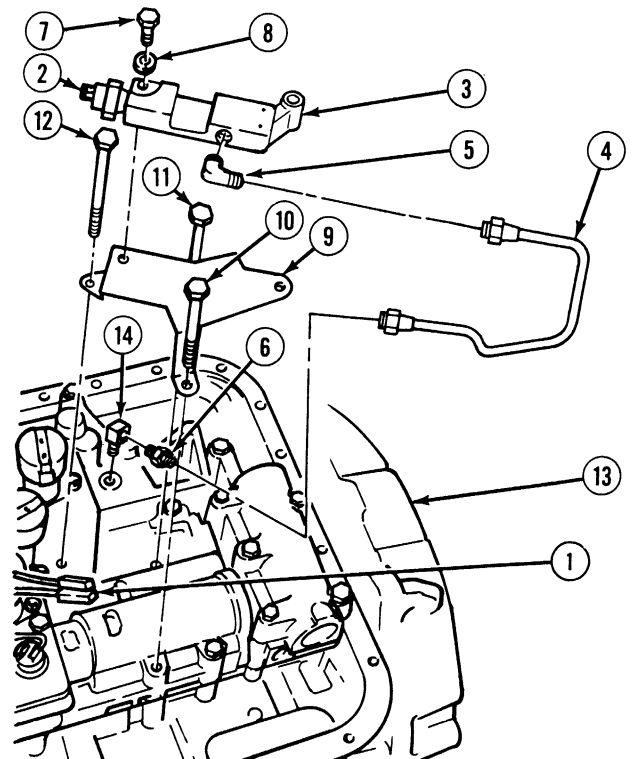
Tag and mark wire and connectors prior to removal.

- (1) Remove two connectors (1) from oil pressure switch (2).
- (2) Remove oil pressure switch (2) from oil sensor body (3).
- (3) Remove low oil sensor tube assembly (4) from elbow (5) and fitting (6).
- (4) Remove two screws (7), washers (8) and low oil sensor body (3) from bracket (9).
- (5) Remove screws (10), (11) and (12) and bracket (9) from transmission (13).

**NOTE**

Note position of fittings prior to removal.

- (6) Remove fitting (6) from elbow (14).
- (7) Remove elbow (14) from transmission (13).
- (8) Remove elbow (5) from low oil sensor body (3).



**23-5. TRANSMISSION LOW OIL SENSOR ASSEMBLY REPLACEMENT (CONT).**

**b. Installation.**

**NOTE**

Install fittings in position noted prior to removal.

- (1) Install elbow (5) in low oil sensor body (3).
- (2) Install elbow (14) in transmission (13).
- (3) Install fitting (6) on elbow (14).
- (4) Install bracket (9) to transmission (13) with screws (10), (11) and (12).
- (5) Position low oil sensor body (3) on bracket (9) with two washers (8) and screws (7).
- (6) Install oil pressure switch (2) to low oil sensor body (3).

**CAUTION**

All valve body screws should be started by hand to prevent binding. Tighten all screws to 50 percent of specified torque. Repeat tightening sequence to 100 percent torque.

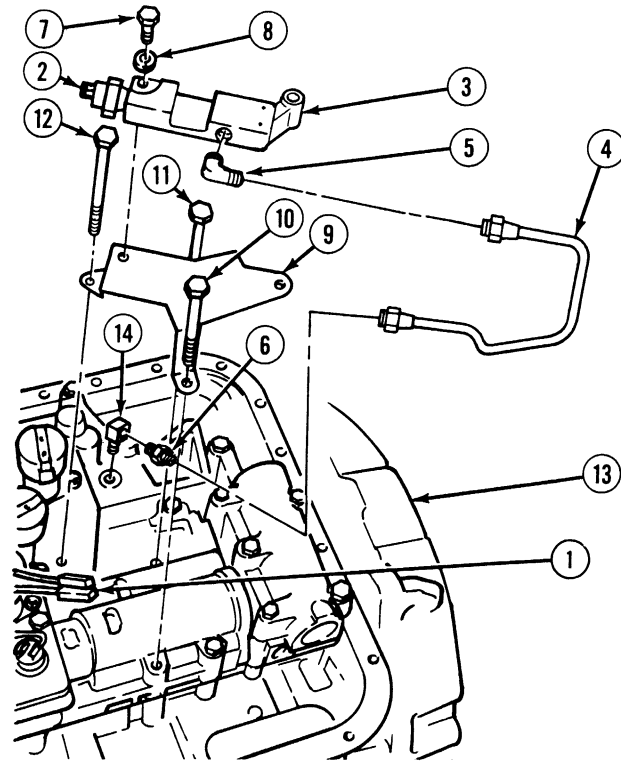
**NOTE**

If screw binds during installation, loosen all screws and check alignment of control valve and components. Repeat tightening procedure until all screws can be tightened without binding.

- (7) Tighten screws (7), (10), (11) and (12) finger tight.
- (8) Tighten screws (7), (10), (11) and (12) to 8 to 12 lb-ft (11 to 16 N·m).
- (9) Install low oil sensor tube assembly (4) on fitting (6) and elbow (5).
- (10) Install two electrical connectors (1) on oil pressure switch (2).

**c. Follow-On Maintenance:**

- Install internal oil filter, (Para 23-4).



**END OF TASK**

## 23-6. FIRST RANGE TRIMMER VALVE REPAIR.

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Caps, Vise Jaw (Item 27, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Vise, Machinist (Item 248, Appendix F)

#### *Personnel Required*

Two

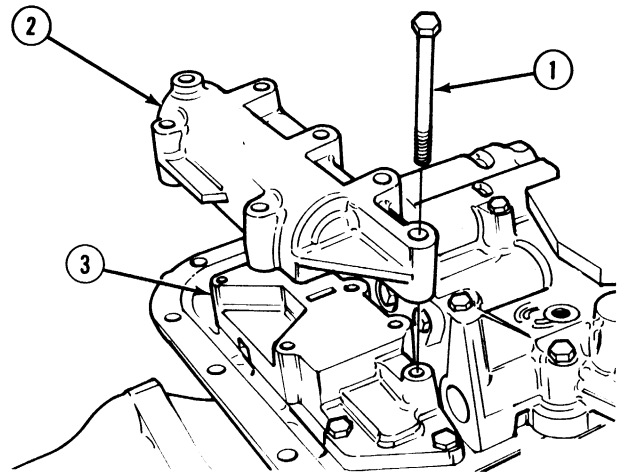
#### *Equipment Condition*

Low oil sensor removed, (Para 23-5)

#### *Materials/Parts*

Cloth, Crocus (Item 12, Appendix B)  
Oil, Hydraulic (Item 34, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Spring (Item 655, Appendix E)

- a. Removal.** Remove six screws (1) and trimmer valve assembly (2) from shift valve (3).



**23-6. FIRST RANGE TRIMMER VALVE REPAIR (CONT).**

**b. Disassembly.**

- (1) Position valve body (1) in soft-jaw vise.

**WARNING**

Use care when removing retaining pin. Spring behind plug is under tension. Wear proper eye protection to avoid injury to personnel.

**NOTE**

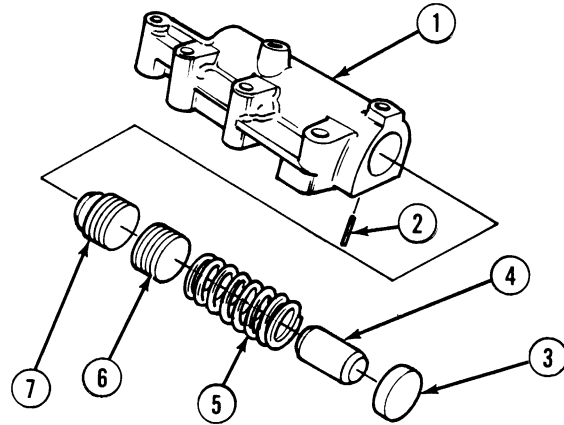
Spring may pop out of valve body upon removal of retaining pin.

- (2) Remove retaining pin (2) from valve body (1).

**CAUTION**

Use extreme care when handling valve parts. Do not bump valve in any way or damage may occur.

- (3) Remove valve plug (3), stop (4), spring (5), plug (6) and valve (7) from valve body (1). Discard spring.



c. *Cleaning/Inspection.*

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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**

Use extreme care when handling valve parts. Do not bump valve in any way or damage may occur.

- (1) Clean all metal parts using drycleaning 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) Dry all metal parts with compressed air.
- (3) Inspect valve body and valve for nicks, burrs and scratches. Remove defects with crocus cloth or soft stone.
- (4) Check that valve moves freely in bore.
- (5) Check retaining pin for deformity. Replace if damaged.
- (6) Coat all parts with hydraulic oil.

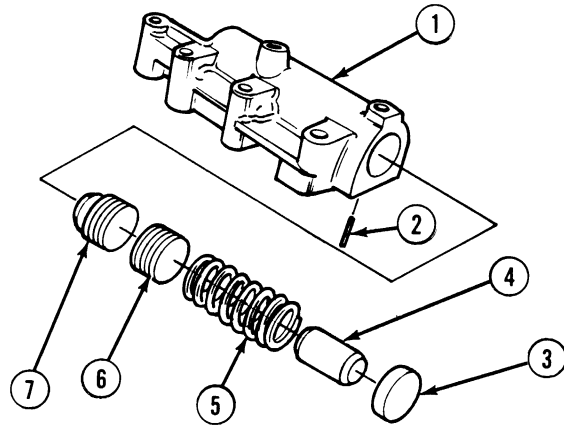
**23-6. FIRST RANGE TRIMMER VALVE REPAIR (CONT).**

**d. Assembly.**

- (1) Install valve (7), plug (6), spring (5), stop (4) and valve plug (3) in valve body (1).

**WARNING**

Use care when replacing valve plug. Spring behind plug is under tension. Wear proper eye protection to avoid personal injury.



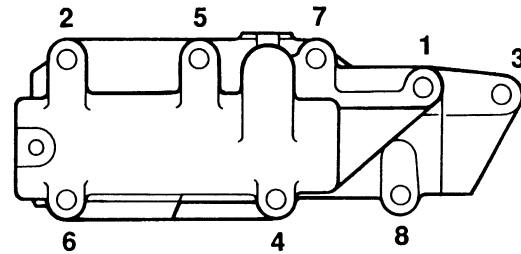
- (2) With the aid of an assistant, compress spring (5) and install retaining pin (2) in valve body (1).
- (3) Remove valve body (1) from soft-jaw vise.

**e. Installation.**

**CAUTION**

All valve body screws should be started by hand to prevent binding. Tighten all screws to 50 percent of specified torque. Repeat tightening sequence to 100 percent torque.

**TIGHTENING SEQUENCE**

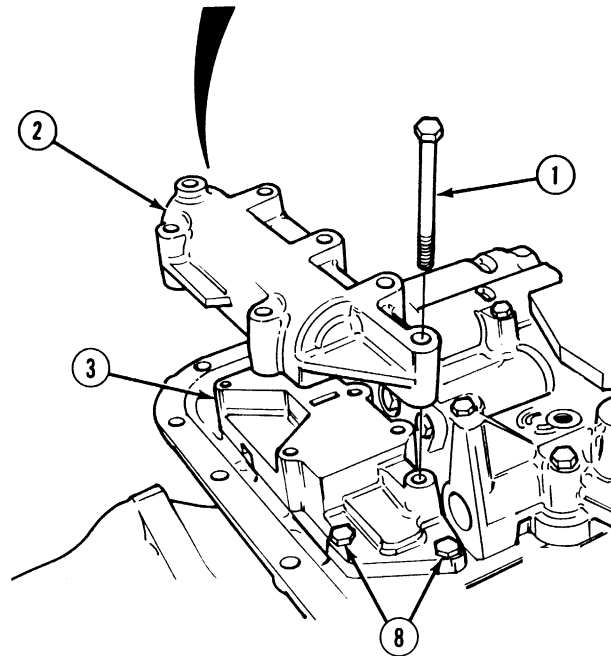


- (1) Position trimmer valve assembly (2) on shift valve (3) with six screws (1).

**NOTE**

Screws tightened in Steps (2) and (3) are screws from first range trimmer valve and first shift valve.

- (2) Hand tighten screws (1) and (8) in sequence shown.
- (3) Tighten screws (1) and (8) in sequence shown to 8 to 12 lb-ft (11 to 16 N·m).



**f. Follow-On Maintenance:**

- Install low oil sensor, (Para 23-5).

**END OF TASK**

## 23-7. FIRST SHIFT VALVE REPAIR.

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Caps, Vise Jaw (Item 27, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Vise, Machinist (Item 248, Appendix F)

#### *Equipment Condition*

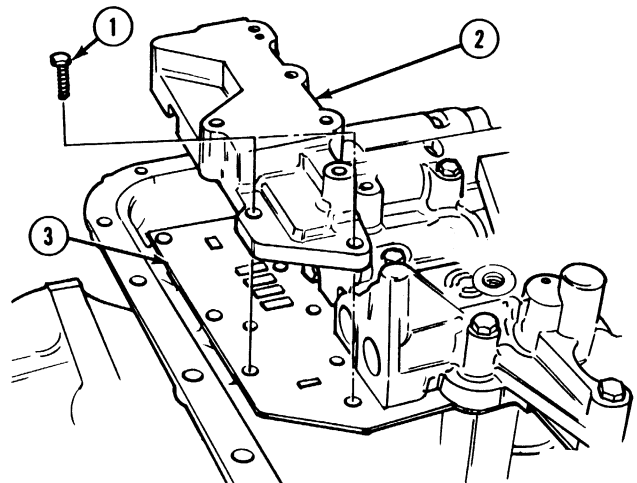
First range trimmer valve removed, (Para 23-6)

#### *Materials/Parts*

Cloth, Crocus (Item 12, Appendix B)  
Oil, Hydraulic (Item 34, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Spring (Item 663, Appendix E)

### a. **Removal.**

- (1) Remove two screws (1) and first shift valve body (2) from separator plate (3).





## 23-7. FIRST SHIFT VALVE REPAIR (CONT).

### b. Disassembly.

- (1) Install valve body (1) in soft-jaw vise.

### WARNING

Use care when removing retaining pin. Spring behind plug is under tension. Wear proper eye protection to avoid personal injury.

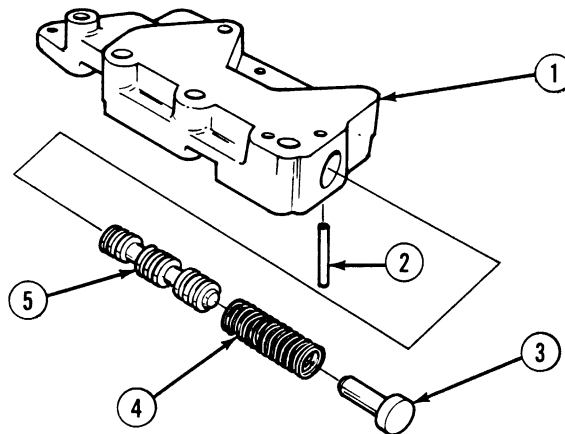
### NOTE

Spring may pop out of valve body upon removal of retaining pin.

- (2) Remove retaining pin (2) from shift valve (1).

### CAUTION

Use extreme care when handling valve parts. Do not bump valve in any way or damage may occur.



- (3) Remove valve stop (3), spring (4) and valve (5) from valve body (1). Discard spring.

### c. Cleaning/Inspection.

### WARNING

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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

Use extreme care when handling valve parts. Do not bump valve in any way or damage may occur.

- (1) Clean all metal parts using drycleaning 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) Dry all metal parts with compressed air.
- (3) Inspect valve body and valve for nicks, burrs, and scratches. Remove defects with crocus cloth or soft stone.
- (4) Check that valve moves freely in bore.
- (5) Check retaining pin for deformity. Replace if damaged.
- (6) Coat all parts with hydraulic oil.
- (7) Remove valve body (2) from soft-jaw vise.

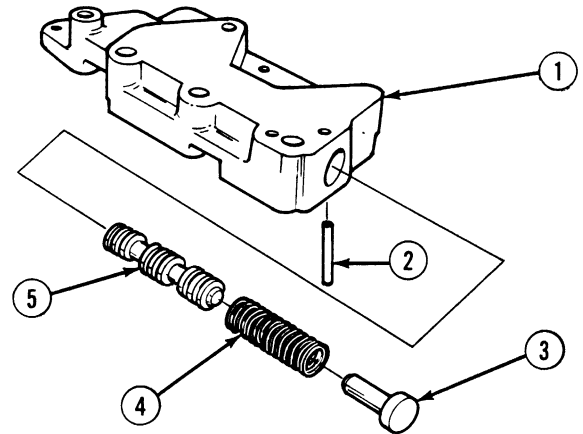
**d. Assembly.**

- (1) Install valve (5), spring (4) and valve stop (3) in valve body (1).

**WARNING**

Use care when replacing valve stop. Spring behind stop is under tension. Wear proper eye protection to avoid injury to personnel.

- (2) Push in valve stop (3) and install retaining pin (2) in valve body (1).



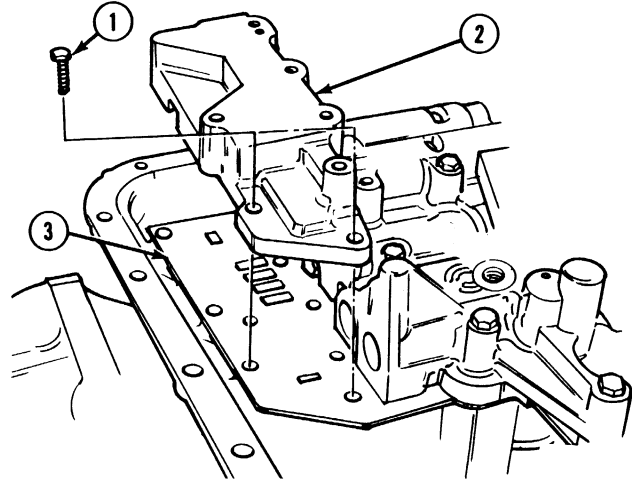
**23-7. FIRST SHIFT VALVE REPAIR (CONT).**

*e. Installation.*

**CAUTION**

Do not tighten screws. Screws will be tightened after first range trimmer valve is installed to prevent warping of separator plate.

- (1) Position valve body (2) on separator plate (3) with two screws (1).



*f. Follow-On Maintenance:*

- Install first range trimmer valve, (Para 23-6).

**END OF TASK**

**23-8. TRANSMISSION SOLENOID WIRING HARNESS REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Bit Set, Screwdriver (Item 17, Appendix F)  
Pliers, Retaining Ring (Item 155, Appendix F)  
Wrench Set, Socket 3/8 in. Drive  
(Item 273, Appendix F)  
Wrench, Torque (0-60 N·m)  
(Item 276, Appendix F)

*Materials/Parts*

Cable Ties (Item 9, Appendix B)  
Oil, Hydraulic (Item 34, Appendix B)

*Materials/Parts - Continued*

Solvent, Drycleaning (Item 68, Appendix B)  
Tags, Identification (Item 72, Appendix B)  
Gasket (Item 63, Appendix E)  
Lockwasher (Item 243, Appendix E)  
Packing, Preformed (Item 400, Appendix E)  
Screw and Washer (4) (Item 547, Appendix E)  
Seal (9) (Item 620, Appendix E)

*Equipment Condition*

First shift valve removed, (Para 23-7)

**23-8. TRANSMISSION SOLENOID WIRING HARNESS REPAIR (CONT).**

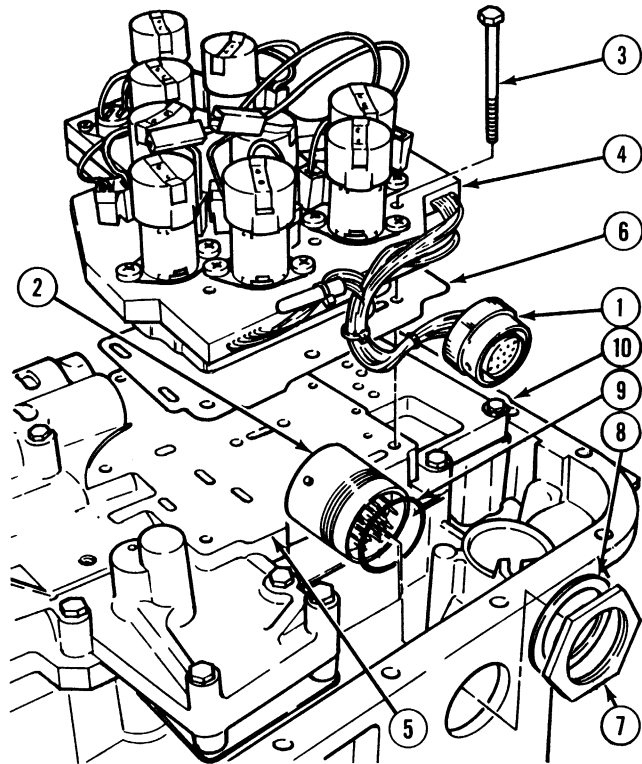
**a. Removal.**

- (1) Disconnect wiring harness (1) from bulkhead connector (2).
- (2) Remove nine screws (3) and solenoid harness assembly (4) from separator plate (5).
- (3) Remove solenoid gasket (6) from separator plate (5). Discard solenoid gasket.

**NOTE**

Perform Steps (4) and (5) if bulkhead connector is damaged.

- (4) Loosen connector nut (7) until slots in nut match extended pins on connector (2).
- (5) Remove nut (7), lockwasher (8), connector (2) and preformed packing (9) from transmission housing (10). Discard lockwasher and preformed packing.



**b. Disassembly.**

**NOTE**

Tag and mark wires, connectors and solenoids prior to removal.

- (1) Disconnect all solenoid and pressure sensor switch connectors (1) from circuit board terminals (2).

**NOTE**

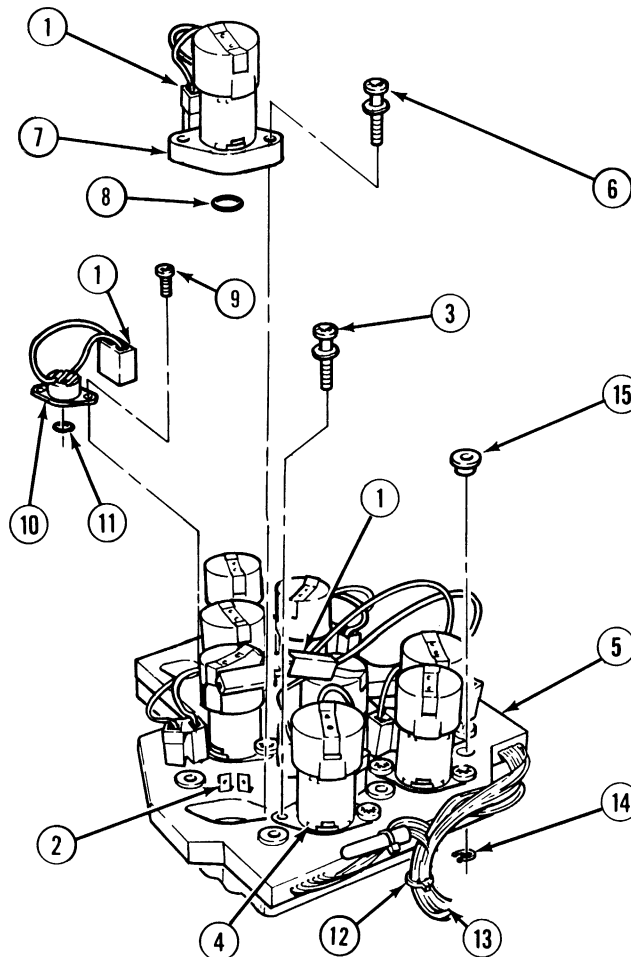
Solenoids with white caps are latching solenoids.

- (2) Remove screws and washers (3) and six latching solenoids (4) from solenoid wiring harness assembly (5). Discard screws and washers.

**NOTE**

Solenoids with black caps are non-latching solenoids.

- (3) Remove screws with washers (6) and three non-latching solenoids (7) from solenoid wiring harness assembly (5). Discard screws and washers.
- (4) Remove and discard seal (8) from nine solenoids (7) and (4).
- (5) Remove screws (9) and pressure switches (10) from solenoid wiring harness assembly (5).
- (6) Remove and discard preformed packing (11) from pressure switches (10).



**NOTE**

Perform Step (7) if cable ties are damaged.

- (7) Remove cable ties (12) from wiring harness cable (13).



Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

**NOTE**

Perform Step (8) if standoffs are damaged.

- (8) Remove 11 retaining rings (14) and standoffs (15) on solenoid wiring harness assembly (5).

**c. Cleaning/Inspection.**

- (1) Inspect solenoid wiring harness assembly for wear, damage, or broken parts.
- (2) Inspect wiring harness and end connectors for damage.
- (3) Replace worn or damaged parts.

**23-8. TRANSMISSION SOLENOID WIRING HARNESS REPAIR (CONT).**

*d. Assembly.*

**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

**NOTE**

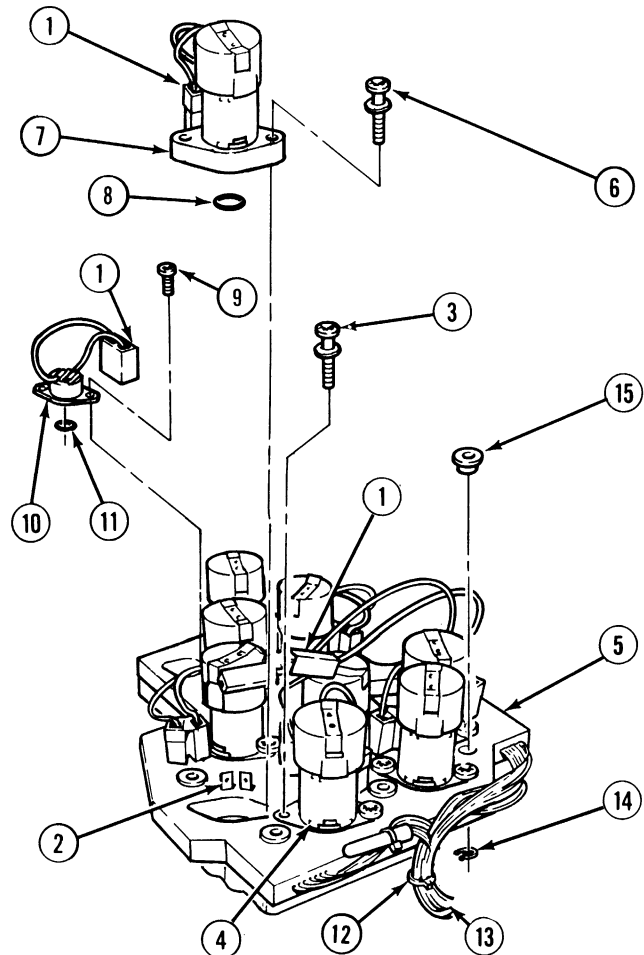
Perform Step (1) if standoffs were removed.

- (1) Install 11 standoffs (15) and retaining rings (14) in solenoid wiring harness assembly (5).

**NOTE**

Perform Step (2) if cable ties were removed.

- (2) Install cable ties (12) on wiring harness cable (13).
- (3) Apply hydraulic oil to three seals (8).
- (4) Install three seals (8) in each mounting surface of three non-latching solenoids (7).
- (5) Install two screws with washers (6) and three non-latching solenoids (7) to solenoid wiring harness assembly (5). Tighten to 84 to 108 lb-in (9 to 12 N·m).
- (6) Apply hydraulic oil to six seals (8).
- (7) Install six seals (8) in each mounting surface of six latching solenoids (4).
- (8) Align each solenoid (7) and (4) on solenoid wiring harness assembly (5) in areas identified for latching solenoids.
- (9) Install six latching solenoids (4) and two screws with washers (3) to solenoid wiring harness assembly (5). Tighten to 84 to 108 lb-in (9 to 12 N·m).
- (10) Apply hydraulic oil to preformed packing (11).
- (11) Position preformed packing (11) on two pressure switches (10).
- (12) Install two pressure switches (10) on solenoid wiring harness assembly (5) with two screws (9). Tighten screws to 60 to 84 lb-in (7 to 9 N·m).
- (13) Connect all solenoid and pressure sensor switch connectors (1) to circuit board terminals (2) on solenoid wiring harness assembly (5).



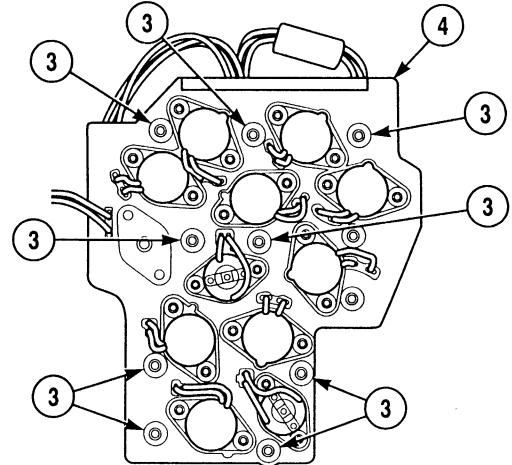
**e. Installation.**

- (1) Align holes and install gasket (6) and solenoid and solenoid harness assembly (4) on separator plate (5).

**NOTE**

Tighten screws in circular sequence starting with screw closest to center.

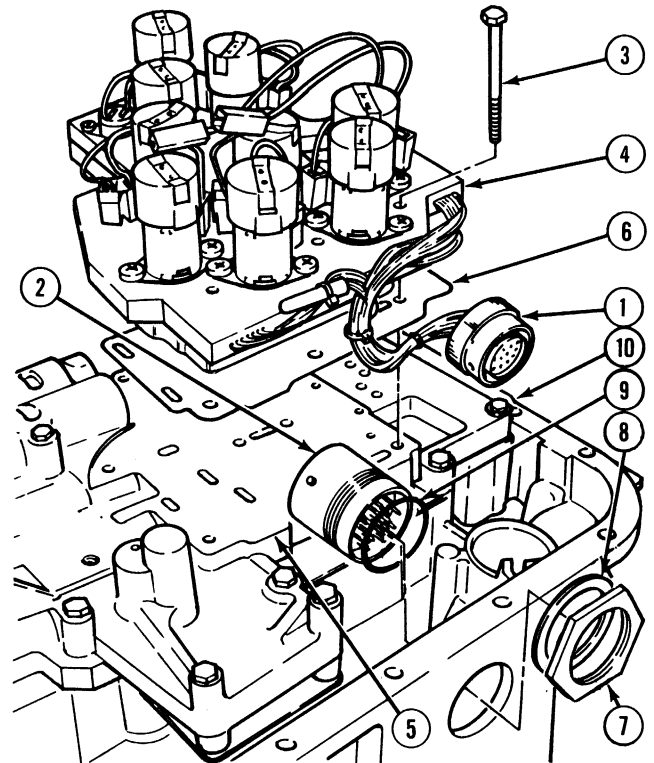
- (2) Install nine screws (3) in solenoid harness assembly (4). Tighten screws to 8 to 12 lb-ft (11 to 16 N·m).



**NOTE**

Perform Steps (3), (4) and (5) if bulkhead connector was removed.

- (3) Apply hydraulic oil to preformed packing (9).
- (4) Install preformed packing (9) on connector (2).
- (5) Install bulkhead connector (2) in transmission housing (10).
- (6) Install lockwasher (8) and connector nut (7) on connector (2). Tighten to 60 to 68 lb-ft (81 to 92 N·m).
- (7) Connect transmission wiring harness (1) to bulkhead connector (2).



**f. Follow-On Maintenance:**

- Install first shift valve, (Para 23-7).

**END OF TASK**



## 23-9. CONTROL VALVE ASSEMBLY REPAIR.

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gage Set, Feeler (Item 67, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Micrometer, Outside, Caliper, Set  
(Item 139, Appendix F)  
Straight Edge (Item 230, Appendix F)  
Wrench Set, Socket 3/8 in. Drive  
(Item 273, Appendix F)  
Wrench, Torque (0-60 N·m)  
(Item 276, Appendix F)

#### *Materials/Parts*

Oil, Hydraulic (Item 34, Appendix B)  
Tags, Identification (Item 72, Appendix B)  
Pin, Spring (2) (Item 433, Appendix E)  
Plate, Separator (Item 437, Appendix E)  
Screw (8) (Item 544, Appendix E)  
Spring Kit (Item 668, Appendix E)

#### *Personnel Required*

Two

#### *Equipment Condition*

Solenoid and wiring harness removed,  
(Para 23-8)

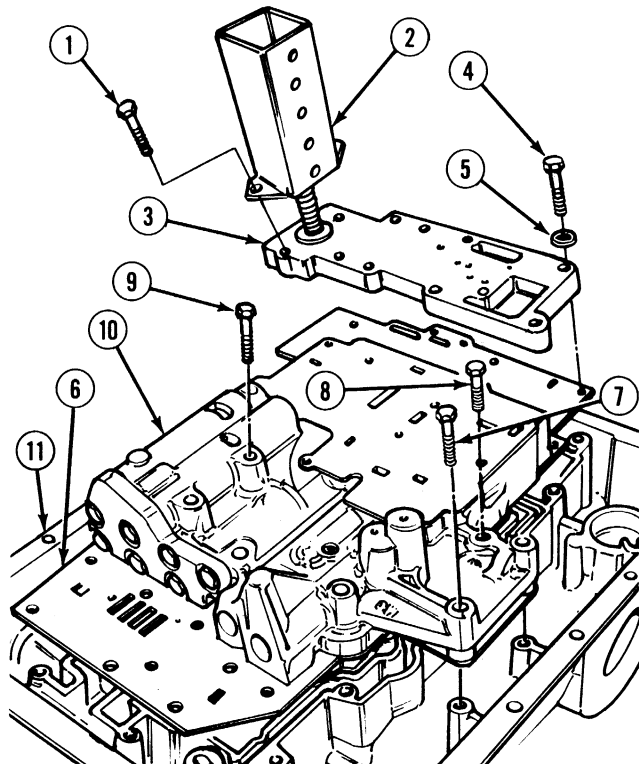
### a. Removal.

- (1) Remove two screws (1) and oil baffle (2) from front plate (3).
- (2) Remove eight screws (4), washers (5) and front plate (3) from separator plate (6).



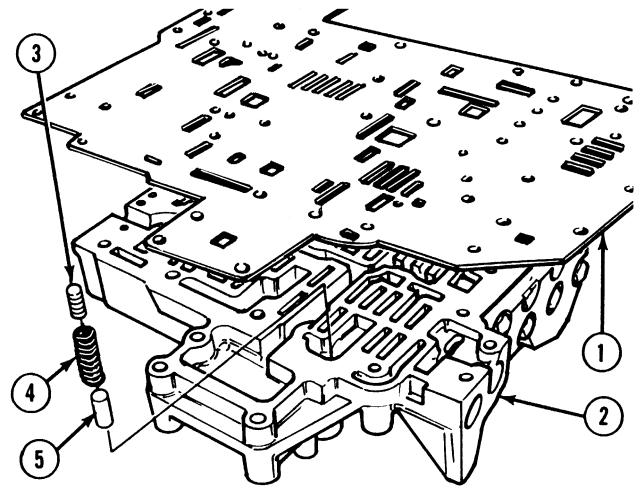
Control valve and separator plate are removed as one assembly. Removing separately may cause damage to parts.

- (3) With the aid of an assistant, remove five screws (7), screw (8), screw (9) control valve (10) and separator plate (6) from transmission (11).



**b. Disassembly.****CAUTION**

- Do not force separator plate from control valve. Damage to key hole slots in separator plate will result.
- Valve body assembly contains springs which can be interchanged easily by mistake. If springs are not installed in correct positions, calibration of valve body functions will be lost.



- (1) With separator plate (1) facing upward, place control valve body (2) on clean work surface.
- (2) Locate two key hole slots and flared head pins in separator plate. Slide separator plate (1) across control valve body (2) so flared heads of pins move into larger part of key hole slots. Remove and discard separator plate (1) from control valve body (2).

**NOTE**

Note and record color and location of all springs.

- (3) Remove directional priority valve (3), priority valve spring (4) and priority valve stop (5) from control valve body (2). Discard spring.

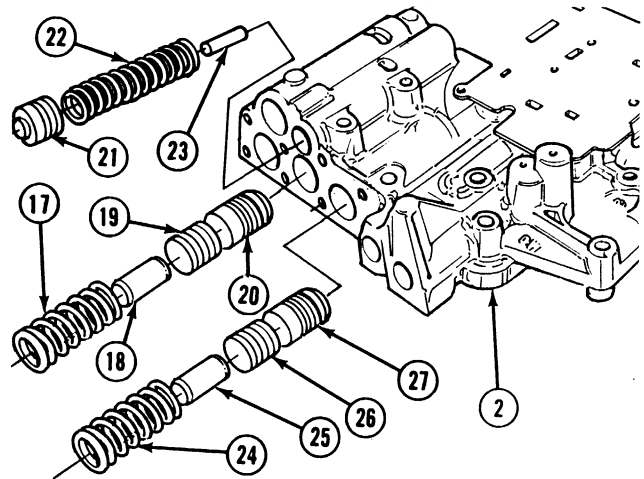
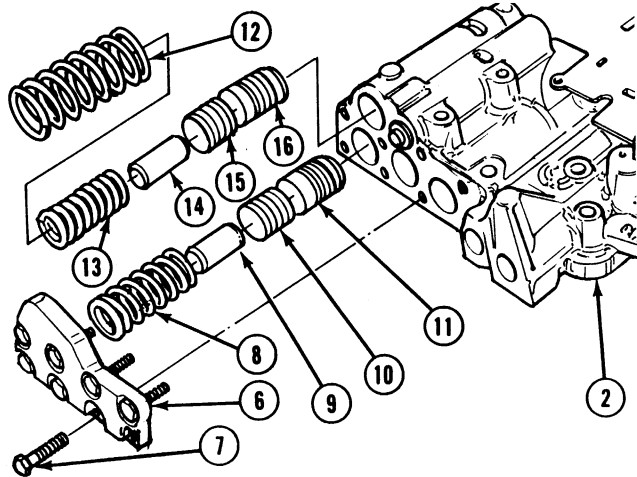
**23-9. CONTROL VALVE ASSEMBLY REPAIR (CONT).**

- (4) Position control valve body (2) flat side down on clean work surface.

**WARNING**

Cover is under spring pressure.  
Wear proper eye protection to avoid personal injury.

- (5) Hold trimmer cover (6) against spring pressure and remove eight screws (7) and cover (6) from control valve body (2). Discard screws.
- (6) Remove spring (8), valve stop (9), plug (10) and fourth clutch trimmer valve (11) from control valve body (2). Discard spring.
- (7) Remove spring (12), spring (13), valve stop (14), plug (15) and second clutch trimmer valve (16) from control valve body (2). Discard springs.
- (8) Remove spring (17), valve stop (18), plug (19) and third clutch trimmer valve (20) from control valve body (2). Discard spring.
- (9) Remove trimmer accumulator valve (21), spring (22) and valve stop (23) from control valve body (2). Discard spring.
- (10) Remove spring (24), valve stop (25), plug (26) and fifth clutch trimmer valve (27) from control valve body (2). Discard spring.



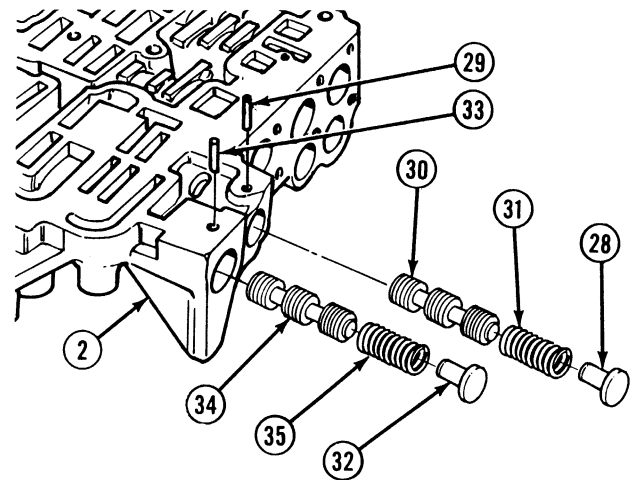
**WARNING**

Components in each valve bore are spring-loaded and must be compressed while removing retaining pin. Ensure proper eye protection is worn to avoid injury to personnel.

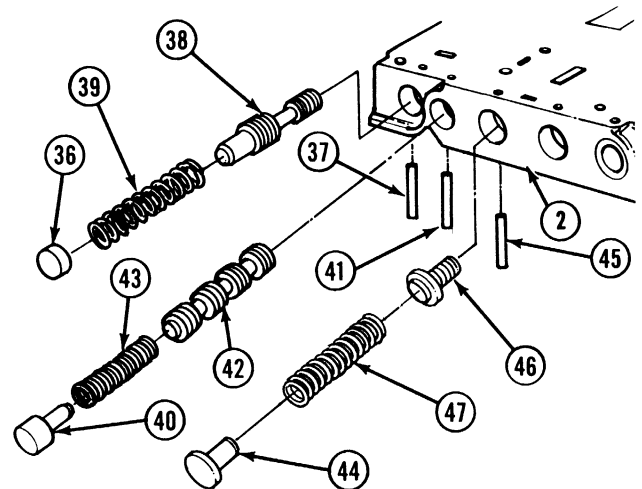
**NOTE**

Note location, type, and size of retaining pins. Retaining pins must be installed in original locations.

- (11) Turn valve body over and compress stop (28) and remove spring pin (29) from 2-3 shift valve (30) from control valve body (2). Discard spring pin.
- (12) Remove stop (28), spring (31) and 2-3 shift valve (30) from control valve body (2). Discard spring.
- (13) Compress stop (32) and discard retaining pin (33) from 3-4 shift valve (34).
- (14) Remove stop (32), spring (35) and 3-4 shift valve (34) from control valve body (2). Discard spring.



- (15) Turn control valve body (2) over and compress stop (36), remove and discard retaining pin (37) from neutral range valve (38).
- (16) Remove stop (36), spring (39) and neutral range valve (38) from control valve body (2). Discard spring.
- (17) Compress stop (40), remove and discard retaining pin (41) from forward and reverse valve (42).
- (18) Remove stop (40), spring (43) and forward and reverse valve (42) from control valve body (2). Discard spring.
- (19) Compress stop (44), remove and discard retaining pin (45) from solenoid priority valve (46).
- (20) Remove stop (44), spring (47) and solenoid priority valve (46) from control valve body (2). Discard spring.

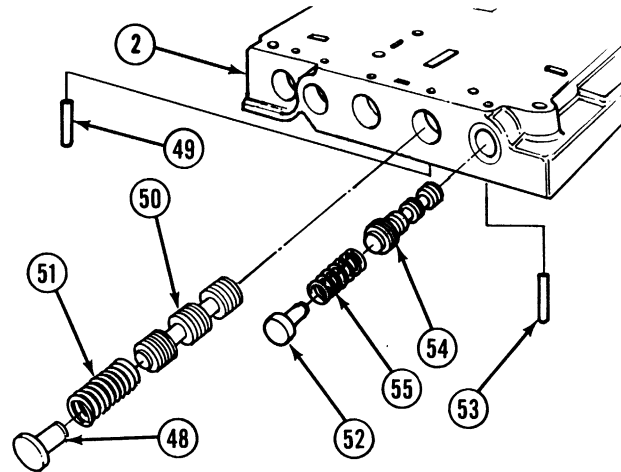


**23-9. CONTROL VALVE ASSEMBLY REPAIR (CONT).**

**WARNING**

Components in each valve bore are spring-loaded and must be compressed while removing retaining pin. Ensure proper eye protection is worn to avoid injury to personnel.

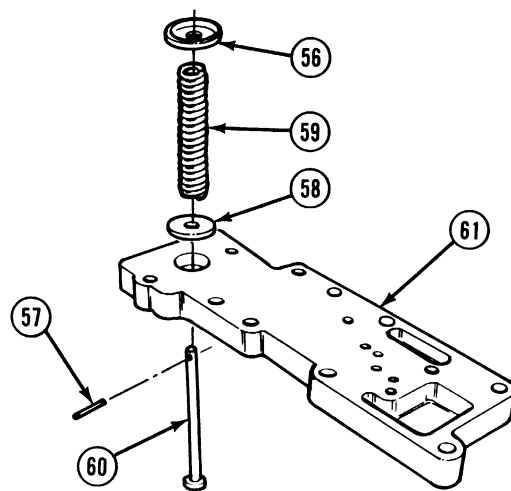
- (21) Compress stop (48), remove and discard flared spring pin (49) from 4-5 shift valve (50).
- (22) Remove stop (48), spring (51) and 4-5 shift valve (50) from control valve body (2). Discard spring.
- (23) Compress stop (52), remove and discard retaining pin (53) from trim boost regulator valve (54).
- (24) Remove stop (52), spring (55) and trim boost regulator valve (54) from control valve body (2). Discard spring.



**WARNING**

Washer is under spring tension. Wear proper eye protection to avoid injury to personnel.

- (25) Compress washer (56) and remove retaining pin (57) from lubrication valve (58).
- (26) Remove washer (56), spring (59), lubrication valve (58) and valve guide pin (60) from front plate (61). Discard spring.



**c. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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**

Use extreme care when handling valve body. Do not bump valve in any way or damage may occur to part.

- (1) Clean control valve housing and cover with drycleaning 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) Dry valve housing and cover with compressed air.
- (3) Inspect bores, valves and surfaces of control valve body for cracks, nicks or burrs. Replace if damaged.
- (4) Inspect machined surface of valve body for scratches, nicks, burrs and scoring. Replace if damaged.

**NOTE**

Machined surface of valve body should be flat to within 0.002 in. (0.051 mm) total not to exceed a rate of 0.0005 in. (0.0127 mm) per inch. Replace valve body if not within specification.

- (5) Measure machined surface of valve body for flatness.

**23-9. CONTROL VALVE ASSEMBLY REPAIR (CONT).**

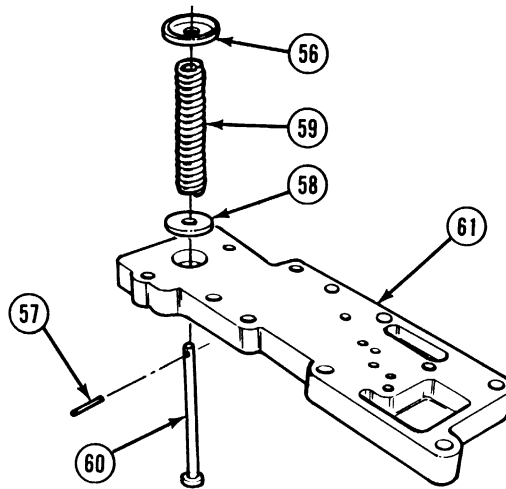
**d. Assembly.**

- (1) Install valve guide pin (60), lubrication valve (58), spring (59) and washer (56) in front plate (61).

**WARNING**

Washer is under spring tension.  
Wear proper eye protection to avoid personal injury.

- (2) Compress washer (56) and install retaining pin (57) in guide pin (60).



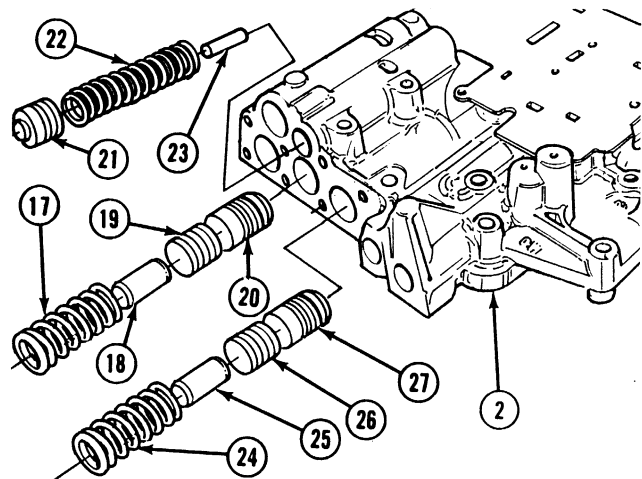
**WARNING**

Components in each valve bore are spring-loaded and must be restrained while installing retaining pin. Springs can act like projectiles if not properly restrained which may result in severe eye injury to personnel.

**CAUTION**

- Valve body contains springs which can be interchanged easily by mistake. If springs are not reinstalled in correct positions, the calibration of valve body functions will be lost.
- Retaining pins must be installed in original location to make sure proper fit.
- When installed, each valve must move freely (dry) in its bore by its own weight. Lubricate valve parts only after valve moves freely (dry) in its bore or damage may result to parts.

- (3) Install third clutch trimmer valve (20), shorter land first, plug (19), spring (17) and valve stop (18) in control valve body (2).
- (4) Install trimmer accumulator valve stop (23), spring (22) and valve (21) in control valve body (2).
- (5) Install fifth clutch trimmer valve (27), plug (26), spring (24) and valve stop (25) in control valve body (2).

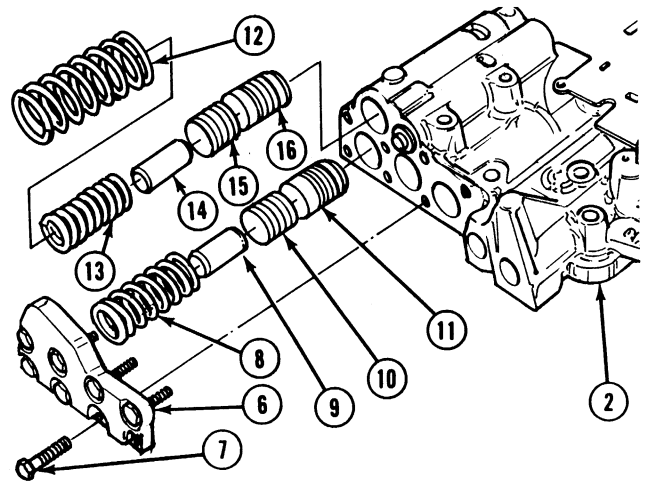


- (6) Install fourth clutch trimmer valve (11), shorter land first, plug (10), spring (8) and valve stop (9) in control valve body (2).
- (7) Install second clutch trimmer valve (16), shorter land first, plug (15), spring (13), spring (12) and valve stop (14) in control valve body (2).

**NOTE**

Springs must be compressed to properly install trimmer valve cover.

- (8) Install trimmer valve cover (6) on control valve body (2) with eight screws (7). Tighten screws to 96 to 144 lb-in (11 to 16 N·m).



**NOTE**

Make sure trim boost regulator valve spring is solid light blue and end color is light green.

- (9) Install trim boost regulator valve (54), spring (55) and valve stop (52) in control valve body (2).
- (10) Compress spring (55) and install retaining pin (53).
- (11) Position control valve body (2) flat side up on clean work surface.

**NOTE**

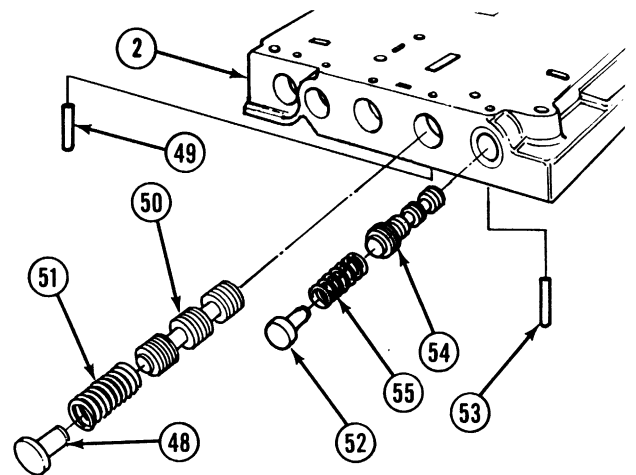
Make sure 4-5 shift valve spring is solid blue with yellow stripe.

- (12) Install 4-5 shift valve (50), spring (51) and valve stop (48) in control valve body (2).

**NOTE**

Flared end of pin must extend 0.065 to 0.069 in. (1.651 to 1.753 mm) above surface of valve body with opening of flare pointing in.

- (13) Compress spring (51) and install flared spring pin (49) in control valve body (2).



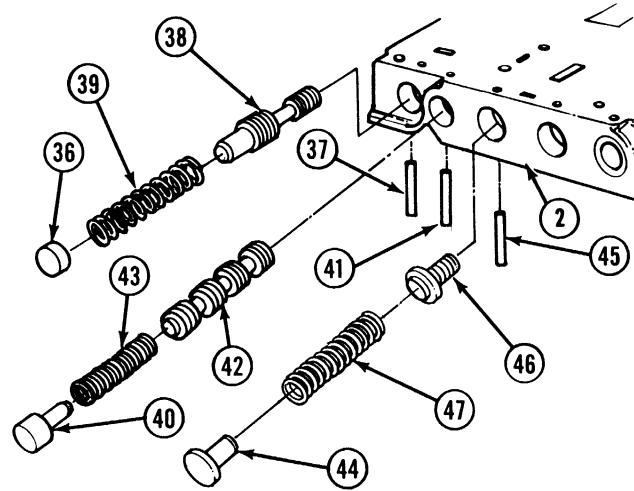


**23-9. CONTROL VALVE ASSEMBLY REPAIR (CONT).**

**NOTE**

Make sure solenoid priority valve spring is solid red with blue stripe.

- (14) Position control valve body flat side down on clean work surface.
- (15) Install solenoid priority valve (46), spring (47) and valve stop (44) in control valve body (2).
- (16) Compress spring (47) and install retaining pin (45) in control valve body (2).



**NOTE**

Make sure forward and reverse spring is solid yellow with orange stripe.

- (17) Install forward and reverse valve (42), spring (43) and valve stop (40) in control valve body (2).
- (18) Compress spring (43) and install retaining pin (41) in control valve body (2).

**NOTE**

Make sure neutral range spring is solid blue with yellow stripe.

- (19) Install neutral range valve (38), spring (39) and valve stop (36) in control valve body (2).
- (20) Compress spring (39) and install retaining pin (37) in control valve body (2).

- (21) Position control valve body (2) flat side up on clean work surface.

**NOTE**

Make sure 3-4 shift valve spring is solid blue with yellow stripe.

- (22) Install 3-4 shift valve (34), spring (35) and valve stop (32) in control valve body (2).
- (23) Compress spring (35) and install retaining pin (33) in control valve body (2).

**NOTE**

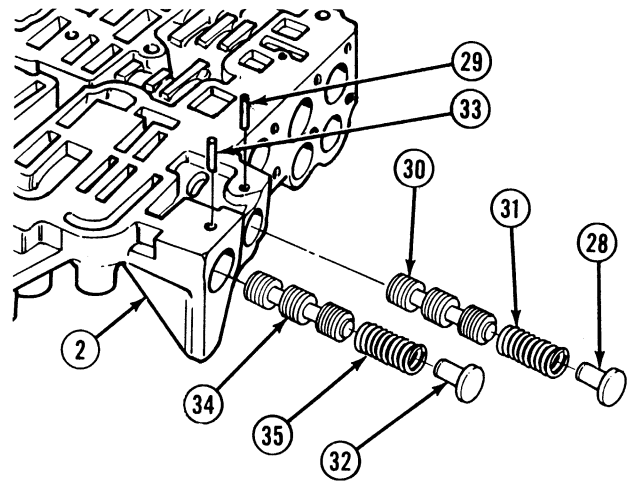
Make sure 2-3 shift valve spring is solid blue.

- (24) Install 2-3 shift valve (30), spring (31) and valve stop (28) in control valve body (2).

**NOTE**

Flared end of pin must extend 0.065 to 0.069 in. (1.651 to 1.753 mm) above surface of control valve body with opening of flare pointing in.

- (25) Compress spring (31) and install flared spring pin (29) in control valve body (2).



**23-9. CONTROL VALVE ASSEMBLY REPAIR (CONT).**

**NOTE**

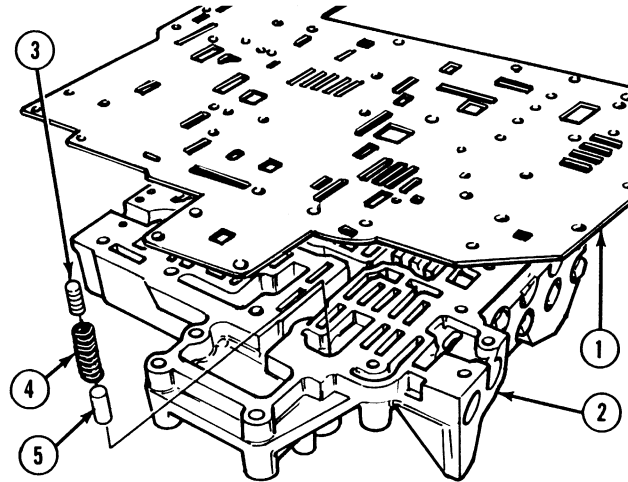
Make sure directional priority valve spring is solid white with yellow stripe.

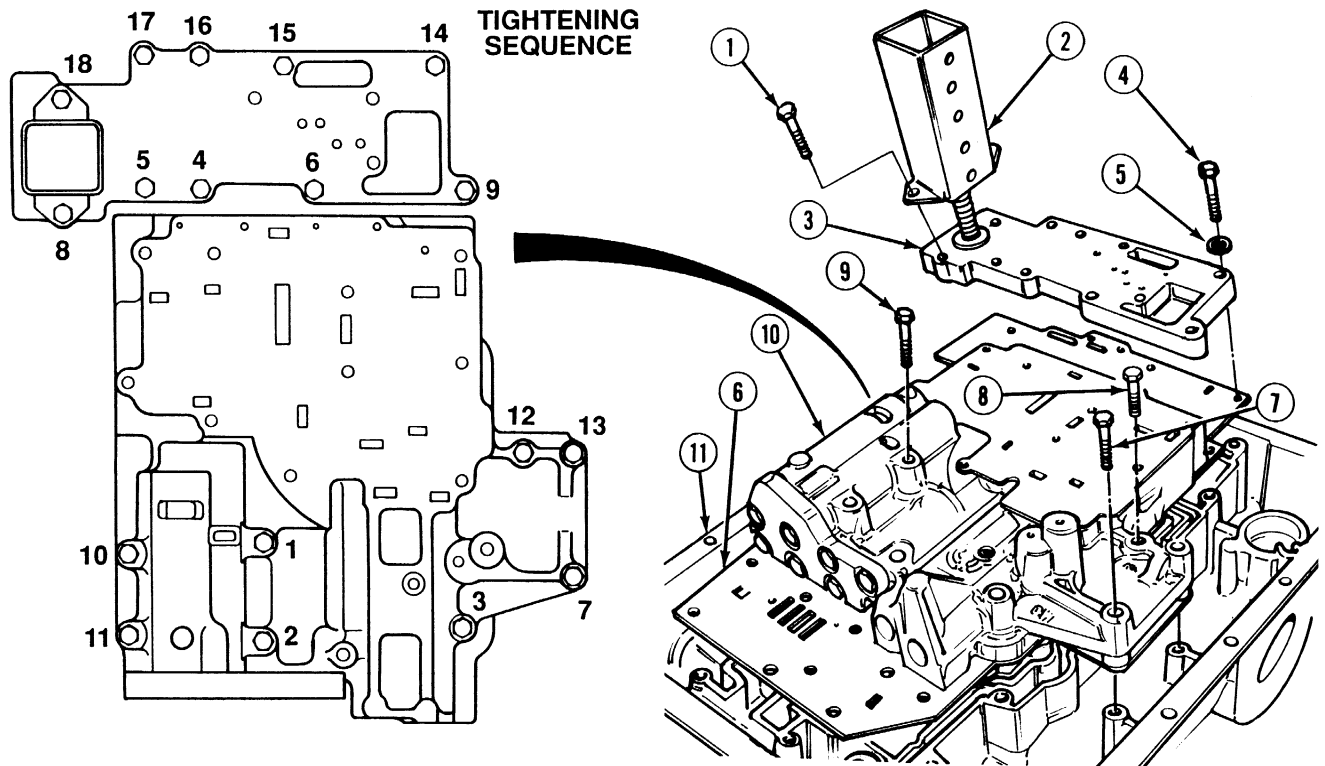
- (26) Install valve stop (5), spring (4) and directional priority valve (3) in control valve body (2).

**NOTE**

Separator plate and control valve are held together by two flared head spring pins. Pins fit through a keyhole slot in separator plate and hold two parts together.

- (27) Lubricate separator plate with hydraulic oil.
- (28) Locate two key hole slots and flared head pins in separator plate (1). Slide plate across valve body so flared heads of pins move from larger part of key hole slots to narrow part.
- (29) Make sure separator plate (1) and control valve body (2) are snug. If plate is loose, align all holes and increase flare of two pins.



**e. Installation.**

- (1) Position transmission so control valve (10) faces upward.

**NOTE**

Control valve and separator plate are installed as one assembly.

- (2) Position control valve (10) and separator plate (6) on transmission (11) with five screws (7), screw (8) and screw (9).
- (3) Position front plate (3) to separator plate (6) with eight washers (5) and screws (4).
- (4) Position oil baffle (2) on front plate (3) with two screws (1).
- (5) Tighten screws in sequence shown to 96 to 144 lb-in (11 to 16 N·m).

**f. Follow-On Maintenance:**

- Install solenoid and wiring harness, (Para 23-8).

**END OF TASK**

## 23-10. TORQUE CONVERTER STATOR REPAIR.

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Holder, Stator Roller (Item 95, Appendix F)

#### *Materials/Parts - Continued*

Petrolatum (Item 43, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)

#### *Equipment Condition*

Flywheel and torque converter turbine removed,  
(Para 7-10)

#### *Materials/Parts*

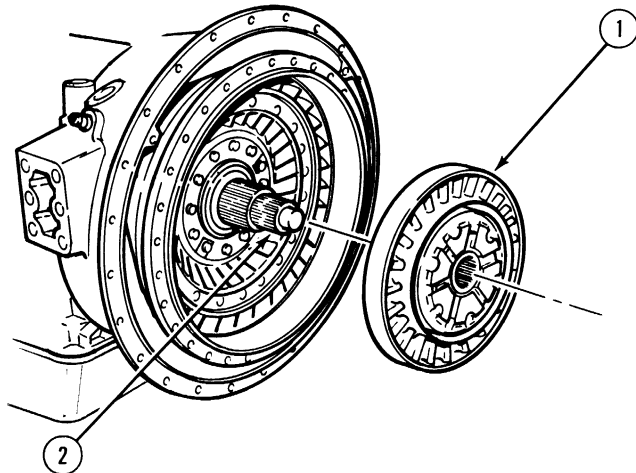
Cloth, Cleaning (Item 11, Appendix B)  
Oil, Hydraulic (Item 34, Appendix B)

### a. Removal.



Keep outer face of stator assembly down to prevent bearings and springs from falling out.

- (1) While applying slight counterclockwise pressure, remove stator assembly (1) from turbine shaft (2).



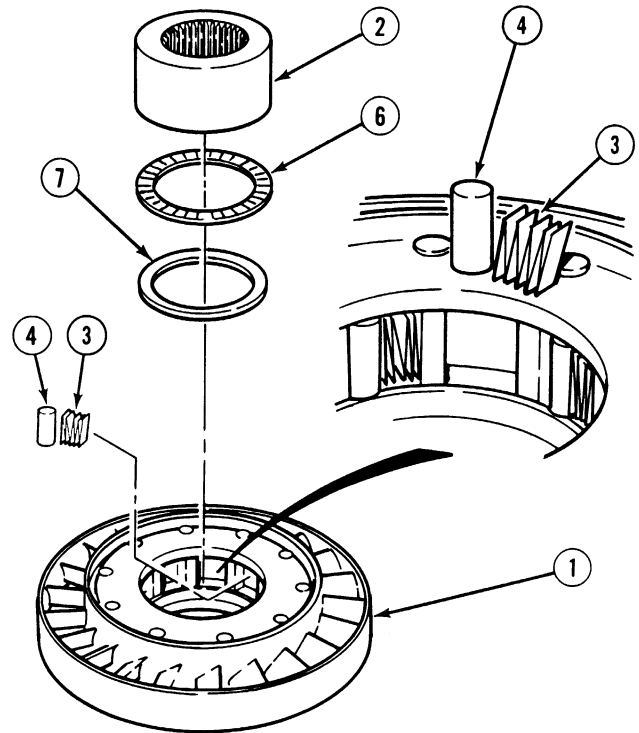
**b. Disassembly.**

- (1) Position stator assembly (1) rear side up.

**NOTE**

Roller race is removed by rotating clockwise and pulling upward.

- (2) Remove roller race (2) from stator assembly (1).
- (3) Note position of springs (3) and remove ten rollers (4) and ten springs (3) from stator assembly (1).
- (4) Remove thrust bearing (6) and thrust bearing race (7) from stator assembly (1).
- (5) Wrap thrust bearing (6) and thrust bearing race (7) in clean lint-free cloth or paper until ready to clean and inspect.

**c. Cleaning/Inspection.****WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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**

Keep bearings clean. The presence of dirt or grit on bearing rollers/balls is usually responsible for bearing failures. It is important to keep bearings clean during Removal, Inspection, and Installation. To make sure maximum bearing life, do not remove wrapper from new or clean used bearings until ready to install them. Do not remove grease in which bearings are packed. Do not lay bearings on a dirty bench; place them on a clean lint-free paper. If assembly is not to be completed at once, wrap or cover the exposed bearings with clean paper or lint-free cloth to keep out dust.

- (1) Clean all parts with drycleaning solvent.

**23-10. TORQUE CONVERTER STATOR REPAIR (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). Failure to comply may result in injury or death to personnel.

- (2) Dry parts, except bearing, with compressed air. Allow bearings to air dry.
- (3) Lubricate bearing with hydraulic oil.
- (4) Inspect bearings for roughness of rotation. Replace bearing if rotation is still rough after cleaning and oiling.

**d. Assembly.**

- (1) Install thrust bearing race (7) in rear side of stator assembly (1).
- (2) Coat pockets of stator assembly (1), springs (3) and rollers (4) with petrolatum.

**NOTE**

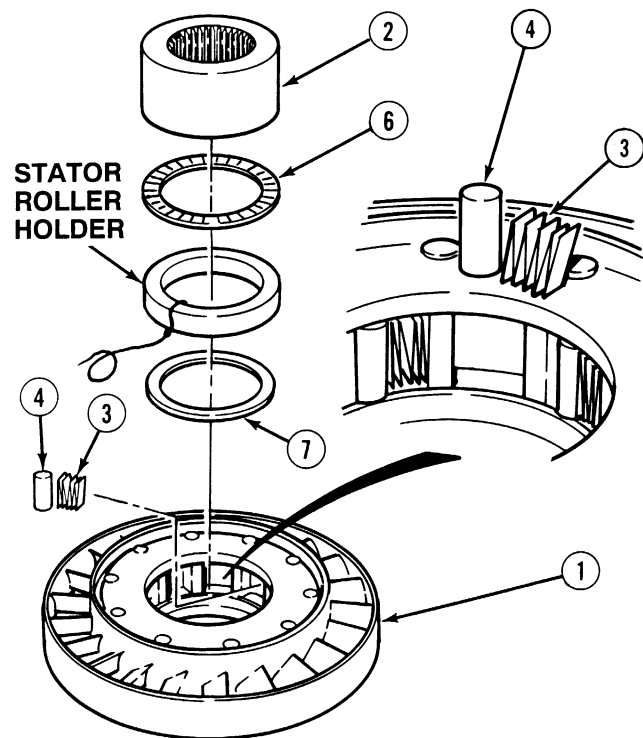
Make sure cord of roller holder hangs out bottom of stator.

- (3) Install stator roller holder in stator assembly (1) against thrust bearing race (7).
- (4) Install ten springs (3) in stator assembly (1). Springs must be positioned as shown.
- (5) Install ten rollers (4) in stator assembly (1).
- (6) Install thrust bearing (6) onto roller race (2).

**NOTE**

Rotate roller race clockwise to properly install in stator assembly.

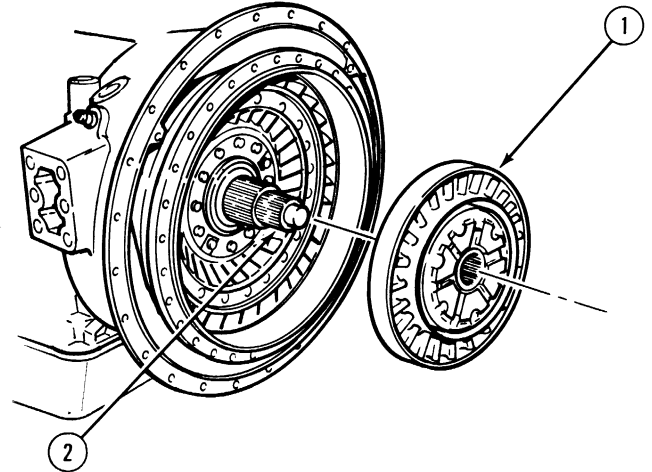
- (7) Install roller race (2) into stator assembly (1).
- (8) Remove stator roller holder by pulling on attached cord. Push roller race (2) in, rotating it clockwise, until thrust bearing (6) seats.
- (9) Rotate roller race (2) counterclockwise to lock in place. Position stator assembly (1) with roller race up.



**e. Installation.**

**CAUTION**

- Keep outer face of stator assembly down to prevent bearings and springs from falling out.
- Stator must turn freely in clockwise direction and lockup in counterclockwise direction. Failure to ensure this may result in improper operation and damage to equipment.



- (1) Install stator (1) on shaft (2). Align splines on shaft. Check that stator turns freely in clockwise direction and locks up in counterclockwise direction.

**f. Follow-On Maintenance:**

- Install flywheel and torque converter turbine, (Para 7-10).

**END OF TASK**



## 23-11. TORQUE CONVERTER PUMP REPAIR.

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Puller, Mechanical (Item 173, Appendix F)  
Puller, Bolts (Item 172, Appendix F)  
Remover, Snap Ring (Item 191, Appendix F)  
Sleeve Puller (Item 202, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

#### *Materials/Parts*

Cloth, Cleaning (Item 11, Appendix B)  
Oil, Hydraulic (Item 34, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Lockstrip (6) (Item 225, Appendix E)  
Retaining Ring (Item 475, Appendix E)  
Seal Ring (Item 609, Appendix E)  
Seal Ring (Item 611, Appendix E)

#### *Personnel Required*

Two

#### *Equipment Condition*

Torque converter stator removed, (Para 23-10)

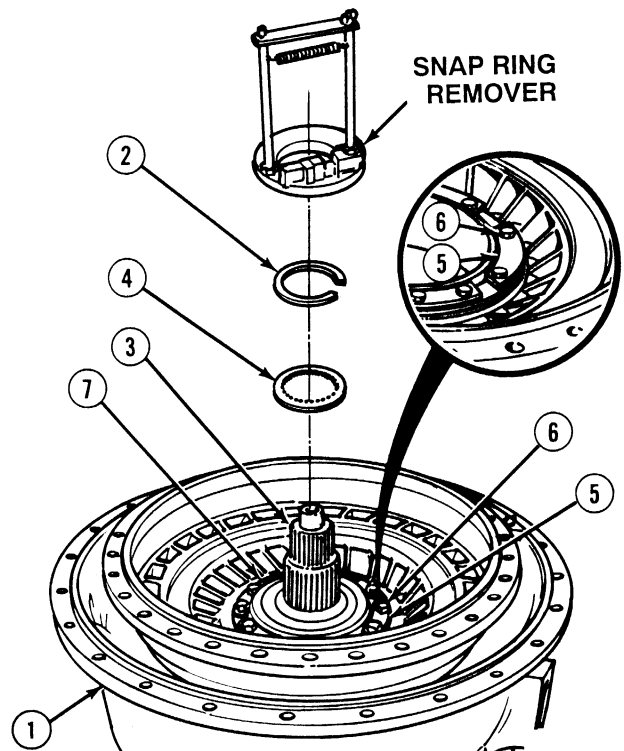
### a. Removal.

- (1) Position transmission assembly so torque converter housing (1) faces up.

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (2) Using snap ring remover, remove and discard retaining ring (2) from ground sleeve (3).
- (3) Remove spacer (4) from ground sleeve (3).
- (4) Bend corners of two lockstrips (5) away from heads of two screws (6) exactly opposite each other on bearing retainers (7).
- (5) Remove two screws (6) from lockstrips (5).



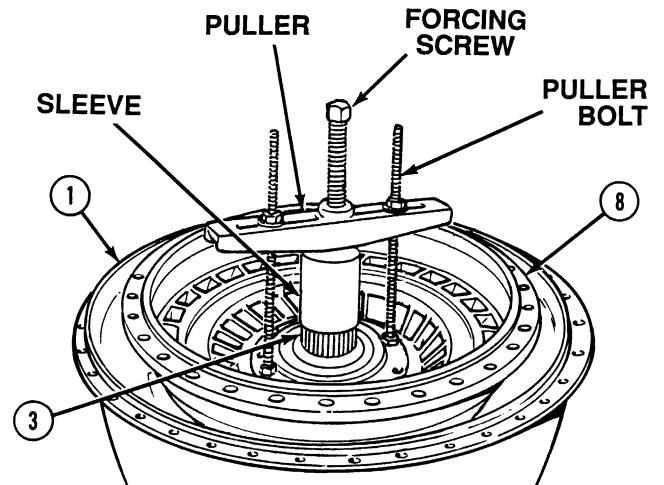
**CAUTION**

Failure to use sleeve when tightening puller may damage parts.

**NOTE**

Puller is installed in holes of screws removed in Step (5).

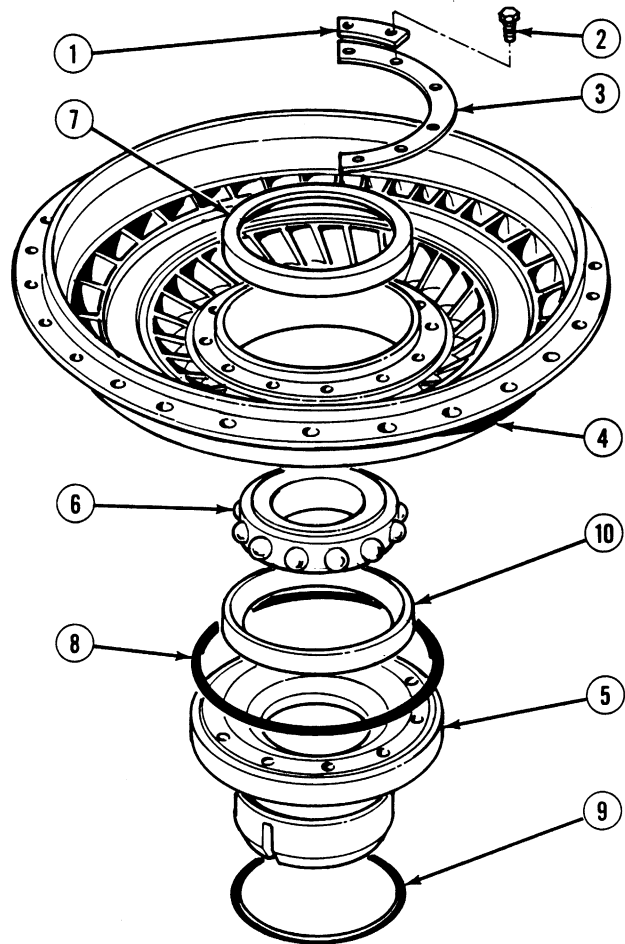
- (6) Install forcing screw and puller bolts in puller and sleeve.
- (7) Install puller on ground sleeve (3).
- (8) Tighten forcing screw to separate torque converter pump (8) from ground sleeve (3).
- (9) Remove puller and sleeve from ground sleeve (3).
- (10) Remove torque converter pump (8) from torque converter housing (1) and place on clean, level surface.



**23-11. TORQUE CONVERTER PUMP REPAIR (CONT).**

**b. Disassembly.**

- (1) Bend remaining ten corners of six lockstrips (1) away from ten screws (2).
- (2) Remove ten screws (2), six lockstrips (1) and two bearing retainers (3) from torque converter pump (4). Discard lockstrips.
- (3) Remove hub (5) from bottom of torque converter pump (4).
- (4) Remove bearing (6) and outer race (7) from hub (5).
- (5) Remove and discard two seal rings (8) and (9) from hub (5).
- (6) Remove inner race (10) from torque converter pump (4).



c. **Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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**

Keep bearings clean. Dirt or grit on bearing rollers/balls is usually responsible for bearing failures. It is important to keep bearings clean during removal, inspection, and installation to make sure maximum bearing life. Do not remove wrapper from new or clean used bearings until ready to install. Do not remove grease in which bearings are packed. Do not lay bearings on dirty bench; place on clean lint-free paper. If assembly is not to be completed at once, wrap or cover exposed bearings with clean paper or lint-free cloth to keep out dust.

- (1) Clean all parts using drycleaning 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) Dry all parts, except bearing, with compressed air. Allow bearing to air dry.
- (3) Inspect all parts for nicks, scratches or burrs. Replace all damaged parts.
- (4) Coat all parts and bearing with clean hydraulic oil.

**CAUTION**

If bearing or any one race is being replaced, replace both bearing races and bearing as a set or damage to parts may occur.

- (5) Inspect bearings for roughness of rotation. Replace bearing if rotation is still rough after cleaning and oiling.

**23-11. TORQUE CONVERTER PUMP REPAIR (CONT).**

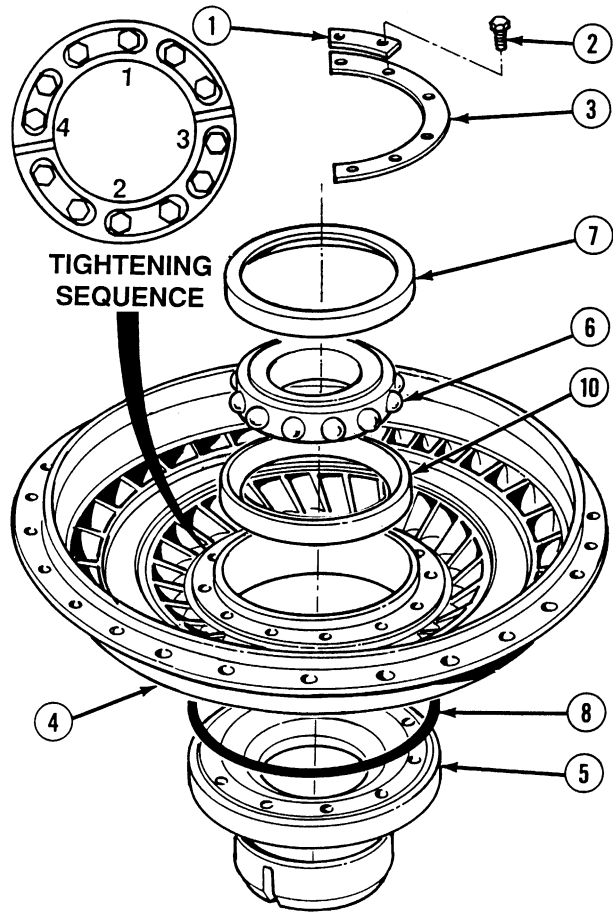
**d. Assembly.**

- (1) Coat grooves on hub (5) with grease.
- (2) Coat seal ring (8) with petrolatum and install on hub (5).

**CAUTION**

Make sure that both bearing races and bearing have same serial number. Bearing races or bearing with different serial numbers will cause damage.

- (3) Install inner race (10) on hub (5).
- (4) Install hub (5) on torque converter pump (4).
- (5) Install bearing (6) in inner race (10).
- (6) Install outer race (7) in torque converter pump (4) until grooves in outer race are clearing surface of torque converter pump.
- (7) Install two bearing retainers (3) in torque converter pump (4) to fit in grooves of outer race (7).
- (8) Position six lockstrips (1) and 12 screws (2) in two bearing retainers (3).



**CAUTION**

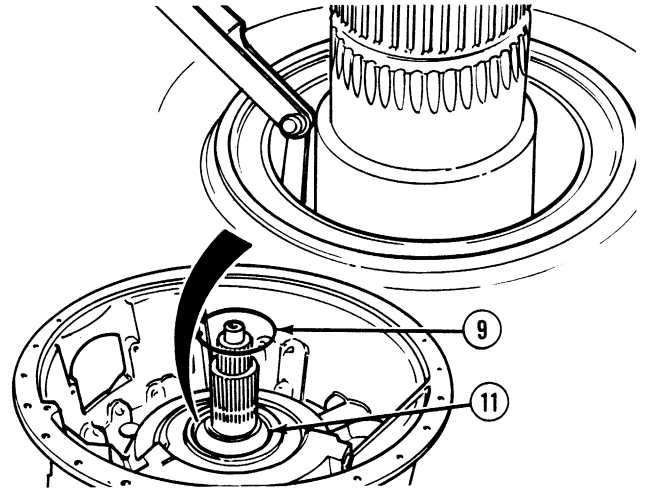
Failure to tighten screws in sequence shown may cause damage to bearing.

- (9) With the aid of an assistant, tighten four screws (2) in sequence shown to 33 to 40 lb-ft (45 to 54 N·m).
- (10) With the aid of an assistant, tighten remaining eight screws (2) to 33 to 40 lb-ft (45 to 54 N·m).
- (11) Bend corners of lockstrips (1) against heads of screws (2).

**e. Installation.****CAUTION**

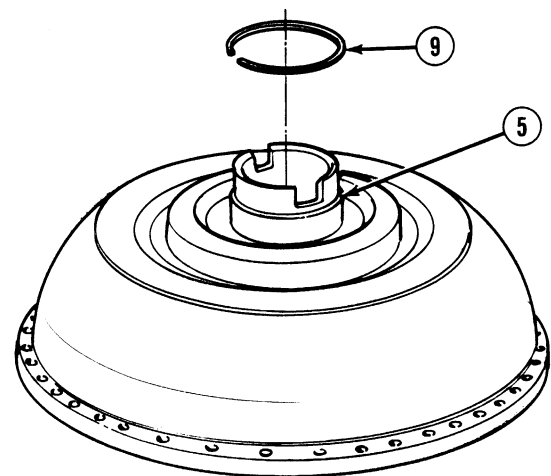
Seal rings are in air tight package. Do not open package until ready to install seal ring. Seal ring will expand from humidity which will cause clutch piston cavity to leak and cause clutch slippage.

- (1) Position seal ring (9) in converter housing hub (11).

**NOTE**

If end clearance is less than 0.015 in. (0.381 mm), discard seal ring and repeat this Step.

- (2) Measure end clearance of seal ring (9).
- (3) Remove seal ring (9).
- (4) Pack groove on torque converter pump hub (5) with petrolatum and install seal ring (9) on hub.



**23-11. TORQUE CONVERTER PUMP REPAIR (CONT).**

**CAUTION**

Ensure tangs of hub engage properly in torque converter pump or damage to equipment could result.

- (5) Install torque converter pump (8) in torque converter housing (1).

**NOTE**

Torque converter pump is seated when retaining ring groove is visible.

- (6) Position sleeve on ground sleeve (3).
- (7) Drive torque converter pump (8) down until seated.
- (8) Remove sleeve from ground sleeve (3).

**NOTE**

Spacer must be installed flat side down over ground sleeve.

- (9) Install spacer (4) over ground sleeve (3).

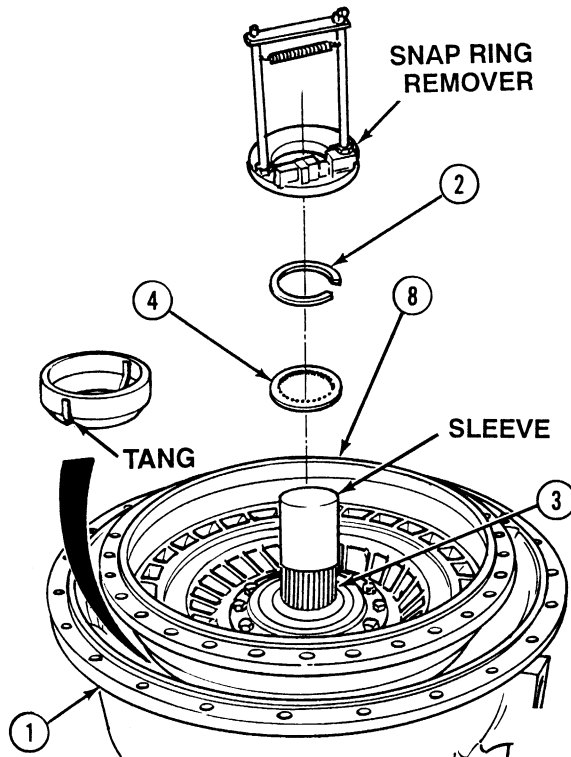
**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (10) Using snap ring remover, install retaining ring (2) on ground sleeve (3).

**f. Follow-On Maintenance:**

- Install torque converter stator assembly, (Para 23-10).



**END OF TASK**

**23-12. TORQUE CONVERTER HOUSING REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
 (Item 240, Appendix F)  
 Compressor Unit, Air (Item 35, Appendix F)  
 Compressor, Spring (Item 40, Appendix F)  
 Extractor, Inertial (Item 56, Appendix F)  
 Extractor, Inertial (Item 57, Appendix F)  
 Gage Set, Feeler (Item 67, Appendix F)  
 Gage, Center And Front (Item 70, Appendix F)  
 Gloves, Chemical Oil Protective  
 (Item 81, Appendix F)  
 Goggles, Industrial (Item 83, Appendix F)  
 Gun, Airblow (Item 86, Appendix F)  
 Hammer, Slide (Item 89, Appendix F)  
 Handle, Driver (Item 91, Appendix F)  
 Handle, Driver (Item 92, Appendix F)  
 Installer, Bearing (Item 107, Appendix F)  
 Installer, Seal (Item 115, Appendix F)  
 Pins, Guide Set (Item 147, Appendix F)  
 Pliers, Retaining Ring (Item 159, Appendix F)  
 Remover, Bearing (Item 186, Appendix F)  
 Remover, Valve Pin (Item 193, Appendix F)  
 Wrench Set, Socket 3/8 in.  
 (Item 273, Appendix F)  
 Wrench, Torque (0-60 N·m)  
 (Item 276, Appendix F)  
 Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
 (Item 277, Appendix F)  
 Lifting Device (Minimum capacity 200 lbs  
 [91 kg])  
 Adapter (Appendix C)  
 Wooden Block (2) (Appendix C)  
 Screws 5/8-11 by 2-1/2 in. (2) (MS90725-166)

*Materials/Parts*

Grease (Item 21, Appendix B)  
 Oil, Hydraulic (Item 34, Appendix B)  
 Sealing Compound (Item 53, Appendix B)  
 Solvent, Drycleaning (Item 68, Appendix B)  
 Tags, Identification (Item 72, Appendix B)  
 Gasket (Item 64, Appendix E)  
 Lockwasher (14) (Item 237, Appendix E)  
 Packing, Preformed (2) (Item 352, Appendix E)  
 Pin, Lube Valve (Item 431, Appendix E)  
 Seal, Oil (Item 583, Appendix E)  
 Seal Ring (Item 608, Appendix E)  
 Seal Ring (2) (Item 614, Appendix E)  
 Spring, Converter By-pass Valve  
 (Item 669, Appendix E)  
 Spring, Lockup Shift Valve  
 (Item 670, Appendix E)  
 Spring, Lube Valve (Item 671, Appendix E)  
 Spring, Main Pressure Regulator Valve  
 (Item 672, Appendix E)  
 Valve, Lube (Item 686, Appendix E)

*Personnel Required*

Two

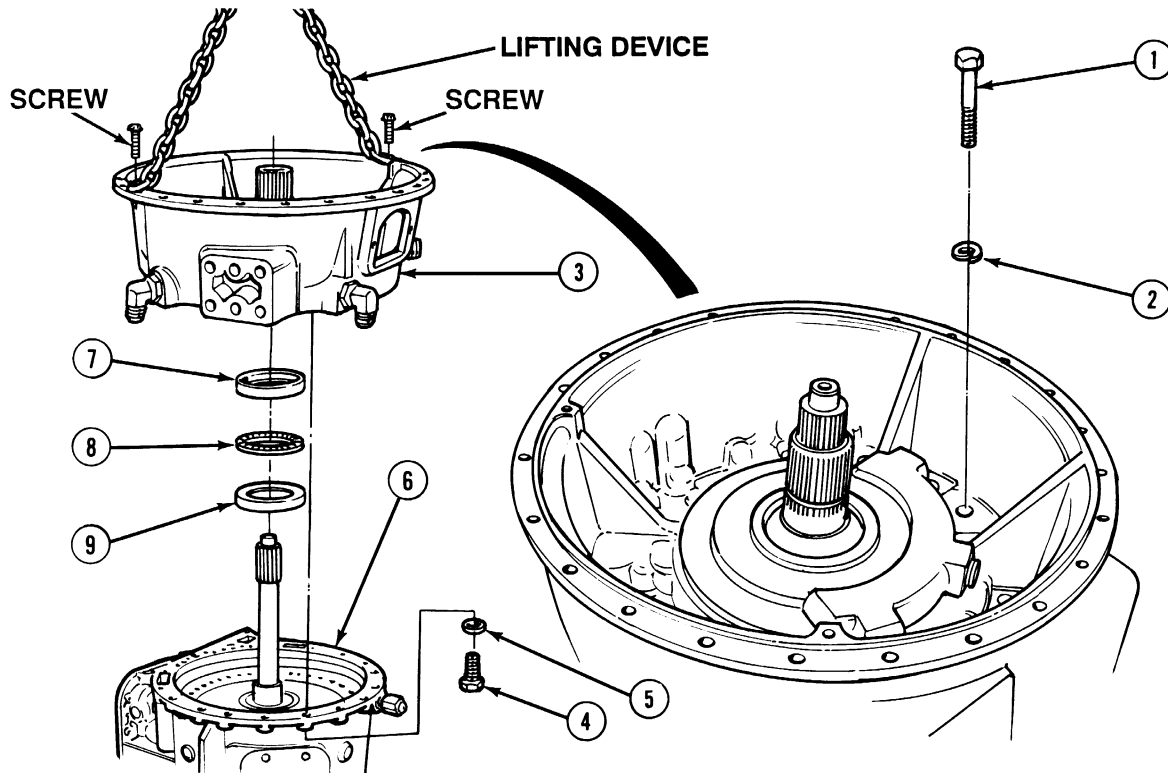
*Equipment Condition*

Torque converter pump removed, (Para 23-11)



**23-12. TORQUE CONVERTER HOUSING REPAIR (CONT).**

**a. Removal.**



- (1) Remove seven screws (1) and lockwashers (2) from inside torque converter housing (3). Discard lockwashers.
- (2) Remove seven screws (4) and lockwashers (5) from transmission housing (6). Discard lockwashers.

**WARNING**

Torque converter housing weighs 100 lbs (45 kg). Attach suitable lifting device for removal or installation to prevent possible injury to personnel.

- (3) Install lifting device on torque converter housing (3) with two screws.
- (4) With the aid of an assistant, remove torque converter housing (3) from transmission housing (6) and place on level work surface.
- (5) Remove two screws and lifting device from torque converter housing (3).

**NOTE**

Bearing races and bearing may remain on either torque converter housing or transmission housing.

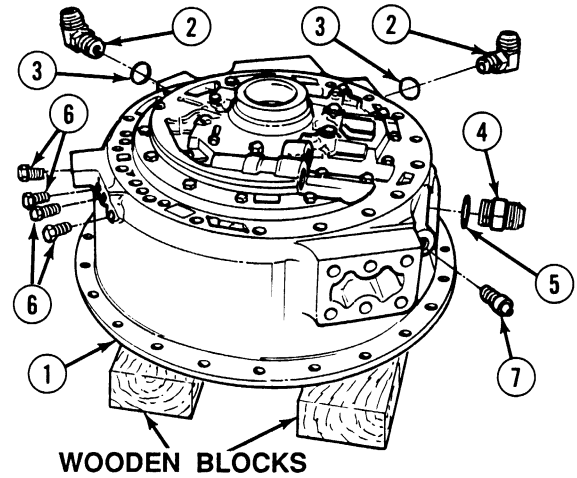
- (6) Remove bearing race (7), roller bearing (8) and bearing race (9) from transmission housing (6) or torque converter housing (3).

**b. Disassembly.**

**NOTE**

Mark position of fitting and elbows prior to removal.

- (1) With the aid of an assistant, position torque converter housing (1) on wooden blocks with engine mounting surface facing down.
- (2) Remove two elbows (2) and preformed packings (3) from torque converter housing (1). Discard preformed packings.
- (3) Remove fitting (4) and preformed packing (5) from torque converter housing (1). Discard preformed packing.



**NOTE**

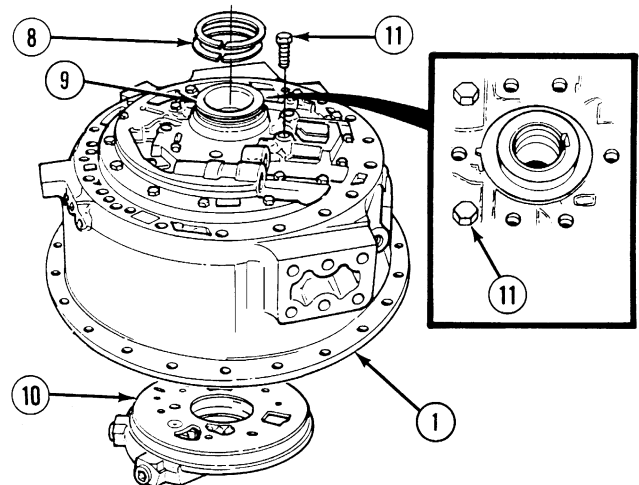
Perform Step (4) only if plugs are damaged.

- (4) Remove four plugs (6) from torque converter housing (1).
- (5) Remove temperature sending unit (7) from torque converter housing (1).
- (6) Remove and discard two seal rings (8) from front support hub (9).

**WARNING**

When screws are removed, oil pump will fall. Make sure that assistant firmly supports oil pump inside torque converter housing to prevent personal injury or damage to parts.

- (7) With the aid of an assistant, support oil pump (10) and remove six screws (11) and oil pump (10) from torque converter housing (1).



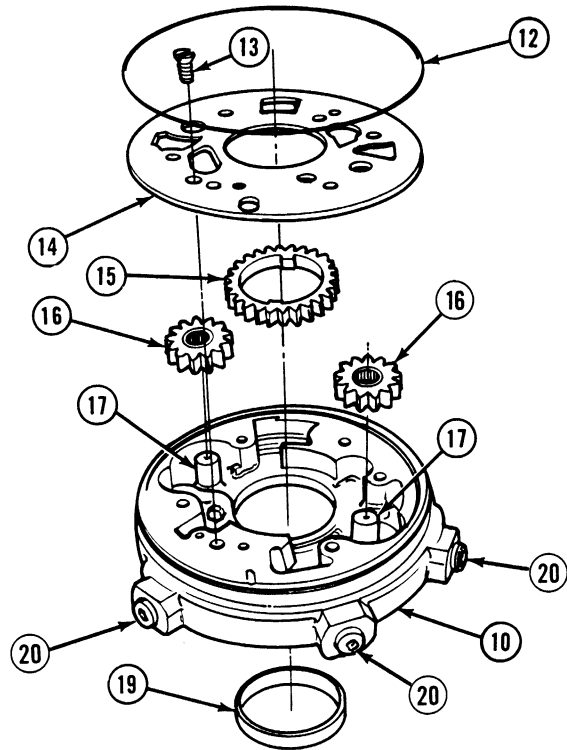
**23-12. TORQUE CONVERTER HOUSING REPAIR (CONT).**

- (8) Remove and discard outer seal ring (12) from oil pump (10).
- (9) Remove screw (13) and pump cover (14) from oil pump (10).
- (10) Remove drive gear (15) from oil pump (10).
- (11) Remove two driven gears (16) from oil pump shafts (17).
- (12) Turn oil pump (10) over and remove oil seal (19) from oil pump.

**NOTE**

Perform Step (13) only if plugs are damaged.

- (13) Remove three plugs (20) from oil pump (10).



**NOTE**

Components must be installed in original location. Tag and mark all valve parts.

- (14) Remove two screws (21) from torque converter housing (1) to permit installation of spring compressor.
- (15) Install spring compressor on torque converter housing (1).
- (16) Tighten spring compressor on main pressure regulator valve retaining washer (22).

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

**CAUTION**

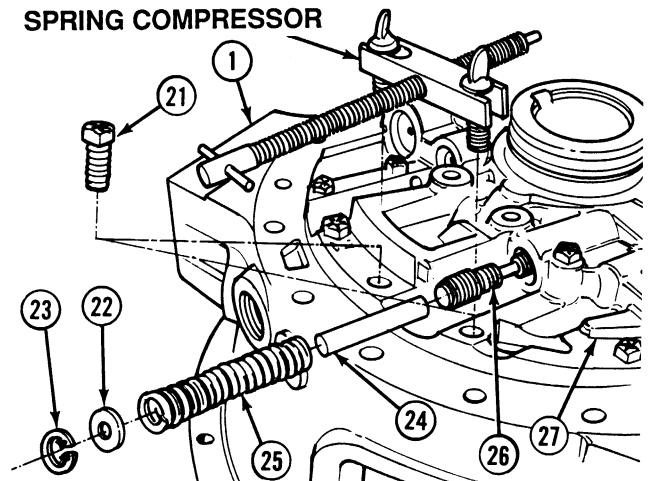
Compress retaining washer just so retaining ring is cleared or damage to valve may occur.

- (17) Using spring compressor, compress retaining washer (22) and remove retaining ring (23).

**CAUTION**

Use extreme care when handling all valve parts. Do not nick or bump valves or damage may result.

- (18) Slowly release pressure of spring compressor and remove spring compressor from torque converter housing (1).
- (19) Remove retaining washer (22), valve stop (24), valve spring (25) and main pressure regulator valve (26) from front support assembly (27). Discard spring.



**23-12. TORQUE CONVERTER HOUSING REPAIR (CONT).**

**WARNING**

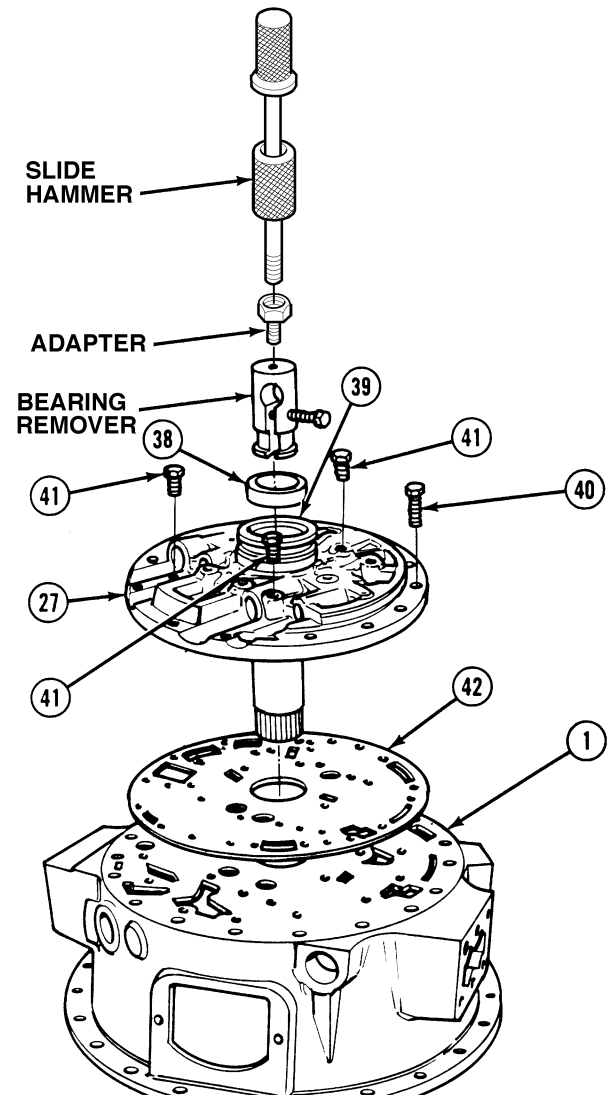
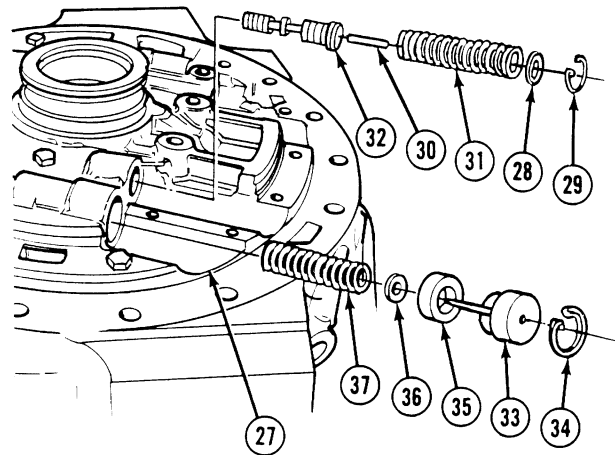
Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (20) With the aid of an assistant, compress retaining washer (28), and remove retaining ring (29) from front support assembly (27).
- (21) Remove retaining washer (28), valve stop (30), valve spring (31) and lockup shift valve (32) from front support assembly (27). Discard spring.
- (22) Compress valve support (33) and remove retaining ring (34) from front support assembly (27).
- (23) Remove valve support (33), valve seat (35), converter bypass valve (36) and valve spring (37) from front support assembly (27). Discard spring.

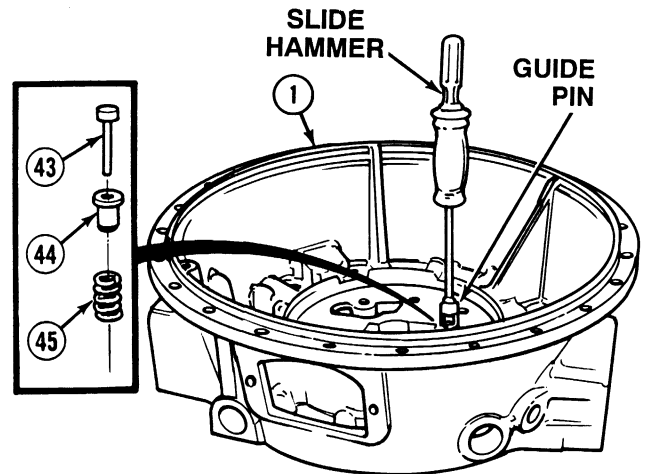
**NOTE**

Perform Steps (24) through (26) only if bearing is damaged.

- (24) Install bearing remover on bearing (38).
- (25) Install adapter on bearing remover.
- (26) Using bearing remover, adapter and slide hammer, remove bearing (38) from ground sleeve bore (39).
- (27) Remove bearing remover from bearing (38). Discard bearing.
- (28) Remove 14 screws (40) from front support assembly (27).
- (29) Remove three screws (41) from front support assembly (27).
- (30) Remove front support assembly (27) from torque converter housing (1).
- (31) Remove and discard gasket (42) from torque converter housing (1).



- (32) With the aid of an assistant, position torque converter housing (1) with engine mounting surface facing upward.
- (33) Position valve pin guide remover on valve pin (43).
- (34) Using valve pin guide remover and slide hammer, remove and discard lube valve pin (43), lube valve (44) and lube valve spring (45) from torque converter housing (1).



**c. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.

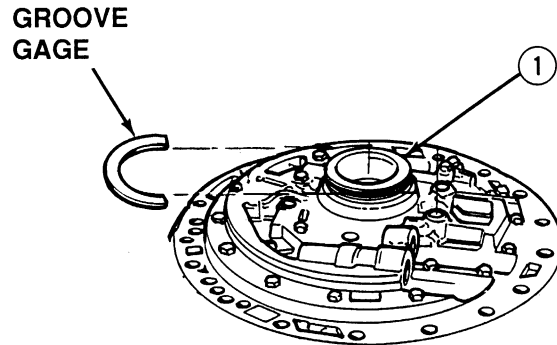
**WARNING**

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) Dry all metal parts, except bearings, with compressed air. Allow bearings to air dry.
- (3) Inspect bearings for pitting or scoring.
- (4) Inspect retaining rings for nicks, distortion or excessive wear.
- (5) Inspect bearings inside two driven gears for pitting or scoring. If bearings are damaged, replace gears.
- (6) Replace any damaged parts.

**23-12. TORQUE CONVERTER HOUSING REPAIR (CONT).**

- (7) Install groove gage in grooves on support hub (1). Rotate gage 360 degrees around support hub. If gage does not rotate freely, replace support hub.
- (8) Lubricate all valve parts with hydraulic oil.

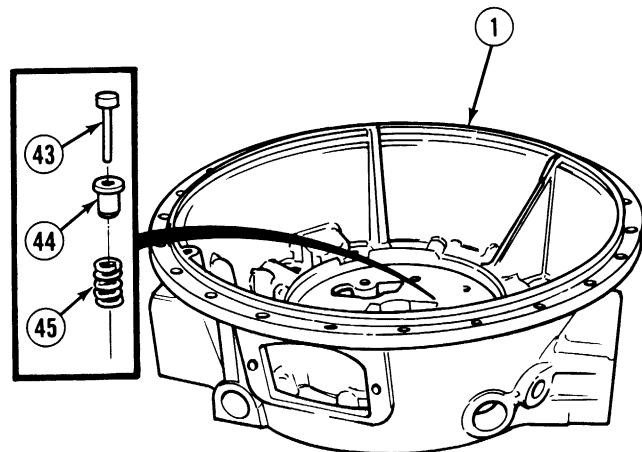


**d. Assembly.**

**NOTE**

Valve pin is installed until valve pin is recessed to .030 in. (0.762 mm) ± 0.010 in. (0.254 mm).

- (1) Install lube valve spring (45), lube valve (44) and lube valve pin (43) in torque converter housing (1).

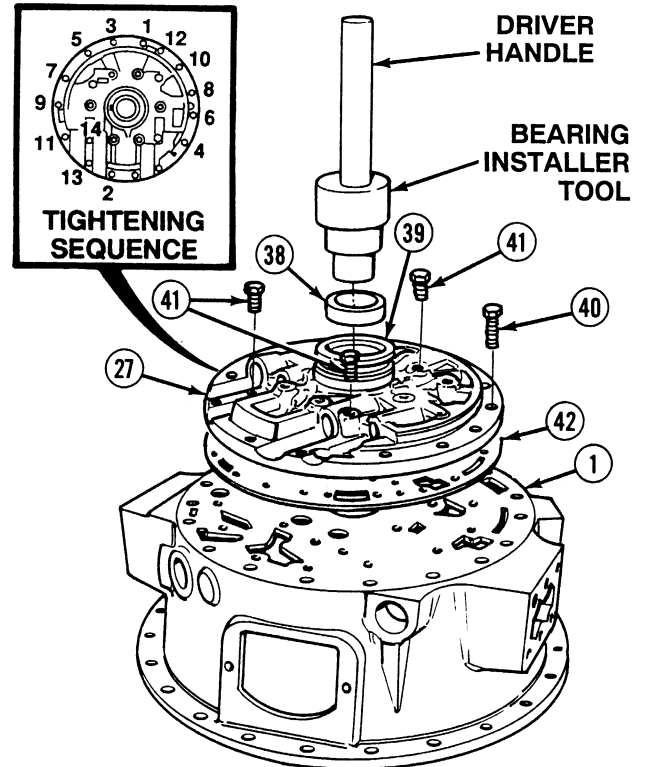


- (2) With the aid of an assistant, position torque converter housing (1) with engine mounting surface facing down.
- (3) Install gasket (42) on torque converter housing (1).
- (4) Align holes and install front support assembly (27) on torque converter housing (1). Tap lightly with soft faced hammer until front support assembly (27) is fully seated.
- (5) Position three screws (41) in front support assembly (27).
- (6) Position 14 screws (40) in front support assembly (27).
- (7) Tighten three screws (41) in front support assembly (27) to 36 to 43 lb-ft (49 to 58 N·m).
- (8) Tighten 14 screws (40) in front support assembly (27) to 36 to 43 lb-ft (49 to 58 N·m) in sequence shown.

**NOTE**

Perform Step (9) only if bearing was removed.

- (9) Coat bearing (38) with grease and, using bearing installer and driver handle, install bearing in ground sleeve bore (39).





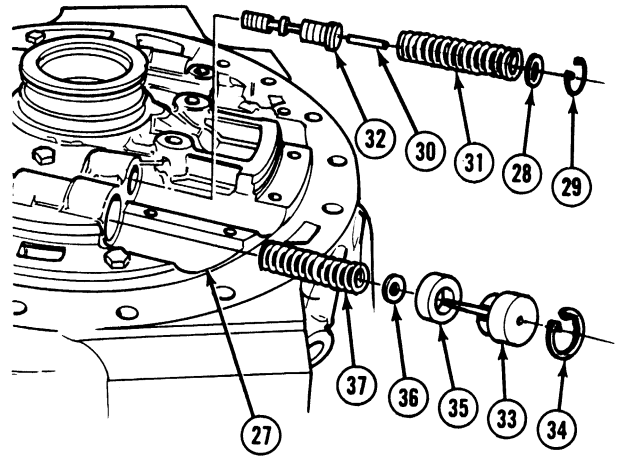
**23-12. TORQUE CONVERTER HOUSING REPAIR (CONT).**

- (10) Install valve spring (37), converter by-pass valve (36), valve seat (35) and valve support (33) on front support assembly (27). Valve must move freely in its bore.

**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (11) Compress valve support (33) and install retaining ring (34) on front support assembly (27).
- (12) Install lockup shift valve (32), valve spring (31), valve stop (30) and retaining washer (28) on front support assembly (27). Valve must move freely in its bore.
- (13) With the aid of an assistant, compress retaining washer (28) in front support assembly (27) and install retaining ring (29).



**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

**CAUTION**

Do not turn torque converter housing on side to install valves. Dropping valves in bore can cause damage to parts.

**NOTE**

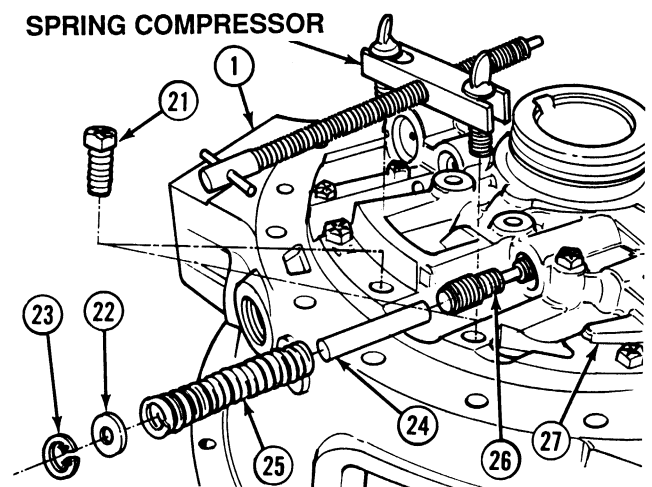
If valve does not move freely in its bore, replace valve.

- (14) Install main pressure regulator valve (26), valve spring (25), valve stop (24) and retaining washers (22) on front support assembly (27). Valve must move freely in its bore.

**NOTE**

Make sure retaining ring is properly positioned before installing spring compressor.

- (15) Install spring compressor on main pressure valve retaining washer (22).

**CAUTION**

Compress retaining washer just so retaining ring groove is cleared or damage will result to valve.

- (16) Compress retaining washer (22) and install retaining ring (23) on front support assembly (27).
- (17) Remove spring compressor from front support assembly (27).
- (18) Install two remaining screws (21) in torque converter housing (1). Tighten screws to 36 to 43 lb-ft (49 to 58 N·m).

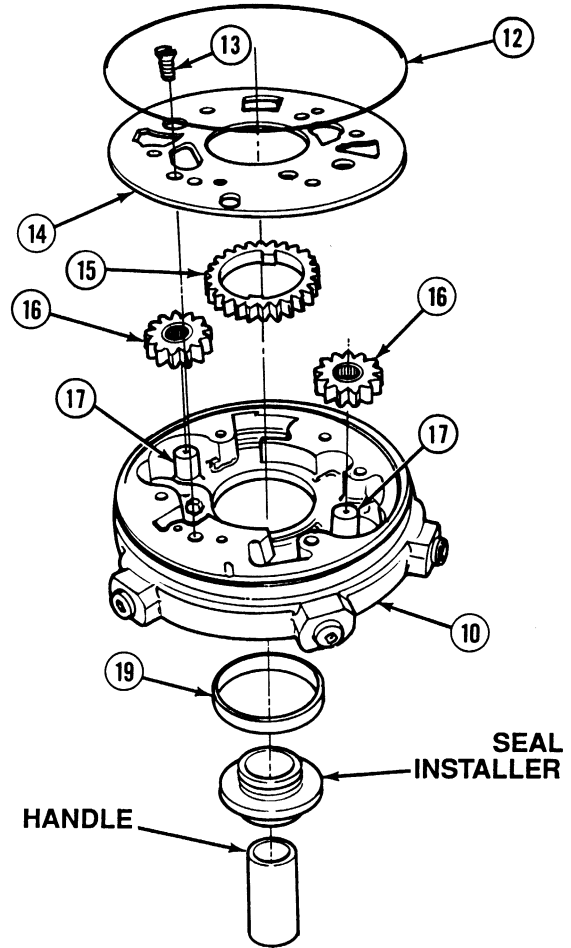
**23-12. TORQUE CONVERTER HOUSING REPAIR (CONT).**

- (19) Lubricate two driven gears (16) with hydraulic oil.
- (20) Install two driven gears (16) on shafts (17).
- (21) Lubricate drive gear (15) with hydraulic oil.
- (22) Install drive gear (15) in oil pump (10).
- (23) Install pump cover (14) and screw (13) on oil pump (10). Make sure pump cover is seated and tighten screw to 108 to 132 lb-in (12 to 15 N·m).

**NOTE**

Maximum clearance for Step (24) is 0.006 in. (0.152 mm).

- (24) Check clearance between pump cover (14), drive gear (15) and driven gears (16) using feeler gages. If clearance exceeds specification, replace oil pump.
- (25) Turn oil pump over and apply hydraulic oil to rubber lip of seal ring (19).
- (26) Using installer and handle, install seal ring (19) in oil pump (10).
- (27) Turn oil pump over and coat outer seal ring (12) with hydraulic oil.
- (28) Install seal ring (12) in groove on oil pump (10).

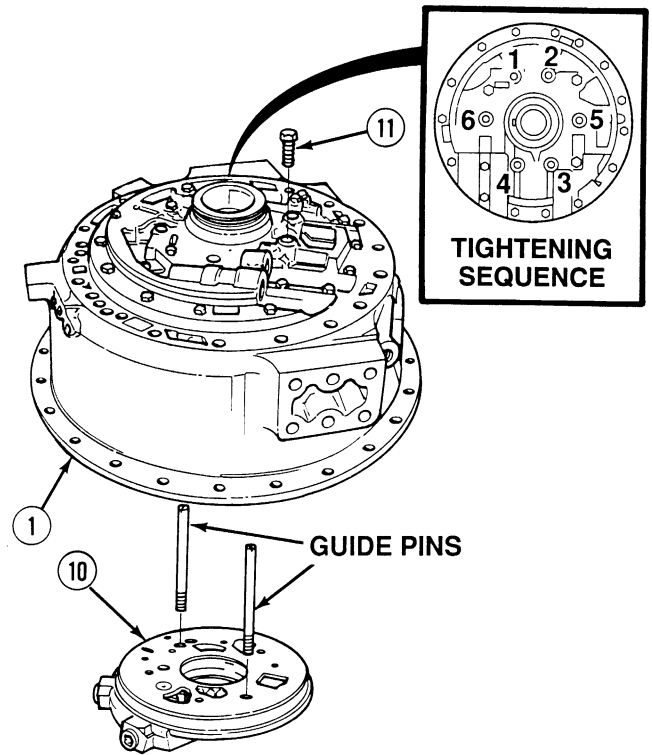


- (29) Install two guide pins in opposing holes in oil pump (10).
- (30) With the aid of an assistant, turn torque converter housing (1) on side.

**NOTE**

Make sure seal ring remains properly positioned on oil pump when installing oil pump in torque converter housing.

- (31) With the aid of an assistant, install oil pump (10) in torque converter housing (1).
- (32) Position four screws (11) in oil pump (10).
- (33) Position torque converter housing (1) on level surface.
- (34) Remove guide pins from oil pump (10).
- (35) Install remaining two screws (11) in oil pump (10).
- (36) Tighten six screws (11) in oil pump (10) in sequence shown to 36 to 43 lb-ft (49 to 58 N·m).



**23-12. TORQUE CONVERTER HOUSING REPAIR (CONT).**

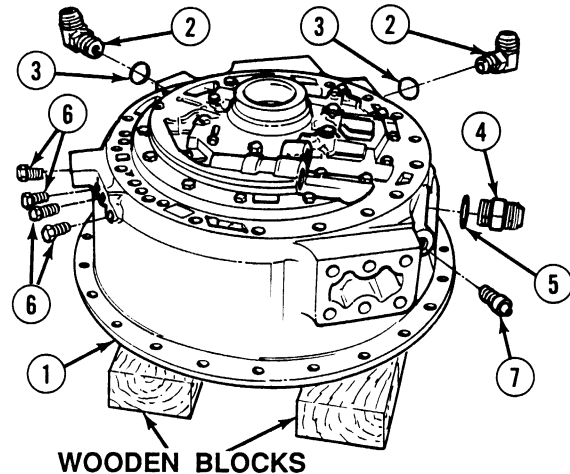
**WARNING**

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**

Perform Steps (37) and (38) only if plugs were removed.

- (37) Apply sealing compound to threads of four plugs (6).
- (38) Install four plugs (6) in torque converter housing (1).
- (39) Install temperature sending unit (7) in torque converter housing (1). Tighten to 50 to 60 lb-in (6 to 7 N·m).
- (40) Apply hydraulic oil to two preformed packings (3).
- (41) Install two preformed packings (3) on elbows (2).

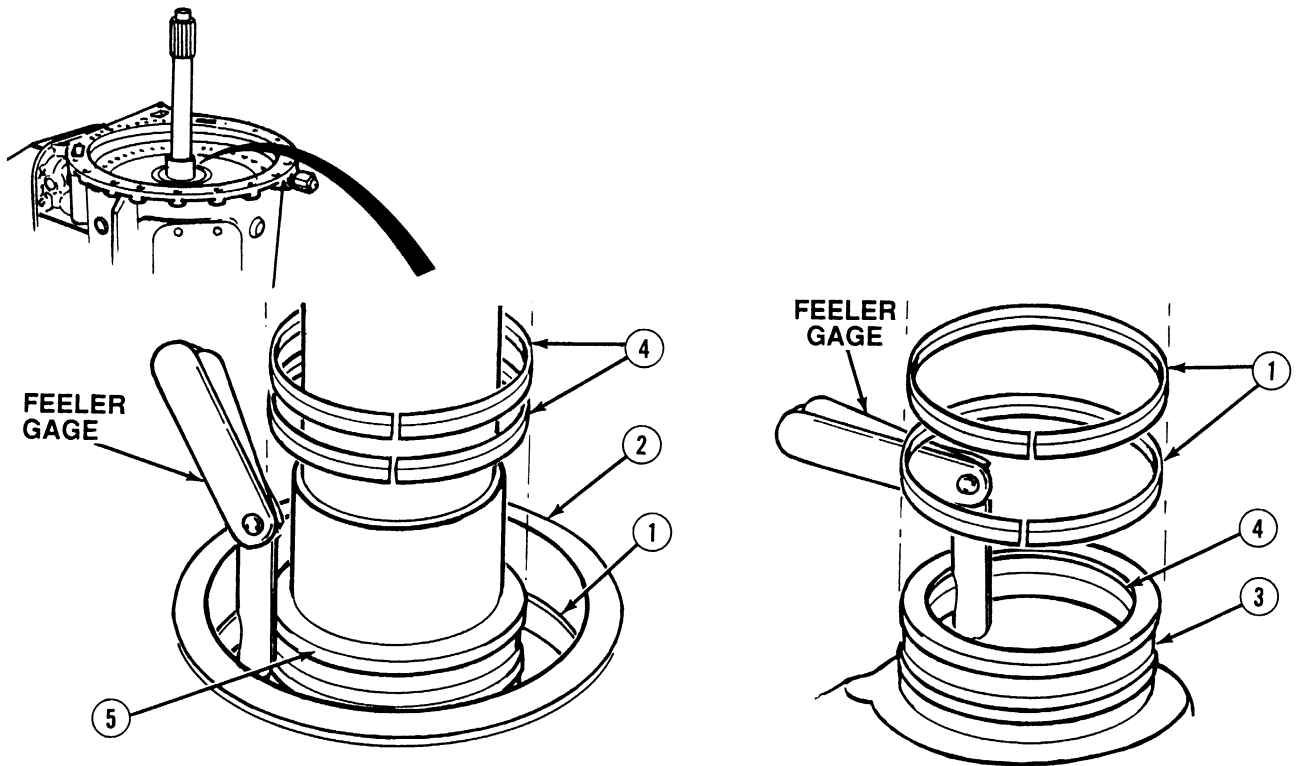


**NOTE**

Install elbows as noted prior to removal.

- (42) Install two elbows (2) in torque converter housing (1).
- (43) Apply hydraulic oil to preformed packing (5).
- (44) Install preformed packing (5) on straight fitting (4).
- (45) Install straight fitting (4) in torque converter housing (1).

e. *Installation.*



**CAUTION**

Seal rings are in air tight package. Do not open package until ready to install seal ring. Seal ring will expand from humidity which will cause clutch piston cavity to leak and cause clutch slippage.

- (1) Position two seal rings (1) in forward clutch hub (2) and measure end clearance of seal rings. Remove seal rings. If end clearance is less than 0.015 in. (0.381 mm), discard seal ring and repeat this Step.
- (2) Pack seal ring grooves of torque converter housing support hub (3) with grease and install two seal rings (1).

**CAUTION**

Seal rings are in air tight package. Do not open package until ready to install seal ring. Seal ring will expand from humidity which will cause clutch piston cavity to leak and cause clutch slippage.

- (3) Position seal rings (4) in torque converter housing support hub (3) and measure end clearance of seal rings. Remove seal rings. If end clearance is less than 0.015 in. (0.381 mm), discard seal rings and repeat this step.
- (4) Pack seal ring grooves on turbine shaft (5) with grease and install seal rings (4) on turbine shaft.

**23-12. TORQUE CONVERTER HOUSING REPAIR (CONT).**

- (5) Install bearing race (6) in transmission housing (7).
- (6) Coat bearing race (8) and roller bearing (9) with grease and install in torque converter housing (10).
- (7) With the aid of an assistant, turn torque converter housing (10) over so support hub faces down.

**WARNING**

Torque converter housing weighs 100 lbs (45 kg). Attach suitable lifting device for removal or installation to prevent possible injury to personnel.

- (8) Install lifting device on torque converter housing (10).
- (9) With the aid of an assistant, position torque converter housing (10) over transmission housing (7) while making sure bearing race (8) does not fall out.

**CAUTION**

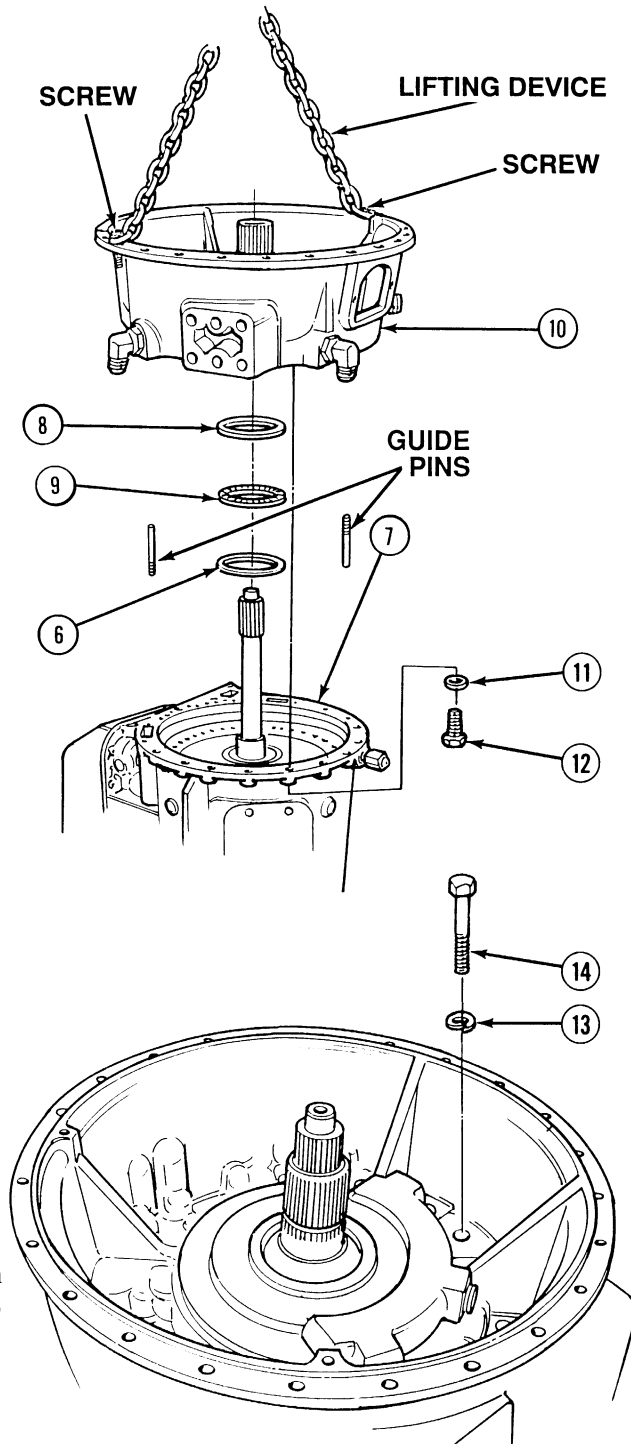
Take care not to damage bearing and seal rings when installing converter housing.

- (10) Install two guide pins, one in transmission housing (7) and one directly opposite in torque converter housing (10). Install torque converter housing (10) on transmission housing (7). Remove lifting device and guide pins.
- (11) Position seven lockwashers (11) and screws (12) in transmission housing (7).
- (12) Install seven lockwashers (13) and screws (14) in torque converter housing (10). Tighten screws to 67 to 80 lb-ft (91 to 108 N·m).
- (13) Tighten screws (12) in transmission housing (7) to 67 to 80 lb-ft (91 to 108 N·m).

**f. Follow-On Maintenance:**

- Install torque converter pump on transmission, (Para 23-11).

**END OF TASK**



**23-13. FORWARD CLUTCH AND TURBINE SHAFT REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Alignment Tool, Clutch (Item 13, Appendix F)  
Caliper, Dial, 0-6 in. w/Dial  
(Item 25, Appendix F)  
Collector Ring Installer and Staking Set  
(Item 34, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Compressor, Spring (Item 39, Appendix F)  
Drill Machine, Upright (Item 47, Appendix F)  
Drill Set, Twist (Item 48, Appendix F)  
Fixture, PTO Gear (Item 63, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)  
Protector, Seal (Item 168, Appendix F)  
Stone, Abrasive Cylinder (Item 228, Appendix F)  
Tool, Lifting (Item 244, Appendix F)  
Torch, Propane (Item 247, Appendix F)  
Lifting Device (Minimum Capacity 200 lbs [91 kg])  
Wooden Blocks (2) (Appendix C)  
Shim Stock (3/32 by 0.020 by 3 in.)

*Materials/Parts*

Cable Ties (Item 9, Appendix B)  
Compound, Retaining (Item 18, Appendix B)  
Oil, Hydraulic (Item 34, Appendix B)  
Petrolatum (Item 43, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Tags, Identification (Item 72, Appendix B)  
Parts Kit, Hydraulic (Item 407, Appendix E)  
Spring (20) (Item 665, Appendix E)

*Personnel Required*

Two

*Equipment Condition*

Torque converter housing removed, (Para 23-12)



**23-13. FORWARD CLUTCH AND TURBINE SHAFT REPAIR (CONT).**

**a. Removal.**

- (1) Attach lifting tool and lifting device to turbine shaft (1).

**WARNING**

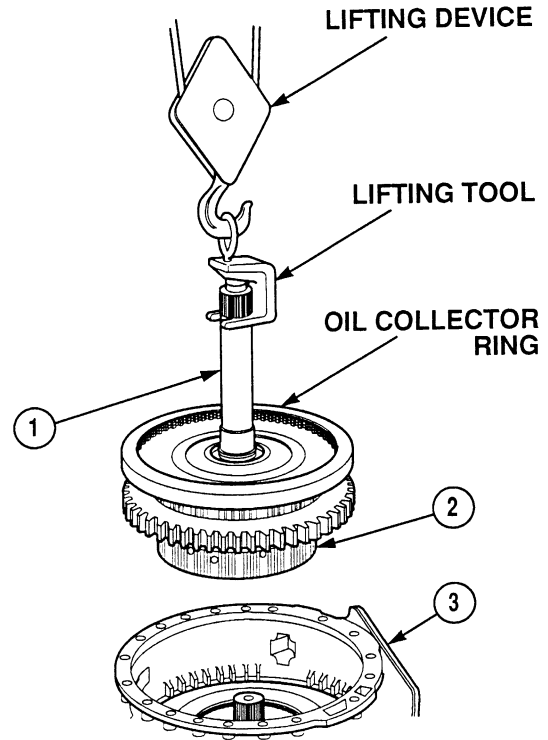
Forward clutch and turbine shaft assembly weighs 67 lbs (30 kg). Attach suitable lifting device for removal to prevent possible injury to personnel.

- (2) Remove forward clutch and turbine shaft assembly (2) from transmission housing (3).

**CAUTION**

Do not allow weight of forward clutch assembly to rest on oil collector ring. Damage to oil collector ring could result.

- (3) Position forward clutch and turbine shaft assembly (2) on wooden blocks on level work surface.
- (4) Remove lifting device and lifting tool from turbine shaft (1).



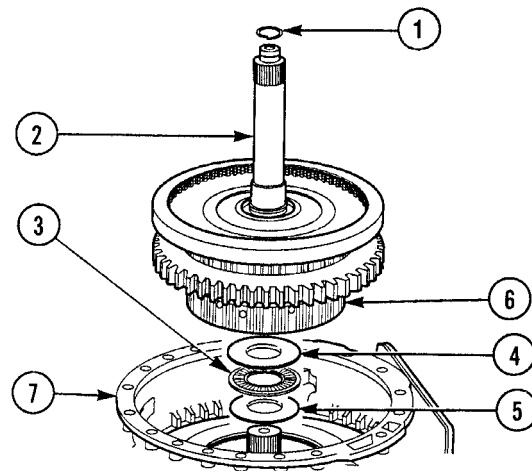
**b. Disassembly.**

- (1) Remove and discard seal ring (1) from turbine shaft (2).

**NOTE**

Bearing and bearing races may remain on forward clutch and turbine shaft assembly or in transmission housing.

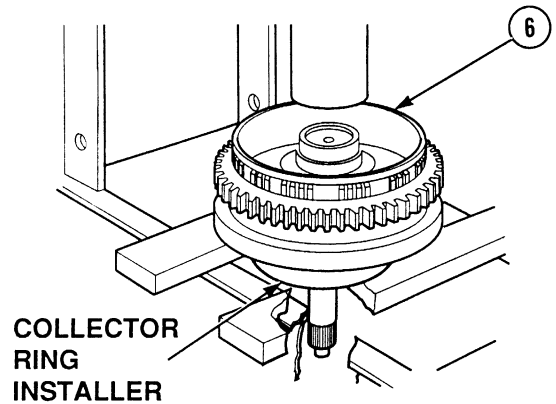
- (2) Remove thrust bearing (3) and bearing races (4) and (5) from forward clutch and turbine shaft assembly (6) or transmission housing (7).



**CAUTION**

Collector ring installer tool should be supported on wooden blocks in press to allow forward clutch and turbine shaft assembly to rest fully supported with shaft down or damage to parts may occur.

- (3) Position collector ring installer tool on wooden blocks in press.
- (4) Position forward clutch and turbine shaft assembly (6) and collector ring installer tool down in press shaft.
- (5) Remove large inner retaining ring (8) from fifth clutch driving hub (9).



**CAUTION**

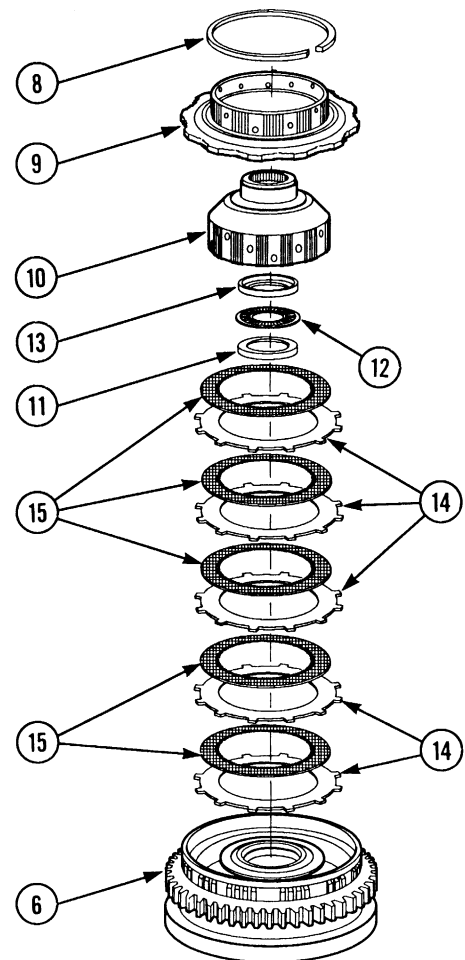
When removing fifth clutch driving hub, ensure clutch plates do not stick to bottom of hub. Failure to comply may result in clutch plates falling and damage to equipment may result.

- (6) Remove fifth clutch driving hub (9) from forward clutch and turbine shaft assembly (6).
- (7) Remove forward clutch driving hub (10), inner race (11), bearing (12), and outer race (13) from forward clutch and turbine shaft assembly (6).

**NOTE**

Make sure external-tanged plates and internal-splined plates are tied together and tagged in order of removal.

- (8) Remove five external-tanged plates (14) and five internal-splined plates (15) from forward clutch and turbine shaft assembly (6).



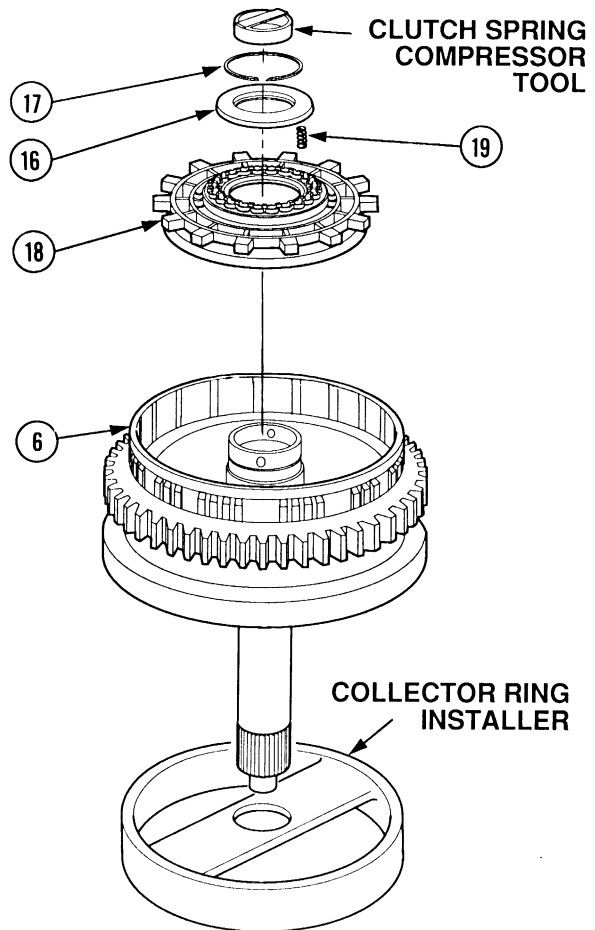
**23-13. FORWARD CLUTCH AND TURBINE SHAFT REPAIR (CONT).**

- (9) Install clutch spring compressor tool on spring retainer (16).

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (10) Compress spring retainer (16) with clutch spring compressor tool and remove retaining ring (17) from forward clutch and turbine shaft assembly (6).
- (11) Slowly release pressure from spring retainer (16).
- (12) Remove clutch spring compressor tool from spring retainer (16).
- (13) Remove spring retainer (16) from forward clutch piston (18).
- (14) Remove and discard 20 piston return springs (19) from forward clutch piston (18).
- (15) Remove forward clutch and turbine shaft assembly (6) from press and position on level surface.
- (16) Remove collector ring installer from press.

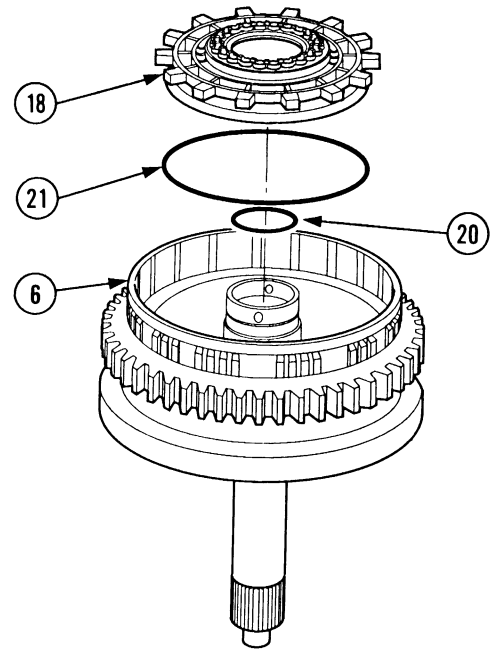


**WARNING**

Use extreme caution when dropping forward clutch assembly. Keep feet and hands out from under parts to avoid personal injury.

**CAUTION**

Make sure turbine shaft faces upward before dropping forward clutch assembly on wooden blocks or damage may result to parts.



- (17) Position wooden blocks on floor.
- (18) Lift forward clutch assembly (6) up two feet and drop on wooden blocks to loosen forward clutch piston (18) from forward clutch and turbine shaft assembly (6).
- (19) Remove forward clutch piston (18) from forward clutch and turbine shaft assembly (6).

**NOTE**

Note position of seal rings.  
Outer and inner seal face  
downward away from tangs.

- (20) Remove and discard gasket (20) and seal (21) from forward clutch piston (18).

**23-13. FORWARD CLUTCH AND TURBINE SHAFT REPAIR (CONT).**

**NOTE**

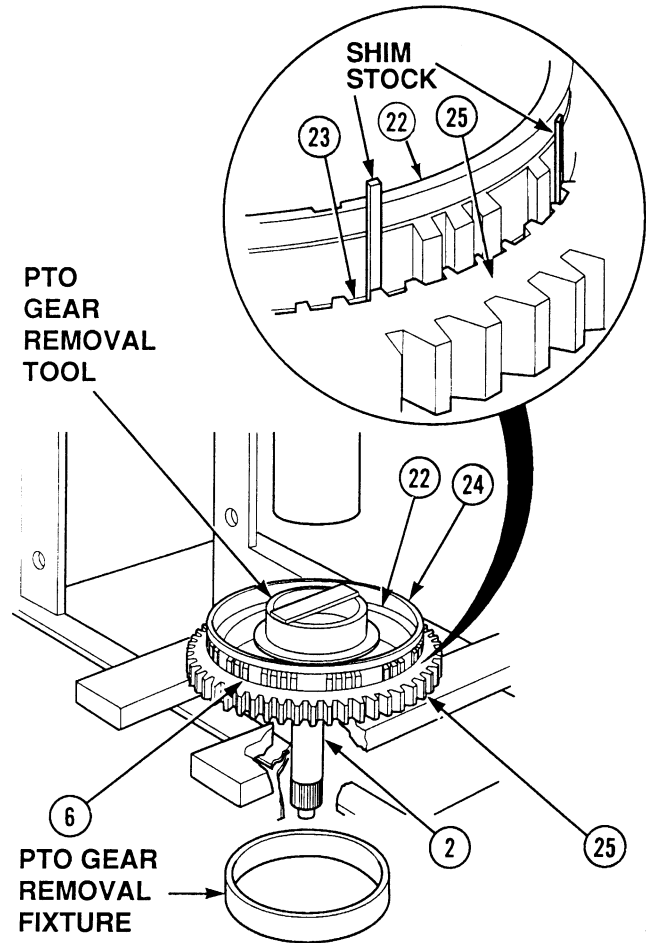
Perform Steps (21) through (30) if replacement of PTO gear is required.

- (21) Position forward clutch and turbine shaft assembly (6) in press.

**NOTE**

If removal of PTO gear is required, remove oil collector ring first.

- (22) Support oil collector ring (22) on inner circumference and press forward clutch housing and turbine shaft assembly (6) from oil collector ring (22).
- (23) Locate retaining ring gap at cutout nearest gap and press retaining ring (23) into groove in forward clutch housing (24).
- (24) Slip piece of shim stock (3/32 by 0.020 by 3 in.) between retaining ring (23) and inner ends of splines of PTO gear (25). Repeat operation at other side of retaining ring gap.
- (25) Working at each opening (missing spline) to compress retaining ring (23), insert eight more pieces of shim stock at approximately 3 in. (76 mm) increments.
- (26) Position PTO gear removal fixture, flat side downward, on press.
- (27) Position forward clutch and turbine shaft assembly (6), turbine shaft (2) downward, so PTO gear rests on tool. Center PTO gear removal fixture directly under PTO gear.
- (28) Position PTO gear removal tool in forward clutch housing (24). Center PTO gear removal fixture in forward clutch housing.
- (29) Press forward clutch housing (24) from PTO gear (25).
- (30) Remove PTO gear (25) and retaining ring (23) from forward clutch housing (24).



c. **Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent and inspect for nicks, burrs, scratches or excessive wear. Replace damaged parts.

**NOTE**

Do not remove forward clutch housing from turbine shaft unless replacement is required.

- (2) Turbine shaft is pressed in forward clutch housing and should be tight. If there is any up and down movement, press forward clutch housing from shaft.

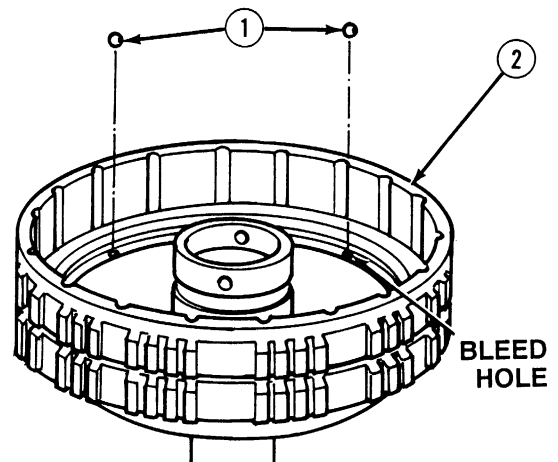
**WARNING**

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.

**NOTE**

Staking must withstand 30 lb (133.45 N) load applied through bleed hole. Remove and replace balls only if damaged or not properly staked.

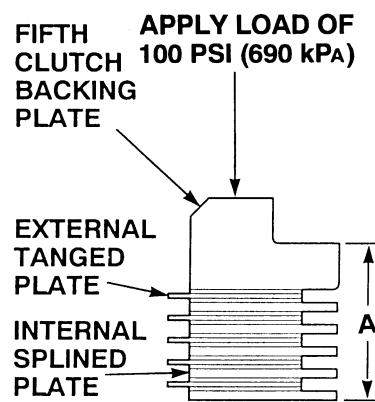
- (3) Inspect four balls (1) in forward clutch housing (2) for freedom of movement and proper staking.
- (4) Clean four ball pockets with drycleaning solvent if there is leakage at bottom side of housing or if balls do not move freely of their own weight.
- (5) Dry pockets with compressed air. Apply hydraulic oil around area of ball pockets.



**23-13. FORWARD CLUTCH AND TURBINE SHAFT REPAIR (CONT).**

- (6) Inspect friction plates for imbedded metal particles, severely pitted faces, excessive wear, cracks, distortion, and damaged or missing spline teeth. Remove burrs using a soft honing stone. Replace defective plates. Tie plates together in order of removal.
- (7) Check that oil grooves are visible on friction plates. Discard plates if oil grooves are not visible. Tie plates together in order of removal.
- (8) Inspect steel plates for scoring, excessive wear, cone distortion, imbedded metal, galling, cracks, breaks, and damaged or missing tangs. Remove burrs and minor surface irregularities, using soft honing stone. Replace defective plates. Tie plates together in order of removal.
- (9) Measure the inside diameter in clutch plates by measuring distance between inside diameter of plate and level surface. Discard plates having a cone in excess of 0.010 in. (0.254 mm). Tie plates together in order of removal.
- (10) Stack forward clutch plates in press as shown. Position fifth clutch hub on clutch plates.
- (11) Evenly apply specified load. Measure dimension A.
- (12) Select proper forward clutch piston, from Table 23-1.
- (13) Remove fifth clutch hub and forward clutch plates from press.
- (14) Tie parts together and tag.
- (15) Coat all parts with hydraulic oil.

**Table 23-1. Forward Clutch Piston**



If Piston Is Marked	Dimension A Should Be
X	1.3615 - 1.3878 in. (34.582 - 35.250 mm)
Y	1.3882 - 1.4148 in. (35.260 - 35.935 mm)
Z	1.4152 - 1.4415 in. (35.946 - 36.614 mm)

**d. Assembly.****NOTE**

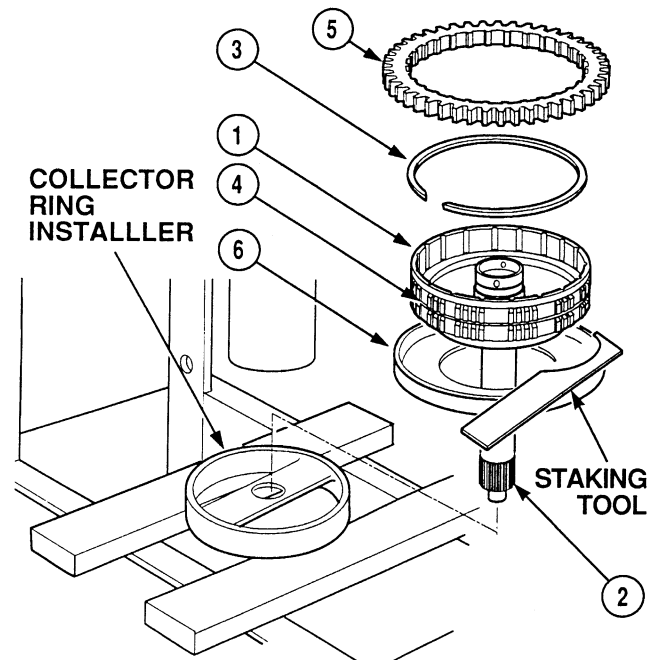
Perform Steps (1) through (8) only if PTO gear and oil collector ring was removed.

- (1) Position forward clutch housing (1), turbine shaft (2), down in press.

**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (2) Install retaining ring (3) in groove (4) in forward clutch housing (1).

**WARNING**

Ensure personnel wear heat resistant gloves prior to heating PTO gear with propane torch. Failure to comply may result in severe injury or death to personnel.

- (3) Heat PTO gear (5) with propane torch.
- (4) Install PTO gear (5), chamfered side first, on forward clutch housing (1) until retaining ring (3) expands into PTO gear groove.
- (5) Position forward clutch housing (1) and turbine shaft (2) upward on work table.

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (6) Apply retaining compound onto bonding surface of forward clutch housing (1) and install oil collector ring (6) on forward clutch housing.
- (7) Use installer to seat collector ring (6) on forward clutch housing (1).

**NOTE**

Entire circumference of oil collector ring should be bent in groove in forward clutch housing.

- (8) Using staking tool, bend edge of oil collector ring (6) in groove in forward clutch housing (1).



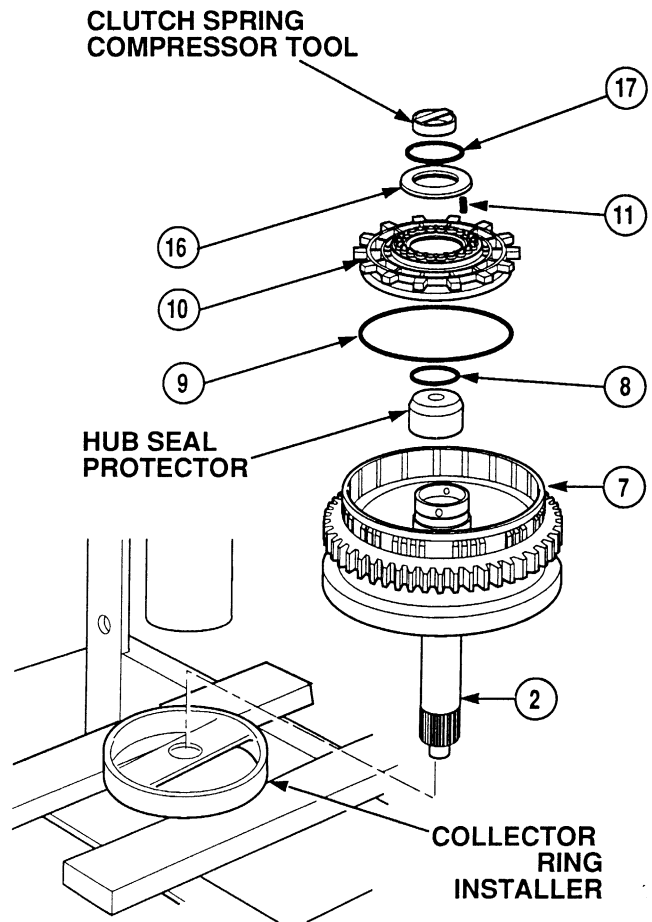
**23-13. FORWARD CLUTCH AND TURBINE SHAFT REPAIR (CONT).**

- (9) Position collector ring installer in press.
- (10) Install forward clutch and turbine shaft assembly (7) and turbine shaft (2) down, on collector ring installer in press.
- (11) Apply hydraulic oil to gasket (8) and seal (9).

**NOTE**

Gasket and seal are installed with lip facing down away from tangs of forward clutch piston.

- (12) Install gasket (8) and seal (9), lips down, on forward clutch piston (10).
- (13) Install inner hub seal protector over inner hub of forward clutch housing (7).
- (14) Install forward clutch piston (10) over seal protector. Carefully work piston completely down until seated.
- (15) Remove inner hub seal protector from forward clutch housing (7).
- (16) Install 20 piston release springs (11) on forward clutch piston (10).



**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

**NOTE**

Ensure clutch spring compressor tool opening is facing forward.

- (17) Install spring retainer (16) and spring compressor tool on forward clutch piston (10).
- (18) Compress spring retainer (16) with clutch spring compressor tool and install retaining ring (17) in forward clutch housing (7).
- (19) Slowly release pressure from spring retainer (16) and remove clutch spring compressor tool from piston (10).

- (20) Install outer race (15) on small hub of forward clutch assembly (7).
- (21) Install thrust bearing (14) on outer race (15).
- (22) Coat inner race (13) with hydraulic oil.
- (23) Install inner race (13) on thrust bearing (14).
- (24) Install forward clutch driving hub (12) on forward clutch assembly (7).
- (25) Soak internal-splined plates (11) in clean lubricating oil for minimum of two minutes.

**NOTE**

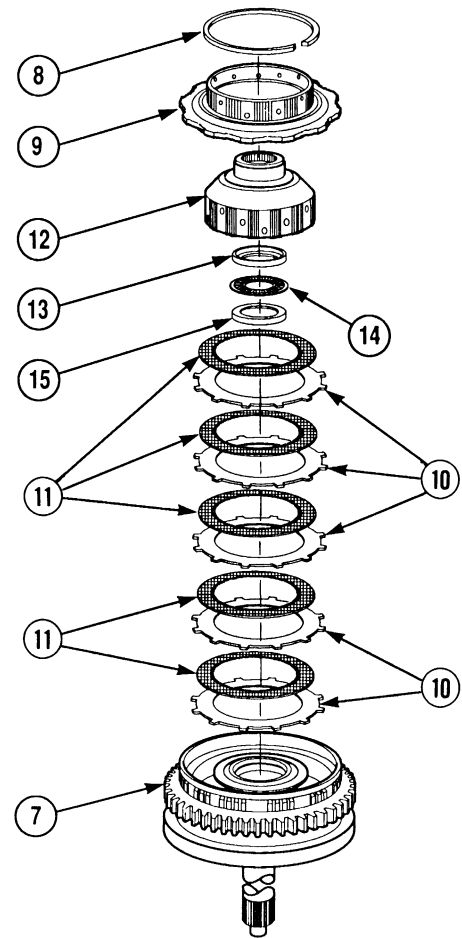
Assemble clutch plates so that cone of each plate faces same direction as cone of adjacent plate.

- (26) Alternately install five external-tanged plates (10) and five internal-splined plates (11) in forward clutch assembly (7).
- (27) Install fifth clutch driving hub (9) on forward clutch assembly (7).

**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (28) Install retaining ring (8) on fifth clutch driving hub (9).



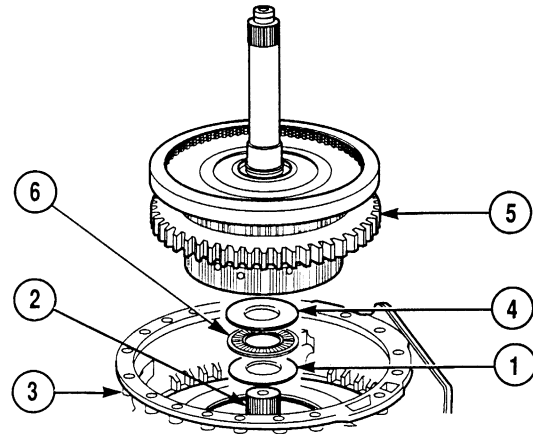
**23-13. FORWARD CLUTCH AND TURBINE SHAFT REPAIR (CONT).**

*e. Installation.*

**CAUTION**

Do not let weight of forward clutch assembly rest on oil collector ring. Damage to oil collector ring can result.

- (1) Install bearing race (1), with outer lip on fifth clutch assembly (2) in transmission housing (3).
- (2) Apply petrolatum to bearing race (4).
- (3) Install bearing race (4), with inner lip on bottom of forward clutch assembly (5).
- (4) Apply petrolatum to thrust bearing (6).
- (5) Install thrust bearing (6) on bearing race (4) in forward clutch assembly (5).

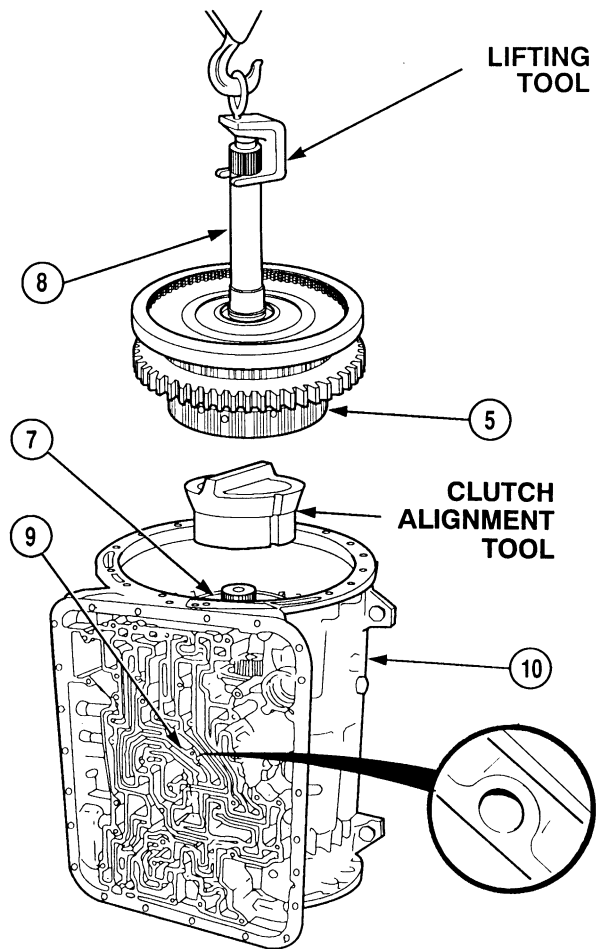


- (6) Using alignment tool, compressed air regulated to a maximum of 40 psi (276 kPa), and controllable rubber tip safety blowgun, align fifth clutch plates as follows:
- (a) Install clutch alignment tool on fifth clutch assembly (7) to align internal-splined fifth clutch plates. To fully seat alignment tool, turn back and forth gently until tool falls in place.
  - (b) Attach lifting tool to turbine shaft (8).

**NOTE**

Assistant must apply constant pressure until forward clutch assembly is installed in transmission.

- (c) With the aid of an assistant, position safety blowgun in fifth clutch oil port (9) located in center of valve body mounting area.
- (d) Apply 40 psi (276 kPa) maximum air pressure through oil port (9) to lock clutch plates.
- (e) Remove clutch alignment tool from fifth clutch assembly (7).



**WARNING**

Forward clutch and turbine shaft assembly weighs 67 lbs (30 kg). Attach suitable lifting device for installation to prevent possible injury to personnel.

- (7) Attach lifting tool to turbine shaft (8).
- (8) With the aid of an assistant, apply air and install forward clutch assembly (5) in transmission housing (10).
- (9) Release air and remove lifting device and lifting tool from turbine shaft (8).

**f. Follow-On Maintenance:**

- Install torque converter housing, (Para 23-12).

**END OF TASK**

## 23-14. FIFTH CLUTCH REPAIR.

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Caliper, Dial, 0-6 in. w/Dial  
(Item 25, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Compressor, Spring (Item 39, Appendix F)  
Gage Set, Feeler (Item 67, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Lifting, Fixture, Clutch (Item 137, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)  
Stone, Abrasive, Cylinder (Item 228, Appendix F)  
Wooden Block (2) (Appendix C)

#### *Materials/Parts*

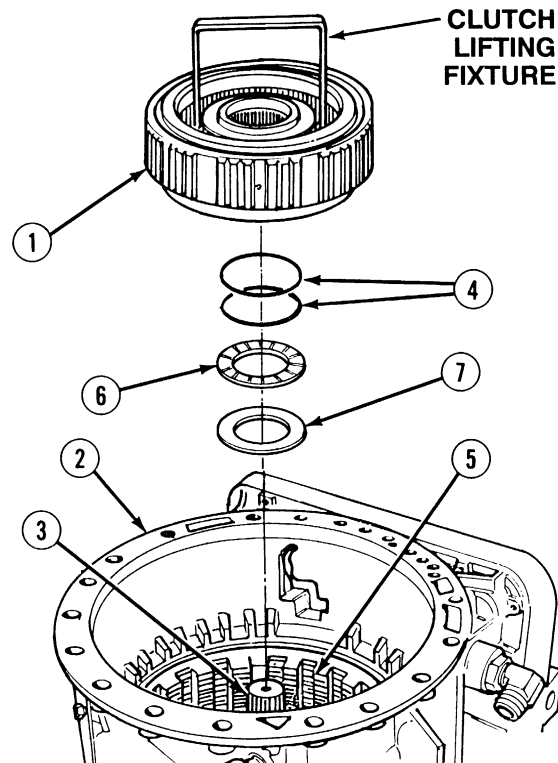
Cable Ties (Item 9, Appendix B)  
Cloth, Cleaning (Item 11, Appendix B)  
Petrolatum (Item 43, Appendix B)  
Oil, Hydraulic (Item 34, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Tags, Identification (Item 72, Appendix B)  
Seal (2) (Item 107, Appendix E)  
Seal Ring (2) (Item 608, Appendix E)  
Spring (20) (Item 665, Appendix E)

#### *Equipment Condition*

Forward clutch assembly removed, (Para 23-13)

### a. Removal.

- (1) Attach clutch lifting fixture to fifth clutch assembly (1).
- (2) Remove fifth clutch assembly (1) from transmission housing (2) and center sun gear shaft (3).
- (3) Remove clutch lifting fixture from fifth clutch assembly (1).
- (4) Remove and discard two seals (4) from center sun gear shaft (3) and center support (5) in transmission housing (2).
- (5) Remove bearing (6) and bottom race (7) from center sun gear shaft (3) and center support (5) in transmission housing (2).



**b. Disassembly.**

- (1) Remove thrust bearing race (1) from rear hub of fifth clutch housing (2).

**WARNING**

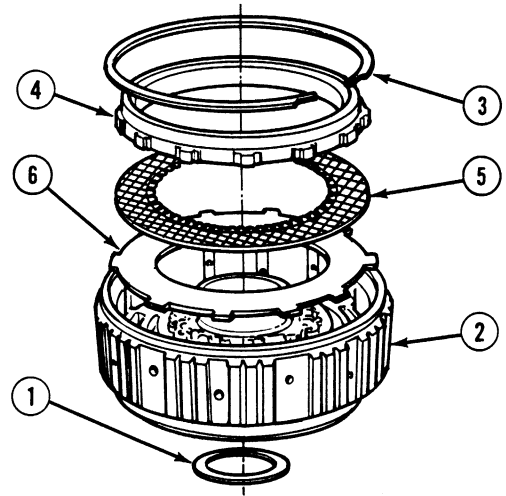
Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (2) Remove retaining ring (3) and backplate (4) from fifth clutch housing (2).

**NOTE**

Make sure internal-splined plates and external-tanged plates are tied together and tagged in order of removal.

- (3) Remove five internal-splined plates (5) and five external-tanged plates (6) from fifth clutch housing (2).



**23-14. FIFTH CLUTCH REPAIR (CONT).**

- (4) Position fifth clutch housing (2) in press.
- (5) Press spring retainer (7) with clutch spring compressor until clear of retaining ring (8).

**WARNING**

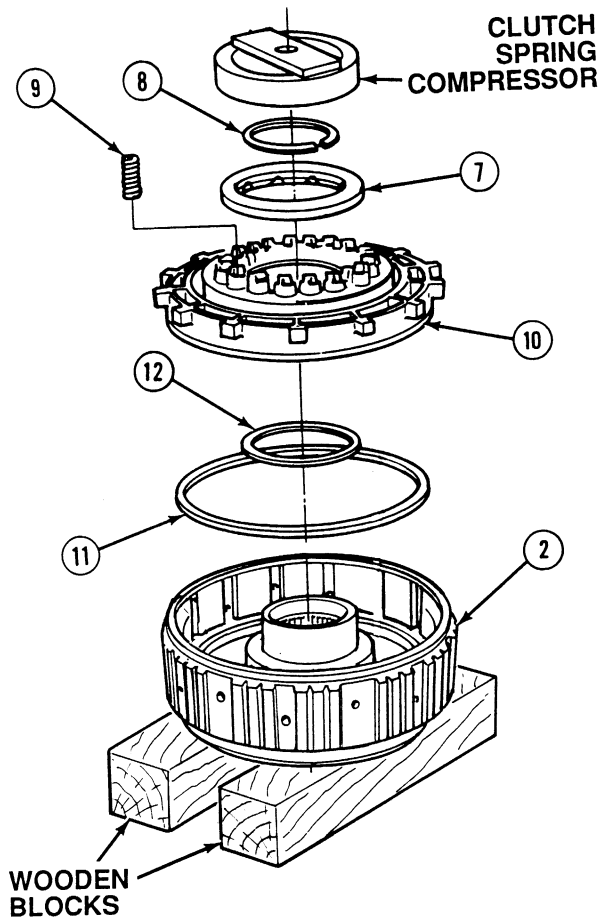
Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (6) Remove retaining ring (8) from fifth clutch housing (2).
- (7) Release pressure from press and remove clutch spring compressor from fifth clutch housing (2).
- (8) Remove spring retainer (7) and 20 piston return springs (9) from piston (10). Discard piston return springs.
- (9) Position fifth clutch housing (2) on wooden blocks on level surface.

**WARNING**

Use extreme caution when dropping fifth clutch housing. Keep feet and hands out from under fifth clutch housing to avoid injury to personnel.

- (10) Lift assembly one foot above wooden blocks and drop on wooden blocks to loosen piston (10) from fifth clutch housing (2).
- (11) Remove piston (10) from fifth clutch housing (2).
- (12) Remove and discard seal (11) and gasket (12) from fifth clutch housing (2).



c. **Cleaning/Inspection.**

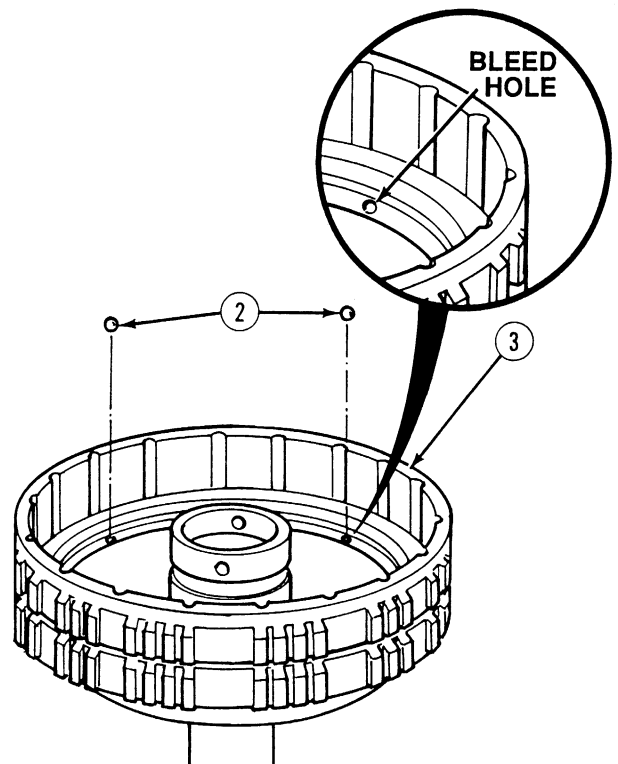
**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent and inspect for nicks, burrs, scratches or dents.

**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.

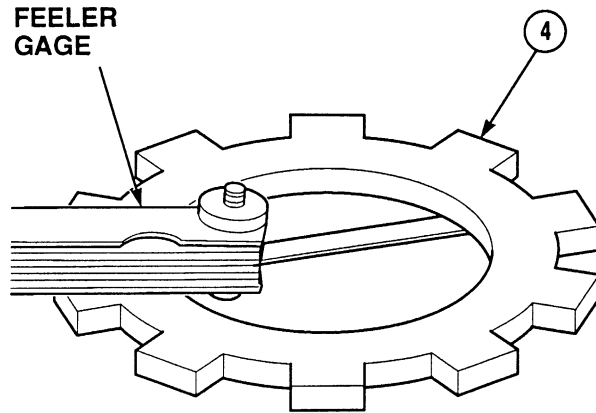
- (2) Dry all metal parts with compressed air.
- (3) Inspect eight balls (2) in fifth clutch housing (3) for freedom of movement and check fifth clutch housing (3) for proper staking. Staking must retain eight balls (2) with 30 psi (207 kPa) of air pressure applied through bleed hole. Remove balls only if damaged or not staked properly.
- (4) Inspect internal-splined plates for imbedded metal particles, severely pitted faces, excessive wear, cracks, distortion, and damaged or missing spline teeth. Remove burrs, using soft honing stone. Replace defective plates.
- (5) Discard internal-splined plates if oil groove is not visible.





**23-14. FIFTH CLUTCH REPAIR (CONT).**

- (6) Inspect external-tanged plates (4) for scoring, excessive wear, cone distortion, imbedded metal, galling, cracks, breaks, and damaged or missing tangs. Remove burrs and minor surface irregularities, using soft honing stone. Replace defective plates.
- (7) Measure clearance between inside diameter of each external-tanged plate (4) and level surface to determine cone. Discard plates having clearance in excess of 0.010 in. (0.254 mm).



**Table 23-2. Fifth Clutch Piston**

- (8) Stack fifth clutch plates and backplate in press as shown.
- (9) Evenly apply specified load. Measure dimension A.
- (10) Select proper fifth clutch piston from Table 23-2.
- (11) Tie parts together and tag.

<p><b>APPLY LOAD OF 100 PSI (690 kPa)</b></p>	
<b>If Piston Is Marked</b>	<b>Dimension A Should Be</b>
X	1.3615 - 1.3878 in. (34.582 - 35.250 mm)
Y	1.3882 - 1.4148 in. (35.260 - 35.935 mm)
Z	1.4152 - 1.4415 in. (35.946 - 36.614 mm)

**d. Assembly.****NOTE**

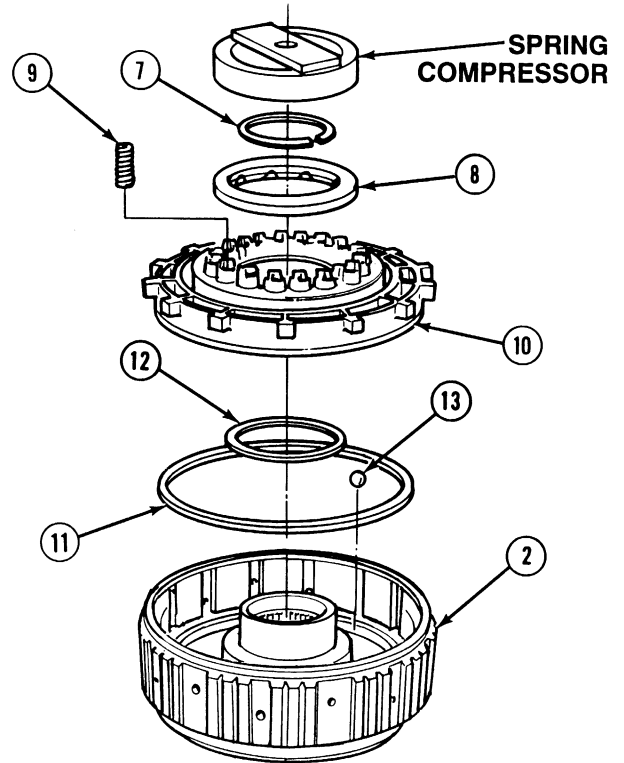
Perform Steps (1) and (2) only if balls were removed.

- (1) Lubricate balls (13) with hydraulic oil.

**NOTE**

Staking must retain eight balls with 30 psi of air pressure applied from front of fifth clutch housing through bleed hole.

- (2) Position balls (13) in fifth clutch housing (2) and stake fifth clutch housing.
- (3) Apply hydraulic oil to seal (11) and gasket (12).
- (4) Install seal (11) and gasket (12) in grooves on piston (10), with lip of seal rings facing bottom of piston cavity.
- (5) Install piston (10) into fifth clutch housing (2).
- (6) Install 20 piston return springs (9) in piston (10).
- (7) Install spring retainer (8) with outer lip down on piston return springs (9).

**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (8) Position spring compressor on spring retainer (8) and position fifth clutch housing (2) in press.
- (9) Compress spring retainer (8) until retaining ring groove on clutch hub is visible.
- (10) Install retaining ring (7) in fifth clutch housing (2).

**23-14. FIFTH CLUTCH REPAIR (CONT).**

**WARNING**

Make sure all personnel stand clear when releasing pressure on spring compressor. Retaining ring can cause personal injury if not properly seated in retaining ring groove.

- (11) Slowly release pressure on spring compressor.
- (12) Remove clutch spring compressor from fifth clutch housing (2).
- (13) Remove fifth clutch housing (2) from press and position on clean level surface.

**NOTE**

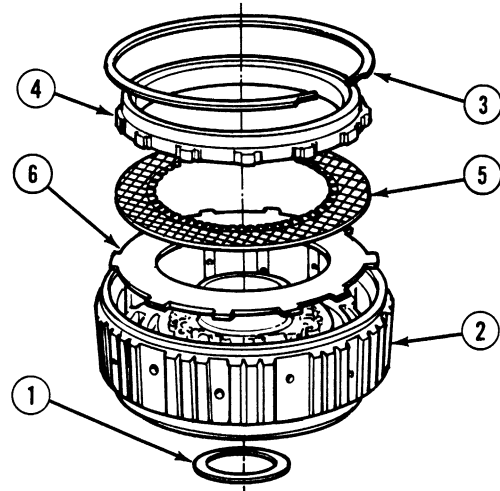
Assemble clutch plates so cone of each plate faces same direction as cone of adjacent plate.

- (14) Soak external-tanged plates (6) and internal-splined plates (5) in hydraulic oil for minimum of two minutes.
- (15) Alternately install five external-tanged plates (6) and five internal-splined plates (5), beginning with external-tanged plate.

**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (16) Install backplate (4) and retaining ring (3) in fifth clutch housing (2).
- (17) Apply grease on thrust bearing race (1) and install on rear hub of fifth clutch housing (2).

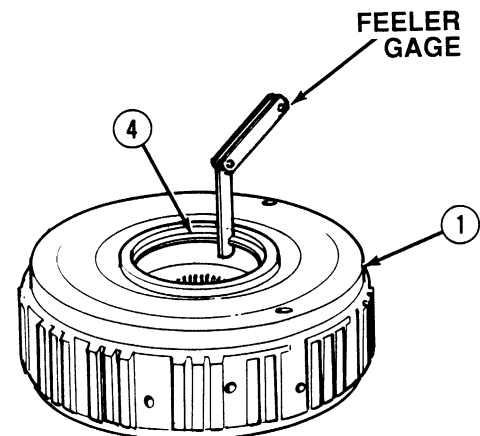
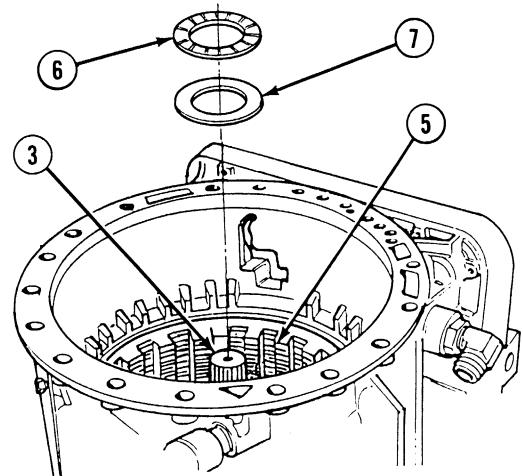


e. **Installation.**

**CAUTION**

Seal rings are in airtight packages and should not be opened until ready to install. Seal ring may expand from humidity and cause leakage from piston cavity and cause clutch slippage.

- (1) Lubricate bearing (6) with hydraulic oil.
- (2) Install bottom race (7) and bearing (6) on center support (5) and sun gear shaft (3).
- (3) Position seal rings (4) in bottom hub of fifth clutch assembly (1) and measure end clearance of seal ring.
- (4) Remove seal rings (4) from fifth clutch assembly (1). If end clearance is less than 0.010 in. (0.254 mm), discard seal ring and repeat Steps (3) and (4).



**23-14. FIFTH CLUTCH REPAIR (CONT).**

- (5) Pack seal ring grooves in center support hub (5) with grease.

**CAUTION**

When rolling up seal rings, ensure not to spread seal rings more than necessary to install on hub or seal rings may leak and clutch slippage may occur.

- (6) Roll up seals (4) to half its free diameter and hold it that way for 10 seconds.

**NOTE**

Seal rings are installed on center support hub by positioning one end of seal ring into groove and gradually working seal ring into groove.

- (7) Install two seals (4) on center support hub (5).
- (8) Install clutch lifting fixture on fifth clutch assembly (1).

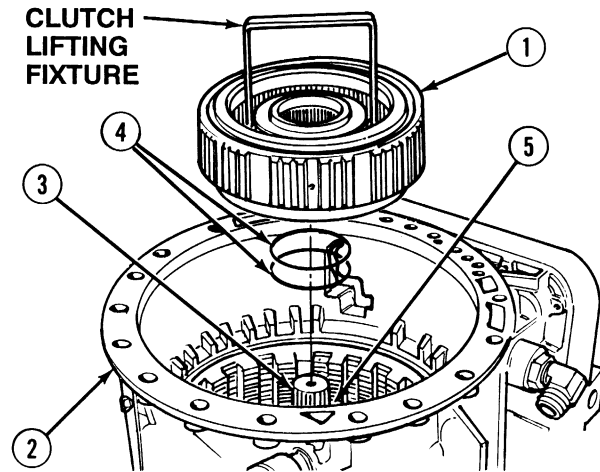
**NOTE**

Make sure teeth of all clutch plates in transmission housing are aligned before installing fifth clutch assembly in transmission housing.

- (9) Install fifth clutch assembly (1) in transmission housing (2) while engaging internal splines with splines on center sun gear shaft (3).
- (10) Remove clutch lifting fixture from fifth clutch assembly (1).

**f. Follow-On Maintenance:**

- Install forward clutch assembly, (Para 23-13).



**END OF TASK**

## 23-15. FOURTH CLUTCH REPAIR.

This task covers:

- a. Disassembly
- b. Cleaning/Inspection
- c. Assembly
- d. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Caliper, Dial, 0-6 in. w/Dial  
(Item 25, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)  
Stone, Abrasive, Cylinder (Item 228, Appendix F)

#### *Materials/Parts*

Cable Ties (Item 9, Appendix B)  
Cloth, Cleaning (Item 11, Appendix B)  
Oil, Hydraulic (Item 34, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Tags, Identification (Item 72, Appendix B)

#### *Equipment Condition*

Fifth clutch removed, (Para 23-14)

### a. Disassembly.

#### WARNING

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

#### CAUTION

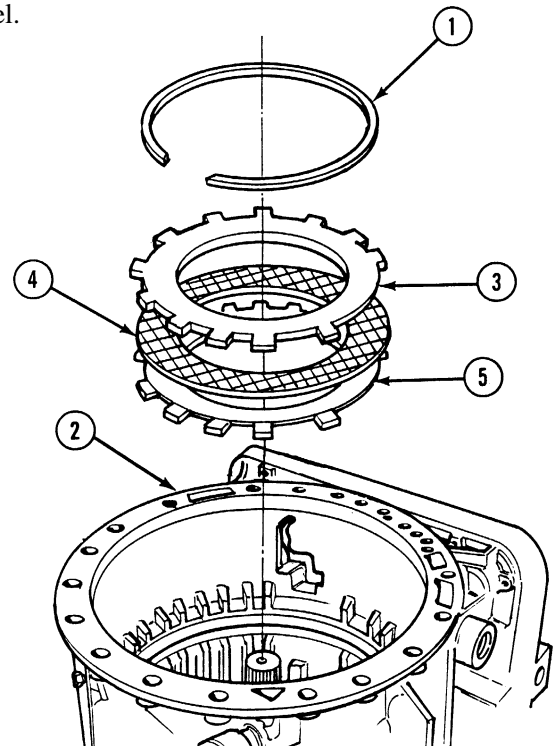
Use care when removing retaining ring to ensure sides of transmission housing are not scratched.

- (1) Remove retaining ring (1) from transmission housing (2).
- (2) Remove backplate (3) from transmission housing (2).

#### NOTE

Make sure internal-splined plates and external-tanged plates are tied together and tagged in order of removal.

- (3) Remove four internal-splined plates (4) and four external-tanged plates (5) from transmission housing (2).



**23-15. FOURTH CLUTCH REPAIR (CONT).**

**b. Cleaning/Inspection.**

**WARNING**

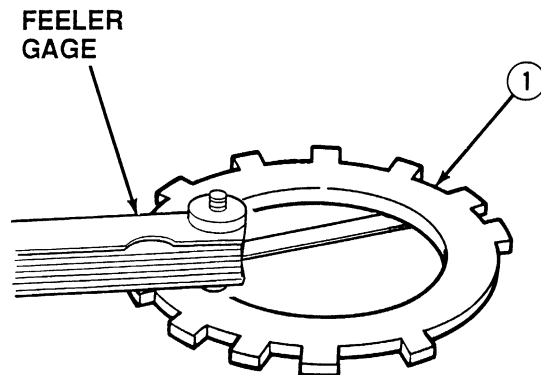
- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes, and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent. The flashpoint for Type II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent and inspect for damage.

**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) to prevent personal injury.

- (2) Dry all parts with compressed air.
- (3) Inspect retaining ring for nicks and distortion. Retaining ring must snap tight in its groove for proper functioning. Replace retaining ring if defective.
- (4) Inspect internal-splined plates for embedded metal particles, severely pitted faces, cracks, distortion, and damaged or missing spline teeth. Remove burrs using soft honing stone. Replace defective plates.
- (5) Discard internal-splined plates if oil groove is not visible.
- (6) Inspect external-tanged plates (1) for scoring, cone distortion, imbedded metal particles, galling, cracks, breaks, and damaged or missing tangs. Remove burrs and minor surface irregularities using soft honing stone. Replace defective plates.
- (7) Measure clearance between inside diameter of each external-tanged plate (1) and level surface to determine cone. Discard plates having clearance in excess of 0.013 in. (0.330 mm).

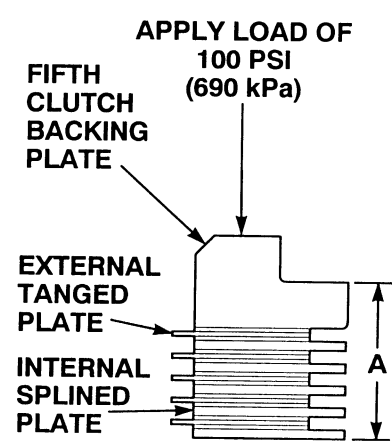


**NOTE**

Piston in Step (8) will be removed in Center Support Repair (Para 23-17 Step **b. Disassembly**).

- (8) Stack fourth clutch plates, piston and backplate in press as shown.
- (9) Evenly apply specified load. Measure dimension A.
- (10) Select proper external-tanged clutch plate combination from Table 23-3.
- (11) Tie fourth clutch plates together and tag.

**Table 23-3. External-Tanged Clutch Plate Combination**



Dimension A		Thin External Tanged Plates 0.0993 to 0.1063	Thick External Tanged Plates 0.1161 to 0.1231
From	To		
3.0932 in. (78.5673 mm)	3.0845 in. (78.3463 mm)	Add 2	Remove 2
3.0845 in. (78.3463 mm)	3.0712 in. (78.0085 mm)	Add 1	Remove 1
3.0712 in. (78.0085 mm)	3.0426 in. (77.2820 mm)	—	—
3.0426 in. (77.2820 mm)	3.0293 in. (76.9442 mm)	Remove 1	Add 1



**23-15. FOURTH CLUTCH REPAIR (CONT).**

**c. Assembly.**

- (1) Position transmission housing (2) in upward position.

**CAUTION**

Ensure third clutch assemblies is fully seated in transmission housing before installation of fourth clutch plates in transmission housing or damage may occur to parts.

- (2) Soak all clutch plate (4) and (5) surfaces in hydraulic oil for a minimum of two minutes.

**NOTE**

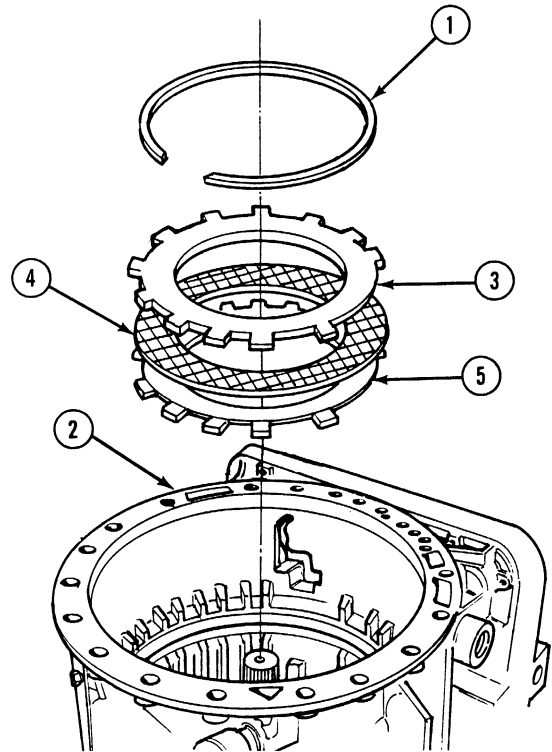
Assemble clutch plates so that cone of each plate faces same direction as cone of adjacent plate.

- (3) Starting with thickest external-tanged plate, alternately install four external-tanged plates (5) and four internal-splined plates (4) in transmission housing (2).
- (4) Install backplate (3) in transmission housing (2).

**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (5) Install retaining ring (1) in transmission housing (2) with gap opposite oil pan side of transmission housing (2).



**d. Follow-On Maintenance:**

- Install fifth clutch assembly, (Para 23-14).

**END OF TASK**

**23-16. CENTER SUPPORT REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gage Set, Telescoping (Item 69, Appendix F)  
Gage, Center and Front (Item 70, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Gun, Heat (Item 87, Appendix F)  
Installer, Lock Ring (Item 109, Appendix F)  
Lifting, Bracket, Center (Item 135, Appendix F)  
Micrometer, Outside, Caliper, Set  
(Item 139, Appendix F)  
Snap Ring Assembly (Item 203, Appendix F)  
Stone, Abrasive, Cylinder (Item 228, Appendix F)  
Wrench Set, Socket 3/8 in. Drive  
(Item 273, Appendix F)  
Wrench, Torque (0-60 N·m)  
(Item 276, Appendix F)  
Wrench, Torque (0-175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

*Materials/Parts*

Cloth, Cleaning (Item 11, Appendix B)  
Oil, Hydraulic (Item 34, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Gasket (Item 70, Appendix E)  
Nut, Push-on (8) (Item 312, Appendix E)  
Ring, Retaining (Blue) (Item 504, Appendix E)  
Ring, Retaining (Red) (Item 505, Appendix E)  
Ring, Retaining (Yellow)  
(Item 506, Appendix E)  
Screw (Item 521, Appendix E)  
Packing, Preformed (2) (Item 605, Appendix E)  
Packing, Preformed (Item 606, Appendix E)  
Seal Ring (Item 608, Appendix E)  
Spring (20) (Item 665, Appendix E)  
Washer, Thrust (Item 700, Appendix E)

*Equipment Condition*

Fourth clutch removed, (Para 23-15)

**23-16. CENTER SUPPORT REPAIR (CONT).**

**a. Removal.**

- (1) Remove and discard center support anchor screw (1) and washer (2) from transmission housing (3).

**WARNING**

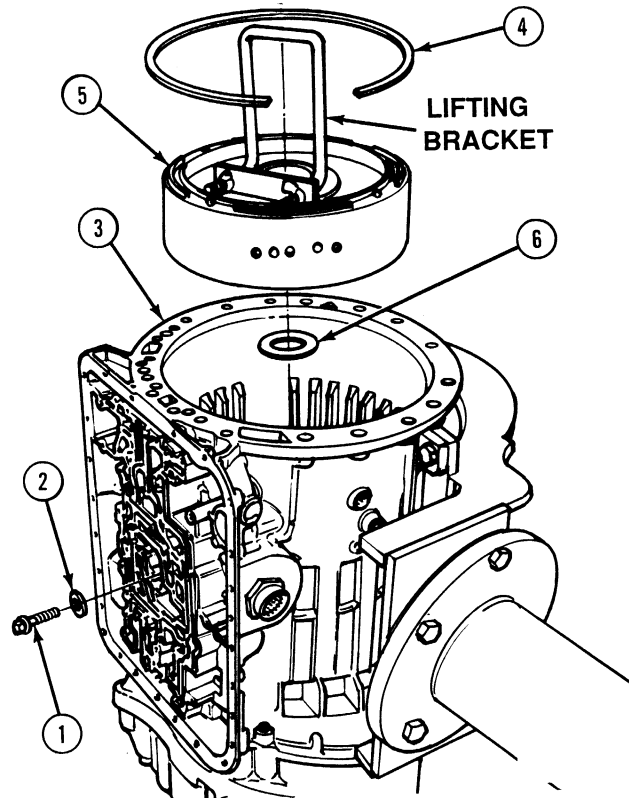
Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (2) Remove retaining ring (4) from transmission housing (3).
- (3) Install lifting bracket on center support (5).

**CAUTION**

Center support housing is fitted to transmission housing with very little clearance and may bind if transmission housing is cold. Heat transmission housing with heat lamp or warm current of air if necessary.

- (4) Lifting straight up, remove center support (5) from transmission housing (3). If center support begins to bind, tap center support downward and lift again.
- (5) Position center support (5) on level work surface.
- (6) Remove and discard thrust washer (6) from transmission housing (3).
- (7) Remove lifting bracket from center support (5).



**b. Disassembly.****WARNING**

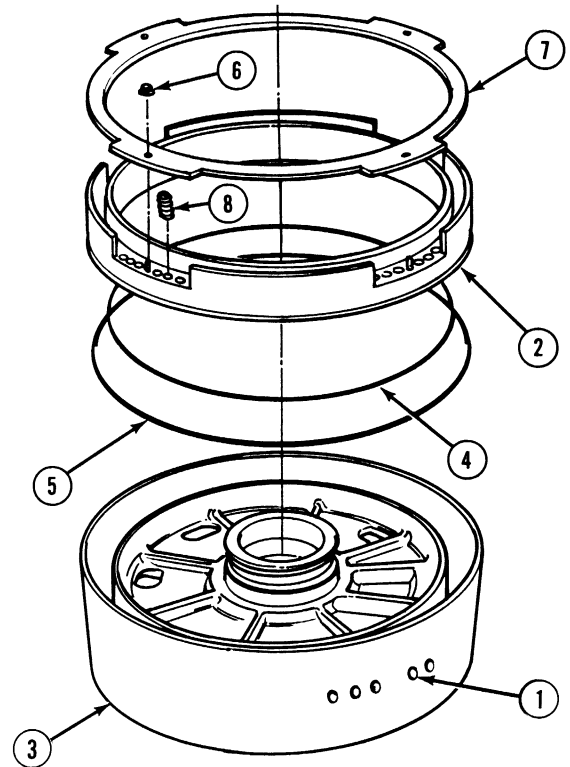
Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc). Failure to comply may result in injury or death to personnel.

- (1) Apply short bursts of compressed air to second hole (1) from right to loosen fourth clutch piston (2) from center support (3).
- (2) Remove fourth clutch piston (2) from center support (3).

**NOTE**

Note direction lip of seal rings face before removing. Lips are facing away from springs.

- (3) Remove and discard preformed packings (4) and (5) from fourth clutch piston (2).
- (4) Cut, remove, and discard four push-on nuts (6) from fourth clutch piston (2).
- (5) Remove spring retainer plate (7) from fourth clutch piston (2).
- (6) Remove and discard 20 piston release springs (8) from fourth piston (2).



**23-16. CENTER SUPPORT REPAIR (CONT).**

- (7) Turn center support (3) over.

**WARNING**

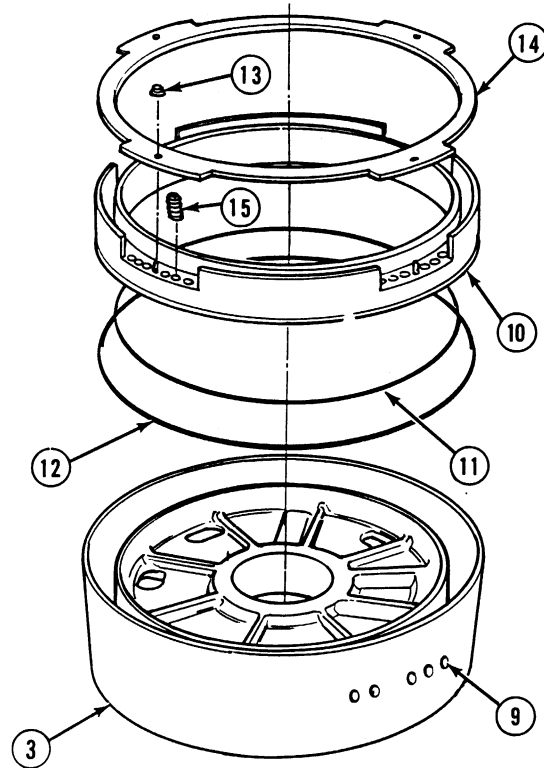
Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc). Failure to comply may result in injury or death to personnel.

- (8) Apply short bursts of compressed air to first hole (9) on right to loosen third clutch piston (10).
- (9) Remove third clutch piston (10) from center support (3).

**NOTE**

Note position of lips on preformed packings. Lips are facing away from springs.

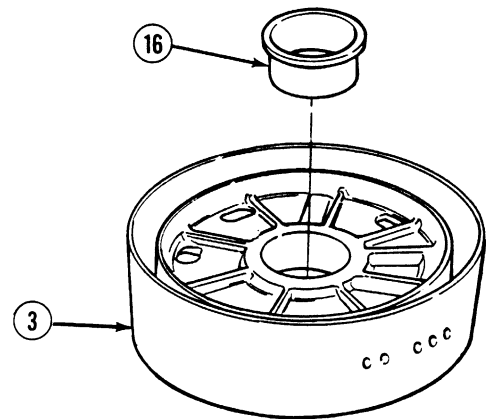
- (10) Remove and discard preformed packings (11) and outer (12) from third clutch piston (10).
- (11) Cut, remove, and discard four push-on nuts (13) from third clutch piston (10).
- (12) Remove spring retainer plate (14) from third clutch piston (10).
- (13) Remove 20 piston release springs (15) from third clutch piston (10). Discard springs.



**NOTE**

Perform Step (14) only if bushing is damaged.

- (14) Using a chisel, collapse bushing (16) at seam and remove from center support housing (3).



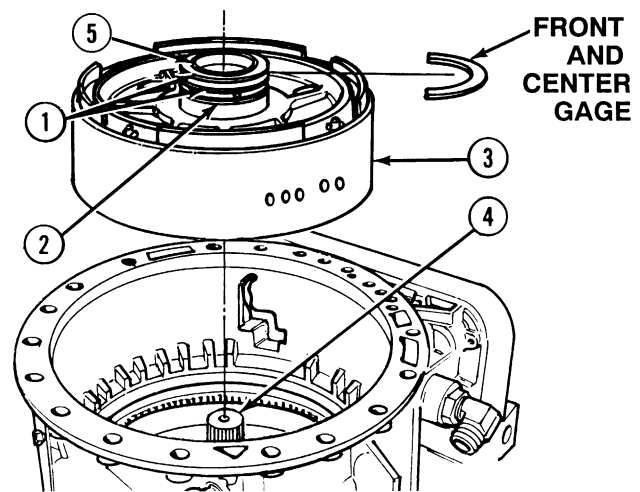
**c. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent and inspect for damage. Replace damaged parts.
  - (2) Dry all metal parts with compressed air.

**23-16. CENTER SUPPORT REPAIR (CONT).**

- (3) Measure thrust washer thickness. Thickness must be a minimum of 0.091 in. (2.311 mm).
- (4) Inspect seal ring grooves (1) on center support hub (2). Rotate front and center gage 360 degrees around hub (2) in seal ring grooves (1). Replace center support housing (3) if seal ring grooves are damaged.
- (5) Using micrometer, measure and record diameter of sun gear shaft (4) (still inside transmission housing) and inside diameter of center support bushing (5). If difference is greater than 0.0085 in. (0.2159 mm), replace center support bushing.
- (6) Inspect seal ring grooves in piston for nicks, burrs, dents, or displaced metal that could damage seal. Remove raised metal, sharp edges, burrs, or nicks with a soft honing stone or crocus cloth. Thoroughly clean all residue from piston prior to assembly.
- (7) Inspect center support housing seal ring surface for nicks, burrs, dents, or displaced metal that could interfere with mating parts or damage piston seal. Remove raised metal, sharp edges, burrs or nicks with soft honing stone or crocus cloth. Thoroughly clean oil residue from center support housing prior to assembly.



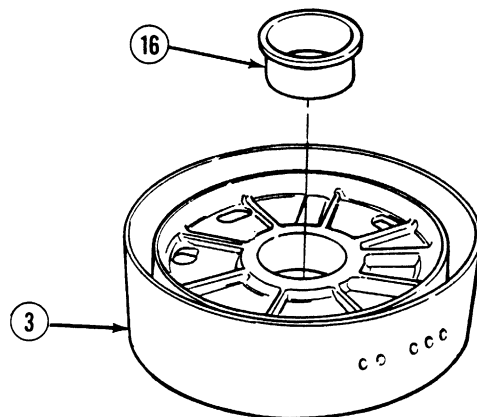
**d. Assembly.**

- (1) Place center support (4) on press, hub side up.

**NOTE**

- Oil hole in bushing must align with oil hole in center hub.
- Perform Step (2) if bushing was removed.

- (2) Install bushing (16) in hub with sleeve compressor.



- (3) Apply hydraulic oil to preformed packings (1) and (2).

**NOTE**

Ensure lips of preformed packings are facing away from springs.

- (4) Install inner preformed packing (1) and outer preformed packing (2) in fourth clutch piston (3).



Install fourth clutch piston slowly in center support or damage to seal rings may occur.

**NOTE**

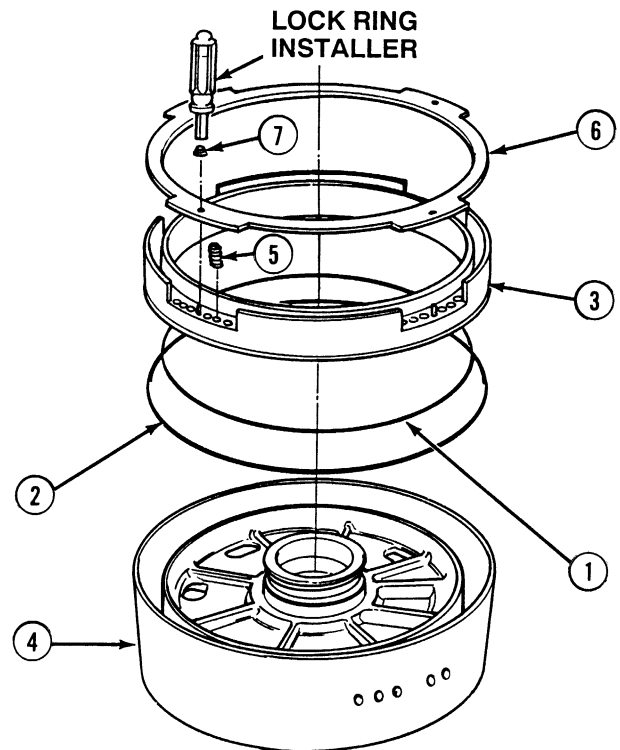
Center support should be hub side facing up prior to installation of fourth clutch piston.

- (5) Apply hydraulic oil to center support (4).
- (6) Install fourth clutch piston (3) in center support (4).
- (7) Install 20 springs (5) in fourth clutch piston (3).
- (8) Install spring retainer plate (6) on fourth clutch piston (3).

**NOTE**

Spring retainer plate must be compressed evenly to sit properly in center support.

- (9) Using lock ring installer, install four push-on nuts (7) on fourth clutch piston (3).





**23-16. CENTER SUPPORT REPAIR (CONT).**

- (10) Turn center support (4) over.
- (11) Apply hydraulic oil to preformed packings (8) and (9).

**NOTE**

Lips of preformed packings face away from springs.

- (12) Install inner preformed packing (8) and outer preformed packing (9) in third clutch piston (10).

**CAUTION**

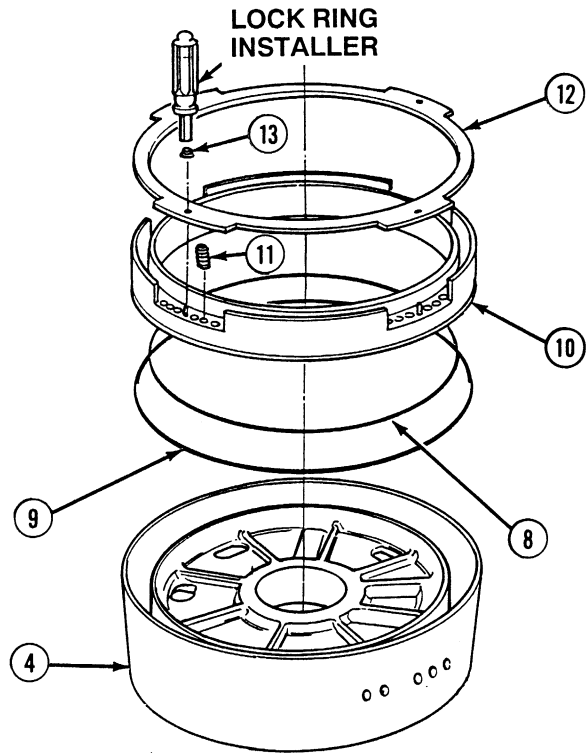
Install third clutch piston slowly in center support or damage to preformed packings may occur.

- (13) Lubricate center support (4) with hydraulic oil.
- (14) Install third clutch piston (10) in center support (4).
- (15) Install 20 springs (11) in third clutch piston (10).
- (16) Install spring retainer plate (12) in third clutch piston (10).

**NOTE**

Spring retainer plate must be compressed evenly to sit properly in center support.

- (17) Using lock ring installer, install four push-on nuts (13) in third clutch piston (10).



**e. Installation.**

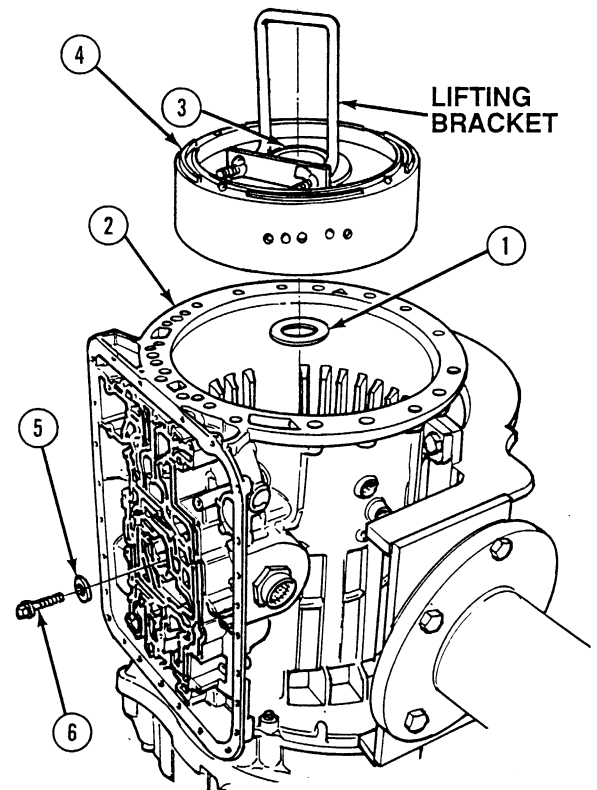
- (1) Install thrust washer (1) in transmission housing (2).
- (2) Install lifting bracket on center support hub (3).

**CAUTION**

Center support is fitted to transmission housing with very little clearance and may bind if transmission housing is cold. Heat transmission housing with heat lamp or heat gun if necessary.

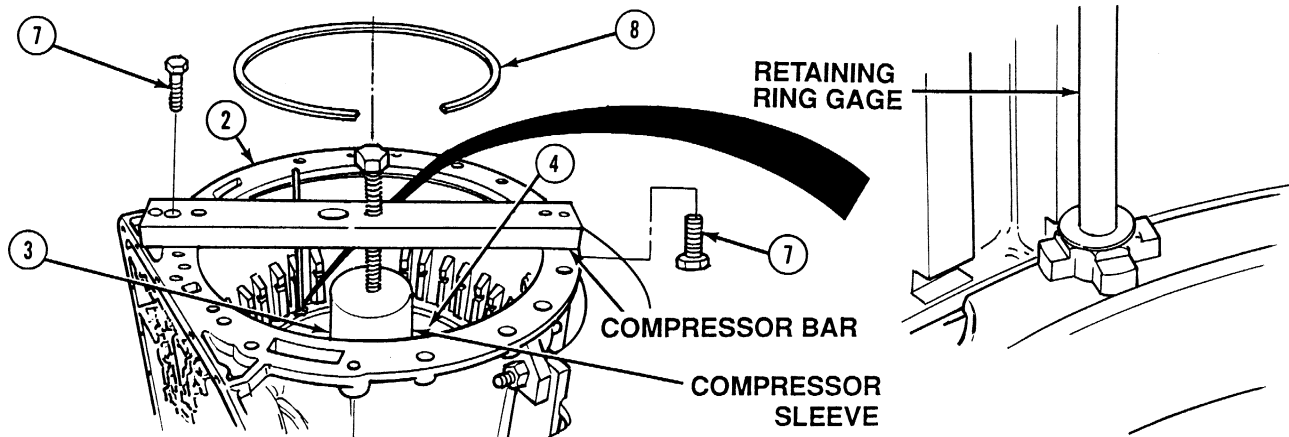
**NOTE**

Make sure tapped hole is aligned with hole in transmission housing.



- (3) Lower center support (4) in transmission housing (2).
- (4) Position washer (5) and center support anchor screw (6) in transmission housing (2) and center support (4).
- (5) Remove lifting bracket from center support hub (3).

**23-16. CENTER SUPPORT REPAIR (CONT).**



- (6) Install compressor sleeve on center support (3).
- (7) Position compressor bar across transmission housing (2) and secure with two screws (7).
- (8) Tighten compressor bar center screw to 60 lb-in (7 N·m) to compress center support housing (4).
- (9) Using retaining ring gage, measure retaining ring (8) opening with each of four lugs of retaining ring gage. This will determine retaining ring size. Select thickest retaining ring (8) that will fit into groove of transmission housing (2).

Retaining Ring Color Code	Size
Blue retaining ring	0.148 to 0.150 in. (3.759 to 3.810 mm) thick
Yellow retaining ring	0.152 to 0.154 in. (3.861 to 3.912 mm) thick
Red retaining ring	0.158 to 0.160 in. (4.013 to 4.064 mm) thick

**WARNING**

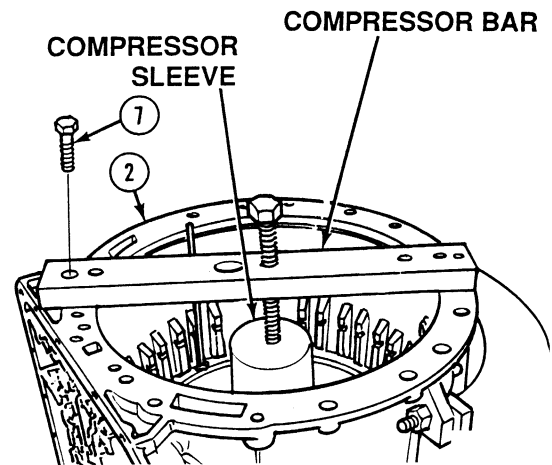
Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

**NOTE**

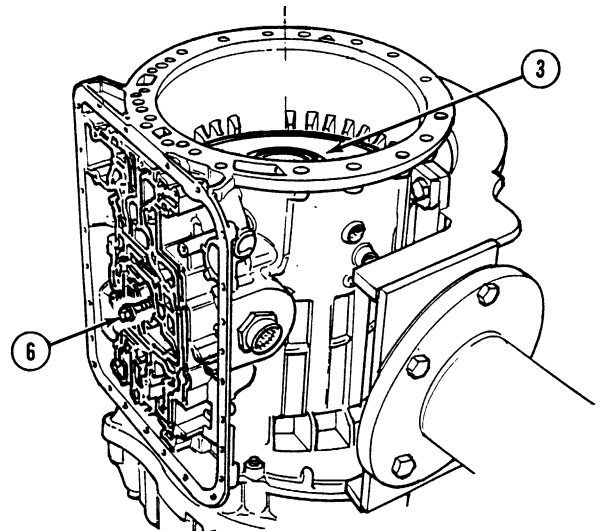
Retaining ring to be installed in Step (10) is same retaining ring which was selected in Step (9).

- (10) Install retaining ring (8) in transmission housing (2). Turn retaining ring (8) until split in retaining ring faces opposite side of oil pan.

- (11) Release tension on compressor bar center screw and remove two screws (7) from transmission housing (2).
- (12) Remove compressor bar and compressor sleeve from transmission housing (2).



- (13) Tighten center support anchor screw (6) in center support (3) to 39 to 46 lb-ft (53 to 62 N·m).



**f. Follow-On Maintenance:**

- Install fourth clutch, (Para 23-15).

**END OF TASK**

**23-17. PLANETARY GEARING, SHAFTS AND THIRD CLUTCH REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Bracket, Lifting (Item 20, Appendix F)
- Bracket, Lifting (Item 21, Appendix F)
- Caliper, Dial 0-6 in. w/Dial (Item 25, Appendix F)
- Gage, Feeler (Item 77, Appendix F)
- Installer, Plug (Item 112, Appendix F)
- Pliers, Retaining Ring (Item 159, Appendix F)
- Press, 60 Ton (Item 164, Appendix F)
- Stone, Abrasive, Cylinder (Item 228, Appendix F)
- Lifting Device, Minimum Capacity 200 lbs (91 kg)

*Materials/Parts - Continued*

- Plug, Lube Orifice (Item 444, Appendix E)
- Washer, Thrust (Item 699, Appendix E)
- Washer, Thrust (Item 700, Appendix E)
- Washer, Thrust (Item 701, Appendix E)

*Personnel Required*

Two

*Equipment Condition*

Center support removed, (Para 23-16)

*Materials/Parts*

- Cloth, Cleaning (Item 11, Appendix B)
- Oil, Hydraulic (Item 34, Appendix B)
- Petrolatum (Item 43, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)
- Tags, Identification (Item 72, Appendix B)

a. *Removal.***WARNING**

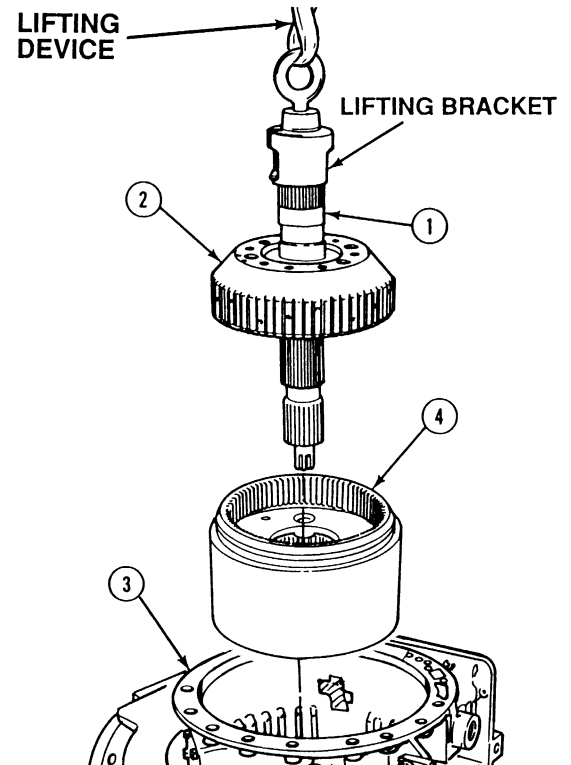
Front planetary carrier assembly weighs 54 lbs (25 kg). Attach suitable lifting device for removal to prevent possible injury to personnel.

- (1) Install lifting bracket and lifting device on main shaft (1).
- (2) With the aid of an assistant, remove front planetary carrier assembly (2) from transmission housing (3).
- (3) Position front planetary carrier assembly (2) on clean level surface.

**WARNING**

Use extreme care when removing lifting bracket. Sun gear shaft, main shaft and gear fit loosely and may fall out and cause injury to personnel or damage to parts.

- (4) Remove lifting device and bracket from main shaft (1).
- (5) Remove planetary connecting drum (4) from transmission housing (3).



**23-17. PLANETARY GEARING, SHAFTS, AND THIRD CLUTCH REPAIR (CONT).**

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

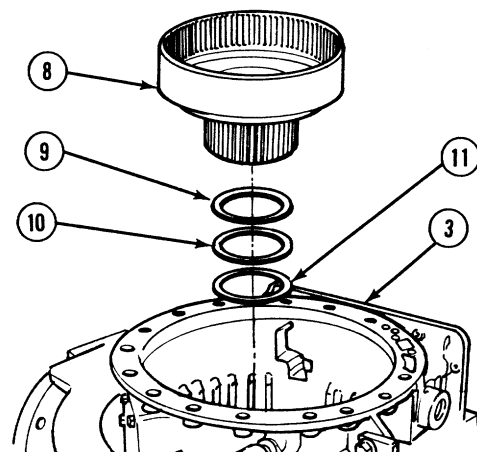
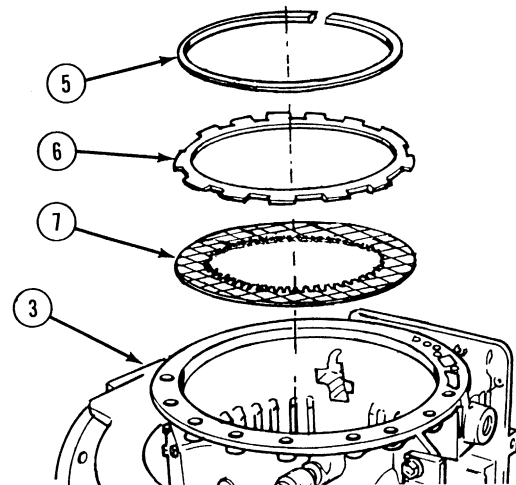
**CAUTION**

Use care when removing retaining ring from transmission housing not to scratch center support area of transmission housing. When removing retaining ring, keep open end of retaining ring in open area of transmission housing. Scratches cause difficulty when installing center support which can cause component damage.

**NOTE**

- Number of external-tanged clutch plates may differ depending upon thickness of clutch pack.
- Make sure external-tanged and internal-splined clutch plates are tied together and tagged in order of removal.

- (6) Remove retaining ring (5), external-tanged clutch plates (6) and internal-splined clutch plates (7) from transmission housing (3).
- (7) Remove center planetary ring and rear sun gear assembly (8) from transmission housing (3).
- (8) Remove outer race (9), needle bearing (10) and inner race (11) from transmission housing (3) or center planetary ring and rear sun gear assembly (8).



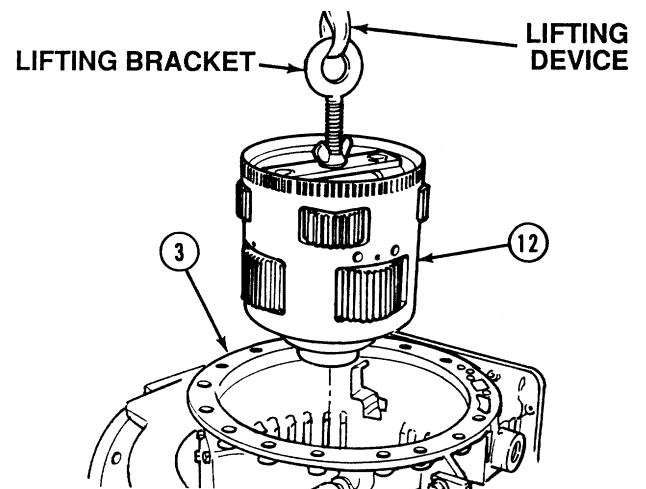
**WARNING**

- Do not lift rear planetary assembly by ball bearing on rear end. Bearing may come off and planetary may fall resulting in personal injury or damage to equipment.
- Rear planetary carrier assembly weighs 86 lbs (39 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

**CAUTION**

- Remove rear planetary carrier assembly slowly. It may be necessary to have assistant turn output shaft to align gears when removing or damage to gears may result.
- If binding of rear planetary carrier assembly occurs, it may be necessary to have assistant hold clutch pack in transmission housing (access through control valve side of transmission housing) down while removing rear planetary carrier assembly.

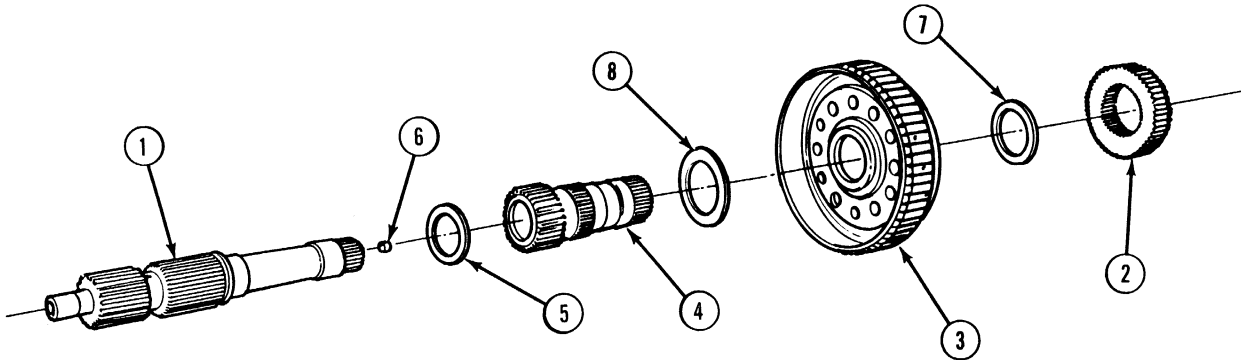
- (9) Install lifting bracket and lifting device on rear planetary carrier assembly (12).
- (10) Remove rear planetary carrier assembly (12) from transmission housing (3).
- (11) Remove lifting device and lifting bracket from rear planetary carrier assembly (12).





**23-17. PLANETARY GEARING, SHAFTS, AND THIRD CLUTCH REPAIR (CONT).**

**b. Disassembly.**



- (1) Remove main shaft (1) and sun gear (2) from front planetary carrier assembly (3).
- (2) Remove center sun gear shaft (4) from front planetary carrier assembly (3).
- (3) Remove and discard thrust washer (5) from main shaft (1).

**NOTE**

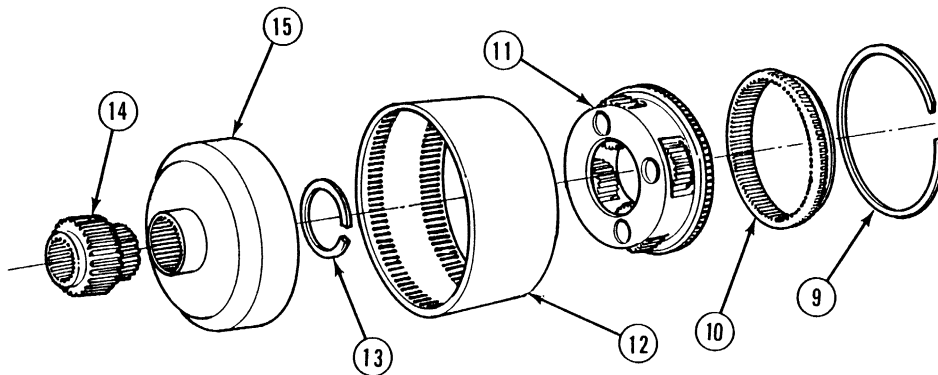
Perform Step (4) only if lube orifice plug is damaged.

- (4) Remove and discard lube orifice plug (6) from main shaft (1).

**NOTE**

Thrust washer may have fallen when center sun gear shaft was removed.

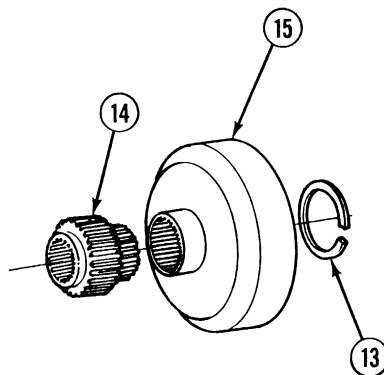
- (5) Remove and discard thrust washers (7) and (8) from front planetary carrier assembly (3).



**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (6) Remove retaining ring (9) and front ring gear (10) from planetary connecting drum (12).
- (7) Remove center planetary carrier assembly (11) from connecting planetary drum (12).



- (8) Remove retaining ring (13) and rear sun gear (14) from center planetary ring gear (15).

**23-17. PLANETARY GEARING, SHAFTS, AND THIRD CLUTCH REPAIR (CONT).**

*c. Cleaning/Inspection.*

**WARNING**

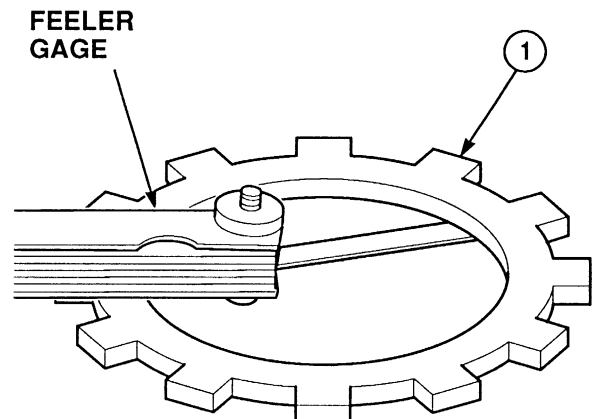
- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes, and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent. The flashpoint for Type II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.

**WARNING**

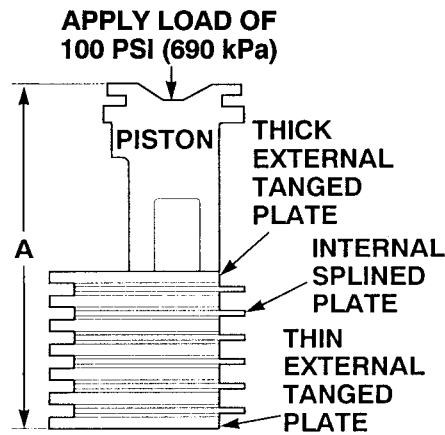
Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc). Failure to comply may result in injury or death to personnel.

- (2) Dry all parts, except bearings, with compressed air. Allow bearings to air dry.
- (3) Inspect all parts for nicks, burrs, scratches or dents.
- (4) Inspect internal-splined plates for imbedded metal particles, severely pitted faces, excessive wear, cracks, distortion and damaged or missing spline teeth. Remove burrs using soft honing stone. Replace defective plates.
- (5) Discard internal-splined plates if oil groove is not visible.
- (6) Inspect external-tanged plates (1) for scoring, excessive wear, cone distortion, imbedded metal, galling, cracks, breaks and damaged or missing tangs. Remove burrs and minor surface irregularities using soft honing stone. Replace defective plates.
- (7) Measure clearance between inside diameter of each external-tanged plate and a level surface to determine cone. Discard plates having clearance in excess of 0.013 in. (0.330 mm).



- (8) Stack third clutch plates and third clutch piston as shown in press.
  - (a) Evenly apply specified load. Measure dimension A.
  - (b) From Table 23-4, select proper external-tanged clutch plate combination.
  - (c) Tie parts together and tag.
  - (d) Install third clutch piston in center support (Para 23-17 *d. Assembly*).

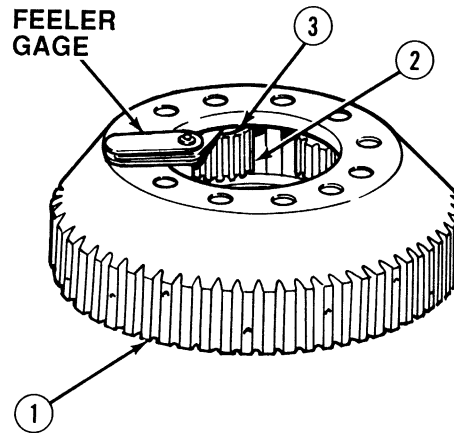
**Table 23-4. External-Tanged Clutch Plate Combination**



Dimension A		Thin External Tanged Plates 0.0993 to 0.1063	Thick External Tanged Plates 0.1161 to 0.1231
From	To		
3.2280 in. (81.9912 mm)	3.2147 in. (81.6534 mm)	Add 2	Remove 2
3.2147 in. (81.6534 mm)	3.2014 in. (81.3156 mm)	Add 1	Remove 1
3.2014 in. (81.3156 mm)	3.1794 in. (80.7568 mm)	—	—
3.1794 in. (80.7568 mm)	3.1661 in. (80.4189 mm)	Remove 1	Add 1
3.1661 in. (80.4189 mm)	3.1528 in. (80.0735 mm)	Remove 2	Add 2

**23-17. PLANETARY GEARING, SHAFTS, AND THIRD CLUTCH REPAIR (CONT).**

- (9) Front planetary carrier assembly inspection.
  - (a) Position front planetary carrier assembly (1) on level work surface, hub facing down.
  - (b) Visually inspect front carrier assembly (1) for evidence of chipped gear teeth, overheat indication or metal contamination.



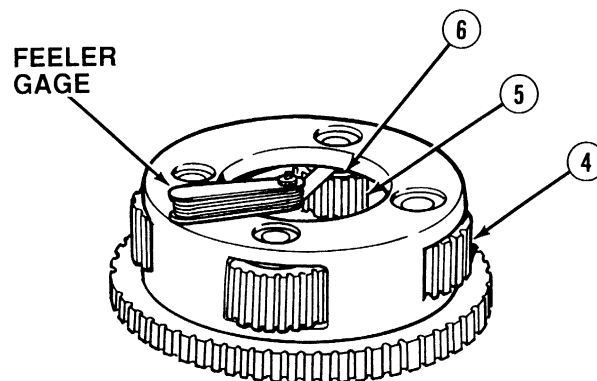
**NOTE**

If front carrier assembly does not meet specifications, replace front carrier assembly.

- (c) Check end play of pinions (2). With thrust washer (3) held flat, insert feeler gage between front carrier assembly and thrust washer. End play must be within 0.008 to 0.031 in. (0.203 to 0.787 mm).
- (d) Replace damaged parts.

- (10) Center planetary carrier assembly inspection.

- (a) Position center planetary carrier assembly (4) on level work surface.
- (b) Visually inspect center planetary carrier assembly (4) for evidence of chipped gear teeth, overheat indication or metal contamination.



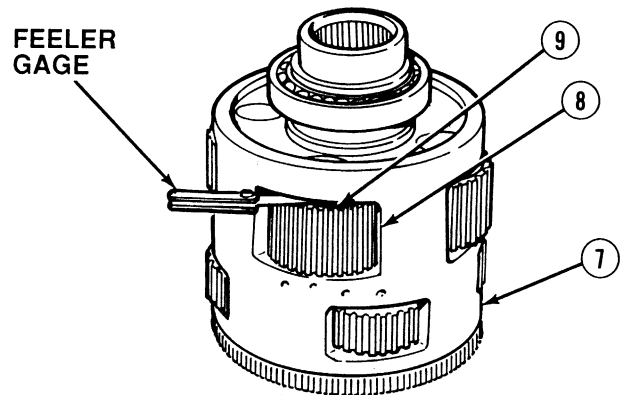
**NOTE**

If center planetary carrier assembly does not meet specifications, replace center planetary carrier assembly.

- (c) Check end play of pinions (5). With thrust washer (6) held flat, insert feeler gage between center carrier assembly and thrust washer. End play must be within 0.008 to 0.031 in. (0.203 to 0.787 mm).
- (d) Replace damaged parts.

(11) Rear planetary carrier assembly inspection.

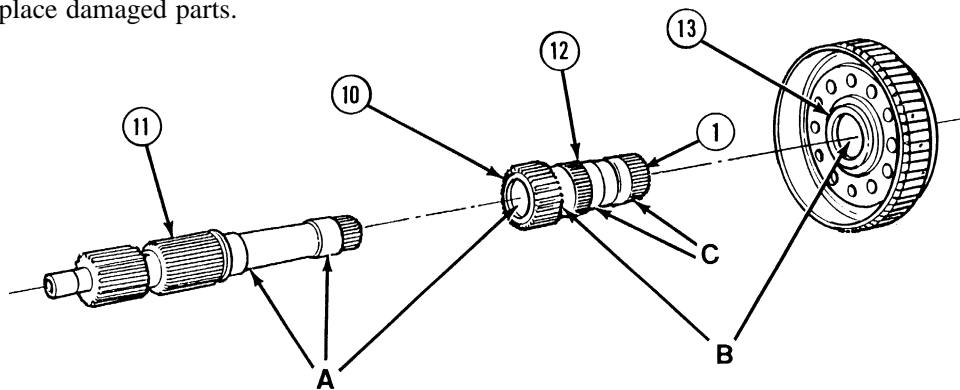
- (a) Position rear planetary carrier assembly (7) on level work surface with splined hub pointing up.
- (b) Visually inspect rear planetary carrier assembly (7) for evidence of chipped gear teeth, overheat indication or metal contamination.



**NOTE**

If rear planetary carrier assembly does not meet specification, replace rear planetary carrier assembly.

- (c) Check end play of pinions (8). With thrust washer (9) held flat, insert feeler gage between rear carrier assembly and thrust washer. End play must be within 0.008 to 0.031 in. (0.203-0.787 mm).
- (d) Replace damaged parts.



**NOTE**

Measure clearance in Steps (12), (13) and (14) by measuring inside diameter and outside diameter of parts. Subtract small value from larger value to determine clearance.

- (12) Measure clearance (A) between sun gear shaft bushings (10) and main shaft (11). Maximum clearance is 0.0085 in. (0.2159 mm). If tolerance is exceeded, replace sun gear shaft.
- (13) Measure clearance (B) between sun gear shaft (12) and support bushings (13). Maximum clearance is 0.0085 in. (0.2159 mm). If tolerance is exceeded, replace support bushing.

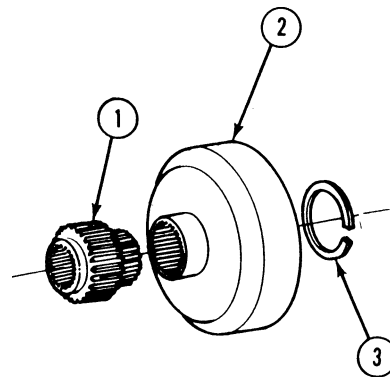
**NOTE**

Front carrier bushing dimensions were measured and recorded in Center Support Repair (Para 23-17 *c. Cleaning/Inspection*).

- (14) Determine clearance (C) between front carrier bushing and sun gear shaft (12). Maximum clearance 0.0072 in. (0.1829 mm). If tolerance is exceeded, replace front carrier bushing.

**23-17. PLANETARY GEARING, SHAFTS, AND THIRD CLUTCH REPAIR (CONT).**

- (15) Inspect bearing for scored, pitted, scratched, cracked or chipped races, or rollers or balls. If any defect is found, replace bearing.
- (16) Lubricate all parts with hydraulic oil.
- (17) Inspect bearing for roughness. Replace bearing if rotation is still rough after cleaning and oiling.

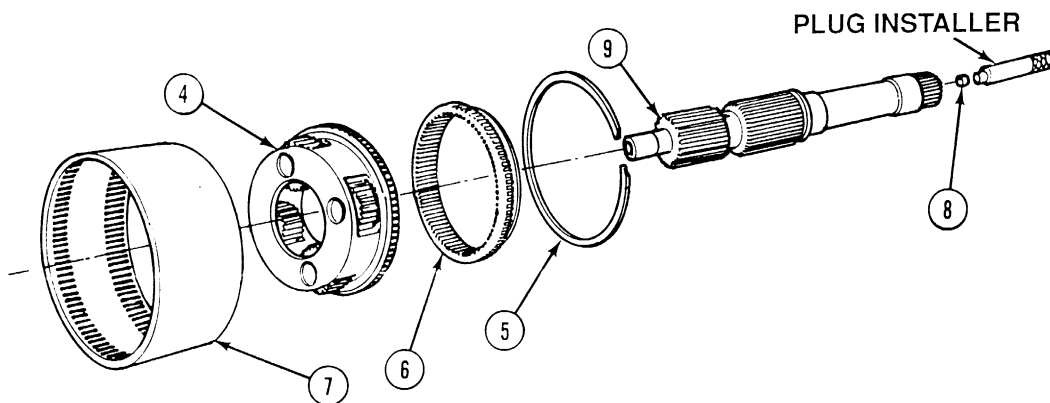


**d. Assembly.**

**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (1) Position rear sun gear (1) in center planetary ring gear (2) and install retaining ring (3) in center planetary ring gear (2).



- (2) Install center planetary carrier assembly (4) in long splined end of planetary connecting drum (7).
- (3) Install front planetary ring gear (6) and retaining ring (5) in planetary connecting drum (7).

**NOTE**

Perform Step (4) only if lube orifice plug was removed.

- (4) Using orifice installer, install lube orifice plug (8) in main shaft (9) until installer contacts shaft.

**e. Installation.**

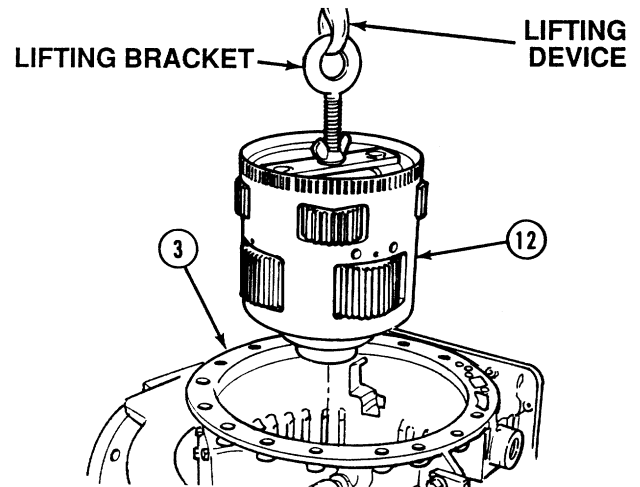
- (1) Install lifting bracket and lifting device on rear planetary carrier assembly (12).

**WARNING**

Rear planetary carrier assembly weighs 86 lbs (39 kg). Attach suitable lifting device for removal or installation to prevent possible injury to personnel.

**NOTE**

If ring gears do not align with pinions on rear planetary carrier assembly while installing, rotate rear planetary carrier assembly or yoke as required.



- (2) Align first and second clutch ring gears inside of transmission housing (3).

**WARNING**

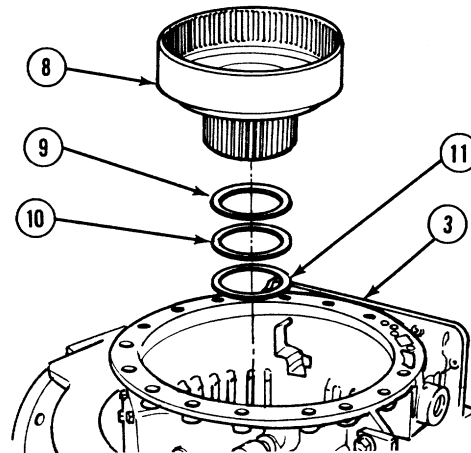
Keep fingers away from inside of transmission housing while installing rear carrier assembly or injury to personnel may result.

- (3) Lubricate bearing on bottom of rear planetary carrier assembly (12) with hydraulic oil.
- (4) With the aid of an assistant, guide rear planetary carrier assembly (12) in transmission housing (3) until rear carrier assembly is fully seated and turns freely within transmission housing.
- (5) Remove lifting device and lifting bracket from rear planetary carrier assembly (12).



**23-17. PLANETARY GEARING, SHAFTS, AND THIRD CLUTCH REPAIR (CONT).**

- (6) Lubricate inner race (11), needle bearing (10) and outer race (9) with hydraulic oil.
- (7) Install inner race (11), needle bearing (10) and outer race (9) on top of rear planetary carrier assembly inside transmission housing (3).
- (8) Install center planetary ring gear (8) in transmission housing (3).



**NOTE**

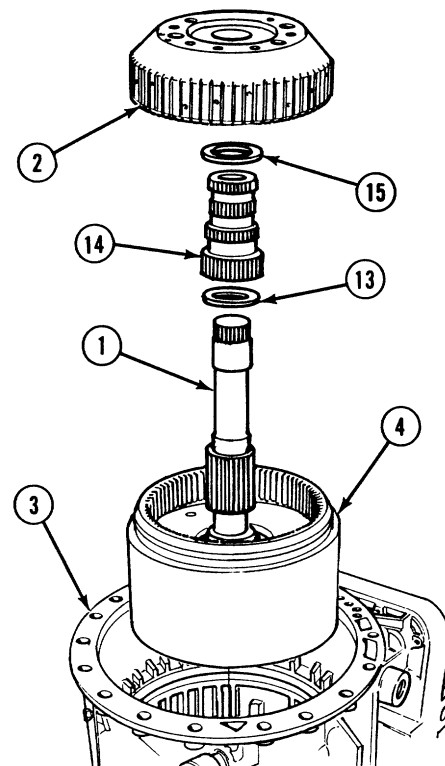
Ring gear portion of planetary connecting drum should be facing upward.

- (9) Install planetary connecting drum (4) in transmission housing (3).
- (10) Install thrust washer (13) on main shaft (1).
- (11) Install main shaft (1) in transmission housing (3).
- (12) Install center sun gear shaft (14) on main shaft (1).

**NOTE**

Petrolatum may be applied to thrust washer to keep thrust washer positioned in front planetary carrier assembly.

- (13) Install thrust washer (15) in bottom of front planetary carrier assembly (2).
- (14) Install front planetary carrier assembly (2) on main shaft (1).



- (15) Install thrust washer (16) and front sun gear (17) in transmission housing (3).
- (16) Soak clutch plates (6) and (7) in hydraulic oil for minimum of two minutes.
- (17) Alternately install seven external-tanged clutch plates (6) and six internal-splined plates (7) so thin external-tanged plate is first.

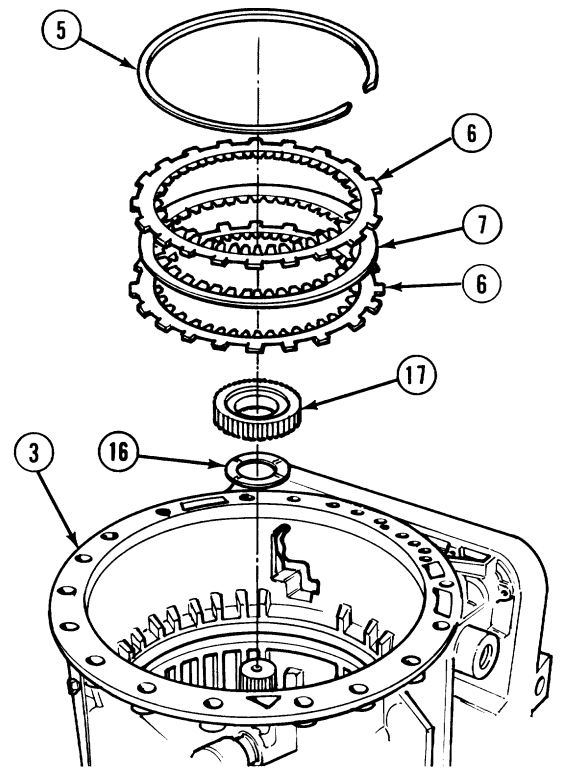
**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

**CAUTION**

Use care when installing retaining ring so not to scratch center support area of transmission housing. Scratches cause difficulty when installing center support which can result in component damage.

- (18) Install retaining ring (5) on transmission housing (3).



**f. Follow-On Maintenance:**

- Install center support, (Para 23-16).

**END OF TASK**

**23-18. REAR TRANSMISSION COVER ASSEMBLY REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Compressor Unit, Air (Item 35, Appendix F)
- Compressor, Spring (Item 39, Appendix F)
- Gage Set, Telescoping (Item 69, Appendix F)
- Gloves, Chemical Oil Protective (Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Gun, Airblow (Item 86, Appendix F)
- Hammer, Hand, Soft Plastic (Item 88, Appendix F)
- Handle, Driver (Item 92, Appendix F)
- Insertor, Bearing and Bushing (Item 101, Appendix F)
- Installer, Output Shaft Seal (Item 111, Appendix F)
- Installer, Plug (Item 113, Appendix F)
- Micrometer, Outside, Caliper, Set (Item 139, Appendix F)
- Multiplier, Torque (Item 141, Appendix F)
- Pliers, Retaining Ring (Item 159, Appendix F)
- Press, 60 Ton (Item 164, Appendix F)
- Protector, Piston (Item 167, Appendix F)
- Wrench Set, Socket 3/4 in. Drive (Item 274, Appendix F)
- Wrench, Torque (0-600 lb-ft [0-814 N·m]) (Item 278, Appendix F)
- Holder, Flange (Appendix C)
- Socket, Flange Nut (Appendix C)
- Wooden Block (3) (Appendix C)

*Materials/Parts*

- Adhesive (Item 1, Appendix B)
- Adhesive (Item 2, Appendix B)
- Compound, Retaining (Item 17, Appendix B)
- Grease, High Temperature (Item 23, Appendix B)
- Oil, Hydraulic (Item 34, Appendix B)
- Sealing Compound (Item 56, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)
- Dust Shield (Item 41, Appendix E)
- Gasket (Item 108, Appendix E)
- Locknut (Item 189, Appendix E)
- Lockwasher (24) (Item 237, Appendix E)
- Packing, Preformed (Item 356, Appendix E)
- Screw (Item 551, Appendix E)
- Seal, Oil (Item 591, Appendix E)
- Seal Ring (Item 615, Appendix E)
- Seal Ring (Item 617, Appendix E)
- Spring (30) (Item 665, Appendix E)
- Tube, Vent (Item 680, Appendix E)

*Personnel Required*

Two

*Equipment Condition*

Planetary gearing, shafts and third clutch removed, (Para 23-17)

a. **Removal.****CAUTION**

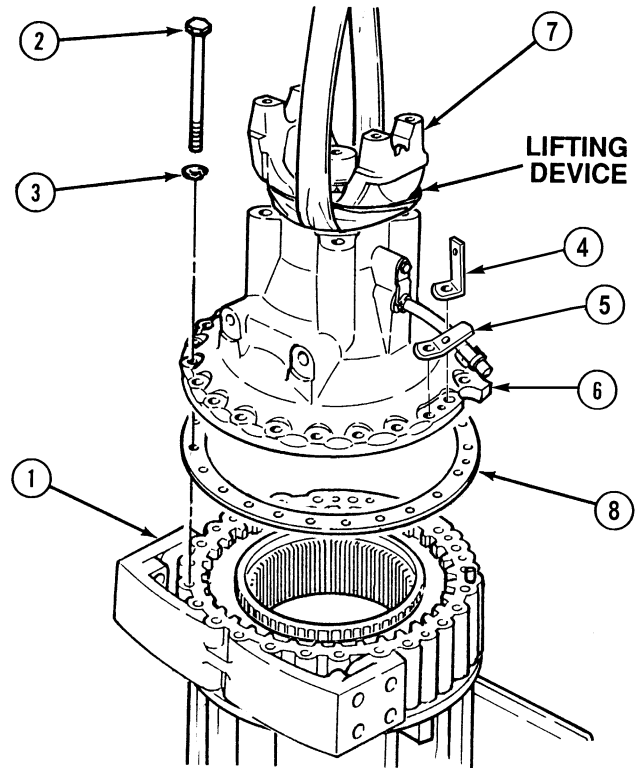
Rear adapter housing is held in place by same 24 bolts that retain rear cover to transmission housing. Use caution when removing rear cover as adapter housing may remain attached to it. In this case adapter housing must be separated from rear cover before rear cover is removed.

- (1) Position transmission with rear adapter housing (1) facing upward.
- (2) Remove 24 screws (2), lockwashers (3), bracket (4) and bracket (5) from rear cover (6). Discard lockwashers.

**WARNING**

Rear cover weighs 98 lbs (44 kg). Attach suitable lifting device for removal or installation to prevent possible injury to personnel.

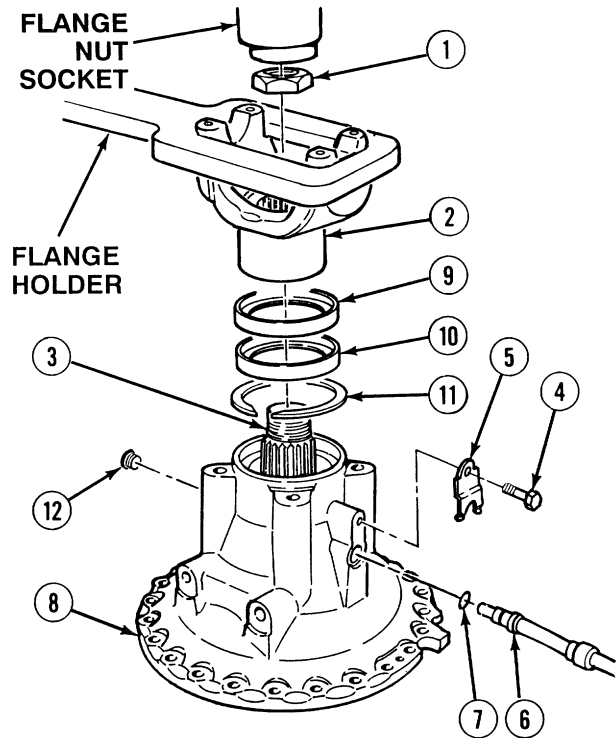
- (3) Attach lifting device to output yoke (7).
- (4) Remove rear cover (6) from rear adapter housing (1).
- (5) Remove and discard gasket (8) from rear adapter housing (1).
- (6) Remove lifting device from output yoke (7).



**23-18. REAR TRANSMISSION COVER ASSEMBLY REPAIR (CONT).**

**b. Disassembly.**

- (1) With the aid of an assistant and flange holder, remove nut (1) and yoke (2) from output shaft (3). Discard nut.
- (2) Remove screw (4), speed sensor retainer (5), magnetic speed sensor (6) and preformed packing (7) from rear cover (8). Discard screw and preformed packing.
- (3) Remove and discard dust shield (9) from rear cover (8).
- (4) Remove and discard oil seal (10) from rear cover (8).



**WARNING**

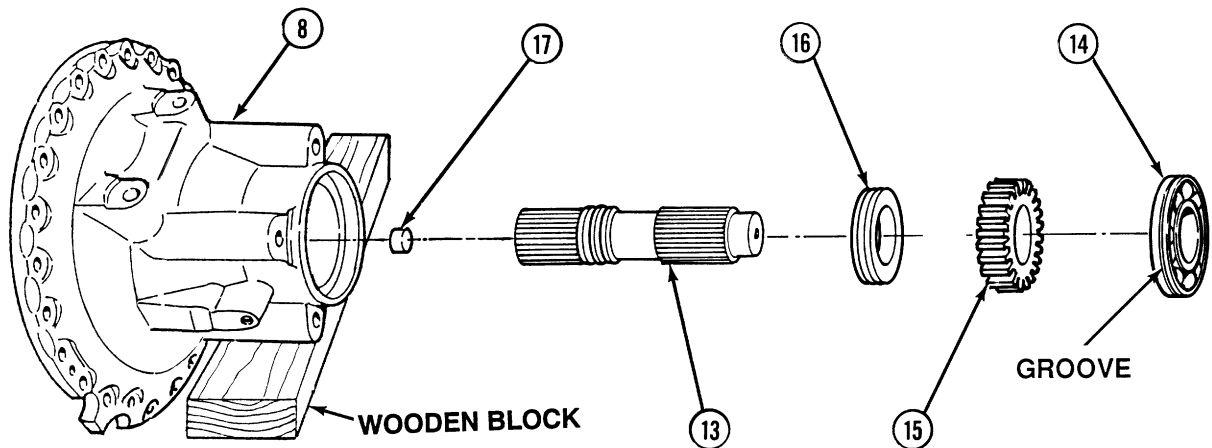
Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (5) Remove retaining ring (11) from rear cover (8).

**NOTE**

Perform Step (6) only if plug is damaged.

- (6) Remove plug (12) from rear cover (8).



- (7) Remove output shaft (13) from rear cover (8).

**NOTE**

Note position of groove in bearing. Groove in bearing faces toward yoke end of shaft.

- (8) Position output shaft (13) in press.
- (9) Remove bearing (14), speed sensor gear (15) and speedometer drive gear (16) from output shaft (13).
- (10) Remove output shaft (13) from press.

**NOTE**

Perform Step (11) only if orifice plug is damaged.

- (11) Inspect orifice plug (17) and remove from output shaft (13).
- (12) Position rear cover (8) in press with yoke side down.

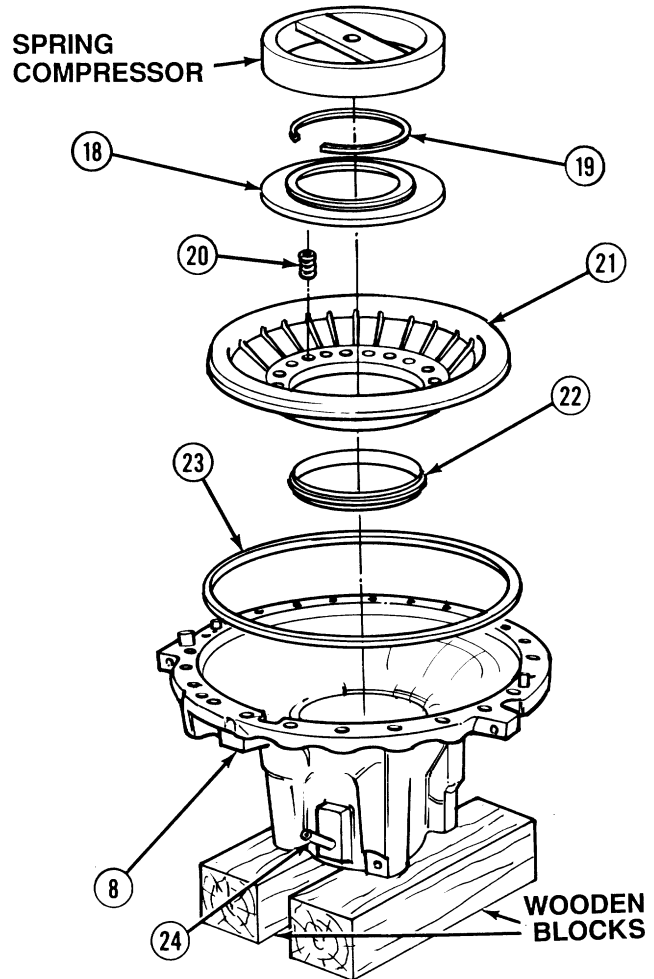
**23-18. REAR TRANSMISSION COVER ASSEMBLY REPAIR (CONT).**

- (13) Install spring compressor on piston spring retainer (18).

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (14) Compress piston spring retainer (18) and remove retaining ring (19) from rear cover (8).
- (15) Remove rear cover (8) from press and position flange side up on wooden blocks.
- (16) Remove spring compressor and piston spring retainer (18) from rear cover (8).
- (17) Remove and discard 30 piston release springs (20) from first clutch piston (21).
- (18) Remove first clutch piston (21) from rear cover (8).
- (19) Remove and discard inner seal ring (22) and outer seal ring (23) from first clutch piston (21).



**NOTE**

Perform Step (20) only if vent tube is damaged.

- (20) Remove and discard vent tube (24) from rear cover (8).

**c. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning 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) Dry all parts, except bearing, with compressed air. Allow bearing to air dry.
- (3) Inspect all parts for dents, burrs or scratches. Replace damaged parts.

**NOTE**

- Maximum clearance for needle bearing or bushing is 0.0015 in. (0.0381 mm).
  - Transmissions with a serial number lower than 2510169200 may have a needle bearing; serial numbers of 2510169200 and higher may have a bushing.
  - Needle bearing clearance is the inside diameter of output shaft needle bearing minus the outside diameter of plain shaft bearing surface.
- (4) Measure and record outside of diameter of main shaft needle bearing surface.
- (5) Measure inside diameter of output shaft needle bearing. If maximum clearance is exceeded, remove and discard needle bearing and replace main shaft (Planetary Gearing, Shafts, and Third Clutch Replacement, Para 23-17).
- (6) If first clutch and adapter housing will be repaired (Para 23-19), go on to **a. Removal** of first clutch and adapter housing. If not, go on to **d. Assembly** of this task.



**23-18. REAR TRANSMISSION COVER ASSEMBLY REPAIR (CONT).**

**d. Assembly.**

**NOTE**

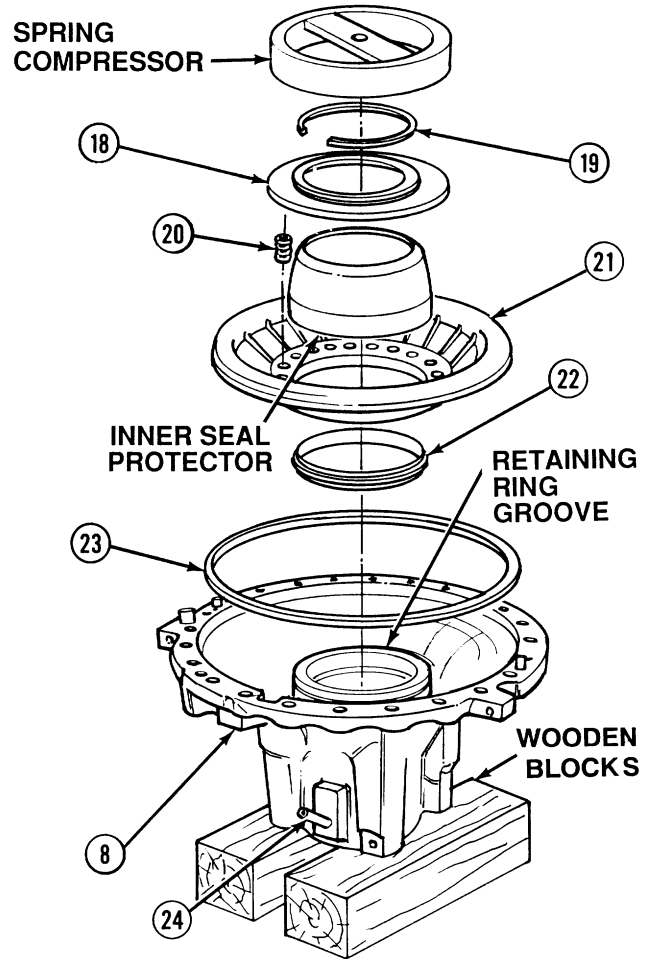
Perform Step (1) only if vent tube was removed.

- (1) Install vent tube (24) in rear cover (8).
- (2) Position rear cover (8), flange side up, on wooden blocks.
- (3) Coat inner seal ring (22) and outer seal ring (23) with hydraulic oil.

**NOTE**

Inner and outer seal rings are installed with lips of seals facing down.

- (4) Install inner seal ring (22) and outer seal ring (23) in first clutch piston (21).
- (5) Position inner seal protector over inner seal ring (22) and install first clutch piston (21) in rear cover (8) by tapping gently with soft hammer.
- (6) Install 30 piston release springs (20) in first clutch piston (21).
- (7) Install piston spring retainer (18) in first clutch piston (21).
- (8) Install spring compressor on piston spring retainer (18) and install rear cover (8) in press.



**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (9) Compress piston spring retainer (18) until retaining ring groove in rear cover (8) is cleared.
- (10) Install retaining ring (19) in rear cover (8) and release pressure.
- (11) Remove spring compressor and rear cover (8) from press.

**NOTE**

Perform Step (12) only if plug was removed.

- (12) Install orifice plug (17) in output shaft (13), using orifice plug installer.

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

**CAUTION**

- A bushing must be installed into an output shaft that had a bushing.
- A needle bearing must be installed into an output shaft that had a needle bearing. Failure to comply may result in damage to equipment.

**NOTE**

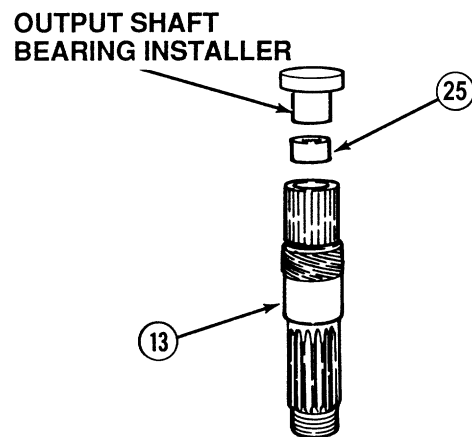
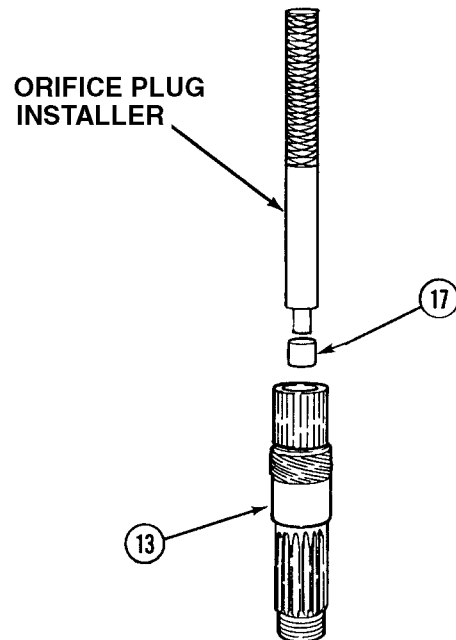
Perform Steps (13) through (15) only if needle bearing was removed.

- (13) Coat outside of output shaft needle bearing (25) with retaining compound.

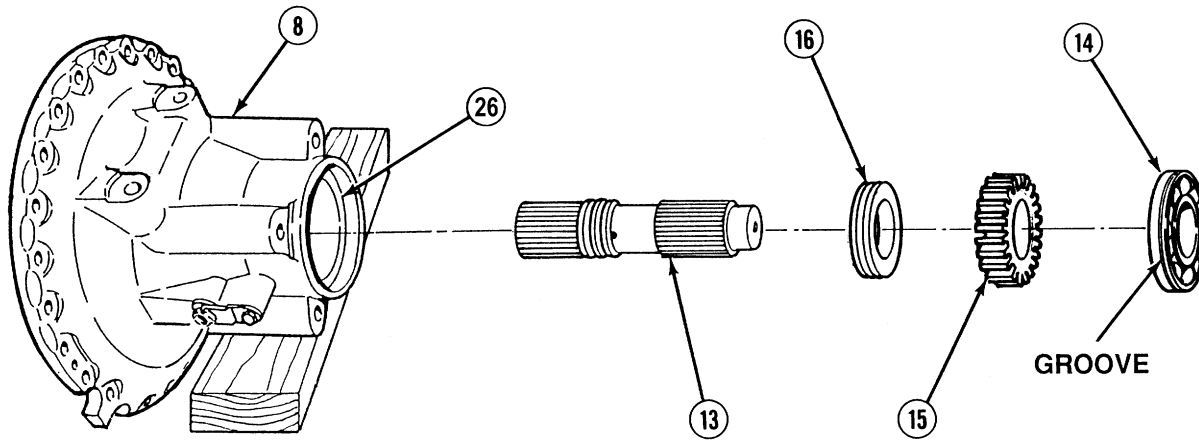
**NOTE**

- Transmissions with a serial number lower than 2510169200 may have a needle bearing; serial numbers of 2510169200 and higher may have a bushing.
- Output shaft needle bearing is installed in output shaft with numbered side of bearing facing outward.

- (14) Position output shaft needle bearing (25) on output shaft (13).
- (15) Using bearing installer, install output shaft needle bearing (25) on output shaft (13) until bearing is 0.145 to 0.165 in. (3.683 to 4.191 mm) from end of shaft.



**23-18. REAR TRANSMISSION COVER ASSEMBLY REPAIR (CONT).**



**CAUTION**

Slot in speed sensor gear must be aligned with lube hole in shaft or damage to equipment could result.

- (16) Install speedometer drive gear (16) on output shaft (13).
- (17) Position output shaft (13) in press.
- (18) Press speed sensor gear (15) on output shaft (13).

**NOTE**

Groove in bearing faces toward yoke end in shaft.

- (19) Press bearing (14) on output shaft (13).
- (20) Remove output shaft (13) from press.
- (21) Position rear cover (8) on side on wooden blocks.
- (22) Install output shaft (13) in rear cover (8) until bearing (14) clears retaining ring groove (26) in rear cover.

**WARNING**

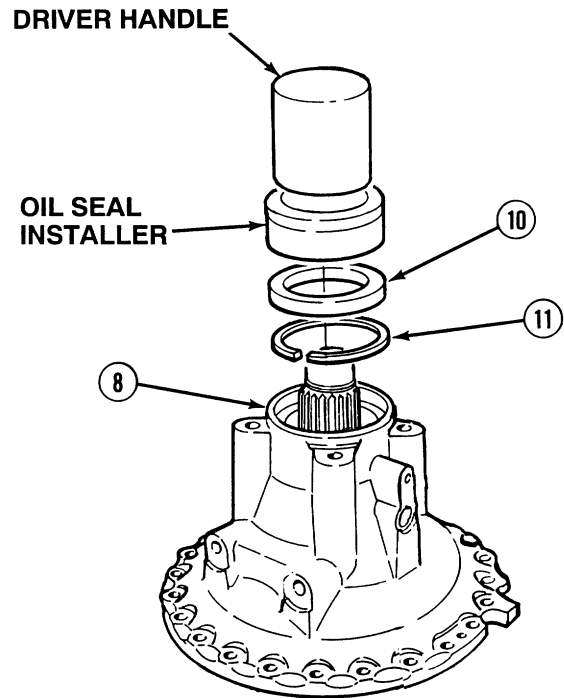
Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (23) Install retaining ring (11) in rear cover (8).
- (24) Coat inside of seal (10) with high temperature grease.

**NOTE**

Install oil seal until oil seal installer lip contacts rear cover.

- (25) Using oil seal installer, install oil seal (10), lip first, in rear cover (8).



**23-18. REAR TRANSMISSION COVER ASSEMBLY REPAIR (CONT).**

**WARNING**

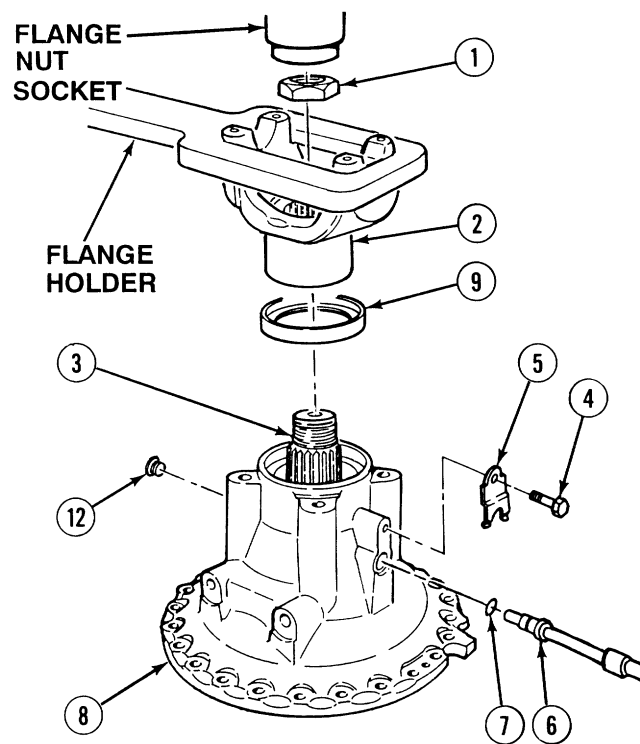
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (26) Coat outer surface of dust shield (9) with adhesive (RTV 108).

**NOTE**

- Install dust shield in rear cover until rear edge of dust shield is flush with surface of rear cover.
- Dust shield is installed in rear cover flat side first.

- (27) Install dust shield (9) in rear cover (8).
- (28) Coat splines of output shaft (3) with adhesive (RTV 732).
- (29) Install yoke (2) on output shaft (3).
- (30) Position retainer nut (1) on output shaft (3).
- (31) Apply sealing compound to threads of screw (4).
- (32) Apply hydraulic oil to preformed packing (7).
- (33) Install preformed packing (7), magnetic speed sensor (6), speed sensor retainer (5) and screw (4) in rear cover (8).



**NOTE**

Perform Step (34) only if plug was removed.

- (34) Install plug (12) in rear cover (8).

**e. Installation.**

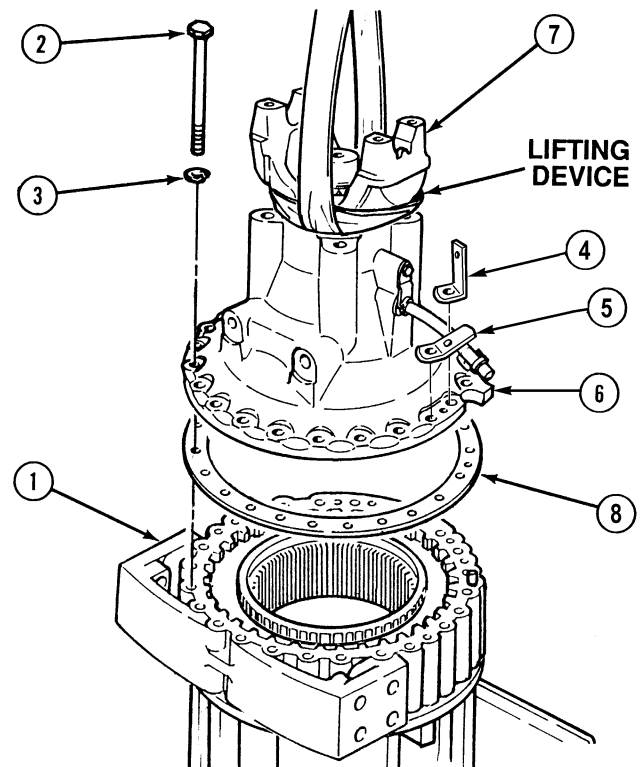
- (1) Install rear cover gasket (8) on adapter housing (1).



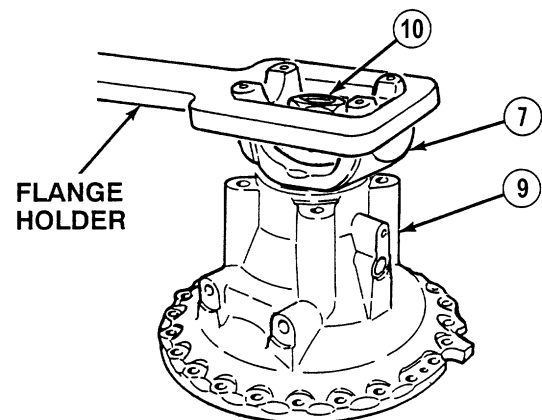
Rear cover weighs 98 lbs (44 kg). Attach suitable lifting device for installation to prevent possible injury to personnel.

**NOTE**

There are two dowel pins on screw flange face of rear cover to help align cover with transmission.



- (2) Attach lifting device to yoke (7).
- (3) With the aid of an assistant, install rear cover (6) on rear adapter housing (1).
- (4) Remove lifting device from yoke (7).
- (5) Position bracket (4), bracket (5), 24 lockwashers (3) and screws (2) in rear cover (6).
- (6) Tighten screws (2) in rear cover (6) 67 to 80 lb-ft (91 to 108 N·m).
- (7) Position transmission (9) so control valve side faces upward.
- (8) With the aid of an assistant, hold yoke (7) with flange holder, tighten nut (10) to 700 lb-ft (949 N·m).



**f. Follow-On Maintenance:**

- Install planetary gearing, shafts and third clutch, (Para 23-17).

**END OF TASK**

**23-19. FIRST CLUTCH AND ADAPTER HOUSING REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Compressor Unit, Air (Item 35, Appendix F)
- Gage Set, Feeler (Item 67, Appendix F)
- Gloves, Chemical Oil Protective (Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Gun, Airblow (Item 86, Appendix F)
- Installer, Lock Ring (Item 109, Appendix F)
- Pliers, Retaining Ring (Item 155, Appendix F)
- Press, 60 Ton (Item 164, Appendix F)

*Materials/Parts*

- Cable Ties (Item 9, Appendix B)

*Materials/Parts - Continued*

- Cloth, Cleaning (Item 11, Appendix B)
- Oil, Hydraulic (Item 34, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)
- Tags, Identification (Item 72, Appendix B)
- Gasket (Item 108, Appendix E)
- Nut, Push-on (4) (Item 312, Appendix E)
- Seal Ring (Item 605, Appendix E)
- Seal (Item 607, Appendix E)
- Spring (28) (Item 664, Appendix E)

*Equipment Condition*

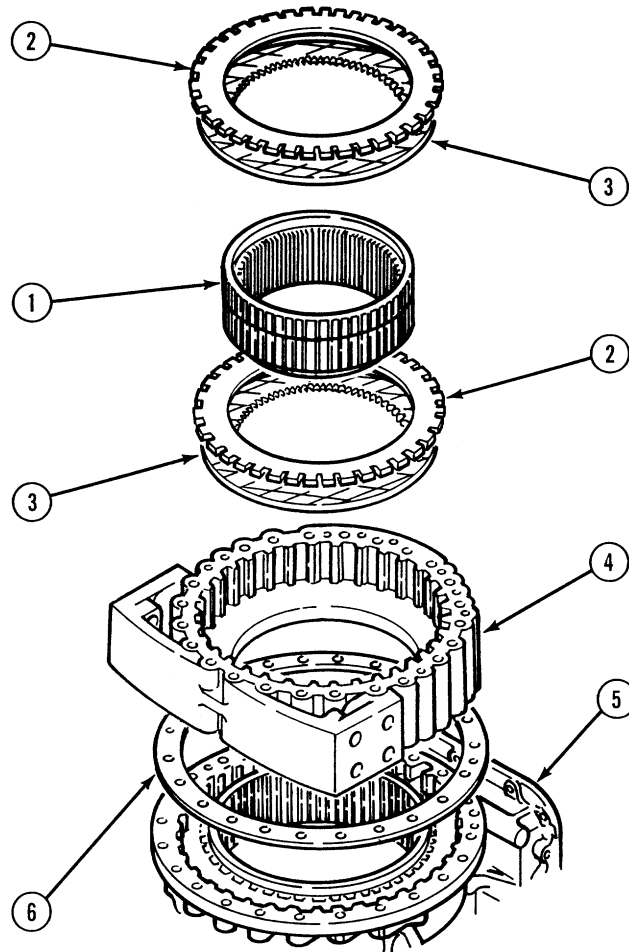
Rear transmission cover assembly removed, (Para 23-18)

**a. Removal.**

**NOTE**

Tie and mark clutch plates in order of removal.

- (1) Remove ring gear (1), four external-tanged clutch plates (2) and four internal-splined clutch plates (3) from adapter housing (4).
- (2) Remove remaining five external-tanged clutch plates (2) and four internal-splined clutch plates (3) from adapter housing (4).
- (3) Remove adapter housing (4) from transmission housing (5).
- (4) Position adapter housing (4) on level surface piston side up.
- (5) Remove and discard gasket (6) from transmission housing (5).



**b. Disassembly.**

- (1) Remove second clutch piston (1) from adapter housing (2).

**NOTE**

Note position of lips of seal rings. Lips face away from springs and will be installed in same position.

- (2) Remove and discard outer seal ring (3) and inner seal (4) from second clutch piston (1).

**CAUTION**

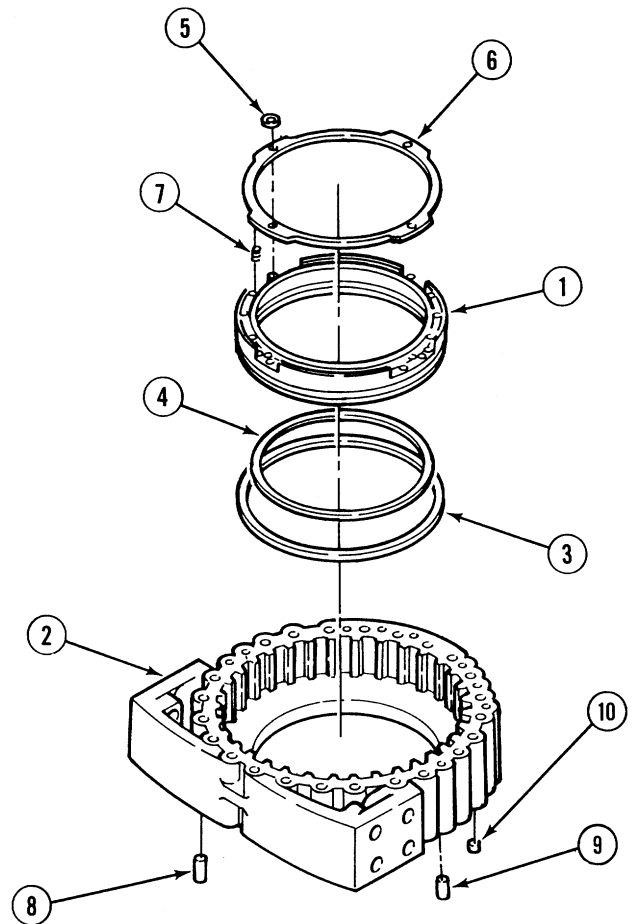
Use extreme caution when cutting retaining washers or damage to parts may result.

- (3) Cut, remove and discard four push-on nuts (5) from second clutch piston (1).
- (4) Remove spring retainer ring (6) from second clutch piston (1).
- (5) Remove and discard 28 springs (7) from second clutch piston (1).

**NOTE**

- Perform Steps (6) and (7) only if dowel pins and lube orifice plug are damaged.
- Dowel pins may have remained in transmission housing during removal of adapter housing.

- (6) Remove dowel pins (8) and (9) from adapter housing (2).
- (7) Remove lube orifice plug (10) from adapter housing (2).





**23-19. FIRST CLUTCH AND ADAPTER HOUSING REPAIR (CONT).**

*c. Cleaning/Inspection.*

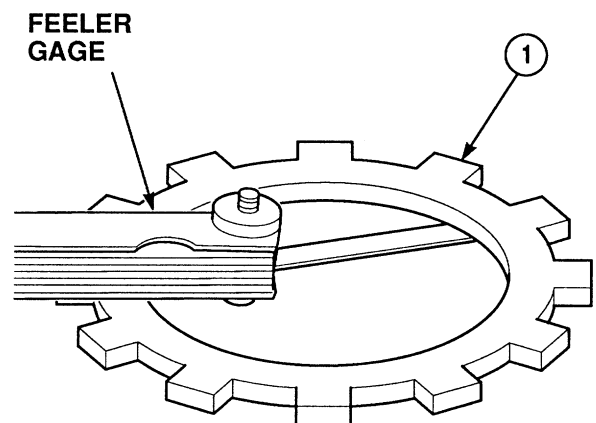
**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.

**WARNING**

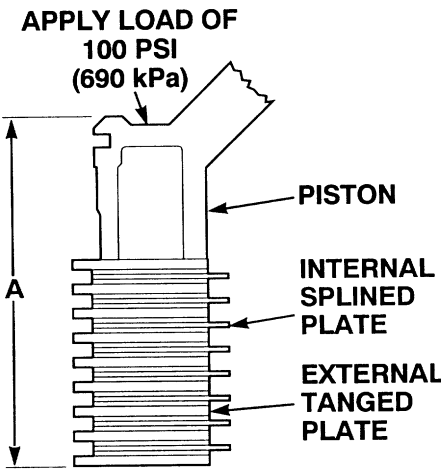
Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc). Failure to comply may result in injury or death to personnel.

- (2) Dry with compressed air.
- (3) Inspect all parts for nicks, burrs or scratches. Replace damaged parts.
- (4) Inspect internal-splined plates for imbedded metal particles, severely pitted faces, cracks, distortion and damaged or missing spline teeth. Remove burrs using a soft honing stone. Replace defective plates.
- (5) Discard internal-splined plates if oil groove is not visible.
- (6) Inspect external-tanged plates (1) for scoring, excessive wear, cone distortion, imbedded metal, cracks, breaks and damaged tangs. Replace plates with these defects. Remove burrs and minor surface irregularities, using a soft honing stone. Replace plates with other defects.
- (7) Measure clearance between inside diameter of each external-tanged plate (1) and a level surface to determine cone. Discard plates having clearance in excess of 0.013 in. (0.330 mm).



- (8) Stack 17 first clutch plates and piston (removed in Rear Cover Repair Para 23-18) as shown in press.
- (9) Evenly apply the specified load. Measure dimension A.
- (10) From Table 23-5, select proper external-tanged clutch plate combination.
- (11) Tie parts together and tag.
- (12) If second clutch will be disassembled, go to **a. Removal** of Second Clutch Repair (Para 23-20).

**Table 23-5. External-Tanged Clutch Plate Combination**



Dimension A		Thin External Tanged Plates 0.0993 to 0.1063	Thick External Tanged Plates 0.1161 to 0.1231
From	To		
3.1363 in. (79.6620 mm)	3.1230 in. (79.3242 mm)	Add 3	Remove 3
3.1230 in. (79.3242 mm)	3.1097 in. (78.9864 mm)	Add 2	Remove 2
3.1097 in. (78.9864 mm)	3.0964 in. (78.6486 mm)	Add 1	Remove 1
3.0964 in. (78.6486 mm)	3.0744 in. (78.0898 mm)	—	—
3.0744 in. (78.0898 mm)	3.0611 in. (77.7519 mm)	Remove 1	Add 1
3.0611 in. (77.7519 mm)	3.0478 in. (77.4141 mm)	Remove 2	Add 2
3.0478 in. (77.4141 mm)	3.0345 in. (77.0763 mm)	Remove 3	Add 3

**23-19. FIRST CLUTCH AND ADAPTER HOUSING REPAIR (CONT).**

**d. Assembly.**

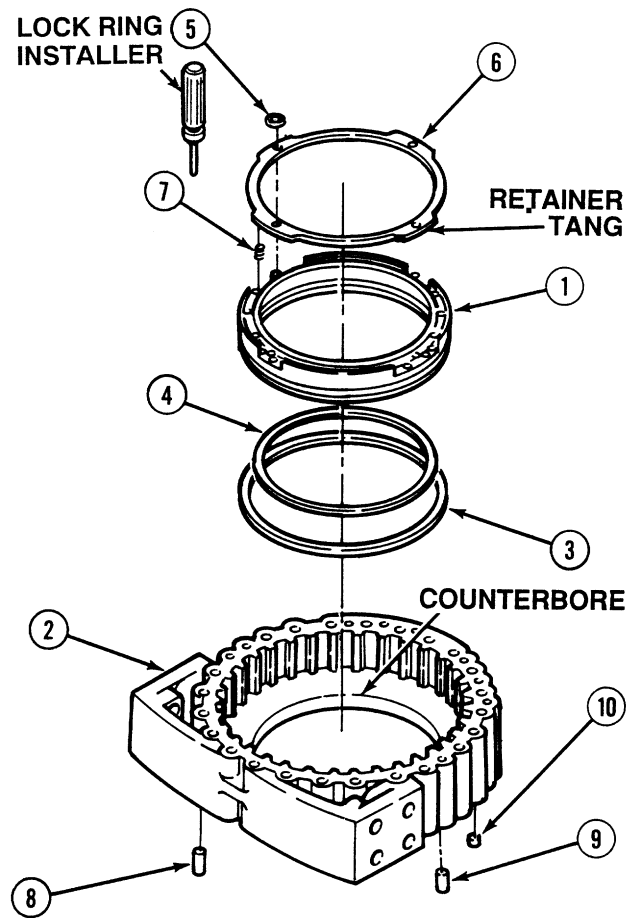
**NOTE**

Perform Steps (1) and (2) only if dowel pins and lube orifice plug were removed.

- (1) Install two dowel pins (8) and (9) in adapter housing (2).
- (2) Install lube orifice plug (10) in adapter housing (2).
- (3) Lubricate outer seal ring (3) and inner seal (4) with hydraulic oil.
- (4) Install outer seal ring (3) and inner seal ring (4) in second clutch piston (1) with lips of seal rings facing away from spring side of piston.

**CAUTION**

Make sure second clutch piston is fully seated in adapter housing. If second clutch piston is not fully seated upon installation of spring retainer ring, proper clutch clearance cannot be established.



- (5) Install second clutch piston (1) in adapter housing (2).
- (6) Install 28 springs (7) in second clutch piston (1).

**NOTE**

Offset tangs of retaining ring face upward.

- (7) Install spring retainer ring (6) in second clutch piston (1).

**NOTE**

Push-on nuts are installed until retainer tangs on spring retainer ring bottom out in counterbore of adapter housing.

- (8) Using lock ring installer, install four push-on nuts (5) on second clutch piston (1).

**e. Installation.**

- (1) Install gasket (6) on transmission housing (5).

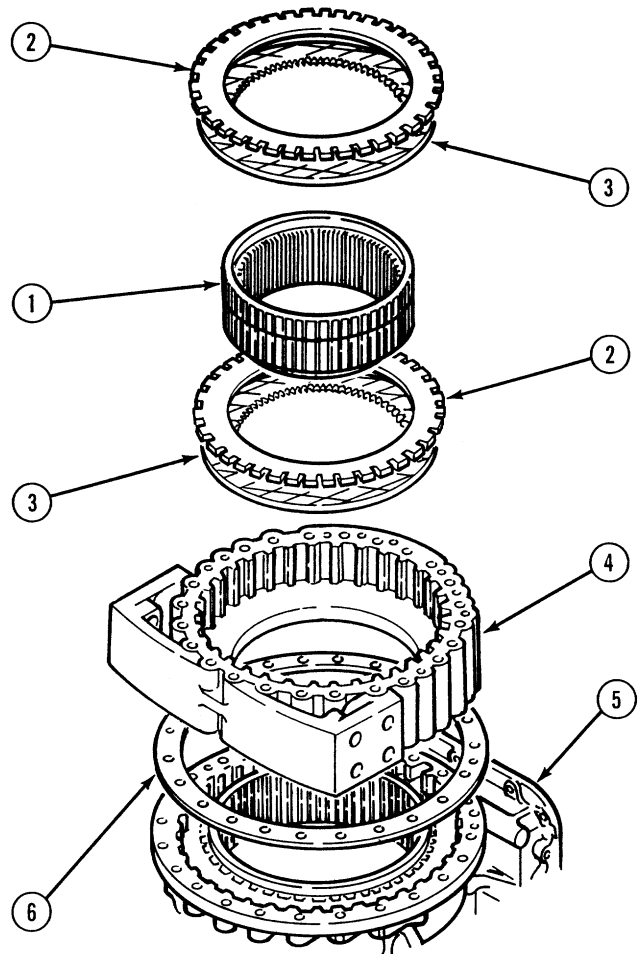
**NOTE**

Position adapter housing so rounded end of adapter housing faces valve body side of transmission housing.

- (2) Install adapter housing (4) on transmission housing (5).
- (3) Soak eight internal-splined plates (3) in hydraulic oil for minimum of two minutes.

**NOTE**

- Assemble clutch plates so that cone of each plate faces same direction as cone of adjacent plate.
- Install external-tanged clutch plates so thickest plates are installed last.
- Aligning splines in internal splined clutch plates during installation will allow for easy installation of first planetary ring gear.



- (4) Alternately install five external-tanged clutch plates (2) and four internal-splined clutch plates (3) in transmission housing (5).
- (5) Install first planetary ring gear (1) in adapter housing (4), small diameter first.
- (6) Install remaining external-tanged clutch plates (2) and four internal-splined clutch plates (3) in transmission housing (5) beginning with internal-splined clutch plate (3) and alternating with external-tanged clutch plate (2).

**f. Follow-On Maintenance:**

- Install rear transmission cover assembly, (Para 23-18).

**END OF TASK**

## 23-20. SECOND CLUTCH REPAIR.

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Removal             | c. Installation          |
| b. Cleaning/Inspection | d. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gage Set, Feeler (Item 67, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Press, 60 ton (Item 164, Appendix F)

#### *Materials/Parts*

Cable Ties (Item 9, Appendix B)  
Oil, Hydraulic (Item 34, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Tags, Identification (Item 72, Appendix B)

#### *Equipment Condition*

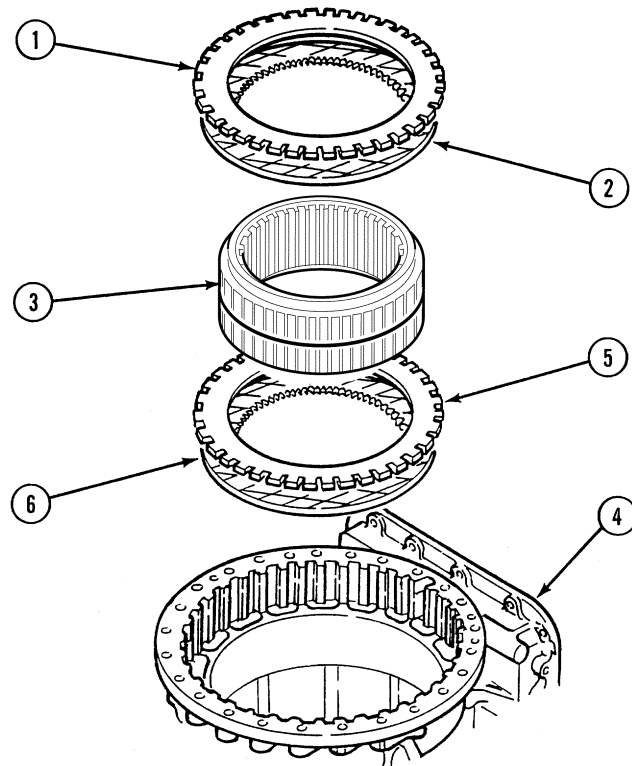
First clutch and adapter housing removed,  
(Para 23-19)

### a. Removal.

#### NOTE

Tie and tag second clutch plates together in order of removal.

- (1) Remove four external-tanged clutch plates (1), four internal-splined clutch plates (2) and rear planetary ring gear (3) from transmission housing (4).
- (2) Remove four external-tanged clutch plates (1) and four internal-splined clutch plates (2) from ring gear (3).
- (3) Remove five external-tanged clutch plates (5) and four internal-splined clutch plates (6) from transmission housing (4).



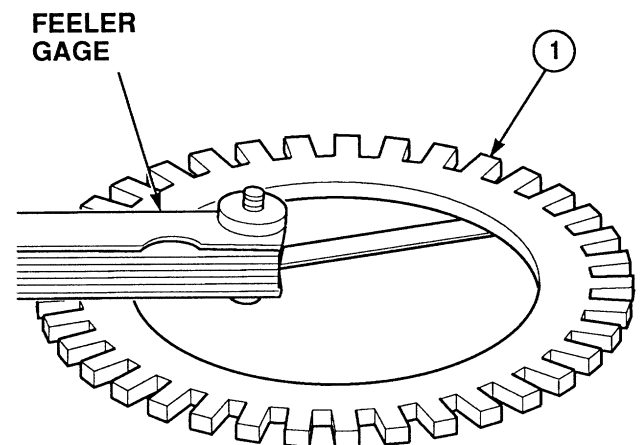
**b. Cleaning/Inspection.****WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 using drycleaning 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) Dry all metal parts with compressed air.
- (3) Inspect all metal parts for nicks, burrs or scratches. Replace damaged parts.
- (4) Inspect internal-splined plates for imbedded metal particles, severely pitted faces, cracks, distortion, and damaged or missing spline teeth. Remove burrs using a soft honing stone. Replace defective plates.
- (5) Discard internal-splined plates if oil groove is not visible.
- (6) Inspect external-tanged plates (1) for scoring, excessive wear, cone distortion, imbedded metal, cracks, breaks, and damaged or missing tangs. Remove burrs and minor surface irregularities using a soft honing stone. Replace defective plates.
- (7) Measure distance between inside diameter of each external-tanged plate (1) and a level surface to determine cone. Discard plates having a cone in excess of 0.013 in. (0.330 mm).



**23-20. SECOND CLUTCH REPAIR (CONT).**

- (8) Stack second clutch plates and piston (removed in First Clutch and Adapter Housing Removal Para 23-20) as shown in press.
- (9) Evenly apply specified load. Measure dimension A.
- (10) From Table 23-6, select proper external-tanged clutch plate combination.
- (11) Tie second clutch together and tag.

**Table 23-6. External-Tanged Clutch Plate Combination**

Dimension A		Thin External Tanged Plates 0.0993 to 0.1063	Thick External Tanged Plates 0.1161 to 0.1231
From	To		
3.6463 in. (92.6160 mm)	3.6330 in. (92.2782 mm)	Add 3	Remove 3
3.6330 in. (92.2782 mm)	3.6197 in. (91.9404 mm)	Add 2	Remove 2
3.6197 in. (91.9404 mm)	3.6064 in. (91.6026 mm)	Add 1	Remove 1
3.6064 in. (91.6026 mm)	3.5844 in. (91.0438 mm)	—	—
3.5844 in. (91.0438 mm)	3.5711 in. (90.7059 mm)	Remove 1	Add 1
3.5711 in. (90.7059 mm)	3.5578 in. (90.3681 mm)	Remove 2	Add 2
3.5578 in. (90.3681 mm)	3.5445 in. (90.0303 mm)	Remove 3	Add 3

**c. Installation.**

- (1) Soak eight internal-splined plates (2) and (6) in hydraulic oil for minimum of two minutes.

**NOTE**

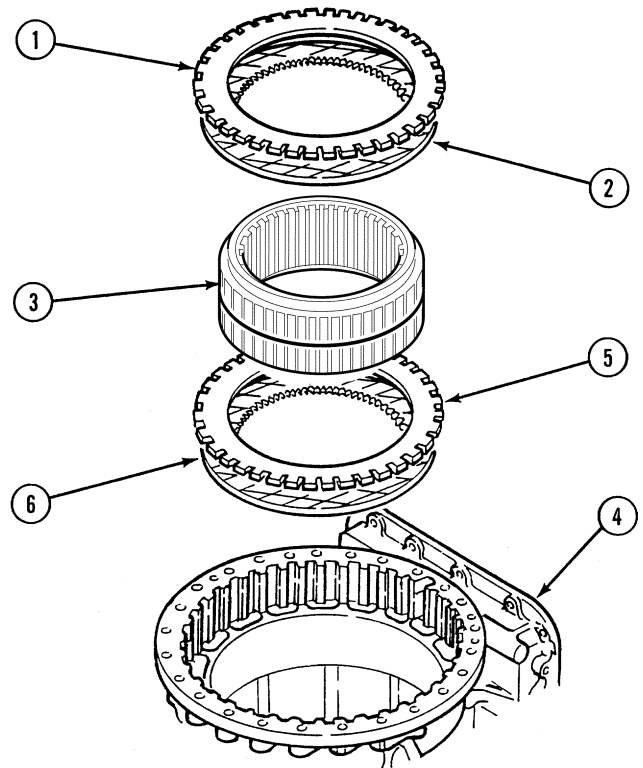
- Aligning splines in internal-splined clutch plates during installation will allow for easy installation of rear planetary ring gear.
- Assemble clutch plates so that cone of each plate faces same direction as cone of adjacent plate.

- (2) Alternately install five external-tanged clutch plates (5) and four internal-splined clutch plates (6) so thickest external-tanged clutch plate is against piston. Align splines on internal-splined clutch plates.

**NOTE**

Bevel in planetary ring gear must face up.

- (3) Install rear planetary ring gear (3) in clutch plates (5) and (6), large diameter end first.
- (4) Install remaining clutch plates (1) and (2) in transmission housing (4), starting with internal-splined clutch plate (2) and alternating with external-tanged clutch plate (1).

**d. Follow-On Maintenance:**

- Install first clutch and adapter housing, (Para 23-19).

**END OF TASK**





## CHAPTER 24

### TRANSFER CASE MAINTENANCE

Para	Contents	Page
24-1	General Support Transfer Case Repair (On Stand) .....	24-1
24-2	Transfer Case On Stand Installation/Removal .....	24-2
24-3	Transfer Case Lubrication Hoses Replacement .....	24-4
24-4	Shift Connector Replacement .....	24-6
24-5	Neutral Start Switch Replacement/Adjustment .....	24-8
24-6	Speedometer Sensor Replacement .....	24-12
24-7	Transfer Case Yoke Replacement .....	24-14
24-8	Transfer Case Assembly Repair .....	24-17
24-9	Transfer Case Differential Assembly Repair .....	24-49
24-10	Front Shaft Assembly Repair .....	24-57
24-11	Rear Shaft Assembly Repair .....	24-64
24-12	Differential Shaft Repair .....	24-70
24-13	Center Shaft Repair .....	24-73
24-14	Upper Shaft Repair .....	24-77
24-15	Upper Shift Rod Repair .....	24-83
24-16	Lower Shift Rod Repair .....	24-86
24-17	Transfer Case Lubrication Pump Repair .....	24-88

**24-1. GENERAL SUPPORT TRANSFER CASE REPAIR (ON STAND).**

This chapter contains maintenance instructions for repairing, replacing, installing and servicing transfer case components as authorized by the Maintenance Allocation Chart (MAC) at the General Support Maintenance level.

**24-2. TRANSFER CASE ON STAND INSTALLATION/REMOVAL.**

This task covers:

- a. Installation
- b. Removal
- c. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Adapter Kit, Transfer Case (Item 2, Appendix F)
- Eye, Lifting (2) (Item 59, Appendix F)
- Fixture, Holding (Item 61, Appendix F)
- Stand, Maintenance, Engine (Item 226, Appendix F)
- Wrench Set, Socket, 3/4 in. Drive (Item 274, Appendix F)
- Wrench, Torque (0-175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

*Tools and Special Tools - Continued*

- Wrench, Torque (0-600 lb-ft [0-814 N·m]) (Item 278, Appendix F)
- Lifting Device Minimum Capacity 1500 lbs (681 kg)

*Materials/Parts*

- Screw (4) (Item 514, Appendix E)

*Equipment Condition*

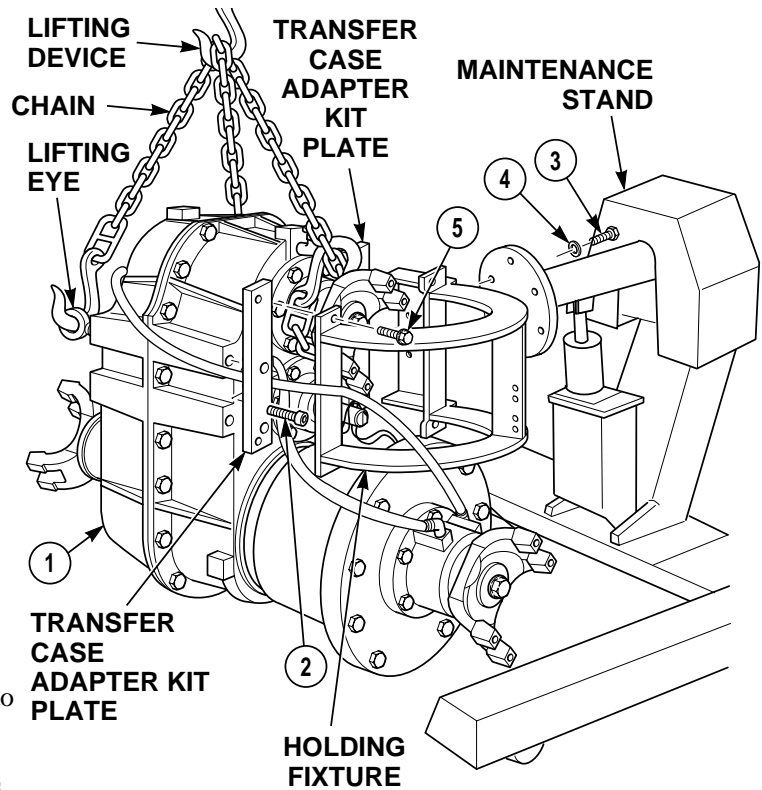
- T-Case removed from container (Para 8-6)

**a. Installation.**



Transfer case weighs 1,500 lbs (681 kg). Attach suitable lifting device before moving to prevent possible injury or death to personnel.

- (1) Install two transfer case adapter kit plates to transfer case (1) with four socket head screws (2).
- (2) Install holding fixture to engine maintenance stand with four screws (3) and washers (4).
- (3) Install two lifting eyes to transfer case (1).
- (4) Install lifting device to transfer case (1) and two lifting eyes.
- (5) Align two transfer case adapter kit plates to holding fixture and install four screws (5).
- (6) Remove lifting device and two lifting eyes from transfer case (1).



**b. Removal.**

**WARNING**

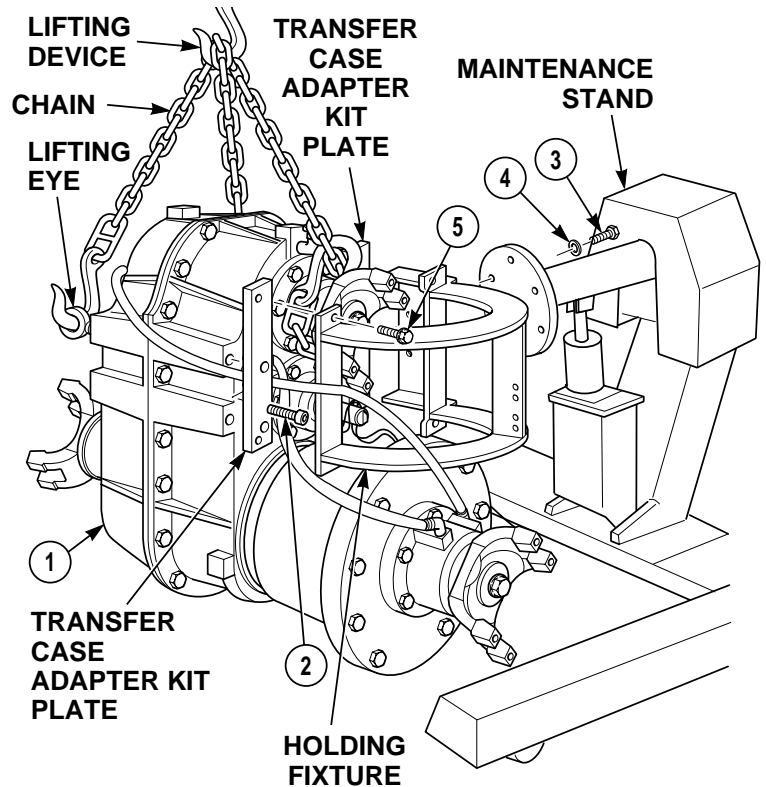
Transfer case weighs 1,500 lbs (681 kg). Attach suitable lifting device before moving to prevent possible injury or death to personnel.

- (1) Install two lifting eyes to transfer case (1).
- (2) Install lifting device to transfer case (1).

**WARNING**

Ensure that upward lifting force is applied to the holding fixture before screws are removed or transfer case may shift downward causing personal injury or damage to equipment.

- (3) Remove four screws (5) from holding fixture and transfer case adapter kit.
- (4) Position transfer case (1) on wooden blocking or secure fixture.
- (5) Remove four socket head screws (2) and two transfer case adapter kit plates from transfer case (1).
- (6) Remove four screws (3), washers (4), and holding fixture from engine maintenance stand.
- (7) Remove lifting device and two lifting eyes from transfer case (1).



**c. Follow-On Maintenance:**

- Install transfer case in container, (Para 8-6).

**END OF TASK**

## 24-3. TRANSFER CASE LUBRICATION HOSES REPLACEMENT.

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Removal             | c. Installation          |
| b. Cleaning/Inspection | d. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Cap and Plug Set (Item 26, Appendix F)

#### *Equipment Condition*

Transfer case installed on stand,  
(Para 24-2)

#### *Materials/Parts*

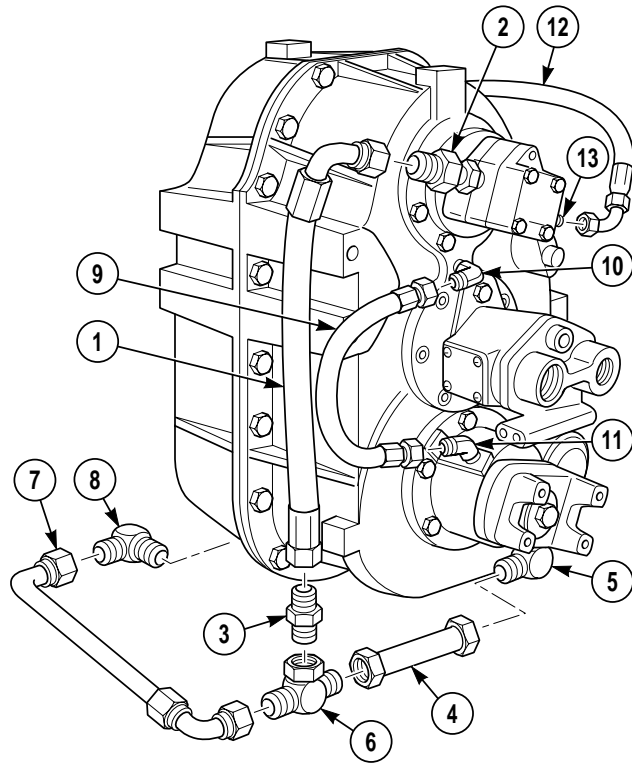
Solution, Soap (Item 67, Appendix B)  
Tags, Identification (Item 72, Appendix B)

### a. Removal.

#### NOTE

- Note location of elbows, tees and adapters prior to removal.
- Cap and plug all hoses and fittings after removal.
- Tag and mark each hose and adapter prior to removal.

- (1) Remove hose 2815 (1) from adapters (2) and (3).
- (2) Remove tube (4) from elbow (5) and tee (6).
- (3) Remove hose 2815 (7) from tee (6) and elbow (8).
- (4) Remove hose 2762 (9) from elbows (10) and (11).
- (5) Disconnect hose 2831 (12) from adapter (13).



#### NOTE

Perform Step (6) if adapter is damaged.

- (6) Remove adapter (3) from tee (6).

- (7) Remove hose 2831 (12) from adapter (14).
- (8) Remove hose 2762 (15) from elbows (16) and (17).

**b. Cleaning/Inspection.**



Keep cleaning solution out of interior of hoses. Cleaning solution could damage internal parts of transfer case.

- (1) Clean hoses with hot soapy water.
- (2) Inspect hoses for cracks, holes or other damage.
- (3) Inspect adapters and couplings of hoses for stripped threads, cracks, or other damage.
- (4) Replace all damaged parts.

**c. Installation.**

- (1) Install hose 2762 (15) on elbows (16) and (17).
- (2) Install hose 2831 (12) on adapter (14).
- (3) Install hose 2831 (12) on adapter (13).

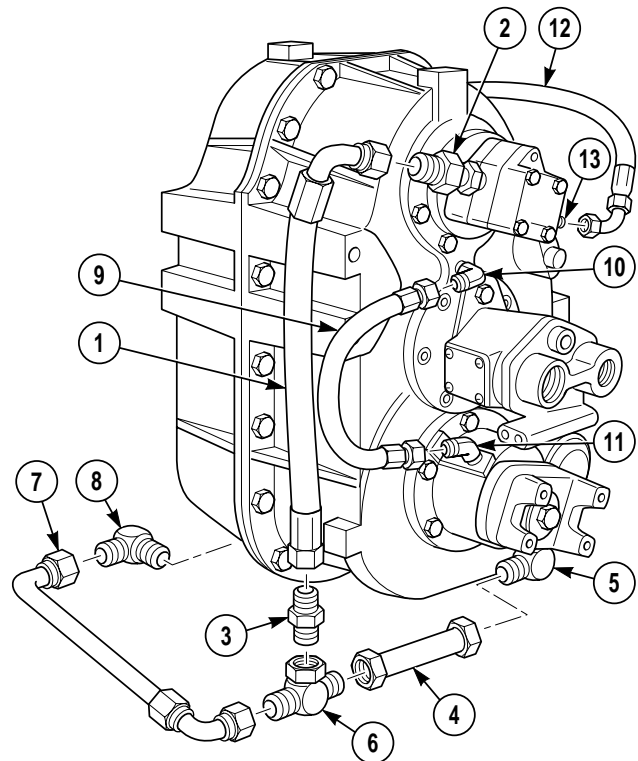
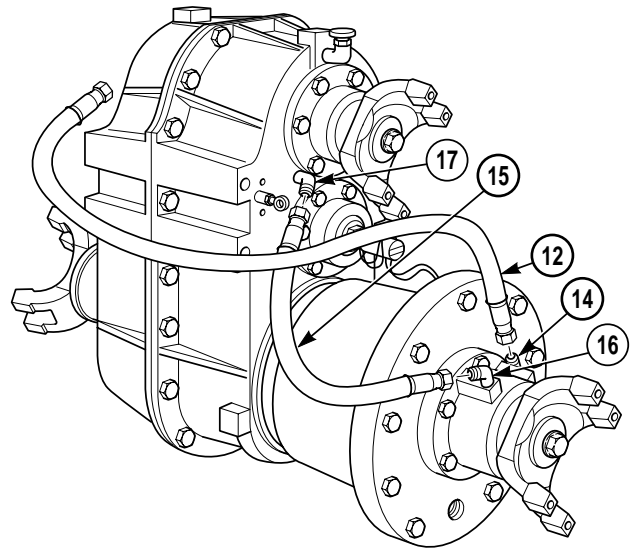
**NOTE**

Perform Step (4) if adapter was removed.

- (4) Install adapter (3) on tee (6).
- (5) Install hose 2815 (1) on adapters (3) and (2).
- (6) Install tube (4) on tee (6) and on elbow (5).
- (7) Install hose 2815 (7) on tee (6) and on elbow (8).
- (8) Install hose 2762 (9) on elbows (10) and (11).

**d. Follow-On Maintenance:**

- Transfer case removed from stand, (Para 24-2).



**END OF TASK**

## 24-4. SHIFT CONNECTOR REPLACEMENT.

This task covers:

a. Removal

b. Installation

c. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Wrench, Torque (0-175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

#### *Materials/Parts*

Grease (Item 21, Appendix B)  
Sealing Compound (Item 56, Appendix B)

#### *Materials/Parts - Continued*

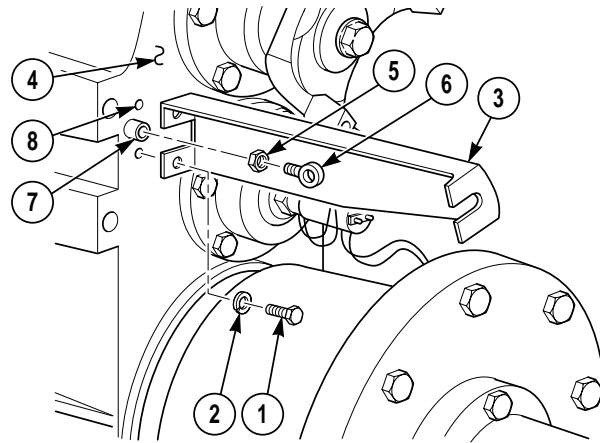
Lockwasher (2) (Item 266, Appendix E)

#### *Equipment Condition*

T-Case lubrication hoses removed/installed,  
(Para 24-3)

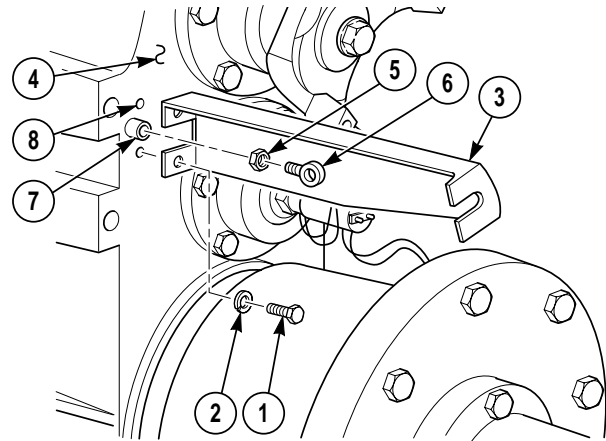
### a. Removal.

- (1) Remove two screws (1), lockwashers (2) and shift cable bracket (3) from front housing (4). Discard lockwashers.
- (2) Note position and loosen jam nut (5) on rod end (6).
- (3) Remove rod end (6) and jam nut (5) from shift rod (7).
- (4) Remove jam nut (5) from rod end (6).



**b. Installation.**

- (1) Install jam nut (5) on rod end (6).
- (2) Coat threads of rod end (6) with grease.
- (3) Install rod end (6) in shift rod (7).
- (4) Tighten jam nut (5) against shift rod (7).

**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.

- (5) Apply sealing compound to internal threads of two screw holes (8) in front housing (4).
- (6) Install bracket (3) on front housing (4) with two screws (1) and lockwashers (2). Tighten screws to 19 lb-ft (26 N·m).

**c. Follow-On Maintenance:**

- Install transfer case lubrication hose, (Para 24-3).

**END OF TASK**



## 24-5. NEUTRAL START SWITCH REPLACEMENT/ADJUSTMENT.

This task covers:

- |                 |                          |
|-----------------|--------------------------|
| a. Removal      | c. Adjustment            |
| b. Installation | d. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Multimeter (Item 140, Appendix F)

#### *Materials/Parts*

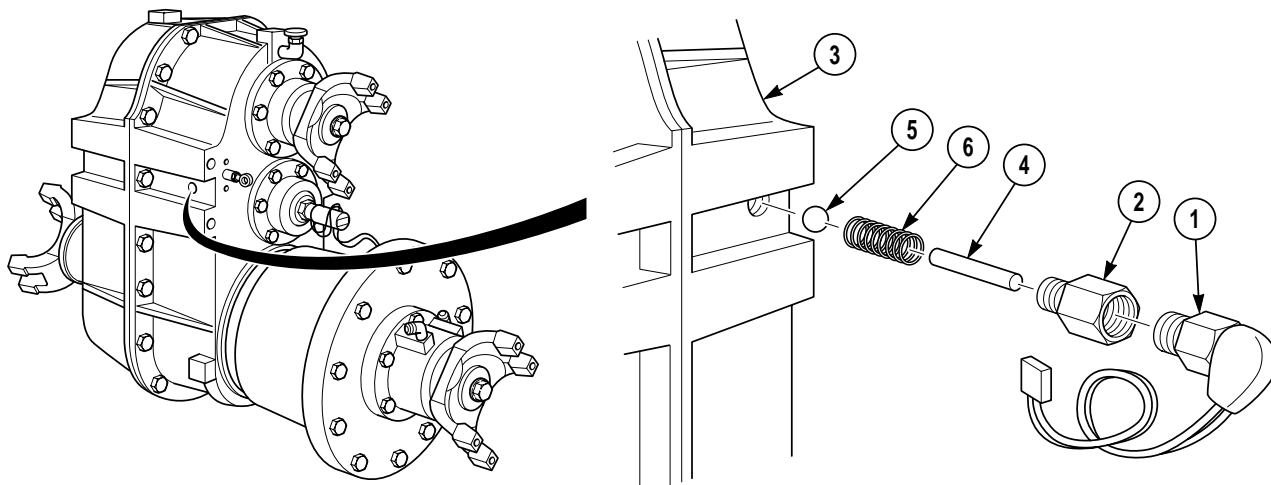
Cloth, Cleaning (Item 11, Appendix B)  
Sealing Compound (Item 53, Appendix B)

#### *Materials/Parts-Continued*

Ball (Item 2, Appendix E)  
Spring (Item 662, Appendix E)

#### *Equipment Condition*

Shift connector removed, (Para 24-4)



### a. Removal.

#### **CAUTION**

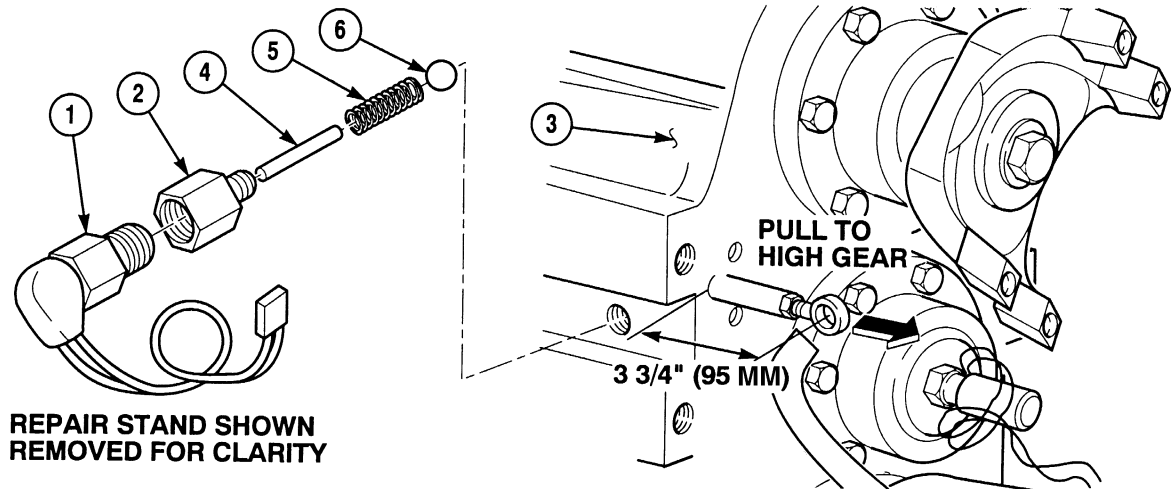
Use extreme care when removing neutral start switch and adapter to avoid damage to start switch.

- (1) Remove neutral start switch (1) from adapter (2).
- (2) Remove adapter (2) from housing (3).

#### **NOTE**

Rod and spring may come out with adapter or stay with housing.

- (3) Remove rod (4), spring (5) and ball (6) from housing (3). Discard spring and ball.

**b. Installation.****NOTE**

Ensure that transfer case is in high gear.

- (1) Install ball (6), spring (5) and rod (4) in housing (3).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (2) Coat threads of neutral start switch (1) and male threads of adapter (2) with sealing compound.

**CAUTION**

Do not overtighten neutral start switch or damage to switch could occur.

- (3) Position adapter (2) in housing (3).
- (4) Install neutral start switch (1) in adapter (2).

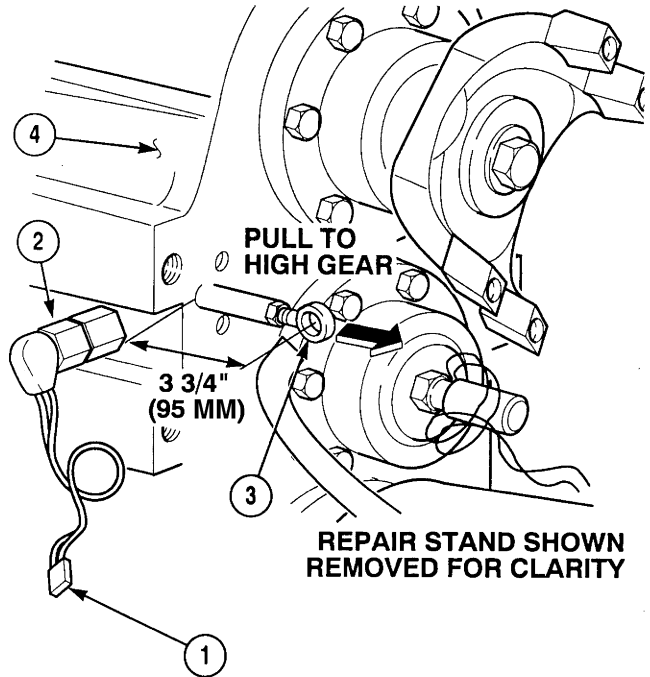
**24-5. NEUTRAL START SWITCH REPLACEMENT (CONT).**

**c. Adjustment.**

**NOTE**

Ensure that transfer case is in high gear.

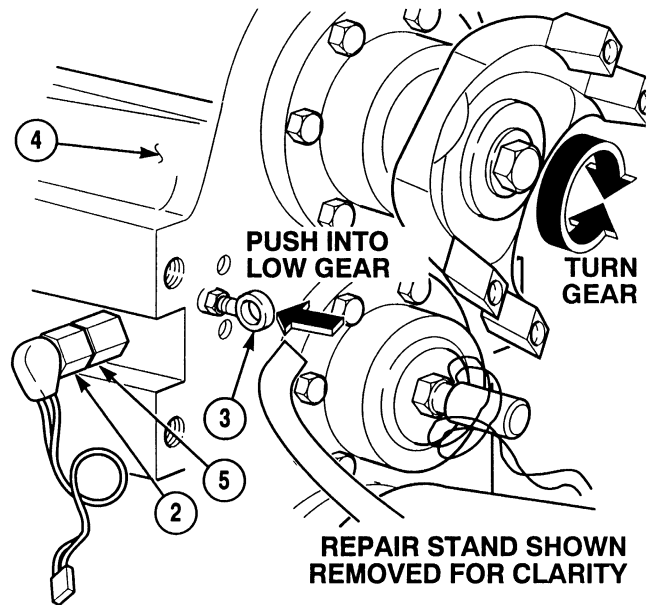
- (1) Insert one multimeter test lead in each socket of neutral start switch connector (1).
- (2) Set multimeter select switch to ohms:
  - (a) If there is no continuity, go to Step (4).
  - (b) If there is continuity, go to Step (3).
- (3) Loosen neutral start switch (2) until circuit tester indicates no continuity. Then, loosen switch 3/4 turn more.



**NOTE**

It may be necessary to turn gear to shift transfer case into low gear in Step (4).

- (4) Shift into low gear by pushing rod end (3) toward housing (4).
  - (a) If multimeter indicates continuity, go to Step (6).
  - (b) If multimeter indicates no continuity, check multimeter connections. If multimeter still shows no continuity, continue with Step (5).
- (5) Tighten neutral start switch (2) and adapter (5) until multimeter indicates continuity. Then, tighten another 3/4 turn.

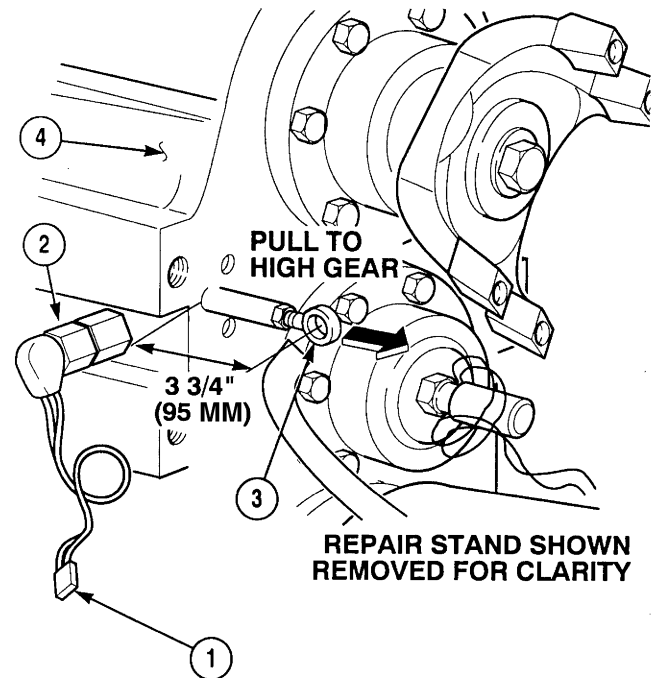


- (6) Shift into high gear again by pulling rod end (3) away from housing (4).
  - (a) If multimeter indicates continuity, repeat Steps (2) through (6).
  - (b) If multimeter does not indicate continuity, go to follow-on maintenance.

**d. Follow-On Maintenance:**

- Install shift connector, (Para 24-4).

**END OF TASK**





**b. Installation.**

**NOTE**

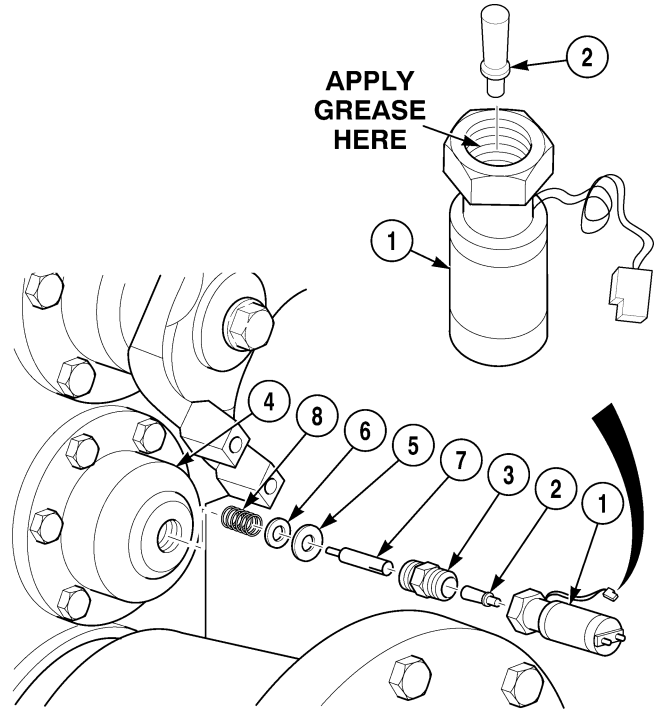
Perform Step (1) only if tang was removed.

- (1) Install tang (2) in sending unit (1).
- (2) Pack inside of sending unit (1) with grease.

**CAUTION**

Use caution when installing parts in bearing cap. Parts can easily fall in transfer case housing. Failure to comply may result in damage to equipment.

- (3) Install speedometer shaft (7), spring (8), washer (6) and thrust bearing (5) as an assembly in bearing cap (4).



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (4) Coat outside threads of sleeve (3) with sealing compound.
- (5) Install sleeve (3) in bearing cap (4).
- (6) Align tang (2) in sending unit (1) with slot in speedometer shaft (7).

**CAUTION**

Do not overtighten sending unit so it moves sleeve, or sending unit could be damaged.

- (7) Install sending unit (1) on sleeve (3).

**c. Follow-On Maintenance:**

- Install neutral start switch, (Para 24-5).

**END OF TASK**

## 24-7. TRANSFER CASE YOKE REPLACEMENT.

This task covers:

- a. Removal
- b. Installation
- c. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Hammer, Hand, Soft Plastic (Item 88,  
Appendix F)  
Wrench Set, Socket, 3/4 in. Drive  
(Item 274, Appendix F)  
Wrench, Torque (0 to 600 lb-ft [0-814 N·m])  
(Item 278, Appendix F)  
Holder, Flange (Appendix C)

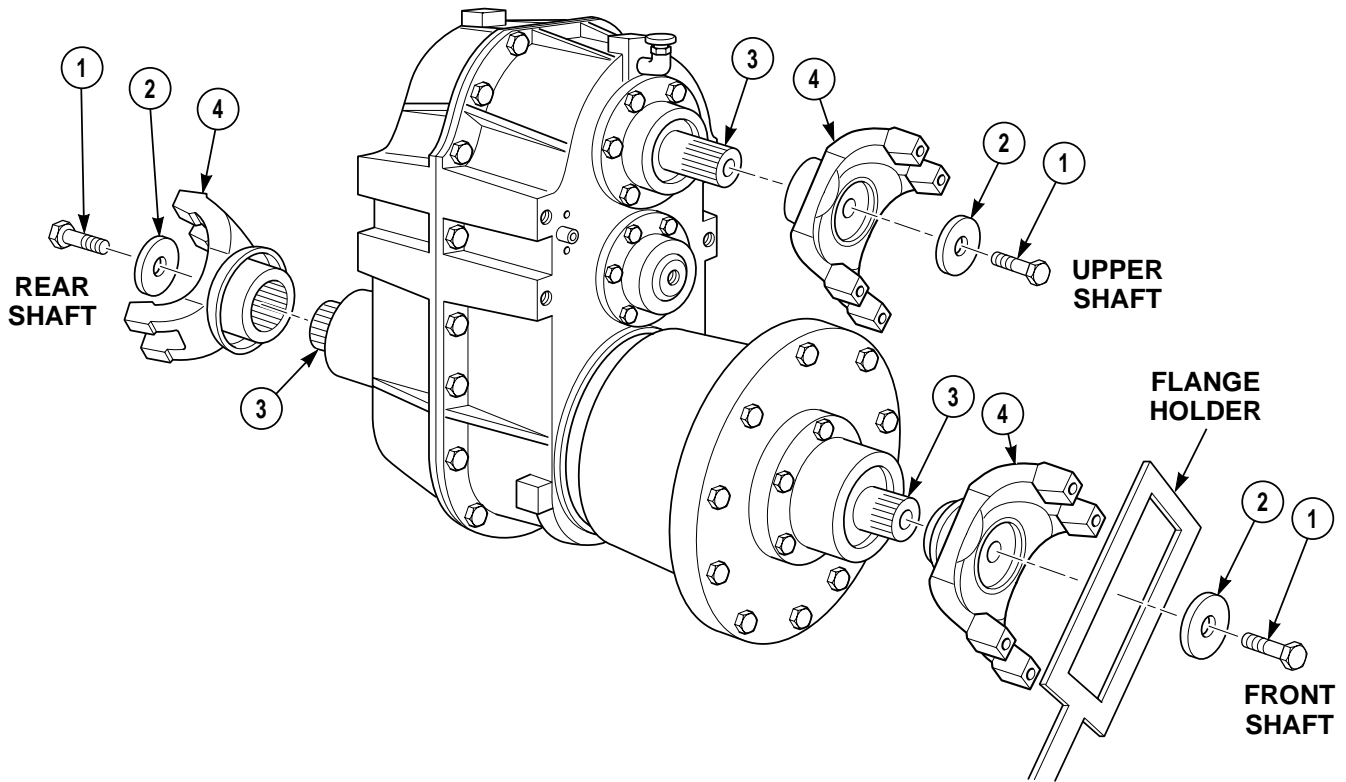
#### *Equipment Condition*

Speedometer sensor removed,  
(Para 24-6)

#### *Materials/Parts*

Adhesive (Item 1, Appendix B)  
Grease (Item 21, Appendix B)  
Sealing Compound (Item 54, Appendix B)  
Tags, Identification (Item 72, Appendix B)

**a. Removal.**



**NOTE**

- This procedure describes removal of yokes from upper shaft assembly, front shaft assembly and rear shaft assembly.
- All three yokes are removed the same way.
- Tag and mark yokes upon removal.

- (1) Using flange holder, remove screw (1) and washer (2) from shaft (3).

**NOTE**

If necessary, use only a soft hammer to remove yoke.

- (2) Remove yoke (4) from shaft (3).



**24-7. TRANSFER CASE YOKE REPLACEMENT (CONT).**

**b. Installation.**

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

**NOTE**

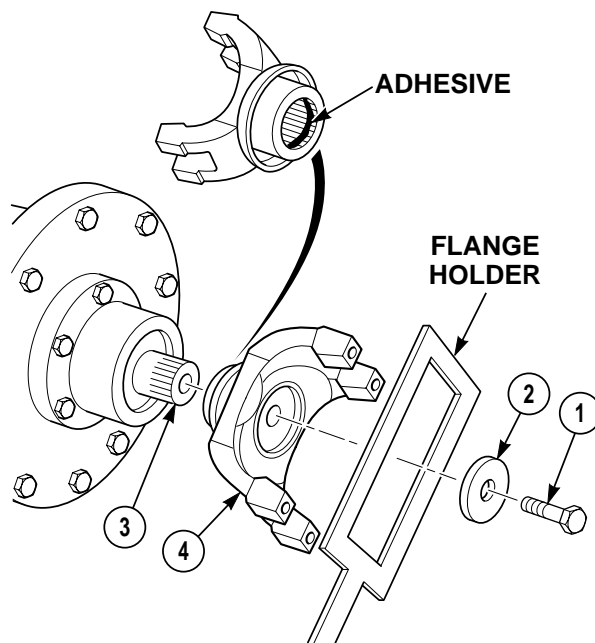
- Ensure splines of yoke and shaft are clean.
- Install yokes as noted prior to removal.

- (1) Apply adhesive to splined surface inside yoke (4).

**NOTE**

It may be necessary to use a soft hammer to install yoke.

- (2) Install yoke (4) on shaft (3).
- (3) Apply sealing compound to threads in center of shaft (3).
- (4) Coat end of shaft (3) with adhesive.
- (5) Install washer (2) on screw (1).
- (6) Apply sealing compound to threads of screw (1).
- (7) Position washer (2) on shaft (3) with screw (1).
- (8) Position flange holder on yoke (4).
- (9) Tighten screw (1) on yoke (4) to 375 lb-ft (509 N·m).
- (10) Remove flange holder from yoke (4).



**c. Follow-On Maintenance:**

- Install speedometer sensor, (Para 24-6).

**END OF TASK**

## 24-8. TRANSFER CASE ASSEMBLY REPAIR.

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/Inspection | d. Follow-on Maintenance |

### INITIAL SETUP

#### Tools and Special Tools

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Eyes, Lifting (Item 58, Appendix F)  
Eyes, Lifting (Item 59, Appendix F)  
Eyes, Lifting (Item 60, Appendix F)  
Indicator, Dial, Set w/Magnetic Base  
(Item 98, Appendix F)  
Micrometer, Outside, Caliper, Set  
(Item 139, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)  
Wrench, Crowsfoot, 9/16 in., 3/8 in. Drive  
(Item 269, Appendix F)  
Wrench Set, Socket, 3/4 in. Drive  
(Item 274, Appendix F)  
Wrench, Torque (0 to 60 N·m)  
(Item 276, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Lifting Device Minimum Capacity 300 lbs  
(136 kg)

#### Materials/Parts

Grease (Item 26, Appendix B)  
Oil, Lubricating (Item 36, Appendix B)  
Sealing Compound (Item 53, Appendix B)  
Sealing Compound (Item 54, Appendix B)

#### Materials/Parts - Continued

Sealing Compound (Item 56, Appendix B)  
Sealing Compound (Item 65, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Tags, Identification (Item 72, Appendix B)  
Ball (2) (Item 2, Appendix E)  
Locknut (Item 197, Appendix E)  
Lockwasher (2) (Item 251, Appendix E)  
Lockwasher (2) (Item 255, Appendix E)  
Lockwasher (48) (Item 266, Appendix E)  
Packing, Preformed (Item 360, Appendix E)  
Ring, Piston (Item 484, Appendix E)  
Seal, Oil (Item 585, Appendix E)  
Seal, Oil (Item 597, Appendix E)  
Spring (2) (Item 662, Appendix E)  
Washer (2) (Item 688, Appendix E)

#### Equipment Condition

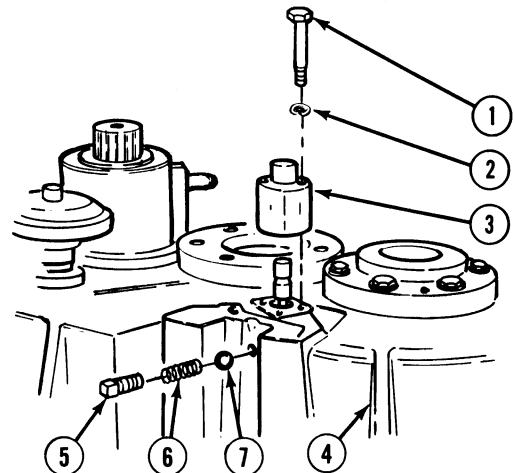
Transfer case installed on stand, (Para 24-2)  
Lubrication hoses removed, (Para 24-3)  
Shift connector removed, (Para 24-4)  
Neutral start switch removed, (Para 24-5)  
Speedometer sensor removed, (Para 24-6)  
Yokes removed, (Para 24-7)  
Lubrication pump removed, (Para 8-5)  
Emergency steering pump removed, (Para 12-12)

### a. Disassembly.

#### NOTE

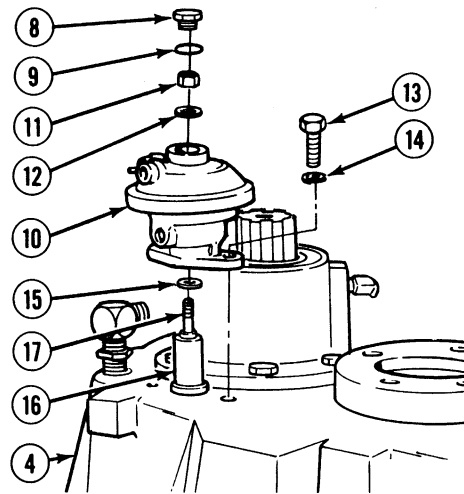
Tag and mark screws, dowels and bearing cups during removal.

- (1) Remove two screws (1), lockwashers (2) and upper shift rod cover (3) from rear housing (4). Discard lockwashers.
- (2) Remove pipe plug (5), spring (6) and ball (7) from rear housing (4). Discard spring and ball.



**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**

- (3) Remove cap nut (8) and preformed packing (9) from top of air chamber (10). Discard preformed packing.
- (4) Remove and discard locknut (11) and washer (12) from inside top of air chamber (10).
- (5) Remove two screws (13) and lockwashers (14) from base of air chamber (10). Discard lockwashers.
- (6) Remove air chamber (10) from rear housing (4).
- (7) Remove and discard washer (15) from end of shift rod (16).



**NOTE**

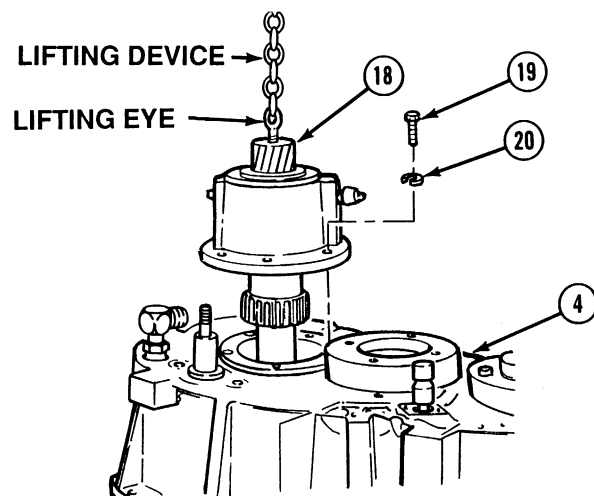
Perform Step (8) only if stud is damaged.

- (8) Remove stud (17) from shift rod (16).

**WARNING**

Rear shaft assembly weighs 100 lbs (45 kg). Attach suitable lifting device to prevent possible injury to personnel.

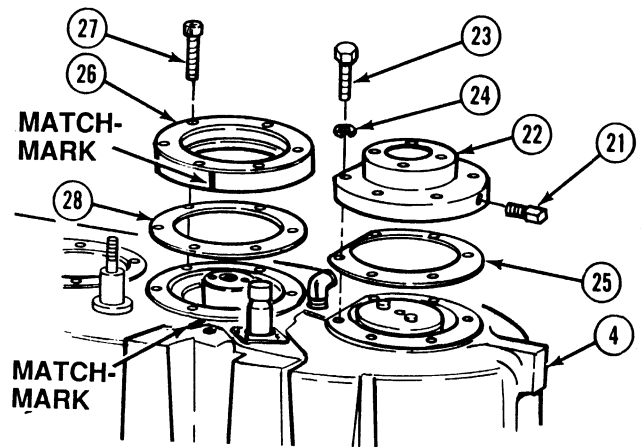
- (9) Attach lifting eye and lifting device on center of rear shaft assembly (18).
- (10) Remove six screws (19) and lockwashers (20) from rear shaft assembly (18). Discard lockwashers.
- (11) Using lifting device and lifting eye, remove rear shaft assembly (18) from rear housing (4).
- (12) Remove lifting device and lifting eye from rear shaft assembly (18).



**NOTE**

Perform Step (13) only if pipe plug is damaged.

- (13) Remove pipe plug (21) from bearing cap (22).
- (14) Remove six screws (23) and lockwashers (24) from bearing cap (22).
- (15) Remove bearing cap (22) from rear housing (4).



**NOTE**

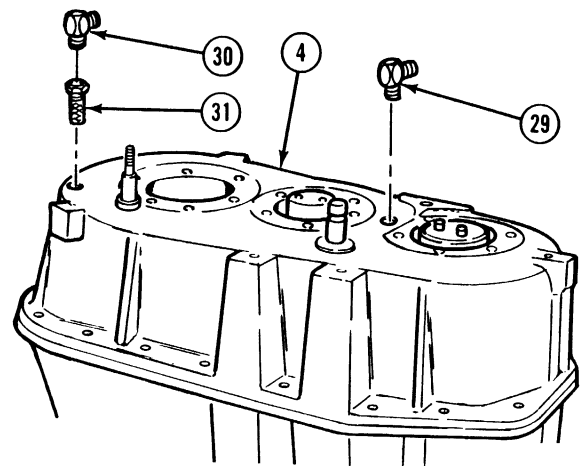
- Shims may come off with bearing cap or stay with rear housing.
- Note and record thickness of shims.

- (16) Remove shims (25) from rear housing (4) or from bearing cap (22).
- (17) Matchmark adapter plate (26) and rear housing (4).
- (18) Remove six screws (27) from adapter plate (26).
- (19) Remove adapter plate (26) from rear housing (4).

**NOTE**

Shims may come off with adapter plate or stay with rear housing.

- (20) Remove shims (28) from adapter plate (26) or rear housing (4).
- (21) Remove fitting (29) from rear housing (4).
- (22) Remove fitting (30) and strainer (31) from rear housing (4).



**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**

- (23) Remove 18 screws (32) from flange of front housing (33).
- (24) Position two screws (32) from Step (23) in half jackscrew holes at each end of front housing (33).
- (25) Tighten two screws (32) from Step (23) to break seal between front housing (33) and rear housing (4).
- (26) Attach three lifting eyes and lifting device to rear housing (4).

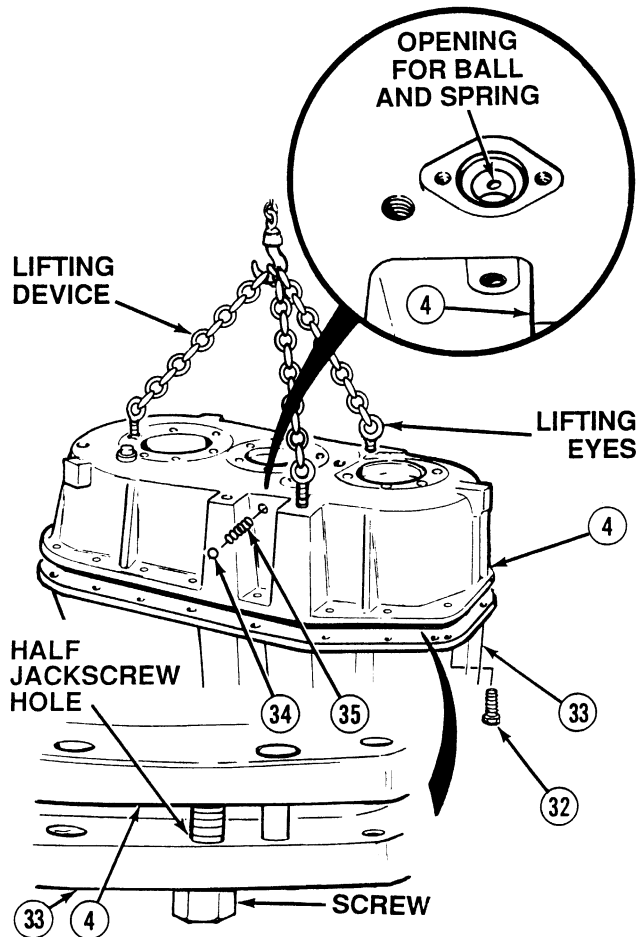
**WARNING**

Rear housing weighs 210 lbs (95 kg). Attach suitable lifting device before removal to prevent possible injury to personnel.

**CAUTION**

- Lift rear housing straight up to prevent damage to upper and lower shift rods.
- As rear housing is lifted, ball and spring retained in rear housing for upper shift rod may fall out. Be careful to prevent loss of these parts.

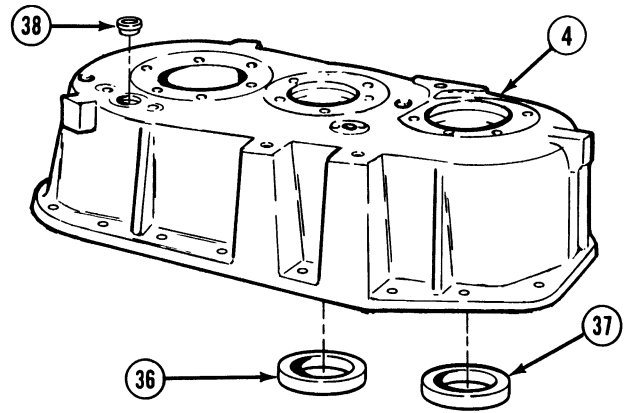
- (27) Remove rear housing (4) from front housing (33).
- (28) Remove and discard ball (34) and spring (35) from rear housing (4).
- (29) Remove two screws (32) from half jackscrew holes.
- (30) Remove three lifting eyes and lifting device from rear housing (4).



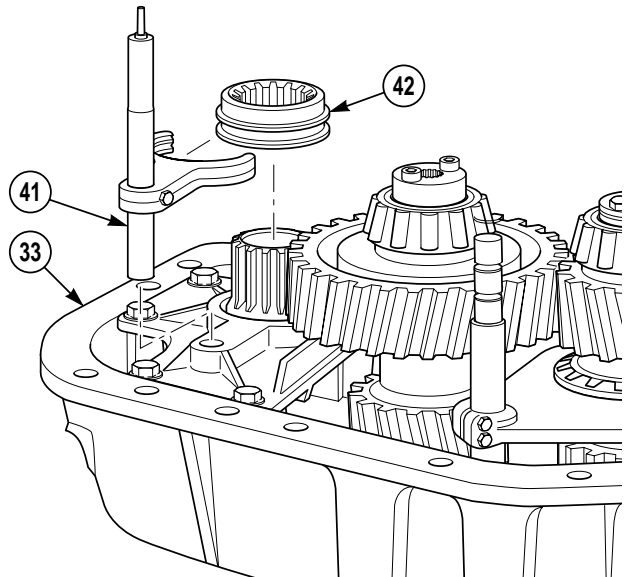
**NOTE**

Tag and mark each bearing cup prior to removal.

- (31) Remove bearing cups (36) and (37) and pilot ring (38) from rear housing (4).



- (32) Remove lower shift fork assembly (41) and clutch collar (42) from front housing (33).

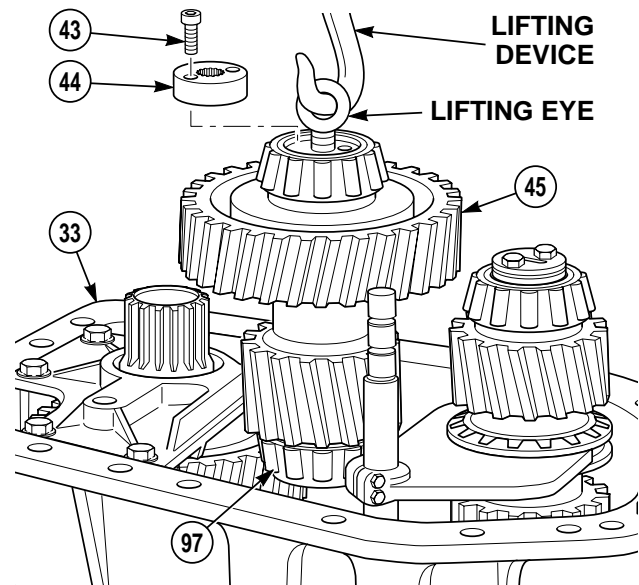


**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**

**WARNING**

Center shaft assembly weighs 145 lbs (66 kg). Attach suitable lifting device before removal to prevent possible injury to personnel.

- (33) Remove two screws (43) and plate (44) from center shaft assembly (45).
- (34) Attach lifting eye and lifting device in end of center shaft assembly (45).
- (35) Remove center shaft assembly (45) from front housing (33).
- (36) Remove two screws (46) and plate (47) from upper shaft assembly (48).
- (37) Remove and discard piston ring (49).
- (38) Attach lifting eye and lifting device in end of upper shaft assembly (48).



**WARNING**

Upper shaft assembly weighs 115 lbs (52 kg). Attach suitable lifting device before removal to prevent possible injury to personnel.

**CAUTION**

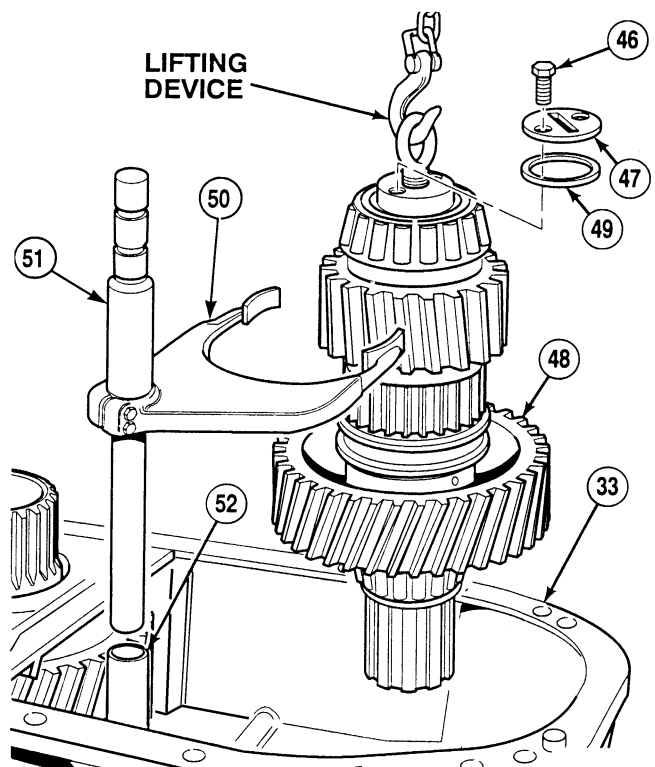
Lift straight up to prevent damage to upper shift fork assembly.

- (39) Using lifting device, remove upper shaft assembly (48) and upper shift fork assembly (50) from front housing (33).

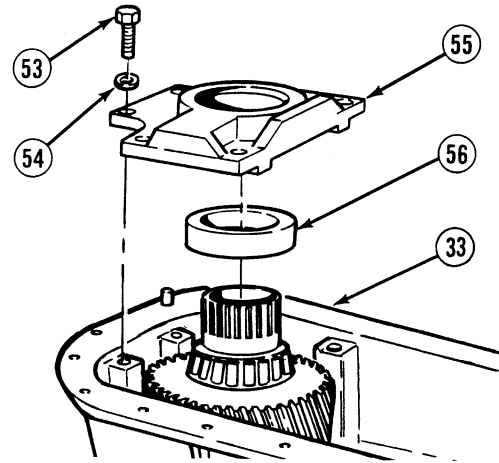
**NOTE**

Spacers may come off with fork assembly or stay with front housing.

- (40) Remove spacers (51) and (52) from upper shift fork assembly (50) or front housing (33).
- (41) Remove lifting device and lifting eye from upper shaft assembly (48).



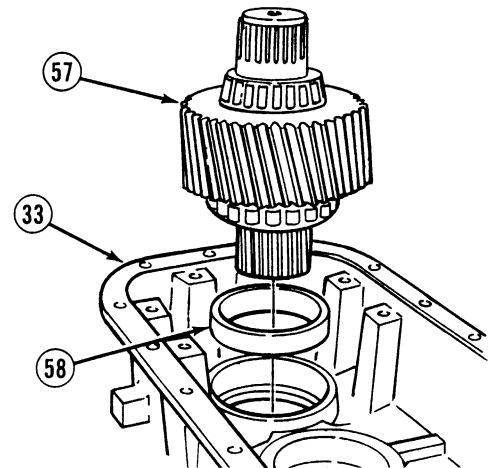
- (42) Remove six screws (53) and washers (54) from bearing support (55).
- (43) Remove bearing support (55) from front housing (33).
- (44) Remove bearing cup (56) from bearing support (55).



**WARNING**

Differential shaft assembly weighs 100 lbs (45 kg). Use an assistant during removal to prevent possible injury to personnel.

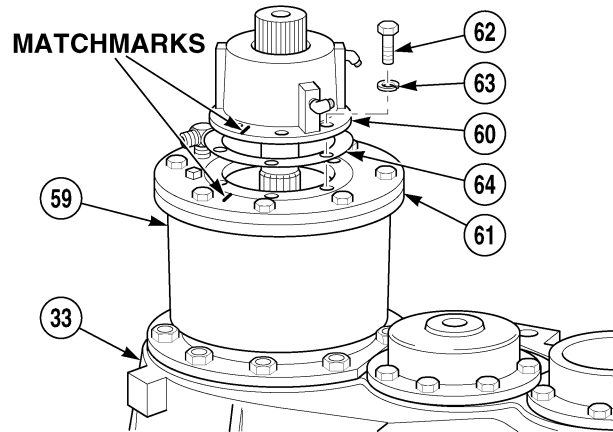
- (45) With the aid of an assistant, remove differential shaft assembly (57) and bearing cup (58) from front housing (33).





**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**

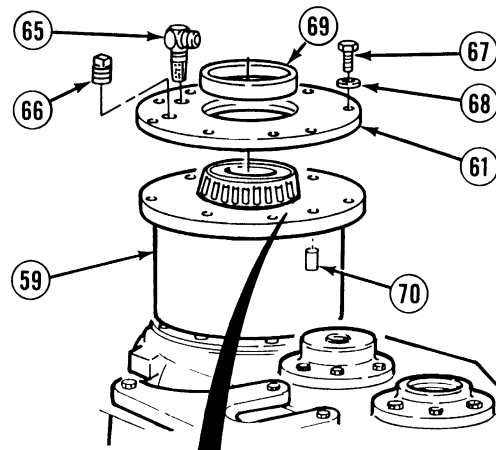
- (46) Rotate front housing (33) until differential housing (59) is on top.
- (47) Matchmark front shaft assembly (60) and cover enclosure (61).
- (48) Remove six screws (62) and lockwashers (63) and front shaft assembly (60) from differential housing (59). Discard lockwashers.



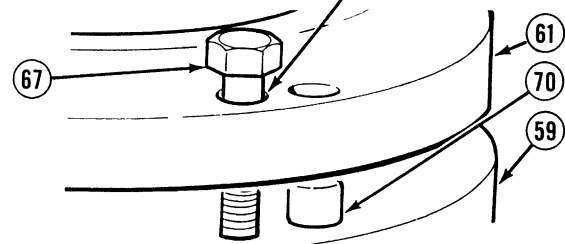
**NOTE**

Note and record thickness of shims.

- (49) Remove shims (64) from cover enclosure (61).
- (50) Remove strainer assembly (65) and pipe plug (66) from cover enclosure (61).
- (51) Remove ten screws (67) and lockwashers (68) from cover enclosure (61). Discard lockwashers.
- (52) Position two screws (67) into half jackscrew holes in cover enclosure (61).
- (53) Tighten screws to break seal between cover enclosure (61) and differential housing (59).
- (54) Remove two screws (67) from cover enclosure (61).
- (55) Remove cover enclosure (61) from differential housing (59).
- (56) Remove bearing cup (69) from cover enclosure (61).



**HALF JACKSCREW HOLE**



**NOTE**

Perform Step (57) only if dowel pin is damaged.

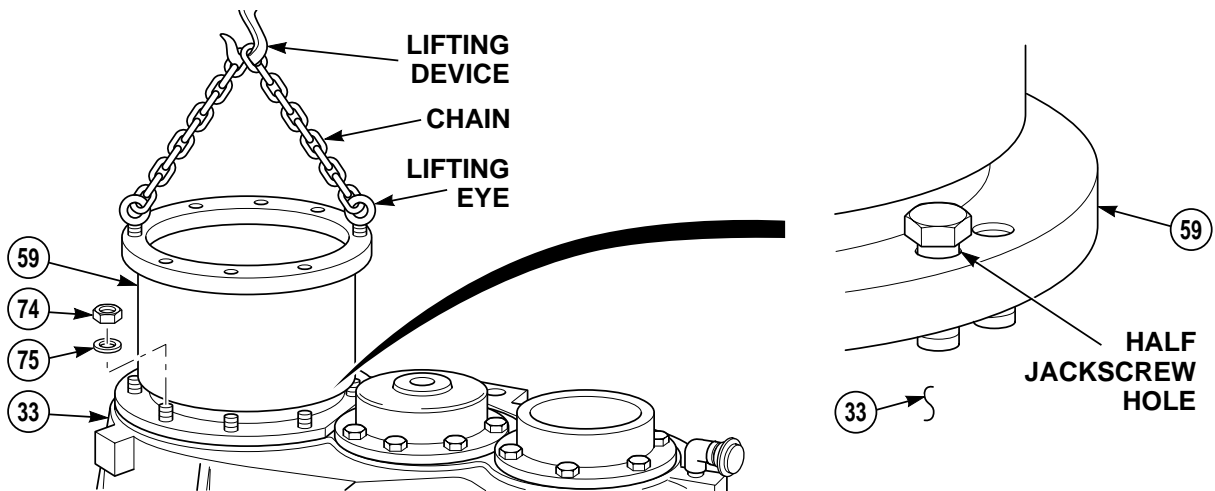
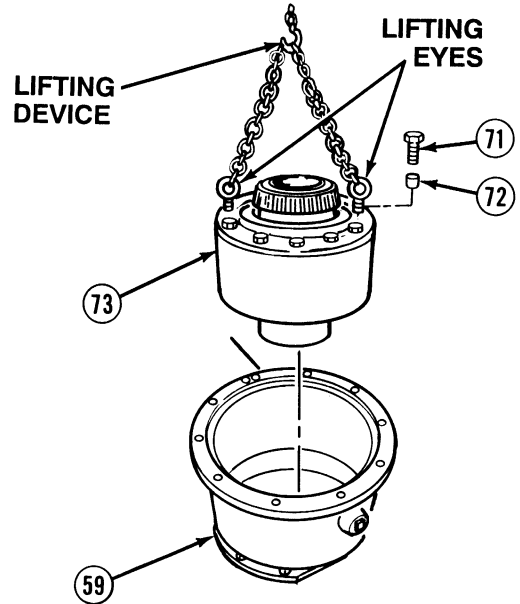
- (57) Remove dowel pin (70) from differential housing (59).

- (58) Remove two screws (71) and taper dowels (72) from planetary differential assembly (73).

**WARNING**

Planetary differential assembly weighs 160 lbs (73 kg). Attach suitable lifting device before removal to prevent possible injury to personnel.

- (59) Attach two lifting eyes and lifting device to planetary differential assembly (73).
- (60) Using lifting device, remove planetary differential assembly (73) from differential housing (59).



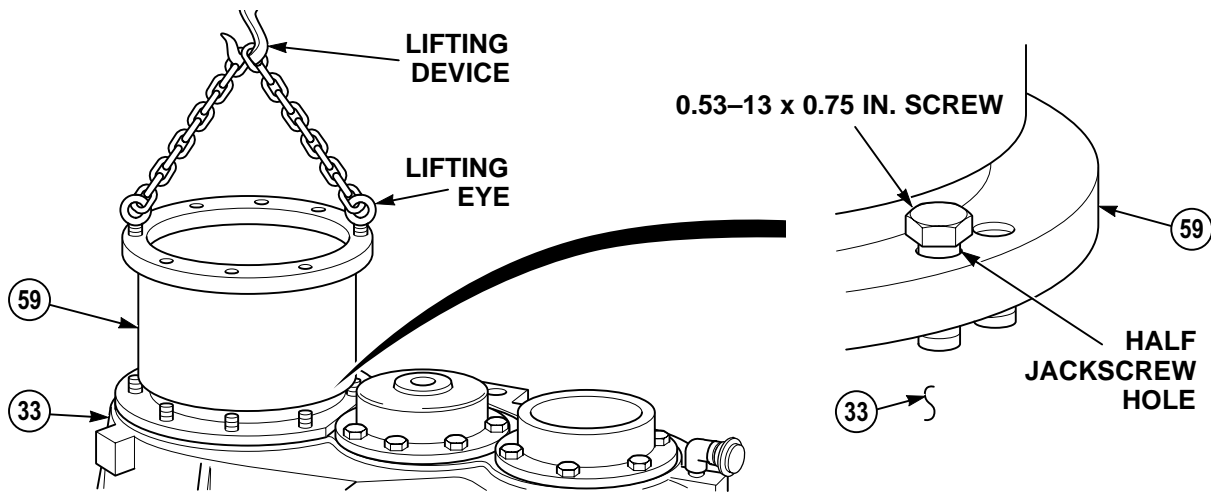
- (61) Remove eight nuts (74) and lockwashers (75) from base of differential housing (59). Discard lockwashers.
- (62) Attach two lifting eyes and lifting device to upper flange of differential housing (59).

**NOTE**

Screws used in Step (63) must be 0.50-13 x 0.75 in.

- (63) Install two screws into half jackscrew holes in bottom of differential housing (59).

**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**



- (64) Tighten screws to break seal between differential housing (59) and front housing (33).

**WARNING**

Differential housing weighs 90 lbs (41 kg). Attach suitable lifting device before removal to prevent possible injury to personnel.

**CAUTION**

Use extreme care to ensure that machined surfaces of differential housing and front housing are not damaged. To prevent damage, use two pry bars. Apply same amount of pressure to both pry bars at same time.

- (65) Using lifting device, remove differential housing (59) from front housing (33).  
(66) Remove lifting device and lifting eyes from differential housing (59).

**NOTE**

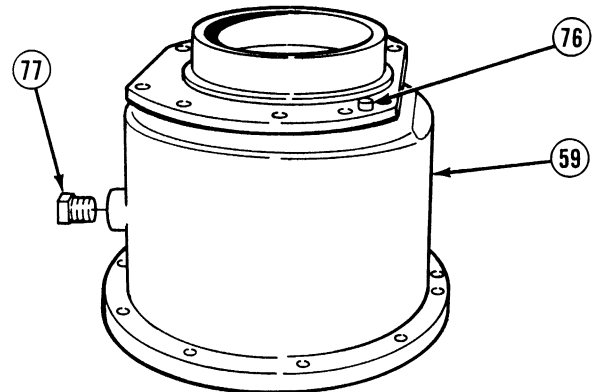
Perform Step (67) only if dowel is damaged.

- (67) Remove dowel (76) from differential housing (59).

**NOTE**

Perform Step (68) only if pipe plug is damaged.

- (68) Remove pipe plug (77) from differential housing (59).



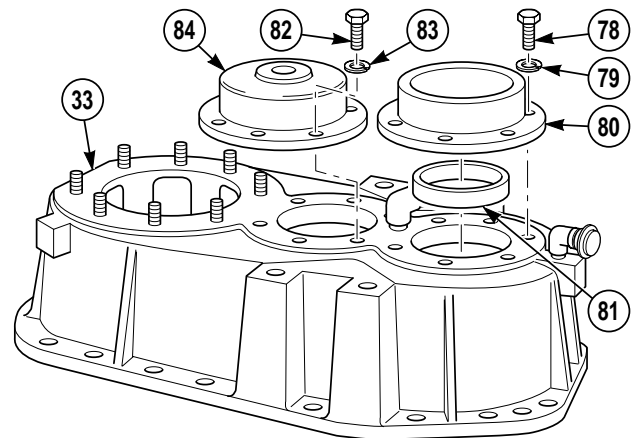
- (69) Remove six screws (78) and lockwashers (79) from bearing cap (80). Discard lockwashers.

- (70) Remove bearing cap (80) from front housing (33).

- (71) Remove and discard oil seal (81) from bearing cap (80).

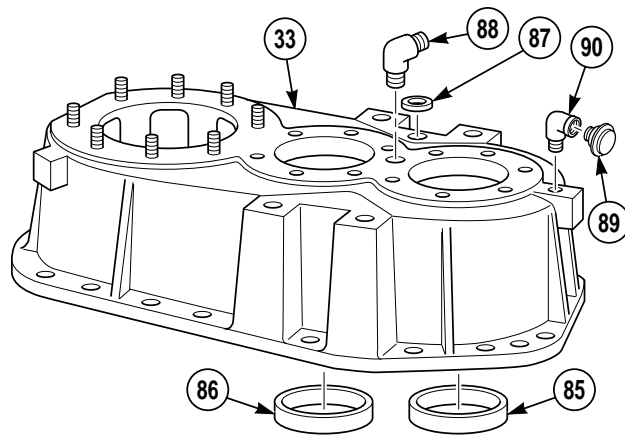
- (72) Remove six screws (82) and lockwashers (83) from bearing cap (84). Discard lockwashers.

- (73) Remove bearing cap (84) from front housing (33).



**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT.)**

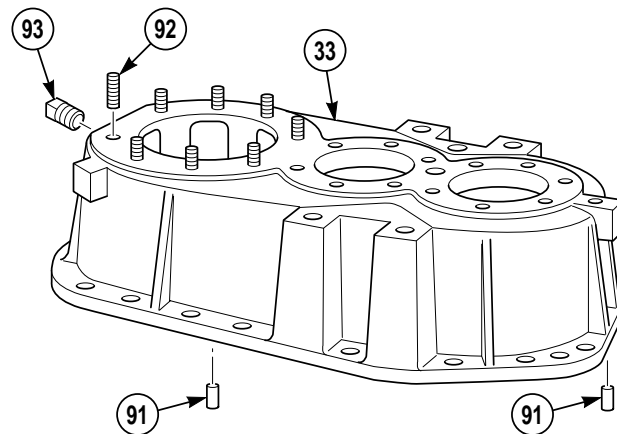
- (74) Remove bearing cup (85) from front housing (33).
- (75) Remove bearing cup (86) from front housing (33).
- (76) Remove and discard oil seal (87) from front housing (33).
- (77) Remove fitting (88) from front housing (33).
- (78) Remove breather (89) and fitting (90) from front housing (33).



**NOTE**

Perform Steps (80) through (82) only if dowels, studs and/or pipe plug are damaged.

- (79) Remove two dowel pins (91) from front housing (33).
- (80) Remove eight studs (92) from front housing (33).
- (81) Remove pipe plug (93) from front housing (33).



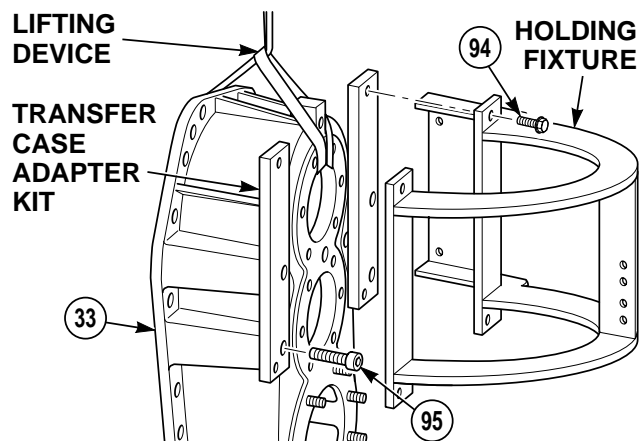
**WARNING**

Front housing weighs 200 lbs (91 kg). Attach suitable lifting device before removal to prevent possible injury to personnel.

**NOTE**

Perform Steps (83) through (86) if front housing is damaged.

- (82) Install lifting device on front housing (33).
- (83) Remove four screws (94) from holding fixture and remove front housing (33) from holding fixture.
- (84) Remove lifting device from front housing (33).
- (85) Remove four socket head screws (95) and transfer case adapter kit from front housing (33).



**b. Cleaning/Inspection.****WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 with drycleaning solvent and allow to air dry.
  - (2) Inspect all components for wear, cracks, warpage, chips, gouges and stripped threads.
  - (3) Replace damaged components.

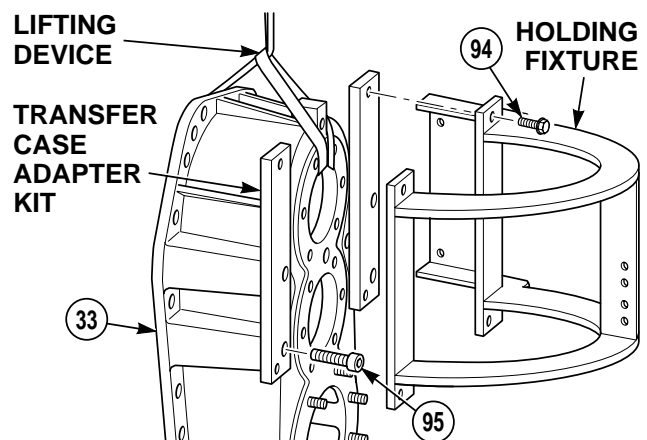
**c. Assembly.****WARNING**

Front housing weighs 200 lbs (91 kg). Attach suitable lifting device before removal to prevent possible injury to personnel.

**NOTE**

Perform Steps (1) through (4) only if front housing was removed.

- (1) Install transfer case adapter kit on front housing (33) with four socket head screws (95).
- (2) Install lifting device on front housing (33).
- (3) Install front housing (33) and transfer case adapter kit on holding fixture with four screws (94).
- (4) Remove lifting device from front housing (33).



**24-8. TRANSFER CASE ASSEMBLY 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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

**NOTE**

Perform Steps (5) and (6) only if pipe plug was removed.

- (5) Coat threads of pipe plug (93) with sealing compound.
- (6) Install pipe plug (93) in front housing (33).

**NOTE**

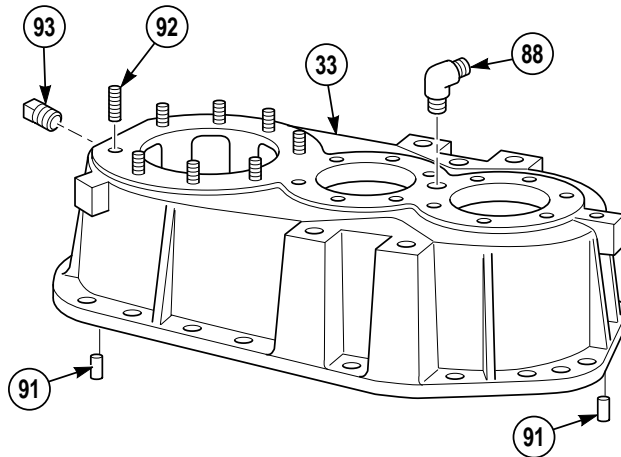
Perform Step (6) if dowel pins were removed.

- (7) Install two dowel pins (91) in front housing (33).

**NOTE**

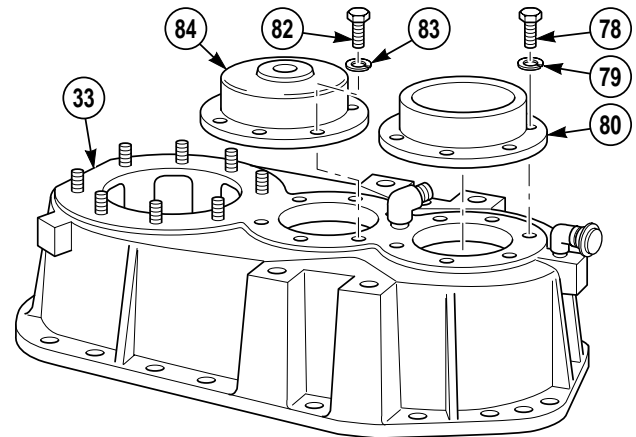
Perform Steps (8) and (9) if studs were removed.

- (8) Coat threads of eight studs (92) with sealing compound.
- (9) Install eight studs (92) in front housing (33).
- (10) Coat threads of fitting (88) with sealing compound.
- (11) Install fitting (88) in front housing (33).



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

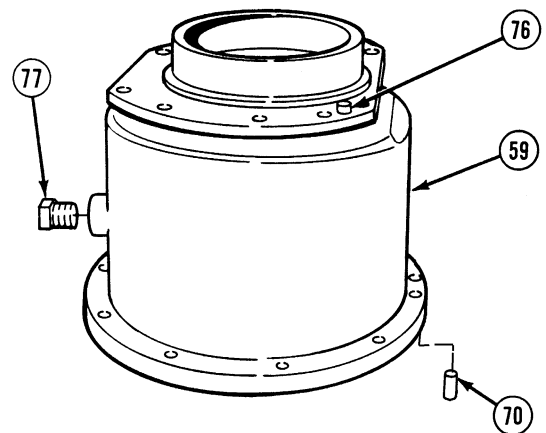


- (12) Apply sealing compound on front housing (33) around openings for bearing cap (84) and bearing cap (80).
- (13) Coat threads of 12 screws (82) and (78) with sealing compound.
- (14) Install bearing cap (84) on front housing (33) with six lockwashers (83) and screws (82). Tighten screws to 60 lb-ft (81 N·m).
- (15) Install bearing cap (80) on front housing (33) with six lockwashers (79) and screws (78). Tighten screws to 60 lb-ft (81 N·m).

**NOTE**

Perform Steps (16) through (18) if pipe plug or dowel pins were removed.

- (16) Coat threads of pipe plug (77) with sealing compound.
- (17) Install pipe plug (77) in differential housing (59).
- (18) Install two dowels (76) and (70) in differential housing (59).





**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**

**WARNING**

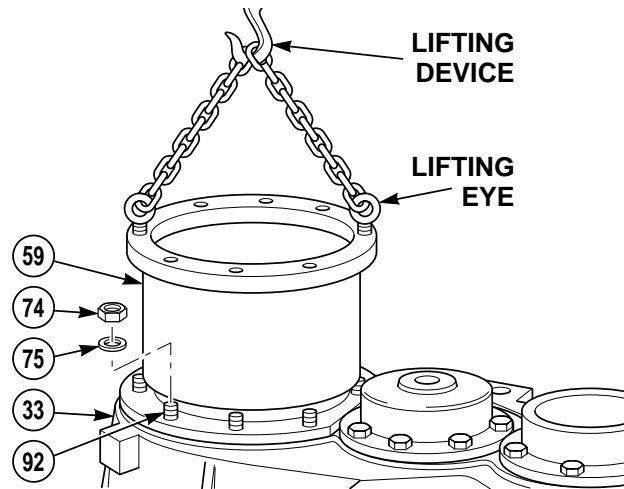
Differential housing weighs 90 lbs (41 kg). Attach suitable lifting device before installation to prevent possible injury to personnel.

- (19) Attach two lifting eyes and lifting device to upper flange of differential housing (59).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

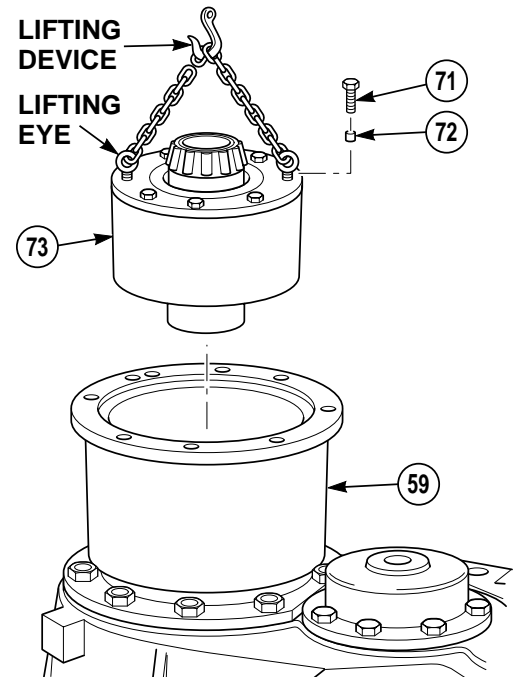
- (20) Apply sealing compound around differential housing mating surface on front housing (33).
- (21) Using lifting device, position differential housing (59) on front housing (33).
- (22) Remove lifting device and two lifting eyes from differential housing (59).
- (23) Coat threads of eight studs (92) with sealing compound.
- (24) Install differential housing (59) on front housing (33) with eight lockwashers (75) and nuts (74).



**WARNING**

Planetary differential assembly weighs 160 lbs (73 kg). Attach suitable lifting device before installation to prevent possible injury to personnel.

- (25) Remove two screws (71) and taper dowels (72) from planetary differential assembly (73).
- (26) Attach two lifting eyes and lifting device to planetary differential assembly (73).
- (27) Using lifting device, position planetary differential assembly (73) in differential housing (59).
- (28) Remove lifting device and lifting eyes from planetary differential assembly (73).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (29) Coat threads of two screws (71) with sealing compound.
- (30) Install two screws (71) and taper dowels (72) in planetary differential assembly (73). Tighten screws to 88 lb-ft (119 N·m).

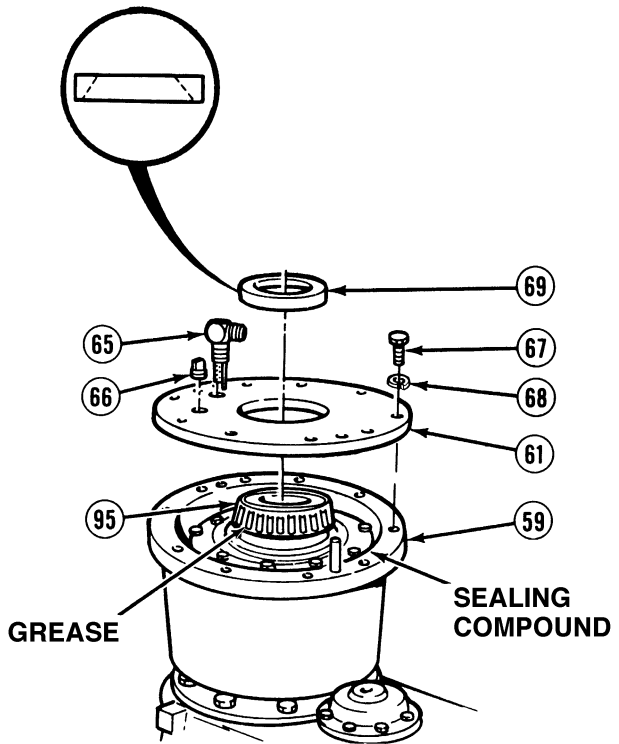
**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**

- (31) Coat bearing (95) with grease.

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (32) Apply sealing compound on flange of differential housing (59).
- (33) Coat threads of ten screws (67) with sealing compound.
- (34) Install cover enclosure (61) with ten lockwashers (68) and screws (67) on differential housing (59). Tighten screws to 60 lb-ft (81 N·m).
- (35) Install bearing cup (69) in cover enclosure (61).
- (36) Coat threads of strainer assembly (65) and pipe plug (66) with sealing compound.
- (37) Install strainer assembly (65) and pipe plug (66) in cover enclosure (61).



**WARNING**

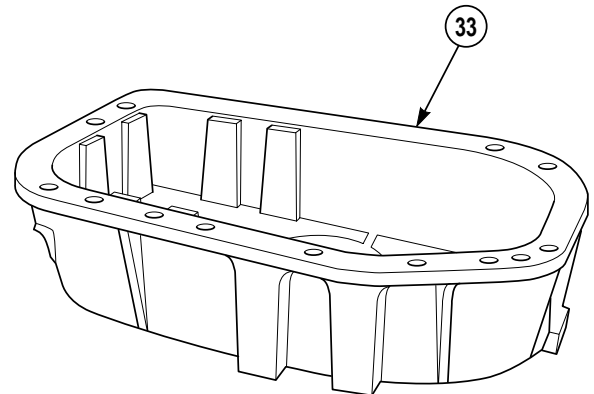
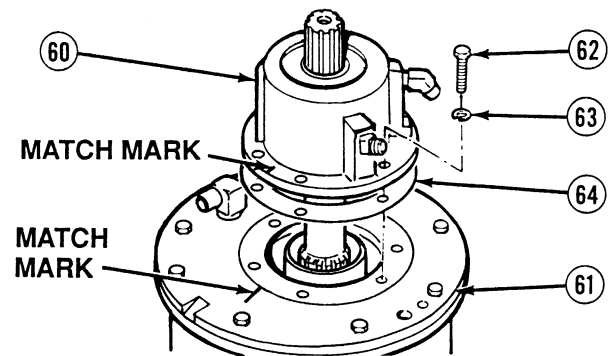
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (38) Apply sealing compound to surface of cover enclosure (61) inside circle made by bolt holes.

**NOTE**

Ensure shims of same thickness, as recorded during removal, are used for installation.

- (39) Coat shims (64) with sealing compound. Position shims on cover enclosure (61).
- (40) Align front shaft assembly (60) on cover enclosure (61). Seat assembly firmly on cover enclosure.
- (41) Coat threads of six screws (62) with sealing compound.
- (42) Install six lockwashers (63) and screws (62) on front shaft assembly (60). Tighten screws to 60 lb-ft (81 N·m).
- (43) Rotate maintenance stand so open side of front housing (33) is facing up.



**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**

**NOTE**

- Outer ring of cylindrical bearing fits loosely.
- Perform Step (44) if outer ring was removed.

- (44) Install bearing cup (58) in differential housing (59) .

**WARNING**

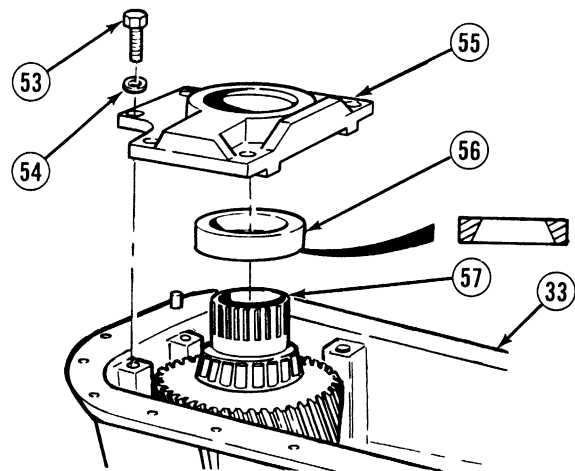
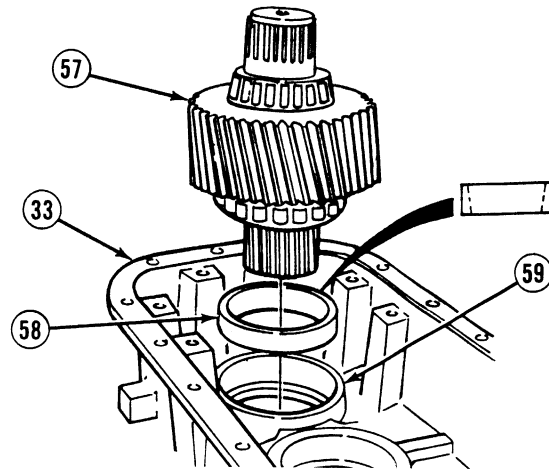
Differential shaft assembly weighs 100 lbs (45 kg). Use an assistant during installation to prevent possible injury to personnel.

- (45) With the aid of an assistant, install differential shaft assembly (57) in front housing (33).
- (46) Install bearing cup (56) in bearing support (55).
- (47) Position bearing support (55) on differential shaft assembly (57).
- (48) Position bearing support (55) in front housing (33).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (49) Coat threads of six screws (53) with sealing compound.
- (50) Install six washers (54) and screws (53) in bearing support (55). Tighten screws to 88 lb-ft (119 N·m).

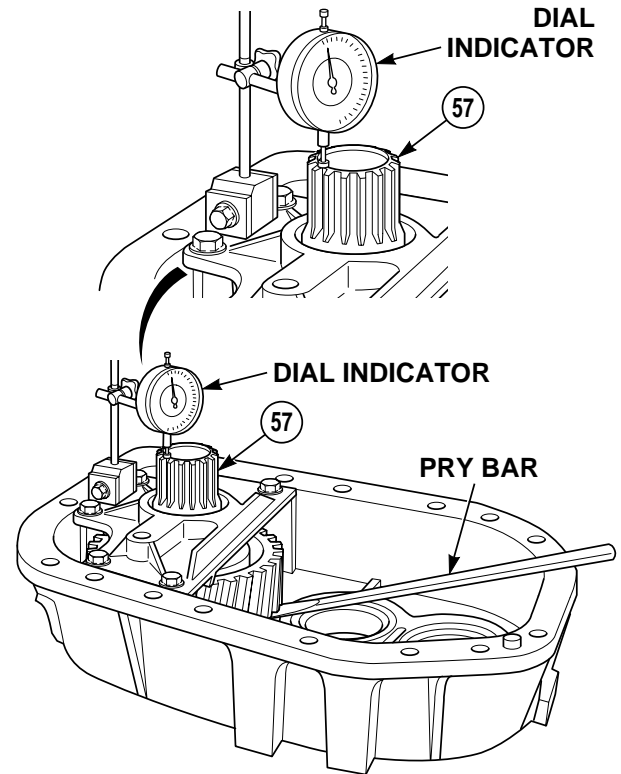


- (51) Position dial indicator on differential shaft assembly (57).
- (52) While using pry bar to lift differential shaft assembly (57) as far as possible, measure end play and record deflection on dial indicator.
- (53) If end play deflection is 0.003 to 0.006 in. (0.076 to 0.152 mm), correct number of shims are installed. Go to Step (62).

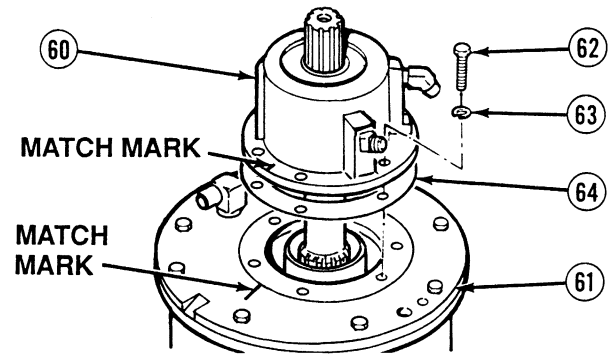
**NOTE**

If deflection is not within specifications, perform Steps (55) through (61).

- (54) If deflection is less than 0.003 in. (0.076 mm), shims must be added below front shaft assembly. If deflection is more than 0.006 in. (0.152 mm), shims must be removed.



- (55) Matchmark front shaft assembly (60) and cover enclosure (61).
- (56) Remove six screws (62) and lockwashers (63) from cover enclosure (61). Discard lockwashers.
- (57) Remove front shaft assembly (60) from cover enclosure (61).
- (58) Remove shims (64) from cover enclosure (61) or front shaft assembly (60).
- (59) Add or remove shims (64) to stack to equal proper thickness.
- (60) Repeat Steps (38) through (42) and install front shaft assembly (60).
- (61) Repeat Steps (50) through (59) and check and adjust end play on differential shaft assembly (57).

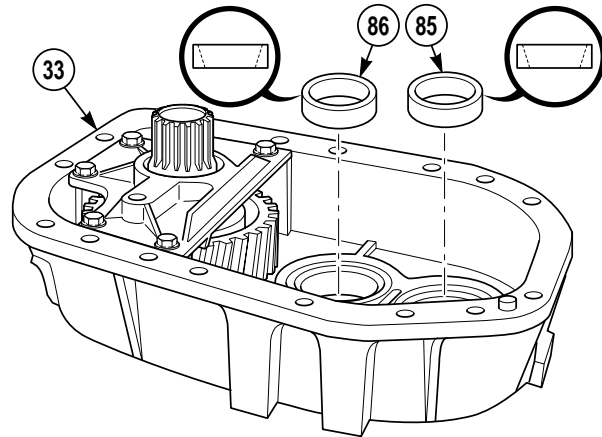


**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**

**NOTE**

Bearing cups may fit loosely.

- (62) Install bearing cups (85) and (86) in front housing (33).

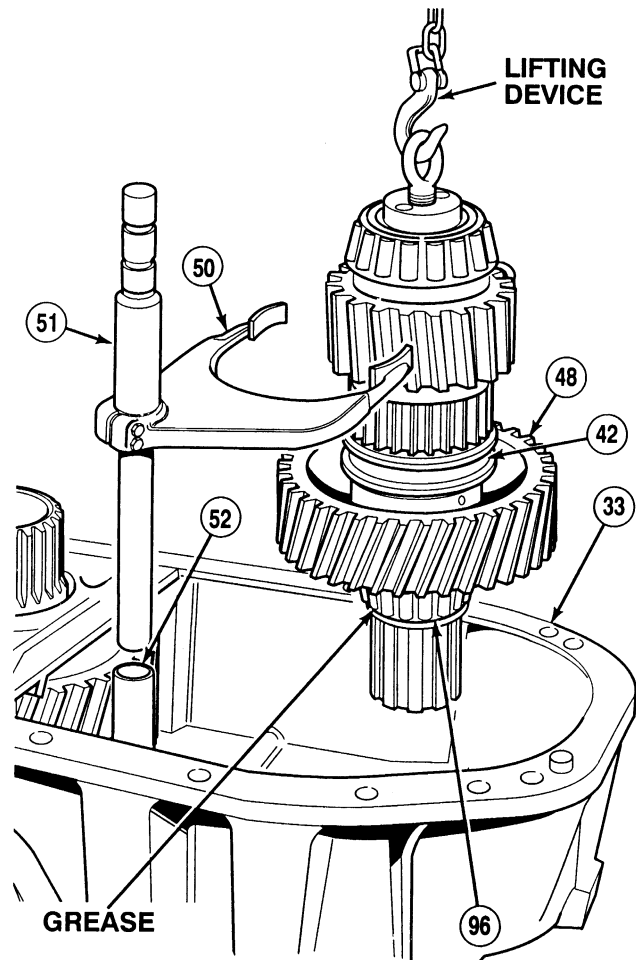


- (63) Install lifting eye and lifting device to upper shaft assembly (48).
- (64) Coat lower bearing (96) on upper shaft assembly (48) with grease.

**NOTE**

Install short spacer on end of shift rod with three grooves.

- (65) Install spacers (51) and (52) on upper shift fork assembly (50).
- (66) Position upper shift fork assembly (50) in clutch collar (42).



**WARNING**

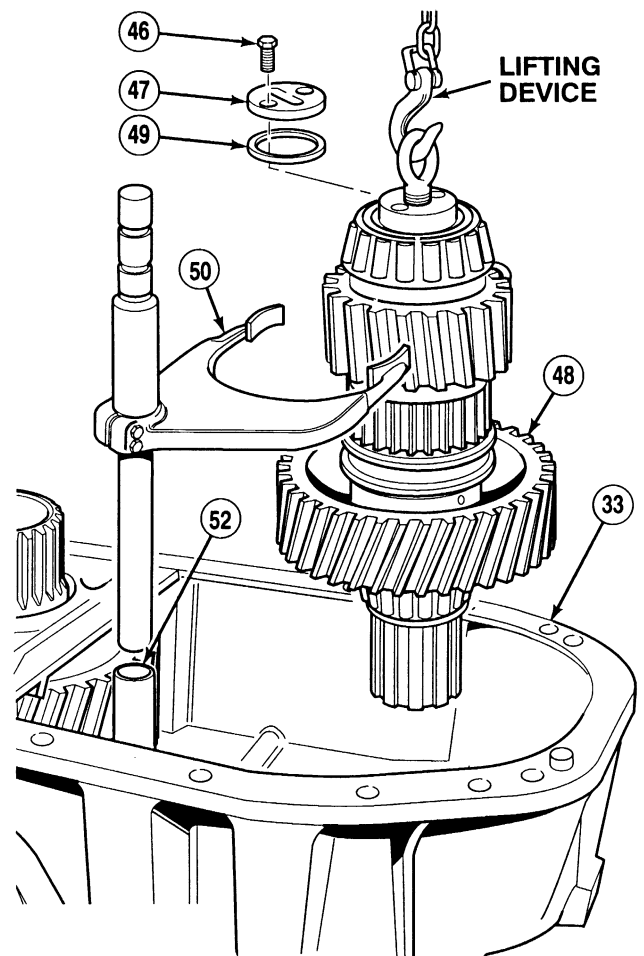
- Upper shaft assembly weighs 115 lbs (52 kg). Attach suitable lifting device before installation to prevent possible injury to personnel.
- To prevent injury to personnel or equipment damage, make sure chains will not slip off shaft assembly during lifting operation.
- Lower straight down to prevent damage to upper shift fork assembly.

- (67) Using lifting device, install upper shift fork assembly (50) and upper shaft assembly (48) in front housing (33).
- (68) Carefully seat upper shaft assembly (48) in front housing (33).
- (69) Remove lifting eye and lifting device from upper shaft assembly (48).
- (70) Install piston ring (49) in plate (47).

**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.

- (71) Apply sealing compound to threads of two screws (46).
- (72) Install plate (47) and two screws (46) in upper shaft assembly (48). Tighten to 88 lb-ft (119 N·m).





**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**

- (73) Attach lifting eye and lifting device to end of center shaft assembly (45).
- (74) Coat lower bearing (97) on center shaft assembly (45) with grease.

**WARNING**

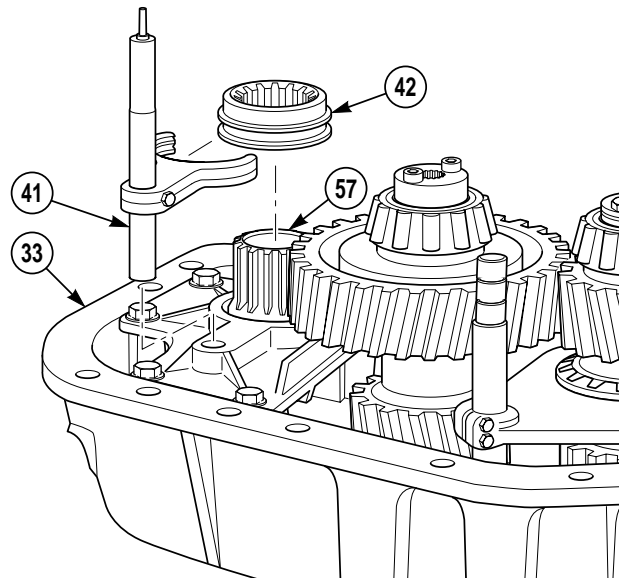
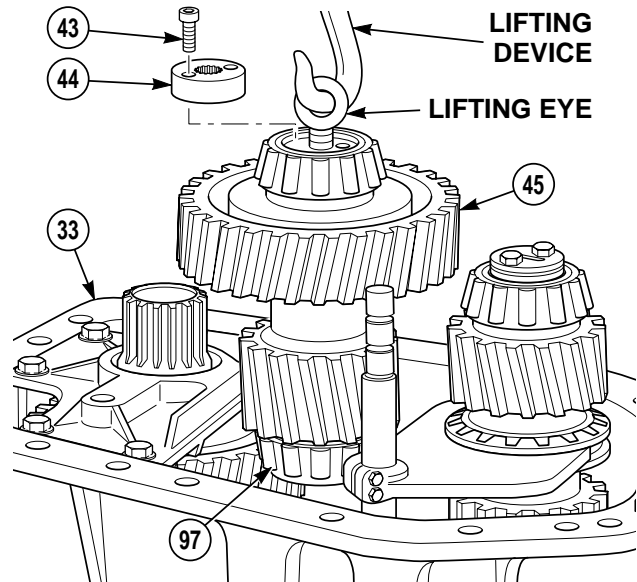
Center shaft assembly weighs 145 lbs (66 kg). Attach suitable lifting device before installation to prevent possible injury to personnel.

- (75) Using lifting device, install center shaft assembly (45) in front housing (33).
- (76) Seat center shaft assembly (45) in front housing (33).
- (77) Remove lifting device and lifting eye from center shaft assembly (45).
- (78) Install plate (44) and two screws (43) on center shaft assembly (45). Tighten to 40 lb- ft (54 N·m).

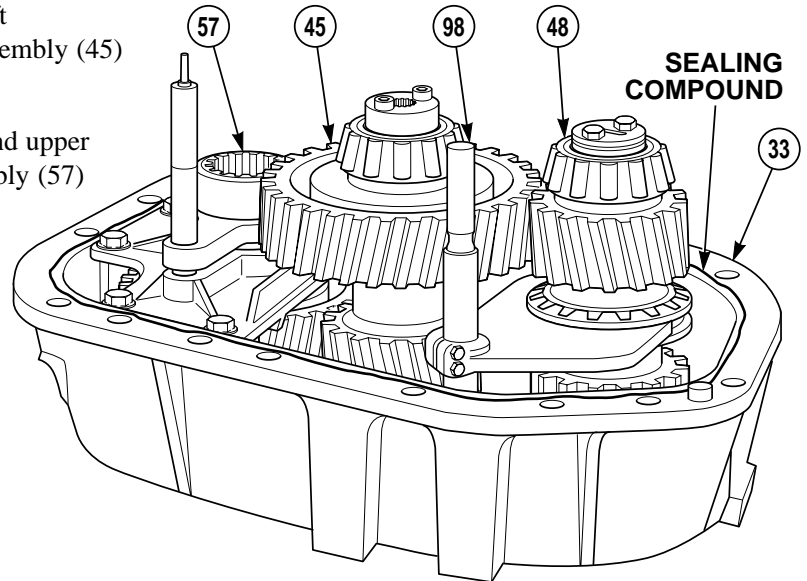
**NOTE**

Long shoulder on clutch collar should be positioned up toward stud on shift rod.

- (79) Coat clutch collar (42) and differential shaft assembly (57) with grease.
- (80) Install lower shift fork assembly (41) and clutch collar (42) in front housing (33) and over differential shaft assembly (57).



- (81) Coat upper bearings on upper shaft assembly (48) and center shaft assembly (45) with grease.
- (82) Coat end of upper shift rod (98) and upper splines on differential shaft assembly (57) with grease.

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (83) Apply sealing compound to flange of front housing (33).

**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**

**WARNING**

Rear housing assembly weighs 210 lbs (95 kg). Attach suitable lifting device before installation to prevent possible injury to personnel.

**NOTE**

- Rear housing should be lowered until upper shift rod enters rod hole in housing. End of rod should not cover opening for ball and spring in rear housing.
- If necessary, turn front shaft to align splines on rear shaft.

- (84) Attach three lifting eyes and lifting device to rear housing (4).
- (85) Using lifting device, lower rear housing (4) on front housing (33) and align on upper shift rod (98) and lower shift fork assembly (41).

**NOTE**

Ball and spring must be compressed in hole to allow installation of shaft rod in transfer case housing.

- (86) Install spring (35) and ball (34) in rear housing (4). Hold spring and ball with small push rod while slowly lowering rear housing. When upper shift rod (98) contacts small push rod, pull small push rod out of rear housing.

**NOTE**

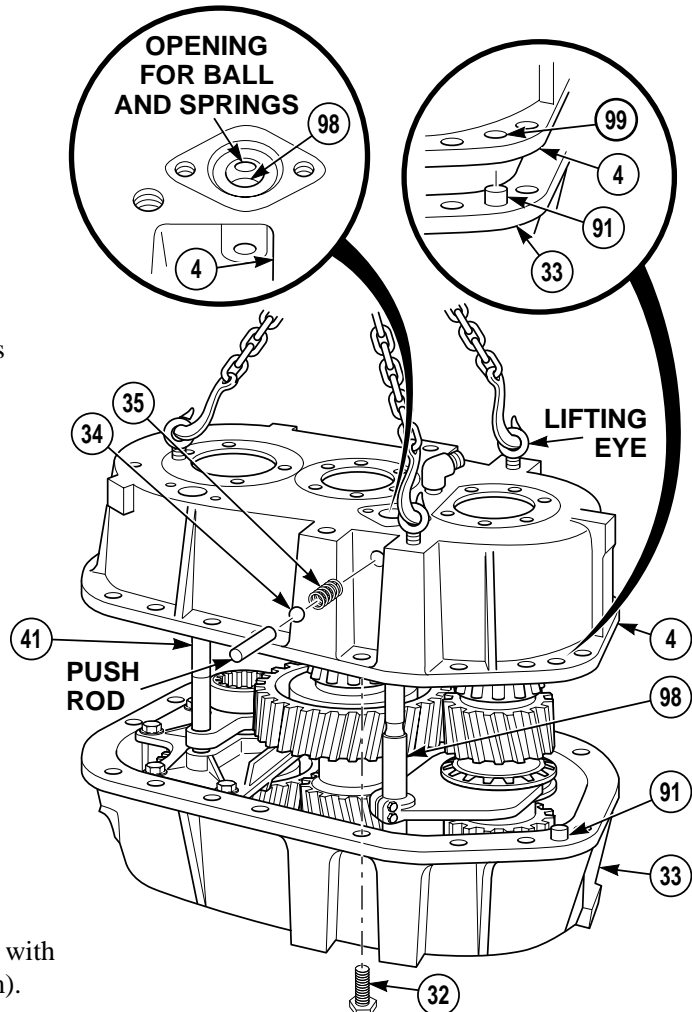
If necessary, use soft hammer to align and seat rear housing on dowel pins.

- (87) Align two dowel pin holes (99) in flange of rear housing (4) with two dowel pins (91) in flange of front housing (33).
- (88) Lower rear housing (4) until fully seated on front housing (33).
- (89) Remove lifting devices and three lifting eyes from rear housing (4).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

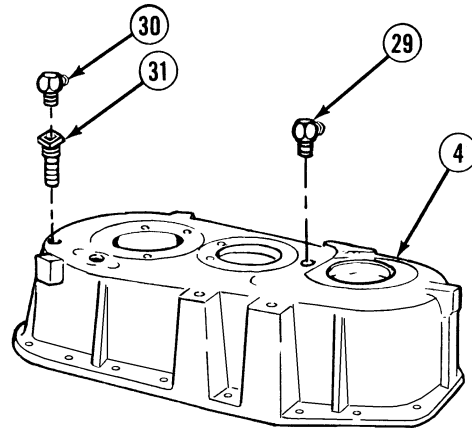
- (90) Coat threads of 20 screws (32) with sealing compound.
- (91) Install rear housing (4) to front housing (33) with 20 screws (32). Tighten to 88 lb-ft (119 N·m).



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (92) Coat pipe threads of fitting (30), strainer (31) and adapter (29) with sealing compound.
- (93) Install fitting (30), strainer (31) and fitting (29) in rear housing (4).



**WARNING**

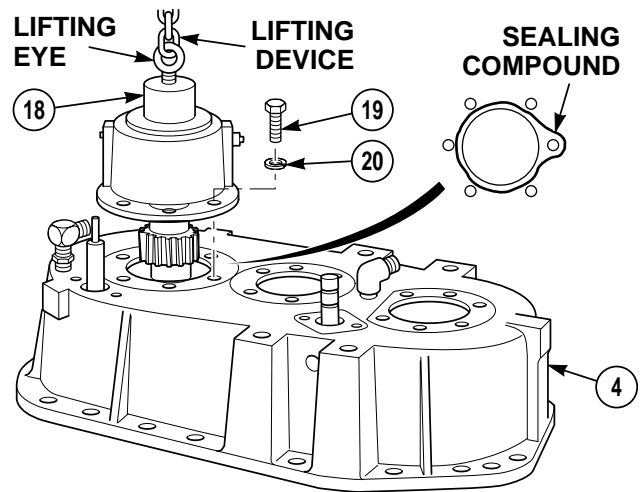
Rear shaft assembly weights 100 lbs (45 kg). Attach suitable lifting device before installation to prevent possible injury to personnel.

- (94) Attach lifting eye and lifting device to rear shaft assembly (18).

**NOTE**

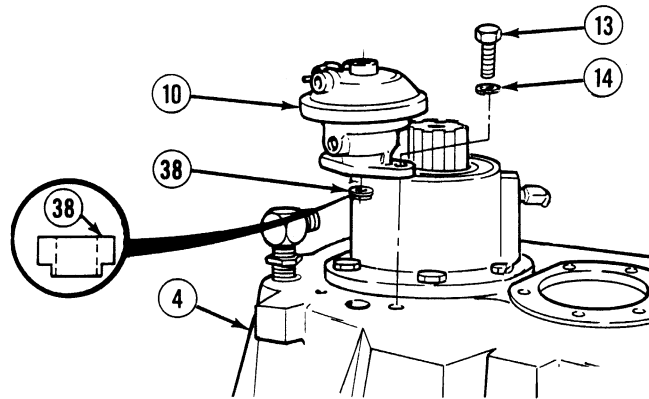
Apply sealing compound in pattern shown.

- (95) Apply sealing compound on rear housing (4) around opening for rear shaft assembly (18).
- (96) Using lifting device, position rear shaft (18) on rear housing (4).
- (97) Coat threads of six screws (19) with sealing compound.
- (98) Install six lockwashers (20) and screws (19) in rear housing (4). Tighten screws to 60 lb-ft (81 N·m).
- (99) Remove lifting device and lifting eye from rear shaft assembly (18).

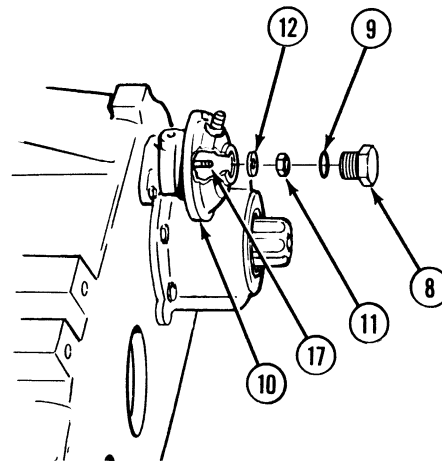


**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**

- (100) Install pilot ring (38) in base of air chamber (10).
- (101) Apply sealing compound to rear housing (4) around opening for air chamber (10).
- (102) Coat threads of two screws (13) with sealing compound.
- (103) Install two lockwashers (14) and screws (13) through base of air chamber (10) in rear housing (4). Tighten screws to 25 lb-ft (34 N·m).



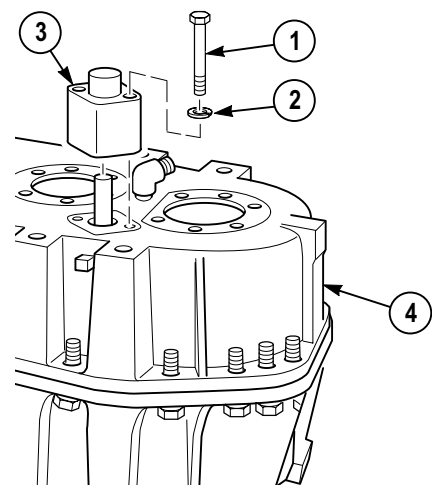
- (104) Position washer (12) on top of stud (17).
- (105) Install locknut (11) on stud (17). Tighten to 180 lb-in (20 N·m).
- (106) Apply lubricating oil to preformed packing (9).
- (107) Install preformed packing (9) and cap nut (8) on air chamber (10).



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (108) Apply sealing compound to base of upper shift rod cover (3) and to threads of two screws (1).
- (109) Install upper shift rod cover (3) on rear housing (4) with two lockwashers (2) and screws (1). Tighten screws to 168 lb-in (19 N·m).



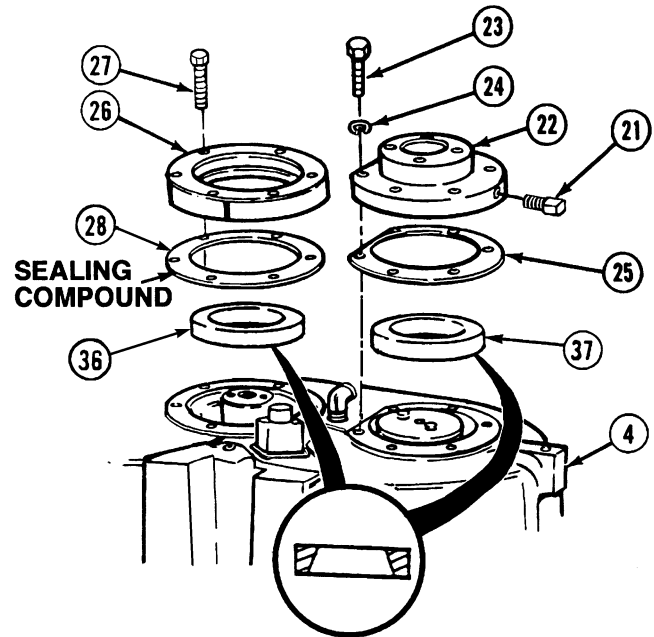
- (110) Install bearing cups (36) and (37) in rear housing (4).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

**NOTE**

Ensure shims of same thickness, as recorded in removal, are installed.



- (111) Coat shims (28) with sealing compound and position on rear housing (4).
- (112) Align steering pump adapter plate (26) on rear housing (4).
- (113) Coat threads of six screws (27) with sealing compound.
- (114) Install six screws (27) in rear housing (4). Tighten screws to 60 lb-ft (81 N·m).

**NOTE**

Ensure shims of same thickness, as recorded in removal, are installed.

- (115) Coat shims (25) with sealing compound and position on rear housing (4).
- (116) Align lube pump bearing cap (22) on rear housing (4).
- (117) Coat threads of six screws (23) with sealing compound.
- (118) Install six lockwashers (24) and screws (23) in rear housing (4). Tighten screws to 60 lb-ft (81 N·m).

**NOTE**

Perform Steps (119) and (120) only if plug was removed.

- (119) Coat threads of plug (21) with sealing compound.
- (120) Install plug (21) in lube pump bearing cap (22).

**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**

**NOTE**

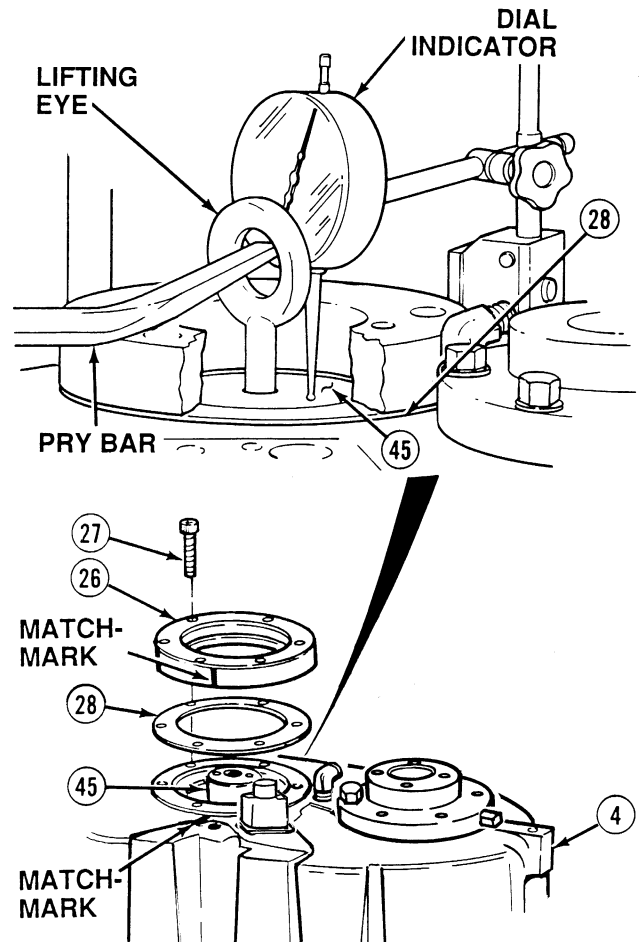
Ensure shaft assembly is fully seated prior to performing Step (121).

- (121) Install lifting eye in end of center shaft assembly (45).
- (122) Position dial indicator and measure end play on center shaft assembly (45).
- (123) While using pry bar to lift center shaft assembly (45) as far as possible, record deflection on dial indicator.

**NOTE**

If deflection is less than 0.003 in. (0.076 mm), shims (28) must be added. If deflection is more than 0.006 in. (0.152 mm), shims must be removed.

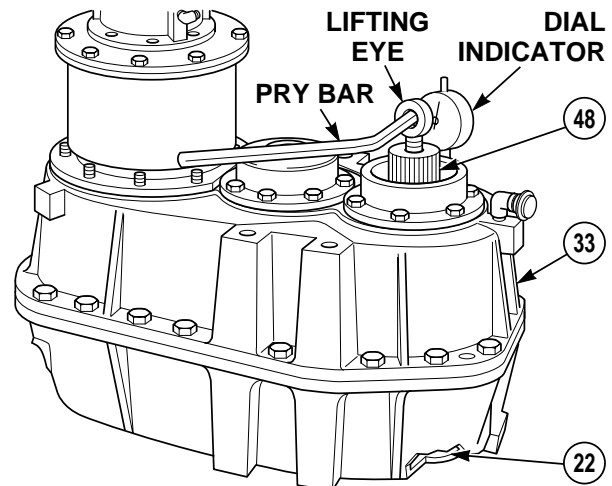
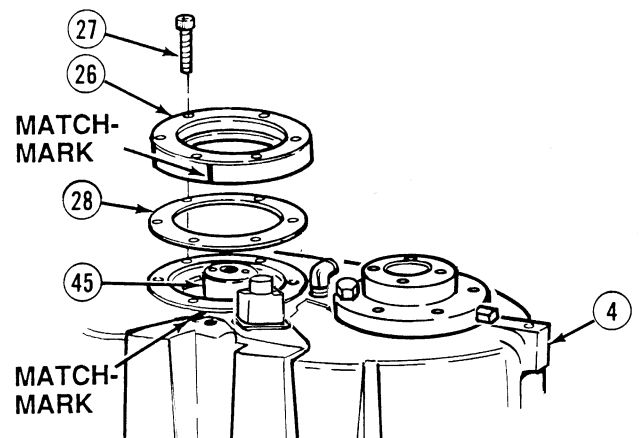
- (124) If end play deflection is 0.003 to 0.006 in. (0.076 to 0.152 mm). Go to Step (134).
- (125) Matchmark steering pump adapter plate (26) and rear housing (4).
- (126) Remove six screws (27) and adapter plate (26) from rear housing (4).
- (127) Remove shims (28) from rear housing (4).
- (128) Add or remove shims (28) to stack to equal proper thickness.



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (129) Coat shims (28) with sealing compound. Position shims on rear housing (4).
- (130) Install and align matchmarks on steering pump adapter plate (26) on rear housing (4).
- (131) Coat threads of six screws (27) with sealing compound.
- (132) Install six screws (27) in rear housing (4). Tighten screws to 60 lb-ft (81 N·m).
- (133) Perform Steps (121) through (124) to check and adjust end-play of center shaft assembly (45).
- (134) Remove lifting eye from center shaft assembly (45).
- (135) Rotate maintenance stand so upper shaft assembly (48) is up.
- (136) Install lifting eye in end of upper shaft assembly (48) on front housing (33). Check end-play as described in Steps (121) through (124).
- (137) Perform Steps (125) through (132) to adjust end-play of upper shaft assembly (48) at lube pump bearing cap (22) on rear housing (4).
- (138) Remove lifting eye from upper shaft assembly (48).





**24-8. TRANSFER CASE ASSEMBLY REPAIR (CONT).**

- (139) Coat inner surface of oil seal (87) with grease.
- (140) Install oil seal (87) on upper shift rod (16) in front housing (33).

**WARNING**

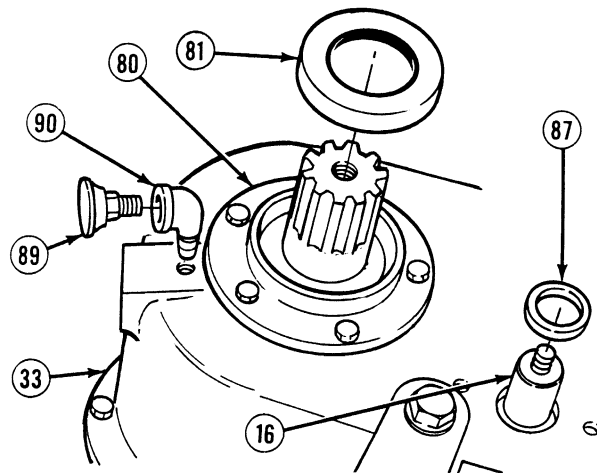
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (141) Coat threads of breather (89) and elbow (90) with sealing compound.
- (142) Install elbow (90) in front housing (33).
- (143) Install breather (89) in elbow (90).
- (144) Coat inner lip of oil seal (81) with grease.

**NOTE**

Align inner lip of oil seal as shown.

- (145) Install oil seal (81) in upper shaft bearing cap (80).



**d. Follow-On Maintenance:**

- Install emergency steering pump, (Para 12-12).
- Install lube pump, (Para 8-5).
- Install yokes, (Para 24-7).
- Install speedometer sensor, (Para 24-6).
- Install shift connector, (Para 24-4).
- Install neutral start switch, (Para 24-5).
- Install lube hoses, (Para 24-3).
- Remove transfer case from maintenance stand, (Para 24-2).
- Install transfer case in container, (Para 8-6).

**END OF TASK**

## 24-9. TRANSFER CASE DIFFERENTIAL ASSEMBLY REPAIR.

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/Inspection | d. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Eyes, Lifting (2) (Item 60, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)  
Wrench, Torque (0-175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Lifting Device, Minimum Capacity 200 lbs  
(91 kg)

#### *Materials/Parts*

Grease (Item 21, Appendix B)  
Sealing Compound (Item 54, Appendix B)  
Sealing Compound (Item 56, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Wire, Nonelectrical (Item 79, Appendix B)

#### *Personnel Required*

Two

#### *Equipment Condition*

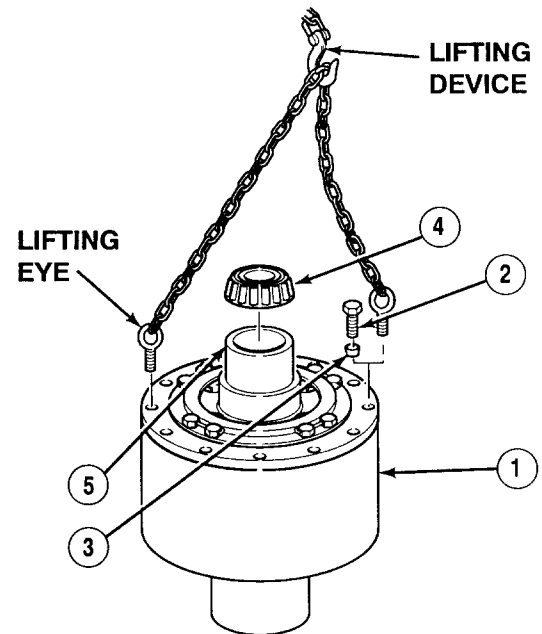
Planetary differential removed from transfer case, (Para 24-8)

### a. Disassembly.

#### **WARNING**

Planetary differential assembly weighs 160 lbs (73 kg). Use suitable lifting device to prevent possible injury to personnel.

- (1) Attach lifting eyes and lifting device to differential case (1) and position on clean, level surface.
- (2) Remove lifting device, two lifting eyes, ten screws (2) and taper dowels (3) from differential case (1).
- (3) Remove bearing (4) from planetary carrier (5).

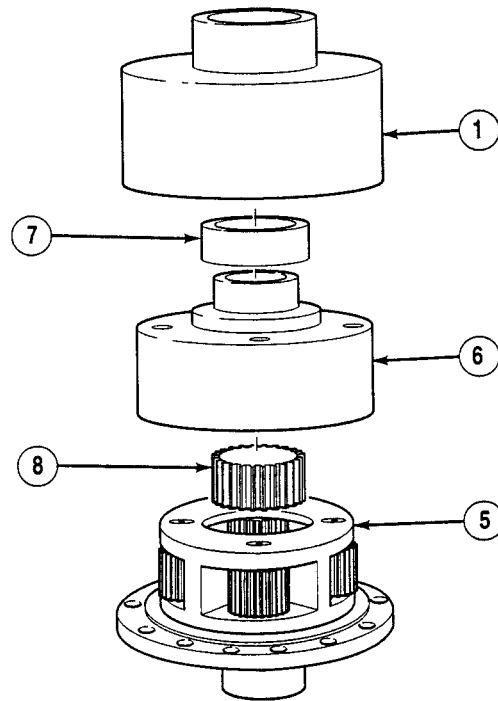


**24-9. TRANSFER CASE DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

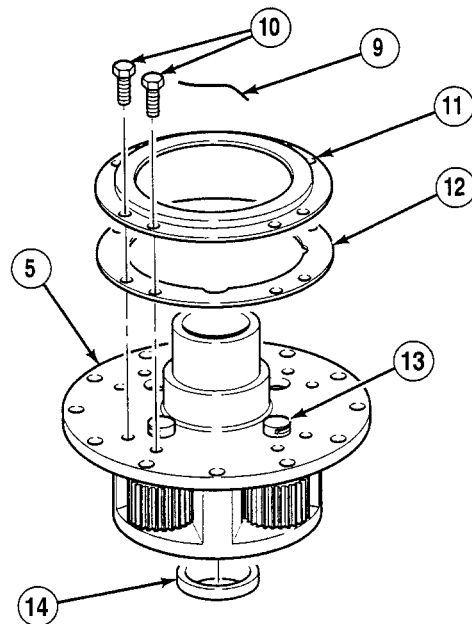
**WARNING**

Planetary carrier assembly weighs 85 lbs (39 kg). Use the aid of an assistant to turn differential case over to prevent injury to personnel.

- (4) With the aid of an assistant, turn differential case (1) over.
- (5) Remove differential case (1) from annulus (6) and planetary carrier (5).
- (6) Remove annulus (6) from planetary carrier (5).
- (7) Remove ring (7) from differential case (1).
- (8) Remove sun gear (8) from annulus (6).



- (9) Remove four safety wires (9) from eight screws (10). Discard safety wires.
- (10) Remove eight screws (10) and cover (11) from planetary carrier (5).
- (11) Turn differential ring (12) until four notches align with four pins (13).
- (12) Remove differential ring (12) from planetary carrier (5).
- (13) Remove spacer (14) from planetary carrier (5).



**b. Cleaning/Inspection.****WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
  - (2) Dry with compressed air.
  - (3) Inspect all parts for wear, cracks, nicks, burrs or scratches.
  - (4) Inspect sun gear for chipped teeth or wear.
  - (5) Replace all damaged parts.

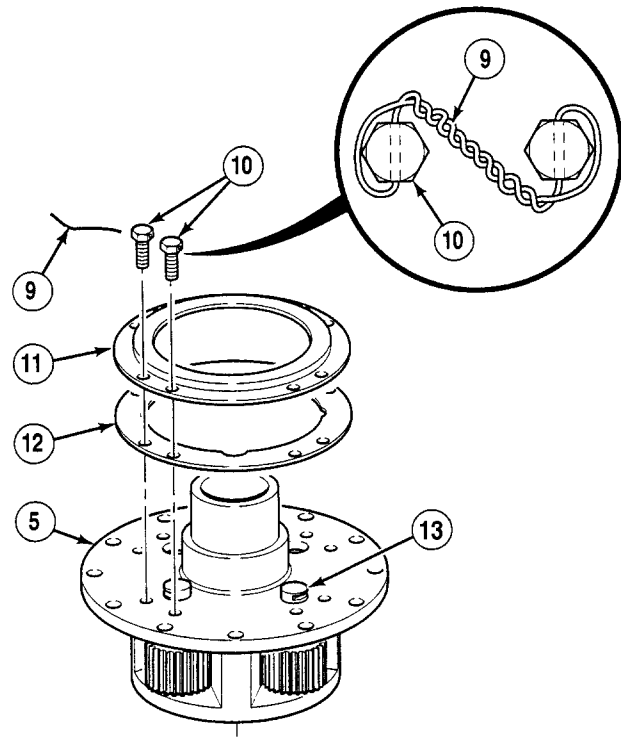
**24-9. TRANSFER CASE DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**c. Assembly.**

- (1) Install differential ring (12) on planetary carrier (5). Rotate differential ring on planet carrier to lock four pins (13) and align bolt holes.

**WARNING**

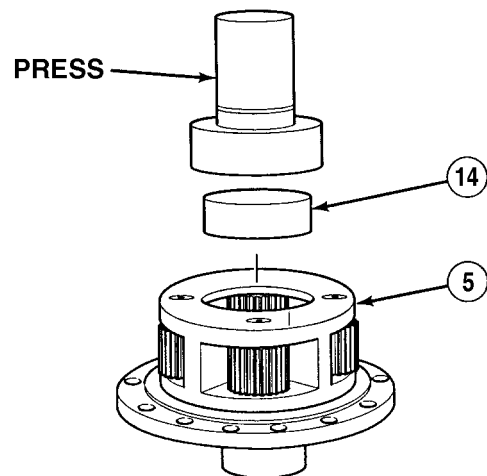
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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



- (2) Coat threads of eight screws (10) with sealing compound.
- (3) Install cover (11) on planetary carrier (5) with eight screws (10). Tighten screws to 25 lb-ft (34 N·m).
- (4) Install four safety wires (9), twist wires (9) as shown through adjacent pairs of eight screws (10).

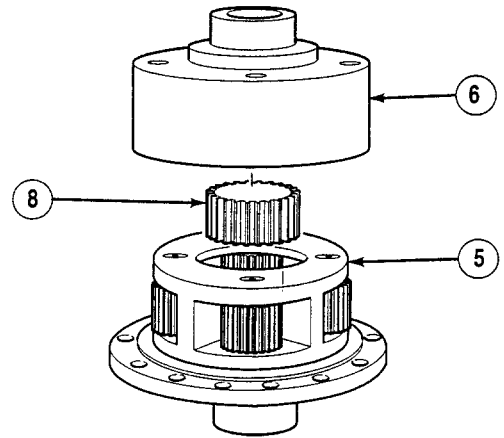
**WARNING**

Planetary carrier assembly weighs 85 lbs (39 kg). Use the aid of an assistant to turn carrier over to prevent injury to personnel.

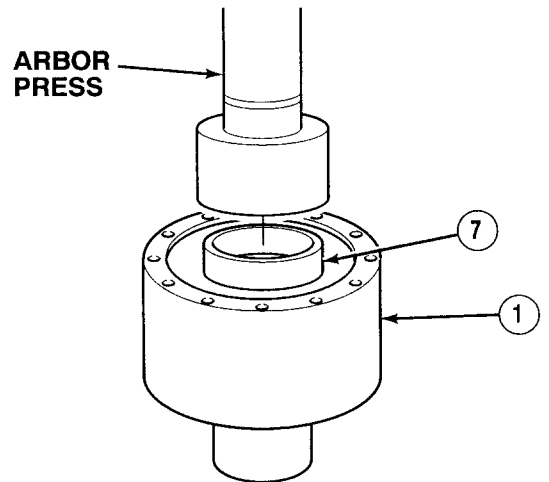


- (5) With aid of assistant, turn planetary carrier (5) over.
- (6) Using press, install spacer (14) in planetary carrier (5).

- (7) Coat sun gear (8) with grease.
- (8) Install sun gear (8) in planetary carrier (5).
- (9) Install annulus (6) on planetary carrier (5).

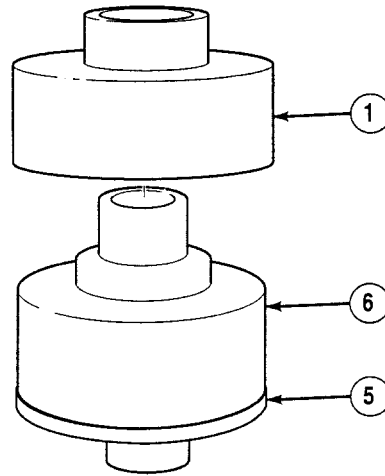


- (10) Using press, install ring (7) in differential case (1).



**24-9. TRANSFER CASE DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

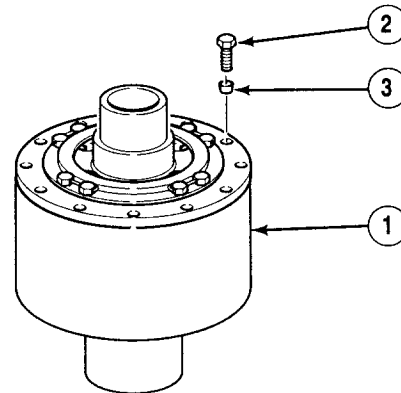
- (11) Install differential case (1) on annulus (6) and planetary carrier (5).



**WARNING**

Planetary differential assembly weighs 160 lbs (73 kg). Use suitable lifting device to prevent possible injury to personnel.

- (12) With aid of assistant, turn differential case (1) over.
- (13) Install 12 screws (2) in taper dowels (3).



**WARNING**

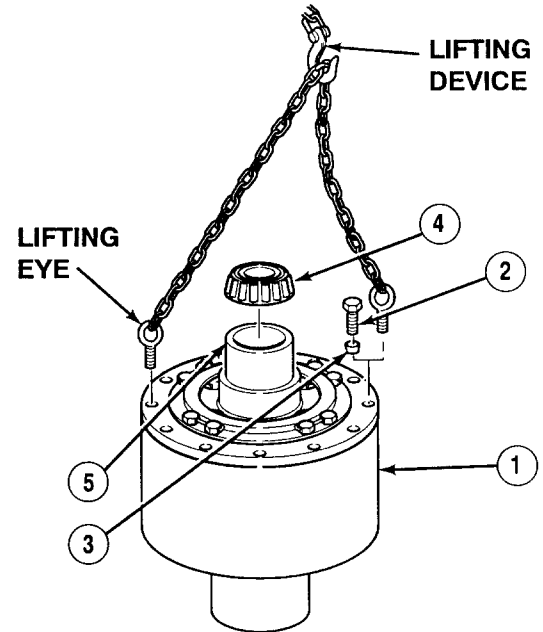
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (14) Coat threads of ten screws (2) with sealing compound.

**NOTE**

Leave two screw holes on opposite sides of planetary differential assembly for lifting eyes.

- (15) (Install ten screws (2) and taper dowels (3) in differential case (1). Tighten screws to 88 lb-ft (119 N·m).
- (16) Install two lifting eyes and lifting device in differential case (1) and position in press.





**24-9. TRANSFER CASE DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

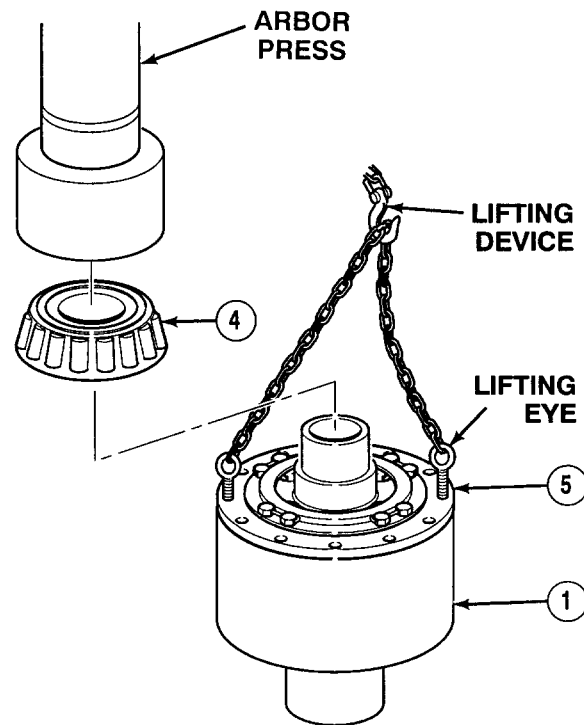
**WARNING**

Press on inner diameter of bearing or equipment damage may result.

**NOTE**

Ensure that bottom of bearing is seated on shoulder of planet carrier.

- (17) Using press, install bearing (4) in planet carrier (5).
- (18) Remove differential case (1) from press and position on clean, level surface.
- (19) Remove lifting device and lifting eyes from differential case (1).



**d. Follow-On Maintenance:**

- Install planetary differential assembly in transfer case, (Para 24-8).

**END OF TASK**

## 24-10. FRONT SHAFT ASSEMBLY REPAIR.

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/inspection | d. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Hammer, Hand, Soft Plastic  
(Item 88, Appendix F)  
Installer, Seal, Transfer Case  
(Item 119, Appendix F)  
Press, Arbor, Hand Operated  
(Item 164, Appendix F)

#### *Materials/Parts*

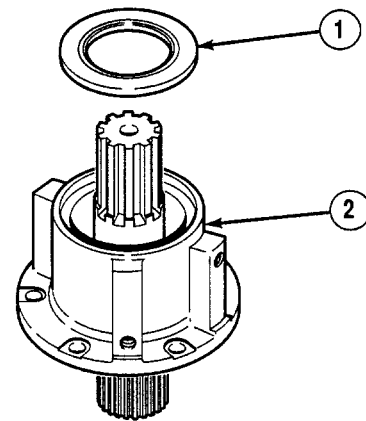
Grease (Item 21, Appendix B)  
Sealing Compound (Item 53, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Ring, Piston (2) (Item 485, Appendix E)  
Seal, Oil (Item 585, Appendix E)

#### *Equipment Condition*

Front shaft removed from transfer case,  
(Para 24-8)

### a. *Disassembly.*

- (1) Remove and discard oil seal (1) from bearing cap (2).

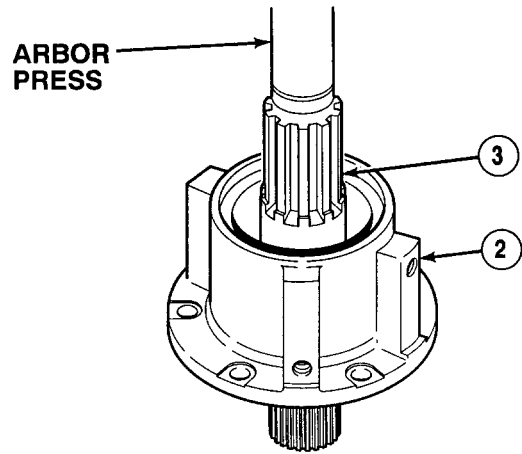


**24-10. FRONT SHAFT ASSEMBLY REPAIR (CONT).**

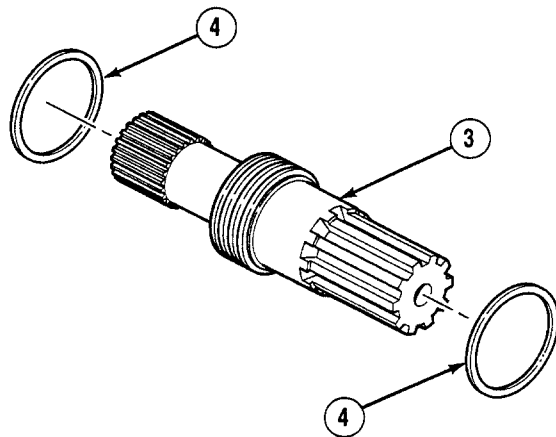
**CAUTION**

Use care not to damage bearings when front shaft is removed from bearing cap. Failure to comply may result in damage to equipment.

- (2) Using press, remove front shaft (3) from bearing cap (2).



- (3) Remove and discard two piston rings (4) from front shaft (3).



- (4) Remove bearing (5) from bearing race (6).
- (5) Remove spacer (7) from bearing cap (2).
- (6) Remove bearing race (6) from bearing cap (2).

**WARNING**

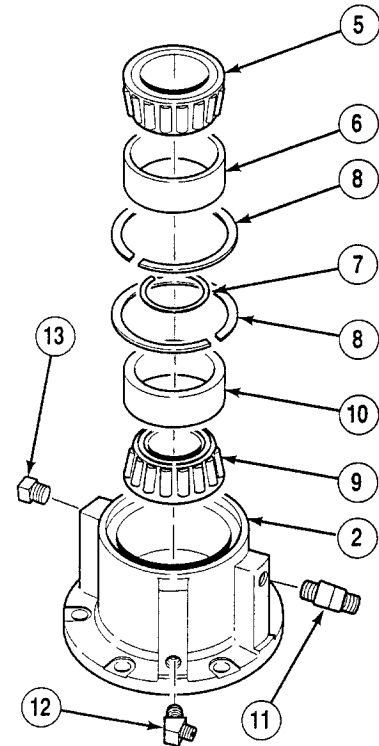
Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (7) Remove two retaining rings (8) from bearing cap (2).
- (8) Remove bearing (9) and bearing race (10) from bearing cap (2).

**NOTE**

Perform Step (9) only if adapter and plug are damaged.

- (9) Remove adapters (11) and (12) and plug (13) from bearing cap (2).



**b. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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.

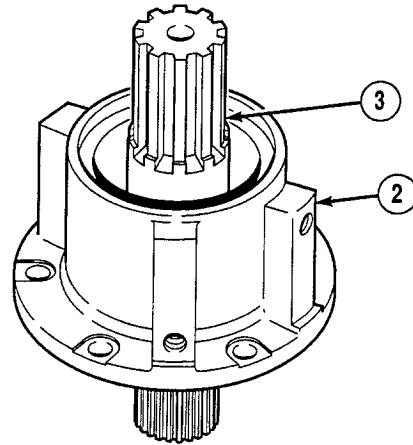
**NOTE**

Bearing assembly is a matched set. Replace all components if any damage is found.

- (1) Clean all metal parts with drycleaning solvent.
- (2) Dry with compressed air.

**24-10. FRONT SHAFT ASSEMBLY REPAIR (CONT).**

- (3) Clean oil passages in front shaft (3) and bearing cap (2).
- (4) Inspect all parts for wear, cracks, nicks, burrs or scratches and clogged passages.
- (5) Replace all damaged parts.

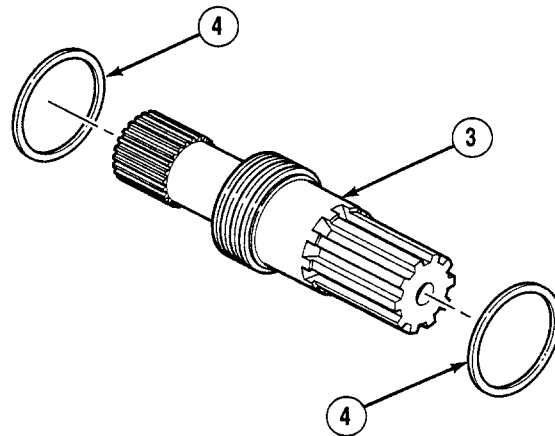


**c. Assembly.**

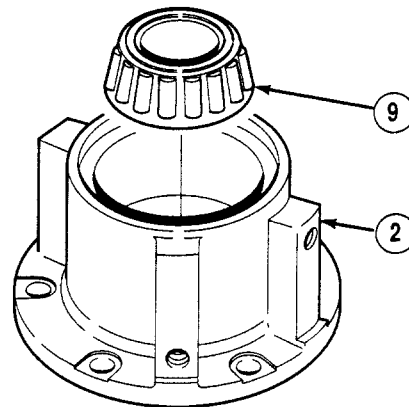
- (1) Coat two piston rings (4) with grease.

**CAUTION**

When installing piston rings, do not stretch or twist them. Ensure that rings are aligned straight and are seated evenly around front shaft. Improper alignment can cause oil leak.



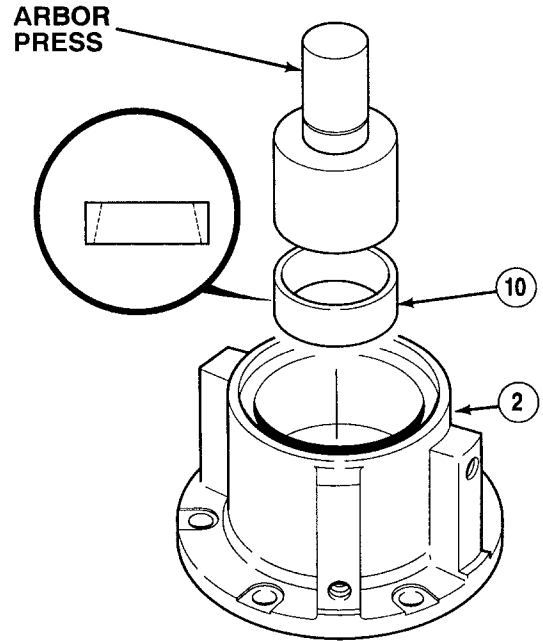
- (2) Install two piston rings (4) on front shaft (3).
- (3) Coat bearing (9) with grease. Install bearing in bearing cap (2).



**NOTE**

Retaining ring groove should be visible after bearing race is seated.

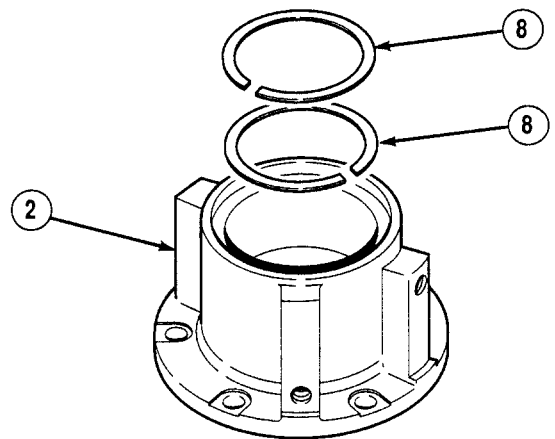
- (4) Using press, install inboard bearing race (10) in bearing cap (2) until seated.



**WARNING**

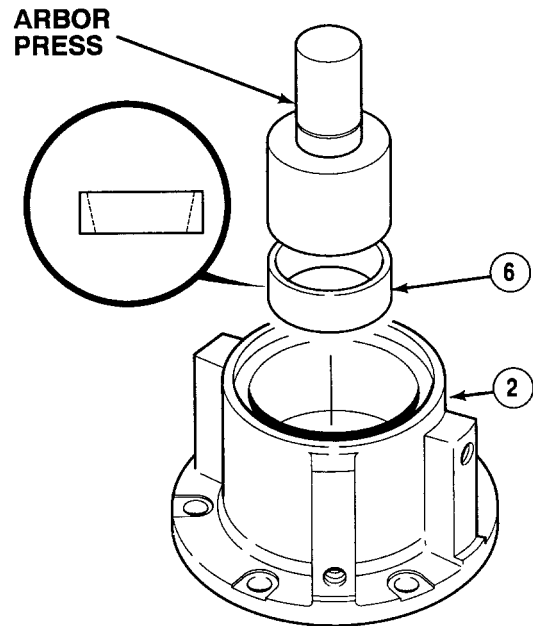
Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (5) Install two retaining rings (8) in bearing cap (2).

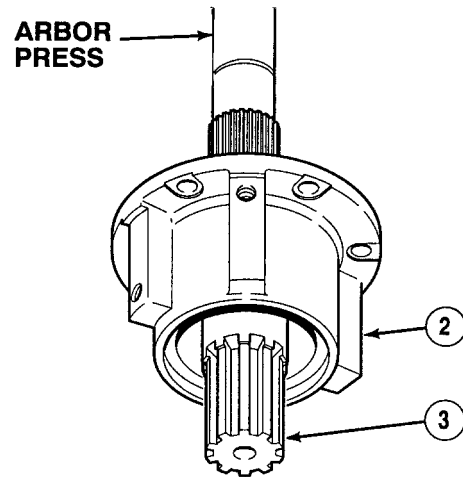


**24-10. FRONT SHAFT ASSEMBLY REPAIR (CONT).**

- (6) Using press, install outboard bearing race (6) in bearing cap (2) until fully seated.



- (7) Using press, install front shaft (3) in bearing cap (2).



- (8) Install spacer (7) on front shaft (3).
- (9) Coat outboard bearing (5) with grease.
- (10) Using press, install bearing in bearing cap (2) until fully seated.
- (11) Ensure that front shaft (3) turns freely. If binding occurs, using a soft faced hammer, tap shoulder of bearing cap (2).
- (12) Coat inner lip of oil seal (1) with grease.

**NOTE**

Ensure lip of seal is facing inside of bearing cap.

- (13) Install oil seal (1) in bearing cap (2).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

**NOTE**

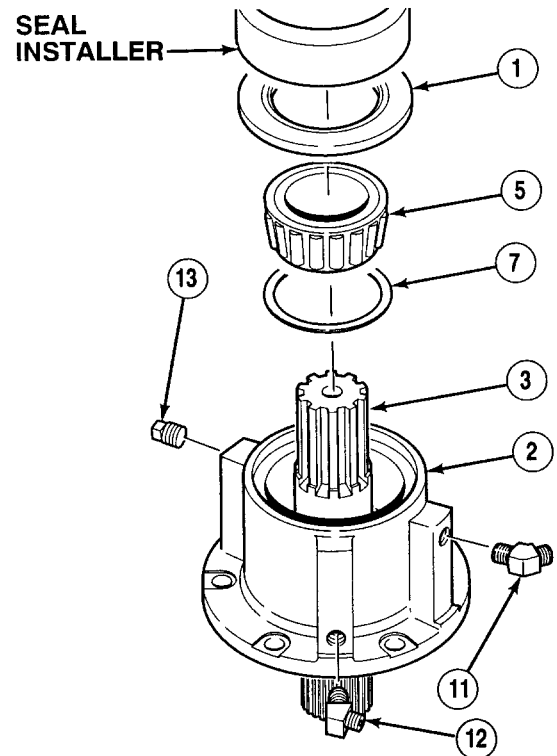
Perform Steps (14) and (15) only if plug and adapters were removed.

- (14) Apply sealing compound to pipe plug (13) and adapters (11) and (12).
- (15) Install pipe plug (13) and adapters (11) and (12) in bearing cap (2).

**d. Follow-On Maintenance:**

- Install front shaft in transfer case, (Para 24-8).

**END OF TASK**





## 24-11. REAR SHAFT ASSEMBLY REPAIR.

This task covers:

- a. Disassembly
- b. Cleaning/inspection
- c. Assembly
- d. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Installer, Seal, Transfer Case  
(Item 119, Appendix F)  
Press, Arbor, Hand Operated  
(Item 162, Appendix F)

#### *Materials/Parts*

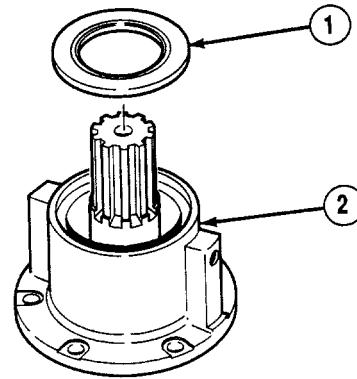
Grease (Item 21, Appendix B)  
Sealing Compound (Item 53, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Seal, Oil (Item 586, Appendix E)

#### *Equipment Condition*

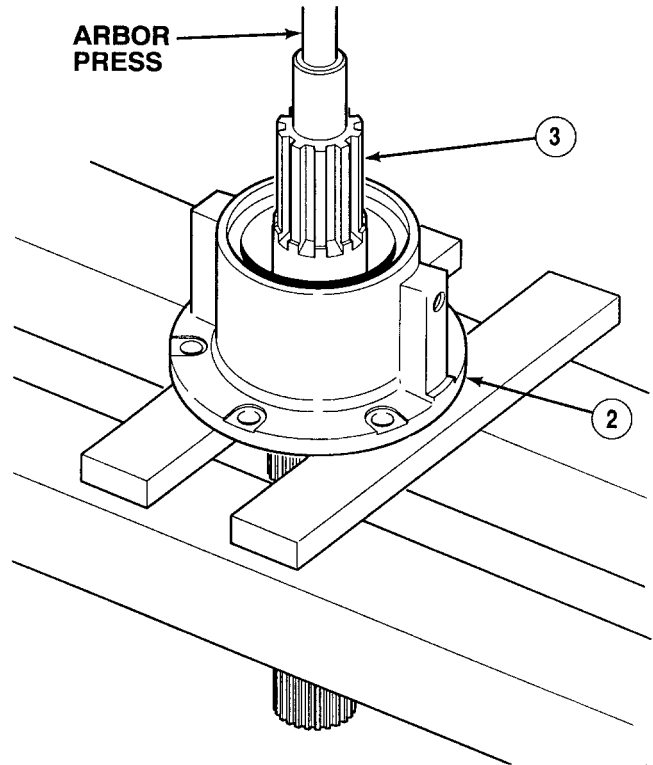
Rear shaft removed from transfer case,  
(Para 24-8)

### a. *Disassembly.*

- (1) Remove and discard oil seal (1) from bearing cap (2).



- (2) Using press, remove rear shaft (3) from bearing cap (2).



**CAUTION**

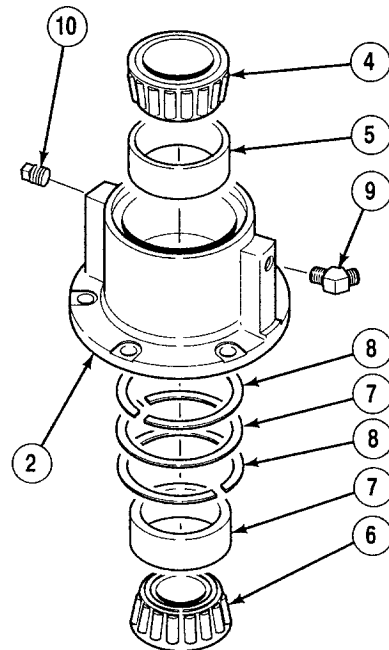
Press on inner diameter of bearing or damage to equipment may occur.

- (3) Using press, remove bearing (4) and spacer (5) from rear shaft (3).

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (4) Remove bearing (6), two bearing races (7) and retaining rings (8) from bearing cap (2).



**NOTE**

Perform Step (5) if adapter and plug are damaged.

- (5) Remove adapter (9) and plug (10) from bearing cap (2).

**24-11. REAR SHAFT ASSEMBLY REPAIR (CONT).**

**b. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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.

**NOTE**

Bearing and spacer are a matched set. Replace all components if any damage is found.

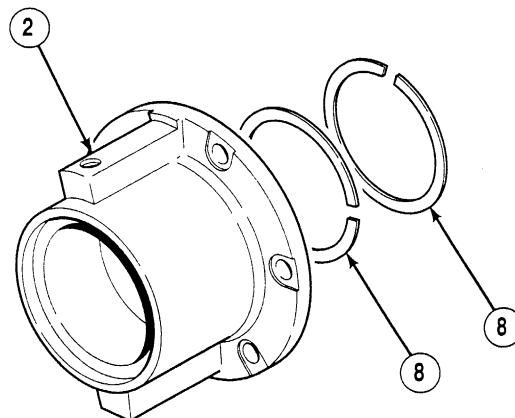
- (1) Clean all metal parts with drycleaning solvent.
- (2) Dry with compressed air.
- (3) Inspect all parts for damage, wear, cracks, burrs or scratches.
- (4) Replace all damaged parts.

**c. Assembly.**

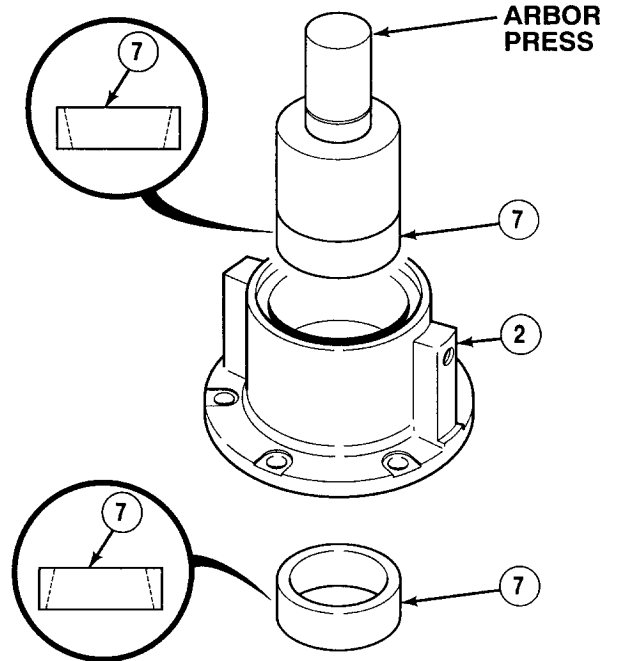
**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (1) Install two retaining rings (8) in bearing cap (2).



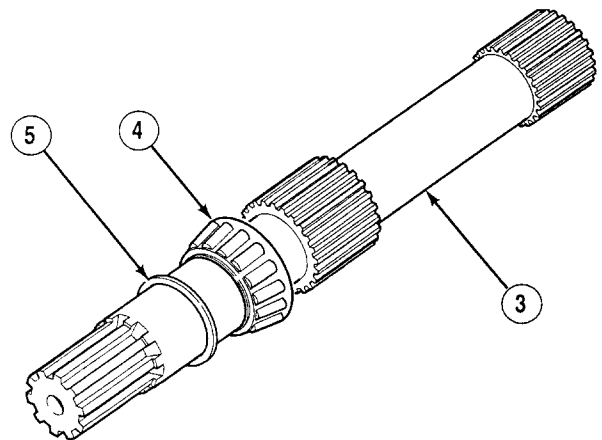
- (2) Using press, install two bearing races (7) in bearing cap (2).



**CAUTION**

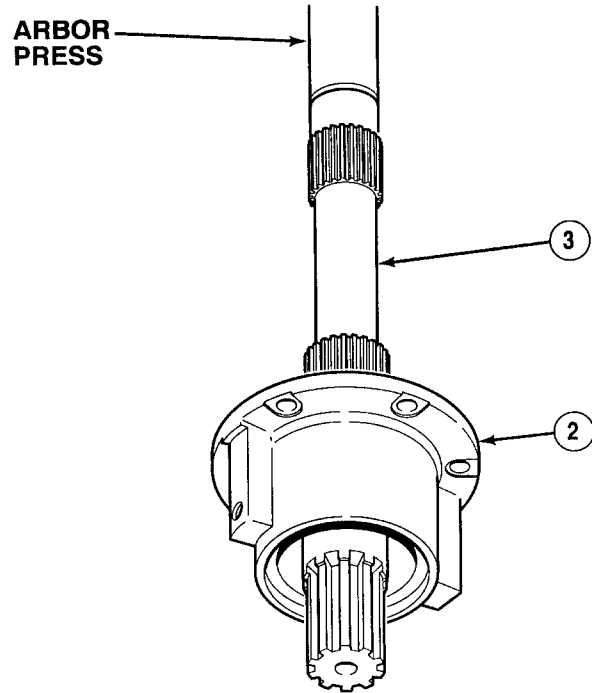
Press on inner diameter of bearing or damage to equipment may occur.

- (3) Using press, install bearing (4) and spacer (5) on rear shaft (3). Coat bearing with grease.



**24-11. REAR SHAFT ASSEMBLY REPAIR (CONT).**

- (4) Position rear shaft (3) in bearing cap (2).

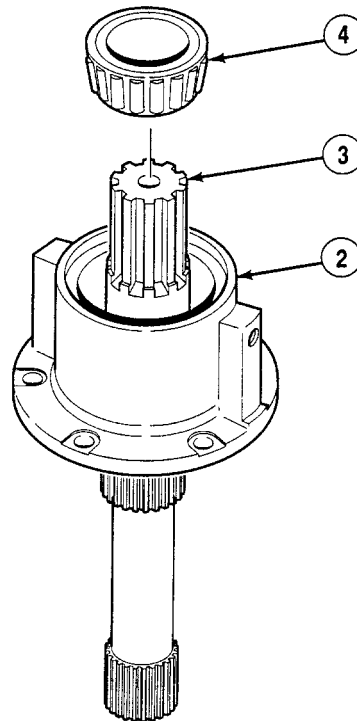


- (5) Coat bearing (4) with grease.

**CAUTION**

Press on inner diameter of bearing or damage to equipment may result.

- (6) Using press, install bearing (4) in bearing cap (2).
- (7) Check that rear shaft (3) turns freely. If it binds, tap shoulder of bearing cap (2).



**NOTE**

Ensure that lip of seal is facing inside of bearing cap.

- (8) Coat inner lip of oil seal (1) with grease.
- (9) Using seal installer, install oil seal (1) in bearing cap (2).

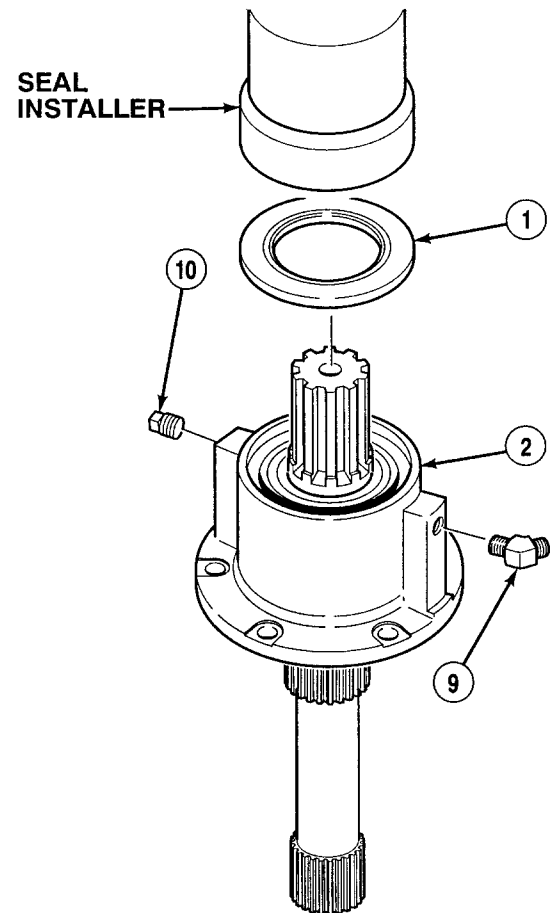
**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

**NOTE**

Perform Step (10) if plug and adapter were removed.

- (10) Apply sealing compound to pipe plug (10) and adapter (9).
- (11) Install pipe plug (10) and adapter (9) in bearing cap (2).

**d. Follow-On Maintenance:**

- Install rear shaft in transfer case, (Para 24-8).

**END OF TASK**

## 24-12. DIFFERENTIAL SHAFT REPAIR.

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/inspection | d. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240 Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)

#### *Materials/Parts*

Solvent, Drycleaning (Item 68, Appendix B)

#### *Personnel Required*

Two

#### *Equipment Condition*

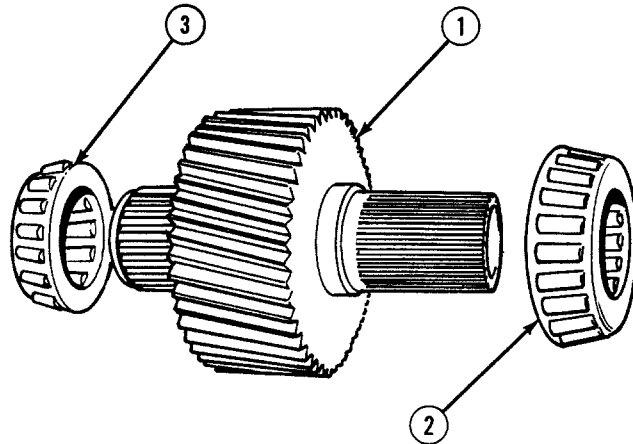
Differential shaft removed from transfer case,  
(Para 24-8)

### a. Disassembly.

#### **WARNING**

Differential shaft assembly weighs 100 lbs (45 kg). Use an assistant to prevent possible injury to personnel.

- (1) With the aid of an assistant, position pinion gear (1) in press.
- (2) Remove cone bearing (2) from pinion gear (1).
- (3) Remove cylindrical bearing (3) from pinion gear (1).
- (4) With the aid of an assistant, remove pinion gear (1) from press.



**b. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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).

- (1) Clean all parts with drycleaning solvent.
- (2) Dry with compressed air.
- (3) Inspect parts for breaks, obvious wear, cracks, burrs, sharp edges, pitting, galling, discoloration, chipped or broken teeth.
- (4) Replace all damaged parts.

**c. Assembly.**

**WARNING**

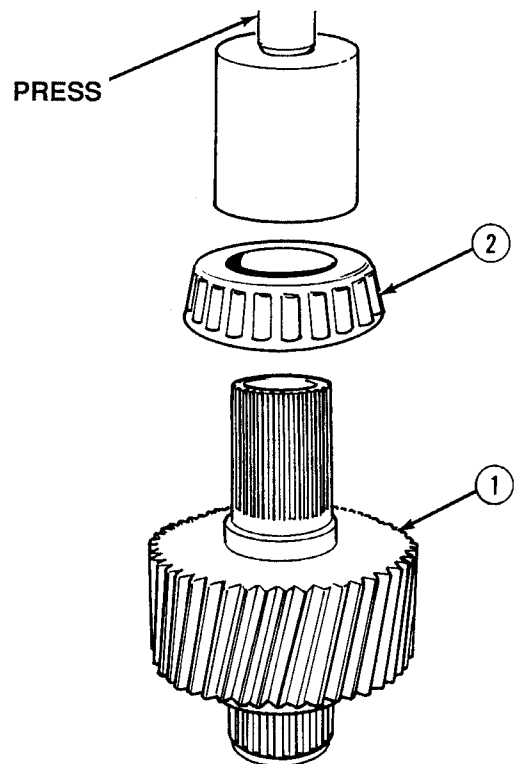
Differential shaft assembly weighs 100 lbs (45 kg). Use an assistant to prevent possible injury to personnel.

- (1) With the aid of an assistant, position pinion gear (1) in press.

**CAUTION**

Install bearing by pressing on inner diameter only. Ensure that bearings are seated against shoulder of gear.

- (2) Using press, install cone bearing (2) on pinion gear (1).





**24-12. DIFFERENTIAL SHAFT REPAIR (CONT).**

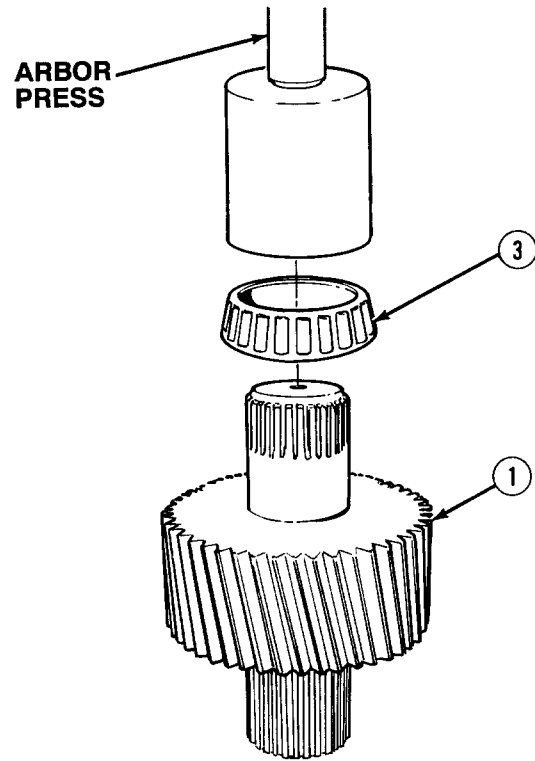
**CAUTION**

Install bearing by pressing on inner diameter only. Ensure that bearings are seated against shoulder of gear.

**NOTE**

End of cylindrical bearing with beveled inside is installed first.

- (3) Using press, install cylindrical bearing (3) on pinion gear (1).
- (4) With the aid of an assistant, remove pinion gear (1) from press.



**d. Follow-On Maintenance:**

- Install differential shaft assembly in transfer case, (Para 24-8).

**END OF TASK**

**24-13. CENTER SHAFT REPAIR.**

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/inspection | d. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Eyes, Lifting (Item 58, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)  
Wrench, Torque (0-175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Lifting Device, Minimum Capacity 145 lbs  
(66 kg)

*Materials/Parts*

Sealing Compound (Item 54, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)

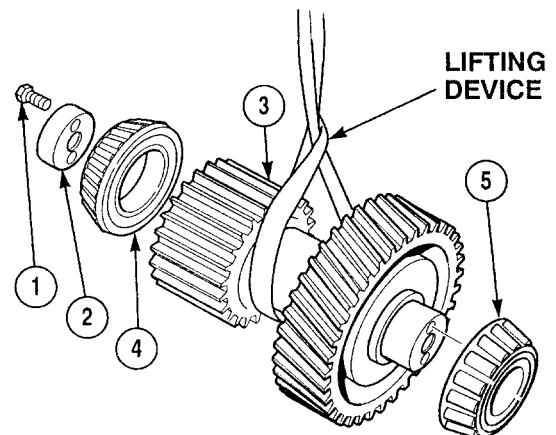
*Equipment Condition*

Center shaft removed from transfer case,  
(Para 24-8)

**a. Disassembly.****WARNING**

Center shaft assembly weighs 145 lbs (66 kg). Use suitable lifting device to prevent possible injury to personnel.

- (1) Remove two screws (1) and drive coupling (2) from shaft gear (3).
- (2) Attach lifting device to shaft gear (3) and position in press.
- (3) Remove bearing (4) from shaft gear (3).
- (4) Remove bearing (5) from shaft gear (3).
- (5) Remove shaft gear (3) from press.
- (6) Remove lifting device from shaft gears (3).



**24-13. CENTER SHAFT REPAIR (CONT).**

***b. Cleaning/Inspection.***

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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).
- (1) Clean all parts with drycleaning solvent.
  - (2) Dry with compressed air.
  - (3) Inspect parts for breaks, obvious wear, cracks, burrs or sharp edges.
  - (4) Replace all damaged parts.

c. *Assembly.*

**WARNING**

Center shaft assembly weighs 145 lbs (66 kg). Use suitable lifting device to prevent possible injury to personnel.

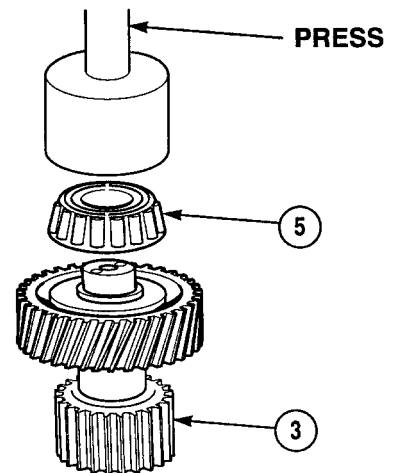
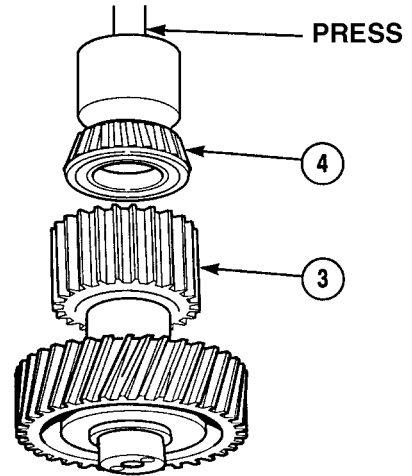
**CAUTION**

Press on inner diameter of bearing or damage to equipment may occur.

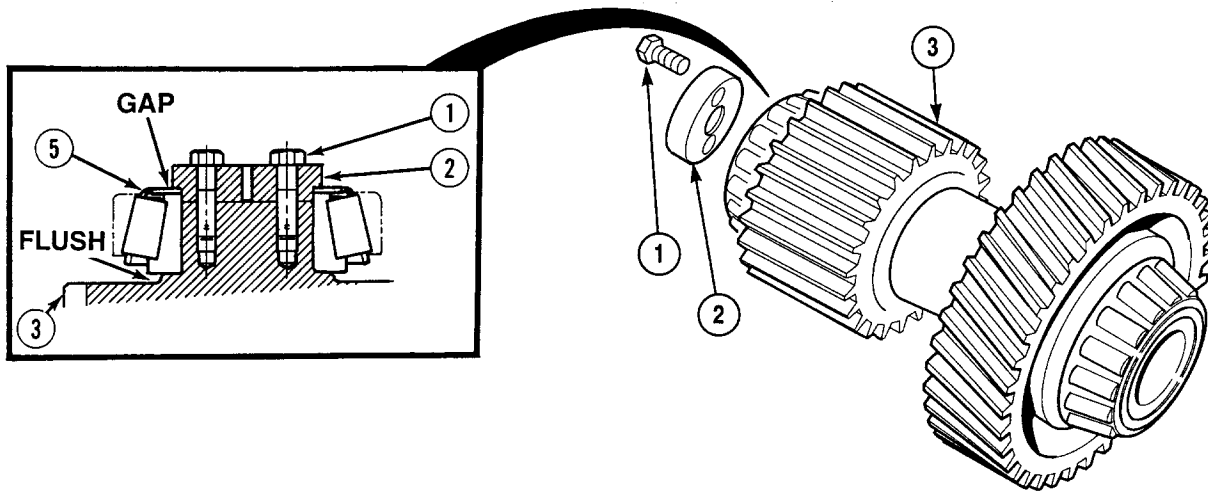
**NOTE**

- End of bearing with beveled inside is installed first.
- Ensure that bearings are seated against shoulder of gear.

- (1) Attach lifting device to shaft gear (3) and position on press.
- (2) Using press, install bearing (4) on shaft gear (3).
- (3) Using press, install bearing (5) on shaft gear (3).
- (4) Remove shaft gear (3) from press.
- (5) Remove lifting device from shaft gear (3).



**24-13. CENTER SHAFT 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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (6) Apply sealing compound on threads of screw (1) and in screw holes at both ends of shaft gear (3).
- (7) Install drive coupling (2) on shaft gear (3) with two screws (1). Tighten screws to 40 lb-ft (54 N·m).
- (8) Check that gap is between drive coupling (2) and bearing (5). If gap is not present, seat bearing against shoulder of shaft gear (3) until gap is visible.

**d. Follow-On Maintenance:**

- Install center shaft assembly in transfer case, (Para 24-8).

**END OF TASK**

**24-14. UPPER SHAFT REPAIR.**

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/inspection | d. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)

*Materials/Parts*

Grease (Item 21, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Tags, Identification (Item 72, Appendix B)

*Personnel Required*

Two

*Equipment Condition*

Upper shaft removed from transfer case,  
(Para 24-8)

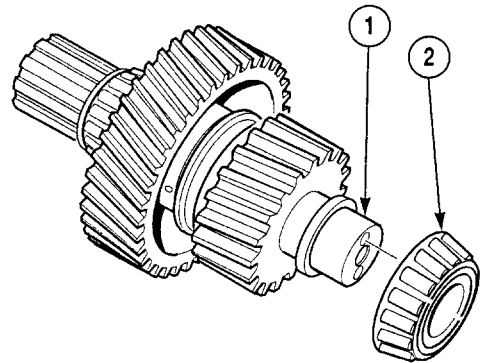
**a. Disassembly.****WARNING**

Upper shaft assembly weighs 115 lbs (52 kg). Use an assistant to prevent possible injury to personnel.

**NOTE**

Tag and mark bearing before removal.

- (1) With the aid of an assistant, position upper shaft (1) in press.
- (2) Remove bearing (2) from upper shaft (1).

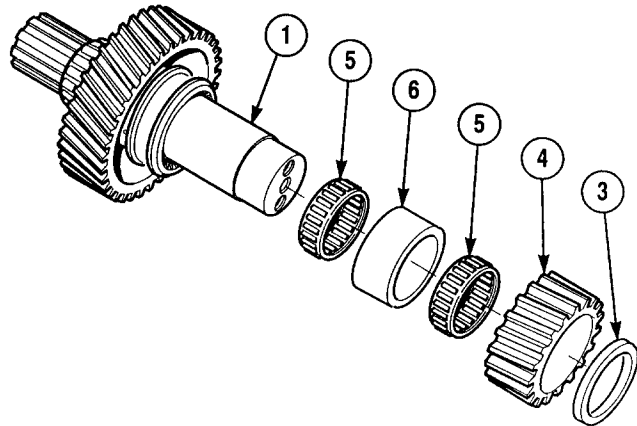


**24-14. UPPER SHAFT REPAIR (CONT).**

**NOTE**

Tag and mark bearing spacer before removal.

- (3) Remove bearing spacer (3) and small gear (4) from upper shaft (1).
- (4) Remove two caged rollers (5) and bearing spacer (6) from upper shaft (1).

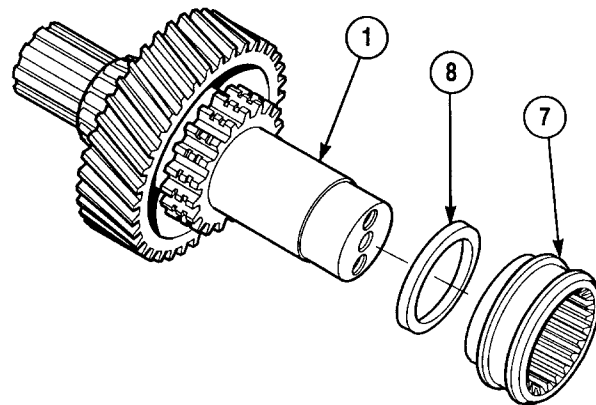


- (5) Remove clutch collar (7) from upper shaft (1).

**NOTE**

Tag and mark gear spacer before removal.

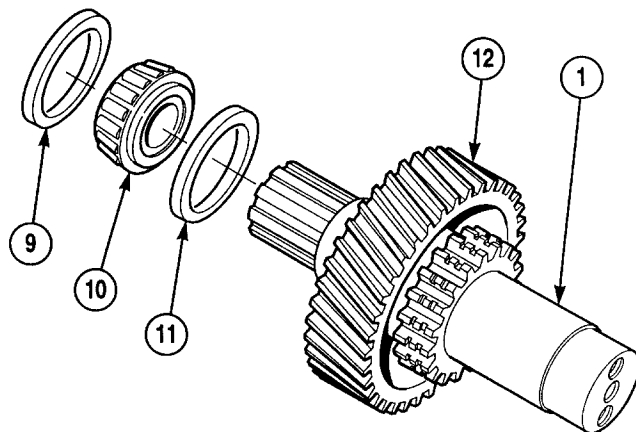
- (6) Remove gear spacer (8) from upper shaft (1).



**NOTE**

Tag and mark bearing spacer before removal.

- (7) Remove bearing spacer (9) from upper shaft (1).
- (8) Remove bearing (10) from upper shaft (1).



**NOTE**

Tag and mark bearing spacer before removal.

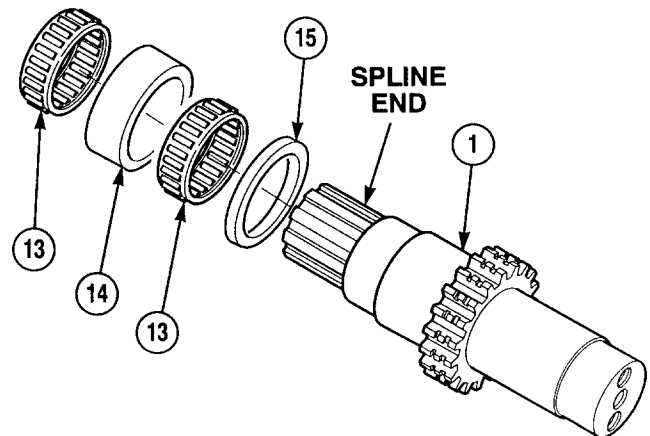
- (9) Remove bearing spacer (11) and gear (12) from upper shaft (1).

- (10) Remove two caged rollers (13) and bearing spacer (14) from upper shaft (1).

**NOTE**

Tag and mark gear spacer before removal.

- (11) Remove gear spacer (15) from upper shaft (1).
- (12) With the aid of an assistant, remove upper shaft (1) from press.



**b. Cleaning/Inspection.**

**WARNING**

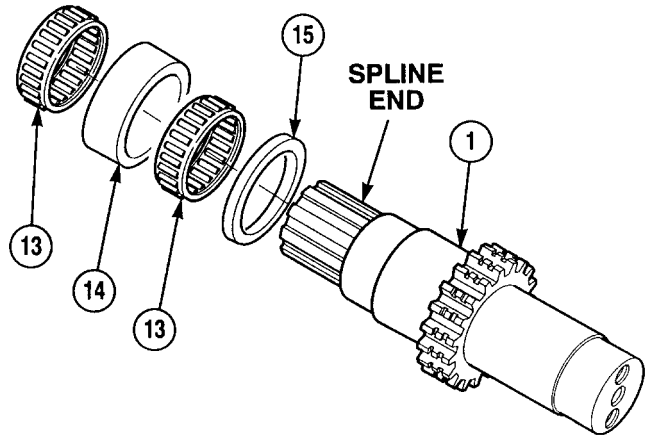
- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes, and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent. The flashpoint for Type II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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).
- (1) Clean all parts with drycleaning solvent.
  - (2) Dry with compressed air.
  - (3) Inspect parts for breaks, obvious wear, cracks, burrs or sharp edges.
  - (4) Replace all damaged parts.



**24-14. UPPER SHAFT REPAIR (CONT).**

**c. Assembly.**

- (1) With the aid of an assistant, position upper shaft (1) in press.
- (2) Install gear spacer (15) on spline end of upper shaft (1).
- (3) Coat two caged rollers (13) with grease.
- (4) Install one caged roller (13), bearing spacer (14) and second caged roller (13) on spline end of upper shaft (1).

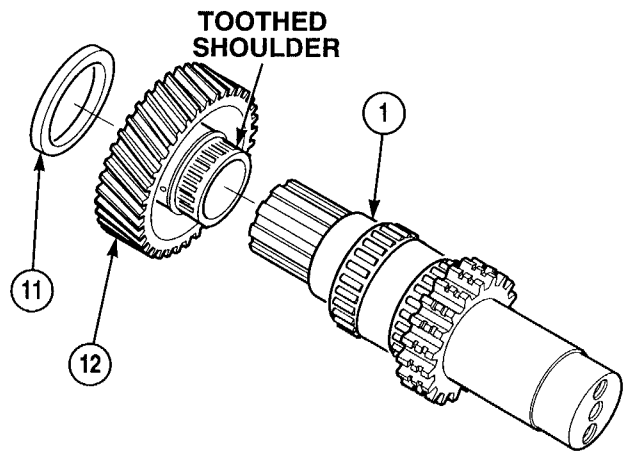


- (5) Coat mating surfaces of gear (12) and bearing spacer (11) with grease.

**NOTE**

Install toothed shoulder of gear on upper shaft first.

- (6) Install gear (12) and bearing spacer (11) on upper shaft (1).



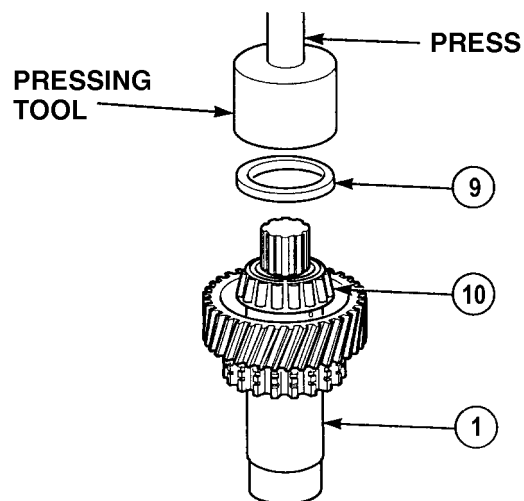
**WARNING**

Assembled portion of upper shaft assembly weighs 80 lbs (36 kg). Use an assistant to prevent possible injury to personnel.

**CAUTION**

Press on inner diameter of bearing or damage to equipment may result.

- (7) Using press, install bearing (10) and bearing spacer (9) onto upper shaft (1).

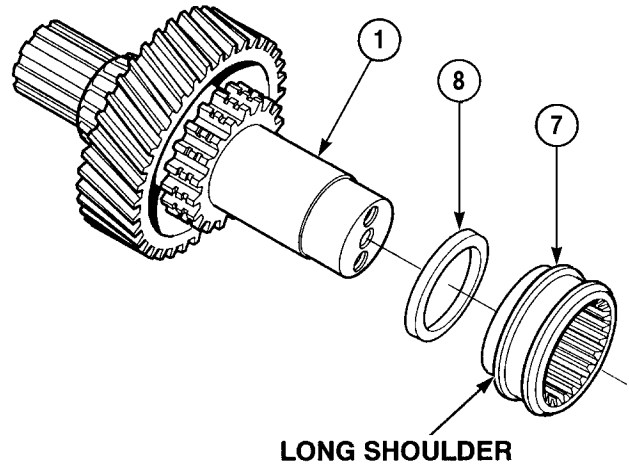


- (8) Coat inside of clutch collar (7) with grease.

**NOTE**

Long shoulder of clutch collar must be next to gear.

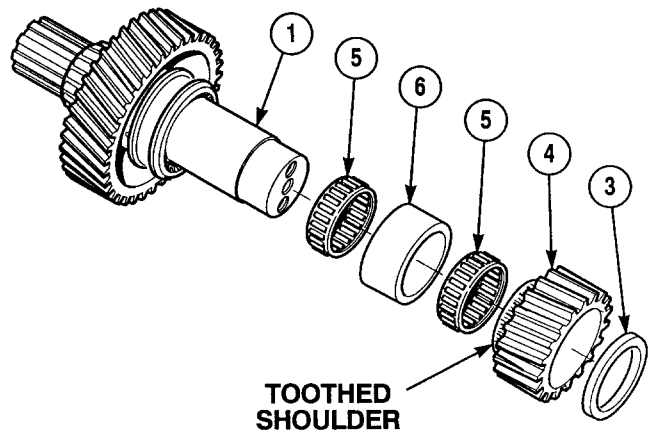
- (9) Install clutch collar (7) on upper shaft (1).
- (10) Install gear spacer (8) on upper shaft (1).



- (11) Coat two caged rollers (5) with grease.
- (12) Install one caged roller (5), bearing spacer (6) and second caged roller on upper shaft (1).

**WARNING**

Assembled portion of upper shaft assembly weighs 100 lbs (45 kg). Use an assistant to prevent possible injury to personnel.



- (13) Coat mating surfaces of small gear (4) and bearing spacer (3) with grease.

**NOTE**

Install toothed shoulder of small gear onto upper shaft first.

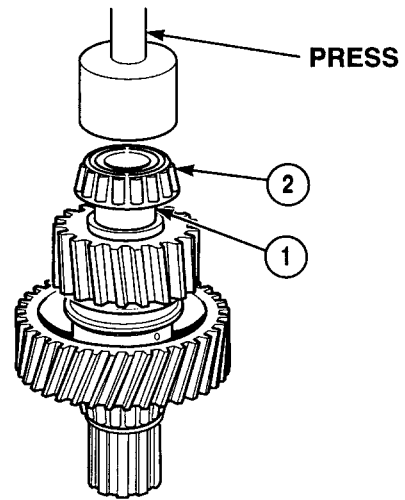
- (14) Install small gear (4) and bearing spacer (3) onto upper shaft (1).

**24-14. UPPER SHAFT REPAIR (CONT).**

**CAUTION**

Press on inner diameter of bearing or damage to equipment may occur.

- (15) Using press, install bearing (2) on upper shaft (1).



**d. Follow-On Maintenance:**

- Install upper shaft assembly in transfer case, (Para 24-8).

**END OF TASK**

## 24-15. UPPER SHIFT ROD REPAIR.

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/Inspection | d. Follow-on Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Wrench, Torque (0-175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

#### *Materials/Parts*

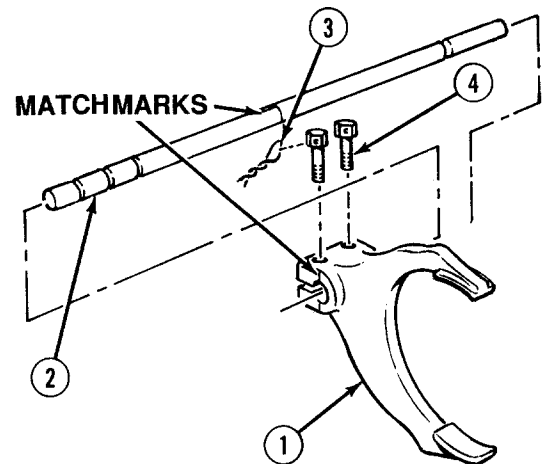
Sealing Compound (Item 56, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Wire, Nonelectrical (Item 79, Appendix B)

#### *Equipment Condition*

Shift rod removed from transfer case,  
(Para 24-8)

### a. *Disassembly.*

- (1) Matchmark shift fork (1) and upper shift rod (2) to ensure proper alignment of fork along length of rod.
- (2) Remove wire (3) and two screws (4) from shift fork (1). Discard wire.
- (3) Remove shift fork (1) from upper shift rod (2).



**24-15. UPPER SHIFT ROD REPAIR (CONT).**

***b. Cleaning/Inspection.***

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.

**WARNING**

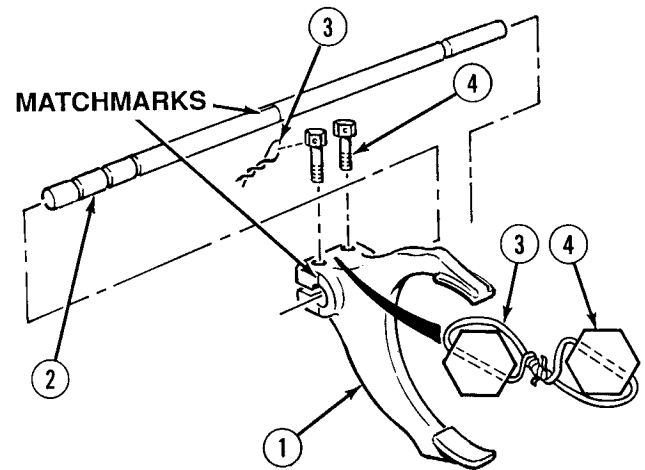
Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc).

- (2) Dry with compressed air.
- (3) Inspect parts for breaks, obvious wear, cracks, burrs or sharp edges.
- (4) Replace all damaged parts.

**c. Assembly.****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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (1) Coat threads of two screws (4) with sealing compound.
- (2) Align matchmarks and install shift fork (1) on upper shift rod (2) with two screws (4). Tighten screws to 40 lb-ft (54 N·m).
- (3) Install wire (3) in two screws (4).

**d. Follow-On Maintenance:**

- Install upper shift rod in transfer case, (Para 24-8).

**END OF TASK**

## 24-16. LOWER SHIFT ROD REPAIR.

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Disassembly         | c. Assembly              |
| b. Cleaning/Inspection | d. Follow-on Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Wrench, Torque (0-175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

#### *Materials/Parts*

Sealing Compound (Item 56, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Wire, Nonelectrical (Item 79, Appendix B)

#### *Equipment Condition*

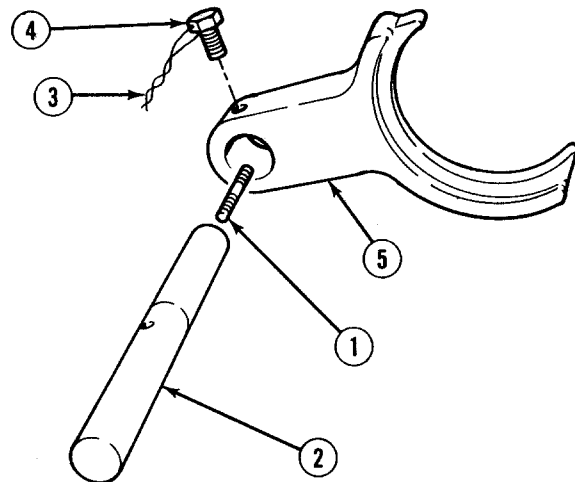
Lower shift rod removed from transfer case,  
(Para 24-8)

#### a. *Disassembly.*

#### NOTE

Perform Step (1) only if stud is damaged.

- (1) Remove stud (1) from lower shift rod (2).
- (2) Remove safety wire (3) and screw (4) from shift fork (5). Discard safety wire.
- (3) Remove shift fork (5) from lower shift rod (2).



#### b. *Cleaning/Inspection.*

#### WARNING

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning 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).

- (2) Dry with compressed air.
- (3) Inspect parts for breaks, obvious wear, cracks, burrs or sharp edges.
- (4) Replace all damaged parts.

**c. Assembly.****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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (1) Coat threads of screw (4) with sealing compound.
- (2) Install shift fork (5) on lower shift rod (2) with screw (4). Tighten screw to 40 lb-ft (54 N·m).

**NOTE**

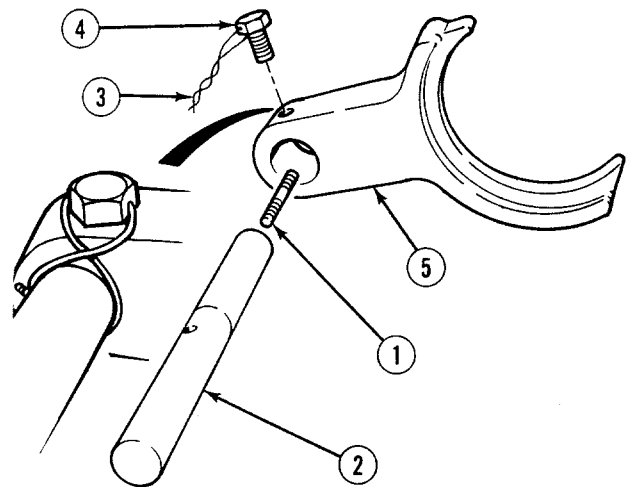
Wire goes on lower side of shift fork.

- (3) Install wire (3) in screw (4).

**NOTE**

Perform Steps (4) and (5) if stud was removed.

- (4) Coat coarse threads of stud (1) with sealing compound.
- (5) Install stud (1) in end of lower shift rod (2).

**d. Follow-On Maintenance:**

- Install lower shift rod in transfer case, (Para 24-8).

**END OF TASK**



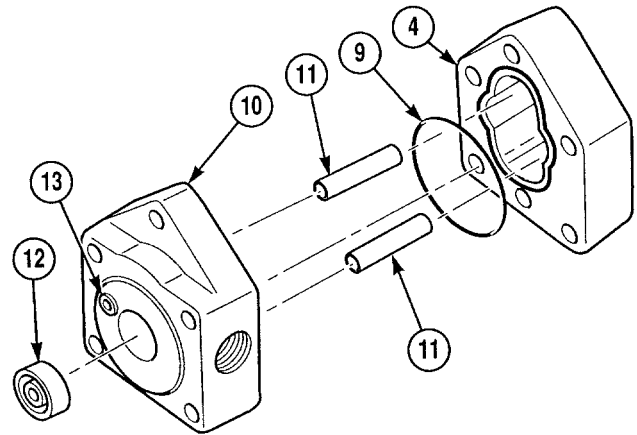


- (4) Remove housing (4) and gasket (9) from end plate (10). Discard gasket.
- (5) Remove two alignment sleeves (11) from end plate (10).
- (6) Remove seal (12) from end plate (10). Discard seal.

**NOTE**

Perform Step (7) if plug is damaged.

- (7) Remove plug (13) from end plate (10).



**b. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
  - (2) Inspect all parts for wear, nicks, burrs or scratches.
  - (3) Replace damaged parts.

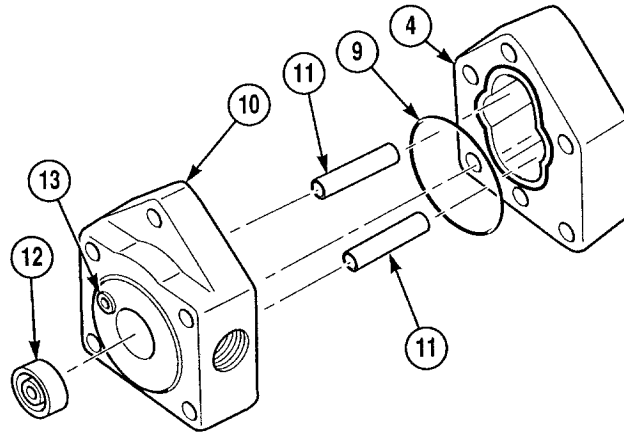
**24-17. TRANSFER CASE LUBRICATION PUMP REPAIR (CONT).**

**c. Assembly.**

- (1) Apply lubricating oil to seal (12) and install in end plate (10).

**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.

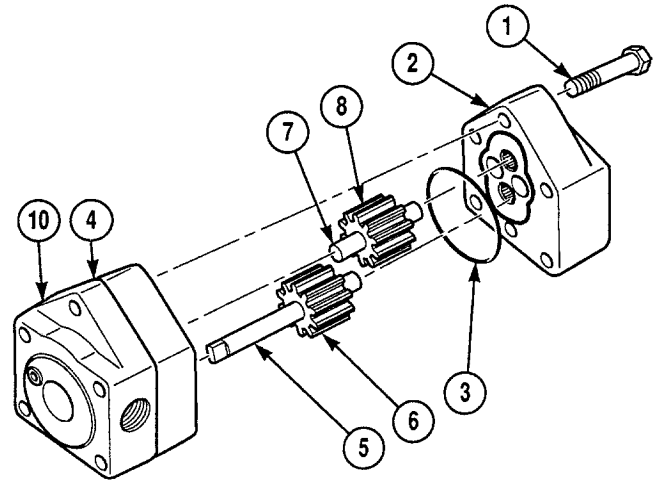


**NOTE**

Perform Steps (2) and (3) if plug was removed.

- (2) Apply sealing compound to plug (13).
- (3) Install plug (13) in end plate (10).
- (4) Install two alignment sleeves (11) in end plate (10).
- (5) Apply lubricating oil to gasket (9).
- (6) Install gasket (9) in housing (4).

- (7) Install housing (4) on end plate (10).
- (8) Install shaft (5) with gear (6) in housing (4) and end plate (10).
- (9) Install shaft (7) with gear (8) in housing (4) and end plate (10).
- (10) Apply lubricating oil to gasket (3).
- (11) Install gasket (3) on head (2).
- (12) Align screw holes in head (2) with sleeves in housing (4).



**NOTE**

Install head with gasket facing housing.

- (13) Install head (2) on housing (4) and end plate (10) with two screws (1).

**END OF TASK**



## CHAPTER 25

### AXLE MAINTENANCE

Para	Contents	Page
25-1	General Support Axle Maintenance Introduction .....	25-1
25-2	Axle On Stand Removal/Installation .....	25-2
25-3	Axle No. 1, 2 And 5 Brake Drum Replacement .....	25-4
25-4	Axle No. 1 And 2 Air Brake Chamber Replacement .....	25-8
25-5	Axle No. 5 Air Brake Chamber Replacement .....	25-13
25-6	Axle No. 1, 2 And 5 Planetary Hub Gear Replacement .....	25-17
25-7	Axle No. 1, 2 And 5 Wheel Hub Assembly Repair .....	25-20
25-8	Axle No. 1, 2 And 5 Brake Assembly Replacement .....	25-27
25-9	Axle No. 1, 2 And 5 Tie Rod Repair .....	25-30
25-10	Axle No. 1 And 5 Locking Cylinder Replacement .....	25-35
25-11	Axle No. 2 Locking Cylinder Replacement .....	25-38
25-12	Axle No. 1, 2 And 5 Pivot And Spindle/Trunnion Bearing Assembly Repair .....	25-43
25-13	Axle No. 1, 2 And 5 Constant Velocity Joint Repair .....	25-52
25-14	Axle No. 2 Rear Output Assembly Replacement .....	25-58
25-15	Axle No. 1 And 5 Differential Assembly Repair .....	25-62
25-16	Axle No. 2 Differential Assembly Repair .....	25-79
25-17	Axle No. 3 And 4 Brake Drum Replacement .....	25-103
25-18	Axle No. 3 And 4 Air Brake Chamber Replacement .....	25-107
25-19	Axle No. 3 And 4 Planetary Hub Gear Replacement .....	25-111
25-20	Axle No. 3 And 4 Wheel Hub Assembly Repair .....	25-114
25-21	Axle No. 3 And 4 Brake Assembly Replacement .....	25-122
25-22	Axle No. 3 Locking Cylinder Replacement .....	25-125
25-23	Axle No. 4 Locking Cylinder Replacement .....	25-129
25-24	Axle No. 3 And 4 Spindle Repair .....	25-134
25-25	Axle No. 3 And 4 Shafts Replacement .....	25-138
25-26	Axle No. 3 Rear Flange Oil Seal Replacement .....	25-140
25-27	Axle No. 4 Rear Output Assembly Replacement .....	25-142
25-28	Axle No. 3 Differential Assembly Repair .....	25-146
25-29	Axle No. 4 Differential Assembly Repair .....	25-181
25-30	Dressed Axle Air line Replacement .....	25-207

#### 25-1. GENERAL SUPPORT AXLE MAINTENANCE INTRODUCTION.

This chapter contains maintenance instructions for replacing and repairing axle components as authorized by the Maintenance Allocation Chart (MAC) at the General Support Maintenance level.



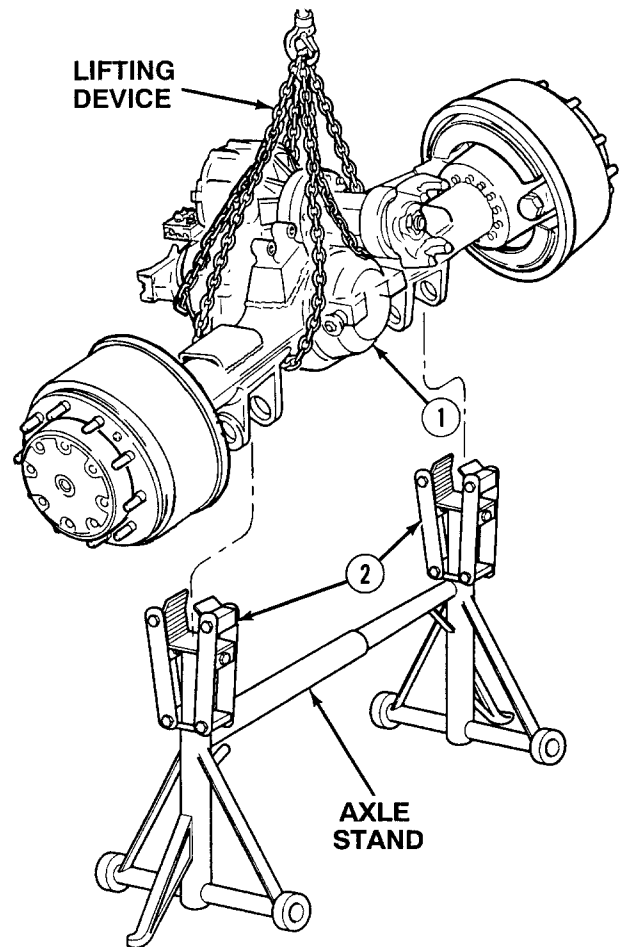
**b. Removal.****WARNING**

Axle No. 3 weighs 2,048 lbs (930 kg). Attach a suitable lifting device prior to removal to prevent possible injury to personnel. Stabilizing chains must be attached to axle housing to prevent an out of balance condition when axle is lifted. Axle could roll out of control causing serious injury or death to personnel.

**NOTE**

Axle No. 3 is shown. Axles No. 1, 2, 4 and 5 are similar.

- (1) Attach lifting device to Axle No. 3 (1).
- (2) Loosen two axle stand clamping bolts (2) and remove Axle No. 3 (1) from axle stand.
- (3) Remove lifting device from Axle No. 3 (1).

**c. Follow-On Maintenance:**

- Install axle, (Para 9-3, Para 9-4, Para 9-11, Para 9-12 or Para 9-13).

**END OF TASK**



## 25-3. AXLE NO. 1, 2 AND 5 BRAKE DRUM REPLACEMENT.

This task covers:

- |                             |                               |                          |
|-----------------------------|-------------------------------|--------------------------|
| a. Caging Air Brake Chamber | c. Installation               | e. Follow-On Maintenance |
| b. Removal                  | d. Uncaging Air Brake Chamber |                          |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Lifting Device, Minimum Capacity 132 lbs  
(60 kg)

#### *Materials/Parts*

Compound, Antiseize (Item 14, Appendix B)  
Oil, Lubricating (Item 36, Appendix B)

#### *Materials/Parts - Continued*

Sealing Compound (Item 53, Appendix B)  
Packing, Preformed (Item 399, Appendix E)

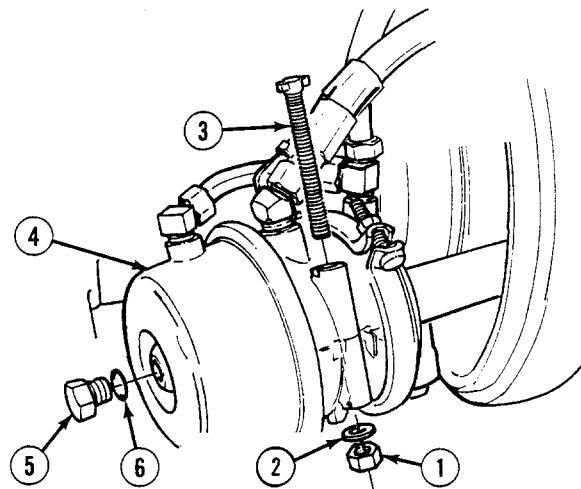
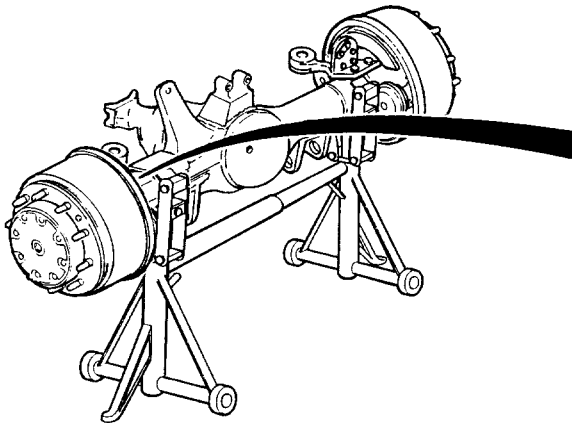
#### *Personnel Required*

Two

#### *Equipment Condition*

Axle on stand, (Para 25-2)

### a. Caging air brake chamber.

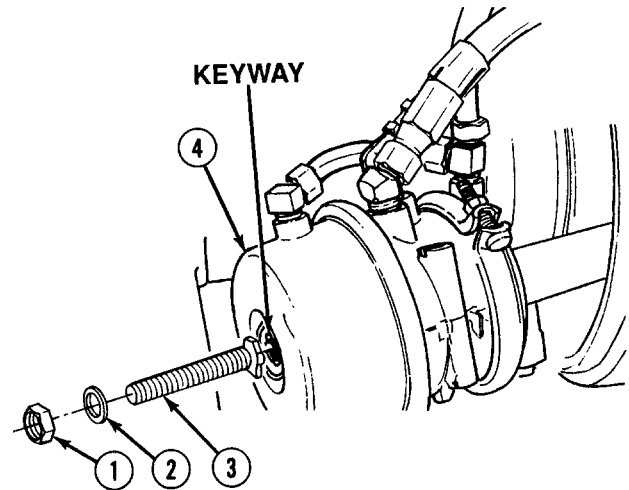


### NOTE

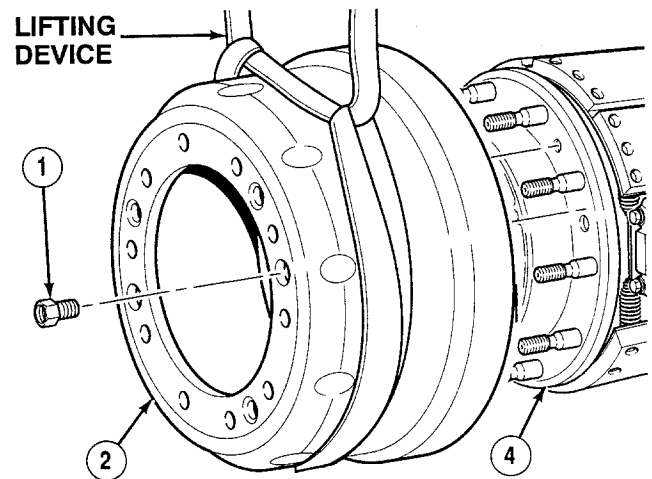
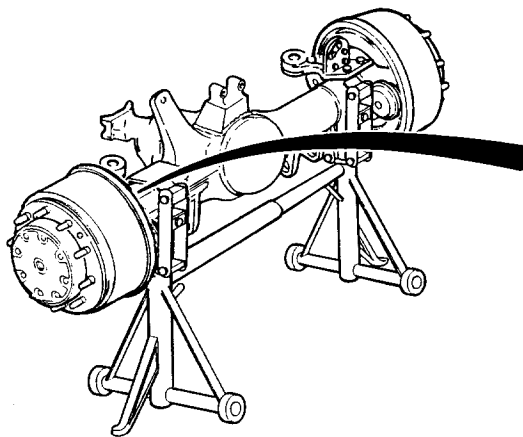
- Only Axles No. 3, 4, and 5 are caged.
- Perform Steps (1) through (4) for Axle No. 5. Axle No. 5 is shown.

- (1) Remove nut (1), washer (2) and caging bolt (3) from storage slot of air brake chamber (4).
- (2) Remove plug (5) and preformed packing (6) from air brake chamber (4). Discard preformed packing.

- (3) Insert caging bolt (3) into keyway of air brake chamber (4). Turn caging bolt 1/4 turn to the right. Caging bolt will contact a lock plate.
- (4) Install washer (2) and nut (1) onto caging bolt (3). Cage air brake chamber (4) by tightening nut.



**b. Removal.**



- (1) Remove two fittings (1) from brake drum (2).

**WARNING**

Brake drum weighs 132 lbs (60 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (2) Attach lifting device to brake drum (2).
- (3) With the aid of an assistant and a lifting device, remove brake drum (2) from hub (4).
- (4) Remove lifting device from brake drum (2).

**25-3. AXLE NO. 1, 2 AND 5 BRAKE DRUM REPLACEMENT (CONT).**

**c. Installation.**

**WARNING**

Brake drum weighs 132 lbs (60 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- (1) Attach lifting device to brake drum (2).

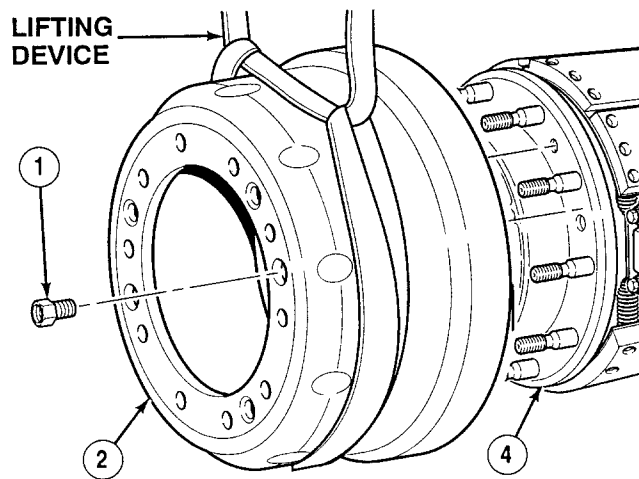
**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

**NOTE**

Ensure that fitting holes line up before securing brake drum in place.

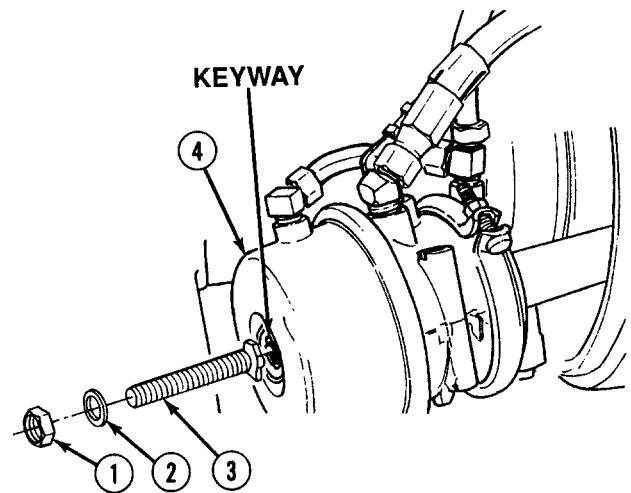
- (2) With the aid of an assistant and using a lifting device, install brake drum (2) on hub (4).
- (3) Coat threads of two fittings (1) with sealing compound.
- (4) Install two fittings (1) in brake drum (2).



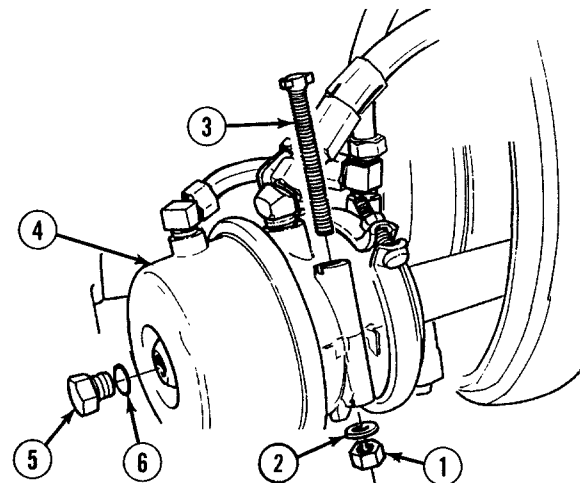
**d. Uncaging air brake chamber.****NOTE**

Perform Steps (1) through (5) for Axle No. 5. Axle No. 5 is shown.

- (1) Loosen and remove nut (1) and washer (2) from caging bolt (3).
- (2) Turn caging bolt (3) 1/4 turn to the left and remove from air brake chamber (4).



- (3) Install caging bolt (3) in storage slot using washer (2) and nut (1).
- (4) Apply lubricating oil to preformed packing (6).
- (5) Install plug (5) and preformed packing (6) in air brake chamber (4).

**e. Follow-On Maintenance:**

- Remove axle from stand, (Para 25-2).

**END OF TASK**

## 25-4. AXLE NO. 1 AND 2 AIR BRAKE CHAMBER REPLACEMENT.

This task covers:

- a. Front Air Brake Chamber Replacement
- b. Rear Air Brake Chamber Replacement
- c. Follow-On Maintenance

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Wrench, Spanner (Item 275, Appendix F)  
Wrench, Torque (0 to 600 lb-ft [0-814 N·m])  
(Item 278, Appendix F)

#### *Materials/Parts*

Grease (Item 23, Appendix B)

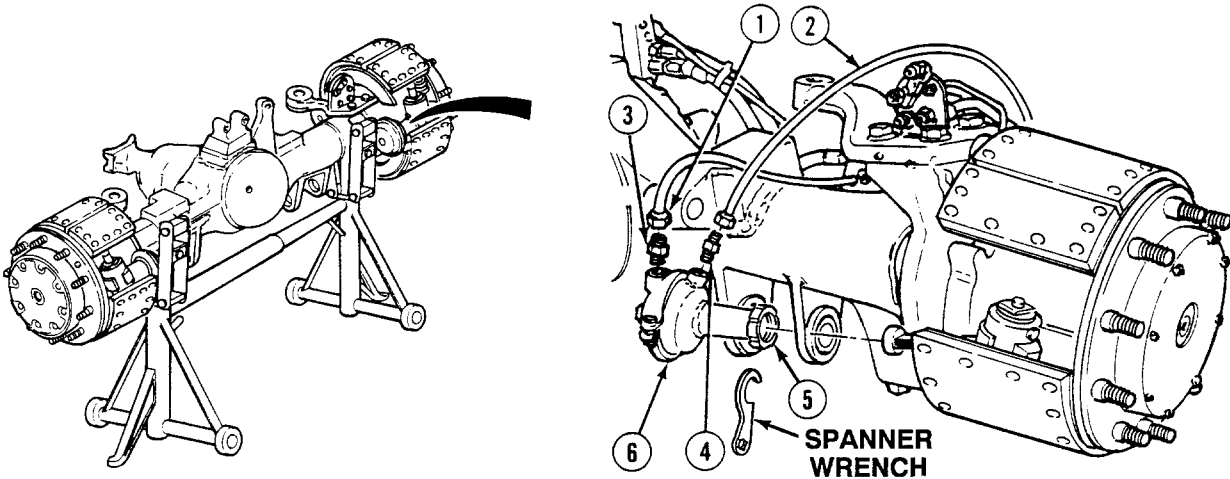
#### *Materials/Parts - Continued*

Sealing Compound (Item 52, Appendix B)  
Sealing Compound (Item 53, Appendix B)  
Tags, Identification (Item 72, Appendix B)

#### *Equipment Condition*

Brake drum removed, (Para 25-3)

### a. Front Air Brake Chamber Replacement.



### NOTE

- Tag and mark air lines before removal.
- Refer to Table 25-1 for air line numbers.
- Note position of air brake chamber prior to removal.
- Axle No. 2 air chambers are removed the same way. Axle No. 1 is shown.

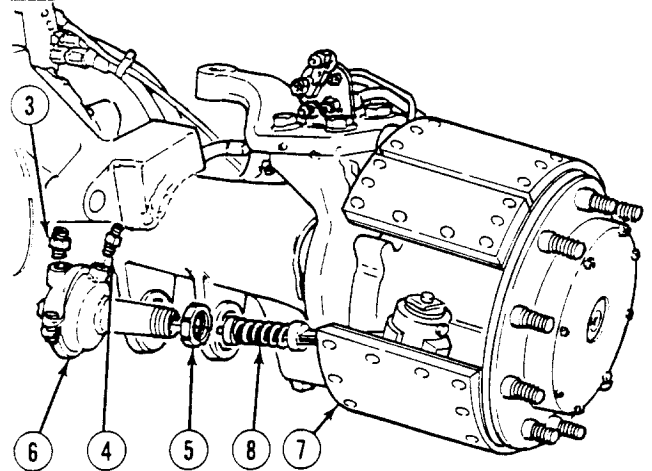
#### (1) *Removal.*

- (a) Remove air lines (1) and (2) from fittings (3) and (4).
- (b) Using spanner wrench, loosen collet nut (5) on air brake chamber (6).

**NOTE**

Perform Step (c) only if fittings are damaged or new air chamber is being installed.

- (c) Remove two fittings (3) and (4) from air brake chamber (6).
- (d) Remove air brake chamber (6) from brake assembly (7).
- (e) Remove wedge assembly (8) from brake assembly (7).



**NOTE**

Perform Step (f) only if collet nut is damaged.

- (f) Remove collet nut (5) from air brake chamber (6).

**Table 25-1. Air Line Numbers**

Axle No. 1		Axle No. 2	
Right Side	Left Side	Right Side	Left Side
2874	2874	2874	2874
2013	2012	2387	2388
2874	2874	2874	2874

(2) *Installation.*

- (a) Coat wedge assembly (8) with grease.
- (b) Install wedge assembly (8) in brake assembly (7).

**NOTE**

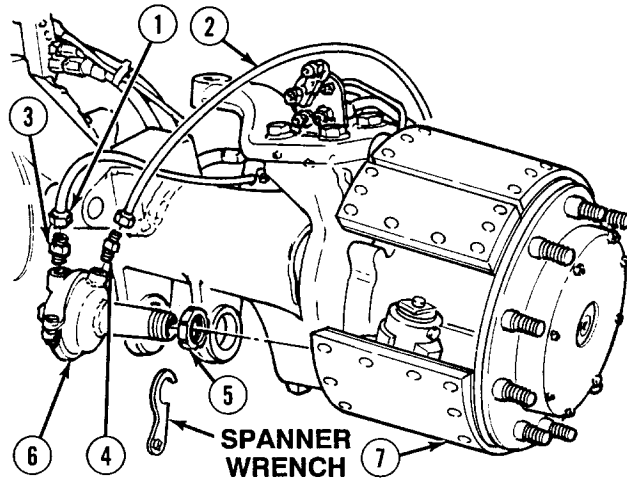
Perform Step (c) only if collet nut was removed.

- (c) Install collet nut (5) onto air brake chamber (6) until threads on air brake chamber run out.

**25-4. AXLE NO. 1 AND 2 AIR BRAKE CHAMBER REPLACEMENT (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.



- (d) Coat first three threads of air brake chamber (6) with sealing compound.
- (e) Install air brake chamber (6) into brake assembly (7) until air brake chamber bottoms out in brake assembly.

**CAUTION**

Air brake chamber can only be unscrewed a maximum of one turn. Otherwise, incorrect brake operation could result.

- (f) Rotate air brake chamber (6) to align air ports.
- (g) Using spanner wrench, tighten collet nut (5) to 250 to 280 lb-ft (339 to 380 N·m).

**NOTE**

Perform Step (h) only if fittings were removed.

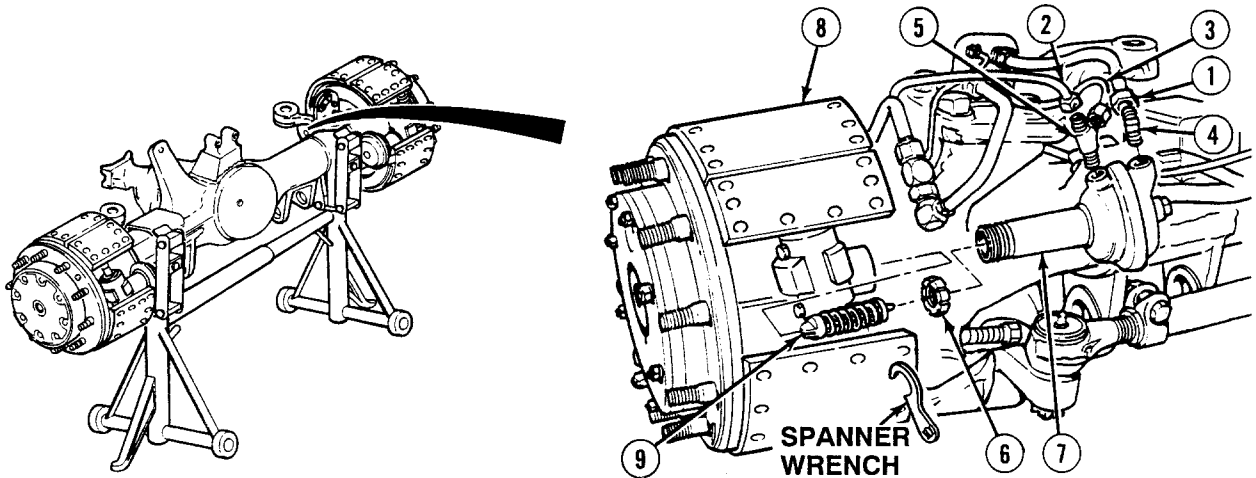
- (h) Coat threads of two fittings (3) and (4) with sealing compound.
- (i) Install fittings (3) and (4) in air brake chamber (6).

**NOTE**

Refer to Table 25-1 for air line numbers.

- (j) Install air lines (1) and (2) to air brake chamber fittings (3) and (4).

**b. Rear Air Brake Chamber Replacement.**



**NOTE**

- Tag and mark air lines before removal.
- Refer to Table 25-1 for air line numbers.
- Note position of air brake chamber prior to removal.
- Axle No. 2 air chambers are removed the same way. Axle No. 1 is shown.

(1) *Removal.*

- (a) Remove air lines (1), (2) and (3) from elbow (4) and tee (5).
- (b) Using spanner wrench, loosen collet nut (6) on air brake chamber (7).

**NOTE**

Perform Step (c) only if elbow and tee are damaged or new air brake chamber is being installed.

- (c) Remove elbow (4) and tee (5) from air brake chamber (7).
- (d) Remove air brake chamber (7) from brake assembly (8).
- (e) Remove wedge assembly (9) from brake assembly (8).

**NOTE**

Perform Step (f) only if collet nut is damaged.

- (f) Remove collet nut (6) from air brake chamber (7).



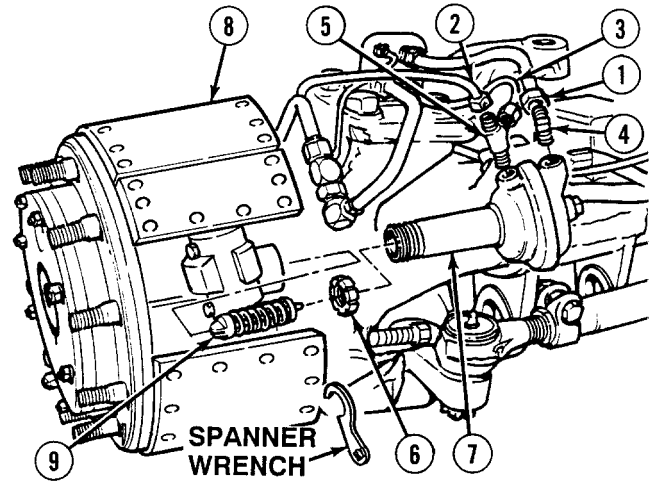
**25-4. AXLE NO. 1 AND 2 AIR BRAKE CHAMBER REPLACEMENT (CONT).**

(2) *Installation.*

- (a) Coat wedge assembly (9) with grease.
- (b) Install wedge assembly (9) in brake assembly (8).
- (c) Install collet nut (6) onto air brake chamber (7) until threads on air brake chamber run out.

**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.



- (d) Coat first three threads of air brake chamber (7) with sealing compound.
- (e) Install air brake chamber (7) into brake assembly (8) until air brake chamber bottoms out in brake assembly.

**CAUTION**

Air brake chamber can only be unscrewed a maximum of one turn. Otherwise, incorrect brake operation could result.

- (f) Rotate air brake chamber (7) to align air ports.
- (g) Using spanner wrench, tighten collet nut (6) to 250 to 280 lb-ft (339 to 380 N·m).

**NOTE**

Perform Step (h) and (i) if elbow and tee were removed.

- (h) Coat threads of elbow (4) and tee (5) with sealing compound.
- (i) Install elbow (4) and tee (5) in air brake chamber (7).
- (j) Connect air lines (1), (2) and (3) to elbow (4) and tee (5).

**c. Follow-On Maintenance:**

- Install brake drum, (Para 25-3).

**END OF TASK**



**25-5. AXLE NO. 5 AIR BRAKE CHAMBER REPLACEMENT (CONT).**

**WARNING**

Spring in air brake chamber is very powerful and is under tension. Failure to cage air brake chamber before removal will release tension of spring abruptly and could result in injury to personnel.

- (5) Using spanner wrench, loosen collet nut (10).
- (6) Remove air brake chamber (9) from brake assembly (11).

**NOTE**

Perform Step (7) only if collet nut is damaged.

- (7) Remove collet nut (10) from air brake chamber (9).
- (8) Remove wedge assembly (12) from brake assembly (11).

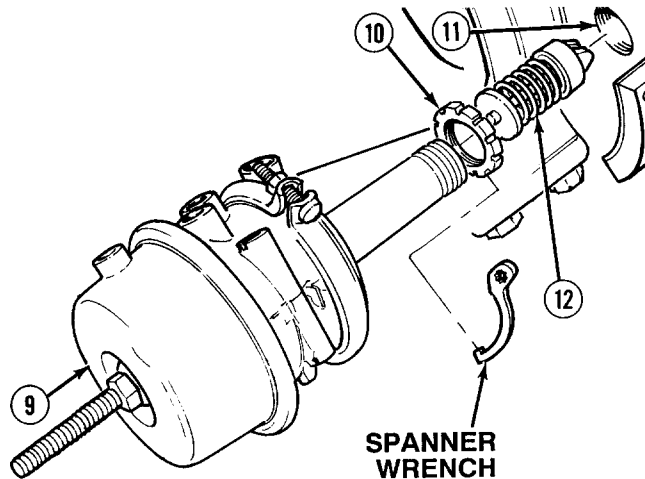
**b. Installation.**

- (1) Coat wedge assembly (12) with grease.
- (2) Install wedge assembly (12) in brake assembly (11).

**NOTE**

Perform Step (3) only if collet nut was removed.

- (3) Install collet nut (10) onto air brake chamber (9) until threads on air brake chamber run out.



**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.

- (4) Coat first three threads of air brake chamber (9) with sealing compound.

**NOTE**

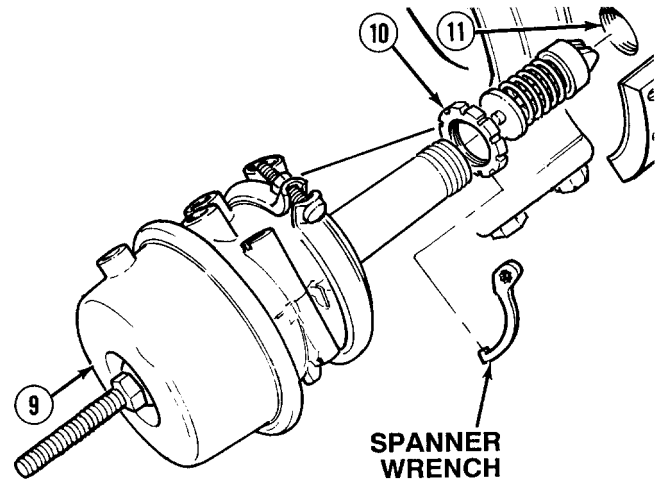
If installing a new air brake chamber, the air brake chamber must be caged before it can be installed.

- (5) Install air brake chamber (9) into brake assembly (11) until air brake chamber bottoms out in brake assembly.

**WARNING**

Air brake chamber can only be unscrewed a maximum of one turn. Otherwise, incorrect brake operation could result.

- (6) Rotate air brake chamber (9) to align air ports.
- (7) Using spanner wrench, tighten collet nut (10) to 250 to 280 lb-ft (339 to 380 N·m).



**25-5. AXLE NO. 5 AIR BRAKE CHAMBER REPLACEMENT (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**

Perform Steps (8) and (9) if elbows or tee were changed, or if a new air brake chamber was installed.

- (8) Coat threads of elbows (2), (7) and (8) and tee (3) with sealing compound.

**NOTE**

Install fittings as noted prior to removal.

- (9) Install elbows (2), (7) and (8) and tee (3) on air brake chamber (9).

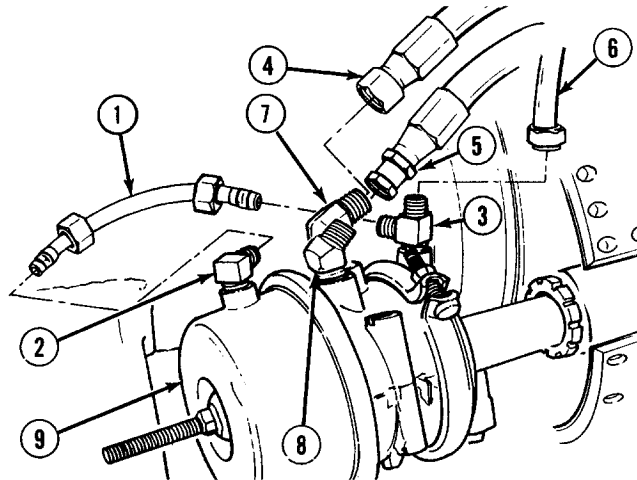
**NOTE**

Perform Step (10) for left side and Step (11) for right side.

- (10) Install air lines 2141 (4), 2016 (5) and 2874 (6) to elbows (7) and (8) and tee (3).
- (11) Install air lines 2140 (4), 2018 (5) and 2874 (6) to elbows (7) and (8) and tee (3).
- (12) Install air line 2874 (1) to elbow (2) and tee (3).

**c. Follow-On Maintenance:**

- Install brake drum, (Para 25-3).



**END OF TASK**

**25-6. AXLE NO. 1, 2 AND 5 PLANETARY HUB GEAR REPLACEMENT.**

This task covers:

- a. Removal
- b. Installation
- c. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Socket, Socket Head Screw, 12 mm (Item 206, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m]) (Item 277, Appendix F)
- Extractor, Jet (Appendix C)

*Equipment Condition*

- Air brake chamber removed, (Para 25-4 or Para 25-5)
- Axle air lines removed, (Para 25-30)

*Materials/Parts*

- Adhesive (Item 1, Appendix B)
- Sealing Compound (Item 56, Appendix B)
- Locknut (8) (Item 217, Appendix E)

**a. Removal.**

**NOTE**

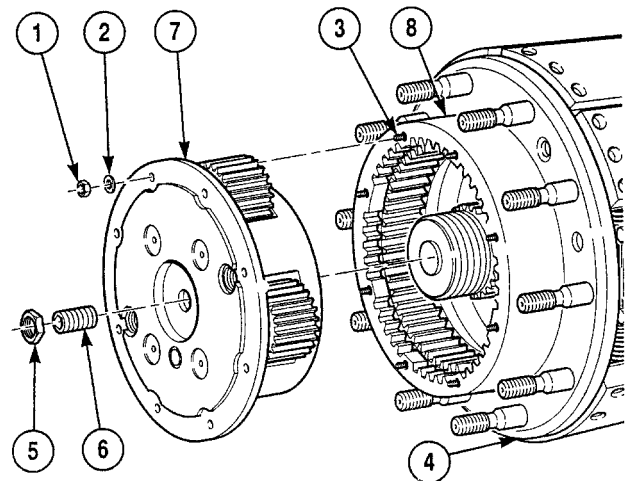
Studs may come off with locknuts.

- (1) Remove eight locknuts (1) and washers (2) from studs (3). Discard locknuts.

**NOTE**

Screw may come off with nut. If this happens, separate screw and nut and install screw.

- (2) Hold hub (4) and remove nut (5) from screw (6).
- (3) Tighten screw (6) until planetary gear carrier assembly (7) is separated from ring gear carrier assembly (8). Remove screw (6) from planetary gear assembly (7).
- (4) Remove planetary gear carrier assembly (7) from ring gear carrier assembly (8).



**25-6. AXLE NO. 1, 2 AND 5 PLANETARY HUB GEAR REPLACEMENT (CONT).**

- (5) Remove end cap (9) from sun gear (10).
- (6) Position jet extractor between teeth of sun gear (10) and teeth of ring gear carrier assembly (8).
- (7) Remove screw (11) from sun gear (10).
- (8) Remove jet extractor.
- (9) Remove sun gear (10) and muff (12) from ring gear carrier assembly (8).

**NOTE**

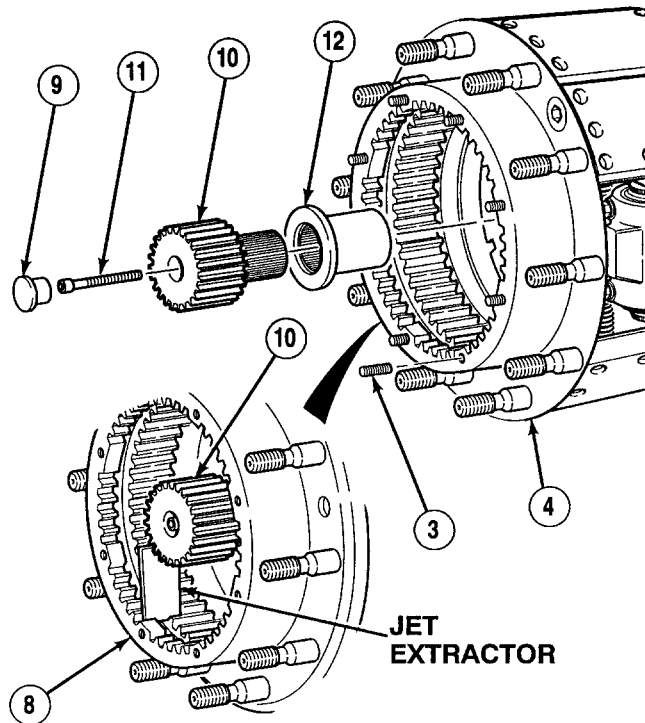
Perform Step (10) only if studs are damaged.

- (10) Remove eight studs (3) from ring gear carrier assembly (8).

**b. Installation.**

**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**

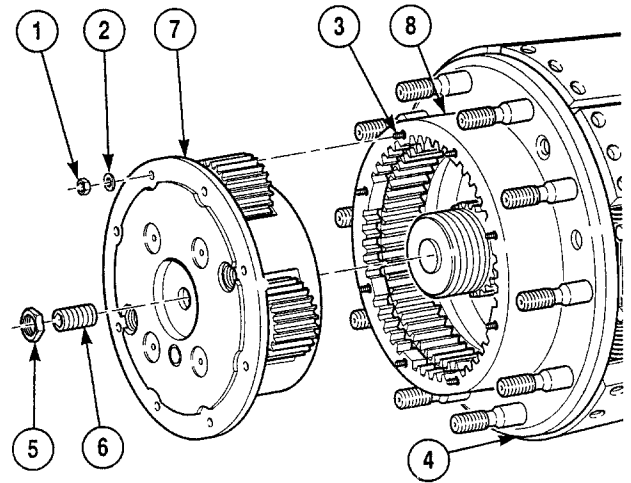
Perform Steps (1) and (2) only if studs were removed.

- (1) Coat threads of eight studs (3) with sealing compound.
- (2) Install eight studs (3) in ring gear carrier assembly (8).
- (3) Install muff (12) and sun gear (10) in ring gear carrier assembly (8).
- (4) Position jet extractor between teeth of sun gear (10) and teeth of ring gear carrier assembly (8).
- (5) Coat screw (11) with sealing compound.
- (6) Install screw (11) in sun gear (10). Tighten screw to 135 to 165 lb-ft (183 to 223 N·m).
- (7) Install end cap (9) on sun gear (10).

**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.

- (8) Coat mating surface of ring gear carrier assembly (8) with adhesive.
- (9) Install planetary gear carrier assembly (7) in ring gear carrier assembly (8).
- (10) Coat protruding threads of eight studs (3) with adhesive.
- (11) Install eight washers (2) and locknuts (1) on studs (3). Tighten locknuts to 38 to 45 lb-ft (52 to 61 N·m).
- (12) Install screw (6) in planetary gear carrier assembly (7) and tighten until screw bottoms out. Back screw off 3/4 of a turn.
- (13) Coat protruding threads of screw (6) with sealing compound.
- (14) Install nut (5) on screw (6). Tighten nut to 152 lb-ft (206 N·m).



**c. Follow-On Maintenance:**

- Install axle air lines, (Para 25-30).
- Install air brake chambers, (Para 25-4 or Para 25-5).

**END OF TASK**



## 25-7. AXLE NO. 1, 2 AND 5 WHEEL HUB ASSEMBLY REPAIR.

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Adapter, Socket (3/4 in. female to 1 in. male)  
(Item 10, Appendix F)  
Driver, CTIS Seal (Item 52, Appendix F)  
Driver, CTIS Seal (Item 53, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Hammer, Hand, Soft Plastic  
(Item 88, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)  
Protector, Spindle (Item 169, Appendix F)  
Puller Kit, Universal, Slide Hammer  
(Item 175, Appendix F)  
Socket, Spindle Nut (Item 219, Appendix F)  
Wrench, Torque (0 to 600 lb-ft [0-814 N·m])  
(Item 278, Appendix F)  
Lifting Device, Minimum Capacity 115 lbs  
(52 kg)

#### *Materials/Parts*

Grease (Item 22, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Lockwasher (Item 264, Appendix E)  
Seal, Oil (Item 600, Appendix E)  
Seal, Ring (Item 618, Appendix E)  
Seal, Ring (Item 619, Appendix E)  
Snap Ring (Item 649, Appendix E)

#### *Personnel Required*

Two

#### *Equipment Condition*

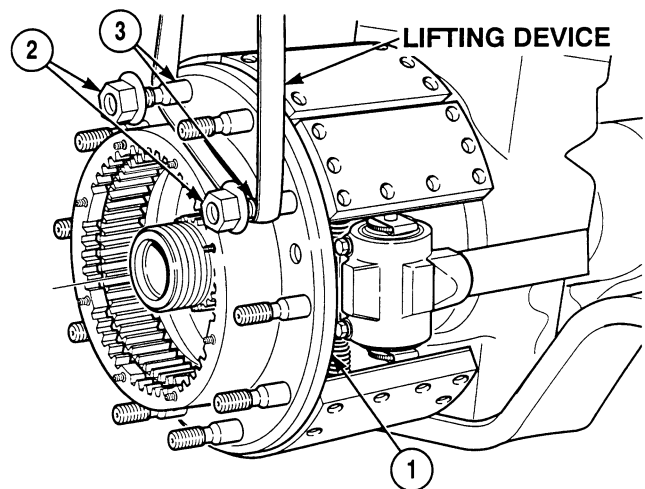
Planetary hub gear removed, (Para 25-6)

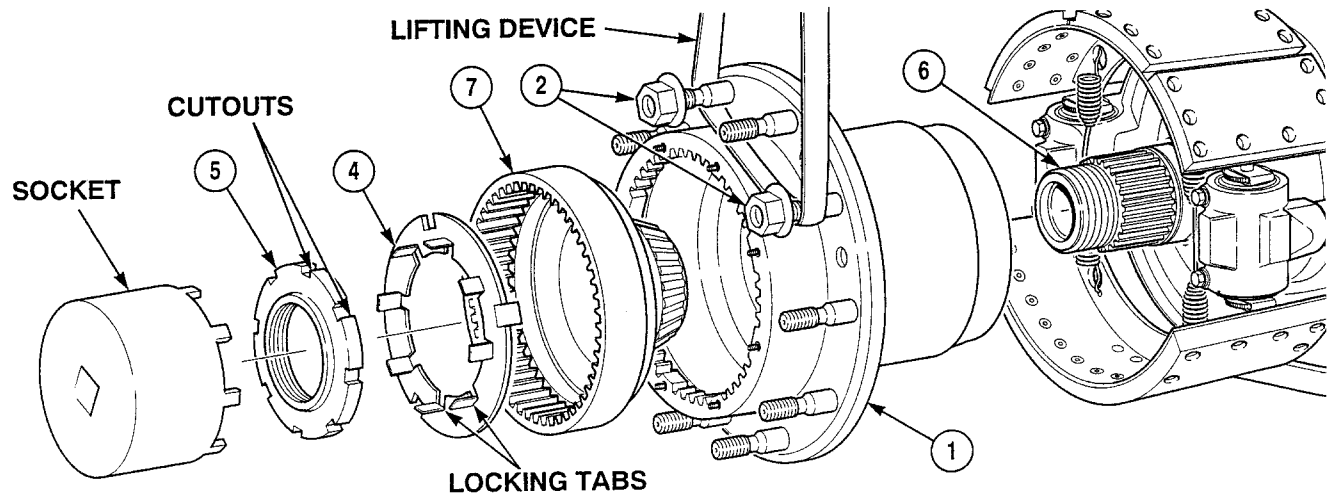
### a. Removal.

#### **WARNING**

Wheel hub assembly weighs 115 lbs (52 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (1) Attach strap and lifting device to wheel hub assembly (1).
- (2) Attach two wheel nuts (2) on two studs (3).

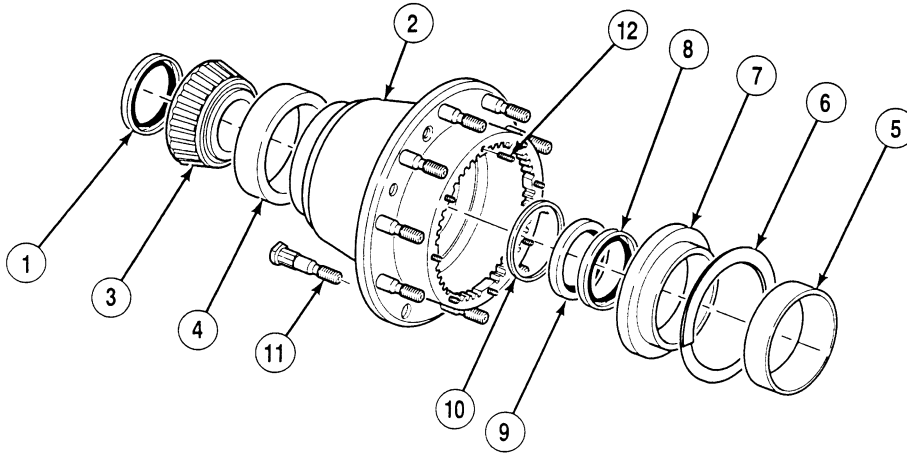




- (3) Bend up two locking tabs on lockwasher (4) clear of cutouts on spindle nut (5).
- (4) Using socket, remove spindle nut (5) and lockwasher (4) from pivot and spindle assembly (6). Discard lockwasher.
- (5) With the aid of an assistant, use lifting device and remove wheel hub assembly (1) from pivot and spindle assembly (6).
- (6) Remove two wheel nuts (2) and lifting device from wheel hub assembly.
- (7) Remove ring gear carrier assembly (7) from wheel hub assembly (1).

**25-7. AXLE NO. 1, 2 AND 5 WHEEL HUB ASSEMBLY REPAIR (CONT).**

**b. Disassembly.**



- (1) Remove oil seal (1) from wheel hub (2). Discard oil seal.
- (2) Remove bearing (3) from wheel hub (2).
- (3) Remove bearing races (4) and (5) from wheel hub (2).

**WARNING**

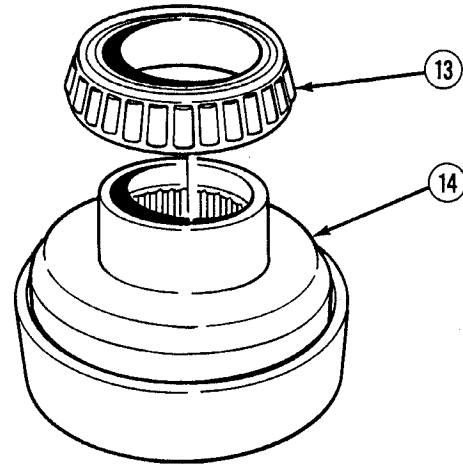
Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (4) Remove snap ring (6), outside ring (7), seals (8) and (9) and guide ring (10) from wheel hub (2). Discard seals and snap ring.

**NOTE**

- Perform Steps (5) and (6) only if studs are damaged.
  - Four studs are longer than the other six studs to retain wheel cover. Note location of these studs for proper assembly.
- (5) Remove studs (11) from wheel hub (2).
  - (6) Remove studs (12) from wheel hub (2).

- (7) Using press, remove bearing (13) from ring gear carrier assembly (14).



**c. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
  - (2) Inspect metal parts for breaks, cracks, burrs, and sharp edges.
  - (3) Inspect bearings for wear, scoring, cracks, or other obvious damage.
  - (4) Replace all damaged parts.

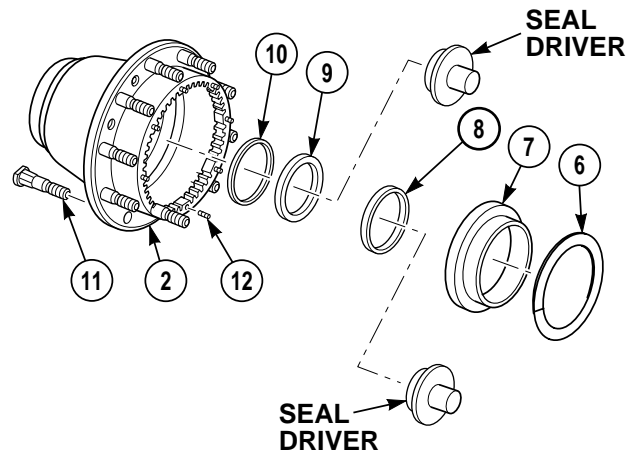
**d. Assembly.**

- (1) Pack bearing (13) with grease.
- (2) Install bearing (13) on ring gear carrier assembly (14).

**25-7. AXLE NO. 1, 2 AND 5 WHEEL HUB ASSEMBLY REPAIR (CONT).**

**NOTE**

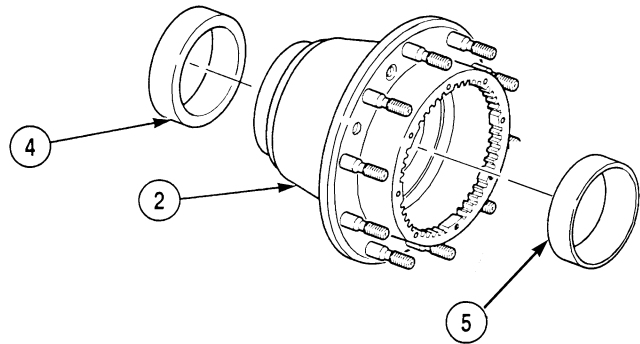
- Perform Steps (3) or (4) if studs were removed.
- Install four longer studs in positions marked during disassembly.
- Ensure flat edge of stud head is positioned parallel to edge of wheel hub.



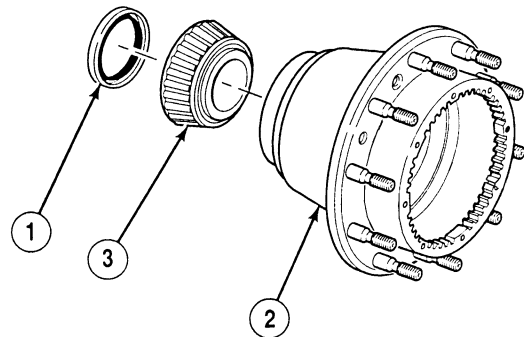
- (3) Install studs (11) in wheel hub (2).
- (4) Install studs (12) in wheel hub (2).
- (5) Coat seals (8) and (9) with grease.
- (6) Using seal driver, install guide ring (10) and seal (9) in wheel hub (2).
- (7) Using seal driver, install seal (8) in wheel hub (2).

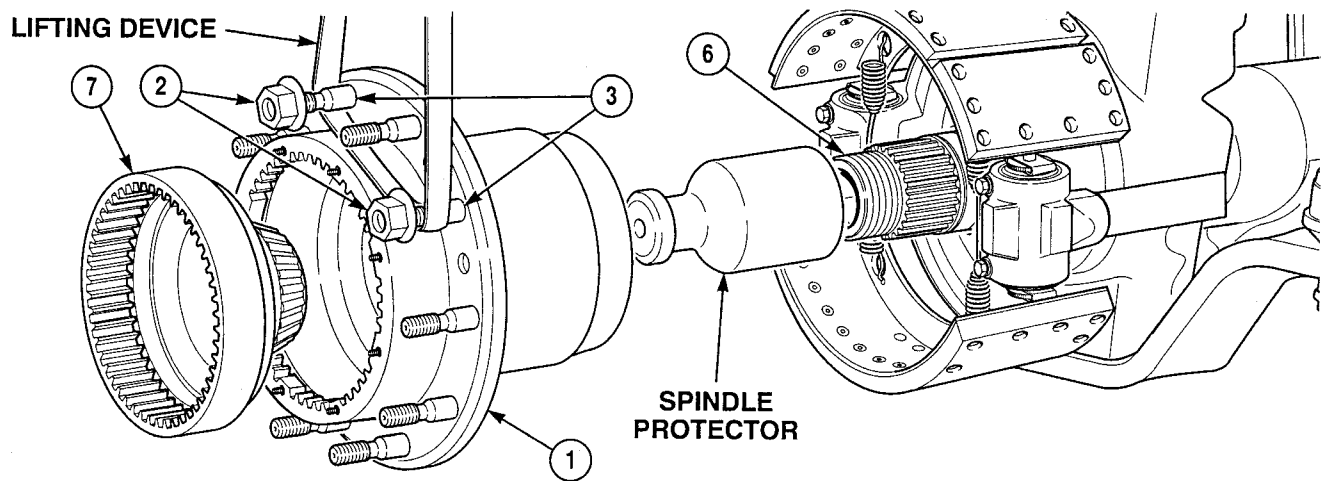
**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.



- (8) Install outside ring (7) and retaining ring (6) in wheel hub (2).
- (9) Coat bearing races (4) and (5) with grease.
- (10) Install bearing races (4) and (5) in wheel hub (2).
- (11) Pack bearing (3) with grease.
- (12) Install bearing (3) in wheel hub (2).
- (13) Coat oil seal (1) with grease.
- (14) Install oil seal (1) in wheel hub (2).



**e. Installation.**

- (1) Attach lifting device to wheel hub assembly (1).
- (2) Install two wheel nuts (2) on two studs (3).
- (3) Install spindle protector on pivot and spindle assembly (6).

**WARNING**

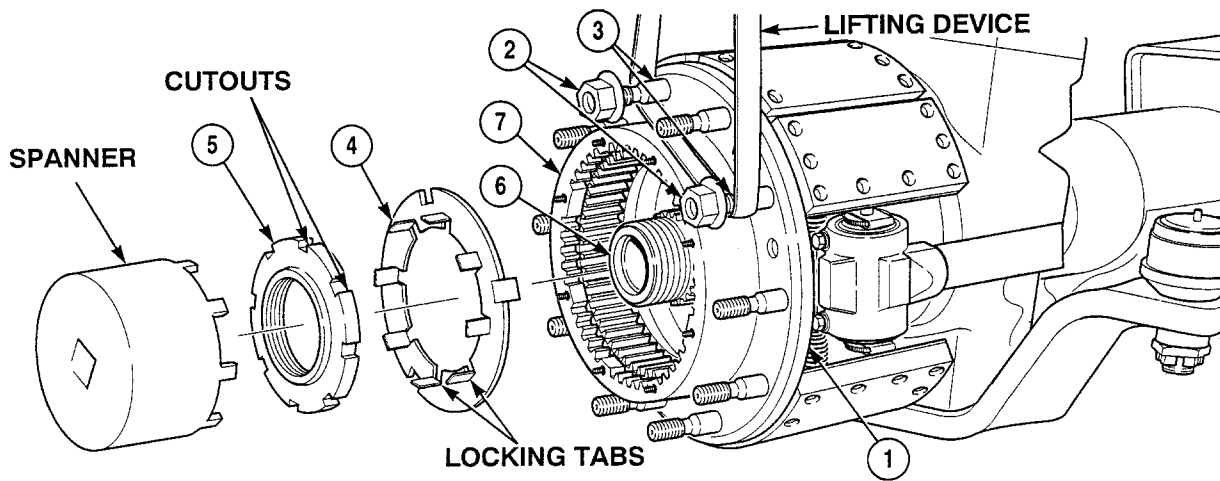
Wheel hub assembly weighs 115 lbs (52 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

**CAUTION**

Install wheel hub assembly straight on spindle, using spindle protector and taking care not to drag wheel hub assembly along spindle shaft, to prevent damage to CTIS seals.

- (4) With the aid of an assistant and using a lifting device, install wheel hub assembly (1) on pivot and spindle assembly (6).
- (5) Remove spindle protector from pivot and spindle assembly (6).
- (6) Install ring gear carrier assembly (7) in wheel hub assembly (1).

**25-7. AXLE NO. 1, 2 AND 5 WHEEL HUB ASSEMBLY REPAIR (CONT).**



- (7) Position lockwasher (4) on pivot and spindle assembly (6).
- (8) With the aid of an assistant and using socket, install spindle nut (5) on pivot and spindle assembly (6). Tighten spindle nut to 247 lb-ft to 290 lb-ft (335-393 N·m).
- (9) Remove wheel nuts (2) from studs (3).
- (10) Remove lifting device from wheel hub assembly (1).
- (11) Rotate wheel hub assembly (1) while tapping on wheel hub assembly with soft face hammer, until wheel hub assembly is fully seated.
- (12) With the aid of an assistant, recheck tightness of spindle nut (5) on pivot and spindle assembly (6) and tighten to 247 lb-ft to 290 lb-ft (335-393 N·m).
- (13) With the aid of an assistant, use socket to unscrew spindle nut (5) a minimum of 1/16 of a turn or until two locking tabs of lockwasher (4) are aligned with cutouts of spindle nut.
- (14) Bend two locking tabs of lockwasher (4) into cut outs on spindle nut (5).

**f. Follow-On Maintenance:**

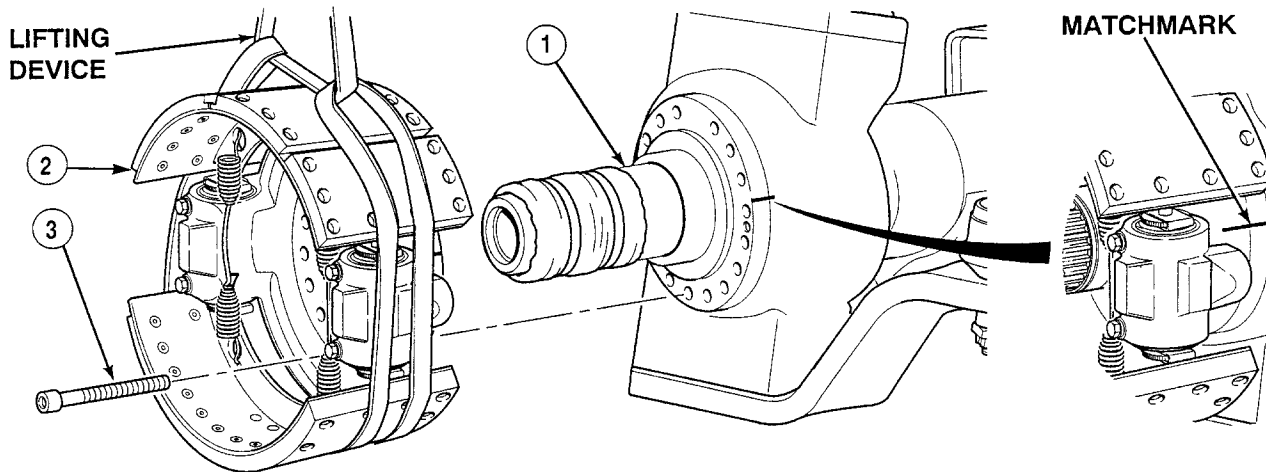
- Install planetary hub gear, (Para 25-6).

**END OF TASK**





**25-8. AXLE NO 1, 2 AND 5 BRAKE ASSEMBLY REPLACEMENT (CONT).**



**WARNING**

Brake assembly weighs 80 lbs (36 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (2) Attach lifting device to brake assembly (2).
- (3) Remove 16 screws (3) from brake assembly (2) and pivot and spindle assembly (1).
- (4) Remove brake assembly (2) from pivot and spindle assembly (1).
- (5) Remove lifting device from brake assembly (2).

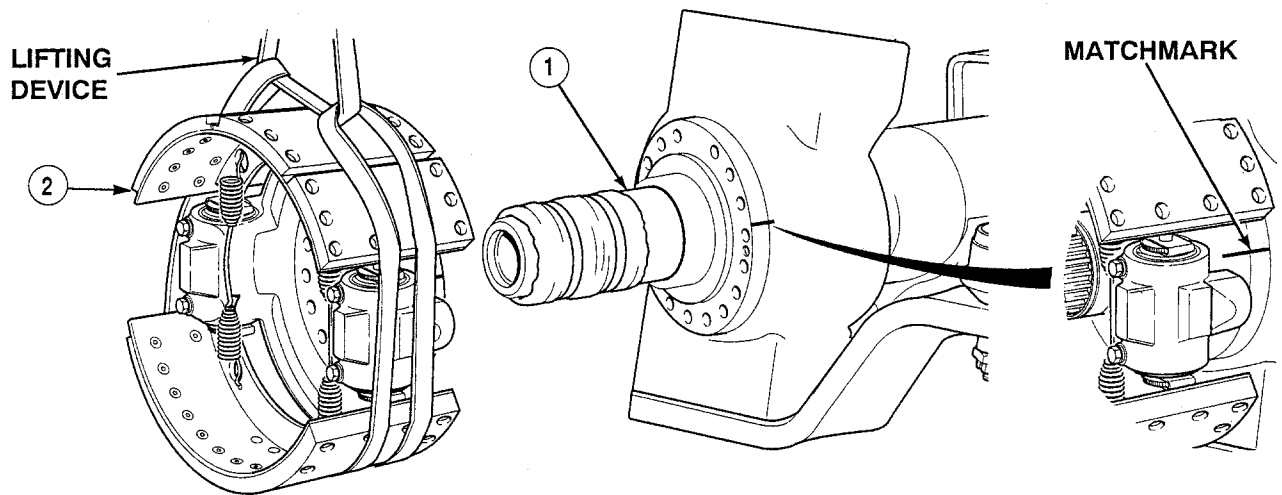
**b. Installation.**

- (1) Wrap cleaning cloth around spindle of pivot and spindle assembly (1) to protect spindle races.

**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.

- (2) Coat end threads of 16 screws (3) with sealing compound.
- (3) Attach lifting device to brake assembly (2).
- (4) Position brake assembly (2) onto pivot and spindle assembly (1).
- (5) Align matchmarks on brake assembly (2) and pivot and spindle assembly (1).
- (6) Install 16 screws (3). Tighten screws to 181 to 210 lb-ft (245 to 285 N·m).



- (7) Remove lifting device from brake assembly (2).
- (8) Remove cleaning cloth from pivot and spindle assembly (1).

**c. Follow-On Maintenance:**

- Install wheel hub assembly, (Para 25-7).

**END OF TASK**

## 25-9. AXLE NO. 1, 2 AND 5 TIE ROD REPAIR.

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Multiplier, Torque (Item 141, Appendix F)  
Tape, Measuring (Item 235, Appendix F)  
Wrench, Combination 1-5/16 in.  
(Item 257, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

#### *Materials/Parts*

Solvent, Drycleaning (Item 68, Appendix B)  
Locknut (2) (Item 194, Appendix E)  
Pin, Cotter (2) (Item 424, Appendix E)

#### *Equipment Condition*

Brake assembly removed, (Para 25-8)

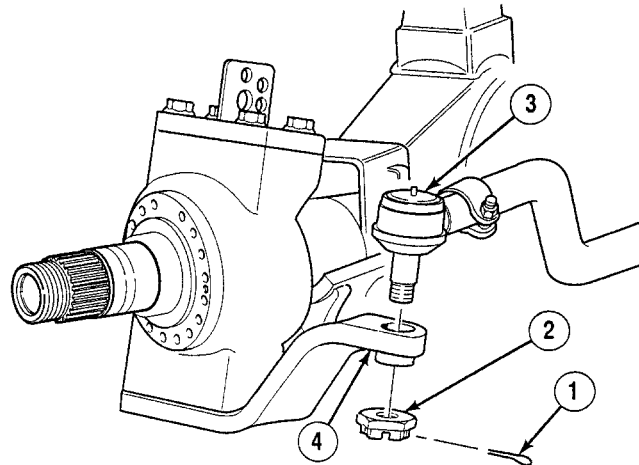
### a. Removal.

- (1) Remove cotter pin (1) and castle nut (2) from each tie rod end (3). Discard cotter pin.

#### NOTE

Tie rod can only be installed one way. Note position of tie rod ends before removal.

- (2) Remove tie rod ends (3) from steering swivel arms (4).

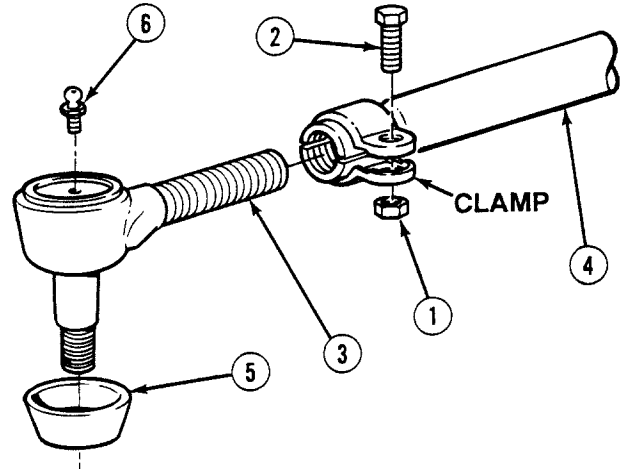


**b. Disassembly.**

**NOTE**

- Note location and position of tie rod ends prior to removal.
- Both tie rod ends are removed the same way.

- (1) Remove locknut (1) and screw (2) from clamp. Discard locknut.
- (2) Remove tie rod end (3) from tie rod (4).



**NOTE**

Do not perform Steps (3) and (4) if tie rod end is lube for life. These are permanently lubricated, have no lube fitting and dust cover is part of tie rod end.

- (3) Remove dust cover (5) from tie rod end (3).

**NOTE**

Perform Step (4) if grease fitting is damaged.

- (4) Remove grease fitting (6) from tie rod end (3).
- (5) Repeat Steps (1) through (4) for remaining tie rod end (3).

**25-9. AXLE NO. 1, 2 AND 5 TIE ROD REPAIR (CONT).**

*c. Cleaning/Inspection.*

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
  - (2) Dry all metal parts with compressed air.
  - (3) Clean rubber parts with clean, dry cloth.
  - (4) Inspect all metal parts for cracks, stripped threads and other signs of wear.
  - (5) Replace all damaged parts.

**d. Assembly.**

**NOTE**

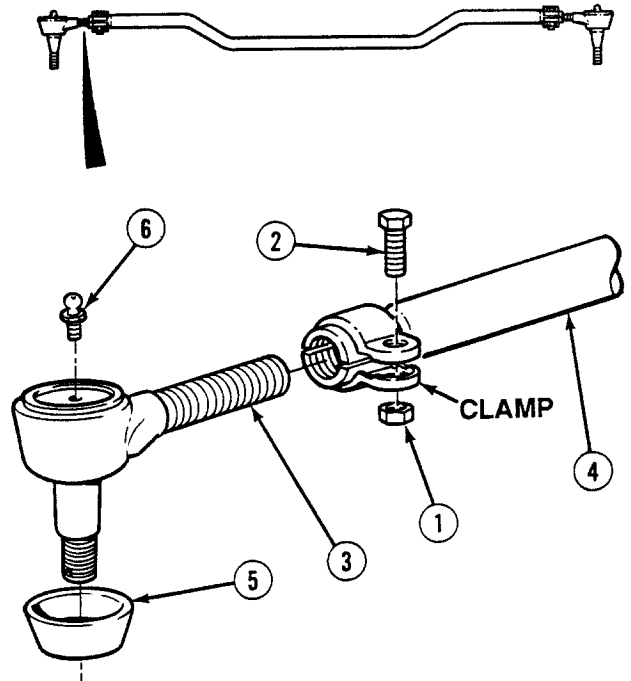
- Both tie rod ends are installed the same way.
- Ensure tie rod ends are installed as noted prior to removal.
- Perform Step (1) if grease fitting was removed.
- Do not perform Steps (1) and (2) if tie rod end is lube for life.

- (1) Install grease fitting (6) on tie rod end (3).
- (2) Install dust cover (5) on tie rod end (3).

**NOTE**

Make sure that tie rod and tie rod ends are pointed in same direction.

- (3) Install tie rod end (3) on tie rod (4).
- (4) Position screw (2) and locknut (1) on tie rod end (3).
- (5) Repeat Steps (1) through (4) for remaining tie rod end (3).
- (6) Measure distance between two grease fittings (6) on tie rod ends (3).
- (7) Turn tie rod ends (3) in or out evenly until measurement between grease fittings (6) are in compliance with Table 25-2.
- (8) Tighten two locknuts (1) on screws (2) to 100 lb-ft (136 N·m).



**Table 25-2. Tie Rod Measurements**

Tie Rod	Measurement
Axle No. 1	56-5/8 in.
Axle No. 2	54-9/16 in.
Axle No. 5	51-9/16 in.

**25-9. AXLE NO. 1, 2 AND 5 TIE ROD REPAIR (CONT).**

**e. Installation.**

**CAUTION**

Tie rod ends must be threaded into tie rod so threads are beyond opening under clamp or damage to equipment will result.

**NOTE**

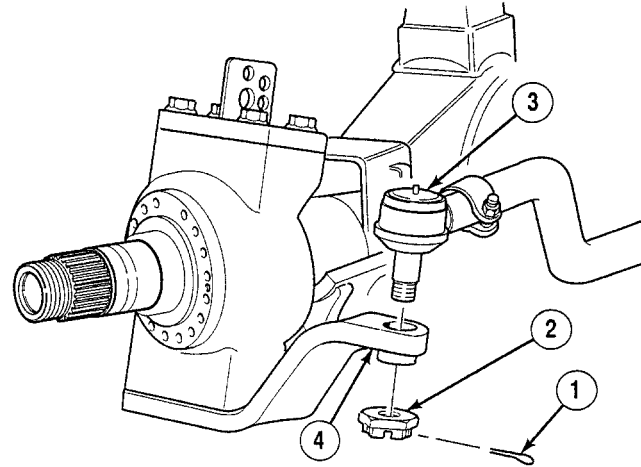
Ensure tie rod ends are installed as noted prior to removal.

- (1) Install two tie rod ends (3) on steering swivel arms (4).
- (2) Install castle nut (2) on each tie rod end (3). Tighten castle nuts to 175 lb-ft (237 N·m).

**NOTE**

Castle nut may need to be rotated slightly to install cotter pin.

- (3) Install cotter pins (1) in castle nuts (2).



**f. Follow-On Maintenance:**

- Install brake assembly, (Para 25-8).

**END OF TASK**





## 25-10. AXLE NO. 1 AND 5 LOCKING CYLINDER REPLACEMENT (CONT).

### b. Installation.

#### 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.

- (1) Coat mating surface of differential (2) with adhesive.
- (2) Position locking cylinder (1) on differential (2).
- (3) Install plastic washer (3), washer (4) and screw (5) on locking cylinder (1).

#### NOTE

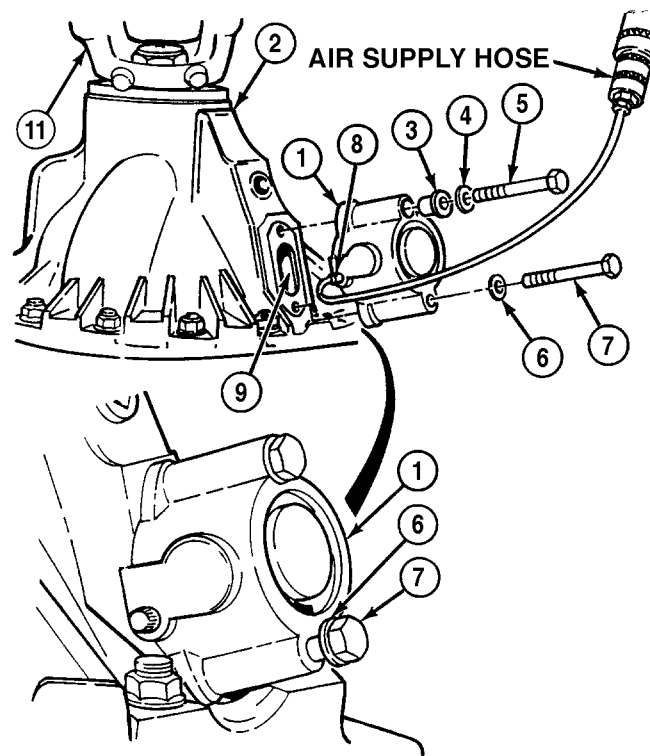
Screw is installed so that only three or four threads of screw are engaged. Screw is being installed at this time only to keep screw hole aligned.

- (4) Install washer (6) and screw (7) to locking cylinder (1).
- (5) Tighten screw (5) on locking cylinder (1) to 25 to 32 lb-ft (34 to 43 N·m).
- (6) Connect air supply hose to air line fitting (8) on locking cylinder (1).
- (7) Using air supply hose, apply air pressure (100 to 120 psi [690 to 827 kPa]) to locking cylinder (1).

#### NOTE

When locking cylinder engages both hub gears will turn in same direction, while rotating one wheel.

- (8) Turn flange assembly (11) back and forth until locking cylinder (1) engages.
- (9) Turn screw (7) slowly until screw contacts fork (9) in differential (2).

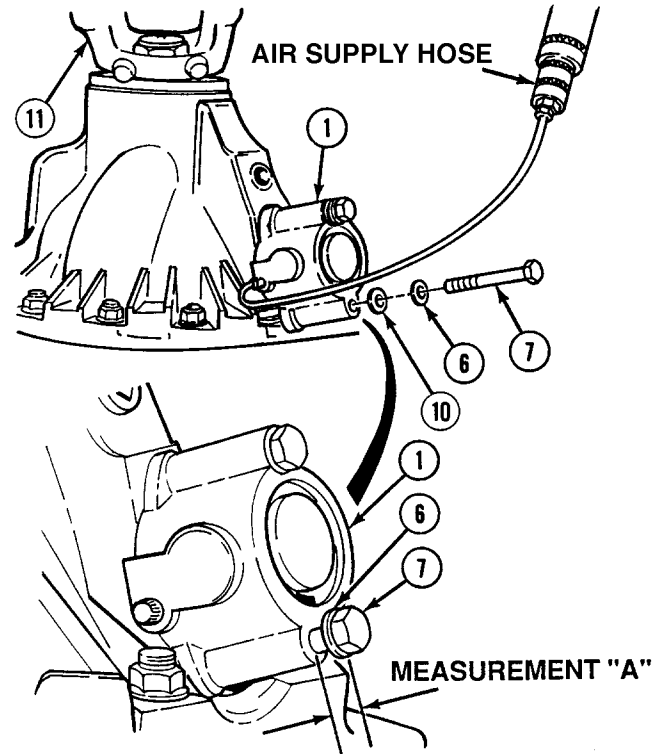


- (10) Using caliper measure distance from face of washer (6) and top of locking cylinder (1). Record measurement of distance "A".
- (11) Determine shim thickness. Shim thickness is "A" - 0.004 in. (0.102 mm) to 0.020 in. (0.508 mm).
- (12) Remove screw (7) and washer (6) from locking cylinder (1).

**NOTE**

Shim thickness was determined in Step (11).

- (13) Install shim (10), washer (6) and screw (7) in locking cylinder (1). Tighten screw 25 to 32 lb-ft (34 to 43 N·m).
- (14) Remove air supply hose from locking cylinder (1).



**c. Follow-On Maintenance:**

- Install tie rod, (Para 25-9).

**END OF TASK**



**b. Installation.****WARNING**

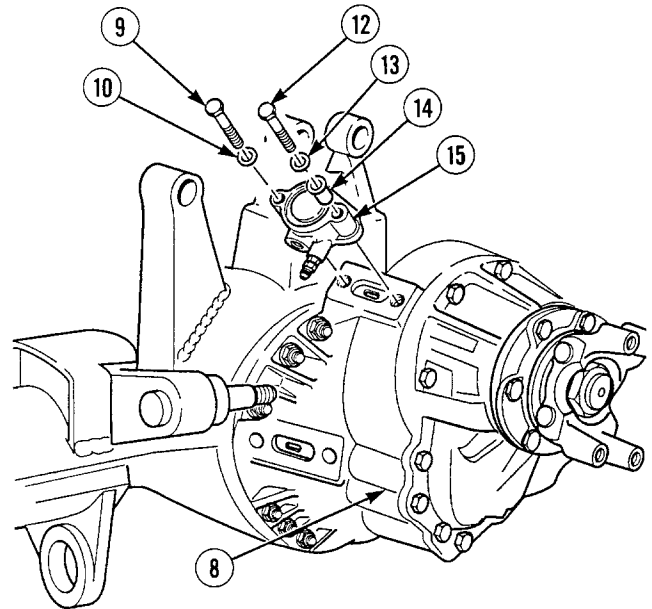
Adhesives, solvents and sealing compounds can burn easily, can give off harmful vapors and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap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

- (1) Coat mating surface of differential (8) with adhesive.
- (2) Position locking cylinder (15) on differential (8).
- (3) Install plastic washer (14), washer (13) and screw (12) on locking cylinder (15).

**NOTE**

Install screw so that only three or four threads of screw are engaged. Screw is being installed only to keep screw hole in locking cylinder aligned with differential.

- (4) Install screw (9) and washer (10) on locking cylinder (15).
- (5) Tighten screw (12) to 25 to 32 lb-ft (34 to 43 N·m).



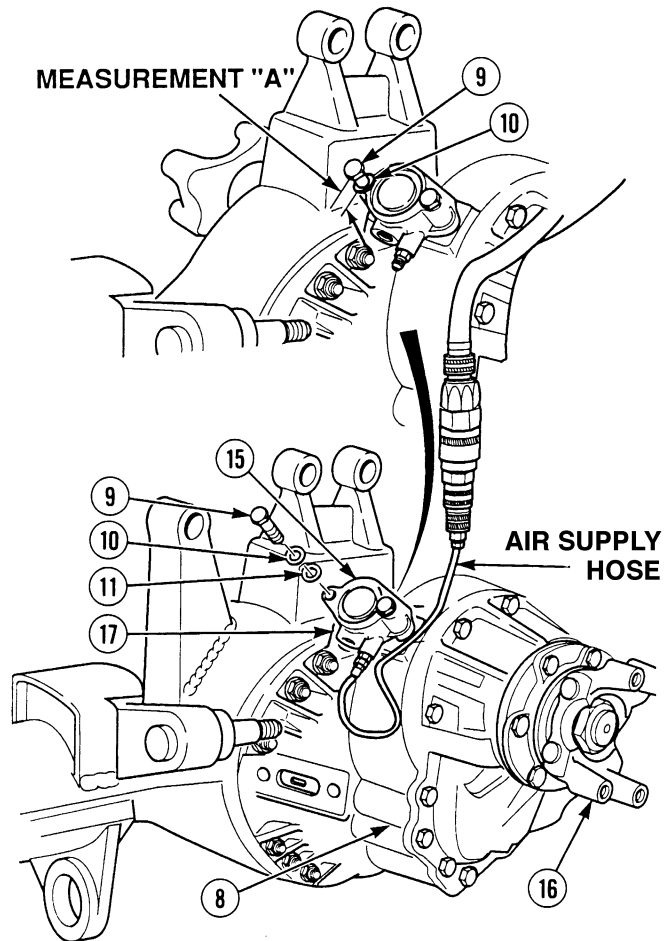
**25-11. AXLE NO. 2 LOCKING CYLINDER REPLACEMENT (CONT).**

- (6) Connect air supply hose to locking cylinder (15).
- (7) Using air supply hose, apply air pressure (100 to 120 psi [690 to 827 kPa]) to locking cylinder (15).

**NOTE**

When locking cylinder engages, rear flange assembly will turn when turning front flange assembly.

- (8) Turn front flange assembly (16) back and forth until locking cylinder (15) engages.
- (9) Turn screw (9) slowly until screw contacts fork (17) in differential (8).
- (10) Using caliper, measure distance from face of washer (10) and top of locking cylinder (15) and record as measurement "A".
- (11) Determine shim (11) thickness. Shim thickness is: measurement "A" - 0.004 in. (0.102 mm) to 0.020 in. 0.508 mm.
- (12) Remove screw (9) and washer (10).



**NOTE**

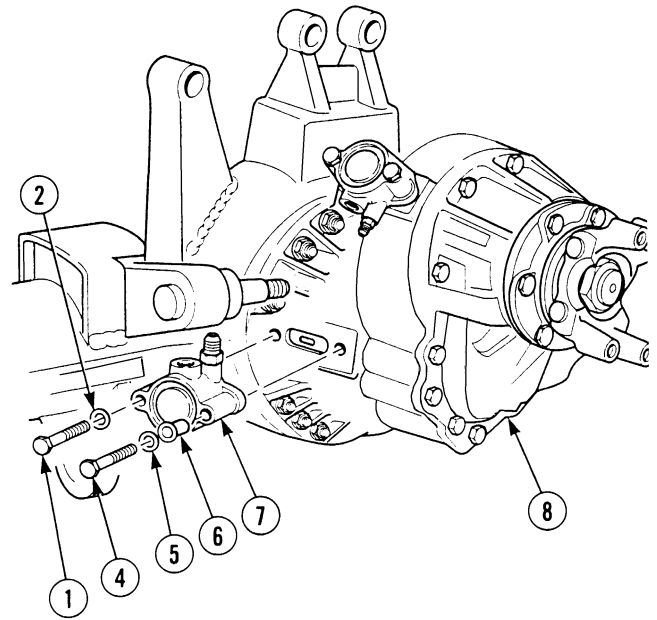
Shim thickness is determined in Step (11).

- (13) Install shim (11), washer (10) and screw (9). Tighten screw 25 to 32 lb-ft (34 to 43 N·m).
- (14) Remove air supply hose from locking cylinder (15).

**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.

- (15) Coat mating surface of differential (8) with adhesive.
- (16) Position locking cylinder (7) on differential (8).
- (17) Install plastic washer (6), washer (5) and screw (4) on locking cylinder (7).

**NOTE**

Install screw so that only three or four threads of screw are engaged. Screw is being installed at this time only to keep screw hole aligned.

- (18) Install screw (1) and washer (2) on locking cylinder (7).
- (19) Tighten screw (4) to 25 to 32 lb-ft (34 to 43 N·m).

**25-11. AXLE NO. 2 LOCKING CYLINDER REPLACEMENT (CONT).**

- (20) Connect air supply hose to locking cylinder (7).
- (21) Using air supply hose, apply air pressure 100 to 120 psi (690-827 kPa) to locking cylinder (7).

**NOTE**

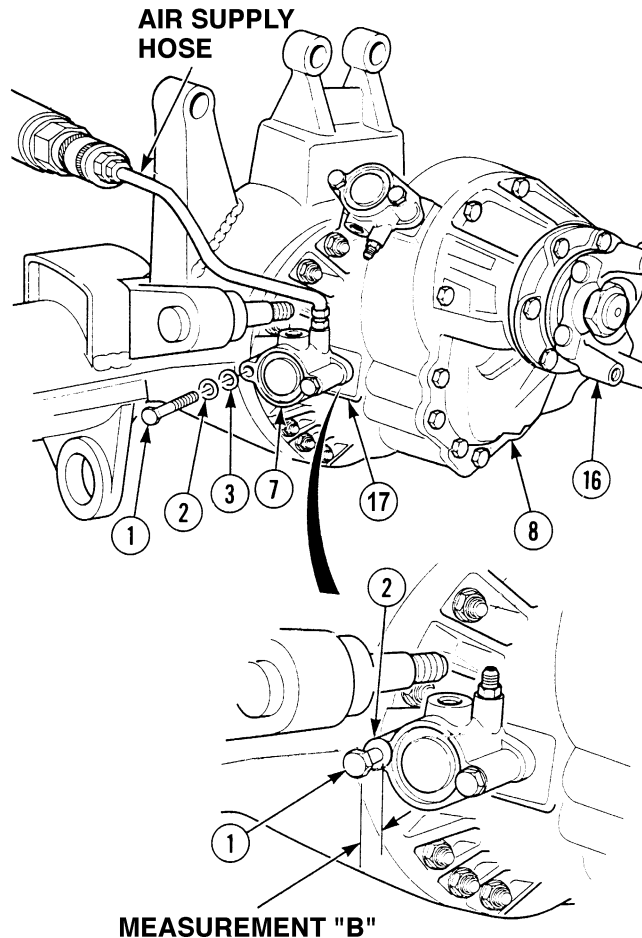
When locking cylinder engages both hub gears will turn in same direction, while rotating one wheel.

- (22) Turn flange assembly (16) back and forth until locking cylinder (7) engages.
- (23) Turn screw (1) slowly until screw contacts fork (17) in differential (8).
- (24) Using caliper, measure distance between face of washer (2) and top of locking cylinder (7) and record as measurement "B".
- (25) Determine shim (3) thickness. Shim thickness is: measurement "B" - 0.004 in. (0.102 mm) to 0.020 in. (0.508 mm).
- (26) Remove screw (1) and washer (2).

**NOTE**

Shim thickness is determined in Step (25).

- (27) Install shim (3), washer (2) and screw (1). Tighten screw 25 to 32 lb-ft (34 to 43 N·m).
- (28) Remove air supply hose from locking cylinder (7).



**c. Follow-On Maintenance:**

- Install tie rod, (Para 25-9).

**END OF TASK**

## 25-12. AXLE NO. 1, 2 AND 5 PIVOT AND SPINDLE/TRUNNION BEARING ASSEMBLY REPAIR.

This task covers:

- |                |                 |                          |
|----------------|-----------------|--------------------------|
| a. Removal     | c. Assembly     | e. Follow-On Maintenance |
| b. Disassembly | d. Installation |                          |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Extractor, Inertial (Item 56, Appendix F)  
Extractor, Inertial (Item 57, Appendix F)  
Gage, Depth, Micrometer (Item 73, Appendix F)  
Gloves, Heavy Duty (Item 82, Appendix F)  
Hammer, Hand, Soft Plastic  
(Item 88, Appendix F)  
Micrometer, Outside, Caliper, Set  
(Item 139, Appendix F)  
Multiplier, Torque (Item 141, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)  
Puller Kit, Universal (Item 174, Appendix F)  
Socket, Socket Head Screw, 3/4 in.  
(Item 208, Appendix F)  
Tool, Knuckle Adjusting  
(Item 243, Appendix F)  
Torch, Propane (Item 247, Appendix F)  
Wrench Set, Socket, 3/4 in. Drive  
(Item 274, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Wrench, Torque (0 to 600 lb-ft [0-814 N·m])  
(Item 278, Appendix F)

#### *Materials/Parts*

Adhesive (Item 1, Appendix B)  
Grease (Item 22, Appendix B)  
Sealing Compound (Item 59, Appendix B)  
Sealing Compound (Item 60, Appendix B)  
Tags, Identification (Item 72, Appendix B)  
Ring, Spindle (2) (Item 512, Appendix E)  
Seal, Oil (2) (Item 599, Appendix E)  
Sealing Kit, (Inner) (Item 623, Appendix E)  
Sealing Kit, (Outer) (Item 624, Appendix E)  
Shim Kit, Adjusting (Item 644, Appendix E)

#### *Personnel Required*

Two

#### *Equipment Condition*

Locking cylinder removed, (Para 25-10 or 25-11)



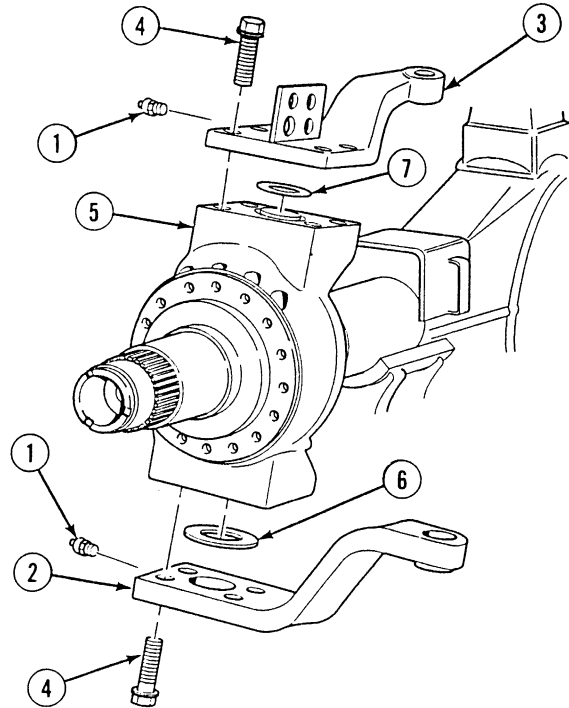
**25-12. AXLE NO. 1, 2 AND 5 PIVOT AND SPINDLE/TRUNNION BEARING ASSEMBLY REPAIR (CONT).**

**a. Removal.**

**NOTE**

- Tag and mark all parts to prevent interchanging during installation.
- Pivot and spindle assembly on left side of truck has steering arm. Pivot and spindle assembly on right side of truck has upper cover.
- Procedures for spindles are the same. Axle No. 1 left side is shown.

- (1) Remove two grease fittings (1) from steering swivel arm (2) and upper cover (3).
- (2) Remove four screws (4) and steering swivel arm (2) from pivot and spindle assembly (5).
- (3) Remove shim (6) from pivot and spindle assembly (5). Discard shim.
- (4) Remove four screws (4) and upper cover (3) from pivot and spindle assembly (5).
- (5) Remove shim (7) from pivot and spindle assembly (5). Discard shim.



**WARNING**

Pivot and spindle assembly weighs 90 lbs (41 kg). Support pivot and spindle prior to removal to prevent possible injury to personnel.

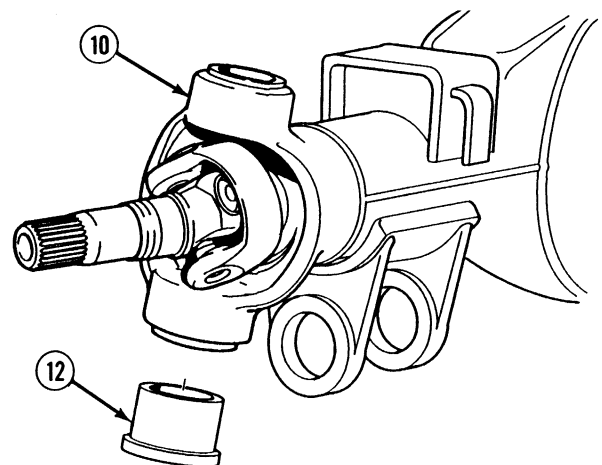
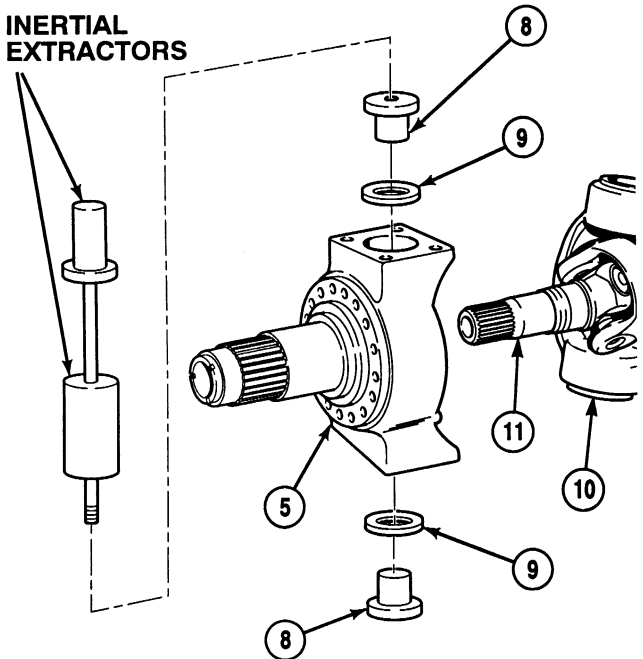
- (6) With the aid of an assistant, support spindle and use inertial extractors to remove two trunnions (8).
- (7) Remove two oil seals (9) by tapping down on one side of oil seal to knock it loose. Discard oil seals.

**CAUTION**

Support axle shaft during removal of pivot and spindle assembly to prevent damage to bearings inside pivot and spindle assembly.

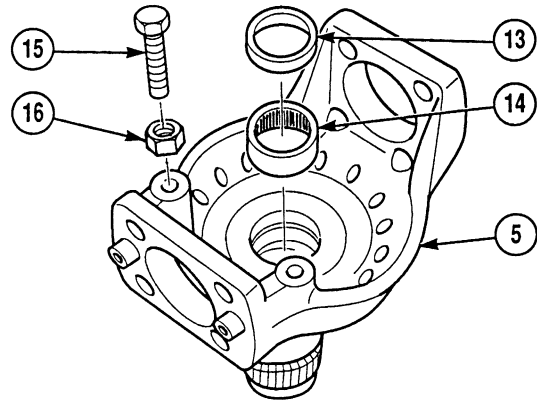
- (8) With the aid of an assistant, remove pivot and spindle assembly (5) from axle housing (10) and axle shaft (11).
- (9) Remove two trunnion bearings (12) from axle housing (10).

**INERTIAL EXTRACTORS**



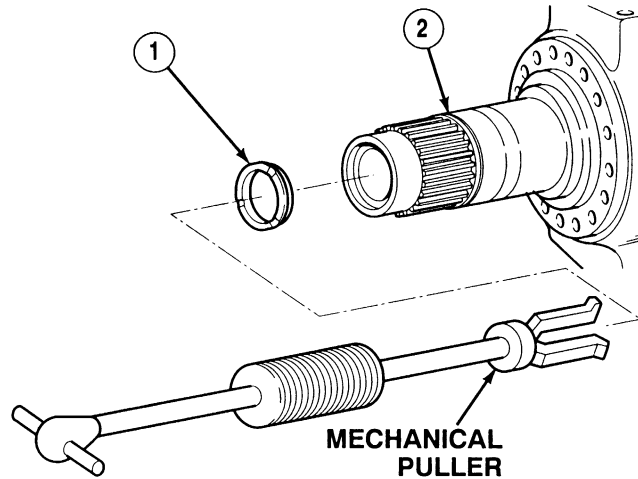
**25-12. AXLE NO. 1, 2 AND 5 PIVOT AND SPINDLE/TRUNNION BEARING ASSEMBLY REPAIR (CONT).**

- (10) Using a puller, remove seal (13) and bearing (14) from pivot and spindle assembly (5). Discard seal and bearing.
- (11) Remove steering stop bolt (15) and nut (16) from pivot and spindle assembly (5).



**b. Disassembly.**

- (1) Using puller, remove spindle ring (1) from spindle assembly (2). Discard spindle ring.

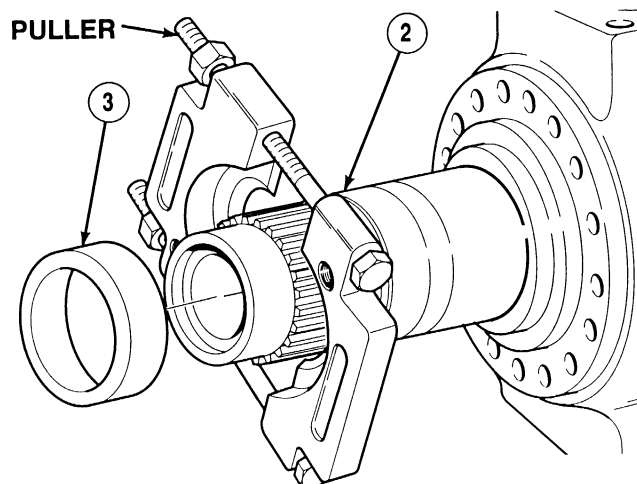


- (2) Heat seal race (3) with propane torch.

**WARNING**

Seal race is extremely hot. Do not touch seal race without protective gloves or severe burns to hands could result.

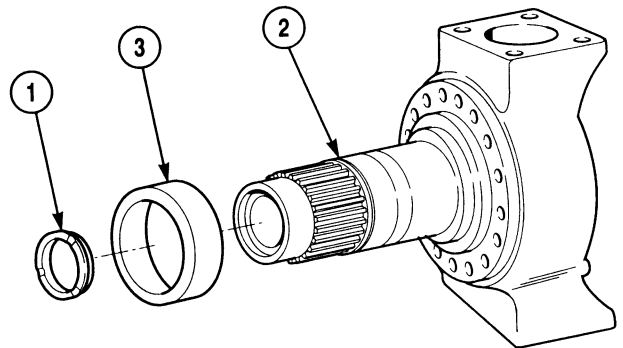
- (3) Using puller and press, remove seal race (3) from spindle assembly (2).



**c. Assembly.**

**WARNING**

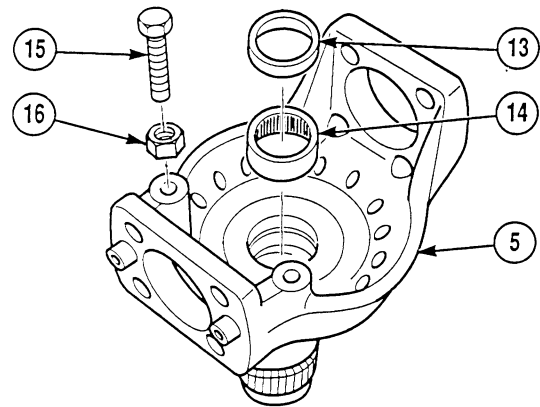
Adhesives, solvents and sealing compounds can burn easily, can give off harmful vapors and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap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



- (1) Coat mating surface of spindle (2) with sealing compound.
- (2) Using press, install seal race (3) on spindle (2).
- (3) Install spindle ring (1) on spindle (2).

**d. Installation.**

- (1) Install steering stop bolt (15) and nut (16) to pivot and spindle assembly (5).
- (2) Apply light coat of grease on bearing (14).
- (3) Install bearing (14) to pivot and spindle assembly (5).
- (4) Apply light coat of grease to seal (13).
- (5) Install seal (13) to pivot and spindle assembly (5).

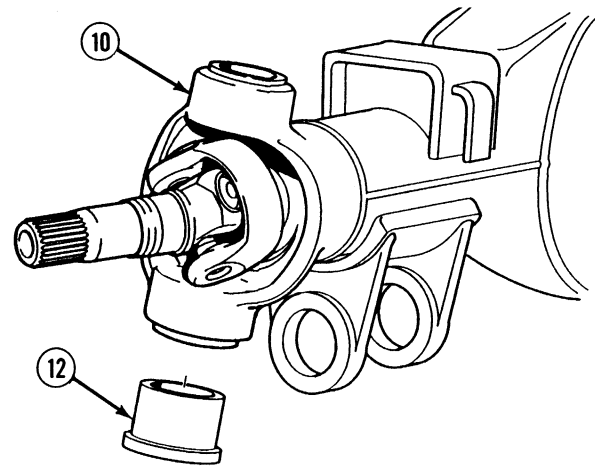


**25-12. AXLE NO. 1, 2 AND 5 PIVOT AND SPINDLE/TRUNNION BEARING ASSEMBLY REPAIR (CONT).**

**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.

- (6) Apply sealant to outside surface of two trunnion bearings (12).
- (7) Install two trunnion bearings (12) to axle housing (10).
- (8) Coat two oil seals (9) and inside of pivot and spindle assembly (5) where trunnions (8) seat with grease.



**WARNING**

Pivot and spindle assembly weighs 90 lbs (41 kg). Use the aid of an assistant to prevent possible injury to personnel.

**CAUTION**

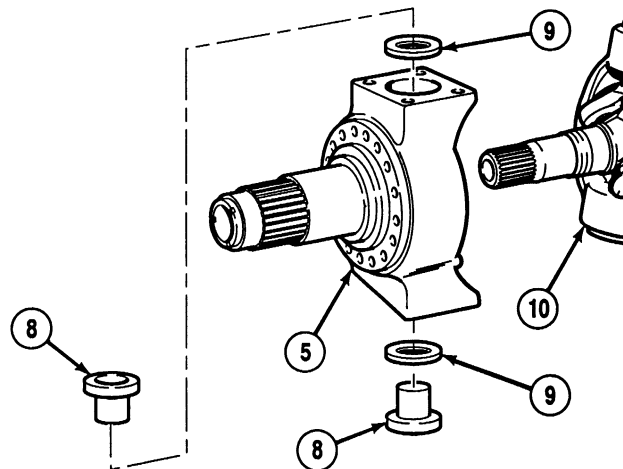
Support axle shaft during installation of pivot and spindle assembly to prevent damage to bearings inside pivot and spindle assembly.

- (9) With the aid of an assistant, install pivot and spindle assembly (5) on axle housing (10).

**NOTE**

Lip of oil seal should be facing toward bottom of trunnions when installed.

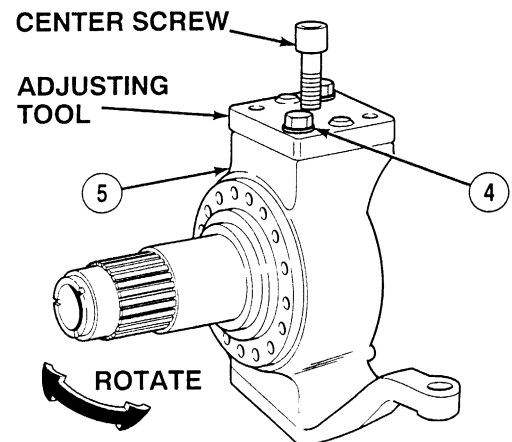
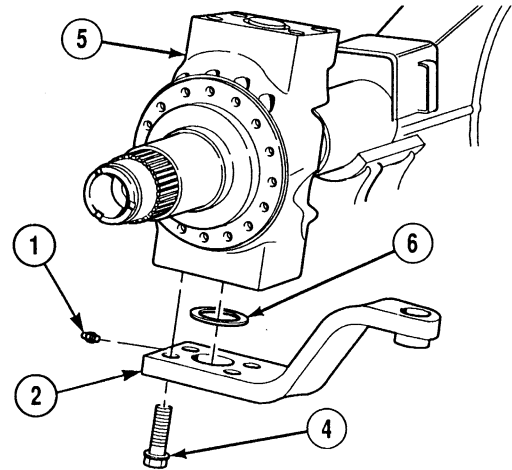
- (10) Install two oil seals (9) on two trunnions (8).
- (11) With the aid of an assistant, align pivot and spindle assembly (5) and install two trunnions (8) into pivot and spindle assembly with soft faced mallet.



**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.

- (12) Coat mating surface of steering swivel arm (2) and pivot and spindle assembly (5) with silicone adhesive sealant.
- (13) Install 0.0039 in. (0.0991 mm) shim (6) on steering swivel arm (2).
- (14) Install steering swivel arm (2) on pivot and spindle assembly (5).
- (15) With the aid of an assistant, install four screws (4). Using torque wrench and multiplier, tighten screws first to 250 lb-ft (339 N·m), then to 500 lb-ft (678 N·m) and then to 720 to 800 lb-ft (976 to 1,085 N·m).
- (16) Install grease fitting (1) on steering swivel arm (2).
- (17) Install adjusting tool on pivot and spindle assembly (5) with two cross-mounted screws (4). Tighten screws to 200 lb-ft (271 N·m).
- (18) Install center screw of adjusting tool. Tighten center screw to 200 lb-ft (271 N·m).
- (19) Loosen center screw slightly until pivot and spindle assembly (5) moves freely under its own weight.
- (20) Center pivot and spindle assembly (5).
- (21) Tighten center screw in adjusting tool to 50 lb-ft (68 N·m).

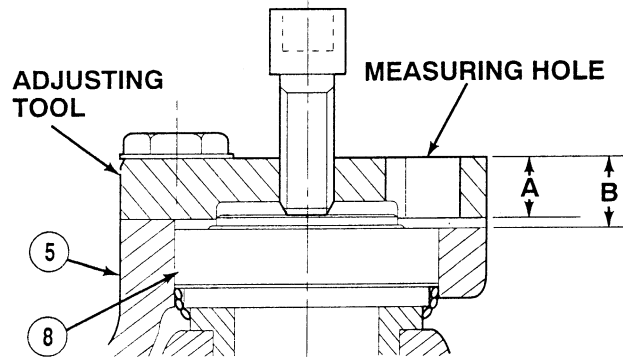
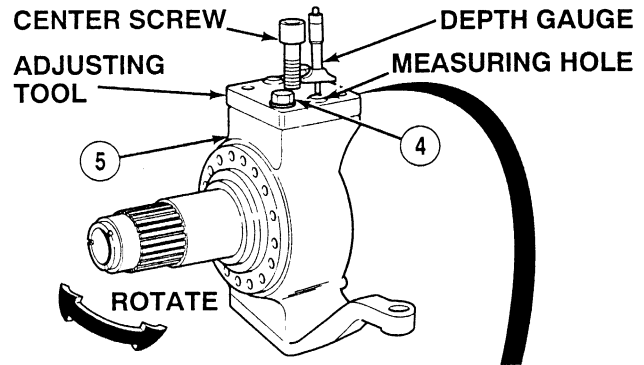


**25-12. AXLE NO. 1, 2 AND 5 PIVOT AND SPINDLE/TRUNNION BEARING ASSEMBLY REPAIR (CONT).**

**NOTE**

Measure distance through measuring hole.

- (22) Using depth gage, measure the distance from top of adjusting tool to top of pivot and spindle assembly (5) and record as dimension "A".
- (23) Using depth gage, measure distance from top of adjusting tool to top of trunnion (8) and record as dimension "B".
- (24) Subtract dimension "A" from dimension "B" ( $B - A$ ). The answer is the gap between pivot and spindle assembly (5) and top of trunnion (8).
- (25) Refer to Table 25-3 to determine shim thickness.
- (26) Remove screws (4) and adjusting tool.
- (27) Rotate pivot and spindle assembly (5) to centered position.

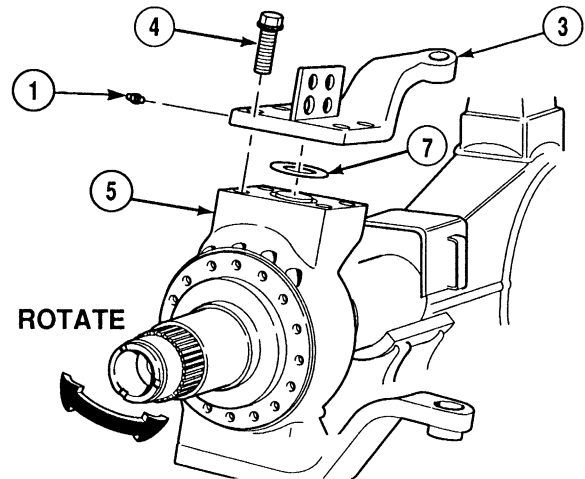


**Table 25-3. Determining Shim Thickness**

Gap between pivot and spindle assembly and trunnion	Shim thickness
0.018 to 0.022 in. (0.457 to 0.559 mm)	0.016 in. (0.406 mm)
0.022 to 0.026 in. (0.559 to 0.660 mm)	0.020 in. (0.508 mm)
0.026 to 0.030 in. (0.660 to 0.762 mm)	0.024 in. (0.610 mm)
0.030 to 0.033 in. (0.762 to 0.838 mm)	0.028 in. (0.711 mm)
0.033 to 0.037 in. (0.838 to 0.940 mm)	0.031 in. (0.787 mm)
0.037 to 0.041 in. (0.940 to 1.041 mm)	0.035 in. (0.889 mm)
0.041 to 0.045 in. (1.041 to 1.143 mm)	0.039 in. (0.991 mm)

**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.



- (28) Coat mating surface of spindle assembly (5) with adhesive.
- (29) Install shim (7), thickness determined in Step (24), on pivot and spindle assembly (5).
- (30) Install steering arm (3) on pivot and spindle assembly (5).
- (31) Install four screws (4). Tighten screws to 100 lb-ft (136 N·m).
- (32) Install grease fitting (1) on upper cover (3).
- (33) Rotate pivot and spindle assembly (5) around three times to check for excessive play or force. If incorrect, repeat Steps (16) through (31).
- (34) Tighten four screws (4) first to 250 lb-ft (339 N·m), then to 500 lb-ft (678 N·m) and then to 720 to 800 lb-ft (976 to 1,085 N·m).
- (35) With torque wrench on screw (4), verify that pivot and spindle assembly (5) requires between 57 to 72 lb-ft (77 to 98 N·m) to start rotation of the pivot and spindle assembly about its pivot from the centered position. If incorrect, repeat Steps (14) through (32).

**e. Follow-On Maintenance:**

- Install locking cylinder, (Para 25-10 or 25-11).

**END OF TASK**



## 25-13. AXLE NO. 1, 2 AND 5 CONSTANT VELOCITY JOINT REPAIR.

This task covers:

- |                        |                          |
|------------------------|--------------------------|
| a. Removal             | c. Installation          |
| b. Cleaning/Inspection | d. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Extractor, Inertial (Item 56, Appendix F)  
Extractor, Inertial (Item 57, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Pliers, Retaining Ring (Item 158, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)  
Puller Kit, Universal, Slide Hammer  
(Item 175, Appendix F)  
Removal Tool, Bearing Cap, Constant Velocity  
U-Joint (Appendix C)

#### *Materials/Parts*

Grease (Item 22, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Wire, Nonelectrical (Item 79, Appendix B)  
Cross (2) (Item 38, Appendix E)  
Fitting, Grease (4) (Item 50, Appendix E)  
Sealing Kit (Item 623, Appendix E)

#### *Personnel Required*

Two

#### *Equipment Condition*

Axle No. 1, 2 and 5 pivot and spindle/trunnion  
bearing assembly removed, (Para 25-12)

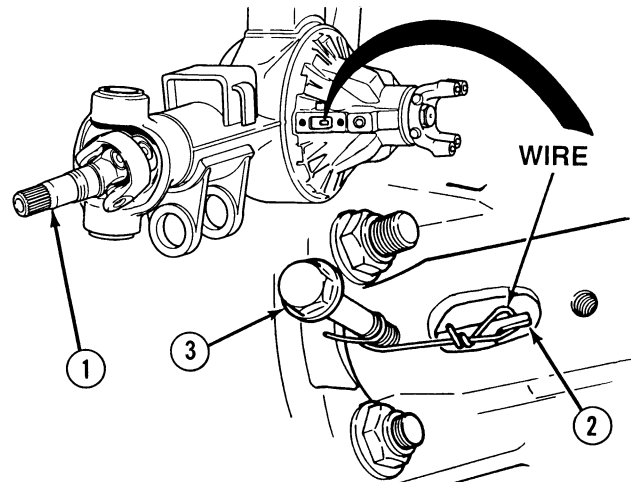
### a. Removal.

### CAUTION

The following step keeps clutch gear from disengaging after constant velocity shaft are removed. Failure to perform step makes assembly difficult and could damage parts.

### NOTE

- Screw used in Step (1) is from locking cylinder.
  - Step (1) is for left side constant velocity joint removal on Axle No. 1 and 5 only.
  - Step (1) is for right side constant velocity joint for Axle No. 2 only.
  - Axle No. 1 is shown in illustration. Axles No. 2 and 5 are similar.
  - Axles No. 1, 2 and 5 constant velocity shafts are removed the same.
  - Clutch collar is engaged when both constant velocity shafts turn in the same direction when axle yoke is turned.
- (1) With the aid of an assistant, engage clutch collar by turning constant velocity shafts (1) slowly, while pulling outward on fork (2).
  - (2) Form a wire hook around fingers of fork (2) and anchor with screw (3).

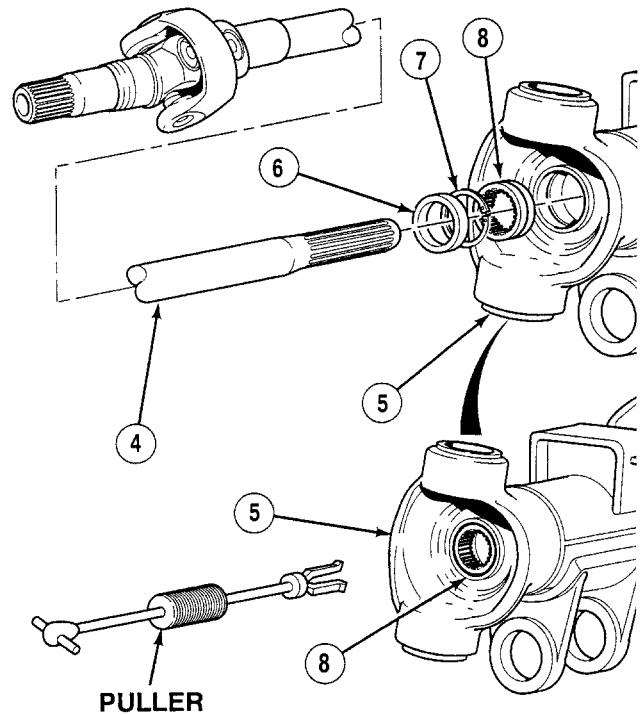


- (3) Remove constant velocity joint (4) from axle housing (5).
- (4) Remove seal (6) from axle housing (5). Discard seal.

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (5) Remove retaining ring (7) from axle housing (5). Discard retaining ring.
- (6) Using puller, remove bearing (8) from axle housing (5). Discard bearing.

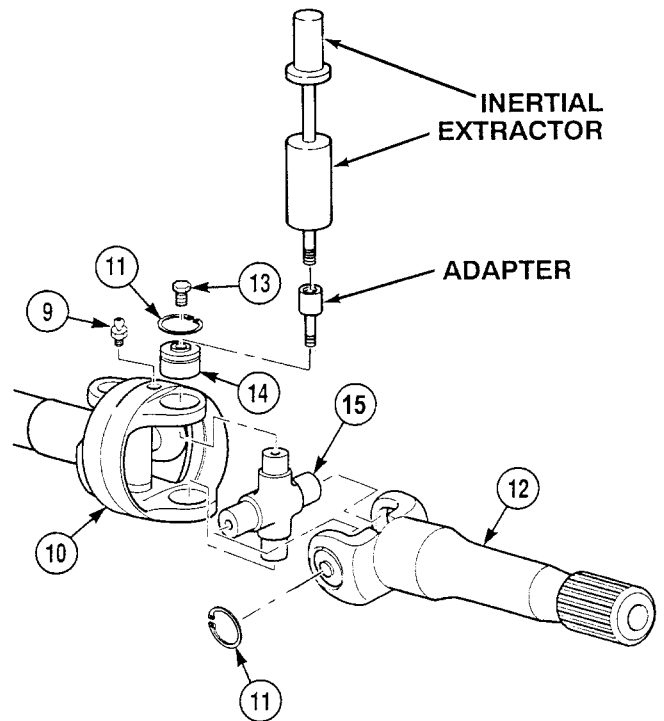


- (7) Remove two grease fittings (9) from block (10). Discard grease fittings.

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (8) Remove two retaining rings (11) from block (10). Discard retaining rings.
- (9) Remove two retaining rings (10) from shaft (12). Discard retaining rings.
- (10) Remove two screws (13) from caps (14). Discard screws.
- (11) Using inertial extractor and adapter, remove two caps (14) from cross (15) and block (10). Discard caps.

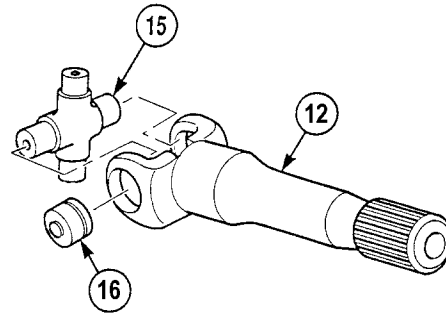


**25-13. AXLE NO 1, 2 AND 5 CONSTANT VELOCITY JOINT REPAIR (CONT).**

**NOTE**

Mark offset on cross for proper installation.

- (12) Using a press, remove two caps (16) from cross (15) and shaft (12). Discard caps.
- (13) Remove cross (15) from shaft (12). Discard cross.
- (14) Repeat Steps (7) through (13) for remaining shaft.



**b. Cleaning/Inspection.**

**WARNING**

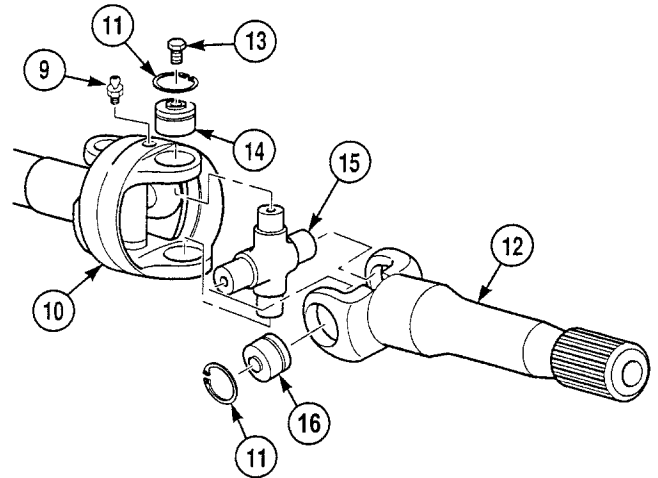
- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes, and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent. The flashpoint for Type II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
  - (2) Inspect all parts for wear, nicks, burrs or scratches.
  - (3) Replace damaged parts.

**c. Installation.**

- (1) Position cross (15) into shaft (12).
- (2) Install two caps (16) on cross (15) and shaft (12).

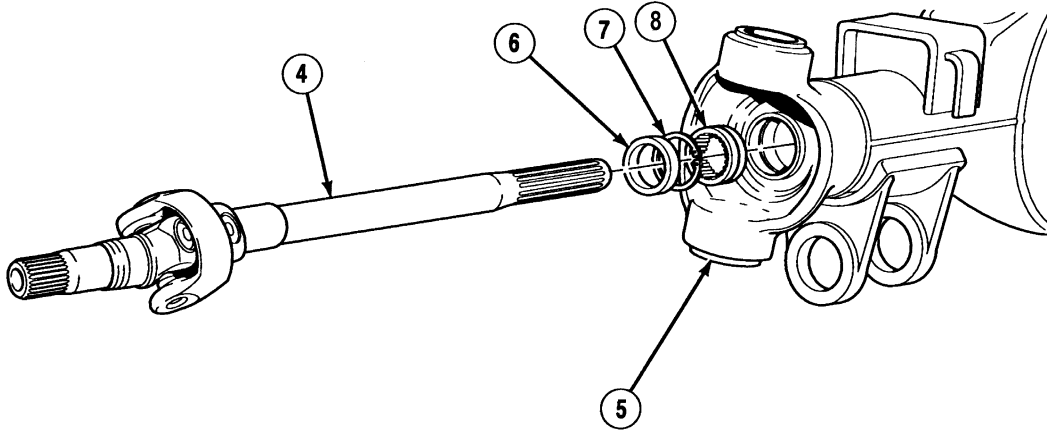


Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.



- (3) Install two retaining rings (11) on shaft (12).
- (4) Install two caps (14) on cross (15) and block (10).
- (5) Install two retaining rings (11) on block (10).
- (6) Install two screws (13) in caps (14).
- (7) Install two grease fittings (9) on block (10).

**25-13. AXLE NO 1, 2 AND 5 CONSTANT VELOCITY JOINT REPAIR (CONT).**



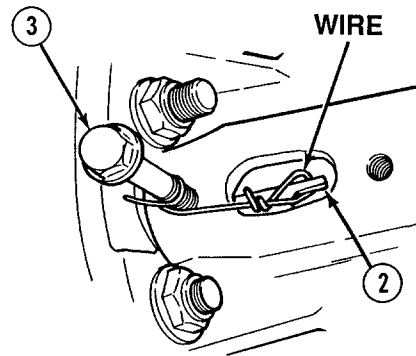
- (8) Coat bearing (8) with a light coat of grease.
- (9) Install bearing (8) in axle housing (5).

**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (10) Install retaining ring (7) in axle housing (5).
- (11) Coat seal (6) with light coat of grease.
- (12) Install seal (6) in axle housing (5).
- (13) Install constant velocity joint (4) in axle housing (5).
- (14) Repeat Steps (2) through (13) for remaining joint.

- (15) Remove screw (3) and wire from around fingers of fork (2).



**d. Follow-On Maintenance:**

- Install Axle No. 1, 2 and 5 pivot and spindle/trunnion bearing assembly, (Para 25-12).

**END OF TASK**

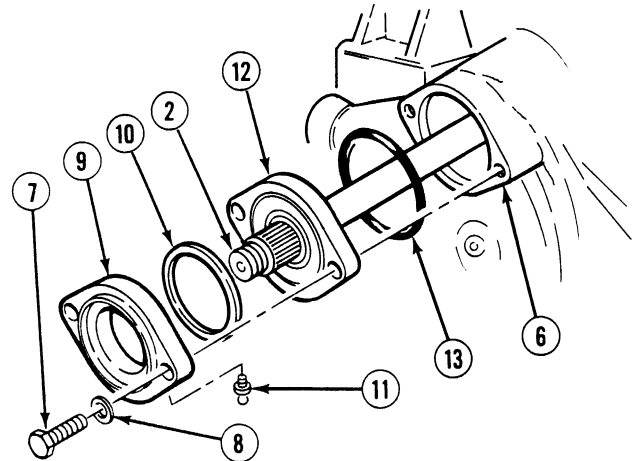


- (6) Remove two screws (7), washers (8) and cover (9) from axle housing (6).
- (7) Remove adjusting shim (10) from cover (9). Discard adjusting shim.

**NOTE**

Perform Step (8) if grease fittings are damaged.

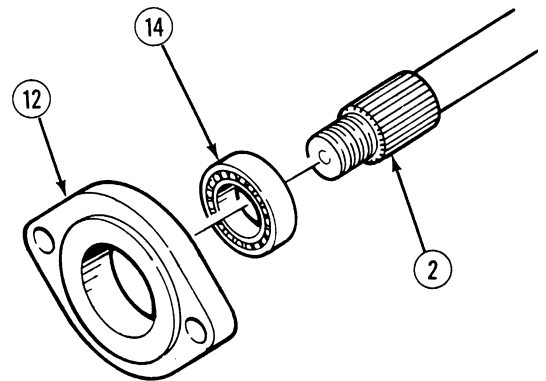
- (8) Remove two grease fittings (11) from cover (9). Discard grease fittings.
- (9) Pull output shaft (2) from axle housing (6).
- (10) Remove output housing (12) from axle housing (6).
- (11) Remove preformed packing (13) from output housing (12). Discard preformed packing.
- (12) Press output housing (12) from output shaft (2).



**NOTE**

Perform Step (13) only if bearing is damaged.

- (13) Press bearing (14) out of output housing (12).

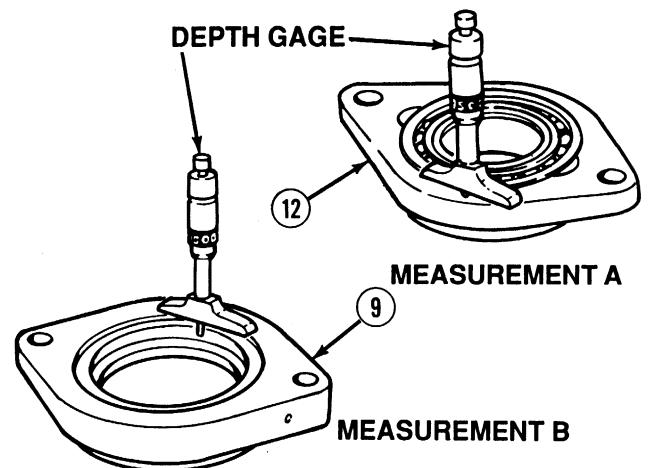


**b. Installation.**

**NOTE**

Perform Steps (1) and (2) only if bearing was removed.

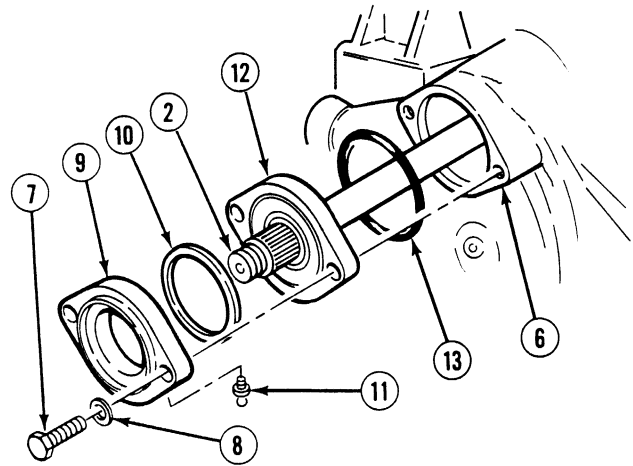
- (1) Apply grease to outside surface of bearing (14).
- (2) Press bearing (14) in output housing (12).
- (3) Using depth gage, measure distance “A” between face of bearing (14) and machined surface of output housing (12).
- (4) Using depth gage, measure distance “B” between machined surface of cover (9) and bottom of first land in cover.
- (5) Calculate adjusting shim thickness as follows:  $(A - B) - 0.004 \text{ in. (0.102 mm)}$  equals shim thickness.





**25-14. AXLE NO. 2 REAR OUTPUT ASSEMBLY REPLACEMENT (CONT).**

- (6) Press output shaft (2) in output housing (12).
- (7) Apply lubricating oil to preformed packing (13).
- (8) Install preformed packing (13) in axle housing (6).



**NOTE**

If installation of shaft is difficult, have assistant pull outward on lockup fork.

- (9) Install output shaft (2) in axle housing (6).

**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.

- (10) Coat mating surface of axle housing (6) with adhesive.

**NOTE**

Shim thickness was determined in Steps (3) through (5).

- (11) Install adjusting shim (10) on cover (9).
- (12) Coat threads of two screws (7) with sealing compound.
- (13) Install cover (9) with two washers (8) and screws (7) on axle housing (6). Tighten screws to 90 lb-ft (122 N·m).

**NOTE**

Perform Step (14) if grease fittings were removed from cover.

- (14) Install two grease fittings (11) in cover (9).

- (15) Install oil seal (5) in axle housing (6).
- (16) Install dust cover (4) on flange assembly (3).

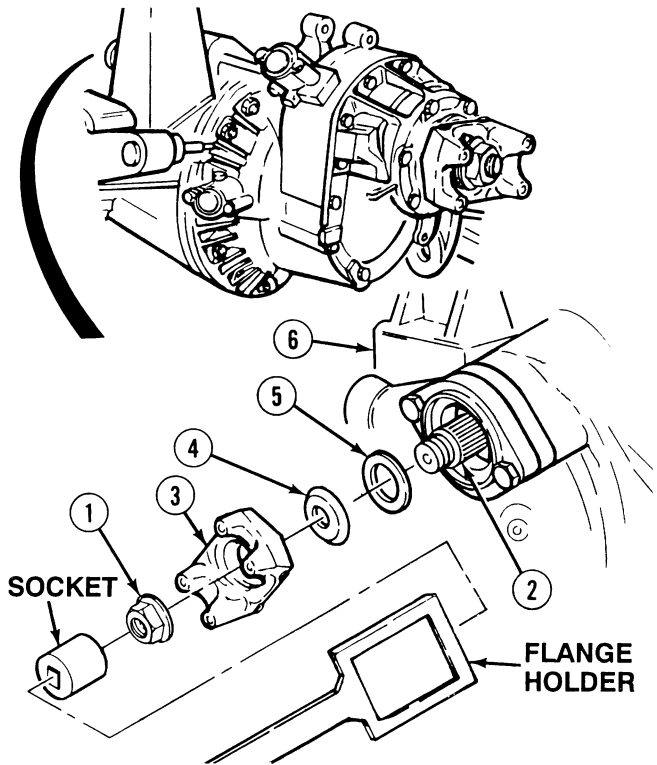
**NOTE**

Flange assembly should be positioned so large openings of flange assembly align with slots of pinion shaft. This will ease staking of nut.

- (17) Install flange assembly (3) on pinion shaft (2).

**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.



- (18) Coat threads of pinion shaft (2) with adhesive.
- (19) Apply adhesive to face of flange assembly (3) where adjusting nut (1) seats.
- (20) With the aid of an assistant, and using flange holder and socket, install adjusting nut (1) on pinion shaft (2) using flange holder. Tighten adjusting nut to 680 to 796 lb-ft (922 to 1,079 N·m).
- (21) Ensure adhesive has squeezed out around entire outside diameter of adjusting nut (1). If adhesive is not visible around entire outside diameter of adjusting nut (1), remove and discard adjusting nut (1) and repeat Steps (18) through (19).
- (22) Stake adjusting nut (1) in two slots of pinion shaft (2) directly 180 degrees apart.

**c. Follow-On Maintenance:**

- Install constant velocity joint, (Para 25-13).

**END OF TASK**

**25-15. AXLE NO. 1 AND 5 DIFFERENTIAL ASSEMBLY REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's  
(Item 240, Appendix F)
- Adapter, Maintenance Stand, Differential  
(Item 3, Appendix F)
- Compressor Unit, Air (Item 35, Appendix F)
- Gloves, Chemical Oil Protective  
(Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Gun, Airblow (Item 86, Appendix F)
- Hammer, Hand, Soft Plastic  
(Item 88, Appendix F)
- Indicator, Dial, Set w/Magnetic Base  
(Item 98, Appendix F)
- Micrometer, Outside, Caliper Set  
(Item 139, Appendix F)
- Press, 60 Ton (Item 164, Appendix F)
- Puller Kit, Universal, Slide Hammer  
(Item 175, Appendix F)
- Socket, 55 mm (Item 217, Appendix F)
- Stand, Maintenance, Engine  
(Item 226, Appendix F)
- Torch, Propane (Item 247, Appendix F)
- Wrench Set, Socket, 3/8 in. Drive  
(Item 273, Appendix F)

*Tools and Special Tools - Continued*

- Wrench, Torque (0-60 N·m)  
(Item 276, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)
- Wrench, Torque (0 to 600 lb-ft [0-814 N·m])  
(Item 278, Appendix F)
- Lifting Device, Minimum Capacity 198 lbs  
(90 kg)
- Adapter, Differential Preload (Appendix C)
- Holder, Flange (Appendix C)

*Materials/Parts*

- Adhesive (Item 1, Appendix B)
- Dye, Prussian Blue (Item 20, Appendix B)
- Grease (Item 22, Appendix B)
- Sealing Compound (Item 56, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)
- Tag, Identification (Item 72, Appendix B)
- Locknut (14) (Item 215, Appendix E)
- Nut, Adjusting (Item 308, Appendix E)
- Seal, Oil (Item 598, Appendix E)
- Shim Kit, Adjusting (Item 635, Appendix E)
- Shim Kit, Adjusting (Item 636, Appendix E)
- Shim Kit, Adjusting (Item 639, Appendix E)

*Personnel Required*

Two

*Equipment Condition*

Constant velocity joint removed, (Para 25-13)

a. **Removal.**

**NOTE**

Axle No. 5 is shown. Axle No. 1 is similar. Axle No. 1 differential housing is a mirror image of Axle No. 5, but internal components are the same.

- (1) Remove 14 locknuts (1), washers (2) and three taper rings (3) from studs (4). Discard locknuts.



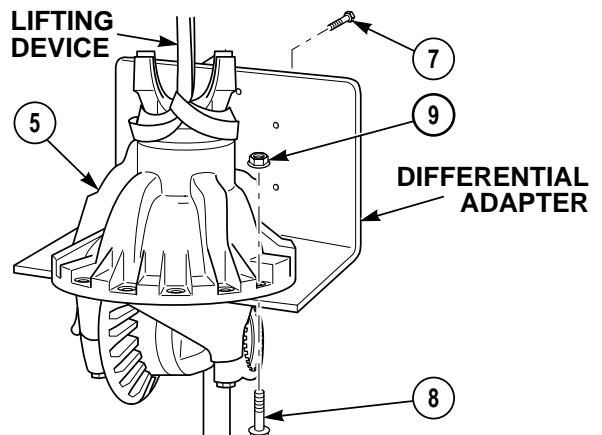
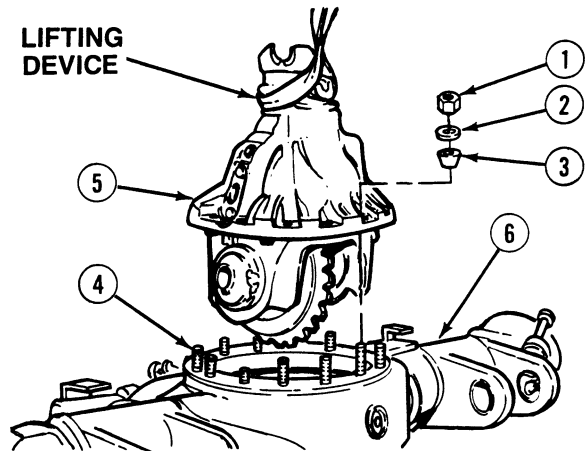
Differential assembly weighs 198 lbs (90 kg). Attach a suitable lifting device prior to removal to prevent possible injury to personnel.

- (2) Attach lifting device on differential assembly (5).
- (3) With the aid of an assistant, remove differential assembly (5) from axle housing (6).

**NOTE**

Perform Step (4) only if studs are damaged.

- (4) Remove studs (4) from axle housing (6).
- (5) With the aid of an assistant, install differential adapter on engine stand with six screws (7).
- (6) With the aid of an assistant, install differential assembly (5) on differential adapter with six screws (8) and nuts (9).
- (7) Remove lifting device from differential assembly (5).



**25-15. AXLE NO. 1 AND 5 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**b. Disassembly.**



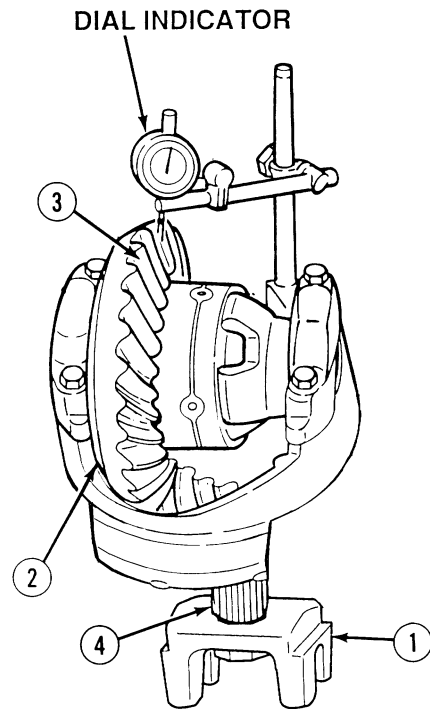
Make sure pinion shaft does not move while backlash is being measured or incorrect reading will result.

- (1) With the aid of an assistant, hold yoke (1) while turning differential gear (2) counterclockwise until gear stops to take up backlash.

**NOTE**

Shaft from dial indicator must be at right (90 degree) angle to face of tooth when in contact.

- (2) Install dial indicator on differential gear face (3).
- (3) Turn differential gear (2) clockwise until it stops.



**NOTE**

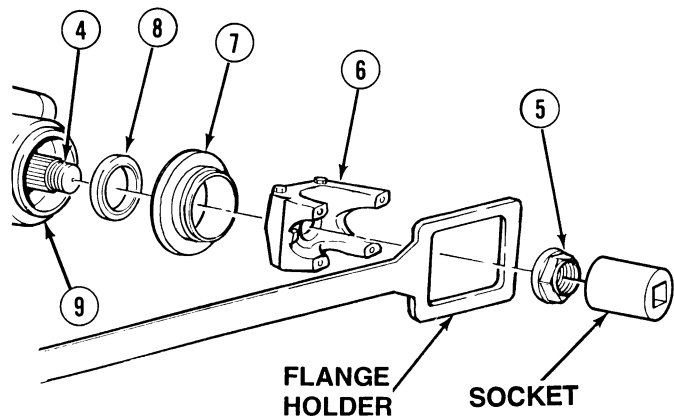
Record differential gear to pinion shaft backlash and contact pattern. Backlash should be 0.010 to 0.016 in. (0.254 to 0.406 mm).

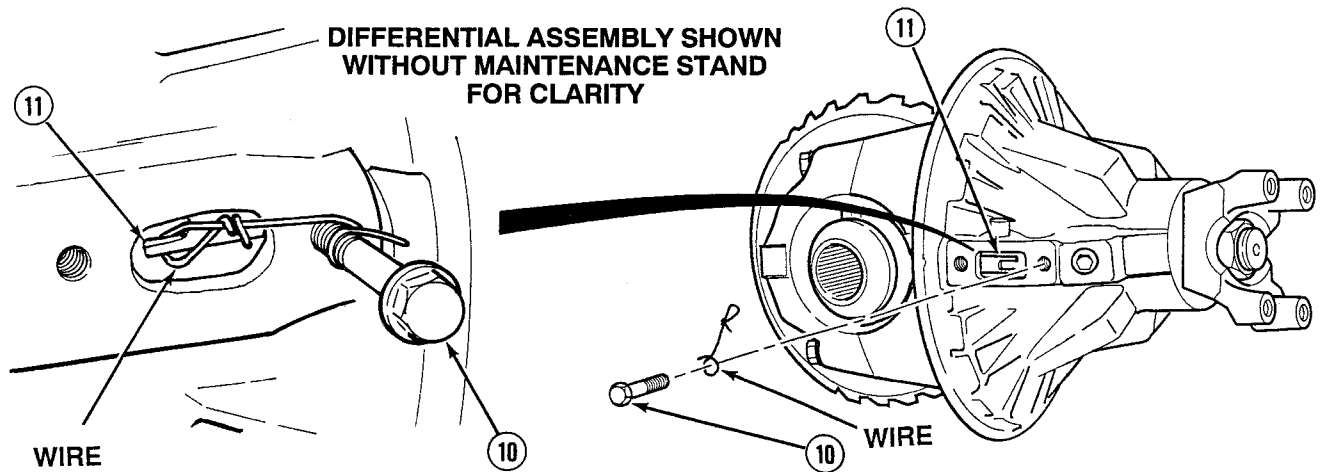
- (4) Check differential gear (2) to pinion shaft (4) backlash as measured on dial indicator and contact pattern.

**NOTE**

Turn differential assembly 90 degrees.

- (5) Unstake adjusting nut (5) from pinion shaft (4).
- (6) With the aid of an assistant and using flange holder and socket, remove adjusting nut (5) from pinion shaft (4). Discard adjusting nut.
- (7) Remove flange assembly (6) from pinion shaft (4).
- (8) Separate dust cover (7) from flange assembly (6).
- (9) Remove oil seal (8) from axle housing (9). Discard oil seal.

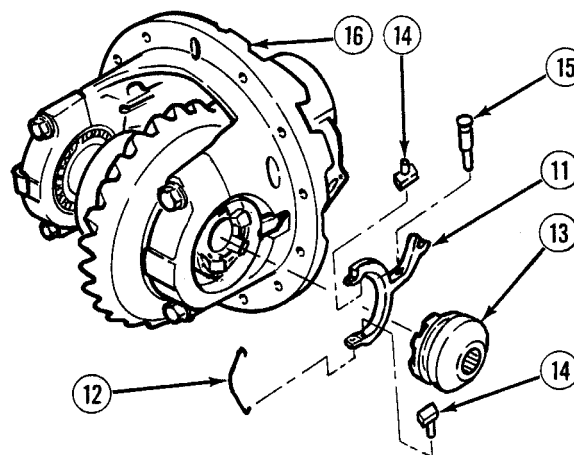




**NOTE**

Reposition differential assembly with pinion shaft facing down.

- (10) Remove screw (10) and wire from finger of fork (11).



**WARNING**

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

- (11) Remove retaining ring (12) from fork (11).
- (12) Remove clutch gear (13) from fork (11).
- (13) Remove two finger forks (14) from fork (11).
- (14) Punch out fork pin (15) and remove fork (11) from differential housing (16).

**25-15. AXLE NO. 1 AND 5 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

- (15) Remove screw (17) and nut lock plate (18) from bearing cap (19).

**NOTE**

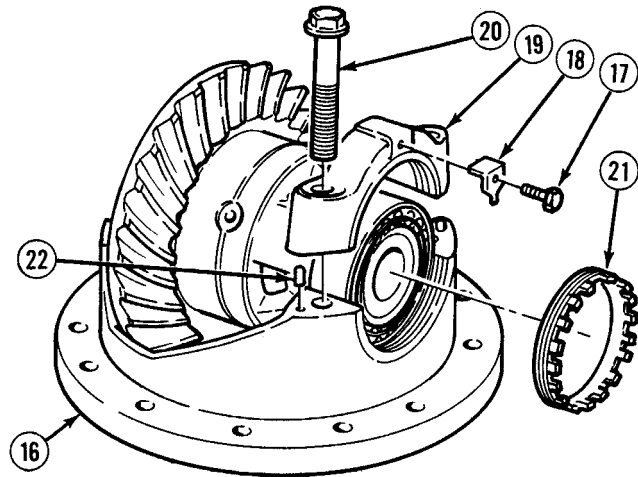
Bearing caps are part of a matched assembly with the differential housing assembly.

- (16) Remove four screws (20), two bearing caps (19) and adjusting nut (21) from differential housing (16).

**NOTE**

Perform Step (17) only if locating pins are damaged.

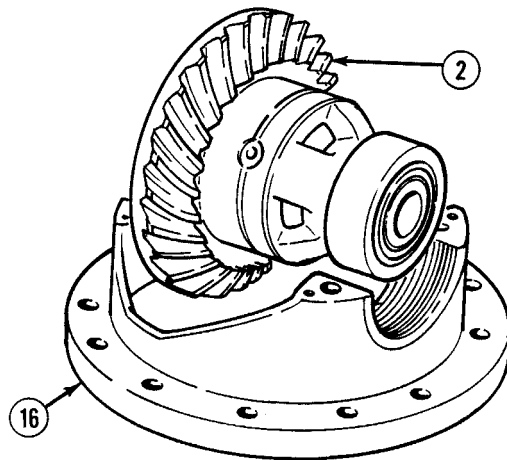
- (17) Remove four locating pins (22) from differential housing (16).



**WARNING**

Differential and bevel gear weighs 70 lbs (32 kg). Attach a suitable lifting device prior to removal to prevent possible injury to personnel.

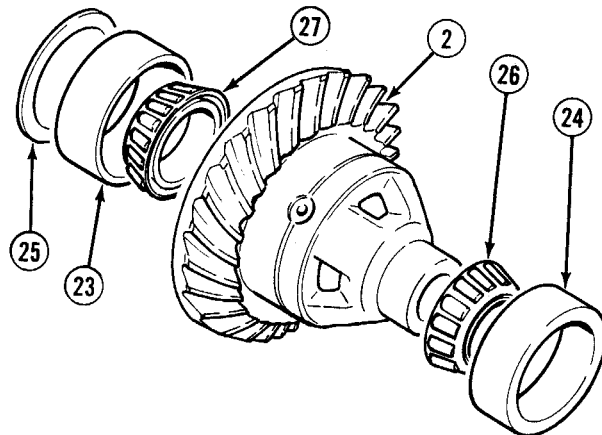
- (18) With the aid of an assistant, remove differential gear (2) from differential housing (16).



**NOTE**

Tag and mark bearings and races before removal. Bearing races are part of matched assemblies with taper bearings.

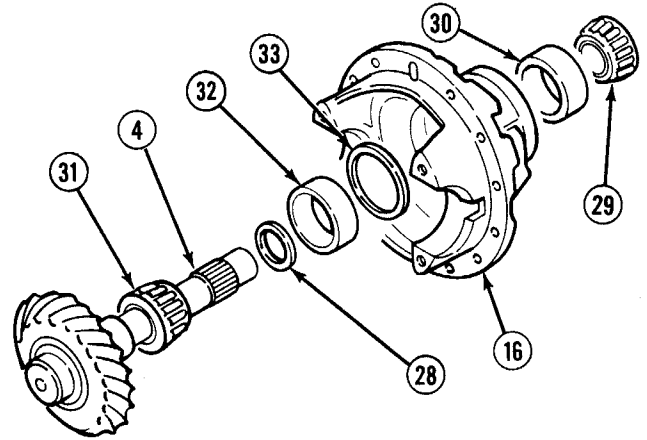
- (19) Remove bearing races (23) and (24) and adjusting shim (25) from differential gear (2).
- (20) Measure and record width of adjusting shim (25). Discard adjusting shim.
- (21) Using puller, remove taper bearings (26) and (27) from differential gear (2).



**CAUTION**

Properly support pinion shaft during removal. Failure to comply may result in damage to pinion shaft.

- (22) With the aid of an assistant and using a soft faced hammer, remove pinion shaft (4) from differential housing (16).
- (23) Remove adjusting shim (28) from pinion shaft (4).
- (24) Measure and record thickness of adjusting shim (28) Discard adjusting shim.
- (25) Remove taper bearing (29) from bearing race (30).



**NOTE**

Bearing may have to be heated with a propane torch to be removed.

- (26) Position pinion shaft (4) in press.
- (27) Using arbor press, remove taper bearing (31) from pinion shaft (4).
- (28) Remove pinion shaft (4) from press.
- (29) Remove bearing races (32) and (30) from differential housing (16).
- (30) Remove adjusting shim (33) from differential housing (16).
- (31) Measure and record thickness of adjusting shim (33). Discard adjusting shim.



**25-15. AXLE NO. 1 AND 5 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**c. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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.

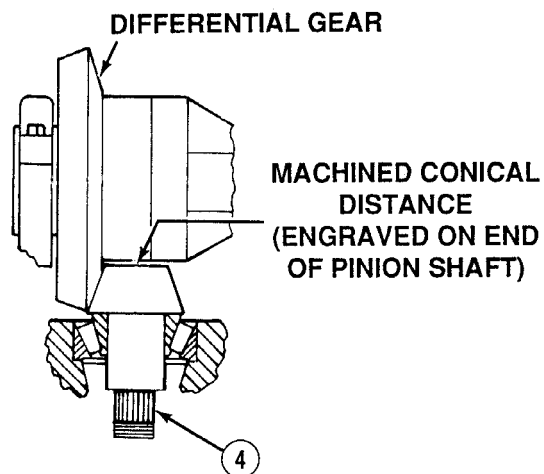
- (1) Clean all metal parts with drycleaning solvent.
- (2) Inspect metal parts for breaks, cracks, burrs and sharp edges.
- (3) Inspect all bearings for wear, scoring and cracks.
- (4) Inspect differential and bevel gear for broken splines and wear.
- (5) Inspect pinion shaft for broken splines and wear.
- (6) Replace all damaged parts.

**d. Assembly.**

**NOTE**

- Perform Steps (1) through (7) only if new pinion shaft and differential and bevel gear are being installed.
- The machined conical distance is engraved on pinion shaft head.

- (1) Record machined conical distance of used pinion shaft (4) which was removed from differential assembly.
- (2) Record machined conical distance of new pinion shaft (4) which is to be installed in the differential assembly.
- (3) Compare two distances recorded in Steps (1) and (2). If distance recorded in Step (1) is larger than distance recorded in Step (2), proceed to Step (4). If distance recorded in Step (2) is larger than distance recorded in Step (1), go to Step (5).



- (4) The new adjusting shim thickness will be:  
 $\text{Step (1) distance} - \text{Step (2) distance} =$   
 amount of shim thickness to be added to old  
 adjusting shim thickness to create new  
 adjusting shim. Go to Step (6).
- (5) The new adjusting shim thickness will be:  
 $\text{Step (2) distance} - \text{Step (1) distance} =$   
 amount of shim thickness to be removed  
 from old adjusting shim thickness to create  
 new adjusting shim. Go to Step (6).

**NOTE**

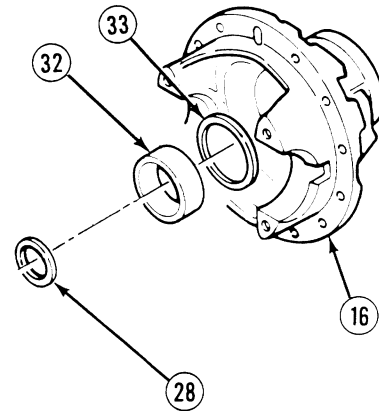
Adjusting shim thickness was  
 determined in Steps (1)  
 through (5).

- (6) Assemble new adjusting shim (33).

**NOTE**

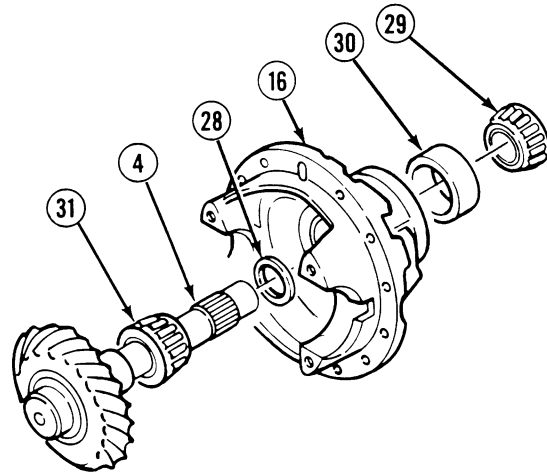
If adjusting shim thickness in  
 Step (6) was increased, adjusting  
 shim thickness for Step (7) will  
 be decreased an equal amount.

- (7) Assemble new adjusting shim (28) by  
 applying same change of thickness applied  
 to adjusting shim (33).
- (8) Install adjusting shim (33) in differential  
 housing (16).
- (9) Apply grease to bearing race (32).
- (10) Install bearing race (32) in differential  
 housing (16).



**25-15. AXLE NO. 1 AND 5 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

- (11) Apply grease to bearing race (30).
- (12) Install bearing race (30) in differential housing (16).
- (13) Install taper bearing (31) on pinion shaft (4).
- (14) Install adjusting shim (28) on pinion shaft (4).
- (15) Install pinion shaft (4) in differential housing (16).
- (16) With the aid of an assistant, install taper bearing (29) on pinion shaft (4).
- (17) Coat oil seal (8) with grease.
- (18) Install oil seal (8) in axle housing (9).
- (19) Install dust cover (7) on flange assembly (6).



**NOTE**

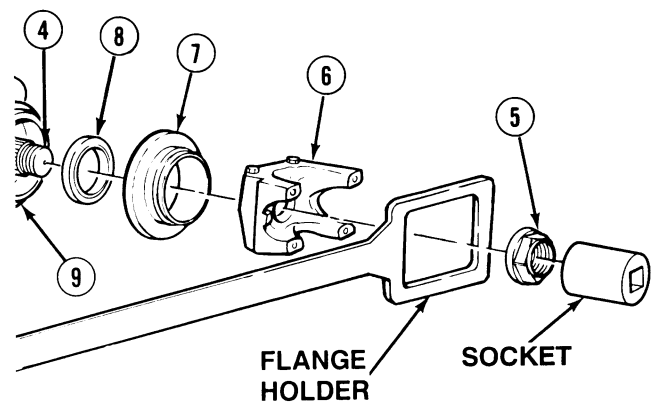
Flange assembly should be positioned so large openings of flange assembly align with slots of pinion shaft. This will ease staking of nut.

- (20) Position flange assembly (6) on pinion shaft (4).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (21) Coat threads of pinion shaft (4) with adhesive.
- (22) Apply adhesive to face of flange assembly (6) where adjusting nut (5) seats.
- (23) With the aid of an assistant and using flange holder and socket, install adjusting nut (5) on pinion shaft (4). Tighten adjusting nut to 486 to 572 lb-ft (659 to 776 N·m).
- (24) Ensure adhesive has squeezed out around entire outside diameter of adjusting nut (5). If adhesive is not visible around entire outside diameter of adjusting nut (5), remove and discard adjusting nut (5) and repeat Steps (21) through (23).



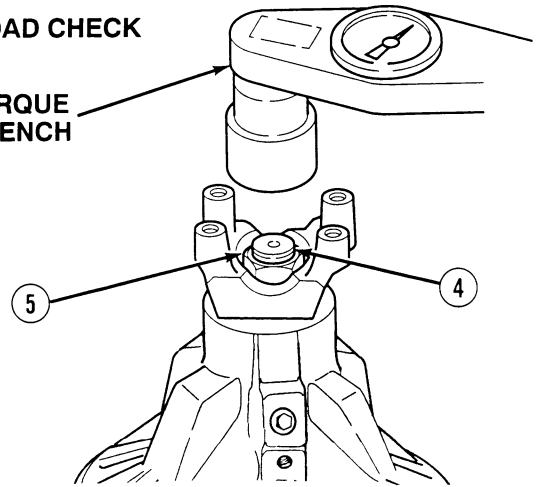
**NOTE**

If preload is incorrect, refer to Step (7).

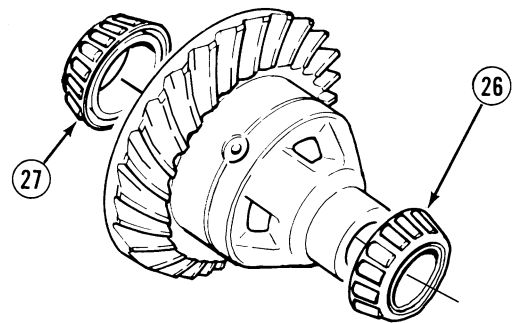
- (25) Check preload on pinion shaft (4) using a torque wrench. Preload must be 48 lb-in. (5 N·m).
- (26) Stake adjusting nut (5) in two slots of pinion shaft (4) directly 180 degrees apart.

**PRELOAD CHECK**

**TORQUE WRENCH**



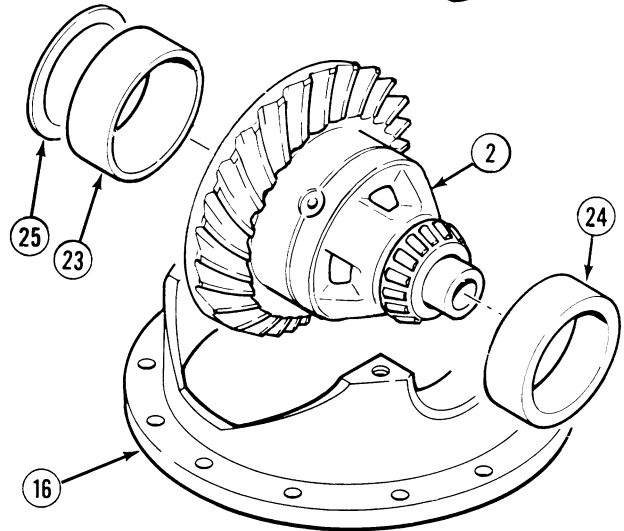
- (27) Assemble adjusting shim (25) thickness by applying the opposite change of thickness applied to adjusting shim (33) in Step (6).
- (28) Install bearing (26) on differential gear (2).
- (29) Install bearing (27) on differential gear (2).
- (30) Install adjusting shim (25) and bearing races (23) and (24) on differential gear (2).



**WARNING**

The differential and bevel gear weighs 70 lbs (32 kg). Attach a suitable lifting device prior to installation to prevent possible injury to personnel.

- (31) With the aid of an assistant, install differential gear (2) in differential housing (16).

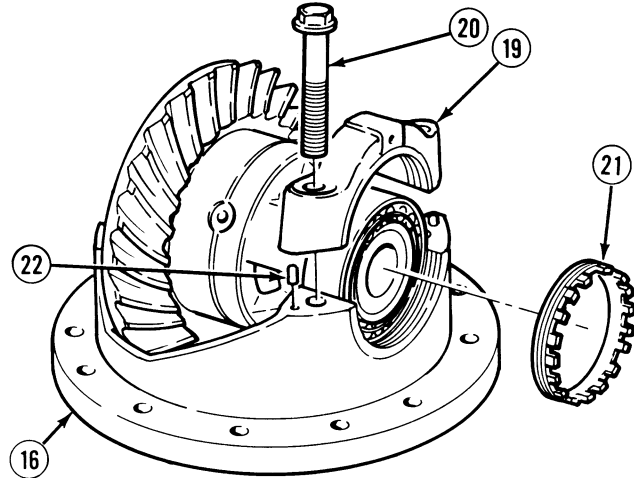


**25-15. AXLE NO. 1 AND 5 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**NOTE**

Perform Step (30) only if locating pins were removed.

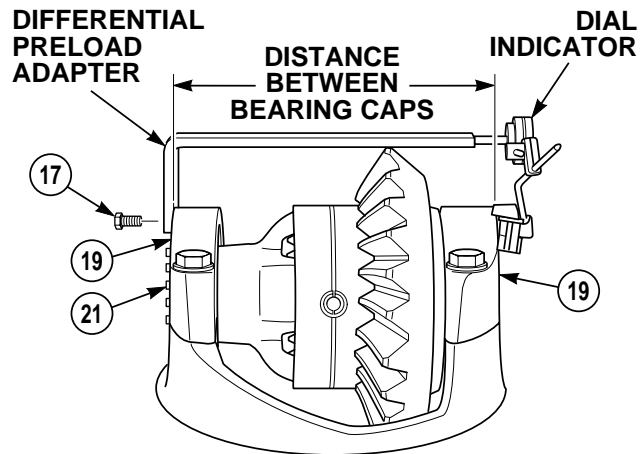
- (32) Install four locating pins (22) in differential housing (16).
- (33) Install adjusting nut (21), two bearing caps (19) and four screws (20) in differential housing (16). Tighten screws to 25 lb-in (3 N·m).
- (34) Install differential preload adapter on bearing cap (19) with screw (17).
- (35) Position dial indicator base on bearing cap (19) and indicator end on differential preload adapter.



**NOTE**

Steps (36) through (38) adjust bearing preload of differential and bevel gear.

- (36) Tighten adjusting nut (21) to obtain a dial indicator measurement of 0.0137 to 0.017 in. (0.3480 to 0.432 mm).
- (37) Remove dial indicator, screw (17) and differential preload adapter from bearing caps (19).



- (38) With the aid of an assistant, hold yoke (1) while turning differential gear (2) counterclockwise until it stops taking up backlash.

**NOTE**

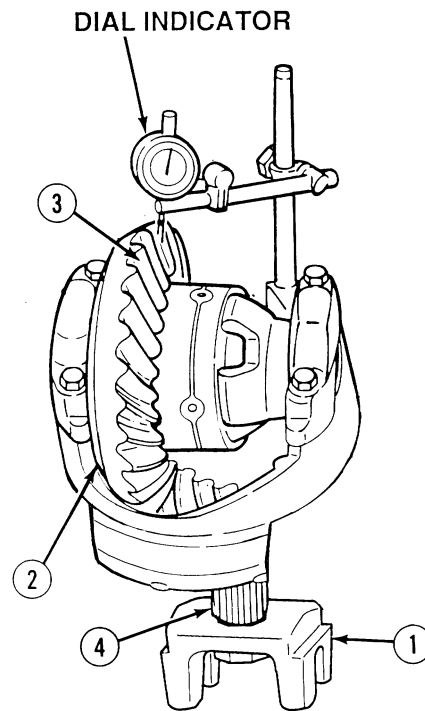
Shaft from dial indicator must be at right (90 degree) angle to face of tooth when in contact.

- (39) Install dial indicator on face of differential gear tooth (3).  
 (40) Turn differential gear (2) clockwise until it stops.

**NOTE**

Backlash should be 0.010 to 0.016 in. (0.254 to 0.406 mm).

- (41) Record differential gear (2) to pinion shaft (4) backlash measured on dial indicator.



**WARNING**

Prussian Blue Dye is poisonous and can burn skin on contact. Over exposure to dye can cause heart and skin problems, dizziness and unconsciousness.

**NOTE**

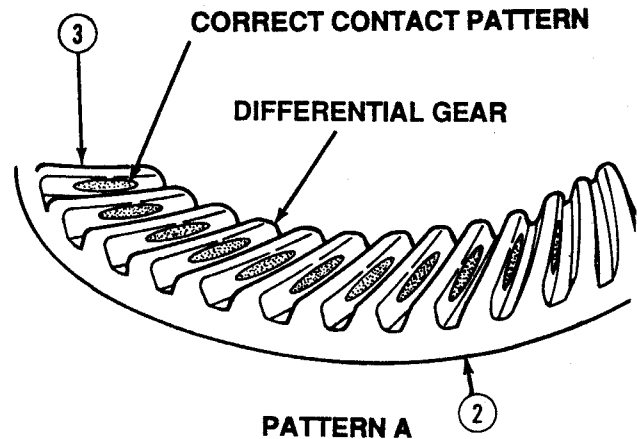
Steps (42) through (49) adjust tooth contact pattern.

- (42) Coat gear teeth (3) differential gear (2) with Prussian blue dye.  
 (43) Turn differential gear (2) back and forth to set dye pattern.

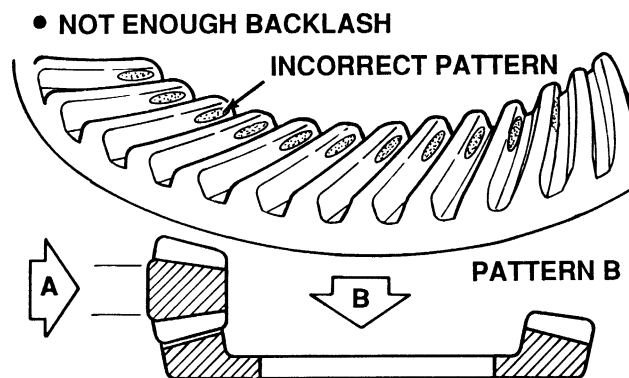
**25-15. AXLE NO. 1 AND 5 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**NOTE**

- To obtain correct tooth contact pattern two considerations must be observed: One is the lengthwise contact pattern that is in the length direction of the teeth, the other is face width pattern that is in height direction of teeth.
- A correct gear pattern for a used pinion shaft and differential and bevel gear is clear of the toe and centers evenly along the face of gear tooth, but can be any length and shape and is acceptable as long as pattern does not run off gear tooth at any point.



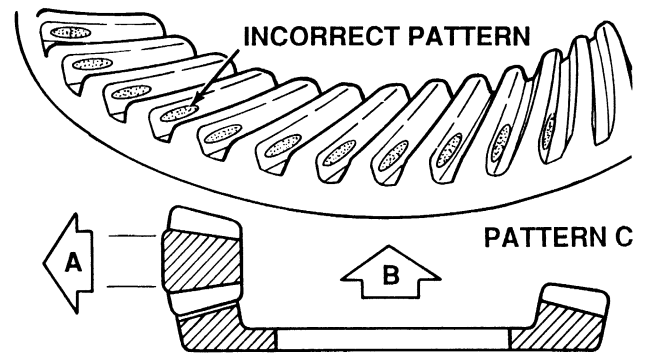
- (44) Check tooth contact pattern on differential gear (2).
- (45) If tooth contact pattern is like pattern A, do not adjust tooth contact pattern. Go to Step (47).
- (46) If tooth contact pattern is like pattern B, add backlash. Refer to Step (35).



**A : PROFILE CONTACT ADJUSTMENT  
B : INCREASE LONGITUDINAL BEARING**

- (47) If tooth contact pattern is like pattern C, subtract backlash. Refer to Step (35).

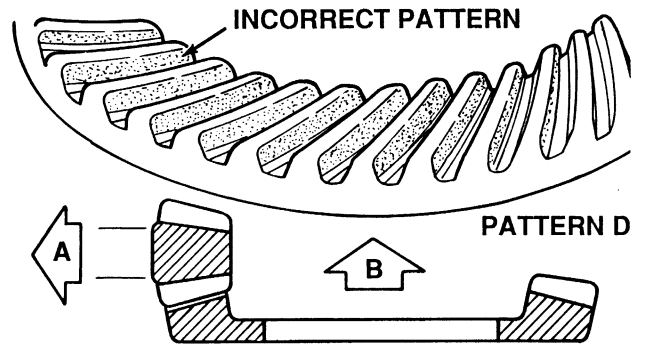
• **TOO MUCH BACKLASH**



**A : PROFILE CONTACT ADJUSTMENT**  
**B : INCREASE LONGITUDINAL BEARING**

- (48) If tooth contact pattern is like pattern D, move pinion shaft away from bevel gear by adjusting shims. Refer to Step (6) or (7) if installing new gears.

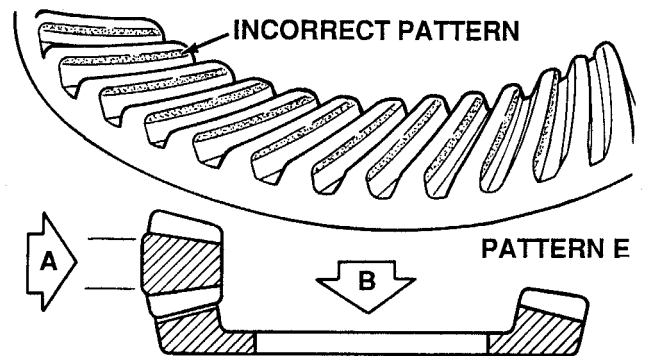
• **PINION SHAFT TOO CLOSE**



**A : RAISE THE PROFILE CONTACT**  
**B : BACKLASH ADJUSTMENT**

- (49) If tooth contact pattern is like pattern E, move pinion shaft closer toward bevel gear by adjusting shims. Refer to Step (6) or (7) if installing new gears.

• **PINION SHAFT TOO FAR AWAY**



**A : LOWER THE PROFILE CONTACT**  
**B : BACKLASH ADJUSTMENT**



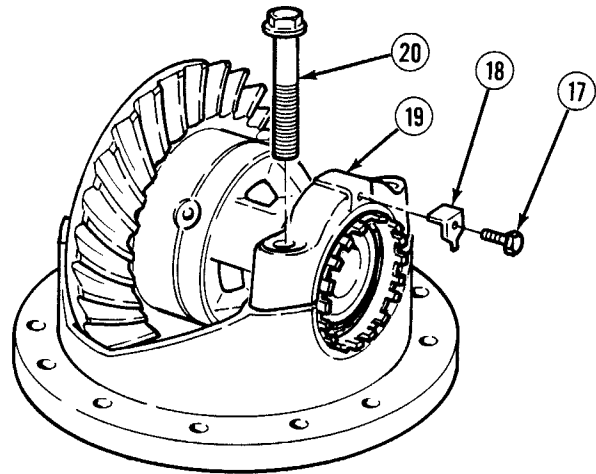
**25-15. AXLE NO. 1 AND 5 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

- (50) Remove one of four screws (20) from bearing caps (19).

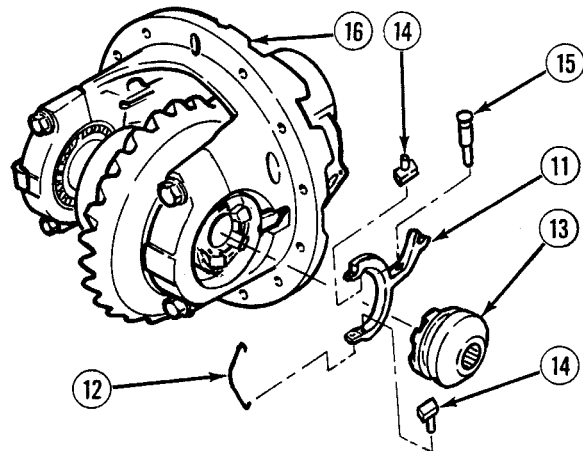
**WARNING**

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.

- (51) Coat threads of screw (20) with sealing compound.
- (52) Install screw (20) and tighten 123 to 137 lb-ft (167 to 186 N·m).
- (53) Repeat Steps (47) through (49) for three remaining screws (20).
- (54) Coat threads of screw (17) with sealing compound.
- (55) Install nut locking plate (18) to bearing cap (19) with screw (17). Tighten to 132 to 216 lb-in (15 to 24 N·m).



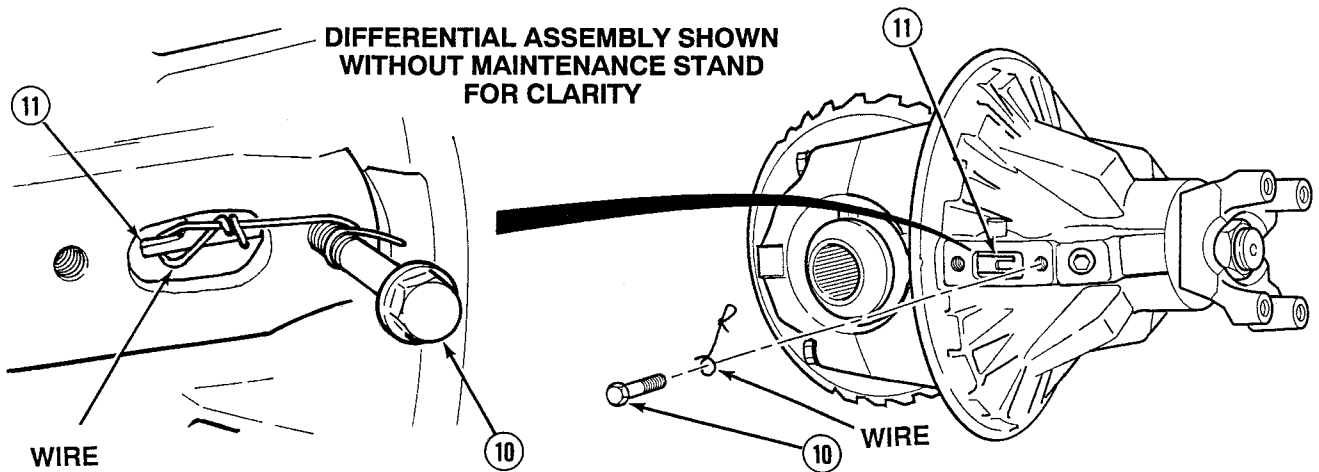
- (56) Install fork (11) with retaining pin (15) in differential housing (16).
- (57) Stake retaining pin (15) on largest diameter end.
- (58) Coat both ends of retaining pin (15) with adhesive.
- (59) Install two finger forks (14) in fork (11).



**WARNING**

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

- (60) Install clutch gear (13) on fork (11) with retaining ring (12).



(61) Use wire and screw (10) to fasten fork (11) in engaged position.

**e. Installation.**

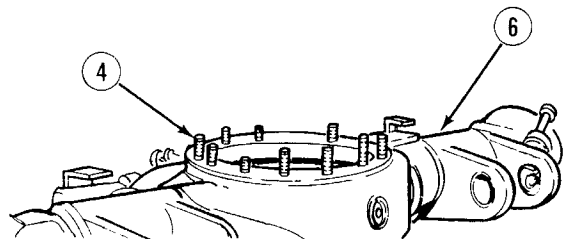
**WARNING**

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**

Perform Steps (1) and (2) if studs were removed.

- (1) Coat threads of 14 studs (4) with sealing compound.
- (2) Install 14 studs (4) in axle housing (6). Tighten studs to 76 lb-ft (103 N·m).
- (3) Coat mating surface of axle housing (6) with adhesive.



**25-15. AXLE NO. 1 AND 5 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**WARNING**

Differential assembly weighs 198 lbs (90 kg). Attach a suitable lifting device prior to installation to prevent possible injury to personnel.

- (4) Attach lifting device on differential assembly (5).
- (5) With the aid of an assistant, remove six nuts (9) and screws (8) from differential assembly (5) and differential adapter.

**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.

- (6) Coat mating surface of axle housing (6) with adhesive.
- (7) With the aid of an assistant, remove differential assembly (5) from differential adapter and install in axle housing (6).
- (8) Coat beveled contact face of three taper rings (3) with adhesive.

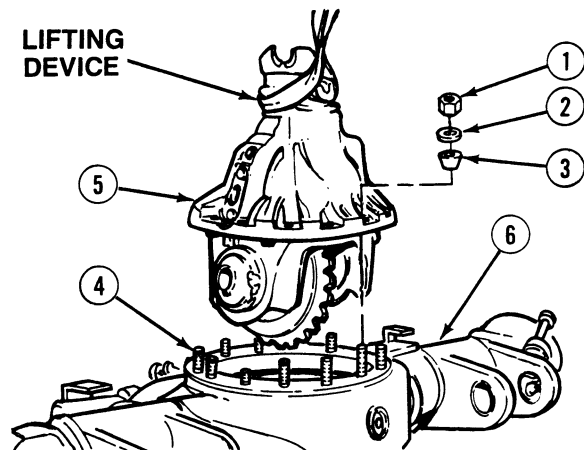
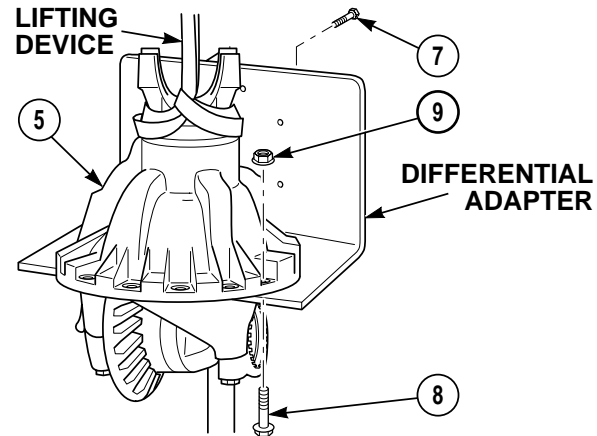
**NOTE**

Install washers and nuts on three studs which contain taper rings first. Tighten these three nuts before installing and tightening remaining washers and nuts.

- (9) Install three taper rings (3), 14 washers (2) and locknuts (1) on studs (4). Tighten locknuts to 140 to 152 lb-ft (190 to 206 N·m).
- (10) Remove lifting device from differential assembly (5).
- (11) With the aid of an assistant, remove six screws (7) and differential adapter from engine maintenance stand.

**f. Follow-On Maintenance:**

- Install constant velocity joint, (Para 25-13).



**END OF TASK**

**25-16. AXLE NO. 2 DIFFERENTIAL ASSEMBLY REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Adapter, Maintenance Stand, Differential  
(Item 3, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gage, Depth, Micrometer (Item 73, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Hammer, Hand, Soft Plastic  
(Item 88, Appendix F)  
Indicator, Dial, Set w/Magnetic Base  
(Item 98, Appendix F)  
Micrometer, Outside, Caliper Set  
(Item 139, Appendix F)  
Multiplier, Torque (Item 141, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)  
Puller Kit, Universal, Slide Hammer  
(Item 175, Appendix F)  
Socket, 63 mm (Item 218, Appendix F)  
Stand, Maintenance, Engine  
(Item 226, Appendix F)  
Torch, Propane (Item 247, Appendix F)  
Wrench Set, Socket, 3/8 in. Drive  
(Item 273, Appendix F)

*Tools and Special Tools - Continued*

Wrench, Torque (0-60 N·m)  
(Item 276, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Wrench, Torque (0 to 600 lb-ft [0-814 N·m])  
(Item 278, Appendix F)  
Lifting Device, Minimum Capacity 450 lbs  
(204 kg)  
Extractor, Jet (Appendix C)  
Holder, Flange (Appendix C)  
Adapter, Differential Preload (Appendix C)

*Materials/Parts*

Adhesive (Item 1, Appendix B)  
Dye, Prussian Blue (Item 20, Appendix B)  
Grease (Item 22, Appendix B)  
Sealing Compound (Item 59, Appendix B)  
Sealing Compound (Item 60, Appendix B)  
Solvent, Dry Cleaning (Item 68, Appendix B)  
Wire, Nonelectrical (Item 79, Appendix B)  
Locknut (16) (Item 215, Appendix E)  
Nut, Adjusting (Item 307, Appendix E)  
Seal, Oil (Item 598, Appendix E)  
Shim Kit, Adjusting (2) (Item 639, Appendix E)  
Shim Kit, Adjusting (Item 640, Appendix E)  
Shim Kit, Adjusting (Item 641, Appendix E)

*Personnel Required*

Two

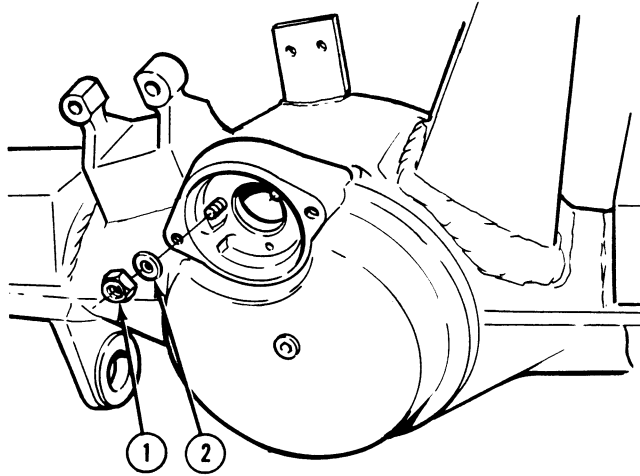
*Equipment Condition*

Rear output assembly removed, (Para 25-14)

**25-16. AXLE NO. 2 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**a. Removal.**

- (1) Remove two locknuts (1) and washers (2). Discard locknuts.
- (2) Remove 12 locknuts (3), washers (4) and ten taper rings (5) from studs (6). Discard locknuts.



**WARNING**

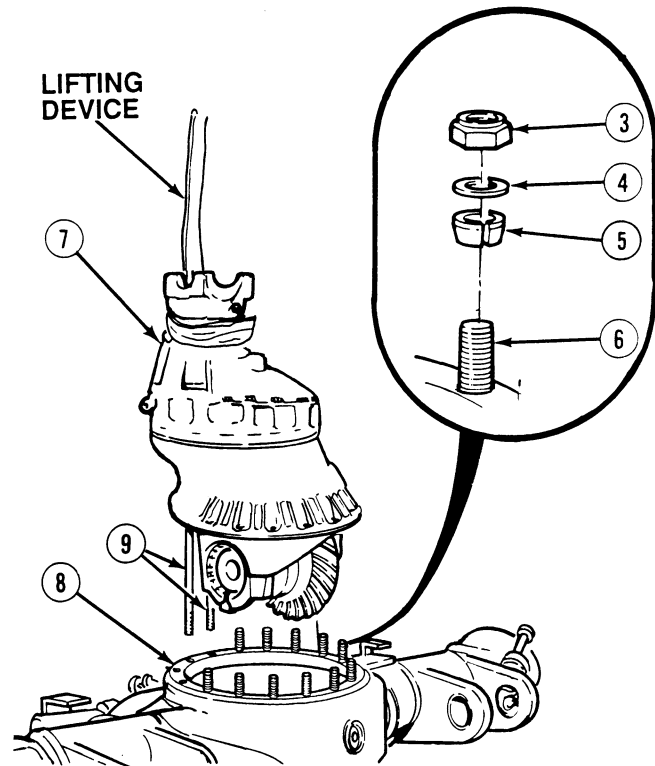
Differential assembly weighs 450 lbs (204 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (3) Attach lifting device to differential assembly (7).
- (4) With the aid of an assistant and lifting device, remove differential assembly (7) from axle housing (8).

**NOTE**

Perform Step (5) if studs are damaged.

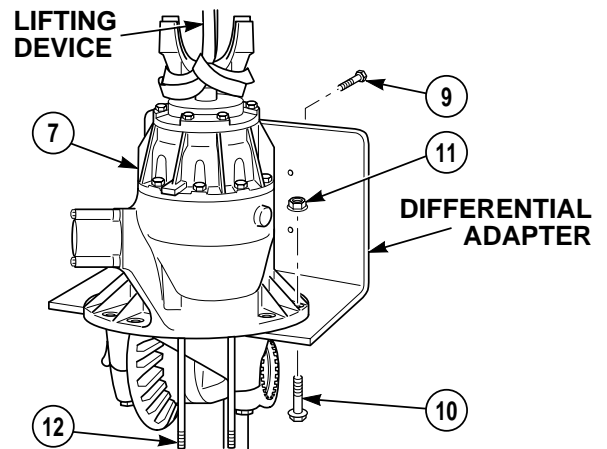
- (5) Remove 12 studs (6) from axle housing (8).



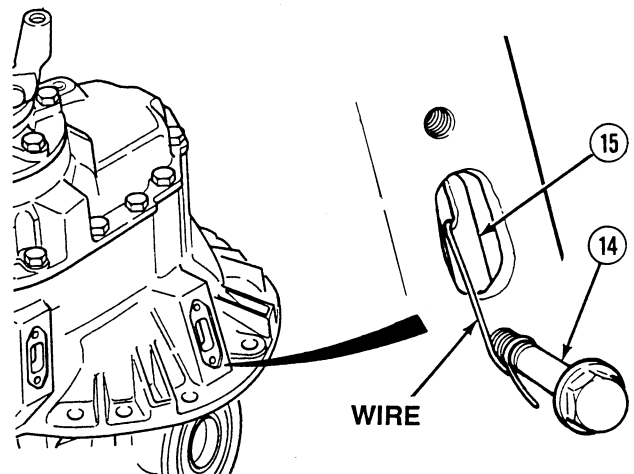
**WARNING**

Differential assembly weighs 450 lbs (204 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (6) With the aid of an assistant, install differential adapter on engine maintenance stand with six screws (9).
- (7) With the aid of an assistant, install differential assembly (7) on differential adapter with six screws (10) and nuts (11).
- (8) Remove lifting device from differential assembly (7).
- (9) Remove two studs (12) from differential adapter (7).



- (10) Remove wire and screw (14) from fork (15).



**25-16. AXLE NO. 2 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**b. Disassembly.**

**CAUTION**

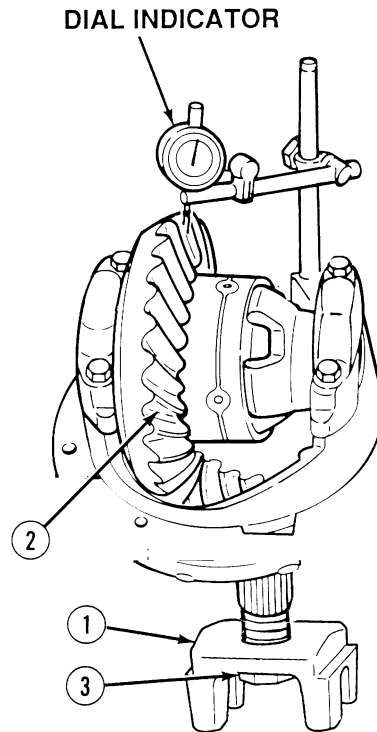
Make sure pinion shaft does not move while backlash is being measured or incorrect reading will result.

- (1) With the aid of an assistant, hold yoke (1) while turning differential gear (2) counter clockwise until gear stops to take up backlash.

**NOTE**

Shaft from dial indicator must be at right 90 degree angle to face of tooth when in contact.

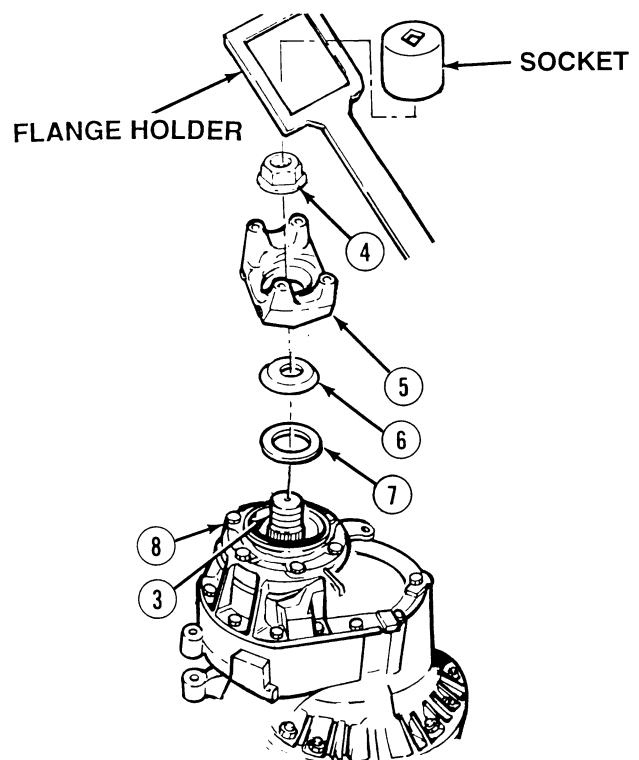
- (2) Install dial indicator on face of differential gear tooth (2).
- (3) Turn differential gear (2) clockwise until gear stops.



**NOTE**

Record differential gear to pinion shaft backlash and contact pattern. Backlash should be 0.010 to 0.016 in. (0.254 to 0.406 mm).

- (4) Check differential gear (2) to pinion shaft (3) backlash measured on dial indicator and contact pattern.
- (5) Unstake adjusting nut (4) on pinion shaft (3).
- (6) With the aid of an assistant and using flange holder and socket, remove adjusting nut (4) from pinion shaft (3). Discard adjusting nut.
- (7) Remove flange assembly (5) from pinion shaft (3).
- (8) Separate dust cover (6) from flange assembly (5).
- (9) Using puller, remove seal (7) from differential assembly (8). Discard oil seal.



- (10) Remove one screw (9) and five screws (10) from cover (11).

**NOTE**

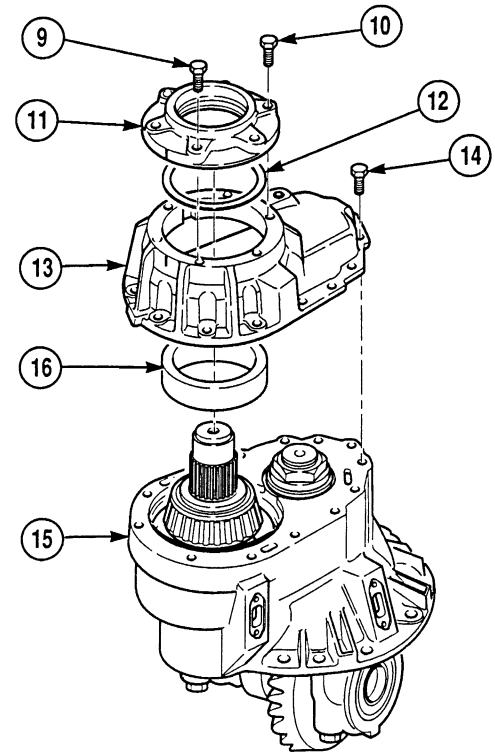
Matchmark housing cover and housing before removal.

- (11) Remove cover (11) and adjusting shim (12) from front housing (13). Measure and record thickness of adjusting shim. Discard adjusting shim.
- (12) Remove 13 screws (14) from front housing (13).
- (13) Remove front housing (13) from housing assembly (15).

**NOTE**

Bearing race is part of a matched set with a taper bearing.

- (14) Remove bearing race (16) from front housing (15).



**WARNING**

Split torque weighs 62 lbs (28 kg). The aid of an assistant is required to prevent possible injury to personnel.

**NOTE**

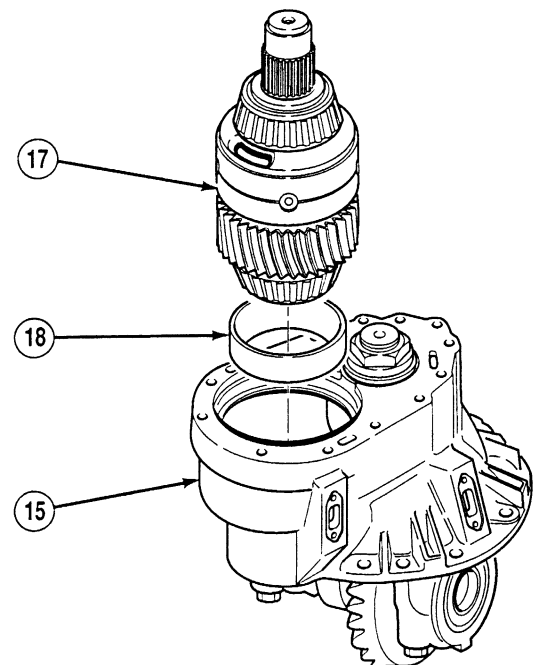
Install flange assembly on shaft of split torque to remove split torque from housing assembly.

- (15) With the aid of an assistant, remove split torque (17) from housing assembly (15).

**NOTE**

The bearing race is part of a matched set with a taper bearing.

- (16) Remove bearing race (18) from housing assembly (15).



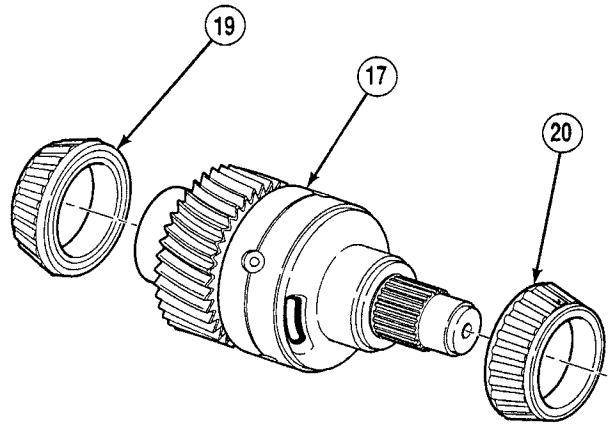


**25-16. AXLE NO. 2 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**NOTE**

Each taper bearing is part of its own matched set with a bearing race.

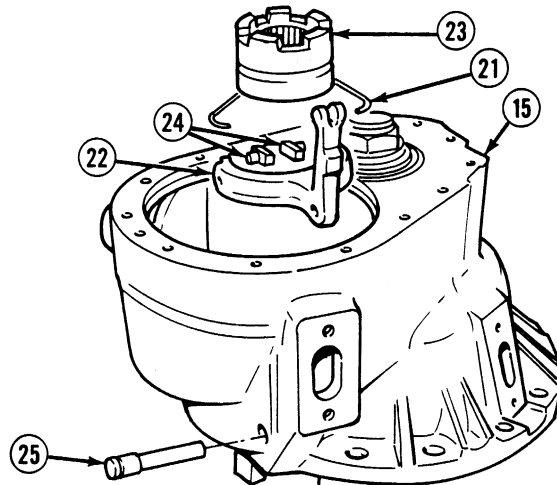
- (17) Using gear puller, remove two taper bearings (19) and (20) from split torque (17).



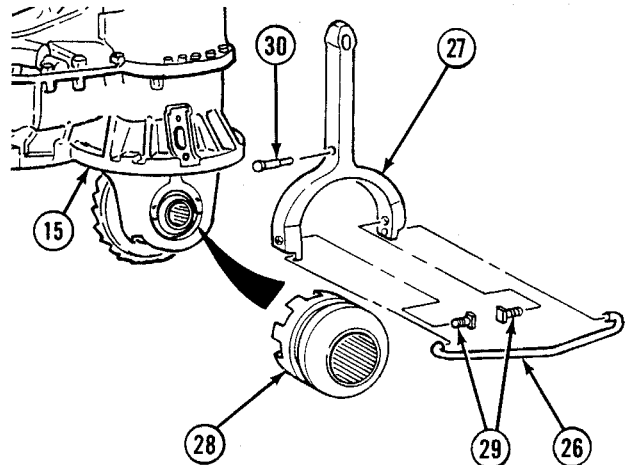
**WARNING**

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

- (18) Remove retaining ring (21) from fork (22).
- (19) Remove clutch gear (23) from fork (22).
- (20) Remove two finger forks (24) from fork (22).
- (21) Punch out fork pin (25) and remove fork (22) from housing assembly (15).



- (22) Remove retaining ring (26) from fork (27).
- (23) Remove clutch gear (28) from fork (27).
- (24) Remove two finger forks (29) from fork (27).
- (25) Punch out fork pin (30) and remove fork (27) from housing assembly (15).



- (26) Remove screw (31) and nut lock plate (32) from bearing cap (33).

**NOTE**

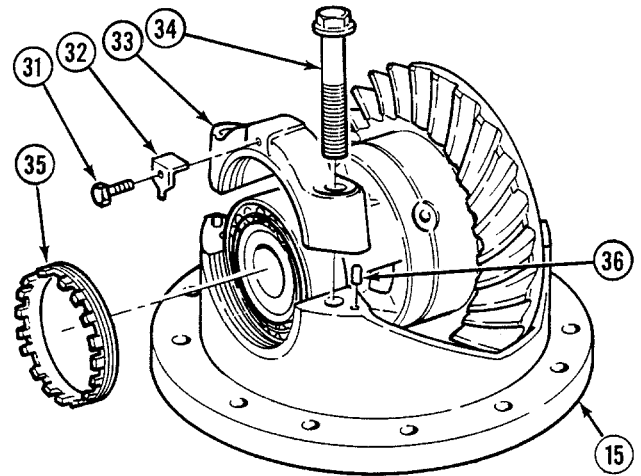
Bearing caps are part of a matched assembly with housing assembly.

- (27) Remove four screws (34), two bearing caps (33) and adjusting nut (35) from housing assembly (15).

**NOTE**

Perform Step (30) only if locating pins are damaged.

- (28) Remove four locating pins (36) from housing assembly (15).

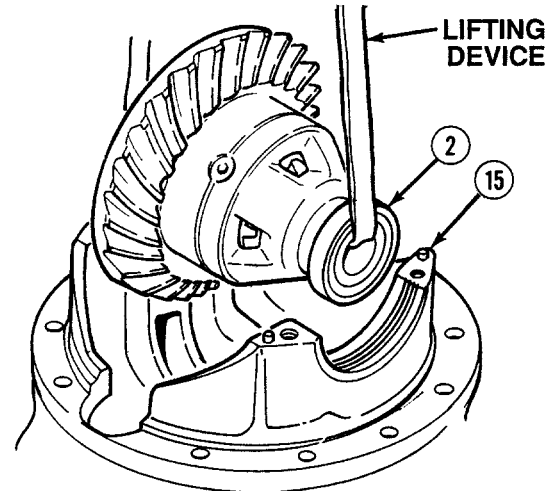


**WARNING**

Differential and bevel gear weigh 70 lbs (32 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**NOTE**

Differential and bevel gear assembly is part of a matched assembly with pinion shaft.

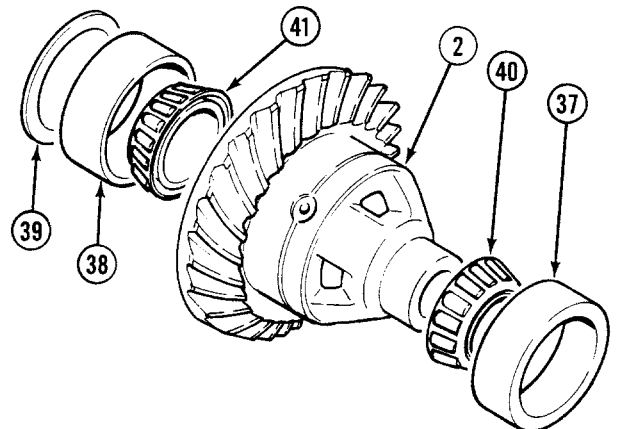


- (29) Attach lifting device to differential gear (2).
- (30) Using lifting device, remove differential gear (2) from housing assembly (15).
- (31) Remove lifting device from differential gear (2).

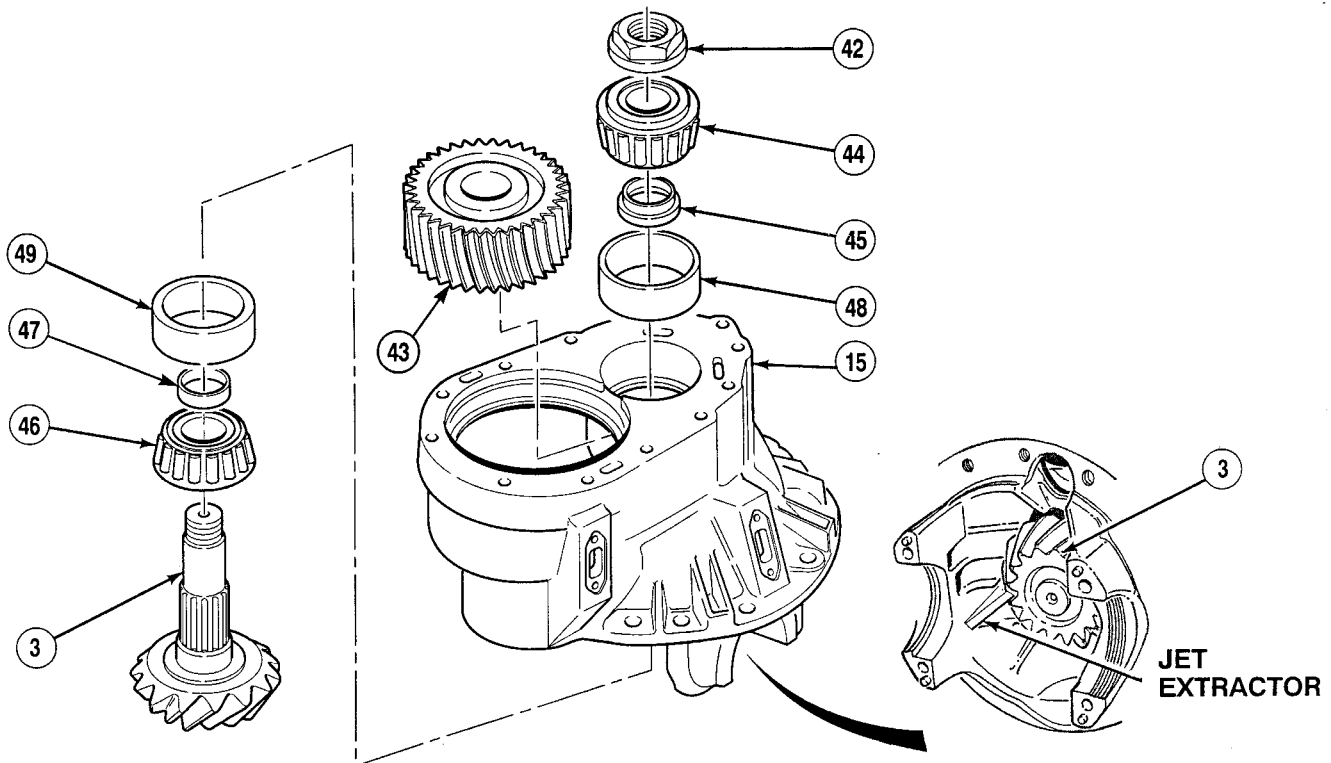
**NOTE**

Tag and mark bearings and races before removal. Bearing races are part of matched assemblies with taper bearings.

- (32) Remove bearing races (37) and (38) and adjusting shim (39) from differential gear (2). Record and discard adjusting shim.
- (33) Using puller, remove taper bearings (40) and (41) from differential gear (2).



**25-16. AXLE NO. 2 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**



**NOTE**

Nut is staked in two places.

- (34) Unstake nut (42) on pinion shaft (3).
- (35) Position jet extractor between gear teeth of pinion shaft (3) and housing assembly (15). Remove adjusting nut (42). Discard adjusting nut.

**NOTE**

Pinion shaft is part of a matched assembly with differential and bevel gear.

- (36) With the aid of an assistant and using a soft faced hammer, remove pinion shaft (3) from housing assembly (15).
- (37) Remove driven gear (43) from housing assembly (15).

**NOTE**

Taper bearings are part of a matched assembly with bearing races.

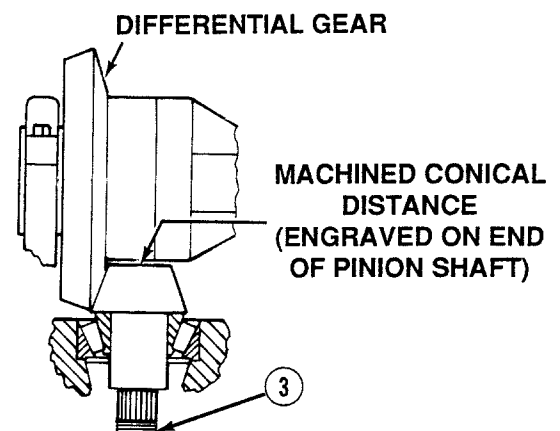
- (38) Remove taper bearing (44), adjusting shim (45) from housing assembly (15). Record adjusting shim thickness and discard.
- (39) Using press, remove taper bearing (46) and adjusting shim (47) from pinion shaft (3). Record shim thickness and discard.
- (40) Using puller, remove bearing races (48) and (49) from housing assembly (15).

**c. Cleaning/Inspection.****WARNING**

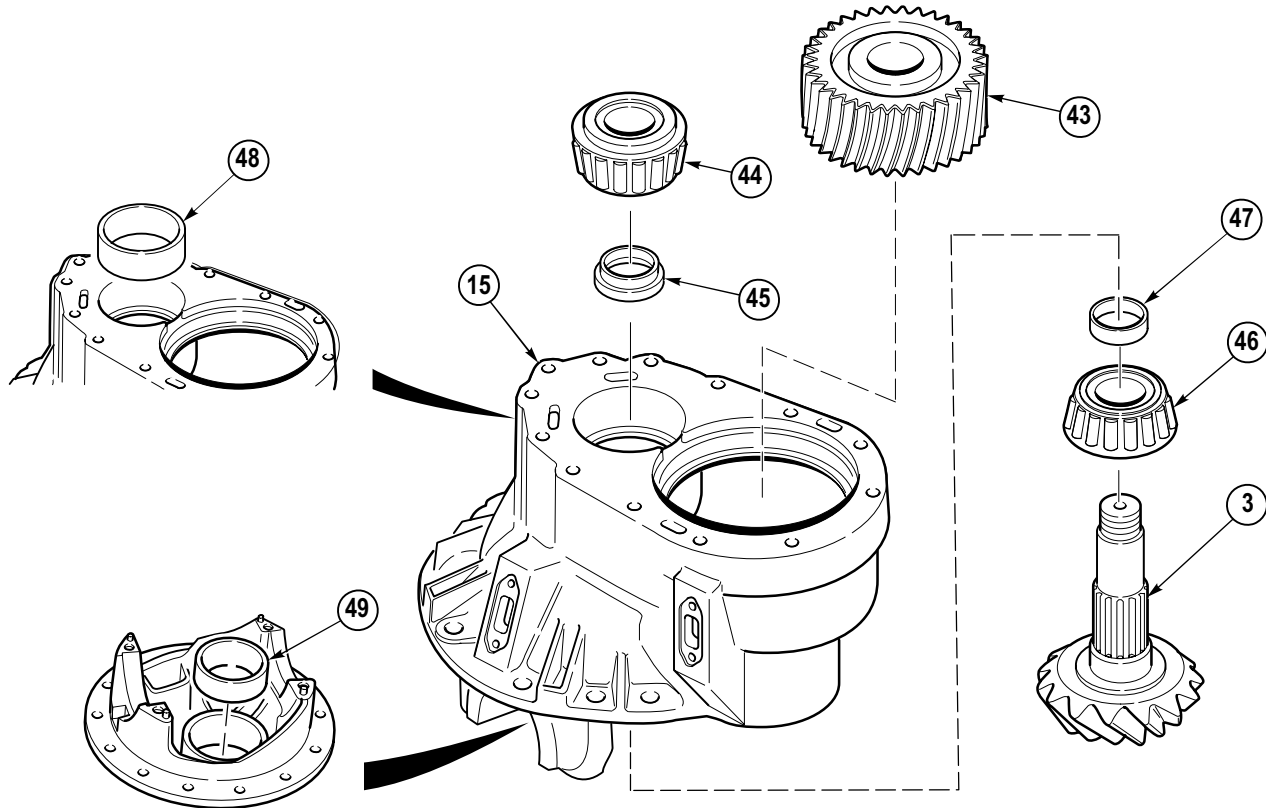
- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes, and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent. The flashpoint for Type II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
  - (2) Inspect metal parts for breaks, cracks, burrs and sharp edges.
  - (3) Inspect all bearings for wear, scoring and cracks.
  - (4) Inspect split torque for broken splines and wear.
  - (5) Inspect differential and bevel gear for broken splines and wear.
  - (6) Inspect driven gear for broken splines and wear.
  - (7) Inspect pinion shaft for broken splines and wear.
  - (8) Replace all damaged parts.

**d. Assembly.****NOTE**

- Perform Steps (1) through (7) only if new pinion shaft and differential gear are being installed.
  - The machined conical distance is engraved on pinion shaft head.
- (1) Record machined conical distance of used pinion shaft (3) which was removed from differential assembly.
  - (2) Record machined conical distance of new pinion shaft (3) which is to be installed in the differential assembly.
  - (3) Compare two distances recorded in Steps (1) and (2). If distance recorded in Step (1) is larger than distance recorded in Step (2), proceed to Step (4). If distance recorded in Step (2) is larger than distance recorded in Step (1), proceed to Step (5).



**25-16. AXLE NO. 2 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**



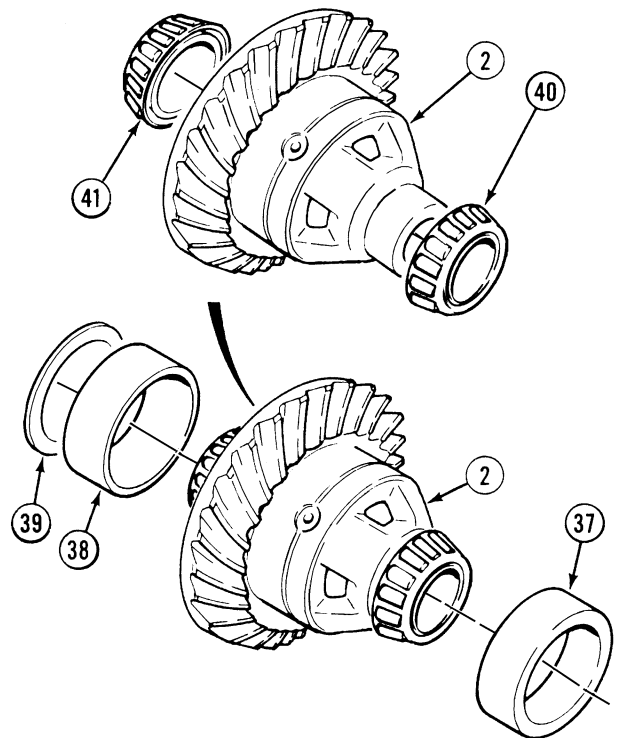
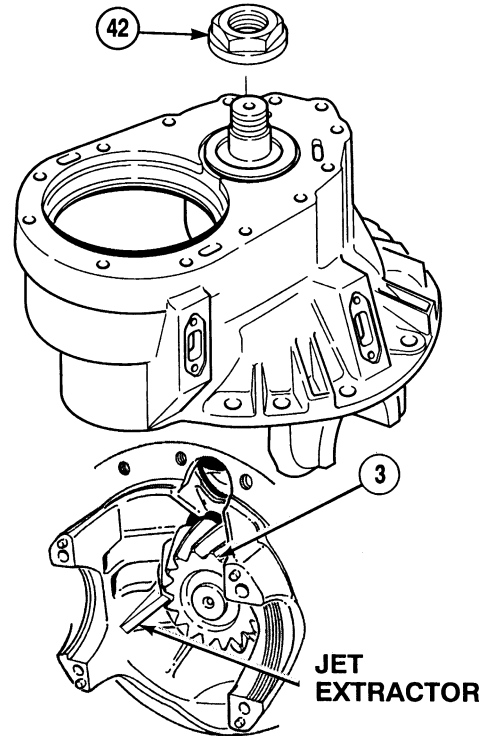
- (4) The new adjusting shim (47) thickness will be: Step (1) distance – Step (2) distance = amount of shim thickness to be added to old adjusting shim thickness to create new adjusting shim. Proceed to Step (6).
- (5) The new adjusting shim (47) thickness will be: Step (2) distance – Step (1) distance = amount of shim thickness to be removed from old adjusting shim to create new adjusting shim. Proceed to Step (6).
- (6) Assemble adjusting shim (47) to thickness determined in Steps (1) through (5).
- (7) Assemble adjusting shim (45) thickness by applying same change of thickness applied to adjusting shim (47).
- (8) Apply grease to bearing race (49).
- (9) Install bearing race (49) in housing assembly (15).
- (10) Apply grease to bearing race (48).
- (11) Install bearing race (48) in housing assembly (15).
- (12) Install taper bearing (46) on pinion shaft (3).
- (13) Install adjusting shim (47) on pinion shaft (3).
- (14) Install driven gear (43) in housing assembly (15).
- (15) Install pinion shaft (3) in housing assembly (15).
- (16) Install adjusting shim (45) on pinion shaft (3).
- (17) With the aid of an assistant, hold pinion shaft (3) in place and install taper bearing (44) on pinion shaft.

- (18) Position jet extractor between gear teeth of pinion shaft (3) and install adjusting nut (42). Tighten nut to 543 to 572 lb-ft (736 to 776 N·m).
- (19) Using a torque wrench, check preload of pinion shaft (3). Preload must be 48 lb-in (5 N·m).

**NOTE**

- If preload is correct, go on to Step (20).
- If preload is incorrect, repeat Steps (1) through (19) until proper preload is obtained.

- (20) Stake adjusting nut (42) in two places.
- (21) Install taper bearing (41) on differential gear (2).
- (22) Install taper bearing (40) on differential gear (2).
- (23) Assemble new adjusting shim (39) thickness by applying opposite change of thickness applied to adjusting shim kit (47) in Step (6).
- (24) Install adjusting shim (39) and bearing races (38) and (37) on differential gear (2).

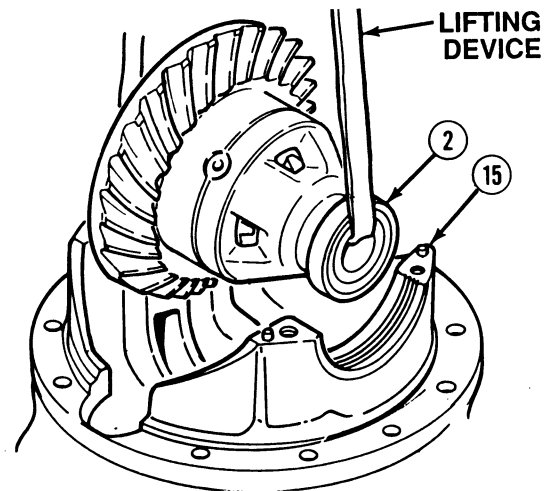


**25-16. AXLE NO. 2 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**WARNING**

Differential gear weighs 70 lbs (32 kg). Attach a suitable lifting device prior to installation to prevent possible injury to personnel.

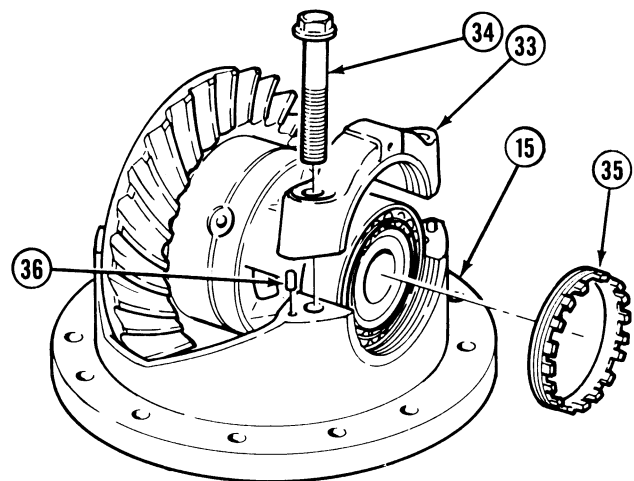
- (25) Attach lifting device through differential gear (2).
- (26) Install differential gear (2) in housing assembly (15).
- (27) Remove lifting device from differential gear (2).



**NOTE**

Perform Step (28) only if locating pins were removed.

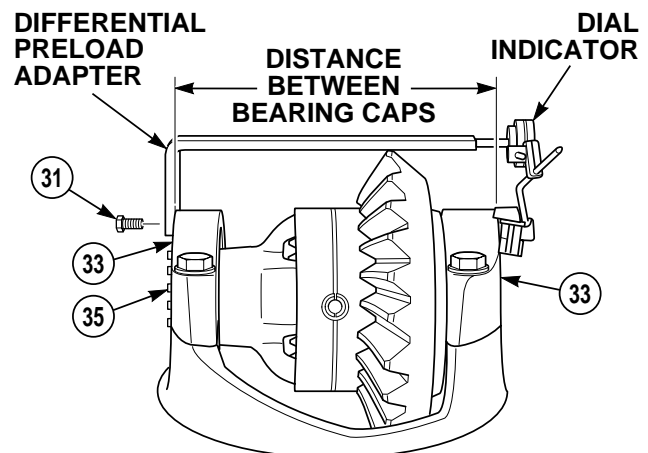
- (28) Install four locating pins (36) in housing assembly (15).
- (29) Install adjusting nut (35), two bearing caps (33) and four screws (34). Tighten screws to 25 lb-in (3 N·m).
- (30) Install differential preload adapter on bearing cap (33) with screw (31).
- (31) Position dial indicator base on bearing cap (33) and indicator end on differential preload adapter.



**NOTE**

Steps (32) through (34) adjust bearing preload.

- (32) Tighten adjusting nut (35) to obtain a dial indicator reading of 0.014 to 0.018 in. (0.356 to 0.457 mm).
- (33) Remove screw (31), dial indicator and differential preload adapter from bearing cap (33).



**CAUTION**

Make sure pinion shaft does not move while backlash is being measured. Incorrect readings will result.

- (34) Hold pinion shaft (3) so differential gear (2) does not move.
- (35) Turn differential gear (2) counterclockwise until gear takes up backlash.

**NOTE**

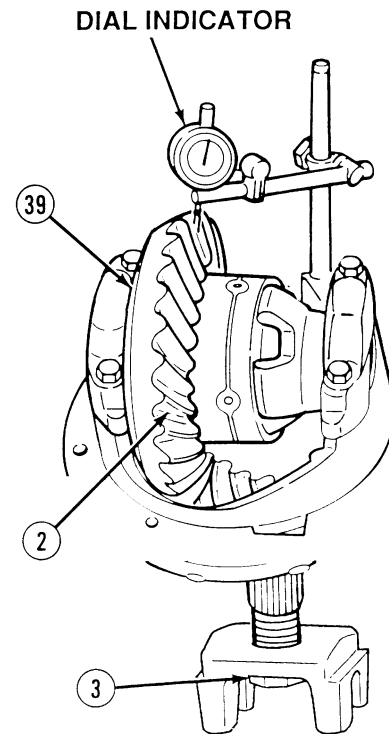
Shaft from dial indicator must be at 90 degree angle to face of tooth when in contact.

- (36) Install dial indicator on face of differential gear (2) tooth.
- (37) Turn differential gear (2) clockwise until gear stops.

**NOTE**

Backlash should be 0.010 to 0.013 in. (0.254 to 0.330 mm).

- (38) Record differential gear (2) to bevel gear backlash measured on dial indicator.
- (39) If backlash is not correct, adjust adjusting shim (39) until proper backlash is obtained.





**25-16. AXLE NO. 2 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

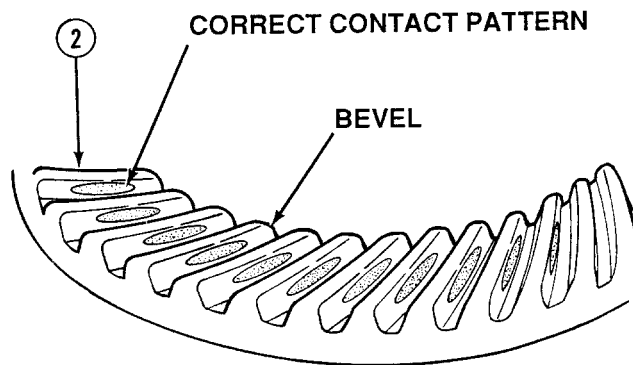
**WARNING**

Prussian Blue Dye is poisonous and can burn skin on contact. Over exposure to dye can cause heart and skin problems, dizziness, and unconsciousness.

**NOTE**

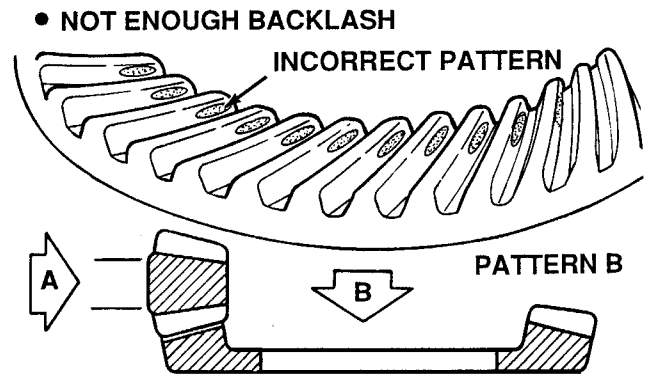
Steps (40) through (46) adjusts tooth contact pattern.

- (40) Coat bevels of differential gear (2) with Prussian blue dye.
- (41) Turn differential gear (2) back and forth to set dye pattern. Check tooth contact pattern.



**NOTE**

- To obtain correct tooth contact pattern two considerations must be observed: One is the lengthwise contact pattern that is in length direction of teeth, the other is face width pattern that is in height direction of teeth.
- A correct gear pattern for a used pinion shaft and differential and bevel gear is clear of the toe and centers evenly along the face of gear tooth, but can be any length and shape and is acceptable as long as pattern does not run off gear tooth at any point.

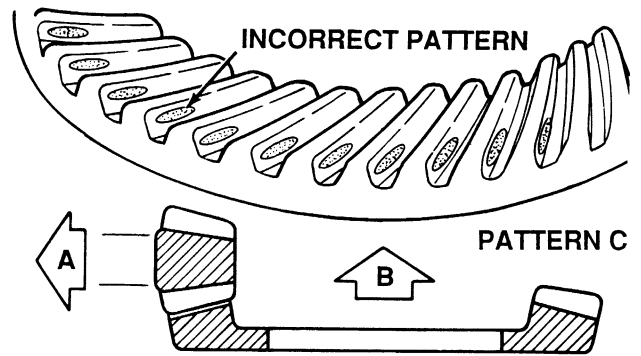


**A : PROFILE CONTACT ADJUSTMENT  
B : INCREASE LONGITUDINAL BEARING**

- (42) If tooth contact pattern is like pattern A, do not adjust tooth contact pattern. Go on to Step (47).
- (43) If tooth contact pattern is like pattern B, add backlash. Go to Step (32).

- (44) If tooth contact pattern is like pattern C, remove backlash. Go to Step (31).

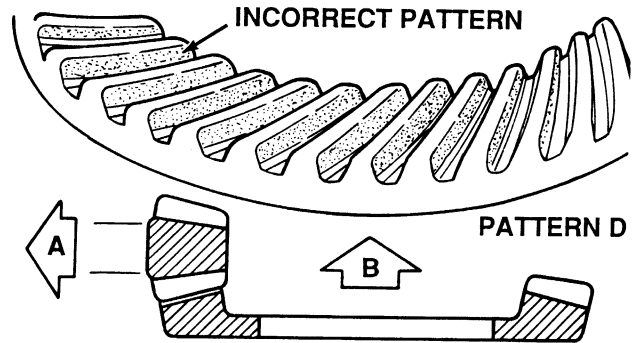
• TOO MUCH BACKLASH



A : PROFILE CONTACT ADJUSTMENT  
B : INCREASE LONGITUDINAL BEARING

- (45) If tooth contact pattern is like pattern D, move pinion shaft away from bevel gear by adjusting shims. Go to Step (6) if installing new gears.

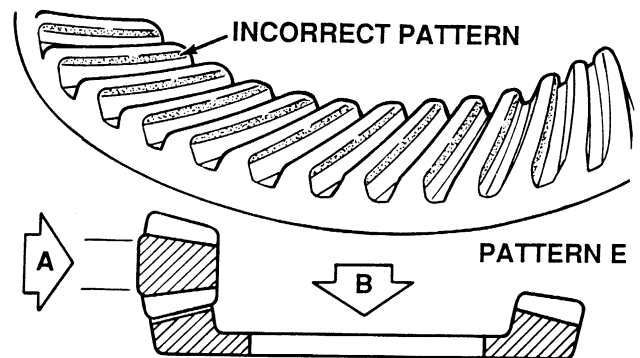
• PINION SHAFT TOO CLOSE



A : RAISE THE PROFILE CONTACT  
B : BACKLASH ADJUSTMENT

- (46) If tooth contact pattern is like pattern E, move pinion shaft closer toward bevel gear by adjusting shims. Go to Step (6) if installing new gears.

• PINION SHAFT TOO FAR AWAY



A : LOWER THE PROFILE CONTACT  
B : BACKLASH ADJUSTMENT

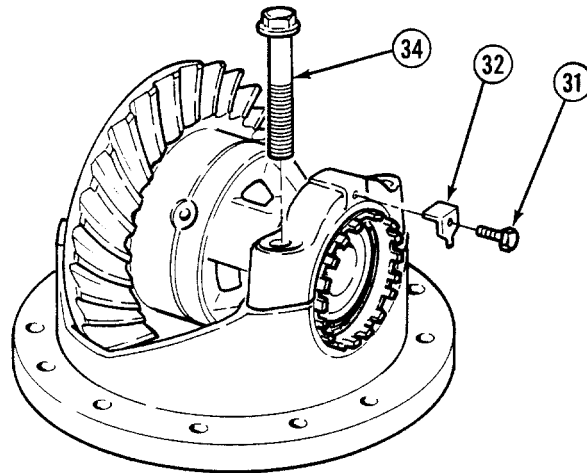
**25-16. AXLE NO. 2 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

- (47) Remove one of four screws (34).

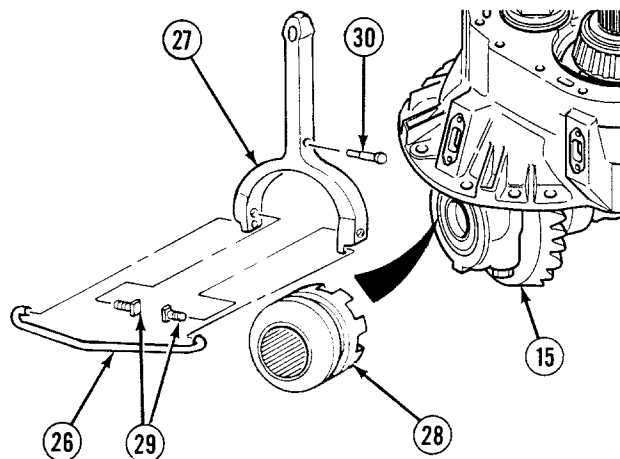
**WARNING**

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.

- (48) Coat threads of screw (34) with sealing compound.
- (49) Install screw (34) and tighten to 123 to 138 lb-ft (167 to 187 N·m).
- (50) Repeat Steps (47) through (49) for three remaining screws (34).
- (51) Coat the threads of screw (31) with sealing compound.
- (52) Install screw (31) in lock plate (32).



- (53) Install fork (27) in housing assembly (15) with retaining pin (30).
- (54) Stake retaining pin (30) on largest diameter end.
- (55) Coat both ends of retaining pin (30) with adhesive.
- (56) Install two finger forks (29) in fork (27).

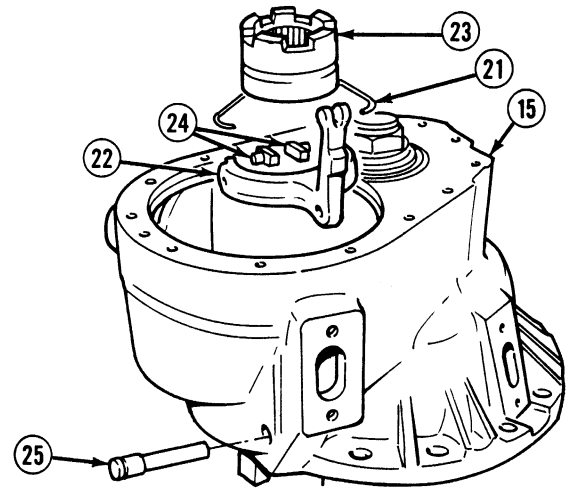


**WARNING**

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

- (57) Install clutch gear (28) on fork (27) with retaining ring (26).

- (58) Install fork (22) and fork pin (25) in housing assembly (15).
- (59) Stake retaining pin (25) on largest diameter end.



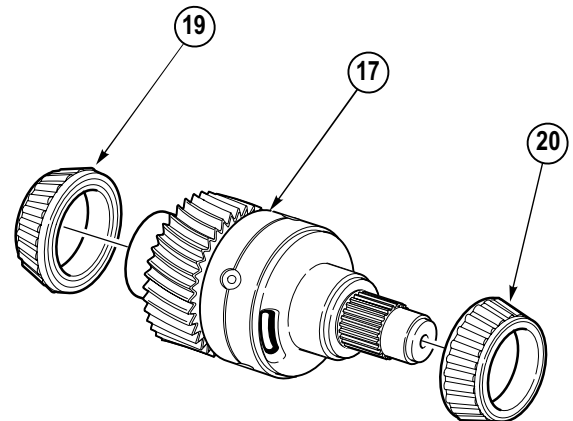
**WARNING**

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.

- (60) Coat both ends of retaining pin (25) with adhesive.
- (61) Install two finger forks (24) in fork (22).

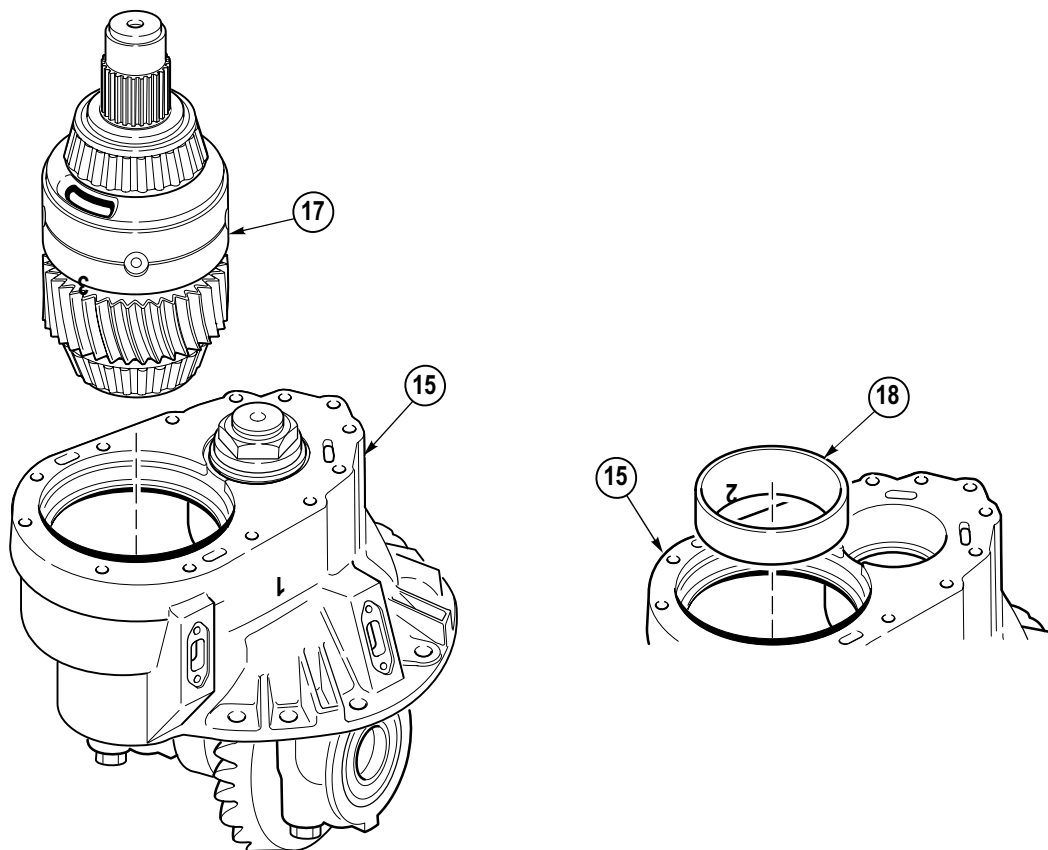
**WARNING**

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



- (62) Install clutch gear (23) on fork (22) with retaining ring (21).
- (63) Install taper bearings (19) and (20) on split torque (17).

**25-16. AXLE NO. 2 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**



- (64) Coat bearing race (18) with grease.
- (65) Install bearing race (18) in housing assembly (15).

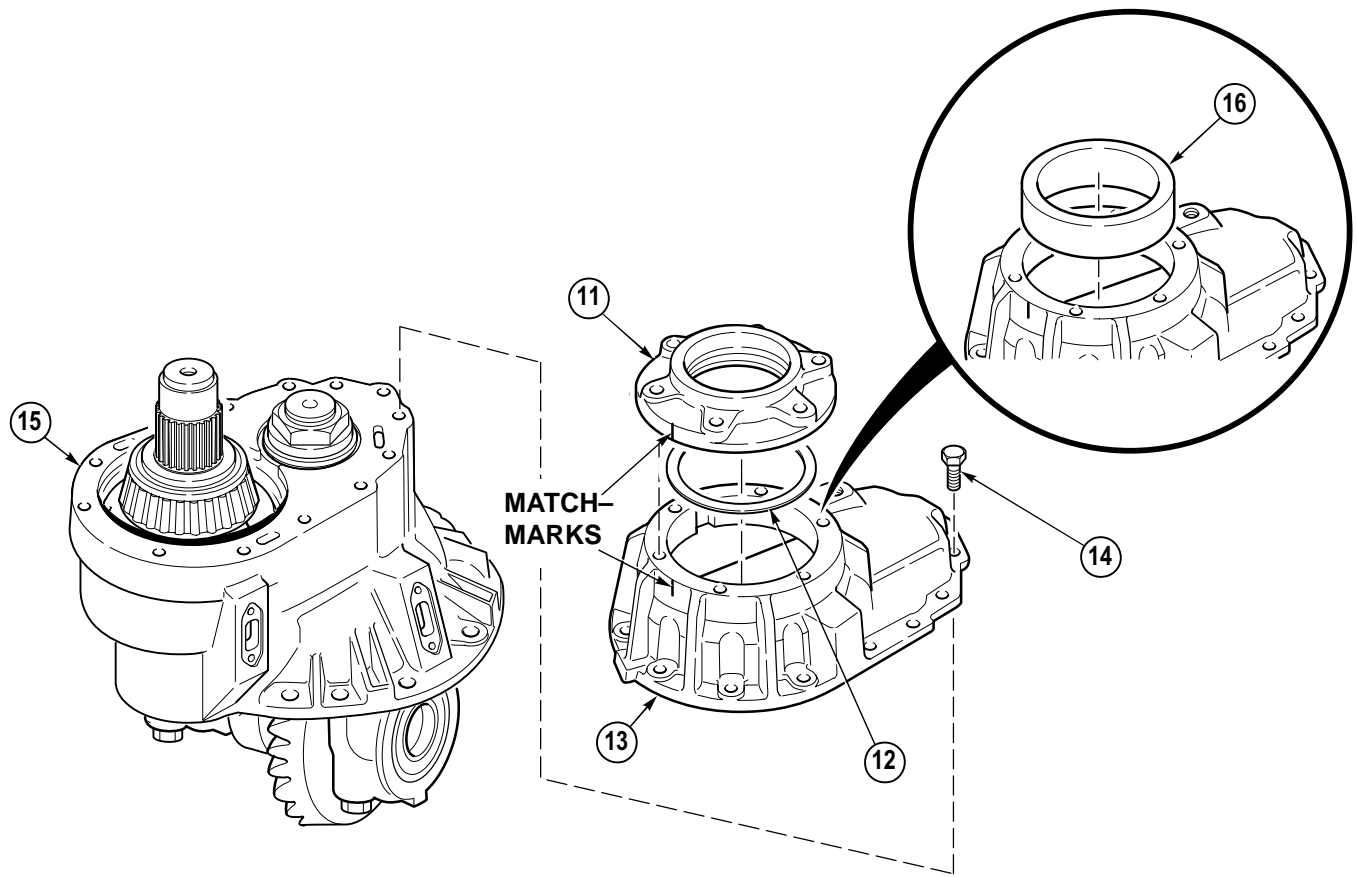
**WARNING**

Split torque weighs 62 lbs (28 kg) without flange assembly and 75 lbs (34 kg) with flange assembly. The aid of an assistant is required to prevent possible injury to personnel.

**NOTE**

Install flange on shaft of split torque to install split torque in housing assembly.

- (66) With the aid of an assistant, install split torque (17) in housing assembly (15).

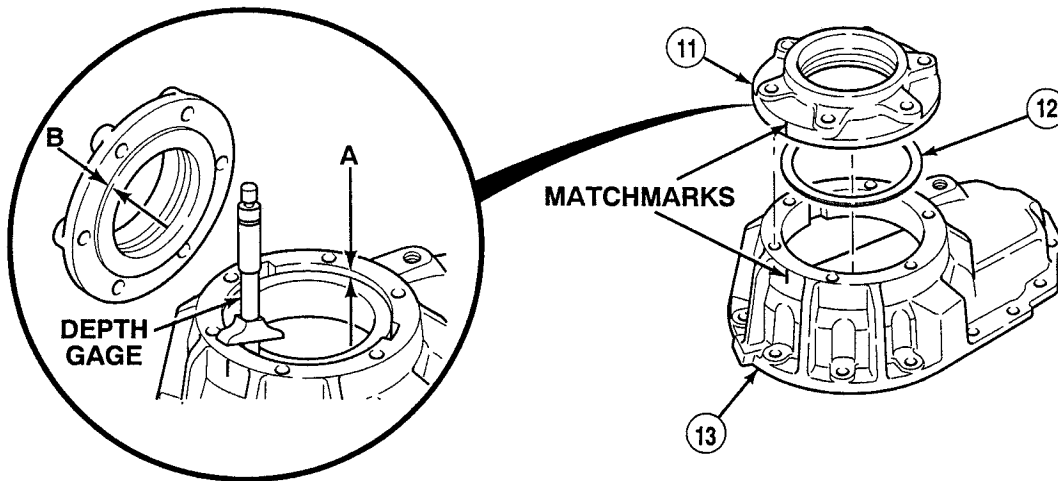


**WARNING**

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.

- (67) Coat mating surface of housing assembly (15) with sealing compound.
- (68) Coat threads of screws (14) with sealing compound.
- (69) Install front housing (13) on housing assembly (15) with screws (14). Tighten screws to 44 lb-ft (60 N·m).
- (70) Coat bearing race (16) with grease.
- (71) Install bearing race (16) in front housing (13).

**25-16. AXLE NO. 2 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

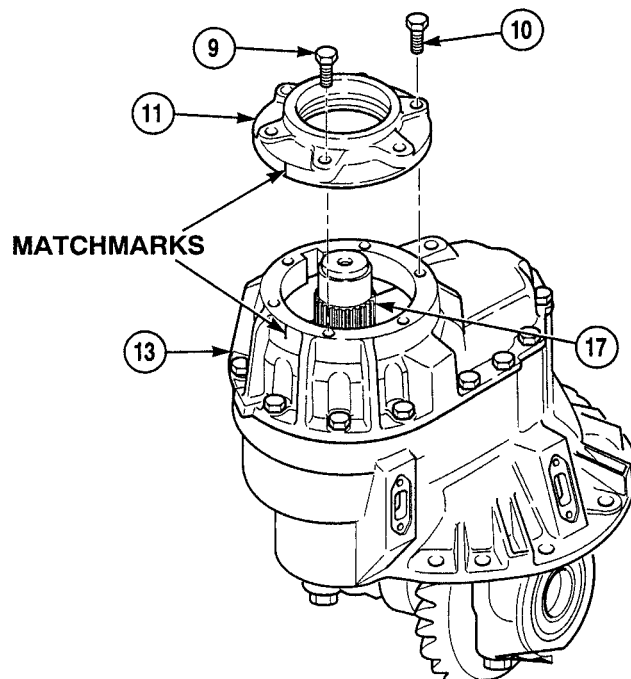


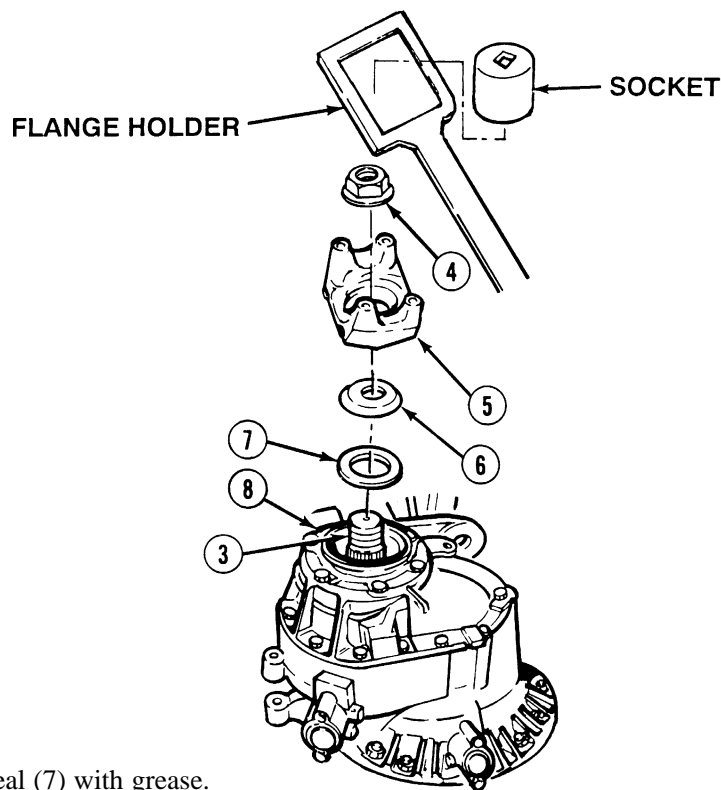
- (72) Using depth gage, measure and record distance “A” on front housing (13).
- (73) Using depth gage, measure and record distance “B” on cover (11).
- (74) Assemble adjusting shim (12) to a thickness of  $A - B \pm 0.002$  in. (0.051 mm).
- (75) Install adjusting shim (12) in front housing (13).

**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.

- (76) Coat mating surface of front housing (13) with sealing compound.
- (77) Coat threads of screws (9) and (10) with sealing compound.
- (78) Install cover (11) on front housing (13) with screw (9) and five screws (10). Tighten screw (9) to 44 lb-ft (60 N·m) and five screws (10) to 56 lb-ft (76 N·m).
- (79) Check split torque (17) for free rotation. If split torque does not rotate freely, repeat Steps (72) through (76).





- (80) Coat seal (7) with grease.
- (81) Install seal (7) in differential assembly (8).
- (82) Install dust cover (6) on flange assembly (5).

### NOTE

Flange assembly should be positioned so large openings of flange assembly align with slots of pinion shaft. This will ease staking of nut.

- (83) Install flange assembly (5) on pinion shaft (3).

### 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.

- (84) Coat threads of pinion shaft (3) with adhesive.
- (85) Apply adhesive to face of flange assembly (5) where adjusting nut (4) seats.
- (86) With the aid of an assistant and using flange holder and socket, install adjusting nut (4) on pinion shaft (3). Tighten adjusting nut to 680 to 796 lb-ft (922 to 1079 N·m).
- (87) Ensure adhesive has squeezed out around entire outside diameter of adjusting nut (4). If adhesive is not visible around entire outside diameter of adjusting nut (4), remove and discard adjusting nut (4) and repeat Steps (83) through (84).
- (88) Stake adjusting nut (4) in two slots of pinion shaft (3) directly 180 degrees apart.



**25-16. AXLE NO. 2 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**e. Installation.**

- (1) Install screw (14) and wire to fasten fork (15) in engaged position.

**WARNING**

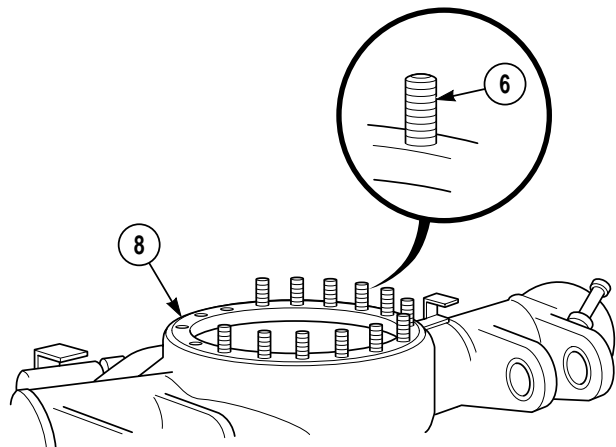
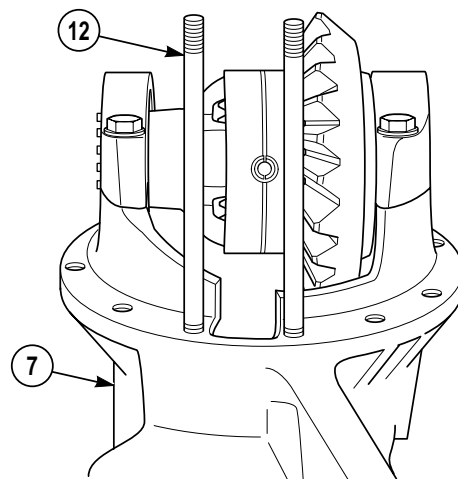
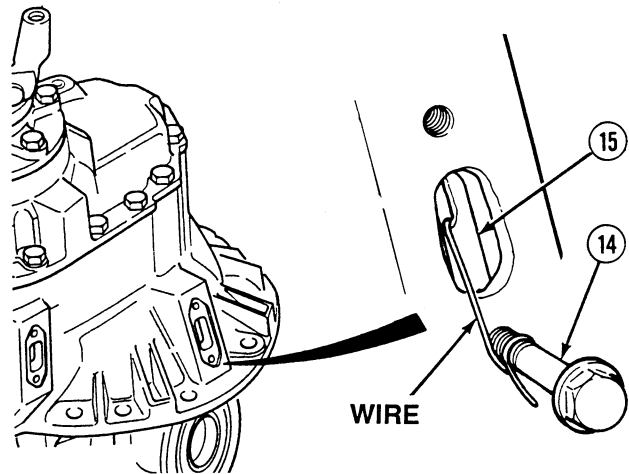
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (2) Coat threads of two studs (12) with sealing compound.
- (3) Install two studs (12) in differential assembly (7). Tighten studs to 76 lb-ft (103 N·m).

**NOTE**

Perform Step (4) only if studs were removed.

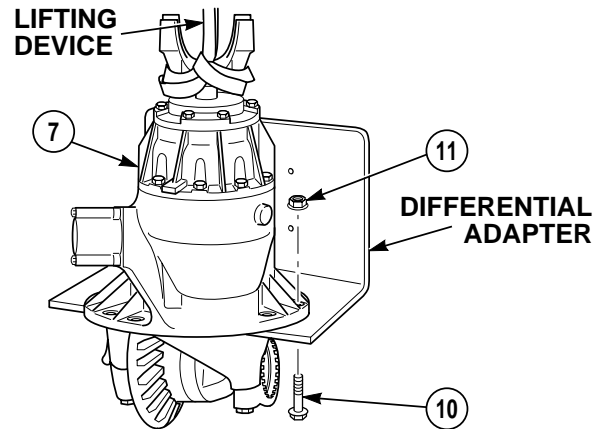
- (4) Coat threads of studs (6) with sealing compound.
- (5) Install studs (6) in axle housing (8). Tighten studs to 76 lb-ft (103 N·m).



**WARNING**

Differential assembly weighs 450 lbs (204 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

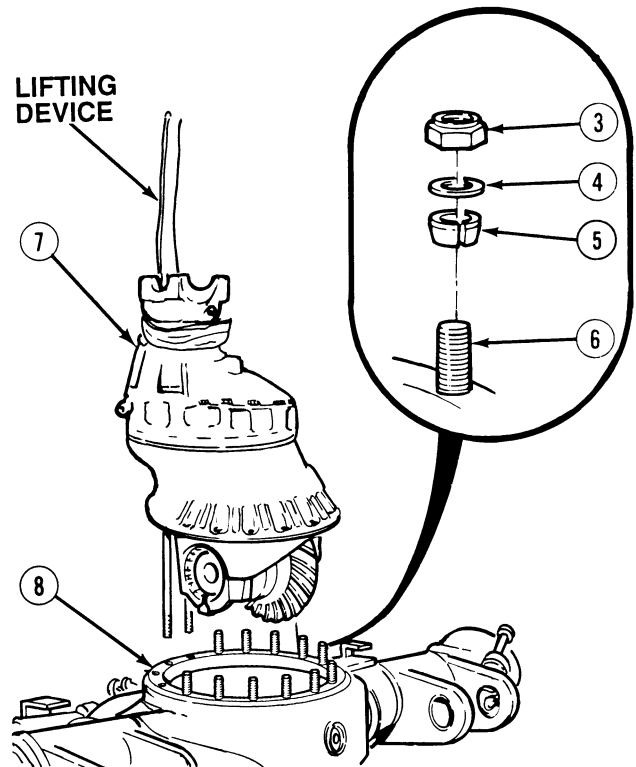
- (6) Attach lifting device to differential assembly (7).
- (7) With the aid of an assistant, remove six nuts (11) and screws (10) from differential assembly (7) and differential assembly adapter.



**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.

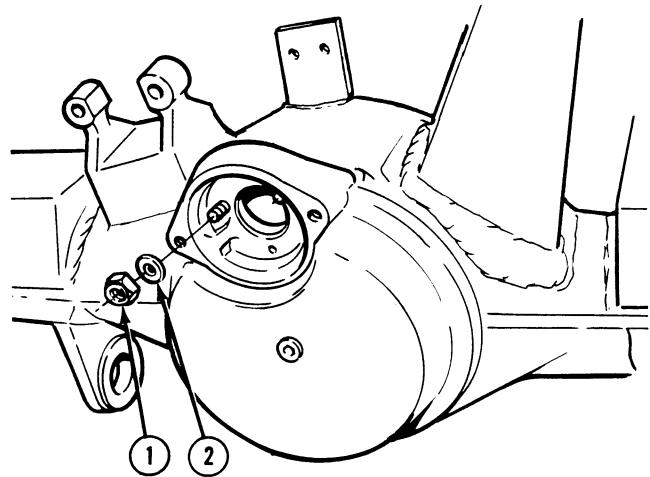
- (8) Coat mating surface of axle housing (8) with adhesive.
- (9) Install differential assembly (7) in axle housing (8).
- (10) Remove lifting device from differential assembly (7).
- (11) Coat beveled contact face of taper rings (5) with adhesive.
- (12) Install ten taper rings (5), 12 washers (4) and locknuts (3). Tighten nuts to 140 to 152 lb-ft (190 to 206 N·m).



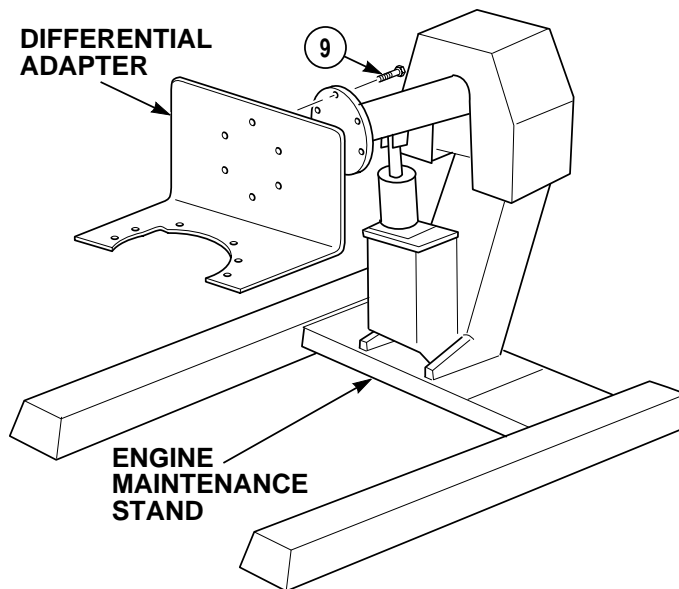
**25-16. AXLE NO. 2 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.



- (13) Coat threads of studs (12) with sealing compound.
- (14) Install two washers (2) and locknuts (1). Tighten nuts to 117 to 137 lb-ft (159 to 186 N·m).
- (15) With the aid of an assistant, remove six screws (9) and differential adapter from engine stand.



**f. Follow-On Maintenance:**

- Install rear output assembly, (Para 25-14).

**END OF TASK**

## 25-17. AXLE NO. 3 AND 4 BRAKE DRUM REPLACEMENT.

This task covers:

- |                             |                               |                          |
|-----------------------------|-------------------------------|--------------------------|
| a. Caging air brake chamber | c. Installation               | e. Follow-On Maintenance |
| b. Removal                  | d. Uncaging air brake chamber |                          |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Stand, Maintenance, Axle  
(Item 225, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Lifting Device, Minimum Capacity 132 lbs  
(60 kg)

#### *Personnel Required*

Two

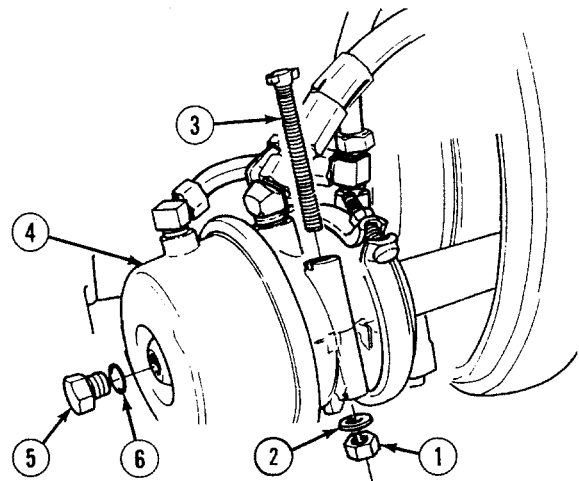
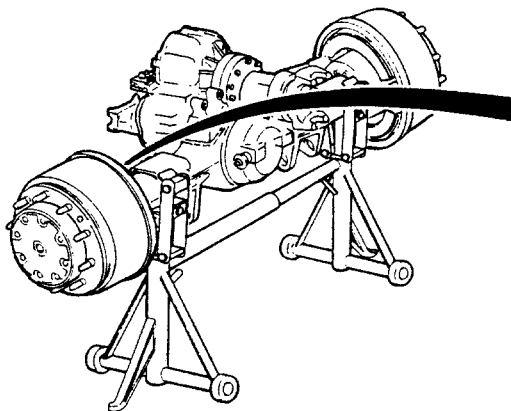
#### *Equipment Condition*

Axle on stand, (Para 25-2)

#### *Materials/Parts*

Oil, Lubricating (Item 36, Appendix B)  
Sealing Compound (Item 53, Appendix B)  
Packing, Preformed (Item 399, Appendix E)

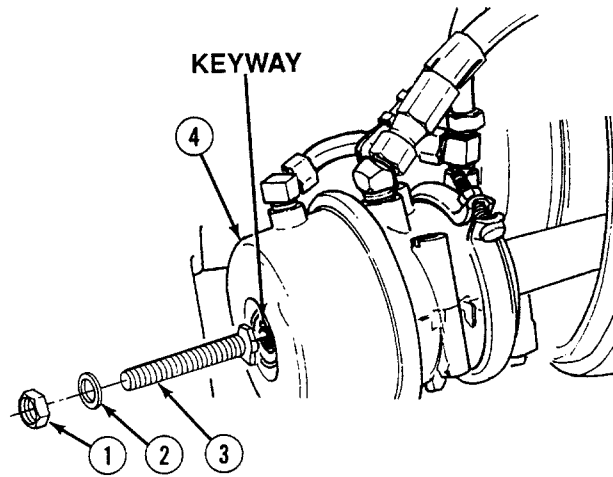
### a. *Caging air brake chamber.*



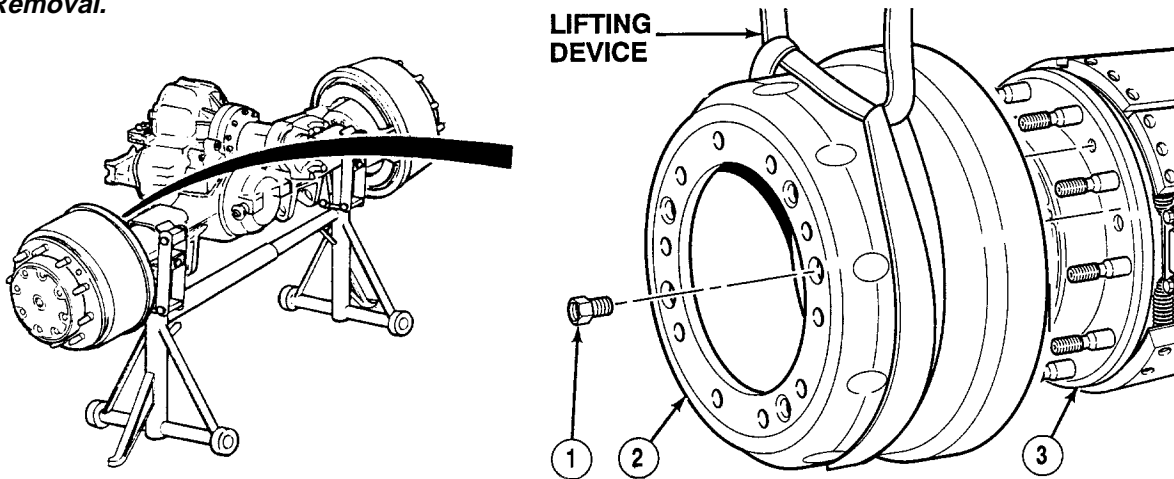
- (1) Remove nut (1), washer (2) and caging bolt (3) from storage slot of air brake chamber (4).
- (2) Remove plug (5) and preformed packing (6) from air brake chamber (4). Discard preformed packing.

**25-17. AXLE NO. 3 AND 4 BRAKE DRUM REPLACEMENT (CONT).**

- (3) Insert caging bolt (3) into keyway of air brake chamber (4). Turn caging bolt 1/4 turn to the right. Caging bolt will contact a lock plate.
- (4) Install washer (2) and nut (1) onto caging bolt (3). Cage air brake chamber (4) by tightening nut.



**b. Removal.**



- (1) Remove two fittings (1) from brake drum (2).

**WARNING**

Brake drum weighs 132 lbs (60 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (2) Attach lifting device to brake drum (2).
- (3) Remove brake drum (2) from hub (3) and lower to ground.
- (4) Remove lifting device from brake drum (2).

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

Brake drum weighs 132 lbs (60 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- (1) Attach lifting device to brake drum (2).

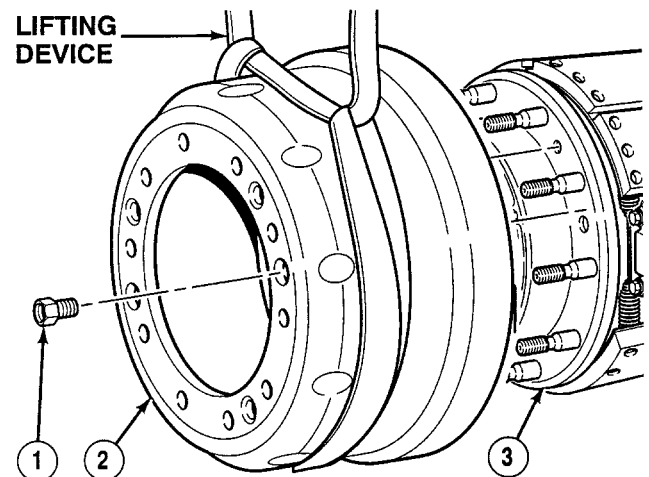
**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

**NOTE**

Make sure that fitting holes line up before securing brake drum in place.

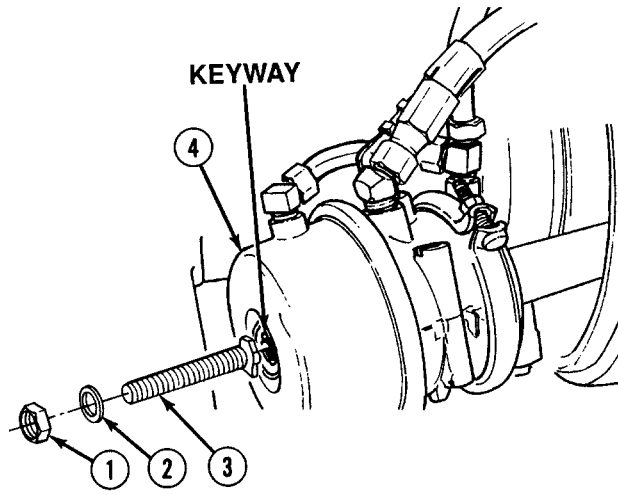
- (2) Install brake drum (2) on hub (3).
- (3) Coat threads of two fittings (1) with sealing compound.
- (4) Install two fittings (1) in brake drum (2).



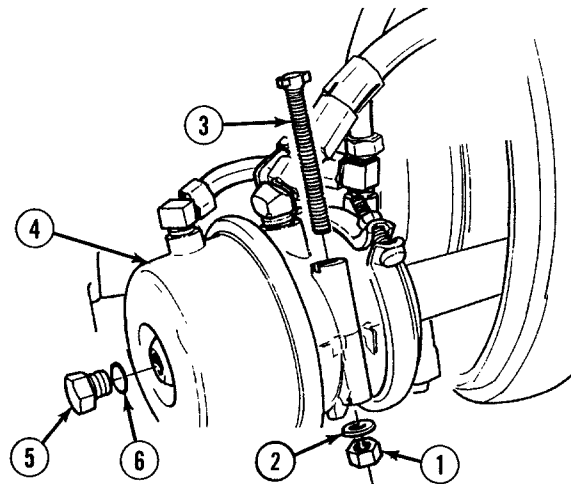
**25-17. AXLE NO. 3 AND 4 BRAKE DRUM REPLACEMENT (CONT).**

**d. Uncaging air brake chamber.**

- (1) Loosen and remove nut (1) and washer (2).
- (2) Turn caging bolt (3) 1/4 turn to the left and remove from air brake chamber (4).



- (3) Install caging bolt (3) in storage slot using washer (2) and nut (1).
- (4) Apply lubricating oil to preformed packing (6).
- (5) Install plug (5) and preformed packing (6) in air brake chamber (4).



**e. Follow-On Maintenance:**

- Remove axle from stand, (Para 25-2).

**END OF TASK**

**25-18. AXLE NO. 3 AND 4 AIR BRAKE CHAMBER REPLACEMENT.**

This task covers:

- a. Removal
- b. Installation
- c. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Multiplier, Torque (Item 141, Appendix F)
- Wrench, Spanner (Item 275, Appendix F)
- Wrench, Torque (0 to 600 lb-ft [0-814 N·m]) (Item 278, Appendix F)

*Materials/Parts - Continued*

- Tag, Identification (Item 72, Appendix B)

*Equipment Condition*

- Brake drum removed, (Para 25-17)

*Materials/Parts*

- Grease (Item 23, Appendix B)
- Sealing Compound (Item 52, Appendix B)
- Sealing Compound (Item 53, Appendix B)

**a. Removal.**

**NOTE**

- Tag and mark air lines prior removal.
- Note position of fittings prior to removal.
- Note position of air chamber prior to removal.

- (1) Remove air line 2874 (1) from elbow (2) and tee (3).

**NOTE**

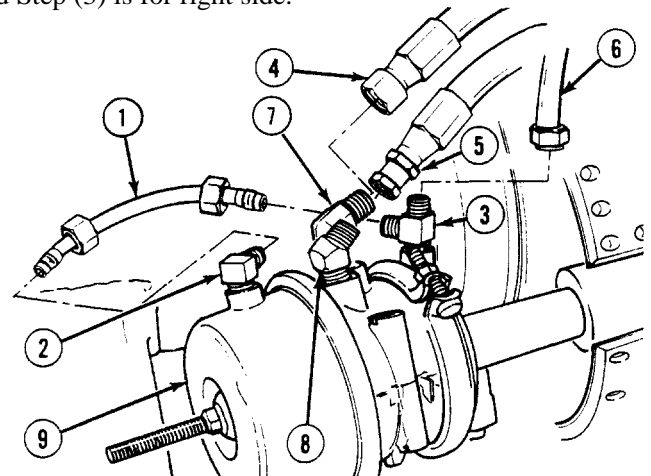
Step (2) is for left side and Step (3) is for right side.

- (2) Remove air lines 2141 (4), 2016 (5) and 2874 (6) from elbows (7) and (8) and tee (3).
- (3) Remove air lines 2140 (4), 2018 (5) and 2874 (6) from elbows (7) and (8) and tee (3).

**NOTE**

Perform Step (4) if elbows or tee are damaged or a new air chamber is being installed.

- (4) Remove elbows (2), (7) and (8) and tee (3) from air brake chamber (9).



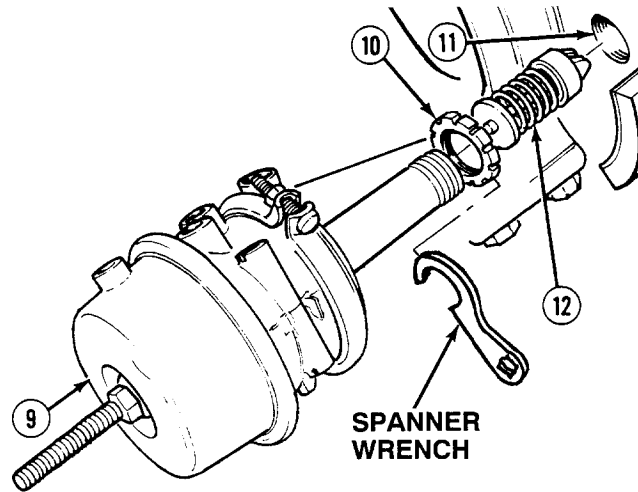


**25-18. AXLE NO. 3 AND 4 AIR BRAKE CHAMBER REPLACEMENT (CONT).**

**WARNING**

Spring in air brake chamber is very powerful and is under tension. Failure to cage air brake chamber before removal will release tension of spring abruptly and could result in injury to personnel.

- (5) Using spanner wrench, loosen collet nut (10).
- (6) Remove air brake chamber (9) from brake assembly (11).



**NOTE**

Perform Step (7) if collet nut is damaged.

- (7) Remove collet nut (10) from air brake chamber (9).
- (8) Remove wedge assembly (12) from brake assembly (11).

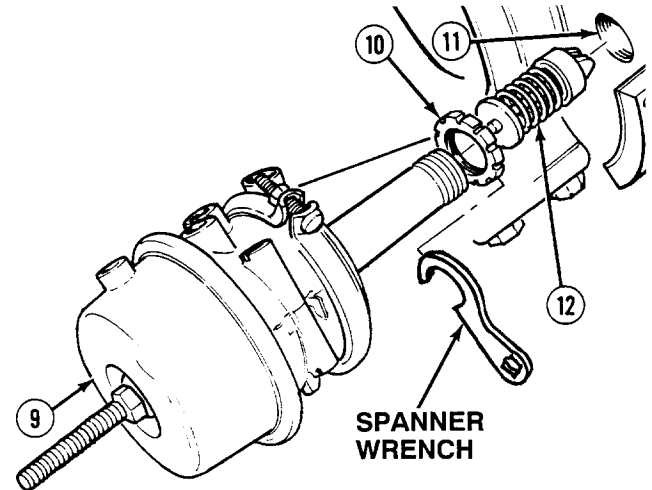
**b. Installation.**

- (1) Coat wedge assembly (12) with grease.
- (2) Install wedge assembly (12) in brake assembly (11).

**NOTE**

Perform Step (3) only if collet nut was removed.

- (3) Install collet nut (10) onto air brake chamber (9) until threads on air brake chamber run out.

**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.

- (4) Coat first three threads of air chamber (9) with sealing compound.

**NOTE**

Air brake chamber must be caged before it can be installed.

- (5) Install air brake chamber (9) into brake assembly (11) until air brake chamber bottoms out in brake assembly.

**WARNING**

Air brake chamber can only be unscrewed a maximum of one turn. Otherwise, incorrect brake operation could result.

- (6) Rotate air brake chamber (9) to align air ports.
- (7) Using spanner wrench, tighten collet nut (10) on air brake chamber (9) to 250 to 280 lb-ft (339 to 380 N·m).

**25-18. AXLE NO. 3 AND 4 AIR BRAKE CHAMBER REPLACEMENT (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**

Perform Steps (8) and (9) if elbows or tee were removed or if a new air chamber is being installed.

- (8) Coat threads of elbows (2), (7) and (8) and tee (3) with sealing compound.

**NOTE**

Install fittings as noted prior to removal.

- (9) Install elbows (2), (7) and (8) and tee (3) on air brake chamber (9).

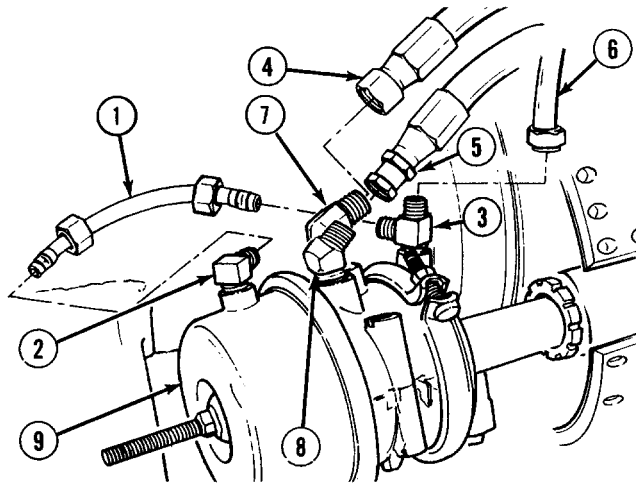
**NOTE**

Step (10) is for left side and  
Step (11) is for right side.

- (10) Connect air lines 2141 (4), 2016 (5) and 2874 (6) to elbows (7) and (8) and tee (3).
- (11) Connect air lines 2140 (4), 2018 (5) and 2874 (6) to elbows (7) and (8) and tee (3).
- (12) Connect air line 2874 (1) to elbow (2) and tee (3).

**c. Follow-On Maintenance:**

- Install brake drum, (Para 25-17).



**END OF TASK**

**25-19. AXLE NO. 3 AND 4 PLANETARY HUB GEAR REPLACEMENT.**

This task covers:

- a. Removal
- b. Installation
- c. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Socket, Socket Head Screw 12 mm (Item 206, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m]) (Item 277, Appendix F)
- Extractor, Jet (Appendix C)

*Materials/Parts*

- Adhesive (Item 1, Appendix B)
- Sealing Compound (Item 56, Appendix B)
- Locknuts (8) (Item 217, Appendix E)

*Equipment Condition*

- Axle air brake chambers removed, (Para 25-18)
- Axle air lines removed, (Para 25-30)

**a. Removal.**

**NOTE**

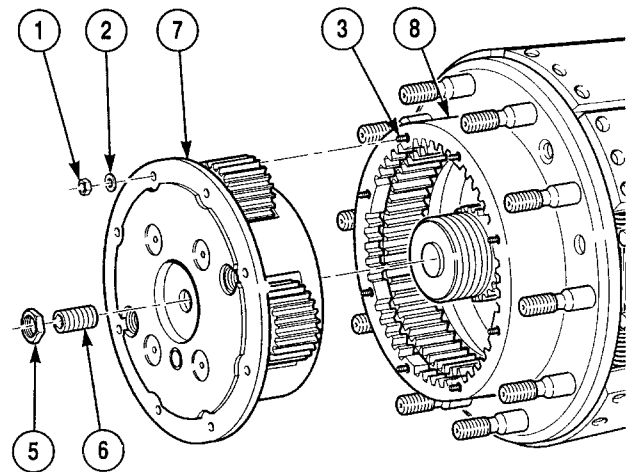
Studs may come off with locknuts.

- (1) Remove eight locknuts (1) and washers (2) from studs (3). Discard locknuts.

**NOTE**

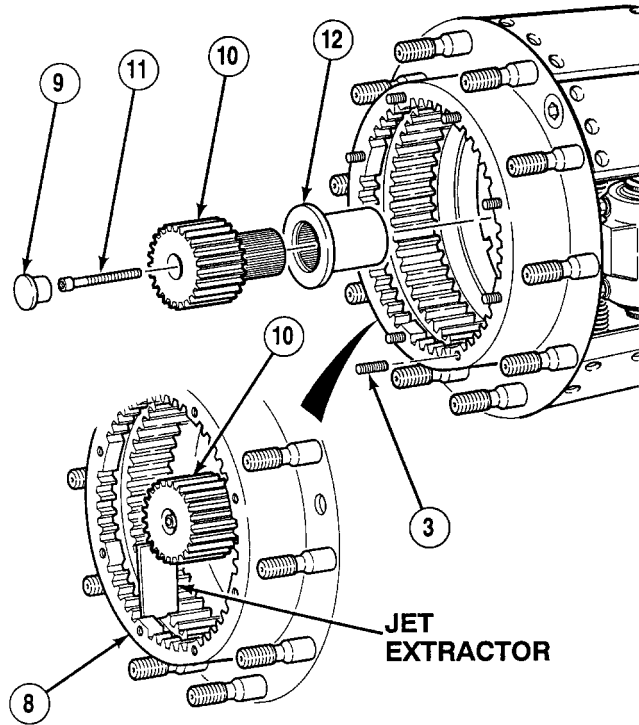
Screw may come off with nut. If this happens, separate screw and nut and install screw.

- (2) Hold hub (4) and remove nut (5) from screw (6).
- (3) Turn screw (6) to the right until planetary gear carrier assembly (7) is separated from ring gear carrier assembly (8). Remove screw (6) from planetary gear assembly (7).
- (4) Remove planetary gear carrier assembly (7) from ring gear carrier assembly (8).



**25-19. AXLE NO. 3 AND 4 PLANETARY HUB GEAR REPLACEMENT (CONT).**

- (5) Remove end cap (9) from sun gear (10).
- (6) Position jet extractor between teeth of sun gear (10) and teeth of ring gear carrier assembly (8).
- (7) Remove screw (11) from sun gear (10). Remove jet extractor.
- (8) Remove sun gear (10) and muff (12) from ring gear carrier assembly (8).



**NOTE**

Perform Step (9) if studs are damaged.

- (9) Remove eight studs (3) from ring gear carrier assembly (8).

**b. Installation.**

**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.

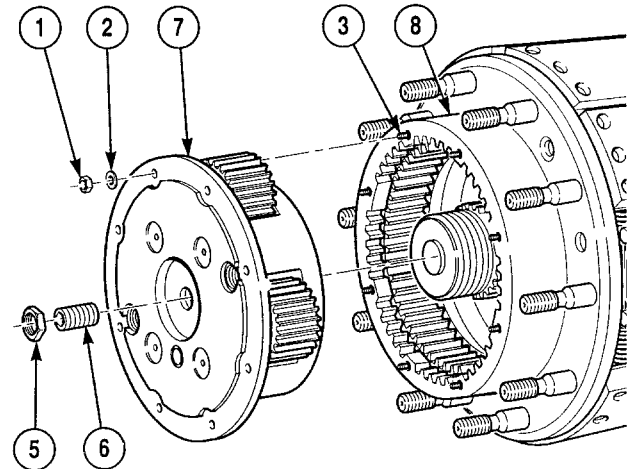
**NOTE**

Perform Steps (1) and (2) if studs were removed.

- (1) Coat threads of eight studs (3) with sealing compound.
- (2) Install eight studs (3) in ring gear carrier assembly (8).
- (3) Install muff (12) and sun gear (10) in ring gear carrier assembly (8).
- (4) Position jet extractor between teeth of sun gear (10) and teeth of ring gear carrier assembly (8).
- (5) Coat screw (11) with sealing compound.
- (6) Install screw (11) in sun gear (10). Tighten screw to 135 to 165 lb-ft (183 to 224 N·m). Remove jet extractor.
- (7) Install end cap (9) on sun gear (10).

**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.



- (8) Coat mating surface of ring gear carrier assembly (8) with adhesive.
- (9) Install planetary gear carrier assembly (7) in ring gear carrier assembly (8).
- (10) Coat protruding threads of eight studs (3) with adhesive.
- (11) Install eight washers (2) and locknuts (1) on studs (3). Tighten locknuts to 38 to 45 lb-ft (52 to 61 N·m).
- (12) Install screw (6) in planetary gear carrier assembly (7) and tighten until screw bottoms out. Back screw off 3/4 of a turn.
- (13) Coat protruding threads of screw (6) with sealing compound.
- (14) Install nut (5) on screw (6). Tighten nut to 152 lb-ft (206 N·m).

**c. Follow-On Maintenance:**

- Install axle air lines, (Para 25-30).
- Install air brake chambers, (Para 25-18).

**END OF TASK**

**25-20. AXLE NO. 3 AND 4 WHEEL HUB ASSEMBLY REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Adapter, Socket (3/4 in. female to 1 in. male) (Item 10, Appendix F)
- Compressor Unit, Air (Item 35, Appendix F)
- Driver, CTIS Seal (Item 52, Appendix F)
- Driver, CTIS Seal (Item 53, Appendix F)
- Gloves, Chemical Oil Protective (Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Hammer, Hand, Soft Plastic (Item 88, Appendix F)
- Press, 60 Ton (Item 164, Appendix F)
- Protector, Spindle (Item 169, Appendix F)
- Puller Kit, Universal, Slide Hammer (Item 175, Appendix F)
- Socket, Spindle Nut (Item 219, Appendix F)
- Wrench, Torque (0 to 600 lb-ft [0-814 N·m]) (Item 278, Appendix F)
- Lifting Device, Minimum Capacity 115 lbs (52 kg)

*Materials/Parts*

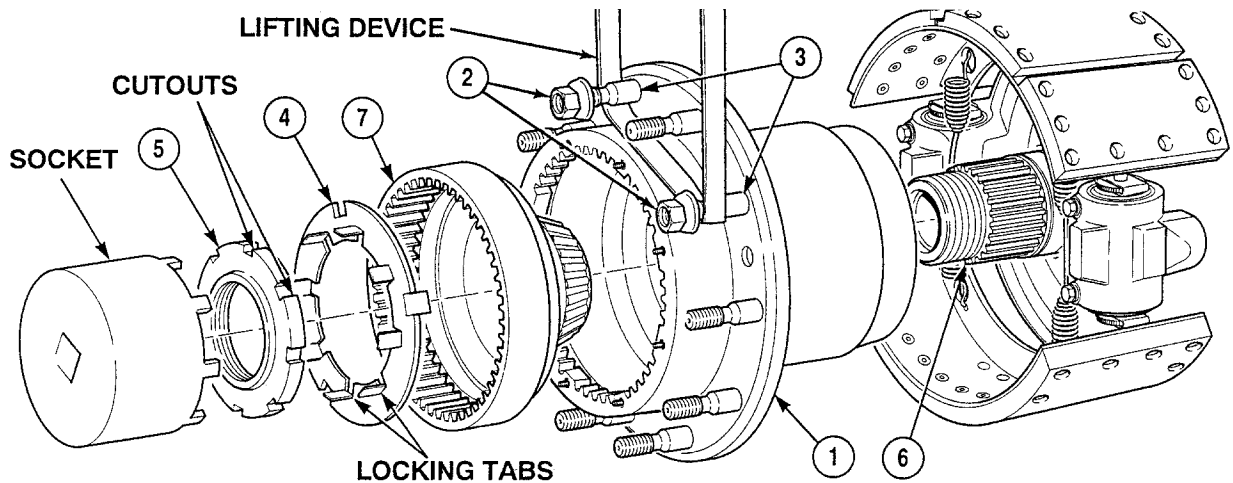
- Grease (Item 22, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)
- Lockwasher (Item 301, Appendix E)
- Seal, Oil (Item 600, Appendix E)
- Seal, Ring (Item 618, Appendix E)
- Seal, Ring (Item 619, Appendix E)
- Snap Ring (Item 649, Appendix E)

*Personnel Required*

Two

*Equipment Condition*

Planetary hub gear removed, (Para 25-19)

a. *Removal.*

**WARNING**

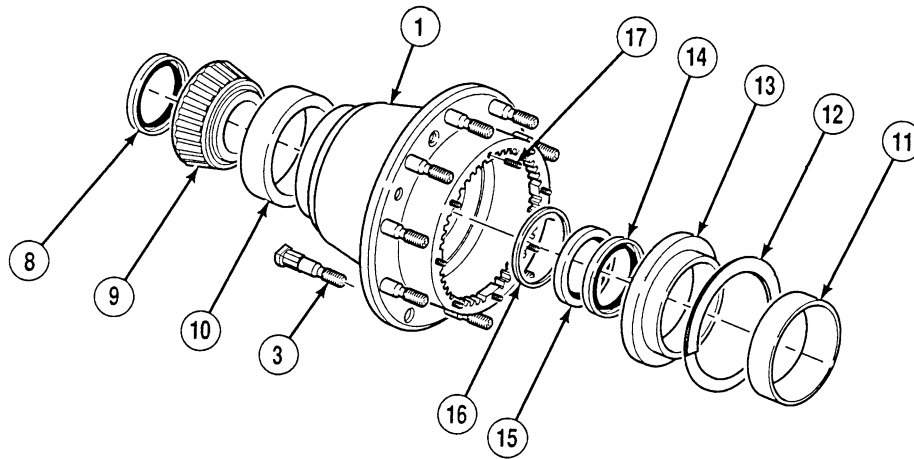
Wheel hub assembly weighs 115 lbs (52 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (1) Attach strap and lifting device to hub (1).
- (2) Attach two wheel nuts (2) on two studs (3).
- (3) Bend up two locking tabs on lockwasher (4) clear of cutouts on spindle nut (5).
- (4) Using spanner, remove spindle nut (5) and lockwasher (4) from pivot and spindle assembly (6). Discard lockwasher.
- (5) With the aid of an assistant use lifting device, and remove wheel hub assembly (1) from pivot and spindle assembly (6).
- (6) Remove two wheel nuts (2) and lifting device from wheel hub assembly (1).
- (7) Remove ring gear carrier assembly (7) from wheel hub assembly (1).



**25-20. AXLE NO. 3 AND 4 WHEEL HUB ASSEMBLY REPAIR (CONT).**

**b. Disassembly.**



- (1) Remove oil seal (8) from wheel hub (1). Discard oil seal.
- (2) Remove bearing (9) from wheel hub (1).
- (3) Remove bearing races (10) and (11) from wheel hub (1).

**WARNING**

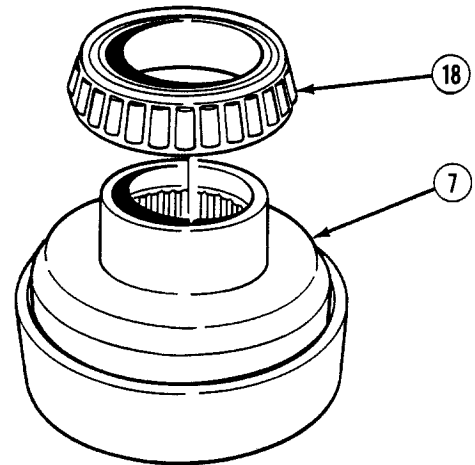
Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (4) Remove retaining ring (12), outside ring (13), seals (14) and (15) and guide ring (16) from wheel hub (1). Discard seals.

**NOTE**

- Perform Steps (5) and (6) only if studs are damaged.
  - Four studs are longer than the other six studs to retain wheel cover. Note location of these studs for proper assembly.
- (5) Remove studs (3) from wheel hub (1).
  - (6) Remove studs (17) from wheel hub (1).

- (7) Using press, remove bearing (18) from ring gear carrier assembly (7).



**c. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
  - (2) Inspect metal parts for breaks, cracks, burrs, and sharp edges.
  - (3) Inspect bearings for wear, scoring, cracks, or other obvious damage.
  - (4) Replace all damaged parts.

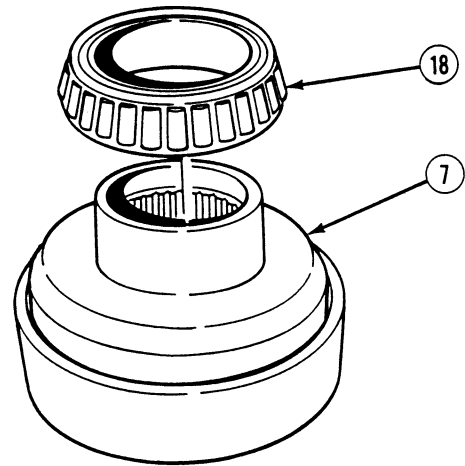
**25-20. AXLE NO. 3 AND 4 WHEEL HUB ASSEMBLY REPAIR (CONT).**

**d. Assembly.**

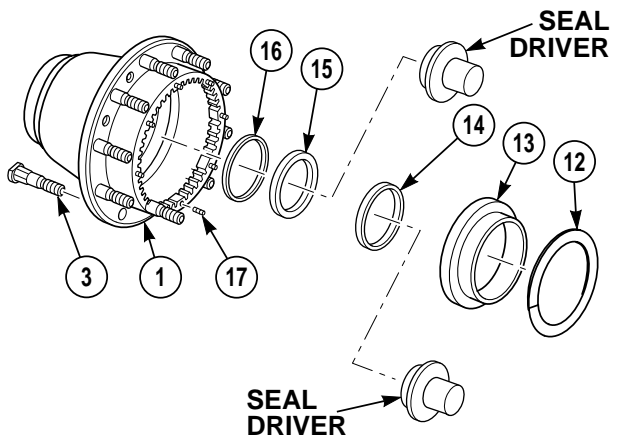
- (1) Pack bearing (18) with grease.
- (2) Using press, install bearing (18) on ring gear carrier assembly (7).

**NOTE**

- Perform Steps (3) or (4) if studs were removed.
- Install four longer studs in positions marked during disassembly.
- Ensure flat edge of stud head is positioned parallel to edge of wheel hub.



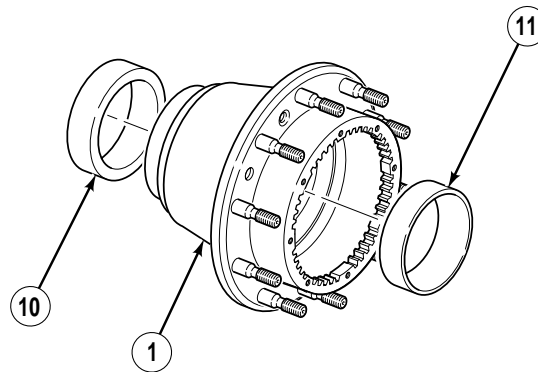
- (3) Install studs (3) in wheel hub (1).
- (4) Install studs (17) in wheel hub (1).
- (5) Coat seals (14) and (15) with grease.
- (6) Using seal driver, install guide ring (16) and seal (15) in wheel hub (1).
- (7) Using seal driver, install seal (14) in wheel hub (1).



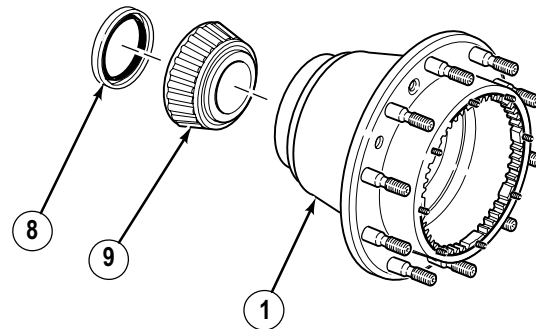
**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (8) Install outside ring (13) and retaining ring (12) in wheel hub (1).

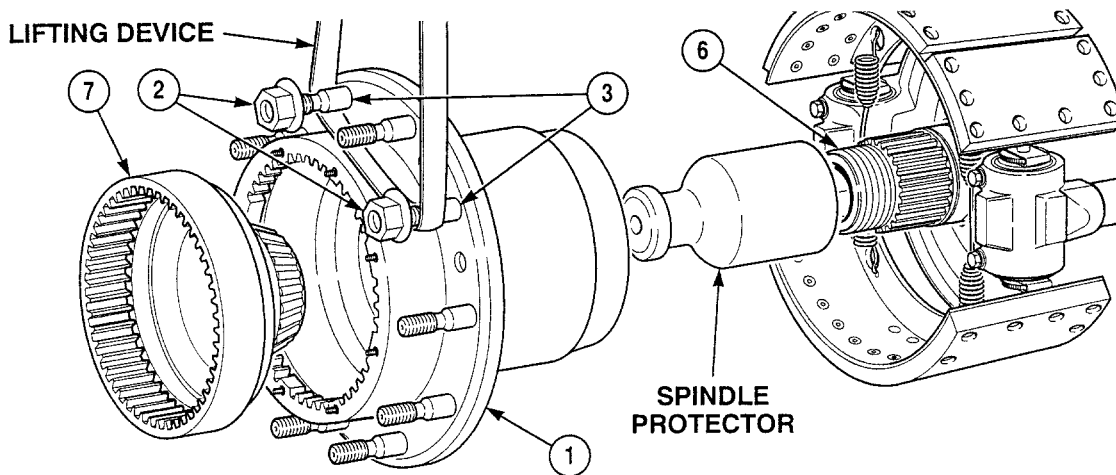


- (9) Coat bearing races (10) and (11) with grease.
- (10) Install bearing races (10) and (11) in wheel hub (1).
- (11) Pack bearing (9) with grease.
- (12) Install bearing (9) in wheel hub (1).
- (13) Coat oil seal (8) with grease.
- (14) Install oil seal (8) in wheel hub (1).



**25-20. AXLE NO. 3 AND 4 WHEEL HUB ASSEMBLY REPAIR (CONT).**

**e. Installation.**



- (1) Attach lifting device to wheel hub assembly (1).
- (2) Install two wheel nuts (2) on two studs (3).
- (3) Install spindle protector on pivot and spindle assembly (6).

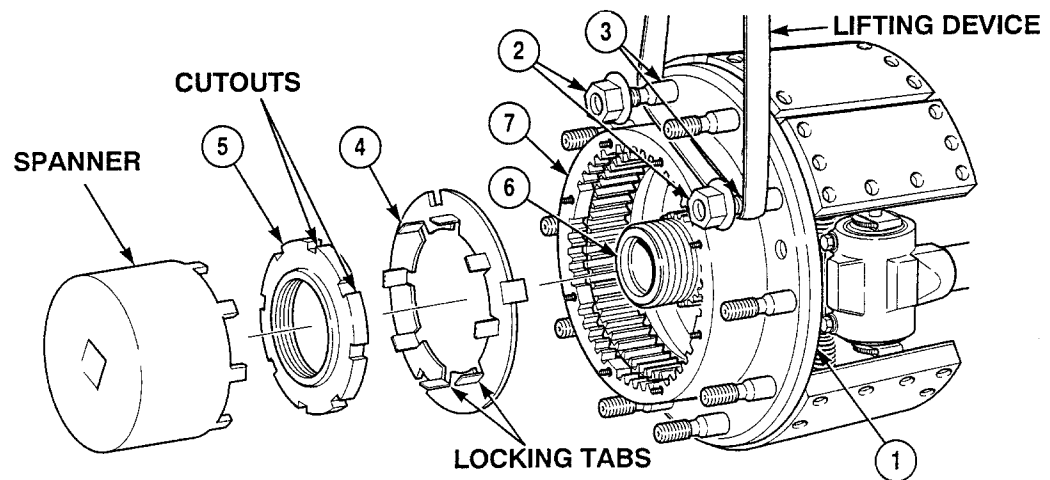
**WARNING**

Wheel hub assembly weighs 115 lbs (52 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**CAUTION**

Install wheel hub assembly straight on spindle, using spindle protector and taking care not to drag wheel hub assembly along spindle shaft, to prevent damage to CTIS seals.

- (4) With the aid of an assistant and using a lifting device, install wheel hub assembly (1) on pivot and spindle assembly (6).
- (5) Remove spindle protector from pivot and spindle assembly (6).
- (6) Install ring gear carrier assembly (7) in wheel hub assembly (1).



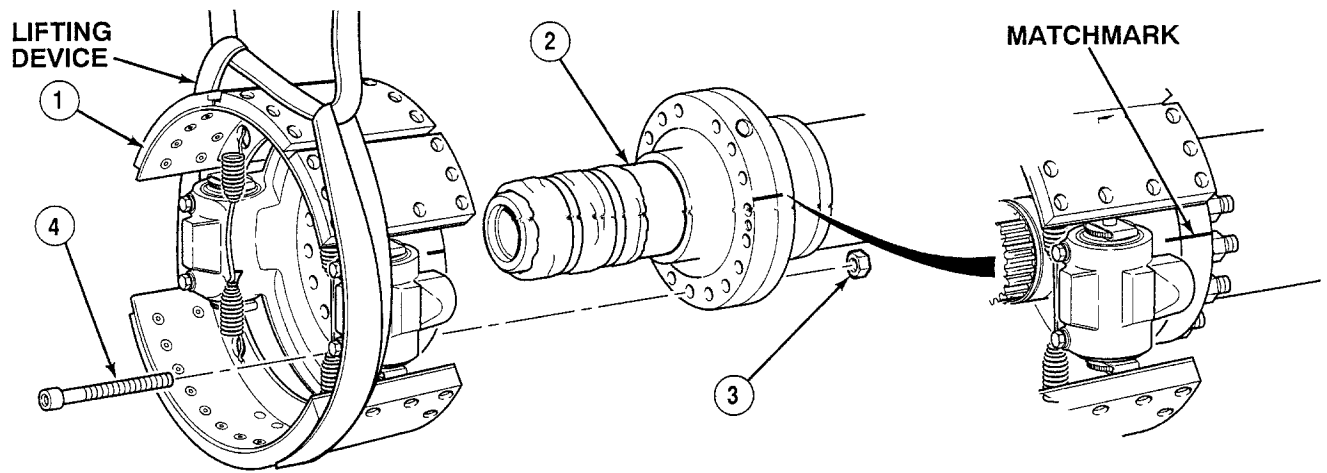
- (7) Position lock washer (4) on pivot and spindle assembly (6).
- (8) With the aid of an assistant and using spanner socket, install spindle nut (5) on pivot and spindle assembly (6). Tighten spindle nut to 247 to 290 lb-ft (335 to 393 N·m).
- (9) Remove wheel nuts (2) from studs (3).
- (10) Remove lifting device from wheel hub assembly (1).
- (11) Rotate wheel hub assembly (1) while tapping on wheel hub assembly with soft face hammer, until wheel hub assembly is fully seated.
- (12) With the aid of an assistant, tighten spindle nut (5) on pivot and spindle assembly (6) to 247 to 290 lb-ft (335 to 393 N·m).
- (13) With the aid of an assistant, use spanner socket to unscrew spindle nut (5) a minimum of 1/16 of a turn or until two locking tabs of lockwasher (4) are aligned with cutouts of spindle nut.
- (14) Bend two locking tabs of lockwasher (4) into cutouts on spindle nut (5).

**f. Follow-On Maintenance:**

- Install planetary hub gear, (Para 25-19).

**END OF TASK**





### NOTE

Matchmark brake assembly and pivot and spindle assembly prior to removal.

- (1) Wrap a cleaning cloth around pivot and spindle assembly (2) to protect spindle races.

### WARNING

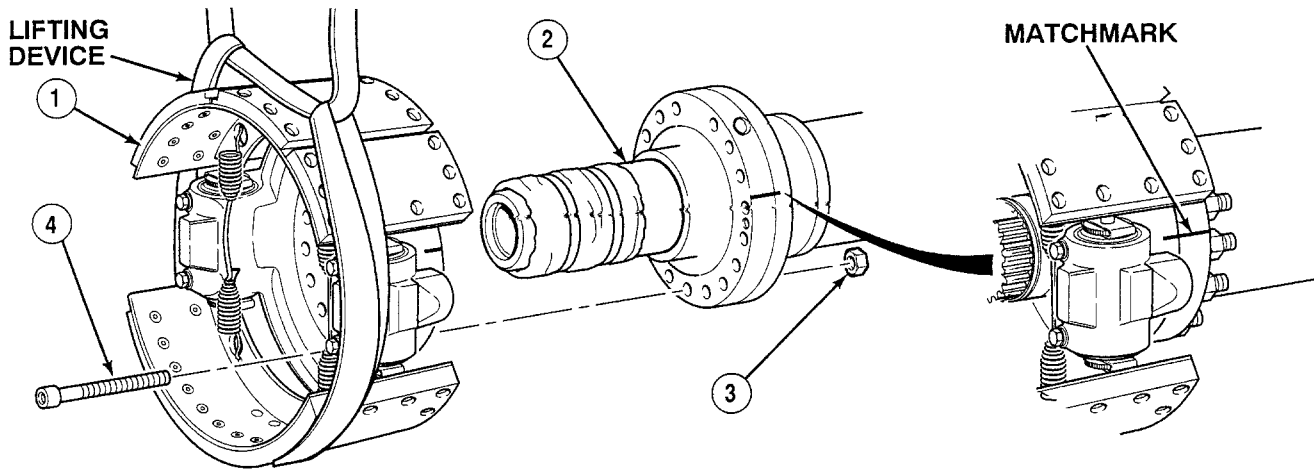
Brake assembly weighs 80 lbs (36 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (2) Attach lifting device to brake assembly (1).
- (3) Remove 15 locknuts (3) and screws (4) from brake assembly (1) with aid of assistant. Discard locknuts.
- (4) Remove brake assembly (1) from pivot and spindle assembly (2).
- (5) Remove lifting device from brake assembly (1).



**25-21. NO. 3 AND 4 AXLE BRAKE ASSEMBLY REPLACEMENT (CONT).**

**b. Installation.**



- (1) Wrap cleaning cloth around spindle of pivot and spindle assembly (2) to protect spindle races.

**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.

- (2) Coat end threads of 15 screws (4) with sealing compound.

**WARNING**

Brake assembly weighs 80 lbs (36 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- (3) Attach lifting device, to brake assembly (1).
- (4) Position brake assembly (1) on pivot and spindle assembly (2).
- (5) Align matchmarks on brake assembly (1) and pivot and spindle assembly (2).
- (6) With the aid of an assistant, install 15 screws (4) and locknuts (3) to brake assembly (1) and pivot and spindle assembly (2). Tighten screws to 185 to 235 lb-ft (251 to 319 N·m).
- (7) Remove lifting device from brake assembly (1).
- (8) Remove cleaning cloth from pivot and spindle assembly (2).

**c. Follow-On Maintenance:**

- Install wheel hub assembly, (Para 25-20).

**END OF TASK**

**25-22. AXLE NO. 3 LOCKING CYLINDER REPLACEMENT.**

This task covers:

- a. Removal
- b. Installation
- c. Follow-On Maintenance

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's  
(Item 240, Appendix F)
- Caliper, Dial, 0-6 in., w/Dial  
(Item 25, Appendix F)
- Compressor Unit, Air (Item 35, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Micrometer, Outside, Caliper, Set  
(Item 139, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)
- Deleted

*Materials/Parts*

- Adhesive (Item 1, Appendix B)
- Oil, Lubricating (Item 36, Appendix B)
- Sealing Compound (Item 56, Appendix B)
- Tags, Identification (Item 72, Appendix B)
- Packing, Preformed (Item 349, Appendix E)
- Shim Kit, Adjusting (Item 639, Appendix E)

*Equipment Condition*

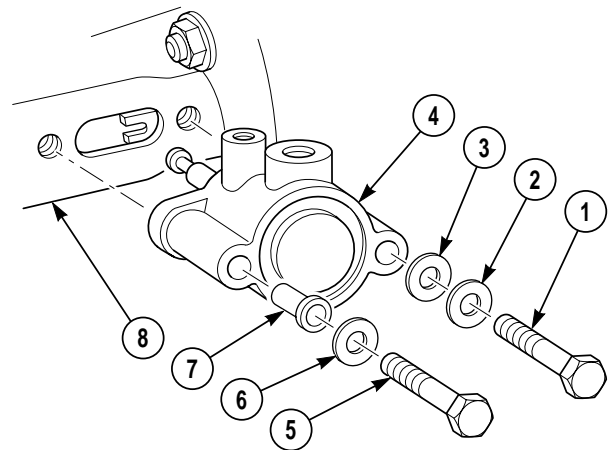
Brake assembly removed, (Para 25-21)

**a. Removal.**

**NOTE**

Tag and note which screw location contains shim kit to allow for proper installation.

- (1) Remove screw (1), washer (2) and shim (3) from locking cylinder (4). Discard shim.
- (2) Remove screw (5), washer (6) and plastic washer (7) from locking cylinder (4).
- (3) Pull left and outward on locking cylinder (4) and remove from differential (8).

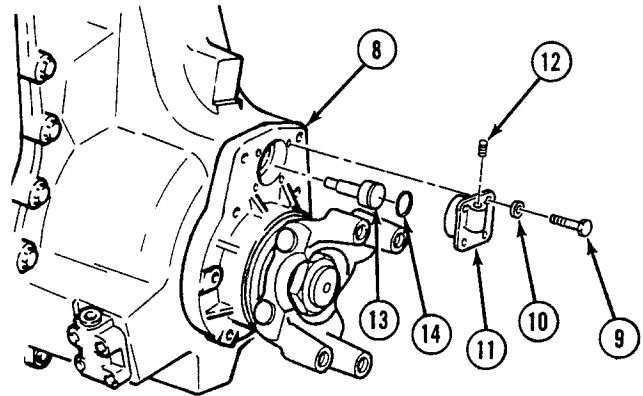


**25-22. AXLE NO. 3 LOCKING CYLINDER REPLACEMENT (CONT).**

- (4) Remove four screws (9), washers (10) and cover (11) from differential (8).
- (5) Remove plug (12) from cover (11).
- (6) Remove piston (13) and preformed packing (14) from differential (8). Discard preformed packing.

**b. Installation.**

- (1) Apply lubricating oil to preformed packing (14).
- (2) Install preformed packing (14) on piston (13).
- (3) Install piston (13) in cover (11).



**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.

- (4) Apply sealing compound to threads of plug (12).
- (5) Install plug (12) in cover (11).
- (6) Coat mating surface of cover (11) with adhesive.
- (7) Coat screws (9) with sealing compound.
- (8) Install cover (11) with four washers (10) and screws (9) on differential (8).

**WARNING**

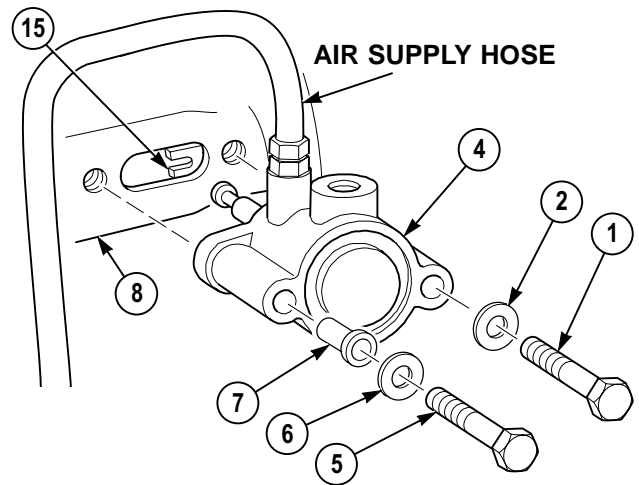
Adhesives, solvents and sealing compounds can burn easily, can give off harmful vapors and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap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

- (9) Coat mating surface of differential (8) with adhesive.
- (10) Position locking cylinder (4) on differential (8).
- (11) Install plastic washer (7), washer (6) and screw (5) in locking cylinder (4).

**NOTE**

Install screw so that only three or four threads of screw are engaged. Screw is being installed only to keep screw hole in locking cylinder aligned with differential.

- (12) Position washer (2) and screw (1) in locking cylinder (4).
- (13) Tighten screw (1) in locking cylinder (4) to 25 to 32 lb-ft (34 to 43 N·m).
- (14) Connect air supply test air hose to locking cylinder (4).
- (15) Using air supply shop air hose, apply air pressure 100 to 120 psi (690 to 827 kPa) to locking cylinder (4).
- (16) Turn flange assemblies back and forth until locking cylinder (4) engages.
- (17) Turn screw (1) slowly until screw contacts fork (15) in differential (8).
- (18) Using dial caliper, measure distance between face of washer (2) and top of locking cylinder (4) and record as measurement "A".



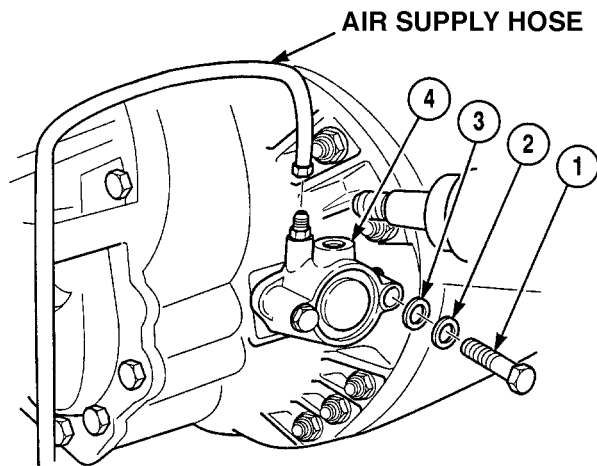
**25-22. AXLE NO. 3 LOCKING CYLINDER REPLACEMENT (CONT).**

- (19) Remove screw (1) and washer (2) from locking cylinder (4).
- (20) Determine shim (3) thickness as follows:  
Measurement "A" – 0.004 to 0.020 in.  
(0.102 to 0.508 mm).

**NOTE**

Shim thickness was determined in Step (20).

- (21) Install shim (3), washer (2) and screw (1) to locking cylinder (4). Tighten screw to 25 to 32 lb-ft (34 to 43 N·m).
- (22) Remove air supply hose from locking cylinder (4).



**c. Follow-On Maintenance.**

- Install brake assembly, (Para 25-21).

**END OF TASK**



**25-23. AXLE NO. 4 LOCKING CYLINDER REPLACEMENT (CONT).**

**b. Installation.**

**WARNING**

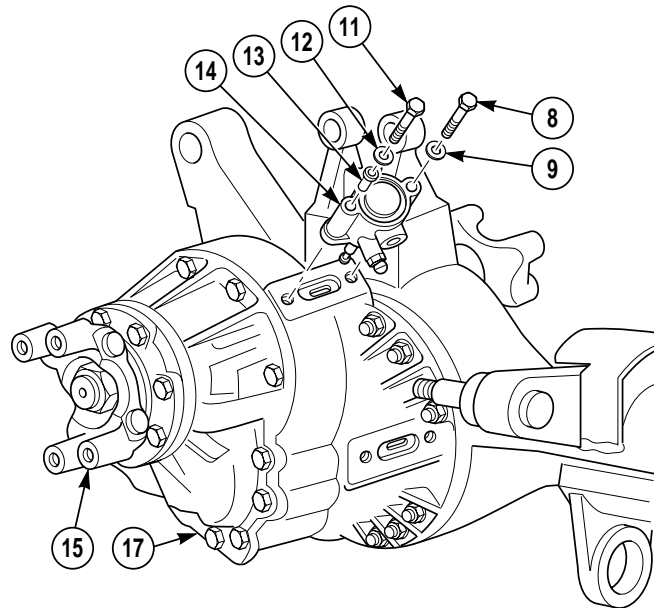
Adhesives, solvents and sealing compounds can burn easily, can give off harmful vapors and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap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

- (1) Coat mating surface of locking cylinder (14) with adhesive.
- (2) Position locking cylinder (14) on differential (17).
- (3) Install plastic washer (13), washer (12) and screw (11) on locking cylinder (14).

**NOTE**

Screw is installed so that only three or four threads of screw are engaged. Screw is installed only to keep screw hole in locking cylinder aligned with differential.

- (4) Position screw (8) and washer (9) on locking cylinder (14).
- (5) Tighten screw (11) to 25 to 32 lb-ft (34 to 43 N·m).



- (6) Connect air supply hose to locking cylinder (14).
- (7) Using air supply hose, apply air pressure 100 to 120 psi (690 to 827 kPa) to locking cylinder (14).

**NOTE**

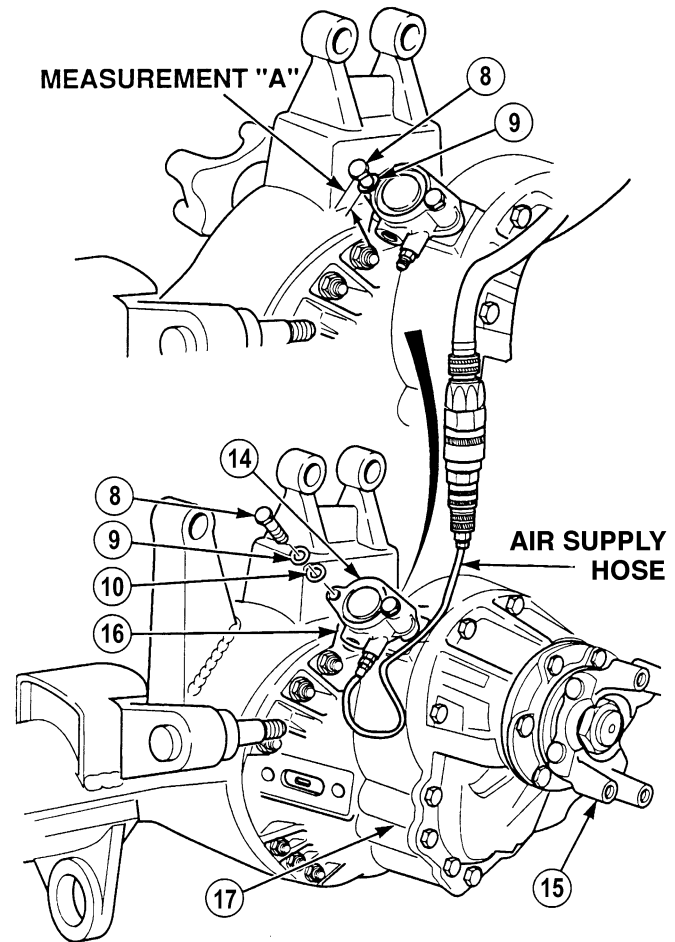
When locking cylinder engages both input shaft and output shaft ends will turn in the same direction, while turning input shaft.

- (8) Turn front flange assembly (15) back and forth until locking cylinder (14) engages.
- (9) Turn screw (8) slowly until screw contacts fork (16) in differential (17).
- (10) Using dial caliper, measure distance from face of washer (9) to top of locking cylinder (14) and record and measurement "A".
- (11) Determine shim (10) thickness. Shim thickness is measurement A – 0.004 to 0.020 in. (0.102 to 0.508 mm).
- (12) Remove screw (8) and washer (9).

**NOTE**

Shim thickness is determined in Step (11).

- (13) Install shim (10), washer (9) and screw (8) on locking cylinder (14). Tighten screw to 25 to 32 lb-ft (34 to 43 N·m).
- (14) Remove air supply hose from locking cylinder (14).



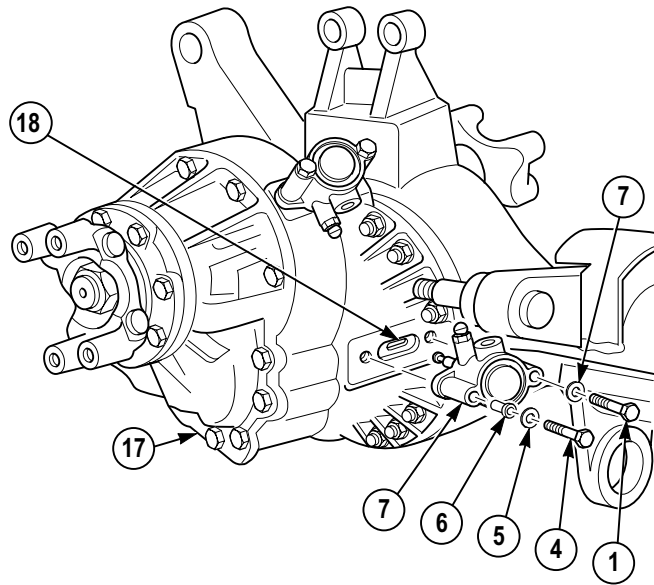


**25-23. AXLE NO. 4 LOCKING CYLINDER REPLACEMENT (CONT).**

**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.

- (15) Coat mating surface of differential (17) with adhesive.
- (16) Position locking cylinder (7) on differential (17).
- (17) Install plastic washer (6), washer (5) and screw (4) on locking cylinder (7).



**NOTE**

Screw is installed so that only three or four threads of screw are engaged. Screw is installed at this time only to keep screw hole aligned.

- (18) Position screw (1) and washer (2) on locking cylinder (7).
- (19) Tighten screw (4) to 25 to 32 lb-ft (34 to 43 N·m).

- (20) Connect air supply hose to locking cylinder (7).
- (21) Using air supply hose apply air pressure 100 to 120 psi (690 to 827 kPa) to locking cylinder (7).

**NOTE**

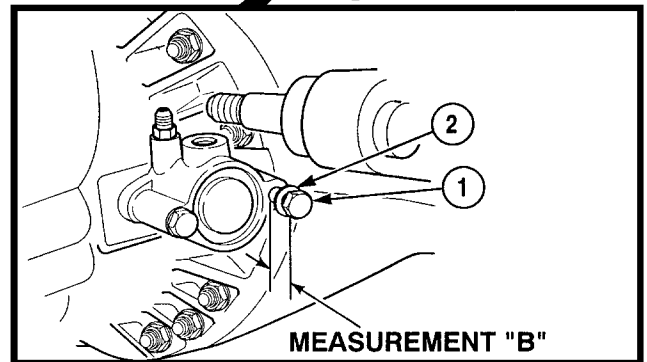
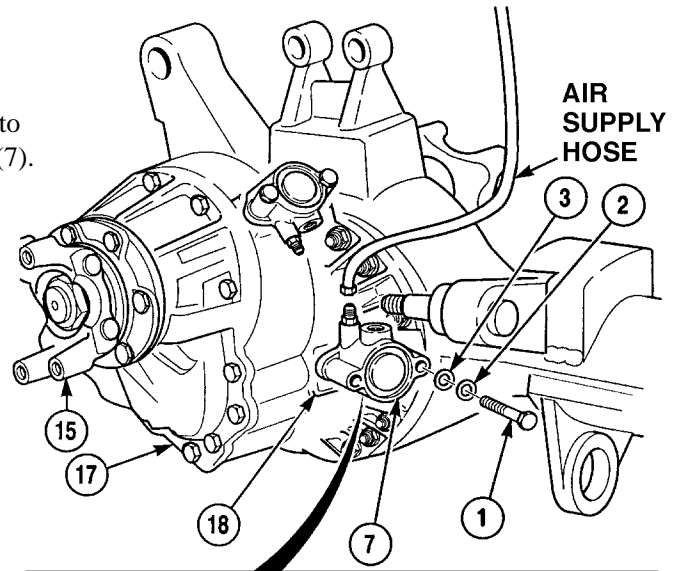
When locking cylinder engages both hub gears will turn in opposite directions, while rotating one wheel.

- (22) Turn flange assembly (15) back and forth until locking cylinder (7) engages.
- (23) Turn screw (1) slowly until screw contacts fork (18) in differential (17).
- (24) Using dial caliper, measure distance between face of washer (2) and top of locking cylinder (7) and record as measurement "B".
- (25) Determine shim (3) thickness. Shim thickness is: measurement "B" - 0.004 to 0.020 in. (0.102 to 0.508 mm).
- (26) Remove screw (1) and washer (2).

**NOTE**

Shim thickness is determined in Step (25).

- (27) Install shim (3), washer (2) and screw (1) on locking cylinder (7). Tighten screw to 25 to 32 lb-ft (34 to 43 N·m).
- (28) Remove air supply hose from locking cylinder (7).



**c. Follow-On Maintenance:**

- Install brake assembly, (Para 25-21).

**END OF TASK**

**25-24. AXLE NO. 3 AND 4 SPINDLE REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Gloves, Chemical Oil Protective (Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Hammer, Hand, Soft Plastic (Item 88, Appendix F)
- Press, 60 Ton (Item 164, Appendix F)
- Puller Kit, Universal (Item 174, Appendix F)
- Socket, Socket Head Screw, 12 mm (Item 206, Appendix F)
- Torch, Propane (Item 247, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

*Materials/Parts*

- Adhesive (Item 1, Appendix B)
- Sealing Compound (Item 56, Appendix B)
- Sealing Compound (Item 60, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)

*Equipment Condition*

- Locking cylinders removed, (Para 25-22 or 25-23)

**a. Removal.**

- (1) Matchmark spindle (1) and axle housing (2).
- (2) Remove two screws (3) from spindle (1).

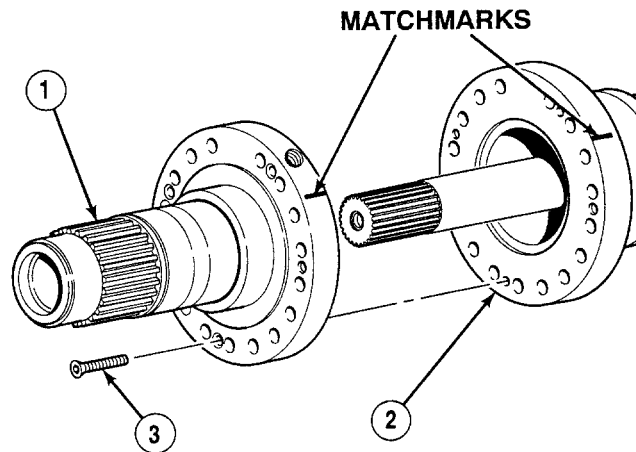


Properly support spindle during removal. Failure to comply may result in injury to personnel.

**NOTE**

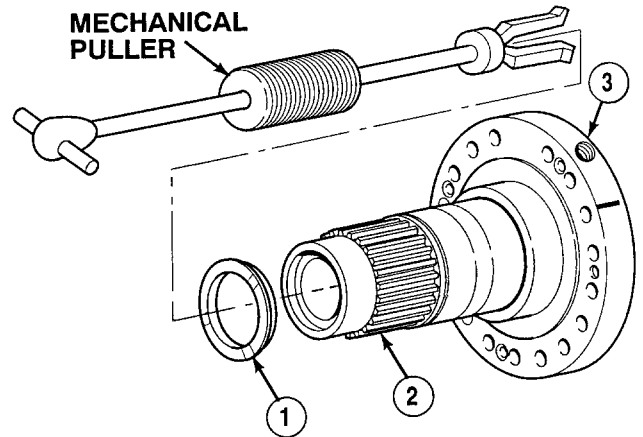
It may be necessary to use a soft face hammer and tap on spindle to break adhesive grip.

- (3) Remove spindle (1) from axle housing (2).



**b. Disassembly.**

- (1) Using puller, remove spindle ring (1) from spindle (2).

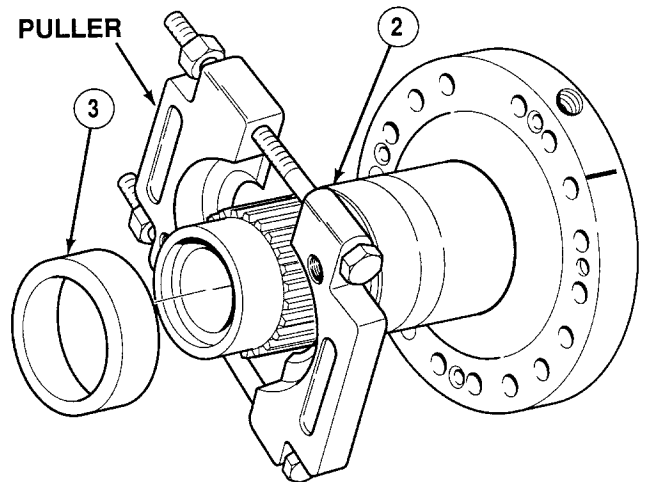


- (2) Heat seal race (3) with propane torch.

**WARNING**

Seal race is extremely hot. Do not touch seal race without protective gloves or severe burns to hands could result.

- (3) Using puller and press, remove seal race (3) from spindle (2).



**c. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
- (2) Inspect metal parts for breaks, cracks, burrs and sharp edges.
- (3) Inspect seal race for wear, scoring and cracks.

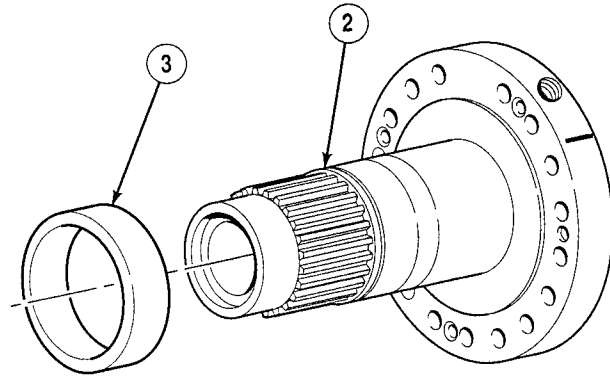
**25-24. AXLE NO. 3 AND 4 SPINDLE REPAIR (CONT).**

- (4) Inspect spindle shaft for broken splines and wear.
- (5) Replace all damaged parts.

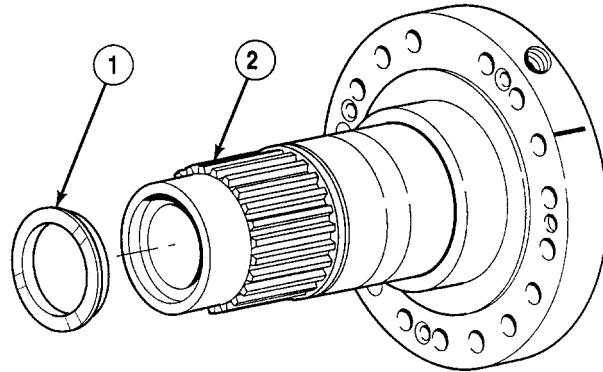
**d. Assembly.**

**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.

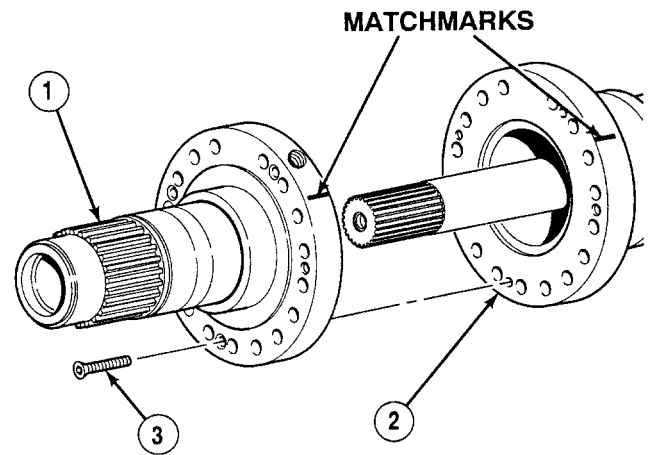


- (1) Coat mating surface of seal race (3) on spindle (2) with sealing compound.
- (2) Using press, install seal race (3) on spindle (2).
- (3) Apply sealing compound to spindle ring (1).
- (4) Install spindle ring (1) on spindle (2).



**e. Installation.****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.



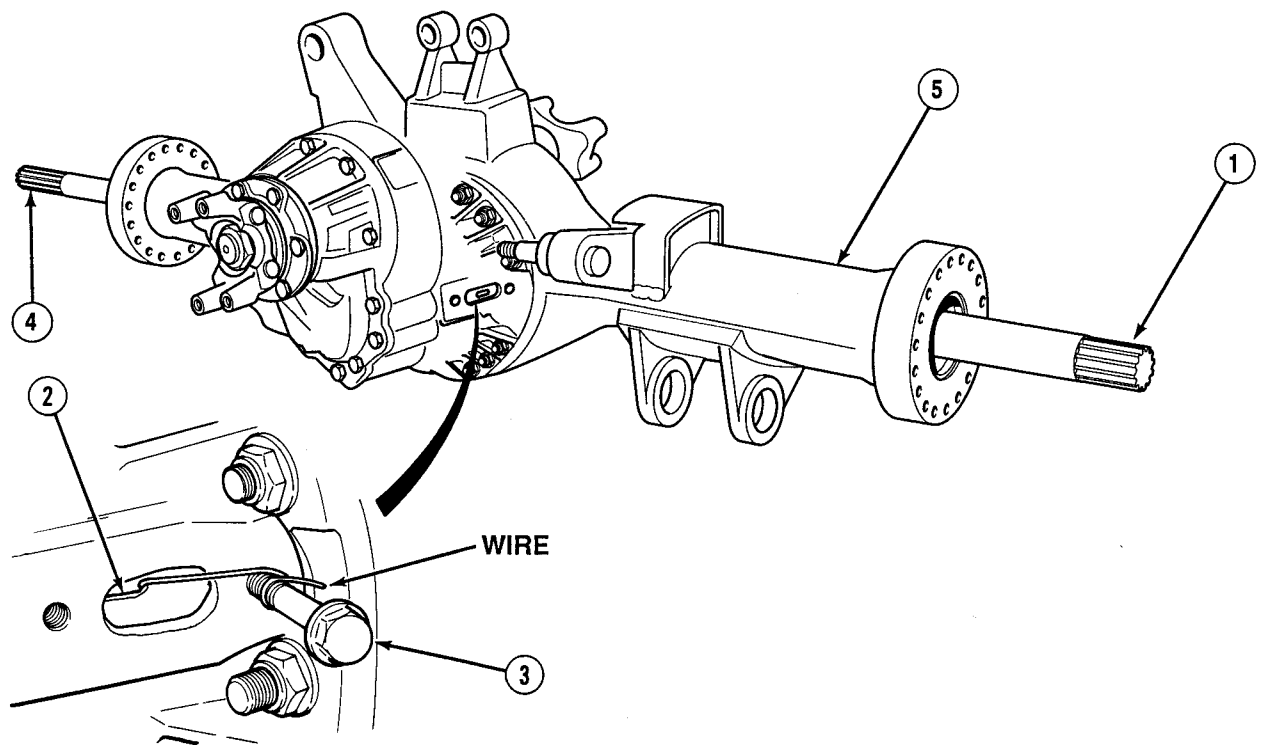
- (1) Coat mating surfaces of axle housing (2) with sealing compound.
- (2) Coat screws (3) with sealing compound.
- (3) Align matchmarks and install spindle (1) on axle housing (2) with two screws (3). Tighten screws to 15 lb-ft (20 N·m).

**f. Follow-On Maintenance:**

- Install locking cylinders, (Para 25-22 or 25-23).

**END OF TASK**



**b. Installation.****NOTE**

- Steps (1) and (2) are for left side axle shaft only.
- Step (3) is for the right side axle shaft only.
- The end of axle shaft with long splines goes in axle housing.

- (1) Install axle shaft (1) in axle housing (5) by aligning axle splines of axle shaft with differential carrier splines and pushing axle shaft inward until axle shaft bottoms out.
- (2) Remove screw (3) and wire from fingers of fork (2).
- (3) Install axle shaft (4) in axle housing (5) by aligning axle splines of axle shaft with differential carrier splines and pushing axle shaft inward until axle shaft bottoms out.

**c. Follow-On Maintenance:**

- Install Axle No. 3 or 4 spindle, (Para 25-24).

**END OF TASK**





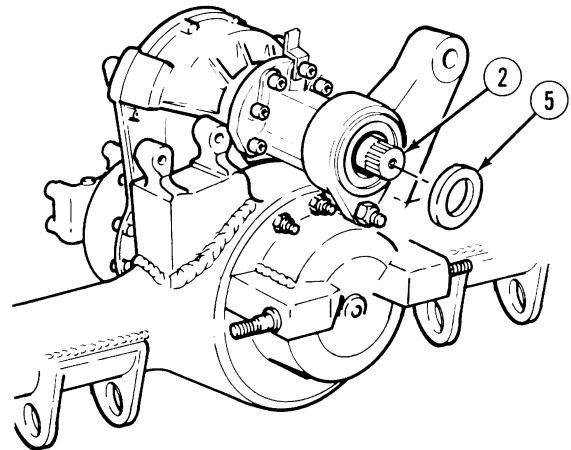
**b. Installation.**

- (1) Coat oil seal (5) with grease.
- (2) Install oil seal (5) in housing (6).
- (3) Install dust cover (4) on flange assembly (3).

**NOTE**

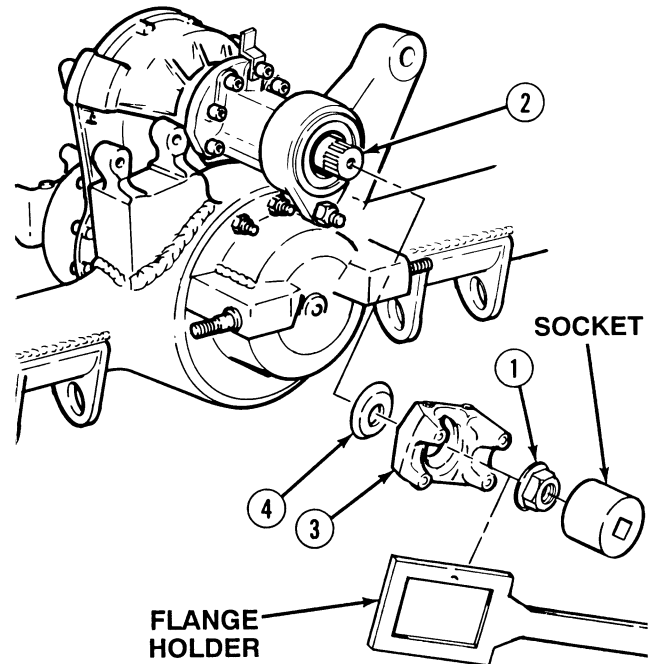
Flange assembly should be positioned so large openings of flange assembly align with slots of pinion shaft. This will ease staking of nut.

- (4) Install flange assembly (3) on pinion shaft (2).

**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.

- (5) Coat threads of pinion shaft (2) with adhesive.
- (6) Apply adhesive to face of flange assembly (3) where adjusting nut (1) seats.
- (7) With the aid of an assistant and using flange holder and socket install adjusting nut (1) on pinion shaft (2). Tighten adjusting nut to 680 to 796 lb-ft (922 to 1,079 N·m).
- (8) Ensure adhesive has squeezed out around entire outside diameter of adjusting nut (1). If adhesive is not visible around entire outside diameter of adjusting nut (1), remove and discard adjusting nut (1) and repeat Steps (6) and (7).
- (9) Stake adjusting nut (1) in two slots of pinion shaft (2) directly 180 degrees apart.

**c. Follow-On Maintenance:**

- Install axle shafts, (Para 25-25).

**END OF TASK**

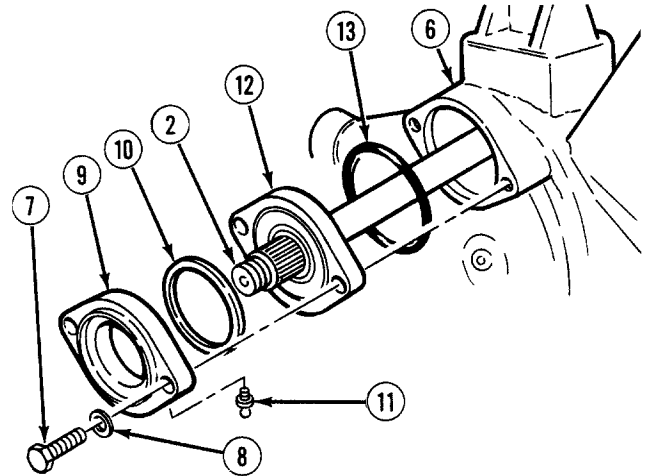


- (6) Remove two screws (7), washers (8) and cover (9) from axle housing (6).
- (7) Remove adjusting shim (10) from cover (9). Discard adjusting shim.

**NOTE**

Perform Step (8) if grease fittings are damaged.

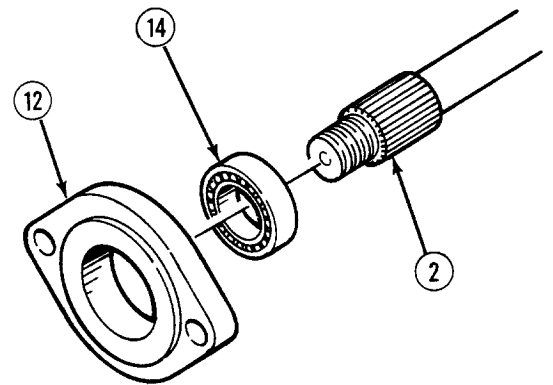
- (8) Remove two grease fittings (11) from cover (9). Discard grease fittings.
- (9) Pull output shaft (2) from axle housing (6).
- (10) Remove output housing (12) from axle housing (6).
- (11) Remove preformed packing (13) from output housing (12). Discard preformed packing.
- (12) Press output housing (12) from output shaft (2).



**NOTE**

Perform Step (13) only if bearing is damaged.

- (13) Press bearing (14) out of output housing (12).

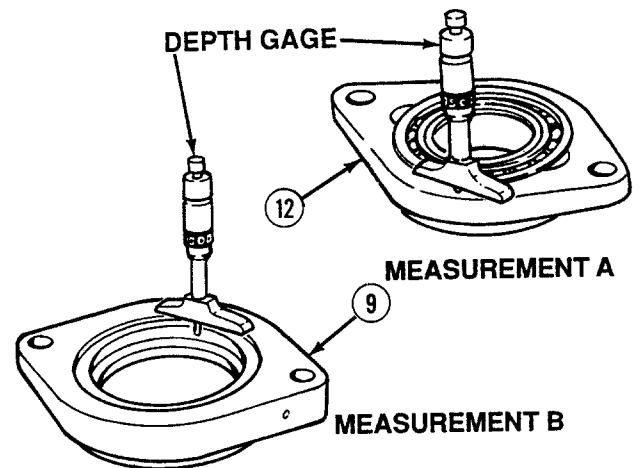


**b. Installation.**

**NOTE**

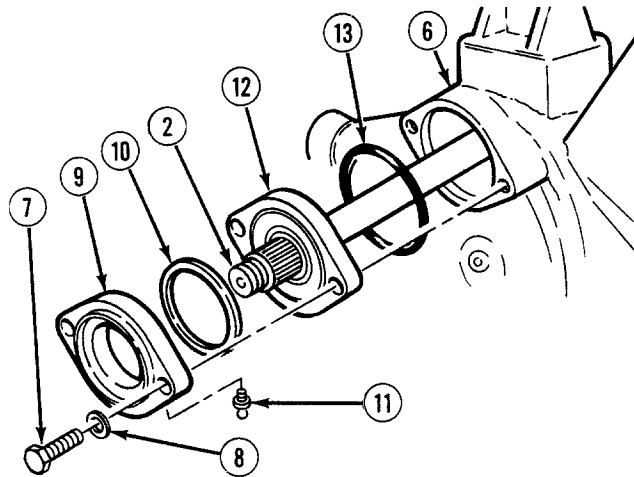
Perform Step (1) only if bearing was removed.

- (1) Apply grease to outside diameter of bearing (14) and press bearing (14) in output housing (12).
- (2) Using depth gage, measure distance “A” between face of bearing (14) and machined surface of output housing (12).
- (3) Using depth gage, measure distance “B” between machined surface of cover (9) and bottom of first land in cover.
- (4) Calculate adjusting shim thickness as follows:  $(A - B) - 0.004 \text{ in. (0.102 mm)}$  equals shim thickness.



**25-27. AXLE NO. 4 REAR OUTPUT ASSEMBLY REPLACEMENT (CONT).**

- (5) Press output shaft (2) in output housing (12).
- (6) Apply lubricating oil to preformed packing (13).
- (7) Install preformed packing (13) in axle housing (6).



**NOTE**

If installation of shaft is difficult, have assistant pull outward on lockup fork.

- (8) Install output shaft (2) in axle housing (6).

**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.

- (9) Coat mating surfaces of cover (9) with adhesive.

**NOTE**

Shim thickness was determined in Steps (2) through (4).

- (10) Install adjusting shim (10) on cover (9).
- (11) Coat threads of two screws (7) with adhesive.
- (12) Install cover (9) with two washers (8) and screws (7) on axle housing (6). Tighten screws to 90 lb-ft (122 N·m).

**NOTE**

Perform Step (13) if grease fittings were removed from cover.

- (13) Install two grease fittings (11) in cover (9).

- (14) Install oil seal (5) in axle housing (6).
- (15) Install dust cover (4) on flange assembly (3).

### NOTE

Flange assembly should be positioned so large openings of flange assembly align with slots of output shaft. This will ease staking of nut.

- (16) Position flange assembly (3) on output shaft (2).

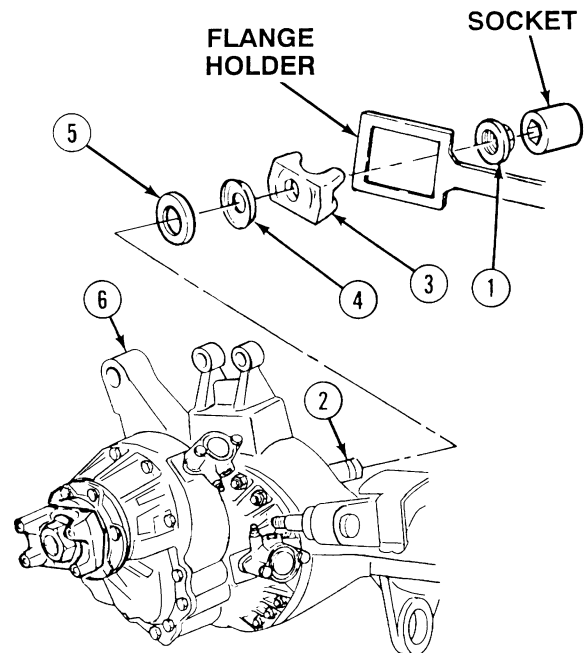
### WARNING

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (17) Coat threads of output shaft (2) with adhesive.
- (18) Apply adhesive to face of flange assembly (3) where adjusting nut (1) seats.
- (19) With the aid of an assistant and using flange holder and socket, install adjusting nut (1) on output shaft (2). Tighten adjusting nut to 680 to 796 lb-ft (922 to 1,079 N·m).
- (20) Inspect to see that adhesive has squeezed out around entire outside diameter of nut (1). If adhesive is not visible around entire outside diameter of nut, remove and discard nut and repeat Steps (18) and (19).
- (21) Stake adjusting nut (1) in two slots of output shaft (2) directly 180 degrees apart.

### c. Follow-On Maintenance.

- Install axle shaft, (Para 25-25).



### END OF TASK

**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Adapter, Maintenance Stand, Differential (Item 3, Appendix F)
- Compressor Unit, Air (Item 35, Appendix F)
- Driver (Item 50, Appendix F)
- Gage, Depth, Micrometer (Item 73, Appendix F)
- Gloves, Chemical Oil Protective (Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Gun, Airblow (Item 86, Appendix F)
- Hammer, Hand, Soft Plastic (Item 88, Appendix F)
- Indicator, Dial, Set w/Magnetic Base (Item 98, Appendix F)
- Multiplier, Torque (Item 141, Appendix F)
- Pliers, Retaining Ring (Item 155, Appendix F)
- Pliers, Retaining Ring (Item 157, Appendix F)
- Press, 60 Ton (Item 164, Appendix F)
- Micrometer, Outside, Caliper, Set (Item 170, Appendix F)
- Puller Kit, Universal Slide Hammer (Item 175, Appendix F)
- Socket, 63 mm (Item 218, Appendix F)
- Spanner (Item 222, Appendix F)
- Spanner (Item 223, Appendix F)
- Spanner (Item 224, Appendix F)
- Stand, Maintenance, Engine (Item 226, Appendix F)
- Wrench Set, Socket, 3/4 in. Drive (Item 274, Appendix F)
- Wrench, Torque (0-60 N·m) (Item 276, Appendix F)
- Wrench, Torque (0 to 175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

*Tools and Special Tools - Continued*

- Wrench, Torque (0 to 600 lb-ft [0-814 N·m]) (Item 278, Appendix F)
- Lifting Device (Minimum Capacity 500 lbs [227 kg])
- Adapter, Differential Preload (Appendix C)
- Extractor, Jet (Appendix C)
- Holder, Flange (Appendix C)

*Materials/Parts*

- Adhesive (Item 1, Appendix B)
- Dye, Prussian Blue (Item 20, Appendix B)
- Grease (Item 22, Appendix B)
- Oil, Lubricating (Item 36, Appendix B)
- Sealing Compound (Item 59, Appendix B)
- Sealing Compound (Item 60, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)
- Wire, Nonelectrical (Item 79, Appendix B)
- Locknut (16) (Item 215, Appendix E)
- Nut, Adjusting (Item 307, Appendix E)
- Nut, Spanner (Item 313, Appendix E)
- Nut, Spanner (Item 314, Appendix E)
- Nut, Spanner (Item 315, Appendix E)
- Pump Assembly (Item 456, Appendix E)
- Ring, Retaining (Item 499, Appendix E)
- Ring, Retaining (Item 500, Appendix E)
- Ring, Retaining (Item 501, Appendix E)
- Seal, Oil (Item 598, Appendix E)
- Shim Kit, Adjusting (Item 635, Appendix E)
- Shim Kit, Adjusting (Item 639, Appendix E)
- Shim Kit, Adjusting (Item 640, Appendix E)
- Shim Kit, Adjusting (Item 642, Appendix E)
- Shim Kit, Adjusting (Item 643, Appendix E)
- Sleeve (Item 647, Appendix E)

*Personnel Required*

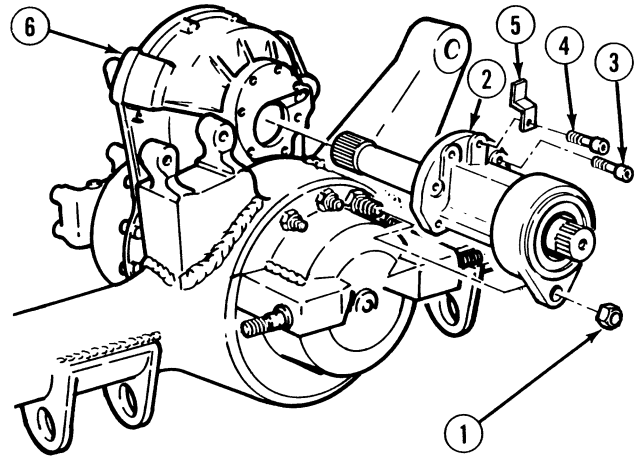
Two

*Equipment Condition*

Axle No. 3 rear flange assembly removed, (Para 25-26)

**a. Removal.**

- (1) Remove nut (1) from rear output assembly (2).
- (2) Remove six screws (3) from rear output assembly (2).
- (3) Remove screw (4) and bracket (5) from rear output assembly (2).
- (4) Remove rear output assembly (2) from differential assembly (6).

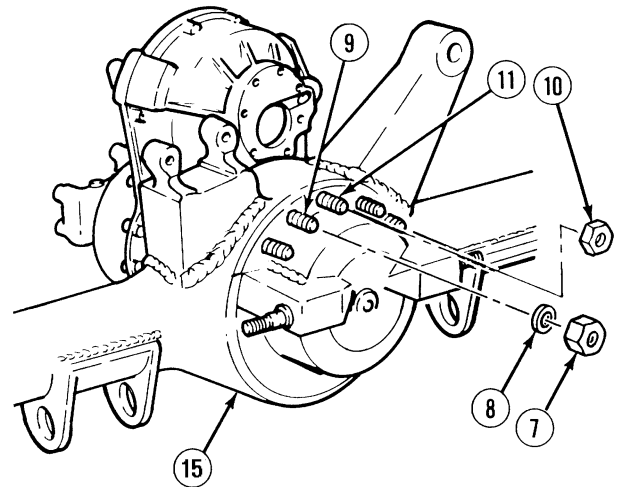


- (5) Remove four locknuts (7) and washers (8) from studs (9). Discard locknuts.

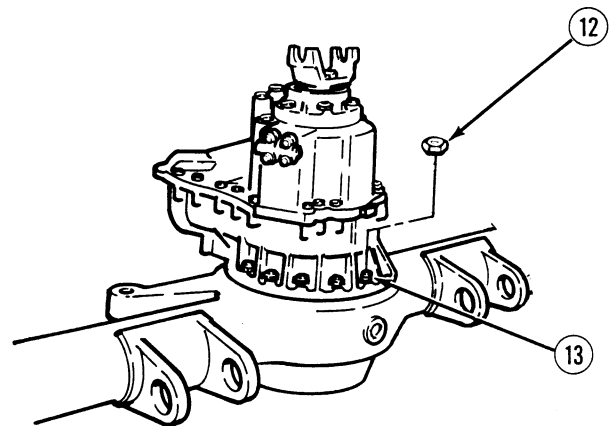
**NOTE**

Perform Step (6) and (7) only if nut or stud is damaged.

- (6) Remove nut (10) from stud (11).
- (7) Remove stud (11) from axle housing (15).



- (8) Remove ten locknuts (12) from studs (13). Discard locknuts.



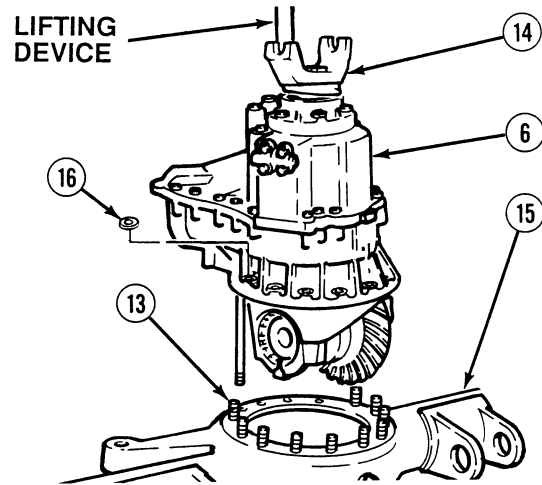


**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**WARNING**

Differential assembly weighs 500 lbs (227 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

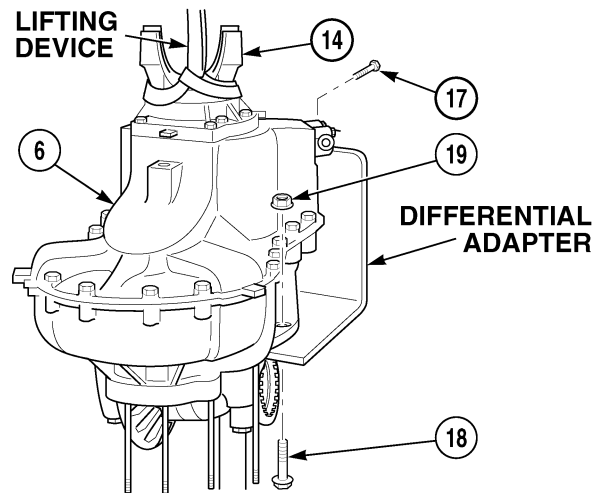
- (9) Attach lifting device to flange assembly (14).
- (10) With the aid of an assistant, remove differential assembly (6) from axle housing (15).
- (11) Remove ten washers (16) from differential assembly (6).



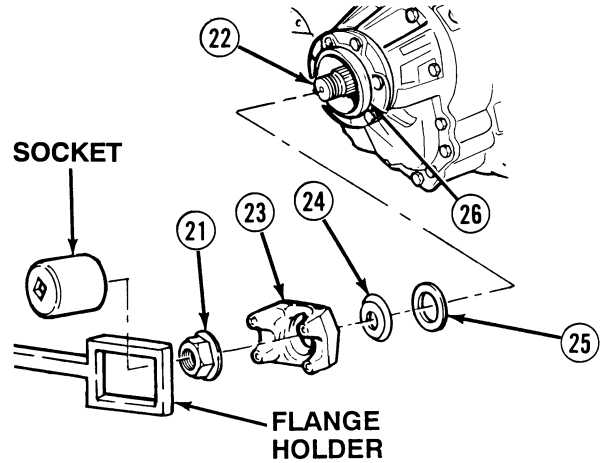
**NOTE**

Perform Step (12) if studs are damaged.

- (12) Remove ten studs (13) from axle housing (15).
- (13) With the aid of an assistant, install differential adapter on engine stand with six screws (17).
- (14) With the aid of an assistant, install differential assembly (6) on differential adapter with six screws (18) and nuts (19).
- (15) Remove lifting device from flange assembly (14).



- (16) Unstake adjusting nut (21) from pinion shaft (22).
- (17) With the aid of an assistant and using flange holder and socket, remove adjusting nut (21) from pinion shaft (22). Discard adjusting nut.
- (18) Remove flange assembly (23) from pinion shaft (22).
- (19) Separate dust cover (24) from flange assembly (23).
- (20) Remove oil seal (25) from differential housing (26). Discard oil seal.

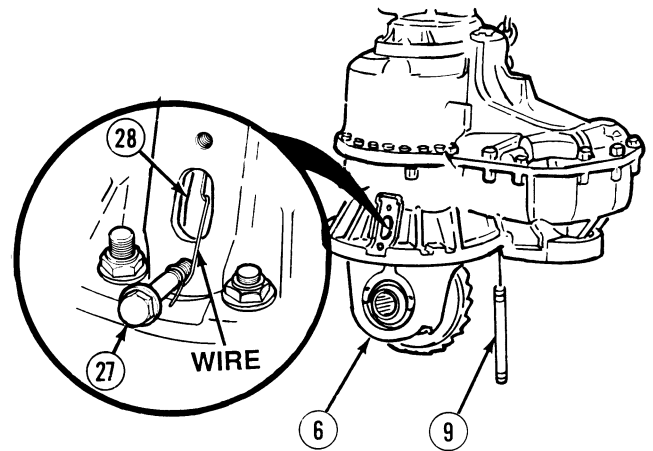


- (21) Remove screw (27) and wire from fork (28).

**NOTE**

Perform Step (22) if studs are damaged.

- (22) Remove four studs (9) from differential assembly (6). Discard studs.



**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**b. Disassembly.**

**CAUTION**

Make sure pinion shaft does not move while backlash is being measured or incorrect reading will result.

- (1) Hold bevel gear shaft (1) so bevel gear (2) does not move.
- (2) Turn differential gear (3) counter clockwise until gear takes up backlash.

**NOTE**

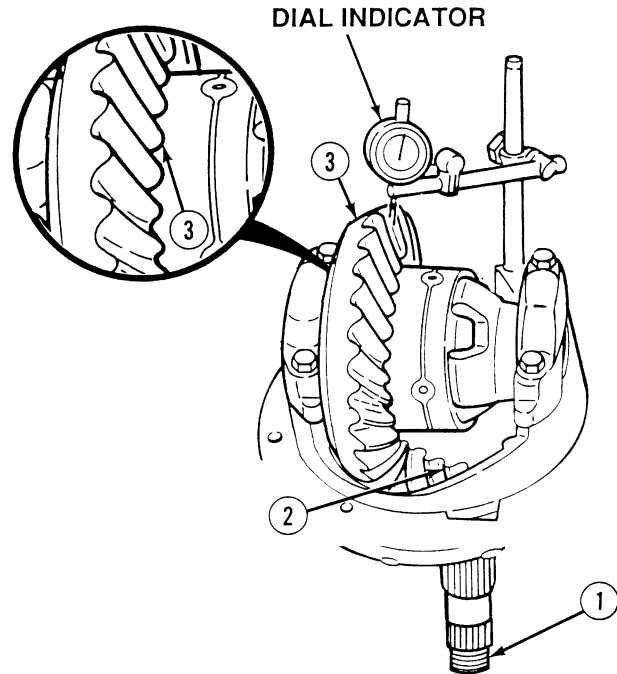
Shaft from dial indicator must be at right (90 degree) angle to face of tooth when in contact.

- (3) Install dial indicator on face of differential gear tooth (3).
- (4) Turn differential gear (3) clockwise until it stops.

**NOTE**

Record differential gear to pinion shaft backlash and contact pattern.  
Backlash should be 0.010 to 0.013 in. (0.254 to 0.330 mm)

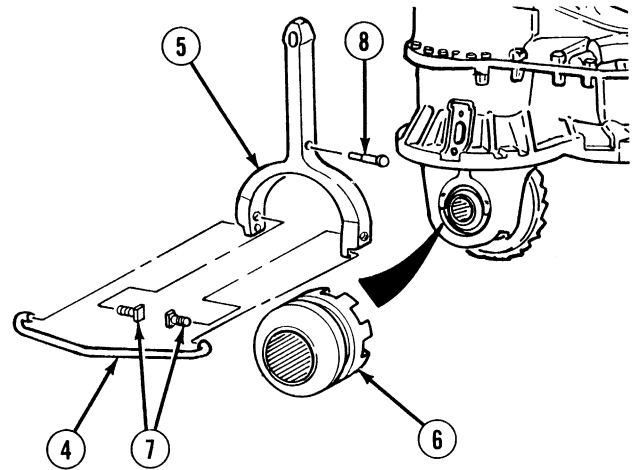
- (5) Check differential gear (3) to bevel gear (2) backlash measured on dial indicator and contact pattern.



**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

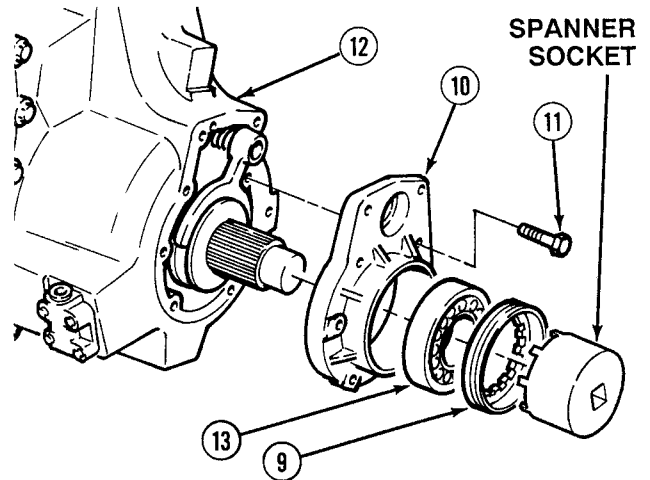
- (6) Remove retaining ring (4) from fork (5).
- (7) Remove clutch gear (6) from fork (5).
- (8) Remove two finger forks (7) from fork (5).



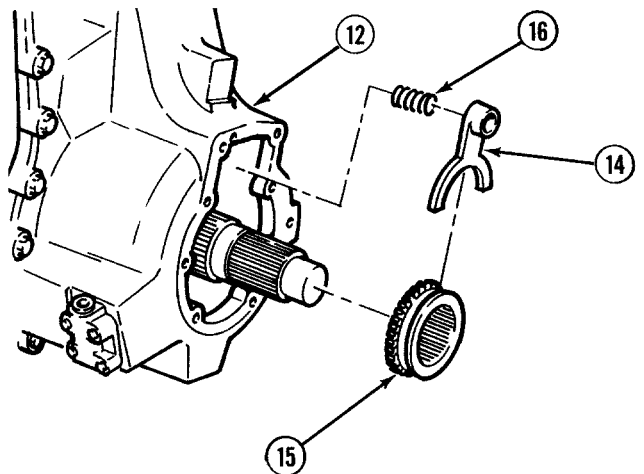
**NOTE**

Fork pin is tapered and can only be removed one way. Fork pin must be removed from larger hole.

- (9) Punch out fork pin (8) and remove fork (5).
- (10) Using spanner socket, remove spanner nut (9) from cover (10). Discard spanner nut.
- (11) Remove six screws (11) from cover (10).

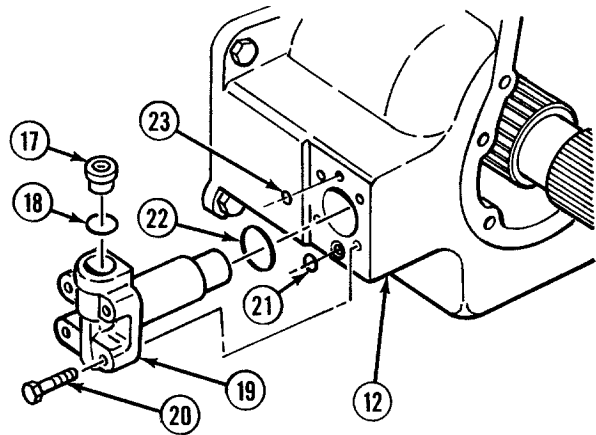


- (12) Using puller, remove cover (10) from differential assembly (12).
- (13) Using press, press bearing (13) from cover (10).
- (14) Remove fork (14), gear (15) and spring (16) from differential assembly (12).



**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

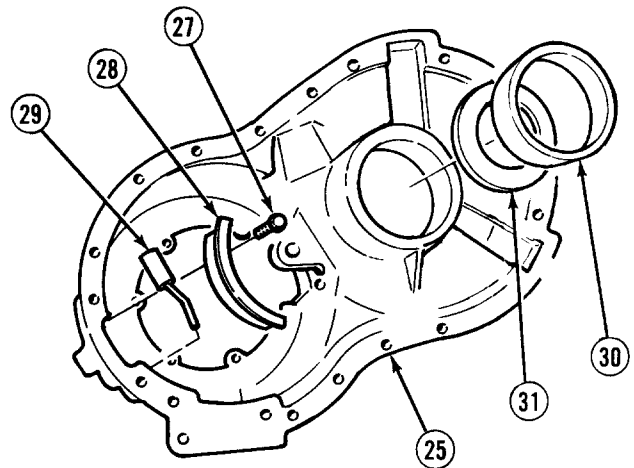
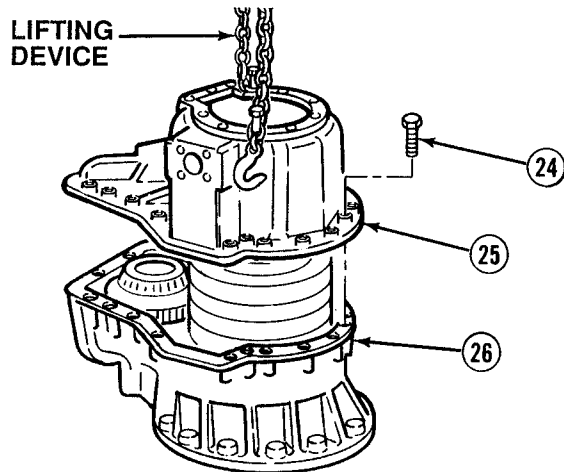
- (15) Remove plug (17) and preformed packing (18) from pump assembly (19). Discard preformed packing.
- (16) Remove four screws (20) from pump assembly (19).
- (17) Remove pump assembly (19) and preformed packings (21), (22) and (23) from differential assembly (12). Discard pump and preformed packings.
- (18) Remove 20 screws (24) from front housing (25).



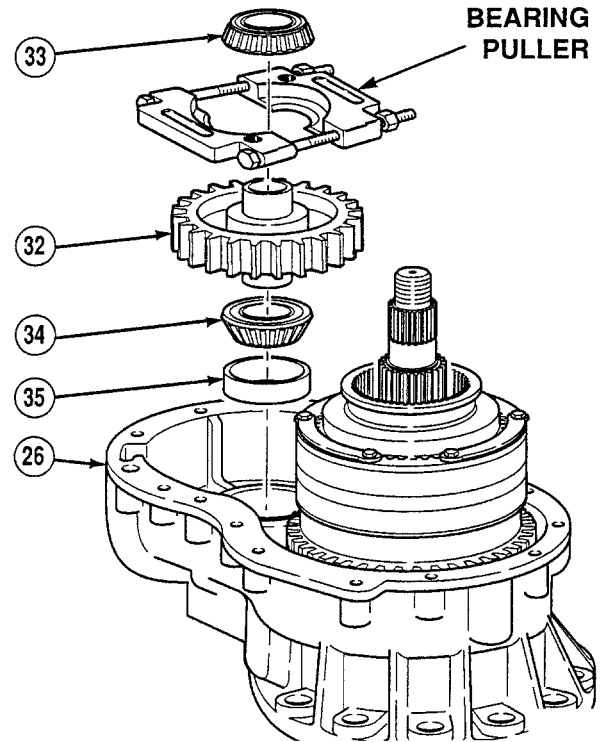
**WARNING**

Front housing weighs 90 lbs (41 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

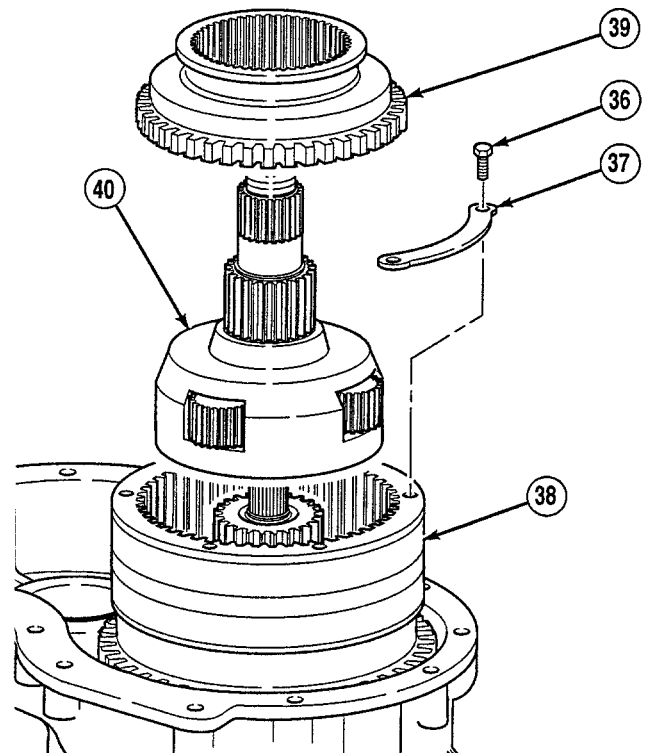
- (19) Attach lifting device to front housing (25).
- (20) Remove front housing (25) from housing (26).
- (21) Remove lifting device from front housing (25).
- (22) Remove two screws (27) and deflector (28) from front housing (25).
- (23) Remove pipe (29) from front housing (25).
- (24) Remove bearing race (30) and adjusting shim (31) from front housing (25). Discard adjusting shim.



- (25) Remove gear (32) from housing (26).
- (26) Using bearing puller, remove bearings (33) and (34) from gear (32).
- (27) Remove bearing race (35) from housing (26).



- (28) Remove six screws (36) and three sectors (37) from ring and pinion assembly (38).
- (29) Remove ring gear carrier (39) from ring and pinion assembly (38).
- (30) With the aid of an assistant, remove planetary gear carrier assembly (40) from ring and pinion assembly (38).

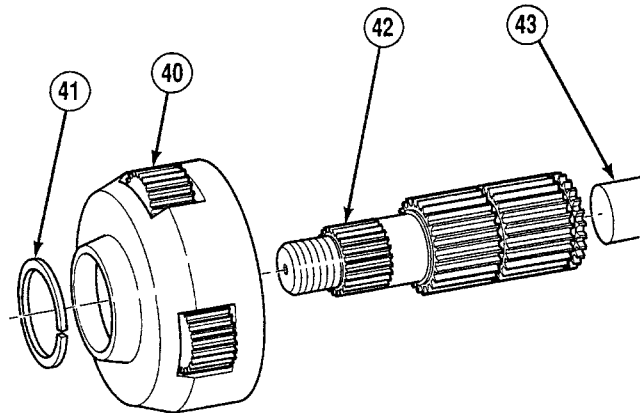


**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (31) Remove retaining ring (41) from input shaft (42).
- (32) Remove input shaft (42) from planetary gear assembly (40).



**NOTE**

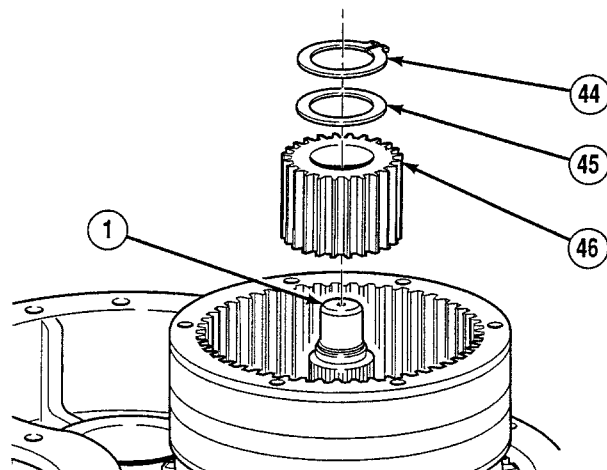
Perform Step (33) if bushing is damaged.

- (33) Remove brass bushing (43) from input shaft (42).

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (34) Remove retaining ring (44) and washer (45) from bevel gear shaft (1).
- (35) Using gear puller, remove sun gear (46) from pinion shaft (1).

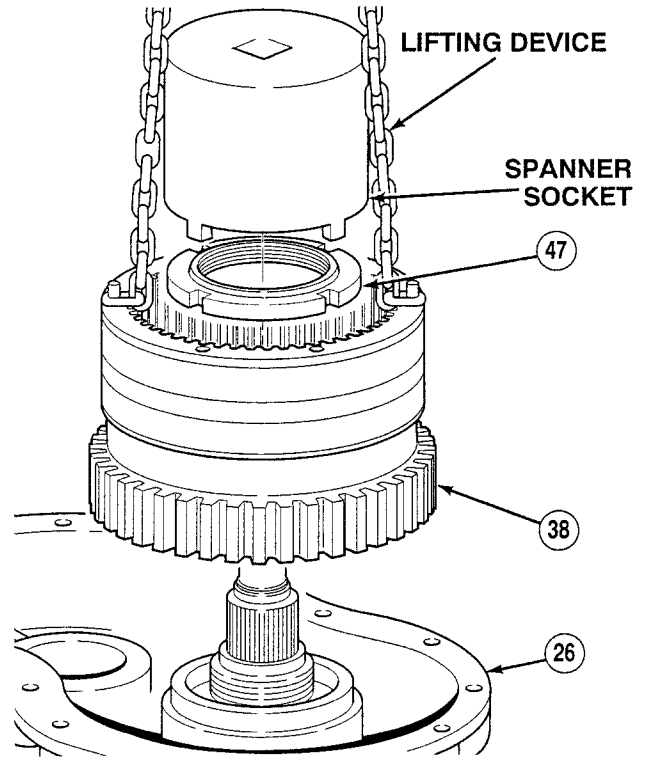


- (36) Unstake spanner nut (47) from pinion shaft (1).
- (37) Using spanner socket, remove spanner nut (47) from ring and pinion assembly (38). Discard spanner nut.

**WARNING**

Ring and pinion assembly weighs 60 lbs (27 kg). Attach a suitable lifting device prior to removal to prevent possible injury to personnel.

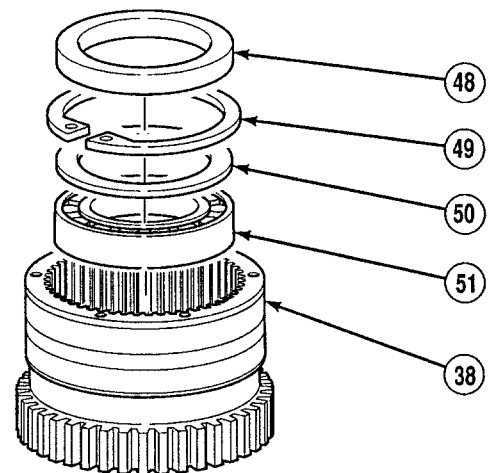
- (38) Attach lifting device to ring and pinion assembly (38).
- (39) Remove ring and pinion assembly (38) from housing (26).
- (40) Remove lifting device from ring and pinion assembly (38).



**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (41) Remove deflector (48), retaining ring (49), adjusting shim (50) and bearing (51) from ring and pinion assembly (38). Measure and record thickness of adjusting shim then discard.





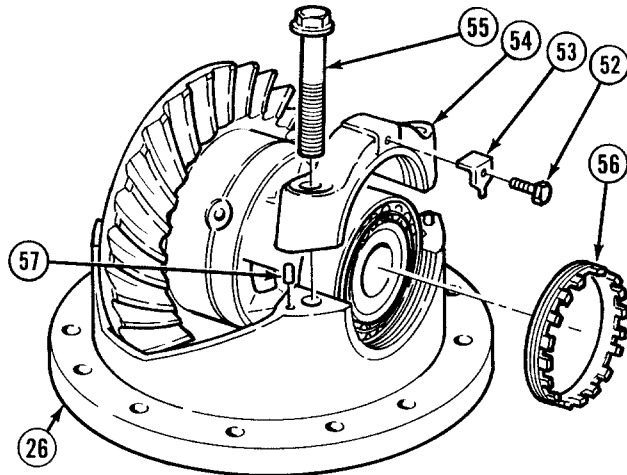
**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

- (42) Remove screw (52) and nut lock plate (53) from bearing cap (54).

**CAUTION**

Loosen screws so adjusting nut may be loosened. If screws are loosened too much, adjusting nut may be forced sideways, stripping threads of adjusting nut and bearing cap.

- (43) Partially loosen two screws (55) so adjusting nut (56) may be loosened.
- (44) Loosen adjusting nut (56) until it moves easily.



**NOTE**

Bearing caps are part of a matched assembly with the differential housing assembly.

- (45) Remove four screws (55), two bearing caps (54) and adjusting nut (56).

**NOTE**

Perform Step (46) if locating pins are damaged.

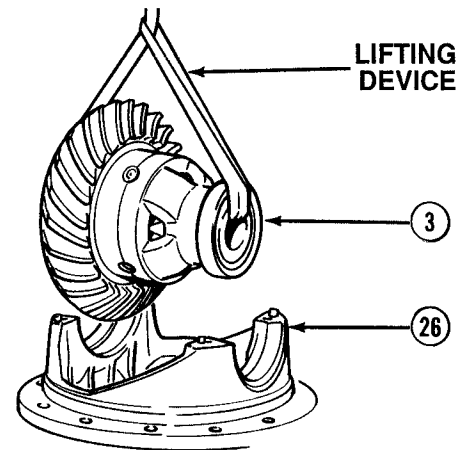
- (46) Remove four locating pins (57) from housing (26).

**WARNING**

Differential and bevel gear weighs 70 lbs (32 kg). Attach a suitable lifting device prior to removal to prevent possible injury to personnel.

**NOTE**

Differential and bevel gear assembly is part of a matched assembly with pinion shaft.

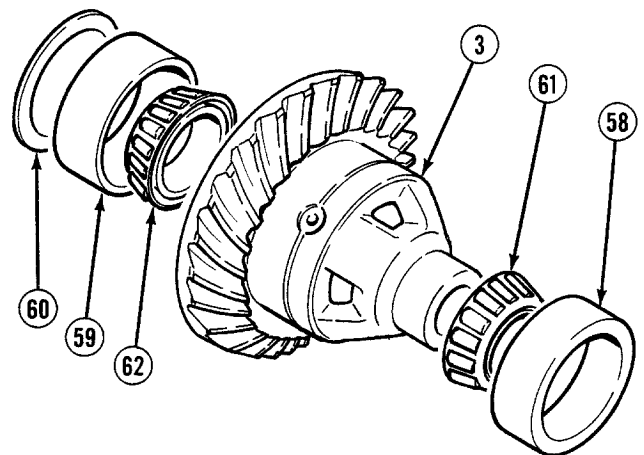


- (47) Attach lifting device through differential gear (3).
- (48) Remove differential gear (3) from housing (26).
- (49) Remove lifting device from differential gear (3).

**NOTE**

Bearing races are part of matched assemblies with the taper bearings.

- (50) Remove bearing races (58) and (59) and adjusting shim (60). Measure and record thickness of adjusting shim then discard.
- (51) Using puller, remove taper bearings (61) and (62) from differential gear (3).

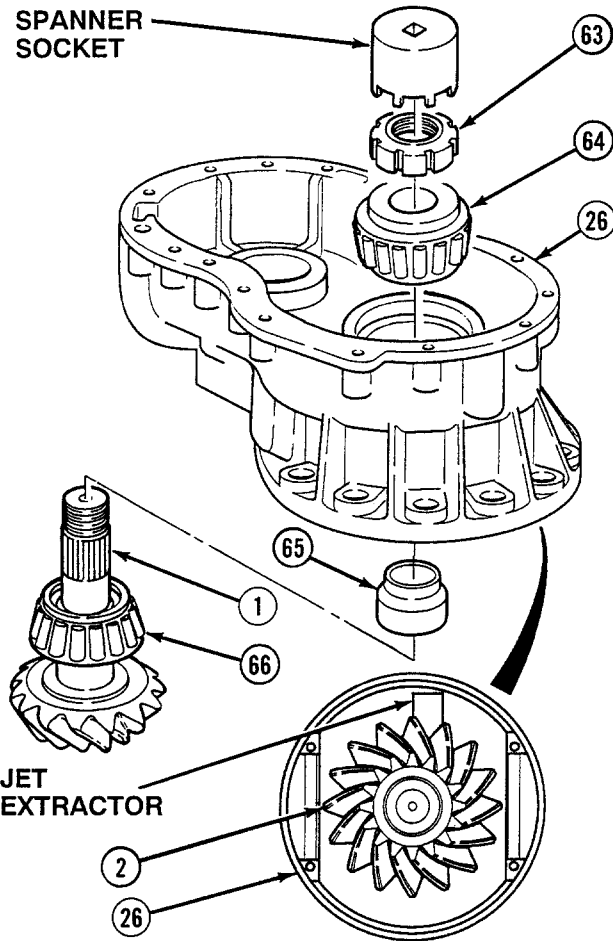


**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

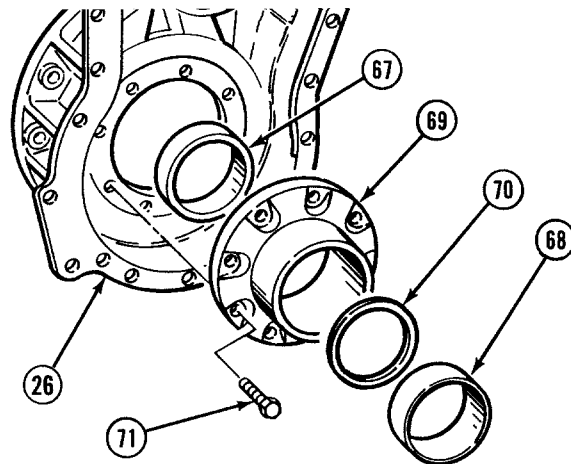
**NOTE**

Spanner nut will be staked in two places.

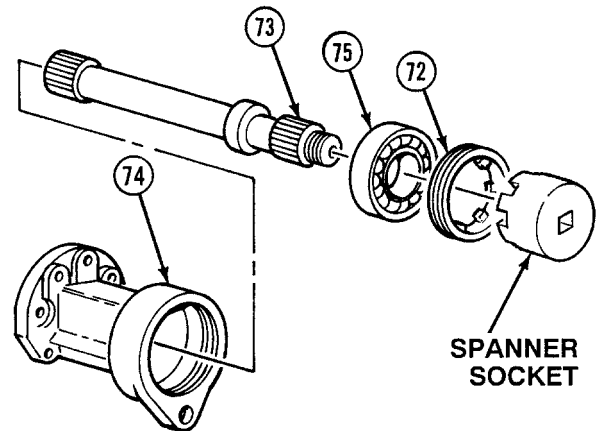
- (52) Unstake spanner nut (63) on pinion shaft (1).
- (53) Position jet extractor between gear teeth of bevel gear (2) and housing (26).
- (54) Using spanner socket remove spanner nut (63). Discard spanner nut.
- (55) With the aid of an assistant and soft faced hammer, remove pinion shaft (1) out of housing (26).
- (56) Remove bearing (64) from housing (26).
- (57) Remove spacer (65) from pinion shaft (1).
- (58) Using puller and press, remove bearing (66) from pinion shaft (1).



- (59) Remove bearing races (67) and (68) from bearing housing (69).
- (60) Remove adjusting shim (70) from bearing housing (69). Discard adjusting shim.
- (61) Remove eight screws (71) from bearing housing (69).
- (62) Remove bearing housing (69) from housing (26).



- (63) Using spanner socket, remove nut (72) from output shaft (73).
- (64) Remove output shaft (73) from output housing (74).
- (65) Using press, remove bearing (75) from output shaft (73).



**c. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
  - (2) Inspect all metal parts for breaks, cracks, burrs and sharp edges.
  - (3) Inspect all bearings for wear, scoring and cracks.
  - (4) Inspect differential and bevel gear for broken splines and wear.
  - (5) Inspect driven gear for broken splines and wear.
  - (6) Inspect pinion shaft for broken splines and wear.
  - (7) Replace all damaged parts.

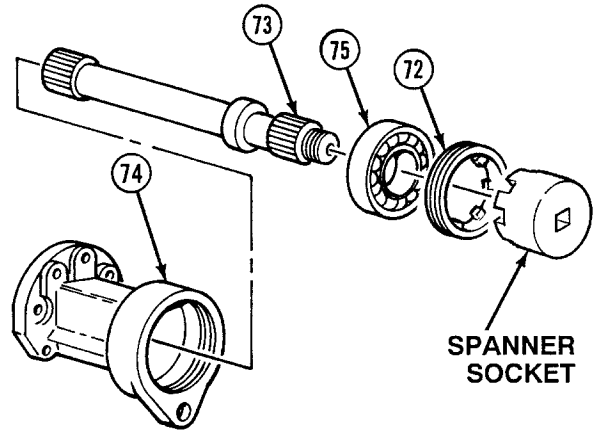
**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**d. Assembly.**

- (1) Using press, install bearing (75) on output shaft (73).
- (2) Install output shaft (73) in output housing (74).

**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.

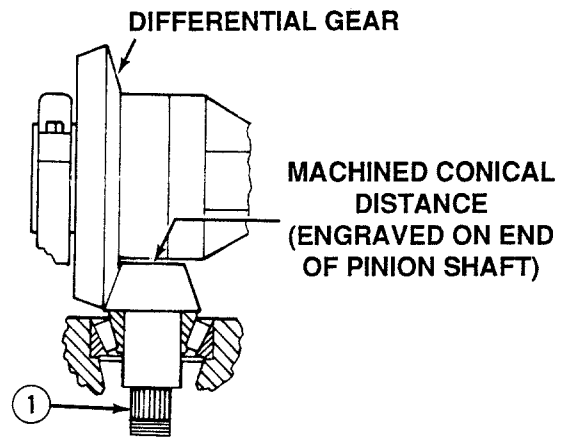


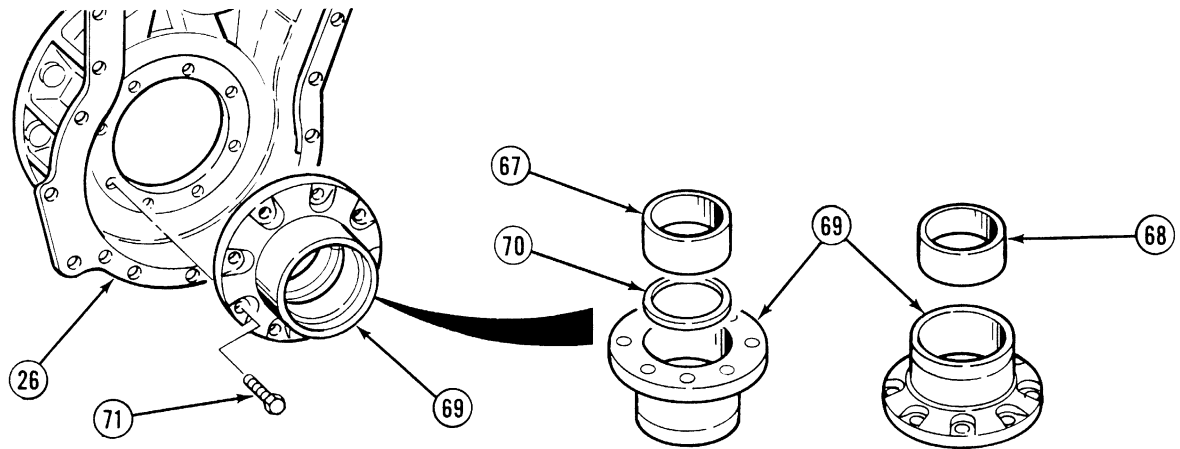
- (3) Coat threads of nut (72) with sealing compound.
- (4) Using spanner socket, install nut (72). Tighten nut to 253 lb-ft (343 N·m).

**NOTE**

- Perform Steps (5) through (11) only if a new pinion shaft and differential bevel gear are being installed.
- The machined conical distance is engraved on pinion shaft head.

- (5) Record machined conical distance of used pinion shaft (1) removed from differential assembly.
- (6) Record machined conical distance of new pinion shaft (1) to be installed in the differential assembly.
- (7) Compare two distances recorded in Steps (5) and (6). If distance recorded in Step (5) is larger than distance recorded in Step (6), proceed to Step (8). If distance recorded in Step (6) is larger than distance recorded in Step (5), proceed to Step (9).





- (8) The new adjusting shim (70) thickness will be: Step (5) distance – Step (6) distance = amount of shim thickness to be added to old adjusting shim thickness to create new adjusting shim kit. Proceed to Step (10).
- (9) The new adjusting shim (70) thickness will be: Step (6) distance – Step (5) distance = amount of shim thickness to be removed from old adjusting shim thickness to create new adjusting shim kit. Proceed to Step (10).
- (10) Assemble new adjusting shim (70) to thickness determined per Step (7).
- (11) Install adjusting shim (70) in bearing housing (69).
- (12) Apply grease to bearing race (67).
- (13) Install bearing race (67) in bearing housing (69).
- (14) Apply grease to bearing race (68).
- (15) Install bearing race (68) in bearing housing (69).
- (16) Install bearing housing (69) on housing (26) with eight screws (71). Tighten screws to 80 lb-ft (108 N·m).

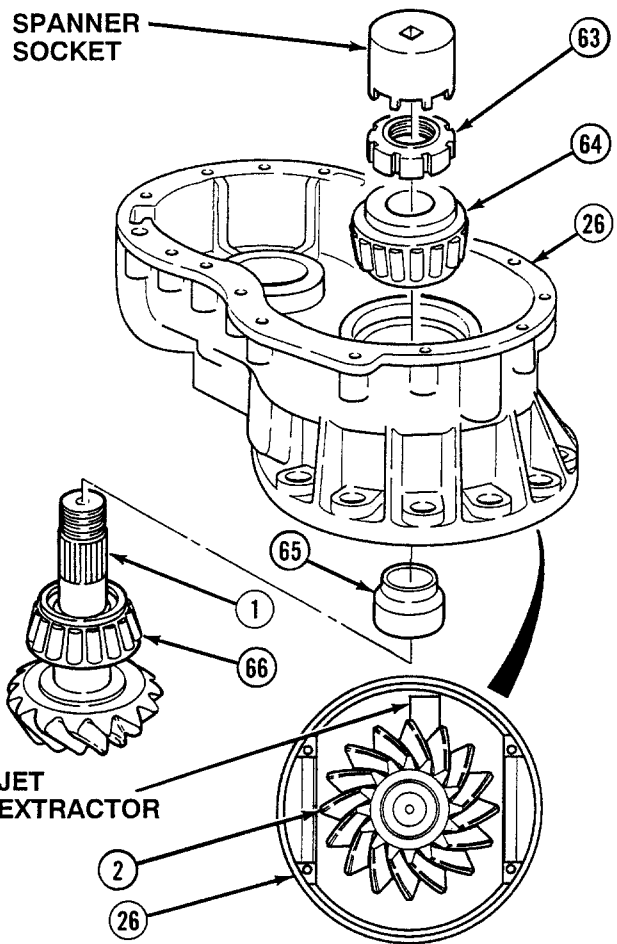
**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

- (17) Install taper bearing (66) on pinion shaft (1).
- (18) Install spacer (65) on pinion shaft (1).
- (19) Install pinion shaft (1) and bearing (64) in housing (26).
- (20) Position jet extractor between gear teeth of bevel gear (2) and housing (26).
- (21) With the aid of an assistant, install spanner nut (63). Tighten spanner nut to 528 to 564 lb-ft (716 to 765 N·m).

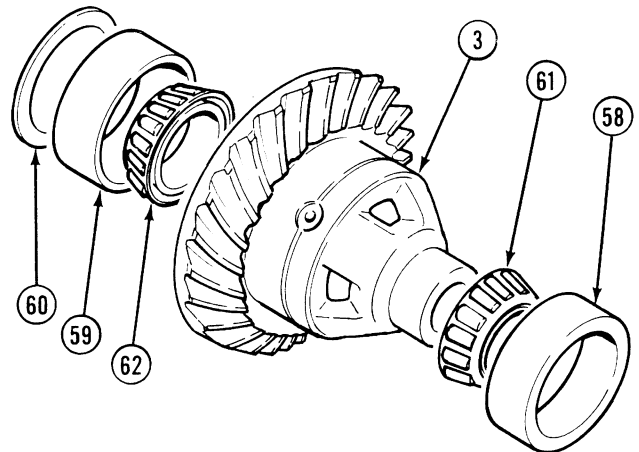
**NOTE**

If preload is incorrect refer to Step (10). If preload is correct go to Step (23).

- (22) Check preload on pinion shaft (1) by turning spanner nut (63) with a torque wrench. Preload must be 2 to 3 lb-ft (3 to 4 N·m).
- (23) Stake spanner nut (63) in two places.



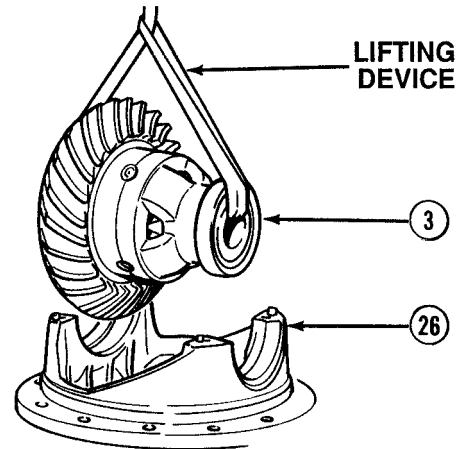
- (24) Install taper bearings (61) and (62) on differential gear (3).
- (25) Adjust the adjusting shim (60) thickness by applying the opposite change of thickness applied to adjusting shim (70) in Step (10).
- (26) Install adjusting shim (60) and bearing races (58) and (59) on differential gear (3).



**WARNING**

Differential and bevel gear weighs 70 lbs (32 kg). Attach a suitable lifting device prior to installation to prevent possible injury to personnel.

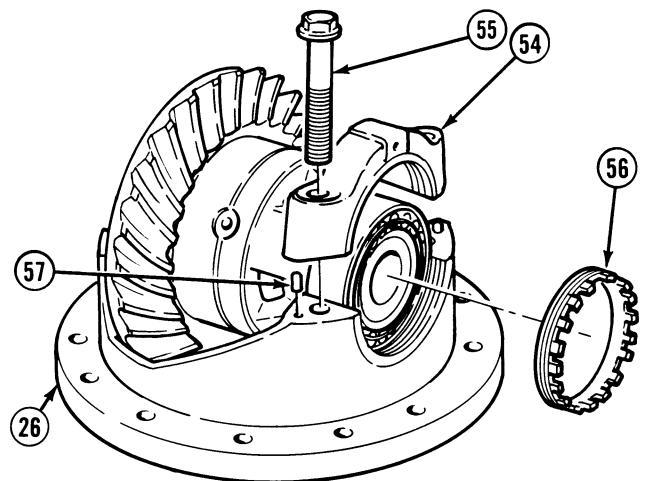
- (27) Attach lifting device to differential gear (3).
- (28) Install differential gear (3) in housing (26).
- (29) Remove lifting device from differential gear (3).



**NOTE**

Perform Step (30) if locating pins were removed.

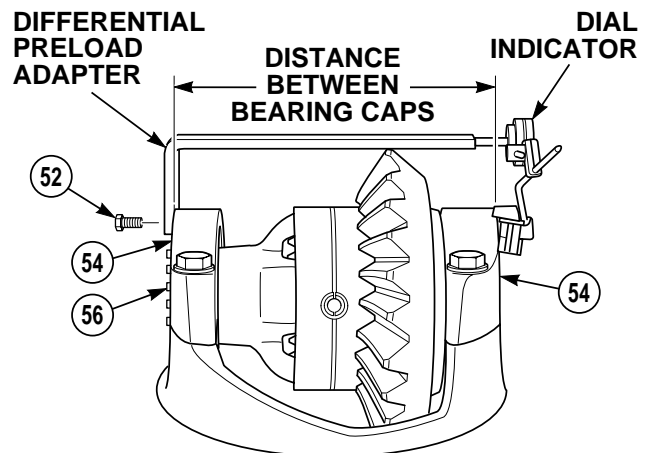
- (30) Install four locating pins (57) in housing (26).
- (31) Install adjusting nut (56), two bearing caps (54) and four screws (55). Tighten screws to 25 lb-in (3 N·m).
- (32) Install differential preload adapter on bearing cap (54) with screw (52).
- (33) Position dial indicator base on bearing cap (54) and indicator end on differential preload adapter.



**NOTE**

Steps (34) and (36) adjust bearing preload.

- (34) Tighten adjusting nut (56) to obtain a dial indicator reading of 0.014 to 0.018 in. (0.356 to 0.457 mm).
- (35) Remove screw (52), dial indicator and differential preload adapter from bearing cap (54).





**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**CAUTION**

Make sure pinion shaft does not move while backlash is being measured. Incorrect reading will result.

- (36) Hold pinion shaft (1) so bevel gear (2) does not move.
- (37) Turn differential gear (3) counterclockwise until gear takes up backlash.

**NOTE**

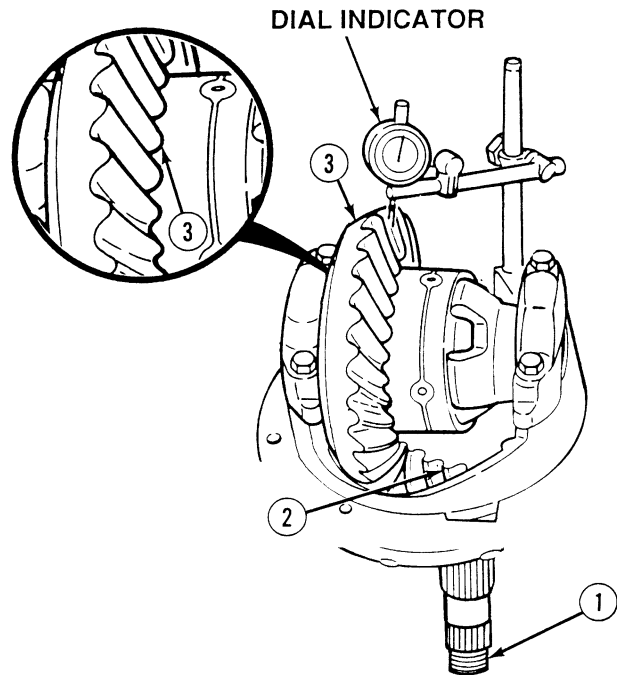
Shaft from dial indicator must be at right (90 degree) angle to face of tooth when in contact.

- (38) Install dial indicator on face of differential gear tooth (3).
- (39) Turn differential gear (3) clockwise until gear stops.

**NOTE**

Backlash should be 0.010 to 0.013 in. (0.254 to 0.330 mm).

- (40) Record differential gear (3) to bevel gear (2) backlash measured on dial indicator.
- (41) If backlash is not correct, repeat Steps (25) through (38) and select thickness of adjusting shim (60) until proper backlash is obtained.



**WARNING**

Prussian Blue Dye is poisonous and can burn skin on contact. Over exposure to dye can cause heart and skin problems, dizziness and unconsciousness.

**NOTE**

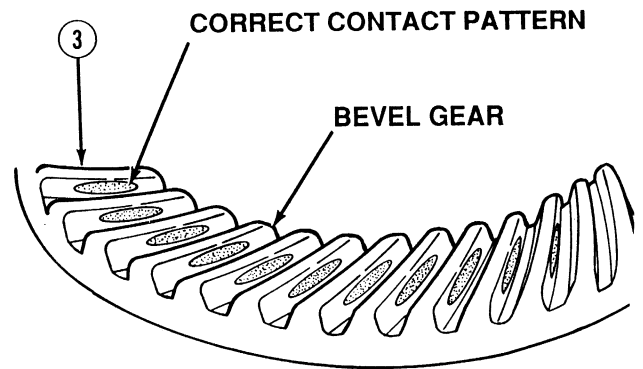
Steps (42) through (48) adjust tooth contact pattern.

- (42) Coat gear teeth of differential gear (3) with Prussian blue dye.
- (43) Turn differential gear (3) to set dye pattern. Check tooth contact pattern.

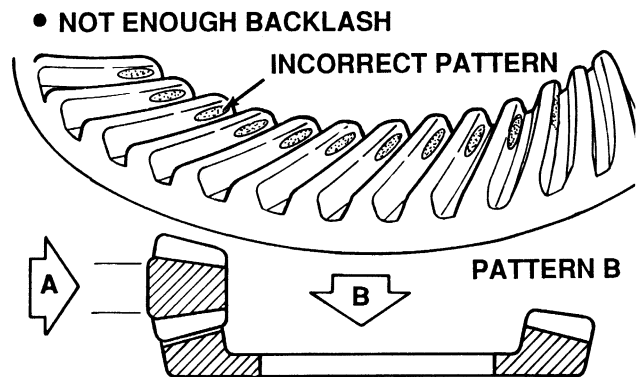
**NOTE**

To obtain the correct tooth contact pattern, two considerations must be observed: One is the lengthwise contact pattern that is in the length direction of the teeth, the other is the face width pattern that is in the height direction of the teeth.

- (44) If tooth contact pattern is like pattern A, do not adjust tooth contact pattern. Go to Step (48).
- (45) If tooth contact pattern is like pattern B, add backlash. Go to Step (34).



**PATTERN A**

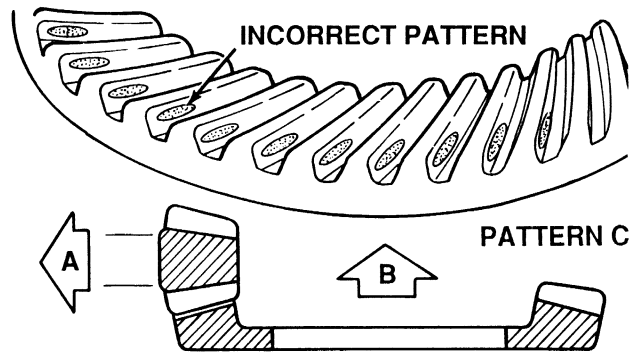


**A : PROFILE CONTACT ADJUSTMENT  
B : INCREASE LONGITUDINAL BEARING**

**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

- (46) If tooth contact pattern is like pattern C, reduce backlash. Go to Step (34).

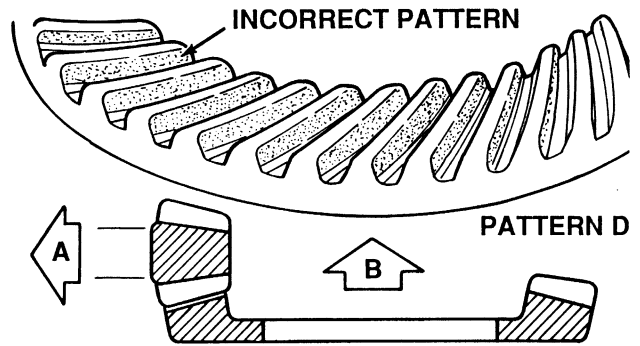
• **TOO MUCH BACKLASH**



A : PROFILE CONTACT ADJUSTMENT  
B : INCREASE LONGITUDINAL BEARING

- (47) If tooth contact pattern is like pattern D, move pinion shaft away from bevel gear by adjusting shims. Go to Step (9) if installing new gears and shims.

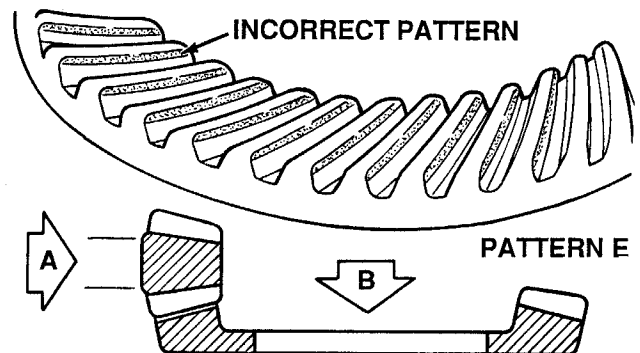
• **PINION SHAFT TOO CLOSE**



A : RAISE THE PROFILE CONTACT  
B : BACKLASH ADJUSTMENT

- (48) If tooth contact pattern is like pattern E, move pinion shaft closer toward bevel gear by adjusting shims. Go to Step (9) if installing new gears and shims.

• **PINION SHAFT TOO FAR AWAY**

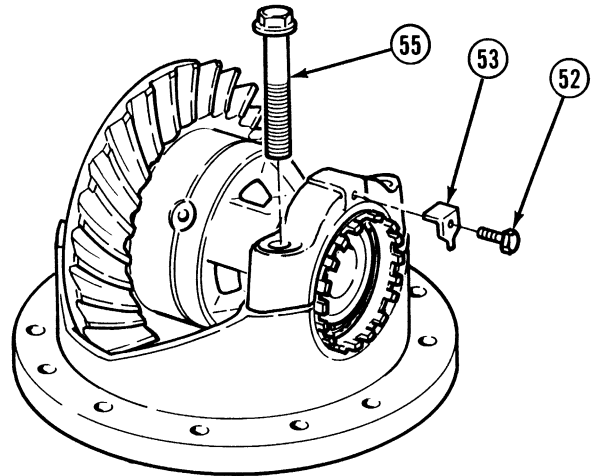


A : LOWER THE PROFILE CONTACT  
B : BACKLASH ADJUSTMENT

- (49) Remove one of four screws (55).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.



- (50) Coat threads of screw (55) with sealing compound.
- (51) Install screw (55) and tighten to 123 to 138 lb-ft (167 to 187 N·m).
- (52) Repeat Steps (49) through (51) for three remaining screws (55).
- (53) Coat threads of screw (52) with sealing compound.
- (54) Install nut lock plate (53) with screw (52).

**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

- (55) Measure bearing (51) thickness and record as dimension "B".

**WARNING**

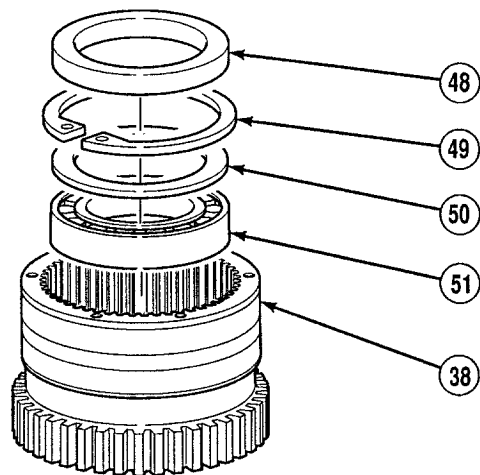
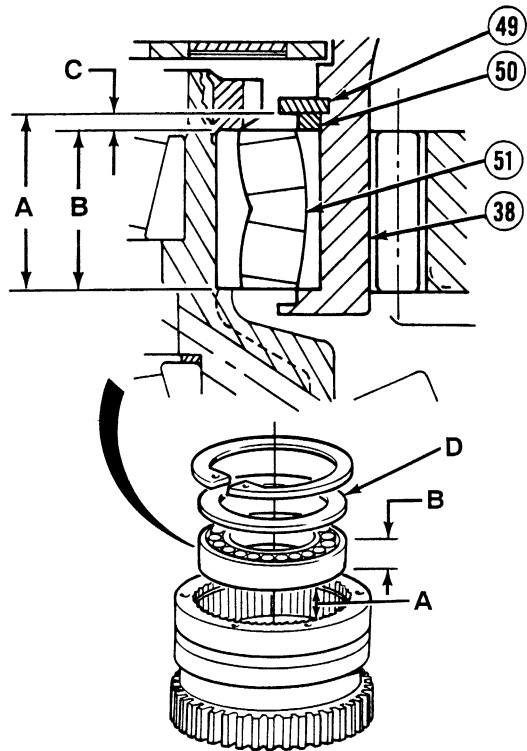
Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (56) Install retaining ring (49) in ring and pinion assembly (38). Using depth micrometer, measure distance between face of retaining ring (49) and bottom face of ring and pinion assembly (38) and record as dimension "A".
- (57) Subtract dimension "B" from dimension "A" to get dimension "C" ( $C = A - B$ ). Subtract 0.004 in. (0.102 mm) from dimension "C" to get dimension "D" ( $D = C - 0.004 \text{ in. [0.102 mm]}$ ). Dimension "D" is adjusting shim (50) thickness.

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

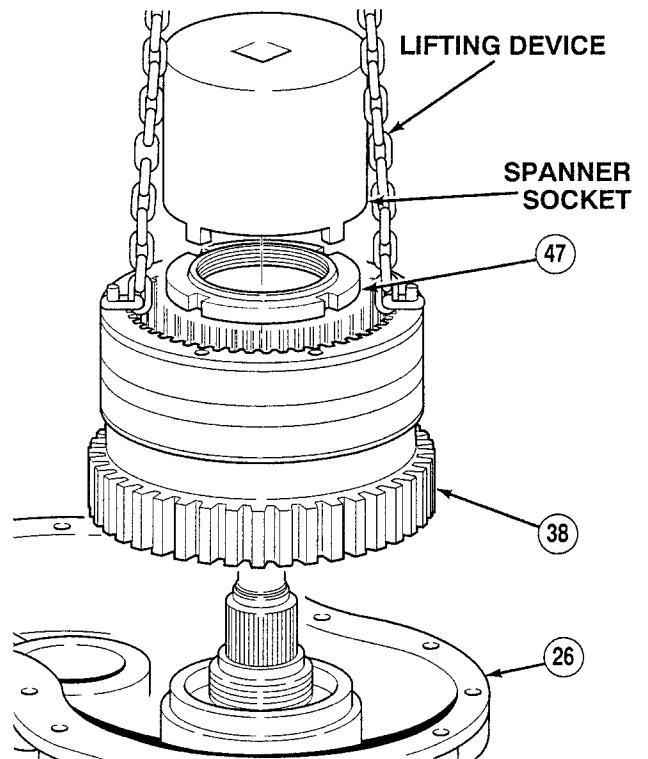
- (58) Remove retaining ring (49) from ring and pinion assembly (38).
- (59) Install bearing (51) and adjusting shim (50) in ring and pinion assembly (38) with retaining ring (49).
- (60) Install deflector (48) in ring and pinion assembly (38).



**WARNING**

Ring and pinion assembly weighs 60 lbs (27 kg). Attach a suitable lifting device prior to removal to prevent possible injury to personnel.

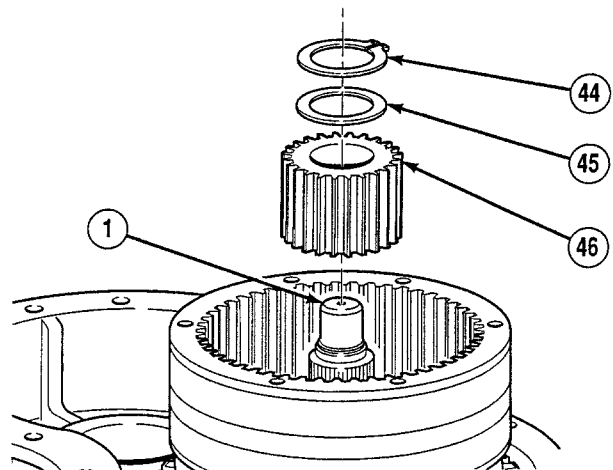
- (61) Attach lifting device to ring and pinion assembly (38).
- (62) Install ring and pinion assembly (38) in housing (26).
- (63) Remove lifting device from ring and pinion assembly (38).
- (64) Using spanner socket, install spanner nut (47). Tighten spanner nut to 325 to 362 lb-ft (441 to 491 N·m). Stake spanner nut.



**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (65) Install sun gear (46) and washer (45) on pinion shaft (1) with retaining ring (44).

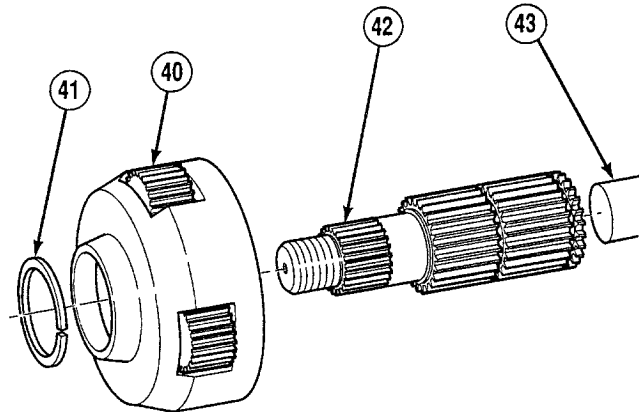


**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**NOTE**

Perform Step (66) if bushing was removed.

- (66) Using press, install brass bushing (43) into input shaft (42).
- (67) Using a mallet, tap input shaft (42) into planetary gear assembly (40).



**WARNING**

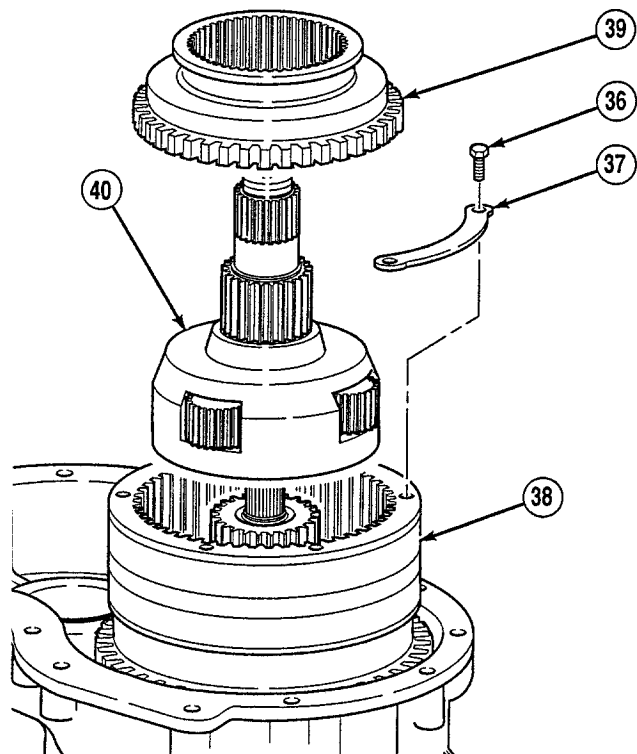
Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (68) Install retaining ring (41) on input shaft (42).
- (69) Install planet gear carrier assembly (40) in ring and pinion assembly (38).
- (70) Install ring gear carrier (39) in ring and pinion assembly (38).

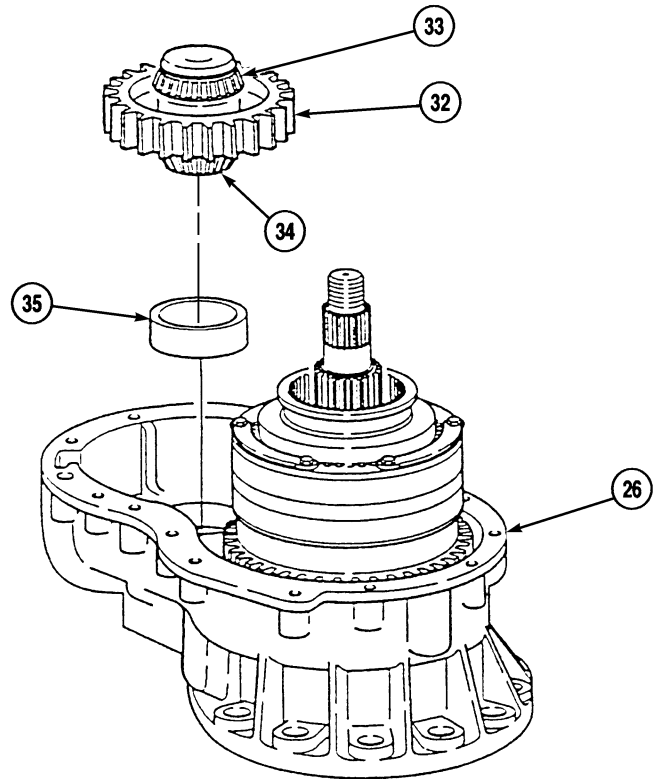
**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

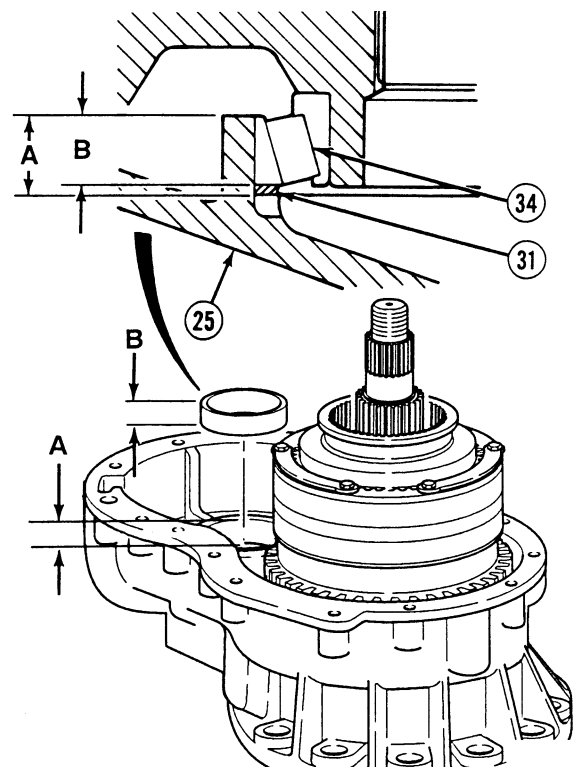
- (71) Coat threads of six screws (36) with sealing compound.
- (72) Install three sectors (37) using six screws (36). Tighten screws to 120 lb-in (14 N·m).



- (73) Install bearing race (35) in housing (26).
- (74) Install taper bearings (33) and (34) on gear (32).
- (75) Install gear (32) in housing (26).



- (76) Measure bearing race (35) thickness and record as dimension "B".
- (77) Measure distance between top face of opening in front housing (25) and bottom face of opening in front housing (lip on which adjusting shim (31) rests when installed) and record as dimension "A".
- (78) Subtract dimension "B" from dimension "A" to get dimension "C" ( $C = A - B$ ). Dimension "C" is adjusting shim (31) thickness.



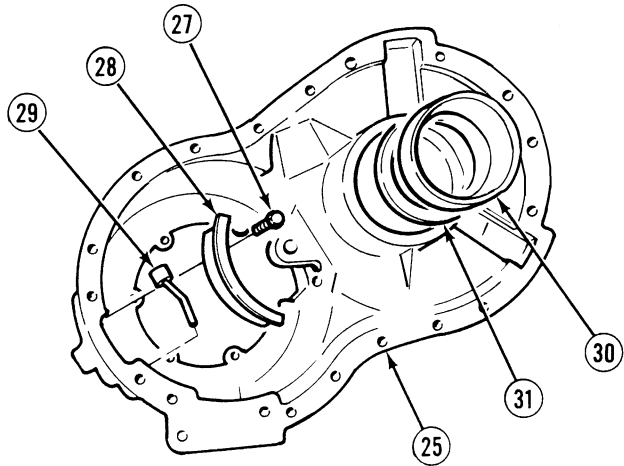


**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

- (79) Install adjusting shim (31) in front housing (25).
- (80) Install bearing race (30) in front housing (25).
- (81) Install pipe (29) in front housing (25).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

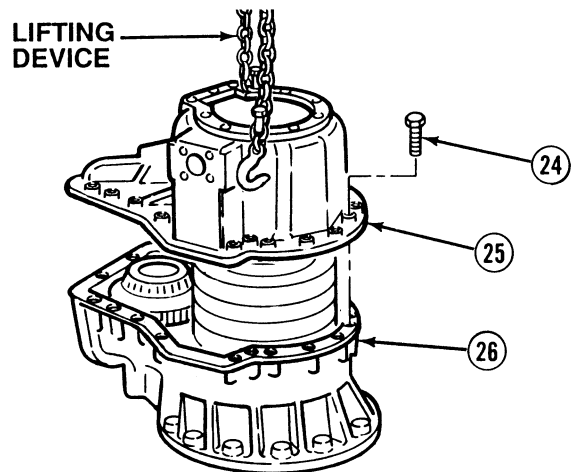


- (82) Coat opening in front housing (25) where pipe (29) extends with sealing compound.
- (83) Coat threads of two screws (27) with sealing compound.
- (84) Install deflector (28) in front housing (25) with two screws (27). Tighten screws to 120 lb-in (14 N·m).
- (85) Coat mating surface of housing (26) with sealing compound.
- (86) Coat threads of 20 screws (24) with sealing compound.

**WARNING**

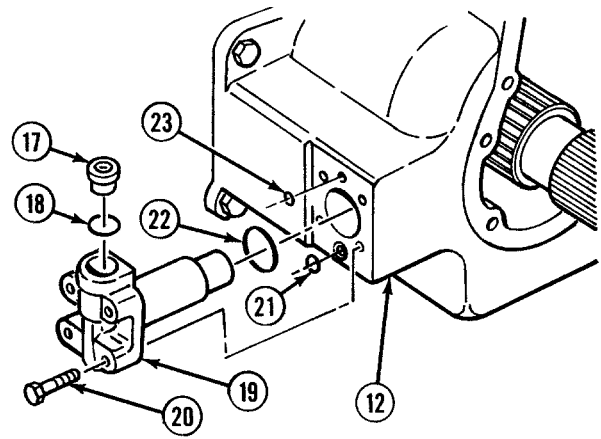
Front housing weighs 90 lbs (41 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- (87) Attach lifting device to front housing (25).
- (88) Install front housing (25) on housing (26) with 20 screws (24). Tighten screws to 80 lb-ft (108 N·m).
- (89) Remove lifting device from front housing.



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.



- (90) Apply lubricating oil to preformed packings (18), (21), (22) and (23).
- (91) Install preformed packing (21) in differential housing (12).
- (92) Install preformed packings (21), (22) and (23) on pump assembly (19).

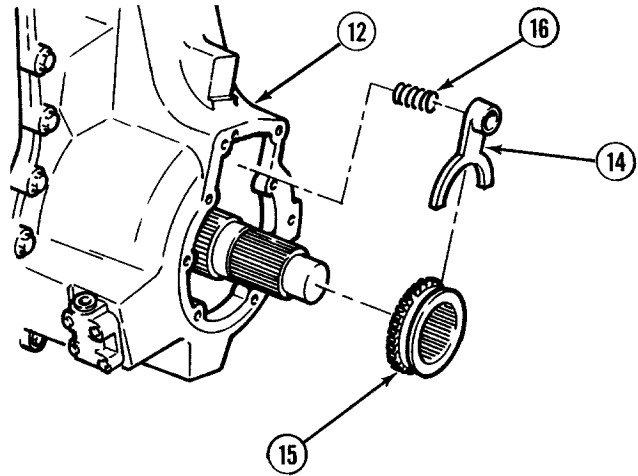
**CAUTION**

Use care when coating face of pump with sealant and when installing pump. If sealant gets into lubrication holes damage to equipment could result.

- (93) Coat face of pump assembly (19) with sealant.
- (94) Coat threads of four screws (20) with sealing compound.
- (95) Install pump assembly (19) with four screws (20). Tighten screws to 29 lb-ft (39 N·m).
- (96) Install preformed packing (18) and plug (17) in pump assembly (19).

**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

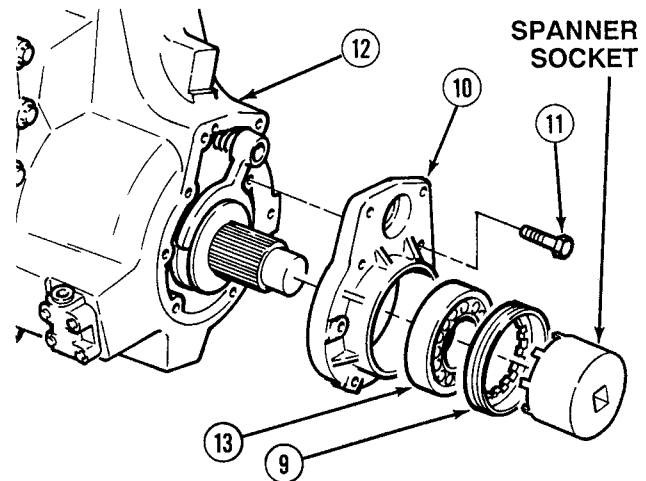
- (97) Install spring (16), gear (15) and fork (14) in differential assembly (12).



- (98) Using press, install bearing (13) in cover (10).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

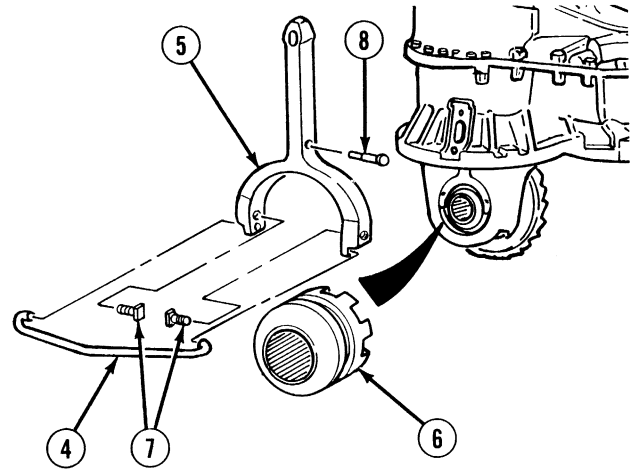


- (99) Coat mating surfaces of cover (10) with sealing compound.
- (100) Coat threads of six screws (11) with sealing compound.
- (101) Install cover (10) with six screws (11). Tighten screws to 46 lb-ft (62 N·m).
- (102) Using spanner socket, install spanner nut (9). Tighten spanner nut to 210 to 230 lb-ft (285 to 312 N·m).

- (103) Install fork (5) with fork pin (8). Stake fork pin on largest diameter end.

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.



- (104) Apply adhesive to both ends of fork pin (8) to seal fork pin.
- (105) Install two finger forks (7) in fork (5).

**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (106) Install clutch gear (6) on fork (5) using retaining ring (4).

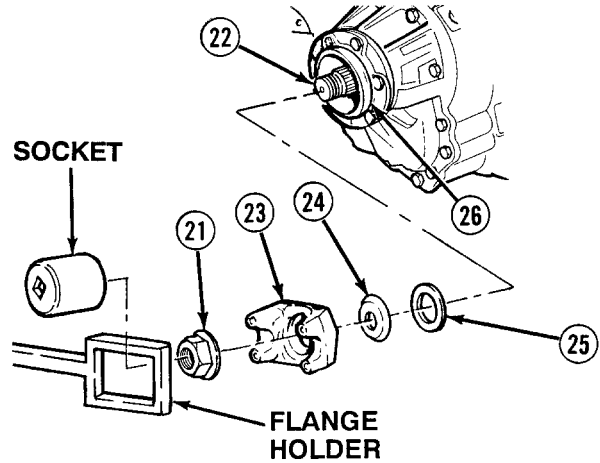
**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).****e. Installation.**

- (1) Coat oil seals (25) with grease.
- (2) Using driver, install oil seal (25) in cover (26).
- (3) Install dust cover (24) on flange assembly (23).

**NOTE**

Flange assembly should be positioned so large openings of flange assembly align with slots of pinion shaft. This will ease staking of nut.

- (4) Install flange assembly (23) on pinion shaft (22).

**WARNING**

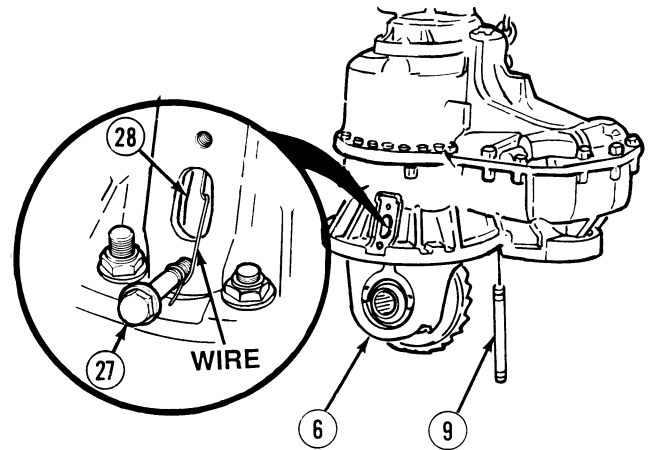
Adhesives, solvents and sealing compounds can burn easily, can give off harmful vapors and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (5) Coat threads of pinion shaft (22) with adhesive.
- (6) Apply adhesive to face of flange assembly (23) where adjusting nut (21) seats.
- (7) With the aid of an assistant and using flange holder and socket, install adjusting nut (21) on pinion shaft (22). Tighten adjusting nut to 680 to 796 lb-ft (922 to 1,079 N·m).
- (8) Ensure adhesive has squeezed out around entire outside diameter of adjusting nut (21). If adhesive is not visible around entire outside diameter of adjusting nut (21), remove and discard adjusting nut (21) and repeat Steps (6) and (7).
- (9) Stake adjusting nut (21) in two slots of pinion shaft (22) directly 180 degrees apart.

**NOTE**

Perform Steps (10) and (11) if studs were removed.

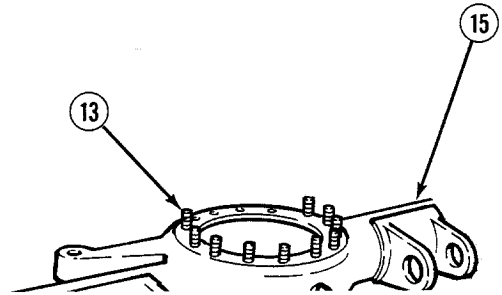
- (10) Coat threads of four studs (9) with sealing compound.
- (11) Install four studs (9) in differential assembly (6). Tighten studs to 76 lb-ft (103 N·m).
- (12) Install screw (27) and wire to secure fork (28) in the locked position.



**NOTE**

Perform Steps (13) and (14) if studs were removed.

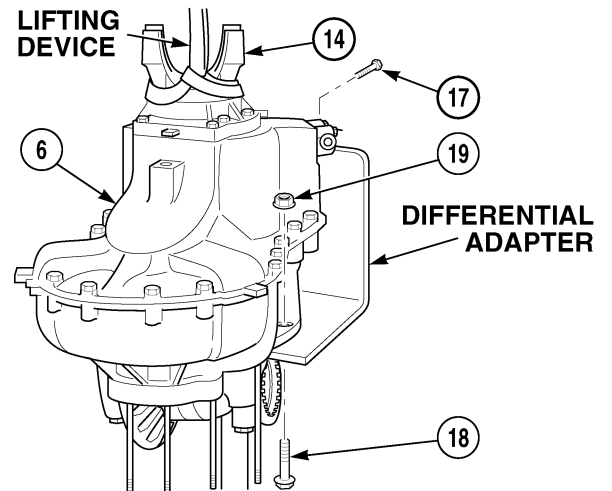
- (13) Apply sealing compound to studs (13).
- (14) Install ten studs (13) in axle housing (15). Tighten studs to 76 lb-ft (103 N·m).



**WARNING**

Differential assembly weighs 500 lbs (227 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- (15) Attach lifting device to flange assembly (14).
- (16) With the aid of an assistant, remove six screws (18) and nuts (19) from differential assembly and differential adapter.

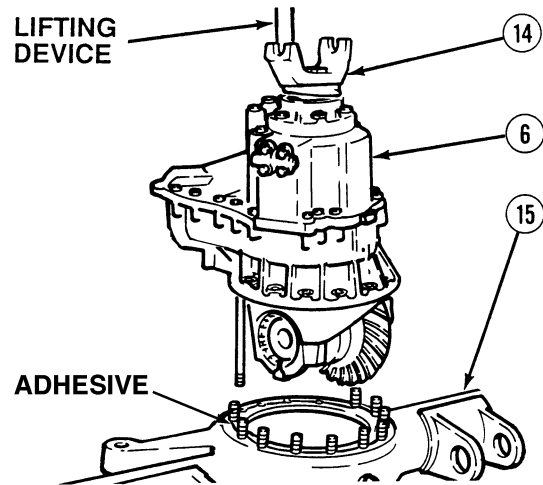


**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

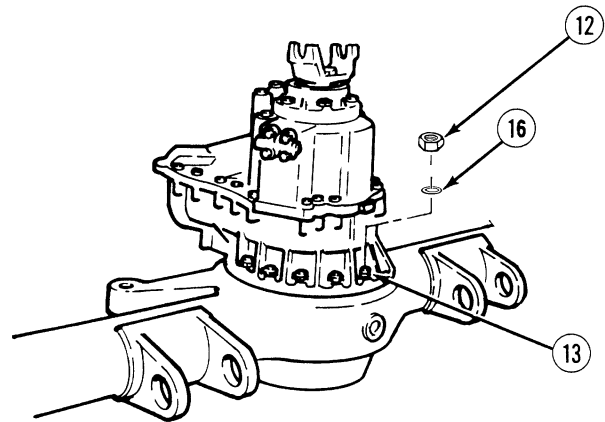
**WARNING**

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.

- (17) Coat mating surface of housing (15) with adhesive.
- (18) With the aid of an assistant, remove differential assembly (6) from differential adapter and install in axle housing (15).
- (19) Remove lifting device from flange assembly (14).



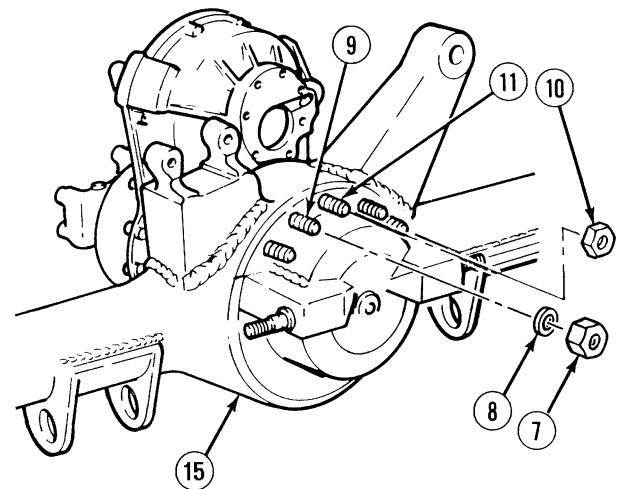
- (20) Install ten washers (16) and locknuts (12) on studs (13). Tighten nuts to 140 to 152 lb-ft (190 to 206 N·m).



**NOTE**

- Perform Steps (21) and (22) only if nut and stud was removed.
- Nut is installed all the way to end of threads and next to shoulder on stud.

- (21) Apply sealing compound to stud (11) and install in axle housing (15).
- (22) Install nut (10) on stud (11).



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

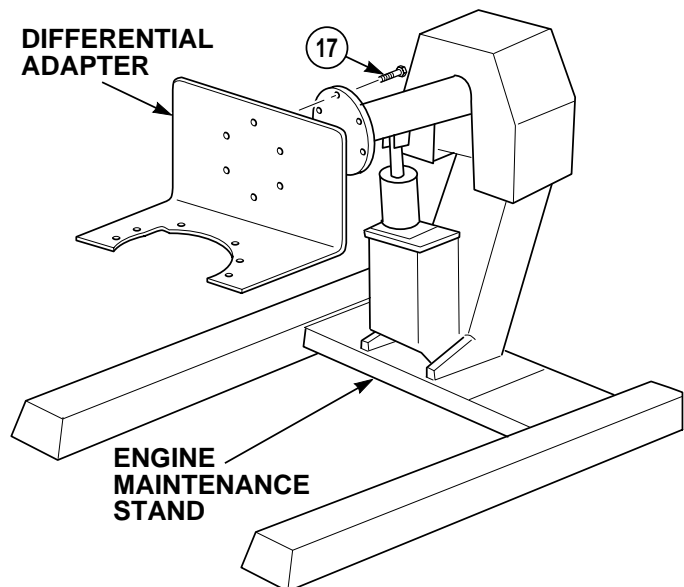
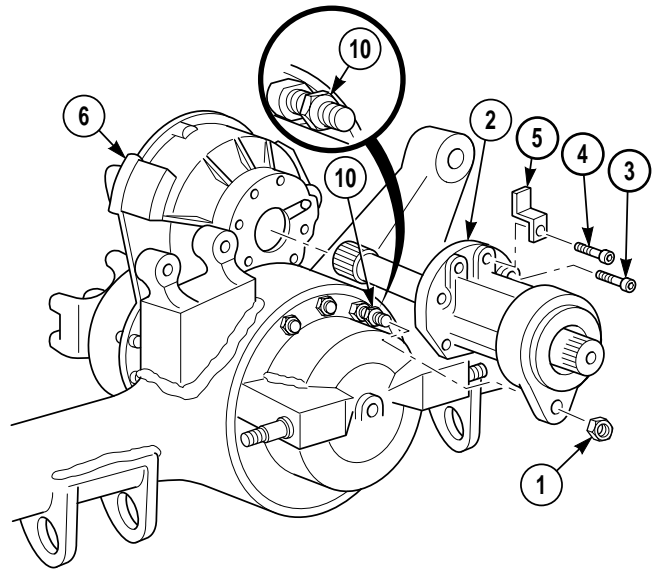
- (23) Coat bottom face of washers (8) with adhesive.
- (24) Install washers (8) and locknuts (7) on four studs (9). Tighten nuts to 117 to 137 lb-ft (159 to 186 N·m).



**25-28. AXLE NO. 3 DIFFERENTIAL ASSEMBLY 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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (25) Coat mating surfaces of rear output assembly (2) and differential housing (6) with adhesive.
- (26) Coat threads of six screws (3) and screw (4) with sealing compound.
- (27) Install rear output assembly (2) on differential assembly (6) with six screws (3). Tighten screws to 61 to 80 lb-ft (83 to 108 N·m).
- (28) Install screw (4) and bracket (5) on rear output assembly (2). Tighten screw to 61 to 80 lb-ft (83 to 108 N·m).
- (29) Turn nut (10) until it contacts rear output assembly (2).
- (30) Install nut (1). Tighten nut to 128 to 150 lb-ft (174 to 203 N·m).
- (31) With the aid of an assistant, remove six screws (17) and differential adapter from engine stand.

**f. Follow-On Maintenance:**

- Install Axle No. 3 rear flange assembly, (Para 25-26).

**END OF TASK**

**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Adapter, Maintenance Stand, Differential  
(Item 3, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gage, Depth (Item 71, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Hammer, Hand, Soft Plastic  
(Item 88, Appendix F)  
Indicator, Dial, Set (Item 98, Appendix F)  
Micrometer, Outside, Caliper, Set  
(Item 139, Appendix F)  
Multiplier, Torque (Item 141, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)  
Puller Kit, Universal, Slide Hammer  
(Item 175, Appendix F)  
Socket, 63 mm (Item 218, Appendix F)  
Stand, Maintenance, Engine  
(Item 226, Appendix F)  
Torch, Propane (Item 247, Appendix F)  
Wrench Set, Socket, 3/8 in. Drive  
(Item 273, Appendix F)  
Wrench, Torque (0-60 N·m)  
(Item 276, Appendix F)  
Wrench, Torque (0 to 175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)  
Wrench, Torque (0-600 lb-ft [0-814 N·m])  
(Item 278, Appendix F)  
Lifting Device (Minimum  
Capacity 450 lbs [204 N·m])  
Adapter, Differential Preload (Appendix C)  
Extractor, Jet (Appendix C)  
Holder, Flange (Appendix C)

*Materials/Parts*

Adhesive (Item 1, Appendix B)  
Dye, Prussian Blue (Item 20, Appendix B)  
Grease (Item 22, Appendix B)  
Sealing Compound (Item 59, Appendix B)  
Sealing Compound (Item 60, Appendix B)  
Solvent, Dry Cleaning (Item 68, Appendix B)  
Wire, Nonelectrical (Item 79, Appendix B)  
Locknut (14) (Item 215, Appendix E)  
Nut, Adjusting (Item 307, Appendix E)  
Seal, Oil (Item 598, Appendix E)  
Shim Kit, Adjusting (2) (Item 639, Appendix E)  
Shim Kit, Adjusting (Item 640, Appendix E)  
Shim Kit, Adjusting (Item 641, Appendix E)

*Personnel Required*

Two

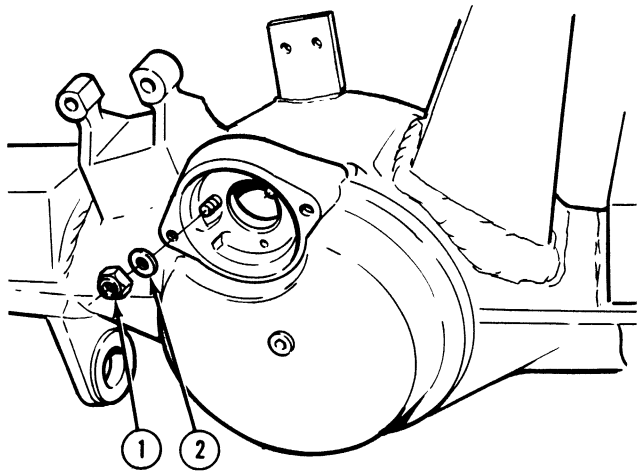
*Equipment Condition*

Rear output assembly removed, (Para 25-27)

**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**a. Removal.**

- (1) Remove two locknuts (1) and washers (2). Discard locknuts.

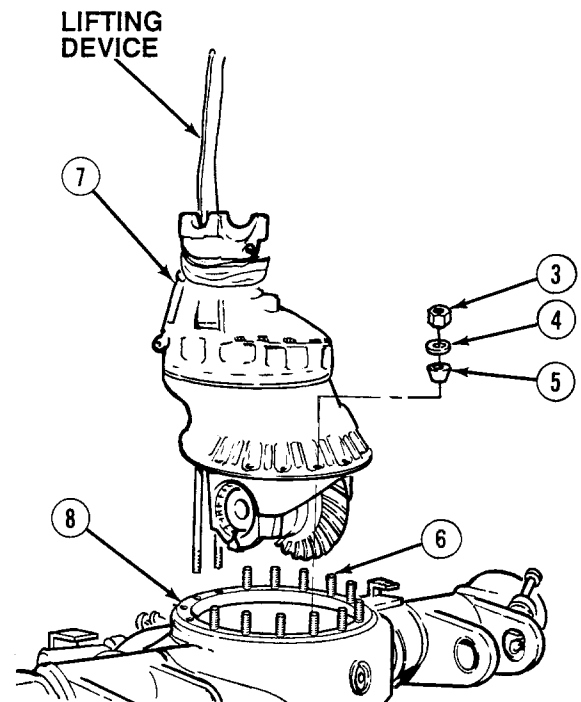


- (2) Remove 12 locknuts (3), washers (4) and ten taper rings (5) from studs (6). Discard locknuts.

**WARNING**

Differential assembly weighs 450 lbs (204 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- (3) Attach lifting device to differential assembly (7).
- (4) With the aid of an assistant and lifting device, remove differential assembly (7) from axle housing (8).

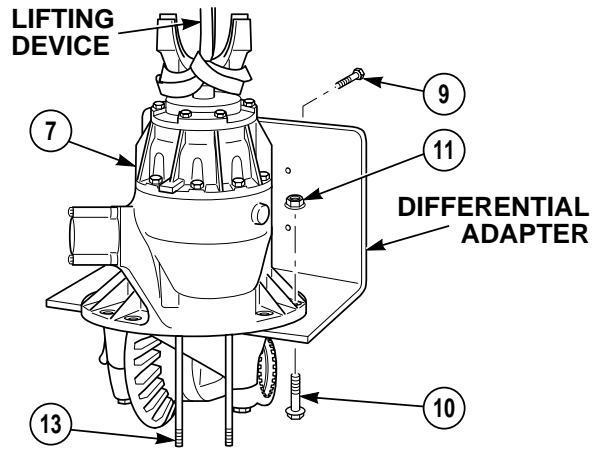


**NOTE**

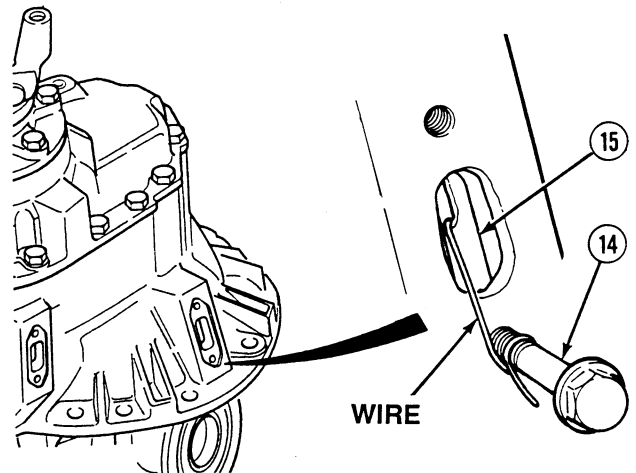
Perform Step (5) if studs are damaged.

- (5) Remove 12 studs (6) from axle housing (8).

- (6) With the aid of an assistant, install differential adapter on engine stand with six screws (9).
- (7) With the aid of an assistant, install differential assembly (7) on differential adapter with six screws (10) and nuts (11).
- (8) Remove two studs (13) from differential assembly (7).
- (9) Remove lifting device from differential assembly (7).



- (10) Remove wire and screw (14) from fork (15).



**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**b. Disassembly.**

**CAUTION**

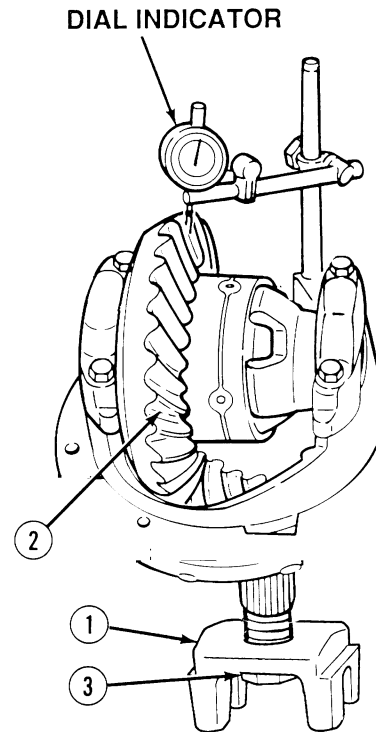
Make sure pinion shaft does not move while backlash is being measured or incorrect reading will result.

- (1) With the aid of an assistant, hold yoke (1) while turning differential gear (2) counter clockwise until gear stops to take up backlash.

**NOTE**

Shaft from dial indicator must be at right 90 degree angle to face of tooth when in contact.

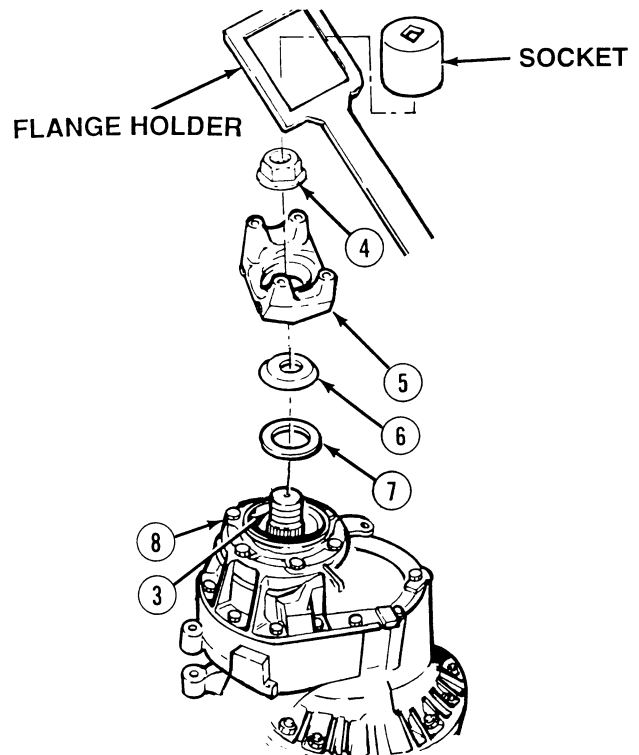
- (2) Install dial indicator on face of differential gear tooth (2).
- (3) Turn differential gear (2) clockwise until gear stops.



**NOTE**

Record differential gear to pinion shaft backlash and contact pattern. Backlash should be 0.010 to 0.016 in. (0.254 to 0.406 mm).

- (4) Check differential gear (2) to pinion shaft (3) backlash measured on dial indicator and contact pattern.
- (5) Unstake adjusting nut (4) on pinion shaft (3).
- (6) With the aid of an assistant and using flange holder and socket, remove adjusting nut (4) from pinion shaft (3). Discard adjusting nut.
- (7) Remove flange assembly (5) from pinion shaft (3).
- (8) Separate dust cover (6) from flange assembly (5).
- (9) Using puller, remove seal (7) from differential assembly (8). Discard oil seal.



- (10) Remove one screw (9) and five screws (10) from cover (11).

**NOTE**

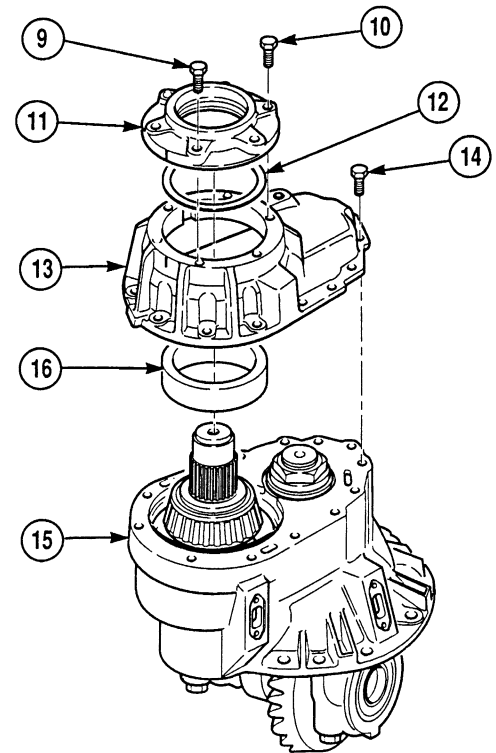
Matchmark housing cover and housing before removal.

- (11) Remove cover (11) and adjusting shim (12) from front housing (13). Measure and record thickness of adjusting shim. Discard adjusting shim.
- (12) Remove 13 screws (14) from front housing (13).
- (13) Remove front housing (13) from housing assembly (15).

**NOTE**

The bearing race is part of a matched set with a taper bearing.

- (14) Remove bearing race (16) from front housing (15).



**WARNING**

Split torque weighs 62 lbs (28 kg) without flange assembly and 75 lbs (34 kg) with flange assembly. The aid of an assistant is required to prevent possible injury to personnel.

**NOTE**

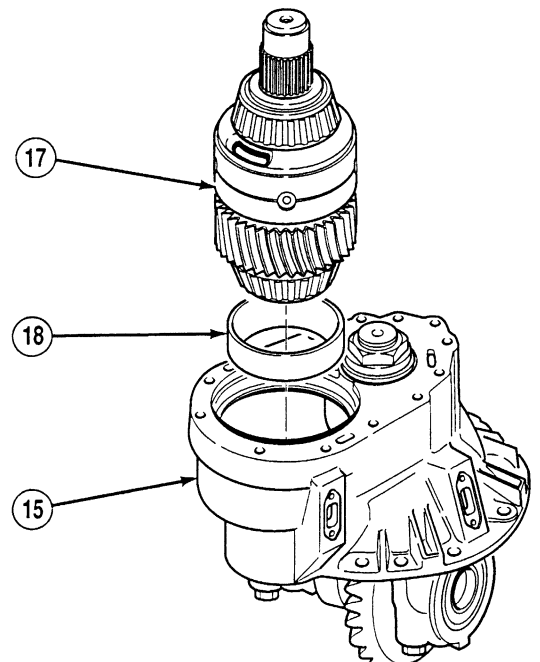
Install flange assembly on shaft of split torque to remove split torque from housing assembly.

- (15) With the aid of an assistant, remove split torque (17) from housing assembly (15).

**NOTE**

The bearing race is part of a matched set with a taper bearing.

- (16) Remove bearing race (18) from housing assembly (15).

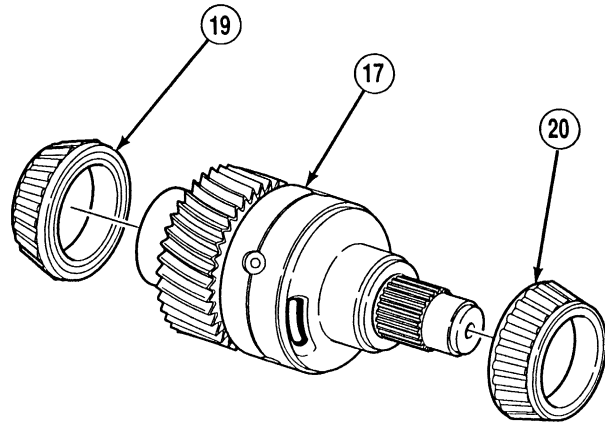


**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**NOTE**

Each taper bearing is part of its own matched set with a bearing race.

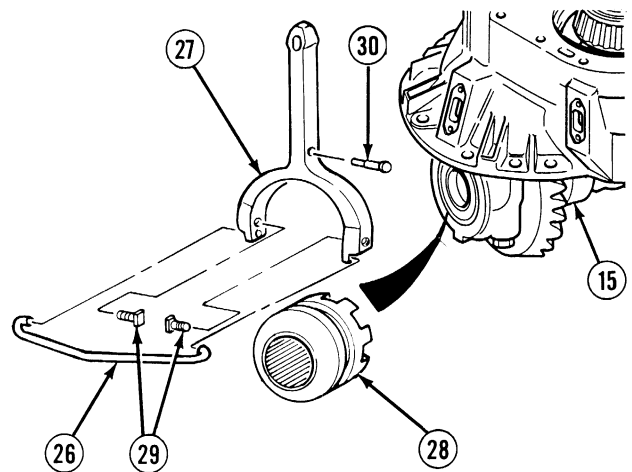
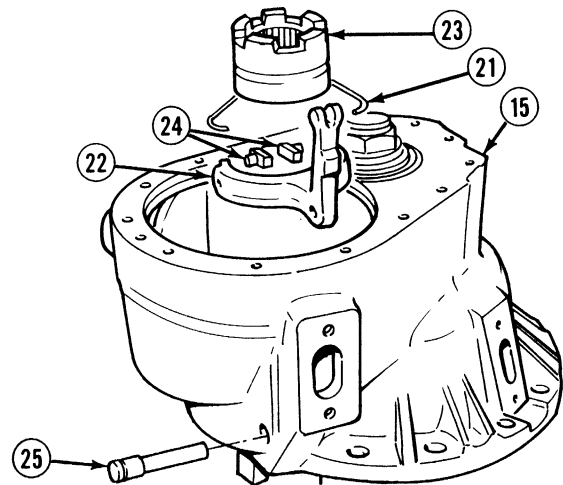
- (17) Using gear puller, remove two taper bearings (19) and (20) from split torque (17).



**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (18) Remove retaining ring (21) from fork (22).
- (19) Remove clutch gear (23) from fork (22).
- (20) Remove two finger forks (24) from fork (22).
- (21) Punch out fork pin (25) and remove fork (22) from housing assembly (15).
- (22) Remove retaining ring (26) from fork (27).
- (23) Remove clutch gear (28) from fork (27).
- (24) Remove two finger forks (29) from fork (27).
- (25) Punch out fork pin (30) and remove fork (27) from housing assembly (15).



- (26) Remove screw (31) and nut lock plate (32) from bearing cap (33).

**CAUTION**

Loosen screws so adjusting nut may be loosened. If screws are loosened too much, adjusting nut may be forced sideways, stripping threads of adjusting nut and bearing cap.

- (27) Partially loosen two screws (34) so adjusting nut (35) may be loosened.
- (28) Loosen adjusting nut (35) until it moves easily.

**NOTE**

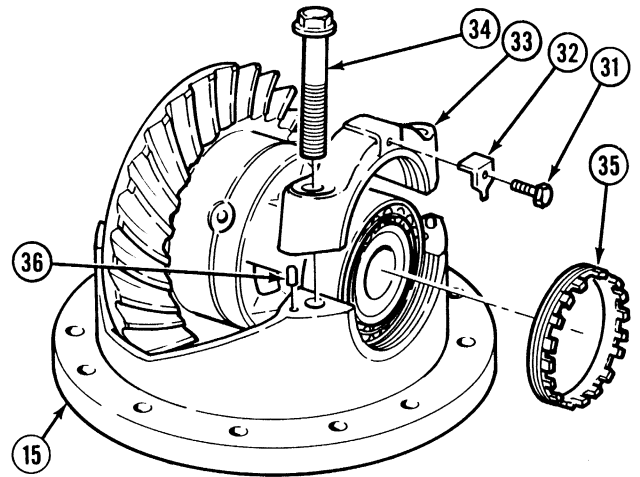
Bearing caps are part of a matched assembly with housing assembly.

- (29) Remove four screws (34), two bearing caps (33) and adjusting nut (35) from housing assembly (15).

**NOTE**

Perform Step (30) if locating pins are damaged.

- (30) Remove four locating pins (36) from housing assembly (15).





**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

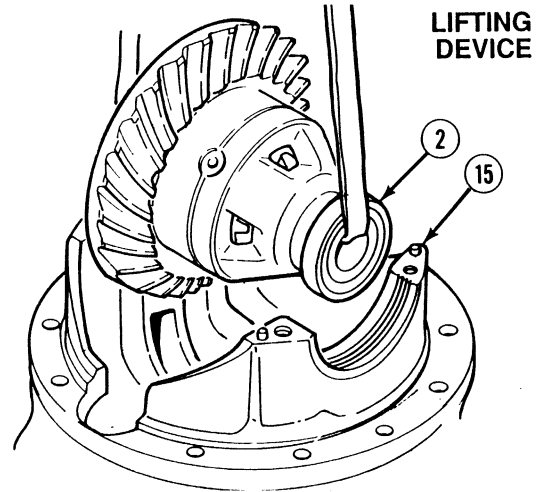
**WARNING**

Differential and bevel gear weigh 70 lbs (32 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

**NOTE**

Differential and bevel gear assembly is part of a matched assembly with pinion shaft.

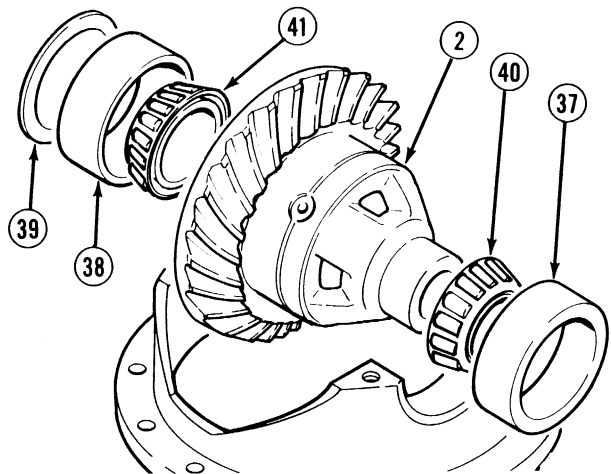
- (31) Attach lifting device through differential gear (2).
- (32) Using lifting device, remove differential gear (2) from housing assembly (15).
- (33) Remove lifting device from differential gear (2).

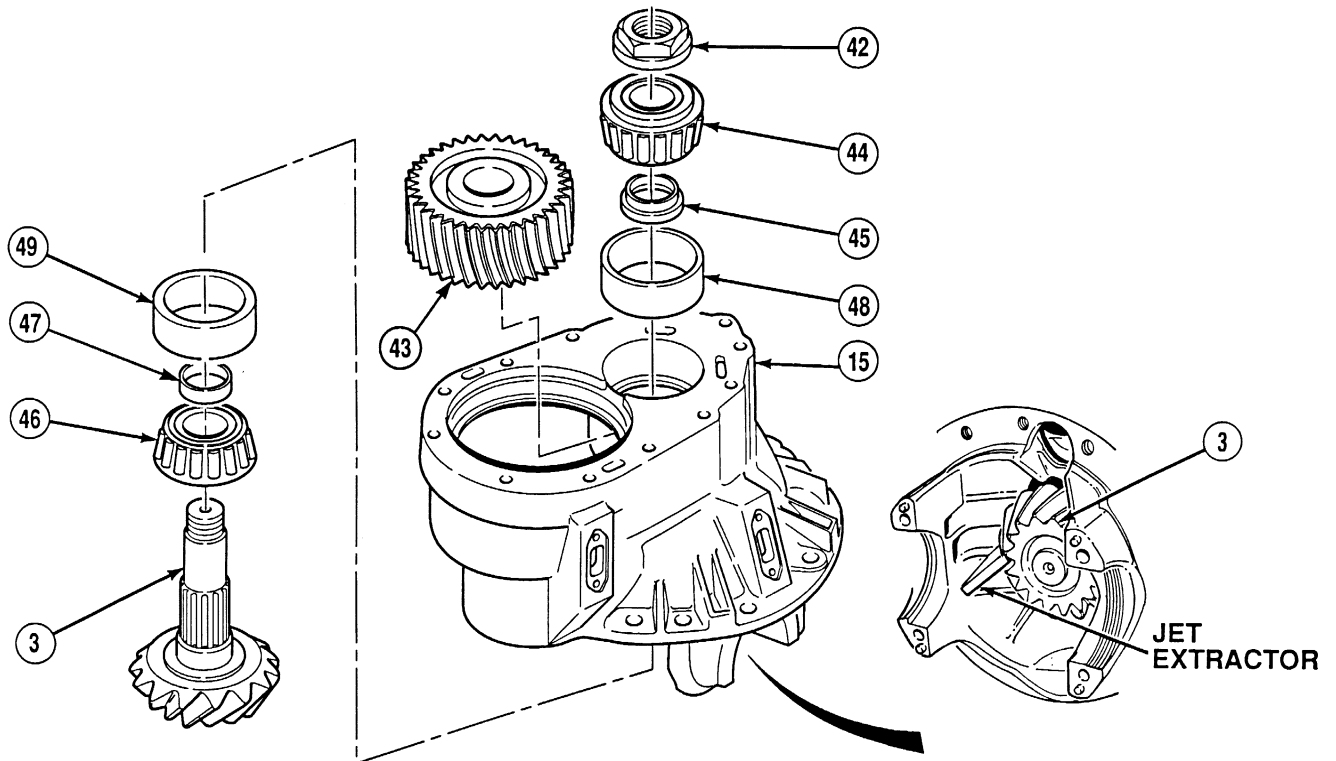


**NOTE**

Bearing races are part of matched assemblies with taper bearings.

- (34) Remove bearing races (37) and (38) and adjusting shim (39) from differential gear (2). Record and discard adjusting shim.
- (35) Using puller, remove taper bearings (40) and (41) from differential gear (2).



**NOTE**

Nut is staked in two places.

- (36) Unstake nut (42) on pinion shaft (3).
- (37) Position jet extractor between gear teeth of pinion shaft (3) and housing assembly (15). Remove adjusting nut (42). Discard adjusting nut.

**NOTE**

Pinion shaft is part of a matched assembly with differential and bevel gear.

- (38) With the aid of an assistant and using a soft faced hammer, remove pinion shaft (3) from housing assembly (15).
- (39) Remove driven gear (43) from housing assembly (15).

**NOTE**

Taper bearings are part of a matched assembly with bearing races.

- (40) Remove taper bearing (44), adjusting shim (45) from housing assembly (15). Record adjusting shim thickness and discard.
- (41) Using gear puller, remove taper bearing (46) and adjusting shim (47) from pinion shaft (3). Record shim thickness and discard.
- (42) Using gear puller, remove bearing races (48) and (49) from housing assembly (15).

**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**c. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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.

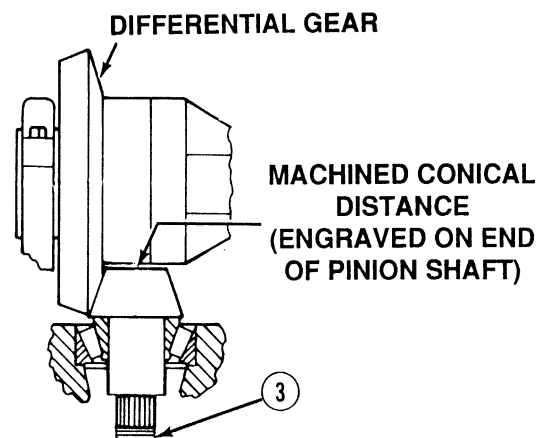
- (1) Clean all metal parts with drycleaning solvent.
- (2) Inspect metal parts for breaks, cracks, burrs and sharp edges.
- (3) Inspect all bearings for wear, scoring and cracks.
- (4) Inspect split torque for broken splines and wear.
- (5) Inspect differential and bevel gear for broken splines and wear.
- (6) Inspect driven gear for broken splines and wear.
- (7) Inspect pinion shaft for broken splines and wear.
- (8) Replace all damaged parts.

**d. Assembly.**

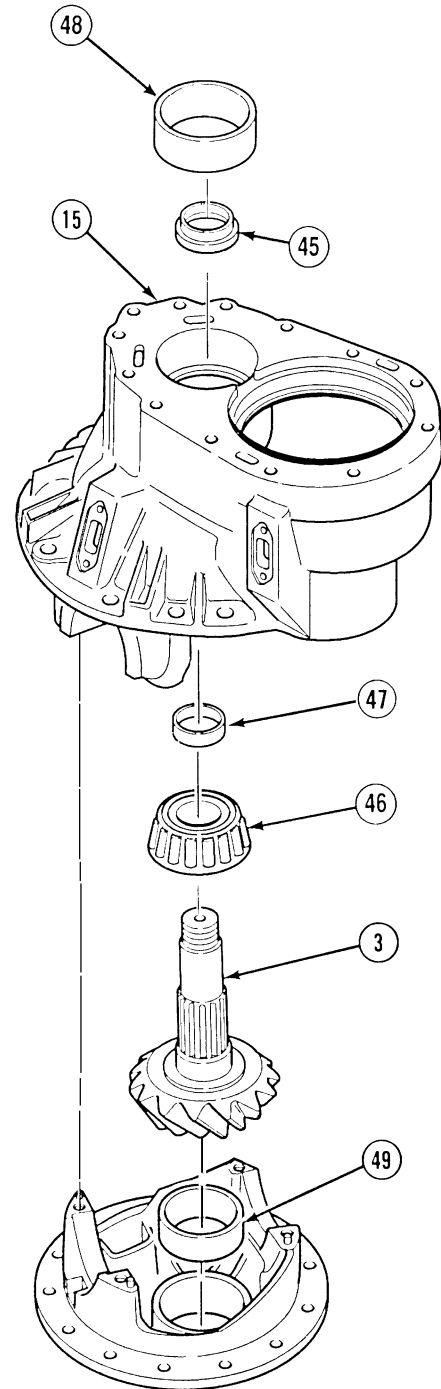
**NOTE**

- Perform Steps (1) through (7) only if new pinion shaft and differential gear are being installed.
- The machined conical distance is engraved on pinion shaft head.

- (1) Record machined conical distance of used pinion shaft (3) which was removed from differential assembly.
- (2) Record machined conical distance of new pinion shaft (3) which is to be installed in the differential assembly.
- (3) Compare two distances recorded in Steps (1) and (2). If distance recorded in Step (1) is larger than distance recorded in Step (2), proceed to Step (4). If distance recorded in Step (2) is larger than distance recorded in Step (1), proceed to Step (5).

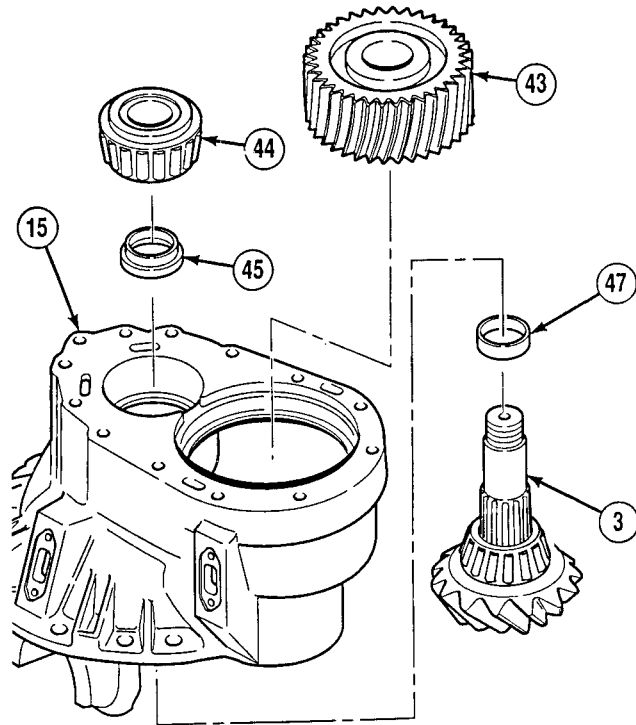


- (4) The new adjusting shim (47) thickness will be: Step (1) distance – Step (2) distance = amount of shim thickness to be added to old adjusting shim thickness to create new adjusting shim. Proceed to Step (6).
- (5) The new adjusting shim (47) thickness will be: Step (2) distance – Step (1) distance = amount of shim thickness to be removed from old adjusting shim thickness to create new adjusting shim. Proceed to Step (6).
- (6) Assemble adjusting shim (47) to thickness determined in Steps (1) through (5).
- (7) Assemble adjusting shim (45) thickness by applying same change of thickness applied to adjusting shim (47).
- (8) Install bearing race (49) in housing assembly (15).
- (9) Install bearing race (48) in housing assembly (15).
- (10) Install taper bearing (46) on pinion shaft (3).

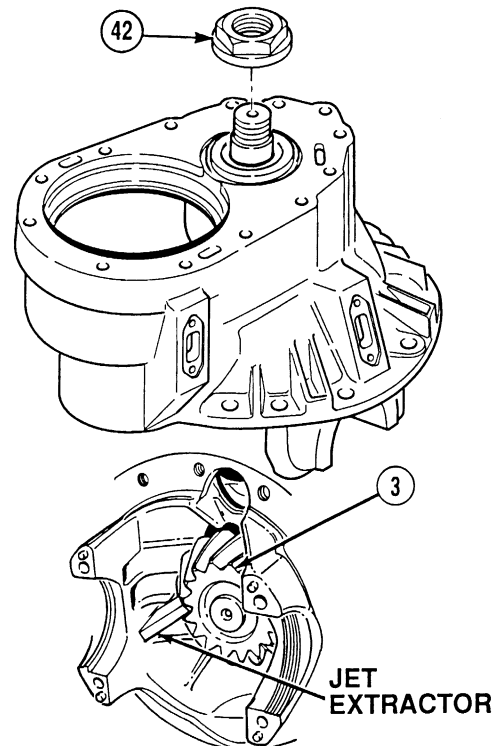


**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

- (11) Install adjusting shim (47) on pinion shaft (3).
- (12) Install driven gear (43) in housing assembly (15).
- (13) Install pinion shaft (3) in housing assembly (15).
- (14) Install adjusting shim (45) on pinion shaft (3).
- (15) With the aid of an assistant, hold pinion shaft (3) in place and install taper bearing (44) on pinion shaft.



- (16) Position jet extractor between gear teeth of pinion shaft (3) and install adjusting nut (42). Tighten nut to 543 to 572 lb-ft (736 to 776 N·m).
- (17) Using a torque wrench, check preload of pinion shaft (3). Preload must be 3 to 4 lb-ft (4 to 5 N·m).



**NOTE**

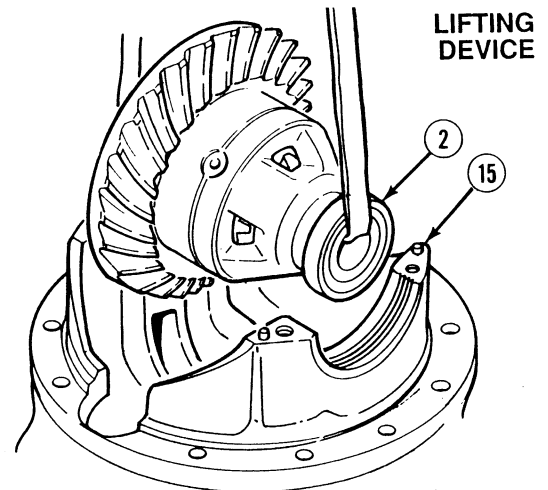
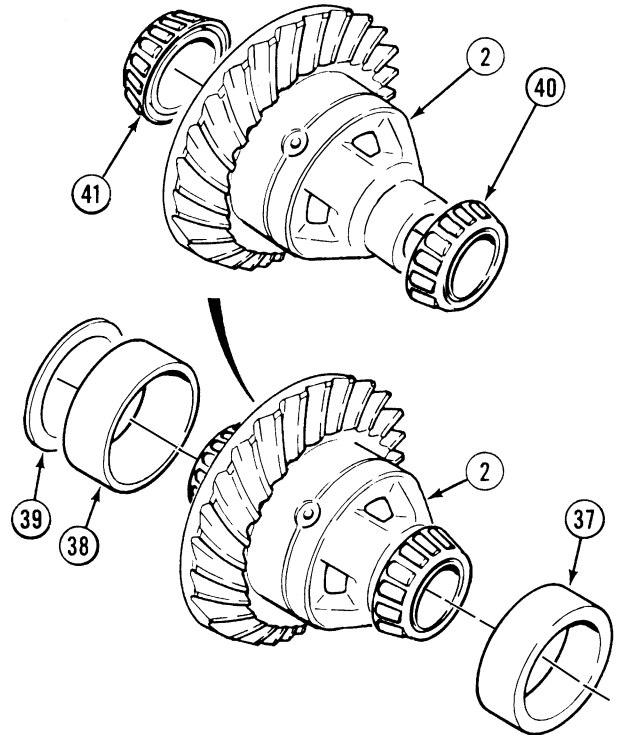
- If preload is correct, go on to Step (18).
  - If preload is incorrect, repeat Steps (1) through (17) until proper preload is obtained.
- (18) Stake adjusting nut (42) in two places.

- (19) Install taper bearing (41) on differential gear (2).
- (20) Install taper bearing (40) on differential gear (2).
- (21) Assemble new adjusting shim (39) thickness by applying opposite change of thickness applied to adjusting shim kit (47) in Step (6).
- (22) Install adjusting shim (39) and bearing races (38) and (37) on differential gear (2).

**WARNING**

Differential and bevel gear weighs 70 lbs (32 kg). Attach a suitable lifting device prior to installation to prevent possible injury to personnel.

- (23) Attach lifting device through differential gear (2).
- (24) Install differential gear (2) in housing assembly (15).
- (25) Remove lifting device from differential gear (2).

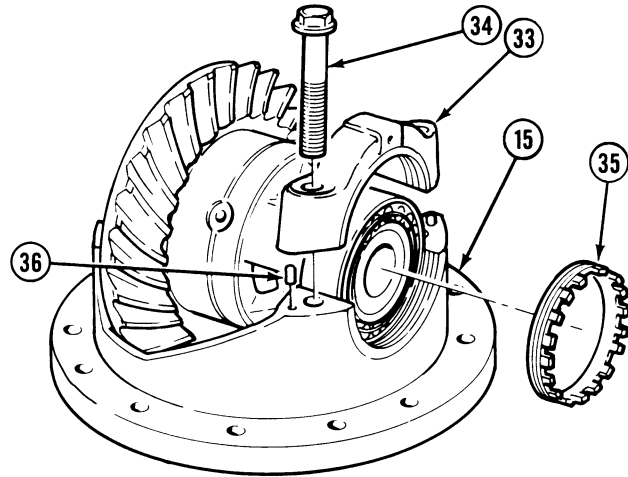


**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**NOTE**

Perform Step (26) if locating pins were removed.

- (26) Install four locating pins (36) in housing assembly (15).
- (27) Install adjusting nut (35), two bearing caps (33) and four screws (34). Tighten screws to 25 lb-in (3 N·m).

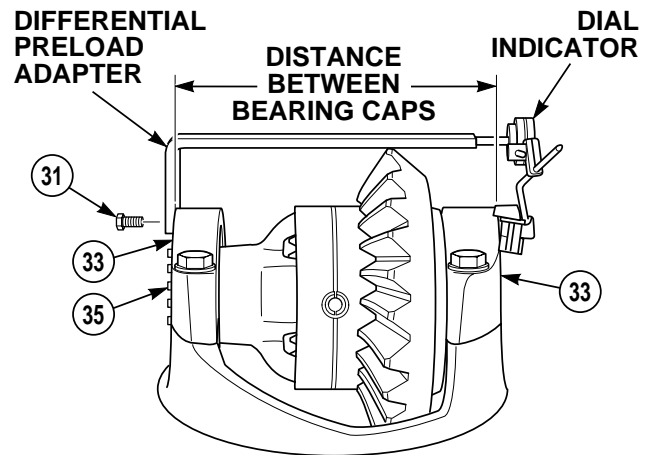


- (28) Install differential preload adapter on bearing cap (33) with screw (31).
- (29) Position dial indicator base on bearing cap (33) and indicator end on differential preload adapter.

**NOTE**

Steps (30) and (32) adjust bearing preload.

- (30) Tighten adjusting nut (35) to obtain a dial indicator reading of 0.014 to 0.018 in. (0.356 to 0.457 mm).
- (31) Remove screw (31), dial indicator and differential preload adapter from bearing cap (33).



**CAUTION**

Make sure pinion shaft does not move while backlash is being measured. Incorrect readings will result.

- (32) Hold pinion shaft (3) so differential gear (2) does not move.
- (33) Turn differential gear (2) counterclockwise until gear takes up backlash.

**NOTE**

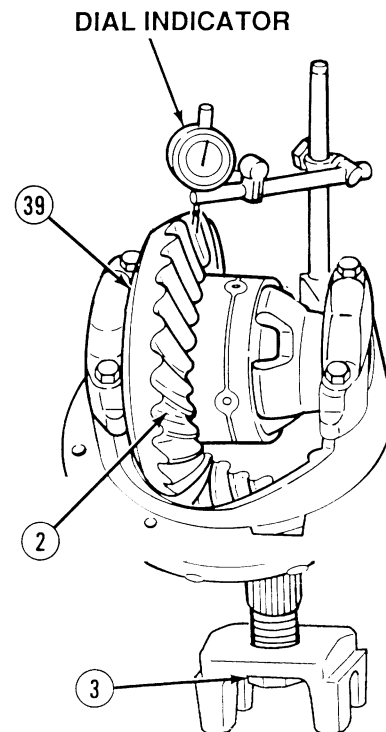
Shaft from dial indicator must be at 90 degree angle to face of tooth when in contact.

- (34) Install dial indicator on face of differential gear (2) tooth.
- (35) Turn differential gear (2) clockwise until gear stops.

**NOTE**

Backlash should be 0.010 to 0.013 in. (0.254 to 0.330 mm).

- (36) Record differential gear (2) to bevel gear backlash measured on dial indicator.
- (37) If backlash is not correct, adjust adjusting shim (39) until proper backlash is obtained.





**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**WARNING**

Prussian blue dye is poisonous and can burn skin on contact. Over exposure to dye can cause heart and skin problems, dizziness, and unconsciousness.

**NOTE**

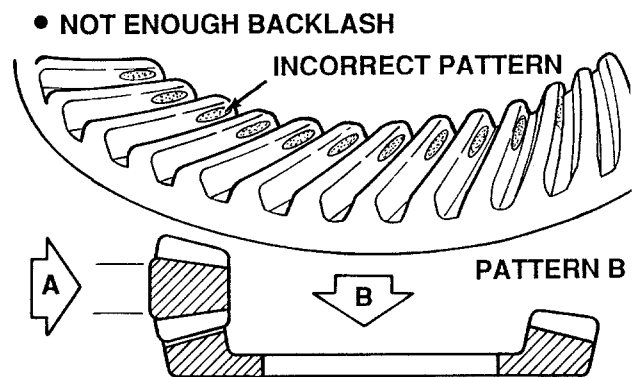
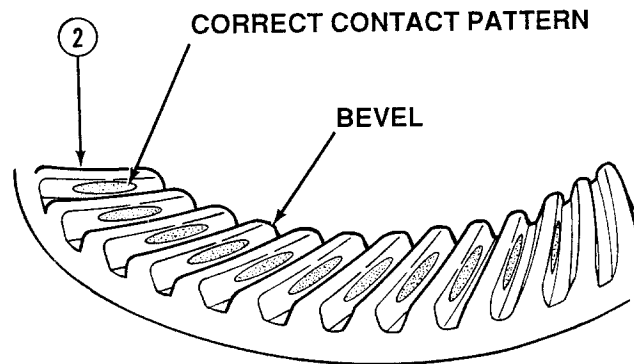
Steps (38) through (44) adjusts tooth contact pattern.

- (38) Coat bevels of differential gear (2) with Prussian blue dye.
- (39) Turn differential gear (2) back and forth to set dye pattern. Check tooth contact pattern.

**NOTE**

- To obtain correct tooth contact pattern two considerations must be observed: One is the lengthwise contact pattern that is in length direction of teeth, the other is face width pattern that is in height direction of teeth.
- A correct gear pattern for a used pinion shaft and differential and bevel gear is clear of the toe and centers evenly along the face of gear tooth, but can be any length and shape and is acceptable as long as pattern does not run off gear tooth at any point.

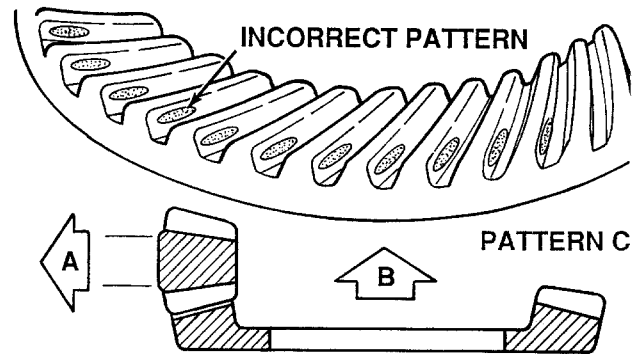
- (40) If tooth contact pattern is like pattern A, do not adjust tooth contact pattern. Go on to Step (43).
- (41) If tooth contact pattern is like pattern B, add backlash. Refer to Step (30).



**A : PROFILE CONTACT ADJUSTMENT  
B : INCREASE LONGITUDINAL BEARING**

- (42) If tooth contact pattern is like pattern C, remove backlash. Refer to Step (29).

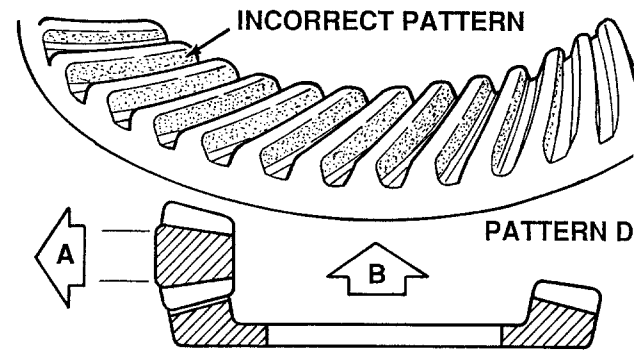
• TOO MUCH BACKLASH



A : PROFILE CONTACT ADJUSTMENT  
B : INCREASE LONGITUDINAL BEARING

- (43) If tooth contact pattern is like pattern D, move pinion shaft away from bevel gear by adjusting shims. Go to Step (6) if installing new gears.

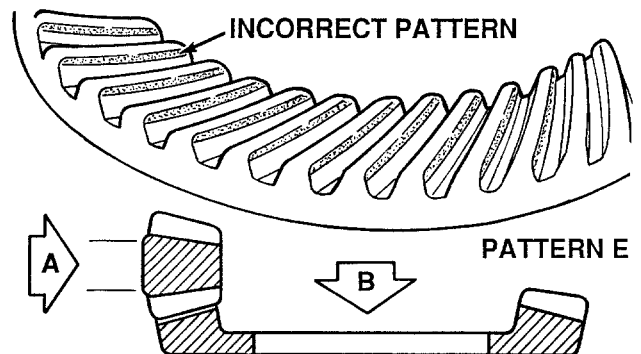
• PINION SHAFT TOO CLOSE



A : RAISE THE PROFILE CONTACT  
B : BACKLASH ADJUSTMENT

- (44) If tooth contact pattern is like pattern E, move pinion shaft closer toward bevel gear by adjusting shims. Go to Step (6) if installing new gears.

• PINION SHAFT TOO FAR AWAY



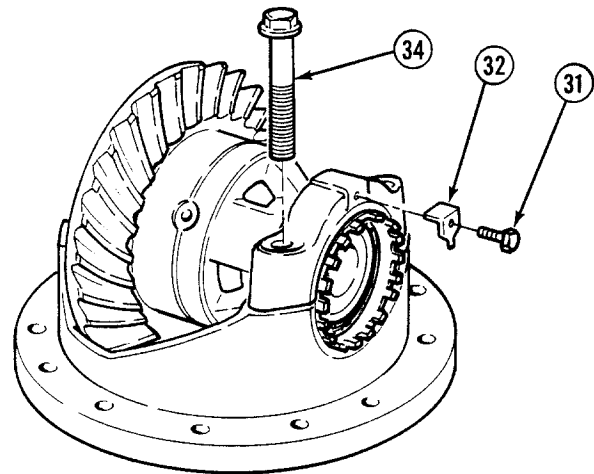
A : LOWER THE PROFILE CONTACT  
B : BACKLASH ADJUSTMENT

**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

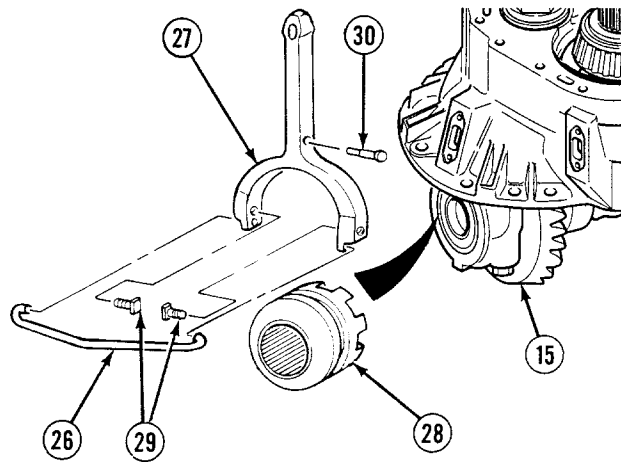
- (45) Remove one of four screws (34).

**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.



- (46) Coat threads of screw (34) with sealing compound.
- (47) Install screw (34) and tighten to 123 to 138 lb-ft (167 to 187 N·m).
- (48) Repeat Steps (45) through (47) for three remaining screws (34).
- (49) Coat threads of screw (31) with sealing compound.
- (50) Install screw (31) in lock plate (32).
- (51) Install fork (27) in housing assembly (15) with retaining pin (30).
- (52) Stake retaining pin (30) on largest diameter end.
- (53) Coat both ends of retaining pin (30) with adhesive.
- (54) Install two finger forks (29) in fork (27).

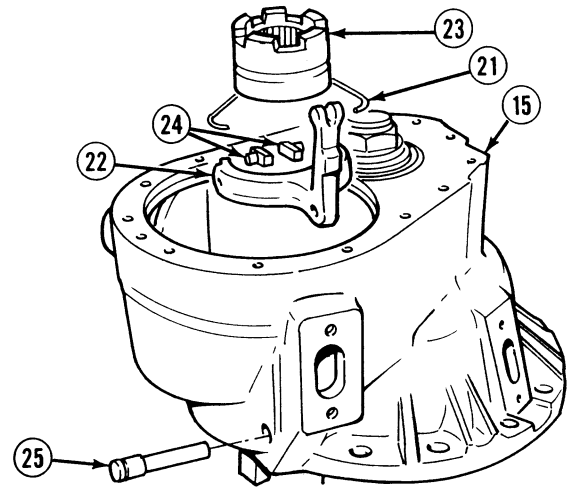


**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (55) Install clutch gear (28) on fork (27) with retaining ring (26).

- (56) Install fork (22) and fork pin (25) in housing assembly (15).
- (57) Stake retaining pin (25) on largest diameter end.



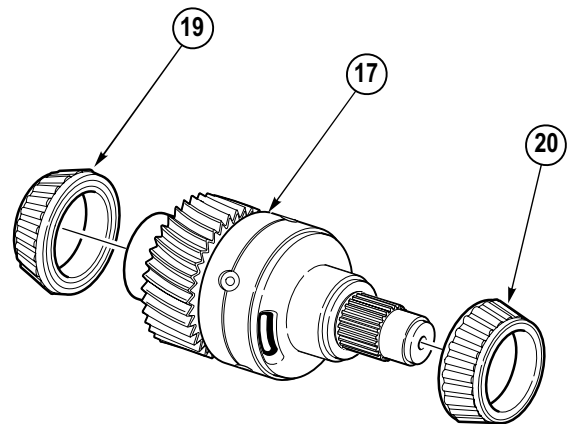
**WARNING**

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.

- (58) Coat both ends of retaining pin (25) with adhesive.
- (59) Install two finger forks (24) in fork (22).

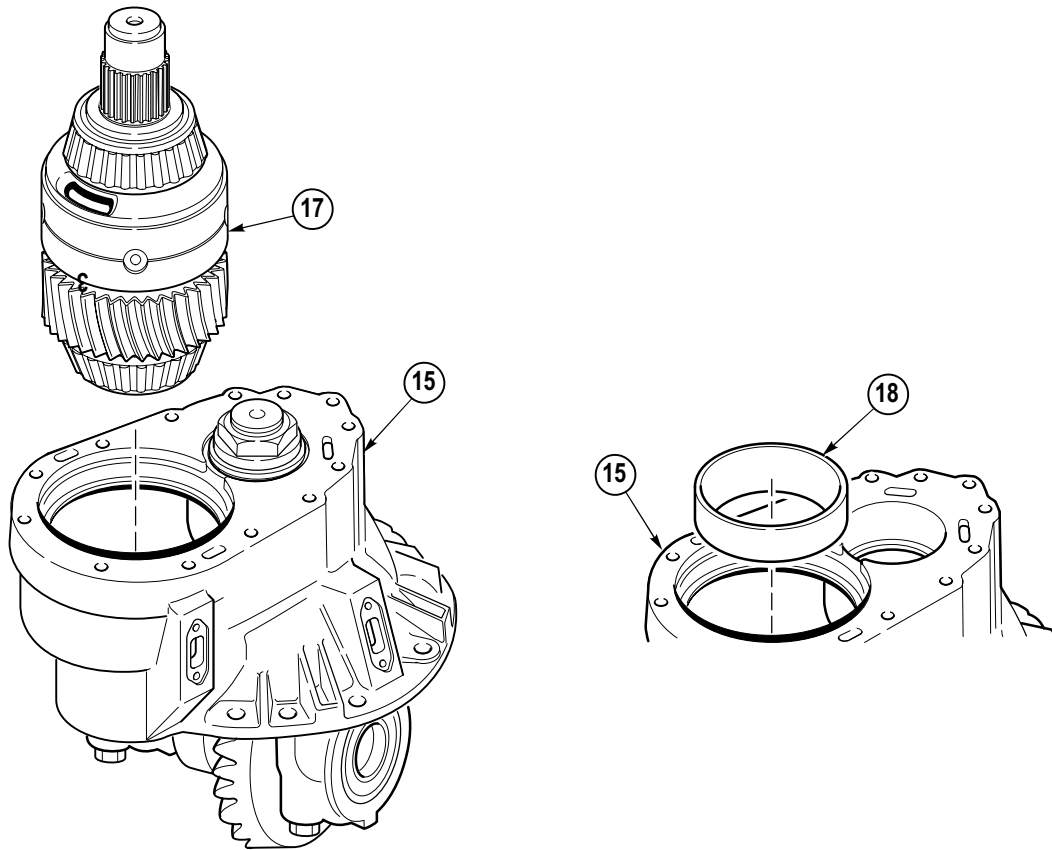
**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.



- (60) Install clutch gear (23) on fork (22) with retaining ring (21).
- (61) Install taper bearings (19) and (20) on split torque (17).

**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**



- (62) Coat bearing race (18) with grease.
- (63) Install bearing race (18) in housing assembly (15).

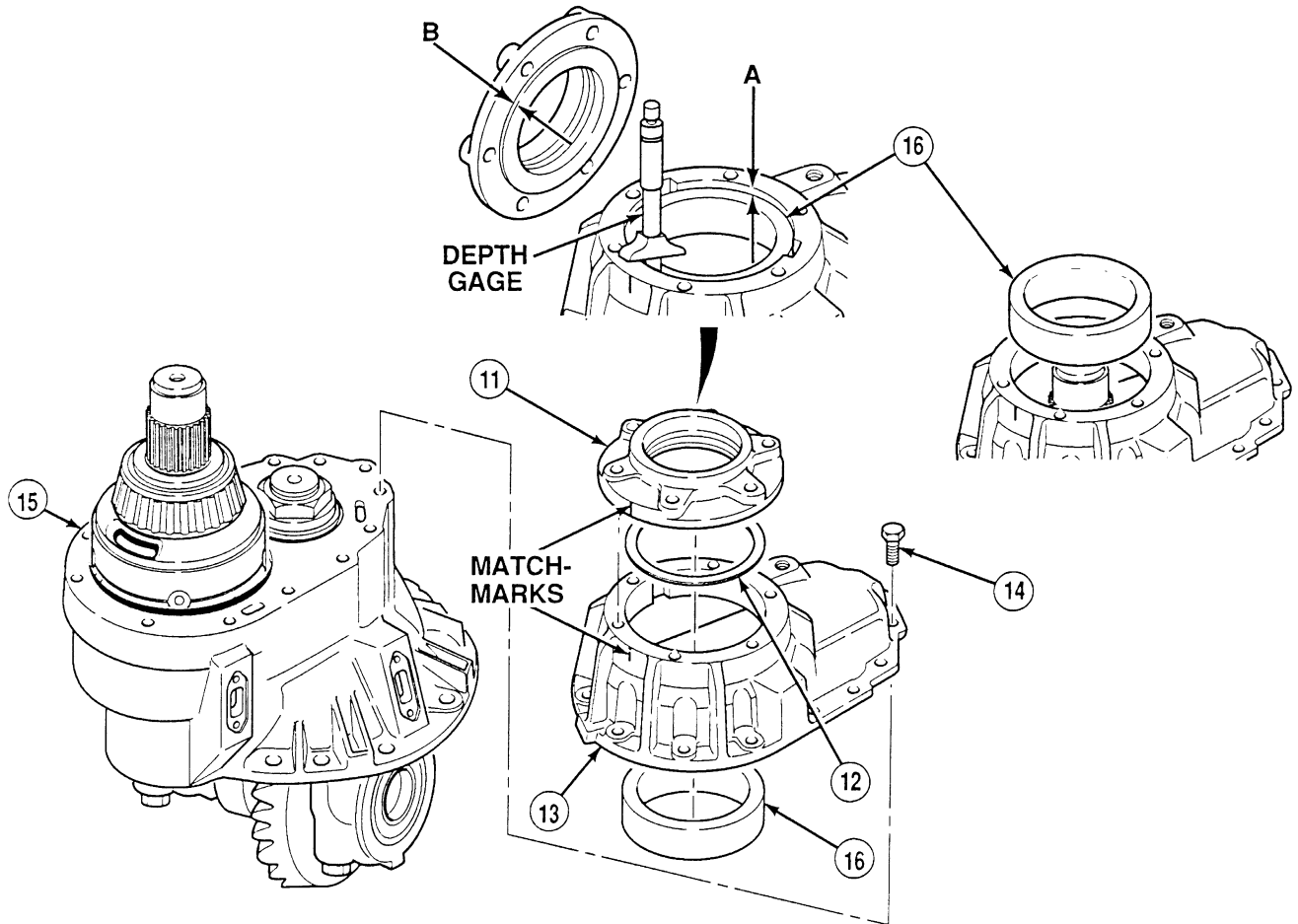
**WARNING**

Split torque weighs 62 lbs (28 kg) without flange assembly and 75 lbs (34 kg) with flange assembly. The aid of an assistant is required to prevent possible injury to personnel.

**NOTE**

Installing flange on shaft of split torque is best way to install split torque in housing assembly.

- (64) With the aid of an assistant, install split torque (17) in housing assembly (15).



**WARNING**

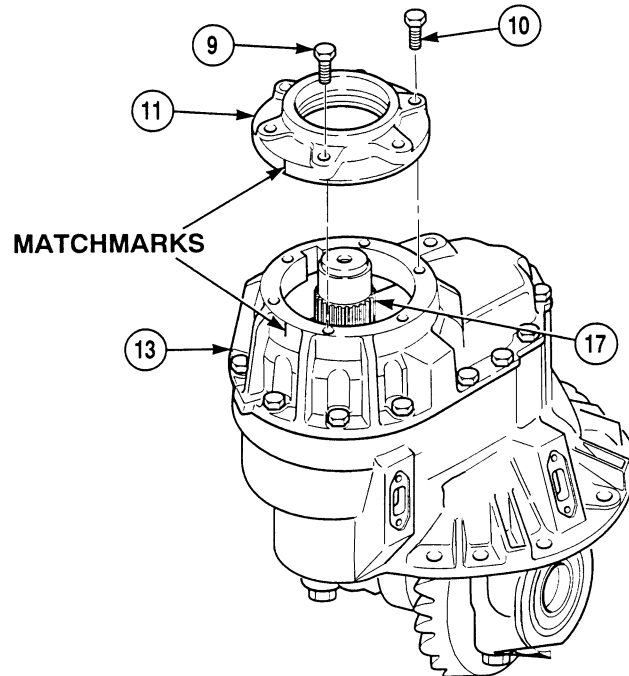
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

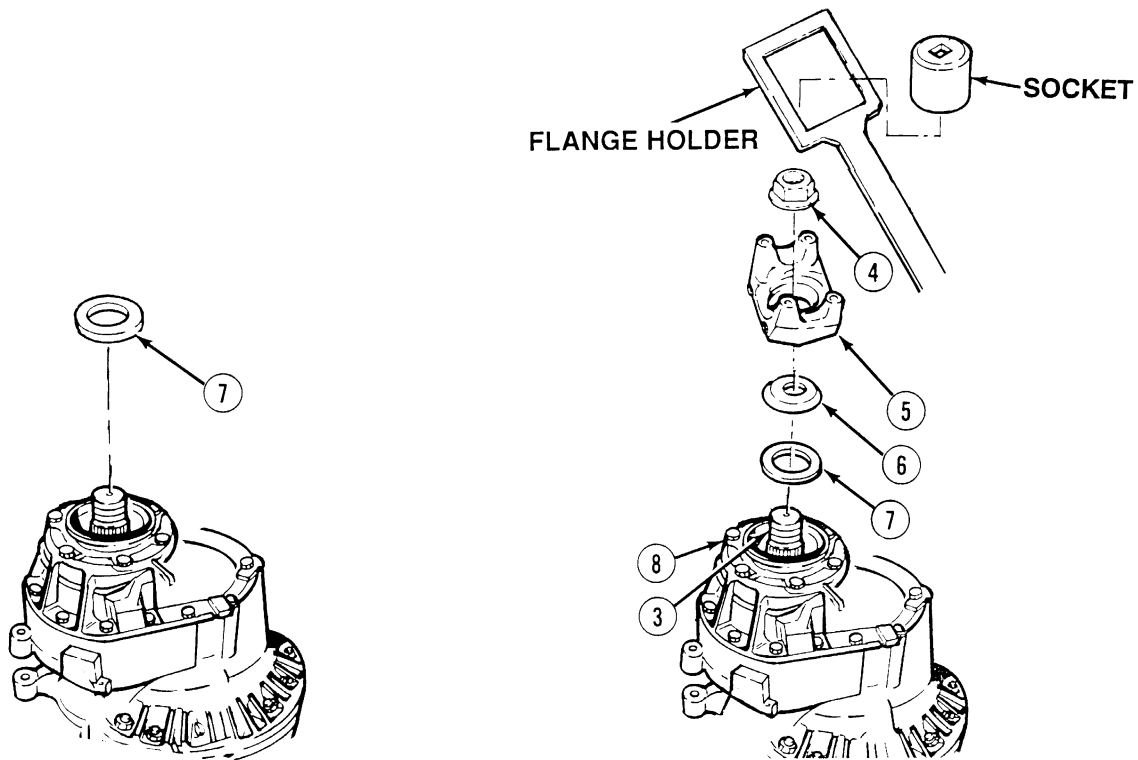
- (65) Coat mating surface of housing assembly (15) with sealing compound.
- (66) Coat threads of screws (14) with sealing compound.
- (67) Install front housing (13) on housing assembly (15) with screws (14). Tighten screws to 44 lb-ft (60 N·m).
- (68) Coat bearing race (16) with grease.
- (69) Install bearing race (16) in front housing (13).
- (70) Using depth gage, measure and record distance "A" on front housing (13).
- (71) Using depth gage, measure and record distance "B" on cover (11).
- (72) Assemble adjusting shim (12) to a thickness of  $A - B \pm 0.002$  in. (0.051 mm).
- (73) Install adjusting shim (12) in front housing (13).

**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY 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.

- (74) Coat mating surface of front housing (13) with sealing compound.
- (75) Coat threads of screws (9) and (10) with sealing compound.
- (76) Install cover (11) on front housing (13) with screw (9) and five screws (10). Tighten screw (9) to 44 lb-ft (60 N·m) and five screws (10) to 56 lb-ft (76 N·m).
- (77) Check split torque (17) for free rotation. If split torque does not rotate freely, repeat Steps (72) through (76).





- (78) Coat seal (7) with grease.
- (79) Install seal (7) in differential assembly (8).
- (80) Install dust cover (6) in flange assembly (5).

**NOTE**

Flange assembly should be positioned so large openings of flange assembly align with slots of pinion shaft. This will ease staking of the nut.

- (81) Install flange assembly (5) on pinion shaft (3).

**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.

- (82) Coat threads of pinion shaft (3) with adhesive.
- (83) Apply adhesive to face of flange assembly (5) where adjusting nut (4) seats.
- (84) With the aid of an assistant and using flange holder and socket, install adjusting nut (4) on pinion shaft (3). Tighten adjusting nut to 680 to 796 lb-ft (922 to 1,079 N·m).
- (85) Ensure adhesive has squeezed out around entire outside diameter of adjusting nut (4). If adhesive is not visible around entire outside diameter of adjusting nut (4), remove and discard adjusting nut (4) and repeat Steps (82) through (84).
- (86) Stake adjusting nut (4) in two slots of pinion shaft (3) directly 180 degrees apart.



**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

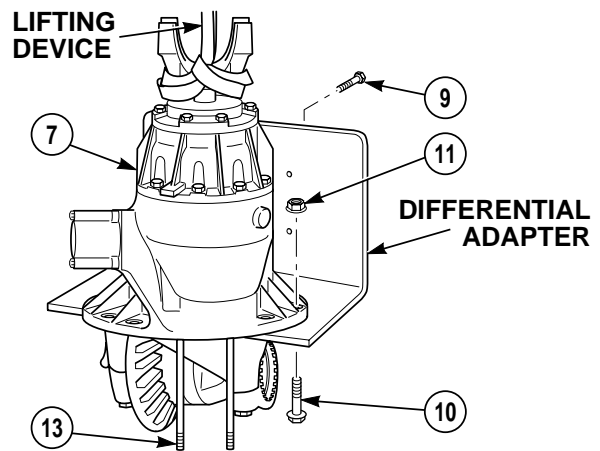
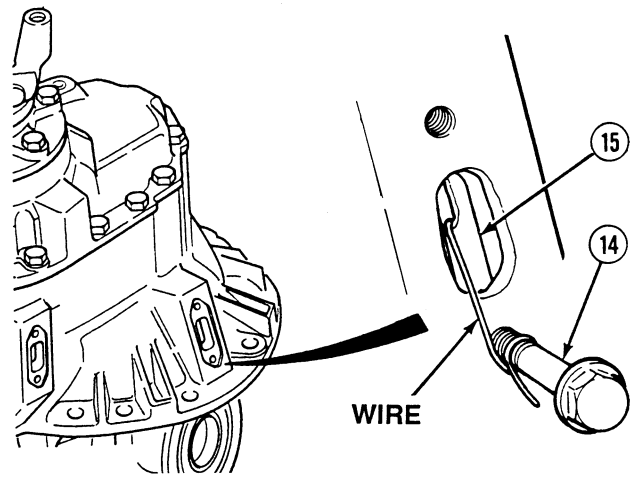
**e. Installation.**

- (1) Install screw (14) and wire to fasten fork (15) in engaged position.

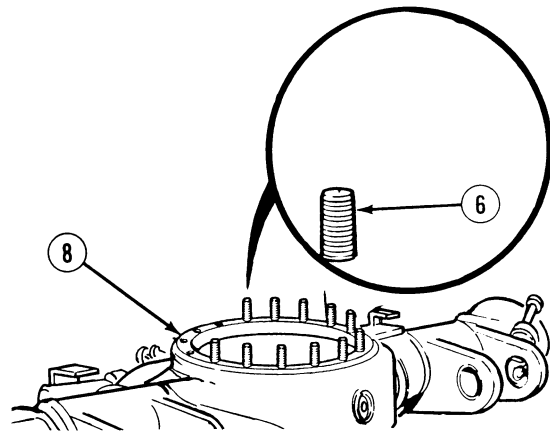
**WARNING**

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.

- (2) Coat threads of two studs (13) with sealing compound.
- (3) Install two studs (13) in differential assembly (7). Tighten to 76 lb-ft (103 N·m).



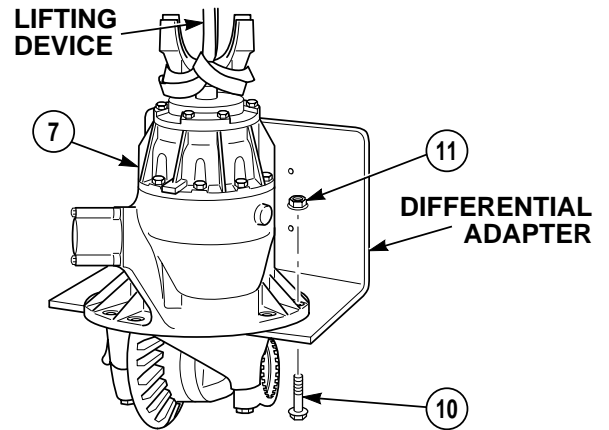
- (4) If removed, coat threads of studs (6) with sealing compound.
- (5) Install studs (6) in axle housing (8). Tighten to 76 lb-ft (103 N·m).



**WARNING**

Differential assembly weighs 450 lbs (204 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

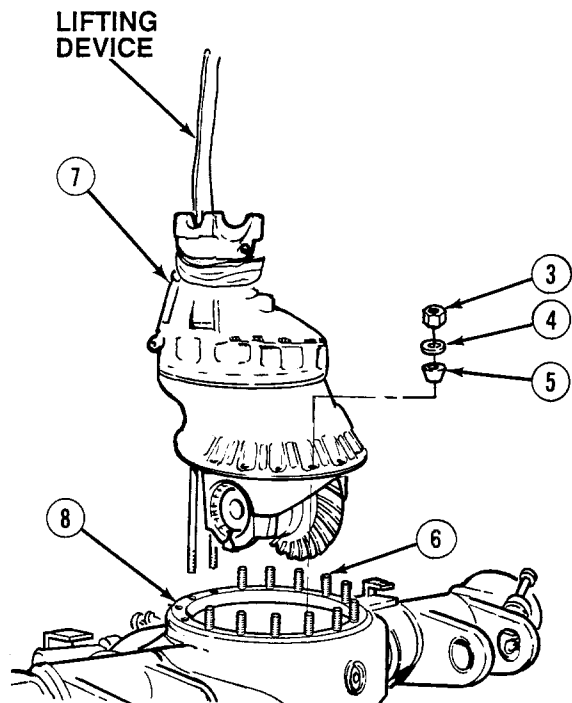
- (6) Attach lifting device to differential assembly (7).
- (7) With the aid of an assistant, remove six nuts (11) and screws (10) from differential assembly (7) and differential assembly adapter plates.
- (8) Coat mating surface of axle housing (8) with adhesive.
- (9) Install differential assembly (7) in axle housing (8).
- (10) Remove lifting device from differential assembly (7).



**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.

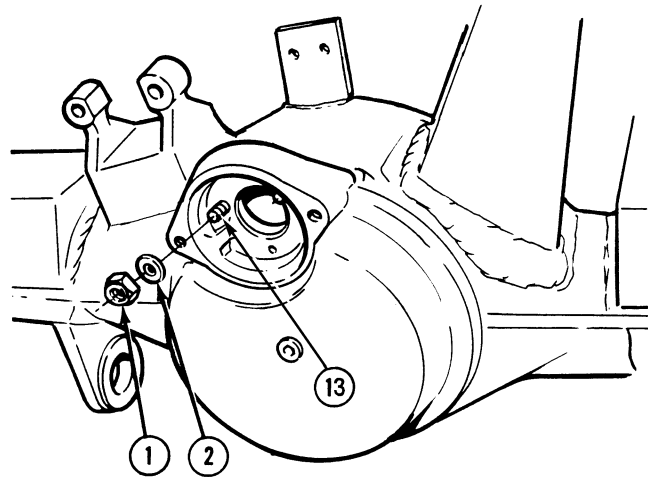
- (11) Coat beveled contact face of taper rings (5) with adhesive.
- (12) Install ten taper rings (5), 12 washers (4) and nuts (3) on studs (6). Tighten nuts to 140 to 152 lb-ft (190 to 206 N·m).



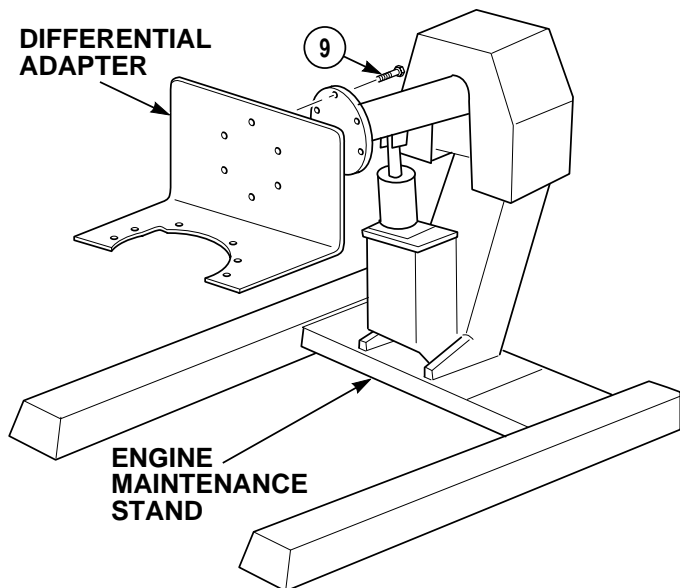
**25-29. AXLE NO. 4 DIFFERENTIAL ASSEMBLY REPAIR (CONT).**

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.



- (13) Coat threads of two studs (13) with sealing compound.
- (14) Install two washers (2) and nuts (1). Tighten nuts to 117 to 137 lb-ft (159 to 186 N·m).
- (15) With the aid of an assistant, remove six screws (9) and differential adapter from engine stand.



**f. Follow-On Maintenance:**

- Install rear output assembly, (Para 25-27).

**END OF TASK**

**25-30. DRESSED AXLE AIR LINE REPLACEMENT.**

This task covers:

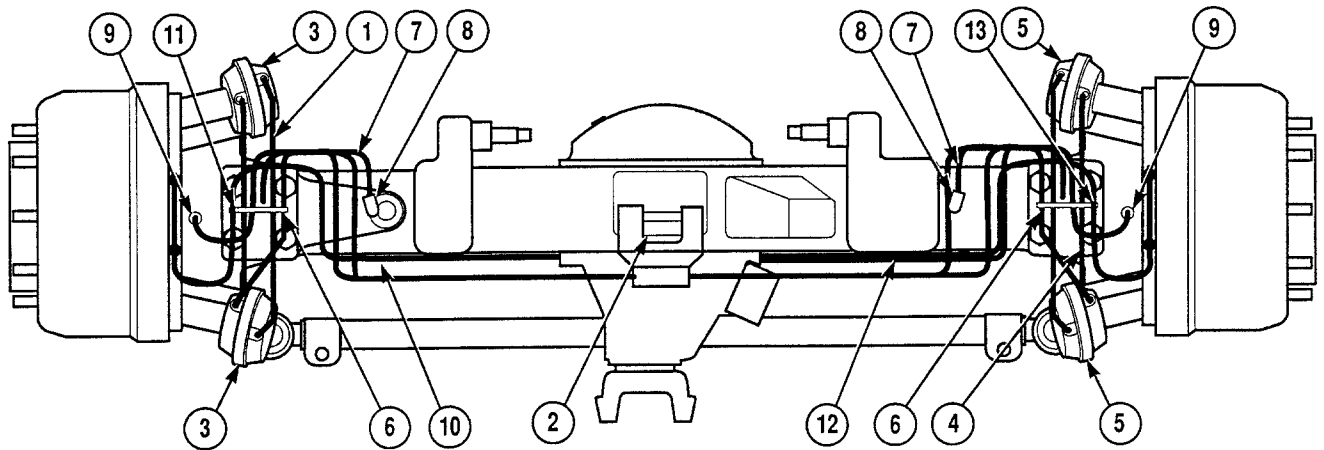
Air line locations

**INITIAL SETUP**

*Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)

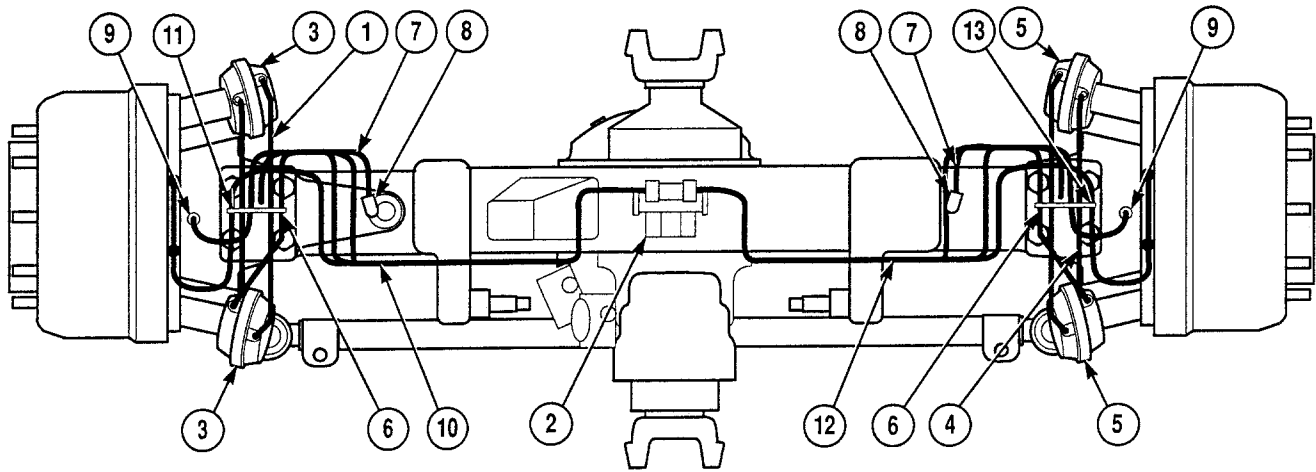
**Air Line Locations.**



**Table 25-4. Axle No. 1 Air Lines**

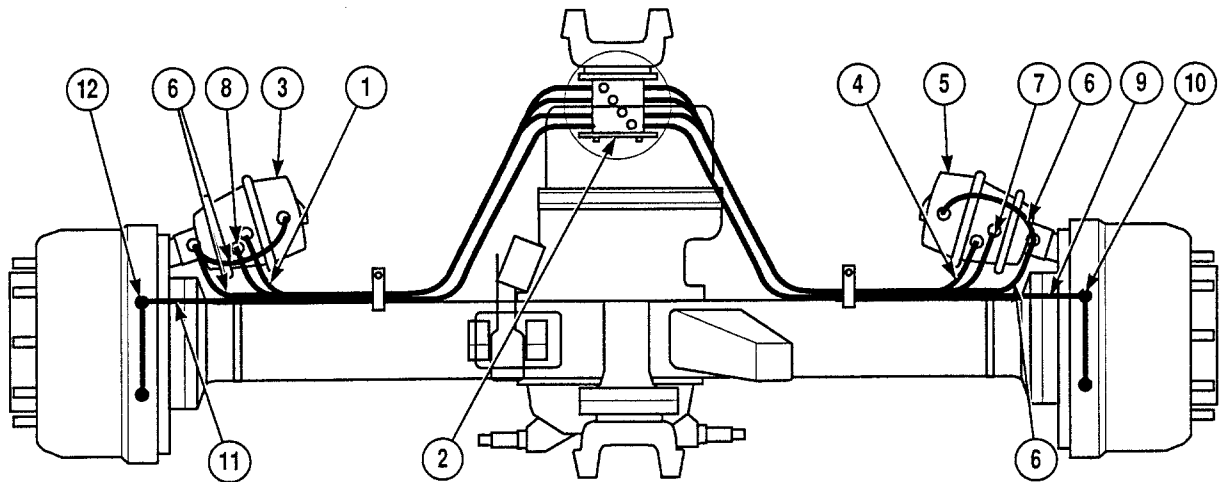
Hose No. Item No.	From (Location On Component)	To (Location On Component)
2012 (1)	Air Manifold Axle No. 1 Left Center (2)	Left Air Chambers Top Inner (3)
2013 (4)	Air Manifold Axle No. 1 Right Center (2)	Right Air Chambers Top Inner (5)
2874 (6)	Air Manifold Axle No. 1 Right and Left Top (2)	All Air Chambers Top Outer, (3) and (5)
2893 (7)	Left and Right Elbow Fittings (8)	Left and Right Spindles (9)
2101 (10)	Air Manifold Axle No. 1 Left (2)	Axle Steering Arm Bracket, Left (11)
2097 (12)	Air Manifold Above Axle No. 1 Right (2)	Axle Steering Arm Bracket, Right (13)

**25-30. DRESSED AXLE AIR LINE REPLACEMENT (CONT).**



*Table 25-5. Axle No. 2 Air lines*

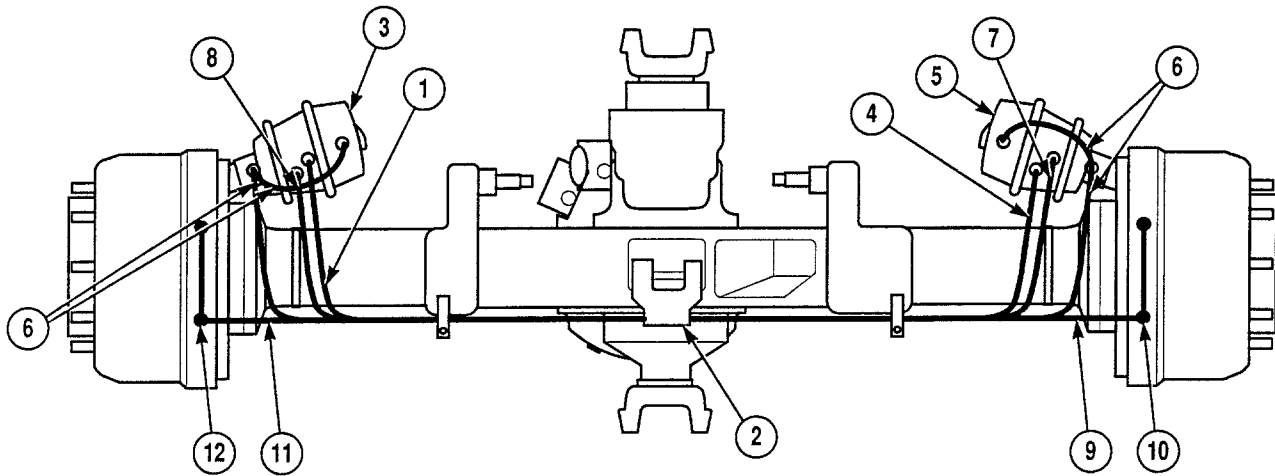
Hose No. Item No.	From (Location On Component)	To (Location On Component)
2388 (1)	Air Manifold Axle No. 2 Left Rear (2)	Left Air Chambers Top Inner (3)
2387 (4)	Lower Air Manifold Axle No. 2 Right Rear (2)	Right Air Chambers Top Inner (5)
2874 (6)	Upper Air Manifold Axle No. 2 Right and Left (2)	All Air Chambers Top Outer, (3) and (5)
2893 (7)	Left and Right Elbow Fittings (8)	Left and Right Spindles (9)
2103 (10)	Lower Air Manifold Axle No. 2 Left Front (2)	Axle Steering Arm Bracket, Left (11)
2099 (12)	Lower Air Manifold Axle No. 2 Right Front (2)	Axle Steering Arm Bracket, Right (13)



**Table 25-6. Axle No. 3 Air lines**

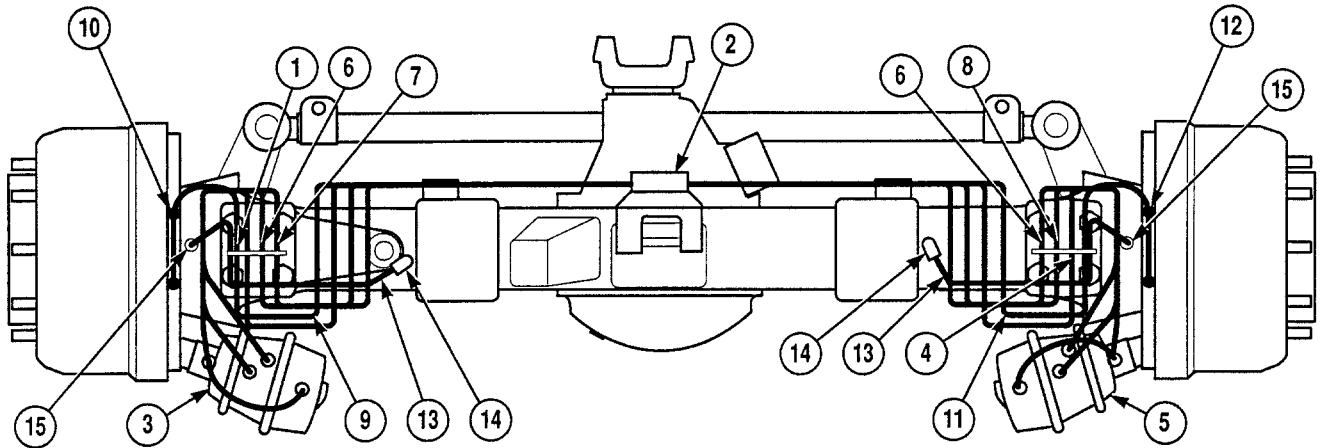
<b>Hose No. Item No.</b>	<b>From (Location On Component)</b>	<b>To (Location On Component)</b>
2023 (1)	Air Manifold Axle No. 3 Left Second From Front (2)	Left Air Chamber Middle Right (3)
2022 (4)	Air Manifold Axle No. 3 Right 2nd From Front (2)	Right Air Chamber Middle Left (5)
2874 (6)	Air Manifold Axle No. 3 Front Right and Left (2)	Both Air Chambers Outer Fittings, (3) and (5)
2546 (7)	Air Manifold Axle No. 3 Right 3rd Fitting From Front (2)	Right Air Chamber Middle Right (5)
2547 (8)	Air Manifold Axle No. 3, Left 3rd Fitting From Front (2)	Left Air Chamber Middle Left (3)
2105 (9)	Air Manifold Axle No. 3, Right 4th Fitting From Front (2)	Right "T" Fitting (10)
2869 (11)	Air Manifold, Axle No. 3, Left, 4th Fitting From Front (2)	Left "T" Fitting (12)

**25-30. DRESSED AXLE AIR LINE REPLACEMENT (CONT).**



*Table 25-7. Axle No. 4 Air lines*

Hose No. Item No.	From (Location On Component)	To (Location On Component)
2138 (1)	Air Manifold Axle No. 4 Left Second From Top (2)	Left Air Chamber Middle Right (3)
2139 (4)	Air Manifold Axle No. 4 Right 2nd From Top (2)	Right Air Chamber Middle Left (5)
2874 (6)	Air Manifold Axle No. 4 Top Right and Left (2)	Both Air Chambers Outer Fittings, (3) and (5)
2015 (7)	Air Manifold Axle No. 4 Right 3rd Fitting From Top (2)	Right Air Chamber Middle Right (5)
2017 (8)	Air Manifold Axle No. 4, Left 3rd Fitting From Top (2)	Left Air Chamber Middle Left (3)
2107 (9)	Air Manifold Axle No. 4, Right 4th Fitting From Top (2)	Right Spindle "T" Fitting (10)
2871 (11)	Air Manifold, Axle No. 4, Left 4th Fitting From Top (2)	Left Spindle "T" Fitting (12)



**Table 25-8. Axle No. 5 Air lines**

<b>Hose No. Item No.</b>	<b>From (Location On Component)</b>	<b>To (Location On Component)</b>
2141 (1)	Air Manifold Axle No. 5 Left Second From Top (2)	Left Air Chamber Middle Left (3)
2140 (4)	Air Manifold Axle No. 5 Right 2nd From Top (2)	Right Air Chamber Middle Left (5)
2874 (6)	Air Manifold Axle No. 5 Top Right and Left (2)	Both Air Chambers Outer Fittings, (3) and (5)
2016 (7)	Air Manifold Axle No. 5 Left 3rd Fitting From Top (2)	Left Air Chamber Middle Left (3)
2018 (8)	Air Manifold Axle No. 5, Right 3rd Fitting From Top (2)	Right Air Chamber Middle Right (5)
2873 (9)	Air Manifold Axle No. 5, Left 4th Fitting From Top (2)	Left Spindle "T" Fitting (10)
2109 (11)	Air Manifold, Axle No. 5, Left 4th Fitting From Top (2)	Right Spindle "T" Fitting (12)
2893 (13)	Left and Right Elbow Fittings (14)	Left and Right Spindles (15)

**END OF TASK**





## CHAPTER 26

### BRAKE SYSTEM MAINTENANCE

Para	Contents	Page
26-1	General Support Brake System Maintenance Introduction .....	26-1
26-2	Air Compressor Repair .....	26-2

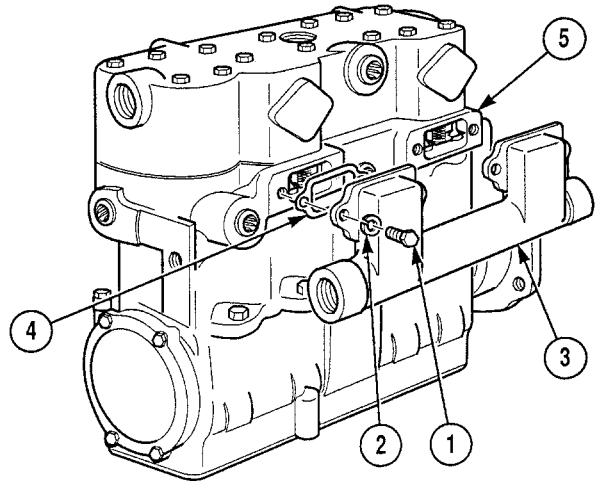
**26-1. GENERAL SUPPORT BRAKE SYSTEM MAINTENANCE INTRODUCTION.**

This chapter contains maintenance instructions for repairing brake system components as authorized by the Maintenance Allocation Chart (MAC) at the General Support Maintenance level.



**a. Disassembly.**

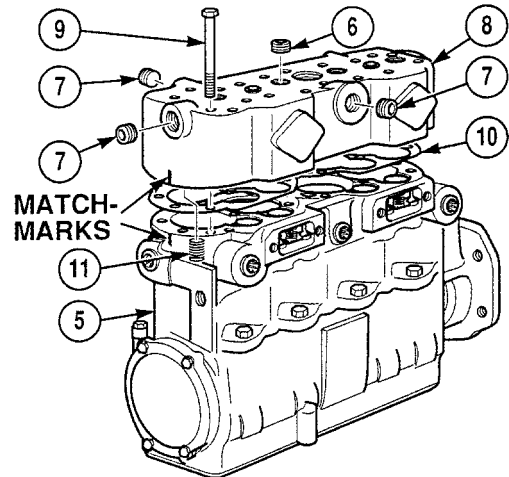
- (1) Remove four screws (1), lockwashers (2), intake manifold (3) and two gaskets (4) from cylinder block (5). Discard gaskets.



**NOTE**

Perform Step (2) if plugs are damaged.

- (2) Remove two plugs (6) and six plugs (7) from cylinder head (8).
- (3) Remove 18 screws (9) from cylinder head (8).
- (4) Matchmark and remove cylinder head (8) and gasket (10) from cylinder block (5). Discard gasket.



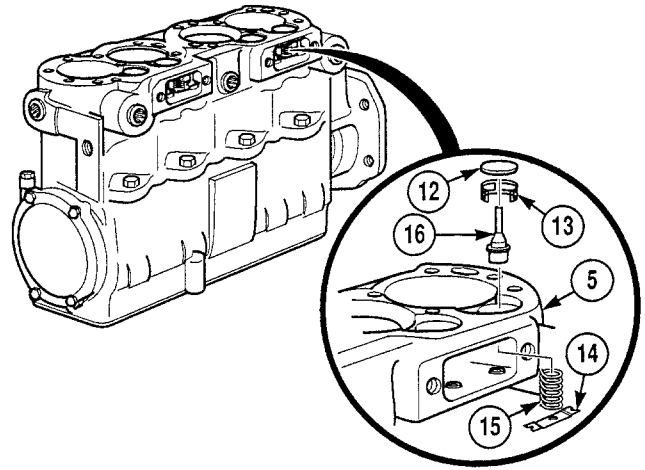
**CAUTION**

Use care when removing springs from plastic retainers in cylinder head or damage to equipment may result.

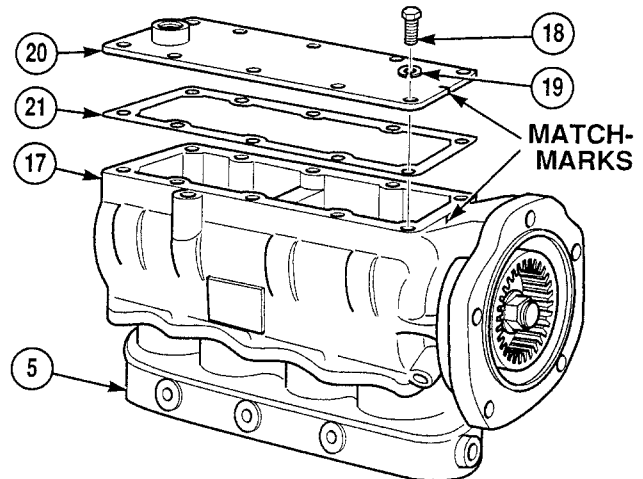
- (5) Remove four springs (11) from cylinder head (8).

**26-2. AIR COMPRESSOR REPAIR (CONT).**

- (6) Remove four valves (12) and valve guides (13) from cylinder block (5).
- (7) Remove two spring saddles (14), springs (15) and four plungers (16) from cylinder block (5).



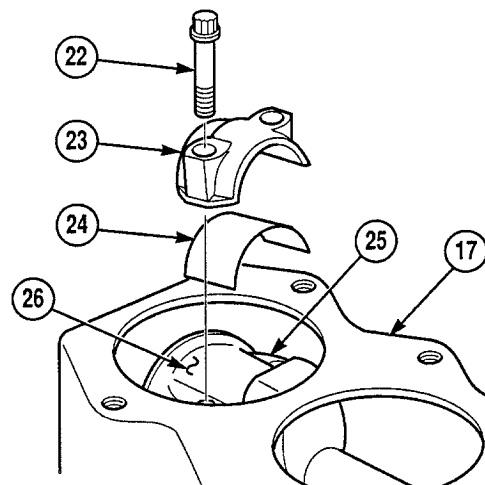
- (8) Position cylinder block (5) over, with crankcase (17) side up.
- (9) Remove ten screws (18) and lockwashers (19) from crankcase cover (20) and crankcase (17). Discard lockwashers.
- (10) Matchmark and remove crankcase cover (20) and gasket (21) from crankcase (17). Discard gasket.



**NOTE**

Tag and mark all screws, rod caps and bearing halves during removal.

- (11) Remove eight screws (22), four rod caps (23) and lower bearing halves (24) from connecting rods (25) and crankshaft (26).
- (12) Rotate crankshaft (26) to remove connecting rods (25) from crankshaft (26).



- (13) Position cylinder block (5) with crankcase (17) side down.

**NOTE**

Perform Step (14) if plugs are damaged.

- (14) Remove six plugs (27) from cylinder block (5).
- (15) Remove ten screws (28) and lockwashers (29) from cylinder block (5) and crankcase (17). Discard lockwashers.

**NOTE**

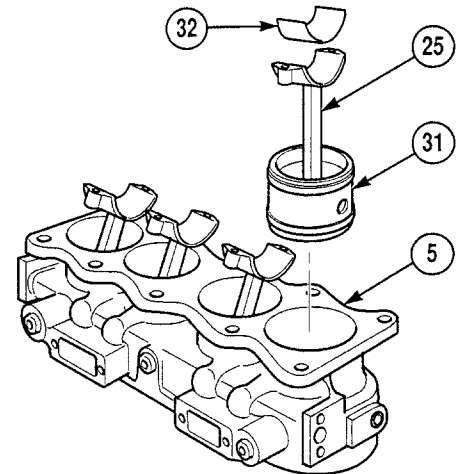
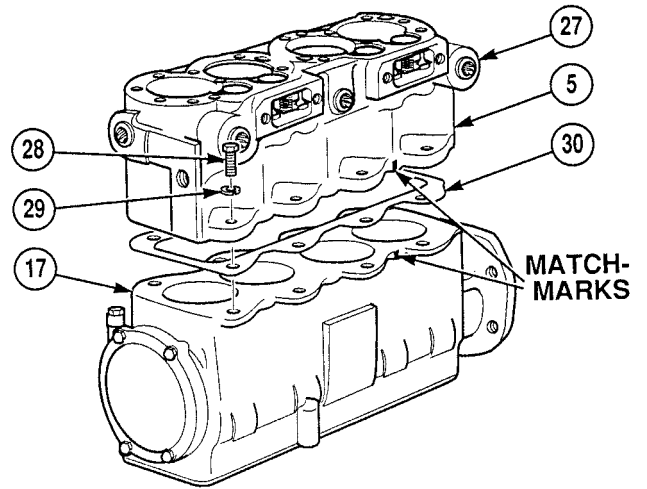
Piston and rod assemblies will stay with cylinder block.

- (16) Matchmark and remove cylinder block (5) and gasket (30) from crankcase (17). Discard gasket.
- (17) Remove four pistons (31) and connecting rods (25) as assemblies from bottom of cylinder block (5).

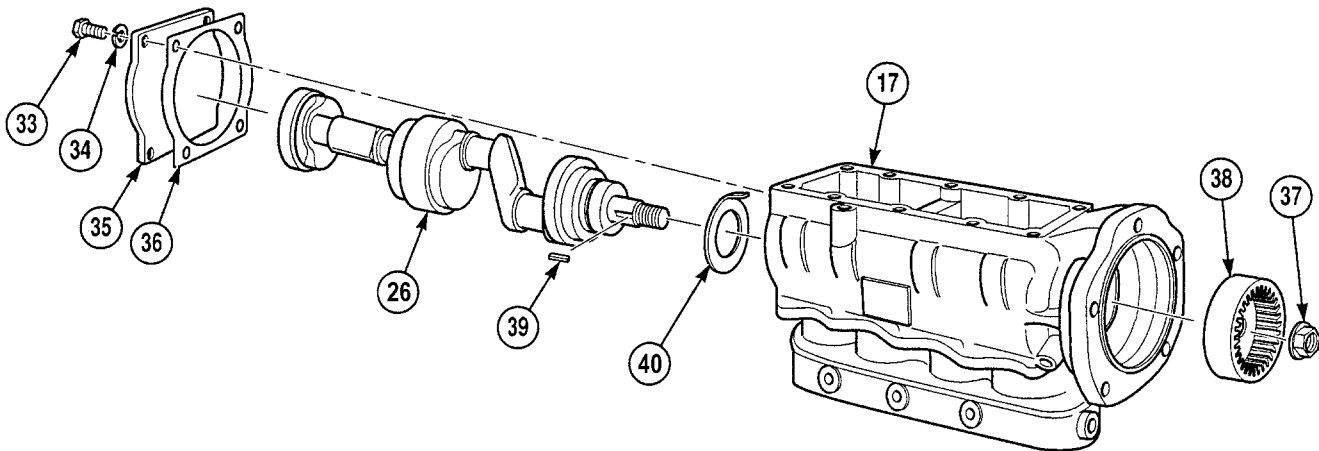
**NOTE**

Tag and mark upper bearing halves upon removal.

- (18) Remove upper bearing halves (32) from connecting rods (25).



**26-2. AIR COMPRESSOR REPAIR (CONT).**



- (19) Remove four screws (33), lockwashers (34), end cover (35) and gasket (36) from crankcase (17). Discard lockwashers and gasket.

**NOTE**

Gear nut is installed very tightly. It may be necessary to use an air wrench to remove.

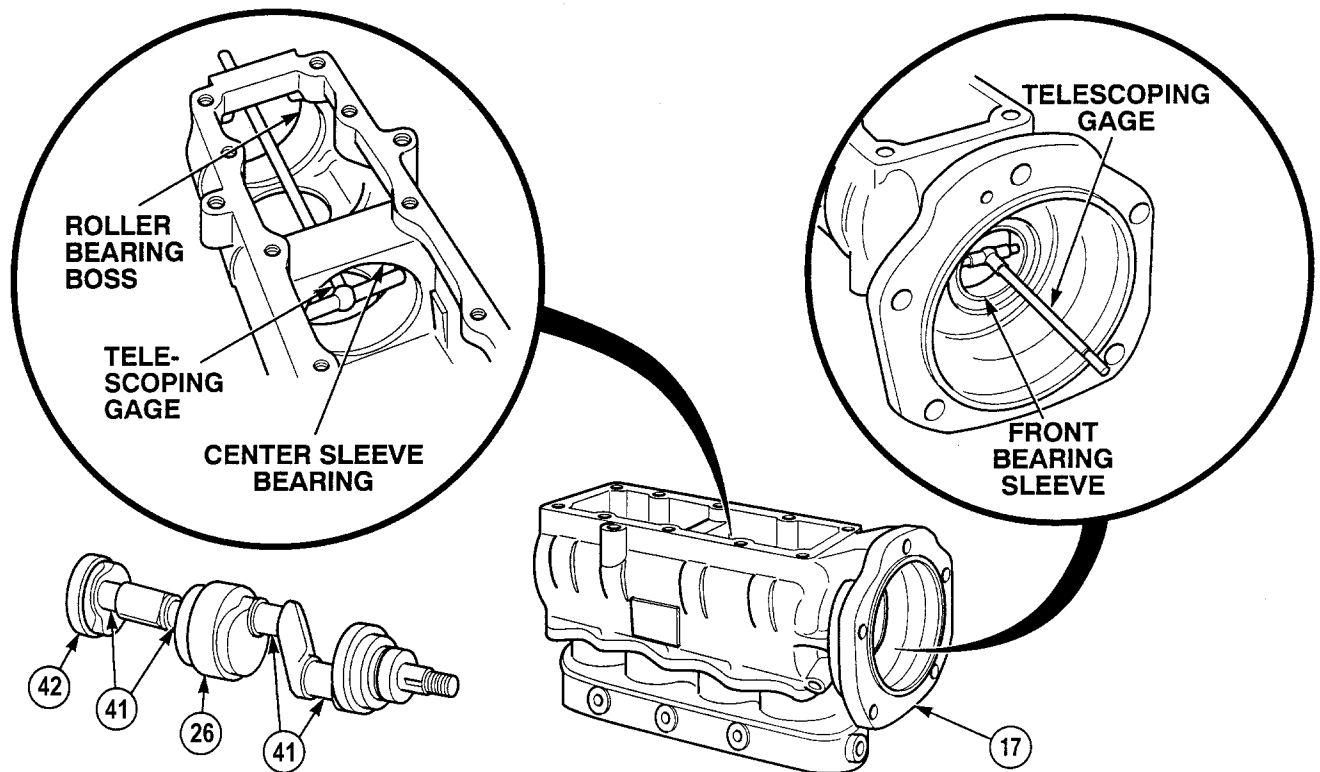
- (20) Remove nut (37), gear (38) and key (39) from crankshaft (26). Discard nut.
- (21) Remove crankshaft (26) and thrust washer (40) from crankcase (17).

**b. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 to personnel.

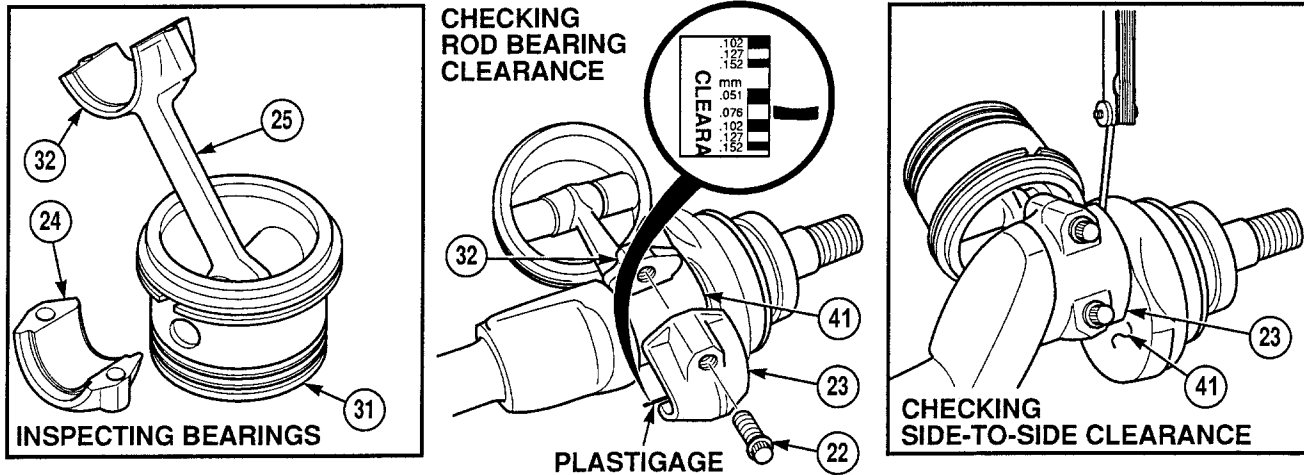
- (1) Clean metal parts with drycleaning solvent.
- (2) Dry parts with compressed air.



- (3) Clean interior air and water passages and blow out passages with compressed air.
- (4) Remove any residual gasket material from mating surfaces.
- (5) Inspect cylinder head, cylinder block and crankcase for cracks, gouges and stripped threads.
- (6) Inspect intake valves for wear, grooves, cracks or pits.
- (7) Inspect pistons for scoring, glazing and cracks.
- (8) Inspect cylinder bores for scratches, scoring and pitting.
- (9) Measure inside diameter of front bearing sleeve. If measurement is not between 2.0026 in. and 2.0036 in. (50.8660 and 50.8914 mm), replace crankcase.
- (10) Measure inside diameter of center sleeve bearing. If measurement in not between 3.5163 in. and 3.5178 in. (89.3140 and 89.3521 mm), replace crankcase.
- (11) Visually inspect roller bearing boss for scoring, pitting and cracks.
- (12) Inspect crankshaft (26) for scoring, pitting and cracks.
- (13) Visually inspect crankshaft journals (41) for scoring, pitting and cracks.
- (14) Check ball bearings (42) for wear. Rotate bearings by hand to detect binding. If binding is evident, replace crankcase (17).



**26-2. AIR COMPRESSOR REPAIR (CONT).**

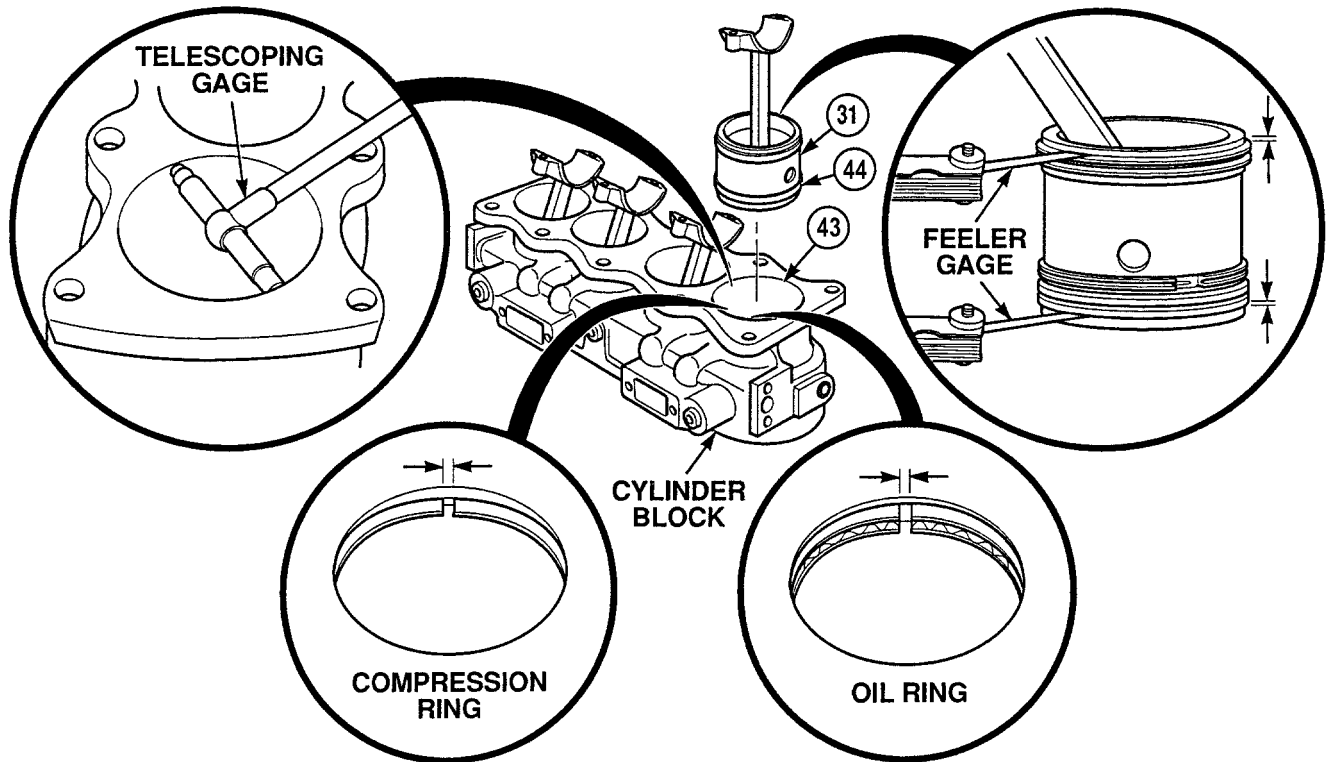


- (15) Inspect upper connecting rod bearing half (32) and lower connecting rod bearing half (24) for scoring, pitting and cracks.
- (16) Position upper bearing half (32) on connecting rod (25) and install on crankshaft journal (41).
- (17) Lay piece of plastigage on crankshaft journal (41).

**NOTE**

Locating tabs on bearing halves are installed in notches of rod caps.

- (18) Install rod cap (23) with lower bearing half (24) on crankshaft journal (41) and upper bearing half (32) and secure with two screws (22). Tighten screws to 105 to 135 lb-in (12 to 15 N·m).
- (19) Measure clearance between side of rod cap (23) and crankshaft journal (41). If clearance exceeds 0.010 in. (0.254 mm), replace piston assembly (31).
- (20) Remove two screws from crankshaft journal (41).
- (21) Measure plastigage. If clearance between bearing (24) and crankshaft journal (41) exceeds 0.0021 in. to 0.005 in. (0.053 to 0.127 mm), replace piston assembly (31).
- (22) Repeat Steps (15) through (21) to measure side clearance and bearing clearance on all remaining piston and rod assemblies.



- (23) Measure piston (31) outside diameter. Measure cylinder bore (43) inside diameter. Piston to bore clearance should not exceed 0.008 in. (0.203 mm). Replace pistons and cylinder block if clearance is exceeded.
- (24) Inspect bores (43) for out-of-round or taper. Bores must not be out-of-round more than 0.0005 in. (0.0127 mm). Bores must not taper more than 0.001 in. (0.025 mm) from top to bottom of bore. Replace cylinder block if limits are exceeded.
- (25) Inspect piston rings (44) for cracks or wear.

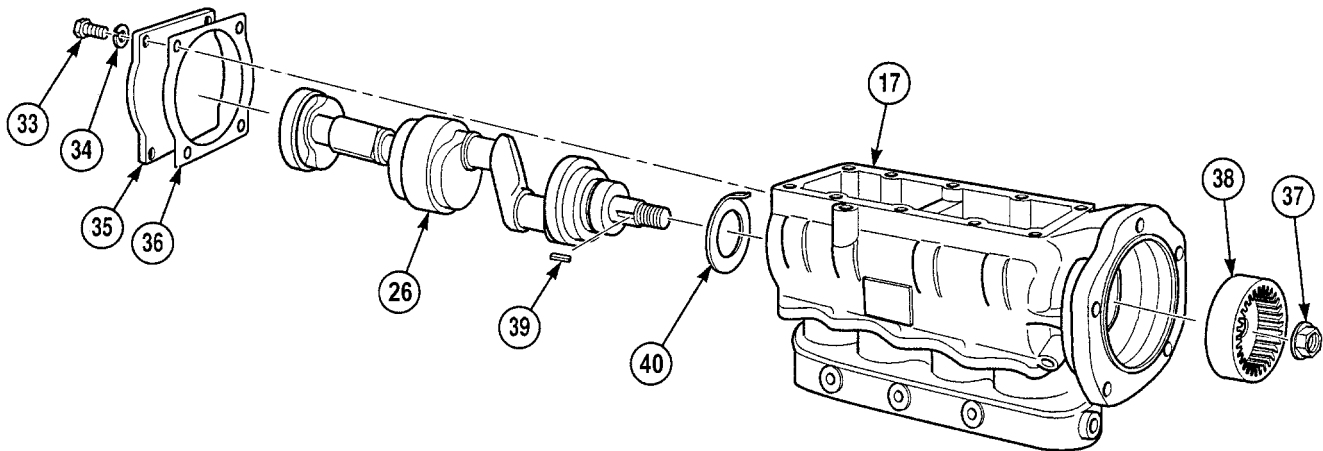
### NOTE

Tag and mark all piston rings upon removal.

- (26) Remove piston rings (44) from piston (31).
- (27) Position compression ring in cylinder bore (43) and measure end gap clearance. If clearance exceeds 0.017 in. (0.432 mm), replace piston rings. Repeat for all pistons.
- (28) Position oil ring in cylinder bore (43) and measure end gap clearance. If clearance exceeds 0.0055 in. (0.1397 mm), replace piston rings. Repeat for all pistons.
- (29) Install all piston rings (44) on pistons (31).

**26-2. AIR COMPRESSOR REPAIR (CONT).**

**c. Assembly.**



**NOTE**

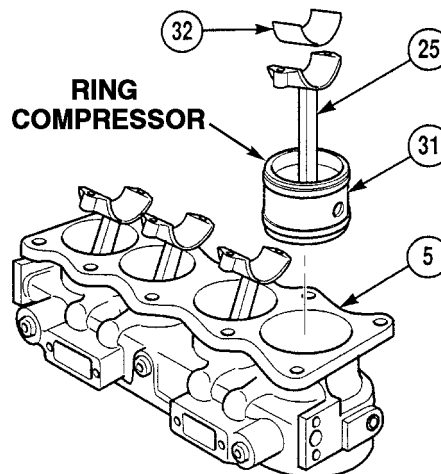
- Tab on thrust washer must face forward and fit in upper slot of crankcase housing.
- Install all parts as noted during removal.

- (1) Position thrust washer (40) on crankshaft (26) and install crankshaft in crankcase (17).
- (2) With the aid of an assistant, install key (39), gear (38) and gear nut (37) on crankshaft (26). Tighten gear nut to 80 lb-ft (108 N·m).
- (3) Install gasket (36) and end cover (35) on crankcase (17) with four screws (33) and lockwashers (34).

**NOTE**

Locating tabs on bearing halves should be installed in notches on connecting rods.

- (4) Install four upper bearing halves (32) in connecting rods (25).
- (5) Coat bores of cylinder block (5), four pistons (31) and bearing halves (32) with lubricating oil.
- (6) Using ring compressor, install four pistons (31) and connecting rods (25) as assemblies in cylinder block (5).



- (7) Position gasket (30) on cylinder block (5).

**CAUTION**

Ensure not to score cylinder bores or crankshaft journals with ends of connecting rods or equipment may be damaged.

- (8) With the aid of an assistant, position crankcase (17) on gasket (30) and cylinder block (5) and position connecting rods (25) on to journals of crankshaft (26).
- (9) Position crankcase (17) and cylinder block (5) with crankcase (17) side down.

**WARNING**

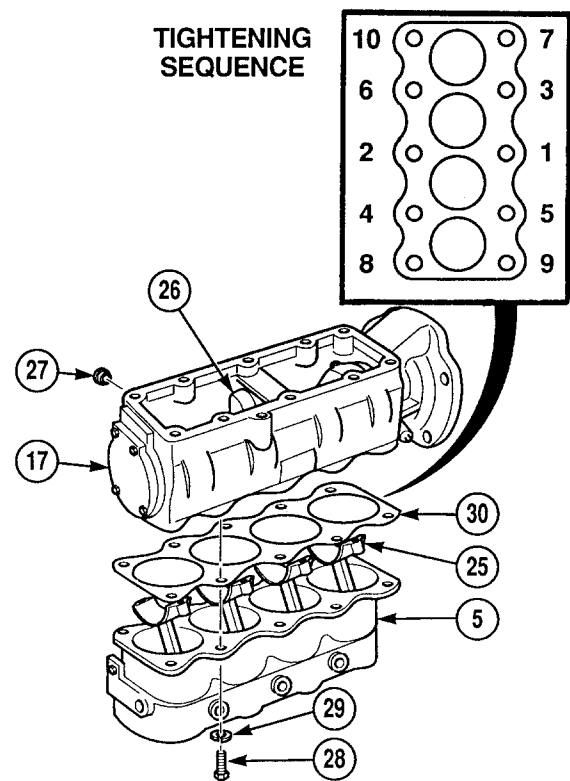
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (10) Apply sealing compound to threads of screws (28).
- (11) Install ten lockwashers (29) and screws (28) on cylinder block (5). Tighten screws to 96 lb-in (11 N·m) in sequence shown. Retighten again 27 to 33 lb-ft (37 to 45 N·m).

**NOTE**

Perform Step (12) if plugs were removed.

- (12) Coat threads of six plugs (27) with sealing compound and install in crankcase (17).
- (13) Position crankcase (17) and cylinder block (5) with crankcase (17) side up.

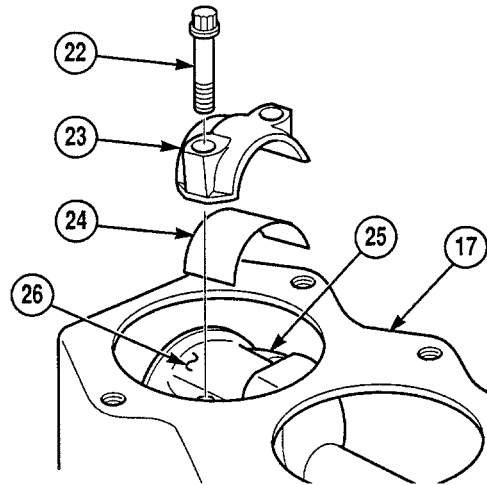


**26-2. AIR COMPRESSOR REPAIR (CONT).**

**NOTE**

Locating tabs on bearing halves are installed in notches of rod caps.

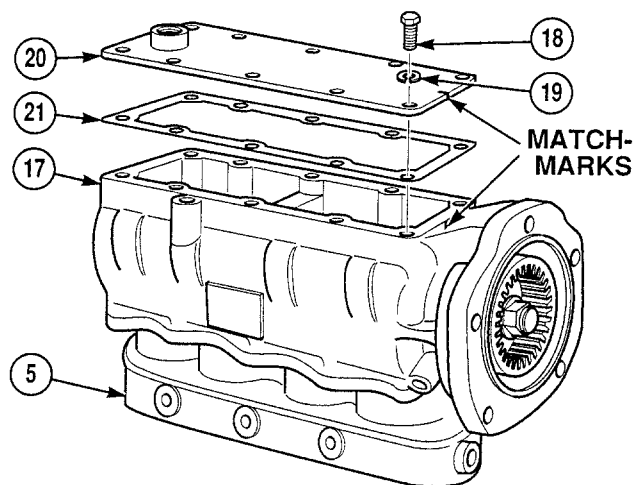
- (14) Install four lower bearing halves (24) in rod caps (23).
- (15) Coat journals of crankshaft (26) with lubricating oil.



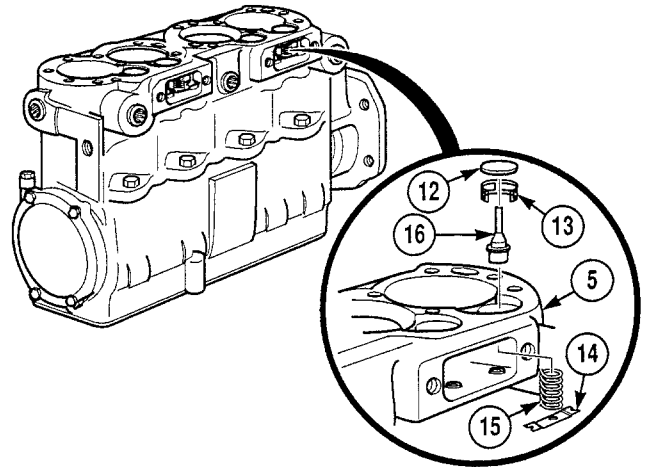
**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (16) Apply sealing compound to threads of eight screws (22).
- (17) Install four rod caps (23) over journals of crankshaft (26) on connecting rods (25) with eight screws (22). Tighten screws to 105 to 135 lb-in (12 to 15 N·m).
- (18) Apply sealing compound to threads of ten screws (18).
- (19) Install gasket (21) and crankcase cover (20) on crankcase (17) with ten lockwashers (19) and screws (18). Tighten screws to 110 to 150 lb-in (12 to 17 N·m).
- (20) Position crankcase (17) and cylinder block (5) with crankcase (17) side down.



- (21) Install four plungers (16), two spring saddles (14) and springs (15) in cylinder block (5).
- (22) Install four valve guides (13) and valves (12) in cylinder block (5).



- (23) Install four springs (11) in cylinder head (8).

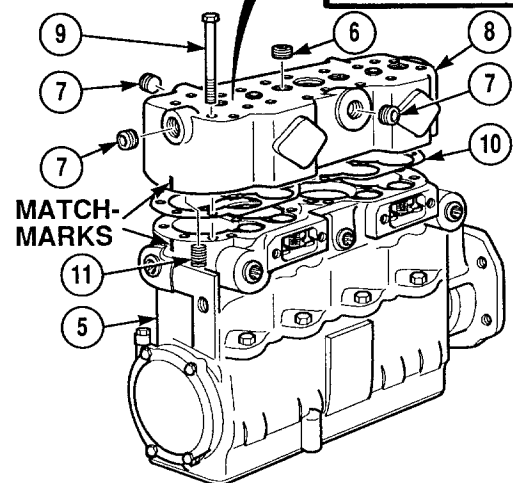
**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (24) Apply sealing compound to threads of 18 screws (9).
- (25) Install gasket (10) and cylinder head (8) on cylinder block (5) with 18 screws (9). Tighten screws to 13 lb-ft (18 N·m) in sequence shown.

**TIGHTENING SEQUENCE**

18	○	○	15
14	○	○	11
10	○	○	7
6	○	○	3
1	○	○	2
4	○	○	5
8	○	○	9
12	○	○	13
16	○	○	17



**NOTE**

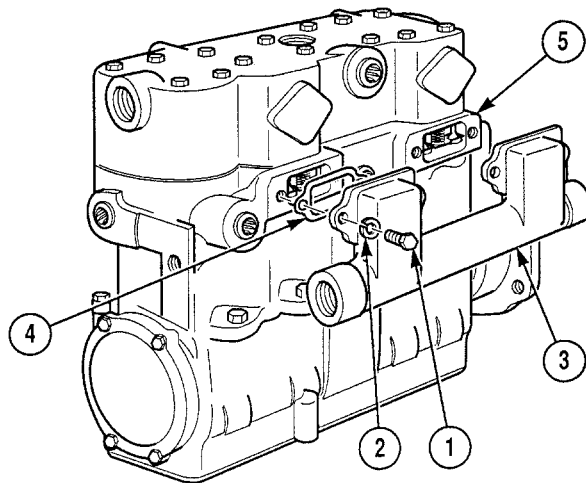
Perform Step (26) if plugs were removed.

- (26) Apply sealing compound to threads of two plugs (6) and six plugs (7) and install plugs in cylinder head (8).

26-2. AIR COMPRESSOR 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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.



- (27) Apply sealing compound to threads of four screws (1).
- (28) Install two gaskets (4) and intake manifold (3) on cylinder block (5) with four lockwashers (2) and screws (1). Tighten screws to 13 lb-ft (18 N·m).

END OF TASK

## CHAPTER 27

### STEERING SYSTEM MAINTENANCE

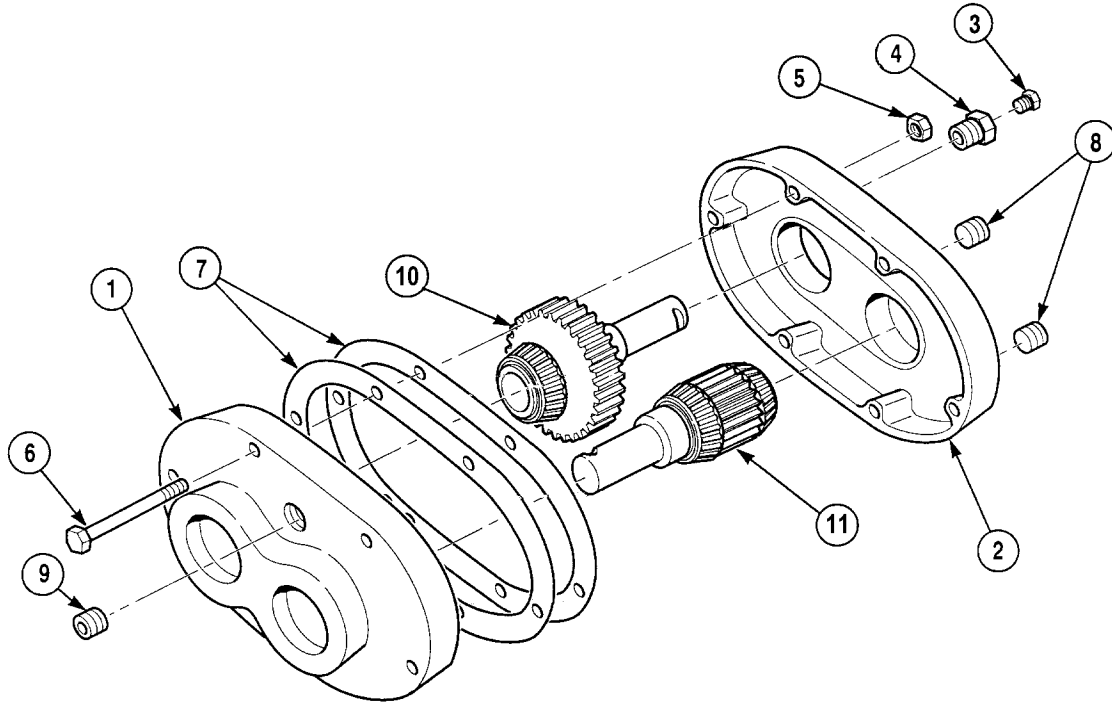
Para	Contents	Page
27-1	General Support Steering System Maintenance Introduction .....	27-1
27-2	2.21:1 Gear Reducer Repair .....	27-2
27-3	Front And Rear Steering Gear Repair .....	27-11
27-4	Intermediate Steering Gear Repair .....	27-21

**27-1. GENERAL SUPPORT STEERING SYSTEM MAINTENANCE INTRODUCTION.**

This chapter contains maintenance instructions for repairing steering system components as authorized by the Maintenance Allocation Chart (MAC) at the General Support Maintenance level.







- (3) Remove vent (3) from reducer (4)
- (4) Remove reducer (4) from output housing (2).
- (5) Remove six nuts (5) and screws (6) from input housing (1) and output housing (2) and separate housing halves. Allow oil to drain from housing halves.
- (6) Remove and discard shims (7) from input housing (1) or output housing (2).
- (7) Remove two plugs (8) from output housing (2).
- (8) Remove plug (9) from input housing (1).
- (9) Remove output shaft assembly (10) from output housing (2).
- (10) Remove input shaft assembly (11) from input housing (1).

**27-2. 2.21:1 GEAR REDUCER REPAIR (CONT).**

**NOTE**

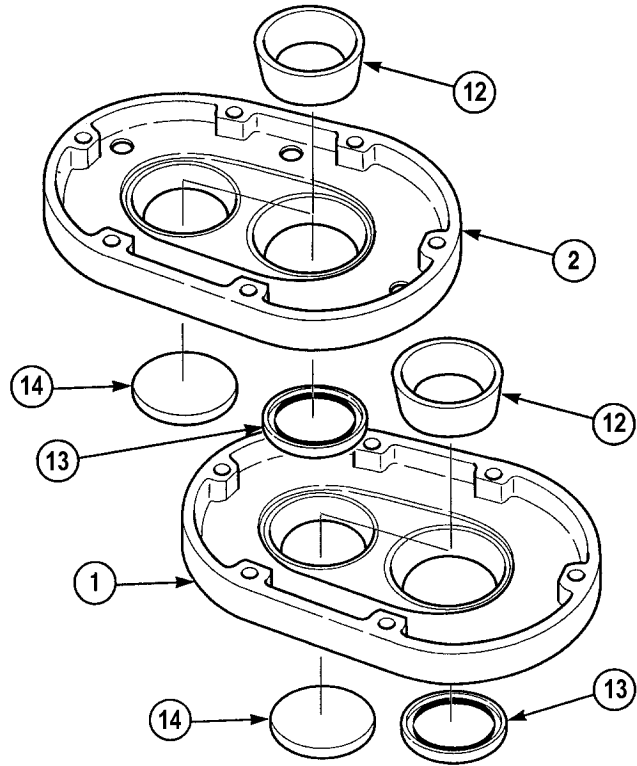
Both housing halves are repaired the same way.

- (11) Remove two bearing cups (12) and oil seals (13) from input housing (1) and output housing (2). Discard oil seals.

**NOTE**

Perform Step (12) if plugs are damaged.

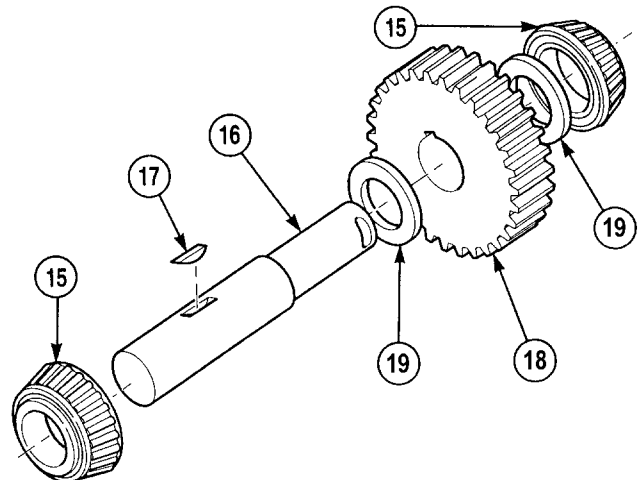
- (12) Remove plugs (14) from input housing (1) and output housing (2).



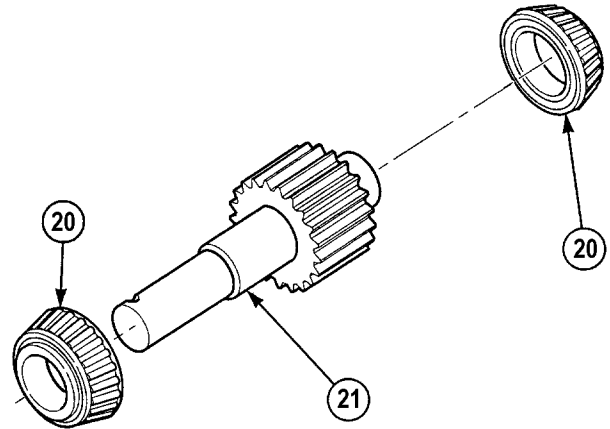
**NOTE**

Perform Steps (13) and (14) for output shaft. Perform Step (15) for input shaft.

- (13) Remove cone bearings (15) from output shaft (16).
- (14) Remove key (17), gear (18) and two spacers (19) from output shaft (16).



- (15) Remove two cone bearings (20) from input shaft (21).



**b. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
- (2) Allow bearings to air dry.

**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 to personnel.

- (3) Dry metal parts with compressed air except bearings.
- (4) Inspect metal parts for breaks, cracks and sharp edges.
- (5) Inspect gear teeth for damage.
- (6) Replace all damaged parts.
- (7) Lubricate bearings with lubricating oil.

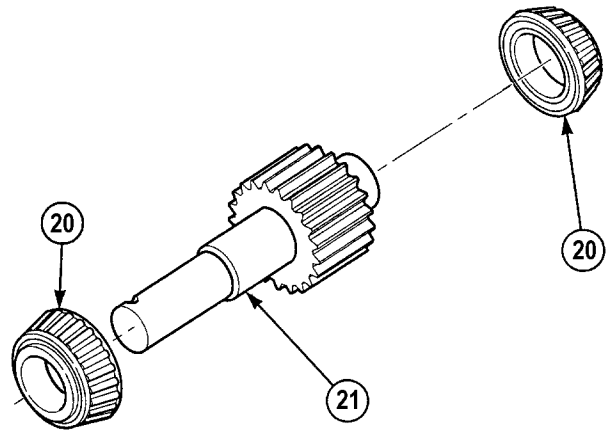
**27-2. 2.21:1 GEAR REDUCER REPAIR (CONT).**

**c. Assembly.**

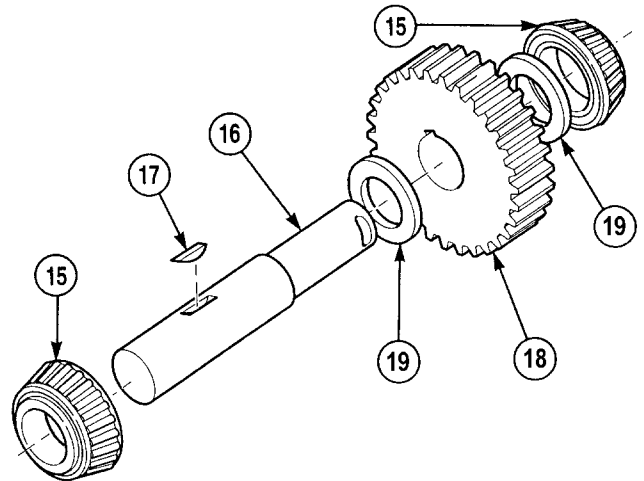
**NOTE**

Perform Step (1) for input shaft.  
Perform Steps (2) and (3) for  
output shaft.

- (1) Install two cone bearings (20) on input shaft (21).



- (2) Install key (17), spacer (19) and gear (18) on output shaft (16).
- (3) Install spacer (19) and cone bearings (15) on output shaft (16).



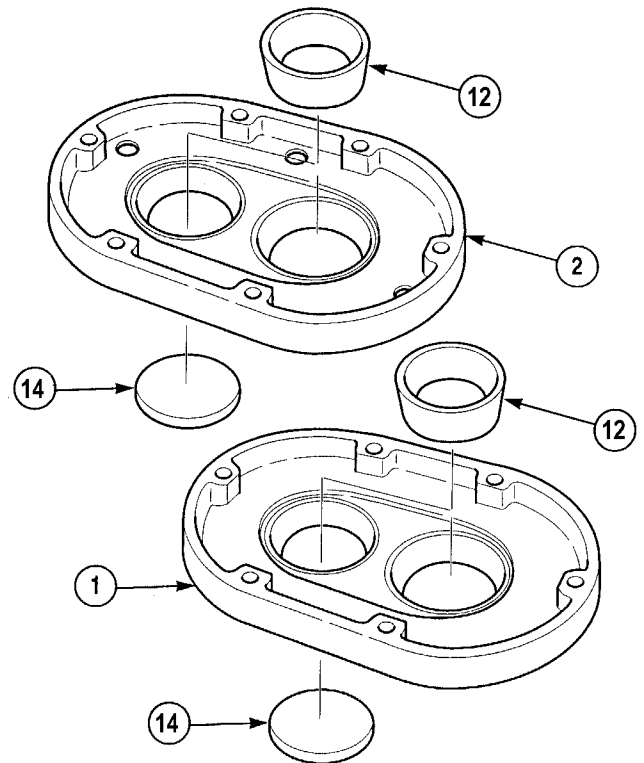
**WARNING**

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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

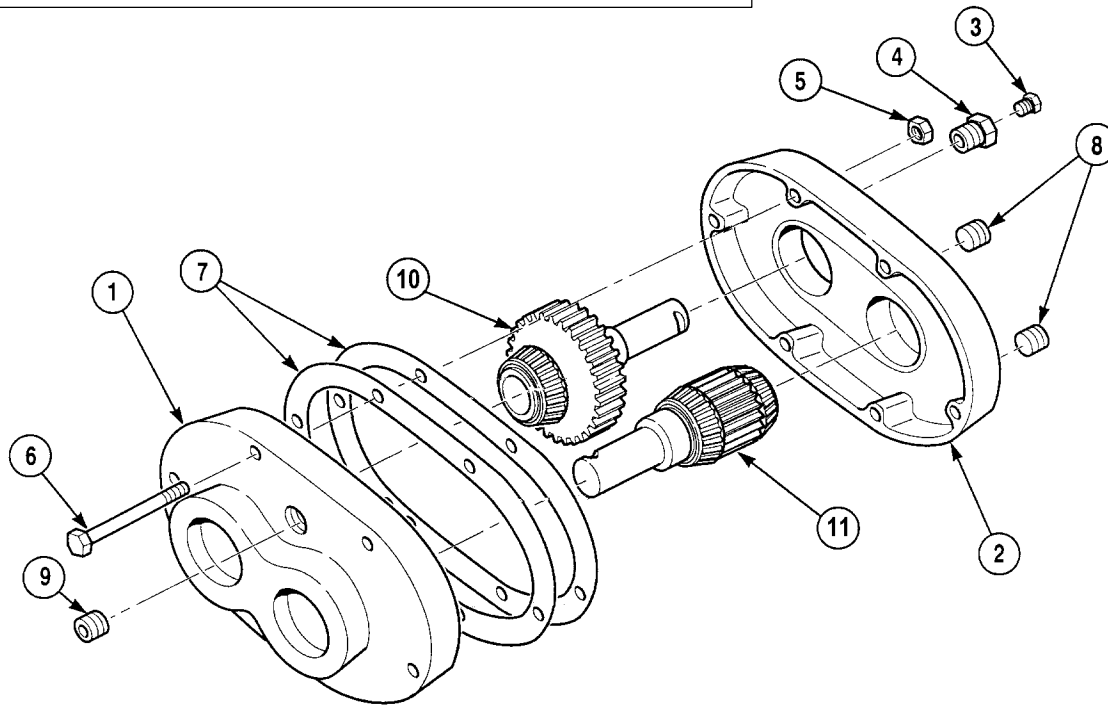
**NOTE**

Perform Steps (4) and (5) if plugs were removed.

- (4) Apply sealing compound to outside edge of two plugs (14).
- (5) Install plugs (14) in input housing (1) and output housing (2).
- (6) Install two bearing cups (12) in input housing (1) and output housing (2).



**27-2. 2.21:1 GEAR REDUCER 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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (7) Apply sealing compound to threads and install plug (9) in input housing (1).
- (8) Apply sealing compound to threads and install two plugs (8) in output housing (2).
- (9) Apply sealing compound to threads and install reducer (4) and vent (3) on output housing (2).
- (10) Install output shaft assembly (10) and input shaft assembly (11) into output housing (2).
- (11) Position three blue shims (7) on output housing (2).
- (12) Align matchmark and position input housing (1) over output housing (2).

**CAUTION**

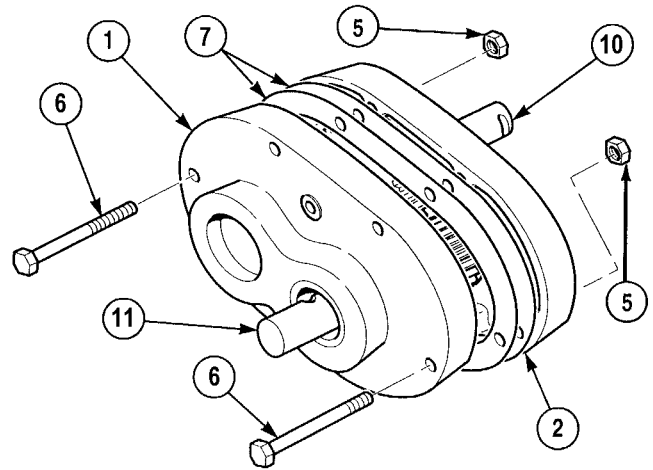
Ensure gear assemblies are meshed prior to bolting together by rotating shaft assemblies by hand. Failure to comply may result in damage to equipment.

- (13) Install six screws (6) and nuts (5) in gear input housing (1) and output housing (2). Tighten screws to 20 lb-ft (27 N·m).

**NOTE**

Bearing assemblies are adjusted by removing or adding shims until the bearings bind and then add one shim at a time until shaft assemblies rotate freely with no end play, red shim = 0.002 in. (0.05 mm) and blue shim = 0.005 in. (0.13 mm).

- (14) Check input housing (1) and output housing (2) adjustment to ensure shaft assemblies (10) and (11) rotate freely with no end play.

**NOTE**

- If shaft assembly binds or has end play, go to next step.
- If shaft assembly rotates freely and has no end-play, go to Step (16).

- (15) Remove six screws (6), nuts (5) and input housing (1) from output housing (2).
- (16) Add or subtract required shims (7) between input housing (1) and output housing (2) and reinstall screws (6) and nuts (5). Repeat Steps (15) and (16) until shaft assemblies (10) and (11) rotate freely with no end-play.
- (17) Remove six nuts (5).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

**CAUTION**

Do not allow sealing compound to get on equipment or bearings or damage to bearings and equipment may result.

- (18) Apply sealing compound to both sides of shims (7) and reposition shims and input housing (1) on output housing (2).
- (19) Apply sealing compound to threads and install six nuts (5). Tighten nuts to 20 lb-ft (27 N·m).

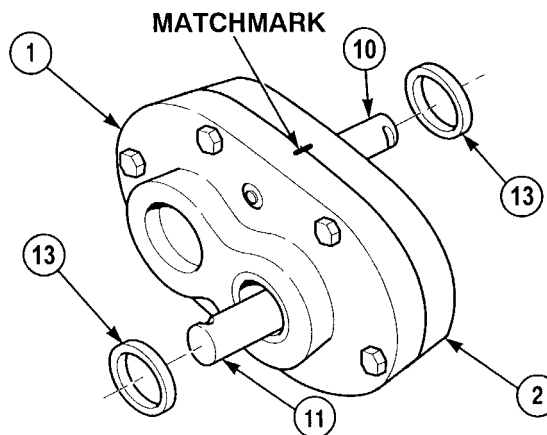


**27-2. 2.21:1 GEAR REDUCER REPAIR (CONT).**

**CAUTION**

Masking tape, plastic shim stock or paper must be placed over key slot to prevent damage to seal.

- (20) Place masking tape over entire key slot on input shaft assembly (11).
- (21) Apply lubricating oil to input shaft (11) and inside diameter of seal (13).
- (22) Using soft faced hammer carefully slide seal (13) over input shaft (11) and tap into input housing (1).
- (23) Remove masking tape from key slot.
- (24) Repeat Steps (20) through (23) for output shaft assembly (10).



**END OF TASK**



**27-3. FRONT AND REAR STEERING GEAR REPAIR (CONT).**

- (5) Remove preformed packing (8) from cover (2). Discard preformed packing.

**NOTE**

Perform Step (6) if roller bearing is damaged.

- (6) Remove roller bearing (9) from cover (2).

**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

**NOTE**

Perform Step (7) if roller bearing is damaged.

- (7) Remove retaining ring (11) and roller bearing (10) from gear housing (1).

**NOTE**

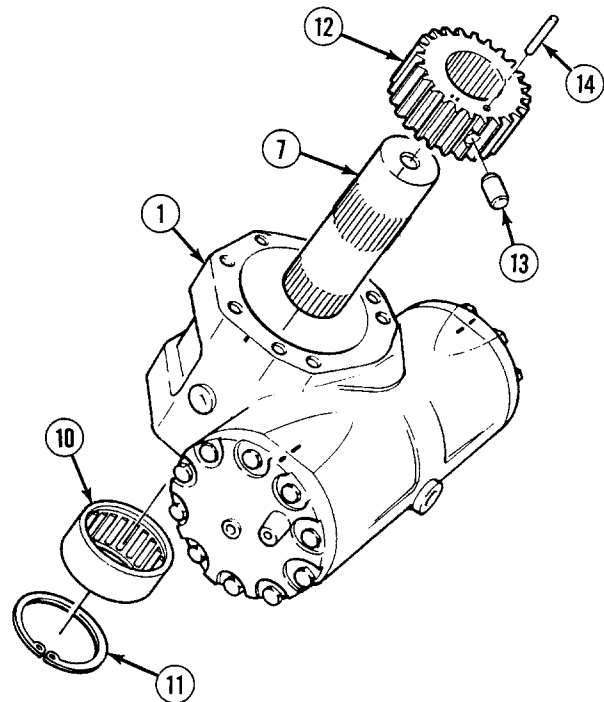
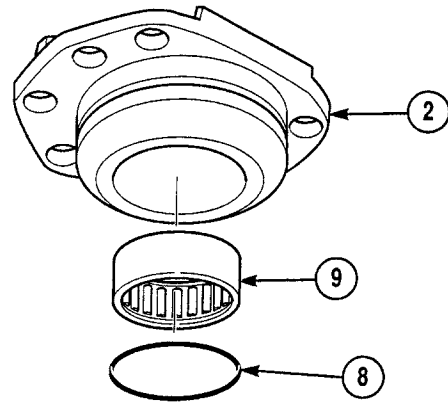
Perform Step (8) only if gear is damaged.

- (8) Position shaft (7) in press and press gear (12) off of shaft (7).

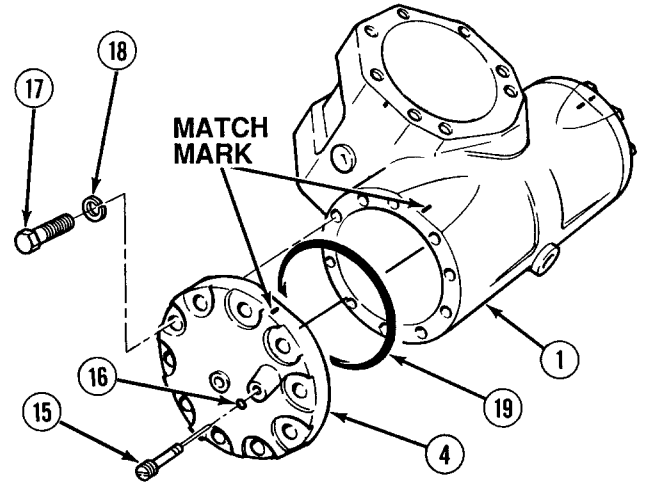
**NOTE**

Perform Steps (9) and (10) only if gear was removed.

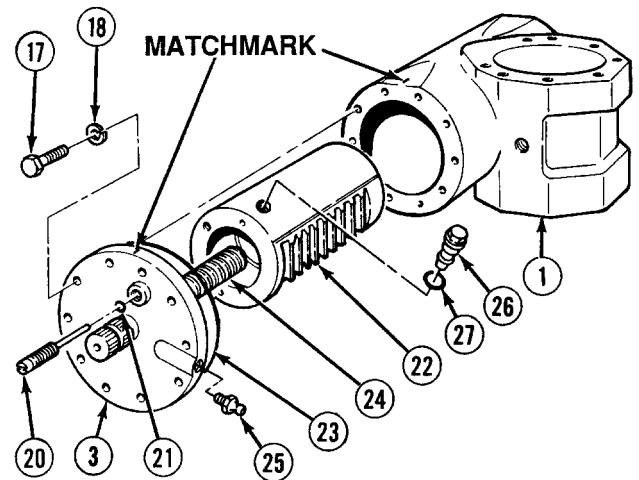
- (9) Remove shaft (7) from press.
- (10) Remove pins (13) and (14) from gear (12). Discard pins.



- (11) Position drain pan under gear housing (1).
- (12) Remove and discard valve (15) and preformed packing (16) from cylinder head (4).
- (13) Remove 10 screws (17), lockwashers (18) and cylinder head (4) from gear housing (1). Discard lockwashers.
- (14) Remove and discard preformed packing (19) from cylinder head (4).



- (15) Remove and discard valve (20) and preformed packing (21) from bearing cap (3).
- (16) Remove 10 screws (17), lockwashers (18), bearing cap (3) and piston (22) from gear housing (1). Discard lockwashers.
- (17) Remove and discard preformed packing (23) from bearing cap (3).
- (18) Turn bearing cap (3) counterclockwise to remove actuating shaft (24) from piston (22).



**NOTE**

Perform Step (19) only if grease fitting is damaged.

- (19) Remove grease fitting (25) from bearing cap (3).
- (20) Remove valve (26) and preformed packing (27) from piston (22). Discard preformed packing.

**27-3. FRONT AND REAR STEERING GEAR REPAIR (CONT).**

**CAUTION**

Do not drill more than 3/8 in. deep or damage to equipment may result.

**NOTE**

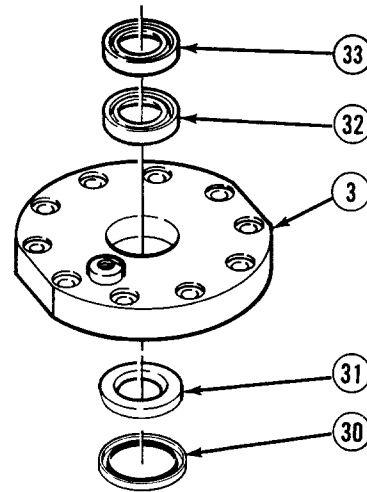
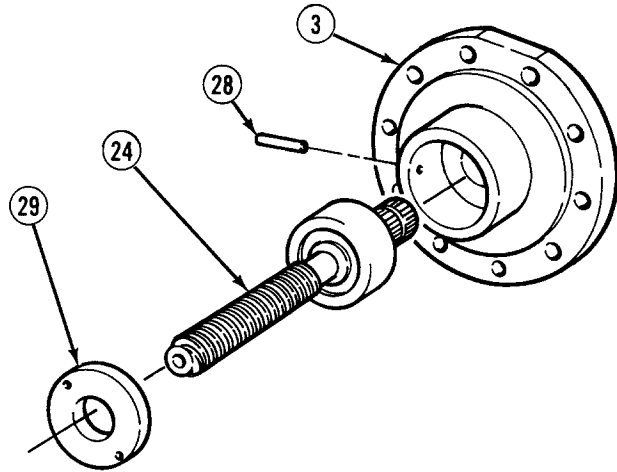
Perform Steps (21) and (22) only if seals in bearing cap are leaking or damaged.

- (21) Using 5/64 in. drill and drill press, drill out locking pin (28) and remove retaining nut (29) from bearing cap (3). Discard locking pin.
- (22) Remove actuating shaft (24) from bearing cap (3).

**NOTE**

Seals and backup washer are removed by pressing all three seals towards inside of bearing cap.

- (23) Remove high pressure seal (30), backup washer (31), salt seal (32) and dirt seal (33) from bearing cap (3).



**b. Cleaning/Inspection.****WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 to personnel.
- (1) Clean all metal parts with drycleaning solvent.
  - (2) Allow roller bearing to air dry, then coat with hydraulic oil.
  - (3) Dry metal parts with compressed air, except bearings.
  - (4) Inspect metal parts for breaks, cracks and sharp edges.
  - (5) Inspect bushing for cuts or nicks.
  - (6) Inspect bearings for loose rollers or cracked and broken races.
  - (7) Inspect actuating shaft and bearing for nicks, burrs or scratches.

**27-3. FRONT AND REAR STEERING GEAR REPAIR (CONT).**

**c. Assembly.**

**NOTE**

- Perform Steps (1) through (10) if seals and actuating shaft were removed.
- Backup washer must be installed with undercut facing outside of bearing cap.

- (1) Install backup washer (31) in bearing cap (3).

**NOTE**

- Lip of high pressure seal must face away from backup washer.
- High pressure seal must be fully seated against backup washer.

- (2) Install high pressure seal (30) in bearing cap (3).

**NOTE**

- Lip of dirt seal must face away from backup washer.
- Dirt seal must be fully seated against backup washer.

- (3) Install dirt seal (33) in bearing cap (3).

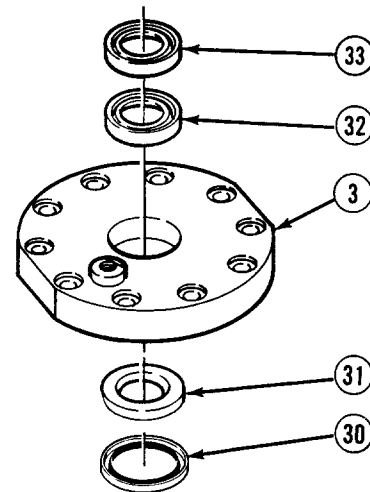
**NOTE**

- Lip of salt seal must face outside end of bearing cap.
- Outer edge of dirt seal must be flush with outside edge of bearing cap.

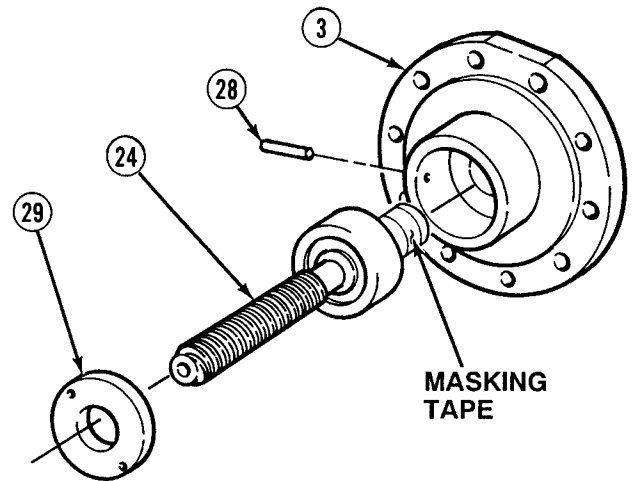
- (4) Install salt seal (32) in bearing cap (3).

- (5) Apply grease to lip of dirt seal (32) and salt seal (33).

- (6) Apply hydraulic oil to lip of high pressure seal (30).



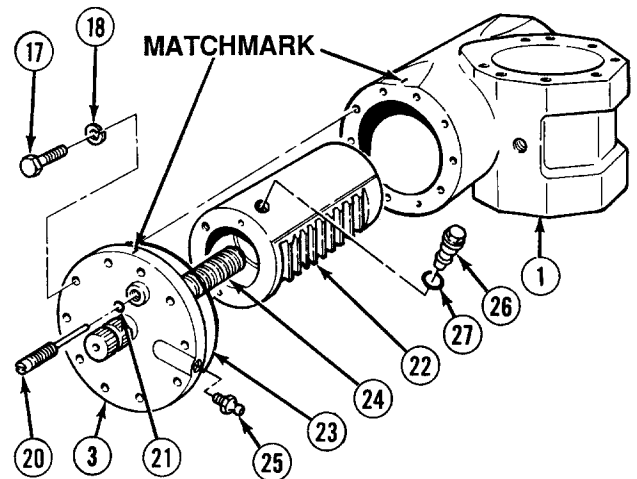
- (7) Wrap masking tape on splined end of actuating shaft (24).
- (8) Position actuating shaft (24) in bearing cap (3).
- (9) Install retaining nut (29) and locking pin (28) in bearing cap (3).
- (10) Remove masking tape from actuating shaft (24).
- (11) Apply hydraulic oil to preformed packing (27).
- (12) Install preformed packing (27), valve (26) on piston (22).



**NOTE**

Perform Step (13) if grease fitting was removed.

- (13) Install grease fitting (25) in bearing cap (3).
- (14) Apply hydraulic oil to preformed packing (23).
- (15) Install preformed packing (23) on bearing cap (3).
- (16) Thread actuating shaft (24) and bearing cap (3) into piston (22).
- (17) Position piston assembly (22) and bearing cap (3) in gear housing (1).



**WARNING**

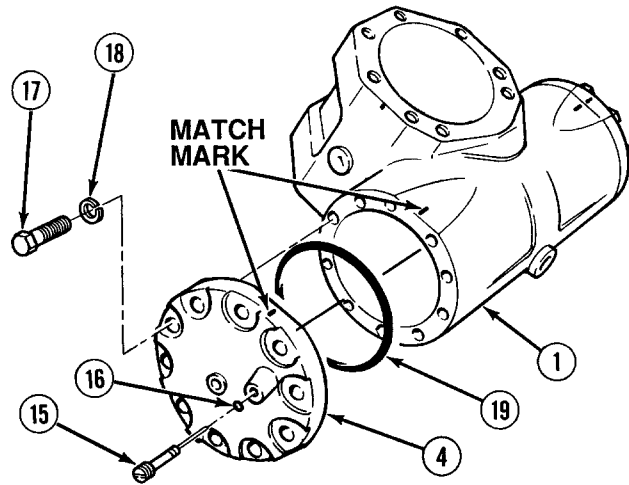
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (18) Coat threads of 10 screws (17) with sealing compound.
- (19) Align matchmarks and install bearing cap (3) on gear housing (1) with 10 lockwashers (18) and screws (17). Tighten screws to 20 to 30 lb-ft (27 to 41 N·m).
- (20) Apply hydraulic oil to preformed packing (21).
- (21) Install preformed packing (21) on valve (20).
- (22) Install valve (20) in bearing cap (3). Tighten valve six turns.



**27-3. FRONT AND REAR STEERING GEAR REPAIR (CONT).**

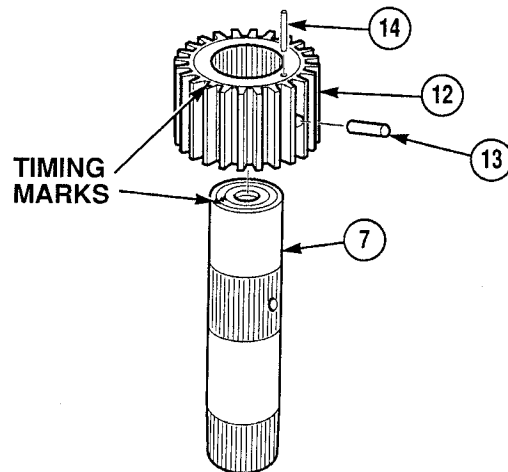
- (23) Apply hydraulic oil to preformed packing (19).
- (24) Install preformed packing (19) on cylinder head (4).
- (25) Align matchmarks and position cylinder head (4) on gear housing (1).
- (26) Coat threads of 10 screws (17) with sealing compound.
- (27) Install ten lockwashers (18) and screws (17) in cylinder head (4). Tighten screws to 20 to 30 lb-ft (27 to 41 N·m).
- (28) Apply hydraulic oil to preformed packing (16).
- (29) Install preformed packing (16) on valve (15).
- (30) Install valve (15) in cylinder head (4). Tighten valve six turns.



**NOTE**

Perform Steps (31) through (33) if gear was removed.

- (31) Align timing marks and position shaft (7) in press and press gear (12) on shaft (7).
- (32) Remove shaft (7) from press.
- (33) Install pins (13) and (14) in gear (12) and shaft (7).



**WARNING**

Use care when removing 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**

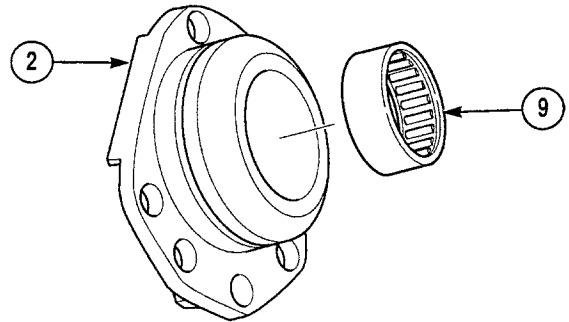
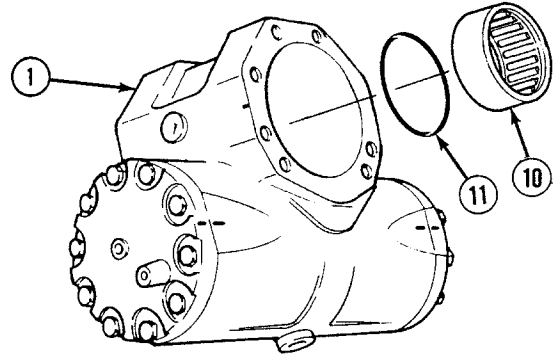
Perform Step (34) if bearing was removed.

- (34) Install retaining ring (11) and roller bearing (10) until bearing (10) is flush with inner face of gear housing (1).

**NOTE**

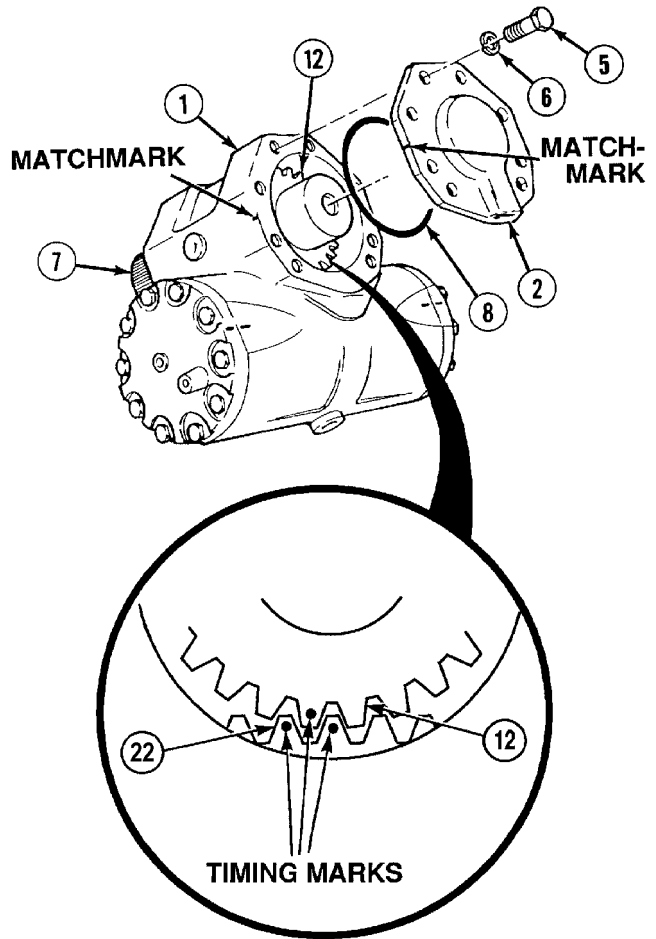
Perform Step (35) if bearing was removed.

- (35) Install roller bearing (9) in cover (2).
- (36) Apply grease to inner surface of roller bearings (9) and (10).



**27-3. FRONT AND REAR STEERING GEAR REPAIR (CONT).**

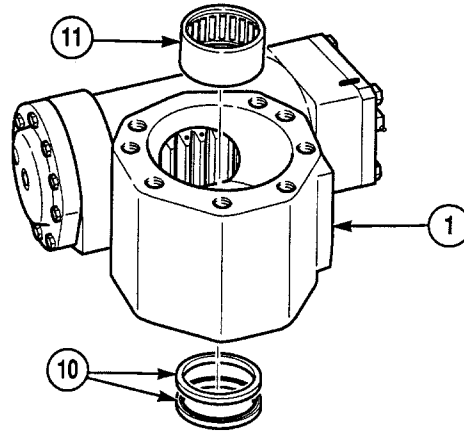
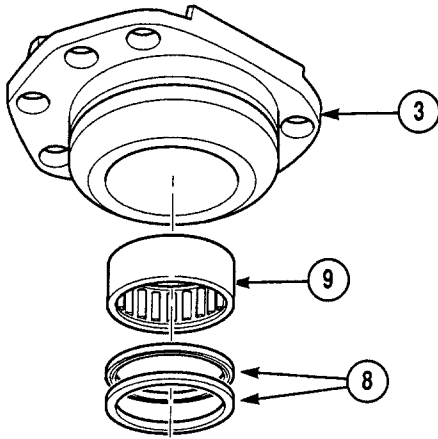
- (37) Align timing marks on gear (12) and piston (22) and install shaft (7) in gear housing (1).
- (38) Apply hydraulic oil to preformed packing (8).
- (39) Install preformed packing (8) on cover (2).
- (40) Align matchmarks and install cover (2) on gear housing (1) with eight lockwashers (6) and screws (5). Tighten screws 55 lb-ft (75 N·m).
- (41) Remove steering gear housing (1) from chain vise.



**END OF TASK**



**27-4. INTERMEDIATE STEERING GEAR REPAIR (CONT).**



- (6) Remove two-piece seal (8) from inside of cover (3). Discard seal.

**NOTE**

Perform Step (7) if roller bearing is damaged.

- (7) Remove roller bearing (9) from cover (3).
- (8) Remove two-piece seal (10) from steering gear assembly (1). Discard seal.

**NOTE**

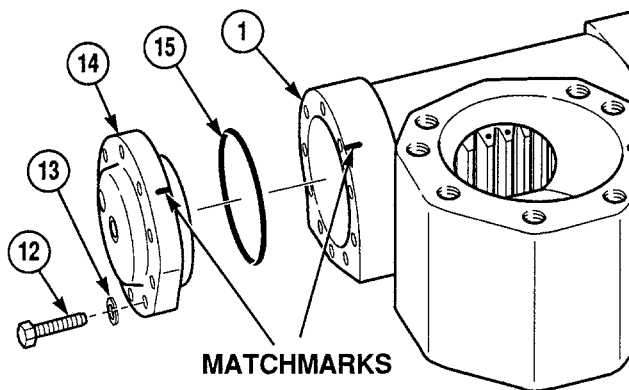
Perform Step (9) if roller bearing is damaged.

- (9) Remove roller bearing (11) from steering gear assembly (1).

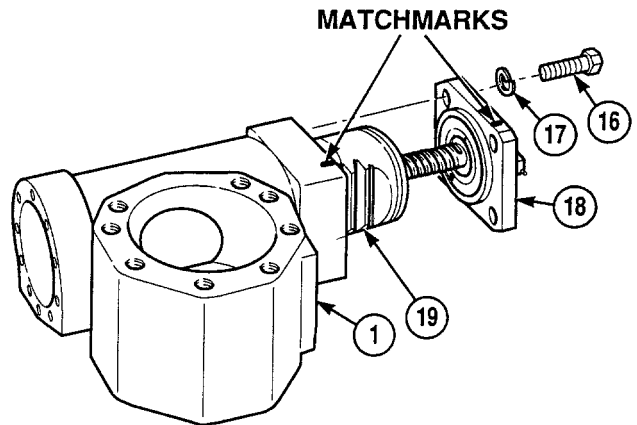
**NOTE**

Matchmark cylinder head, bearing cap, and steering gear assembly prior to removal.

- (10) Remove 10 screws (12), lockwashers (13) and cylinder head (14) from steering gear assembly (1). Discard lockwashers.
- (11) Remove preformed packing (15) from cylinder head (14). Discard preformed packing.



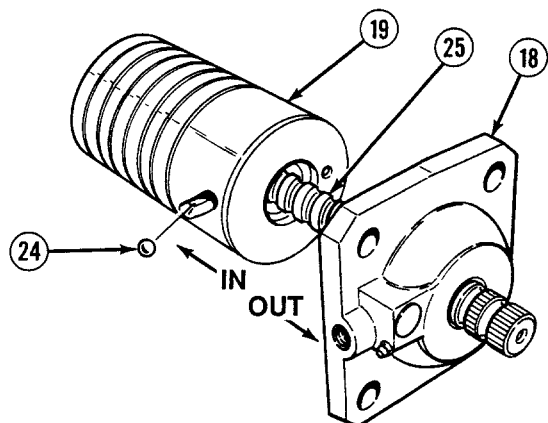
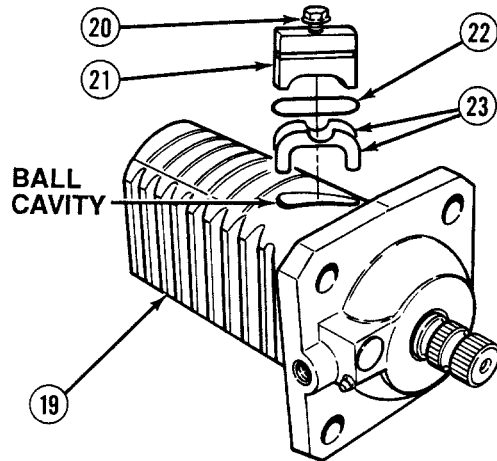
- (12) Remove four screws (16) and lockwashers (17) from bearing cap (18). Discard lockwashers.
- (13) Remove bearing cap (18) and piston assembly (19) from steering gear assembly (1).



**NOTE**

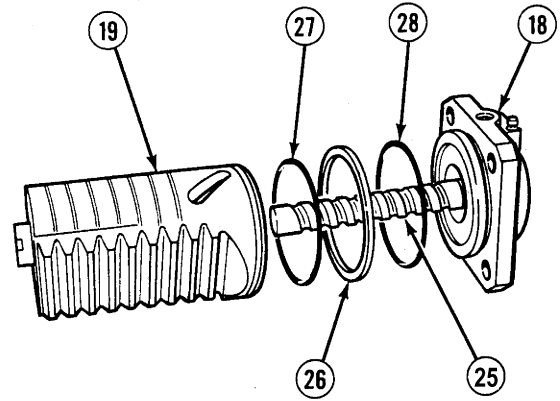
Perform Steps (14) through (26) only if seals in the bearing cap are leaking or damaged.

- (14) Install screw (20) in plug (21) on piston assembly (19).
- (15) Remove plug (21) from piston assembly (19).
- (16) Remove screw (20) from plug (21). Discard plug.
- (17) Remove preformed packing (22) from plug (21). Discard preformed packing.
- (18) Remove both halves of guides (23) from ball cavity in piston assembly (19).
- (19) Remove 24 steel balls (24) from ball cavity while turning piston assembly (19) so that ball cavity is facing downward and rotate actuating shaft (25) and bearing cap (18) in and out of the piston assembly (19).

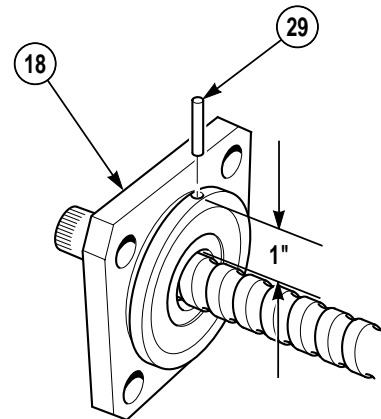


**27-4. INTERMEDIATE STEERING GEAR REPAIR (CONT).**

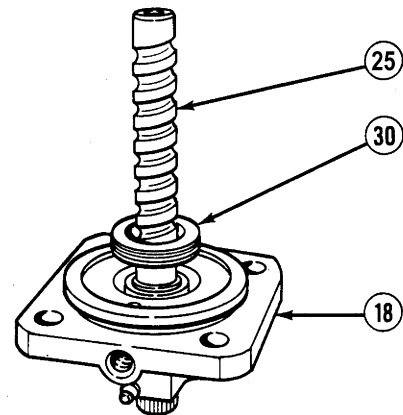
- (20) Remove actuating shaft (25) and bearing cap (18) from piston assembly (19).
- (21) Remove ring (26) and preformed packing (27) from piston assembly (19). Discard ring and preformed packing.
- (22) Remove preformed packing (28) from bearing cap (18). Discard preformed packing.



- (23) Using a drill press and a 5/64 in. drill, drill one in. (2.54 mm) deep through retaining pin (29) in bearing cap (18). Discard retaining pin.



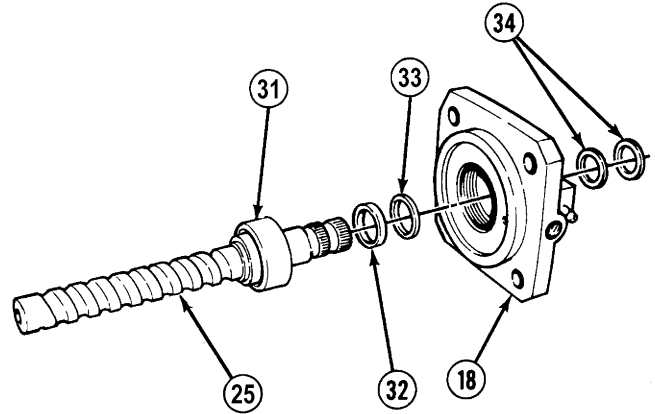
- (24) Remove bearing retainer (30) from bearing cap (18) and actuating shaft (25).



- (25) Using a soft faced hammer, tap splined end of actuating shaft (25) and remove actuating shaft (25) and bearing (31) from bearing cap (18).

**NOTE**

Seals and backup washer are removed by pressing all three seals towards inside of cylinder head.

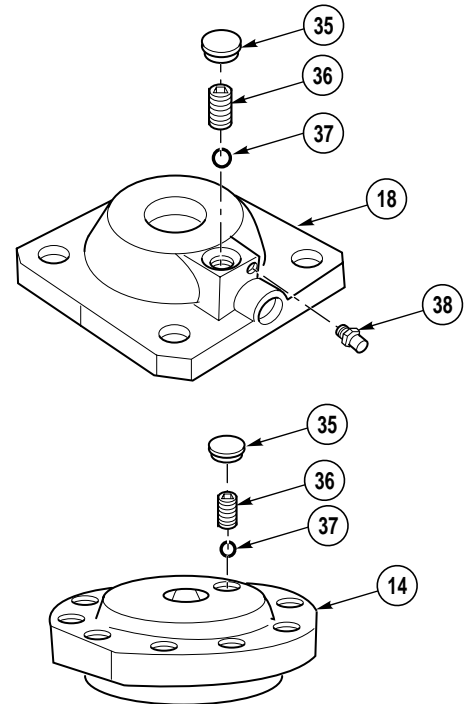


- (26) Position bearing cap (18) with machined surface down and remove seal (32), backup washer (33) and seals (34) from bearing cap (18). Discard seals.
- (27) Remove and discard cap (35), set screw (36) and ball (37) from bearing cap (18) and cylinder head (14).

**NOTE**

Perform Step (28) if grease fitting is damaged.

- (28) Remove grease fitting (38) from bearing cap (18).





## 27-4. INTERMEDIATE STEERING GEAR REPAIR (CONT).

### *b. Cleaning/Inspection.*

#### **WARNING**

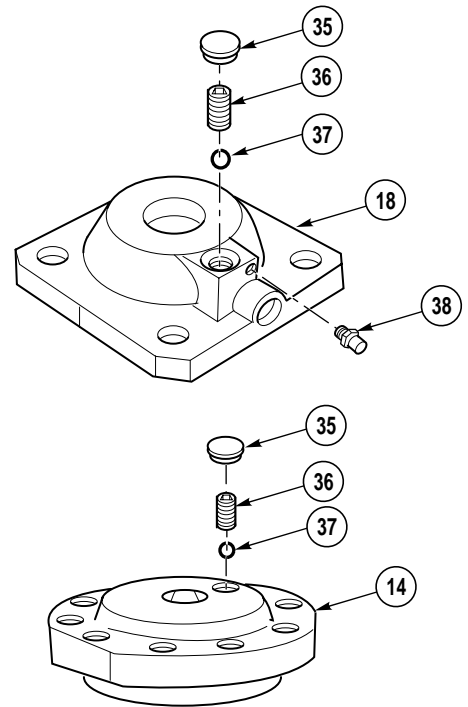
- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes, and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent. The flashpoint for Type II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 to personnel.
- (1) Clean all metal parts with drycleaning solvent.
  - (2) Allow bearing to air dry, then coat with hydraulic oil.
  - (3) Dry metal parts with compressed air.
  - (4) Inspect metal parts for breaks, cracks and sharp edges.
  - (5) Inspect bushing for cut or nicks.
  - (6) Inspect bearings for loose rollers or cracked and broken races.
  - (7) Inspect actuating shaft and bearing for nicks, burrs or scratches.
  - (8) Replace all damaged parts.

**c. Assembly.**

**NOTE**

Perform Step (1) if grease fitting was removed.

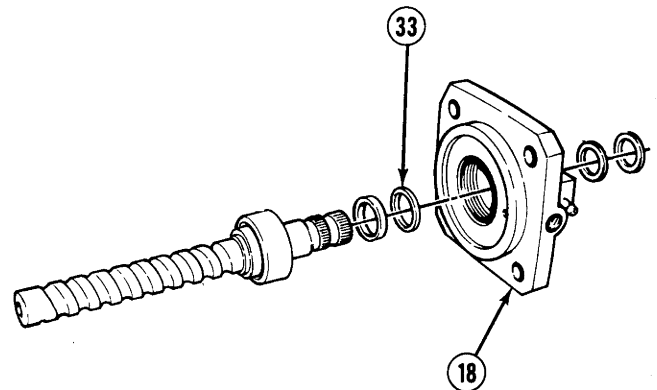
- (1) Install grease fitting (38) in bearing cap (18).
- (2) Install ball (37), set screw (36) and cap (35) in bearing cap (18) and cylinder head (14).



**NOTE**

- Perform Steps (3) through (12) if seals and actuating shaft were removed.
- Backup washer must be installed with undercut facing outside of bearing cap.

- (3) Install backup washer (33) in bearing cap (18).



**27-4. INTERMEDIATE STEERING GEAR REPAIR (CONT).**

**NOTE**

- Lip of high pressure seal must face away from backup washer.
- High pressure seal must be fully seated against backup washer.

- (4) Install high pressure seal (32) in bearing cap (18).

**NOTE**

- Lip of dirt seal must face away from backup washer.
- Dirt seal must be fully seated against backup washer.

- (5) Install dirt seal (34) in bearing cap (18).

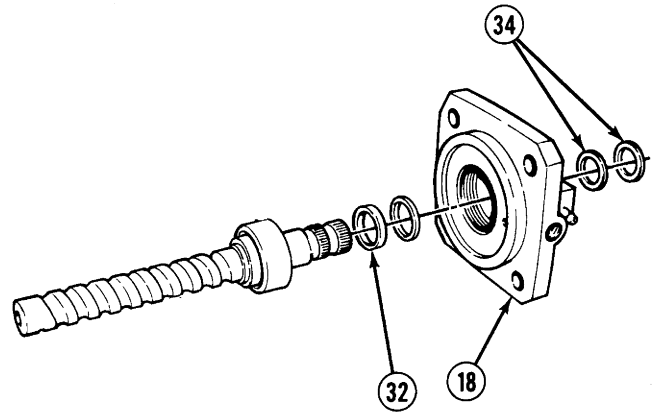
**NOTE**

- Lip of salt seal must face outside end of bearing cap.
- Outer edge of dirt seal must be flush with outside edge of bearing cap.

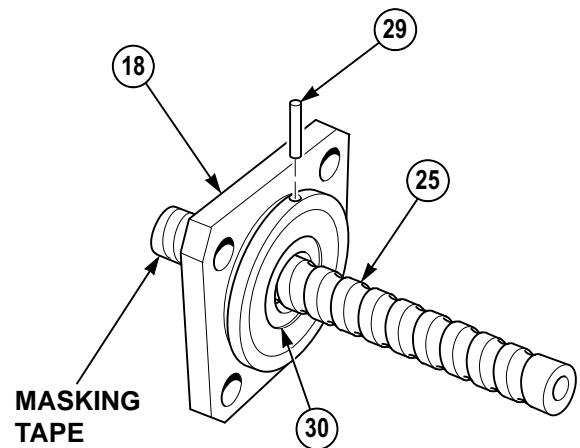
- (6) Install salt seal (34) in bearing cap (18).

- (7) Apply grease to lip of two seals (34).

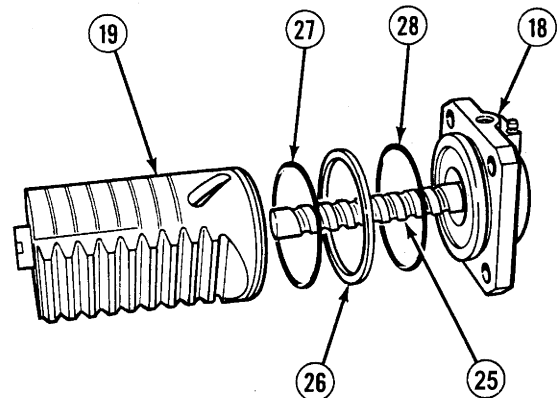
- (8) Apply hydraulic oil to lip of high pressure seal (32).



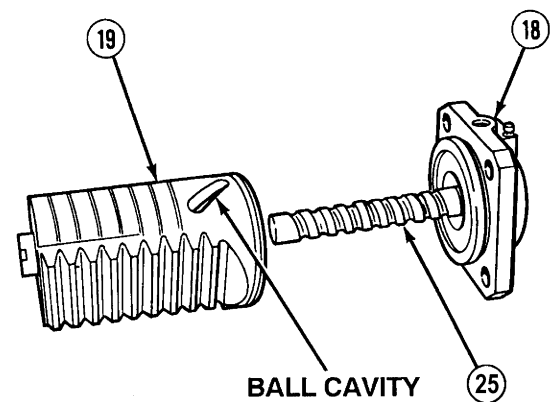
- (9) Wrap masking tape on splined end of actuating shaft (25).
- (10) Position actuating shaft (25) in bearing cap (18).
- (11) Install retaining nut (30) and locking pin (29) in bearing cap (18).
- (12) Remove masking tape from actuating shaft (25).



- (13) Apply hydraulic oil to preformed packing (28), (27) and ring (26).
- (14) Install preformed packing (28) on bearing cap (18).
- (15) Install preformed packing (27) and ring (26) on piston assembly (19).



- (16) Insert actuating shaft (25) and bearing cap (18) in piston assembly (19) until bearing cap (18) is within 3 in. (76 mm) from the face of piston assembly (19).
- (17) Position piston assembly (19) so that ball cavity is facing upward.

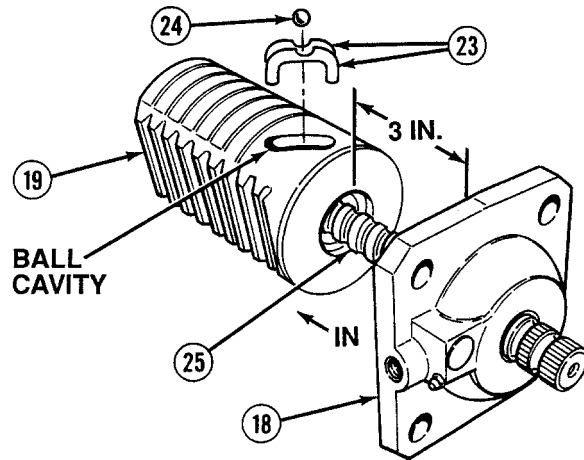


**27-4. INTERMEDIATE STEERING GEAR REPAIR (CONT).**

**CAUTION**

Insure that both halves of ball guides are pushed into the ball cavity entirely. Failure to do so will result in ball guides being pushed out of the piston assembly with possible loss of steel balls.

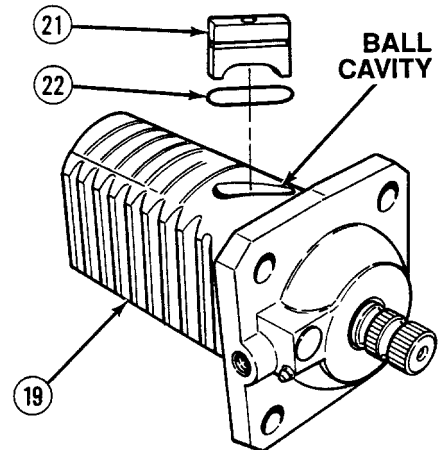
- (18) Install both halves of ball guides (23) in ball cavity in piston assembly (19).



**CAUTION**

Do not attempt to backout the actuating shaft from the piston assembly while installing steel balls in the ball cavity. This will cause steel balls to bind on the actuating shaft and shaft damage may occur.

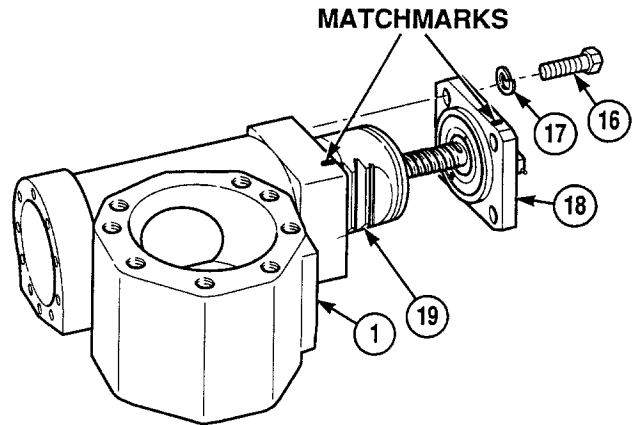
- (19) While installing the 24 steel balls (24) in the ball guides (23), slowly turn the actuating shaft (25) and bearing cap (18) into the piston assembly (19) until all steel balls (24) are installed.
- (20) Apply hydraulic oil to preformed packing (22).
- (21) Install preformed packing (22) on plug (21).
- (22) Install plug (21) in ball cavity in piston assembly (19) until flush with contour of piston assembly (19).



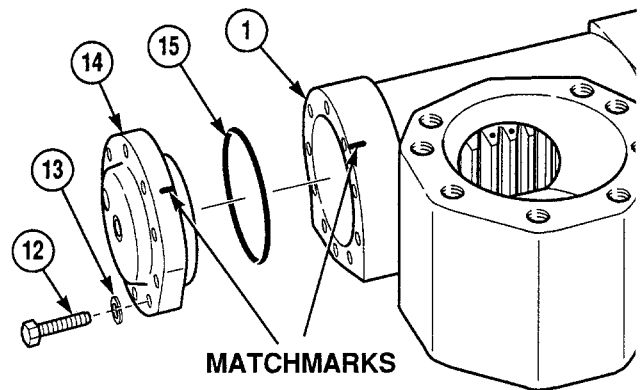
**NOTE**

Apply a light coat of hydraulic fluid on the piston assembly and in the piston bore.

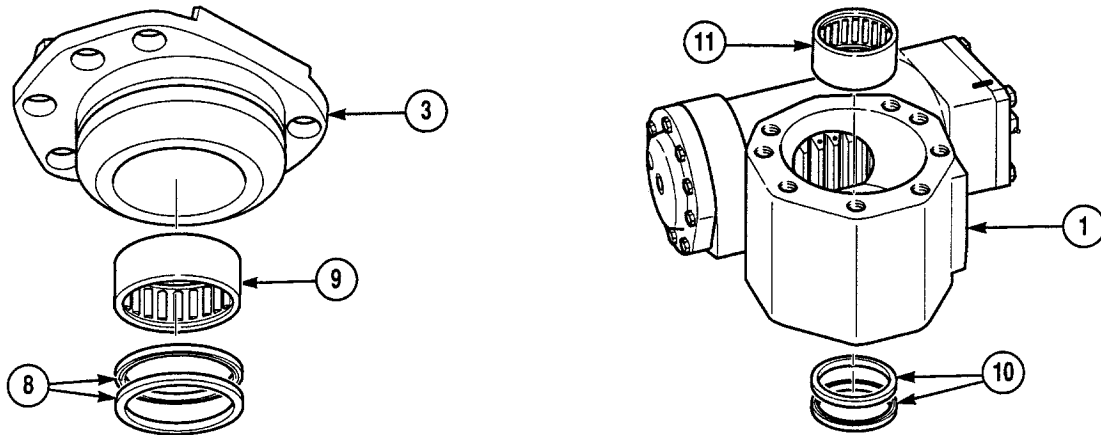
- (23) Install piston assembly (19) and bearing cap (18) in bore of steering gear assembly (1).
- (24) Align matchmarks and install bearing cap (18) on steering gear assembly (1) with four lockwashers (17) and screws (16). Tighten screws to 145 lb-ft (197 N·m).



- (25) Apply hydraulic oil to preformed packing (15).
- (26) Install preformed packing (15) on cylinder head (14).
- (27) Align matchmarks and install cylinder head (14) on steering gear assembly (1) with ten lockwashers (13) and screws (12). Tighten screws to 53 to 63 lb-ft (72 to 85 N·m).



**27-4. INTERMEDIATE STEERING GEAR REPAIR (CONT).**



**NOTE**

Perform Step (28) only if roller bearing was removed.

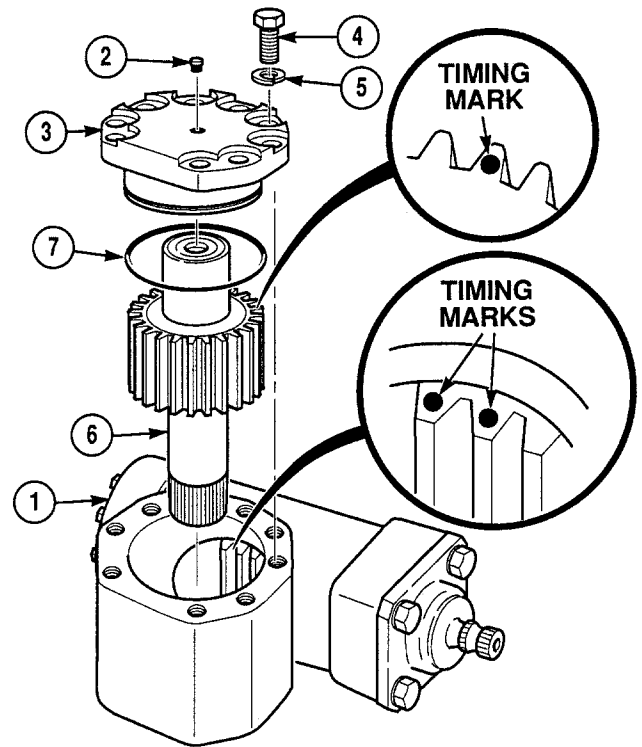
- (28) Install roller bearing (11) in steering gear assembly (1).
- (29) Install two-piece seal (10) in steering gear assembly (1).

**NOTE**

Perform Step (30) only if roller bearing was removed.

- (30) Install roller bearing (9) in cover (3).
- (31) Install two-piece seal (8) in cover (3).

- (32) Apply hydraulic oil to preformed packing (7).
- (33) Install preformed packing (7) on cover (3).
- (34) Align timing marks and install shaft (6) in steering gear assembly (1).
- (35) Install cover (3) on steering gear assembly (1) with eight lockwashers (5) and screws (4). Tighten screws to 145 lb-ft (197 N·m).
- (36) Install dust cap (2) in cover (3).
- (37) Remove steering gear assembly (1) from chain vise.



**END OF TASK**





## CHAPTER 28

### MATERIAL HANDLING CRANE AND SELF-RECOVERY WINCH MAINTENANCE

Para	Contents	Page
28-1	General Support Material Handling Crane And Self-Recovery Winch Maintenance Introduction .....	28-1
28-2	Erection Cylinder Repair .....	28-2
28-3	Lift Cylinder Repair .....	28-10
28-4	Tension Link Repair .....	28-19
28-5	Mast Assembly Repair .....	28-21
28-6	Telescope Cylinder Repair .....	28-24
28-7	Hoist Assembly Repair .....	28-30
28-8	Hydraulic Hoist Motor Repair .....	28-39
28-9	Swing Drive Gear Reducer Repair .....	28-43
28-10	Swing Drive Brake Repair .....	28-61
28-11	Outrigger Cylinder Repair .....	28-64
28-12	Hydraulic Motor Replacement .....	28-71
28-13	Self-Recovery Winch Brake Repair .....	28-73
28-14	Self-Recovery Winch Base Mount Replacement .....	28-78
28-15	Self-Recovery Winch Motor End Support Repair .....	28-81
28-16	Self-Recovery Winch Motor End Hub Repair .....	28-85
28-17	Self-Recovery Winch Ring Gear Assembly/Hub Drum Repair .....	28-88

#### Section I. INTRODUCTION

#### 28-1. GENERAL SUPPORT MATERIAL HANDLING CRANE AND SELF-RECOVERY WINCH MAINTENANCE INTRODUCTION.

This chapter contains maintenance instructions for repairing, replacing, installing and servicing the Material Handling Crane (MHC) and Self-Recovery Winch (SRW) components as authorized by the Maintenance Allocation Chart (MAC) at the General Support Maintenance level.

**Section II. MATERIAL HANDLING CRANE MAINTENANCE**

**28-2. ERECTION CYLINDER REPAIR.**

This task covers:

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

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Caps, Vise Jaw (Item 27, Appendix F)
- Compressor Unit, Air (Item 35 Appendix F)
- Gage Set, Telescoping (Item 69, Appendix F)
- Gloves, Chemical Oil Protective (Item 81 , Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Gun, Airblow (Item 86, Appendix F)
- Micrometer, Outside, Caliper, Set (Item 139, Appendix F)
- Pan, Drain 6 gal (Item 145, Appendix F)
- Press, 60 Ton (Item 164, Appendix F)
- Vise, Machinist's (Item 248, Appendix F)
- Vise, Pipe, Chain (Item 249, Appendix F)
- Wrench, Combination 1-1/8 in. (Item 255, Appendix F)
- Wrench, Torque (0-175 lb-ft [0-237 N·m]) (Item 277, Appendix F)
- Wooden Blocks (2) (Appendix C)

*Materials/Parts*

- Grease (Item 22, Appendix B)
- Oil, Hydraulic (Item 34, Appendix B)
- Sealing Compound (Item 56, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)
- Packing, Preformed (Item 336, Appendix E)
- Packing, Preformed (Item 347, Appendix E)
- Packing, Preformed (Item 389, Appendix E)
- Repair Kit (2) (Item 461, Appendix E)
- Repair Kit (Item 469, Appendix E)

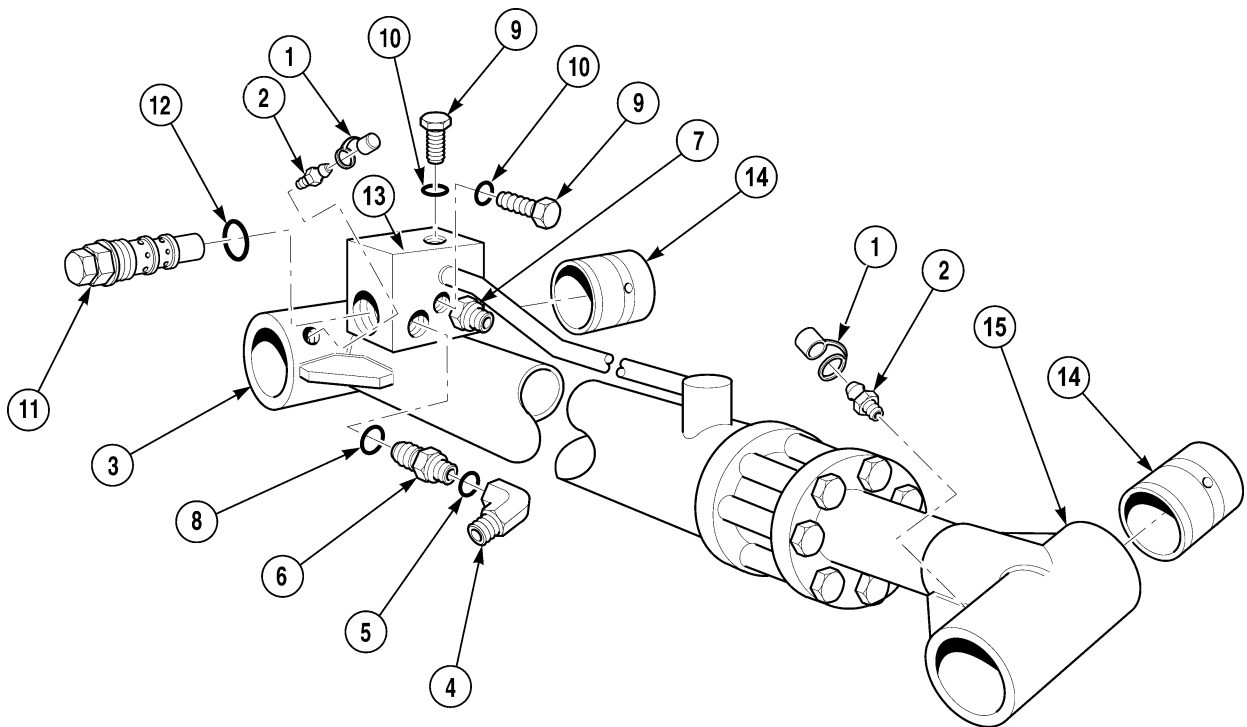
*Personnel Required*

Two

*Equipment Condition*

Erection cylinder on clean work surface

**a. Disassembly.**



**NOTE**

Note position and location of fittings, elbows, plugs and valves prior to removal.

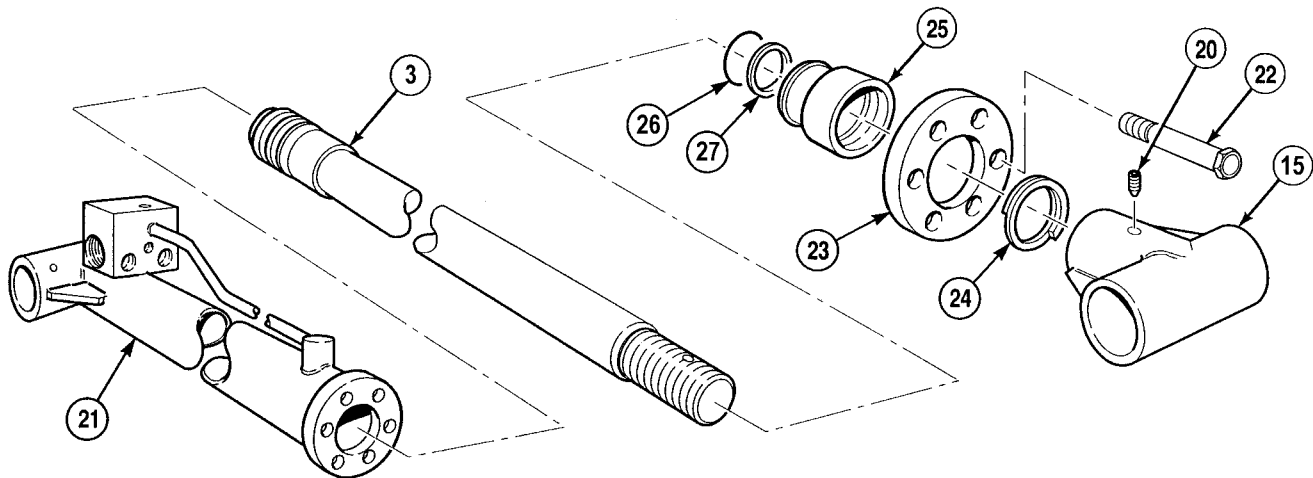
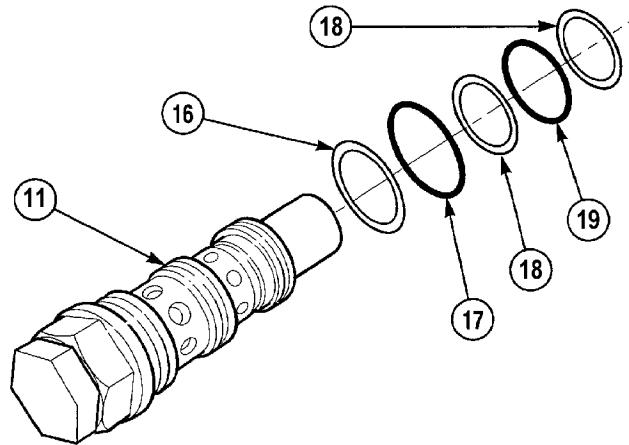
- (1) Remove four grease caps (1) and lube fittings (2) from erection cylinder (3).
- (2) Remove two elbows (4) and preformed packings (5) from adapters (6) and (7). Discard preformed packings.
- (3) Remove adapters (6) and (7) and preformed packings (8) from erection cylinder (3). Discard preformed packings.
- (4) Remove two plugs (9) and preformed packings (10). Discard preformed packings.
- (5) Remove two cartridge holding valves (11) and preformed packings (12) from erection cylinder manifold (13). Discard preformed packings.

**NOTE**

- There are two different types of weld head configurations. If there is a shoulder machined in the weld head between the bushings preventing the bushings from being pressed out, bushings must be tapped out from inside of weld head. If there is not a shoulder between bushings, both bushings can be pressed out from one side.
  - Perform Step (6) if bushings are damaged or worn.
- (6) Remove four bushings (14) from erection cylinder (3) and rod end (15).

**28-2. ERECTION CYLINDER REPAIR (CONT).**

- (7) Remove backup ring (16), preformed packing (17), two backup rings (18) and preformed packing (19) from holding valve (11). Discard preformed packings and backup rings.
- (8) Repeat Step (7) for remaining holding valve (11).



- (9) Remove setscrew (20) from rod end (15).

**CAUTION**

Cylinder must not be dented when held in vise, or leakage and improper operation may result.

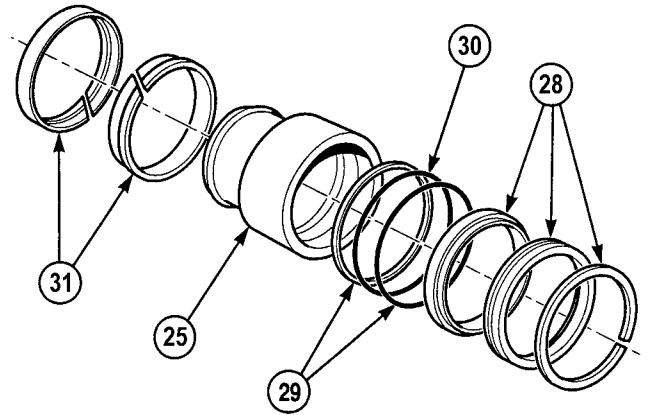
- (10) Position erection cylinder (3) in chain vise with wooden blocks.
- (11) Remove rod end (15) from cylinder rod (21).
- (12) Remove six screws (22) and retaining plate (23) from erection cylinder (3).
- (13) Remove seal (24) from retaining plate (23).

**NOTE**

- Weld head may have to be reinstalled to apply leverage while turning end cap.
- Place drain pan under cylinder.

- (14) Pull cylinder rod (21) and cylinder head (25) from erection cylinder (3). Remove end cap from rod.
- (15) Remove preformed packing (26) and backup ring (27) from cylinder head (25). Discard preformed packing.

- (16) Remove buffer seal assembly (28), backup ring (29), preformed packing (30), backup ring (29) and two split seals (31) from inside cylinder head (25). Discard seals, preformed packings and backup rings.



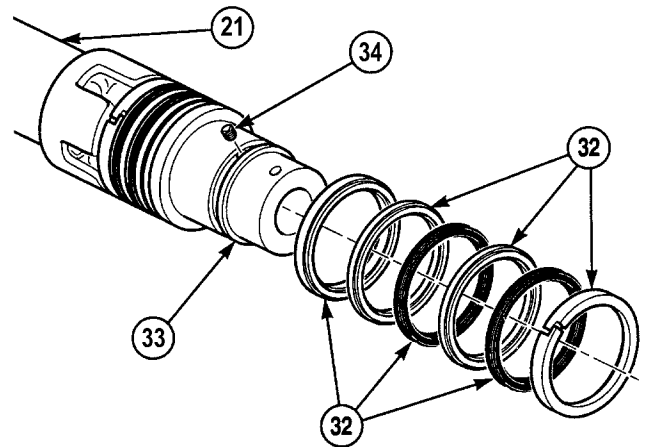
**NOTE**

Note position of seal assembly prior to removal.

- (17) Remove seal assembly (32) from piston (33). Discard seal assembly.



Do not clamp on machined surface of cylinder rod or damage will result. Clamp on welded boss portion of cylinder rod.



- (18) Position cylinder rod (21) in soft jaw vise.  
 (19) Remove setscrew (34) from piston (33).

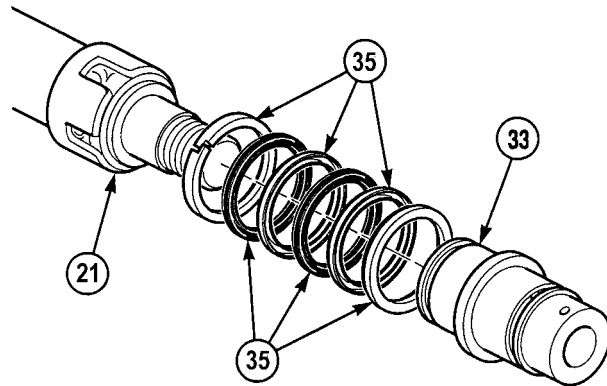
**28-2. ERECTION CYLINDER REPAIR (CONT).**

- (20) Remove piston (33) from cylinder rod (21).

**NOTE**

Note position of seal assembly prior to removal.

- (21) Remove seal assembly (35) from piston (33).  
Discard seal assembly.



**b. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 to personnel.

- (1) Clean all metal parts in drycleaning solvent.
- (2) Dry all parts with compressed air.
- (3) Inspect each part for cracks, bends, gouges or stripped threads.
- (4) Replace damaged parts.
- (5) Bushing inside diameter cannot be larger than 2.015 in. (51.18 mm). Replace worn bushings.

**c. Assembly.**

**NOTE**

Position seal assembly as noted prior to removal.

- (1) Apply hydraulic oil to seal assembly (35) and install on piston (33).



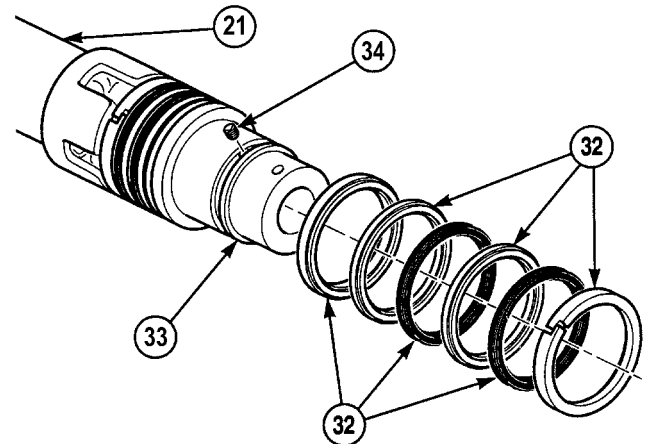
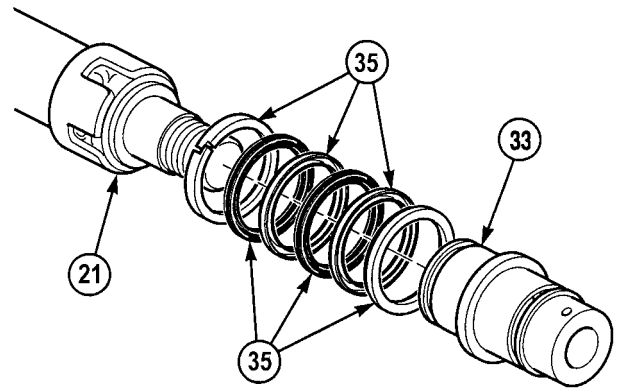
Do not clamp on machined surface of cylinder rod or damage will result. Clamp on welded boss portion of cylinder rod.

- (2) Position cylinder rod (21) in chain vise with wooden blocks



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.

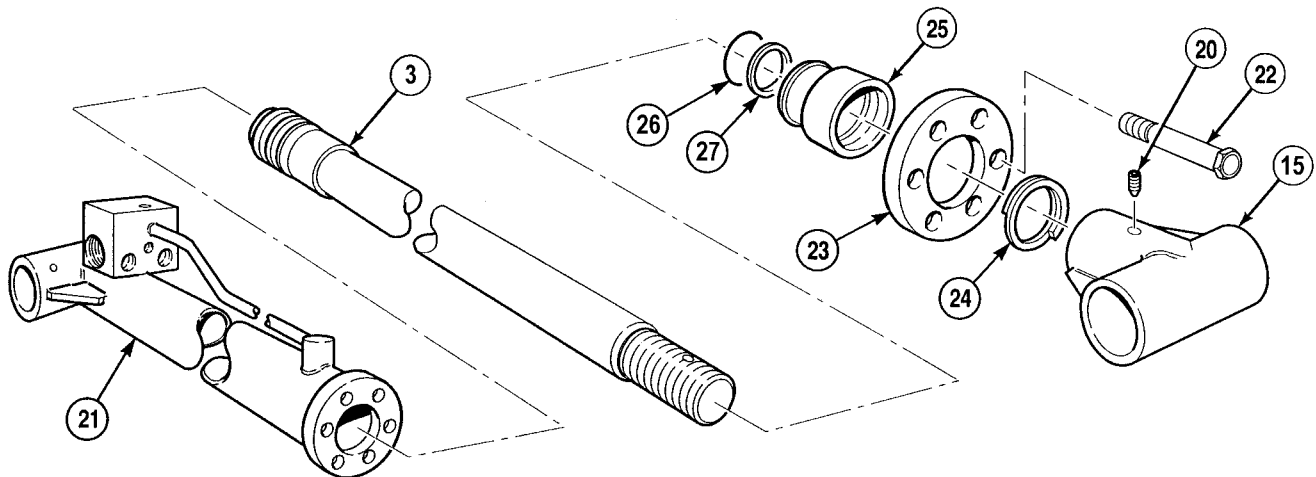
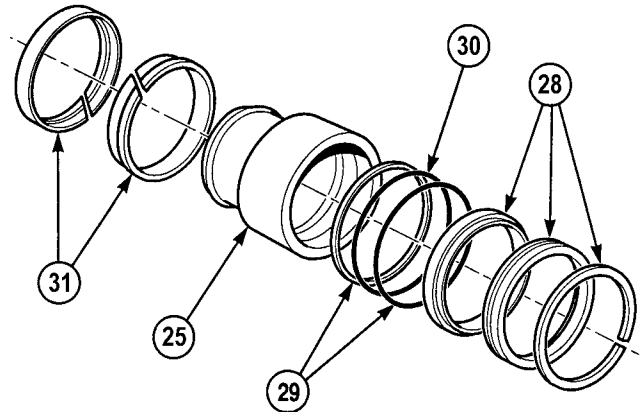
- (3) Coat threads of cylinder rod (21) with sealing compound.
- (4) Install piston (33) on cylinder rod (21) until setscrew holes line up.
- (5) Coat threads on setscrew (34) with sealing compound.
- (6) Install setscrew (34) in piston (33) and cylinder rod (21).
- (7) Apply hydraulic oil to seal assembly (32) and install on piston (33).





**28-2. ERECTION CYLINDER REPAIR (CONT).**

- (8) Apply hydraulic oil to two split seals (31), preformed packing (30), two backup rings (29), and buffer seal assembly (28) and install inside cylinder head (25).



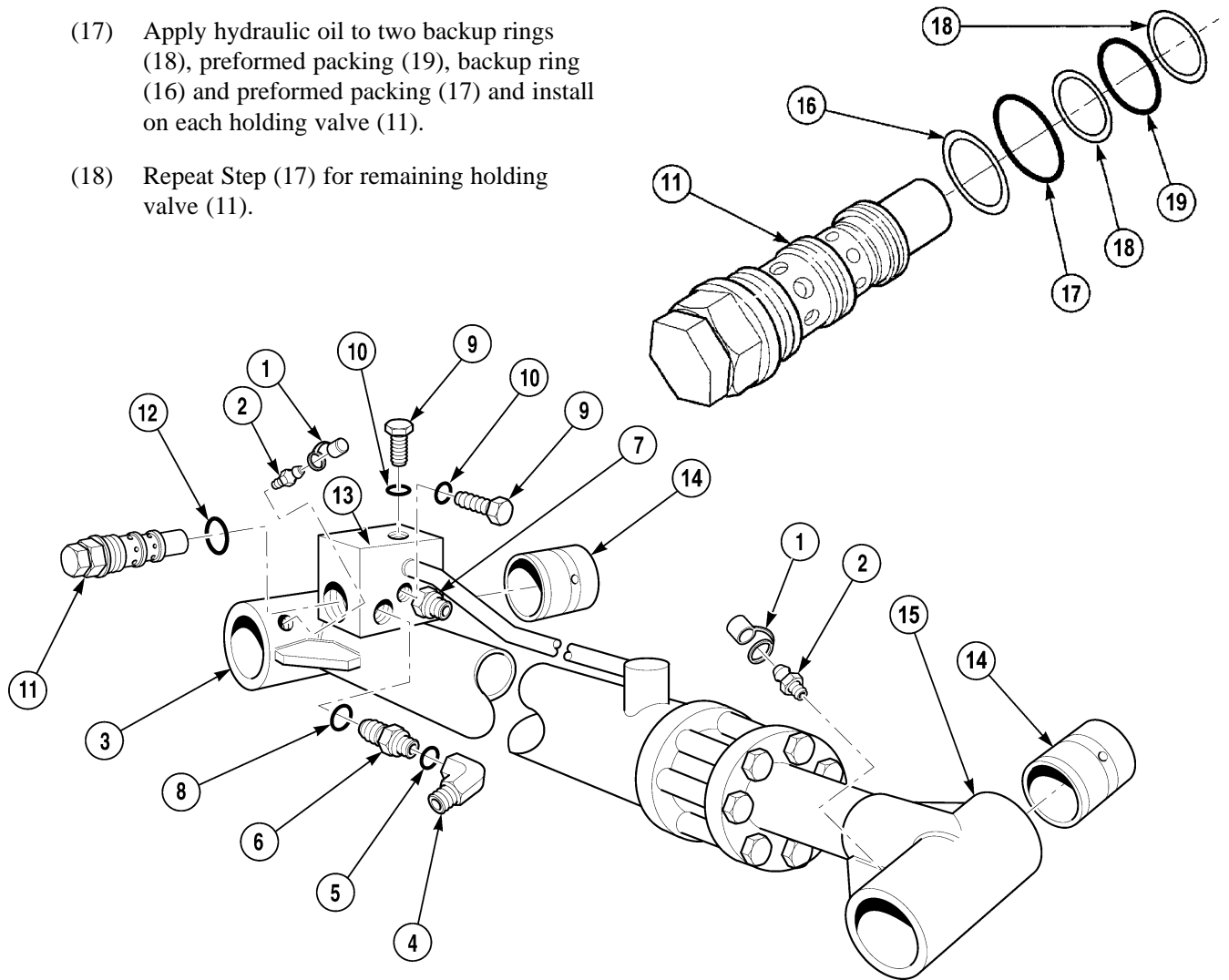
- (9) Apply hydraulic oil to backup ring (27) and preformed packing (26) and install on cylinder head (25).  
 (10) Install cylinder head (25) on cylinder rod (21).  
 (11) With the aid of an assistant, install cylinder rod (21) and cylinder head (25) in erection cylinder (3) while guiding rod and steadying cylinder.  
 (12) Apply hydraulic oil to preformed packing (24).  
 (13) Install seal (24) in retaining plate (23) and retaining plate on erection cylinder (3) with six screws (22). Tighten screws 43 to 47 lb-ft (58 to 64 N·m).

**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (14) Apply sealing compound on threads of setscrew (20).  
 (15) Coat threads of cylinder rod (21) with sealing compound.  
 (16) Install rod end (15) on cylinder rod (21) with setscrew (20).

- (17) Apply hydraulic oil to two backup rings (18), preformed packing (19), backup ring (16) and preformed packing (17) and install on each holding valve (11).
- (18) Repeat Step (17) for remaining holding valve (11).



**NOTE**

Perform Step (19) only if bushings were removed.

- (19) Using a press install four bushings (14) in erection cylinder (3) and rod end (15).
- (20) Apply hydraulic oil to two preformed packings (12) and install on holding valves (11).
- (21) Install two holding valves (11) on erection cylinder manifold (13).
- (22) Tighten two holding valves (11) to 50 to 55 lb-ft (68 to 75 N·m).
- (23) Apply hydraulic oil to two preformed packings (10) and install on plugs (9).
- (24) Install two plugs (9) on erection cylinder manifold (13).
- (25) Apply hydraulic oil to two preformed packings (8) and install on adapters (7) and (6).
- (26) Install adapters (7) and (6) on erection cylinder manifold (13).
- (27) Apply hydraulic oil to two preformed packings (5) and install on elbows (4).
- (28) Install two elbows (4) on adapters (7) and (6).
- (29) Install four lube fittings (2) and grease caps (1) on erection cylinder (3).

**END OF TASK**

**28-3. LIFT CYLINDER REPAIR.**

This task covers:

a. Disassembly

b. Cleaning/Inspection

c. Assembly

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's  
(Item 240, Appendix F)
- Compressor Unit, Air (Item 35, Appendix F)
- Gage Set, Telescoping (Item 69, Appendix F)
- Gloves, Chemical Oil Protective  
(Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Gun, Airblow (Item 86, Appendix F)
- Micrometer, Outside, Caliper, Set  
(Item 139, Appendix F)
- Pan, Drain 6 gal (Item 145, Appendix F)
- Press, 60 Ton (Item 164, Appendix F)
- Vise, Pipe, Chain (Item 249, Appendix F)
- Wrench, Chain (Item 253, Appendix F)
- Wrench, Combination, 1-3/8 in.  
(Item 258, Appendix F)

*Tools and Special Tools - Continued*

- Wrench, Torque (0-175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)
- Wooden Block (2) (Appendix C)

*Materials/Parts*

- Grease (Item 22, Appendix B)
- Oil, Hydraulic (Item 34, Appendix B)
- Sealing Compound (Item 56, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)
- Repair Kit (Item 460, Appendix E)
- Repair Kit (Item 467, Appendix E)
- Screw (Item 545, Appendix E)

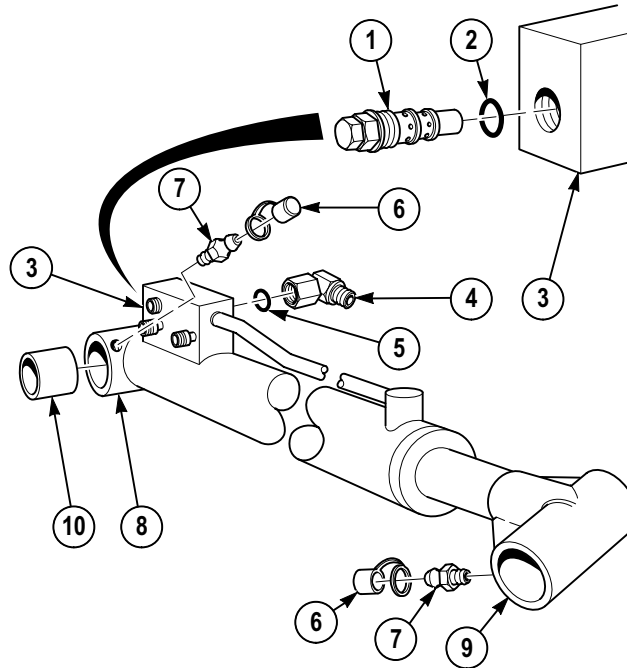
*Personnel Required*

Two

*Equipment Condition*

Lift cylinder on clean work surface

a. *Disassembly.*



**NOTE**

Left and right side lift cylinders are disassembled the same way.

- (1) Remove holding valve (1) and preformed packing (2) from lift cylinder manifold (3). Discard preformed packing.

**NOTE**

Note position of elbow prior to removal.

- (2) Remove elbow (4) and preformed packing (5) from lift cylinder manifold (3). Discard preformed packing.
- (3) Remove four grease caps (6) and lube fittings (7) from cylinder head (8) and rod weld end (9).

**NOTE**

- Perform Step (4) if bushings are damaged.
- There are two different types of weld head configurations. If there is a shoulder machined in the weld head between the bushings preventing the bushings from being pressed out, bushings must be tapped out from inside of weld head. If there is not a shoulder between bushings, both bushings can be pressed out from one side.

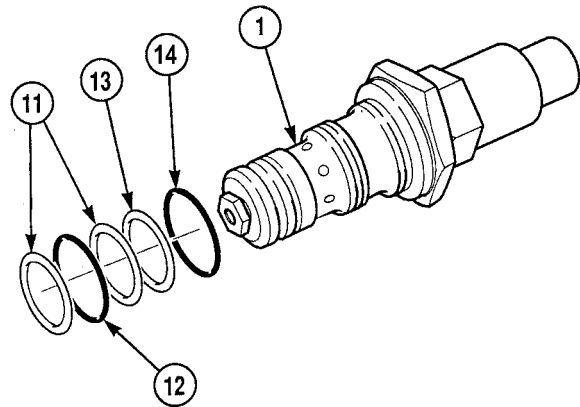
- (4) Remove four bushings (10) from cylinder head (8) and rod weld end (9).

**28-3. LIFT CYLINDER REPAIR (CONT).**

- (5) Remove two backup rings (11), preformed packing (12), and (13) and backup ring (14) from holding valve (1). Discard preformed packings and backup rings.

**CAUTION**

Cylinder must not be dented when held in vise, or leakage and improper operation may result.

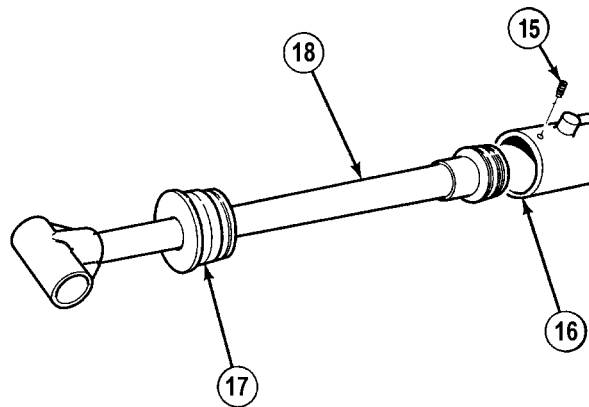


- (6) Remove setscrew (15) from cylinder barrel (16) and place barrel in chain vise with wooden blocks.

**NOTE**

Position drain pan under cylinder.

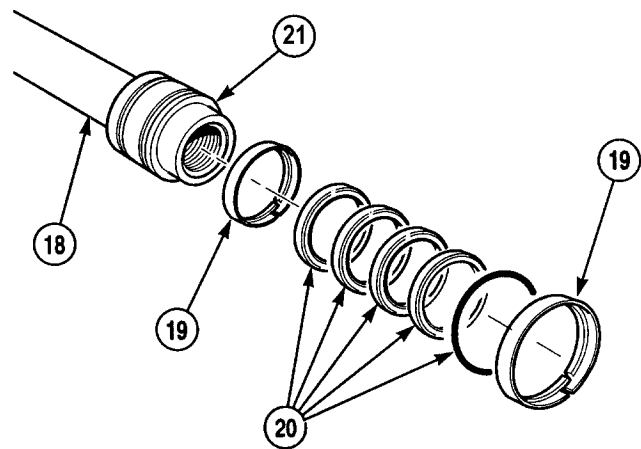
- (7) With the aid of an assistant, hold cylinder barrel (16) while unscrewing cylinder head (17).
- (8) With the aid of an assistant, hold cylinder barrel (16) while pulling cylinder head (17) out 5 in. (127 mm).
- (9) With the aid of an assistant, remove cylinder rod (18) from cylinder barrel (16).



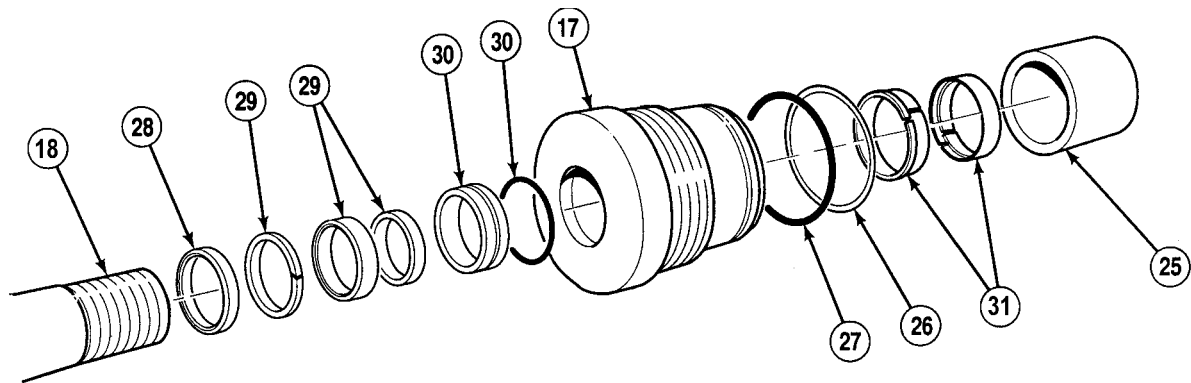
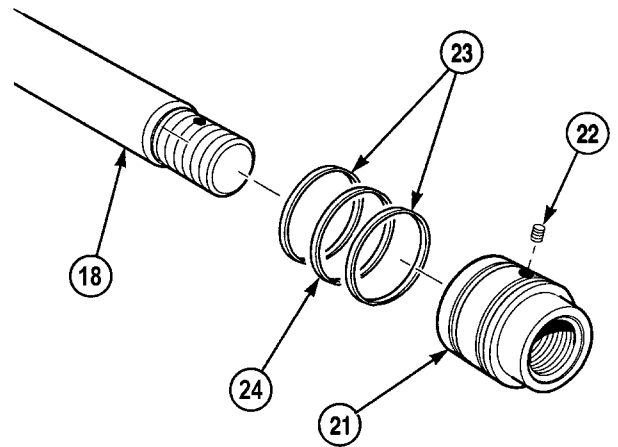
**NOTE**

Note position of hydro lock seals before removal.

- (10) Remove split seal (19), piston seal assembly (20) and split seal (19) from piston (21). Discard seal and piston seal assembly.



- (11) Remove setscrew (22) from piston (21).
- (12) Remove piston (21) from cylinder rod (18).
- (13) Remove two backup rings (23) and preformed packing (24) from inside piston (21). Discard preformed packing and backup rings.



- (14) Remove spacer (25) from cylinder rod (18).
- (15) Remove cylinder head (17) from cylinder rod (18).
- (16) Remove preformed packing (26) and backup ring (27) from outside cylinder head (17). Discard preformed packing and backup ring.
- (17) Remove seal (28), seal assembly (29), buffer seal assembly (30), and two split rings (31) from inside cylinder head (17). Discard seal assembly.

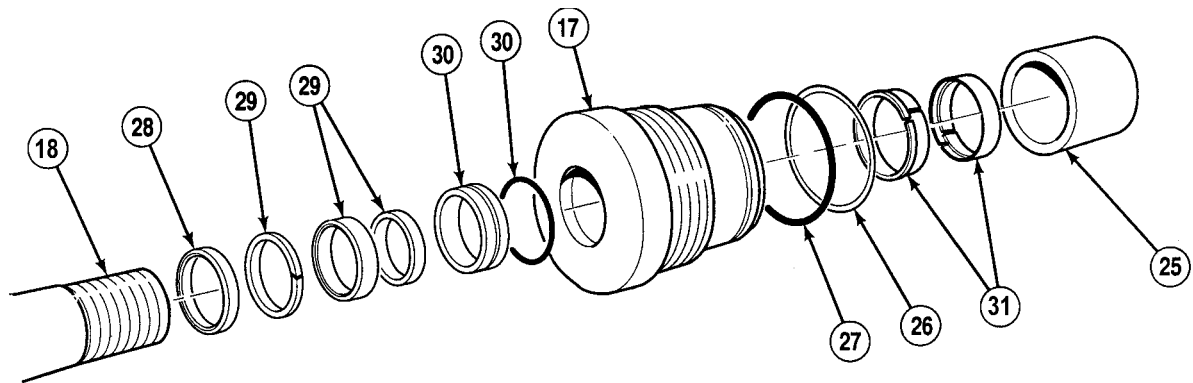
**28-3. LIFT CYLINDER REPAIR (CONT).**

*b. Cleaning/Inspection.*

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 to personnel.
- (1) Clean all metal parts in drycleaning solvent.
  - (2) Dry all parts with compressed air.
  - (3) Inspect each part for cracks, gouges, bends and stripped threads.
  - (4) Replace damaged parts.
  - (5) Bushing inside diameter cannot be larger than 2.020 in. (51.31 mm). Replace worn bushings.

**c. Assembly.**



**NOTE**

Left and right side lift cylinders are assembled the same way.

- (1) Apply hydraulic oil to buffer seal assembly (30), two split rings (31), seal assembly (29) and seal (28) and install inside cylinder head (17).
- (2) Apply hydraulic oil to backup ring (27) and preformed packing (26) and install on outside of cylinder head (17).

**NOTE**

Lubricate rod with hydraulic oil before installation.

- (3) Install cylinder head (17) on cylinder rod (18).
- (4) Install spacer (25) on cylinder rod (18).

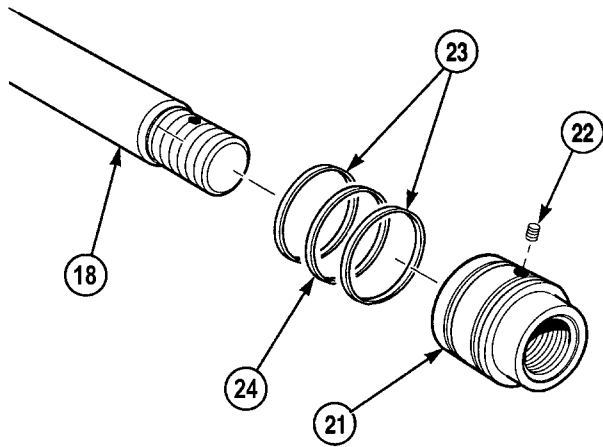


**28-3. LIFT CYLINDER REPAIR (CONT).**

- (5) Apply hydraulic oil to preformed packing (24) and two backup rings (23) and install inside piston (21).
- (6) Install piston (21) on cylinder rod (18), aligning setscrew holes.

**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.

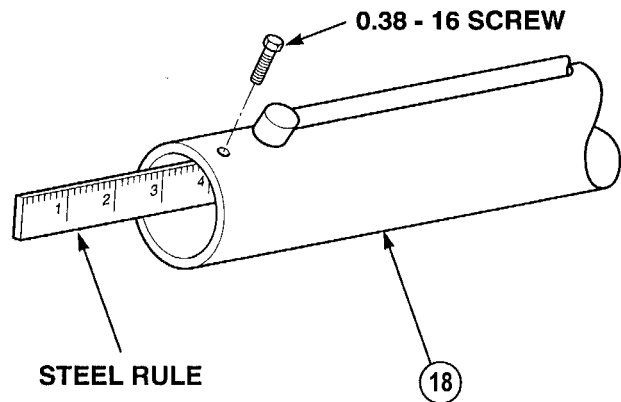


- (7) Apply sealing compound to threads of setscrew (22) and install in piston (21) and cylinder rod (18).

**CAUTION**

Ensure 0.38-16 screw is properly installed in cylinder rod. Failure to install screw properly may result in preformed packing in cylinder cap being damaged as cylinder cap is installed.

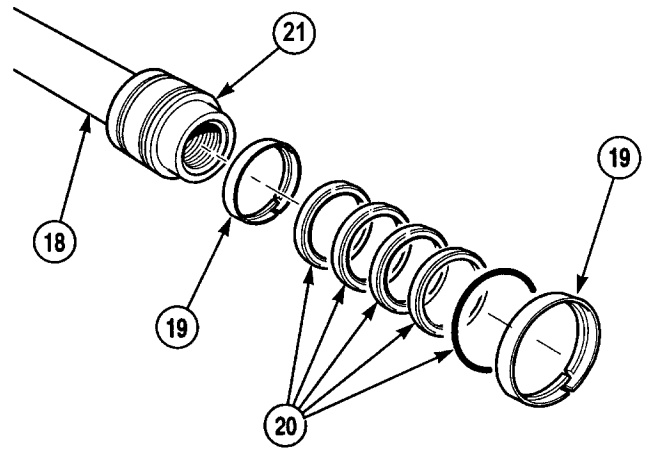
- (8) Hold edge of steel rule against the inside of the cylinder rod (18) and against setscrew hole.
- (9) Install a 0.38-16 screw into setscrew hole until screw touches edge of steel rule.
- (10) Back out 0.38-16 screw one flat and remove steel rule.



**NOTE**

Install seal as noted prior to removal.

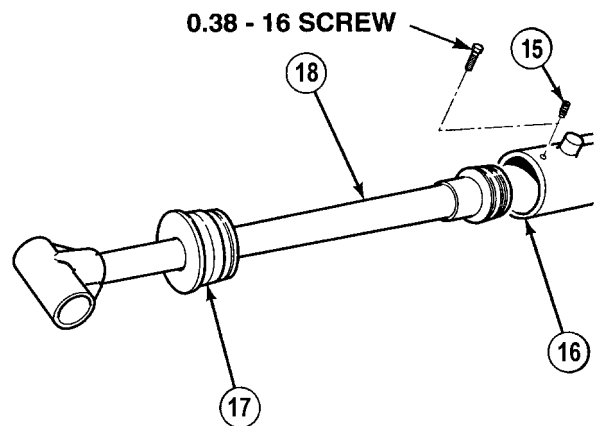
- (11) Apply hydraulic oil to split seal (19), piston seal assembly (20) and split seal (19) and install on piston (21).
- (12) With the aid of an assistant, install cylinder rod (18) in cylinder barrel (16).



- (13) Install cylinder head (17) in cylinder barrel (16).
- (14) Remove 0.38-16 screw and align set screw hole in cylinder rod (18) to hole in cylinder head (17).
- (15) Push cylinder rod (18) into cylinder barrel (16) to cylinder head (17).

**WARNING**

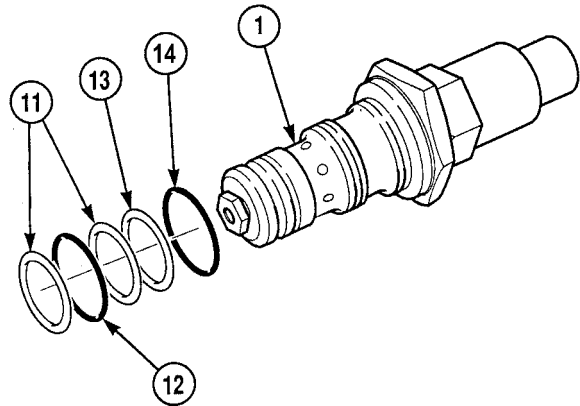
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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



- (16) Apply sealing compound to threads of setscrew (15) and install in cylinder barrel (16).

**28-3. LIFT CYLINDER REPAIR (CONT).**

- (17) Apply hydraulic oil to backup ring (14), performed packing (13), backup ring (11), performed packing (12) and backup ring (11) and install on holding valve (1).



**NOTE**

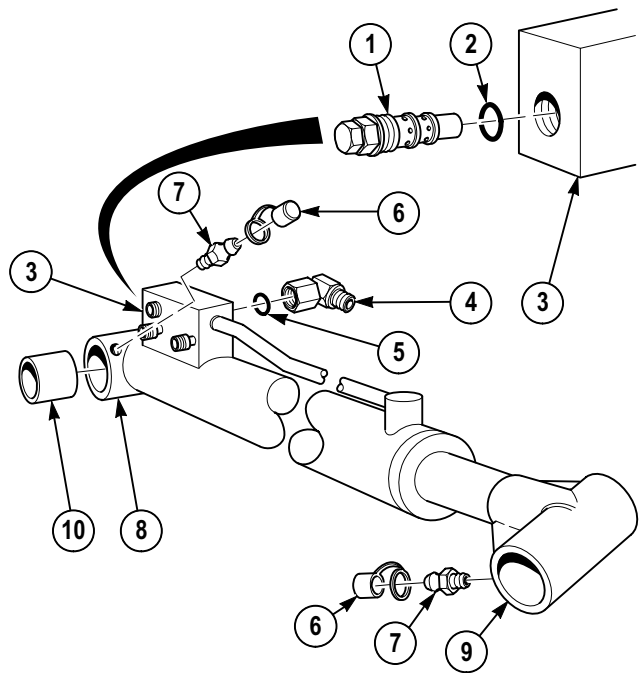
Perform Step (18) and (19) only if bushings were removed.

- (18) Apply grease to outside diameter of four bushings (10).
- (19) Install four bushings (10) in cylinder head (8) and rod weld end (9).
- (20) Install four lube fittings (7) and grease caps (6) in cylinder head (8) and rod weld end (9).

**NOTE**

Install elbow in same position as noted prior to removal.

- (21) Apply hydraulic oil to preformed packing (5) and (2).
- (22) Install preformed packing (5) and elbow (4) in lift cylinder manifold (3).
- (23) Install preformed packing (2) and holding valve (1) in lift cylinder manifold (3).
- (24) Tighten holding valve (1) to 50 to 55 lb-ft (68 to 75 N·m).



**END OF TASK**



**28-4. TENSION LINK REPAIR. (CONT).**

**b. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 to personnel.

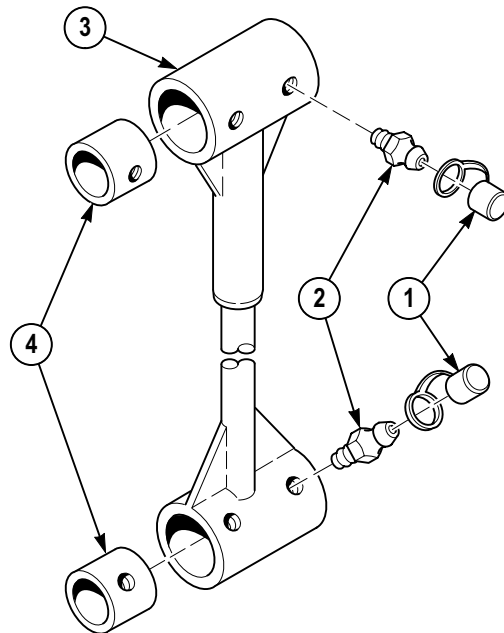
- (1) Clean all metal parts in drycleaning solvent.
- (2) Dry all parts with compressed air.
- (3) Inspect each part for nicks, burrs, scratches or dents.
- (4) Replace damaged parts.
- (5) Bushing inside diameter must not exceed 2.015 in. (51.18 mm). Replace worn bushings.

**c. Assembly.**

**NOTE**

Perform Steps (1) and (2) only if bushings were removed.

- (1) Apply grease to outside diameter of four bushings (4).
- (2) Using press install four bushings (4) in tension cylinder (3).
- (3) Install four lube fittings (2) and grease caps (1) in tension cylinder (3).



**END OF TASK**



**28-5. MAST ASSEMBLY REPAIR. (CONT).**

***b. Cleaning/Inspection.***

**WARNING**

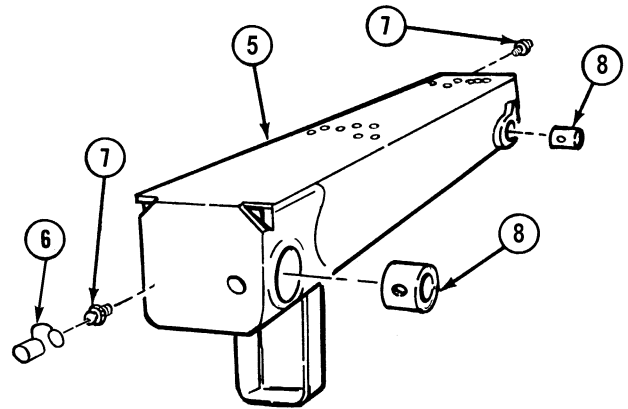
- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes, and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent. The flashpoint for Type II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 to personnel.
- (1) Clean all metal parts in drycleaning solvent.
  - (2) Dry all parts using compressed air.
  - (3) Inspect each part for nicks, burrs, scratches or dents.
  - (4) Replace damaged parts.
  - (5) Bushing diameter must not be greater than 2.015 in. (51.18 mm). Replace worn bushings.

**c. Assembly.**

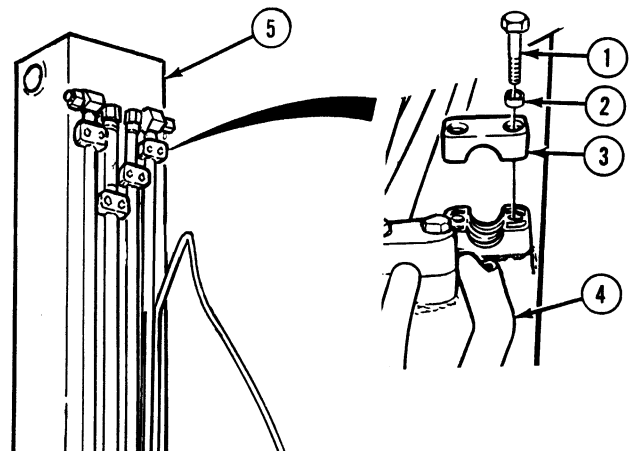
**NOTE**

Perform Step (1) only if bushings were removed.

- (1) Apply grease to outside diameter of four bushings (8).
- (2) Using press install four bushings (8) in mast (5).
- (3) Install four lube fittings (7) and grease caps (6) in mast (5).



- (4) Install 5 tubes (4) on mast (5) with 10 clamp halves (3), 16 washers (2) and screws (1).



**END OF TASK**



**28-6. TELESCOPE CYLINDER REPAIR.**

This task covers:

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

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Caps, Vise Jaw (Item 27, Appendix F)
- Compressor Unit, Air (Item 35, Appendix F)
- Gage Set, Telescoping (Item 69, Appendix F)
- Gloves, Chemical Oil Protective (Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Gun, Airblow (Item 86, Appendix F)
- Micrometer, Outside, Caliper, Set (Item 139, Appendix F)
- Pan, Drain 6 gal (Item 145, Appendix F)
- Press, 60 Ton (Item 164, Appendix F)
- Vise, Machinist's (Item 248, Appendix F)
- Vise, Pipe, Chain (Item 249, Appendix F)
- Wrench, Combination, 1-1/8 in. (Item 255, Appendix F)

*Tools and Special Tools - Continued*

- Wrench, Torque (0-175 lb-ft [0-237 N·m]) (Item 277, Appendix F)
- Wooden Blocks (2) (Appendix C)

*Materials/Parts*

- Grease (Item 22, Appendix B)
- Oil, Hydraulic (Item 34, Appendix B)
- Sealing Compound (Item 56, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)
- Tags, Identification (Item 72, Appendix B)
- Repair Kit (Item 465, Appendix E)
- Repair Kit (Item 467, Appendix E)

*Personnel Required*

Two

*Equipment Condition*

Telescope cylinder on clean work surface

a. **Disassembly.**

**NOTE**

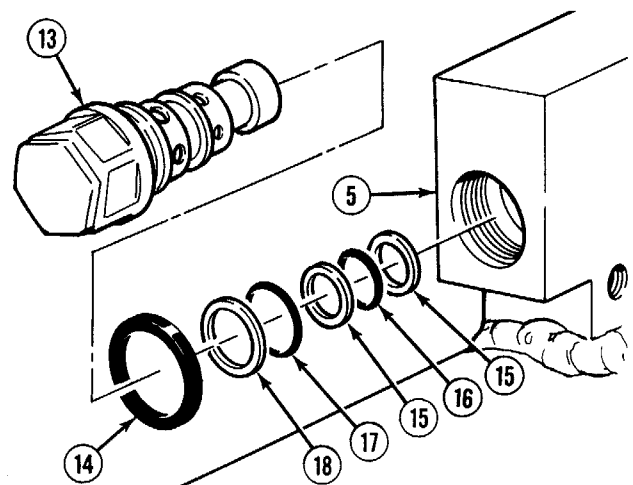
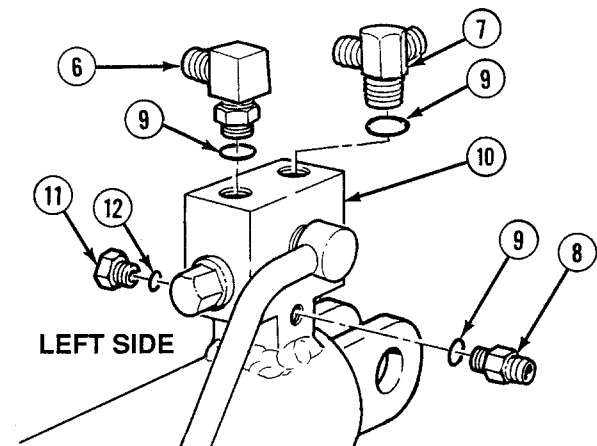
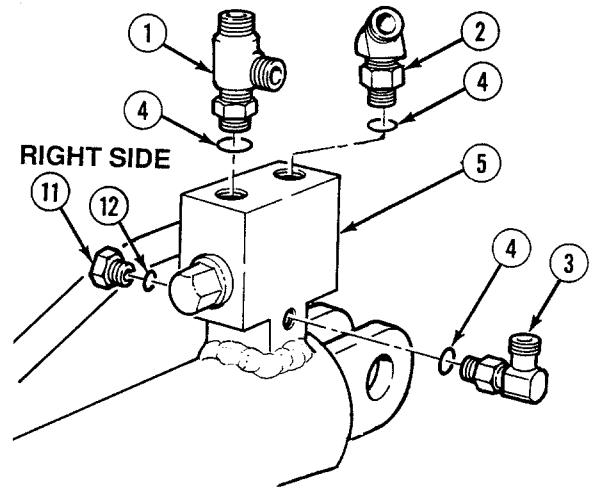
- Fittings for left and right side telescope cylinders are different. Perform Step (1) for right side cylinder and Step (2) for left side cylinder.
- Note positions of fittings and elbows prior to removal.

- (1) Remove tee (1), elbows (2) and (3) and three preformed packings (4) from right side telescope cylinder manifold (5). Discard preformed packings.
- (2) Remove elbow (6), tee (7), adapter (8) and three preformed packings (9) from left side telescope cylinder manifold (10). Discard preformed packings.

**NOTE**

Left and right side telescope cylinders are disassembled the same way from Step (3) on.

- (3) Remove plug (11) and preformed packing (12) from telescope cylinder manifold (5) or (10). Discard preformed packings.
- (4) Remove holding valve (13) and preformed packing (14) from manifold (5) or (10). Discard preformed packing.
- (5) Remove backup ring (15), preformed packing (16), backup ring (15), preformed packing (17) and backup ring (18) from holding valve (13). Discard preformed packings and backup rings.



**28-6. TELESCOPE CYLINDER REPAIR (CONT).**

**NOTE**

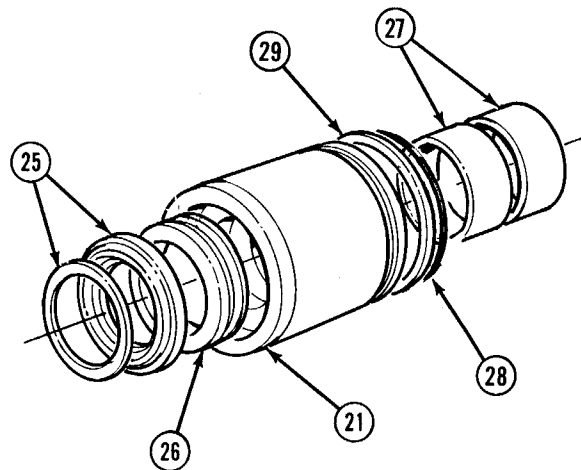
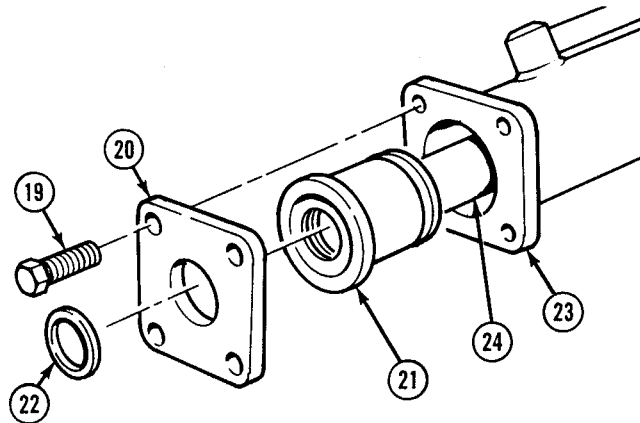
Place cylinder head and end over drain pan.

- (6) Remove four screws (19) and retaining plate (20) from cylinder head (21). Remove and discard seal (22) from plate (20).



Cylinder must not be dented when held in vise, or leakage and improper operation may result.

- (7) Place cylinder barrel (23) in chain vise with wooden blocks and pull cylinder head (21) from cylinder barrel.
- (8) Remove cylinder head (21) from cylinder rod (24).
- (9) Remove two-piece rod seal assembly (25), and buffer seal assembly (26) from inside cylinder head (21). Discard seal assemblies.
- (10) Remove and discard two wear rings (27) from inside cylinder head (21).
- (11) Remove preformed packing (28) and backup ring (29) from outside cylinder head (21). Discard preformed packing and backup ring.

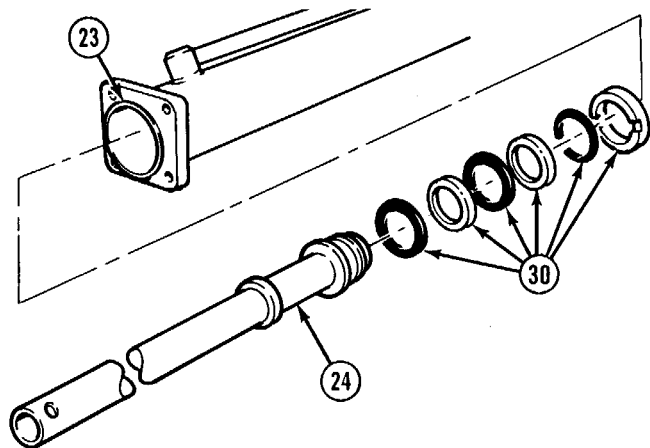


- (12) Remove cylinder rod (24) from cylinder barrel (23).

**NOTE**

Note position of seal assembly before removal.

- (13) Remove and discard seal assembly (30) from cylinder rod (24).



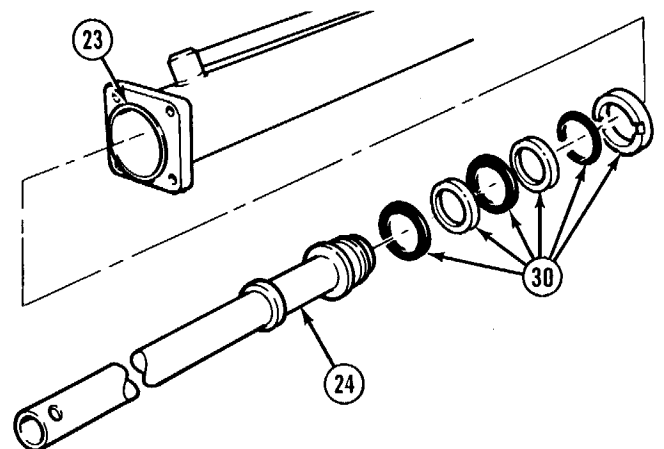
**b. Cleaning/Inspection.****WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 to personnel.
- (1) Clean all metal parts in drycleaning solvent.
  - (2) Dry all parts with compressed air.
  - (3) Inspect each part for nicks, burrs, scratches or dents.
  - (4) Replace damaged parts.

**c. Assembly.****NOTE**

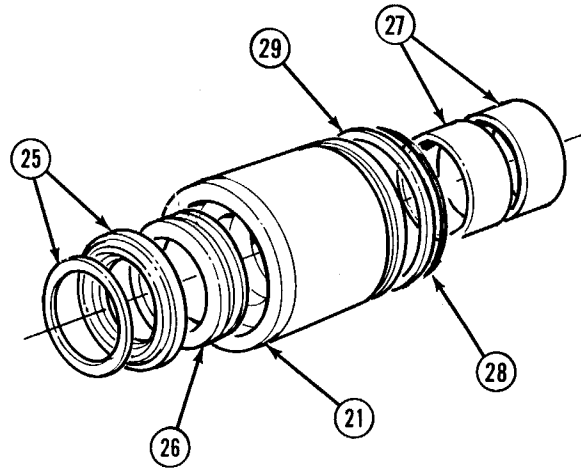
Position seal assembly as noted during removal.

- (1) Install seal assembly (30) on cylinder rod (24).
- (2) Install cylinder rod (24) in cylinder barrel (23).



**28-6. TELESCOPE CYLINDER REPAIR (CONT).**

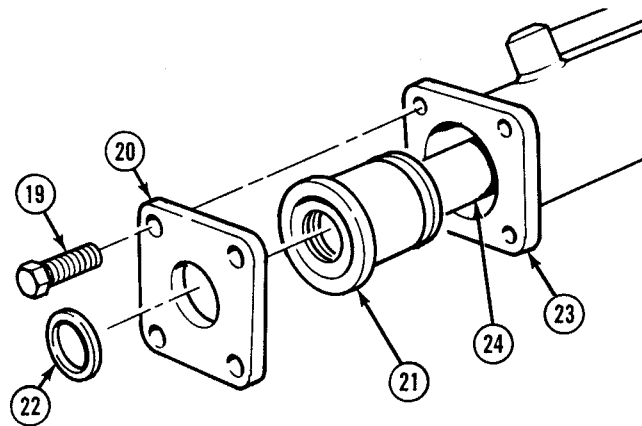
- (3) Install two wear rings (27) inside cylinder head (21).
- (4) Apply hydraulic oil to buffer seal assembly (26) and install inside cylinder head (21).
- (5) Apply hydraulic oil to two-piece rod seal assembly (25) and install inside cylinder head (21).
- (6) Apply hydraulic oil to backup ring (29) and preformed packing (28) and install on outside of cylinder head (21).
- (7) With the aid of an assistant, hold cylinder rod (24) while installing cylinder head (21).
- (8) Install seal (22) in retaining plate (20).



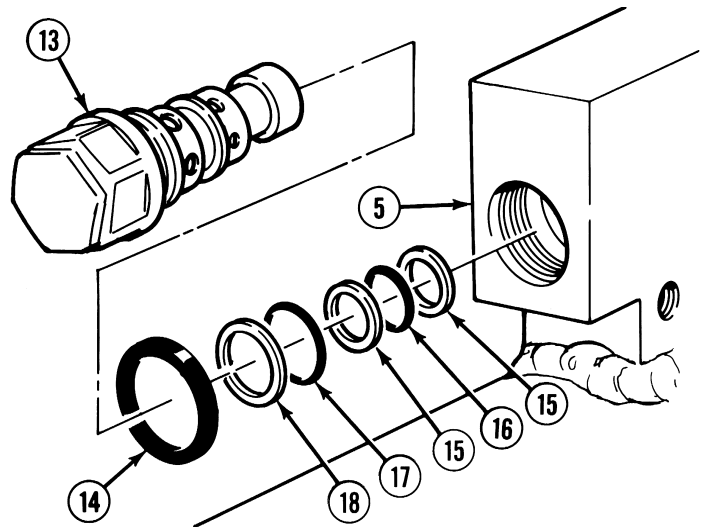
**WARNING**

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.

- (9) Apply sealing compound to threads of four screws (19) and install retaining plate (20) with screws. Tighten screws 43 to 47 lb-ft (58 to 64 N·m).



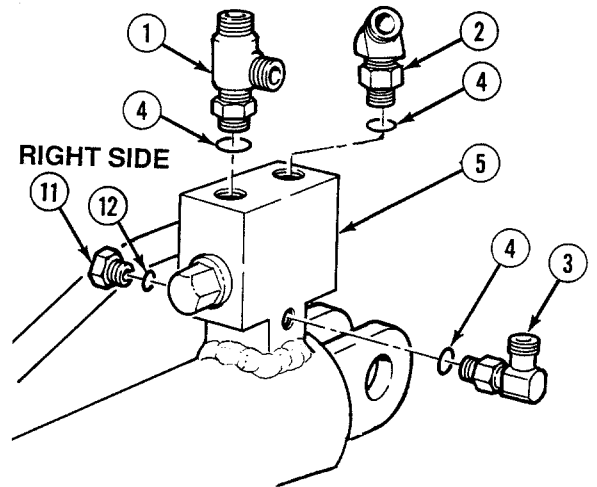
- (10) Apply hydraulic oil to backup ring (18), preformed packing (17), backup ring (15), preformed packing (16) and backup ring (15) and install on holding valve (13).
- (11) Apply hydraulic oil to preformed packing (14).
- (12) Install preformed packing (14) and holding valve (13) in manifold (5) or (10).
- (13) Tighten holding valve (13) to 50 to 55 lb-ft (68 to 75 N·m).



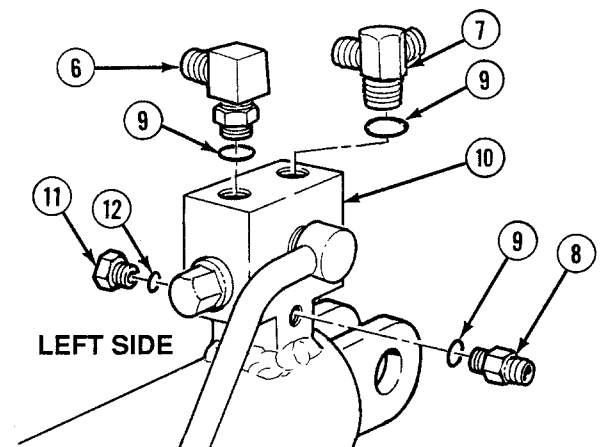
- (14) Apply hydraulic oil to preformed packing (12).
- (15) Install plug (11) and preformed packing (12) in manifold (5) or (10).

**NOTE**

Fittings for left and right side telescope cylinders are different. Perform Step (16) for left side cylinder and Step (17) for right side cylinder.



- (16) Apply hydraulic oil to three preformed packing (9) and (4).
- (17) Install three preformed packings (9), adapter (8), elbows (7) and (6) in left side telescope cylinder manifold (10).
- (18) Install three preformed packings (4), two elbows (2) and (3) and tee (1) in right side telescope cylinder manifold (5).



**END OF TASK**



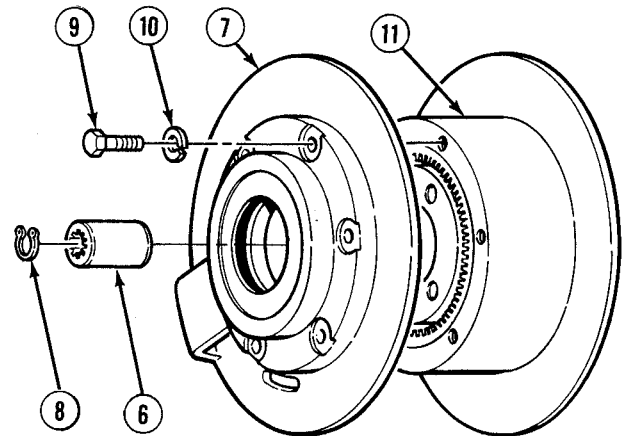
**NOTE**

Perform Step (3) if coupling stays with drum end.

- (3) Remove coupling (6) from drum end (7).

**WARNING**

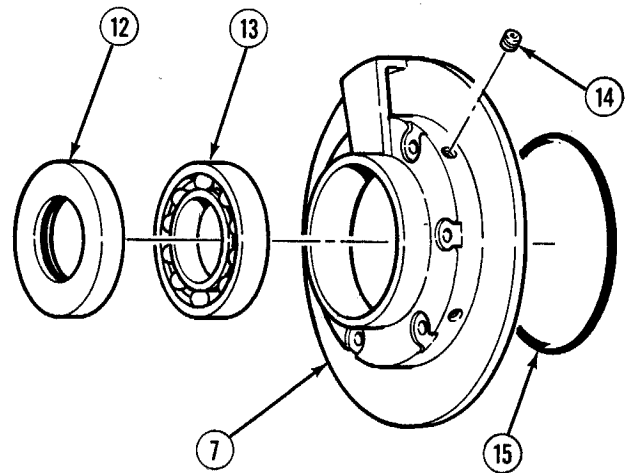
Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.



**NOTE**

Perform Step (4) if retaining ring is damaged.

- (4) Remove retaining ring (8) from coupling (6). Discard retaining ring.
- (5) Remove six screws (9), lockwashers (10) and drum end (7) from ring gear (11). Discard lockwashers.
- (6) Remove oil seal (12) and bearing (13) from drum end (7). Discard oil seal.



**NOTE**

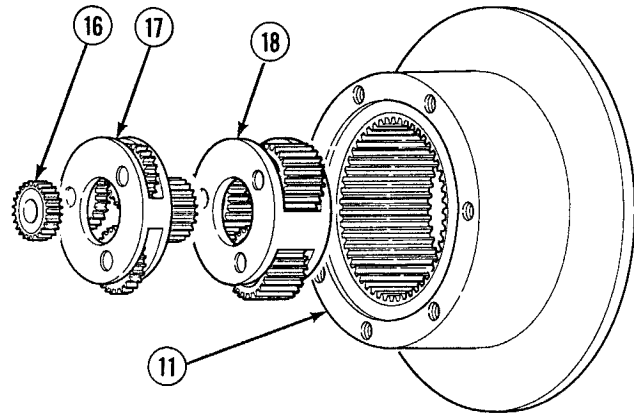
Perform Step (7) if plugs are damaged.

- (7) Remove two plugs (14) from drum end (10).
- (8) Remove and discard preformed packing (15).



**28-7. HOIST ASSEMBLY REPAIR (CONT).**

- (9) Remove spur gear (16) and planetaries (17) and (18) from ring gear (11).



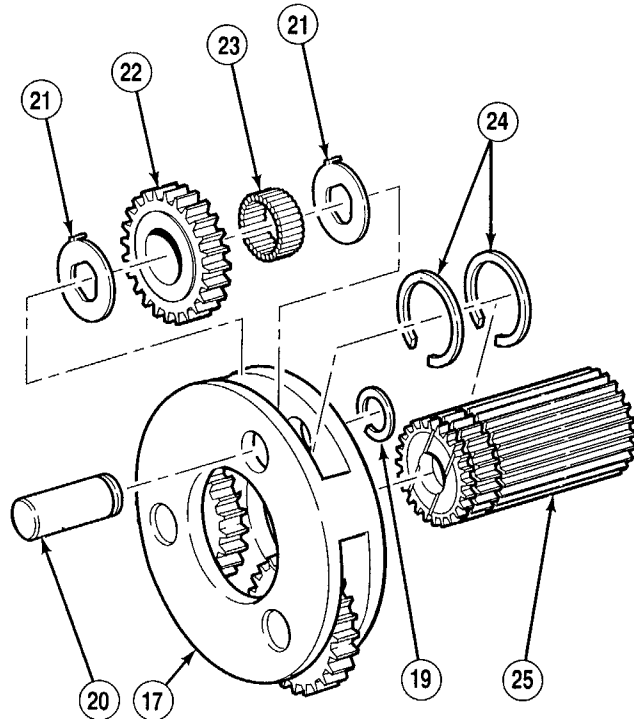
**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

**NOTE**

Use care when removing gear, or rollers may fall.

- (10) Remove lock ring (19), shaft (20), two washers (21), gear (22) and 17 needle bearings (23). Discard lock ring.
- (11) Repeat Step (10) for two remaining gears (22).
- (12) Remove retaining ring (24) and drive gear (25) from planetary (17). Discard retaining ring.
- (13) Remove retaining ring (24) from drive gear (25). Discard retaining ring.



**WARNING**

Use care when removing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

**NOTE**

Use care when removing gear, or rollers may fall.

- (14) Remove lock ring (26), shaft (27), two washers (28), gear (29), 34 roller bearings (30) and retaining ring (31) from planetary (18). Discard lock ring.

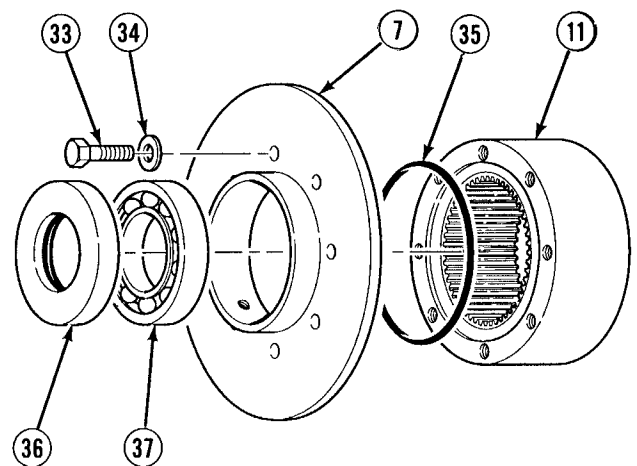
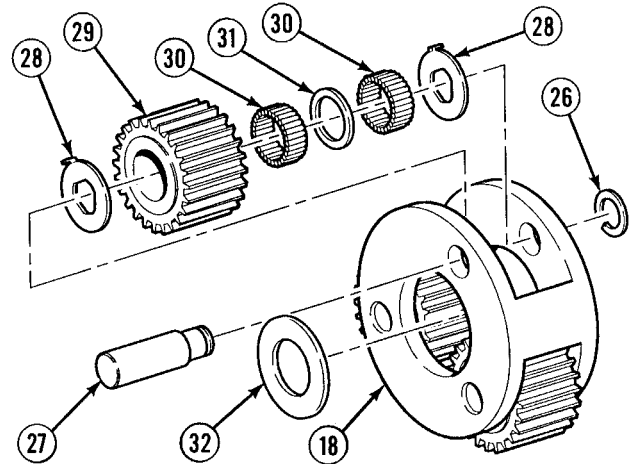
- (15) Repeat Step (14) for two remaining gears (29).

- (16) Remove washer (32) from planetary (18).

- (17) Remove eight screws (33), washers (34) and drum end (7) from ring gear (11).

- (18) Remove and discard preformed packing (35) from drum end (7).

- (19) Remove oil seal (36) and bearing (37) from drum end (7). Discard oil seal.

**b. Cleaning/Inspection.****WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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.

**28-7. HOIST ASSEMBLY REPAIR (CONT).**

- (1) Clean all metal parts in drycleaning 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 to personnel.

- (2) Dry all metal parts with compressed air. Allow bearings to air dry.
- (3) Inspect each part for nicks, burrs, scratches or dents.
- (4) Replace damaged parts.

**c. Assembly.**

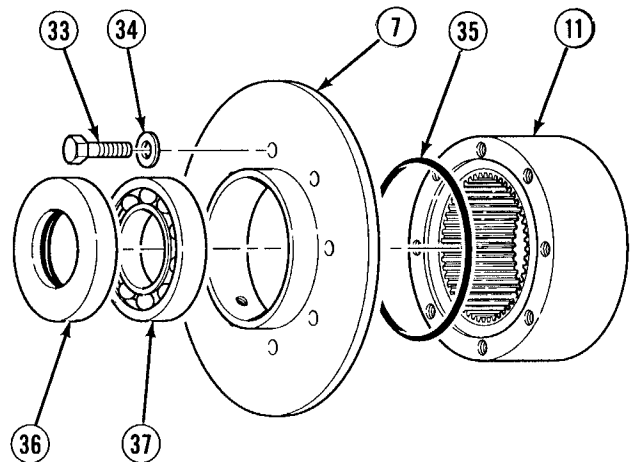
**NOTE**

Large slot in bearing faces down.

- (1) Install bearing (37) and oil seal (36) in drum end (7).

**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.



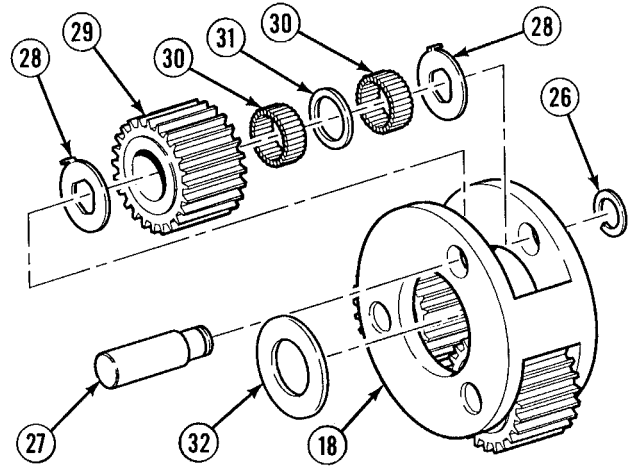
- (2) Apply adhesive to drum end (7) and install preformed packing (35) on drum end (7).
- (3) Apply sealing compound to threads of eight screws (33).
- (4) Install drum end (7) on ring gear (11) with eight washers (34) and screws (33). Tighten screws to 216 lb-in (24 N·m).

- (5) Position washer (33) in planetary (18).

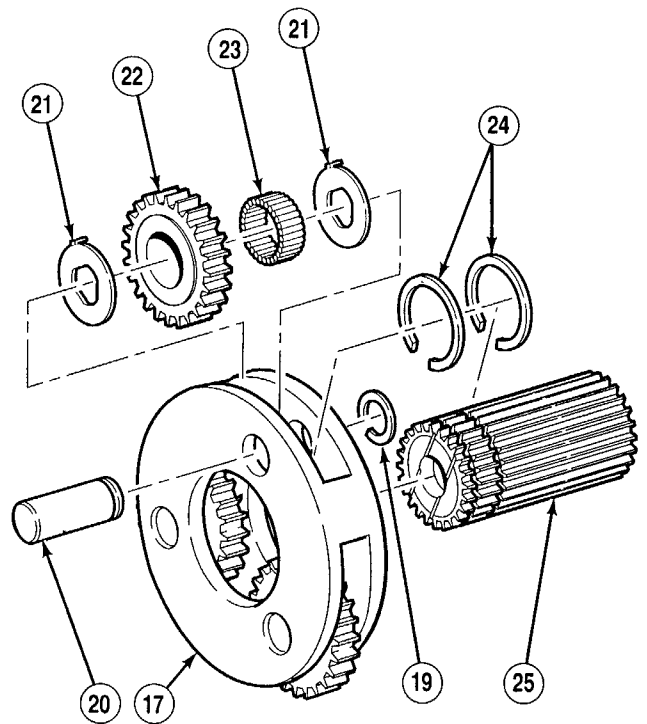
**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

- (6) Install 34 roller bearings (30) and retaining ring (31) in gear (29).
- (7) Install gear (29) and two washers (28) in planetary (18).
- (8) Align and install shaft (27) with retaining ring (26).
- (9) Repeat Steps (6) through (8) for remaining two gears (29).

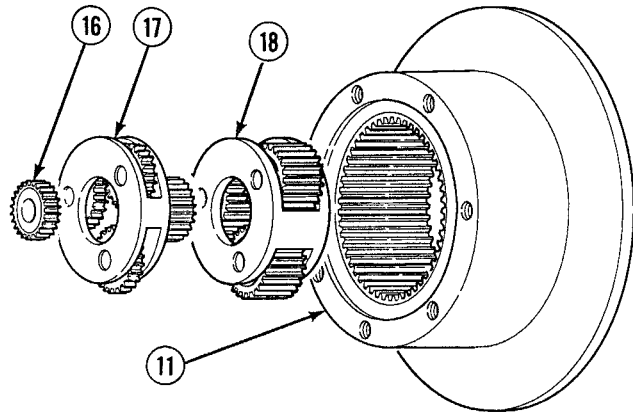


- (10) Install retaining ring (24) on drive gear (25).
- (11) Install drive gear (25) in planetary (17).
- (12) Install retaining ring (24) on drive gear (25).
- (13) Install 17 roller bearings (23) in gear (22).
- (14) Install gear (22) and two washers (21) in planetary (17).
- (15) Align and install shaft (20) with retaining ring (19).
- (16) Repeat Steps (13) through (15) for remaining two gears (22).



**28-7. HOIST ASSEMBLY REPAIR (CONT).**

- (17) Install planetary (18), planetary (17) and spur gear (16) in ring gear (11).



**NOTE**

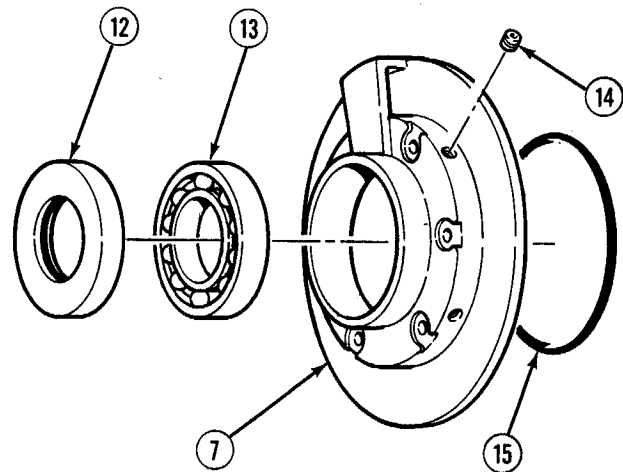
Perform Step (18) if plugs were removed.

- (18) Install two plugs (14) in drum end (7).

**NOTE**

Large slot in bearing faces out.

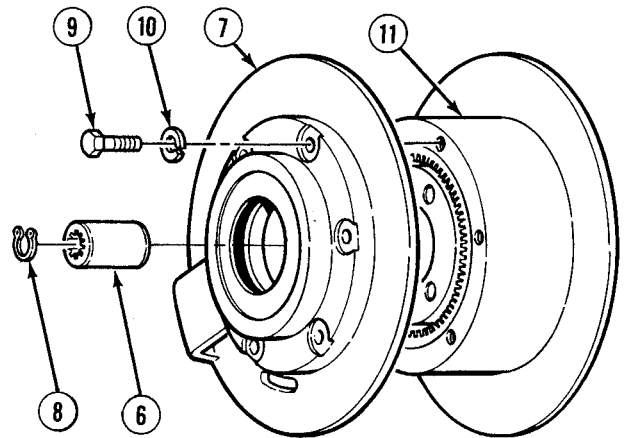
- (19) Install bearing (13) and oil seal (12) in drum end (7).
- (20) Install preformed packing (15) in drum end (7).



**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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (21) Apply adhesive to face of drum end (7) and position drum end on ring gear (11).
- (22) Apply sealing compound to threads of six screws (9).
- (23) Install drum end (7) on ring gear (11) with six lockwashers (10) and screws (9). Tighten screws to 31 lb-ft (42 N·m).

**WARNING**

Use care when installing retaining rings. Retaining rings are under tension and can act as projectiles when released causing injury to personnel.

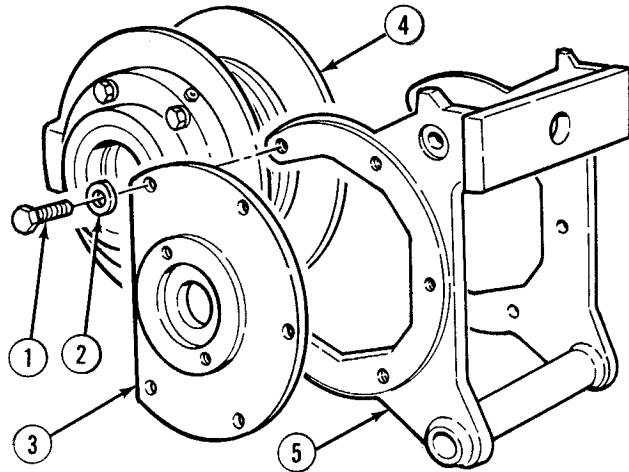
**NOTE**

- Perform Step (24) if snap ring was removed.
  - Do not tip drum or coupling will fall out. Coupling is installed on brace spline.
- (24) Install retaining ring (8) inside coupling (6).
  - (25) Install coupling (6) in drum end (7).

**28-7. HOIST ASSEMBLY 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.



- (26) Apply sealing compound to threads of five screws (1).
- (27) Install drum assembly (4) and plate (3) on housing (5) with washers (2) and screws (1). Tighten screws to 75 lb-ft (102 N·m).

**END OF TASK**

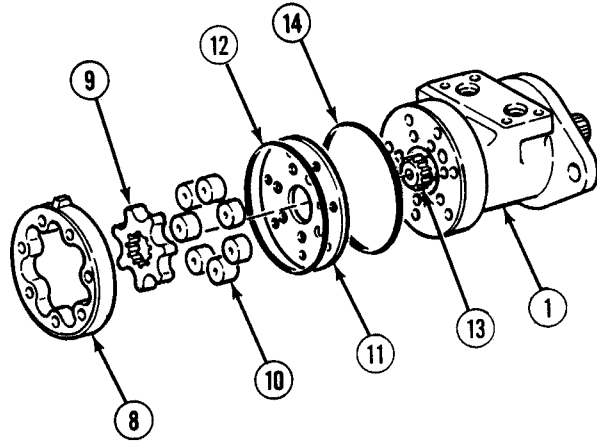




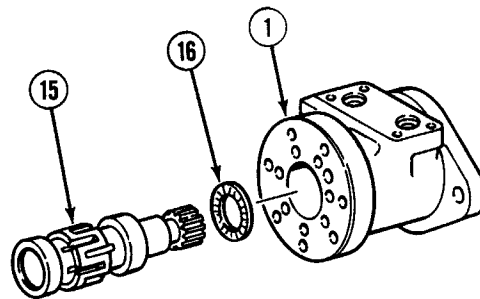
**28-8. HYDRAULIC HOIST MOTOR REPAIR (CONT).**

**CAUTION**

- Geroler, star and rollers are a loose assembly. Be careful when removing. Remove as an assembly.
- Geroler assembly can be installed upside down. If geroler assembly is installed upside down, motor will not operate properly. Be sure to mark "up" side of geroler assembly.

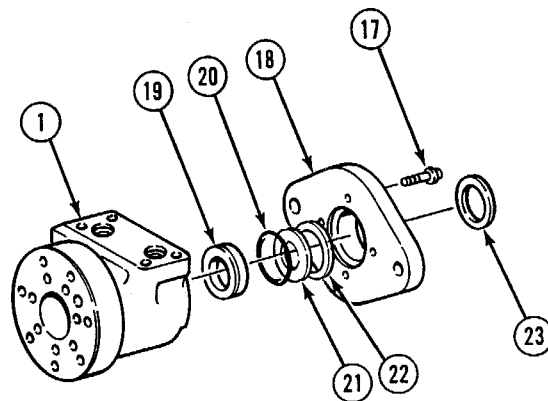


- (4) Remove geroler (8), star (9) and seven rollers (10) as an assembly from end cap (11).
- (5) Remove preformed packing (12), end cap (11), shaft (13) and preformed packing (14) from motor (1). Discard preformed packings.



- (6) Remove shaft (15) and bearing (16) from motor (1).

- (7) Remove four screws (17), plate (18) and inner ring bearing (19) from motor (1).
- (8) Remove preformed packing (20), seal (21) and retaining washer (22) from plate (18). Discard preformed packing and seal.
- (9) Remove seal (23) from plate (18). Discard seal.



**b. Cleaning/Inspection.****WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield and gloves and 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 Drycleaning Solvent is 100 degrees F (38 degrees C) and for Type II Drycleaning Solvent is 140 degrees F (60 degrees 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 to personnel.

- (1) Clean all metal parts in drycleaning solvent.
- (2) Dry all parts with compressed air. Allow bearings to air dry.
- (3) Inspect each part for nicks, burrs, scratches or dents.
- (4) Inspect bearing for grooves, pits or cracks.
- (5) Replace damaged parts.

**c. Assembly.**

- (1) Apply hydraulic oil to seal (23) and install on plate (18).
- (2) Apply hydraulic oil to retaining washer (22), seal (21) and preformed packing (20) and install on plate (18).

**WARNING**

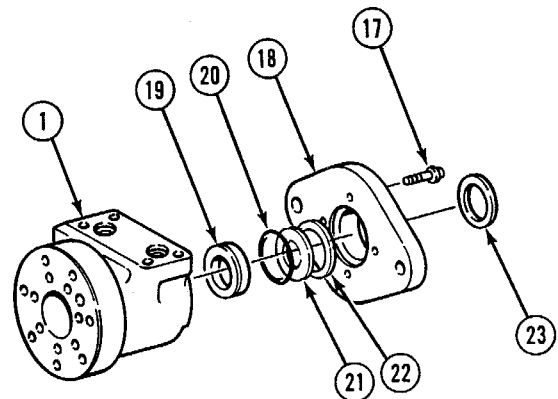
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (3) Apply sealing compound to threads of four screws (17).

**NOTE**

Ensure inner ring bearing seats in flange.

- (4) Install inner ring bearing (19) and plate (18) on motor (1) with four screws (17). Tighten screws 132 lb-in (15 N·m).



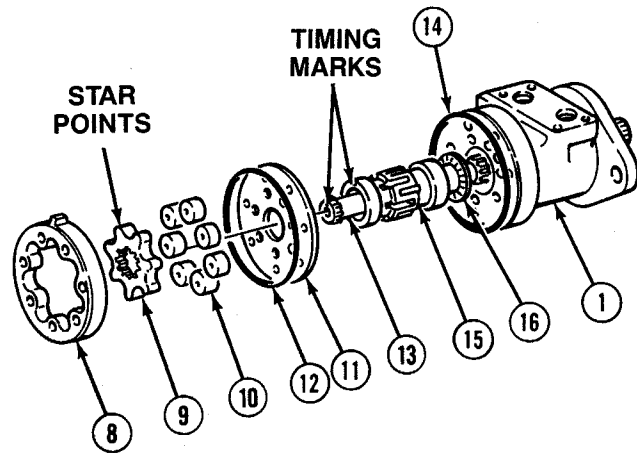
**28-8. HYDRAULIC HOIST MOTOR REPAIR (CONT).**

- (5) Install bearing (16) and shaft (15) in motor (1).
- (6) Install shaft (13) in shaft (15).

**NOTE**

Only timing marks on one end of shaft will line up.

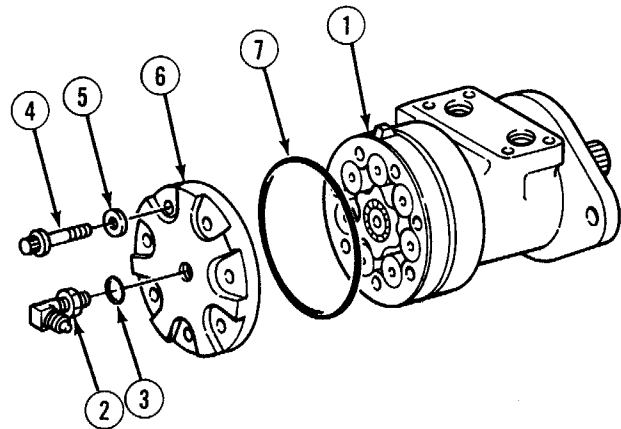
- (7) Align timing mark on shaft (13) with timing mark on shaft (15).
- (8) Apply hydraulic oil to preformed packing (14).
- (9) Install preformed packing (14) and plate (11) on motor (1).



**NOTE**

Perform Steps (10) and (11) if geroler was disassembled.

- (10) Apply hydraulic oil to preformed packing (12).
- (11) Install seven rollers (10), star (9) and preformed packing (12) in geroler (8).
- (12) Install geroler (8) as an assembly and align any star point with timing mark on shaft (15).
- (13) Apply hydraulic oil to preformed packing (7).
- (14) Install preformed packing (7) and end cap (6) on motor (1) with seven seal washers (5) and screws (4). Tighten screws 175 to 200 lb-in. (20 to 23 N·m).
- (15) Apply hydraulic oil to preformed packing (3).
- (16) Install preformed packing (3) and elbow (2).

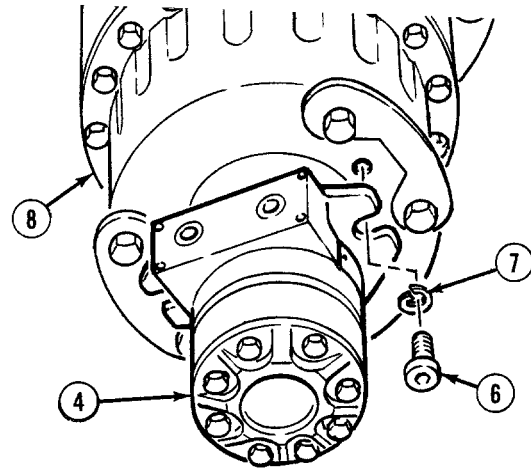


**END OF TASK**

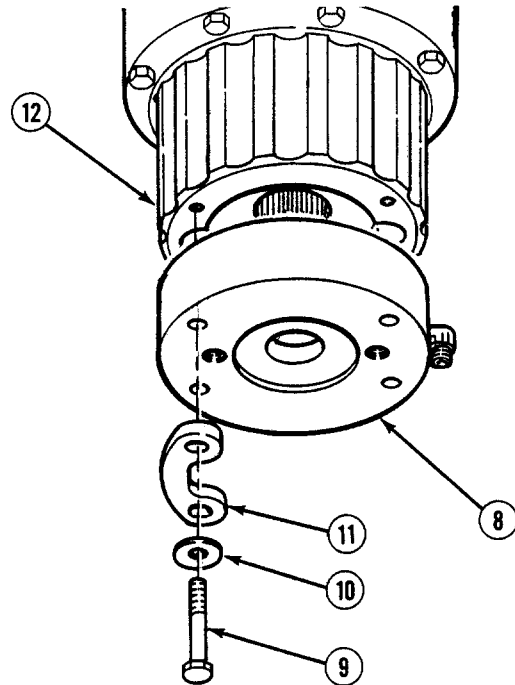


**28-9. SWING DRIVE GEAR REDUCER REPAIR (CONT).**

- (5) Remove two screws (6) and lockwashers (7) from motor (4). Discard lockwashers.
- (6) Remove motor (4) from brake (8).



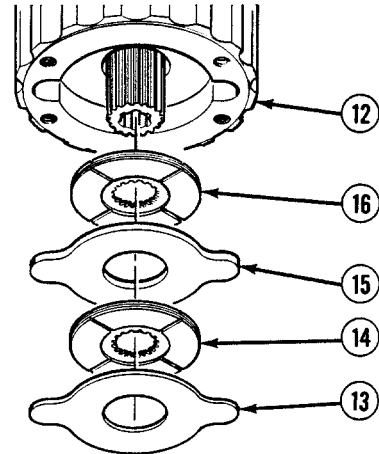
- (7) Remove four screws (9), washers (10) and two stops (11) from brake (8).



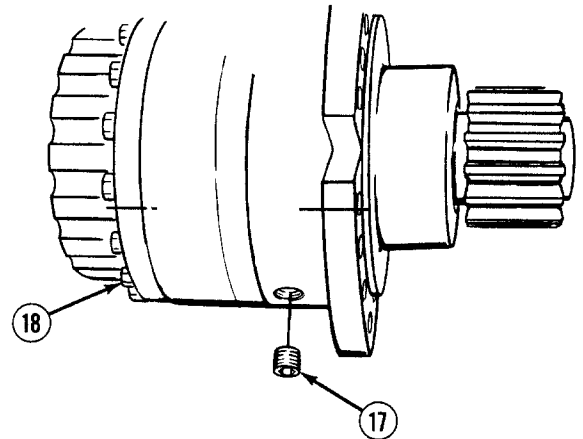
**NOTE**

Disc and spacers may drop when brake is removed.

- (8) Remove brake (8) from swing drive assembly (12).
- (9) Remove spacer (13), disc (14), spacer (15) and disc (16) from swing drive assembly (12).



- (10) Remove two plugs (17) from swing drive gear reducer (18) and drain oil in drain pan.
- (11) Matchmark length of swing drive gear reducer (18) and place gear side down on wooden blocks.

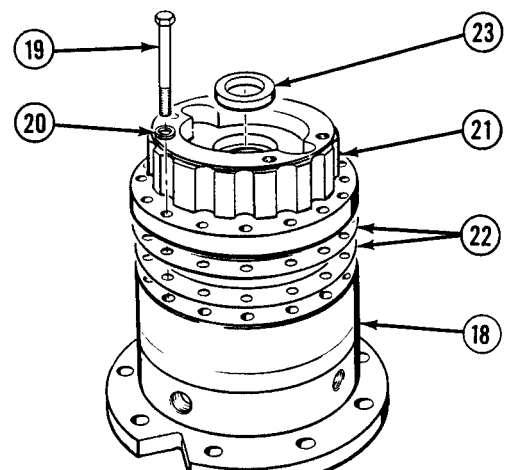


- (12) Remove 16 screws (19) and lockwashers (20) from swing drive gear reducer (18). Discard lockwashers.

**NOTE**

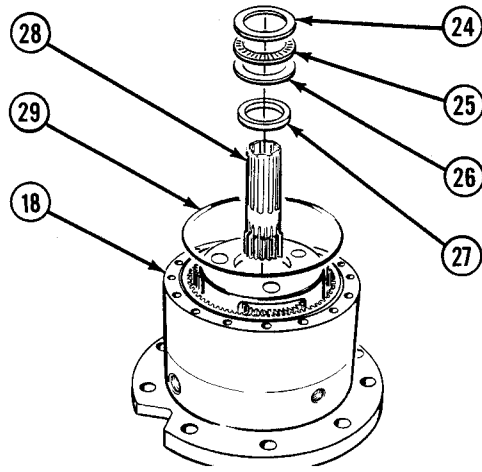
Number of shims may vary.

- (13) Remove end cover (21) and shims (22) from swing drive gear reducer (18).
- (14) Remove oil seal (23) from end cover (21). Discard oil seal.

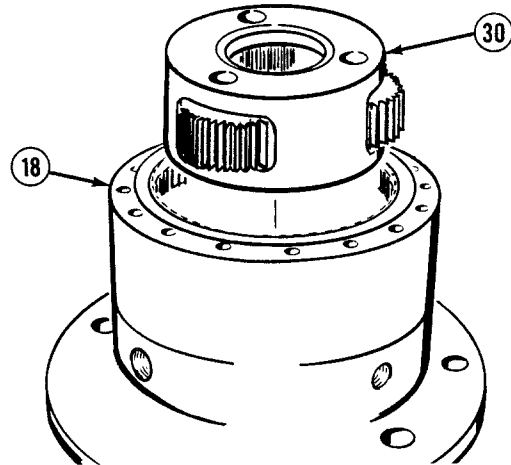


**28-9. SWING DRIVE GEAR REDUCER REPAIR (CONT).**

- (15) Remove race (24), bearing (25), race (26) and spacer (27) from sun gear (28).
- (16) Remove sun gear (28) and preformed packing (29) from swing drive gear reducer (18).



- (17) Remove planetary assembly (30) from swing drive gear reducer (18).

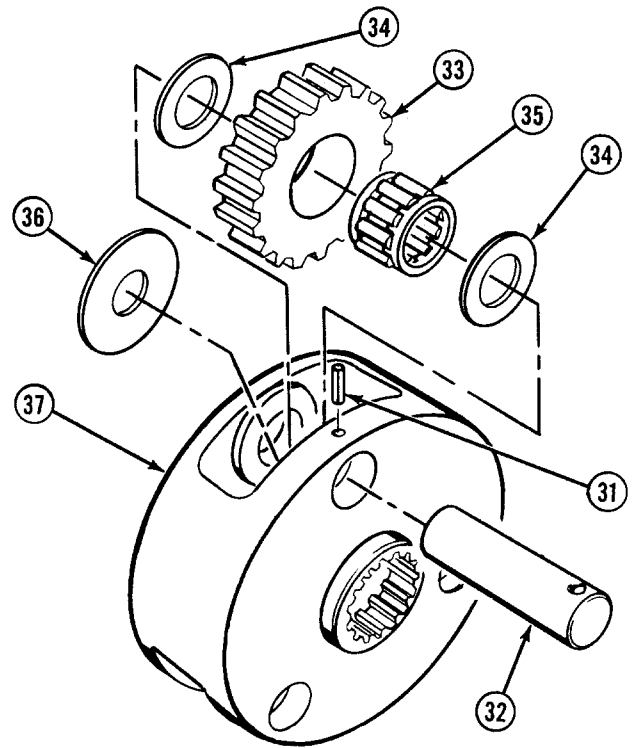


- (18) Drive spring pin (31) into pin (32).
- (19) Remove pin (32), gear (33) and two spacers (34).
- (20) Remove spring pin (31) from pin (32). Discard spring pin.

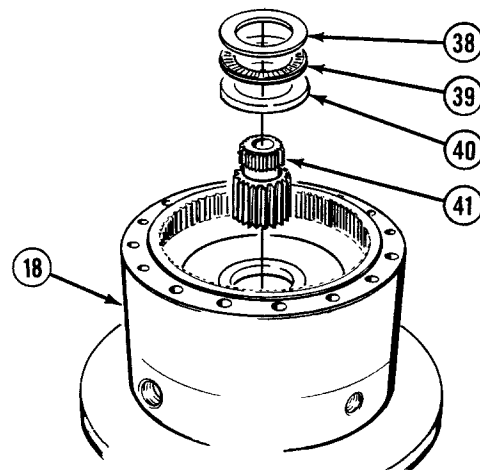
**CAUTION**

Handle bearing with care or individual needles may be lost.

- (21) Remove bearing (35) from gear (33).
- (22) Repeat steps (18) through (21) for other two gear assemblies.
- (23) Remove center spacer (36) from carrier (37).



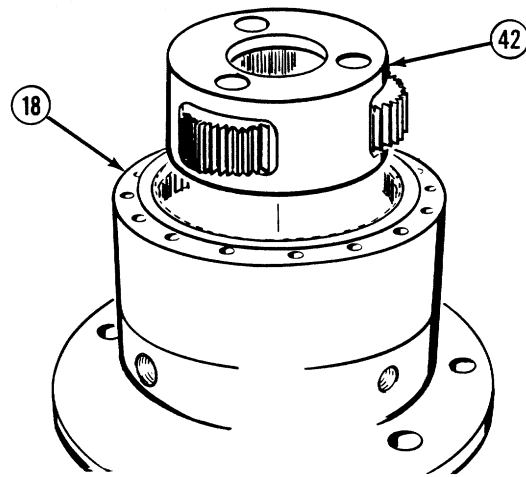
- (24) Remove race (38), bearing (39) and race (40) from swing drive gear reducer (18).
- (25) Remove secondary sun gear (41) from swing drive gear reducer (18).





**28-9. SWING DRIVE GEAR REDUCER REPAIR (CONT).**

- (26) Remove inner planetary assembly (42) from swing drive gear reducer (18).

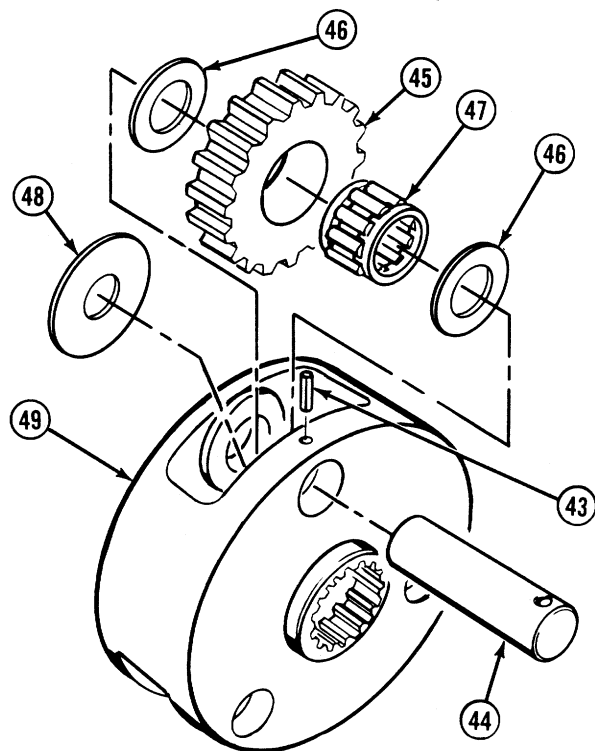


- (27) Drive spring pin (43) into pin (44).
- (28) Remove pin (44), gear (45) and two spacers (46).
- (29) Remove spring pin (43) from pin (44). Discard spring pin.

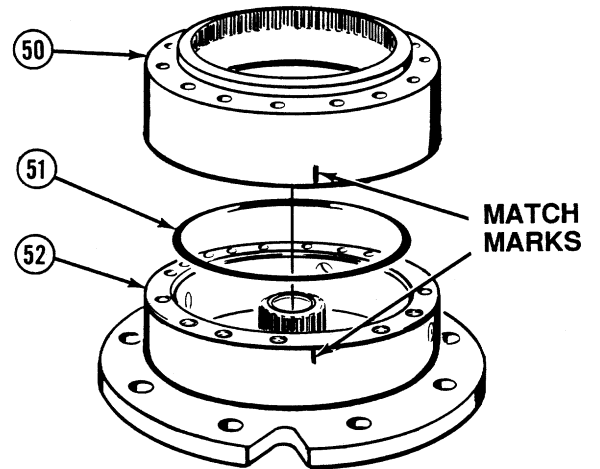
**NOTE**

Handle bearing with care or individual needles may be lost.

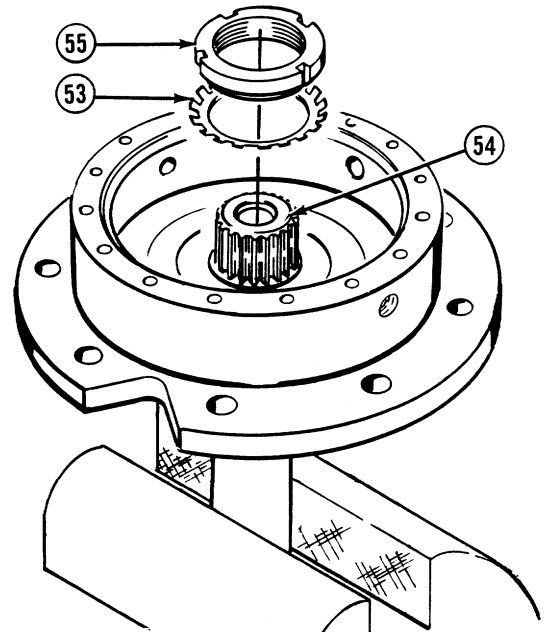
- (30) Remove bearing (47) from gear (45).
- (31) Repeat steps (27) through (30) for other two assemblies.
- (32) Remove center spacer (48) from carrier (49).



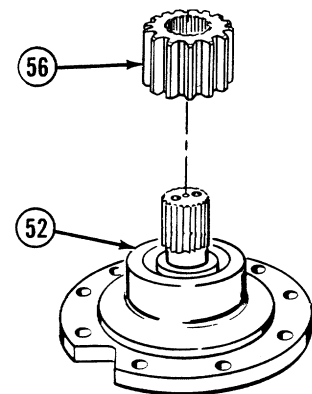
- (33) Matchmark and remove ring gear (50) and preformed packing (51) from hub (52). Discard preformed packing.



- (34) Bend down tine of lockwasher (53).
- (35) Position shaft (54) in soft jaw vise.
- (36) Remove nut (55) and lockwasher (53). Discard nut and lockwasher.
- (37) Remove shaft (54) from vise.

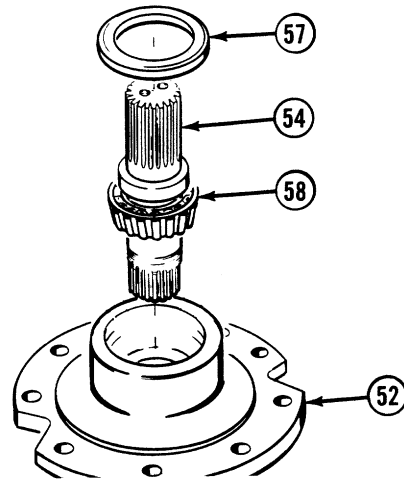


- (38) Turn hub (52) over and remove gear (56).

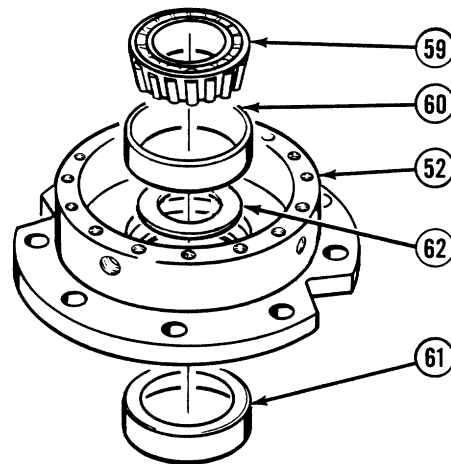


**28-9. SWING DRIVE GEAR REDUCER REPAIR (CONT).**

- (39) Remove seal (57) from hub (52). Discard seal.
- (40) Position hub (52) in press.
- (41) Press shaft (54) and bearing (58) from hub (52).
- (42) Remove hub (52) from press.
- (43) Position shaft (54) in press.
- (44) Press bearing (58) from shaft (54).
- (45) Remove shaft (54) from press.



- (46) Remove bearing (59), race (60) and (61), and spacer (62) from hub (52).

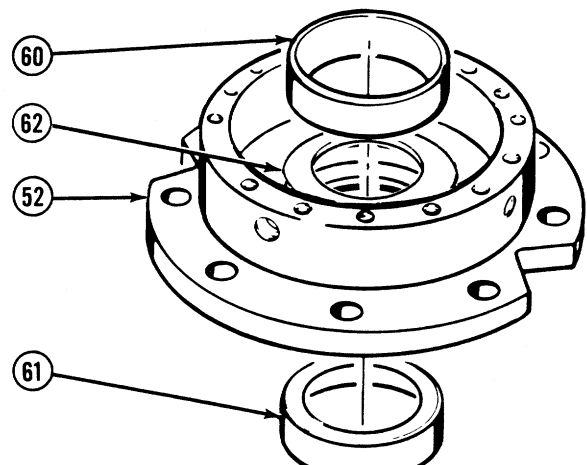


**b. Cleaning/Inspection.****WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 to personnel.
- (1) Clean all metal parts in drycleaning solvent.
  - (2) Dry all parts with compressed air. Allow bearing to air dry.
  - (3) Inspect each part for nicks, burrs, scratches or dents.
  - (4) Inspect bearing and races for pitting or cracks.
  - (5) Replace damaged parts.

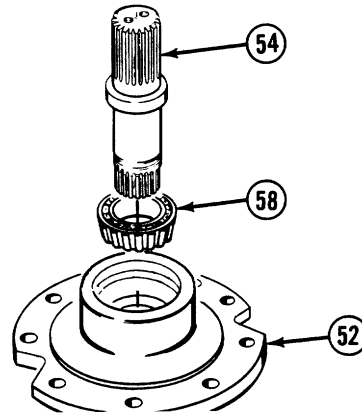
**c. Assembly.**

- (1) Apply thin coat of grease to race (61).
- (2) Install race (61) and (60) spacer (62) in hub (52).

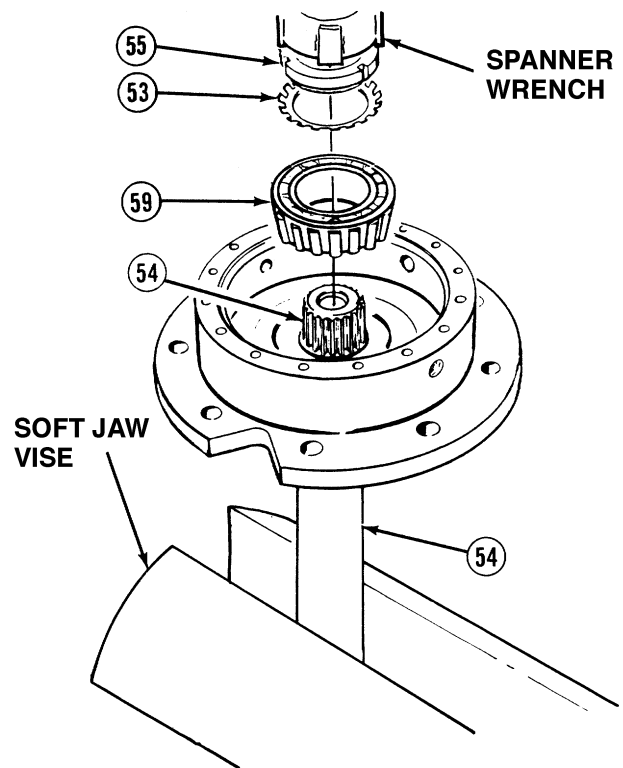


**28-9. SWING DRIVE GEAR REDUCER REPAIR (CONT).**

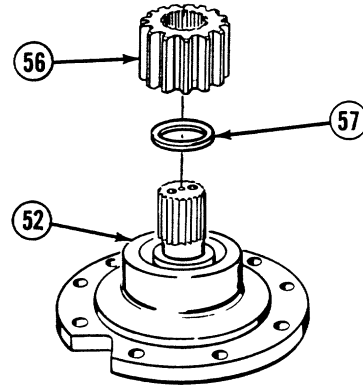
- (3) Position shaft (54) in press.
- (4) Pack bearing (58) with grease and press bearing (58) on shaft (54).
- (5) Remove shaft (54) from press.
- (6) Install shaft (54) in hub (52).



- (7) Pack bearing (59) with grease and install bearing (59) on shaft (54).
- (8) Install lockwasher (53) and nut (55) on shaft (54).
- (9) Tighten nut (55) until shaft (54) starts to turn.
- (10) Position shaft (54) in soft jaw vise.
- (11) Hold shaft (54) and tighten nut (55) until one tine on lockwasher (53) aligns with slot in nut.
- (12) Bend tine of lockwasher (53) up in slot of nut (55).
- (13) Remove shaft (54) from vise.



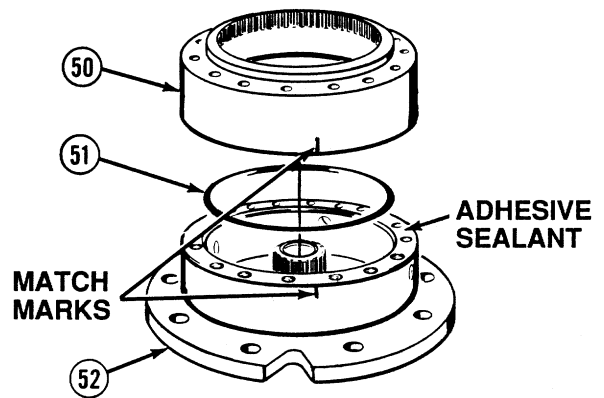
- (14) Turn hub (52) over and install seal (57) and gear (56) on hub (52).



**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.

- (15) Apply adhesive on mating surface of hub (52) and install preformed packing (51) on hub (52).
- (16) Align matchmarks and install ring gear (50) on hub (52).



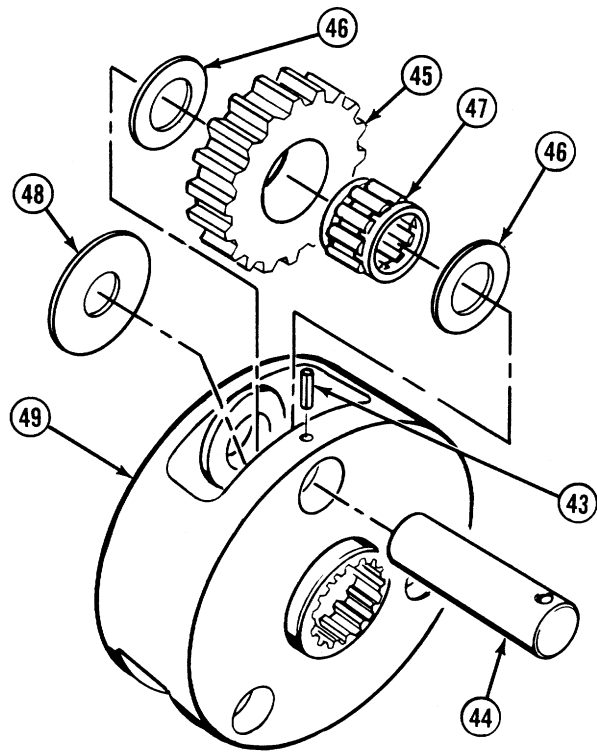
**28-9. SWING DRIVE GEAR REDUCER REPAIR (CONT).**

- (17) Position center spacer (48) in carrier (49).

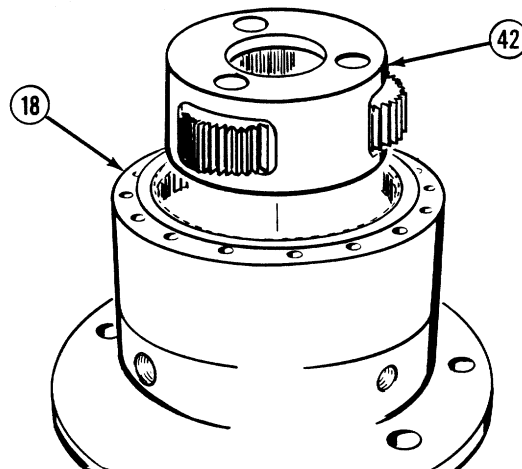
**CAUTION**

Handle bearings with care or individual needle bearing may be lost.

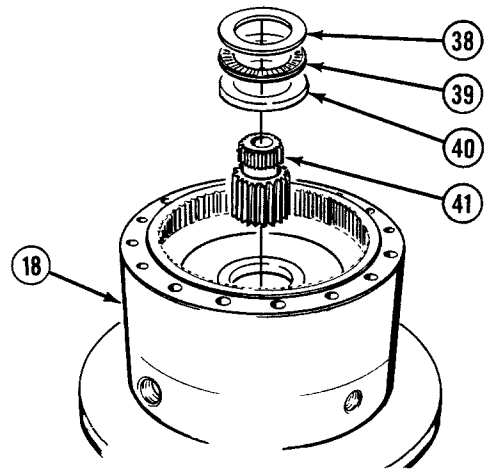
- (18) Pack bearing (47) with grease and install in gear (45).
- (19) Install gear (45) and two spacers (46) with pin (44) and spring pin (43).
- (20) Repeat Steps (13) and (14) for other two assemblies.



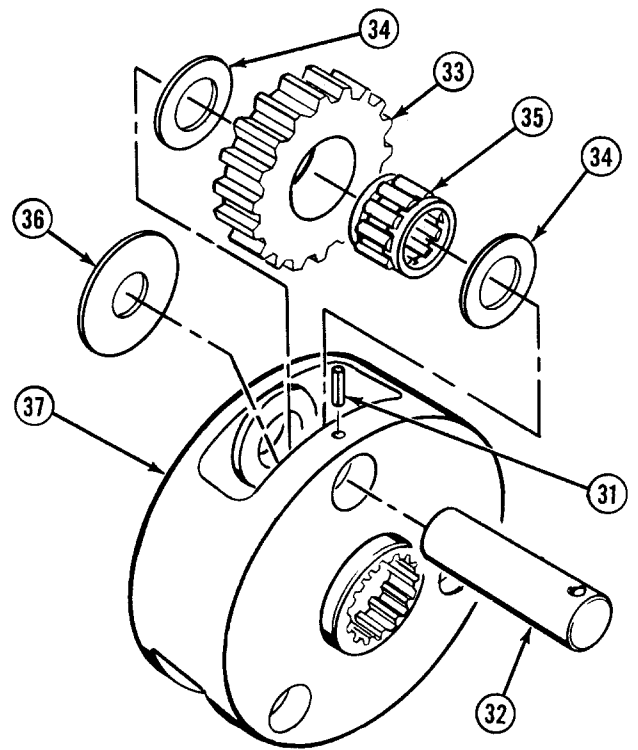
- (21) Install inner planetary assembly (42) in swing drive gear reducer (18).



- (22) Install sun gear (41), race (40), bearing (39) and race (38) in swing drive gear reducer (18).



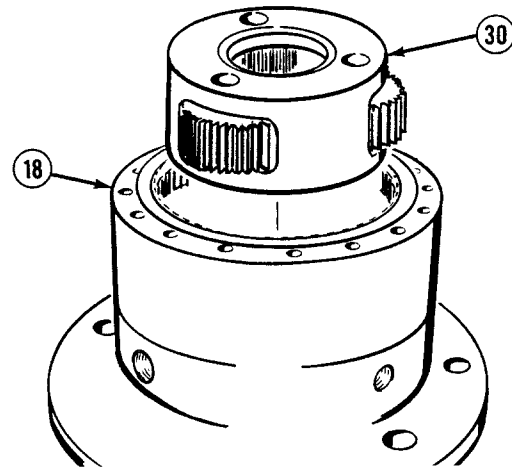
- (23) Position center spacer (36) in carrier (37).
- (24) Pack bearing (35) with grease and install in gear (33).
- (25) Install gear (33) and two spacers (34) with pin (32) and spring pin (31).
- (26) Repeat Steps (22), (23) and (24) for other two assemblies.





**28-9. SWING DRIVE GEAR REDUCER REPAIR (CONT).**

- (27) Install planetary assembly (30) in swing drive gear reducer (18).



**WARNING**

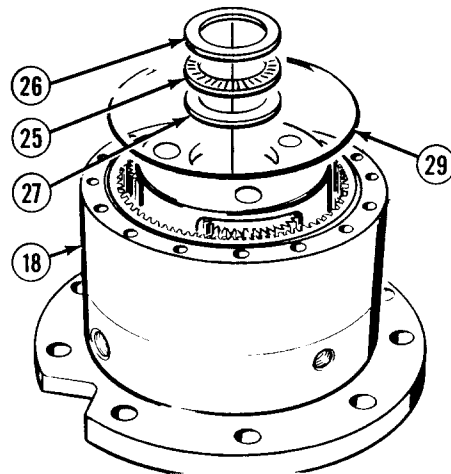
Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with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

- (28) Apply adhesive on mating surface of swing drive gear reducer (18).
- (29) Install preformed packing (29) on swing drive gear reducer (18).

**NOTE**

Install thin race first.

- (30) Install spacer (27), race (26) and bearing (25) in swing drive gear reducer (18).



- (31) Install oil seal (23) in end cover (21).
- (32) Install sun gear (28) and race (24) in swing drive gear reducer (18)
- (33) Align matchmarks and position end cover (21) on swing drive gear reducer (18).

**NOTE**

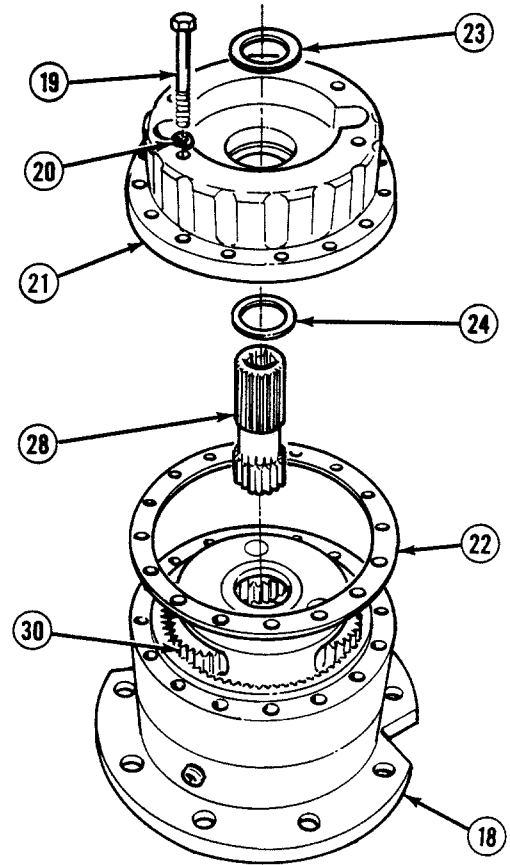
Movement is checked through hole in end cover.

- (34) Check for free movement by moving planetary assembly up and down with sun gear (28).
- (35) If no movement is felt, install shims (22) in progressions of 0.002 in. (0.05 mm) until movement is felt.

**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.

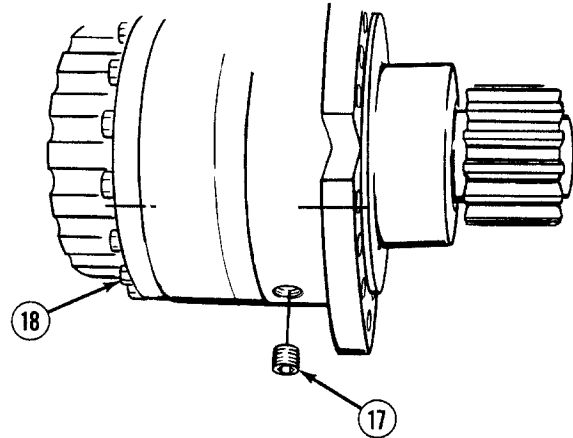
- (36) Apply sealing compound to threads of 16 screws (19).
- (37) Install end cover (21) with 16 lockwashers (20) and screws (19). Tighten screws to 55 lb-ft (74.6 N·m).



**28-9. SWING DRIVE GEAR REDUCER 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.

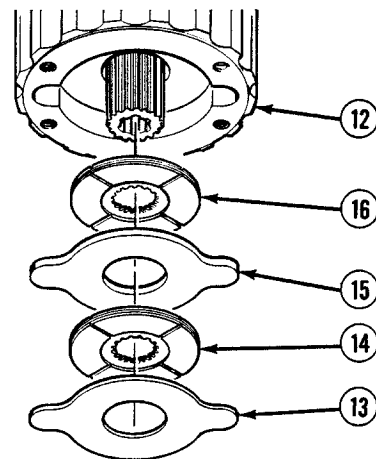


- (38) Apply sealing compound to threads of two plugs (17).
- (39) Install two plugs (17) in swing drive gear reducer (18).
- (40) Install disc (16) in swing drive assembly (12).

**NOTE**

Thick spacer is installed first.

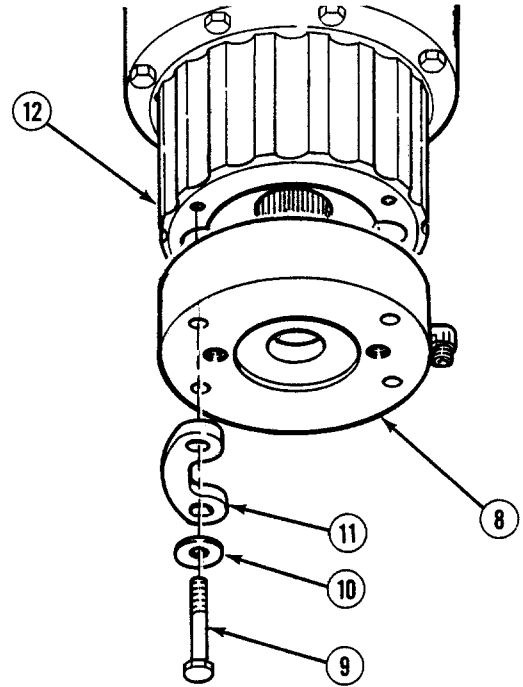
- (41) Install spacer (15), disc (14) and spacer (13).



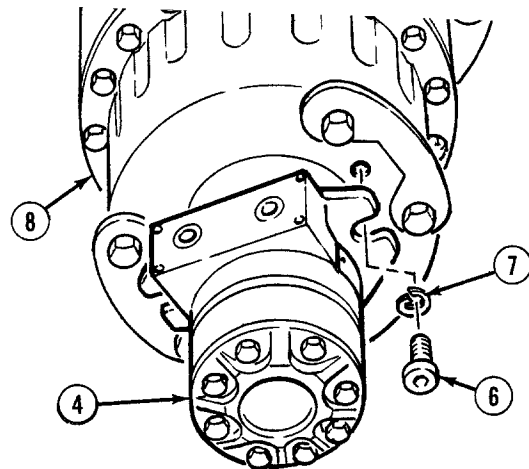
**WARNING**

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.

- (42) Apply adhesive to back of brake (8).
- (43) Align and install brake (8) on swing drive assembly (12).
- (44) Apply sealing compound to threads of four screws (9).
- (45) Install two stops (11) with four washers (10) and screws (9). Tighten screws to 35 lb-ft (47 N·m).

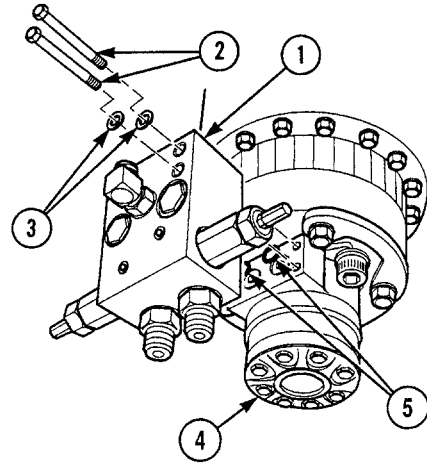


- (46) Install motor (4) on brake (8) with two lockwashers (7) and screws (6). Tighten screws to 127 lb-ft (172 N·m).



**28-9. SWING DRIVE GEAR REDUCER REPAIR (CONT).**

- (47) Apply hydraulic oil to preformed packing (5).
- (48) Install two preformed packings (5) in motor (4).
- (49) Install swing motor valve (1) on motor (4) with four lockwashers (3) and screws (2).



**END OF TASK**



**28-10. SWING DRIVE BRAKE REPAIR (CONT).**

**b. Cleaning/Inspection.**

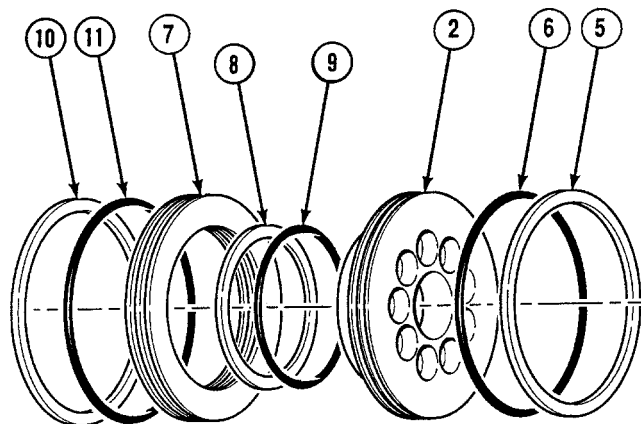
**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning solvent.
- (2) Inspect each part for cracks, gouges or stripped threads.
- (3) Replace all damaged parts.

**c. Assembly.**

- (1) Apply hydraulic oil to preformed packing (9).
- (2) Install preformed packing (9) and retainer (8) in spacer (7).
- (3) Install piston (2) on spacer (7).
- (4) Apply hydraulic oil to preformed packing (11).
- (5) Install preformed packing (11) and retainer (10) on spacer (7).
- (6) Apply hydraulic oil to preformed packing (6).
- (7) Install preformed packing (6) and retainer (5) on piston (2).



**NOTE**

Leave one hole empty between every two springs.

- (8) Install piston assembly (2) and six springs (3) in cylinder housing (4).

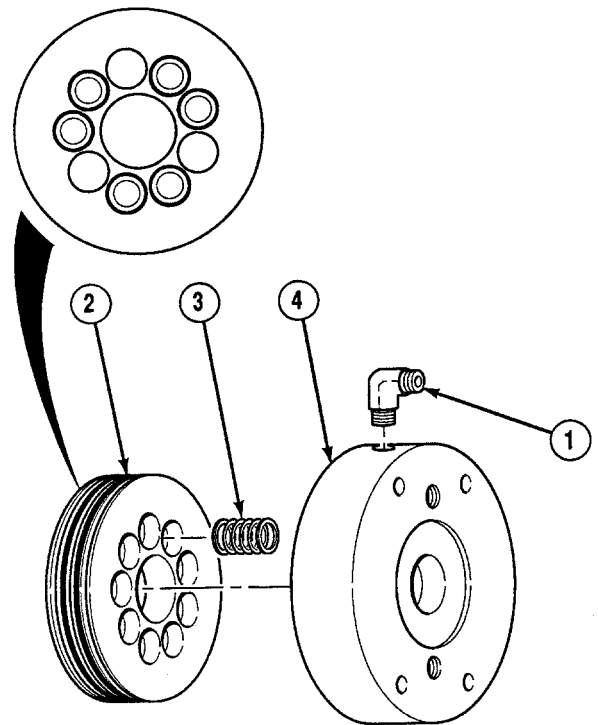
**WARNING**

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**

Position elbow as noted prior to removal.

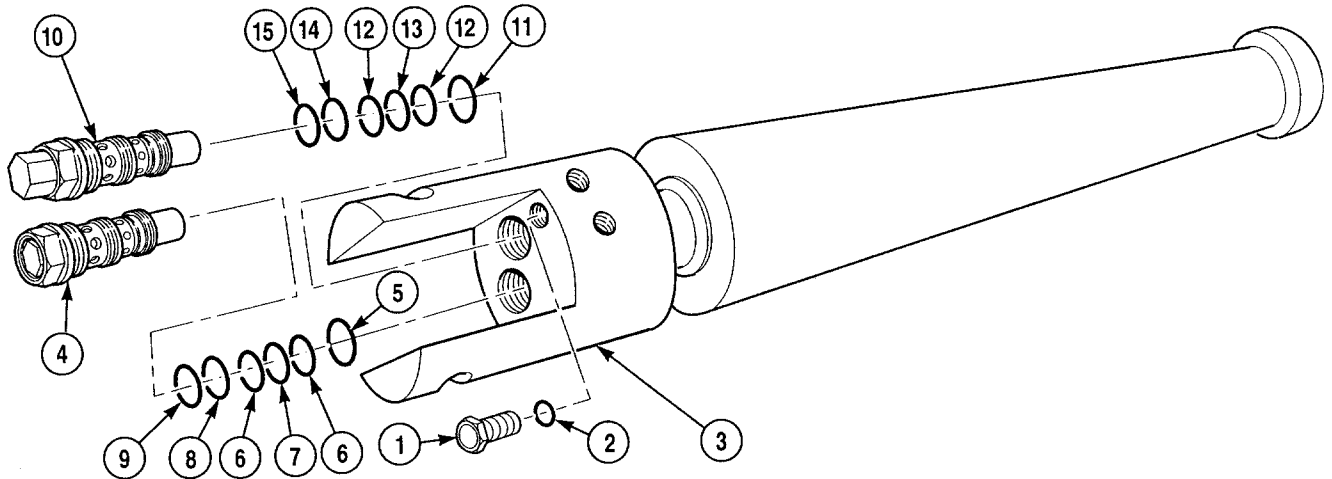
- (9) Apply sealing compound to threads of elbow (1) and install in cylinder housing (4).



**END OF TASK**





**a. Disassembly.****NOTE**

- Left and right hand outrigger cylinders are disassembled the same way.
- Position drain pan under cylinder.

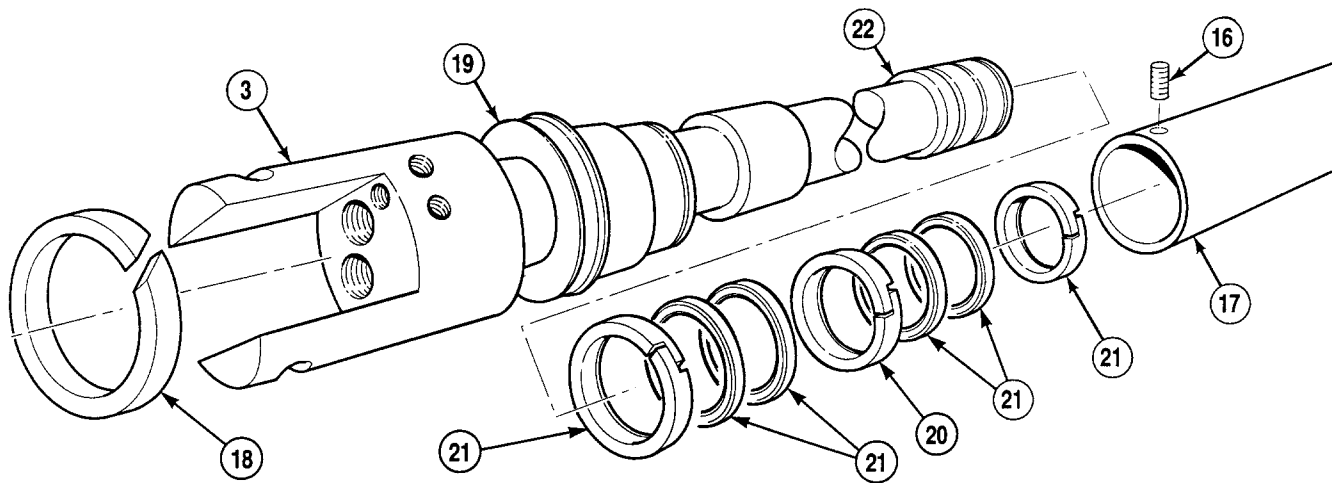
- (1) Remove plug (1) and preformed packing (2) from cylinder rod (3). Discard preformed packing.

**NOTE**

Tag and mark all valves prior to removal.

- (2) Remove check valve (4) and preformed packing (5) from cylinder rod (3). Discard preformed packing.
- (3) Remove two backup rings (6) and preformed packing (7) from check valve (4). Discard preformed packing and backup rings.
- (4) Remove backup ring (8) and preformed packing (9) from check valve (4). Discard preformed packing and backup ring.
- (5) Remove cartridge holding valve (10) and preformed packing (11) from cylinder rod (3). Discard preformed packing.
- (6) Remove two backup rings (12) and preformed packing (13) from cartridge holding valve (10). Discard preformed packing and backup rings.
- (7) Remove preformed packing (14) and backup ring (15) from cartridge holding valve (10). Discard preformed packing and backup ring.

**28-11. OUTRIGGER CYLINDER REPAIR (CONT).**



- (8) Remove setscrew (16) from cylinder barrel (17).

**CAUTION**

Cylinder must not be dented when held in vise, or leakage and improper operation may result.

- (9) Place cylinder barrel (17) in chain vise with wooden blocks.
- (10) Remove wear ring (18) from cylinder head (19). Discard split ring.
- (11) With the aid of an assistant, pull cylinder rod (3) out of cylinder barrel (17). Allow hydraulic fluid to drain into drain pan.

**NOTE**

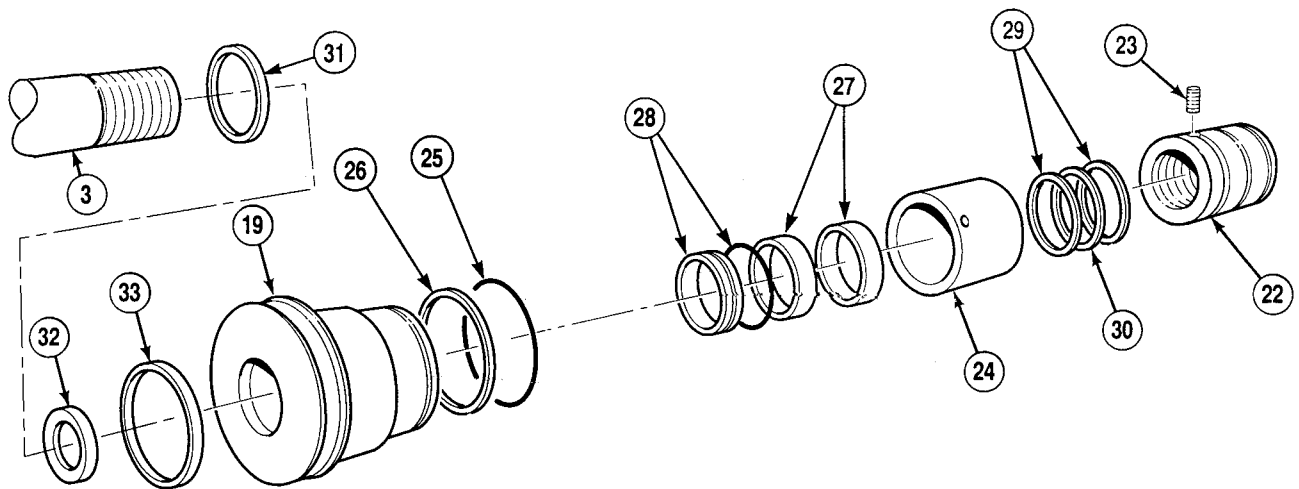
Cylinder head is threaded.

- (12) Remove cylinder head (19) and cylinder rod (3) from cylinder barrel (17).
- (13) Remove cylinder head (19) from cylinder rod (3).

**NOTE**

Note position of seal assemblies and ring.

- (14) Turn cylinder rod (3) around and remove two seal assemblies (21) and ring (20) from piston (22). Discard seal assemblies, and ring.



- (15) Remove setscrew (23), and piston (22) from cylinder rod (3).
- (16) Remove backup ring (29), preformed packing (30) and backup ring (29) from piston (22). Discard preformed packings and backup rings.
- (17) Remove spacer (24) from cylinder rod (3).
- (18) Remove cylinder head (19) from cylinder rod (3).
- (19) Remove preformed packing (25) and backup ring (26) from outside of cylinder head (19). Discard preformed packing and backup ring.
- (20) Remove two wear rings (27) and buffer seal assembly (28) from inside cylinder head (19). Discard seals and wiper ring.
- (21) Remove wiper ring (31), seal (32) and ring (33) from inside cylinder head (19).

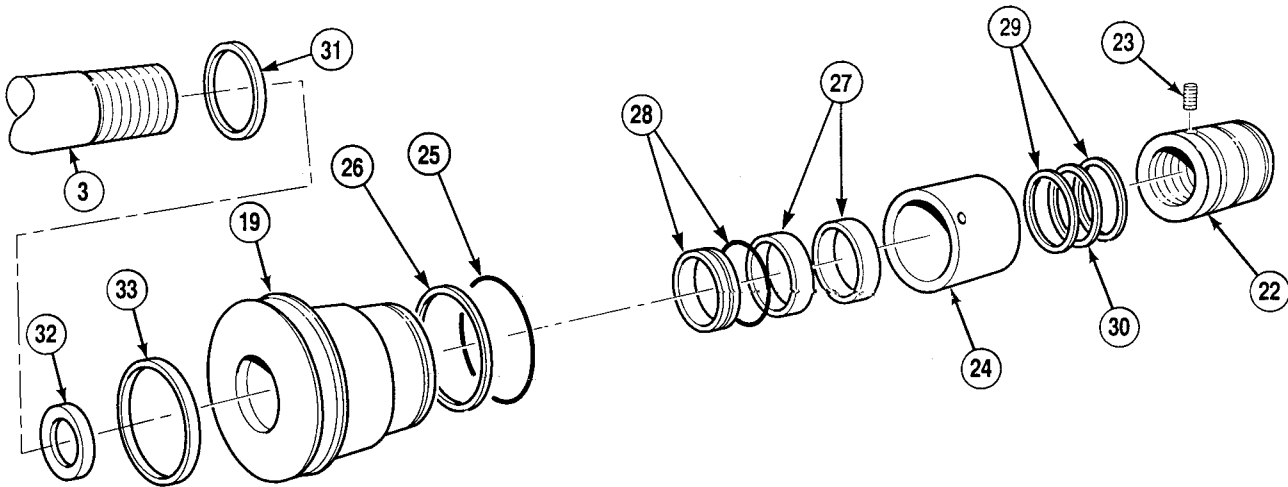
**b. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 to personnel.
- (1) Clean all metal parts in drycleaning solvent.
  - (2) Dry all metal parts with compressed air.
  - (3) Inspect each part for cracks, bends, gouges and stripped threads.
  - (4) Replace damaged parts.

**28-11. OUTRIGGER CYLINDER REPAIR (CONT).**

**c. Assembly.**



**NOTE**

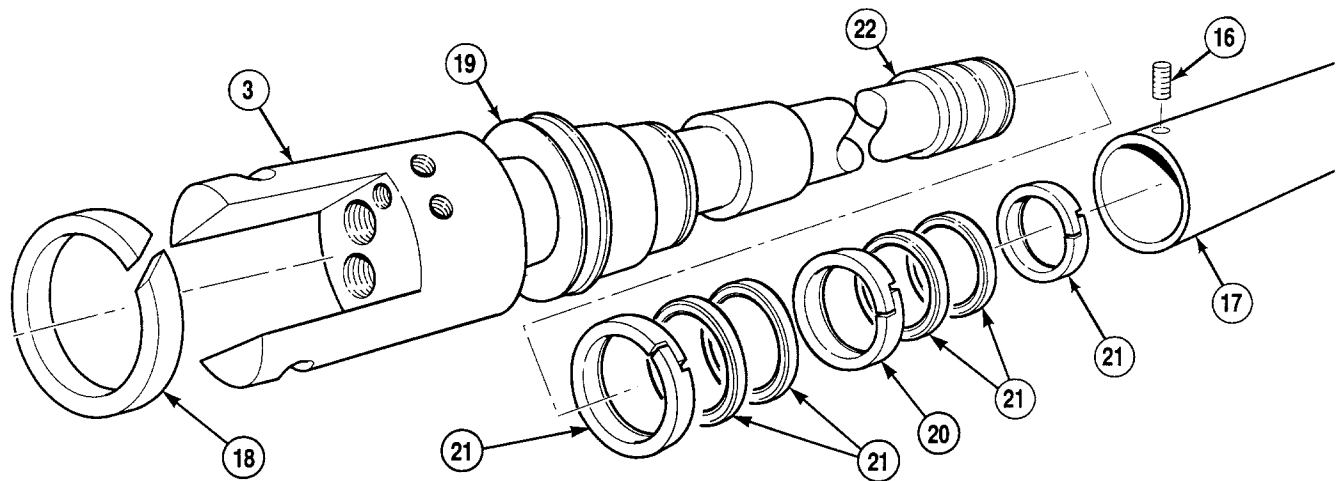
Both outrigger cylinders are assembled the same way.

- (1) Apply hydraulic oil to buffer seal assembly (28) and two wear rings (27) and install in cylinder head (19).
- (2) Apply hydraulic oil to backup ring (26) and preformed packing (25) and install on outside of cylinder head (19).
- (3) Install cylinder head (19) on cylinder rod (3).
- (4) Install spacer (24) with drilled hole facing threaded end of cylinder rod (3).
- (5) Install piston (22) on cylinder rod (3).
- (6) Install cylinder rod (3) in vise with soft jaws.
- (7) Tighten piston (22) on cylinder rod (3) until setscrew holes are aligned.

**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.

- (8) Apply sealing compound on threads of setscrew (23).
- (9) Install setscrew (23) in piston (22).
- (10) Apply hydraulic oil to backup ring (29), preformed packing (30) and backup ring (29) and install on piston (22).



### NOTE

Install seal assemblies and ring as noted prior to removal.

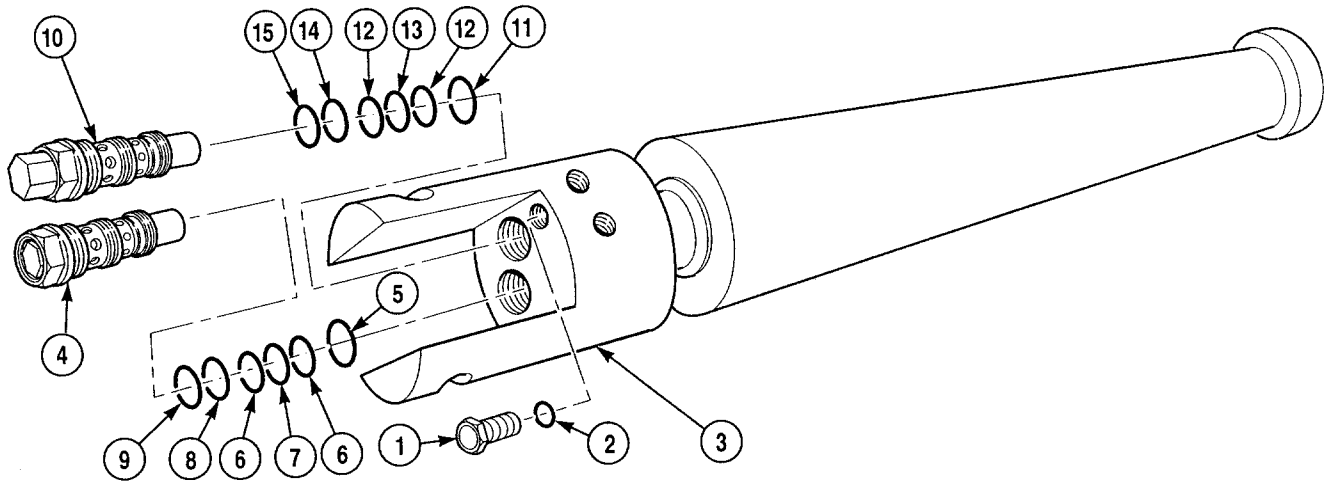
- (11) Apply hydraulic oil to seal assemblies (21) and ring (20) and install on piston (22).
- (12) Place cylinder barrel (17) in chain vise with wooden blocks.
- (13) Install cylinder rod (3) in cylinder barrel (17).
- (14) Turn cylinder head (19) on cylinder rod (3) until setscrew holes are aligned.

### 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 a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

- (15) Apply sealing compound on threads of setscrew (16).
- (16) Install setscrew (16) in cylinder barrel (17).
- (17) Install wear ring (18) on cylinder barrel (17).

**28-11. OUTRIGGER CYLINDER REPAIR (CONT).**



- (18) Apply hydraulic oil to backup ring (15) and preformed packing (14) and install on holding valve (10).
- (19) Apply hydraulic oil to preformed packing (13) and two backup rings (12) and install on holding valve (10).
- (20) Apply hydraulic oil to preformed packing (11) and holding valve (10) and install on cylinder rod (3) side marked "P".
- (21) Tighten holding valve (10) to 50 to 55 lb-ft (68 to 75 N·m).
- (22) Apply hydraulic oil to preformed packing (9) and backup ring (8) and install on check valve (4).
- (23) Apply hydraulic oil to preformed packing (7) and two backup rings (6) and install on check valve (4).
- (24) Apply hydraulic oil to preformed packing (5) and check valve (4) and install on cylinder rod (3).
- (25) Apply hydraulic oil to preformed packing (2).
- (26) Install preformed packing (2) and plug (1) on cylinder rod (3).

**END OF TASK**

**Section III. SELF-RECOVERY WINCH MAINTENANCE**

**28-12. HYDRAULIC MOTOR REPLACEMENT.**

This task covers:

- a. Removal
- b. Installation

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Wrench, Torque (0-175 lb-ft [0-237 N·m]) (Item 277, Appendix F)

*Equipment Condition*

Self Recovery Winch (SRW) on clean work surface

*Materials/Parts*

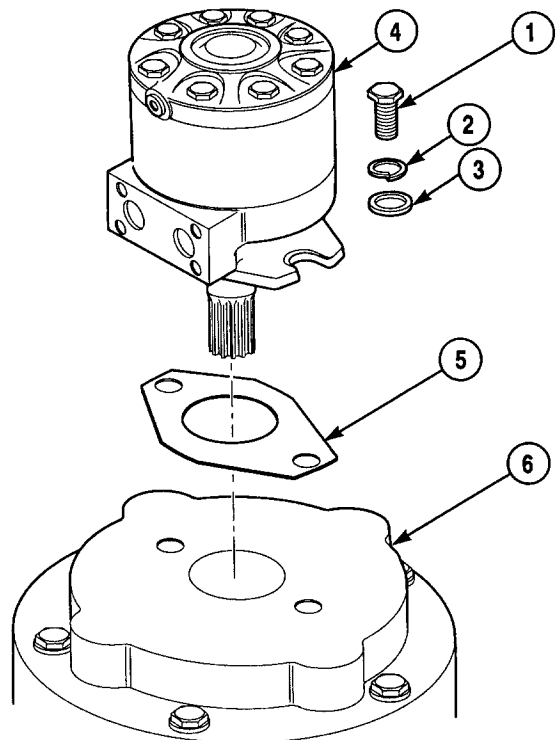
- Adhesive (Item 1, Appendix B)
- Lockwasher (2) (Item 232, Appendix E)
- Repair Kit (Item 464, Appendix E)

**a. Removal.**

**NOTE**

Matchmark hydraulic motor and brake housing prior to removal.

- (1) Remove two screws (1), lockwashers (2) and washers (3) from hydraulic motor (4). Discard lockwashers.
- (2) Remove hydraulic motor (4) and gasket (5) from brake housing (6). Discard gasket.





**28-12. HYDRAULIC MOTOR REPLACEMENT (CONT).**

**b. Installation.**

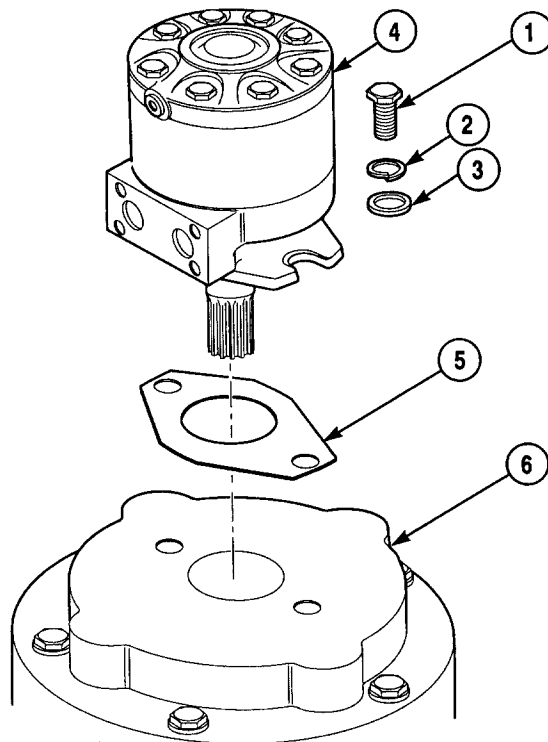
**WARNING**

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.

**CAUTION**

Apply adhesive sparingly to hydraulic motor and brake housing. Ensure gasket sealer does not leak to other parts or damage may result to equipment.

- (1) Apply adhesive to mating surface of hydraulic motor (4) and brake housing (6).
- (2) Install gasket (5) on hydraulic motor (4).
- (3) Install hydraulic motor (4) on brake housing (6) with two washers (3), lockwashers (2) and screws (1). Tighten screws 75 to 95 lb-ft (102 to 129 N·m).



**END OF TASK**

**28-13. SELF-RECOVERY WINCH BRAKE REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Hammer, Hand Soft Plastic  
(Item 88, Appendix F)  
Micrometer, Outside, Caliper, Set  
(Item 139, Appendix F)  
Wrench, Torque (0-175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

*Tools and Special Tools - Continued*

Wooden Block (2) (Appendix C)

*Materials/Parts*

Oil, Hydraulic (Item 34, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Lockwasher (6) (Item 232, Appendix E)  
Repair Kit (Item 462, Appendix E)  
Repair Kit (Item 463, Appendix E)

*Equipment Condition*

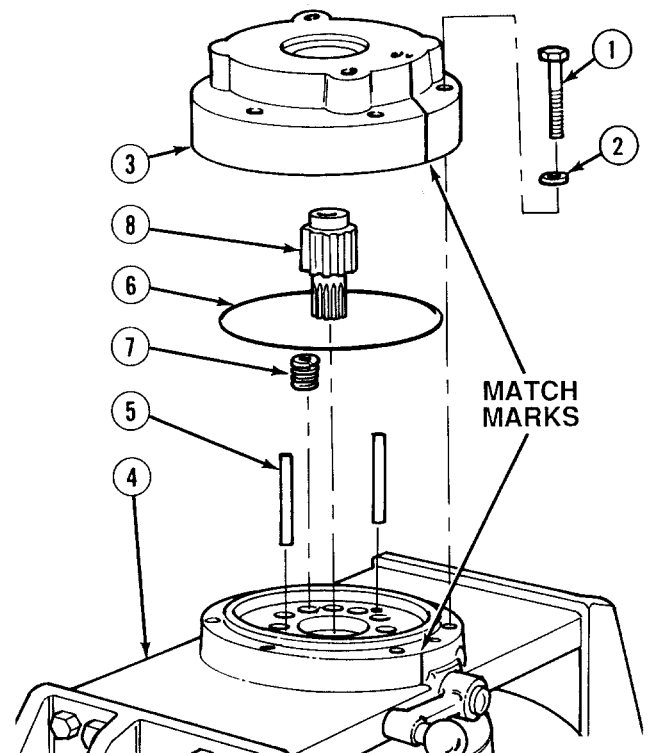
Hydraulic motor removed, (Para 28-12)

**a. Removal.**

- (1) Remove six screws (1) and lockwashers (2) from brake housing (3). Discard lockwashers.

**NOTE**

- Twelve springs may fall out upon removal of brake housing.
  - Dowel pins may or may not come out with removal of brake housing.
  - Matchmark position of brake housing and front motor support prior to removal.
- (2) Remove brake housing (3) from front motor support (4).
  - (3) Remove dowel pins (5) from brake housing (3) or front motor support (4).
  - (4) Remove and discard preformed packing (6) from front motor support (4).
  - (5) Remove twelve springs (7) from front motor support (4). Discard springs.
  - (6) Remove brake shaft (8) from front motor support (4).



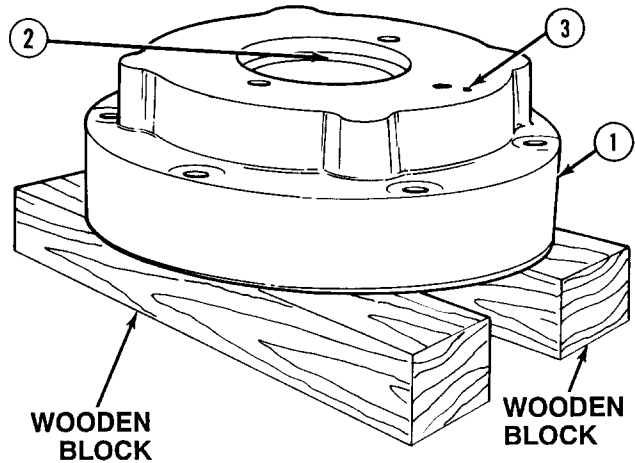
**28-13. SELF-RECOVERY WINCH BRAKE REPAIR (CONT).**

**b. Disassembly.**

- (1) Place brake housing (1) on wooden blocks with piston (2) facing downward.

**WARNING**

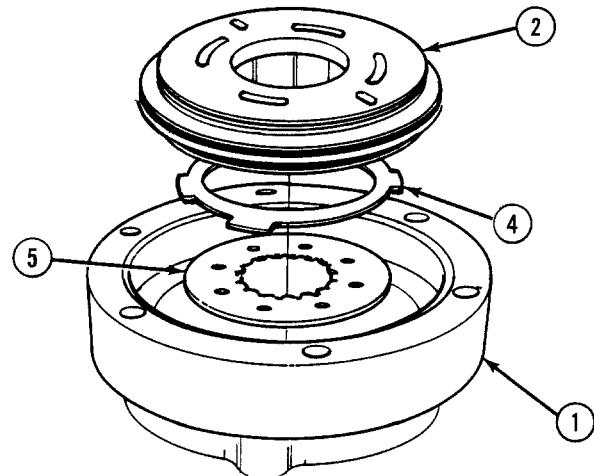
Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc). Failure to comply may result in injury to personnel.



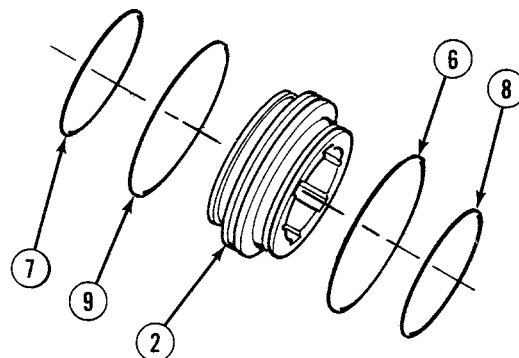
- (2) Apply air pressure through air hole (3) to loosen piston (2) from brake housing (1).
- (3) Turn brake housing (1) over with piston (2) facing up.
- (4) Remove piston (2) from brake housing (1).

**NOTE**

Friction plates and drive plates may come out with piston or some may remain in brake housing.



- (5) Remove ten friction plates (4) and nine drive plates (5) from brake housing (1) or piston (2).
- (6) Remove and discard preformed packings (6) and (7) and backing rings (8) and (9) from piston (2).



**c. Cleaning/Inspection.****WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 drycleaning 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 to personnel.

- (2) Dry all metal parts with compressed air.
- (3) Inspect all threaded parts for crossed and stripped threads.
- (4) Inspect all machined parts for cracks, chips and gouges.
- (5) Check housing and piston for cracks, chips and gouges.
- (6) Replace friction plates when overall thickness is less than 0.080 in. (2.032 mm) or when bronze faces are broken, cracked or chipped or when part is warped or bent.
- (7) Replace steel drive plates when part thickness is worn to 0.055 in. (1.397 mm) or when surface is not flat or is cracked or chipped and will not slide freely on brake shaft.
- (8) Replace all damaged parts.

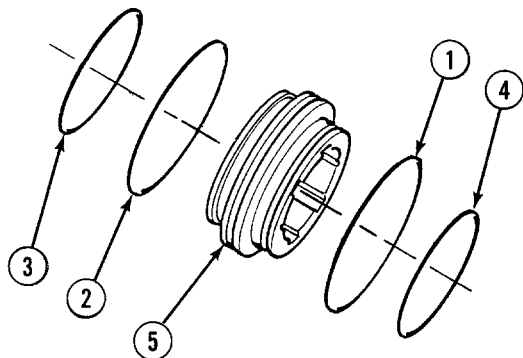
**d. Assembly.**

- (1) Coat two preformed packings (1) and (2) and backup rings (3) and (4) with hydraulic oil.

**NOTE**

Cup side of backup rings should face preformed packings.

- (2) Install two preformed packings (1) and (2) and two backing rings (3) and (4) on piston (5).



**28-13. SELF-RECOVERY WINCH BRAKE REPAIR (CONT).**

**e. Installation.**

- (1) Coat brake shaft (1) with hydraulic oil.
- (2) Install brake shaft (1) in front motor support (2), splined end down.
- (3) Coat two dowel pins (3) with hydraulic oil.
- (4) Install two dowel pins (3), small tapered end down, in front motor support (2).
- (5) Coat twelve springs (4) with hydraulic oil.
- (6) Install twelve springs (4) in slots in front motor support (2).
- (7) Coat preformed packing (5) with hydraulic oil.
- (8) Install preformed packing (5) in front motor support (2).

**NOTE**

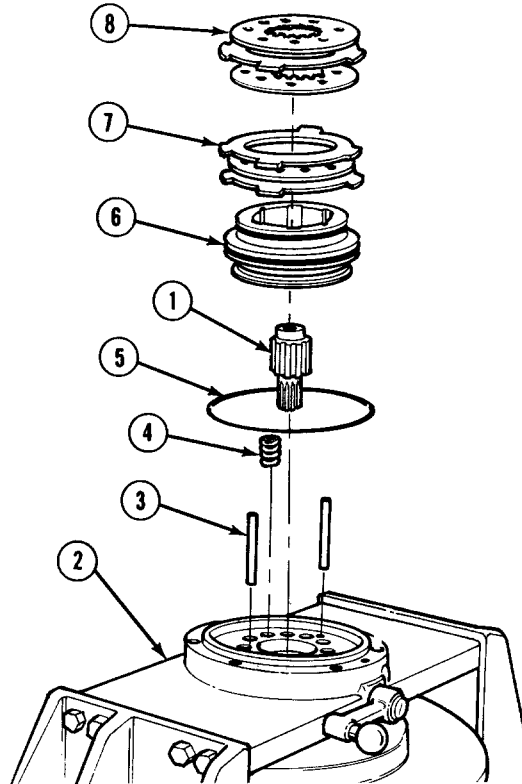
Align dowel pins through alignment holes in piston.

- (9) Coat piston (6) with hydraulic oil.
- (10) Install piston (6) in front motor support (2).
- (11) Coat ten friction plates (7) and nine drive plates (8) with hydraulic oil.

**NOTE**

Friction plates and drive plates are installed friction plate first and alternating with drive plate.

- (12) Install ten friction plates (7) and nine drive plates (8) in piston (6).

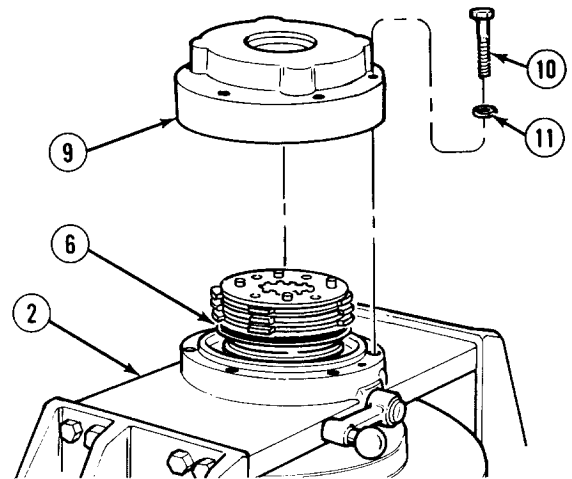


**CAUTION**

Use extreme care when installing brake housing over piston or damage to preformed packings and backup rings may result.

**NOTE**

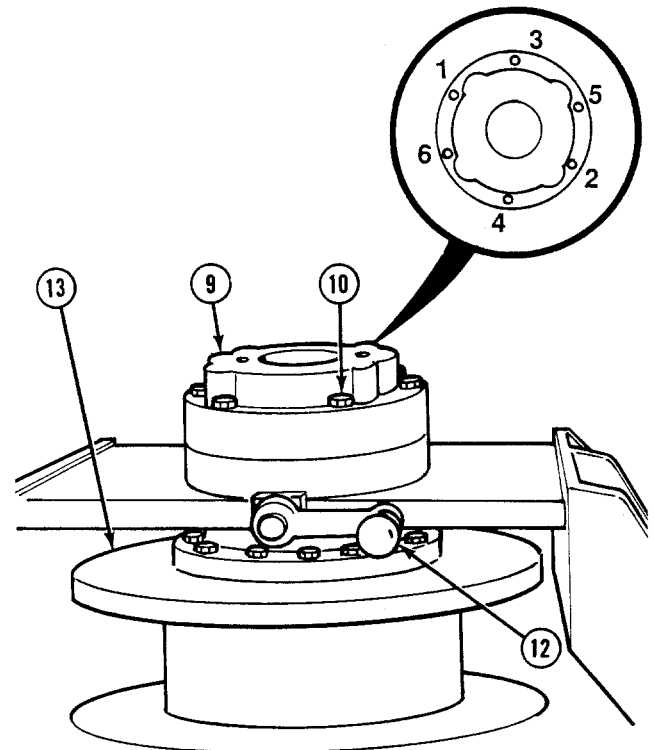
- Ensure brake housing is aligned with dowel pins.
- Ensure matchmark on brake housing and front motor support are aligned.



- (13) Install brake housing (9) over piston (6). Tap lightly with soft hammer until firmly seated.
- (14) Position six lockwashers (11) and six screws (10) in brake housing (9).
- (15) Tighten six screws (10) in brake housing (9) in sequence shown to 50 lb-ft (68 N·m).
- (16) Move shifter arm (12) to free-spool position and ensure ring gear (13) turns freely.

**NOTE**

If ring gear does not turn freely, perform Steps (17) through (18).  
If ring gear does turn freely, go to Follow-On Maintenance.



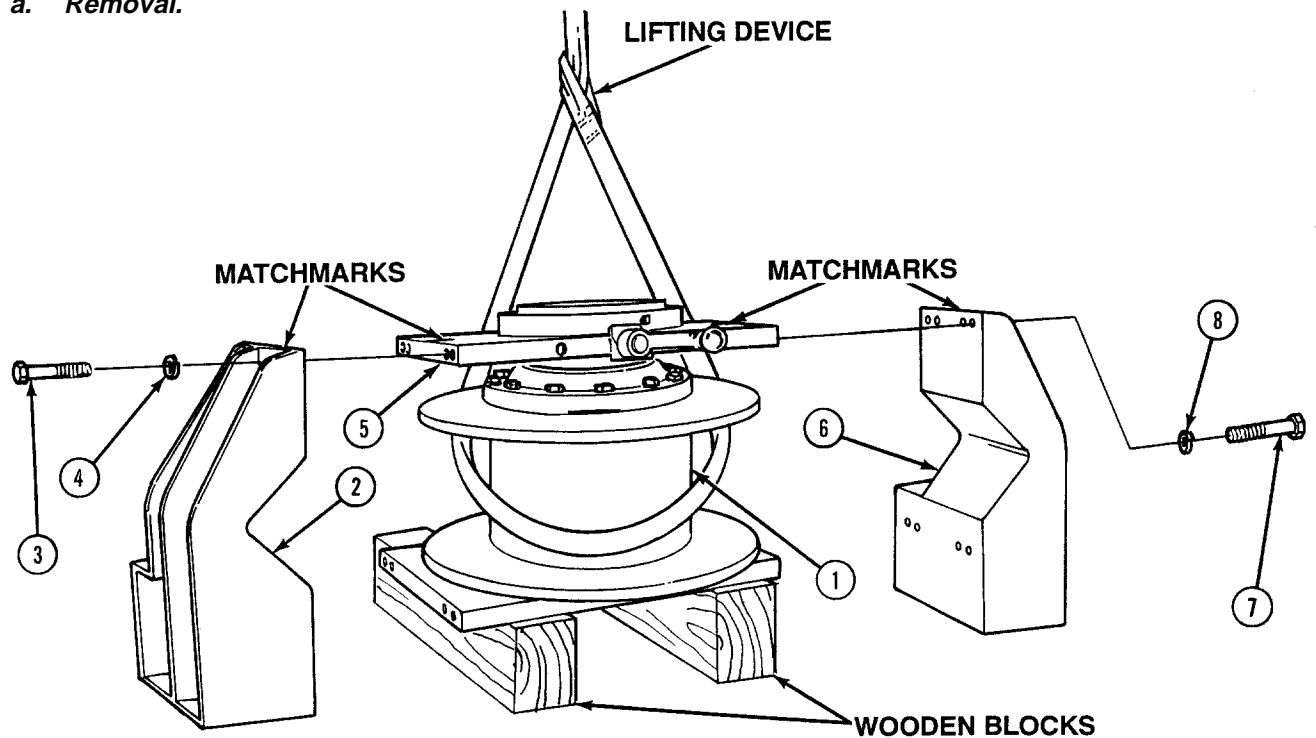
- (17) Loosen six screws (10) and turn brake housing (9) slightly.
- (18) Tighten six screws (10) in sequence shown to 50 lb-ft (68 N·m).

**f. Follow-On Maintenance.**

- Install hydraulic motor, (Para 28-12).

**END OF TASK**



**a. Removal.****WARNING**

Self-recovery winch weighs 980 lbs (445 kg). Attach suitable lifting device prior to removal to prevent injury to personnel.

- (1) Using lifting device, position self-recovery winch (1) on wooden blocks.
- (2) Matchmark location of left side mount (2).

**WARNING**

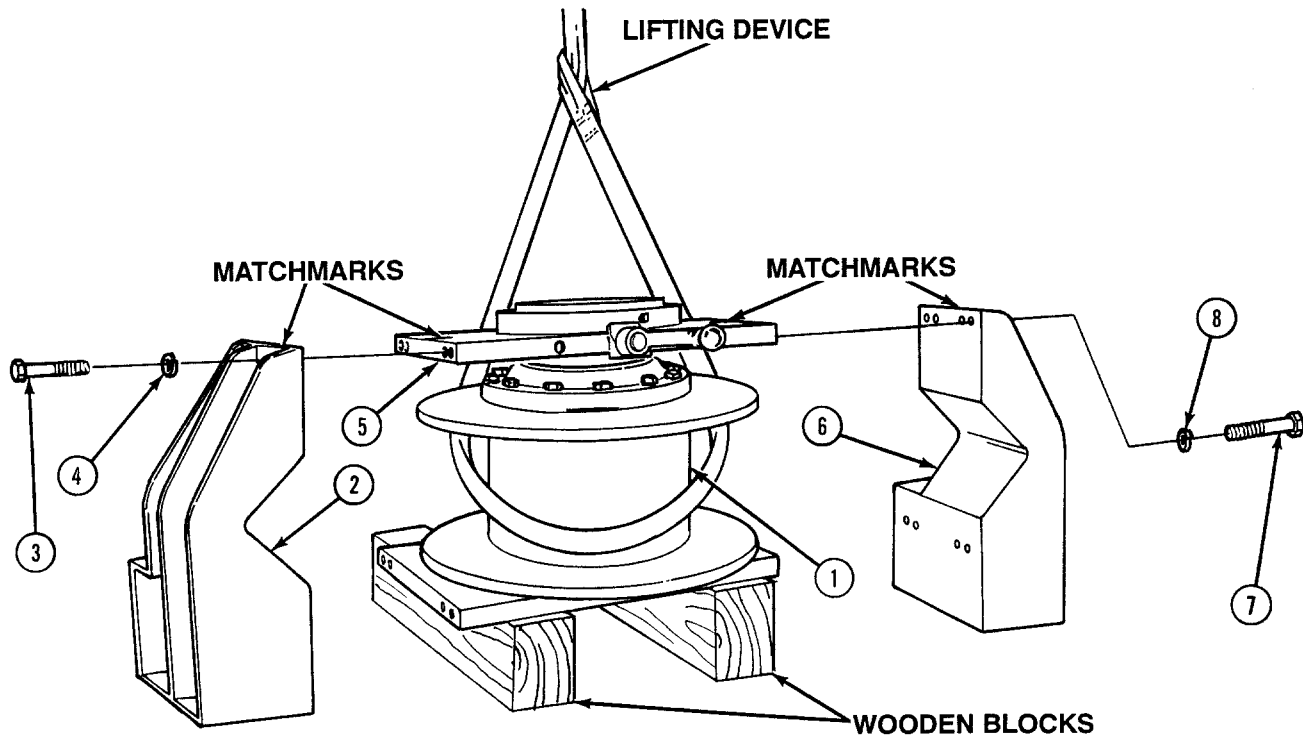
Mounts weigh 48 lbs (22 kg). Ensure hands and fingers are kept clear of left side and right side mounts during removal. Failure to comply may result in serious injury to personnel.

- (3) With the aid of an assistant, remove eight screws (3) and lockwashers (4) from left side base mount (2). Discard lockwashers.
- (4) Remove left side mount (2) from motor end support (5).
- (5) Matchmark location of right side mount (6).
- (6) With the aid of an assistant, remove eight screws (7) and lockwashers (8) from right side mount. Discard lockwashers.
- (7) Remove right side mount (6) from motor end support (5).



**28-14. SELF-RECOVERY WINCH BASE MOUNT REPLACEMENT (CONT).**

**b. Installation.**



**WARNING**

- Mounts weigh 48 lbs (22 kg). Ensure hands and fingers are kept clear of left side and right side mounts during installation. Failure to comply may result in serious injury to personnel.
- Self-recovery winch weighs 980 lbs (445 kg). Attach suitable lifting device prior to installation to prevent injury to personnel.

- (1) With the aid of an assistant, align left side mount (2) with matchmark on motor end support (5), and position eight lockwashers (4) and screws (3).
- (2) With the aid of an assistant, align right side mount (6) with matchmark on motor end support (5), and position eight lockwashers (8) and screws (7).
- (3) Tighten 16 screws (3) and (7) on right side mount (6) and left side mount (2) 70 to 95 lb-ft (95 to 129 N·m).

**c. Follow-On Maintenance.**

- Install self-recovery winch brake, (Para 28-13).

**END OF TASK**

**28-15. SELF-RECOVERY WINCH MOTOR END SUPPORT REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP**

*Tools and Special Tools*

- Tool Kit, General Mechanic's (Item 240, Appendix F)
- Compressor Unit, Air (Item 35, Appendix F)
- Gloves, Chemical Oil Protective (Item 81, Appendix F)
- Goggles, Industrial (Item 83, Appendix F)
- Gun, Airblow (Item 86, Appendix F)
- Press, 60 Ton (Item 164, Appendix F)

*Materials/Parts*

- Oil, Hydraulic (Item 34, Appendix B)
- Solvent, Drycleaning (Item 68, Appendix B)
- Packing, Preformed (3) (Item 395, Appendix E)
- Pin, Roll (Item 432, Appendix E)

*Equipment Condition*

- Self-Recovery Winch base mounts removed, (Para 28-14)

**a. Removal.**

- (1) Remove motor end support (1) from gear end (2).

**NOTE**

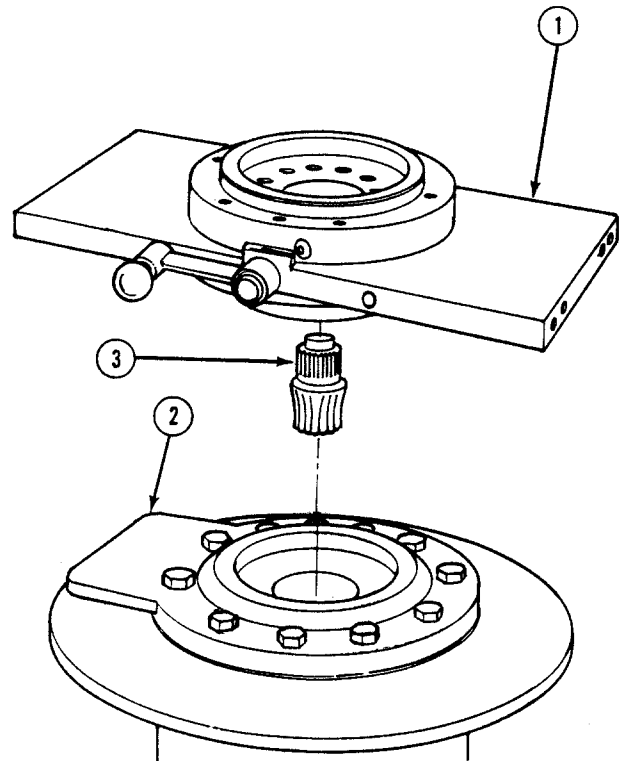
Roll pin from shifter arm may fall out when performing Step (2).

- (2) Position motor end support (1) on level surface with bearing side up.

**NOTE**

Perform Step (3) to remove sun gear primary shaft if not removed during removal of motor end support.

- (3) Remove sun gear primary shaft (3) from gear end (2).



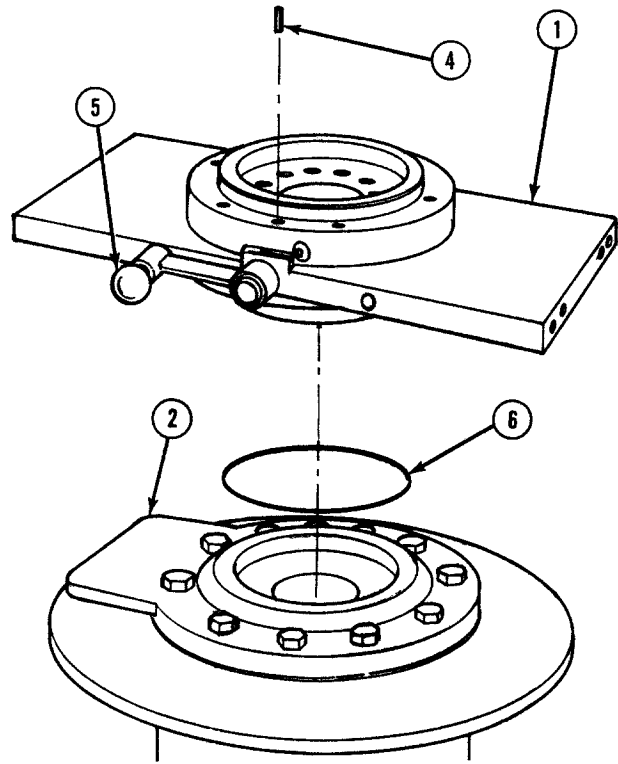
**28-15. SELF-RECOVERY WINCH MOTOR END SUPPORT REPAIR (CONT).**

**b. Disassembly.**

**NOTE**

Perform Step (1) if roll pin from shifter arm did not fall out during removal of motor end support.

- (1) Remove and discard roll pin (4) from shifter arm (5) by lifting motor end support (1) upward and shaking gently.
- (2) Remove and discard preformed packing (6) from motor end support (1) or gear end (2).

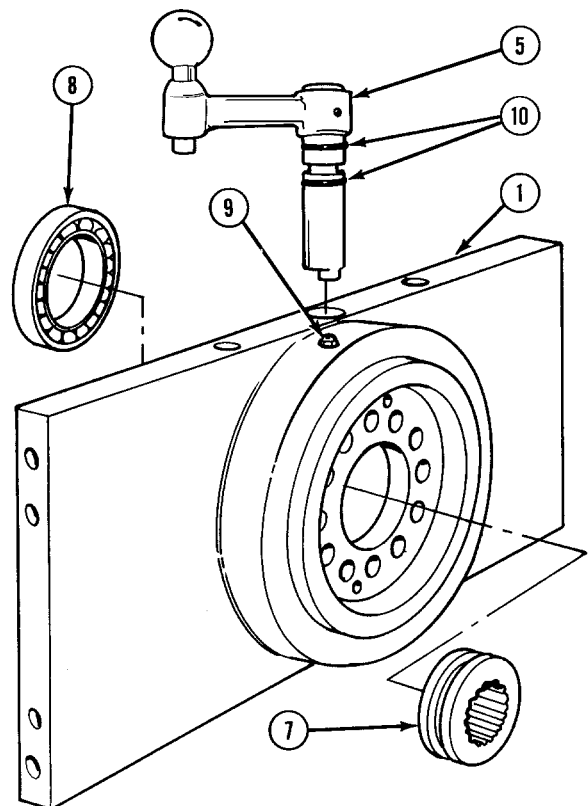


- (3) Place motor end assembly (1) on side with shifter arm (5) facing upward.

**NOTE**

When removing shifter arm, gear drive will be loose.

- (4) Remove shifter arm (5) from motor end assembly (1) by pulling upward.
- (5) Remove gear drive shifter (7) from motor end assembly (1).
- (6) Press bearing (8) from motor end assembly (1).
- (7) Remove vent (9) from motor end assembly (1).
- (8) Place motor end (1) on level surface with bearing side facing upward.
- (9) Remove and discard two preformed packings (10) from shifter arm (5).



*c. Cleaning/Inspection.*

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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.

**WARNING**

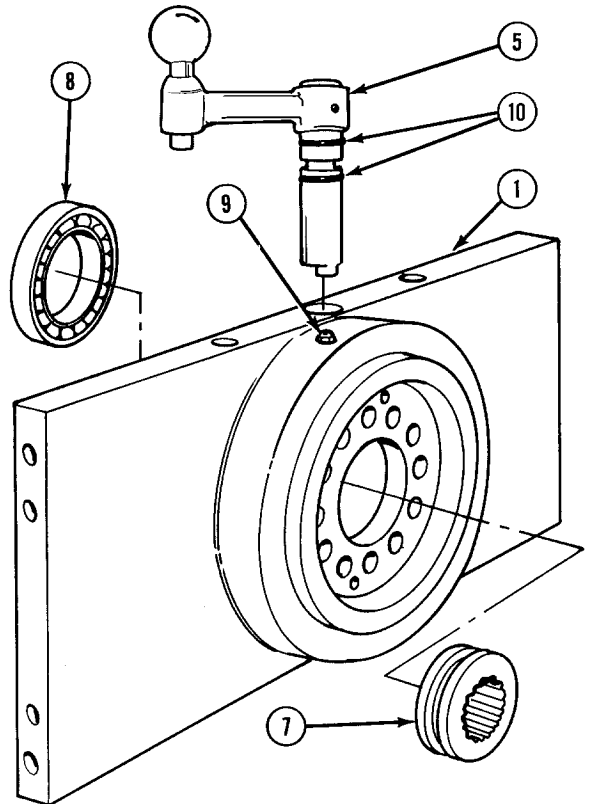
Compressed air used for cleaning purposes will not exceed 30 psi (207 kPa). Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc). Failure to comply may result in injury to personnel.

- (2) Dry all parts, except bearing, with compressed air. Allow bearing to air dry.
- (3) Inspect all mating surfaces for scratches and burrs.
- (4) Inspect bearing for scratches or pitting.
- (5) Inspect gear drive shifter splines for scratches or burrs.
- (6) Replace all scratched or damaged parts.

**28-15. SELF-RECOVERY WINCH MOTOR END SUPPORT REPAIR (CONT).**

**d. Assembly.**

- (1) Lubricate bearing (8) and shifter arm (5) with hydraulic oil
- (2) Install bearing (8) in motor end support (1).
- (3) Place motor end support (1) on side and install vent (9).
- (4) Coat two preformed packings (10) with hydraulic oil.
- (5) Install two preformed packings (10) on shifter arm (5).
- (6) Install gear drive shifter (7) in motor end support (1). Position gear drive shifter (7) so groove is aligned with hole for shifter arm (5) tab.
- (7) Install shifter arm (5) until fully seated in groove of gear drive shifter (7).
- (8) Coat preformed packing (6) with hydraulic oil.
- (9) Install preformed packing (6) on motor end support (1).
- (10) Install roll pin (4) in shifter arm (5).



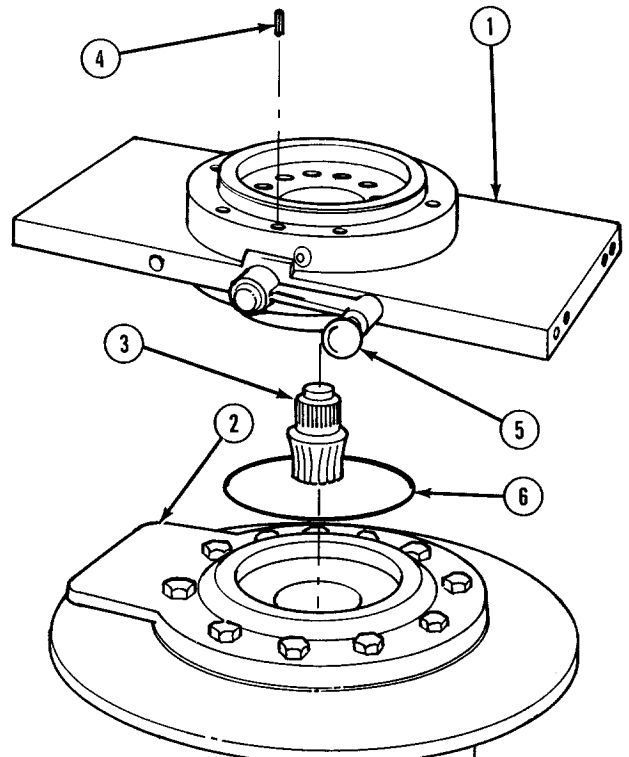
**e. Installation.**

- (1) Lubricate sun gear primary shaft (3) with hydraulic oil.
- (2) Install sun gear primary shaft (3) in gear end (2), splined end down.

**NOTE**

Ensure roll pin is fully seated in shifter arm assembly.

- (3) Install motor end support (1) on gear end (2), bearing side down, until fully seated.



**f. Follow-On Maintenance:**

- Install Self-Recovery Winch base mounts, (Para 28-14).

**END OF TASK**

**28-16. SELF-RECOVERY WINCH MOTOR END HUB REPAIR.**

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

**INITIAL SETUP***Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)  
Puller Kit, Universal, Slide Hammer  
(Item 175, Appendix F)  
Wrench, Torque (0-175 lb-ft [0-237 N·m])  
(Item 277, Appendix F)

*Materials/Parts*

Oil, Hydraulic (Item 34, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Lockwasher (12) (Item 234, Appendix E)  
Packing, Preformed (Item 395, Appendix E)  
Seal (Item 573, Appendix E)

*Personnel Required*

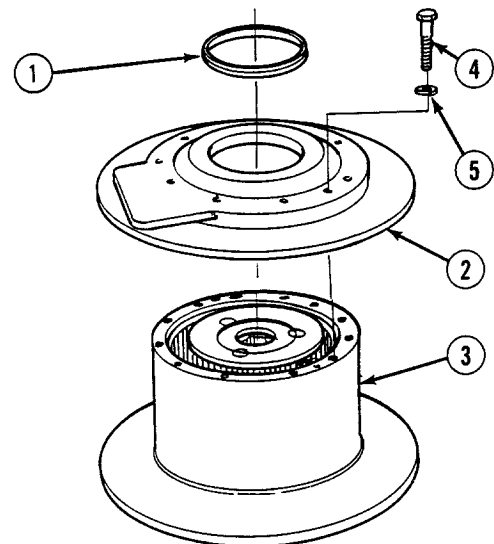
Two

*Equipment Condition*

Self-Recovery Winch motor end support removed,  
(Para 28-15)

**a. Removal.**

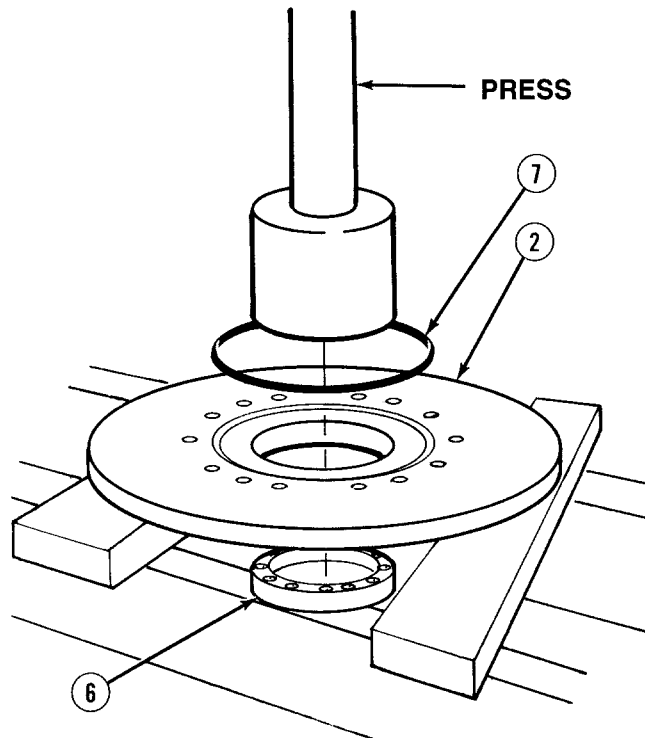
- (1) Remove and discard seal (1) from motor end hub (2).
- (2) With the aid of an assistant, remove 12 screws (3) and lockwashers (4) from motor end hub (2) and ring gear (5). Discard lockwashers.
- (3) With the aid of an assistant, remove motor end hub (2) from ring gear (5).



**28-16. SELF-RECOVERY WINCH MOTOR END HUB REPAIR (CONT).**

**b. Disassembly.**

- (1) Position motor end hub (2) bearing side down in press.
- (2) Press bearing (6) from motor end hub (2).
- (3) Remove motor end hub (2) from press.
- (4) Remove and discard preformed packing (7) from motor end hub (2).



**c. Cleaning/Inspection.**

**WARNING**

- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, 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 II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 to personnel.

- (1) Clean all metal parts with dry cleaning solvent.
- (2) Dry all parts, except bearing, with compressed air. Allow bearing to air dry.
- (3) Inspect all parts for cracks, broken welds and gouges.
- (4) Replace all damaged parts.

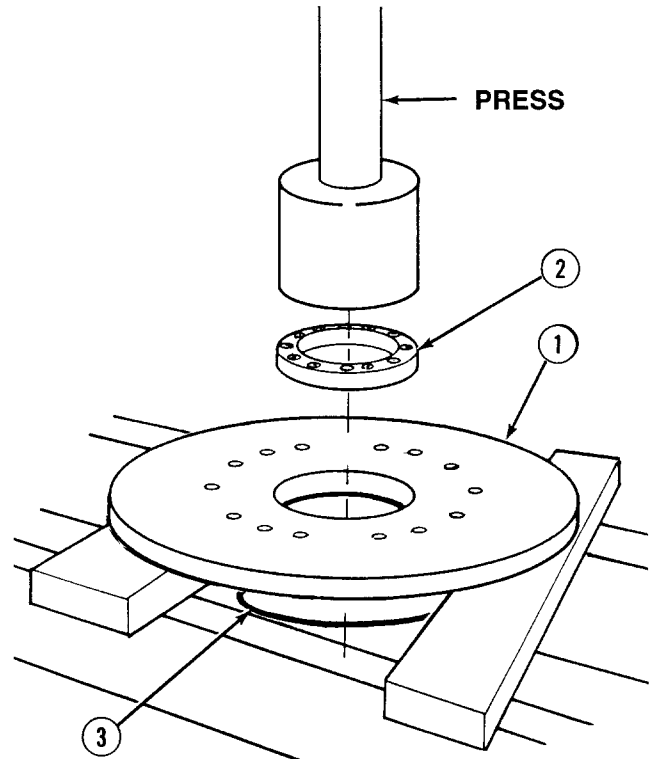
**d. Assembly.**

- (1) Position motor end hub (1) in press.
- (2) Apply hydraulic oil to bearing (2).

**NOTE**

Ensure groove in bearing faces upward during installation.

- (3) Press bearing (2) in motor end hub (1).
- (4) Remove motor end hub (1) from press.
- (5) Apply hydraulic oil to preformed packing (3).
- (6) Install preformed packing (3) in motor end hub (1).



**e. Installation.**

**NOTE**

Ensure spiral pins, of motor end hub, are aligned with alignment holes in ring gear installation.

- (1) Install motor end hub (1) on ring gear (4) until fully seated.
- (2) Position 12 lockwashers (5) and screws (6) in motor end hub (1).
- (3) Tighten 12 screws (6) in motor end hub (1) 70 to 95 lb-ft (95 to 129 N·m) in sequence shown.
- (4) Apply hydraulic oil to seal (7).

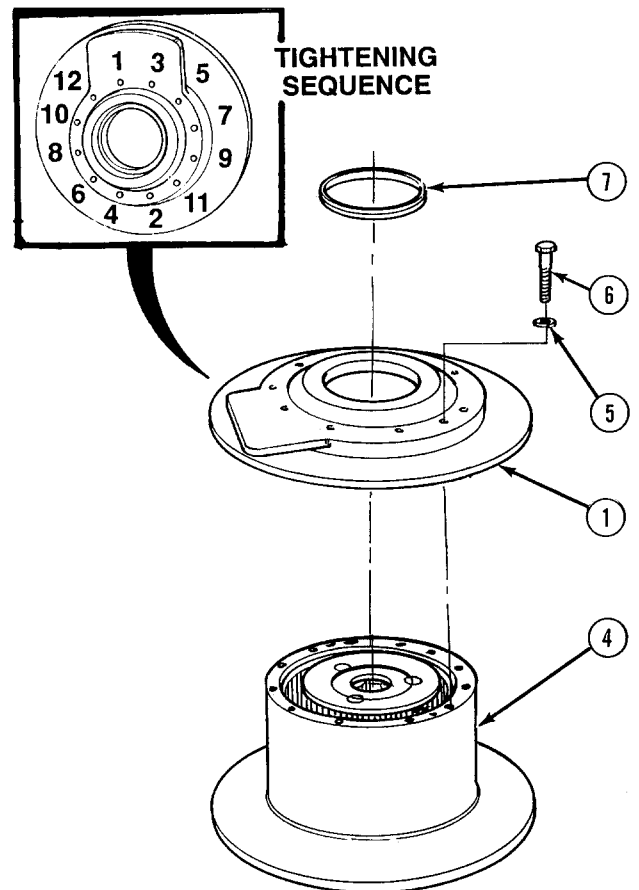
**NOTE**

Seal is installed with rubber lip of seal facing upward.

- (5) Install seal (7) in motor end hub (1).

**f. Follow-On Maintenance:**

- Install Self-Recovery Winch motor end support, (Para 28-15).



**END OF TASK**



## 28-17. SELF-RECOVERY WINCH RING GEAR ASSEMBLY/HUB DRUM REPAIR.

This task covers:

- |                |                        |                          |
|----------------|------------------------|--------------------------|
| a. Removal     | c. Cleaning/Inspection | e. Installation          |
| b. Disassembly | d. Assembly            | f. Follow-On Maintenance |

### INITIAL SETUP

#### *Tools and Special Tools*

Tool Kit, General Mechanic's  
(Item 240, Appendix F)  
Compressor Unit, Air (Item 35, Appendix F)  
Gloves, Chemical Oil Protective  
(Item 81, Appendix F)  
Goggles, Industrial (Item 83, Appendix F)  
Gun, Airblow (Item 86, Appendix F)  
Pan, Drain 6 gal (Item 145, Appendix F)  
Press, 60 Ton (Item 164, Appendix F)  
Kit, Puller, Universal, Slide Hammer  
(Item 175, Appendix F)  
Wrench, Torque (0-175 lb-ft [0-237 N·m])  
(Item, 277, Appendix F)

#### *Materials/Parts*

Oil, Lubricating Gear (Item 40, Appendix B)  
Solvent, Drycleaning (Item 68, Appendix B)  
Lockwasher (12) (Item 234, appendix E)  
Repair Kit (Item 464, Appendix E)

#### *Personnel Required*

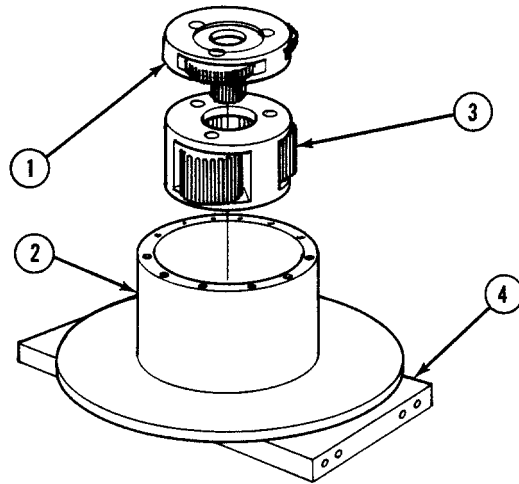
Two

#### *Equipment Condition*

Self Recovery Winch motor end hub removed,  
(Para 28-16)

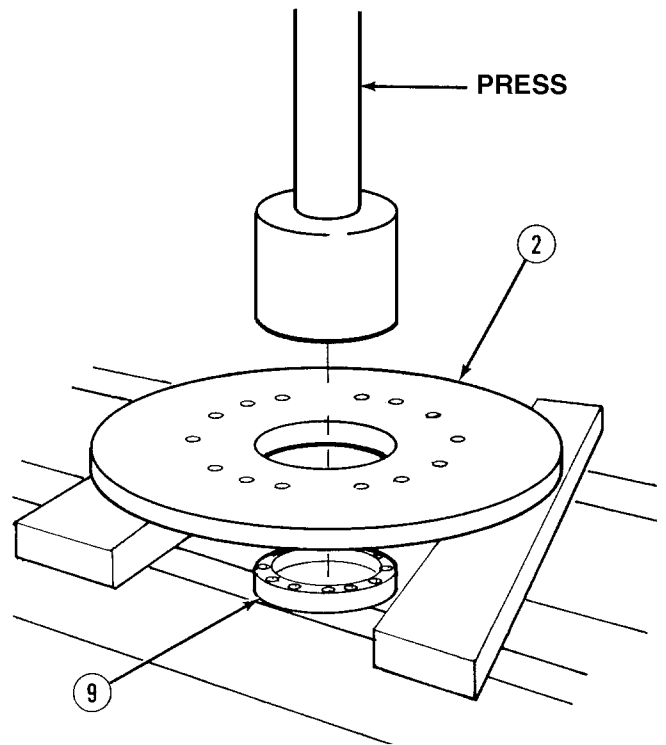
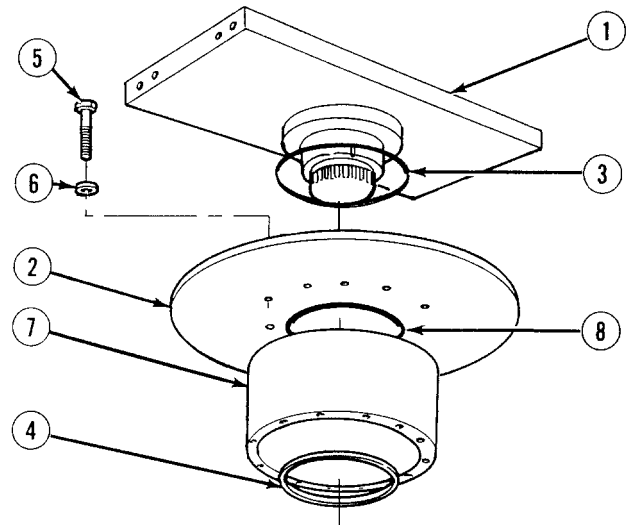
### a. Removal.

- (1) Remove primary planetary carrier assembly (1) from ring gear (2).
- (2) Remove secondary planetary carrier assembly (3) from ring gear (2).
- (3) Remove support end gear (4) from ring gear (2).



**b. Disassembly.**

- (1) Remove support end gear (1) from hub drum end (2).
- (2) Remove and discard preformed packing (3) from support end gear (1).
- (3) Remove and discard inner seal (4) from hub drum end (2).
- (4) Remove 12 screws (5) and lockwashers (6) from hub drum end (2). Discard lockwashers.
- (5) Remove ring gear (7) from hub drum end (2).
- (6) Turn hub drum assembly (2) over and remove and discard preformed packing (8).
- (7) Position hub drum assembly (2) in press.
- (8) Press out bearing (9) from hub drum assembly (2).
- (9) Remove hub drum assembly (2) from press.



**28-17. SELF-RECOVERY WINCH RING GEAR ASSEMBLY/HUB DRUM REPAIR  
(CONT).**

*c. Cleaning/Inspection.*

**WARNING**

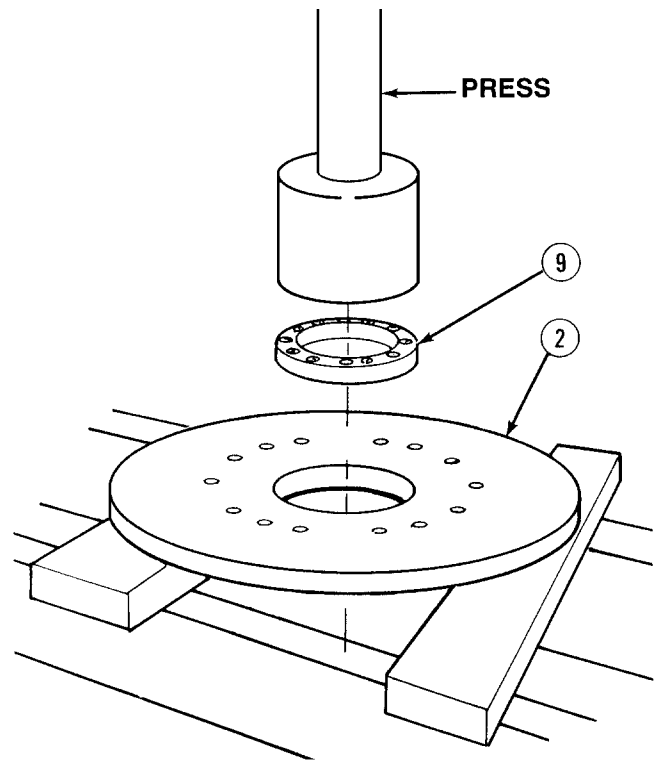
- Drycleaning Solvent (P-D-680) is TOXIC and flammable. Wear protective goggles, face shield, and gloves; use only in a well-ventilated area; avoid contact with skin, eyes, and clothes, and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent. The flashpoint for Type II Drycleaning Solvent is 140 degrees F (60 degrees C) and Type III Drycleaning Solvent is 200 degrees F (93 degrees 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 to personnel.
- (1) Clean all metal parts with drycleaning solvent.
  - (2) Dry all parts, except bearings, with compressed air. Allow bearings to air dry.
  - (3) Inspect all parts for broken welds, cracks and gouges.
  - (4) Inspect bearing for scratches or pitting.
  - (5) Replace all damaged parts.

**d. Assembly.**

**NOTE**

Ensure groove in bearing faces upward installation during.

- (1) Coat bearing (9) with gear oil.
- (2) Position hub drum (2) in press and install bearing (9) on hub drum (2).
- (3) Remove hub drum (2) from press and position with bearing side up.

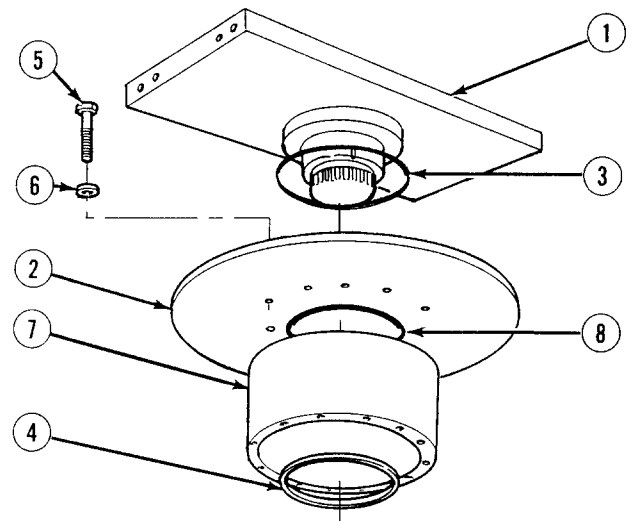


- (4) Coat preformed packing (8) with gear oil.
- (5) Install preformed packing (8) in hub drum (2).

**NOTE**

Ensure spiral pins of hub drum end, are aligned with alignment holes in ring gear.

- (6) Install hub drum end (2) on ring gear (7).
- (7) Install 12 lockwashers (6) and screws (5) in hub drum end (2). Tighten until snug.
- (8) With the aid of an assistant, tighten 12 screws (5) in hub drum end (2) 70 to 95 lb-ft (95 to 129 N·m).
- (9) Coat inner seal (4) with gear oil.
- (10) Install inner seal (4) in hub drum end (2).
- (11) Coat preformed packing (3) with gear oil.
- (12) Install preformed packing (3) in support end gear (1).



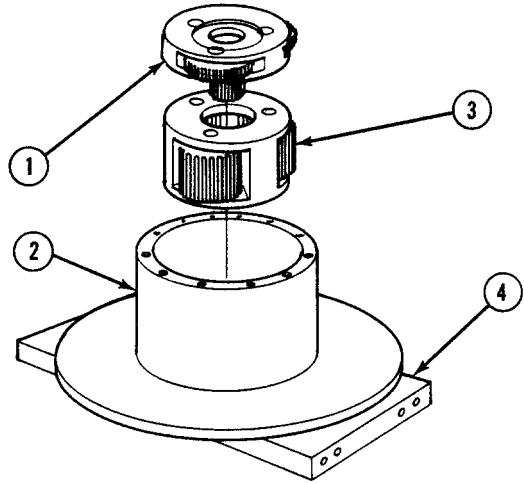
**28-17. SELF-RECOVERY WINCH RING GEAR ASSEMBLY/HUB DRUM REPAIR (CONT).**

**e. Installation.**

- (1) Install support end gear (4) on ring gear (2) until fully seated.
- (2) Turn ring gear (2) over so support end gear (4) is down.

**WARNING**

Ensure fingers do not get caught between secondary planetary carrier and ring gear or injury to personnel may result.



- (3) Coat secondary planetary carrier assembly (3) with gear oil.
- (4) Install secondary planetary carrier assembly (3) in ring gear (2) with gear end facing down.
- (5) Coat primary planetary carrier assembly (1) with gear oil.
- (6) Install primary planetary carrier assembly (1) in ring gear (2).

**f. Follow-On Maintenance:**

- Install Self-Recovery Winch motor end hub, (Para 28-16).

**END OF TASK**

## APPENDIX A

### REFERENCES

**A-1. SCOPE.**

Indexes should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to material covered in this publication.

Military Publication Indexes.

Consolidated Index of Army Publications and Forms ..... DA PAM 310-1

**A-2. FORMS.**

Refer to DA PAM 738-750, The Army Maintenance Management System (TAMMS), for instructions on the use of maintenance forms pertaining to the vehicle.

**A-3. FIELD MANUALS.**

The following publications contain information pertinent to the vehicle material.

Camouflage .....	FM 20-3
Manual for Wheel Vehicle Driver .....	FM 21-305
Nuclear, Biological, and Chemical Defense .....	FM 21-40
Basic Cold Weather Manual .....	FM 31-70
Northern Operations .....	FM 31-71
Chemical, Biological, and Radiological (CBR) Decontamination .....	FM 3-5
Nuclear, Biological, and Chemical (NBC) Reconnaissance and Decontamination Operations (How to Fight) .....	FM 3-87 (HTF)
Army Motor Transport Units and Operations .....	FM 55-30
Operation and Maintenance of Ordnance Materiel in Cold Weather 0°F to -65°F .....	FM 9-207

**A-4. TECHNICAL MANUALS.**

Painting Instructions .....	TM 43-0139
General Shop Practice Requirements for Repair, Maintenance, and Test of Electronic Equipment .....	TM 43-0158

**A-4. TECHNICAL MANUALS (CONT).**

Administrative Storage of Equipment ..... TM 740-90-1

Procedures for Destruction of Tank Automotive Equipment to Prevent  
Enemy Use (U.S. Army Tank-Automotive Command) ..... TM 750-244-6

Operator’s and Organizational Support Maintenance Manual  
for Care, Maintenance, Repair, and Inspection of Pneumatic  
Tires and Inner Tubes ..... TM 9-2610-200-14

Operator/Unit/Direct Support/General Support Maintenance Manual Including  
Repair Parts and Special Tools List for Simplified Test Equipment  
For Internal Combustion Engines ..... TM 9-4910-571-12&P

Maintenance and Repair for Lead-Acid Storage Batteries ..... TM 9-6140-200-14

Inspection, Care, and Maintenance of Antifriction Bearings ..... TM 9-214

Materials Used for Cleaning, Preserving, Abrading, and Cementing  
Ordinance Material and Related Materials Including Chemicals ..... TM 9-247

**A-5. MISCELLANEOUS PUBLICATIONS.**

Description, Use, Bonding Techniques, and Properties of Adhesives ..... TB ORD1032

Safety Inspection and Testing of Lifting Devices ..... TB 43-0142

Use of Antifreeze Solutions and Cleaning Compounds in  
Engine Cooling Systems ..... TB 750-651

Operator’s Circular for Welding Theory and Application ..... TC 9-237

## APPENDIX B

### EXPENDABLE SUPPLIES AND MATERIALS LIST

#### Section I. INTRODUCTION

##### B-1. SCOPE.

This appendix lists expendable supplies and materials you will need to operate and maintain the truck. These items are authorized to you by CTA50-970, Expendable Items (Except Medical, Class V, Repair Parts and Heraldic Items) or CTA8-100, 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 task box to identify the material (e.g., “Compound, Antiseize, Item 14, Appendix B”).
- b. Column (2) - Level.** This indicates the level of maintenance authorized to use the material as approved by the Maintenance Allocation Chart (MAC).
- 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 Commercial and Government Entity (CAGE) code in parentheses followed by the part number.
- e. Column (5) - Unit of Measure.** Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (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 SUPPLIES AND MATERIALS LIST**

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
1	F	8040-00-843-0802 8040-00-225-4548	Adhesive, RTV 108 (80244) MIL-A-46106 GP1TY1 3 ounce kit 12 ounce tube	oz oz
2	F	8040-00-865-8991	Adhesive, RTV 732 (19207) 12266964	kt
3	F		Adhesive, (OPMN0) Sika 255FC BLK (45152) 3145938	oz
4	F		Adhesive, Spray (45152) 1537350	oz
5	F	6810-01-075-5546	Alcohol, Isopropyl (53390) 7618-19-4 40 ounce bottle	oz
6	F	6850-00-181-7940	Antifreeze	gl
7	F	7920-00-062-5468	Brush, Bristle (72387) 2-305SBN	ea
8	H	8020-00-324-9700	Brush, Paint (96906) MS 16866	ea
9	F	5975-00-273-8133	Cable Ties (96906) MS3367-3	pk
10	F	7510-00-223-6706	Chalk (58536) A-A-318	bx
11	F	7920-00-165-7195 7920-00-044-9281	Cloth, Cleaning (81349) MIL-C-85043 Type 1 - 10 lb box Type 2 - 10 lb box	lb lb
12	F	5350-00-221-0872	Cloth, Crocus (81348) P-C-458 50 sheet package	sh
13	F	8030-01-106-8393	Coating, Protective (09687) 57-021-102 1 quart can	qt
14	F	8030-01-087-8254 8030-00-155-6444	Compound, Antiseize (81399) MIL-A-907 8 ounce can with brush applicator 16 ounce aerosol can	oz oz

## Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST (CONT)

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
15	F	8030-00-062-6950 8030-01-149-1731 8030-00-837-6557 8030-00-903-0931	Compound, Corrosion Preventive (81349) MIL-C-16173 Grade 1 - 1 quart can Grade 2 - 1 quart can Grade 3 - 1 pint can Grade 4 - 1 pint can	qt qt pt pt
16	F		Compound, International No. 2 (45152) 5198563	oz
17	H		Compound, Retaining Type II (81349) MIL-R-46082B	oz
18	F	8030-00-231-2349 8030-00-231-2344	Compound, Rust Preventive (81349) MIL-R-10036 1 gallon can 5 gallon can	gl gl
19	F	6950-01-092-3550	Compound, Silicone (75037) 1609 can aerosol	oz
20	H	8010-00-889-9745	Dye, Prussian Blue (45152) 15963	oz
21	F	9150-01-197-7688 9150-01-197-7689	Grease, Automotive and Artillery (81349) MIL-G-10924 2.25 ounce tube 6.5 pound can	oz lb
22	F	9150-01-306-9202 9150-00-823-8047	Grease, General Purpose (81349) MIL-G-23549 1 pound can 35 pound can	lb lb
23	F	9150-01-145-1259	Grease, High Temperature (81349) DOD-G-85733	qt
24	F	9150-01-137-4657	Grease, HI-Vacuum (98079) 269352-2	qt
25	H	9150-01-235-5057	Grease, Instrument (97343) SRI-2 1 pint can	pt
26	F	9150-00-076-1587	Grease, Lithium (07748) 5555	oz
27	F	9150-01-091-9336	Grease, Molybdenum Disulfide (58372) 60G 1.5 pound can	lb

**Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST (CONT)**

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
28	F	9150-00-754-2595 9150-00-965-2003	Grease, Molybdenum Disulfide (81349) MIL-G-21164 1.75 pound can 35 pound can	lb lb
29	F		Heatshrink (46152) 1704940	ea
30	F		Heatshrink (45152) 1704950	ea
31	F	2540-00-256-5529 2540-00-256-5526  2540-00-256-5527	Lubricant, Tire (96980) AA20 5 gallon can 1 quart can (96980) AA17 1 gallon can	gl qt  gl
32	F	9140-00-286-5294	Oil, Diesel, Fuel BULK (81348) VVF800GRADED2RE	gl
33	H	9150-01-024-6059	Oil, Honing (58436) MB-30	qt
34	F	9150-00-189-6727 9150-00-183-7807	Oil, Hydraulic OE/HDO 10 (81349) MIL-L-2104 1 quart can 55 gallon drum	qt gl
35	F	6850-00-779-6851	Oil, Injector Test (33287) J 26400-5	oz
36	F	9150-00-186-6681 9150-00-189-6729	Oil, Lubricating OE/HDO 30 (81349) MIL-L-2104 1 quart can 55 gallon drum	qt gl
37	F	9150-00-189-6730 9150-00-405-2987	Oil, Lubricating, Engine OE/HDO 40 (81349) MIL-L-2104 1 quart can 55 gallon drum	qt gl
38	F	9150-01-152-4117 9150-01-152-4119	Oil, Lubricating, Engine OE/HDO 15W/40 (81349) MIL-L-2104 1 quart can 55 gallon drum	qt gl
39	F	9150-00-186-6699 9150-00-186-6703	Oil, Lubricating, Engine OE/HDO 10W/30 (81349) MIL-L-46152 1 quart can 55 gallon drum	qt gl

## Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST (CONT)

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
40	F		Oil, Lubricating, Gear 75 W/90 (81349) MIL-L-2105	qt
41	F		Oil, Lubricating, Gear 80W/90 (81349) MIL-L-2105	
		9150-01-035-5392	1 quart can	qt
		9150-00-001-9395	5 gallon can	gl
42	H		Paint, Black (45152) PS-025-9	oz
43	H		Petrolatum (81348) VV-P-236	
		9150-00-250-0931	8 ounce tube	oz
		9150-00-250-0933	7.5 pound can	lb
44	H		Plastigage (77220) PR-1	ea
45	F		Primer, (OPMN0) Sika Cleaner 205 (45152) 3145939	oz
46	F		Primer, "T" 7471 (05972) 19267	oz
47	F		Rags, Wiping (58536) A-A-531	
		7920-00-205-1711	50 pound bale	lb
48	F		Rope, 3/4 in. thick, 20 ft. (19207) MIL-R-24050	ea
49	F		Sealant, Adhesive (81349) MIL-S-46163	
		8030-00-111-2762	50 cc bottle	bt
		8030-01-253-2319	12 ounce tube	tu
50	F		Sealant, Electrical (00CE9) RTV200-257	
51	F		Sealer, Automotive (45152) 706786X	oz
52	H		Sealing Compound (77247) 51D	
		8030-00-954-9371	1 pint can	pt
53	F		Sealing Compound (05972) 56765	tu
54	F		Sealing Compound (05972) MIL-S-46163 Type 1 Grade K	
		8030-01-158-6070	10 milliliter bottle	bt

**Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST (CONT)**

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
55	F	8030-01-069-3046	Sealing Compound (111280A) (05972) MIL-S-46163A Type II Grade M	bt
56	F	8030-01-104-5392 8030-01-025-1692	Sealing Compound (05972) Loctite #242 (80244) MIL-S-46163A Type 2 Grade N 10 milliliter bottle 250 milliliter bottle	bt bt
57	F	8030-01-159-4374 8030-01-142-9830 8030-01-142-3131	Sealing Compound (05972) Loctite #262 10 milliliter bottle 50 milliliter bottle 250 milliliter bottle	ml ml ml
58	F	8030-01-303-0502 8030-01-387-2007	Sealing Compound (05972) Loctite #680 50 milliliter bottle 250 milliliter bottle	ml ml
59	F	8030-00-180-6150 8030-00-180-6222 8030-00-891-8358	Sealing Compound (05972) Loctite #609 (80244) MIL-R-46082B Type 1 10 milliliter bottle 50 milliliter bottle 250 milliliter bottle	bt bt bt
60	F		Sealing Compound (05972) Loctite #518 50 milliliter bottle 300 milliliter cartridge	bt cr
61	O	8030-01-054-0740 8030-00-204-9149 8030-01-166-0675	Sealing Compound (05972) Loctite #567 50 milliliter bottle 250 milliliter tube (05972) Loctite #567-47 50 milliliter tube	ml ml ml
62	F	8040-01-260-1939	Sealing Compound (71984) RTV 738	oz
63	F	8030-00-291-1787 8030-00-291-1789	Sealing Compound (81349) MIL-S-45180 1 pint can 1 gallon can	pt gl
64	F	8030-00-656-1426	Sealing Compound (77247) Permatex-3D 1 pint can	pt

## Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST (CONT)

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
65	F	8030-01-137-6964	Sealing Compound (05972) Loctite #515 50 milliliter tube	tu
66	O	6850-00-177-5094	Silicone Compound, Anti-Corrosion (71984) DC4-2OZ 2 ounce tube	oz
67	F	6810-00-252-1345	Solution, Soap (81349) MIL-W-15000 Class C	bt
68	F	6850-00-664-5685 6850-00-264-9038	Solvent, Drycleaning (81348) P-D-680 1 quart can 5 gallon can	qt gl
		6850-01-378-0679	(Environmentally Compliant Solvent) (OK209) Breakthrough 5 gallon can	gl
69	F	8010-00-440-4224	Spirits, Mineral (83992) 3526	gl
70	F	9515-01-268-9500	Strip, Metal (39428) 9500K18	in
71	F	9320-00-491-5351	Strip, Rubber (98882) 70-17-13	ft
72	F	9905-00-537-8957 9905-00-537-8955	Tags, Identification (81349) MIL-T-12755 White Yellow	ea ea
73	F	7510-00-680-2395	Tape, Masking (26066) 231	ea
74	F	5970-00-547-0966	Tape, Electrical (19207) BISEALTYPE3	ea
75	F	7510-01-358-8770	Tape, Pressure Sensitive (52152) 4950 36 yard roll	yd
76	H	8010-00-401-0421	Varnish (79810) FIXATIF	qt
77	F	5970-00-901-5331	Varnish, Insulating, Electrical (15202) 10-9002	oz
78	F	6145-01-074-7535	Wire, 16 Gage (45152) 1927FX	ft
79	H	9505-00-331-3275	Wire, Nonelectrical (96906) MS20995C41	lb



## APPENDIX C

### ILLUSTRATED LIST OF MANUFACTURED ITEMS

#### Section I. INTRODUCTION

##### C-1. SCOPE.

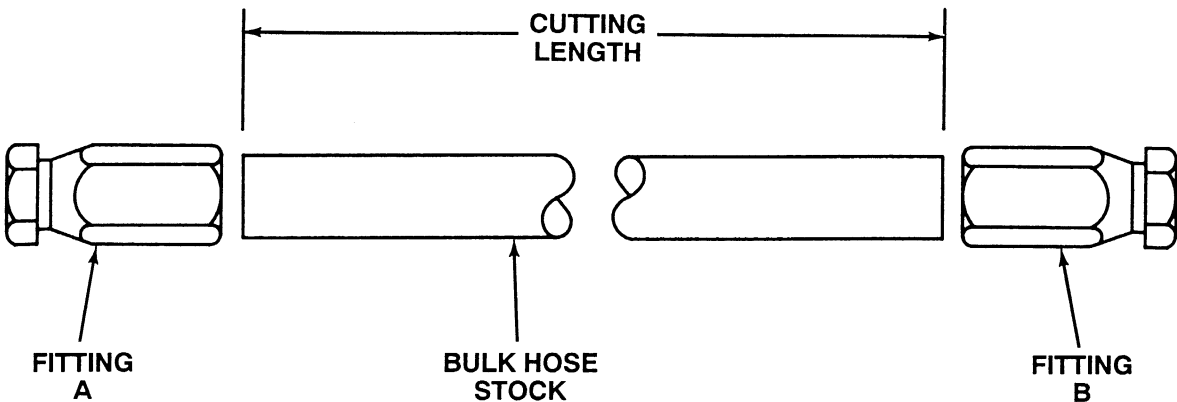
This appendix includes complete instructions for manufacturing or fabricating authorized items locally. All bulk materials needed to manufacture an item are listed by part number or specification number in a tabular list with an illustration, as needed.

#### Section II. MANUFACTURED ITEMS

##### C-2. FUEL HOSE FABRICATION.

The following hoses are cut from bulk hose using a fine-toothed hacksaw or suitable cutting device. Locations and installation instructions for fuel hoses are found in TM 9-2320-364-20. Table C-1 lists the fuel hoses.

*Table C-1. Fuel System Hoses*



Hose Assembly P/N	Bulk Hose P/N	Cut off Length	
		Inches	cm
65068AX-024	2575-48RL	24	610
47371AXU-018	FC350-04	18	457
EU102958-025	FC350-06	25	635
EU01958-052	FC350-06	52	1321
1924600U-034	FC350-10	34	864
56845AXU-005	FC350-10	5	127



**C-3. AIR INTAKE HOSE FABRICATION.**

There are two hoses in the air intake system that require fabrication. Both hoses can be cut from bulk stock using a fine-toothed hacksaw or suitable cutting device. Refer to TM 9-2320-364-20 for locations and installation instructions.

*Table C-2. Air Intake Hoses*

Hose Assembly P/N	Bulk Hose P/N	Cutoff Length	
		Inches	mm
2103FXW-120	21020FX	120	3048
1732400U-067	FC300-16	67	1702

**C-4. COOLING SYSTEM HOSES FABRICATION.**

The following hoses for the cooling system are cut from bulk hose using a fine-toothed hacksaw or suitable cutting device. Locations and installation instructions are found in TM 9-2320-364-20.

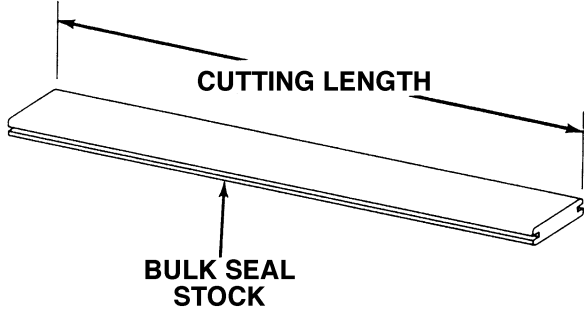
*Table C-3. Cooling System Hoses*

Hose Assembly P/N	Bulk Hose P/N	Cutoff Length	
		Inches	mm
69940AX-048	3230-0293	48	1219
4811FX-100	4811FX	100	2540
46754AX-U-020	FC350-06	20	508

**C-5. SEAL FABRICATION.**

Fabricate seals from bulk seal stock listed in Table C-4. Use a suitable cutting tool to cut seal to length required.

**Table C-4. Seal, Nonmetallic**



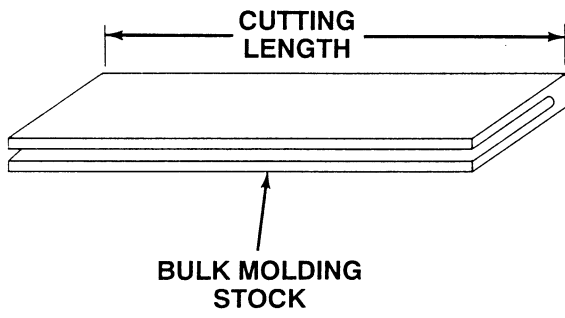
The diagram shows a perspective view of a long, thin, rectangular piece of bulk seal stock. A double-headed arrow above the piece is labeled "CUTTING LENGTH", indicating the distance from the left end to a specific point on the right side. An arrow points from the text "BULK SEAL STOCK" below to the center of the piece.

Seal P/N	Seal Bulk P/N	Cutoff Length	
		inches	mm
59747AX-040	101-2203	40	1016
59747AX-055	101-2203	55	1397
59745AX-040	75000519	40	1016
59745AX-055	75000519	55	1397
125865A-047	75001366	47	1194
125865A-116	75001366	116	2946
125865A-160	75001366	160	4064

**C-6. EDGING AND MOLDING FABRICATION.**

Edging and molding can be fabricated from bulk stock listed in Table C-5. Use suitable cutting tool to cut to length required.

**Table C-5. Edging and Molding**

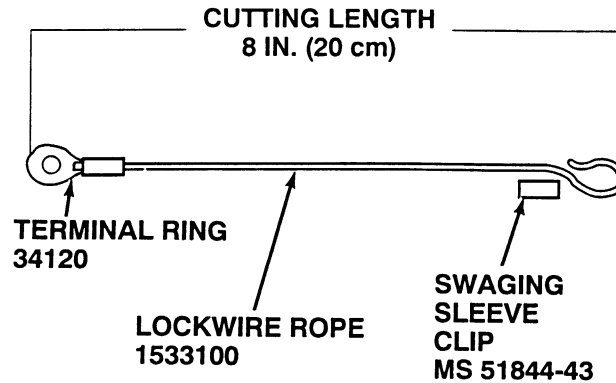


The diagram shows a perspective view of a rectangular block of material, labeled 'BULK MOLDING STOCK'. A horizontal double-headed arrow above the block is labeled 'CUTTING LENGTH', indicating the dimension to be cut.

Edging/Molding P/N	Edging/Molding Bulk P/N	Cutoff Length	
		inches	mm
1339700-011	1339700	11	279
26927AX-026	26927AX	26	660
26947BX-002	75000317	2	51
26947BX-003	75000317	3	76
26947BX-004	75000317	4	102
26947BX-005	75000317	5	127
26947BX-006	75000317	6	152
26947BX-017	75000317	17	432
26947BX-018	75000317	18	457
1467160-012	75000317	12	305
42925AX-005	OR40	5	127
27022AX-002	R-422-N	2	5
27022AX-019	R-422-N	19	483
27022AX-024	R-422-N	24	610
27022AX-043	R-422-N	43	1092
27022AX-093	R-422-N	93	2362
27022AX-101	R-422-N	101	2565
27022AX-130	R-422-N	130	3302

**C-7. LOCKWIRE ROPE FABRICATION.**

The lockwire length is shown in Table C-6. Crimped button stop caps are used to attach the lockwire to other components. Each application requires two swaging sleeve clips.



**NOTES:**

1. Obtain all components required to fabricate lockwire.
2. Use a fine toothed hacksaw or suitable cutting device, and cut lockwire to length required.
3. Slide wire through hole in component, until lockwire comes through other side.
4. Slide cap onto lockwire, until cap bottoms against component and wire comes through cap.
5. Crimp cap to lockwire.
6. Slide opposite end of wire through assembly, and slide other cap over end of wire.
7. Slide wire through hole in component, until lockwire comes through other side.
8. Slide cap onto lockwire, until cap bottoms against component and wire comes through cap.
9. Crimp cap to lockwire

The following wire rope is cut from bulk stock. Refer to Table C-6 for cutting lengths.

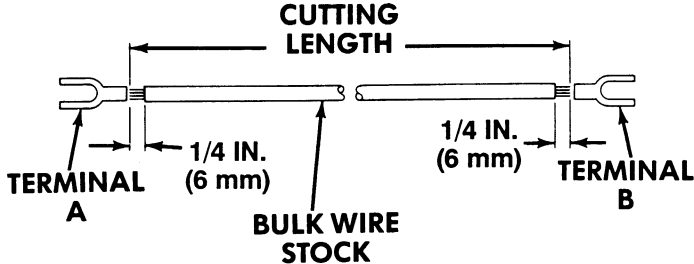
**Table C-6. Lockwire Rope**

Lockwire Rope Part Number	Lockwire Rope Bulk Park Number	Cutoff Length	
		Inches	cm
1533100-010	1533100	10	25
1533100-015	1533100	15	38
1533100-020	1533100	20	51
1533100-024	1533100	24	61

**C-8. WIRE AND WIRE ASSEMBLIES FABRICATION.**

Fabricate from bulk wire stock listed in Table C-7. Use wire cutters to cut wire to required length, then strip ends of wire 1/4 in (6.35 mm). Crimp the required lugs or terminals onto wire ends.

**Table C-7. Wire and Wire Assemblies**



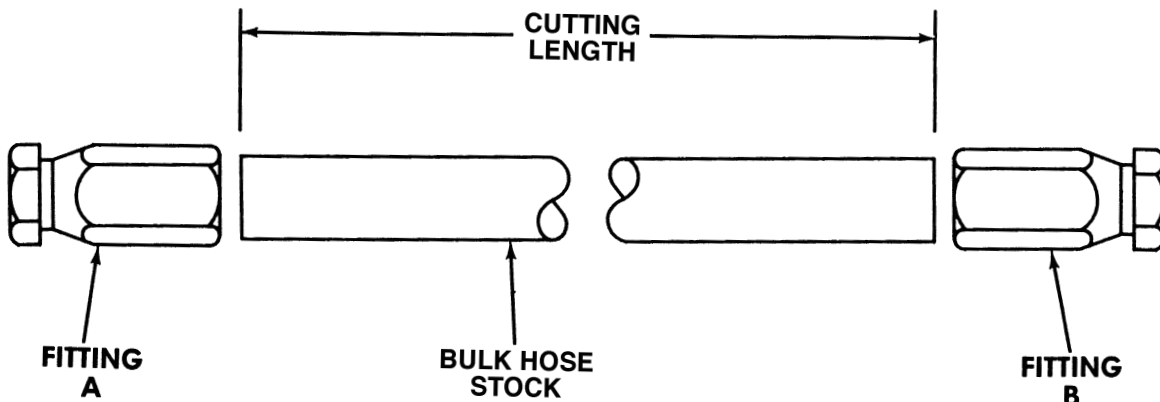
The diagram illustrates the fabrication of a wire assembly. It shows a central section of 'BULK WIRE STOCK' with a 'CUTTING LENGTH' indicated by a double-headed arrow above it. On each end of the wire, there is a 'TERMINAL' (labeled 'A' and 'B'). The distance from the center of the bulk wire stock to the center of each terminal is marked as '1/4 IN. (6 mm)'. The terminals are shown as crimped lugs.

Wire/Assembly Part Number	Bulk Wire Part Number	Cutoff Length	
		inches	cm
1884540W-012	121782A	12	31
1947560W-012	121782A	12	31
1959390W-012	121782A	12	31
1959600W-012	121782A	12	31
1977300W-010	4127FX	10	25
1974580-013	R-64951	13	33
1974590-005	R-64951	5	13
1978470W-005	R-64951	5	13

**C-9. HOSES AND TUBES.**

Fabricate hoses and tubes from bulk hose or tube stock listed in Table C-8. Use a fine toothed hacksaw or suitable cutting device and cut hose/tube to desired length. Place fitting A in vise and screw hose/tube counterclockwise until hose/tube bottoms out in fitting. Back off 1/4 turn. Repeat for fitting B.

**Table C-8. Hoses and Tubes**



Hose/Tube Part Number	Bulk Hose Part Number	Cutoff Length	
		Inches	cm
5113689-12	1525-6	12	31
21021FX-026	2102CFX	26	66
32850AX-014	22020	14	36
32850AX-016	22020	16	41
32850AX-030	22020	30	76
32850AX-036	22020	36	91
32850AX-51	22020	51	130
31270AX-029	31270AX	29	74
31270AX-082	31270AX	82	208
31270AX-096	31270AX	96	244
31270AX-140	31270AX	140	356
69940AX-006	3230-0293	6	15
69940AX-065	3230-0293	65	165
31271AX-040	3250-101	40	102
31271AX-047	3250-101	47	119
31271AX-053	3250-101	53	135
31271AX-092	3250-101	92	234
31271AX-150	3250-101	150	381

**Table C-8. Hoses and Tubes (Cont)**

Hose/Tube Part Number	Bulk Hose Part Number	Cutoff Length	
		Inches	cm
AAAC0085	5199575	85	216
AAAC0105	5199575	105	267
AAAC0190	5199575	190	483
AAAC0260	5199575	260	660
AAAE0090	5199575	90	229
1944510	70-062		Variable
1944520	70-062		Variable
23319FX-012	C604-200 BLK	12	31
23319FX-023	C604-200 BLK	23	58
23319FX-029	C604-200 BLK	29	74
23319FX-244	C604-200 BLK	244	620
23319FX-257	C604-200 BLK	257	653
23323FX-008	C606 BLACK	8	20
23323FX-008	C606 BLACK	8	20
23323FX-010	C606 BLACK	10	25
23323FX-010	C606 BLACK	10	25
23323FX-012	C606 BLACK	12	31
23323FX-014	C606 BLACK	14	36
23323FX-019	C606 BLACK	19	48
23323FX-022	C606 BLACK	22	56
23323FX-026	C606 BLACK	26	66
23323FX-030	C606 BLACK	30	76
23323FX-033	C606 BLACK	33	84
23323FX-042	C606 BLACK	42	107
23323FX-042	C606 BLACK	42	107
23323FX-044	C606 BLACK	44	112
23323FX-046	C606 BLACK	46	117
23323FX-050	C606 BLACK	50	127
23323FX-052	C606 BLACK	52	132
23323FX-055	C606 BLACK	55	140
23323FX-057	C606 BLACK	57	145
23323FX-060	C606 BLACK	60	152
23323FX-060	C606 BLACK	60	152
23323FX-082	C606 BLACK	82	208
23323FX-087	C606 BLACK	87	221
23323FX-089	C606 BLACK	89	226

**Table C-8. Hoses and Tubes (Cont)**

<b>Hose/Tube Part Number</b>	<b>Bulk Hose Part Number</b>	<b>Cutoff Length</b>	
		<b>Inches</b>	<b>cm</b>
23323FX-148	C606 BLACK	148	376
23323FX-159	C606 BLACK	159	404
23323FX-163	C606 BLACK	163	414
23323FX-200	C606 BLACK	200	508
23323FX-335	C606 BLACK	335	851
23323FX-377	C606 BLACK	377	958
198872A U-200	FC300-04	20	51
115134A W-004	FC300-04	4	10
1732400 U-067	FC300-16	67	170
1620950 U-099	FC350-04	99	252
47371AX U-055	FC350-04	5	13
47371AX U-006	FC350-04	6	15
47371AX U-012	FC350-04	12	31
47371AX U-017	FC350-04	17	43
47371AX U-018	FC350-04	18	46
47371AX U-120	FC350-04	120	305
60264AX U-031	FC350-04	31	79
60264AX U-034	FC350-04	34	86
60264AX U-054	FC350-04	54	137
60264AX U-057	FC350-04	57	145
60264AX U-063	FC350-04	63	160
60264AX U-082	FC350-04	82	208
60296AX U-029	FC350-04	29	74
60296AX U-036	FC350-04	36	91
60296AX U-061	FC350-04	61	155
1780700 U-032	FC350-06	32	81
1780700 U-035	FC350-06	35	89
1780700 U-039	FC350-06	39	99
1780700 U-041	FC350-06	41	104
1782400 U-022	FC350-06	22	56
1782410 U-021	FC350-06	21	53
1782450 U-025	FC350-06	25	64
47336AX-060	FC350-06	60	152
47554AX U-020	FC350-06	20	51
118971A U-022	FC350-08	22	56
118971A U-095	FC350-08	95	241



**Table C-8. Hoses and Tubes (Cont)**

Hose/Tube Part Number	Bulk Hose Part Number	Cutoff Length	
		Inches	cm
119784A U-010	FC350-08	10	25
119784A U-021	FC350-08	21	53
119784A U-047	FC350-08	47	119
1782340 U-019	FC350-08	19	48
1782360 U-020	FC350-08	20	51
1921290 U-025	FC350-08	25	64
1936150 U-032	FC350-08	32	81
1936150 U-034	FC350-08	34	86
1936150 U-038	FC350-08	38	97
1936150 U-040	FC350-08	40	102
69390AX U-006	FC350-08	6	15
69390AX U-019	FC350-08	19	48
69390AX U-020	FC350-08	20	51
69390AX U-020	FC350-08	20	51
69390AX U-021	FC350-08	21	53
69390AX U-025	FC350-08	25	37
1780720 U-020	FC350-10	20	51
1780720 U-051	FC350-10	51	130
1782370 U-037	FC350-10	37	94
1782380 U-031	FC350-10	31	79
1782390 U-020	FC350-10	20	51
1782420 U-039	FC350-10	39	99
1782430 U-031	FC350-10	31	79
1782440 U-019	FC350-10	19	48
1924600 U-090	FC350-10	90	229
47750AX U-009	FC350-10	9	23
58989AX U-020	FC350-10	20	51
58989AX U-034	FC350-10	34	86
58989AX U-064	FC350-10	64	163
66798AX U-020	FC350-10	20	51
66798AX U-025	FC350-10	25	64
66798AX U-030	FC350-10	30	76
66798AX U-077	FC350-10	77	196
1780710 U-082	FC350-12	82	208
1780710 U-083	FC350-12	83	211
47369AX U-127	FC350-12	127	323

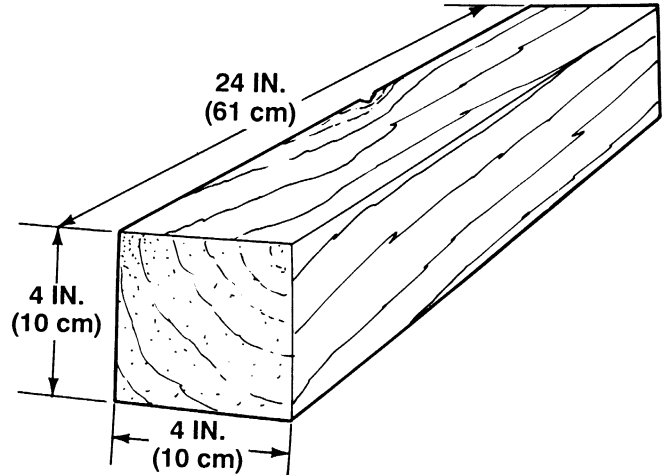
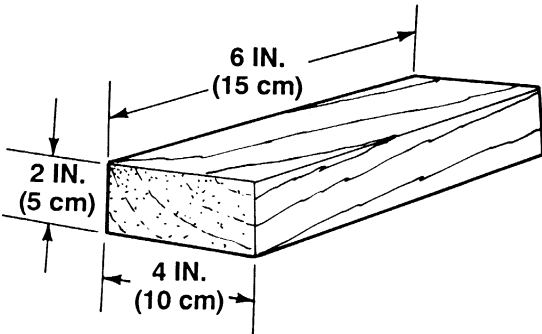
**Table C-8. Hoses and Tubes (Cont)**

<b>Hose/Tube Part Number</b>	<b>Bulk Hose Part Number</b>	<b>Cutoff Length</b>	
		<b>Inches</b>	<b>cm</b>
61608AX U-093	FC350-12	93	236
61608AX U-142	FC350-12	142	361
47468AX U-011	FC350-16	11	28
47468AX U-022	FC350-16	22	56
47468AX U-045	FC350-16	45	114
47468AX U-046	FC350-16	46	117
47468AX U-089	FC350-16	89	226
47213AX-012	NT10012-50FT	12	31
47213AX-016	NT10012-50FT	16	41
47213AX-021	NT10012-50FT	21	53
47213AX-023	NT10012-50FT	23	58
47213AX-025	NT10012-50FT	25	64
47213AX-025	NT10012-50FT	25	64
47213AX-060	NT10012-50FT	60	152
47213AX-073	NT10012-50FT	73	185
47213AX-073	NT10012-50FT	73	185
47213AX-173	NT10012-50FT	173	439
47213AX-194	NT10012-50FT	194	493
1656470-030	PFT-4A-BLU	30	76
1656470-104	PFT-4A-BLU	104	264
1656470-115	PFT-4A-BLU	115	292
1656470-139	PFT-4A-BLU	139	353
1605260-008	PFT-4A-GRN	8	20
1605330-020	PFT-4A-ORG	20	51
1605330-040	PFT-4A-ORG	40	102
1605330-071	PFT-4A-ORG	71	180
1605330-112	PFT-4A-ORG	112	285
1605330-124	PFT-4A-ORG	124	315
1605170-007	PFT-4A-RED	7	18
1605270-023	PFT-6B-GRN	23	58
1605270-028	PFT-6B-GRN	28	71
1605270-056	PFT-6B-GRN	56	142
1605270-057	PFT-6B-GRN	57	145
1605270-100	PFT-6B-GRN	100	254
1605270-108	PFT-6B-GRN	108	274
1605270-146	PFT-6B-GRN	146	371

**Table C-8. Hoses and Tubes (Cont)**

Hose/Tube Part Number	Bulk Hose Part Number	Cutoff Length	
		Inches	cm
1605320-205	PFT-6B-ORG	205	521
1605160-012	PFT-6B-RED	12	31
1605160-014	PFT-6B-RED	14	36
1605160-030	PFT-6B-RED	30	76
1605160-031	PFT-6B-RED	31	79
1605160-047	PFT-6B-RED	47	119
1605160-048	PFT-6B-RED	48	122
1605160-049	PFT-6B-RED	49	125
1605160-055	PFT-6B-RED	55	140
1605160-102	PFT-6B-RED	102	259
1605160-103	PFT-6B-RED	103	262
1605160-114	PFT-6B-RED	114	290
1605160-165	PFT-6B-RED	165	419
1605160-213	PFT-6B-RED	213	541
1605300-026	PFT-6B-YEL	26	66
1605300-066	PFT-6B-YEL	66	168
1605300-070	PFT-6B-YEL	70	178
1605300-129	PFT-6B-YEL	129	328
1605300-132	PFT-6B-YEL	132	335
1605300-150	PFT-6B-YEL	150	381
1605300-022	PFT-8B-BLU	22	56
1605300-316	PFT-8B-BLU	316	802
1656500-128	PFT-10B-GRN	128	325
1656500-183	PFT-10B-GRN	183	465
1656490-102	PFT-10B-RED	102	259
1656490-202	PFT-10B-RED	202	513
1656490-257	PFT-10B-RED	257	653
W-22-13	W-22	13	33
W-22-9	W-22	9	23
40AW168-010	W-22-L	10	25
40AW168-050	W-22-L	50	127
40AW168-19	W-22-L	19	48
40AW168-27	W-22-L	27	69
40AW168-45	W-22-L	45	114

**C-10. WOODEN BLOCKS.**



- a. Fabricate from MML751 lumber stock.
- b. Using saw and standard planing machine, cut stock to size required in Table C-9.

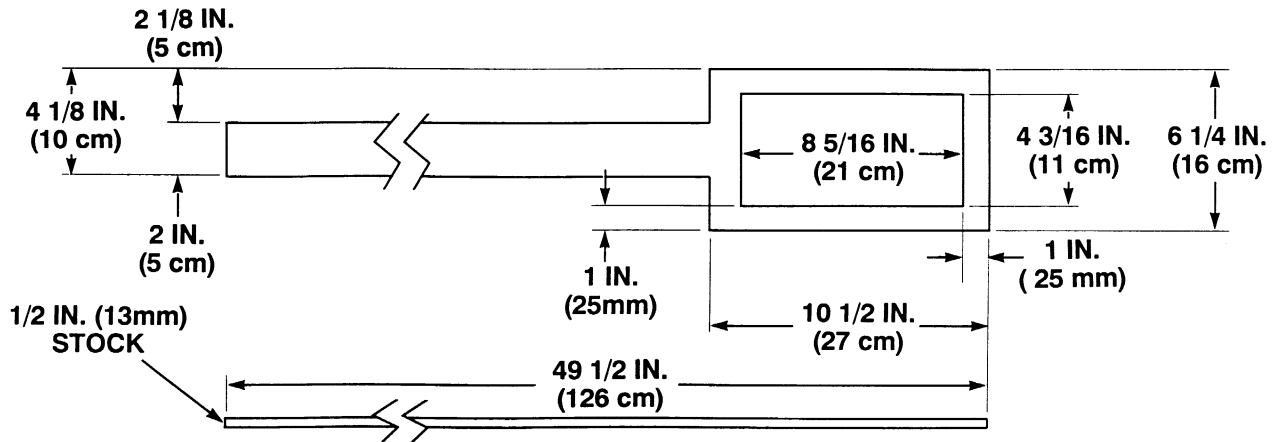
**Table C-9. Wooden Blocks**

Para Number	Finished Dimensions of Block In. (cm)	Qty.
2-14	2 by 12 by 72 in. (5 by 30 by 183 cm)	4
2-15	2 by 4 by 12 in. (5 by 10 by 30 cm)	1
2-15	4 by 4 by 24 in. (10 by 10 by 61 cm)	1
3-7	4 by 4 by 24 in. (10 by 10 by 61 cm)	2
3-12	2 by 4 by 16 in. (5 by 10 by 41 cm)	2
3-18	4 by 4 by 24 in. (10 by 10 by 61 cm)	2
3-19	4 by 4 by 24 in. (10 by 10 by 61 cm)	2
3-33	2 by 4 by 12 in. (5 by 10 by 30 cm)	1
5-7	2 by 4 by 12 in. (5 by 10 by 30 cm)	2
6-31	4 by 4 by 24 in. (10 by 10 by 61 cm)	2
7-10	2 by 4 by 30 in. (5 by 10 by 76 cm)	2
9-3	2 by 4 by 12 in. (5 by 10 by 30 cm)	1
9-11	2 by 4 by 12 in. (5 by 10 by 30 cm)	1
9-13	2 by 4 by 12 in. (5 by 10 by 30 cm)	1
12-9	2 by 4 by 12 in. (5 by 10 by 30 cm)	1
12-9	2 by 4 by 11 in. (5 by 10 by 28 cm)	1
12-9	4 by 6 by 11 in. (10 by 15 by 28 cm)	1
12-10	2 by 4 by 12 in. (5 by 10 by 30 cm)	1
12-11	2 by 4 by 12 in. (5 by 10 by 30 cm)	1
13-2	2 by 4 by 6 in. (5 by 10 by 15 cm)	2
13-4	2 by 4 by 6 in. (5 by 10 by 15 cm)	2
13-13	6 by 7 by 15 in. (15 by 18 by 38 cm)	2
14-6	1 by 3 by 12 in. (3 by 8 by 30 cm)	1
15-2	2 by 2 by 4 in. (5 by 5 by 10 cm)	2
16-2	4 by 6 by 42 in. (10 by 15 by 107 cm)	4
16-3	2 by 4 by 12 in. (5 by 10 by 30 cm)	1
16-3	4 by 4 by 36 in. (10 by 10 by 91 cm)	1

**Table C-9 Wooden Blocks (Continued)**

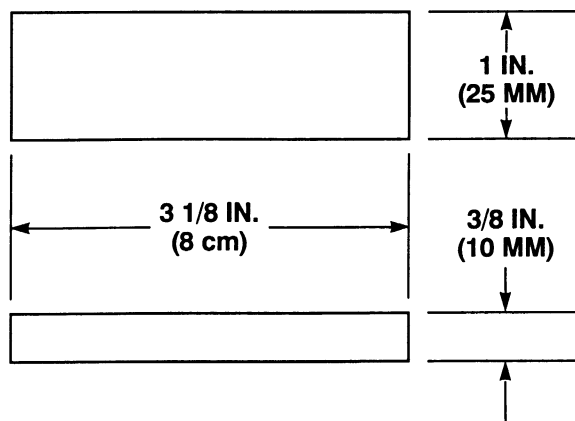
<b>Para Number</b>	<b>Finished Dimensions of Block In. (cm)</b>	<b>Qty.</b>
16-6	4 by 4 by 18 in. (10 by 10 by 46 cm)	1
16-17	4 by 6 by 42 in. (10 by 15 by 107 cm)	2
16-26	4 by 4 by 18 in. (10 by 10 by 46 cm)	1
16-31	2 by 4 by 6 in. (5 by 10 by 15 cm)	1
16-38	4 by 6 by 35 in. (10 by 15 by 89 cm)	2
16-40	4 by 6 by 35 in. (10 by 15 by 89 cm)	2
16-41	2 by 4 by 6 in. (5 by 10 by 15 cm)	2
17-8	2 by 4 by 6 in. (5 by 10 by 15 cm)	2
17-12	4 by 6 by 35 in. (10 by 15 by 89 cm)	2
17-13	4 by 6 by 35 in. (10 by 15 by 89 cm)	2
17-14	1 by 2 by 6 in. (3 by 5 by 15 cm)	2
17-15	4 by 6 by 35 in. (10 by 15 by 89 cm)	2
17-16	4 by 6 by 35 in. (10 by 15 by 89 cm)	2
20-19	4 by 4 by 24 in. (10 by 10 by 61 cm)	2
20-39	2 by 4 by 12 in. (5 by 10 by 30 cm)	2
20-47	4 by 4 by 24 in. (10 by 10 by 61 cm)	2
20-48	2 by 4 by 36 in. (5 by 10 by 91 cm)	2
20-49	2 by 4 by 36 in. (5 by 10 by 91 cm)	2
20-50	4 by 4 by 24 in. (10 by 10 by 61 cm)	2
20-52	4 by 4 by 24 in. (10 by 10 by 61 cm)	2
20-53	4 by 4 by 24 in. (10 by 10 by 61 cm)	2
21-2	4 by 4 by 16 in. (10 by 10 by 41 cm)	2
23-12	2 by 4 by 30 in. (5 by 10 by 76 cm)	2
23-13	4 by 6 by 24 in. (10 by 15 by 61 cm)	2
23-14	6 by 6 by 16 in. (15 by 15 by 41 cm)	2
23-15	4 by 4 by 16 in. (10 by 10 by 41 cm)	2
23-18	2 by 4 by 30 in. (5 by 10 by 76 cm)	1
23-18	4 by 4 by 24 in. (10 by 10 by 61 cm)	2
23-19	4 by 4 by 24 in. (10 by 10 by 61 cm)	2
28-2	2 by 2 by 12 in. (5 by 5 by 30 cm)	2
28-3	2 by 2 by 12 in. (5 by 5 by 30 cm)	1
28-6	2 by 2 by 12 in. (5 by 5 by 30 cm)	2
28-9	4 by 6 by 35 in. (10 by 15 by 89 cm)	1
28-11	2 by 2 by 12 in. (5 by 5 by 30 cm)	2
28-13	2 by 2 by 12 in. (5 by 5 by 30 cm)	2
28-14	4 by 4 by 24 in. (10 by 10 by 61 cm)	2

**C-11. FLANGE HOLDER.**



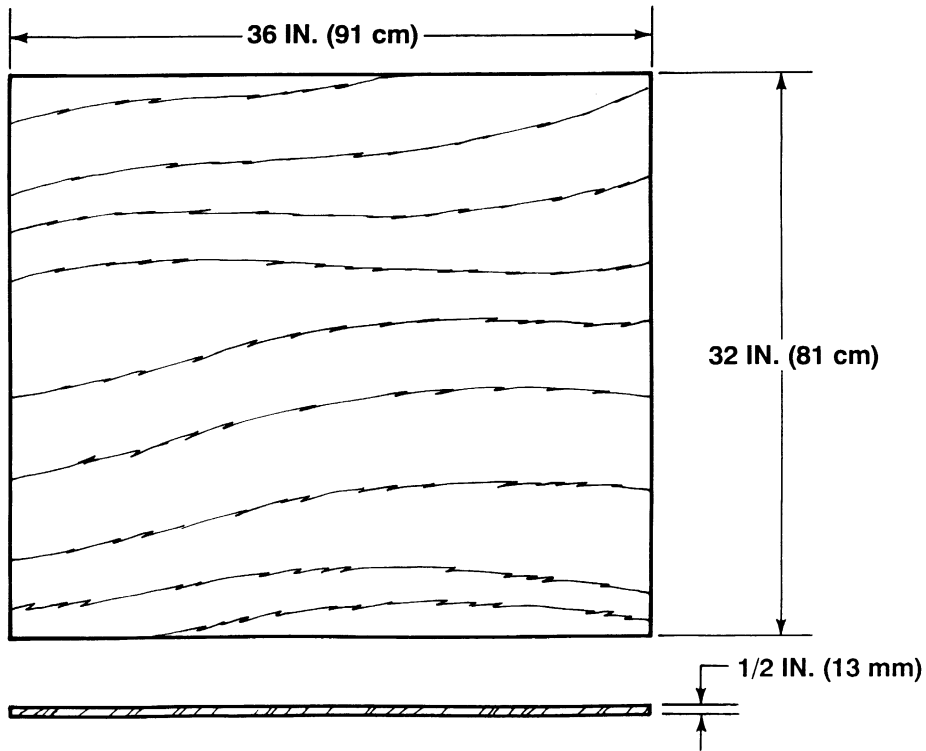
Fabricate the flange holder from 1/2 in. (13 mm) thick mild steel stock. Using a torch, cut steel stock to dimensions shown. Using a grinder, remove all rough edges.

**C-12. JET EXTRACTOR.**



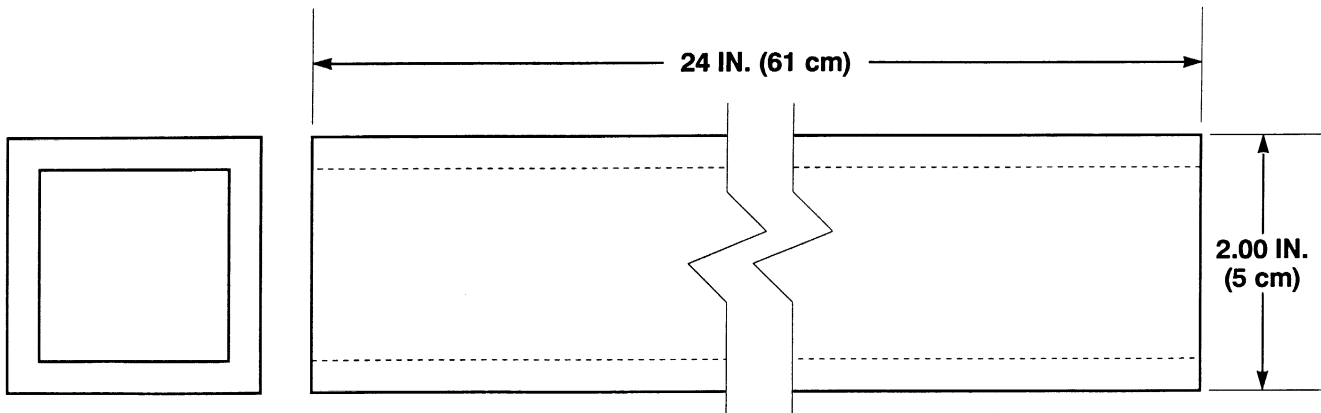
Fabricate from 3/8 in. (10 mm) thick mild steel stock. Using a hacksaw, cut to dimensions shown. Using a file or grinder, remove all rough edges.

**C-13. PLYWOOD SHEET.**



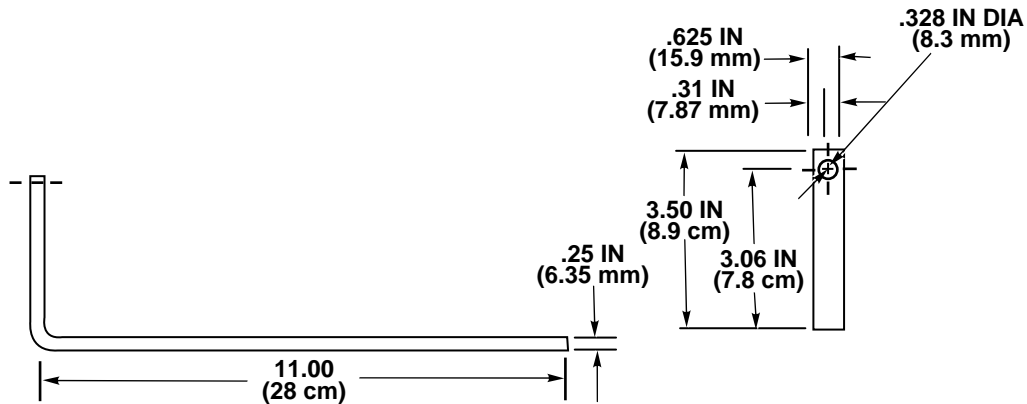
Fabricate from 1/2 in. (13 mm) thick plywood stock. Using a saw, cut to dimensions shown. Using a file or sandpaper, remove all rough edges.

**C-14. STEEL TUBE.**



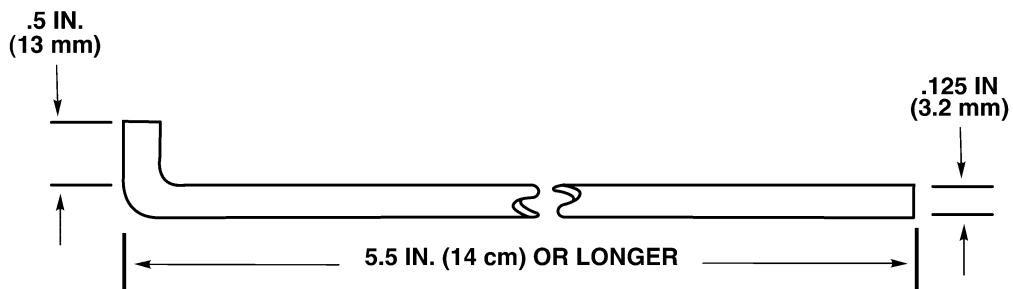
Fabricate from 1/4 in. (6 mm) thick steel square tube stock. Using a hacksaw, cut a 24 in. (61 cm) length piece of tube. File off rough edges.

**C-15. ADAPTER DIFFERENTIAL PRELOAD.**



- (1) Fabricate from .250 in. (6.4 mm) thick x .625 in. (13 mm) wide mild steel stock.
- (2) Drill .328 in. (8.3 mm) hole where indicated.
- (3) Bend 90° where indicated.

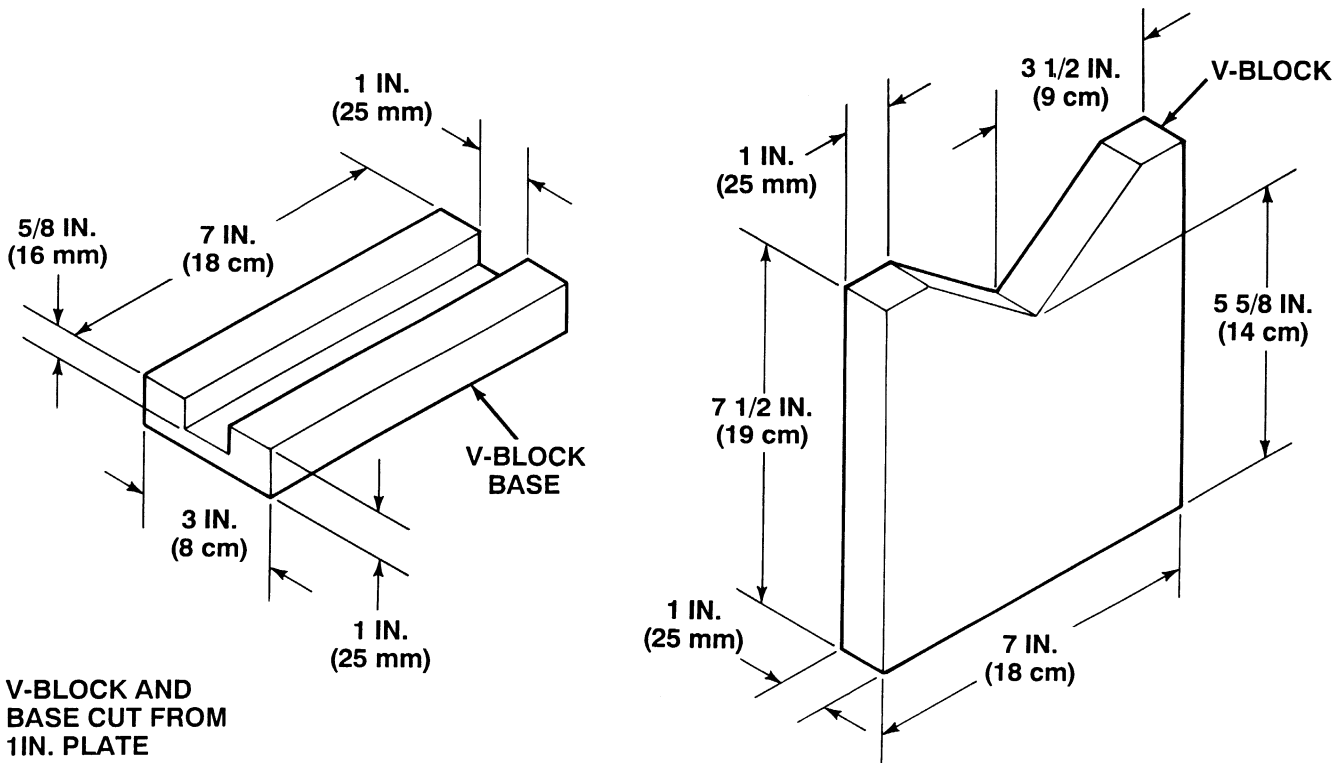
**C-16. WIRE HOOK.**



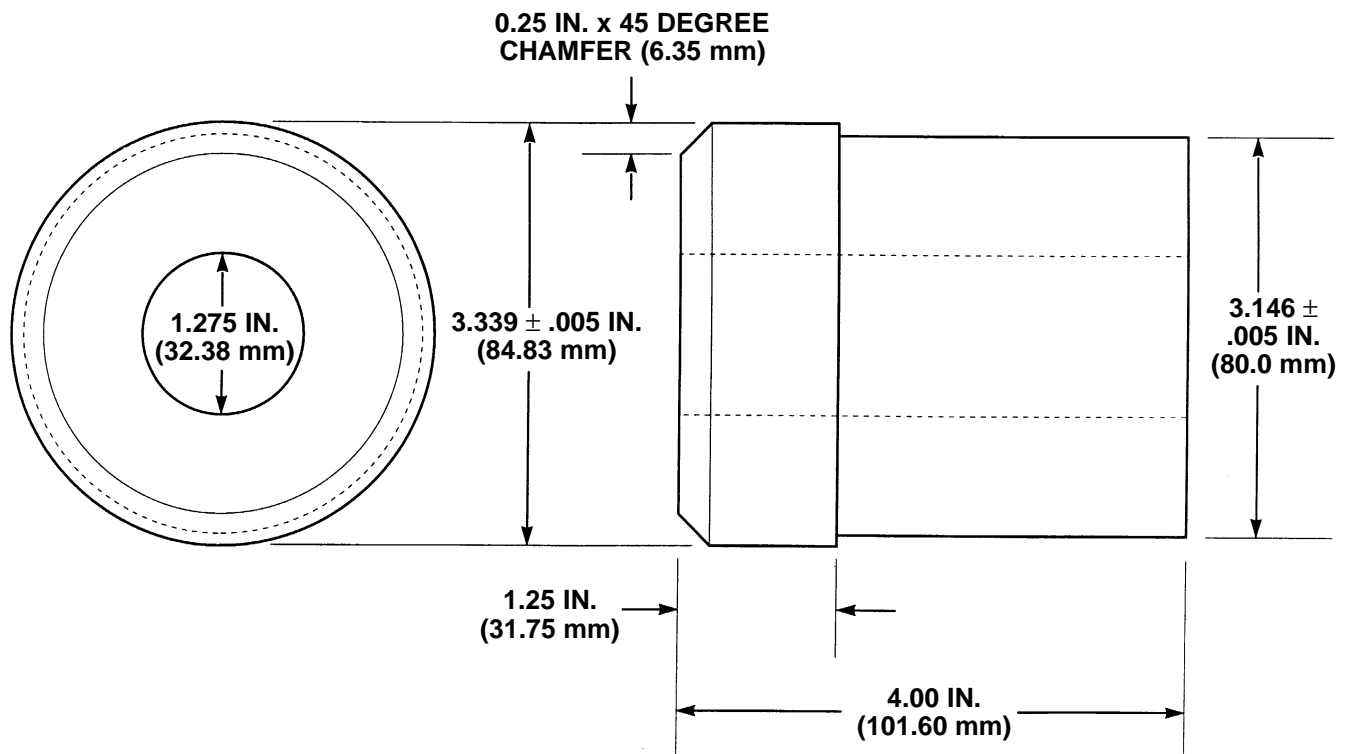
- (1) Fabricate from 1/8 in. (3.2 mm) diameter steel welding rod or equivalent stiff wire.
- (2) Using cutting pliers, cut welding rod to 6 in. (15.2 cm) length or longer.
- (3) Using machinist's vise, bend 1/2 in. (13 mm) length of rod 90 degrees.



**C-17. V-BLOCK BASE AND V-BLOCK.**



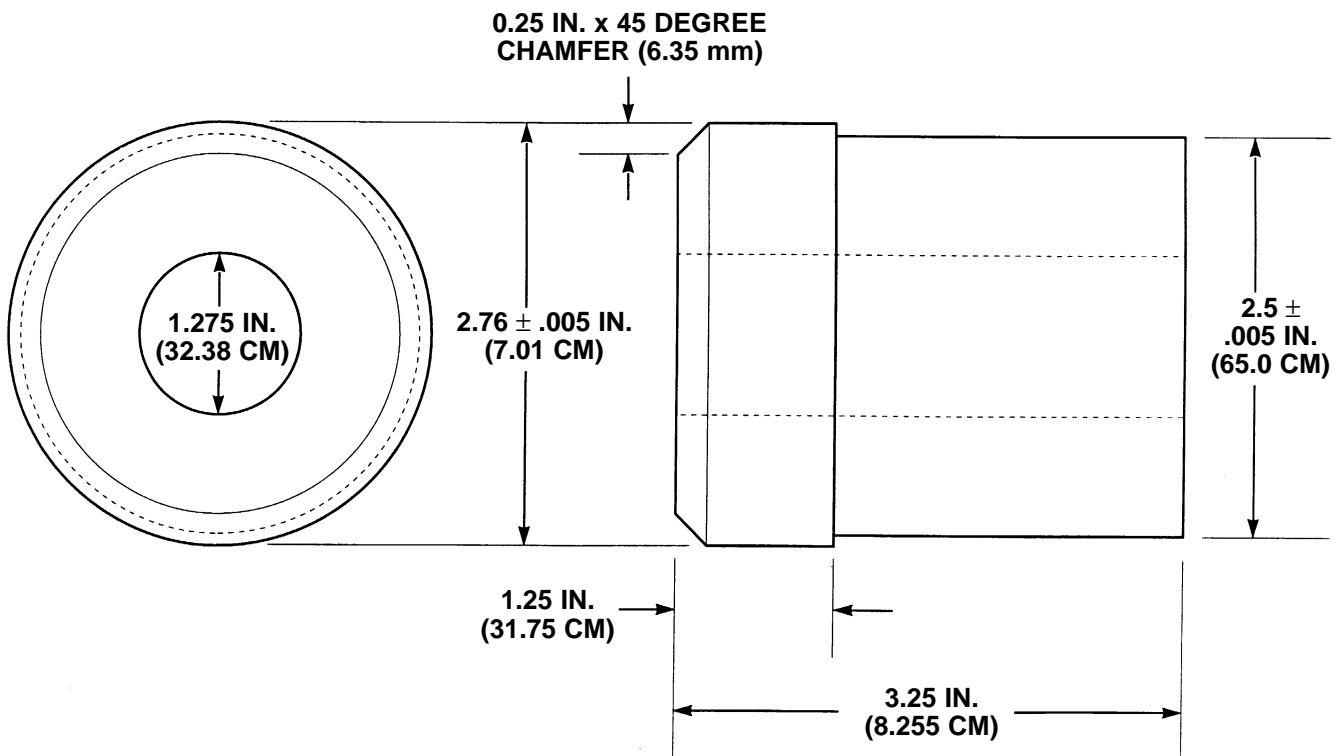
Fabricate V-Block from 1 in. (25 mm) thick mild steel stock. Using a grinder, remove any sharp edges. Using a file and then a sharpening stone, remove roughness from the inside surface of the V.

**C-18. LHS BUSHING REMOVER/INSTALLER (SMALL).**


Fabricate large LHS bushing remover/installer from 4 in. (101 mm) x 3.339 in. diameter steel stock.

- a.** Turn round stock to 3.339 in. ± .005 in.
- b.** Cut a 1/4 in. (6 mm) x 45 degree chamfer where indicated.
- c.** Drill through a 1.275 in. hole in the center of the 3.339 in. diameter steel stock where indicated.
- d.** Starting at the end opposite of the chamfer, turn a length of 2.75 in. down to 3.146 in. ± .005 in. where indicated.
- e.** Paint as required.

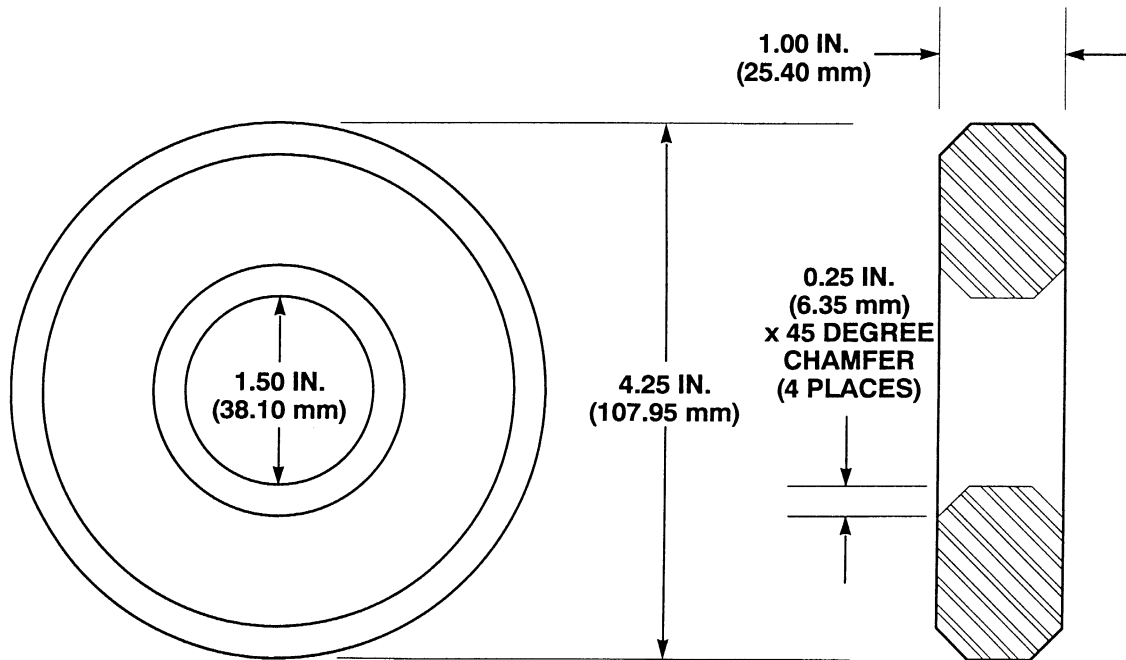
**C-19. CHU BUSHING REMOVER/INSTALLER (SMALL).**



Fabricate small CHU bushing remover/installer from 3.25 in. (8.255 cm) x 2.76 in. (7.01 cm) diameter steel stock.

- a. Turn round stock to 2.76 in. ± .005 in. (7.01 cm ± ∞∞®)
- b. Cut a 1/4 in. (6 mm) x 45 degree chamfer where indicated.
- c. Drill through a 1.275 in. (32.38 mm) hole in the center of the 2.76 in. diameter steel stock where indicated.
- d. Starting at the end opposite of the chamfer, turn a length of 2.00 in. down to 2.5 in. ± .005 in. where indicated.
- e. Paint as required.

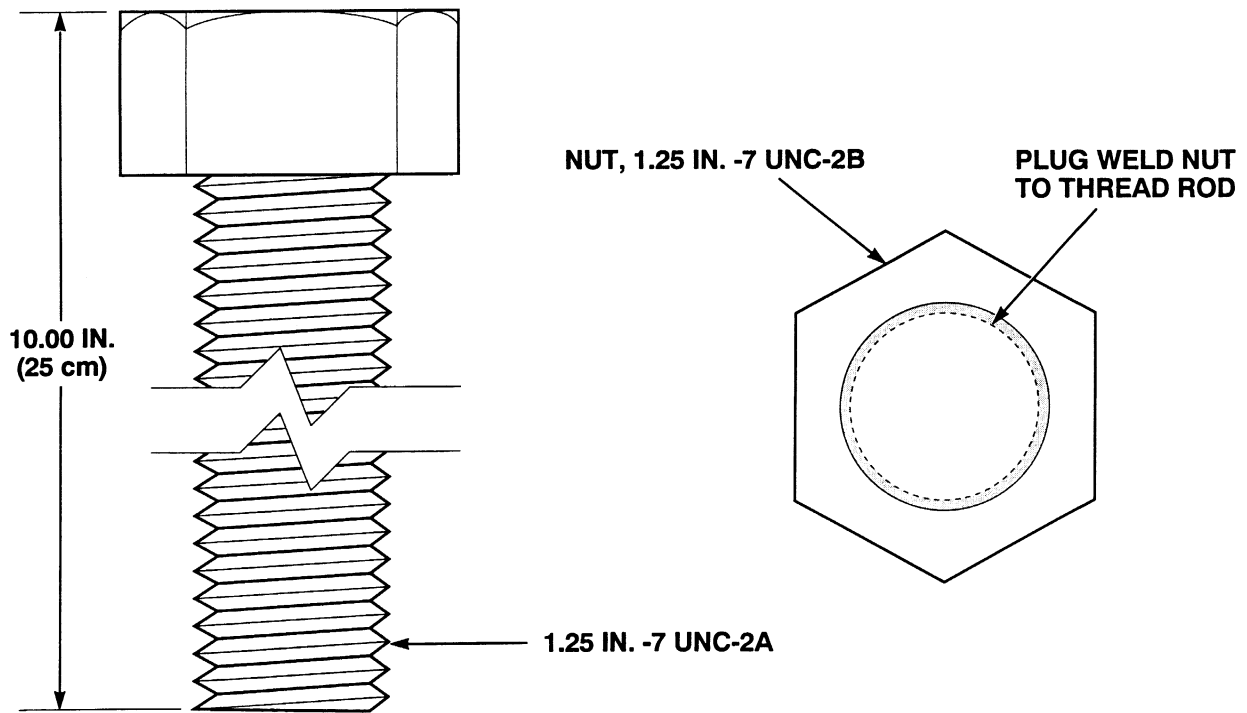
**C-20. LHS BUSHING REMOVER/INSTALLER (LARGE).**



Fabricate small LHS bushing remover/installer from 1 in. (25 mm) x 4 1/4 in. (108 mm) diameter steel stock.

- a.** Drill 1 1/2 in. (38 mm) through steel stock where indicated.
- b.** Cut a 1/4 in. (6.35 mm) x 45 degree chamfer on both inside and outside diameters where indicated.
- c.** Paint as required.

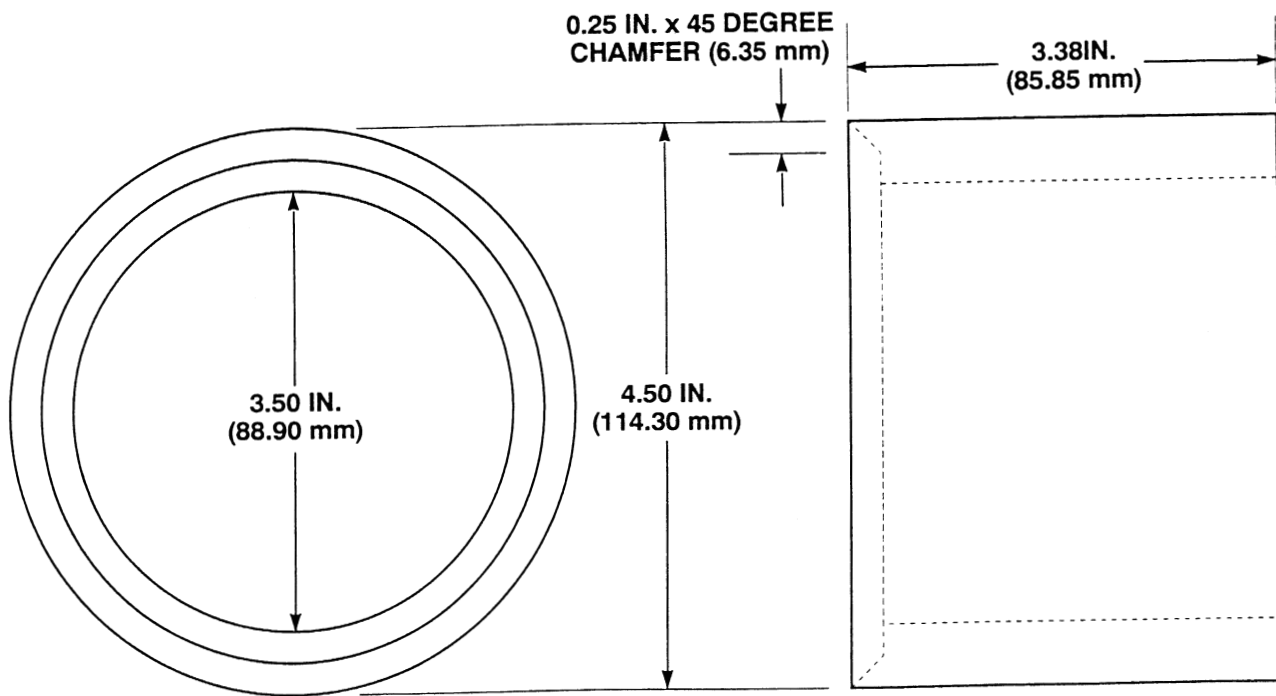
**C-21. LHS LEAD SCREW.**



Fabricate LHS lead screw from grade 8 steel.

- a.** Cut length of thread rod to 9.750 in. (25 cm).
- b.** Thread nut on rod until total length measures 10.00 in. (25 cm).
- c.** Plug weld nut to thread rod.
- d.** Two grade 8 nuts are required, one loose and one welded.

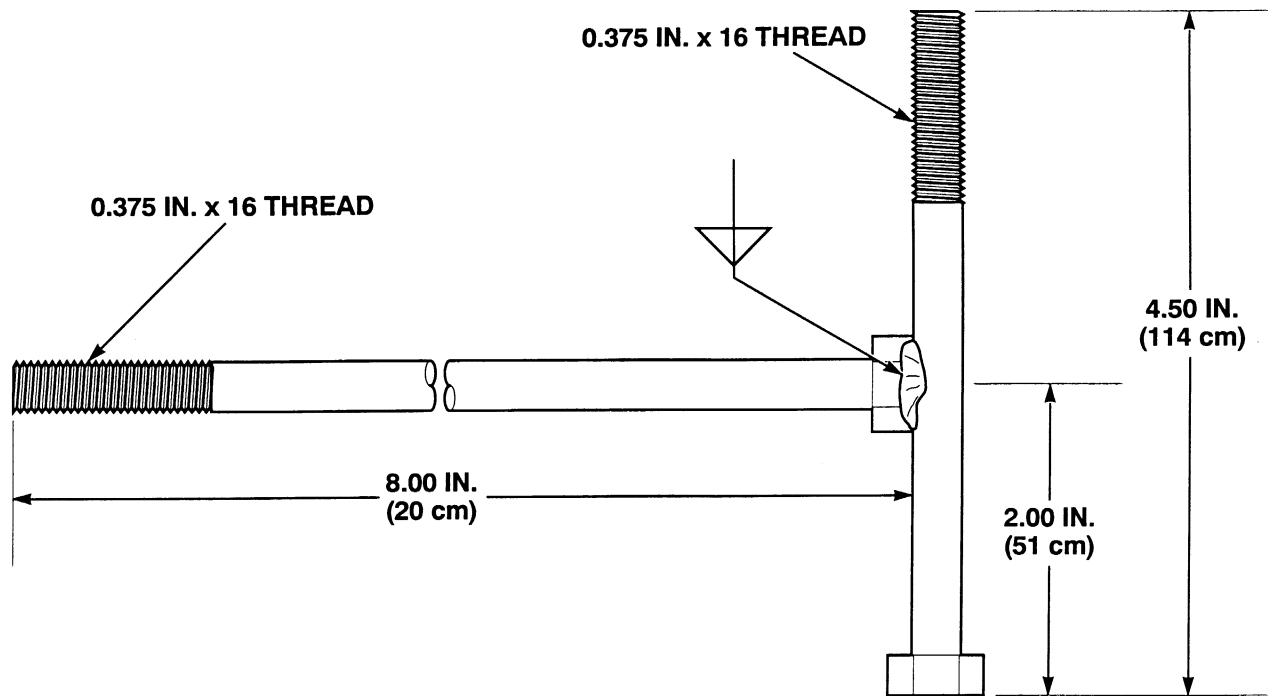
**C-22. LHS BUSHING REMOVER.**



Fabricate LHS bushing remover from 3.38 in. (85.85mm) x 4 1/2 in. (114 mm) diameter steel tubing.

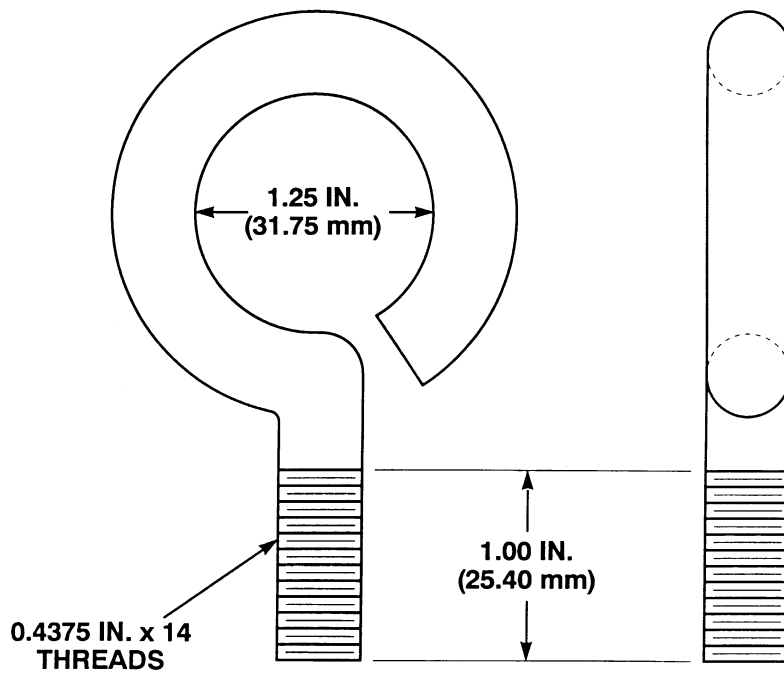
- a.** Cut 4 1/2 in. (114 mm) outside diameter x 1/2 in. (13 mm) thick tubing to cut length of 3.38 in. (85.85 mm).
- b.** Cut a 1/4 in. (6 mm) x 45 degree chamfer where indicated.
- c.** Paint as required.

**C-23. LIFTING TEE HANDLES.**



Fabricate material from: screw (1) .375 in. x 16 x 8 in. (20 cm) grade 5, and screw (1) .375 in. x 16 x 4 1/2 in. (11 cm) grade 5.

- a. Weld together screws where indicated.
- b. Paint as required.

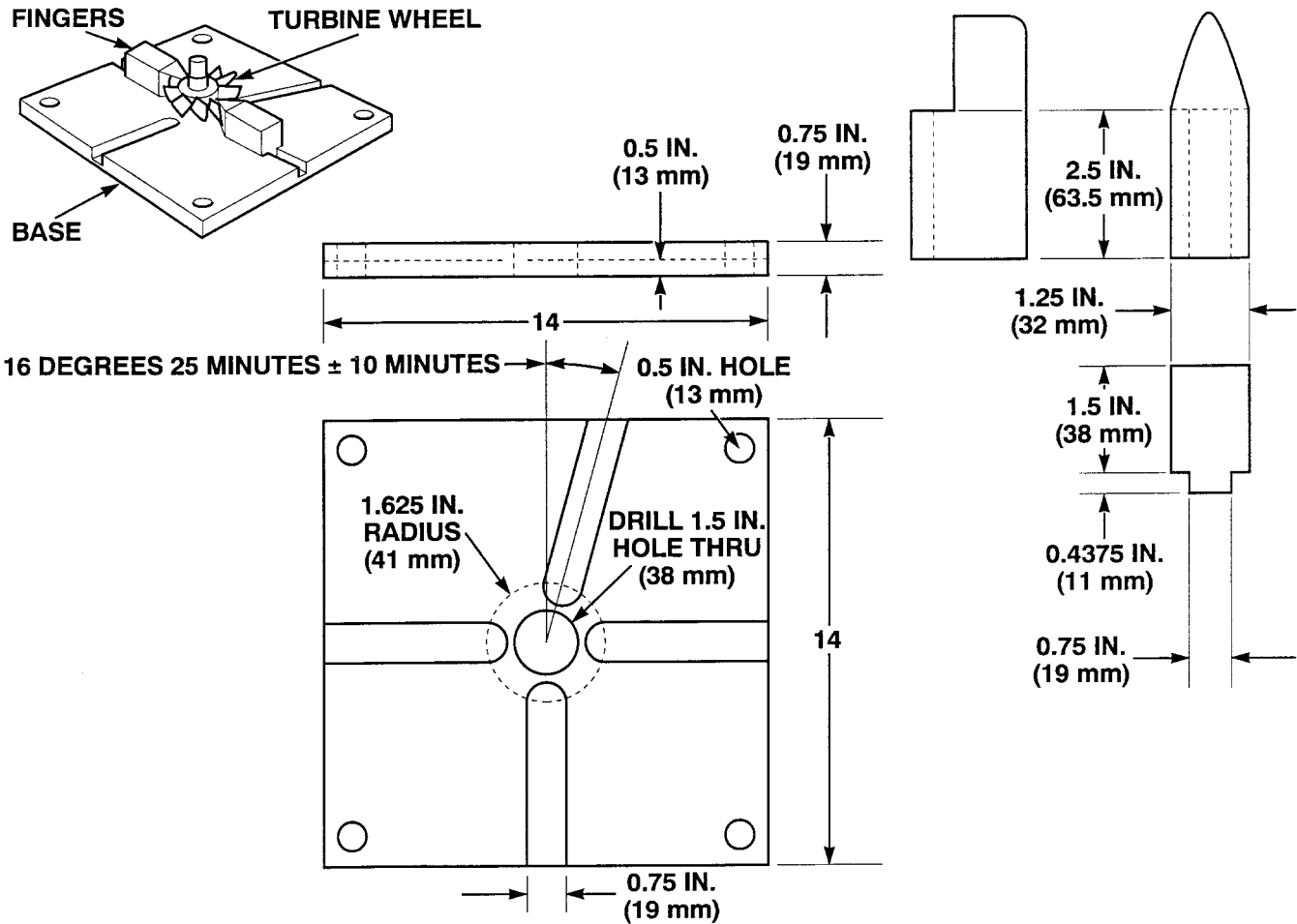
**C-24. LIFTING EYES.**

Fabricate from 7/16 in. (11 mm) x 6 in. (152 mm) cold rolled steel.

- a.** Thread 7/16 x 14 x 1 in. (25 mm) long.
- b.** Heat unthreaded end and bend over 1 1/4 in. (32 mm) diameter rod.

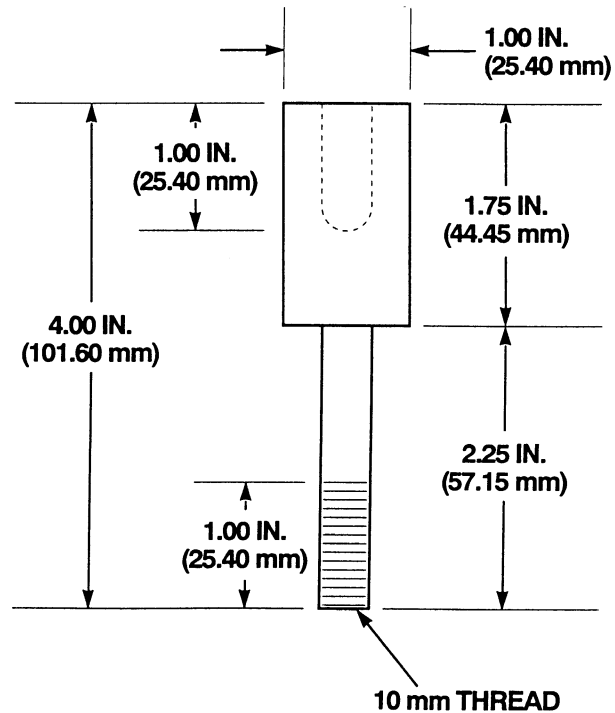


**C-25. TURBOCHARGER HOLDING FIXTURE.**



Fabricate from 3/4 in. (19 mm) exterior grade plywood.

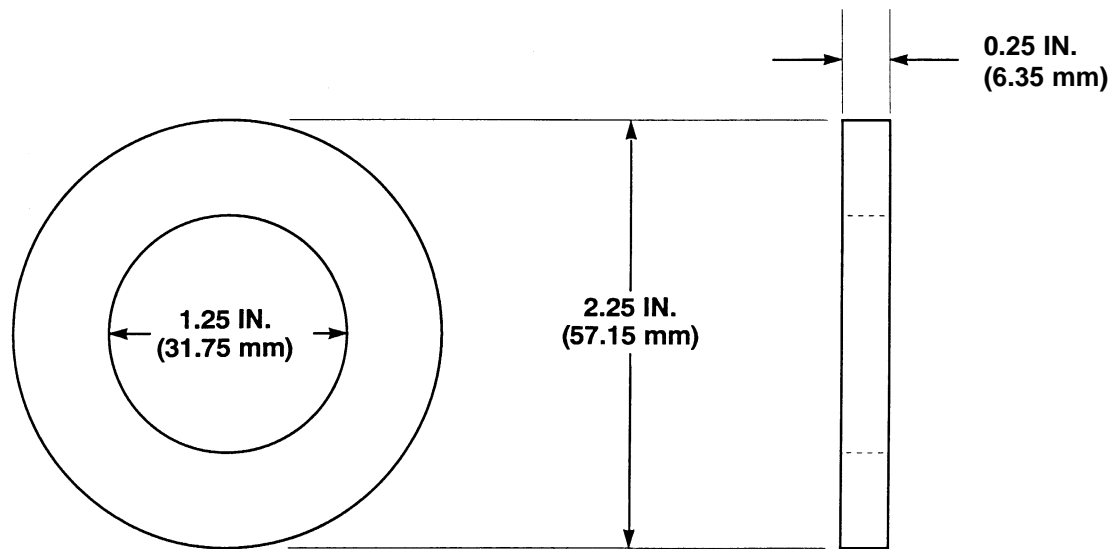
- a. Drill 1 1/2 in. (38 mm) diameter hole in center of base.
- b. Drill four 1/2 in. (13 mm) diameter holes in corners of base.
- c. Draw a circle with a 1 5/8 in. (41 mm) radius.
- d. Route four 1/2 in. (13 mm) x 3/4 in. (19 mm) slots in base into circle as shown.
- e. Fabricate two 1 15/16 in. (49 mm) x 2 1/2 in. (63.5 mm) x 1 1/4 in. (32 mm) fingers from plywood.
- f. Grind bottom of fingers 23/32 in. (18 mm) wide and 7/16 in. (11 mm) high. Contour front surface of fingers to fit turbine wheel blades.

**C-26. CONSTANT VELOCITY U-JOINT BEARING CAP REMOVAL TOOL.**


Fabricate from 1 in. (25.4 mm) mild steel round stock; 4 in. (101.6 mm) long.

- a.** Turn down 2 1/4 in. (57.15 mm) of 1 in. (25.4 mm) mild steel round stock to .39 in. (10 mm).
- b.** Tap 1 in. (25.4 mm) of 10 mm diameter shaft with 10 mm by 1 in. (25.4 mm) threads.
- c.** Drill 5/8 in. (16mm) hole 1 in. (25.4mm) deep in 1 in. (25.4 mm) end of mild steel round stock.
- d.** Tap 1 in. (25.4 mm) of 3/4 in. by 16 diameter hole in 1 in. (25.4 mm) end of mild steel round stock.

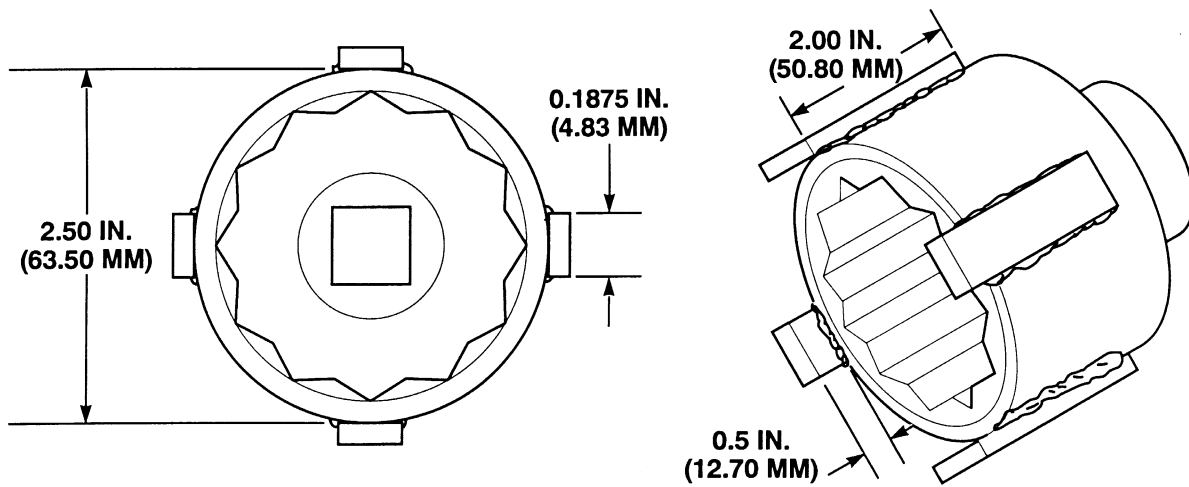
**C-27. LHS WASHER.**



Fabricate LHS washer from 2 1/4 in. (57.15 mm) by 1/4 in. (6.35 mm) diameter steel stock.

- a.** Drill 1 1/4 in. (31.75 mm) hole through steel stock where indicated.
- b.** Paint as required.
- c.** An alternate flat washer that may be used is part number MS51412-44.

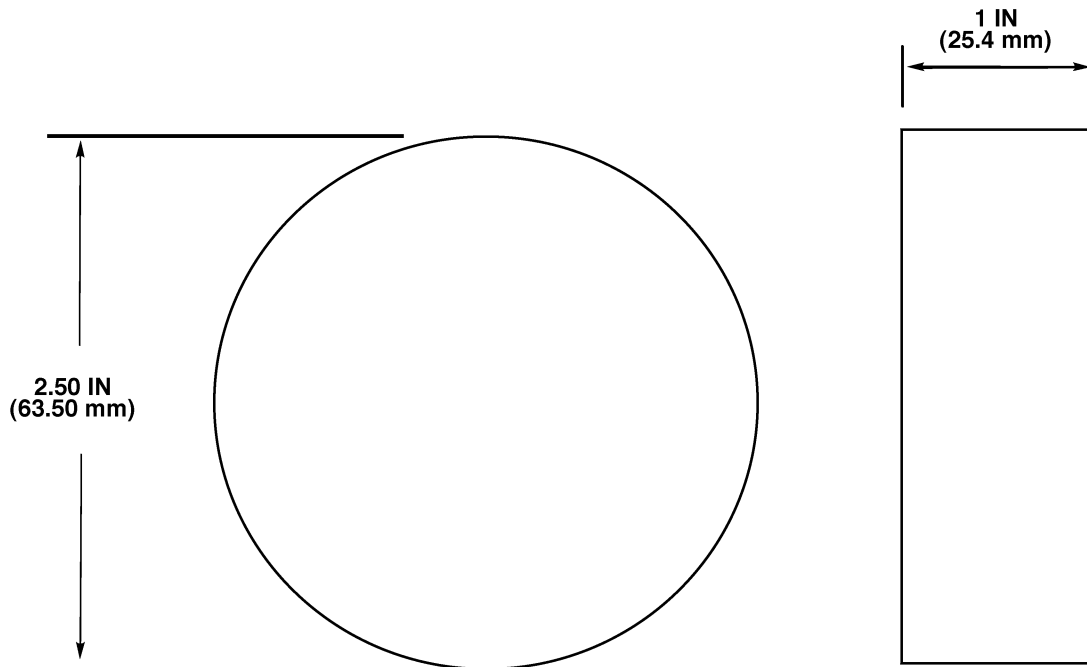
**C-28. SPANNER SOCKET.**



Fabricate spanner wrench from any 2 1/2 in. (63.50 mm) OD socket.

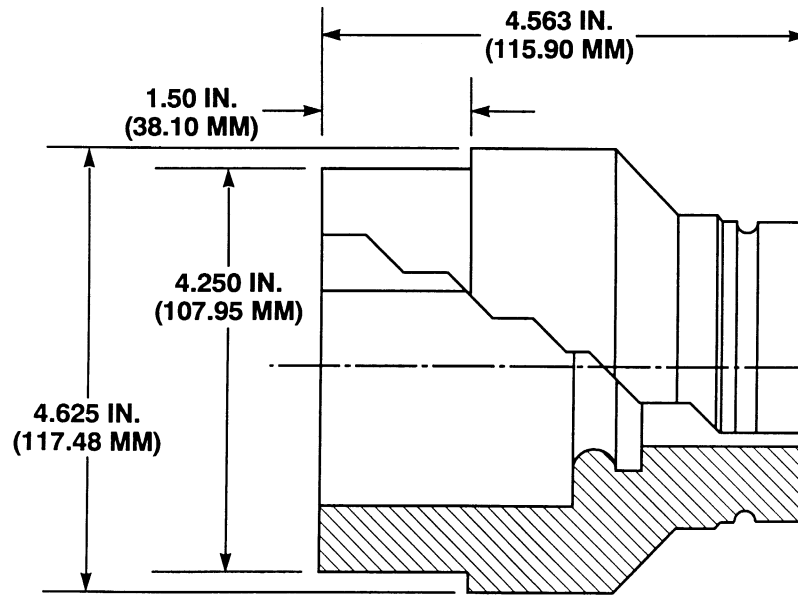
- a. Weld four 2 in. (50.80 mm) long strips of 3/16 in. (4.83 mm) keystock on socket, so that 1/2 in. (12.70 mm) extends beyond socket face.

**C-29. STEEL DISC.**



Fabricate steel disc from 2.5 in. (63.5 mm) round steel stock. Using a hacksaw, cut to dimension shown. File off rough edges.

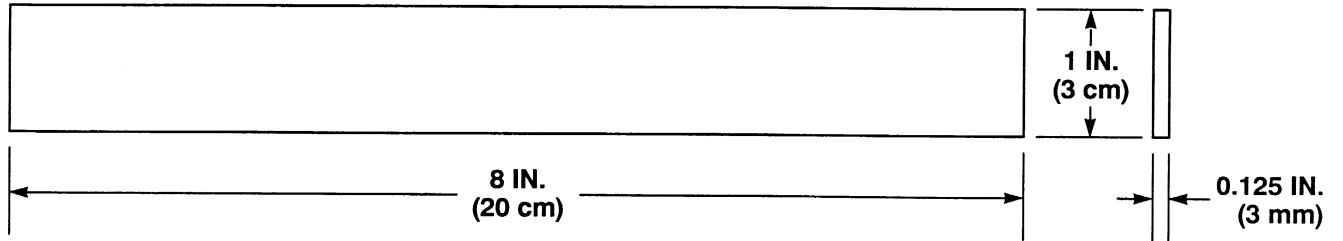
**C-30. FLANGE NUT SOCKET.**



Fabricate flange nut socket from socket P/N 1M1005 NSN 5130-00-234-1890.

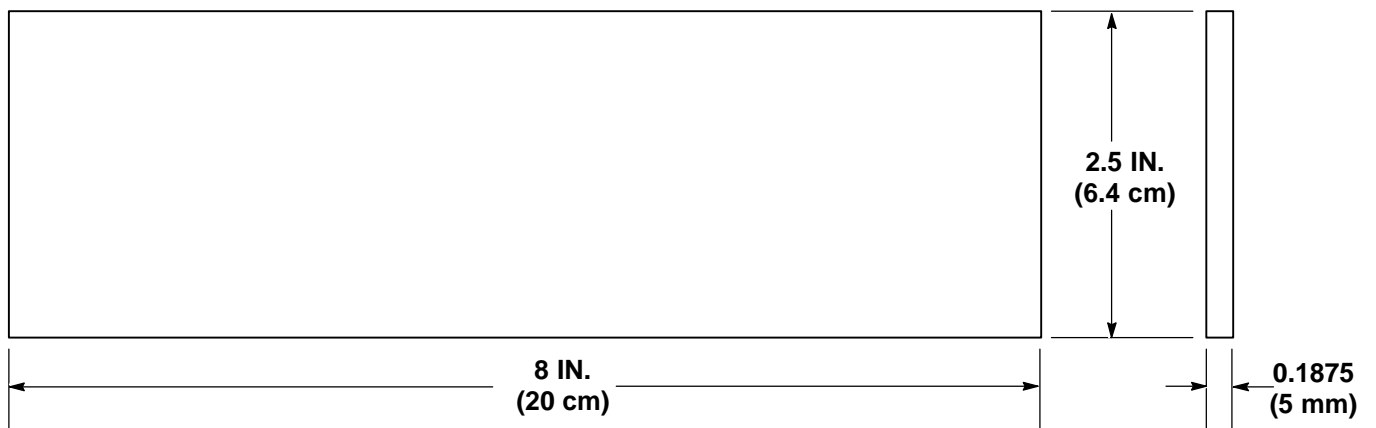
- a.** Machine down outside diameter, face end of socket by 4.250 in. (107.95 mm) at a depth of 1.50 in. (38.10 mm).

**C-31. STEERING STOP PLATE.**



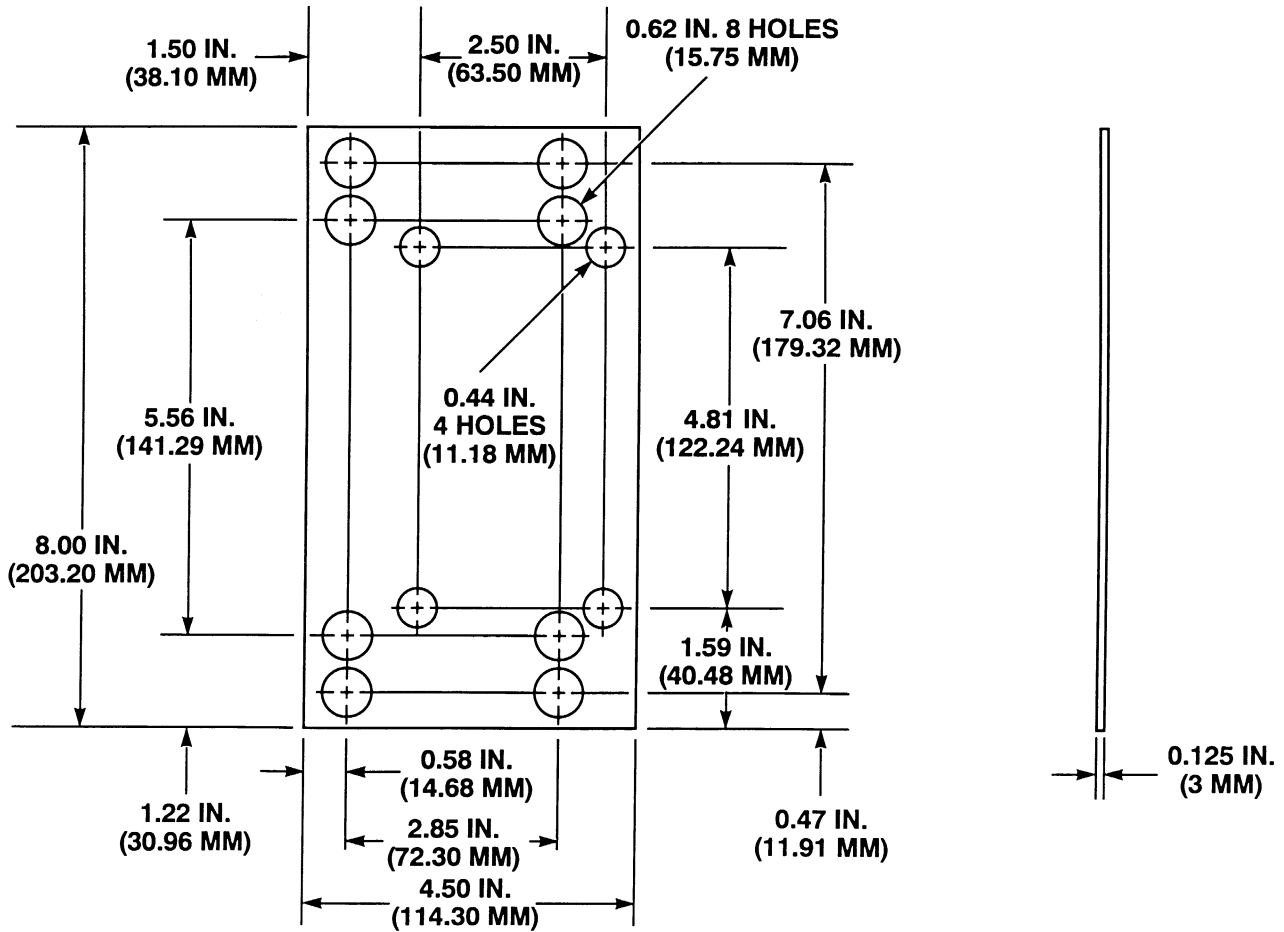
Fabricate steering stop plate from 1/8 in. (3 mm) thick mild steel stock. Using a hacksaw, cut to dimension shown. File off rough edges.

**C-32. PITMAN ARM ANGLE PLATE.**



Fabricate pitman arm angle plate from 3/16 in. (4.76 mm) thick mild steel stock. Using a hacksaw, cut to dimension shown. File off rough edges.

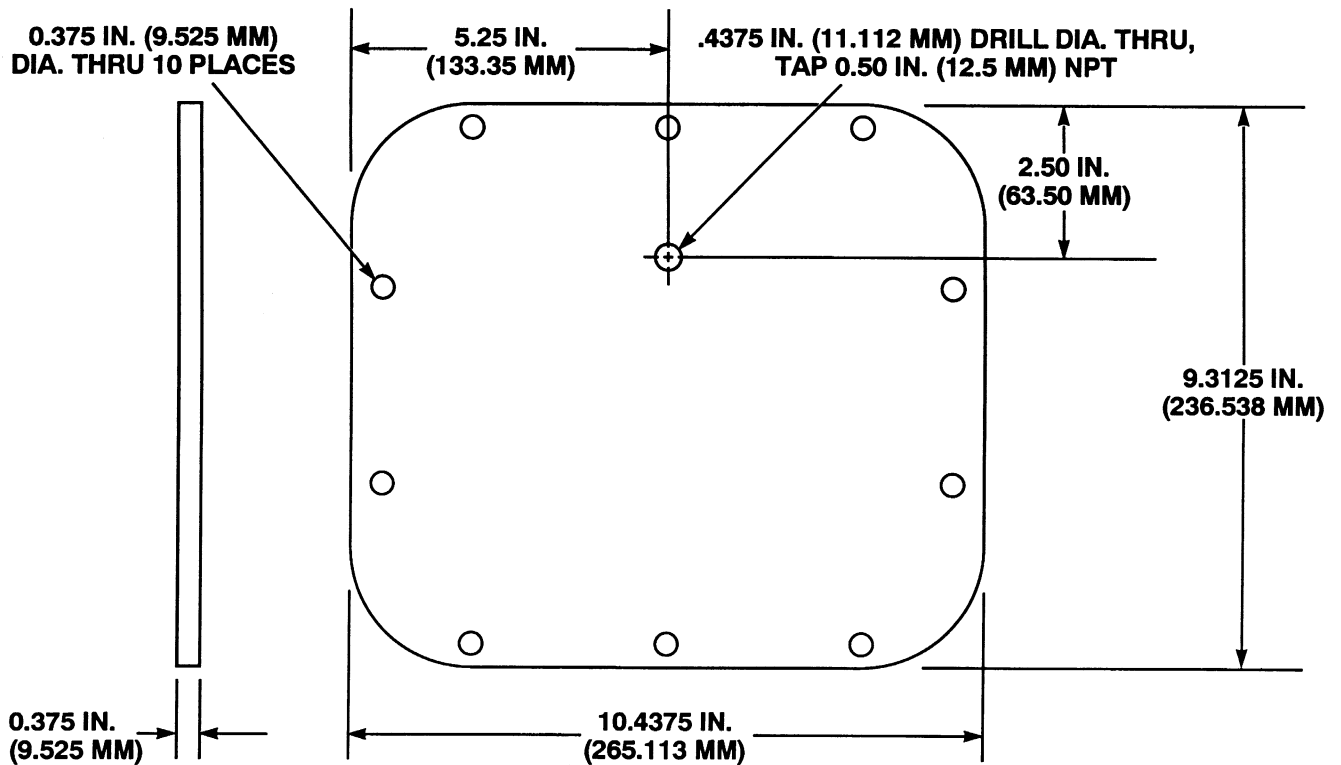
**C-33. AXLE PLATE.**



Fabricate axle plate from 1/8 in. (3 mm) thick mild steel stock.

- a. Cut a steel plate 4.50 in. (114.30 mm) by 8 in. (203.20 mm).
- b. Drill eight .62 in. (15.75 mm) diameter holes where shown.
- c. Drill four .44 in. (11.18 mm) diameter holes where shown.
- d. File off rough edges.
- e. Paint as required.

**C-34. OIL COOLER TEST PLATE.**

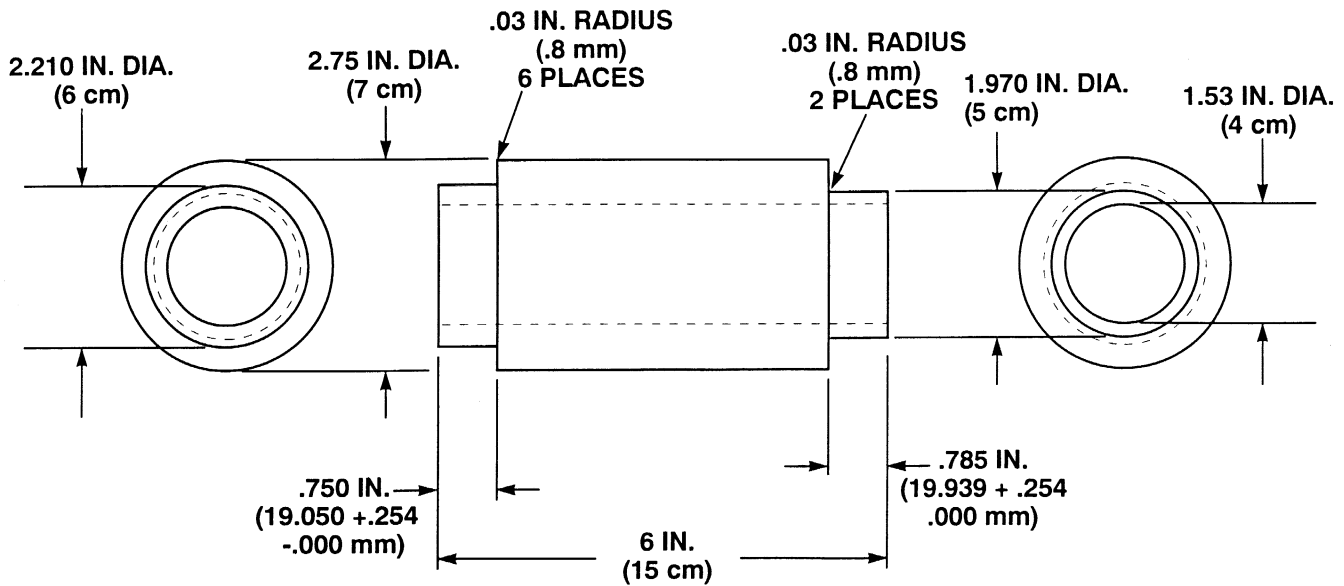


Fabricate oil cooler test plate from 3/8 in. (9.525 mm) thick mild steel stock.

- a.** Using oil cooler gasket for template, cut a steel plate 9 5/16 in. (236 mm) by 10 7/16 in. (265 mm).
- b.** Drill ten 3/8 in. (9.525 mm) diameter holes where shown.
- c.** Drill 7/16 in. (11 mm) diameter hole where shown and tap to fit 1/2 in. NPT fitting.
- d.** File off rough edges.
- e.** Paint as required.



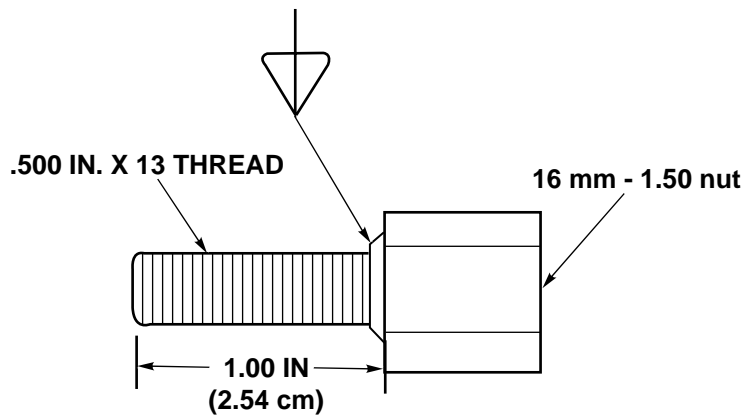
**C-35. SEAL INSTALLER.**



Machine seal installer from 2.75 in. (7 cm) diameter aluminum round stock.

- a.** Cut a 6 in. (15 cm) piece of 2.75 in. (7 cm) diameter aluminum round stock.
- b.** Drill 1.53 in. (4 cm) diameter hole through center of piece.
- c.** Turn down to 1.970 in. (5 cm) diameter by .785 in. (20 cm) deep.
- d.** Turn down to 2.210 in. (6 cm) diameter by .750 in. (19 cm) deep.

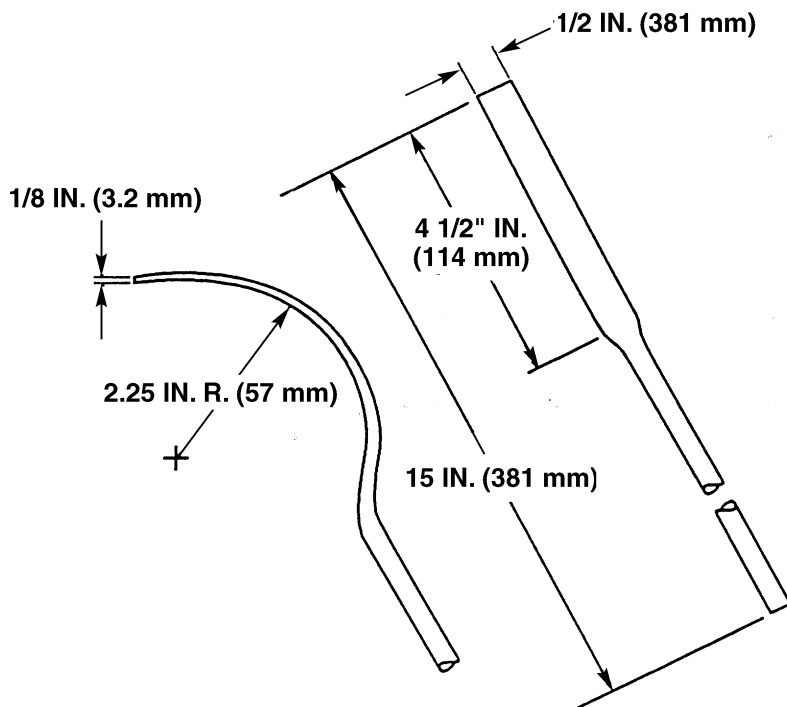
**C-36. ADAPTER.**



Fabricate from: screw (1) .500 in. x 13 x 1 in. grade 5, and nut 16mm x 1.50.

- a. Weld together screw and nut where indicated.
- b. Paint as required.

**C-37. BEARING SHELL REMOVER.**



- (1) Fabricate from 3/8 in. (9.5 mm) diameter cold rolled steel.
- (2) Heat and flatten 4-1/2 in. (114 mm) length of round stock until end is 1/8 X 1/2 X 4-1/2 in. (3.2 X 13 X 114 mm).
- (3) All dimensions are in inches (millimeters).



## APPENDIX D

### TORQUE LIMITS

#### D-1. SCOPE.

This section provides general torque limits for the screws, hoses and fittings used on the truck. Special torque limits are listed in the maintenance procedures for applicable components. The general torque limits given in this appendix shall be used when specific torque limits are not indicated in the maintenance procedure. These general torque limits cannot be applied to screws that retain rubber components. The rubber components will be damaged before the torque limit is reached. If a special torque limit is not given in the maintenance instructions, tighten the screw or nut until it touches the metal bracket then tighten it one more turn.

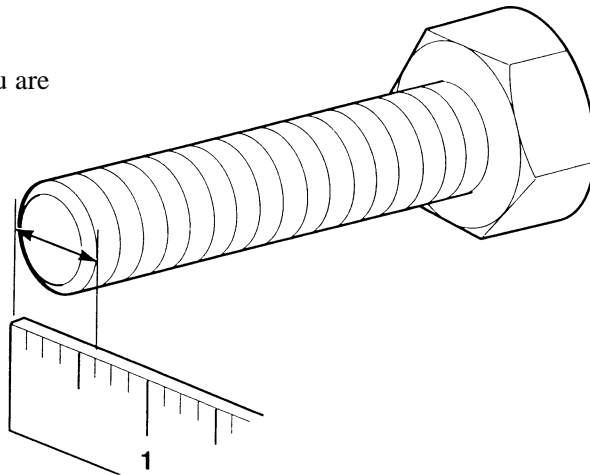
#### D-2. TORQUE LIMITS.

Table D-1 lists the torque limits for wet flange nuts. Table D-2 lists the torque limits for wet socket head capscrews. Table D-3 lists dry torque limits for capscrews. Dry torque limits are used on screws that do not have high pressure lubricants applied to the threads. Table D-4 lists wet torque limits for capscrews. Wet torque limits are used on screws that have high pressure lubricants applied to the threads. Table D-5 lists the torque limits for SAE 37 degree flare hose connections. Table D-6 lists the torque limits for SAE 45 degree flare hose connections. Table D-7 lists the torque limits for ORS preformed packing face seal hose connections. Table D-8 lists the torque limits for NPSM swivel connections.

#### D-3. HOW TO USE TORQUE TABLE.

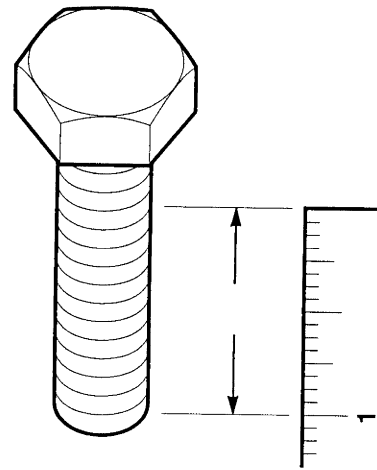
##### a. *Screws and Nuts.*

- (1) Measure the diameter of the screw you are installing with a ruler.

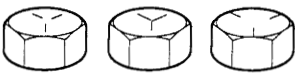
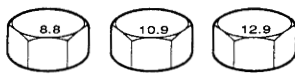


**D-3. HOW TO USE TORQUE TABLE (CONT).**

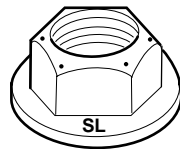
- (2) Measure out one inch with a ruler and count the number of threads per inch.
- (3) Under the heading **SIZE**, look down the left hand column until you find the diameter of the screw you are installing (there will usually be two lines beginning with the same size).
- (4) In the second column under **SIZE**, find the number of threads per inch that matches the number of threads per inch you counted in Step 2. (Not required for metric screws).
- (5) To find the grade screw you are installing, match the markings on the head to the correct picture of **CAPSCREW HEAD MARKINGS** on the torque table.
- (6) Look down the column under the picture you found in Step 5. until you find the torque limit (lb-ft or N·m) for the diameter and threads per inch of the screw you are installing.
- (7) Use wet torque values.



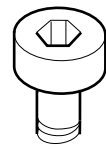
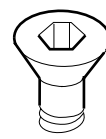
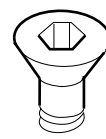
**CAPSCREW HEAD MARKINGS**

<p>Manufacturer's marks may vary. These are all SAE Grade 5 (3-line).</p>  <p><b>STANDARD</b></p>	<p>Metric screws are of three grades: 8.8, 10.9, and 12.9. Grades &amp; Manufacturer's marks appear on the screw head.</p>  <p><b>METRIC</b></p>
---	---

**Table D-1. Torque Limits For Wet Flange Nuts**

SPIRALLOCK FLANGE NUT MARKINGS GRADE 8	DIAMETER		THREADS PER INCH	TORQUE	
	IN.	MM		LB-FT	N·m
	1/4	6.35	20	15	20
	5/16	7.94	18	25	34
	3/8	9.65	16	45	61
	1/2	12.70	13	110	149
	5/8	15.87	11	210	285
	3/4	19.05	10	375	508

**Table D-2. Torque Limits For Wet Socket Head Cap Screws**

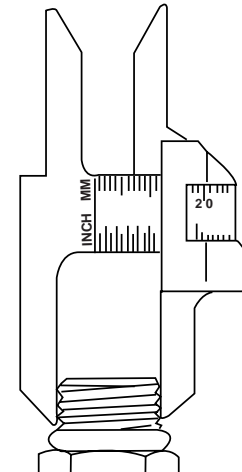
 SOC HEAD/12 PT.	TORQUE IN FT. LBS. (CAP SCREWS) LUBED		
	SIZE	SOC HD OR 12 PT	SOC FLAT HD
 SOC FLAT HEAD	.10-24	5	2.5
	.25-20	12	6
	.31-18	25	12
	.38-16	44	22
	.50-13	70	36
 SOC FLAT HEAD	.56-12	106	53
	.62-11	212	106
	.75-10	375	187
	1.00-8	781	

**b. Hoses and Fittings.**

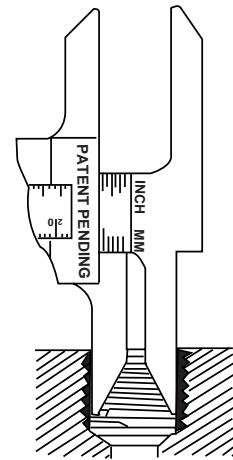
**NOTE**

Most fluid piping system sizes are measured by dash numbers. These are universally used abbreviations for the size of the component expressed as the numerator of the fraction with the denominator always being 16. For example, a -04 port is 4/16 or 1/4-inch. Dash numbers are usually nominal (in name only) and are abbreviations that make ordering of components easier.

- (1) Measure the I.D./O.D. diameter with a caliper as shown.
- (2) Under the heading MALE THREAD O.D. and FEMALE THREAD I.D., match the measurements with the row in table to determine proper torque.
- (3) To find the sealing surface angle, use a protractor and measure the sealing surface parallel to the center line of the fitting.



**O.D.  
(MALE THREADS)**



**I.D.  
(FEMALE THREADS)**

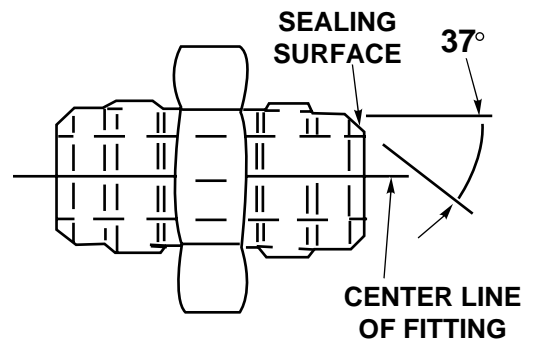


Table D-3. Torque Limits For Dry Fasteners

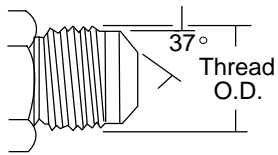
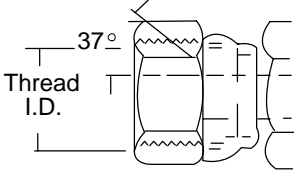
CAPSCREW HEAD MARKINGS			TORQUE							
SIZE			SAE GRADE NO. 2		SAE GRADE NO. 5		SAE GRADE NO. 6 or 7		SAE GRADE NO. 8	
			POUNDS FEET	NEWTON METERS	POUNDS FEET	NEWTON METERS	POUNDS FEET	NEWTON METERS	POUNDS FEET	NEWTON METERS
DIA. INCHES	THREADS PER INCH	MILLIMETERS								
1/4	20	6.35	5	7	8	11	10	14	12	16
1/4	28	6.35	6	9	10	14	12	16	14	19
5/16	18	7.94	11	15	17	23	21	28	25	34
5/16	24	7.94	12	16	19	26	24	33	25	34
3/8	16	9.53	20	27	30	41	40	54	45	61
3/8	24	9.53	23	31	35	47	45	61	50	68
7/16	14	11.11	30	41	50	68	60	81	70	95
7/16	20		35	47	55	75	70	95	80	108
1/2	13	12.70	50	68	75	102	95	129	110	149
1/2	20		55	75	90	122	100	136	120	163
9/16	12	14.29	65	88	110	149	135	183	150	203
9/16	18		75	102	120	163	150	203	170	231
5/8	11	15.88	90	122	150	203	190	258	220	298
5/8	18		100	136	180	244	210	285	240	325
3/4	10	19.05	160	217	260	353	320	434	380	515
3/4	16		180	244	300	407	360	488	420	570
7/8	9	22.23	140	190	400	542	520	705	600	814
7/8	14		155	210	440	597	580	786	660	895
1	8	25.40	220	298	580	786	800	1085	900	1220
1	12		240	325	640	868	860	1166	1000	1356
1-1/8	7	25.58	300	407	800	1085	1120	1519	1280	1736
1-1/8	12		340	461	880	1193	1260	1709	1440	1953
1-1/4	7	31.75	420	570	1120	1519	1580	2142	1820	2468
1-1/4	12		460	624	1240	1681	1760	2387	2000	2712
1-3/8	6	34.93	560	759	1460	1980	2080	2820	2380	3227
1-3/8	12		640	868	1680	2278	2380	3227	2720	3688
1-1/2	6	38.10	740	1003	1940	2631	2780	3770	3160	4285
1-1/2	12		840	1139	2200	2983	3100	4204	3560	4827

Table D-4. Torque Limits For Wet Fasteners

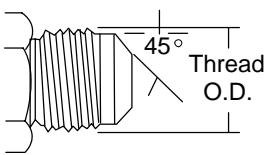
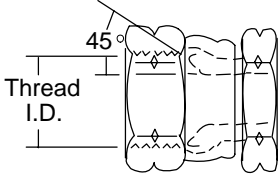
CAPSCREW HEAD MARKINGS			TORQUE							
SIZE			SAE GRADE NO. 2		SAE GRADE NO. 5		SAE GRADE NO. 6 or 7		SAE GRADE NO. 8	
DIA. INCHES	THREADS PER INCH	MILLIMETERS	POUNDS FEET	NEWTON METERS	POUNDS FEET	NEWTON METERS	POUNDS FEET	NEWTON METERS	POUNDS FEET	NEWTON METERS
1/4	20	6.35	4	6	6	8	8	11	9	12
1/4	28	6.35	5	7	7	9	9	12	10	14
5/16	18	7.94	8	11	13	18	16	22	18	24
5/16	24	7.94	9	12	14	19	18	24	20	27
3/8	16	9.53	15	20	23	31	30	41	35	47
3/8	24	9.53	17	23	25	34	30	41	35	47
7/16	14	11.11	24	33	35	47	45	61	55	75
7/16	20		25	34	40	54	50	68	60	81
1/2	13	12.70	35	47	55	75	70	95	80	108
1/2	20		40	54	65	88	80	108	90	122
9/16	12	14.29	50	68	80	108	100	136	110	149
9/16	18		55	75	90	122	110	149	130	176
5/8	11	15.88	70	95	110	149	140	190	170	231
5/8	18		80	108	130	176	160	217	180	244
3/4	10	19.05	120	163	200	271	240	325	280	380
3/4	16		140	190	220	298	280	380	320	434
7/8	9	22.23	110	149	300	407	400	542	460	624
7/8	14		120	163	320	434	440	597	500	678
1	8	25.40	160	217	440	597	600	814	680	922
1	12		170	231	480	651	660	895	740	1003
1-1/8	7	25.58	220	298	600	814	840	1139	960	1320
1-1/8	12		260	353	660	895	940	1275	1080	1464
1-1/4	7	31.75	320	434	840	1139	1100	1492	1360	1844
1-1/4	12		360	488	920	1248	1320	1790	1500	2034
1-3/8	6	34.93	420	570	1100	1492	1560	2115	1780	2414
1-3/8	12		460	624	1260	1709	1780	2414	2040	2776
1-1/2	6	38.10	560	760	1460	1980	2080	2820	2360	3200
1-1/2	12		620	841	1640	2224	2320	3146	2660	3607



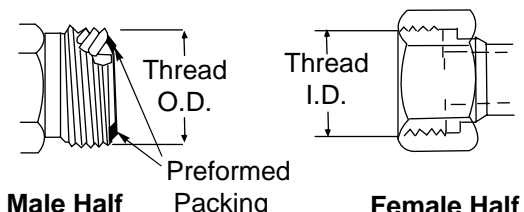
**Table D-5. Torque Limits For 37 Degree Flare Hose Connections**

				
<b>Male Half</b>		<b>Female Half</b>		
INCH SIZE	DASH NO.	THREAD SIZE	TORQUE LB.FT.	TORQUE N·m
1/4	04	7/16-20	11-12	15-16
3/8	06	9/16-18	18-21	24-28
1/2	08	3/4-16	36-39	49-53
5/8	10	7/8-14	57-62	77-84
3/4	12	1 1/16-12	79-87	107-118
7/8	14	1 3/16-12	83-91	113-123
1	16	1 5/16-12	108-113	146-153
1 1/4	20	1 5/8-12	127-133	172-180
1 1/2	24	1 7/8-12	158-167	214-224
2	32	2 1/2-12	245-258	332-350

**Table D-6. Torque Limits For 45 Degree Flare Hose Connections**

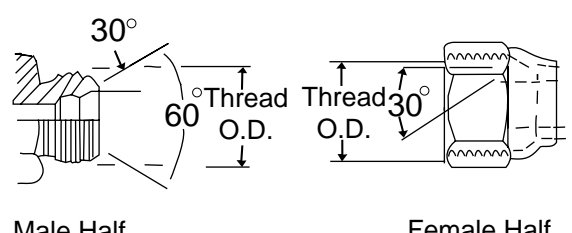
				
<b>Male Half</b>		<b>Female Half</b>		
INCH SIZE	DASH NO.	THREAD SIZE	TORQUE LB.FT.	TORQUE N·m
1/4	04	7/16-20	8-9	11-12
3/8	06	5/8-18	18-20	24-27
1/2	08	3/4-16	36-38	49-51
5/8	10	7/8-14	52-54	70-73
3/4	12	1 1/16-14	71-74	97-100

**Table D-7. Torque Limits For ORS Preformed Packing Face Seal Hose Connections**



INCH SIZE	DASH NO.	THREAD SIZE	TORQUE LB.FT.	TORQUE N-m
1/4	04	9/16-18	10-12	14-16
3/8	06	11/16-16	18-20	24-27
1/2	08	13/16-16	32-35	43-47
5/8	10	1-14	46-50	62-68
3/4	12	1 3/16-12	65-70	88-95
1	16	1 7/16-12	108-113	146-153
1 1/4	20	1 11/16-12	127-133	172-180
1 1/2	24	2-12	158-167	214-226

**Table D-8. Torque Limits For NPSM Swivel Connections**



INCH SIZE	DASH NO.	THREAD SIZE	TORQUE LB.FT.	TORQUE N-m
1/8	02	1/8-27	3-4	4-5
1/4	04	1/4-18	10-11	14-15
3/8	06	3/8-18	16-18	22-24
1/2	08	1/2-14	25-27	34-37
3/4	12	3/4-14	46-48	62-65
1	16	1-1 1/2	80-83	108-113
1 1/4	20	1 1/4-11/2	130-134	176-182
1 1/2	24	1 1/2-11/2	160-164	217-222
2	32	2-11/2	170-174	231-240



## APPENDIX E

### MANDATORY REPLACEMENT PARTS

#### Section I. INTRODUCTION

##### E-1. SCOPE.

This appendix lists all mandatory replacement parts required for performance of Direct and General Support Maintenance of the PLS truck. It authorizes the requisitioning, issue, and disposition of consumable repair parts. All consumable repair parts listed in the maintenance tasks are listed here for ease of reference.

##### E-2. EXPLANATION OF COLUMNS (SECTION II).

- a. Column (1) - Replacement Part Reference Code.* This number is assigned to the entry in the listing and is referenced in the narrative task box to identify the part e.g., Clamp (Item 12, Appendix E).
- b. Column (2) - Nomenclature.* Indicates the federal item name and, if required, a description to identify the item.
- c. Column (3) - Part Number.* This is the vendor number assigned to the item.
- d. Column (4) - National Stock Number.* This is the National Stock Number assigned to the item; use it to request or requisition the item.

## Section II. MANDATORY REPLACEMENT PARTS LIST

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
1	Adapter, Fuel	8928631	4730-01-336-6943
2	Ball	4B9880	3110-00-949-1438
3	Beam Center Bushing	29481-5	5365-01-161-4062
4	Beam Center Bushing	49400	3120-01-329-4297
5	Beam Center Bushing	C-2159	5365-01-344-2477
6	Beam End Bushing	45163	3120-01-345-0940
7	Beam End Bushing	45900	3120-01-155-4522
8	Bearing	23503649	3110-01-359-4525
9	Bearing	23503687	3110-01-359-4677
10	Bearing	441843-0001	3120-01-239-1369
11	Bearing Kit, Taper	V88130017	3120-01-346-7757
12	Bearing Set	2405CPA	3120-01-157-6832
13	Bearing, Intermediate	5196026	3120-00-843-6994
14	Bearing, Piston Pin	23501687	3120-00-094-3552
15	Bearing, Taper	V75650169	3110-01-273-0041
16	Bearing, Thrust	443688-1	3120-01-239-5139
17	Bearing, Thrust	TP612	3120-00-596-7688
18	Bolt Kit, Air Spring	A-10284	5305-01-345-3748
19	Bolt Set	A-5332	5306-01-344-7993
20	Bolt, Self-Locking	N9077	5306-01-223-4345
21	Bushing	209P-8-4	4730-01-348-6542
22	Bushing	5122445	3120-00-811-4699
23	Bushing	5123700	3120-00-662-1651
24	Bushing	GLY.PG 808560 A	5364-01-355-9529
25	Bushing, Plastic, Spacer	194	5365-01-154-8511
26	Clamp	24433	5340-01-131-8313
27	Clamp	5132650	5340-01-048-7743
28	Clamp	5143999	4730-00-080-5799
29	Clamp	700-88	5340-01-355-7648
30	Clamp	X300	5340-01-197-1196
31	Clip	COV0713	5340-01-029-9172
32	Collar, Adjustment	B-2848	3040-01-346-9820
33	Collar, Shaft	8925751	3040-01-234-8467
34	Copper Washer	265850FC88	5310-00-193-9753
35	Copper Washer	23513842	5310-01-395-1250
36	Copper Washer	5108436	5310-00-486-3129
37	Cover, Access	5117733	5340-00-833-0822
38	Cross	V75750400	2520-01-352-9164
39	Cross And Bearing	5-103X	2530-01-244-4949
40	Dust Cover	L-28-VC-121	5340-01-346-2252
41	Dust Shield	23016012	5340-01-318-9153

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
42	Element	5101760	2940-00-089-2520
43	Element	5106910	4730-01-160-5668
44	Filter Element	2020PMOR	2910-01-344-5791
45	Filter Element	23014205	2940-01-328-5584
46	Filter Element	25010643	4330-01-132-4842
47	Filter Element	25010778	2910-01-022-8183
48	Fitting, Grease	N1199N1860	4730-01-348-9511
49	Fitting, Grease	V75501903	4730-01-345-0734
50	Fitting, Grease	V75503714	4730-01-384-6286
51	Fitting, Lubrication	MS15002-3	4730-00-172-0015
52	Front/Rear Steer Gear Repair Kit	5518181	2530-01-335-7776
53	Fuel Pipe, Jumper	8928628	4710-01-337-4466
54	Gasket	02-23-00870-150	5330-01-281-1842
55	Gasket	03158320033	
56	Gasket	03158320035	
57	Gasket	0601-16501	5330-01-356-9971
58	Gasket	11007B	5330-01-344-0539
59	Gasket	11028B	5330-01-147-2520
60	Gasket	14079550	5330-00-107-3925
61	Gasket	23016017	5330-01-302-5092
62	Gasket	23017225	5330-01-328-7635
63	Gasket	23045365	5330-01-341-6493
64	Gasket	23046658	5330-01-088-5980
65	Gasket	23501587	5330-01-058-0587
66	Gasket	23506157	5330-01-348-3331
67	Gasket	23515145	5330-01-390-9045
68	Gasket	23520287	5330-01-447-1706
69	Gasket	2-510-011-860	5330-01-145-4573
70	Gasket	3921989	5330-00-107-3925
71	Gasket	5100638	5330-01-058-0586
72	Gasket	5100860	5330-01-058-8267
73	Gasket	5101408	5330-01-133-0119
74	Gasket	5104081	5330-01-078-7186
75	Gasket	5104105	5330-01-163-8178
76	Gasket	5104507	5330-01-088-5984
77	Gasket	5104978	5330-01-163-8179
78	Gasket	5117231	5330-00-972-8108
79	Gasket	5117243	5330-00-735-4289
80	Gasket	5117254	5330-00-745-7831
81	Gasket	5117269	5330-00-735-4291
82	Gasket	5117332	5330-00-725-2301
83	Gasket	5117535	5330-00-844-2907
84	Gasket	5117734	5330-00-745-7776

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
85	Gasket	5117786	5330-00-781-7117
86	Gasket	5117993	5330-00-973-1415
87	Gasket	5120224	5330-00-862-6929
88	Gasket	5121714	5330-00-745-7669
89	Gasket	5121835	5330-00-847-4967
90	Gasket	5123240	5330-00-054-8290
91	Gasket	5123570	5330-00-915-2835
92	Gasket	5123638	5330-00-862-6934
93	Gasket	5123812	5330-00-892-1764
94	Gasket	5126160	5330-00-458-2325
95	Gasket	5126161	5330-00-458-2324
96	Gasket	5126499	5330-00-736-0228
97	Gasket	5130995	5330-00-980-1546
98	Gasket	5136678	5330-00-198-7953
99	Gasket	5138659	5330-00-769-4882
100	Gasket	23520012	5330-00-915-4511
101	Gasket	5144901	5330-01-054-2399
102	Gasket	5145581	5330-00-222-0801
103	Gasket	5148810	5330-01-058-0585
104	Gasket	5150193	5330-00-212-6290
105	Gasket	6750186	5330-00-537-2388
106	Gasket	6-794-000557	3040-01-199-7951
107	Gasket	6833980	5330-01-236-1753
108	Gasket	6839213	5330-01-049-0552
109	Gasket	6880389	5330-01-141-9579
110	Gasket	731740-002	5330-01-355-4809
111	Gasket	79031	5330-01-078-2825
112	Gasket	8921312	5330-01-206-3263
113	Gasket	8923492	5330-01-037-4129
114	Gasket	8923512	5330-01-206-3264
115	Gasket	8923791	5330-01-088-5982
116	Gasket	8923792	5330-01-206-3265
117	Gasket	8924266	5330-01-270-1161
118	Gasket	8924413	
119	Gasket	8925778	5330-01-247-2474
120	Gasket	8926782	5330-00-758-2863
121	Gasket	97706	5330-01-078-2826
122	Gasket	D346-177	5330-00-364-3550
123	Gasket, Compression	5100404	5330-01-054-2398
124	Gasket, Cylinder Block	297428	5330-01-346-1605
125	Gasket, Cylinder Cover	297429	5330-01-348-8352
126	Gasket, Cylinder Head	297427	5330-01-346-1604
127	Gasket, Manifold	243430	5330-00-262-3272

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
128	Gasket, Oil Pan	23013339	5330-01-363-8833
129	Gasket, Seal Strip	5183476	5330-00-171-8763
130	Hardware Kit, Electronic	5234934	2920-01-408-8145
131	Impeller	23505995	2930-01-354-4353
132	Insert, Liner	5148501	2815-01-058-0254
133	Inserts, Screw	5121459	5340-00-921-6413
134	Intermediate Steer Gear Repair Kit	5541261	5330-01-344-0581
135	Isolator	23512307	5340-01-414-2177
136	Isolators	5104515	5340-01-057-4230
137	Key	49749AX	5315-00-837-2919
138	Key	5131724	5315-00-089-8807
139	Key	6772552	5315-00-402-0421
140	Key	7-569-000030	5315-01-203-6490
141	Key	8-47-17-06-002	5315-01-280-7372
142	Key	8926247	5315-01-214-1876
143	Key	8928537	5315-01-260-4595
144	Key	8928545	5315-01-304-9174
145	Kit, Overhaul	23012606	2520-01-176-6004
146	Kit, Plug	3331322K	5365-01-394-5979
147	Kit, Repair	5199617	5330-01-056-1111
148	Kit, Repair	711917	5330-01-362-0907
149	Kit, Repair	7350-5	5330-01-352-8831
150	Kit, Repair	75251-01SK	5330-01-372-4652
151	Kit, Repair	75251-13SK	5330-01-373-2973
152	Kit, Repair	75252-08SK	5330-01-392-8534
153	Kit, Repair	9-752-101064	5330-01-374-3260
154	Kit, Repair	9-752-101065	5330-01-372-4651
155	Kit, Repair	MS28775-008	5330-00-579-3158
156	Kit, Repair	SK-16-2	4820-01-233-3441
157	Kit, Repair	SKMEH-3	5330-01-372-5297
158	Kit, Repair	SKMEH-4	5330-01-372-5296
159	Kit, Seal Replacement	RPGC-QAN	5330-01-K63-2529
160	Kit, Wire Gate	K240111	
161	Lip Seal	2-283-001-378	5330-01-233-8692
162	Lock, Valve	5111337	2815-00-529-8193
163	Locknut	0223-01030-011	5310-01-395-6272
164	Locknut	103026	5310-00-011-7049
165	Locknut	110310A	5310-01-159-8178
166	Locknut	110311-A	5310-01-111-0645
167	Locknut	110312A	5310-01-150-5918
168	Locknut	111316A	5306-01-106-7496
169	Locknut	115307A	5310-01-151-1036
170	Locknut	11841	5310-01-151-5546



(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
171	Locknut	1244954-2	5310-00-074-1387
172	Locknut	1333510	5310-01-340-5671
173	Locknut	1408910	5310-01-111-0645
174	Locknut	1571850	5310-01-288-5096
175	Locknut	1598030	5310-01-342-8595
176	Locknut	1600460	5310-01-346-9445
177	Locknut	1764650	5301-01-346-3692
178	Locknut	192481	5310-01-058-3353
179	Locknut	22NM04	5310-00-207-9341
180	Locknut	2560HX	5310-01-081-5351
181	Locknut	29749	5310-01-019-3129
182	Locknut	30191	5310-01-178-5976
183	Locknut	41NE120	5310-00-530-0239
184	Locknut	44NTE-1210	5310-01-346-3789
185	Locknut	5117972	5310-00-043-0427
186	Locknut	5149163	2835-01-015-5419
187	Locknut	5151601	5310-00-270-7111
188	Locknut	60861A	5310-01-061-5678
189	Locknut	6772182	5310-01-228-6394
190	Locknut	8925752	5310-01-268-6783
191	Locknut	9174746	5310-00-844-0127
192	Locknut	93604342	5310-01-081-5351
193	Locknut	9413533	5310-01-018-5266
194	Locknut	L-10-MNS-500-X-1	5310-01-345-2350
195	Locknut	MA219-21065	5310-01-328-9940
196	Locknut	MS51849-74	5305-00-470-3321
197	Locknut	MS35690-525	5310-00-012-0368
198	Locknut	MS51922-21	5310-00-959-1488
199	Locknut	MS51922-37	5310-00-067-9507
200	Locknut	MS51922-53	5310-00-225-6408
201	Locknut	MS51922-9	5310-00-984-3806
202	Locknut	MS51943-31	5310-00-061-4650
203	Locknut	MS51967-14	5310-00-768-0318
204	Locknut	MS51967-23	5310-00-763-8921
205	Locknut	MS51967-27	5310-00-880-8187
206	Locknut	N12	5310-00-185-6345
207	Locknut	N9091	5310-01-050-5005
208	Locknut	N9406	5310-01-362-6171
209	Locknut	N9410	5310-01-348-8398
210	Locknut	T893R	5310-01-288-1116
211	Locknut	TLA-10008-GRC	5310-01-080-9201
212	Locknut	TLA-1213-GRC	5310-01-081-8244
213	Locknut	TLA-3816-GRC	5310-01-222-9097

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
214	Locknut	TLNF-0832-S	5310-01-165-1312
215	Locknut	V75502830	5310-01-344-6738
216	Locknut	V75503336	5310-01-344-6740
217	Locknut	V75503716	5310-01-357-3768
218	Lockplate	57022	5340-01-127-5636
219	Lockscrew	190770	5305-00-019-0770
220	Lockscrew	5101196	5306-01-120-3659
221	Lockscrew	5148324	5306-01-083-9374
222	Lockscrew	9409047	5306-01-210-3836
223	Lockscrew	9409620	5306-01-336-9667
224	Lockscrew	9412014	5305-01-165-3295
225	Lockstrip	6880899	5340-01-056-0037
226	Lockwasher	103321	5310-00-261-7340
227	Lockwasher	112264	5310-01-081-0799
228	Lockwasher	114021	5310-01-081-0798
229	Lockwasher	11500879	5305-01-320-2395
230	Lockwasher	11501719	5306-01-407-7190
231	Lockwasher	122078A	5310-01-344-5946
232	Lockwasher	1388	5310-01-162-5737
233	Lockwasher	1459-254	5310-00-171-1734
234	Lockwasher	1495-Z	5310-01-161-2527
235	Lockwasher	1498	5310-01-161-7311
236	Lockwasher	1813	5310-01-132-0955
237	Lockwasher	187130	5310-00-584-5272
238	Lockwasher	1937550	5310-01-355-8798
239	Lockwasher	2150HX1	5310-01-141-5565
240	Lockwasher	2152HX	5310-00-939-1060
241	Lockwasher	2250HX	
242	Lockwasher	2261H	5310-00-080-9786
243	Lockwasher	23016303	5310-01-081-0799
244	Lockwasher	237648	5310-00-085-3891
245	Lockwasher	237686	5310-00-465-5643
246	Lockwasher	2434	5310-00-775-5139
247	Lockwasher	2435	5310-00-045-3299
248	Lockwasher	2523	5310-00-775-5182
249	Lockwasher	318B	5310-01-061-5302
250	Lockwasher	3231	5310-00-032-1814
251	Lockwasher	351AX	5310-01-129-0450
252	Lockwasher	352A	5310-01-081-1283
253	Lockwasher	352AX	5310-01-081-1283
254	Lockwasher	353AX	5310-00-582-5965
255	Lockwasher	355AX	5310-01-133-2130
256	Lockwasher	371AX	5310-00-775-5139

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
257	Lockwasher	50001716	5310-01-372-6391
258	Lockwasher	5177769	5310-00-209-1543
259	Lockwasher	7520854	5310-00-264-1888
260	Lockwasher	777-A	5310-01-061-4481
261	Lockwasher	7-949-000235	5310-01-173-3637
262	Lockwasher	7-949-000527	5310-01-205-3471
263	Lockwasher	7-949-000534	5310-01-259-6358
264	Lockwasher	7-950-160050	5310-01-292-4150
265	Lockwasher	8926285	5310-01-233-1338
266	Lockwasher	93613642	5310-01-068-8446
267	Lockwasher	AE30574	5310-00-092-6831
268	Lockwasher	MS15795-19	5310-00-209-0693
269	Lockwasher	MS27183-12	5310-00-081-4219
270	Lockwasher	MS35333-105	5310-00-019-0669
271	Lockwasher	MS35335-31	5310-00-596-7693
272	Lockwasher	MS35335-62	5310-00-184-9562
273	Lockwasher	MS35338-100	5310-00-261-8278
274	Lockwasher	MS35338-101	5310-00-184-8970
275	Lockwasher	MS35338-103	5310-00-184-8971
276	Lockwasher	MS35338-105	5310-00-577-5354
277	Lockwasher	MS35338-138	5310-00-933-8120
278	Lockwasher	MS35338-15	5310-00-012-1326
279	Lockwasher	MS35338-41	5310-00-045-4007
280	Lockwasher	MS35338-42	5310-00-045-3299
281	Lockwasher	MS35338-43	5310-00-045-3296
282	Lockwasher	MS35338-44	5310-00-582-5965
283	Lockwasher	MS35338-45	5310-00-407-9566
284	Lockwasher	MS35338-46	5310-00-637-9541
285	Lockwasher	MS35338-47	5310-00-209-0965
286	Lockwasher	MS35338-48	5310-00-584-5272
287	Lockwasher	MS35338-49	5310-00-167-0680
288	Lockwasher	MS35338-50	5310-00-820-6653
289	Lockwasher	MS35338-51	5310-00-584-7888
290	Lockwasher	MS35338-6	5310-00-010-3319
291	Lockwasher	MS35338-7	5310-00-010-3320
292	Lockwasher	MS35338-8	5310-00-261-7340
293	Lockwasher	MS35340-45	5310-00-959-4679
294	Lockwasher	MS45904-60	5310-00-080-9786
295	Lockwasher	MS51848-7	5310-01-040-7762
296	Lockwasher	N9015	4310-01-046-0186
297	Lockwasher	N9018	5310-01-032-4827
298	Lockwasher	N9265	5310-01-136-4888
299	Lockwasher	N9461	5310-01-348-8392

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
300	Lockwasher	N9574	5310-01-439-0818
301	Lockwasher	V88350241	5310-01-346-0138
302	Lockwasher	V88412056	2835-01-355-1918
303	Lockwasher	W08	5310-01-355-8794
304	Lockwasher	W 12	5310-00-010-6265
305	Machine Gun Kit	1878620U	1005-01-363-2502
306	Mount, Resilient	5104515	5340-01-057-4230
307	Nut, Adjusting	V75502102	5310-01-344-6280
308	Nut, Adjusting	V88140038	5310-01-344-6279
309	Nut, Flange	298125	5310-01-346-3787
310	Nut, Flanged Wiz Lock	31 WLF 51618	5310-00-166-8341
311	Nut, Plain, Hex	V75700689	5310-01-345-3757
312	Nut, Push-On	390963	5310-01-143-0542
313	Nut, Spanner	V75503561	5310-01-344-6313
314	Nut, Spanner	V88350222	5310-01-345-5495
315	Nut, Spanner	V88900207	5310-01-344-6312
316	Nut, Spring Clip	7-659-000256	5310-01-271-3286
317	Oil Ring Expander	8924105	2815-01-321-6439
318	Packing, Preformed	001081	5330-01-086-1013
319	Packing, Preformed	001082	5330-01-085-3105
320	Packing, Preformed	001083	5330-01-086-6196
321	Packing, Preformed	00908-77-00-00	5330-01-361-1181
322	Packing, Preformed	1081	5330-00-408-9895
323	Packing, Preformed	1082	5330-01-352-3354
324	Packing, Preformed	1083	5330-01-157-3798
325	Packing, Preformed	11007B	5330-01-344-0539
326	Packing, Preformed	11350	5330-01-147-6003
327	Packing, Preformed	11-910	5330-01-106-4336
328	Packing, Preformed	1332	
329	Packing, Preformed	177969	5330-01-353-9388
330	Packing, Preformed	19265FX	5330-01-054-7297
331	Packing, Preformed	200-116-4490	5330-01-361-1505
332	Packing, Preformed	200-214-4490	5330-01-116-8112
333	Packing, Preformed	200-912-4490	5330-00-395-5737
334	Packing, Preformed	2-011N103-70	5330-00-419-0749
335	Packing, Preformed	2-011N507-90	5330-01-265-8308
336	Packing, Preformed	2-012N507-90	5330-01-092-5502
337	Packing, Preformed	2-014N103-70	5330-00-213-8722
338	Packing, Preformed	2-016N552-90	5330-01-115-8225
339	Packing, Preformed	2-018N507-90	5330-01-092-5503
340	Packing, Preformed	2-021N507-90	5330-01-109-1366
341	Packing, Preformed	2-029N507-90	5330-01-093-3503
342	Packing, Preformed	2-040N674-70	5330-00-137-3204

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
343	Packing, Preformed	2-112N507-90	5330-01-093-3504
344	Packing, Preformed	2-114N507-90	5330-01-288-4786
345	Packing, Preformed	22012-10	5330-00-966-8620
346	Packing, Preformed	22012-12	5330-00-966-8621
347	Packing, Preformed	22012-6	5330-00-200-8125
348	Packing, Preformed	22012-8	5330-00-996-8627
349	Packing, Preformed	2-219N674-70	5330-00-013-7784
350	Packing, Preformed	22617-10	5330-01-040-4772
351	Packing, Preformed	22617-12	5330-00-228-7196
352	Packing, Preformed	22617-16	5330-01-168-0885
353	Packing, Preformed	22617-20	5330-01-168-1802
354	Packing, Preformed	22617-6	5330-01-198-8439
355	Packing, Preformed	22617-8	5330-01-244-2273
356	Packing, Preformed	23017303	5330-01-334-9946
357	Packing, Preformed	23045075	5330-01-341-6763
358	Packing, Preformed	23503769	5365-01-286-3994
359	Packing, Preformed	23504352	5330-01-420-8670
360	Packing, Preformed	235063	5330-00-454-0370
361	Packing, Preformed	32185	5330-00-013-7784
362	Packing, Preformed	353264	5330-01-358-5432
363	Packing, Preformed	3-924N552-90	5330-01-038-3074
364	Packing, Preformed	405862	5330-00-490-1899
365	Packing, Preformed	5101138	5330-01-062-0942
366	Packing, Preformed	5101160	5330-01-058-0281
367	Packing, Preformed	5101198	5330-00-090-4638
368	Packing, Preformed	5101419	5330-01-164-0344
369	Packing, Preformed	6830007	5330-01-049-0547
370	Packing, Preformed	71040	5330-01-012-2722
371	Packing, Preformed	71041	5330-00-633-6827
372	Packing, Preformed	7-543-002870	4720-01-352-6004
373	Packing, Preformed	7-755-014003	5330-00-472-2783
374	Packing, Preformed	7-755-166003	5330-01-353-9544
375	Packing, Preformed	7-755-238003	5330-01-352-7742
376	Packing, Preformed	7-755-246003	5330-01-354-0235
377	Packing, Preformed	85318952	5330-01-155-4277
378	Packing, Preformed	8-74-80-09-059	5330-01-388-3727
379	Packing, Preformed	8923959	5330-00-166-1020
380	Packing, Preformed	8928676	5330-01-346-0846
381	Packing, Preformed	962	5330-00-056-4405
382	Packing, Preformed	9631	5330-00-232-0635
383	Packing, Preformed	A307777000-8	5330-00-920-4157
384	Packing, Preformed	FF446-25	5330-01-269-6152
385	Packing, Preformed	FF9446-12	5330-01-115-8226

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
386	Packing, Preformed	FF9446-14	5330-01-269-8580
387	Packing, Preformed	FF9446-18	5330-01-092-5503
388	Packing, Preformed	FF9446-21	5330-01-269-4323
389	Packing, Preformed	FF9855-12	5330-01-376-9629
390	Packing, Preformed	FF9855-16	5330-01-372-3867
391	Packing, Preformed	FF9855-18	5330-01-363-7073
392	Packing, Preformed	FF9855-21	5330-01-363-7074
393	Packing, Preformed	J200AS128	5330-00-111-3747
394	Packing, Preformed	MS28775-026	5330-00-631-1342
395	Packing, Preformed	MS28775-121	5330-00-542-1398
396	Packing, Preformed	MS28778-16	5330-00-804-5694
397	Packing, Preformed	MS28778-20	5330-00-816-3546
398	Packing, Preformed	MS28778-4	5330-00-805-2966
399	Packing, Preformed	MS29512-16	5330-00-263-8054
400	Packing, Preformed	MS29561-14	5330-00-729-5254
401	Packing, Preformed	RK11341	5330-01-214-5090
402	Packing, Preformed	V75502787	5330-01-354-4160
403	Packing, Preformed	Z053071038	5330-00-633-6818
404	Packing, Preformed	Z053095777	5330-01-304-3453
405	Parts Kit, Air Flow	289352	2530-01-134-1834
406	Parts Kit, Gear Box	02-23-01251-022	5330-00-633-6188
407	Parts Kit, Hydraulic	23012606	2520-01-176-6004
408	Parts Kit, Seal	SK-10-2	5330-01-162-8277
409	Parts Kit, Seal	SK-10-3	2920-00-060-3411
410	Parts Kit, Seal	SK3-0002N-1	5330-01-357-7904
411	Parts Kit, Seal	SK3-10-3S	5330-01-358-3739
412	Parts Kit, Seal	SK3-16-3S	5330-01-358-3740
413	Pin	274889	5315-00-823-4333
414	Pin	5106909	5315-01-089-6864
415	Pin	5156295	5315-00-238-0843
416	Pin, Cotter	MS24665-134	5315-00-839-5820
417	Pin, Cotter	MS24665-283	5315-00-842-3044
418	Pin, Cotter	MS24665-287	5315-00-011-9120
419	Pin, Cotter	MS24665-291	5315-00-019-0777
420	Pin, Cotter	MS24665-353	5315-00-839-5822
421	Pin, Cotter	MS24665-360	5315-00-298-1499
422	Pin, Cotter	MS24665-624	5315-00-059-0217
423	Pin, Cotter	MS24665-625	5315-00-209-7273
424	Pin, Cotter	MS24665-627	5315-00-013-7308
425	Pin, Cotter	MS24665-752	5315-00-546-4297
426	Pin, Dowel	141346	5315-00-014-1346
427	Pin, Dowel	142522	5315-00-081-9924
428	Pin, Dowel	5103045	5315-01-137-3373

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
429	Pin, Dowel	5151576	5315-00-524-7660
430	Pin, Dowel	5175641	5315-00-829-0381
431	Pin, Lube Valve	6838442	5315-01-055-4411
432	Pin, Roll	WLM110004	5315-01-174-4642
433	Pin, Spring	6835729	5360-01-083-1433
434	Pin, Spring	7-690-081044	5315-01-382-8969
435	Plastic Bushing	45289-2	5365-01-163-8204
436	Plate	5103307	2815-01-058-3683
437	Plate, Separator	29501599	5365-01-342-8541
438	Plug	121-6T	5365-01-272-1481
439	Plug	8923313	4730-01-188-3492
440	Plug	8924749	4730-00-005-7376
441	Plug	8924750	4730-01-210-4251
442	Plug	8924751	4730-01-210-4253
443	Plug, Expansion	5139989	5340-00-255-4423
444	Plug, Lube Orifice	6883707	4730-01-127-6900
445	Plug, Nylon	715001A	5340-01-372-3982
446	Preformed Packing Kit	22617-12	5330-00-228-7196
447	Preformed Packing Kit	9S000104	5330-01-363-0667
448	Preformed Packing Kit	9S-000105	5330-01-393-5075
449	Preformed Packing Kit	9S000106	5330-01-372-8377
450	Preformed Packing Kit	FF9446-11	5330-01-214-4857
451	Preformed Packing Kit	SK2-10-2	5330-01-226-6810
452	Preformed Packing Kit	SK3-0017N-1	5330-01-357-7511
453	Preformed Packing Kit	SK3-0039N-1	5330-01-357-7510
454	Preformed Packing Kit	SK3-0024N-1	5330-01-357-7512
455	Preformed Packing Kit	SK3-0088N-1	5330-01-355-9248
456	Pump Assembly	V75503039	5365-01-345-1088
457	Push Clips	H360-4-2	5340-01-151-8391
458	Quickedge Molding	75000317	2510-01-176-1177
459	Repair Kit	60539	5330-01-302-2413
460	Repair Kit	711921	5330-01-393-4779
461	Repair Kit	711922	5330-01-354-4314
462	Repair Kit	9400	2530-01-344-5748
463	Repair Kit	9403	5330-01-344-2572
464	Repair Kit	9436	2520-01-344-9375
465	Repair Kit	9-752-100778	5330-01-353-9623
466	Repair Kit	9-752-100788	5330-01-352-6659
467	Repair Kit	9-752-100901	5330-01-353-9513
468	Repair Kit	9-752-100915	5330-01-354-3834
469	Repair Kit	9-752-101050	5330-01-353-9514
470	Retainer	1790632	2530-01-340-4080
471	Retainer	5149154	5365-01-015-5414

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
472	Retainer	MS28783-16	5330-00-171-5910
473	Retainer	MS28783-26	5330-00-944-9577
474	Retainer, Piston Pin	5180250	5340-00-792-9020
475	Retaining Ring	6758779	5365-00-852-2641
476	Ring Set	282525	2530-01-104-9031
477	Ring, Lock	14-00-139-040	5365-01-201-8981
478	Ring, Lock	5115572	5365-00-590-1739
479	Ring, Locking	2262131	5310-01-344-0559
480	Ring, Oil Collector	23011130	2520-01-145-0301
481	Ring, Piston	23502891	2815-01-337-3963
482	Ring, Piston	8923113	2815-01-321-2231
483	Ring, Piston	8923729	2815-01-247-7125
484	Ring, Piston	T-560-0330-001	3040-01-341-2340
485	Ring, Piston	T-561-0329-002	2815-01-345-1068
486	Ring, Retaining	001023	5365-01-087-8727
487	Ring, Retaining	1023	5365-01-157-3779
488	Ring, Retaining	14-00-139-033	5365-01-202-2587
489	Ring, Retaining	14-02-053-001	5365-01-205-9013
490	Ring, Retaining	23514733	
491	Ring, Retaining	329-1	5365-00-843-8601
492	Ring, Retaining	5198049	5365-00-930-3257
493	Ring, Retaining	MS16224-1087	5365-00-804-2025
494	Ring, Retaining	MS16624-1250	5365-00-806-2357
495	Ring, Retaining	MS16624-1315	5365-00-200-6684
496	Ring, Retaining	MS16625-1081	5365-00-804-9740
497	Ring, Retaining	MS16625-1200	5365-00-804-2784
498	Ring, Retaining	MS16625-1525	5365-00-504-3138
499	Ring, Retaining	V75501125	5365-01-344-8448
500	Ring, Retaining	V75503628	5365-01-345-2353
501	Ring, Retaining	V88150021	5360-01-345-2728
502	Ring, Retaining	V88510252	5330-01-354-4218
503	Ring, Retaining	V88510253	5330-01-345-0157
504	Ring, Retaining (Blue)	6882795	5365-01-083-1532
505	Ring, Retaining (Red)	6882797	5365-01-083-1533
506	Ring, Retaining (Yellow)	6882796	5365-01-083-1534
507	Ring, Seal	23019653	5330-01-338-6302
508	Ring, Seal	5103544	5330-01-088-6596
509	Ring, Seal	5197583	5330-00-930-3254
510	Ring, Seal	5198936	5365-01-016-0443
511	Ring, Seal, Cylinder Liner	8927189	5330-01-054-2267
512	Ring, Spindle	V88350243	5365-01-344-6016
513	Rod Bearing Set	23501025	3120-01-336-3064
514	Screw	115289A	5306-01-150-5884



(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
515	Screw	1344950	5305-01-155-6107
516	Screw	1514640	5305-01-347-9802
517	Screw	1756870	5306-01-341-0712
518	Screw	186292	5306-00-849-8812
519	Screw	2009HX	5305-01-210-7413
520	Screw	2271280	
521	Screw	23045343	5306-01-245-9837
522	Screw	23512308	5306-01-411-6384
523	Screw	3829139	5306-00-024-6580
524	Screw	5103530	5306-01-084-4413
525	Screw	5103534	5306-01-078-4981
526	Screw	5103642	5305-01-078-1999
527	Screw	5121466	5306-00-894-2391
528	Screw	5148794	5305-01-058-5320
529	Screw	54067AX	5305-01-150-8714
530	Screw	7092	5305-00-335-4067
531	Screw	711053A	5305-01-355-2641
532	Screw	8-73-412	5306-01-336-8874
533	Screw	8920631	5306-01-169-5526
534	Screw	8923569	5305-01-192-2168
535	Screw	8923570	5306-01-208-7957
536	Screw	8923571	5306-01-128-3980
537	Screw	8925603	5306-01-297-6987
538	Screw	8927580	5306-01-193-9291
539	Screw	B1821BH038C400N	5305-00-781-3928
540	Screw	C95A37	5305-01-066-1825
541	Screw	CPR102737	5306-00-182-9230
542	Screw	MS35295-58	5305-01-056-5448
543	Screw	MS51095-416	5305-00-964-0589
544	Screw	MS90725-5	5305-00-068-0501
545	Screw	MS90725-60	5305-00-269-3211
546	Screw	MS90728-193	5305-00-947-4356
547	Screw And Washer Assy	23018827	5305-01-341-8904
548	Screw, Cap W/Lockwasher	237757	5305-01-133-7193
549	Screw, Lock	5145092	5306-00-869-2868
550	Screw, Self-Locking	11504603	5305-01-336-6757
551	Screw, Self-Locking	23015458	5306-01-363-4057
552	Screw, Self-Locking	31 WLFS 51618-062	5306-01-350-8223
553	Screw, Self-Locking	378429-8	5306-01-145-6949
554	Screw, Self-Locking	9409010	5306-00-940-9010
555	Screw, Self-Locking	9409037	5305-00-292-4595
556	Screw, Self-Locking	MS35763-1033	5306-00-842-8223
557	Screw, Self-Tapping	1324510	5305-01-157-5624

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
558	Screw, Self-Tapping	1345280	5305-01-159-8544
559	Screw, Self-Tapping	1723180	5305-01-145-4003
560	Screw, Self-Tapping	58368AX	5305-01-167-0288
561	Screw, Self-Tapping	B71-10015-002	5305-01-352-2066
562	Screw, Tapping	234-94420-382	5305-01-351-8783
563	Seal	001332	5330-01-173-6825
564	Seal	23504641	5330-01-336-2997
565	Seal	23511486	5330-01-397-6491
566	Seal	3S9643-00	5330-00-246-6380
567	Seal	5102098	5330-01-058-5220
568	Seal	5103646	5330-01-088-2740
569	Seal	513439	5330-01-384-9330
570	Seal	5148502	5365-01-062-0943
571	Seal	589332	5330-01-372-5634
572	Seal	71246	5330-01-187-3640
573	Seal	80X100X10	5330-01-355-9269
574	Seal	8922140	5330-00-764-1659
575	Seal	NA1205A2315	5330-01-344-0635
576	Seal	NA1205W2259	5330-01-345-4712
577	Seal Kit	430457B	5330-01-394-3549
578	Seal Kit	9638	5330-01-344-2573
579	Seal Kit, Needle	23500533	5340-00-678-0944
580	Seal, Double Lipped, Teflon	3J3598	5330-01-162-8277
581	Seal, Oil	10124	5330-01-281-0907
582	Seal, Oil	13585	5330-00-202-1292
583	Seal, Oil	23016947	5330-01-245-0159
584	Seal, Oil	31333CRWH1	5330-01-204-5486
585	Seal, Oil	415023-SSR	5330-01-340-9882
586	Seal, Oil	415025-SSR	5330-01-340-9882
587	Seal, Oil	415304	5330-01-033-2697
588	Seal, Oil	5106223	5330-01-083-3980
589	Seal, Oil	5148502	5365-01-062-0943
590	Seal, Oil	5177786	5330-00-961-9801
591	Seal, Oil	6773311	5330-00-999-3752
592	Seal, Oil	8-74-21-25-017	5330-01-138-2629
593	Seal, Oil	8-74-21-25-021	5330-01-207-6676
594	Seal, Oil	8921150	5330-01-166-3618
595	Seal, Oil	8921209	5330-00-992-0695
596	Seal, Oil	9-734-100635	5330-01-208-7006
597	Seal, Oil	A11507	5330-00-846-8177
598	Seal, Oil	E75503729	5330-01-344-8263
599	Seal, Oil	V75503486	5330-01-344-8935
600	Seal, Oil	V75503596	5330-01-350-2906

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
601	Seal, Oil	V88350180	5330-01-344-0639
602	Seal, Oil, Rear	8929750	5330-01-324-0437
603	Seal, Plain	6836799	5330-01-145-0697
604	Seal, Plain, Encased	5177786	5330-00-961-9801
605	Seal, Ring	23011453	5330-01-088-5847
606	Seal, Ring	23011454	5365-01-084-5258
607	Seal, Ring	23011455	2520-01-149-3273
608	Seal, Ring	23014441	5330-01-087-6849
609	Seal, Ring	23014631	5935-01-342-3363
610	Seal, Ring	23019652	5330-01-054-2242
611	Seal, Ring	23045519	5330-01-280-7491
612	Seal, Ring	6758740	5330-00-582-0456
613	Seal, Ring	6770492	5330-00-999-3760
614	Seal, Ring	6833980	5330-01-236-1753
615	Seal, Ring	6836796	5330-01-336-6709
616	Seal, Ring	6836799	5330-01-145-0697
617	Seal, Ring	6836800	5330-01-336-2998
618	Seal, Ring	NA1205A2315	5330-01-344-0635
619	Seal, Ring	NA1205W2259	5330-01-345-4712
620	Seal, Valve	23045075	5330-01-341-6763
621	Seal, Water	23506248	5330-01-359-2143
622	Seal, Water	5148502	5365-01-062-0943
623	Sealing Kit (Inner)	V88510252	5330-01-354-4218
624	Sealing Kit (Outer)	V88510253	5330-01-345-0157
625	Setscrew	8927479	5305-01-297-7528
626	Setscrew	8927579	5305-01-336-5925
627	Setscrew Assy	35370-2	5305-01-167-0232
628	Shaft	23506053	3040-01-354-0406
629	Shim	4-195-9-00297	5365-01-354-0251
630	Shim	4-195-9-00298	5365-01-354-0252
631	Shim	4-195-9-00299	5365-01-354-0253
632	Shim	5183323	5365-00-377-2888
633	Shim	5185318	5365-00-377-2889
634	Shim	5185319	5365-00-377-2887
635	Shim Kit, Adjusting	V86010008	5365-01-344-6846
636	Shim Kit, Adjusting	V86010009	5365-01-344-6847
637	Shim Kit, Adjusting	V86010010	5365-01-344-4425
638	Shim Kit, Adjusting	V86010012	5365-01-344-6848
639	Shim Kit, Adjusting	V86010048	5310-01-345-2637
640	Shim Kit, Adjusting	V86010049	5365-01-350-3080
641	Shim Kit, Adjusting	V86010079	5365-01-345-2639
642	Shim Kit, Adjusting	V86010080	5365-01-345-3969
643	Shim Kit, Adjusting	V86010081	5365-01-345-3962

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
644	Shim Kit, Adjusting	V86020076	5365-01-345-0228
645	Shims	5100703	5365-01-082-1972
646	Skirt, Piston	23508986	2815-01-406-1952
647	Sleeve	V75503563	5365-01-344-4387
648	Snap Ring	8922605	5365-01-173-3437
649	Snap Ring	N1229N4408	5365-01-344-2598
650	Spacer	2262141	5310-01-344-0560
651	Spacer, Plate	59808BX	5365-01-156-0026
652	Spring	001288	5360-01-174-3821
653	Spring	007500	5360-01-145-7555
654	Spring	011434	5360-01-209-8802
655	Spring	12321866	5360-01-216-7059
656	Spring	3-4X1MD	5360-01-043-4761
657	Spring	5108918	5360-00-689-8264
658	Spring	5108919	2815-00-053-8992
659	Spring	5134477	5360-00-930-3264
660	Spring	5144857	
661	Spring	53733AX	5360-01-145-4724
662	Spring	54396AX	5360-01-086-1419
663	Spring	6768544	5360-00-679-7009
664	Spring	6831656	5360-00-211-9547
665	Spring	6880418	5360-01-035-9396
666	Spring	8923176	5360-01-206-3186
667	Spring	8927794	5360-01-336-9229
668	Spring Kit	23013754	5360-01-128-5646
669	Spring, Converter By-Pass	6834666	4820-01-082-9452
670	Spring, Lockup Shift Val	6839419	5360-01-144-6170
671	Spring, Lube Valve	6837882	5360-01-128-5645
672	Spring, Main Pressure Reg	6839209	5360-01-084-2394
673	Standard Piston Kit	282525	2530-01-104-9031
674	Standoff	23019304	3040-01-K62-9137
675	Strainer, Element	5126143	2940-00-745-7741
676	Stud	5130488	5307-01-044-7270
677	Stud	8925804	5307-00-550-1879
678	Thrust Washer, Oversize	5116485	5365-00-837-8352
679	Thrust Washer, Standard	5111424	3120-00-585-3282
680	Tube, Vent	6769580	4710-00-124-5737
681	U-Bolt	90359-A	4730-01-353-9723
682	U-Bolt	X125	5340-01-351-5690
683	Union, Bulkhead	1890800	4730-01-356-8646
684	Valve Guide	5149771	2815-01-062-0855
685	Valve Seat Insert	5148490	2815-01-055-7659
686	Valve, Lube	6837881	2520-01-051-6670

(1) Index No.	(2) Nomenclature	(3) Part Number	(4) National Stock Number
687	Valve, Seat	5148490	2815-01-055-7659
688	Washer	31425BX	2520-01-041-3542
689	Washer	40393AX	3120-01-146-9782
690	Washer	5104701	5330-00-599-0505
691	Washer	5125108	5310-00-785-3961
692	Washer	8925749	5365-01-239-9477
693	Washer, Flat	5198988	5310-00-153-2717
694	Washer, Flat	60598	5310-00-663-7617
695	Washer, Seal	1760040	5310-01-353-2062
696	Washer, Spring	M12133/1-12P	5310-01-038-2294
697	Washer, Thrust	5111424	3120-00-585-3282
698	Washer, Thrust	5117005	2815-00-735-4202
699	Washer, Thrust	6835321	3120-01-084-4607
700	Washer, Thrust	6881352	3120-01-056-2112
701	Washer, Thrust	6881638	3120-01-053-1819
702	Wear Pad	4-198-9-00020	2590-01-199-7975
703	Wear Pad	6-671-000306	2590-01-354-8240
704	Wear Pad	6-671-000308	2590-01-354-5443
705	Wear Pad	6-671-000362	2590-01-352-2339
706	Windshield Seal/Locking Strip	7500690	5330-01-178-7174

## APPENDIX F

### TOOL IDENTIFICATION LIST

#### Section I. INTRODUCTION

**F-1. SCOPE.**

This appendix lists all of the tools needed to repair the PLS.

**F-2. GENERAL.**

This appendix is a list of tools, both common and special, test equipment and tool kits used at Direct and General Support Maintenance level to repair the truck. This list is arranged alphabetically and shows the nomenclature, Part Number (P/N) and National Stock Number (NSN), when applicable. The index number corresponds to the index number found in the task box of maintenance procedures.

#### Section II. TOOLS, TEST EQUIPMENT AND TOOL KITS

Item No.	Description	Part No.	NSN	Reference
1	Adapter, Engine Stand	J33850	4910-00-146-9624	
2	Adapter Kit, Transfer Case	J-39911	4910-01-385-6779	
3	Adapter, Maintenance Stand, Differential	J-39929-A	4910-01-384-6264	
4	Adapter, Mechanical Puller	J7932	5120-00-733-8890	
5	Adapter, Press	206457	5120-01-357-0740	
6	Adapter, Radiator	J-29003-A	4910-01-170-4929	
7	Adapter, Slip Test	J33765	5935-01-297-2481	
8	Adapter, Socket (3/4 in. male to 1/2 in. female)	11655788-3	5120-00-144-5207	SC 4910-95-A31
9	Adapter, Socket (3/4 in. female to 1/2 in. male)	97-3725	5120-00-227-8088	
10	Adapter, Socket (3/4 in. female to 1 in. male)	A-A-2172	5120-00-227-8104	
11	Adapter, Socket (3/8 in. female to 1/4 in. male)	A-6	5120-00-227-8095	SC 4940-95-B20-HR
12	Alignment Tool, Blower	J33001	5120-01-158-3991	
13	Alignment Tool, Clutch	J-24221	5120-01-115-1156	
14	Alignment Tool, Pin	J24285	5120-01-232-0007	
15	Analyzer Set, STE/ICE-R	12259266	4910-01-222-6589	
16	Attachment, Ball, Micro	J4757	5210-00-221-1921	
17	Bit Set, Screwdriver	38699-1	5120-01-170-4454	SC 4910-95-A72-HR
18	Blade Kit, Hole Saw	GGG-S-66	3455-00-684-3918	
19	Box, Chalk, Reel and Line	GGG-C-291	5210-00-273-9793	

## Section II. TOOLS, TEST EQUIPMENT AND TOOL KITS (CONT)

Item No.	Description	Part No.	NSN	Reference
20	Bracket, Lifting	J-24196	5120-01-115-1157	
21	Bracket, Lifting	J24408-A	5306-01-338-6292	
22	Bracket, Mounting, Cylinder Liner	J24565-02	5340-01-158-3984	
23	Brush, Wire, Scratch	HB178	7920-00-291-5815	SC 4910-95-31
24	Brush, Wire, Valve Cylinder	J5437	5120-00-766-2141	
25	Caliper, Dial, 0-6 in. w/Dial	599-579-2	5210-01-010-4522	SC 3470-95-A02
26	Cap and Plug Set	10935405	5340-00-450-5718	
27	Caps, Vise Jaw	GGG-C-137	5120-00-246-4747	
28	Cartridge, ATEC	J38500-303	4940-01-367-6194	
29	Cartridge, DDEC	J38500-750	4940-01-367-4657	
30	Charging Kit, Pressure	12252157	4910-01-046-7109	
31	Clamp	42052	5340-01-084-4459	
32	Clamp, Machinist's	GGG-C-406	5120-00-222-1612	SC 4910-95-A72-HR
33	Clamp Plate	206459	5120-01-357-0741	
34	Collector Ring Installer and Staking Set	J24200	5120-01-048-3124	
35	Compressor Unit, Air	MIL-C-13874	4130-00-752-9633	
36	Compressor, Ring	J24204-1	5120-01-048-3130	
37	Compressor, Ring	J24227	4910-01-158-3974	
38	Compressor, Ring, Piston	RC40C	5120-00-250-6055	
39	Compressor, Spring	J24204-3	5120-01-048-2159	
40	Compressor, Spring	J24219	5120-01-048-2160	
41	Compressor, Spring, Valve	J7455-A	5120-01-297-2347	
42	Connector Remover	J38384	5120-01-355-3012	
43	Crowbar	1051985	5120-00-224-1390	SC 4910-95-A31
44	DDEC Repair Kit	J35888	2815-01-355-5993	
45	Detector, Leak, Vacuum Gage	J-23987-B	6685-01-061-4253	
46	Die Set, Metal Stamping	GGG-D-280	5110-00-289-0004	SC 4910-95-A31
47	Drill Machine, Upright	MIL-D-80038	3413-00-165-4117	
48	Drill Set, Twist	GGG-D-751	5133-00-449-6775	SC 3470-95-A02
49	Drill, Electric, Portable, 1/4 in.	1070	5130-00-889-8993	SC 4910-95-A31
50	Driver	2HS115	5120-01-374-6200	
51	Driver Bearing, Gear	J25257	5120-01-033-8902	
52	Driver, CTIS Seal	J41112	5120-01-355-0857	
53	Driver, CTIS Seal	J41113	5120-01-355-0858	

## Section II. TOOLS, TEST EQUIPMENT AND TOOL KITS (CONT)

Item No.	Description	Part No.	NSN	Reference
54	Expander, Seal, Oil	J4239	5120-00-336-0445	
55	Expander, Seal, Oil	J8682	5120-01-232-0005	
56	Extractor, Inertial	2HE226	5120-01-355-3010	
57	Extractor, Inertial	2HE227	5120-01-354-9543	
58	Eyes, Lifting	3016T39	5306-01-197-6569	
59	Eyes, Lifting	8891T82	5306-01-333-5486	
60	Eyes, Lifting	3016T65	5306-01-239-5053	
61	Fixture, Holding	J-24310	5120-01-115-1165	
62	Fixture, Lifting, Cylinder Head	J22062-01	4910-00-456-7620	
63	Fixture, PTO, Gear	J26899	4910-01-158-3969	
64	Fixture, Test, Head	J28454	4910-01-158-3985	
65	Gage Set, Cylinder Compression	J7334-E	4910-01-148-1236	
66	Gage Set, Feeler	FB310B	5210-01-119-7601	
67	Gage Set, Feeler	J 1698-02	5210-01-245-9564	
68	Gage Set, Feeler, Piston	J5438-01	5210-00-116-1631	
69	Gage Set, Telescoping	599-590	5210-00-473-9350	SC 4910-95-A63
70	Gage, Center And Front	J-29198-3	5210-01-133-6888	
71	Gage, Depth	J-22273-01	5210-00-023-4798	
72	Gage, Depth, Cylinder Liner	J24898	5210-01-174-4498	
73	Gage, Depth, Micrometer	GGG-C-105	5210-00-619-4045	SC 3470-95-A02
74	Gage, Dial	J-8165-2	4910-00-779-7103	
75	Gage, Dial, Bore, Cylinder	J5347-B	5210-01-070-4543	
76	Gage, Feeler	J3174-02	5210-00-671-2275	
77	Gage, Feeler	J9708-15	5210-01-156-7302	
78	Gage, Feeler, Jacobs Brake	007958	5210-01-214-2938	
79	Gage, Piston, Groove	J24599	5220-01-028-1109	
80	Gage, Timing, Injector	J25502	5220-01-348-1638	
81	Gloves, Chemical Oil Protective	ZZ-G-381	8415-00-641-4601	
82	Gloves, Heavy Duty	A-A-50022	8415-00-268-7859	SC 4910-95-A31
83	Goggles, Industrial	GGG-G-513	4240-00-269-7912	SC 4910-95-A31
84	Grinding Kit, Valve Seat	1750	4910-00-473-6437	SC 4910-95-A63
85	Grinding Machine, Valve Face	00G686	4910-00-540-4679	SC 4910-95-A63
86	Gun, Airblow	GGG-G-770	4940-00-333-5541	SC 4910-95-A31
87	Gun, Heat	500	4940-00-561-1002	SC 4910-95-A31
88	Hammer, Hand, Soft Plastic	3-HD	5120-01-065-9037	SC 4910-95-A72-HR



## Section II. TOOLS, TEST EQUIPMENT AND TOOL KITS (CONT)

Item No.	Description	Part No.	NSN	Reference
89	Hammer, Slide	J6125-1B	5120-01-112-2165	
90	Handle, Driver	J8092	5120-00-677-2259	
91	Handle, Driver	J-3154-1	5120-00-808-5082	
92	Handle, Driver	J24202-4	5120-01-054-4048	
93	Handle, Installer	J7079-2	5120-00-977-5578	
94	Harness, Breakout	J34517	6150-01-373-7771	
95	Holder, Stator Roller	J24218-2	5120-01-115-1158	
96	Honing Unit, Cylindrical Bore, Portable	J5902-01	5130-00-629-9782	
97	Indicator, Dial, Set	J5959-01	5120-00-794-9178	SC 4910-95-A31
98	Indicator, Dial, Set w/Magnetic Base	J7872	5120-00-402-9619	
99	Indicator, Dial, Timing Tool	J34930A	2815-01-355-6628	
100	Insertor and Remover, Charge Pump	J33080	5120-01-166-0572	
101	Insertor, Bearing And Bushing	J25562	5120-01-158-3946	
102	Insertor, Center Bushing, Front	302031	5120-01-186-3126	
103	Insertor, Plug, Cylinder Block	J-21850	5120-01-166-5419	
104	Insertor, Seal	J35373	5120-01-340-1820	
105	Installation Tool, Cup Plug	J33420	5120-01-297-2457	
106	Installer and Remover	J25275	5120-01-048-2180	
107	Installer, Bearing	J-24197	5120-01-115-1160	
108	Installer, Guide, Valve	J-21520	5120-00-999-8617	
109	Installer, Lock Ring	J24453	5120-01-054-4050	
110	Installer, Oil Seal, Sleeve	J21983	5120-01-227-8483	
111	Installer, Output Shaft Seal	J-24202-1A	5120-01-054-4042	
112	Installer, Plug	J-24411	5120-01-385-7288	
113	Installer, Plug	J24369	5120-01-054-4053	
114	Installer, Seal, Crankshaft, Front	J9783	5120-00-936-4377	
115	Installer, Seal	J9791	5120-01-013-1678	
116	Installer, Seal	J8550	5120-00-977-5579	
117	Installer, Seal	J24198	5120-01-054-4049	
118	Installer, Seal, Oil	J8501	5120-00-937-7267	
119	Installer, Seal, Transfer Case	6227 TRS	5120-01-383-7878	
120	Installer, Sleeve	J21983	5120-01-227-8483	
121	Installer, Valve Bridge	J7482	5120-00-999-8616	

## Section II. TOOLS, TEST EQUIPMENT AND TOOL KITS (CONT)

Item No.	Description	Part No.	NSN	Reference
122	Installer, Water Pump Seal	J-38858	5120-01-365-4079	
123	Installer Tool, Center Bushing, Rear	302026	4910-01-158-3941	
124	Installing Tool, Piston	J-23762-A	5120-00-127-7757	
125	Installing Tool, Valve	J24357	5120-01-048-3118	
126	Installing/Removing Tool	J-23019	5120-01-130-8864	
127	Jack, Dolly Type	93660	4910-00-289-7233	SC 4910-95-A31
128	Jack, Hydraulic, Hand	5029209-111-101	5120-00-188-1790	SC 4910-95-A31
129	Jack, Kit, Hydraulic, Hand	GGG-J-60	5120-00-595-8387	SC 4910-95-A31
130	Jack, Stabilizer	LO-J		
131	Jack, Transmission	49	4910-00-585-3622	SC 4910-95-A62
132	Jackstand	306	4910-00-251-8013	SC 4910-95-A74
133	Lathe, Brake Drum	4100	4910-01-028-9849	SC 4910-95-A31
134	Level	2579573-002	4920-00-064-8974	
135	Lifting, Bracket, Center	J-24195	5120-01-116-6048	
136	Lifting, Bracket, Flywheel	J-24365	5120-01-116-6049	
137	Lifting, Fixture, Clutch	J-24209	5120-01-115-1159	
138	Mag Ins Unit, Stat	MIL-M-6867C	6635-00-566-9772	
139	Micrometer, Outside, Caliper, Set	GGG-C-105	5210-00-554-7134	SC 3470-95-A02
140	Multimeter	ANURM105C	6625-00-999-6282	SC 4910-95-A31
141	Multiplier, Torque	292	5120-00-574-9318	SC 4910-95-A72-HR
142	OSS Tester	13189	4910-00-370-4908	
143	Oil, Seal, Expander	J8682	5120-01-232-0005	
144	Pan, Drain 4 gal	450	4910-00-387-9592	SC 4910-95-A31
145	Pan, Drain 6 gal	MIL-P-45819	4910-00-287-2944	
146	Pin, Guide	J1126	5315-01-165-1469	
147	Pin, Guide Set	J24315	5315-01-141-9458	
148	Plate Kit, Gear Bearing	2SK900	5180-01-167-4285	
149	Plate, Adapter, Transfer Case	TRS4114	5340-01-372-6413	
150	Pliers, Brake Repair	131A	5120-00-690-8044	SC 4910-95-A31
151	Pliers, Channel Lock	GGG-W-649	5120-00-287-2512	
152	Pliers, Retaining Ring	2BH945	5120-01-375-5699	
153	Pliers, Retaining Ring	0200	5120-00-288-9717	SC 4910-95-A31
154	Pliers, Retaining Ring	0500	5120-00-293-0046	SC 4910-95-A31
155	Pliers, Retaining Ring	0100	5120-00-293-0048	SC 4910-95-A31

## Section II. TOOLS, TEST EQUIPMENT AND TOOL KITS (CONT)

Item No.	Description	Part No.	NSN	Reference
156	Pliers, Retaining Ring	0400	5120-00-293-0049	SC 4910-95-A31
157	Pliers, Retaining Ring	0900	5120-00-293-0186	SC 4910-95-A31
158	Pliers, Retaining Ring	407	5120-00-595-9551	SC 4910-95-A31
159	Pliers, Retaining Ring	S6800	5120-00-595-9552	SC 4910-95-A31
160	Plug, Cylinder Block	J24597	5120-01-166-5421	
161	Plumb Bob	GGG-P-501	5210-00-007-8229	
162	Press, Arbor, Hand Operated	MIL-P-80261	3444-00-163-4338	SC 4910-95-A31
163	Press Plate	51100	5120-01-357-0743	
164	Press, 60 Ton	26A49	3444-00-449-7295	SC 4910-95-A31
165	Pressure Test Kit	3SK912	4910-01-378-8863	
166	Pressure Test Kit	3SK911	4910-01-378-9068	
167	Protector, Piston	J24210	5120-01-048-2156	
168	Protector, Seal	J24216-01	5120-01-048-2157	
169	Protector, Spindle	2HE234	3830-01-349-7390	
170	Protractor, Magnetic	2150A251	5210-01-415-0075	
171	Protractor, Square	05-12INCH	5210-00-273-1937	
172	Puller, Bolts	J26901-A	5210-01-185-6811	
173	Puller, Mechanical	J1902-B	5120-00-219-8397	
174	Puller Kit, Universal	1677	5180-00-423-1596	SC 4910-95-A31
175	Puller Kit, Universal, Slide Hammer	1178	5120-00-313-9496	SC 4910-95-A74
176	Pulley Kit, Pump, Roof Mount	2HP645	5120-01-375-5700	
177	Pulley Remover	J5356	5120-00-944-0363	
178	Pump, Force	466-46483	4130-01-192-0496	
179	Punch, Drift	PWA14920	5120-00-004-4921	
180	Reader, Diagnostic	J 38500-1	4910-01-343-3508	
181	Reamer Set, Hand	GGG-R-180	5110-00-357-6858	SC 3470-95-A02
182	Reconditioning Set, Injector Tube	J-22525-B	5180-00-019-4208	
183	Remover and Installer, Piston Ring	7950177	5120-00-494-1846	
184	Remover Assembly	J24563-A	4910-01-158-3982	
185	Remover Set, Valve Bridge	J7091-01	5120-00-999-8614	
186	Remover, Bearing, Front Support	J28557	5120-01-117-2523	
187	Remover, Bushing, Beam End	302030	5120-01-186-3125	
188	Remover, Center Bushing, Front	302032	5120-01-374-8970	
189	Remover, Center Bushing, Rear	302027	5120-01-357-0742	

## Section II. TOOLS, TEST EQUIPMENT AND TOOL KITS (CONT)

Item No.	Description	Part No.	NSN	Reference
190	Remover, Guide, Valve	J6569	5120-00-733-8880	
191	Remover, Snap Ring	J26598-A	4910-01-158-3996	
192	Remover, Valve Bridge	J7453	5120-00-999-8615	
193	Remover, Valve Pin	J-24412-2	5120-01-048-3128	
194	Remover, Valve Seat	J23479-E	5120-01-165-1935	
195	Respirator, Air Filter	GGG-M-125/6	4240-00-022-2524	SC 4910-95-A31
196	Rivet Gun	352	5130-00-982-8078	
197	Rule, Steel, Machinist	GGG-R-791	5210-00-204-1283	
198	Sander, Portable, Disk Electric	OOS90	5130-00-596-9728	SC4910-95-A31
199	Scale, Tension	J-8129	4910-00-779-6832	
200	Screw, Guide	J-1927-01	5120-01-144-4483	
201	Seal Installer, Flywheel	J21112-B	4910-01-176-4230	
202	Sleeve, Puller	J25007-4	4910-01-162-3633	
203	Snap Ring Assembly	J-24208-D	5120-01-116-5016	
204	Socket Set, 3/8 in.	221FSMY	5120-01-117-3876	SC 4910-94-A72-HR
205	Socket Set, Deep Well, 1/2 in.	GGG-W-641	5120-00-596-8622	SC 4910-95-A72-HR
206	Socket, Socket Head Screw, 12 mm	SAM12A	5120-01-104-5346	SC 4910-95-A31
207	Socket, Socket Head Screw, 14 mm	SAM14A	5120-01-079-8033	SC 4910-95-A31
208	Socket, Socket Head Screw, 3/4 in.	LAW124A	4470-01-350-0895	
209	Socket, Socket Head Screw, 1/8 in., 3/8 in. Drive	FA4A	5120-00-516-4979	
210	Socket, Socket Head Screw, 3/16 in., 3/8 in. Drive	4080-12	5120-00-683-8597	SC 4910-95-A31
211	Socket, Socket Head Screw, 5/16 in., 1/2 in. Drive	SA10A	5120-01-022-9505	
212	Socket, Socket Head Screw, 9/16 in., 1/2 in. Drive	SA18A	5120-01-367-3466	
213	Socket, Socket Head Screw, 5/8 in., 3/4 in. Drive	LAW120A	5120-00-601-6934	
214	Socket, Socket Head Screw, 3/8 in., 1/2 in. Drive	SA12A	5120-00-585-6237	
215	Socket, 12 mm Hex Head	849550-3-8AF	5120-00-240-6148	
216	Socket, 1-11/16 in.	GGG-W-641	5120-01-024-0168	
217	Socket, 55 mm	J39938	5120-01-386-5999	
218	Socket, 63 mm	J39939	5120-01-386-5988	

## Section II. TOOLS, TEST EQUIPMENT AND TOOL KITS (CONT)

Item No.	Description	Part No.	NSN	Reference
219	Socket, Spindle Nut	J41111	5120-01-354-9451	
220	Socket, Swivel 13/16 in.	A-A-1396	5120-00-236-7619	
221	Socket, Wrench Attachment, Screwdriver	J34650	5120-01-297-2374	
222	Spanner	2HE229	5120-01-354-9452	
223	Spanner	2HE230	5120-01-354-9450	
224	Spanner	2HE231	5120-01-354-9449	
225	Stand, Maintenance, Axle	150-AX	4910-00-241-3329	
226	Stand, Maintenance, Engine	J29109	4910-00-808-3372	
227	Steam Cleaner	PRO 12-5	7910-01-157-8272	
228	Stone, Abrasive, Cylinder	J5902-14	5130-00-937-7280	
229	Stone, Sharpening	A6F0	5345-00-584-4607	
230	Straight Edge	11-1480	4920-00-442-1030	SC 3470-95-A02
231	Stud Remover and Setter	GGG-S-775	5120-00-596-0980	SC 4910-95-A31
232	Stud Set	J25002	5120-01-048-2155	
233	Studs, Guide	J-24748	5315-01-162-3630	
234	Tap and Die Set	TDM99117	5136-01-119-0005	
235	Tape, Measuring	D-1420-A	5210-00-234-6745	SC 4910-95-A31
236	Tension Gage, Belt	J-23600-B	6635-01-093-3710	
237	Tester, Pressure, Radiator	J24460-01	4910-01-170-4928	
238	Testing Kit, Cylinder Block	2SK737	5180-01-252-9800	
239	Tool Kit, Electric	7550526	5180-00-876-9336	SC 4910-95-A01
240	Tool Kit, General Mechanic's	SC5180-90-CL-N05	5180-00-699-5273	
241	Tool Kit, General Mechanic's: Automotive	SC5180-90-N26	5180-00-177-7033	
242	Tool Set, Blower	J-6270-G	4940-00-611-7945	
243	Tool, Knuckle, Adjusting	J41115	5120-01-355-6571	
244	Tool, Lifting	J33079	5120-01-159-1736	
245	Tool, Staking	J24200-1	5120-01-359-2757	
246	Tool, Timing, SRS/TRS	J39815	5120-01-343-1001	
247	Torch, Propane	737-1-0000	3433-01-161-4998	
248	Vise, Machinist's	504M2	5120-00-293-1439	SC 4910-95-A31
249	Vise, Pipe, Chain	CV12	5120-00-078-6662	
250	Weatherpac Crimper	J38852	5120-00-374-8936	
251	Welder, Arc	MIL-W-4125	3433-00-357-6311	SC 3433-90-N01-HR

## Section II. TOOLS, TEST EQUIPMENT AND TOOL KITS (CONT)

Item No.	Description	Part No.	NSN	Reference
252	Winch, Cable, Hand Operating	415526-1	3950-00-079-1202	
253	Wrench, Chain	CW24	5120-01-192-9403	
254	Wrench, Combination 1-1/16 in.	1234	5120-00-228-9515	SC 4910-95-A74
255	Wrench, Combination 1-1/8 in.	1172	5210-00-228-9516	SC 4910-95-A74
256	Wrench, Combination 1-1/4 in.	1173	5120-00-228-9517	SC 4910-95-A74
257	Wrench, Combination 1-5/16 in.	1174	5120-00-228-9518	SC 4910-95-A74
258	Wrench, Combination 1-3/8 in.	1175	5120-00-277-8833	SC 4910-95-A74
259	Wrench, Combination 1-7/16 in.	1176	5120-00-228-9519	SC 4910-95-A74
260	Wrench, Combination 1-1/2 in.	1178	5120-00-277-8834	SC 4910-95-A74
261	Wrench, Combination 1-5/8 in.	1180	5120-01-016-7144	
262	Wrench, Combination 1-11/16 in.	A-A-1351	5120-00-184-8566	
263	Wrench, Combination 1-3/4 in.	1256	5120-00-020-8658	
264	Wrench, Combination 1-13/16 in.	GGG-W-636TY4	5120-00-081-9099	
265	Wrench, Combination 1-7/8 in.	1260	5120-00-020-8632	
266	Wrench, Combination 2-1/8 in.	1268	5120-00-203-4795	
267	Wrench, Crowfoot, 7/8 in., 3/8 in. Drive	FC28A	5120-00-541-4071	
268	Wrench, Crowfoot, 3/4 in., 3/8 in. Drive	FC024	5120-00-187-7898	SC 4910-95-A31
269	Wrench, Crowfoot, 9/16 in., 3/8 in. Drive	GGG-W-646	5120-00-222-7975	SC 4910-95-A31
270	Wrench, Fuel Line	J-8932-B	5120-00-019-5232	
271	Wrench, Pipe 3-1/2 in. Opening	GGG-W-651	5120-00-277-1485	SC 4910-95-A31
272	Wrench Set, Pushrod	J21100-D	5120-00-132-2109	
273	Wrench Set, Socket 3/8 in. Drive	51200017510	5120-00-322-6231	SC 4910-95-A31
274	Wrench Set, Socket 3/4 in. Drive	FEDSTD353	5120-00-204-1999	SC 4910-95-A31
275	Wrench, Spanner	2HS129	5120-01-375-4502	
276	Wrench, Torque (0-60 N·m)	TESI60	5120-01-112-9531	SC 4910-95-A31
277	Wrench, Torque (0-175 lb-ft [0-237 N·m])	A-A-2411	5120-00-640-6364	SC 4910-95-A31
278	Wrench, Torque (0-600 lb-ft [0-814 N·m])	SW130-301	5120-00-221-7983	SC 4910-95-A31
279	Wrench, Torque Driver	TQSC6A	5120-01-112-9532	SC 4910-95-A72-HR
280	Zonal Separator, Oil and Water Spray Gun	MIL-S-12928CLASS1	4940-00-242-4100	SC 4910-95-A73



## INDEX

Subject, Para

Subject, Para

**A**

Accumulator Service, 16-22  
 Adapter Housing, First Clutch Repair, 23-19  
 Adjustments, Engine 3-2  
 Aftercooler  
   Inspection, 20-56  
   Installation, 20-86  
   Removal, 20-21  
   Replacement, 5-5  
 Air  
   Bags Replacement, No. 3 Axle, 14-4  
 Box  
   Drain  
     Installation, 20-89  
     Removal, 20-18  
     Replacement, 3-16  
   Cover and Gasket Replacement, 3-15  
 Covers  
   Installation, 20-90  
   Removal, 20-17  
 Brake Chamber Replacement  
   No. 1 and 2 Axle, 25-4  
   No. 3 and 4 Axle, 25-18  
   No. 5 Axle, 25-5  
 Compressor  
   Repair, 26-2  
   Replacement, 10-4  
 Dryer Guard Installation, 18-7  
 Horn Kit Installation, 18-8  
 Inlet Housing  
   Installation, 20-103  
   Replacement, 4-3  
 Inlet Housing Turbocharger, Removal, 20-5  
 Line Replacement, Dressed Axle, 25-30  
 Suspension Beam Assembly, Repair, No. 3 Axle, 14-6  
 Suspension Beam Mount Replacement/Adjustment,  
   No. 3 Axle, 14-7  
 System, 1-13  
 System Troubleshooting Procedures, 2-13  
 Alternator  
   Assembly  
     Repair, 145 Amp, 6-2  
     Repair, 200 Amp, 6-3  
   Kit Installation (200 Amp.), 18-3

**A (Cont)**

Arctic Kit, Engine, Installation, 18-2  
 ATEC Wire Harness Replacement, 6-26  
 Auxiliary Fuel Tank Installation, 18-6  
 Axle Assembly  
   No. 1, Replacement, 9-3  
   No. 2, Replacement, 9-4  
   No. 3, Replacement, 9-11  
   No. 4, Replacement, 9-12  
   No. 5, Replacement, 9-13  
 Axle  
   Brake Assembly Replacement, 10-2  
   On Stand Removal/Installation, 25-2  
   Shaft, No. 3 and 4, Replacement, 9-5

**B**

Base Mount Replacement, SRW, 28-14  
 Battery Disconnect Switch Kit Installation  
   (200 Amp), 18-11  
 Battery Disconnect Wire Harness Replacement  
   (200 Amp with Battery Disconnect Switch), 6-41  
 Bearing  
   Main, and Crankshaft Installation, 20-65  
   Main, and Crankshaft Repair, 20-63  
 Block Plate  
   Front Cylinder, Installation, 20-71  
   Rear Cylinder, Installation, 20-72  
 Blower  
   Assembly  
     Installation, 20-95  
     Removal, 20-13  
     Repair, 21-2  
     Replacement, 4-4  
   By-Pass Valve Replacement, 4-7  
   Oil Supply Tube Assembly Repair, 4-5  
 Blower Drive Assembly  
   Installation, 20-87  
   Removal, 20-20  
   Replacement, 4-6  
   Repair, 20-55  
 Boom Assembly Repair, 16-3  
 Boom Cable and Chain Adjustment, 16-4



## INDEX (CONT).

Subject, Para

Subject, Para

### B (Cont)

Brake Assembly  
 Axle, Replacement, 10-2  
 Replacement No. 1, 2 and 5 Axle, 25-8  
 Replacement No. 3 and 4 Axle, 25-21  
 Brake Drum  
 Inspection/Repair, 11-3  
 Replacement  
 No. 1, 2, 5 Axle, 25-3  
 No. 3 and 4 Axle, 25-17  
 Brake Retarder, Engine  
 Removal, 20-14  
 Replacement, 3-32  
 Brake, Swing Drive  
 Repair, 28-10  
 Replacement, 16-21  
 Brake, Treadle Valve, Repair, 10-3  
 Brake, Winch, SRW, Repair, 28-13  
 Breather and Hoses, Engine Oil, Replacement, 3-23  
 By-Pass Valve, Blower, Replacement, 4-7

### C

Cab, 1-21  
 Cab  
 Assembly Replacement, 15-2  
 Support, Front, Replacement, 13-2  
 Support, Rear, Replacement, 13-4  
 Wire Harness Replacement, 6-19  
 Cable and Connector, Crane Remote Control, Left  
 Side and Right Side, Repair, 16-30  
 Cam Follower/Push Rod Repair, 20-47  
 Cam Follower and Push Rod  
 Replacement, 3-19  
 Camshaft Repair, 20-62  
 Camshaft  
 Assembly  
 Installation, 20-73  
 Removal, 20-34  
 Cell Replacement, Tension Load, 16-25  
 Center  
 Shaft Repair, 24-13  
 Support Repair, 23-16

### C (Cont)

Central Tire Inflation System (CTIS), 1-20  
 Chassis Wire Harness Replacement, 6-29  
 Chemical Alarm Kit Installation, 19-3  
 Common Tools and Equipment, 2-1  
 Compression Frame Repair, 16-42  
 Connecting Rod and Piston Repair, 20-60  
 Connecting Rod and Liner, Piston  
 Installation, 20-67  
 Removal, 20-40  
 Constant Velocity Joint Repair, No. 1, 2 and 5  
 Axle, 9-8, 25-13  
 Container Handling Unit (CHU)  
 Kit Installation, 18-13  
 Lifting Frame Lower Container Lock Handle Repair,  
 16-46  
 Pivot Repair, 16-44  
 Rail Transport ISO Corner Locks Repair, 16-47  
 Slider Arm Bushing Replacement, 16-45  
 Container, Shipping  
 Engine Assembly Replacement, 3-33  
 Transfer Case Assembly Replacement, 8-6  
 Transmission Assembly Replacement, 7-11  
 Control Valve  
 Assembly, Repair, 23-9  
 Bank Mount, Four/Three Function, Replacement,  
 16-29  
 Bank Repair  
 Four Function, 16-26  
 Three Function, 16-27  
 Bank, Two Function, Replacement, 16-28  
 Crane, Repair, 16-33  
 Hoist Motor  
 Repair, 16-13  
 Replacement, 16-12  
 LHS Directional, Control Valve Replacement, 17-10  
 Main Frame Replacement LHS, Load, 17-6  
 Mount, Four/Three Function, Replacement, 16-29  
 Cooler  
 Adapter, Engine Oil, Replacement, 3-30  
 Assembly  
 Engine Oil, Installation, 20-83  
 Engine Oil, Removal, 20-24  
 Engine Oil, Replacement, 3-29  
 Convert DDEC II Engine Assembly to DDEC III  
 Engine Assembly, 18-14

**INDEX (CONT).**

Subject, Para

Subject, Para

**C (Cont)**

Counterbalance Valve Repair, Self-Recovery Winch  
16-36

Covers, Air Box  
Installation, 20-90  
Removal, 20-17

Crane  
Assembly Replacement, 16-2  
Control Valves Repair, 16-33  
Junction Box Assembly Repair, 6-6  
Load Test, 16-32  
Material Handling (MHC), 1-17  
Remote Control, Cable and Connector, Repair, Left  
Side and Right Side, 16-30  
Subframe Replacement, 16-17  
Troubleshooting Procedures, 2-15  
Wiring Replacement, 6-30

Crankcase  
Front Cover and Oil Seal Replacement, 3-12

Crankshaft  
and Main Bearing  
Installation, 20-65  
Removal, 20-42  
Repair, 20-63

Front Cover and Seal  
Installation, 20-68  
Removal, 20-39

Pulley  
Installation, 20-70  
Removal, 20-37  
Replacement, 3-9

Timing Gear  
Installation, 20-74  
Removal, 20-33

Crossmember  
Gusset  
Front Tandem, Replacement, 13-6  
Rear Tandem, Replacement, 13-10  
Front Tandem, Replacement, 13-6  
Front, Replacement, 13-5  
Rear, Replacement, 13-11  
Replacement  
No. 1 Intermediate, 13-7  
No. 2 Intermediate, 13-8  
No. 3 Intermediate, 13-9

**C (Cont)**

CTIS  
Cab Wire Harness Replacement, 6-27  
Chassis Wire Harness Replacement, 6-28

Cylinder  
Block, Engine, Repair, 20-64  
Erection, Repair, 28-2  
Erection, Replacement, 16-5  
Head Assembly Replacement, 3-7  
Head  
Installation, 20-88  
Removal, 20-19  
Repair, 20-49  
LHS Hook Arm, Replacement, 17-12  
Lift  
Repair, 28-3  
Replacement, 16-6  
Liner Repair, 20-61  
Outrigger  
Repair, 28-11  
Replacement, 16-31  
Telescope  
Replacement, 16-10  
Repair, 28-6

**D**

Damper and Front Balance, Vibration, Cover  
Installation, 20-82

DDEC  
Battery Power Wire Harness Replacement  
(145 Amp), 6-17  
Battery Power Wire Harness Replacement  
(200 Amp), 6-18  
Engine Power Wire Harness Replacement, 6-14  
Speed Sensor Pulse Wheel Replacement, 3-21  
DDEC II Timing and Synchronous Reference  
Sensor (TRS/SRS) Replacement/Adjustment, 6-10  
DDEC III Timing and Synchronous Reference  
Sensor (TRS/SRS) Replacement/Adjustment, 6-11  
DDEC II Wire Harness Replacement, 6-15  
DDEC III Wire Harness Replacement, 6-16  
Decontamination Kit Installation, 19-4

## INDEX (CONT).

Subject, Para

Subject, Para

### D (Cont)

Destruction Of Army Material To Prevent Enemy Use, 1-3  
 Differential Assembly Repair  
     No. 1 and 5 Axle, 25-15  
     No. 2 Axle, 25-16  
     No. 3 Axle, 25-28  
     No. 4 Axle, 25-29  
 Differential Shaft Repair, 24-12  
 Dipstick and Dipstick Tube, Engine Oil, Replacement, 3-25  
 Diverter Block Repair, 17-19  
 Drag Link Repair, 12-3  
 Drain, Air Box,  
     Installation, 20-89  
     Removal, 20-18  
 Dressed Axle Air Line Replacement, 25-30

### E

ECB/Transmission Wire Harness Replacement, 6-35  
 ECB Wire Harness Replacement, 6-25  
 Electrical Proportional Analog Control (EPAC)  
     Controller Replacement and Adjustment, 6-12  
 Electrical System, 1-12  
 Electronic Control Box Light Wire Harness Replacement, 6-24  
 Electronic Control Box Wire Harness Replacement, 6-25  
 Electronic Control Module (ECM)  
     Installation, 20-104  
     Removal, 20-4  
 Emergency Steering Pump Replacement, 12-12  
 Engine  
     Adjustments, 3-2, 20-94  
     Assembly Replacement, Shipping Container, 3-33  
     Arctic Kit Installation, 18-2  
     Brake Retarder  
         Installation, 20-93  
         Removal, 20-14  
         Repair, 20-44

### E (Cont)

Engine (cont)  
     Brake Retarder (cont)  
         Replacement, 3-32  
     Cylinder Block Repair, 20-64  
     Lifting Brackets  
         Installation, 20-102  
         Removal, 20-6  
         Replacement, 3-6  
 Oil  
     Breather and Hoses Replacement, 3-23  
     Cooler Adapter Replacement, 3-30  
     Cooler Assembly  
         Installation, 20-83  
         Removal, 20-24  
         Replacement, 3-29  
         Testing, 20-57  
     Dipstick and Dipstick Tube Replacement, 3-25  
     Filler Tube Replacement, 3-24  
     Filter and Spin-On Adapter Housing  
         Installation, 20-84  
         Removal, 20-23  
     Pan and Gasket Replacement, 3-22  
     Pan  
         Installation, 20-80  
         Removal, 20-27  
     Pressure  
         Regulator Valve  
             Installation, 20-79  
             Removal, 20-28  
             Replacement, 3-27  
         Relief Valve  
             Installation, 20-78  
             Removal, 20-29  
             Replacement, 3-28  
     Pump Assembly  
         Installation, 20-77  
         Removal, 20-30  
         Repair, 3-26  
     Pump Drive Gear  
         Inspection, 20-59  
         Installation, 20-66  
         Removal, 20-41  
         Testing, 3-3

## INDEX (CONT).

Subject, Para

Subject, Para

### E (Cont)

Engine (cont)  
     Troubleshooting Procedures, 2-11  
     Wire Harness Replacement, 6-13  
 Engine Systems, 1-11  
 Engine Tune-up Adjustments, 20-94  
 Engine/Transmission  
     Assembly Replacement, 3-4  
     Separation, 3-5  
 Equalizer Beam, Front and Rear Tandem Repair, 14-5  
 Equipment Characteristics, Capabilities, And  
     Features, 1-7  
 Equipment Data, 1-9  
 Erection Cylinder  
     Repair, 28-2  
     Replacement, 16-5  
 Exhaust  
     Manifold  
         Installation, 20-105  
         Removal, 20-3  
         Replacement, 3-31  
     Valve Bridge  
         Repair, 20-46  
         Replacement, 3-17  
     Valve  
         Repair, 20-48  
         Replacement, 3-18  
 Expansion Plug Replacement, 3-8

### F

Fan  
     Drive Motor Replacement, 5-9  
     Suction, Assembly Replacement, 5-8  
 Fender  
     Right, Replacement, 15-4  
     Left, Replacement, 15-5  
 Fifth Clutch Repair, 23-14  
 Filler Tube, Engine Oil, Replacement, 3-24  
 Filter and Spin-On  
     Adapter, Engine Oil, Housing Installation, 20-84  
     Engine Oil, Adapter Housing Removal, 20-23  
 Filter Element, Transmission Internal Oil,  
     Replacement, 7-4

### F (Cont)

Filter Unit Kit, Gas Particulate, Installation, 19-2  
 First  
     Clutch and Adapter Housing Repair, 23-19  
     Range Trimmer Valve Repair, 23-6  
     Shift Valve Repair, 23-7  
 Flange Assembly and Oil Seal Replacement  
     No. 1 and 5 Axle, 9-7  
     No. 2 Axle, 9-18  
     No. 3 and 4 Axle, 9-18  
 Flange Assembly Rear Oil Seal Replacement,  
     Axle No. 3, 25-26  
 Flatrack (FR), PLS, 1-23  
 Flex Plate  
     Installation, 20-81  
     Removal, 20-26  
 Flex Plate and Hub Replacement, 3-13  
 Flywheel  
     and Torque Converter Turbine Repair, 7-10  
     Housing and Rear Oil Seal  
         Installation, 20-76  
         Removal, 20-31  
 Forward Clutch and Turbine Shaft Repair, 23-13  
 Four Function Control Valve Bank Repair, 16-26  
 Four/Three Function Control Valve Bank Mount  
     Replacement, 16-29  
 Fourth Clutch Repair, 23-15  
 Frame  
     Compression, Repair, 16-42  
     LHS Middle, Repair, 16-40  
     Tube, LHS Middle, Replacement, 16-41  
 Front  
     Balance and Vibration Damper Cover  
         Removal, 20-25  
     Balance Cover and Vibration Damper  
         Replacement, 3-10  
     Cab Support Replacement, 13-2  
     Cover and Seal, Crankshaft, Installation, 20-68  
     Crossmember Replacement, 13-5  
     Cylinder Block Plate  
         Installation, 20-71  
         Removal, 20-36  
     Shaft Assembly Repair, 24-10  
     Steering Gear and Pitman Arm Replacement, 12-9  
     Tandem Crossmember/Gusset Replacement, 13-6

## INDEX (CONT).

Subject, Para

Subject, Para

### F (Cont)

Front (cont)  
 Tow Eye and Cross Brace Replacement, 13-3  
 Front and Rear  
     Spring Assembly Replacement, 14-3  
     Steering Gear Repair, 27-3  
     Tandem Equalizer Beam Replacement, 14-5  
 Fuel Hoses Removal/Head/Secondary Fuel Filter, 20-9  
 Fuel Injector  
     Installation, 20-92  
     Removal, 20-15  
     Repair, 4-2  
 Fuel Pump Assembly Installation, 20-98  
 Fuel Pump  
     Removal, 20-10  
     Replacement, 4-10  
 Fuel/Water Separator Repair, 4-9

### G

Gas Particulate Filter Unit (GPFU) Kit Installation, 19-2  
 Gasket  
     Pan, Transmission Oil, Replacement, 23-3  
     Rocker Cover Removal, 20-11  
 Gear Box, 90 Degree, Repair, 12-5  
 Gear  
     Front Steering and Pitman Arm, Replacement, 12-9  
     Intermediate Steering and Pitman Arm,  
         Replacement, 12-10  
     Rear Steering and Pitman Arm, Replacement, 12-11  
     Replacement, and Turntable, 16-16  
 Gear Reducer, 2.21:1  
     Repair, 27-2  
     Replacement, 12-6  
 Gear Reducer, Swing Drive  
     Repair, 28-9  
     Replacement, 16-18  
 General  
     Assembly Instructions, 2-26  
     Cleaning Instructions, 2-22  
     Disassembly Instructions, 2-21  
     Ground Handling, 2-19  
     Inspection Instructions, 2-23  
     Installation Instructions, 2-27

### G (Cont)

General (cont)  
     Removal Instructions, 2-20  
     Repair Instructions, 2-25  
     Welding Instructions, 2-24  
     Welding Maintenance, 6-39

### H

Hand Receipt Manual and Inventory of Equipment, 2-5  
 Hoist  
     Assembly  
         Repair, 28-7  
         Replacement, 16-11  
     Boom, Telescope, Swing Solenoid Valve  
         Repair, 16-34  
     Brake Repair, 16-14  
     Cable Follower Repair, 16-15  
     Hydraulic, Motor, Repair, 28-8  
     Motor Valve Repair, 16-13  
     Proximity Sensor Replacement/Adjustment, 6-9  
 Holding Valve, Lift Cylinder, Replacement, 16-7  
 Hook Arm/Main Cylinder Repair, LHS, 17-14  
 Hub  
     Drum Repair/Ring Gear Assembly, Self-Recovery  
         Winch, 28-17  
     Repair, Motor End, Self-Recovery Winch, 28-16  
 Hub and Flex Plate Replacement, 3-13  
 Hydraulic  
     Adjustment, Steering System, 12-2  
     Adjustment, Main Hydraulic System, 17-5  
     Hoist Motor  
         Repair, 28-8  
         Replacement, 16-12  
     Manual Override Solenoid Manifold Repair, 16-24  
     Motor Replacement, 28-12  
     Multifunction Manifold/Bracket Repair, 17-18  
     Pump, Emergency Steering, Replacement, 12-12  
     Return Manifold Replacement, 17-17  
     System, 1-14  
     System Troubleshooting Procedures, 2-13

**INDEX (CONT).**

Subject, Para

Subject, Para

**I**

Idler Gear  
 Installation, 20-75  
 Removal, 20-32  
 Repair, 20-58  
 Inflation System (CTIS), Central Tire, 1-20  
 Injector Tube Repair, 20-53  
 Inner Axle Shaft Seal Replacement, 9-10  
 Installing Engine On Stand, 20-2  
 Interface Kit Installation, 18-9  
 Intergear Link Repair, 12-4  
 Intermediate Crossmember No. 1 Replacement, 13-7  
 Intermediate Crossmember No. 2 Replacement, 13-8  
 Intermediate Crossmember No. 3 Replacement, 13-9  
 Intermediate Steering Gear and Pitman Arm  
 Replacement, 12-10  
 Intermediate Steering Gear Repair, 27-4  
 Inter-Steering Shaft Repair, 12-7  
 Inter-Steering Shaft, 2.21:1 Gear Reducer,  
 Replacement, 12-6  
 Introduction to Logic Tree Troubleshooting, 2-9

**J**

Junction Box Assembly Repair, Crane, 6-6

**L**

Lateral Torque Rod Replacement, 14-8  
 Left Fender Replacement 15-5  
 Left Side  
 Power Module Frame Replacement, 13-12  
 Thermostat Housing  
 Removal, 20-7  
 Replacement, 5-4  
 Left Side and Right Side Crane Remote Control  
 Cable and Connector Repair, 16-30  
 Left Thermostat Housing Installation, 20-101  
 LHS  
 Cab-to-Bulkhead Wire Harness Replacement, 6-33  
 Compression Frame Repair, 16-42  
 Controller Protection Kit Installation, 18-10  
 Differential Pressure Switch Replacement, 6-5  
 Directional Control Valve Replacement, LHS, 17-10

**L (Cont)**

LHS (cont)  
 Hook Arm  
 Cylinder Replacement, LHS, 17-12  
 Manifold Repair, 17-13  
 Repair, 16-39  
 Hook  
 Arm/Main Cylinder Repair, LHS, 17-14  
 Arm Repair, 16-39  
 Replacement, 16-38  
 Main  
 Cylinder  
 Hook Arm, Repair, 17-14  
 Manifold Repair, 17-16  
 Frame Load Control Valve Replacement, 17-6  
 Manifold  
 Bracket Replacement, 16-43  
 Check Valve Replacement, 17-7  
 Relief Valve Replacement, 17-8  
 Solenoid Valve and Coil Replacement, 17-9  
 Middle Frame  
 Repair, 16-40  
 Tube Replacement, 16-41  
 Transit Valve Replacement, 17-11  
 Wire Harness, Main Replacement, 6-31  
 LHS Cab Interface Wire Harness Replacement, 6-32  
 LHS Load Control Valve Main Frame Replacement,  
 17-6  
 LHS Main Wire Harness Replacement, 6-31  
 Lift Cylinder  
 Holding Valve Replacement, 16-7  
 Repair, 28-3  
 Replacement, 16-6  
 Lifting Brackets, Engine  
 Installation, 20-102  
 Removal, 20-6  
 Replacement, 3-6  
 Load Cell, Tension, Replacement, 16-25  
 Load Handling System (LHS), 1-18  
 Load Handling System (LHS) Troubleshooting  
 Procedures, 2-13  
 Location And Description Of Major Components, 1-8  
 Locking Cylinder Replacement  
 No. 1 and 5 Axle, 9-15, 25-10  
 No. 2 Axle, 9-16, 25-11

## INDEX (CONT).

Subject, Para

Subject, Para

### L (Cont)

Locking Cylinder Replacement (cont)  
 No. 3 Axle, 9-17, 25-22  
 No. 4 Axle, 9-16, 25-23  
 Longitudinal Torque Rod Replacement, 14-9  
 Low Oil  
     Sensor Assembly Replacement, Transmission,  
     7-5, 23-5  
     Sensor Harness Replacement, Transmission, 7-6  
 Lower Shift Rod Repair, 24-16  
 Lubrication Pump, Transfer Case, Replacement, 8-5

### M

Machine Gun Kit Installation, 18-5  
 Maintenance Forms, Records, And Reports, 1-2  
 Maintenance  
     Introduction, 2-18  
     Storage Procedures, 2-30  
 Main Bearing and Crankshaft  
     Installation, 20-65  
     Removal, 20-42  
     Repair, 20-63  
 Main Cylinder Replacement, 17-15  
 Main Cylinder, Hook Arm Repair, LHS, 17-14  
 Main Frame Replacement, Load Control Valve, 17-6  
 Main Hydraulic  
     Pump Control Subassembly Replacement, 17-4  
     Pump Repair, 17-2  
     Pump Input Shaft Seal Repair, 17-3  
     System Adjustment, 17-5  
 Main Manifold  
     LHS  
         Bracket Replacement, 16-43  
         Check Valve Replacement, 17-7  
         Relief Valve Replacement 17-8  
         Solenoid Valve and Coil Replacement, 17-9  
 Manifold  
     Exhaust  
         Installation, 20-105  
         Removal, 20-3  
         Replacement, 3-31  
     LHS Hook Arm, Repair, 17-13  
     LHS Main Cylinder Repair, 17-16  
     LHS Main Cylinder Replacement, 17-15

### M (Cont)

Manifold (cont)  
     Self-Recovery Winch, Replacement, 16-37  
 Manual Override Solenoid Manifold Repair, 16-24  
 Mast Assembly  
     Repair, 28-5  
     Replacement, 16-9  
 Material Handling Crane (MHC), 1-17  
 Material Handling Crane (MHC) Troubleshooting  
     Procedures, 2-15  
 Motor End  
     Hub Repair, Self-Recovery Winch, 28-16  
     Support Repair, Self-Recovery Winch, 28-15  
 Motor  
     Hydraulic Hoist, Repair, 28-8  
     Replacement, Self-Recovery Winch, 16-35  
     Replacement, Fan Drive, 5-9  
     Swing Drive, Replacement, 16-20  
 Multifunction Manifold Bracket, Hydraulic Repair,  
     17-18

### N

Neutral Start Switch Replacement/Adjustment, 24-5  
 90 Degree Gear Box Repair, 12-5  
 No. 1 and 2 Axle  
     Air Brake Chamber Replacement, 25-4  
 No. 1 and 5 Axle  
     Differential Assembly Repair, 25-15  
     Flange Assembly and Oil Seal Replacement, 9-7  
     Locking Cylinder Replacement, 9-15, 25-10  
 No. 1 Axle  
     Assembly Replacement, 9-3  
     Intermediate Crossmember Replacement, 13-7  
 No. 1, 2 and 5 Axle  
     Brake  
         Assembly Replacement, 25-8  
         Drum Replacement, 25-3  
     Constant Velocity Joint Repair, 9-8, 25-13  
     Dressed Axle Air Line Replacement, 25-30  
     Inner and Outer Axle Shaft Seals and Bearing  
     Replacement, 9-10  
     Pivot and Spindle Assembly and Outer Axle Shaft  
     Seal and Bearing Replacement, 9-9  
     Pivot and Spindle/Trunnion Bearing Assembly  
     Repair, 25-12

**INDEX (CONT).**

Subject, Para

Subject, Para

**N (Cont)****N (Cont)**

No. 1, 2 and 5 Axle (cont)

Planetary Hub Gear Replacement, 9-6, 25-6

Tie Rod Repair, 25-9

Trunnion Bearing Inspection, 9-2

Wheel

Hub Assembly

Repair, 11-2

Replacement, 25-7

No. 2 Axle

Assembly Replacement, 9-4

Differential Assembly Repair, 25-16

Flange Assembly and Oil Seal Replacement, 9-18

Intermediate Crossmember Replacement, 13-8

Locking Cylinder Replacement, 9-16, 25-11

Rear Output Assembly Replacement, 25-14

No. 3 and 4 Axle

Air Brake Chamber Replacement, 25-18

Brake Assembly Replacement, 25-21

Brake Drum Replacement, 25-17

Flange Assembly and Oil Seal Replacement, 9-18

Planetary Hub Gears Replacement, 9-6, 25-19

Shaft Replacement, 9-5, 25-25

Spindle Assembly Repair, 9-14

Spindle Repair, 25-24

Wheel Hub Assembly Repair, 25-20

No. 3 Axle

Air

Bags Replacement, 14-4

Suspension Beam

Assembly Repair, 14-6

Mount Replacement/Adjustment, 14-7

Assembly Replacement, 9-11

Differential Assembly Repair, 25-28

Dressed Axle Air Line Replacement, 25-30

Flange Assembly and Oil Seal Replacement, 9-18

Intermediate Crossmember Replacement, 13-9

Locking Cylinder Replacement, 9-17, 25-22

Rear Flange Oil Seal Replacement, 25-26

No. 4 Axle

Assembly Replacement, 9-12

Differential Assembly Repair, 25-29

Dressed Axle Air Line Replacement, 25-30

Flange Assembly and Oil Seal Replacement, 9-18

Locking Cylinder Replacement, 9-16, 25-23

No. 4 Axle (cont)

Rear Output Assembly Replacement, 25-27

No. 5 Axle

Air Brake Chamber Replacement, 25-5

Assembly Replacement, 9-13

**O**Official Nomenclature, Names, And Designations, 1-4  
Oil

Engine, Breather and Hoses Replacement, 3-23

Engine, Cooler Adapter Replacement, 3-30

Engine, Cooler Assembly Replacement, 3-29

Engine, Dipstick and Dipstick Tube Replacement,  
3-25

Engine, Filler Tube Replacement, 3-24

Engine, Pressure Regulator Valve Replacement,  
3-27

Engine, Pressure Relief Valve Replacement, 3-28

Engine, Pump Repair, 3-26

Oil Filter Element, Transmission Internal, Replacement,  
7-4, 23-4

Oil Pan and Gasket

Engine, Replacement, 3-22

Transmission, Replacement, 7-3, 23-3

Oil Seal and Crankcase Front Cover Replacement, 3-12

Oil Seal/Sleeve, Rear, Replacement, 3-14

Oil Seal, Transmission Yoke/Dust Shield/  
Replacement, 7-9

Oil Seals, Transfer Case Yoke, Replacement, 8-4

Oil Sensor Assembly, Transmission Low Oil,  
Replacement, 7-5, 23-5Oil Sensor Harness, Transmission Low Oil,  
Replacement, 7-6

Outrigger Cylinder

Repair 28-11

Replacement, 16-31

Overload Shutdown System

Replacement, 6-8

Wire Gasket Replacement, 6-7



## INDEX (CONT).

Subject, Para

Subject, Para

### P

Packing/Unpacking Shipping Container  
 Engine Assembly Replacement, 3-33  
 Transfer Case Assembly Replacement, 8-6  
 Transmission Assembly Replacement, 7-11  
 Piston and Connecting Rod Repair, 20-60  
 Piston, Connecting Rod, and Liner  
 Installation, 20-67  
 Removal, 20-40  
 Pivot and Spindle Assembly and Outer Axle Shaft  
 Seal and Bearing Replacement,  
 No. 1, 2 and 5 Axle, 9-9  
 Planetary  
 Hub Gears Replacement, 9-6  
 Hub Gear Replacement, No. 1, 2 and 5 Axle, 25-6  
 Gearing, Shafts and Third Clutch Repair, 23-17  
 PLS Flatrack (FR), 1-23  
 PLS Trailer (PLST), 1-22  
 Polarity Power Wire Harness Replacement (200 Amp),  
 6-37  
 Polarity Protection and Alternator Wire Harness  
 Replacement (200 Amp with Battery Disconnect  
 Switch), 6-40  
 Polarity Wire Harness Replacement (200 Amp), 6-38  
 Power Module Frame  
 Left Side, Replacement, 13-12  
 Right Side, Replacement, 13-13  
 Power Train, 1-10  
 Preparation for Storage or Shipment, 2-29  
 Preparation for Storage or Shipment Introduction, 2-28  
 Pressure Switch, LHS Differential, Replacement, 6-5  
 Principles of Operation:  
 Air System, 1-13  
 Cab, 1-21  
 Central Tire Inflation System (CTIS), 1-20  
 Electrical System, 1-12  
 Engine Systems, 1-11  
 Hydraulic System, 1-14  
 Load Handling System (LHS), 1-18  
 Material Handling Crane (MHC), 1-17  
 Power Train, 1-10  
 Self-Recovery Winch (SRW), 1-16  
 Steering System, 1-15  
 Wheels And Tires, 1-19  
 Pulley, Crankshaft Replacement, 3-9

### P (Cont)

Pump  
 Assembly Engine Oil,  
 Installation, 20-77  
 Removal, 20-30  
 Repair, 3-26  
 Drive Gear  
 Engine Oil  
 Inspection, 20-59  
 Installation, 20-66  
 Removal, 20-41  
 Main Hydraulic  
 Input Shaft Seal Replacement, 17-3  
 Repair, 17-2  
 Push Rod and Cam Follower  
 Repair, 20-47  
 Replacement, 3-19

### R

Radiator Assembly Repair/Test, 5-2  
 Rear  
 Cab Support Replacement, 13-4  
 Crossmember Replacement, 13-11  
 Cylinder Block Plate  
 Installation, 20-72  
 Removal, 20-35  
 Oil Seal/Sleeve Replacement, 3-14  
 Oil  
 and Flywheel Housing Seal Removal, 20-31  
 Seal and Flywheel Housing Installation, 20-76  
 Output Assembly Replacement  
 No. 2 Axle, 25-14  
 No. 4 Axle, 25-27  
 Shaft Assembly Repair, 24-11  
 Steering Gear and Pitman Arm Replacement, 12-11  
 Steering Gear Assembly  
 Repair, 27-3  
 Tandem Crossmember  
 Gusset Replacement, 13-10  
 Transmission Cover Assembly Repair, 23-18

## INDEX (CONT).

Subject, Para

Subject, Para

**R (Cont)****S**

Regulator Valve, Engine Oil Pressure,  
 Installation, 20-79  
 Removal, 20-28  
 Replacement, 3-27

Relief Valve  
 Engine Oil Pressure,  
 Installation, 20-78  
 Replacement, 3-28  
 Removal, 20-29

Remote Engine Oil Filter Kit Installation, 18-12

Remote Engine Oil Filter Manifold  
 Installation, 20-84  
 Removal, 20-23

Removing Engine From Stand, 20-106

Repair Parts, 2-3

Reporting Equipment Improvement Recommendations  
 (EIR), 1-5

Reverse Polarity Power Wire Harness Replacement  
 (145 Amp), 6-36

Right Fender Replacement, 15-4

Right Thermostat Housing Installation, 20-100

Right Side  
 Crane Remote Control Cable Connector Repair,  
 16-30  
 Power Module Frame Replacement, 13-13  
 Thermostat Housing  
 Removal, 20-8  
 Replacement, 5-3

Ring Gear Assembly/Hub Assembly Repair,  
 Self-Recovery Winch, 28-17

Rocker  
 Arm  
 Repair, 20-45  
 Replacement, 3-20

Cover  
 Installation, 20-97  
 Repair, 20-43

Cover and Gasket  
 Removal, 20-11

Scope, 1-1

Seals, Inner and Outer Axle Shaft and Bearing,  
 Replacement, 9-10

Second Clutch Repair, 23-20

Secondary Fuel Filter, Head and Fuel Hoses  
 Installation, 20-99  
 Removal, 20-9

Self-Recovery Winch  
 Base Mount Replacement, 28-14  
 Brake Repair, 28-13  
 Counterbalance Valve Replacement, 16-36  
 Manifold Replacement, 16-37  
 Motor End Hub Repair, 28-16  
 Motor End Support Repair, 28-15  
 Motor Replacement, 16-35  
 Ring Gear Assembly/Hub Drum Repair, 28-17

Self-Recovery Winch (SRW), 1-16

Service Before Operation, 2-6

Shafts  
 No. 3 and 4 Axle, Replacement, 25-25  
 Planetary Gearing, and Third Clutch Repair, 23-17

Shift Connector Replacement, 24-4

Shift Rod  
 Upper, Repair, 24-15  
 Lower, Repair, 24-16

Shipment or Storage  
 Introduction, 2-28  
 Preparation, 2-29

Shipping Container  
 Engine Assembly Replacement, 3-33  
 Transfer Case Assembly Replacement, 8-6  
 Transmission Assembly Replacement, 7-11

Singars Radio Kit, Installation, 18-4

Solenoid  
 Manifold, Manual Override Repair, 16-24  
 Valve and Coil Repair, LHS Main Manifold, 17-9  
 Valve, Hoist, Boom, Telescope Swing, Repair, 16-34

Special Tools, TMDE, and Support Equipment, 2-2

Speedometer Sensor Replacement, 24-6

Spindle, No. 3 and 4 Axle  
 Repair, 9-14, 25-24

## INDEX (CONT).

Subject, Para

### S (Cont)

Spring  
 Assembly, Front and Rear, Replacement, 14-3  
 Tandem Hanger Replacement, 14-2  
 Starter Repair, 6-4  
 STE/ICE-R  
 Alternator Wire Harness Replacement (145 Amp),  
 6-21  
 Alternator Wire Harness Replacement (200 Amp),  
 6-22  
 Chassis Wire Harness Replacement, 6-23  
 Wire Harness Replacement, 6-20  
 Steering Gear  
 Front and Rear Repair, 27-3  
 Intermediate, Repair, 27-4  
 Steering System, 1-15  
 Steering System  
 Alignment and Adjustment, 12-8  
 Hydraulic Adjustment, 12-2  
 Manifold Repair, 12-13  
 Purging Procedure, 12-14  
 Troubleshooting Procedures, 2-17  
 Storage Maintenance Procedures, 2-30  
 Storage or Shipment  
 Introduction, 2-28  
 Preparation, 2-29  
 Suction Fan Assembly Replacement, 5-8  
 Swing Drive  
 Brake  
 Repair, 28-10  
 Replacement, 16-21  
 Gear Reducer  
 Repair, 28-9  
 Replacement, 16-18  
 Motor  
 Replacement, 16-20  
 Valve Repair, 16-19  
 Swing Solenoid Valve, Hoist, Boom, Telescope, Repair,  
 16-34  
 Synchronous and Timing Reference Sensor (TRS/SRS)  
 Installation, 20-91  
 Removal, 20-16  
 Replacement/Adjustment, 6-10, 6-11

Subject, Para

### S (Cont)

System  
 Air, 1-13  
 Electrical, 1-12  
 Hydraulic, 1-14  
 (LHS) Load Handling, 1-18  
 Systems, Engine, 1-11

### T

2.21:1 Gear Reducer and Inter-Steering Shaft  
 Replacement, 12-6  
 2.21:1 Gear Reducer Repair, 27-2  
 Tachometer Drive Assembly  
 Installation, 20-96  
 Removal, 20-12  
 Tandem Spring Hanger Replacement, 14-2  
 Telescope Cylinder  
 Repair, 28-6  
 Replacement, 16-10  
 Tension Link  
 Repair, 28-4  
 Replacement, 16-8  
 Tension Load Cell Replacement, 16-25  
 Thermostat Housing  
 Left Side, Replacement, 5-4  
 Right Side, Replacement, 5-3  
 Third Clutch, and Planetary Gearing, Shafts  
 Repair, 23-17  
 Three Function Control Valve Bank Repair, 16-27  
 Tie Rod Repair, No. 1, 2, 5 Axle, 25-9  
 Timing and Synchronous Reference Sensor (TRS/SRS)  
 Installation, 20-91  
 Removal, 20-16  
 Replacement/Adjustment (DDEC II and III), 6-10,  
 6-11  
 Timing Gear, Crankshaft  
 Installation, 20-74  
 Removal, 20-33  
 Torque Converter  
 Flywheel, Turbine Repair, 7-10  
 Housing Repair, 23-12  
 Pump Repair, 23-11  
 Stator Repair, 23-10

**INDEX (CONT).**

Subject, Para

Subject, Para

**T (Cont)**

Torque Rod  
 Lateral, Replacement, 14-8  
 Longitudinal, Replacement, 14-9  
 Tow Eye, Front and Cross Brace Replacement, 13-3  
 Trailer (PLST), PLS, 1-22  
 Transfer Case  
 Assembly  
 Repair, 24-8  
 Replacement, 8-2  
 Support Replacement, 8-3  
 Differential Assembly Repair, 24-9  
 Lubrication Hoses Replacement, 24-3  
 Lubrication Pump  
 Repair, 24-17  
 Replacement, 8-5  
 Oil Seal Replacement, 8-4  
 On Stand Installation/Removal, 24-2  
 Shipping Container, Assembly Replacement, 8-6  
 Yoke Replacement, 8-4, 24-7  
 Transit Valve Replacement, LHS, 17-11  
 Transmission  
 Internal Oil Filter Element Replacement, 7-4, 23-4  
 Low Oil Sensor Assembly Replacement, 7-5, 23-5  
 Low Oil Sensor Harness Replacement, 7-6  
 Oil Pan and Gasket  
 Replacement, 7-3, 23-3  
 On Stand Installation/Removal, 23-2  
 Shipping Container, Assembly Replacement, 7-11  
 Solenoid Pressure Switch Replacement, 7-8  
 Solenoid Replacement, 7-7  
 Solenoid Wire Harness Repair, 23-8  
 Solenoid Wire Harness Replacement, 7-2  
 Transmission/Engine  
 Assembly Replacement, 3-4  
 Separation, 3-5  
 Troubleshooting Procedures, 2-12  
 Yoke/Dust Shield/Oil Seal Replacement, 7-9  
 Trimmer Valve, First Range, Repair, 23-6  
 Troubleshooting  
 Instructions, 2-8  
 Introduction, 2-7  
 Procedures  
 Air System, 2-12

**T (Cont)**

Troubleshooting (cont)  
 Procedures (cont)  
 Crane, 2-15  
 Engine, 2-10  
 Hydraulic System, 2-13  
 Load Handling System (LHS), 2-14  
 Steering System, 2-17  
 Transmission, 2-11  
 Winch, 2-16  
 Trunnion Bearing Inspection, No. 1, 2 and 5 Axle, 9-2  
 Turbine Shaft and Forward Clutch Repair, 23-13  
 Turbocharger  
 and Air Inlet Housing  
 Installation, 20-103  
 Removal, 20-5  
 Assembly  
 Repair, 21-3  
 Replacement, 4-8  
 Turntable and Gear Replacement, 16-16  
 Two Function Control Valve Bank Repair, 16-28  
 Two Way Hydraulic Solenoid Valve Repair, 16-23

**U**

Unpacking and Deprocessing, 2-4  
 Upper  
 Shaft Repair, 24-14  
 Shift Rod Repair, 24-15

**V**

Valve  
 Bridge, Exhaust  
 Repair, 20-46  
 Replacement, 3-17  
 Bridge Guide Repair, 20-51  
 Exhaust, Replacement, 3-18  
 Guide Repair, 20-50  
 Seat Insert Repair, 20-52  
 Vibration Damper  
 Installation, 20-69  
 Removal, 20-38  
 Replacement, 3-11

## INDEX (CONT).

Subject, Para

### V (Cont)

Vibration Damper and Front Balance Cover  
 Installation, 20-82  
 Removal, 20-25  
 Vibration Damper/Front Balance Cover Replacement,  
 3-10

### W

Warranty Information, 1-6  
 Water  
   Nozzle Repair, 20-54  
   Pump  
     Assembly  
       Installation, 20-85  
       Removal, 20-22  
       Repair, 22-2  
       Replacement, 5-6  
     Drive Gear Replacement, 5-7  
 Welding, General Maintenance, 6-39  
 Wheel  
   Hub Assembly  
     No. 1, 2 and 5 Axle Replacement, 25-7  
     No. 3 and 4 Axle Repair, 25-20  
     Repair, 11-2  
 Wheels and Tires, 1-19  
 Windshield Glass Replacement, 15-3  
 Winch (Self-Recovery) Troubleshooting Procedures,  
 2-16  
 Winch (SRW), Self-Recovery, 1-16  
 Wire Harness  
   ATEC, Replacement, 6-26  
   Battery Disconnect, Replacement (200 Amp with  
     Battery Disconnect Switch), 6-41  
   Cab, Replacement, 6-19  
   Chassis, Replacement, 6-29  
   CTIS Cab, Replacement, 6-27  
   CTIS, Chassis, Replacement, 6-28  
   DDEC  
     Battery Power, Replacement (145 Amp), 6-17  
     Battery Power, Replacement (200 Amp), 6-18  
     Engine Power, Replacement, 6-14  
   ECB Light, Replacement, 6-24  
   ECB, Replacement, 6-25

Subject, Para

### W (Cont)

Wire Harness (cont)  
   ECB/Transmission, Replacement, 6-35  
   Engine, Replacement, 6-13  
   LHS  
     Cab-to-Bulkhead, Replacement, 6-33  
     Main, Replacement, 6-31  
   LHS Cab Interface, Replacement, 6-32  
   Polarity Power, Replacement (200 Amp), 6-37  
   Polarity Protection and Alternator, Replacement  
     (200 Amp with Battery Disconnect Switch), 6-40  
   Polarity, Replacement (200 Amp), 6-38  
   Reverse Polarity Power, Replacement (145 Amp),  
     6-36  
   STE/ICE-R  
     Alternator, Replacement (145 Amp), 6-21  
     Alternator, Replacement (200 Amp), 6-22  
     Chassis, Replacement, 6-23  
     Replacement, 6-20  
     Transmission Solenoid, Replacement, 7-2  
     Transmission Solenoid, Repair, 23-8  
     24 Volt Trailer, Replacement, 6-34  
 Wiring, Crane, Replacement, 6-30

### Y

Yoke and Oil Seal, Transfer Case, Replacement, 8-4

# SCHEMATICS

The following sections contain the schematics which are the same in all volumes of TM 9-2320-364-20 and TM 9-2320-364-34.

Section I contains the schematics for trucks equipped with the 145 amp alternator and the DDEC II engine.

Section II contains the schematics for trucks equipped with the 200 amp alternator and the DDEC III engine.



# SCHEMATICS

## **Section I. 145 AMP ALTERNATOR AND DDEC II ENGINE.**

Section I contains the schematics for trucks equipped with the 145 amp alternator and the DDEC II engine.









CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
439	MC116-MC106	4	EMERGENCY ENG STOP
439	MC116-S30	3	EMERGENCY ENG STOP
439	MC116-S30	3	EMERGENCY ENG STOP
439	MC116-CB13	4	DDEC
439	MC106-MC13	3	
439	SPLC-MC106	4	
439	MC11-MC18	5	ECM
439	MC8-L6	3	CHECK ENGINE LIGHT
439	MC8-L3	3	ENGINE STOP LIGHT
439	MC44-MC8	3	
439	MC11-SPLICE	4	
439	SPLICE-MC44	4	
439	SPLC-MC116	4	
451	MC11-MC18	5	ECM
451	MC106-MC13	3	
451	MC11-MC106	4	
505	MC106-MC13	3	
505	MC11-MC106	4	
505	MC11-MC18	5	ECM
508	MC11-R7	4	TRANSMISSION
508	MC11-MC18	5	ECM
509	MC11-MC18	5	ECM
509	MC8-L3	3	ENGINE STOP LIGHT
509	MC44-MC8	3	
509	MC11-MC44	4	
510	MC11-MC18	5	ECM
510	MC44-PS4	3	PARKING BRAKE
510	R22-MC44	4	
510	MC11-R22	4	
900	MC11-MC106	4	
900	MC11-MC18	5	ECM
900	MC106-MC13	3	
901	MC11-MC18	5	ECM
901	MC106-MC13	3	
901	MC11-MC106	4	
908	MC11-MC18	5	ECM
908	MC11-M4	4	THROTTLE POSN CONT
916	MC44-MC6	3	
916	MC11-MC44	4	
916	MC38-M16	3	
916	MC6-MC38	3	VERNIER CONTROL
916	MC6-M35	3	THROTTLE SENSOR
916	MC11-MC18	5	ECM
952	MC38-M16	3	
952	MC11-MC44	4	
952	MC44-MC6	3	THROTTLE SENSOR
952	MC11-MC18	5	ECM
952	MC6-MC38	3	VERNIER CONTROL
1001	MC8-L4	3	
1001	MC7-SPLICE	3	
1001	MC8-SPLICE	3	
1001	SPLICE-L13	3	
1001	SPLICE-L14	3	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1001	S1-MC7	3	RH HEADLIGHT
1002	S1-MC7	3	LH HEADLIGHT
1002	MC8-L11	3	
1002	MC7-SPLICE	3	
1002	SPLICE-MC8	3	
1002	SPLICE-L18	3	
1002	SPLICE-L16	3	
1003	MC7-MC3	3	
1003	S1-MC7	3	LH RR TURN SIGNAL
1003	MC3-MC80	6	
1003	MC3-MC16	6	TRAILER CONN 12VDC
1003	MC1-R15	4	LH TURN LIGHT
1003	MC80-L24	6	LH STOP LIGHT
1003	MC27-MC3	6	FRONT TOW
1003	MC7-MC1	3	
1003C	MC25-R17	4	LH TURN LIGHT
1003C	MC25-MC15	6	TRAILER CONN 12VDC
1004	MC7-MC1	3	
1004	MC7-MC3	3	
1004	S1-MC7	3	
1004	MC3-MC80	6	
1004	MC80-L22	6	RH STOP LIGHT
1004	MC27-MC3	6	
1004	MC3-MC78	6	
1004	MC3-MC16	6	
1004	MC1-R16	4	
1004C	MC25-R16	4	RH TURN LIGHT
1004C	MC25-MC15	6	TRAILER CONN 24VDC
1005	MC126-S9	3	
1005	PS3-MC3	3	
1005	MC3-MC16	6	TRAILER CONN 24VDC
1005	MC126-PS1	3	
1005	PS2-PS3	3	
1005	MC27-MC3	6	FRONT TOW
1005	PS1-PS2	3	
1005A	MC7-MC126	3	
1005A	MC126-S9	3	
1005A	S1-MC7	3	TURN SIGNAL/DIM SW
1006	MC2-SPLICE	3	
1006	SPLICE-L12	3	
1006	SPLICE-L17	3	
1006	MC2-R5	4	DIMMER
1007	MC2-R5	4	DIMMER
1007	MC2-SPLICE	3	
1007	SPLICE-L12	3	
1007	SPLICE-L17	3	
1008	MC3-MC78	6	
1008	MC4-S12	3	HEADLIGHTS

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1008	MC27-MC3	6	FRONT TOW
1008	MC3-SPLICE	3	
1008	MC3-MC4	3	
1008	MC3-MC16	6	TRAILER CONN 12VDC
1008	MC78-L22	6	RH TAIL LIGHT
1008	MC78-L24	6	LH TAIL LIGHT
1008C	MC25-MC15	6	TRAILER CONN 24VDC
1008C	MC25-R14	4	B.O. SERVICE
1009	PS2-PS3	3	
1009	PS1-PS2	3	
1009	MC2-PS1	3	
1009	MC2-CB6	4	STOP LIGHT
1012	MC3-SPLICE	3	
1012	SPLC-SPLC	3	
1012	MC2-SPLICE	3	
1012	SPLC-SPLC	3	
1012	SPLICE-L19	3	
1012	MC2-R2	4	CLEARANCE LIGHTS
1012	MC3-SPLICE	6	
1012	SPLICE-MC27	6	
1012	SPLICE-MC80	6	
1012	SPLICE-L32	6	RH SIDE MARKER
1012	SPLICE-L34	6	LH SIDE MARKER
1012	MC90-L31	6	RR SIDE MARKER
1012	MC90-L25	6	ID LIGHTS
1012	MC80-MC90	6	
1012	MC90-L33	6	RR SIDE MARKER
1016	MC92-MC2	3	
1016	S15-MC92	3	
1016	MC2-R3	4	HORN
1017	SPLICE-R5	4	
1017	MC52-R14	4	
1017	R2-MC52	4	
1017	MC2-SPLICE	4	
1017	SPLICE-R1	4	
1017	MC91-MC2	3	
1017	S1-MC91	3	
1017A	MC91-MC2	3	
1017A	S1-MC91	3	
1017A	MC2-R5	4	
1018	MC8-L10	3	HIGH BEAM
1018	MC8-1007	3	
1019	L15-1679	3	
1020	L14-L16	3	
1020	DUVAC IGN	5	FUEL PUMP
1020	S2-MC21	3	
1020	R27-MC48	5	
1020	MC60-IGN	5	DUVAC CONTROLLER
1020	MC21-MC60	5	
1020	MC108-M81	5	
1020	M81-MC60	5	
1021	MC2-S2	3	
1021	MC2-R11	4	
1021	R11-M76	4	

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 3 OF 35  
ENGINEERING DWG 1878290 SHEET 1  
FP-5/FP-6 BLANK

REVISION V  
CN 23138  
11-24-92

CODE SORT			
CCCE	ROUTING	SH	DESCRIPTION
1021	MC52-R11	4	FRONT TOW
1021A	R11-MC1	4	
1021A	MC1-MC21	3	
1021A	MC21-MC60	5	
1021A	MC60-R27	5	
1026	MC52-CB16	4	
1029	MC2-R6	4	BEACON
1029	MC2-MC28	3	
1031	R3-SPLICE	4	
1032	MC8-MC21	3	
1032	M39-L9	3	LOW OIL PSI
1032	MC8-M39	3	
1032	PS9-MC21	5	ENGINE OIL PSI SW
1033	M39-M18	3	OIL PSI/H WTR ALM
1036	MC23-M8	5	
1036	MC23-M7	5	
1036	MC21-MC56	5	ETHER START
1036	MC21-S25	3	
1040	CB4-R4	4	WORKLIGHT
1040A	S6-MC4	3	
1040A	MC2-R4	4	WORKLIGHT
1040A	MC4-MC2	3	
1040B	MC3-MC79	6	RH WORKLIGHT
1040B	MC2-MC3	3	
1040B	MC2-R4	4	WORKLIGHT
1040B	MC3-MC54	6	LH WORKLIGHT
1045	R27-M7	5	
1049	MC2-R1	4	HEADLIGHTS
1049	MC4-MC2	3	
1049	S12-MC4	3	
1052	S20-S19	3	CHEM ALM-GPF
1052	S19-S18	3	GAS PART FLTR-SRW
1052	S18-S4	3	SRW-SRW/MHC
1052	S4-S30	3	SRW/MHC-EMER ENG S D
1052	S30-SPLICE	3	EMER ENG SHUT DOWN
1052	SPLICE-G11	3	AIR PRESSURE GAUGE
1052	MC4-SPLICE	3	
1052	SPLICE-L44	3	HEATER PANEL LIGHT
1052	S5-S6	3	BEACON LT-WORK LT
1052	S6-S7	3	WORK LT-WSHLD WSHR
1052	S7-S8	3	WSHLD WASHER-WIPERS
1052	S8-S21	3	WIPERS-DOME LIGHT
1052	S21-S9	3	DOME LT-B.O.SERV SEL
1052	S9-S10	3	BO SERV SEL-BO MKR
1052	S10-S11	3	B.O. MARKER-B.O. DR
1052	S11-S12	3	B.O. DRIVE-HEADLTS
1052	S12-S16	3	HEADLIGHTS-ENG BK
1052	S16-S14	3	ENG BRAKE-RHEO/DOME
1052	S14-SPLICE	3	RHEOSTAT/DOME
1052	SPLICE-G6	3	VOLTMETER 12V
1052	SPLC-SPLC	3	
1052	SPLICE-G10	3	XMSN OIL TEMP GAUGE
1052	SPLICE-G1	3	WATER TEMP GAUGE
1052	SPLICE-G2	3	OIL PRESSURE GAUGE
1052	SPLICE-G4	3	TACHOMETER
1052	SPLICE-G5	3	SPEEDOMETER
1052	SPLICE-G3	3	FUEL GAUGE

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1052	MC1-SPLICE	3	
1052	SPLICE-L43	3	POST LIGHT
1052	SPLC-MC125	3	
1052	MC125-G12	3	AIR RESTRICTION GA
1052	MC1-SPLICE	3	
1052	MC1-CB1	4	15 AMP HEADLIGHT
1052	MC50-MC1	4	
1055	MC115-M7	5	
1055	M7-1277	5	
1055	M7-1281	5	
1056	MC111-MC32	3	
1056	MC32-MC109	6	CTI POWER MANIFOLD
1057	M20-M20	5	
1057	MC111-MC32	3	
1057	MC32-MC109	6	CTI POWER MANIFOLD
1058	MC32-MC109	6	CTI POWER MANIFOLD
1058	MC111-MC32	3	
1059	MC32-MC109	6	CTI POWER MANIFOLD
1059	MC111-MC32	3	
1061	MC22-MC109	6	CTI POWER MANIFOLD
1061	MC111-MC32	3	
1062	MC32-MC109	6	CTI POWER MANIFOLD
1062	MC111-MC32	3	
1063	MC32-MC109	6	CTI POWER MANIFOLD
1064	MC32-MC109	6	CTI POWER MANIFOLD
1064	MC111-MC32	3	
1065	MC32-MC109	6	CTI POWER MANIFOLD
1065	MC111-MC32	3	
1066	MC32-MC64	6	CTI AUX MANIFOLD
1066	MC110-MC32	3	
1067	MC32-MC64	6	CTI AUX MANIFOLD
1068	MC32-MC64	6	CTI AUX MANIFOLD
1068	MC110-MC32	3	
1070	MC32-MC64	6	CTI AUX MANIFOLD
1070	MC110-MC32	3	
1071	MC110-MC32	3	
1071	MC32-MC64	6	CTI AUX MANIFOLD
1072	R26-R25	3	
1072	MC110-MC32	3	
1072	MC32-MC64	6	CTI AUX MANIFOLD
1073	MC32-MC64	6	CTI AUX MANIFOLD
1073	MC110-MC32	3	
1074	MC110-MC32	3	
1074	R25-CB10	4	
1074	MC32-MC64	6	CTI AUX MANIFOLD
1075	M6-R25	4/3	
1075B	R25-R18	4	
1076	MC110-MC32	3	
1076	MC32-MC64	6	CTI AUX MANIFOLD
1079	CB5-M6	4	HAZARD LIGHTS
1080	MC7-MC2	3	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1080	MC2-M5	4	TURN SIGNAL/FLASHER
1082	MC2-MC52	4	
1082	MC2-M81	3	
1082	M81-S3	3	
1082	MC52-CB15	4	HEATER
1084	MC1-CB5	4	B.O. LIGHTS
1084	MC4-MC1	3	
1084	MC4-S9	3	
1091	L17-GROUND	3	
1092	L7-MC8	3	
1092	MC8-M51	3	
1093	MC31-MC57	6	
1093	MC1-MC31	3	
1093	MC1-CB16	4	
1093	MC57-S13	6	DRIVE LINE LOCK-UP
1094	S5-S14	3	
1095	R23-R24	4	
1095	MC44-R23	4	
1095	MC31-MC44	3	
1095	MC57-S13	6	DRIVE LINE LOCK-UP
1095	MC31-MC57	6	
1108	MC44-MC8	3	
1108	S05-MC44	4	
1108	MC8-G4	3	TACHOMETER
1113	MC8-MC21	3	
1113	G2-MC8	3	OIL PSI GAUGE
1113	SU3-MC21	5	ENG OIL PSI SNDG UN
1114	M66-MC8	3	
1114	MC96-MC8	3	LOW OIL LEVEL LIGHT
1114	MC8-L36	3	
1114	L36-M66	3	
1118	MC4-1919	3	
1118	S8-MC4	3	
1120	M66-MC8	3	
1120	M66-M3	3	
1120	PS6-PS7	3	
1120	PS6-MC8	3	
1120	L2-M66	3	
1137	M6(1)-M6(2)	5	
1137	M6(3)-M6(4)	5	
1138	M48-M7	5	SHUNT
1138	M7-M23	5	SLAVE
1138	M6-M48	5	SHUNT
1138	M77-M7	5	ARCTIC BATTERIES
1139	M7-M23	5	SLAVE
1139	M6-M7	5	
1139	M77-M7	5	ARCTIC BATTERIES
1147	TS2-MC21	5	ENG WTR TEMP SNDG UN
1147	M39-L8	3	HIGH WATER TEMP
1147	MC8-MC21	3	
1147	MC8-M39	3	
1149	MC1-R10	4	REVERSE
1149	MC3-MC78	6	
1149	MC1-MC124	3	
1149	MC78-MC77	6	REVERSE LIGHT
1149	MC124-MC77	6	

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 4 OF 35  
ENGINEERING DWG 1878290 SHEET 2  
FP-7/FP-8 BLANK



CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1153	S21-MC4	3	
1153	MC4-L20	3	DOME LIGHT
1168	MC2-R3	4	HORN
1168	MC2-M15	3	
1174	BUS BAR	4	
1175	R28-CB5	4	
1176	MC113-PS13	6	EMERGENCY STEER
1184	S5-MC4	3	
1184	MC2-R6	4	
1184	MC2-MC4	3	
1189	MC4-S9	3	
1189	MC44-R28	4	
1189	MC4-SPLICE	3	
1189	MC4-S21	3	
1189	MC2-SPLICE	3	
1189	MC2-M5	4	
1189	SPLICE-MC44	3	
1274	MC115-SPLC	5	
1274	M64-SPLICE	5	
1274	M8-SPLICE	5	
1275	M6-M20	5	
1275	M6-200 AMP	5	
1276	MC2-MC4	3	
1276	MC2-CB8	3	
1276	SPLICE-S14	3	
1276	SPLICE-MC53	3	
1276	MC4-SPLICE	3	
1276	MC2-SPLICE	4	
1276	MC53-SPLICE	3	
1276	SPLC-SPLC	3	
1276	SPLC-SPLC	3	
1276	SPLICE-M3	3	LOW AIR ALARM
1276	SPLICE-G5	3	SPEEDOMETER
1276	SPLICE-L1	3	PARKING BRAKE
1276	SPLICE-L2	3	LOW AIR
1276	SPLICE-L35	3	EMERGENCY STEERING
1276	SPLICE-L36	3	LOW HYDR OIL
1276	SPLC-SPLC	3	
1276	SPLICE-L5	3	XMSN CHECK
1276	SPLICE-L8	3	HIGH WATER TEMP
1276	SPLICE-L9	3	LOW OIL PSI
1276	SPLICE-G3	3	FUEL GAUGE
1276	SPLICE-G6	3	VOLTMETER 12V
1276	SPLICE-G1	3	WATER TEMP GAUGE
1276	SPLICE-G2	3	OIL PRESSURE GAUGE
1276	SPLICE-G4	3	TACHOMETER
1276	SPLICE-G10	3	XMSN OIL TEMP GAUGE
1276	SPLICE-M18	3	ALARM
1277	MC115-SPLC	5	
1277	MC8-SPLICE	5	
1278	M20-M79	5	
1278	MC8-SPLICE	5	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1279	PS14-1277	5	
1279	MC115-PS14	5	
1279	M64-1280	5	
1280	CB21-R26	4	
1280	1281-R26	5	
1281	1280-MC47	5	
1281	R27-M81	5	
1281	1281-1281	5	
1292	MC4-S6	3	
1292	CB4-MC2	4	
1292	MC2-MC4	3	
1292	MC4-S12	3	
1314	1118-S7	3	
1318	MC3-MC8	3	
1318	MC3-G3	3	FUEL GAUGE
1318	MC3-SU5	6	FUEL LEVEL
1320	SU1-MC2	5	WATER TEMP SNDG UN
1320	G1-MC8	3	WATER TEMP
1320	MC8-MC21	3	
1340	CB15-MC14	4	SWING FIRE
1344	M20-MC22	5	
1362	R27-M64	5	
1371	MC8-PS5	3	
1371	L1-MC8	3	
1409	MC8-MC1	3	
1409	L5-MC8	3	
1409	MC1-R9	4	
1413	CB3-SPLICE	4	
1413	SPLICE-R6	4	
1430	R28-SH5	4/5	
1430	1832-R28	5	
1431	MC3-S2	3	
1431	MC3-M6	6	BATTERIES
1431	MC3-M6	6	BATTERIES
1431	MC1-MC119	4	
1431	MC119-R32	4	
1431	R32-S29	4	ARCTIC PUMP
1431	MC119-CB20	4	
1435	MC78-MC124	6	
1435	MC124-M78	6	
1435	MC77-MC124	6	
1435	MC85-MC86	7	
1435	MC86-MC87	7	
1435	MC33-MC84	7	
1435	GROUND	3	
1435	MC81-MC82	7	
1435	MC84-MC83	7	
1435	MC81-MC82	7	
1435	MC108-GND	5	
1435	GND	5	
1435	MC22-GND	5	
1435	M52-R26	4	
1435	M52-R28	4	
1435	R27-GND	5	
1435	MC125-GND	3	
1449	MC8-MC21	3	
1449	G10-MC8	3	TRANS OIL TEMP

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1449	SU2-MC21	5	TRANS TEMP SNDG UN
1454	MC81-MC82	7	
1460	MC81-MC82	7	
1461	MC86-MC87	7	
1461	MC85-MC86	7	
1462	MC81-MC82	7	
1463	MC81-MC82	7	
1464	MC81-MC82	7	
1465	MC81-MC82	7	
1466	MC85-MC86	7	
1466	MC86-MC87	7	
1467	MC81-MC82	7	
1468	MC81-MC82	7	
1469	MC81-MC82	7	
1469	MC86-MC87	7	
1469	MC85-MC86	7	
1470	MC86-MC87	7	
1470	MC85-MC86	7	
1471	MC85-MC86	7	
1471	MC86-MC87	7	
1471	MC81-MC82	7	
1472	MC85-MC86	7	
1472	MC81-MC82	7	
1472	MC86-MC88	7	
1475	MC85-MC86	7	
1475	MC86-MC87	7	
1480	MC84-MC93	7	
1480	MC84-MC83	7	
1481	MC84-MC83	7	
1481	MC84-MC93	7	
1482	MC84-MC93	7	
1482	MC84-MC83	7	
1483	MC83-MC84	7	
1483	MC84-MC93	7	
1484	MC83-MC84	7	
1484	MC84-MC93	7	
1485	MC84-MC94	7	
1485	MC83-MC84	7	
1486	MC84-MC94	7	
1486	MC83-MC84	7	
1487	MC1-S25	3	
1487	MC1-CB15	4	
1487	MC83-MC84	7	
1487	MC84-MC94	7	
1488	MC84-MC94	7	
1488	MC83-MC84	7	
1489	MC83-MC84	7	
1489	MC84-MC94	7	
1490	MC84-MC94	7	
1490	MC83-MC84	7	
1491	L16-1008	3	
1491	L14-1008	3	
1517	PS8-MC11	5	ATEC OIL PSI SWITCH
1517	MC11-R9	4	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1519	MC8-MC35	3	CTI OVERSPEED
1519	MC3-MC8	3	SPEEDOMETER
1519	MC8-MC35	3	CTI OVERSPEED
1519	G5-MC8	3	SPEEDOMETER
1519	MC3-SU4	6	SPEEDOMETER
1519	G5-MC8	3	SPEEDOMETER
1519	MC3-MC8	3	SPEEDOMETER
1519	MC3-SU4	6	SPEEDOMETER
1525	M16-PS4	3	
1534	MC107-M9	6	FUEL/WATER SEP
1534	MC2-SPLICE	4	
1534	SPLICE-CB8	4	
1534	MC3-MC107	6	
1534	MC2-MC3	3	
1534	MC3-S22	3	T-CASE LOCK-UP
1534	CB15-M76	4	
1538	MC97-M13	6	AIR DRYER
1538	MC25-MC97	6	
1538	MC25-CB15	4	
1538	MC25-MC98	6	
1538	MC99-M11	6	AFTER COOLER
1538	MC98-M14	6	AIR DRYER
1538	MC25-MC99	6	
1538	MC25-MC73	6	FAN CONTROL
1538	M76-MC25	4	
1640	MC119-SPLC	4	
1640	SPLICE-R26	4	
1640	SPLICE-MC44	4	
1640	MC44-S2	3	
1640	MC119-R32	4	
1644	MC119-R33	4	
1644	R33-R33	4	
1644	MC119-S29	4	ARCTIC PUMP
1644	R33-S29	4	ARCTIC PUMP
1644	MC119-MC25	4	
1644	MC25-MC120	6	
1644	MC120-M80	6	ARCTIC PUMP
1645	S29-R33	4	ARCTIC PUMP
1665C	MC25-MC15	6	TRAILER CONN 24VDC
1665C	MC25-CB20	4	
1674	S11-S10	3	
1674	S11-S9	3	
1676	R17-R16	4	
1676	R16-R15	4	
1676	R14-R3	4	
1676	R15-R14	4	
1676	CB20-R17	4	
1678	MC3-MC78	6	
1678	MC1-SPLICE	3	
1678	MC78-L24	6	LH B.O. STOP LIGHT

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 5 OF 35  
ENGINEERING DWG 1878290 SHEET 2  
FP-9/FP-10 BLANK

REVISION V  
CN 24138  
11-24-92

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1678	MC78-L22	6	RH B.O. STOP LIGHT
1678	SPLICE-MC3	3	
1678	MC1-R13	4	
1678	SPLICE-MC4	3	
1678	MC4-S9	3	
1678C	MC25-R13	4	B.O. STOP LIGHT
1678C	MC25-MC15	6	TRAILER CONN 24VDC
1679	L15-MC4	3	
1679	MC4-S11	3	
1680	MC3-SPLICE	3	
1680	SPLICE-MC1	3	
1680	SPLC-SPLC	3	
1680	SPLICE-MC4	3	
1680	SPLC-SPLC	3	
1680	SPLC-SPLC	3	
1680	SPLICE-L19	3	
1680	SPLICE-L19	3	
1680	MC3-MC78	6	
1680	MC4-S10	3	
1680	MC78-L24	6	LH B.O. TAIL LIGHT
1680	MC1-R17	4	B.O. LIGHTS
1680	MC78-L22	6	RH B.O. TAIL LIGHT
1680C	MC25-MC15	6	TRAILER CONN 24VDC
1680C	MC25-MC15	6	TRAILER CONN 24VDC
1680C	MC25-R17	4	B.O. TAIL LIGHTS
1680C	MC25-MC15	6	TRAILER CONN 24VDC
1702	MC44-MC34	3	
1702	MC34-G7	3	
1702	MC44-R26	4	
1708	M32-1709	3	PASSENGER AIR HTR
1709	MC58-S19	3	GAS PART FILTER SW
1709	MC58-M30	3	
1710	M31-1709	3	DRIVER AIR HEATER
1711	CB11-R7	4	
1712	MC1-CB7	4	ENGINE BRAKE
1712	MC4-MC1	3	
1713	MC53-L37	3	
1713	MC4-MC1	3	
1713	S16-MC4	3	ENGINE BRAKE
1713	MC1-R7	4	TRANSMISSION
1713	S16-MC53	3	
1714	MC1-1716	4	
1714	MC4-MC1	3	ENGINE BRAKE
1714	S16-MC4	3	ENGINE BRAKE
1715	MC4-MC1	3	ENGINE BRAKE
1715	S16-MC4	3	ENGINE BK RH COILS
1715	MC11-MC1	4	
1715	MC11-M21	5	LH ENGINE BRAKE
1716	MC11-R5	4	RETARDER
1716	MC11-M22	5	RH ENGINE BRAKE
1717	MC44-S20	3	CHEMICAL ALARM SW
1717	MC44-CB19	4	
1718	M76-M77	6	BACK-UP ALARM
1722	MC34-1734	3	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1722	L26-MC34	3	
1722	MC33-MC84	7	
1722	MC84-MC83	7	
1723	MC44-S18	3	SELF RECOVERY WN SW
1723	MC44-CB18	4	
1724	MC112-SPLC	3	
1724	SPLICE-MC33	3	
1724	MC33-MC93	7	
1724	L27-MC112	3	
1724	M67-SPLICE	3	
1724	SPLC-MC112	3	
1724	M67-MC33	3	
1725	L28-MC112	3	
1725	MC84-MC83	7	
1725	MC33-MC84	7	
1725	MC112-MC33	3	
1726	MC33-MC84	7	
1726	MC84-MC83	7	
1726	MC112-MC33	3	
1726	L29-MC112	3	
1729	MC31-S18	3	SELF RECOVERY WINCH
1729	MC31-MC55	6	
1729	MC55-MC121	6	SELF RECOVERY WINCH
1730	MC31-S18	3	SELF RECOVERY WINCH
1730	MC55-MC122	6	SELF RECOVERY WINCH
1730	MC31-MC55	6	
1731	MC3-S4	3	SELF RECOVERY WINCH
1731	MC3-S4	3	SELF RECOVERY WINCH
1731	MC3-MC29	6	CRANE
1732	MC55-MC123	6	SELF RECOVERY WINCH
1732	S4-MC31	3	SELF RECOVERY WINCH
1732	MC31-MC55	6	
1733	MC31-M67	3	
1733	MC31-M51	6	
1734	M67-SPLICE	3	
1734	SPLC-SPLC	3	
1734	SPLICE-MC31	3	
1734	MC31-M10	6	
1736	MC39-MC39	5	
1737	MC31-MC1	3	
1737	MC1-R22	4	CRANE HI IDLE
1737	MC31-MC29	6	CRANE
1738	MC44-1755	4	
1738	MC44-MC31	3	
1738	MC31-MC29	6	CRANE
1739	MC44-CB21	4	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1739	MC44-S19	3	GAS PARTICULATE SW
1744	S4-M67	3	
1745	MC103-S20	3	CHEMICAL ALARM
1746	MC103-M29	3	CHEMICAL ALARM
1747	MC103-M29	3	CHEMICAL ALARM
1755	MC84-MC83	7	
1755	MC44-CB18	4	
1755	MC33-MC84	7	
1755	MC33-MC44	3	
1765	MC3-MC113	6	
1765	L35-MC8	3	
1765	MC3-MC8	3	
1809	MC41-MC65	5	PULSE TACH DRIVE
1809	MC65-MC39	5	STE/ICE
1809	MC41-M40	5	PULSE TACH DRIVE
1810	MC65-MC39	5	STE/ICE
1810	MC41-M40	5	PULSE TACH DRIVE
1810	MC41-MC65	5	PULSE TACH DRIVE
1811	MC42-M41	5	DIFFERENTIAL PSI
1811	MC42-MC39	5	STE/ICE
1812	MC42-M41	5	DIFFERENTIAL PSI
1812	MC42-MC39	5	STE/ICE
1813	MC39-M6	5	
1814	MC39-M6	5	BATTERIES
1815	MC39-MC24	5	
1815	MC24-MC114	5	
1815	MC24-M20	5	
1816	MC39-MC65	5	STE/ICE
1816	MC39-M7	5	STARTER

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1818	MC39-M7	5	STARTER
1818	MC39-MC65	5	STE/ICE
1819	MC39-M7	5	
1820	MC24-M20	5	
1820	MC24-M20	5	
1820	MC39-MC24	5	
1821	MC39-M6	5	
1822	MC39-M6	5	BATTERIES
1824	SPLICE-MC67	5	
1824	MC66-M70	5	
1824	MC68-M72	5	
1824	SPLICE-MC70	5	
1824	SPLICE-MC71	5	
1824	MC65-MC39	5	STE/ICE
1824	SPLICE-MC68	5	
1824	MC67-M71	5	
1824	MC43-M42	5	FUEL PSI
1824	MC69-M73	5	
1824	MC70-M74	5	
1824	MC71-M75	5	
1824	SPLICE-MC69	5	
1824	MC66-SPLICE	5	
1824	SPLICE-MC65	5	
1824	SPLICE-MC43	5	
1825	MC68-MC69	5	
1825	MC70-MC71	5	
1825	MC65-MC43	5	
1825	MC43-MC67	5	
1825	MC67-MC68	5	
1825	MC70-M74	5	
1825	MC69-MC70	5	
1825	MC41-MC65	5	
1825	MC68-M72	5	
1825	MC66-M70	5	TURBO OUTLET PSI
1825	MC65-MC39	5	STE/ICE
1825	MC69-M73	5	
1825	MC67-M71	5	
1825	MC39-MC40	5	STE/ICE MODULE
1825	MC43-M42	5	FUEL PSI
1825	MC71-M75	5	
1825A	MC39-MC40	5	STE/ICE MODULE
1826	MC40-MC39	5	
1827	MC40-MC39	5	
1828	MC39-M48	5	SHUNT
1829	MC39-M48	5	SHUNT
1835	R2-CB2	4	
1839	R7-R8	4	
1860	MC39-MC24	5	
1860	MC24-MC114	5	
1861	MC24-MC114	5	

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 6 OF 35  
ENGINEERING DWG 1878290 SHEET 2  
FP-11/FP-12 BLANK





REVISION P  
CN 23873  
5-14-92

28 27 26 25 24 23 22 21 20

H  
G  
F  
E  
D  
C  
B  
A

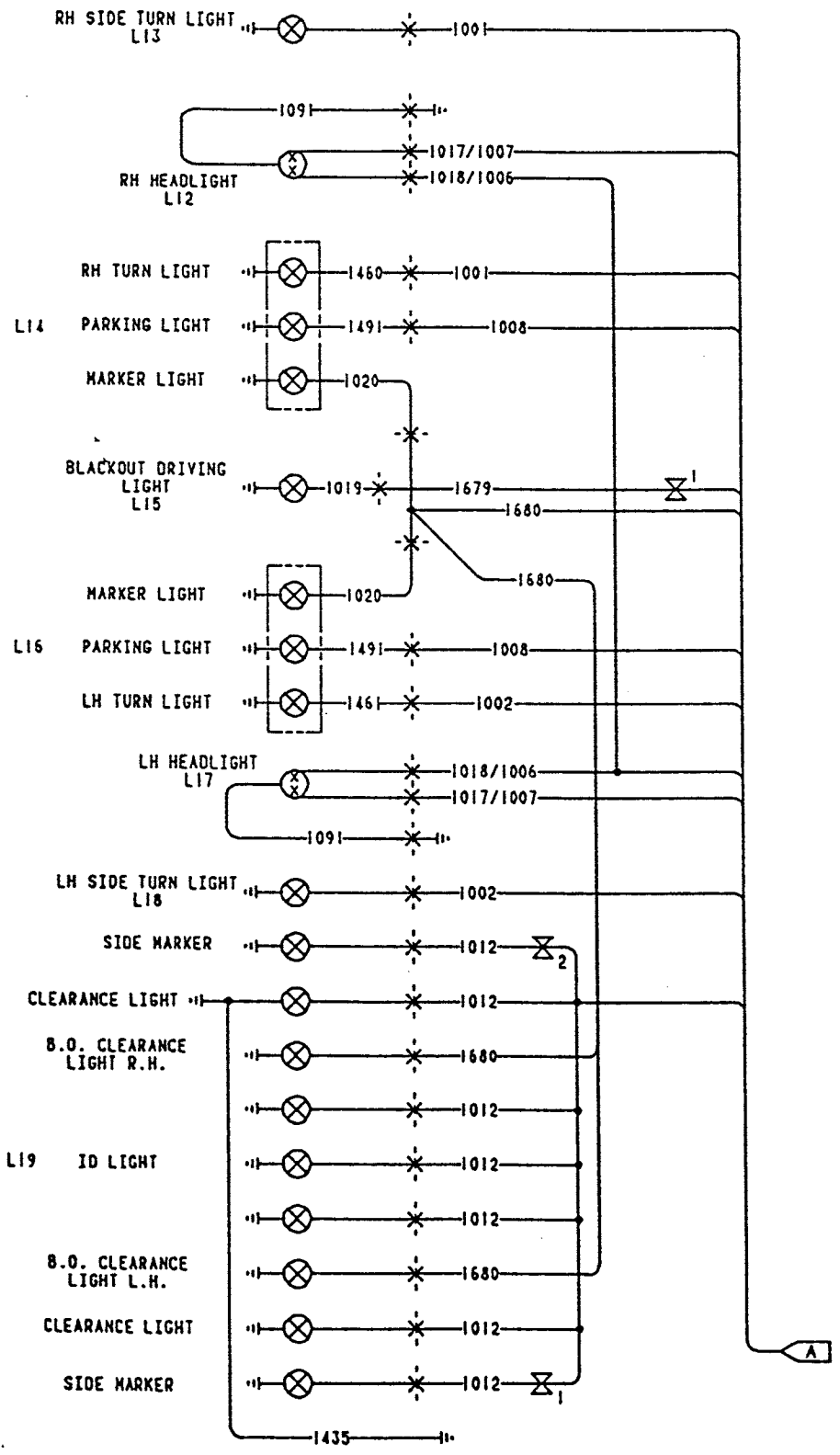


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 8 OF 35  
ENGINEERING DWG 1878290 SHEET 3  
FP-15/FP-16 BLANK

28 27 26 25 24 23 22 21 20

REVISION P  
CN 23873  
5-14-92

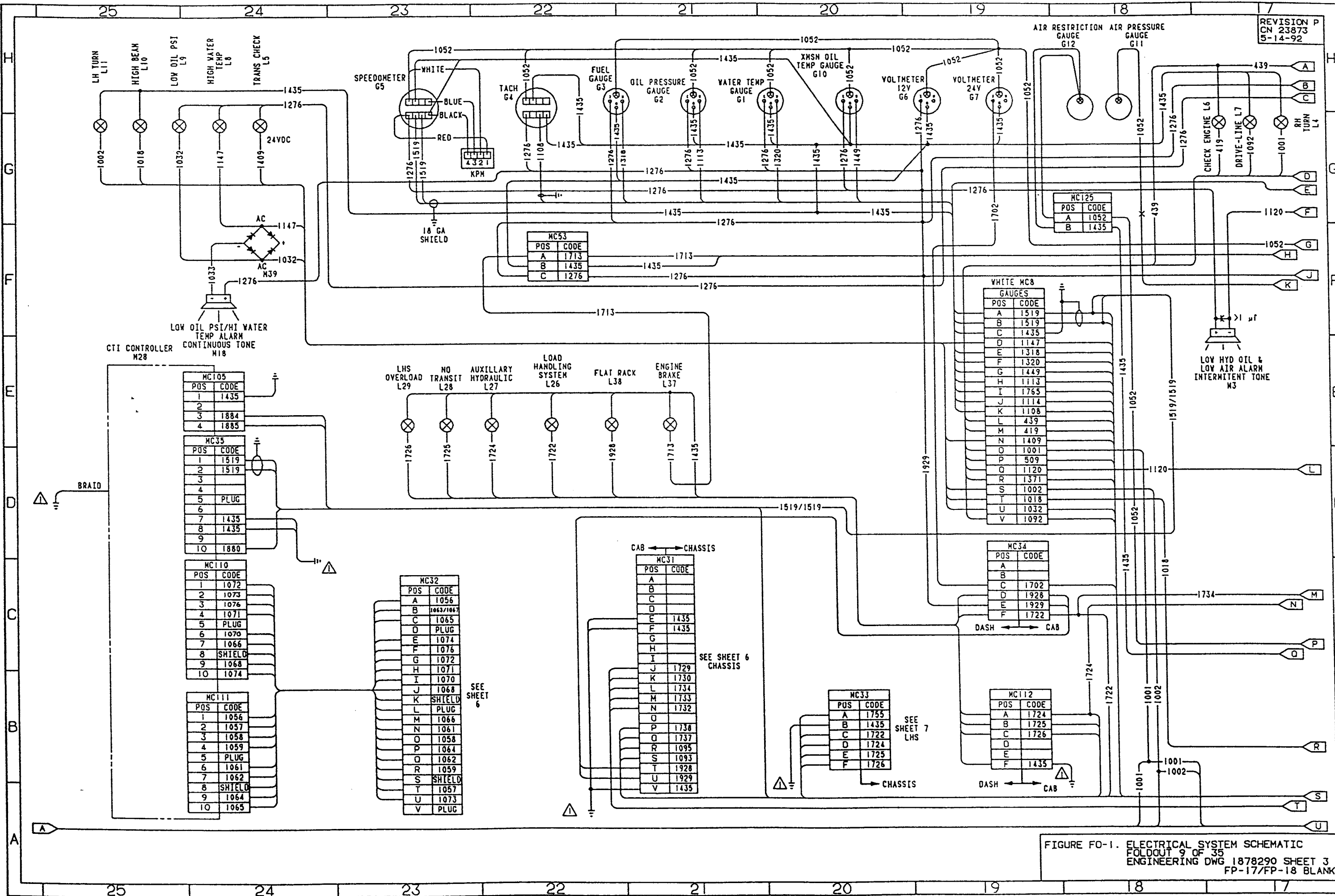


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 9 OF 35  
ENGINEERING DWG 1878290 SHEET 3  
FP-17/FP-18 BLANK

REVISION P  
CN 23873  
5-14-92

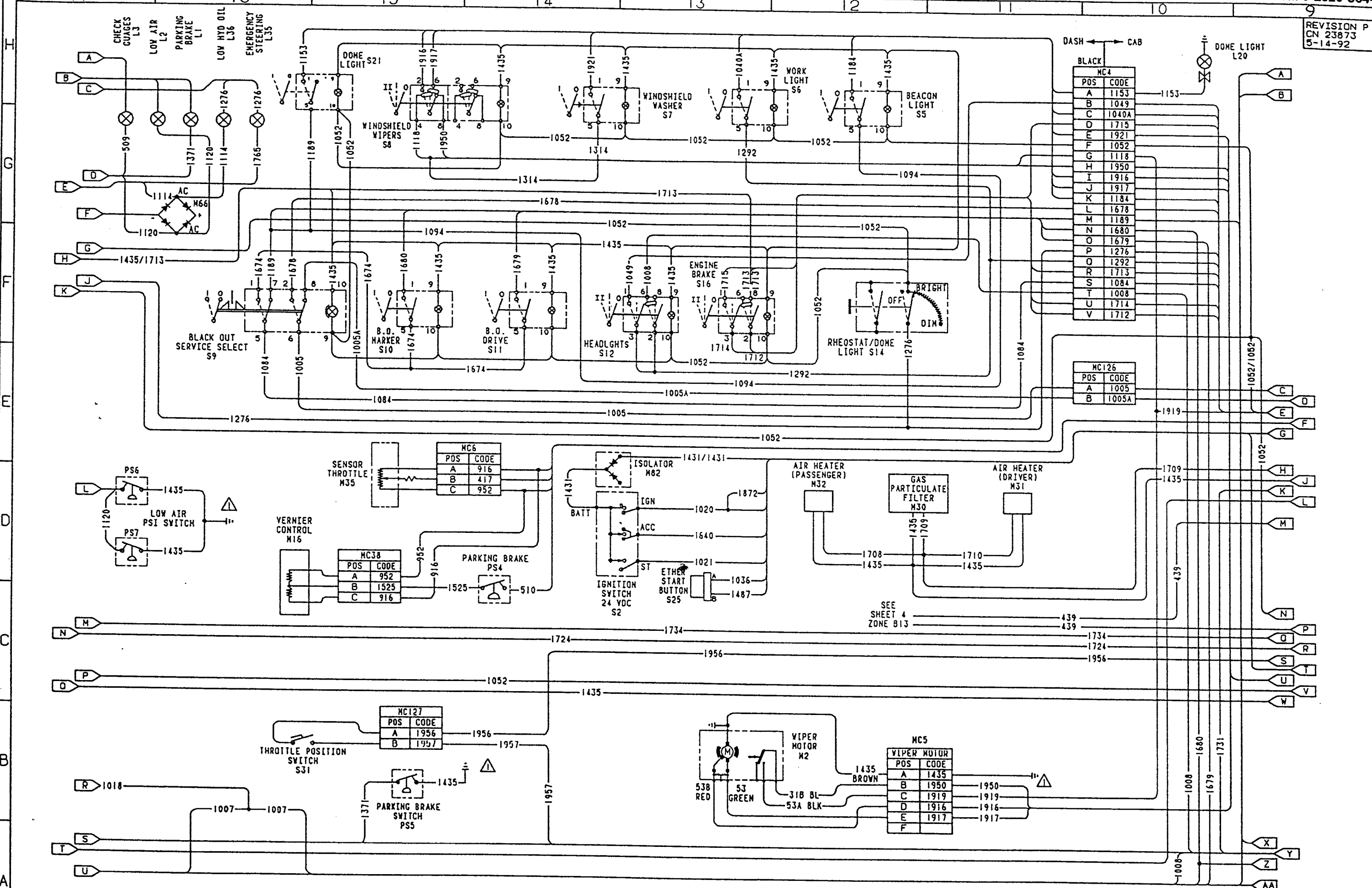


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 10 OF 35  
 ENGINEERING DWG 1878290 SHEET 3  
 FP-19/FP-20 BLANK

REVISION P  
CN 23873  
5-14-92

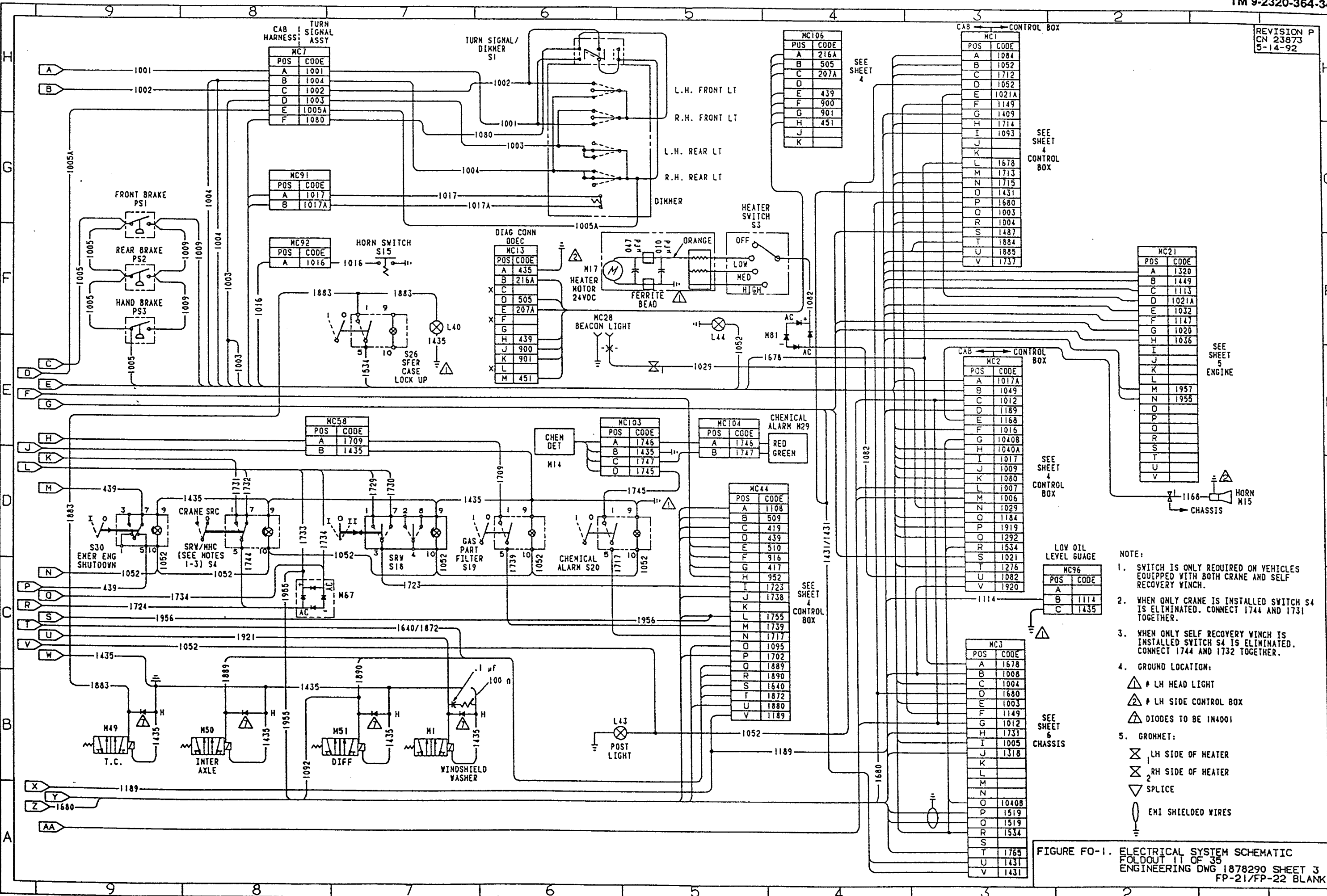


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 11 OF 35  
ENGINEERING DWG 1878290 SHEET 3  
FP-21/FP-22 BLANK

REVISION AA  
CN 24575  
9-9-94

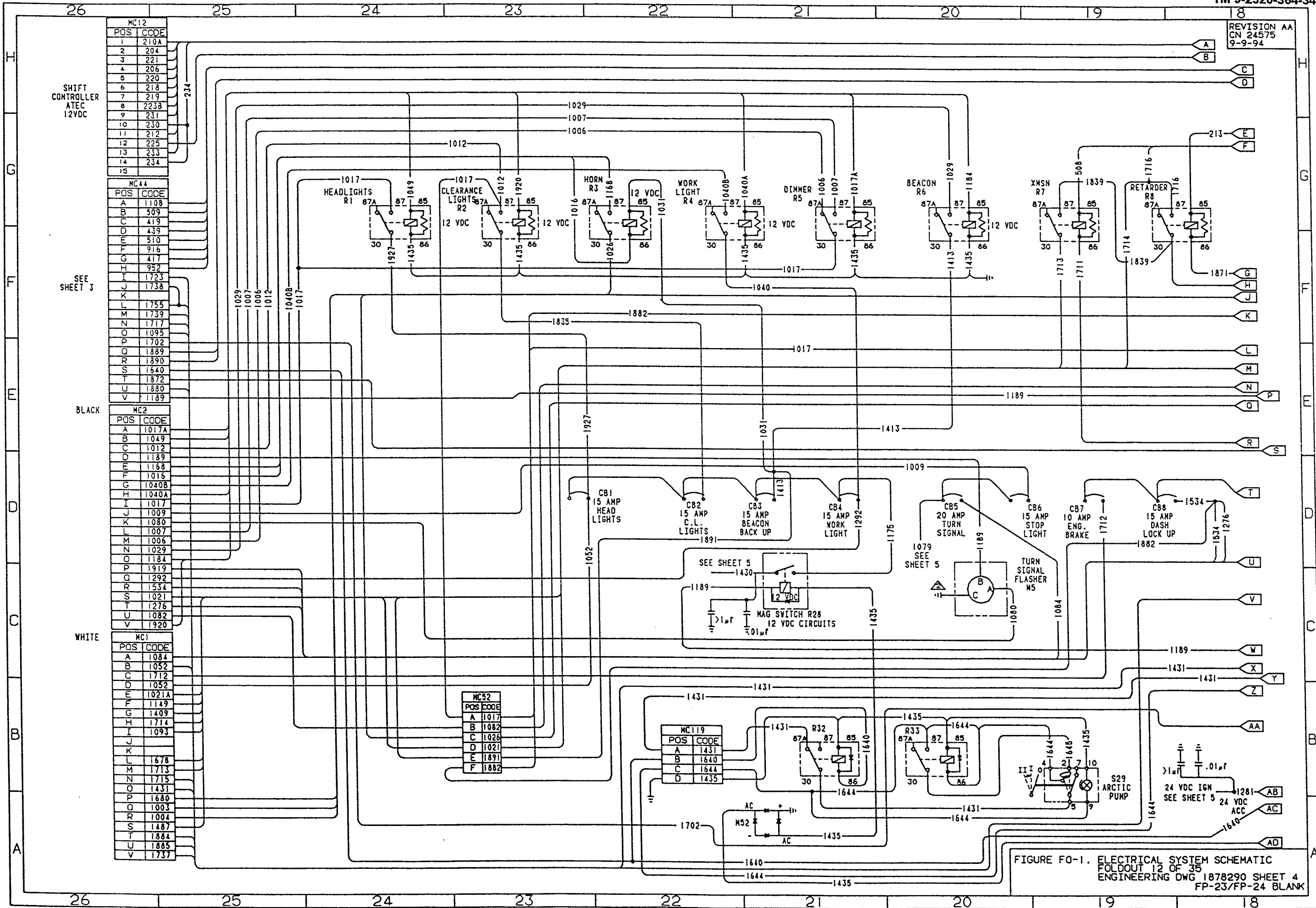


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 12 OF 35  
ENGINEERING DWG 1878290 SHEET 4  
FP-23/FP-24 BLANK

REVISION AA  
CN 24575  
9-9-94

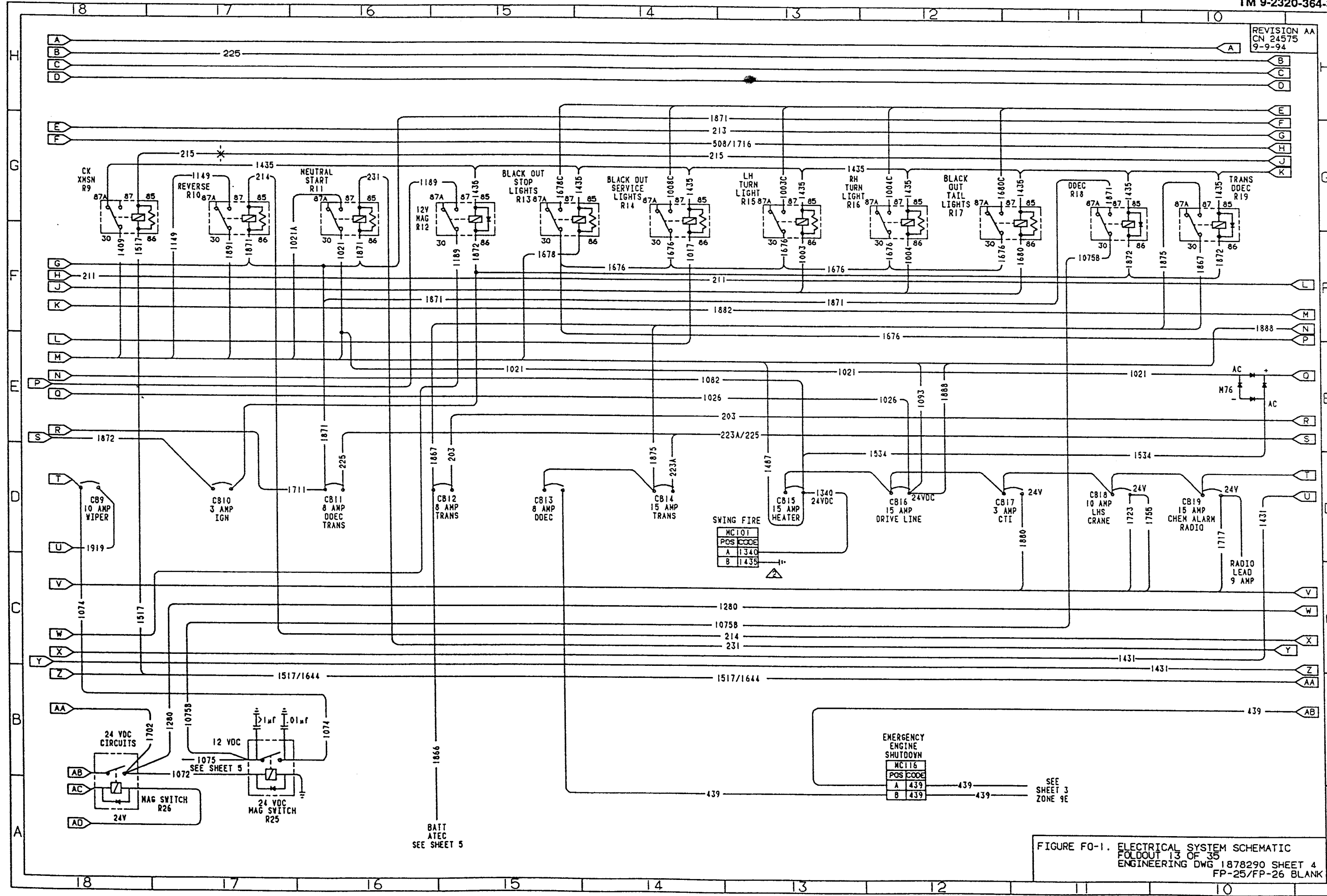


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 13 OF 35  
ENGINEERING DWG 1878290 SHEET 4  
FP-25/FP-26 BLANK

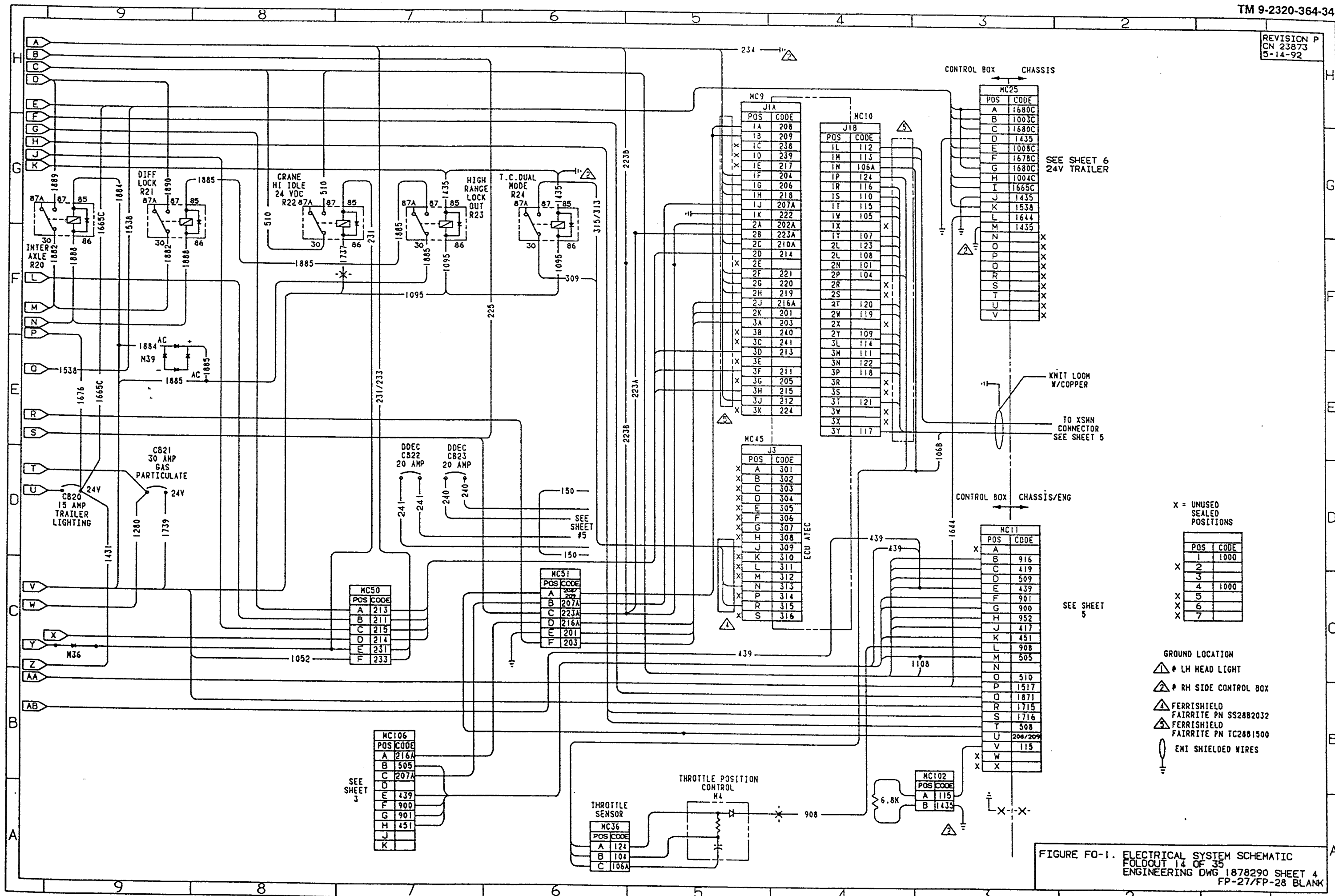


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 14 OF 35  
ENGINEERING DWG 1878290 SHEET 4  
FP-27/FP-28 BLANK



REVISION AA  
CN 24575  
9-9-94

POS	CODE
A	1320
B	1449
C	1113
D	1021A
E	1032
F	1147
G	1020
H	1036
J	X
K	X
L	X
M	1957
N	1955
O	X
P	X
Q	X
R	X
S	X
T	X
U	X
V	X

POS	CODE
A	1021A
B	1020

POS	CODE
1	GREEN
2	ORANGE
3	BROWN
4	RED
5	BLACK
6	PLUG
7	PLUG

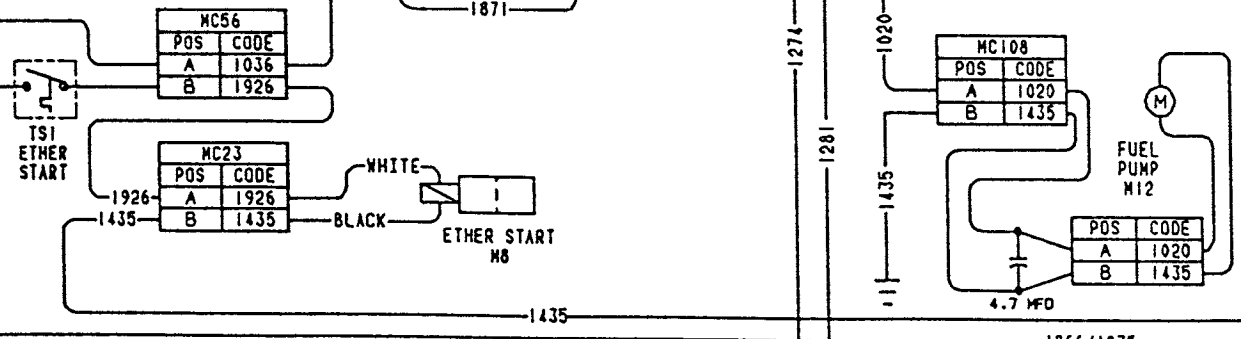
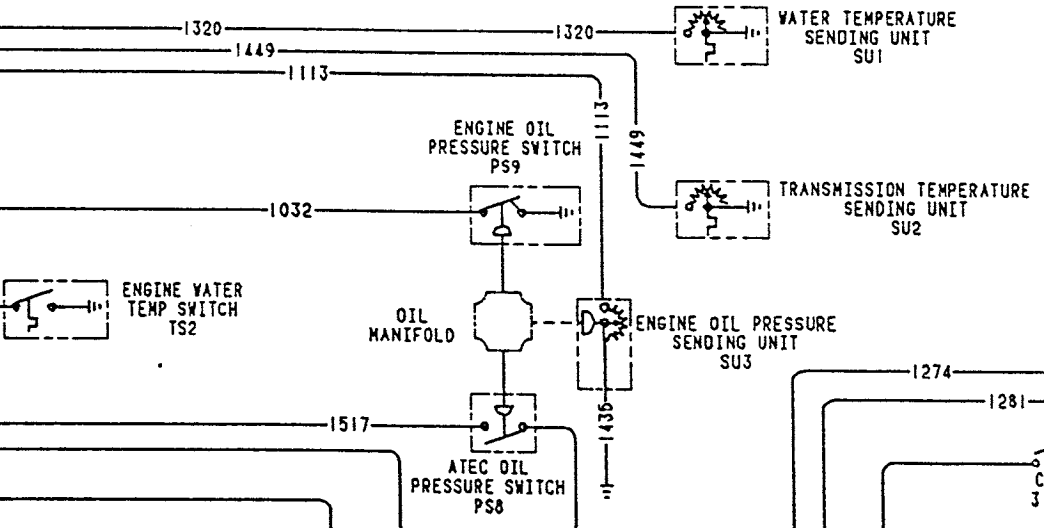
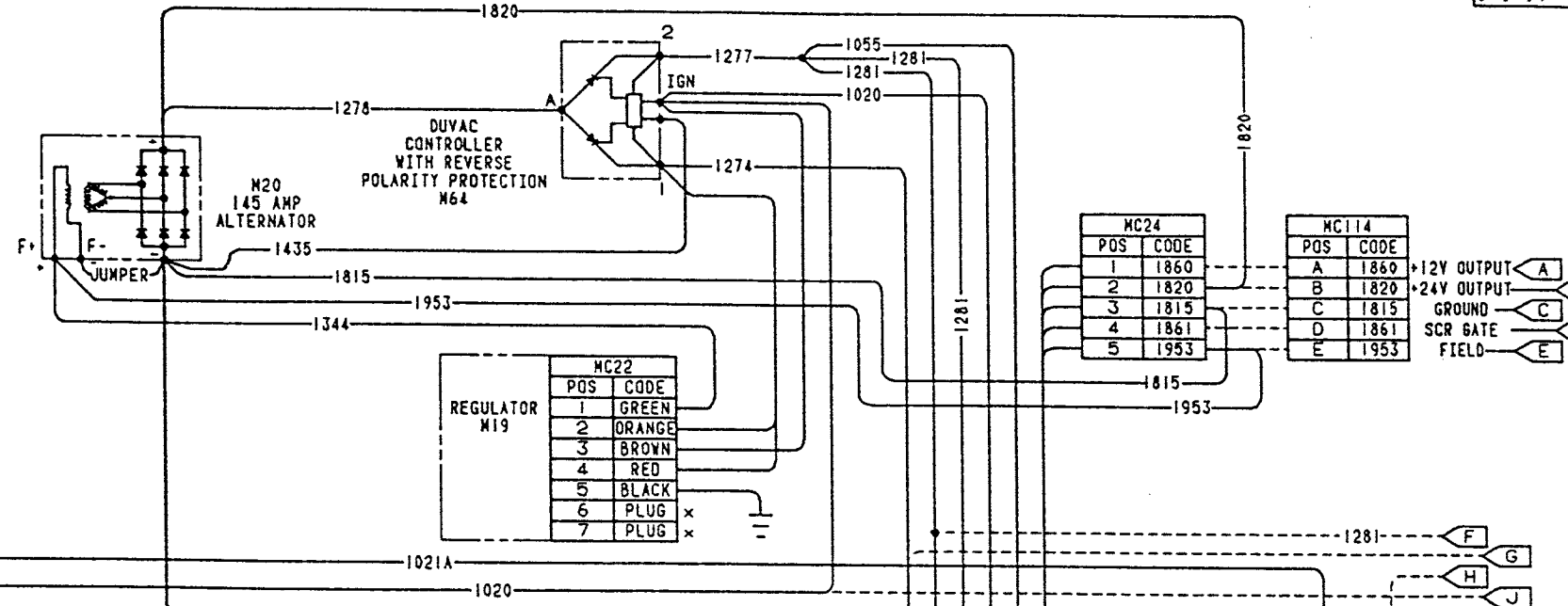
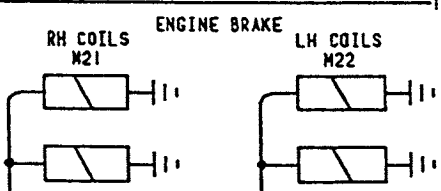
POS	CODE
1	1860
2	1820
3	1815
4	1861
5	1953

POS	CODE
A	1860
B	1820
C	1815
D	1861
E	1953

BOOST PRESSURE SWITCH  
PS15  
SPST-N.C.  
P 7.5 PSI ± .5 PSI  
ON RISING PRESSURE

CONTROL BOX ← CHASSIS/ENGINE

POS	CODE
A	916
B	419
C	509
D	439
E	901
F	900
G	952
H	417
J	451
K	908
L	505
N	X
O	510
P	1517
Q	1871
R	1715
S	1716
T	508
U	208/209
V	115
W	X
X	X



SEE SHEET 4

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 15 OF 35  
ENGINEERING DWG 1878290 SHEET 5  
FP-29/FP-30 BLANK



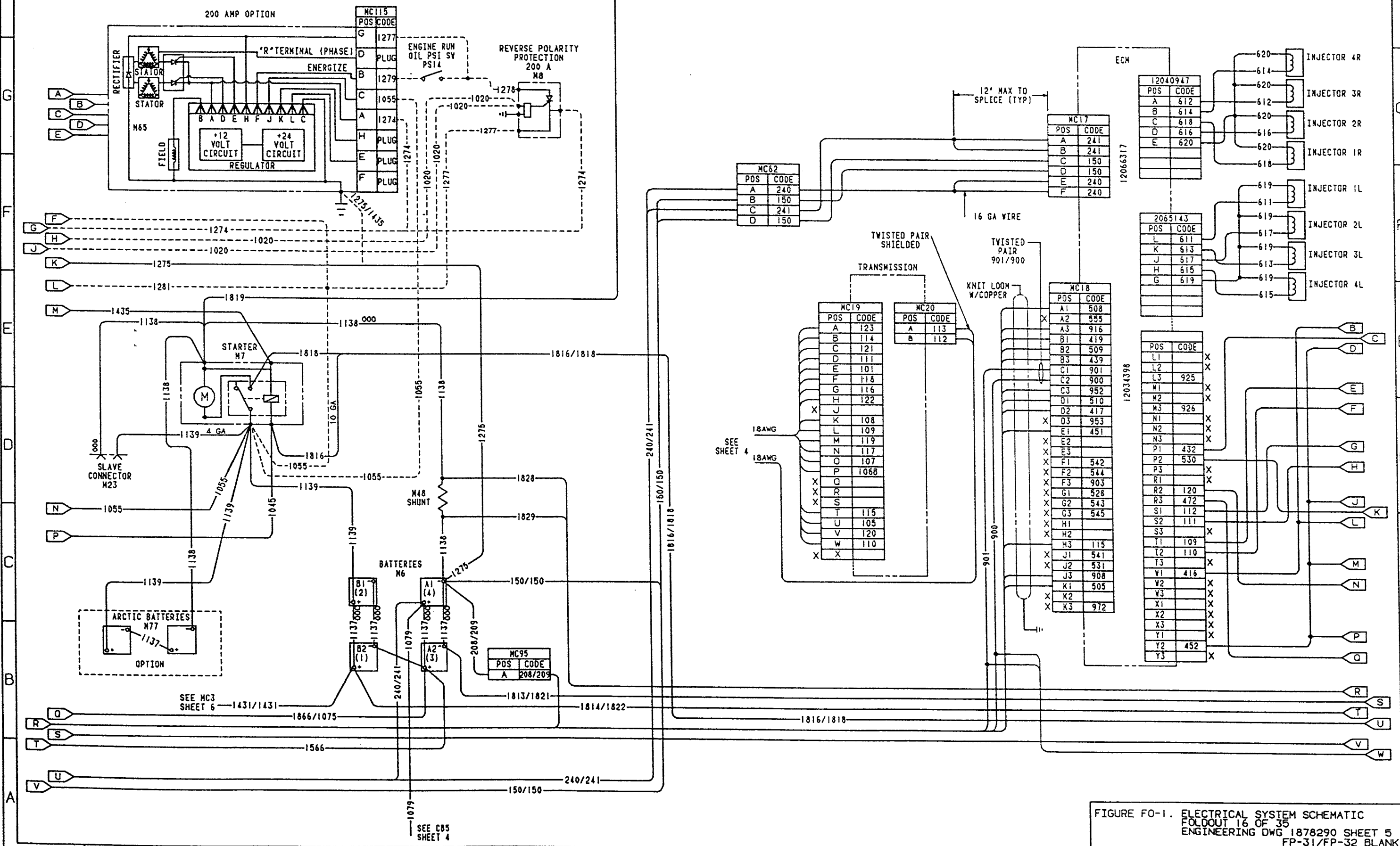


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 16 OF 35  
ENGINEERING DWG 1878290 SHEET 5  
FP-31/FP-32 BLANK

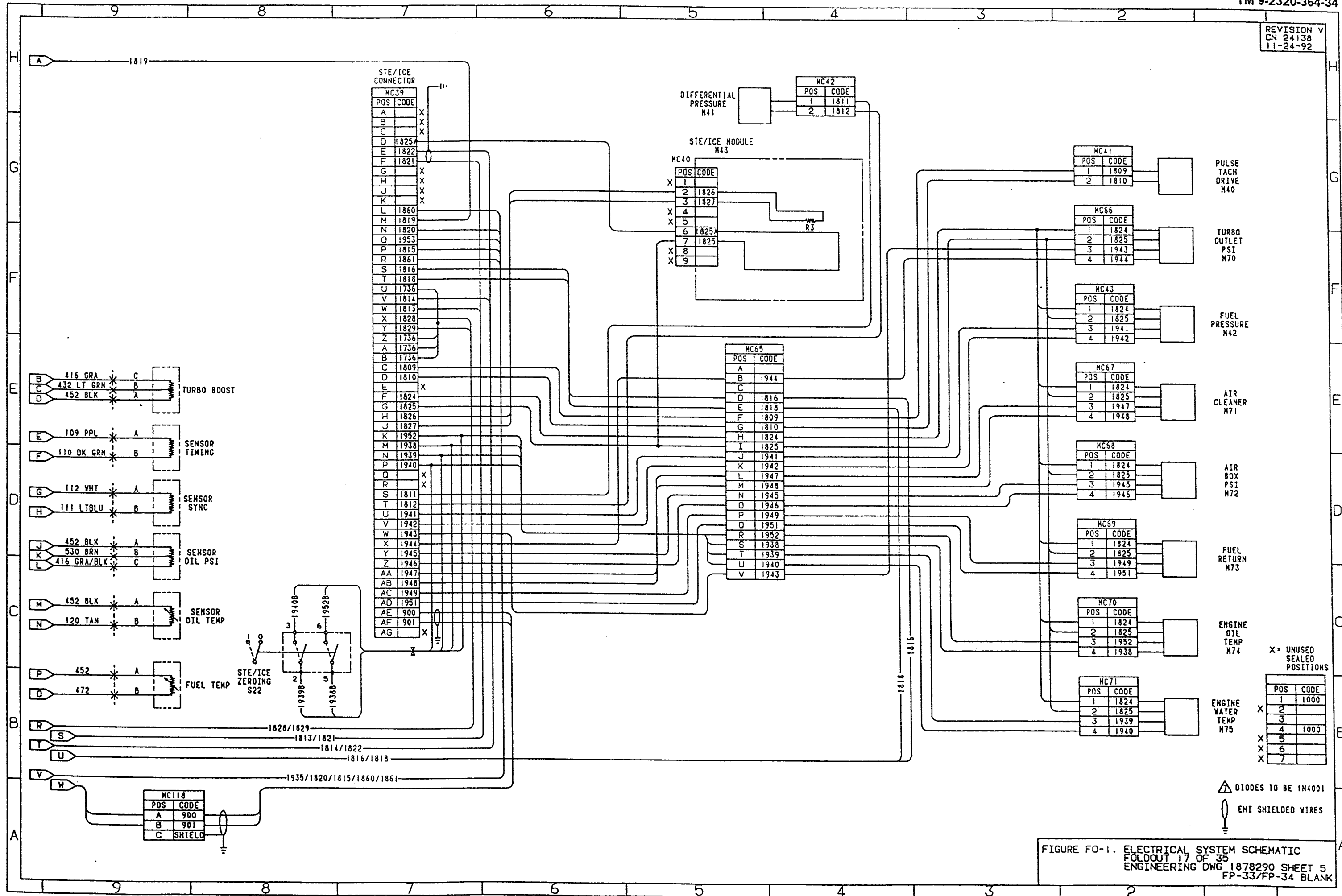


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 17 OF 35  
ENGINEERING DWG 1878290 SHEET 5  
FP-33/FP-34 BLANK

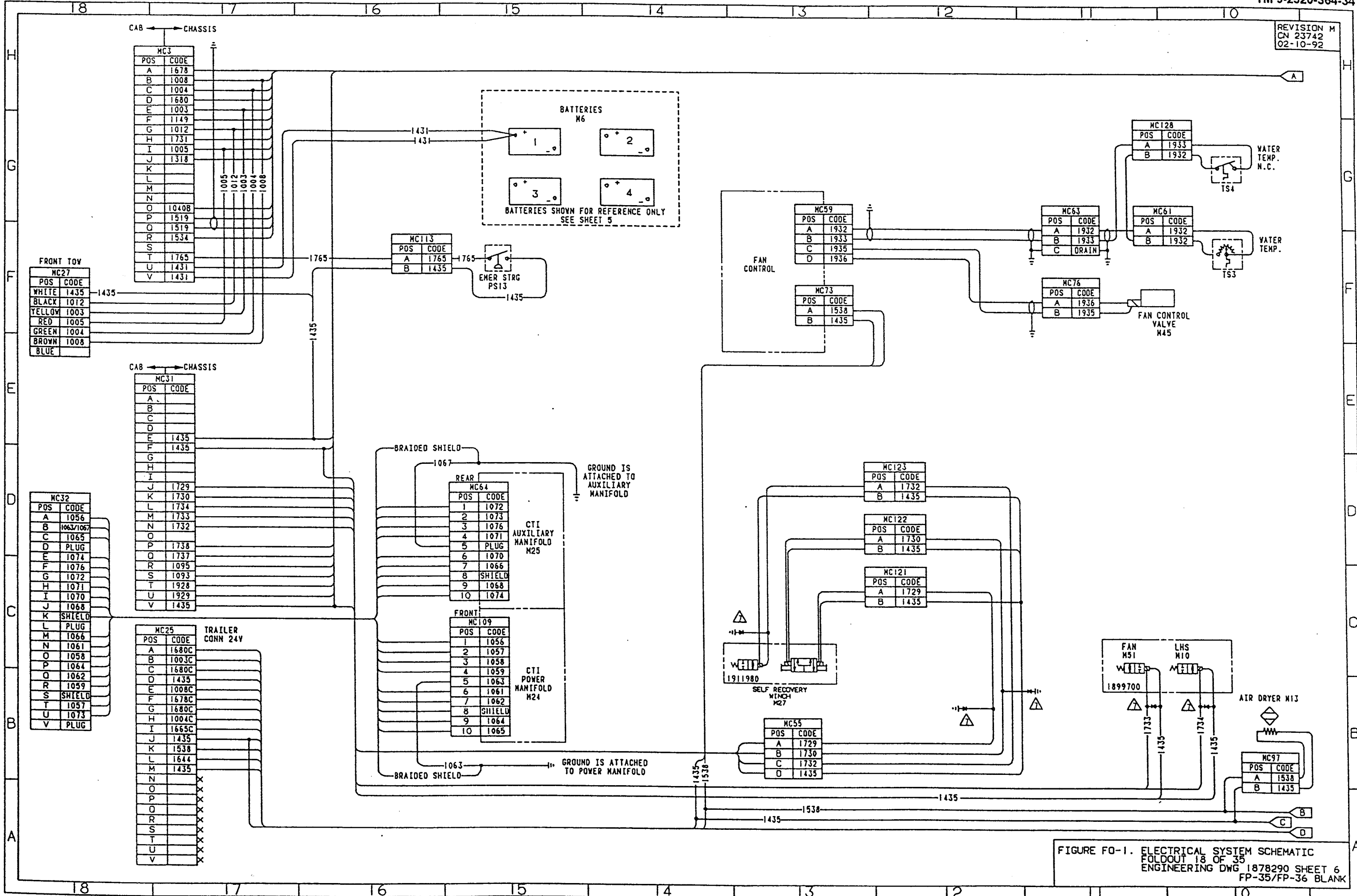


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 18 OF 35  
ENGINEERING DWG 1878290 SHEET 6  
FP-35/FP-36 BLANK

REVISION M  
CN 23742  
02-10-92

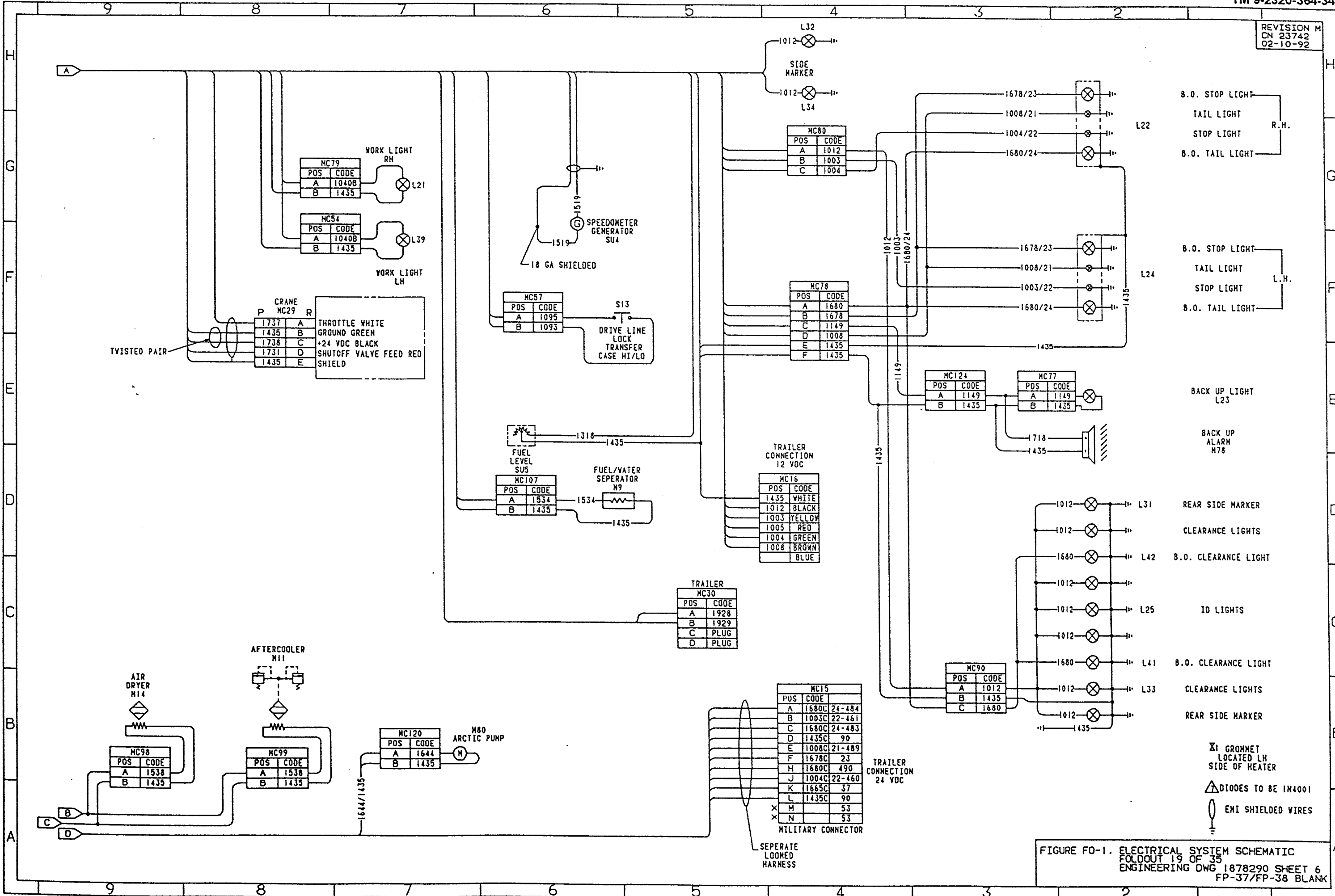


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 19 OF 35  
ENGINEERING DWG 1878290 SHEET 6  
FP-37/FP-38 BLANK

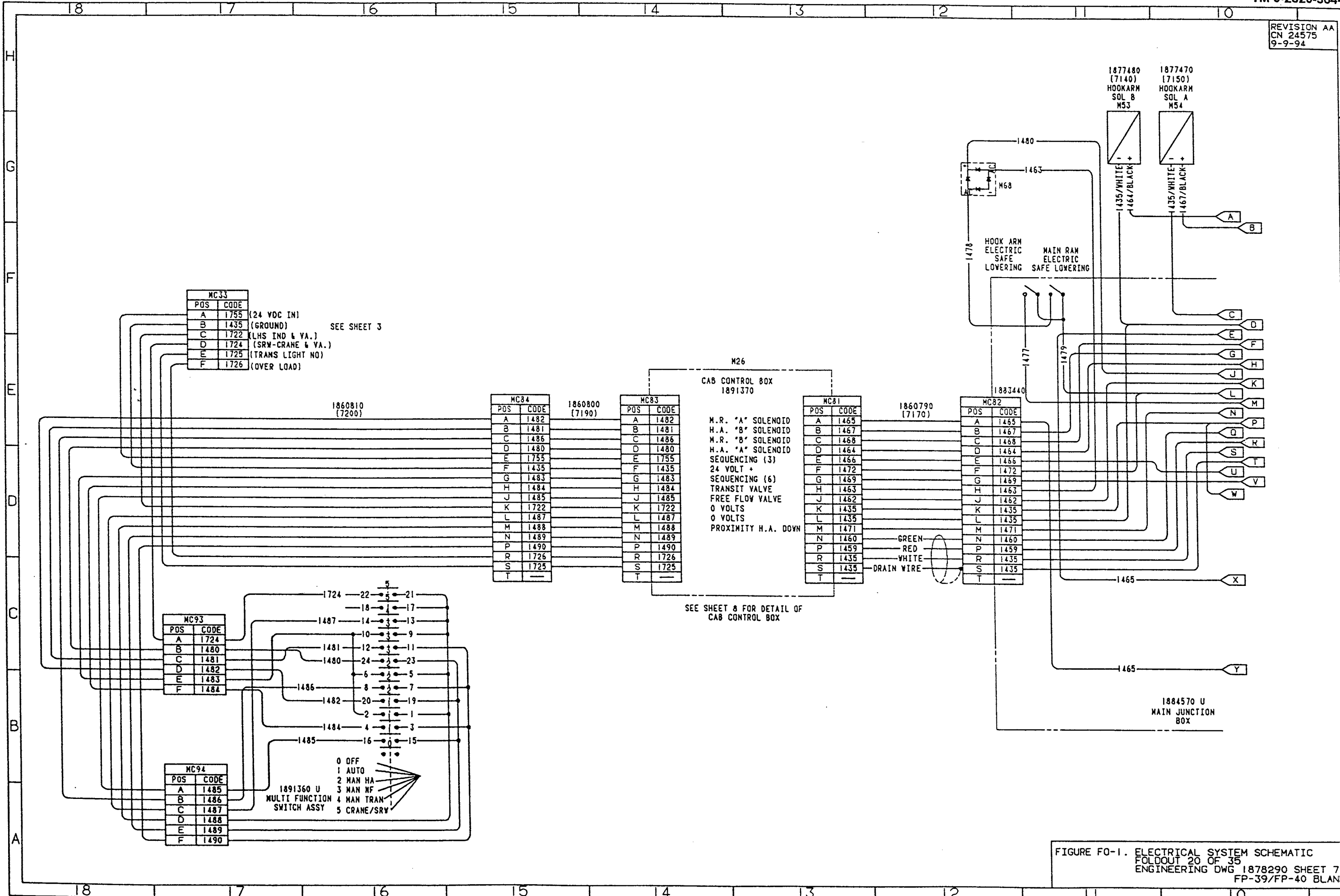


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 20 OF 35  
ENGINEERING DWG 1878290 SHEET 7  
FP-39/FP-40 BLANK

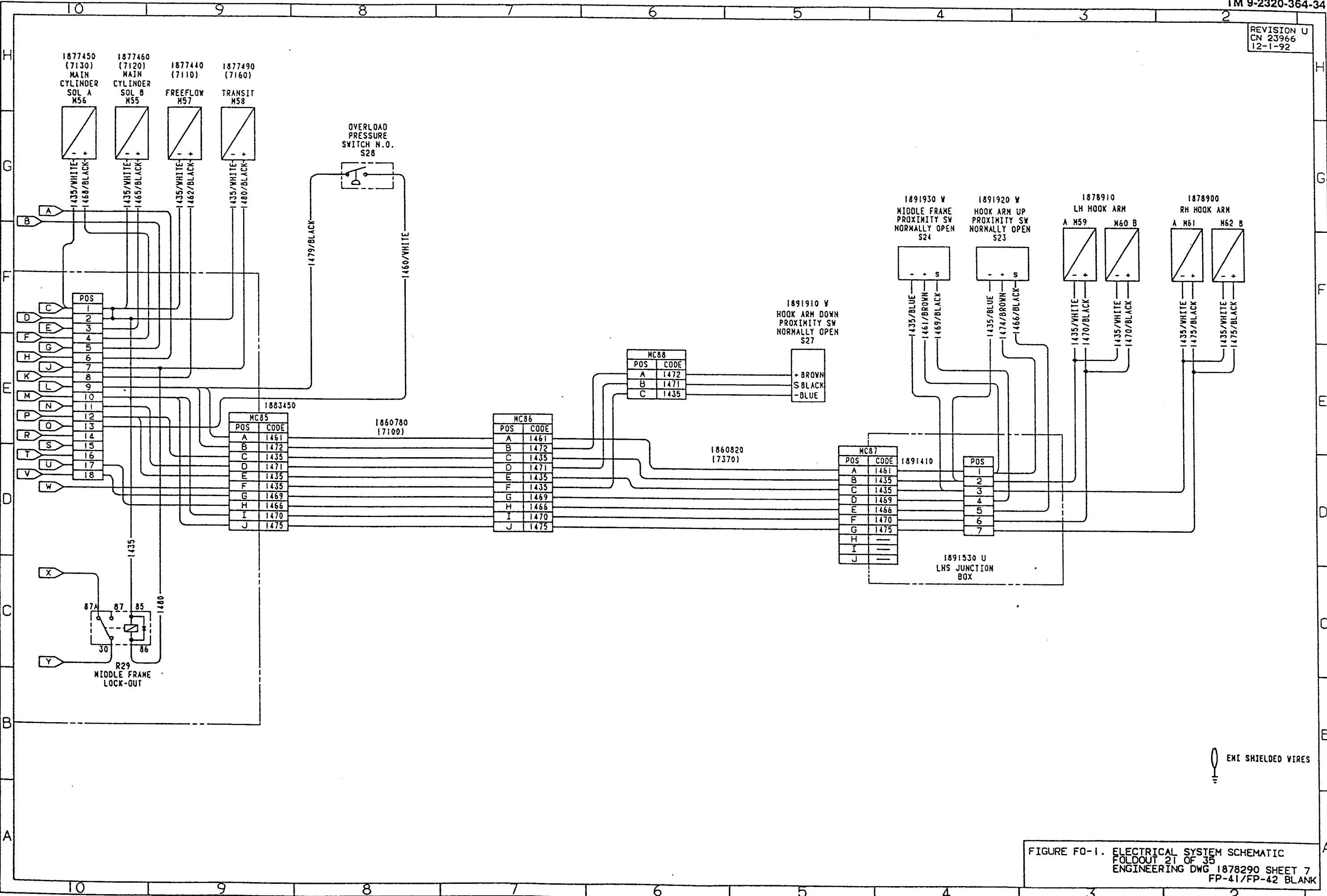
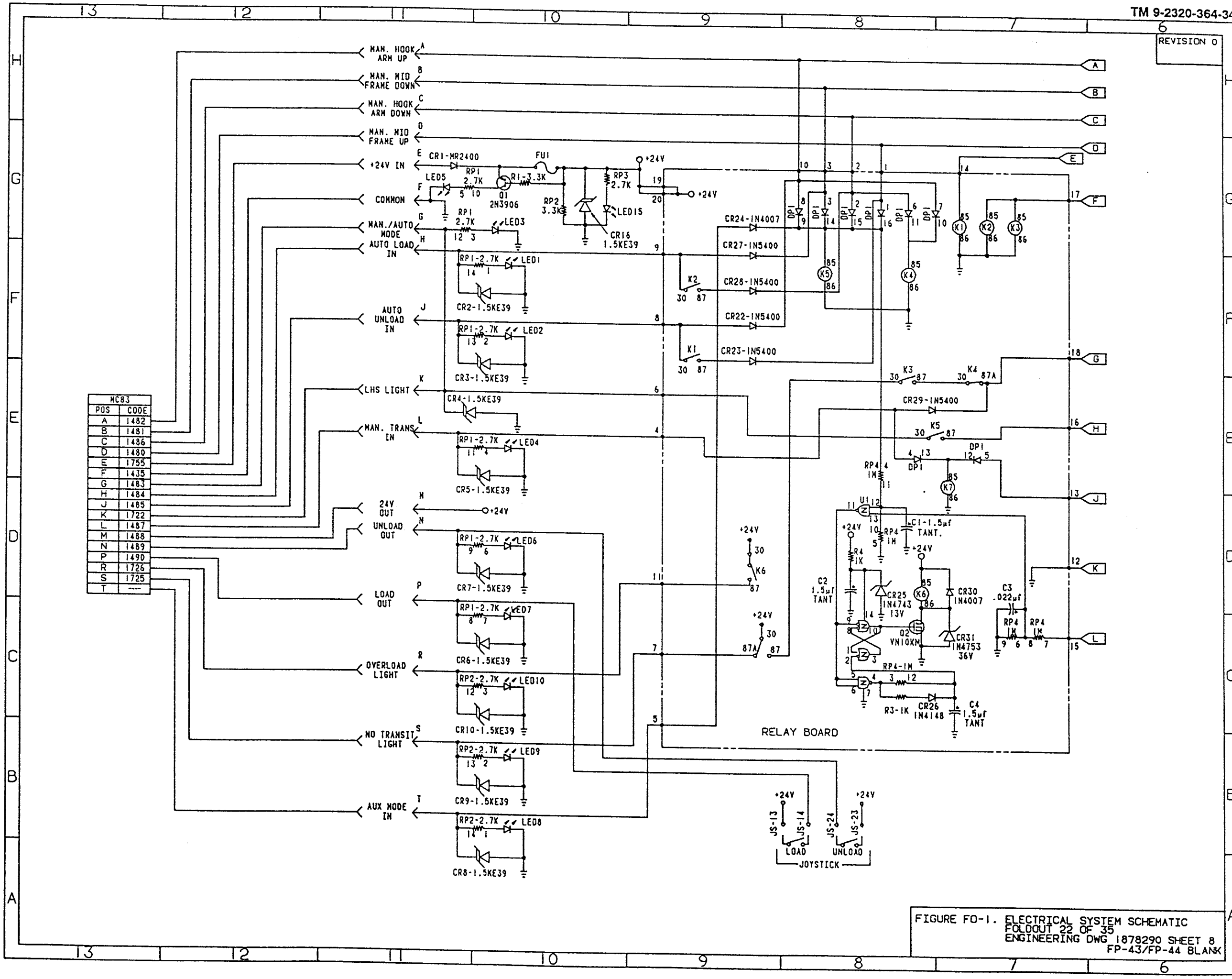


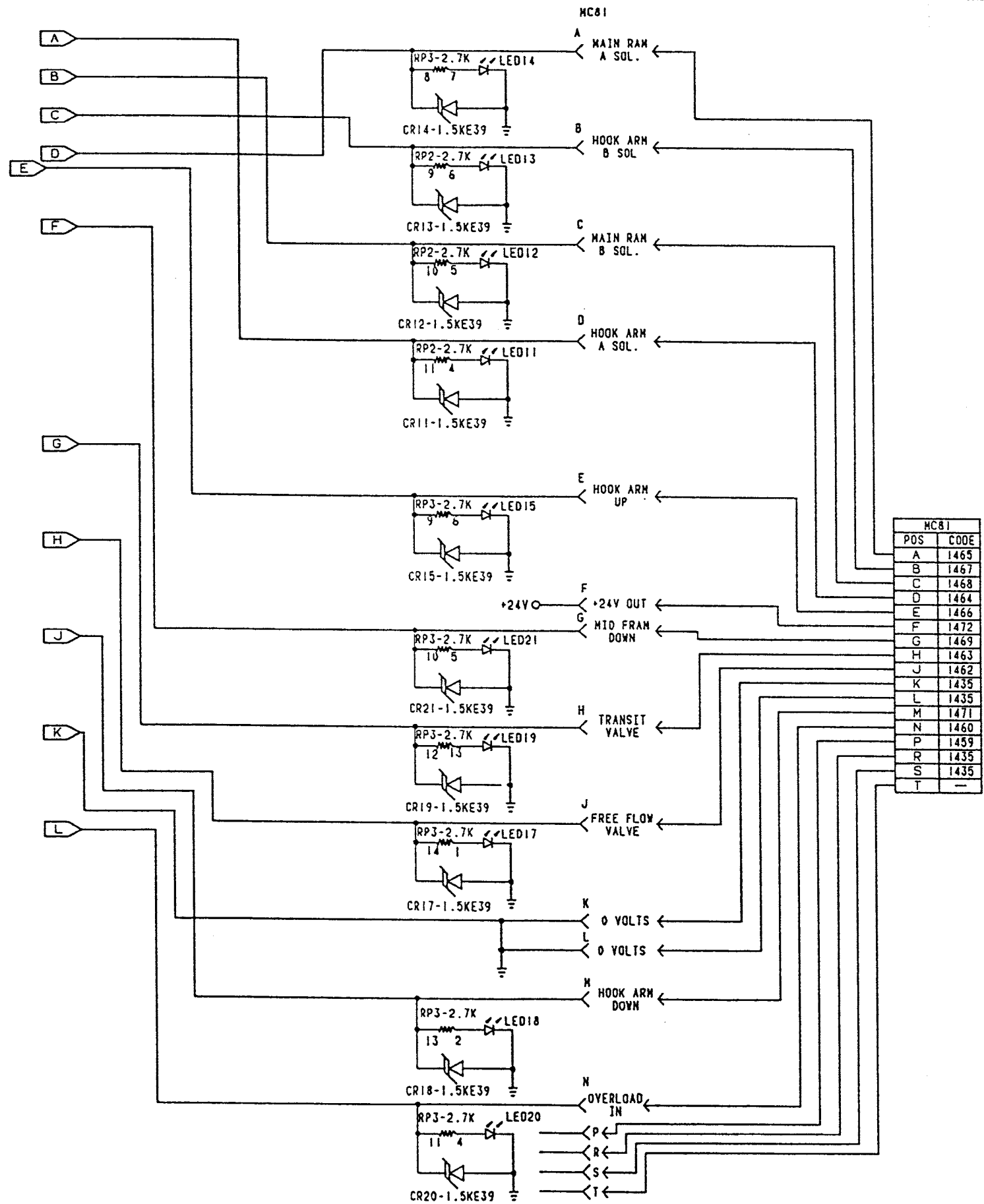
FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 21 OF 35  
ENGINEERING DWG 1878290 SHEET 7  
FP-41/FP-42 BLANK



MC83	
POS	CODE
A	1482
B	1481
C	1486
D	1480
E	1755
F	1435
G	1483
H	1484
J	1485
K	1722
L	1487
M	1488
N	1489
P	1490
R	1726
S	1725
T	---

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 22 OF 35  
 ENGINEERING DWG 1878290 SHEET 8  
 FP-43/FP-44 BLANK

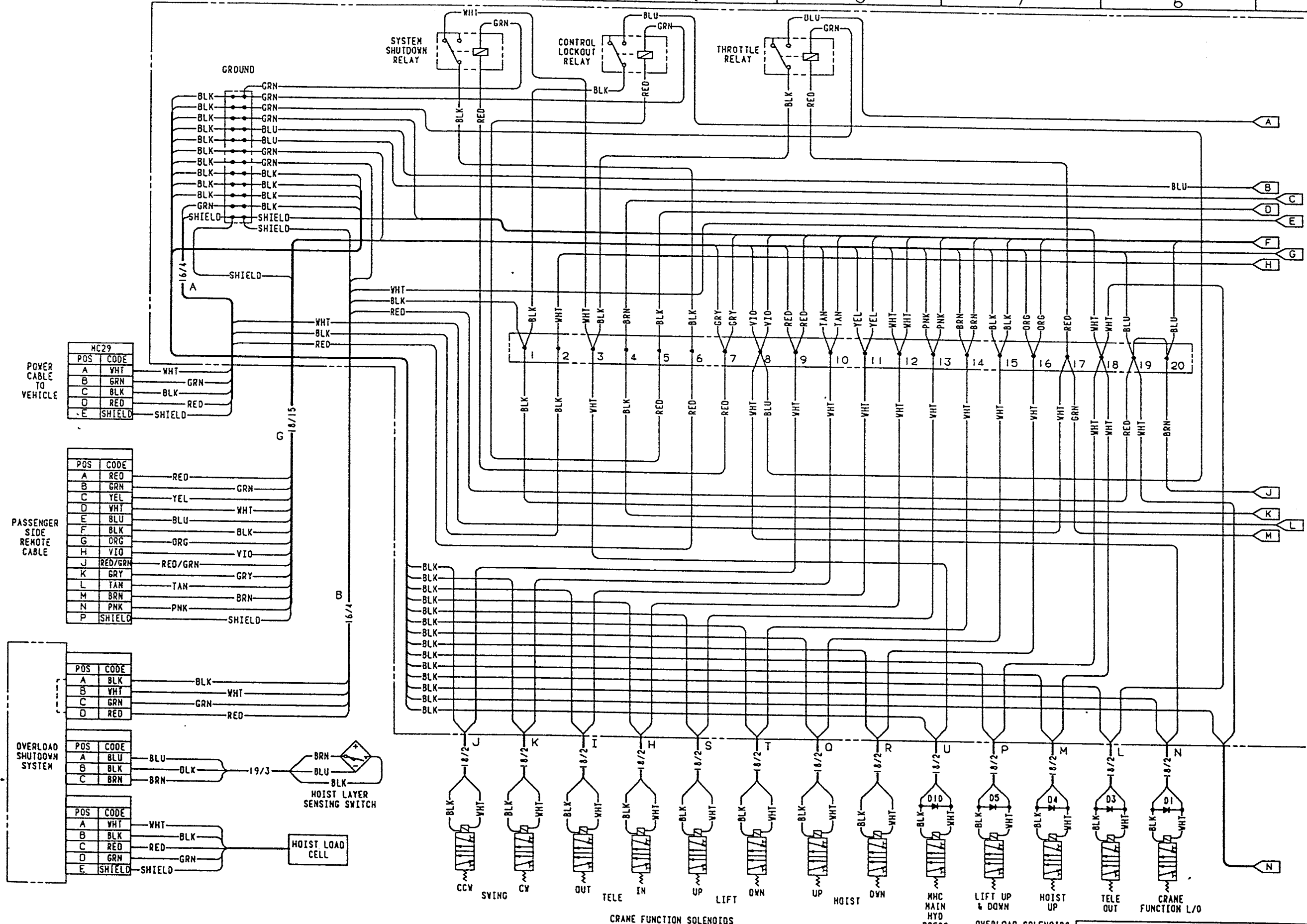
REVISION 0



MC81	
POS	CODE
A	1465
B	1467
C	1468
D	1464
E	1466
F	1472
G	1469
H	1463
J	1462
K	1435
L	1435
M	1471
N	1460
P	1459
R	1435
S	1435
T	-

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 23 OF 35  
 ENGINEERING DWG 1878290 SHEET 8  
 FP-45/FP-46 BLANK





POS	CODE
A	WHT
B	GRN
C	BLK
D	RED
E	SHIELD

POS	CODE
A	RED
B	GRN
C	YEL
D	WHT
E	BLU
F	BLK
G	ORG
H	VIO
J	RED/GRN
K	GRY
L	TAN
M	BRN
N	PNK
P	SHIELD

POS	CODE
A	BLK
B	WHT
C	GRN
D	RED

POS	CODE
A	BLU
B	BLK
C	BRN

POS	CODE
A	WHT
B	BLK
C	RED
D	GRN
E	SHIELD

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 24 OF 35  
 ENGINEERING DWG 1878290 SHEET 9  
 FP-47/FP-48 BLANK

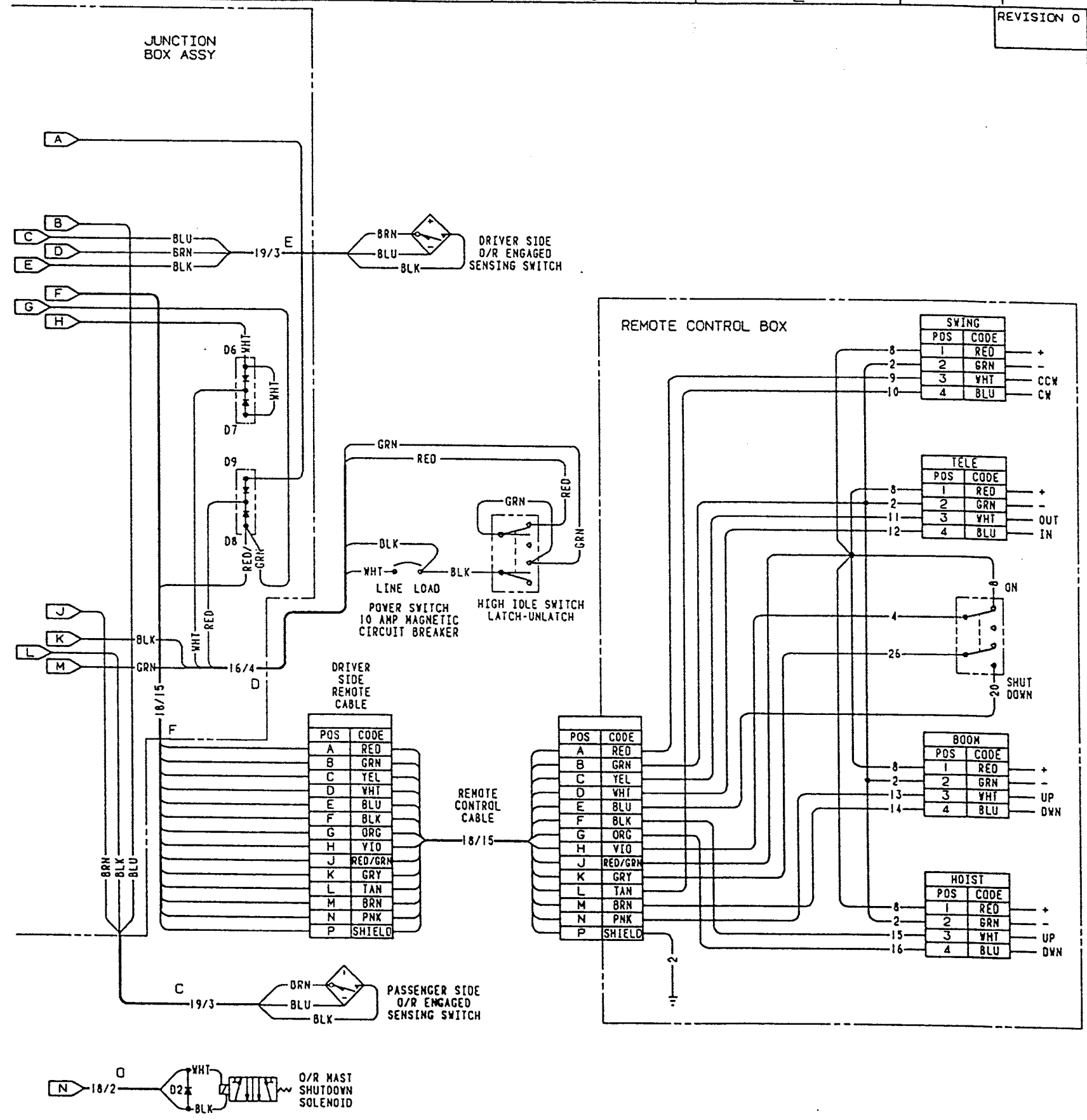
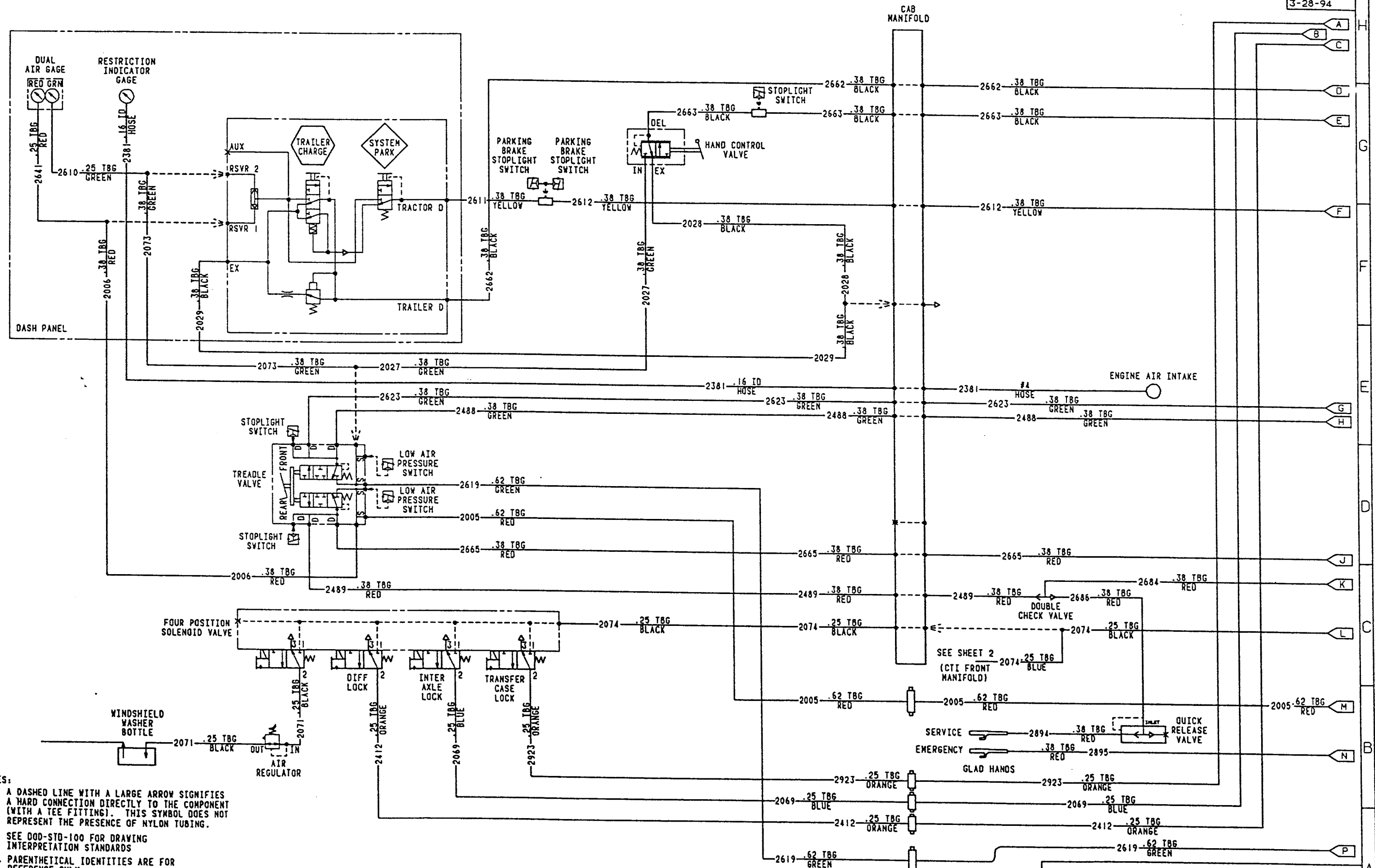


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLLOUT 25 OF 35  
 ENGINEERING DWG 1878290 SHEET 9  
 FP-49/FP-50 BLANK

REVISION F  
CN 24526  
3-28-94



- NOTES:
1. A DASHED LINE WITH A LARGE ARROW SIGNIFIES A HARD CONNECTION DIRECTLY TO THE COMPONENT (WITH A TEE FITTING). THIS SYMBOL DOES NOT REPRESENT THE PRESENCE OF NYLON TUBING.
  2. SEE OOD-STD-100 FOR DRAWING INTERPRETATION STANDARDS
  3. PARENTHEICAL IDENTITIES ARE FOR REFERENCE ONLY

FIGURE FO-2. AIR SYSTEM SCHEMATIC  
FOLDOUT 26 OF 35  
ENGINEERING DWG 1878300 SHEET 1  
FP-51/FP-52 BLANK

REVISION D  
CN 24303  
6-25-93

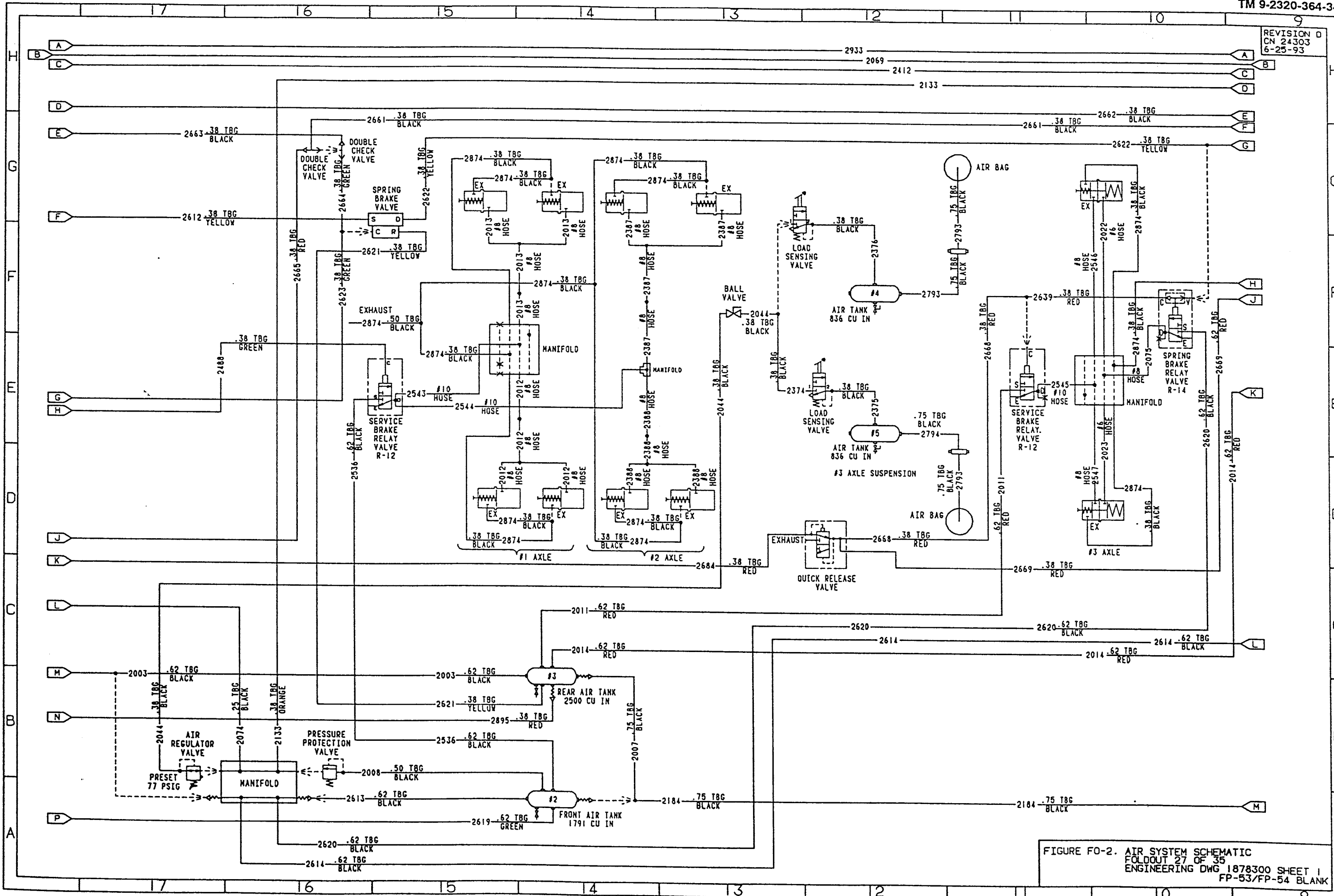
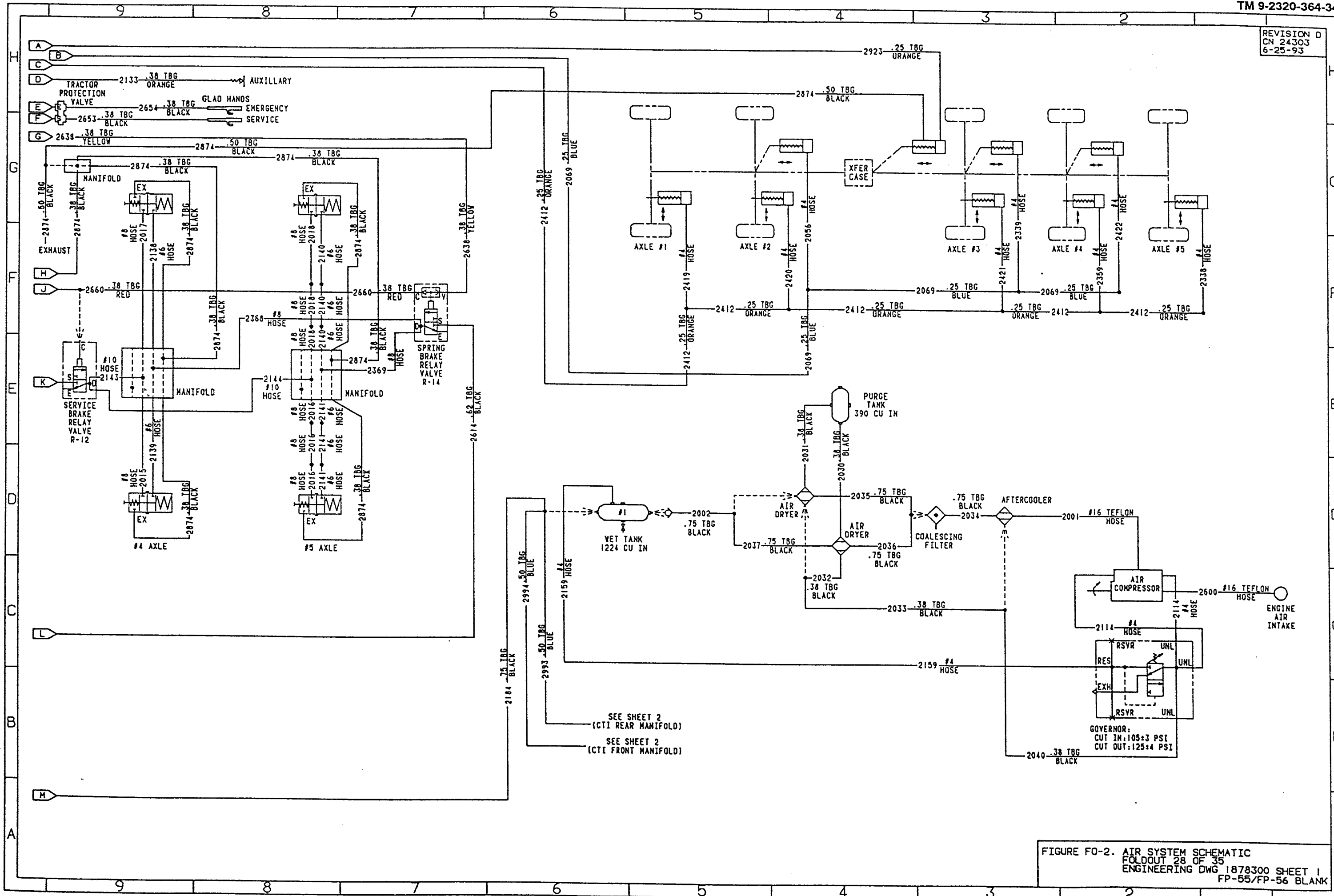


FIGURE FO-2. AIR SYSTEM SCHEMATIC  
 FOLIO 27 OF 35  
 ENGINEERING DWG 1878300 SHEET 1  
 FP-53/FP-54 BLANK



SEE SHEET 2  
(CTI REAR MANIFOLD)  
SEE SHEET 2  
(CTI FRONT MANIFOLD)

FIGURE FO-2. AIR SYSTEM SCHEMATIC  
FOLDOUT 28 OF 35  
ENGINEERING DWG 1878300 SHEET 1  
FP-55/FP-56 BLANK

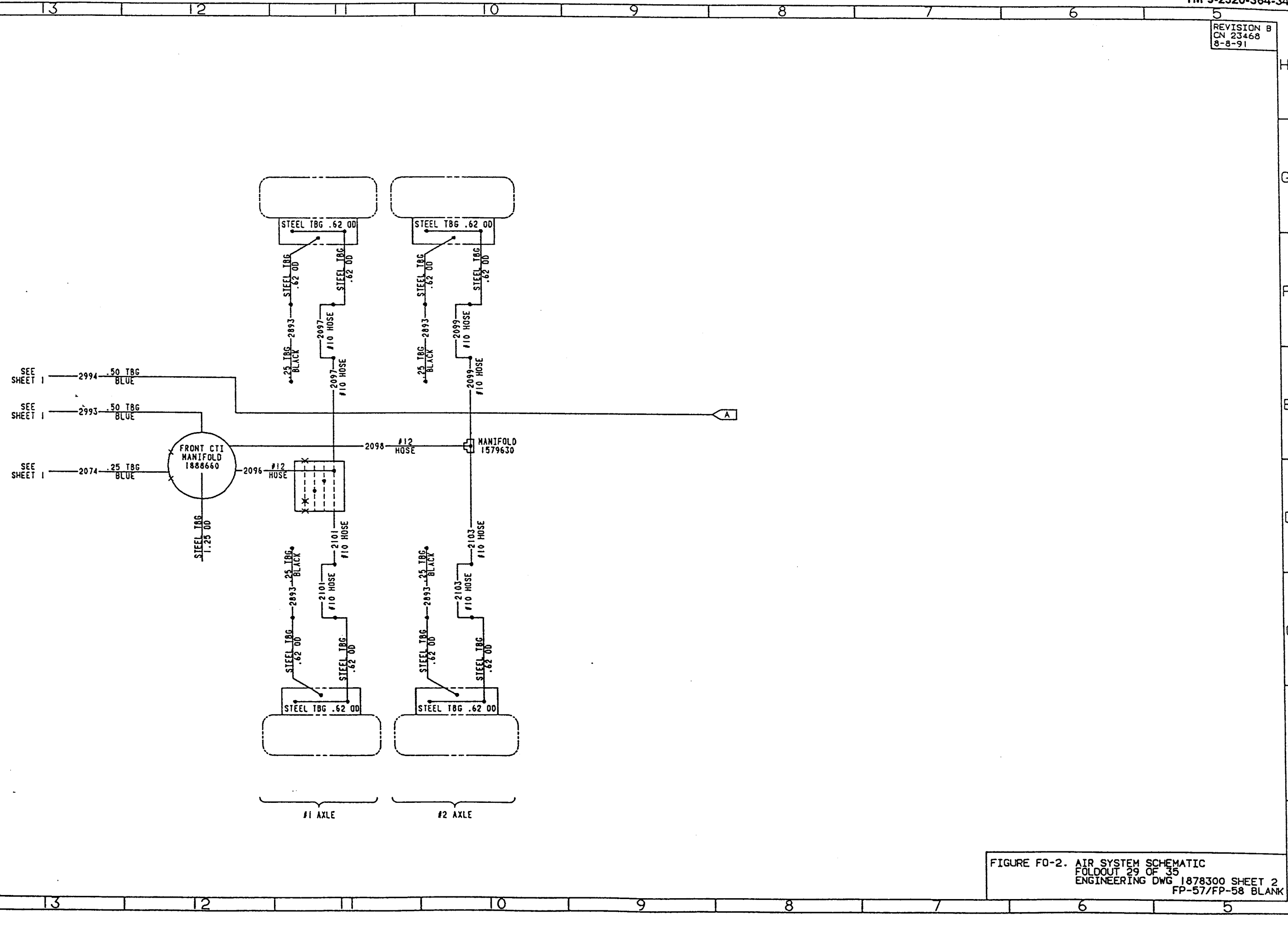


FIGURE FO-2. AIR SYSTEM SCHEMATIC  
FOLDOUT 29 OF 35  
ENGINEERING DWG 1878300 SHEET 2  
FP-57/FP-58 BLANK

REVISION B  
CN 23468  
8-8-91

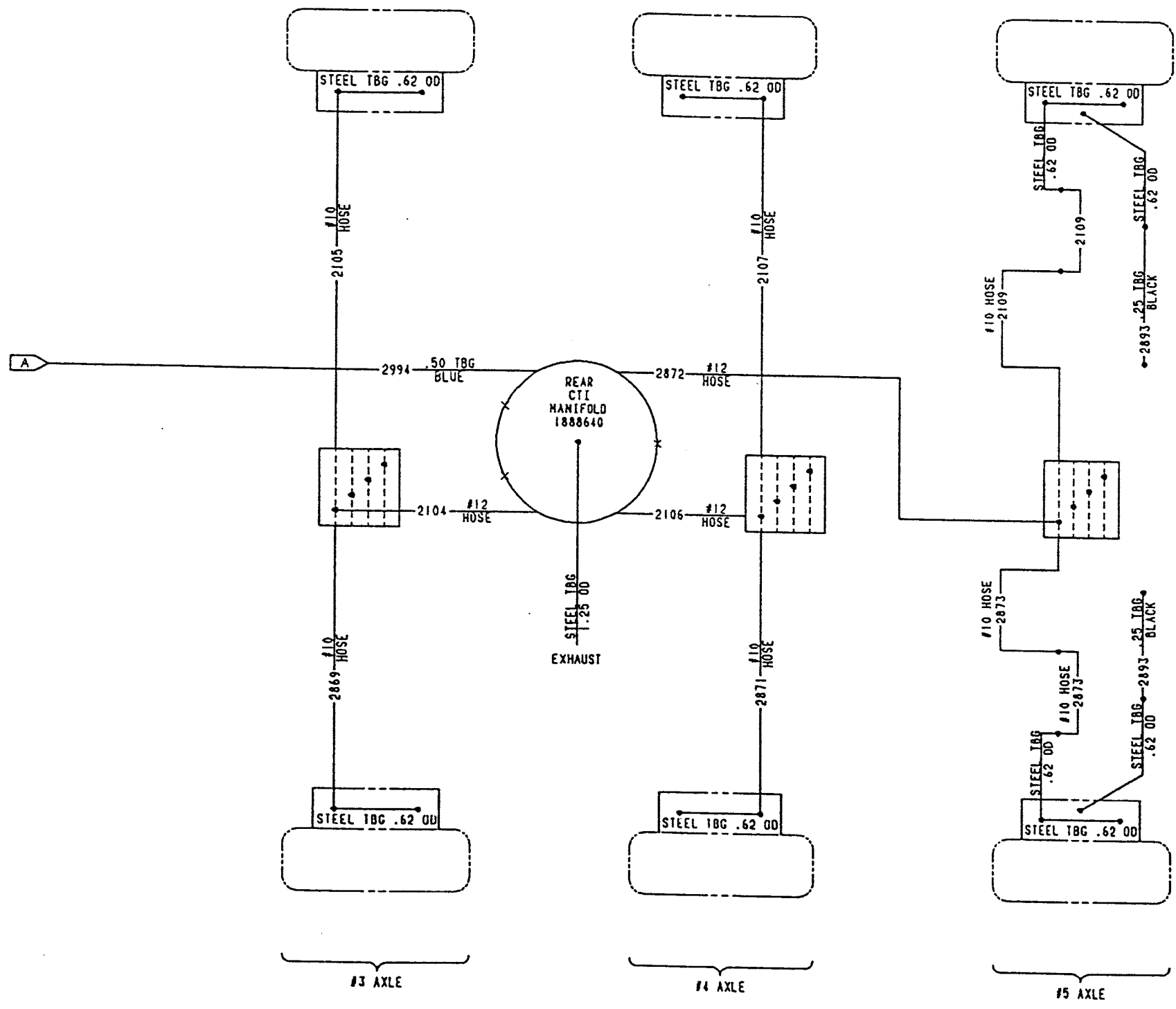


FIGURE FO-2. AIR SYSTEM SCHEMATIC  
FOLDOUT 30 OF 35  
ENGINEERING DWG 1878300 SHEET 2  
FP-59/FP-60 BLANK

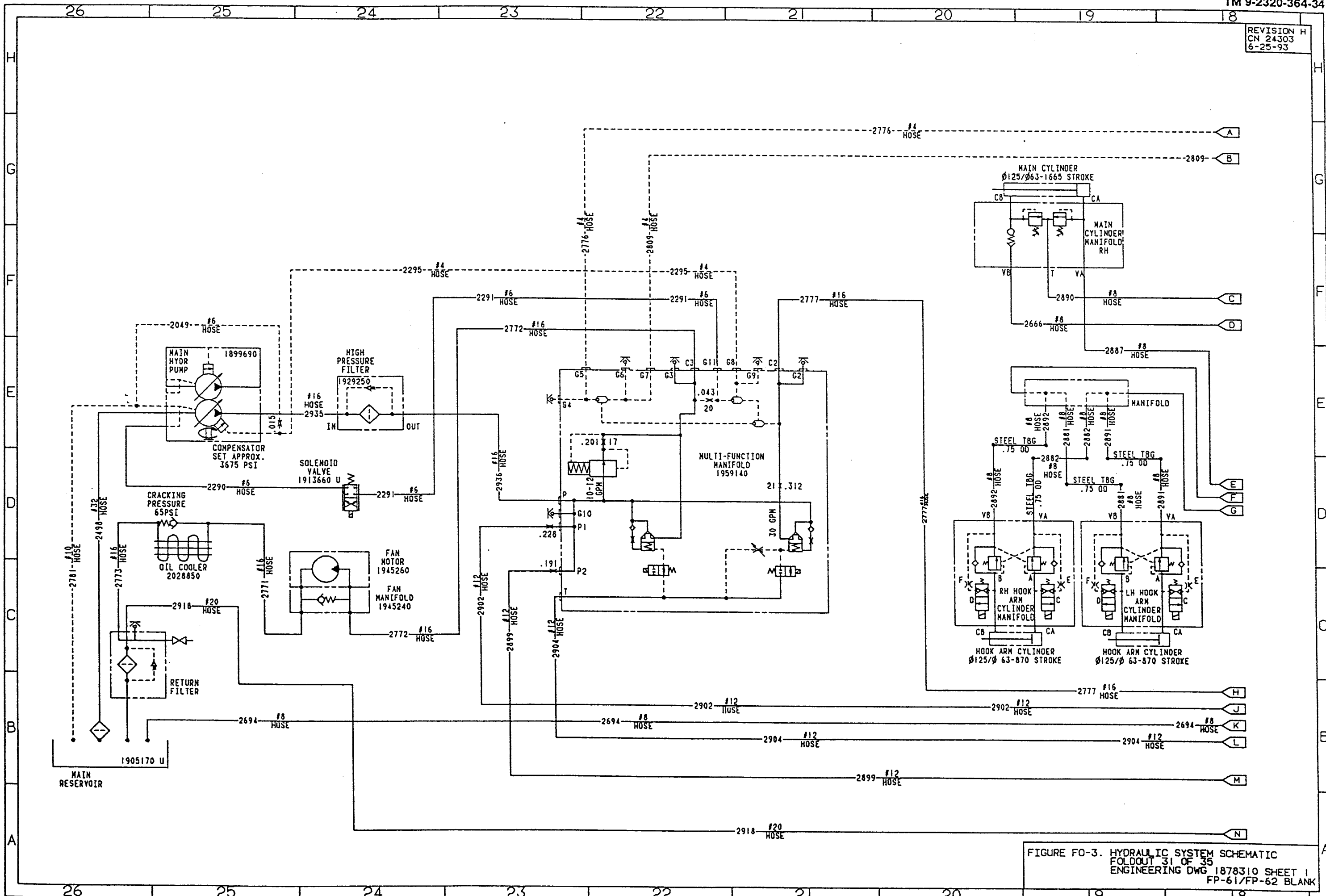


FIGURE FO-3. HYDRAULIC SYSTEM SCHEMATIC  
 FOLDOUT 31 OF 35  
 ENGINEERING DWG 1878310 SHEET 1  
 FP-61/FP-62 BLANK



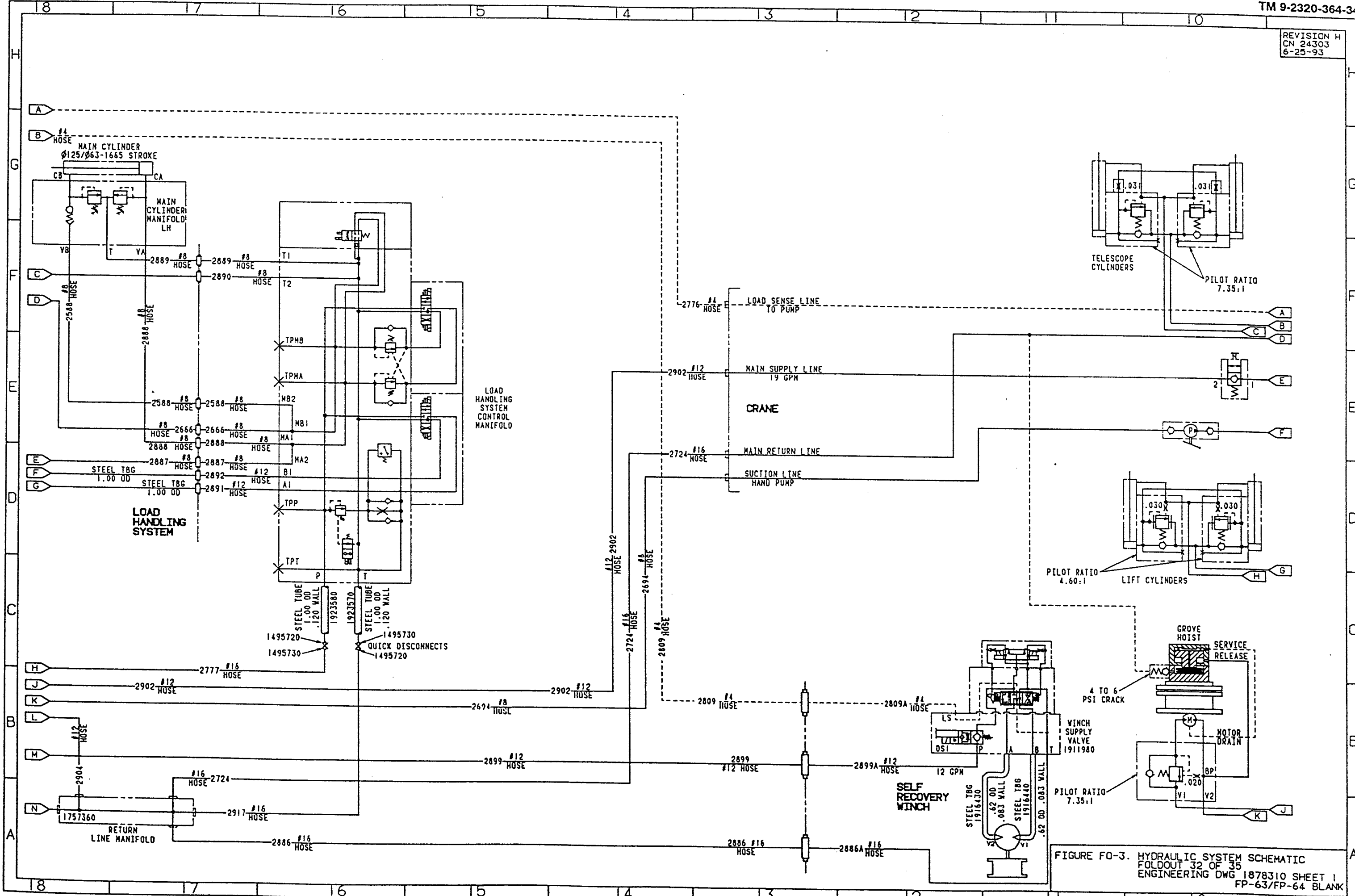


FIGURE FO-3. HYDRAULIC SYSTEM SCHEMATIC  
FOLDOUT 32 OF 35  
ENGINEERING DWG 1878310 SHEET 1  
FP-63/FP-64 BLANK

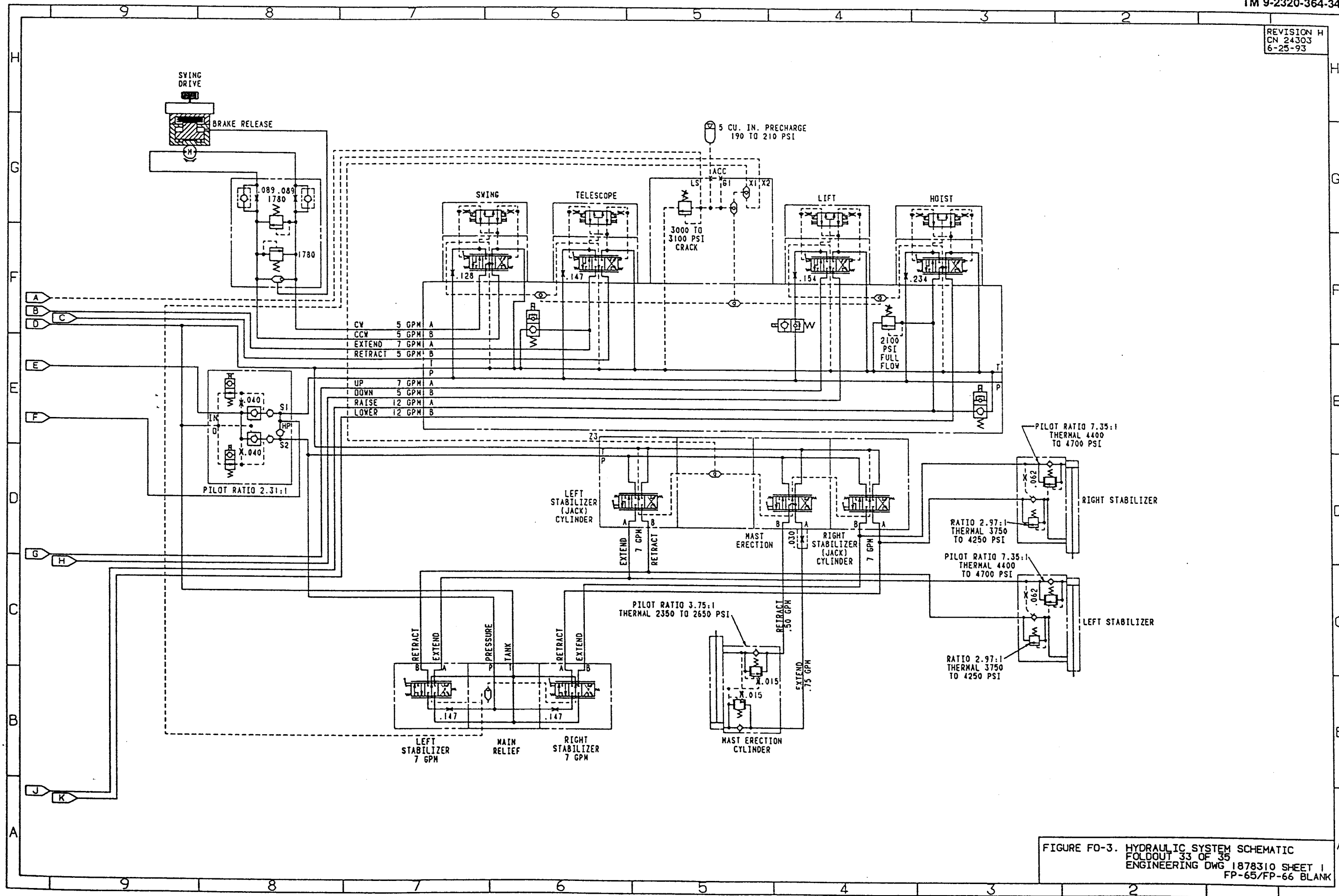


FIGURE FO-3. HYDRAULIC SYSTEM SCHEMATIC  
FOLDOUT 33 OF 35  
ENGINEERING DWG 1878310 SHEET 1  
FP-65/FP-66 BLANK

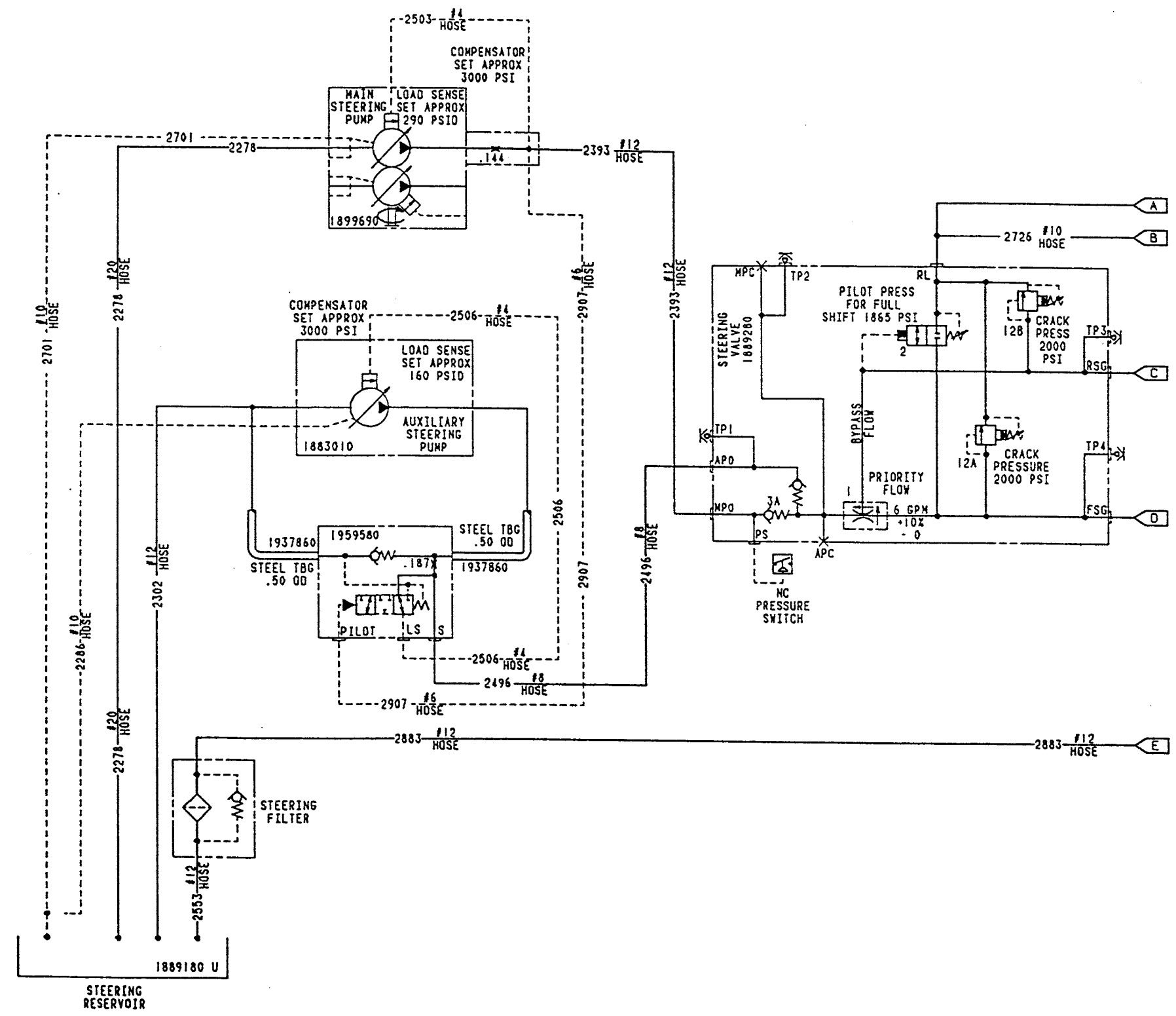


FIGURE FO-3. HYDRAULIC SYSTEM SCHEMATIC  
FOLDOUT 34 OF 35  
ENGINEERING DWG 1878310 SHEET 2  
FP-67/FP-68 BLANK

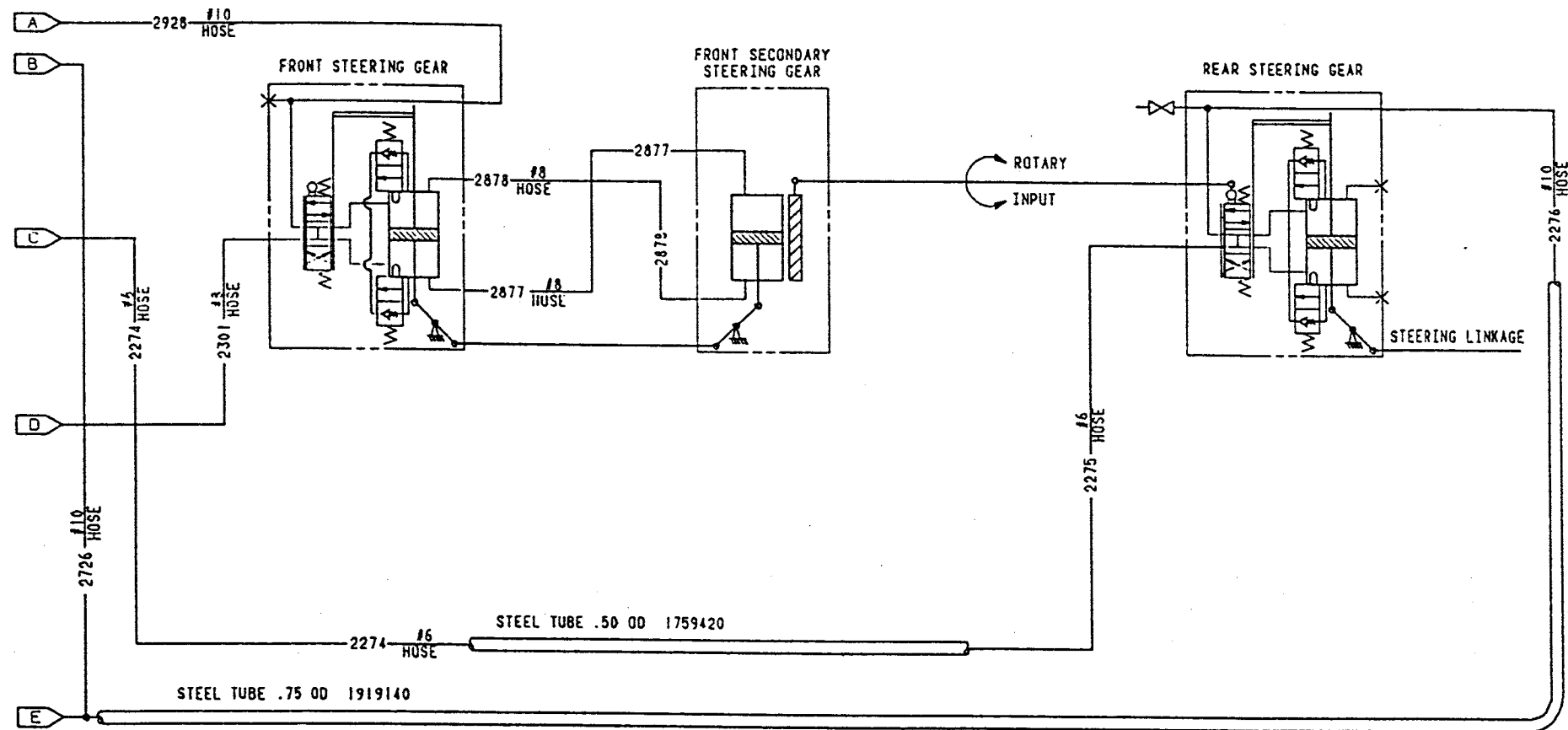


FIGURE FO-3. HYDRAULIC SYSTEM SCHEMATIC  
FOLDOUT 35 OF 35  
ENGINEERING DWG 1878310 SHEET 2  
FP-69/FP-70 BLANK

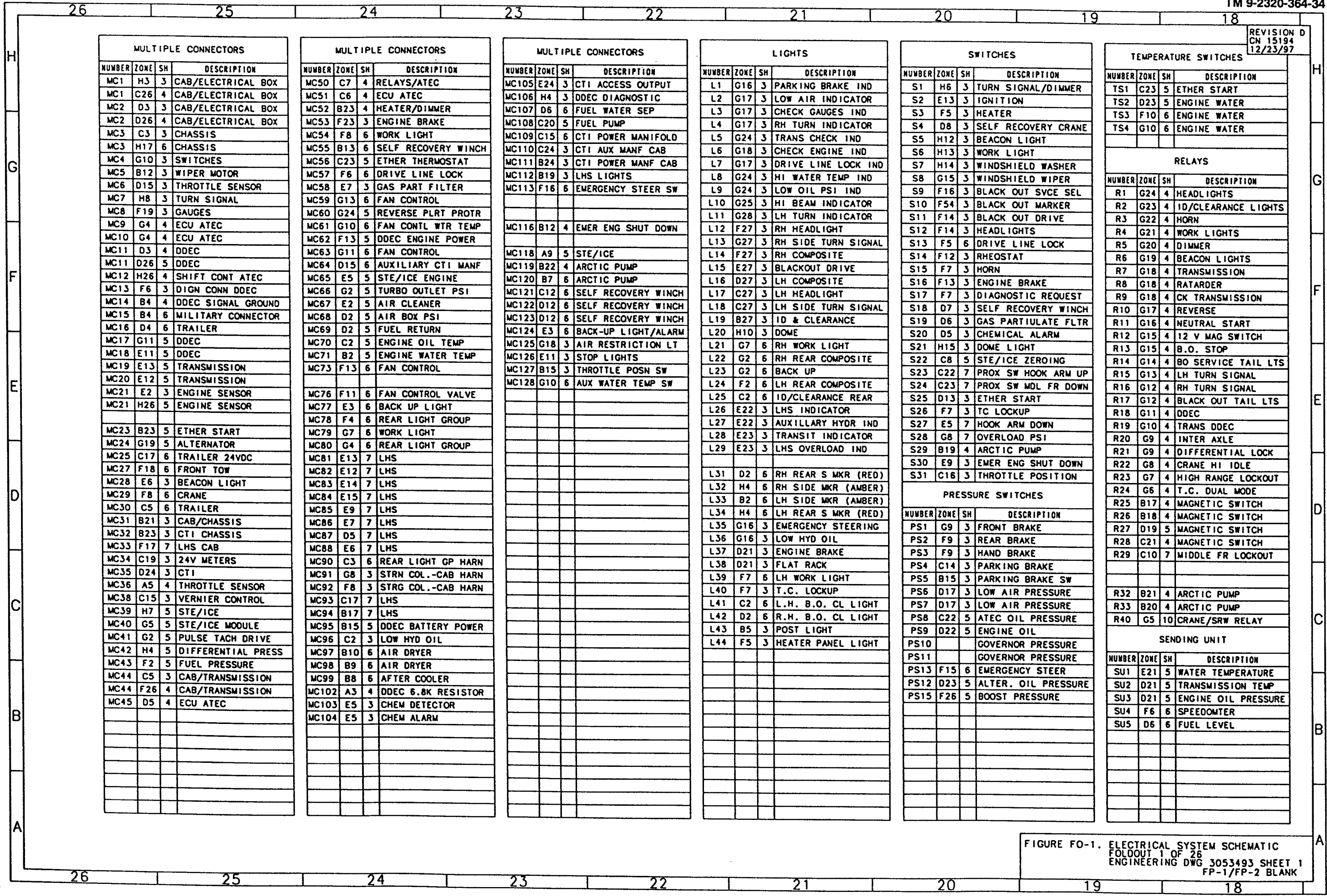
# SCHEMATICS

## **Section II. 200 AMP ALTERNATOR AND DDEC III ENGINE.**

Section II contains the schematics for trucks equipped with the 200 amp alternator and the DDEC III engine.



REVISION D  
CN 15194  
12/23/97



MULTIPLE CONNECTORS			
NUMBER	ZONE	SH	DESCRIPTION
MC1	H3	3	CAB/ELECTRICAL BOX
MC1	C26	4	CAB/ELECTRICAL BOX
MC2	D3	3	CAB/ELECTRICAL BOX
MC2	D26	4	CAB/ELECTRICAL BOX
MC3	C3	3	CHASSIS
MC3	H17	6	CHASSIS
MC4	G10	3	SWITCHES
MC5	B12	3	WIPER MOTOR
MC6	D15	3	THROTTLE SENSOR
MC7	H8	3	TURN SIGNAL
MC8	F19	3	GAUGES
MC9	G4	4	ECU ATEC
MC10	G4	4	ECU ATEC
MC11	D3	4	DDEC
MC11	D26	5	DDEC
MC12	H26	4	SHIFT CONT ATEC
MC13	F6	3	DIGN CONN DDEC
MC14	B4	4	AIR CLEANER
MC15	B4	6	MILITARY CONNECTOR
MC16	D4	6	TRAILER
MC17	G11	5	DDEC
MC18	E11	5	DDEC
MC19	E13	5	TRANSMISSION
MC20	E12	5	TRANSMISSION
MC21	E2	3	ENGINE SENSOR
MC21	H26	5	ENGINE SENSOR
MC23	B23	5	ETHER START
MC24	G19	5	ALTERNATOR
MC25	C17	6	TRAILER 24VDC
MC27	F18	6	FRONT TOW
MC28	E6	3	BEACON LIGHT
MC29	F8	6	CRANE
MC30	C5	6	TRAILER
MC31	B21	3	CAB/CHASSIS
MC32	B23	3	CTI CHASSIS
MC33	F17	7	LHS CAB
MC34	C19	3	24V METERS
MC35	D24	3	CTI
MC36	A5	4	THROTTLE SENSOR
MC38	C15	3	VERNIER CONTROL
MC39	H7	5	STE/ICE
MC40	G5	5	STE/ICE MODULE
MC41	G2	5	PULSE TACH DRIVE
MC42	H4	5	DIFFERENTIAL PRESS
MC43	F2	5	FUEL PRESSURE
MC44	C5	3	CAB/TRANSMISSION
MC44	F26	4	CAB/TRANSMISSION
MC45	D5	4	ECU ATEC

MULTIPLE CONNECTORS			
NUMBER	ZONE	SH	DESCRIPTION
MC50	C7	4	RELAYS/ATEC
MC51	C6	4	ECU ATEC
MC52	B23	4	HEATER/DIMMER
MC53	F23	3	ENGINE BRAKE
MC54	F8	6	WORK LIGHT
MC55	B13	6	SELF RECOVERY WINCH
MC56	C23	5	ETHER THERMOSTAT
MC57	F6	6	DRIVE LINE LOCK
MC58	E7	3	GAS PART FILTER
MC59	G13	6	FAN CONTROL
MC60	G24	5	REVERSE PLRT PROTR
MC61	G10	6	FAN CONTL WTR TEMP
MC62	F13	5	DDEC ENGINE POWER
MC63	G11	6	FAN CONTROL
MC64	D15	6	AUXILIARY CTI MANF
MC65	E5	5	STE/ICE ENGINE
MC66	E2	5	TURBO OUTLET PSI
MC67	G2	5	AIR CLEANER
MC68	D2	5	AIR BOX PSI
MC69	D2	5	FUEL RETURN
MC70	C2	5	ENGINE OIL TEMP
MC71	B2	5	ENGINE WATER TEMP
MC73	F13	6	FAN CONTROL
MC76	F11	6	FAN CONTROL VALVE
MC77	E3	6	BACK UP LIGHT
MC78	F4	6	REAR LIGHT GROUP
MC79	G7	6	WORK LIGHT
MC80	G4	6	REAR LIGHT GROUP
MC81	E13	7	LHS
MC82	E12	7	LHS
MC83	E14	7	LHS
MC84	E15	7	LHS
MC85	E9	7	LHS
MC86	E7	7	LHS
MC87	D5	7	LHS
MC88	E6	7	LHS
MC90	C3	6	REAR LIGHT GP HARN
MC91	G8	3	STRN COL.-CAB HARN
MC92	F8	3	STRG COL.-CAB HARN
MC93	C17	7	LHS
MC94	B17	7	LHS
MC95	B15	5	DDEC BATTERY POWER
MC96	C2	3	LOW HYD OIL
MC97	B10	6	AIR DRYER
MC98	B9	6	AIR DRYER
MC99	B8	6	AFTER COOLER
MC102	A3	4	DDEC 6.8K RESISTOR
MC103	E5	3	CHEM DETECTOR
MC104	E5	3	CHEM ALARM

MULTIPLE CONNECTORS			
NUMBER	ZONE	SH	DESCRIPTION
MC105	E24	3	CTI ACCESS OUTPUT
MC106	H4	3	DDEC DIAGNOSTIC
MC107	D6	6	FUEL WATER SEP
MC108	C20	5	FUEL PUMP
MC109	C15	6	CTI POWER MANIFOLD
MC110	C24	3	CTI AUX MANF CAB
MC111	B24	3	CTI POWER MANF CAB
MC112	B19	3	LHS LIGHTS
MC113	F16	6	EMERGENCY STEER SW
MC116	B12	4	EMER ENG SHUT DOWN
MC118	A9	5	STE/ICE
MC119	B22	4	ARCTIC PUMP
MC120	B7	6	ARCTIC PUMP
MC121	C12	6	SELF RECOVERY WINCH
MC122	D12	6	SELF RECOVERY WINCH
MC123	D12	6	SELF RECOVERY WINCH
MC124	E3	6	BACK-UP LIGHT/ALARM
MC125	G18	3	AIR RESTRICTION LT
MC126	E11	3	STOP LIGHTS
MC127	B15	3	THROTTLE POSN SW
MC128	G10	6	AUX WATER TEMP SW

LIGHTS			
NUMBER	ZONE	SH	DESCRIPTION
L1	G16	3	PARKING BRAKE IND
L2	G17	3	LOW AIR INDICATOR
L3	G17	3	CHECK GAUGES IND
L4	G17	3	RH TURN INDICATOR
L5	G24	3	TRANS CHECK IND
L6	G18	3	CHECK ENGINE IND
L7	G17	3	DRIVE LINE LOCK IND
L8	G24	3	HI WATER TEMP IND
L9	G24	3	LOW OIL PSI IND
L10	G25	3	HI BEAM INDICATOR
L11	G28	3	LH TURN INDICATOR
L12	F27	3	RH HEADLIGHT
L13	G27	3	RH SIDE TURN SIGNAL
L14	F27	3	RH COMPOSITE
L15	E27	3	BLACKOUT DRIVE
L16	D27	3	LH COMPOSITE
L17	C27	3	LH HEADLIGHT
L18	C27	3	LH SIDE TURN SIGNAL
L19	B27	3	ID & CLEARANCE
L20	H10	3	DOVE
L21	G7	6	RH WORK LIGHT
L22	G2	6	RH REAR COMPOSITE
L23	G2	6	BACK UP
L24	F2	6	LH REAR COMPOSITE
L25	C2	6	ID/CLEARANCE REAR
L26	E22	3	LHS INDICATOR
L27	E22	3	AUXILIARY HYDR IND
L28	E23	3	TRANSIT INDICATOR
L29	E23	3	LHS OVERLOAD IND
L31	D2	6	RH REAR S MKR (RED)
L32	H4	6	RH SIDE MKR (AMBER)
L33	B2	6	LH SIDE MKR (AMBER)
L34	H4	6	LH REAR S MKR (RED)
L35	G16	3	EMERGENCY STEERING
L36	G16	3	LOW HYD OIL
L37	D21	3	ENGINE BRAKE
L38	D21	3	FLAT RACK
L39	F7	6	LH WORK LIGHT
L40	F7	3	T.C. LOCKUP
L41	C2	6	L.H. B.O. CL LIGHT
L42	D2	6	R.H. B.O. CL LIGHT
L43	B5	3	POST LIGHT
L44	F5	3	HEATER PANEL LIGHT

SWITCHES			
NUMBER	ZONE	SH	DESCRIPTION
S1	H6	3	TURN SIGNAL/DIMMER
S2	E13	3	IGNITION
S3	F5	3	HEATER
S4	D8	3	SELF RECOVERY CRANE
S5	H12	3	BEACON LIGHT
S6	H13	3	WORK LIGHT
S7	H14	3	WINDSHIELD WASHER
S8	G15	3	WINDSHIELD WIPER
S9	F16	3	BLACK OUT SVCE SEL
S10	F54	3	BLACK OUT MARKER
S11	F14	3	BLACK OUT DRIVE
S12	F14	3	HEADLIGHTS
S13	F5	6	DRIVE LINE LOCK
S14	F12	3	RHEOSTAT
S15	F7	3	HORN
S16	F13	3	ENGINE BRAKE
S17	F7	3	DIAGNOSTIC REQUEST
S18	D7	3	SELF RECOVERY WINCH
S19	D6	3	GAS PARTIULATE FLTR
S20	D5	3	CHEMICAL ALARM
S21	H15	3	DOVE LIGHT
S22	C8	5	STE/ICE ZEROING
S23	C22	7	PROX SW HOOK ARM UP
S24	C23	7	PROX SW MDL FR DOWN
S25	D13	3	ETHER START
S26	F7	3	TC LOCKUP
S27	E5	7	HOOK ARM DOWN
S28	G8	7	OVERLOAD PSI
S29	B19	4	ARCTIC PUMP
S30	E9	3	EMER ENG SHUT DOWN
S31	C16	3	THROTTLE POSITION

TEMPERATURE SWITCHES			
NUMBER	ZONE	SH	DESCRIPTION
TS1	C23	5	ETHER START
TS2	D23	5	ENGINE WATER
TS3	F10	6	ENGINE WATER
TS4	G10	6	ENGINE WATER

RELAYS			
NUMBER	ZONE	SH	DESCRIPTION
R1	G24	4	HEADLIGHTS
R2	G23	4	ID/CLEARANCE LIGHTS
R3	G22	4	HORN
R4	G21	4	WORK LIGHTS
R5	G20	4	DIMMER
R6	G19	4	BEACON LIGHTS
R7	G18	4	TRANSMISSION
R8	G18	4	RATARDER
R9	G18	4	CK TRANSMISSION
R10	G17	4	REVERSE
R11	G16	4	NEUTRAL START
R12	G15	4	12 V MAG SWITCH
R13	G15	4	B.O. STOP
R14	G14	4	BO SERVICE TAIL LTS
R15	G13	4	LH TURN SIGNAL
R16	G12	4	RH TURN SIGNAL
R17	G12	4	BLACK OUT TAIL LTS
R18	G11	4	DDEC
R19	G10	4	TRANS DDEC
R20	G9	4	INTER AXLE
R21	G9	4	DIFFERENTIAL LOCK
R22	G8	4	CRANE HI IDLE
R23	G7	4	HIGH RANGE LOCKOUT
R24	G6	4	T.C. DUAL MODE
R25	B17	4	MAGNETIC SWITCH
R26	B18	4	MAGNETIC SWITCH
R27	D19	5	MAGNETIC SWITCH
R28	C21	4	MAGNETIC SWITCH
R29	C10	7	MIDDLE FR LOCKOUT
R32	B21	4	ARCTIC PUMP
R33	B20	4	ARCTIC PUMP
R40	G5	10	CRANE/SRW RELAY

SENDING UNIT			
NUMBER	ZONE	SH	DESCRIPTION
SU1	E21	5	WATER TEMPERATURE
SU2	D21	5	TRANSMISSION TEMP
SU3	D21	5	ENGINE OIL PRESSURE
SU4	F6	6	SPEEDOMETER
SU5	D6	6	FUEL LEVEL

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC FOLDOUT 1 OF 26 ENGINEERING DWG 3053493 SHEET 1 FP-1/FP-2 BLANK

CIRCUIT BREAKERS			
NUMBER	ZONE	SH	DESCRIPTION
CB1	D22	4	15 AMP
CB2	D22	4	15 AMP
CB3	D21	4	15 AMP
CB4	D21	4	15 AMP
CB5	D20	4	20 AMP
CB6	D20	4	15 AMP
CB7	D19	4	10 AMP
CB8	D19	4	15 AMP
CB9	D18	4	10 AMP
CB10	D17	4	3 AMP
CB11	D16	4	8 AMP
CB12	D16	4	8 AMP
CB13	D15	4	8 AMP
CB14	D14	4	15 AMP
CB15	D13	4	15 AMP
CB16	D12	4	15 AMP
CB17	D12	4	3 AMP
CB18	D11	4	10 AMP
CB19	D10	4	15 AMP
CB20	D9	4	15 AMP
CB21	D9	4	30 AMP
CB22	D7	4	20 AMP
CB23	D7	4	20 AMP
CB24	C20	5	3 AMP
CB25	A14	4	15 AMP
CB26	A13	4	15 AMP
GAUGES			
NUMBER	ZONE	SH	DESCRIPTION
G1	G20	3	WATER TEMPERATURE
G2	G21	3	OIL PRESSURE
G3	G22	3	FUEL LEVEL
G4	G22	3	TACHOMETER
G5	G23	3	SPEEDOMETER
G6	G19	3	VOLTMETER 12V
G7	G19	3	VOLTMETER 24V
G10	G20	3	XMSN OIL TEMP
G11	G18	3	AIR PRESSURE
G12	H18	3	AIR RESTRICTION

MISCELLANEOUS			
NUMBER	ZONE	SH	DESCRIPTION
M1	B6	3	WINDSHIELD WSHR SOL
M2	B13	3	WIPER MOTOR
M3	E17	3	LOW OIL & AIR ALARM
M4	A5	4	THROTTLE POSN CONT
M5	C20	4	FLASHER
M6	C16	5	BATTERIES
M7	E17	5	STARTER
M8	B22	5	ETHER START
M9	D6	6	FUEL/WATER SEP
M10	C10	6	LHS SOLENOID VALVE
M11	C8	6	AFTERCOOLER
M12	C20	5	FUEL PUMP
M13	B10	6	AIR DRYER
M14	E6	3	CHEMICAL DETECTOR
M14	B9	6	AIR DRYER
M15	D1	3	HORN
M16	D16	3	VERNIER CONTROL
M17	F5	3	HEATER MOTOR
M18	F24	3	LOW OIL PRESS ALARM
M20	G22	5	ALTERNATOR, STD
M21	C25	5	RH SIDE ENG BK COIL
M22	C24	5	LH SIDE ENG BK COIL
M23	D18	5	SLAVE CONNECTER
M24	B15	6	CTI POWER MANIFOLD
M25	D15	6	CTI AUXILIARY MANF
M26	E13	7	LHS CAB CONTROLLER
M27	B13	6	SELF RECOVERY WINCH
M28	E25	3	CTI CONTROLLER
M29	G14	7	CHEMICAL ALARM
M30	D11	3	GAS PART FILTER
M31	D11	3	AIR HEATER DRIVER
M32	D12	3	AIR HEATER PASS
M33	D3	7	SRW SOLENOID VALVE
M35	E15	3	THROTTLE POSITIONER
M36	C9	4	DIODE
M39	F9	4	RECTIFIER
M40	G2	5	PULSE TACH DRIVE
M41	H5	5	DIFFERENTIAL PRESS
M42	F2	5	FUEL PRESSURE
M43	G5	5	STE/ICE MODULE
M45	F10	6	FAN CONTROL VALVE
M48	D16	5	SHUNT
M49	B9	3	XFR CASE LKUP SOL
M50	B8	3	INTER AXLE SOL V
M51	B8	3	DIFF SOLENOID VALVE
M51	C11	6	FAN
M52	A21	4	RECTIFIER
M53	G11	7	LHS HOOK ARM B
M54	G10	7	LHS HOOK ARM A
M55	G10	7	LHS MAIN CYLINDER B
M56	G10	7	LHS MAIN CYLINDER A

MISCELLANEOUS			
NUMBER	ZONE	SH	DESCRIPTION
M57	G9	7	LHS FREEFLOW
M58	G9	7	LHS TRANSIT
M59	F3	7	LHS LH HOOK ARM A
M60	F3	7	LHS LH HOOK ARM B
M61	F2	7	LHS RH HOOK ARM A
M62	F2	7	LHS RH HOOK ARM B
M64	C19	5	POLARITY PROTECTION
M66	G16	3	RECTIFIER
M67	C8	3	RECTIFIER
M68	G12	7	RECTIFIER
M70	F2	5	TURBO OUTLET PSI
M71	E2	5	AIR CLEANER
M72	D2	5	AIR BOX PSI
M73	C2	5	FUEL RETURN
M74	C2	5	ENGINE OIL TEMP
M75	B2	5	ENGINE WATER TEMP
M76	E10	4	RECTIFIER
M77	B17	5	ARCTIC BATTERIES
M78	E2	6	BACK-UP ALARM
M80	B7	6	ARCTIC PUMP
M81	F4	3	RECTIFIER
M83	F3	10	LHS FUSE - 5 AMP

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
104	MC36-M4	4	THROTTLE SENSOR
104	MC10-MC36	4	THROTTLE SENSOR
105	MC10-MC19	4/5	ATEC
106A	MC10-MC36	4	THROTTLE SENSOR
106A	MC36-M4	4	THROTTLE SENSOR
106A	MC10-106B	4/5	ATEC
106B	106A-MC19	4/5	ATEC
107	MC10-MC19	4/5	ATEC
108	MC10-MC19	4/5	ATEC
109	MC10-MC19	4/5	ATEC
110	MC10-MC19	4/5	ATEC
111	MC10-MC19	4/5	ATEC
112	MC10-MC20	4/5	ATEC
113	MC10-MC20	4/5	ATEC
114	MC10-MC19	4/5	ATEC
115	MC11-MC18	5	ECM
115	MC11-MC102	4	6.8K RESISTOR
115	MC10-MC19	4/5	ATEC
116	MC10-MC19	4/5	ATEC
117	MC10-MC19	4/5	ATEC
118	MC10-MC19	4/5	ATEC
119	MC10-MC19	4/5	ATEC
120	MC10-MC19	4/5	ATEC
121	MC10-MC19	4/5	ATEC
122	MC10-MC19	4/5	ATEC
123	MC10-MC19	4/5	ATEC
124	MC36-M4	4	THROTTLE SENSOR
124	MC10-MC36	4	THROTTLE SENSOR
150	MC62-MC62	5/4	
150	MC17-MC62	5	
195	MC5-M2	3	
201	MC51-GROUND	4	
201	MC9-MC51	4	
202A	MC9-SPLICE	4	
203	MC9-MC51	4	
203	MC51-CB12	4	
204	MC9-MC12	4	ATEC
206	MC9-MC12	4	ATEC
207A	MC51-MC106	4	ATEC
207A	MC9-MC51	4	ATEC
207A	MC106-MC13	4	
208/209	MC11-SPLICE	4	
208/209	SPLICE-MC51	4	
208/209	M6-MC95	5	
208/209	MC95-MC11	5	
208/209	MC51-MC9	4	
210A	MC9-MC12	4	
211	R8-MC50	4	
211	MC50-R8	4	RETARDER
211	MC9-MC50	4	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
212	MC9-MC12	4	
213	MC50-R8	4	RETARDER
213	MC9-MC50	4	
214	MC50-R10	4	REVERSE
214	MC9-MC50	4	
215	MC9-MC50	4	
215	MC50-R9	4	CHECK TRANSMISSION
216A	MC106-MC13	3	
216A	MC9-MC51	4	ATEC
216A	MC51-MC106	4	ATEC
218	MC9-MC12	4	ATEC
219	MC9-MC12	4	ATEC
220	MC9-MC12	4	ATEC
221	MC9-MC12	4	ATEC
222	MC9-GROUND	4	ATEC
223A	MC51-CB14	4	TRANSMISSION
223A	MC51-SPLICE	4	
223A	SPLC-SPLC	4	
223A	SPLC-SPLC	4	
223A	SPLC-SPLC	4	
223A	SPLICE-MC9	4	
223B	MC12-SPLICE	4	
225	CB11-MC12	4	
230	MC12-234	4	
231	MC50-MC12	4	
231	MC50-R22	4	CRANE HI IDLE
231	MC50-M36	4	
231	M36-R11	4	NEUTRAL START
233	MC50-MC12	4	
234	MC12-GROUND	4	
240	MC62-CB23	5/4	
240	CB23-M6	4/5	
240	MC17-MC62	5	
240	MC62-M6	5	
241	MC62-CB22	5/4	
241	MC62-M6	5	
241	MC17-MC62	5	
241	CB22-M6	4/5	
309	MC45-R24	4	TC DUAL MODE
313	MC45-R24	4	TC DUAL MODE
315	MC45-R24	4	TC DUAL MODE
417	MC6-M35	3	
417	MC11-MC44	4	
417	MC11-MC18	5	ECM
417	MC44-MC6	3	THROTTLE SENSOR
419	MC11-MC18	5	ECM
419	MC11-MC44	4	
419	MC44-MC8	3	
419	MC8-L6	3	CHECK ENGINE LIGHT

REVISION D  
CN 15194  
12/23/97

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 2 OF 26  
ENGINEERING DWG 3053493 SHEET 1  
FP-3/FP-4 BLANK



REVISION D  
CN 15194  
12/23/97

CODE SORT				CODE SORT				CODE SORT			
CODE	ROUTING	SH	DESCRIPTION	CODE	ROUTING	SH	DESCRIPTION	CODE	ROUTING	SH	DESCRIPTION
439	MC116-MC106	4	EMERGENCY ENG STOP	1001	MC7-SPLICE	3		1008	MC27-MC3	6	FRONT TOW
439	MC116-S30	3	EMERGENCY ENG STOP	1001	MC8-SPLICE	3		1008	MC3-SPLICE	3	
439	MC116-S30	3	EMERGENCY ENG STOP	1001	SPLICE-L13	3		1008	MC3-MC4	3	
439	MC116-CB13	4	DDEC	1001	SPLICE-L14	3		1008	MC3-MC16	6	TRAILER CONN 12VDC
439	MC106-MC13	3		1001	S1-MC7	3	RH HEADLIGHT	1008	MC78-L22	6	RH TAIL LIGHT
439	SPLC-MC106	4		1002	S1-MC7	3	LH HEADLIGHT	1008	MC78-L24	6	LH TAIL LIGHT
439	MC11-MC18	5	ECM	1002	MC8-L11	3		1008C	MC25-MC15	6	TRAILER CONN 24VDC
439	MC8-L6	3	CHECK ENGINE LIGHT	1002	MC7-SPLICE	3		1008C	MC25-R14	4	B.O. SERVICE
439	MC8-L3	3	ENGINE STOP LIGHT	1002	SPLICE-MC8	3		1009	PS2-PS3	3	
439	MC44-MC8	3		1002	SPLICE-L18	3		1009	PS1-PS2	3	
439	MC11-SPLICE	4		1002	SPLICE-L16	3		1009	MC2-PS1	3	
439	SPLICE-MC44	4		1003	MC7-MC3	3		1009	MC2-CB6	4	STOP LIGHT
439	SPLC-MC116	4		1003	S1-MC7	3	LH RR TURN SIGNAL	1012	MC3-SPLICE	3	
505	MC44-MC8	3	TACHOMETER	1003	MC3-MC80	6		1012	SPLC-SPLC	3	
505	MC11-MC44	4		1003	MC3-MC16	6	TRAILER CONN 12VDC	1012	MC2-SPLICE	3	
505	MC8-G4	3		1003	MC1-R15	4	LH TURN LIGHT	1012	SPLC-SPLC	3	
505	MC11-MC18	5		1003	MC80-L24	6	LH STOP LIGHT	1012	SPLICE-L19	3	
509	MC11-MC18	5	ECM	1003	MC27-MC3	6	FRONT TOW	1012	MC2-R2	4	CLEARANCE LIGHTS
509	MC8-L3	3	ENGINE STOP LIGHT	1003	MC7-MC1	3		1012	MC3-SPLICE	6	
509	MC44-MC8	3		1003C	MC25-R17	4	LH TURN LIGHT	1012	SPLICE-MC27	6	
509	MC11-MC44	4		1003C	MC25-MC15	6	TRAILER CONN 12VDC	1012	SPLICE-MC80	6	
510	MC11-MC18	5	ECM	1004	MC7-MC1	3		1012	SPLICE-L32	6	RH SIDE MARKER
510	MC44-PS4	3	PARKING BRAKE	1004	MC7-MC3	3		1012	SPLICE-L34	6	LH SIDE MARKER
510	R22-MC44	4		1004	S1-MC7	3		1012	MC90-L31	6	RR SIDE MARKER
510	MC11-R22	4		1004	MC3-MC80	6		1012	MC90-L25	6	ID LIGHTS
528	MC11-MC18	5	DIAG. REQ.	1004	MC80-L22	6	RH STOP LIGHT	1012	MC80-MC90	6	
528	MC106-S17	3		1004	MC27-MC3	6		1012	MC90-L33	6	RR SIDE MARKER
528	MC11-MC106	4		1004	MC3-MC78	6		1016	MC92-MC2	3	
900	MC11-MC106	4		1004	MC3-MC16	6		1016	S15-MC92	3	
900	MC11-MC18	5	ECM	1004	MC1-R16	4		1016	MC2-R3	4	HORN
900	MC106-MC13	3		1004C	MC25-R16	4	RH TURN LIGHT	1017	SPLICE-R5	4	
901	MC11-MC18	5	ECM	1004C	MC25-MC15	6	TRAILER CONN 24VDC	1017	MC52-R14	4	
901	MC106-MC13	3		1005	MC126-S9	3		1017	R2-MC52	4	
901	MC11-MC106	4		1005	PS3-MC3	3		1017	MC2-SPLICE	4	
908	MC11-MC18	5	ECM	1005	MC3-MC16	6	TRAILER CONN 24VDC	1017	SPLICE-R1	4	
908	MC11-M4	4	THROTTLE POSN CONT	1005	MC126-PS1	3		1017	MC91-MC2	3	
916	MC44-MC6	3		1005	PS2-PS3	3		1017	S1-MC91	3	
916	MC11-MC44	4		1005	MC27-MC3	6	FRONT TOW	1017A	MC91-MC2	3	
916	MC38-M16	3		1005	PS1-PS2	3		1017A	S1-MC91	3	
916	MC6-MC38	3	VERNIER CONTROL	1005A	MC7-MC126	3		1017A	MC2-R5	4	
916	MC6-M35	3	THROTTLE SENSOR	1005A	MC126-S9	3		1018	MC8-L10	3	HIGH BEAM
916	MC11-MC18	5	ECM	1005A	S1-MC7	3	TURN SIGNAL/DIM SW	1018	MC8-1007	3	
952	MC38-M16	3		1006	MC2-SPLICE	3		1019	L15-1679	3	
952	MC11-MC44	4		1006	SPLICE-L12	3		1020	L14-L16	3	
952	MC44-MC6	3	THROTTLE SENSOR	1006	SPLICE-L17	3		1020	S2-MC21	3	
952	MC11-MC18	5	ECM	1006	MC2-R5	4	DIMMER	1020	MC60-CB24	5	
952	MC6-MC38	3	VERNIER CONTROL	1007	MC2-R5	4	DIMMER	1020	MC21-MC60	5	
953	M6-MC14	5	DDEC SIGNAL GROUND	1007	MC2-SPLICE	3		1020	M12-MC60	5	
953	MC14-SPLICE	4		1007	SPLICE-L12	3		1020A	CB24-PS12	5	
953	SPLICE-MC102	4		1007	SPLICE-L17	3		1020B	PS12-ENG	5	ALTERNATOR
953	SPLICE-R22	4		1008	MC3-MC78	6		1021	MC2-S2	3	
953	SPLICE-MC106	4		1008	MC4-S12	3	HEADLIGHTS	1021	MC2-R11	4	
953	MC106-S17	3						1021	R11-M76	4	
953	S17-MC13	3						1021A	R11-MC1	4	
988	MC11-R7	4	TRANSMISSION					1021A	MC1-MC21	3	
988	MC11-MC18	5	ECM					1021B	MC21-MC60	5	
1001	MC8-L4	3						1021B	MC60-R27	5	

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 3 OF 26  
ENGINEERING DWG 3053493 SHEET 1  
FP-5/FP-6 BLANK

28

27

26

25

24

23

22

21

20

REVISION 0

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1021	MC52-R11	4	FRONT TOW
1021A	R11-MC1	4	
1021A	MC1-MC21	3	
1021A	MC21-MC60	5	
1021A	MC60-R27	5	
1026	MC52-CB16	4	
1029	MC2-R6	4	BEACON
1029	MC2-MC28	3	
1031	R3-SPLICE	4	
1032	MC8-MC21	3	
1032	M39-L9	3	LOW OIL PSI
1032	MC8-M39	3	
1032	PS9-MC21	5	ENGINE OIL PSI SW
1033	M39-M18	3	OIL PSI/H WTR ALM
1036	MC23-M8	5	
1036	MC23-M7	5	
1036	MC21-MC56	5	ETHER START
1036	MC21-S25	3	
1040	CB4-R4	4	WORKLIGHT
1040A	S6-MC4	3	
1040A	MC2-R4	4	WORKLIGHT
1040A	MC4-MC2	3	
1040B	MC3-MC79	6	RH WORKLIGHT
1040B	MC2-MC3	3	
1040B	MC2-R4	4	WORKLIGHT
1040B	MC3-MC54	6	LH WORKLIGHT
1045	R27-M7	5	
1049	MC2-R1	4	HEADLIGHTS
1049	MC4-MC2	3	
1049	S12-MC4	3	
1052	S20-S19	3	CHEM ALM-GPF
1052	S19-S18	3	GAS PART FLTR-SRW
1052	S18-S4	3	SRW-SRW/MHC
1052	S4-S30	3	SRW/MHC-EMER ENG S D
1052	S30-SPLICE	3	EMER ENG SHUT DOWN
1052	SPLICE-G11	3	AIR PRESSURE GAUGE
1052	MC4-SPLICE	3	
1052	SPLICE-L44	3	HEATER PANEL LIGHT
1052	S5-S6	3	BEACON LT-WORK LT
1052	S6-S7	3	WORK LT-WSHLD WSHR
1052	S7-S8	3	WSHLD WASHER-WIPERS
1052	S8-S21	3	WIPERS-DOME LIGHT
1052	S21-S9	3	DOME LT-B.O.SERV SEL
1052	S9-S10	3	BO SERV SEL-BO MKR
1052	S10-S11	3	B.O. MARKER-B.O. DR
1052	S11-S12	3	B.O. DRIVE-HEADLTS
1052	S12-S16	3	HEADLIGHTS-ENG BK
1052	S16-S14	3	ENG BRAKE-RHEO/DOME
1052	S14-SPLICE	3	RHEOSTAT/DOME
1052	SPLICE-G6	3	VOLTMETER 12V
1052	SPLC-SPLC	3	
1052	SPLICE-G10	3	XMSN OIL TEMP GAUGE
1052	SPLICE-G1	3	WATER TEMP GAUGE
1052	SPLICE-G2	3	OIL PRESSURE GAUGE
1052	SPLICE-G4	3	TACHOMETER
1052	SPLICE-G5	3	SPEEDOMETER
1052	SPLICE-G3	3	FUEL GAUGE

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1052	MC1-SPLICE	3	
1052	SPLICE-L43	3	POST LIGHT
1052	SPLC-MC125	3	
1052	MC125-G12	3	AIR RESTRICTION GA
1052	MC1-SPLICE	3	
1052	MC1-CB1	4	15 AMP HEADLIGHT
1052	MC50-MC1	4	
1055	M7-R27	5	
1056	MC111-MC32	3	
1056	MC32-MC109	6	CTI POWER MANIFOLD
1057	MC111-MC32	3	
1057	MC32-MC109	6	CTI POWER MANIFOLD
1058	MC32-MC109	6	CTI POWER MANIFOLD
1058	MC111-MC32	3	
1059	MC32-MC109	6	CTI POWER MANIFOLD
1059	MC111-MC32	3	
1061	MC22-MC109	6	CTI POWER MANIFOLD
1061	MC111-MC32	3	
1062	MC32-MC109	6	CTI POWER MANIFOLD
1062	MC111-MC32	3	
1063	MC32-MC109	6	CTI POWER MANIFOLD
1064	MC32-MC109	6	CTI POWER MANIFOLD
1064	MC111-MC32	3	
1065	MC32-MC109	6	CTI POWER MANIFOLD
1065	MC111-MC32	3	
1066	MC32-MC64	6	CTI AUX MANIFOLD
1066	MC110-MC32	3	
1067	MC32-MC64	6	CTI AUX MANIFOLD
1068	MC32-MC64	6	CTI AUX MANIFOLD
1068	MC110-MC32	3	
1070	MC32-MC64	6	CTI AUX MANIFOLD
1070	MC110-MC32	3	
1071	MC110-MC32	3	
1071	MC32-MC64	6	CTI AUX MANIFOLD
1072	R26-R25	3	
1072	MC110-MC32	3	
1072	MC32-MC64	6	CTI AUX MANIFOLD
1073	MC32-MC64	6	CTI AUX MANIFOLD
1073	MC110-MC32	3	
1074	MC110-MC32	3	
1074	R25-CB10	4	
1074	MC32-MC64	6	CTI AUX MANIFOLD
1075	M6-R25	4/3	
1075B	R25-R18	4	
1076	MC110-MC32	3	
1076	MC32-MC64	6	CTI AUX MANIFOLD
1079	CB5-M6	4	HAZARD LIGHTS
1080	MC7-MC2	3	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1080	MC2-M5	4	TURN SIGNAL/FLASHER
1082	MC2-MC52	4	
1082	MC2-M81	3	
1082	M81-S3	3	
1082	MC52-CB15	4	HEATER
1084	MC1-CB5	4	B.O. LIGHTS
1084	MC4-MC1	3	
1084	MC4-S9	3	
1091	L17-GROUND	3	
1092	L7-MC8	3	
1092	MC8-M51	3	
1093	MC31-MC57	6	
1093	MC1-MC31	3	
1093	MC1-CB16	4	
1093	MC57-S13	6	DRIVE LINE LOCK-UP
1094	S5-S14	3	
1095	R23-R24	4	
1095	MC44-R23	4	
1095	MC31-MC44	3	
1095	MC57-S13	6	DRIVE LINE LOCK-UP
1095	MC31-MC57	6	
1113	MC8-MC21	3	
1113	G2-MC8	3	OIL PSI GAUGE
1113	SU3-MC21	5	ENG OIL PSI SNOG UN
1114	M66-MC8	3	
1114	MC96-MC8	3	LOW OIL LEVEL LIGHT
1114	MC8-L36	3	
1114	L36-M66	3	
1118	MC4-1919	3	
1118	S8-MC4	3	
1120	M66-MC8	3	
1120	M66-M3	3	
1120	PS6-PS7	3	
1120	PS6-MC8	3	
1120	L2-M66	3	
1137	M6(1)-M6(2)	5	
1137	M6(3)-M6(4)	5	
1138	M48-M7	5	SHUNT
1138	M7-M23	5	SLAVE
1138	M6-M48	5	SHUNT
1138	M77-M7	5	ARCTIC BATTERIES
1139	M7-M23	5	SLAVE
1139	M6-M7	5	
1139	M77-M7	5	ARCTIC BATTERIES
1147	TS2-MC21	5	ENG WTR TEMP SNOG UN
1147	M39-L8	3	HIGH WATER TEMP
1147	MC8-MC21	3	
1147	MC8-M39	3	
1149	MC1-R10	4	REVERSE
1149	MC3-MC78	6	
1149	MC1-MC124	3	
1149	MC78-MC77	6	REVERSE LIGHT
1149	MC124-MC77	6	

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 4 OF 26  
 ENGINEERING DWG 3053493 SHEET 2  
 FP-7/FP-8 BLANK

REVISION B  
CN 13985  
8/28/97

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1153	S21-MC4	3	
1153	MC4-L20	3	DOME LIGHT
1168	MC2-R3	4	HORN
1168	MC2-M15	3	
1174	BUS BAR	4	
1175	R28-CB5	4	
1176	MC113-PS13	6	EMERGENCY STEER
1184	S5-MC4	3	
1184	MC2-R6	4	
1184	MC2-MC4	3	
1189	MC4-S9	3	
1189	MC44-R28	4	
1189	MC4-SPLICE	3	
1189	MC4-S21	3	
1189	MC2-SPLICE	3	
1189	MC2-M5	4	
1189	SPLICE-MC44	3	
1274	M20-M6	5	
1274	M8-SPLICE	5	
1275	M6-M20	5	
1276	MC2-MC4	3	
1276	MC2-CB8	3	
1276	SPLICE-S14	3	
1276	SPLICE-MC53	3	
1276	MC4-SPLICE	3	
1276	MC2-SPLICE	4	
1276	MC53-SPLICE	3	
1276	SPLC-SPLC	3	
1276	SPLC-SPLC	3	
1276	SPLICE-M3	3	LOW AIR ALARM
1276	SPLICE-G5	3	SPEEDOMETER
1276	SPLICE-L1	3	PARKING BRAKE
1276	SPLICE-L2	3	LOW AIR
1276	SPLICE-L35	3	EMERGENCY STEERING
1276	SPLICE-L36	3	LOW HYDR OIL
1276	SPLC-SPLC	3	
1276	SPLICE-L5	3	XMSN CHECK
1276	SPLICE-L8	3	HIGH WATER TEMP
1276	SPLICE-L9	3	LOW OIL PSI
1276	SPLICE-G3	3	FUEL GAUGE
1276	SPLICE-G6	3	VOLTMETER 12V
1276	SPLICE-G1	3	WATER TEMP GAUGE
1276	SPLICE-G2	3	OIL PRESSURE GAUGE
1276	SPLICE-G4	3	TACHOMETER
1276	SPLICE-G10	3	XMSN OIL TEMP GAUGE
1276	SPLICE-M18	3	ALARM
1279	PS14-1277	5	
1279	MC115-PS14	5	
1279	M64-1280	5	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1280	CB21-R26	4	
1280	1281-R26	5	
1281	1280-MC47	5	
1281	R27-M81	5	
1281A	M20-M6	5	BATTERIES
1281A	M6-M64	5	
1292	MC4-S6	3	
1292	CB4-MC2	4	
1292	MC2-MC4	3	
1292	MC4-S12	3	
1314	1118-S7	3	
1318	MC3-MC8	3	
1318	MC3-G3	3	FUEL GAUGE
1318	MC3-SU5	6	FUEL LEVEL
1320	SU1-MC2	5	WATER TEMP SNOG UN
1320	G1-MC8	3	WATER TEMP
1320	MC8-MC21	3	
1340	CB15-MC14	4	SWING FIRE
1344	M20-MC22	5	
1362	R27-M64	5	
1371	MC8-PS5	3	
1371	L1-MC8	3	
1409	MC8-MC1	3	
1409	L5-MC8	3	
1409	MC1-R9	4	
1413	CB3-SPLICE	4	
1413	SPLICE-R6	4	
1430	R28-SH5	4/5	
1430	1832-R28	5	
1431	MC3-S2	3	
1431	MC3-M64	5/6	POLARITY PROTECTION
1431	MC3-M64	5/6	POLARITY PROTECTION
1431	MC1-MC119	4	
1431	MC119-R32	4	
1431	R32-S29	4	ARCTIC PUMP
1431	MC119-CB20	4	
1435	MC78-MC124	6	
1435	MC124-M78	6	
1435	MC77-MC124	6	
1435	MC85-MC86	7	
1435	MC86-MC87	7	
1435	MC33-MC84	7	
1435	GROUND	3	
1435	MC81-MC82	7	
1435	MC84-MC83	7	
1435	MC81-MC82	7	
1435	MC108-GND	5	
1435	GND	5	
1435	MC22-GND	5	
1435	M52-R26	4	
1435	M52-R28	4	
1435	R27-GND	5	
1435	MC125-GND	3	
1435	MC23-M7	5	
1435	MC23-M8	5	EITHER START

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1449	MC8-MC21	3	
1449	G10-MC8	3	TRANS OIL TEMP
1449	SU2-MC21	5	TRANS TEMP SNOG UN
1454	MC81-MC82	7	
1460	MC81-MC82	7	
1461	MC86-MC87	7	
1461	MC85-MC86	7	
1462	MC81-MC82	7	
1463	MC81-MC82	7	
1464	MC81-MC82	7	
1465	MC81-MC82	7	
1466	MC85-MC86	7	
1466	MC86-MC87	7	
1467	MC81-MC82	7	
1468	MC81-MC82	7	
1469	MC81-MC82	7	
1469	MC86-MC87	7	
1469	MC85-MC86	7	
1470	MC86-MC87	7	
1470	MC85-MC86	7	
1471	MC85-MC86	7	
1471	MC86-MC87	7	
1471	MC81-MC82	7	
1472	MC85-MC86	7	
1472	MC81-MC82	7	
1472	MC86-MC88	7	
1475	MC85-MC86	7	
1475	MC86-MC87	7	
1480	MC84-MC93	7	
1480	MC84-MC83	7	
1481	MC84-MC83	7	
1481	MC84-MC93	7	
1482	MC84-MC93	7	
1482	MC84-MC83	7	
1483	MC83-MC84	7	
1483	MC84-MC93	7	
1484	MC83-MC84	7	
1484	MC84-MC93	7	
1485	MC84-MC94	7	
1485	MC83-MC84	7	
1486	MC84-MC94	7	
1486	MC83-MC84	7	
1487	MC1-S25	3	
1487	MC1-CB15	4	
1487	MC83-MC84	7	
1487	MC84-MC94	7	
1488	MC84-MC94	7	
1488	MC83-MC84	7	
1489	MC83-MC84	7	
1489	MC84-MC94	7	
1490	MC84-MC94	7	
1490	MC83-MC84	7	
1491	L16-1008	3	
1491	L14-1008	3	
1517	PS8-MC11	5	ATEC OIL PSI SWITCH
1517	MC11-R9	4	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1519	MC8-MC35	3	CTI OVERSPEED
1519	MC3-MC8	3	SPEEDOMETER
1519	MC8-MC35	3	CTI OVERSPEED
1519	G5-MC8	3	SPEEDOMETER
1519	MC3-SU4	6	SPEEDOMETER
1519	G5-MC8	3	SPEEDOMETER
1519	MC3-MC8	3	SPEEDOMETER
1519	MC3-SU4	6	SPEEDOMETER
1525	M16-PS4	3	
1534	MC107-M9	6	FUEL/WATER SEP
1534	MC2-SPLICE	4	
1534	SPLICE-CB8	4	
1534	MC3-MC107	6	
1534	MC2-MC3	3	
1534	MC3-S22	3	T-CASE LOCK-UP
1534	CB15-M76	4	
1538	MC97-M13	6	AIR DRYER
1538	MC25-MC97	6	
1538	MC25-CB15	4	
1538	MC25-MC98	6	
1538	MC99-M11	6	AFTER COOLER
1538	MC98-M14	6	AIR DRYER
1538	MC25-MC99	6	
1538	MC25-MC73	6	FAN CONTROL
1538	M76-MC25	4	
1640	MC119-SPLC	4	
1640	SPLICE-R26	4	
1640	SPLICE-MC44	4	
1640	MC44-S2	3	
1640	MC119-R32	4	
1644	MC119-R33	4	
1644	R33-R33	4	
1644	MC119-S29	4	ARCTIC PUMP
1644	R33-S29	4	ARCTIC PUMP
1644	MC119-MC25	4	
1644	MC25-MC120	6	
1644	MC120-M80	6	ARCTIC PUMP
1645	S29-R33	4	ARCTIC PUMP
1665C	MC25-MC15	6	TRAILER CONN 24VDC
1665C	MC25-CB20	4	
1674	S11-S10	3	
1674	S11-S9	3	
1676	R17-R16	4	
1676	R16-R15	4	
1676	R14-R3	4	
1676	R15-R14	4	
1676	CB20-R17	4	
1678	MC3-MC78	6	
1678	MC1-SPLICE	3	
1678	MC78-L24	6	LH B.O. STOP LIGHT

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 5 OF 26  
ENGINEERING DWG 3053493 SHEET 2  
FP-9/FP-10 BLANK

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1678	MC78-L22	6	RH B.O. STOP LIGHT
1678	SPLICE-MC3	3	
1678	MC1-R13	4	
1678	SPLICE-MC4	3	
1678	MC4-S9	3	
1678C	MC25-R13	4	B.O. STOP LIGHT
1678C	MC25-MC15	6	TRAILER CONN 24VDC
1679	L15-MC4	3	
1679	MC4-S11	3	
1680	MC3-SPLICE	3	
1680	SPLICE-MC1	3	
1680	SPLC-SPLC	3	
1680	SPLICE-MC4	3	
1680	SPLC-SPLC	3	
1680	SPLICE-L19	3	
1680	SPLICE-L19	3	
1680	MC3-MC78	6	
1680	MC4-S10	3	
1680	MC78-L24	6	LH B.O. TAIL LIGHT
1680	MC1-R17	4	B.O. LIGHTS
1680	MC78-L22	6	RH B.O. TAIL LIGHT
1680C	MC25-MC15	6	TRAILER CONN 24VDC
1680C	MC25-MC15	6	TRAILER CONN 24VDC
1680C	MC25-R17	4	B.O. TAIL LIGHTS
1680C	MC25-MC15	6	TRAILER CONN 24VDC
1702	MC44-MC34	3	
1702	MC34-G7	3	
1702	MC44-R26	4	
1708	M32-1709	3	PASSENGER AIR HTR
1709	MC58-S19	3	GAS PART FILTER SW
1709	MC58-M30	3	
1710	M31-1709	3	DRIVER AIR HEATER
1711	CB11-R7	4	
1712	MC1-CB7	4	ENGINE BRAKE
1712	MC4-MC1	3	
1713	MC53-L37	3	
1713	MC4-MC1	3	
1713	S16-MC4	3	ENGINE BRAKE
1713	MC1-R7	4	TRANSMISSION
1713	S16-MC53	3	
1714	MC1-1716	4	
1714	MC4-MC1	3	ENGINE BRAKE
1714	S16-MC4	3	ENGINE BRAKE
1715	MC4-MC1	3	ENGINE BRAKE
1715	S16-MC4	3	ENGINE BK RH COILS
1715	MC11-MC1	4	
1715	MC11-M21	5	LH ENGINE BRAKE
1716	MC11-R5	4	RETARDER
1716	MC11-M22	5	RH ENGINE BRAKE
1717	MC44-S20	3	CHEMICAL ALARM SW
1717	MC44-CB19	4	
1718	M78-M77	6	BACK-UP ALARM
1722	MC34-1734	3	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1722	L26-MC34	3	
1722	MC33-MC84	7	
1722	MC84-MC83	7	
1723	MC44-S18	3	SELF RECOVERY WN SW
1723	MC44-CB18	4	
1724	MC112-SPLC	3	
1724	SPLICE-MC33	3	
1724	MC33-MC93	7	
1724	L27-MC112	3	
1724	M67-SPLICE	3	
1724	SPLC-MC112	3	
1724	M67-MC33	3	
1725	L28-MC112	3	
1725	MC84-MC83	7	
1725	MC33-MC84	7	
1725	MC112-MC33	3	
1726	MC33-MC84	7	
1726	MC84-MC83	7	
1726	MC112-MC33	3	
1726	L29-MC112	3	
1729	MC31-S18	3	SELF RECOVERY WINCH
1729	MC31-MC55	6	
1729	MC55-MC121	6	SELF RECOVERY WINCH
1730	MC31-S18	3	SELF RECOVERY WINCH
1730	MC55-MC122	6	SELF RECOVERY WINCH
1730	MC31-MC55	6	
1731	MC3-S4	3	SELF RECOVERY WINCH
1731	MC3-S4	3	SELF RECOVERY WINCH
1731	MC3-MC29	6	CRANE
1732	MC55-MC123	6	SELF RECOVERY WINCH
1732	S4-MC31	3	SELF RECOVERY WINCH
1732	MC31-MC55	6	
1733	MC31-M67	3	
1733	MC31-M51	6	
1734	M67-SPLICE	3	
1734	SPLC-SPLC	3	
1734	SPLICE-MC31	3	
1734	MC31-M10	6	
1736	MC39-MC39	5	
1737	MC31-MC1	3	
1737	MC1-R22	4	CRANE HI IDLE
1737	MC31-MC29	6	CRANE
1738	MC44-1755	4	
1738	MC44-MC31	3	
1738	MC31-MC29	6	CRANE
1739	MC44-CB21	4	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1739	MC44-S19	3	GAS PARTICULATE SW
1744	S4-M67	3	
1745	MC103-S20	3	CHEMICAL ALARM
1746	MC103-M29	3	CHEMICAL ALARM
1747	MC103-M29	3	CHEMICAL ALARM
1755	MC84-MC83	7	
1755	MC44-CB18	4	
1755	MC33-MC84	7	
1755	MC33-MC44	3	
1765	MC3-MC113	6	
1765	L35-MC8	3	
1765	MC3-MC8	3	
1809	MC41-MC65	5	PULSE TACH DRIVE
1809	MC65-MC39	5	STE/ICE
1810	MC41-M40	5	PULSE TACH DRIVE
1810	MC65-MC39	5	STE/ICE
1810	MC41-M40	5	PULSE TACH DRIVE
1810	MC41-MC65	5	PULSE TACH DRIVE
1811	MC42-M41	5	DIFFERENTIAL PSI
1811	MC42-MC39	5	STE/ICE
1812	MC42-M41	5	DIFFERENTIAL PSI
1812	MC42-MC39	5	STE/ICE
1813	MC39-M6	5	
1814	MC39-M6	5	BATTERIES
1815	MC39-MC24	5	
1815	MC24-MC114	5	
1815	MC24-M20	5	
1816	MC39-MC65	5	STE/ICE
1816	MC39-M7	5	STARTER

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1818	MC39-M7	5	STARTER
1818	MC39-MC65	5	STE/ICE
1819	MC39-M7	5	
1820	MC24-M20	5	
1820	MC24-M20	5	
1820	MC39-MC24	5	
1821	MC39-M6	5	
1822	MC39-M6	5	BATTERIES
1824	SPLICE-MC67	5	
1824	MC66-M70	5	
1824	MC68-M72	5	
1824	SPLICE-MC70	5	
1824	SPLICE-MC71	5	
1824	MC65-MC39	5	STE/ICE
1824	SPLICE-MC68	5	
1824	MC67-M71	5	
1824	MC43-M42	5	FUEL PSI
1824	MC69-M73	5	
1824	MC70-M74	5	
1824	MC71-M75	5	
1824	SPLICE-MC69	5	
1824	MC66-SPLICE	5	
1824	SPLICE-MC65	5	
1824	SPLICE-MC43	5	
1825	MC68-MC69	5	
1825	MC70-MC71	5	
1825	MC65-MC43	5	
1825	MC43-MC67	5	
1825	MC67-MC68	5	
1825	MC70-M74	5	
1825	MC69-MC70	5	
1825	MC41-MC65	5	
1825	MC68-M72	5	
1825	MC66-M70	5	TURBO OUTLET PSI
1825	MC65-MC39	5	STE/ICE
1825	MC69-M73	5	
1825	MC67-M71	5	
1825	MC39-MC40	5	STE/ICE MODULE
1825	MC43-M42	5	FUEL PSI
1825	MC71-M75	5	
1825A	MC39-MC40	5	STE/ICE MODULE
1826	MC40-MC39	5	
1827	MC40-MC39	5	
1828	MC39-M48	5	SHUNT
1829	MC39-M48	5	SHUNT
1835	R2-CB2	4	
1839	R7-R8	4	
1860	MC39-MC24	5	
1860	MC24-MC114	5	
1861	MC24-MC114	5	

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 6 OF 26  
 ENGINEERING DWG 3053493 SHEET 2  
 FP-11/FP-12 BLANK

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1861	MC39-MC24	5	
1866	CB12-M6	4	
1866	M6-CB12	4/3	
1867	R19-CB12	4	
1871	MC11-CB11	4	DDEC TRANS
1871	PS8-MC11	5	ATEC OIL PSI SWITCH
1871	MC11-R8	4	
1871	MC11-R11	4	
1871	MC11-R10	4	
1871	MC11-R18	4	
1872	R19-MC44	4	
1872	MC44-R18	4	DDEC
1872	MC44-1020	3	
1875	CB14-R19	4	
1880	MC4-MC35	3	
1880	MC44-CB17	4	CTI
1882	MC52-R21	4	
1882	MC52-SPLICE	4	
1882	MC52-R20	4	
1883	S26-L40	3	TC LOCK-UP LIGHT
1883	S26-M49	3	TC LOCK-UP
1884	MC1-R20	4	INTER AXLE
1884	MC1-M39	4	
1884	MC1-MC105	3	
1885	MC1-M39	4	
1885	MC1-MC105	3	
1885	R23-R21	4	
1885	MC1-R23	4	
1888	CB16-R21	4	DIFFERENTIAL LOCK
1888	CB16-R20	4	INTER AXLE
1889	MC44-R20	4	INTER AXLE
1889	MC44-M50	3	INTER AXLE LOCK
1890	MC44-M51	3	DIFFERENTIAL LOCK
1890	MC44-R21	4	DIFFERENTIAL LOCK
1891	MC52-SPLICE	4	
1891	MC52-R10	4	REVERSE
1916	S8-MC4	3	
1916	MC5-M2	3	WIPER MOTOR
1916	MC5-MC4	3	WIPER MOTOR
1917	MC5-M2	3	
1917	MC5-MC4	3	
1917	S8-MC4	3	
1919	MC2-MC5	3	
1919	MC5-M2	3	
1919	MC5-1118	3	
1919	MC2-CB10	4	
1920	MC2-1008	3	
1920	MC2-R2	4	CLEARANCE LIGHTS
1921	S7-MC4	3	
1921	M1-MC4	3	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1926	MC56-MC23	5	ETHER START
1927	R1-CB1	4	HEADLIGHTS
1928	MC34-MC31	3	
1928	L38-MC34	3	
1928	MC31-MC30	6	TRAILER
1929	MC31-MC30	6	TRAILER
1929	MC34-MC31	3	
1932	MC128-MC61	6	WATER TEMP
1932	MC61-TS3	6	WATER TEMP
1932	MC59-MC63	6	
1932	MC63-MC128	6	
1933	MC61-TS3	6	WATER TEMP
1933	MC63-MC61	6	
1933	MC59-MC63	6	
1935	MC76-M45	6	FAN CONTROL VALVE
1935	MC59-MC76	6	
1935	MC76-M45	6	FAN CONTROL VALVE
1935	MC59-MC76	6	
1938	MC70-M74	5	
1938	MC70-MC65	5	
1938	MC65-MC39	5	
1938B	MC39-S22	5	STE/ICE ZEROING
1939	MC71-M75	5	ENGINE WATER TEMP
1939	MC65-MC39	5	STE/ICE
1939	MC71-MC65	5	
1939B	MC39-S22	5	STE/ICE ZEROING
1940	MC71-MC65	5	
1940	MC71-M75	5	ENGINE WATER TEMP
1940	MC65-MC39	5	STE/ICE
1940B	MC39-S22	5	STE/ICE ZEROING
1941	MC43-M42	5	FUEL PSI
1941	MC43-MC65	5	
1941	MC65-MC39	5	STE/ICE
1942	MC43-MC65	5	
1942	MC65-MC39	5	
1942	MC43-M42	5	FUEL PSI
1943	MC65-MC39	5	STE/ICE
1943	MC66-M70	5	TURBO OUTLET PSI
1943	MC66-MC65	5	TURBO OUTLET PSI
1944	MC66-M70	5	
1944	MC65-MC39	5	STE/ICE
1944	MC66-MC65	5	TURBO OUTLET PSI
1945	MC68-MC65	5	
1945	MC68-M72	5	AIR BOX PSI
1945	MC65-MC39	5	STE/ICE
1946	MC67-M71	5	

CODE SORT			
CODE	ROUTING	SH	DESCRIPTION
1946	MC65-MC39	5	STE/ICE
1946	MC68-M72	5	AIR BOX PSI
1946	MC68-MC65	5	
1947	MC67-MC65	5	
1947	MC65-MC39	5	STE/ICE
1947	MC67-M71	5	AIR CLEANER
1948	MC67-MC65	5	
1948	MC65-MC39	5	STE/ICE
1949	MC69-MC65	5	FUEL RETURN
1949	MC69-MC65	5	
1949	MC65-MC39	5	STE/ICE
1950	MC5-MC4	3	
1950	S8-MC4	3	
1951	MC65-MC39	5	STE/ICE
1951	MC69-M73	5	FUEL RETURN
1951	MC69-MC65	5	
1952	MC65-MC39	5	
1952	MC70-M74	5	ENGINE OIL TEMP
1952	MC70-MC65	5	
1952B	MC39-S22	5	STE/ICE ZEROING
1953	MC39-MC24	5	
1953	MC24-MC114	5	
1953	MC24-M20	5	
1955	M67-MC21	3	FAN SPEED CONTROL
1956	MC127-MC44	3	FAN SPEED CONTROL
1957	MC127-MC21	3	FAN SPEED CONTROL
SHIELD	MC32-MC64	6	CTI AUX MANIFOLD
SHIELD	MC32-MC109	6	CTI POWER MANIFOLD

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 7 OF 26  
 ENGINEERING DWG 3053493 SHEET 2  
 FP-13/FP-14 BLANK

REVISION 0

28 27 26 25 24 23 22 21 20

H  
G  
F  
E  
D  
C  
B  
A

H  
G  
F  
E  
D  
C  
B  
A

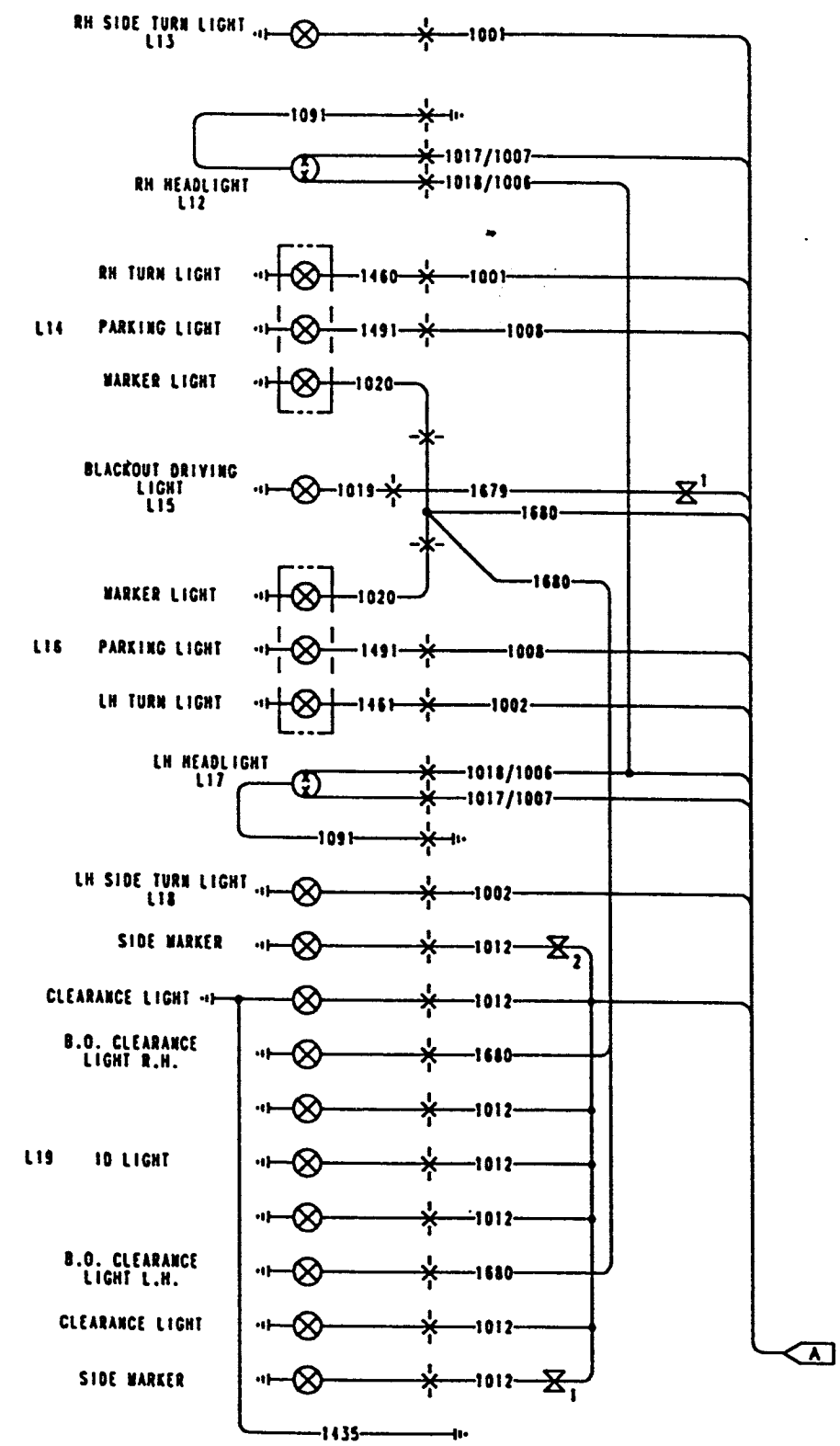


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 8 OF 26  
 ENGINEERING DWG 3053493 SHEET 3  
 FP-15/FP-16 BLANK

28 27 26 25 24 23 22 21 20



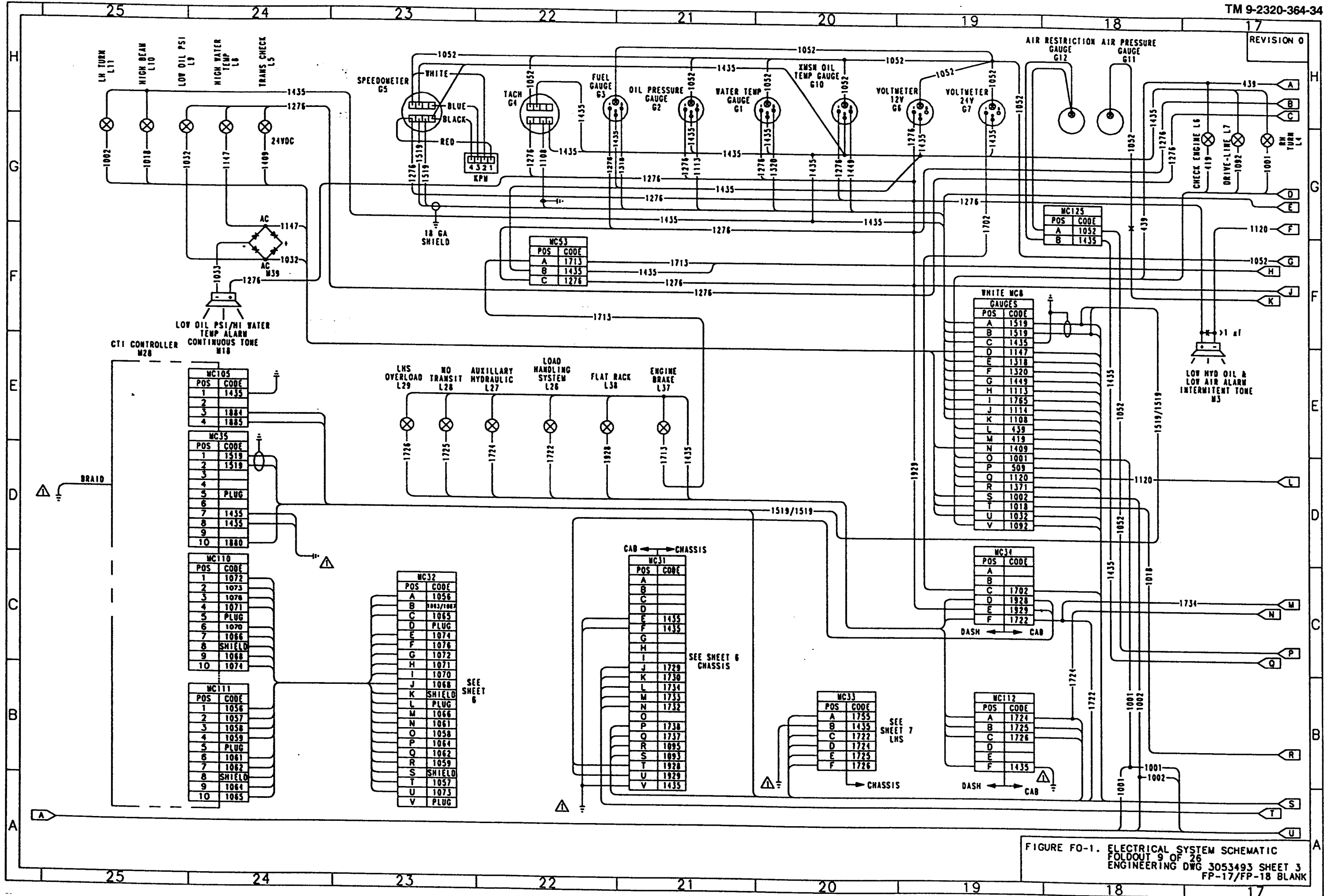


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 9 OF 26  
 ENGINEERING DWG 3053493 SHEET 3  
 FP-17/FP-18 BLANK

REVISION D

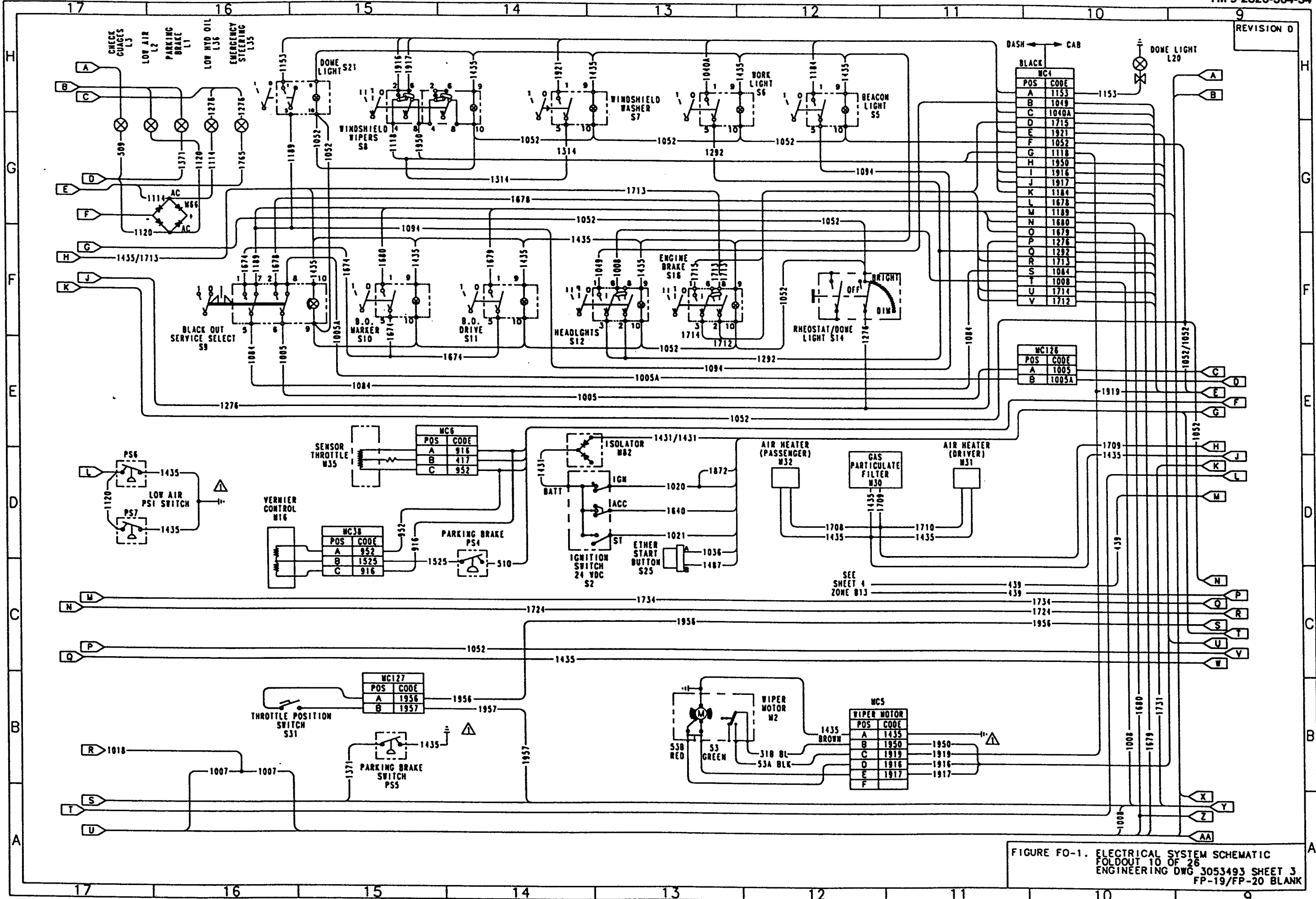


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 10 OF 26  
 ENGINEERING DWG 3053493 SHEET 3  
 FP-19/FP-20 BLANK



REVISION 0

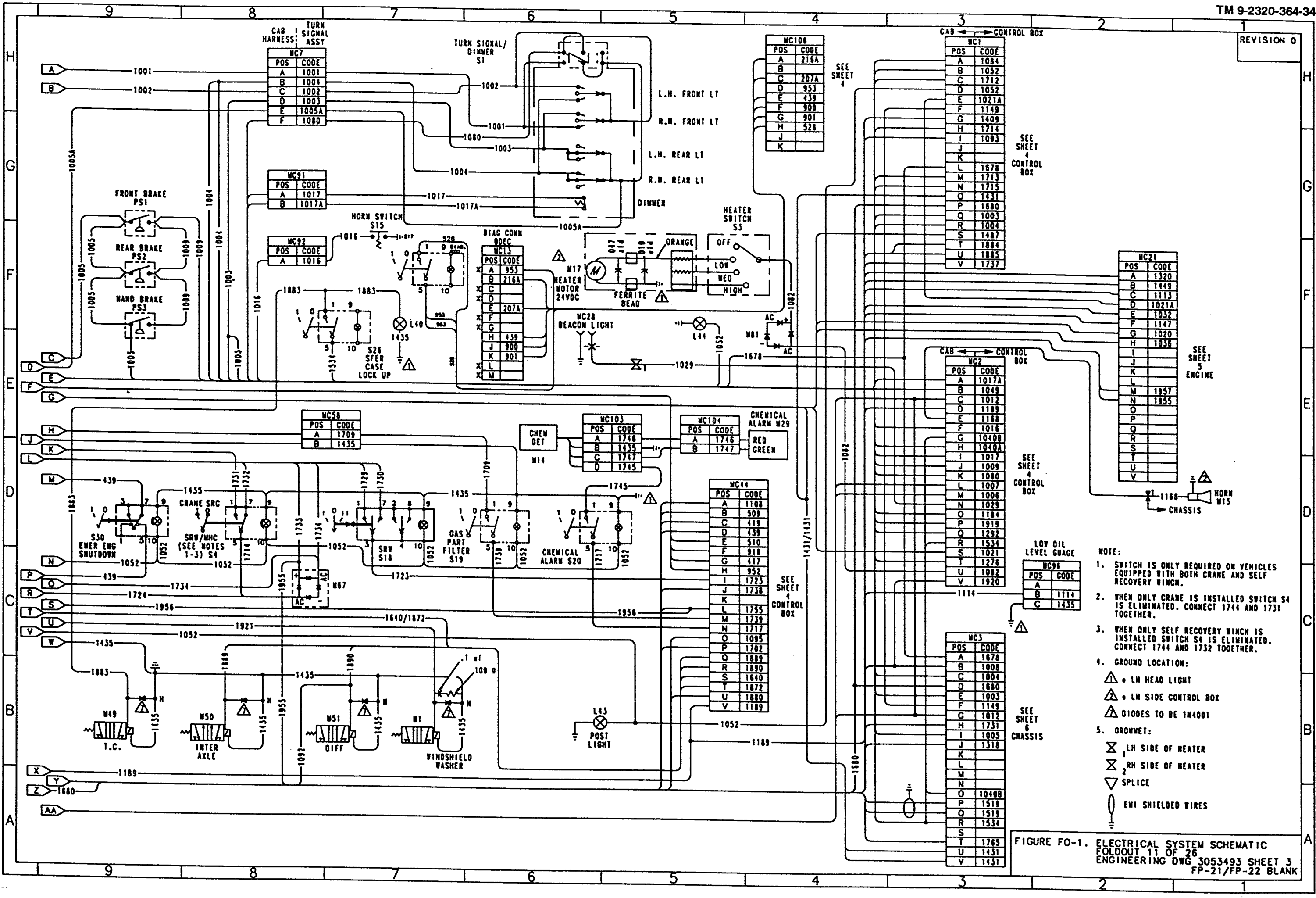


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC FOLDOUT 11 OF 26 ENGINEERING DWG 3053493 SHEET 3 FP-21/FP-22 BLANK



REVISION C  
CN 14815  
12-15-97

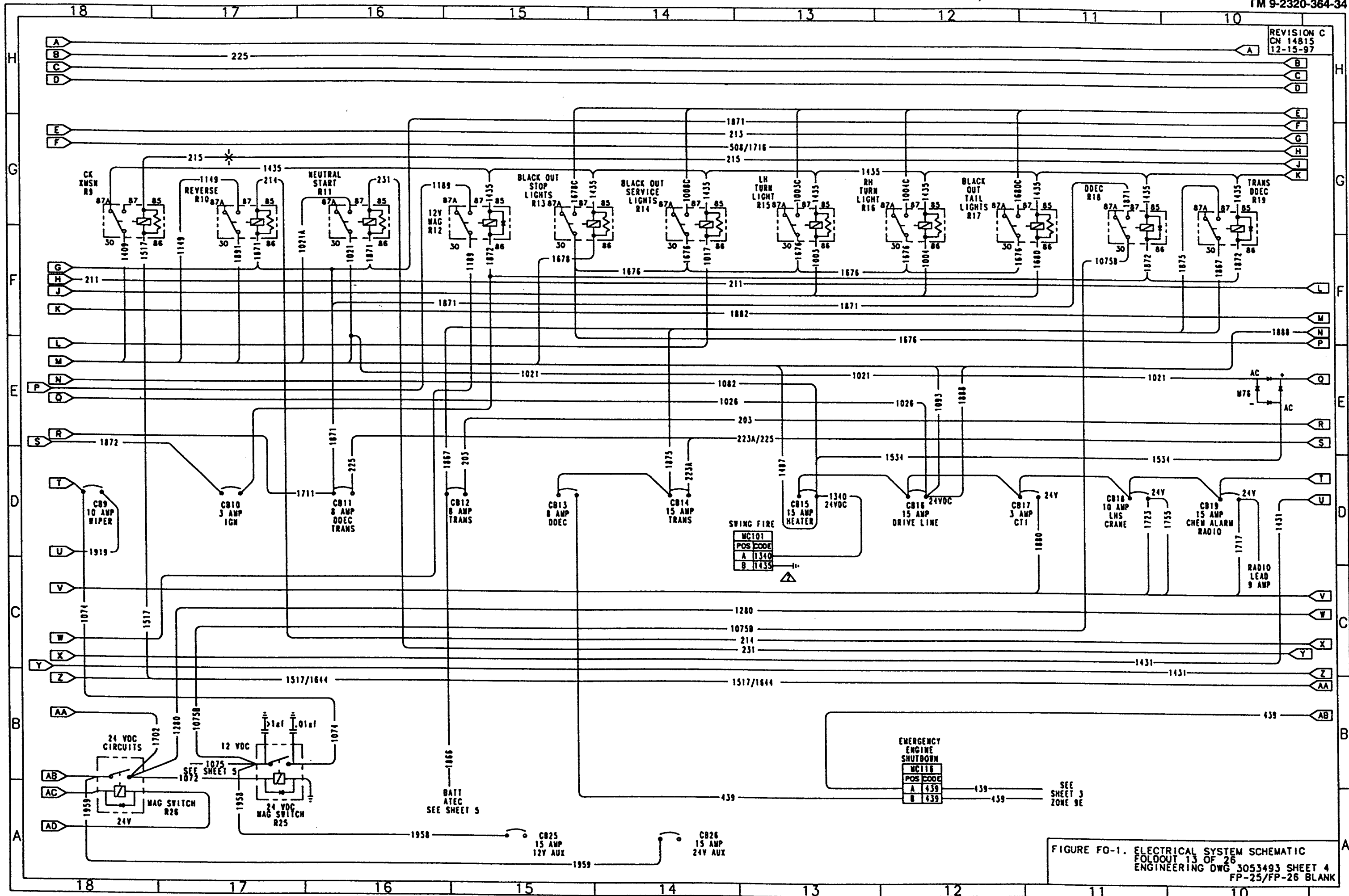


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 13 OF 26  
 ENGINEERING DWG 3053493 SHEET 4  
 FP-25/FP-26 BLANK

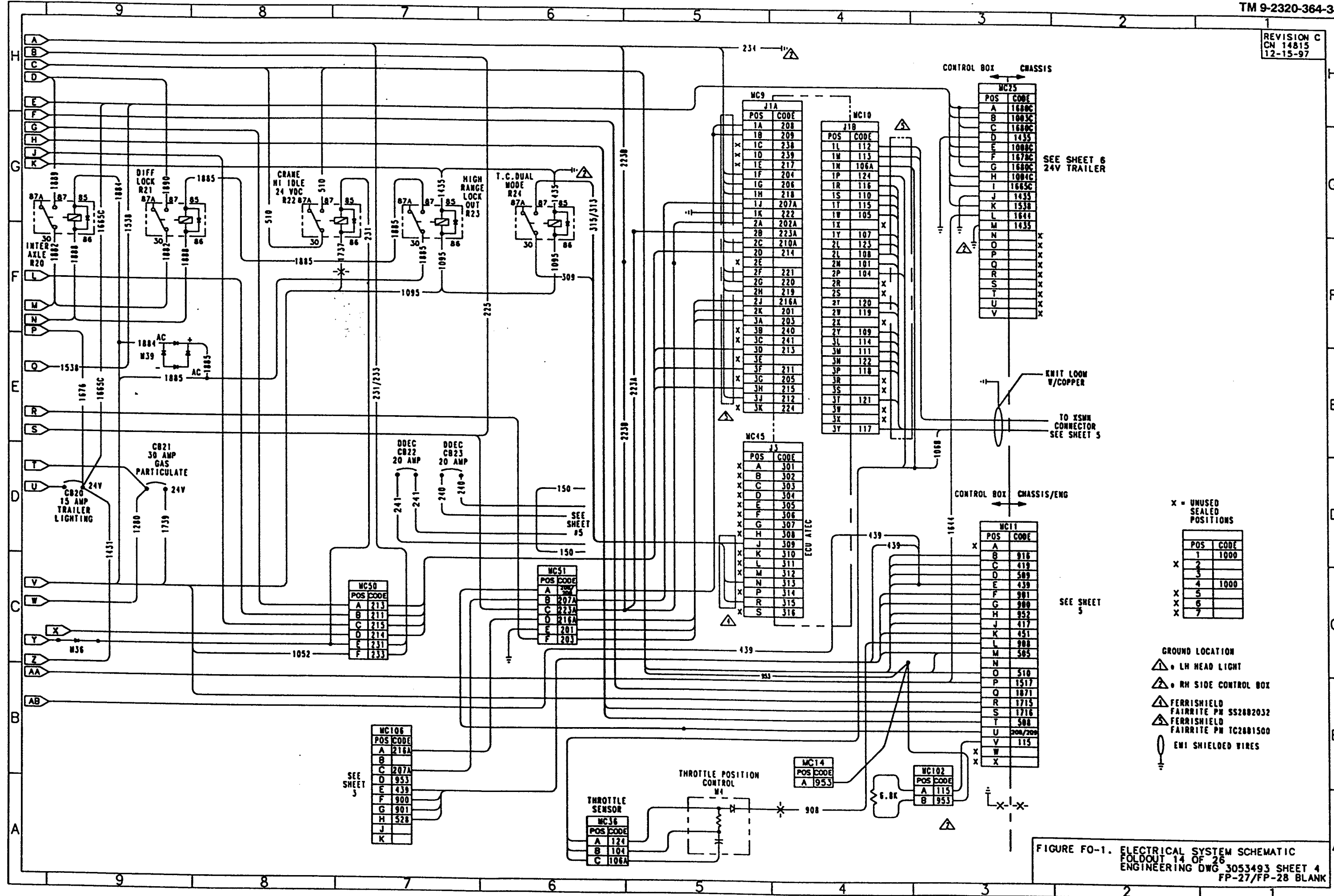
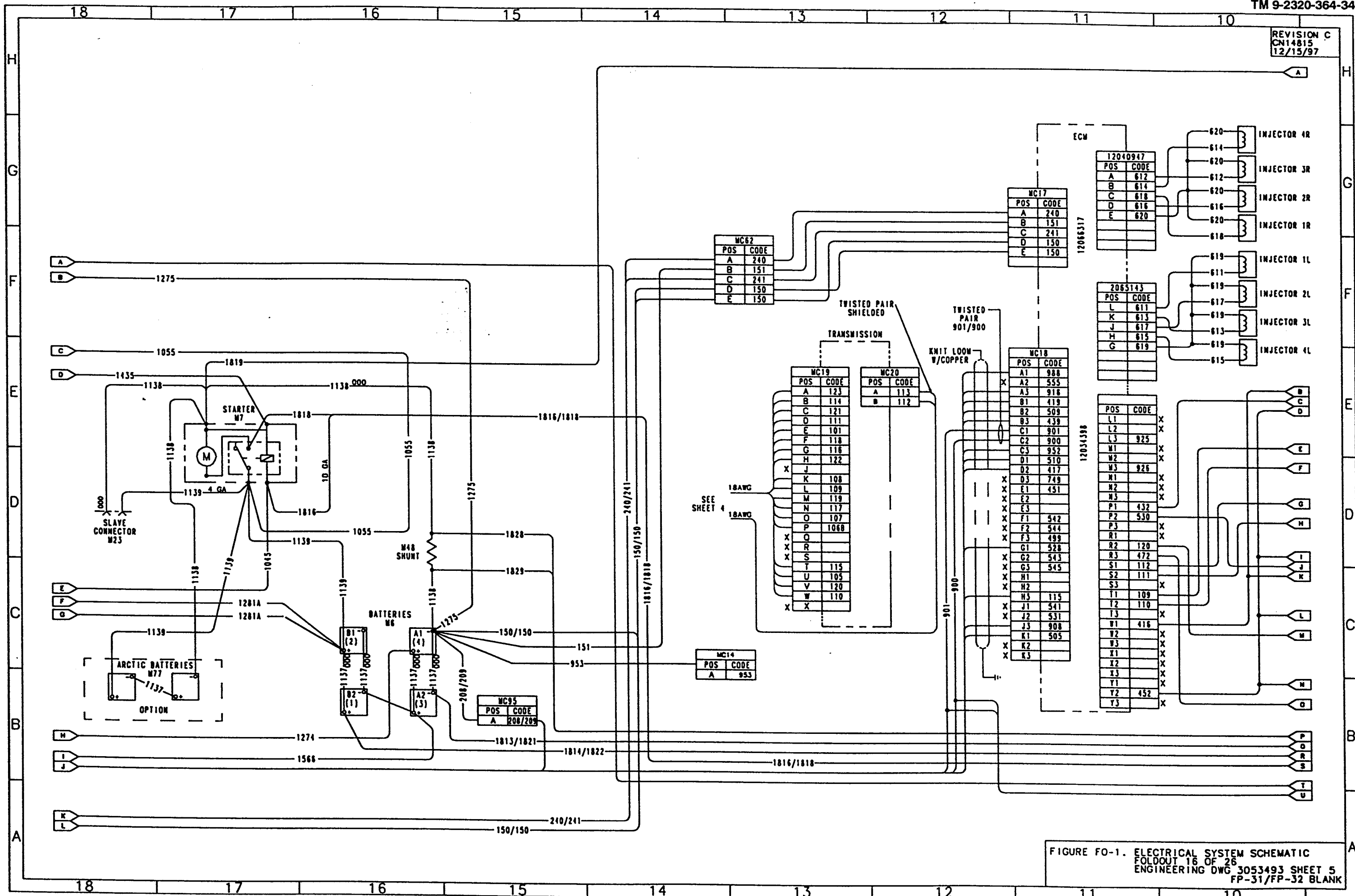


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 14 OF 26  
ENGINEERING DWG 3053493 SHEET 4  
FP-27/FP-28 BLANK



REVISION C  
CN14815  
12/15/97



POS	CODE
A	240
B	151
C	241
D	150
E	150

POS	CODE
A	240
B	151
C	241
D	150
E	150

POS	CODE
A	123
B	114
C	121
D	111
E	101
F	118
G	116
H	122
J	
K	108
L	109
M	119
N	117
O	107
P	1068
Q	
R	
S	
T	115
U	105
V	120
W	110
X	

POS	CODE
A	113
B	112

POS	CODE
A1	988
A2	555
A3	916
B1	419
B2	509
B3	439
C1	901
C2	900
C3	952
D1	510
D2	417
D3	749
E1	451
E2	
E3	
F1	542
F2	544
F3	499
G1	528
G2	543
G3	545
H1	
H2	
H3	115
J1	541
J2	531
J3	908
K1	505
K2	
K3	

POS	CODE
L1	X
L2	X
L3	925
M1	X
M2	X
M3	926
N1	X
N2	X
N3	X
P1	432
P2	530
P3	X
R1	X
R2	120
R3	472
S1	112
S2	111
S3	X
T1	109
T2	110
T3	X
V1	416
V2	X
V3	X
X1	X
X2	X
X3	X
Y1	X
Y2	452
Y3	X

POS	CODE
A	208/209

POS	CODE
A	953

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 16 OF 26  
 ENGINEERING DWG 3053493 SHEET 5  
 FP-31/FP-32 BLANK

REVISION C  
CN 14815  
12-15-97

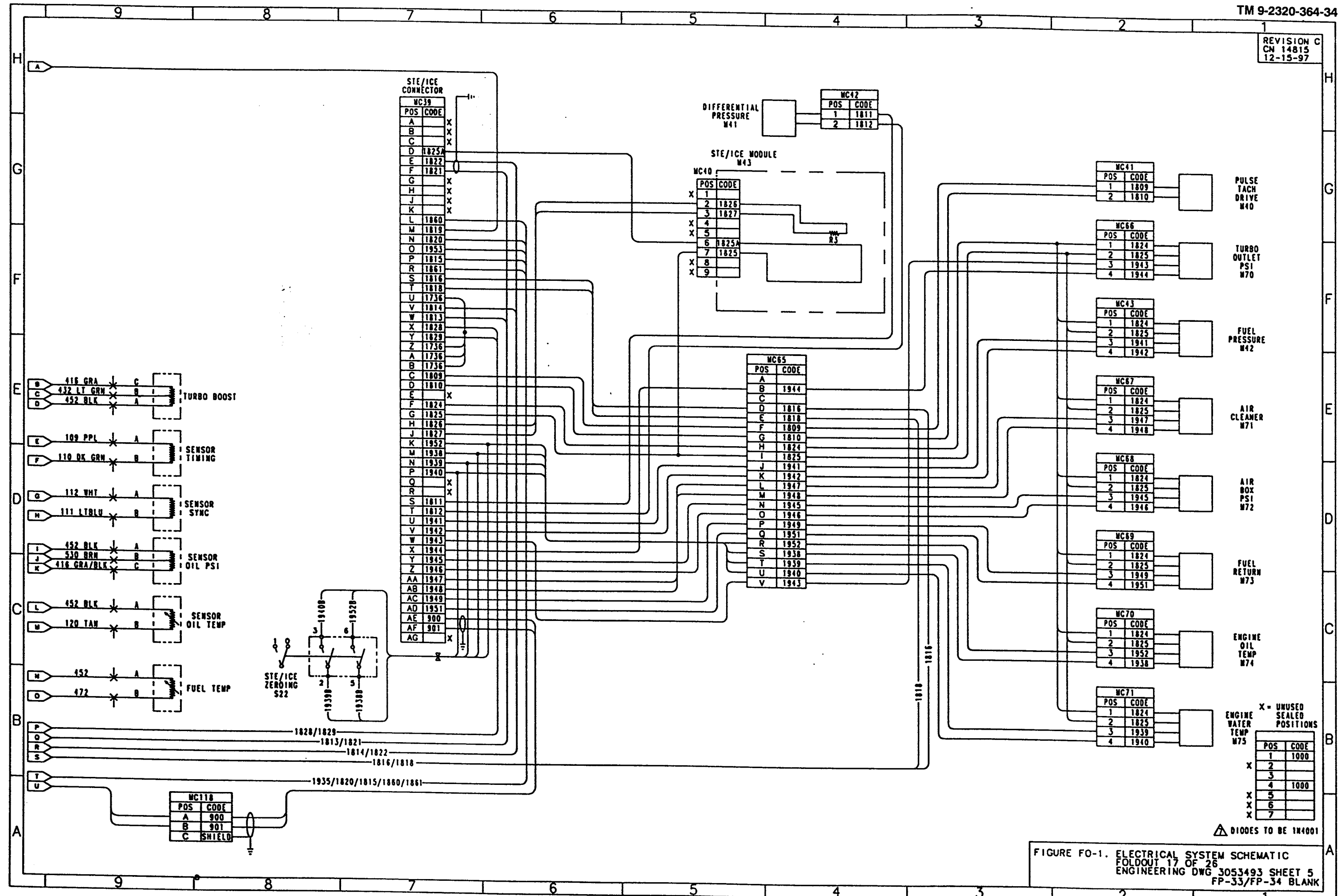


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
FOLDOUT 17 OF 26  
ENGINEERING DWG 3053493 SHEET 5  
FP-33/FP-34 BLANK



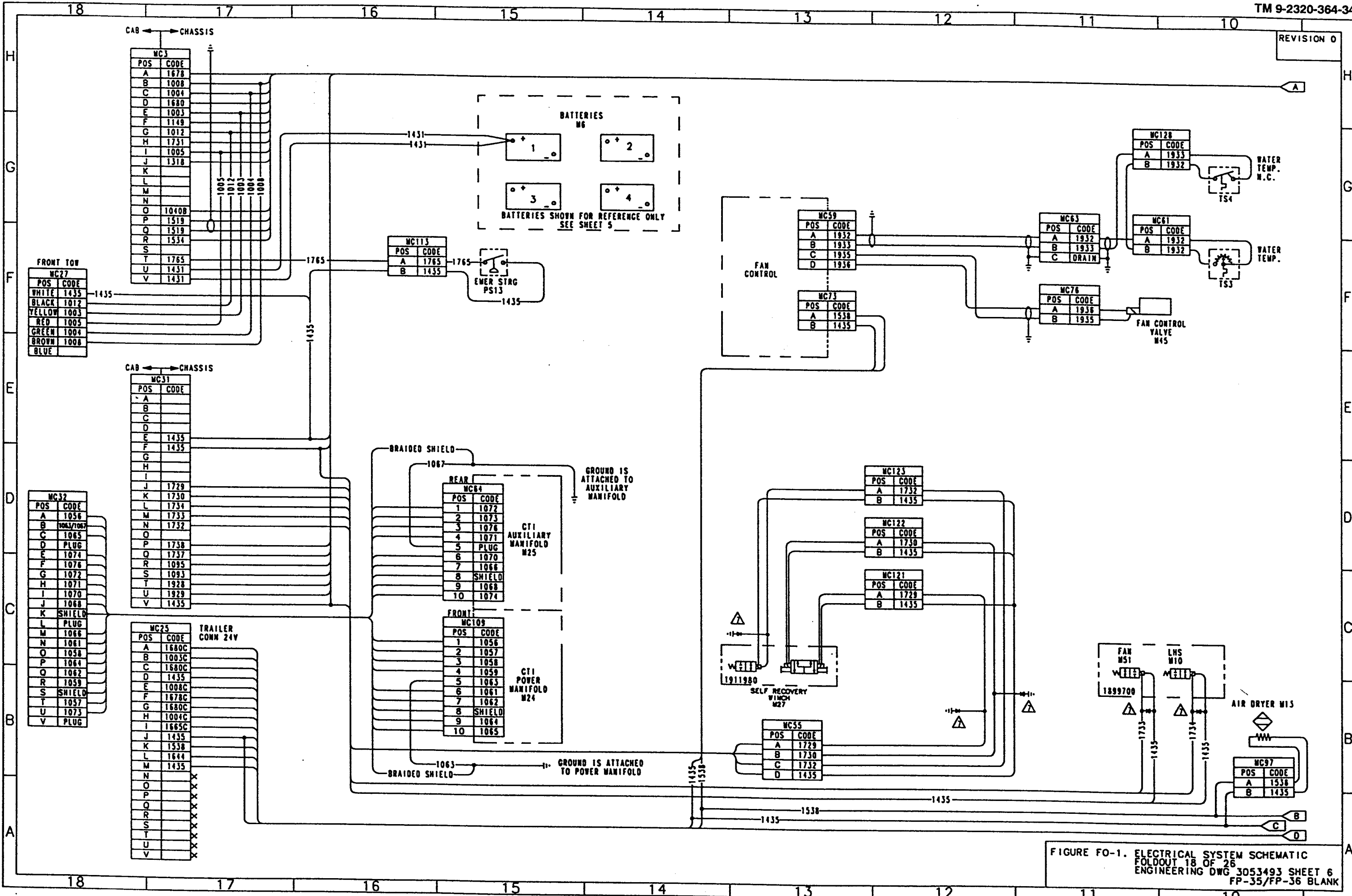


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 18 OF 26  
 ENGINEERING DWG 3053493 SHEET 6  
 FP-35/FP-36 BLANK



REVISION 0

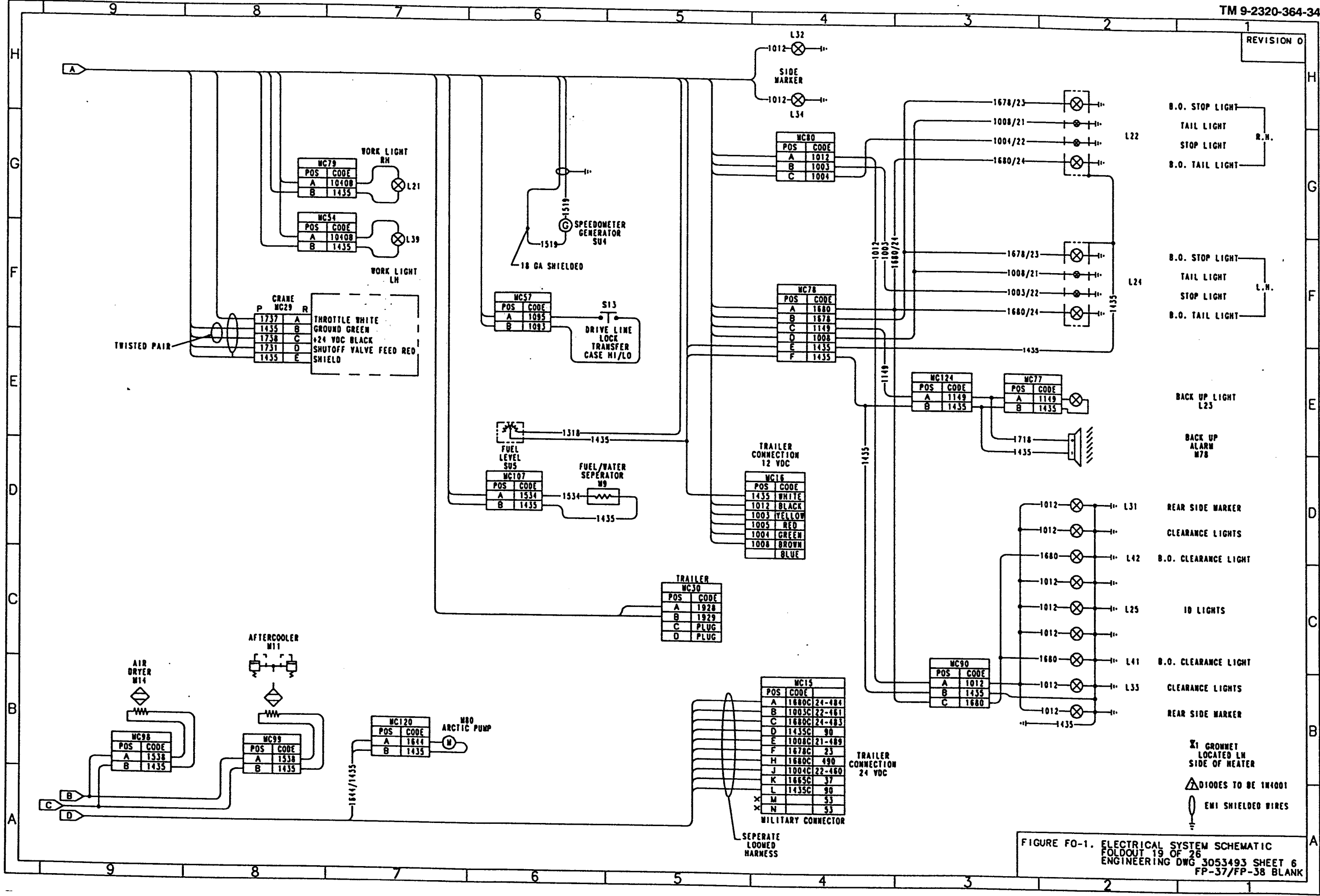


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 19 OF 26  
 ENGINEERING DWG 3053493 SHEET 6  
 FP-37/FP-38 BLANK

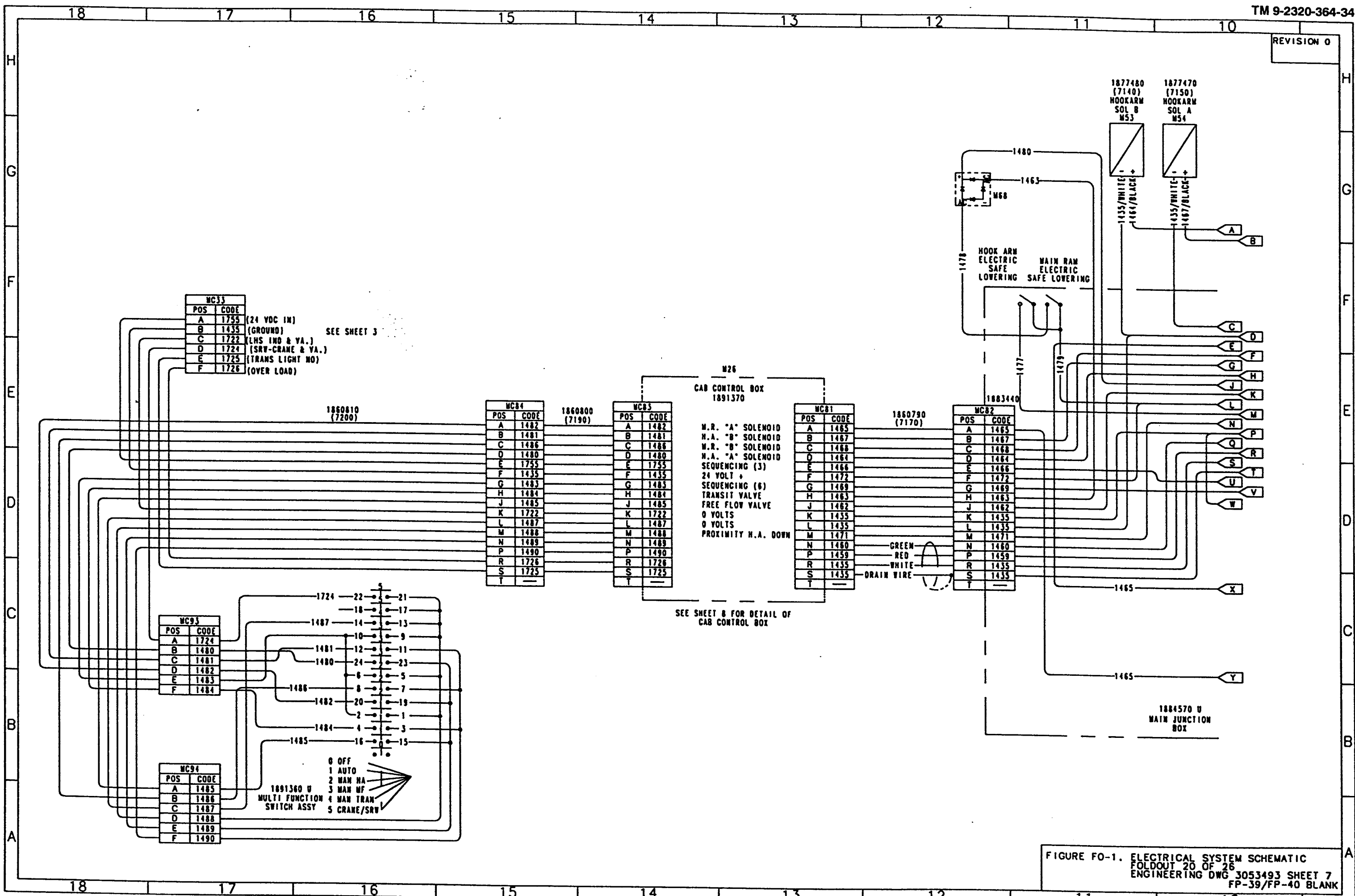


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 20 OF 26  
 ENGINEERING DWG 3053493 SHEET 7  
 FP-39/FP-40 BLANK

REVISION D

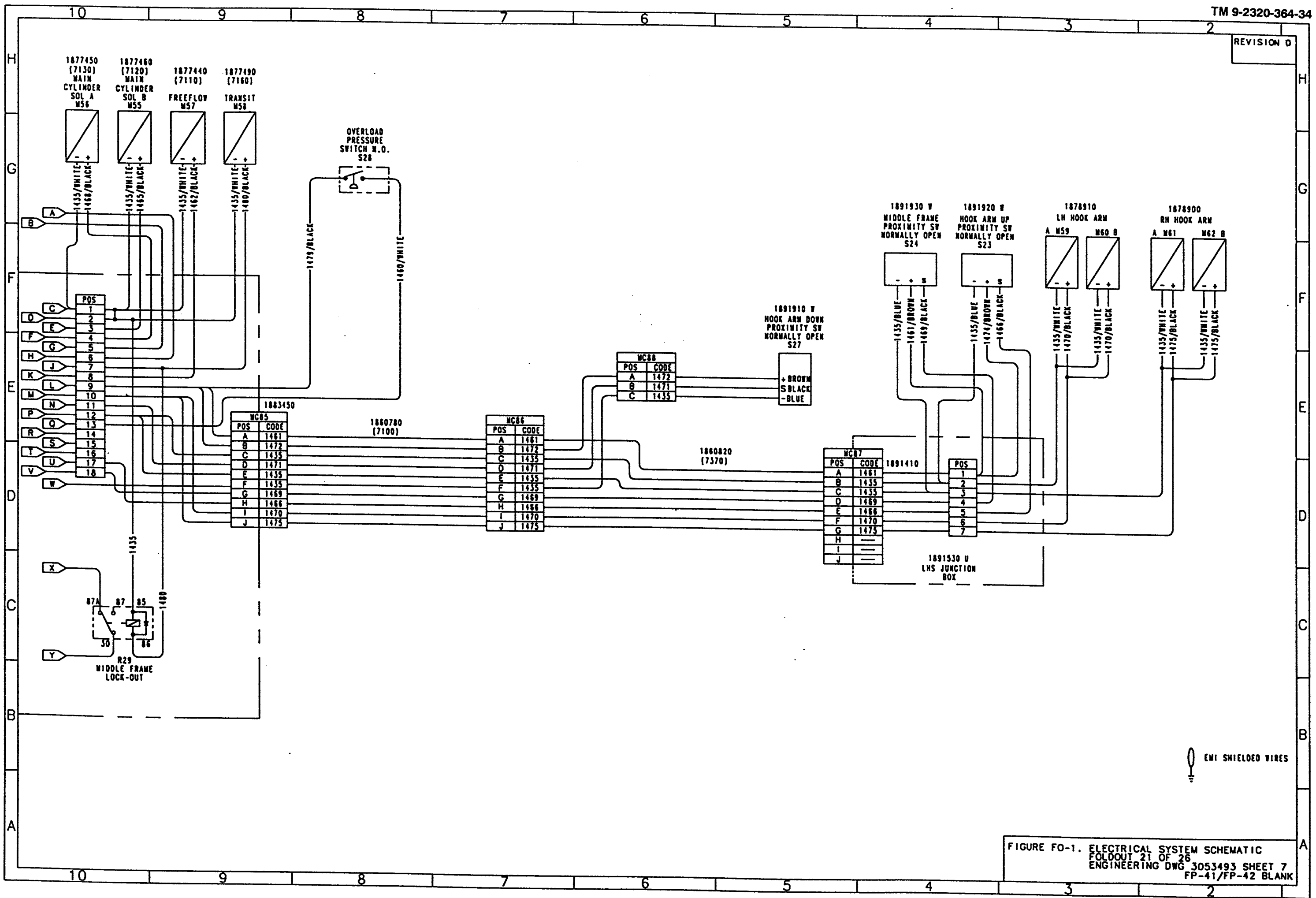
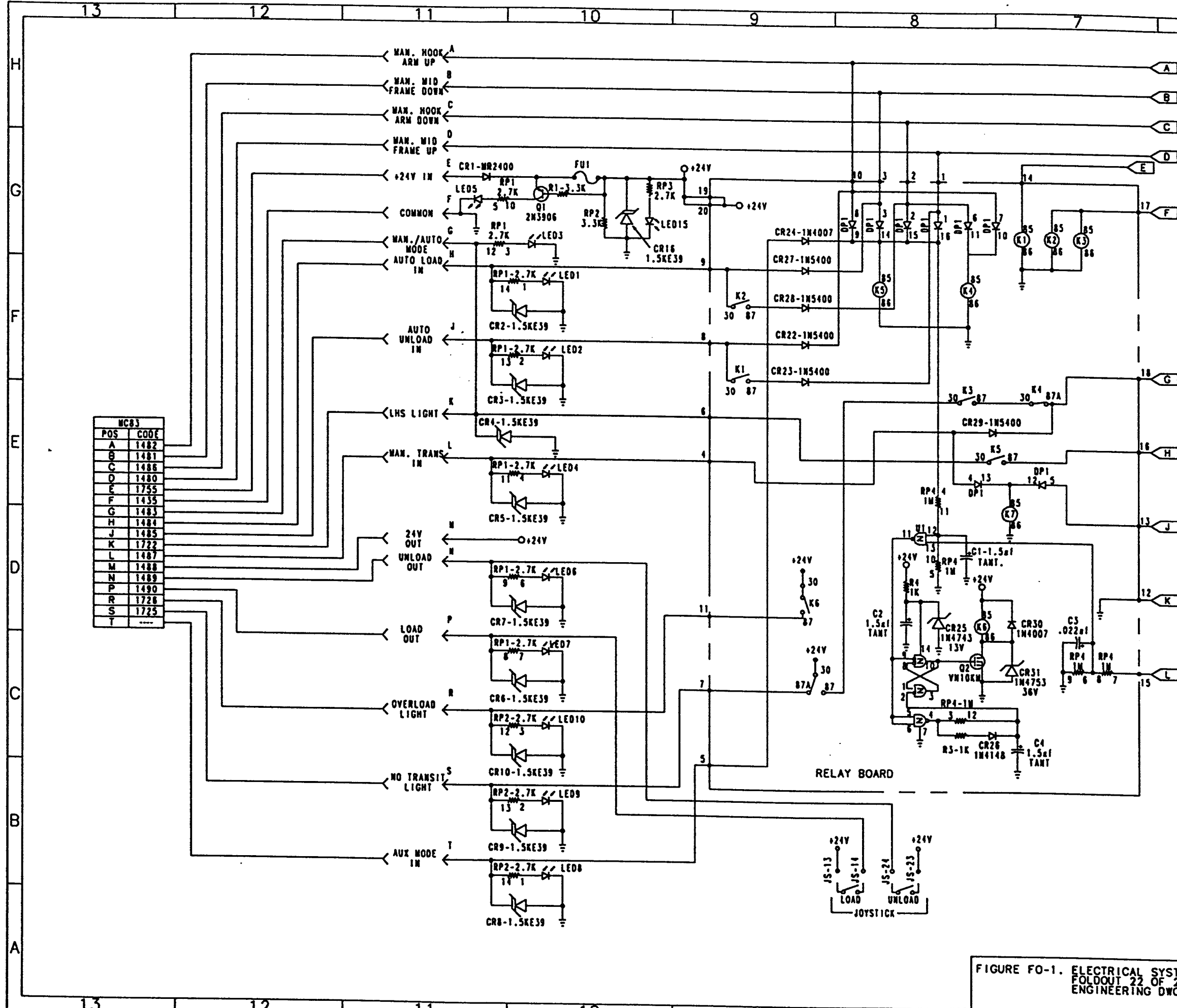


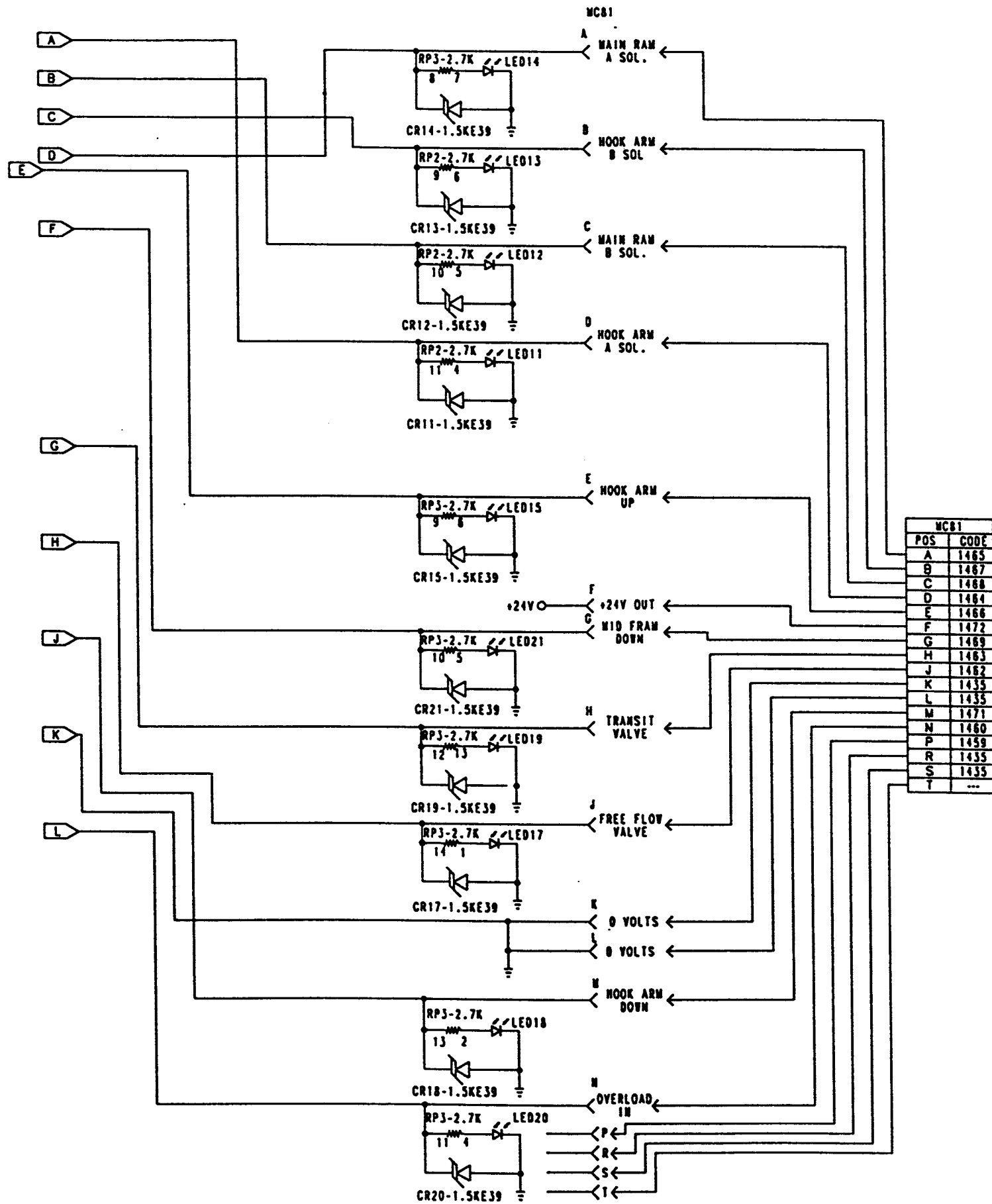
FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 21 OF 26  
 ENGINEERING DWG 3053493 SHEET 7  
 FP-41/FP-42 BLANK

EMI SHIELDED WIRES



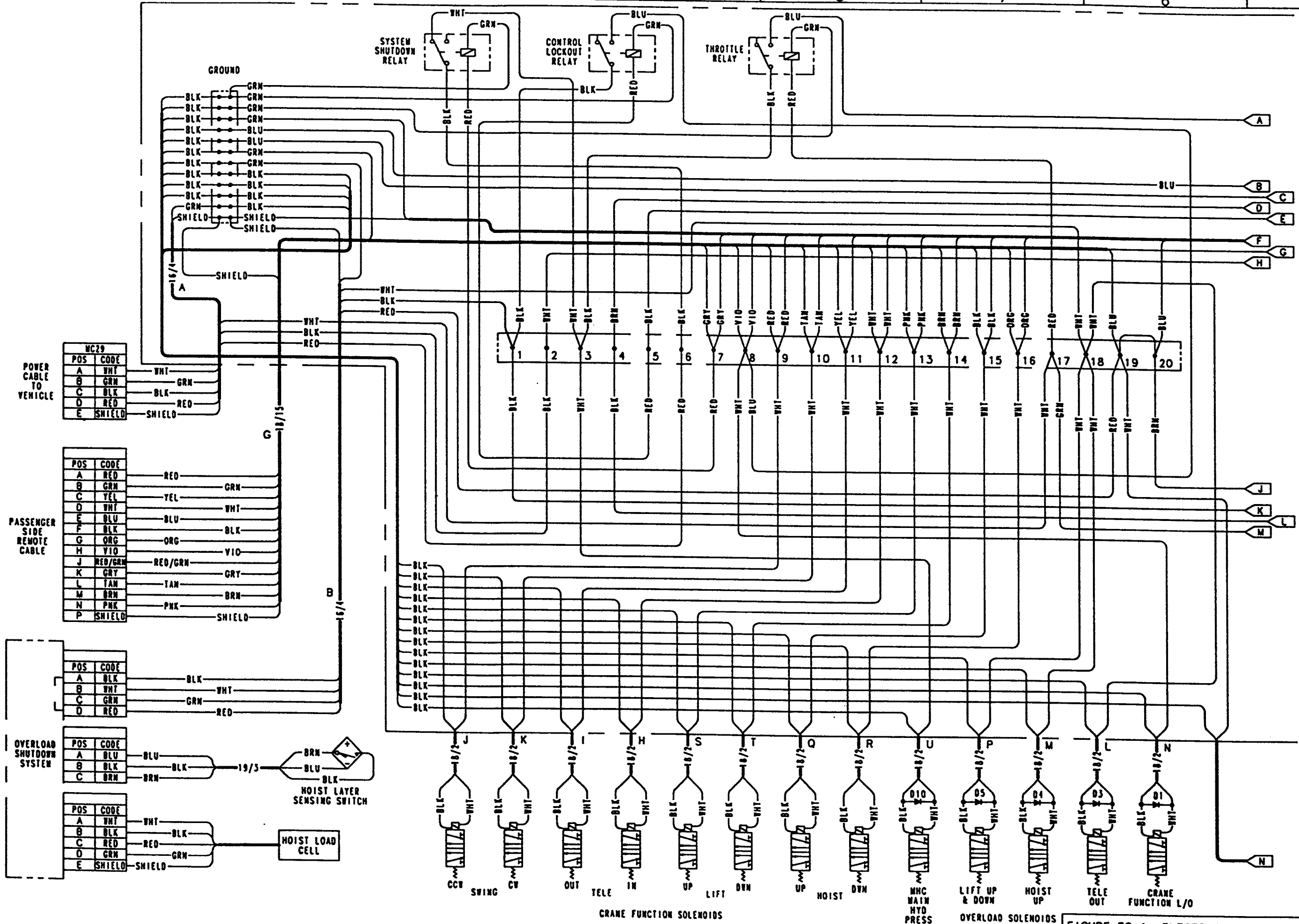
NC83	
POS	CODE
A	1482
B	1481
C	1486
D	1480
E	1755
F	1435
G	1483
H	1484
J	1485
K	1722
L	1487
M	1488
N	1489
P	1490
R	1728
S	1725
T	----

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 22 OF 26  
 ENGINEERING DWG 3053493 SHEET 8  
 FP-43/FP-44 BLANK



MCB1	
POS	CODE
A	1465
B	1467
C	1468
D	1464
E	1466
F	1472
G	1469
H	1463
J	1462
K	1435
L	1435
M	1471
N	1460
P	1459
R	1435
S	1435
T	---

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 23 OF 26  
 ENGINEERING DWG 3053493 SHEET 8  
 FP-45/FP-46 BLANK



MC29

POS	CODE
A	WHT
B	GRN
C	BLK
D	RED
E	SHIELD

PASSENGER SIDE REMOTE CABLE

POS	CODE
A	RED
B	GRN
C	YEL
D	WHT
E	BLU
F	BLK
G	ORG
H	VIO
J	RED/GRN
K	GRY
L	TAN
M	BRN
N	PNK
P	SHIELD

OVERLOAD SHUTDOWN SYSTEM

POS	CODE
A	BLK
B	WHT
C	GRN
D	RED

OVERLOAD SHUTDOWN SYSTEM

POS	CODE
A	BLU
B	BLK
C	BRN

OVERLOAD SHUTDOWN SYSTEM

POS	CODE
A	WHT
B	BLK
C	RED
D	GRN
E	SHIELD

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 24 OF 26  
 ENGINEERING DWG 3053493 SHEET 9  
 FP-47/FP-48 BLANK

REVISION 0

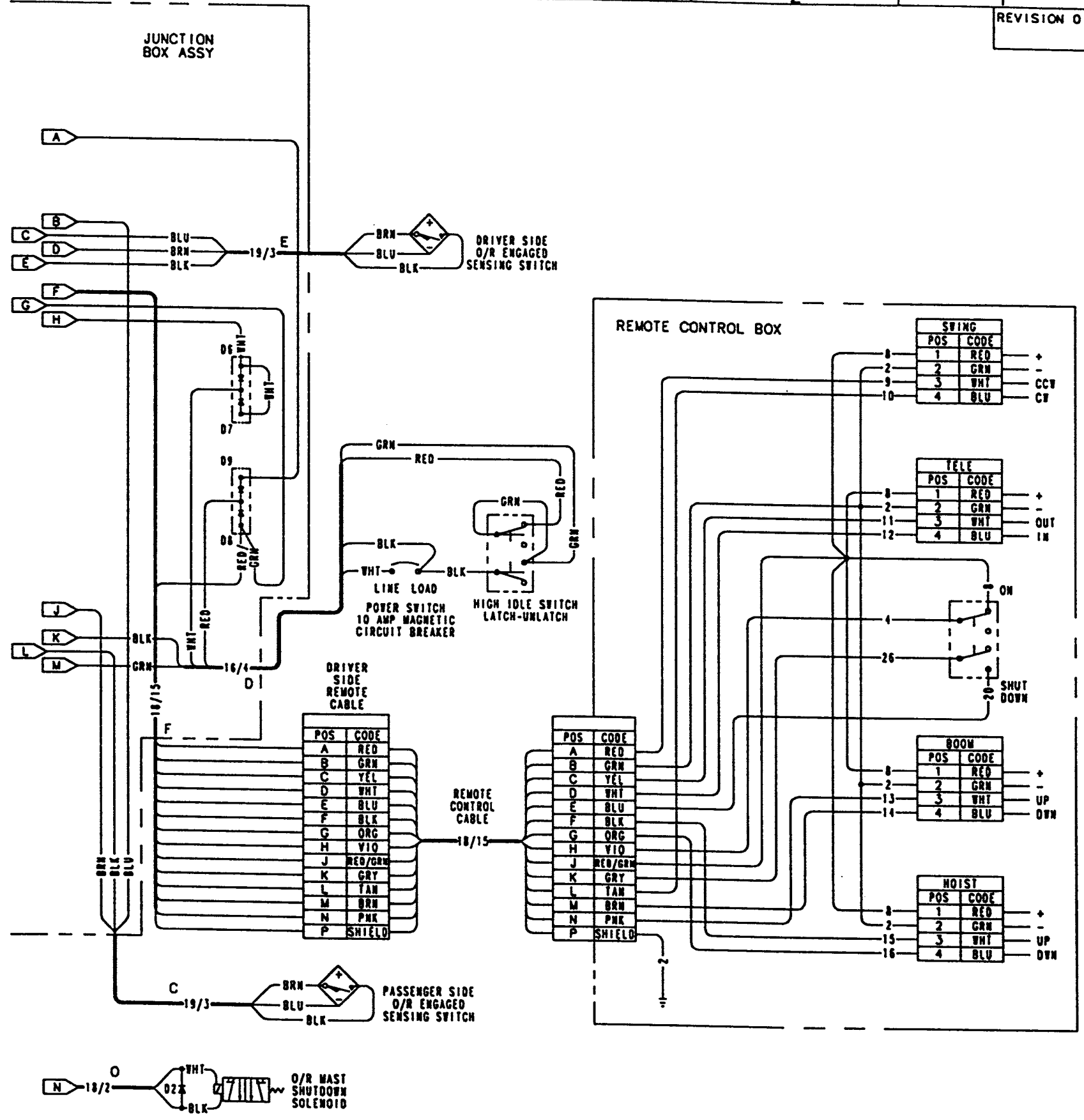
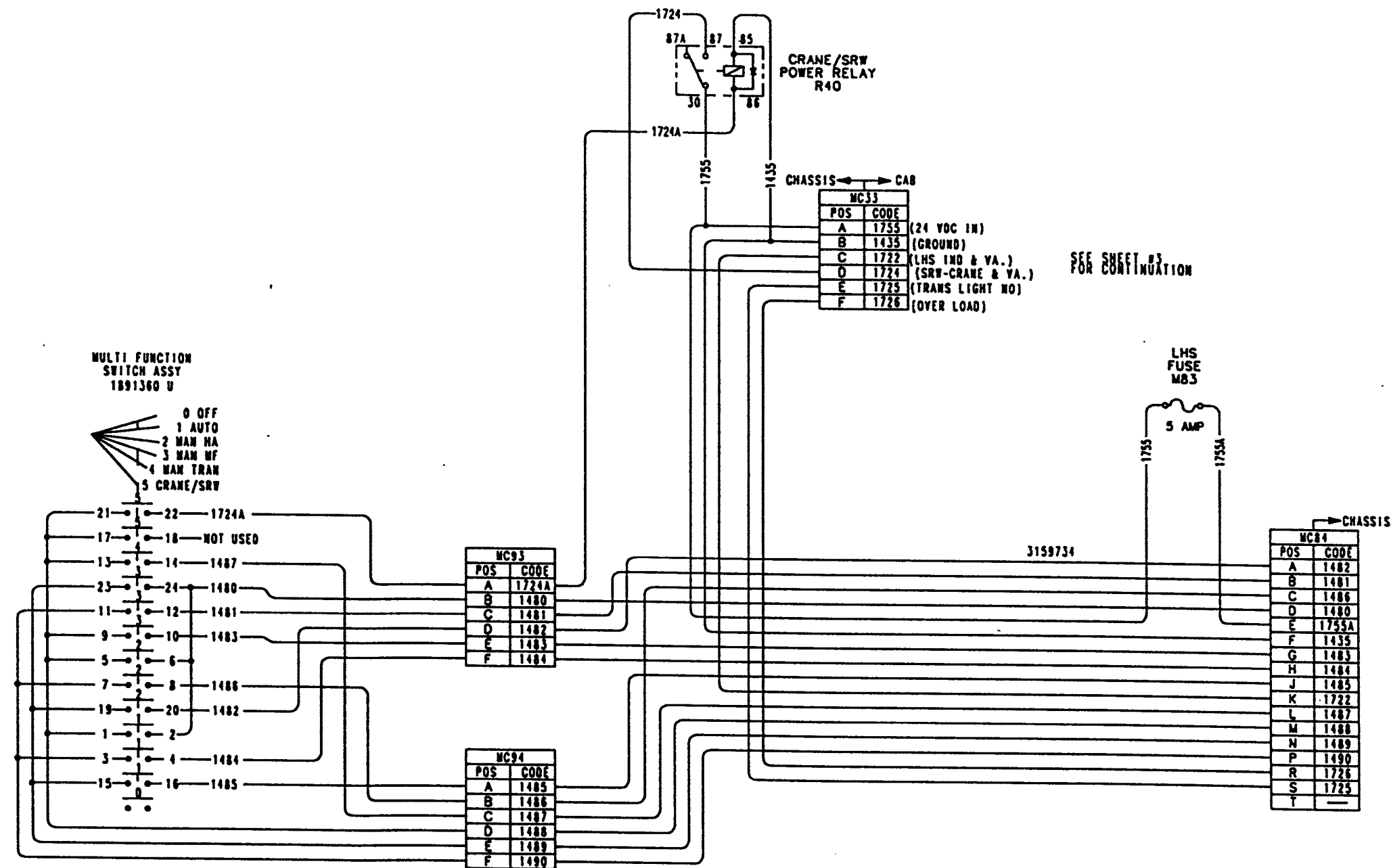


FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC  
 FOLDOUT 25 OF 26  
 ENGINEERING DWG 3053493 SHEET 9  
 FP-49/FP-50 BLANK



FOR LHS CIRCUIT PROTECTION CONFIGURATION

FIGURE FO-1. ELECTRICAL SYSTEM SCHEMATIC FOLDOUT 26 OF 26 ENGINEERING DWG 3053493 SHEET 10 FP-51/FP-52 BLANK



RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



THEN... JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT. FOLD IT AND DROP IT IN THE MAIL!

**SOMETHING WRONG WITH THIS PUBLICATION?**

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

Enter your mailing address

DATE SENT

Date you filled out this form

PUBLICATION NUMBER

TM 9-2320-364-34

PUBLICATION DATE

Date of TM

PUBLICATION TITLE

Title of TM

BE EXACT... PIN-POINT WHERE IT IS

PAGE NO	PARA-GRAPH	FIGURE NO.	TABLE NO
3		2	
109		51	

3

109

2

51

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

Item 10. Change illustration. Reason: Tube end shown assembled on wrong side of lever cam.

Item 3. The NSN and P/N are not listed on the AMDF nor the MCRL. Request correct NSN and P/N be furnished.

SAMPLE

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

Your title and telephone number

SIGN HERE:

Your signature

DA FORM 2028-2  
1 JUL 79

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

FILL IN YOUR  
UNIT'S ADDRESS

FIELD OFFICE

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

SAMPLE




NOTE:  
Apply Stamp

Commander  
U.S. Army Tank-automotive and Armaments Command  
ATTN: AMSTA-AC-NML  
Rock Island, IL 61299-7630

TEAR ALONG PERFORATED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



## SOMETHING WRONG WITH THIS PUBLICATION?

THEN... JOT DOWN THE DOPE ABOUT IT ON THIS FORM, CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

---

DATE SENT

PUBLICATION NUMBER  
TM 9-2320-364-34

PUBLICATION DATE

PUBLICATION TITLE  
Palletized Load System Direct Support and General Support Maintenance Manual

BE EXACT... PIN-POINT WHERE IT IS				IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
PAGE NO	PARA-GRAPH	FIGURE NO.	TABLE NO	

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 2028-2  
1 JUL 79

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

FILL IN YOUR  
UNIT'S ADDRESS



FOLD BACK

DEPARTMENT OF THE ARMY

---


---

OFFICIAL BUSINESS

Commander  
U.S. Army Tank-automotive and Armaments Command  
ATTN: AMSTA-AC-NML  
Rock Island, IL 61299-7630

TEAR ALONG PERFORATION LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



## SOMETHING WRONG WITH THIS PUBLICATION?

THEN... JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

---

DATE SENT

PUBLICATION NUMBER

TM 9-2320-364-34

PUBLICATION DATE

PUBLICATION TITLE

Palletized Load System Direct Support and General Support Maintenance Manual

BE EXACT... PIN-POINT WHERE IT IS				IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
PAGE NO	PARA-GRAPH	FIGURE NO.	TABLE NO	

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 2028-2  
1 JUL 79

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

FILL IN YOUR  
UNIT'S ADDRESS



FOLD BACK

DEPARTMENT OF THE ARMY

---


---

OFFICIAL BUSINESS

Commander  
U.S. Army Tank-automotive and Armaments Command  
ATTN: AMSTA-AC-NML  
Rock Island, IL 61299-7630

TEAR ALONG PERFORATION LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS



## SOMETHING WRONG WITH THIS PUBLICATION?

THEN... JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

---

DATE SENT

PUBLICATION NUMBER

TM 9-2320-364-34

PUBLICATION DATE

PUBLICATION TITLE

Palletized Load System Direct Support and General Support Maintenance Manual

BE EXACT... PIN-POINT WHERE IT IS				IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
PAGE NO	PARA-GRAPH	FIGURE NO.	TABLE NO	

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 2028-2  
1 JUL 79

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

FILL IN YOUR  
UNIT'S ADDRESS



FOLD BACK

DEPARTMENT OF THE ARMY

---

---

OFFICIAL BUSINESS

Commander  
U.S. Army Tank-automotive and Armaments Command  
ATTN: AMSTA-AC-NML  
Rock Island, IL 61299-7630

TEAR ALONG PERFORATION LINE



**By Order of the Secretary of the Army:**

**DENNIS J. REIMER**  
*General, United States Army*  
*Chief of Staff*

Official:



**JOEL B. HUDSON**  
*Administrative Assistant to the*  
*Secretary of the Army*  
9911902

DISTRIBUTION: To be distributed in accordance with the initial distribution number (IDN) 380893, requirements for TM 9-2320-364-34-4

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

$5/9 (°F - 32) = °C$   
 212° Fahrenheit is equivalent to 100° Celsius  
 90° Fahrenheit is equivalent to 32.2° Celsius  
 32° Fahrenheit is equivalent to 0° Celsius  
 $9/5 C + 32 = F$

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/Sq 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
Sq Centimeters.....	Square Inches.....	0.155
Square Meters.....	Square Feet.....	10.764
Square Meters.....	Square Yards.....	1.196
Square Kilometers.....	Square Miles.....	0.386
Sq 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 Sq Inch.....	0.145
Km per Liter.....	Miles per Gallon.....	2.354
Km per Hour.....	Miles per Hour.....	0.621

