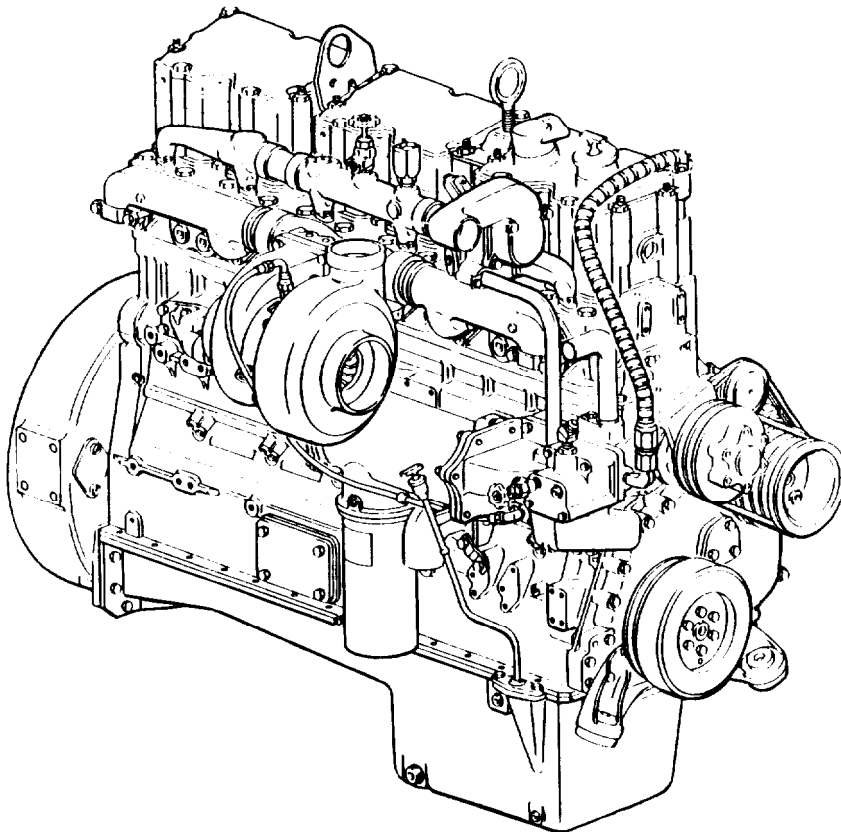


**TM 5-2815-241-34&P**

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**TECHNICAL MANUAL**

**DIRECT SUPPORT AND GENERAL SUPPORT  
MAINTENANCE  
(INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)**



**EQUIPMENT DESCRIPTION  
AND DATA  
PAGE 1-3**

**MAINTENANCE  
INSTRUCTIONS  
PAGE 2-1**

**REPAIR PARTS AND  
SPECIAL TOOLS LIST  
PAGE C-1**

**ENGINE, DIESEL NTC-290  
PART NO. 515501C94  
(NSN 2815-00-375-5958)**

**Approved for Public Release; Distribution is unlimited.**

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**HEADQUARTERS, DEPARTMENT OF THE ARMY  
MARCH 1987**



CHANGE

NO. 1

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
Washington D.C., 30 March 1992

**DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE  
MANUAL (INCLUDING REPAIR PARTS AND  
SPECIAL TOOLS LIST)**

FOR

**ENGINE, DIESEL NTC-290  
PART NO. 515501C94  
(NSN 2815-00-375-5958)**

Current as of 25 September 1991

TM 5-2815-241-34&P, dated 30 March 1987, is changed as follows:

1. Remove old pages and insert new pages.
2. New or changed material is indicated by an asterisk or by a vertical bar adjacent to the TA number.

**Remove Pages**

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1-1 and 1-2  
2-93 and 2-94  
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2-739 and 2-140  
2-145 and 2-146  
2-155 and 2-156  
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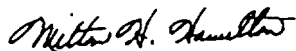
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*General, United States Army  
Chief of Staff*

Distribution:

To be distributed in accordance with DA Form 12-25-E (Block 3699) Direct and General Support maintenance requirements for TM 5-2815-241-34&P.

**WARNING**

## EXHAUST GAS CAN KILL YOU

Exhaust gas is without color or smell, but can kill you. Breathing exhaust gas produces symptoms of headache, dizziness, loss of muscular control, a sleepy feeling, and coma. Brain damage or death can result from heavy exposure to exhaust fumes of fuel-burning internal combustion engines. Exhaust gases can become dangerously concentrated under conditions of no air movement. Precautions must be followed to ensure crew safety when the engine of any vehicle is operated for any purpose.

1. DO NOT operate vehicle engine inside building unless ample ventilation is available.
2. DO NOT idle engine for long periods without ventilator blower operating.
3. DO NOT drive any vehicle with inspection plates, cover plates, or engine compartment doors removed unless necessary for maintenance purposes.
4. BE ALERT at all times during vehicle operation for exhaust odors and exposure symptoms. If either is present, IMMEDIATELY VENTILATE personnel compartments. If symptoms persist, remove affected crew to fresh air; keep warm; DO NOT PERMIT PHYSICAL EXERCISE; and, if necessary, give artificial respiration.
5. FOR ARTIFICIAL RESPIRATION, REFER TO FM 21-11.
6. BE AWARE; the field protective mask for chemical-biological-radiological (CBR) protection will not protect you from exhaust gas fumes.

THE BEST DEFENSE AGAINST ENGINE EXHAUST FUMES IS GOOD VENTILATION.

**WARNING**

Particles blown by compressed air are hazardous. Make certain the air stream is directed away from user and other personnel in the area. Compressed air used for cleaning purposes shall not exceed 30 psi (207 kPa). User must wear safety goggles or face shield to prevent personnel injury.

**WARNING**

Safety goggles must be worn to prevent eye injury caused by flying steel chips.

**WARNING**

Drycleaning solvent P-D-680 is toxic and flammable. Wear safety goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes, and do not breathe vapors. Do not use near open flame or excessive heat. Flashpoint for type #1 drycleaning solvent is 100°F (38°C) and for type #2 is 138°F (59°C). If you become dizzy while using solvent, get fresh air immediately, and get medical aid. If contact with eyes is made, wash your eyes with water, and get medical aid immediately. Failure to observe these precautions could cause serious injury or death to personnel.

**WARNING**

Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.

**WARNING**

Improper cleaning methods and use of unauthorized cleaning liquids or solvents can injure personnel and damage equipment. Refer to TM 9-247, Materials Used for Cleaning, Preserving, Abrading, and Cementing Ordnance Materiel and Related Materials Including Chemicals.

**WARNING**

Repair of engine must be performed on engine repair stand (page 2-11). Due to excessive weight assistance will be needed to prevent injury when lifting heavy parts.

**WARNING**

When fuel is forced from injector spray holes, keep hands and body away from spray stream. High-pressure fuel may pierce the skin.

**WARNING**

Fuel is flammable and can explode. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Smoking is prohibited while working with fuel.

**WARNING**

Heat protective cloth mittens must be worn to prevent serious injury to hands when handling heated parts.

**WARNING**

Approximately halfway through the cut, the tool will begin to cut the counterbore ledge. Be prepared for the added load on the drill when the counterbore is being cut, or personal injury could result.

**WARNING**

Extreme care must be taken when releasing springs under pressure. Injury to personnel could result.

**WARNING**

Slave piston spring is under tension. Care must be taken when removing retaining ring, spring retainer, and slave piston spring to prevent injury.

**WARNING**

Slave piston spring will be under tension when installing. Extreme care must be taken to prevent injury.

**WARNING**

Pressure regulator spring is under tension. Maintain pressure on retaining yoke to prevent injury.

TECHNICAL MANUAL

NO. 5-2815-241-34&P

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, DC 30 March 1987

**Direct Support and General Support Maintenance  
(Including Repair Parts and Special Tools List)**

**ENGINE, DIESEL NTC-290  
PART NO. 515501C94  
(NSN 2815-00-375-5958)**

Current as of 25 September 1991

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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes, or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Tank-Automotive Command, ATTN: AMSTA-MB, Warren, MI 48397-5000. A reply will be sent to you.

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\*This manual supersedes the engine information contained in TM-5-3805-254-14&P-1, 22 August 1980, and TM 5-3805-254-14&P-2, 12 June 1980, including all changes.

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### HOW TO USE THIS MANUAL

This manual is designed to help you disassemble, repair, and assemble the diesel engine. The tabbed table of contents on the front cover is provided for quick reference to information frequently used. A complete table of contents is located at the first pages of this manual for help in finding specific chapters and sections. At the beginning of each chapter, a section index appears which lists sections included in that chapter. At the beginning of each section, a more specific subject index is located, to help you find the exact paragraph you're looking for. There is also an alphabetical index located in the back of the manual for use in locating specific information.

Warnings listed in the front of this manual should be read and understood before performing any tasks. These warnings advise you of threats to your personal safety, and the safety of others, which may occur if certain precautions are not taken.

Cautions let you know when equipment will be damaged if certain procedures are not followed.

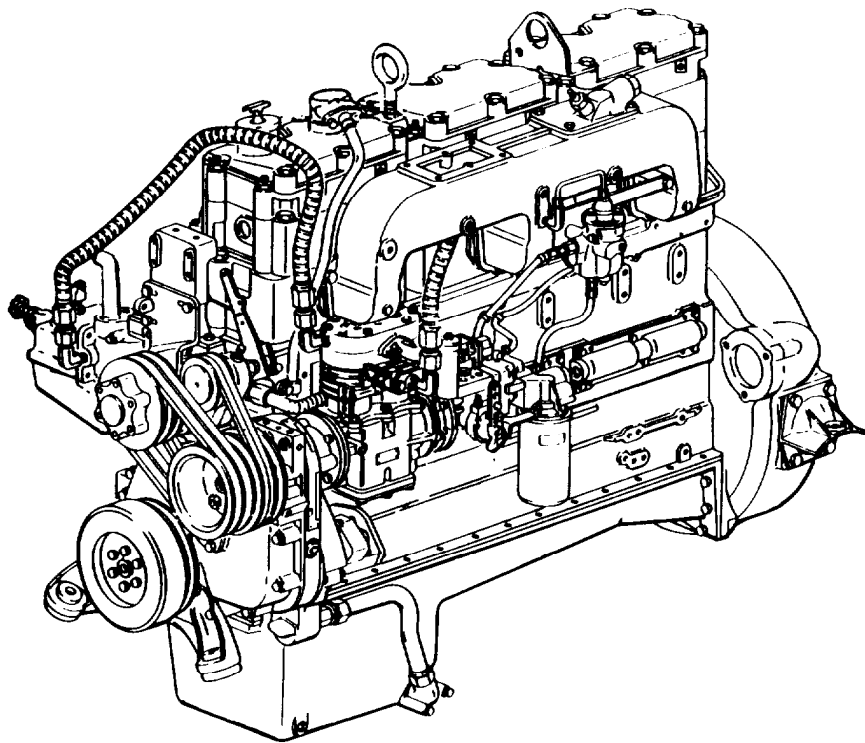
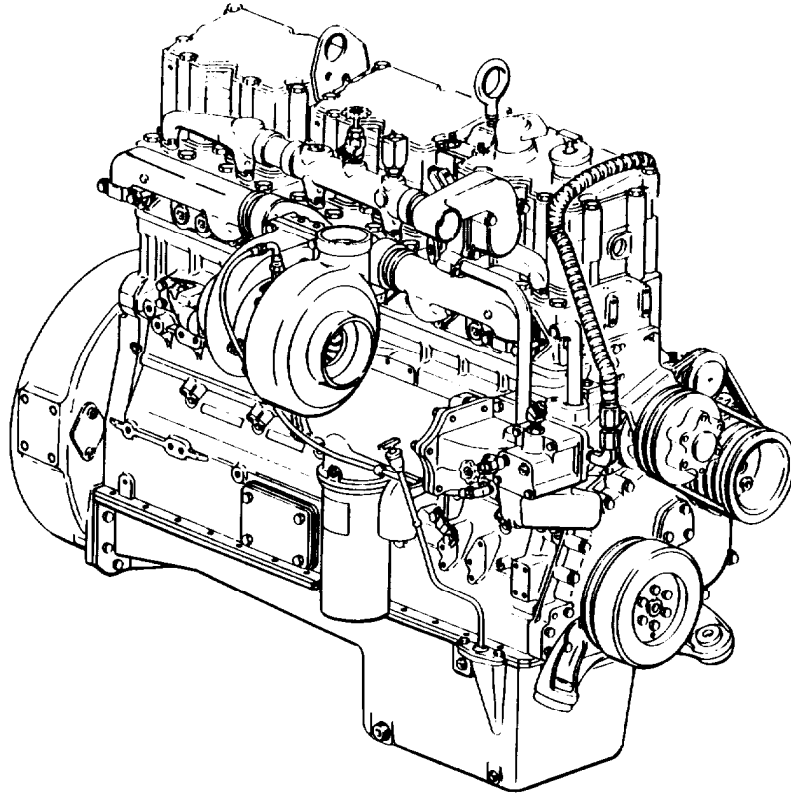
Notes are used to highlight important information which pertains to a specific procedure. They will also help you understand the text to which they apply, and make it easier for you to perform the task.

Measurements in this manual are given in both US standard and metric units. A metric to US standard conversion chart can be found on the inside back cover.

Location and directional terms in this manual (ie, front, rear, top, bottom, right, and left) apply as if you were viewing the engine from the flywheel end. If direction of rotation is questionable, clockwise and counterclockwise will be shown as if you were facing them.

Art in this manual is used to illustrate the task you are performing, help identify parts, and explain the actual procedures involved in a task.





Engine, Diesel, NTC-290

# CHAPTER 1

## INTRODUCTION

### OVERVIEW

This chapter contains information on various forms used to report discrepancies found or improvements needed. It also provides the user with general information relating to the location and description of major components and specific equipment data.

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### Section I. GENERAL INFORMATION

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Destruction of Army Materiel to Prevent Enemy Use .....	1-1	Reporting Equipment Improvement Recommendations (EIR) .....	1-2
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### SCOPE

Type of Manual: Direct Support and General Support Maintenance Manual (Including Repair Parts and Special Tools List).

Equipment Name and Model Number: Engine, diesel, NTC-290.

Purpose of Equipment: To provide power to move vehicle and power accessories such as, PTO and air compressor.

### MAINTENANCE FORMS AND RECORDS

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

### DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

Refer to TM 750-244-6, Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use (US Army Tank-Automotive Command).

### PREPARATION FOR STORAGE AND SHIPMENT

Preparation for storage and method of shipment will be at the discretion of the using facility.

## **REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR)**

If your diesel engine needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your engine. Let us know why you don't like the design. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Tank-Automotive Command, ATTN: AMSTA-MP, Warren, MI 48347-5000. We will send you a reply.

## **EQUIPMENT IMPROVEMENT REPORT AND MAINTENANCE DIGEST (EIR MD)**

■ The quarterly Equipment Improvement Report and Maintenance Digest, TB 43-0001-39 series, contains valuable field information on the equipment covered in this manual. The information in the TB 43-0001-39 series is compiled from some of the Equipment Improvement Reports that you prepared on the vehicles covered in this manual. Many of these articles result from comments, suggestions, and improvement recommendations that you submitted to the EIR program. The TB 43-0001-39 series contains information on equipment improvements, minor alterations, proposed Modification Work Orders (MWO's), warranties (if applicable), actions taken on some of your DA Form 2028's (Recommended Changes to Publications), and advance information on proposed changes that may affect this manual. The information will help you in doing your job better and will help in keeping you advised of the latest changes to this manual. Also refer to DA PAM 25-30, Consolidated Index of Army Publications and Blank Forms, and appendix A, of this manual.

**Section II. EQUIPMENT DESCRIPTION AND DATA**

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**GENERAL**

This section contains information needed to familiarize you the user with the NTC-290 diesel engine. It includes engine characteristics, capabilities and features, and location and description of components being repaired. Engine specifications are presented in tabular format.

**EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES**

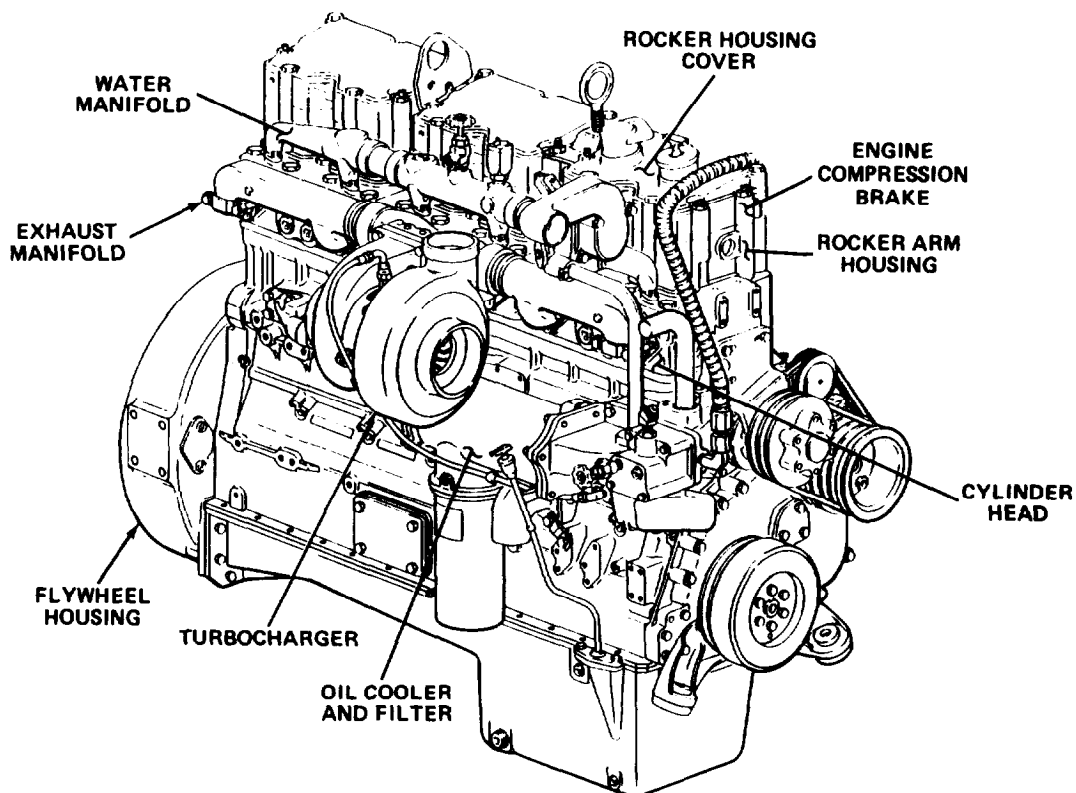
**CAPABILITIES**

Able to develop 290 hp at 2100 governed rpm.

**CHARACTERISTICS/FEATURES**

- Single turbocharged diesel engine
- Six cylinder in-line, four stroke per cycle
- Liquid cooled
- Fuel injection
- Three separate cylinder heads; one head per two cylinders
- Internal fuel passages in cylinder heads
- Overhead valve, using separate housings for rocker arms
- Four valves per cylinder
- Engine compression brake
- Replaceable cylinder sleeves
- One-piece pistons
- Piston cooling nozzles
- Preheater system for cold weather starting
- Low oil pressure engine shutdown safety system
- High coolant temperature shutdown safety system
- Integral lubricating oil filter cooler assembly
- External engine oil pump
- Gear-driven air compressor
- Alcohol evaporator system for air supply
- Direct-driven fuel injection pump
- Secondary fuel filter integral with fuel injection pump
- Aneroid control valve
- Electric or manual fuel shutdown valve

## LOCATION AND DESCRIPTION OF MAJOR COMPONENTS



### WATER MANIFOLD

Three sections of cast-iron piping and two steel tubes, containing thermostat, temperature gage sending unit, high-temperature engine shutdown switch, and shutter control valve. The water manifold serves as a passage for hot coolant that has circulated through the cylinder block and cylinder heads to be delivered to the radiator.

### ENGINE COMPRESSION BRAKE

Three separate units, one mounted above each of three rocker arm housings. They contain electrically operated solenoids that open engine exhaust valves near the top of the compression stroke. The engine brake system is energized from a dash-mounted switch. The electrical solenoids are supplied with power through a switch mounted on the fuel pump and controlled by the throttle lever.

### ROCKER HOUSING COVER

Three separate aluminum covers, used to cover each rocker arm housing. The front rocker housing cover contains the crankcase breather, oil filler opening, and cap. The center and rear rocker housing covers are plain.



**LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED****ROCKER ARM HOUSING**

Three separate aluminum housings, mounted above each of three cylinder heads. Each housing contains two intake valve rocker arms, two exhaust valve rocker arms, and two fuel injector rocker arms, all mounted on a common shaft. Each rocker arm has an adjusting screw and locknut for injector setting and valve adjustment.

**CYLINDER HEAD**

Three separate cast-iron assemblies, each mounted to cylinder block above two adjacent cylinders. Each contains one fuel injector and two intake and exhaust valve assemblies per cylinder. The cylinder head also includes the intake and exhaust ports, and passages for coolant to carry away heat from engine combustion. Each contain internal fuel passages for fuel injectors connected by fuel cross-overs between cylinder head assemblies.

**OIL COOLER AND FILTER**

A tube and shell type heat exchanger, used to dissipate heat from the engine lubricating oil, into the cooling system. The oil cooler helps maintain lubricating oil temperature within proper operating range of 165° to 195°F (74° to 91°C).

**TURBOCHARGER**

Mounted directly to exhaust manifold and consists of an exhaust-driven turbine wheel and an impeller that forces additional air into combustion chambers. This allows engine to burn more fuel and therefore develop more horsepower. The turbocharger is engine oil lubricated and cooled.

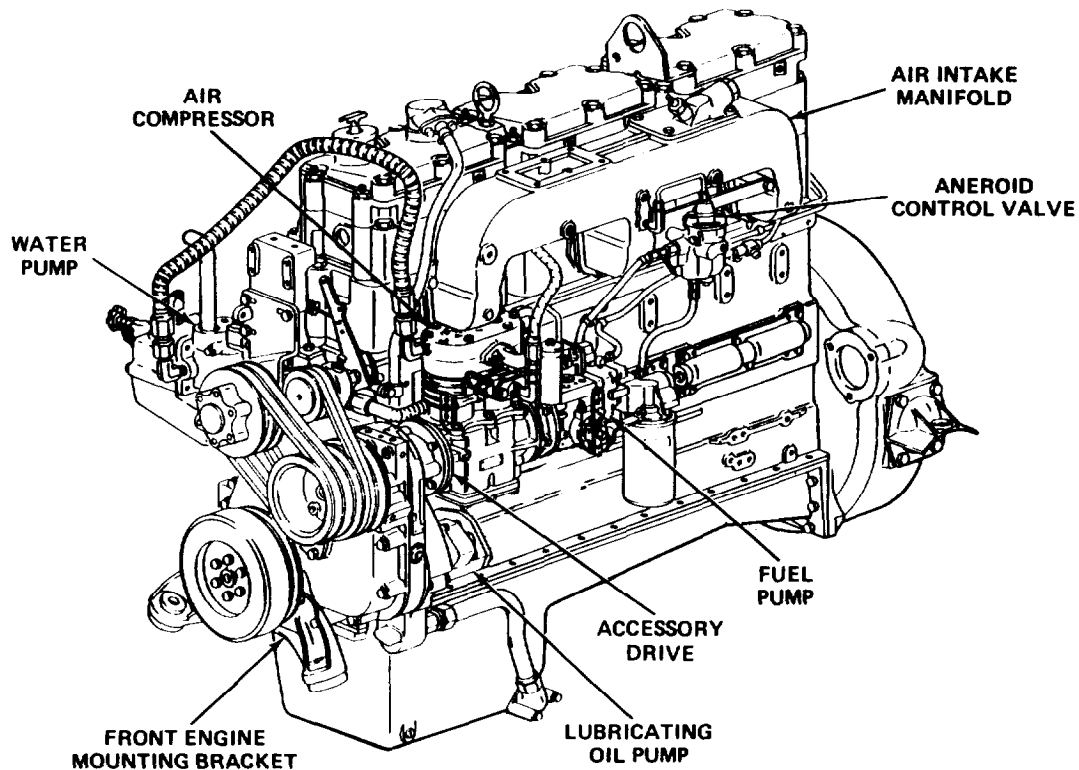
**FLYWHEEL HOUSING**

Mounted directly to rear of engine block and used to connect main transmission to engine assembly. Attached to the flywheel housing, are the rear engine mounting brackets.

**EXHAUST MANIFOLD**

Three sections of cast-iron piping, mounted directly to each of three cylinder head assemblies. The turbocharger is mounted to the center section of the exhaust manifold. The exhaust manifold serves as a passage for exhaust gases that power the turbocharger, then directs gases into the exhaust system.

LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED



AIR INTAKE MANIFOLD

A hollow aluminum casting, mounted to cylinder head assemblies on drivers side of engine. It receives intake air from turbocharger through air crossover connection and delivers it to intake ports of each of three cylinder head assemblies.

ANEROID CONTROL VALVE

An air intake manifold pressure-controlled valve, mounted at fuel pump outlet line, to create a delay in fuel supply line equal to the delay or lag of intake air pressure caused by slow turbocharger speed buildup. Aneroid control valve eliminates excessive exhaust smoke caused by high fuel-to-air ratio.

LUBRICATING OIL PUMP

A geardriven gear pump, mounted on left side of engine, below air compressor. It draws lubricating oil from oil pan and circulates it, under pressure, through engine oil passages. An integral pressure regulator controls the lubricating oil pressure.

**LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED****FUEL PUMP**

Is mounted to rear of air compressor, and driven by accessory drive through air compressor. It draws fuel from fuel tank through fuel filters, and delivers to fuel injectors at the correct pressure for the power requirements of the engine. The fuel pump is lubricated and cooled by fuel passing through fuel pump internal passages. Electrically operated shutdown switch is mounted at fuel pump outlet.

**ACCESSORY DRIVE**

Is camshaft gear-driven, through crankshaft gear. Located on front of engine, the accessory drive is used to drive air compressor and fuel pump. Pulley mounted on front of accessory drive, drives water pump and fan hub assembly by V-belts.

**WATER PUMP**

A centrifugal pump mounted to front of cylinder block. It contains an impeller which draws coolant from radiator, through water transfer connection, and circulates it through cylinder block, cylinder head cooling passages, and engine-coolant cooled components. Coolant accumulates heat from engine operation as it is circulated by water pump which returns it to radiator for heat dissipation.

**AIR COMPRESSOR**

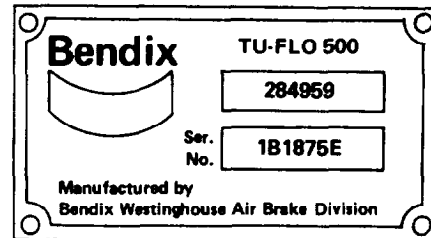
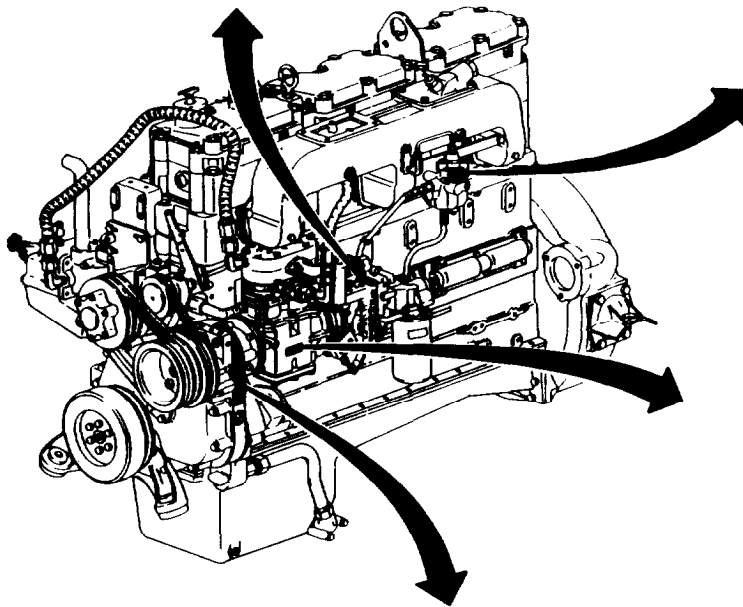
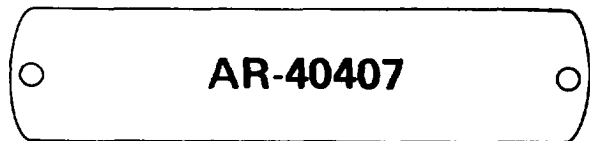
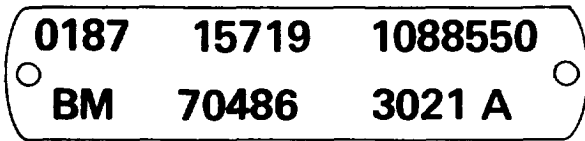
A two-cylinder reciprocating piston air pump, mounted to and driven by engine accessory drive. Air compressor is engine-oil lubricated and water-cooled by engine coolant and receives air for compression through pipe and fittings from air intake manifold. Adjustable governor, mounted to air compressor cylinder head, controls maximum air pressure output. Air compressor outlet is connected by tubes and fittings to air reservoir.

**FRONT ENGINE MOUNTING BRACKET**

A steel bracket, with rubber bushings, that supports front of engine when in vehicle frame. It is attached to engine and bolts to frame crossmember.

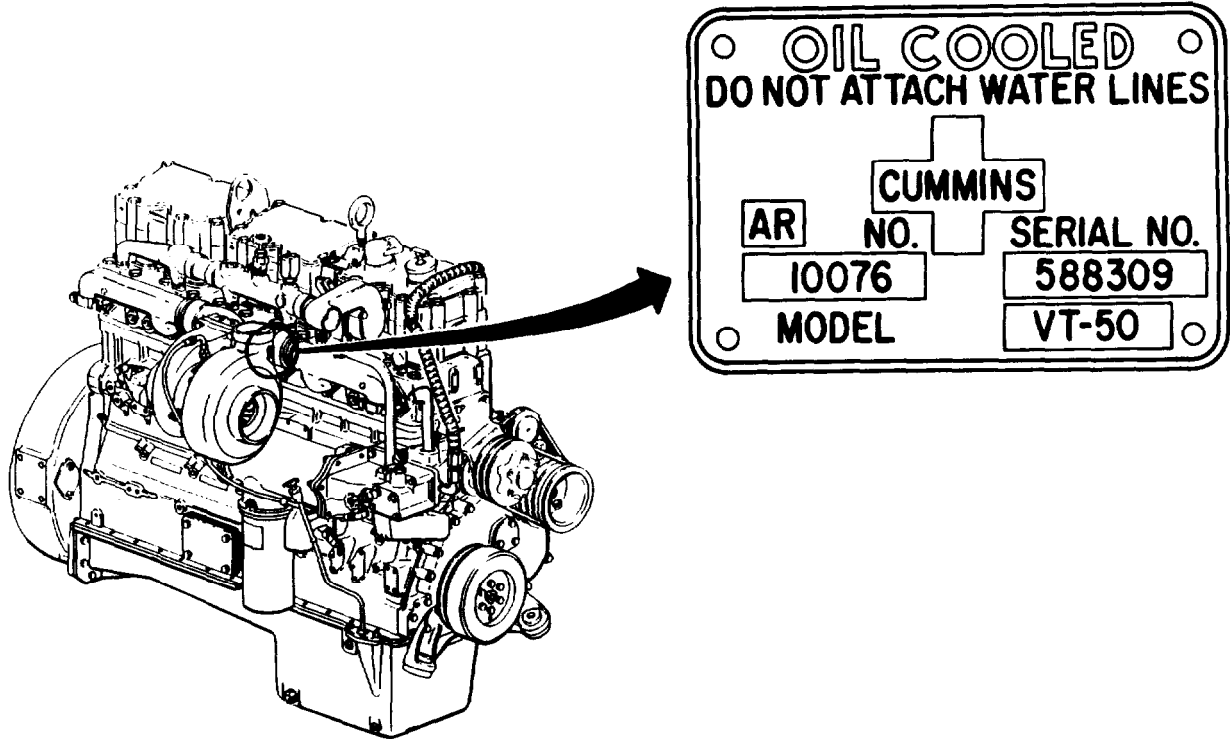
**LOCATION AND DESCRIPTION OF IDENTIFICATION PLATES**

The following illustrations show the location of identification instruction and data plates on the NTC 290 diesel engine. These views are provided to show where each plate is located.



Ref. No. 522815-C91		Family CPL	Advertised HP290 at 2100 RPM		Engine Exhaust Emission Control Information: This engine conforms to California regulation applicable to 1975 model-year heavy duty diesel engines.
Model NTC-290			Identification 092 0187	Fuel rate at advertised HP 158mm <sup>3</sup> /stroke	
Date of Delivery		So. No. 15719	Initial injection timing code	A8	WARNING: Injury may result and warranty is voided if fuel rate, RPM or altitudes exceed published maximum values for this model and application.
Cont. No. D092083 BX01		Date of manufacture 3-75	Injector travel .170 Inch		
Engine No. 10437196		Manufactured by Cummins Engine Company, Inc., U.S.A. 3002256	Injector torque Inch - Lbs.		

LOCATION AND DESCRIPTION OF IDENTIFICATION PLATES - CONTINUED



**EQUIPMENT DATA**

Specific engine data for the NTC-290 diesel engine are listed here in tabular format.

**ENGINE**

Manufacturer	Cummins Engine Company, Inc
Model	NTC-290
Type	Four-stroke cycle, turbocharged diesel

**EQUIPMENT DATA - CONTINUED**

Dimensions

Length	58.88 in. (14.96 cm)
Width	33.63 in. (8.54 cm)
Height	50.91 in. (12.93 cm)
Net weight, dry	2600 lb (11.80 kg)

Cylinders

Number	Six
Arrangement	Inline
Firing order	1-5-3-6-2-4
Bore	5.5 in. (14.0 cm)
Stroke	6 in. (15.2 cm)
Displacement	855 cu in. (14 L)
Compression ratio	13.5:1

Governed Speed

Full load	2100 rpm
No load	2400 rpm
Idle speed	600 rpm

Lubrication System

Type	Force fed
Operating pressure (normal)	50 - 70 psi (345 - 483 kPa)
Operating pressure (minimum)	15 psi (100 kPa) at idle
System capacity, including bypass filter	44 qt (41.6 L)
Operating temperature (normal)	200° - 250°F (95°C - 121°C)
Oil pump	Gear type

Cooling System

Type	Liquid
Operating temperature (normal)	165° - 195°F (74° - 91°C)
Thermostat	One

## CHAPTER 2

### MAINTENANCE INSTRUCTIONS

#### OVERVIEW

This chapter contains information for the guidance of maintenance personnel responsible for removing, testing, inspecting, repairing, and installing components of the NTC-290 diesel engine. It also gives you checks that will help you find defects and corrective actions in Final Testing, Adjustments, and Troubleshooting on Engine Test Stand that can be performed by the direct or general support mechanic.

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#### Section I. SERVICE UPON RECEIPT

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## EQUIPMENT INSPECTION

The following explains what must be done upon initial receipt of engine. All tags and DA Form 2404, Equipment Inspection and Maintenance Worksheet, must be checked to ensure that serial numbers appearing on tags and forms match those on engine received. DA Form 2406, Materiel Condition Status Report, must be checked to include items listed below.

1. Turbocharger
2. Turbocharger Crossover Tube  
(Not Attached)
3. Fuel Pump, P/T Type G
4. Air Compressor
5. Secondary Fuel Filter
6. Aneroid Valve
7. Water Manifold
8. Intake Manifold
9. Exhaust Manifold
10. Oil Cooler with Oil Filter
11. Front Engine Mount

## UNPACKING

The procedure for unpacking will be determined by the method of packing used by the sending facility.

## CLEANING

### **WARNING**

Improper cleaning methods and use of unauthorized cleaning liquids or solvents can injure personnel and damage equipment. Refer to TM 9-247, Materials Used for Cleaning, Preserving, Abrading, and Cementing Ordnance Materiel and Related Materials Including Chemicals.

The method of cleaning will be at the discretion of the using facility. Cleaning procedure must include the total removal of grease, dirt, and foreign material, from all mating surfaces, to eliminate the introduction of contaminants into vital engine components.

## TESTING

Engine to be tested is placed on a suitable engine test stand, and all applicable hoses, lines, fittings, and wires are connected to monitoring gages and meters while simulating actual engine performance. At this time, if a malfunction is found, the symptom index, found on page 2-422, is consulted for direction to the possible corrective action.

## Section II. TROUBLESHOOTING

If troubleshooting performed in TM 5-3805-254-34 failed to isolate the specific malfunction or problem and removal of engine from chassis was deemed necessary, place engine on appropriate engine test stand and hook up test and diagnostic equipment to further aid in locating fault.

If engine has been removed from chassis and established malfunction or problem noted on DA Form 2404 and DA Form 2406, perform maintenance procedure or procedures required.



### Section III. GENERAL MAINTENANCE INSTRUCTIONS

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#### SCOPE

The purpose of this section is to provide general procedures which are applicable to all tasks. To avoid repetition throughout engine maintenance, general procedures are given below.

#### CLEANING

The procedures for cleaning will be similar for most components and parts of the engine. Any cleaning procedure that is peculiar to a specific part or component is covered in the paragraph relating to the item.

The importance of cleaning must be fully understood in order to perform a successful component repair. The presence of dirt or foreign matter can affect the operation of the component and possibly cause premature breakdown. The following should apply to all cleaning procedures,

#### **WARNING**

Drycleaning solvent P-D-680 is toxic and flammable. Wear safety goggles and gloves and use only in well-ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. Flashpoint for type #1 Drycleaning solvent is 100°F (38°C) and for type #2 is 138°F (59°C). If you become dizzy while using solvent, get fresh air immediately, and get medical aid. If contact with eyes is made, wash your eyes with water, and get medical aid immediately. Failure to observe these precautions could cause serious injury or death to personnel.

1. Clean all parts before inspection, after repair, and before assembly.
2. Hands should be kept free of any accumulation of grease which can collect dust and grit.
3. After cleaning, all parts should be covered or wrapped to protect them from dust, dirt, and foreign matter.
4. Observe all Warnings and Cautions when using drycleaning solvent (item 16, appendix B). Personnel injury and damage to rubber and plastic parts may occur.

## CLEANING - CONTINUED

### CASTINGS

1. Scrape all gasket material from mating surfaces.
2. Clean inner and outer surfaces of castings, and all areas subject to oil and grease, with drycleaning solvent (item 16, appendix B).
3. Remove sludge, rust, and gum deposits from castings using a stiff brush.

### **WARNING**

Particles blown by compressed air are hazardous. Make certain the airstream is directed away from user and other personnel in the area. Compressed air used for cleaning purposes shall not exceed 30 psi (207 kPa). User must wear safety goggles or face shield to prevent injury.

4. Use clean, dry, compressed air to blow out and dry all tapped holes in castings.

### OIL PASSAGES

Particular attention must be given to all oil passages in castings and machined parts. All oil passages must be clean and free of obstruction.

1. Clean passages with a suitable piece of wire or probe to break up any sludge or gum deposits.

### **CAUTION**

Do not allow drycleaning solvents to come in contact with seals or flexible hoses. These cleaners cause leather, rubber, and synthetic materials to dry out, rot, and lose pliability.

2. Wash passages by flushing with drycleaning solvent (item 16, appendix B).
3. Dry passages by blowing them out with compressed air.

### OIL SEALS AND FLEXIBLE HOSES

Clean seals and flexible hoses with lubricating soap (item 15, appendix B) and water.

### BALL BEARINGS

1. Refer to TM 9-214, Inspection, Care, and Maintenance of Antifriction Bearings, for information on care and maintenance of bearings.
2. Bearings require special cleaning. After removing surface oil and gum deposits, place bearings in hot oil, 140°F (60°C), to loosen hardened oil or grease. Wipe bearings dry; do not use compressed air. After cleaning, coat bearings with a light film of lubricating oil (item 12, appendix B), and wrap to protect from dust, dirt, and foreign matter, until parts are inspected and assembled.

## INSPECTION

The procedures for inspection will be similar for most components and parts of the engine. Any inspection procedure that is peculiar to a specific part or component is covered in the paragraph relating to that item.

### CASTINGS

1. Inspect all castings for cracks using a magnifying glass and strong light. Particularly check the areas near studs, pipe plugs, threaded inserts, and in sharp corners and fillets.
2. Inspect machined surfaces of castings for nicks, burrs, and raised metal. Mark damaged areas for repair.
3. Check all mating flanges on housings and supports for warpage using a straightedge or surface plate. Inspect mating flanges for discoloration which may indicate constant oil leakage.
4. Inspect all pipe plug and capscrew tapped openings for damaged or stripped threads.
5. Check actual casting specifications against those given in the paragraph relating to the item.

### BALL BEARINGS

Refer to TM 9-214 for inspection of bearings. Check actual bearing specifications against those given in the paragraph relating to the item.

### STUDS

Inspect all studs for stripped or damaged threads, bent or loose condition, and signs of stretching.

### GEARS

1. Inspect all gears for cracks, using a magnifying glass and strong light.
2. Inspect all gear teeth for wear, sharp fins, burrs, and galled or pitted surfaces.
3. Check actual gear specifications against those given in the paragraph relating to the item.

### BUSHINGS AND BUSHING-TYPE BEARINGS

1. Check all bushings and bushing-type bearings for secure fit in the castings or mating part in which they are used.
2. Inspect for wear, burrs, nicks, and out-of-round condition.
3. Check for dirt in lubrication holes or grooves. Holes and grooves must be clean and free from damage to ensure proper lubrication.
4. Check actual bushing or bushing-type bearing specifications against those given in the paragraph relating to the item.

## INSPECTION - CONTINUED

### OIL SEALS

Inspect feather edge of oil seal for hardness or cracks. Metal-encased oil seals should not be replaced unless inspection indicates damage.

### CORE HOLE PLUGS

Inspect core hole plugs for evidence of leakage. Replace if damaged or if leakage is evident.

## REPAIR

The procedures for repair will be similar for most components and parts that make up the engine. Any repair procedure that is peculiar to a specific part or component is covered in the paragraph relating to the item. After repair, clean all parts thoroughly to prevent metal chips or abrasives, that may accumulate during repair, from entering moving parts of engine.

### CASTINGS

1. Replace all cracked castings.
2. Replace all castings that do not meet specifications given in paragraph relating to that item.
3. Repair minor damage to machined surfaces with a fine file, emery cloth (item 1, appendix B), or crocus cloth (item 4, appendix B) dipped in drycleaning solvent (item 16, appendix B). Replace all castings with machined surfaces burred or nicked so badly that, after milling or grinding, they still will not allow proper assembly or operation.
4. Repair minor warpage of mounting flanges and gasket surfaces by moving the surface across a sheet of emery cloth (item 1, appendix B) held tightly on a surface plate or similar flat surface. Finish with crocus cloth (item 4, appendix B). Replace castings with flanges warped so badly that they will not allow proper assembly or operation.

### NOTE

Pipe plug threads in castings must be in good condition to prevent oil or water leakage.

5. Repair damaged pipe plug or screw threads in tapped holes by using the appropriate tap.

### BALL BEARINGS

1. Replace all galled, pitted, or damaged ball bearings.
2. Replace all ball bearings that do not meet specifications given in paragraph relating to the part in which they are installed.
3. Refer to TM 9-214 for maintenance of bearings.

## STUDS

1. Replace all bent or loose studs and studs showing signs of stretching.
2. Repair minor thread damage using a thread chaser.
3. Replace all studs having stripped or damaged threads. If a stud has to be replaced, note the following:

### Removal

- a. Using a stud extractor, unscrew studs slowly to prevent heating and possible seizure.
- b. When studs are broken too short to use stud extractor, drill the stud and remove it with an easyout.

### Replacement

Only standard studs are supplied for replacement. If threaded openings are damaged and retapping will not clean up threads, drill and tap opening to larger size and install a threaded insert.

### NOTE

All replacement studs have a special coating and must have a small amount of mica-based antiseize compound (item 2, appendix B) applied on threads before stud is installed.

## GEARS

1. Replace cracked gears.
2. Replace gears that do not meet specifications given in paragraph relating to the port in which they are installed.
3. Replace gears having worn, galled, or pitted teeth. Remove sharp fins and burrs from gear teeth with crocus cloth (item 4, appendix B) dipped in drycleaning solvent (item 16, appendix B).

## BUSHINGS AND BUSHING-TYPE BEARINGS

When bushings or bushing-type bearings are damaged or worn beyond specified limits, the associated parts with which they are used must also be replaced.

## OIL SEALS

Oil seals must be replaced when the thin feather edge is found to be damaged or when the seal material becomes hard or brittle.

### Removal

Press or pry a damaged oil seal from the casting or adapter, being careful not to damage bore in casting or adapter.

## REPAIR - CONTINUED

### Repair

When a casting oil seal bore or adapter is burred to a point where an oil tight seal is impossible, replace the casting or adapter. Remove slight nicks, burrs, and scratches from casting bore or adapter with crocus cloth (item 4, appendix B) dipped in drycleaning solvent (item 16, appendix B).

### Installation

Install a new oil seal in bore of casting or adapter, using proper oil seal installing tool.

## ASSEMBLY

Extreme care must be taken in all component assembly operations to ensure satisfactory engine performance. General cautions are outlined below. Step-by-step procedures for assembly of various components are covered in paragraphs relating to the specific components.

1. Cleanliness is the most important factor to consider during the assembly of all components. The smallest amounts of dirt and dust can be abrasive and cause premature component failure.
2. Coat all bearings and contact surfaces with lubricating oil (item 12, appendix B) to ensure lubrication of parts during initial engine startup.
3. Replace all gaskets, preformed packings, and lockwashers.

## TAPING THREADS

Antiseizing tape (item 18, appendix B) is wrapped around threads, pipe plugs, screws, studs, and other type of threaded attaching hardware, to provide a better seal and also to permit easier removal.

1. Make sure item to be wrapped is clean and dry before applying antiseizing tape.
2. Start the tape one or two threads from the leading edge, joining the tape together with an overlap of approximately 1/8 inch.
3. Wrap tape tightly in the same direction you would screw in the item being taped. Press tape into threads without ripping or cutting tape.

## TAGGING PARTS

Before disconnecting or separating electrical, air, hydraulic, or mechanical components, always identify the mating parts for correct installation later. This can be done by tagging each part (item 17, appendix B) with duplicate numbers or letters, or, in the case of electrical connections, identify the terminal or circuit number on the individual wire or the wire number on the terminal or circuit.

Parts to be repaired must be tagged as needing repair. Note necessary information on repair tags.

**PRELIMINARY STARTING PROCEDURES****WARNING****EXHAUST GAS CAN KILL YOU**

Exhaust gas is without color or smell, but can kill you. Breathing exhaust gas produces symptoms of headache, dizziness, loss of muscular control, a sleepy feeling, and coma. Brain damage or death can result from heavy exposure to exhaust fumes of fuel-burning internal combustion engines. Exhaust gases can become dangerously concentrated under conditions of no air movement. Precautions must be followed to ensure crew safety when the engine of any vehicle is operated for any purpose.

1. DO NOT operate vehicle engine inside building unless ample ventilation is available.
2. DO NOT idle engine for long periods without ventilator blower operating.
3. DO NOT drive any vehicle with inspection plates, cover plates, or engine compartment doors removed unless necessary for maintenance purposes.
4. BE ALERT at all times during vehicle operation for exhaust odors and exposure symptoms. If either is present, IMMEDIATELY VENTILATE personnel compartments. If symptoms persist, remove affected crew to fresh air; keep warm; DO NOT PERMIT PHYSICAL EXERCISE; if necessary, give artificial respiration.
5. FOR ARTIFICIAL RESPIRATION, REFER TO FM21-11.
6. BE AWARE; the field protective mask for chemical-biological-radiological (CBR) protection will not protect you from carbon monoxide poisoning.

THE BEST DEFENSE AGAINST CARBON MONOXIDE POISONING IS GOOD VENTILATION.

**NOTE**

Perform the following steps as they are applicable before starting engine in the engine test stand.

1. Make sure engine exhaust outlet is connected to a suitable shop exhaust system to evacuate the engine exhaust gases safely from the testing area.
2. Check air inlet piping to ensure it is attached correctly and tight.
3. Make sure all cooling system water hoses and clamps are attached correctly and are tight with no leaks.
4. Check all fuel lines and fittings to make sure they are attached correctly and are tight with no leaks.
5. Make sure all engine test stand gauges and controls are attached to engine properly and are tight.
6. Check engine oil level with oil level dipstick to make sure crankcase is full. Oil level should be between the H (high) and L (low) marks on dipstick.

**Section IV. ENGINE DISASSEMBLY AND ASSEMBLY**

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## GENERAL

These tasks contain information needed to disassemble engine and its components, and to assemble engine from its subassemblies into a complete engine.

Before disassembly, a visual inspection of engine and its subassemblies is recommended to determine if repair is required. Inspection of each subassembly and tagging of components and positions will help ensure correct assembly. Remove and replace components and parts from engine in order in which they appear in this section. Individual components may be removed by noting equipment condition to be performed.

Before assembly, it is important to check each subassembly to make sure nothing has been overlooked during inspection and repair.

Read and understand all WARNINGS, CAUTIONS, and NOTES.

Torque limits and tolerances will be included in each applicable task. It is important to pay attention to all torque limits and tolerances. Section XVI, chapter 2 contains a complete list of all torque limits and tolerances.

Any cleaning procedure, except for unique situations, can be found in section III, chapter 2, General Maintenance Instructions. Lubricants should be kept in clean, covered containers. Work area should be kept as clean as possible.

When engine is removed from chassis, support it on engine transport stand. Perform all necessary disassembly procedures to prepare engine for mounting on suitable engine repair stand. Engine maintenance is performed on the engine repair stand. For final assembly of engine, remove it from the engine repair stand and remount engine on engine transport stand. Mounting procedures on engine repair and transport stands are left up to the discretion of the repair facility.

Disassembly and assembly of the NTC-290 diesel engine must be performed in the order that the paragraphs are presented in this section, starting with Turbocharger and Oil Line Removal.

**TURBOCHARGER AND OIL LINE REMOVAL**

INITIAL SETUP

Tools

- Extension, 6-inch, 1/2-inch drive
- Handle, ratchet, 1/2-inch drive
- Joint, universal, 1/2-inch drive
- Screwdriver, flat-tip, 1/4-inch
- Socket, 9/16-inch, 1/2-inch drive
- Wrench, box-end, 1/2-inch
- Wrench, box-end, 9/16-inch (two required)
- Wrench, open-end, 5/8-inch
- Wrench, open-end, 3/4-inch

Tools - Continued

- Wrench, open-end, 1 1/4-inch
- Wrench, open-end, 1 5/16-inch
- Wrench, open-end, 1 3/8-inch

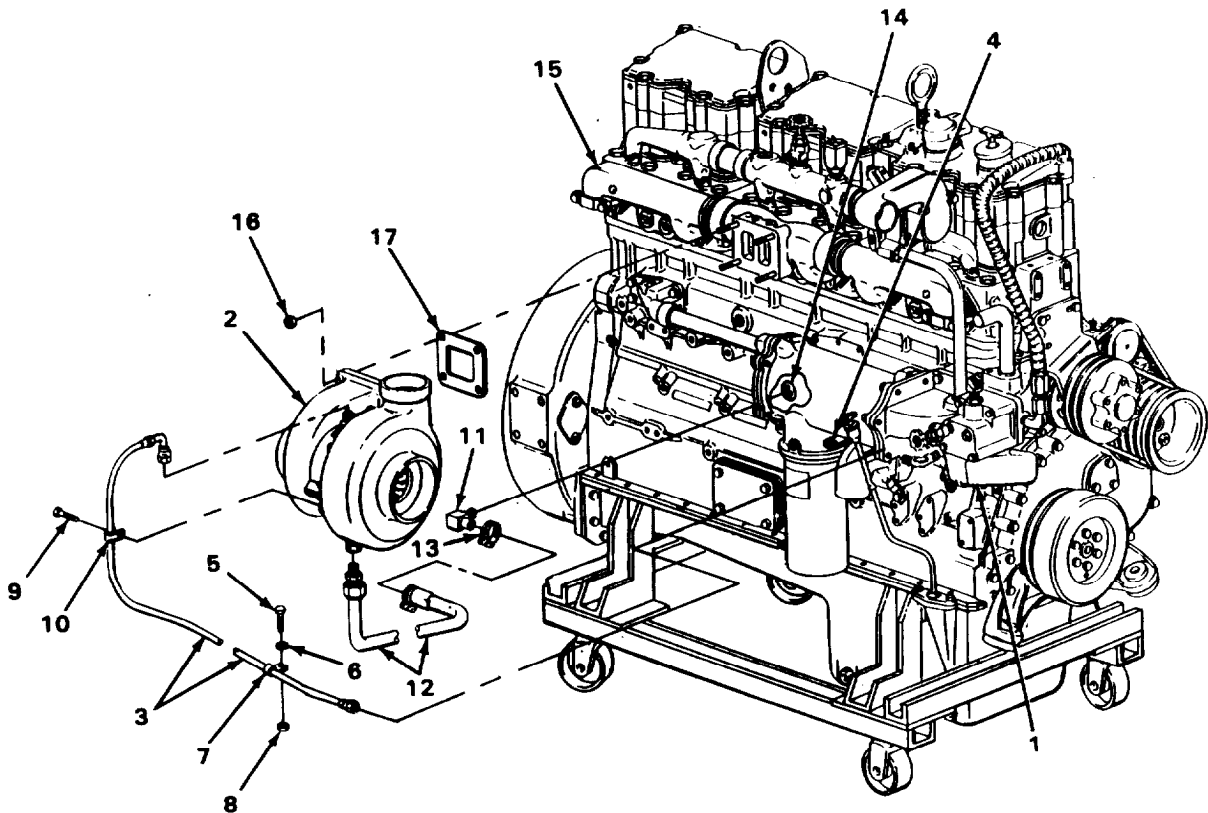
Equipment Condition

Engine mounted on engine support stand. (Engine support stand and mounting instructions) will be at the discretion of the repair facility.

LOCATION	ITEM	ACTION REMARKS
1. Oil cooler (1) and turbocharger (2)	Oil supply line and fittings (3)	<ul style="list-style-type: none"> <li>a. Using 1/2-inch box-end wrench and 3/4-inch open-end wrench, unscrew and take off oil supply line and fitting from oil cooler.</li> <li>b. Using 5/8-inch and 3/4-inch open-end wrenches, unscrew and take off oil supply line and fitting from turbocharger.</li> </ul>
2. Bracket (4) on oil cooler (1)	Screw (5), flat washer (6), clamp (7), and nut (8)	<p>Using two 9/16-inch box-end wrenches, unscrew and take off nut.</p> <p><b>Pull off screw, flat washer, and clamp from bracket and screw on nut to prevent loss.</b></p>
3. Turbocharger (2)	Screw (9) and clamp (10)	<p>Using 1/2-inch box-end wrench, unscrew and take off screw, oil supply line, and fittings from turbocharger.</p> <p><b>Remove screw from clamp and install on turbocharger to prevent loss.</b></p>
4. Turbocharger (2) and oil return hose fitting (11)	Oil return tube and hose (12) and clamp (13)	<ul style="list-style-type: none"> <li>a. Using 1/4-inch flat-tip screwdriver, loosen clamp and disconnect oil return tube and hose from oil return hose fitting.</li> <li>b. Using 1 3/8-inch and 1 5/16-inch open-end wrenches, unscrew and take off oil return tube and hose from turbocharger,</li> </ul>

**TURBOCHARGER AND OIL LINE REMOVAL - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
5. Right side of cylinder block (14)	Oil return hose fitting (11)	Using 1 1/4-inch open-end wrench, unscrew and take off.
6. Exhaust manifold (15)	Four nuts (16), turbocharger (2), and gasket (17)	a. Using 1/2-inch drive 9/16-inch socket, 6-inch extension, universal joint, and ratchet handle, unscrew and take off four nuts. b. Take off turbocharger and gasket. <b>Discard gasket and screw four nuts onto exhaust manifold to prevent loss.</b>



**TASK ENDS HERE**

**EXHAUST MANIFOLD REMOVAL**

---

INITIAL SETUP

Tools

Chisel, cold, 1/2-inch  
 Extension, 6-inch, 1/2-inch drive  
 Goggles, safety  
 Hammer, ball-peen, 16-ounce  
 Handle, ratchet, 1/2-inch drive  
 Socket, 5/8-inch, 1/2-inch drive

Personnel Required

Two

Equipment Condition

Turbocharger and oil lines removed  
 (page 2-12).

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LOCATION	ITEM	ACTION REMARKS
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**WARNING**

Safety goggles must be worn to prevent eye injury caused by flying steel chips.

- |                         |  |   |
|-------------------------|--|---|
| 1. Exhaust manifold (1) | Four nut locking plates (2) and four key washers (3)                         | Using 16-ounce ball-peen hammer and 1/2-inch cold chisel, bend back tabs on nut locking plates and key washers.                       |
| 2.                      | Eight screws (4), four nut locking plates (2), and eight sleeve bearings (5) | Using 1/2-inch drive W-inch socket, 6-inch extension, and ratchet handle, unscrew and take off.<br><b>Discard nut locking plates.</b> |
| 3.                      | Four screws (6), four key washers (3), and two retaining straps (7)          | Using 1/2-inch drive 5/8-inch socket, 6-inch extension, and ratchet handle, unscrew and take off.<br><b>Discard key washers.</b>      |

**EXHAUST MANIFOLD REMOVAL - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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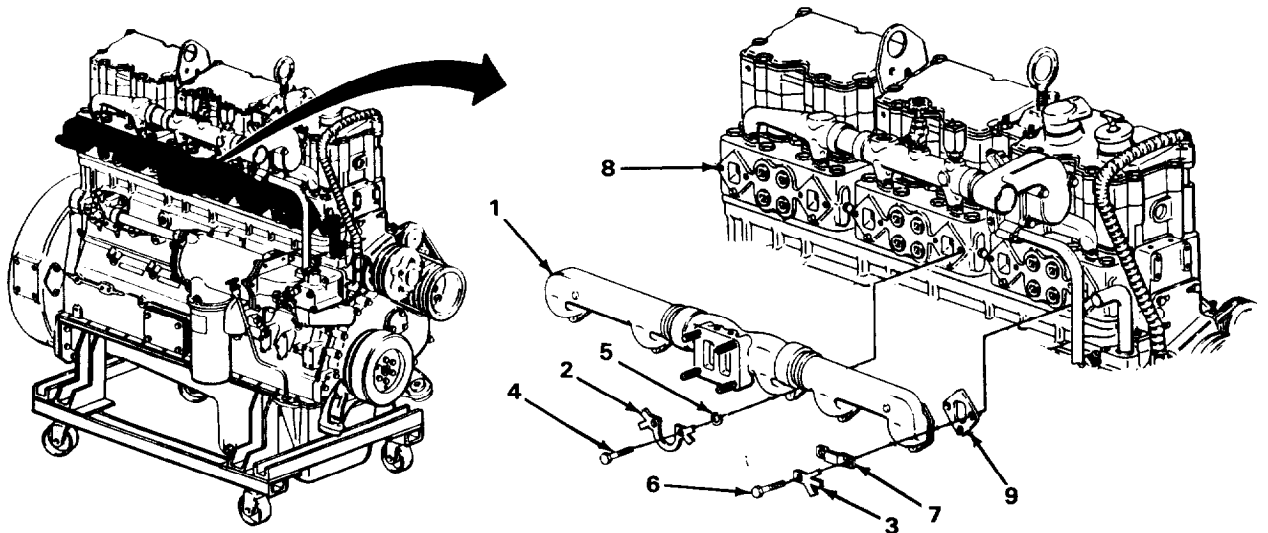
**WARNING**

Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.

**CAUTION**

Exhaust manifold is in three sections and could separate, causing damage to equipment. Assistance will be needed to perform step 4.

- |                      |   |   |
|----------------------|---|---|
| 4. Cylinder head (8) | Exhaust manifold (1)<br>and six gaskets (9) | With assistance, take off.<br><b>Discard gaskets.</b> |
|----------------------|---|---|



**TASK ENDS HERE**

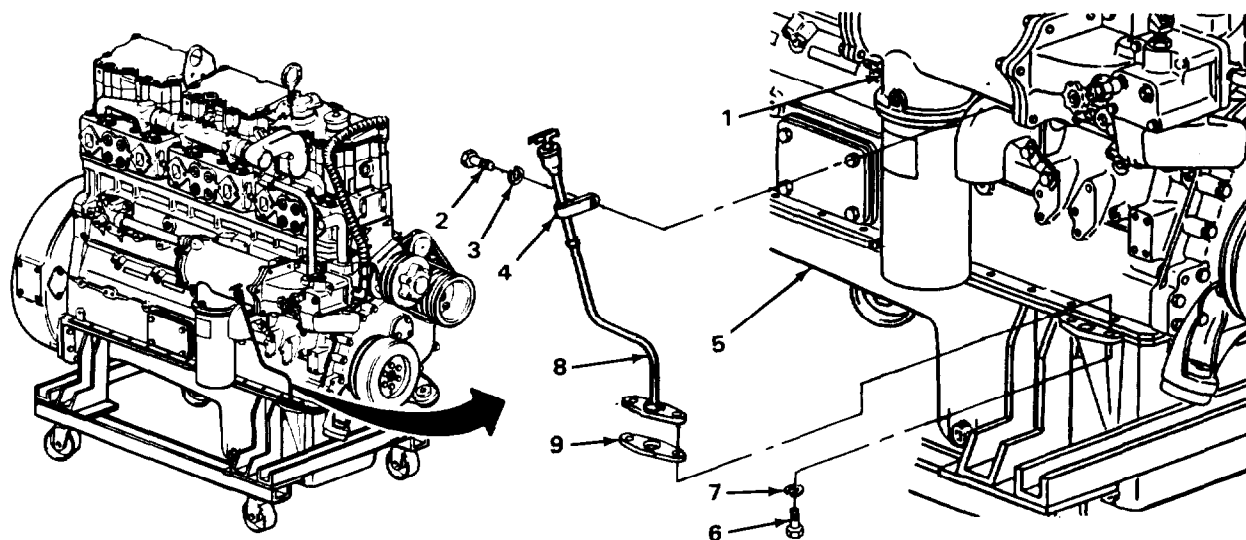
**OIL DIPSTICK TUBE REMOVAL**

INITIAL SETUP

Tools

- Handle, ratchet, 1/2-inch drive
- Socket, 5/8-inch, 1/2-inch drive
- Wrench, box-end, 9/16-inch

LOCATION	ITEM	ACTION REMARKS
1. Oil cooler (1)	Screw (2), lock-washer (3), and bracket (4)	a. Using 9/16-inch box-end wrench, unscrew and take off. <b>Discard lockwasher.</b> b. Reinstall screw in oil cooler to prevent loss.
2. Oil pan (5)	Two screws (6) and two lockwashers (7)	Using 1/2-inch drive 5/8-inch socket and ratchet handle, unscrew and take out. <b>Discard lockwashers.</b>
3.	Oil dipstick tube (8) and gasket (9)	Pull out of oil pan to remove. <b>Discard gasket.</b>
4.	Two screws (6) and oil dipstick tube (8)	Install two screws in oil dipstick tube to prevent loss.



**TASK ENDS HERE**

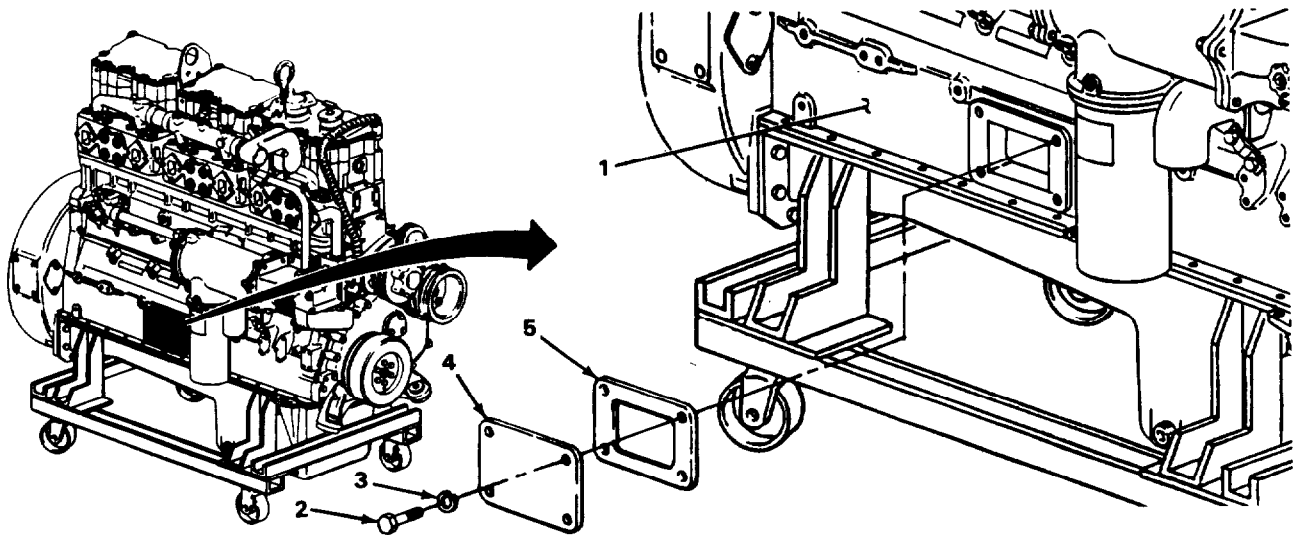
**CRANKCASE ACCESS COVER REMOVAL**

INITIAL SETUP

Tools

Handle, ratchet, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive

LOCATION	ITEM	ACTION REMARKS
1. Right side of cylinder block (1)	Four screws (2) and four lockwashers (3)	Using 1/2-inch drive 9/16-inch socket and ratchet handle, unscrew and take out. <b>Discard lockwashers.</b>
2.	Crankcaseaccess cover (4) and gasket (5)	Take off. <b>Discard gasket.</b>



**TASK ENDS HERE**

**WATER MANIFOLD ASSEMBLY REMOVAL**

---

INITIAL SETUP

Tools

Wrench, open-end, 9/16-inch

---

LOCATION	ITEM	ACTION REMARKS
1. Rear and center cylinder heads (1)	Four screws (2) and four lockwashers (3)	Using 9/16-inch open-end wrench, unscrew and take out. <b>Discard lockwashers.</b>
2.	Four screws (4) and four lockwashers (5)	Using 9/16-inch open-end wrench, unscrew and take out. <b>Discard lockwashers.</b>
3.	Water manifold center and rear sections (6) and four gaskets (7)	Carefully pull out and remove. <b>Discard gaskets.</b>
4. Front cylinder head (8)	Two screws (9) and two lockwashers (10)	Using 9/16-inch open-end wrench, unscrew and take out. <b>Discard lockwasher.</b>
5.	Two screws (11) and two lockwashers (12)	Using 9/16-inch open-end wrench, unscrew and take out. <b>Discard lo&amp;washers.</b>

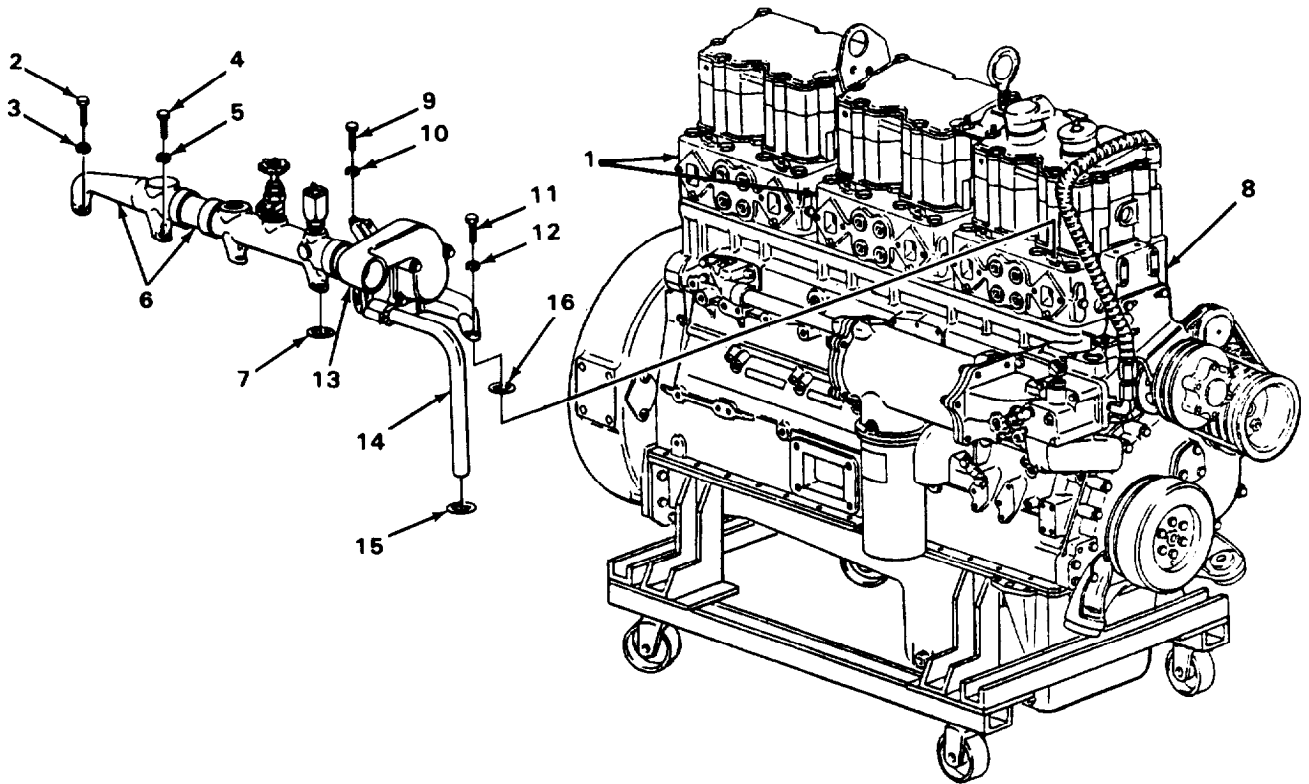
**CAUTION**

Care must be taken not to damage connector tube. Connector tube remains with water manifold front section.



**WATER MANIFOLD ASSEMBLY REMOVAL - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
6.	Water manifold front section (13), connector tube (14), packing (15), and two gaskets (16)	Carefully pull up and take off. <b>Discard packing and gaskets.</b>



**TASK ENDS HERE**

**ENGINE OIL COOLER REMOVAL**

INITIAL SETUP

<p>Tools</p> <p>Extension, 6-inch, 1/2-inch drive                  Handle, ratchet, 1/2-inch drive                  Socket, 9/16-inch, 1/2-inch drive                  Socket, 3/4-inch, 1/2-inch drive                  Wrench, box-end, 7/16-inch</p>	<p>Personnel Required</p> <p>Two</p> <p>Equipment Condition</p> <p>Water manifold removed (page 2-18).</p>
---	--

LOCATION	ITEM	ACTION REMARKS
1. Rear water header cover (1)	Six screws (2) and six lockwashers (3)	Using 7/16-inch box-end wrench, unscrew and take out. <b>Discard lockwashers.</b>
2. Right side of cylinder block (4)	Rear water header cover (1), gasket (5), water transfer tube (6), and two packings (7)	Take off and pull out. <b>Discard gasket and packings.</b>
3. Engine oil cooler brace (8)	Screw (9), lock-washer (10), and flat washer (11)	Using 1/2-inch drive 3/4-inch socket, 6-inch extension, and ratchet handle, unscrew and take out. <b>Discard lockwasher.</b>
<b>NOTE</b>		
When performing step 4, support oil filter shell to prevent it from falling,		
4. Oil filter shell (12)	Retaining screw (13)	Using 1/2-inch drive 9/16-inch socket and ratchet handle, loosen. <b>Retaining screw remains attached to oil filter shell.</b>
5. Engine oil cooler (14)	Oil filter shell (12)	Lower and remove.
6. Oil filter shell (12)	Oil filter cartridge (15) and packing (16)	Take out. <b>Discard oil filter cartridge and packing.</b>

**ENGINE OIL COOLER REMOVAL - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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**CAUTION**

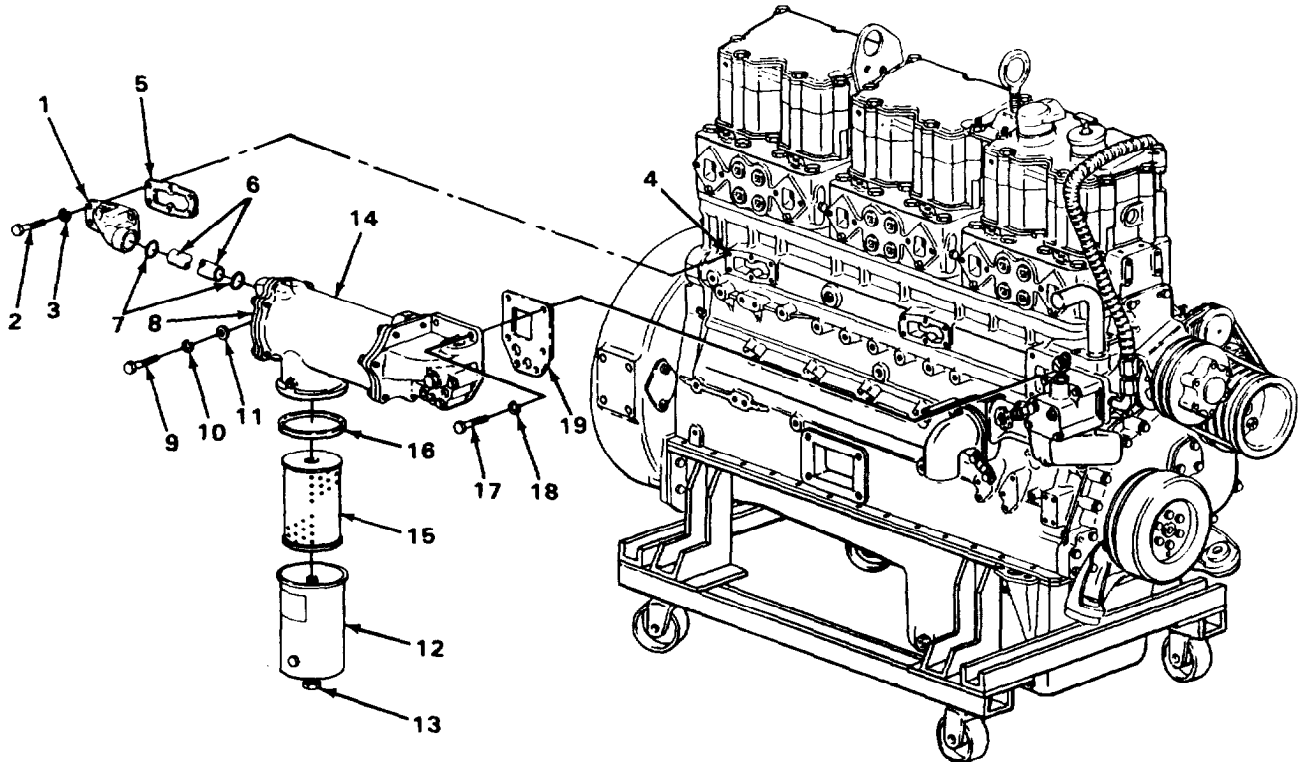
When performing steps 7 and 8, assistance will be needed to support oil cooler while removing hardware, to prevent oil cooler from falling.

7. Engine oil cooler (14)	Six screws (17) and six lockwashers (18)	Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and ratchet handle, unscrew and take out. <b>Discard lockwashers.</b>
---------------------------	--	---

**WARNING**

Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.

8. Right side of cylinder block (4)	Engine oil cooler (14) and gasket (19)	With assistance, take off. <b>Discard gasket.</b>
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**TASK ENDS HERE**

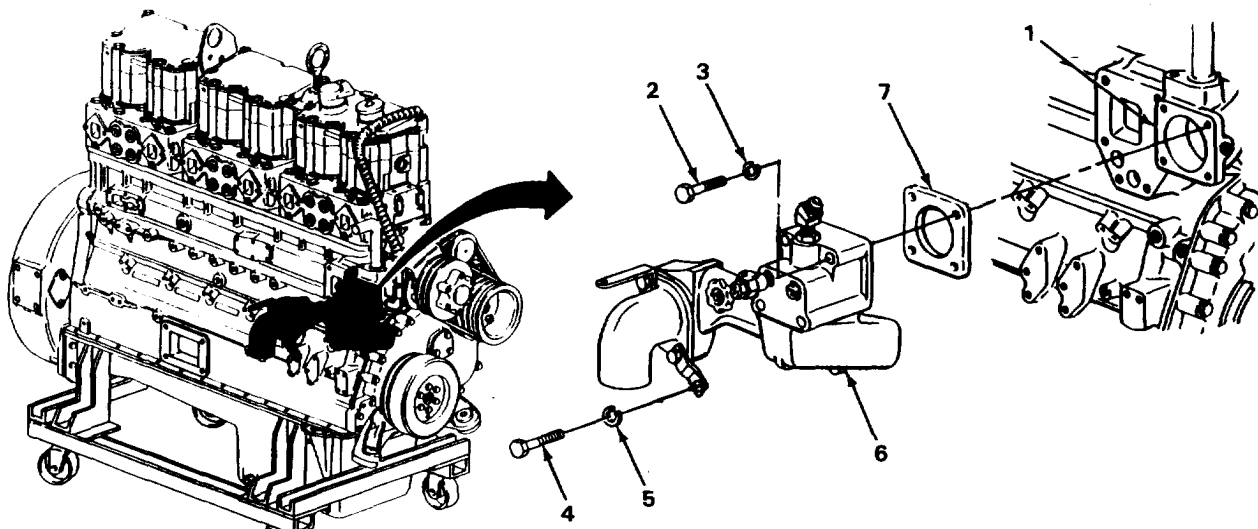
**WATER INLET HOUSING REMOVAL**

INITIAL SETUP

Tools

- Extension, 6-inch, 1/2-inch drive
- Handle, ratchet, 1/2-inch drive
- Socket, 9/16-inch, 1/2-inch drive

LOCATION	ITEM	ACTION REMARKS
<b>REMOVAL</b>		
1. Right front of cylinder block (1)	Four screws (2) and four lockwashers (3)	Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and ratchet handle, unscrew and remove. <b>Discard lockwashers.</b>
2.	Screw (4) and lockwasher (5)	Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and ratchet handle, unscrew and remove. <b>Discard lockwasher.</b>
3.	Water inlet housing (6) and gasket (7)	Take off. <b>Discard gasket.</b>



**TASK ENDS HERE**

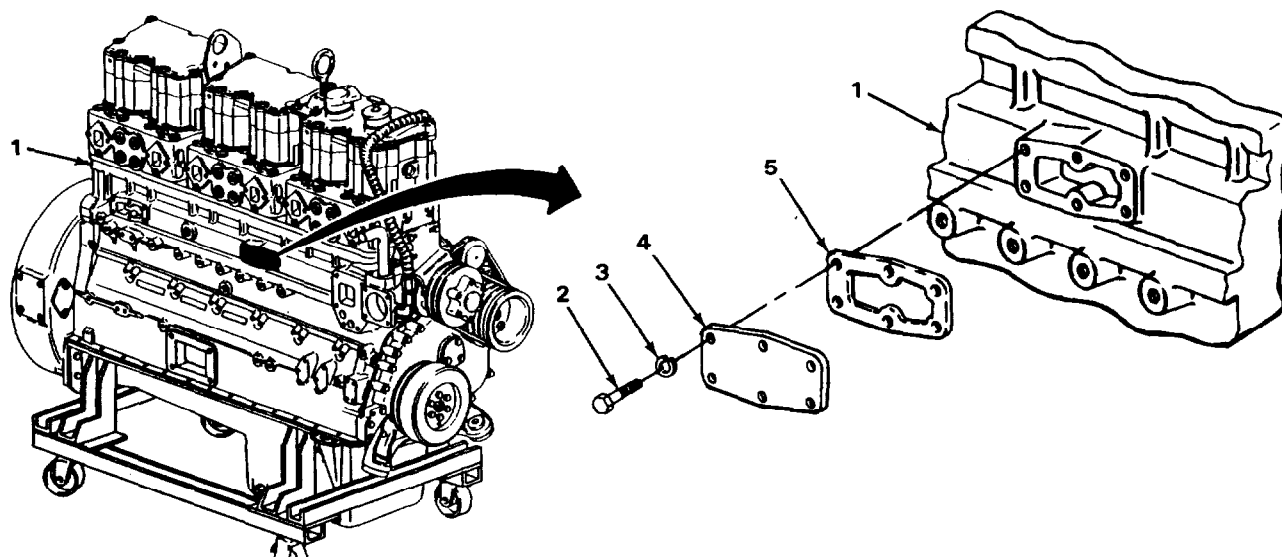
## WATER HEADER COVER REMOVAL

### INITIAL SETUP

#### Tools

Handle, ratchet, 1/2-inch drive  
 Socket, 7/16-inch, 1/2-inch drive

LOCATION	ITEM	ACTION REMARKS
1. Right side of cylinder block (1)	Six screws (2) and six lockwashers (3)	Using 1/2-inch drive 7/16-inch socket and ratchet handle, unscrew and take out. <b>Discard lockwashers.</b>
2.	Water header cover (4) and gasket (5)	Take off. <b>Discard gasket.</b>



**TASK ENDS HERE**

**PISTON COOLING NOZZLE REMOVAL**

INITIAL SETUP

Tools

Handle, ratchet, 1/2-inch drive  
 Socket, 1/2-inch, 1/2-inch drive

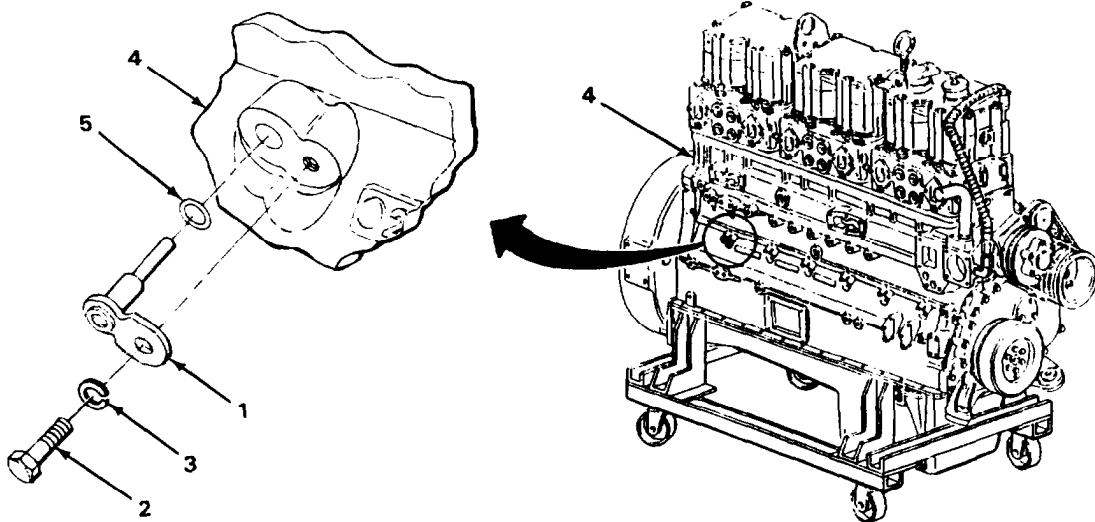
LOCATION	ITEM	ACTION	REMARKS
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REMOVAL

**NOTE**

Steps given are typical for all six piston cooling nozzles.

- |                                     |   |  |
|-------------------------------------|---|--|
| 1. Piston cooling nozzle (1)        | Screw (2) and lockwasher (3)              | Using 1/2-inch drive 1/2-inch socket and ratchet handle, unscrew and take out.<br><b>Discard lockwasher.</b> |
| 2. Right side of cylinder block (4) | Piston cooling nozzle (1) and packing (5) | Pull out of cylinder block.<br><b>Discard packing.</b>   |



**TASK ENDS HERE**

## ANEROID CONTROL VALVE REMOVAL

### INITIAL SETUP

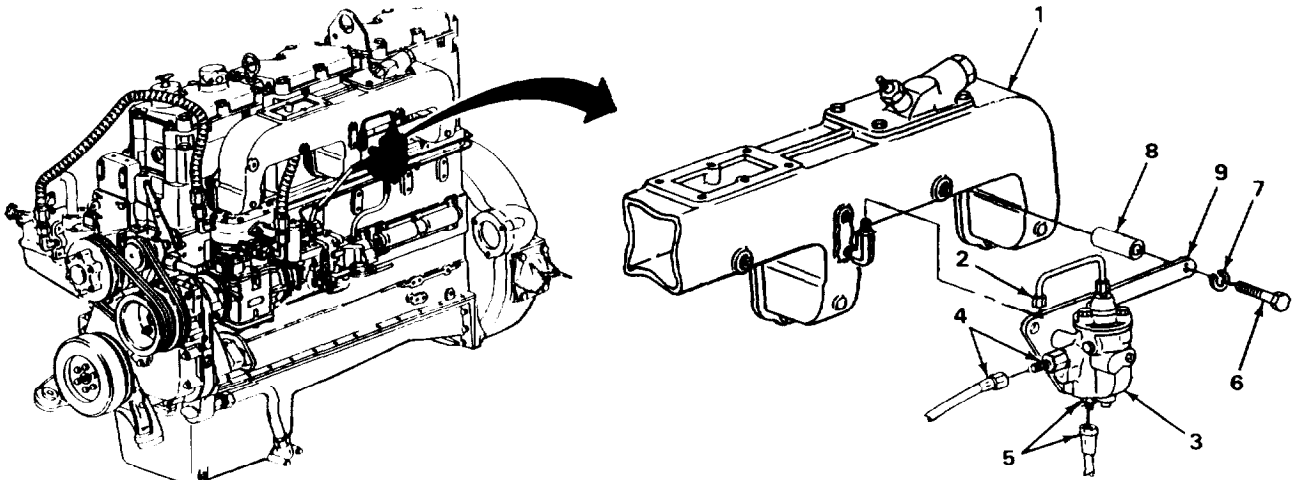
#### Tools

Extension, 6-inch, 1/2-inch drive  
 Handle, ratchet, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive  
 Wrench, open-end, 9/16-inch  
 Wrench, open-end, 5/8-inch  
 Wrench, open-end, 7/8-inch

#### Equipment Condition

Engine removed from engine transport stand and mounted on engine repair stand. (Engine repair stand and mounting instructions will be at discretion of repair facility.)

LOCATION	ITEM	ACTION REMARKS
1. Intake manifold (1)	Vacuum line nut (2)	Using 9/16-inch open-end wrench, loosen and disconnect.
2. Aneroid control valve (3)	Fuel line nuts (4)	Using 5/8-inch and 7/8-inch open-end wrenches, loosen and disconnect.
3.	Fuel line nuts (5)	Using 5/8-inch and 9/16-inch open-end wrenches, loosen and disconnect.
4. Intake manifold (1)	Two screws (6), two lockwashers (7), two spacers (8), aneroid control valve (3) and bracket (9)	a. Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and ratchet handle, unscrew and take out. b. Take off aneroid control valve with bracket. <b>Discard lockwashers.</b>



**TASK ENDS HERE**

**INTAKE MANIFOLD REMOVAL**

INITIAL SETUP

Tools

Extension, 6-inch, 1/2-inch drive  
 Handle, ratchet, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive  
 Wrench, open-end, 1-inch

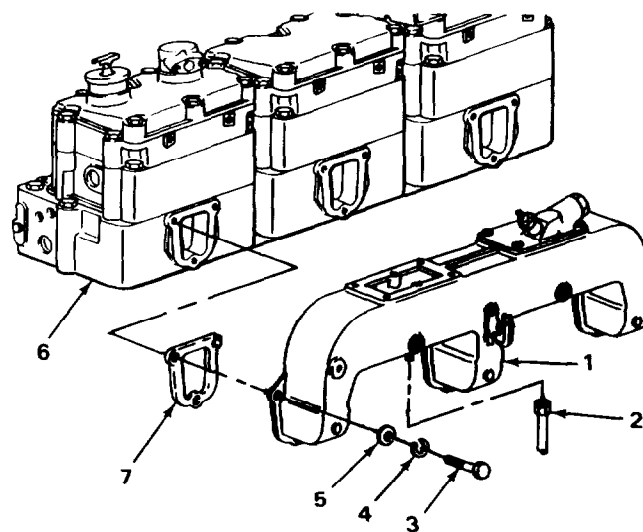
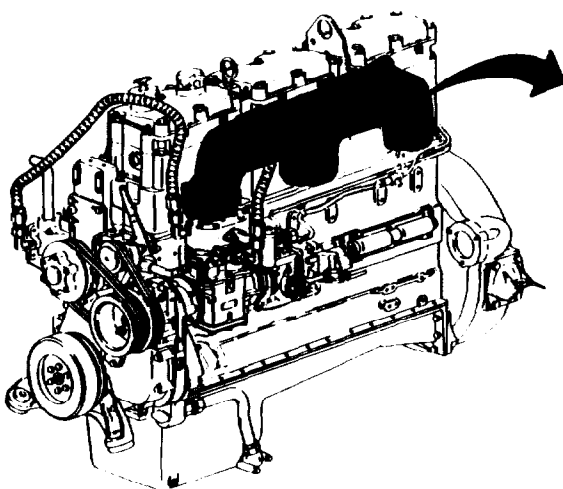
Personnel Required

Two

Equipment Condition

Aneroid control valve removed (page 2-25).

LOCATION	ITEM	ACTION REMARKS
1. Intake manifold (1)	Air compressor hose nuts (2)	Using 1-inch open-end wrench, loosen and disconnect.
2.	Seven screws (3), seven lockwashers (4) and seven flat washers (5)	Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and ratchet handle, unscrew and take out. <b>Discard lockwashers.</b>
<b><u>WARNING</u></b>		
Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.		
3. Cylinder head (6)	Intake manifold (1) and three gaskets (7)	With assistance, take off. <b>Discard gaskets.</b>



**TASK ENDS HERE**



## ROCKER ARM COVER REMOVAL

### INITIAL SETUP

#### Tools

Handle, ratchet, 1/2-inch drive  
 Screwdriver, flat-tip, 1/4-inch  
 Socket, 9/16-inch, 1/2-inch drive

LOCATION	ITEM	ACTION	REMARKS
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### **CAUTION**

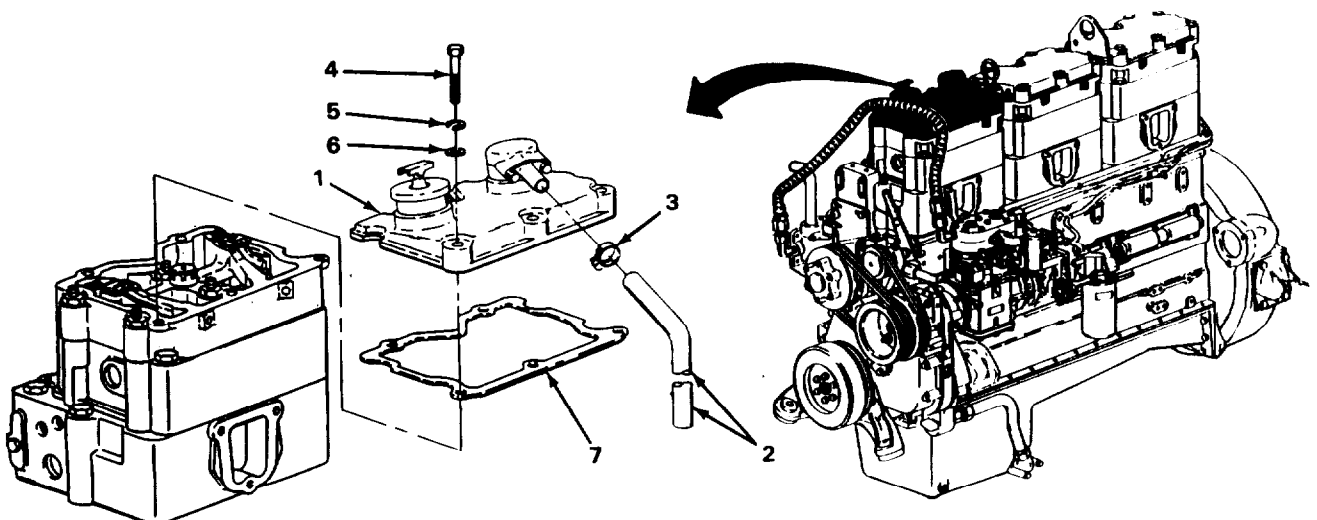
Do not damage injector adjustment procedure decal on rocker arm cover.

1. Front rocker arm cover (1)	Crankcase breather hose (2) and clamp (3)	Using 1/4-inch flat-tip screwdriver, loosen clamp and take off hose.	
-------------------------------	---	--	--

### **NOTE**

Step 2 is typical for all three rocker arm covers.

2.	Five screws (4), five lockwashers (5), five flat washers (6), rocker arm cover (1), and gasket (7)	a. Using 1/2-inch drive 9/16-inch socket and ratchet handle, unscrew and take off. b. Take off rocker arm cover. <b>Discard gasket and lockwashers.</b>	
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**TASK ENDS HERE**

**ENGINE COMPRESSION BRAKE HOUSING REMOVAL**

INITIAL SETUP

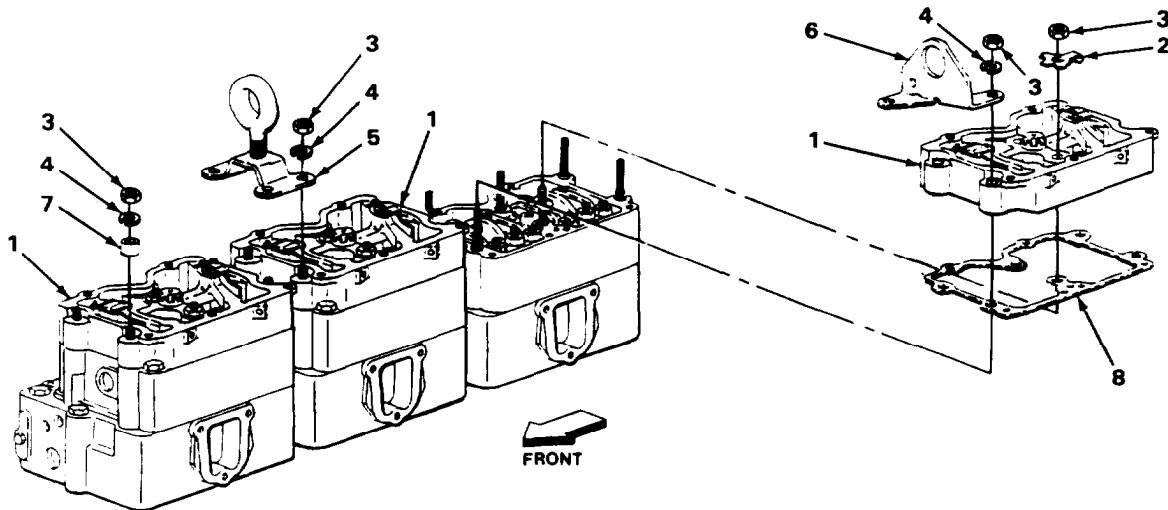
Tools

Extension, 6-inch, 1/2-inch drive  
 Handle, ratchet, 1/2-inch drive  
 Screwdriver, flat-tip, 3/8-inch  
 Socket, 3/4-inch, 1/2-inch drive

Equipment Condition

Rocker arm cover removed (page 2-27).

LOCATION	ITEM	ACTION REMARKS
1. Three engine compression brake housings (1)	Six lock tabs (2), eighteen nuts (3) and twelve lockwashers (4)	a. Using 3/8-inch flat-tip screwdriver, pry ends of lock tabs away from nuts. b. Using 1/2-inch drive 3/4-inch socket, 6-inch extension and ratchet handle, unscrew and take off. <b>Discard lock tabs and lockwashers.</b>
2.	Front lifting eye (5), rear lifting eye (6), two spacers (7) three engine compression brake housings (1), and three gaskets (8)	Take off. Discard gaskets.



## CYLINDER HEAD FUEL LINE REMOVAL

### INITIAL SETUP

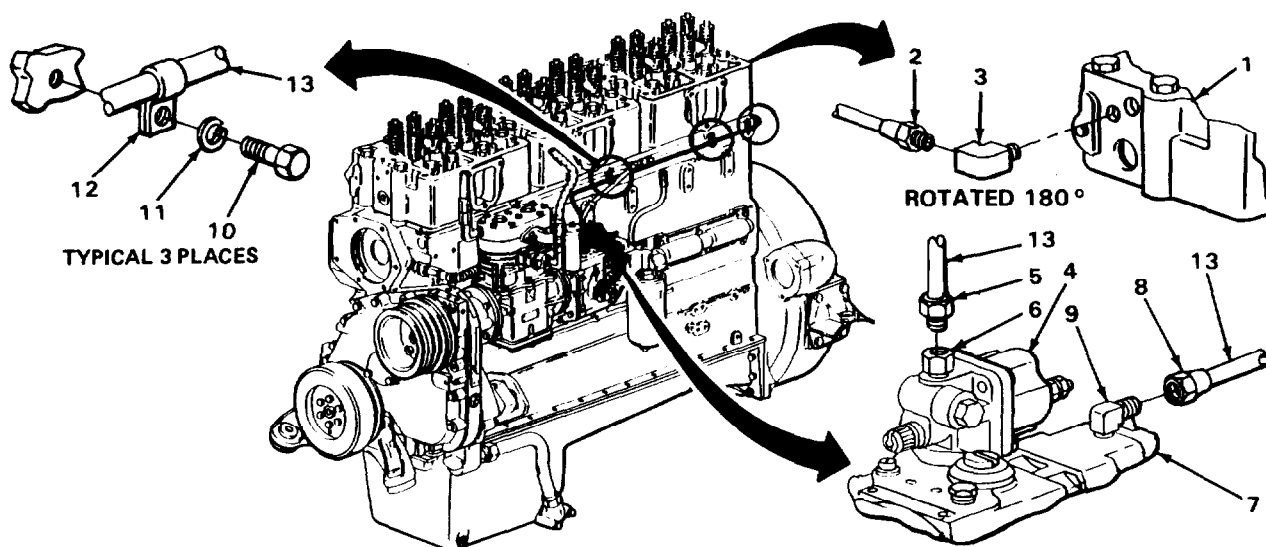
#### Tools

Handle, ratchet, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive  
 Wrench, open-end, 1/2-inch

#### Tools - Continued

Wrench, open-end, 9/16-inch  
 Wrench, open-end, 5/8-inch

LOCATION	ITEM	ACTION REMARKS
1. Rear cylinder head (1)	Two fuel line nuts (2) and two fittings (3)	a. Using 1/2-inch open-end wrench, loosen and disconnect fuel line nuts. b. Using 5/8-inch open-end wrench, unscrew and take out fittings. <b>Install fittings on fuel line nuts to prevent loss.</b>
2. Fuel shutoff switch (4)	Fuel line nut (5) and fitting (6)	Using 5/8-inch and 1/2-inch open-end wrenches, loosen and disconnect.
3. Fuel pump (7)	Fuel line nut (8) and fitting (9)	Using 9/16-inch open-end wrench, loosen and disconnect fuel line nut.
4. Left side of cylinder block	Three screws (10), three lockwashers (11), three clamps (12), and two fuel lines (13)	Using 1/2-inch drive 9/16-inch socket and ratchet handle, unscrew and take off. <b>Discard lockwashers.</b> <b>Install three screws in cylinder block to prevent loss.</b>



TASK ENDS HERE

**ROCKER ARM HOUSING REMOVAL**

INITIAL SETUP

Tools

- Handle, ratchet, 3/8-inch drive
- Mallet, rubber
- Screwdriver, flat-tip, 3/8-inch
- Socket, 7/16-inch, 3/8-inch drive
- Wrench, box-end, 5/8-inch
- Wrench, box-end, 3/4-inch

Materials/Parts

Tags, marker (item 17, appendix B)

Equipment Condition

Engine compression brake housings removed (page 2-28).

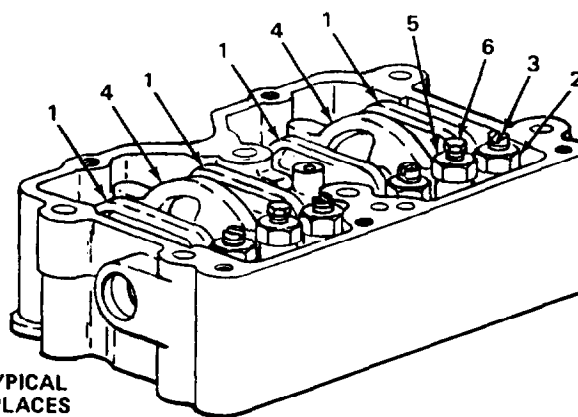
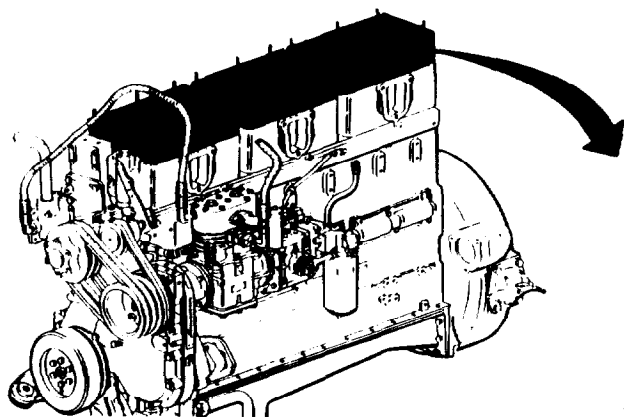
LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

Before performing following steps, tag rocker arm housings with location on engine.

Steps given are typical for all three rocker arm housings.

- |  |  |  |
|--|--|--|
| <p>1. Intake and exhaust valve rocker arms (1)</p> | <p>Locknut (2) and adjusting screw (3)</p> | <p>Using 3/4-inch box-end wrench and 3/8-inch flat-tip screwdriver, loosen locknut and unscrew adjusting screw until rocker arm moves freely.</p>                    |
| <p>2. Fuel injector rocker arm (4)</p>             | <p>Locknut (5) and adjusting screw (6)</p> | <p>Using 3/8-inch drive 7/16-inch socket, ratchet handle, and 3/4-inch box-end wrench, loosen locknut and unscrew adjusting screw until rocker arm moves freely.</p> |



TYPICAL  
3 PLACES

**NOTE**

Rocker arm studs are different lengths. Before performing step 3, tag rocker arm studs. See illustration for location and lengths.

**ROCKER ARM HOUSING REMOVAL - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
3. Rocker arm housing (7)	Six rocker arm studs (8)	Using 5/8inch box-end wrench, unscrew and take out.
4. Cylinder head (9)	Rocker arm housing (7) and gasket (10)	Using rubber mallet, tap lightly and take off. Discard gasket.

**STUD LOCATION DIAGRAM**

**TYPICAL 3 PLACES**

STUD A 8 5/8 IN.  
STUD B 8 1/8 IN.  
STUD C 7 IN.

**TASK ENDS HERE**

**CROSSHEAD REMOVAL**

**INITIAL SETUP**

**Tools**

Screwdriver, flat-tip, 1/4inch  
Wrench, open-end, 9/16-inch

**Equipment Condition**

Rocker arm housings removed (page 2-30).

**Materials/Parts**

Tags, marker (item 17, appendix B)

CROSSHEAD REMOVAL - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
1. Crosshead (1)	Locknut (2) and adjusting screw (3)	Using 9/16-inch open-end wrench and 1/4-inch flat-tip screwdriver, loosen locknut and unscrew adjusting screw two full turns.	

**NOTE**

Before performing step 2, tag crossheads, from front cylinder to rear cylinder, for identification and location as shown in table below.

2. Cylinder heads (4)	Twelve cross-heads (1)	Take off.
-----------------------	------------------------	-----------

TAG NO.	CYL NO.	VALVE
1	1	EXHAUST
2	1	INTAKE
3	2	INTAKE
4	2	EXHAUST
5	3	EXHAUST
6	3	INTAKE
7	4	INTAKE
8	4	EXHAUST
9	5	EXHAUST
10	5	INTAKE
11	6	INTAKE
12	6	EXHAUST

TASK ENDS HERE

**PUSH ROD REMOVAL**

INITIAL SETUP

Materials/Parts

Equipment Condition

Tags, marker (item 17, appendix B)

Rocker arm housings removed (page 2-30).

LOCATION	ITEM	ACTION	REMARKS
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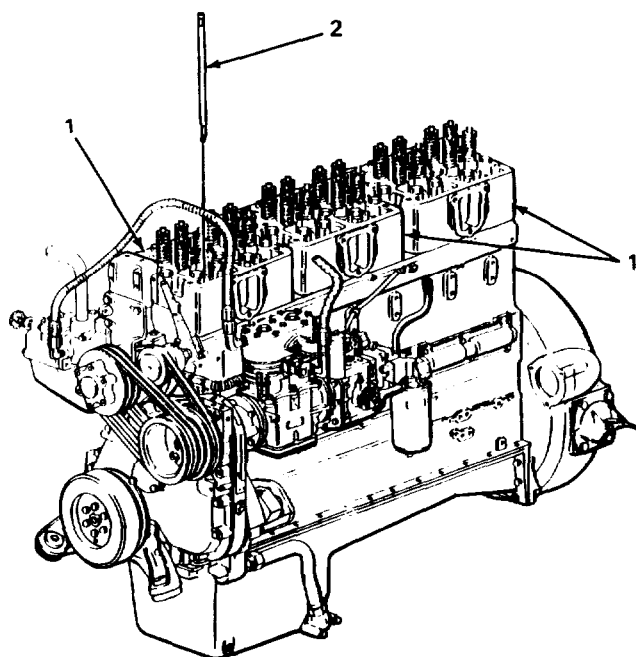
**NOTE**

Before removing, tag push rods, from front cylinder to rear cylinder, for location as shown in table below.

Cylinder heads (1)

Push rods (2)

Pull out.



PUSH ROD LOCATION AND DESCRIPTION			
TAG No.	CYL No.	LOCATION	DESCRIPTION
1	1	EXHAUST	W/COLLAR
2	1	INJECTOR	THICK
3	1	INTAKE	THIN
4	2	INTAKE	THIN
5	2	INJECTOR	THICK
6	2	EXHAUST	W/COLLAR
7	3	EXHAUST	W/COLLAR
8	3	INJECTOR	THICK
9	3	INTAKE	THIN
10	4	INTAKE	THIN
11	4	INJECTOR	THICK
12	4	EXHAUST	W/COLLAR
13	5	EXHAUST	W/COLLAR
14	5	INJECTOR	THICK
15	5	INTAKE	THIN
16	6	INTAKE	THIN
17	6	INJECTOR	THICK
18	6	EXHAUST	W/COLLAR

**TASK ENDS HERE**

**FUEL INJECTOR REMOVAL**

INITIAL SETUP

Tools

Extension, 6-inch, VP-inch drive  
 Handle, ratchet, 1/2-inch drive  
 Puller, fuel injector  
 Socket, 1/2-inch, 1/2-inch drive

Materials/Parts

Tags, marker (item 17, appendix B)

Equipment Condition

Rocker arm housings removed (page 2-30).

LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

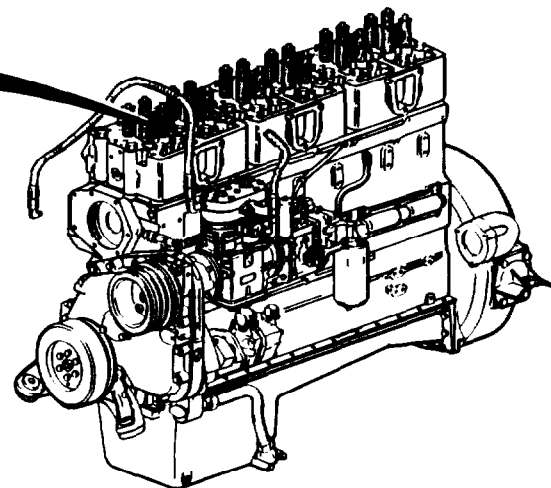
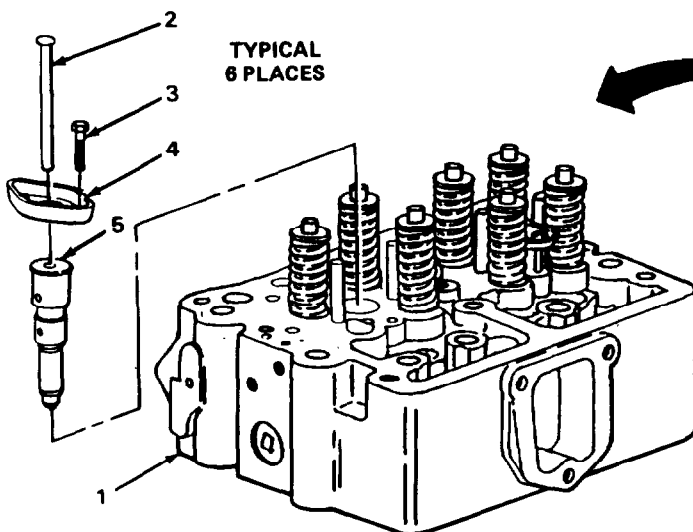
Steps given are typical for all six fuel injectors.

- |                      |   |   |
|----------------------|---|---|
| 1. Cylinder head (1) | Fuel injector link (2), two screws (3), and fuel injector clamp (4) | a. Take out fuel injector link.<br>b. Using 1/2-inch drive 1/2-inch socket, 6-inch extension, and ratchet handle, unscrew and take out. |
|----------------------|---|---|

**CAUTION**

To avoid dropping plunger, do not turn fuel injector upside down. Place fuel injectors in a rack for protection and tag by number from cylinder removed.

- |    |                   |                                       |
|----|-------------------|---------------------------------------|
| 2. | Fuel injector (5) | Using fuel injector puller, pull out. |
|----|-------------------|---------------------------------------|



**TASK ENDS HERE**



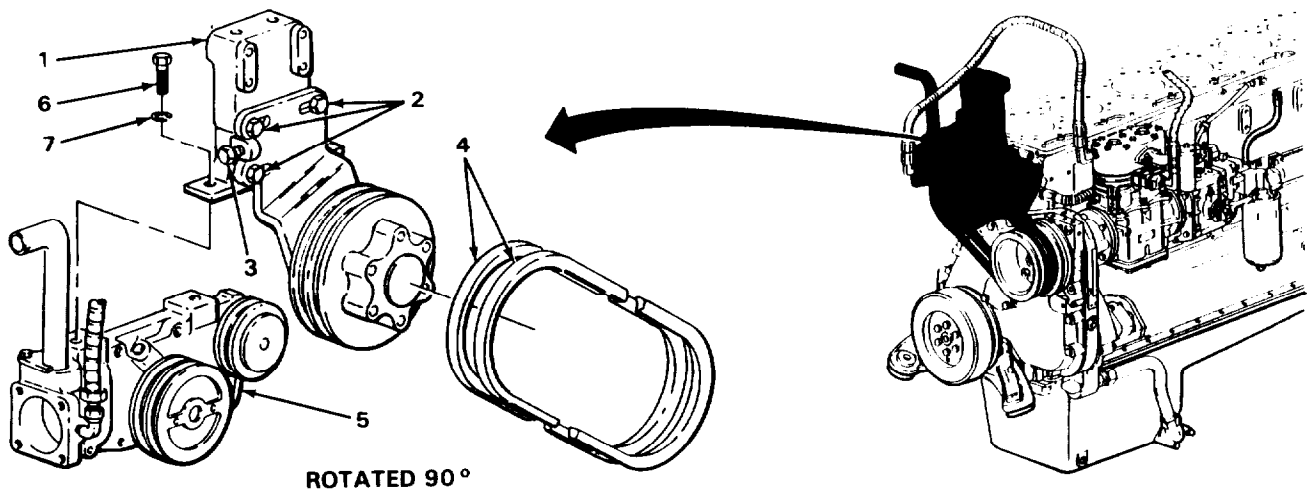
**FAN HUB REMOVAL**

INITIAL SETUP

Tools

- Extension, 10-inch, 1/2-inch drive
- Handle, ratchet, 1/2-inch drive
- Socket, 9/16-inch, 1/2-inch drive
- Socket, 3/4-inch, 1/2-inch drive

LOCATION	ITEM	ACTION REMARKS
1. Fan hub assembly (1)	Three screws (2)	Using 1/2-inch drive 3/4-inch socket and ratchet handle, loosen.
2.	Fan hub adjuster screw (3) and two fan belts (4)	a. Using 1/2-inch drive 9/16-inch socket and ratchet handle, loosen. b. Take off two fan belts and check for cracks. Discard fan belts if defective.
3. Water pump (5)	Two screws (6) and two lockwashers (7)	Using 1/2-inch drive 3/4-inch socket, 10-inch extension, and ratchet handle, unscrew and take out. Discard lockwashers.
4.	Fan hub assembly (1)	Lift off.



**TASK ENDS HERE**

**CYLINDER HEAD REMOVAL**

---

INITIAL SETUP

Tools	Personnel Required
Handle, hinged, 3/4-inch drive Screwdriver, flat-tip, 1/4-inch Socket, 11/16-inch, 3/4-inch drive	Two
Materials/Parts	Equipment Condition
Tags, marker (item 17, appendix B)	Cylinder head fuel lines removed (page 2-29). Rocker arm covers removed (page 2-27).

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LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

Steps given are typical for all three cylinder heads. Before removing, tag cylinder heads for location. Fuel crossovers are between front and center cylinder head and center and rear cylinder head only.

1. Cylinder head (1)	Four screws (2), four lockwashers (3), fuel crossover (4), and four packings (5)	Using 1/4-inch flat-tip screwdriver, loosen and take off. Discard packings and lockwashers.
----------------------	--	---

**NOTE**

Use suitable material to plug fuel crossover passages to prevent any dust or dirt from entering.

2.	Twelve screws (6) and twelve hardened washers (7)	Using 3/4-inch drive 11/16-inch socket and hinged handle, unscrew and take out. Discard hardened washers.
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**Warning**

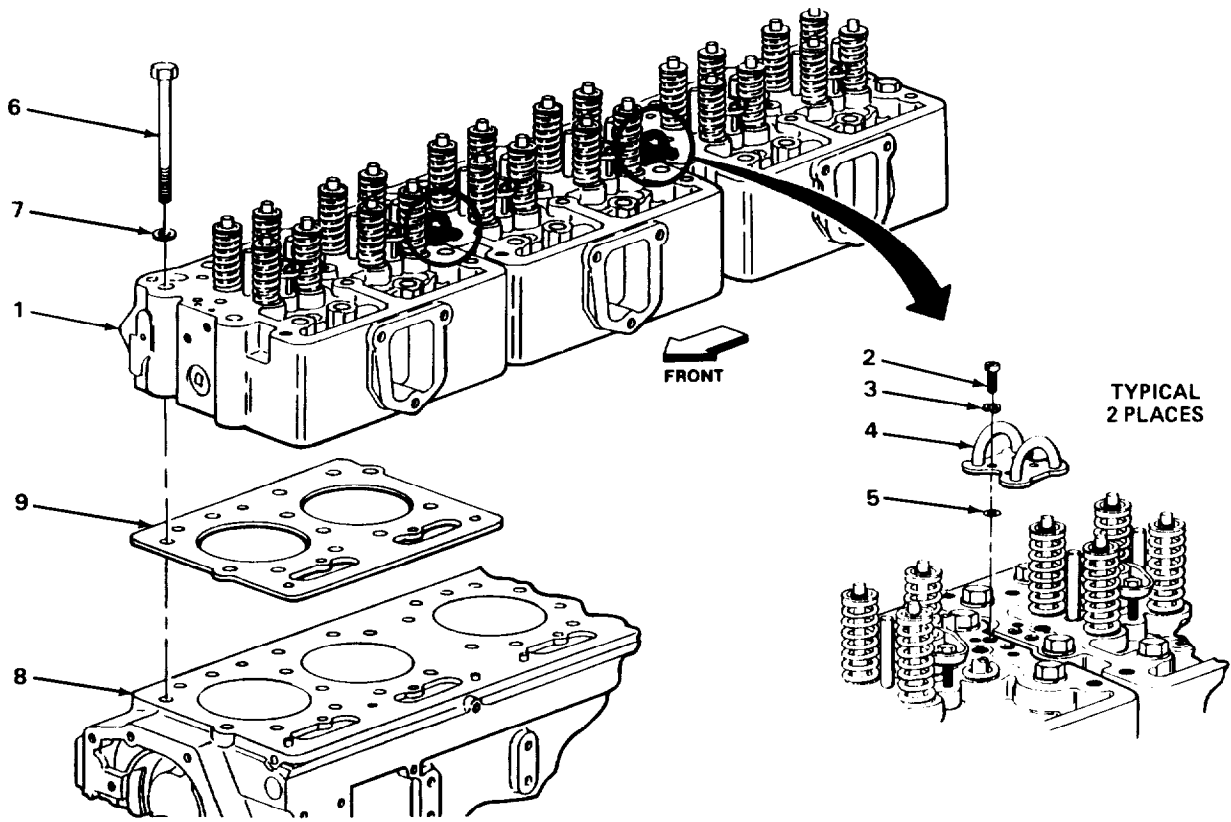
Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.

3. Cylinder block (8)	Cylinder head (1) and cylinder head gasket (9)	Take off. Discard gasket.
-----------------------	--	------------------------------

**NOTE**

Install crossheads in respective positions according to table and illustration shown in Crosshead Removal (page 2-31).

**CYLINDER HEAD REMOVAL - CONTINUED**



**TASK ENDS HERE**

**WATER PUMP REMOVAL**

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**INITIAL SETUP**

**T o o l s**

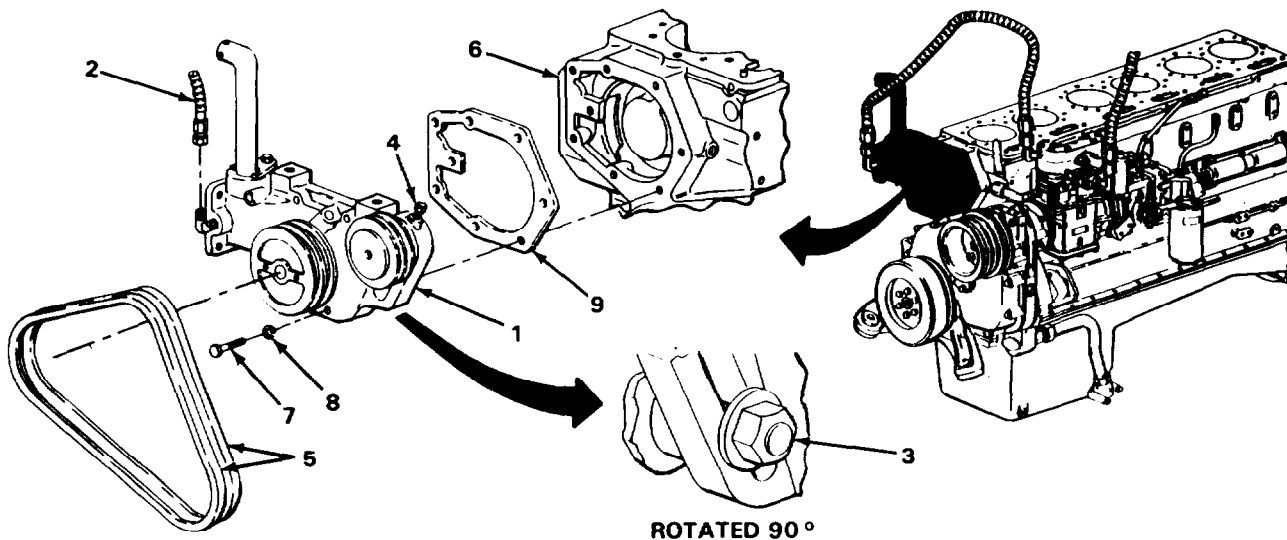
- Extension, 6-inch, 1/2-inch drive
- Handle, ratchet, 1/2-inch drive
- Socket, 9/16-inch, 1/2-inch drive
- Socket, 7/8-inch, 1/2-inch drive
- Wrench, open-end, 1-inch
- Wrench, open-end, 11/16-inch

**Equipment Condition**

Fan hub removed (page 2-35).

**WATER PUMP REMOVAL - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
1. Water pump (1)	Air compressor coolant hose (2)	Using 1-inch open-end wrench, unscrew and disconnect. <b>Move out of way.</b>
2.	Idler pulley locknut (3)	Using 11/16-inch open-end wrench, loosen.
3.	Idler pulley adjusting screw (4) and two water pump belts (5)	a. Using 1/2-inch drive 7/8-inch socket and ratchet handle, loosen. b. Take off water pump belts and check for cracks. <b>Discard water pump belts if defective.</b>
4. Front of cylinder block (6)	Seven screws (7), seven lockwashers (8), water pump (1), and gasket (9)	a. Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and ratchet handle, unscrew and take off screws and lockwashers. b. Take off water pump and gasket. <b>Discard gasket and lockwashers.</b>



**TASK ENDS HERE**

**COMPRESSION RELEASE SHAFT REMOVAL**

INITIAL SETUP

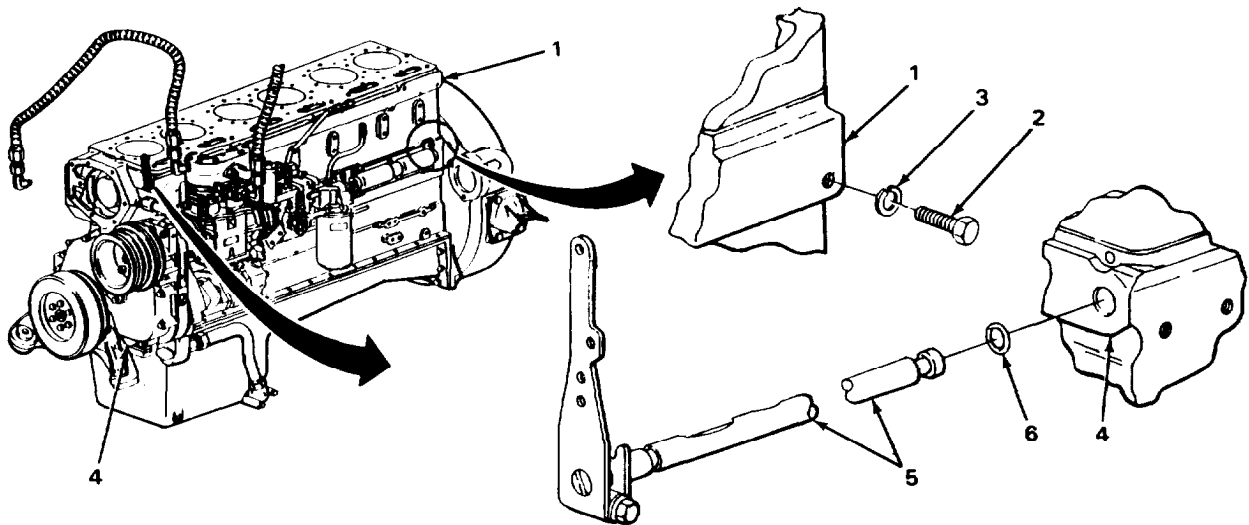
Tools

Wrench, box-end, 9/16-inch

Equipment Condition

Water pump removed (page 2-37).

LOCATION	ITEM	ACTION REMARKS
1. Left rear of cylinder block (1)	Screw (2) and lockwasher (3)	Using 9/16-inch box-end wrench, unscrew and take out. Discard lockwasher.
2. Left front of cylinder block (4)	Compression release shaft (5) and packing (6)	Pull out. Discard packing.



**TASK ENDS HERE**

**LUBRICATING OIL PUMP REMOVAL**

INITIAL SETUP

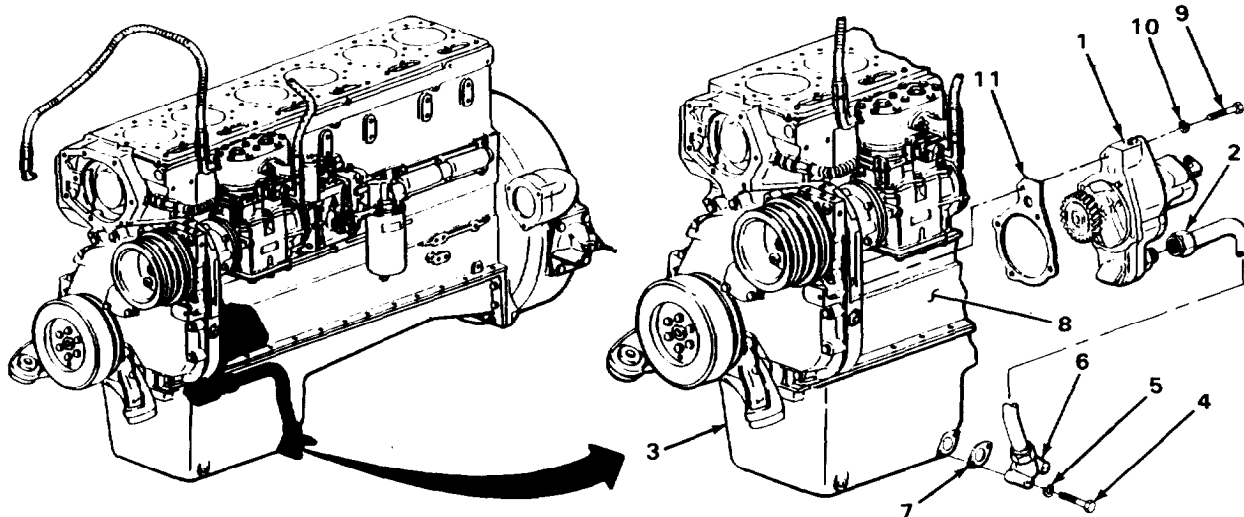
Tools

Extension, 6-inch, 1/2-inch drive  
 Handle, ratchet, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive

Tools - Continued

Socket, 5/8-inch, 1/2-inch drive  
 Wrench, open-end, 1 7/8.inch

LOCATION	ITEM	ACTION REMARKS
1. Bottom of lubricating oil pump (1)	Tubing nut (2)	Using 1 7/8-inch open-end wrench, loosen and disconnect.
2. Oil pan (3)	Two screws (4), two lockwashers (5) suction tube with flange (6), and gasket (7)	Using 1/2-inch drive 9/16-inch socket and ratchet handle, unscrew and take off. Discard gasket and lockwashers.
3. Left side of cylinder block (8)	Five screws (9), five lockwashers (10), lubricating oil pump (1), and gasket (11)	Using 1/2-inch drive 5/8-inch socket, 6-inch extension, and ratchet handle, unscrew and take off. Discard gasket and lockwashers.



**TASK ENDS HERE**

**AIR COMPRESSOR AND FUEL PUMP REMOVAL**

INITIAL SETUP

Tools

- Handle, ratchet, 1/2-inch drive
- Oil filter removing tool
- Socket, 9/16-inch, 1/2-inch drive
- Wrench, box-end, 5/8-inch
- Wrench, box-end, half-moon, 5/8-inch
- Wrench, open-end, 11/16-inch
- Wrench, open-end, 7/8-inch
- Wrench, open-end, 1-inch

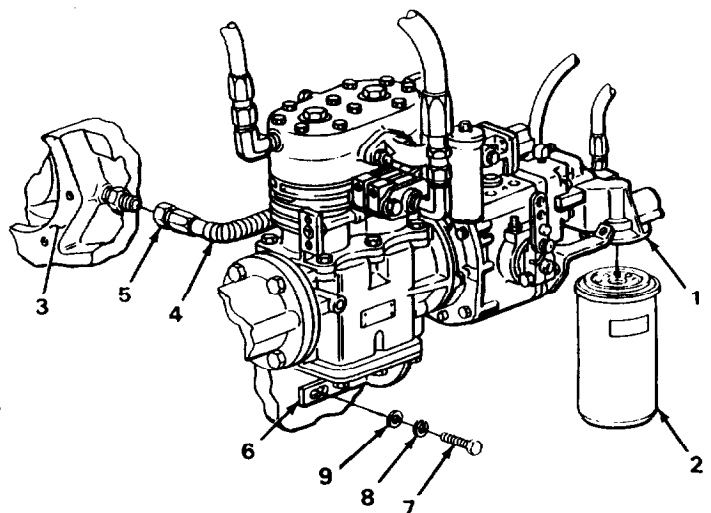
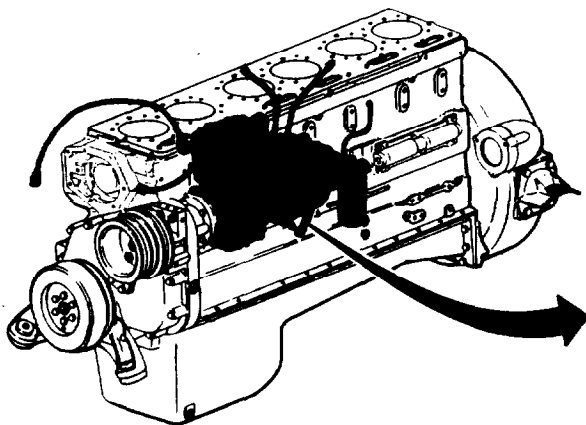
Personnel Required

Two

Equipment Condition

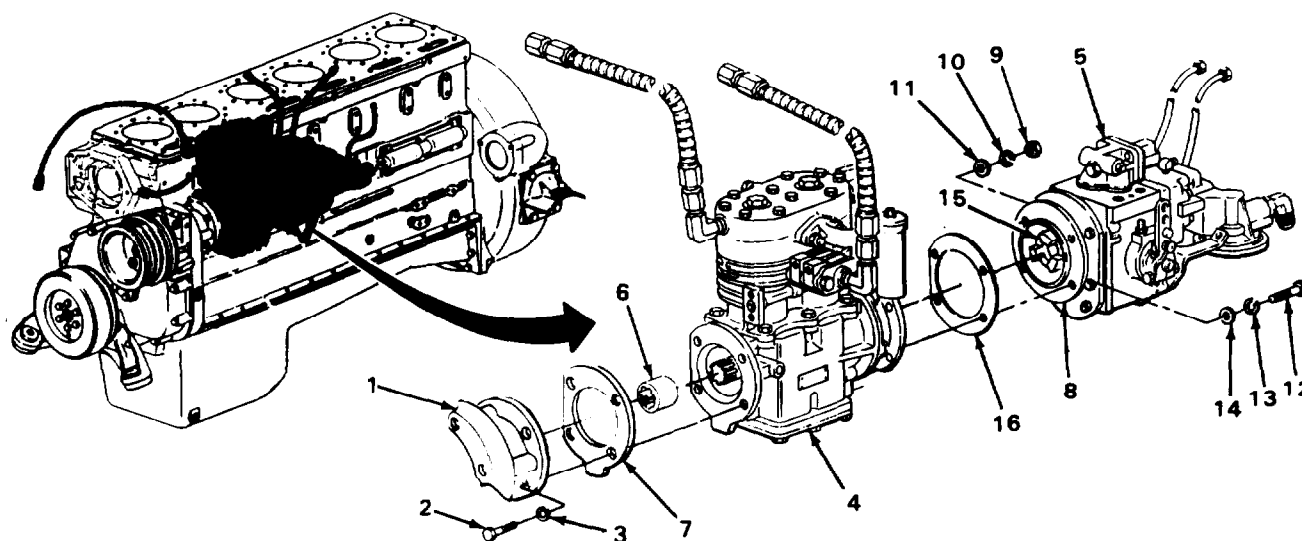
- Aneroid control valve removed (page 2-25).
- Cylinder head fuel lines removed (page 2-29).
- Lubricating oil pump removed (page 2-40).

LOCATION	ITEM	ACTION REMARKS
1. Fuel pump (1)	Secondary fuel filter (2)	Using oil filter removing tool, loosen and take off. <b>Discard.</b>
2. Cylinder block (3)	Air compressor coolant hose (4) and hose nut (5)	Using 1-inch and 7/8-inch open-end wrench, loosen and disconnect.
3. Air compressor bracket (6)	Screw (7), lock-washer (8), and flat washer (9)	Using 1/2-inch drive 9/16-inch socket and ratchet handle, unscrew and take off. <b>Discard lockwasher.</b>



**AIR COMPRESSOR AND FUEL PUMP REMOVAL - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
<b><u>WARNING</u></b>		
Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.		
4. Accessory drive flange (1)	Four screws (2) and four lockwashers (3)	Using 5/8-inch half-moon box-end wrench, unscrew and take out. <b>Discard lockwashers.</b>
5.	Air compressor (4), fuel pump (5) coupler (6) and gasket (7)	With assistance, take off. <b>Discard gasket.</b>
6. Fuel pump mounting flange (8)	Two nuts (9), two lockwashers (10), and two flat washers (11)	Using 11/16-inch open-end wrench, unscrew and take off. <b>Discard lockwashers.</b>
7.	Two screws (12), two lockwashers (13), and two flat washers (14)	Using 5/8-inch box-end wrench, unscrew and take out. <b>Discard lockwashers.</b>
8.	Fuel pump (5) coupler (15), and gasket (16)	Take off. <b>Discard gasket.</b>



**TASK ENDS HERE**

TA 242364



**ACCESSORY DRIVE REMOVAL**

INITIAL SETUP

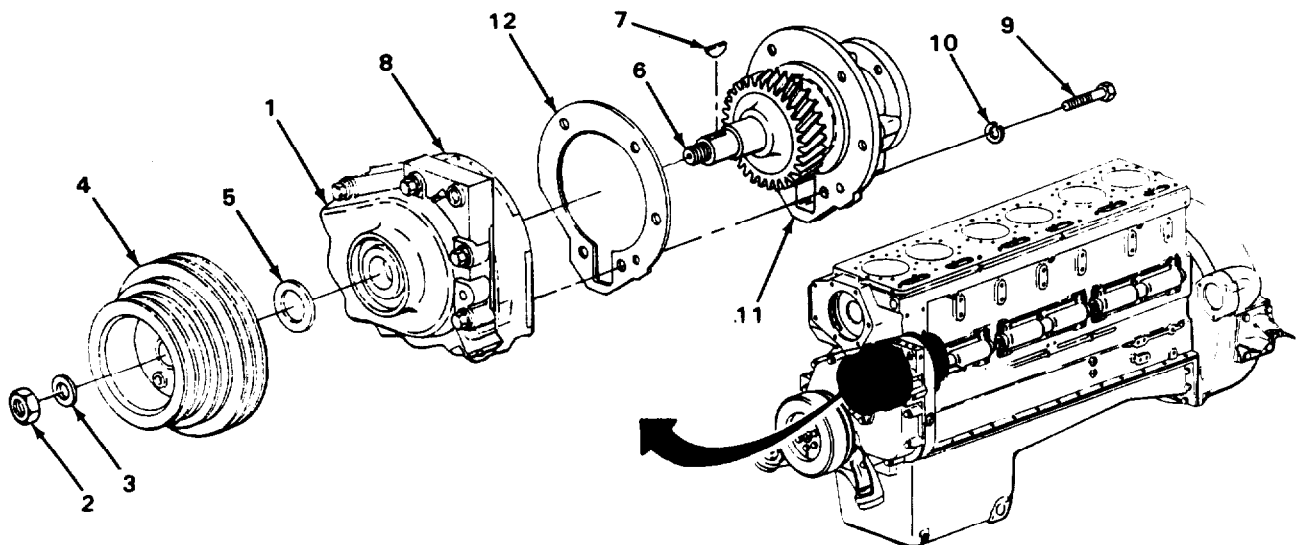
Tools

Extension, 6-inch, 1/2-inch drive  
 Handle, hinged, 1/2-inch drive  
 Puller, accessory drive pulley  
 Screwdriver, flat-tip, 1/4-inch  
 Socket, 11/4-inch, 1/2-inch drive  
 Wrench, box-end, half-moon, 5/8-inch

Equipment Condition

Air compressor and fuel pump removed  
 (page 2-41).

LOCATION	ITEM	ACTION REMARKS
1. Gearcase cover (1)	Self-locking nut (2) and flat washer (3)	Using 1/2-inch drive 11/4-inch socket, 6-inch extension, and hinged handle, unscrew and take off.
2.	Pulley (4) and oil slinger (5)	Using accessory drive pulley puller, take off.
3. Accessory drive shaft (6)	<b>Key (7)</b> Five screws (9), five lockwashers (10), accessory drive (11), and gasket (12)	Using 1/4-inch flat-tip screwdriver, pry out.
4. Left front of cylinder block (8)		Using 5/8-inch half-moon box-end wrench, unscrew and take off. <b>Discard gasket and lockwashers.</b>



**TASK ENDS HERE**

OIL PAN REMOVAL

---

INITIAL SETUP

Tools	Personnel Required
Handle, ratchet, 1/2-inch drive Socket, 1/2-inch, 1/2-inch drive Socket, 9/16-inch, 1/2-inch drive Socket, 5/8-inch, 1/2-inch drive Socket, 3/4-inch, 1/2-inch drive Socket, 13/16-inch, 1/2-inch drive Wrench, box-end, 3/4-inch Wrench, open-end, 1 7/8-inch	Two

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LOCATION	ITEM	ACTION REMARKS
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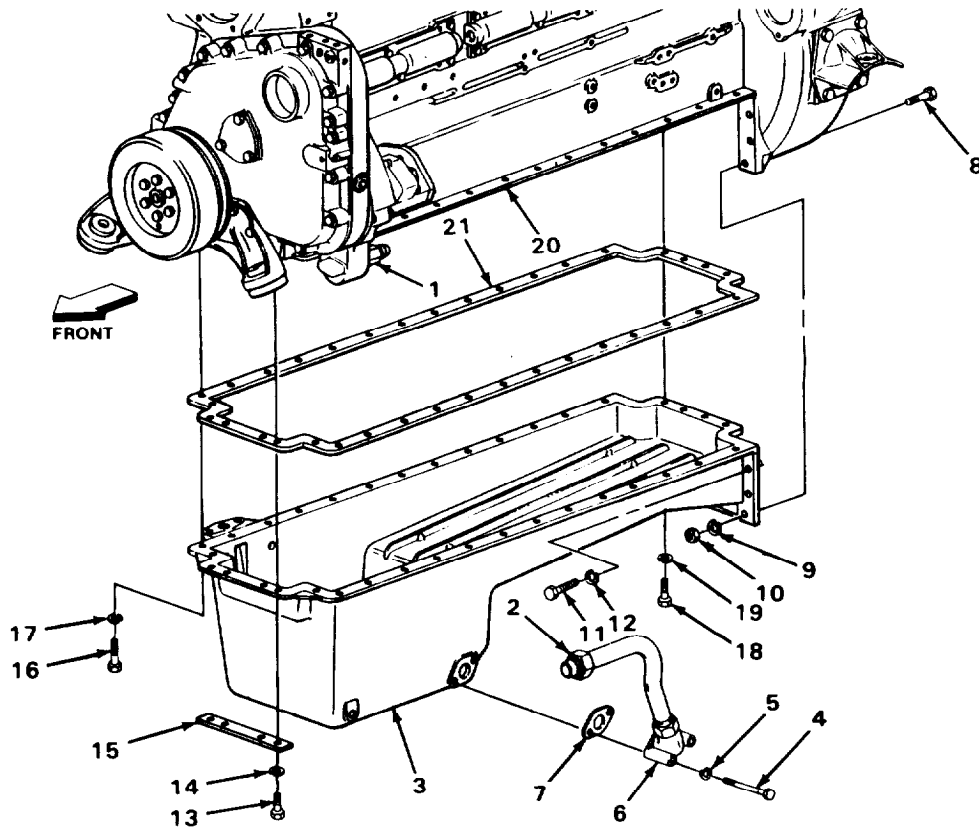
**NOTE**

If oil pump has been removed, proceed to step 3.

1. Oil pump bottom (1)	Nut (2)	Using 1 7/8-inch open-end wrench, loosen and disconnect.
2. Oil pan (3)	Two screws (4), two lockwashers (5), suction tube with flange (6) and gasket (7)	Using 1/2-inch drive 9/16-inch socket and ratchet handle, unscrew and take off. <b>Discard gasket and lockwashers.</b>
3	Two screws (8), two lockwashers (9), and two nuts (10)	Using 1/2-inch drive 13/16-inch socket, ratchet handle, and 3/4-inch box-end wrench, unscrew and take out. <b>Discard lockwashers.</b>
4	Four screws (11) and four lockwashers (12)	Using 1/2-inch drive 3/4-inch socket and ratchet handle, unscrew and take out. <b>Discard lockwashers.</b>
5	Four screws (13), four lockwashers (14), and spacer (15)	Using 1/2-inch drive 5/8-inch socket and ratchet handle, unscrew and take out. <b>Discard lockwashers.</b>

**OIL PAN REMOVAL - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
6 .	Twenty-eight screws (16) and twenty-eight lockwashers (17)	Using 1/2-inch drive 5/8-inch socket and ratchet handle, unscrew and take out. <b>Discard lockwashers.</b>
7.	Four screws (18) and four lockwashers (19)	Using 1/2-inch drive 1/2-inch socket and ratchet handle, unscrew and take out. <b>Discard lockwashers.</b>
<b><u>WARNING</u></b>		
Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.		
8. Bottom of cylinder block (20)	Oil pan (3) and gasket (21)	Take off. <b>Discard gasket.</b>



**TASK ENDS HERE**

**FLYWHEEL HOUSING REMOVAL**

INITIAL SETUP

Tools

Extension, 6-inch, 1/2-inch drive  
 Handle, ratchet, 1/2-inch drive  
 Pliers, diagonal-cutting, 8-inch  
 Socket, 7/8-inch, 1/2-inch drive  
 Socket, 15/16-inch, 1/2-inch drive

Personnel Required

Two

Equipment Condition

Oil pan removed (page 2-44).

Materials/Parts

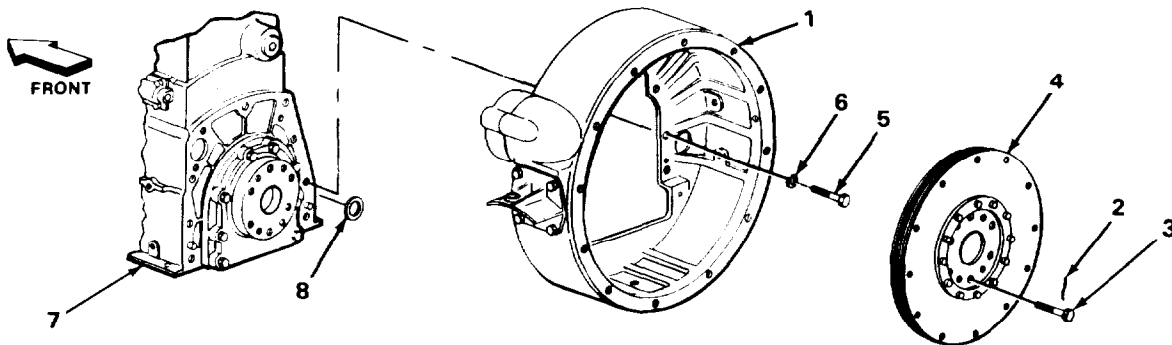
Gasket, flywheel housing

LOCATION	ITEM	ACTION REMARKS
1. Flywheel housing (1)	Lockwire (2), six screws (3) and flex plate (4)	a. Using 8-inch diagonal-cutting pliers, cut lockwire. b. Using 1/2-inch drive 7/8-inch socket, 6-inch extension, and ratchet handle, unscrew and take off.
2.	Nine screws (5) and nine lockwashers (6)	Using 1/2-inch drive 15/16-inch socket, 6-inch extension, and ratchet handle, unscrew and take out. <b>Discard lockwashers.</b>

**WARNING**

Due to excessive weight, assistance will be needed to prevent personnel injury when lifting heavy parts.

3. Cylinder block (7)	Flywheel housing (1) and flywheel housing gasket (8)	a. With assistance, take off flywheel housing. b. Take out flywheel housing gasket, c. Discard gasket.
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**TASK ENDS HERE**

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**CAM FOLLOWER HOUSING REMOVAL**

INITIAL SETUP

Tools

Handle, ratchet, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive

Equipment Condition

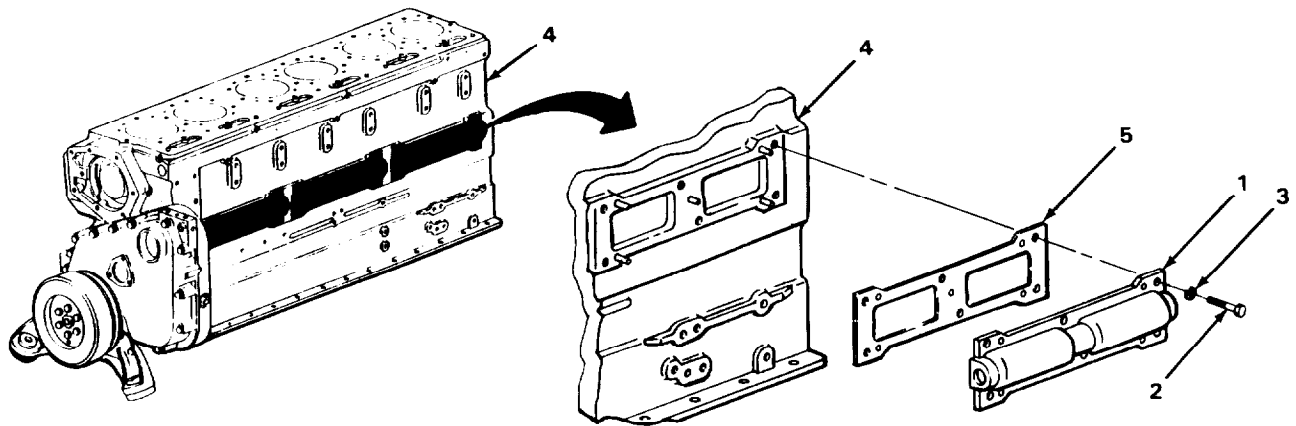
Accessory drive removed (page 2-43).

LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

Steps given are typical for all three cam follower housings.

- |                                    |   |  |
|------------------------------------|---|--|
| 1. Cam follower housing (1)        | Six screws (2) and six lockwashers (3)  | Using 1/2-inch drive 9/16-inch socket and ratchet handle, unscrew and take out.<br><b>Discard lockwashers.</b> |
| 2. Left side of cylinder block (4) | Cam follower housing (1) and gasket (5) | Take off.  |



**TASK ENDS HERE**

**GEAR CASE COVER REMOVAL**

---

INITIAL SETUP

Tools	Personnel Required
Extension, 6-inch, 1/2-inch drive	Two
Handle, ratchet, 1/2-inch drive	
Socket, 7/16-inch, 12-point, 1/2-inch drive	Equipment Condition
Socket, 5/8-inch, 1/2-inch drive	Accessory drive removed (page 2-43).
Socket, 7/8-inch, 1/2-inch drive	Oil pan removed (page 2-44).

---

LOCATION	ITEM	ACTION REMARKS
1. Gearcase cover (1)	Six screws (2) and six lockwashers (3)	Using 1/2-inch drive 7/8-inch socket, 6-inch extension, and ratchet handle, unscrew and take out. <b>Discard lockwashers.</b>
2.	Vibration damper and pulley (4)	Take off.
3.	Two screws (5) and two lockwashers (6)	Using 1/2-inch drive 12-point, 7/16-inch socket and ratchet handle, unscrew and take out. <b>Discard lockwashers.</b>
4.	Six screws (7) six lockwashers (8), and engine mount (9)	Using 1/2-inch drive 5/8-inch socket and ratchet handle, unscrew and take off. <b>Discard lockwashers.</b>
5.	Thirteen screws (10) and thirteen lockwashers (11)	Using 1/2-inch drive 5/8-inch socket and ratchet handle, unscrew and take out. <b>Discard lockwashers.</b>
<b><u>WARNING</u></b>		
Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.		
6. Front of cylinder block (12)	Gearcase cover (1) and gasket (13)	With assistance, take off. <b>Discard gasket.</b>

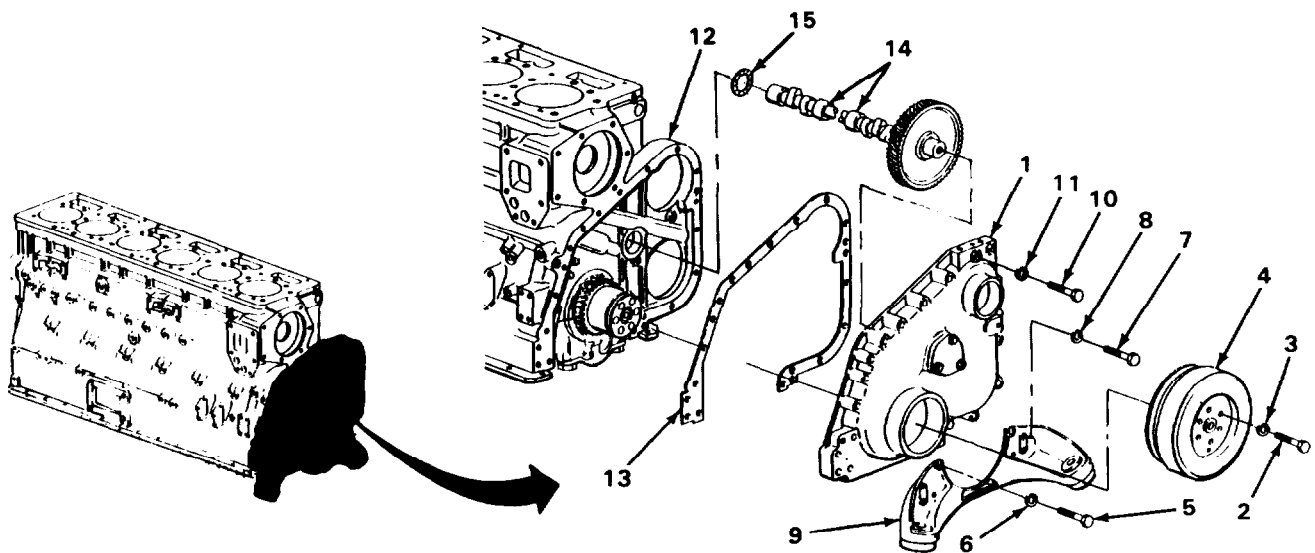
**GEARCASE COVER REMOVAL - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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**CAUTION**

When performing step 7, rotate camshaft while removing. Failure to do so may cause damage to camshaft and camshaft bearings.

<b>7.</b>	Camshaft with gear (14) and thrust washer (15)	Pull out.	
-----------	--	-----------	--



**TASK ENDS HERE**

**CRANKSHAFT REMOVAL**

**INITIAL SETUP**

**Tools**

Chisel, cold, 1/2-inch  
 Goggles, safety  
 Hammer, ball-peen, 16-ounce  
 Handle, hinged, 3/4-inch drive  
 Handle, ratchet, 1/2-inch drive

**Tools - Continued**

Screwdriver, flat-tip, 3/8-inch  
 Socket, 9/16-inch, 1/2-inch drive  
 Socket, 15/16-inch, 3/4-inch drive  
 Socket, 1 1/2-inch, 3/4-inch drive

**CRANKSHAFT REMOVAL - CONTINUED**

---

**INITIAL SETUP - CONTINUED**

Materials/Parts	Equipment Condition
Covering, suitable, connecting rod Tag, marker (item 17, appendix B)	Oil pan removed (page 2-44). Gearcase cover removed (page 2-48).

---

LOCATION	ITEM	ACTION REMARKS
1. Rear of cylinder block (1)	Eight screws (2), eight lockwashers (3), rear cover (4), and gasket (5)	Using 1/2-inch drive 9/16-inch socket and ratchet handle, unscrew and take off. <b>Discard gasket and lockwashers.</b>
2. Connecting rod caps (6)	Twelve nuts (7) and twelve hardened washers (8)	Using 3/4-inch drive 15/16-inch socket and hinged handle, unscrew and take off. <b>Discard hardened washers.</b>

**NOTE**

Tag connecting rod caps, lower bearings, and upper bearings to aid in correct reassembly.

3. Crankshaft (9)	Connecting rod caps (6), lower bearing (10), and upper bearing (11)	Take off.
-------------------	---	-----------

**WARNING**

Safety goggles must be worn to prevent eye injury caused by flying steel chips.

**CAUTION**

Use suitable covering over connecting rod bolts to protect journals.

4. Main bearing caps (12)	Fourteen lock plates (13)	Using 16-ounce ball-peen hammer and 1/2-inch cold chisel, bend back tabs on lock plates.
5.	Fourteen screws (14) and fourteen lock plates (13)	Using 3/4-inch drive 1 1/2-inch socket and hinged handle, unscrew and take out. <b>Discard lock plates.</b>



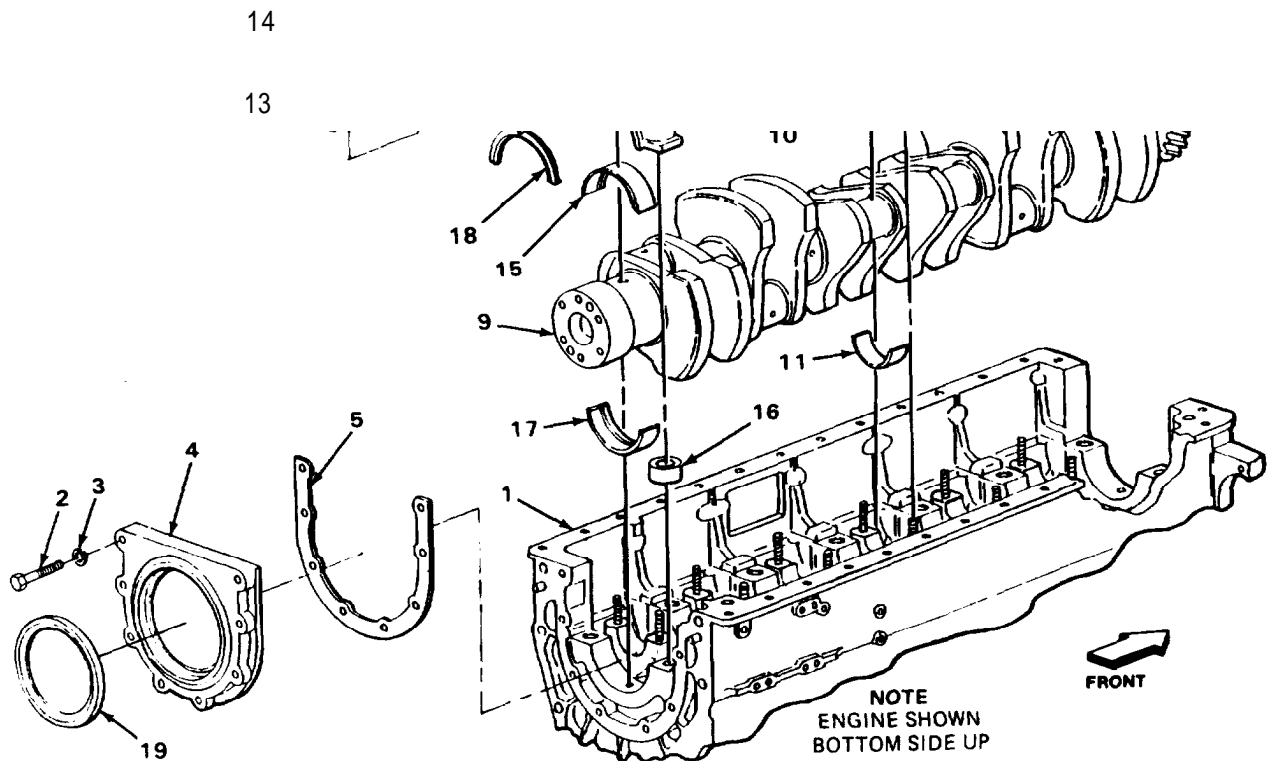
**CRANKSHAFT REMOVAL - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

Tag main bearing caps, lower bearings, and upper bearings to aid in inspection and assembly.

6. Bottom of cylinder block (1)	Seven main bearing caps (12), seven lower bearings (15), and seven ring dowels (16)	Take off.	<b>Discard ring dowels.</b>
7.	Crankshaft (9) upper bearings (17), and thrust washers (18)	a. Lift out crankshaft. b. Take out upper bearings and thrust washers.	
8. Rear cover (4)	Seal (19)	Using 3/8-inch flat-tip screwdriver, pry out.	<b>Discard seal.</b>



**TASK ENDS HERE**

**PISTON ASSEMBLY REMOVAL**

---

INITIAL SETUP

Tools	Personnel Required
Reamer, ridge	Two
Materials/Parts	Equipment Condition
Cloth, emery (item 1, appendix B)	Crankshaft removed (page 2-49).

---

LOCATION	ITEM	ACTION REMARKS
----------	------	-------------------

---

**CAUTION**

If ridge in cylinder bore is present and must be removed, care should be taken not to remove more material than necessary.

**NOTE**

Steps given are typical for all six piston assemblies.

- |                       |                   |                                   |
|-----------------------|-------------------|-----------------------------------|
| 1. Cylinder block (1) | Cylinder bore (2) | Using ridge reamer, remove ridge. |
|-----------------------|-------------------|-----------------------------------|

**CAUTION**

When performing step 2, care should be taken not to damage cylinder bore. Use emery cloth to remove rough surface left by ridge reamer.

- |    |                   |  |
|----|-------------------|--|
| 2. | Cylinder bore (2) | Using emery cloth, remove rough surface. |
|----|-------------------|--|

**NOTE**

Before performing steps 3 and 4, cleaning of cylinder bores may be required. See general cleaning procedures, General Maintenance Instructions, page 2-3.

When installing connecting rod cap to connecting rod, make sure tang on connecting rod and connecting rod cap are aligned properly.

PISTON ASSEMBLY REMOVAL - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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3. Cylinder bore (2)

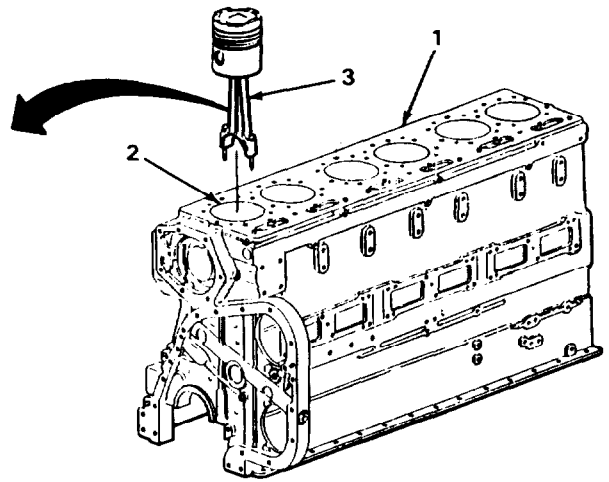
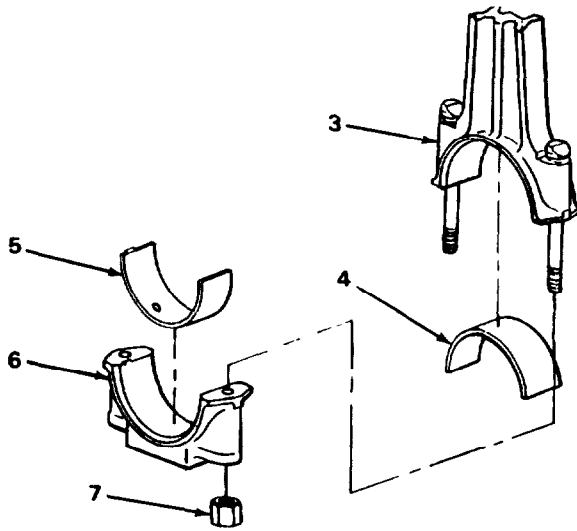
Piston assembly (3)

With assistance, push out.

4. Piston assembly (3)

Upper bearing shell (4), lower bearing shell (5), connecting rod cap (6), and nut (7)

a. Put on.  
b. Tighten nuts.  
**Nuts are tightened to secure parts only. DO NOT TORQUE.**



TASK ENDS HERE

**CRANKSHAFT INSTALLATION**

---

INITIAL SETUP

Tools

- Bar, pry
- Hammer, ball-peen, 16-ounce
- Handle, hinged, 3/4-inch drive
- Handle, ratchet, 3/4-inch drive
- Indicator, dial
- Mandrel, seal
- Punch, driftpin, 1/8-inch
- Socket, 9/16-inch, 1/2-inch drive
- Socket, 1 1/2-inch, 3/4-inch drive
- Wrench, torque, 0 to 250 ft lb (0 to 350 N-m), 1/2-inch drive
- Wrench, torque, 100 to 600 ft lb (140 to 840 N-m), 3/4-inch drive

Materials/Parts

- Cloth, crocus (item 4, appendix B)
- Crankshaft and bearing kit
- Dowel, ring (seven required)
- Gasket, rear cover
- Gear oil (item 9, appendix B)
- Lock plates (14 required)
- Lockwashers (eight required)
- Oil, lubricating (item 12, appendix B)
- Seal, rear cover
- Washer, thrust (four required)

Equipment Condition

Cylinder block mounted on engine repair stand (page 2-11).

---

LOCATION	ITEM	ACTION REMARKS
1. Cylinder block (1)	Fourteen screws (2) and seven main bearing caps (3)	Using 3/4-inch drive 1 1/2-inch socket and hinged handle, unscrew and take off.
<b><u>CAUTION</u></b>		
Do not touch wear surface of main bearings and thrust rings with hands. Acid from hands can cause premature bearing failure.		
<b>NOTE</b>		
Before performing steps 2 thru 5, coat upper main bearings, ring dowels, upper thrust rings, and crankshaft main journals with lubricating oil.		
2.	New upper main bearing number seven (4)	Put in and aline with oilhole and ring dowel hole in cylinder block.
3.	Six new upper main bearings (5) and seven new ring dowels (6)	<ul style="list-style-type: none"> <li>a. Aline oilholes in upper main bearings with oilholes in cylinder block, and put in.</li> <li>b. Put ring dowels in holes in cylinder block.</li> </ul>

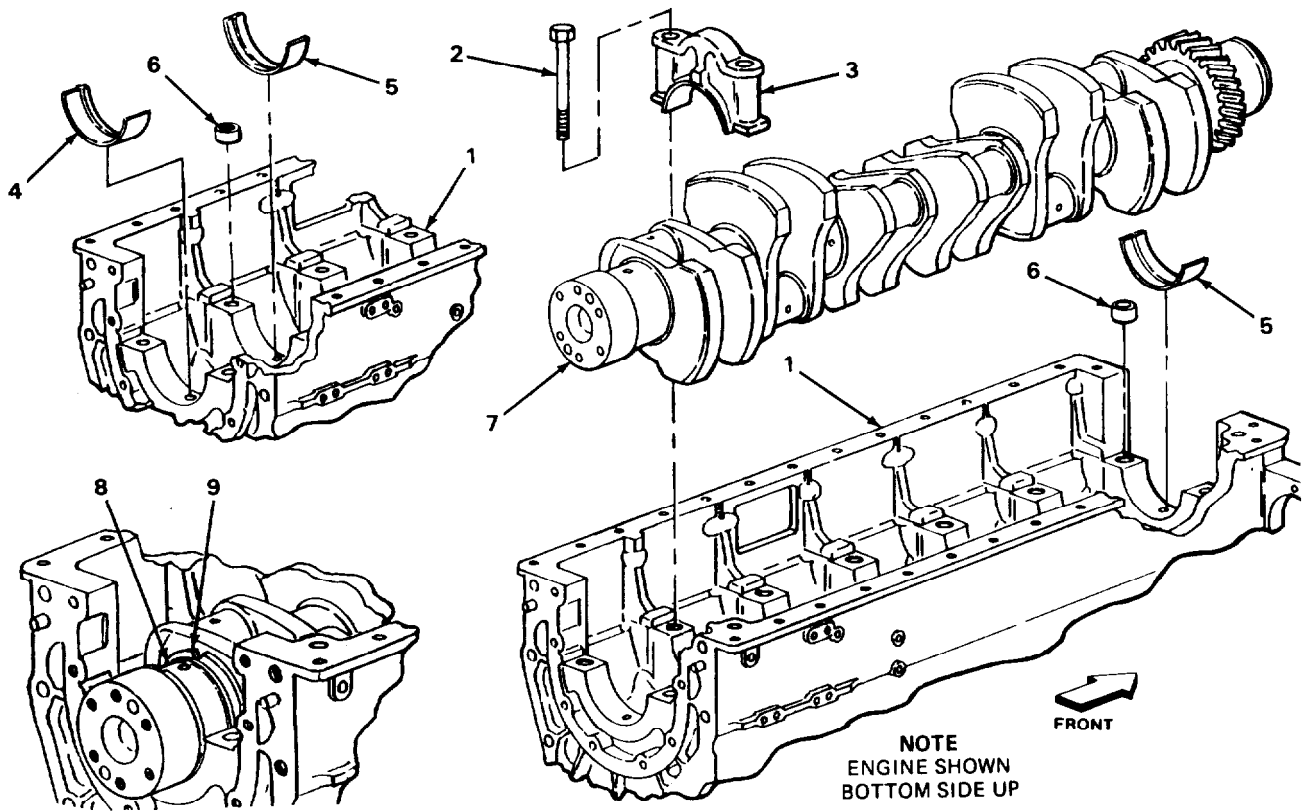
**CRANKSHAFT INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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**CAUTION**

When performing step 4, care should be taken not to damage crankshaft journals and upper main bearings. Engine damage could result.

- |    |  |  |
|----|--|--|
| 4. | New crankshaft (7)   | Lower into cylinder block.   |
| 5. | Rear main crankshaft journal (8)<br>Two new thrust washers (9) | Put in.<br><b>Roll thrust washer around crankshaft until thrust washer seats evenly with new upper main bearing.</b> |



**CRANKSHAFT INSTALLATION - CONTINUED**

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LOCATION	ITEM	ACTION REMARKS
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**NOTE**

Before performing steps 6 and 7, coat lower main bearings and lower thrust rings with lubricating oil.

6. Crankshaft main bearing journals (1)	Seven new lower main bearings (2)	Put in and aline notch in lower main bearing with ring dowels in cylinder block.
7. Rear main bearing cap (3)	Two new thrust washers (4)	Aline ring dowel grooves with ring dowels on rear main bearing cap and put on.

**NOTE**

Before performing step 8, coat main bearing capscrew threads with lubricating oil and coat under head of screws and lockplates with gear oil.

Position main bearing caps with number identification stamp facing camshaft side of engine.

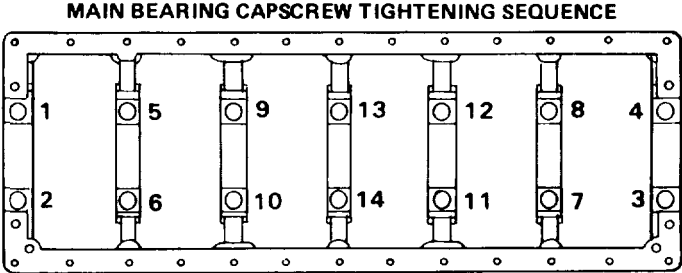
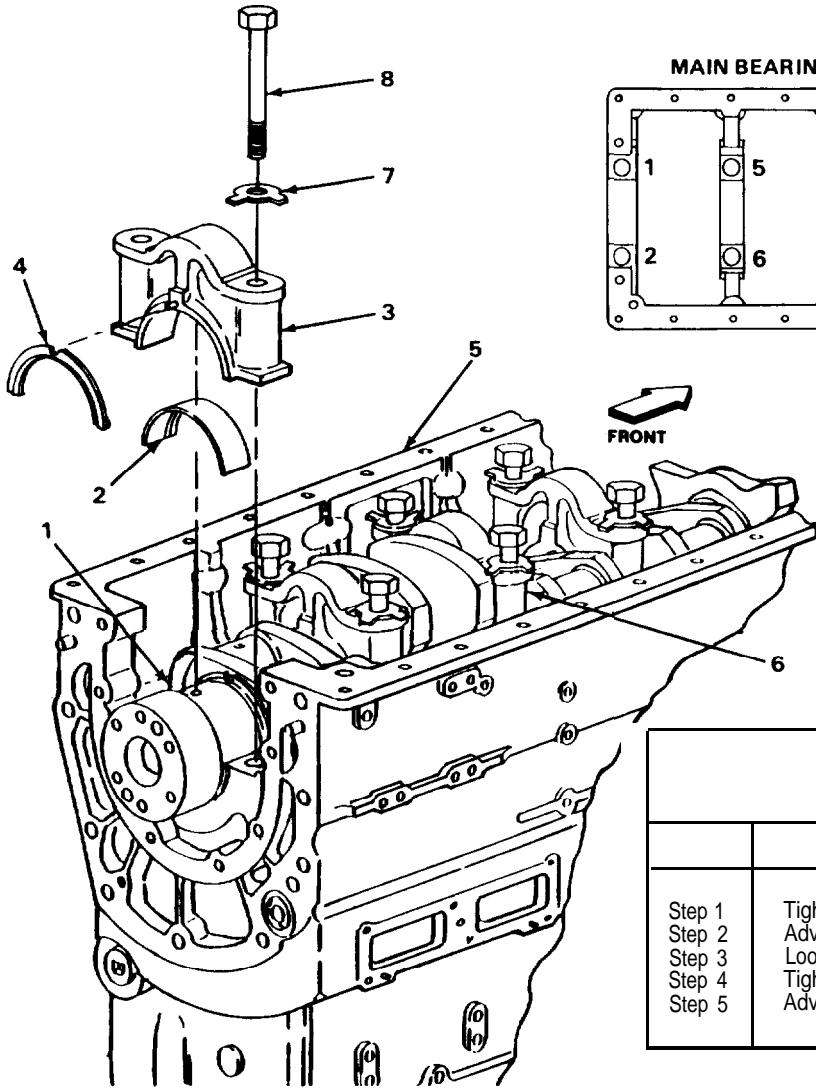
8. Cylinder block (5)	Six main bearing caps (6), rear main bearing cap (3) fourteen new lock plates (7) and fourteen capscrews (8)	a. Position six main bearing caps and rear main bearing cap on cylinder block. b. Using 3/4-inch drive 1 1/2-inch socket and ratchet handle, screw in. <b>Do not tighten.</b>
-----------------------	--	---

**NOTE**

When performing step 9, torque capscrews in the order shown in Main Bearing Capscrew Tightening Sequence (page 2-57).

9.	Fourteen cap-screws (8)	Using 3/4-inch drive 1 1/2-inch socket and 100 to 600 ft lb (140 to 840 N•m) torque wrench, torque in step sequence shown in Main Bearing Capscrew Torquing Sequence (page 2-57).
----	-------------------------	---

CRANKSHAFT INSTALLATION - CONTINUED



**NOTE**  
ENGINE IS SHOWN  
BOTTOM SIDE UP

**MAIN BEARING CAPSCREW TORQUING SEQUENCE**

		MIN FT/Lbs(kgml)	MAX FT/Lbs(kgm)
Step 1	Tighten to	140 (19,4)	150 (20,7)
Step 2	Advance to	300 (41,5)	310 (42,9)
Step 3	Loosen to	0	0
Step 4	Tighten to	140 (19,4)	150 (20,7)
Step 5	Advance to	300 (41,5)	310 (42,9)

**CRANKSHAFT INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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**NOTE**

Method for mounting dial indicator is at discretion of using facility. Set contact point of dial indicator on crankshaft end face.

10. Cylinder block (1)	Crankshaft (2)	a. Using pry bar, pry crankshaft toward front of cylinder block. <b>Set dial Indicator to zero.</b> b. Using pry bar, pry crankshaft toward rear of cylinder block. <b>Dial Indicator reading should be 0.007 to 0.017 Inch (0.18 to 0.43 mm). If reading is less than 0.007 Inch (0.18 mm), perform step 11. If reading is more than 0.017 Inch (0.43 mm), install oversized thrust rings.</b>
11.	Fourteen screws (3) and crankshaft (2)	a. Using 3/4-inch drive 1 1/2-inch socket and hinged handle, loosen screws one turn, b. Using pry bar, pry crankshaft toward front and rear of cylinder block. <b>Perform steps 9 and 10 again.</b>
12. Seven main bearing caps (4)	Fourteen new lock plates (5)	Using 1/8-inch driftpin punch and 16-ounce ball-peen hammer, bend tabs of lock plates against heads of screws (3).

**NOTE**

Before performing step 13, clean crankshaft seal area with crocus cloth. Crankshaft seal area must be clean and dry.

13. Cylinder block (1)	Eight screws (6), eight new lock-washers (7), rear cover (8), and new gasket (9)	a. Position rear cover and gasket on front of cylinder block. b. Screw in eight screws and lockwashers. <b>Hand tighten only.</b>
------------------------	--	---

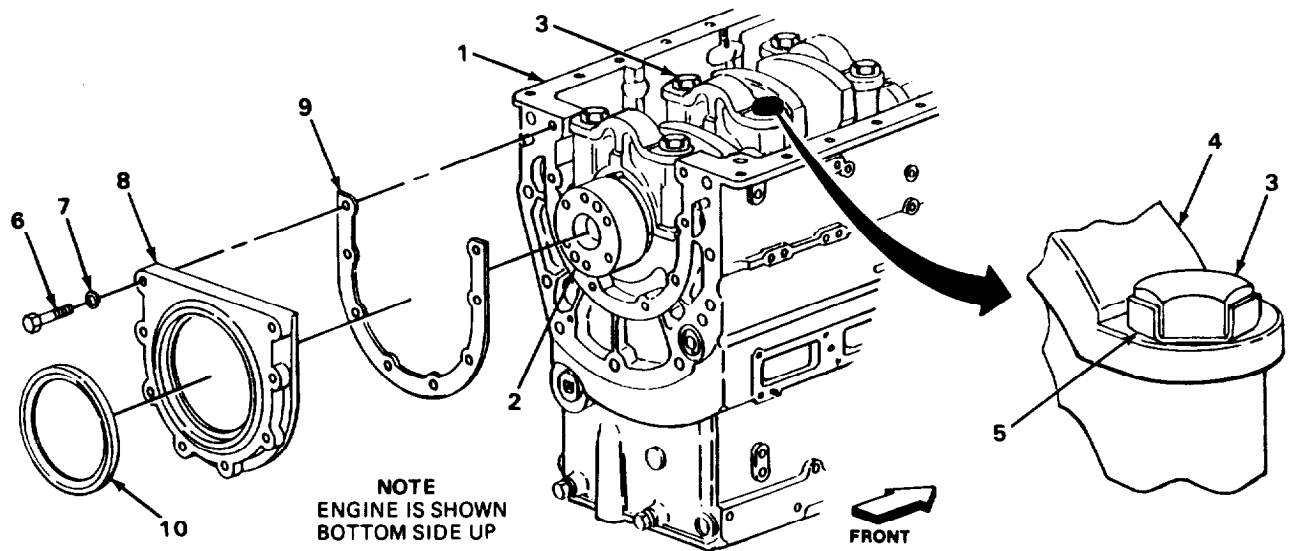
**NOTE**

Method for mounting dial indicator is at discretion of using facility. Position dial indicator on crankshaft end face and set contact point on edge of cover opening. Set dial indicator to zero.



**CRANKSHAFT INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
14.	Crankshaft (2)	Check dial indicator reading, while rotating crankshaft. Total reading should not exceed 0.005 inch (0.13 mm). <b>If total dial indicator reading is less than 0.005 inch (0.13 mm), perform next step. If reading exceeds 0.005 inch (0.13 mm), remove rear cover and clean mating surfaces. Perform steps 13 and 14 again.</b>
15.	Eight screws (6)	Using 1/2-inch drive 9/16-inch socket and 0 to 250 ft lb (0 to 350 N•m torque wrench, tighten to 24 to 29 ft lb (33.6 to 40.6 N•m).
16. Rear cover (8)	New seal (10)	Using seal mandrel and 16ounce ball-peen hammer, put in.



**TASK ENDS HERE**

**PISTON ASSEMBLY INSTALLATION**

---

INITIAL SETUP

Tools

Compressor, piston ring, ST-1176  
 Expander, piston ring, ST-763  
 Gage, thickness  
 Handle, ratchet, 1/2-inch drive  
 Socket, 15/16-inch, 1/2-inch drive  
 Wrench, torque, 0 to 250 ft lb (0 to 350 NY•m), 1/2-inch drive

Materials/Parts - Continued

Oil, lubricating (item 12, appendix B)  
 Piston ring set  
 Covering, suitable connecting rod

Personnel Required

Two

Materials/Parts

Gear oil (item 9, appendix B)

Equipment Condition

Crankshaft installed (page 2-54).

---

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

---

**CAUTION**

Care should be taken not to scratch cylinder sleeves. Piston ring failure may occur.

**NOTE**

New rings and bearings are included with piston assembly.

Before performing step 1, lightly coat cylinder sleeves and piston rings with lubricating oil.

Number stamped on side of connecting rod and cap indicate cylinder number from which the piston was removed. Check ring end gap in cylinder number stamped on connecting rod and connecting rod cap.

Steps given are typical for all six piston assemblies and all four piston rings.

PISTON ASSEMBLY INSTALLATION - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

- |                        |   |  |  |
|------------------------|---|--|--|
| 1. Cylinder sleeve (1) | New chrome-plated compression ring (2), two new compression rings (3), new oil ring (4), and piston (5) | <ol style="list-style-type: none"> <li>Put new piston rings in cylinder sleeve and, using head of piston, push into cylinder 2 inches.</li> <li>Using thickness gage, measure new piston rings end gap. (See table below).</li> <li>Take out new piston rings from cylinder sleeve.</li> </ol> |  |
|------------------------|---|--|--|

**TYPICAL ALL RINGS**

PISTON RING END-GAP TOLERANCES		
Piston Ring End Gap	New Min	New Max
Top Compression *	0.023 (0.58 mm)	0.033 (0.85 mm)
Center Compression *	0.019 (0.48 mm)	0.029 (0.74 mm)
Bottom Compression *	0.028 (0.71 mm)	0.038 (0.97 mm)
Oil Control *	0.010 (0.25 mm)	0.020 (0.51 mm)

\*Add 0.003 inch [0.08 mm] ring gap to new maximum limit for 0.001 inch [0.03 mm] wear in cylinder liner wall.

**PISTON ASSEMBLY INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

**CAUTION**

Over expanding piston rings during installation on piston can cause piston ring distortion. This will cause scoring of cylinder sleeves and premature piston ring failure.

Never file or grind chrome plated piston rings.

Never use chrome plated piston rings in chrome plated cylinder sleeves.

**NOTE**

Expand piston rings only enough to pass over piston.

Piston rings must be installed in same number piston and cylinder sleeve that ring end gap was checked.

2. Piston assembly (1)	New chrome-plated compression ring (2), new compression ring (3), new compression ring (4), and new oil ring (5)	a. Using ST-763 piston ring expander, expand each ring and install in proper ring groove on piston as shown. b. Rotate piston rings to separate ring end-gap openings as shown.	
3. Connecting rod (6)	Two nuts (7), two new hardened connecting rod washers (8), and connecting rod cap (9)	Unscrew and take off.	
4.	Two connecting rod bolts (10)	Using suitable covering, cover threads.	

**NOTE**

Before performing next step, coat piston sides, piston rings, and upper connecting rod bearings with lubricating oil and position piston ring end gap 90 degrees apart.

5. Piston (1)	Chrome-plated compression ring (2), compression ring (3), compression ring (4), and oil ring (5)	Using ST-1176 piston ring compressor, compress piston rings to piston.	
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**PISTON ASSEMBLY INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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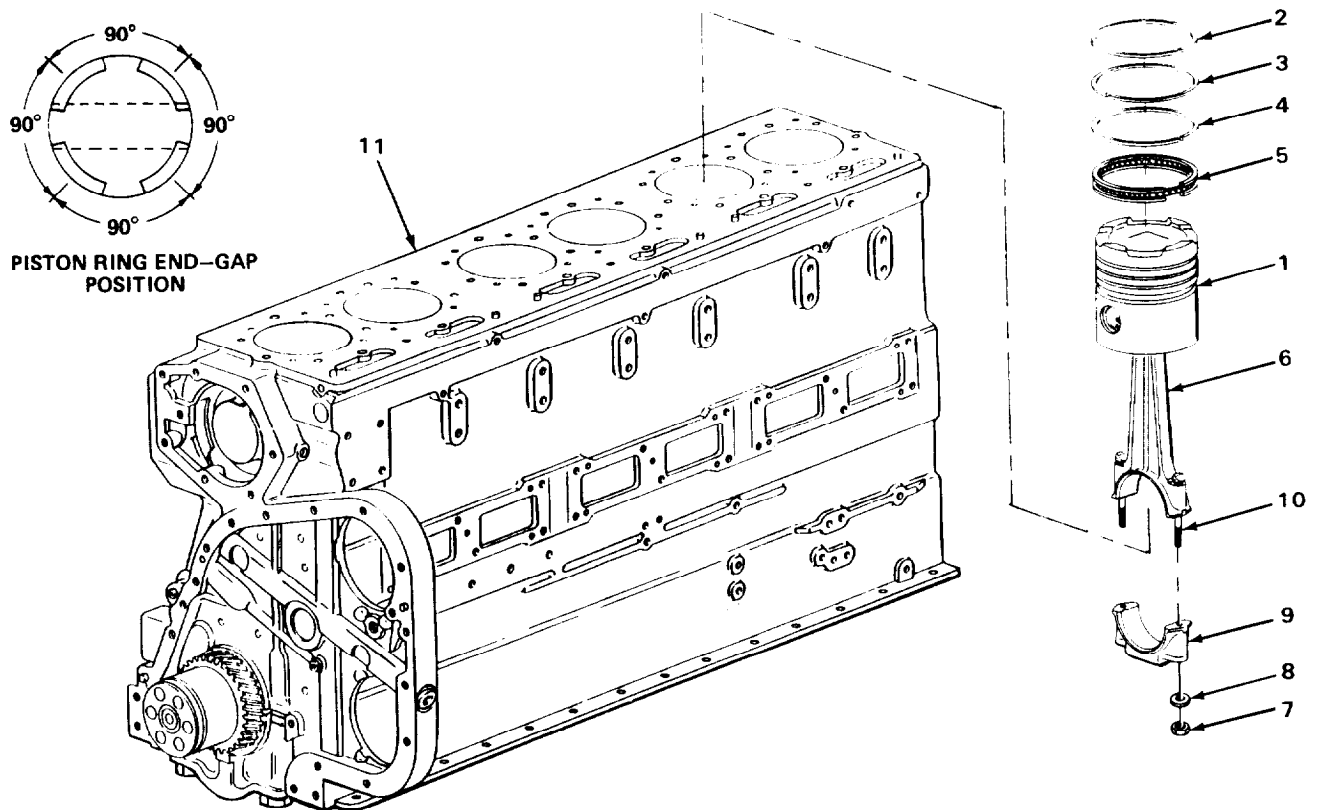
**CAUTION**

Piston assemblies must always be installed in same number cylinder as number stamped on side of connecting rod. Numbered side of connecting rod must always face camshaft side of engine to ensure proper operation.

**NOTE**

When performing step 6, assistance will be needed to guide connecting rod through cylinder sleeve and onto crankshaft connecting rod journal.

6. Cylinder block (11)	Piston (1)	Push into cylinder sleeve until connecting rod seats on crankshaft connecting rod journal.
------------------------	------------	--



**PISTON ASSEMBLY INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
7. Connecting rod bolts (1)	Thread cover (2)	Take off. Discard.	

**NOTE**

Before performing step 8, coat lower connecting rod bearings and connecting rod bolts with lubricating oil and coat hardened washers with gear oil.

When performing step 8, match and align numbers stamped on connecting rods and connecting rod caps.

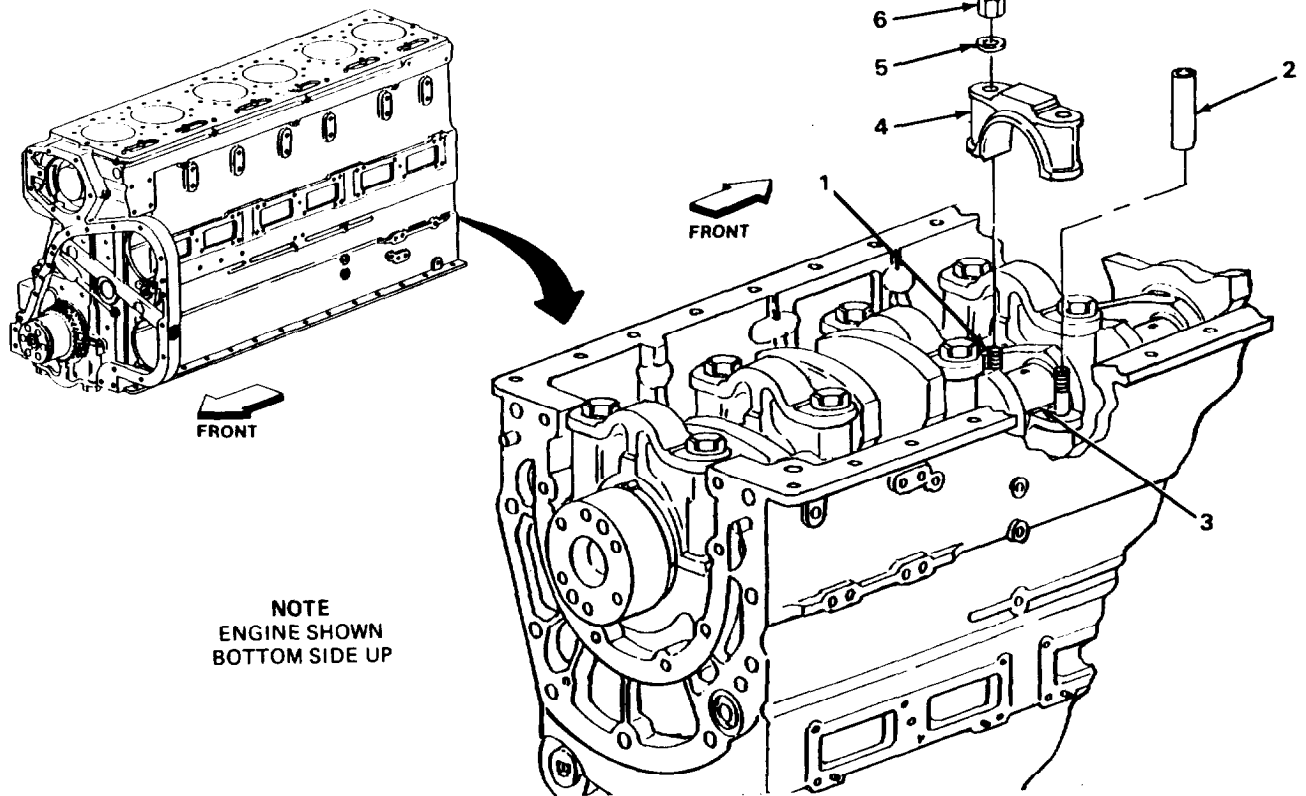
8. Crankshaft (3)	Connecting rod cap (4), two new hardened connecting rod washers (5), and two nuts (6)	a. Put connecting rod cap on crankshaft. b. Install hardened connecting rod washers and nuts using 1/2-inch drive 15/16-inch socket and ratchet handle, and screw in until snug. <b>Do not tighten.</b>	
9.	Two nuts (6)	Using 1/2-inch drive 15/16-inch socket and 0 to 250 ft lb (0 to 350 N-m) torque wrench, torque in step sequence shown in Connecting Rod Nut Torquing Sequence.	

**CONNECTING ROD NUT TORQUING SEQUENCE**

TIGHTENING SEQUENCE	TIGHTENING VALUES FT LB (NY•M)
Step 1 Tighten to	70 - 75 (98 - 105)
Step 2 Tighten to	140 - 150(196 - 210)
Step 3 Loosen to	0 (zero)
Step 4 Tighten to	25 - 30 (35 - 42)
Step 5 Advance to	70 - 75 (98 - 105)
Step 6 Advance to	140 - 150(196 - 210)

PISTON ASSEMBLY INSTALLATION - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
10. Crankshaft (3)	Connecting rod with connecting rod cap (4)	Using thickness gage, measure side clearance.	<b>Side clearance should be 0.006 to 0.011 inch (0.15 to 0.28 mm).</b>



TASK ENDS HERE

**CAMSHAFT INSTALLATION**

---

INITIAL SETUP

Tools

Indicator, dial

Equipment Condition

Piston assemblies Installed (page 2-60).

Materials/Parts

Grease, extreme-pressure (item 10, appendix B)

Washer, thrust bearing

---

LOCATION	ITEM	ACTION	REMARKS
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---

**NOTE**

Before performing the following steps, coat both sides of thrust bearing washer and camshaft lobes and journals with extreme-pressure grease.

1. Camshaft and gear (1)	New thrust washer (2)	Put on.	<b>Grooves must face camshaft gear.</b>
--------------------------	-----------------------	---------	---

**CAUTION**

When performing step 2, care must be taken to prevent damaging camshaft bushings and camshafts.

**NOTE**

When performing step 2, align timing marks, two O's (zeros) on camshaft gear and crankshaft gear as shown in view.

2. Cylinder block (3)	Camshaft and gear (1) and crankshaft gear (4)	Put in.	<b>Rotate while installing to align timing marks.</b>
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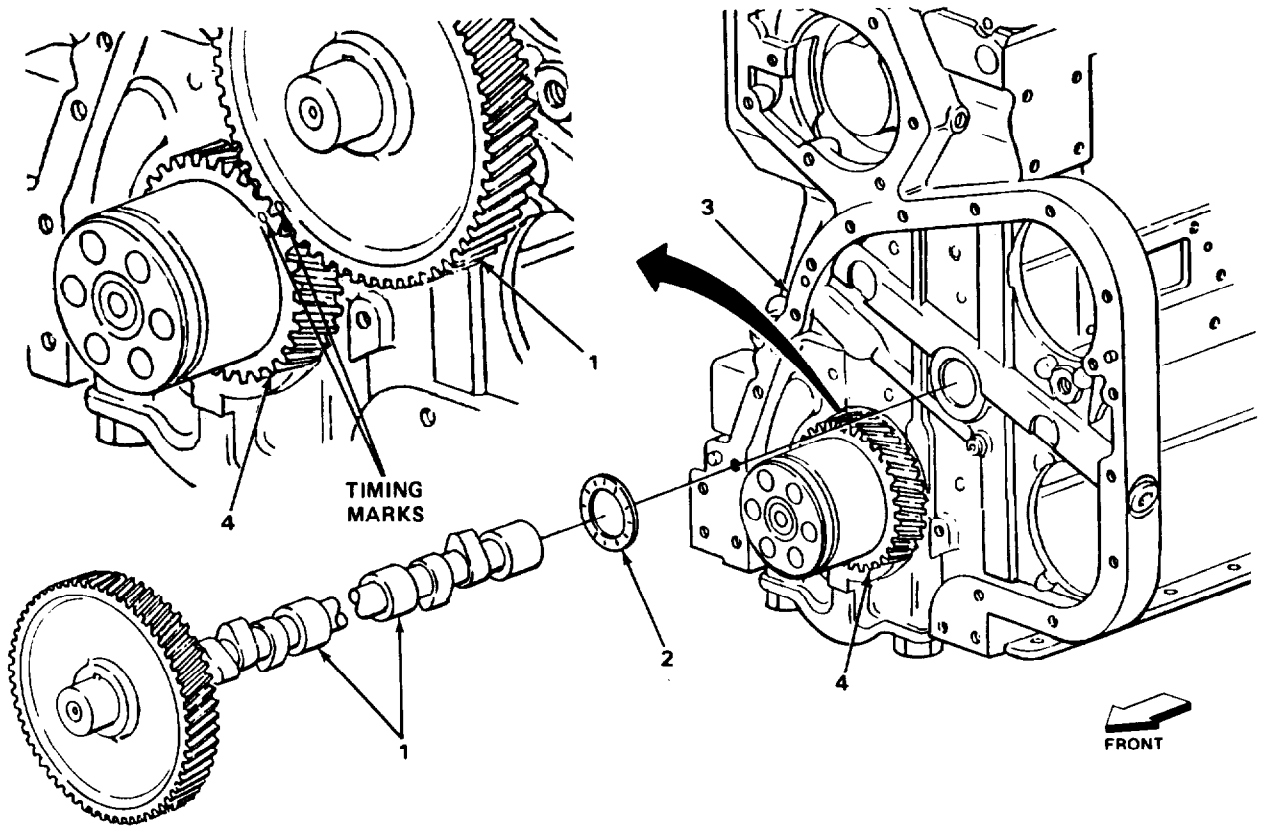
**NOTE**

Method used for mounting dial indicator is at discretion of using facility. Set contact point of dial indicator on camshaft gear tooth.



**CAMSHAFT INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
3. Cylinder block (3)	Camshaft and gear (1)	a. Rotate gear in one direction as far as it will move. b. Set dial indicator to zero.
4.	Camshaft and gear (1)	Rotate gear and read dial indicator for gear backlash. <b>Normal backlash is 0.0045 to 0.0105 inch (0.114 to 0.267 mm) on a new gear, with a minimum of 0.002 inch (0.05 mm).</b>



**TASK ENDS HERE**

**CYLINDER HEAD INSTALLATION**

---

INITIAL SETUP

Tools

- Bit, screwdriver, flat-tip, 1/4-inch drive
- Handle, ratchet, 3/4-inch drive
- Socket, 1 1/16-inch, 3/4-inch drive
- Wrench, torque, 0 to 200 in. lb (0 to 23 N•m), 1/4-inch drive
- Wrench, torque, 0 to 600 ft lb (0 to 840 N•m), 3/4-inch drive

Materials/Parts - Continued

- Lockwashers (four required)
- Oil, lubricating (item 12, appendix B)
- Packings, fuel crossover (four required)
- Washers, hardened (12 required)

Equipment Condition

Piston assemblies installed (page 2-60).

Materials/Parts

- Gasket, cylinder head
  - Grommet, water (as required)
- 

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

---

**CAUTION**

When performing step 1, care should be taken to position cylinder head gasket over dowel pins with word TOP visible or gasket damage may result.

**NOTE**

Steps given are typical for all three cylinder heads.

Before performing step 1, if waterholes in cylinder block are free of erosion, use gasket with standard white grommets, 0.097 to 0.103 inch (3.8 to 4.1 mm) thick. If erosion is evident, use black grommets, 0.107 to 0.113 inch (4.2 to 4.4 mm) thick. No grommet retainers are required.

1. Cylinder block (1)	New cylinder head gasket (2) and new water grommets (3)	Put on.
-----------------------	---	---------

**CAUTION**

Use care when installing cylinder head not to damage machined surface.

2.	Cylinder head (4)	Put on.
----	-------------------	---------

**CAUTION**

Correct cylinder head screws have letters NT forged on top of screwheads. Do not use any other type screw. Screws will break, preventing engine assembly.

**CYLINDER HEAD INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

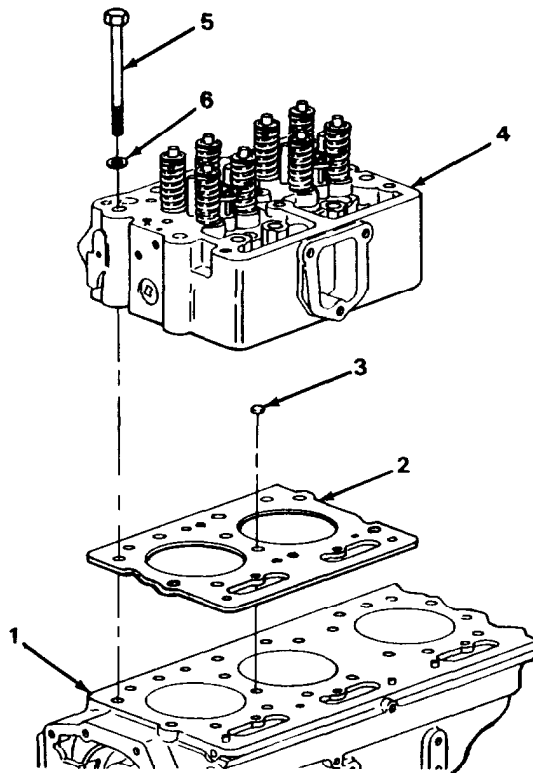
Before performing step 3, coat cylinder head screws with lubricating oil.

3. Cylinder head (4)	Twelve capscrews (5) and twelve new hardened washers (6)	Using 3/4-inch drive 1 1/16-inch socket and ratchet handle, screw in until snug. <b>Do not tighten.</b>	
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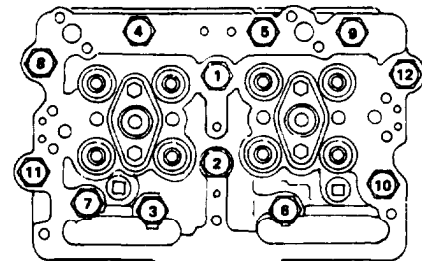
**NOTE**

When performing step 4, tighten capscrews in order shown in Cylinder Head Capscrew Tightening Sequence.

4.	Twelve cap screws (5)	Using 3/4-inch drive 1 1/16-inch socket and 0 to 600 ft lb (0 to 840 N•m) torque wrench, torque in steps sequence shown in Cylinder Head Torquing Sequence.	
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CYLINDER HEAD CAPSCREW TIGHTENING SEQUENCE



CYLINDER HEAD TORQUING SEQUENCE

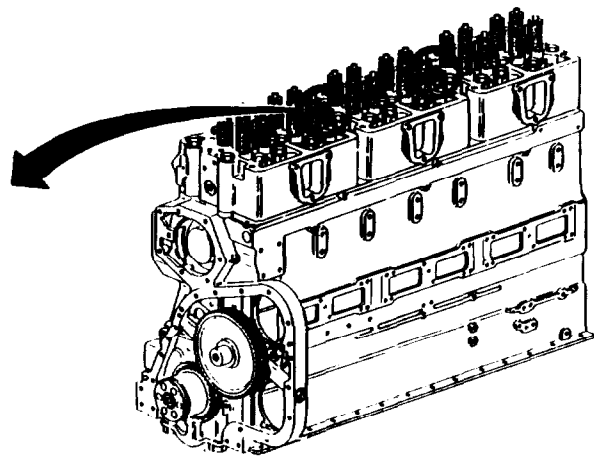
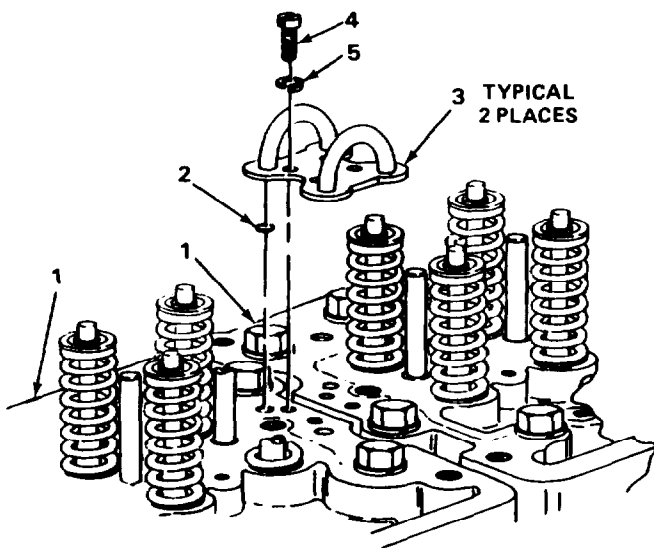
STEP	TORQUE (lb-ft)
1	25
2	80-100
3	180-200
4	280-300

**NOTE**

Before performing step 5, coat packings with lubricating oil.

**CYLINDER HEAD INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
5. Cylinder head (1)	Four new packings (2)	Put in.	
6.	Fuel crossover (3), four screws (4), and four new lockwashers (5)	Using 1/4-inch drive flat-tip screwdriver bit and 0 to 200 in. lb (0 to 23 N•m) torque wrench, tighten to 34 to 38 in. lb (3.9 to 4.4 N•m).	



**TASK ENDS HERE**

**CAM FOLLOWER HOUSING INSTALLATION**

**INITIAL SETUP**

**Tools**

Socket, 9/16-inch, 1/2-inch drive  
 Wrench, torque, 0 to 250 ft lb  
 (0 to 350 N.m), 1/2-inch drive

**Materials/Parts**

Gasket, cam follower housing  
 Lockwasher (six required)

**Equipment Condition**

Camshaft installed (page 2-66).

**CAM FOLLOWER HOUSING INSTALLATION - CONTINUED**

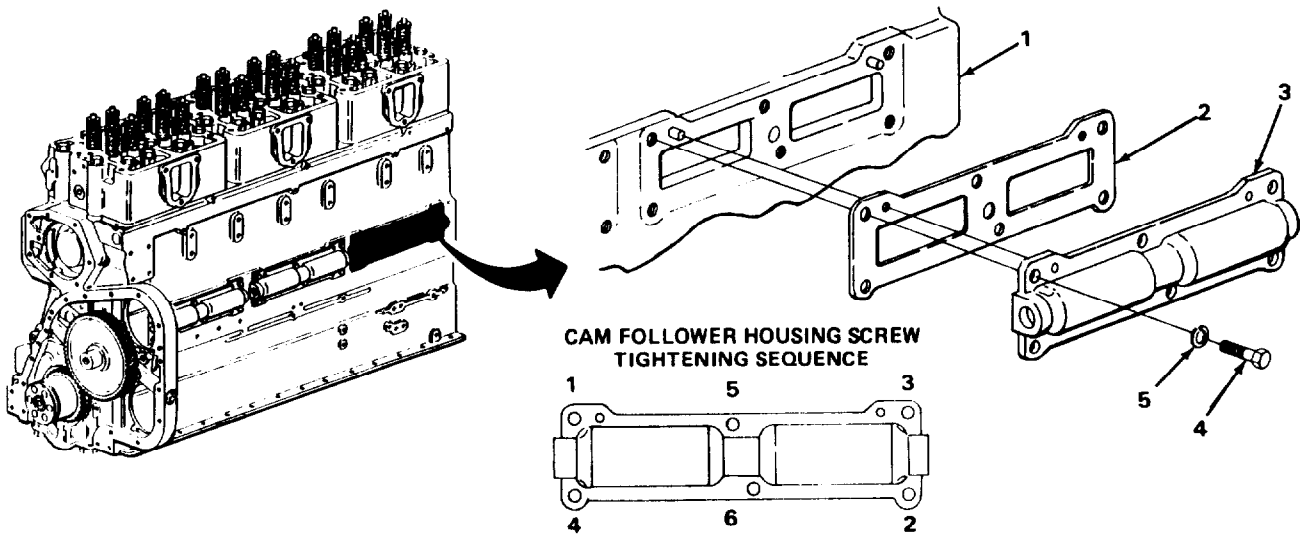
LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

Steps given are typical for all three cam follower housings.

Position gasket with sealing material side away from cylinder block.

- |                       |   |   |
|-----------------------|---|---|
| 1. Cylinder block (1) | New gasket (2) and cam follower housing (3) | Aline with dowel pins and put on.   |
| 2.                    | Six screws (4) and six new lock-washers (5) | a. Screw in until snug.<br>b. Using 1/2-inch drive 9/16-inch socket and 0 to 250 ft lb (0 to 350 N <sub>o</sub> m) torque wrench, tighten to 30 to 35 ft lb (42 to 49 N <sub>o</sub> m) as shown in Cam Follower Housing Screw Tightening Sequence. |



**TASK ENDS HERE**

**COMPRESSION RELEASE SHAFT INSTALLATION**

INITIAL SETUP

Tools

Wrench, box-end, 9/16-inch

Materials/Parts

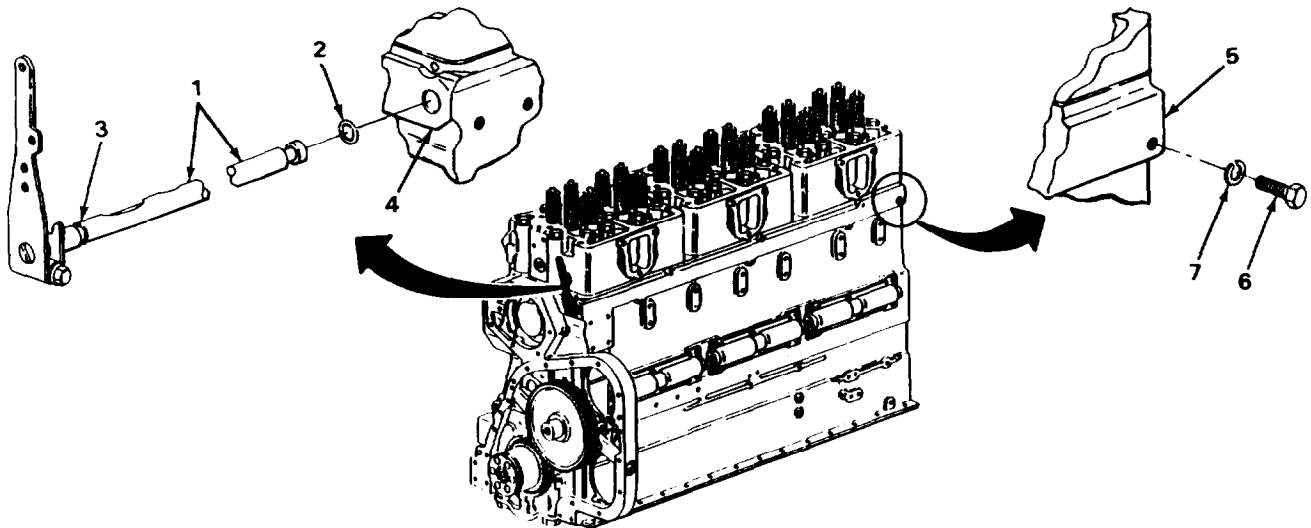
Lockwasher  
 Oil, lubricating (item 12, appendix B)  
 Packing, preformed

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

**NOTE**

Before performing step 1, coat packing with lubricating oil.

- |                                    |                                  |   |
|------------------------------------|----------------------------------|---|
| 1. Compression release shaft (1)   | New preformed packing (2)        | Slide on and position in groove (3).                  |
| 2. Front of cylinder block (4)     | Compression release shaft (1)    | Put in.   |
| 3. Left rear of cylinder block (5) | Screw (6) and new lockwasher (7) | Using 9/16-inch box-end wrench, screw in and tighten. |



**TASK ENDS HERE**

**PUSH ROD INSTALLATION**

INITIAL SETUP

Equipment Condition

Cylinder heads installed (page 2-68).

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

**NOTE**

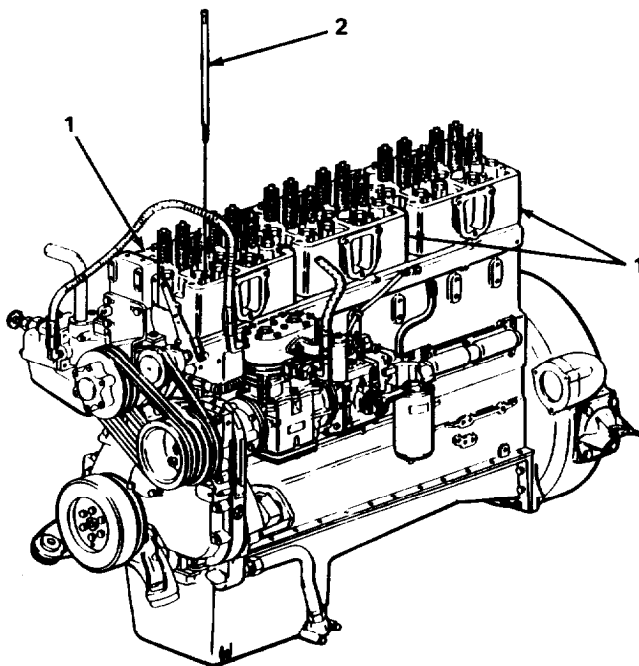
Before installing push rods, check tags for location as shown in chart below.

Cylinder heads (1)

Push rod (2)

Put in.

**Position with ball-end down.**



PUSH ROD LOCATION AND DESCRIPTION			
TAG No.	CYL No.	LOCATION	DESCRIPTION
1	1	EXHAUST	W/COLLAR
2	1	INJECTOR	THICK
3	1	INTAKE	THIN
4	2	INTAKE	THIN
5	2	INJECTOR	THICK
6	2	EXHAUST	W/COLLAR
7	3	EXHAUST	W/COLLAR
8	3	INJECTOR	THICK
9	3	INTAKE	THIN
10	4	INTAKE	THIN
11	4	INJECTOR	THICK
12	4	EXHAUST	W/COLLAR
13	5	EXHAUST	W/COLLAR
14	5	INJECTOR	THICK
15	5	INTAKE	THIN
16	6	INTAKE	THIN
17	6	INJECTOR	THICK
18	6	EXHAUST	W/COLLAR

**TASK ENDS HERE**

**INJECTOR TIMING ADJUSTMENT**

---

INITIAL SETUP

Tools

Barring tool, crankshaft  
 Injector timing tool, ST-593

Equipment Condition

Push rods installed (page 2-73).

Materials/Parts

Cam follower housings gaskets  
 (as required)

---

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

---

**NOTE**

Timing procedure is performed on cylinders one, three, and five.

Camshaft must be pushed back against rear of cylinder block for zero end play.

- |                                    |                                      |   |
|------------------------------------|--------------------------------------|---|
| 1. Injector sleeve (1)             | ST-593 injector timing tool (2)      | Position into injector sleeve.                                |
| 2. ST-593 injector timing tool (2) | Push rod (3) and timing tool rod (4) | Aline and put timing tool rod into push rod socket.           |
| 3.                                 | Knurled holddowns (5)                | Tighten evenly until timing tool is secured to cylinder head. |

**NOTE**

Make sure ST-593 injector timing tool is flat on cylinder head, otherwise incorrect timing will occur.

- |                                    |                                   |  |
|------------------------------------|-----------------------------------|--|
| 4 .                                | Dial indicator supports (6 and 7) | Loosen.  |
| 5. Cylinder block (8)              | Crankshaft (9)                    | Using crankshaft barring tool, rotate crankshaft clockwise to TDC (top dead center).<br><b>Piston travel plunger (10) will be near full upward position.</b>   |
| 6. ST-593 injector timing tool (2) | Dial indicators (11 and 12)       | a. Push down to fully compressed position.<br>b. Note readings on both dial Indicators.<br>c. Raise both dial indicators 0.020 inch from noted readings.<br>d. Using thumbscrew (15), lock in place. |



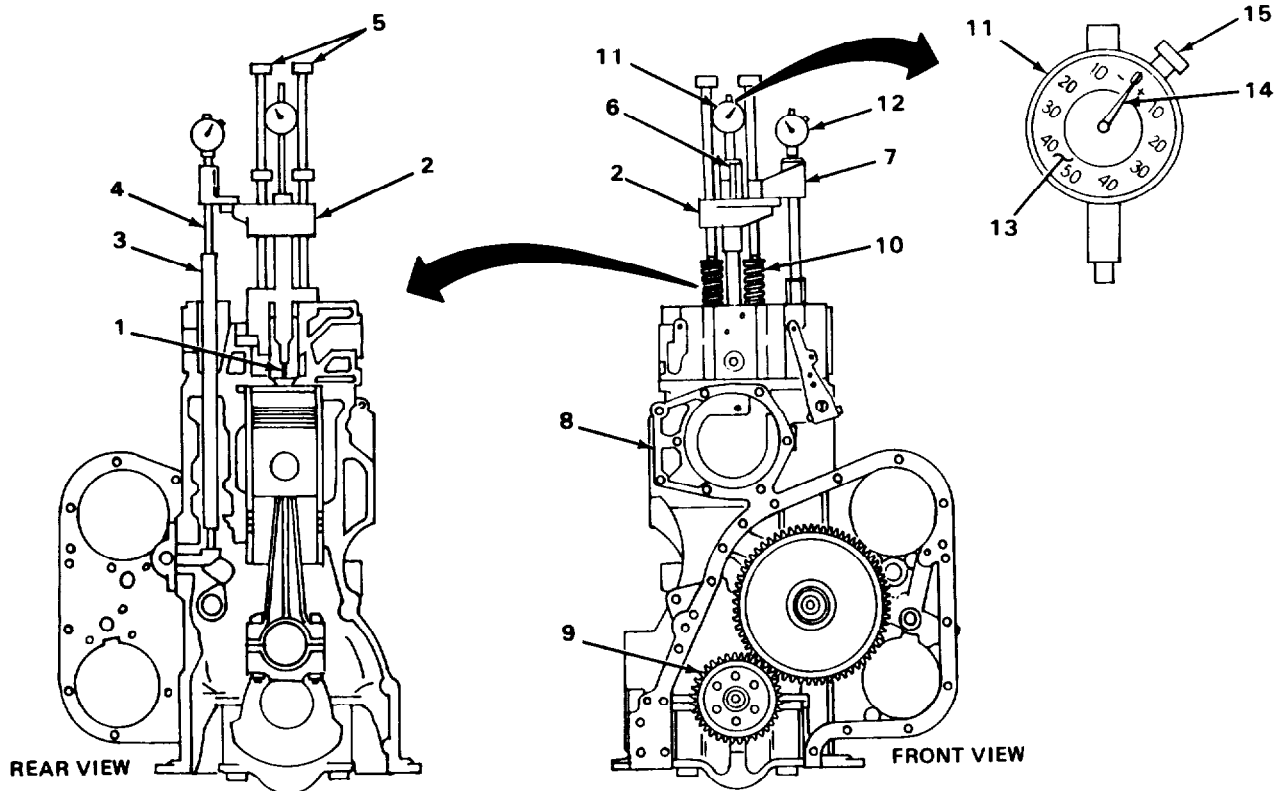
INJECTOR TIMING ADJUSTMENT - CONTINUED

LOCATION	ITEM	ACTION REMARKS
----------	------	-------------------

**NOTE**

To ensure that piston is on compression stroke, both dial indicators must move in same direction.

- |                        |  |  |
|------------------------|--|--|
| 7. Cylinder block (8)  | Crankshaft (9)   | Using crankshaft barring tool, rotate crankshaft back and forth to make sure piston is precisely at TDC (top dead center) on compression stroke.<br><b>TDC is Indicated by maximum clockwise position of dial indicator pointer.</b> |
| 8. Dial indicator (11) | Dial face (13), dial indicator pointer (14), and thumbscrew (15) | a. Set dial face to align zero with dial indicator pointer.<br>b. Turn thumbscrew to lock dial face.   |



**INJECTOR TIMING ADJUSTMENT - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
9. Cylinder block (1)	Crankshaft (2)	Using crankshaft barring tool, rotate crankshaft clockwise 90 degrees ATDC (after top dead center). <b>Piston travel plunger (3) will be near its lowest position.</b>
10. Dial indicator (4)	Dial face (5), dial indicator pointer (6), and thumbscrew (7)	a. Set dial face to align zero with dial indicator pointer. b. Turn thumbscrew to lock dial face.
11. Cylinder block (1)	Crankshaft (2)	Using crankshaft barring tool, rotate crankshaft counterclockwise through TDC to 45 degrees BTDC (before top dead center).
12. ST-593 injector timing tool (8)	Piston travel plunger (3) and dial indicator stem (9)	Using crankshaft barring tool, rotate crankshaft clockwise until piston travel plunger on fixture is in contact with dial indicator stem.
13.	Dial indicator (10)	Using crankshaft barring tool, slowly rotate crankshaft in clockwise direction until dial indicator reads 0.0032 inch (0.0812 mm) before zero. <b>This position is actually 0.2032 Inch before zero on dial Indicator since the pointer has rotated twice.</b>
14.	Dial indicator (4)	Note reading. Reading should be within limits given in table.

**NOTE**

If Injector timing is not within specification given, perform step 15 before making changes in cam follower housing gaskets to correct injector timing.

15. ST-593 injector timing tool (8)	Dial indicators (4 and 10)	a. Check dial indicator positioning. Be sure dial indicators are not bottoming or binding. <b>Carefully recheck TDC.</b>
-------------------------------------	----------------------------	---

INJECTOR TIMING ADJUSTMENT - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

- b. If required, advance or retard by adding or removing cam follower housing gaskets.

Remove gaskets to retard injector timing and add gaskets to advance timing. Push rods and cam follower housings must be removed. See Push Rod Removal (page 2-33) and Cam Follower Housing Removal (page 2-47).

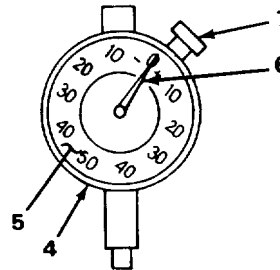
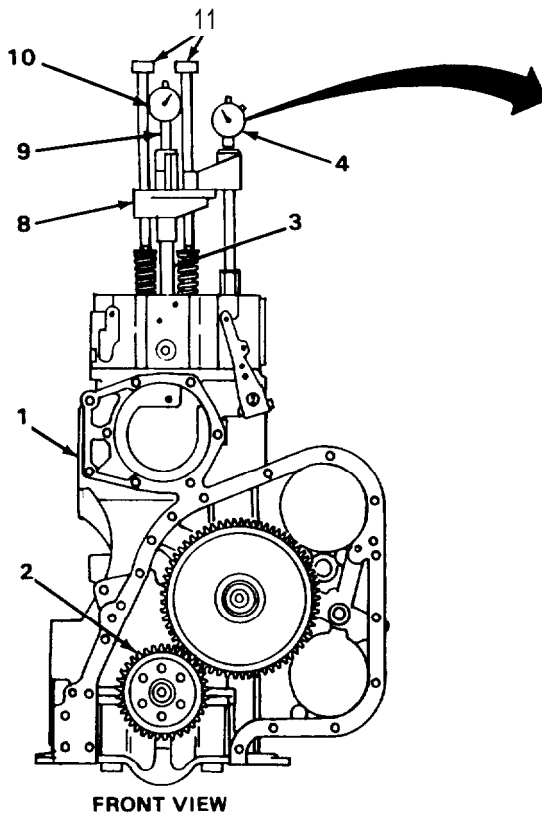
NOTE

Support ST-593 injector timing tool while performing next step.

16. ST-593 injector timing tool (8)

- Knurled holddowns (11)

Loosen enough to remove injector timing tool from engine.



INJECTION TIMING CODES AND PUSH ROD TRAVEL		
TIMING (1) CODE	PUSH ROD TRAVEL (2) (INCHES)	
	FAST	SLOW
AS	- 0.035	-0.037

- (1) Check the engine dataplate to find the Timing Code.  
 (2) Measure the push rod travel when the piston is at 0.2032 inch Before Top Dead Center.

TASK ENDS HERE

**FUEL INJECTOR INSTALLATION**

---

INITIAL SETUP

Tools

Extension, 6-inch, 1/2-inch drive  
 Handle, ratchet, 1/2-inch drive  
 Puller, fuel injector  
 Socket, 1/2-inch, 1/2-inch drive  
 Wrench, torque, 0 to 250 ft lb  
 (0 to 350 N•m), 1/2-inch drive

Materials/Parts

Oil, lubricating (item 12, appendix B)  
 Packing, preformed (fuel injector)  
 Gasket (two required)

Equipment Condition

Injector timing adjusted (page 2-74).

---

LOCATION	ITEM	ACTION	REMARKS
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---

**NOTE**

Steps given are typical for all six fuel injectors.

Coat packings and injector with lubricating oil.

1. Fuel injector (1)	Two new gaskets (2) and preformed packing (3)	Roll on.	
----------------------	---	----------	--

**NOTE**

Install fuel injectors in same cylinder from which they were removed.

Position fuel injectors with filter screen facing exhaust manifold side of engine.

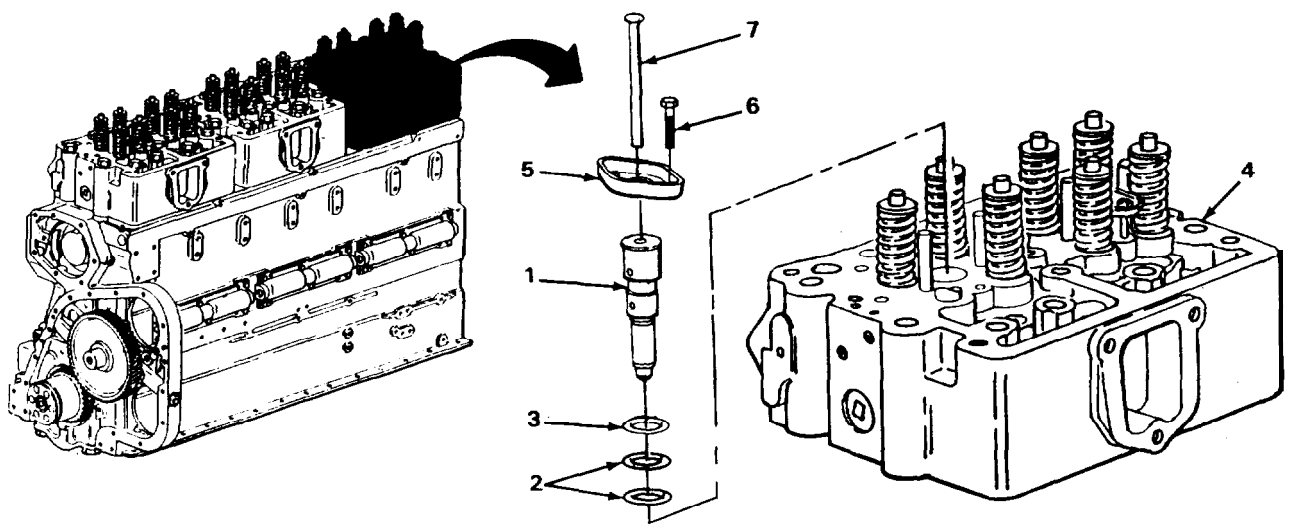
2. Cylinder head (4)	Fuel injector (1)	Aline and put in.	
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**NOTE**

Method for mounting valve spring compressor is at discretion of using facility.

FUEL INJECTOR INSTALLATION - CONTINUED

LOCATION	ITEM	ACTION REMARKS
3.	Fuel injector (1)	Using fuel injector puller, seat fuel injector.
4.	Fuel injector clamp (5) and two screws (6)	a. Using 1/2-inch drive 1/2-inch socket, 6-inch extension, and ratchet handle, screw in until screw just seats on fuel injector clamp. <b>Do not tighten.</b> b. Using 1/2-inch drive 1/2-inch socket, 6-inch extension, and 0 to 250 ft lb (0 to 350 N•m) torque wrench, torque two screws to 11 to 12 ft lb (15.4 to 16.8 N•m).
5.	Fuel injector link (7)	Put in.



TASK ENDS HERE

**CROSSHEAD INSTALLATION**

---

**INITIAL SETUP**

Tools	Equipment Condition
Adapter set, torque, ST-669, 3/8-inch drive	Cylinder heads installed (page 2-68).
Gage, thickness	
Handle, ratchet, 3/8-inch drive	
Socket, 9/16-inch, 3/8-inch drive	
Wrench, torque, 0 to 150 ft lb (0 to 210 N•m), 3/8-inch drive	

---

LOCATION	ITEM	ACTION REMARKS
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---

**NOTE**

Steps given are typical for all 12 crossheads.

Crossheads are tagged by location from front cylinder to rear cylinder. Check tags for location. See illustration.

Wide crossheads are for exhaust valves and narrow crossheads are for intake valves.

1. Cylinder head (1)	Crosshead (2)	Put on. <b>Adjusting screw must face exhaust side of engine.</b>
2. Crosshead (2)	Locknut (3) and adjusting screw (4)	Using 3/8-inch drive ST-669 torque adapter set, 9/16-inch socket and ratchet handle, loosen.

**NOTE**

When performing step 3, apply light finger pressure to rocker arm contact surface on crosshead.

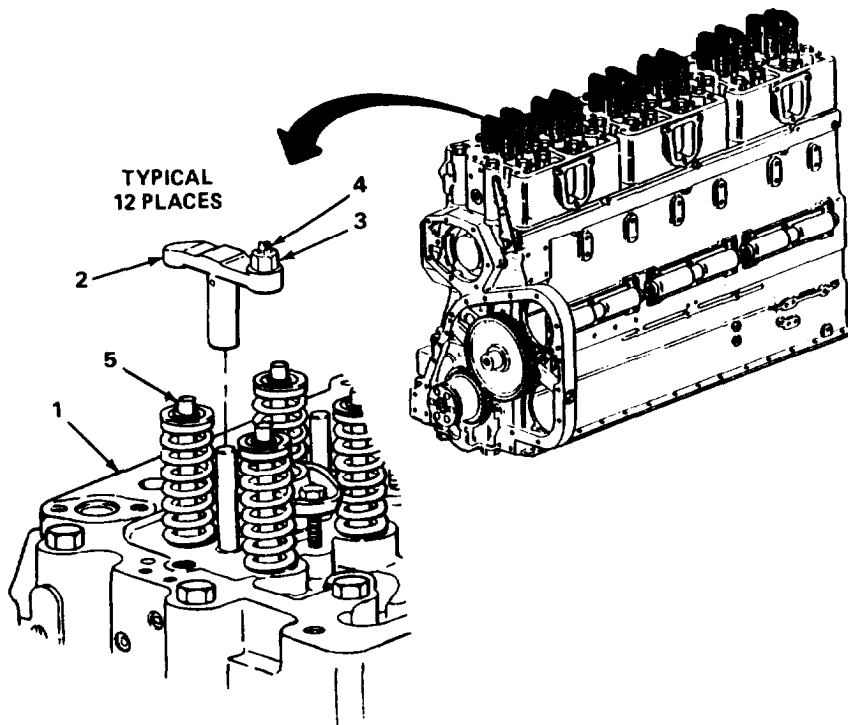
When using new crossheads and guides, advance adjusting screw one-third turn to straighten stem on its guide and to compensate for slack in threads.

When using old crossheads and guides, it may be necessary to advance the screw one-half turn in order to straighten the stem in its guide.

3. Crosshead (2)	Adjusting screw (4)	Using 3/8-inch drive ST-669 torque adapter set, screw in until adjusting screw seats on valve stem. <b>Do not tighten.</b>
------------------	---------------------	---

**CROSSHEAD INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
4. Crosshead (2)	Valve spring retainer (5)	Using thickness gage, check for minimum clearance of 0.020 inch (0.51 mm).
5.	Locknut (3) and adjusting screw (4)	Using 3/8-inch drive ST-669 torque adapter set, 9/16-inch socket and 0 to 150 ft lb (0 to 210 N•m) torque wrench, tighten to 22 to 26 ft lb (30.8 to 36.4 N•m).



CROSSHEAD LOCATION		
TAG NO.	CYL. NO.	VALVE
1	1	EXHAUST
2	1	INTAKE
3	2	INTAKE
4	2	EXHAUST
5	3	EXHAUST
6	3	INTAKE
7	4	INTAKE
8	4	EXHAUST
9	5	EXHAUST
10	5	INTAKE
11	6	INTAKE
12	6	EXHAUST

**TASK ENDS HERE**

**ROCKER ARM HOUSING INSTALLATION**

---

**INITIAL SETUP**

Tools	Materials/Parts
Adapter set, torque, ST-669, 3/8 inch drive	Gasket
Handle, ratchet, 3/8-inch drive	Washers, steel, engine compression brake (six required)
Socket, 7/16-inch, 3/8-inch drive	
Socket, M-inch, 3/8-inch drive	Equipment Condition
Wrench, torque, 0 to 150 ft lb (0 to 210 N•m), 3/8-inch drive	Injector timing adjusted (page 2-74).

---

LOCATION	ITEM	ACTION REMARKS
----------	------	-------------------

**NOTE**

Steps given are typical for all three rocker arm housings.

1. Cylinder head (1)	New gasket (2)	Put on.
2. intake and exhaust valve rocker arms (3)	Locknut (4) and adjusting screw (5)	Using 3/8-inch drive ST-669 torque adapter set and ratchet handle, loosen locknut and unscrew adjusting screw three turns.
3. Fuel injector rocker arm (6)	Locknut (7) and adjusting screw (8)	Using 3/8-inch drive ST-669 torque adapter set, 7/16-inch socket, and ratchet handle, loosen locknut and unscrew adjusting screw three turns.
4. Cylinder head (1)	Rocker arm housing (9)	Put on. <b>Aline ball socket on rocker arm with socket in push tube.</b>
5. Rocker arm housing (9)	Six new engine compression brake steel washers (10)	Put on.

**NOTE**

Rocker arm studs are different lengths, See illustration for locations and lengths.



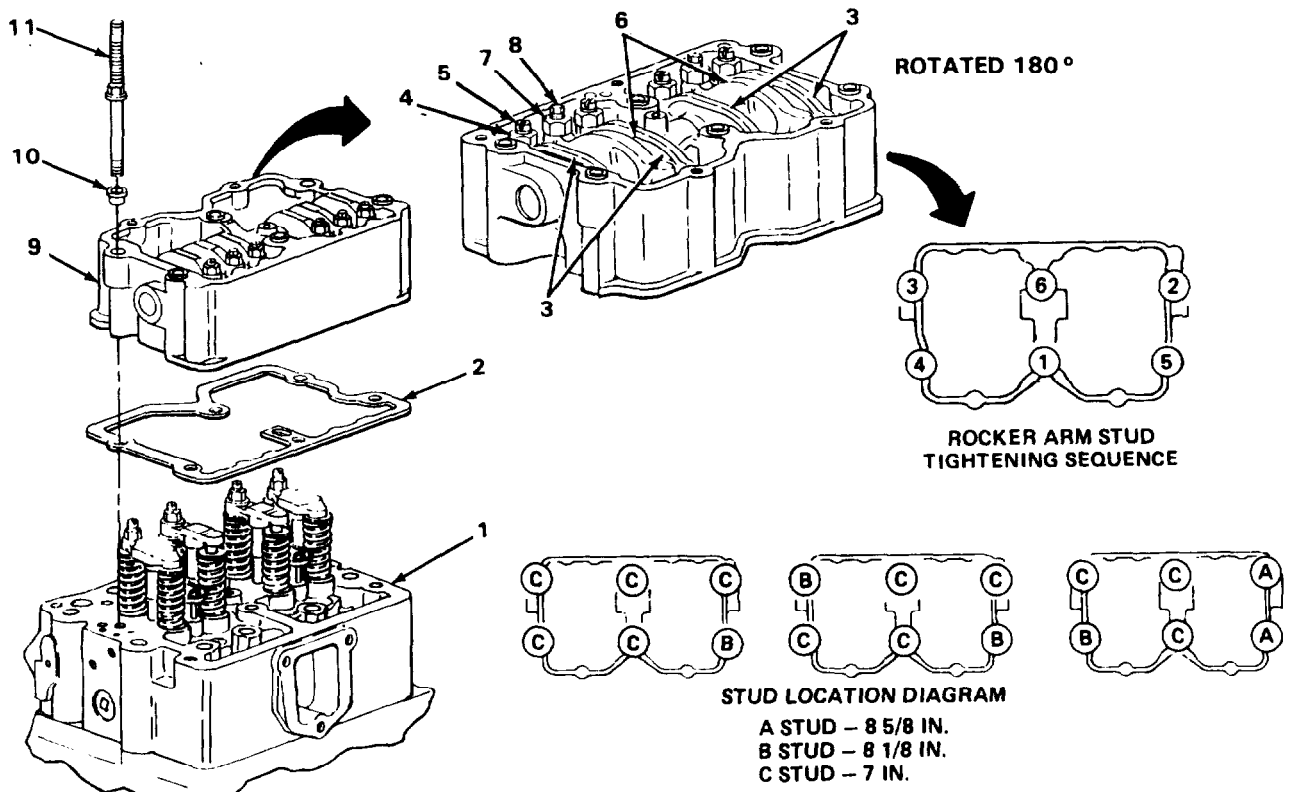
**ROCKER ARM HOUSING INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
6.	Six rocker arm studs (11)	Using 3/8-inch drive 5/8-inch socket and ratchet handle, screw in until snug.	<b>Do not tighten.</b>

**NOTE**

When performing step 7, tighten rocker arm studs in sequence shown in Rocker Arm Stud Tightening Sequence below.

- |    |                           |  |
|----|---------------------------|--|
| 7. | Six rocker arm studs (11) | a. Using 3/8-inch drive 5/8-inch socket and 0 to 150 ft lb (0 to 210 N•m) torque wrench, tighten to 40 to 45 ft lb (56 to 63 N•m).<br>b. Tighten to 60 to 65 ft lb (84 to 91 N•m). |
|----|---------------------------|--|



**TASK ENDS HERE**

**ACCESSORY DRIVE INSTALLATION**

---

**INITIAL SETUP**

Tools

Barring tool, crankshaft  
 Indicator, dial  
 Wrench, box-end, half-moon, 5/8-inch

Materials/Parts

Gasket, accessory drive  
 Lockwashers (five required)

Equipment Condition

Camshaft installed (page 2-66).

---

LOCATION	ITEM	ACTION REMARKS
1. Cylinder block (1)	Crankshaft (2)	a. Using crankshaft barring tool, rotate crankshaft until piston number one is at TDC (top dead center) on compression stroke. <b>Rocker arms for cylinder number one will be loose.</b> b. Using crankshaft barring tool, rotate engine 90 degrees ATDC (after top dead center).
2. Accessory drive (3)	Key (4) and new gasket (5)	a. Put key in keyway. b. Put on gasket and aline.

**NOTE**

When performing step 3, aline timing marks on camshaft gear and accessory drive gear (see illustration).

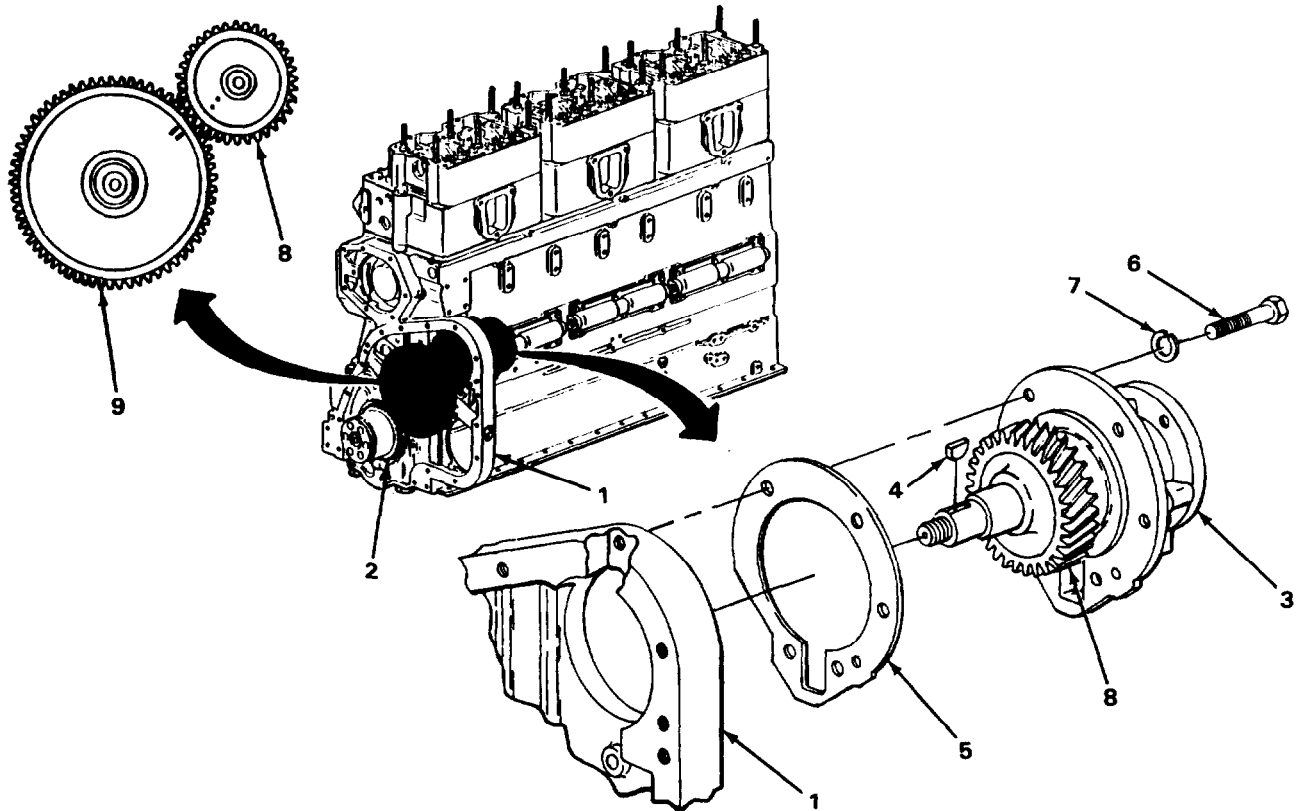
3. Cylinder block (1)	Accessory drive (3)	Put in.
4. Accessory drive (3)	Five screws (6) and five new lockwashers (7)	Using 5/8-inch half-moon box-end wrench, screw in and tighten.

**NOTE**

Method used for mounting dial indicator is at discretion of using facility. Set contact point of dial indicator on accessory drive gear tooth.

ACCESSORY DRIVE INSTALLATION - CONTINUED

LOCATION	ITEM	ACTION REMARKS
5. Cylinder block (1)	Gear (8) and cam-shaft gear (9)	a. Rotate gear in one direction as far as it will move. b. Set dial indicator to zero. c. Rotate gear in opposite direction and check dial indicator for backlash reading of 0.0045 to 0.0105 inch (0.114 to 0.267 mm).



TASK ENDS HERE

**AIR COMPRESSOR AND FUEL PUMP INSTALLATION**

---

**INITIAL SETUP**

Tools

- Extension, 6-inch, 1/2-inch drive
- Handle, ratchet, 1/2-inch drive
- Socket, 9/16-inch, 1/2-inch drive
- Wrench, box-end, half-moon, 5/8-inch
- Wrench, open-end, 11/16-inch
- Wrench, open-end, 1-inch

Materials/Parts

- Gasket, air compressor to accessory drive
- Gasket, air compressor to fuel pump
- Lockwasher, air compressor to accessory drive (four required)

Materials/Parts - Continued

- Lockwasher, air compressor bracket
- Lockwasher, fuel pump to air compressor (four required)

Personnel Required

Two

Equipment Condition

Accessory drive installed (page 2-84).

---

LOCATION	ITEM	ACTION REMARKS
1. Air compressor (1)	Crankshaft (2)	Rotate to position part numbers stamped on gear towards engine (see illustration).
2. Fuel pump (3)	New gasket (4) and coupler (5)	Put on gasket and aline couplers.
3. Air compressor (1)	Fuel pump (3)	Aline and put together.
4. Fuel pump (3)	Two nuts (6) two new lockwashers (7) and two flat washers (8)	Using 11/16-inch open-end wrench, screw in until snug. <b>Do not tighten.</b>
5.	Two screws (9), two new lockwashers (10), and two flat washers (11)	Using 5/8-inch half-moon box-end wrench, screw in and tighten.
6.	Two nuts (6)	Using 11/16-inch open-end wrench, tighten.
7. Air compressor (1)	New gasket (12) and coupling (13)	Put on.

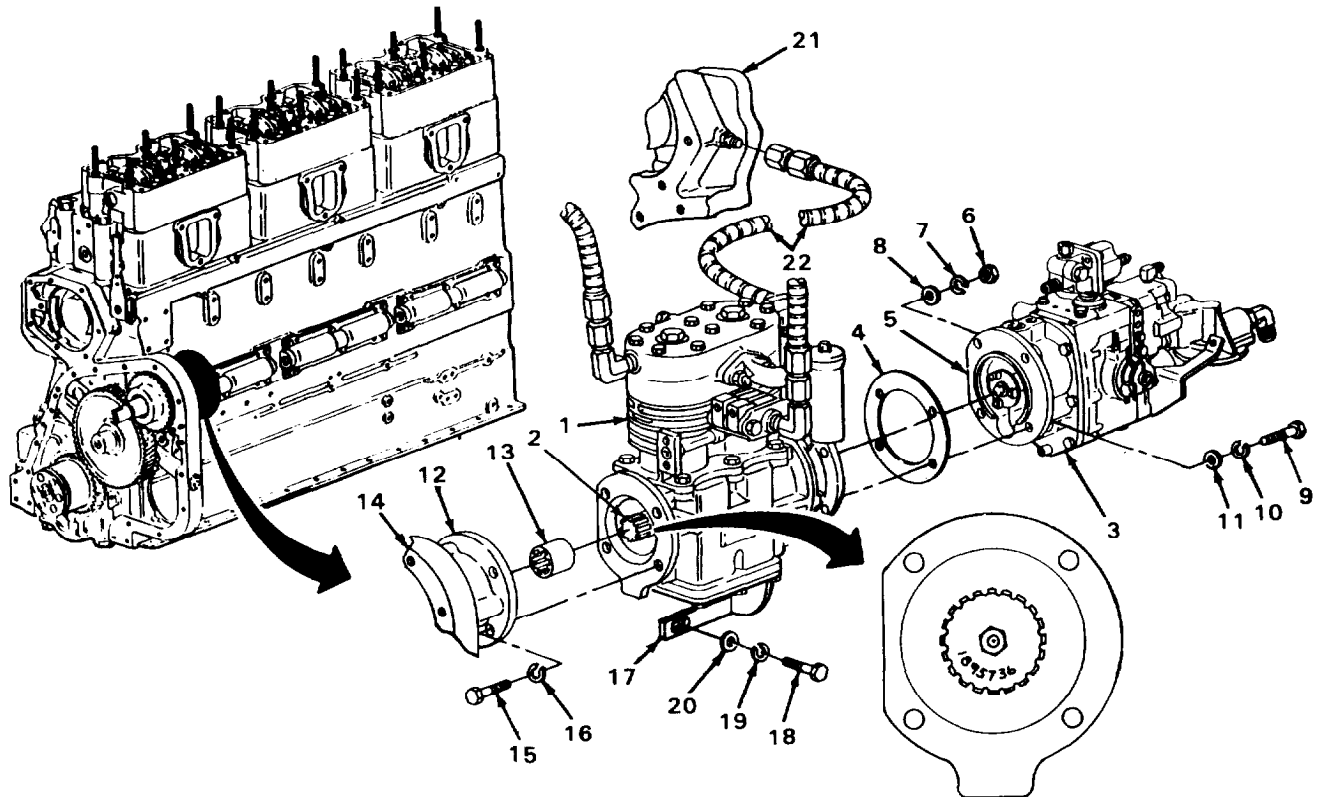
**AIR COMPRESSOR AND FUEL PUMP INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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**WARNING**

Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.

8. Accessory drive (14)	Air compressor (1) and fuel pump (3)	Put on and aline couplings.
9.	Four screws (15) and four new lockwashers (18)	Using 5/8-inch half-moon box-end wrench, screw in and tighten.
10. Air compressor bracket (17)	Screw (18), new lockwasher (19), and flat washer (20)	Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and ratchet handle, screw in and tighten.
11. Cylinder block (21)	Air compressor coolant hose (22)	Using 1-inch open-end wrench, screw in and tighten.



**TASK ENDS HERE**

**LUBRICATING OIL PUMP INSTALLATION**

---

**INITIAL SETUP**

Tools

Extension, 6-inch, 1/2-inch drive  
 Handle, ratchet, 1/2-inch drive  
 Indicator, dial  
 Socket, 5/8-inch, 1/2-inch drive  
 Wrench, torque, 0 to 250 ft lb  
 (0 to 350 N•m), 1/2-inch drive

Materials/Parts

Gasket  
 Lockwasher (five required)

Equipment Condition

Air compressor and fuel pump installed  
 (page 2-86).

---

LOCATION	ITEM	ACTION REMARKS
1. Oil pump (1)	New gasket (2)	Put on.

**NOTE**

When performing step 2, aline gear teeth on oil pump to mesh with gear teeth on camshaft.

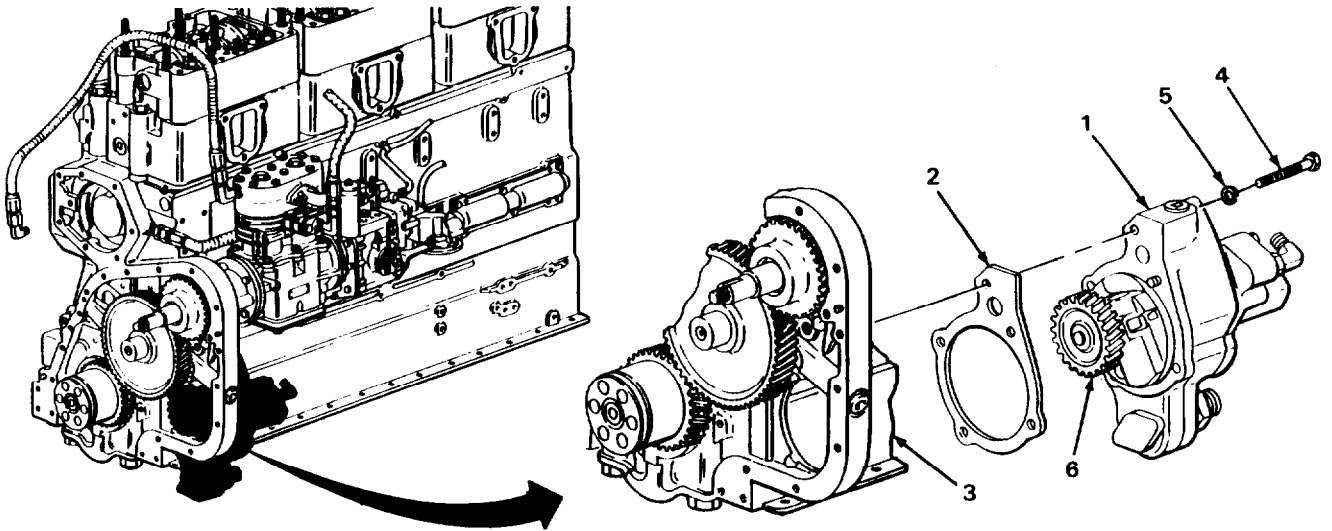
2. Cylinder block (3)	Oil pump (1)	Put in.
3. Oil pump (1)	Five screws (4) and five new lockwashers (5)	Using 1/2-inch drive 5/8-inch socket, 6-inch extension, and ratchet handle, screw in until snug.
4.	Five screws (4)	Using 1/2-inch drive 5/8-inch socket, 6-inch extension, and 0 to 250 ft lb (0 to 350 N•m) torque wrench, tighten to 40 to 46 ft lb (56 to 63 N•m).

**NOTE**

Method used for mounting dial indicator is at discretion of using facility. Set contact point of dial indicator on oil pump gear teeth.

LUBRICATING OIL PUMP INSTALLATION - CONTINUED

LOCATION	ITEM	ACTION REMARKS
5. Cylinder block (3)	Oil pump gear (6)	<ul style="list-style-type: none"> <li>a. Rotate gear in one direction as far as it will move.</li> <li>b. Set dial indicator to zero.</li> <li>c. Rotate gear in opposite direction and check dial indicator reading for backlash of 0.002 to 0.016 inch (0.051 to 0.40 mm).</li> </ul>



TASK ENDS HERE

## GEARCASE COVER INSTALLATION

---

### INITIAL SETUP

#### Tools

Assembly tool, pulley, ST-386  
 Barring tool, crankshaft  
 Extension, 6-inch, 1/2-inch drive  
 Gage, depth  
 Gage, thickness  
 Hammer, ball-peen, 16-ounce  
 Handle, ratchet, 1/2-inch drive  
 Indicator, dial  
 Mandrel, seal, ST-1173  
 Mandrel, seal, ST-1259  
 Pilot, seal, ST-1260  
 Socket, 7/16-inch, 12-point, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive  
 Socket, 5/8-inch, 1/2-inch drive  
 Socket, 7/8-inch, 1/2-inch drive  
 Socket, 1 1/16-inch, 1/2-inch drive  
 Straightedge, 24-inch  
 Wrench, torque, 0 to 250 ft lb (0 to 350 N•m), 1/2-inch drive

#### Materials/Parts

Cutting fluid, lapping (item 5, appendix B)  
 Gasket, gearcase cover  
 Lockwasher, camshaft support (three required)  
 Lockwasher, engine mount (eight required)  
 Lockwasher, gearcase cover to engine (13 required)  
 Lockwasher, vibration damper (six required)  
 Oil, lubricating (item 12, appendix 6)  
 Packing, camshaft support  
 Prussian blue (item 13, appendix B)  
 Seal, accessory drive  
 Seal, crankshaft  
 Shims, camshaft support (as required)

#### Personnel Required

Two

#### Equipment Condition

Lubricating oil pump installed (page 2-88).

---

LOCATION	ITEM	ACTION REMARKS
1. Cylinder block (1)	New gasket (2)	Aline with dowel pins (3) and put on.
<b><u>CAUTION</u></b>		
Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.		
2.	Gearcase cover (4)	Aline with dowel pins and put on.
3. Gearcase cover (4)	Thirteen screws (5) and thirteen new lockwashers (6)	Using 1/2-inch drive 5/8-inch socket, 6-inch extension, and ratchet handle, screw in until snug. <b>Do not tighten.</b>



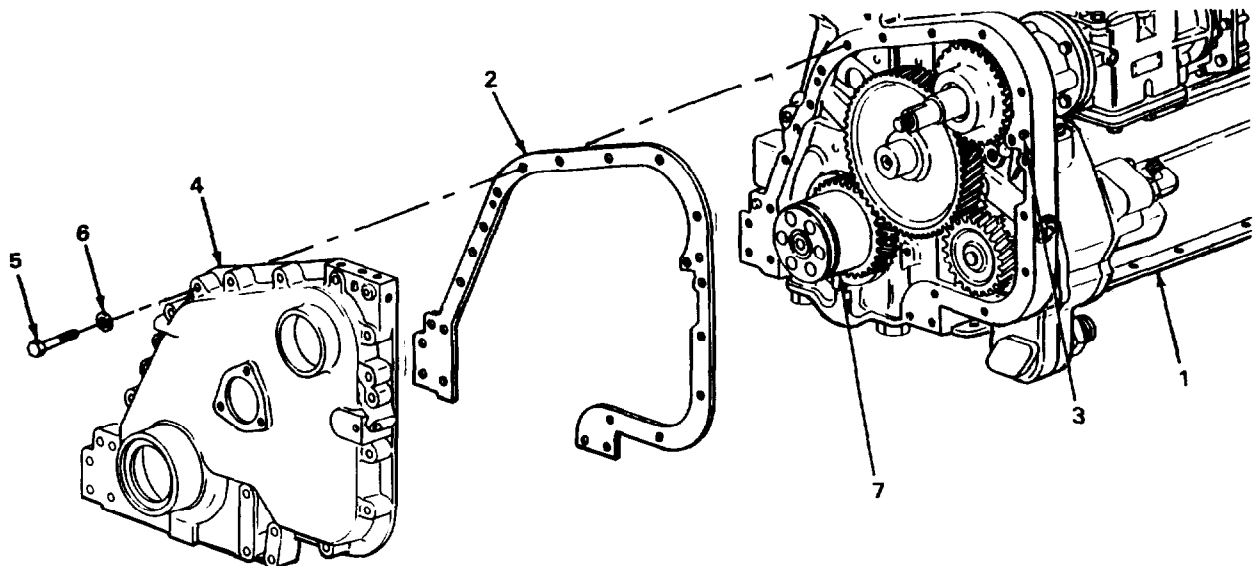
**GEARCASE COVER INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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**NOTE**

Method used for mounting dial indicator is at discretion of using facility. Position dial indicator on crankshaft end face and set contact point of dial indicator on crankshaft oil seal bore.

- |                       |                     |   |
|-----------------------|---------------------|---|
| 4. Cylinder block (1) | Crankshaft (7)      | <ul style="list-style-type: none"> <li>a. Set dial indicator to zero.</li> <li>b. Using crankshaft barring tool, rotate crankshaft and check dial indicator reading for runout not to exceed 0.010 inch (0.25 mm).</li> </ul> |
| 5.                    | Gearcase cover (4)  | Aline.  |
| 6. Gearcase cover (4) | Thirteen screws (5) | Using 1/2-inch drive 5/8-inch socket and 0 to 250 ft lb (0 to 350 N•m) torque wrench, tighten to 45 to 50 ft lb (63 to 70 N•m).   |



**GEARCASE COVER INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
7. Bottom of cylinder block (1)	Gearcase cover (2)	Using 24-inch straightedge and thickness gage, make sure bottom of gearcase cover and oil pan mounting surface are flush within 0.004 inch (0.10 mm).

**NOTE**

Before performing step 8, coat seals with lubricating oil.

8. Gearcase cover (2)	New crankshaft seal (3)	a. Using 16-ounce ball-peen hammer, ST-1259 seal mandrel, and ST-1260 seal pilot, put in. b. Using depth gage, check clearance of crankshaft seal with boss on gearcase cover. <b>Minimum clearance is 0.030 inch (0.78 mm). Seal should not touch bottom of bore.</b>
9.	New accessory drive seal (4) and oil slinger (5)	Using 16-ounce ball-peen hammer, ST-1173 seal mandrel, and ST-386 pulley assembly tool, put in. <b>ST-1173 seal mandrel will put in seal to required depth.</b>
10.	Camshaft support (6)	a. Put in and hold against stop. b. Using thickness gage, measure distance between camshaft support and gearcase cover. <b>Clearance should be 0.008 to 0.013 inch (0.20 to 0.33 mm). Shim as needed.</b> c. Take out.

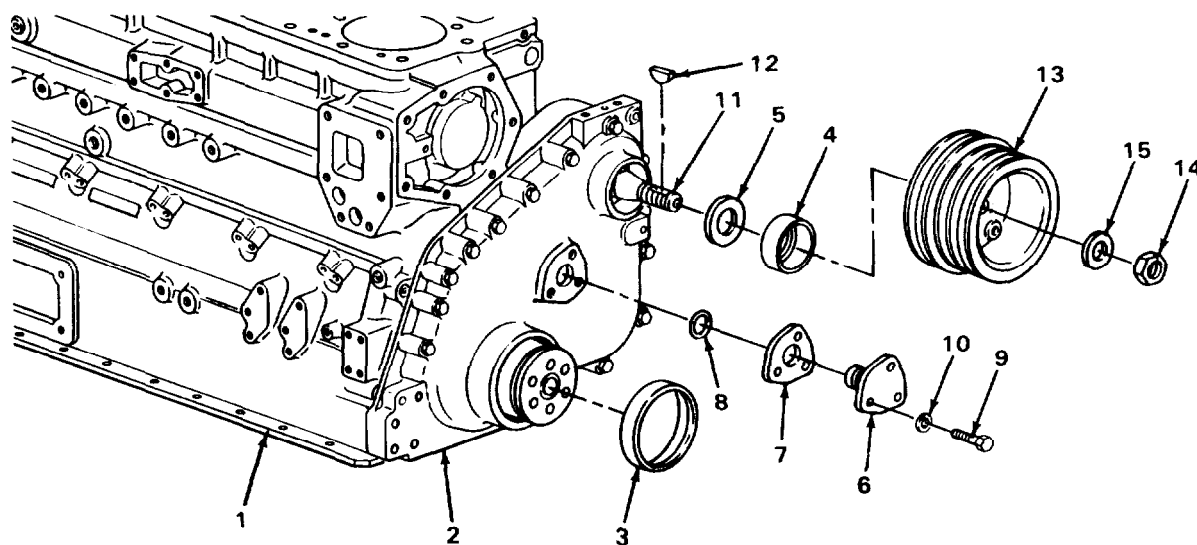
**NOTE**

Before performing step 11, coat packing with lubricating oil.

11.	Camshaft support (6), new shims (7) and new packing (8)	Put in.
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**GEARCASE COVER INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
12. Camshaft support (6)	Three screws (9) and three new lock-washers (10)	Using 1/2-inch drive 9/16-inch socket and ratchet handle, screw in and tighten.
13. Accessory drive shaft (11)	Key (12) and pulley (13)	Put on.
14.	Self-locking nut (14) and flat washer (15)	Using 1/2-inch drive 1 1/16-inch socket, 6-inch extension, and ratchet handle, screw in until snug,
15.	Self-locking nut (14)	Using 1/2-inch drive 1 1/16-inch socket, 6-inch extension, and 0 to 250 ft lb (0 to 350 N•m) torque wrench, tighten to 95 to 100 ft lb (133 to 140 N•m).



**NOTE**

Each time the crankshaft vibration damper is removed or replaced, it should be lapped to the crankshaft to provide maximum contact area between mating parts.

Ensure that all mating surfaces are free of burrs, nicks, and gouges. Do not attempt lapping until all imperfections have been removed.

**GEARCASE COVER INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
16. Gearcase cover (1)	Crankshaft face (2)	Apply a light coat of lapping cutting fluid.
17. Crankshaft face (2)	Vibration damper (3)	Put on and lap by turning vibration damper one-fourth to one-half turn back and forth, until both crankshaft and vibration damper are mated.
18.	Vibration damper (3)	a. Take off. b. Clean all cutting fluid from crankshaft and vibration damper.
19. Gearcase cover (1)	Crankshaft face (2)	Apply a light even coat of prussian blue.
20. Crankshaft face (2)	Vibration damper (3)	Put on and turn one-quarter turn and take off. <b>Contact area should be 100 percent for distance of 1/2 Inch (12.70 mm) at large diameter of crankshaft face. Remainder of taper must have 70 to 80 percent of contact.</b>
21.	Six screws (4), six new lockwashers (5), and engine mount (6)	Using 1/2-inch drive 5/8-inch socket, 6-inch extension, and ratchet handle, screw in and tighten.
22. Engine mount (6)	Two screws (7) and two new lock-washers (8)	Using 1/2-inch drive 12-point 7/16-inch socket and ratchet handle, screw in and tighten.

**CAUTION**

Do not lubricate when using gearcase cover casting numbers 115562, 115563, 175183, and 175185.

23. Gearcase cover (1)      Crankshaft face (2)      Lubricate with lubricating oil.

**WARNING**

Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.

24. Crankshaft face (2)      Vibration damper (3)      Put on.  
**Have assistant hold in place.**

25. Vibration damper (3)      Six screws (9) and six new lock-washers (10)      Using 1/2-inch drive 7/8-inch socket and ratchet handle, screw in until snug.

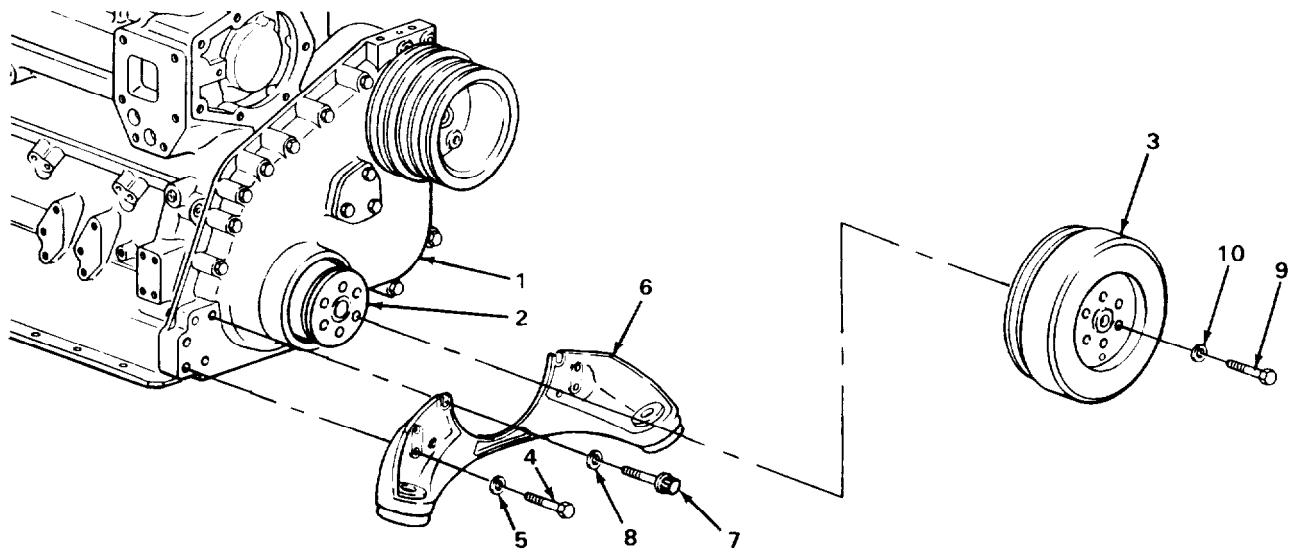
**GEARCASE COVER INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
26. Vibration damper (3)	Six screws (9)	Using 1/2-inch drive 7/8-inch socket and 0 to 250 ft lb (0 to 350 N•m) torque wrench, tighten to 115 to 125 ft lb (161 to 175 N•m).

**NOTE**

Method used for mounting dial indicator is at discretion of using facility. Position dial indicator on gearcase cover and set contact point of dial indicator on vibration damper face.

- |                        |                      |   |
|------------------------|----------------------|---|
| 27. Gearcase cover (1) | Vibration damper (3) | <ul style="list-style-type: none"> <li>a. Set dial indicator to zero.</li> <li>b. Using crankshaft barring tool, rotate engine and check dial indicator reading for runout not to exceed 0.004 inch (0.10 mm).</li> </ul> |
|------------------------|----------------------|---|



**TASK ENDS HERE**

**OIL PAN INSTALLATION**

---

**INITIAL SETUP**

Tools

- Extension, 6-inch, 1/2-inch drive
- Handle, ratchet, 1/2-inch drive
- Socket, 1/2-inch, 1/2-inch drive
- Socket, 9/16-inch, 1/2-inch drive
- Socket, 5/8-inch, 1/2-inch drive
- Wrench, open-end, 1 7/8-inch
- Wrench, torque, 0 to 150 ft lb (0 to 210 N•m), 1/2-inch drive

Materials/Parts

- Gasket, oil pan
- Gasket, suction tube flange

Materials/Parts - Continued

- Lockwasher, oil pan front (four required)
- Lockwasher, oil pan rear (four required)
- Lockwasher, oil pan sides (28 required)
- Lockwasher, suction tube flange (two required)

Personnel Required

Two

Equipment Condition

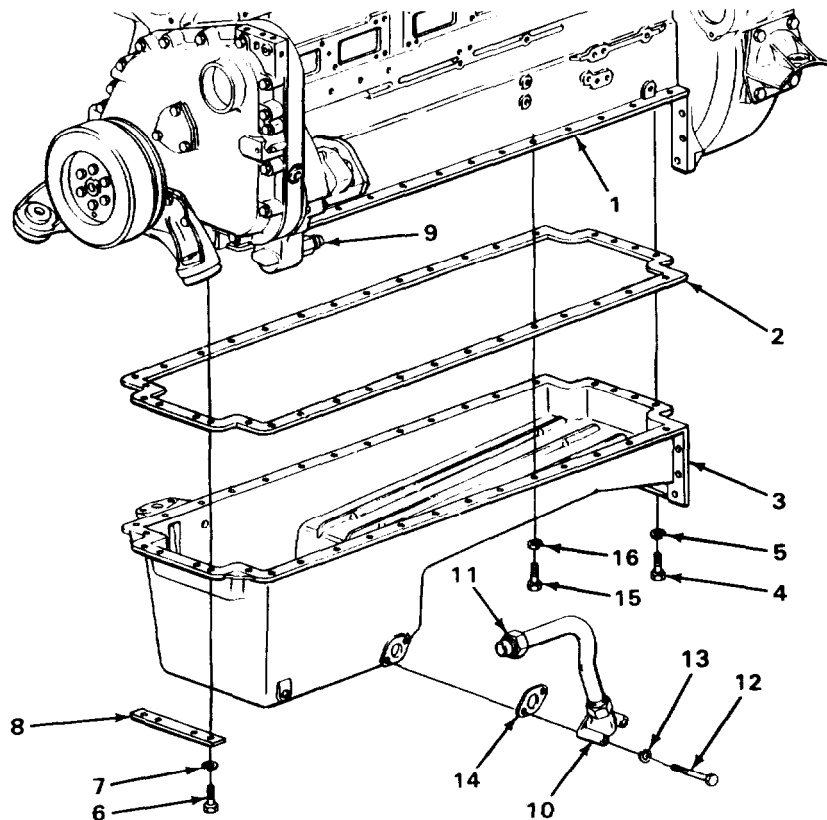
Lubricating oil pump installed (page 2-88).

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LOCATION	ITEM	ACTION REMARKS
1. Cylinder block (1)	New gasket (2)	Put on. <b>Aline holes in gasket with screw holes in cylinder block.</b>
<b><u>WARNING</u></b>		
Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.		
2.	Oil pan (3)	Put on. <b>Aline screw holes in oil pan with screw holes in gasket and cylinder block.</b>
3. Oil pan (3)	Four screws (4) and four new lockwashers (5)	Using 1/2-inch drive 1/2-inch socket, 6-inch extension, and ratchet handle, screw in. <b>Do not tighten.</b>
4.	Four screws (6), four new lockwashers (7), and spacer (8)	a. Position spacer on front of oil pan. b. Using 1/2-inch drive 5/8-inch socket, 1-inch extension, and ratchet handle, screw in. <b>Do not tighten.</b>
5. Oil pump (9)	Suction tube with flange (10) and nut (11)	a. Position suction tube with flange on oil pump. b. Screw on by hand. <b>Do not tighten.</b>

**OIL PAN INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
8. Oil pan (3)	Suction tube with flange (10), two screws (12), two new lockwashers (13), and new gasket (14),	a. Position suction tube with flange and gasket on oil pan. b. Using 1/2-inch drive 9/16-inch socket and ratchet handle, screw in and tighten.	
7. Oil pump (9)	Nut (11)	Using 1 7/8-inch open-end wrench, tighten.	
8. Oil pan (3)	Four screws (4)	Using 1/2-inch drive 1/2-inch socket, 6-inch extension, and 0 to 150 ft lb (0 to 210 N•m) torque wrench, screw in and torque evenly 15 to 20 ft lb (20 to 27 N•m).	
9.	Four screws (6), twenty-eight screws (15) and twenty-eight new lockwashers (16)	Using 1/2-inch drive 5/8-inch socket, 6-inch extension, and 0 to 150 ft lb (0 to 210 N•m) torque wrench, screw in and torque evenly 35 to 40 ft lb (47 to 54 N•m).	



**TASK ENDS HERE**

**FLYWHEEL HOUSING INSTALLATION**

---

**INITIAL SETUP**

Tools

- Barring tool, crankshaft
- Extension, 6-inch, 1/2-inch drive
- Hammer, plastic-faced
- Handle, ratchet, 1/2-inch drive
- Indicator, dial
- Pliers, slip-joint, 8-inch
- Scribe, machinist
- Socket, 3/4-inch, 1/2-inch drive
- Socket, 13/16-inch, 1/2-inch drive
- Socket, 7/8-inch, 1/2-inch drive
- Socket, 15/16-inch, 1/2-inch drive
- Wrench, box-end, 3/4-inch
- Wrench, torque, 0 to 250 ft lb  
(0 to 350 N•m), 1/2-inch drive

Materials/Parts

- Gasket, flywheel housing
- Lockwasher, flywheel housing to engine (nine required)
- Lockwasher, flywheel housing to oil pan (six required)
- Wire, locking (item 21, appendix B)

Personnel Required

Two

Equipment Condition

Oil pan installed (page 2-96).

---

LOCATION	ITEM	ACTION REMARKS
1. Cylinder block (1)	New flywheel housing gasket (2)	Put in.
<b><u>WARNING</u></b>		
Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.		
2.	Flywheel housing (3)	Using assistance, align with dowel pins and put on.
3. Flywheel housing (3)	Nine screws (4) and nine new lockwashers (5)	Using 1/2-inch drive 15/16-inch socket, 6-inch extension, and ratchet handle, screw in until snug. <b>Do not tighten.</b>
4. Cylinder block (1)	Flywheel housing (3)	Using machinist scribe, mark flywheel housing at 12, 3, 6, and 9 o'clock positions.



FLYWHEEL HOUSING INSTALLATION - CONTINUED

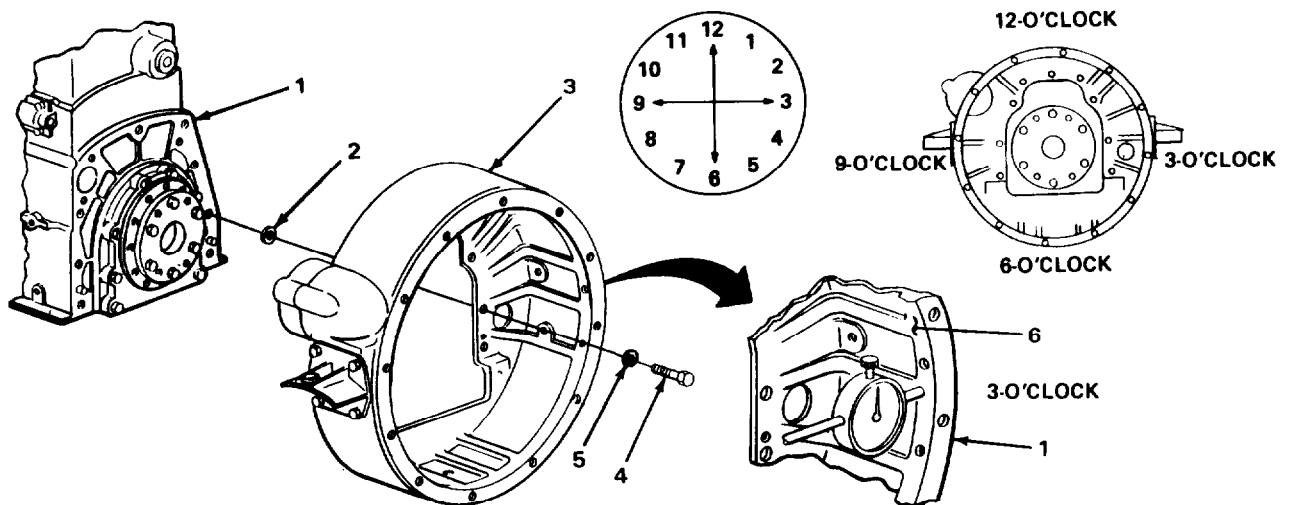
LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

Method used for mounting dial indicator is at discretion of using facility. Position dial indicator on crankshaft face and set contact point of dial indicator on inner bore of flywheel housing.

- |                         |                |   |
|-------------------------|----------------|---|
| 5. Flywheel housing (3) | Inner bore (6) | <ol style="list-style-type: none"> <li>a. Using crankshaft barring tool, rotate crankshaft until dial indicator is at 9 o'clock position on flywheel housing.</li> <li>b. Set dial indicator to zero.</li> <li>c. Using crankshaft barring tool, rotate crankshaft until dial indicator is at 3 o'clock position on flywheel housing.</li> <li>d. Note that reading on dial indicator does not exceed 0.008 inch (0.20 mm).<br/> <b>If dial indicator reading meets or is below specification, proceed to step 7. If dial indicator reading exceeds specification, perform step 6.</b></li> </ol> |
|-------------------------|----------------|---|

- |                       |                      |  |
|-----------------------|----------------------|--|
| 8. Cylinder block (1) | Flywheel housing (1) | Using plastic-faced hammer, move flywheel housing one-half of dial indicator reading towards 9 o'clock position. |
|-----------------------|----------------------|--|

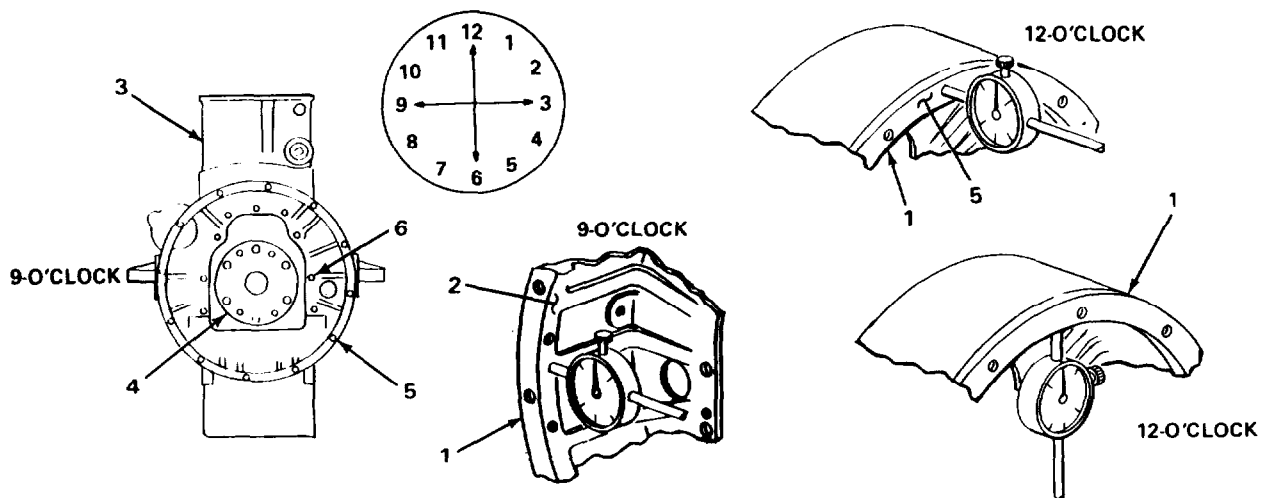


**FLYWHEEL HOUSING INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
7. Flywheel housing (1)	Inner bore (2)	a. Set dial indicator to zero. b. Using crankshaft barring tool, rotate crankshaft until dial indicator is at 9 o'clock position on flywheel housing. c. Note that reading on dial indicator does not exceed 0.008 inch (0.20 mm). <b>If dial Indicator readings vary when positioned across from Initial starting point, check flywheel housing for out-of-round condition.                      If out-of-round, discard flywheel housing.</b>
8.	Inner bore (2)	a. Using crankshaft barring tool, rotate crankshaft until dial indicator is at 12 o'clock position on flywheel housing. b. Set dial indicator to zero. c. Using crankshaft barring tool, rotate crankshaft until dial indicator is at 6 o'clock position on flywheel housing. d. Note that reading on dial indicator does not exceed 0.008 inch (0.20 mm). <b>If dial Indicator reading exceeds specification, perform step 9. If dial indicator reading meets or is below specification, proceed to step 10.</b>
9. Cylinder block (3)	Flywheel housing (1)	Using plastic-faced hammer, move flywheel housing one-half of dial indicator reading towards 12 o'clock position.
10. Flywheel housing (1)	Inner bore (2)	a. Set dial indicator to zero. b. Using crankshaft barring tool, rotate crankshaft until dial indicator is at 12 o'clock position on flywheel housing. c. Note that reading on dial indicator does not exceed 0.008 inch (0.20 mm). <b>If dial Indicator reading meets or is below specification, perform step 11. If dial indicator readings vary when positioned across from Initial starting point, check flywheel housing for out-of-round condition.                      If out-of-round, discard flywheel housing.</b>

FLYWHEEL HOUSING INSTALLATION - CONTINUED

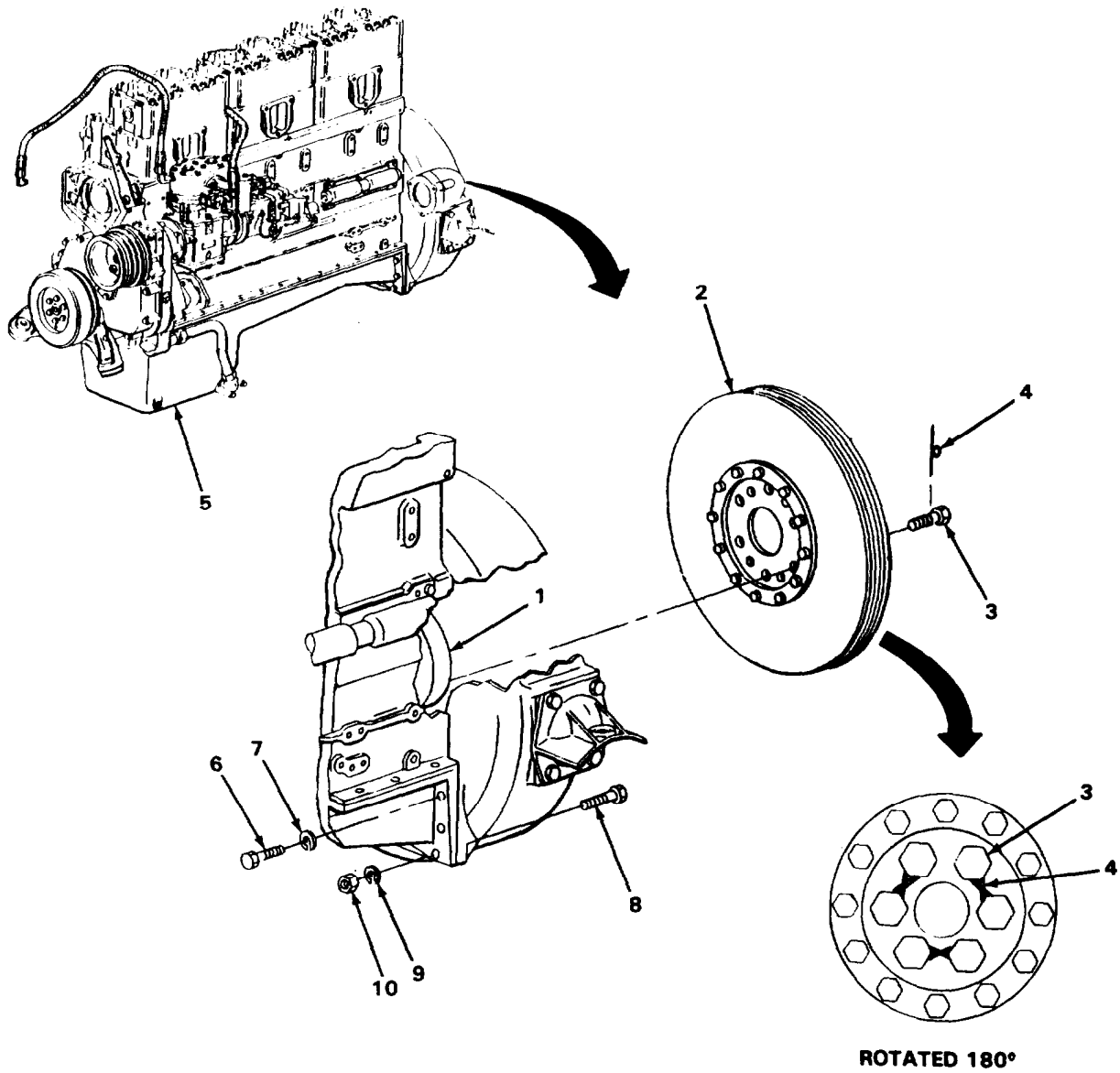
LOCATION	ITEM	ACTION REMARKS
11.	Crankshaft (4)	Push forward to remove end clearance.
12.	Outer face (5)	<p>a. Set contact point of dial indicator on outer face of flywheel housing and set dial indicator to zero.</p> <p>b. Using crankshaft barring tool, rotate crankshaft until dial indicator is at 6 o'clock position on flywheel housing.</p> <p>c. Note that reading on dial indicator does not exceed 0.008 inch (0.20 mm).</p> <p><b>If dial indicator reading meets or is below specification, perform step 13.</b></p> <p><b>If dial indicator reading exceeds specifications, tap flywheel housing with inserted plastic-face hammer and repeat steps 11 and 12.</b></p>
13.	Nine screws (6)	Using 1/2-inch drive 15/16-inch socket, 6-inch extension, and 0 to 250 ft lb (0 to 350 N•m) torque wrench, tighten evenly to 150 ft lb (210 N•m).



**FLYWHEEL HOUSING INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
14. Crankshaft (1)	Flex plate (2)	Align screw holes and put on.
15. Flex plate (2)	Six screws (3)	Using 1/2-inch drive 7/8-inch socket, 6-inch extension, and ratchet handle, screw in until snug. <b>Do not tighten.</b>
16.	six screws (3)	Using 1/2-inch drive 7/8-inch socket, 6-inch extension, and 0 to 250 ft lb (0 to 360 N•m) torque wrench, tighten alternately to 190 to 200 ft lb (266 to 280 N•m).
17. Six screws (3)	Three new locking wires (4)	Thread one locking wire through two screws and, using 6-inch slip-joint pliers, twist ends to secure (see illustration).
18. Oil pan (5)	Four screws (6) and four new lockwashers (7)	Using 1/2-inch drive 3/4-inch socket, 6-inch extension, and ratchet handle, screw in and tighten.
19.	Two screws (8), two new lockwashers (9), and two nuts (10)	Using 1/2-inch drive 13/16-inch socket, ratchet handle, and 3/4-inch box-end wrench, screw in and tighten.

FLYWHEEL HOUSING INSTALLATION - CONTINUED



TASK ENDS HERE

**CYLINDER HEAD FUEL LINE INSTALLATION**

---

**INITIAL SETUP**

Tools

Extension, 6-inch, 1/2-inch drive  
 Handle, ratchet, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive  
 Wrench, open-end, 1/2-inch  
 Wrench, open-end, 9/16-inch  
 Wrench, open-end, 5/8-inch

Materials/Parts

Lockwasher (three required)

Equipment Condition

Cylinder heads installed (page 2-68).  
 Air compressor and fuel pump installed  
 (page 2-86).

---

LOCATION	ITEM	ACTION	REMARKS
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---

**CAUTION**

Do not overtighten fuel line fittings and fuel line nuts. Damage or leaks may result.

1. Rear cylinder head (1)	Two fuel line fittings (2)	Using 5/8-inch open-end wrench, screw in.	<b>Position fitting toward intake side of engine and slightly downward.</b>
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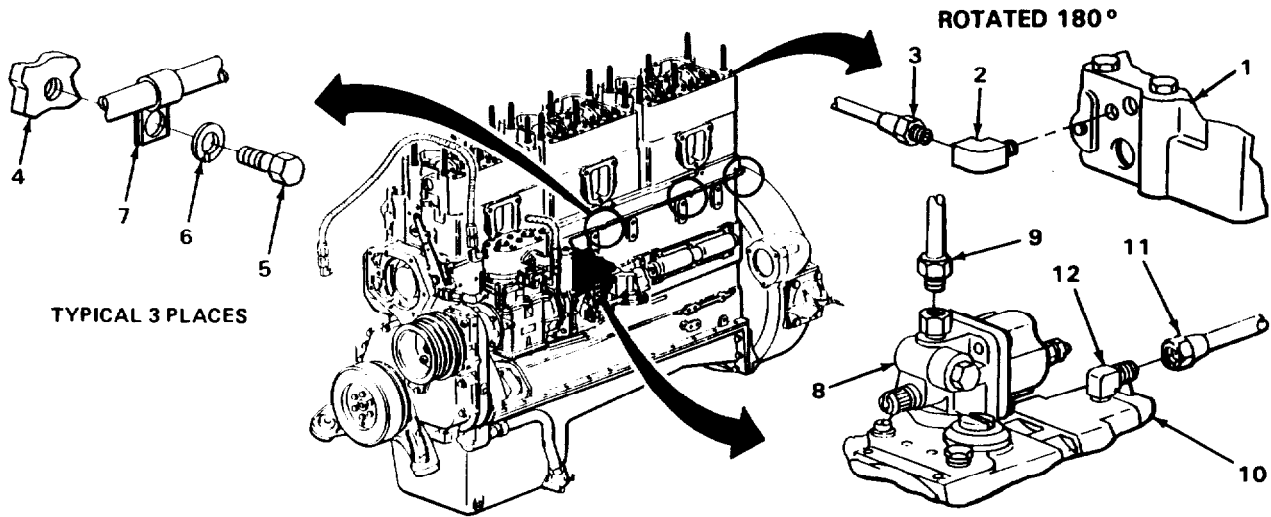
**NOTE**

Position steel feed line on lower fitting.

2. Two fuel line fittings (2)	Two fuel line nuts (3)	Using 1/2-inch open-end wrench, screw in.	<b>Do not tighten.</b>
3. Left side of engine block (4)	Three screws (5), three new lockwashers (6), and three clamps (7) with fuel lines	Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and ratchet handle, screw in.	<b>Do not tighten.</b>
4. Fuel shutoff switch (8)	Fuel line nut (9)	Using 5/8-inch open-end wrench and 1/2-inch open-end wrench, screw in and tighten.	

**CYLINDER HEAD FUEL LINE INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
5. Fuel pump (10)	Fuel line nut (11) and elbow (12)	Using 9/16-inch and 1/2-inch open-end wrenches, screw in and tighten.
6. Left side of engine block (4)	Three screws (5)	Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and ratchet handle, tighten.
7. Rear cylinder head (1)	Two fuel line nuts (3) and two fuel line fittings (2)	Using 5/8-inch and 1/2-inch open-end wrenches, tighten.



**TASK ENDS HERE**

**VALVE AND INJECTOR ADJUSTMENTS**

---

This task covers:

- a. Dial Indicator Method (page 2-108)
  - b. Torque Method (page 2-112)
- 

**INITIAL SETUP**

Tools

Actuator, rocker arm, ST-1193  
 Adapter set, ST-669, 3/8-inch drive  
 Barring tool, crankshaft  
 Gage, thickness  
 Indicator, dial, ST-1170  
 Socket, 7/16-inch, 1/4-inch drive  
 Wrench, torque, 0 to 150 ft lb  
 (0 to 210 N•m), 3/8-inch drive

Tools - Continued

Wrench, torque, 0 to 150 in. lb (0 to 17.5 N•m), ST-753-1, 3/8-inch drive

Equipment Condition

Rocker arm housings installed (page 2-82).

---

LOCATION	ITEM	ACTION REMARKS
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DIAL INDICATOR METHOD

Checking Plunger-Free Travel

**CAUTION**

In order to prevent excessive loading of the injector actuating system and possible failure, all injectors must be checked as follows.

**NOTE**

Steps given are typical for all six injectors.

- |                            |                                     |  |
|----------------------------|-------------------------------------|--|
| 1. Injector rocker arm (1) | Adjusting screw (2) and locknut (3) | Using 3/8-inch drive ST-669 adapter set and 1/4-inch drive 7/16-inch socket, loosen.                               |
| 2. Rocker arm housing (4)  | ST-1170 dial indicator (5)          | a. Put on.<br>b. Position ST-1170 dial indicator on top of injector plunger.<br><b>Set dial Indicator to zero.</b> |



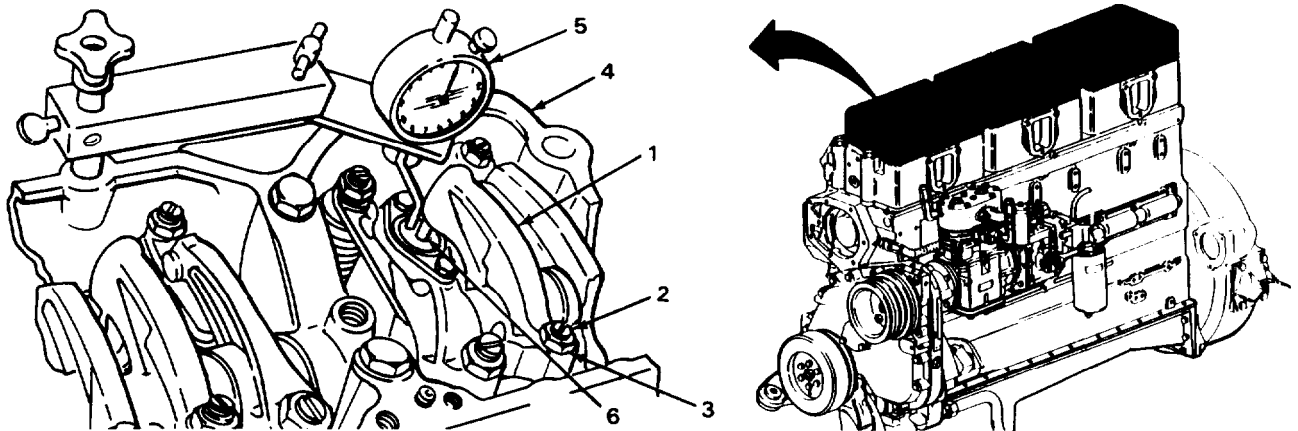
VALVE AND INJECTOR ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION REMARKS
3.	Injector plunger (6)	Using crankshaft barring tool, rotate engine and check dial indicator (5) reading for plunger-free travel not exceeding 0.206 inch (5.3 mm).

**NOTE**

If plunger-free travel exceeds 0.206 inch (5.23 mm), torque method of adjustment (steps 17 thru 23) must be used.

4.	ST-1170 dial indicator (5)	If injector free travel is within limits, proceed to adjustment procedures.
----	----------------------------	---



**Adjustment**

**NOTE**

During repairs, injectors and valves are cold set with temperature of oil and component parts within 10oF (-11°C) of ambient air room temperature. Final hot-set adjustments will be made on engine test stand. See Final Testing, Adjustments, and Troubleshooting on Engine Test Stand (page 2-414).

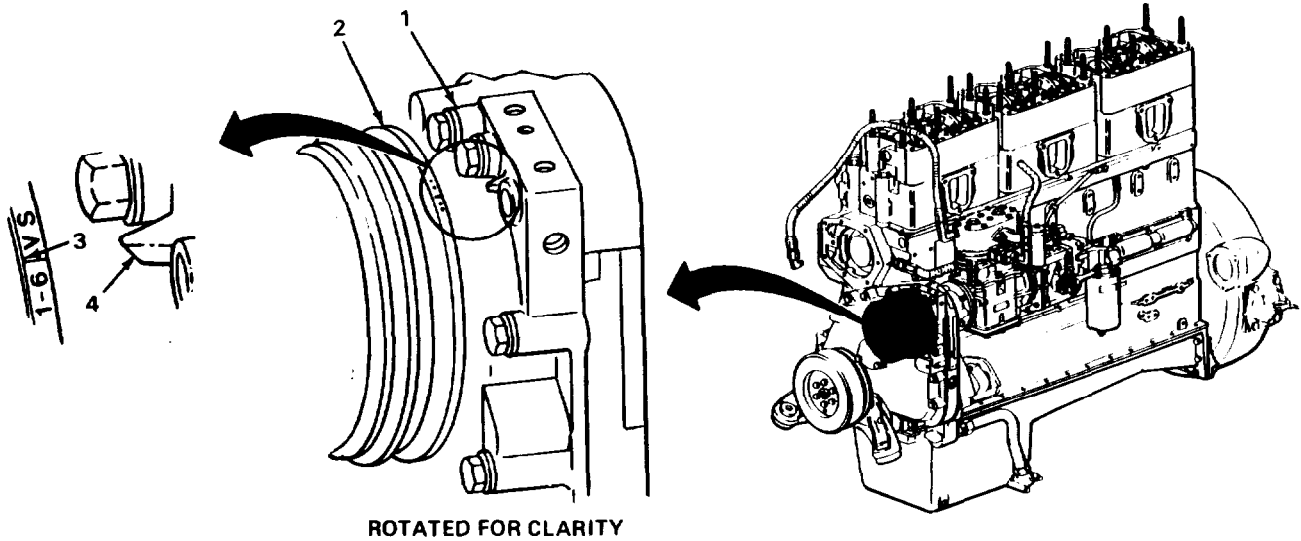
The following injector and valve adjusting procedures and Engine Specifications (page 2-434) require injectors be adjusted before valves.

VALVE AND INJECTOR ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DIAL INDICATOR METHOD - CONTINUED

- |                       |   |   |  |
|-----------------------|---|---|--|
| 5. Gearcase cover (1) | Accessory drive pulley (2) timing mark (3), and pointer (4) | Using crankshaft barring tool, rotate crankshaft in direction of engine rotation until timing mark A or 1-6 VS is aligned with pointer. |  |
|-----------------------|---|---|--|



NOTE

Both intake and exhaust rocker arm for cylinder number five must be loose (valves closed). Injector plunger for cylinder number three must be at top of travel before beginning adjustment.

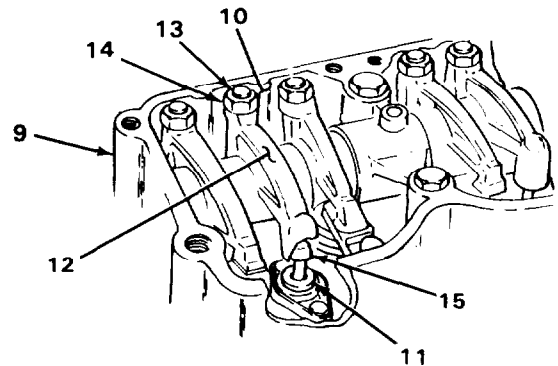
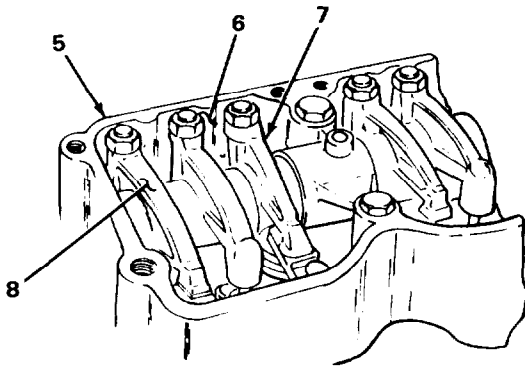
- |                           |  |  |
|---------------------------|--|--|
| 6. Rocker arm housing (5) | Number five cylinder (6), intake rocker arm (7) and exhaust rocker arm (8) | Both rocker arms must be loose.<br><b>If rocker arms are not loose, repeat step 5.</b>       |
| 7. Rocker arm housing (9) | Number three cylinder (10) and injector plunger (11)                       | Injector plunger must be at top of travel.<br><b>If not at top of travel, repeat step 5.</b> |

VALVE AND INJECTOR ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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8. Injector rocker arm (12) adjusting screw (13), locknut (14) plunger (15)

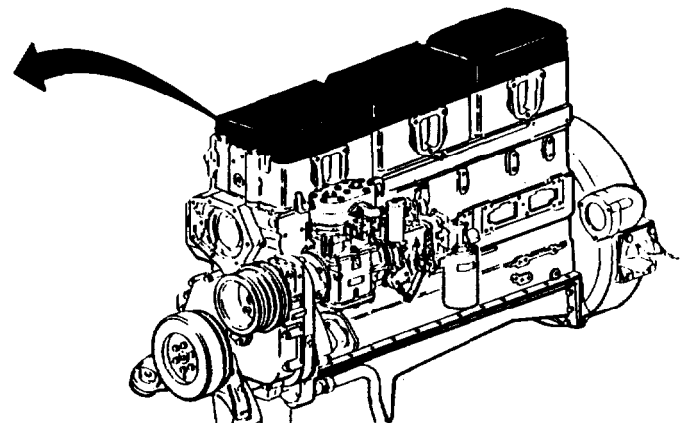
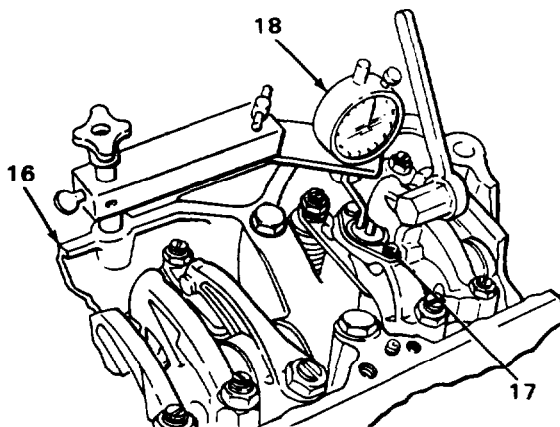
- a. Using 3/8-inch drive ST-669 adapter set and 1/4-inch drive 7/16-inch socket, loosen locknut and screw in adjusting screw until plunger contacts rocker arm cup.
- b. Advance adjusting screw 15 degrees to squeeze oil from rocker arm cup.
- c. Loosen adjusting screw one-half turn.



9. Rocker arm housing (16)

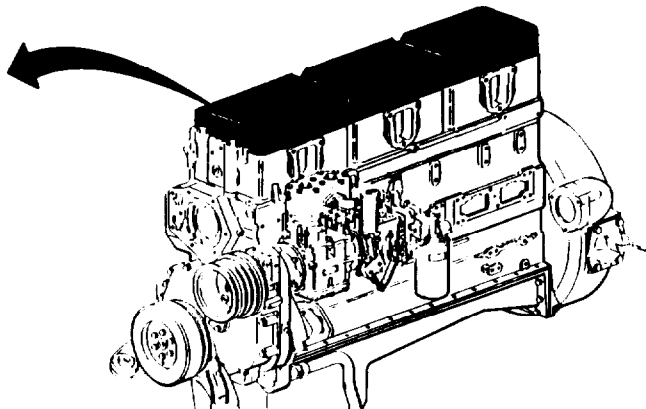
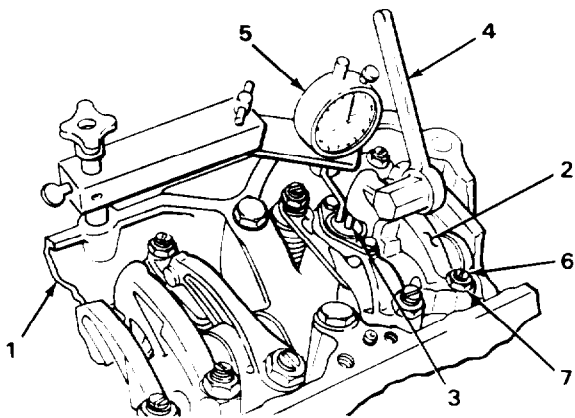
- Injector plunger (17) and ST-1170 dial indicator (18)

Position ST-1170 dial indicator, position on top of injector plunger.



VALVE AND INJECTOR ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
DIAL INDICATOR METHOD - CONTINUED			
10. Rocker arm housing (1)	Injector rocker arm (2), injector plunger (3) and ST-1193 rocker arm actuator (4)	a. Using ST-1193 rocker arm actuator, press injector rocker arm down toward fuel injector until fuel injector reaches bottom. b. Release rocker arm and press down again.	
11.	ST-1170 dial indicator (5)	Set ST-1170 dial indicator to zero.	
12.	Adjusting screw (6) and locknut (7)	Using 3/8-inch drive ST-669 adapter set and 1/4-inch drive 7/16-inch socket, screw in until ST-1170 dial indicator reads 0.170 inch (4.3 mm).	
13.	Rocker arm (2) and injector plunger (3)	Bottom plunger and release rocker arm to allow injector plunger to rise. <b>ST-1170 dial indicator must show travel of 0.170 inch (4.32 mm).</b>	
14.	Adjusting screw (6) and locknut (7)	Using 3/8-inch drive ST-669 adapter set and 1/4-inch drive 7/16-inch socket, and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque locknut to 25 to 35 ft lb (35 to 49 N•m). <b>Check adjustment by performing steps 10 thru 14 again.</b>	



VALVE AND INJECTOR ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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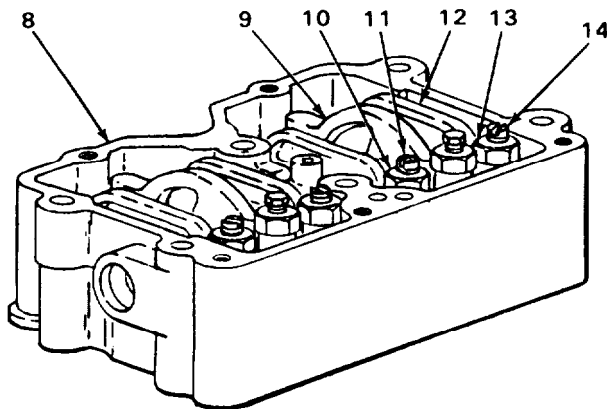
**NOTE**

With accessory drive pulley timing mark at A or 1-6 VS, number three injector has been adjusted. Valves in number five cylinder now must be adjusted.

- |                            |   |  |
|----------------------------|---|--|
| 15. Rocker arm housing (8) | Intake rocker arm (9), locknut (10), and adjusting screw (11)   | <ol style="list-style-type: none"> <li>a. Using 3/8-inch drive ST-669 adapter set, and 1/4-inch drive 7/16-inch socket, loosen locknut and unscrew adjusting screw.</li> <li>b. Using thickness gage, put in between rocker arm and crosshead.<br/><b>Clearance should be 0.011 inch (0.28 mm).</b></li> <li>c. Using 3/8-inch drive ST-669 adapter set and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque to 25 to 35 ft lb (35 to 49 N•m).</li> </ol> |
| 16.                        | Exhaust rocker arm (12), locknut (13), and adjusting screw (14) | <p>Perform same adjustment procedures described in step 15.<br/><b>Clearance should be 0.023 Inch (0.58 mm).</b></p>   |

**NOTE**

Repeat steps 5 thru 16 as per Injector and Valve Set Position table below.



INJECTOR AND VALVE SET POSITION			
ROTATION DIRECTION	PULLEY POSITION	ADJUST CYLINDER	
		INJECTOR	VALVE
Start	1-6 "VS"	3	5
Advance to	2-5 "VS"	6	3
Advance to	3-4 "VS"	2	6
Advance to	1-6 "VS"	4	2
Advance to	2-5 "VS"	1	4
Advance to	3-4 "VS"	5	1

NOTE: Two complete revolutions of the pulley are required to adjust all injectors and valves.

VALVE AND INJECTOR ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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**TORQUE METHOD**

Preadjustment Setup

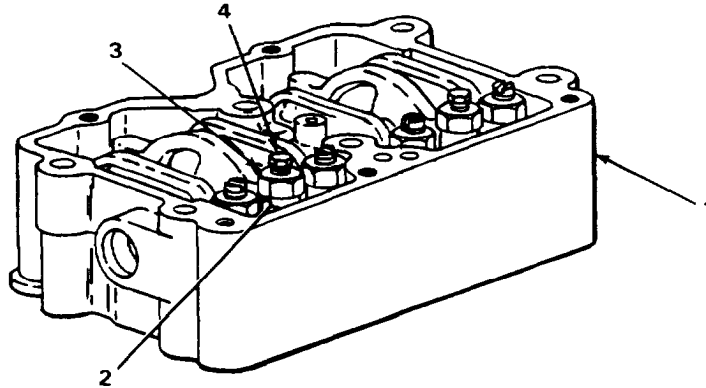
**NOTE**

Injector plungers are adjusted before valves are adjusted.

Loosening all injector rocker arm adjusting screws and locknuts will indicate difference between cylinders that have been adjusted and cylinders needing adjustment.

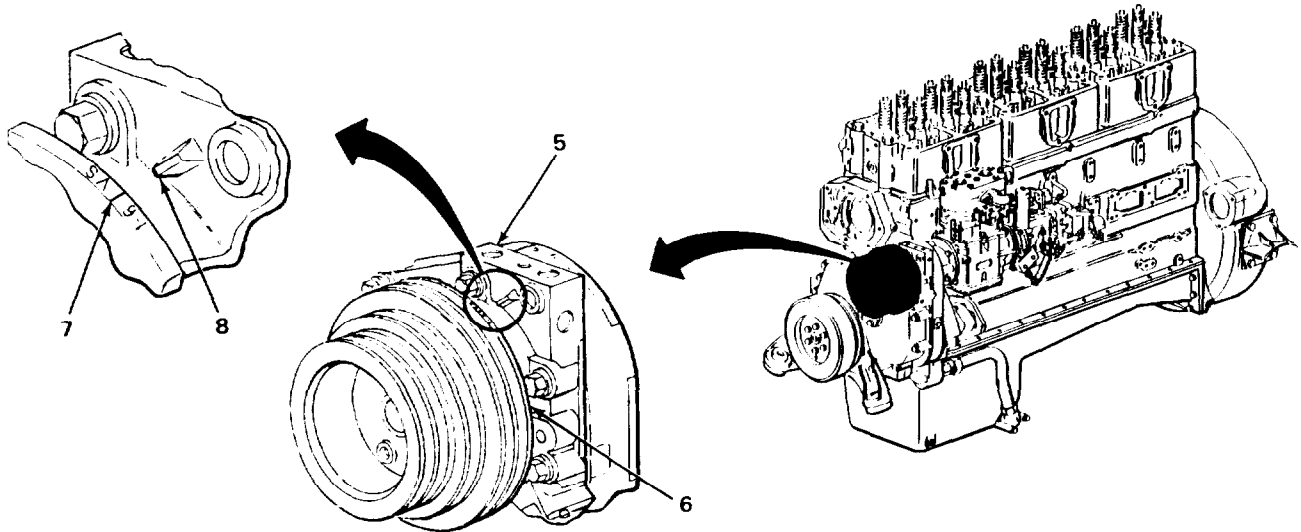
Steps given are typical for all three rocker arm housings.

17. Rocker arm housing (1)	Injector rocker arm (2), locknut (3), and adjusting screw (4)	Using 3/8-inch drive ST-669 adapter set, and 1/4-inch drive 7/16-inch socket, loosen locknut and unscrew adjusting screw one turn.
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VALVE AND INJECTOR ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION REMARKS
18. Gearcase cover (5)	Accessory drive pulley (6), timing mark (7) and pointer (8)	Rotate crankshaft until timing mark A or 1-6 VS is aligned with pointer.



Adjustment

**NOTE**

During repairs, injectors and valves are cold set with temperature of oil and component parts within 10oF (-11 °C) of ambient air room temperature. Final hot-set adjustments will be made on engine test stand. See Final Testing, Adjustments, and Troubleshooting on Engine Test Stand (page 2-414).

The following injector and valve adjusting procedures and Engine Specifications (page 2-434) require that injectors be adjusted before valves.

VALVE AND INJECTOR ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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TORQUE METHOD - CONTINUED

**NOTE**

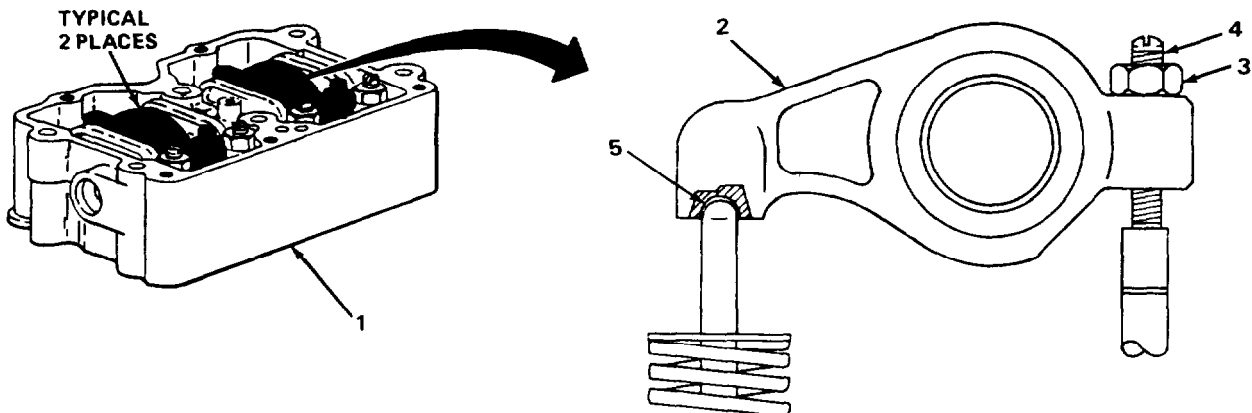
Steps given are typical for all three rocker arm housings.

19. Rocker arm housings (1)	Two injector rocker arms (2), two locknuts (3), two adjusting screws (4), and two cups (5)	<ol style="list-style-type: none"> <li>Using 3/8-inch drive ST-669 adapter set, and 1/4-inch drive 7/16-inch socket, loosen locknut and screw in adjusting screw until top of injector link touches cup.</li> <li>Advance adjusting screw 15 degrees to squeeze oil from cup.</li> <li>Unscrew adjusting screw one turn.</li> </ol>	
-----------------------------	--	---	--

**NOTE**

Use ST-753-1 torque wrench to adjust injectors. Set torque wrench on value required to pull to zero. Loosen adjusting screw each time and pull to torque value given in each tightening sequence.

20. Two injector rocker arms (2)	Two adjusting screws (4)	<ol style="list-style-type: none"> <li>Using 3/8-inch drive ST-669 adapter set, 1/4-inch drive 7/16-inch socket, and ST-753-10 to 150 in. lb (0 to 17.5 N•m) torque wrench, tighten to 30 in. lb (3.5 N•m).</li> <li>Tighten to 50 in. lb (5.8 N•m).</li> <li>Tighten to 72 in. lb (8.4 N•m).</li> <li>Hold adjusting screws and tighten locknuts to 40 to 45 ft lb (54 to 61 N•m).</li> </ol>	
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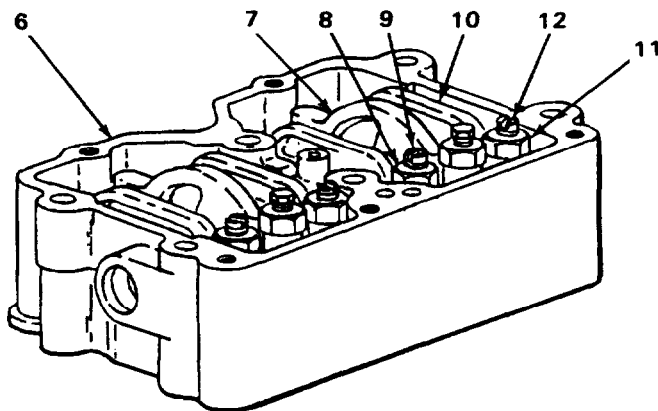


**VALVE AND INJECTOR ADJUSTMENTS - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
21. Rocker arm housing (6)	Intake rocker arm (7), locknut (8), and adjusting screw (9)	a. Using 3/8-inch drive ST-669 adapter set, and 1/4-inch drive 7/16-inch socket, loosen locknut and unscrew adjusting screw. b. Using thickness gage, put in between rocker arm and crosshead.	When using Torque Method, valves and injector are adjusted in same cylinder before rotating crankshaft for next cylinder. See Table below for clearance.
22.	Locknut (8)	Using 3/8-inch drive ST-669 adapter set, 1/4-inch drive 7/16-inch socket, and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque to 40 to 45 ft lb (54 to 61 N•m).	
23.	Exhaust rocker arm (10), locknut (11), and adjusting screw (12)	Perform same adjustment procedures described in steps 21 and 22.	

**NOTE**

Repeat steps 17 thru 23 as per illustration shown below.



VALVE CLEARANCE			
INTAKE VALVES		EXHAUST VALVES	
COLD SET	HOT SET	COLD SET	HOT SET
0.014 in. (0.36 mm)	0.014 in. (0.36 mm)	0.027 in. (0.69 mm)	0.027 in. (0.69 mm)

TASK ENDS HERE

**ENGINE COMPRESSION BRAKE HOUSING INSTALLATION**

---

**INITIAL SETUP**

Tools

Extension, 6-inch, 1/2-inch drive  
 Gage, thickness  
 Hammer, 8-ounce, ball-peen  
 Key, hex, 3/16-inch  
 Socket, 3/4-inch, 1/2-inch drive  
 Wrench, box-end, 9/16-inch  
 Wrench, torque, 0 to 250 ft lb  
 (0 to 350 N•m), 1/2-inch drive

Materials/Parts

Gasket (three required)  
 Lock tab (six required)  
 Lockwasher (12 required)

Equipment Condition

Valve and injector adjustment performed  
 (page 2-106).

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LOCATION	ITEM	ACTION	REMARKS
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---

**NOTE**

Steps given are typical for all three engine compression brake housings,

- |  |   |  |
|--|---|--|
| 1. Three rocker arm housings (1)               | Three new gaskets (2) and three engine compression brake housings (3) | Put on.  |
| 2. Three engine compression brake housings (3) | Two spacers (4), front lifting eye (5) and rear lifting eye (6)       | a. Put two spacers on two front engine compression brake housing studs.<br>b. Put lifting eyes on either side of center engine compression brake housing as shown. |

**NOTE**

Two lifting eyes are positioned on both sides of center engine compression brake housing.

Lock tabs are installed on two studs located in center of each engine compression brake housing.

Two spacers are installed on two front studs of front engine compression brake housing.

- |    |  |   |
|----|--|---|
| 3. | Six new lock tabs (7)                            | Put on two center studs of each engine compression brake housing.   |
| 4. | Twelve new lockwashers (8) and eighteen nuts (9) | Using 1/2-inch drive 3/4-inch socket, 6-inch extension, and 0 to 250 ft lb (0 to 350 N•m) torque wrench, screw on and tighten to 55 to 60 ft lb (77 to 84 N•m) as shown in Tightening Sequence. |

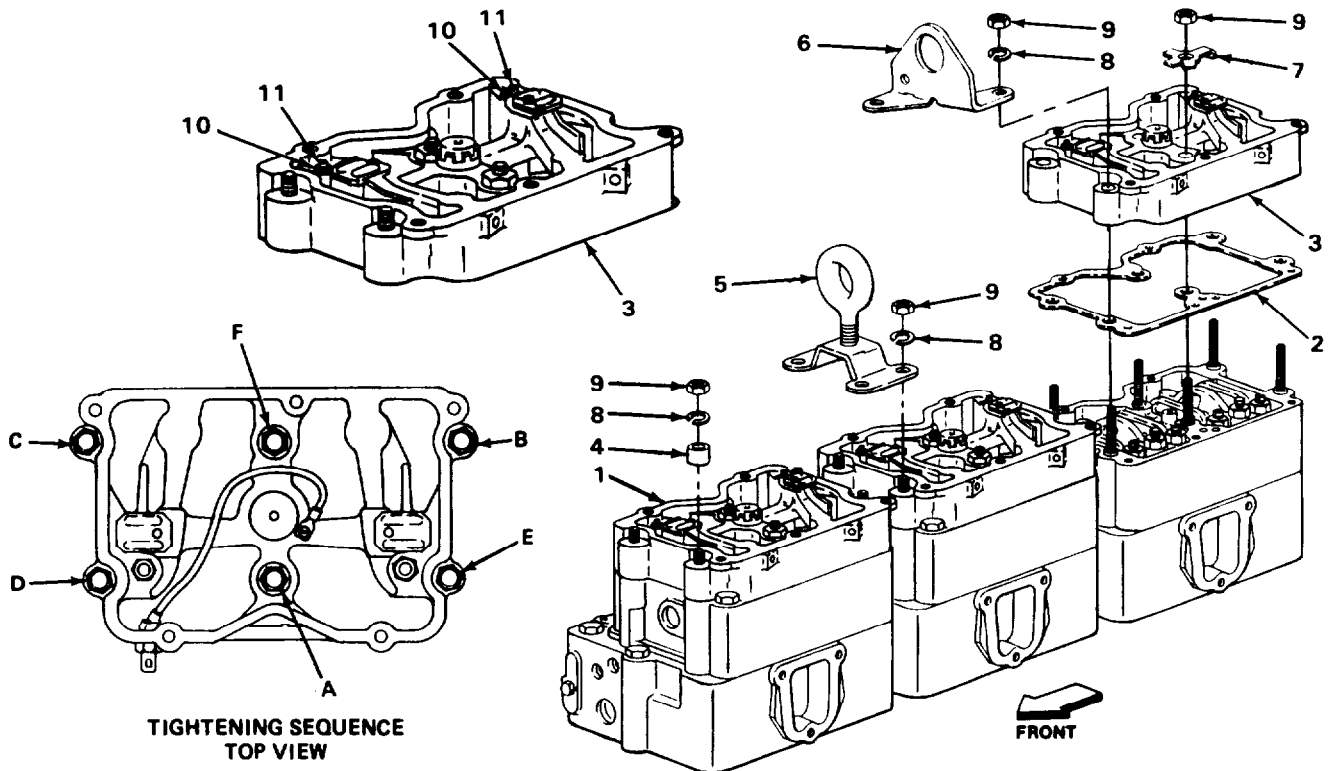
ENGINE COMPRESSION BRAKE HOUSING INSTALLATION - CONTINUED

LOCATION	ITEM	ACTION REMARKS
5.	Six new lock tabs (7)	Using 8-ounce ball-peen hammer, bend long tab over housing and one short tab against flat of nut.
6.	Six locknuts (10)	Using 9/16-inch box-end wrench, loosen.
7.	Six adjusting screws (11)	Using 3/16-inch hex key, unscrew until slave piston seats in bore.

**NOTE**

Adjustment must be made with exhaust valves closed. Rotate engine until markings on accessory drive pulley line up with pointer on gearcase cover and adjust the corresponding cylinder's adjusting screw.

- |    |   |   |
|----|---|---|
| 6. | Six adjusting screws (11) and six locknuts (10) | <ul style="list-style-type: none"> <li>a. Using 3/16-inch hex key and thickness gage, screw in adjusting screws until clearance is 0.018-inch (0.46 mm).</li> <li>b. Using 3/16-inch hex key and 9/16-inch box-end wrench, hold adjusting screws and tighten locknuts.</li> </ul> |
|----|---|---|



TIGHTENING SEQUENCE  
TOP VIEW

TASK ENDS HERE

## ROCKER ARM COVER INSTALLATION

### INITIAL SETUP

**Tools**

Screwdriver, flat-tip, 1/4-inch  
 Socket, 9/16-inch, 3/8-inch drive  
 Wrench, torque, 0 to 50 ft lb  
 (0 to 70 N•m), 3/8-inch drive

**Materials/Parts**

Gasket  
 Lockwasher (five required)

**Equipment Condition**

Engine compression brake housing installed  
 (page 2-116).

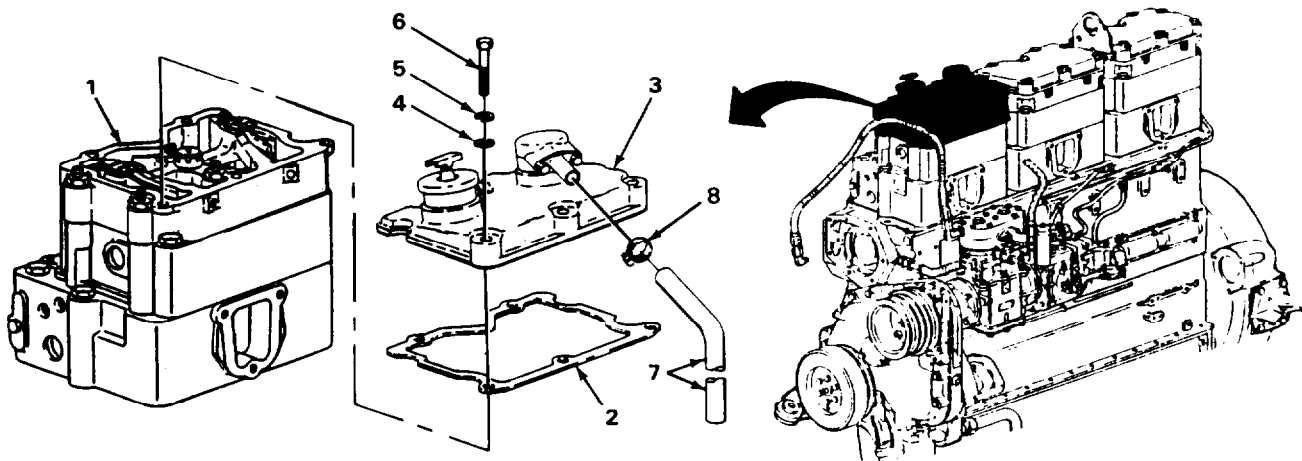
LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

Steps given are typical for all three rocker arm covers.

Only front rocker arm cover contains oil filler cap and crankcase breather.

- |   |  |   |
|---|--|---|
| 1. Engine compression brake housing (1) | New gasket (2) and rocker arm cover (3)                            | Put on.   |
| 2. Rocker arm cover (3)                 | Five flat washers (4) five new lockwashers (5) and five screws (6) | Using 3/8-inch drive 9/16-inch socket and 0 to 50 ft lb (0 to 70 N•m) torque wrench, screw in and tighten to 12 to 17 ft lb (16.8 to 23.8 N•m). |
| 3.                                      | Crankcase breather hose (7) and clamp (8)                          | a. Put on.<br>b. Using 1/4-inch flat-tip screwdriver, tighten clamp.  |



**TASK ENDS HERE**

**INTAKE MANIFOLD INSTALLATION**

**INITIAL SETUP**

**Tools**

Extension, 6-inch, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive  
 Wrench, open-end, 1-inch (two required)  
 Wrench, torque, 0 to 50 ft lb (0 to 70 N•m), 1/2-inch drive

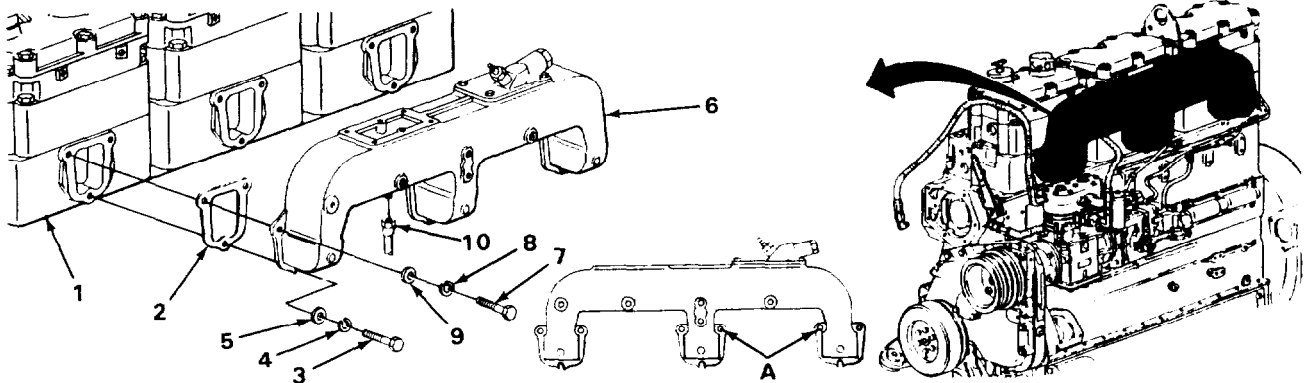
**Materials/Parts**

Gasket (three required)  
 Lockwasher (seven required)

**Equipment Condition**

Cylinder heads installed (page 2-68).

LOCATION	ITEM	ACTION REMARKS
1. Cylinder head (1)	Three new gaskets (2) three screws (3), three new lockwashers (4), and three flat washers (5)	Put one screw, lockwasher, and flat washer through gasket and into hole at bottom of each intake port.
2.	Intake manifold (6)	Put onto screws (3).
3.	Four screws (7), four new lockwashers (8), and four flat washers (9)	Screw in. <b>Do not put screws in holes marked A.</b>
	Seven screws (3 and 7)	Using 1/2-inch drive 9/16-inch socket, 6-inch extension and 0 to 50 ft lb (0 to 70 N•m) torque wrench, tighten to 20 to 25 ft lb (28 to 35 N•m).
5. Intake manifold (6)	Air compressor hose nuts (10)	Using two 1-inch open-end wrenches, put on and tighten.



**TASK ENDS HERE**

**PISTON COOLING NOZZLE INSTALLATION**

**INITIAL SETUP**

Tools

Handle, ratchet, 1/2-inch drive  
 Socket, 1/2-inch, 1/2-inch drive  
 Wrench, torque, 0 to 150 ft lb  
 (0 to 210 N•m)

Materials/Parts

Lockwasher  
 Packing, preformed

LOCATION	ITEM	ACTION	REMARKS
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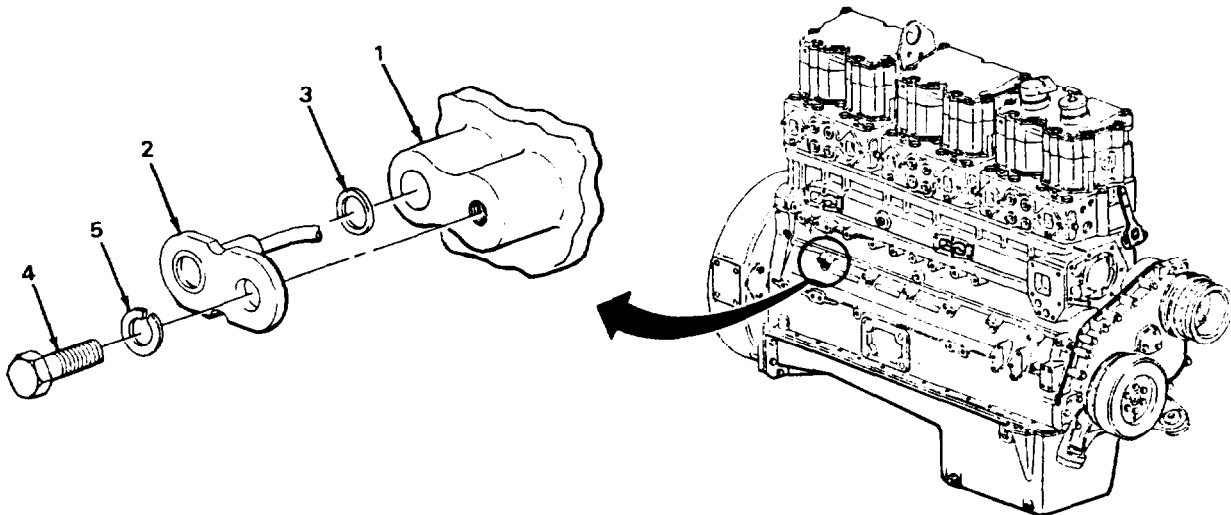
**NOTE**

Step given is typical for all six piston cooling nozzles.

Right side of cylinder block (1)

Piston cooling nozzle (2), new preformed packing (3), screw (4), and new lockwasher (5)

- a. Put packing on piston cooling nozzle and put in.
- b. Put lockwasher on screw and, using 1/2-inch drive 1/2-inch socket and ratchet handle, screw in until snug.
- c. Using 1/2-inch drive 1/2-inch socket and 0 to 150 ft lb (0 to 210 N•m) torque wrench, tighten to 16 to 22 ft lb (22.4 to 30.8 N•m).



**TASK ENDS HERE**

**WATER PUMP INSTALLATION**

**INITIAL SETUP**

Tools

Extension, 6-inch, 1/2-inch drive  
 Gage, belt tension, ST-1274  
 Handle, ratchet, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive  
 Socket, 7/8-inch, 1/2-inch drive  
 Wrench, open-end, 1-inch  
 Wrench, open-end, 1 1/16-inch

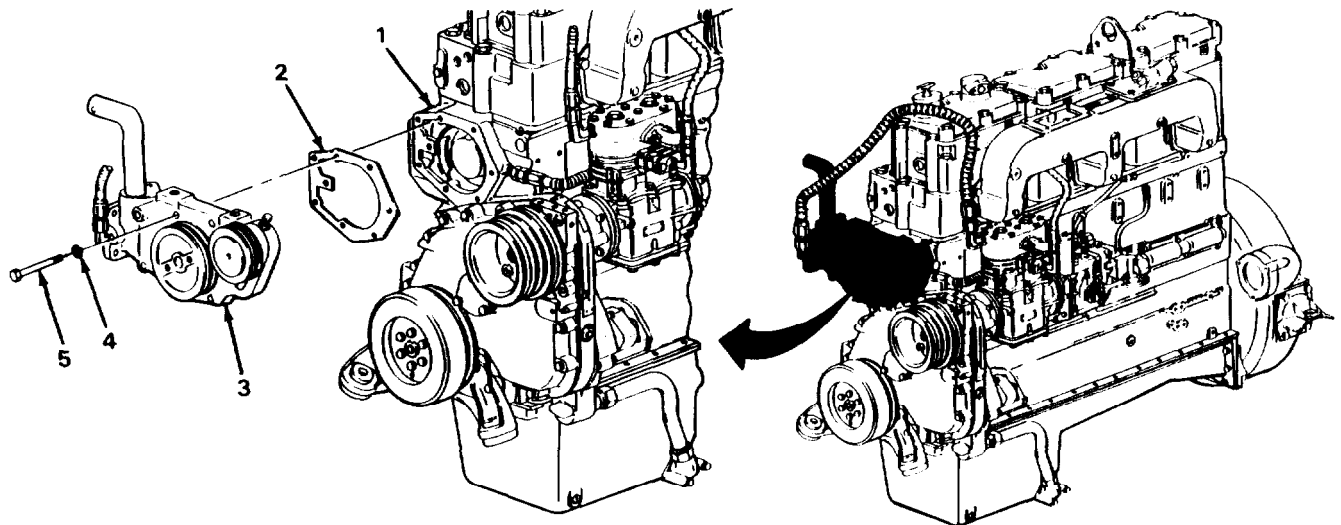
Tools - Continued

Wrench, torque, 0 to 250 ft lb (0 to 350 N•m),  
 1/2-inch drive

Materials/Parts

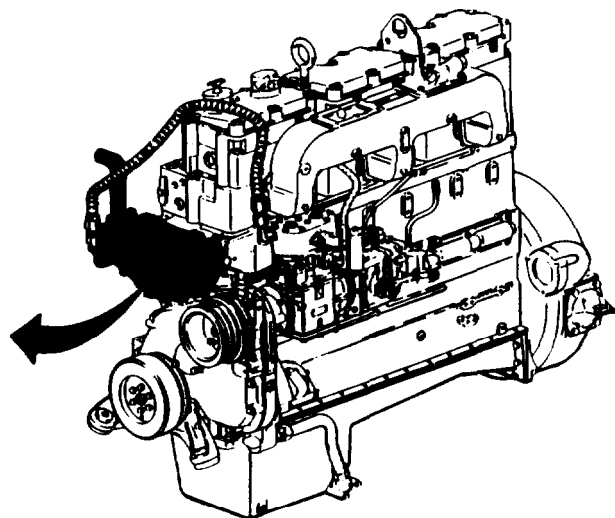
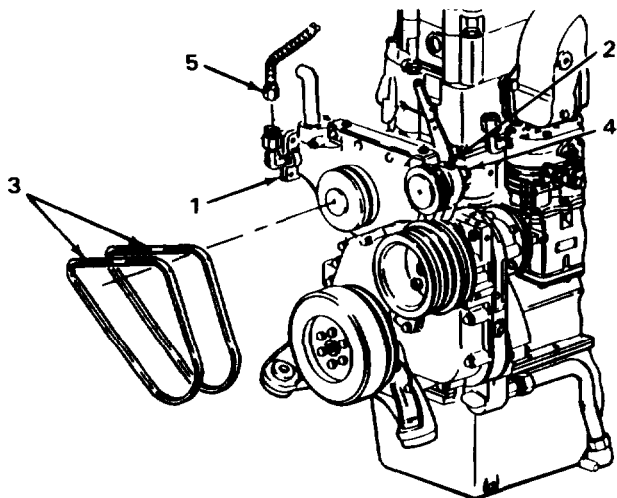
Belt, water pump (two required)  
 Gasket, water pump  
 Lockwasher (seven required)

LOCATION	ITEM	ACTION REMARKS
1. Front of cylinder block (1)	New gasket (2), water pump (3) seven new lockwashers (4), and seven screws (5)	a. Position on front of cylinder block. b. Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and 0 to 250 ft lb (0 to 350 N•m) torque wrench, torque screws to 10 ft lb (13 N•m). c. Repeat torquing to 20 ft lb (27 N•m). d. Repeat torquing for final torque of 30 ft lb (41 N•m).



**WATER PUMP INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
2. Water pump (1)	Idler pulley adjusting screw (2) and two new water pump belts (3)	a. Using 1/2-inch drive 7/8-inch socket and ratchet handle, loosen Idler pulley adjusting screw and lower Idler pulley. b. Position water pump belts on pulleys and, using 1/2-inch drive 7/8-inch socket, ratchet handle, and ST-1274 belt tension gage, tighten idler pulley adjusting screw to adjust idler pulley to obtain 120 to 140 lb belt tension.
3.	Idler pulley lock-nut (4)	Using 1 1/16-inch open-end wrench, tighten idler pulley locknut.
4.	Air compressor coolant hose (5)	a. Position on water pump and hand tighten. b. Using 1-inch open-end wrench, tighten.



**TASK ENDS HERE**



## FAN HUB INSTALLATION

### INITIAL SETUP

**Tools**

Handle, ratchet, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive  
 Socket, 3/4-inch, 1/2-inch drive

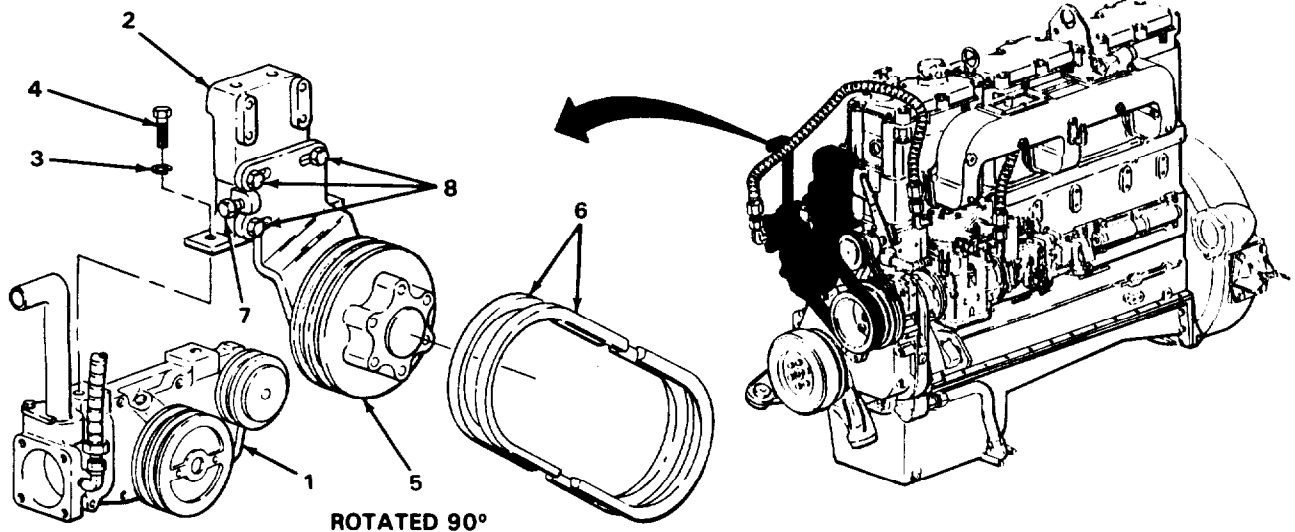
**Materials/Parts**

Fan belt (as required)  
 Lockwasher (two required)

**Equipment Condition**

Water pump installed (page 2-121).

LOCATION	ITEM	ACTION REMARKS
1. Water pump (1)	Fan hub assembly (2)	Put on.
2.	Two new lockwashers (3) and two screws (4)	Using 1/2-inch drive 3/4-inch socket and ratchet handle, screw in and tighten.
3. Fan hub pulley (5)	Fan belts (6)	a. Put on. b. Using 1/2-inch drive 9/16-inch socket and ratchet handle, tighten adjusting screw (7). <b>Fan belts should have 7/16-inch (11.11 mm) deflection per foot (0.3 m) when adjusted.</b>
4.	Three screws (8)	Using 1/2-inch drive 3/4-inch socket and ratchet handle, tighten.



**TASK ENDS HERE**

## WATER INLET HOUSING INSTALLATION

### INITIAL SETUP

#### Tools

Extension, 6-inch, 1/2-inch drive  
 Handle, ratchet, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive  
 Wrench, torque, 0 to 150 ft lb (0 to 210 N•m), 1/2-inch drive

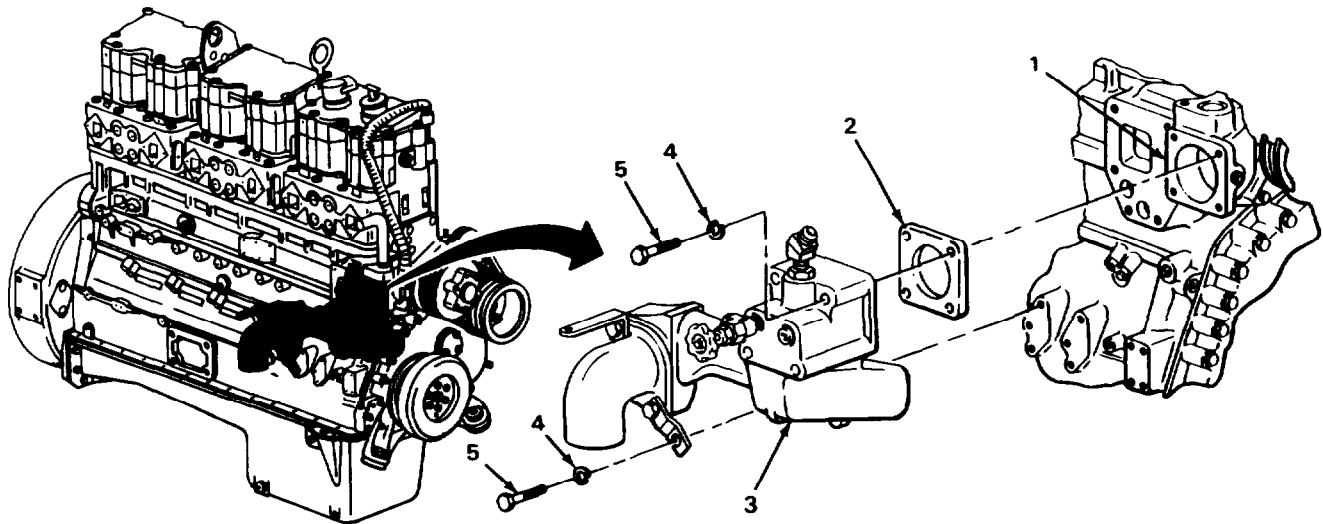
#### Materials/Parts

Gasket, water inlet housing  
 Lockwasher (five required)

#### Equipment Condition

Water pump installed (page 2-121).

LOCATION	ITEM	ACTION REMARKS
Right front of cylinder block (1)	New water inlet housing gasket (2), water inlet housing (3), five new lockwashers (4), and five screws (5)	<ol style="list-style-type: none"> <li>Position water inlet housing and gasket on cylinder block.</li> <li>Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and ratchet handle, screw in five screws and lockwashers until snug.</li> <li>Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque to 30 to 35 ft lb (40.6 to 47.4 N•m).</li> </ol>



**TASK ENDS HERE**

**WATER HEADER COVER INSTALLATION**

**INITIAL SETUP**

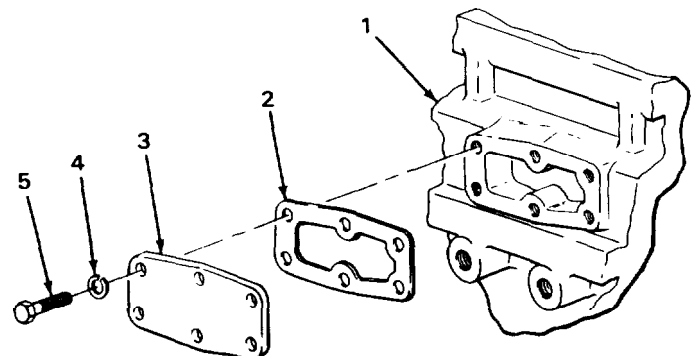
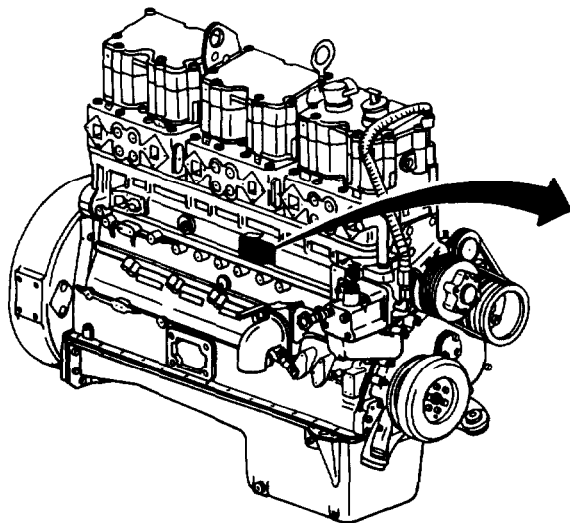
Tools

Handle, ratchet, 1/2-inch drive  
 Socket, 7/16-inch, 1/2-inch drive  
 Wrench, torque, 0 to 150 ft lb (0 to 210 N•m), 1/2-inch drive

Materials/Parts

Gasket, water header cover  
 Lockwasher (six required)

LOCATION	ITEM	ACTION REMARKS
Right side of engine block (1)	New water header cover gasket (2), water header cover (3), six new lockwashers (4) and six screws (5)	a. Position water header cover gasket and water header cover to right side of engine block. b. Using 1/2-inch drive 7/16-inch socket and ratchet handle, screw in six screws and lockwashers until snug. c. Using 1/2-inch drive 7/16-inch socket and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque to 25 to 28 ft lb (33.9 to 37.9 N•m).



**TASK ENDS HERE**

**CRANKCASE ACCESS COVER INSTALLATION**

**INITIAL SETUP**

Tools

Handle, ratchet, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive  
 Wrench, torque, 0 to 150 ft lb (0 to 210 N•m), 1/2-inch drive

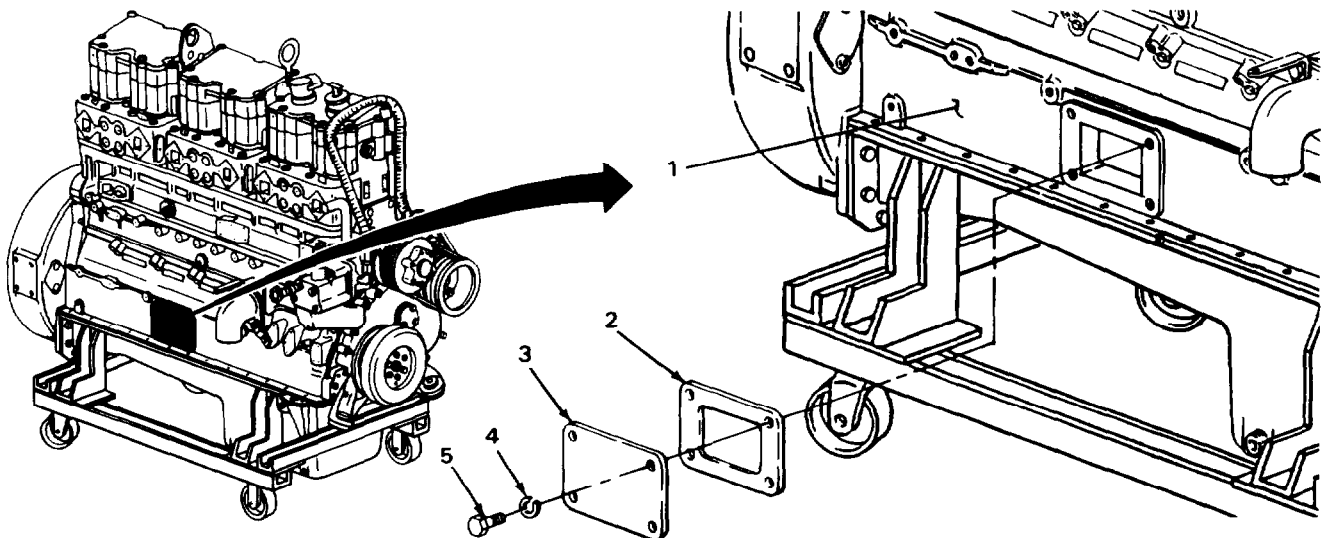
Equipment Condition

Engine removed from engine repair stand and mounted on engine transport stand. (Engine transport stand and mounting instructions will be at discretion of repair facility.)

Materials/Parts

Gasket, crankcase access cover  
 Lockwasher (four required)

LOCATION	ITEM	ACTION REMARKS
Right side of engine block (1)	New crankcase access cover gasket (2), crankcase access cover (3), four new lockwashers (4), and four screws (5)	a. Position crankcase access cover gasket and crankcase access cover on right side of engine block. b. Using 1/2-inch drive 9/16-inch socket and ratchet handle, screw in four screws with lockwashers until snug. c. Using 1/2-inch drive 9/16-inch socket and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque to 31 to 35 ft lb (42 to 49 N•m).



**TASK ENDS HERE**

## ENGINE OIL COOLER INSTALLATION

---

### INITIAL SETUP

#### Tools

Extension, 6-inch, 1/2-inch drive  
 Handle, ratchet, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive  
 Socket, 3/4-inch, 1/2-inch drive  
 Socket, 7/16-inch, 1/2-inch drive  
 Wrench, box-end, 7/16-inch  
 Wrench, torque, 0 to 150 ft lb (0  
 to 210 N•m), 1/2-inch drive

#### Materials/Parts

Cartridge, oil filter  
 Gasket, oil cooler

#### Materials/Parts - Continued

Gasket, water header cover  
 Lockwasher, oil cooler, front (six required)  
 Lockwasher, oil cooler, rear  
 Lockwasher, water header cover (six  
 required)  
 Oil, lubricating (item 12, appendix B)  
 Packing, preformed, water transfer tube  
 (two required)  
 Packing, preformed, oil filter

#### Personnel Required

Two

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**ENGINE OIL COOLER INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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**WARNING**

Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.

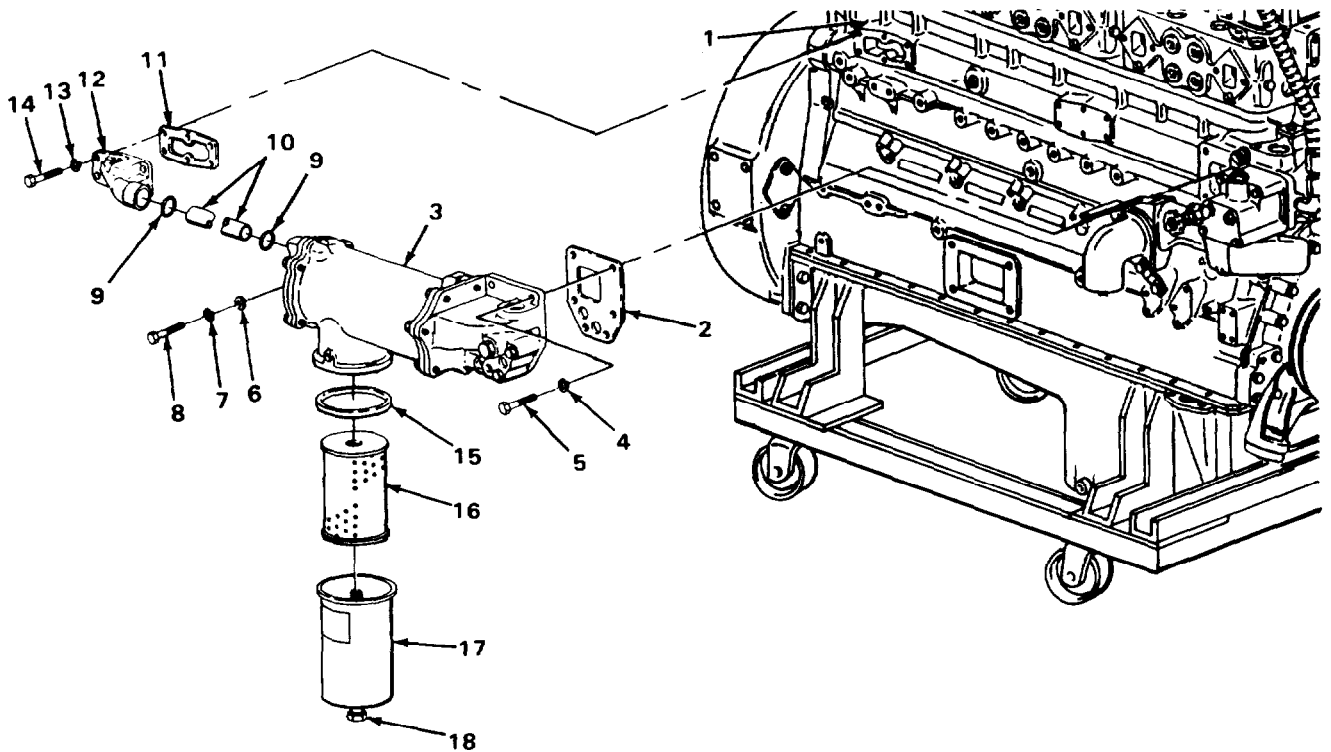
**CAUTION**

When performing step 1, assistant must support oil cooler and gasket in position as hardware is being installed to prevent damaging oil cooler gasket.

1. Right side of engine block (1)	New oil cooler gasket (2), engine oil cooler (3), six new lockwashers (4), and six screws (5)	<ul style="list-style-type: none"> <li>a. With assistance, position new oil cooler gasket and engine oil cooler on engine block.</li> <li>b. Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and ratchet handle, screw in until snug.</li> <li>c. Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque to 30 to 35 ft lb (40.6 to 47.4 N•m).</li> </ul>
2. Engine oil cooler (3)	Flat washer (6), new lockwasher (7) and screw (8)	<ul style="list-style-type: none"> <li>a. Using 1/2-inch drive 3/4-inch socket, 6-inch extension, and ratchet handle, screw in until snug.</li> <li>b. Using 1/2-inch drive 3/4-inch socket, 6-inch extension, and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque to 95 to 105 ft lb (128.8 to 142.4 N•m).</li> </ul>
3. Right side of engine block (1)	Two new packings (9), water transfer tube (10), new gasket (11), rear water header cover (12), six new lockwashers (13), and six screws (14)	<ul style="list-style-type: none"> <li>a. Lubricate two new packings with lubricating oil and position one on each end of connector tube.</li> <li>b. Position water transfer tube in engine oil cooler and rear water header cover.</li> <li>c. Install new gasket between engine block and rear water header cover, and screw in six screws and new lockwashers.</li> <li>d. Using 7/16-inch box-end wrench, tighten.</li> <li>e. Using 1/2-inch drive 7/16-inch socket and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque to 7 to 10 ft lb (9.8 to 14 N•m).</li> </ul>

ENGINE OIL COOLER INSTALLATION - CONTINUED

LOCATION	ITEM	ACTION REMARKS
4. Engine oil cooler (3)	New packing (15), new oil filter cartridge (16), oil filter shell (17), and oil filter screw (18)	a. Lubricate new packing with lubricating oil and position on engine oil cooler. b. Place oil filter cartridge in oil filter shell and position on engine oil cooler. c. Using 1/2-inch drive 9/16-inch socket and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque to 25 to 35 ft lb (33.9 to 47.4 N•m).



TASK ENDS HERE

**WATER MANIFOLD ASSEMBLY INSTALLATION**

---

INITIAL SETUP

Tools

Wrench, open-end, 9/16-inch

Materials/Parts

Gasket, water manifold (six required)  
 Lockwasher (12 required)

Materials/Parts - Continued

Oil, lubricating (Item 12, appendix B)  
 Packing, preformed, connector tube  
 Packing, preformed, water manifold (as required)

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LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

If all water manifold sections have been separated, all four preformed packings must be replaced.

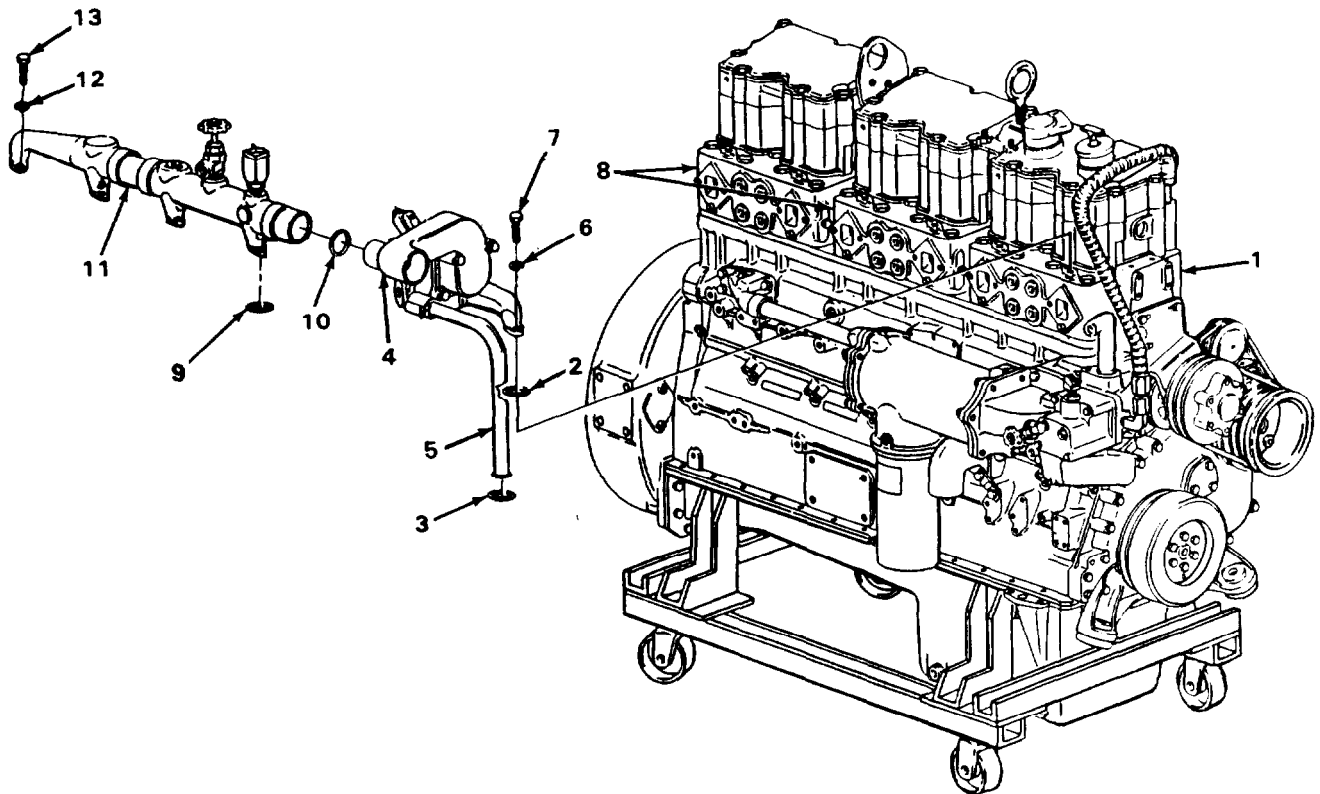
<p>1. Front cylinder head (1)</p>	<p>Two new gaskets (2), new preformed packing (3), water manifold front section (4) with connector tube (5), four new lockwashers (6), and four screws (7)</p>	<p>a. Lubricate two new gaskets with lubricating oil and place in position on front cylinder head.                      b. Lubricate new preformed packing with lubricating oil and position on end of connector tube.                      c. Lower water manifold front section with connector tube onto front cylinder head positioning connector tube into water inlet housing.                      d. Put in four new lockwashers and four screws.  <b>Hand tighten only.</b></p>	
<p>2. Rear and center cylinder heads (8)</p>	<p>Four new gaskets (9), new preformed packing (10), rear and center water manifold sections (11), eight new lockwashers (12), and eight screws (13)</p>	<p>a. Lubricate four new gaskets with lubricating oil and place in position on rear and center cylinder heads.                      b. Lubricate new preformed packing with lubricating oil and place in position on end of center water manifold section.                      c. Position rear and center water manifold sections on rear and center cylinder heads making sure to fully engage center water manifold section with front water manifold section.                      d. Put in eight new lockwashers and eight screws.  <b>Hand tighten only.</b></p>	



**WATER MANIFOLD ASSEMBLY INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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- |   |                   |   |
|---|-------------------|---|
| 3. Water manifold front section (4) and rear and center manifold section (11) | Twelve screws (7) | Using 9/16-inch open-end wrench, tighten. |
|---|-------------------|---|



**TASK ENDS HERE**

**ANEROID CONTROL VALVE INSTALLATION**

INITIAL SETUP

Tools

Extension, 6-inch, 1/2-inch drive  
 Socket, 9/16-inch, 1/2-inch drive  
 Wrench, open-end, 9/16-inch  
 Wrench, open-end, 5/8-inch  
 Wrench, open-end, 7/8-inch  
 Wrench, torque, 0 to 50 ft lb (0 to 70 N•m), 1/2-inch drive

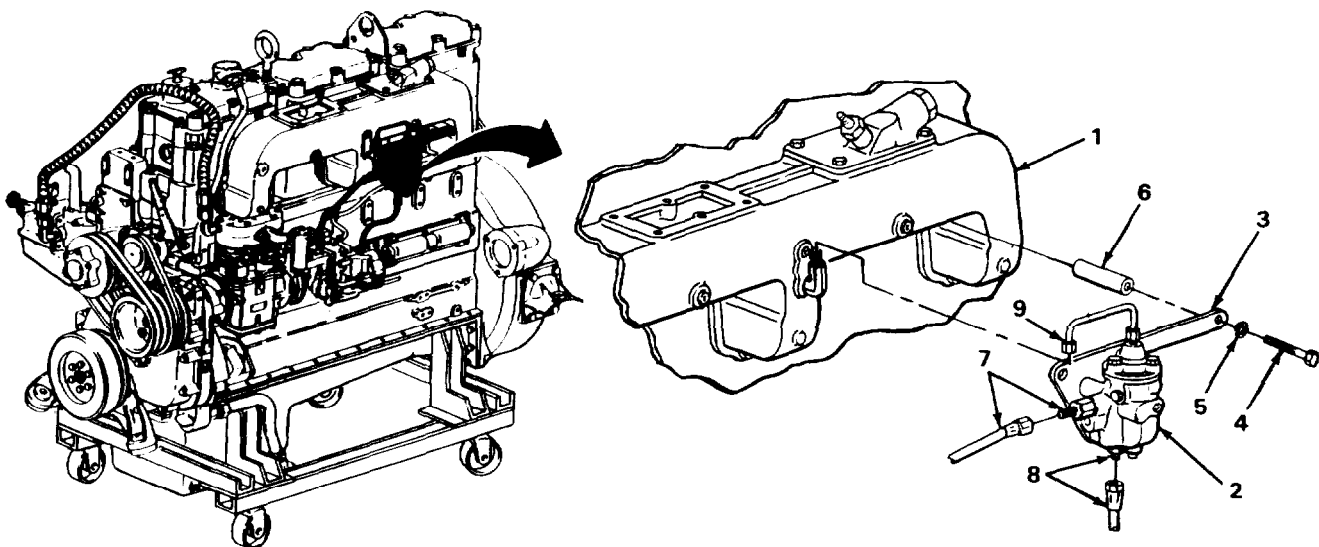
Materials/Parts

Lockwasher (two required)

Equipment Condition

Intake manifold installed (page 2-119).

LOCATION	ITEM	ACTION REMARKS
1. Intake manifold (1)	Aneroid control valve (2), bracket (3), two screws (4) two new lockwashers (5) and two spacers (6)	a. Position aneroid control valve on intake manifold. b. Using 1/2-inch drive 9/16-inch socket, 6-inch extension, and 0 to 50 ft lb torque wrench (0 to 70 N•m), screw in and tighten to 20 to 25 ft lb (28 to 35 N•m) torque.
2.	Fuel line nuts (7)	Using 5/8-inch and 7/8-inch open-end wrenches, put on and tighten.
3.	Fuel line nuts (8)	Using 5/8-inch and 9/16-inch open-end wrenches, put on and tighten.
4.	Vacuum line nut (9)	Using 9/6-inch open-end wrench, put on and tighten.



**TASK ENDS HERE**

TA 242421

**OIL DIPSTICK TUBE INSTALLATION**

INITIAL SETUP

Tools

Socket, 9/16-inch, 12-inch drive  
 Socket, 5/8-inch, 1/2-inch drive  
 Wrench, torque, 0 to 150 ft lb  
 (0 to 210 N•m), 1/2-inch drive

Materials/Parts

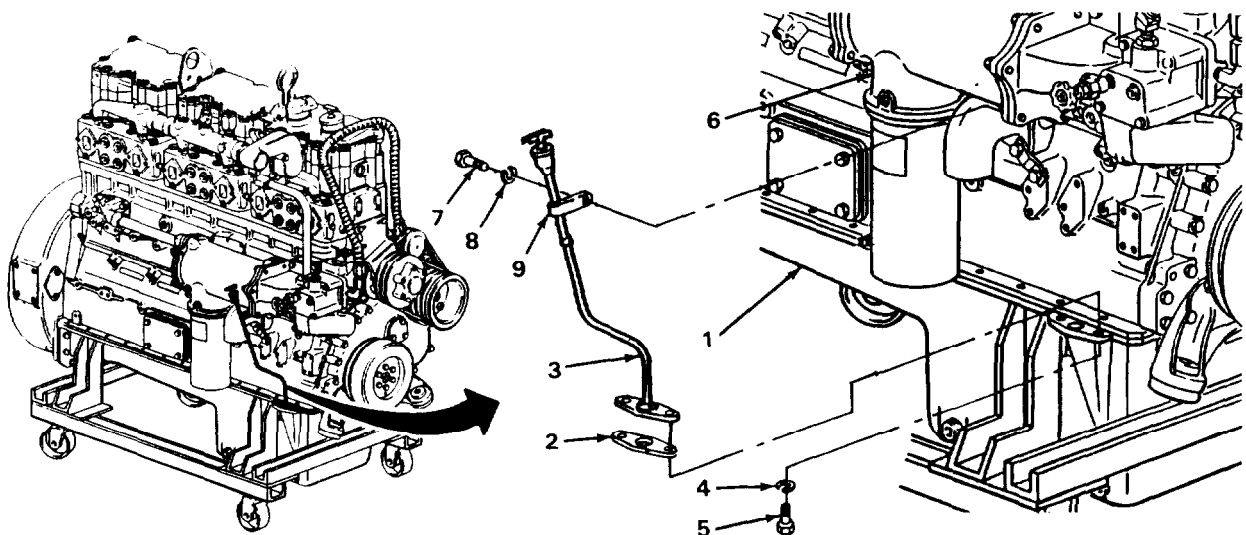
Gasket  
 Lockwasher, bracket  
 Lockwasher, oil dipstick tube (two required)

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

**NOTE**

Remove screw from oil cooler before installation of oil dipstick tube.

- |                          |  |  |
|--------------------------|--|--|
| <p>1. Oil pan (1)</p>    | <p>New gasket (2) oil dipstick tube (3), two new lockwashers (4), and two screws (5)</p> | <p>a. Position gasket and oil dipstick tube on oil pan and put in two screws with new lockwashers and tighten until snug.<br/>                 b. Using 1/2-inch drive 5/8-inch socket and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque to 30 to 35 ft lb (40 to 47 N•m).</p> |
| <p>2. Oil cooler (6)</p> | <p>Screw (7), new lockwasher (8) and bracket (9)</p>                                     | <p>a. Screw in.<br/>                 b. Using 1/2-inch drive 9/16-inch socket and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque to 30 to 35 ft lb (40 to 47 N•m).</p>  |



**TASK ENDS HERE**

**EXHAUST MANIFOLD INSTALLATION**

---

INITIAL SETUP

Tools

Chisel, cold, 1/2-inch  
 Extension, 6-inch, 1/2-inch drive  
 Goggles, safety  
 Hammer, ball-peen, 16-ounce  
 Socket, 5/8-inch, 1/2-inch drive  
 Wrench, torque, 0 to 150 ft lb (0 to 210 N•m), 1/2-inch drive

Materials/Parts

Gasket (six required)  
 Key washer (four required)  
 Locking plate, nut, exhaust manifold (four required)

Personnel Required

Two

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LOCATION	ITEM	ACTION	REMARKS
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**WARNING**

Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.

**CAUTION**

Exhaust manifold is in three sections and care must be taken when installing not to allow sections to separate. Assistance will be needed to support exhaust manifold while performing steps 1 and 2.

- |                         |   |  |
|-------------------------|---|--|
| 1. Cylinder heads (1)   | Six new gaskets (2) and exhaust manifold (3)                                    | a. Position six new gaskets on cylinder head dowels.<br>b. With assistance, position exhaust manifold on cylinder heads. |
| 2. Exhaust manifold (3) | Four new nut locking plates (4), eight sleeve bearings (5) and eight screws (6) | Position four new nut locking plates with screws and spacers on exhaust manifold and screw in until finger tight.        |
| 3.                      | Two retaining straps (7), new key washers (8), and four screws (9)              | Position two retaining straps with screws and new key washers on exhaust manifold and screw in until finger tight.       |

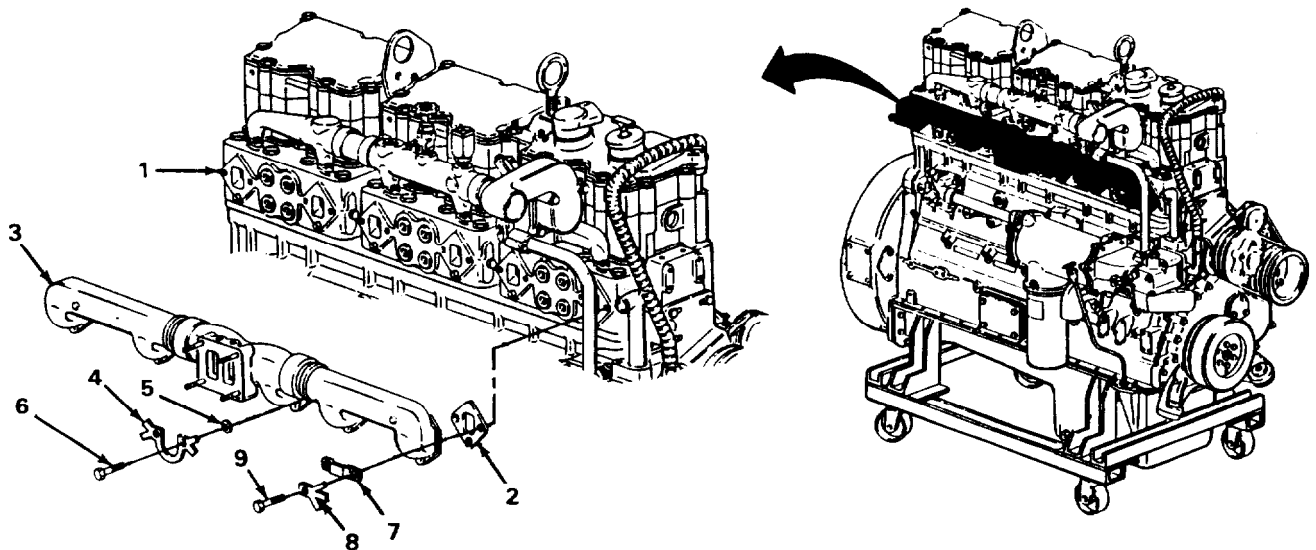
**EXHAUST MANIFOLD INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
4.	Twelve screws (6 and 9)	Using 1/2-inch drive 5/8-inch socket, 6-inch extension, and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque to 25 ft lb (34 N•m).

**WARNING**

Safety goggles must be worn to prevent eye injury caused by flying steel chips.

5.	Four new nut locking plates (4) and four new key washers (8)	Using 16-ounce ball-peen hammer and 1/2-inch cold chisel, bend up tabs of new nut locking plates and new key washers.
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**TASK ENDS HERE**

**TURBOCHARGER AND OIL LINE INSTALLATION**

---

INITIAL SETUP

Tools

- Extension, 6-inch, 1/2-inch drive
- Joint, universal, 1/2-inch drive
- Screwdriver, flat-tip, 1/4-inch
- Socket, 9/16-inch, 1/2-inch drive
- Wrench, box-end, 9/16-inch (two required)
- Wrench, open-end, 1/2-inch
- Wrench, open-end, 5/8-inch
- Wrench, open-end, 3/4-inch
- Wrench, open-end, 1 1/4-inch

Tools - Continued

- Wrench, open-end, 1 5/16-inch
- Wrench, open-end, 1 3/8-inch
- Wrench, torque, 0 to 150 ft lb (0 to 210 N•m), 1/2-inch drive

Materials/Parts

- Compound, antiseize (item 2, appendix B)
- Gasket

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LOCATION	ITEM	ACTION	REMARKS
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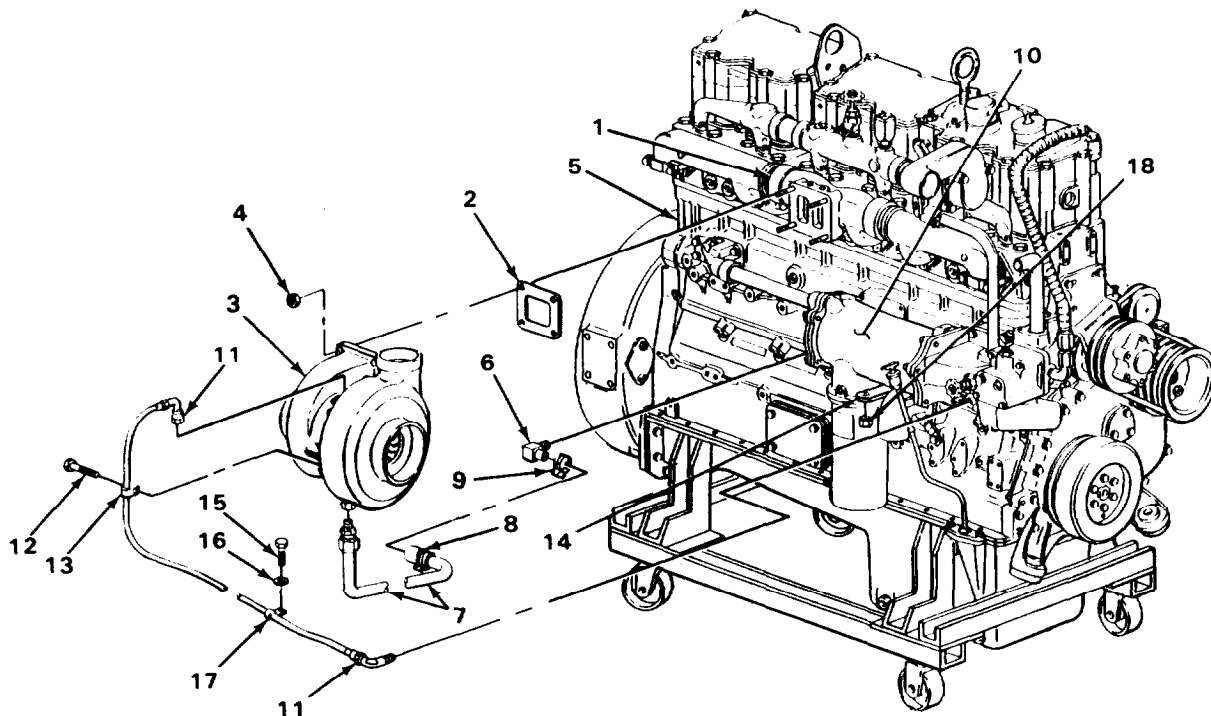
**NOTE**

Remove nuts from studs on exhaust manifold and tape from all openings on turbocharger. Make sure oil return line fitting is facing down.

1. Exhaust manifold (1)	New gasket (2) turbocharger (3), and four nuts (4)	a. Coat mounting studs on exhaust manifold with antiseize compound. b. Position new gasket on exhaust manifold with convex side toward turbocharger. c. Position turbocharger on exhaust manifold. d. Screw on four nuts until finger tight. e. Using 1/2-inch drive 9/16-inch socket, 6-inch extension, universal joint, and 0 to 150 ft lb (0 to 210 N•m) torque wrench, torque nuts to 22 to 28 ft lb (30 to 38 N•m).	
2. Right side of cylinder block (5)	Oil return hose fitting (6)	Using 1 1/4-inch open-end wrench, screw in and tighten.	
3.	Oil return tube (7), hose (8), and clamp (9)	a. Position clamp on hose end of oil return tube and hose. b. Position hose end of oil return tube and hose on oil return hose fitting. c. Using 1/4-inch flat-tip screwdriver, tighten clamp. d. Position oil tube and hose fitting on turbocharger oil return hose fitting (6). e. Using 1 3/8-inch and 1 5/16-inch open-end wrenches, tighten.	

**TURBOCHARGER AND OIL LINE INSTALLATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
4. Oil cooler (10) and turbocharger (3)	Oil supply line and fittings (11)	a. Using 1/2-inch and 3/4-inch open-end wrenches, screw on to oil cooler and tighten oil supply line and fittings. b. Using 5/8-inch and 3/4-inch open-end wrenches, screw on to turbocharger, and tighten oil supply line and fittings.
5. Turbocharger (3)	Screw (12) and clamp (13)	Remove screw from turbocharger and position clamp on turbocharger and screw in and tighten using 1/2-inch open-end wrench.
6. Bracket (14)	Screw (15), flat washer (16), clamp (17), and nut (18)	a. Remove nut from screw and install screw with flat washer and clamp through bracket. Screw on nut finger tight. b. Using two 9/16-inch box-end wrenches, tighten.



**NOTE**

FOLLOW-ON MAINTENANCE: Perform final testing, adjustments, and troubleshooting on engine test stand (page 2-414).

**TASK ENDS HERE**

**TURBOCHARGER CROSSOVER TUBE INSTALLATION**

---

INITIAL SETUP

Tools

Extension, 6-inch, 1/2-inch drive  
 Handle, ratchet, 1/2-inch drive  
 Pry bar, 18-inch  
 Socket, 9/16-inch, 1/2-inch drive  
 Wrench, open-end, 7/16-inch

Materials/Parts

Gasket  
 Lockwasher (four required)

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LOCATION	ITEM	ACTION REMARKS
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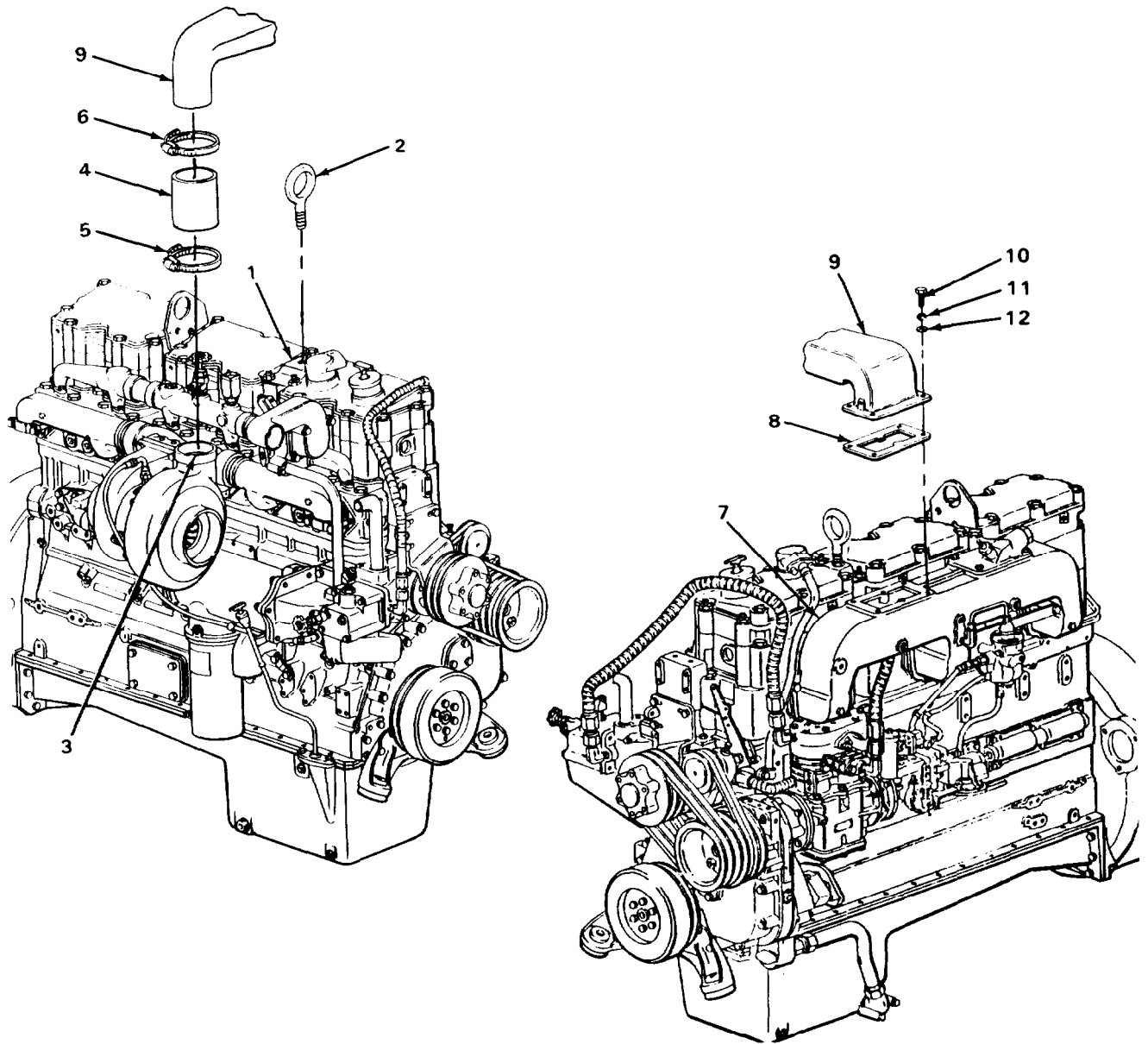
**NOTE**

Turbocharger crossover tube is removed from engine before removing engine from vehicle to allow installation of front lifting eye. It is shipped with engine to allow testing and adjustments to be accomplished on engine test stand.

1. Top of engine (1)	Lifting eye (2)	Using 18-inch pry bar, unscrew and take out.
2. Turbocharger air outlet (3)	Hose (4), hose clamp (5), and hose clamp (6)	a. Push on hose (4). b. Put hose clamps (5) and (6) over hose.
3. Top of intake manifold (7)	New gasket (8)	Aline holes in gasket and intake manifold and put on.
4.	Turbocharger cross-over tube (9)	Position on intake manifold (7) and Into hose (4).
5.	Four screws (10), four new lockwashers (11), and four flat washers (12)	Using 1/2-inch drive, 9/16-inch socket, 6-inch extension, and ratchet handle, screw In and tighten.
6. Hose (4)	Hose clamp (5)	Position on lower portion of hose and using 7/16-inch open-end wrench, tighten.
7.	Hose clamp (6)	Position on upper portion of hose and using 7/16-inch open-end wrench, tighten.



**TURBOCHARGER CROSSOVER TUBE INSTALLATION - CONTINUED**



**NOTE**

**FOLLOW-ON MAINTENANCE:** Perform final testing, adjustments, and troubleshooting on engine test stand (page 2-412).

**TASK ENDS HERE**

## Section V. CRANKCASE AND CYLINDER BLOCK MAINTENANCE

	Page		Page
Cylinder Block.....	2-140	Oil Pan .....	2-175
Gearcase Cover.....	2-172		

### CYLINDER BLOCK

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This task covers:

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>a. Disassembly (page 2-141)</li> <li>b. Cleaning/Inspection (page 2-142)</li> </ul> | <ul style="list-style-type: none"> <li>c. Repair (page 2-153)</li> <li>d. Assembly (page 2-168)</li> </ul> |
|--|--|
- 

### INITIAL SETUP

#### Tools

Adapter, drive, flex, 1/2-inch drive  
 Adapter, ST-1064  
 Bit, drill, 23/64-inch  
 Bit, drill, 23/32-inch  
 Bit, drill, 1 1/32-inch  
 Drill, electric, portable, 1/2-inch  
 Driver, bushing, camshaft, ST-1228  
 Driver, bushing, ST-1010-9  
 Driver, sleeve, repair  
 Driver, sleeve, salvage  
 Driver, sleeve, ST-1229  
 Driver, ST-1059  
 File, mill, flat, wide  
 Gage, bore, dial  
 Gage, concentricity, ST-1252  
 Gage, depth, dial indicator  
 Gage, thickness  
 Goggles, safety  
 Hammer, ball-peen, 16-ounce  
 Hammer, plastic-faced  
 Handle, driver, repair sleeve  
 Handle, ratchet, 3/8-inch drive  
 Handle, ratchet, 1/2-inch drive  
 Holder, ST-1065  
 Insert kit, screw thread, ST-476  
 Insert kit, screw thread, ST-1230  
 Key, hex, 1/2-inch  
 Key, square, 5/16-inch  
 Machine, milling  
 Micrometer, 0- to 1-inch  
 Micrometer, 6-inch to 7-inch  
 Micrometer, gate, tool bit  
 Micrometer, inside, 2- to 3-inch  
 Puller assembly, sleeve, ST-1202  
 Puller, bridge, sleeve, ST-1201

#### Tools - Continued

Puller, pin  
 Ruler, 24-inch (60.9 mm)  
 Socket, 1 1/16-inch, 1/2-inch drive  
 Socket, 1 1/2-inch, 3/4-inch drive  
 Tool, boring, ST-1081  
 Tool, boring, ST-1177  
 Tool, counterbore, ST-1059  
 Tool, salvage, cylinder sleeve, ST-1168  
 Tool, salvage, cylinder sleeve, ST-1068  
 Tool, salvage, cylinder sleeve, ST-1184  
 Wrench, box-end, 7/16-inch  
 Wrench, box-end, 9/16-inch  
 Wrench, open-end, 1/2-inch  
 Wrench, open-end, 11/16-inch  
 Wrench, torque, 0 to 150 ft lb (0 to 210 N•m)  
 Wrench, torque, 0 to 600 ft lb (0 to 813.6 N•m)

#### Materials/Parts

Cloth, emery (item 1, appendix B)  
 Dye, leak-detection (item 7, appendix B)  
 Gasket, cylinder sleeve  
 Oil, lubricating (item 12, appendix B)  
 Packing, cylinder sleeve  
 Packing, preformed, cylinder sleeve  
 Pin, straight, cylinder block (as required)  
 Prussian blue (item 13, appendix B)  
 Rag, wiping (item 14, appendix B)  
 Tags, marker (item 17, appendix B)  
 Tape, antiseizing (item 18, appendix B)

#### Personnel Required

Two

CYLINDER BLOCK - CONTINUED

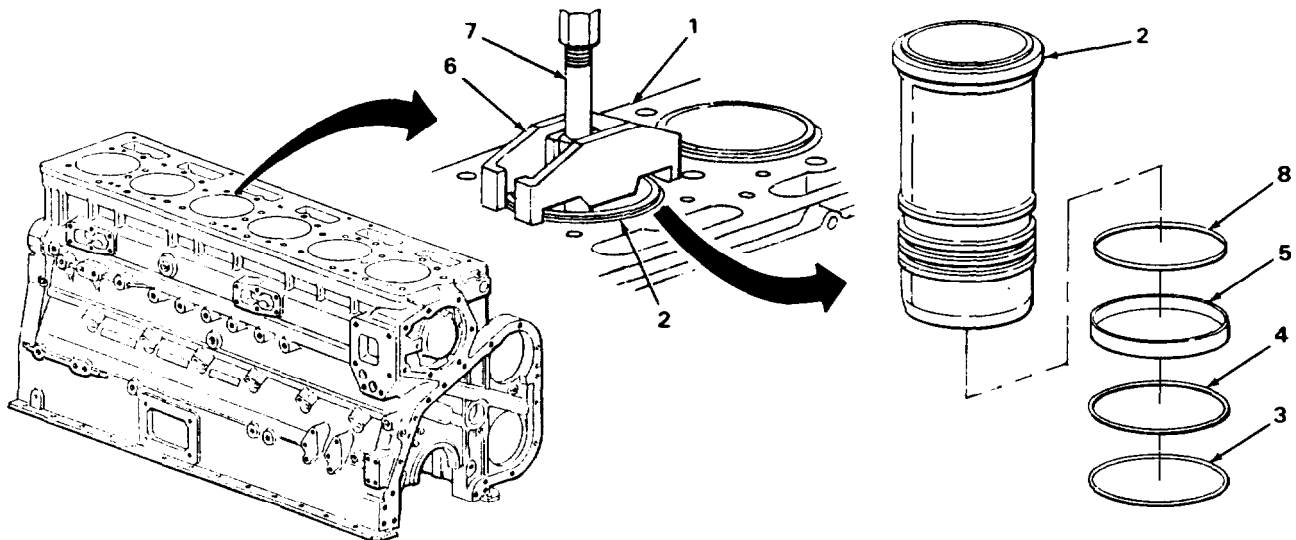
LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY

**NOTE**

Steps 1 and 2 are typical for the removal of all six cylinder sleeves.

- |                        |  |  |
|------------------------|--|--|
| 1. Cylinder block (1)  | Cylinder sleeve (2),<br>preformed packing (3),<br>packing (4),<br>and gasket (5) | Using ST-1201 sleeve puller bridge (6) and<br>ST-1202 sleeve puller assembly (7),<br>remove.<br><b>Discard preformed packing, packing,<br/>and gasket.</b>   |
| 2. Cylinder sleeve (2) | Shim or spacer (8)   | a. Remove from sleeve and, using 0- to 1-<br>inch micrometer, measure thickness.<br><b>Record readings so same shim or<br/>spacer thickness can be installed.</b><br>b. Tag shim or spacer, keep together with<br>respective sleeve, and hold for<br>inspection. |



CYLINDER BLOCK - CONTINUED

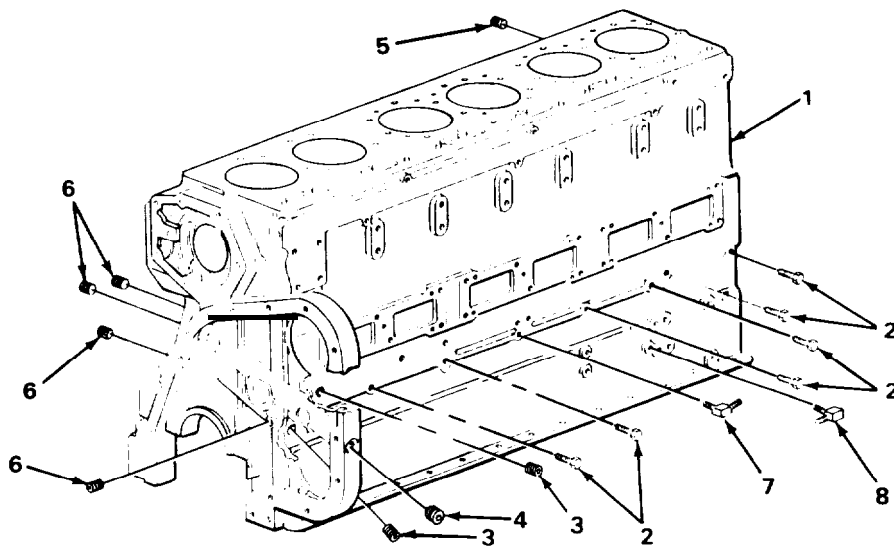
LOCATION	ITEM	ACTION REMARKS
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DISASSEMBLY - CONTINUED

**NOTE**

Tag location of plug removal for installation.

- |    |                    |               |   |
|----|--------------------|---------------|---|
| 3. | Cylinder block (1) | Pipe Plug (2) | Using 7/16-inch box-end wrench, loosen and remove.      |
| 4. |                    | Pipe plug (3) | Using 3/8-inch drive ratchet handle, loosen and remove. |
| 5. |                    | Pipe plug (4) | Using 1/2-inch hex key, loosen and remove.              |
| 6. |                    | Pipe plug (5) | Using 9/16-inch box-end wrench, loosen and remove.      |
| 7. |                    | Pipe plug (6) | Using 5/16-inch square key, loosen and remove.          |
| 8. |                    | Fitting (7)   | Using 1/2-inch open-end wrench, loosen and remove.      |
| 9. |                    | Fitting (8)   | Using 11/16-inch open-end wrench, loosen and remove.    |



**CYLINDER BLOCK - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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CLEANING/INSPECTION

**WARNING**

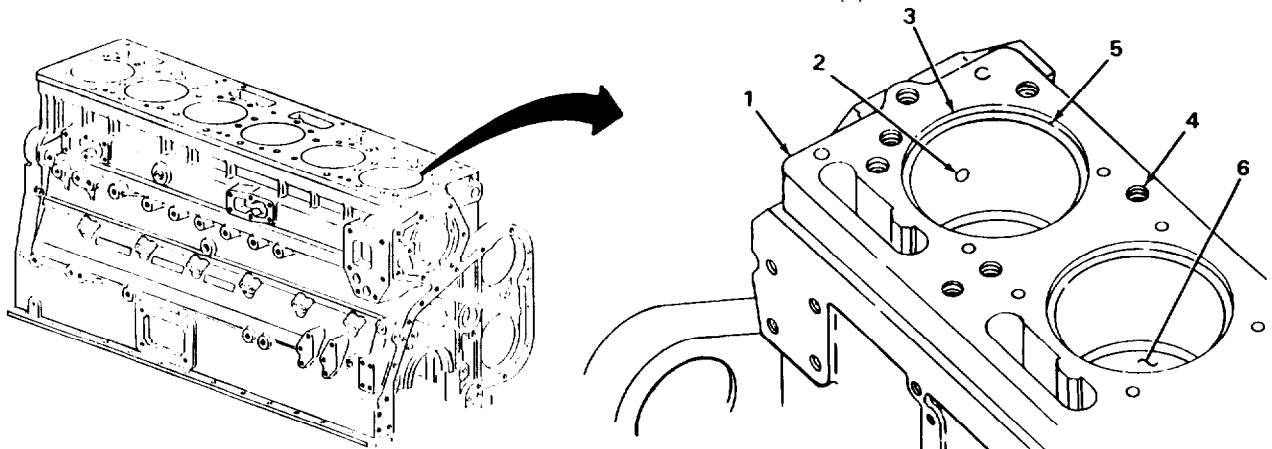
Particles blown by compressed air are hazardous. Make certain the airstream is directed away from user and other personnel in the area. Compressed air used for cleaning purposes shall not exceed 30 psi (207 kPa). User must wear safety goggles or face shield to prevent injury.

Drycleaning solvent P-D-680 is toxic and flammable. Wear safety goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. Flash point for Type #1 Drycleaning Solvent is 100°F (38°C) and for Type #2 is 138° F (59° C). If you become dizzy while using solvent, get fresh air immediately, and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately. Failure to observe these precautions could cause serious injury or death to personnel.

**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

- |     |                    |   |
|-----|--------------------|---|
| 10. | Cylinder block (1) | <ul style="list-style-type: none"> <li>a. Using compressed air, clean water pump air bleed hole (2) in number one cylinder bore (3).</li> <li>b. Using compressed air, blow all dirt and cleaning solvent from all capscrew holes (4).</li> <li>c. Remove scale from sleeve counterbore ledge (5).</li> <li>d. Using emery cloth, clean lower sleeve bore (6).</li> </ul> |
|-----|--------------------|---|



ROTATED 180°  
AND UP FOR CLARITY

CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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CLEANING/INSPECTION - CONTINUED

**WARNING**

Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.

**CAUTION**

Inspection of cylinder block must be performed on a flat surface to prevent distortion. Do not leave on engine repair stand (page 2-11).

**NOTE**

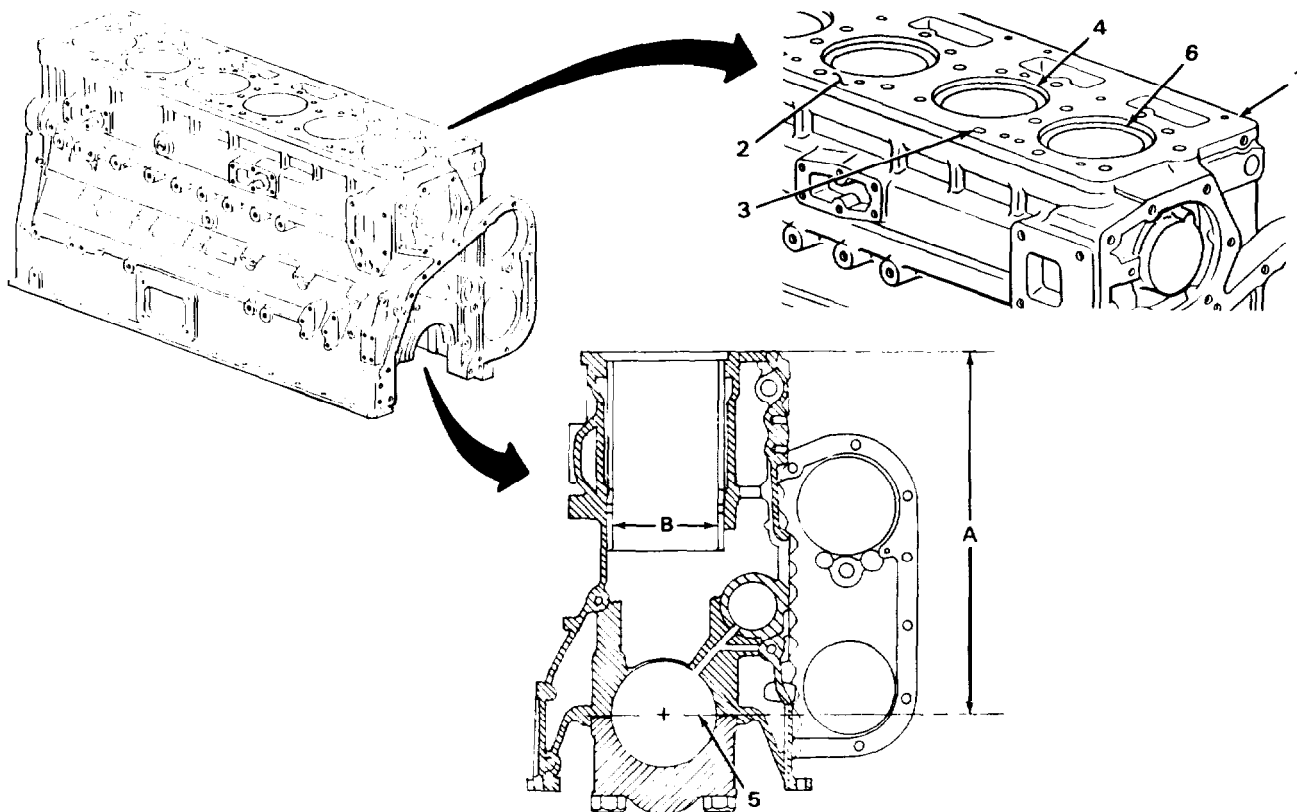
Decision to salvage or discard cylinder block due to crack size or location will be left up to the repair facility.

- |     |                    |  |
|-----|--------------------|--|
| 11. | Cylinder block (1) | <ul style="list-style-type: none"> <li>a. Using leak-detection dye, inspect for cracks, porosity, or leaks.<br/> <b>If cracks, porosity, or leaks exist, and cylinder block is deemed unreparable, discard cylinder block.</b></li> <li>b. Inspect cylinder block mating surface (2), near water passage holes (3), for pits and scratches.<br/> <b>If pits and scratches are more than 0.003 inch (0.08 mm) deep in the area 1/18 to 3/32 inch (1.59 to 2.38 mm) near water passage holes, tag water passage hole for sleeving, step 24.</b><br/> <b>If pits and scratches are within 1/32 to 3/32 inch (0.79 to 2.38 mm) from cylinder sleeve counterbore (4), tag cylinder block for resurfacing, steps 25 and 26.</b></li> <li>c. Using 24-inch (60.9 mm) ruler, check distance A from cylinder head mating surface (2) to main bearing bore centerline (5).<br/> <b>If measurement varies more than 0.002 inch (0.05 mm) throughout length of cylinder block, tag cylinder block for resurfacing, steps 25 and 26.</b></li> </ul> |
|-----|--------------------|--|

CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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- d. Using 6- to 7-inch inside micrometer, check cylinder sleeve lower bore diameter B.  
**If diameter is greater than 6.126 inches (155.80 mm), tag cylinder block for repair sleeve, steps 29 thru 35.**
- e. Inspect cylinder sleeve counterbore (4) for damaged or cracked counterbore ledge (6).  
**If damage or crack can be repaired by enlarging and installing salvage sleeve, tag cylinder sleeve counterbore for installing salvage sleeve, steps 57 thru 63.**  
**If damage or crack cannot be repaired by enlarging and installing salvage sleeve, discard cylinder block.**
- f. Check cylinder head capscrew threads for damage.  
**If damage exists, tag for thread repair, step 27.**



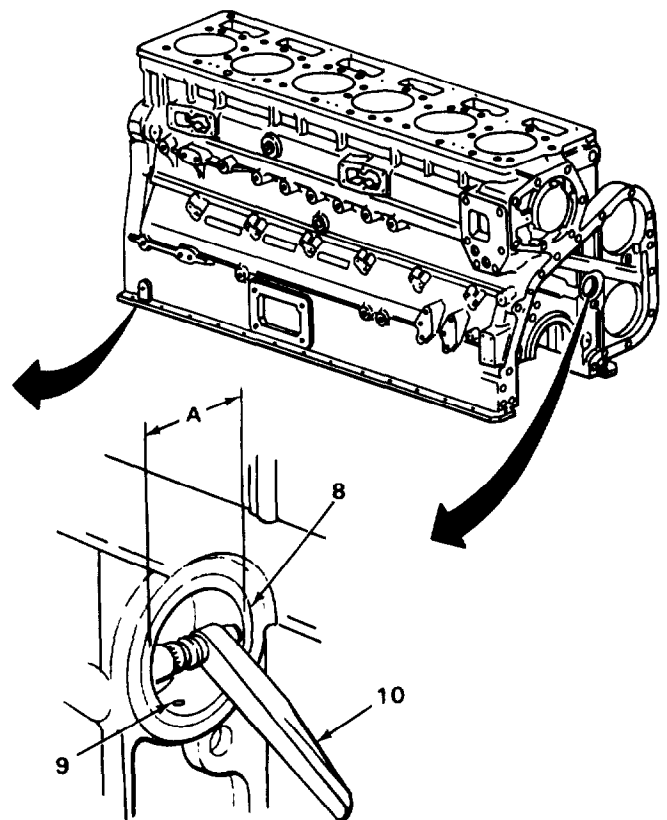
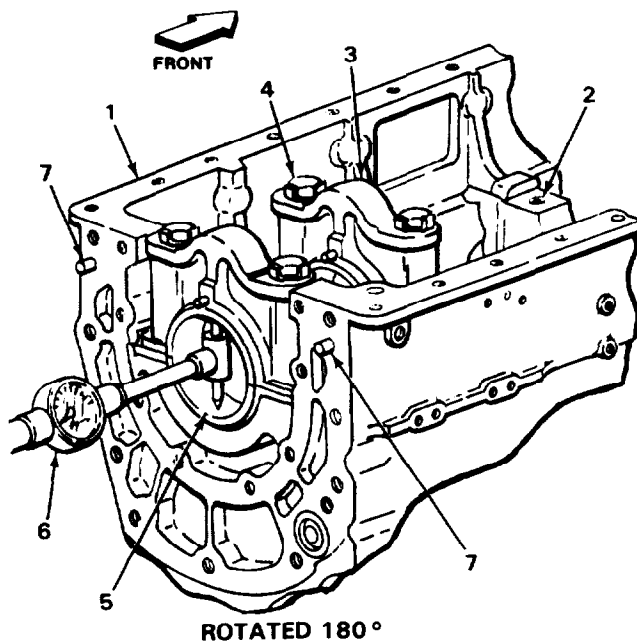
CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION REMARKS
CLEANING/INSPECTION - CONTINUED		
12.	Cylinder block (1)	a. Check main bearing capscrew threads (2) for damage. <b>If damage exists, tag for thread repair, step 28.</b> b. Check main bearing caps (3) for looseness in cylinder block. <b>If any perceptible clearance or shake exists, tag main bearing cap for replacement, steps 36 thru 39.</b>
<b><u>CAUTION</u></b>		
Main bearing cap bolts must be tightened alternately and slowly to ensure proper seating of bearing caps.		
13. Cylinder block (1)	Main bearing caps (3)	Position in cylinder block in their respective locations as tagged.
14. Main bearing caps (3)	Main bearing capscrews (4)	a. Lubricate with clean lubricating oil. b. Install through main bearing caps. c. Using 3/4-inch drive 1 1/2-inch socket and 0 to 600 ft lb torque wrench, tighten each capscrew to 140 to 150 ft lb (197 to 210 N•m) to seat main bearing caps, then continue to tighten each capscrew to 300 to 310 ft lb (407 to 420 N•m).
15.	Main bearing bore (5)	Using dial bore gage (6), measure main bearing bores horizontally, vertically, and diagonally. <b>If main bearing cap has been determined to be distorted, or If main bearing bore diameter is greater than 4.7505 inch (120.883 mm), tag cylinder block for reaming, steps 41 thru 50.</b>
16. Cylinder block (1)	Camshaft bushings (8)	a. Inspect for chips, scores, or scratches. <b>If camshaft bushings are chipped, scored, or scratched, tag camshaft bushings for replacement, steps 51 and 52.</b>



CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION REMARKS
17. Cylinder block (1)	Straight pins (7)	<p>b. Inspect to ensure oil passages (9) between camshaft bushings and cylinder block are properly aligned.  <b>If oil passages are not aligned, tag camshaft bushings for replacement, steps 51 and 52.</b></p> <p>c. Using 2- to 3-inch inside micrometer (10), measure camshaft bushing inside diameter, A, horizontally and vertically.  <b>If camshaft bushing inside diameter is greater than 2.0015 inches (50.838 mm), tag camshaft bushings for replacement, steps 51 and 52.</b></p> <p>Inspect straight pins for nicks, or out of round.  <b>If nicked or out of round, repair, step 40.</b></p>



CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION REMARKS
CLEANING/INSPECTION - CONTINUED		
18. Cylinder block (1)	Counterbore (2)	<p>a. Using 6-inch to 7-inch micrometer, measure counterbore diameter, A. <b>If diameter is greater than 6.5635 inches (188.713 mm), tag counterbore for salvage sleeve, steps 57 thru 63.</b></p> <p>b. Using dial indicator depth gage, measure counterbore depth, B. <b>If depth is greater than 0.412 inch (10.486 mm), tag counterbore for salvage sleeve, steps 57 thru 63.</b></p> <p>c. Using dial indicator depth gage, measure counterbore depth at four equally spaced points at the edge of the bore. <b>If there is a total of 0.001 inch (0.03 mm) difference in these measurements, tag counterbore for cutting, steps 53 thru 56.</b> <b>If counterbore ledge (3) is not flat with the top of the cylinder block within 0.0014 inch (0.038 mm) overall, tag counterbore for cutting, steps 53 thru 56.</b></p> <p>d. Check that counterbore ledge (3) is at a 90-degree angle to cylinder sleeve bore. <b>If counterbore ledge is not at a go-degree angle to cylinder sleeve bore, to within 0.005 inch (0.13 mm), tag counterbore for cutting, steps 53 thru 56.</b></p>
19.	Cylinder sleeve (4)	<p>a. Using leak-detection dye, inspect for cracks just under top flange (5) at bottom of sleeve (6) or above gasket groove (7). <b>If cracks exist, discard cylinder sleeve.</b></p> <p>b. Inspect for corrosion, pits, or erosion. <b>If corrosion, pits, or erosion exists 1/16 inch (1.59 mm) deep or more, discard cylinder sleeve.</b></p> <p>c. Inspect underside of cylinder sleeve top flange (5) for dents, or pitting. <b>If dents or pitting cannot be removed by lapping, discard cylinder sleeve.</b></p>

CYLINDER BLOCK - CONTINUED

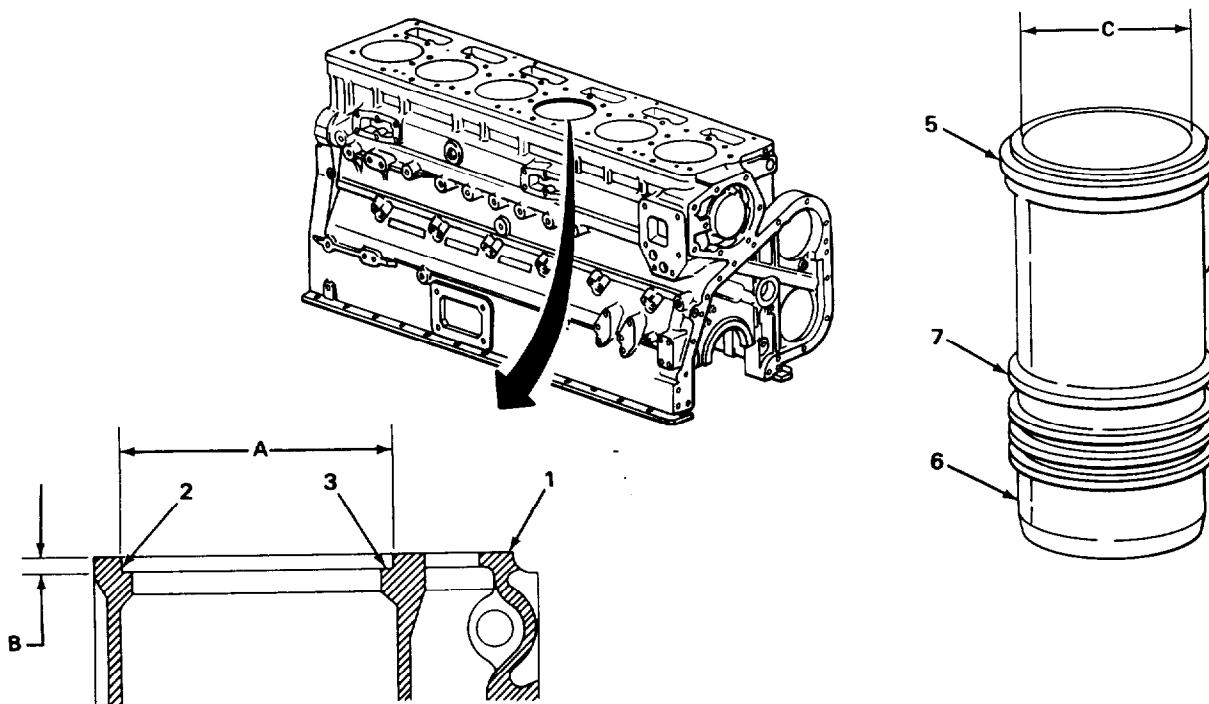
LOCATION	ITEM	ACTION REMARKS
		<p>d. Using dial bore gage, measure cylinder sleeve inside diameter, C.  <b>If diameter is greater than 5.505 inch (139.83 mm), discard cylinder sleeve.</b></p> <p>e. Inspect for scoring or vertical grooving on inside bore.  <b>If scores or grooves cannot be removed during deglazing, discard cylinder sleeve.</b></p> <p>f. Deglaze cylinder sleeves that have passed checks and inspections.</p>

**WARNING**

Particles blown by compressed air are hazardous. Make certain the air stream is directed away from user and other personnel in the area. Compressed air used for cleaning purposes shall not exceed 30 psi (207 kPa). User must wear safety goggles or face shield to prevent personnel injury.

**NOTE**

After cylinder sleeves are deglazed, clean thoroughly with compressed air to remove all particles from cylinder sleeve. Coat bores with lubricating oil after cleaning.



**CYLINDER BLOCK - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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CLEANING/INSPECTION - CONTINUED

**NOTE**

If cylinder sleeves are to be reused, they must be installed in their original location for checking cylinder sleeve protrusion. If one or more cylinder sleeves were discarded, a new cylinder sleeve must be substituted. After cylinder sleeve protrusion is adjusted, the shims and spacers used for adjustment must be kept with that cylinder sleeve and shims, spacers, and cylinder sleeves must be tagged for their respective location in cylinder block for assembly.

- |     |                     |   |
|-----|---------------------|---|
| 20. | Cylinder sleeve (1) | <ul style="list-style-type: none"> <li>a. Using 0- to 1-inch micrometer (2), measure and record cylinder sleeve flange (3) width.<br/><b>Do not include bead (4) when taking measurements.</b></li> <li>b. Using dial indicator depth gage (5), measure and record counterbore (6) ledge depth.</li> <li>c. Subtract counterbore ledge depth (step b) from cylinder sleeve flange width (step a).<br/><b>If the difference is less than 0.003 inch (0.06 mm), add shims or spacers so protrusion, A, is between 0.003 to 0.006 inch (0.06 to 0.15 mm).<br/>If the difference is greater than 0.006 inch (0.15 mm), tag counterbore (6) for cutting, steps 53 thru 56, and record the amount of material to be removed.</b></li> </ul> |
|-----|---------------------|---|

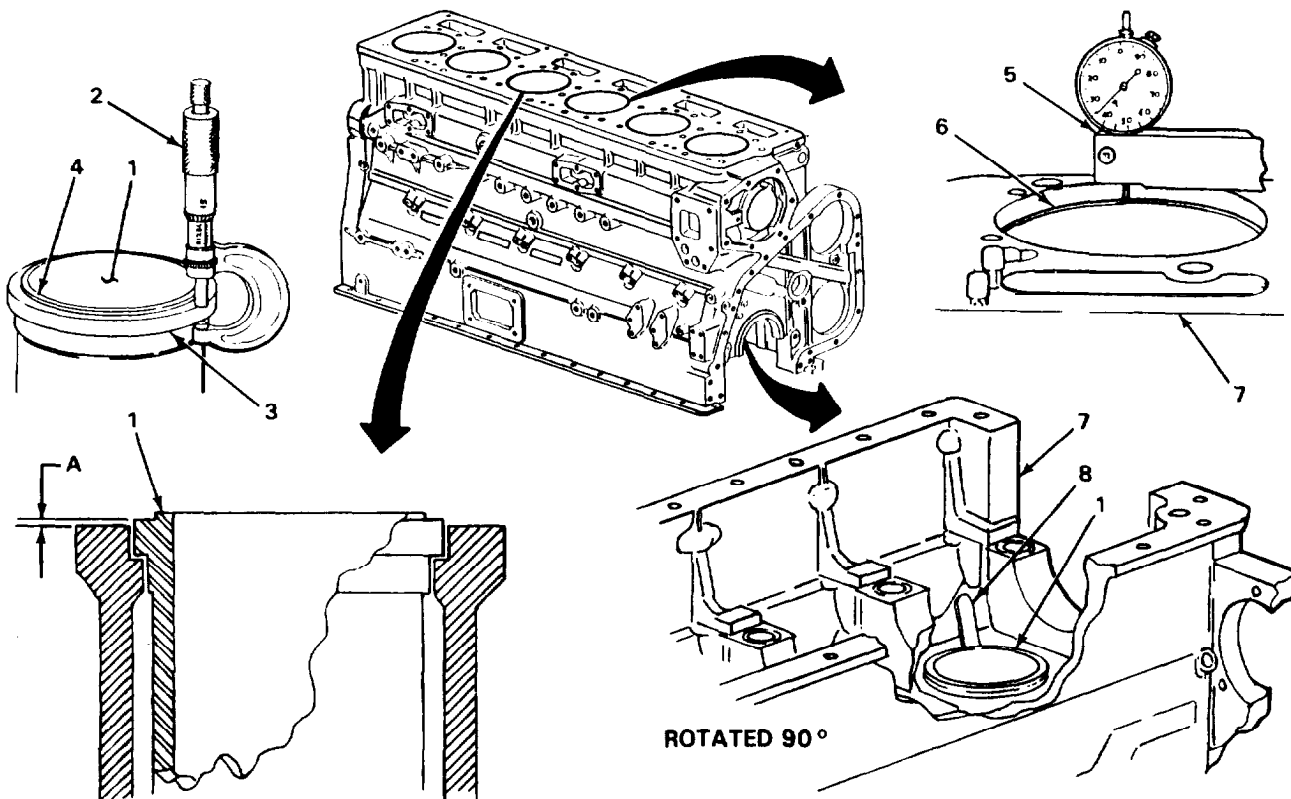
**NOTE**

The thinnest shim available is 0.007 inch (0.18 mm), therefore it may be necessary to use a combination of counterbore cutting and adding shims or spacers to achieve the correct protrusion of 0.003 to 0.006 inch (0.08 to 0.15 mm).

If material to be removed during counterbore cutting will result in counterbore depth exceeding 0.412 inch (10.46 mm), cylinder block cannot be reused, unless a salvage sleeve can be installed, steps 57 thru 63.

CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION REMARKS
21. Cylinder block (7)	Cylinder sleeve (1)	<p>a. Install, without preformed packing, packing, or gasket.</p> <p>b. Using thickness gage (8), check clearance between cylinder sleeve (1) and cylinder block (7). Clearance should be 0.002 inch (0.05 mm) to 0.006 inch (0.15 mm).</p> <p><b>Clearance less than 0.002 inch (0.05 mm) is permissible as long as any cylinder sleeve to cylinder block contact does not cause cylinder sleeve to be out of round, step 22.</b></p> <p><b>If clearance is greater than 0.008 inch (0.15 mm), tag cylinder block for cylinder sleeve lower bore repair sleeve, steps 29 thru 35.</b></p>



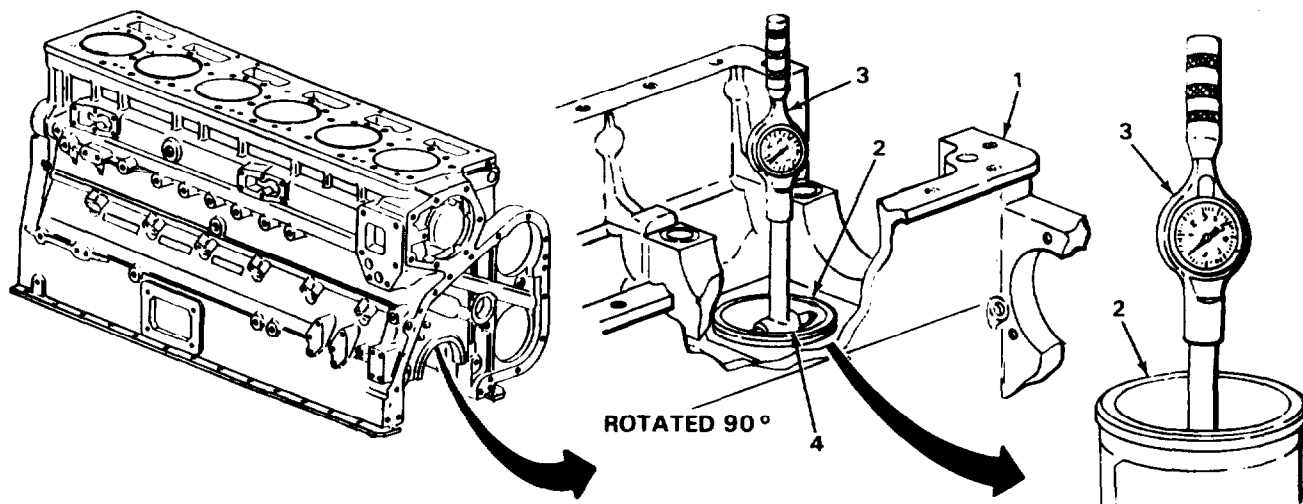
CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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CLEANING/INSPECTION - CONTINUED

- |                        |                     |  |
|------------------------|---------------------|--|
| 22. Cylinder block (1) | Cylinder sleeve (2) | <p>a. Using dial bore gage (3), check cylinder sleeve for out-of-round condition.<br/> <b>If cylinder sleeve is more than 0.002 Inch (0.05 mm) out of round in gasket area due to cylinder sleeve to cylinder block contact, tag cylinder block for cylinder sleeve lower bore repair sleeve, steps 29 thru 35.</b></p> <p>b. Remove, and using dial bore gage (3), check cylinder sleeve for out-of-round condition.<br/> <b>If cylinder sleeve is more than 0.002 inch (0.05 mm) out of round in gasket area, cylinder sleeve is distorted. Discard cylinder sleeve.</b></p> |
|------------------------|---------------------|--|

- |     |                                |   |
|-----|--------------------------------|---|
| 23. | Cylinder sleeve lower bore (4) | <p>Using ST-1252 concentricity gage, check counterbore to lower cylinder sleeve bore concentricity.<br/> <b>If cylinder sleeve lower bore is not concentric within 0.005 inch (0.13 mm) total indicator reading, tag cylinder block for cylinder sleeve lower bore repair sleeve, steps 29 thru 35.</b></p> |
|-----|--------------------------------|---|



CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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REPAIR

**WARNING**

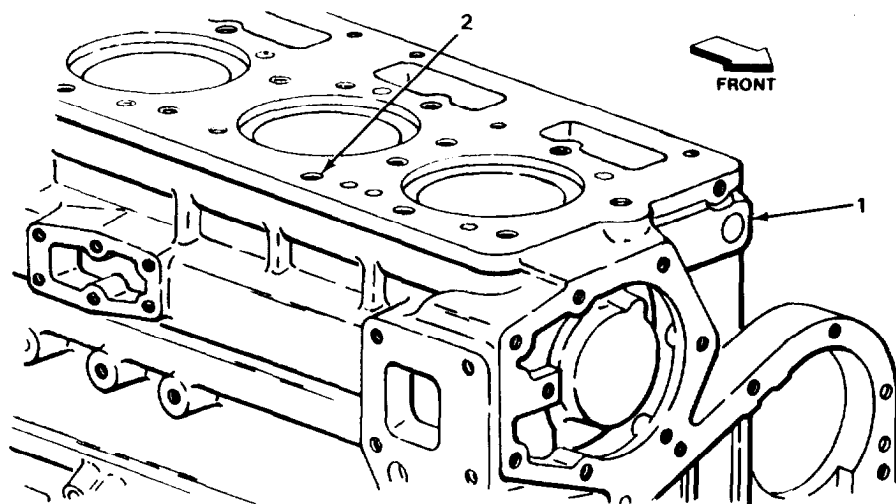
Repair of engine must be performed on engine repair stand (page 2-11). Due to excessive weight assistance will be needed to prevent injury when lifting heavy parts.

24. Cylinder block (1)	Eroded water passage holes (2)	<ul style="list-style-type: none"> <li>a. Using ST-1010 water hole counterboring tool, enlarge water passage hole for sleeve.</li> <li>b. Slide sleeve onto stop end of ST-1010-9 bushing driver.</li> <li>c. Aline sleeve in top of water passage hole.</li> <li>d. Using 16-ounce ball-peen hammer, strike ST-1010-9 bushing driver to drive sleeve into water passage hole until it bottoms.</li> </ul>	<p><b>Sleeve will protrude above surface of cylinder block.</b></p>
------------------------	--------------------------------	--	---

**NOTE**

If cylinder block is to be resurfaced, it is not necessary to file sleeve flush with top of cylinder block. If cylinder block is not resurfaced, perform step e.

- e. Using a wide flat mill file, file sleeve flush with top of cylinder block.



**CYLINDER BLOCK - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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REPAIR - CONTINUED

**NOTE**

Steps 24 and 26 are provided for cylinder block if tagged for resurfacing.

- |     |                    |   |
|-----|--------------------|---|
| 25. | Cylinder block (1) | <ul style="list-style-type: none"> <li>a. Position main bearing pads (2) of cylinder block on milling machine.</li> <li>b. Remove grooved headless pins (3) from cylinder head mounting surface (4).</li> </ul> |
|-----|--------------------|---|

**WARNING**

Due to excessive weight, assistance will be needed to prevent personal injury when lifting heavy parts.

**CAUTION**

When resurfacing cylinder block, do not remove so much material that the height, A, from the centerline of the main bearing bore to the top surface of the cylinder block is less than 18.994 inches (482.448 mm), or cylinder block will become unusable.

**NOTE**

Cylinder block may be salvaged by removing a maximum of 0.010 inch (0.25 mm) of material from the top surface.

- |     |                    |  |
|-----|--------------------|--|
| 26. | Cylinder block (1) | <ul style="list-style-type: none"> <li>c. Using a milling machine, remove only enough material from top of cylinder block to repair damage.</li> </ul> <p>Remove from milling machine.</p> |
|-----|--------------------|--|

**NOTE**

The following step is provided for cylinder head capscrew threads tagged for repair.

- |     |   |  |
|-----|---|--|
| 27. | Cylinder block (1)<br>Cylinder head capscrew hole (5) | <ul style="list-style-type: none"> <li>a. Using a dial indicator depth gage with a 1/4-inch wide blade seated in center taper of hole (5), determine depth of hole.                             <ul style="list-style-type: none"> <li><b>If depth is 2 11/32 inches (59.53 mm) deep, proceed to steps b,c,d, and e.</b></li> <li><b>If depth is 2 9/18 inches (85.09 mm) deep, proceed to steps f, g, and h.</b></li> </ul> </li> </ul> |
|-----|---|--|



CYLINDER BLOCK - CONTINUED

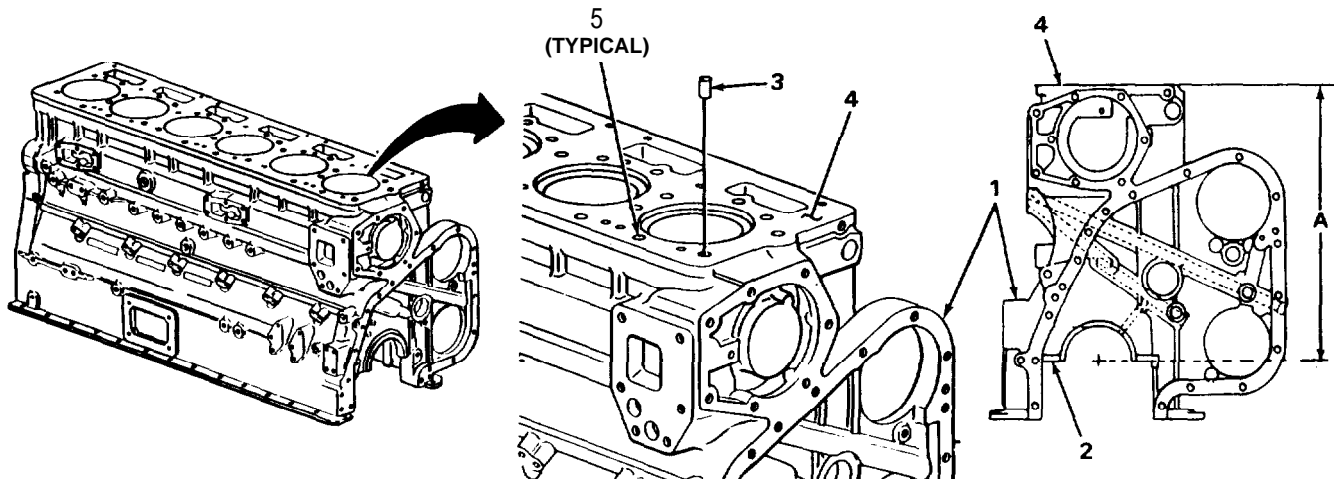
LOCATION	ITEM	ACTION	REMARKS
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**WARNING**

Safety goggles must be worn to prevent eye injury caused by flying steel chips.

Particles blown by compressed air are hazardous. Make certain the air stream is directed away from user and other personnel in the area. Compressed air used for cleaning purposes shall not exceed 30 psi (207 kPa). User must wear safety goggles or face shield to prevent personnel injury.

- b. Using 1/2-inch portable electric drill and 23/32-inch drill bit, drill hole to a depth of 1 7/8 inches (47.63 mm).
- c. Using ST-476 screw thread insert kit, tap hole to 1 3/4-inch (44.45 mm) depth.
- d. Clean all chips and shavings from hole with compressed air.
- e. Using ST-476 screw thread insert kit, install screw thread insert to a depth of 1/2 inch (12.70 mm) below top surface of cylinder block (1).
- f. Using 1/2-inch portable electric drill and 23/64-inch drill bit, drill hole to a depth of 2 1/16 inches (52.39 mm).
- g. Using ST-476 screw thread insert kit, tap hole to 1 15/16-inch (49.21 mm) depth.
- h. Clean all chips and shavings with compressed air from hole.
- i. Using ST-476 screw thread insert kit, install screw thread insert to a depth of 11/16 inch (17.46 mm) below top surface of cylinder block.



CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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REPAIR - CONTINUED

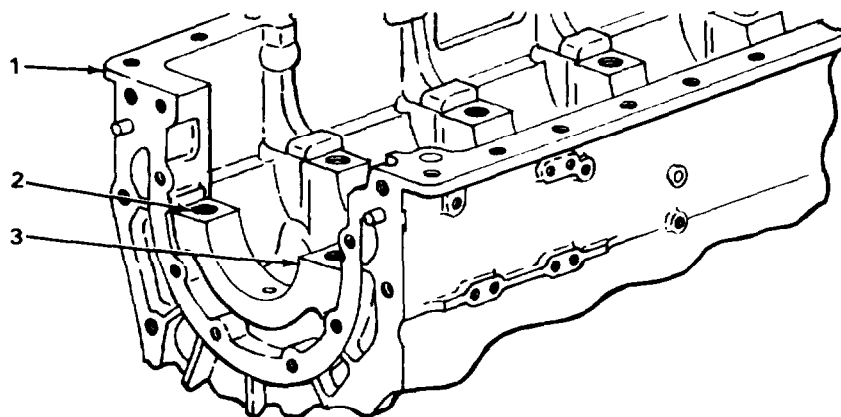
**WARNING**

Safety goggles must be worn to prevent eye injury caused by flying steel chips.

**NOTE**

Step 28 is for main bearing capscrew threads tagged for repairs and steps 29 thru 35 are for cylinder block tagged for sleeve lower bore repairs.

- |                                      |                                       |  |
|--------------------------------------|---------------------------------------|--|
| <p><b>28.</b> Cylinder block (1)</p> | <p>Main bearing capscrew hole (2)</p> | <ol style="list-style-type: none"> <li>a. Using 1/2-inch portable electric drill and 1 1/32-inch bit, drill hole 2.675 to 2.705 inches (68.16 to 68.74 mm) deep from main bearing cap pad (3).</li> <li>b. Using ST-1230 screw thread insert kit, tap hole of 2.425 to 2.455 inches (61.60 to 62.36 mm) deep.</li> <li>c. Using inserting tool from kit, install screw thread insert 0.860 to 0.890 inch (21.84 to 22.61 mm) deep below main bearing cap pad (3).</li> </ol> |
|--------------------------------------|---------------------------------------|--|



- |                                      |                                |   |
|--------------------------------------|--------------------------------|---|
| <p><b>29.</b> Cylinder block (1)</p> | <p>ST-1081 boring tool (4)</p> | <p>Install assembled ST-1081 boring tool, allowing bore adapter (5) to engage counterbore, and holes in adapter plate (6) to match holes in cylinder block.</p>   |
| <p><b>30.</b></p>                    | <p>Adapter plate (6)</p>       | <ol style="list-style-type: none"> <li>a. Fasten in place with capscrews (7).</li> <li>b. Using 1/2-inch drive, 1 1/16-inch socket, and 0 to 150 ft lb (0 to 210 N•m) torque wrench, screw in and torque cap-screw 50 to 75 ft lb (6.9 to 10.4 kgm).</li> </ol> |

**CYLINDER BLOCK - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
31. Adapter plate (6)	Torque reaction bar (8)	Install into place.
32. ST-1081 boring tool (4)	Drive gear (9), 1/2-inch drive flex drive adapter (10) and 1/2-inch portable electric drill (11)	Engage 1/2-inch drive flex drive adapter into 1/2-inch portable electric drill, fasten in place, and engage onto drive gear.

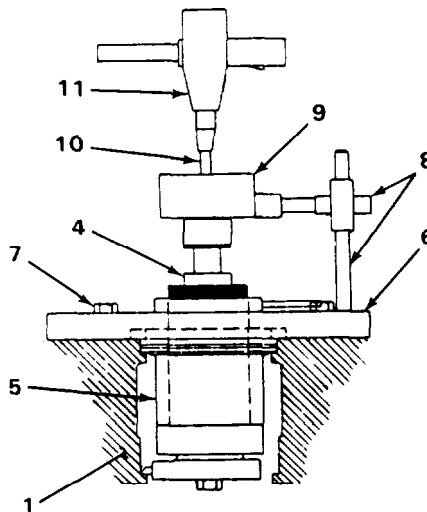
**WARNING**

Safety goggles must be worn to prevent eye injury caused by flying steel chips.

**NOTE**

Be sure ST-1081 boring tool drive shaft is in maximum up position before turning on drill.

- |                        |                                       |  |
|------------------------|---------------------------------------|--|
| 33.                    | 1/2-inch portable electric drill (11) | <ul style="list-style-type: none"> <li>a. Using 1/2-inch portable electric drill, apply a slight downward pressure until maximum depth of bore is complete.</li> <li>b. Pull drive shaft of ST-1081 boring tool up until shaft is in up position.</li> </ul> |
| 34. Cylinder block (1) | ST-1081 boring tool (4)               | Remove from cylinder block.  |



**CYLINDER BLOCK - CONTINUED**

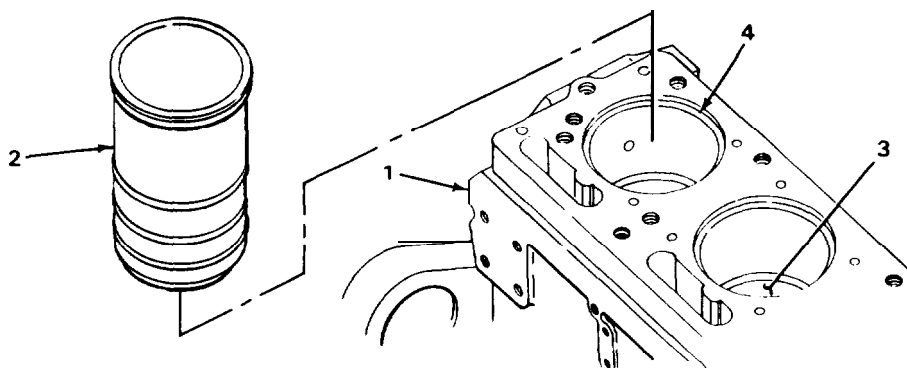
LOCATION	ITEM	ACTION	REMARKS
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REPAIR - CONTINUED

**NOTE**

Inside diameter chamfer of repair sleeve is installed towards top surface of cylinder block.

- |                        |                   |   |
|------------------------|-------------------|---|
| 35. Cylinder block (1) | Repair sleeve (2) | <ol style="list-style-type: none"> <li>a. Push through upper bore and position in lower bore (3).</li> <li>b. Insert repair sleeve driver handle into repair sleeve driver, and position on repair sleeve.</li> <li>c. Install locator over repair sleeve driver handle and into counterbore (4).</li> <li>d. Using 16-ounce ball-peen hammer, tap gently on repair sleeve driver handle until repair sleeve is located on starting radius, then drive repair sleeve into place.</li> </ol> <p style="margin-left: 20px;"><b>When repair sleeve is in correct position, the repair sleeve driver handle will become free for removal.</b></p> |
|------------------------|-------------------|---|



**NOTE**

Steps 36 thru 39 are provided for cylinder blocks tagged for main bearing cap replacement.

Replacement main bearing caps have 0.015 inch (0.36 mm) material in bore. Other dimensions are the same as finished main bearing caps. Number 7 replacement main bearing cap does not have cap to block dowel holes and must be machined to block width.

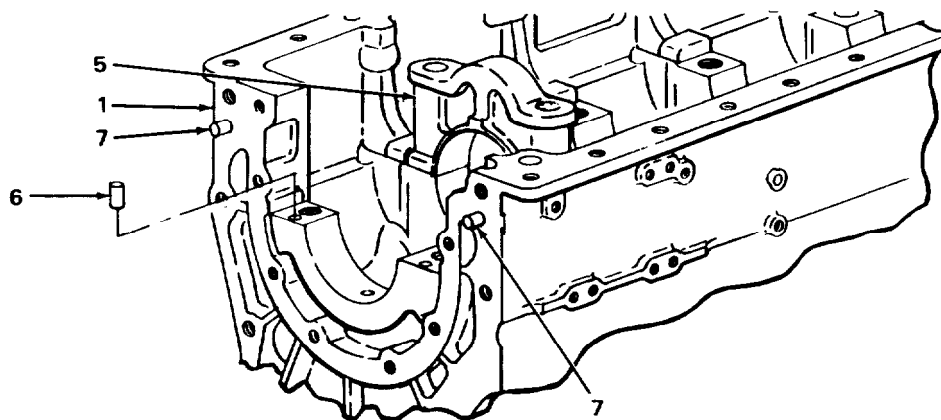
## CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION REMARKS
36. Cylinder block (1)	Main bearing cap (5)	Place in correct position in cylinder block. <b>Main bearing caps provide a 0.0015 to 0.0045 inch (0.04 to 0.11 mm) interference fit in cylinder block.</b>

**NOTE**

Steps 34 thru 36 apply to replacing the number 7 main bearing cap.

- |     |                      |  |
|-----|----------------------|--|
| 37. | Locating dowels (6)  | Remove from block.   |
| 38. | Main bearing cap (5) | <ol style="list-style-type: none"> <li>Using prussian blue on block surface, place main bearing cap in position, and locate dowel holes in main bearing cap.</li> <li>Remove main bearing cap.</li> <li>Install dowels in cylinder block and re-install main bearing cap.</li> </ol> |
| 39. |                      | Install all caps and tag cylinder block for main bearing bore reaming, steps 41 thru 50.   |
| 40. | Straight pins (7)    | <ol style="list-style-type: none"> <li>If nicked, using emery cloth remove all nicks.</li> <li>If out of round, using pin puller, remove.</li> <li>Using plastic-faced hammer, install new straight pins.</li> </ol>   |



CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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REPAIR - CONTINUED

**NOTE**

Steps 39 thru 48 are provided for cylinder block tagged for main bearing reaming.

41.	Cylinder block (1) Main bearing caps (2)	<ul style="list-style-type: none"> <li>a. Using wide flat mill file, remove 0.002 to 0.003 inch (.051 to .076 mm) of stock from milled seating surface of main bearing caps which are determined to be distorted. <b>If replacement cap is being used, removing this material is not necessary.</b></li> <li>b. Remove two undamaged main bearing caps, preferably one from each end of block or as far apart as possible.</li> </ul>
42.	ST-1177 boring tool (3)	Insert proper centering rings, with oiler up, in two undamaged bores, and tap with plastic-faced hammer to seat.
43.	Main bearing caps (2)	Using 0 to 600 ft lb (0 to 813.6 N•m) torque wrench, reinstall and torque to specifications. <b>See procedure, step 14.</b>

**NOTE**

If centering ring must be installed where replacement main bearing caps have been substituted, limit torque to 10 ft lb (14 N•m).

44.	ST-1177 boring tool (3)	<ul style="list-style-type: none"> <li>a. Install with proper cutting tools.</li> <li>b. Using lubricating oil, lubricate cutting tools and main bearing bores.</li> </ul>
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**CAUTION**

Be sure tool bit cutting edge is turned in the same direction as 1/2-inch portable electric drill rotation.

Keep ST-1177 boring tool and main bearing bores well lubricated during all boring operations.

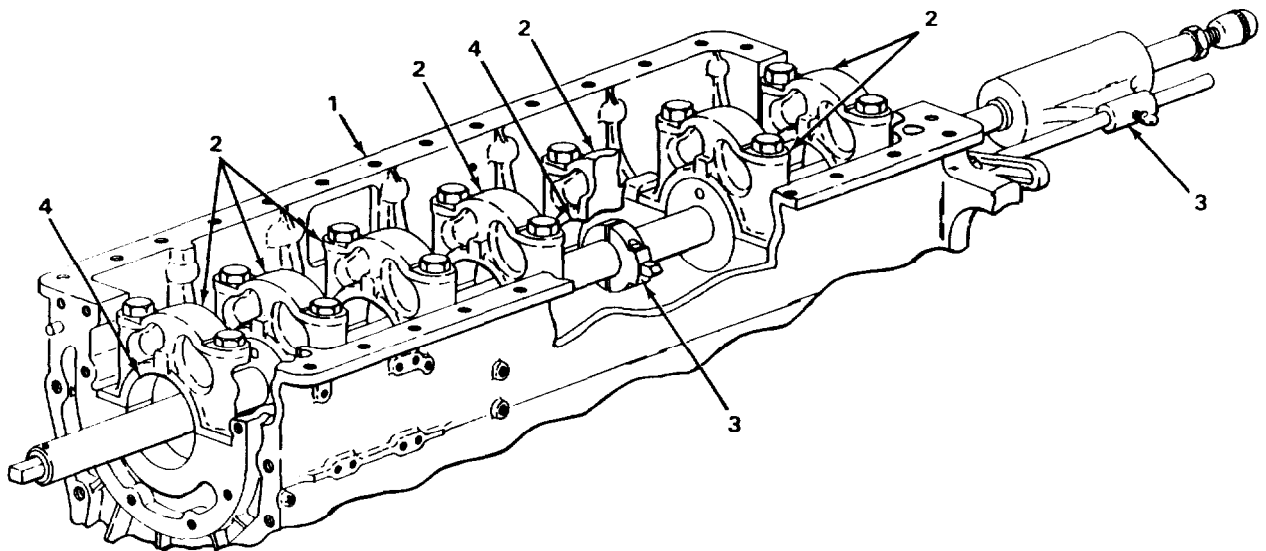
CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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**WARNING**

Safety goggles must be worn to prevent eye injury caused by flying steel chips.

- |     |                         |  |  |
|-----|-------------------------|--|--|
| 45. | ST-1177 boring tool (3) | a. Attach 1/2-inch portable electric drill to ST-1177 boring tool swivel joint.<br>b. Turn on 1/2-inch portable electric drill and ream main bearing bore.<br>c. Turn off 1/2-inch portable electric drill and remove from ST-1177 boring tool swivel joint. |  |
| 46. | Cylinder block (1)      | Adjust to next main bearing bore to be cut.  |  |
| 47. | Cylinder block (1)      | Repeat steps 45 and 46 until all main bearing bores to be cut are reamed.  |  |
| 48. | ST-1177 boring tool (3) | Remove from cylinder block.  |  |
| 49. | Cylinder block (1)      | Thoroughly clean cylinder block.<br><b>See page 2-3, for general cleaning instructions.</b>  |  |
| 50. | Main bearing bore (4)   | Using a dial bore gage, check size of all main bearing bores, see steps 14 and 15.   |  |



**CYLINDER BLOCK - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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REPAIR - CONTINUED

**NOTE**

Steps 51 and 52 are provided for cylinder blocks tagged for camshaft bushing replacement.

51. Cylinder block (1)	Camshaft bushings (2)	Using ST-1228 camshaft bushing driver (3), remove.	
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**CAUTION**

Positioning of new camshaft bushing in number seven bushing bore (rear of cylinder block) is critical. The new bushing must be pressed in, leaving clearance between bushing and rear face of cylinder block to allow oil to drain from hole at rear of camshaft. Hydraulic lock will occur if oil drain passage is blocked.

Be sure oil hole in camshaft bushings is alined with oil feed hole in cylinder block. Damage to engine will occur if camshaft bushings are installed improperly.

**NOTE**

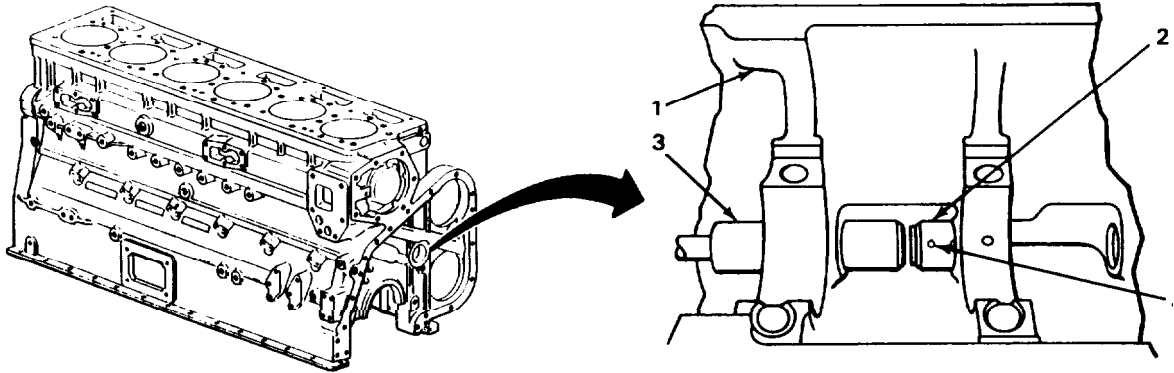
Number one camshaft bushing (front of cylinder block) is different from the other six camshaft bushings.

52.	Camshaft bushings (2)	<ul style="list-style-type: none"> <li>a. Position on ST-1228 camshaft bushing driver (3), alining oil hole (4) with oil hole in camshaft bushing bore.</li> <li>b. Press in to position in camshaft bushing bore.</li> <li>c. Check oil hole alinement. <b>If oil hole (4) is not alined, reposition camshaft bushings.</b></li> </ul>	
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CYLINDER BLOCK - CONTINUED

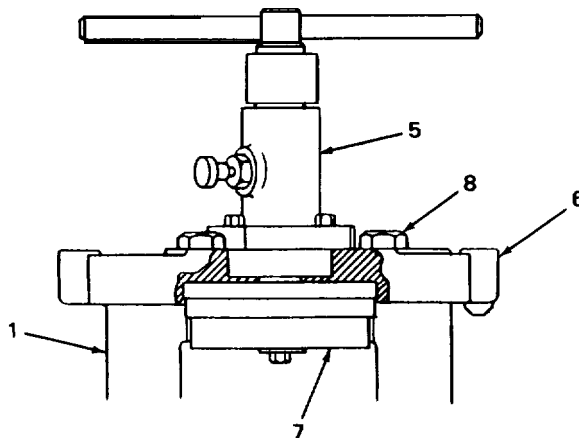
LOCATION	ITEM	ACTION REMARKS
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**NOTE**

Steps 53 thru 56 are provided for cylinder blocks tagged for counterbore cutting.

- |     |  |  |
|-----|--|--|
| 53. | ST-1059 driver (5),<br>ST-1084 adapter (6),<br>and ST-1065<br>holder (7) | Attach together and place unit on cylinder<br>block with holddown holes matching in<br>cylinder block.   |
| 54. | ST-1064 adapter (8)  | Holddown capscrews<br>and washers (8)  |
|     |  | Install through ST-1064 adapter into cylinder<br>block, finger tight. Using 1/2-inch drive<br>1 1/8-inch socket and 0 - 800 ft lb (0 -<br>813.8 N•m) torque wrench, torque to 50 to<br>75 ft lb (70 to 105 N•m). |



CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION REMARKS
REPAIR - CONTINUED		
<b>NOTE</b>		
Tool bit must rotate freely and clear counterbore ledge.		
55. Cylinder block (1)	Counterbore (2)	Using dial indicator depth gage, measure depth of counterbore through four counterbore measuring holes on ST-1064 adapter. <b>The average of the four readings will be the present depth of counterbore.</b>
58.	ST-1059 counterbore tool (3)	a. Rotate adjusting nut until tool bit is resting on lowest part of counterbore ledge and there is clearance between housing (4) and adjusting nut (5).

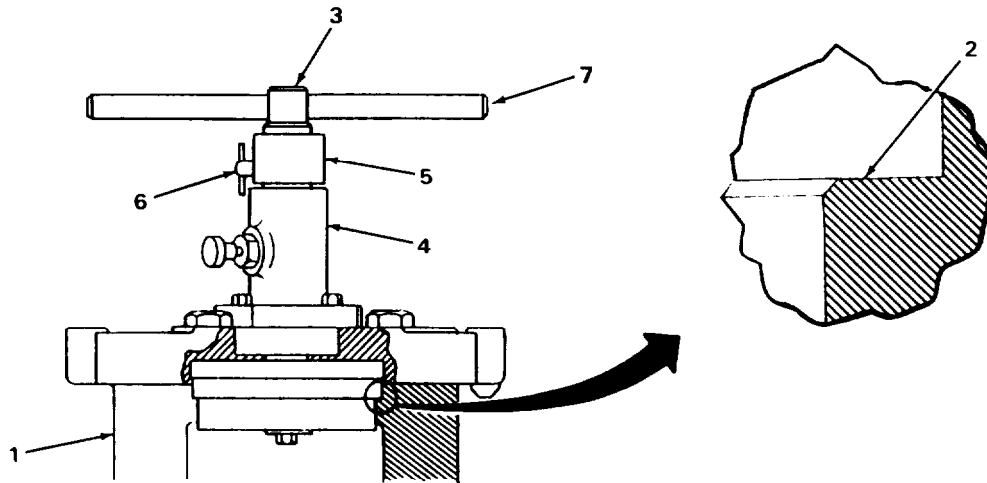
**NOTE**

The distance between housing and adjusting nut equals amount of material that will be removed from counterbore ledge.

- b. Using a thickness gage of the same thickness as amount of material needed to be removed from counterbore ledge (step 20) rotate adjusting nut until thickness gage is just held between adjusting nut and top of housing. Tighten locking nut (8).
- c. Hold down on handle (7), applying more pressure on tool bit side, and rotate handle in a clockwise direction until unit turns freely and is bottomed out between adjusting nut and top of housing.
- d. Measure depth of counterbore as described in step 55.  
**Compare with specifications in step 18.**

CYLINDER BLOCK - CONTINUED

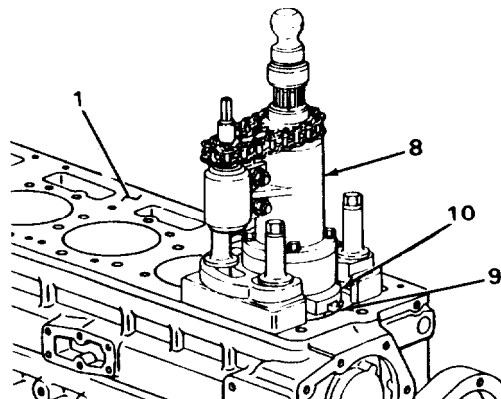
LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

Steps 57 thru 63 are provided for cylinder blocks tagged for cylinder sleeve counterbore salvage sleeve.

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|--|--|--|
| 57. ST-1168 cylinder sleeve salvage tool (8) | Cutting tool (9)                         | Remove from holding plate (10).  |
| 58. Cylinder block (1)                       | ST-1168 cylinder sleeve salvage tool (8) | a. Place on cylinder block above bore to be cut.<br>b. Install mounting capscrews into cylinder block. |
- Using 0 - 150 ft lb (0 - 210 N•m) torque wrench, tighten to 25 to 35 ft lb (33.9 to 47.5 N•m).**



CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION REMARKS
REPAIR - CONTINUED		
59. Cylinder block (1)	ST-1168 cylinder sleeve salvage tool (2)	a. Retract tool holder by pulling up on orifice retractor knob (3). b. Loosen setscrew in back end of tool bit (4) and push setpin all the way in. c. Lock setscrew.
60.	Tool bit gate micrometer (5)	a. Adjust to 6.750 inch (171.45 mm). b. Insert tool bit and hold firmly against stop and hardened pad. c. Loosen setscrew and allow setpin to come out against tool bit gate micrometer spindle. d. Lock setscrew.

**NOTE**

As a further check, back off thimble on tool bit gate micrometer and recheck tool bit length.

61.	ST-1168 cylinder sleeve salvage tool (2)	a. Insert tool bit (4) into tool holder and tighten lock screw. <b>Tool bit must be held all the way in against tool holder.</b> b. Turn tool holder until tool bit recess is at large opening in adapter plate (6). c. While pulling up on retractor knob (3) and pushing down on set collar (7), place a 0.004-inch (0.10 mm) thickness gage between cylinder block and tool bit. d. Lower tool bit onto thickness gage. e. Loosen set collar (7) setscrew and back off set collar (7) counterclockwise until salvage sleeve can be placed between set collar (7) and boring tool ST-1177 main body (8) to be used as a depth indicator. f. Tighten setscrew in set collar. <b>Remove thickness gage.</b>
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CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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**NOTE**

The thickness gage is used to make sure that the salvage sleeve will not be below the top of the cylinder block.

- g. Place 1/2-inch portable electric drill and 1/2-inch drive flex adapter on drive shaft (9).

**WARNING**

Approximately halfway through the cut, the tool will begin to cut the counterbore ledge. Be prepared for the added load on the drill when the counterbore is being cut, or personal injury could result.

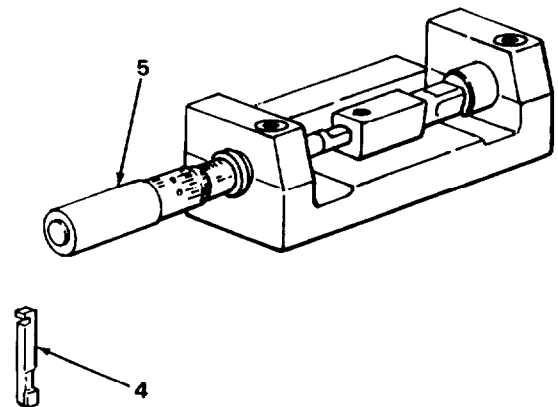
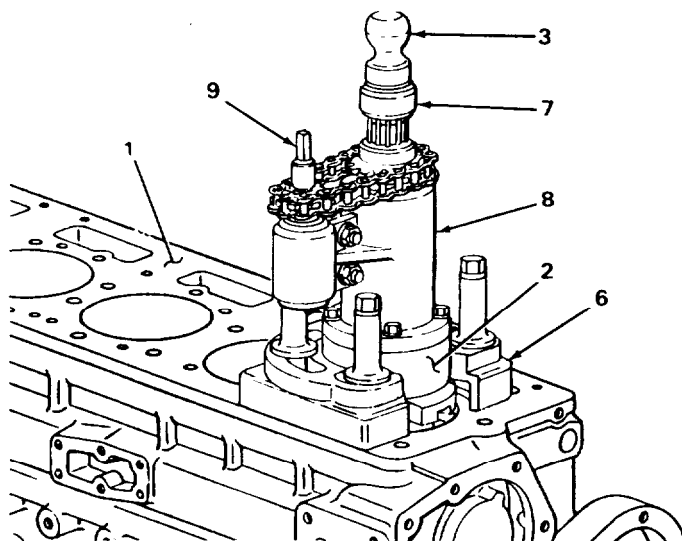
Safety goggles must be worn to prevent eye injury caused by flying steel chips.

- h. Operating 1/2-inch portable electric drill, bore hole until drill freewheels.  
**Stop immediately when drill freewheels.**
- i. Pull up on retractor knob (3) and remove tool bit (4) from tool holder.
- j. Remove ST-1168 cylinder sleeve salvage tool from cylinder block.

62.

Cylinder block (1)

Using emery cloth, deburr counterbore.



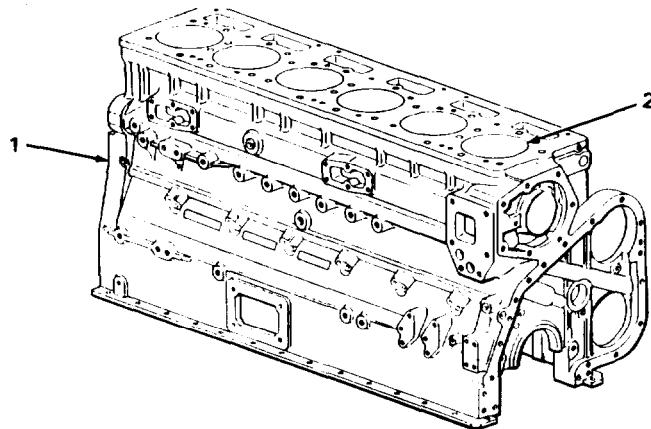
CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION REMARKS
REPAIR - CONTINUED		
63. Cylinder block (1)	Cylinder sleeve counterbore (2)	a. Using wiping rag, clean thoroughly. b. Place salvage sleeve on cylinder sleeve counterbore. c. Using salvage sleeve driver, drive salvage sleeve into bore until it bottoms. <b>A solid sound can be heard when salvage sleeve bottoms.</b>

**NOTE**

Salvage sleeve will protrude above top of cylinder block by 0.004 inch (0.10 mm) and must be filed even with top of cylinder block. Remove all burrs with emery cloth.

The salvage sleeve is designed to be 0.005 to 0.010 inch (0.13 to 0.25 mm) above required counterbore depth. Check depth and cut to specifications as described in step 18 and in steps 53 thru 56.



ASSEMBLY

**NOTE**

Steps 64 thru 68 are typical for installing all six cylinder sleeves in cylinder block.

CYLINDER BLOCK - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

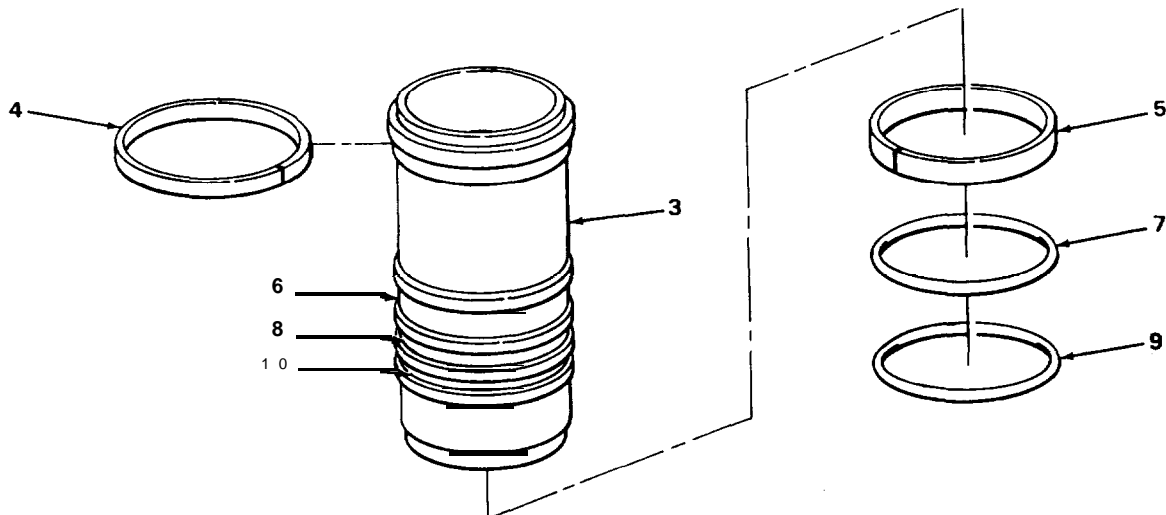
Before installing cylinder sleeves, check cylinder sleeve protrusion as described in step 20.

Be sure to install cylinder sleeves in their respective counterbores as tagged.

64.	Cylinder sleeve (3)	Shims or spacer (4)	Install onto cylinder sleeve.
65.	New gasket (5)	Install in gasket groove (6).	<b>Be sure gasket is not twisted.</b>
66.	New packing (7)	Install in packing groove (8).	<b>Be sure packing is not twisted.</b>
67.	New preformed packing (9)	Install in preformed packing groove (10).	<b>Be sure preformed packing is not twisted.</b>

**NOTE**

Lubricate gasket, packing, and preformed packing just prior to installation. The packing and preformed packing will increase in size when they are in contact with lubricating oil for an extended period of time.



CYLINDER BLOCK - CONTINUED

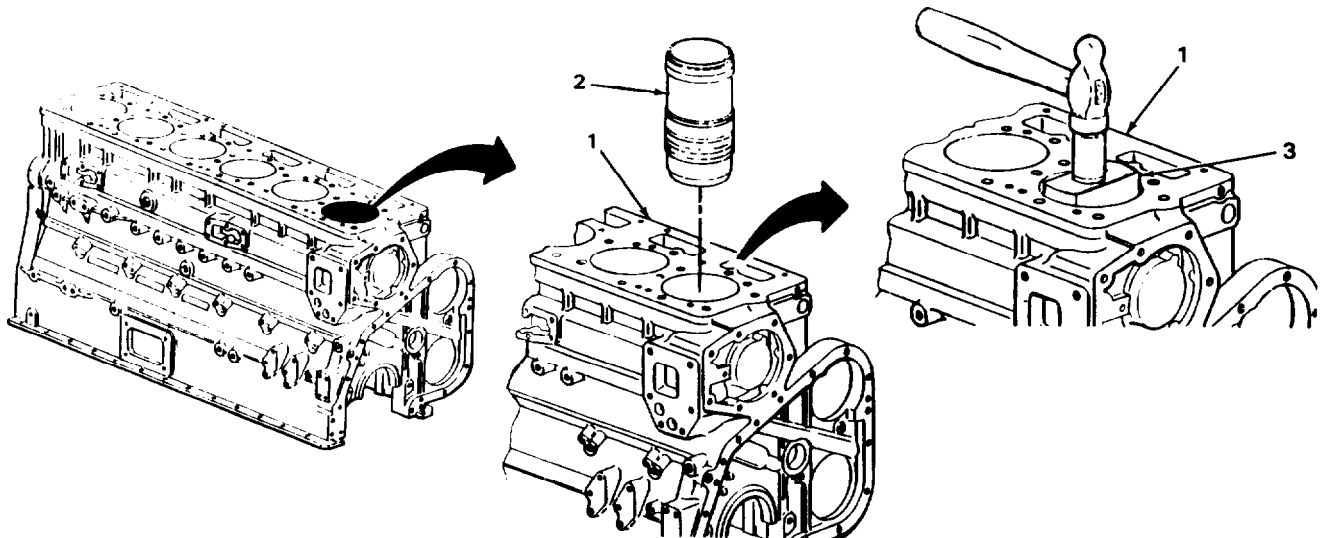
LOCATION	ITEM	ACTION	REMARKS
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ASSEMBLY - CONTINUED

**NOTE**

Lubricate machined portions of cylinder block, on which gasket, packing, and preformed packing seat, with a light coat of clean lubricating oil.

- |                        |                     |  |
|------------------------|---------------------|--|
| 68. Cylinder block (1) | Cylinder sleeve (2) | <ul style="list-style-type: none"> <li>a. Place in cylinder block.                             <ul style="list-style-type: none"> <li><b>Be careful not to dislodge gasket, packing, and preformed packing.</b></li> </ul> </li> <li>b. Press into position by hand.</li> <li>c. Using ST-1229 sleeve driver (3) and 16-ounce ball-peen hammer, drive cylinder sleeve securely into cylinder block so it fits squarely into cylinder block bore.</li> <li>d. Install ST-1184 cylinder sleeve salvage tool so foot of tool rests upon cylinder sleeve fire ring.</li> <li>e. Using 0 - 150 ft lb (0 - 210 N•m) torque wrench, tighten securing cap screws to 50 ft lb (70 N•m) torque.</li> <li>f. Check cylinder sleeve protrusion. See step 20.</li> <li>g. Check cylinder sleeve for out-of-round condition. See step 22.                             <ul style="list-style-type: none"> <li><b>If cylinder sleeve is out of round, remove and check for cause of distortion.</b></li> </ul> </li> </ul> |
|------------------------|---------------------|--|





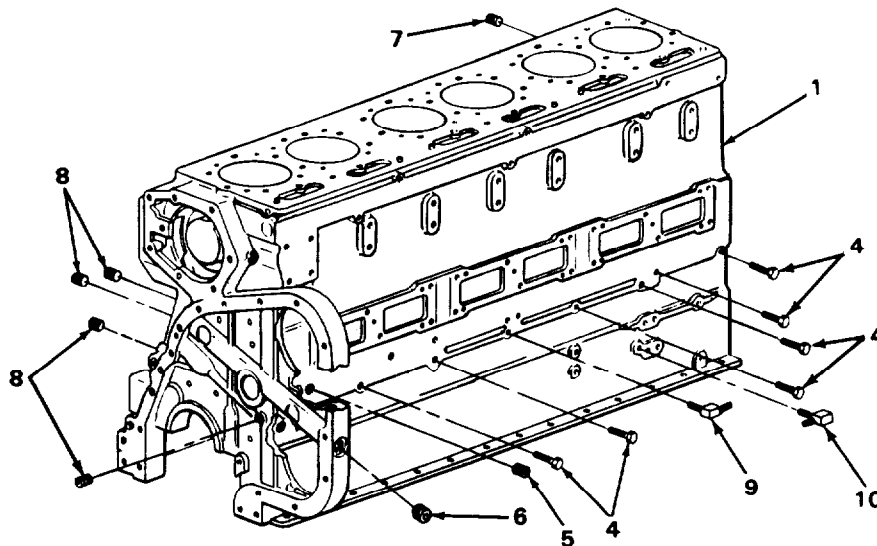
**CYLINDER BLOCK - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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**NOTE**

Be sure to wrap pipe plug threads with antiseizing tape before installation, and install as tagged in steps 3 thru 7

- |     |                    |               |   |
|-----|--------------------|---------------|---|
| 69. | Cylinder block (1) | Pipe plug (4) | Screw in and tighten using 7/16-inch box wrench.          |
| 70. |                    | Pipe plug (5) | Screw in and tighten using 3/8-inch drive ratchet handle. |
| 71. |                    | Pipe plug (8) | Screw in and tighten using 1/2-inch hex key.              |
| 72. |                    | Pipe plug (7) | Screw in and tighten using 9/16-inch box-end wrench.      |
| 73. |                    | Pipe plug (8) | Screw in and tighten using 5/16-inch square key.          |
| 74. |                    | Fitting (9)   | Screw in and tighten using 1/2-inch open-end wrench.      |
| 75. |                    | Fitting (10)  | Screw in and tighten using 11/16-inch open-end wrench.    |



**NOTE**

FOLLOW-ON MAINTENANCE: Install crankshaft (page 2-54).

**TASK ENDS HERE**

**GEARCASE COVER**

---

This task covers:

- a. Disassembly (page 2-172)
  - b. Cleaning/Inspection (page 2-172)
  - c. Repair (page 2-174)
  - d. Assembly (page 2-174)
- 

**INITIAL SETUP**

**Tools**

- Gage, bore, dial
- Handle, ratchet, 1/2-inch drive
- Mandrel, ST-598
- Press, arbor
- Socket, 9/18-inch, 1/2-inch drive

**Equipment Condition**

Gearcase cover removed (page 2-48).

---

LOCATION	ITEM	ACTION REMARKS
<b>DISASSEMBLY</b>		
1.	Gearcase cover (1)	Crankshaft seal (2)
		Remove. <b>Discard.</b>
2.		Accessory drive seal (3)
		Remove. <b>Discard.</b>
3.		Camshaft support (4), three screws (5), lockwashers (6), and flat washers (7)
		Using 1/2-inch drive 9/16-inch socket and ratchet handle, unscrew and take off. <b>Discard lockwashers.</b>
4.	Camshaft support (4)	Shim pack (8)
		Remove from camshaft support. <b>Hold for assembly.</b>

**CLEANING/INSPECTION**

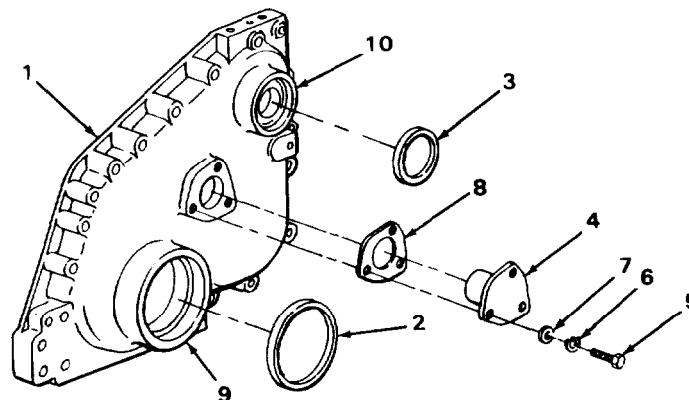
**NOTE**

For general cleaning procedures, see General Maintenance Instructions page 2-3.

- 5. Gearcase cover (1)
- Inspect for cracks or other damage.  
**If cracks or other damage exists, discard gearcase cover.**

GEARCASE COVER - CONTINUED

LOCATION	ITEM	ACTION REMARKS
6. Gearcase cover (1)	Trunnion (9)	Inspect inside diameter for wear. <b>If wear is excessive, tag gearcase cover for trunnion bushing installation.</b>
7.	Accessory drive bushing (10)	<p>a. Inspect inside diameter for scoring or pitting. <b>If scoring or pitting exists, tag accessory drive bushing for replacement.</b></p> <p>b. Using dial bore gage, check inside diameter. <b>If inside diameter is larger than 1.571 inch (39.90 mm), tag for replacement.</b></p>
8.	Camshaft support (4)	<p>a. Inspect for cracks or other damage. <b>If cracks or other damage exists, discard camshaft support.</b></p> <p>b. Using dial bore gage, check inside diameter. <b>If inside diameter is greater than 1.757 inch (44.83 mm), discard camshaft support.</b></p>



**GEARCASE COVER - CONTINUED**

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LOCATION	ITEM	ACTION REMARKS
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REPAIR

**NOTE**

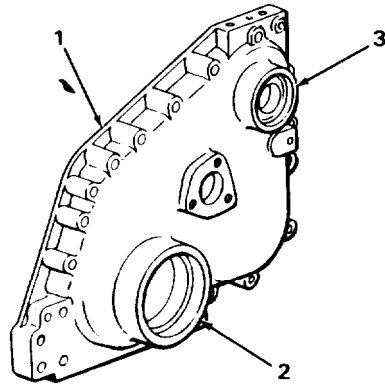
Perform step 9 or 10 if gearcase trunnion or accessory drive bushings need replacement.

9.	Gearcase cover (1) Trunnion (2)	Using arbor press, press bushing into trunnion. <b>Be sure chamfered side of bushing is toward gearcase.</b>
10.	Accessory drive bushing (3)	a. Using ST-598 mandrel, drive out and install new bushing.

ASSEMBLY

**NOTE**

Install new crankshaft seal, accessory drive seal, and camshaft support after gearcase cover is installed on cylinder block.



**NOTE**

FOLLOW-ON MAINTENANCE: Install on cylinder block (page 2-90).

**TASK ENDS HERE**

**OIL PAN**

This task covers:

Cleaning/Inspection

**OIL PAN - Continued**

INITIAL SETUP

Tools

Key, square, 3/8-inch

Key, square, 1/2-inch

Materials/Parts

Gasket, drain plug  
Dye, leak-detection (item 7,  
appendix B)

Equipment Condition

Oil pan removed from engine (page 2-44).

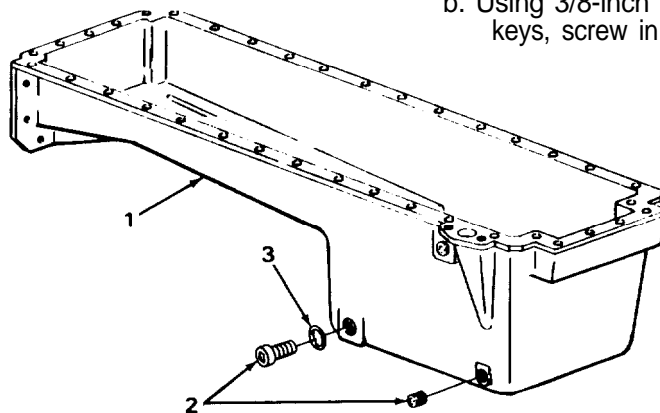
LOCATION	ITEM	ACTION	REMARKS
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CLEANING/INSPECTION

**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

- |    |  |   |
|----|--|---|
| 1. | Oil pan (1)  | <ul style="list-style-type: none"> <li>a. Using leak detection dye, inspect oil pan for cracks.<br/><b>If cracks exists, discard.</b></li> <li>b. Inspect holes for damaged threads.<br/><b>If damage exists, discard.</b></li> </ul>   |
| 2. | Oil pan (1)<br><br>Drain plugs (2)<br>and gasket (3) | <ul style="list-style-type: none"> <li>a. Using 3/8-inch and 1/2-inch square keys, unscrew and take out. Inspect holes and drain plugs gasket for damage.<br/><b>If damaged, discard.</b></li> <li>b. Using 3/8-inch and 1/2-inch square keys, screw in and tighten.</li> </ul> |



**NOTE**

FOLLOW-ON MAINTENANCE: Install oil pan (page 2-96).

**TASK ENDS HERE**

## Section VI. CYLINDER HEAD MAINTENANCE

### CYLINDER HEAD

---

This task covers:

- |                             |                                 |
|-----------------------------|---------------------------------|
| a. Disassembly (page 2-177) | c. Inspection (page 2-180)      |
| b. Cleaning (page 2-180)    | d. Repair/Assembly (page 2-191) |
- 

### INITIAL SETUP

#### Tools

Arbor set, valve guide, ST-663  
 Brush, wire  
 Checking tool, injector tip protrusion, ST-981  
 Compressor, spring, valve  
 Cutter, injector sleeve, ST-884  
 Cutter, valve seat insert, ST-662  
 Cutting tool, bead, ST-788  
 Driftpin, 1/4-inch  
 Driver, tool, ST-1122  
 Driver tool, valve seat insert, ST-257  
 Eccentricimeter  
 Extension, 3-inch, 1/2-inch drive  
 Extractor, valve seat, ST-1133  
 Gage, bore, dial  
 Grinder, surface  
 Grinder, valve seat, ST-685  
 Hammer, ball-peen, 16-ounce  
 Hammer, plastic-faced  
 Handle, ratchet, 1/2-inch drive  
 Holder, injector sleeve cutter, ST-884-1  
 Holding tool, injector sleeve, ST-1179  
 Indicator, dial, ST-547  
 Key, hex, 5/32-inch  
 Key, hex, 3/16-inch  
 Machine, refacer, valve  
 Mandrel, crosshead guide, ST-633  
 Mandrel, installation, injector sleeve, ST-1227  
 Mandrel, valve guide, ST-1217  
 Micrometer, 0- to 1-inch  
 Micrometer, 2- to 3-inch  
 Micrometer, depth  
 Micrometer, inside  
 Pencil  
 Pilot, injector sleeve cutter, ST-884-6  
 Press, arbor  
 Press, drill, suitable

#### Tools - Continued

Puller, dowel, ST-667  
 Puller, dowel, ST-1134  
 Puller, injector sleeve, ST-1244  
 Roller tool, expanding, ST-880  
 Rule, machinist's, steel  
 Socket, 1/2-inch, 1/2-inch drive  
 Socket, impact wrench, injector sleeve puller, ST-1247  
 Staking tool, insert, ST-1124  
 Tester, vacuum, 6-volt, ST-417  
 Tester, vacuum, 12-volt, ST-417-A  
 Tester, vacuum, 110-volt, ST-1257  
 Tester, valve spring  
 Wrench, torque, 0 to 150 in. lb (0 to 16.9 N•m), 1/2-inch drive  
 Wrench, torque, 0 to 175 ft lb (0 to 245 N•m), 1/2 inch drive

#### Materials/Parts

Collet, half (16 required)  
 Crocus cloth (item 4, appendix B)  
 Cutting fluid, lapping (item 5, appendix B)  
 Grease, extreme-pressure (item 10, appendix B)  
 Oil, lubricating (item 12, appendix B)  
 Packing, preformed, injector sleeve (two required)  
 Prussion blue (item 13, appendix B)  
 Tags, marker (item 17, appendix B)  
 Tape, antiseizing (item 18, appendix B)

#### References

TM 55-1500-335-23, Inspection Methods, Non-Destructive

#### Equipment Condition

Cylinder head removed (page 2-36).

CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

DISASSEMBLY

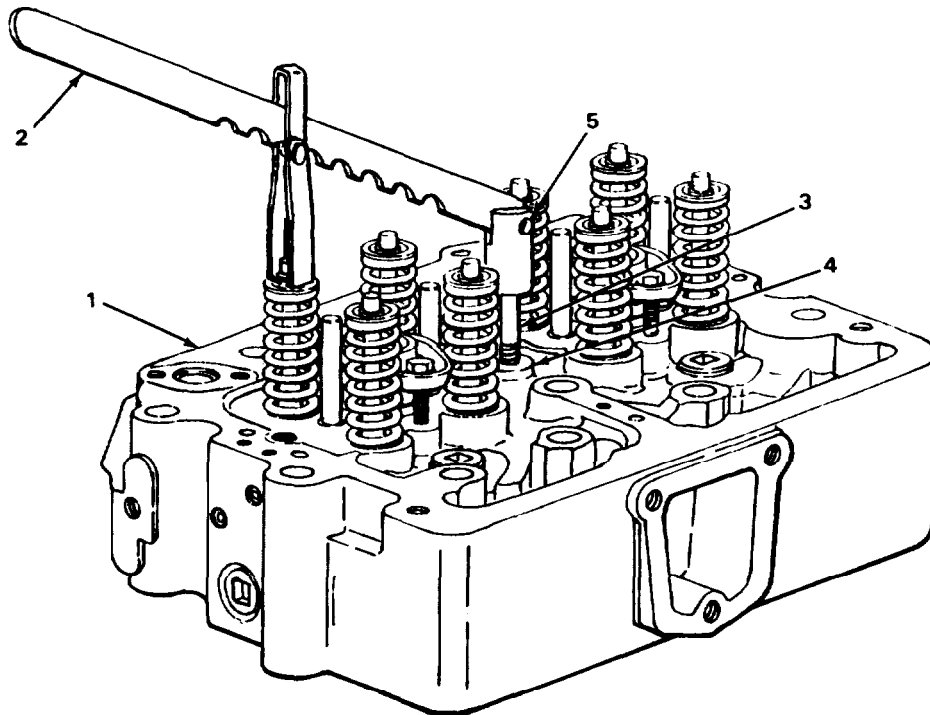
**WARNING**

Extreme care must be taken when releasing springs under pressure. Injury to personnel could result.

**NOTE**

Steps given are typical for all three cylinder heads.

- |                      |                             |   |
|----------------------|-----------------------------|---|
| 1. Cylinder head (1) | Valve spring compressor (2) | a. Screw stud (3) into rocker lever cap-screw hole (4).<br>b. Install valve spring compressor pivot head (5) on stud (3). |
|----------------------|-----------------------------|---|



**CYLINDER HEAD - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY - CONTINUED

**NOTE**

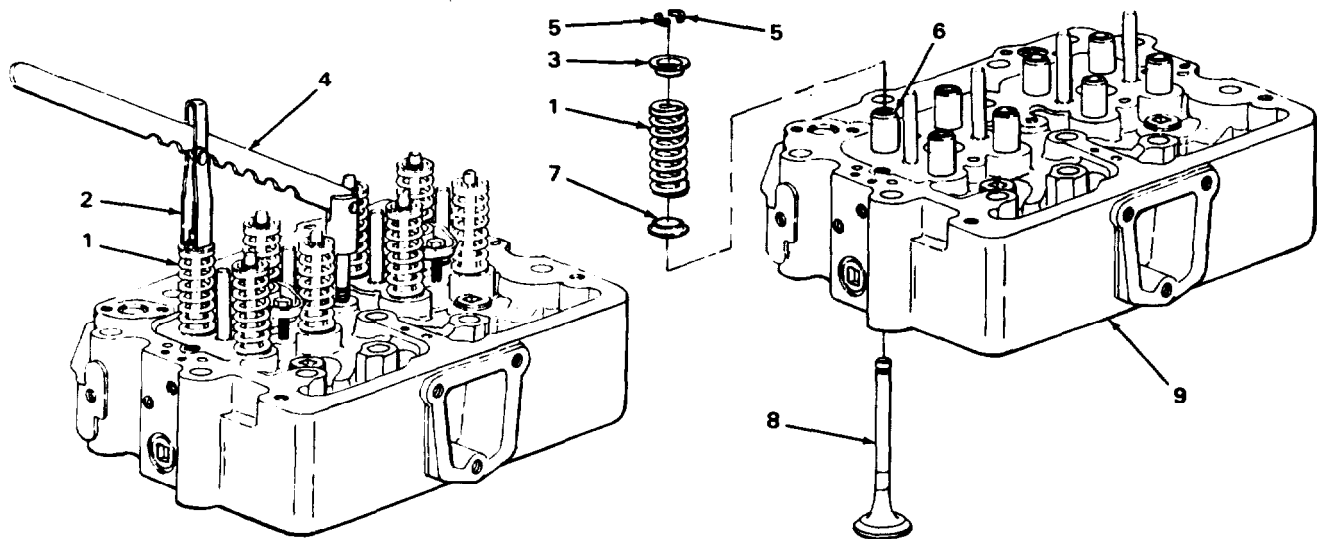
Each of the eight valve springs can be reached without relocating stud. Compress one valve spring at a time to remove half collets.

2. Valve spring (1)	Compression head (2)	Place on valve spring retainer (3) and press down valve spring compressor (4).	<b>Remove and discard half collets (5).</b>
3. Valve guide (6)	Valve spring retainer (3), valve spring (1), and spring seat (7)	Lift off.	

**NOTE**

Tag valves (8) as to their location in cylinder head (9) so they can be reassembled in the same valve guide (6).

4. Cylinder head (9)	Valve (8)	Using 16-ounce ball-peen hammer, tap valve (8) down lightly to remove from cylinder head (9).	<b>Tag valves (8) and hold for inspection.</b>
----------------------	-----------	---	--





CYLINDER HEAD - CONTINUED

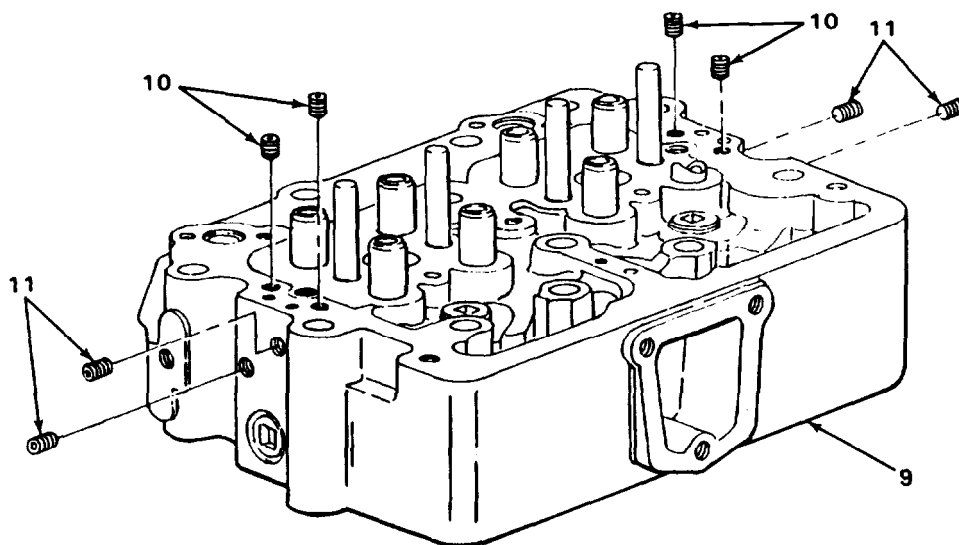
LOCATION	ITEM	ACTION REMARKS
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**NOTE**

All fuel passage pipe plugs in cylinder heads must be removed before cleaning. Do not discard pipe plugs. Hold plugs for reinstallation.

The number and location of pipe plugs may vary because of cylinder head location on cylinder block.

- |                      |                      |   |
|----------------------|----------------------|---|
| 5. Cylinder head (9) | Four pipe plugs (10) | Using 5/32-inch hex key, loosen and remove. |
| 6.                   | Four pipe plugs (11) | Using 3/16-inch hex key, loosen and remove. |

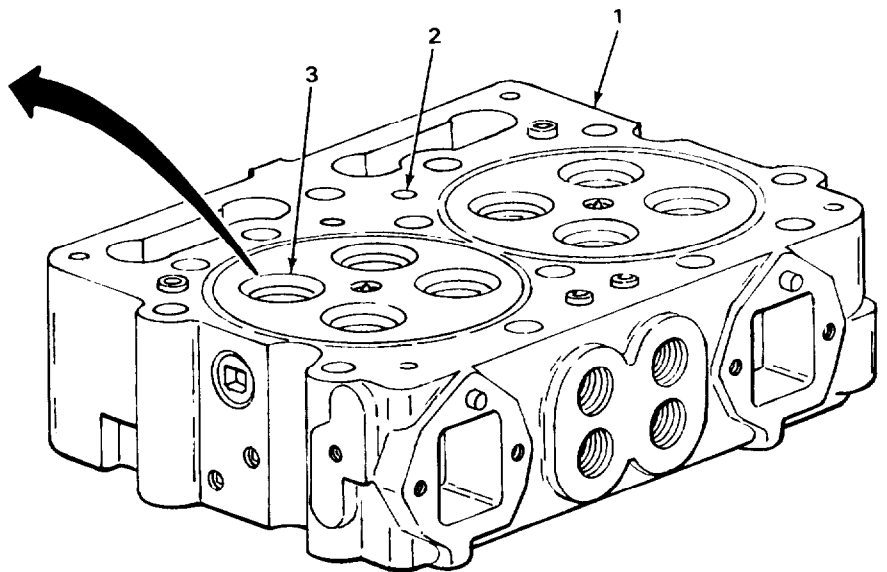
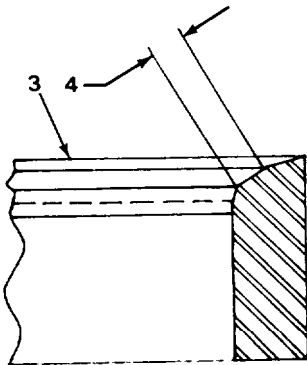


CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
CLEANING		
<b>NOTE</b>		
For general cleaning procedures, see General Maintenance Instructions, page 2-3.		
INSPECTION		
<b>NOTE</b>		
Steps given are typical for all three cylinder heads.		
For more complete inspection of cylinder head, polish mating surfaces with crocus cloth.		
For tagging parts, see General Maintenance Instructions, page 2-3.		
7. Cylinder head (1)		<ul style="list-style-type: none"> <li>a. Using magnetic inspection method, inspect for cracks. <b>If cracks are found, discard cylinder head (1).</b></li> <li>b. Visually inspect surface near water passage holes (2) for pits and scratches.</li> <li>c. Using steel machinist's rule, measure length of pits and scratches. <b>If pits and scratches are more than 2/32 to 5/32-inch (1.59 to 3.97 mm) from edge of water hole, discard cylinder head (1).</b></li> <li>d. Check for warped mating surfaces. <b>If cylinder head is warped, tag cylinder head for resurfacing. See steps 24 and 25.</b></li> </ul>
8.	Valve seat insert (3)	Visually inspect for cracks or burns. <b>If cracks or burns exist, tag valve seat for replacement. See steps 26 thru 34.</b>

CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
9. Cylinder head (1)	Valve seat insert (3)	Using plastic-faced hammer, carefully tap cylinder head around valve seat insert. <b>If valve seat insert bounces, tag for replacement. See steps 26 thru 34.</b>
10. Valve seat insert (3)	Valve seat width (4)	Using steel machinist's rule, measure width. <b>If width (4) exceeds 0.125 inch (3.18 mm) at any one point, and cannot be narrowed to between 2/32 and 4/32-inch (1.66 to 3.18 mm) during regrind, tag valve seat for replacement. See steps 28 thru 34.</b>

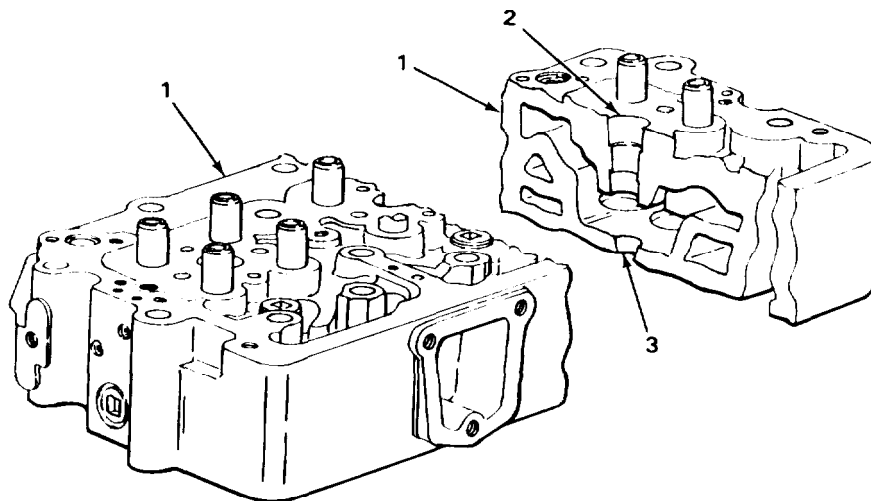


CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION - CONTINUED

- |                       |                     |  |   |
|-----------------------|---------------------|--|---|
| 11. Cylinder head (1) | Injector sleeve (2) | Visually inspect cup seating area (3) for scratches. | <b>If cup seating area is scratched, tag for replacement. See steps 35 thru 48.</b> |
|-----------------------|---------------------|--|---|



- |                          |                       |  |  |
|--------------------------|-----------------------|--|--|
| 12. Cup seating area (3) | Injector cup (4)      | Lightly coat injector cup with prussian blue.  |  |
| 13. Injector sleeve (2)  | Injector assembly (5) | <p>a. Using 1/2-inch drive 1/2-inch socket, 3-inch extension, and ratchet handle, install injector assembly. Secure with clamp (6) and capscrews (7).</p> <p><b>Using 1/2-inch drive, 1/2-inch socket, and 0 to 175 ft lb (0 to 245 N•m) torque wrench, tighten capscrews (7) alternately in 4 ft lb (5.4 N•m) increments to 10 to 12 ft lb (13.5 to 16.2 N•m).</b></p> <p>b. Using 1/2-inch drive 1/2-inch socket, 3-inch extension, and ratchet handle, remove capscrews (7) clamp (6), and injector assembly.</p> |  |

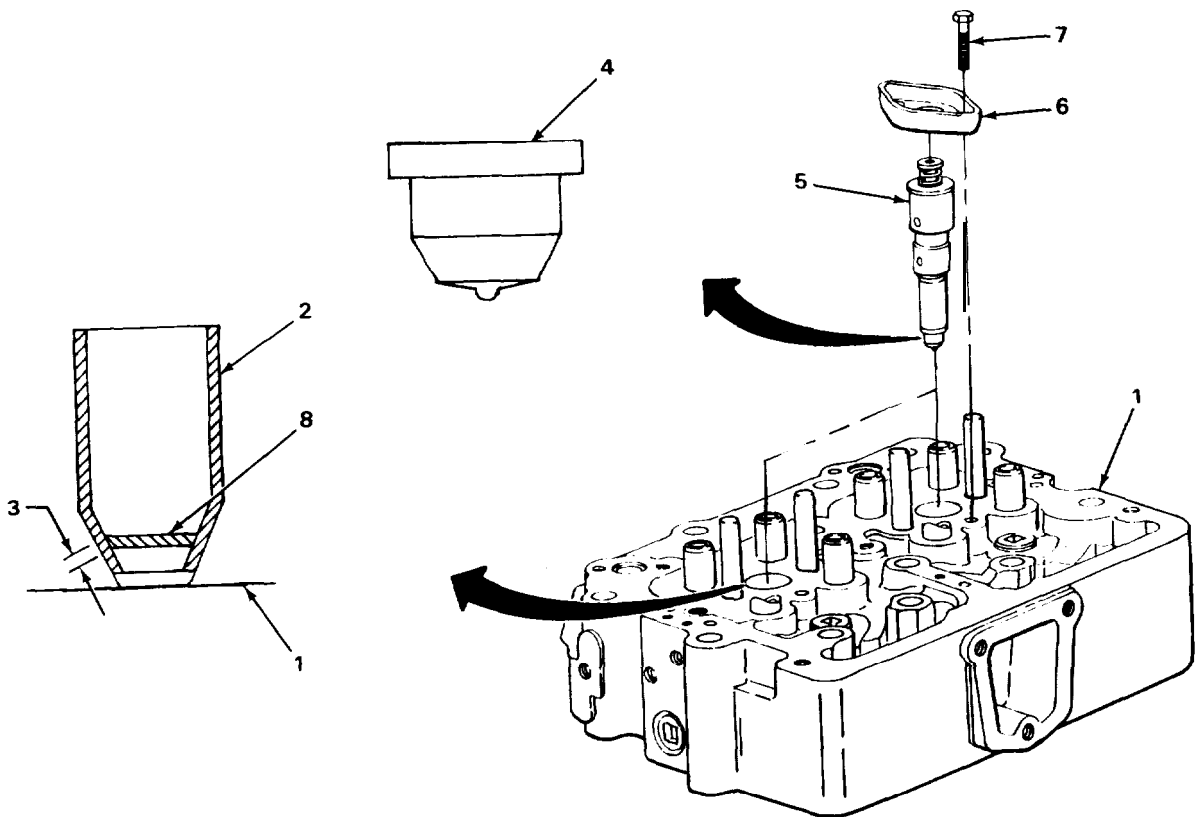
CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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14. Injector sleeve (2)  
and cup seating  
area (3)

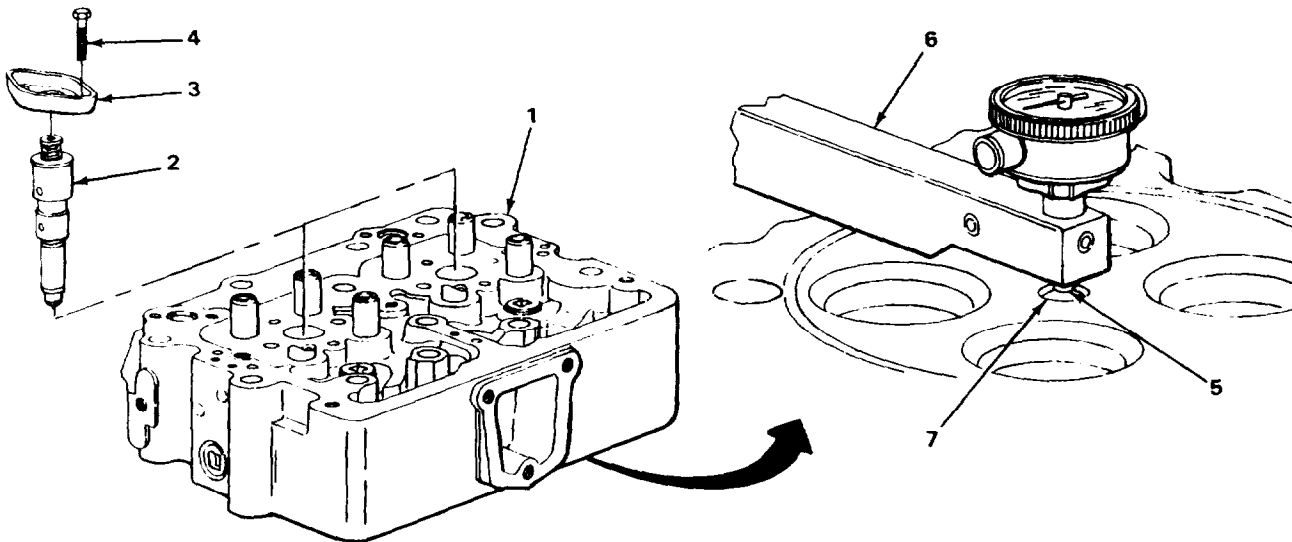
Check seat pattern in bottom of injector  
sleeve (2).

Blued band (8) on Injector sleeve  
In cup seating area must be 0.060  
inch (1.52 mm) minimum width, and  
be located approximately 0.469 inch  
(11.91 mm) from bottom of cylinder  
head surface (1). If seating pattern  
does not meet these specifications,  
tag injector sleeve for replacement.  
See steps 35 thru 48.



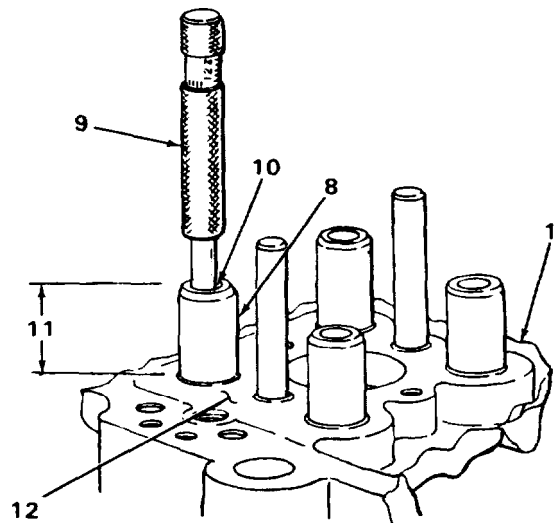
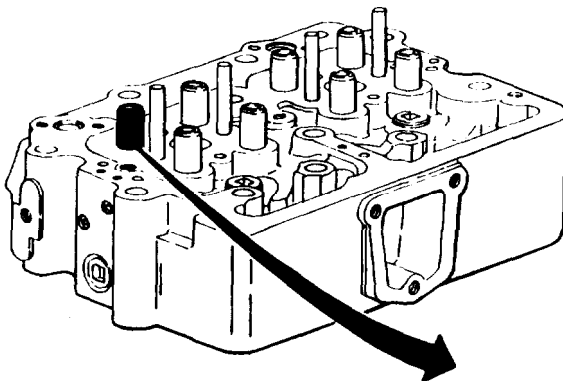
CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
INSPECTION - CONTINUED		
15. Cylinder head (1)	Injector assembly (2)	<p>a. Using 1/2-inch drive 1/2-inch socket, 3-inch extension, and ratchet handle, install injector assembly. Secure with clamp (3) and capscrews (4).</p> <p>b. Using 1/2-inch drive 0 to 175 ft lb (0 to 245 N•m) torque wrench, tighten capscrews alternately in 4 ft lb (5.4 N•m) increments to 10 to 12 ft lb (14 to 16.8 N•m).</p>
16.	Injector tip (5)	<p>Using ST-547 dial indicator and ST-981 injector tip protrusion checking tool (6), measure injector tip protrusion.</p> <p><b>Injector tip protrusion must be 0.060 to 0.070 Inch (1.52 to 1.78 mm). If injector tip protrusion is not within these specifications, tag injector sleeve (7) for replacement. See pages 35 thru 48.</b></p>



CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
17.	Valve guide (8)	<p>a. Inspect for chips, cracks, burrs, or broken sections.  <b>If chipped, cracked, or broken, or burrs are found, tag valve guide for replacement. See step 23.</b></p> <p>b. Set dial bore gage (9) at 0.4552 inch (11.562 mm). Attempt to insert gage into valve guide bore (10).  <b>If gage goes into bore, tag valve guide for replacement. See step 23.</b></p> <p>c. Check for out-of-round bores.  <b>If bore is out of round, tag valve guide for replacement. See step 23.</b></p> <p>d. Check valve guide protrusion (11) from cylinder head surface (12).  <b>If protrusion is less than 1.315 inches (33.43 mm), tag valve guide for replacement. See step 23.</b></p>

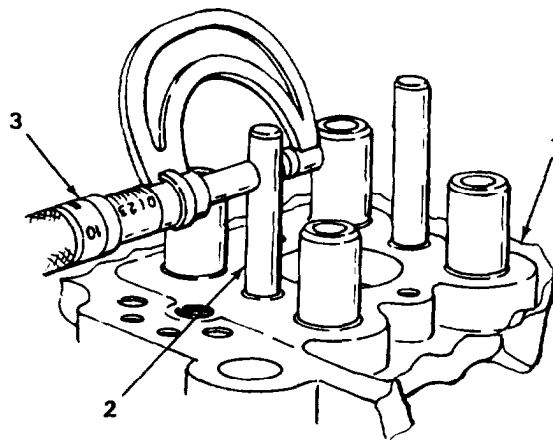
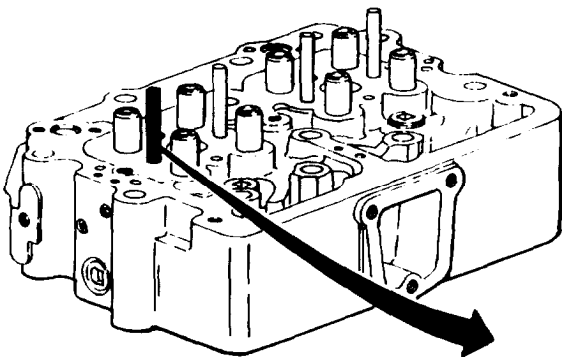


CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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INSPECTION - CONTINUED

- |                       |                     |  |
|-----------------------|---------------------|--|
| 18. Cylinder head (1) | Crosshead guide (2) | <p>a. Using 0- to 1-inch micrometer (3), check outside diameter.<br/> <b>If outside diameter is less than 0.432 in. (10.97 mm), tag crosshead guide for replacement. See step 22.</b></p> <p>b. Using steel machinist rule, check for straightness.<br/> <b>If crosshead guide is not at right angle to milled surface of cylinder head, tag crosshead guide for replacement. See step 22.</b></p> |
|-----------------------|---------------------|--|

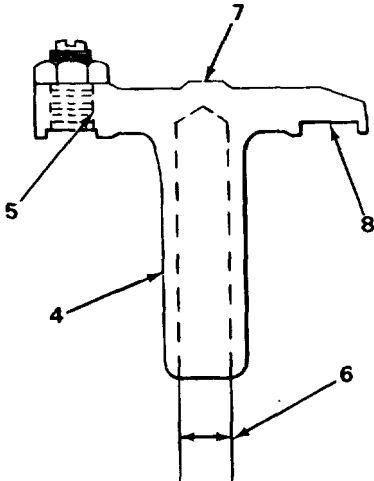


- |     |               |   |
|-----|---------------|---|
| 19. | Crosshead (4) | <p>a. Using magnetic inspection method, inspect for cracks.<br/> <b>If cracks are found, discard crosshead.</b></p> |
|-----|---------------|---|



CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
		<p>b. Inspect adjusting screw threads (5) and crosshead threads for wear or distortion. <b>If adjusting screw threads (5) or crosshead threads are damaged, discard valve crosshead.</b></p> <p>c. Set dial bore gage at 0.4402 inch (11.81 mm). Attempt to Insert gage into bore (6). <b>If bore gage goes into bore (6), discard valve crosshead (4).</b></p> <p>d. Check for out of round bore by gaging at several points 90 degrees apart. <b>If bore is out of round, discard valve crosshead (4).</b></p> <p>e. inspect for excessive wear on rocker arm contact area (7) and on valve stem contact area (8). <b>If excessive wear is found on either rocker arm contact area (7) or valve stem contact area (8), discard valve crosshead (4).</b></p>



CYLINDER HEAD - CONTINUED

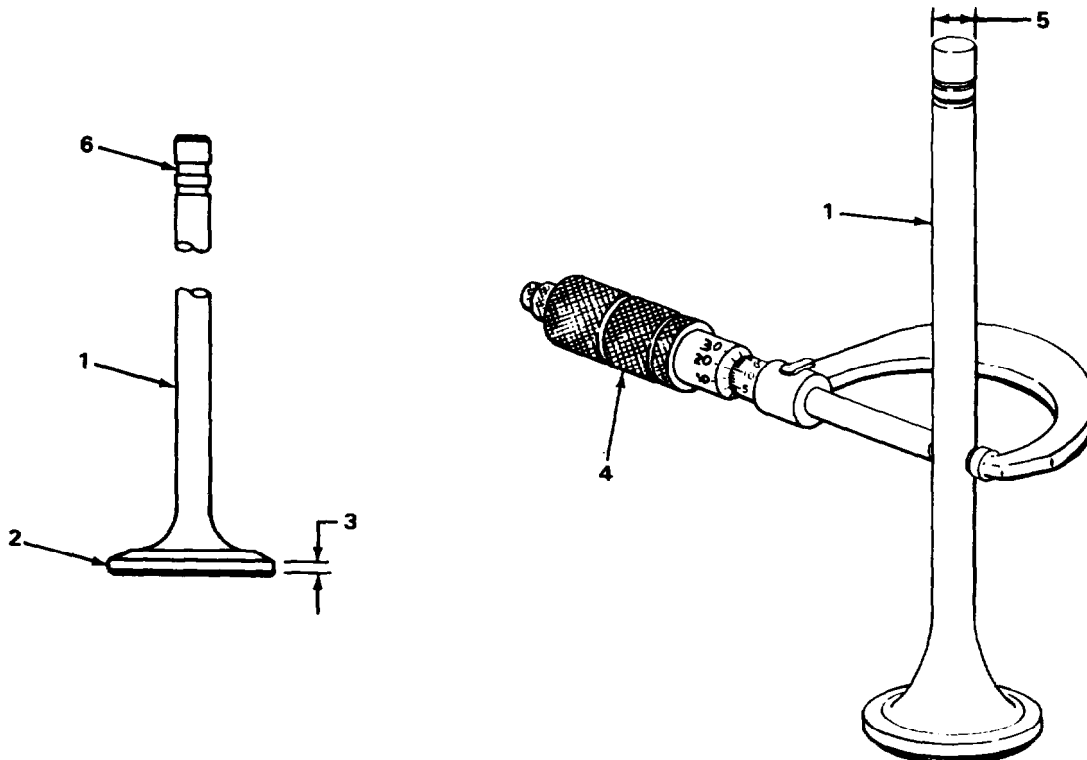
LOCATION	ITEM	ACTION REMARKS
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INSPECTION - CONTINUED

**WARNING**

Safety goggles must be worn to prevent eye injury caused by flying steel chips.

- |     |           |   |
|-----|-----------|---|
| 20. | Valve (1) | <ul style="list-style-type: none"> <li>a. Using a wire brush, clean valves and polish with crocus cloth.</li> <li>b. Inspect valve head (2) for cups, cracks, pits.<br/><b>If cups, cracks, or pits are found, discard valve.</b></li> <li>c. Using 0- to 1-inch micrometer, check valve head rim thickness (3).<br/><b>If thickness is less than 0.105 Inch (2.87 mm), discard valve.</b></li> <li>d. Using 0- to 1-inch micrometer (4), check valve stem diameter (5).<br/><b>If valve stem diameter (5) is less than 0.449 Inch (11.41 mm), discard valve.</b></li> <li>e. Check collet recesses (6) for wear.<br/><b>If new collet will not fit in recesses securely, discard valve.</b></li> </ul> |
|-----|-----------|---|



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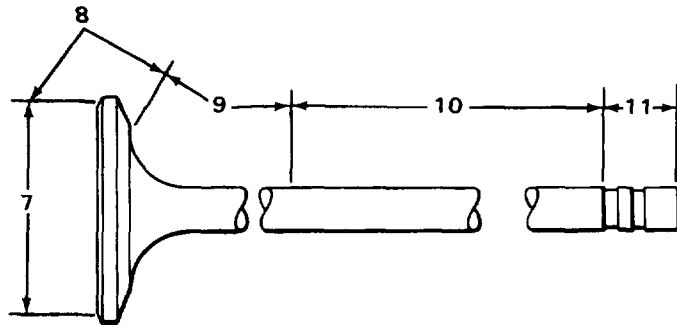
CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

Welded valves which have two types of metal, may be magnetic tested. However, due to change of metal at weld, there will be magnetic leakage at this point. This will be indicated by a broad fuzzy pattern of magnetic particles.

- f . Using magnetic inspection method, inspect for magnetic indications.  
**If indications appear over 1/2 inch (12.70 mm) in length or more than five indications are spaced closer than 1/8 inch (3.18 mm) in area (7), discard valve.**
- g. If magnetic indications appear in areas (8), (9), (10), or (11), discard valve.



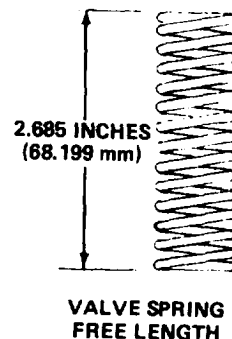
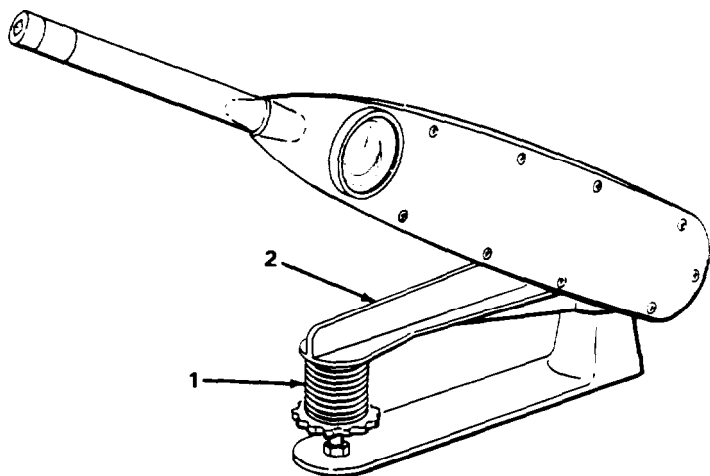
CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
INSPECTION - CONTINUED		
21.	Valve spring (1)	a. Inspect for distortion, cracks, breaks and missing or collapsed coils. <b>If valve spring is collapsed, broken, cracked, or distorted, discard valve spring.</b>  b. Check valve spring free length. <b>Approximate free length is 2.685 inches (68.199 mm). If valve spring does not meet this specification, discard valve spring.</b>

**WARNING**

Extreme care must be taken when releasing springs under pressure. Injury to personnel could result.

- c. Using valve spring tester (2), test valve spring tension.  
**Apply load to valve spring tester. If valve spring compresses to length of 1.724 inches (43.789 mm) before load reaches 143 pounds (94.895 kg), discard valve spring.**



CYLINDER HEAD - CONTINUED

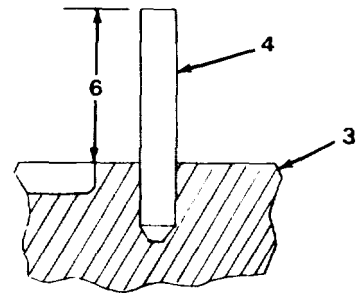
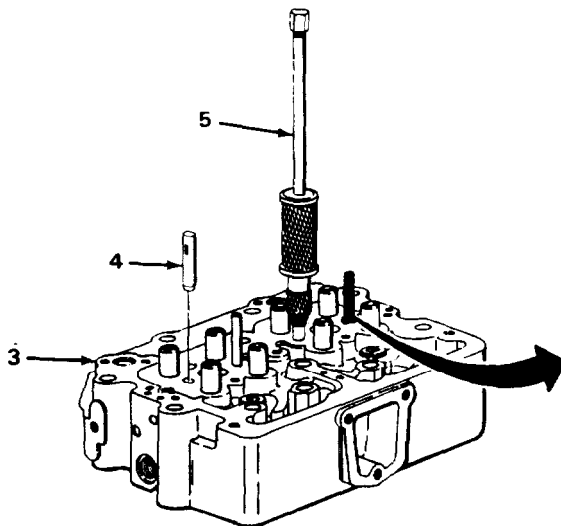
LOCATION	ITEM	ACTION	REMARKS
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REPAIR/ASSEMBLY

**NOTE**

Step 22 is typical for all cylinder head crosshead guide pins tagged for replacement.

- |                       |                         |   |
|-----------------------|-------------------------|---|
| 22. Cylinder head (3) | Crosshead guide pin (4) | <p>a. Using ST-667 or ST-1134 dowel puller (5), remove crosshead guide pin.</p> <p>b. Using arbor press and ST-633 crosshead guide mandrel, press new crosshead guide pin into cylinder head to obtain protrusion (6) of 1.860 to 1.860 inches (47.24 to 47.75 mm).</p> <p><b>If new crosshead guide pin will not fit securely in cylinder head, discard cylinder head.</b></p> |
|-----------------------|-------------------------|---|



CYLINDER HEAD - CONTINUED

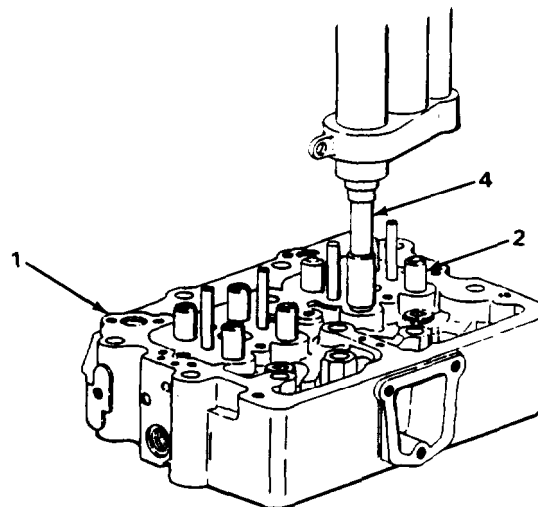
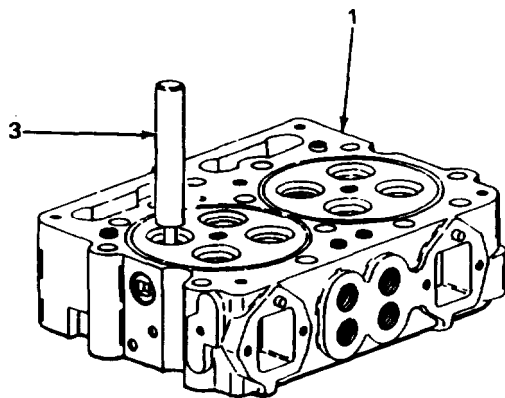
LOCATION	ITEM	ACTION	REMARKS
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REPAIR/ASSEMBLY - CONTINUED

**NOTE**

Step 23 is typical for all cylinder head valve guides tagged for replacement.

- |                       |                 |   |
|-----------------------|-----------------|---|
| 23. Cylinder head (1) | Valve guide (2) | <ul style="list-style-type: none"> <li>a. Using a 16-ounce ball-peen hammer and 1/4-inch driftpin (3) drive valve guide out from underside of cylinder head.</li> <li>b. Inspect valve guide bore in cylinder head (1).<br/><b>If valve guide bore in cylinder head is damaged, discard cylinder head.</b></li> <li>c. Using arbor press and ST-1217 valve guide mandrel (4), install new valve guide into cylinder head.<br/><b>If new valve guide is not secure in cylinder head, discard cylinder head.</b></li> </ul> |
|-----------------------|-----------------|---|



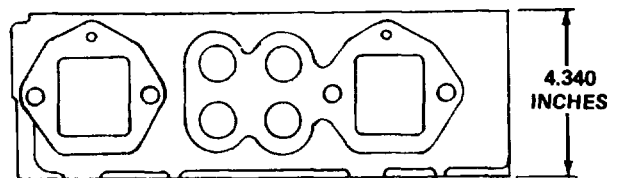
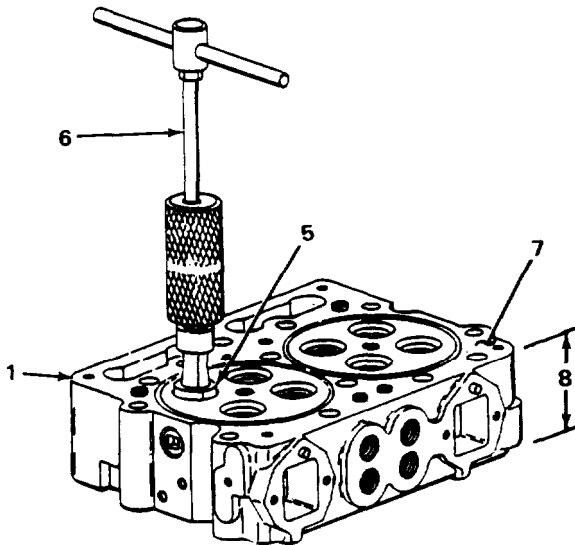
CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

Steps 24 and 25 are typical for all cylinder heads tagged for resurfacing.

- |                                      |                       |  |
|--------------------------------------|-----------------------|--|
| 24. Cylinder head (1)                | Valve seat insert (5) | Using ST-1133 valve seat extractor (6), remove all valve seat inserts.   |
| 25. Cylinder head mating surface (7) |                       | Using surface grinder, resurface cylinder head mating surface.<br><b>Only remove as much material as necessary to repair damage to cylinder head mating surface. If cylinder head must be resurfaced so cylinder head height (8) is less than 4.340 inches (110.24 mm), discard cylinder head.</b> |



CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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REPAIR/ASSEMBLY - CONTINUED

**NOTE**

Steps 26 through 31 are typical for all cylinder head valve seat Inserts tagged for replacement or previously removed during cylinder head resurfacing.

26. Cylinder head (1)	Valve seat Insert (2)	If cylinder head has not been resurfaced, use ST-1133 valve seat extractor (3) to remove valve seat inserts tagged for replacement.
-----------------------	--------------------------	---

**CAUTION**

Each replacement valve seat insert's outside diameter and thickness must be measured and compared to relating valve seat counterbore in cylinder head before counterboring. These measurements will prevent overboring and damage to the cylinder head.

27.	Valve seat insert (2)	<ul style="list-style-type: none"> <li>a. Using 2-to3-inch micrometer, measure outside diameter. <b>Record reading and compare to specifications in the following table.</b></li> <li>b. Using 0- to 1-inch micrometer, measure thickness. <b>Record reading and compare to specifications in the following table.</b></li> </ul>
28.	Valve seat counterbore (4)	<ul style="list-style-type: none"> <li>a. Using depth micrometer (5), measure depth (6). <b>Record reading and compare to specifications in the following table.</b></li> <li>b. Using inside micrometer (7), measure inside diameter. <b>Record reading and compare to specifications in the following table.</b></li> </ul>

**NOTE**

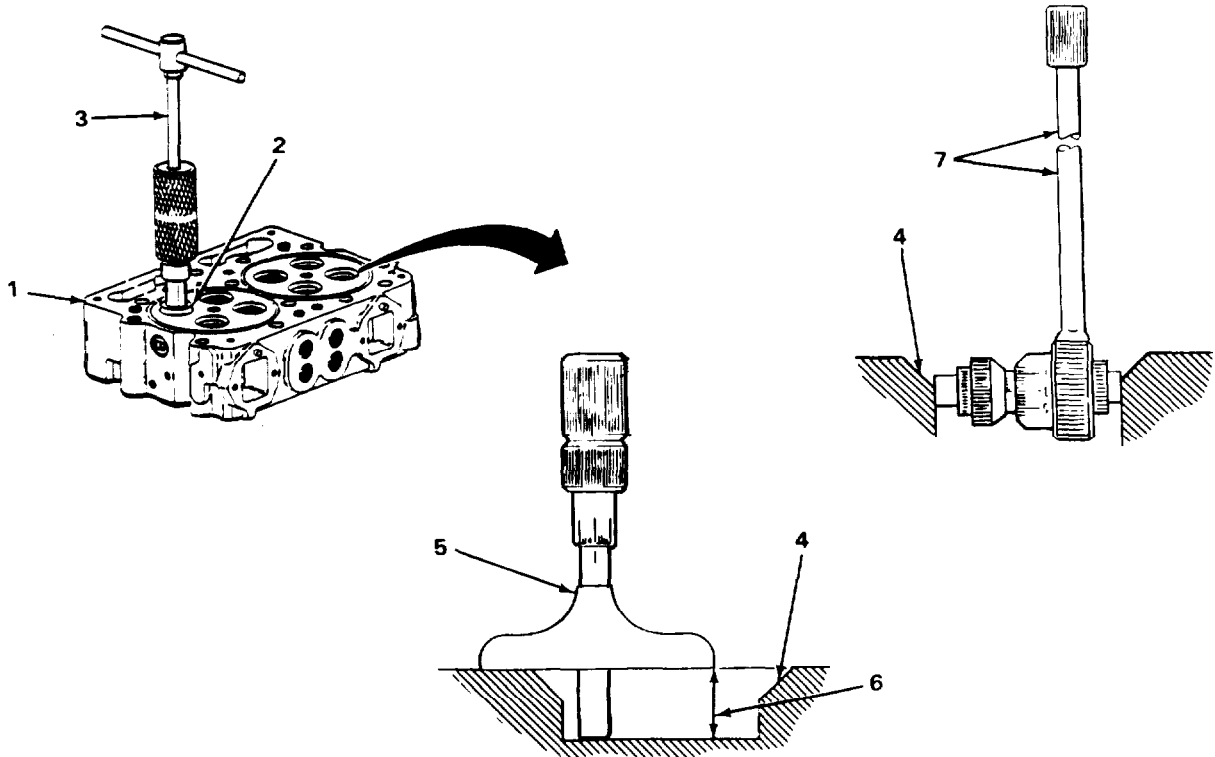
After comparing measurements of removed valve seat insert and valve seat counterbore in cylinder head to the following table, choose the next oversize for replacement valve seat insert, and counterbore the cylinder head to dimensions specified for that oversize valve seat insert.



CYLINDER HEAD - CONTINUED

VALVE SEAT INSERT SPECIFICATIONS

VALVE SEAT INSERT	CYLINDER HEAD VALVE SEAT COUNTERBORE DEPTH IN. (MM)	VALVE INSERT OUTSIDE DIAMETER IN. (MM)	CYLINDER HEAD COUNTERBORE INSIDE DIAMETER IN. (MM)	INSERT THICKNESS IN. (MM)
1st oversize	standard	2.0075/2.0085 (50.991/51.016)	2.0045/2.0055 (50.914/50.940)	0.278/0.282 (7.061/7.16)
2nd oversize	standard	2.0125/2.0135 (51.118/51.143)	2.0095/2.0105 (51.041/51.067)	0.278/0.282 (7.061/7.16)
3rd oversize	0.005 (0.137)	2.0225/2.0235 (51.372/51.397)	2.0195/2.0205 (51.295/51.321)	0.283/0.287 (7.191/7.29)
4th oversize	0.010 (0.25)	2.0325/2.0335 (51.626/51.651)	2.0295/2.0305 (51.549/51.575)	0.288/0.292 (7.32/7.42)
5th oversize	0.015 (0.38)	2.0425/2.0435 (51.880/51.905)	2.0395/2.0405 (51.803/51.829)	0.293/0.297 (7.44/7.54)



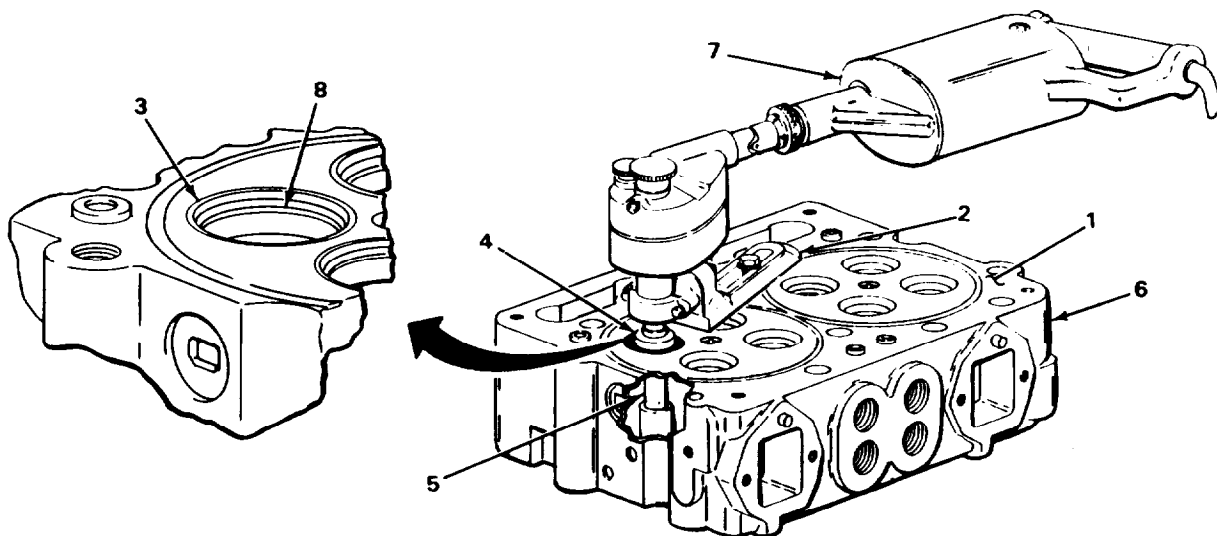
CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
REPAIR/ASSEMBLY - CONTINUED			
29. Cylinder head mating surface (1)		a. Clamp base of ST-663 valve guide arbor set (2) to cylinder head mating surface near valve seat insert bore (3). b. Center ST-662 valve seat insert cutter (4) in valve seat insert bore (3) and on ST-1217 valve guide mandrel (5). <b>After tool assembly is centered, be sure tool assembly is securely clamped to cylinder head.</b>	

NOTE

To ensure a perfectly flat bottom of bore for valve seat inserts to seat correctly, allow cutter to turn several revolutions at exact moment the proper depth in cylinder head is reached.

30. Cylinder head (6)	Valve seat insert bore (3)	Using ST-257 valve seat insert driver tool (7), cut counterbore (8) 0.006 to 0.010 inch (0.1524 to 0.2540 mm) deeper than insert thickness to allow staking of cylinder head to secure valve seat insert.
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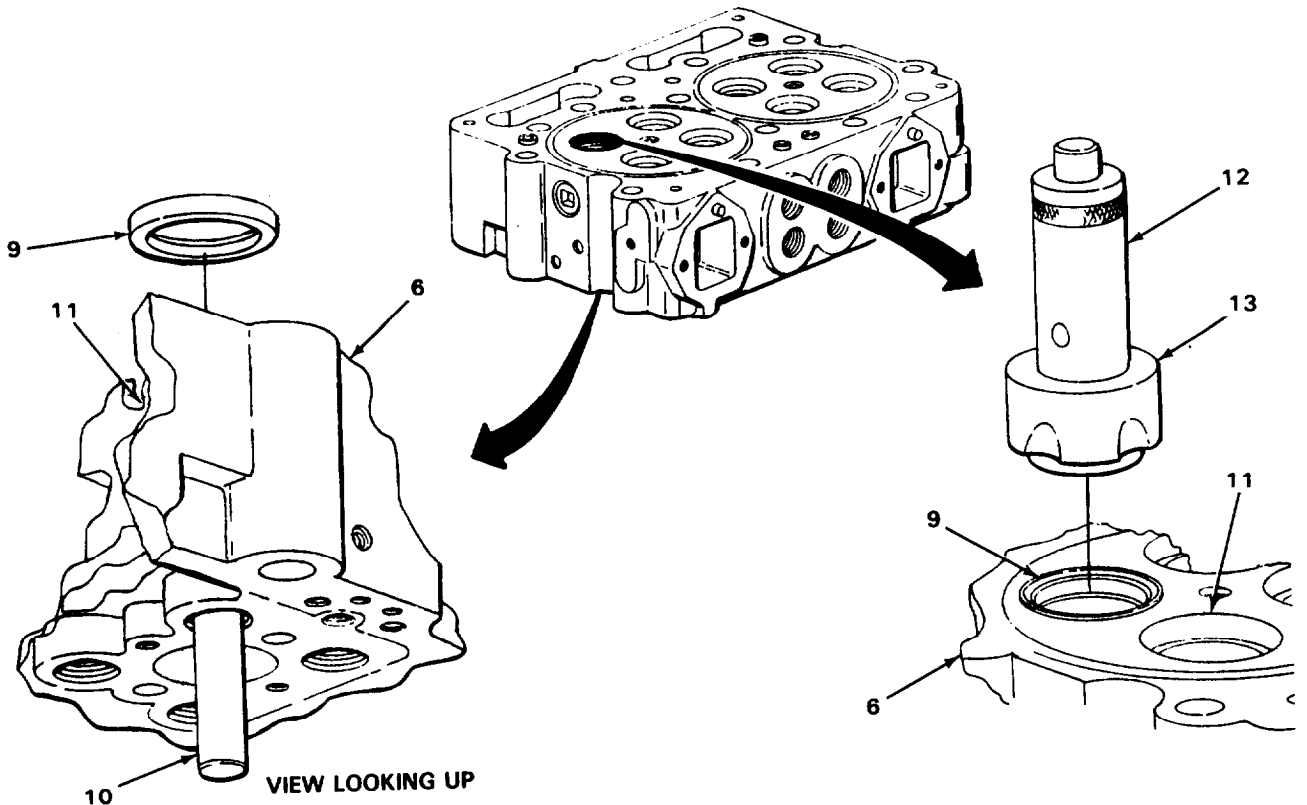
CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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**CAUTION**

Overstaking around valve seat insert may crack cylinder head.

- |     |                       |  |
|-----|-----------------------|--|
| 31. | Valve seat insert (9) | <ul style="list-style-type: none"> <li>a. Using ST-257 valve seat insert driver tool (10), drive valve seat insert into valve seat bore (11), until fully seated.</li> <li>b. Using ST-1122 tool driver (12) over shaft of ST-1124 insert staking tool (13), stake valve seat insert into cylinder head.</li> <li>c. Check valve seat width.<br/><b>See step 10.</b></li> <li>d. Remove tools secured to cylinder head.</li> </ul> |
|-----|-----------------------|--|



CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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REPAIR/ASSEMBLY - CONTINUED

**CAUTION**

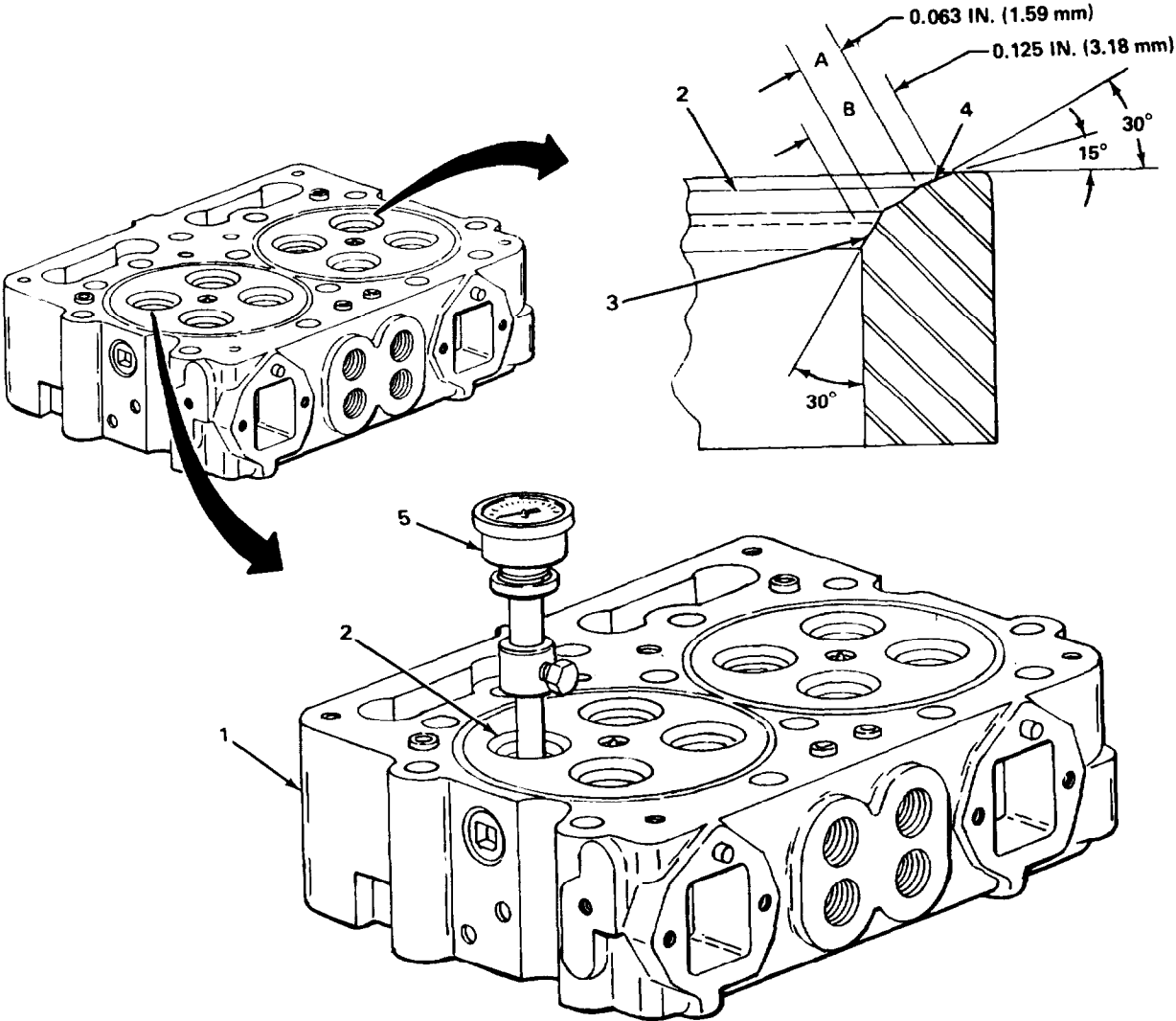
Do not apply side pressure to ST-685 valve seat grinder motor. This action will cause the valve seat to be ground off-center.

**NOTE**

Steps 32, 33, and 34 are typical for all cylinder head valve seat inserts marked for regrinding.

32.	Cylinder head (1)  Valve seat insert (2)	<ul style="list-style-type: none"> <li>a. Using ST-685 valve seat grinder and the correct arbor from ST-663 valve guide arbor set, grind valve seat inserts to specifications below.</li> <li>b. Check seat width. It should be no smaller than dimension A and no larger than dimension B. <b>If seat width is wider than dimension B, material can be removed from points (3) and (4) with specially dressed grind stones. Narrowing should not extend beyond chamfer on valve seat insert. Chamfer provides metal for staking insert into cylinder head.</b></li> </ul>	
33.		<p>Using eccentricimeter (5), check valve seat insert runout. Total runout should not exceed 0.002 inch (0.05 mm). <b>if runout exceeds this measurement, repeat step 32.</b></p>	
34.		<ul style="list-style-type: none"> <li>a. Remove all tools from valve seat insert.</li> <li>b. Clean cylinder head. See General Maintenance Instructions, page 2-3.</li> </ul>	

CYLINDER HEAD - CONTINUED



CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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REPAIR/ASSEMBLY - CONTINUED

**NOTE**

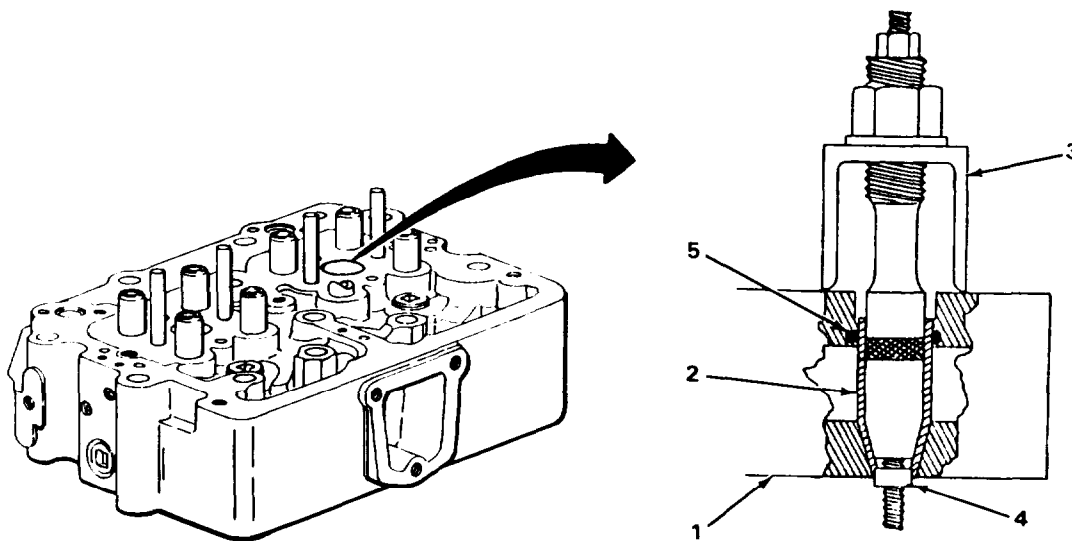
Steps 35 thru 48 are typical for all cylinder head fuel injector sleeves tagged for replacement.

35.	Cylinder head (1) Fuel injector sleeve (2)	Install ST-1244 injector sleeve puller (3) to fuel injector sleeve.
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**CAUTION**

Make sure extractor tip (4) of ST-1244 injector sleeve puller is firmly seated against bottom of injector sleeve to prevent cylinder head damage.

36.	Fuel injector sleeve (2)	Using ST-1247 injector sleeve puller impact wrench socket and ST-1244 injector sleeve puller (3), remove fuel injector sleeve and discard.
37.	Preformed packing (5)	Remove. <b>Discard.</b>



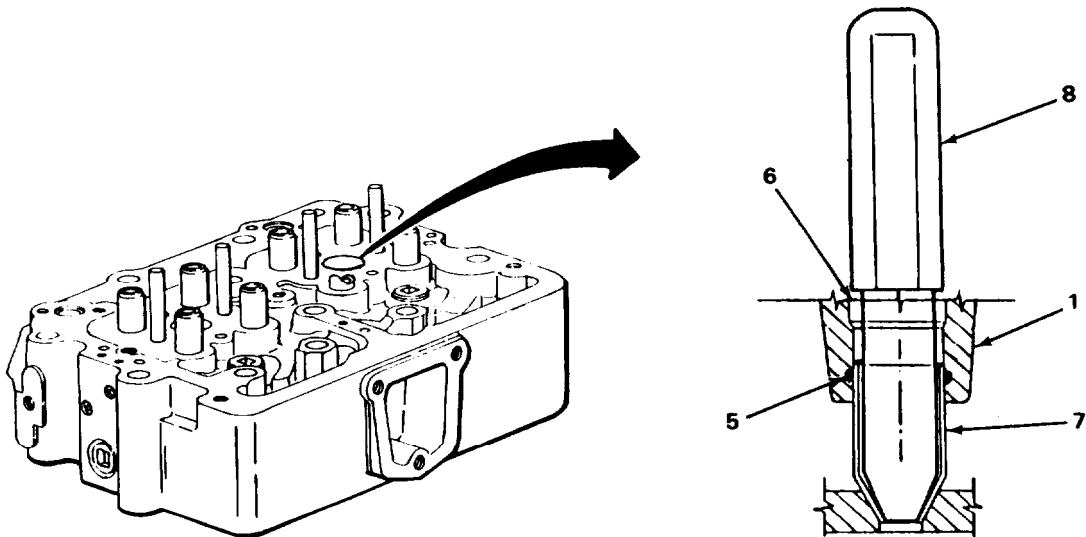
CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
38. Cylinder head (1)	Injector bore (6)	Inspect the bead in the bottom of the cylinder head injector bore for smoothness. <b>If the bead is not smooth, use ST-788 bead cutting tool with ST-884-1 injector sleeve cutter holder and ST-884-6 injector sleeve cutter pilot to cut the bead in the injector bore.</b>
39.	New preformed packing (5)	Coat new packing with clean lubricating oil, and install packing into cylinder head packing groove.

**CAUTION**

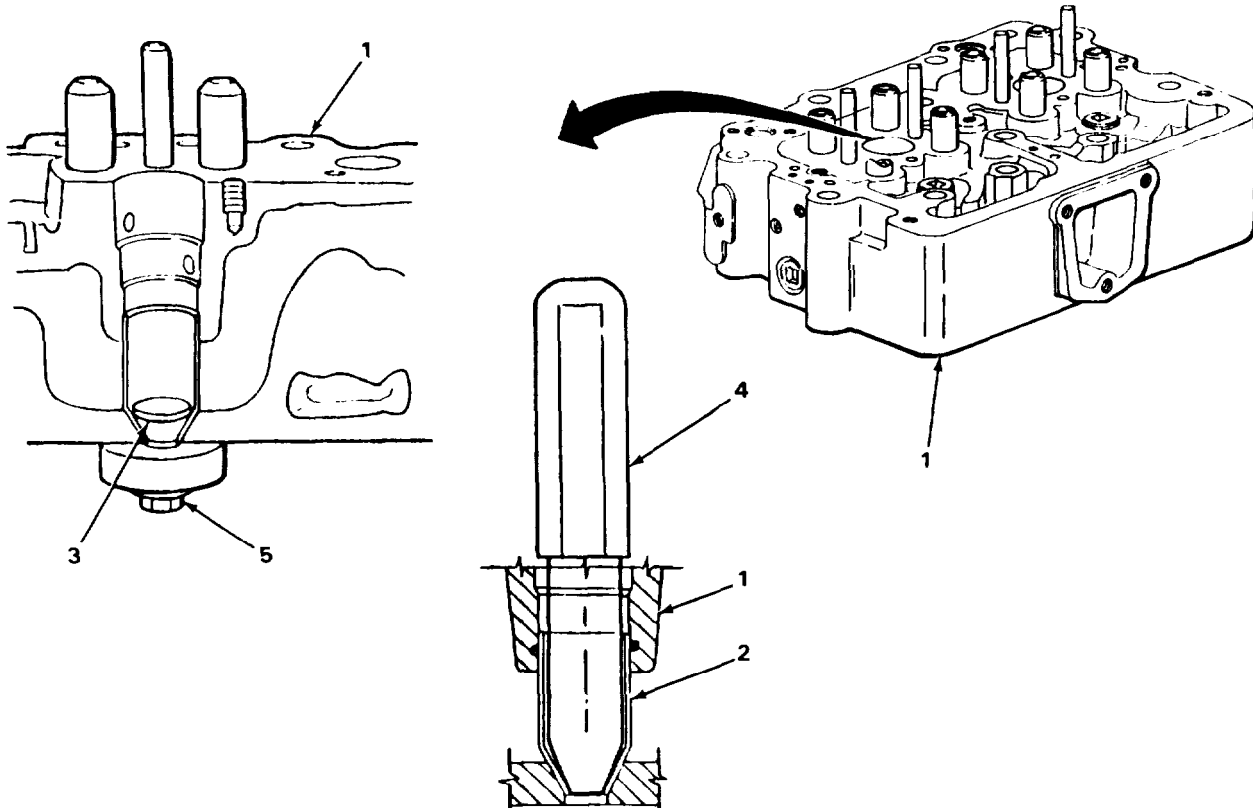
Do not strike mandrel with hammer before installing ST-1179 injector sleeve holding tool. Damage to injector sleeve could result.

40. Cylinder head injector bore (6)	Injector sleeve (7)	Using ST-1227 injector sleeve Installation mandrel (8), push injector sleeve into cylinder head injector bore, until it bottoms.
-------------------------------------	---------------------	--



CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
REPAIR/ASSEMBLY - CONTINUED		
41. Cylinder head (1)	Injector sleeve (2) and ST-1179 injector sleeve holding tool (3)	a. Install ST-1179 injector sleeve holding tool and tighten nut (5) to 35 to 40 lb ft (49 to 56 N•m) torque. b. Insert ST-1227 injector sleeve instal- lation mandrel (4) into injector sleeve.
42. Injector sleeve (2)	ST-1227 injector sleeve installation mandrel (4)	Using 16-ounce ball-peen hammer, strike mandrel with two moderate blows to ensure that injector sleeve is properly seated.
43.	ST-1179 injector sleeve holding tool nut (5)	Using 1/2-inch drive 0 to 175 ft lb (0 to 245 N•m) torque wrench, tighten to 35 to 40 lb (49 to 56 N•m).





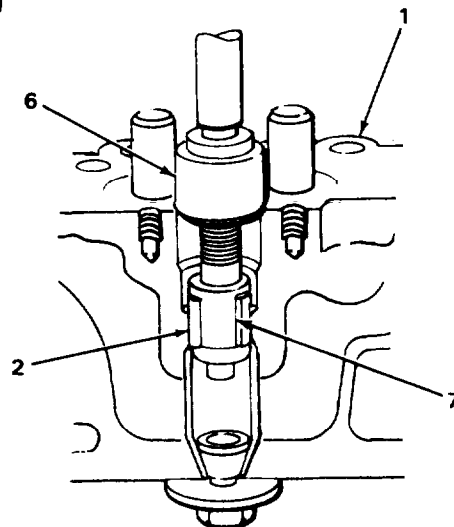
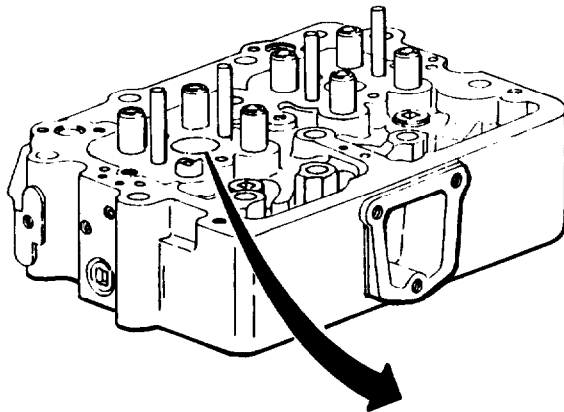
CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
44. Cylinder head (1)	Injector sleeve (2)	Position ST-880 expanding roller tool (6) into injector sleeve.
45. Injector sleeve (2)	ST-880 expanding roller tool (6)	Adjust depth of expanding roller tool so that roller (7) extends 0.5 inch (12.7 mm) into injector sleeve.

**CAUTION**

Overrolling of injector sleeve will cause deformation of sleeve into preformed packing groove.

46. ST-880 expanding roller tool (6)
- Using 1/2-inch drive 0 to 150 in. lb (0 to 16.9 N•m) torque wrench, tighten roller (7) until a 75 in. lb maximum torque reading is reached.
  - Remove tools from injector sleeve.



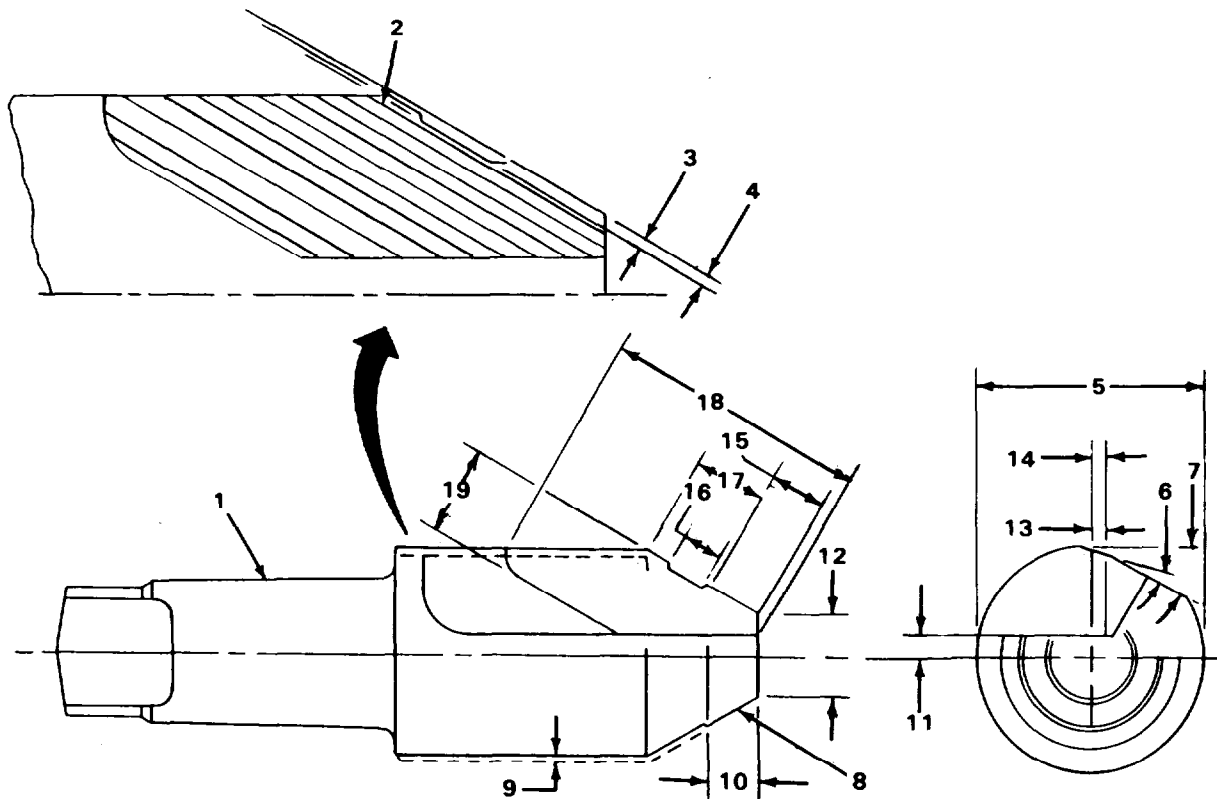
CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
REPAIR/ASSEMBLY - CONTINUED			

47. ST-884 injector sleeve cutter (1) Size, grind, and inspect cutter. Make sure it is ground to the exact specifications as listed in the following table.

CUTTER SPECIFICATIONS

ITEM	SPECIFICATION IN. (MM)	ITEM	SPECIFICATION IN. (MM)
2	0.080 - 0.090 (2.0320 - 2.2860)	11	0.125 (3.1750)
3	0.0015 - 0.0025 (0.0381 - 0.0635)	12	0.375 (9.5250)
4	0.0077 - 0.0097 (0.1955 - 0.2463)	13	0.010 (0.2540)
5	1.0815 - 1.0635(41.0210 - 41.5290)	14	0.0937 (2.3812)
6	15-degree angle relief	15	0.384 - 0.386 (9.7536 - 9.8044)
7	15-degree angle relief	16	0.226 - 0.236 (5.7404 - 5.9944)
8	30-degree, 9-minute angle relief	17	0.3425 (8.6995)
9	0.375 (9.5250)	18	1.250 (31.7500)
10	0.312 (7.9375)	19	0.375 (9.5250)



CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

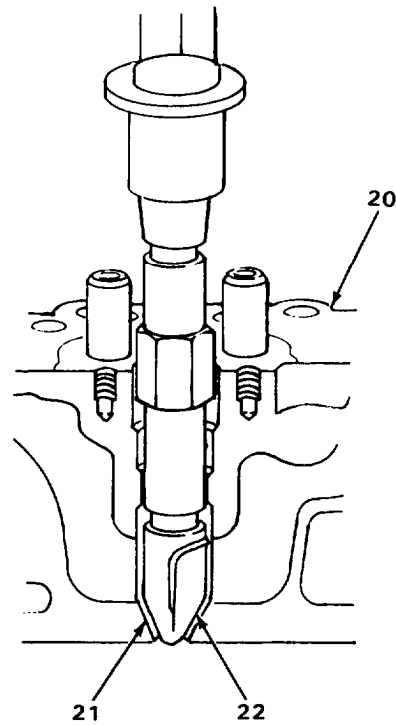
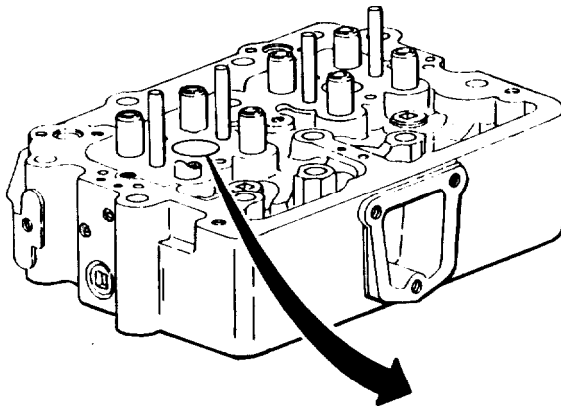
To determine amount of cut to injector sleeve seat, measure tip protrusion. See steps 18 and 19.

When cutting injector sleeve seat, use a solid stream of good cutting fluid to allow cutter to cut freely without grabbing.

48. Cylinder head (20)                      Injector sleeve (21)

Using ST-884 injector sleeve cutter (22) and suitable drill press, cut injector sleeve just enough to provide for proper seating of injector and to maintain correct injector tip protrusion. See steps 12 thru 16.

**If Injector seating area or Injector tip protrusion are not within specifications, recut Injector sleeve seat.**



CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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REPAIR/ASSEMBLY - CONTINUED

**NOTE**

Steps 49, 50, and 51 are typical for all cylinder head valves requiring refacing.

Valve refacer operating instructions are provided with the valve refacer machine.

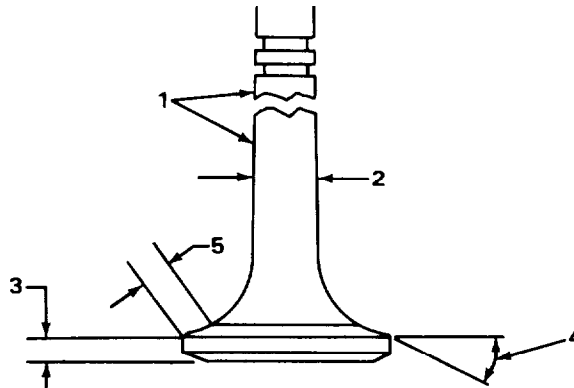
<b>49.</b>	Valve (1)	Insert valve stem in valve refacer chuck on guide area of stem (2).
<b>50.</b> Valve refacer	Valve (1)	a. Check valve for out-of-round condition. <b>If runout exceeds 0.001 inch (0.03 mm), valve is warped. Discard valve.</b> b. Using ST-685 valve seat grinder, wet grind valve to an exact 30-degree angle from horizontal, just enough to reface completely around the valve head. <b>If after grinding, valve head thickness (3) is less than 0.105 inch (2.67 mm), discard valve.</b> c. Compare refaced valve to the following table.

VALVE SPECIFICATIONS

ITEM	INTAKE AND EXHAUST VALVES	NEW MINIMUM	NEW MAXIMUM WORN LIMITS	
2	stem	0.4500 inch (11.4300 mm)	0.4510 inch (11.4554 mm)	0.4490 inch (11.4046 mm)
3	valve head thickness	0.105 inch (2.67 mm)		0.105 inch (2.67 mm)
4	seat angle	30 degrees	30 degrees	
5	refacing valve seating area	0.0625 inch (1.59 mm)		0.0625 inch (1.59 mm)

CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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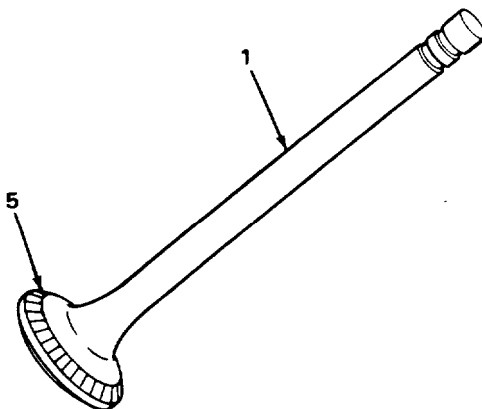


51. Valve (1)

Valve seating area (5)

- a. Using pencil, mark valve seating area as shown below.
- b. Insert valve into cylinder head valve guide to fully closed position. Rotate 10 degrees.

**A good valve seat area will be indicated if all pencil marks are broken. If pencil marks are not broken, readjust valve refacer machine, redress ST-685 valve seat grinder, and reface valve.**



CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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REPAIR/ASSEMBLY - CONTINUED

**NOTE**

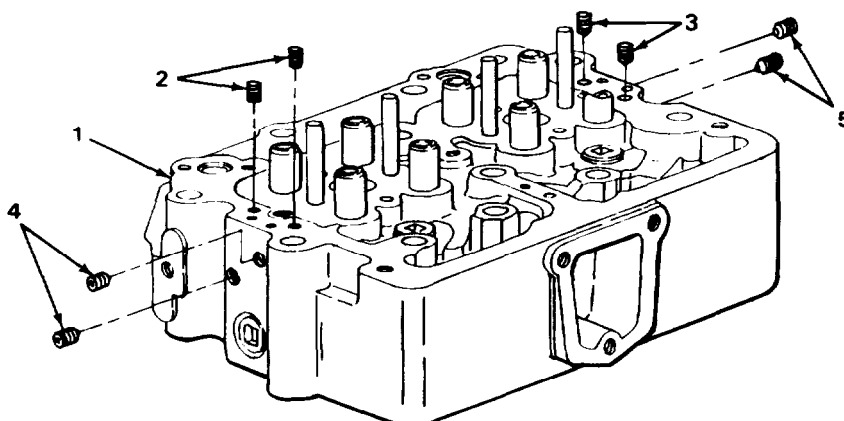
Wrap threaded ends of pipe plugs with antiseizing tape to prevent leakage.

Applicable pipe plug locations for each cylinder head are shown in the following table.

52. Cylinder head (1)	Four pipe plugs (2 and 3)	Using 5/32-inch hex key, install where applicable and tighten.
53.	Four pipe plugs (4 and 5)	Using 3/16-inch hex key, install where applicable and tighten.

CYLINDER HEAD PIPE PLUG LOCATION

PIPE PLUG	FORWARD CYLINDER HEAD	MIDDLE CYLINDER HEAD	REAR CYLINDER HEAD
2	open	open	1/8inch (3.18 mm)
3	3/8-inch (9.54 mm)	3/8-inch (9.54 mm)	3/8-inch (9.54 mm)
4	1/8-inch (3.18 mm)	open	open
5	3/8-inch (9.54 mm)	3/8-inch (9.54 mm)	3/8-inch (9.54 mm)



CYLINDER HEAD - CONTINUED

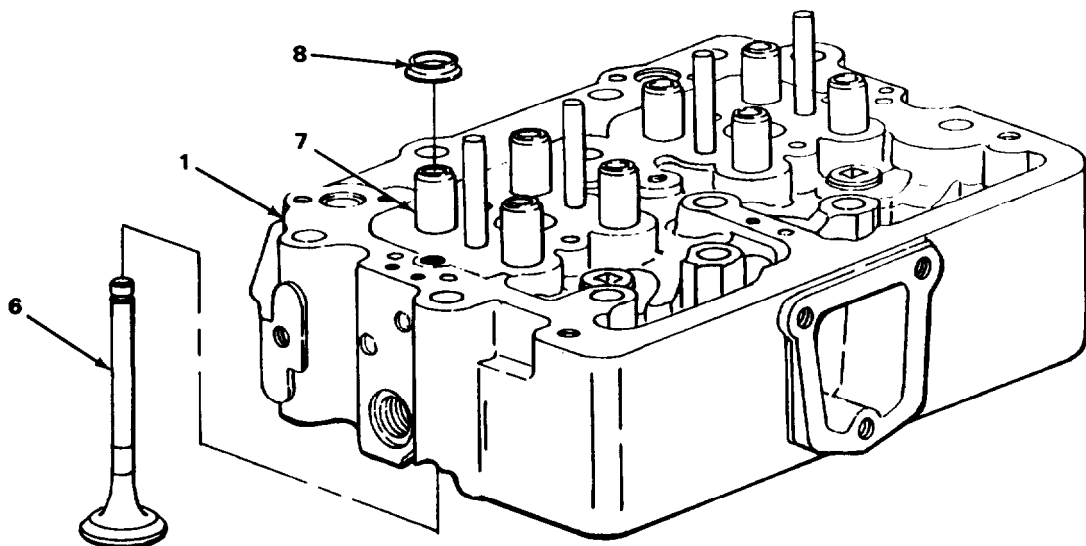
LOCATION	ITEM	ACTION REMARKS
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**NOTE**

Be sure to install valves in original locations as tagged in step 4.

Steps 54 thru 64 are typical for all cylinder head valve assemblies.

54.	Cylinder head (1)	Be sure cylinder head is clean. <b>If cylinder head needs cleaning, see General Maintenance Instructions, page 2-3.</b>
55. Cylinder head (1)	Valve (6)	Dip valve stem in clean lubricating oil and insert into valve guides (7).
56.	Cylinder head (1)	Place cylinder head, mating surface down, on wooden bench or other protective surface.
57. Valve guide (7)	Valve spring spacer (8)	If valve seat insert and valve have been refaced more than a total of 0.030 inch (0.76 mm), place a maximum of two valve spring spacers over valve guide (7).



CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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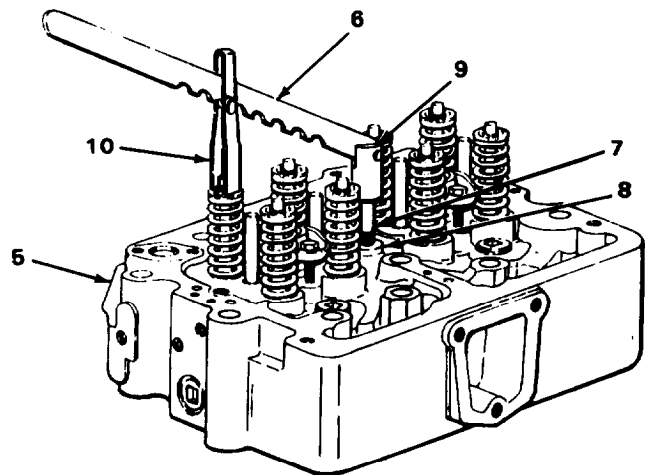
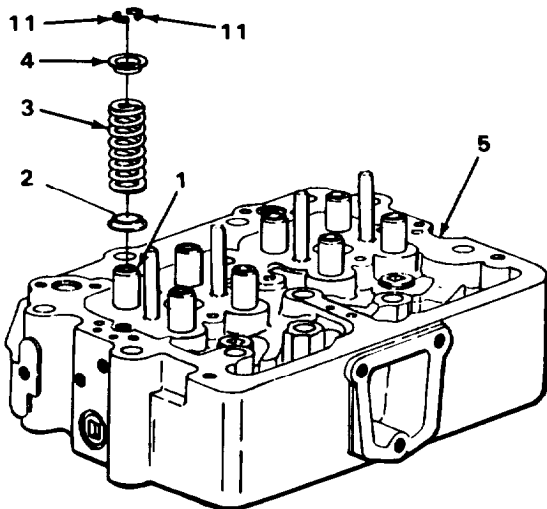
REPAIR/ASSEMBLY - CONTINUED

58. Valve guide (1)	Valve spring seat (2), valve spring (3), and valve spring retainer (4)	Assemble onto valve guide.	
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**WARNING**

Extreme care must be taken when installing springs under pressure. Injury to personnel could result.

59. Cylinder head (5)	Valve spring compressor (6)	<ol style="list-style-type: none"> <li>Install stud (7) into rocker lever cap screw hole (8).</li> <li>Install valve spring compressor pivot head (9) on stud (7).</li> <li>Place compression head (10) on valve spring retainer (4), press down valve spring compressor, and install new half collets (11).</li> <li>Remove valve spring compressor and stud (7) from cylinder head.</li> </ol>	
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CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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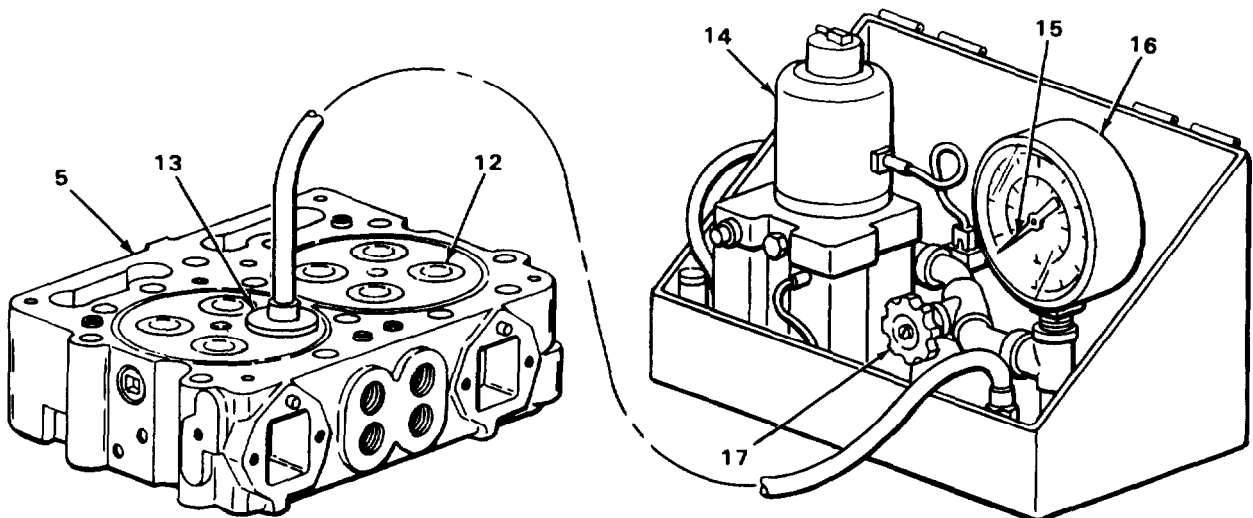
**CAUTION**

Never vacuum test cylinder head with injectors installed. Installation of injectors while head is removed from block could cause misalignment of valves in valve seat area and result in leakage during testing which would not necessarily occur during actual engine operation.

**NOTE**

Steps 60 thru 64 are typical for all valves. (Vacuum tester operating instructions are provided with tester.)

- |                       |                  |   |
|-----------------------|------------------|---|
| 60. Cylinder head (5) | Valve (12)       | Using ST-417, ST-417-A, or ST-1257 vacuum testers, hold vacuum cup (13) over head of valve and seat flat on cylinder head surface surrounding valve.  |
| 61.                   | Vacuum pump (14) | <ul style="list-style-type: none"> <li>a. Operate vacuum pump until hand (15) on vacuum gage (16) reaches 18 to 25 inches vacuum, then close shutoff valve (17) and stop pump.</li> <li>b. Start timing when hand on gage reaches 1&amp;inches vacuum.</li> <li>c. Stop timing when hand on gage reaches 8-inches vacuum.<br/>If elapsed time is less than 10 seconds, valve seat is unsatisfactory.</li> </ul> |



CYLINDER HEAD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
REPAIR/ASSEMBLY - CONTINUED		
62. Cylinder head (1)	Valve (2)	<ul style="list-style-type: none"> <li>a. Using plastic-faced hammer, tap stem end of valve and retest by repeating steps 60 and 61. <b>If valve seating is satisfactory, proceed to next step.</b></li> <li>b. Check for leaking connections in tester by placing vacuum cup against a clean window glass or any smooth flat surface. <b>Repair any leaks in test equipment.</b></li> <li>c. Check valve and seat area to be sure they are free of dirt particles, Retest valve seating. <b>If valve seating is unsatisfactory, regrind seat and reface valve. See steps 32, 33, and 34 and steps 49, 50, and 51.</b></li> </ul>

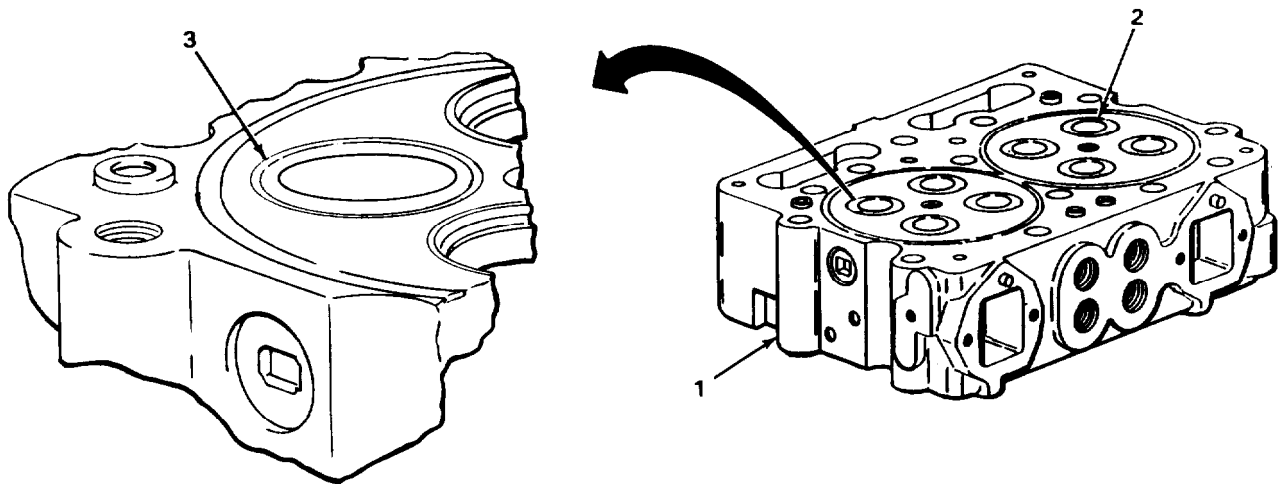
**NOTE**

It is possible to mistake leakage around valve seat insert for valve seat leakage. If this type of leak is suspected, proceed with the following step.

63. Cylinder head (1)	Valve seat insert (3)	<ul style="list-style-type: none"> <li>a. Apply extreme-pressure grease around outside edge of valve seat insert to make a grease seal.</li> <li>b. Perform vacuum test and inspect grease seal for a break indicating air leakage between wall of counterbore and valve seat insert. <b>Restake valve seat Insert. See step 31.</b></li> <li>c. Vacuum test and recheck for air leakage around valve seat insert. <b>If air leakage is present, see steps 26 thru 31. Replace valve seat Insert.</b></li> </ul>
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**CYLINDER HEAD - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
64. Cylinder head (1)	Valve (2)	Vacuum test and check valve seating. If test is unsatisfactory, repeat steps 60 thru 64. If test is satisfactory, perform follow-on maintenance.



**NOTE**

Be sure cylinder head is clean. If cylinder head needs cleaning, see General Maintenance Instructions, page 2-3.

Be sure to keep valve crossheads and fuel injector assemblies together with cylinder head for engine reassembly.

FOLLOW-ON MAINTENANCE: Install cylinder head (page 2-68).

**TASK ENDS HERE**

**Section VII. CRANKSHAFT MAINTENANCE**

	Page		Page
Crankshaft Assembly . . . . .	2-214	Vibration Damper. . . . .	2-219

**CRANKSHAFT ASSEMBLY**

---

This task covers:

- |                             |                          |
|-----------------------------|--------------------------|
| a. Cleaning (page 2-214)    | d. Repair (page 2-217)   |
| b. Disassembly (page 2-214) | e. Assembly (page 2-218) |
| c. Inspection (page 2-215)  |                          |
- 

**INITIAL SETUP**

Tools

- Grinder, crankshaft
- Indicator, dial
- Mandrel, hollow-core
- Micrometer, 3- to 4-inch
- Micrometer, 4- to 5-inch
- Micrometer, depth
- Mittens, cloth, heat-protective
- Press, arbor
- Puller, gear, circular-type
- Torch, heating, oxy/acetylene

Materials/Parts - Continued

- Key, machine
- Grease, extreme-pressure (item 10, appendix B)
- Tags, marker (item 17, appendix B)

Equipment Condition

Crankshaft assembly removed (page 2-49).

References

TM 55-1500-335-23, Inspection Methods, Non-Destructive

Materials/Parts

- Bearing set
  - Cloth, emery (item 1, appendix B)
- 

	ACTION	
LOCATION	ITEM	REMARKS

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**CLEANING**

**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

**DISASSEMBLY**

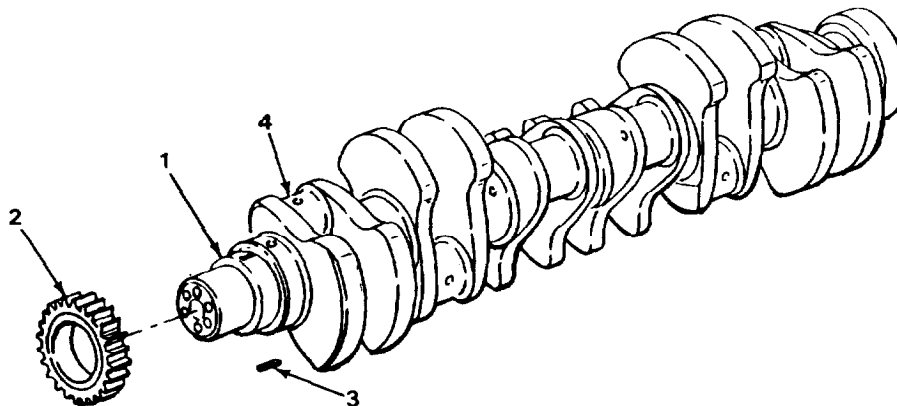
**WARNING**

Heat-protective cloth mittens must be worn to prevent serious injury to hands when handling heated parts.

- |  |   |  |
|--|---|--|
| 1. Crankshaft (1) with assembled parts | Crankshaft gear (2) and machine key (3) | a. Using a oxy/acetylene heating torch, heat crankshaft gear to 300° to 400°F (150° to 205°C). |
|--|---|--|

**CRANKSHAFT ASSEMBLY - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
		b. Using circular-type gear puller, pull crankshaft gear from crankshaft. c. Remove machine key. <b>Discard.</b>
<b>INSPECTION</b>		
2.	Crankshaft (1)	a. Inspect for cracks. Discard if cracked. b. Inspect for and using depth micrometer, measure depth of scratches and nicks on bearing journals. <b>If scratches and nicks exceed depth of 0.020 inch (0.508 mm), discard crankshaft. If depth of scratches and nicks is 0.020 inch (0.508 mm) or less, tag for grinding.</b>
3. Crankshaft (1)	Connecting rod journals (4)	a. Using 3- to 4-inch micrometer, measure diameter of six connecting rod journals in several places. Check for out-of-round condition. Connecting rod journals should be 3.122 to 3.125 inches (79.293 to 79.375 mm). <b>Tag crankshaft connecting rod journals for grinding if worn smaller than 3.122 inches (79.298 mm) or more than 0.002 inch (0.05 mm) out of round.</b> b. Using 3- to 4- inch micrometer, measure six connecting rod journals for taper across length of journals. <b>Tag for grinding if taper exceeds 0.0005 inch (0.0127 mm).</b>



CRANKSHAFT ASSEMBLY - CONTINUED

LOCATION	ITEM	ACTION REMARKS
INSPECTION - CONTINUED		
4. Crankshaft (1)	Main bearing journals (2)	<p>a. Using 4- to 5-inch micrometer, measure diameter of seven main bearing journals in several places. Check for out-of-round condition. Main bearing journals should be 4.4975 to 4.500 inches (114.24 to 114.30 mm).  <b>Tag crankshaft main bearing journals for grinding if worn smaller than 4.4975 inches (114.23 mm) or more than 0.002 inch (0.05 mm) out-of-round.</b></p> <p>b. Using 4-to 5-inch micrometer, measure seven main bearing journals for taper across length of journals.  <b>Tag for grinding if taper exceeds 0.0005 inch (0.0127 mm).</b></p>
5.	Thrust bearing flanges (3)	<p>a. Inspect for and, using depth micrometer, measure depth of scratches, nicks, and score marks.  <b>If scratches, nicks, or score marks exceed 0.020 inch (0.568 mm), discard crankshaft. If scratches, nicks or score marks are 0.020 inch (0.508 mm) or less, tag for grinding.</b></p> <p>b. Using 3 to 4-inch micrometer, measure distance between thrust bearing flanges. Distance must be 3.001 to 3.006 inches (76.225 to 76.352 mm).  <b>If distance exceeds 3.006 inches (76.352 mm), tag for grinding.</b></p> <p>c. Using dial indicator, check thrust bearing flanges for flatness. Flatness should vary no more than 0.003 inch (0.076 mm).  <b>If flatness exceeds 0.003 inch (0.0076 mm), tag for grinding</b></p>

**CRANKSHAFT ASSEMBLY - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
6.	Crankshaft (1)	Using magnetic inspection procedure, inspect for cracks. <b>Discard if cracked.</b>
7.	Crankshaft gear (4)	Inspect for cracks, breaks, nicks, and scratches by visual and magnetic inspection. <b>Discard if cracked or broken. Polish out small nicks and scratches with emery cloth.</b>

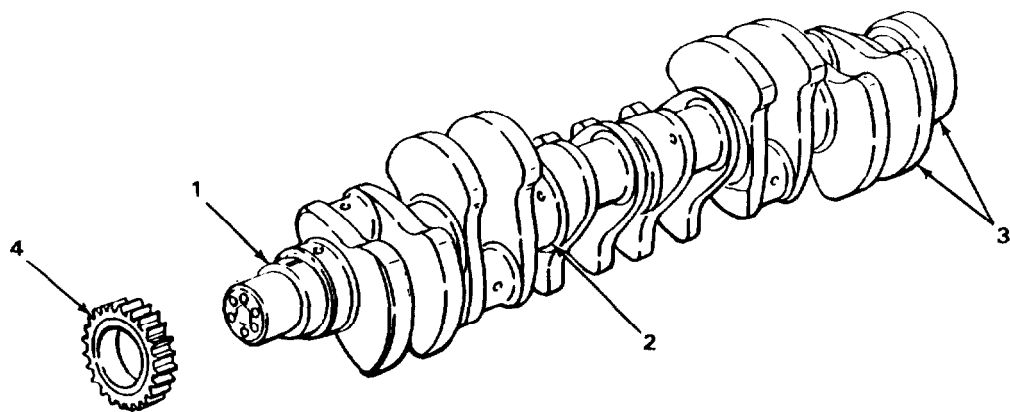
REPAIR

**NOTE**

Main bearing and connecting rod bearing sets are available in 0.010-, 0.020-, 0.030-, and -040-inch (0.254, 0.508, 0.762, and 1.016 mm) undersizes. Thrust bearings are in 0.010- and 0.020-inch (0.254 and 0.508 mm) oversizes. When grinding crankshaft, do not remove more material than necessary to clean up bearing surfaces and fit the next size bearing or washer.

Perform step 8 only if crankshaft grinding is required.

- |    |                |   |
|----|----------------|---|
| 8. | Crankshaft (1) | Using crankshaft grinder, grind as necessary. |
|----|----------------|---|



CRANKSHAFT ASSEMBLY - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
REPAIR - CONTINUED			
9.	Crankshaft (1)	a.	Mark size of rod and main bearings to be used on front counterweight as shown in view A.
		b.	Mark size of front and rear thrust washers to be used on rear counterweight as shown in view B.

ASSEMBLY

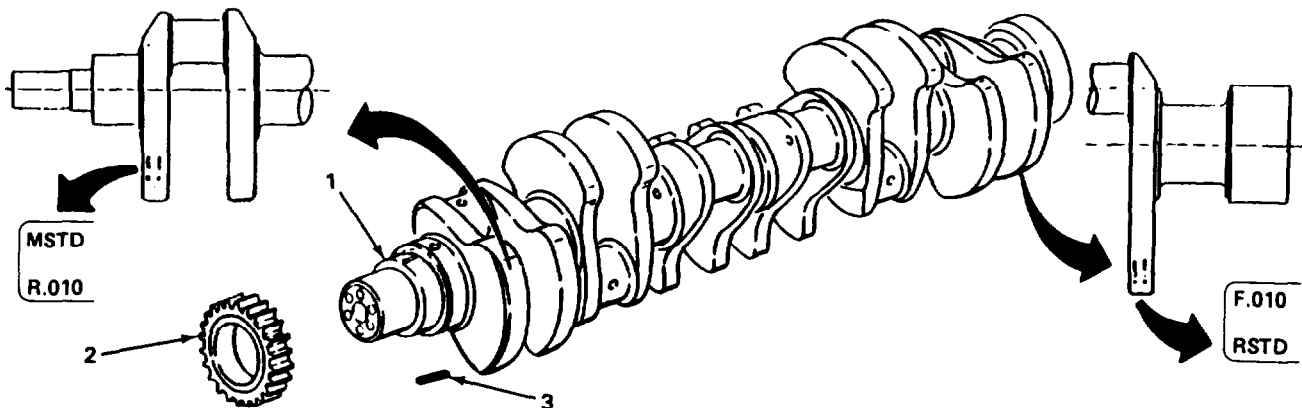
**WARNING**

Heat-protective cloth mittens must be worn to prevent serious injury to hands when handling heated parts.

10.	Crankshaft (1)	Crankshaft gear (2) and new machine key (3)	a.	Heat crankshaft gear for one hour at 450°F (214°C).
			b.	Position new machine key on crankshaft.
			c.	Lubricate crankshaft gear flange with extreme-pressure grease, align crankshaft gear with crankshaft, and using arbor press and hollow-core mandrel, press crankshaft gear into position.

**NOTE**

Pack proper size bearings, as marked on crankshaft, with crankshaft for assembly.



**NOTE**

FOLLOW-ON MAINTENANCE: install crankshaft assembly and bearings (page 2-54).

**TASK ENDS HERE**



**VIBRATION DAMPER**

---

This task covers:

Cleaning/Inspection

---

INITIAL SETUP

Tools

Mittens, cloth, heat-protective

Materials/Parts

Dye, leak-detection (item 7, appendix B)

Materials/Parts - Continued

Rags, wiping (item 14, appendix B)

Equipment Condition

Vibration damper removed (page 2-48).

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LOCATION	ITEM	ACTION REMARKS
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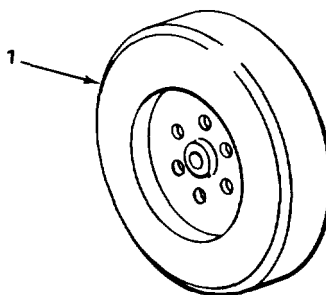
CLEANING/INSPECTION

- |    |                      |                      |
|----|----------------------|----------------------|
| 1. | Vibration damper (1) | Wipe clean with rag. |
|----|----------------------|----------------------|

**WARNING**

Heat-protective cloth mittens must be worn to prevent serious injury to hands when handling heated parts.

- |    |  |
|----|--|
| 2. | <ul style="list-style-type: none"> <li>a. Coat with leak-detection dye.</li> <li>b. Heat in oven to 200°F (93°C).</li> <li>c. Inspect for any indications of leakage.</li> </ul> <p style="text-align: center;"><b>Discard if leaking.</b></p> |
|----|--|



**NOTE**

FOLLOW-ON MAINTENANCE: Install vibration damper (page 2-90).

**TASK ENDS HERE**

**Section VIII. PISTON AND CONNECTING ROD MAINTENANCE**

**PISTON AND CONNECTING ROD**

This task covers:

- a. Disassembly (page 2-220)
- b. Cleaning/inspection (page 2-222)
- c. Repair (page 2-231)
- d. Assembly (page 2-235)

**INITIAL SETUP**

**Tools**

- Arbor, expanding
- Container, 2-gallon
- Expander, piston ring
- File, half-round
- Fixture, checking, connecting rod, ST-561
- Gage, bore, dial
- Gage, plug, ST-205
- Gage, ring groove, ST-560
- Gage, thickness
- Handle, hinged, 1/2-inch drive
- Machine, boring, ST-526
- Mandrel and block, ST-870
- Mandrel, piston pin
- Mandrel set, ST-1242
- Micrometer, 0-to 1-inch
- Micrometer, 1-to 2-inch
- Micrometer, 5- to 6-inch
- Mittens, cloth, heat-protective
- Plate, surface
- Pliers, snap-ring, 6-inch
- Press, arbor
- Scraper

**Tools - Continued**

- Socket, 15/16-inch, 1/2-inch drive
- Vise, machinist's
- Wrench, torque, 0 to 150 ft lb (0 to 210 N•m), 1/2-inch drive

**Materials/Parts**

- Cutting fluid, lapping (item 5, appendix B)
- Prussian blue (item 13, appendix B)
- Ring set, piston (six required)
- Soap, lubricating (item 15, appendix B)
- Tags, marking (item 17, appendix B)
- Washers, connecting rod (12 required)

**Equipment Condition**

Piston and connecting rod removed (page 2-52).

**References**

TM 55-1500-335-23, Inspection Methods, Non-Destructive

LOCATION	ITEM	ACTION REMARKS
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**DISASSEMBLY**

**NOTE**

Steps given are typical for all six pistons and connecting rods. Be sure to tag all pistons, bearings, and bearing caps to their respective connecting rod and location in cylinder block. If a new or reground crankshaft is used, discard used bearings.

- |                       |   |                                      |
|-----------------------|---|--------------------------------------|
| 1. Connecting rod (1) | Bearing cap (2), two nuts (3) and two washers (4) | Take off.<br><b>Discard washers.</b> |
|-----------------------|---|--------------------------------------|

**PISTON AND CONNECTING ROD - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
2.	Upper bearing (5)	Take out. <b>Tag and hold for inspection.</b>
3. Bearing cap (2)	Lower bearing (6)	Take out. <b>Tag and hold for inspection.</b>
4. Piston (7)	Four piston rings (8)	Using piston ring expander, take off.
5. Piston pin bore (9)	Two retaining rings (10)	Using 6-inch snap-ring pliers, take out.

**WARNING**

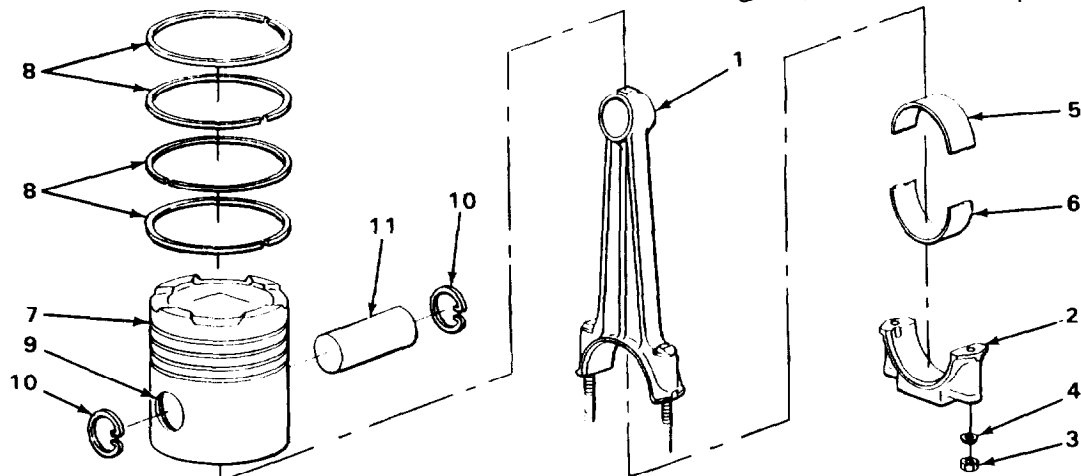
Heat-protective cloth mittens must be worn to prevent serious injury to hands when handling heated parts.

**CAUTION**

Pistons must be heated in hot water to prevent piston damage during piston pin removal.

Do not drive piston pin with hammer. Driving may cause distortion of piston, causing piston seizure in cylinder sleeve.

- 8 .                      Piston (7) and connecting rod (1)
- a. Submerge in 2-gallon container of boiling water for 15 minutes to allow pistons to expand.
  - b. Remove from boiling water, clamp connecting rod gently in machinist's vise.
  - c. Push piston pin (11) out of piston pin bore (9).
  - d. Tag piston, piston pin (11), and connecting rod, and hold for inspection.



PISTON AND CONNECTING ROD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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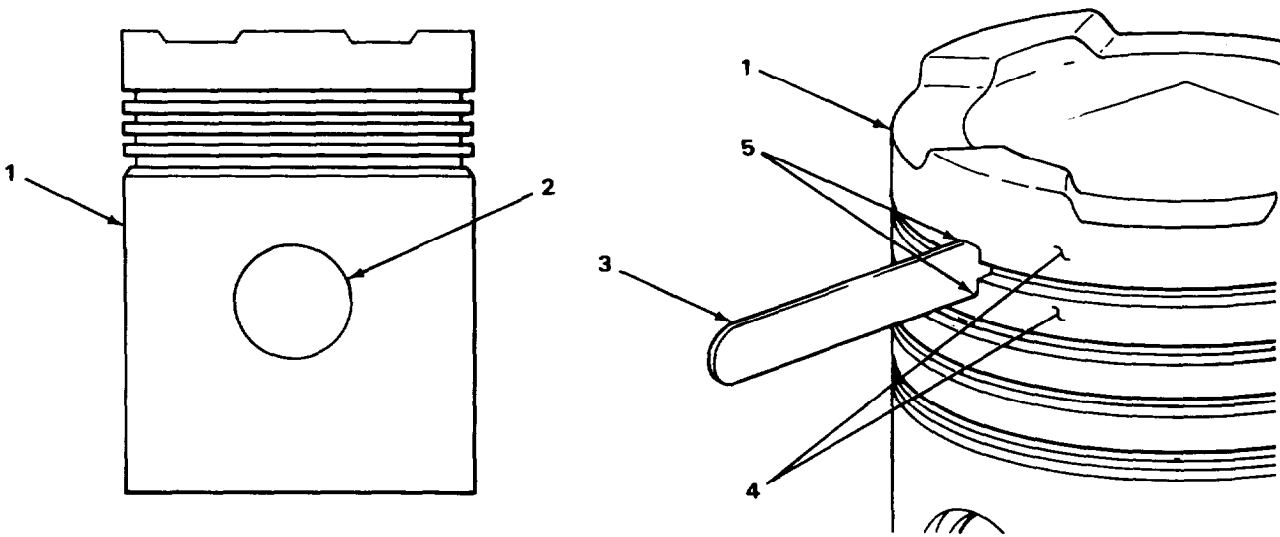
CLEANING/INSPECTION

**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

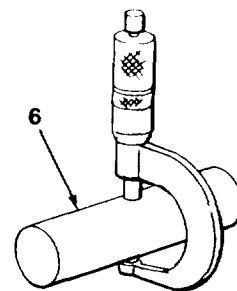
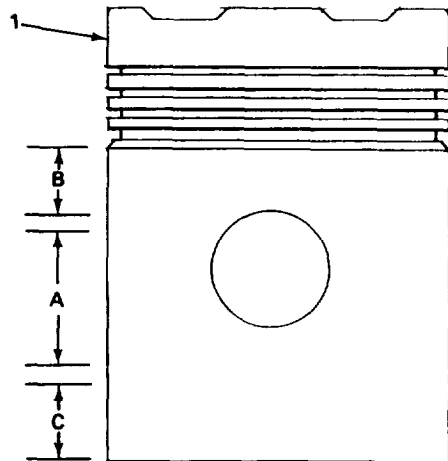
Pistons should be inspected at ambient temperatures of 70° to 90°F (2° to 32°C).

- |    |            |   |
|----|------------|---|
| 7. | Piston (1) | <ul style="list-style-type: none"> <li>a. Inspect wear surface for scoring, scuffing, and cracks.<br/><b>If scoring, scuffing, or cracks exist, discard piston.</b></li> <li>b. Inspect piston pin bore (2) for fractures.<br/><b>If fractures exist, discard piston.</b></li> <li>c. Using ST-560 ring groove gage (3) check top and second ring groove lands (4) depth for wear.<br/><b>If shoulders of gage (5) touch ring groove lands (4), discard piston.</b></li> <li>d. Using dial bore gage, measure piston pin bore (2) Inside diameter.<br/><b>If piston pin bore (2) exceeds 1.999 inch (50.775 mm) at 70°F (21°C) discard piston. Add 0.0005 inch (0.013 mm) per each 10°F (5.5°C) over 70°F.</b></li> </ul> |
|----|------------|---|



PISTON AND CONNECTING ROD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
8.	Piston (1)	<p>a. Using 5- to 6-inch micrometer, measure piston skirt diameter at right angle to piston pin bore.  <b>For barrel ground pistons proceed with step b.</b>  <b>For straight or tapered ground pistons proceed with step c.</b></p> <p>b. Measure at location A.  <b>If diameter is less than 5.483 inch (139.27 mm), discard piston.</b></p> <p>c. Measure at location B and C.  <b>If diameter is less than 5.483 inch (139.27 mm), discard piston.</b></p>
9.	Piston pin (6)	<p>a. Using 1-to 2-inch micrometer, measure outside diameter.  <b>If outside diameter is less than 1.9978 inch (50.754 mm), discard piston pin.</b></p> <p>b. Using 1- to 2-inch micrometer, check piston pin for out-of-round condition.  <b>If piston pin is out-of-round more than 0.001 inch (0.03 mm), discard piston pin.</b></p>



**PISTON AND CONNECTING ROD - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
CLEANING/INSPECTION - CONTINUED		
10.	Connecting rod (1), bearing cap (2), and two bolts (3)	Using magnetic inspection procedure, inspect for cracks. <b>Pay particular attention to cracks in critical areas (4). If cracks exist, discard connecting rod.</b>
11. Connecting rod (1)	Bearing cap (2), two nuts (5), and two new washers (6)	a. Put bearing cap on connecting rod and install nuts and new washers. b. Using 1/2-inch drive 15/16-inch socket and 0 to 150 ft lb (0 to 210 N•m) torque wrench, tighten nuts as shown in table below.

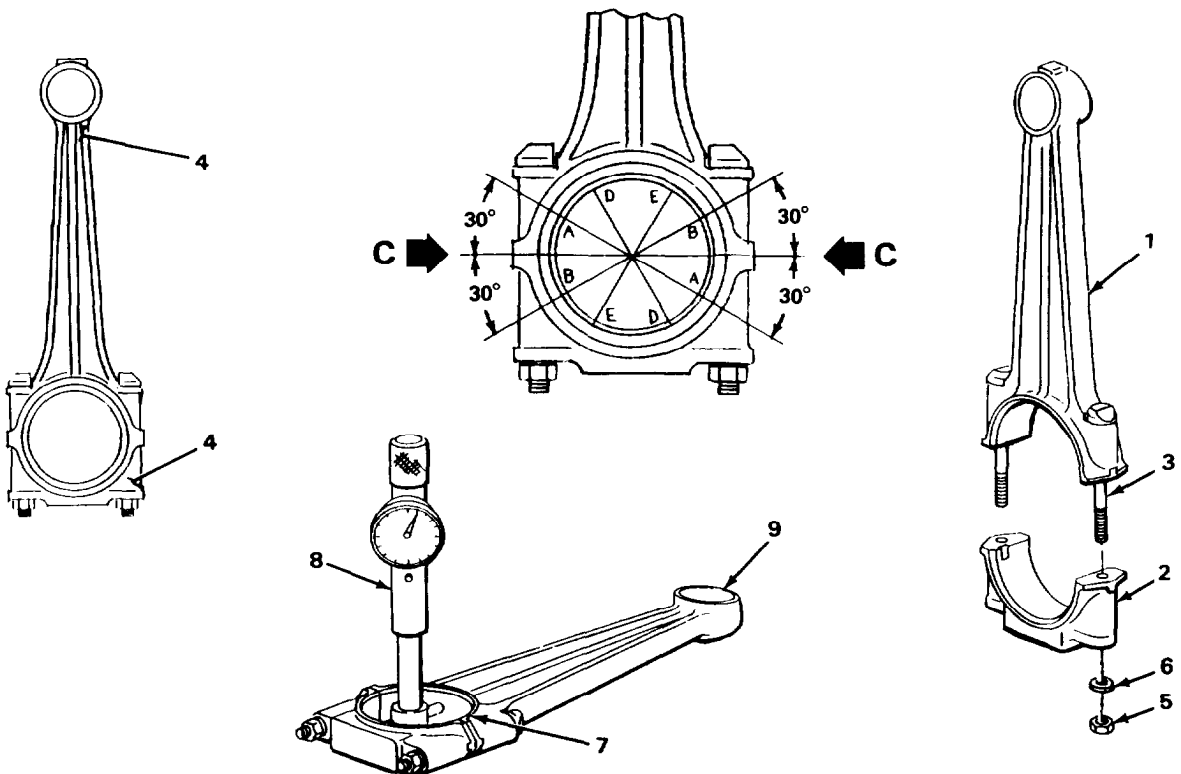
**CONNECTING ROD NUTTIGHTENING SEQUENCE**

TIGHTENING SEQUENCE	TORQUE VALVE	
	FT LB	(N•m)
Step 1. Tighten to	70 - 75	(95 - 102)
Step 2. Advance to	140 - 150	(190 - 203)
Step 3. Loosen to	0	(0)
Step 4. Tighten to	25 - 30	(34 - 41)
Step 5. Advance to	70 - 75	(95 - 102)
Step 6. Advance to	140 - 150	(190 - 203)

12.	Crankpin bore (7)	a. Using dial bore gage (8), measure inside diameter at points A - A and B - B up to 30° either side of parting line C, and record readings. <b>If crankpin bore diameter is not between 3.2722 to 3.2736 inch (83.114 to 83.149 mm), tag connec- ting rod for crankpin bore resizing.</b>
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PISTON AND CONNECTING ROD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
13.	Piston pin bushing bore (9)	<p>b. Measure at points D - D and E - E, and record readings.  <b>If crankpin bore diameter is not between 3.2722 to 3.2732 inch (83.114 to 83.139 mm), tag connecting rod (1) for crankpin bore resizing.</b></p> <p>Using dial bore gage, check inside diameter.  <b>If inside diameter is greater than 2.0025 inch (50.884 mm).</b></p>



PISTON AND CONNECTING ROD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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CLEANING/INSPECTION - CONTINUED

**NOTE**

All connecting rod assemblies must be checked for twist, length, and alignment. The ST-561 connecting rod checking fixture must be calibrated before use.

14.	Connecting rod (1)	Select connecting rod that has been checked for correct crankpin bore (2) to piston pin bore (3) center length of 12 inches (304.60 mm).
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**NOTE**

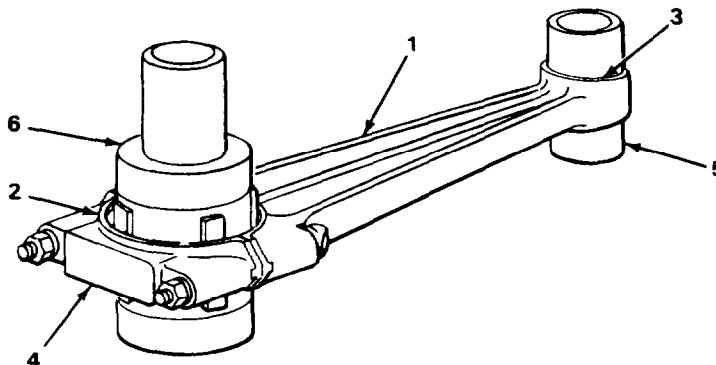
For identification purposes, the connecting rod selected in step 14 will be referred to as "master connecting rod" in the following steps.

15. Master connecting rod (1)	Bearing cap (4)	Make sure bearing cap is torqued correctly. <b>See step 11.</b>
16.	Piston pin mandrel (5)	Insert into piston pin bore (3). <b>Mandrel is furnished with checking fixture kit.</b>

**NOTE**

The expanding arbor must be installed with locking pin down and on center line of rod.

17.	Expanding arbor (6)	Insert into crankpin bore (2). <b>Tighten to snug only.</b>
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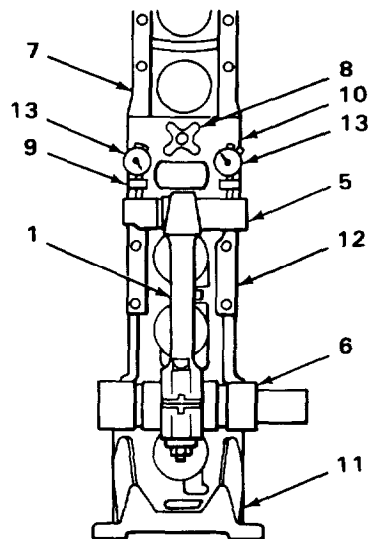
PISTON AND CONNECTING ROD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

Procedure for checking connecting rods is typical for use of the ST-561 connecting rod checking fixture.

- |     |  |                       |  |
|-----|--|-----------------------|--|
| 18. | ST-561 connecting rod checking fixture (7) | Holder plate knob (8) | <ul style="list-style-type: none"> <li>a. Loosen.<br/><b>Raise high enough so piston pin mandrel (5) will clear Indicator pins (9) when installed.</b></li> <li>b. Raise holder plate (10) and retighten holder plate knob.</li> </ul> |
| 19. | Master connecting rod (1)                  |                       | Position in checking fixture by seating expanding arbor (6) in base (11) and piston pin mandrel (5) against frame (12).  |
| 20. | Holder plate knob (8)                      |                       | <ul style="list-style-type: none"> <li>a. Loosen and slowly lower holder plate (10) until indicator pins (9) just seat on piston pin mandrel (5).</li> <li>b. Tighten holder plate knob securely.</li> </ul>                           |
| 21. | Two dial indicators (13)                   |                       | Set dials to zero.   |



**PISTON AND CONNECTING ROD - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
CLEANING/INSPECTION - CONTINUED		
22. ST-561 connecting rod checking fixture (1)	Master connecting rod (2)	Gently remove and rotate 160° horizontally and place back into checking fixture allowing dial indicators (3) to register a reading. <b>If both dial indicators (3) register readings other than original zero "0" settings, record these readings.</b>
23.	Dial indicator (3)	Set zero "0" to one-half readings recorded in step 20. <b>Checking fixture (1) is now calibrated.</b>
24.	Master connecting rod (2)	a. Remove from checking fixture (1). b. Remove piston pin mandrel and expanding arbor.

**NOTE**

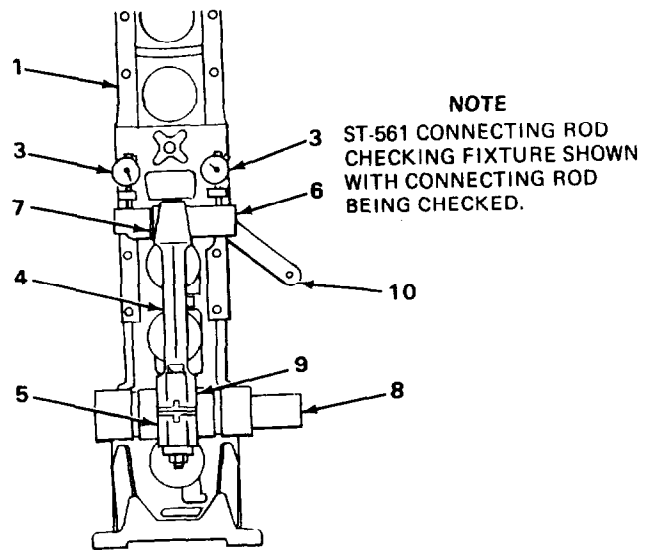
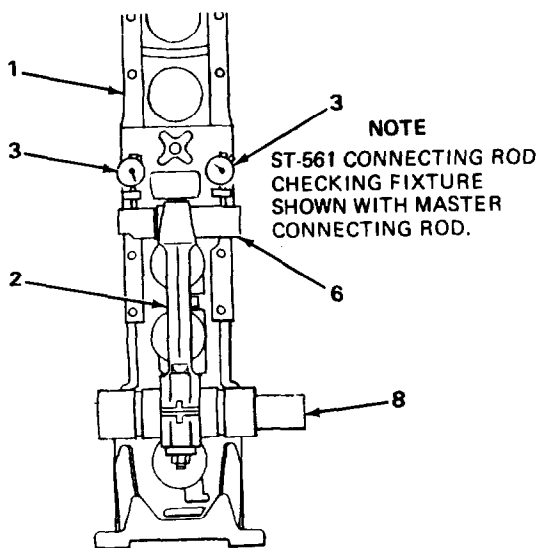
Connecting rod alinement measurements read directly from dial indicators, indicate comparative length and misalinement of bores. Measurements apply with or without piston pin bushings installed.

25. Connecting rod (4)	Bearing cap (5)	Make sure bearing cap is torqued correctly. <b>See step 11.</b>
26.	Piston pin mandrel (6)	Insert into piston pin bore (7).
27.	Expanding arbor (8)	Insert into crankpin bore (9). <b>Tighten to snug only.</b>
28.	Connecting rod (4)	a. Set into ST-561 connecting rod checking fixture (1). <b>See steps 18 thru 21.</b> b. Check dial indicator (3) readings for length and compare to length set up in calibration of checking fixture (1). <b>Record reading.</b> c. Check dial indicator (3) readings for alinement of bores and compare the difference of reading from one dial indicator to other. <b>Record reading.</b>

PISTON AND CONNECTING ROD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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- d. Remove from checking fixture (1), rotate 180° horizontally, and place back into checking fixture (1).
- e. Compare reading for length with recorded reading. Length must be within 0.001 inch (0.0254 mm).  
**If reading is greater than 0.001 inch (0.0254 mm), discard connecting rod.**
- f. Compare reading for alinement of bores with recorded reading. Total reading must not exceed 0.004 inch (0.10 mm) with piston pin bushing installed and bored to size, or 0.008 inch (0.20 mm) without piston pin bushing.  
**If reading exceeds these specifications, discard connecting rod.**
- g. Using thickness gage (10) between piston pin mandrel (6) and dial holding plate, check connecting rod twist. Twist must not exceed 0.010 inch (0.25 mm) with piston pin bushing installed and bored to size, or 0.020 inch (0.51 mm) without piston pin bushing.  
**If reading exceeds these specifications, discard connecting rod.**



**PISTON AND CONNECTING ROD - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
CLEANING/INSPECTION - CONTINUED		
29.	Connecting rod (1) Two bolts (2)	Check that boltheads rest squarely on milled surface (3) of connecting rod. <b>If boltheads do not rest squarely on milled surface, tag connecting rod for milled surface repair.</b>
30.	Connecting rod (1) and bearing cap (4) Two bolts (2), two nuts (5), and two washers (6)	a. Using 1/2-inch drive 15/16-inch socket and hinged handle, unscrew and take off. b. Using 0- to 1-inch micrometer, check inside diameter of boltholes (7). <b>If diameter is greater than 0.6249 Inch (15.872 mm), discard connecting rod and bearing cap.</b>
31.	Connecting rod (1) Two bolts (2)	a. Check for distorted or damaged threads. If threads are distorted or damaged, discard bolt. b. Using 0- to 1-inch micrometer, check smallest outside diameter. <b>If smallest outside diameter is less than 0.540 inch (13.72 mm) discard bolt.</b>
32.	Connecting rod (1)	a. Using 0- to 1-inch micrometer, check fillet radius (8) at all corners where connecting rod is milled for bolthead. <b>If fillet radius does not measure 0.045 to 0.055 inch (1.14 to 1.40 mm), tag connecting rod for milled surface repair.</b> b. Check fillet radius (8) for nicks and dents. <b>If nicks and dents are deeper than 1/16 inch (1.59 mm), discard connecting rod. if nicks and dents exist but are less than 1/16-inch (1.59 mm) deep, tag connecting rod for milled surface repair.</b>
33.	Two nuts (5)	Check for distorted or damaged threads. <b>If threads are distorted or damaged, discard nut.</b>

PISTON AND CONNECTING ROD - CONTINUED

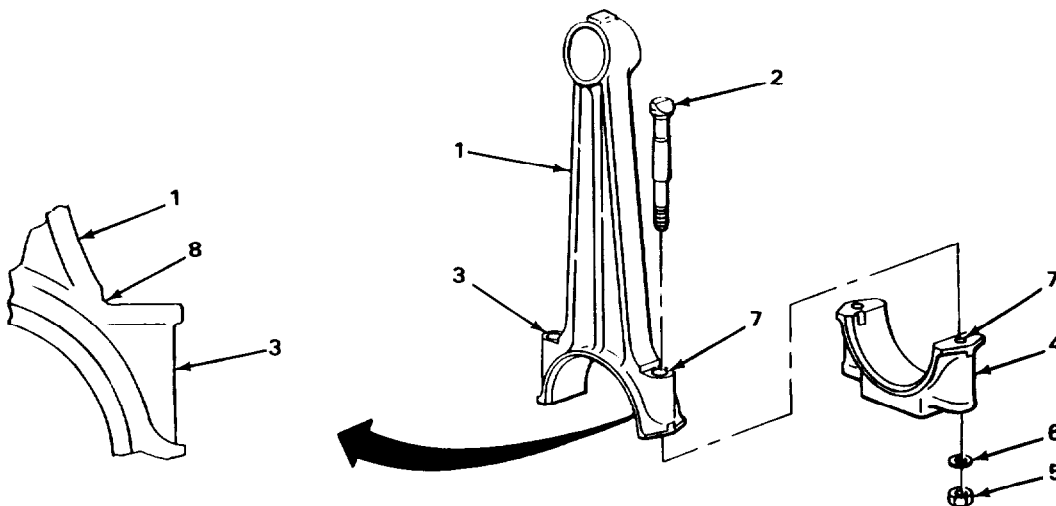
LOCATION	ITEM	ACTION REMARKS
34.	Bearing cap (4), two bolts (2), two nuts (5), and two washers (6)	Put on and torque nuts as specified in step 11.

REPAIR

**NOTE**

Perform steps 35, 36, and 37 for connecting rods tagged for milled surface repair.

- |                        |  |  |
|------------------------|--|--|
| 35. Connecting rod (1) | Bearing cap (4),<br>two bolts (2), and<br>two nuts (5)                     | Using 1/2-inch drive 15/16-inch socket and hinged handle, unscrew and take off.  |
| 36.                    | Connecting rod (1)   | a. Using half-round file, file milled surface of connecting rod a maximum of 1/16 inch (1.59 mm).<br>b. Form a fillet radius (8) at all corners where connecting rod (1) is milled for bolthead to a dimension of 0.045 to 0.055 inch (1.14 to 1.40 mm).<br><b>Fillet radius must be 1/2 inch (12.7 mm) in length or more. Blend radii at ends of cut.</b> |
| 37.                    | Bearing cap (4),<br>two bolts (2), two<br>nuts (5), and two<br>washers (6) | Put on and torque nuts as specified in step 11.  |



**PISTON AND CONNECTING ROD - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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REPAIR - CONTINUED

**NOTE**

Perform steps 38 thru 41 for connecting rods tagged for crankpin bore resizing.

- |     |                    |   |
|-----|--------------------|---|
| 38. | Connecting rod (1) | <ul style="list-style-type: none"> <li>a. Make sure bearing cap (2) is torqued correctly.<br/><b>See step 11.</b></li> <li>b. Using ST-870 mandrel and block, push out old piston pin bushing (3).</li> <li>c. Using ST-561 connecting rod checking fixture, recheck connecting rod length.<br/><b>If connecting rod length is 11.991 inch (304.57 mm) or less, connecting rod cannot be resized. Discard.</b></li> <li>d. Using 1/2-inch drive 15/16-inch socket and hinged handle, unscrew and take off two nuts (4), two bolts (5), two washers (6), and bearing cap (2).</li> </ul> |
|-----|--------------------|---|

**NOTE**

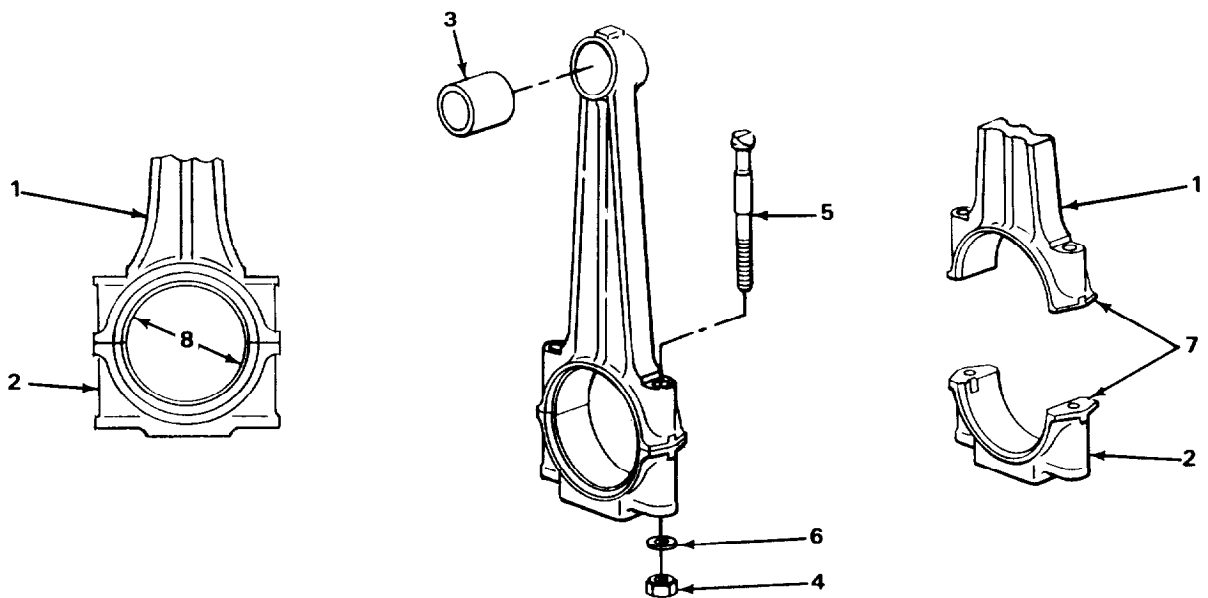
The maximum amount of material that can be ground and lapped off connecting rod and bearing cap mating surfaces, can be determined by subtracting 11.991 inch (304.57 mm) from the actual length of the connecting rod to be repaired, as measured using the ST-561 connecting rod checking fixture.

During grinding and lapping operation, parts must be clamped securely to ensure proper contact of entire mating surfaces and proper alignment of bolt bores when assembled. Boltholes must remain perpendicular to machined mating surfaces.

- e. Using surface plate and cutting fluid, lap connecting rod, bearing cap (2), and mating surfaces (7).
- f. Using prussian blue, check seating of mating surfaces (7).  
**Seating pattern must show a minimum of 75 percent contact. Seating pattern in area outside bolt center line (area farthest from crankpin bore center line) must indicate 100 percent seating.**

PISTON AND CONNECTING ROD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
		<p>g. Put on bearing cap (2), bolts (5), nuts (4), and washers (6).</p> <p>h. Torque nuts as specified in step 11.</p> <p>i. Using ST-526 boring machine, grind crankpin bore (8) to 3.2720 to 3.2725 inch (83.119 to 83.134 mm) inside diameter.  <b>Finished surface must be 75 micro-inch or better to ensure proper contact with bearings.</b></p> <p>j. Using ST-561 connecting rod checking fixture, check connecting rod alignment.  <b>See step 28.</b></p> <p>k. Install new heavy wall piston pin bushing (3).  <b>See steps 38 thru 41.</b></p> <p>l. Bore piston pin bushing (3) off center to restore connecting rod (1) to original 11.998- to 12.000-inch (304.75 to 304.80 mm) length.</p>



**PISTON AND CONNECTING ROD - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
REPAIR - CONTINUED		
39. Block (1)	Connecting rod (2)	a. Place on block and support in horizontal position. b. Line up mark on guide sleeve (3) with middle of boss on connecting rod. c. Using ST-1242 mandrel set (4), assembly sleeve (5), guide sleeve (3), and arbor press, push in new piston pin bushing (6), making sure oil hole in piston pin bushing and piston pin bore (7) are lined up. <b>Push in until assembly sleeve (5) contacts side of connecting rod boss.</b>
40. Connecting rod (2)	Piston pin bushing (6)	Using ST-1242 mandrel set (4), removal sleeve (8), and arbor press, push out.

**WARNING**

Safety goggles must be worn to prevent eye injury caused by flying steel chips.

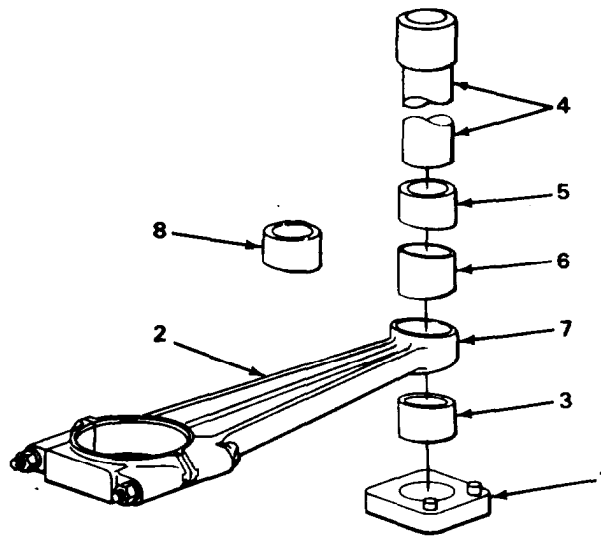
41.	Connecting rod (2)	a. Fill lubricating holes with lubricating soap to keep out shavings. b. Mount in ST-526 boring machine or equivalent. <b>Lower mandrel should have only the two horizontal blades in place to properly locate the side position of the piston pin end of connecting rod (2).</b> c. Bore piston pin bushing (6) to 2.001-to 2.0015-inch (50.83 to 50.84 mm) inside diameter. d. Remove from ST-526 boring machine, or equivalent, and using ST-205 plug gage, check inside diameter. <b>If inside diameter is less than 2.001 inch (56.83 mm), continue boring operation, steps a, b, and c.                      If inside diameter is greater than 2.0015 inch (50.84 mm), replace piston pin bushing (6).                      See steps 38 thru 41.</b> e. Using scraper, remove any sharp edges from piston pin bushing (6).
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PISTON AND CONNECTING ROD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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- f. Clean thoroughly.  
**Make sure all shavings and soap are removed from oil passages.**
- g. Using ST-561 connecting rod checking fixture, recheck all dimensions on re-bushed and rebored connecting rods (2).  
**See steps 14 thru 28.**



**PISTON AND CONNECTING ROD - CONTINUED**

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LOCATION	ITEM	ACTION REMARKS
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ASSEMBLY

**CAUTION**

Pistons are machined to a very close weight tolerance. Make sure the same part number piston is used throughout the engine. Weight difference will affect engine operation.

42. Piston (1)	Retaining ring (2)	Using 6-inch snapping pliers, put in groove in piston bore.
----------------	--------------------	---

**WARNING**

Heat-protective cloth mittens must be worn to prevent serious injury to hands when handling heated parts.

**CAUTION**

Pistons must be heated in hot water to prevent piston damage during piston pin installation.

Do not drive piston pins with hammer. Driving may cause distortion of piston, causing piston seizure in cylinder sleeve.

Be sure retaining ring is firmly seated in groove of piston pin bore to prevent serious engine damage.

Do not attempt to push in piston pin after piston has cooled. At 70°F (21°C), the piston pin fit is 0.0001 to - 0.0003 inch (0.003 to - 0.008 mm), which prevents piston pin assembly unless piston is heated.

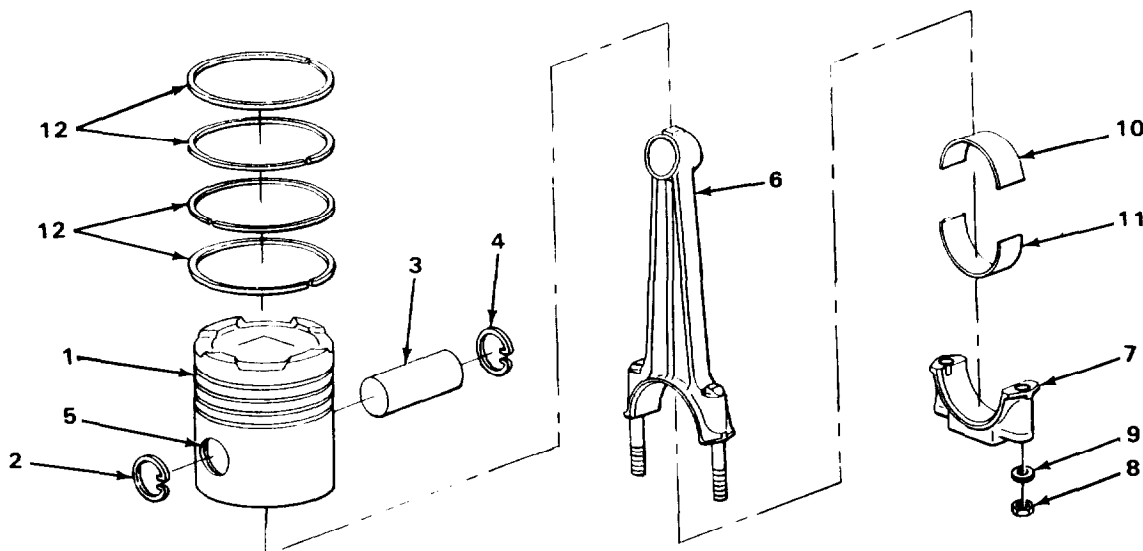
**NOTE**

Install new or inspection-approved pistons on connecting rod. Be sure to install pistons on their companion connecting rod, as tagged during disassembly.

43.	Piston pin (3) and retaining ring (4)	<ol style="list-style-type: none"> <li>a. Submerge in container of boiling water for 15 minutes to allow pistons to expand.</li> <li>b. Remove from boiling water and place connecting rod in piston.</li> <li>c. Push piston pin through piston pin bore (5) and connecting rod bore before piston cools.</li> <li>d. Using 6-inch snapping pliers, put retaining ring in groove in piston pin bore (5).</li> </ol>
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**PISTON AND CONNECTING ROD - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
44. Connecting rod (6)	Bearing cap (7), two nuts (8), and two washers (9)	Take off.	
<b>NOTE</b>			
<p>Install new or inspection-approved connecting rod bearings. Be sure to install bearings to their respective connecting rod and bearing cap, as tagged during disassembly. If crankshaft is new or has been machined, install new bearings. If an upper or lower bearing has been replaced with a new bearing, its other half must also be replaced with a new bearing.</p>			
45. Connecting rod (6)	Upper bearing (10)	Put in.	
46. Bearing cap (7)	Lower bearing (11)	Put in.	
47. Connecting rod (6)	Bearing cap (7), two washers (9), and two nuts (8)	a. Put on. b. Hand tighten, to keep bearings from slipping out of connecting rod.	
48.	Bearings (10 and 11) and four piston rings (12)	Keep together with piston (1) and connecting rod (6), tag location in cylinder block, hold for engine assembly.	



**NOTE**

FOLLOW-ON MAINTENANCE: Install pistons and connecting rods (page 2-60).

**TASK ENDS HERE**

## Section IX. CAMSHAFT AND TIMING SYSTEM MAINTENANCE

### OVERVIEW

The following paragraphs provide maintenance instructions for the camshaft and timing system of the NTC-290 diesel engine. For camshaft bearing repair, see section V, page 2-140.

	Page		Page
Cam Follower Assembly.....	2-254	Rocker Arm Housing and	
Camshaft and Gear Assembly.....	2-238	Push Rod .....	2-242

### CAMSHAFT AND GEAR ASSEMBLY

---

This task covers:

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>a. Cleaning (page 2-238)</li> <li>b. Inspection (page 2-239)</li> </ul> | <ul style="list-style-type: none"> <li>c. Disassembly (page 2-239)</li> <li>d. Assembly (page 2-240)</li> </ul> |
|--|---|
- 

### INITIAL SETUP

**Tools**

- Gage, thickness
- Key, hex, 3/16-inch
- Mandrel and block ST-691
- Micrometer, 1- to 2-inch
- Micrometer, 0- to 1-inch
- Mittens, cloth, heat-protective
- Press, arbor
- V-blocks

**Materials/Parts**

- Key, machine, camshaft gear
- Rags, wiping (item 14, appendix B)

**Equipment Condition**

Camshaft and gear removed (page 2-48).

**References**

TM 55-1500-335-23, Inspection Methods, Non-Destructive

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LOCATION	ITEM	ACTION REMARKS
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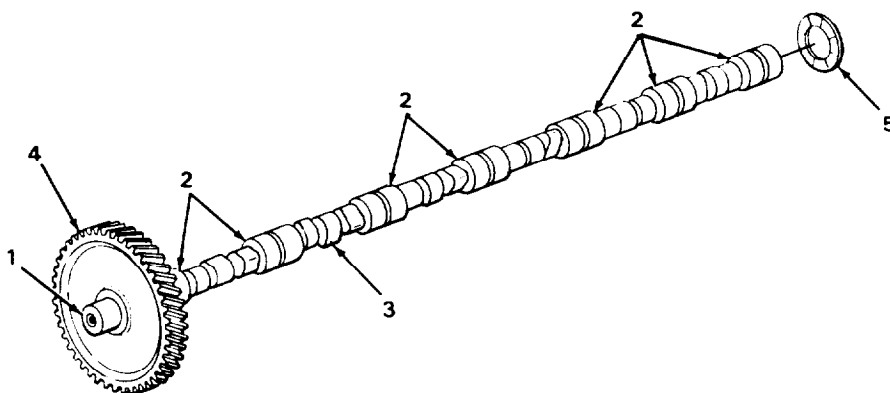
### CLEANING

#### NOTE

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

**CAMSHAFT AND GEAR ASSEMBLY - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
<b>INSPECTION</b>		
1. Camshaft and gear assembly (1)	Bearing journals (2)	Using a 1-to 2-inch micrometer, measure diameter. <b>If diameter is less than 1.996 Inches (59.70 mm), replace camshaft. New camshaft bearing journals will be 1.997 to 1.998 inches (50.72 to 50.75 mm).</b>
2.	Camshaft (3)	Inspect for breaks, pits, scoring, or scuffing. Inspect for cracks or imperfections by visual and magnetic inspection methods. <b>If broken, cracked, pitted, scored, or scuffed, replace camshaft.</b>
3. Camshaft and gear assembly (1)	Camshaft gear (4)	Inspect for chips, cracks, visible wear, sharp fins, nicks, and burrs. <b>If chipped, cracked, worn, nicked, or sharp fins and burrs are observed, replace camshaft gear.</b>
4.	Thrust bearing (5)	Using a 0- to 1-inch micrometer, measure thickness. <b>If less than 0.083 inch (2.11 mm), replace thrust bearing.</b>
<b>DISASSEMBLY</b>		
5. Camshaft and gear assembly (1)	Thrust bearing (5)	Remove.



**CAMSHAFT AND GEAR ASSEMBLY - CONTINUED**

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LOCATION	ITEM	ACTION REMARKS
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DISASSEMBLY - CONTINUED

**WARNING**

Heat-protective cloth mittens must be worn to prevent serious injury to hands when handling heated parts.

**CAUTION**

Never support gear on outer gear surface. Always support hub area to prevent damage to parts or equipment.

6. Camshaft and gear assembly (1)	Camshaft gear (2)	a. Support camshaft and gear in V-blocks and heat camshaft gear to 300° to 400°F (148° to 204°C). b. Using arbor press and ST-691 mandrel and block, press camshaft from camshaft gear.
7. Camshaft (3)	Camshaft gear machine key (4)	Remove. Discard.
8.	Vent plug (5)	Using 3/16-inch hex key, unscrew and take out.

ASSEMBLY

**CAUTION**

Parts must be free from dust and dirt to prevent damage.

9. Camshaft (3)	New camshaft gear machine key (4)	Place in camshaft keyway.
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**CAMSHAFT AND GEAR ASSEMBLY - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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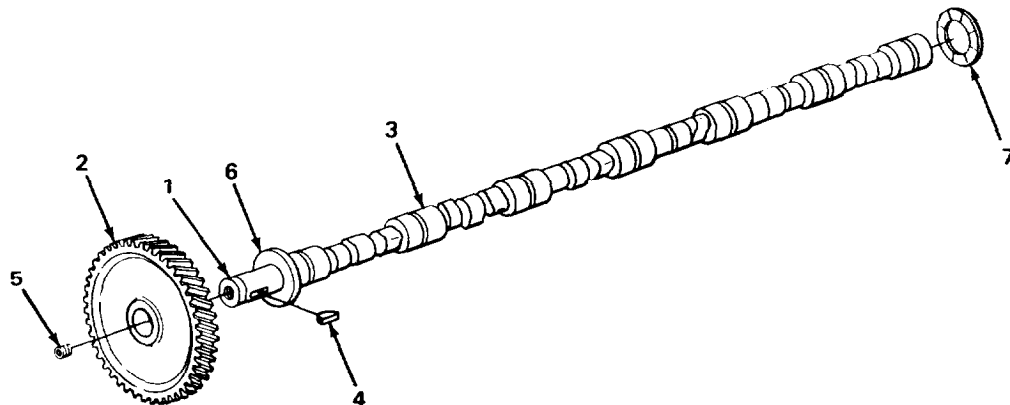
**WARNING**

Heat-protective cloth mittens must be worn to prevent serious injury to hands when handling heated parts.

**CAUTION**

Never support gear on outer gear surface. Always support hub area to prevent damage to parts or equipment.

- |     |  |   |
|-----|--|---|
| 10. | Camshaft (3) and camshaft gear (2)     | <ul style="list-style-type: none"> <li>a. Support camshaft and gear in V-blocks and heat camshaft gear to 300° to 400°F (148° to 204°C).</li> <li>b. Using arbor press and ST-691 mandrel and block, press camshaft gear onto camshaft.</li> <li>c. Using thickness gage, check clearance between camshaft gear and camshaft flange (6).<br/><b>Clearance should not exceed 0.0015 Inch (0.38 mm).</b></li> </ul> |
| 11. | Camshaft and gear (1)<br>Vent plug (5) | Using 3/16-inch hex key, screw in and tighten.  |
| 12. | Thrust bearing (7)                     | Install.  |



**NOTE**

FOLLOW-ON MAINTENANCE: Install camshaft and gear (page 2-66).

**TASK ENDS HERE**

**ROCKER ARM HOUSING AND PUSH ROD**

This task covers:

- a. Disassembly (page 2-242)
- b. Cleaning (page 2-244)
- c. Inspection (page 2-245)
- d. Assembly (page 2-251)

**INITIAL SETUP**

**Tools**

- Bit, drill, 9/32-inch
- Driftpin, brass, 3/4-inch
- Drill, electric, 3/8-inch
- Gage, bore, dial
- Gage, radius, 1/4-inch
- Gage, radius, 5/16-inch
- Goggles, safety
- Hammer, ball-peen, 16-ounce
- Key, hex, 5/32-inch
- Mandrel and block, ST-691
- Micrometer, 1- to 2-inch
- Press, arbor
- Punch, pin, 1/4-inch
- Screwdriver, flat-tip, 3/8-inch
- Wrench, box-end, 7/16-inch
- Wrench, box-end, 3/4-inch

**Materials/Parts**

- Bushing, rocker arm (as required)
- Cloth, emery (item 1, appendix B)
- Locknut (six required)
- Oil, lubricating (Item 12, appendix B)
- Packing, preformed (two required)
- Prussian blue (item 13, appendix B)
- Solvent, drycleaning (item 16, appendix B)
- Tags, marker (item 17, appendix B)

**Equipment Condition**

Rocker arm housing removed (page 2-30).

**References**

TM 55-1500-335-23, Inspection Methods, Non-Destructive

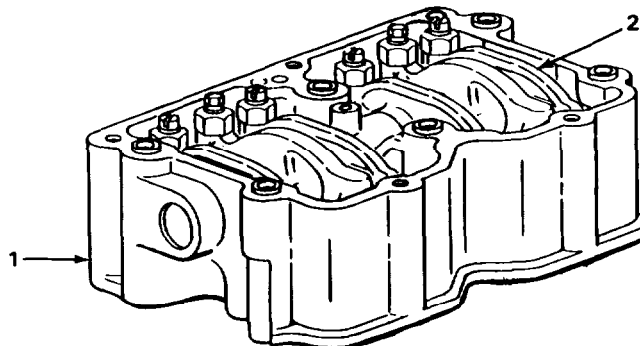
LOCATION	ITEM	ACTION	REMARKS
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**DISASSEMBLY**

**NOTE**

Steps given are typical for all three rocker arm housings

- |                           |                     |  |
|---------------------------|---------------------|--|
| 1. Rocker arm housing (1) | Six rocker arms (2) | Tag and number rocker arms in sequence 1 thru 6 starting from front of rocker arm housing. |
|---------------------------|---------------------|--|





**ROCKER ARM HOUSING AND PUSH ROD - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
2. Rocker arm housing (1)	Six engine compression brake steel washers (3)	Using 3/8-inch flat-tip screwdriver, pry out. <b>Discard engine compression brake steel washers.</b>
3.	Rocker arm shaft setscrew (4)	Using 5/32-inch hex key, unscrew and remove.

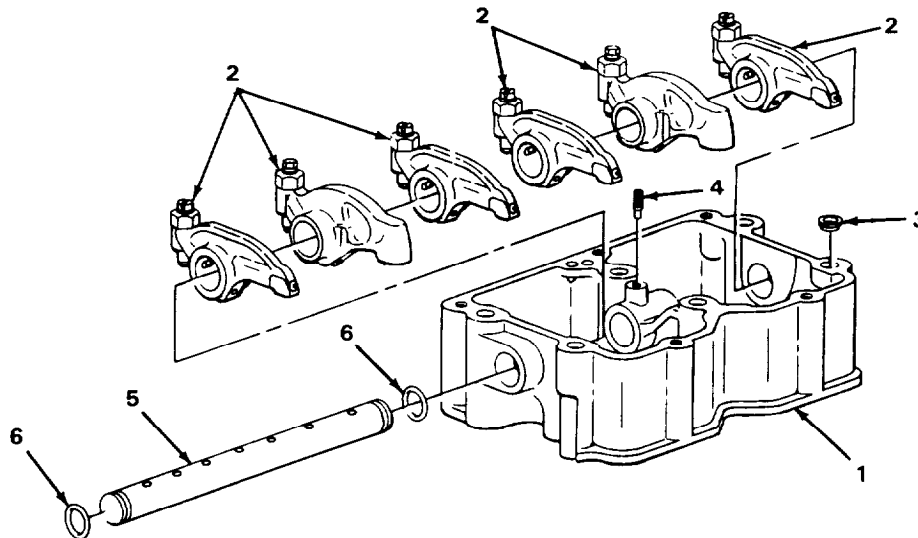
**CAUTION**

When removing rocker arm shaft, center driftpin on rocker arm shaft and tap lightly. Striking rocker arm housing or rocker arm will cause damage.

**NOTE**

When removing rocker arm shaft, remove and set aside rocker arms (2) as they become free from rocker arm shaft.

4.	Rocker arm shaft (5)	Using 16-ounce ball-peen hammer and 3/4-inch brass driftpin, drive out.
5. Rocker arm shaft (5)	Preformed packing (6)	Remove. Discard packings.



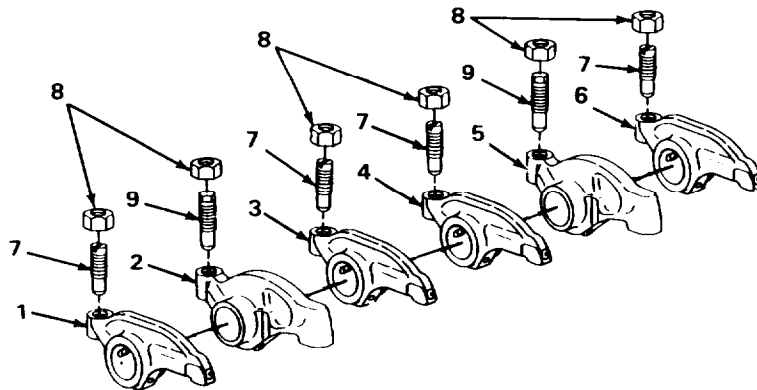
**ROCKER ARM HOUSING AND PUSH ROD - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
<b>DISASSEMBLY - CONTINUED</b>		
6. Rocker arms (1,3, 4, and 6)	Four rocker arm adjusting screws (7) and four locknuts (8)	Using 3/4-inch box-end wrench and 3/8-inch flat-tip screwdriver, loosen and remove as an assembly.
7. Rocker arms (2 and 5)	Two rocker arm adjusting bolts (9) and two locknuts (8)	Using 3/4-inch and 7/16-inch box-end wrenches, loosen and remove as an assembly.
8. Rocker arm adjusting screws (7) and rocker arm adjusting bolts (9)	Six locknuts (8)	Unscrew. <b>Discard six locknuts.</b>

**CLEANING**

**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.



**ROCKER ARM HOUSING AND PUSH ROD - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION

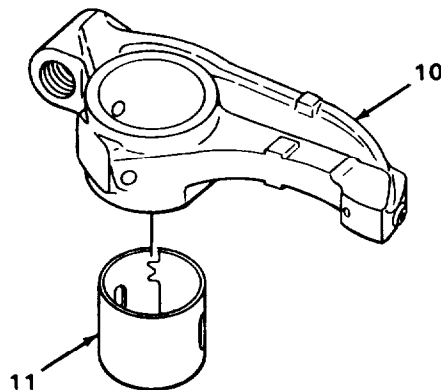
**WARNING**

Drycleaning solvent P-D-680 is toxic and flammable. Wear safety goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. Flashpoint for type #1 drycleaning solvent is 100°F (38°C) and for type #2 is 138°F (59°C). If you become dizzy while using solvent, get fresh air immediately, and get medical aid. If contact with eyes is made, wash your eyes with water, and get medical aid immediately. Failure to observe these precautions could cause serious injury or death to personnel.

**NOTE**

Steps given are typical for all rocker arm bushings.

- |                    |                         |  |
|--------------------|-------------------------|--|
| 9. Rocker arm (10) | Rocker arm bushing (11) | <ul style="list-style-type: none"> <li>a. Using drycleaning solvent, clean and wipe dry with rag and inspect for cracks and pitting.<br/><b>Discard, if cracked or pitted.</b></li> <li>b. Using bore gage, measure inside diameter at several points for wear.<br/><b>If inside diameter exceeds 1.128 Inch (28.664 mm), discard rocker arm bushing.</b></li> </ul> |
| 10.                | Rocker arm bushing (11) | <p>Using arbor press and ST-691 mandrel and block, press out.<br/><b>Install new rocker arm bushing, see steps 22 and 23.</b></p>  |



ROCKER ARM HOUSING AND PUSH ROD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
INSPECTION - CONTINUED		
<b><u>WARNING</u></b>		
<p>Drycleaning solvent P-D-680 is toxic and flammable. Wear safety goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes, and do not breathe vapors. Do not use near open flame or excessive heat. Flashpoint for type #1 drycleaning solvent is 100°F (38°C) and for type #2 is 138°F (59°C). If you become dizzy while using solvent, get fresh air immediately, and get medical aid. If contact with eyes is made, wash your eyes with water, and get medical aid immediately. Failure to observe these precautions could cause serious injury or death to personnel.</p> <p>Particles blown by compressed air are hazardous. Make certain the air stream is directed away from user and other personnel in the area. Compressed air used for cleaning purposes shall not exceed 30 psi (207 kPa). User must wear safety goggles or face shield to prevent personnel injury.</p>		
<b>NOTE</b>		
Steps 11, 12, and 13 are typical for all rocker arms.		
11.	Fuel injector rocker arm (1)	<p>a. Wipe clean with rag and inspect for breaks and clogged oil passages. <b>If oil passages (2) are clogged, clean with drycleaning solvent and use compressed air to thoroughly clean oil passages.</b></p> <p>b. Check for cracks and imperfections by visual and magnetic inspection. <b>If broken or cracked, replace.</b></p>
12. Fuel injector rocker arm (1)	Socket seat (3)	<p>Inspect as follows:</p> <p>a. Coat new injector link ball end (4) with prussian blue.</p> <p>b. Place injector link ball end (4) into socket seat and rotate using hand pressure.</p> <p>c. Check socket seat wear area. <b>If socket seat wear area is not 80-percent blued, replace socket seat.</b></p>
13. Fuel injector rocker arm (1)	Socket seat (3)	<p>Remove as follows:</p> <p>a. Using 3/8-inch electric drill and 9/32-inch drill bit, drill hole through rocker arm above socket seat.</p> <p>b. Using 16-ounce ball-peen hammer and 1/4-inch pin punch, drive out socket seat.</p>

ROCKER ARM HOUSING AND PUSH ROD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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- c. Install plug in hole and stake in place.  
**Install new socket seat. See step 24.**

**WARNING**

Drycleaning solvent P-D-680 is toxic and flammable. Wear safety goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes, and do not breathe vapors. Do not use near open flame or excessive heat. Flashpoint for type #1 drycleaning solvent is 100°F (38°C) and for type #2 is 138°F (59°C). If you become dizzy while using solvent, get fresh air immediately, and get medical aid. If contact with eyes is made, wash your eyes with water, and get medical aid immediately. Failure to observe these precautions could cause serious injury or death to personnel.

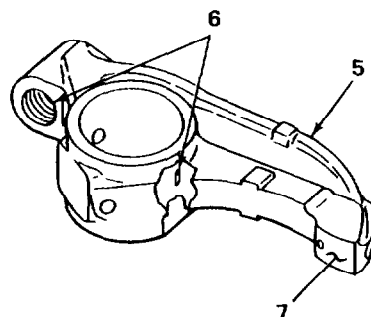
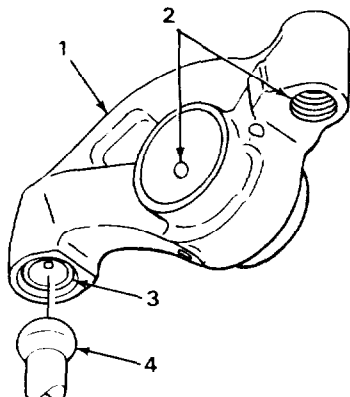
Particles blown by compressed air are hazardous. Make certain the air stream is directed away from user and other personnel in the area. Compressed air used for cleaning purposes shall not exceed 30 psi (207 kPa). User must wear safety goggles or face shield to prevent personnel injury.

**NOTE**

Steps 14 and 15 are typical for all intake and exhaust rocker arms.

- 14. Exhaust rocker arm (5)
  - a. Wipe clean with rag and inspect for breaks and clogged oil passages.  
**If oil passages (8) are clogged, clean with drycleaning solvent and use compressed air to thoroughly clean oil passages.**
  - b. Check for cracks and imperfections by visual and magnetic inspection.  
**If broken or cracked, replace.**

- 15. Exhaust rocker arm (5)
  - Check exhaust rocker arm-to-crosshead contact surface (7).  
**If worn or damaged, replace.**



ROCKER ARM HOUSING AND PUSH ROD - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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INSPECTION - CONTINUED

**NOTE**

Steps given are typical for all push rods.

- |     |              |  |
|-----|--------------|--|
| 16. | Push rod (1) | <ul style="list-style-type: none"> <li>a. Wipe clean with rag and inspect for cracks and bends.<br/><b>If cracked or bent, replace.</b></li> <li>b. Coat ball end of adjusting screw (2) with prussian blue.</li> <li>c. Place ball end of adjusting screw (2) into push rod socket (3) and rotate using hand pressure.</li> <li>d. Check push rod socket (3) wear area.<br/><b>If push rod socket (3) wear area is not 80-percent blued, replace push rod.</b></li> </ul> |
| 17. | Push rod (1) | <ul style="list-style-type: none"> <li>a. Using 5/16-inch radius gage, check ball end (4) for wear.<br/><b>If ball end (4) diameter is not 0.623 to 0.625 inch, replace push rod.</b></li> <li>b. Check for loose push rod socket ends (3) or ball ends (4).<br/><b>If socket ends or ball ends are loose, replace push rod.</b></li> </ul>  |

**NOTE**

Steps given are typical for adjusting screws and adjusting bolts.

- |     |   |   |
|-----|---|---|
| 18. | Six adjusting screws (5) and six new locknuts (6) | <p>Wipe clean and screw locknut down full length of threads by hand.<br/><b>If locknut binds on threads, replace adjusting screw or adjusting bolt (7).</b></p> |
|-----|---|---|

ROCKER ARM HOUSING AND PUSH ROD - CONTINUED

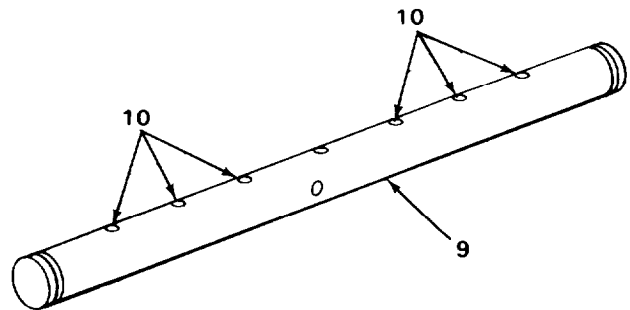
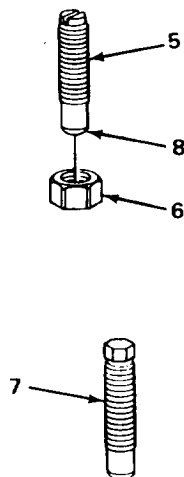
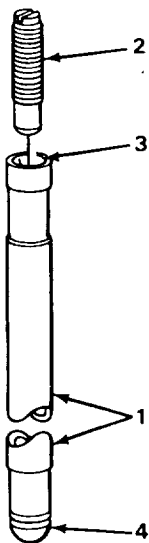
LOCATION	ITEM	ACTION REMARKS
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- |     |                          |   |
|-----|--------------------------|---|
| 19. | Six adjusting screws (5) | Using 1/4-inch radius gage, check ball end (8) for flat spots and roundness.<br><b>If out-of-round, or flat spots are noticed, replace.</b> |
|-----|--------------------------|---|

**WARNING**

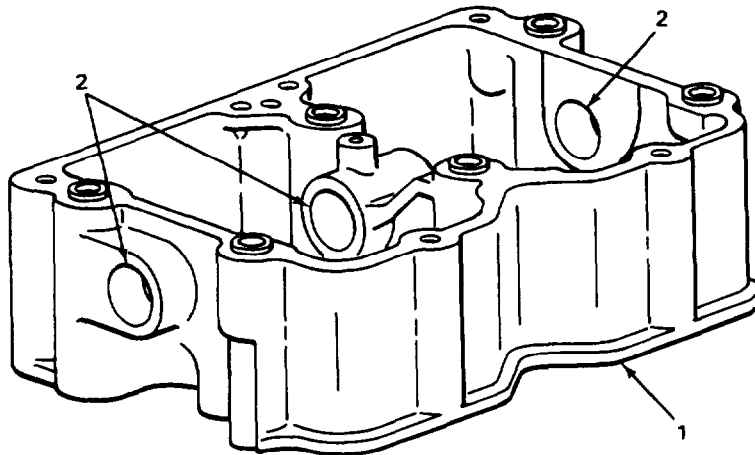
Drycleaning solvent P-D-680 is toxic and flammable. Wear safety goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes, and do not breathe vapors. Do not use near open flame or excessive heat. Flashpoint for type #1 drycleaning solvent is 100°F (38°C) and for type #2 is 138°F (59°C). If you become dizzy while using solvent, get fresh air immediately, and get medical aid. If contact with eyes is made, wash your eyes with water, and get medical aid immediately. Failure to observe these precautions could cause serious injury or death to personnel.

- |     |                      |   |
|-----|----------------------|---|
| 20. | Rocker arm shaft (9) | a. Using drycleaning solvent, clean oil passages (10).<br>b. Using a 1- to 2-inch micrometer, measure outside diameter at several points for wear. Visually inspect for scratches.<br><b>If scratched, or outside diameter is less than 1.122 inch (28.50 mm), replace.</b> |
|-----|----------------------|---|



ROCKER ARM HOUSING AND PUSH ROD - CONTINUED

LOCATION	ITEM	ACTION REMARKS
INSPECTION - CONTINUED		
21.	Rocker arm housing (1)	<p>a. Wipe clean with rag and inspect for cracks, breaks, dents, or distorted mating surfaces.  <b>If cracked, broken, dented, or mating surfaces distorted, replace.</b></p> <p>b. Inspect rocker arm shaft bores (2) for scratches. Using dial bore gage, measure diameter of shaft bores (2) at several points.  <b>If shaft bores (2) are scratched, or if diameter is not 1.1238 to 1.1246 inches (28.545 to 28.565 mm) replace.</b></p> <p>c. Visually inspect edges of shaft bore (2) for nicks and burrs.  <b>Remove sharp edges, nicks, and burrs using emery cloth.</b></p>





**ROCKER ARM HOUSING AND PUSH ROD - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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ASSEMBLY

**CAUTION**

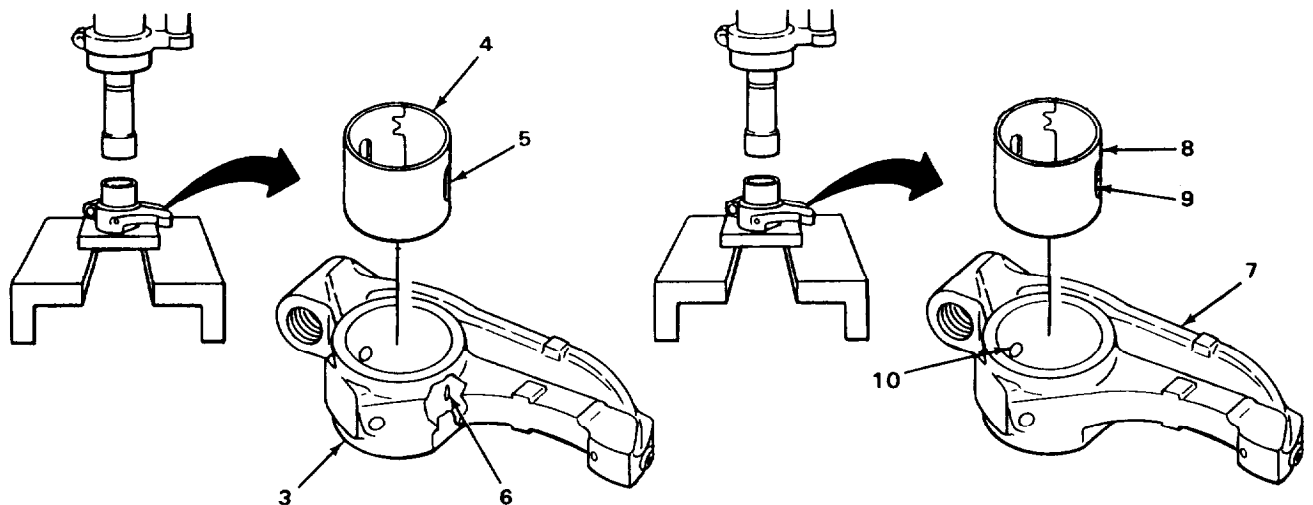
Make sure that all parts are free from dirt and dust.

**NOTE**

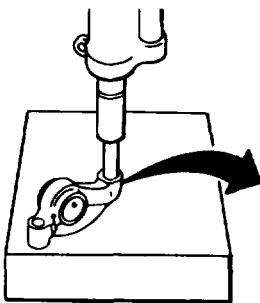
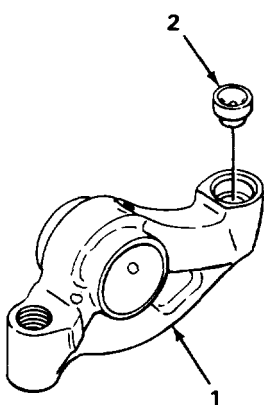
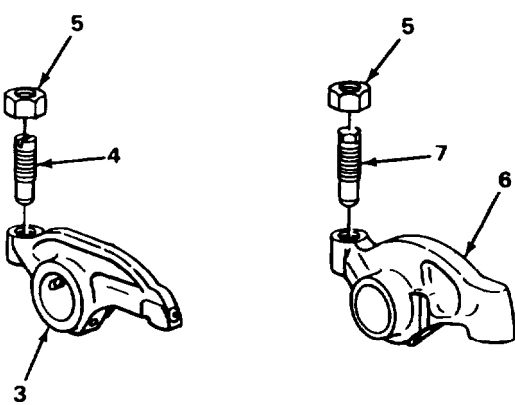
Step 22 is typical for fuel injector and exhaust rocker arms only.

Step 23 is typical for Intake rocker arm only.

- |   |                               |  |
|---|-------------------------------|--|
| <p><b>22.</b> Rocker arm (3)</p>        | <p>Rocker arm bushing (4)</p> | <p>a. Place on rocker arm, alining oil hole (5) with crosshead nose oil hole (6).<br/>b. Using arbor press and ST-691 mandrel and block, press in.</p>           |
| <p><b>23.</b> Intake rocker arm (7)</p> | <p>Rocker arm bushing (8)</p> | <p>a. Place on intake rocker arm, alining slot hole (9) with adjusting screw oil hole (10).<br/>b. Using arbor press and ST-691 mandrel and block, press in.</p> |

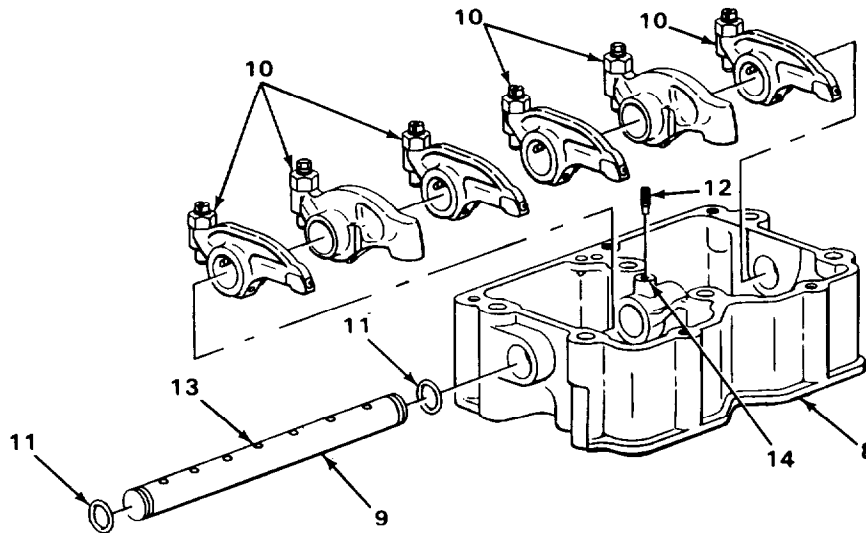


**ROCKER ARM HOUSING AND PUSH ROD - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
<b>ASSEMBLY - CONTINUED</b>		
<b>24.</b> Fuel injector rocker arm (1)	Socket seat (2)	a. Place in position on rocker arm. b. Using arbor press and ST-691 mandrel and block, press in.
<b>NOTE</b>		
Step 25 is typical for intake and exhaust rocker arms only.		
Step 26 is typical for fuel injector rocker arms only.		
<b>25.</b> Rocker arm (3)	Adjusting screw (4) and new locknut (5)	a. Screw adjusting screw into rocker arm until bottom threads are flush with bottom of rocker arm. b. Hand tighten locknut onto adjusting screw until snug with rocker arm.
<b>26.</b> Fuel injector rocker arm (6)	Adjusting bolt (7) and new locknut (5)	a. Screw adjusting bolt into rocker arm until bottom threads are flush with bottom of rocker arm. b. Hand tighten locknut onto adjusting bolt until snug with rocker arm.
		
<b>27.</b> Rocker arm housing (8)	Rocker arm shaft (9) and six rocker arms (10)	a. Coat rocker arm shaft with clean lubricating oil and start rocker arm shaft into rocker arm housing. b. Install six rocker arms on rocker arm shaft as it is pushed through rocker arm housing. <b>Note tag numbers on rocker arms for correct location.</b>

**ROCKER ARM HOUSING AND PUSH ROD - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
28. Rocker arm shaft (9)	Two new preformed packing (11)	a. Coat with lubricating oil. b. With rocker arm shaft extended 1/2 inch from rocker arm housing (8), install one packing on rocker arm shaft. c. Push rocker arm shaft through rocker arm housing (8) until other end extends 1/2 inch from rocker arm housing (8) and install one packing on rocker arm shaft.
29. Rocker arm housing (8)	Setscrew (12)	a. Center rocker arm shaft (9) in rocker arm housing. b. Squeeze two rocker arms (10) together to rotate rocker arm shaft (9) to align rocker arm shaft locking hole (13) with rocker arm housing locking hole (14). c. Using 5/32-inch hex key, install set-screw in rocker arm housing locking hole (14), screw in and tighten.
30.	Rocker arms (10)	Check for freedom of movement.



**NOTE**

FOLLOW-ON MAINTENANCE: Install rocker arm housing (2-82) and push rods (page 2-73).

**TASK ENDS HERE**

**CAM FOLLOWER ASSEMBLY**

---

This task covers:

- a. Disassembly (page 2-254)
  - b. Cleaning (page 2-256)
  - c. Inspection (page 2-256)
  - d. Assembly (page 2-260)
- 

**INITIAL SETUP**

**Tools**

- Cutter, 60-degree angle (chamfering cutter)
- Gage, plug, ST-195
- Gage, bore, dial
- Gage, thickness
- Goggles, safety
- Hammer, ball-peen, 16-ounce
- Hone, bushing, 0- to 1-inch
- Mandrel and block, ST-249
- Mandrel, plug driving, ST-970
- Mandrel, plug driving, ST-1053
- Micrometer, 0- to 1-inch
- Micrometer, 1- to 2-inch
- Press, arbor
- Press, drill, suitable
- Punch, center
- Punch, drive-pin, 3/32-inch
- Screwdriver, flat-tip, 1/4-inch

**Materials/Parts**

- Cloth, emery (item 1, appendix B)
- Oil, lubricating (item 12, appendix B)
- Pin, roll (nine required)
- Plugs, cup (two required)
- Prussian blue (item 13, appendix B)
- Rags, wiping (item 14, appendix B)
- Solvent, drycleaning (item 16, appendix B)
- Tags, marker (item 17, appendix B)

**Equipment Condition**

Cam follower housing removed (page 2-47).

**References**

TM 55-1500-335-23, Inspection Methods, Non-Destructive

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LOCATION	ITEM	ACTION REMARKS
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**DISASSEMBLY**

**NOTE**

Steps given are typical for all three cam follower assemblies.

- |                             |                         |                              |
|-----------------------------|-------------------------|------------------------------|
| 1. Cam follower housing (1) | Cam follower levers (2) | Tag and number for location. |
|-----------------------------|-------------------------|------------------------------|

**CAM FOLLOWER ASSEMBLY - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
2. Cam follower housing (1)	Two lockscrews (3)	Using 1/4-inch flat-tip screwdriver, unscrew and take out.	
3.	Two cup plugs (4)	Using 16-ounce ball-peen hammer and center punch, knock out. <b>Discard.</b>	

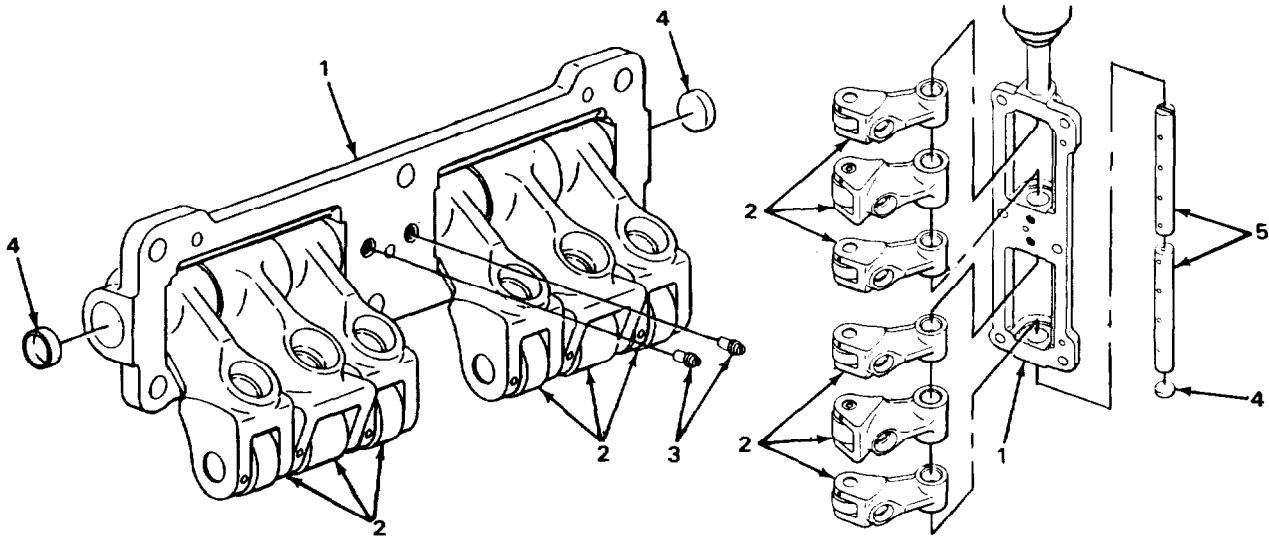
**CAUTION**

When removing cam follower shafts, center drive pin on cam follower shaft and tap lightly. Striking housing or cam followers will cause damage.

**NOTE**

When removing cam follower shaft, remove and set aside cam followers as they become free from cam follower shaft.

4.	Cam follower shafts (5)	Using arbor press and ST-1053 plug driving mandrel, press out of cam follower housing (1).
----	-------------------------	--



**NOTE**

Steps 5 and 6 are typical for all cam follower levers.

**CAM FOLLOWER ASSEMBLY - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
<b>DISASSEMBLY - CONTINUED</b>		
5.	Cam follower lever (1)	Roll pin (2)  Using 16-ounce ball-peen hammer and 3/32-inch drive-pin punch, drive out. <b>Discard roll pin.</b>
6.	Cam follower roller pin (3)	a. Using arbor press and ST-970 plug driving mandrel, press out of cam follower lever (1). b. Remove cam follower roller (4).

**CLEANING**

**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

**INSPECTION**

**WARNING**

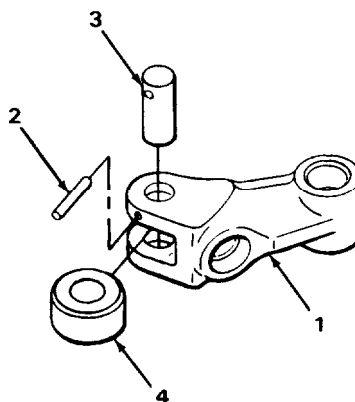
Drycleaning solvent P-D-680 is toxic and flammable. Wear safety goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. Flashpoint for type #1 drycleaning solvent is 100°F (38°C) and for type #2 is 138°F (59°C). If you become dizzy while using solvent, get fresh air immediately, and get medical aid. If contact with eyes is made, wash your eyes with water, and get medical aid immediately. Failure to observe these precautions could cause serious injury or death to personnel.

Particles blown by compressed air are hazardous. Make certain the air stream is directed away from user and other personnel in the area. Compressed air used for cleaning purposes shall not exceed 30 psi (207 kPa). User must wear safety goggles or face shield to prevent injury.

7.	Cam follower lever (1)	Wipe clean with rag and inspect for breaks or clogged oil passages. Check for cracks and imperfections by visual and magnetic inspection. <b>If broken or cracked, replace. If oil passages are clogged, clean with drycleaning solvent and use compressed air to thoroughly clean oil passages.</b>
----	------------------------	---

CAM FOLLOWER ASSEMBLY - CONTINUED

LOCATION	ITEM	ACTION REMARKS
8.	Cam follower roller pin (3)	<p>a. Inspect for breaks, cracks, or out-of-round condition. <b>If broken, cracked, or out-of-round, replace.</b></p> <p>b. Using 0- to 1-inch micrometer, measure outside diameter. <b>If outside diameter is less than 0.497 inch (12.82 mm), replace.</b> <b>New roller pins should measure 0.4995 to 0.500 inch (12.89 to 12.70 mm).</b></p>
9.	Injector cam follower roller (4)	<p>a. Inspect for breaks, cracks, or out-of-round condition. <b>If broken, cracked, or out-of-round, replace.</b></p> <p>b. Using dial bore gage, measure inside diameter of injector cam follower roller at several points for wear. <b>If larger than 0.505 inch (12.83 mm), replace.</b> <b>New roller inside diameter should be 0.503 to 0.504 inch (12.78 to 12.80 mm).</b></p> <p>c. Using a 1- to 2-inch micrometer, measure outside diameter of injector cam follower roller at several points for wear. <b>If smaller than 1.2485 inches (31.71 mm), replace.</b> <b>New roller outside diameter should be 1.2490 to 1.251 inches (31.72 to 31.77 mm).</b></p>



CAM FOLLOWER ASSEMBLY - CONTINUED

LOCATION	ITEM	ACTION REMARKS
INSPECTION - CONTINUED		
10. Cam follower lever (1)	Valve cam follower roller (2)	<ul style="list-style-type: none"> <li>a. Inspect for breaks, cracks, or out-of-round condition. <b>If broken, cracked, or out-of-round, replace.</b></li> <li>b. Using dial bore gage, measure inside diameter at several points for wear. <b>If larger than 0.503 Inch (12.83 mm), replace.</b> <b>New valve cam follower roller inside diameter should be 0.5005 to 0.5015 inch (12.713 to 12.738 mm).</b></li> <li>c. Using a 1- to 2-inch micrometer, measure outside diameter at several points. <b>If smaller than 1.248 inches (31.71 mm), replace.</b> <b>New valve cam follower roller outside diameter should be 1.2490 to 1.2500 inches (31.72 to 31.75 mm).</b></li> </ul>

**NOTE**

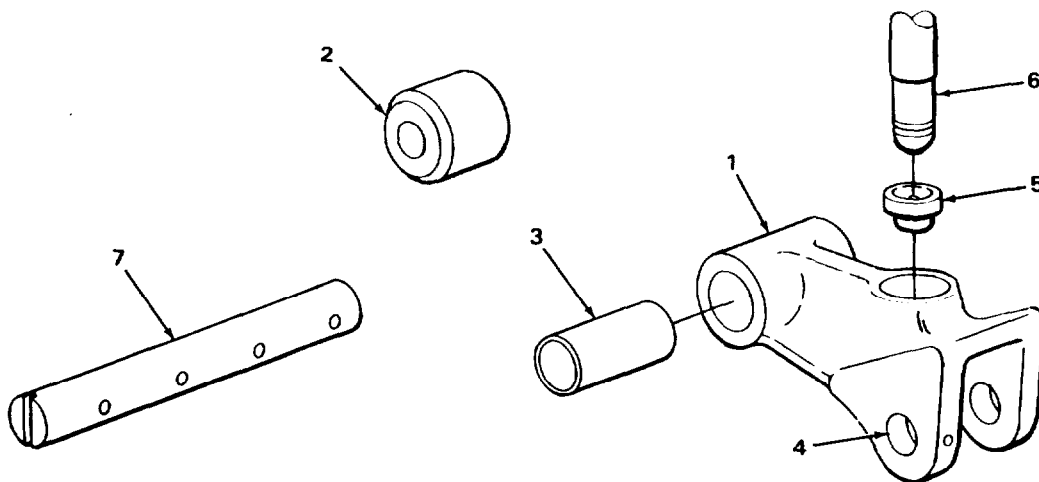
Steps 11 to 14 are typical for all cam follower rollers, bushings, and levers.

11.	Valve cam follower roller (2)	<ul style="list-style-type: none"> <li>a. Using 0- to 1-inch micrometer, check inside and outside diameters for roundness. <b>If more than 0.002 inch (0.05 mm), out of round, replace.</b></li> <li>b. Using 0- to 1-inch micrometer, measure ends of roller for squareness to inside diameter and parallelism to each other. <b>If more than 0.004 inch (0.10 mm), replace.</b></li> </ul>
12.	Cam follower bushing (3)	Using dial bore gage, measure Inside diameter. <b>If more than 0.752 inch (19.10 mm), using arbor press and ST-249 mandrel and block, remove and discard.</b>
13.	Roller pin bore (4)	Using dial bore gage, measure inside diameter of roller pin bore. <b>If more than 0.4997 inch (12.892 mm), replace.</b>



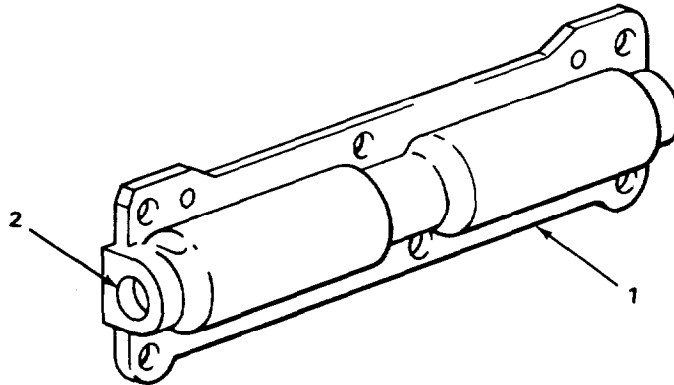
CAM FOLLOWER ASSEMBLY - CONTINUED

LOCATION	ITEM	ACTION REMARKS
14. Cam follower lever (1)	Cam follower socket (5)	Inspect cam follower socket as follows: <ol style="list-style-type: none"> <li>Coat new push rod ball end (6) with prussian blue.</li> <li>Place push rod ball end (6) into cam follower socket and rotate using hand pressure.</li> <li>Check cam follower socket wear area. <b>If cam follower socket wear area is not 80-percent blued, replace cam follower socket.</b></li> <li>Using 16-ounce ball-peen hammer and 3/32-inch drive-pin punch, drive out. <b>Install new cam follower socket, see step 18.</b></li> </ol>
15.	Two cam follower shafts (7)	<ol style="list-style-type: none"> <li>Using 0- to 1-inch micrometer, measure outside diameter of cam follower shafts. <b>If 0.748 inch (19.00 mm) or less, replace.</b></li> <li>Visually inspect around lockscrew end to make sure grooves are clean. Check for cracks, breaks, bends, galling, or surface imperfections. <b>If cracked, broken, galled, bent, or surface is damaged, replace.</b></li> </ol>



**CAM FOLLOWER ASSEMBLY - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
INSPECTION - CONTINUED		
16.	Cam follower housing (1)	a. Inspect for cracks, breaks, and damaged mating surfaces. <b>If cracked, broken, or mating surfaces damaged, replace.</b> b. Inspect edges of cup plug holes (2) for sharp edges, nicks, or burrs. <b>Using emery cloth, remove sharp edges, nicks, burrs and chamfer edge of holes to aid in installation of cup plug.</b>



ASSEMBLY

**WARNING**

Drycleaning solvent P-D-680 is toxic and flammable. Wear safety goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes, and do not breathe vapors. Do not use near open flame or excessive heat. Flashpoint for type #1 drycleaning solvent is 100°F (38°C) and for type #2 is 138°F (59°C). If you become dizzy while using solvent, get fresh air immediately, and get medical aid. If contact with eyes is made, wash your eyes with water, and get medical aid immediately. Failure to observe these precautions could cause serious injury or death to personnel.

**CAUTION**

Make sure that all parts are free from dust and dirt.

**CAM FOLLOWER ASSEMBLY - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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**NOTE**

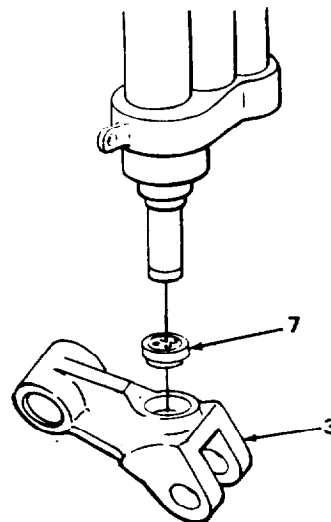
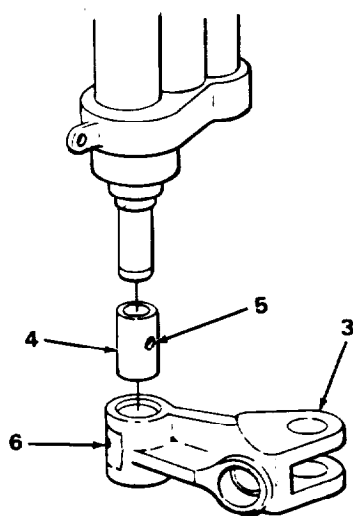
Steps 17 to 19 are typical for all cam follower levers.

17. Cam follower lever (3)	Cam follower bushing (4)	<ul style="list-style-type: none"> <li>a. Place on cam follower lever, alining oil hole (5) with oil hole (6).</li> <li>b. Using arbor press and ST-970 plug driving mandrel, press in.</li> <li>c. Using 60-degree angle cutter and suitable drill press, chamfer each end of cam follower bushing.</li> <li>d. Using 0- to 1-inch bushing hone, hone cam follower bushing to 0.7495 to 0.7505 inch (19.037 to 19.063 mm).  <b>Clean with drycleaning solvent, after honing, to remove all grit.</b>  <b>Use ST-195 plug gage to check bore diameter.</b> </li> </ul>
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**NOTE**

If new cam follower sockets are installed in cam follower levers, new push rods must be used when engine is reassembled.

18.	Cam follower socket (7)	<ul style="list-style-type: none"> <li>a. Place in position in cam follower lever (3).</li> <li>b. Using arbor press and ST-249 mandrel and block, press in.</li> </ul>
-----	-------------------------	---



**CAM FOLLOWER ASSEMBLY - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
ASSEMBLY - CONTINUED		
19. Cam follower lever (1)	Roller (2), roller pin (3), and new roll pin (4)	<ul style="list-style-type: none"> <li>a. Place roller in cam follower lever.</li> <li>b. Using thickness gage, check between cam follower lever and roller for clearance of 0.006 inch (0.15 mm).</li> <li>c. Install roller pin through lever and aline with roller.</li> <li>d. Aline roller pin hole (5) with hole (6) in lever.</li> <li>e. Using arbor press and ST-970 plug driving mandrel, press in.</li> <li>f. Position roll pin in cam follower lever.</li> <li>g. Using 16-ounce ball-peen hammer and 3/32-inch drive-pin punch, drive roll pin thru roller pin.</li> </ul> <p style="text-align: center;"><b>Check roller for free movement.</b></p>

**NOTE**

When performing next step, position two cam follower levers with screw slots facing toward ends of cam follower housing.

20. Cam follower housing (7)	Two cam follower shafts (8) and six cam follower levers (9)	<ul style="list-style-type: none"> <li>a. Coat two cam follower shafts with clean lubricating oil and start through each side of cam follower housing. <b>Aline lock screw holes in shafts with lock screw holes in cam follower housing.</b></li> <li>b. Install cam follower levers onto shafts as they are pressed through cam follower housing. <b>Note tag numbers on cam follower levers.</b></li> <li>c. Using arbor press and ST-1053 plug driving mandrel, press in.</li> </ul>
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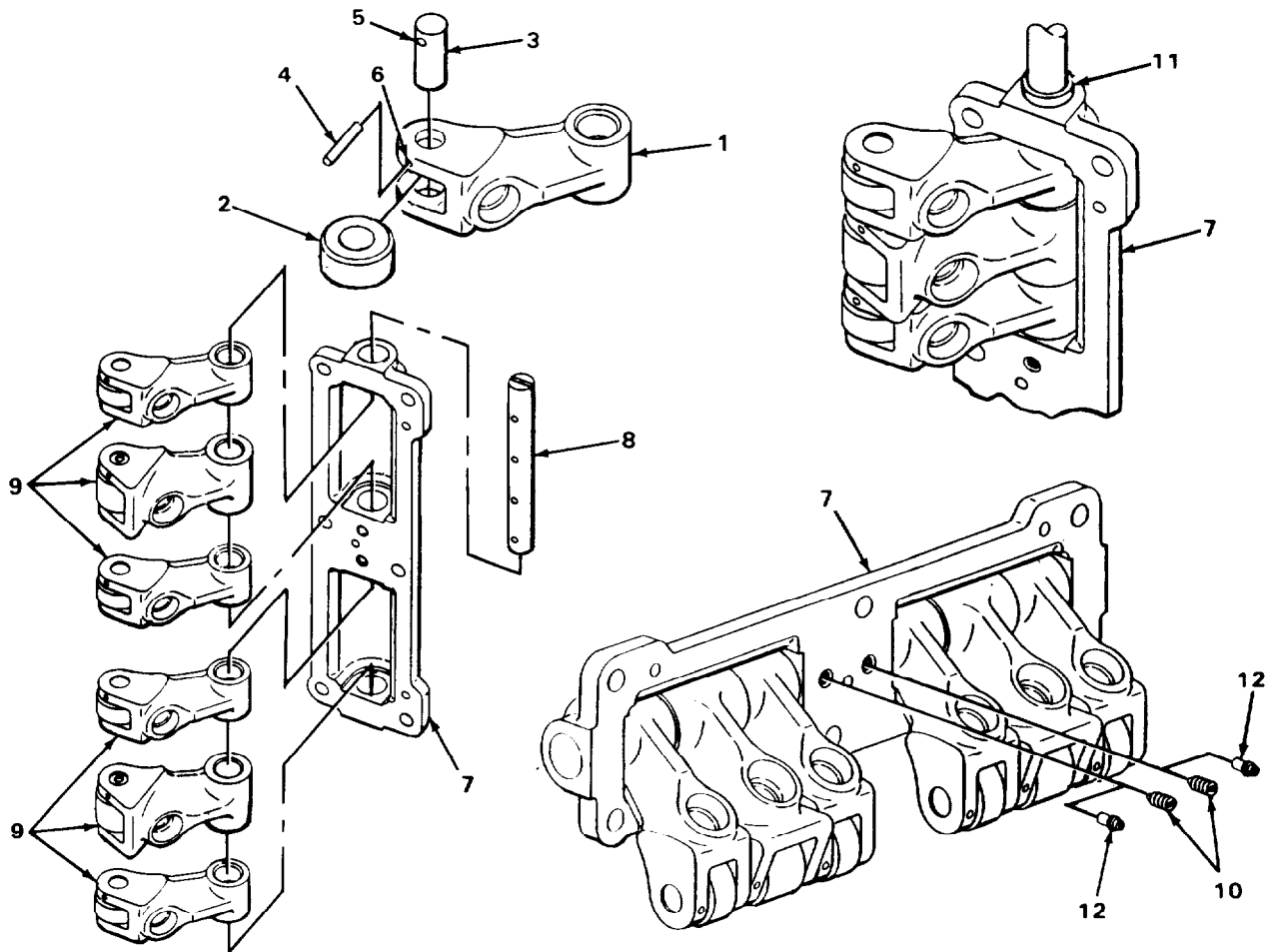
**NOTE**

A dummy screw is installed at this point to prevent lock screw breakage. Lock screws have a tendency to break due to very close cam follower housing-to-cam follower shaft fit, which causes the cup plugs to act as a ram when driven into place.

21.	Two dummy screws (10)	Using 1/4-inch flat-tip screwdriver, install and tighten.
-----	-----------------------	---

**CAM FOLLOWER ASSEMBLY - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
22.	Two new cup plugs (11)	Using arbor press and ST-1053 plug driving mandrel, press in until flush with end of cam follower housing (7) or 0.010 inch (0.25 mm) below edge of hole.
23.	Two dummy screws (10) and two lock-screws (12)	a. Using 1/4-inch flat-tip screwdriver, remove two dummy screws. b. Using 1/4-inch flat-tip screwdriver, install and tighten two lock screws.



**NOTE**

FOLLOW-ON MAINTENANCE: Install cam follower housing (page 2-70).

**TASK ENDS HERE**

## Section X. ENGINE LUBRICATION SYSTEM MAINTENANCE

	Page		Page
Lubricating Oil Filter .....	2-264	Lubricating Oil Pump .....	2-264

### LUBRICATING OIL FILTER

For lubricating oil filter maintenance, refer to TM 5-3805-254-20.

### LUBRICATING OIL PUMP

---

This task covers:

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>a. Disassembly (page 2-265)</li> <li>b. Cleaning (page 2-266)</li> </ul> | <ul style="list-style-type: none"> <li>c. Inspection/Repair (page 2-267)</li> <li>d. Assembly (page 2-270)</li> </ul> |
|---|---|
- 

### INITIAL SETUP

#### Tools

- Extension, 6-inch, 3/8-inch drive
- Gage, bore, dial
- Gage, thickness
- Hammer, plastic-faced
- Handle, ratchet, 3/8-inch drive
- Machine, boring
- Mandrel
- Mandrel, bushing, ST-1158
- Mandrel, spacer, ST-1157
- Micrometer, 0- to 1-inch
- Pliers, round-nose, 6-inch
- Press, arbor
- Puller, dowel, ST-1134
- Puller, gear
- Screwdriver, flat-tip, 3/8-inch
- Socket, 1/2-inch, 3/8-inch drive

#### Tools - Continued

- Socket, 9/16-inch, 3/8-inch drive
- Wrench, box-end, 9/16-inch
- Wrench, hex-head, 1/2-inch
- Wrench, torque, 0 to 100 ft lb (0 to 140 N•m), 3/8-inch drive

#### Materials/Parts

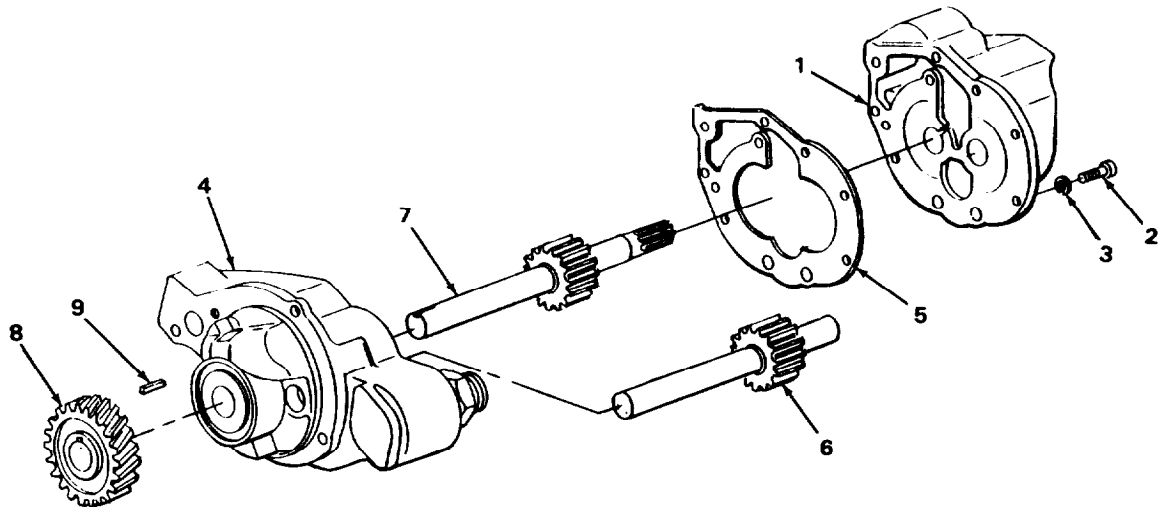
- Bushing (if required)
- Gasket, adapter housing to oil pump body
- Lockwasher, adapter housing (eight required)
- Oil, lubricating (item 12, appendix B)

#### Equipment Condition

- Lubricating oil pump removed (page 2-40).

LUBRICATING OIL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
DISASSEMBLY		
1. Adapter housing (1)	Eight screws (2) and eight lock- washers (3)	Using 3/8-inch drive 1/2-inch socket, 6- inch extension, and ratchet handle, loosen and take out. <b>Discard lockwashers.</b>
2. Oil pump body (4)	Adapter housing (1)	a. Using plastic-faced hammer, tap lightly to loosen from oil pump body. b. Pull apart.
3.	Gasket (5)	Take off. <b>Discard.</b>
4.	Idler gear (6)	Pull out.
5. Drive shaft (7)	Main drive gear (8) and key (9)	a. Using gear puller, pull gear from drive shaft. b. Take off key.
6. Oil pump body (4)	Drive shaft (7)	Pull out from rear.



LUBRICATING OIL PUMP - CONTINUED

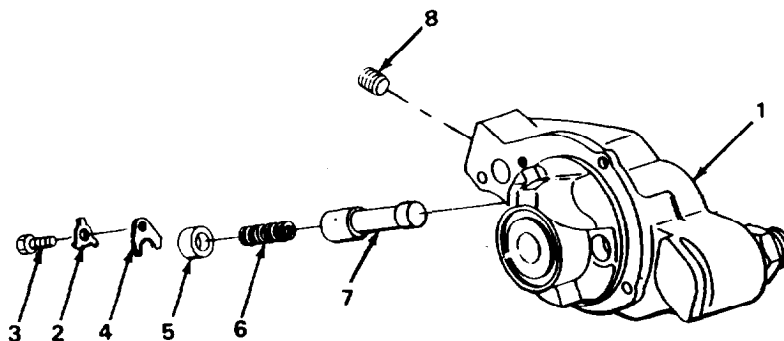
LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY - CONTINUED

**WARNING**

Pressure regulator spring is under tension. Maintain pressure on retaining yoke to prevent injury.

- |    |                   |   |   |
|----|-------------------|---|---|
| 7. | Oil pump body (1) | Lock plate (2), screw (3), and retaining yoke (4)                     | <ul style="list-style-type: none"> <li>a. Using 3/8-inch flat-tip screwdriver, bend back lock plate tabs.</li> <li>b. Using 9/16-inch box-end wrench, loosen and take retaining yoke off slowly.</li> </ul> |
| 8. |                   | Pressure regulator cap (5), spring (6), plunger (7) and pipe plug (8) | <ul style="list-style-type: none"> <li>a. Pull out cap, spring and plunger.</li> <li>b. Using 1/2-inch hex-head wrench, unscrew and take out plug.</li> </ul>   |



CLEANING

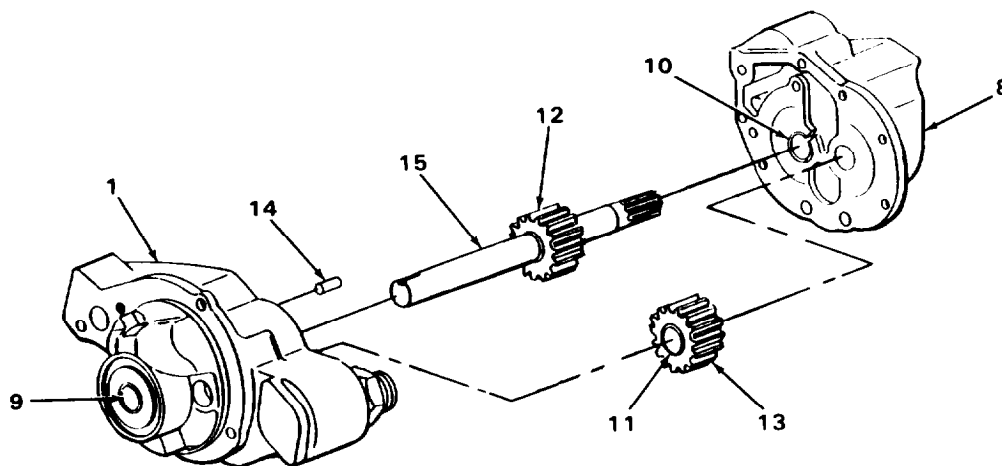
**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.



LUBRICATING OIL PUMP - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
INSPECTION/REPAIR			
9.	Oil pump body (1) and adapter housing (8)	a. Inspect all gasket mating surfaces for flatness, nicks, or burrs. <b>If unevenness, nicks, or burrs exist, discard.</b> b. Inspect for pitting or cracks. <b>If pitting or cracks exist, discard.</b> c. Inspect for damaged threads. <b>If thread damage exists, discard.</b> d. Inspect bushings (9, 10, and 11). <b>If worn or scored, discard.</b>	
10.	Drive gear (12) and idler gear (13)	Inspect for worn or broken teeth, pitting, or cracks. <b>If broken teeth, pitting, or cracks exist, discard.</b>	
11.	Dowel pins (14)	Inspect for damaged dowel pins. <b>If dowel pin damage exists, use ST-1134 dowel puller, remove damaged dowel pin, and replace with new.</b>	
12.	Drive shaft (15)	Inspect for nicks, burrs, scores, or damaged splines. <b>Replace if damaged.</b>	



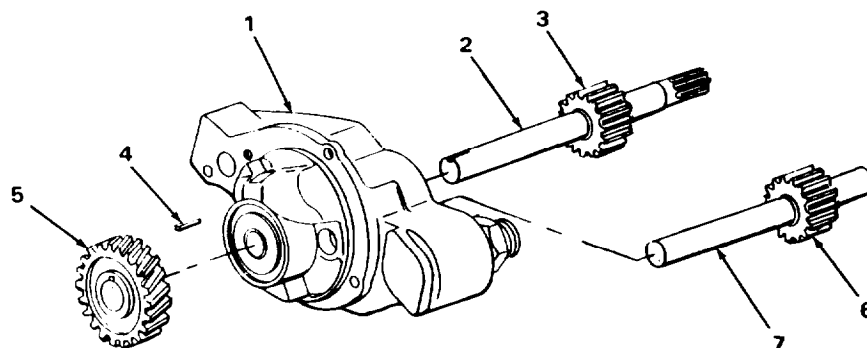
LUBRICATING OIL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
INSPECTION/REPAIR - CONTINUED		
13. Oil pump body (1)	Idler shaft (2)	<p>a. Using 0- to 1-inch micrometer, check outside diameter.  <b>If outside diameter is less than 0.873 inch (22.17 mm), continue with steps b and c. If outside diameter is 0.873 to 0.875 inch (22.17 to 22.22 mm), proceed to step 14.</b></p> <p>b. Using arbor press and mandrel, press idler shaft from oil pump body and discard.</p> <p>c. Using arbor press and deep end of ST-1157 spacer mandrel, press stamped end of new idler shaft into oil pump body until idler shaft protrudes 0.955 inch (24.26 mm) above oil pump body.</p>
14.	Drive shaft (3)	<p>a. Using 0- to 1-inch micrometer, check outside diameter.  <b>If outside diameter is less than 0.873 Inch (22.17 mm), continue with steps b and c. If outside diameter is 0.873 to 0.875 inch (22.17 to 22.22 mm), proceed to step 15.</b></p> <p>b. Using arbor press and mandrel, press drive shaft from drive gear (4) and discard.</p> <p>c. Using shallow end of ST-1157 spacer mandrel, press drive gear (4) onto new drive shaft until drive shaft protrudes from drive gear 1.035 to 1.055 inch (26.29 to 26.80 mm).</p>
15. Oil pump body (1), adapter housing (5), and idler gear (6)	Bushings (7)	<p>a. Inspect for damage and, using dial bore gage, check inside diameter.  <b>If damage exists, or if inside diameter is greater than 0.879 inch (22.33 mm), continue with steps b, c, and d. If bushing is serviceable, proceed to step 16.</b></p>



**LUBRICATING OIL PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
ASSEMBLY		
17. Oil pump body (1)	Drive shaft (2) and drive gear (3)	Lubricate with clean lubricating oil and position into oil pump body.
18. Drive shaft (2) and drive gear (3)	Key (4) and main drive gear (5)	<ol style="list-style-type: none"> <li>a. Position key in drive shaft and align with main drive gear.</li> <li>b. Support drive shaft on arbor press and press drive gear on drive shaft.</li> <li>c. Using thickness gage, leave 0.002 to 0.004 inch (0.05 to 0.10 mm) clearance between drive gear surface and bottom of gear pocket in oil pump body. Also, clearance between main drive gear and oil pump body must not be greater than 0.012 inch (0.30 mm).</li> </ol>
19.	Idler gear (6)	Lubricate with clean lubricating oil and position on idler shaft (7).

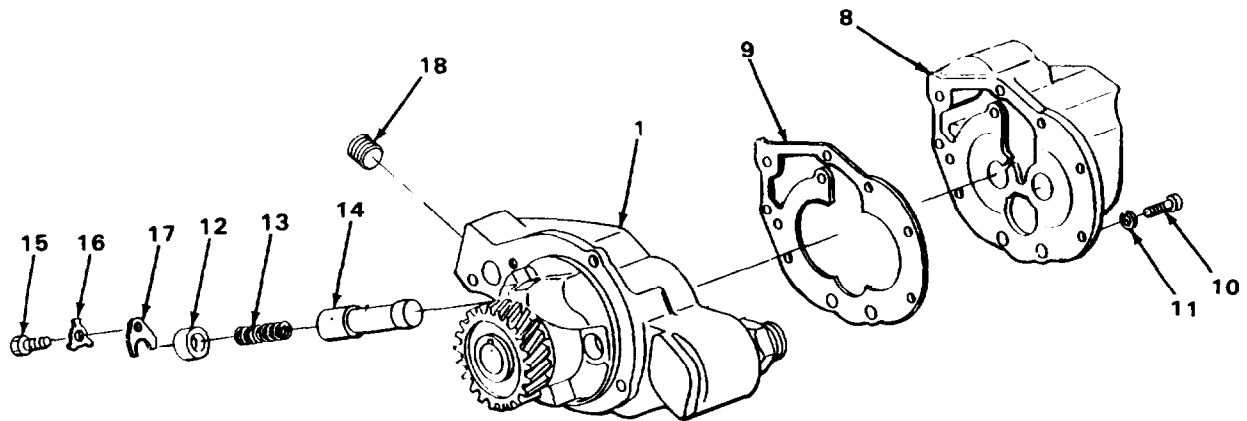


**NOTE**

Before installing adapter housing to oil pump body, make sure all gears, shafts, and bushings are well lubricated with clean lubricating oil.

LUBRICATING OIL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
20.	Adapter housing (8) and new gasket (9)	Install new gasket and position adapter housing on oil pump body (1).
21.	Eight capscrews (10) and eight new lockwashers (11)	Using 3/8-inch drive 0 to 100 ft lb (0 to 140 N•m) torque wrench, 6-inch extension, and 1/2-inch socket screw in and tighten to 30 to 35 ft lbs (42 to 49 N•m).
22.	Pressure regulator cap (12), spring (13), and plunger (14)	Place in oil pump body. <b>Make sure spring is in open end of plunger.</b>
23.	Screw (15), lock plate (16), retaining yoke (17), and pipe plug (18)	<ul style="list-style-type: none"> <li>a. Install over pressure regulator cap (12), screw in screw, and, using 3/8-inch drive 0 to 100 ft lb (0 to 140 N•m) torque wrench and 9/16-inch socket, tighten to 30 to 35 ft lbs (42 to 49 N•m).</li> <li>b. Using 6-inch round-nose pliers, bend lock plate.</li> <li>c. Using 1/2-inch hex-head wrench, screw in and tighten plug.</li> </ul>



**NOTE**

FOLLOW-ON MAINTENANCE: Install lubricating oil pump (page 2-88).

**TASK ENDS HERE**

## Section XI. MANIFOLD MAINTENANCE

	Page		Page
Exhaust Manifold .....	2-272	Intake Manifold .....	2-274

### EXHAUST MANIFOLD

---

This task covers:

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>a. Disassembly</li> <li>b. Cleaning/Inspection</li> </ul> | <ul style="list-style-type: none"> <li>c. Assembly</li> </ul> |
|--|---|
- 

#### INITIAL SETUP

Equipment Condition

Exhaust manifold removed (page 2-14).

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LOCATION	ITEM	ACTION REMARKS
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#### DISASSEMBLY

- |  |   |  |
|--|---|--|
| <ul style="list-style-type: none"> <li>1. Manifold assembly</li> </ul> | <ul style="list-style-type: none"> <li>Front section (1), center section (2), and rear section (3)</li> </ul> | <ul style="list-style-type: none"> <li>Pull three sections apart,</li> </ul> |
|--|---|--|

#### CLEANING/INSPECTION

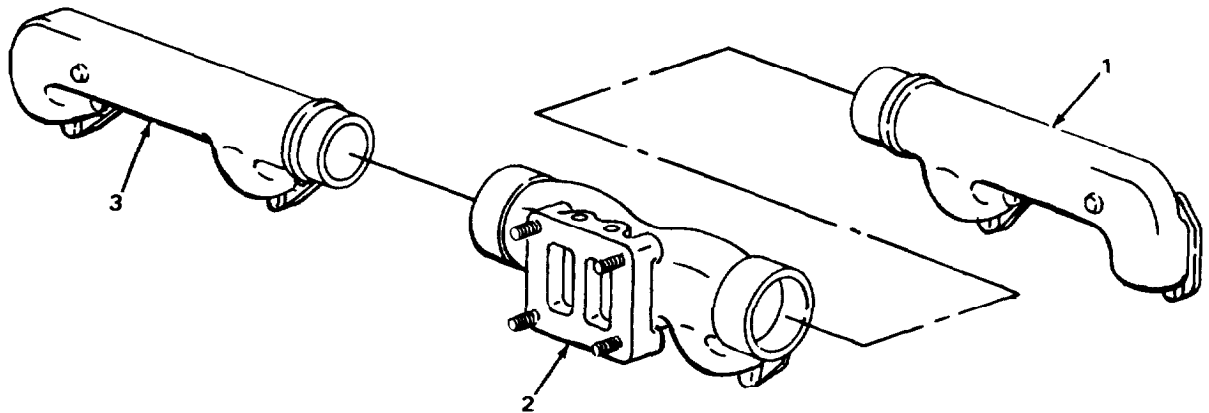
#### NOTE

For general cleaning and inspection procedures, see General Maintenance Instructions, page 2-3.

#### ASSEMBLY

**EXHAUST MANIFOLD - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
2.	Manifold front section (1), center section (2), and rear section (3)	Align all exhaust ports and push three sections together.



**NOTE**

FOLLOW-ON MAINTENANCE: Install exhaust manifold (page 2-134).

**TASK ENDS HERE**

**INTAKE MANIFOLD**

---

This task covers:

- a. Disassembly (page 2-274)
  - b. Cleaning/Inspection (page 2-274)
  - c. Assembly (page 2-275)
- 

**INITIAL SETUP**

**Tools**

- Wrench, box-end, 9/16-inch
- Wrench, box-end, 7/8-inch
- Wrench, box-end, 1 1/4-inch

**Equipment Condition**

Intake manifold removed (page 2-26).

**Materials/Parts**

- Gasket, preheater assembly
  - Lockwasher, intake manifold (five required)
- 

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

---

**DISASSEMBLY**

**NOTE**

Disassembly is limited to the removal of the glow plug and preheater assembly.

- |   |   |   |
|---|---|---|
| 1. Intake manifold (1)                  | Five screws (2) and five lockwashers (3)            | Using 9/16-inch box-end wrench, unscrew and take out.<br><b>Discard lockwashers.</b>  |
| 2.                                      | Glow plug and preheater assembly (4) and gasket (5) | Lift off and remove.<br><b>Discard gasket.</b>  |
| 3. Glow plug and preheater assembly (4) | Glow plug (6) and preheater nozzle (7)              | a. Using 7/8-inch box-end wrench, unscrew and take out glow plug.<br>b. Using 1 1/4-inch box-end wrench, unscrew and take out preheater nozzle. |

**CLEANING/INSPECTION**

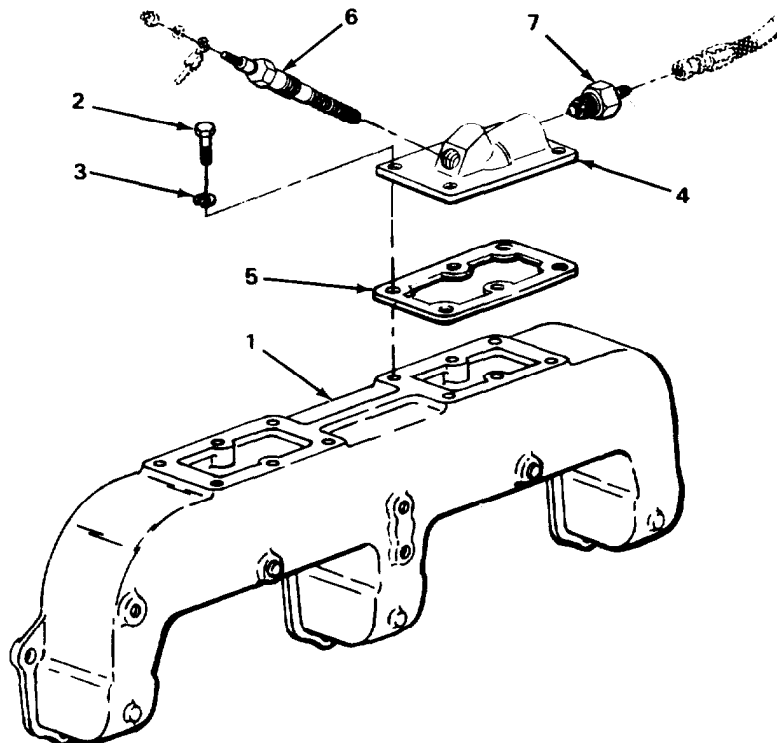
**NOTE**

For general cleaning and inspection procedures, see General Maintenance Instructions, page 2-3.



**INTAKE MANIFOLD - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
4. Glow plug and pre-heater assembly (4)	Glow plug (6) and preheater nozzle (7)	Inspect for stripped threads, cracked porcelain or cracked preheater nozzle. <b>If stripped or cracked, replace.</b>
ASSEMBLY		
5. Glow plug and pre-heater assembly (4)	Glow plug (6) and preheater nozzle (7)	a. Using 7/8-inch box-end wrench, screw in glow plug and tighten. b. Using 1 1/4-inch box-end wrench, screw in preheater nozzle and tighten.
6. Intake manifold (1)	New gasket (5) and glow plug and pre-heater assembly (4)	Place in position.
7. Glow plug and pre-heater assembly (4)	Five screws (2) and five new lockwashers (3)	Using 9/16-inch box-end wrench, install and tighten.



**NOTE**

FOLLOW-ON MAINTENANCE: Install intake manifold (page 2-119).

**TASK ENDS HERE**

## Section XII. ACCESSORY DRIVE MAINTENANCE

	Page		Page
Accessory Drive .....	2-276	Accessory Drive Pulley .....	2-280

### ACCESSORY DRIVE

---

This task covers:

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>a. Disassembly (page 2-276)</li> <li>b. Cleaning (page 2-277)</li> </ul> | <ul style="list-style-type: none"> <li>c. Inspection/Repair (page 2-277)</li> <li>d. Assembly (page 2-279)</li> </ul> |
|---|---|
- 

### INITIAL SETUP

**Tools**

- Driver, bushing
- Extension, 3-inch, 1/2-inch drive
- Handle, ratchet, 1/2-inch drive
- Micrometer, 1- to 2-inch
- Micrometer, inside, 1- to 2-inch
- Press, arbor
- Puller, gear, coupling, ST-1249
- Screwdriver, 1/4-inch, flat-tip
- Socket, 1 5/16-inch, 1/2-inch drive

**Materials/Parts**

- Bushing (if required)
- Key (two required)

**Equipment Condition**

- Accessory drive removed (page 2-43).
- 

LOCATION	ITEM	ACTION REMARKS
----------	------	-------------------

---

### DISASSEMBLY

- |                              |                                  |   |
|------------------------------|----------------------------------|---|
| 1. Accessory drive shaft (1) | Self-locking nut (2)             | Using 1/2-inch drive 1 5/16-inch socket, 3-inch extension, and ratchet handle, loosen and remove. |
| 2.                           | Coupling gear (3)                | Using ST-1249 coupling gear puller, pull from accessory drive shaft (1).                          |
| 3.                           | Washer (4) and thrust washer (5) | Take off.   |
| 4. Housing (6)               | Accessory drive shaft (1)        | Pull out.   |
| 5. Accessory drive shaft (1) | Gear (7) and thrust washer (8)   | Using arbor press, press off.   |

**ACCESSORY DRIVE - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
6. Accessory drive shaft (1)	Two keys (9)	Using 1/4-inch flat-tip screwdriver, pry out. <b>Discard.</b>

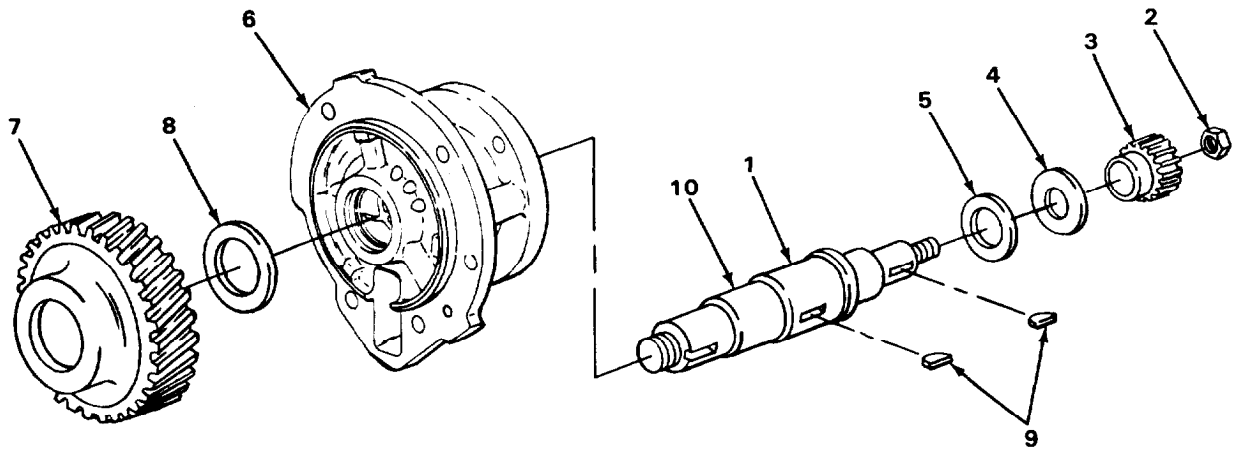
CLEANING

**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

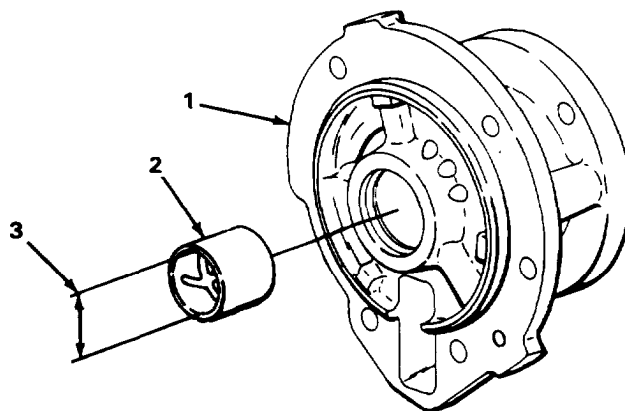
INSPECTION/REPAIR

- |    |                           |  |
|----|---------------------------|--|
| 7. | Accessory drive shaft (1) | Using 1- to 2-inch micrometer, check outside diameter at bushing area, (10).<br><b>If accessory drive shaft measures less than 1.310 inch (33.27 mm), discard accessory drive shaft.</b> |
|----|---------------------------|--|



ACCESSORY DRIVE - CONTINUED

LOCATION	ITEM	ACTION REMARKS
INSPECTION/REPAIR - CONTINUED		
8.	Housing (1)	Inspect for damage caused by bushing rotating in housing. <b>If bushing has rotated in housing, discard housing.</b>
9. Housing (1)	Sleeve bearing (2)	<p>a. Inspect for damage. <b>If bearing is damaged, perform steps d and e.</b> <b>If bearing is serviceable, proceed to step 10.</b></p> <p>b. Using a 1- to 2-inch inside micrometer, check inside diameter, (3). <b>If inside diameter is greater than 1.321 inch (33.55 mm) proceed to steps d and e.</b> <b>If inside diameter is less than 1.321 inch (33.55 mm), proceed to step c.</b></p> <p>c. Using a 1- to 2-inch inside micrometer, check for out-of-round condition. <b>If bearing is out-of-round, more than 0.002 inch (0.05 mm), perform steps d and e.</b> <b>If bearing is out-of-round less than 0.002 inch (0.05 mm), proceed to step 10.</b></p> <p>d. Using bearing driver and arbor press, push out.</p> <p>e. Using bearing driver and arbor press, press in new bearing.</p>



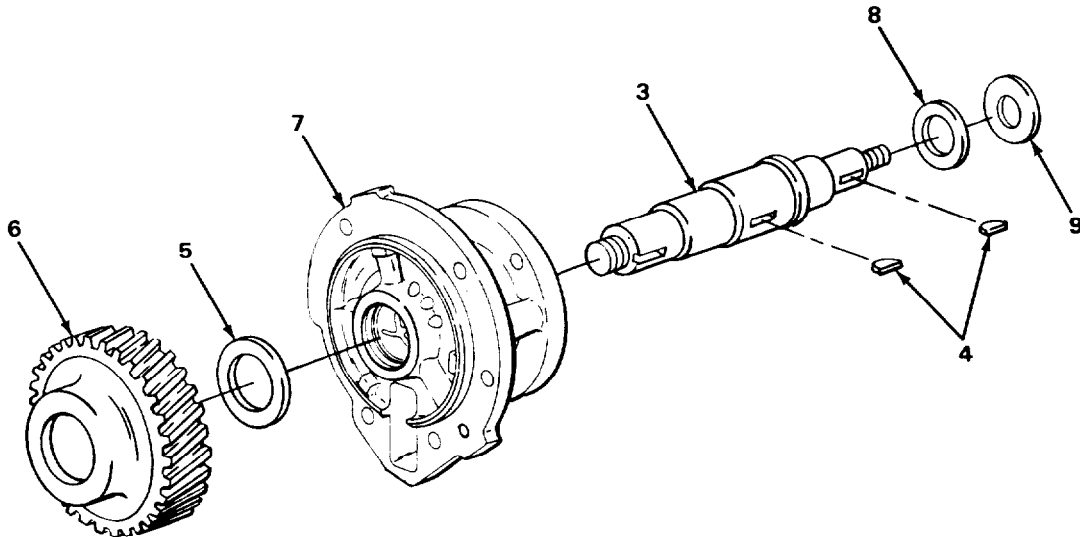
**ACCESSORY DRIVE - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
<b>ASSEMBLY</b>			
10. Accessory drive shaft (3)	Two new keys (4)	Place in shaft.	
11.	Thrust washer (5) and gear (6)	Using arbor press, put on until gear is against shoulder on accessory drive shaft.	

**CAUTION**

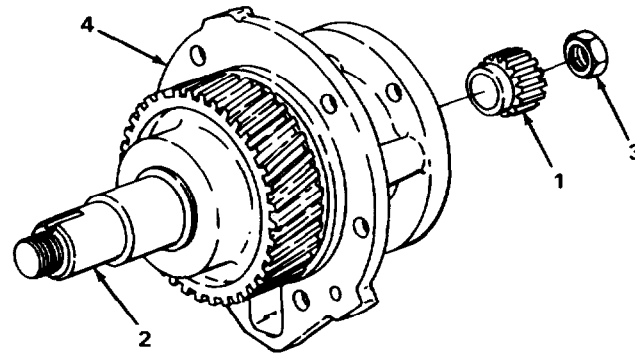
Grooved sides of thrust washers are to be installed away from the housing. Incorrect installation of these thrust washers will result in excessive wear and increased end play, which will cause failure of the accessory drive.

12. Accessory drive housing (7)	Accessory drive shaft (3)	Put in.
13. Accessory drive shaft (3)	Thrust washer (8) and washer (9)	Put on.



**ACCESSORY DRIVE - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
14.	Coupling gear (1)	Using arbor press, install on accessory drive shaft (2).
15.	Self-locking nut (3)	Using 1/2-inch drive 1 5/16-inch socket, 3-inch extension, and ratchet handle, put on and tighten.
16. Housing (4)	Accessory drive shaft (2)	Check to make sure end clearance is between 0.005 and 0.010 inch (0.13 to 0.25 mm).



**NOTE**

FOLLOW-ON MAINTENANCE: Install accessory drive (page 2-84).

**TASK ENDS HERE**

**ACCESSORY DRIVE PULLEY**

This task covers:

- a. Cleaning (page 2-281)
- b. Inspection/Repair (page 2-281)

**INITIAL SETUP**

**Tools**

- Chisel, cold, 3/8-inch
- Hammer, ball-peen, 16-ounce
- Mandrel, oil seal sleeve
- Press, arbor

**Equipment Condition**

Accessory drive pulley removed from engine (page 2-43).

TA 242526

**ACCESSORY DRIVE PULLEY**

LOCATION	ITEM	ACTION	REMARKS
----------	------	--------	---------

CLEANING

**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

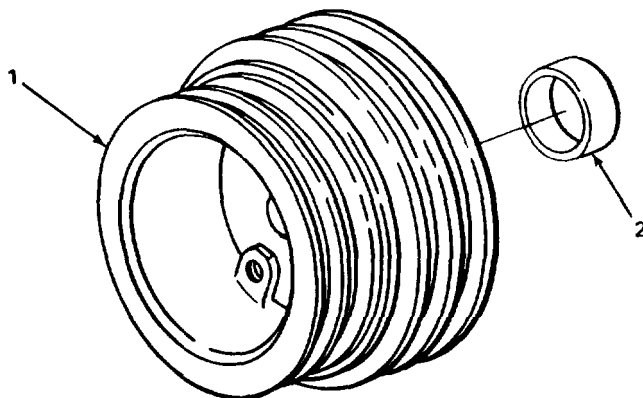
INSPECTION/REPAIR

1.	Accessory drive pulley (1)	<ul style="list-style-type: none"> <li>a. Inspect for cracks and chips in hub, web, and groove areas. <b>If cracks or chips exist, discard accessory drive pulley.</b></li> <li>b. Inspect for wear in grooves and oil seal sleeve (2). <b>If wear exists in grooves, discard accessory drive pulley.</b> <b>If wear exists in oil seal sleeve, proceed with step 2.</b></li> </ul>
----	----------------------------	---

**NOTE**

The following step is for replacing oil seal sleeve on accessory drive pulley.

2. Accessory drive pulley (1)	Oil seal sleeve (2)	<ul style="list-style-type: none"> <li>a. Using 3/8-inch cold chisel and 16-ounce ball-peen hammer, split worn oil seal sleeve. Be sure not to damage accessory drive pulley hub.</li> <li>b. Remove oil seal sleeve.</li> <li>c. Using arbor press and oil seal sleeve mandrel, press new oil seal sleeve into accessory drive pulley hub, until flush or 0.015 inch (0.38 mm) below face of accessory drive pulley hub.</li> </ul>
-------------------------------	---------------------	--



**NOTE**

FOLLOW-ON MAINTENANCE: Install accessory drive pulley (page 2-90).

**TASK ENDS HERE**

### Section XIII. ENGINE COMPRESSION BRAKE MAINTENANCE

#### ENGINE COMPRESSION BRAKE HOUSING

---

This task covers:

- a. Disassembly (page 2-282)
  - b. Cleaning (page 2-284)
  - c. Inspection (page 2-284)
  - d. Assembly (page 2-286)
- 

#### INITIAL SETUP

**Tools**

- Pliers, needle-nose
- Pliers, snap-ring
- Press, arbor
- Screwdriver, flat-tip, 3/8-inch
- Wrench, box-end, 7/16-inch
- Wrench, hex, 5/32-inch
- Wrench, solenoid

**Materials/Parts**

- Oil, lubricating (item 12, appendix B)
- Seal, ring, center
- Seal, ring, lower
- Seal, ring, upper

**Equipment Condition**

Engine compression brake housing removed (page 2-28).

---

LOCATION	ITEM	ACTION REMARKS
----------	------	-------------------

---

#### DISASSEMBLY

**NOTE**

Steps given are typical for multiple components on each of three engine brake housings.

- |                                |   |  |
|--------------------------------|---|--|
| 1. Housing (1)<br>(topside up) | Screw (2) and control valve cover plate (3) | <ul style="list-style-type: none"> <li>a. Using 5/32-inch hex wrench, unscrew and take out.</li> <li>b. Take off control valve cover plate.</li> </ul> |
| 2.                             | Control valve spring (4)                    | Using needle-nose pliers, take out.  |
| 3.                             | Control valve (5)                           | Using needle-nose pliers, take out.  |
| 4. Solenoid valve (6)          | Screw (7), washer (8), and wire (9)         | Using 3/8-inch flat-tip screwdriver, unscrew and take off wire.<br><b>Install screw and washer to prevent loss.</b>                                    |
| 5.                             | Solenoid valve (6)                          | Using solenoid wrench, unscrew and take out.   |

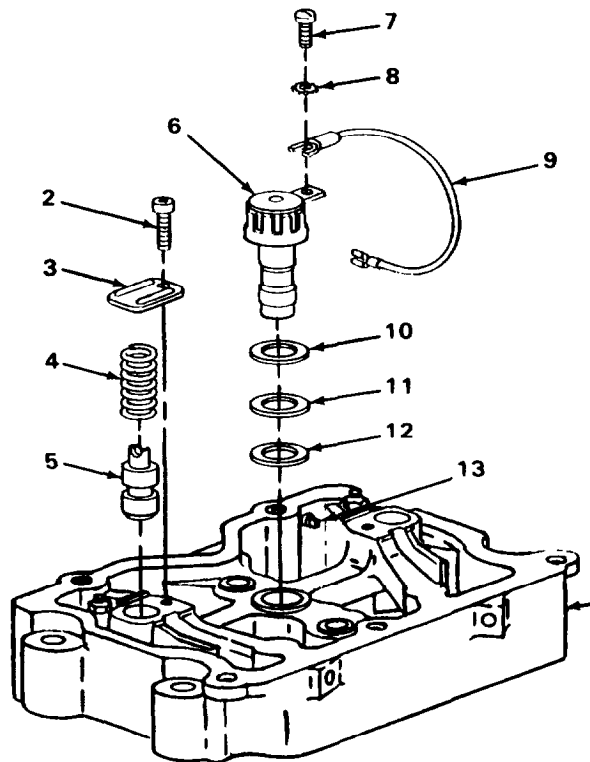


ENGINE COMPRESSION BRAKE HOUSING - CONTINUED

LOCATION	ITEM	ACTION REMARKS
6.	Upper ring seal (10), center ring seal (11), and lower ring seal (12)	Take off and discard.

**NOTE**

Leadout terminal bushing (13) is replaced only if terminal ends are broken.



**ENGINE COMPRESSION BRAKE HOUSING - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
DISASSEMBLY - CONTINUED		
7. Housing (1) (topside down)	Screw (2), flat-washer (3), and master piston spring (4)	Using 7/16-inch box-end wrench, unscrew and take off.
8.	Master piston (5)	Take out.
<b><u>WARNING</u></b>		
Slave piston spring is under tension. Care must be taken when removing retaining ring, spring retainer, and slave piston spring to prevent injury.		
9.	Spring retainer (6) and retaining ring (7)	a. Using arbor press, push down on spring retainer. b. Using snap-ring pliers, close retaining ring and take off. c. Carefully release arbor press tension.
10.	Slave piston spring (8) and slave piston (9)	Take out.

CLEANING

**NOTE**

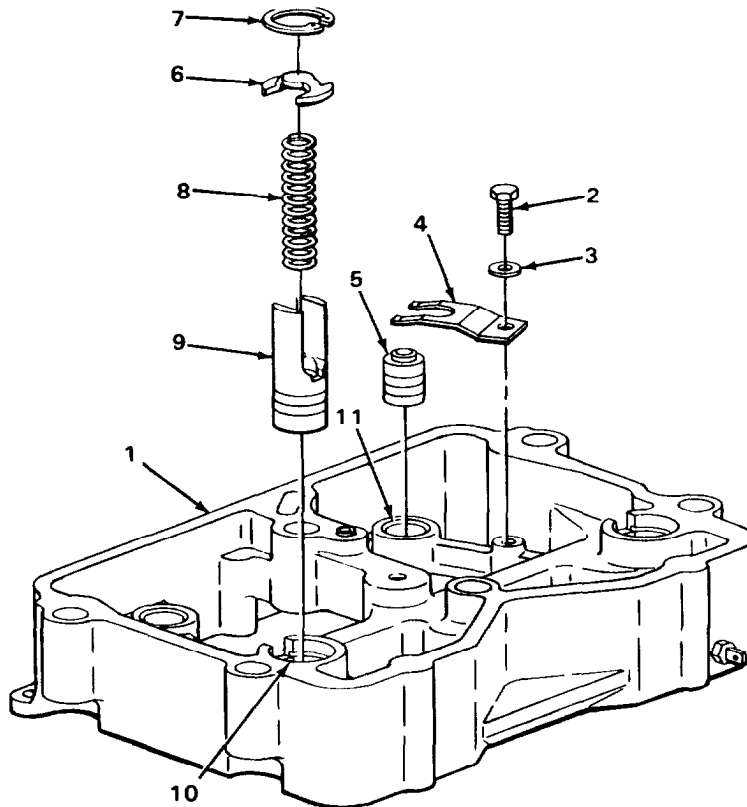
For general cleaning procedures, see General Maintenance Instructions, page 2-3.

INSPECTION

11. Housing (1) (topside down)	Slave piston (9)	a. Place into slave piston bore (10) and check for freedom of movement. If binding is found, check for dirt or damage. b. Wipe slave piston and slave piston bore clean and recheck for freedom of movement. Replace slave piston if damaged.
12.	Slave piston spring (8), retaining ring (7), and spring retainer (6)	a. Check for cracks, breaks, or other damage. b. Check for worn slave piston spring. Replace parts if damaged.

ENGINE COMPRESSION BRAKE HOUSING - CONTINUED

LOCATION	ITEM	ACTION REMARKS
13.	Master piston (5)	a. Place into master piston bore (11) and check for freedom of movement. <b>If binding is found, check for dirt or damage.</b> b. Wipe master piston and master piston bore clean and recheck for freedom of movement. <b>Replace master piston if damaged.</b>
14.	Master piston spring (4)	Check for wear, cracks or breaks. <b>Replace if damaged.</b>



**ENGINE COMPRESSION BRAKE HOUSING - CONTINUED**

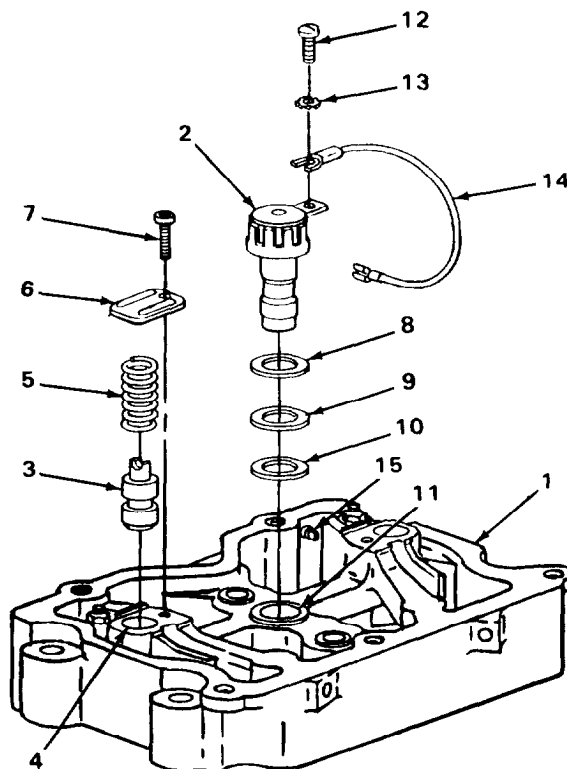
LOCATION	ITEM	ACTION REMARKS
INSPECTION - CONTINUED		
15. Housing (1) (topside up)	Solenoid valve (2)	a. Check for cracks, breaks, or damaged threads. b. Check for broken electrical connector. <b>Replace solenoid valve if damaged.</b>
16.	Control valve (3)	a. Place into control valve bore (4) and check for freedom of movement. <b>If binding is found, check for dirt or damage.</b> b. Wipe control valve and control valve bore (4) clean and recheck for freedom of movement. <b>Replace control valve if damaged.</b>
17.	Control valve spring (5) and control valve cover plate (6)	a. Check for cracks or breaks. b. Check for worn control valve spring. <b>Replace parts if damaged.</b>
ASSEMBLY		
18. Housing (1) (topside up)	Control valve (3) and control valve spring (5)	Put into control valve bore (4).
19.	Control valve cover plate (6) and screw (7)	a. Put in place. b. Using 5/32-inch hex wrench, tighten.
20. Solenoid valve (2)	New upper ring seal (8), new center ring seal (9), and new lower ring seal (10)	a. Apply a coat of lubricating oil. b. Push onto solenoid valve in correct order.
21. Housing (1) (topside up)	Solenoid valve (2)	a. Screw into solenoid valve bore (11). b. Using solenoid wrench, tighten.

ENGINE COMPRESSION BRAKE HOUSING - CONTINUED

LOCATION	ITEM	ACTION REMARKS
22.	Screw (12), washer (13), and wire (14)	a. Using 3/8-inch flat-tip screwdriver, unscrew and take off. b. Put wire washer and screw in place. c. Using 3/8-inch flat-tip screwdriver, tighten.

**NOTE**

Make sure other end of wire (14) is connected to leadout terminal bushing (15).



**ENGINE COMPRESSION BRAKE HOUSING - CONTINUED**

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LOCATION	ITEM	ACTION REMARKS
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ASSEMBLY - CONTINUED

23. Housing (1) (topside down)	Master piston (2)	Put into master piston bore (3).
-----------------------------------	-------------------	----------------------------------

**NOTE**

When performing next step, position master piston spring (4) as shown in illustration.

23.	Master piston spring (4), flatwasher (5), and screw (6)	<ul style="list-style-type: none"> <li>a. Put in place. <b>Aline master piston spring (4) on master piston (2).</b></li> <li>b. Using 7/16-inch box-end wrench, tighten.</li> </ul>
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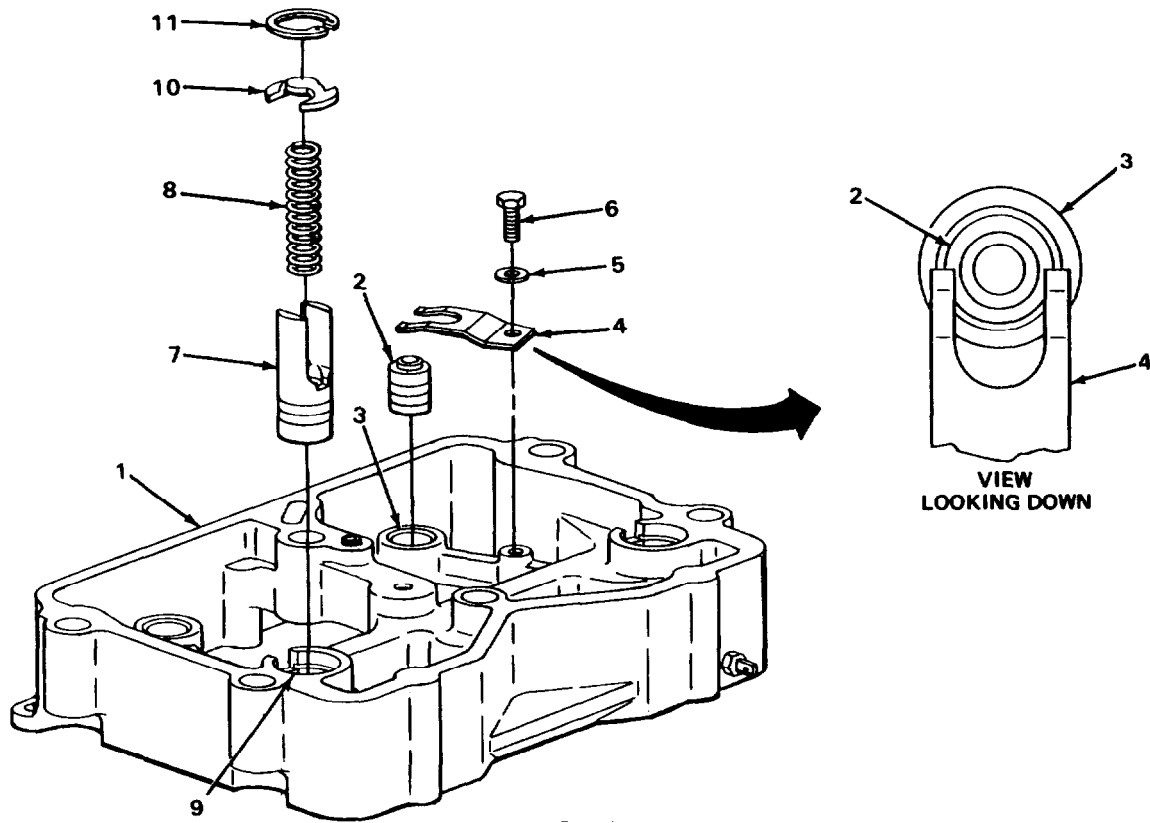
24.	Slave piston (7) and slave piston spring (8)	Put into slave piston bore (9).
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**WARNING**

Slave piston spring will be under tension when installing. Extreme care must be taken to prevent injury.

25.	Spring retainer (10) and retaining ring (11)	<ul style="list-style-type: none"> <li>a. Position spring retainer in housing grooves and on top of slave piston spring.</li> <li>b. Using arbor press, push down on spring retainer.</li> <li>c. Using snap-ring pliers, close retaining ring and place into position. <b>Make sure retaining ring is seated in groove.</b></li> <li>d. Carefully release arbor press tension.</li> </ul>
-----	--	--

**ENGINE COMPRESSION BRAKE HOUSING - CONTINUED**



**NOTE**

FOLLOW-ON MAINTENANCE: Install engine compression brake housing (page 2-116).

**TASK ENDS HERE**

**Section XIV. FUEL SYSTEM MAINTENANCE**

	Page		Page
Aneroid Control Valve .....	2-398	Fuel Pump.....	2-289
Fuel Injector .....	2-352	Turbocharger .....	2-384
Fuel Pump Calibration .....	2-333		

**FUEL PUMP**

This task covers:

- a. Cleaning (page 2-291)
- b. Disassembly (page 2-291)
- c. Filter Screen Inspection (page 2-294)
- d. Gear Pump Repair (page 2-295)
- e. Pulsation Damper Repair (page 2-301)
- f. Shutdown Valve Repair (page 2-304)
- g. Front Cover Assembly Repair (page 2-308)
- h. Fuel Pump Housing Repair (page 2-322)
- i. Governor Plunger Repair (page 2-325)
- j. Governor Spring Pack Repair (page 2-328)
- k. Throttle Shaft Repair (page 2-329)
- l. Fuel Pump Assembly (page 2-330)

**FUEL PUMP - CONTINUED**

INITIAL SETUP

Tools

- Assembly tool, ST-419
- Bit, drill, 1/4-inch
- Bit, drill, 11/64-inch
- Bit, screwdriver, flat-tip, 3/16-inch, 3/8-inch drive
- Block, support (two required)
- Chisel, gouge, 1/2-inch
- Drill, electric, 3/8-inch
- Driver, ST-853
- Gage, bore
- Gage, pressure, oil 0 to 600 psi (0 to 4136 kPa)
- Gage, thickness
- Goggles, safety
- Hammer, ball-peen, 16-ounce
- Hammer, plastic-faced
- Handle, ratchet, 3/8-inch drive
- Handle, ratchet, 1/2-inch drive
- Key, hex, 3/16-inch
- Key, hex, 5/32-inch
- Mandrel
- Mandrel, seal driving
- Micrometer, 0- to 1-inch
- Micrometer, depth, 0- to 1-inch
- Mittens, cloth, heat-protective
- Ohmmeter
- Pliers, diagonal-cutting, 8-inch
- Pliers, slip-joint, 6-inch
- Pliers, snapping
- Power supply, 12 vdc
- Press, arbor
- Puller, ST-709
- Puller, dowel, ST-667
- Puller, gear, ST-1231
- Punch, center
- Punch, driftpin, brass, 3/16-inch
- Reamer
- Scale, machinist's, 6-inch
- Screwdriver, flat-tip, 3/8-inch
- Screwdriver, flat-tip, 1/4-inch
- Scribe, machinist's
- Socket, 3/16-inch hex-head, 1/2-inch drive
- Socket, 7/16-inch, 3/8-inch drive
- Socket, 7/16-inch, 1/2-inch drive
- Socket, 1/2-inch, 1/2-inch drive
- V-blocks
- Vise, soft-jawed
- Wrench, box-end, 7/16-inch

Tools - Continued

- Wrench, open-end, 7/16-inch (two required)
- Wrench, open-end, 1/2-inch
- Wrench, open-end, 5/8-inch
- Wrench, open-end, 15/16-inch
- Wrench, open-end, 1-inch
- Wrench, torque, 0 to 150 in. lb (0 to 16.9 N.m), 3/8-inch drive
- Wrench, torque, 0 to 150 ft lb (0 to 210 N.m), 1/2-inch drive

Materials/Parts

- Cloth, emery (item 1, appendix B)
- Gasket, fuel pump housing
- Gasket, gear pump
- Gasket, governor spring pack cover
- Grease, extreme-pressure (item 10, appendix B)
- Key, coupling, front cover
- Lockwasher, front cover (two required)
- Lockwasher, fuel pump housing (seven required)
- Lockwasher, gear pump (four required)
- Lockwasher, governor spring pack cover (four required)
- Lockwasher, pulsation damper (six required)
- Lockwasher, shutdown valve (six required)
- Lockwasher, throttle lever (two required)
- Oil, lubricating (item 12, appendix B)
- Oil, fuel (item 11, appendix B)
- Seal, cap, fuel pump housing
- Packing, preformed, pulsation damper (two required)
- Packing, preformed, shutdown valve (two required)
- Packing, preformed, throttle shaft (two required)
- Packing, preformed, pulsation damper (two required)
- Packing, preformed, shutdown valve
- Prussian blue (item 13, appendix B)
- Seal, oil, front cover (four required)
- Seal, oil, pulsation damper
- Shaft, shutdown valve
- Tags, marker (item 17, appendix B)
- Washer, nylon, pulsation damper
- Wire, locking (item 21, appendix B)



**FUEL PUMP - CONTINUED**

Equipment Condition

Fuel pump assembly removed (page 2-41).

LOCATION	ITEM	ACTION	REMARKS
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CLEANING

**CAUTION**

Do not use chemical or caustic solutions or solvents that may damage aluminum or aluminum alloy parts. Serious damage to parts will occur.

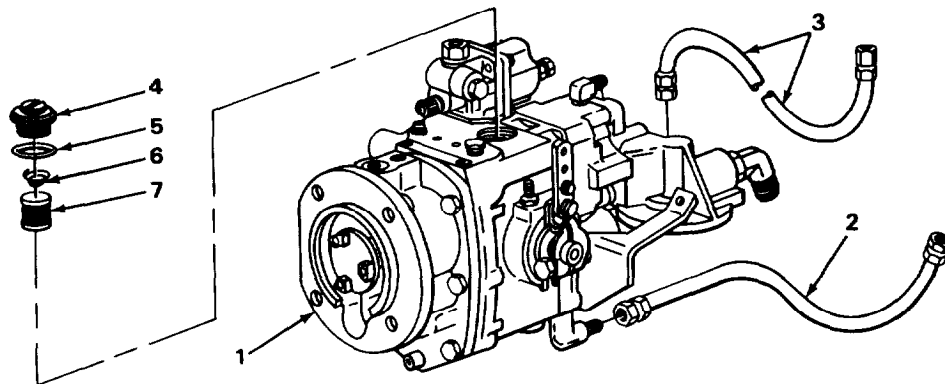
Do not use wire brushes or stiff-bristle brushes on fuel pump parts for cleaning. Wire or stiff bristle brushes will cause serious damage to parts.

**NOTE**

For general cleaning procedures, see General Maintenance Instructions (page 2-30).

DISASSEMBLY

- |                           |  |   |
|---------------------------|--|---|
| 1. Fuel pump assembly (1) | Aneroid control feed line (2) and return line (3)  | Using 5/8-inch open-end wrench, unscrew and remove.   |
| 2.                        | Filter screen cover (4), preformed packing (5), spring (6), and filter screen assembly (7) | <ul style="list-style-type: none"> <li>a. Using 3/8-inch flat-tip screwdriver, unscrew and remove filter screen cover.</li> <li>b. Remove packing.<br/><b>Discard packing.</b></li> <li>c. Lift out spring and filter screen assembly.</li> </ul> |

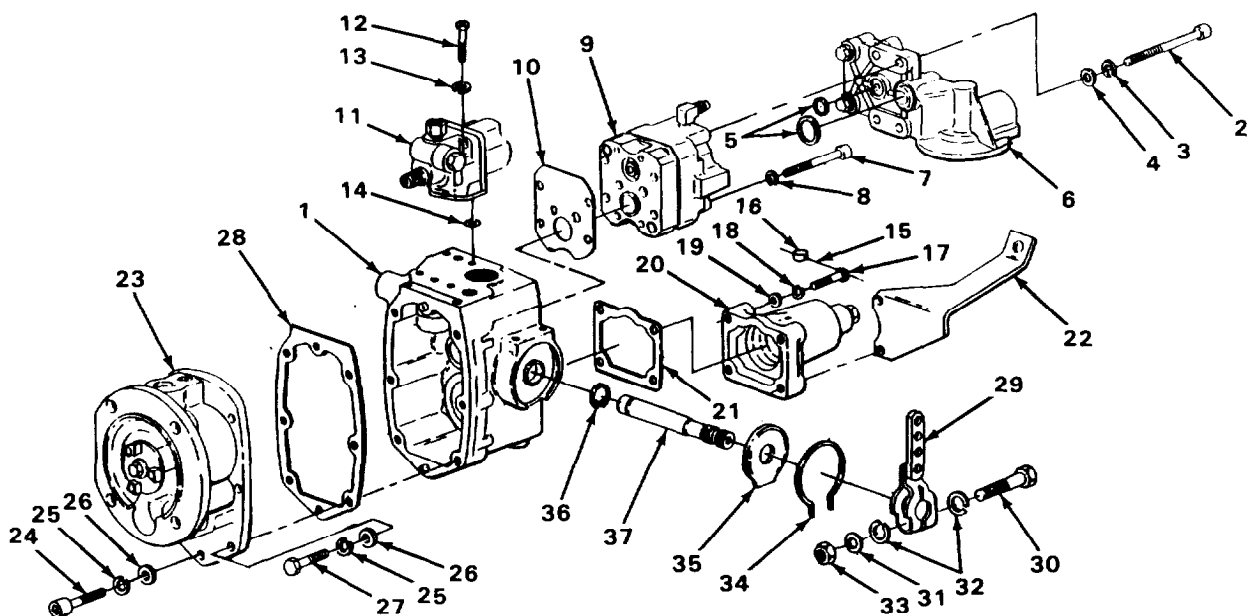


FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
DISASSEMBLY - CONTINUED		
3. Fuel pump assembly (1)	Four screws (2), four lockwashers (3), four flat washers (4), two preformed packings (5), and pulsation damper (6)	<p>a. Using 3/16-inch hex key, unscrew and remove four screws and four lockwashers. <b>Discard lockwashers.</b></p> <p>b. Using plastic-faced hammer, tap shoulders of pulsation damper to loosen.</p> <p>c. Take off pulsation damper and packing. <b>Discard packing.</b></p>
4.	Four screws (7), four lockwashers (8), gear pump (9), and gasket (10)	<p>a. Using 3/16-inch hex key, unscrew and remove four screws and four lockwashers. <b>Discard lockwashers.</b></p> <p>b. Using plastic-faced hammer, tap shoulders of gear pump to loosen.</p> <p>c. Take off gear pump and gasket. <b>Discard gasket.</b></p>
5.	Shutdown valve (11), two screws (12), two lockwashers (13), and gasket (14)	<p>a. Using 3/16-inch hex key, unscrew and remove two screws and two lockwashers. <b>Discard lockwashers.</b></p> <p>b. Take off shutdown valve and gasket. <b>Discard gasket.</b></p>
	Lock wire (15), fuel pump regulator seal (16), four screws (17), four lockwashers (18), four flat washers (19), governor spring pack cover (20), gasket (21), and bracket (22)	<p>a. Using 8-inch diagonal-cutting pliers, cut lock wire.</p> <p>b. Take off fuel pump regulator seal and lock wire. <b>Discard lock wire.</b></p> <p>c. Using 7/16-inch box-end wrench, unscrew and take out four screws, four lockwashers, four flat washers, and bracket. <b>Discard lockwashers.</b></p> <p>d. Using plastic-faced hammer, tap shoulders of governor spring pack cover to loosen.</p> <p>e. Take off governor spring pack cover and gasket. <b>Discard gasket.</b></p>

FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
7.	Front cover (23), screw (24), six screws (27), seven lockwashers (25), seven flat washers (26), and gasket (28)	a. Using 5/32-inch hex key, unscrew and remove screw (24), lockwasher, and flat washer. b. Using 7/16-inch box-end wrench, unscrew and remove six screws (27), lockwashers, and flat washers. <b>Discard lockwashers.</b> c. Using plastic-faced hammer, tap cover and seal to loosen. d. Take off cover and seal and gasket. <b>Discard gasket.</b>	
8.	Throttle lever (29), throttle lever screw (30), flat washer (31), two lockwashers (32), and nut (33)	a. Using two 7/16-inch open-end wrenches, loosen, unscrew, and take off nut. b. Take off lockwashers and flat washer. <b>Discard lockwashers.</b> c. Take out throttle lever screw. d. Remove throttle lever.	
9.	Snapping (34), throttle shaft cover (35), snapping (36), and throttle shaft assembly (37)	a. Using 6-inch slip-joint pliers, take out snapping (34). b. Remove throttle shaft cover. c. Using snapping pliers, take out snapping (36). d. Pull out throttle shaft assembly. <b>Handle throttle shaft carefully.</b>	



FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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FILTER SCREEN INSPECTION

**NOTE**

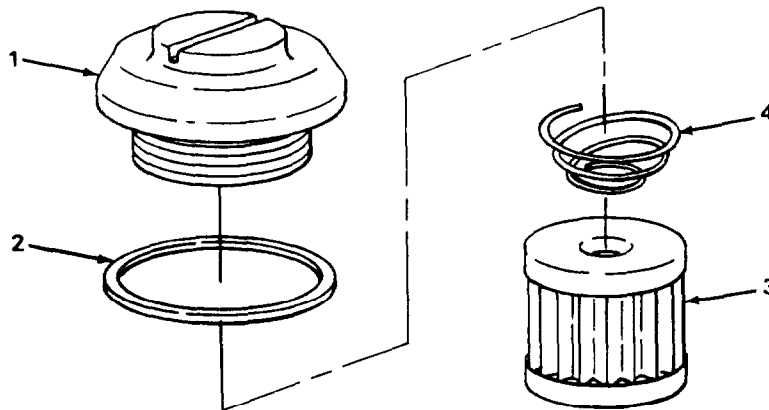
For fuel pump filter screen removal, see step 2 (page 2-291).

10. Filter screen cover (1)	Cap seal (2)	Inspect for damage or wear.	<b>Discard, if damaged or worn.</b>
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**WARNING**

Particles blown by compressed air are hazardous. Make certain the airstream is directed away from user and other personnel in the area. Compressed air used for cleaning purposes shall not exceed 30 psi (207 kPa). User must wear safety goggles or face shield to prevent injury.

11.	Filter screen cover (1)	a. Clean in fuel oil and blow dry with compressed air. b. Inspect for damage or wear.	<b>Discard if damaged or worn.</b>
12.	Filter screen (3)	a. Inspect for holes or imbedded foreign particles. b. Clean in fuel oil and blow dry with compressed air. c. Remove any metal particle buildup from magnet inside filter screen.	<b>Discard if damaged or clogged.</b>
13.	Spring (4)	Inspect for damage or wear.	<b>Discard if damaged or worn.</b>



FUEL PUMP - CONTINUED

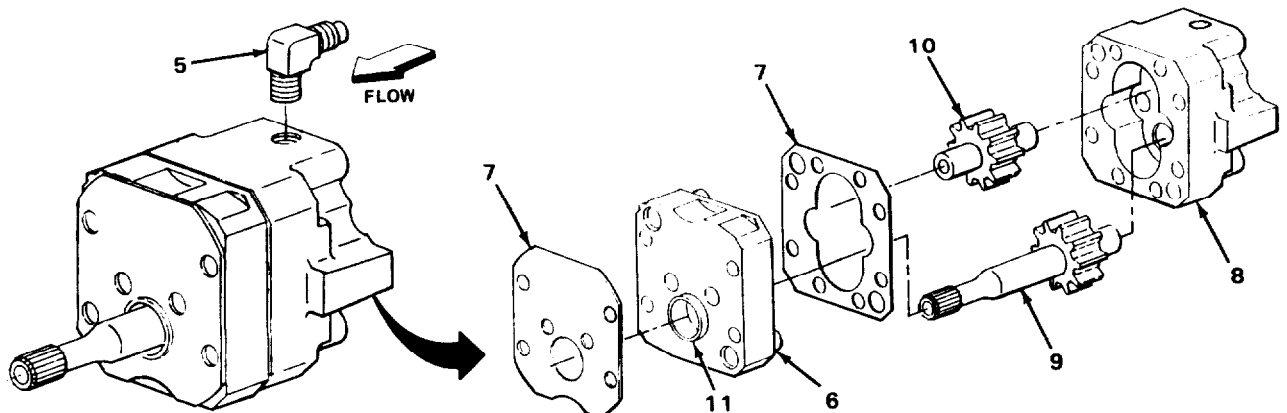
LOCATION	ITEM	ACTION REMARKS
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GEAR PUMP REPAIR

**NOTE**

For gear pump removal procedures, see steps 3 and 4 (page 2-292).

14. Gear pump assembly	Elbow check valve (5)	a. Using 1/2-inch open-end wrench, unscrew and remove. b. Check for one way flow operation. <b>Discard if not operational.</b>
15.	Gear pump cover (6) and gaskets (7)	a. Using 16-ounce ball-peen hammer, tap gear pump cover from gear pump housing (8). b. Take off gasket. <b>Discard gasket.</b>
16. Gear pump housing (8)	Drive gear and shaft (9) and driven gear and shaft (10)	Lift drive gear and shaft and driven gear and shaft from gear pump housing.
17. Gear pump cover (6)	Bushing sleeve (11)	a. Inspect for nicks, burrs, wear, or scoring. <b>Discard if worn or scored.</b> b. Using emery cloth, polish out nicks and burrs.



FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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GEAR PUMP REPAIR - CONTINUED

**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

- |     |  |  |
|-----|--|--|
| 18. | Gear pump housing (1) and gear pump cover (2)          | <ul style="list-style-type: none"> <li>a. Check gear pump housing and gear pump cover for scoring or wear.<br/><b>Discard if scored or worn.</b></li> <li>b. Using 0- to 1-inch depth micrometer, measure depth of gear pump housing gear pocket.<br/><b>Gear pocket depth should be 0.7478 to 0.7483 inch (18.994 to 19.006 mm). Discard if depth exceeds 0.7483 inch (19.006 mm).</b></li> <li>c. Using bore gage, measure shaft bore diameters in gear pump housing and gear pump cover. Shaft bore should be 0.5013 to 0.5016 inch (12.733 to 12.740 mm).<br/><b>Discard if shaft bores exceed 0.5016 inch (12.740 mm).</b></li> </ul> |
| 19. | Drive gear and shaft (3) and driven gear and shaft (4) | <ul style="list-style-type: none"> <li>a. Inspect shafts for wear or scoring.<br/><b>Discard if worn or scored.</b></li> <li>b. Using 0- to 1-inch micrometer, measure diameter of shafts.<br/><b>Shafts should be 0.4998 to 0.5001 inch (12.695 to 12.703 mm). Discard if worn smaller than 0.4998 inch (12.703 mm).</b></li> <li>c. Check gears for damage.<br/><b>Discard if worn.</b></li> <li>d. Using 0-to 1-inch micrometer, measure width of drive gear and driven gear.<br/><b>Gear width should be 0.7483 to 0.7486 inch (19.006 to 19.014 mm). Discard gears if smaller than 0.7483 inch (19.006 mm).</b></li> </ul>            |

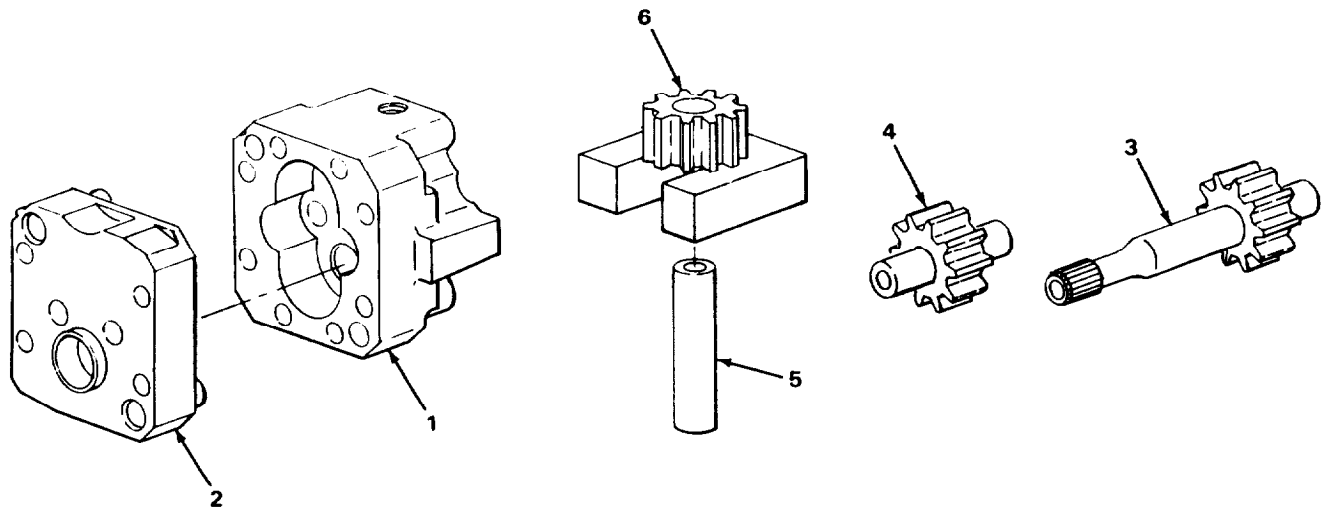
FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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**NOTE**

Steps 20 and 21 are for replacement of gear or shaft. If gear or shaft replacement is not necessary, proceed to step 22. Step 20 is for driven gear and shaft assembly only. Step 21 is typical for both drive and driven gear and shaft assemblies.

- |     |  |   |
|-----|--|---|
| 20. | Spur gear and idler shaft assembly (4) | Using prussian blue, mark shaft on gear pump housing side.  |
| 21. | Shaft (5) and gear (6)                 | <ul style="list-style-type: none"> <li>a. Support gear and, using arbor press and mandrel, press out shaft.</li> <li>b. Lubricate shaft with extreme-pressure grease.</li> <li>c. Position shaft in gear and, using arbor press and mandrel, press shaft into gear until gear face is 0.680 to 0.690 inch (17.27 to 17.53 mm) from gear pump housing end of shaft.</li> </ul> |



**FUEL PUMP - CONTINUED**

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LOCATION	ITEM	ACTION	REMARKS
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GEAR PUMP REPAIR - CONTINUED

**NOTE**

Steps 22 and 23 are for gear pump cover or dowel ring replacement only. If gear pump cover or dowel ring replacement is not required, proceed to step 24.

22.	Gear pump cover (1)	Bushing sleeve (2)	Remove.
23.		Bushing sleeve (2)	a. Lubricate dowel ring with extreme-pressure grease. b. Position dowel ring over drive gear and shaft bore in gear pump cover and, using arbor press and mandrel, press in.

**NOTE**

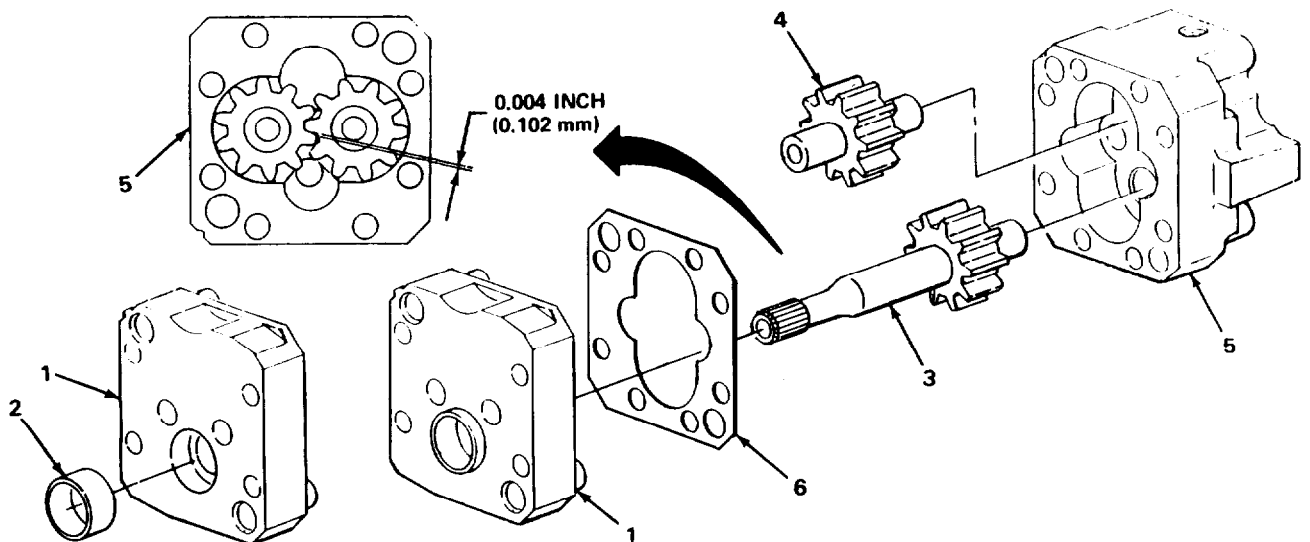
Make sure all parts are clean before assembly, paying particular attention to lubricating holes in gear pump cover and gear pump housing.

24.	Drive gear and shaft (3), spur gear and idler shaft (4), and gear pump housing (5)	a. Using 0- to 1-inch micrometer, measure width of drive gear and driven gear. <b>Write down measurement indicated by micrometer.</b> b. Using 0- to 1-inch depth micrometer, measure depth of gear pocket in gear pump housing. <b>Write down measurement indicated by depth micrometer.</b> c. Subtract measurement obtained in step b from measurement obtained in step a. The result will indicate which gasket must be used, for assembly, to obtain proper end clearance for gear pump gears.
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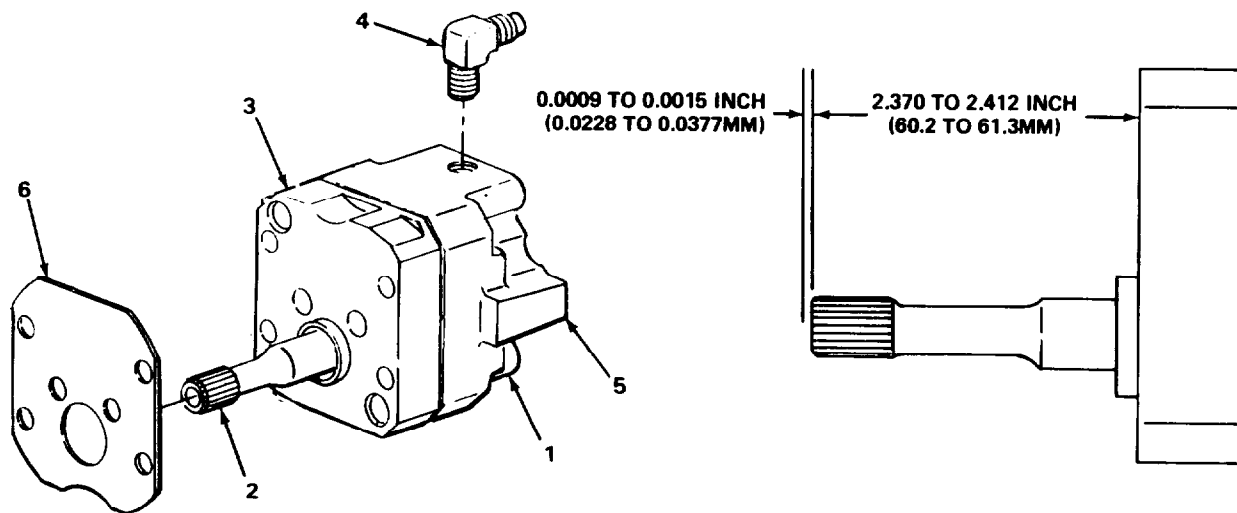
FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
25. Gear pump housing (5)	Drive gear and shaft (3) and spur gear and idler shaft (4)	<ul style="list-style-type: none"> <li>a. Lubricate gear pump housing, drive gear and shaft, and driven gear and shaft with lubricating oil.</li> <li>b. Clean prussian blue from gear pump housing end of driven gear and shaft, and position driven gear and shaft into gear pump housing.</li> <li>c. Position drive gear and shaft into gear pump housing.</li> <li>d. Using thickness gage, check gear backlash as shown. <b>Backlash must not exceed 0.004 inch (0.102 mm).</b></li> </ul>
26.	New gasket (6) and gear pump cover (1)	<ul style="list-style-type: none"> <li>a. Install red, 0.002-inch (0.51 mm), or purple, 0.0015-inch (0.38 mm), new gasket as determined in step 24.</li> <li>b. Position gear pump cover on gear pump housing (5), making sure dowels and dowel holes are aligned, and press together.</li> <li>c. Check that pump turns freely by finger pressure only.</li> </ul>



FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
GEAR PUMP REPAIR - CONTINUED			
27. Gear pump assembly (1)			Using 6-inch machinist's scale, measure from end of drive gear and shaft (2) to gear pump cover (3). <b>Distance should be 2.370 to 2.412 inches (60.2 to 61.3 mm).</b>
28.	Drive gear and shaft (2)		Using dial indicator, check end clearance. <b>End clearance should be 0.0009 to 0.0015 inch (0.0228 to 0.0377 mm).</b>
28.	Elbow check valve (4)		Using 1/2-inch open-end wrench, screw in and tighten so open end of elbow check valve faces away from fuel inlet port (5) on gear pump body.
30.	New gear pump gasket (6)		Install new gear pump gasket to gear pump cover.



FUEL PUMP - CONTINUED

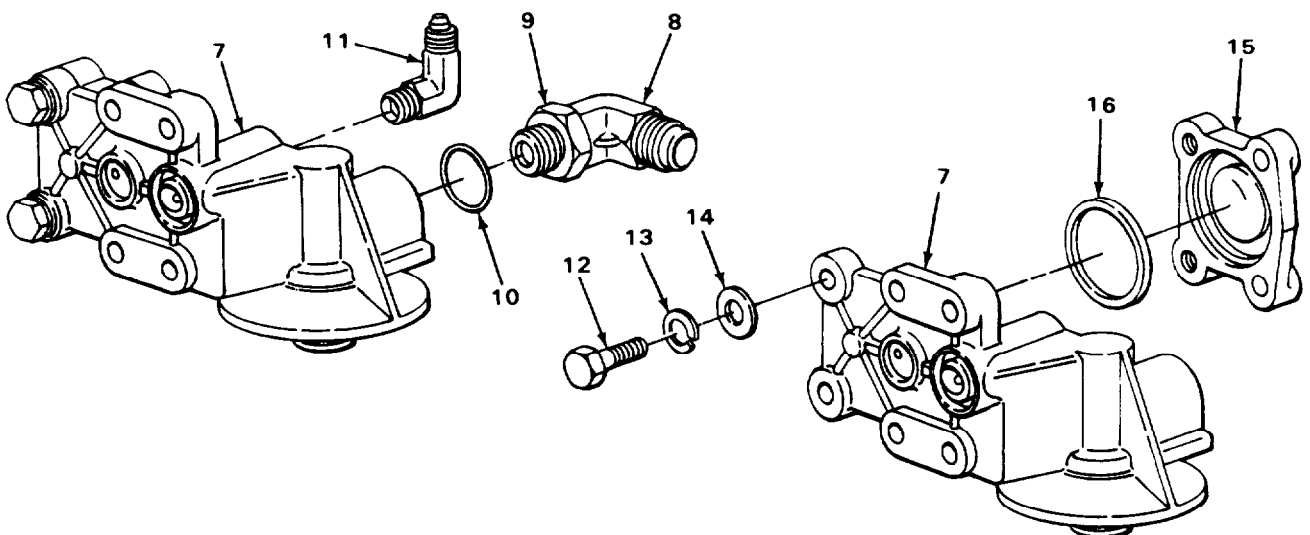
LOCATION	ITEM	ACTION REMARKS
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PULSATION DAMPER REPAIR

**NOTE**

For pulsation damper removal procedures, see step 3, page 2-292.

31. Pulsation damper assembly (7)	Fuel inlet connection (8), locknut (9), and preformed packing (10)	a. Using 1-inch and 15/16-inch open-end wrenches, loosen locknut. b. Unscrew and remove fuel inlet connection and packing. <b>Discard packing.</b>
32.	Elbow (11)	Using 7/16-inch open-end wrench, unscrew and remove.
33.	Two screws (12), two lockwashers (13), two flat washers (14), and cover (15)	a. Using 7/16-inch open-end wrench, unscrew and remove two screws, two lockwashers, and two flat washers. b. Take off cover. <b>Discard lockwashers.</b>
34. Cover (15)	Preformed packing (16)	Take out. <b>Discard.</b>



**FUEL PUMP - CONTINUED**

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LOCATION	ITEM	ACTION REMARKS
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PULSATION DAMPER REPAIR - CONTINUED

35. Pulsation damper assembly (1)	Nylon washer (2), plate (3), and pre-formed packing (4)	Take out nylon washer, plate, and pre-formed packing. <b>Discard nylon washer and preformed packing.</b>
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**CAUTION**

Do not use chemical or caustic solutions or solvents that may damage aluminum or aluminum alloy parts. Serious damage to parts will occur.

Do not use wire brushes or stiff bristle brushes on aluminum or aluminum alloy parts. Wire or stiff bristle brushes will cause serious damage to parts.

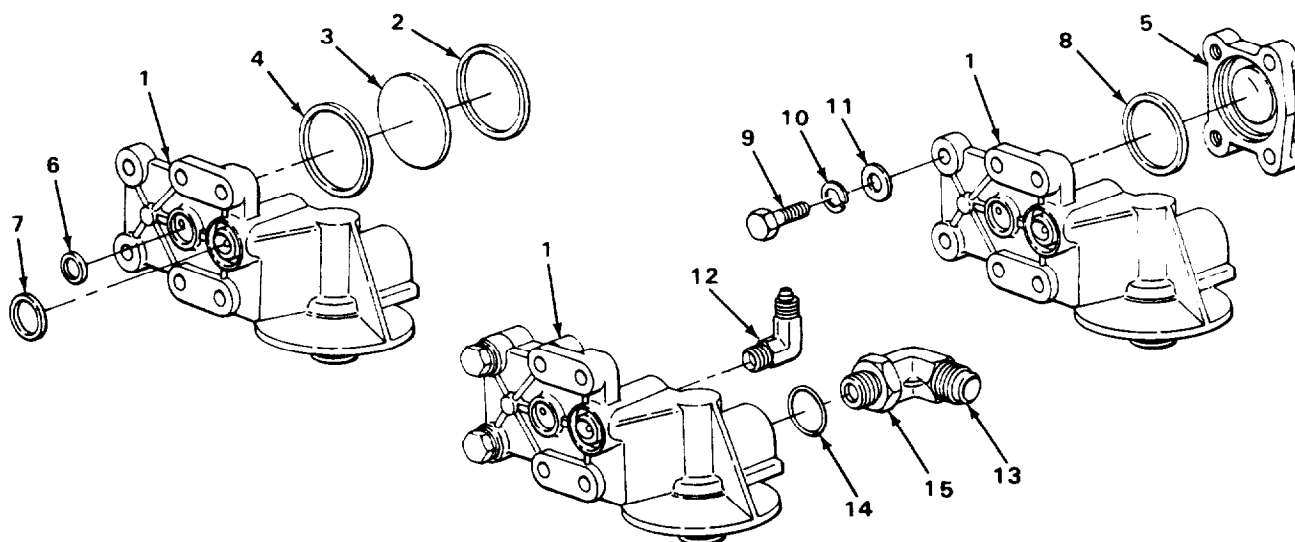
**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

36.	Cover (5)	Inspect for corrosion, wear, cracks, or damage. <b>Discard if corroded, worn, cracked, or damaged.</b>
37.	Plate (3)	a. Inspect for corrosion or wear. <b>Discard if corroded or worn.</b> b. Visually check for cracks. <b>Discard if cracked.</b>
38. Pulsation damper assembly (1)	New preformed packing (4), plate (3), new nylon washer (2), new oil seal (6), and new O-ring (7)	a. Install new preformed packing in groove. b. Coat diaphragm with lubricating oil and place in position. c. Place new nylon washer in position. d. Install new seal and new O-ring in end of body.

FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
39. Pulsation damper assembly (1)	Cover (5), new pre-formed packing (8), two screws (9), two new lockwashers (10), and two flat washers (11)	<ul style="list-style-type: none"> <li>a. Install new preformed packing in groove of cover.</li> <li>b. Position cover on pulsation damper assembly.</li> <li>c. Install one new lockwasher and one flat washer on each screw.</li> <li>d. Using 7/16-inch box-end wrench, screw in and tighten two screws.</li> </ul>
40.	Elbow (12)	Using 7/16-inch open-end wrench, screw in and tighten so open end of elbow faces up.
41.	Fuel inlet connection (13), new pre-formed packing (14), and locknut (15)	<ul style="list-style-type: none"> <li>a. Put in new packing on fuel inlet connection.</li> <li>b. Screw in by hand and face open end of fuel inlet connection away from cover.</li> <li>c. Using 1-inch and 15/16-inch open-end wrenches, tighten locknut on fuel inlet connection.</li> </ul>



**FUEL PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
SHUTDOWN VALVE REPAIR		
<b>NOTE</b>		
For shutdown valve removal procedures, see step 5, page 2-292.		
42. Shutdown valve housing (1)	Four machine screws (2) and four lockwashers (3)	Using 1/4-inch flat-tip screwdriver, unscrew and remove. <b>Discard lockwashers.</b>
43.	Coil assembly (4)	Remove.
44.	Access cover plate (5), spring washer (6), preformed packing (7), disk valve (8)	Remove. <b>Discard packing.</b>
45.	Override knob (9)	Pull off.
46.	Shaft (10), preformed packing (11) and O-ring (12)	Using 1/4-inch flat-tip screwdriver, unscrew and remove shaft and preformed packing from coil end. <b>Discard shaft, preformed packing and O-ring.</b>
47.	Pipe plug (13)	Using 7/16-inch open-end wrench, unscrew and remove.

**CAUTION**

Do not wet coil assembly with solvents or cleaners. Solvents or cleaners will cause damage to coil.

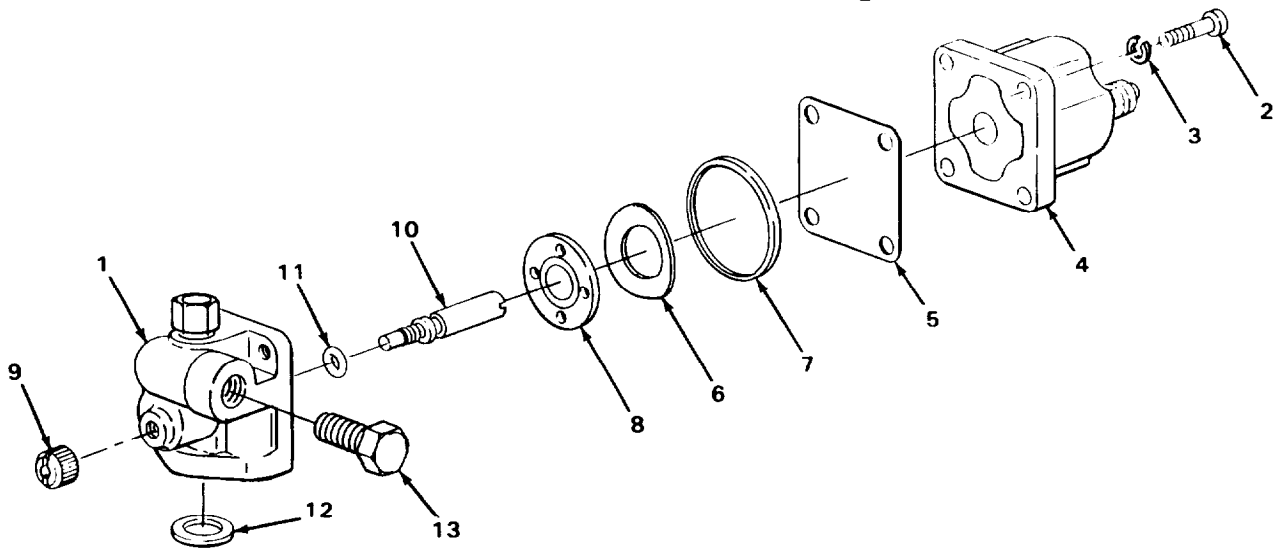
**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

48.	Coil assembly (4)	Using ohmmeter, check coil resistance. <b>Resistance should be 7.5 ohms ± 0.5 ohms.</b>
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FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
49.	Disk valve (8)	Inspect disc valve for wear, bonding failure, surface cuts, separations, or corrosion. <b>Discard if worn, cut, corroded, or bonding has failed or separated.</b>
50.	Shutdown valve housing (1)	<ul style="list-style-type: none"> <li>a. Inspect for wear, damage, or corrosion. <b>Discard if worn, damaged, or corroded.</b></li> <li>b. Inspect valve seating area for wear or damage. <b>Discard if worn or damaged.</b></li> <li>c. Using 6-inch machinist's scale, measure width of valve seat. <b>Minimum valve seat width should be 0.015 inch (0.38 mm).</b></li> </ul>



FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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SHUTDOWN VALVE REPAIR - CONTINUED

**NOTE**

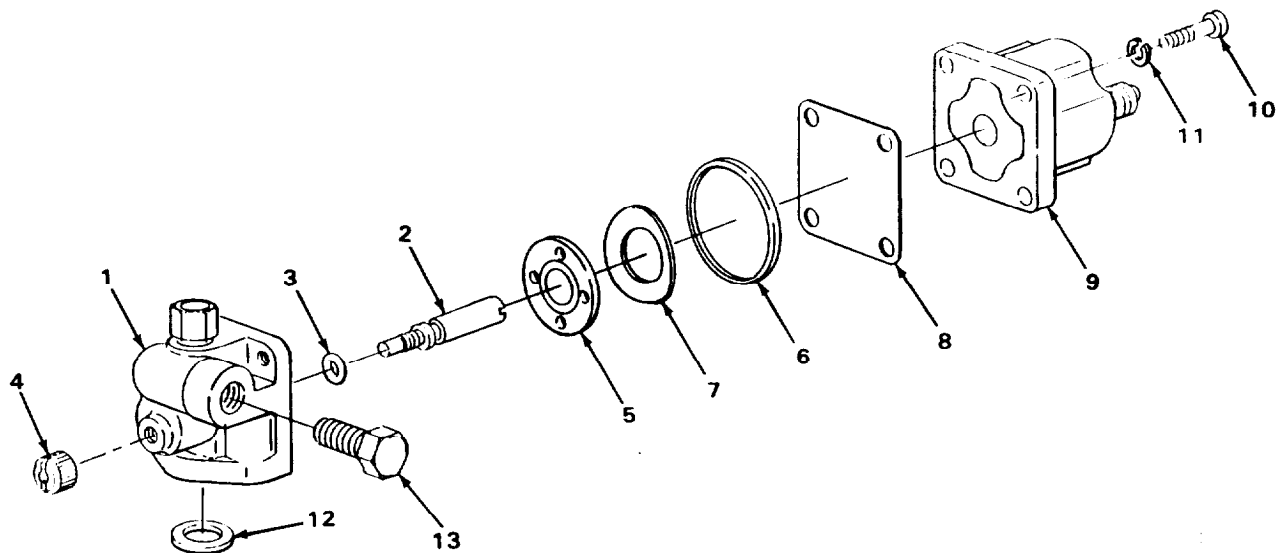
Make sure all parts are clean before assembly.

51. Shutdown valve housing (1)	New shaft (2) and new preformed packing (3)	<ul style="list-style-type: none"> <li>a. Install new preformed packing on new shaft and coat with lubricating oil.</li> <li>b. Screw new shaft into bore of shutdown valve housing until it reaches bottom.</li> <li>c. Using 0- to 1-inch depth micrometer set at 0.118 inch (2.997 mm), place depth micrometer on face of shutdown valve housing (1), and screw new shaft out until tip touches spindle of depth micrometer. <b>Do not move shaft after 0.118 inch (2.997 mm) depth is attained.</b></li> </ul>
52.	Override knob (4)	Press on until override knob contacts shutdown valve housing.
53.	Disk valve (5)	Install with rubber side toward shutdown valve housing.
54.	New preformed packing (6)	Coat new packing with lubricating oil and install in groove in shutdown valve housing.
55.	Spring washer (7)	Place spring washer on disk valve (5), with concave side up, and in position around locator on valve.
56.	Access cover plate (8), coil assembly (9), four machine screws (10), and four new lock-washers (11)	<ul style="list-style-type: none"> <li>a. Place access cover plate and coil assembly on shutdown valve housing and install four machine screws.</li> <li>b. Using 3/8-inch drive 3/16-inch flat-tip screwdriver bit and 0 to 150 in. lb (0 to 16.9 N•m) torque wrench, screw in and torque four machine screws to 25 to 35 in. lb (3 to 5 N•m).</li> </ul>



FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
57. Shutdown valve housing (1)	New O-ring (12)	Install on bottom of shutdown valve.
58.	Pipe plug (13)	Using 7/16-inch open-end wrench, screw in and tighten.
59.	Shutdown valve housing (1)	<p>a. Using 12 vdc power supply, and oil pressure gage, 0 to 600 psi (0 to 4136 kPa) hook up shutdown valve and attach lines to shutdown valve inlet and outlet.</p> <p>b. Energize coil and pump test fluid through valve at 300 psi (2068 kPa) maximum.</p> <p>c. Deenergize valve and check to be sure valve holds 300 psi (2068 kPa) load with no leakage.</p> <p><b>If shutdown valve does not hold specified pressure, check shutdown valve housing to access cover plate mating surface for damage. Also check rubber on access cover plate for swelling or damage, and replace as necessary.</b></p>



**FUEL PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
FRONT COVER ASSEMBLY REPAIR		
<b>NOTE</b>		
For front cover assembly removal procedures, see step 7, page 2-292.		
Steps 60 thru 101 contain repair procedures for the front cover, drive shaft, and weight carrier.		
60.	Front cover (1)  Weight carrier (2)	Check for excessive weight carrier shaft bushing wear by moving weight carrier shaft (3) from side to side in bushing (4). <b>There is excessive wear if weight carrier shaft can be moved from side to side in weight carrier shaft bushing. Tag for replacement if wear is observed.</b>
61.	Drive shaft gear (5) and spur gear (6)	Using thickness gage, check gear backlash. <b>Backlash should be 0.005 to 0.009 inch (0.13 to 0.23 mm).</b>
62.	Weight assist plunger (7), weight assist shim (8), and weight assist spring (9)	Remove.

**NOTE**

When removing weight carrier, retaining ring (10) may be pulled from weight carrier shaft (3) leaving bushing (4) in front cover. If snapping is pulled from weight carrier shaft (3), weight carrier may also be pulled from shaft.

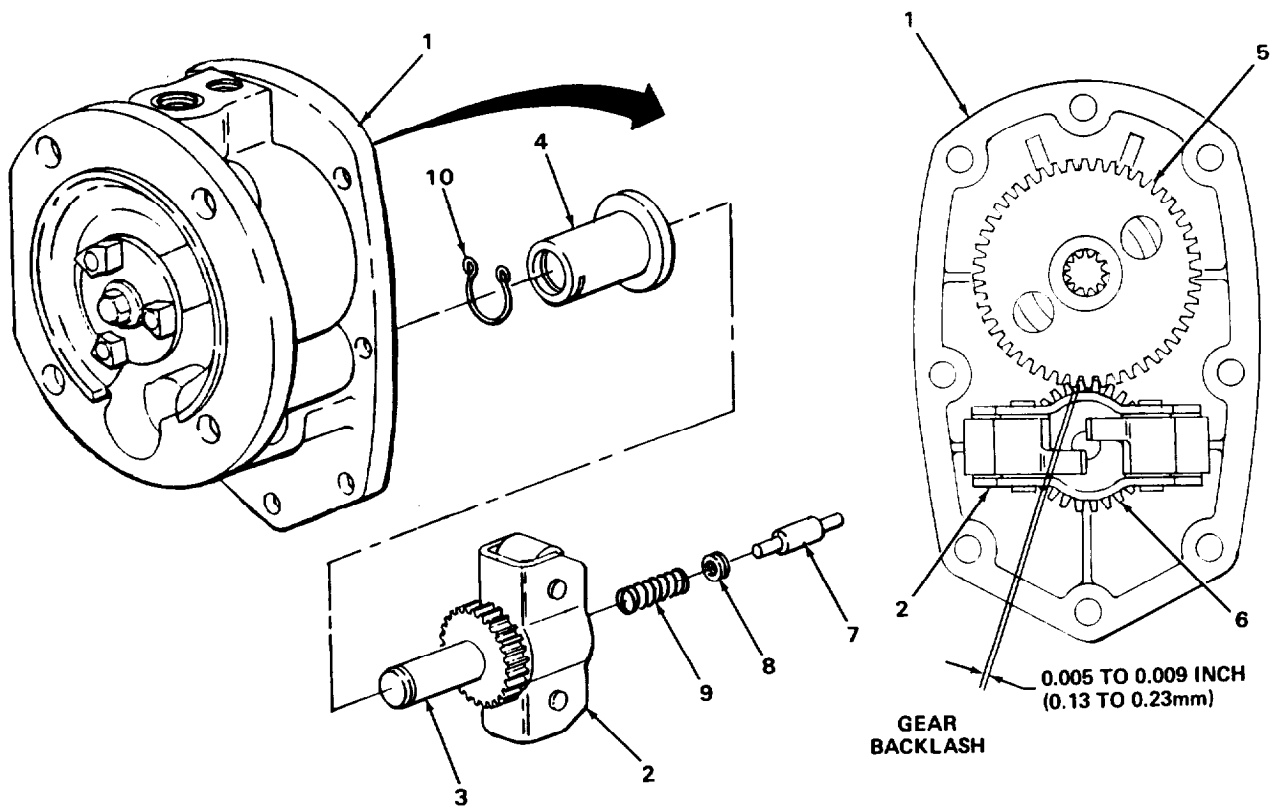
63.	Weight carrier (2)	Using ST-709 puller, pull weight carrier from front cover (1).
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**NOTE**

Perform step 64 only if weight carrier shaft remains in front cover when removing weight carrier.

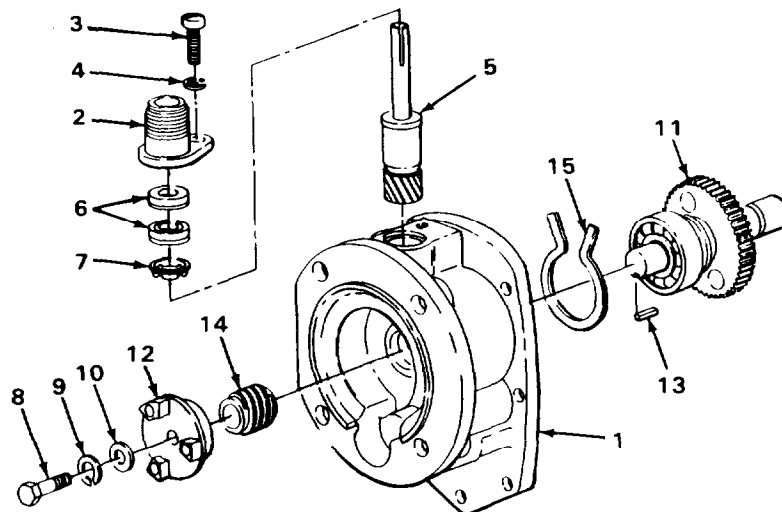
FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
64. Front cover (1)	Weight carrier shaft (3)	Using ST-667 dowel puller, pull out.
<b>NOTE</b>		
Perform step 65 only if bushing (4) remains in front cover when removing weight carrier and weight carrier shaft.		
65.	Bushing (4)	Using ST-709 puller, pull bushing from front cover (1).
66. Weight carrier (2)	Retaining ring (10) and bushing (4)	Using snapping pliers, take retaining ring off bushing.



FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
FRONT COVER ASSEMBLY REPAIR - CONTINUED		
67. Front cover (1)	Tachometer drive housing (2), screw (3), and lock-washer (4)	a. Using 3/8-inch flat-tip screwdriver, unscrew and remove. <b>Discard lockwasher.</b> b. Lift off tachometer drive housing.
68.	Tachometer drive shaft assembly (5), two oil seals (6), and spacer (7)	a. Using ST-667 dowel puller, remove tachometer drive shaft assembly. b. Take out oil seals and spacers. <b>Discard oil seals.</b>
69.	Coupling screw (8), coupling lockwasher (9), and flat washer (10)	Using 1/2-inch drive 1/2-inch socket and ratchet handle, unscrew and take out. <b>Discard lockwasher.</b>
70. Drive shaft assembly (11)	Drive coupling (12) and coupling key (13)	a. Using ST-709 puller, pull off drive coupling. b. Remove coupling key. <b>Discard coupling key.</b>
71.	Tachometer drive gear (14)	Using ST-1231 gear puller, remove.
72.	Snapping (15) and drive shaft assembly (11)	a. Using 6-inch slip-joint pliers, remove snapping. b. Remove drive shaft assembly.



**FUEL PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
73. Front cover (1)	Two oil seals (16)	Using arbor press and mandrel, press out. <b>Discard.</b>

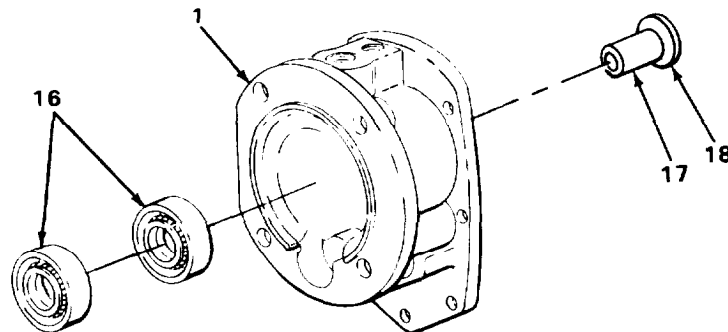
**CAUTION**

Do not use chemical or caustic solutions or solvents that may damage aluminum or aluminum alloy parts. Serious damage to parts will occur.

**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

74.	Front cover (1)	<ol style="list-style-type: none"> <li>Inspect for cracks, wear, or corrosion. <b>Discard if cracked, worn, or corroded.</b></li> <li>Inspect all mating surfaces for scratches, nicks, or burrs. <b>Remove small scratches, nicks, and burrs with emery cloth.</b></li> <li>Inspect shaft bores and bearing bores for out-of-round condition. <b>Discard if out-of-round.</b></li> </ol>
75.	Weight carrier shaft bushing (17)	<ol style="list-style-type: none"> <li>Using bore gage, measure inside diameter. <b>Discard if worn more than 0.504 inch (12.80 mm).</b></li> <li>Inspect thrust face (18) for excessive wear. <b>Discard if excessively worn or scratched.</b></li> </ol>



**FUEL PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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FRONT COVER ASSEMBLY REPAIR - CONTINUED

**NOTE**

Step 76 covers procedures for inspecting cast weight carrier. These procedures also apply to welded weight carrier with the following exception. If welded weight carrier is found to be worn, discard entire weight carrier. Only cast weight carrier has replaceable parts.

76. Weight carrier (1)	Governor weight pins (2)	a. Place 1/4-inch drill bit under governor weights (3). b. Try to place 11/64-inch drill bit between governor weights (3). <b>Replace governor weight pins if 11/64-inch drill bit does not fit between weights.</b>
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**NOTE**

Perform step 77 only if governor weight pins (2) are to be replaced.

77. Weight carrier (1)	Two governor weight pins (2) and two governor weights (3)	a. Using 3/16-inch brass driftpin punch and 16-ounce ball-peen hammer, tap out two governor weight pins. <b>Discard governor weight pins.</b> b. Take out governor weights.
78.	Two governor weights (3)	Inspect for wear or damage. <b>Discard if worn or damaged.</b>
79.	Weight carrier (1)	Inspect for wear or damage. <b>Discard if worn or damaged.</b>
80. Weight carrier (1)	Two governor weights (3) and two new governor weight pins (2)	Position governor weights in weight carrier and using 3/16-inch brass drift-pin punch and 16-ounce ball-peen hammer, drive in two new governor weight pins. <b>Center new governor weight pins in weight carrier.</b>

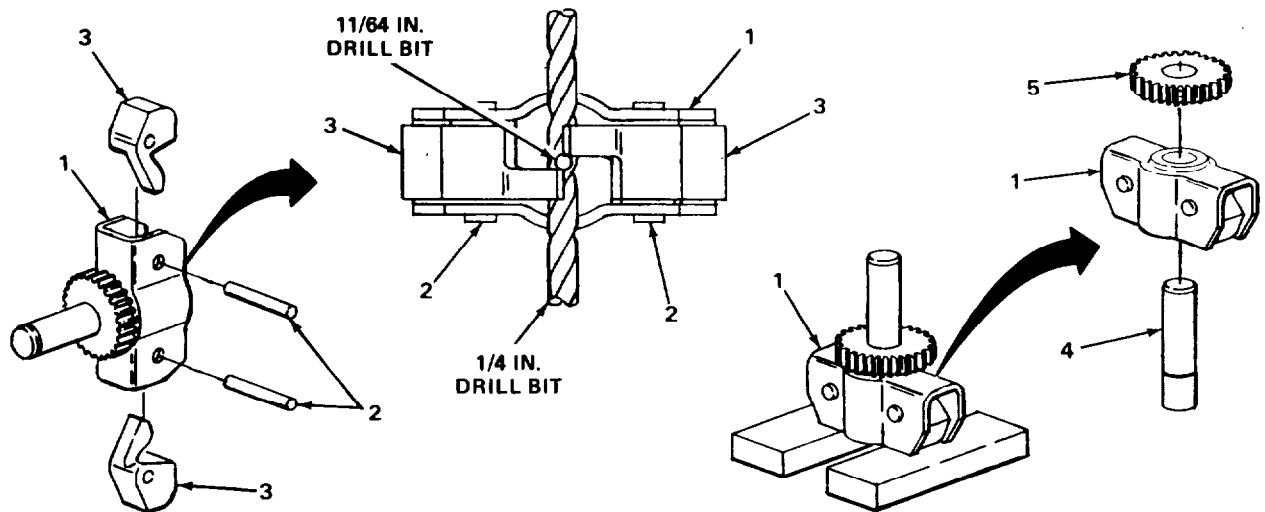
FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
81.	Weight carrier shaft (4) and spur gear (5)	Inspect for wear, scratches, nicks, burrs, and damaged gear teeth. <b>Tag weight carrier shaft or spur gear for replacement if worn, scratched, nicked, burrs are noted, or gear teeth are missing or damaged.</b>

**NOTE**

Perform step 82 only if spur gear (5) or weight carrier shaft (4) is to be replaced.

82. Weight carrier (1)	Weight carrier shaft (4) and spur gear (5)	Support weight carrier (1) on support blocks and, using arbor press and mandrel, press out weight carrier shaft. <b>Discard weight carrier shaft or spur gear as determined in step 81.</b>
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FUEL PUMP - CONTINUED

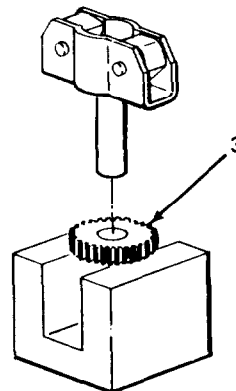
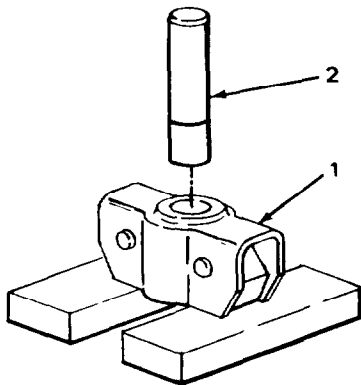
LOCATION	ITEM	ACTION	REMARKS
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FRONT COVER ASSEMBLY REPAIR - CONTINUED

**NOTE**

Step 83 covers assembly of weight carrier shaft. If old parts came off shaft during disassembly and are to be used again, weight carrier shaft must be a minimum of 0.0005 inch (0.013 mm) larger than spur gear bore and weight carrier bore for an interference fit.

- |                        |  |   |
|------------------------|--|---|
| 83. Weight carrier (1) | Weight carrier shaft (2) and spur gear (3) | <ul style="list-style-type: none"> <li>a. Support weight carrier on support blocks and, using arbor press and mandrel, press weight carrier shaft into weight carrier until it is 0.005 inch (0.13 mm) to flush with weight side of weight carrier.</li> <li>b. Support weight carrier and shaft assembly in ST-1231 gear puller and, using arbor press and mandrel, press weight carrier shaft into spur gear.<br/> <b>Make sure rough edge of gear is facing weight carrier.</b></li> </ul> |
|------------------------|--|---|



- |     |                          |
|-----|--------------------------|
| 84. | Drive shaft assembly (4) |
|-----|--------------------------|

Inspect drive shaft (5), drive gear (6), drive coupling (7), and ball bearing (8) for wear or damage.  
**Tag worn or damaged parts for replacement.**

**NOTE**

Steps 85 thru 88 are for drive shaft, drive gear, drive coupling, and ball bearing replacement only. If no replacement is necessary, proceed to step 90.



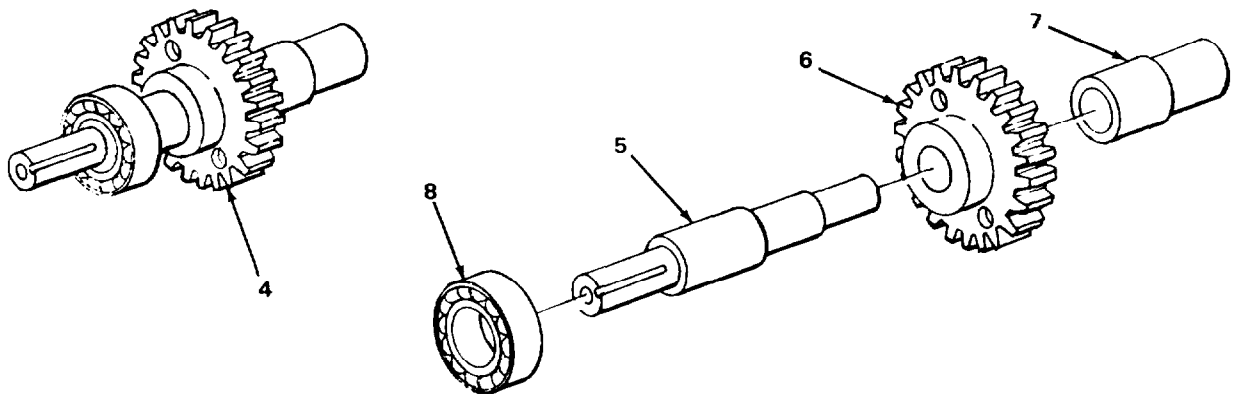
**FUEL PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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**CAUTION**

Press drive gear away from ball bearing. Pressing drive gear towards ball bearing will cause serious damage to parts.

85.	Drive shaft (5)  Drive gear (6) and drive coupling (7)	Using arbor press and mandrel, press drive shaft from drive gear and drive coupling.
86.	Ball bearing (8)	<ul style="list-style-type: none"> <li>a. Support inner race, and using arbor press and mandrel, press drive shaft (5) from ball bearing.</li> <li>b. Lubricate drive shaft (5) with extreme-pressure grease.</li> <li>c. Position ball bearing on drive shaft (5), and, using arbor press and mandrel against inner race, press into place.</li> </ul>
87.	Drive gear (6)	Position on drive shaft (5) and, using arbor press and mandrel, press until drive gear reaches shoulder on drive shaft (5).
88.	Drive coupling (7)	<ul style="list-style-type: none"> <li>a. Lubricate drive shaft (5) with extreme-pressure grease.</li> <li>b. Position on drive shaft (5) and, using arbor press and mandrel, press against drive gear (6).</li> </ul>



**FUEL PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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FRONT COVER ASSEMBLY REPAIR - CONTINUED

89.	Tachometer drive housing (1)	Inspect for damage or wear. <b>Discard if damaged or worn.</b>
90.	Assembled tachometer drive shaft and gear (2)	Inspect for wear, scoring, nicks, or broken gear teeth. <b>Tag worn, scored, nicked, and broken parts for replacement.</b>

**NOTE**

Perform steps 91 thru 94 only if tachometer drive shaft, bushing, or gear are to be replaced. If none of these parts are to be replaced, proceed to step 95.

91. Tachometer drive shaft (3)	Tachometer gear (4) and tachometer bushing (5)	a. Using arbor press and mandrel, or ST-1231 gear puller, press or pull tachometer gear from tachometer drive shaft. b. Remove tachometer bushing.
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**NOTE**

Steps 92 and 93 cover inspection for tachometer drive shaft and tachometer bushing. Perform steps 92 and 93 only if these parts have not been tagged for replacement.

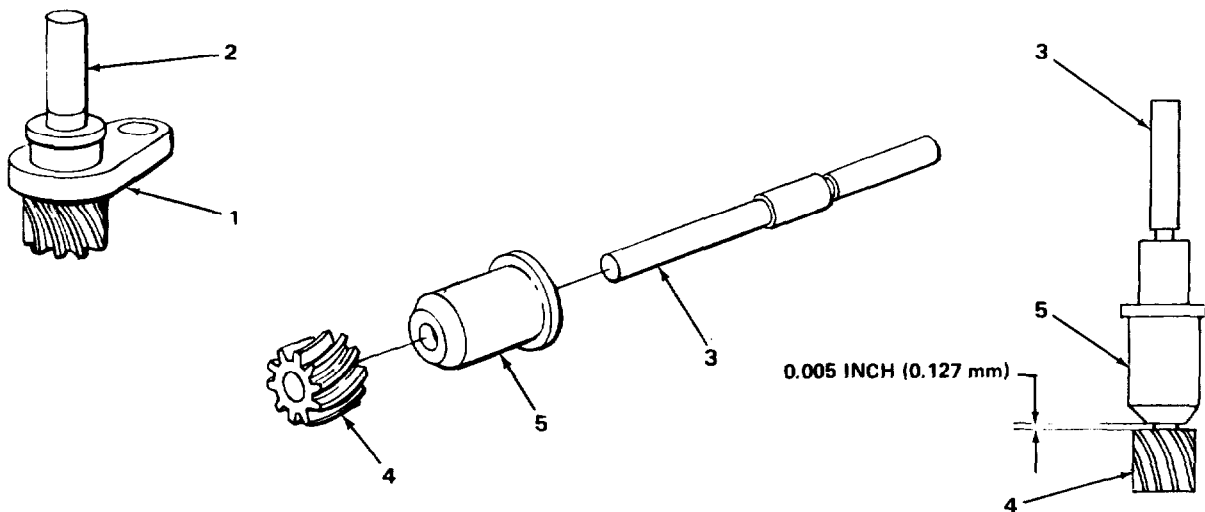
92.	Tachometer drive shaft (3)	Using 0- to 1-inch micrometer, measure tachometer drive shaft in several places. Diameter should be 0.3950 to 0.3955 inch (10.033 to 10.046 mm). <b>Discard if worn smaller than 0.3950 inch (10.033 mm).</b>
93.	Tachometer bushing (5)	Using bore gage, measure inside diameter of tachometer bushing. Inside diameter should be 0.3963 to 0.3970 inch (10.066 to 10.084 mm). <b>Discard if worn larger than 0.3970 inch (10.084 mm).</b>

FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
94. Tachometer drive shaft (3)	Tachometer bushing (5) and tachometer gear (4)	<ul style="list-style-type: none"> <li>a. Lubricate tachometer drive shaft with extreme-pressure grease.</li> <li>b. Install tachometer bushing with chamfered end towards tachometer gear.</li> <li>c. Position tachometer gear on tachometer shaft and, using arbor press and mandrel, press tachometer gear onto tachometer shaft until flush with end of tachometer shaft.</li> <li>d. Check to see that tachometer gear and shaft turn freely in tachometer bushing.</li> <li>e. Using thickness gage, measure clearance between tachometer bushing and tachometer gear. Maximum clearance is 0.005 inch (0.127 mm).</li> </ul>

**NOTE**

Make sure all parts and subassemblies are clean and free of dust and dirt before proceeding with assembly procedures.

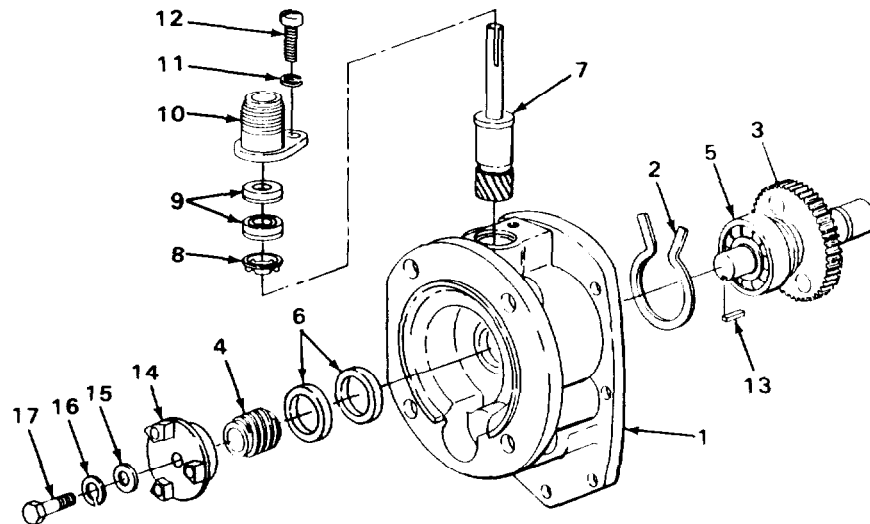


FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
FRONT COVER ASSEMBLY REPAIR - CONTINUED		
95. Front cover (1)	Retaining ring (2) and drive shaft (3)	<ul style="list-style-type: none"> <li>a. Position retaining ring on drive shaft between tachometer drive gear (4) and ball bearing (5).</li> <li>b. Lubricate ST-419 assembly tool with lubricating oil and install over drive shaft.</li> <li>c. Position drive shaft in front cover, alining ball bearing (5) with bore in front cover and, using arbor press, press in until ball bearing (5) is seated in front cover.</li> <li>d. Using 6-inch slip-joint pliers, secure retaining ring in groove in front cover. <b>Look through holes in drive gear to make sure retaining ring is fully seated.</b></li> </ul>
96.	Two new oil seals (6)	<ul style="list-style-type: none"> <li>a. Position one new oil seal on drive shaft (3) with lip towards rear of pump and, using arbor press and seal driving mandrel, press into place.</li> <li>b. Position second new oil seal on drive shaft (3) with lip towards front of pump and using arbor press and seal driving mandrel, press into place.</li> </ul>
97.	Tachometer shaft and gear assembly (7), spacer (8), two new oil seals (9), tachometer drive housing (10), new lockwasher (11), and screw (12)	<ul style="list-style-type: none"> <li>a. Aline oil groove on top of tachometer bushing with fuel pump drive shaft.</li> <li>b. Press tachometer shaft and gear assembly into front cover (1) until bushing bottoms in its bore.</li> <li>c. Position spacer on bushing with slotted edge down.</li> <li>d. Position two new oil seals on top of spacer with spring side down, and cover with a thin coat of lubricating oil.</li> <li>e. Place tachometer drive housing on front cover (1) and using 3/8-inch drive 3/16-inch flat-tip screwdriver bit and ratchet handle, screw in and tighten screw and new lockwasher.</li> </ul>

FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
98.	New coupling key (13), tachometer drive gear (4), drive coupling (14), flat washer (15), new coupling lockwasher (16), and coupling screw (17)	<p>a. Position new coupling key on drive shaft (3).</p> <p>b. Lubricate drive shaft (3) with extreme-pressure grease and, using arbor press and mandrel, press tachometer drive gear and drive coupling into place.  <b>Make sure tachometer drive gear and tachometer gear teeth are aligned.</b></p> <p>c. Position new coupling lockwasher and flat washer on coupling screw. Using 1/2-inch drive 1/2-inch socket and ratchet handle, screw on and tighten.  <b>Hold drive coupling or drive shaft in soft-jawed vise while tightening coupling screw.</b></p>	



**FUEL PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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FRONT COVER ASSEMBLY REPAIR - CONTINUED

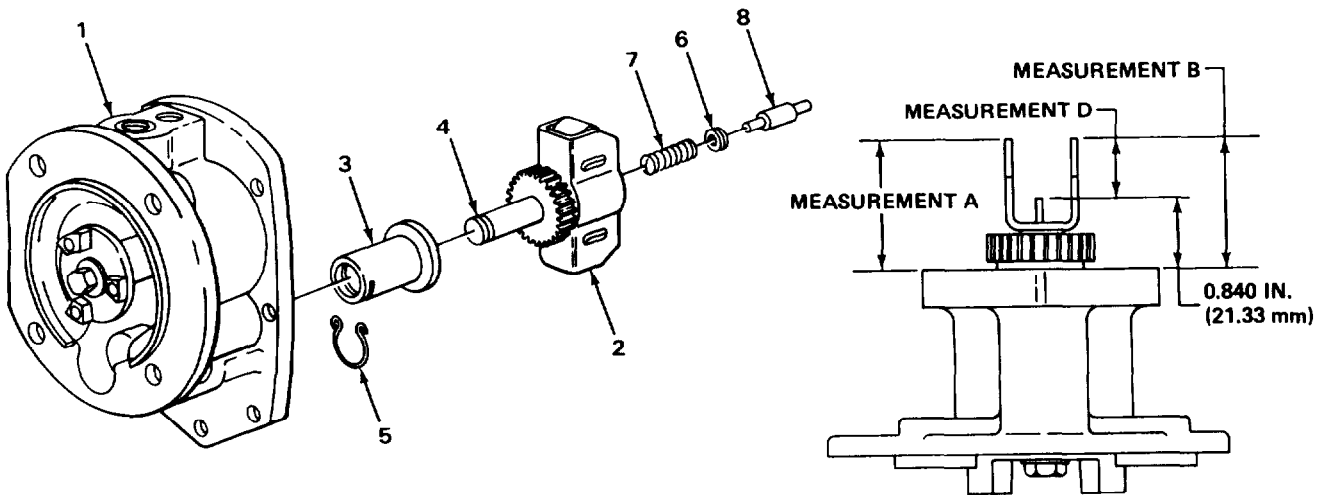
**CAUTION**

Make sure gears mesh when pressing weight carrier assembly into front cover to avoid damage to gear teeth.

99. Front cover (1)	Weight carrier (2), weight carrier shaft bushing (3), weight carrier shaft (4), and retaining ring (5)	<ul style="list-style-type: none"> <li>a. Push retaining ring onto end of weight carrier shaft.</li> <li>b. Lubricate weight carrier shaft bushing with extreme-pressure grease and position in front cover.</li> <li>c. Lubricate weight carrier shaft with lubricating oil and position in weight carrier shaft bushing.</li> <li>d. Using arbor press and mandrel, center mandrel against back of weight carrier between weights, and with gears alined, press weight carrier and weight carrier shaft bushing into front cover until bushing is seated.</li> <li>e. Rotate weight carrier with weights opened out to make sure it will turn completely in housing.</li> </ul>
100. Weight carrier (2)	Weight assist shims (6), weight assist spring (7), and weight assist plunger (8)	<ul style="list-style-type: none"> <li>a. Install items and in order given. <b>Make sure small end of weight assist plunger is closest to weight carrier assembly weights.</b></li> <li>b. Using 0 to 1-inch depth micrometer, place one leg of depth micrometer base across weight carrier walls and measure distance to front cover (1) mating surface. <b>Record as measurement A.</b></li> <li>c. Repeat step 100b for other side of weight carrier. <b>Record as measurement B.</b></li> </ul>

FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
		<p>d. Add measurements A and B and divide by 2.  <b>Record finding C.</b></p> <p>e. Using 0 to 1-inch depth micrometer, center depth micrometer on weight carrier over weight assist plunger and measure distance to end of weight assist plunger.  <b>Do not depress weight assist spring.</b>  <b>Record measurement D.</b></p> <p>f. Subtract measurement D from finding C. The result is the weight assist protrusion. Weight assist protrusion should be 0.840 inch (21.33 mm). If weight assist protrusion is below 0.840 inch (21.33 mm), add weight assist shims (5). If weight assist protrusion is above 0.840 inch (21.33 mm), remove shims (5), or if no shims are used, grind small end of weight assist plunger. Weight assist shims are available in 0.007 inch (0.178 mm) and 0.016 inch (0.406 mm) thicknesses.</p>



**FUEL PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
FUEL PUMP HOUSING REPAIR		
<b>NOTE</b>		
For fuel pump housing disassembly procedures, see steps 1 thru 10.		
101.	Fuel pump housing (1)	Inspect fuel pump housing for scratches, nicks, burrs, and cracks. <b>Discard if cracked. Polish out scratches, nicks, and burrs with emery cloth.</b>
102.	Fuel pump housing (1)	Throttle sleeve (2) Inspect throttle sleeve for wear or damage. <b>Throttle sleeve is a nonreplaceable item. If worn or damaged, replace fuel pump housing, and throttle sleeve.</b>
103.	Drive shaft bushing (3)	a. Inspect drive shaft bushing for damage. <b>Mark for replacement if damaged.</b> b. Using bore gage, measure inside diameter of drive shaft bushing. Inside diameter should be no larger than 0.7525 inch (19.11 mm). <b>If worn to 0.7525 inch (19.11 mm) or larger, mark for replacement.</b>
104.	Spring pack housing (4)	Inspect for any signs of wear or damage. <b>Mark for replacement if worn or damaged.</b>

**NOTE**

Steps 105 to 111 are for drive shaft bushing or governor barrel replacement only. If these parts are not to be replaced, proceed to step 114.

105.	Fuel pump housing (1)	Drive shaft bushing (3)	Using 1/2-inch gouge chisel and 16-ounce ball-peen hammer, remove. <b>Discard.</b>
106.		New drive shaft bushing (3)	Lubricate with extreme-pressure grease and, using arbor press and mandrel, press in until flush with end of drive shaft bushing bore.



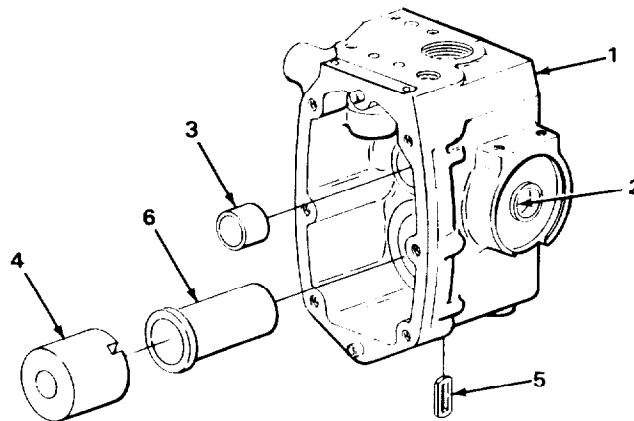
FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
107.	Sleeve bearing (3)	Lubricate 0.750 inch (19.05 mm) reamer with lubricating oil and ream sleeve bearing to 0.7495 to 0.750 inch (19.04 to 19.06 mm).

**WARNING**

Heat-protective cloth mittens must be worn to prevent serious injury to hands when handling heated parts.

108.	Spring pack housing (4) and clip (5)	<ol style="list-style-type: none"> <li>Using lock wire, hook through plug hole in bottom of fuel pump housing (1) and pull out clip.</li> <li>Heat fuel pump housing (1) to 300°F (149 °C) and, using arbor press and mandrel, press out spring pack housing.</li> </ol>
109.	Fuel pump housing (1), spring pack housing (4), and barrel assembly (6)	<ol style="list-style-type: none"> <li>Inspect spring pack housing bore and barrel assembly for scoring or damage. <b>Polish out score marks using emery cloth. If deeply scored or damaged, discard.</b></li> <li>Using bore gage, measure inside diameter of spring pack housing bore.</li> <li>Using 0 to 1-inch micrometer, measure outside diameter of new spring pack housing. <b>Outside diameter of spring pack housing should be 0.002 inch (0.051 mm) larger than spring pack housing bore.</b></li> </ol>



FUEL PUMP - CONTINUED

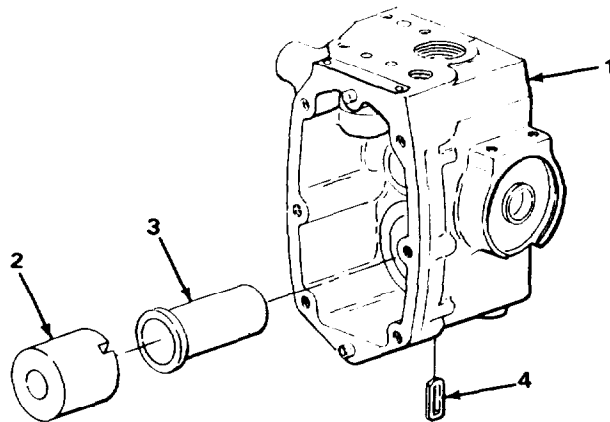
LOCATION	ITEM	ACTION	REMARKS
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FUEL PUMP HOUSING REPAIR - CONTINUED

**WARNING**

Heat-protective cloth mittens must be worn to prevent serious injury to hands when handling heated parts.

110. Fuel pump housing (1)	Spring pack housing (2) and barrel assembly (3)	a. Aline spring pack housing fuel passages with fuel passages in spring pack housing bore and scribe a center line on spring pack housing and spring pack housing bore. b. Heat fuel pump housing using machinist's scribe to 300°F (149°C). Drop in barrel assembly and, using arbor press and mandrel, press in spring pack housing, with scribe marks aligned, until it bottoms against barrel assembly. <b>Make sure clip hole is towards bottom of fuel pump housing.</b>
111.	Clip (4)	Using ST-853 driver, install clip into bottom of spring pack housing (2) with slot towards front of fuel pump housing (1).



**FUEL PUMP - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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GOVERNOR PLUNGER REPAIR

**CAUTION**

Do not remove torque spring by pulling it straight off. This will stretch it beyond its elastic limit so it has to be replaced.

**NOTE**

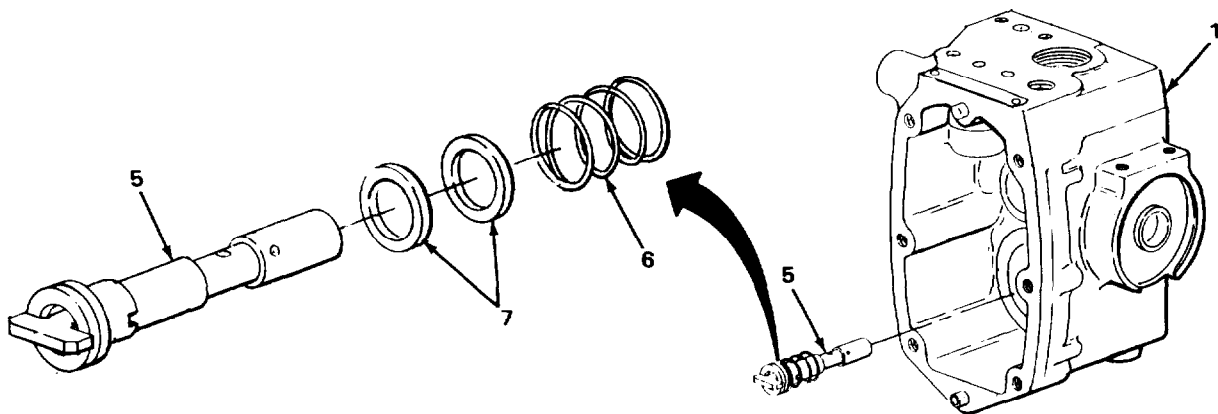
Remove governor plunger from fuel pump housing if not previously removed.

112. Governor plunger assembly (5)	Torque spring (6) and shims (7)	a. Take torque spring off by twisting. b. Take off shims.
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**NOTE**

Step 113 is for determining new governor plunger to be used if spring pack housing has been replaced. If spring pack housing has not been replaced, proceed to step 114.

113. Fuel pump housing (1)	Governor plunger assembly (5)	a. Attempt to fit governor plunger in spring pack housing. b. If governor plunger enters, try the next larger size governor plunger. c. Keep trying larger sizes until one will not enter. d. Select a governor plunger two sizes smaller than the last governor plunger that does fit inside spring pack housing. <b>Do not force a governor plunger into the spring pack housing.</b> e. Mark spring pack housing with size of governor plunger determined to be used.
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**FUEL PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
GOVERNOR PLUNGER REPAIR - CONTINUED		
114. Governor plunger assembly (1)	Thrust washer (2)	Inspect thrust washer for wear or damage. <b>Tag for replacement if worn or damaged.</b>
115.	Governor plunger (3)	Inspect governor plunger for excessive wear or scoring. <b>Tag for replacement if worn or scored.</b>
<b>NOTE</b>		
Steps 116 thru 120 are for governor plunger, thrust washer, driver, and stop sleeve replacement only. Proceed to step 121 only if these parts do not need to be replaced.		
116.	Retainer pin (4), stop sleeve (5), driver (6), and thrust washer (2)	a. Support governor plunger assembly in V-blocks and drive retainer pin from stop sleeve, governor plunger (3), and driver. b. Take out driver and thrust washer. <b>Replace parts as necessary.</b>
117.	Stop sleeve (5)	Using arbor press and mandrel, press stop sleeve from governor plunger (3). <b>Replace parts as necessary.</b>
118. Governor plunger (3)	Stop sleeve (5)	a. Lubricate governor plunger with extreme-pressure grease and position over stop sleeve with retainer pin-holes aligned. b. Using arbor press and mandrel, press in governor plunger until flush with face of stop sleeve.
119.	Thrust washer (2), driver (6), and retainer pin (4)	Place thrust washer and driver in position and, with governor plunger supported on V-blocks, drive in retainer pin. <b>Chamfered side of thrust washer must be next to driver.</b>

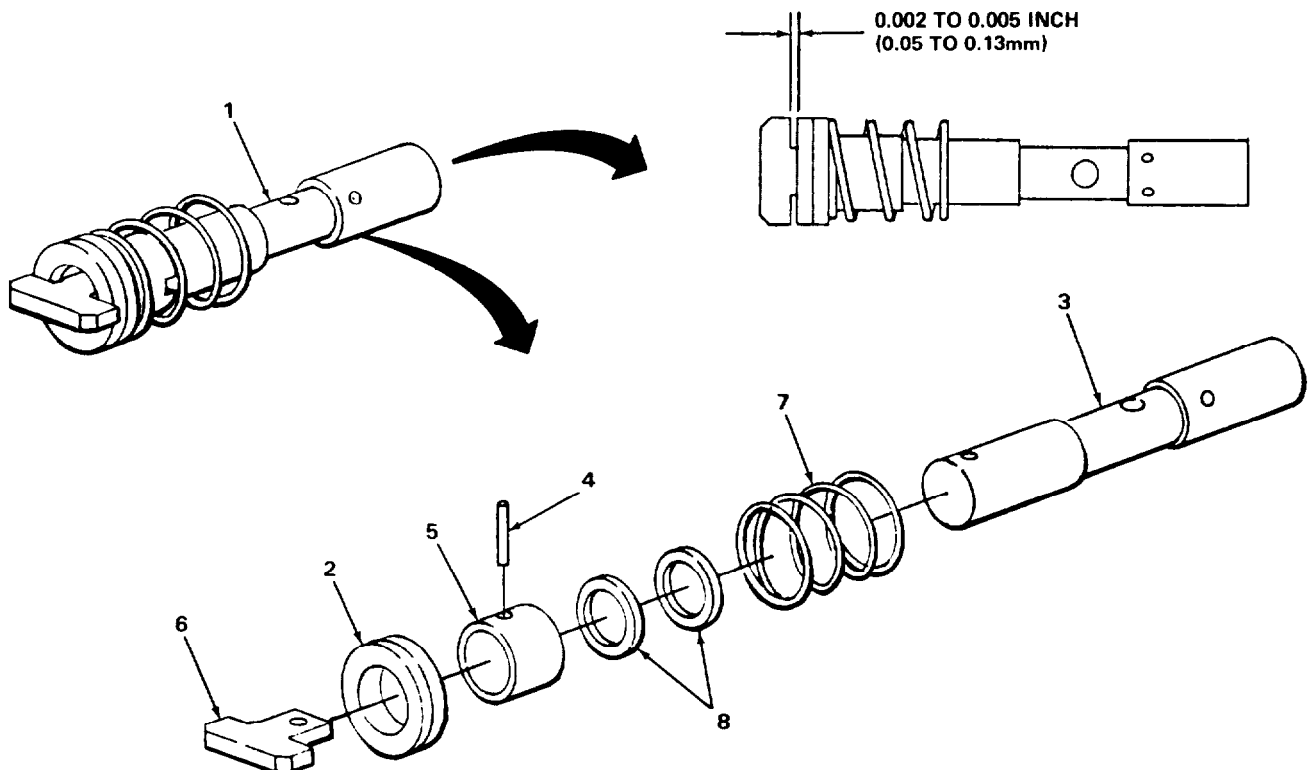
FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

When installing shims, number of shims may vary to obtain proper clearance.

120. Governor plunger assembly (1)	Torque spring (7) and shims (8)	a. Install shims as required. b. Install torque spring with small end towards shoulder end of plunger by twisting.	<b>Replacement torque spring is color coded red-blue.</b>
121.	Driver (6) and thrust washer (2)	Using thickness gage, check clearance between driver tang and thrust washer. Clearance must be 0.002 to 0.005 inch (0.05 to 0.13 mm).	<b>If clearance does not meet these dimensions, repair as necessary.</b>



**FUEL PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
GOVERNOR SPRING PACK REPAIR		
122. Governor barrel assembly (1)	Retaining ring (2)	Using snapping pliers, take off.
123.	Spring retainer (3), shims (4), and high-speed spring (5)	a. Take out. b. Inspect for wear or damage. <b>Replace parts as necessary.</b>
124.	Idle spring plunger guide assembly (6)	Take out.
125. Idle spring plunger guide (7)	Adjusting screw (8), flat washer (9), idle spring (10), idle spring plunger (11), and adapter (12)	a. Take out. b. Inspect all parts for wear damage. <b>Replace parts as necessary.</b>
126.	Adjusting screw (8), flat washer (9), idle spring (10), idle spring plunger (11), and adapter (12)	a. Screw in adjusting screw and place flat washer over screw point inside idle spring plunger guide. b. Place idle spring inside, and install idle spring plunger over idle spring. c. Install adapter.
127. Governor barrel assembly (1)	Idle spring plunger guide assembly (6)	Install.
128.	High-speed spring (5), shims (4), spring retainer (3), and retaining ring (2)	a. Install high-speed spring and shims as required. <b>The final number of shims will be determined during fuel pump calibration.</b> b. Install spring retainer.

**WARNING**

Safety goggles must be worn to prevent possible eye injury when compressing barrel assembly spring.

- c. Compress governor barrel assembly spring in governor barrel assembly housing (1) and, using snapping pliers, install retaining ring.



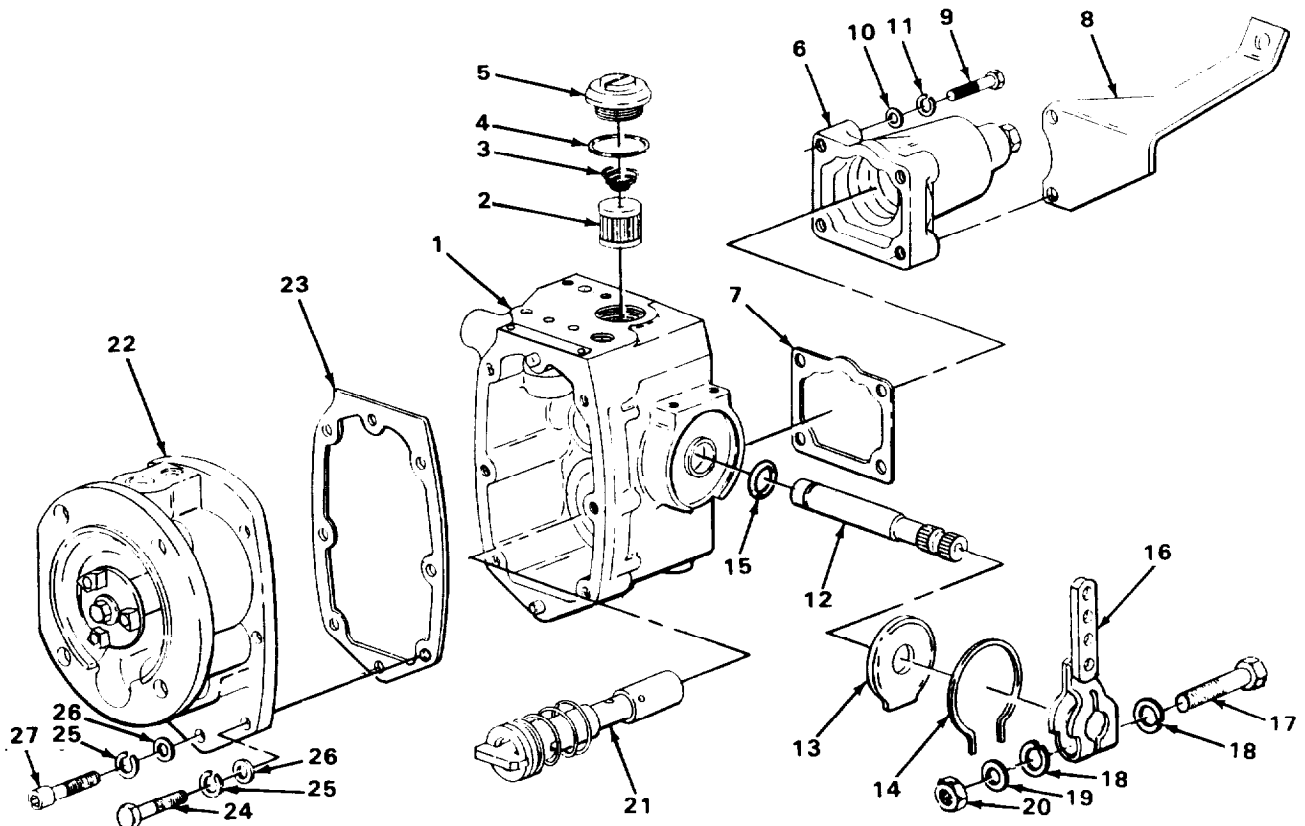
FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
FUEL PUMP ASSEMBLY		
134. Fuel pump housing (1)	Filter screen (2), spring (3), cap seal (4) and filter screen cover (5)	<ul style="list-style-type: none"> <li>a. Install filter screen and spring.</li> <li>b. Install cap seal on filter screen cover.</li> <li>c. Screw in filter screen cover and, using 3/8-inch flat-tip screwdriver, tighten.</li> </ul>
135.	Governor barrel assembly cover (6)	<ul style="list-style-type: none"> <li>a. Remove all traces of old gasket material.</li> <li>b. Inspect for cracks or damage. <b>Discard if cracked or damaged.</b></li> </ul>
136.	New cover gasket (7), governor barrel assembly cover (6), bracket (8), four screws (9), four flat washers (10), and four new lock-washers (11)	<ul style="list-style-type: none"> <li>a. Install new cover gasket, governor barrel assembly cover and bracket.</li> <li>b. Install screws, lockwashers, and flat washers.</li> <li>c. Using 3/8-inch drive 7/16-inch socket and 0 to 150 In. lb (0 to 16.9 N•m) torque wrench, tighten to 108 to 132 in. lb (1.02 to 1.24 N•m).</li> </ul>
137.	Throttle shaft assembly (12), throttle shaft cover (13), retaining ring (14), and preformed packing (15)	<ul style="list-style-type: none"> <li>a. Install preformed packing and insert throttle shaft assembly into fuel pump housing (1) with fuel port facing down and throttle stop slanted down.</li> <li>b. Install throttle shaft cover.</li> <li>c. Using 6-inch slip-joint pliers, install retaining ring.</li> </ul>
138.	Throttle lever (16), throttle lever screw (17), two new lock-washers (18), flat washer (19), and nut (20)	<ul style="list-style-type: none"> <li>a. Install throttle lever on throttle shaft assembly (11) making sure serrations are aligned and idle position of throttle lever is near vertical.</li> <li>b. Assemble throttle lever screw, flat washer, lockwashers to throttle lever and, using two 7/16-inch open-end wrenches, screw on and tighten nut.</li> </ul>
139.	Governor plunger assembly (21)	Lubricate with lubricating oil and install in spring pack housing.



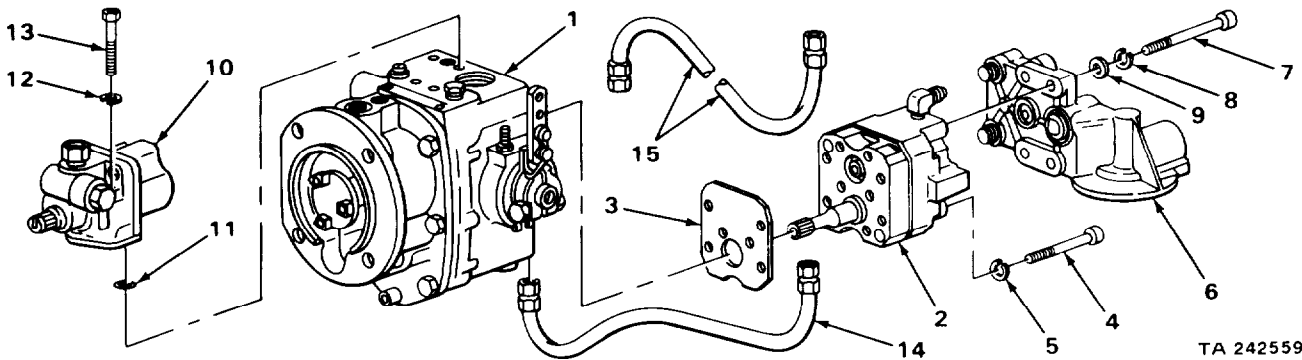
FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
140. Fuel pump housing (1)	Cover (22), new gasket (23), six screws (24) seven new lockwashers (25) seven flat washers (26), and screw (27)	<p>a. Position new gasket on fuel pump housing alining holes with dowels.</p> <p>b. Position governor plunger driver and weight carrier assembly horizontally.</p> <p>c. Hold governor weight carrier assembly weights in and ready to straddle governor plunger drive, while assembling cover to fuel pump housing.  <b>Make sure tachometer drive gears mesh properly.</b></p> <p>d. Install six new lockwashers, six flat washers, and six screws to fuel pump housing through cover.</p> <p>e. Using 7/16-inch box-end wrench, tighten.</p> <p>f. Install screw (27) new lockwasher, and flat washer to fuel pump housing through cover.</p> <p>g. Using 5/32-inch hex key, screw in and tighten.</p>



FUEL PUMP - CONTINUED

LOCATION	ITEM	ACTION REMARKS
FUEL PUMP ASSEMBLY - CONTINUED		
141.	Fuel pump assembly (1)	Turn drive coupling to be sure tachometer drive gear is in mesh.
142. Fuel pump assembly (1)	Gear pump (2), new gear pump gasket (3), four screws (4), and four new lockwashers (5)	<ol style="list-style-type: none"> <li>Check new gear pump gasket against gear pump to be sure all fuel pump holes are on new gear pump gasket.</li> <li>Position new gear pump gasket on fuel pump assembly.</li> <li>Install gear pump, four screws and four new lockwashers to fuel pump housing.</li> <li>Using 1/2-inch drive 3/16-inch hex-head socket and 0 to 150 ft lb (0 to 210 N•m) torque wrench, tighten in increments to 11 to 13 ft lb (15 to 18 N•m).</li> <li>Turn drive coupling to make sure gear pump turns freely.</li> </ol>
143.	Pulsation damper (6), four screws (7), four new lockwashers (8), and four flat washers (9)	<ol style="list-style-type: none"> <li>Check to make sure seal and O-ring are in pulsation damper body and position pulsation damper on gear pump.</li> <li>Install four new lockwashers, four flat washers, and four screws.</li> <li>Using 3/8-inch drive 3/16-inch hex-head socket and 0 to 150 in. lb (0 to 16.9 N•m) torque wrench, tighten to 132 to 156 in. lb (1.24 to 1.47 N•m).</li> </ol>
144.	Shutdown valve (10), new gasket (11), two new lockwashers (12), and two screws (13)	<ol style="list-style-type: none"> <li>Position gasket and shutdown valve on fuel pump assembly.</li> <li>Install two new lockwashers and two screws.</li> <li>Using 3/16-inch hex key, screw in and tighten.</li> </ol>
145.	Aneroid control feed line (14) and return (15)	Using 5/8-inch open-end wrench, screw on and tighten.



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**FUEL PUMP - CONTINUED****NOTE**

FOLLOW-ON MAINTENANCE: Calibrate fuel pump (page 2-333).

**TASK ENDS HERE****FUEL PUMP CALIBRATION**

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This task covers:

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>a. Cleaning (page 2-334)</li> <li>b. Mounting Pump to Test Stand (page 2-334)</li> <li>c. Fuel Pump Run-In (page 2-338)</li> <li>d. Pump Seal Testing (page 2-340)</li> <li>e. Governor Cutoff RPM Testing (page 2-340)</li> <li>f. Throttle Testing and Adjusting (page 2-342)</li> <li>g. Idle Speed Testing and Adjusting (page 2-344)</li> </ul> | <ul style="list-style-type: none"> <li>h. Throttle Lever Travel Checking and Adjusting (page 2-345)</li> <li>i. Pump Main Pressure Testing and Adjusting (page 2-346)</li> <li>j. Fuel Pressure Testing and Adjusting (page 2-346)</li> <li>k. Governor Fuel Pressure Testing and Adjusting (page 2-347)</li> <li>l. Governor Weight Setting Checking and Adjusting (page 2-348)</li> <li>m. Removing Pump from Test Stand (page 2-349)</li> </ul> |
|---|--|
- 

**INITIAL SETUP****Tools**

Adapter, fuel filter  
 Adjusting tool, spring pack, ST-984  
 Bit, drill, 1/4-inch  
 Drill, portable, electric, 3/8-inch  
 Protractor  
 Punch, center  
 Screwdriver, flat-tip, 1/8-inch  
 Straightedge  
 Template, travel  
 Tester, fuel injection (Test Stand, ST-848, ST-775 or ST-445)  
 Wrench, box-end, 9/16-inch  
 Wrench, box-end, 7/16-inch

**Materials/Parts**

Gasket, pump  
 Grease, extreme-pressure (Item 10, appendix B)  
 Oil, fuel (item 11, appendix B)  
 Test oil, injector (item 20, appendix B)

**Equipment Condition**

Fuel pump removed (page 2-41).

**FUEL PUMP CALIBRATION - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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CLEANING

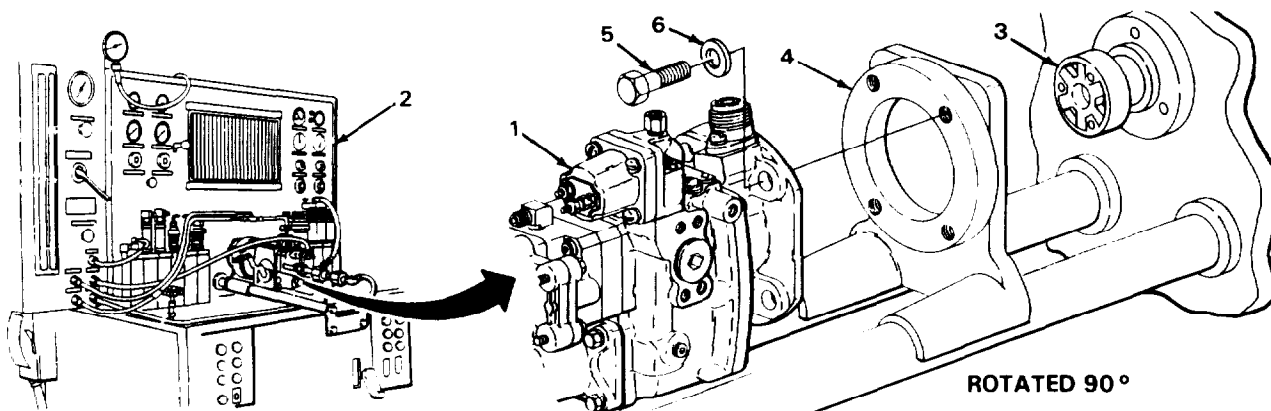
**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

- |    |               |                                    |
|----|---------------|------------------------------------|
| 1. | Fuel pump (1) | Clean exterior surface thoroughly. |
|----|---------------|------------------------------------|

MOUNTING PUMP TO TEST STAND

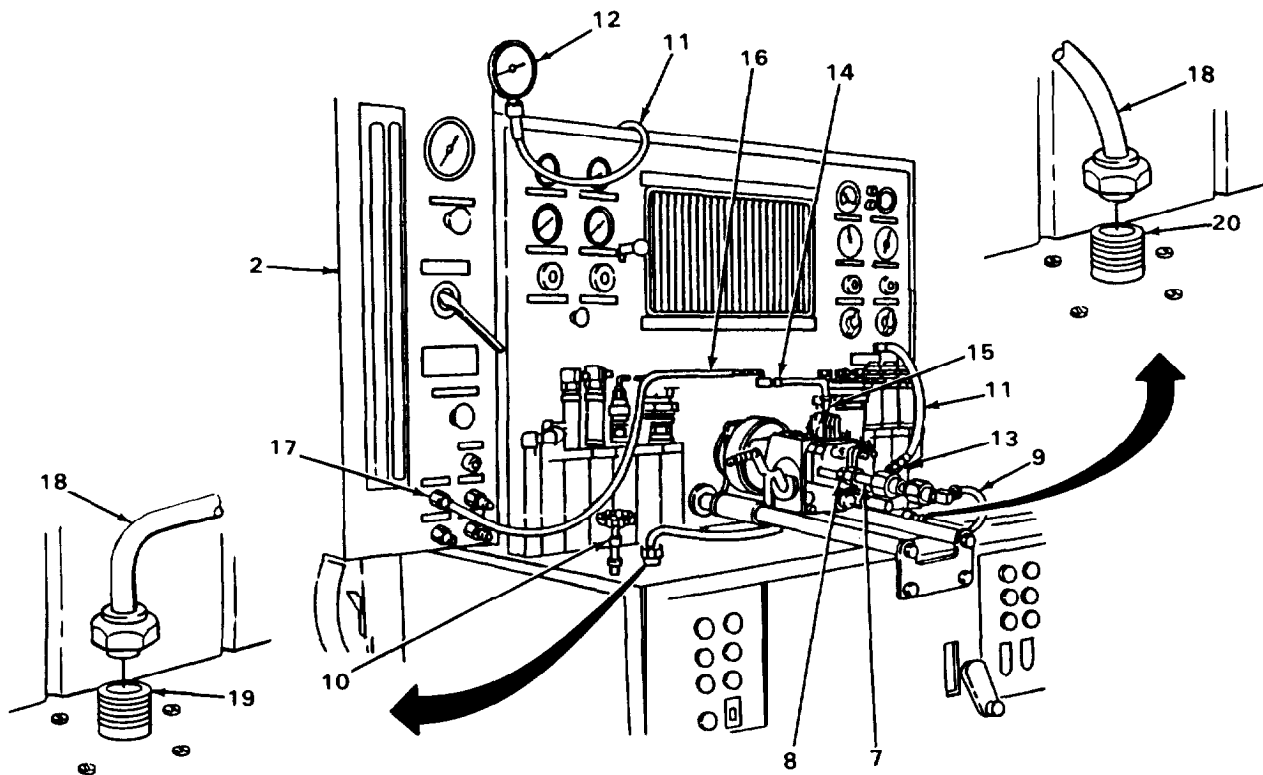
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|----|--|--|--|
| 2. | Test stand (2)   | Drive coupling (3) and test stand adapter plate (4)  | Install proper drive coupling and adapter plate to test stand as required. |
| 3. | Fuel pump (1), four screws (5) and four flat washers (6) | Position fuel pump to adapter plate (4) leaving 1/16 inch (1.5875 mm) between fuel pump drive coupling and test stand drive coupling (3), and secure with four screws and four flat washers. |  |



- |    |                                      |  |
|----|--------------------------------------|--|
| 4. | Pump inlet adapter assembly (7)      | Install in pump inlet port (8).  |
| 5. | 1/2-inch (12.7 mm) flexible hose (9) | Connect from stand suction control valve (10) to adapter elbow on pump inlet adapter assembly (7). |

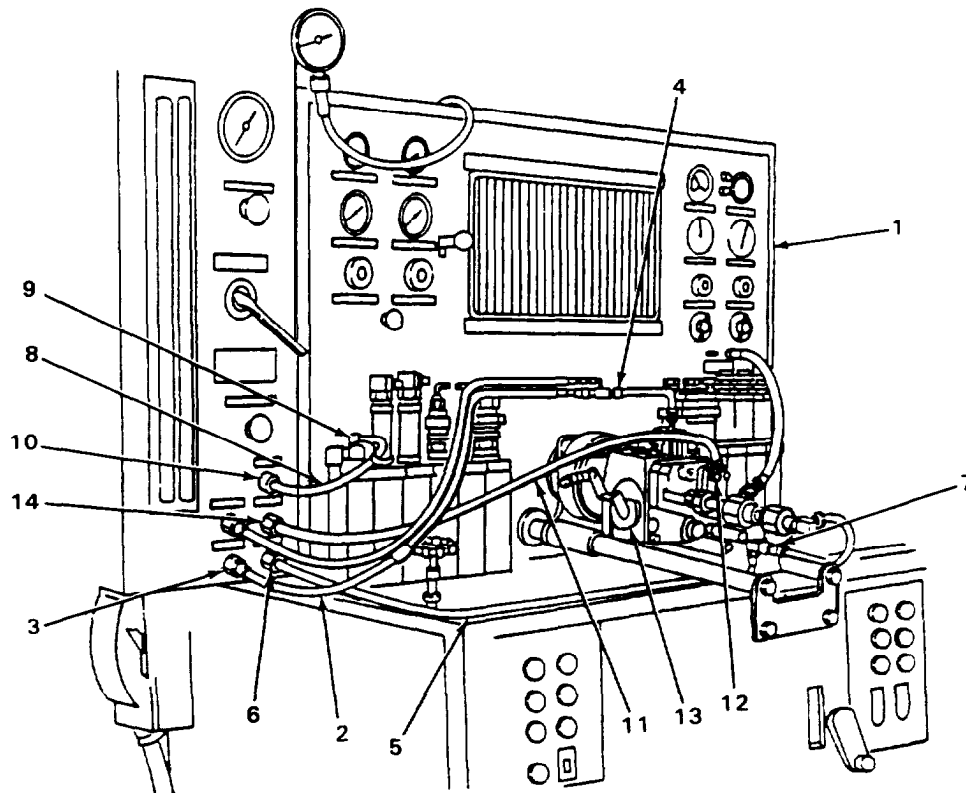
FUEL PUMP CALIBRATION - CONTINUED

LOCATION	ITEM	ACTION REMARKS
6. Test stand (2)	1/4-inch (6.35 mm) clear manifold hose (11)	Connect from no. 2 manifold vacuum gage (12) to 1/4-inch (6.35 mm) adapter (13) on pump inlet adapter assembly (7).
7.	Pump discharge fitting assembly (14)	Install in pump fuel shutoff solenoid valve (15).
8.	Fuel pressure hose (16)	Install from test stand pressure gage outlet (17) to pump discharge fitting assembly (14).
9.	1/4-inch (6.35 mm) flexible hose (18)	Install 1/4-inch (6.35 mm) flexible hose (18) from test stand lube pressure connector (19) to test stand lube return connector (20).



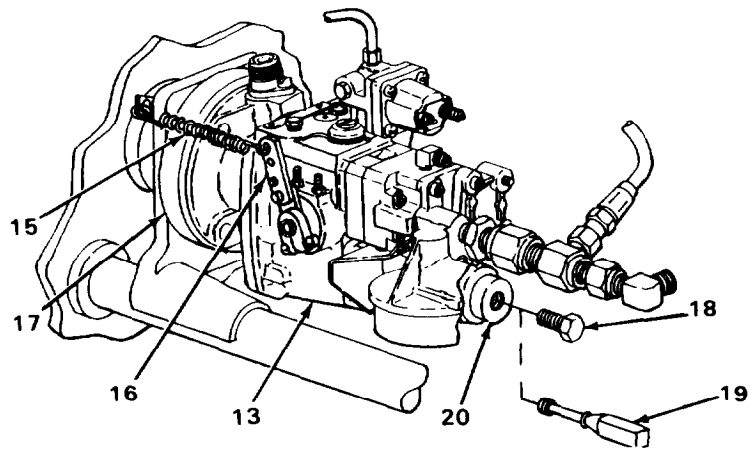
**FUEL PUMP CALIBRATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
MOUNTING PUMP TO TEST STAND - CONTINUED		
10. Test stand (1)	Fuel input hose (2)	Install from test stand fuel input connector (3) to input discharge fitting (4).
11.	Fuel suction hose (5)	Install from test stand fuel outlet connector (6) to test stand fuel return connector (7).
12.	Leakage accumulator hose (8)	Install to no. 1 accumulator cam (9) from test stand leak test connector (10).
13.	1/4-inch (6.35 mm) flexible hose (11)	Connect from small fitting (12) on fuel pump (13) to auxiliary return connector (14).



FUEL PUMP CALIBRATION - CONTINUED

LOCATION	ITEM	ACTION REMARKS
14. Fuel pump (13)	Throttle lever position holding spring (15)	Install from top of throttle shaft lever (16) to ring adapter assembly (17). <b>Spring will hold throttle lever to full fuel position.</b>
15.	Governor barrel assembly cover plug (18) and spring pack adjusting tool (19)	a. Remove governor barrel assembly cover plug. b. Install ST-984 spring pack adjusting tool into barrel assembly housing (20).



**FUEL PUMP CALIBRATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
<b>FUEL PUMP RUN-IN</b>		
16. Test stand (1)	Bypass valve (2), suction valve (3) and flow control valve (4)	Place in OPEN position.
<b><u>WARNING</u></b>		
Fuel is flammable and can explode. To avoid serious injury or death, keep fuel away from open fire and keep extinguisher within easy reach when working with fuel. Smoking is prohibited while working with fuel.		
<b><u>CAUTION</u></b>		
Make sure fuel pump screen is clean and fuel filter is installed with hole in filter facing down. Foreign material in pump, or filter installed upside down, will cause fuel pump damage.		
Test stand motor switch is marked REVERSE and FORWARD. For all fuel tests for this fuel pump, the test stand switch must be set to the REVERSE position.		
<b>NOTE</b>		
Seat all other test stand valves by opening one-quarter turn and reclosing, to make sure they are in the closed position, to prevent leakage.		
17. Fuel pump (5)	Fuel filter adapter (8) and gasket (7)	Mount fuel filter adapter and gasket.
18.	Plug (8)	Using 9/16-inch box end wrench, remove plug and fill fuel pump (5) with test oil or fuel oil, and reinstall plug.
19.	Fuel shutoff valve manual override knob (9)	Open by turning fully clockwise.
20. Test stand (1)	Power switch (10)	Place in ON position.
21.	Fuel heat switch (11)	Place in ON position. <b>Observe that fuel temperature gage reads 90° to 100oF (32° to 38°C) for test oil or diesel fuel.</b>
22.	Selector valve (12)	Place in ROTAMETER position.
23.	Range crank (13)	Turn to HIGH range position.



**FUEL PUMP CALIBRATION - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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**WARNING**

Fuel is flammable and can explode. To avoid serious injury or death, keep fuel away from open fire and keep extinguisher within easy reach when working with fuel. Smoking is prohibited while working with fuel.

**CAUTION**

Do not hold throttle in idle position any longer than necessary to complete test. Pump may overheat, since fuel flow is used to cool the pump.

**NOTE**

Pump must pick up fuel at 500 rpm without priming. If no fluid pickup is indicated at rotameter, check fuel filter for improper installation and motor switch for correct rotation, Make sure open suction valve, hose, and gear pump connections are tight.

Check rotameter for air in fuel flow. If air bubbles are present, work pump throttle lever from fuel full open to idle several times, to relieve trapped air in pump.

If air bubbling persists, it is an indication of an air leak in the system. Turn test stand off and check the line for loose connections between tank and pump, mating of gear pump housing, and full fuel supply tank.

If pump is new or has been disassembled or reassembled, run pump slightly over rated speed for 5 minutes to allow bearings and seals to seat, and to purge air from system.

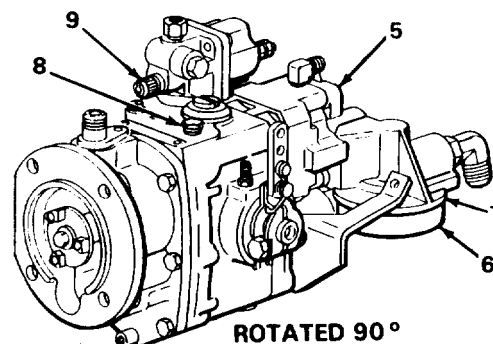
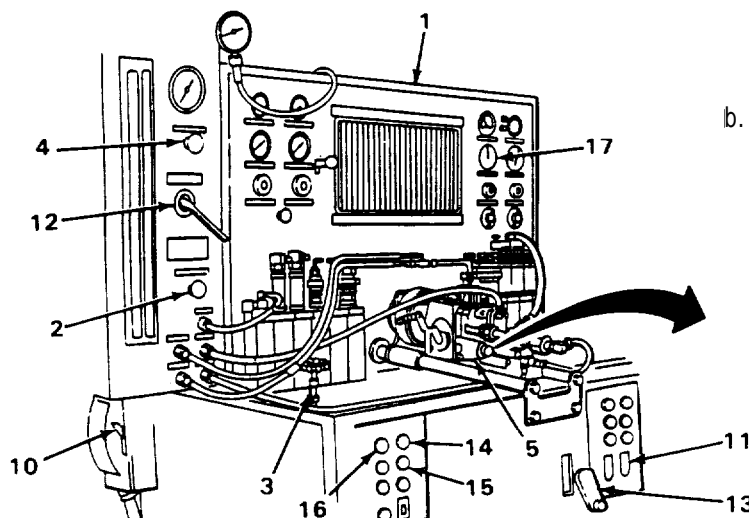
24. Test stand (1)

Speed control buttons (14 and 15)

a. Start test stand by depressing start button (18) until 2130 to 2150 rpm is indicated on test stand tachometer (17).

**Depress and release FAST (14) or SLOW (15) button to maintain 2130 to 2150 rpm.**

b. At end of 5-minute period, reduce fuel pump speed to 500 rpm.



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**FUEL PUMP CALIBRATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
PUMP SEAL TESTING		
25. Test stand (1)	Fuel pump (2)	<p>Check oil seals for leaks as follows:</p> <ul style="list-style-type: none"> <li>a. With test stand operating at 500 rpm, close suction valve (3).</li> <li>b. Place fuel flow control valve (4) to OPEN position. <b>If 25-inch (83.5 mm) vacuum is not obtained, check all test stand hose connections.</b></li> <li>c. Place bypass valve (5) in closed position.</li> <li>d. Place a small amount of extreme-pressure grease over the vent of weep hole (8).</li> <li>e. If extreme-pressure grease is pulled into weep hole (8) at 25-inch (83.5 mm) vacuum, the seal is defective. <b>To replace seal, see Fuel Pump, page 2-289.</b></li> </ul>

**CAUTION**

Do not hold throttle lever in idle position any longer than necessary to complete test. Pump may overheat, since fuel flow is used to cool the pump.

28.	Fuel pump tachometer drive seal (7)	<p>Check as follows:</p> <ul style="list-style-type: none"> <li>a. With test stand (1) operating at 500 rpm, remove tachometer drive cap (8). <b>Depress and release FAST (9) or SLOW (10) button to maintain 500 rpm.</b></li> <li>b. Fill tachometer seal bore with test oil or diesel fuel from test stand (1).</li> <li>c. If fuel is drawn into pump at 25-inch (83.5 mm) vacuum setting, the seal is defective. <b>To replace seal, see Fuel Pump, page 2-289.</b></li> </ul>
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GOVERNOR CUTOFF RPM TESTING

**NOTE**

Test stand must be shut off to change shims in spring pack.

When pump is opened to make adjustments, it must be purged of air before retest. With fuel pump at 2100 rpm, move throttle back and forth until the rotameter shows no air.

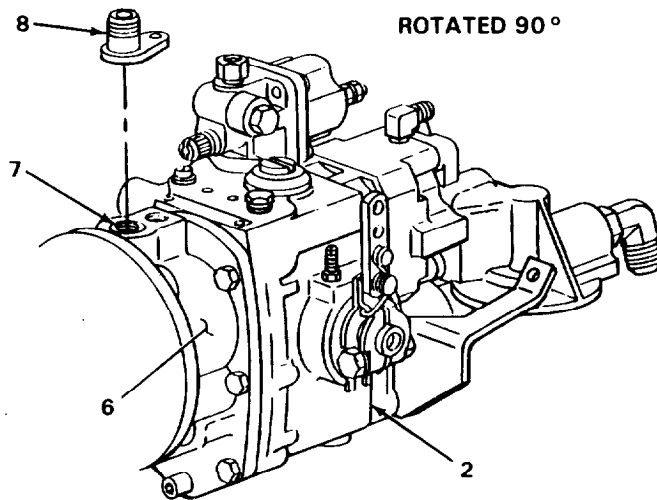
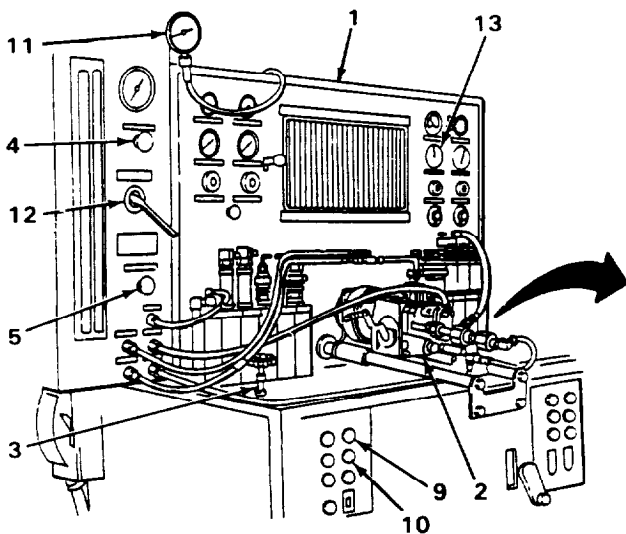
FUEL PUMP CALIBRATION - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

Once 8-inch HG vacuum setting is obtained, do not change setting. Readings will fluctuate during other tests. Note the increases or decreases as they occur.

- |     |               |  |
|-----|---------------|--|
| 27. | Fuel pump (2) | Test governor cutoff rpm as follows: <ol style="list-style-type: none"> <li>a. Open fuel flow control valve (4) completely.</li> <li>b. Increase pump speed to 2000 rpm.<br/><b>Depress and release FAST (9) or SLOW (10) button to obtain 2000 rpm.</b></li> <li>c. Adjust fuel flow control valve (4) to obtain 8-inch (20.32 mm) HG vacuum on no. 2 vacuum gage (11).</li> <li>d. Increase pump speed to 2100 rpm.</li> <li>e. Open the fuel flow control valve (4) and place the selector valve (12) in ROTAMETER position.</li> <li>f. Increase pump speed until the fuel pressure drops. Test stand tachometer (13) reading should be 2130 to 2150 rpm.</li> </ol> |
|-----|---------------|--|



**FUEL PUMP CALIBRATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
<b>GOVERNOR CUTOFF RPM TESTING - CONTINUED</b>		
27. Continued	Fuel pump (1)	g. If cutoff rpm is too low, remove barrel assembly cover (2) and add shims. If cutoff rpm is too high, remove shims. (See Fuel Pump, page 2-289.) <b>Each 0.001 in. (0.025 mm) shim thickness will change speed approximately two rpm. Shims are available in 0.005-, 0.007-, 0.010-, and 0.020-inch (0.13, 0.18, 0.25, and 0.51 mm) thickness.</b>

**CAUTION**

Do not hold throttle lever in idle position any longer than necessary to complete test. Pump may overheat, since fuel flow is used to cool the pump.

- h. Air must be purged from fuel pump. With fuel pump at 500 rpm, move throttle lever (3) back and forth until rotameter shows no air, and recheck governor cutoff rpm.

**THROTTLE TESTING AND ADJUSTING**

**CAUTION**

Do not hold throttle lever in idle position any longer than necessary to complete test. Pump may overheat, since fuel flow is used to cool the pump.

**NOTE**

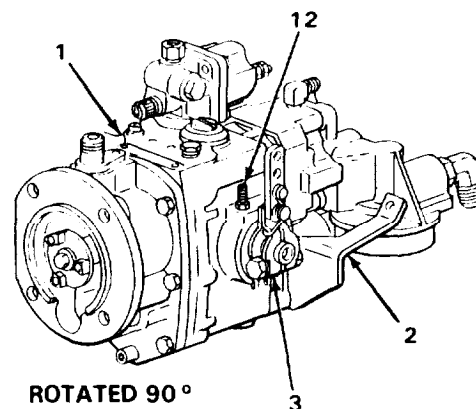
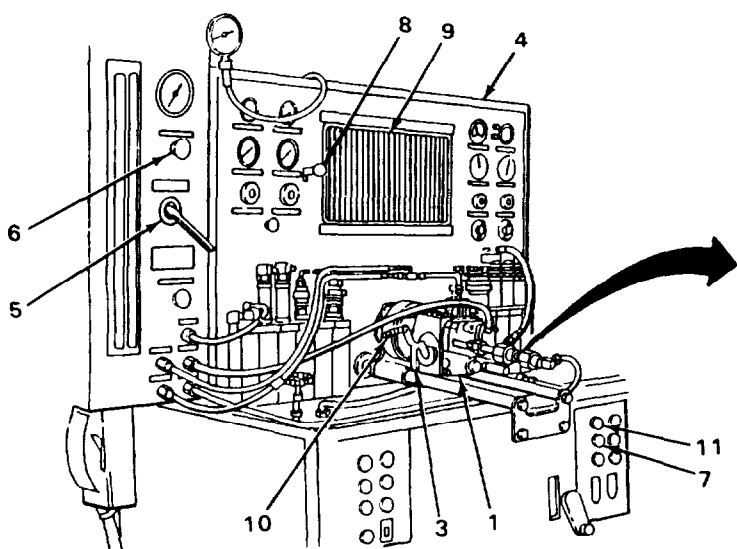
This setting controls fuel leakage inside fuel pump, to control deceleration time, and keeps fuel in all lines during closed throttle position, preventing air locks.

A test cycle is one-half minute duration.

28. Test stand (4)	Fuel pump (1) and throttle lever (3)	Test and adjust throttle leakage as follows: <ul style="list-style-type: none"> <li>a. Increase fuel pump speed to 2100 rpm.</li> <li>b. Place selector valve (5) to ROTAMETER position.  <b>This is to see if any air is in system.</b></li> <li>c. Set fuel flow control valve (8) for 315 lb/hr reading.  <b>At 2100 rpm, fuel flow should be 315 lb/hr.</b></li> </ul>
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FUEL PUMP CALIBRATION - CONTINUED

LOCATION	ITEM	ACTION REMARKS
		<ul style="list-style-type: none"> <li>d. Place selector valve (5) to LEAKAGE TEST position.</li> <li>e. Place COUNT SELECTOR SWITCH (7) to the 100 position.</li> <li>f. Pull out dumping lever (8) to retain fuel in no. 1 burette (9).</li> <li>g. Remove throttle spring (10) and manually position throttle lever (3) to idle position.</li> <li>h. Push dumping lever (8) inward. <b>Burette must be cleared of fuel to prevent overflow at this time.</b></li> <li>i. Depress pulse counter button (11) to fill no. 1 burette (9).</li> <li>j. At the end of a cycle, read the amount of fuel in no. 1 burette (9) on the scale. <b>For one-half minute cycle, fuel delivery is 37 cc.</b></li> <li>k. If throttle leakage is not as specified, using 7/16-inch box-end wrench and 1/8-inch flat-tip screwdriver, adjust front throttle screw (12) in or out until cc delivery comes to specifications.</li> <li>l. Check leakage with light and heavy throttle lever (3) load. If leakage is decreased by additional pressure on throttle lever in closed position, set leakage under these conditions.</li> </ul>



FUEL PUMP CALIBRATION - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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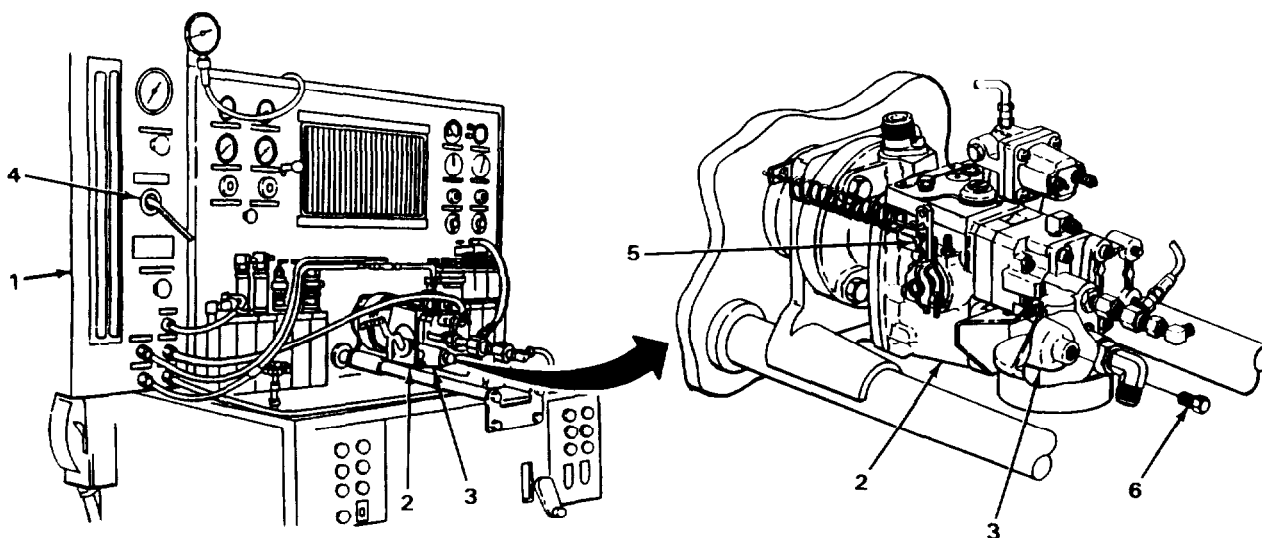
IDLE SPEED TESTING AND ADJUSTING

**NOTE**

If pressure is low and the adjusting screw bottoms, stop the test stand, add shims to the spring end of the adjusting screw (see Fuel Pump, page 2-289) and retest cutoff rpm and throttle leakage, steps 27 and 28.

Each time governor barrel assembly cover or spring pack adjusting tool is removed, run pump until purged of air.

- |                    |  |   |
|--------------------|--|---|
| 29. Test stand (1) | Fuel pump (2)<br>governor barrel<br>assembly cover (3) | Test and adjust idle speed as follows:<br>a. Place selector valve (4) in IDLE position.<br>b. Increase fuel pump speed to 500 rpm.<br>c. Pull throttle lever (5) to idle position.<br><b>Fuel pressure gage should read 28 psi (179.27 kPa).</b><br>d. If fuel pressure is not 28 psi (179.27 kPa), adjust idle screw using ST-984 barrel assembly adjusting tool.<br>e. After proper adjustment is made, stop test stand (1) and remove ST-984 barrel assembly adjusting tool.<br>f. Install barrel assembly cover plug (8).<br>g. Purge fuel pump of air (see step 24). |
|--------------------|--|---|



**FUEL PUMP CALIBRATION - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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**THROTTLE LEVER TRAVEL CHECKING AND ADJUSTING**

**NOTE**

Do not adjust front throttle screw from valve set under throttle leakage. The front throttle screw has already been set to provide the proper deceleration time for the engine. Any changes at this point will require recalibration of throttle leakage.

Travel template no. 3375355 or protractor will be used to set fuel pump throttle lever travel adjustment. Make sure the combination of the first and third or second and fourth holes on the template are used. Any other combination will result in an inaccurate reading. Correct travel is 27 to 29 degrees.

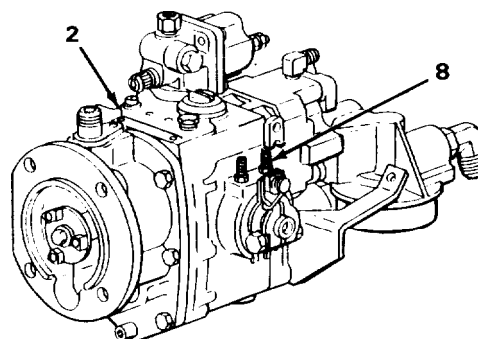
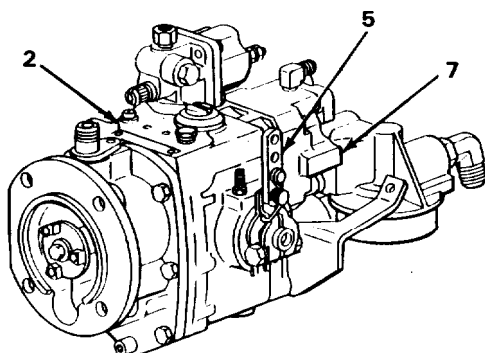
The throttle lever may be repositioned on throttle shaft as required, to line up throttle lever and template holes.

30. Fuel pump (2)

Throttle lever (5)

Check and adjust throttle travel as follows:

- a. Place travel template no. 3375355 (7) against fuel pump housing as shown.
- b. Move throttle lever to idle position.
- c. Line up travel template no. 3375355 (7) idle hole with center of throttle lever.  
**Use straightedge to align.**
- d. Move throttle lever to full throttle position.
- e. Aline travel template no. 3375355 (7) MAX holes with hole in throttle lever.
- f. If throttle lever travel is incorrect, using 7/16-inch box-end wrench and 1/8-inch flat-tip screwdriver, adjust rear throttle stop screw (8) to obtain 27- to 29-degrees travel.



**FUEL PUMP CALIBRATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
PUMP MAIN PRESSURE TESTING AND ADJUSTING		
31.	Test stand (1)	Test and adjust pump main pressure as follows: <ol style="list-style-type: none"> <li>a. With vacuum set at 8 inch (203.2 mm) HG on no. 2 vacuum gage (2) and throttle lever (3) wide open, adjust speed to 2100 rpm.</li> <li>b. Place selector valve (4) to ROTAMETER position.</li> <li>c. Set fuel flow to 315 pph with fuel flow control valve (5). <b>Fuel pressure should be 172 to 178 psi (1188 to 1227 kPa).</b></li> <li>d. If 172 to 178 psi (1186 to 1227 kPa) fuel pressure does not read on pressure gage (6) adjust pressure.</li> </ol>

FUEL PRESSURE TESTING AND ADJUSTING

**CAUTION**

Be careful not to damage bore of throttle shaft when drilling out ball.

**NOTE**

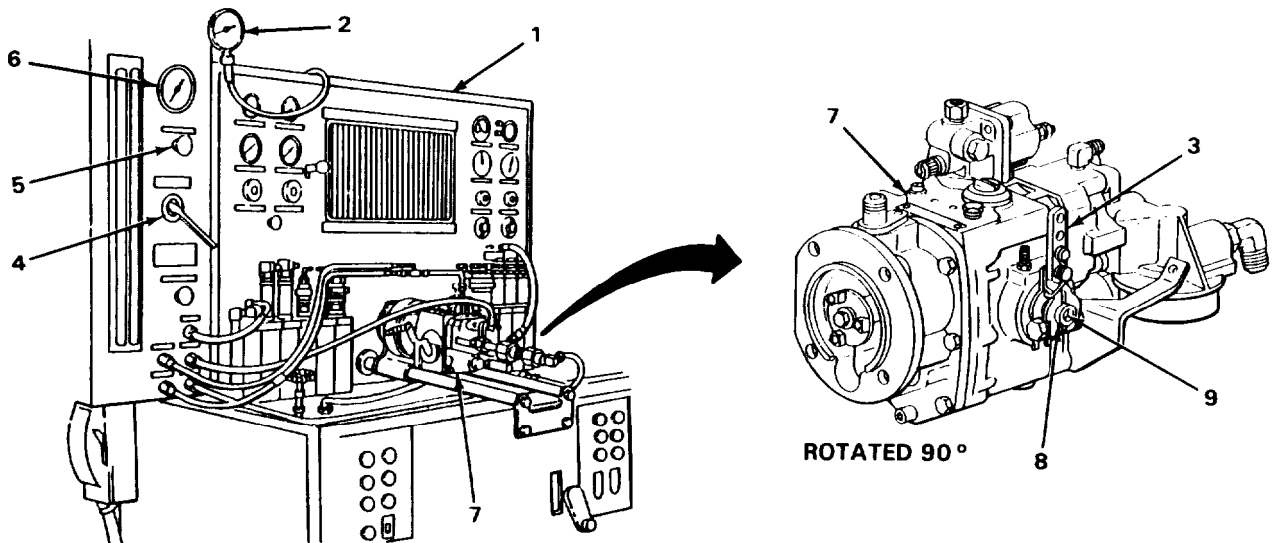
Throttle shaft internal adjusting screw is covered by a soft steel ball in end of throttle shaft, and must be removed if not previously removed. Perform step 32 only if ball has not been previously removed.

32. Fuel pump (7) throttle shaft (8)	Ball (9)	Using center punch, 1/4-inch drill bit, and 3/8-inch portable electric drill, drill out ball.
33. Test stand (1)	Fuel pump (7) throttle shaft (8)	Test and adjust fuel pressure as follows: Set fuel pressure to 172 to 178 psi (1186 to 1227 kPa). <b>Screw Internal fuel adjusting screw In throttle shaft in to increase pressure, or out to decrease pressure.</b>



**FUEL PUMP CALIBRATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
<b>GOVERNOR FUEL PRESSURE TESTING AND ADJUSTING</b>		
34. Test stand (1)	Fuel pump (7)	<p>Test and adjust fuel pump governor, operating pressure as follows:</p> <ol style="list-style-type: none"> <li>Adjust fuel pump speed to 1500 rpm.</li> <li>Place selector valve (4) to ROTAMETER position.</li> <li>Place fuel throttle lever (3) to wide open position.</li> <li>Set fuel flow to 230 pph with the fuel flow control valve (5).</li> </ol> <p><b>Fuel pressure should be 100 to 106 psi (989 to 730 kPa).</b></p> <ol style="list-style-type: none"> <li>If fuel pressure is not 100 to 106 psi (689 to 730 kPa), check governor cutoff rpm (see step 28).</li> </ol>



FUEL PUMP CALIBRATION - CONTINUED

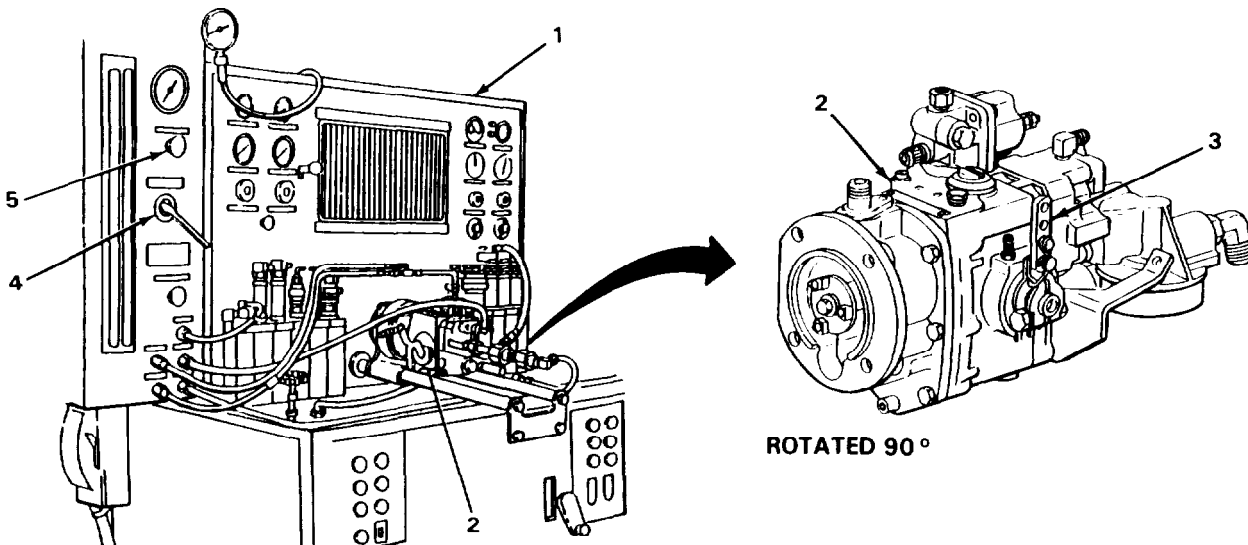
LOCATION	ITEM	ACTION	REMARKS
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GOVERNOR WEIGHT SETTING CHECKING AND ADJUSTING

**NOTE**

Shims are available in 0.007 and 0.015 inch (0.18 and 0.38 mm) thicknesses. Do not change setting more than 0.020 inch (0.508 mm) from specification.

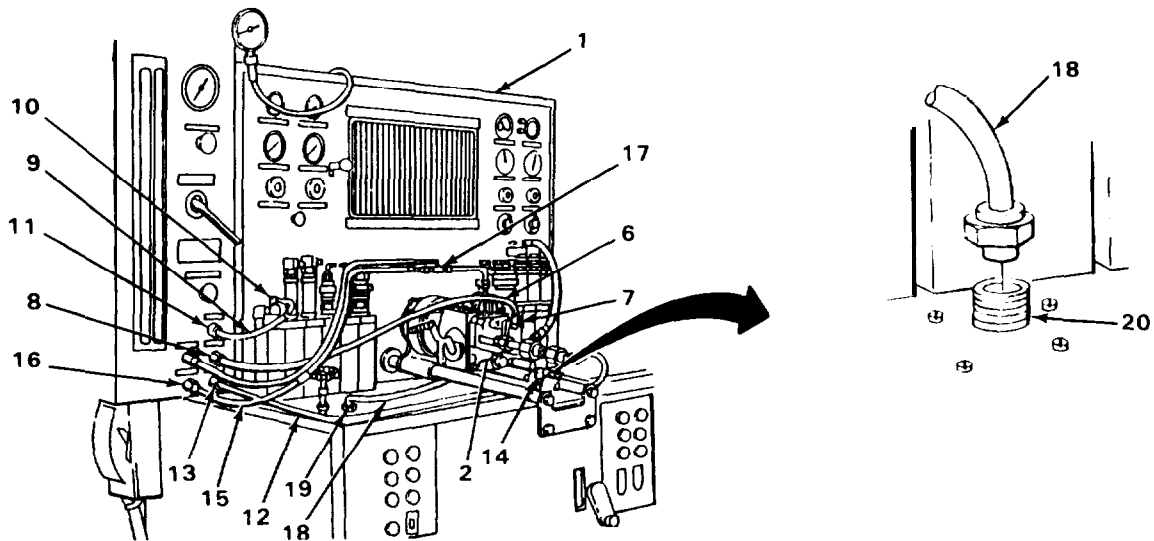
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|--------------------|---------------|---|
| 35. Test stand (1) | Fuel pump (2) | Check fuel pump governor weight setting as follows:   |
|                    |               | <ul style="list-style-type: none"> <li>a. Adjust fuel pump speed to 1000 rpm.</li> <li>b. Place throttle lever (3) to wide open position.</li> <li>c. Place selector valve (4) in ROTAMETER position.</li> <li>d. Set fuel flow to 150 pph with fuel flow control valve (5).</li> </ul> |
|                    |               | <b>Fuel pressure should be 50 to 58 psi (335 to 399 kPa).</b>   |
|                    |               | e. If fuel pressure is not 50 to 58 psi (335 to 399 kPa), adjust.   |
|                    |               | <b>To increase or decrease pressure, add or remove shims as necessary on governor plunger. (See Fuel Pump, page 2-289.)</b>   |



ROTATED 90°

FUEL PUMP CALIBRATION - CONTINUED

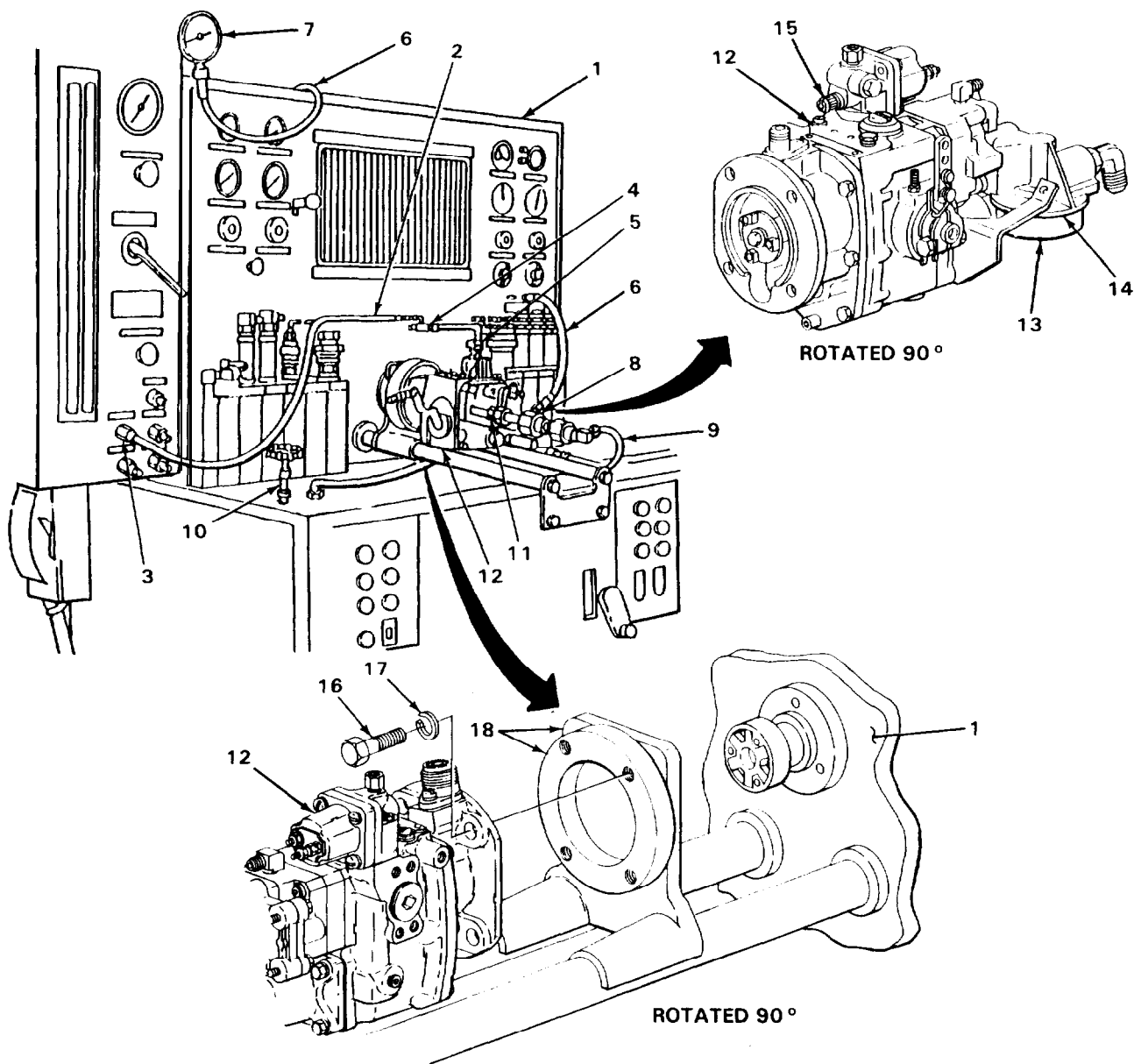
LOCATION	ITEM	ACTION REMARKS
REMOVING PUMP FROM TEST STAND		
36. Test stand (1) and fuel pump (2)	1/4-inch (6.35 mm) flexible hose (6)	Remove flexible hose from small fitting (7) on fuel pump and auxiliary return fitting (8) on test stand.
37. Test stand (1)	Leakage accumulator hose (9)	Remove from no. 1 accumulator cam (10) and test stand leak test connector (11).
38.	Fuel suction hose (12)	Remove from test stand (1), fuel outlet connector (13) and test stand fuel return connector (14).
39.	Fuel input hose (15)	Remove from test stand (1), fuel input connector (16), and fuel pump discharge fitting (17).
40.	1/4-inch (6.35 mm) flexible hose (18)	Remove from test stand lube pressure (19) and test stand lube return (20).



**FUEL PUMP CALIBRATION - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
REMOVING PUMP FROM TEST STAND - CONTINUED		
41. Test stand (1)	Fuel pressure hose (2)	Remove from test stand pressure gage outlet (3) and fuel pump discharge fitting (4).
42.	Fuel pump discharge fitting (4)	Remove fuel pump discharge fitting from fuel pump shutdown valve (5).
43.	1/4-inch (6.35 mm) clear manifold hose (6)	Remove from no. 2 manifold vacuum gage (7) and 1/4-inch (6.35 mm) adapter on pump inlet adapter assembly (8).
44.	1/2-inch (12.7 mm) flexible hose (9)	Remove from test stand suction control valve (10) and adapter elbow on pump inlet adapter assembly (8).
45.	Pump inlet adapter assembly (8)	Remove from pump inlet port (11).
46. Fuel pump (12)	Fuel filter adapter (13) and gasket (14)	Remove.
47.	Fuel shutdown valve manual override knob (15)	Close fully by turning counterclockwise.
48. Test stand (1)	Fuel pump (12) four screws (16) and four lockwashers (17)	a. Remove four screws and four lockwashers from fuel pump and ring adapter assembly (18). b. Remove fuel pump from test stand.
49.	Fuel pump (12)	Plug all fuel pump ports to prevent entry of dirt and foreign matter.

FUEL PUMP CALIBRATION - CONTINUED



**NOTE**

FOLLOW-ON MAINTENANCE: Install fuel pump (page 2-86).

**TASK ENDS HERE**

**FUEL INJECTOR**

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This task covers:

- a. Disassembly (page 2-352)
  - b. Cleaning (page 2-356)
  - c. Inspection (page 2-356)
  - d. Assembly (page 2-363)
  - e. Testing (page 2-366)
- 

**INITIAL SETUP**

Tools

- Adapter, injector
- Adapter, tool, burnishing, ST-708
- Detector, leakage, ST-990
- Extension, plunger, ST-1089
- Gage, size, orifice, ST-1332
- Gage, thickness
- Glass, magnifying
- Handle, hinged, 1/2-inch drive
- Injector, master, ST-1210
- Key, hex, 5/64-inch
- Plate, lapping
- Stand, injector test, ST-790
- Socket, crowsfoot, 1 1/4-inch, 1/2-inch drive
- Tester, spray angle, ST-668
- Tester, spring
- Wrench, body, no. 3375102
- Wrench, box-end, 1 1/4-inch
- Wrench, open-end, 1-inch

Tools - Continued

- Wrench, retainer, ST-995
- Wrench, torque, 0 to 150 in. lb (0 to 16.9 N•m), 3/8-inch drive
- Wrench, torque, 0 to 175 ft lb (0 to 245 N•m), 1/2-inch drive

Materials/Parts

- Cutting fluid, lapping (item 5, appendix B)
- Gasket, orifice plug (if required)
- Gasket (two required)
- Oil, fuel (item 11, appendix B)
- O-ring
- Prussian blue (Item 13, appendix B)
- Test oil, injector (item 20, appendix B)

Equipment Condition

Fuel injectors removed (page 2-34).

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LOCATION	ITEM	ACTION	REMARKS
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**DISASSEMBLY**

- |                 |                                  |                         |                                     |
|-----------------|----------------------------------|-------------------------|-------------------------------------|
| 1. Injector (1) | Injector detent plunger link (2) | Pull out from injector. | <b>Set aside to prevent damage.</b> |
|-----------------|----------------------------------|-------------------------|-------------------------------------|

FUEL INJECTOR - CONTINUED

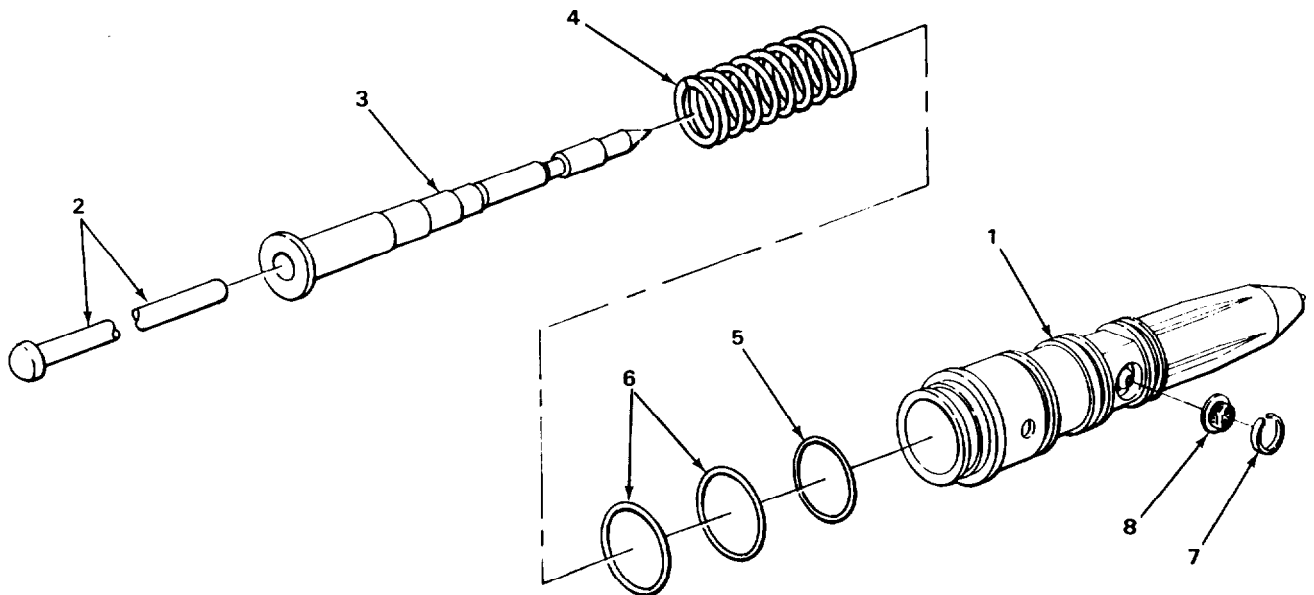
LOCATION	ITEM	ACTION	REMARKS
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**CAUTION**

Injector barrel and plunger are a matched set (class fit). Do not interchange.

Do not touch internal parts unless hands are clean and moistened with fuel oil. Acids from skin can corrode internal parts and affect their close tolerances.

- |    |  |                                |   |
|----|--|--------------------------------|---|
| 2. | Plunger (3) and spring (4)                         | Pull out from injector.        | <b>Store plunger by standing on coupling end.</b> |
| 3. | Preformed packing (5) and two gaskets (6)          | Roll off injector (1).         | <b>Discard packing and gaskets.</b>               |
| 4. | Strainer element clip (7) and strainer element (8) | Remove and inspect for damage. | <b>Discard if damaged.</b>                        |



FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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DISASSEMBLY - CONTINUED

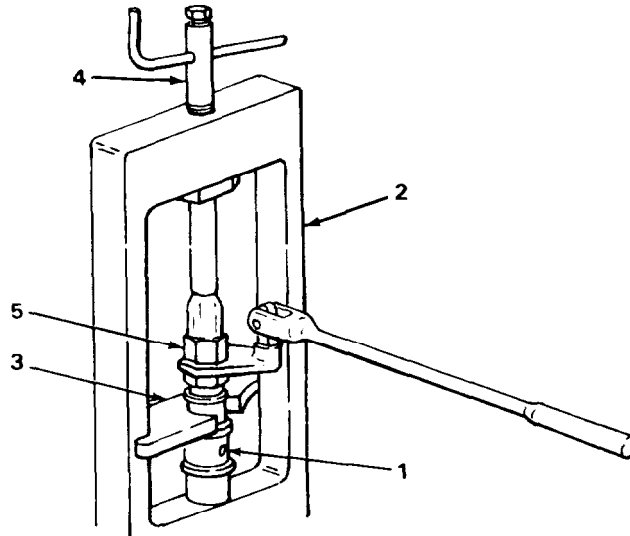
**NOTE**

Do not remove orifice plug from inlet groove.

- |                 |                 |  |  |
|-----------------|-----------------|--|--|
| 5.              | Injector (1)    | Insert injector into loading fixture (2).  |  |
| 6. Injector (1) | Body wrench (3) | <ul style="list-style-type: none"> <li>a. Install body wrench over flats on injector and tighten special screw (4), to hold injector in place.</li> <li>b. Using ST-995 retainer wrench (5), 1/2-inch drive 1 1/4-inch crow'sfoot socket, and hinged handle, loosen, but do not remove cup retainer.</li> <li>c. Loosen special screw (4). Remove tools from injector and remove injector from loading fixture.</li> </ul> |  |

**NOTE**

Another method of loosening cup retainer is to use a 1 1/4-inch box-end wrench on ST-995 retainer wrench and a 1-inch open-end wrench on injector.





FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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**CAUTION**

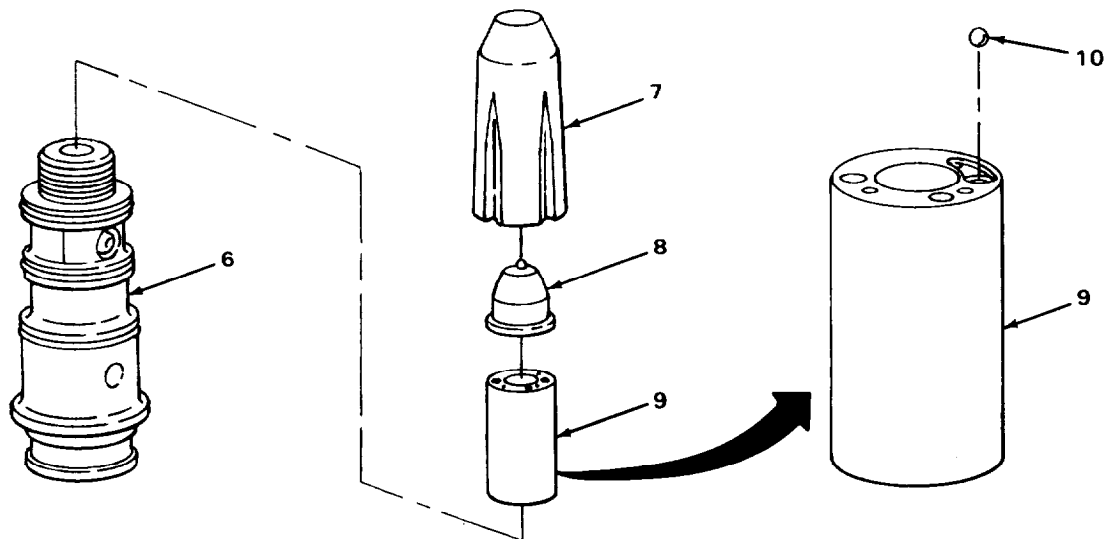
When handling injector, use care not to drop or lose any parts. Do not lose check ball.

- |    |                      |                  |   |
|----|----------------------|------------------|---|
| 7. | Injector adapter (6) | Cup retainer (7) | Stand Injector upright. Screw off cup retainer (7) and remove injector cup (8). |
|----|----------------------|------------------|---|

**CAUTION**

Do not touch internal parts unless hands are clean and moistened with fuel oil. Acids from skin can corrode internal parts and affect their close tolerances.

- |    |  |   |
|----|--|---|
| 8. | Injector barrel (9) and injector adapter (6) | a. Hold together and set barrel end down.<br>b. While holding injector barrel, lift injector adapter straight up. |
| 9. | injector barrel (9)                          | Lift up and tilt until check ball (10) falls out.<br><b>Set check ball in a safe place.</b>                       |



**FUEL INJECTOR - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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CLEANING

**CAUTION**

Do not touch internal parts unless hands are clean and moistened with fuel oil. Acids from skin can corrode internal parts and affect their close tolerances.

Do not clean cup spray holes with wire brush, drills, or other similar instruments that will alter the size of spray holes.

**NOTE**

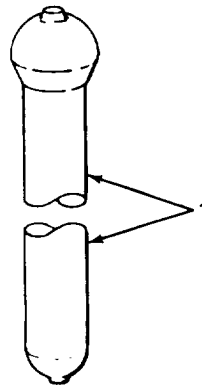
For general cleaning procedures, see General Maintenance Instructions, page 2-3.

Ultrasonic cleaning is recommended for cleaning injector barrel, plunger, and cup.

A clean shop, clean tools, and good cleaning practices are essential to good injector repair. Most injector failures occur because of dirt. Clean all parts before assembly.

INSPECTION

10.	Injector detent plunger link (1)	Check for excessive wear on ends. <b>If the wear can be seen or felt, replace injector detent plunger link.</b>
-----	----------------------------------	--



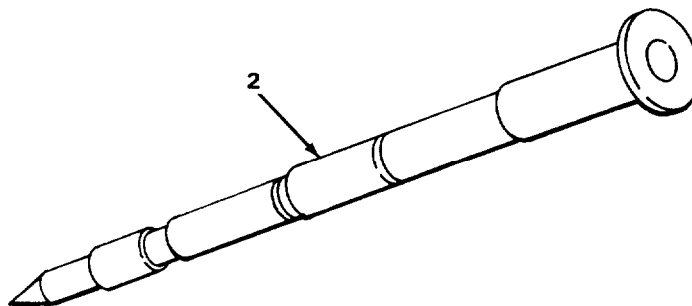
FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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**CAUTION**

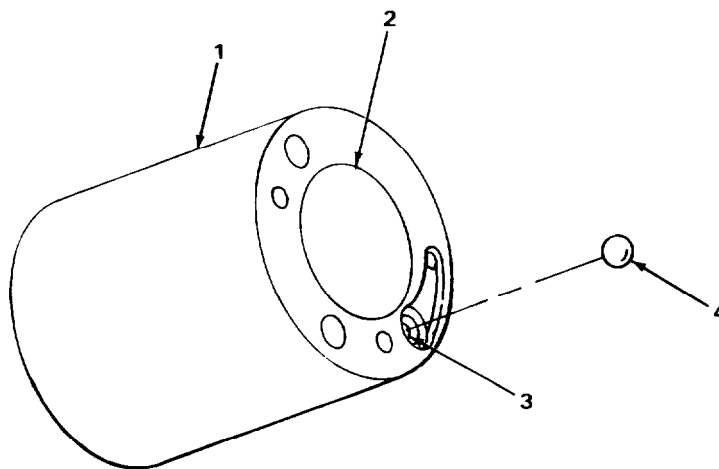
Handle injector plunger with care to prevent damage that would render it useless.

- |     |             |   |
|-----|-------------|---|
| 11. | Plunger (2) | <ul style="list-style-type: none"> <li>a. Inspect machined surfaces for pitting or wear.<br/><b>Bright spots or surface disruption at top of machined area and on opposite sides at bottom of plunger, or at mid-point, are normal results of rocker arm action. If metal is displaced or wear is measurable at these points, replace plunger and barrel. Narrow streaks running the length of plunger are normal. If pitted or worn, replace plunger and barrel.</b></li> <li>b. Inspect machined surfaces for cracks or looseness where plunger is connected to coupler.<br/><b>If cracks or looseness exist, replace plunger and barrel.</b></li> <li>c. Inspect for metal seizure.<br/><b>If metal seizure is present, replace plunger and barrel.</b></li> <li>d. Inspect socket for wear or cracking.<br/><b>If wear or cracking is present in socket, replace plunger and barrel.</b></li> </ul> |
|-----|-------------|---|



FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
INSPECTION - CONTINUED		
12. Barrel (1)	Plunger bore (2) and check ball seat (3)	<ul style="list-style-type: none"> <li>a. Using magnifying glass, inspect plunger bore for scoring. <b>If scoring exists, replace plunger and barrel.</b></li> <li>b. Inspect surface at each end for burrs or scratches. <b>If burrs or scratches exist, replace plunger and barrel.</b></li> <li>c. Inspect check ball seat for nicks or burrs. <b>If nicks or burrs exist, replace plunger and barrel.</b></li> <li>d. Inspect fuel passage plugs for looseness, and barrel for cracks. <b>If looseness or cracks exist, replace plunger and barrel.</b></li> </ul>
13.	Check ball (4)	Inspect check ball for any wear or damage. <b>If damage or wear exists, replace the check ball.</b>



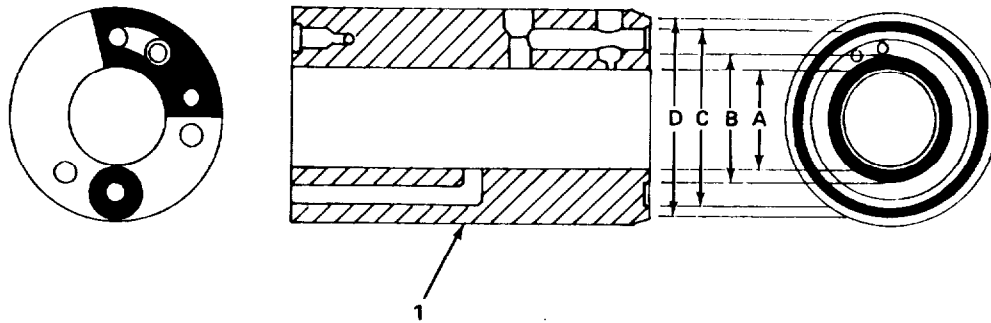
FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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**CAUTION**

Do not use crocus cloth or wire brush on barrel contact area surfaces.

- |     |            |  |
|-----|------------|--|
| 14. | Barrel (1) | <p>Using lapping plate and cutting fluid, lap slightly to check barrel surfaces for mutilation and flatness in area shown by black area in illustration below.</p> <p><b>After lapping slightly, If mutilation or unevenness exists, replace plunger and barrel.</b></p> |
|-----|------------|--|



CUP CONTACT AREA OF BARREL

A-DIAMETER IN. (MM)	B-DIAMETER IN. (MM)	C-DIAMETER IN. (MM)	D-DIAMETER IN. (MM)
0.400 (10.16)	0.540 (13.72)	0.710 (18.03)	0.820 (20.83)

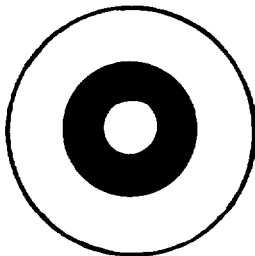
FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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INSPECTION - CONTINUED

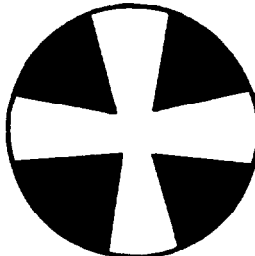
- |     |                  |   |
|-----|------------------|---|
| 15. | Injector cup (1) | <p>a. Using magnifying glass, and comparing with new injector cup (1), inspect injector cup for abrasive wear, corrosion damage, and enlarged or distorted spray holes.<br/> <b>If abrasive wear, corrosion damage, or enlarged or distorted spray holes exist, replace Injector cup.</b></p> <p>b. Using prussian blue on a new plunger, insert plunger into injector cup (1) and rotate 90 degrees.<br/> <b>If plunger seat pattern in Injector cup does not cover a 40-percent continuous area around the injector cup cone, as illustrated below, replace injector cup.</b></p> |
|-----|------------------|---|

CONTINUOUS PATTERN



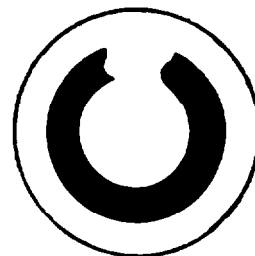
GOOD SEAT

STAR PATTERN



BAD SEAT

BROKEN PATTERN

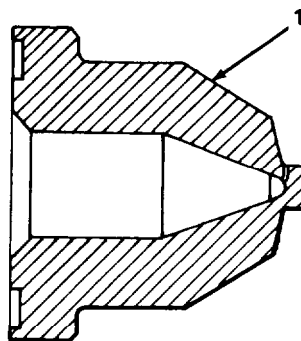
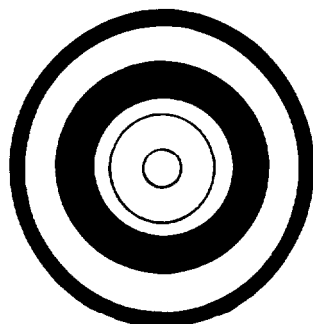


BAD SEAT

- c. Using lapping plate and cutting fluid, lap slightly to check injector cup barrel surface for mutilation and flatness in the areas shown by black in the illustration below.  
**After lapping slightly, if mutilation or unevenness exists, replace Injector cup.**

FUEL INJECTOR - CONTINUED

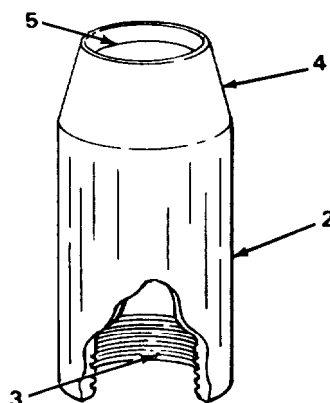
LOCATION	ITEM	ACTION REMARKS
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16. Injector cup  
retainer (2)

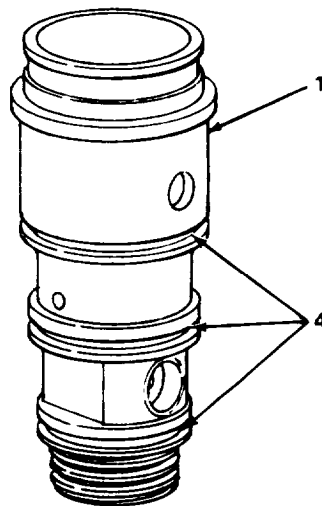
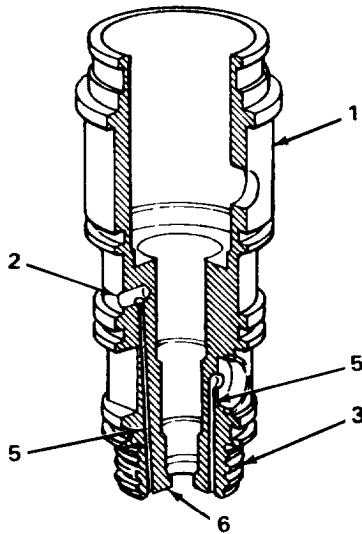
Injector cup threads  
(3), cone (4) and  
cup seating ledge (5)

- a. Inspect injector cup threads for damage.  
**If threads are damaged, replace In-jector cup retainer.**
- b. Inspect outside area of cone for nicks or burrs that could prevent proper seating of injector sleeve in cylinder head.  
**If nicks or burrs exist, replace injector cup retainer.**
- c. Inspect inside of cone area on cup seating ledge for nicks or burrs that could prevent injector cup seating.  
**If nicks or burrs exist, replace injector cup retainer.**



FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
INSPECTION - CONTINUED		
17. Injector adapter (1)	Orifice plug (2) and cup retainer threads (3)	<ul style="list-style-type: none"> <li>a. Inspect orifice plug for burrs. <b>If burrs exist, replace Injector adapter.</b></li> <li>b. Inspect cup retainer threads for damage. <b>If damage exists, replace Injector adapter.</b></li> <li>c. Inspect O-ring and gasket grooves (4) for nicks or burrs that could damage O-ring or gaskets during installation. <b>If nicks or burrs exist, replace injector adapter.</b></li> <li>d. Inspect both fuel passages (5). <b>Make sure fuel passages are open, If fuel passages are plugged, see general cleaning procedures (page 2-3).</b></li> <li>e. Using a lapping plate and cutting fluid, lap slightly to check barrel mating surface (6) for nicks or burrs. <b>If nicks or burrs exist, replace injector adapter.</b></li> </ul>





**FUEL INJECTOR - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
18. Injector spring		a. Inspect injector spring for excessive wear or mutilation. <b>If excessive wear or mutilation exists, replace injector spring.</b> b. Using spring tester, test injector spring. Compare to specifications in table below. <b>If injector spring compresses to dimensions shown below, at less than load indicated under worn limit, replace injector spring.</b>

INJECTOR SPRING DATA

APPROXIMATE FREE LENGTH IN. (MM)	LENGTH IN. (MM)	LOAD REQUIRED TO COMPRESS SPRINGS TO LENGTH		
		NEW MINIMUM LB (KG)	NEW MAXIMUM LB (KG)	WORN LIMIT LB (KG)
1.95 (49.7)	1.663 (42.2)	143.25 (65)	158.75 (72)	138 (63)

ASSEMBLY

**WARNING**

Fuel is flammable and can explode. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Smoking is prohibited while working with fuel.

**CAUTION**

Do not touch internal parts unless hands are clean and moistened with fuel oil. Acids from skin can corrode internal parts and affect their close tolerances.

Lubricate parts only with clean fuel oil before assembly. Do not use lubricating oil. Lubricating oil can crystallize under excessive heat, causing damage to injector components.

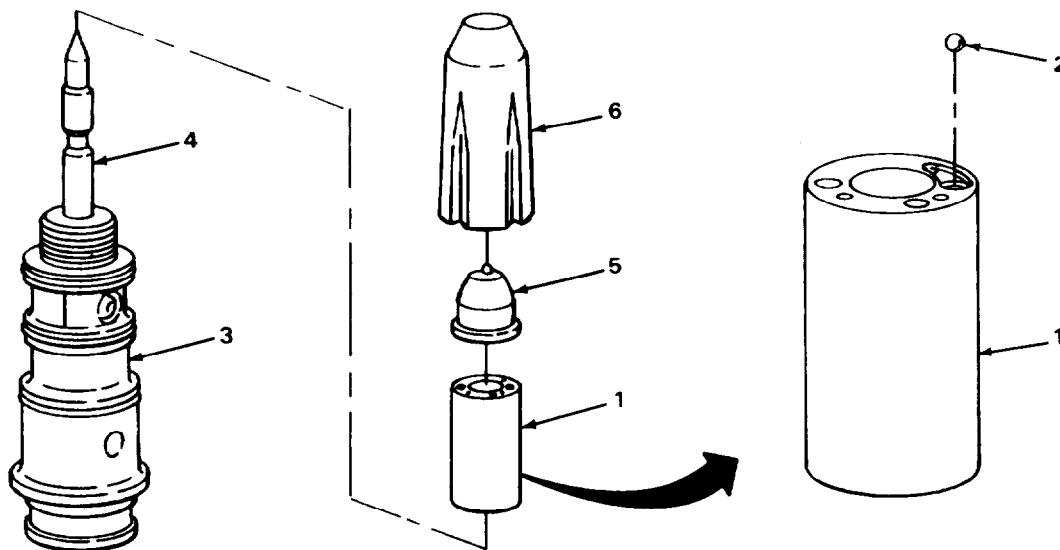
Make sure that all mating surfaces are free of burrs or other imperfections which could result in incorrect fuel flow or torque.

**NOTE**

If the two barrel location pins were removed, install new spiral pins into the barrel.

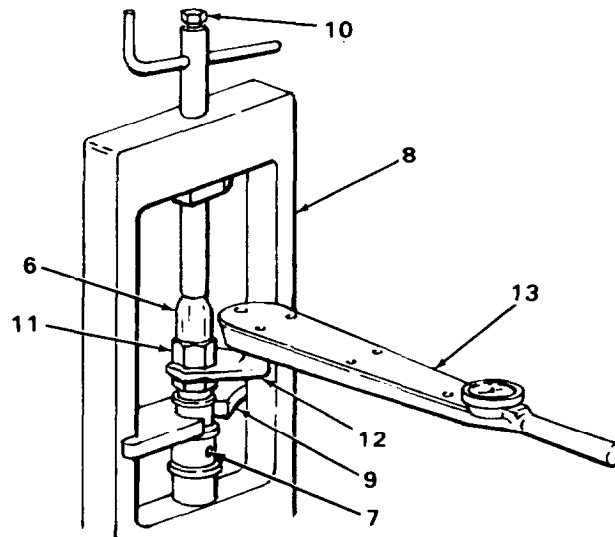
FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
ASSEMBLY - CONTINUED			
19. Barrel (1)	Check ball (2)	Place check ball into top of barrel, in check ball seat.	
20.	Injector adapter (3)	Place injector adapter onto top of barrel.	
21. Injector adapter (3)	Plunger (4)	Immerse plunger in clean injector test oil, and install into injector adapter without injector spring.	
22. Injector adapter (3) and barrel (1)	Injector cup (5)	Turn the injector adapter and barrel with the barrel up. Place the injector cup on the barrel.	
23. Injector adapter (3)	Injector cup (5) and cup retainer (6)	Lubricate the injector cup contact area and the cup retainer threads with clean fuel oil. Screw down finger tight and loosen one-quarter turn.	



FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
24.	Injector (7)	Place into loading fixture (6).
25. Injector (7)	Body wrench no. 3375102 (9)	Install over flats on injector, tighten special screw (10) just enough to hold injector.
26. Loading fixture (8)	Special screw (10)	Using 3/8-inch drive 0 to 150 in. lb (0 to 17.5 N•m) torque wrench, tighten to 75 in. lb (8.5 N•m) to aline injector cup and plunger (4).
27. Injector (7)	Cup retainer (6)	Using ST-995 retainer wrench (11), 1/2- inch drive 1 1/4-inch crowsfoot socket (12), and 0 to 175 ft lb (0 to 245 N•m) torque wrench (13) tighten to 50 ft lb (70 N-m).
28. Loading fixture (8)	Injector (7)	Loosen special screw (10) and remove from loading fixture.
29.	Injector (7)	Remove all tools from injector.



**FUEL INJECTOR - CONTINUED**

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LOCATION	ITEM	ACTION	REMARKS
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ASSEMBLY - CONTINUED

**WARNING**

Fuel is flammable and can explode. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Smoking is prohibited while working with fuel.

When fuel is forced from injector spray holes, keep hands and body away from spray stream. High-pressure fuel may pierce the skin.

- |                  |             |   |
|------------------|-------------|---|
| 30. Injector (1) | Plunger (2) | <ul style="list-style-type: none"> <li>a. Check injector cup to plunger alignment, remove plunger, and coat with clean fuel oil. Install ST-1089 plunger extension on plunger (2).</li> <li>b. Hold injector in vertical position (injector cup down) and allow plunger to drip a few drops of fuel oil into injector cup.</li> <li>c. Insert plunger about 1/2 inch (12.7 mm) into barrel to be certain plunger is started straight.</li> <li>d. Using palm of hand, press plunger into injector cup and rotate 90 degrees while holding plunger firmly against injector cup seat.</li> <li>e. Turn injector so injector cup faces upward. Plunger should slide out when injector is lifted quickly.<br/> <ul style="list-style-type: none"> <li><b>If plunger does not slide out, remove plunger, coat tip with fuel oil, and repeat test.</b></li> <li><b>If plunger sticks because of misalignment, loosen cup retainer, rotate injector cup one-quarter turn, and retorque.</b></li> </ul> </li> <li>f. Remove ST-1089 plunger extension.</li> </ul> |
|------------------|-------------|---|

**WARNING**

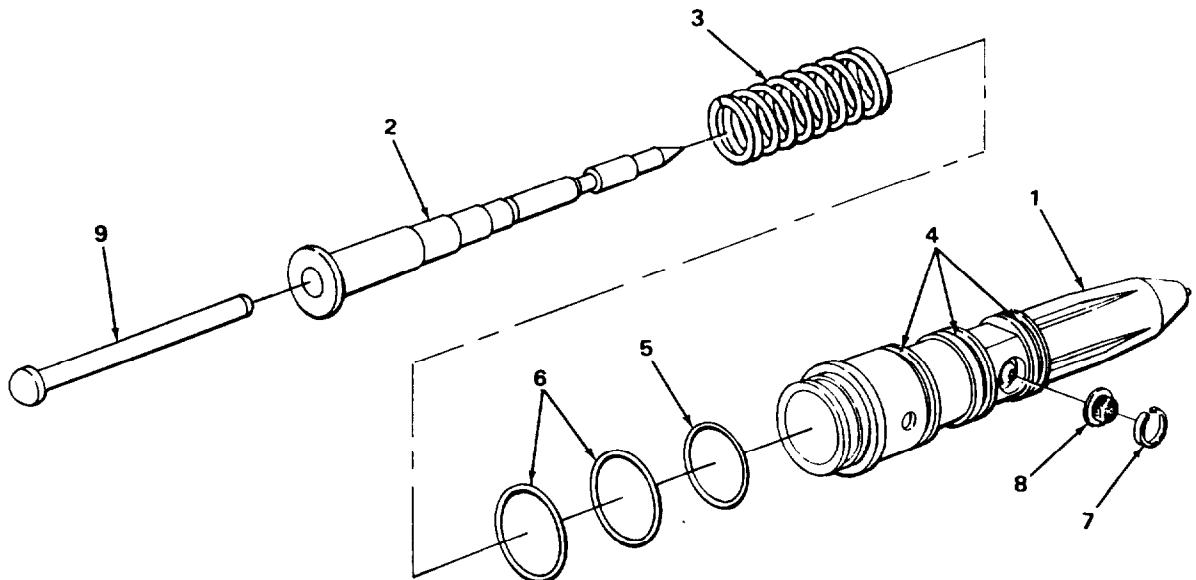
When fuel is forced from injector spray holes, keep hands and body away from spray stream. High-pressure fuel may pierce the skin.

**NOTE**

Step 31 must be performed on test injector before continuing with steps 32 thru 35.

FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
31.	Injector (1)	a. Check plunger leakage on ST-990 leakage detector. See steps 36 thru 60. b. Check injector cup spray pattern on ST-668 spray angle tester. See steps 61 thru 72. c. Check check ball seating, see steps 73 thru 83. d. Test injector on ST-790 injector test stand. (See steps 84 thru 99.)
32.	Plunger (2)	Take out plunger and install injector spring (3). Reinstall plunger.
33. Injector grooves (4)	New preformed packing (5) and two new gaskets (6)	Lubricate with fuel oil and put on if damaged after testing.
34. Injector (1)	Strainer element clip (7) and strainer element (8)	Put in.
35.	Injector (1)	Put detent plunger link (9) into injector and store injector in clean, dry area until ready for installation in cylinder head.



FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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TESTING

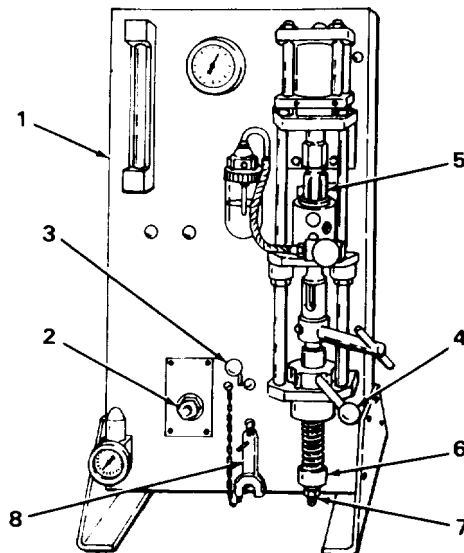
**WARNING**

When fuel is forced from injector spray holes, keep hands and body away from spray stream. High-pressure fuel may pierce the skin.

**NOTE**

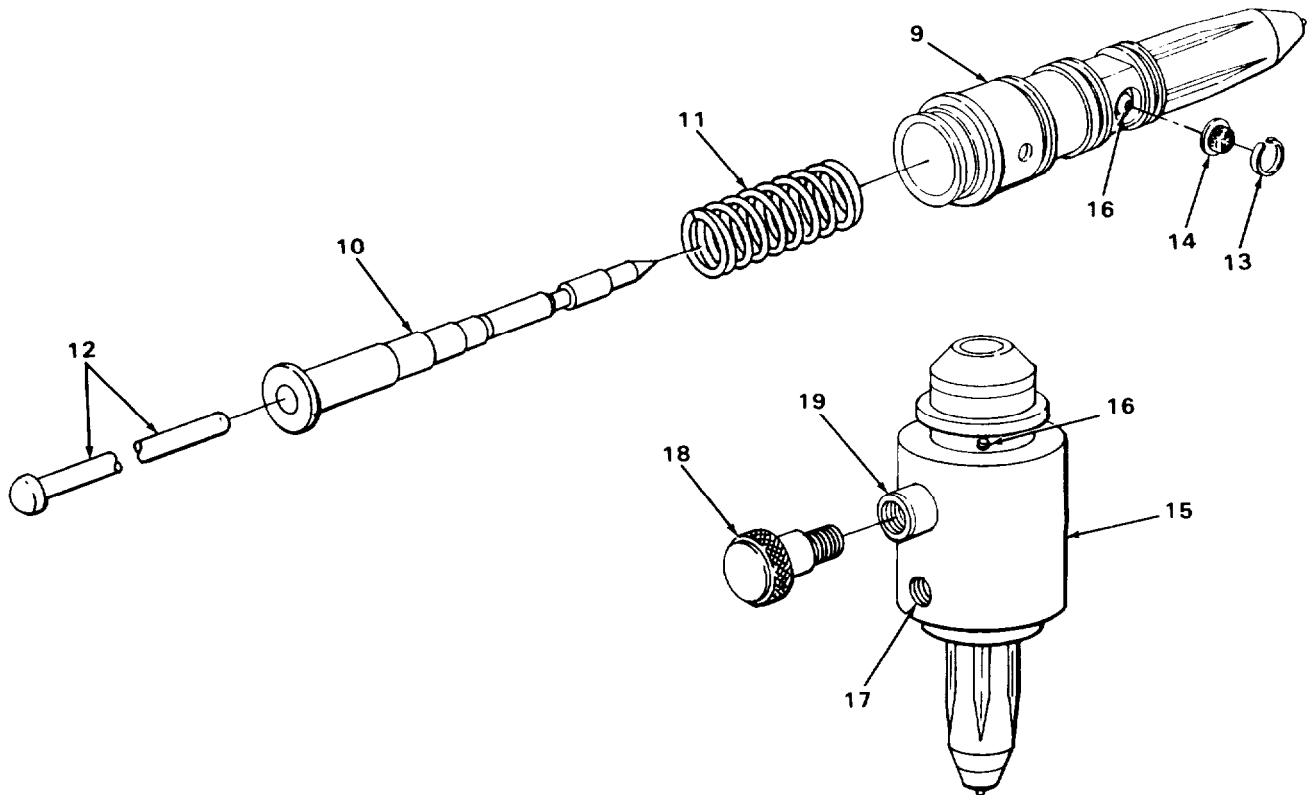
The following testing procedures are based on use of the ST-990 leakage detector, ST-668 spray angle tester, and ST-790 injector test stand.

- |     |                             |                              |  |
|-----|-----------------------------|------------------------------|--|
| 36. | ST-990 leakage detector (1) | Pressure regulator (2)       | Set air pressure at 60 psi (414 kPa).  |
| 37. |                             | Cylinder actuation valve (3) | Operate three times, then reset pressure regulator (2) at precisely 60 psi (414 kPa).                |
| 38. |                             | Retraction lever (4)         | Place in position A.   |
| 39. |                             | Load cell (5)                | Position on leakage detector as shown.   |
| 40. | Load cell (5)               | Knob (6)                     | Adjust until load cell reads 200 psi (1379 kPa).   |
| 41. |                             | Locknut (7)                  | Place thickness gage (8) between knob (6) and locknut.<br><b>Adjust only when load cell is used.</b> |
| 42. | Load cell (5)               |                              | Remove from ST-990 leakage detector.   |



FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
43. Injector (9)	Plunger (10) and spring (11)	Take out.
44.	ST-1089 plunger extension (12)	Push in plunger and place into injector (9).
45.	Strainer element clip (13) and strainer element (14)	Take out if not previously removed.
46.	ST-708 burnishing tool adapter (15)	a. Aline injector orifice plug (16) with hole (17) on ST-708 burnishing tool adapter. b. Insert and tighten locating screw (18) in locating screw hole (19).



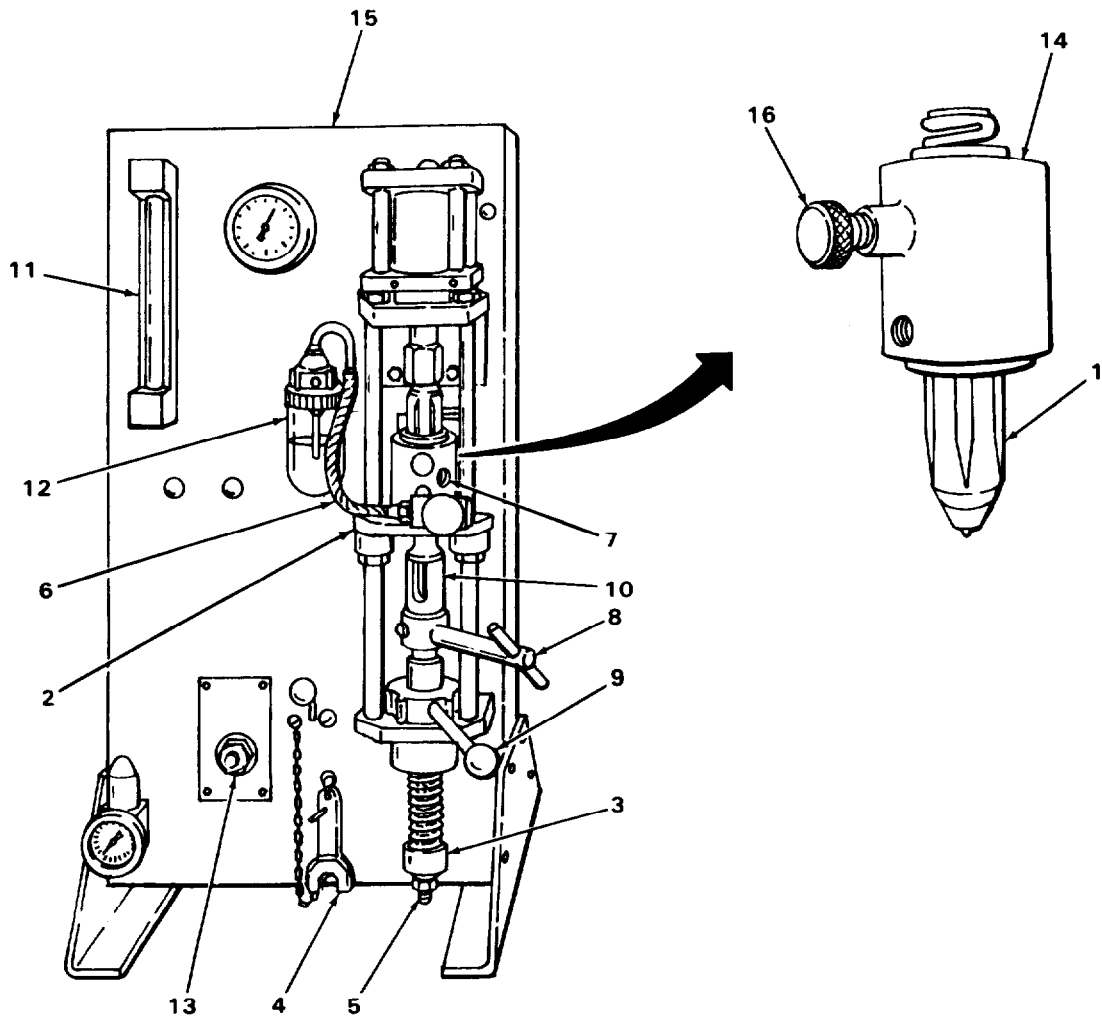
FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
TESTING - CONTINUED		
47.	Injector (1)	Install on support plate (2) and clamp into position. <b>Support plate may be tilted for easier Installation.</b>
48.	Knob (3)	Adjust to obtain proper clearance with thickness gage (4) between knob and locknut (5).
49.	Transfer line (6)	Screw in and tighten in injector drain port (7).
50.	T-handle clamp (8)	Tighten.
51.	Retraction lever (9)	Shift from position A to position B, making sure plunger (10) retracts.
52.	Plunger (10)	Rotate in clockwise direction by small increments, observing airflow meter (11). Stop rotation when highest reading is obtained. <b>If airflow meter indicates in excess of 4.5, replace injector barrel and plunger.</b>
53.	Retraction lever (9)	Shift from position B to position A.
54.	T-handle clamp (8)	Loosen. <b>This applies 200 lb (90.8 kg) load to plunger.</b>
55.	Bubble checker (12)	Observe. <b>If bubbles occur in 10 seconds, or if time interval between consecutive bubbles exceeds 5 seconds, replace injector cup.</b>
56.	Transfer line (6)	Unscrew and remove from injector drain port.
57.	Pressure regulator (13)	Release air pressure.



FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
58.	ST-708 burnishing tool adapter (14)	Remove from leakage detector (15).
59. ST-708 burnishing tool adapter (14)	Locating screw (16) and transfer line (6)	Remove.
60.	Injector (1)	Remove.



FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
TESTING - CONTINUED		
61.	Spray angle tester (1)	Locate on or near ST-790 injector test stand (2). <b>Any other suitable source of 22 psi (152 kPa) constant fuel pressure can be used.</b>
62.	ST-790 injector test stand (2)	Inlet hose (3)
63.	Drain hose (5)	Attach to adapter (4) from ST-790 injector test stand.
64.	Injector (7)	Attach to adapter base (6) and place loose end in ST-790 injector test stand drain area.
65.	Plug (9)	<ul style="list-style-type: none"> <li>a. Check injector markings. See the following illustration and select the appropriate target ring (8) and install injector on ST-668 spray angle tester.</li> <li>b. Select correct size plunger bore plug and rubber seal, and install in injector plunger bore.</li> </ul>
66.	Injector (7)	Install in adapter drain opening.
67.	ST-790 injector test stand (2)	Place in ST-668 spray angle tester seat, adjust holddown bracket (10), and secure with thumbscrew (11). <b>Be sure plunger bore plug and seal are thoroughly sealed.</b>

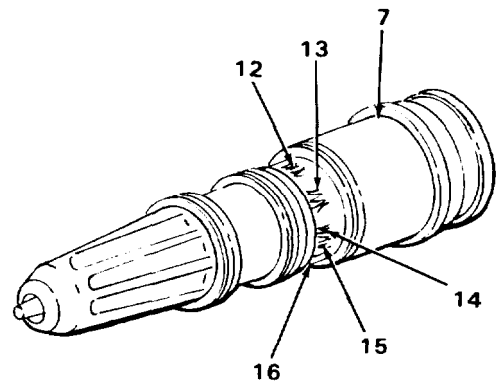
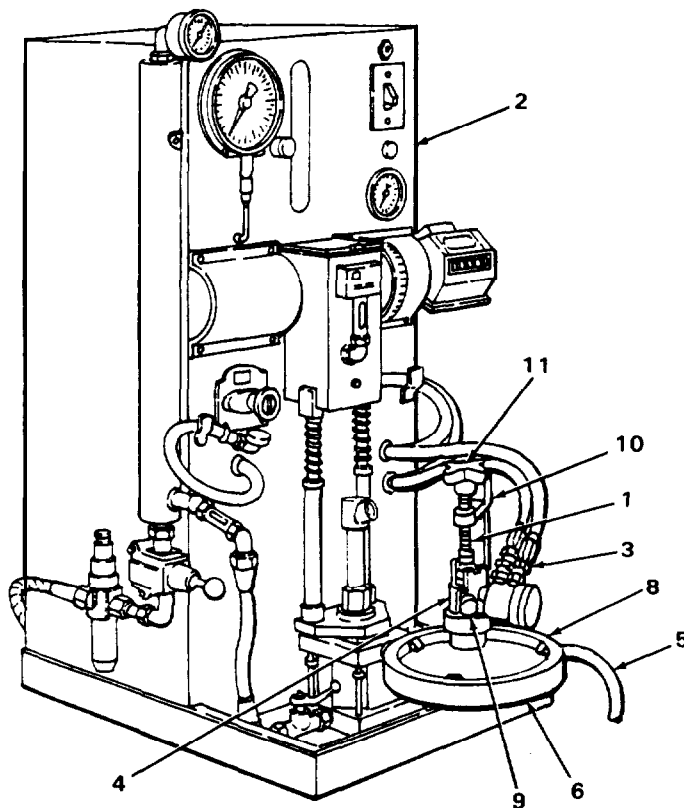
**WARNING**

When fuel is forced from injector spray holes, keep hands and body away from spray stream. High-pressure fuel may pierce the skin.

67.	ST-790 injector test stand (2)	Apply 22 psi (152 kPa) fuel pressure
68.	Target ring (8)	<ul style="list-style-type: none"> <li>a. Shift so one spray stream hits on number 1 or index window. <b>This is the tallest window and provides ± 3 degrees tolerance on injector spray stream location.</b></li> <li>b. Each spray stream must hit a window in target ring. <b>If spray stream is off 2 degrees of window, replace injector cup.</b></li> </ul>

FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
69. ST-668 spray angle tester (1)	Holddown bracket (10)	Loosen thumbscrew (11).
70.	Injector (7)	Remove from ST-668 spray angle tester.
71.	Plug (9)	Remove from adapter drain opening.
72.	Injector (7)	Remove from adapter.



INJECTOR DATA MARKINGS ON INJECTOR ADAPTER

MARKING 12 - INJECTOR FLOW MARKING 13 - PERCENT FLOW MARKING 14 - NUMBER OF HOLES MARKING 15 - SIZE OF HOLES MARKING 16 - DEGREE OF HOLES
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FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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TESTING - CONTINUED

**NOTE**

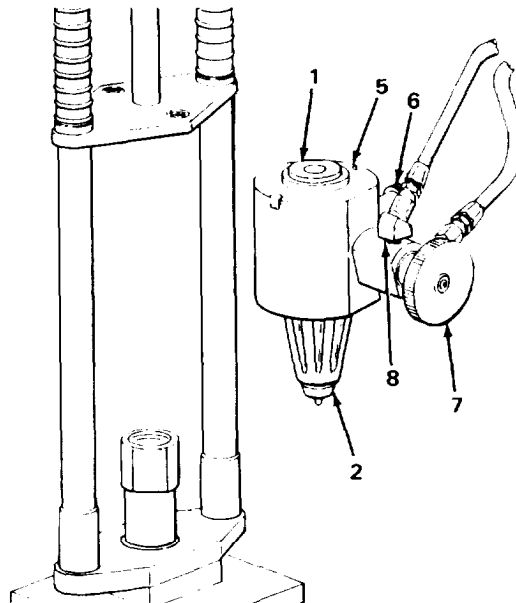
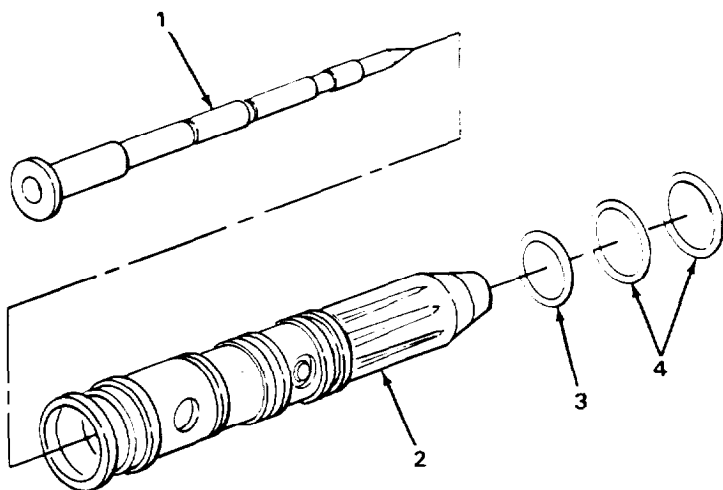
Perform steps 73 thru 83 to test check ball seating.

- |     |   |                                       |
|-----|---|---------------------------------------|
| 73. | Plunger (1)                               | Place in injector (2) without spring. |
| 74. | Preformed packing (3) and two gaskets (4) | Place on injector.                    |
| 75. | ST-708 burnishing tool adapter (5)        | Lubricate inside with fuel oil.       |

**CAUTION**

Injector inlet port and ST-708 burnishing tool adapter inlet hole must be alined to prevent damage to the burnishing tool point, when installed later.

- |     |  |   |
|-----|--|---|
| 76. | Injector (2)   | a. Position in ST-708 burnishing tool adapter (5) so that injector inlet port and adapter inlet holes aline.<br>b. Secure by tightening locating screw (6) on ST-708 burnishing tool adapter. |
| 77. | ST-790 injector test stand inlet line (7) and drain line (8) | Connect to ST-708 burnishing tool adapter.  |



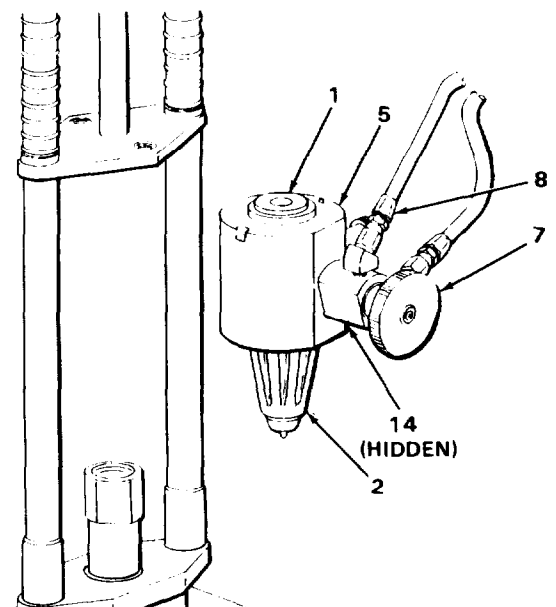
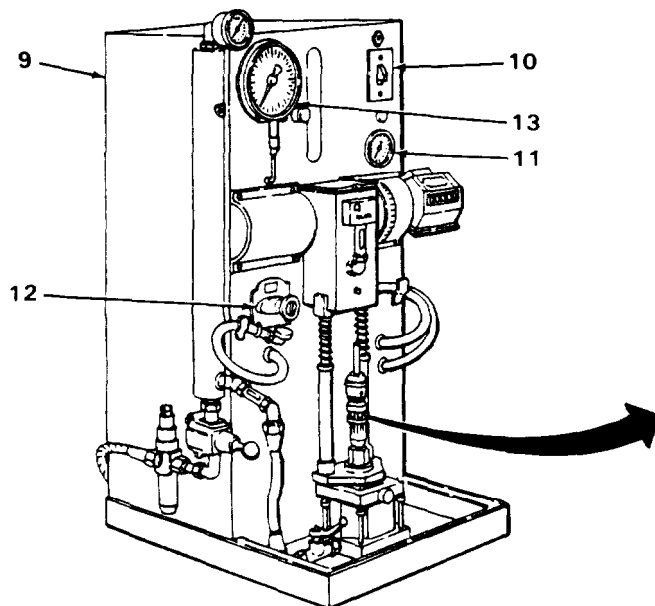
FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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**NOTE**

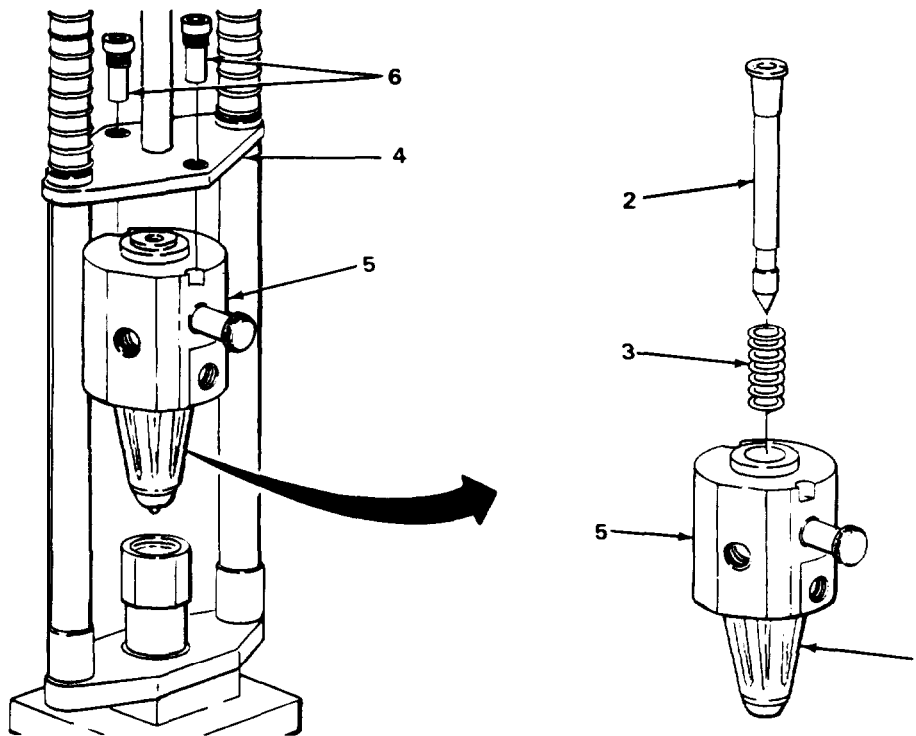
When testing check ball seating, hold injector in hand. Do not place in ST-790 injector test stand holding device.

78.	Injector (2)	Plunger (1)	Hold plunger down in injector.
79.	ST-790 injector test stand (9)	Motor switch (10)	Place in start position. <b>Check temperature gage (11). Test oil testing temperature should be 90° to 95°F (32° to 35°C).</b>
80.		Regulator knob (12)	Adjust by turning until pressure gage (13) reads 150 psi (1034 kPa).
81.		ST-708 burnishing tool adapter orifice plug opening (14)	Check for leakage. A slight see page of + 1 or -2cc from the flow code stamped on the injector is acceptable. <b>If leakage exceeds specifications, replace check ball. See steps 1 thru 7 and 17 thru 27.</b>
82.		Motor switch (10)	Place in stop position.
83.		ST-790 injector test stand inlet line (7) and drain line (8)	Disconnect from ST-708 burnishing tool adapter (5).



FUEL INJECTOR - CONTINUED

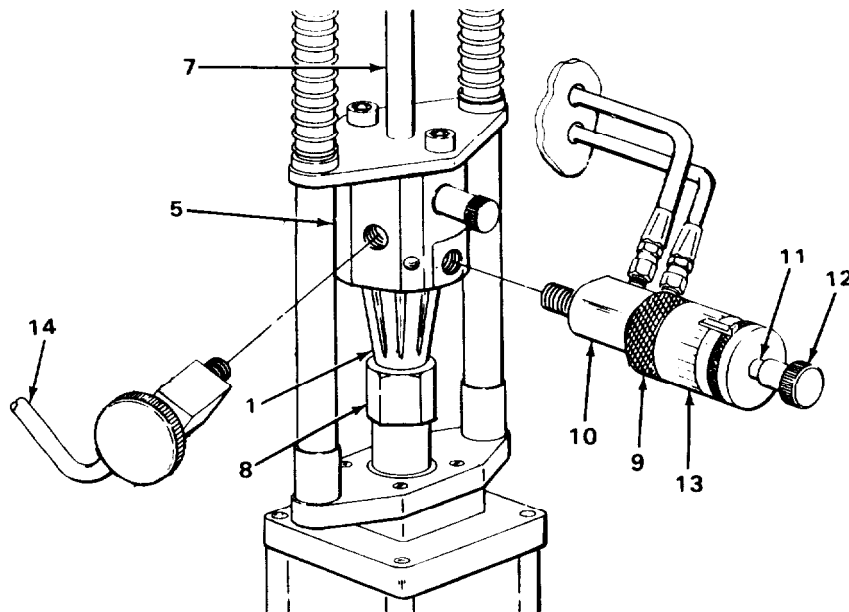
LOCATION	ITEM	ACTION	REMARKS
TESTING - CONTINUED			
84. Injector (1)	Plunger (2)	Pull out.	
85.	Injector spring (3)	Slide onto plunger and place in injector.	
86.	Retainer plate (4)	Place on ST-708 burnishing tool adapter (5) and secure with pins (6).	



87.	Test stand link (7)	Place in ST-708 burnishing tool adapter (5). <b>Use test stand link 6.5 Inches (185 mm) long marked ST 790-331.</b>
88.	Injector (1)	Place in ST-790 injector test stand making sure Injector is in injector seat (8).
89.	Burnishing tool (9)	Install into injector inlet connector (10) on ST-790 injector test stand.

**FUEL INJECTOR - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
90. Burnishing tool (9)	Burnishing tool needle (11)	Retract by pulling out small knob (12).
<b>NOTE</b>		
With burnishing tool needle retracted, burnishing tool may be left in inlet connector during all test operations.		
91. ST-790 injector test stand	Injector inlet connector (10)	Connect by screwing in large knob section (13) to ST-708 burnishing tool adapter (5) inlet hole.
92.	Drain line (14)	Screw into ST-708 burnishing tool adapter (5).



**FUEL INJECTOR - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
<b>TESTING - CONTINUED</b>		
93. ST-790 injector test stand (1)	Air valve (2)	Open to clamp injector in place. <b>Make sure ST-790 injector test stand link is alined.</b>
94.	Hydraulic valve (3)	Close to lock injector in place.
95.	Motor switch (4)	Place in start position. <b>Check temperature gage (5). Test oil testing temperature should be 90° to 95°F (32° to 35°C).</b>
96.	Regulator knob (6)	Adjust by turning until pressure gage (7) reads 120 psi (827 kPa).
97.	Flow start switch (8)	Press in until counter (9) reads the same number of strokes as ST-1210 master injector.
98.	Vial (10)	Observe reading. <b>Correct reading is 182 to 183 cc at 120 psi (827 kPa).</b>

**NOTE**

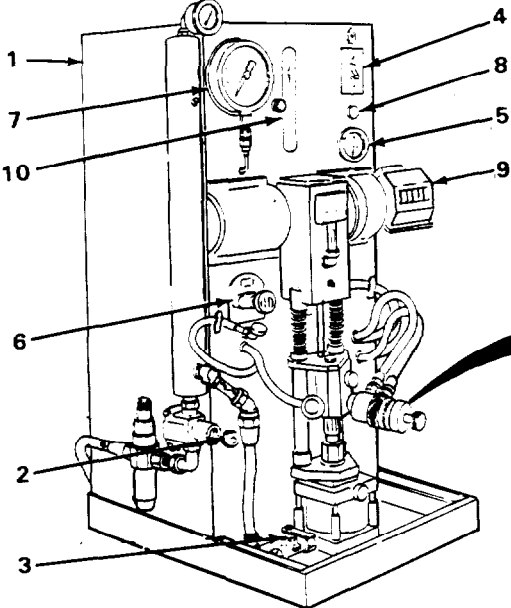
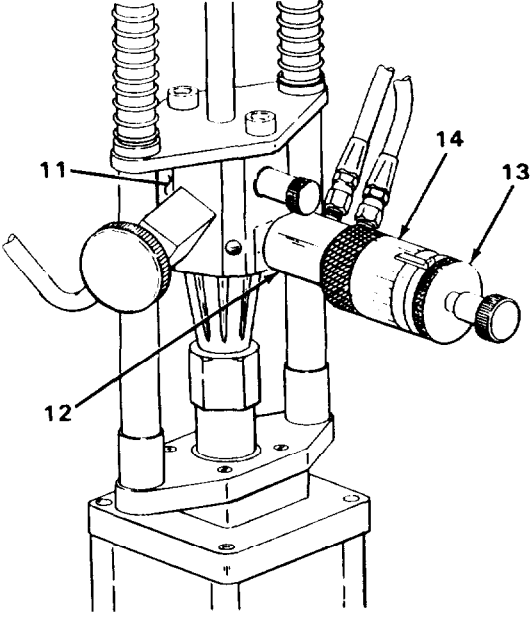
If vial reading is greater than 183 cc, proceed with steps 99 thru 103 to install new orifice plug, and recheck delivery steps 95 thru 98. If vial reading is less than 182 cc, proceed with steps 103 and 104 to burnish orifice plug, and recheck delivery steps 95 thru 96.

If vial reading is correct at 182 to 183 cc, proceed with steps 105 thru 113.

99. ST-708 burnishing tool adapter (11)	Injector inlet connector (12) and burnishing tool (13)	Remove by turning large knob section (14) out until assembly is free.
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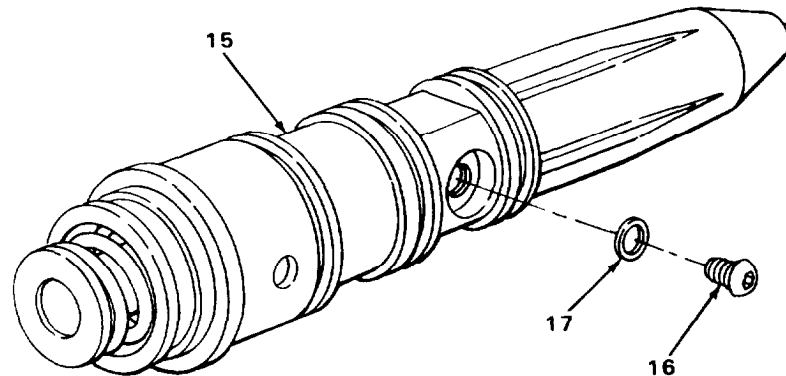


FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
		
100. Injector (15)	Orifice plug (16) and gasket (17)	Using 5/64-inch hex key, remove orifice plug. <b>Discard gasket.</b>
101.	Orifice plug (16)	Using orifice size gage ST-1332, measure orifice plug at the base end, not the wrench end.

**NOTE**

Compare orifice plug inside diameter to table on page 2-380. Choose new orifice plug with inside diameter one size smaller than orifice plug removed.



**FUEL INJECTOR - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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TESTING - CONTINUED

**NOTE**

New orifice plugs contain enough stock in inside diameter so that a small displacement of metal by burnishing will increase delivery. Amount of displacement is limited so several orifice plugs are required.

**INJECTOR ORIFICE PLUGS**

PART NUMBER	INSIDE DIAMETER IN. (MM)	PART NUMBER	INSIDE DIAMETER IN. (MM)
163065	0.015 (0.38)	132800	0.043 (1.09)
163066	0.016 (0.41)	132801	0.044 (1.12)
163067	0.017 (0.43)	132802	0.045 (1.14)
146338	0.018 (0.46)	131099	0.046 (1.17)
163068	0.019 (0.48)	131100	0.047 (1.19)
163069	0.020 (0.51)	131101	0.048 (1.22)
163070	0.021 (0.53)	131102	0.049 (1.24)
163071	0.022 (0.56)	131103	0.050 (1.27)
149726	0.023 (0.58)	131104	0.051 (1.29)
163072	0.024 (0.61)	131105	0.052 (1.32)
163073	0.025 (0.64)	131106	0.053 (1.35)
163074	0.026 (0.66)	131107	0.054 (1.37)
163075	0.027 (0.68)	131108	0.055 (1.40)
163076	0.028 (0.71)	132803	0.056 (1.42)
163077	0.029 (0.74)	132804	0.057 (1.45)
163078	0.030 (0.76)	132805	0.058 (1.47)
163079	0.031 (0.79)	132806	0.059 (1.50)
128132	0.032 (0.81)	132807	0.060 (1.52)
128133	0.033 (0.64)	132808	0.061 (1.55)
128134	0.034 (0.66)	132809	0.062 (1.57)
128135	0.035 (0.89)	132810	0.063 (1.60)
131092	0.036 (0.91)	132811	0.064 (1.63)
131093	0.037 (0.94)	132812	0.065 (1.65)
131094	0.038 (0.97)	132813	0.066 (1.68)
131095	0.039 (0.99)	132814	0.067 (1.70)
131096	0.040 (1.02)	132815	0.068 (1.73)
131097	0.041 (1.04)	132816	0.069 (1.75)
131098	0.042 (1.07)	132817	0.070 (1.78)

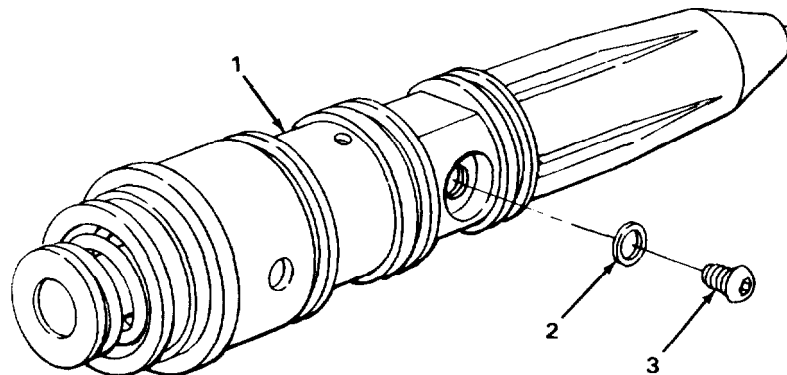
FUEL INJECTOR - CONTINUED

LOCATION	ITEM	ACTION REMARKS
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102. Injector (1)

New gasket (2) and orifice plug (3)

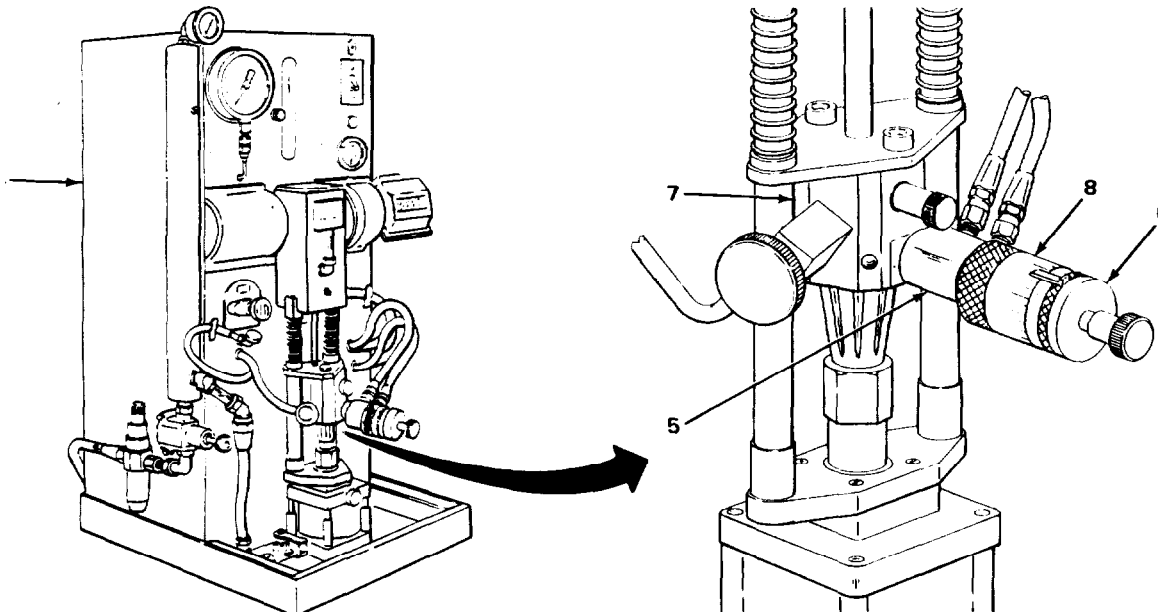
- a. Place gasket in injector.
- b. Screw into injector.
- c. Using 3/8-inch drive, 0 to 150 in. lb (0 to 17.5 N•m) torque wrench and 5/64-inch hex key, tighten orifice plug to 8 to 10 in. lb (0.9 to 1.1 N•m).



103. ST-790 injector test stand (4)

injector inlet connector (5) and burnishing tool (6)

Screw into ST-708 burnishing tool adapter (7) by turning large knob section (8) until secure.



**FUEL INJECTOR - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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TESTING - CONTINUED

**CAUTION**

When seating burnishing tool, use care not to push small knob in too hard, or over-tighten indicator knob. Damage to injector and burnishing tool will occur.

**NOTE**

ST-790 injector test stand must be running while burnishing.

104. ST-790 injector test stand (1)	Burnishing tool (2)	<ul style="list-style-type: none"> <li>a. Turn indicator knob (3) until spaced 3/8 inch (9.5 mm) from large knob (4).</li> <li>b. Slowly push small knob (5) in until slight contact is made in injector (6).</li> <li>c. Turn small knob (5) counterclockwise to lock with large knob (4) and indicator knob (3).</li> <li>d. Slowly turn indicator knob (3) in until slightly seated in injector (6). Do not overtighten.</li> <li>e. Index indicator knob (3) with mark on large knob (4).</li> <li>f. Advance indicator knob (3) one mark, and back off until spaced 3/8 inch (9.5 mm).</li> </ul>
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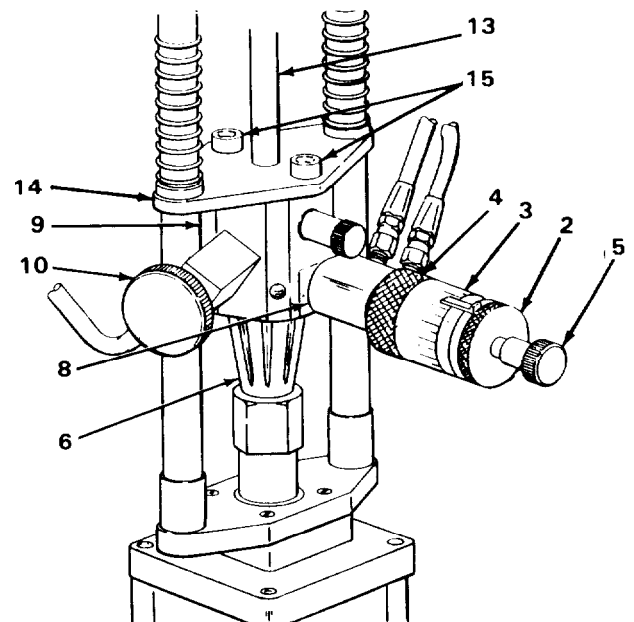
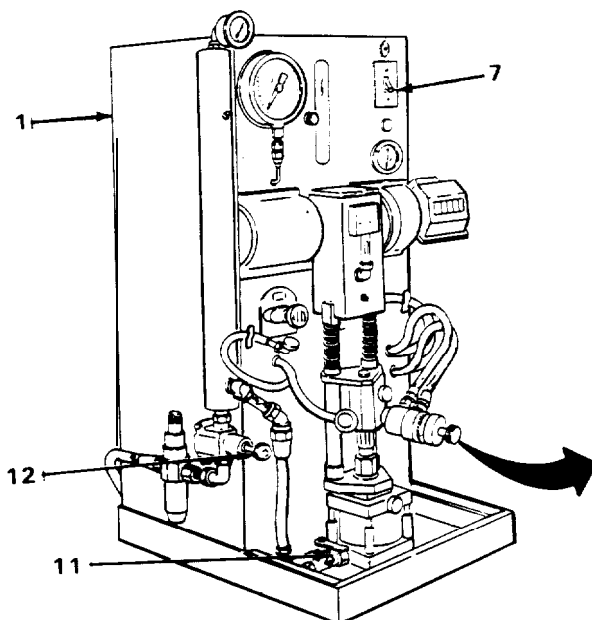
**NOTE**

Follow steps 95 thru 98 and recheck fuel delivery. If delivery is lower than 182 cc, repeat step 104. If delivery is higher than 183 cc, repeat steps 98 thru 104. If delivery is 182 to 183 cc, proceed to step 105.

105.	Motor switch (7)	Place in stop position.
106.	Injector inlet connector (8)	Remove from ST-708 burnishing tool adapter (9) by screwing out large knob (4) on burnishing tool.
107.	Drain connector (10) and burnishing tool (2)	Remove from ST-708 burnishing tool adapter (9).

**FUEL INJECTOR - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
108.	Hydraulic valve (11)	Open.	
109.	Air valve (12)	Close.	
110.	Injector (6)	Remove from ST-790 injector test stand.	
111.	Test stand link (13)	Slide out of ST-708 burnishing tool adapter (9).	
112.	Retainer plate (14)	Remove from ST-708 burnishing tool adapter (9) by removing two pins (15).	
113.	ST-708 burnishing tool adapter (9)	Remove from injector.	
114.	Injector (6)	Proceed with steps 31 thru 35 for injector final assembly.	



**NOTE**

FOLLOW-ON MAINTENANCE: Install injectors in cylinder head (page 2-78).

**TASK ENDS HERE**

## TURBOCHARGER

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This task covers:

- a. Disassembly (page 2-385).
  - b. Cleaning (page 2-388)
  - c. Inspection (page 2-389)
  - d. Assembly (page 2-393)
  - e. Final Inspection (page 2-397)
- 

### INITIAL SETUP

#### Tools

Brush, soft-bristle  
Cleaner, parts (with fluid)  
Extension, 6-inch, 1/2-inch drive  
Gage, bore  
Gage, thickness  
Hammer, ball-peen, 16-ounce  
Hammer, plastic-faced  
Handle, hinged, 1/2-inch drive  
Handle, ratchet, 1/2-inch drive  
Indicator, dial  
Mandrel  
Micrometer 0- to 1-inch  
Micrometer, 1- to 2-inch  
Micrometer, 3- to 4-inch  
Micrometer, 5- to 6-inch  
Press, arbor  
Puller, ST-647  
Socket, 7/16-inch, 3/8-inch drive  
Socket, 7/16-inch, 1/2-inch drive  
Socket, deep, 3/4-inch, 1/2-inch drive  
Socket, ST-1095  
Straightedge  
Support, bearing, ST-881  
Wrench, box-end, 7/16-inch  
Wrench, box-end, 5/8-inch  
Wrench, box-end, 3/4-inch  
Wrench, box-end, 1 3/8-inch  
Wrench, torque, 0 to 150 in. lb (0 to 16.9 N•m), 3/8-inch drive  
Wrench, torque, 0 to 150 ft lb (0 to 210 N•m), 1/2-inch drive

#### Materials/Parts

Cloth, emery (item 1, appendix B)  
Compound, antiseize (item 2, appendix B)  
Dye, leak-detection (item 7, appendix B)  
Insert, bearing  
Lockwasher, diffuser plate (eight required)  
Nut, self-locking, retaining strap (two required)  
Oil, lubricating (item 12, appendix B)  
Packing, preformed, bearing housing  
Packing, bearing housing  
Ring, oil control  
Ring, seal, diffuser plate  
Ring, sealing (two required)  
Screw, retaining strap (two required)  
Tape, masking (item 19, appendix B)  
Washer, flat, retaining strap (four required)

#### Equipment Condition

Turbocharger removed (page 2-12).

**TURBOCHARGER - CONTINUED**

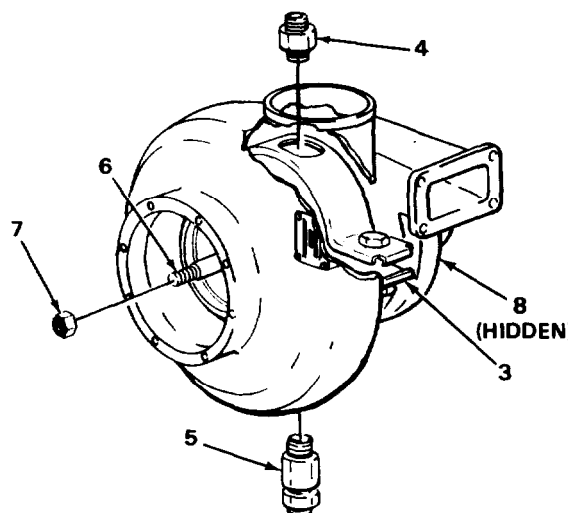
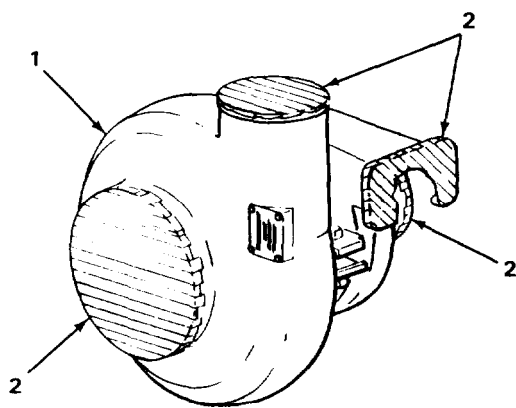
LOCATION	ITEM	ACTION REMARKS
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DISASSEMBLY

**NOTE**

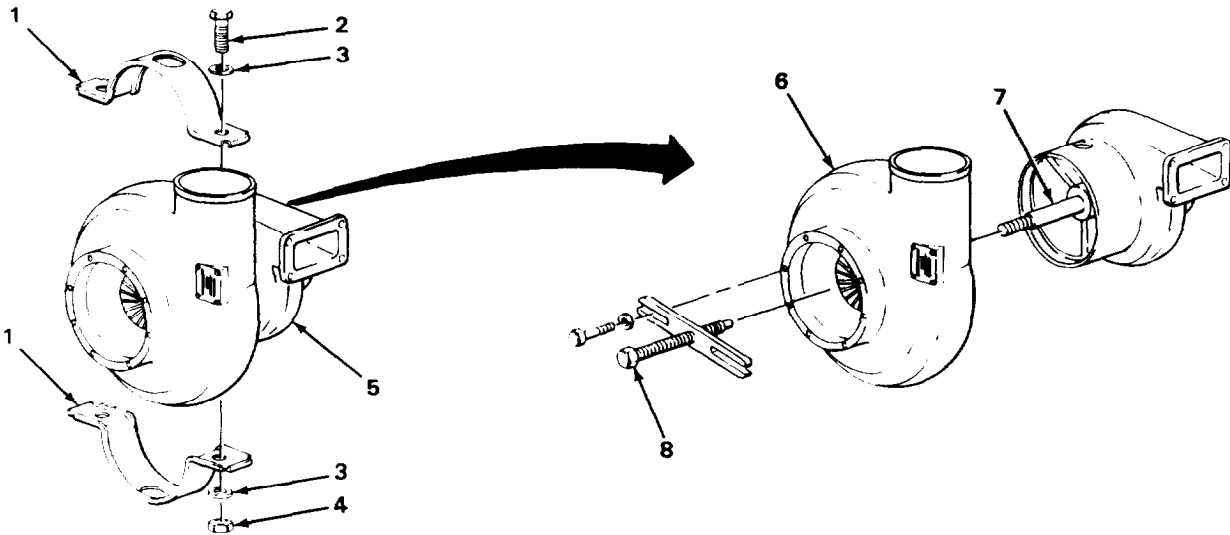
Exterior of turbocharger should be cleaned before disassembly. Mark compressor casing, diffuser plate, turbine casing, bearing housing, and clamps to make certain that parts are assembled in the same position.

- |                        |  |   |
|------------------------|--|---|
| 1. Turbocharger (1)    | Tape (2)   | Remove.<br><b>Discard.</b>  |
| 2. Bearing housing (3) | Oil line inlet fitting (4)                       | Using 5/8-inch box-end wrench, unscrew and take off.  |
| 3.                     | Oil line outlet fitting (5)                      | Using 1 3/8-inch box-end wrench, unscrew and take off.  |
| 4. Rotor shaft (6)     | Self-locking nut (7) and turbine wheel shaft (8) | a. Using ST-1095 socket and 1/2-inch drive hinged handle, hold turbine wheel from turning.<br>b. Using 1/2-inch drive 3/4-inch deep socket, ratchet handle, and 6-inch extension, unscrew and take off nut (7). |



**TURBOCHARGER - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
DISASSEMBLY - CONTINUED		
5. Retaining strap (1)	Two screws (2), four flat washers (3), and two self-locking nuts (4)	Using 7/16-inch box-end wrench, 1/2-inch drive 7/16-inch socket, and ratchet handle, unscrew and take off. Discard screws, flat washers, and self-lucking nuts.
6. Turbocharger (5)	Retaining strap (1)	Using 16-ounce ball-peen hammer, tap loose and take off.
7.	Compressor housing (6) and ST-647 puller (8)	a. Using ST-647 puller, take off compressor housing from shaft (7). b. Remove ST-647 puller.





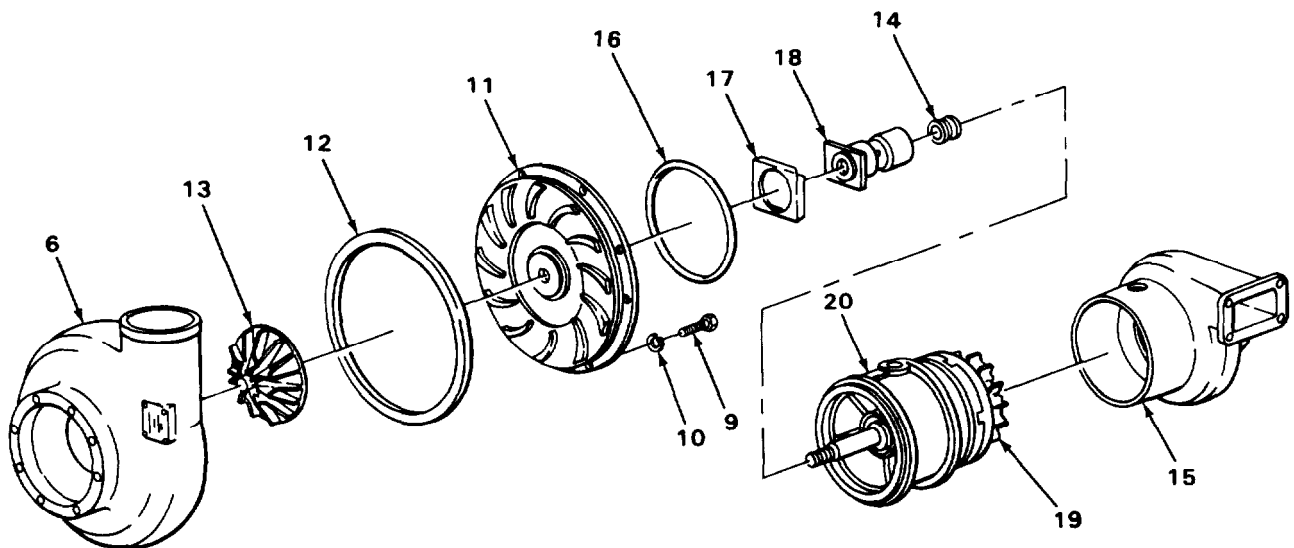
**TURBOCHARGER - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
10. Diffuser plate (11)	Turbocharger sleeve (14)	Take out.
11. Bearing housing and turbine housing (15)	Preformed packing (16), bearing insert (17), and floating bearing (18)	Take out. <b>Discard packing and bearing insert.</b>

**CAUTION**

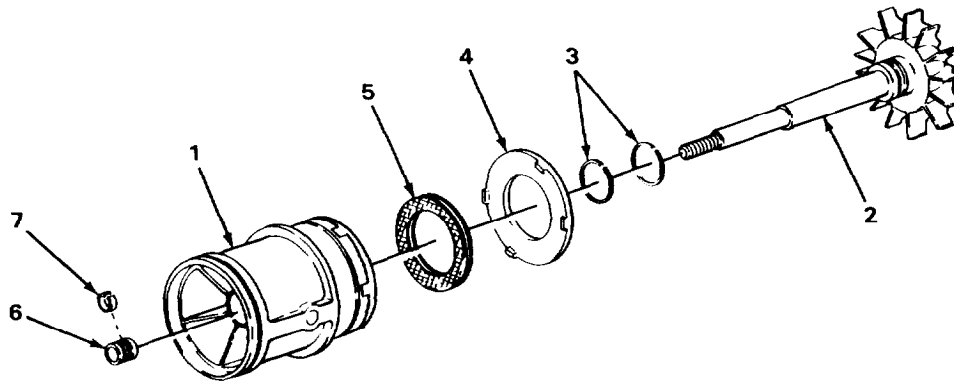
When pressing wheel and shaft from bearing housing, do not allow wheel and shaft to drop. Damage to wheel and shaft will occur.

- |     |   |   |
|-----|---|---|
| 12. | Wheel and shaft (19) and bearing housing (20) | Position ST-881 bearing support over bearing housing and against turbine housing (15). Using arbor press, press wheel, shaft, and bearing housing from turbine housing. |
|-----|---|---|



**TURBOCHARGER - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
DISASSEMBLY - CONTINUED		
13. Bearing housing (1)	Wheel and shaft (2)	Tap end of wheel and shaft lightly on work bench. <b>Remove wheel and shaft from bearing housing.</b>
14. Wheel and shaft (2)	Two sealing rings (3)	Take off. <b>Discard.</b>
15. Bearing housing (1)	Heat shield (4) and packing (5)	Take off. <b>Discard packing.</b>
16. Turbocharger sleeve (6)	Oil control ring (7)	Take off. <b>Discard.</b>



CLEANING

**WARNING**

Drycleaning solvent P-D-680 is toxic and flammable. Wear safety goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes, and do not breathe vapors. Do not use near open flame or excessive heat. Flashpoint for type #1 drycleaning solvent is 100oF (38°C) and for type #2 is 138°F (59°C). If you become dizzy while using solvent, get fresh air immediately, and get medical aid. If contact with eyes is made, flush your eyes with water, and get medical aid immediately. Failure to observe these precautions could cause serious injury or death to personnel.

Particles blown by compressed air are hazardous. Make certain the air stream is directed away from user and other personnel in the area. Compressed air used for cleaning purposes shall not exceed 30 psi (207 kPa). User must wear safety goggles or face shield to prevent injury.

**TURBOCHARGER - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
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**CAUTION**

Do not use glassbeading or sandblasting cleaning methods on parts to remove nearby deposits of carbon or glazed carbon. Serious damage to parts will occur.

Do not use chemical or caustic solutions or solvents that may damage aluminum or aluminum alloy parts. Serious damage to parts will occur.

Do not use wire brushes or stiff-bristle brushes on turbocharger parts for cleaning. Wire or stiff-bristle brushes will cause serious damage to parts.

- |     |           |  |
|-----|-----------|--|
| 17. | All parts | <ul style="list-style-type: none"> <li>a. Place all parts in parts cleaner for soaking. Keep parts separated and do not stack parts.</li> <li>b. Using a soft-bristle brush, brush heavy carbon and dirt deposits from parts.</li> <li>c. Pump parts cleaner fluid through oil passages to flush out loose particles of dirt or carbon.</li> <li>d. Drain off parts and steam clean thoroughly. Make sure oil passages are clean.<br/><b>See General Maintenance instructions, page 2-3 for cleaning procedures.</b></li> <li>e. Blow off excess water and dry parts thoroughly using moisture free compressed air.</li> </ul> |
|-----|-----------|--|

INSPECTION

**CAUTION**

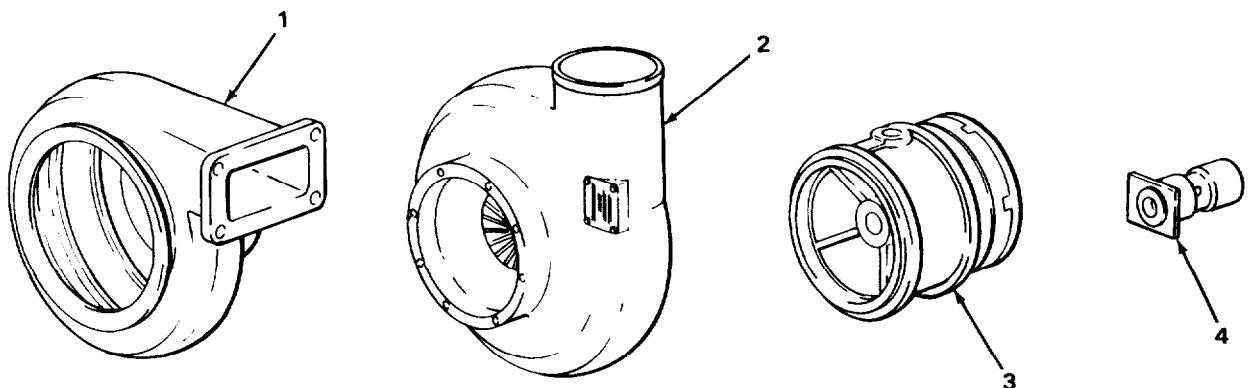
Move parts to clean and dry area for inspection and assembly procedures. Do not stack or bump parts together. Damage to parts may occur.

TURBOCHARGER - CONTINUED

LOCATION	ITEM	ACTION REMARKS
INSPECTION - CONTINUED		
18.	Turbine housing (1)	a. Using straightedge, check mounting flange area for cracks or distortion. <b>if cracked or distorted, discard.</b> b. Inspect turbine wheel side of turbine housing for cracks and distortion or wheel to housing contact. <b>if cracked or distorted, discard. if scratches are deep, discard housing. Small scratches and nicks can be polished out with emery cloth.</b>
19.	Turbine casing (2)	a. Inspect casing for cracks or distortion. <b>If cracked or distorted, discard.</b> b. Inspect impeller side of casing for cracks, scratches, nicks, or scoring. <b>if cracked, deeply scratched, or scored, discard. Small scratches, nicks, or scoring can be polished out with emery cloth.</b>
20.	Bearing housing (3)	a. Inspect for cracks in oil passages, inlet and outlet, and pitting or distortion on turbine end. <b>Discard if cracked, pitted, or distorted.</b> b. Check for cracks where ribs meet bearing housing and bearing housing bore. <b>Discard if cracked.</b> c. Using bore gage, measure inside diameter of bearing housing bore. Bore diameter should be 1.274 to 1.278 inches (32.36 to 32.46 mm). <b>Discard housing if bore exceeds 1.278 inches (32.38 mm).</b> d. Using 5- to 6-inch micrometer, measure turbine housing seating area diameter. Diameter should be 5.049 to 5.055 inches (128.25 to 128.40 mm). <b>Discard if diameter does not meet these specifications. New bearing housing should be 5.050 to 5.052 inches (128.27 to 128.32 mm).</b>

**TURBOCHARGER - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
	Bearing housing (3)	e. Using dial indicator, measure length of bearing housing from compressor stop to turbine stop, at several points. Maximum length is 2.994 inches (76.05 mm). <b>Discard if less than 2.986 inches (75.84 mm) or measurements indicate bearing housing is distorted.</b>
21.	Floating bearing (4)	a. inspect for cracks and chips. <b>Discard if cracked or chipped.</b> b. Using 1- to 2-inch micrometer, measure outside diameter at several places. <b>Discard if micrometer does not indicate 1.272 to 1.273 inches (32.31 to 32.33 mm).</b> c. Using bore gage, measure inside diameter of bearing. <b>Discard if bore gage does not indicate 0.7520 to 0.7525 inch (19.101 to 19.114 mm).</b> d. Using 3- to 4-inch micrometer, measure length of bearing. <b>Discard if micrometer does not indicate 3.078 to 3.080 inches (78.18 to 78.23 mm).</b>

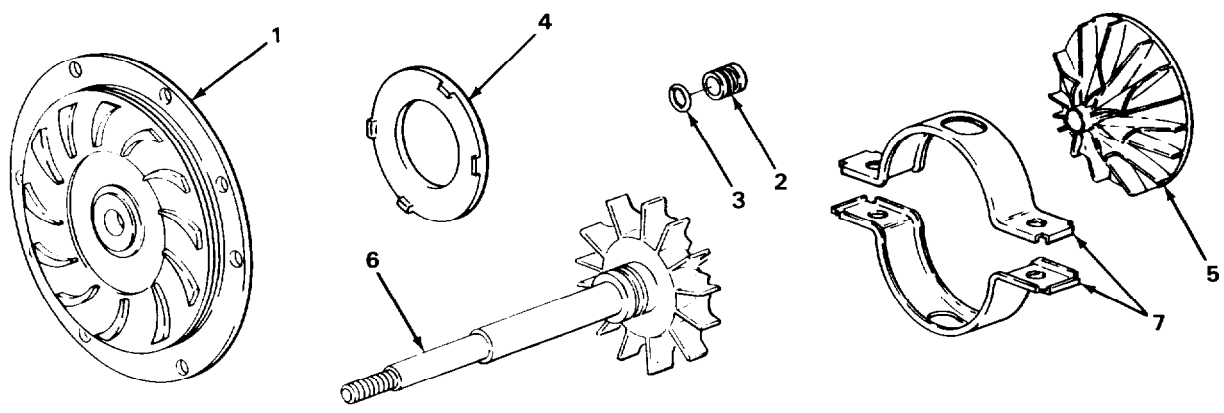


**TURBOCHARGER - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
INSPECTION - CONTINUED		
22.	Diffuser plate (1)	a. Inspect for cracks, burrs, or distortion. <b>Discard if cracked or distorted.</b> <b>Smooth out burrs with emery cloth.</b> b. Using bore gage, measure inside diameter of turbocharger sleeve bore. <b>Discard if bore gage does not indicate 0.999 to 1.004 inches (25.37 to 25.50 mm).</b>
23.	Turbocharger sleeve (2) and new oil control ring (3)	a. Inspect for indications of wear. <b>Discard if worn.</b> b. Using thickness gage and new oil control ring, insert oil control ring into groove on sleeve and measure clearance with thickness gage. <b>Discard if clearance exceeds .009 inch (0.23 mm).</b>
24.	Heat shield (4)	Inspect for cracks, distortion, or burned condition. <b>Discard if distorted, burned, or cracks exceed 1/2 inch (12.7 mm) in length.</b>
25.	Compressor wheel (5)	Inspect for broken vanes or indications of contact with turbine housing. Using leak-detection dye check for cracks. <b>Discard if cracked, broken, or contact with compressor housing is indicated.</b>
26.	Wheel and shaft (6)	a. Using leak-detection dye, check wheel for cracks. <b>Discard if cracked.</b> b. Inspect sealing ring grooves for grooves, scratches, or nicks. <b>Discard if grooves, scratches, or nicks cannot be removed with emery cloth.</b>

**TURBOCHARGER - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
	Wheel and shaft (6)	c. Inspect shaft bearing thrust shoulder for scratches or scoring. <b>Discard if scratches or scoring cannot be removed with emery cloth.</b> d. Using O-to I-inch micrometer, measure shaft bearing journal diameters. <b>if micrometer does not indicate 0.7495 to 0.7505 inch (19.04 to 19.06 mm), discard wheel and shaft.</b>
27.	Retaining strap (7)	Inspect for cracks or distortion. <b>Discard if cracked or distorted.</b>



ASSEMBLY

**CAUTION**

The work area and all parts must be free of grease, dust, dirt, and abrasive particles that may get into turbocharger during assembly, and cause premature turbocharger failure.

**TURBOCHARGER - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
<b>ASSEMBLY - CONTINUED</b>		
28. Wheel and shaft (1)	Floating bearing (2)	a. Coat shaft bearing journals with lubricating oil, and slide bearing into position. b. Using mandrel on shaft shoulder, check bearing end clearance using thickness gage. <b>Clearance should be 0.006 to 0.010 inch (0.15 to 0.25 mm).</b> c. Remove bearing.
29. Bearing housing (3)	New packing (4) and heat shield (5)	Position new packing on turbine end of bearing housing and install heat shield.
30. Wheel and shaft (1)	Two new sealing rings (6)	Apply a light coat of lubricating oil to sealing ring grooves on shaft, and install two new sealing rings.

**CAUTION**

Care must be taken when starting sealing rings in chamfer of bore, to allow sealing rings to compress properly.

**NOTE**

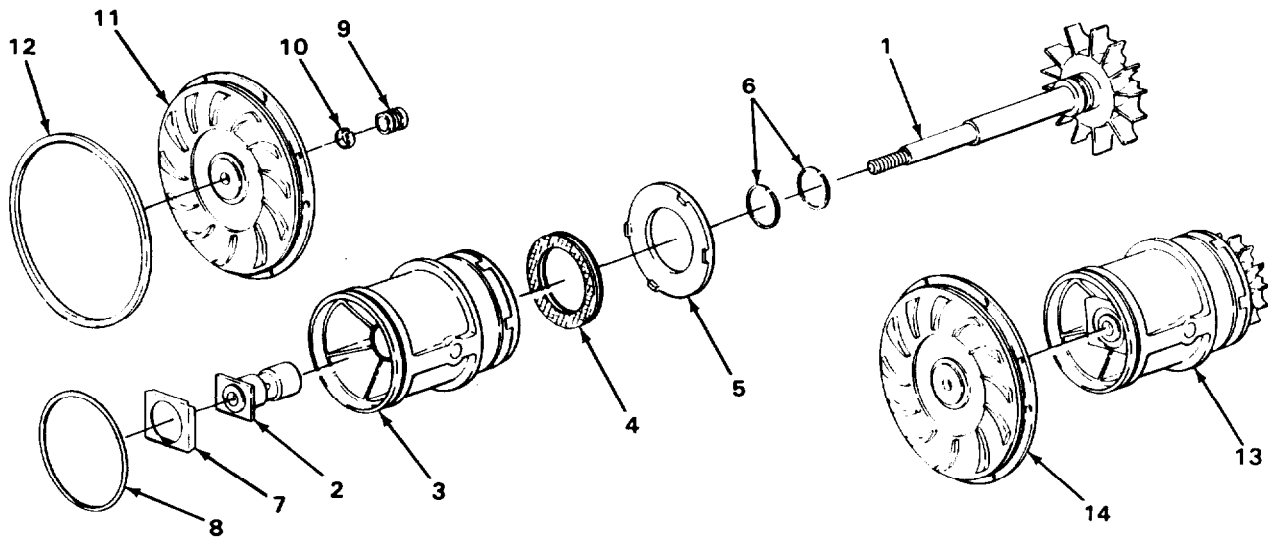
Make sure end caps of sealing rings are 180 degrees from each other when installing wheel and shaft.

31. Bearing housing (3)	Wheel and shaft (1)	Coat bore of bearing housing with lubricating oil and install wheel and shaft.
32.	Floating bearing (2)	Coat wheel and shaft and bearing with lubricating oil, and insert bearing over shaft in bearing housing.



**TURBOCHARGER - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
33.	New bearing insert (7)	Position new bearing insert over shaft to flange on bearing.
34.	New preformed packing (8)	Lubricate new packing with lubricating oil and install in groove on compressor end of bearing housing.
35. Seal (9)	Piston ring (10)	Coat seal and piston ring with lubricating oil and install piston ring on seal.
36. Diffuser plate (11)	Seal (9) and piston ring (10)	Install seal assembly from inside of diffuser plate with piston ring towards outside of diffuser plate.
37.	New seal ring (12)	Lubricate new seal ring with lubricating oil and install on lip of diffuser plate.
38. Bearing housing assembly (13)	Diffuser plate assembly (14)	Coat bearing housing bore with lubricating oil and place diffuser plate over shaft. Align retainer on diffuser plate so that retainer covers side of bearing flange.

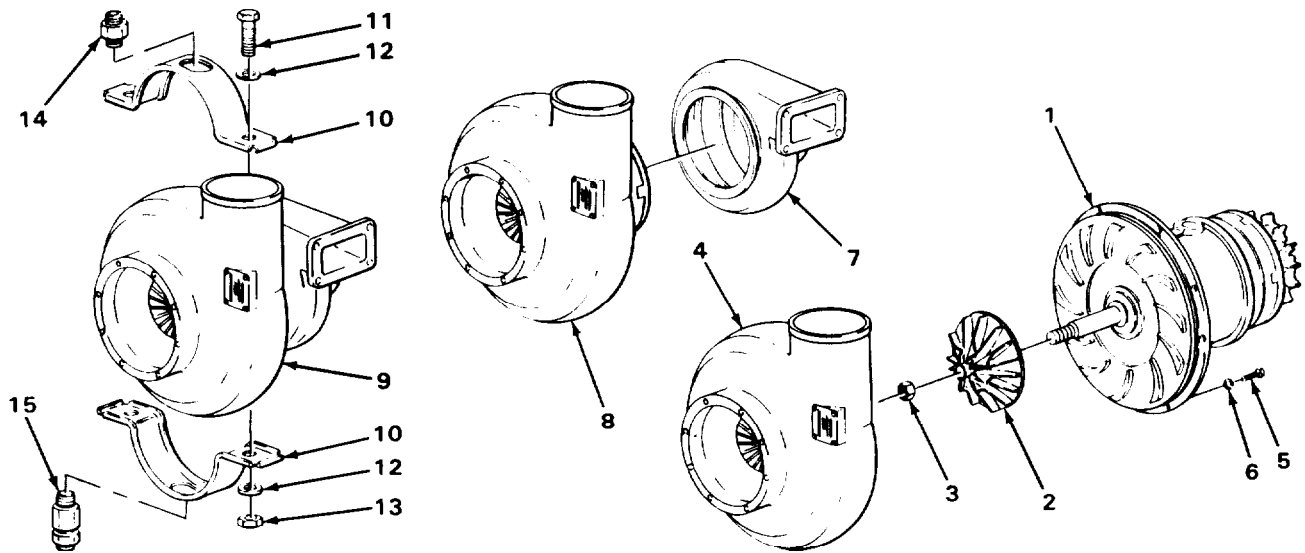


**TURBOCHARGER - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
ASSEMBLY - CONTINUED		
39. Bearing housing assembly (1)	Compressor wheel (2)	<ul style="list-style-type: none"> <li>a. Lubricate shaft with lubricating oil and position compressor wheel on shaft.</li> <li>b. Using arbor press and mandrel, press compressor wheel against seal.</li> </ul>
<b><u>CAUTION</u></b>		
Do not overtorque self-locking nut as this will deform turbine wheel and shaft.		
40.	Self-locking nut (3)	Using 3/4-inch box-end wrench, ST-1095 socket, and 1/2-inch drive 0 to 150 ft lb (0 to 210 N•m) torque wrench, install and tighten self-locking nut to 20 to 24 ft lb (27 to 33 N•m).
41.	Compressor housing (4), eight screws (5), and eight new lockwashers (6)	<ul style="list-style-type: none"> <li>a. install compressor housing on bearing housing assembly, and aline index marks made in disassembly.</li> <li>b. Install new lockwashers on screws and screw into compressor housing.</li> <li>c. Using 3/8-inch drive 7/16-inch socket and 0 to 150 in. lb (0 to 16.9 N•m) torque wrench, tighten to 60 to 84 in. lb (6.7 to 9.7 N•m).</li> </ul>
42. Turbine housing (7)	Bearing housing and compressor assembly (8)	<ul style="list-style-type: none"> <li>a. Lubricate turbine housing bore with anti-seize compound.</li> <li>b. Position bearing housing and compressor assembly into turbine housing and aline index marks made in disassembly.</li> </ul>
43. Turbocharger assembly (9)	Retaining straps (10), two new screws (11), four new flat washers (12) and two new self-locking nuts (13)	<ul style="list-style-type: none"> <li>a. Position retaining straps around bearing housing and center retaining strap openings over oil supply and drain holes.</li> <li>b. Install one new flat washer on each new screw and install through retaining straps.</li> <li>c. Install one new flat washer on each new screw and screw on new self-locking nut.</li> <li>d. Using 7/16-inch box-end wrench, 1/2-inch drive 7/16-inch socket, and 0 to 150 ft lb torque wrench, tighten to 32 to 36 ft lb (3.6 to 4.1 N•m).</li> </ul>

TURBOCHARGER - CONTINUED

LOCATION	ITEM	ACTION REMARKS
44.	Oil line inlet fitting (14)	Screw in and tighten using 5/8-inch box-end wrench.
45.	Oil line outlet fitting (15)	Screw in and tighten using 1 3/8-inch box-end wrench.



FINAL INSPECTION

- 46. Turbocharger assembly

Check radial clearance of diffuser plate and compressor wheel as follows: Push shaft toward side of bore, and using thickness gage, measure minimum distance between wheel vanes and housing.

**Clearance should be 0.006 to 0.028 inch (0.15 to 0.71 mm) for compressor wheel and 0.008 to 0.043 inch (0.20 to 1.09 mm) for turbine wheel.**

**TURBOCHARGER - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
FINAL INSPECTION - CONTINUED		
47.		Using a dial indicator, measure total end clearance of wheels and shaft by pushing shaft down all the way, and then moving back again. <b>End clearance should be 0.006 to 0.018 inch (0.15 to 0.46 mm).</b>
48.		Spin rotor by hand to make sure no interference is present.
49.		Cover all openings in turbocharger with masking tape.

**NOTE**

FOLLOW-ON MAINTENANCE: Install turbocharger on engine (page 2-136).

**TASK ENDS HERE**

**ANEROID CONTROL VALVE**

This task covers:

- |                             |                            |
|-----------------------------|----------------------------|
| a. Disassembly (page 2-399) | c. Inspection (page 2-400) |
| b. Cleaning (page 2-400)    | d. Assembly (page 2-402)   |

**INITIAL SETUP**

**Tools**

- Hammer, plastic-faced
- Pan, drain, 2-gallon
- Pliers, diagonal-cutting
- Screwdriver, flat-tip, 1/4-inch
- Wrench, box-end, 7/16-inch
- Wrench, box-end, 9/16-inch
- Wrench, hex, 3/16-inch
- Wrench, open-end, 7/8-inch

**Materials/Parts**

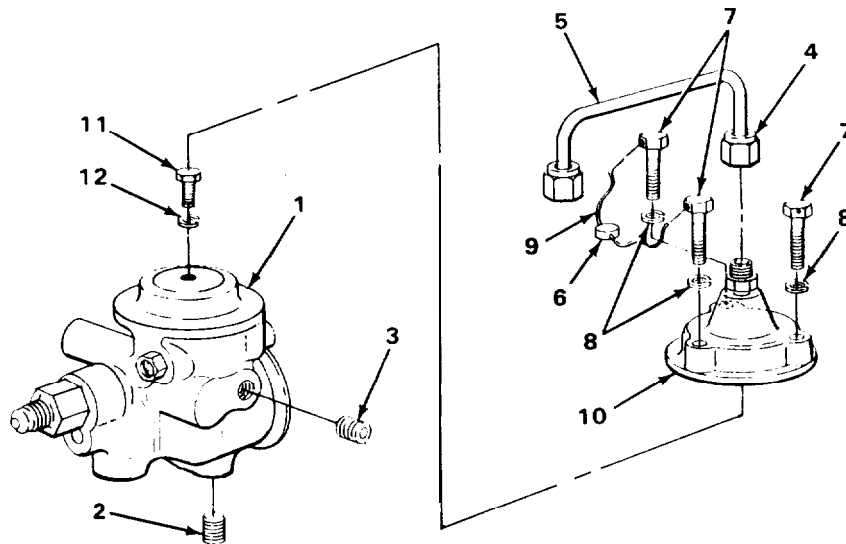
- Cover, side, aneroid control valve
- Lockwasher, bellows
- Lockwasher, bellows cover (three required)
- Packing, preformed (two required)
- Oil, lubricating (item 12, appendix B)
- Wire, locking (item 21, appendix B)

**Equipment Condition**

Aneroid control valve removed (page 2-25).

ANEROID CONTROL VALVE - CONTINUED

LOCATION	ITEM	ACTION REMARKS
<b>DISASSEMBLY</b>		
1. Aneroid control valve (1)	Pipe plugs (2 and 3)	a. Using 3/16-inch hex wrench, unscrew and take out. b. Drain oil into drain pan.
2.	Tubing nut (4) and tubing (5)	Using 9/16-inch box-end wrench, loosen and take off.
3.	Lead seal (6) three screws (7) three lockwashers (8) and lock wire (9)	a. Using diagonal-cutting pliers, cut lock wire and take off. b. Using 7/16-inch box-end wrench, unscrew and take out. <b>Discard lockwashers and lock wire.</b>
4.	Bellows cover (10)	Using plastic-faced hammer, tap gently and take off.
5.	Screw (11) and lockwasher (12)	Using 7/16-inch box-end wrench, unscrew and take off. <b>Discard lockwasher.</b>



**ANEROID CONTROL VALVE - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
DISASSEMBLY - CONTINUED		
6. Aneroid control valve (1)	Bellows washer (2) bellows (3), piston (4), and spring (5)	Take off.
7.	Side control cover (6)	Using 1/4-inch flat-tip screwdriver, pry out. <b>Discard side cover.</b>
8.	Bellows actuating shaft (7), shaft valve (8), and pre-formed packing (9)	a. Lift up bellows actuating shaft and pull out shaft valve. b. Take off packing. <b>Discard.</b>
9.	Check valve (10), gasket (11), and air filter (12)	a. Using 7/8-inch open-end wrench, unscrew check valve and take out. b. Take off gasket. <b>Discard gasket.</b> c. Using 7/16-inch box-end wrench, unscrew air filter and take out.

CLEANING

**WARNING**

Drycleaning solvent P-D-680 is toxic and flammable. Wear safety goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes, and clothes, and do not breathe vapors. Do not use near open flame or excessive heat. Flashpoint for type #1 drycleaning solvent is 100oF (38°C) and for type #2 is 138°F (59°C). If you become dizzy while using solvent, get fresh air immediately, and get medical aid. if contact with eyes is made, wash your eyes with water, and get medical aid immediately. Failure to observe these precautions could cause serious injury or death to personnel.

**NOTE**

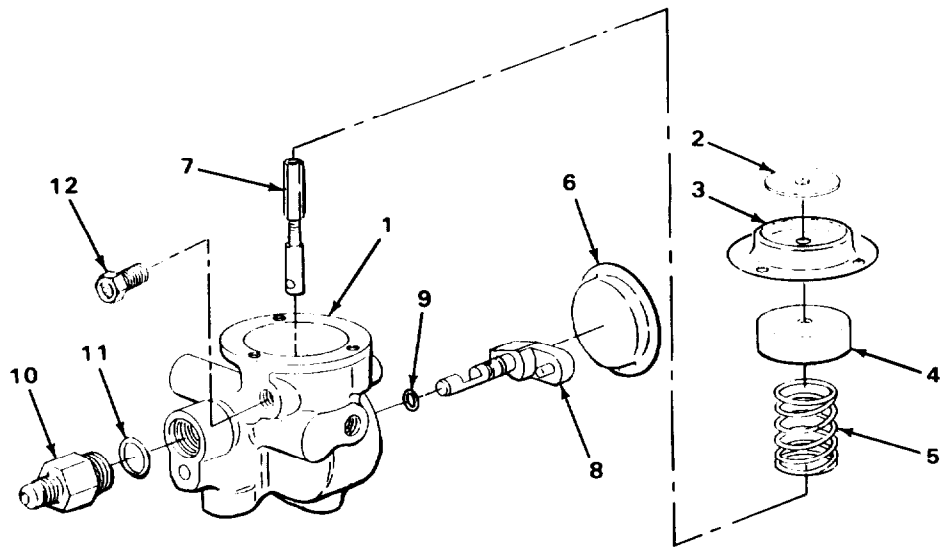
For general cleaning procedures, see General Maintenance Instructions, page 2-3.

INSPECTION

10.	Bellows cover (10)	Check for cracks, chips, or warpage. Discard if cracked, chipped, or warped.
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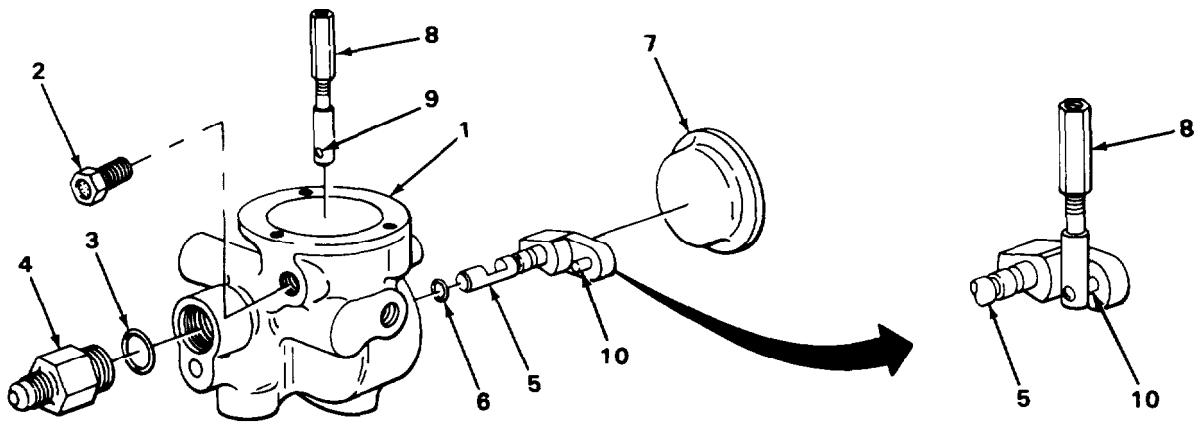
**ANEROID CONTROL VALVE - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
INSPECTION - CONTINUED			
11.	Bellows (3)	Check for cracks, wrinkles, or dryness.	<b>Discard if cracked, wrinkled, or dry.</b>
12.	Spring (5)	Check for cracks, breaks, or loss of tension.	<b>Discard if cracked, broken, or weak.</b>
13.	Bellows actuating shaft (7)	Check for bent shaft or damaged threads.	<b>Discard if bent or damaged.</b>
14.	Aneroid control valve body (1)	Check for cracks, chips, warpage, or damaged screw holes.	<b>Discard if defective.</b>
15.	Air filter (12)	Check for clogged screen.	<b>Discard if defective.</b>



**ANEROID CONTROL VALVE - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
<b>ASSEMBLY</b>		
16. Aneroid control valve (1)	New gasket (3) and check valve (4)	a. install new gasket on check valve. b. Put check valve into position, and using 7/8-inch open-end wrench, tighten.
17.	Air filter (2)	Put in position, and using 7/16-inch box-end wrench, tighten.
18.	Shaft valve (5) and new preformed packing (6)	Put new packing on shaft valve.
19.	Side cover (7)	Put in position and, using plastic-faced hammer, tap in place.
20.	Shaft valve (5) and bellows actuating shaft (8)	Lower bellows actuating shaft into aneroid control valve body (1) alining hole (9) with pin (10) on shaft valve as shown.



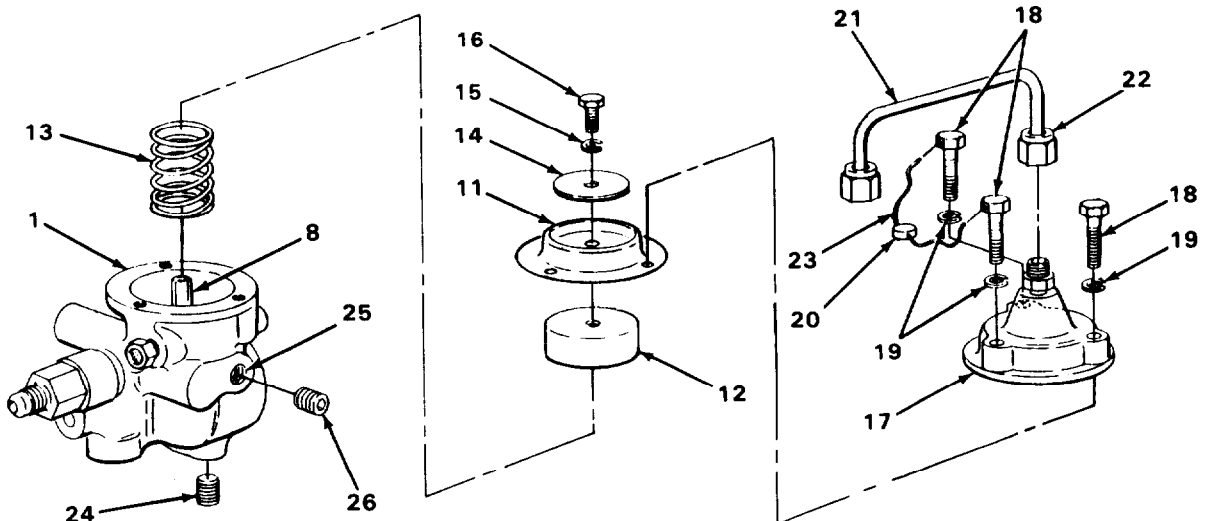
**NOTE**

Before performing step 21, dip bellows in lubricating oil to ensure pliability when assembling.



**ANEROID CONTROL VALVE - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
21. Aneroid control valve body (1)	Bellows (11), piston (12), spring (13), and bellows actuating shaft (8)	Place bellows, piston, and spring on bellows actuating shaft.
22.	Bellows washer (14), new lockwasher (15) and screw (16)	a. Place bellows washer on bellows (11). b. Position new lockwasher and screw, and using 7/16-inch box-end wrench, tighten.
23.	Bellows cover (17)	Aline bellows (11) and bellows cover with holes in aneroid control valve (1).
24.	Three screws (18), and three new lockwashers (19)	Position new lockwashers and screws as shown, and using 7/16-inch box-end wrench, tighten.
25.	Lead seal (20), tubing (21), tubing nut (22), and new lock wire (23)	a. Connect new lock wire to screws and crimp on lead seal. b. Position tubing, and using 9/16-inch box-end wrench, tighten tubing nut.
26.	Pipe plug (24), pipe plug hole (25), and pipe plug (26)	a. Using 3/16-inch hex wrench, screw in and tighten pipe plug (24). b. Fill pipe plug hole with lubricating oil until oil leaks from hole. c. Using 3/16-inch hex wrench, screw in and tighten pipe plug (26).



**ANEROID CONTROL VALVE - CONTINUED**

**NOTE**

FOLLOW-ON MAINTENANCE: Install aneroid control valve (page 2-132).

**TASK ENDS HERE**

**Section XV. COOLING SYSTEM MAINTENANCE**

	Page		Page
idler Pulley .....	2-404	Water Pump .....	2-408

**IDLER PULLEY**

This task covers:

- |                             |                            |
|-----------------------------|----------------------------|
| a. Disassembly (page 2-404) | c. Inspection (page 2-405) |
| b. Cleaning (page 2-405)    | d. Assembly (page 2-406)   |

**INITIAL SETUP**

**Tools**

- Chisel, cold, 1/2-inch
- Hammer, ball-peen, 16-ounce
- Mandrel
- Mandrel, ST-658
- Pliers, snapping
- Press, arbor
- Puller, bearing
- Wrench, box-end, 7/8-inch
- Wrench, hex, 5/32-inch
- Wrench, open-end, 1 1/16-inch

**Materials/Parts**

- Oil, lubricating (item 12, appendix B)
- Packing, preformed, shouldered shaft
- Seal, oil, idler shaft

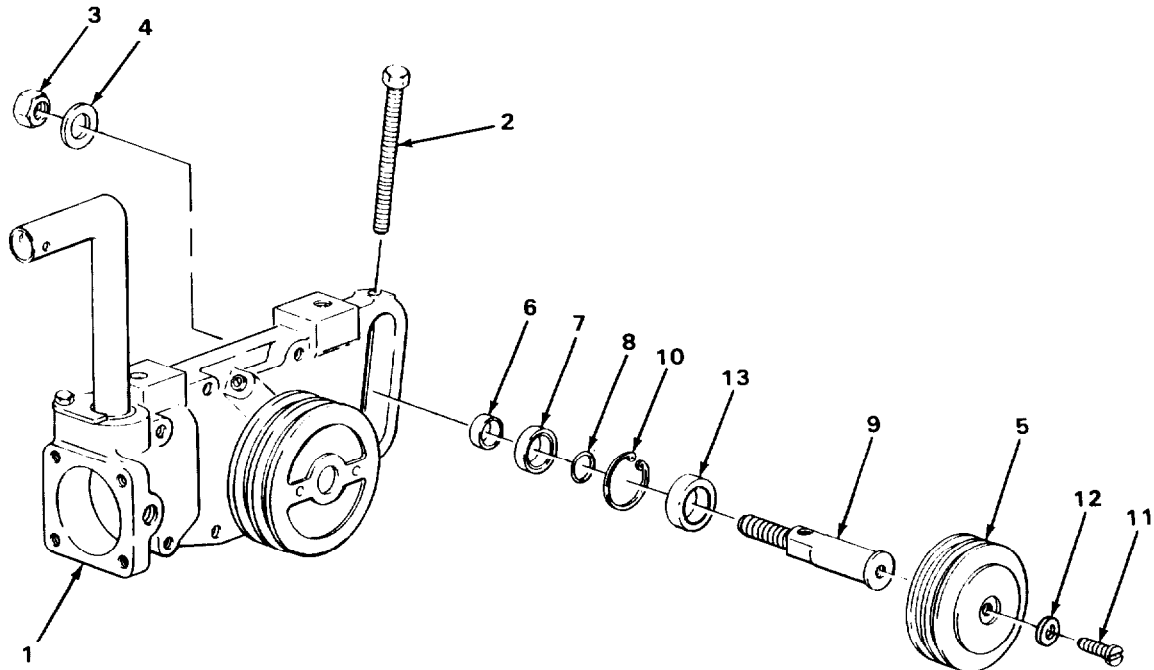
**Equipment Condition**

Water pump removed (page 2-37).

LOCATION	ITEM	ACTION REMARKS
<b>DISASSEMBLY</b>		
1.	Water pump (1)	Fan adjusting screw (2)
		Using 7/8-inch box-end wrench, unscrew and take out.
2.		Nut (3) and flat washer (4)
		a. Using 1 1/16-inch open-end wrench, unscrew and take off.
		b. Remove idler pulley (5) with attached parts.

**IDLER PULLEY - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
3. Idler pulley (5) with attached parts	Sleeve spacer (6), oil seal (7), and preformed packing (8)	a. Using 16-ounce ball-peen hammer and 1/2-inch cold chisel, drive bearing spacer (6) off shouldered shaft (9). b. Take out oil seal and packing. <b>Discard.</b>
4.	Retaining ring (10)	Using snapping pliers, take off.
5. Idler pulley (5)	Screw (11) and flat washer (12)	Using 5/32-inch hex wrench, unscrew and take out.
6.	Shouldered shaft (9) and bearing (13)	Using bearing puller, pull out.
7. Bearing (13)	Shouldered shaft (9)	Using arbor press, press out.



**CLEANING**

**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

**IDLER PULLEY - CONTINUED**

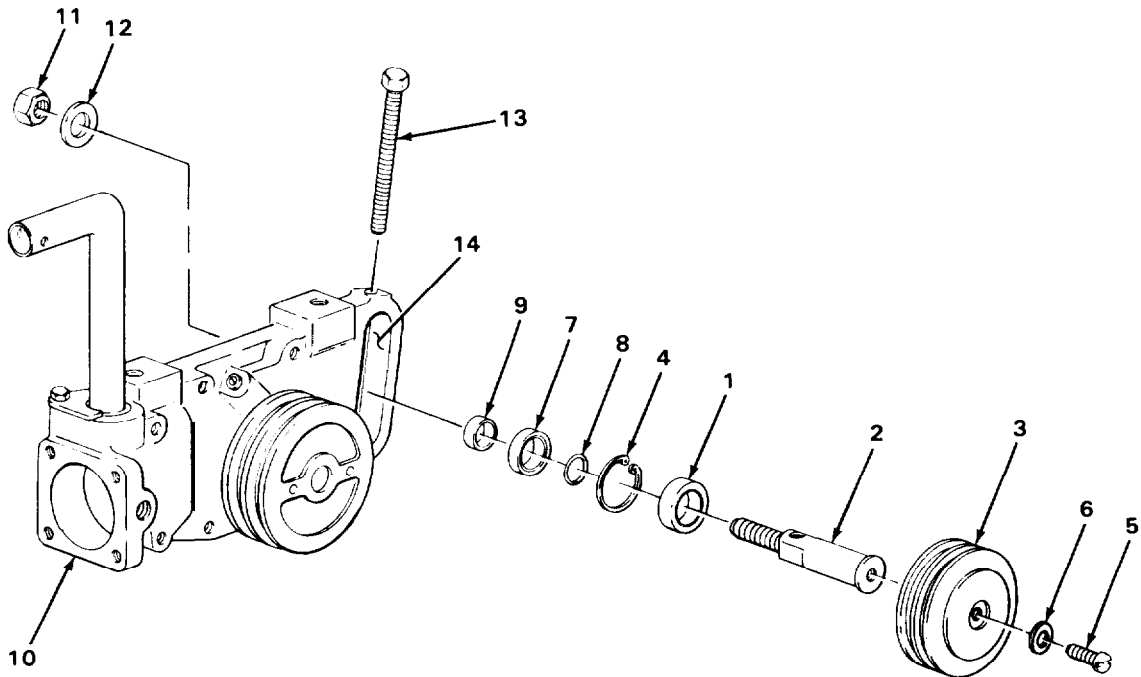
LOCATION	ITEM	ACTION REMARKS
<b>INSPECTION</b>		
8.	Bearing (1) and shouldered shaft (2)	a. Inspect bearing for excessive wear or binding (page 2-444). b. Inspect shaft for straightness, galling, or pitting on bearing surface, or damaged threads. <b>Discard bearing or shaft if defective.</b>
9.	Idler pulley (3)	Inspect pulley groove for excessive wear, chips, cracks, or burrs. <b>Discard if defective.</b>
<b>ASSEMBLY</b>		
10.	Shouldered shaft (2) and bearing (1)	a. Using lubricating oil, lubricate idler shaft. b. Using arbor press and mandrel, press bearing onto shouldered shaft until inner race of bearing touches idler shaft flange.
11.	Idler pulley (3) and bearing (1)	Using arbor press, press bearing with idler shaft (2) into idler pulley until bearing bottoms.
12.	Retaining ring (4)	Using snapping pliers, put in.
13. Idler pulley (3)	Screw (5) and flat washer (6)	a. Put in place. b. Using 5/32-inch hex wrench, tighten.
14. Shouldered shaft (2)	New oil seal (7) and new preformed packing (8)	a. Using lubricating oil, lubricate lip of new oil seal and new packing. b. Position new packing into groove on idler shaft. c. Using arbor press and ST-658 mandrel, press new oil seal into idler pulley (3).

**IDLER PULLEY - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
15.	Bearing spacer (9)	a. Position on idler shaft (2). b. Using arbor press and mandrel, press bearing through oil seal (7) until bottomed against bearing inner race.
16. Water pump (10)	Idler shaft (2), nut (11), flat washer (12), and fan adjusting screw (13)	a. Position shaft in adjusting slot (14). b. Put on nut and flatwasher. <b>Do not tighten.</b> c. Screw fan adjusting screw into idler shaft. <b>Do not tighten.</b>

**NOTE**

Adjustments will be made when installing belts.



**TASK ENDS HERE**

**WATER PUMP**

---

This task covers:

- a. Disassembly (page 2-408)
  - b. Cleaning (page 2-409)
  - c. Inspection (page 2-409)
  - d. Assembly (page 2-410)
- 

**INITIAL SETUP**

Tools

- Disassembly tool, bearing, ST-1114
- Driver, wear sleeve, ST-1159
- Gage, bore
- Hammer, ball-peen, 16-ounce
- Mandrel
- Mandrel, seal, ST-1191-2 and - 3
- Mandrel ST-658
- Micrometer, 0- to 1-inch
- Pliers, snapping
- Press, arbor
- Puller, ST-647
- Punch, straight, 3/16-inch
- Straightedge, 12-inch
- Wrench, box-end, 1/2-inch

Materials/Parts

- Grease, extreme-pressure (item 10, appendix B)
- Oil, lubricating (item 12, appendix B)
- Packing, preformed, water by-pass tube
- Seal, carbon-faced
- Seal, oil, front
- Seal, oil, rear
- Seat and seal, ceramic
- Sleeve, wear (if required)

Equipment Condition

Water pump removed (page 2-37).

---

LOCATION	ITEM	ACTION REMARKS
<b>DISASSEMBLY</b>		
1.	Water pump body (1)	Pulley (2) and impeller (4) Using ST-647 puller, pull from shaft (3).
2.	Ceramic seat and seal (5), front oil seal (6), and bearing retaining ring (7)	a. Take out ceramic seat and seal from impeller side of water pump. <b>Discard.</b> b. Take out front oil seal from pulley side of water pump. <b>Discard.</b> c. Using snapping pliers, take out retaining ring.
3.	Shaft assembly (items 3 and 8 thru 11)	Support pulley side of water pump and, using arbor press and mandrel, press shaft assembly from water pump.
4.	Shaft (3)	Outer bearing (8) and bearing spacer (9) Using ST-1114 bearing disassembly tool, press shaft through outer bearing and bearing spacer.

**WATER PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
5.	Retaining ring (10) and inner bearing (11)	a. Using snapping pliers, take off retaining ring. b. Support inner bearing on inside race and using arbor press and mandrel, press out shaft (3).
6. Water pump body (1)	Carbon-faced seal (12) and rear oil seal (13)	Take out. <b>Discard.</b>
7.	Screw (14), clamp (15), water by-pass tube (16), and pre-formed packing (17)	a. Using 1/2-inch box-end wrench, unscrew and take out screw and clamp. b. Pull water by-pass tube from water pump body. c. Take off packing. <b>Discard.</b>

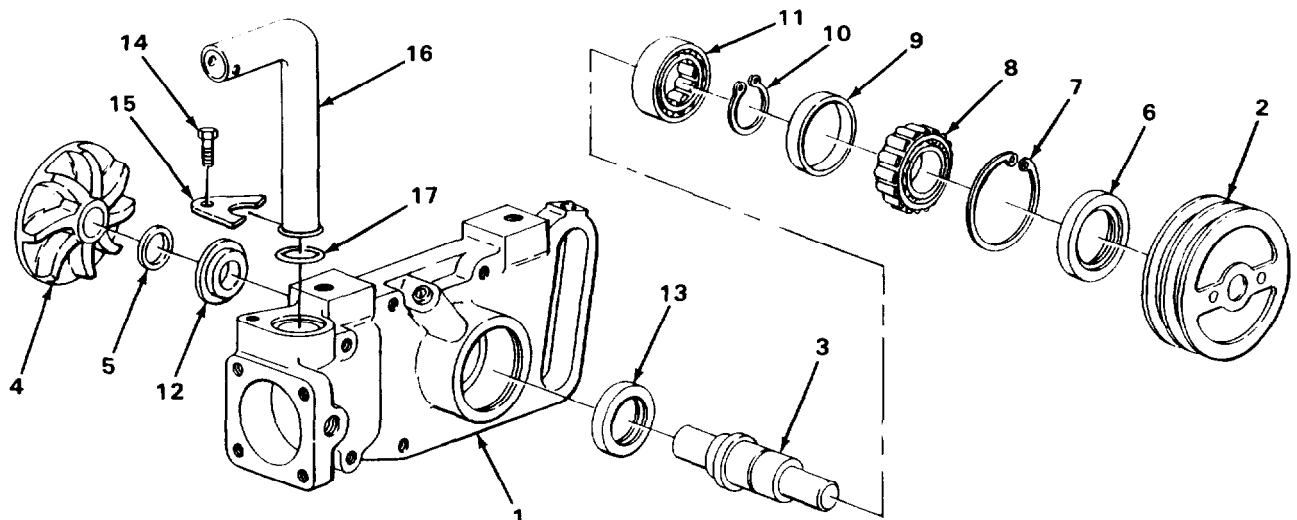
CLEANING

**NOTE**

For general cleaning procedures, see General Maintenance Instructions, page 2-3.

INSPECTION

8. Outer bearing (8) bearing spacer (9), and inner bearing (11)
- Inspect inner bearing and outer bearing for wear, roughness, and damage.  
**Discard if worn, rough, or damaged.**
  - Inspect bearing spacer for wear or damage.  
**Discard if worn or damaged.**



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**WATER PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
INSPECTION - CONTINUED		
9.	Impeller(1), shaft (2), and pulley (3)	a. Using bore gage, measure bore diameter of impeller and pulley. b. Using 0-to 1-inch micrometer, measure shaft diameters that carry pulley and impeller. <b>There must be a minimum of 0.001 inch (.025 mm) press fit between bore diameters and shaft diameters.</b>
10.	Impeller (1)	Inspect for cracks and corrosion. <b>Discard if cracked or corroded.</b>
11.	Shaft (2)	a. Using 12-inch straightedge, check for straightness. <b>Discard if bent.</b> b. Inspect all press fit mating surfaces. <b>Discard if scored.</b>
12.	Pulley (3)	Inspect for cracks, bends, or excess wear in grooves. <b>Discard if cracked, bent, or worn.</b>
13.	Water pump body (4)	Inspect for cracks, damage from bearings warpage, or damaged mating surfaces. <b>Discard if defective.</b>
14. Pulley (3)	Wear sleeve (5)	Inspect for grooves or excessive wear. <b>Replace if worn or if grooves are noted. (See steps 16 and 17).</b>

ASSEMBLY

**NOTE**

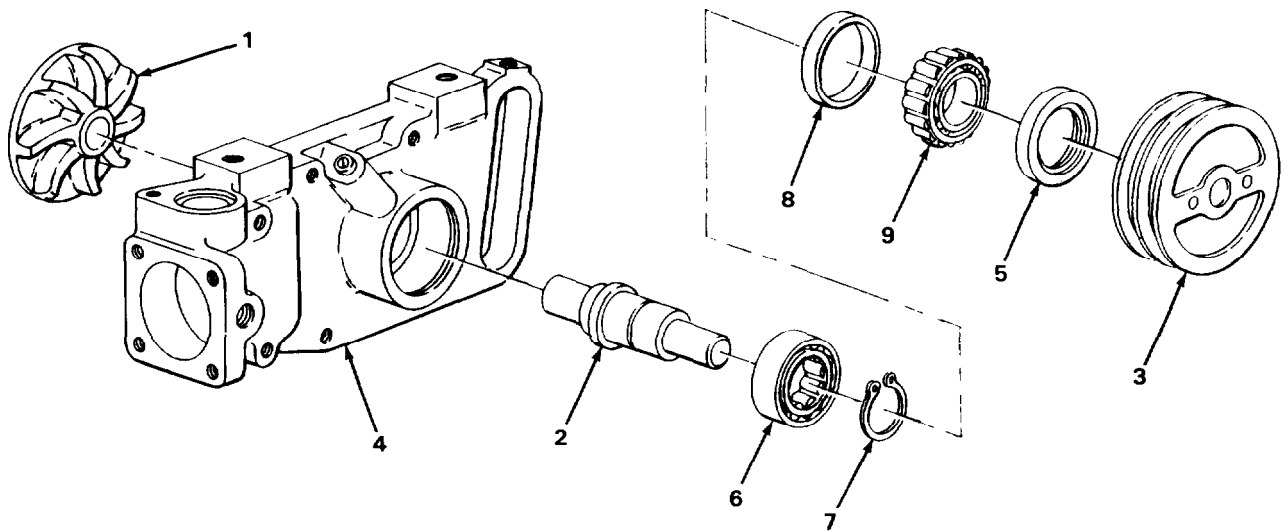
Perform steps 15 and 16 only if wear sleeve is to be replaced.

15.	Pulley (3) and wear sleeve (5)	a. Using 3/16-inch straight punch and 16 ounce ball-peen hammer, drive wear sleeve out of pulley. b. Discard wear sleeve.
16. Pulley (3)	New wear sleeve (5)	a. Position new wear sleeve in pulley hub. b. Using ST-1159 wear sleeve driver, drive in new wear sleeve.



WATER PUMP - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
17. Shaft (2)	Inner bearing (6) and retaining ring (7)	a. Lubricate shaft with extreme-pressure grease and position inner bearing on shaft. b. Using arbor press and ST-658 mandrel seated on inner race, press inner bearing until seated on shoulder of shaft. c. Using snapping pliers, install retaining ring.	
18.	Bearing spacer (8)	Install.	
19.	Outer bearing (9)	Using arbor press and ST-658 mandrel seated on inner race, press on outer bearing until seated against bearing spacer (8).	<b>Check inner bearing and outer bearing for free rotation.</b>



**WATER PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
ASSEMBLY - CONTINUED		
20. Water pump body (1)	New rear oil seal (2)	a. Position new rear oil seal on pulley side of water pump body with lip opposite impeller (3). b. Using ST-1 191-2 seal mandrel, press into water pump body.

**CAUTION**

Keep seal face free from grease or other foreign material to prevent damage to seat.

21.	New carbon-faced seal (4)	a. Position new carbon-faced seal on impeller side of water pump body (1) with lip facing impeller (3). b. Using ST-658 mandrel, press into water pump body until seal bottoms.
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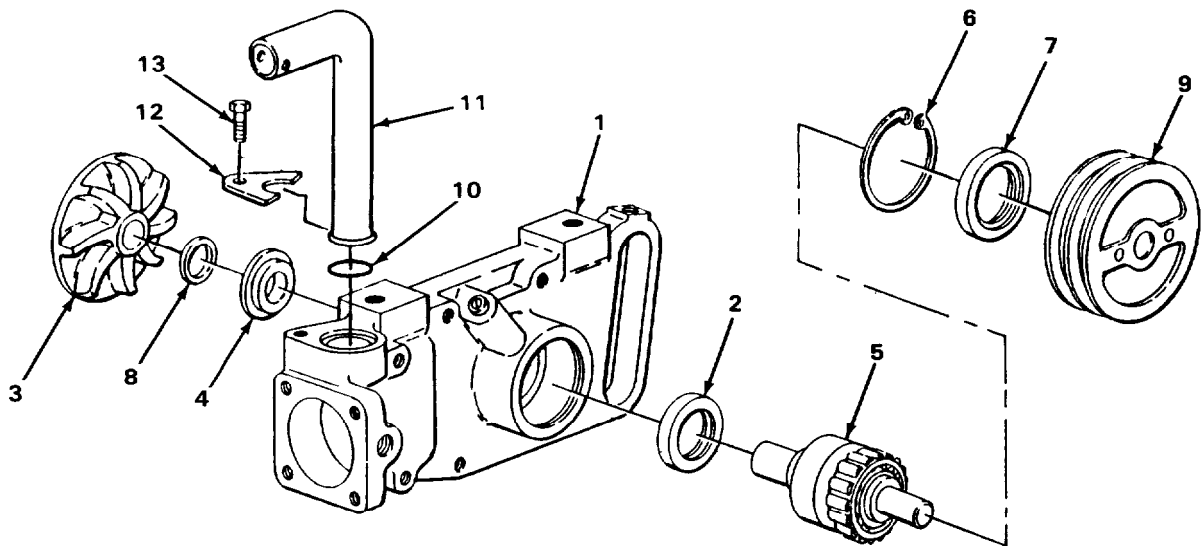
**CAUTION**

Do not support water pump body on thin section of impeller cavity when installing shaft assembly or damage to water pump body may occur.

22.	Shaft assembly (5) and bearing retaining ring (6)	a. Using arbor press and ST-658 mandrel, press shaft assembly into water pump body until inner bearing bottoms on rear oil seal. b. Using snapping pliers, install retaining ring.
23.	New front oil seal (7)	Using arbor press and ST-1191-3 seal mandrel, press in.
24. Water pump body (1)	New ceramic seat and seal (8)	a. Lubricate bore with clean lubricating oil. b. Install new ceramic seat on shaft with dimples facing away from carbon-face seal. c. Install seal on shaft against ceramic seat with flat side toward impeller end of shaft.

**WATER PUMP - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
25.	Impeller (3)	a. Support water pump (1) on pulley end of shaft (5). b. Using arbor press and mandrel, press on impeller, maintaining 0.020 to 0.040 inch (0.5 to 1.01 mm) clearance between impeller and cavity.
26.	Pulley (9)	a. Support water pump (1) on impeller end of shaft (5). b. Using arbor press and mandrel, press pulley on shaft until pulley hub is flush with shoulder on shaft. <b>Check assembly for freedom of rotation.</b>
27.	New preformed packing (10) and by-pass pipe (11)	Lubricate packing with clean lubricating oil and slide into groove on by-pass pipe.
28.	By-pass pipe (11), clamp (12), and screw (13)	Position in water pump and, using 1/2-inch box-end wrench, tighten.



**NOTE**

FOLLOW-ON MAINTENANCE: Install water pump (page 2-121).

**TASK ENDS HERE**

**Section XVI. FINAL TESTING, ADJUSTMENTS, AND TROUBLESHOOTING ON ENGINE TEST STAND**

	Page		Page
Final Testing and Adjustments.....	2-414	Troubleshooting on Engine	
Scope .....	2-414	Test Stand.....	2-424

**SCOPE**

Engine testing and break-in are performed on a suitable engine test stand. Make sure engine test stand capacity is sufficient to allow testing at 100 percent engine horsepower. Engine testing and break-in are accomplished simultaneously. Break-in on a rebuild engine is necessary to provide an operating period for moving parts and mating surfaces to reach a full seat. Final testing helps detect potential problems and establishes a period for final adjustment for best engine performance. During final testing make the following checks frequently. Lubricating oil pressure should remain at a constant figure with engine at speed and load after operating temperature has been reached. Abnormally high or low oil pressure may indicate a problem. Oil temperature should not rise above 225°F (107°C). Shut down engine and diagnose problem(s) before restarting engine. Do not allow oil to go above high mark or below low mark on oil level dipstick.

After engine is started, add coolant as necessary to completely fill cooling system and replace entrapped air. Coolant should not exceed 200°F (93°C), or drop below 160°F (71°C) during engine operation. Allow engine to idle for a few minutes before shutting down after a load run. Engine blowby readings must be taken frequently during run-in to note any blowby increase at a given speed and load. If there is any indication of blowby increase, engine speed must be reduced for a few minutes and then brought back to the original setting. During each power check, if blowby pressure rises, more run-in is required. With engine running at governed speed at 96 to 100 percent rated horsepower, crankcase pressure should not exceed 12 inches (30.48 cm) of water. If crankcase pressure exceeds this figure, operate engine at 96 to 100 percent rated load and rpm for 30 minutes. If there is no rapid change in excess of 2 inches (50.8 mm) of water, and reading does not exceed 12 inches (30.48 cm) of water, blowby is acceptable. Engine troubleshooting is included to further aid in locating faults found during final testing.

**FINAL TESTING AND ADJUSTMENTS**

---

This task covers:

- a. Procedures Before Starting (page 2-415)
  - b. Starting (page 2-418)
  - c. Engine testing (page 2-419)
- 

**INITIAL SETUP**

Tools

- Hammer, ball-peen, 8-ounce
- Handle, ratchet, 1/2-inch drive
- Measuring device, fuel consumption, ST-1190
- Pump, priming
- Punch, 1/4-inch
- Screwdriver, flat-tip, 1/4-inch
- Socket, hex key, 1/2-inch, 1/2-inch drive

Tools - Continued

- Test stand, engine
- Tool, blowby checking, ST-487
- Wrench, box-end, 9/16-inch
- Wrench, open-end, 9/16-inch
- Wrench, open-end, 5/8-inch
- Wrench, open-end, 3/4-inch

**FINAL TESTING AND ADJUSTMENTS - CONTINUED**

**INITIAL SETUP - CONTINUED**

Materials/Parts

- Ball, sealing
- Coolant, antifreeze (item 3, appendix B)
- Filter, fuel
- Oil, fuel (item 11, appendix B)
- Oil, lubricating (item 12, appendix B)

Materials/Parts - Continued

- Seal, lead
- Wire, locking (item 21, appendix B)

Equipment Condition

Engine mounted on suitable engine test stand.

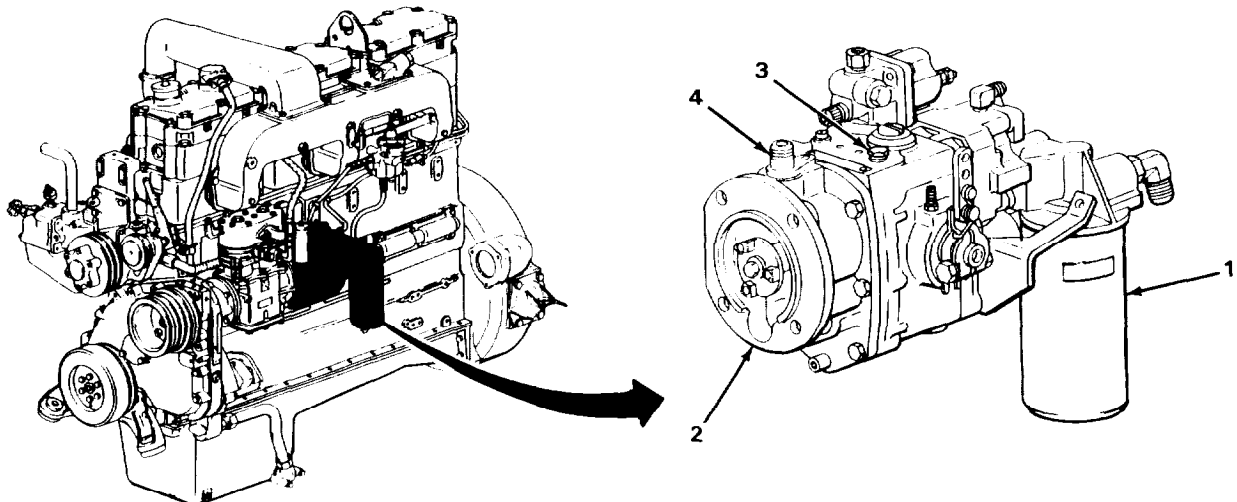
LOCATION	ITEM	ACTION	REMARKS
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PROCEDURES BEFORE STARTING

**WARNING**

Fuel is flammable and can explode. To avoid serious injury or death, keep fuel away from open fire and keep fire extinguisher within easy reach when working with fuel. Smoking is prohibited while working with fuel.

- |  |                 |   |
|--|-----------------|---|
| 1. Engine mounted on engine test stand | Fuel filter (1) | <ul style="list-style-type: none"> <li>a. Fill with clean fuel oil.</li> <li>b. Put on and tighten.</li> </ul>  |
| 2.                                     | Fuel pump (2)   | <ul style="list-style-type: none"> <li>a. Using 9/16-inch box-end wrench, loosen and take out plug (3) next to tachometer drive (4).</li> <li>b. Fill with clean fuel oil.</li> <li>c. Using 9/16-inch box-end wrench, put in and tighten plug (3) next to tachometer drive (4).</li> </ul> |

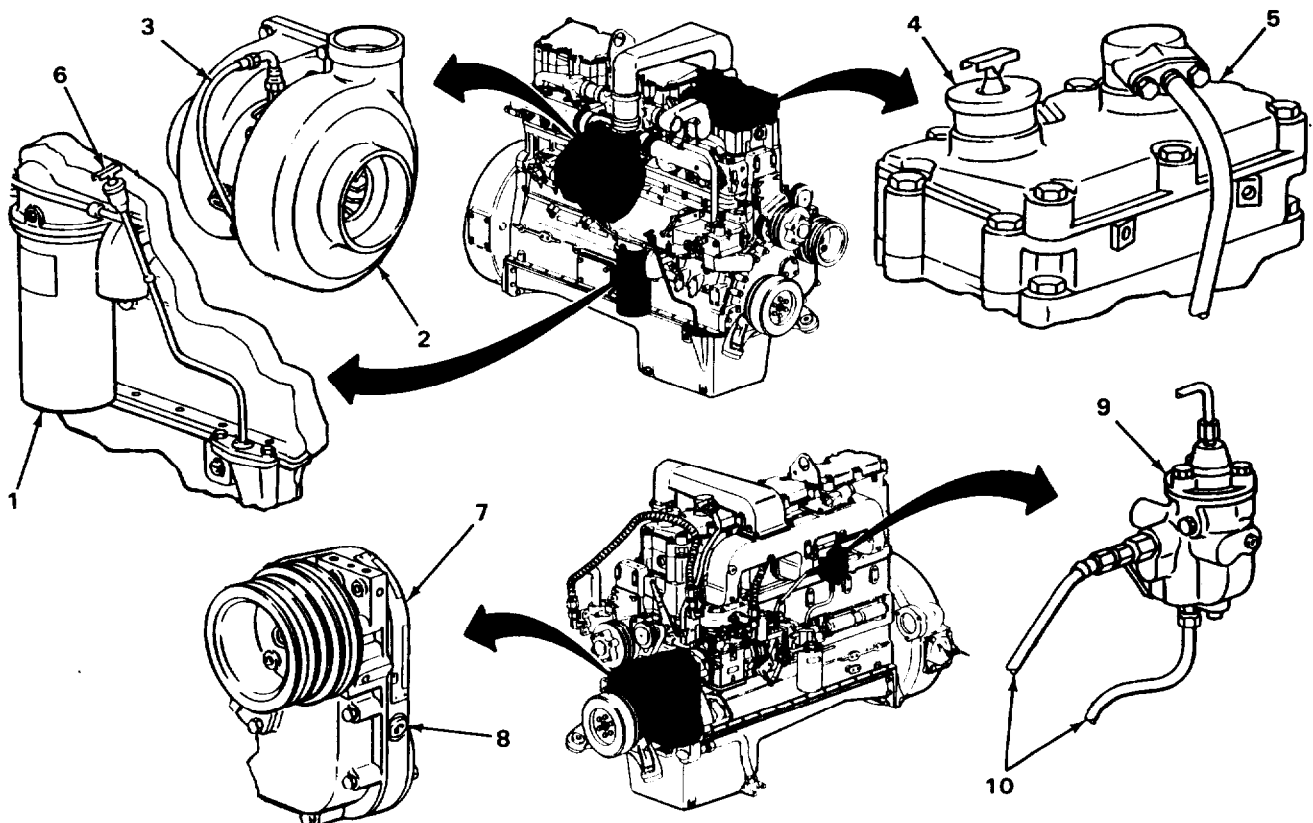


FINAL TESTING AND ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION REMARKS
PROCEDURES BEFORE STARTING - CONTINUED		
3. Engine mounted on engine test stand	Cooling system	Fill with clean coolant.
4.	Oil filter (1)	Fill with lubricating oil.
5.	Turbocharger (2)	<ul style="list-style-type: none"> <li>a. Using 3/4-inch and 5/8-inch open-end wrenches, loosen and take off oil inlet line (3).</li> <li>b. Lubricate bearing with 2 to 3 ounces (60 cc) of clean lubricating oil.</li> <li>c. Using 3/4-inch and 5/8-inch open-end wrenches, put on and tighten oil inlet line.</li> </ul>
6.	Oil filler cap (4)	<ul style="list-style-type: none"> <li>a. Take out of rocker arm cover (5).</li> <li>b. Fill crankcase with lubricating oil to low mark on dipstick (6).</li> <li>c. Put in rocker arm cover.</li> </ul>
7.	Gearcase (7)	<ul style="list-style-type: none"> <li>a. Using 1/2-inch drive 1/2-inch hex key socket and ratchet handle, loosen and take out priming passage plug (8).</li> <li>b. Install priming pump from source of clean lubricating oil to plug boss in gearcase.</li> <li>c. Prime system until a 30 psi (207 kPa) maximum pressure is developed.</li> <li>d. Crank engine at least 15 seconds with fuel shutoff closed, while maintaining oil pressure at a minimum of 15 psi (103.5 kPa).</li> <li>e. Remove priming pump.</li> <li>f. Using 1/2-inch drive 1/2-inch hex key socket and ratchet handle, put in and tighten priming passage plug.</li> <li>g. Clean area of any lubricating oil spilled while priming.</li> </ul>

FINAL TESTING AND ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION REMARKS
8.	Oil filler cap (4)	a. Take out of rocker arm cover. b. Fill crankcase with clean lubricating oil to high mark on dipstick (6). c. Put in rocker arm cover.
9.	ST-1190 fuel consumption measuring device	Attach to engine.
10.	ST-487 blowby checking tool	a. Attach to crankcase breather opening in rocker arm cover. b. Close all openings that would allow blow-by pressure to escape.
11.	Aneroid control valve (9)	a. Using 9/16-inch and 5/8-inch open-end wrenches, disconnect fuel pressure and fuel return lines (10). b. Plug lines.



**FINAL TESTING AND ADJUSTMENTS - CONTINUED**

LOCATION	ITEM	ACTION	REMARKS
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STARTING

**WARNING**

**EXHAUST GAS CAN KILL YOU**

Exhaust gas is without color or smell, but can kill you. Breathing exhaust gas produces symptoms of headache, dizziness, loss of muscular control, a sleepy feeling, and coma. Brain damage or death can result from heavy exposure of exhaust fumes of fuel-burning internal combustion engines. Exhaust gases can become dangerously concentrated under conditions of no air movement. Precautions must be followed to ensure crew safety when the engine of any vehicle is operated for any purpose.

1. DO NOT operate vehicle engine inside building unless ample ventilation is available.
2. DO NOT idle engine for long periods without ventilator blower operating.
3. DO NOT drive any vehicle with inspection plates, cover plates, or engine compartment doors removed unless necessary for maintenance purposes.
4. BE ALERT at all times during vehicle operation for exhaust odors and exposure symptoms. If either is present, IMMEDIATELY VENTILATE personnel compartments. If symptoms persist, remove affected crew to fresh air; keep warm; DO NOT PERMIT PHYSICAL EXERCISE; and, if necessary, give artificial respiration.
5. FOR ARTIFICIAL RESPIRATION, REFER TO FM 21-11.
6. BE AWARE; the field protective mask for chemical-biological-radiological (CBR) protection will not protect you from exhaust gas fumes.

THE BEST DEFENSE AGAINST ENGINE EXHAUST FUMES IS GOOD VENTILATION.

**CAUTION**

To prevent damage to the turbocharger, do not accelerate the engine above 1000 rpm until the reading on the oil pressure gage indicates normal oil pressure at idle speed.

- |                   |              |                     |
|-------------------|--------------|---------------------|
| 12. Fuel pump (1) | Throttle (2) | Set for idle speed. |
|-------------------|--------------|---------------------|

**CAUTION**

After engine starts, run at approximately 800 rpm, disconnect turbocharger oil drain line, and observe oil drain. Oil should flow in 10 to 15 seconds. If no oil flows in 30 seconds, shut down engine and correct fault. Reconnect oil drain line when flow is established.

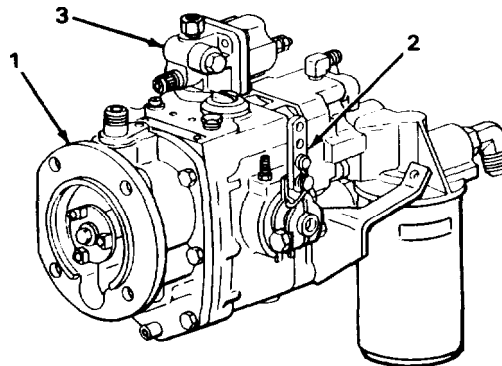
**NOTE**

The manual override knob on forward end of electric shutdown valve allows valve to be opened if power is not available during testing. To use, open valve by turning knob fully clockwise. Each time engine is started, see Preliminary Starting Procedures, page 2-3.



FINAL TESTING AND ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION REMARKS
13.	Engine mounted on engine test stand	a. Apply 12 volts to fuel shutdown valve (3) to open. b. Start engine (page 2-3). Allow to idle at approximately 800 rpm. <b>If engine gives no indication of starting, see engine test stand troubleshooting, page 2-424.</b>
ENGINE TESTING		
14.	Engine mounted on engine test stand	a. Operate at 800 rpm for 5 to 10 minutes. b. Check oil pressure. <b>Shut down engine if not between 10 and 70 psi, and correct fault. See engine test stand troubleshooting, page 2-424.</b> c. Restart engine (page 2-3). d. Check water temperature. <b>Shut down engine if above 200°F (93°C) and correct fault. See engine test stand troubleshooting, page 2-424.</b> e. Restart engine (page 2-3). f. Check all filters, gaskets, connections, and hoses for leaks. <b>Shut down engine, repair or replace all leaking filters, gaskets, connections, and hoses.</b> g. Restart engine (page 2-3). h. Shut down engine. Check oil level. <b>Refill to high mark.</b>



FINAL TESTING AND ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
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ENGINE TESTING - CONTINUED

**NOTE**

Each time engine is started see Preliminary Starting Procedures, page 2-3.

- |     |   |   |
|-----|---|---|
| 15. | Engine (1) mounted on engine test stand | <ul style="list-style-type: none"> <li>a. Restart engine (page 2-3).</li> <li>b. Apply load to 145 horsepower (<math>\pm 10\%</math>) at 1575 rpm (<math>\pm 5\%</math>) until full operating temperature is reached.</li> <li>c. Check crankcase pressure on ST-487 blowby checking tool.</li> </ul> |
|-----|---|---|

**NOTE**

If blowby reading steadily decreases with each different load applied, reduce run-in time at that load by half. Otherwise, run engine for time period specified.

- d. Shut down engine and check oil level. Refill to high mark.
- e. Restart engine (page 2-3).
- f. Apply load to 218 horsepower ( $\pm 10\%$ ) at 2100 rpm ( $\pm 5\%$ ) for 15 minutes.
- g. Set engine governed speed by adding or removing shims under the high-speed governor spring.  
**See fuel pump maintenance, page 2-289.**
- h. Set fuel rate using ST-1190 fuel consumption measuring device.
- i. Allow engine to idle. Adjust engine idle to 600 rpm ( $\pm 20$ ) by removing pipe plug (2) from spring pack cover (3) and, using 1/4-inch flat-tip screwdriver, turning the idle adjustment screw (4).  
**See fuel pump maintenance, page 2-289.**
- j. Apply load to 247 horsepower ( $\pm 10\%$ ) at 2100 rpm ( $\pm 5\%$ ) for 15 minutes.  
**If blowby rises, reduce load to specifications in step f and run for 30 minutes. Return to load specified in step j.**
- k. Apply load to 261 horsepower ( $\pm 10\%$ ) at 2100 rpm ( $\pm 5\%$ ) for 15 minutes.

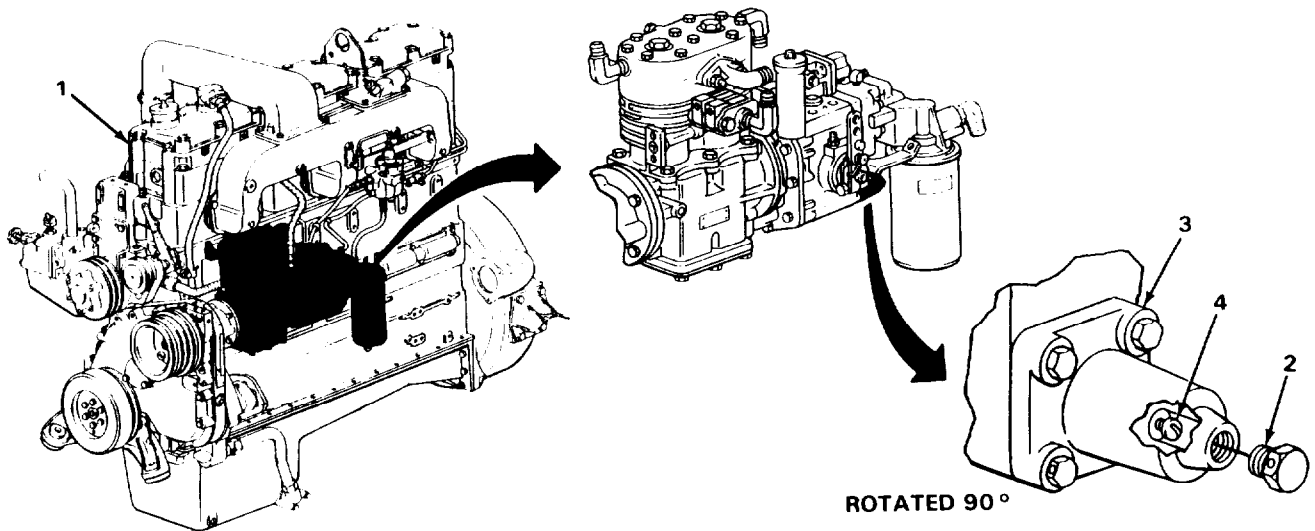
FINAL TESTING AND ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION	REMARKS
		l. Check all filters, gaskets, connections, and hoses for leaks.	
		m. Shut down engine. <b>Check for leaks and repair as necessary.</b>	
		n. Using appropriate tools, tighten all exposed capscrews.	

**NOTE**

Valve and injector readjustment, after one hour of operation, is necessary to ensure lowest smoke potential and to avoid excessive injector train loads.

- o. Restart engine (page 2-3) and run for one hour at 1200 RPM.
- p. Shut down engine.
- q. Check valve and injector adjustments.  
**Adjust valves to hot specifications: 0.008 Inch (0.20 mm) clearance for intake valves, 0.023 Inch (0.58 mm) clearance for exhaust valves, and 0.170 Inch (4.32 mm) for Injector plunger travel. See valve and Injector adjustment, page 2-106.**



FINAL TESTING AND ADJUSTMENTS - CONTINUED

LOCATION	ITEM	ACTION REMARKS
ENGINE TESTING - CONTINUED		
<b>NOTE</b>		
Each time engine is started see Preliminary Starting Procedures, page 2-3.		
15. Continued	Engine (1) mounted in engine test stand	<ul style="list-style-type: none"> <li>r. Restart engine (page 2-3).</li> <li>s. Run engine at approximately 800 rpm for 5 to 10 minutes until full operating temperature is obtained.</li> <li>t. Apply load to 278 horsepower (<math>\pm 10\%</math>) at 2100 rpm (<math>\pm 5\%</math>) for 5 minutes. <b>Engine should develop 278 to 290 horsepower at standard fuel rate of 105 lb/hr.</b></li> <li>u. Check blowby pressure. If <b>blowby pressure exceeds 12 inches (30.48 cm) of water, reduce engine speed and load as specified in step k.</b></li> <li>v. Repeat steps s, t, and u until engine develops a minimum of 278 horsepower at standard fuel rate within permissible blowby pressure.</li> <li>w. Shut down engine.</li> </ul>
18. Engine (1) mounted in engine test stand	Aneroid control valve (2)	<ul style="list-style-type: none"> <li>a. Remove plugs from fuel pressure and fuel return lines (3).</li> <li>b. Using 9/16-inch and 5/8-inch open-end wrenches, connect fuel pressure and fuel return lines.</li> </ul>
17. Fuel pump (4)	Sealing ball (5)	Using 1/4-inch punch and 8-ounce ball-peen hammer, hit into end of throttle shaft (6).
18.	Locking wire (7)	<ul style="list-style-type: none"> <li>a. Thread through pipe plug (8) and two hex head cover screws (9). Twist locking wire until secure.</li> <li>b. Install lead seal (10) onto twisted wire ends.</li> </ul>

**FINAL TESTING AND ADJUSTMENTS - CONTINUED**

LOCATION	ITEM	ACTION REMARKS
19. Engine (1) mounted on engine test stand	Engine coolant	Drain from engine cooling system.
20.	ST-1190 fuel consumption measuring device	Disconnect from engine.
21.	ST-487 blowby checking tool	a. Disconnect from crankcase breather opening. b. Clear all openings closed previously in step 10.

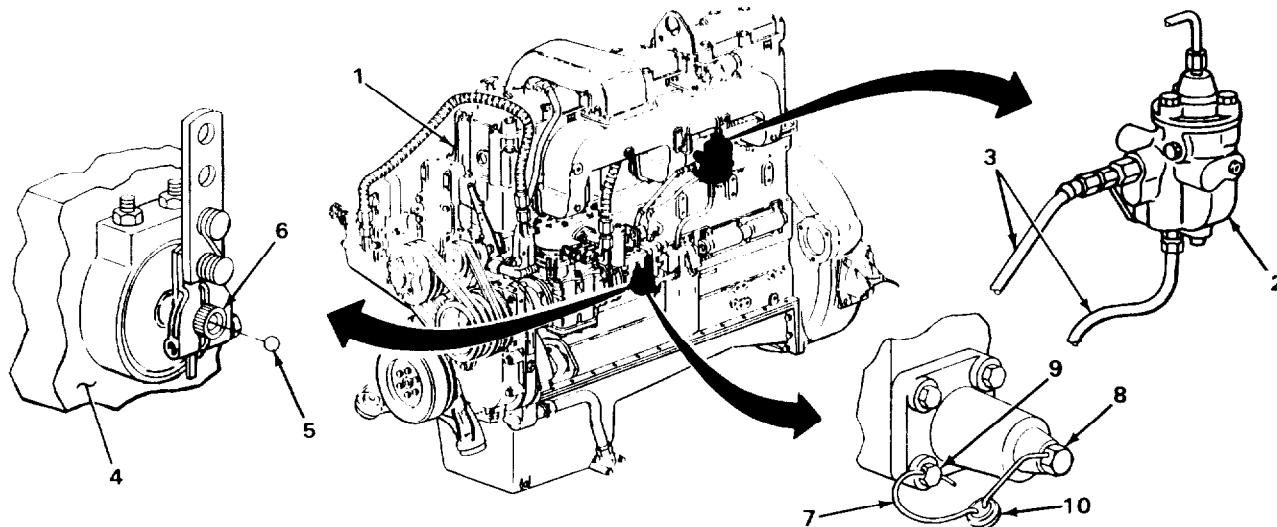
**NOTE**

Disconnect all electrical wiring, water lines, fuel lines, and oil lines between engine and engine test stand. Disconnect exhaust and intake air piping, and all engine test stand gages and controls from engine.

22.	Engine (1)	Remove from engine test stand.
-----	------------	--------------------------------

**NOTE**

Engine storage procedures are at discretion of repair facility.



**TASK ENDS HERE**

## TROUBLESHOOTING ON ENGINE TEST STAND

### GENERAL

The information contained in this paragraph is provided to help in identifying malfunctions that may occur after assembly and during engine test stand final adjustments of the NTC-290 diesel engine. The troubleshooting table lists common malfunctions which can occur. You should perform the tests or inspections and corrective actions in the order listed.

This paragraph cannot list all malfunctions that may occur, or all tests, inspections, and corrective actions. If a malfunction is not presented, or is not corrected by the listed corrective action, notify your supervisor.

### EXPLANATION OF COLUMNS

**MALFUNCTION.** Visual or operational indication that something is wrong with the NTC-290 diesel engine.

**TEST OR INSPECTION.** Procedure to isolate the problem to a component or system.

**CORRECTIVE ACTION.** Procedure to correct the problem.

### SYMPTOM INDEX

The symptom index is provided as a quick way to get you to the part of the troubleshooting table that will help solve your problem. It lists all malfunctions covered in the troubleshooting table.

To use the symptom index, find the problem you are having listed in the index. Then go to the page indicated for the troubleshooting procedure needed to help you find and correct your problem.

### SYMPTOM

	Page
Coolant temperature high .....	2-425
Coolant temperature low .....	2-426
Engine cannot reach governed rpm.....	2-426
Engine crankcase dilution.....	2-426
Engine stops.. ..	2-426
Engine fails to start (cranking system working) .....	2-427
Engine hard to start (cranking system working).....	2-427

**TROUBLESHOOTING ON ENGINE TEST STAND - CONTINUED**

	Page
Engine misses at high idle .....	2-427
Engine misses at idle.....	2-428
Engine misses under load .....	2-428
Engine surges at governed rpm .....	2-429
Excessive black smoke at idle .....	2-429
Excessive black smoke under load.....	2-429
Excessive crankcase pressure.. .....	2-430
Excessive noise.. .....	2-430
Excessive smoke under acceleration .....	2-431
Excessive vibration .....	2-431
Excessive white smoke at idle.....	2-431
Fuel knocks (combustion noise).....	2-432
Low oil pressure.. .....	2-432
Mechanical knocks.. .....	2-433
Oil temperature too high.. .....	2-433
Sluggish engine acceleration.. .....	2-433

---

**MALFUNCTION**

**TEST OR INSPECTION**

**CORRECTIVE ACTION**

---

**1. COOLANT TEMPERATURE HIGH.**

- Step 1. Check coolant level.  
  - Refill to proper level.
- Step 2. Check engine oil level.  
  - Refill crankcase to proper level.
- Step 3. Remove and test thermostat.  
  - Replace defective thermostat.
- Step 4. Remove water pump (page 2-37). Inspect for incorrect or damaged impeller (page 2-408).  
  - Replace damaged or incorrect impeller.

**TROUBLESHOOTING ON ENGINE TEST STAND - CONTINUED**

---

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

---

2. COOLANT TEMPERATURE LOW.

- Step 1. Remove and test thermostat.  
Replace defective thermostat.
- Step 2. Remove water pump (page 2-37). Inspect for incorrect impeller.  
Replace incorrect impeller (page 2-408).

3. ENGINE CANNOT REACH GOVERNED RPM.

- Step 1. Check specifications for high-speed governor setting.  
Reset high-speed governor setting.
- Step 2. Check injector timing (page 2-106).  
Reset injector timing.

4. ENGINE CRANKCASE DILUTION.

- Step 1. Check gaskets and fuel lines for internal or external leaks.  
Repair or replace leaking gaskets and fuel lines.
- Step 2. Remove injectors (page 2-34). Check for cracked injector cups or damaged O-rings (page 2-289).
  - a. Replace cracked injector cups.
  - b. Replace damaged preformed packing.
- Step 3. Check cylinder head gaskets for internal and external leaks. Inspect cylinder head for porous casting.
  - a. Replace defective gaskets (page 2-36).
  - b. Replace defective cylinder head (page 2-36).

5. ENGINE STOPS.

- Step 1. Check fuel shutoff valve for correct operation.  
Replace defective fuel shutoff valve (page 2-289).
- Step 2. Check filters, gaskets, connections, and suction lines for air leaks.  
Replace defective filters, leaking gaskets, hoses, and suction lines.
- Step 3. Remove fuel pump (page 2-41). Check for broken fuel pump drive shaft (page 2-289).  
Replace broken fuel pump drive shaft.
- Step 4. Disassemble fuel pump (page 2-289). Check for correct idle spring assembly.  
Correct idle spring assembly and reassemble.
- Step 5. Disassemble fuel pump (page 2-289). Check for correct governor weight assembly.  
Correct governor weights and reassemble.
- Step 6. Perform engine compression check for cylinder head gasket leakage.  
Replace leaking gasket.



## TROUBLESHOOTING ON ENGINE TEST STAND - CONTINUED

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### MALFUNCTION

#### TEST OR INSPECTION

#### CORRECTIVE ACTION

---

### 6. ENGINE FAILS TO START (CRANKING SYSTEM WORKING).

- Step 1. Check fuel shutoff valve for correct operation.  
Replace defective fuel shutoff valve.
- Step 2. Check filter, gaskets, connections, and lines for air leaks.  
Replace defective filter, leaking gaskets, connections, and suction lines.
- Step 3. Check injector timing (page 2-106).  
Reset injector timing.
- Step 4. Check valve adjustment (page 2-106).  
Readjust valves.
- Step 5. Remove injectors (page 2-34). Check for damaged O-rings (page 2-289).  
Replace damaged preformed packing.

### 7. ENGINE HARD TO START (CRANKING SYSTEM WORKING).

- Step 1. Check filters, gaskets, connections, and lines for air leaks.  
Replace defective filter, leaking gaskets, connections, and suction lines.
- Step 2. Check all fuel lines for bends, breaks, or damage causing restriction.  
Repair or replace all restricted fuel lines.
- Step 3. Check intake and exhaust manifolds for gasket leaks.  
Replace leaking gaskets (page 2-272).
- Step 4. Check injector timing (page 2-106).  
Readjust injector timing.
- Step 5. Check valve adjustment (page 2-106).  
Readjust valves.
- Step 6. Remove injectors (page 2-34). Check for damaged preformed packing or cracked injector cups (page 2-289).  
Replace damaged packing.  
Replace cracked injector cups.
- Step 7. Check engine for excessive blowby and wetness in exhaust caused by broken or damaged rings.  
Isolate damaged cylinders and replace broken or damaged rings.

### 8. ENGINE MISSES AT HIGH IDLE.

- Step 1. Check filter, gaskets, connections, and suction lines for air leaks.  
Replace defective filter, leaking gaskets, connections, and suction lines.
- Step 2. Check injector timing (page 2-106).  
Reset injector timing.
- Step 3. Check valve adjustment (page 2-106).  
Readjust valves.

**TROUBLESHOOTING ON ENGINE TEST STAND - CONTINUED**

---

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

---

8. ENGINE MISSES AT HIGH IDLE - CONTINUED.

- Step 4. Remove injectors (page 2-34). Check for damaged preformed packings or cracked injector cups (page 2-289).  
 Replace damaged packings.  
 Replace cracked injector cups.
- Step 5. Check engine for excessive blowby and wetness in exhaust caused by broken or damaged rings.  
 Isolate damaged cylinders and replace broken or damaged rings.

9. ENGINE MISSES AT IDLE.

- Step 1. Check idle speed according to specifications.  
 Adjust idle speed.
- Step 2. Check filter, gaskets, connections, and suction lines for air leaks.  
 Replace defective filter, leaking gaskets, connections, and suction lines.
- Step 3. Check valve adjustment (page 2-106).  
 Readjust valves.
- Step 4. Check injector timing (page 2-106).  
 Reset injector timing.
- Step 5. Remove injectors (page 2-34). Check for damaged preformed packings (page 2-289).  
 Replace damaged packings.
- Step 6. Check engine for excessive blowby and wetness in exhaust caused by broken or damaged rings.  
 Isolate damaged cylinders and replace broken or damaged rings.

10. ENGINE MISSES UNDER LOAD.

- Step 1. Check all fuel lines for bends, breaks, or damage causing restriction.  
 Repair or replace all restricted fuel lines.
- Step 2. Check filter, gaskets, connections and suction lines for air leaks.  
 Replace defective filter, leaking gaskets, connections, and suction lines.
- Step 3. Check valve adjustment (page 2-106).  
 Readjust valves.
- Step 4. Check injector timing (page 2-106).  
 Reset injector timing.
- Step 5. Remove injectors (page 2-34). Check for damaged preformed packings (page 2-289).  
 Replace damaged packings.

## TROUBLESHOOTING ON ENGINE TEST STAND – CONTINUED

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### MALFUNCTION

#### TEST OR INSPECTION

#### CORRECTIVE ACTION

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### 10. ENGINE MISSES UNDER LOAD – CONTINUED.

- Step 6. Check engine for excessive blowby and wetness in exhaust caused by broken or damaged rings.  
Isolate damaged cylinder and replace broken or damaged rings.
- Step 7. Perform engine compression test. Check for cylinder head gasket leakage.  
Replace leaking head gasket.
- Step 8. Check intake and exhaust gaskets for leakage.  
Replace leaking gaskets.

### 11. ENGINE SURGES AT GOVERNED RPM.

- Step 1. Check filter, gaskets, connections, and suction lines for air leaks.  
Replace defective filter, leaking gaskets, connections, and suction lines.
- Step 2. Perform engine compression test. Check for cylinder head gasket leakage.  
Replace leaking gasket.

### 12. EXCESSIVE BLACK SMOKE AT IDLE.

- Step 1. Remove injectors (page 2-34). Check for correct injector cup size (page 2-289).  
Replace incorrect injector cups.
- Step 2. Check for cracked injector cups (page 2-289).  
Replace damaged injector cups.
- Step 3. Check injector timing (page 2-106).  
Reset injector timing.
- Step 4. Check engine for excessive blowby and wetness in exhaust caused by broken or damaged rings.  
Isolate damaged cylinders and replace broken or damaged rings.

### 13. EXCESSIVE BLACK SMOKE UNDER LOAD.

- Step 1. Check for excessive exhaust back pressure.  
Repair or replace defective turbocharger.
- Step 2. Check all fuel lines for bends, breaks, or damage causing restriction.  
Repair or replace restricted fuel lines.
- Step 3. Remove injectors (page 2-34). Check for correct injector cup size (page 2-289).  
Replace incorrect injector cups.
- Step 4. Check for cracked injector cups (page 2-289).  
Replace damaged injector cups.

**TROUBLESHOOTING ON ENGINE TEST STAND – CONTINUED**

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MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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13. EXCESSIVE BLACK SMOKE UNDER LOAD – CONTINUED.

- Step 5. Check for damaged fuel injector preformed packings (page 2-289).  
Replace damaged packings.
- Step 6. Check valve adjustment (page 2-106).  
Readjust valves.
- Step 7. Check injector timing (page 2-106).  
Reset injector timing.
- Step 8. Check engine for excessive blowby and wetness in exhaust caused by broken or damaged rings.  
Isolate damaged cylinders and replace broken or damaged rings.
- Step 9. Perform engine compression test. Check for cylinder head gasket leakage.  
Replace leaking gasket.

14. EXCESSIVE CRANKCASE PRESSURE.

- Step 1. Check engine for excessive blowby and wetness in exhaust caused by broken or damaged rings.  
Isolate damaged cylinders and replace broken or damaged rings.
- Step 2. Perform engine compression test. Check for cylinder head gasket leakage.  
Replace leaking gasket.

15. EXCESSIVE NOISE.

- Step 1. Check vibration damper and flywheel for damage or improper installation.  
Replace damaged vibration damper and flywheel.  
Reinstall vibration damper and flywheel correctly.
- Step 2. Check valve adjustment (page 2-106).  
Readjust valves.
- Step 3. Check injector timing (page 2-106).  
Reset injector timing.
- Step 4. Check push tubes or cam followers for damage.  
Replace damaged push tubes (page 2-33) and cam followers (page 2-47).
- Step 5. Check for scored pistons and cylinder sleeves.  
Replace scored pistons and cylinder sleeves (page 2-214).

## TROUBLESHOOTING ON ENGINE TEST STAND – CONTINUED

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### MALFUNCTION

#### TEST OR INSPECTION

#### CORRECTIVE ACTION

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### 16. EXCESSIVE SMOKE UNDER ACCELERATION.

- Step 1. Check for excessive exhaust back pressure.  
Repair or replace defective turbocharger (page 2-12).
- Step 2. Check fuel drain lines for restrictions.  
Repair or replace restricted fuel drain lines.
- Step 3. Check for defective aneroid control valve (page 2-289).  
Replace defective aneroid control valve.
- Step 4. Check intake and exhaust gaskets for leakage.  
Replace leaking gaskets (page 2-272).
- Step 5. Check injector timing (page 2-106).  
Reset injector timing.
- Step 6. Check valve adjustment (page 2-106).  
Readjust valves.
- Step 7. Remove injectors (page 2-34). Check for correct injector cup size (page 2-289).  
Replace incorrect injector cups.
- Step 8. Check push tubes or cam followers for damage.  
Replace damaged push tubes (page 2-33) and cam followers (page 2-47).
- Step 9. Perform engine compression test. Check for cylinder head gasket leakage.  
Replace leaking cylinder head gasket.
- Step 10. Check for scored pistons and cylinder sleeves.  
Replace scored pistons and cylinder sleeves.

### 17. EXCESSIVE VIBRATION.

- Inspect vibration damper and flywheel for damage or improper installation.
  - a. Replace damaged vibration damper and flywheel.
  - b. Reinstall vibration damper and flywheel.

### 18. EXCESSIVE WHITE SMOKE AT IDLE.

- Step 1. Check for starting fluid build up in intake manifold.  
Remove built up starting fluid.
- Step 2. Check for raw fuel in intake manifold.  
Repair starting aid (page 2-289) and remove excess fuel.
- Step 3. Check for low coolant temperature or defective thermostat.  
Replace defective thermostat.
- Step 4. Check injector timing (page 2-106).  
Reset injector timing.

**TROUBLESHOOTING ON ENGINE TEST STAND – CONTINUED**

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MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

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18. EXCESSIVE WHITE SMOKE AT IDLE – CONTINUED.

- Step 5. Check valve adjustment (page 2-106).  
Readjust valves.
- Step 6. Remove injectors (page 2-34). Check for correct injector cup size (page 2-289).  
Replace incorrect injector cups.

19. FUEL KNOCKS (COMBUSTION NOISE).

- Step 1. Check for starting fluid build up in intake manifold.  
Remove built up starting fluid.
- Step 2. Check for excess fuel in intake manifold from starting aid.  
Repair starting aid (page 2-289) and remove excess fuel.
- Step 3. Check filter, gaskets, connections, and suction lines for air leaks.  
Replace defective filter, leaking gaskets, connections, and lines.
- Step 4. Check for low coolant temperature or defective thermostat.  
Replace defective thermostat.
- Step 5. Check injector timing (page 2-106).  
Reset injector timing.
- Step 6. Check valve adjustment (page 2-106).  
Readjust valves.
- Step 7. Remove injectors (page 2-34). Check for damaged preformed packings (page 2-289).  
Replace damaged packings.

20. LOW OIL PRESSURE.

- Step 1. Check crankcase oil level.  
Refill to proper level.
- Step 2. Check oil suction line for restrictions.  
Repair or replace restricted line.
- Step 3. Check for high engine temperature or defective thermostat.
  - a. Replace defective thermostat.
  - b. Refill coolant to proper level.
- Step 4. Check bypass filter orifice for correct size (page 2-264).  
Replace orifice with correct size.
- Step 5. Check for correct main and connecting rod bearing clearance (page 2-214).  
Replace bearings with proper size. Repair crankshaft.
- Step 6. Check for main and connecting rod bearing damage (page 2-214).
  - a. Repair cause of damage.
  - b. Replace damaged main and connecting rod bearing. Repair crankshaft.

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**TROUBLESHOOTING ON ENGINE TEST STAND – CONTINUED**


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## MALFUNCTION

## TEST OR INSPECTION

## CORRECTIVE ACTION

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**21. MECHANICAL KNOCKS.**

- Step 1. Check vibration damper and flywheel for looseness and damage.  
Tighten loose bolts.  
Replace damaged vibration damper or flywheel.
- Step 2. Check push tubes and cam followers for damage.  
Replace damaged push tubes (page 2-33) and cam follower (page 2-47).
- Step 3. Check for broken piston rings.  
Replace broken piston rings (page 2-220).
- Step 4. Check for scored pistons and cylinder sleeves.  
Replace scored pistons (page 2-220) or cylinder sleeves (page 2-140).
- Step 5. Check for correct main and connecting rod bearing clearance.  
Replace bearings with proper size. Repair crankshaft (page 2-214 or 2-220).
- Step 6. Check for excessive crankshaft end play.  
Replace thrust bearing with oversize, repair crankshaft (page 2-214).

**22. OIL TEMPERATURE TOO HIGH.**

- Step 1. Check crankcase oil level.  
Refill to proper level and drain excess oil.
- Step 2. Check for high engine temperature or defective thermostat.  
Replace defective thermostat.
- Step 3. Check all hoses, connections, and gaskets for leaks, allowing air into cooling system.  
Repair or replace leaking hoses, connections, and gaskets.

**23. SLUGGISH ENGINE ACCELERATION.**

- Step 1. Check filter, gaskets, connections, and suction lines for air leaks.  
Replace defective filter, leaking gaskets, connections, and lines.
- Step 2. Check all fuel lines for bends, breaks, or damage causing restriction.  
Repair or replaced restricted fuel lines.
- Step 3. Check injector timing (page 2-106).  
Reset injector timing.
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**Section XVII. ENGINE SPECIFICATIONS**

**OVERVIEW**

This section provides quick location of specifications and wear limits needed to maintain, repair, or overhaul the diesel engine and its components. Wear limits indicate that a part may be reused at the worn limit but must be discarded if worn limit is exceeded. Specifications are given in US standard and metric measurements.

This section is numerically structured in repair section number order to aid in locating pertinent information for a specific system. Example: SECTION V, CRANKCASE AND CYLINDER BLOCK; SECTION VI, CYLINDER HEAD AND VALVES, etc.

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**SECTION V, CRANKCASE AND CYLINDER BLOCK**

WEAR LIMITS – INCH (MM)

PART OR LOCATION	NEW MINIMUM	NEW MAXIMUM	WORN LIMIT
Installed Camshaft Bushing Inside Diameter	1.999 (50.77)	2.0005 (50.813)	2.0015 (50.838)
Camshaft Bushing Bore in Block	2.1285 (54.064)	2.1295 (54.089)	2.1305 (54.115)
Cylinder Sleeve Counterbore Inside Diameter	6.5615 (166.662)	6.5635 (166.713)	
Counterbore Depth	0.350 (8.89)	0.352 (8.94)	0.412 (10.46)
Sleeve Protrusion	0.003 (0.08)	0.006 (0.15)	
Sleeve-to-Block Clearance Lower Bore	0.002 (0.05)	0.008 (0.20)	
Cylinder Block Lower Sleeve Bore	6.124 (155.55)	6.126 (155.60)	
Main Bearing Bore	4.7485 (120.612)	4.750 (120.65)	4.7505 (120.663)



**SECTION V, CRANKCASE AND CYLINDER BLOCK – CONTINUED**

PART OR LOCATION	NEW MINIMUM	NEW MAXIMUM	WORN LIMIT
Cylinder Block Height From Main Bearing Bore Center Line	19.004 (482.70)	19.006 (482.75)	18.994 (482.45)
From Top of Alinement Bar	16.629 (422.38)	16.631 (422.43)	16.619 (422.12)
Cylinder Sleeve Counterbore	0.350 (8.89)	0.352 (8.94)	0.412 (10.46)
Cylinder Sleeve Counterbore Shims			
Part No. 143938	0.0063 (0.160)	0.007 (0.18)	
Part No. 143939	0.0072 (0.183)	0.0088 (0.223)	
Part No. 143946	0.0081 (0.206)	0.0099 (0.251)	
Part No. 143947	0.018 (0.46)	0.022 (0.56)	
Part No. 143948	0.028 (0.71)	0.034 (0.86)	
Part No. 143949	0.056 (1.42)	0.068 (1.73)	
Cylinder Sleeve Inside Diameter	5.4995 (139.687)	5.501 (139.73)	5.505 (139.83)

**NOTE**

New cylinder sleeves dimensions at 60° to 70°F (160° to 21 °C); may be 0.0002 to 0.0006 inch (0.005 to 0.015 mm) smaller than indicated due to lubrite coating.

Cylinder Sleeve Protrusion	0.003 (0.08)	0.006 (0.15)	
Camshaft			
Journal Diameter	1.997 (50.72)	1.998 (50.75)	1.996 (50.70)
Camshaft Support Bushing	1.3725 (34.861)	1.3755 (84.938)	1.370 (34.80)
Camshaft Outboard Bearing Support	1.751 (44.48)	1.754 (44.55)	1.757 (44.63)
Gearcase Cover			
Accessory Drive Bushing			
Part No. 132770	1.565 (39.75)	1.569 (39.85)	1.571 (39.90)
Part No. 132771	1.555 (39.41)	1.559 (39.60)	1.561 (39.65)
Part No. 132772	1.545 (39.24)	1.549 (39.34)	1.551 (39.40)

**SECTION V, CRANKCASE AND CYLINDER BLOCK – CONTINUED**

TORQUE LIMITS – FT LB (KGM)

PART OR LOCATION	MINIMUM	MAXIMUM
Main Bearing Capscrews		
1. Tighten to	145 (20.05)	155 (21.44)
2. Advance to	300 (41.49)	310 (42.87)
3. Loosen	All	All
4. Tighten to	140 (19.36)	145 (20.95)
5. Advance to	300 (41.49)	310 (42.87)
Piston Cooling Nozzles Capscrews	16 (22)	21 (28)

**SECTION VI, CYLINDER HEAD AND VALVES**

WEAR LIMITS – INCH (MM)

PART OR LOCATION	NEW MINIMUM	NEW MAXIMUM	WORN LIMIT
Height	4.370 (111.00)	4.380 (111.25)	4.340 (110.24)
Injector Sleeve			
Top Inside Diameter	1.145 (29.09)	1.155 (29.34)	
Injector Cup Protrusion	0.060 (1.52)	0.070 (1.78)	
Valve Seat Insert			
Run-out			0.002 (0.05)
Valve Crossheads and Guides			
Crosshead Stem Inside Diameter	0.434 (11.02)	0.436 (11.07)	0.440 (11.18)
Guide Outside Diameter	0.433 (10.99)	0.4335 (11.011)	0.432 (10.97)
Guide Assembled Height	1.860 (47.24)	1.880 (47.75)	
Depth Valve Stem Pocket	0.120 (3.05)	0.140 (3.56)	
Valve, Guides and Springs			
Valve Stem Outside Diameter	0.450 (11.43)	0.451 (11.46)	0.449 (11.40)
Valve Guide Inside Diameter	0.4525 (11.493)	0.4532 (11.511)	0.455 (11.56)
Valve Guide Protrusion	1.315 (33.40)	1.325 (33.65)	

**SECTION VI, CYLINDER HEAD AND VALVES – CONTINUED**

TORQUE LIMITS – PT LB (N•M)

PART OR LOCATION	MINIMUM	MAXIMUM
Cylinder Head Capscrews (Tighten in sequence)		
Step 1		25 (34)
Step 2	80 (108)	100 (136)
Step 3	180 (244)	200 (271)
Step 4	280 (380)	300 (407)

**SECTION VII, CRANKSHAFT**

WEAR LIMITS – INCH (MM)

PART OR LOCATION	NEW MINIMUM	NEW MAXIMUM	WORN LIMIT
Bearings			
Standard Size (Thickness)			
Main Bearing (All)	0.123 (3.12)	0.1238 (3.144)	0.1215 (3.086)
Connecting Rods (855 Series)	0.0724 (1.839)	0.0729 (1.852)	0.071 (1.80)
Journal Clearance			
Main	0.0015 (0.038)	0.005 (0.13)	0.067 (0.18)
Connecting Rods	0.0015 (0.038)	0.0045 (0.114)	0.007 (0.18)
Crankshaft Thrust Washer Thickness			
Part No. 157280	0.245 (6.22)	0.247 (6.27)	
Part No. 157281	0.255 (6.48)	0.257 (6.53)	
Part No. 157282	0.265 (6.73)	0.267 (6.78)	
Crankshaft End Clearance	0.007 (0.18)	0.017 (0.43)	0.022 (0.56)
Vibration Dampers			
Misalignment of Index Marks		0.0625 (1.587)	

**SECTION VIII, PISTONS AND CONNECTING RODS**

WEAR LIMITS – INCH (MM)

PART OR LOCATION	NEW MINIMUM	NEW MAXIMUM	WORN LIMIT
Piston Pin Bushing	2.001 (50.83)	2.0015 (50.838)	2.0025 (50.863)
Connecting Rod Length Center to Center	11.998 (304.75)	12.000 (304.80)	
Connecting Rod Alinement Without Bushing			0.008 (0.20)
With Bushing			0.004 (0.10)
Twist Without Bushing			0.020 (0.51)
With Bushing			0.010 (0.25)
Connecting Rod Bolt (855 CID Series) Minimum OD	0.541 (13.74)	0.545 (13.84)	0.540 (13.72)
Pilot OD	0.6245 (15.852)	0.625 (15.87)	
Bolthole Inside Diameter Pilot 855 Series Rod	0.6243 (15.857)	0.6248 (15.870)	0.6249 (15.872)
Cap	0.6246 (15.865)	0.6251 (15.877)	0.6252 (15.880)
Piston and Piston Rings Piston Pin Bore Aluminum	1.9985 (50.762)	1.9989 (50.772)	1.999 (50.77)
Piston Pin Diameter	1.9988 (50.769)	1.999 (50.77)	1.9978 (50.754)
Piston Skirt Diameter at 70°F (21°C)	5.487 (139.37)	5.488 (139.40)	5.483 (139.27)
Piston Pin Bore Inside Diameter at 70°F (21°C)	1.9985 (50.762)	1.9990 (50.775)	1.999 (50.775)
Piston Pin Outside Diameter	1.99875 (50.768)	1.9990 (50.775)	1.9978 (50.754)

**SECTION VIII, PISTONS AND CONNECTING RODS – CONTINUED**

PART OR LOCATION	NEW MINIMUM	NEW MAXIMUM	WORN LIMIT
Piston Ring (Gap in Ring Travel Area of Liner)			
Part No. 147670	0.023 (0.58)	0.033 (0.85)	*
Part No. 132880	0.019 (0.48)	0.029 (0.74)	*
Part No. 168680	0.028 (0.71)	0.038 (0.97)	*
Part No. 194610	0.010 (0.25)	0.020 (0.51)	*

\* Add 0.003-inch (0.08 mm) ring gap to new maximum limit for 0.001 (0.03) wear in cylinder liner wall.

**TORQUE LIMITS – FT LB (N•M)**

PART OR LOCATION	MINIMUM	MAXIMUM
Connecting Rod Capscrews		
Step 1 Tighten to	70 (95)	75 (102)
Step 2 Advance to	*140 (190)	*150 (203)
Step 3 Loosen all		Completely
Step 4 Tighten to	25 (34)	30 (41)
Step 5 Advance to	70 (95)	75 (102)
Step 6 Advance to	*140 (190)	*150 (203)

\* Torque to 100 ft lb (136 N•m) with lock plates.

**SECTION IX, CAMSHAFT AND TIMING SYSTEM**

**WEAR LIMITS – INCH (MM)**

PART OR LOCATION	NEW MINIMUM	NEW MAXIMUM	WORN LIMIT
Camshaft Journal Outside Diameter	1.997 (50.72)	1.998 (50.75)	1.996 (50.70)

SECTION IX, CAMSHAFT AND TIMING SYSTEM – CONTINUED

WEAR LIMITS – INCH (MM) – CONTINUED

PART OR LOCATION	NEW MINIMUM	NEW MAXIMUM	WORN LIMIT
Rocker Arm Bushing Inside Diameter	1.1245 (28.562)	1.1275 (28.639)	1.1286 (28.664)
Rocker Arm Shaft Outside Diameter	1.123 (28.52)	1.124 (28.55)	1.122 (28.50)
Cam Follower Shaft Outside Diameter	0.7485 (19.012)	0.749 (19.02)	0.748 (19.00)
Cam Follower Bushing Inside Diameter	0.7495 (19.037)	0.7505 (19.063)	0.7515 (19.088)
Injector Cam Roller Inside Diameter	0.503 (12.78)	0.504 (12.80)	0.505 (12.83)
Injector Cam Roller Outside Diameter	1.249 (31.72)	1.251 (31.78)	1.247 (31.67)
Valve Cam Rollers Inside Diameter	0.5005 (12.713)	0.5015 (12.738)	0.503 (12.78)
Valve Cam Rollers Outside Diameter	1.249 (31.72)	1.250 (31.75)	1.247 (31.67)
Cam Roller Pins Outside Diameter	0.4995 (12.687)	0.500 (12.70)	0.497 (12.62)
Push Rods Ball End Radius	0.623 (15.82)	0.625 (15.87)	
Push Rod Socket Spherical Inside Diameter	0.505 (12.83)	0.520 (13.21)	

TORQUE LIMITS – FT LB (N•M)

PART OR LOCATION	MINIMUM	MAXIMUM
Valve Crosshead Nuts Using ST669 Adapter	22 (30)	26 (35)
Rocker Arm Housing Capscrews	55 (75)	65 (88)
Rocker Arm Shaft Plugs		
Straight	20 (27)	25 (34)
Tapered	20 (27)	30 (41)

**SECTION IX, CAMSHAFT AND TIMING SYSTEM – CONTINUED**

PART OR LOCATION	MINIMUM	MAXIMUM
Cam Follower Capscrews	30 (41)	35 (47)

**SECTION X, ENGINE LUBRICATION SYSTEM**

WEAR LIMITS – INCH (MM)

PART OR LOCATION	NEW MINIMUM	NEW MAXIMUM	WORN LIMIT
Single Lubricating Oil Pump (Double Capacity) Bushing Inside Diameter	0.8767 (22.268)	0.8777 (22.293)	0.879 (22.33)
Drive Shaft Outside Diameter	0.8745 (22.212)	0.875 (22.22)	0.873 (22.17)
Idler Shaft Outside Diameter	0.8745 (22.212)	0.875 (22.22)	0.873 (22.17)
Drive Gear to Body			0.012 (0.30)
Drive Shaft End Play	0.002 (0.05)	0.008 (0.020)	
Idler Shaft Protrusion Above Body to Cover Face		0.955 (24.26)	
Driven Gear and Driving Gear Shaft Protrusion	1.035 (26.29)	1.055 (26.80)	
Piston Cooling Nozzle Tube Protrusion Above Body Mounting Face	2.970 (75.44)	3.000 (76.20)	

TORQUE LIMITS – FT LB (N•M)

PART OR LOCATION	MINIMUM	MAXIMUM
Oil Pump Mounting Capscrew	35 (47)	45 (61)
Piston Cooling Nozzle Capscrew	16 (22)	21 (28)

**SECTION XI, MANIFOLDS**

TORQUE LIMITS – FT LB (N•M)

PART OR COMPONENT	MINIMUM	MAXIMUM
Exhaust Manifold Capscrews 7/16-inch Capscrew with Washer		40 (54)
3/8-inch Stud	20 (27)	25 (34)
Intake Manifold	20 (27)	25 (34)

**SECTION XII, ACCESSORY DRIVE**

WEAR LIMIT – INCH (MM)

PART OR LOCATION	NEW MINIMUM	NEW MAXIMUM	WORN LIMIT
Accessory Drive Bushing Inside Diameter	1.312 (33.32)	1.315 (33.40)	1.31 (33.55)
Accessory Drive Shaft Outside Diameter	1.3115 (33.312)	1.312 (33.32)	1.310 (33.27)
End Clearance	0.005 (0.13)	0.010 (0.25)	
Accessory Drive Bushing Out-of-Round			0.002 (0.05)

TORQUE LIMIT – FT LB (N•M)

PART OR COMPONENT	MINIMUM	MAXIMUM
Accessory Drive Pulley	90 (122)	100 (136)
Accessory Drive Capscrews	40 (54)	45 (61)



**SECTION XIII, ENGINE BRAKE**

ADJUSTMENT – INCH (MM)

PART OR COMPONENT	MINIMUM	MAXIMUM
Slave Piston and Crosshead Clearance		.018 (.46)

TORQUE – FT LB (N•M)

PART OR COMPONENT	MINIMUM	MAXIMUM
Adjusting Screw Locknut	15 (20.3)	18 (24.4)
Rocker Arm Housing Stud	65 (88)	75 (102)
Engine Brake Housing Nuts	55 (75)	60 (81)

**SECTION XIV, FUEL SYSTEM**

TORQUE LIMITS – FT LB (NoM)

PART COMPONENT	MINIMUM	MAXIMUM
Fuel Pump		
Spring Pack Capscrews	9 (12)	11 (15)
Fuel Filter	20 (27)	25 (34)
Brass Filter Fittings	30 (41)	40 (54)
Gear Pump Capscrew	11 (15)	13 (18)
Filter Bracket Capscre	20 (27)	30 (41)
Mounting Capscrews	30 (41)	35 (47)
Throttle Shaft Plug	40 in. lb (4.5)	55 in. lb (6.2)
Fuel Injector		
cups		55 (75)
Mounting Capscrews	10 (14)	12 (16)
Orifice Plug	8 in. lb (0.9)	10 in. lb (1.1)

**SECTION XV, COOLING SYSTEM**

**WEAR LIMITS – INCH (MM)**

PART OR COMPONENT	NEW MINIMUM	NEW MAXIMUM	WORN LIMIT
Water Pump Impeller to Shaft Press Fit			0.001 (0.03)
Impeller to Body Clearance	0.020 (0.51)	0.040 (1.02)	
Fan Hub End Clearance	0.003 (0.08)	0.010 (0.25)	
Bearing to Shaft Press Fit		0.001 (0.03)	
Idler Pulley Bearing to Shaft			0.003 (0.51)

**THERMOSTAT OPERATING RANGES**

RANGE	BEGINS OPENING	FULLY OPEN
Low	160°F (71°C)	175°F (79°C)
Medium	175°F (79°C)	185°F (85°C)
High	180°F (82°C)	195°F (91°C)

**TORQUE LIMITS – FT LB (N•M)**

PART OR LOCATION	MINIMUM	MAXIMUM
Water Pump Capscrews	30 (41)	35 (47)
Water Header Plates	8 (11)	10 (14)
Idler Pulley	12 (16)	15 (20)
Water Manifold	30 (41)	35 (47)

## APPENDIX A

### REFERENCES

#### A-1. SCOPE.

This appendix lists forms, field manuals, technical manuals, and other publications referenced in this manual and which apply to direct and general support maintenance of NTC-290 Diesel Engine.

#### A-2. PUBLICATION INDEX.

DA Pam 25-30, Consolidated Index of Army Publications and Blank Forms, should be consulted frequently for latest changes or revisions and for new publications relating to materiel covered in this technical manual.

#### A-3. FORMS.

Refer to DA Pam 738-750, The Army Maintenance Management System (TAMMS) for instructions on the use of Maintenance Forms.

Equipment Inspection and Maintenance Worksheet .....	DA Form 2404
Equipment Log Assembly (Records) .....	DA Form 2408
Maintenance Request Form .....	DA Form 2407
Material Condition Status Report .....	DA Form 2406
Processing and Deprocessing Record for Shipment, Storage and Issue of Vehicles and Spare Engines .....	DD Form 1397
Product Quality Deficiency Report .....	SF 368
Recommended Changes to Equipment Technical Publications .....	DA Form 2028-2
Recommended Changes to Publications and Blank Forms .....	DA Form 2028

#### A-4. FIELD MANUALS.

Army Motor Transport Units and Operations .....	FM 55-30
Field Hygiene and Sanitation .....	FM 21-10
First Aid for Soldiers .....	FM 21-11
General Fabric Repair .....	FM 10-16
NBC Contamination Avoidance .....	FM 3-3
NBC Decontamination .....	FM 3-5
NBC Protection .....	FM 3-4
Operation and Maintenance of Ordnance Materiel in Cold Weather (0° to -65°F) .....	FM 9-207

#### A-5. TECHNICAL BULLETINS.

Color, Marking, and Camouflage Painting of Military Vehicles, Construction Equipment, and Materials Handling Equipment .....	TB 43-0209
Equipment Improvement Report and Maintenance Digest (U.S. Army Tank-Automotive Command) Tank Automotive Equipment Series .....	TB 43-0001-39
Maintenance in the Desert .....	TB 43-0239
Soldering Methods and Equipment .....	TB SIG 222

#### A-6. TECHNICAL MANUALS.

Inspection Methods, Non-Destructive .....	TM 55-1500-335-23
Inspection, Care, and Maintenance of Antifriction Bearings .....	TM 9-214

**A-6. TECHNICAL MANUALS-Continued.**

Materials Used for Cleaning, Preserving, Abrading, and Cementing Ordnance Materiel and Related Items Including Chemicals . . . . .	TM 9-247
Organizational Support Maintenance Manual, Truck, Dump, 20-Ton, 6x4 . . . . .	TM 5-3805-254-20
Organizational Maintenance Repair Parts and Special Tools Lists, Truck, Dump, 20-Ton,6x4 . . . . .	TM 5-3805-254-20P
Direct Support and General Support Maintenance Manual, Truck, Dump, 20-Ton,6x4 . . . . .	TM 5-3805-254-34
Direct Support and General Support Maintenance Repair Parts and Special Tools Lists, Truck, Dump, 20-Ton, 6x4 . . . . .	TM 5-3805-254-34P
Operator's Manual for Welding Theory and Application . . . . .	TM 9-237
Painting Instructions for Army Materiel . . . . .	TM 43-0139
Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use . . . . .	TM 750-244-6
Storage and Materials Handling . . . . .	TM 743-200-1

**A-7. OTHER PUBLICATIONS.**

Army Logistics Readiness and Sustainability . . . . .	AR 700-138
Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items) . . . . .	CTA 50-970
Lubrication Order, Truck, Dump, 20-Ton, 6x4 . . . . .	LO 5-3805-254-12

## APPENDIX B

### EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

#### Section I. INTRODUCTION

##### B-1. SCOPE.

This appendix lists expendable/durable supplies and materials you will need to operate and maintain the semitrailers. This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items), or CTA 8-100, Army Medical Department Expendable/Durable Items.

##### B-2. EXPLANATION OF COLUMNS.

a. **Column (1), Item Number.** This number is assigned to the entry in the listing and is referenced in the "Initial Setup" of maintenance paragraphs or narrative instructions to identify the material needed (e.g., Dry cleaning solvent, Item 16, Appendix B).

b. **Column (2), Level.** This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew  
 O - Organizational Maintenance  
 F - Direct Support Maintenance  
 H -General Support Maintenance

c. **Column (3), National Stock Number.** This is the National Stock Number assigned to the item. Use it to request or requisition the item.

d. **Column (4), Description.** Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Commercial and Government Entity (CAGE) Code in parentheses followed by the part number, if applicable.

e. **Column (5), Unit of Measure (U/M).** 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/DURABLE SUPPLIES AND MATERIALS LIST

(1) Item number	(2) Level	(3) National Stock Number	(4) Description (CAGE) Part Number	(5) U/M
1	O	5350-00-192-5050	Cloth: Abrasive 50-Sheet Package (58536) A-A-1048	ea
2	O	9150-00-398-4170	Grease: Special Purpose and Lubricant 1-Pound Can (07644) 25-10MS	lb
3	O	6850-00-181-7929	Antifreeze: Permanent, Ethylene Glycol, Inhibited (81348) MIL46153	gal
4	O	5350-00-221-0872	Cloth: Abrasive 50-Sheet Package (81348) A-A-1206	sh
5	F	9150-00-663-1360	Cutting Fluid: Lapping 1-Quart Can (92663) KS9595	St
6	O	7930-00-282-9699	Detergent: Liquid, GP, WS 1-Gallon Can (81349) MIL-D-16791	gal
7	F	6820-00-0014192	Dye: Leak-Detection 1-Gallon Can (81349) MIL-D-81298	gal
8	O	9150-00-698-2382	Fluid: Transmission, Automatic (AFT) A-A Service Protection 1-Quart Can (12204) 4271243	St
9	O	9150-00-270-0067	Oil: Gear, GO 85W/140 5-Gallon Can (81348) VV-L-765	gal
10	F	9150-01-147-3600	Grease: Extreme-Pressure 16-Ounce Aerosol Can (52203) 91491	02
11	O	9140-00-286-5294	Fuel: Diesel DF-2 Regular (81348) VV-F-800	gal

## Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST-Continued

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description (CAGE) Part Number	(5) U/M
12	O	9150-00-186-6681 9150-00-188-9858 9150-00-189-6729	Oil: Lubricating, OE/HDO 30 (81349) MIL-L-2104C  1 -Quart Can Type 1 5-Gallon Can 55-Gallon Drum	qt gal gal
13	F	8010-00-652-3626	Paste: Prussian Blue (81349) MIL-P-30501	OZ
14	C	7920-00-205-1711	Rags: Wiping 50-Pound Bale (58536) A-A-2522	ea
15	C	9150-00-281-1893	Soap: Lubricating 1 Package Quantity, Stick, Package Type (24446) 181A8705POO1	OZ
16	O	6850-00-281-1985 6850-00-285-8012	Solvent: Dry Cleaning, Type II (81348) P-D-680  1-Gallon Can 55-Gallon Can	gal gal
17	O	9905-00-537-8954	Tags: Marker Box of 50 (81349) MIL-T-12755	ea
18	O	8030-00-889-3535	Tape: Antiseizing, Pipe-Joint Sealer 1/2-inch Wide, 260 inches Long (76381) 4B	ft
19	O	7510-00-473-9513	Tape: Pressure Sensitive, Adhesive e-inch Wide (81349) MIL-T-23397	ft
20	F	4910-00-779-6851	Oil: Test, Injector (33287) J-26400-5B	OZ
21	F	9505-00-684-4843	Wire: Locking 1-Pound Roll (72452) 1459-262	lb





## APPENDIX C

### REPAIR PARTS AND SPECIAL TOOLS LISTS

#### Section I. INTRODUCTION

##### C-1. SCOPE.

This RPSTL lists and authorizes spares and repair parts; special tools; special test, measurement, and diagnostic equipment (TMDE); and other special support equipment required for performance of Direct Support and General Support Maintenance of the Diesel Engine. It authorizes the requisitioning, issue, and disposition of spares, repair parts and special tools as indicated by the source, maintenance and recoverability (SMR) codes.

##### C-2. GENERAL.

in addition to Section I, *Introduction*, this Repair Parts and Special Tools List is divided into the following sections:

a. **Section ii. Repair Parts List.** A list of spares and repair parts authorized by this RPSTL for use in the performance of maintenance. The list also includes parts which must be removed for replacement of the authorized parts. Parts lists are composed of functional groups in ascending alphanumeric sequence, with the parts in each group listed in ascending figure and item number sequence. Bulk materials are listed in item name sequence. Repair parts kits are listed separately in their own functional group within Section Ii. Repair parts for repairable special tools are also listed in this section. Items listed are shown on the associated illustration(s)/figure(s).

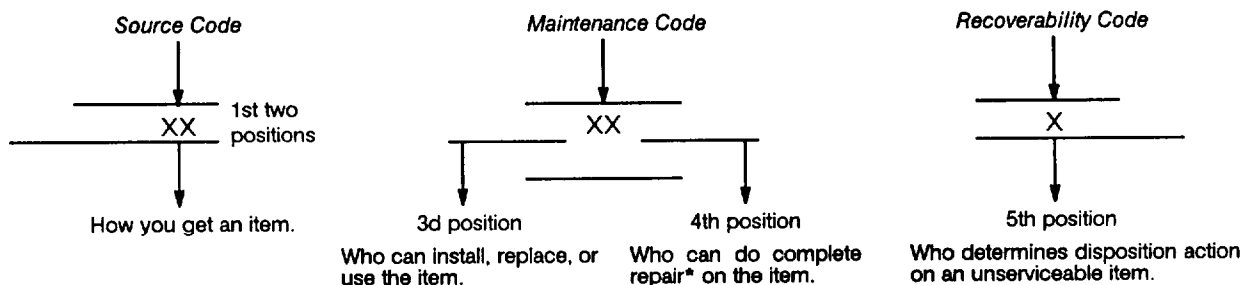
b. **Section iii. Special Tools List.** A list of special tools, special TMDE, and other special support equipment authorized by this HPSTL [as indicated by Basis of issue (BOI) information in the *DESCRIPTION AND USABLE ON CODE* column] for the performance of maintenance.

c. **Section IV. Cross-reference indexes.** A list, in National Item Identification Number (NIIN) sequence, of all National stock numbered items appearing in the listing, followed by a list in alphanumeric sequence of all part numbers appearing in the listings. National stock numbers and part numbers are cross-referenced to each illustration/figure and item number appearance. The figure and item number index lists figure and item numbers in alphanumeric sequence and cross-references NSN, CAGE, and part numbers.

##### C-3. EXPLANATION OF COLUMNS (SECTIONS ii AND iii).

a. **ITEM NO. [Column (1)].** indicates the number used to identify items called out in the illustration.

b. **SMR CODE (Column (2)).** The Source, Maintenance, and Recoverability (SMR) code is a 5-position code containing supply/requisitioning information, maintenance category authorization criteria, and disposition instruction, as shown in the following breakout:



\*Complete Repair: Maintenance capacity, capability, and authority to perform all corrective maintenance tasks of the "Repair" function in a use/user environment in order to restore serviceability to a failed item.

**C-3. EXPLANATION OF COLUMNS (SECTIONS II AND III) – Continued.**

(1) **Source Code.** The source code tells you how to get an item needed for maintenance, repair, or overhaul of an end item/equipment. Explanations of source codes follow:

<u>Code</u>	<u>Application/Explanation</u>
PA PB PC** PD PE PF PG	Stocked items; use the applicable NSN to request/requisition Items with these source codes. They are authorized to the category indicated by the code entered in the 3d position of the SMR code.  <p style="text-align: center;"><i>** Items coded PC are subject to deterioration</i></p>
.....	
KD KF KB	Items with these codes are not to be requested/requisitioned Individually. They are pan of a kit which is authorized to the maintenance category indicated In the 3d position of the SMR code. The complete kit must be requisitioned and applied.
.....	
MO - Made at UM/AVUM Level MF - Made at DS/AVUM Level MH - Made at GS Level MD - Made at Depot	items with these codes are not to be requested/requisitioned individually. They must be made from bulk materiel which is Identified by the part number in the DESCRIPTION AND USABLE ON CODE (UOC) column and listed in the bulk materiel group of the repair parts list in this RPSTL. If the item is authorized to you by the 3d position code of the SMR code, but the source code indicates it is made at a higher level, order the item from the higher level of maintenance.
.....	
AO - Assembled by UM/AVUM Level AF - Assembled by DS/AVUM Level AH - Assembled by GS Level AD - Assembled at De- pot	Items with these codes are not to be requested/requisitioned individually. The pans that make up the assembled item must be requisitioned or fabricated and assembled at the level of maintenance indicted by the source code. If the 3d position code of the SMR code authorizes you to replace the item, but the source code indicates that the item is assembled at a higher level, order the item from the higher level of maintenance.

**NOTE**

**Cannibalization or controlled exchange, when authorized, may be used as a source of supply for items with the above source codes, except for those source coded 'XA.'**

XA - DO NOT requisition an 'XA-coded item. Order its next higher assembly.

XB - If an "XB" item is not available from salvage, order it using the CAGE and pan number given.

**C-3. EXPLANATION OF COLUMNS (SECTIONS II AND III) –Continued.**

XC - Installation drawing, diagram, instruction sheet, field service drawing, that is identified by manufacturer's part number.

XD - Item is not stocked. Order an "XD"-coded item through normal supply channels using the CAGE and part number given, if no NSN is available.

(2) Maintenance Code. Maintenance codes tell you the level(s) of maintenance authorized to use and repair support items. The maintenance codes are entered in the third and fourth positions of the SMR code as follows:

- (a) The maintenance code entered in the third position tells you the lowest maintenance level authorized to remove, replace, and use an item. The maintenance code entered in the third position will indicate authorization to one of the following levels of maintenance.

<u>Code</u>	<u>Application/Explanation</u>
C	- Crew or operator maintenance done within unit maintenance or aviation unit maintenance.
O	- Unit maintenance or aviation unit can remove, replace, and use the item.
F	- Direct support or aviation intermediate level can remove, replace, and use the item.
H	- General support level can remove, replace, and use the item.
L	- Specialized repair activity can remove, replace, and use the item.
D	- Depot level can remove, replace, and use the item.

**NOTE**

Some limited repair may be done on the Item at a lower level of maintenance, if authorized by the Maintenance Allocation Chart (MAC) and SMR codes.

- (b) The maintenance code entered in the fourth position tells whether or not the item is to be repaired and identifies the lowest maintenance level with the capability to do complete repair (i.e., perform all authorized "Repair" functions). This position will contain one of the following maintenance codes:

<u>Code</u>	<u>Application/Explanation</u>
O	- Unit maintenance or aviation unit is the lowest level that can do complete repair of the item.
F	- Direct support or aviation intermediate is the lowest level than can do complete repair of the item.
H	- General support is the lowest level that can do complete repair of the item.
L	- Specialized repair activity is the lowest level that can do complete repair of the item.
D	- Depot is the lowest level that can do complete repair of the item.
Z	- Nonreparable. No repair is authorized.
B	- No repair is authorized. (No parts or special tools are authorized for the maintenance of a "B"-coded item.) However, the item may be reconditioned by adjusting, lubricating, etc., at the user level.

**C-3. EXPLANATION OF COLUMNS (SECTIONS II AND III) -Continued.**

(3) **Recoverability Code.** Recoverability codes are assigned to items to indicate the disposition action on unserviceable items. The recoverability code is entered in the fifth position of the SMR code as follows:

<u>Code</u>	<u>Application/Explanation</u>
Z	- Nonreparable item. When unserviceable, condemn and dispose of the item at the level of maintenance shown in the 3d position of the SMR code.
O	- Reparable item. When uneconomically reparable, condemn and dispose of the Item at unit maintenance or aviation unit level.
F	- Reparable item. When uneconomically reparable, condemn and dispose of the item at the direct support or aviation intermediate level.
H	- Reparable item. When uneconomically reparable, condemn and dispose of the item at the general support level.
D	- Reparable item. When beyond lower level repair capability, return to depot. Condemnation and disposal of item not authorized below depot level.
L	- Reparable item. Condemnation and disposal of item not authorized below specialized repair activity (SRA).
A	- Item requires special handling or condemnation procedures because of specific reasons (e.g., precious metal content, high dollar value, critical material, or hazardous material). Refer to appropriate manuals/directives for specific instructions.

c. **CAGEC [Column (3)]**. The Commercial and Government Entity (CAGE) Code (C) is a 5-digit alphanumeric code which is used to identify the manufacturer, distributor, or Government agency, etc., that supplies the item.

**NOTE**

**When you use an NSN to requisition an Item, the Item you receive may have a different part number from the part ordered.**

d. **PART NUMBER [Column (4)]**. Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements to identify an item or range of items.

e. **DESCRIPTION AND USABLE ON CODE (UOC) [Column (5)]**. This column includes the following information:

- (1) The Federal item name and, when required, a minimum description to identify the item.
- (2) Physical security classification. Not Applicable.
- (3) Items that are included in kits and sets are listed below the name of the kit or set on Figure KIT.
- (4) Spare/repair parts that make up an assembled item are listed immediately following the assembled item line entry.
- (5) Pan numbers for bulk materials are referenced in this column in the line item entry for the item to be manufactured/fabricated.
- (6) When the item is not used with all serial numbers of the same model, the effective serial numbers are shown on the last line(s) of the description (before UOC). Not Applicable.
- (7) me usable on code, when applicable (see paragraph C-5, Special Information).

**C-3. EXPLANATION OF COLUMNS (SECTIONS II AND III) -Continued.**

(8) In the Special Tools List section, the Basis of Issue (BOI) appears as the last line(s) -in the entry for each special tool, special TMDE, and other special support equipment. When density of equipments supported exceeds density spread indicated in the Basis of Issue, the total authorization is increased proportionately.

(9) The statement "END OF FIGURE" appears just below the last item description in Column 5 for a given figure in both Section II and Section III.

f. **QTY [Column (6)].** The QTY (quantity per figure) column indicates the quantity of the item used in the breakout shown on the illustration/figure, which is prepared for a functional group, subfunctional group, or an assembly. A "V" appearing in this column in lieu of a quantity indicates that the quantity is variable and the quantity may vary from application to application.

**C-4. EXPLANATION OF COLUMNS (SECTION IV).****a. National Stock Number (NSN) Index.**

(1) **STOCK NUMBER column.** This column lists the NSN by National Item Identification Number (NIIN) sequence. The NIIN consists of the last nine digits of the NSN (i.e.,

NSN  
5305-01-674-1467)  
NIIN

When using this column to locate an item, ignore the first 4 digits of the NSN. However,

the complete NSN should be used when ordering items by stock number.

(2) **FIG. column.** This column lists the number of the figure where the item is identified/located. The figures are in numerical order in Section II and Section III.

(3) **ITEM column.** The item number identifies the item associated with the figure listed in the adjacent FIG. column. This item is also identified by the NSN listed on the same line.

b. **Part Number Index.** Part numbers in this index are listed by part number in ascending alphanumeric sequence (i.e., vertical arrangement of letter and number combination which places the first letter or digit of each group in order A through Z, followed by the numbers 0 through 9 and each following letter or digit in like order).

(1) **CAGEC column.** The Commercial and Government Entity (CAGE) Code (C) is a 5-digit alphanumeric code used to identify the manufacturer, distributor, or Government agency, etc., that supplies the item.

(2) **PART NUMBER column.** Indicates the primary number used by the manufacturer (individual, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards and inspection requirements to identify an item or range of items.

(3) **STOCK NUMBER column.** This column lists the NSN for the associated part number and manufacturer identified in the PART NUMBER and CAGE columns to the left.

(4) **FIG. column.** This column lists the number of the figure where the item is identified/located in Section II and Section III.

(5) **ITEM column.** The item number is that number assigned to the item as it appears in the figure referenced in the adjacent figure number column.

**c. Figure and Item Number Index.**

(1) **FIG. column.** This column lists the number of the figure where the item is identified/located in Sections II and III.

(2) **ITEM column.** The item number is that number assigned to the item as it appears in the figure referenced in the adjacent figure number column.

(3) **STOCK NUMBER column.** This column lists the NSN for the item.

**C-4. EXPLANATION OF COLUMNS (SECTION IV) – Continued.**

(4) **CAGE column** The Commercial and Government Entity (CAGE) is a 5-digit alphanumeric code used to identify the manufacturer, distributor, or Government agency, etc., that supplies the item.

(5) **PART NUMBER column.** Indicates the primary number used by the manufacturer (individual, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards and inspection requirements to identify an item or range of items.

**C-5. SPECIAL INFORMATION.**

a. **Usable On Code.** me usable on code appears in the lower left corner of the Description column heading. Not Applicable.

b. **Fabrication Instructions.** Bulk materiels required to manufacture items are listed in the Bulk Materiel Functional Group of this RPSTL. Part numbers for bulk materiels are also referenced in the DESCRIPTION column of the line item entry for the item to be manufactured/fabricated. Detailed fabrication instructions for items source coded to be manufactured or fabricated are found in *Appendix D* of this manual.

c. **Assembly Instructions.** Detailed assembly instructions for items source coded to be assembled from component spare/repair parts are found in *Chapter 2*. Items that make up the assembly are listed immediately following the assembly item entry or reference is made to an applicable figure.

d. **Kits.** Line item entries for repair parts kits appear in group 9401 in Section II.

e. **Index Numbers.** Items which have the word BULK in the FIG. column will have an index number shown in the item column. This index number is a cross-reference between the National Stock Number/Part Number Index and the bulk materiel list in Section II.

f. **Associated Publications.** The publications listed below pertain to the NTC-290 Diesel Engine, the 20-Ton Dump Truck, and their components:

<u>Publication</u>	<u>Short Title</u>
LO 5-3805-254-12	Truck, Dump IHC Model F-5070 (CCE)
TM 5-3805-254-10	Truck, Dump IHC Model F-5070 (CCE)
TM 5-3805-254-20-1	Truck, Dump IHC Model F-5070 (CCE)
TM 5-3805-254-20-2	Truck, Dump IHC Model F-5070 (CCE)
TM 5-3805-254-20P	Truck, Dump IHC Model F-5070 (CCE)
TM 5-3805-254-34	Truck, Dump IHC Model F-5070 (CCE)
TM 5-3805-254-34P	Truck, Dump IHC Model F-5070 (CCE)

**C-6. HOW TO LOCATE REPAIR PARTS.**

a. **When National Stock Number or Part Number Is Not Known:**

(1) **First.** Using the Table of Contents, determine the assembly group or subassembly group to which the item belongs. This is necessary since figures are prepared for assembly groups and subassembly groups, and listings are divided into the same groups.

(2) **Second.** Find the figure covering the assembly group or subassembly group to which the item belongs.

(3) **Third.** Identify the item on the figure and use the Figure and Item Number Index to find the NSN.

**C-6. HOW TO LOCATE REPAIR PARTS—Continued.**

**b. When National Stock Number or Part Number Is Known:**

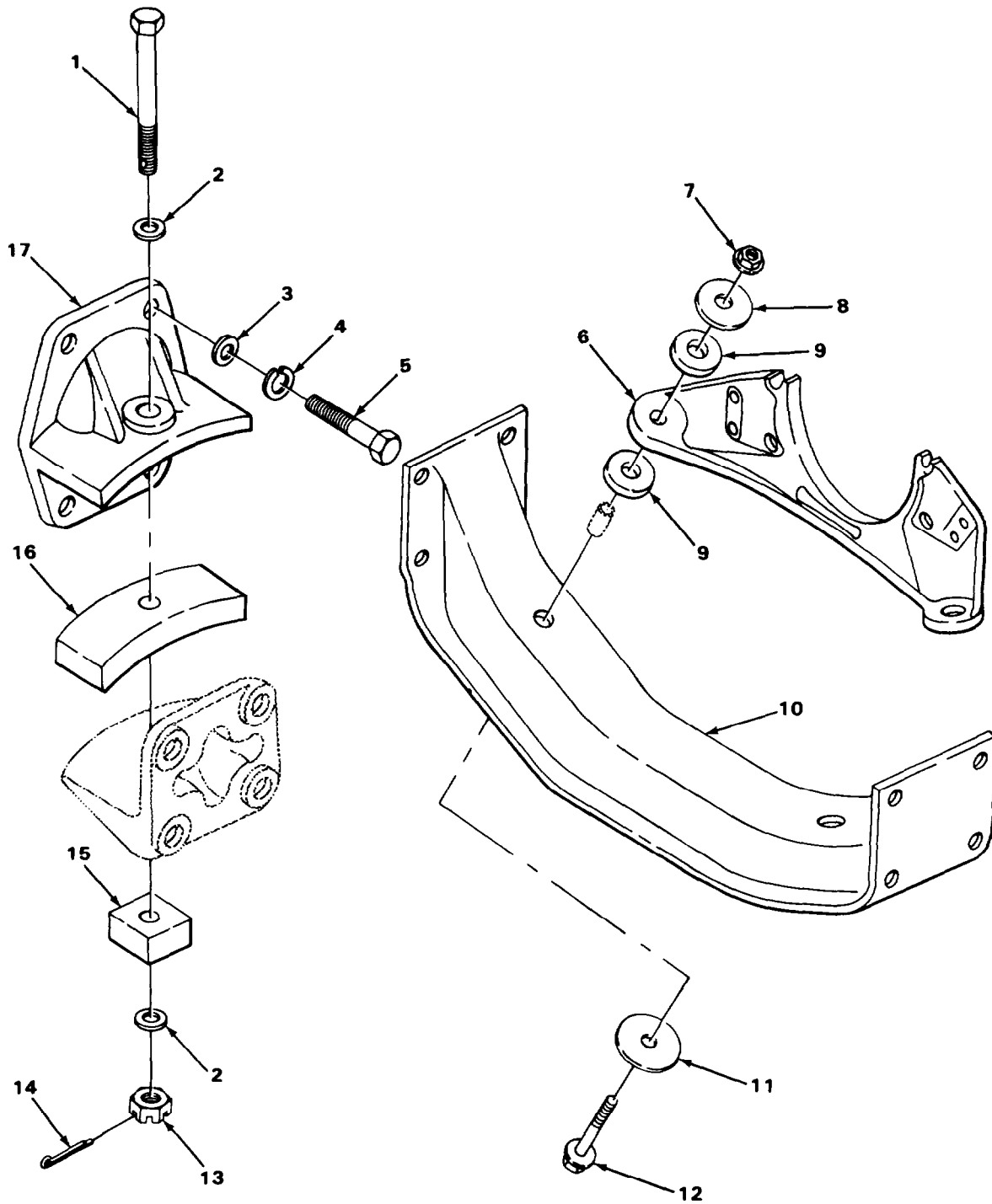
(1) **First.** Using the National Stock Number or Part Number Index, find the pertinent National Stock Number or Part Number. The NSN Index Is in National Item Identification Number (NIIN) sequence [see paragraph C-4.a(1)]. The part numbers in the Part Number Index are listed in ascending alphanumeric sequence (see paragraph C-4.b). Both indexes cross-reference you to the illustration/figure and item number of the item you are looking for.

(2) **Second.** Turn to the figure and item number, verify that the item is the one you're looking for, then locate the item number in the repair parts list for the figure.

**C-7. ABBREVIATIONS.**

For standard abbreviations see MIL-STD-12D, *Military Standard Abbreviations for Use on Drawings, Specifications, Standards, and in Technical Documents.*

<u>Abbreviations</u>	<u>Explanation</u>
NIIN .....	National Item Identification Number (consists of the last 9 digits of the NSN)
RPSTL .....	Repair Parts and Special Tools Lists



TA508243

FIGURE 1. ENGINE MOUNTING BRACKETS.



## SECTION II

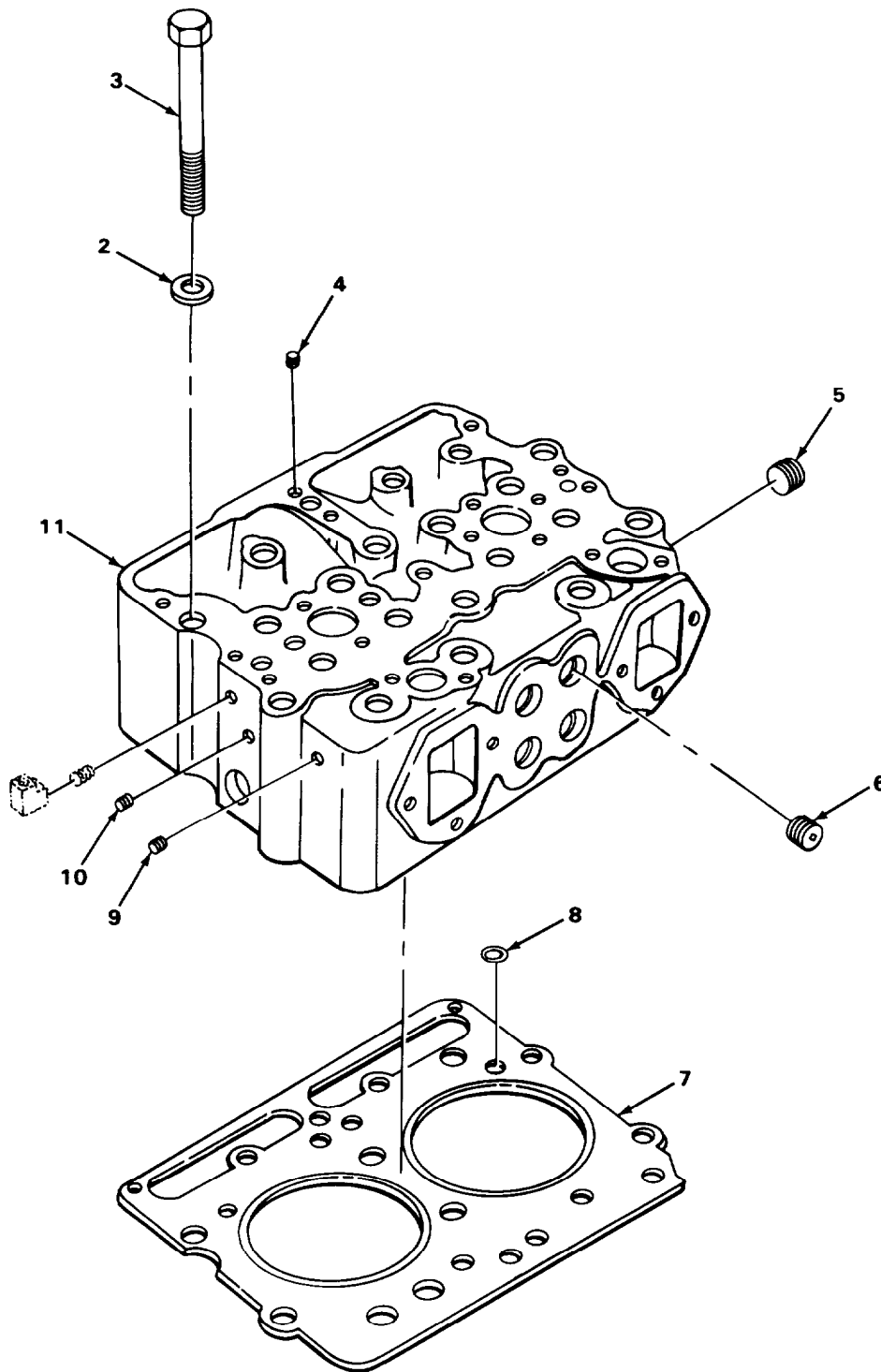
TM5-2815-241-34&amp;P

(1) ILLUSTRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						0101-CRANKCASE, BLOCK, CYLINDRT HEAD		
2	1	XDHHH		89346	AR09911	BLOCK, CYLINDER	EA	1
2	2	PAFZZ	5305-00-942-2196	96906	MS18154-60	.SCREW, CAP, HEXAGON H	EA	4
2	3	PAHZZ	5310-00-261-340	96906	MS35338-8	.WASHER, LOCK	EA	4
2	4	PAFZZ	2815-00-404-2747	15434	158145	.COVER, ACCESS	EA	1
2	5	PAHZZ	2815-00-064-4398	15434	213740	.CYLINDER, SLEEVE	EA	6
2	5	XDHZZ		15434	202226	.SLEEVE, SALVAGE	EA	6
2	6	PAHZZ	5305-00-230-1939	15434	S118A	.SCREW	EA	12
2	7	PAHZZ	5310-00-159-6209	96906	MS122032	.WASHER, LOCK	EA	12
2	8	XDHZZ		89346	210895	.COVER WATER HEADER	EA	1
2	9	PAHZZ	5330-00-537-2382	15434	70089-1	.GASKET WATER HEADER COVER PART OF KIT P/N 3018762	EA	3
2	10	PAHZZ	5330-01-145-5377	15434	3007442	.PACKING, PREFORMED PART OF KIT P/N 3018762	EA	6
2	11	XDHZZ		89346	211475	.NOZZLE	EA	6
2	12	PAHZZ	5310-00-407-9566	96906	MS35338-45	.WASHER, LOCK	EA	6
2	13	XDHZZ		89346	S102A	.SCREW, CAP, HEXAGON HEAD	EA	6
2	14	PAHZZ	2930-00-799-0843	15434	132019	.COVER, WATER HEADER	EA	1
2	15	PAHZZ	4730-00-044-4715	15434	S962	.PLUG, PIPE	EA	1
2	16	XDHZZ		15434	191079	.SLEEVE, WATER, PASSAG	EA	V
2	17	PAHZZ	5315-00-014-1284	24617	141284	.PIN, STRAIGHT, HEADLE FLYWHEEL HOUSING	EA	2
2	18	PAHZZ	5315-00-014-1195	15434	658585	.PIN, STRAIGHR, HEADLE, CAM FOLLOWER TO BLOCK HOUSING	EA	6
2	19	PAHZZ	2815-00-484-8359	15434	42645	.CAP, MAIN BEARING NO.1, 3, 5	EA	3
2	19	PAHZZ	3130-00-408-9041	15434	42646	.CAP, PILLOW BLOCK NO. 2, 4, 6	EA	3
2	19	PAHZZ	2815-00-484-8360	15434	42647	.CAP, MAIN BEARING NO.7	EA	1
2	20	PAHZZ	5310-00-356-1447	15434	3009213	.LOCK, PLATE	EA	14
2	21	PAHZZ	5306-00-804-2468	15434	105953	.BOLT, MACHINE HEAD MAIN BEARING CAP	EA	14
2	22	PAHZZ	5315-00-532-9388	19207	5329388	.PIN, STRAIGHT, HEADLE MAIN BARING TO BLOCK	EA	2
2	23	PAHZZ	4730-00-018-9566	15434	S911B	.PLUG, PIPE	EA	2
2	24	PAHZZ	4730-00-801-8186	15434	S-915-A	.PLUG, PIPE	EA	2
2	25	PAHZZ	5365-01-150-6257	15434	210884	.PLUG, MACHINE THREAD .875 THREAD	EA	1
2	26	PAHZZ	2815-00-772-9434	15434	70653	.DOWEL, DIAMOND, GEAR COVER	EA	1

(1) ILLUSTRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.						USABLE ON CODE	
2						0101 (CONT)		
2	27	PAHZZ	4730-00-057-5555	96906	MS49005-6	.PLUG, PIPE	EA	4
2	28	PAHZZ	5315-00-238-0882	15434	60408	.PIN, STRAIGHT, HEADLE GEAR COVER	EA	1
2	29	PAHZZ	5315-01-058-4551	15434	202903	.PIN, STRAIGHT HEXAGO	EA	2
2	30	PAHZZ	5315-00-281-7610	15434	68445	.PIN, GROOVED, HEADLE HEAD TO BLOCK	EA	6
2	31	PAHZZ	5330-00-058-1767	15434	149105PC183049	.PACKING, PREFORMED	EA	6
2	32	PAFZZ	5330-00-246-0309	79150	26384	.GASKET COVER TO BLOCK PART OF KIT P/N 3018762	EA	1
2	33	PAHZZ	5330-01-049-0466	15434	3008998	.PACKING	EA	6
2	34	PAHZZ	5330-00-064-4399	15434	215090	.GASKET	EA	6
2	35	XDHZZ		15434	153938	.SHIM .007 IN. THK	EA	1
2	35	PAHZZ	5365-00-488-0799	15434	3019956	.SPACER, RING .008 IN. THK	EA	1
2	35	XDHZZ		15434	143946	SHIM .009 IN., THK	EA	1
2	35	PAHZZ	5365-01-086-8214	15434	143947	SPACER, RING .020 IN. THK	EA	1
2	35	XDHZZ		15434	143948	SPACER, RING .031 IN. THK	EA	1
2	35	XDHZZ		15434	143919	SPACER, RING .062 IN. THK	EA	1



2 THRU 11



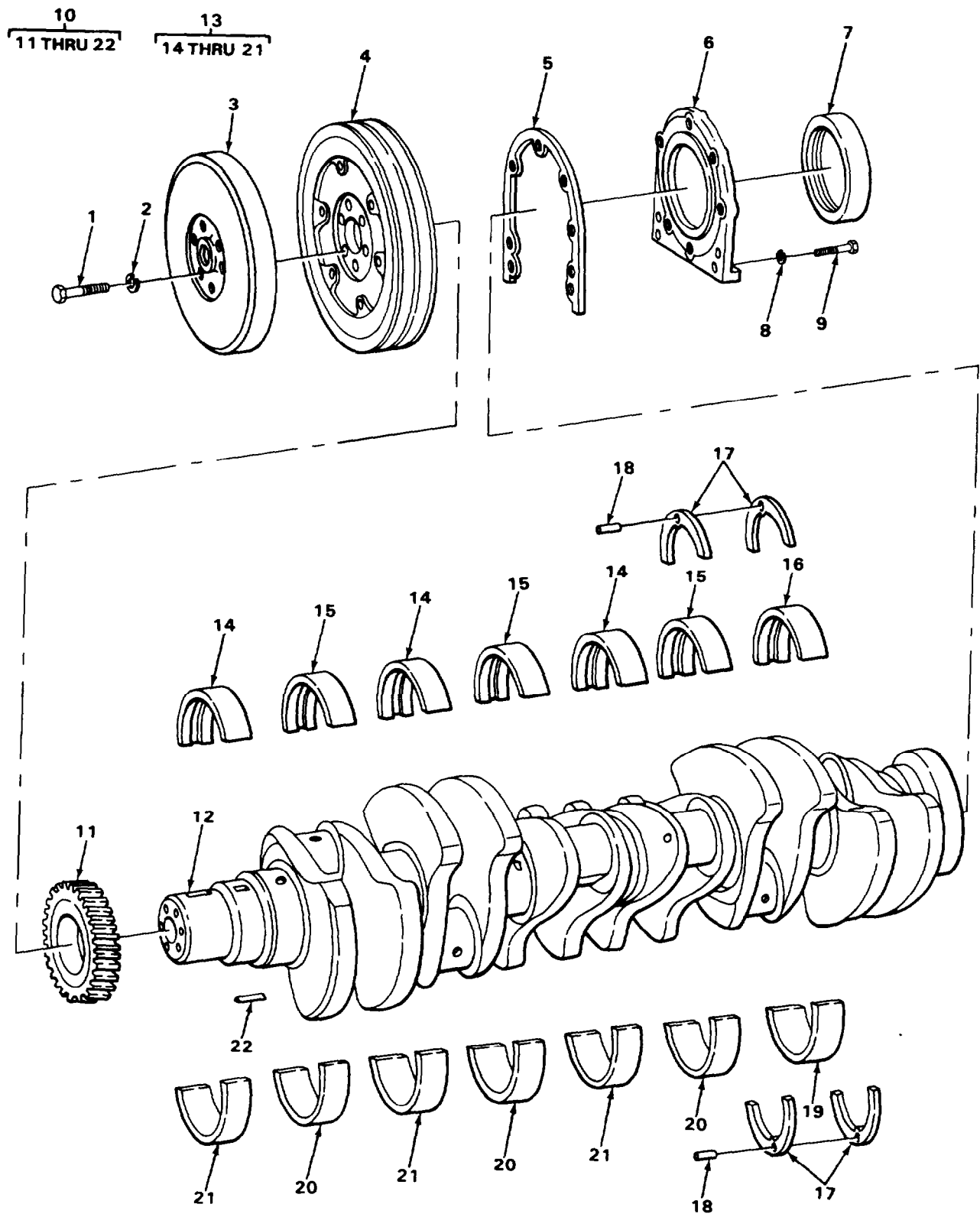
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FIGURE 3. CYLINDER HEAD.

## SECTION II

TM1-1520-248-23P

(1) ILLUSTRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.						USABLE ON CODE	
						0101 (CONT)		
3	1	PAFHH	2815-01-080-0642	15434	300809	CYLINDER HEAD, DIESE	EA	3
3	2	PAFZZ	5310-00-962-5610	15434	69699	.WASHER, FLAT	EA	12
3	3	PAFZZ	5305-00-006-8411	15434	209700	.SCREW	EA	12
3	4	PAHZZ	5365-00-404-2934	15434	S965E	.PLUG, PIPE	EA	3
3	5	PAHZZ	4730-00-289-4770	15434	S995	.PLUG, PIPE	EA	6
3	6	PAHZZ	4730-00-044-4715	15434	S962	.PLUG, PIPE	EA	2
3	7	PAFZZ	5330-01-080-5021	15434	3036126	.GASKET CYLINDER HEAD PART OF KIT P/N 3801330	EA	1
3	8	PAFZZ	5330-00-129-9349	15434	193949	.GASKET	EA	21
3	9	PAHZZ	5340-00-721-5329	00905	H524018	.PLUG, FUSIBLE	EA	1
3	10	PAHZZ	4730-00-018-9566	15434	S911B	.PLUG, PIPE	EA	4
3	11	PAHZZ	2815-00-739-6048	15434	3008100	.CYLINDER HEAD, DIESE	EA	1



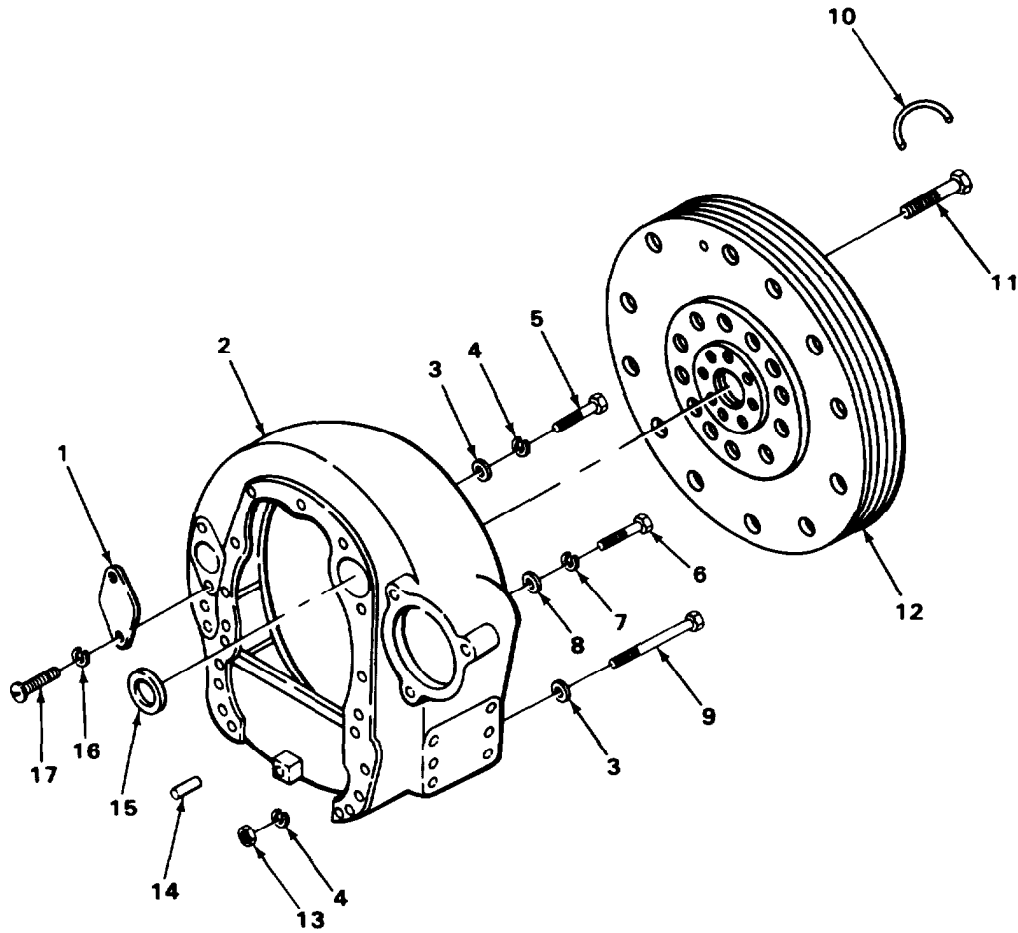
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FIGURE 4. CRANKSHAFT, GEARS AND BEARINGS.

## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUSTRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.						USABLE ON CODE	
						0102-CRANKSHAFT		
4	1	XDFZZ		15434	212113	SCREW, CAP, HEXAGON HEAD		
4	2	PAFZZ	5310-00-820-6653	96906	MS35338-50	WASHER, LOCK		
4	3	XDFZZ		15434	211914	DAMPER, VIBRATION		
4	4	PAFZZ	3020-01-077-4411	15434	211918	PULLLEY, GROOVE		
4	5	PAHZZ	5330-00-361-2955	15434	40662A	GASKET REAR COVER PART OF KIT P/N 3018762		
4	6	PAHZZ	2815-01-146-5925	15434	3006737	COVER, REAR CAMSHAFT		
4	7	PAHZZ	5330-00-005-0858	96906	MS35338-8	SEAL REAR OIL PART OF KIT P/N 3018762		
4	8	PAHZZ	5310-00-261-7340	15434	MS90726-64	WASHER, LOCK		
4	9	PFHZZ		15434	3029348	SCREW, CAP, HEXAGON HEAD		
4	10	PAHHH	2815-01-151-8772	15434	3014614	CRANKSHAFT, ENGINE ASSEMBLY		
4	11	PAHZZ	3020-01-146-0107	15434	3024923	.GEAR, HELICAL		
4	12	PAHHH	2815-01-083-3157	15434	3801261	.CRANKSHAFT, EBGUBE		
4	13	PAHZZ	3120-01-143-9547	35434	3801262	.BEARING HALF SET. SL .010 INCH UNDERSIZE		
4	13	PAHZZ	3120-01-144-8882	15434	3801263	.BEARING HALF SET. SL .020 INCH UNDERSIZE		
4	13	PAHZZ	3120-01-145-9132	15434	3801260	.BEARING HALF SET. SL .030 INCH UNDERSIZE		
4	13	PAHZZ	3120-01-132-9339	15434	H42693	.REARING SET STANDARD		
4	14	PAHZZ	3120-00-349-6444	15434	H42693	..BEARING, HALF SLEEVE STADARD		
4	15	PAHZZ	3120-00-318-8537	15434	H40496	..BEARING, HALF SLEEVE STADARD		
4	16		3120-00-090-5504	15434	42690	..BEARING, HALF SLEEVE STADARD		
4	17	PAHZZ	3120-01-214-7779	15434	157280	..WASHER, HALF TRUST STANDARD		
4	18	PAHZZ	5315-01-058-4551	15434	202903	..PIN, STRAIGHT, HEXAGO		
4	19	PAHZZ	3120-00-593-1507	15434	3019204	..BEARING, HALF SLEEVE STADARD		
4	20	XDHZZ		15434	3019192	..BEARING, HALF SLEEVE STADARD		
4	21	PAHZZ	3120-00-695-1232	15434	3019180	..BEARING, HALF SLEEVE STADARD		
4	22	PAHZZ	5315-01-079-6740	15434	210179	.KEY, MACHINE		



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FIGURE 5. FLYWHEEL HOUSING AND FLEXPLATE.



## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUSTRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.						USABLE ON CODE	
						0103-FLYWHEEL ASSEMBLY		
5	1	PAFZZ	2815-01-122-8002	35434	10657	COVER, HOUSING BRASS	EA	1
5	2	XDFZZ		15434	193717	HOUSING, FLYWHEEL	EA	1
5	3	PAFZZ	5310-00-134-4368	15434	S601	WASHER, OIL PAN	EA	7
5	4	PAFZZ	5310-00-584-5272	96906	MS35338-48	WASHER, LOCK	EA	7
5	5	PAFZZ	5305-00-071-2070	96906	MS90728-114	SCREW, CAP HEXAGON HEAD	EA	4
5	6	PAFZZ	5305-00-795-9353	15434	188936	SCREW, CAP	EA	9
5	7	PAFZZ	5310-00-820-6653	96906	MS35338-50	WASHER, LOCK	EA	9
5	8	PAFZZ	5310-00-109-7638	15434	S658	WASHER, FLAT	EA	9
5	9	PAFZZ	5305-00-091-4009	15434	106289	SCREW, CAP, HEXAGON HEAD	EA	3
5	10	PAFZZ	2815-00-603-7264	15434	64482	LOCKWIRE, BOLT, FLYWH	EA	3
5	11	XDFZZ		15434	120448	SCREW, CAP HEXAGON HEAD	EA	3
5	12	XDFZZ		15434	123000	FLEXPLATE	EA	6
5	13	PAFZZ	5310-00-469-3998	15434	S200	NUT, PLAIN, HEXAGON	EA	1
5	14	PAFZZ	5315-00-014-1284	15434	141284	PIN, STRAIGHT, HEADLE	EA	3
5	15	PFFZZ	5330-00-478-2962	15434	199064	GASKET FLYWHEEL HOUSING PART OF KIT/P/N 3018762	EA	2
5	16	PAFZZ	5310-00-159-6209	96906	MSI22032	WASHER, LOCK PART OF KIT P/N 3018762	EA	1
5	17	XDFZZ		15434	70214	SCREW, MACHINE	EA	2



## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUSTRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.						USABLE ON CODE	
						0104-PISTONS, CONNECTING RODS		
6	1	PAHZZ	2815-01-086-2704	15434	3014149	RING SET, PISTON	EA	6
6	2	PAHZZ	2815-00-962-5618	15434	132880	.RING, PISTON COMPRESSION	EA	2
6	3	PAHZZ	2815-00-994-4427	15434	147670	.RING, PISTON COMPRESSION	EA	1
6	4	PAHZZ	2815-00-994-4429	15434	194610	.RING, PISTON OIL	EA	1
6	5	PFHHH	2815-00-004-8291	15434	AR08190	PISTON ASSEMBLY	EA	6
6	6	PAHZZ	5365-00-282-5030	15434	61908	.RING, RETAINING	EA	2
6	7	PAHZZ	2815-00-480-4347	15434	181970	.PIN, PISTON	EA	1
6	8	XDFZZ		15434	203090	.PISTON	EA	1
6	9	PAHZZ	3120-014-087-3004	15434	214950	BEARING, HALF SLEEVE	EA	12
6	10	PAHZZ	2815-00-753-0660	15434	3015523	CONNECTING ROD, PIST	EA	6
6	22	PAHHH	5310-00-134-4171	15434	200861	.WASHER, FLAT	EA	2
6	12	PAHZZ	5310-00-222-7240	15434	69936	.NUT, PLAIN, HEXAGON	EA	2
6	13	PAHZZ	2815-00-132-0273	15434	187420	.BUSHING, POSTON PIN STANDARD	EA	1
6	13	XDFZZ		15434	152770	.BUSHING, HEAVY WALL	EA	1
6	14	PAHZZ	5306-00-041-0917	15434	9195-3	.BOLT, CONNECTING ROD	EA	2

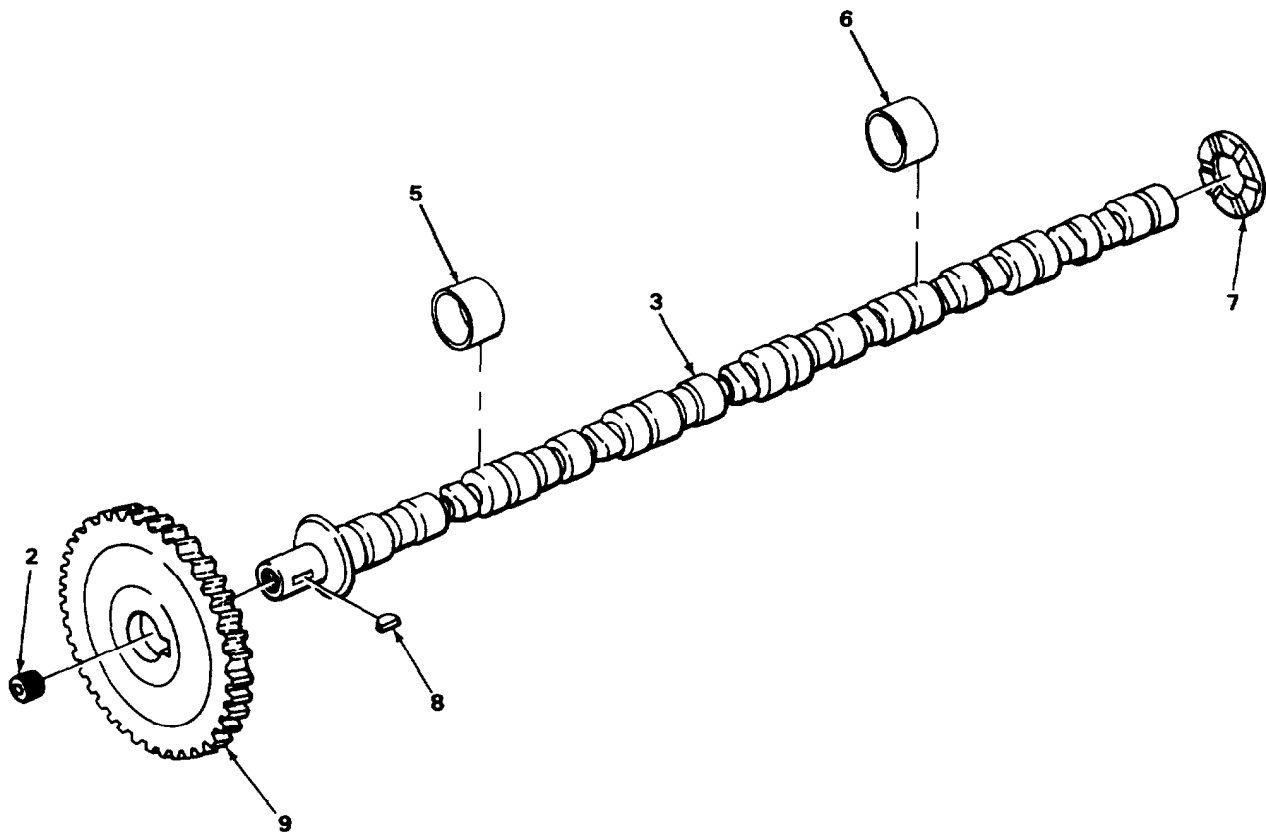
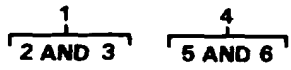


FIGURE 7. CAMSHAFT.

**SECTION II**

**TM 5-2815-241-34&P**

(1) ILLUSTRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.						USABLE ON CODE	
						0105-VALVES, CAMSHAFTS, AND TIMING SYSTEMS		
7	1	XDHHH		15434	3023177	CAMSHAFT, SERVICE AS	EA	1
7	2	XDFZZ		15434	3021601	.PLUG, VENT	EA	1
7	3	XDHZZ		15434	3023229	.CAMSHAFT, ENGINE	EA	1
7	4	PAHZZ	3120-00-339-5642	15434	BM27253	BEARING SET, SLEEVE CAMSHAFT	EA	1
7	5	PAHZZ	3120-00-573-0391	15434	100670	.BEARING, SLEEVE	EA	1
7	6	PAHZZ	3120-00-906-6657	15434	157870	.BEARING, SLEEVE	EA	1
7	7	PAHZZ	3120-00-374-4342	15434	9235-1	BEARING, WASHER THRU	EA	1
7	8	PFFZZ	5315-00-616-5527	96906	MS35756-18	KEY, WOODRUFF CAMSHAFT GEAR	EA	1
7	9	PAFZZ	2815-00-107-115	15434	156226	GEAR, CAMSHAFT	EA	1

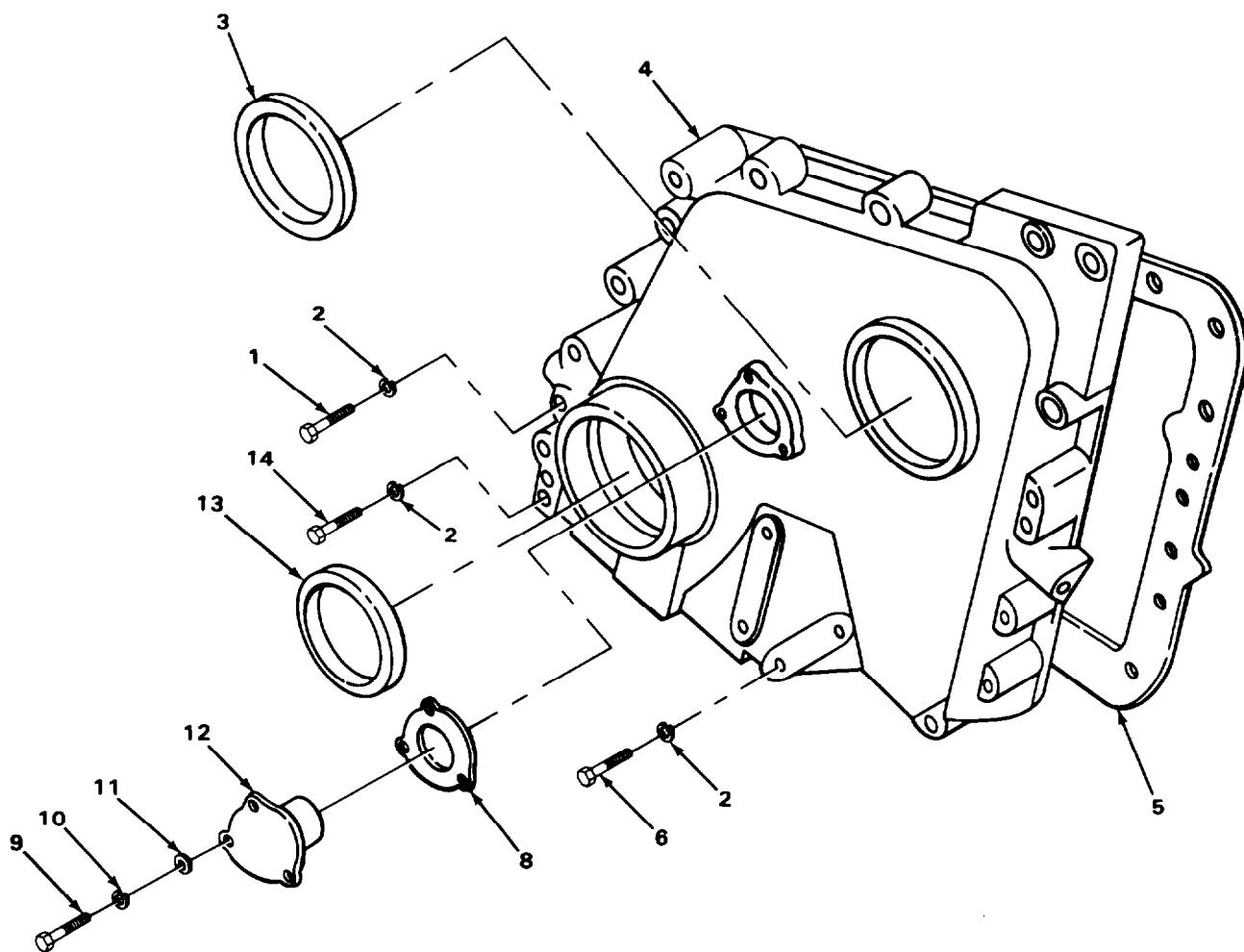
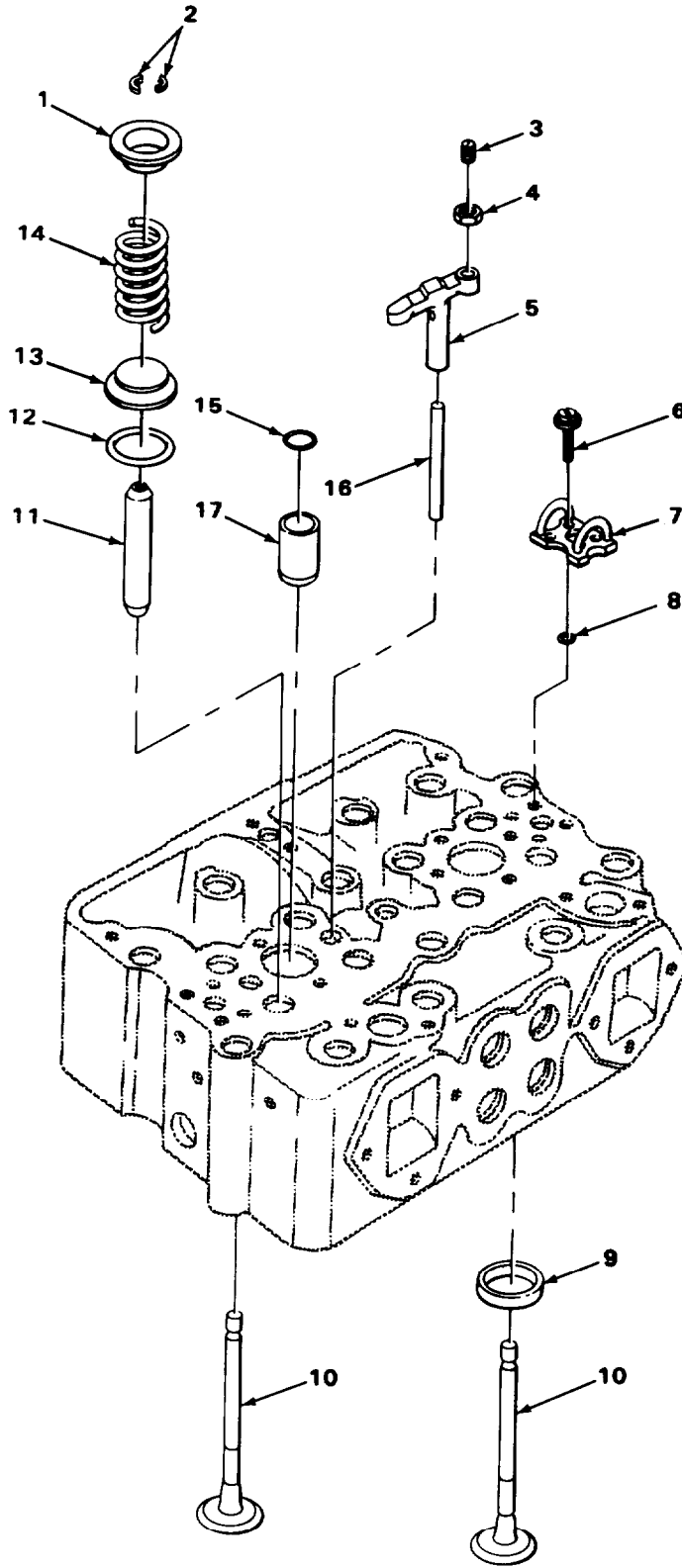


FIGURE 8. GEARCASE COVER.

**SECTION II**

**TM5-2815-241-34&P**

(1) ILLUSTRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.						USABLE ON CODE	
						0105 (CONT)		
8	1	PAFZZ	5305-01-165-3300	15434	S-119-C	SCREW CAP, HEXAGON H TIMING GEAR COVER MTG	EA	1
8	2	PAFZZ	5310-00-209-0965	69606	MS35338-47	WASHER, LOCK	EA	13
8	3	PAFZZ	5330-00-005-0857	15434	30043316	SEAL OIL PART OF KIT P/N 3018762	EA	1
8	4	XDFZZ		15434	AR09473	COVER, GEARCASE	EA	1
8	5	PAFZZ	5330-01-046-0441	15434	210412	GASKET GEAR COVER PART KIT P/N 3018762	EA	1
8	6	PAFZZ	5305-00-709-8537	96906	MS90727-94	SCREW, CAP, HEXAGON H	EA	3
8	7	PAFZZ	5365-00-716-5496	15434	AR01176	SHIM SET CAMSHAFT TRUST	EA	1
8	8	PAFZZ	5365-01-086-7788	15434	185573	.SHIM INSERT	EA	1
8	8	PAFZZ	5365-01-147-0912	15434	65259-A	.SHIM .010 IN. THK	EA	1
8	8	PAFZZ	5365-01-147-0913	15434	65259-B	.SHIM .005 IN. THK	EA	1
8	8	PAFZZ	5365-00-507-3254	15434	65259C	.SHIM .002 IN. THK	EA	1
8	9	PAFZZ	5305-00-942-2196	96906	MS18154-60	SCREW, CAP, HEXAGON H	EA	3
8	10	PAFZZ	5310-00-261-7340	96906	MS35338-8	WASHER, LOCK	EA	3
8	11	PAFZZ	5310-00-080-6004	96906	MS27183-14	WASHER, FLAT	EA	3
8	12	PAFZZ	2815-00-242-2992	15434	150002	SUPPORT, CAMSHAFT	EA	1
8	13	PAFZZ	5330-00-005-0856	15434	3006736	SEAL CRANKSHAFT	EA	1
8	14	PAFZZ	5305-00-709-8542	69606	MS90727-91	SCREW, CAP, HEXAGON H	EA	9



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FIGURE 9. VALVES, SPRINGS AND GUIDES.



## SECTION II

TM5-2815-241-34&amp;P

(1) ILLUSTRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						05105 (CONT)		
9	1	PAFZZ	2815-00-933-3009	15434	170296	SEAL, HELICAL COMPRE	EA	24
9	2	PAFZZ	5340-01-143-6048	15434	127554	HALF-COLLET	EA	48
9	3	PAFZZ	5305-00-062-4378	15434	147389	SETSCREW, CROSSHEAD	EA	12
9	4	PAFZZ	5310-00-426-3990	15434	203131	NUT, PLAIN, HEXAGON	EA	12
9	5	PAFZZ	2815-00-300-0882	15434	3036065	CROSSHEAD, VALVE INTAKE	EA	6
9	5	PAFZZ	2815-01-085-3733	75078	011573	CROSSHEAD, VALVE EXHAUST	EA	6
9	6	PAFZZ	5305-00-477-6769	15434	70772	SCREW, ASSEMBLED	EA	8
9	7	PAFZZ	2910-00-928-3505	15434	147100	CROSSOVER, FUEL	EA	12
9	8	PAFZZ	5330-00-143-8485	15434	131026	PACKING, PREFORMED PART OF KIT P/N 3801330	EA	12
9	9	PAFZZ	2815-00-085-7434	15434	3017759	INSERT, VALVE SEAT EXHAUST, STANDART	EA	12
9	9	PAFZZ	2815-01-140-7421	15434	127935	INSERT, VALVE SEAT .005 INCH OVERSIZE	EA	12
9	9	PAFZZ	2815-00-132-0240	15434	3014622	SEAT, VALVE .010 INCH OVERSIZE	EA	12
9	9	PAFZZ	2815-01-127-1060	15434	3014623	INSERT, VALVE SEAT .020 INCH OVERSIZE	EA	12
9	9	PAFZZ	2815-01-127-3597	15434	3014624	INSERT, VALVE SEAT .030 INCH OVERSIZE	EA	12
9	9	PAFZZ	2815-01-127-3598	15434	3014625	INSERT, VALVE SEAT .040 INCH OVERSIZE	EA	12
9	10	PAFZZ	2815-00-962-5629	15434	145701	VALVE, POPPET, ENGINE EXHAUST	EA	12
9	10	PAFZZ	2815-00-739-6098	15434	135957	VALVE, POPPET, ENGINE	EA	12
9	11	PAFZZ	2815-01-085-2818	15434	3006456	GUIDE, VALVE STEM	EA	24
9	12	XDFZZ		15434	68803-A	SPACER, VALVE	EA	V
9	13	PAFZZ	2815-00-632-6239	15434	172034	SEAT, HELICAL, COMPRE	EA	24
9	14	PAFZZ	5360-00-009-9270	15434	211999	SPRING, HELICAL COMP	EA	24
9	15	PAFZZ	5330-00-406-4542	15434	196641	PACKING, PREFORMED PART OF KIT P/N 3801330	EA	6
9	16	PAFZZ	5315-00-866-5015	15434	123558	PIN, STRAIGHT HEADLE	EA	12
9	17	PAFZZ	2910-01-070-7979	15434	3011935	SLEEVE, COOLING, FUEL	EA	6

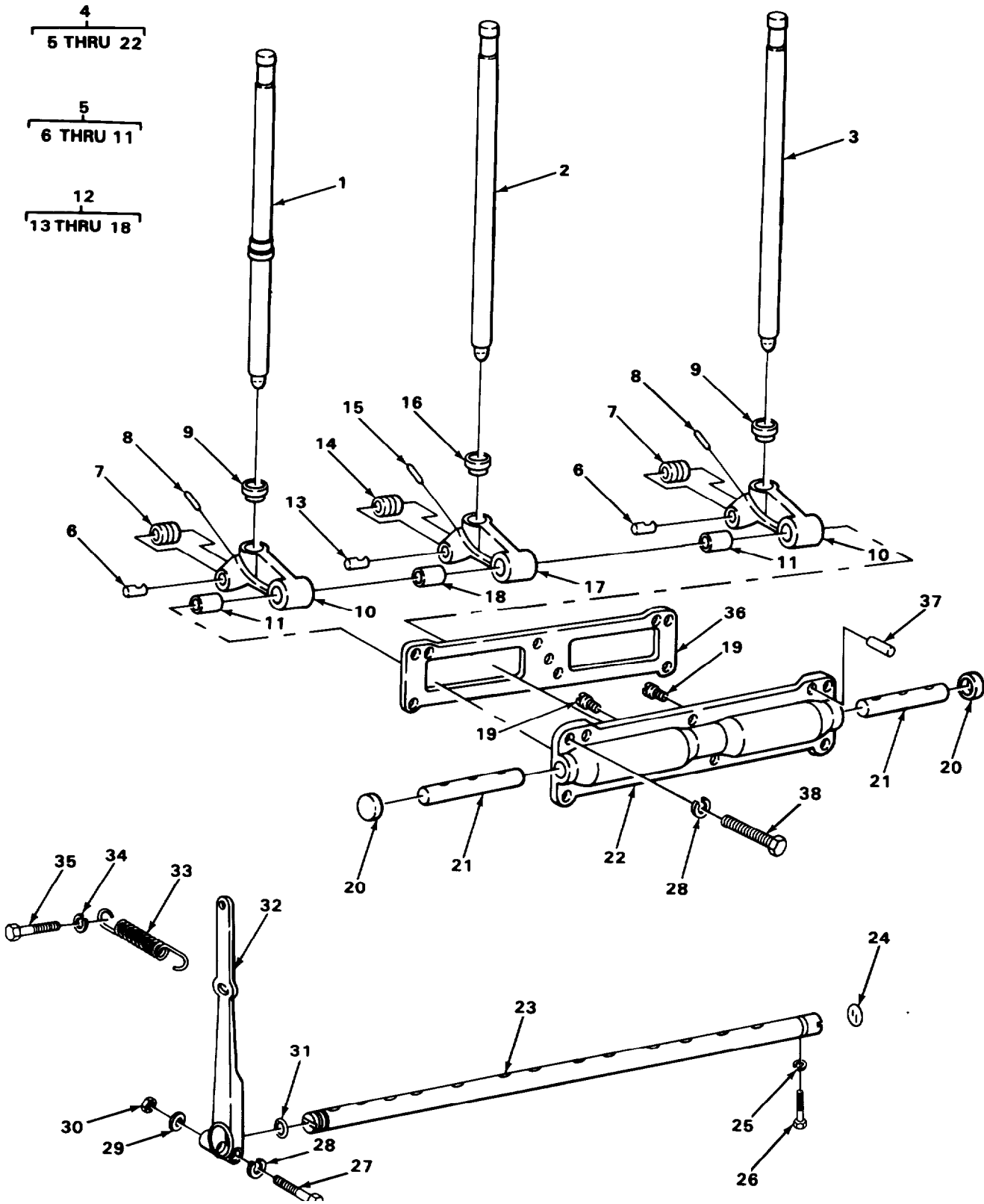


FIGURE 10. PUSH RODS AND CAM FOLLOWERS.

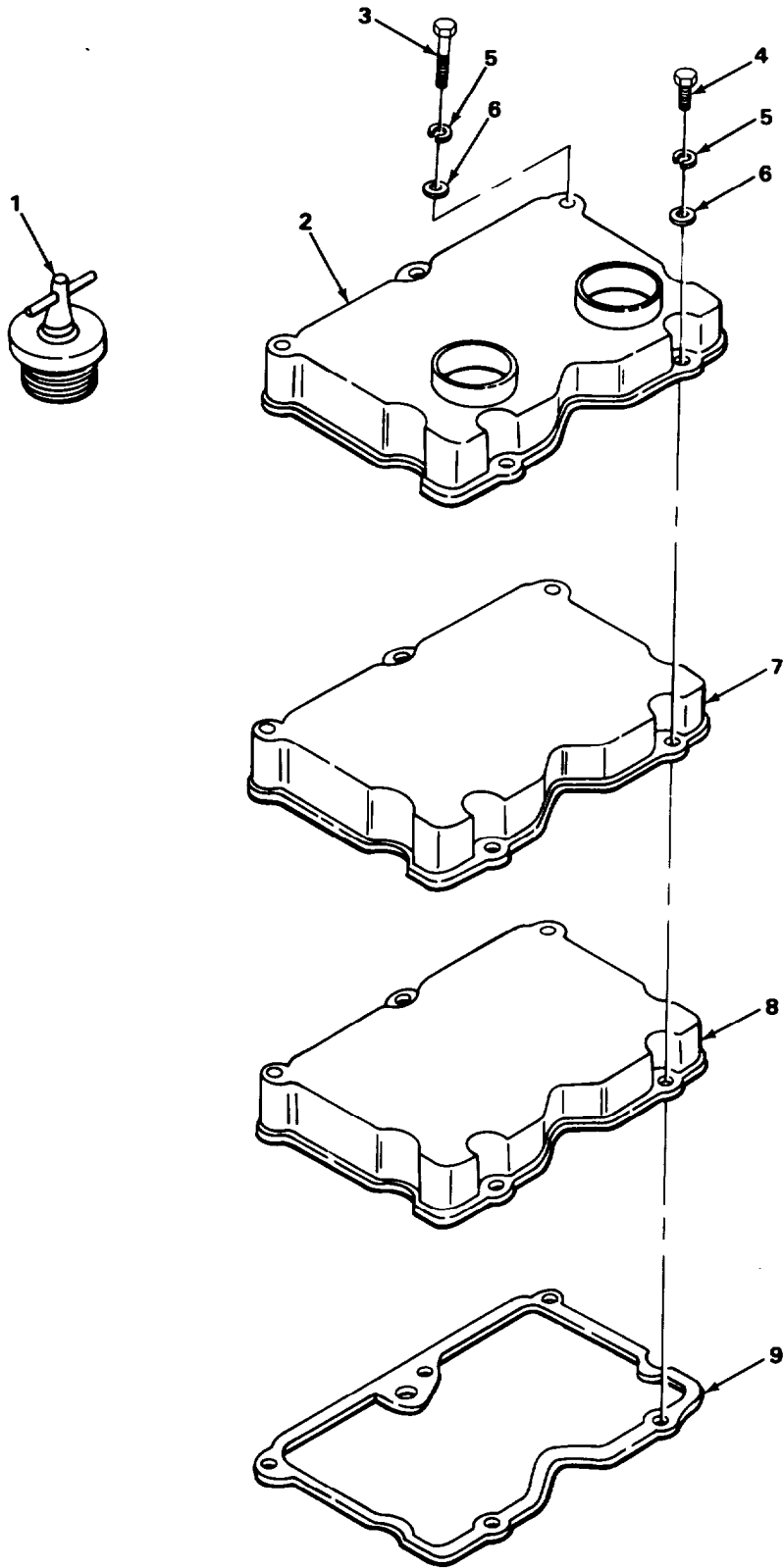
## SECTION II

TM5-2815-241-34&amp;P

(1) ILLUSTRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						0105 (CONT)		
10	1	XDFZZ		15434	2010650	PUSH ROD, EXHAUST VA	EA	6
10	2	PAFZZ	2815-00-590-7385	15434	3027215	ROD, INJECTOR	EA	6
10	3	PAFZZ	2815-00-705-9257	15434	BM47777	ROD, PUSH INTAKE	EA	6
10	4	PAFFF	2818-00-609-7115	15434	BM37625	HOUSING, ASSY CAM FO	EA	3
10	5	PAFFF	2815-00-505-5116	15434	BM37634	.CAM FOLLOWER LEVER INTAKE AND EXHAUST	EA	4
10	6	PAFZZ	5315-00-041-0916	15434	68513	..PIN, STRAIGHT, HEADLE	EA	1
10	7	PAFZZ	2815-00-311-2521	15434	9260-1	..ROLLER	EA	1
10	8	PAFZZ	5315-00-777-3544	15434	118939	..PIN, STRAIGHT, HEADLE	EA	1
10	9	PAFZZ	2815-00-505-5119	15434	107738	..SOCKET, CAM FOLLOWER	EA	1
10	10	XDFZZ		15434	120543	..CAM FOLLOWER LEVER AND BUSHING	EA	1
10	11	PAFZZ	3120-00-659-7808	15434	118378	..BEARING, SLEEVE	EA	1
10	12	PAFFF	2815-00-705-2851	15434	3018049	.CAM FOLLOWER INJECTOR	EA	2
10	13	PAFZZ	5315-00-041-0915	15434	68512	..PIN, STRAIGHT, HEADLE	EA	1
10	14	PAFZZ	2815-00-362-1780	15434	7348-2	..ROLLER, INJECTOR CAM	EA	1
10	15	PAFZZ	5315-00-777-3544	15434	118939	..PIN, STRAUGGTM HEADLE	EA	1
10	16	PAFZZ	2815-00-505-5119	15434	107738	..SOCKET, CAM FOLLOWER	EA	1
10	17	XAFZZ		15434	BM-37496	..CAM FOLLOWER LEVER AND BUSHING	EA	1
10	18	PAFZZ	3120-00-791-1440	15434	118377	..BEARING, SLEEVE	EA	1
10	19	PAFZZ	5305-00-339-1415	15434	69736	.SCREW, MACHINE	EA	6
10	20	PAFZZ	5340-00-485-0945	15434	175831	.PLUG, EXPANSION	EA	2
10	21	PAFZZ	2815-00-388-3126	15434	304731	.SHAFT, STRAIGHT	EA	2
10	22	PAFZZ	2815-00-375-9892	15434	BM73976	.HOUSING	EA	1
10	23	XDFZZ		15434	210685	SHAFT	EA	1
10	24	PAFZZ	5340-00-276-5847	15434	S719	PLUG, EXPANSION	EA	1
10	25	PAFZZ	5310-00-684-3463	96906	MS51092-1	WASHER, LOCK COPPER	EA	1
10	26	PAFZZ	5305-00-362-1536	15434	9237	SETSCREW SHAFT LOCK	EA	1
10	27	XDFZZ		15434	208411	BOLT, MACHINE CARRIAGE	EA	1
10	28	PAFZZ	5310-00-261-7340	96906	MS35338-8	WASHER, LOCK	EA	19
10	29	PAFZZ	5310-00-080-6004	96906	MS27183-14	WASHER, FLAT	EA	1

(1) ILLUSTRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.						USABLE ON CODE	
						0105(CONT)		
10	30	PAFZZ	5310-00-521-8595	15435	S223	NUT, HEXAGON	EA	1
10	31	PAFZZ	5330-00--886-2509	15434	43696	PACKING, PREFORMED	EA	1
10	32	XDFZZ		15434	208581	LEVER COMPRESSION RELEASE	EA	1
10	33	XDFZZ		15434	139289	SPRING	EA	1
10	34	PAFZZ	5310-00-407-9566	96906	MS35338-45	WASHER, LOCK	EA	1
10	35	PAFZZ	5306-00-225-9086	96906	MS90726-31	BOLT, MACHINE	EA	1
10	36	PAFZZ	5330-000-777-3545	15434	120819	GASKET .026 IN. THK PART OR KIT P/N 3018762	EA	1
10	36	PAFZZ	5330-00-175-6585	15434	9266	GASKET .015 IN. THK PART OR KIT P/N 3018762	EA	1
10	36	PAFZZ	5330-00-349-1219	15434	9266A	GASKET .007 IN. THK PART OR KIT P/N 3018762	EA	1
10	37	PAFZZ	3120-00-546-6698	15434	68586	BUSHING, SLEEVE	EA	1
10	38	PAFZZ	5305-00-546-6698	15434	S129	SCREW, CAP, HEXAGON H	EA	1





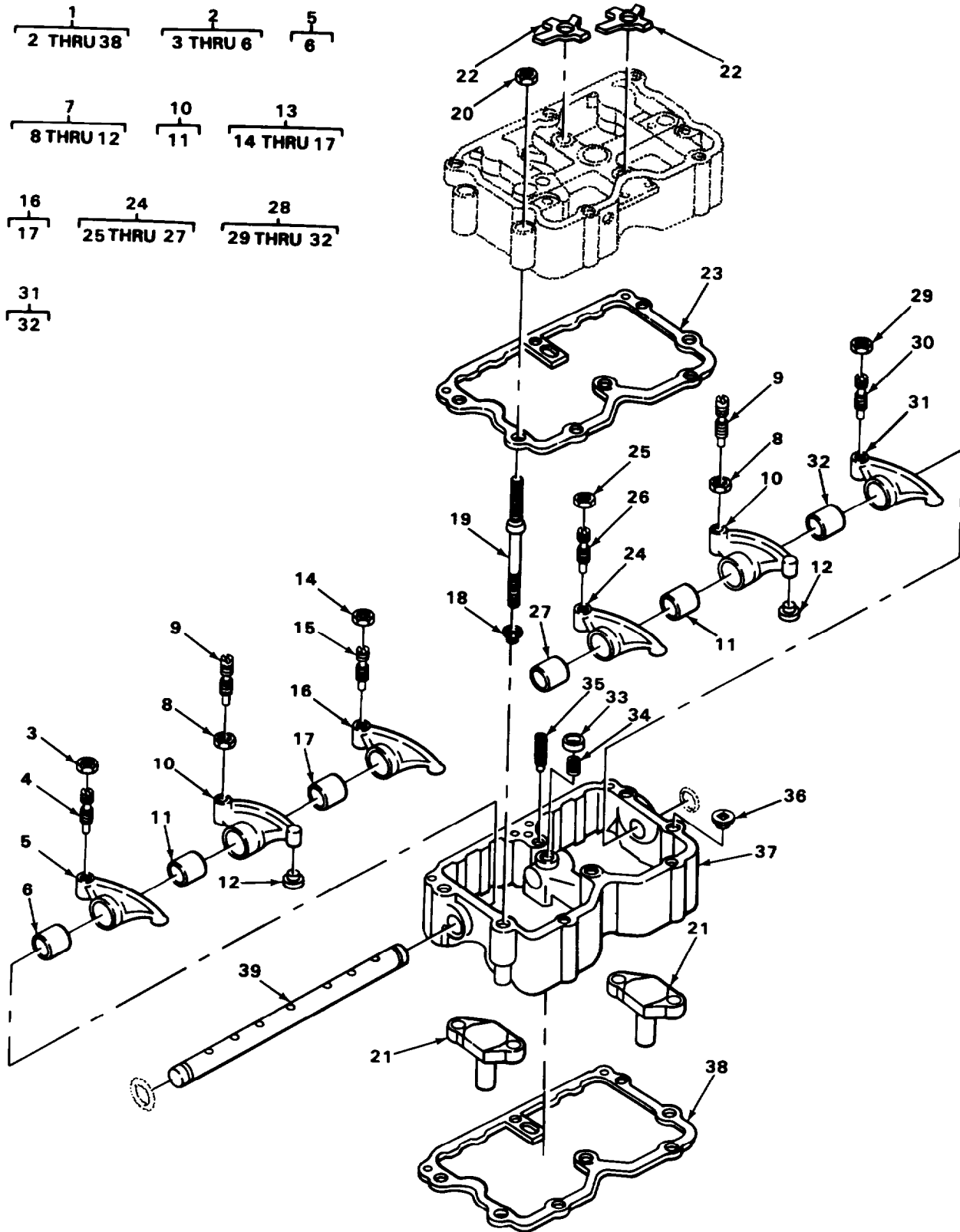
TA242306

FIGURE 11. ROCKER HOUSING COVER AND BREATHER.

## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0105(CONT)			
11	1	PAOZZ	2815-00-590-7378	15434	101322	CAP,FILLER,OPENING		EA	1
11	2	PAFZZ	2815-01-159-1737	15434	3006187	COVER,ROCKER HOUSING		EA	1
11	3	PAFZZ	5305-00-782-9489	96906	MS90728-66	SCREW,CAP,HEXAGON H COVER MTG		EA	9
11	4	PAFZZ	5305-00-942-2196	96906	MS18154-60	SCREW,CAP,HEXAGON H COVER MTG		EA	6
11	5	PAFZZ		96906	MS35338-8	WASHER,LOCK COVER MTG		EA	15
11	6	PAFZZ	5310-00-080-6004	96906	MS27183-14	WASHER,FLAT		EA	15
11	7	PAFZZ	2815-01-142-1732	15434	3006183	COVER,ACCESS		EA	1
11	8	PAFZZ	2815-01-146-1024	15434	3006358	COVER,ROCKER ARM		EA	1
11	9	PAFZZ	5330-01-066-3908	73165	B90429	GASKET		EA	3



TA242307

FIGURE 12. ROCKER ARMS AND HOUSING



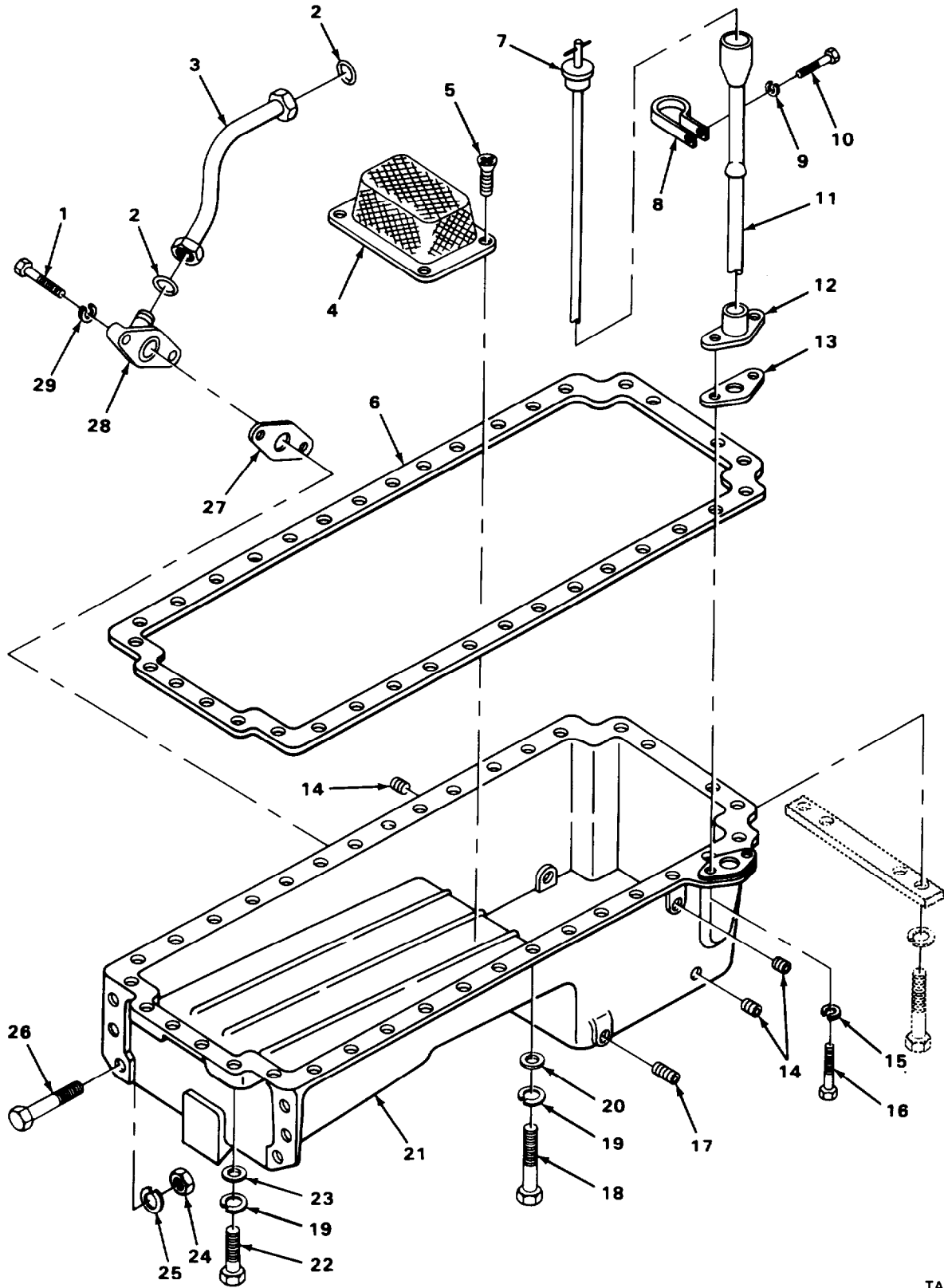
## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0105(CONT)			
12	1	XDIFF		15434	AR03307	HOUSING AND ROCKER		EA	3
12	2	PAFFF	2815-01-096-9198	15434	BM95161	..ROCKER,ARM,ENGINE P EXHAUST		EA	1
12	3	PAFZZ	5310-00-732-0560	36906	MS51968-14	..NUT,ADJUSTING SCREW		EA	1
12	4	XDFZZ		15434	213109	..SCREW,ADJUSTING		EA	1
12	5	XDIFF		15434	169704	..ARM AND BUSHING ASSEMBLY,REAR		EA	1
12	6	PAFZZ	3120-00-589-3537	15434	140330	...BUSHING,SLEEVE		EA	1
12	7	PAFFF	2815-00-005-7431	15434	AR-2308	..LEVER INJECTOR FUEL		EA	2
12	8	PAFZZ	5310-00-732-0560	96906	MS51968-14	..NUT,ADJUSTING SCREW		EA	1
12	9	XDFZZ		15434	199239	..SCREW,INJECTOR ARM ADJUSTING		EA	1
12	10	XDIFF		15434	218152	..LEVER ROCKER ARM		EA	1
12	11	PAFZZ	3120-00-589-3537	15434	140330	..BUSHING,SLEEVE		EA	1
12	12	PAFZZ	2815-00-404-2940	15434	194037	..SEAT,BALL SOCKET		EA	1
12	13	PAFFF	2815-00-195-5894	15434	AR51276	..ROCKER,ARM,ENGINE P		EA	2
12	14	PAFZZ	5310-00-732-0560	96906	MS51968-14	..NUT,ADJUSTING SCREW		EA	1
12	15	XDFZZ		15434	213109	..SCREW,ADJUSTING		EA	1
12	16	XDIFF		15434	168805	..ARM AND BUSHING		EA	1
12	17	PAFZZ	3120-00-589-3537	15434	140330	... BUSHING,SLEEVE		EA	1
12	18	XDFZZ		75078	2514	..WASHER,BEARING		EA	18
12	19	PAFZZ	5307-01-147-1316	75078	2856	..STUD,SHOULDERED INJECTOR		EA	2
12	19	PAFZZ	5307-01-147-2821	75078	1232	..STUD,SHOULDERED		EA	8
12	19	XDFZZ		75078	1199	..STUD,SHOULDERED		EA	8
12	20	KDFZZ		15434	199224	..NUT,ROCKER		EA	18
12	21	PAFZZ	2815-01-085-3733	75078	011573	CROSSHEAD VALVE EXHAUST		EA	2
12	22	XDFZZ		75078	2680	..LOCKPLATE		EA	2
12	23	XDFZZ		15434	199216	..GASKET,HOUSING		EA	1
12	24	PAFFF	2815-00-851-7637	15434	BM95162	ROCKER,ARM,ENGINE P		EA	1
12	25	PAFZZ	5310-00-732-0560	96906	MS51968-14	..NUT,ADJUSTING SCREW		EA	1
12	26	XDFZZ		15434	213109	..SCREW,ADJUSTING		EA	1
12	27	PAFZZ	3120-00-589-3537	15434	140330	..BUSHING,SLEEVE		EA	1

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)		(7)	(8)
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0105(CONT)			
12	28	PAFFF	2815-00-195-5897	15434	BM95160	.ROCKER ARM,ENGINE P		EA	1
12	29	PAFZZ	5310-00-732-0560	96906	MS51968-14	..NUT,ADJUSTING SCREW		EA	1
12	30	KDFZZ		15434	213109	..SCREW,ADJUSTING		EA	1
12	31	KDFFF		15434	168803	..ARM AND BUSHING		EA	1
12	32	PAFZZ	3120-00-589-3537	15434	140330	... BUSHING,SLEEVE		EA	1
12	33	XDFZZ		15434	199220	.SEAL RING OIL SUPPLY SCREW		EA	1
12	34	PAFZZ	2520-01-085-6128	15434	199225	.SCREW,SHAFT LOCK		EA	1
12	35	PAFZZ	5340-00-365-5759	15434	62229	.PLUG,VENTILATOR		EA	1
12	36	KDFZZ		75078	2514	.WASHER		EA	6
12	37	PAFZZ	2815-00-230-0070	15434	3007242	.HOUSIING,ROCKER ARM		EA	1
12	38	PFFZZ	5330-01-133-8493	89346	187589	.GASKET HOUSING TO HEAD PART OF KIT P/N 3801330		EA	1
12	39	PAFFF	2815-01-079-1799	15434	140297	.SHAFT,STRAIGHT		EA	1





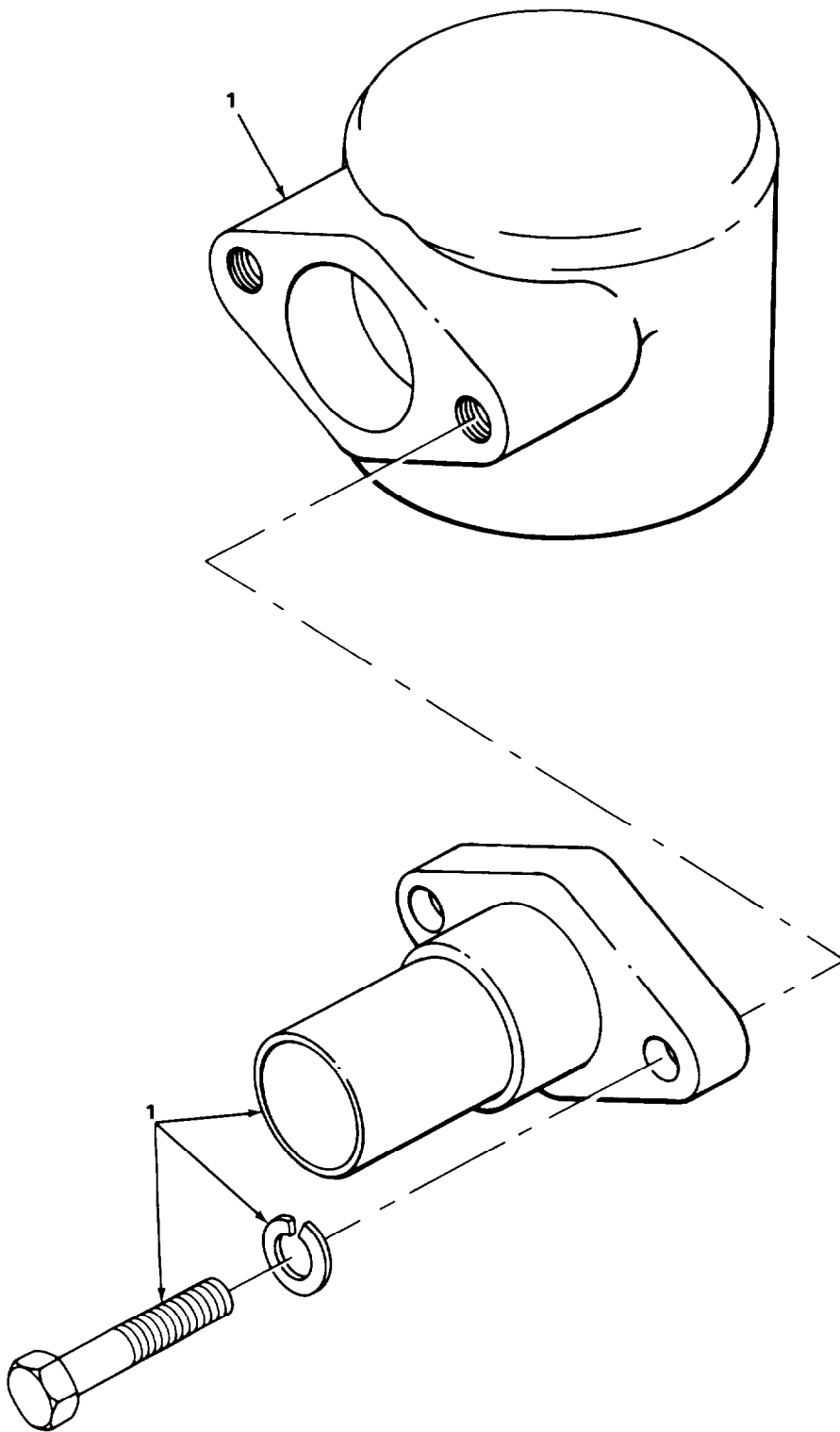
TA242308

FIGURE 13. OIL PAN AND DIPSTICK.

## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0106-ENGINE LUBRICATION SYSTEM			
13	1	XDFZZ		15434	112593	SCREW,CAP,HEXAGON HEAD		EA	2
13	2	PFZZ	5330-01-209-3583	15434	197230	PACKING,PREFORMED		EA	2
13	3	XDFZZ		15434	3019400	HOSE		EA	1
13	4	PAFZZ	2815-00-338-6839	15434	20622	STRAINER,ELEMENT OIL PAN		EA	1
13	5	PAFZZ	5305-00-804-6454	15434	S1354	SCREW HEAD STRAINER MTG		EA	4
13	6	PAFZZ	5330-00-351-6428	15434	3031469	GASKET OIL PAN PART OF KIT P/N 3018762		EA	1
13	7	XDDZZ		15434	204657	DIPSTICK OIL		EA	1
13	8	PAOZZ	5340-00-417-5800	15434	200064	CLAMP,LOOP		EA	1
13	9	PAOZZ	5310-00-637-9541	96906	MS35338-46	WASHER,LOCK		EA	1
13	10	PAOZZ	5305-00-269-3209	96906	MS90725-48	SCREW,CAP,HEXAGON		EA	1
13	11	XDOZZ		15434	211358	TUBE,DIPSTICK OIL		EA	1
13	12	XDFZZ		15434	67347-1	BRACKET,OIL GAGE		EA	1
13	13	XDFZZ		15434	67346	GASKET OIL GAGE BRACKET		EA	1
13	14	PAOZZ	4730-00-801-8186	15434	S-915-A	PLUG,PIPE		EA	3
13	15	PAFZZ	5310-00-261-7340	96906	MS35338-8	WASHER,LOCK		EA	2
13	16	PAFZZ	5305-00-709-8523	96906	MS90727-87	SCREW,CAP,HEXAGON H		EA	2
13	17	PAOZZ	4730-00-203-0395	80218	10003	PLUG,DRAIN		EA	1
13	18	PAFZZ	5306-00-719-5467	15434	70349	BOLT,MACHINE		EA	34
13	19	PAFZZ	5310-00-209-0965	96906	MS35338-47	WASHER,LOCK		EA	38
13	20	PAFZZ	5310-00-562-6557	15434	S622	WASHER,FLAT		EA	34
13	21	XDFZZ		15434	208461	PAN,OIL		EA	1
13	22	PAFZZ	5305-00-463-0428	15434	185804	SCREW,CAP,HEXAGON HEAD		EA	4
13	23	PAFZZ	5310-00-562-6558	15434	S626	WASHER,FLAT		EA	4
13	24	PAFZZ	5310-00-768-0318	96906	MS51967-14	NUT,HEXAGON		EA	2
13	25	PAFZZ	5310-00-584-5272	96906	MS35338-48	WASHER,LOCK		EA	2
13	26	PAFZZ	5305-00-071-1769	96906	MS90725-115	SCREW,CAP,HEXAGON		EA	2
13	27	PAFZZ	5330-00-143-8376	15434	157551	GASKET SUCTION FLANGE PART OF KIT P/N 3018762		EA	1
13	28	PFZZ	4730-01-211-1989	15434	3012527	FLANGE OIL SUCTION		EA	1
13	29	PAFZZ	5310-00-407-9566	96906	MS35338-45	WASHER,LOCK		EA	2



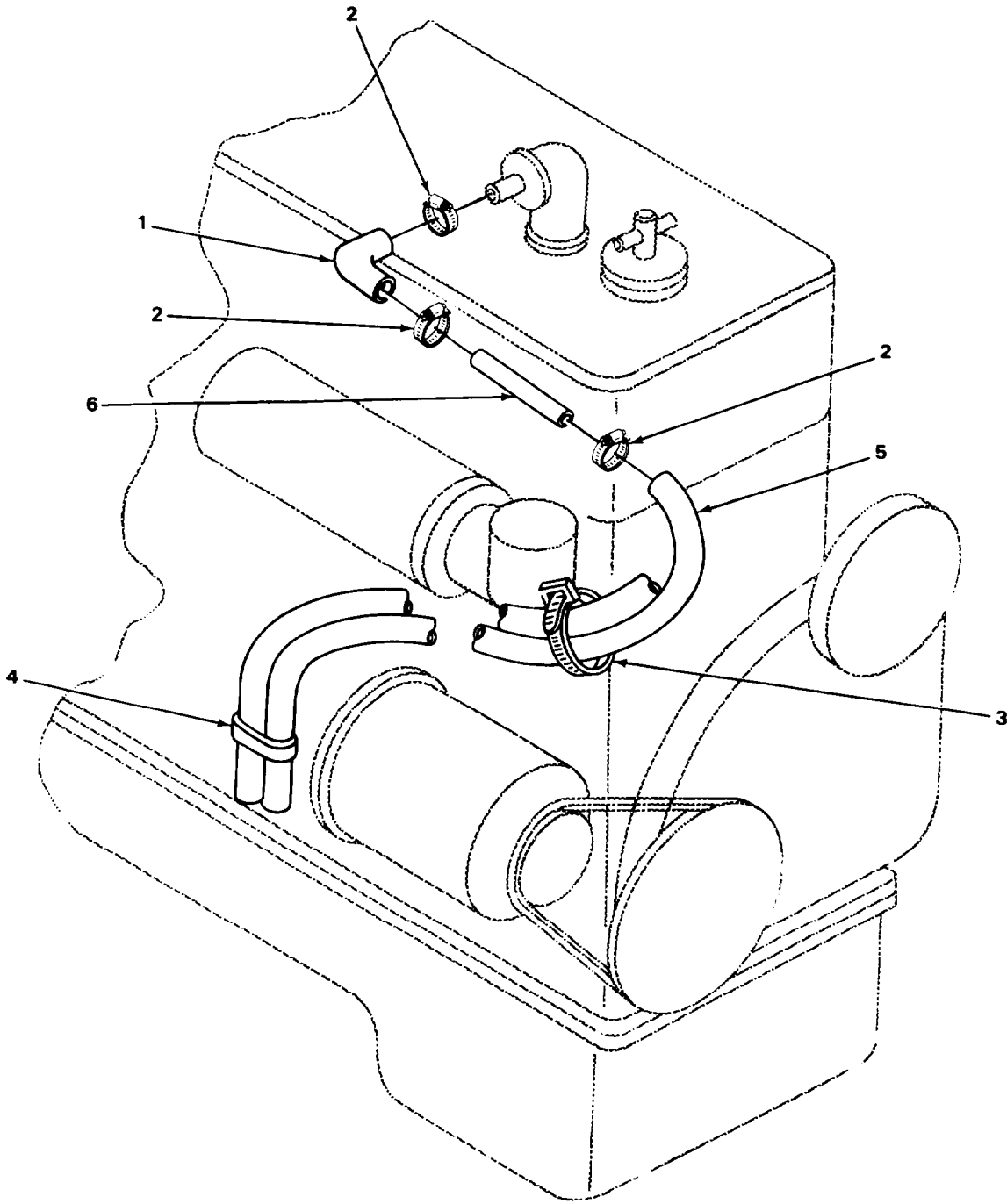
TA242309

FIGURE 14. ENGINE BREATHER ASSEMBLY.

SECTION II

TM 5-2815-241-34&P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
14	1	PAFZZ	2815-00-405-1798	33457	2S7225S	0106(CONT) BREATHER ASSEMBLY ENGINE		EA	1



TA242310

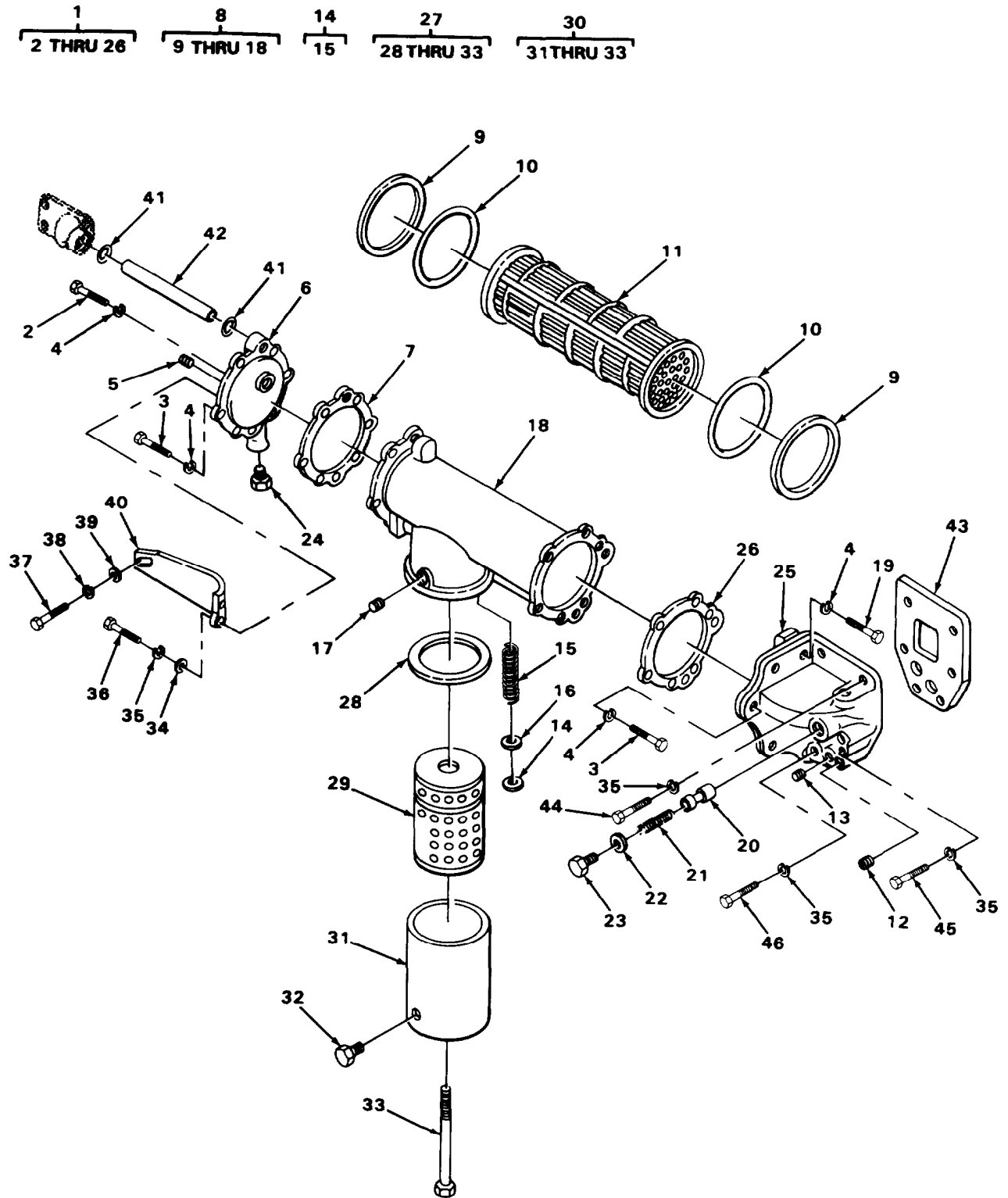
FIGURE 15. ENGINE BREATHER HOSE.



SECTION II

TM 5-2815-241-34&P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	7	(8)	
(a) FIG NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0106(CONT)			
15	1	XDFZZ		15434	390782C1	HOSE,HEATER		EA	1
15	2	XDFZZ		15434	274085R91	CLAMP,HOSE		EA	3
15	3	XDFZZ		15434	209862C1	STRAP,CABLE LOCK		EA	1
15	4	XDFZZ		15434	299263091	CLAMP,RUBBER CUSHIO		EA	1
15	5	MFFZZ		19207	8465575-44	HOSE MANUFACTURE FROM NSN 4720-00-846-5575		EA	1
15	6	XDFZZ		15434	364319C1	TUBE,HOSE		EA	1



TA242311

FIGURE 16. ENGINE OIL FILTER COOLER.

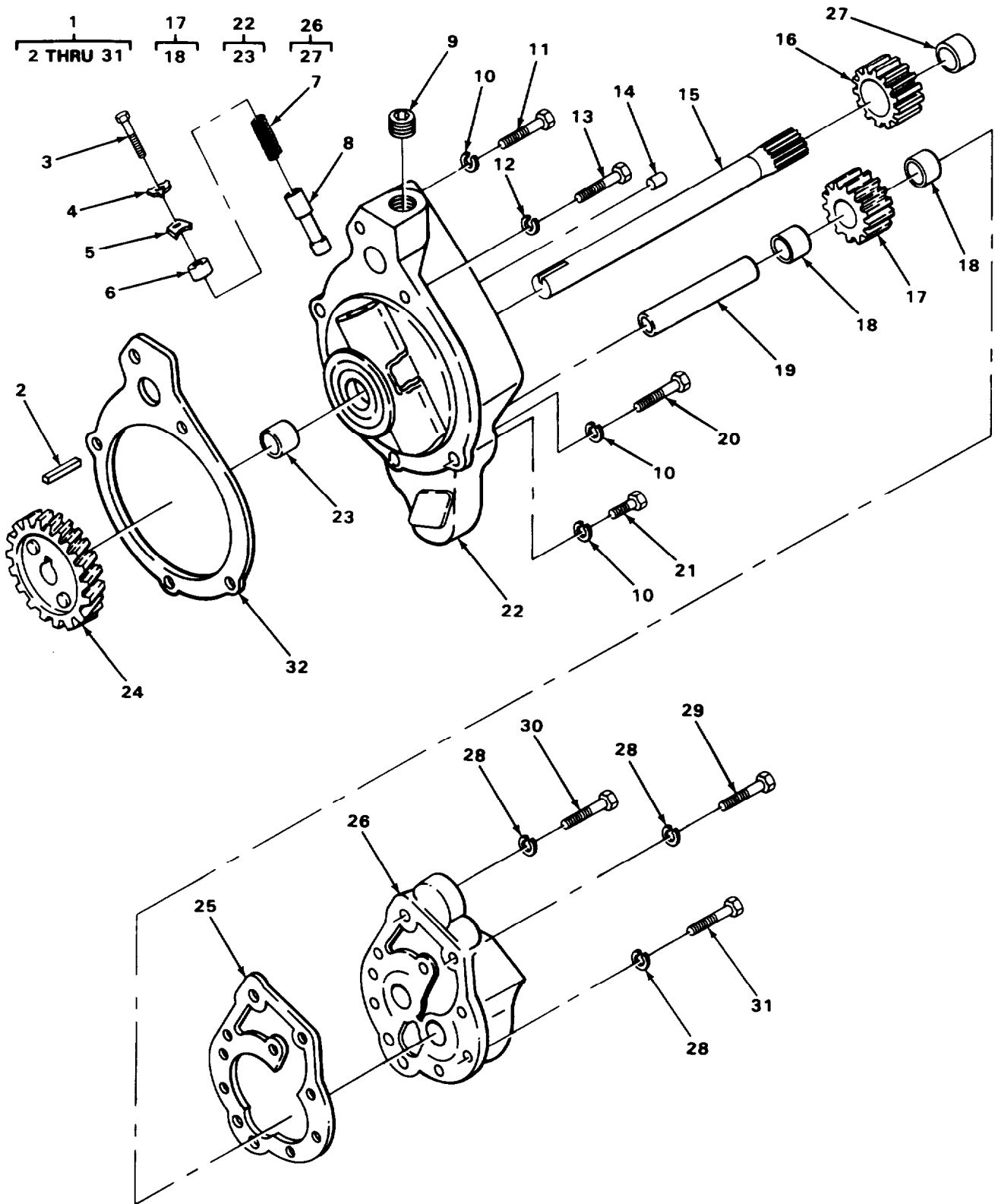
## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)		(7)	(8)
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0106(CONT)			
16	1	XD000		15434	AR09479	COOLER,OIL		EA	1
16	2	PAOZZ	5305-00-068-0511	96906	MS90728-62	.SCREW,CAP,HEXAGON H		EA	1
16	3	PAOZZ	5305-01-062-1054	45152	1816-HX-1	.SCREW,CAP,HEXAGON H		EA	10
16	4	PAOZZ	5310-00-261-7340	96906	MS35338-8	.WASHER,LOCK		EA	12
16	5	PAOZZ	4730-00-057-5555	96906	MS49005-6	.PLUG,PIPE		EA	1
16	6	XDOZZ		15434	210858	.COVER		EA	1
16	7	PAOZZ	5330-01-046-1991	15434	218245	.GASKET OIL COOLER COVER PART OF KIT P/N 3018762		EA	1
16	8	XD000		15434	AR09478	.COOLER,OIL		EA	1
16	9	PAOZZ	2930-00-437-0567	15434	142616	.RETAINER,OIL COOLER		EA	2
16	10	XDOZZ		15434	148295	..PACKING,PREFORMED PART OF KIT P/N 3018762		EA	2
16	11	PAOZZ	2930-00-603-1625	46529	A331987	..CORE,OIL COOLER		EA	1
16	12	PAOZZ	4730-00-057-5555	96906	MS49005-6	..PLUG,PIPE		EA	1
16	13	PAOZZ	4730-01-160-3579	15434	S-910-B	..PLUG,PIPE		EA	1
16	14	PA000	2940-01-146-1995	15434	179063	..SEAT,BY-PASS FILTER		EA	1
16	15	PFOZZ	5360-01-200-0323	15434	202128	... SPRING,FILTER BY-PA		EA	1
16	16	XDOZZ		15434	201707	..DISC,BY-PASS		EA	1
16	17	PAOZZ	4730-00-018-9566	15434	S9118	..PLUG,PIPE		EA	2
16	18	XAOZZ		15434	210832	..HOUSING,FILTER AND		EA	1
16	19	PAOZZ	5305-00-846-5703	96906	MS90728-70	.SCREW,CAP,HEXAGON H		EA	1
16	20	PAOZZ	2815-00-791-1453	15434	127558	.PLUNGER,OIL,PUMP		EA	1
16	21	PAOZZ	5360-00-664-5343	15434	68274	.SPRING,HELICAL,COMP		EA	1
16	22	PAOZZ	5365-00-197-9327	15434	67946	.SPACER,RING PART OF KIT P/N 3018762		EA	1
16	23	PAOZZ	5365-01-112-4281	15434	183913	.PLUG,MACHINE THREAD		EA	1
16	24	PAOZZ	5365-00-708-3434	15434	110907	.PLUG,MACHINE THREAD		EA	1
16	25	XDOZZ		15434	210967	.SUPPORT,COOLER		EA	1
16	26	PAOZZ	5330-01-046-3144	15434	3010030	.GASKET OIL COOLER PART OF KIT P/N 3018762		EA	1
16	27	XD000		15434	AR-09265	FILTER,OIL		EA	1
16	28	PAOZZ	5330-00-132-0248	15434	173368	.PACKING,PREFORMED PART OF KIT P/N 3018762		EA	1
16	29	PAOZZ	2940-00-073-3316	15434	158139	.FILTER,ELEMENT FLUI		EA	1

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0106(CONT)			
16	30	XD000		15434	184387	.SHELL AND BOLT ASSY		EA	1
16	31	XDOZZ		15434	184386	..SHELL		EA	1
16	32	PAOZZ	4730-00-081-9618	79470	C3159X2	..PLUG,PIPE		EA	1
16	33	XCOZZ		15434	184388	..BOLT,SHELL		EA	1
16	34	PAOZZ	5310-00-080-6004	96906	MSS7183-14	WASHER,FLAT		EA	2
16	35	PAOZZ	5310-00-261-7340	96906	MS35338-8	WASHER,LOCK		EA	8
16	36	PAOZZ	5305-00-942-2196	96906	MS18154-60	SCREW,CAP,HEXAGON H		EA	2
16	37	PAOZZ	5305-01-203-6444	15434	S145	SCREW,CAP,HEXAGON H		EA	1
16	38	PAOZZ	5310-01-200-1318	15434	S608	WASHER,LOCK		EA	1
16	39	XDOZZ		15434	132756	WASHER,PLAIN		EA	1
16	40	XDOZZ		15434	210966	BRACE,COOLER		EA	1
16	41	PAOZZ	5330-01-077-5228	15434	212161	PACKING,PREFORMED		EA	2
16	42	XDOZZ		15434	210883	TUBE,WATER TRANSFER		EA	1
16	43	PAOZZ	5330-01-079-6514	15434	3008017	GASKET COOLER SUPPORT PART OF KIT P/N 3018762		EA	1
16	44	PAOZZ	5305-00-068-0511	96906	MS90728-62	SCREW,CAP,HEXAGON H		EA	2
16	45	PAOZZ	5305-00-165-8157	72582	450517	SCREW,CAP,HEXAGON H		EA	2
16	46	PAOZZ	5305-00-404-1388	15434	S199B	SCREW,CAP,HEXAGON H		EA	2





TA242312

FIGURE 17. LUBRICATING OIL PUMP.

## SECTION II

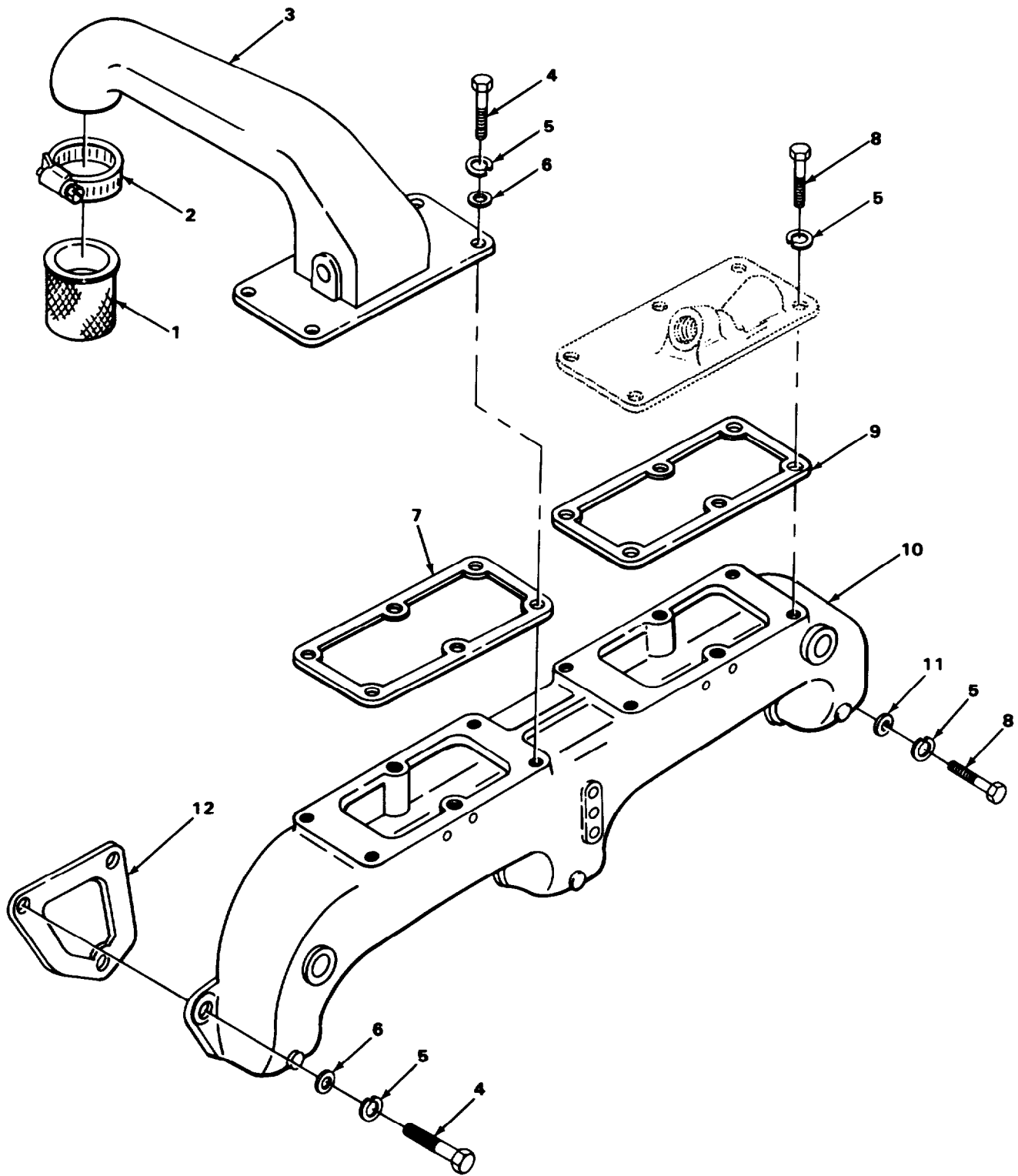
TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	QTY INC IN UNIT
						0106(CONT)		
17	1	PAFFF	2815-01-085-2573	15434	AR10172	PUMP,OIL LUBRICATIN	EA	1
17	2	PAFZZ	5315-00-043-1787	96906	1335756-34	.KEY,WOODRUFF	EA	1
17	3	PAFZZ	5305-01-140-9118	96906	MS90728-59	.SCREW,CAP,HEXAGON H	EA	1
17	4	PAFZZ	2815-00-406-8936	15434	109319	.LOCK PLATE	EA	1
17	5	PAFZZ	2815-00-828-7013	15434	126304	.YOKE,CAP RETAINING	EA	1
17	6	PAFZZ	5340-00-833-7966	15434	134596	.PLUG,BY-PASS VALVE	EA	1
17	7	PAFZZ	5360-01-038-4659	15434	211939	.SPRING,HELICAL,COMP	EA	1
17	8	PAFZZ	2815-00-705-2856	15434	109333	.PLUNGER,PRESSURE RE	EA	1
17	9	PAFZZ	4730-00-289-4770	15434	S995	.PLUG,PIPE	EA	2
17	10	PAFZZ	5310-00-209-0965	96906	MS35338-47	.WASHER,LOCK	EA	5
17	11	PAFZZ	5305-01-165-3300	15434	S-119-C	.SCREW,CAP,HEXAGON H	EA	1
17	12	PAFZZ	5310-00-261-7340	96906	MS35338-8	.WASHER,LOCK	EA	2
17	13	PAFZZ	5305-00-709-8282	96906	MS90727-83	.SCREW,CAP,HEXAGON H	EA	2
17	14	PAFZZ	5315-00-475-2574	15434	69519	.PIN,STRAIGHT,HEADLE	EA	11
17	15	PAFZZ	3040-01-079-1748	15434	199587	.GEARSHAFT,WORM WHEE	EA	1
17	16	PAFZZ	3020-01-084-9640	15434	3014783	.GEAR,SPUR	EA	1
17	17	XDFFF		15434	AR-03636	.GEAR AND BUSHING	EA	1
17	18	PAFZZ	3120-00-566-0480	15434	68365	..BUSHING,SLEEVE	EA	2
17	19	PAFZZ	3040-01-079-3469	15434	177419	.SHAFT,SHOULDERED	EA	1
17	20	XDFZZ		15434	117897	.CAPSCREW	EA	1
17	21	PAFZZ	5305-00-424-3571	15434	S101A	SCREW,CAP,HEXAGON H	EA	2
17	22	PAFFF	2815-01-085-3734	15434	AR09832	.BODY,OIL PUMP WITH	EA	1
17	23	PAFZZ	3120-00-627-6697	15434	69521	..BEARING,SLEEVE	EA	1
17	24	PAFZZ	3020-01-085-3779	15434	204832	.GEAR,HELICAL	EA	1
17	25	PAFZZ	5330-01-066-3910	15434	203145	.GASKET COVER PART OF KIT P/N 3018762	EA	1
17	26	XDFFF		15434	AR08667	.HOUSING,ADAPTER	EA	1
17	27	PAFZZ	3120-00-627-6697	15434	69521	..BEARING,SLEEVE	EA	1
17	28	PAFZZ	5310-00-407-9566	96906	MS35338-45	.WASHER,LOCK	EA	8
17	29	PAFZZ	5305-00-225-9081	96906	MS90725-36	.SCREW,CAP,HEXAGON H	EA	1

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)		(7)	(8)
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0106(CONT)			
17	30	PAFZZ	5306-00-136-9751	15434	S-147-B	BOLT,MACHINE		EA	1
17	31	PAFZZ	5306-00-225-8499	96906	MS90725-34	BOLT,MACHINE		EA	6
17	32	XDFZZ		15434	121907	GASKET PART OF KIT P/N 3018762		EA	1







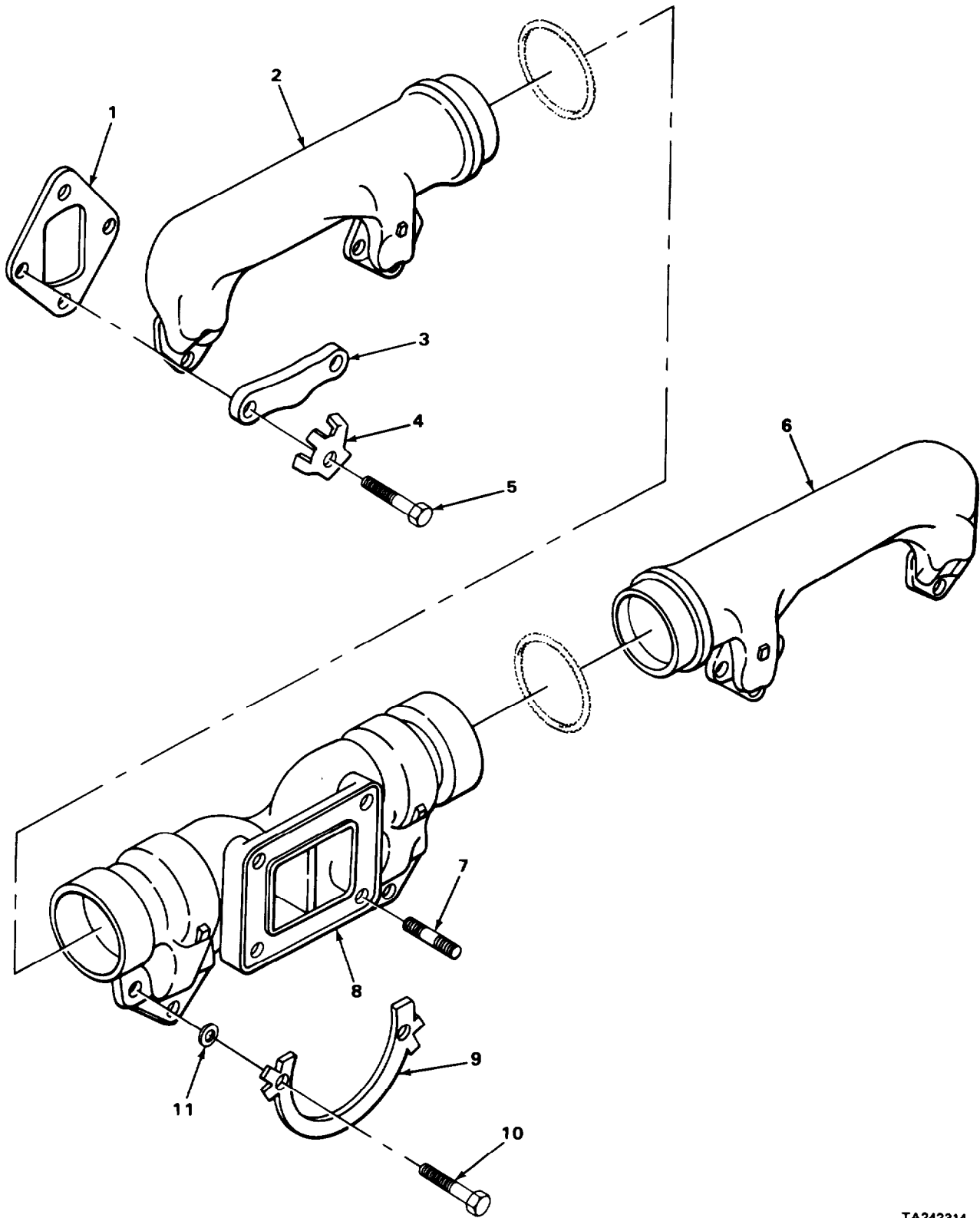
TA242313

FIGURE 18. INTAKE MANIFOLD.

## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0108-MANIFOLDS			
18	1	PAFZZ	4720-01-070-8149	55683	851-202994	HOSE,PREFORMED		EA	1
18	2	PAFZZ	4730-00-477-4160	15434	208326	CLAMP,HOSE		EA	2
18	3	XDFZZ		15434	3022205	CONNECTION,AIR CROS		EA	1
18	4	PAFZZ	5305-00-725-2317	96906	MS90728-64	CAPSCREW		EA	7
18	5	PAFZZ	5310-00-261-7340	96906	MS35338-8	WASHER,LOCK		EA	17
18	6	PAFZZ	5310-00-080-6004	96906	MS27183-14	WASHER,FLAT		EA	10
18	7	XDFZZ		15434	199568	GASKET PART OF KIT P/N 3801330		EA	1
18	8	PAFZZ	5305-00-942-2196	96906	MS18154-60	SCREW,CAP,HEXAGON H		EA	10
18	9	XDFZZ		15434	3019227	GASKET,PLATE		EA	1
18	10	PFZZ	2815-00-070-2251	15434	141761	MANIFOLD,AIR INTAKE		EA	1
18	11	PAFZZ	5310-00-134-4169	15434	63842	WASHER,FLAT		EA	3
18	12	PAFZZ	5330-00-910-8736	15434	202961	GASKET,MANIFOLD		EA	3



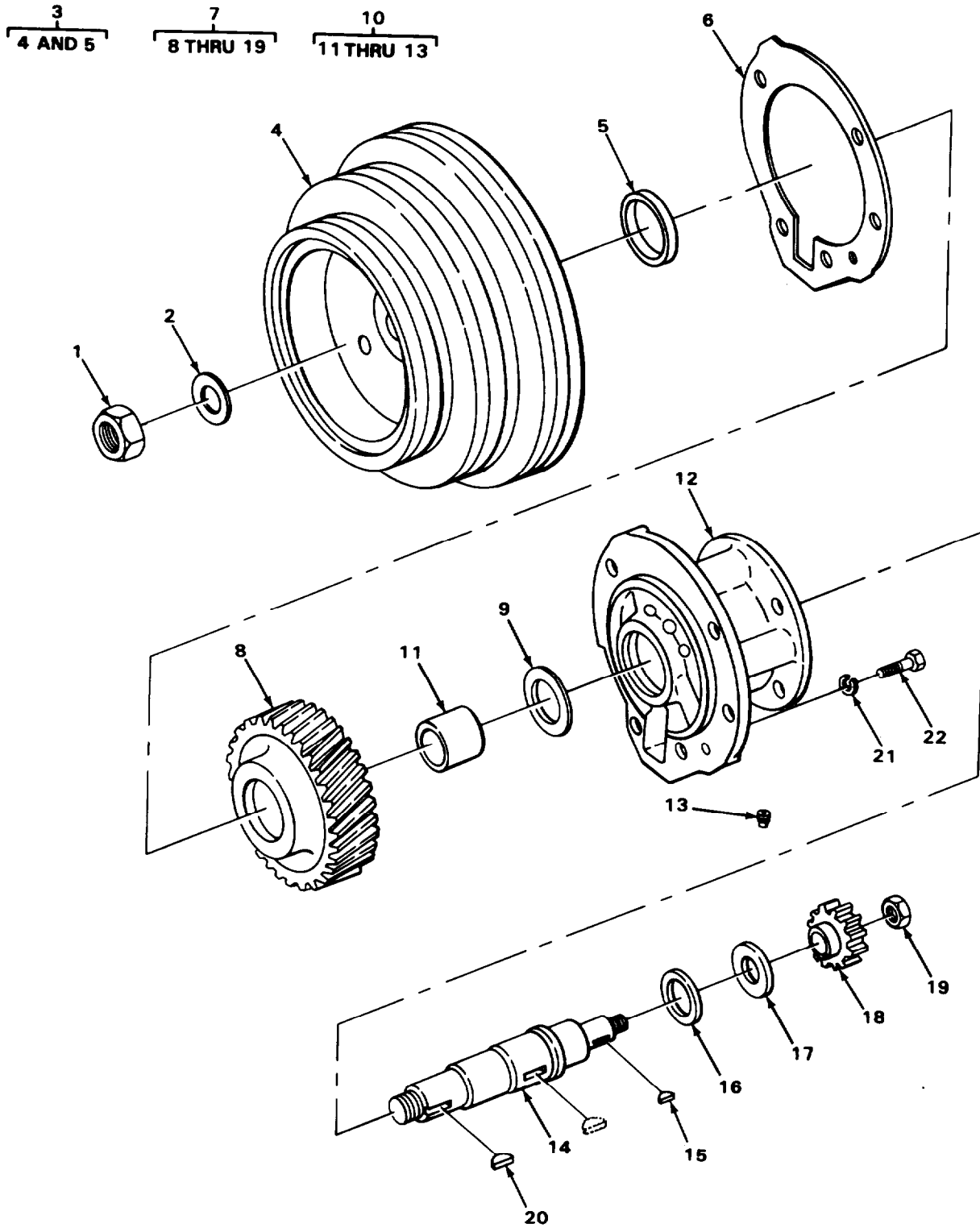
TA242314

FIGURE 19. EXHAUST MANIFOLD.

## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUSTRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0108(CONT)			
19	1	PAFZZ	5330-00-659-3178	15434	3020943	GASKET PART OF KIT P/N 3801330		EA	6
19	2	PAFZZ	2815-00-920-8356	15434	151489	MANIFOLD,EXHAUST REAR		EA	1
19	3	PAFZZ	5340-00-132-3203	15434	200919	STRAP,RETAINING		EA	2
19	4	PAFZZ	5310-00-887-8325	15434	114638	WASHER,KEY		EA	4
19	5	PAFZZ	5305-00-005-0666	15434	200908	SREW,CAP,HEXAGON H		EA	4
19	6	PAFZZ	2815-00-920-2073	15434	151478	MANIFOLD ENGINE FRONT		EA	1
19	7	PAFZZ	2815-00-829-5227	15434	105199	DOWEL,MANIFOLD		EA	4
19	8	PAFZZ	2815-01-077-4463	15434	200566	MANIFOLD,CENTER SEC		EA	1
19	9	PAFZZ	2815-00-767-4012	15434	116982	LOCKING PLATE,NUT A		EA	4
19	10	PAFZZ	5305-01-028-8869	15434	S155	CAPSCREW		EA	8
19	11	PAFZZ	3120-01-079-6527	15434	109594	BEARING,SLEEVE		EA	8



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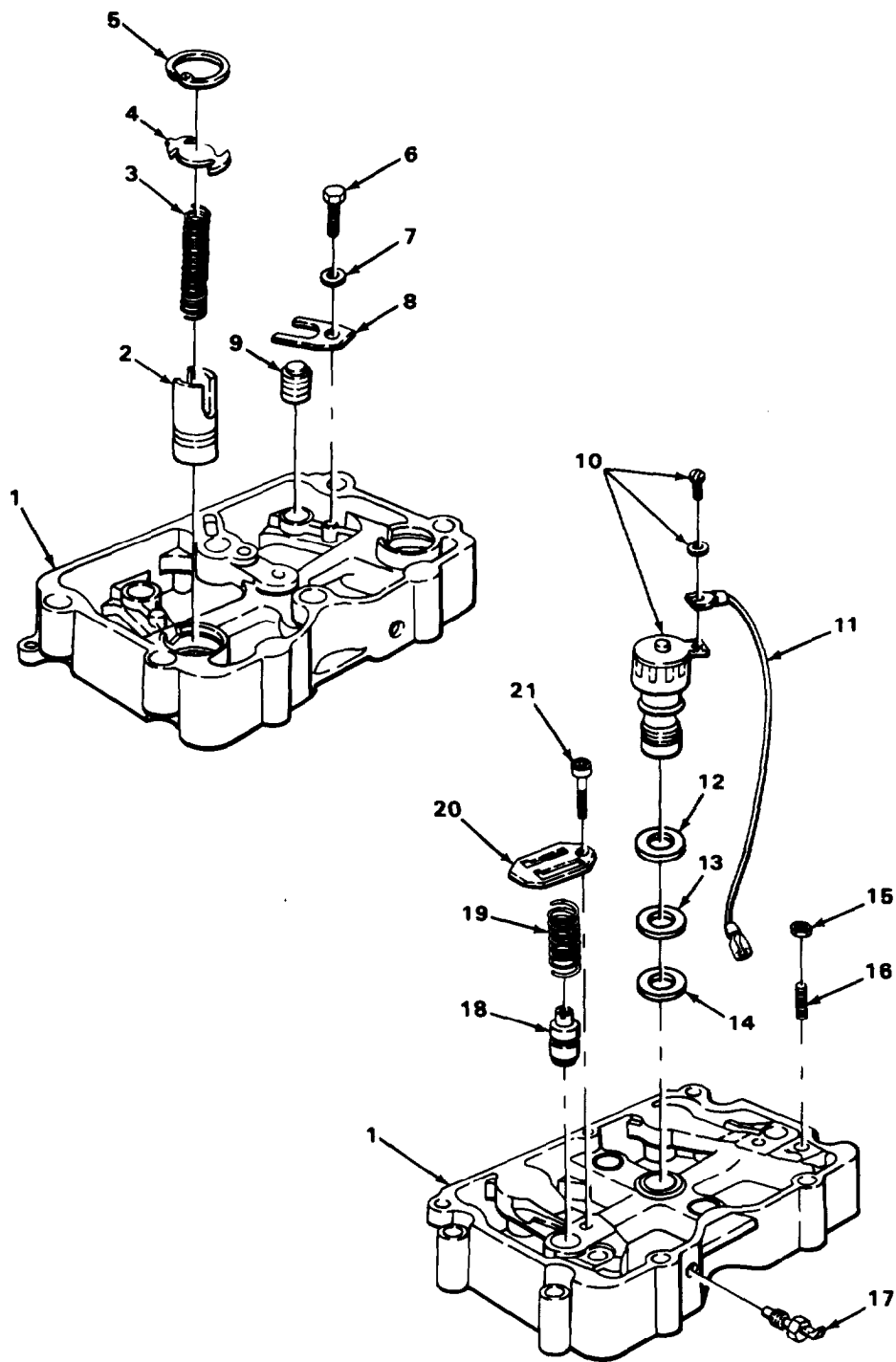
FIGURE 20. ACCESSORY DRIVE.

## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0109-ACCESSORY DRIVING MECHANISMS			
20	1	PAFZZ	5310-00-442-6899	15434	191517	NUT,SELF-LOCKING,HE		EA	1
20	2	XDFZZ		15434	194380	WASHER,FLAT		EA	1
20	3	XDFFF		15434	4R09607	PULLEY FAN AND WATER PUMP DRIVE		EA	1
20	4	XAFZZ		15434	210926	.PULLEY		EA	1
20	5	PAFZZ	2930-00-401-9531	15434	190397	.SLEEVE,PULLEY,PUMP		EA	1
20	6	PAFZZ	5330-00-026-2931	15434	200809	GASKET		EA	1
20	7	XDFHH		15434	AR08366	DRIVE,ACCESSORY DRI		EA	1
20	8	PAFZZ	3020-00-160-9092	15434	142689	.GEAR,HELICAL		EA	1
20	9	PAHZZ	3120-01-147-5275	15434	3026556	.BEARING WASHER,THRU		EA	1
20	10	XDHHH		15434	AR08256	.HOUSING ASSEMBLY		EA	1
20	11	PAHZZ	3120-00-792-9834	15434	116391	..BEARINC,SLEEVE		EA	1
20	12	XAHZZ		15434	199338	..HOUSING		EA	1
20	13	PAHZZ	4730-00-018-9566	15434	S911B	..PLUG,PIPE		EA	2
20	14	PFHZZ	3040-01-203-8549	15434	199969	.SHAFT,ACCESSORY DRI		EA	1
20	15	PAHZZ	5315-00-616-5522	96906	MS35756-12	.KEY		EA	1
20	16	PAHZZ	3120-00-086-8364	15434	116389	.BEARING WASHER,THRU		EA	1
20	17	PAHZZ	5310-00-081-9292	15434	116390	.WASHER,FLAT		EA	1
20	18	XDHZZ		15434	190769	.COUPLING		EA	1
20	19	PAHZZ	5310-00-442-6899	15434	191517	.NUT,SELF-LOCKING,HE		EA	1
20	20	PFFZZ	5315-00-616-5527	96906	MS35756-18	KEY,WODDRUFF PART OF KIT P/N 3018762		EA	1
20	21	PAFZZ	5310-00-209-0965	96906	MS35338-47	WASHER,LOCK		EA	5
20	22	PAFZZ	5305-00-071-1788	96906	MS90728-87	SCREW,CAP,HEXAGON H		EA	5

1  
2 THRU 21



TA242316

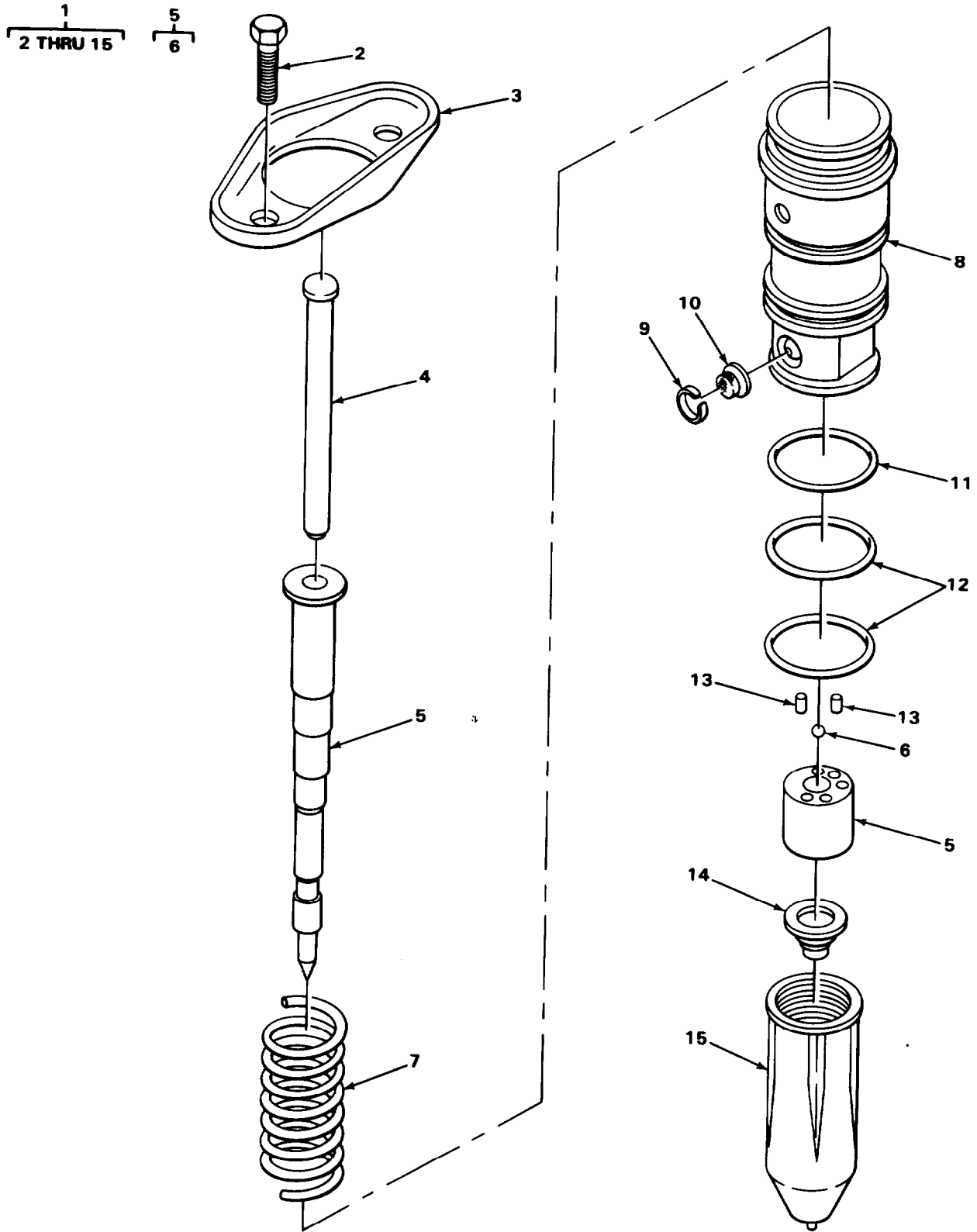
FIGURE 21. ENGINE COMPRESSION BRAKE.



SECTION II

TM 5-2815-241-34&P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0112-ENGINE BRAKE			
21	1	XDFFF		15434	199201	BRAKE,COMPRESSION ENGINE ASSEMBLY		EA	1
21	2	XDFZZ		15434	1484	PISTON,SLAVE		EA	2
21	3	XDFZZ		15434	1022	SPRING,SLAVE PISTON		EA	2
21	4	XDFZZ		15434	1289	RETAINER SLAVE PISTON SPRING		EA	2
21	5	XDFZZ		15434	1023	.RING,RETAINING		EA	2
21	6	XDFZZ		15434	1492	SCREW,CAP,HEXAGON HEAD SPRING RETAINER		EA	2
21	7	XDFZZ		15434	1030	WASHER,FLAT		EA	2
21	8	XDFZZ		15434	1011	SPRING MASTER PISTON		EA	2
21	9	XDFZZ		15434	1017	PISTON,MASTER		EA	2
21	10	XDFZZ		15434	2689	VALVE ASSEMBLY SOLENOID		EA	1
21	11	XDFZZ		15434	2390	HARNES		EA	1
21	12	XDFZZ		15434	1081	SEAL,RING SOLENOID UPPER		EA	1
21	13	XDFZZ		15434	1082	SEAL,RING SOLENOID CENTER		EA	1
21	14	XDFZZ		15434	1083	.SEAL,RING SOLENOID LOWER		EA	1
21	15	XDFZZ		15434	1026	.NUT,PLAIN,HEXAGON ADJUSTING SCREW		EA	2
21	16	XDFZZ		15434	1031	.SETSCREW		EA	2
21	17	XDFZZ		15434	2299	.TERMINAL BUSHING LEADOUT		EA	1
21	18	XDFZZ		15434	1200	.SPOOL ASSEMBLY CONTROL VALVE		EA	1
21	19	XDFZZ		15434	1012	.SPRING, CONTROL VALVE		EA	2
21	20	XDFZZ		15434	4136	.COVER,CONTROL VALVE		EA	2
21	21	XDFZZ		15434	1265	.SCREW,CAP,SOCKET HE AIR BLEED		EA	2



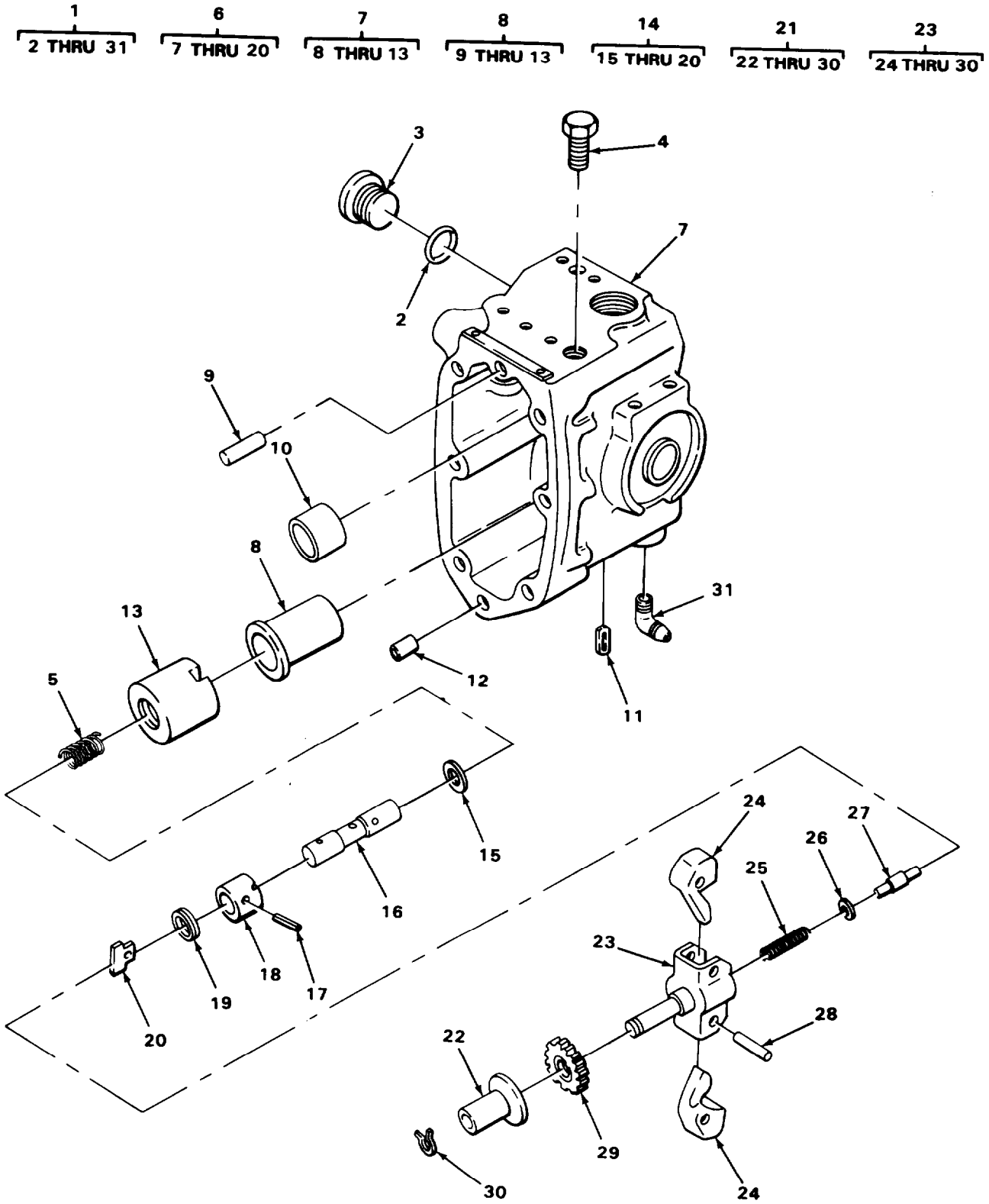
TA242317

FIGURE 22. FUEL INJECTORS.

## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	QTY INC IN UNIT
						GROUP 03-FUEL SYSTEM 0301- FUEL INJECTOR		
22	1	PAFHH	2910-01-150-2631	15434	3018323	NOZZLE,FUEL INJECTI	EA	6
22	2	PAFZZ	5305-01-060-5958	15434	165006	.SCREW,CAP,HEXAGON H CLAMP MTG	EA	2
22	3	PAFZZ	5340-00-134-3529	15434	191218	.CLAMP	EA	1
22	4	PAHZZ	2910-00-238-5435	15434	191916	.PLUNGER,DETENT	EA	1
22	5	PAHZZ	2910-00-237-0056	15434	AR40065	.PARTS KIT,FUEL INJE	EA	1
22	6	PAHZZ	2910-01-070-9710	15434	167157	..BALL CHECK,FUEL INJ	EA	1
22	7	PAHZZ	5360-00-132-0245	15434	166009	.SPRING INJECTOR	EA	1
22	8	PAHZZ	2910-01-105-6457	15434	185139	.ADAPTER,INJECTOR	EA	1
22	9	PAHZZ	5365-00-815-1137	15434	174299	.CLIP,FILTER SCREEN	EA	1
22	10	PAHZZ	2815-00-815-1114	15434	174298	.STRAINER,ELEMENT,SE	EA	1
22	11	PAHZZ	5330-00-924-7757	96906	MS9241-024	.PACKING,PREFORMED PART OF KIT P/N 3801330	EA	1
22	12	PAHZZ	5330-00-132-0276	15434	193736	.GASKET PART OF KIT P/N 3801330	EA	2
22	13	PAHZZ	5315-01-079-6506	15434	203426	.PIN,SPIRAL	EA	2
22	14	PAHZZ	2910-01-152-8531	15434	3012537	.CUP,INJECTOR	EA	1
22	15	PAHZZ	5340-01-079-4678	15434	185138	.RETAINER,CUP	EA	1



TA242318

FIGURE 23. FUEL PUMP HOUSING.

## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0302-FUEL PUMPS			
23	1	PAFHH	2910-01-047-6021	15434	3007300-2764	FUEL PUMP ASSEMBLY		EA	1
23	2	PAFZZ	5330-00-582-7484	96906	MS9021-116	.PACKING,PREFORMED		EA	1
23	3	PAFZZ	5365-00-988-3668	15434	139473	.PLUG,MACHINE THREAD		EA	1
23	4	PAFZZ	5365-01-160-1832	15434	112076	.PLUG,FUEL,OUTLET		EA	1
23	5	XDHZZ		15434	138782	.SPRING,TORQUE CONTR		EA	1
23	6	PAHHH	2910-00-404-9999	15434	BM79290	.HOUSING,FUEL PUMP		EA	1
23	7	XDHHH		15434	NM73902	..HOUSING ASSEMBLY		EA	1
23	8	PAHHH	2910-00-603-2835	15434	BM76665	...BARREL ASSEMBLY		EA	1
23	9	PAHZZ	5315-00-369-2588	15434	68549	.... PIN,STRAIGHT,HEADLE		EA	1
23	10	PAHZZ	3120-00-810-6032	15434	100193	.... BEARING,SLEEVE		EA	1
23	11	PAHZZ	2910-00-400-5178	15434	163733	....CLIP,GOVERNOR BARRE		EA	1
23	12	PAHZZ	5315-00-844-0140	15434	118227	....PIN,HOLLOW		EA	1
23	13	PAHZZ	2910-00-829-5603	15434	140618	.... HOUSING,SPRING PACK		EA	1
23	14	PAHHH	2910-01-091-3204	15434	BM98430	..PLUNGER,GOVERNOR		EA	1
23	15	PAHZZ	5365-00-507-3224	15434	101841	...SHIM		EA	1
23	15	PAHZZ	5365-00-507-3225	15434	101842	...SHIM		EA	1
23	15	PAHZZ	5365-00-543-3744	15434	101843	...SHIM		EA	1
23	16	PAHZZ	2910-01-086-5544	15434	182530	...PLUNGER,DETENT		EA	1
23	17	PAHZZ	5315-00-907-0711	72962	590220940406	...PIN,SPRING		EA	1
23	18	PAHZZ	2910-00-829-5604	15434	144302	...SPACER,FUEL PUMP		EA	1
23	19	XDHZZ		15434	138905	...BEARING,SLEEVE		EA	1
23	20	PAHZZ	2990-00-772-1778	15434	70690	...DRIVER,PLUNGER		EA	1
23	21	PFHHH	2910-00-887-8354	15434	BM73718	.WEIGHT AND CARRIER		EA	1
23	22	PAHZZ	3120-00-904-9595	15434	163944	..BUSHING,GOVERNOR		EA	1
23	23	XDHHH		15434	AR-00796	..CARRIER ASSEMBLY		EA	1
23	24	PAHZZ	2910-00-451-8063	15434	146437	...WEIGHT,GOVERNOR		EA	2
23	25	PAHZZ	5360-00-081-8487	15434	143847	...SPRING,HELICAL,COMP		EA	1
23	26	PFHZZ	5310-00-727-8353	80205	NAS620-5L	...SHIM,WEIGHT ASSIST		EA	1
23	27	PAHZZ	5315-00-082-0448	15434	144178	...PIN,SHOULDER,HEADLE		EA	1

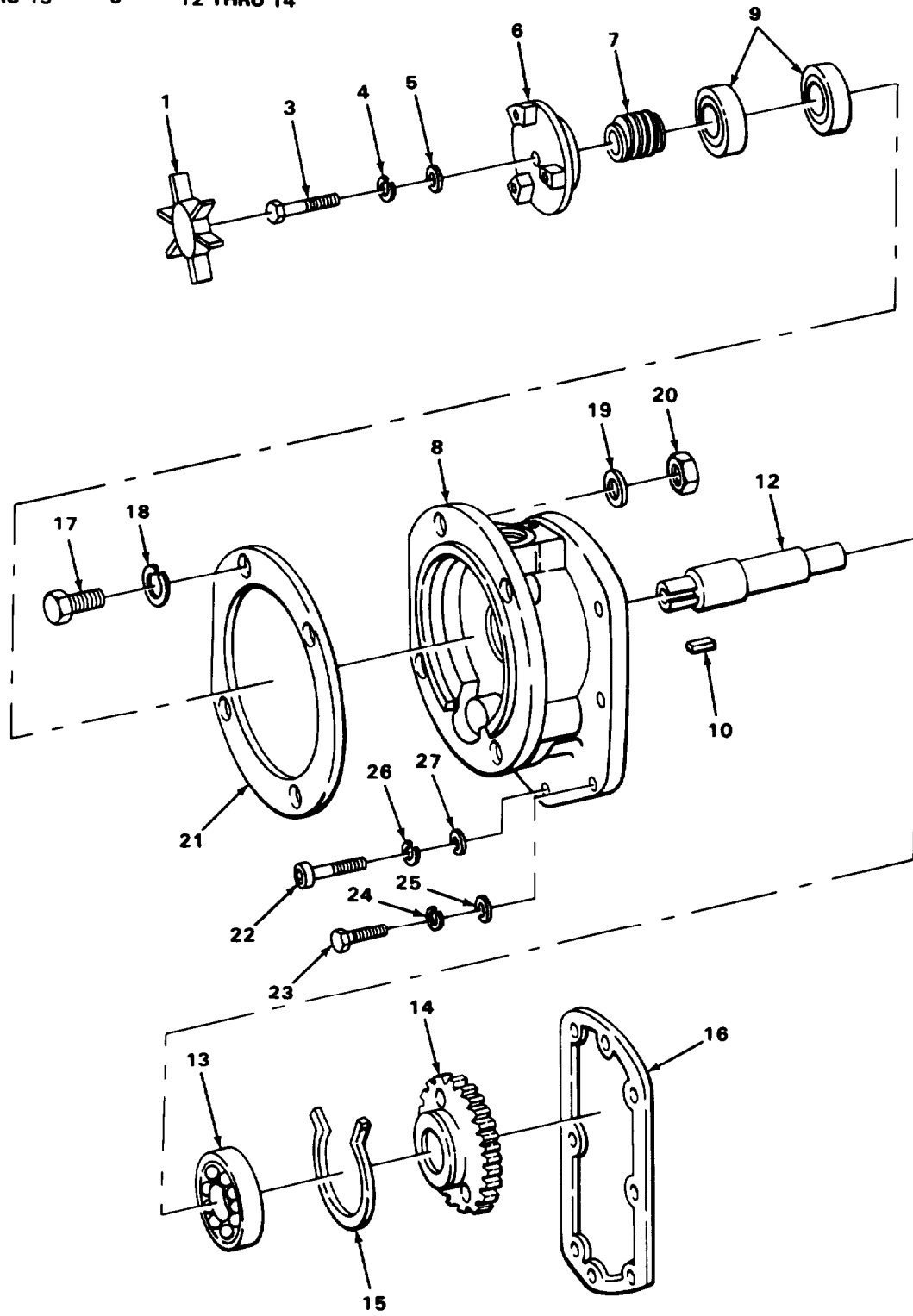
(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0302(CONT)			
23	28	XDHZZ		15434	142204	... PIN,WEIGHT PIVOT		EA	2
23	29	PAHZZ	3020-00-701-11	15434	113244	... GEAR,SPUR		EA	1
23	30	PFHZZ	5365-00-256-28	96906	MS16632-1050	... RING,RETAINER		EA	1
23	31	PAFZZ	4820-00-130-4820	15434	175836	.VALVE,CHECK		EA	1



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3 THRU 15

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11  
12 THRU 14



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FIGURE 24. MAINSHAFT COVER.



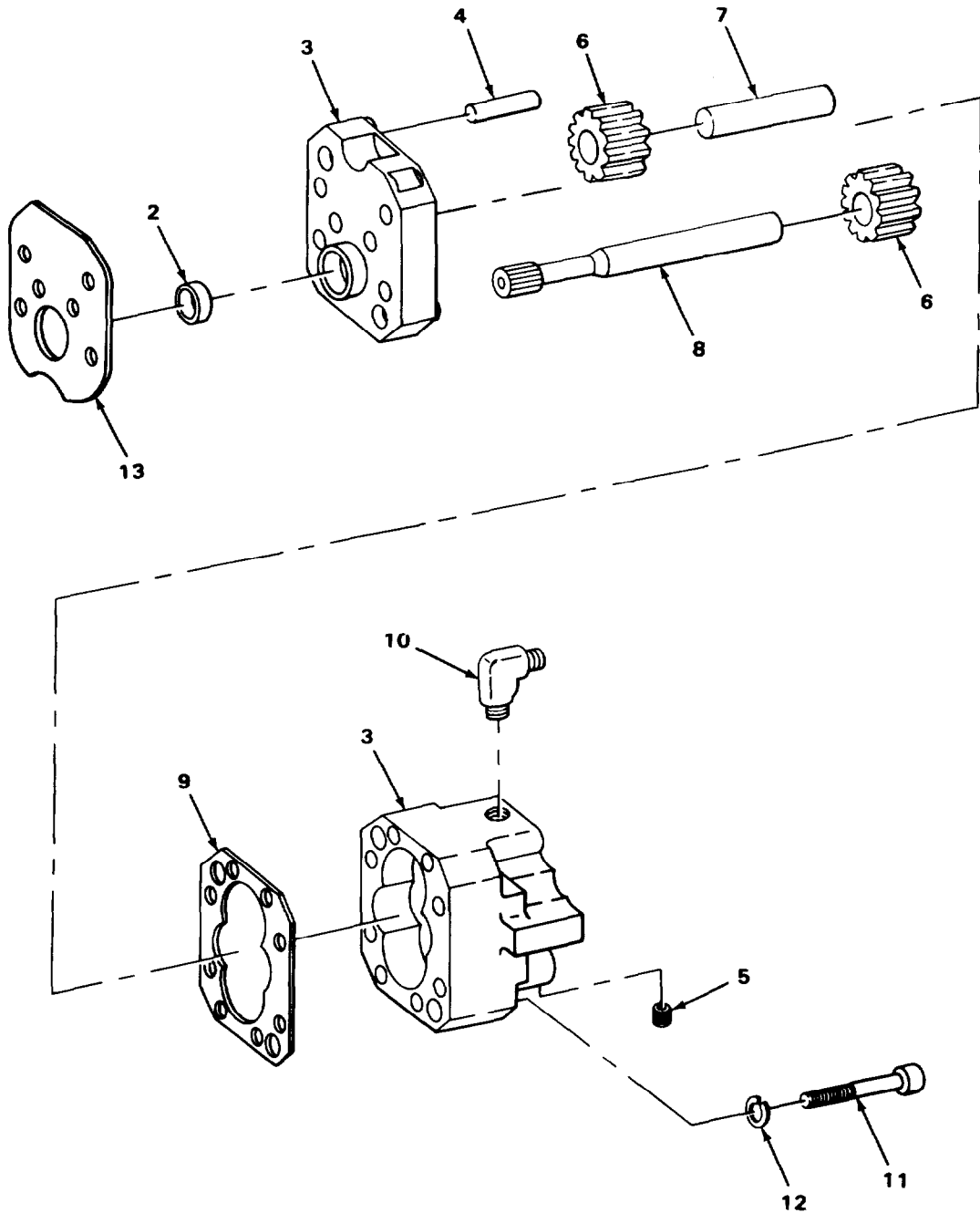
## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)		(7)	(8)
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0302(CDNT)			
24	1	PAFZZ	3010-00-447-9799	15434	162426	INSERT,FLEXIBLE COU		EA	1
24	2	PAFHH	2990-00-237-0058	15434	BM69886	COVER ASSEMBLY MAIN		EA	1
24	3	PAHZZ	5306-00-019-4227	15434	69793	.BOLT,MACHINE		EA	1
24	4	PAHZZ	5310-00-261-7340	96906	MS35338-8	.WASHER,LOCK COUPLING		EA	1
24	5	PAHZZ	5310-00-486-2505	15434	108330	.WASHER,FLAT		EA	1
24	6	PAHZZ	3040-00-695-3285	15434	101918	.COUPLING HALF,SHAFT		EA	1
24	7	PAHZZ	3020-00-567-4356	15434	101983	.GEAR,HELICAL		EA	1
24	8	PAFHH	2910-00-369-8240	15434	BM68879	.HOUSING COVER ASSEM		EA	1
24	9	PAHZZ	5330-00-010-8497	15434	104038	..SEAL,PLAIN ENCASED		EA	2
24	10	PAHZZ	5315-00-695-3292	96906	MS20066-116	..KEY,MACHINE		EA	1
24	11	PAHHH	2910-00-567-4338	15434	AR51307	..GEARSHAFT,SPUR-WORM		EA	1
24	12	PAHZZ	2910-00-773-9369	15434	100192	... SHAFT,SHOULDERED DRIVE		EC	1
24	13	PAHZZ	3110-00-144-8499	24617	903302	...BEARING,BALL		EI	1
24	14	PAHZZ	3020-00-562-1173	15434	103036	... GEAR,SPUR		EI	1
24	15	PAHZZ	5365-00-721-7884	15434	70699	..RING,RETAINING		EA	1
24	16	PAFZZ	5330-00-506-4866	15434	100764	.GASKET COVER TO HOUSING PART OF KIT P/N BM68356		EA	1
24	17	PFFZZ	5305-00-071-2056	96906	MS90728-90	.CAPSCREW		EA	4
24	18	PAFZZ	5310-00-209-0965	96906	MS35338-47	.WASHER,LOCK		EA	4
24	19	PAFZZ	5310-00-562-6557	15434	S622	.WASHER,FLAT		EA	4
24	20	XDFZZ		15434	S274	NUT		EA	4
24	21	PAFZZ	5330-01-109-1283	15434	210374	GASKET PUMP TO COMPRESSOR PART OF KIT P/N 3018762		EA	1
24	22	PAFZZ	5305-00-161-0902	15434	118226	SCREW COVER TO HOUSING		EA	1
24	23	PFFZZ	5305-00-071-2241	96906	MS90725-10	.CAPSCREW		EA	6
24	24	PAFZZ	5310-00-159-6209	96906	MS122032	.WASHER,LOCK		EA	6
24	25	PAFZZ	5310-00-141-1795	88044	AN960-416	WASHER COVER TO HOUSING		EA	6
24	26	PAFZZ	5310-00-410-6756	15434	S606	.WASHER,LOCK		EA	1
24	27	PAFZZ	5310-00-014-5850	96906	MS27183-42	.WASHER,FLAT BODY TO COVER		EA	1

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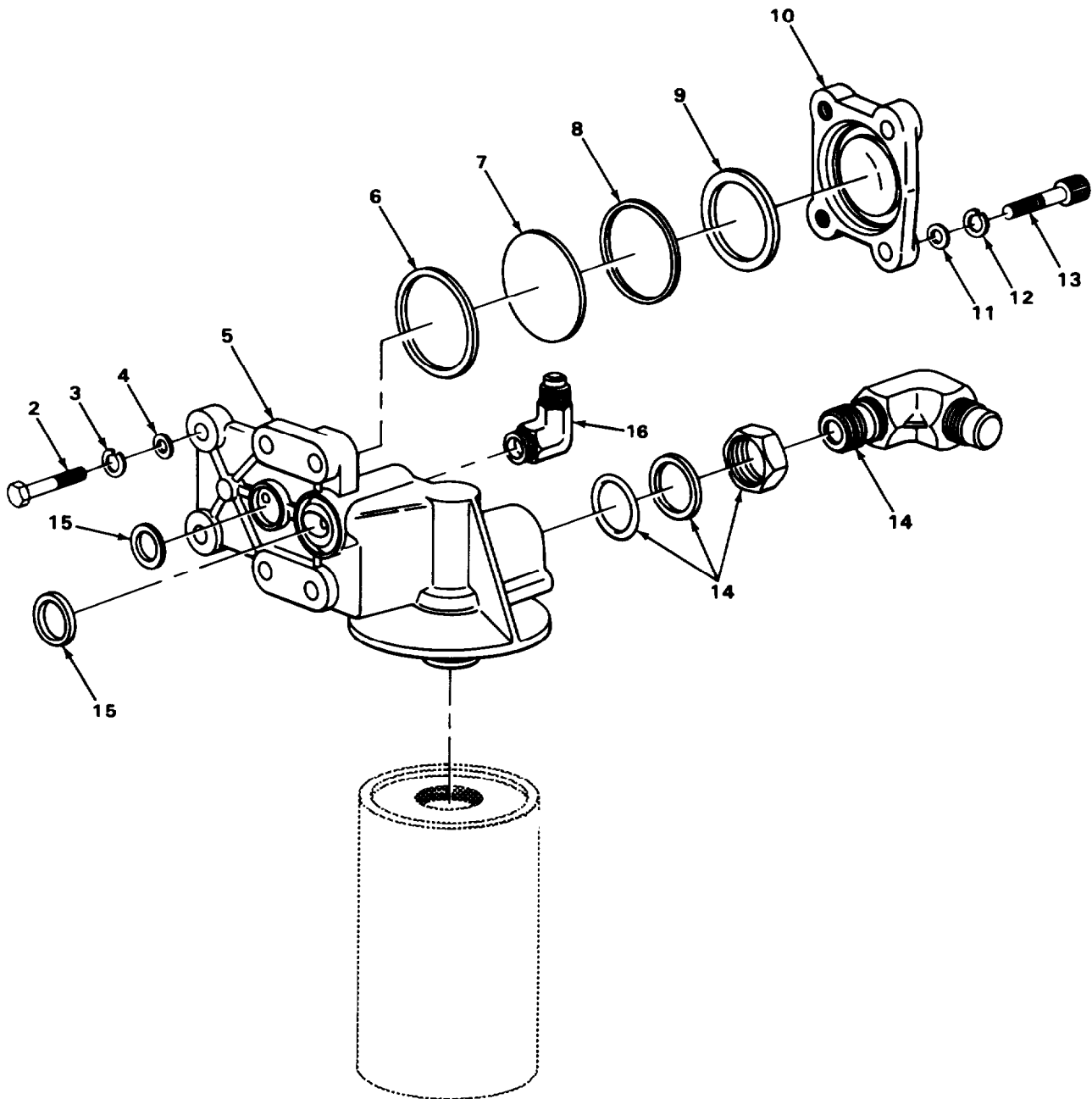
FIGURE 25. GEAR PUMP.

## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)		(7)	(8)
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
25	1	PAFHH	2910-00-869-3428	15434	BM97502	.PUMP,FUEL		EA	1
25	2	PAHZZ	120-00-719-5719	15434	101468	..BUSHING,SLEEVE		EA	1
25	3	PAFHH	910-01-096-9200	15434	BM97497	..HOUSING ASSEMBLY,FU		EA	1
25	4	PAHZZ	315-00-014-1244	30760	17300-1251	...PIN,STRAIGHT,HEADLE COVER TO HOUSING		EA	2
25	5	PAFZZ	365-00-716-6580	15434	68606	...PLUG,MACHINE THREAD		EA	1
25	6	PAHZZ	020-00-892-4704	15434	119363	..GEAR,SPUR		EA	2
25	7	PAHZZ	910-00-933-3012	15434	175864	..SHAFT,DLER,GEA		EA	1
25	8	PAHZZ	910-00-567-4354	15434	100215	..SHAFT,SHOULDERED		EA	1
25	9	PAHZZ	330-00-567-3463	15434	110855	..GASKET COVER TO HOUSING PART OF KIT P/N BM68356		EA	1
25	10	PAHZZ	730-00-803-8353	15434	116936	..CHECK VALVE,ELBOW		EA	1
25	11	PAFZZ	5306-00-485-0790	15434	70790	.BOLT,MACHINE SOCKET HEAD		EA	4
25	12	PAFZZ	1310-00-484-1718	15434	181466	.WASHER,LOCK		EA	4
25	13	PAFZZ	5330-00-006-2494	15434	2'10647	GASKET PART OF KIT P/N BM68356		EA	1

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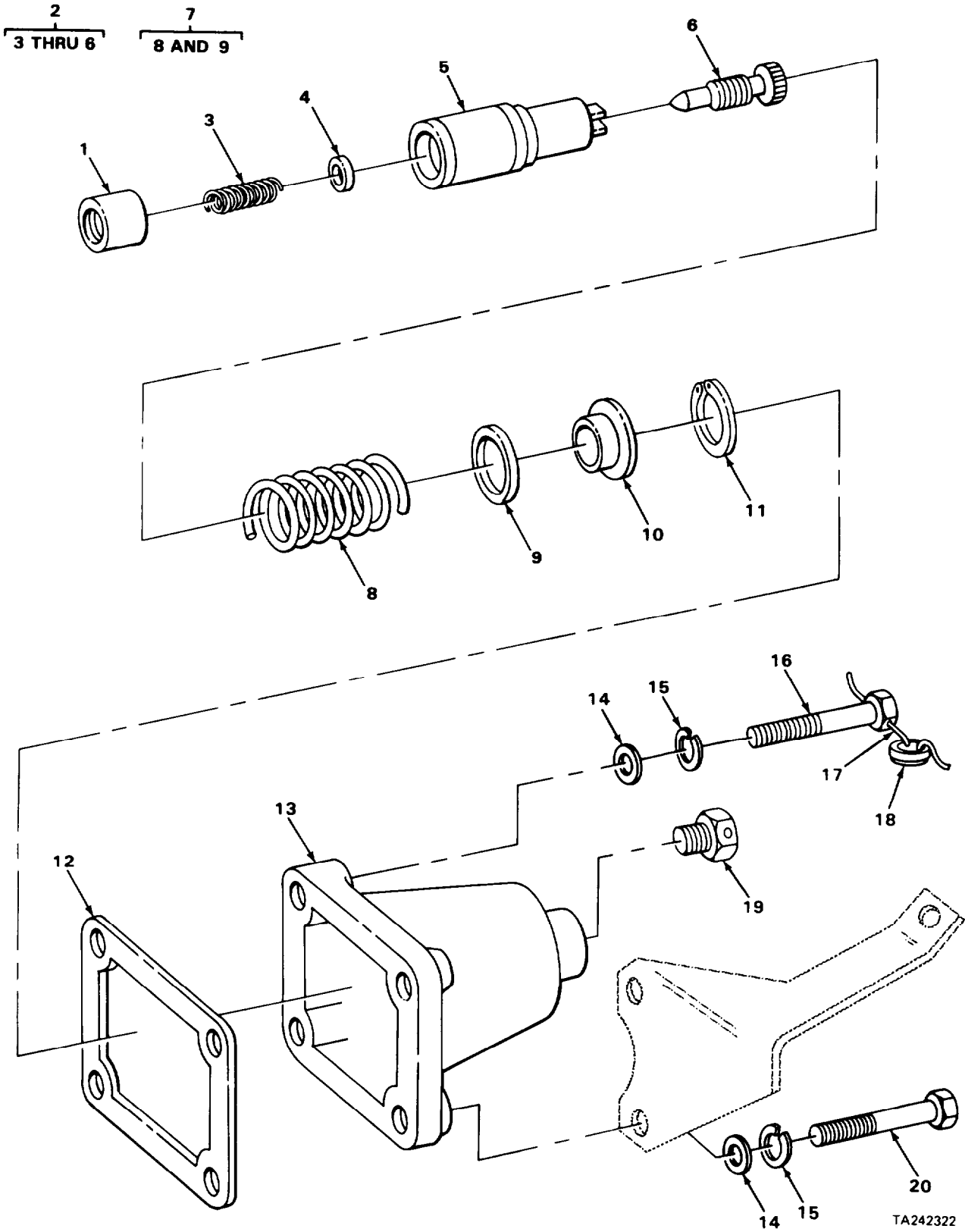
TA242321

FIGURE 26. DAMPER.

SECTION II

TM 5-2815-241-34&P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0302(CONT)			
26	1	PAFHH	2910-00-828-7126	15434	BM76340	.DAMPENER,FLUID PRES		EA	1
26	2	PAFZZ	5305-00-071-2241	96906	MS90725-10	..CAPSCREW		EA	2
26	3	PAFZZ	5310-00-159-6209	96906	MS122032	..WASHER,LOCK		EA	2
26	4	PAFZZ	5310-00-141-1795	88044	AN960-416	..WASHER		EA	2
26	5	PAHZZ	2910-00-829-5616	15434	153336	..HOUSING,FUEL PUMP		EA	1
26	6	PAHZZ	5330-00-809-2667	15434	100099	..PACKING,PREFORMED PART OF KIT P/N BM68356		EA	1
26	7	PAHZZ	2910-00-951-3536	15434	202897	..DISK,SOLID,PLAIN		EA	1
26	8	PAHZZ	5330-00-809-3276	15434	139988	..PACKING PART OF KIT P/N BM68356		EA	1
26	9	PAHZZ	5365-00-965-0870	15434	160514	..SPACER RING PART OF KIT P/N BM68356		EA	1
26	10	PAHZZ	2910-00-829-5617	15434	153338	..COVER,ACCESS		EA	1
26	11	PAFZZ	5310-00-141-1795	88044	AN960-416	.WASHER		EA	1
26	12	PAFZZ	5310-00-484-1718	15434	181466	.WASHER,LOCK		EA	2
26	13	PAFZZ	5306-00-485-0790	15434	70790	.BOLT,MACHINE SOCKET HEAD		EA	2
26	14	PAFZZ	4730-01-078-9859	15434	203849	.ELBOW,TUBE TO BOSS		EA	1
26	15	PAHZZ	5330-00-252-8888	16954	691-10014	.GASKET PART OF KIT P/N BM68356		EA	1
26	16	PAFZZ	4730-00-803-8353	15434	116936	.ELBOW,CONNECTION		EA	1



TA242322

FIGURE 27. SPRING PACK.

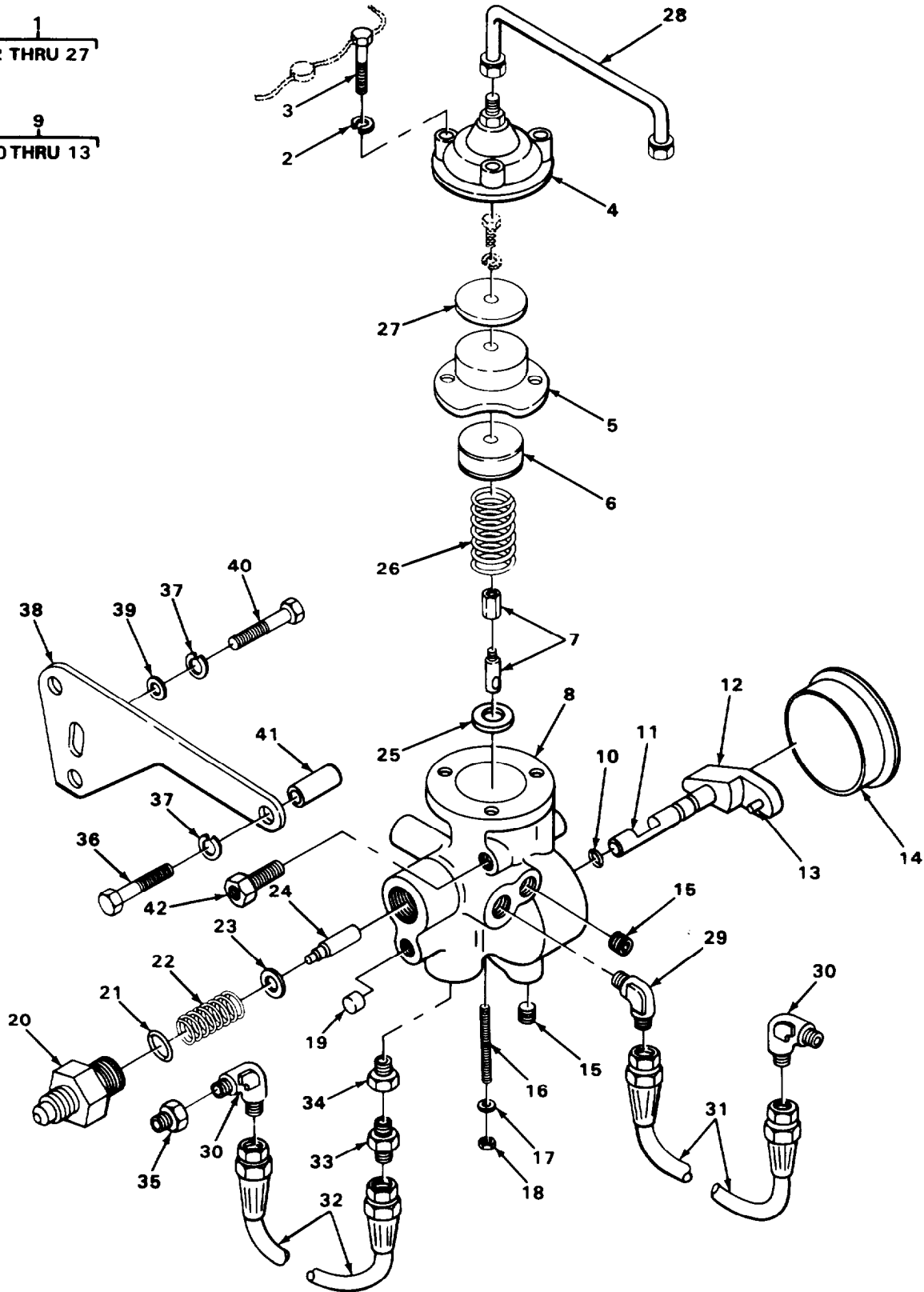
## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0302(CONT)			
27	1	PAFZZ	2910-00-369-8251	15434	140925	.PLUNGER,FUEL INJECT		EA	1
27	2	PAFFF	2990-00-237-0058	15434	BM69886	.COVER ASSEMBLY MAIN IDLING SPRING		EA	1
27	3	PAFZZ	5360-00-082-0124	15434	144195	..SPRING,HELICAL,COMP		EA	1
27	4	PAFZZ	5310-00-507-3259	15434	70715	..WASHER,FLAT		EA	1
27	5	PAFZZ	2910-00-132-0769	15434	BM67416	..GLIDE,CLIP ASSEMBLY		EA	1
27	6	PAFZZ	5305-00-506-5722	15434	70716	..SETSCREW		EA	1
27	7	XDFFF		15434	BM74747	.SPRING ASSEMBLY		EA	1
27	8	PAFZZ	5360-00-461-5738	15434	143251	..SPRING,HELICAL,COMP		EA	1
27	9	PAFZZ	5365-00-507-3260	15434	70717	..SPACER RING		EA	1
27	9	PAFZZ	5365-00-507-3261	15434	70717A	..SHIM		EA	1
27	9	PAFZZ	5365-00-507-3262	15434	70717B	..SHIM		EA	1
27	9	PAFZZ	5365-00-462-4504	15434	189800	..SHIM GOVERNOR		EA	1
27	10	PAFZZ	5340-00-898-1497	15434	70713	.RING RETAINING		EA	1
27	11	PFFZZ	5365-00-807-2636	96906	MS16625-1100	.RING,RETAINING		EA	1
27	12	PAFZZ	5330-00-562-1176	15434	70705	.GASKET PART OF KIT P/N BM68356		EA	1
27	13	PAFZZ	2910-00-858-3522	15434	44678	.COVER,SPRING PACK		EA	1
27	14	PAFZZ	5310-00-141-1795	88044	AN960-416	.WASHER SPRING PACK COVER TO HOUSING		EA	4
27	15	PAFZZ	5310-00-484-1718	15434	181466	.WASHER,LOCK SPRING PACK COVER TO HOUSING		EA	4
27	16	PAFZZ	5305-01-072-8831	15434	203619	.SCREW SPRING PACK COVER TO HOUSING		EA	1
27	17	PAFZZ	5340-00-464-7064	15434	124020	.WIRE,SHAFT SEAL		EA	1
27	18	PAFZZ	2910-00-065-5544	15434	124019	..SEAL,FUEL PUMP REGU		EA	2
27	19	PAFZZ	4730-00-369-7824	15434	177999	.PLUG,PIPE		EA	1
27	20	PAFZZ	5305-00-071-2241	96906	MS90725-10	.CAPSCREW		EA	3

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FIGURE 28. ANEROID CONTROL.



## SECTION II

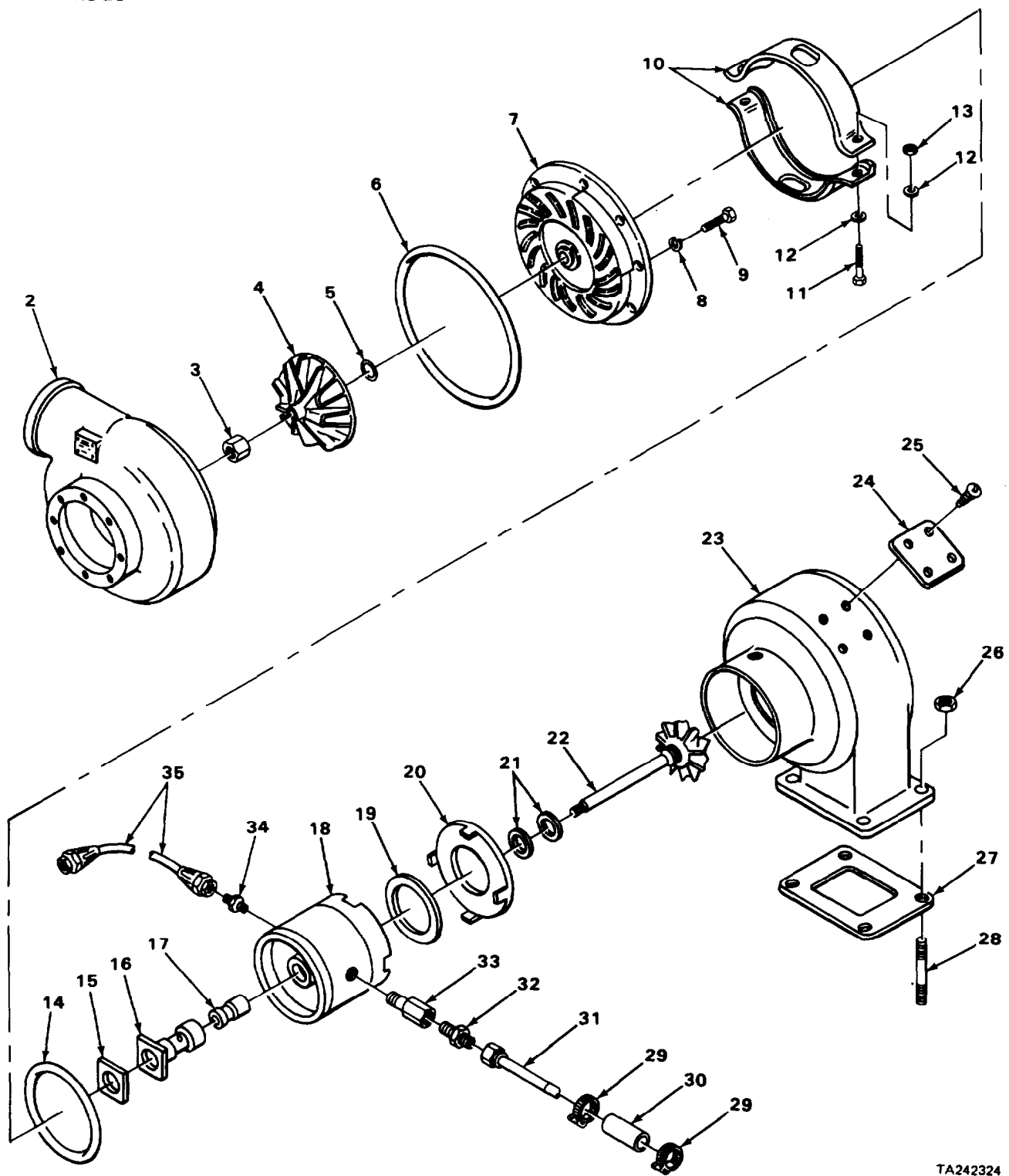
TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	USABLE ON CODE	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.								
						0302(CONT)			
28	1	XDFHH		15434	AR-09454-00EF	CONTROL,ANEROID		EA	1
28	2	PAHZZ	5310-00-159-6209	96906	MS122032	.WASHER,LOCK		EA	3
28	3	PAHZZ	5305-00-071-2241	96906	MS90725-10	.CAPSCREW COVER TO HOUSING		EA	3
28	4	XDHZZ		15434	114947	.COVER,BELLOWS		EA	1
28	5	PAHZZ	2910-00-767-4018	15434	114739	.BELLOWS		EA	1
28	6	XDHZZ		15434	114755	.PISTON,BELLOWS		EA	1
28	7	XDHZZ		15434	115033	.SHAFT,BELLOWS ACTUA		EA	1
28	8	XAHZZ		15434	140357	.HOUSING,CONTROL		EA	1
28	9	XDHHH		15434	EM69381	.VALVE,LEVER AND PIN		EA	1
28	10	PAHZZ	5330-00-816-8148	15434	114791	..PACKING,PREFORMED PART OF KIT P/N BM68356		EA	1
28	11	XDHZZ		15434	140358	..VALVE		EA	1
28	12	XDHZZ		15434	115034	..LEVER		EA	1
28	13	XDHZZ		15434	114940	..PIN		EA	1
28	14	XDHZZ		15434	114773	.COVER,CONTROL		EA	1
28	15	PAHZZ	4730-00-018-9566	15434	S911B	.PLUG,PIPE		EA	2
28	16	PAHZZ	5305-00-063-5043	88044	AN565F428H24	.SCREW,ADJUSTING		EA	1
28	17	PAHZZ	5330-00-580-5327	15434	70815	.PACKING WITH RETAIN PART OF KIT P/N BM68356		EA	1
28	18	PAHZZ	5310-00-757-6367	15434	108074	.NUT,BELLOWS ACTUATING SHAFT		EA	1
28	19	XDHZZ		15434	114765	.PLUG,PLUNGER		EA	1
28	20	XDHZZ		15434	114764	.RETAINER,SPRING		EA	1
28	21	PAHZZ	5330-00-951-3538	91265	TS33-016	.GASKET SPRING RETAINER		EA	1
28	22	XDHZZ		15434	114745	.SPRING,PRESSURE VAL		EA	1
28	23	XDHZZ		15434	114795	.WASHER,PRESSURIZING		EA	1
28	24	XDHZZ		15434	140414	.PLUNGER,PRESSURE		EA	1
28	25	XDHZZ		15434	114921	.SHIM,SPRING		EA	V
28	26	XDHZZ		15434	124033	.SPRING,BELLOWS		EA	1
28	27	XDHZZ		15434	114754	.WASHER BELLOWS RETAINER		EA	1
28	28	XDFZZ		15434	208621	TUBE AIR SUPPLY		EA	1
28	29	PAFZZ	4730-01-157-8923	15434	144372	ELBOW,TUBE TO HOSE		EA	1

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)		(7)	(8)
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0302(CONT)			
28	30	PAFZZ	4730-00-287-1649	96906	MS39230-1	ELBOW		EA	2
28	31	XDFZZ		15434	AS0501900SS	HOSE,CONTROL		EA	1
28	32	PFFZZ	4720-01-169-7509	15434	AS0500760SS	HOSE,CONTROL		EA	1
28	33	XDFZZ		15434	143950	ADAPTER		EA	1
28	34	XDFZZ		15434	NPN	ADAPTER		EA	1
28	35	PAFZZ	4730-00-196-0837	96906	MS51887-5	ADAPTER		EA	1
28	36	PAFZZ	5305-00-782-9489	96906	MS90728-66	SCREW,CAP,HEXAGON H		EA	2
28	37	PAFZZ	5310-00-261-7340	96906	MS35338-8	WASHER,LOCK		EA	4
28	38	XDFZZ		15434	204851	BRACKET		EA	1
28	39	PAFZZ	5310-00-080-6004	96906	MS27183-14	WASHER,FLAT		EA	2
20	40	PAFZZ	5305-00-942-2196	96906	MS18154-60	SCREW,CAP,HEXAGON H		EA	2
28	41	PAFZZ	5365-00-082-1193	15434	63385	SPACER		EA	2
28	42	XDFZZ		15434	213713	FILTER,AIR		EA	1



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FIGURE 29. TURBOCHARGER.

## SECTION II

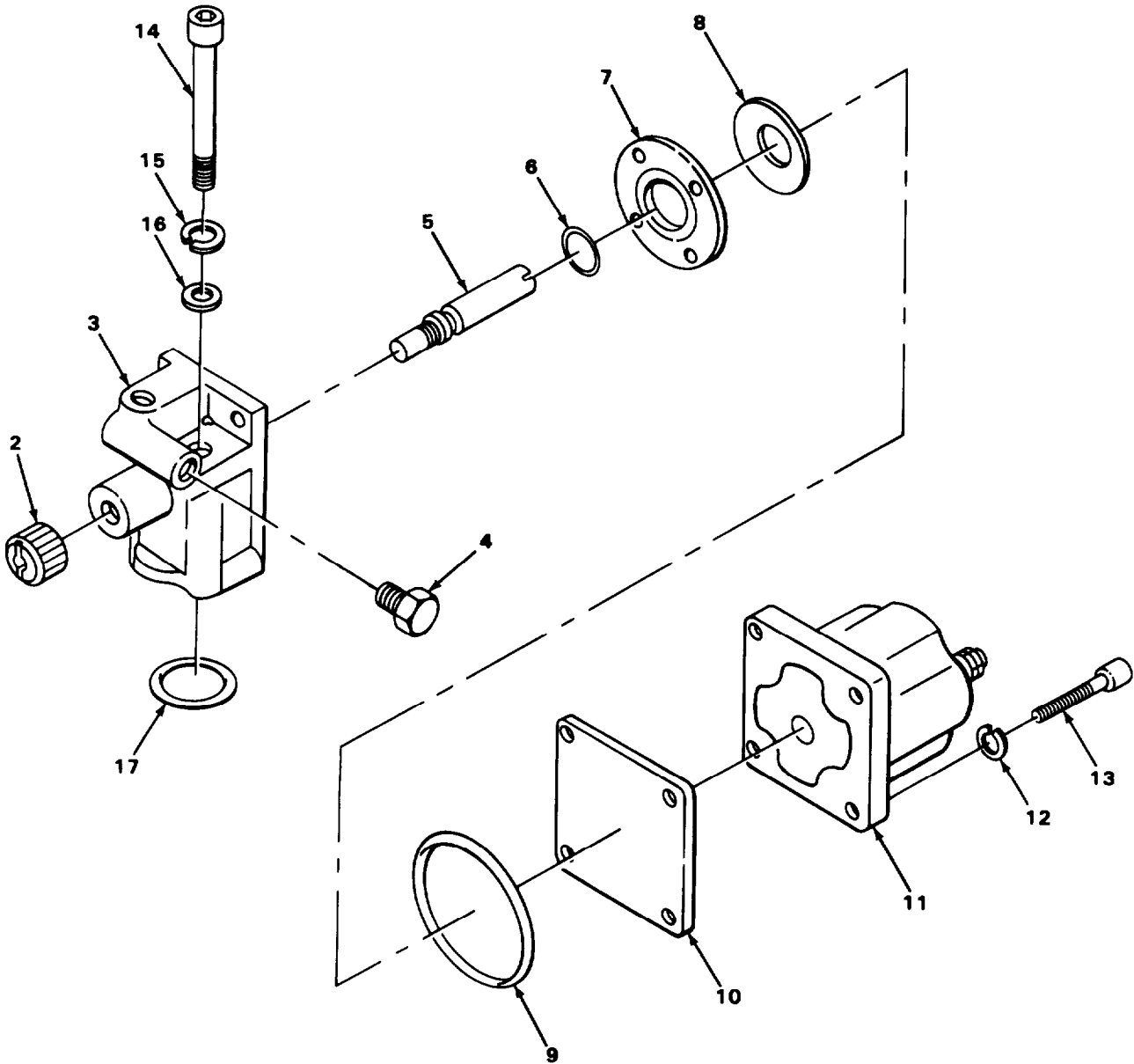
TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0305-SUPERCHARGER, BLOWER, TURBOCHARGER, OR ALTITUDE COMPENSATOR			
29	1	PAFFF	2990-01-046-0171	15434	AR12604	TURBOCHARGER		EA	1
29	2	PAFZZ	2950-00-275-3355	15434	195469	.HOUSING,TURBINE		EA	1
29	3	PFFZZ	5310-00-164-1904	15434	S222A	.NUT,SELF-LOCKING PART OF KIT P/N 3801098		EA	1
29	4	PAFZZ	2950-00-275-9344	15434	212563	.IMPELLER,TURBOCHARG		EA	1
29	5	PAFZZ	5330-00-237-6266	15434	156444	.SEAL PART OF KIT P/N 3801098		EA	1
29	6	PAFZZ	2950-00-275-8276	15434	211375	.RING,SEALING PART OF KIT P/N 3801098		EA	1
29	7	PAFZZ	2950-00-275-4658	15434	203294	.PLATE,DIFFUSER		EA	1
29	8	PAFZZ	5310-00-159-6209	96906	MS122032	.WASHER,LOCK		EA	8
29	9	PAFZZ	5305-00-230-1939	15434	S118A	.CAPSCREW		EA	8
29	10	PAFZZ	5340-00-103-9988	15434	156416	.STRAP,RETAINING		EA	2
29	11	PAFZZ	5305-00-411-9340	15434	194010	.SCREW		EA	2
29	12	PAFZZ	5310-00-562-6560	15434	S631	.WASHER,FLAT		EA	4
29	13	PAFZZ	5310-00-680-6874	72962	1801-040	.NUT,CLAMP		EA	2
29	14	PAFZZ	5330-00-426-2933	15434	202457	.PACKING,PREFORMED PART OF KIT P/N 3801098		EA	1
29	15	PAFZZ	5330-00-632-6182	15434	170510	.GASKET PART OF KIT P/N 3801098		EA	1
29	16	PAFZZ	3120-00-682-7706	15434	156420	.BEARING		EA	1
29	17	PAFZZ	2950-01-085-3580	15434	216802	.SLEEVE,TURBOCHARG PART OF KIT P/N 3801098		EA	1
29	18	PAFZZ	2950-00-432-1559	15434	202376	.HOUSING,BEARING		EA	1
29	19	PAFZZ	5330-00-406-7789	15434	202377	.PACKING,FLAT FIBER PART OF KIT P/N 3801098		EA	1
29	20	PAFZZ	2990-00-477-6159	15434	171570	.SHIELD,HEAT		EA	1
29	21	PAFZZ	5330-01-136-8431	15434	3022969	.RING,RETAINING PART OF KIT P/N 3801098		EA	2
29	22	PAFZZ	2950-00-275-9325	15434	AR10058	.WHEEL AND SHAFT		EA	1
29	23	PFFZZ	2815-01-136-5825	15434	202506	.CASING,TURBINE		EA	1
29	24	PAFZZ	2815-00-406-6737	15434	128936	.PLATE,NAME,TURBO		EA	1
29	25	PAFZZ	5305-00-804-6318	15434	S2286	.SCREW,DRIVE		EA	4
29	26	PFFZZ	5310-00-059-9264	96906	MS21045C6	NUT,LOCK PART OF KIT P/N 3801098		EA	4
29	27	PAFZZ	5330-00-194-8385	15434	190849	GASKET PART OF KIT P/N 3801330, 3801098		EA	1
29	28	PAFZZ	5307-00-922-2626	15434	3010915	STUD,EXHAUST MANIFO		EA	4

(1) ILLUS- TRATION		(2)	(3)	(4)	(5)	(6)	(7)	(8)	
(a) FIG. NO.	(b) ITEM NO.	SMR CODE	NATIONAL STOCK NUMBER	FSCM	PART NUMBER	DESCRIPTION	USABLE ON CODE	U/M	QTY INC IN UNIT
						0305(CONT)			
29	29	PAOZZ	5340-00-400-3449	15434	108722	CLAMP,LOOP		EA	2
29	30	PAOZZ	4720-01-085-1316	15434	AC1600300NF	HOSE,NONMETALLIC		EA	1
29	31	XDOZZ		15434	213936	TUBE ASSEMBLY		EA	1
29	32	PAOZZ	4730-01-006-5103	15434	183669	ADAPTER,STRAIGHT		EA	1
29	33	PAOZZ	4730-09-494-9350	15434	197733	COUPLING,PIPE		EA	1
29	34	KDOZZ		15434	208668	ADAPTER		EA	1
29	35	XDOZZ		15434	209959	HOSE,TEFLON OIL INLET		EA	1
29		PAFZZ	2815-01-128-9187	15434	3801098	KIT,TURBOCHARGER RE		EA	1
29	3					NUT,SELF-LOCKING		EA	1
29	5					SEAL		EA	1
29	6					RING,SEALING		EA	1
29	14					PACKING,PREFORMED		EA	1
29	15					GASKET		EA	1
29	17					SLEEVE,TURBOCHARG		EA	1
29	19					PACKING,FLAT FIBER		EA	1
29	21					RING,RETAINING		EA	2
29	26					NUT,LOCK		EA	4
29	27					GASKET		EA	1



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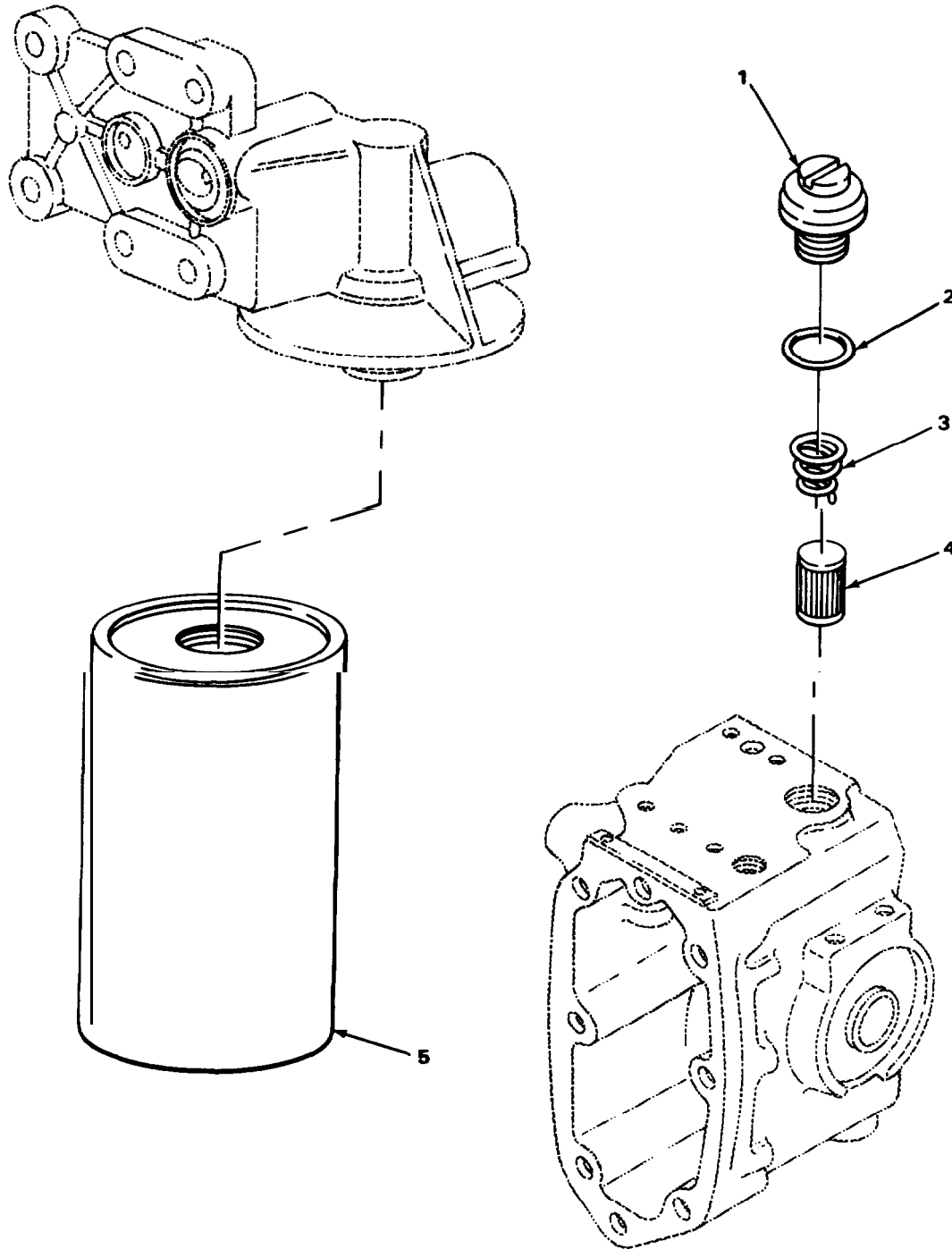
FIGURE 30. SHUT DOWN VALVE.



SECTION II

TM 5-2815-241-34&P

(1) ILLUS- TRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						0306-TANKS, LINES, FITTINGS, HEADERS		
30	1	PAFHH	4810-00-695-3284	15434	3035342	VALVE SOLENOID	EA	1
30	2	PAFZZ	5355-00-082-1189	15434	129838	.KNOB OVERRIDE	EA	1
30	3	PAHZZ	2990-00-829-5600	15434	129826	.HOUSING, SHUT OFF VA	EA	1
30	4	PAFZZ	4730-00-011-3175	15434	70295	.PLUG, PIPE	EA	1
30	5	PAHZZ	4820-01-085-2616	15434	3000266	.STEM, FLUID VALVE	EA	1
30	6	PAHZZ	5330-00-132-0274	15434	190876	PACKING, PREFORMED PART OF KIT P/N BM68356	EA	1
30	7	PAHZZ	2910-01-146-1048	15434	3030970	.DISK, VALVE	EA	1
30	8	PAHZZ	5310-00-082-1888	15434	129768	.WASHER, SPRING TENSI	EA	1
30	9	PAHZZ	5330-00-081-9299	15434	129888	.PACKING, PREFORMED PART OF KIT P/N BM68356	EA	1
30	10	PAHZZ	2910-00-084-7787	15434	129839	.COVER PLATE, ACCESS	EA	1
30	11	PAHZZ	2920-01-121-8859	15434	134072	.COIL ASSEMBLY	EA	1
30	12	PAFZZ	5310-00-922-2017	24617	0120217	.WASHER, LOCK	EA	4
30	13	PAHZZ	5305-00-138-9848	15434	187556	.SCREW, MACHINE	EA	4
30	14	PAHZZ	5305-00-509-8106	15434	S189C	SCREW, CAP, SOCKET HE	EA	2
30	15	PAFZZ	5310-00-484-1718	15434	181466	WASHER, LOCK	EA	2
30	16	PAFZZ	5310-00-262-2986	15434	67684	WASHER, FLAT	EA	2
30	17	PAFZZ	5330-00-951-3538	91265	TS33-016	GASKET PART OF KIT P/N BM68356	EA	1



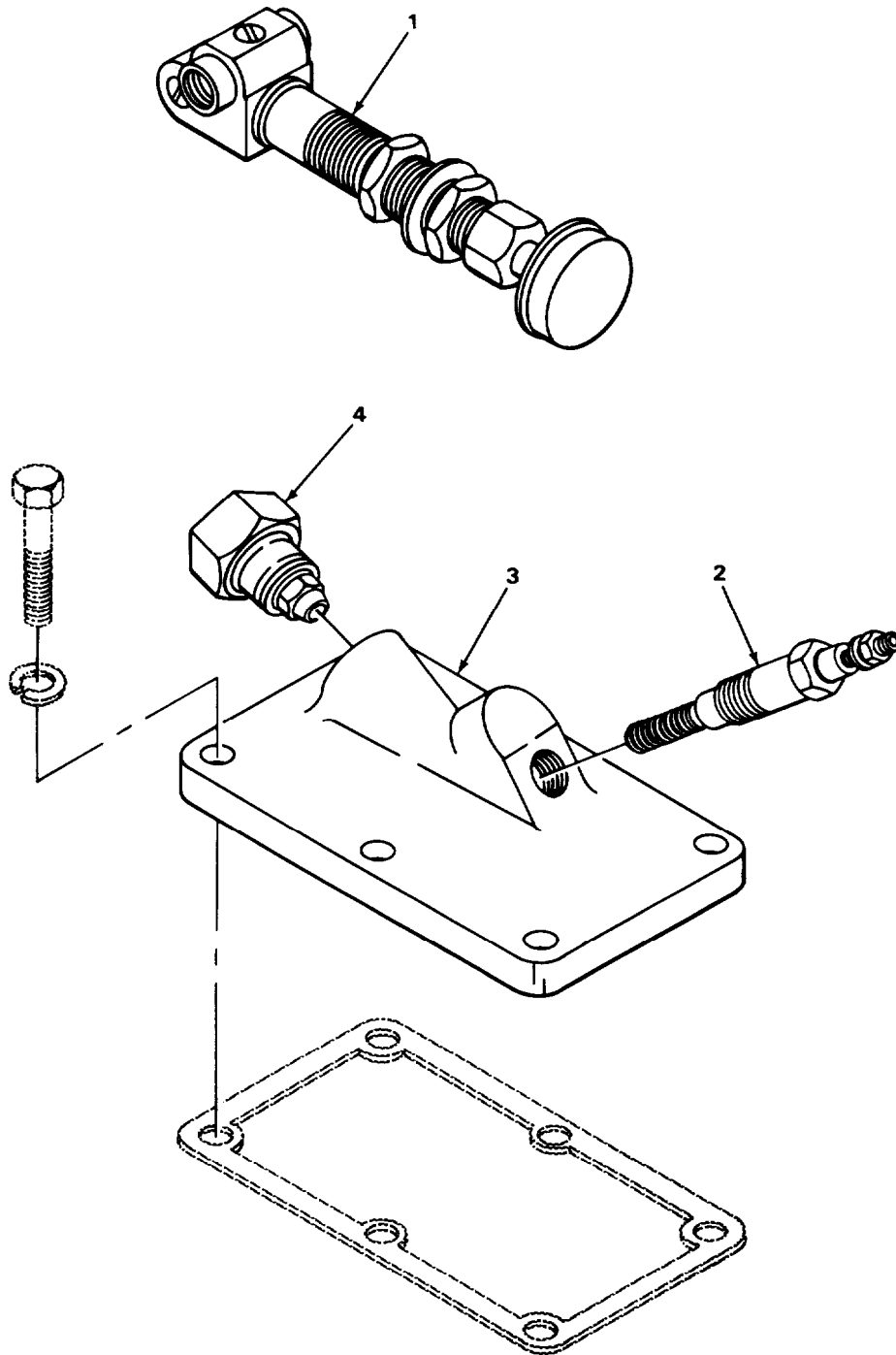
TA242326

FIGURE 31. FUEL PUMP FILTER.

SECTION II

TM 5-2815-241-34&P

(1) ILLUS- TRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						0309-FUEL FILTERS		
31	1	PAOZZ	5365-00-507-3271	15434	157088	PLUG, MACHINE THREAD	EA	1
31	2	PAOZZ	5330-00-961-9470	15434	154088	SEAL CAP PART OF KIT P/N BM68356	EA	1
31	3	PAOZZ	5360-00-597-4570	15434	70700	SPRING, HELICAL, COMP	EA	1
31	4	PAOZZ	2910-00-790-8736	15434	146483	FILTER ELEMENT, FLUI	EA	1
31	5	PAOZZ	2910-00-470-7075	79396	33341	FILTER, ELEMENT, FLUI	EA	1



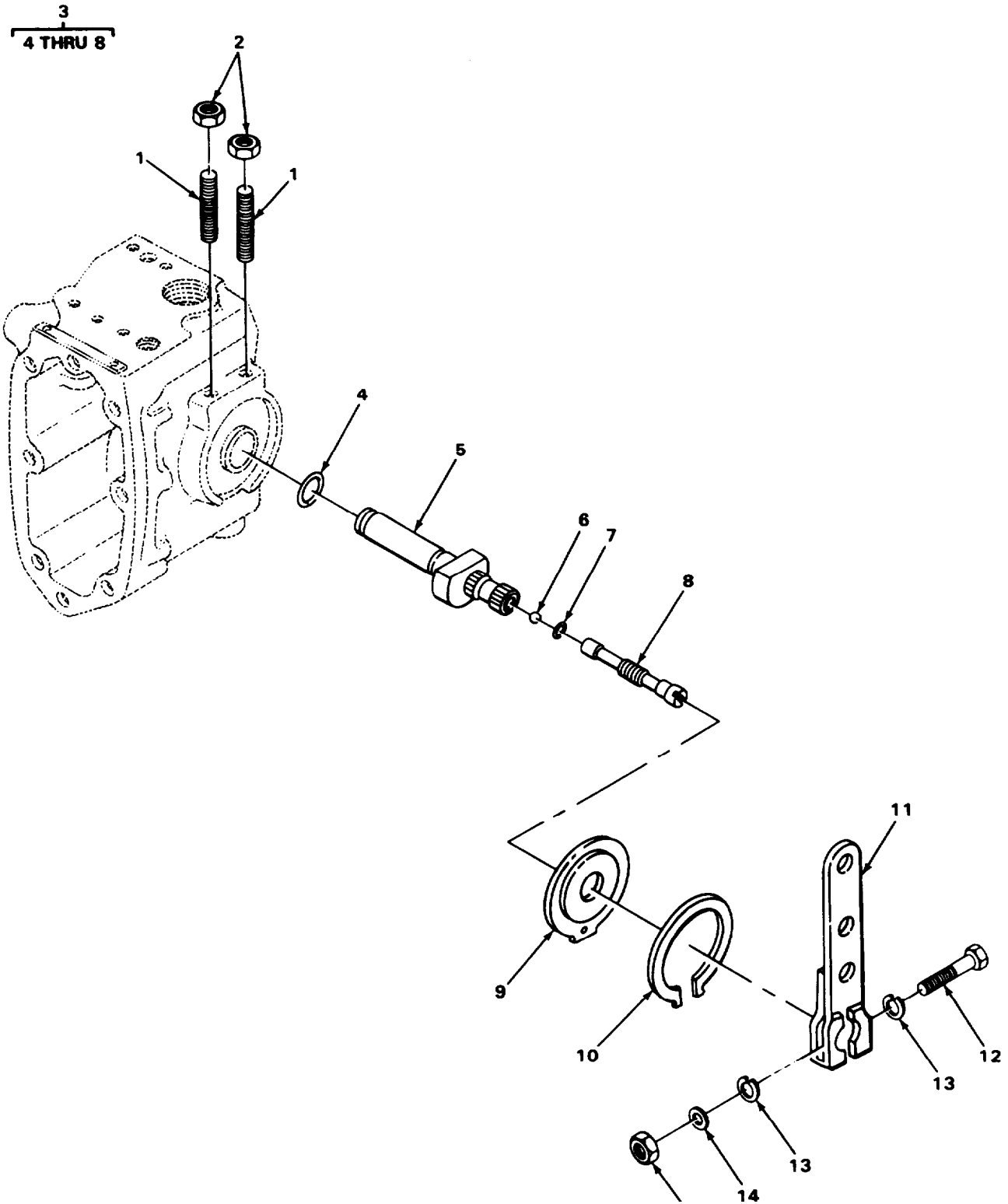
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FIGURE 32. GLOW PLUG AND PREHEATER.

SECTION II

TM 5-2815-241-34&P

(1) ILLUS- TRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						0311-ENGINE STARTING AIDS		
32	1	XDOZZ		15434	106452R91	PRIMER, HAND ASSEMBL	EA	1
32	2	XDOZZ		15434	AC9	PLUG, GLOW	EA	1
32	3	XDOZZ		15434	267627C2	HOUSING, PREHEATER	EA	1
32	4	XDOZZ		15434	236985R1	NOZZLE, PREHEATER	EA	1



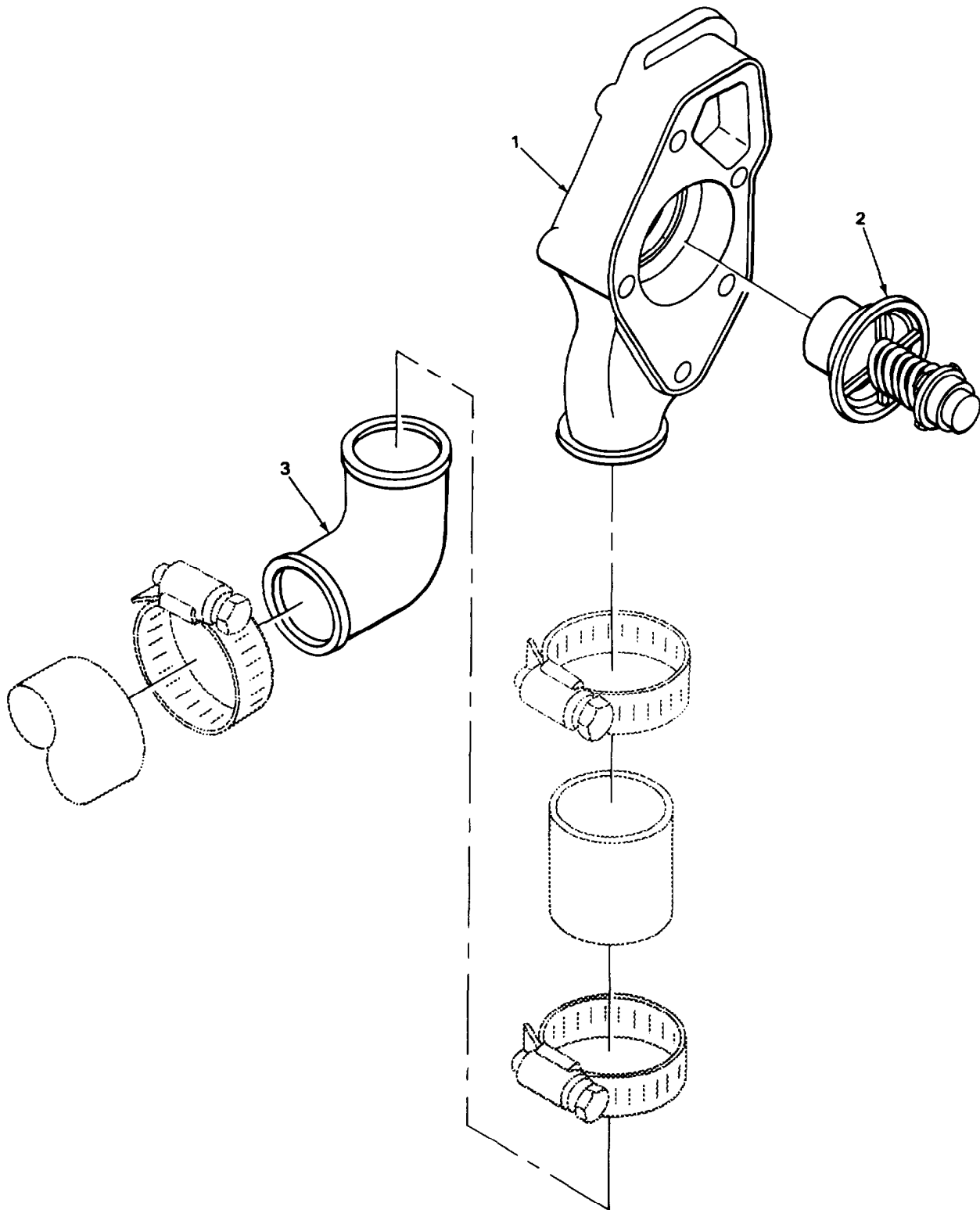
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FIGURE 33. THROTTLE SHAFT.

SECTION II

TM 5-2815-241-34&P

(1) ILLUS- TRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						0312-ACCELERATOR, THROTTLE OR CHOKE CONTROLS	EA	2
33	1	PAOZZ	5350-00-774-4246	15434	109915	SCREW, THROTTLE ADJU	EA	3
33	2	PAOZZ	5310-00-971-7989	96906	MS35691-5	NUT, PLAIN, HEXAGON LEVER AND THROTTLE ADJUSTING	EA	1
33	3	XDFFF		15434	AR51317	THROTTLE SHAFT ASSE	EA	1
33	4	PAFZZ	5330-00-081-9289	15434	100478	.PACKING, PREFORMED PART OF KIT P/N BM68356	EA	1
33	5	PAFZZ	3040-00-085-7439	15434	149030	.SHAFT, SHOULDERED	EA	1
33	6	PAFZZ	3110-01-079-8190	15434	213769	.PLUG, BALL	EA	1
33	7	PAFZZ	5330-01-072-8983	15434	213768	.PACKING, PREFORMED	EA	1
33	8	PAFZZ	5315-01-973-0414	15434	149040	.PIN, GROOVED, HEADED	EA	1
33	9	PAFZZ	2990-00-858-3526	15434	148977	COVER, THROTTLE SHAF	EA	1
33	10	PAFZZ	5365-00-786-0102	15434	S16206	RING, RETAINING	EA	2
33	11	XDOZZ		15434	AR03034	LEVER, THROTTLE	EA	1
33	12	PAOZZ	5305-00-493-3959	15434	S159B	SCREW, CAP, HEXAGON H		
33	13	PAOZZ	5310-00-159-6209	96906	MS122032	WASHER, LOCK		
33	14	PAOZZ	5310-00-141-1795	88044	AN960-416	WASHER		



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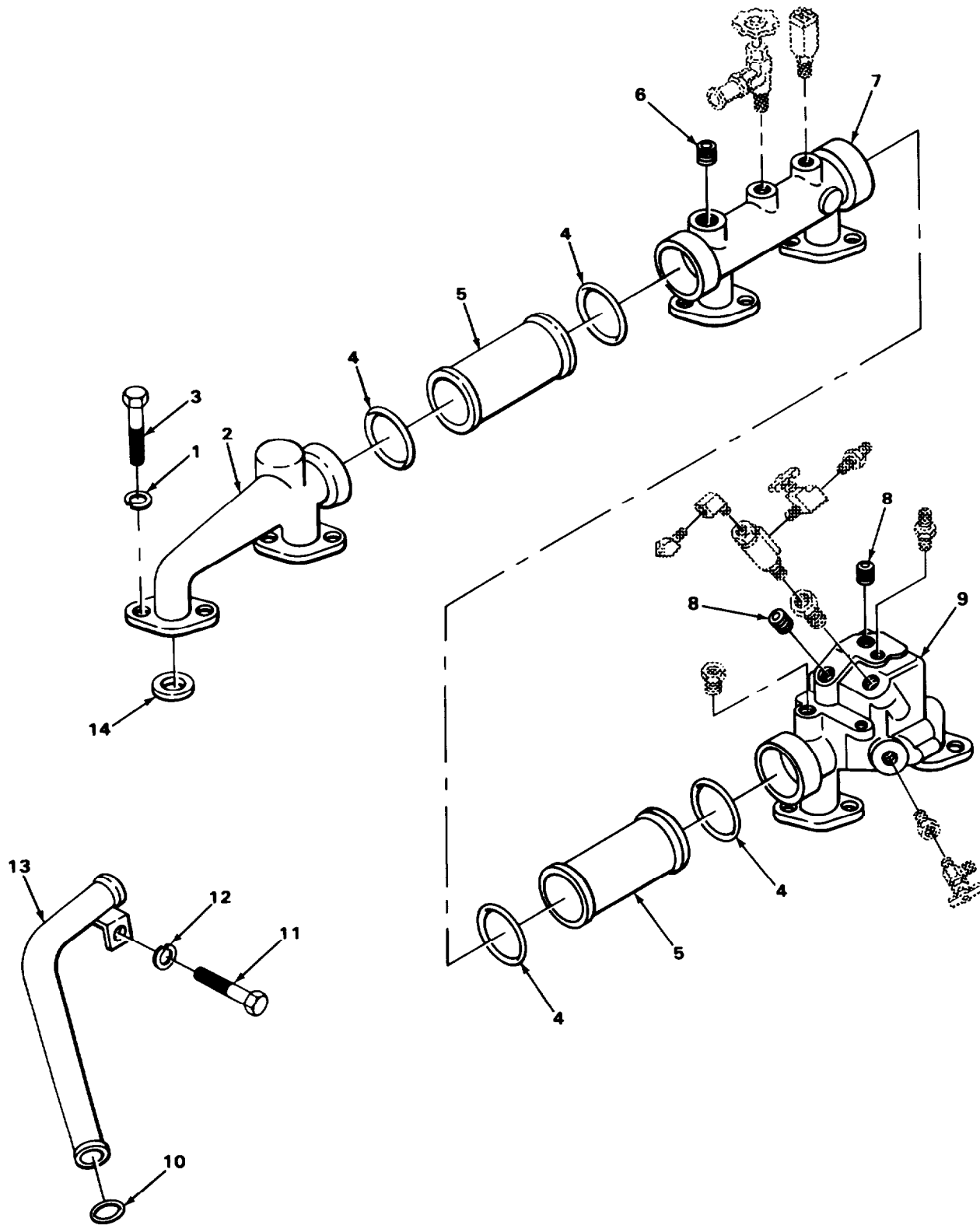
FIGURE 34. THERMOSTAT HOUSING.



SECTION II

TM 5-2815-241-34&P

(1) ILLUS- TRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						GROUP 05-COOLING SYSTEM 0503-WATER MANIFOLD, HEADERS, THERMOSTATS AND HOUSING GASKET		
34	1	XDOZZ		15434	102231	HOUSING, THERMOSTAT	EA	1
34	2	PAOZZ	2930-0-732-5206	15434	145977	VALVE, TEMPERATURE R	EA	1
34	3	XDOZZ		15434	215172	CONNECTION, WATER, OU	EA	1



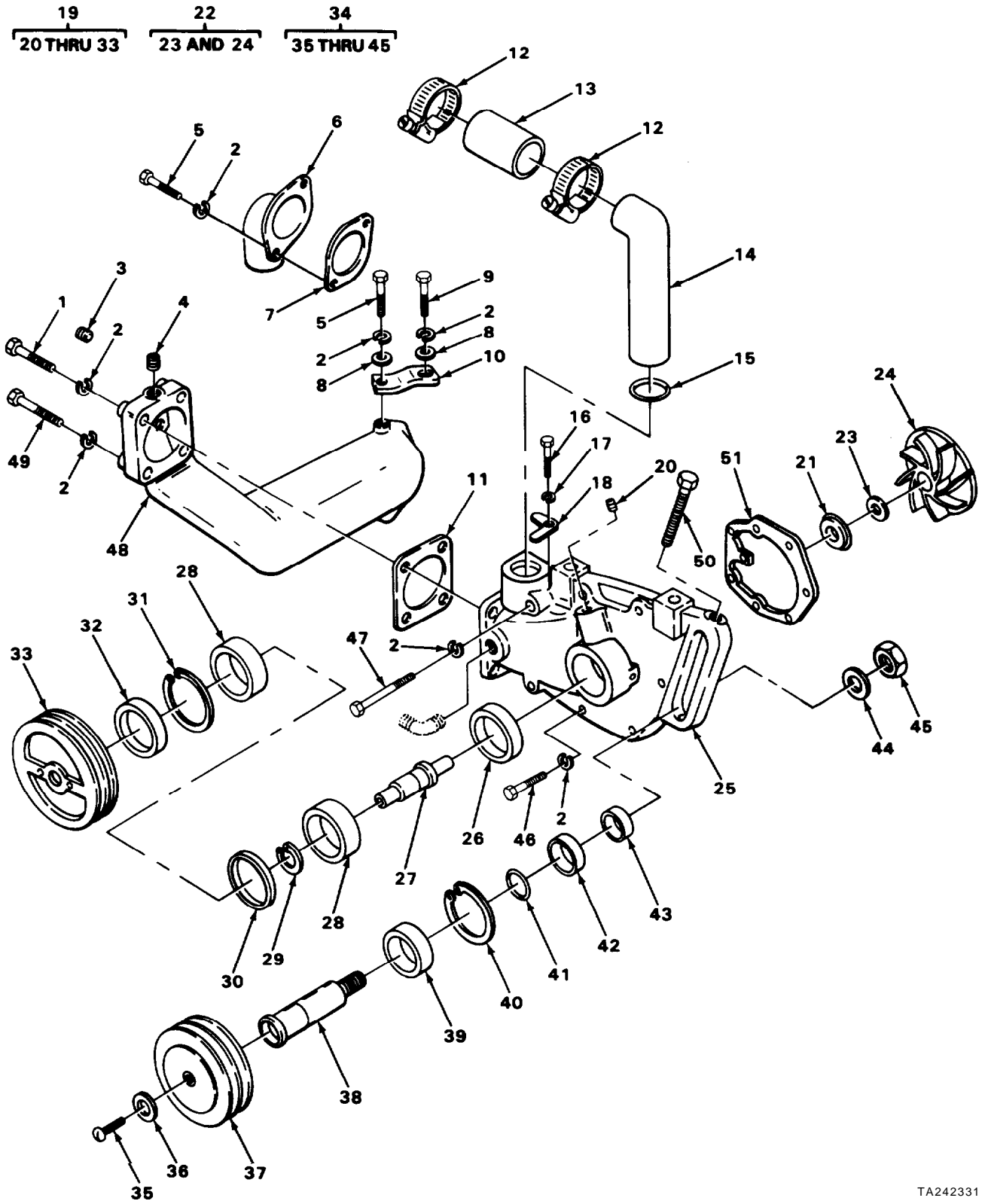
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FIGURE 35. WATER MANIFOLD.

SECTION II

TM 5-2815-241-34&P

(1) ILLUS- TRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						0503 (CONT)		
35	1	PAOZZ	5310-00-261-7340	96906	MS353368-8	WASHER, LOCK	EA	12
35	2	PAOZZ	2930-00-928-3596	15434	133342	MANIFOLD, WATER REAR	EA	1
35	3	PAOZZ	5305-00-068-0511	96906	MS90728-62	SCREW, CAP, HEXAGON H	EA	12
35	4	PAOZZ	5330-00-506-4874	15434	70624	PACKING, PREFORMED PART OF KIT P/N 3801330	EA	4
35	5	PAOZZ	4730-00-404-2906	15434	130394	COUPLING, TUBE	EA	2
35	6	PAOZZ	4730-00-289-4770	15434	S995	PLUG, PIPE	EA	1
35	7	PAOZZ	2930-00-928-3595	15434	130118	MANIFOLD, WATER CENTER	EA	1
35	8	PAOZZ	4730-00-801-8186	15434	S-915-A	PLUG, PIPE	EA	3
35	9	XDOZZ		15434	211016	MANIFOLD, WATER FRONT	EA	1
35	10	PAOZZ	5330-01-077-5228	15434	212161	PACKING, PREFORMED PART OF KIT P/N 3801330	EA	2
35	11	PAOZZ	5305-01-114-9279	15434	S110	SCREW, CAP, HEXAGON, H	EA	1
35	12	PAOZZ	5310-00-407-9566	96906	MS35338-45	WASHER, LOCK	EA	1
35	13	PAOZZ	4710-01-085-6130	15434	211027	TUBE, BENT, METALLIC	EA	1
35	14	PAOZZ	5330-00-143-8369	15434	148203	GASKET PART OF KIT P/N 3801330	EA	6



TA242331

FIGURE 36. WATER PUMP.

## SECTION II

TM 5-2815-241-34&amp;P

(1) ILLUS- TRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						0504-WATER PUMP		
36	1	PAOZZ	5305-00-846-5703	96906	MS90728-70	SCREW, CAP, HEXAGON H	EA	2
36	2	PAOZZ	5310-00-261-7340	96906	MS35338-8	WASHER, LOCK	EA	15
36	3	PAOZZ	4730-00-801-8186	15434	S-915-A	PLUG, PIPE	EA	1
36	4	PAOZZ	4730-00-044-4715	15434	S962	PLUG, PIPE	EA	1
36	5	PAOZZ	5305-00-068-0511	96906	MS90728-62	SCREW, CAP, HEXAGON H	EA	3
36	6	XDOZZ		15434	210806	CONNECTION	EA	1
36	7	XDOZZ		15434	210805	GASKET	EA	1
36	8	PAOZZ	5310-00-486-2505	15434	108330	WASHER, FLAT	EA	3
36	9	PAOZZ	5305-00-725-2317	96906	MS90728-64	CAPSCREW	EA	1
36	10	XDOZZ		15434	214476	BRACKET, CONNECTION	EA	1
36	11	PAOZZ	5330-01-080-5020	15434	208132	GASKET	EA	1
36	12	PAOZZ	4730-00-909-8627	96906	MS35842-13	CLAMP, HOSE	EA	12
36	13	XDOZZ		15434	63495-D	HOSE	EA	1
36	14	XDOZZ		15434	209600	PIPE, WATER BY-PASS	EA	1
36	15	PAOZZ	5330-00-159-1464	15434	43463A	PACKING, PREFORMED PART OF KIT P/N 3801330 BM68356	EA	2
36	16	PAOZZ	5305-01-114-9279	15434	S110	SCREW, CAP, HEX, HD	EA	1
36	17	PAOZZ	5310-00-407-9566	96906	MS35338-45	WASHER, LOCK	EA	1
36	18	PAOZZ	5340-01-135-7250	15434	214617	CLAMP, RIM, CLENCHING	EA	1
36	19	PAOOO	2930-01-046-3493	15434	AR-045090	PUMP, WATER	EA	1
36	20	PAOZZ	4730-00-018-9566	15434	S911B	.PLUG, PIPE	EA	1
36	21	XDOZZ		15434	214173	.SEAL, WATER PUMP	EA	1
36	22	XDOOO		15434	AR08853	.IMPELLER	EA	1
36	23	PAOZZ	5330-00-005-0407	15434	3033677	..PACKING WITH RETAIN	EA	1
36	24	XAOZZ		15434	208134	..IMPELLER, WATER PUMP	EA	1
36	25	XAOZZ		15434	210238	.BODY, WATER PUMP	EA	1
36	26	PAOZZ	5330-00-011-7939	15434	203100	.GASKET, PUMP PART OF KIT P/N 3018762	EA	1
36	27	XDOZZ		15434	208138	.SHAFT, WATER PUMP	EA	1
36	28	PAOZZ	3110-00-144-8519	15434	S16073	.BEARING, BALLL, ANNULA	EA	2

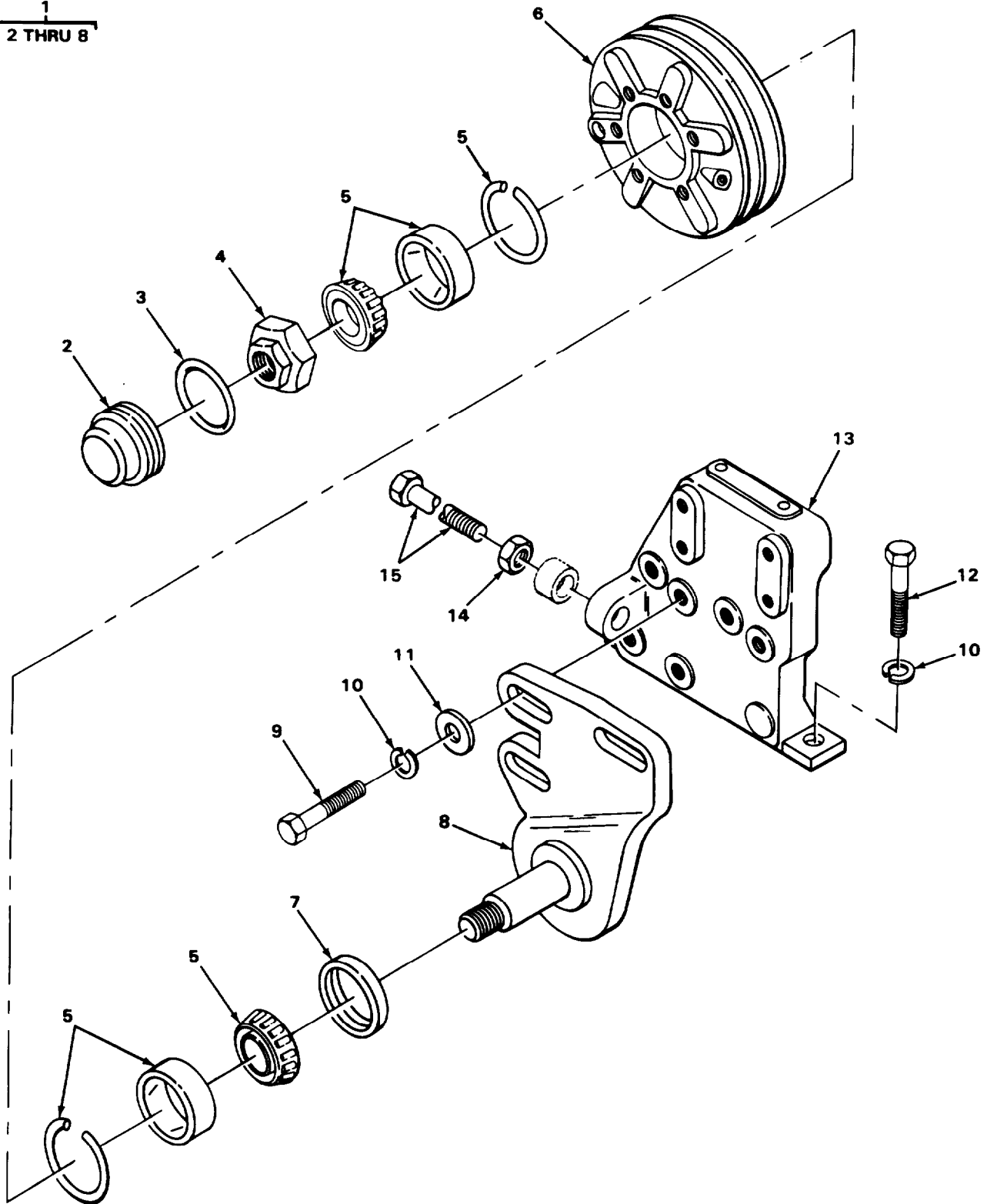
(1) ILLUS- TRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						0504 (CONT)		
36	29	PAOZZ	5365-00-420-9696	15434	112302	.RING, RETAINING	EA	1
36	30	PAOZZ	5365-01-132-1984	15434	196844	.SPACER	EA	1
36	31	PAOZZ	2815-00-815-0355	15434	S16255	.RING, BEARING RETAIN	EA	1
36	32	PAOZZ	5330-01-080-2992	15434	3038998	.SEAL, PLAIN, ENCASED	EA	1
36	33	XDOZZ		15434	AR08854	.PULLEY, WATER PUMP	EA	1
36	34	XDOOO		15434	AR08851	IDLER, WATER PUMP	EA	1
36	35	XDOZZ		15434	210860	.CAPSCREW, BUTTON HEA	EA	1
36	36	PAOZZ	5310-00-276-2816	15434	61623	.WASHER, FLAT	EA	1
36	37	XDOZZ		15434	208118	.PULLEY, IDLER	EA	1
36	38	PAOZZ	3040-01-079-3468	15434	208119	.SHAFT, SHOULDERED	EA	1
36	39	PAOZZ	3110-01-144-8519	15434	S16073	.BEARING, BALL, ANNULA	EA	1
36	40	PAOZZ	2815-00-815-0355	15434	S16255	.RING, BEARING RETAIN	EA	1
36	41	PAOZZ	5330-01-086-3991	15434	145506	.PACKING, PREFORMED	EA	1
36	42	PAOZZ	5330-01-080-2992	15434	3038998	.SEAL, PLAIN ENCASED	EA	1
36	43	PAOZZ	5365-01-080-0409	15434	208120	.SPACER, SLEEVE	EA	1
36	44	PAOZZ	5310-01-145-0762	15434	213082	.WAHSER, FLAT	EA	1
36	45	PAOZZ	5310-00-763-8920	96906	MS51967-20	.NUT, PLAIN, HEXAGON	EA	1
36	46	PAOZZ	5305-00-269-2811	96906	MS90726-67	SCREW, CAP, HEXAGON H	EA	5
36	47	XDOZZ		15434	137797	CAPSCREW	EA	2
36	48	XDOZZ		15434	210804	CONNECTION, WATER TRANSFER	EA	1
36	49	PAOZZ	5305-00-404-1390	15434	S149A	SCREW, CAP, HEXAGON H	EA	2
36	50	PAOZZ	5305-00-058-6604	15434	182706	SCREW, CAP, HEXAGON H	EA	1
36	51	PAOZZ	5330-00-106-6370	15434	130226	GASKET PART OF KIT P/N 3018762	EA	1
36		PAHZZ	5330-01-092-4143	15434	3018762	SET, GASKET	EA	1
2	9					GASKET	EA	2
2	10					PACKING, PREFORMED	EA	6
2	32					GASKET	EA	1
4	5					GASKET	EA	1
4	7					SEAL	EA	1
5	15					GASKET	EA	1
5	16					WASHER, LOCK	EA	2
8	3					SEAL	EA	1
8	5					GASKET	EA	1
10	36					GASKET	EA	1
10	36					GASKET	EA	1

SECTION II

TM 5-2815-241-34&P

(1) ILLUS- TRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) UM	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						0504 (CONT)		
10	36					GASKET	EA	1
13	6					GASKET	EA	1
13	27					GASKET	EA	1
16	7					GASKET	EA	1
16	10					PACKING, PREFORMED	EA	2
16	22					SPACER, RING	EA	1
16	26					GASKET	EA	1
16	28					PACKING, PREFORMED	EA	1
16	43					GASKET	EA	1
17	25					GASKET	EA	1
17	32					GASKET	EA	1
20	20					KEY, WOODRUFF	EA	1
24	21					GASKET	EA	1
36	26					GASKET, PUMP	EA	1
36	51					GASKET	EA	1
36		PAFZZ	5330-01-149-9715	15434	3801330	GASKET AND SEAL SET	EA	1
3	7					GASKET	EA	1
9	8					PACKING, PREFORMED	EA	8
9	15					PACKING, PREFORMED	EA	6
12	38					GASKET	EA	1
18	7					GASKET	EA	1
19	1					GASKET	EA	6
22	11					PACKING, PREFORMED	EA	1
22	12					GASKET	EA	2
29	27					GASKET	EA	1
35	4					PACKING, PREFORMED	EA	4
35	10					PACKING, PREFORMED	EA	2
35	14					GASKET	EA	6
36	15					PACKING, PREFORMED	EA	2
36		PAHZZ	5330-00-888-4988	15434	BM68356	GASKET SET	EA	1
24	16					GASKET	EA	1
25	9					GASKET	EA	1
25	13					GASKET	EA	1
26	6					PACKING, PREFORMED	EA	1
26	8					PACKING	EA	1
26	9					SPACER RING	EA	1
26	15					GASKET	EA	1
27	12					GASKET	EA	1
28	10					PACKING, PREFORMED	EA	1
28	17					PACKING WITH RETAIN	EA	1
30	6					PACKING, PREFORMED	EA	1
30	9					PACKING, PREFORMED	EA	1
30	17					GASKET	EA	1
31	2					SEAL CAP	EA	1
33	4					PACKING, PREFORMED	EA	1
36	15					PACKING, PREFORMED	EA	2

1  
2 THRU 8



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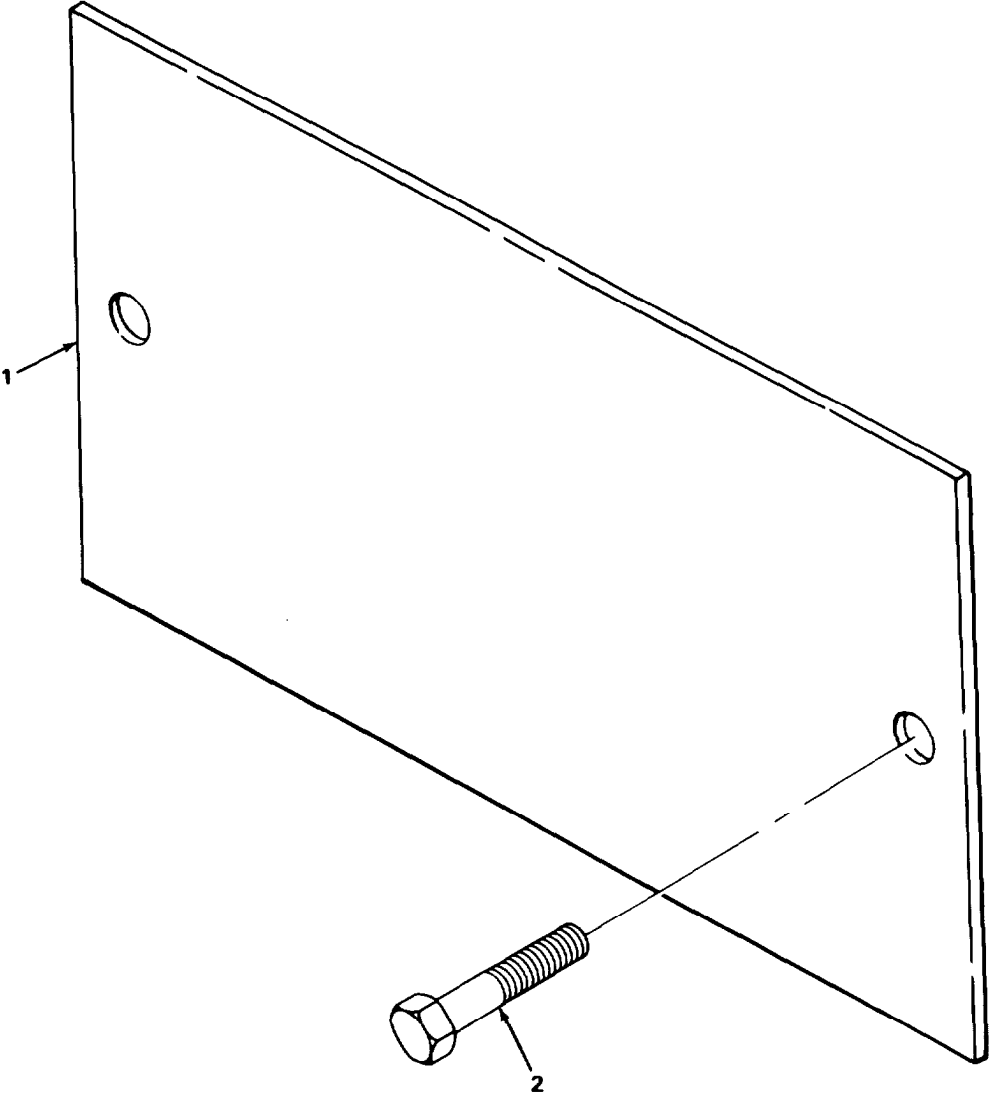
FIGURE 37. FAN HUB.



SECTION II

TM 5-2815-241-34&P

(1) ILLUS- TRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						0505-FAN ASSEMBLY		
37	1	XDOOO		15434	AR10142	HUB, FAN	EA	1
37	2	XDOZZ		15434	210996	.RETAINER	EA	1
37	3	PAOZZ		15434	145551	.PACKING, PREFORMED	EA	1
37	4	PAOZZ	5310-01-072-8821	15434	142176	.NUT, HUGLOCK	EA	1
38	5	PAOZZ	3110-01-073-2576	60038	ASSEMBLY90028	.BEARING, ROLLER, TAPE	EA	1
34	6	XDOZZ		15434	211869	.PULLEY	EA	1
37	7	PAOZZ	5330-01-072-8822	15434	200307	.SEAL, OIL	EA	1
37	8	XDOZZ		15434	AR10141	.BRACKET AND SHAFT	EA	1
37	9	PAOZZ	5330-00-719-5235	96906	MS90727-114	SCREW, CAP, HEXAGON H	EA	3
37	10	PAOZZ	5310-00-584-5272	96906	MS35338-48	WASHER, LOCK	EA	5
37	11	PAOZZ	5310-00-809-5997	96906	MS27183-17	WASHER, FLAT	EA	2
37	12	PAOZZ	5305-00-725-4183	96906	MS90726-113	SCREW, CAP, HEXAGON H	EA	2
37	13	PAOZZ	2930-01-098-0175	15434	208829	BRACKET, FAN SUPPORT	EA	1
37	14	PAOZZ	5310-00-470-6154	15434	S285	NUT, PLAIN, HEXAGON	EA	1
37	15	PAOZZ	5305-01-091-2498	15434	166777	SCREW	EA	1



TA242333

FIGURE 38. NAME PLATES.

SECTION II

TM 5-2815-241-34&P

(1) ILLUS- TRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
						GROUP 22-BODY CHASSIS AND ACCESSORY ITEMS 2210-DATA PLATES AND INSTRUCTION HOLDERS		
38	1	PAOZZ	9905-00-733-7622	15434	105375	PLATES DESIGNAT	EA	2
38	2	PAOZZ	5305-00-804-6318	15434	S2286	SCREW	EA	4



**SECTION II**

**TM 5-2815-241-34&P**

(1) ILLUS- TRATION		(2) SMR CODE	(3) NATIONAL STOCK NUMBER	(4) FSCM	(5) PART NUMBER	(6) DESCRIPTION	(7) U/M	(8) QTY INC IN UNIT
(a) FIG. NO.	(b) ITEM NO.					USABLE ON CODE		
BULK	1	XDFZZ		89346	364359C1	GROUP 95-GENERAL USE STANDARDIZED PARTS 9501-BULK MATERIEL  HOSE, NONMETALLIC	FT	V



NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.	NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.
2815-00-004-8291	6	5	2940-00-073-3316	16	29
5330-00-005-0407	36	23	5310-00-080-6004	8	11
5305-00-005-0666	19	5	5310-00-080-6004	10	29
5330-00-005-0856	8	13	5310-00-080-6004	11	6
5330-00-005-0857	8	3	5310-00-080-6004	16	34
5330-00-005-0858	4	7	5310-00-080-6004	18	6
2815-00-005-7431	12	7	5310-00-080-6004	28	39
5330-00-006-2494	25	13	5360-00-081-8487	23	25
5305-00-006-8411	3	3	5330-00-081-9289	33	4
5360-00-009-9270	9	14	5310-00-081-9292	20	17
5330-00-010-8497	24	9	5330-00-081-9299	30	9
4730-00-011-3175	30	4	4730-00-081-9618	16	32
5330-00-011-7939	36	26	5360-00-082-0124	27	3
5315-00-012-0123	1	14	5315-00-082-0448	23	27
5315-00-014-1195	2	18	5355-00-082-1189	30	2
5315-00-014-1244	25	4	5365-00-082-1193	28	41
5315-00-014-1284	2	17	5310-00-082-1888	30	8
5315-00-014-1284	5	14	2910-00-084-7787	30	10
5310-00-014-5850	24	27	2815-00-085-7434	9	9
4730-00-018-9566	2	23	3040-00-085-7439	33	5
4730-00-018-9566	3	10	3120-00-086-8364	20	16
4730-00-018-9566	16	17	3120-00-090-5504	4	16
4730-00-018-9566	20	13	5305-00-091-4009	5	9
4730-00-018-9566	28	15	5340-00-103-9988	29	10
4730-00-018-9566	36	20	5330-00-106-6370	36	51
5306-00-019-4227	24	3	2815-00-107-1115	7	9
5330-00-026-2931	20	6	5310-00-109-7638	5	8
5330-00-026-2933	29	14	5330-00-129-9349	3	8
5315-00-041-0915	10	13	4820-00-130-4820	23	31
5315-00-041-0916	10	6	2815-00-132-0240	9	9
5306-00-041-0917	6	14	5360-00-132-0245	22	7
5315-00-043-1787	17	2	5330-00-132-0248	16	28
4730-00-044-4715	2	15	2815-00-132-0273	6	13
4730-00-044-4715	3	6	5330-00-132-0274	30	6
4730-00-044-4715	36	4	5330-00-132-0276	22	12
4730-00-057-5555	2	27	2910-00-132-0769	27	5
4730-00-057-5555	16	5	5340-00-132-3203	19	3
4730-00-057-5555	16	12	5340-00-134-3529	22	3
5330-00-058-1767	2	31	5310-00-134-4168	5	3
5305-00-058-6604	36	50	5310-00-134-4169	18	11
5310-00-059-9264	29	26	5310-00-134-4171	6	11
5305-00-062-4378	9	3	5306-00-136-9751	17	30
5305-00-063-5043	2 8	16	5305-00-138-9848	30	13
2815-00-064-4398	2	5	5310-00-141-1795	24	25
5330-00-064-4399	2	34	5310-00-141-1795	26	4
2910-00-065-5544	27	18	5310-00-141-1795	26	11
5305-00-068-0511	16	2	5310-00-141-1795	27	14
5305-00-068-0511	16	44	5310-00-141-1795	33	14
5305-00-068-0511	35	3	5330-00-143-8369	35	14
5305-00-068-0511	36	5	5330-00-143-8376	13	27
2815-00-070-2251	18	10	5330-00-143-8485	9	8
5305-00-071-1769	13	26	3110-00-144-8499	24	13
5305-00-071-1788	20	22	3110-00-144-8519	36	28
5305-00-071-2056	24	17	3110-00-144-8519	36	39
5305-00-071-2070	5	5	5330-00-159-1464	36	15
5305-00-071-2241	24	23	5310-00-159-6209	2	7
5305-00-071-2241	26	2	5310-00-159-6209	2	16
5305-00-071-2241	27	20	5310-00-159-6209	24	24
5305-00-071-2241	28	3	5310-00-159-6209	26	3
			5310-00-159-6209	28	2

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NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.	NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.
5310-00-159-6209	29	8	5365-00-282-5030	6	6
5310-00-159-6209	33	13	4730-00-287-1649	28	30
3020-00-160-9092	20	8	4730-00-289-4770	3	5
5305-00-161-0902	24	22	4730-00-289-4770	17	9
5310-00-164-1904	29	3	4730-00-289-4770	35	6
5305-00-165-8157	16	45	2815-00-300-0882	9	5
5330-00-175-6585	10	36	2815-00-311-2521	10	7
5330-00-194-8385	29	27	3120-00-318-8537	4	15
2815-00-195-5894	12	13	2815-00-338-6839	13	4
2815-00-195-5897	12	28	5305-00-339-1415	10	19
4730-00-196-0837	28	35	3120-00-339-5642	7	4
5365-00-197-9327	16	22	5330-00-349-1219	10	36
4730-00-203-0395	13	17	3120-00-349-6444	4	14
5310-00-209-0965	8	2	5330-00-351-6428	13	6
5310-00-209-0965	13	19	5310-00-356-1447	2	20
5310-00-209-0965	17	10	5330-00-361-2955	4	5
5310-00-209-0965	20	21	5305-00-362-1536	10	26
5310-00-209-0965	24	18	2815-00-362-1780	10	14
5310-00-222-7240	6	12	5340-00-365-5759	12	35
5306-00-225-8499	17	31	5315-00-369-2588	23	9
5305-00-225-9081	17	29	4730-00-369-7824	27	19
5306-00-225-9086	10	35	2910-00-369-8240	24	8
2815-00-230-0070	12	37	2910-00-369-8251	27	1
5305-00-230-1939	2	6	3120-00-374-4342		7
5305-00-230-1939	29	9	2815-00-375-9892	10	22
2910-00-237-0056	22	5	2815-00-388-3126	10	21
2990-00-237-0058	24	2	5340-00-400-3449	29	29
2990-00-237-0058	27	2	2910-00-400-5178	23	11
5330-00-237-6266	29	5	2930-00-401-9531	20	5
5315-00-238-0882	2	28	5305-00-404-1388	16	46
2910-00-238-5435	22	4	5305-00-404-1390	36	49
2815-00-242-2992	8	12	4730-00-404-2906	35	5
5330-00-246-0309	2	32	5365-00-404-2934	3	4
5330-00-252-8888	26	15	2815-00-404-2940	12	12
5365-00-256-2846	23	30	2815-00-404-2947	2	4
5310-00-261-7340	2	3	2910-00-404-9999	23	6
5310-00-261-7340	4	8	2815-00-405-1798	14	1
5310-00-261-7340	8	10	5330-00-406-4542	9	15
5310-00-261-7340	10	28	2815-00-406-6737	29	24
5310-00-261-7340	11	5	5330-00-406-7789	29	19
5310-00-261-7340	13	15	2815-00-406-8936	17	4
5310-00-261-7340	16	4	5310-00-407-9566	2	12
5310-00-261-7340	16	35	5310-00-407-9566	10	34
5310-00-261-7340	17	12	5310-00-407-9566	13	29
5310-00-261-7340	18	5	5310-00-407-9566	17	28
5310-00-261-7340	24	4	5310-00-407-9566	35	12
5310-00-261-7340	28	37	5310-00-407-9566	36	17
5310-00-261-7340	35	1	3130-00-408-9041	2	19
5310-00-261-7340	36	2	5310-00-410-6756	24	26
5310-00-262-2986	30	16	5305-00-411-9340	29	11
5305-00-269-2811	36	46	5340-00-417-5800	13	8
5305-00-269-3209	13	10	5365-00-420-9696	36	29
2950-00-275-3355	29	2	5305-00-424-3571	17	21
2950-00-275-4658	29	7	5310-00-426-3990	9	4
2950-00-275-8276	29	6	2950-00-432-1559	29	18
2950-00-275-9325	29	22	2930-00-437-0567	16	9
2950-00-275-9344	29	4	5310-00-442-6899	20	1
5310-00-276-2816	36	36	5310-00-442-6899	20	19
5340-00-276-5847	10	24	3010-00-447-9799	24	1
5315-00-281-7610	2	30	2910-00-451-8063	23	24



NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.	NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.
5360-00-461-5738	27	8	5330-00-582-7484	23	2
5365-00-462-4504	27	9	5310-00-584-5272	5	4
5305-00-463-0428	13	22	5310-00-584-5272	13	25
5340-00-464-7064	27	17	5310-00-584-5272	37	11
5310-00-469-3998	5	13	3120-00-589-3537	12	6
5310-00-470-6154	37	15	3120-00-589-3537	12	11
2910-00-470-7075	31	5	3120-00-589-3537	12	17
5315-00-475-2574	17	14	3120-00-589-3537	12	27
4730-00-477-4160	18	2	3120-00-589-3537	12	32
2990-00-477-6159	29	20	2815-00-590-7378	11	1
5305-00-477-6769	9	6	2815-00-590-7385	10	2
5330-00-478-2962	5	15	3120-00-593-1507	4	19
2815-00-480-4347	6	7	5360-00-597-4570	31	3
5310-00-484-1718	25	12	2930-00-603-1625	16	11
5310-00-484-1718	26	12	2910-00-603-2835	23	8
5310-00-484-1718	27	15	2815-00-603-7264	5	10
5310-00-484-1718	30	15	2815-00-609-7115	10	4
2815-00-484-8359	2	19	5315-00-616-5522	20	15
2815-00-484-8360	2	19	5315-00-616-5527	7	8
5306-00-485-0790	25	11	5315-00-616-5527	20	20
5306-00-485-0790	26	13	3120-00-627-6697	17	23
5340-00-485-0945	10	20	3120-00-627-6697	17	27
5310-00-486-2505	24	5	5330-00-632-6182	29	15
5310-00-486-2505	36	8	2815-00-632-6239	9	13
5365-00-488-0799	2	35	5310-00-637-9541	13	9
5305-00-493-3959	33	12	5330-00-659-3178	19	1
4730-00-494-9350	29	33	3120-00-659-7808	10	11
2815-00-505-5116	10	5	3120-00-661-6646	10	37
2815-00-505-5119	10	9	5360-00-664-5343	16	21
2815-00-505-5119	10	16	5310-00-680-6874	29	13
5330-00-506-4866	24	16	3120-00-682-7706	29	16
5330-00-506-4874	35	4	5310-00-684-3463	10	25
5305-00-506-5722	27	6	3120-00-695-1232	4	21
5365-00-507-3224	23	15	4810-00-695-3284	30	1
5365-00-507-3225	23	15	3040-00-695-3285	24	6
5365-00-507-3254	8	8	5315-00-695-3292	24	10
5310-00-507-3259	27	4	3020-00-701-1112	23	29
5365-00-507-3260	27	9	2815-00-705-2851	10	12
5365-00-507-3261	27	9	2815-00-705-2856	17	8
5365-00-507-3262	27	9	2815-00-705-9257	10	3
5365-00-507-3271	31	1	5365-00-708-3434	16	24
5305-00-509-8106	30	14	5305-00-709-8282	17	13
5310-00-521-8595	10	30	5305-00-709-8523	13	16
5315-00-532-9388	2	22	5305-00-709-8537	8	6
5330-00-537-2382	2	9	5305-00-709-8542	8	14
5365-00-543-3744	23	15	5365-00-716-5496	8	7
5305-00-546-6698	10	38	5365-00-716-6580	25	5
3020-00-562-1173	24	14	5305-00-719-5235	37	10
5330-00-562-1176	27	12	5306-00-719-5467	13	18
5310-00-562-6557	13	20	3120-00-719-5719	25	2
5310-00-562-6557	24	19	5340-00-721-5329	3	9
5310-00-562-6558	13	23	5365-00-721-7884	24	15
5310-00-562-6560	29	12	5305-00-725-2317	18	4
3120-00-566-0480	17	18	5305-00-725-2317	36	9
5330-00-567-3463	25	9	5305-00-725-4183	37	13
2910-00-567-4338	24	11	5310-00-727-8353	23	26
2910-00-567-4354	25	8	5310-00-732-0560	12	3
3020-00-567-4356	24	7	5310-00-732-0560	12	8
3120-00-573-0391	7	5	5310-00-732-0560	12	14
5330-00-580-5327	28	17	5310-00-732-0560	12	25
			5310-00-732-0560	12	29

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NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.	NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.
2930-00-732-5206	34	2	5305-00-846-5703	36	1
9905-00-733-7622	38	1	2815-00-851-7637	12	24
2815-00-739-6084	3	11	2910-00-858-3522	27	13
2815-00-739-6098	9	10	2990-00-858-3526	33	9
2815-00-753-0660	6	10	5315-00-866-5015	9	16
5310-00-757-6367	28	18	2910-00-869-3428	25	1
5310-00-763-8920	36	45	5330-00-886-2509	10	31
2815-00-767-4012	19	9	5310-00-887-8325	19	4
2910-00-767-4018	28	5	2910-00-887-8354	23	21
5310-00-768-0318	13	24	5330-00-888-4988	36	KIT
2990-00-772-1778	23	20	3020-00-892-4704	25	6
2815-00-772-9434	2	26	5340-00-898-1497	27	10
2910-00-773-9369	24	12	3120-00-904-9595	23	22
5305-00-774-4246	33	1	3120-00-906-6657	7	6
5315-00-777-3544	10	8	5315-00-907-0711	23	17
5315-00-777-3544	10	15	4730-00-909-8627	36	12
5330-00-777-3545	10	36	5330-00-910-8736	18	12
5305-00-782-9489	11	3	2815-00-920-2073	19	6
5305-00-782-9489	28	36	2815-00-920-8356	19	2
5365-00-786-0102	33	10	5310-00-922-2017	30	12
2910-00-790-8736	31	4	5307-00-922-2626	29	28
3120-00-791-1440	10	18	5330-00-924-7757	22	11
2815-00-791-1453	16	20	2910-00-928-3505	9	7
3120-00-792-9834	20	11	2930-00-928-3595	35	7
5305-00-795-9353	5	6	2930-00-928-3596	35	2
2930-00-799-0843	2	14	2815-00-933-3009	9	1
4730-00-801-8186	2	24	2910-00-933-3012	25	7
4730-00-801-8186	13	14	5305-00-942-2196	2	2
4730-00-801-8186	35	8	5305-00-942-2196	8	9
4730-00-801-8186	36	3	5305-00-942-2196	11	4
4730-00-803-8353	25	10	5305-00-942-2196	16	36
4730-00-803-8353	26	16	5305-00-942-2196	18	8
5306-00-804-2468	2	21	5305-00-942-2196	28	40
5305-00-804-6318	29	25	2910-00-951-3536	26	7
5305-00-804-6318	38	2	5330-00-951-3538	28	21
5305-00-804-6454	13	5	5330-00-951-3538	30	17
5365-00-807-2636	27	11	5330-00-961-9470	31	2
5330-00-809-2667	26	6	5310-00-962-5610	3	2
5330-00-809-3276	26	8	2815-00-962-5618	6	2
5310-00-809-5997	37	12	2815-00-962-5623	9	10
3120-00-810-6032	23	10	5365-00-965-0870	26	9
2815-00-815-0355	36	31	5310-00-971-7989	33	2
2815-00-815-0355	36	40	5315-00-973-0414	33	8
2815-00-815-1114	22	10	5365-00-988-3668	23	3
5365-00-815-1137	22	9	2815-00-994-4427	6	3
5330-00-816-8148	28	10	2815-00-994-4429	6	4
5310-00-820-6653	1	4	4730-01-006-5103	29	32
5310-00-820-6653	4	2	5305-01-028-8869	19	10
5310-00-820-6653	5	7	5360-01-038-4659	17	7
2815-00-828-7013	17	5	2990-01-046-0171	29	1
2910-00-828-7126	26	1	5330-01-046-0441	8	5
2815-00-829-5227	19	7	5330-01-046-1991	16	7
2990-00-829-5600	30	3	5330-01-046-3144	16	26
2910-00-829-5603	23	13	2930-01-046-3493	36	19
2910-00-829-5604	23	18	2910-01-047-6021	23	1
2910-00-829-5616	26	5	5330-01-049-0466	2	33
2910-00-829-5617	26	10	5315-01-058-4551	2	29
5340-00-833-7966	17	6	5315-01-058-4551	4	18
5315-00-844-0140	23	12	5305-01-060-5958	22	2
5305-00-846-5703	16	19	5305-01-062-1054	16	3

NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.	NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.
5330-01-066-3908	11	9	5305-01-114-9279	36	16
5330-01-066-3910	17	25	2920-01-121-8859	30	11
2910-01-070-7979	9	17	2815-01-122-8002	5	1
4720-01-070-8149	18	1	2815-01-127-1060	9	9
2910-01-070-9710	22	6	2815-01-127-3597	9	9
5310-01-072-8821	37	4	2815-01-127-3598	9	9
5330-01-072-8822	37	7	2815-01-128-9187	29	KIT
5305-01-072-8831	27	16	5365-01-132-1984	36	30
5330-01-072-8983	33	7	3120-01-132-9339	4	13
3110-01-073-2576	37	5	5365-01-133-8271	1	16
3020-01-077-4411	4	4	5330-01-133-8493	12	38
2815-01-077-4463	19	8	5340-01-135-7250	36	18
5330-01-077-5228	16	41	2815-01-136-5825	29	23
5330-01-077-5228	35	10	5330-01-136-8431	29	21
4730-01-078-9859	26	14	2815-01-140-7421	9	9
3040-01-079-1748	17	15	5305-01-140-9118	17	3
2815-01-079-1799	12	39	2815-01-142-1732	11	7
3040-01-079-3468	36	38	5340-01-143-6048	9	2
3040-01-079-3469	17	19	3120-01-143-9547	4	13
5340-01-079-4678	22	15	3120-01-144-8882	4	13
5315-01-079-6506	22	13	5310-01-145-0762	36	44
5330-01-079-6514	16	43	5330-01-145-5377	2	10
3120-01-079-6527	19	11	3120-01-145-9132	4	13
5315-01-079-6740	4	22	3020-01-146-0107	4	11
3110-01-079-8190	33	6	2815-01-146-1024	11	8
5365-01-080-0409	36	43	2910-01-146-1048	30	7
2815-01-080-0642	3	1	2940-01-146-1995	16	14
5330-01-080-2992	36	32	2815-01-146-5925	4	6
5330-01-080-2992	36	42	5365-01-147-0912	8	8
5330-01-080-5020	36	11	5365-01-147-0913	8	8
5330-01-080-5021	3	7	5307-01-147-1316	12	19
2815-01-083-3157	4	12	5307-01-147-2821	12	19
3020-01-084-9640	17	16	3120-01-147-5275	20	9
4720-01-085-1316	29	30	5330-01-149-9715	36	KIT
2815-01-085-2573	17	1	2910-01-150-2631	22	1
4820-01-085-2616	30	5	5365-01-150-6257	2	25
2815-01-085-2618	9	11	2815-01-151-8772	4	10
2950-01-085-3580	29	17	2910-01-152-8531	22	14
2815-01-085-3733	9	5	4730-01-157-8923	28	29
2815-01-085-3733	12	21	2815-01-159-1737	11	2
2815-01-085-3734	17	22	5365-01-160-1832	23	4
3020-01-085-3779	17	24	4730-01-160-3579	16	13
2520-01-085-6128	12	34	5305-01-165-3300	8	1
4710-01-085-6130	35	13	5305-01-165-3300	17	11
2815-01-086-2704	6	1	4720-01-169-7509	28	32
5330-01-086-3991	36	41	5310-01-186-4361	1	7
2910-01-086-5544	23	16	5970-01-193-0895	1	15
5365-01-086-7788	8	8	5306-01-197-6194	1	12
5365-01-086-8214	2	35	5360-01-200-0323	16	15
3120-01-087-3004	6	9	5310-01-200-1318	16	38
5305-01-091-2498	37	16	5305-01-203-6444	16	37
2910-01-091-3204	23	14	3040-01-203-8549	20	14
5330-01-092-4143	36	KIT	5330-01-209-3583	13	2
2815-01-096-9198	12	2	4730-01-211-1989	13	28
2910-01-096-9200	25	3	3120-01-214-7779	4	17
2930-01-098-0175	37	14			
2910-01-105-6457	22	8			
5330-01-109-1283	24	21			
5365-01-112-4281	16	23			
5305-01-114-9279	35	11			

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FSCM	PART NUMBER	NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.	FSCM	PART NUMBER	NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.
15434	AC1600300NF	4720-01-085-1316	29	30	15434	BM79290	2910-00-404-9999	23	6
15434	AC9		32	2	15434	BM95160	2815-00-195-5897	12	28
88044	AN565F428H24	5305-00-063-5043	28	16	15434	BM95161	2815-01-096-9198	12	2
88044	AN960-416	5310-00-141-1795	24	25	15434	8195162	2815-00-851-7637	12	24
88044	AN960-416	5310-00-141-1795	26	4	15434	BM97497	2910-01-096-9200	25	3
88044	AN960-416	5310-00-141-1795	26	11	15434	BM97502	2910-00-869-3428	25	1
88044	AN960-416	5310-00-141-1795	27	14	15434	BM98430	2910-01-091-3204	23	14
88044	AN960-416	5310-00-141-1795	33	14	73165	B90429	5330-01-066-3908	11	9
15434	AR-00796		23	23	79470	C3159x2	4730-00-081-9618	16	32
15434	AR-03636		17	17	15434	H40496	3120-00-318-8537	4	15
15434	AR-045090	2930-01-046-3493	36	19	15434	H42693	3120-00-349-6444	4	14
15434	AR-09265		16	27	00905	H524018	5340-00-721-5329	3	9
15434	AR-09454-OOEF		28	1	96906	MS122032	5310-00-159-6209	2	7
15434	AR-2308	2815-00-005-7431	12	7	96906	MS122032	5310-00-159-6209	5	16
15434	AR01176	5365-00-716-5496	8	7	96906	MS122032	5310-00-159-6209	24	24
15434	AR03034		33	11	96906	MS122032	5310-00-159-6209	26	3
15434	AR03307		12	1	96906	MS122032	5310-00-159-6209	28	2
15434	AR08190	2815-00-004-8291	6	5	96906	MS122032	5310-00-159-6209	29	8
15434	AR08256		20	10	96906	MS122032	5310-00-159-6209	33	13
15434	AR08366		20	7	96906	MS16625-1100	5365-00-807-2636	27	11
15434	AR08667		17	26	96906	MS16632-1050	5365-00-256-2846	23	30
15434	AR08851		36	34	96906	MS18154-60	5305-00-942-2196	2	2
15434	AR08853		36	22	96906	MS18154-60	5305-00-942-2196	8	9
15434	AR08854		36	33	96906	MS18154-60	5305-00-942-2196	11	4
15434	AR09473		8	4	96906	MS18154-60	5305-00-942-2196	16	36
15434	AR09478		16	8	96906	MS18154-60	5305-00-942-2196	18	8
15434	AR09479		16	1	96906	MS18154-60	5305-00-942-2196	28	40
15434	AR09607		20	3	96906	MS20066-116	5315-00-695-3292	24	10
15434	AR09832	2815-01-085-3734	17	22	96906	MS21045C6	5310-00-059-9264	29	26
89346	AR09911		2	1	96906	MS24665-355	5315-00-012-0123	1	14
15434	AR10058	2950-00-275-9325	29	22	96906	MS27183-14	5310-00-080-6004	8	11
15434	AR10141		37	8	96906	MS27183-14	5310-00-080-6004	10	29
15434	AR10142		37	1	96906	MS27183-14	5310-00-080-6004	11	6
15434	AR10172	2815-01-085-2573	17	1	96906	MS27183-14	5310-00-080-6004	16	34
15434	AR12604	2990-01-046-0171	29	1	96906	MS27183-14	5310-00-080-6004	18	6
15434	AR40065	2910-00-237-0056	22	5	96906	MS27183-14	5310-00-080-6004	28	39
15434	AR51276	2815-00-195-5894	12	13	96906	MS27183-17	5310-00-809-5997	37	12
15434	AR51307	2910-00-567-4338	24	11	96906	MS27183-42	5310-00-014-5850	24	27
15434	AR51317		33	3	96906	1335338-45	5310-00-407-9566	2	12
60038	ASSEMBLY90028	3110-01-073-2576	37	5	96906	MS35338-45	5310-00-407-9566	10	34
15434	AS0500760SS	4720-01-169-7509	28	32	96906	MS35338-45	5310-00-407-9566	13	29
15434	AS0501900SS		28	31	96906	MS35338-45	5310-00-407-9566	17	28
46529	A331987	2930-00-603-1625	16	11	96906	MS35338-45	5310-00-407-9566	35	12
15434	BM-37496		10	17	96906	MS35338-45	5310-00-407-9566	36	17
15434	BM27253	3120-00-339-5642	7	4	96906	MS35338-46	5310-00-637-9541	13	9
15434	BM37625	2815-00-609-7115	10	4	96906	MS35338-47	5310-00-209-0965	8	2
15434	BM37634	2815-00-505-5116	10	5	96906	MS35338-47	5310-00-209-0965	13	19
15434	BM47777	2815-00-705-9257	10	3	96906	MS35338-47	5310-00-209-0965	17	10
15434	BM67416	2910-00-132-0769	27	5	96906	MS35338-47	5310-00-209-0965	20	21
15434	BM68356	5330-00-888-4988	36	KIT	96906	MS35338-47	5310-00-209-0965	24	18
15434	BM68879	2910-00-369-8240	24	8	96906	MS35338-48	5310-00-584-5272	5	4
15434	BM69381		28	9	96906	MS35338-48	5310-00-584-5272	13	25
15434	BM69886	2990-00-237-0058	24	2	96906	MS35338-48	5310-00-584-5272	37	11
15434	BM69886	2990-00-237-0058	27	2	96906	MS35338-50	5310-00-820-6653	1	4
15434	BM73718	2910-00-887-8354	23	21	96906	MS35338-50	5310-00-820-6653	4	2
15434	BM73902		23	7	96906	MS35338-50	5310-00-820-6653	5	7
15434	BM73976	2815-00-375-9892	10	22	96906	MS35338-8	5310-00-261-7340	2	3
15434	BM74747		27	7	96906	MS35338-8	5310-00-261-7340	4	8
15434	BM76340	2910-00-828-7126	26	1	96906	MS35338-8	5310-00-261-7340	8	10
15434	BM76665	2910-00-603-2835	23	8	96906	MS35338-8	5310-00-261-7340	10	28

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FSCM PART NUMBER		NATIONAL STOCK NUMBER	FIGURE ITEM NO. NO.		FSCM PART NUMBER		NATIONAL STOCK NUMBER	FIGURE ITEM NO. NO.	
96906	MS35338-8	5310-00-261-7340	11	5	96906	MS90728-90	5305-00-071-2056	24	17
96906	MS35338-8	5310-00-261-7340	13	15	96906	MS9241-024	5330-00-924-7757	22	11
96906	MS35338-8	5310-00-261-7340	16	4	80205	NAS620-5L	5310-00-727-8353	23	26
96906	MS35338-8	5310-00-261-7340	16	35	15434	NPN		28	34
96906	MS35338-8	5310-00-261-7340	17	12	15434	S-119-C	5305-01-165-3300	8	1
96906	MS35338-8	5310-00-261-7340	18	5	15434	S-119-C	5305-01-165-3300	17	11
96906	MS35338-8	5310-00-261-7340	24	4	15434	S-147-B	5306-00-136-9751	17	30
96906	MS35338-8	5310-00-261-7340	28	37	15434	S-910-B	4730-01-160-3579	16	13
96906	MS35338-8	5310-00-261-7340	35	1	15434	S-915-A	4730-00-801-8186	2	24
96906	MS35338-8	5310-00-261-7340	36	2	15434	S-915-A	4730-00-801-8186	13	14
96906	MS35691-5	5310-00-971-7989	33	2	15434	S-915-A	4730-00-801-8186	35	8
96906	MS35756-12	5315-00-616-5522	20	15	15434	S-915-A	4730-00-801-8186	36	3
96906	MS35756-18	5315-00-616-5527	7	8	15434	S101A	5305-00-424-3571	17	21
96906	MS35756-18	5315-00-616-5527	20	20	89346	S102A		2	13
96906	MS35756-34	5315-00-043-1787	17	2	15434	S110	5305-01-114-9279	35	11
96906	MS35842-13	4730-00-909-8627	36	12	15434	S110	5305-01-114-9279	36	16
96906	MS39230-1	4730-00-287-1649	28	30	15434	S118A	5305-00-230-1939	2	6
96906	MS49005-6	4730-00-057-5555	2	27	15434	S118A	5305-00-230-1939	29	9
96906	MS49005-6	4730-00-057-5555	16	5	15434	S129	5305-00-546-6698	10	38
96906	MS49005-6	4730-00-057-5555	16	12	15434	S1354	5305-00-804-6454	13	5
96906	MS51092-1	5310-00-684-3463	10	25	15434	S145	5305-01-203-6444	16	37
96906	MS51887-5	4730-00-196-0837	28	35	15434	S149A	5305-00-404-1390	36	49
96906	MS51967-14	5310-00-768-0318	13	24	15434	S155	5305-01-028-8869	19	10
96906	MS51967-20	5310-00-763-8920	36	45	15434	S159B	5305-00-493-3959	33	12
96906	MS51968-14	5310-00-732-0560	12	3	15434	S16073	3110-00-144-8519	36	28
96906	MS51968-14	5310-00-732-0560	12	8	15434	S16073	3110-00-144-8519	36	39
96906	MS51968-14	5310-00-732-0560	12	14	15434	S16206	5365-00-786-0102	33	10
96906	MS51968-14	5310-00-732-0560	12	25	15434	S16255	2815-00-815-0355	36	31
96906	MS51968-14	5310-00-732-0560	12	29	15434	S16255	2815-00-815-0355	36	40
96906	MS9021-116	5330-00-582-7484	23	2	15434	S189C	5305-00-509-8106	30	14
96906	MS90725-10	5305-00-071-2241	24	23	15434	S199B	5305-00-404-1388	16	46
96906	MS90725-10	5305-00-071-2241	26	2	15434	S200	5310-00-469-3998	5	13
96906	MS90725-10	5305-00-071-2241	27	20	15434	S222A	5310-00-164-1904	29	3
96906	MS90725-10	5305-00-071-2241	28	3	15434	S223	5310-00-521-8595	10	30
96906	MS90725-115	5305-00-071-1769	13	26	15434	S2286	5305-00-804-6318	29	25
96906	MS90725-34	5306-00-225-8499	17	31	15434	S2286	5305-00-804-6318	38	2
96906	MS90725-36	5305-00-225-9081	17	29	15434	S274		24	20
96906	MS90725-58	5305-00-269-3209	13	10	15434	S285	5310-00-470-6154	37	15
96906	MS90726-113	5305-00-725-4183	37	13	15434	S601	5310-00-134-4168	5	3
96906	MS90726-31	5306-00-225-9086	10	35	15434	S606	5310-00-410-6756	24	26
15434	MS90726-64		4	9	15434	S608	5310-01-200-1318	16	38
96906	MS90726-67	5305-00-269-2811	36	46	15434	S622	5310-00-562-6557	13	20
96906	MS90727-114	5305-00-719-5235	37	10	15434	S622	5310-00-562-6557	24	19
96906	MS90727-83	5305-00-709-8282	17	13	15434	S626	5310-00-562-6558	13	23
96906	MS90727-87	5305-00-709-8523	13	16	15434	S631	5310-00-562-6560	29	12
96906	MS90727-91	5305-00-709-8542	8	14	15434	S658	5310-00-109-7638	5	8
96906	MS90727-94	5305-00-709-8537	8	6	15434	S719	5340-00-276-5847	10	24
96906	MS90728-114	5305-00-071-2070	5	5	15434	S911B	4730-00-018-9566	2	23
96906	MS90728-59	5305-01-140-9118	17	3	15434	S911B	4730-00-018-9566	3	10
96906	MS90728-62	5305-00-068-0511	16	2	15434	S911B	4730-00-018-9566	16	17
96906	MS90728-62	5305-00-068-0511	16	44	15434	S911B	4730-00-018-9566	20	13
96906	MS90728-62	5305-00-068-0511	35	3	15434	S911B	4730-00-018-9566	28	15
96906	MS90728-62	5305-00-068-0511	36	5	15434	S911B	4730-00-018-9566	36	20
96906	MS90728-64	5305-00-725-2317	18	4	15434	S962	4730-00-044-4715	2	15
96906	MS90728-64	5305-00-725-2317	36	9	15434	S962	4730-00-044-4715	3	6
96906	MS90728-66	5305-00-782-9489	11	3	15434	S962	4730-00-044-4715	36	4
96906	MS90728-66	5305-00-782-9489	28	36	15434	S965E	5365-00-404-2934	3	4
96906	MS90728-70	5305-00-846-5703	16	19	15434	S995	4730-00-289-4770	3	5
96906	MS90728-70	5305-00-846-5703	36	1	15434	S995	4730-00-289-4770	17	9
96906	MS90728-87	5305-00-071-1788	20	22	15434	S995	4730-00-289-4770	35	6

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91265 TS33-016	5330-00-951-3538	28	21	15434 114764		28	20
91265 TS33-016	5330-00-951-3538	30	17	15434 114765		28	19
75078 011573	2815-01-085-3733	9	5	15434 114773		28	14
75078 011573	2815-01-085-3733	12	21	15434 114791	5330-00-816-8148	28	10
24617 0120217	5310-00-922-2017	30	12	15434 114795		28	23
80218 10003	4730-00-203-0395	13	17	15434 114921		28	25
15434 100099	5330-00-809-2667	26	6	15434 114940		28	13
15434 100192	2910-00-773-9369	24	12	15434 114947		28	4
15434 100193	3120-00-810-6032	23	10	15434 115033		28	7
15434 100215	2910-00-567-4354	25	8	15434 115034		28	12
15434 100478	5330-00-081-9289	33	4	15434 116389	3120-00-086-8364	20	16
15434 100670	3120-00-573-0391	7	5	15434 116390	5310-00-081-9292	20	17
15434 100764	5330-00-506-4866	24	16	15434 116391	3120-00-792-9834	20	11
15434 1011		21	8	15434 116936	4730-00-803-8353	25	10
15434 1012		21	19	15434 116936	4730-00-803-8353	26	16
15434 101322	2815-00-590-7378	11	1	15434 116982	2815-00-767-4012	19	9
15434 101468	3120-00-719-5719	25	2	30760 117300-1251	5315-00-014-1244	25	4
15434 1017		21	9	15434 117897		17	20
15434 101841	5365-00-507-3224	23	15	15434 118226	5305-00-161-0902	24	22
15434 101842	5365-00-507-3225	23	15	15434 118227	5315-00-844-0140	23	12
15434 101843	5365-00-543-3744	23	15	15434 118377	3120-00-791-1440	10	18
15434 101918	3040-00-695-3285	24	6	15434 118378	3120-00-659-7808	10	11
15434 101983	3020-00-567-4356	24	7	15434 118939	5315-00-777-3544	10	8
15434 1022		21	3	15434 118939	5315-00-777-3544	10	15
15434 102231		34	1	15434 119363	3020-00-892-4704	25	6
15434 1023		21	5	75078 1199		12	19
15434 1026		21	15	15434 1200		21	18
15434 1030		21	7	15434 120448		5	11
15434 103036	3020-00-562-1173	24	14	15434 120543		10	10
15434 1031		21	16	15434 120819	5330-00-777-3545	10	36
15434 104038	5330-00-010-8497	24	9	15434 121907		17	32
15434 105199	2815-00-829-5227	19	7	15434 123000		5	12
15434 105375	9905-00-733-7622	38	1	75078 1232	5307-01-147-2821	12	19
15434 105953	5306-00-804-2468	2	21	15434 123558	5315-00-866-5015	9	16
15434 106289	5305-00-091-4009	5	9	15434 124019	2910-00-065-5544	27	18
15434 106452R91		32	1	15434 124020	5340-00-464-7064	27	17
15434 107738	2815-00-505-5119	10	9	15434 124033		28	26
15434 107738	2815-00-505-5119	10	16	15434 126304	2815-00-828-7013	17	5
15434 108074	5310-00-757-6367	28	18	15434 1265		21	21
15434 1081		21	12	15434 127554	5340-01-143-6048	9	2
15434 1082		21	13	15434 127558	2815-00-791-1453	16	20
15434 1083		21	14	15434 127935	2815-01-140-7421	9	9
15434 108330	5310-00-486-2505	24	5	15434 1289		21	4
15434 108330	5310-00-486-2505	36	8	15434 128936	2815-00-406-6737	29	24
15434 108722	5340-00-400-3449	29	29	15434 129768	5310-00-082-1888	30	8
15434 109319	2815-00-406-8936	17	4	15434 129826	2990-00-829-5600	30	3
15434 109333	2815-00-705-2856	17	8	15434 129838	5355-00-082-1189	30	2
15434 109594	3120-01-079-6527	19	11	15434 129839	2910-00-084-7787	30	10
15434 109915	5305-00-774-4246	33	1	15434 129888	5330-00-081-9299	30	9
15434 110855	5330-00-567-3463	25	9	15434 130118	2930-00-928-3595	35	7
15434 110907	5365-00-708-3434	16	24	15434 130226	5330-00-106-6370	36	51
15434 112076	5365-01-160-1832	23	4	15434 130394	4730-00-404-2906	35	5
15434 112302	5365-00-420-9696	36	29	15434 131026	5330-00-143-8485	9	8
15434 112593		13	1	15434 132019	2930-00-799-0843	2	14
15434 113244	3020-00-701-1112	23	29	15434 132756		16	39
15434 114638	5310-00-887-8325	19	4	15434 132880	2815-00-962-5618	6	2
15434 114739	2910-00-767-4018	28	5	15434 133342	2930-00-928-3596	35	2
15434 114745		28	22	15434 134072	2920-01-121-8859	30	11
15434 114754		28	27	15434 134596	5340-00-833-7966	17	6
15434 114755		28	6	15434 135957	2815-00-739-6098	9	10

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15434	137797		36	47	15434	156226	2815-00-107-1115	7	9
15434	138782		23	5	15434	156416	5340-00-103-9988	29	10
15434	138905		23	19	15434	156420	3120-00-682-7706	29	16
15434	139289		10	33	15434	156444	5330-00-237-6266	29	5
15434	139473	5365-00-988-3668	23	3	15434	157088	5365-00-507-3271	31	1
15434	139988	5330-00-809-3276	26	8	15434	157280	3120-01-214-7779	4	17
15434	140297	2815-01-079-1799	12	39	15434	157551	5330-00-143-8376	13	27
15434	140330	3120-00-589-3537	12	6	15434	157870	3120-00-906-6657	7	6
15434	140330	3120-00-589-3537	12	11	15434	158139	2940-00-073-3316	16	29
15434	140330	3120-00-589-3537	12	17	15434	158145	2815-00-404-2947	2	4
15434	140330	3120-00-589-3537	12	27	15434	160514	5365-00-965-0870	26	9
15434	140330	3120-00-589-3537	12	32	15434	162426	3010-00-447-9799	24	1
15434	140357		28	8	15434	163733	2910-00-400-5178	23	11
15434	140358		28	11	15434	163944	3120-00-904-9595	23	22
15434	140414		28	24	15434	165006	5305-01-060-5958	22	2
15434	140618	2910-00-829-5603	23	13	15434	166009	5360-00-132-0245	22	7
15434	140925	2910-00-369-8251	27	1	15434	166777	5305-01-091-2498	37	16
24617	141284	5315-00-014-1284	2	17	15434	167157	2910-01-070-9710	22	6
24617	141284	5315-00-014-1284	5	14	15434	168803		12	31
15434	141761	2815-00-070-2251	18	10	15434	168805		12	16
15434	142176	5310-01-072-8821	37	4	15434	169704		12	5
15434	142204		23	28	15434	170296	2815-00-933-3009	9	1
15434	142616	2930-00-437-0567	16	9	15434	170510	5330-00-632-6182	29	15
15434	142689	3020-00-160-9092	20	8	15434	171570	2990-00-477-6159	29	20
15434	143251	5360-00-461-5738	27	8	15434	172034	2815-00-632-6239	9	13
15434	143847	5360-00-081-8487	23	25	15434	173368	5330-00-132-0248	16	28
15434	143938		2	35	15434	174298	2815-00-815-1114	22	10
15434	143946		2	35	15434	174299	5365-00-815-1137	22	9
15434	143947	5365-01-086-8214	2	35	15434	175831	5340-00-485-0945	10	20
15434	143948		2	35	15434	175836	4820-00-130-4820	23	31
15434	143949		2	35	15434	175864	2910-00-933-3012	25	7
15434	143950		28	33	15434	177419	3040-01-079-3469	17	19
15434	144178	5315-00-082-0448	23	27	15434	177999	4730-00-369-7824	27	19
15434	144195	5360-00-082-0124	27	3	15434	179063	2940-01-146-1995	16	14
15434	144302	2910-00-829-5604	23	18	72962	1801-040	5310-00-680-6874	29	13
15434	144372	4730-01-157-8923	28	29	15434	181466	5310-00-484-1718	25	12
15434	145506	5330-01-086-3991	36	41	15434	181466	5310-00-484-1718	26	12
15434	145551		37	3	15434	181466	5310-00-484-1718	27	15
15434	145701	2815-00-962-5623	9	10	15434	181466	5310-00-484-1718	30	15
15434	145977	2930-00-732-5206	34	2	45152	1816-HX-1	5305-01-062-1054	16	3
15434	146437	2910-00-451-8063	23	24	15434	182530	2910-01-086-5544	23	16
15434	146483	2910-00-790-8736	31	4	15434	182706	5305-00-058-6604	36	50
15434	147100	2910-00-928-3505	9	7	15434	183669	4730-01-006-5103	29	32
15434	147389	<b>5305-00-062-4378</b>	9	3	15434	183913	5365-01-112-4281	16	23
15434	147670	2815-00-994-4427	6	3	15434	184386		16	31
15434	148203	5330-00-143-8369	35	14	15434	184387		16	30
15434	148295		16	10	15434	184388		16	33
15434	1484		21	2	15434	185138	5340-01-079-4678	22	15
15434	148977	2990-00-858-3526	33	9	15434	185139	2910-01-105-6457	22	8
15434	149030	3040-00-085-7439	33	5	15434	185573	5365-01-086-7788	8	8
15434	149040	5315-00-973-0414	33	8	15434	185804	5305-00-463-0428	13	22
15434	149105PC183049	5330-00-058-1767	2	31	15434	187420	2815-00-132-0273	6	13
15434	1492		21	6	15434	187556	5305-00-138-9848	30	13
15434	150002	2815-00-242-2992	8	12	89346	187589	5330-01-133-8493	12	38
15434	151478	2815-00-920-2073	19	6	89346	187893R1		1	8
15434	151489	2815-00-920-8356	19	2	15434	188936	5305-00-795-9353	5	6
15434	152770		6	13	15434	189800	5365-00-462-4504	27	9
15434	153336	2910-00-829-5616	26	5	15434	190397	2930-00-401-9531	20	5
15434	153338	2910-00-829-5617	26	10	15434	190769		20	18
15434	154088	5330-00-961-9470	31	2	15434	190849	5330-00-194-8385	29	27

NATIONAL STOCK NUMBER AND PART NUMBER INDEX

FSCM	PART NUMBER	NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.	FSCM	PART NUMBER	NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.
15434	190876	5330-00-132-0274	30	6	15434	204657		13	7
15434	191079		2	16	15434	204832	3020-01-085-3779	17	24
15434	191218	5340-00-134-3529	22	3	15434	204851		28	38
15434	191517	5310-00-442-6899	20	1	15434	20622	2815-00-338-6839	13	4
15434	191517	5310-00-442-6899	20	19	15434	208118		36	37
15434	191916	2910-00-238-5435	22	4	15434	208119	3040-01-079-3468	36	38
15434	191970	2815-00-480-4347	6	7	15434	208120	5365-01-080-0409	36	43
15434	193717		5	2	15434	208132	5330-01-080-5020	36	11
15434	193736	5330-00-132-0276	22	12	15434	208134		36	24
15434	193949	5330-00-129-9349	3	8	15434	208138		36	27
15434	194010	5305-00-411-9340	29	11	15434	208326	4730-00-477-4160	18	2
15434	194037	2815-00-404-2940	12	12	15434	208411		10	27
15434	194380		20	2	15434	208461		13	21
15434	194610	2815-00-994-4429	6	4	15434	208581		10	32
15434	195469	2950-00-275-3355	29	2	15434	208621		28	28
89346	19581R1		1	13	15434	208668		29	34
15434	196641	5330-00-406-4542	9	15	15434	208829	2930-01-098-0175	37	14
15434	196844	5365-01-132-1984	36	30	15434	209600		36	14
15434	197230	5330-01-209-3583	13	2	15434	209700	5305-00-006-8411	3	3
15434	197733	4730-00-494-9350	29	33	15434	209862C1		15	3
15434	199064	5330-00-478-2962	5	15	15434	209919	2815-01-146-5925	4	6
15434	199201		21	1	15434	209959		29	35
15434	199216		12	23	15434	210179		4	22
15434	199220		12	33	15434	210238	5315-01-079-6740	36	25
15434	199224		12	20	15434	210374	5330-01-109-1283	24	21
15434	199225	2520-01-085-6128	12	34	15434	210412	5330-01-046-0441	8	5
15434	199239		12	9	15434	210647	5330-00-006-2494	25	13
15434	199338		20	12	15434	210685		10	23
15434	199568		18	7	15434	210804		36	48
15434	199587	3040-01-079-1748	17	15	15434	210805		36	7
15434	199969	3040-01-203-8549	20	14	15434	210806		36	6
33457	2S7222S	2815-00-405-1798	14	1	15434	210832		16	18
15434	200064	5340-00-417-5800	13	8	15434	210858		16	6
15434	200307	5330-01-072-8822	37	7	15434	210860		36	35
15434	200566	2815-01-077-4463	19	8	15434	210883		16	42
15434	200809	5330-00-026-2931	20	6	15434	210884	5365-01-150-6257	2	25
15434	200861	5310-00-134-4171	6	11	89346	210895		2	8
15434	200908	5305-00-005-0666	19	5	15434	210926		20	4
15434	200919	5340-00-132-3203	19	3	15434	210966		16	40
15434	2010650		10	1	15434	210967		16	25
15434	201124		37	9	15434	210996		37	2
15434	201707		16	16	15434	211016		35	9
15434	202128	5360-01-200-0323	16	15	15434	211027	4710-01-085-6130	35	13
15434	202226		2	5	15434	211358		13	11
15434	202376	2950-00-432-1559	29	18	15434	211375	2950-00-275-8276	29	6
15434	202377	5330-00-406-7789	29	19	89346	211475		2	11
15434	202457	5330-00-026-2933	29	14	15434	211869		37	6
15434	202506	2815-01-136-5825	29	23	15434	211914		4	3
15434	202897	2910-00-951-3536	26	7	15434	211918	3020-01-077-4411	4	4
15434	202903	5315-01-058-4551	2	29	15434	211939	5360-01-038-4659	17	7
15434	202903	5315-01-058-4551	4	18	15434	211999	5360-00-009-9270	9	14
15434	202961	5330-00-910-8736	18	12	15434	212113		4	1
15434	203090		6	8	15434	212161	5330-01-077-5228	16	41
15434	203100	5330-00-011-7939	36	26	15434	212161	5330-01-077-5228	35	10
15434	203131	5310-00-426-3990	9	4	15434	212563	2950-00-275-9344	29	4
15434	203145	5330-01-066-3910	17	25	15434	213082	5310-01-145-0762	36	44
15434	203294	2950-00-275-4658	29	7	15434	213109		12	4
15434	203426	5315-01-079-6506	22	13	15434	213109		12	15
15434	203619	5305-01-072-8831	27	16	15434	213109		12	26
15434	203849	4730-01-078-9859	26	14	15434	213109		12	30



## NATIONAL STOCK NUMBER AND PART NUMBER INDEX

FSCM	PART NUMBER	NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.	FSCM	PART NUMBER	NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.
15434	213713		28	42	15434	3018049	2815-00-705-2851	10	12
15434	213740	2815-00-064-4398	2	5	15434	3018323	2910-01-150-2631	22	1
15434	213768	5330-01-072-8983	33	7	15434	3018762	5330-01-092-4143	36	KIT
15434	213769	3110-01-079-8190	33	6	15434	3019180	3120-00-695-1232	4	21
15434	213936		29	31	15434	3019192		4	20
15434	214173		36	21	15434	3019204	3120-00-593-1507	4	19
15434	214476		36	10	15434	3019227		18	9
15434	214617	5340-01-135-7250	36	18	15434	3019400		13	3
15434	214950	3120-01-087-3004	6	9	15434	3019956	5365-00-488-0799	2	35
15434	215090	5330-00-064-4399	2	34	15434	3020943	5330-00-659-3178	19	1
15434	215172		34	3	15434	3021601		7	2
15434	216802	2950-01-085-3580	29	17	15434	3022205		18	3
15434	218152		12	10	15434	3022969	5330-01-136-8431	29	21
15434	218245	5330-01-046-1991	16	7	15434	3023177		7	1
15434	2299		21	17	15434	3023229		7	3
15434	236985R91		32	4	15434	3024923	2815-01-083-3157	4	12
15434	2390		21	11	15434	3026556	3120-01-147-5275	20	9
89346	24874R1		1	5	15434	3027215	2815-00-590-7385	10	2
75078	2514		12	18	15434	3029348	2815-01-151-8772	4	10
75078	2514		12	36	15434	3030970	2910-01-146-1048	30	7
89346	25711R1		1	3	15434	3031469	5330-00-351-6428	13	6
79150	26384	5330-00-246-0309	2	32	15434	3033677	5330-00-005-0407	36	23
15434	267627C2		32	3	15434	3035342	4810-00-695-3284	30	1
75078	2680		12	22	15434	3036065	2815-00-300-0882	9	5
15434	2689		21	10	15434	3036126	5330-01-080-5021	3	7
15434	274085R91		15	2	15434	3038998	5330-01-080-2992	36	32
75078	2856	5307-01-147-1316	12	19	15434	3038998	5330-01-080-2992	36	42
89346	299227C3		1	1	15434	3047031	2815-00-388-3126	10	21
89346	299228C1	5970-01-193-0895	1	15	79396	33341	2910-00-470-7075	31	5
15434	299263091		15	4	15434	364319C1		15	6
15434	3000266	4820-01-085-2616	30	5	89346	364359C1			BULK 1
15434	3004316	5330-00-005-0857	8	3	15434	3801098	2815-01-128-9187	29	KIT
15434	3006183	2815-01-142-1732	11	7	15434	3801260	3120-01-132-9339	4	13
15434	3006187	2815-01-159-1737	11	2	15434	3801261	3120-01-143-9547	4	13
15434	3006358	2815-01-146-1024	11	8	15434	3801262	3120-01-144-8882	4	13
15434	3006456	2815-01-085-2618	9	11	15434	3801263	3120-01-145-9132	4	13
15434	3006736	5330-00-005-0856	8	13	15434	3801330	5330-01-149-9715	36	KIT
15434	3006737	5330-00-005-0858	4	7	15434	390782C1		15	1
15434	3007242	2815-00-230-0070	12	37	15434	40662A	5330-00-361-2955	4	5
15434	3007300-2764	2910-01-047-6021	23	1	15434	4136		21	20
15434	3007442	5330-01-145-5377	2	10	89346	414085C1	5306-01-197-6194	1	12
15434	3008017	5330-01-079-6514	16	43	89346	414089C1	5310-01-186-4361	1	7
15434	3008089	2815-01-080-0642	3	1	89346	424140C2			17
15434	3008100	2815-00-739-6084	3	11	89346	424141C2			17
15434	3008998	5330-01-049-0466	2	33	15434	42645	2815-00-484-8359	2	19
15434	3009213	5310-00-356-1447	2	20	15434	42646	3130-00-408-9041	2	19
15434	3010030	5330-01-046-3144	16	26	15434	42647	2815-00-484-8360	2	19
15434	3010915	5307-00-922-2626	29	28	15434	42690	3120-00-090-5504	4	16
15434	3011935	2910-01-070-7979	9	17	89346	427820C1			2
15434	3012527	4730-01-211-1989	13	28	15434	43463A	5330-00-159-1464	36	15
15434	3012537	2910-01-152-8531	22	14	15434	43696	5330-00-886-2509	10	31
15434	3014149	2815-01-086-2704	6	1	89346	441889C2			10
15434	3014614	3020-01-146-0107	4	11	89346	446002R1			11
15434	3014622	2815-00-132-0240	9	9	15434	44678	2910-00-858-3522	27	13
15434	3014623	2815-01-127-1060	9	9	72582	450517	5305-00-165-8157	16	45
15434	3014624	2815-01-127-3597	9	9	89346	465225C2			6
15434	3014625	2815-01-127-3598	9	9	89346	47686961			9
15434	3014783	3020-01-084-9640	17	16	19207	5329388	5315-00-532-9388	2	22
15434	3015523	2815-00-753-0660	6	10	72962	590220940406	5315-00-907-0711	23	17
15434	3017759	2815-00-085-7434	9	9	15434	60408	5315-00-238-0882	2	28

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FSCM	PART NUMBER	NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.	FSCM	PART NUMBER	NATIONAL STOCK NUMBER	FIGURE NO.	ITEM NO.
15434	61623	5310-00-276-2816	36	36	15434	9260-1	2815-00-311-2521	10	7
15434	61908	5365-00-282-5030	6	6	15434	9266	5330-00-175-6585	10	36
15434	62229	5340-00-365-5759	12	35	15434	9266A	5330-00-349-1219	10	36
15434	63385	5365-00-082-1193	28	41	89346	969783R1	5365-01-133-8271	1	16
15434	63495-D		36	13					
15434	63842	5310-00-134-4169	18	11					
15434	64482	2815-00-603-7264	5	10					
15434	65259-A	5365-01-147-0912	8	8					
15434	65259-B	5365-01-147-0913	8	8					
15434	65259C	5365-00-507-3254	8	8					
15434	67346		13	13					
15434	67347-1		13	12					
15434	67684	5310-00-262-2986	30	16					
15434	67946	5365-00-197-9327	16	22					
15434	68274	5360-00-664-5343	16	21					
15434	68365	3120-00-566-0480	17	18					
15434	68445	5315-00-281-7610	2	30					
15434	68512	5315-00-041-0915	10	13					
15434	68513	5315-00-041-0916	10	6					
15434	68549	5315-00-369-2588	23	9					
15434	68585	5315-00-014-1195	2	18					
15434	68586	3120-00-661-6646	10	37					
15434	68606	5365-00-716-6580	25	5					
15434	68803-A		9	12					
16954	691-10014	5330-00-252-8888	26	15					
15434	69519	5315-00-475-2574	17	14					
15434	69521	3120-00-627-6697	17	23					
15434	69521	3120-00-627-6697	17	27					
15434	69699	5310-00-962-5610	3	2					
15434	69736	5305-00-339-1415	10	19					
15434	69793	5306-00-019-4227	24	3					
15434	69936	5310-00-222-7240	6	12					
15434	70089-1	5330-00-537-2382	2	9					
15434	70214		5	17					
15434	70295	4730-00-011-3175	30	4					
15434	70349	5306-00-719-5467	13	18					
15434	70624	5330-00-506-4874	35	4					
15434	70653	2815-00-772-9434	2	26					
15434	70657	2815-01-122-8002	5	1					
15434	70690	2990-00-772-1778	23	20					
15434	70699	5365-00-721-7884	24	15					
15434	70700	5360-00-597-4570	31	3					
15434	70705	5330-00-562-1176	27	12					
15434	70713	5340-00-898-1497	27	10					
15434	70715	5310-00-507-3259	27	4					
15434	70716	5305-00-506-5722	27	6					
15434	70717	5365-00-507-3260	27	9					
15434	70717A	5365-00-507-3261	27	9					
15434	707178	5365-00-507-3262	27	9					
15434	70772	5305-00-477-6769	9	6					
15434	70790	5306-00-485-0790	25	11					
15434	70790	5306-00-485-0790	26	13					
15434	70815	5330-00-580-5327	28	17					
15434	7348-2	2815-00-362-1780	10	14					
19207	8465575-44		15	5					
55683	851-202994	4720-01-070-8149	18	1					
24617	903302	3110-00-144-8499	24	13					
15434	9195-3	5306-00-041-0917	6	14					
15434	9235-1	3120-00-374-4342	7	7					
15434	9237	5305-00-362-1536	10	26					

SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM NO	SMR CODE	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
GROUP 01 ENGINE						
GROUP 0100 ENGINE ASSEMBLY						
FIG. 1 ENGINE MOUNTING BRACKETS						
1	XDFZZ	89346	R99227C3	BOLT, MACHINE	2	
2	XDFZZ	89346	427820C1	WASHER, FLAT	4	
3	XDFZZ	89346	25711R1	WASHER, FLAT	8	
4	PAFZZ	96906	MS35338-50	WASHER, LOCK	8	
5	XDFZZ	89346	24874R1	BOLT, HEXAGON HEAD	8	
6	XDFZZ	89346	46522502	BRACKET FRONT ENGINE MTG	1	
7	PPFZZ	89346	414089C1	SHOULDERED NUT	2	
8	XDFZZ	89346	187893R1	WASHER, FLAT	2	
9	XDFZZ	89346	476669C1	WASHER, INSULATOR	4	
10	XDFZZ	89346	441889C2	CROSSMEMBER ENGINE FRONT MTG	1	
11	XDFZZ	89346	446002R1	WASHER, SPECIAL	2	
12	PPFZZ	89346	414085C1	BOLT, SHOULDER HEAD	2	
13	XDFZZ	89346	19581R1	NUT, SLOTTED, HEXAGON	2	
14	PPFZZ	96906	MS24665-355	PIN, COTTER	2	
15	PPFZZ	89346	299228C1	INSULATOR REAR ENGINE MTG LOWER	2	
16	PPFZZ	89346	96 97 83R1	INSULATOR REAR ENGINE MTG UPPER	2	
17	XDFZZ	89346	424140C2	BRACKET REAR ENGINE MTG LEST SIDE	1	
17	XDFZZ	89346	424141C2	BRACKET REAR ENGINE MTG RIGHT SIDE	1	

END OF FIGURE

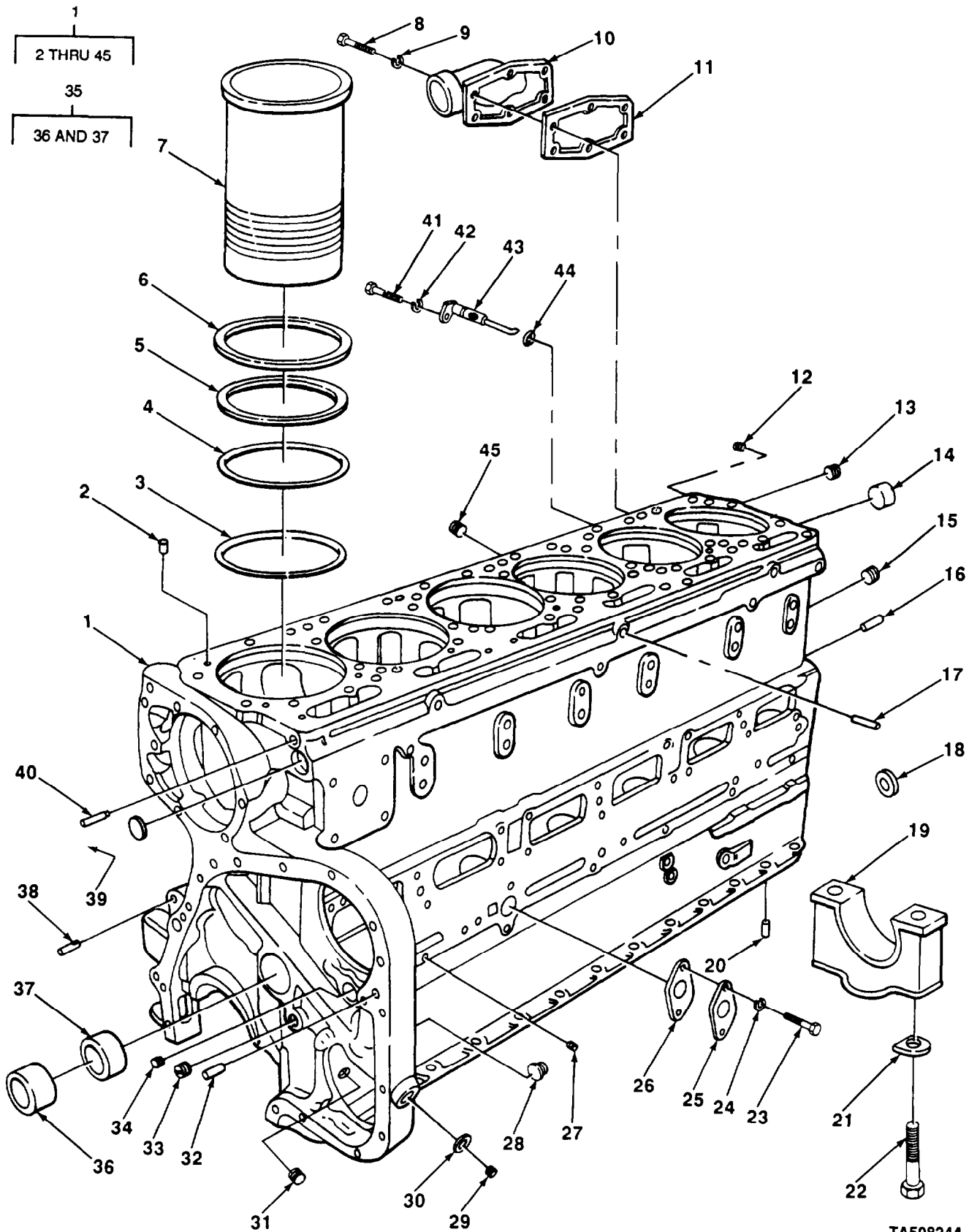


FIGURE 2. CYLINDER BLOCK.

TA508244

SECTION II			TM 5-2815-241-34&P		(5)	(6)
(1)	(2)	(3)	(4)			
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES(UOC)	QTY	
<b>GROUP 0101 CRANKCASE, BLOCK, CYLINDER HEAD</b>						
<b>FIG. 2 CYLINDER BLOCK</b>						
1	XDH	89346	AR-09912	BLOCK ,CYLINDER		1
2	PAH	15434	68445	. PIN, GROOVE, HEADLES HEAD TO BLOCK		6
3	PAH	15434	183049	. PACKING, PREFORMED		6
4	PAH	15434	3008998	. PACKING		6
5	PAH	15434	215090	. GASKET		6
6	PAH	15434	143938	. SHIM 0.007 IN. THK		1
6	PAH	15434	143939	. SPACER, RING 0.008 IN. THK		1
6	PAH	15434	143946	. SHIM 0.008 IN. THK		1
6	XDH	15434	143947	. SPACER, RING 0.020 IN. THK		1
6	PAH	15434	143948	. SHIM 0.031 IN. THK		1
6	PAH	15434	143949	. SHIM 0.062 IN. THK		1
7	PAH	15434	213740	. CYLINDER SLEEVE		6
7	XDH	15434	202226	. SLEEVE, SALVAGE		6
8	PAH	24617	S-118-A	. SCREW, ASSEMBLED WAS		12
9	PAH	24617	S-600	. WASHER, LOCK		12
10	XDH	89346	210895	. COVER WATER HEADER		1
11	PAH	15434	70089-1	. GASKET WATER HEADER COVER PART OF KIT P/N 3018762		2
12	PAH	15434	112076	. PLUG, FUEL OUTLET		3
13	PAH	15434	S-966E	. PLUG ,PIPE		1
14	PAH	96906	MS35648-8	. PLUG, EXPANSION		1
15	PAH	15434	69901	. PLUG, PIPE		7
16	PAH	15434	9226	. PIN, STRAIGHT, HEADLE FLYWHEEL HOUSING		2
17	PAH	15434	68585	. PIN, STRAIGHT, HEADLE CAM FOLLOWER TO BLOCK HOUSING		6
18	PAH	15434	199064	. BASKET, HOUSING DRY		1
18	PAH	15434	9333-1	. GASKET, HOUSING WET		1
19	PAH	15434	42645	. CAP, MAIN BEARING NO. 1,3,5		3
19	PAH	15434	42646	. CAP, PILLOW BLOCK NO. 2,4,6		3
19	PAH	15434	42647	. CAP, MAIN BEARING NO. 7		1
20	PAH	19207	5329388	. PIN, STRAIGHT, HEADLE MAIN BEARING TO BLOCK		2
21	PAH	15434	3009213	. WASHER, LOCK		14
22	PAH	15434	105953	. BOLT, MACHINE HEAD MAIN BEARING CAP		14
23	PAH	15434	S129	. SCREW, CAP, HEXAGON H HEAD		2
24	PAH	15434	S604	. WASHER, LOCK		6
25	PAH	15434	132648	. FLANGE BLIND OIL		1
26	PAH	15434	67963	. GASKET SUCTION FLANGE		1
27	PAH	15434	S-911-B	. PLUG, PIPE		2
28	PAH	15434	199067	. PLUG, PIPE		2
29	PAH	15434	210884	. PLUG, MACHINE THREAD		1
30	PAH	15434	66292	. WASHER, FLAT		1
31	PAH	15434	3008468	. PLUG, PIPE		3
32	PAH	15434	70653	. DOWEL, METALLIC COVER		1
33	PAH	15434	67622	. PLUG, PIPE		1
34	PAH	15434	3008469	. PLUG, PIPE		1

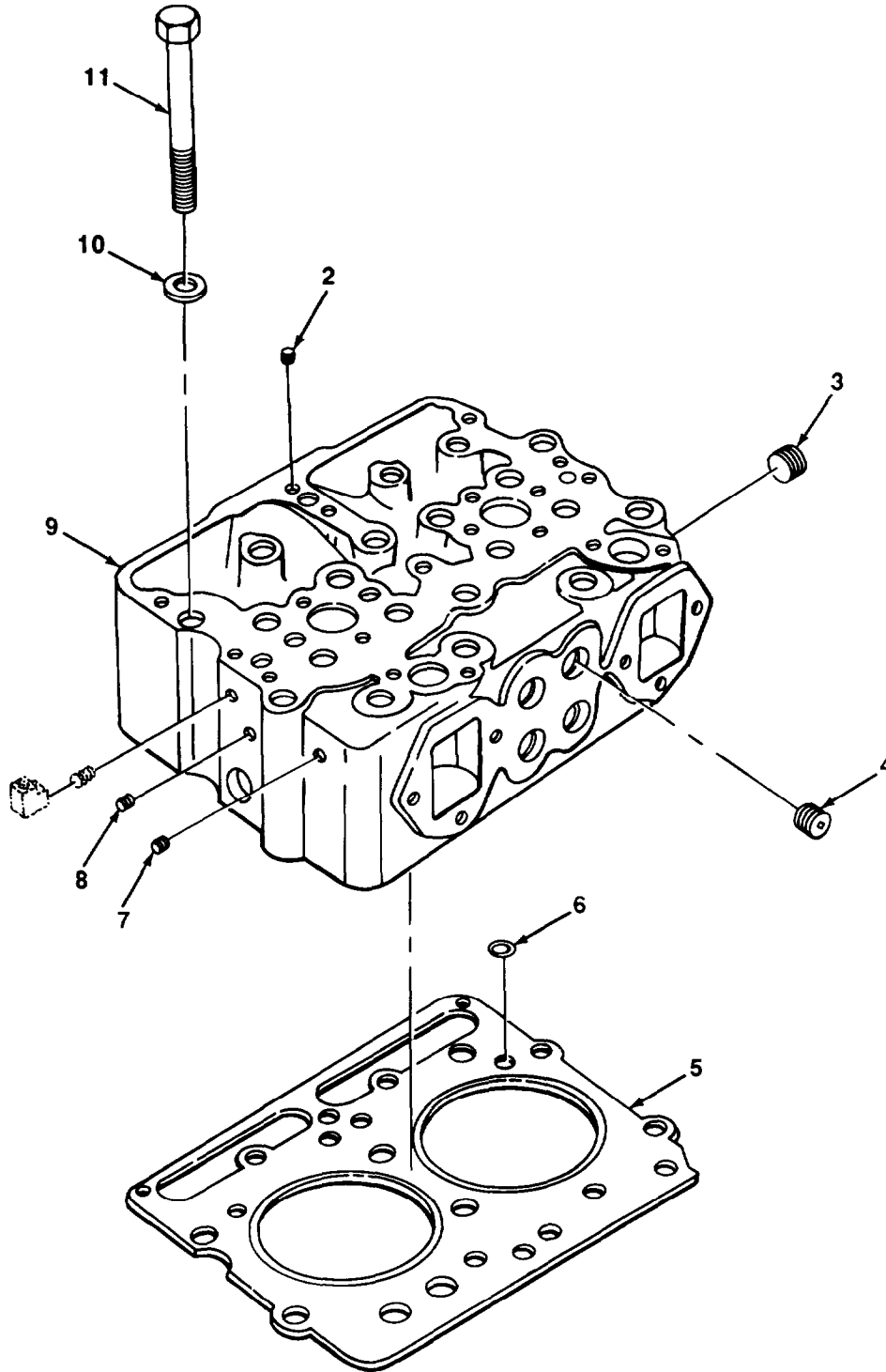
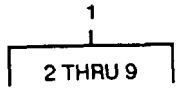
## SECTION II

TM 5-2815-241-34&amp;P

(1) ITEM NO	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES(UOC)	(6) QTY
35	PAHZZ	15434	BM 427253	.BEARING SET, SLEEVE CAPSHAFT..	1
36	PAHZZ	15434	100670	. .BEARING ,SLEEVE	1
37	PAHZZ	15434	157870	. .BEARING ,SLEEVE	6
38	PAHZZ	15434	60408	.PIN, STRAIGHT ,HEADLE GEAR COVER	1
39	PAHZZ	15434	S719	.PLUG, EXPANSION..	1
40	PAHZZ	15434	68445	.PIN STRAIGHT HEXAGO	2
41	XDHZZ	89346	3010395	.SCREW,CAP,HEXAGON HEAD	6
42	PAHZZ	15434	S-605	. WASHER ,LOCK	6
43	XDHZZ	89346	3007976	.NOZZLE	6
44	PAHZZ	15434	3007442	.PACKING, PREFORMED PART OF KIT P/N 3018762	6
45	PAHZZ	15434	S962	.PLUG, PIPE	1

END OF FIGURE





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FIGURE 3. CYLINDER HEAD.

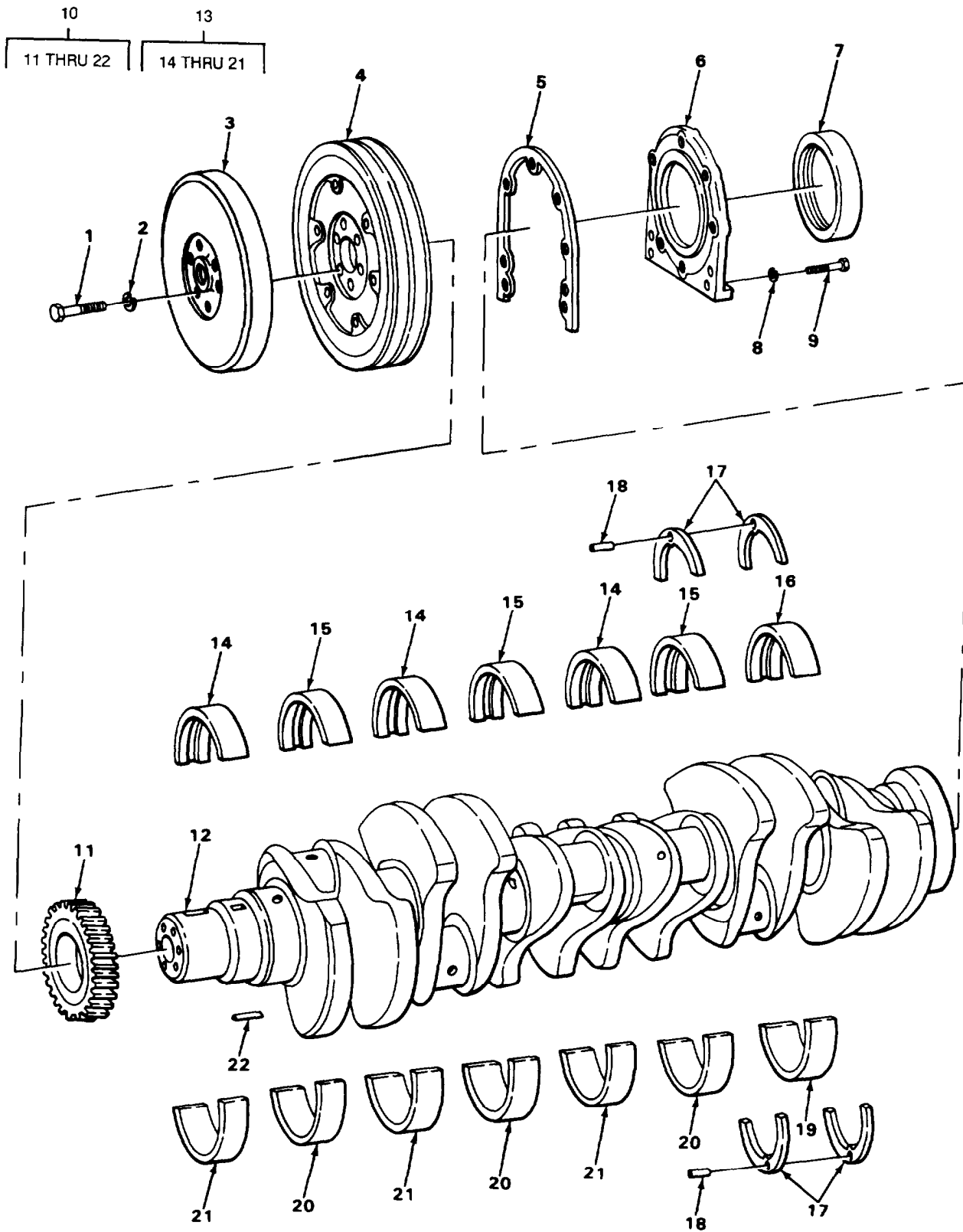


## SECTION II

TM 5-2815-241-34&amp;P

(1) ITEM NO	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES(UOC)	(6) QTY
				GROUP 0101 CRANKCASE, BLOCK CYLINDER HEAD	
				FIG. 3 CYLINDER HEAD	
1	PAFHH	15434	3007716	CYLINDER HEAD, DIESE	3
2	PAHZZ	15434	S965E	.PLUG, MACHINE THREAD	3
3	PAHZZ	15434	S995	.PLUG, PIPE	6
4	PAHZZ	15434	216524	.PLUG, PIPE	2
5	PAFZZ	15434	3047402	.GASKET CYLINDER HEAD PART OF KIT P/N 3801330	1
6	PAFZZ	15434	193949	.GASKET	21
7	PAHZZ	15434	70459	.PLUG, FUSIBLE	1
8	PAHZZ	15434	S911B	.PLUG, PIPE	4
9	PAFDD	15434	3008100	.CYLINDER HEAD, DIESE..	1
10	PAFZZ	15434	69699	WASHER, FLAT	12
11	PAFZZ	15434	209700	SCREW	12

END OF FIGURE



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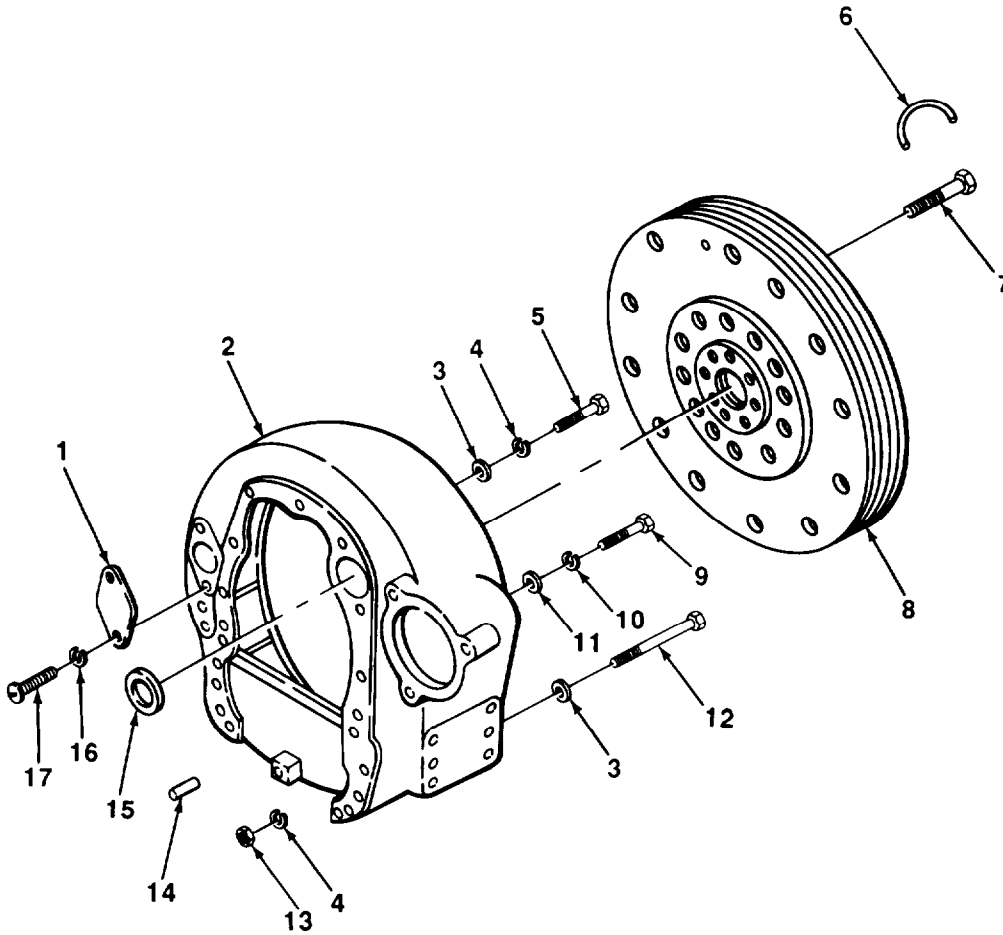
FIGURE 4. CRANKSHAFT, GEARS, AND BEARINGS.

SECTION II

TM 5-2815-241-34&P

(1) ITEM NO	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES(UOC)	(6) QTY
GROUP 0102 CRANKSHAFT					
FIG. 4 CRANKSHAFT, GEARS, AM BEARINGS					
1	PAFZZ	15434	204165	SCREW, CAP, HEXAGON HEAD	6
2	PAFZZ	15434	127316	WASHER, LOCK	6
3	XDFZZ	15434	211915	DAMPER, VIBRATION	1
4	PAFZZ	15434	211918	PULLEY, GROOVE	1
5	PAHZZ	15434	40662A	GASKET REAR COVER PART OF KIT, P/N 3018762	1
6	PAHZZ	15434	209919	COVER, TIMING GEAR,	1
7	PAHZZ	15434	204829	SEAL REAR OIL PART OF KIT P/N 3018762	1
8	PAHZZ	15434	S604	WASHER, LOCK	8
9	PAHZZ	96934	MS90727-64	SCREW, CAP, HEXAGON H HEAD	8
10	PAHHH	15434	3004165	CRANKSHAFT, ENGINE	1
11	PAHZZ	15434	215965	.GEAR, HELICAL	1
12	PAHZZ	15434	3000140	.CRANKSHAFT, ENGINE	1
13	PAHZZ	15434	3801261	.BEARING HALF SET, SL 0.010 INCH UNDERSIZE	1
13	PAHZZ	15434	3801262	.BEARING HALF SET, SL 0.020 INCH UNDER SIZE	1
13	PAHZZ	15434	3801263	BEARING HALF SET, SL 0.030 INCH UNDER SIZE	1
13	PAHZZ	15434	AR-07110	.BEARING SET STANDARD	1
14	PAHZZ	15434	44383	..BEARING HALF, SLEEVE STANDARD	3
15	PAHZZ	15434	3019186	. .BEARING HALF, SLEEVE STANDARD	3
16	PAHZZ	15434	44387	..BEARING HALF, SLEEVE STANDARD	1
17	PAHZZ	15434	3019218	..BEARING, WASHER, THRU STANDARD	4
18	PAHZZ	15434	202903	..PIN STRAIGHT HEXAGO STANDARD	2
19	PAHZZ	15434	187680	..BEARING HALF, SLEEVE STANDARD	1
20	XDHZZ	15434	3019192	..BEARING, HALF SLEEVE STANDARD	3
21	PAHZZ	15434	3019180	..BEARING HALF, SLEEVE STANDARD	3
22	PAHZZ	15434	210179	.KEY, MACHINE	1

END OF FIGURE



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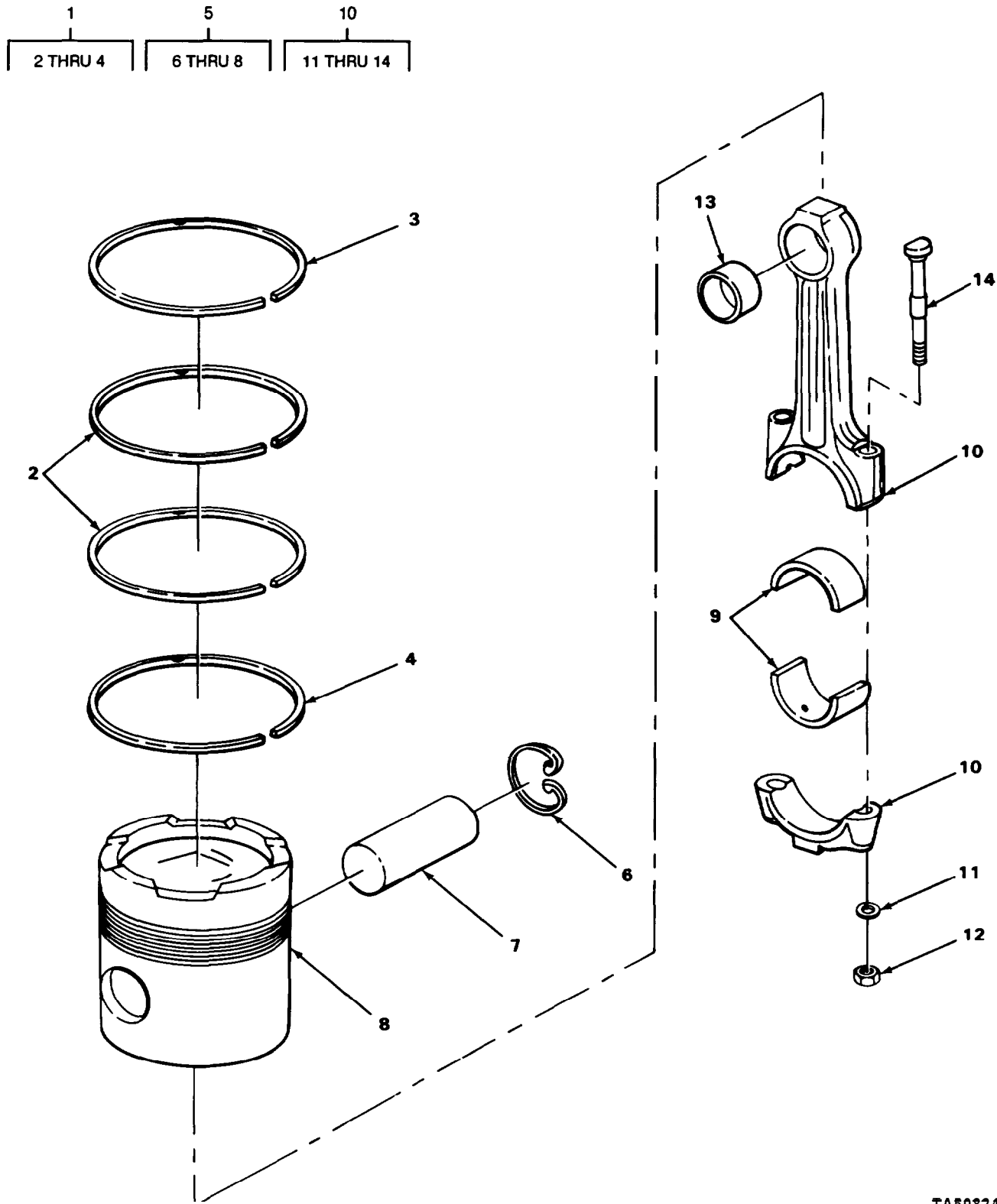
FIGURE 5. FLYWHEEL HOUSING AND FLEXPATE.

## SECTION II

TM 5-2813-241-34&amp;P

(1) ITEM NO	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES(UOC) GROUP 0103 FLYWHEEL ASSEMBLY  FIG. 5 FLYWHEEL HOUSING AND FLEXPLATE	(6) QTY
1	PAFZZ	15434	70657	COVER, ACCESS BRASS	1
2	XDFZZ	15434	193717	HOUSING, FLYWHEEL	1
3	PAFZZ	15434	S601	WASHER, FLAT PAN	7
4	PAFZZ	96906	MS35338-48	WASHER, LOCK	7
5	XDFZZ	15434	S106	SCREW, CAP, HEXAGON HEAD	4
6	PAFZZ	15434	64482	LOCKWIRE, BOLT, FLYWH	3
7	XDFZZ	15434	120448	SCREW, CAP, HEXAGON HEAD	6
8	XDFZZ	15434	123000	FLEXPLATE	1
9	PAFZZ	15434	188936	SCREW, CAP	9
10	PAFZZ	15434	S603	WASHER, LOCK	9
11	PAFZZ	15434	S658	WASHER, FLAT	9
12	PAFZZ	15434	106289	SCREW, CAP, HEXAGON H HEAD	3
13	PAFZZ	15434	S200	NUT, PLAIN, HEXAGON	3
14	PAFZZ	24617	141284	PIN, STRAIGHT, HEADLE	2
15	PFFZZ	15434	199064	GASKET FLYWHEEL HOUSING PART OF KIT P/N 3018762	1
16	PAFZZ	96906	MS122032	WASHER, LOCK PART OF KIT P/N 3018762	2
17	PAFZZ	96939	MS35204-239	SCREW, MACHINE	2

END OF FIGURE



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FIGURE 6. PISTON AND CONNECTING ROD.

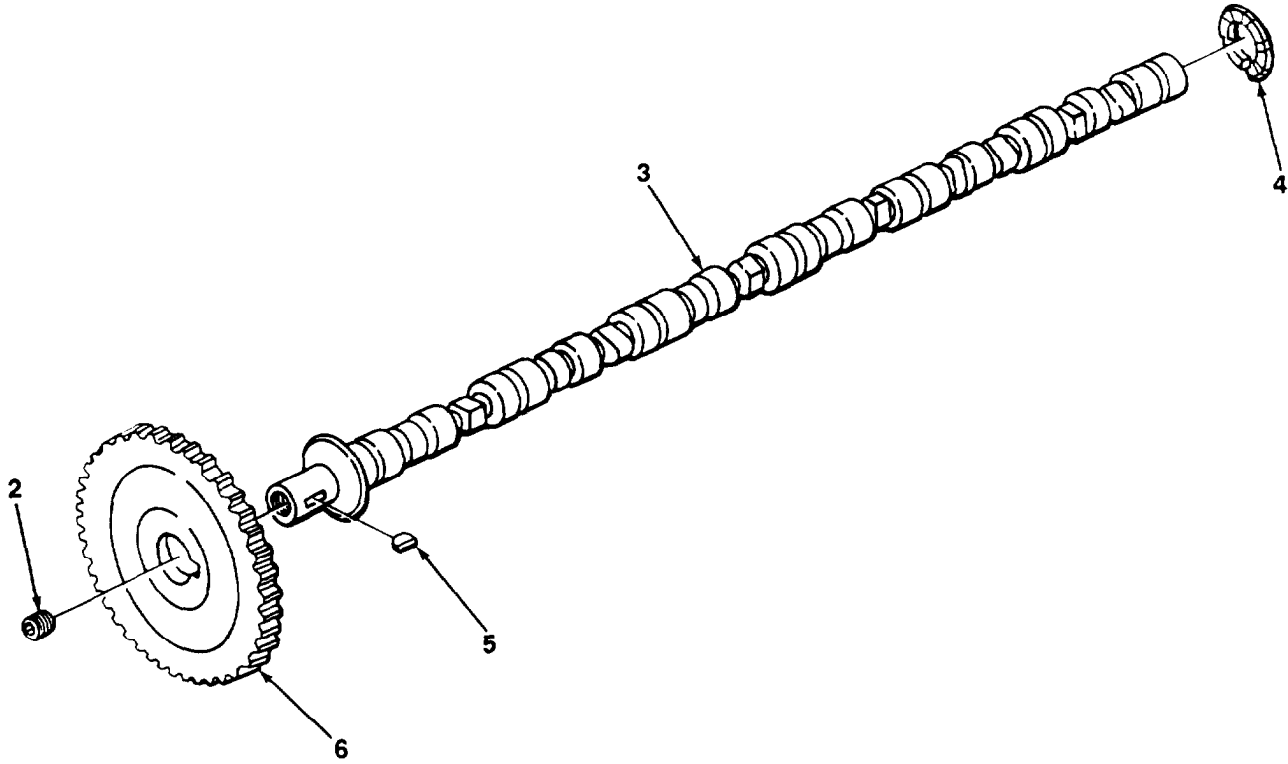
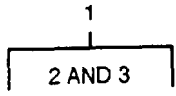
SECTION II			TM 5-2815-241-34&P		
(1)	(2)	(3)	(4)	(5)	(6)
ITEM	SMR		PART		
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES(UOC)	QTY

GROUP 0104 PISTONS, CONNECTING RODS

**FIG. 6 PISTON AND CONNECTING ROD**

1	PAHZZ	15434	3014149	RING SET, PISTON	6
2	PFHZZ	15434	132880	.RING ,PISTON	2
3	PAHZZ	15434	147670	.RING, PISTON	1
4	PAHZZ	15434	194610	.RING, PISTON	1
5	PFHHH	15434	AR-08190	PISTON ASSEMBLY	6
6	PFHZZ	15434	175755	.RING, RETAINING	2
7	PAHZZ	15434	191970	.PIN, PISTON	1
6	XDHZZ	15434	203090	.PISTON	1
9	PAHZZ	15434	214950	BEARING	12
10	PAHHH	15434	BM 52474	CONNECTING ROD, PIST	6
11	PAHZZ	15434	200861	.WASHER, FLAT	2
12	PAHZZ	15434	69936	.NUT, PLAIN, HEXAGON	2
13	PAHZZ	15434	187420	.BUSHING, PISTON PIN	1
13	XDHZZ	15434	152770	.BUSHING, HEAVY WALL	1
14	PAHZZ	15434	9195-3	.BOLT, CONNECTING ROD	2

END OF FIGURE



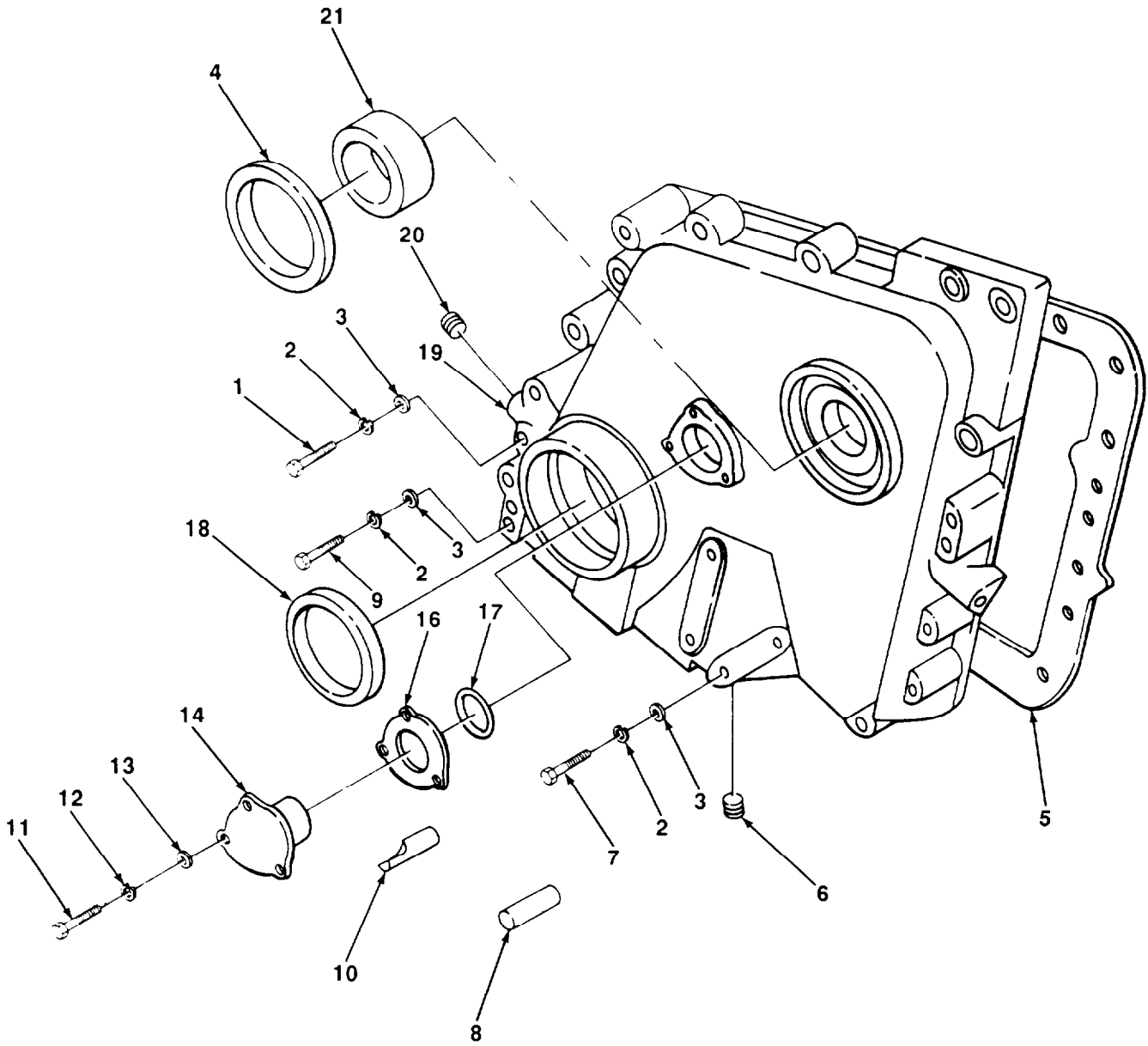
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FIGURE 7. CAMSHAFT.



SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
				GROUP 6105 VALVES, CAMSHAFTS, AND TIMING SYSTEM		
				FIG. 7 CAMSHAFT		
1	XDHHH	15434	3023177	CAMSHAFT, SERVICE AS	1	
2	PAFZZ	15434	68193	. PLUG, VENT	1	
3	PAHZZ	15434	143450	. CAMSHAFT, ENGINE	1	
4	PAHZZ	15434	9235-1	BEARING, WASHER, THRU	1	
5	PFFZZ	15434	69550	KEY, MACHINE CAMSHAFT GEAR	1	
6	PAFZZ	15434	156226	GEAR, CAMSHAFT	1	

END OF FIGURE



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FIGURE 8. GEARCASE COVER.

SECTION II			TM 5-2815-241-34&P		(5)	(6)
(1)	(2)	(3)	(4)			
ITEM NO	SMR CODE	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	GROUP 0105 VALVES, CAMSHAFTS, AND TIMING SYSTEM	QTY
				FIG. 8 GEARCASE COVER		
1	PAFZZ	15434	S-119-C	SCREW, CAP, HEXAGON HEAD, TIMING GEAR COVER MTG		1
2	PAFZZ	96906	MS35338-47	WASHER, LOCK		13
3	PAFZZ	15434	S622	WASHER, FLAT		13
4	PAFZZ	15434	3004316	SEAL OIL PART OF KIT P/N 3018762		1
5	PAFZZ	15434	210412	GASKET GEAR COVER PART OF KIT P/N 3018762		1
6	PAFZZ	15434	S-908	PLUG, PIPE		3
7	PAFZZ	96906	MS90727-94	SCREW, CAP, HEXAGON H		3
8	PAFZZ	15434	60408	PIN, STRAIGHT, HEADLE		1
9	PAFZZ	96906	MS90727-91	SCREW, CAP, HEXAGON H		9
10	PAFZZ	15434	70653	DOWEL, METALLLC		1
11	PAFZZ	96906	MS18154-60	SCREW, CAP, HEXAGON H HEAD		3
12	PAFZZ	15434	S604	WASHER, LOCK		3
13	PAFZZ	96906	MS27183-14	WASHER, FLAT		3
14	PAFZZ	15434	150002	SUPPORT, CAMSHAFT		1
15	PAFZZ	15434	AR01176	SHIM SET CAMSHAFT THRUST		1
16	PAFZZ	15434	185573	. SHIM INSERT		1
16	PAFZZ	15434	65259-A	. SHIM 0.010 IN. THK		1
16	PAFZZ	15434	65259-B	. SHIM 0.005 IN. THK		1
16	PAFZZ	15434	65259-C	. SHIM 0.002 IN. THK		1
17	PAFZZ	15434	215705	PACKING, PREFORMED PART OF KIT P/N 3018762		1
18	PAFZZ	15434	3006736	SEAL, PLAIN ENCASED CRANKSHAFT		1
19	XDFFF	15434	AR09473	COVER, GEAR CASE		1
20	PAFZZ	15434	S-908	. PLUG, PIPE		1
21	PAFZZ	15434	3029852	. BEARING , SLEEVE		1

END OF FIGURE

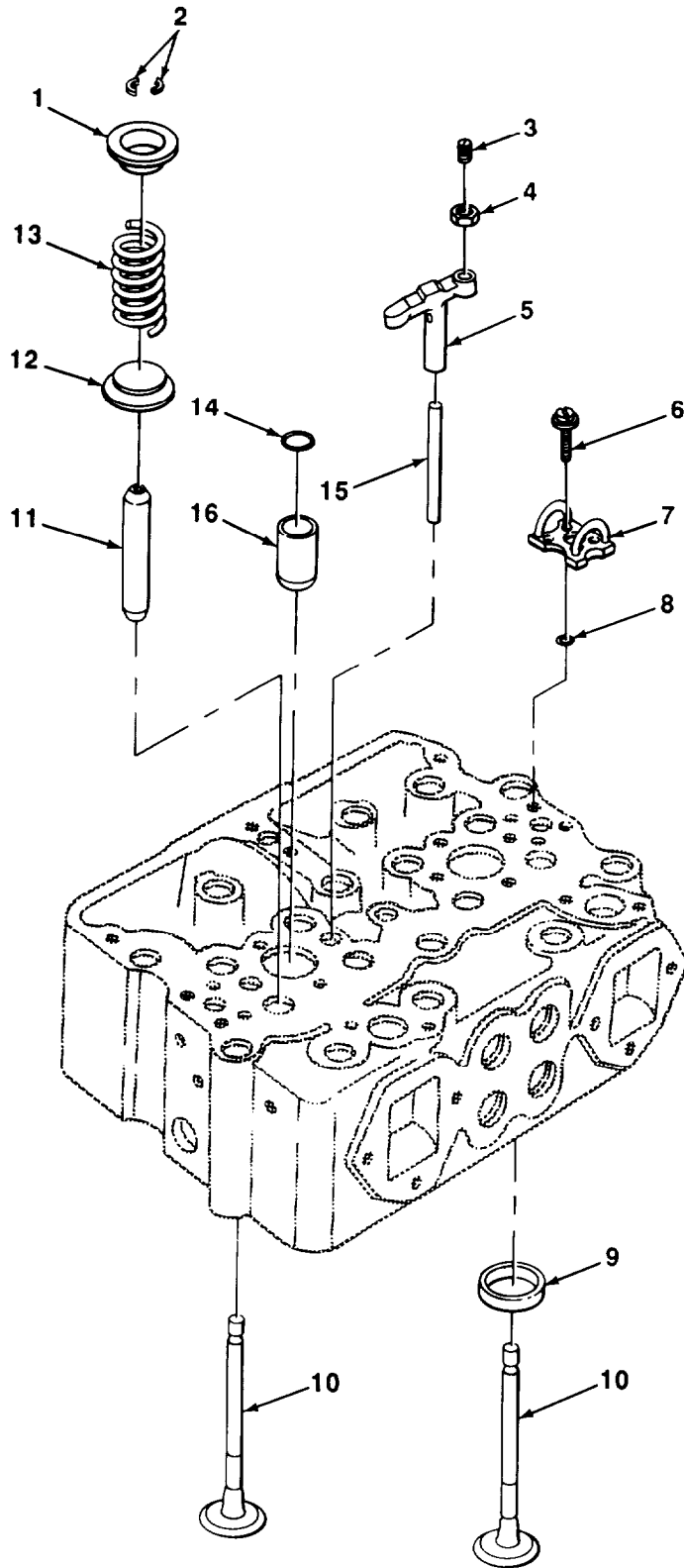
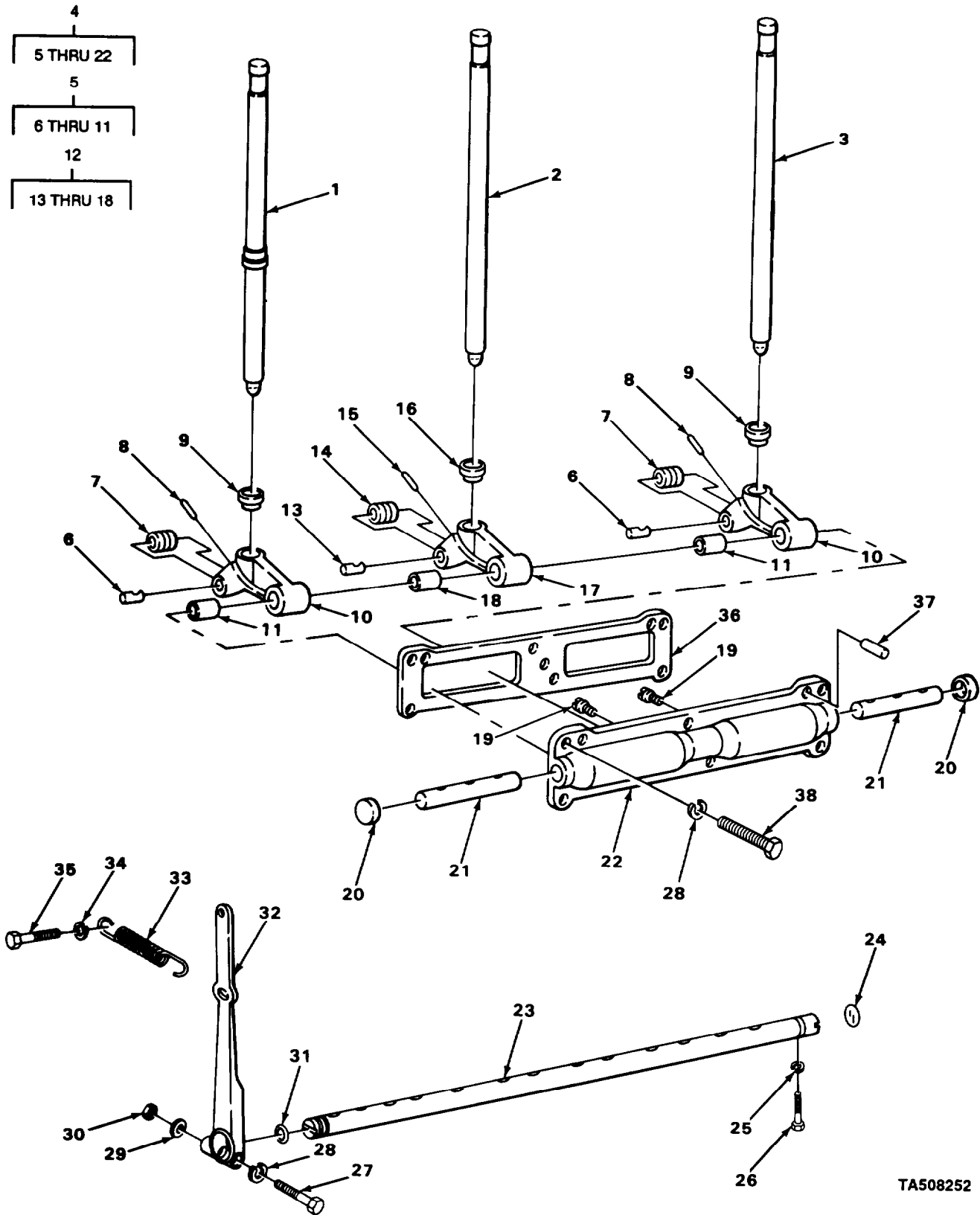


FIGURE 9. VALVES, SPRINGS, AND GUIDES.

SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
				GROUP 0105 VALVES, CAMSHAFTS, AND TIMING SYSTEM		
				FIG. 9 VALVES, SPRINGS, AND GUIDES		
1	PAFZZ	15434	170296	SEAT, HELICAL COMPRE	24	
2	PAFZZ	15434	127554	HALF-COLLET	48	
3	PAFZZ	15434	147389	SETSCREW	12	
4	PAFZZ	15434	203131	NUT, CROSS HD	12	
5	PAFZZ	15434	3036065	CROSSHEAD, VALVE INTAKE	6	
5	PAFZZ	75078	17339	CROSSHEAD, VALVE EXHAUST	6	
6	PAFZZ	15434	70772	SCREW, ASSEMBLED WAS	8	
7	PAFZZ	15434	147100	CROSSOVER, FUEL	2	
8	PAFZZ	15434	131026	PACKING, PREFORMED PART OF KIT P/N 3801330	8	
9	PAFZZ	15434	3017759	SEAT, VALVE EXHAUST, STANDARD	12	
9	PAFZZ	15434	127935	SEAT, VALVE 0.005 INCH OVERSIZE	12	
9	PAFZZ	15434	3014622	SEAT, VALVE 0.010 INCH OVERSIZE	12	
9	PAFZZ	15434	3014623	INSERT, VALVE SEAT 0.020 INCH OVERSIZE	12	
9	PAFZZ	15434	3014624	SEAT, VALVE 0.030 INCH OVERSIZE	12	
9	PAFZZ	15434	3014625	INSERT, VALVE SEAT 0.040 INCH OVERSIZE	12	
10	PAFZZ	15434	145701	VALVE, POPPET, ENGINE EXHAUST	12	
10	PAFZZ	15434	135957	VALVE, POPPET, ENGINE	12	
11	PAFZZ	15434	3006456	GUIDE, VALVE STEM	24	
12	PAFZZ	15434	172034	SEAT, HELICAL COMPRE	24	
13	PAFZZ	15434	211999	SPRING, HELICAL, COMP	24	
14	PAFZZ	15434	3007759	PACKING, PREFORMED PART OF KIT P/N 3801330	6	
15	PAFZZ	15434	123558	PIN, STRAIGHT, HEADLE	12	
16	PAFZZ	15434	3011935	SLEEVE, COOLING, FUEL	6	

END OF FIGURE



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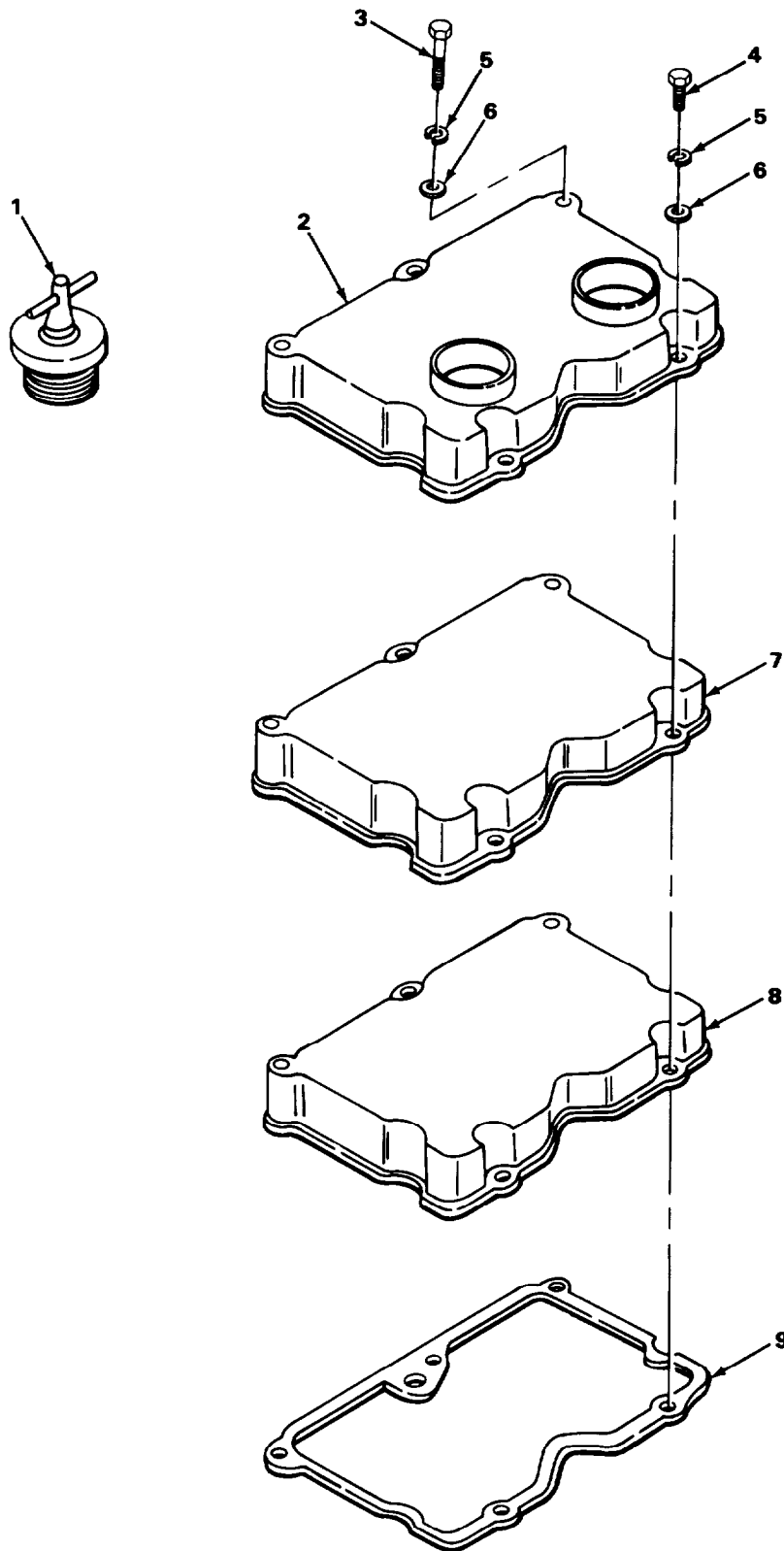
FIGURE 10. PUSHRODS AND CAM FOLLOWERS.

## SECTION II

TM 5-2815-241-34&amp;P

(1) ITEM NO	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
				GROUP 0105 VALVES, CAMSHAFTS, AND TIMING SYSTEM	
				FIG. 10 PUSHRODS AND CAM FOLLOWERS	
1	PAFZZ	15434	BM47777	PUSH ROD, EXHAUST VA	6
2	PAFZZ	15434	3027215	PUSH ROD, ENGINE POP	6
3	PAFZZ	15434	210650	ROD, PUSH, INTAKE	6
4	PAFFF	15434	BM37625	HOUSING ASSY, CAM FO	3
5	PAFFF	15434	BH37634	. LEVER ASSEMBLY, CAM INTAKE AND EXHAUST	4
6	PAFZZ	15434	68513	. . PIN, STRAIGHT, HEADLE	1
7	PAFZZ	15434	9260-1	.. ROLLER, VALVE CAM	1
8	PAFZZ	15434	118939	.. PIN, STRAIGHT, HEADLE	1
9	PAFZZ	15434	107738	.. SOCKET, CAM FOLLOWER	1
10	XDFZZ	15434	120543	. . CAM FOLLOWER LEVER AND BUSHING	1
11	PAFZZ	15434	118378	.. BEARING, SLEEVE	1
12	PAFFF	15434	3018049	. LEVER ASSEMBLY, INJE INJECTOR	2
13	PAFZZ	15434	68512	.. PIN, STRAIGHT, HEADLE	1
14	PAFZZ	15434	7348-2	.. ROLLER, INJECTOR CAM	1
15	PAFZZ	15434	118939	.. PIN, STRAIGHT, HEADLE	1
16	PAFZZ	15434	107738	.. SOCKET, CAM FOLLOWER	1
17	XDFZZ	15434	BM-37496	.. CAM FOLLOWER LEVER AND BUSHING	1
18	PAFZZ	15434	118377	. . BEARING, SLEEVE	1
19	PAFZZ	15434	69736	. SCREW, MACHINE	6
20	PAFZZ	15434	175831	. PLUG, EXPANSION	2
21	PAFZZ	15434	3065125	. SHAFT, STRAIGHT	2
22	PAFZZ	15434	BM73976	. HOUSING, CAM FOLLOWER	1
23	XDFZZ	15434	210685	SHAFT	1
24	PAFZZ	15434	S719	PLUG, EXPANSION	1
25	PAFZZ	96906	MS51092-1	WASHER, FLAT COPPER	1
26	PFFZZ	15434	9237	SETSCREW SHAFT LOCK	1
27	XDFZZ	15434	208411	BOLT, MACHINE CARRIAGE	1
28	PAFZZ	96906	MS35338-8	WASHER, LOCK	19
29	PAFZZ	96906	MS27183-14	WASHER, FLAT	1
30	PAFZZ	15434	S223	NUT HEXAGON	1
31	PFFZZ	15434	43696	PACKING, PREFORMED	1
32	XDFZZ	15434	208581	LEVER COMPRESSION RELEASE	1
33	XDFZZ	15434	139289	SPRING	1
34	PAFZZ	96906	MS35338-45	WASHER, LOCK	1
35	PAFZZ	96906	MS90727-31	BOLT, MACHINE	1
36	PAFZZ	15434	120819	GASKET 0.026 THK PART OF KIT P/N 3018762	1
36	PAFZZ	15434	9266	GASKET 0.015 THK PART OF KIT P/N 3018762	1
36	PAFZZ	15434	9266A	GASKET 0.007 THK PART OF KIT P/N 3018762	1
37	PAFZZ	15434	68586	BEARING, SLEEVE	6
38	PAFZZ	15434	S129	SCREW, CAP, HEXAGON H	18

END OF FIGURE



TA508253

FIGURE 11. ROCKER HOUSING COVER AND BREATHER.

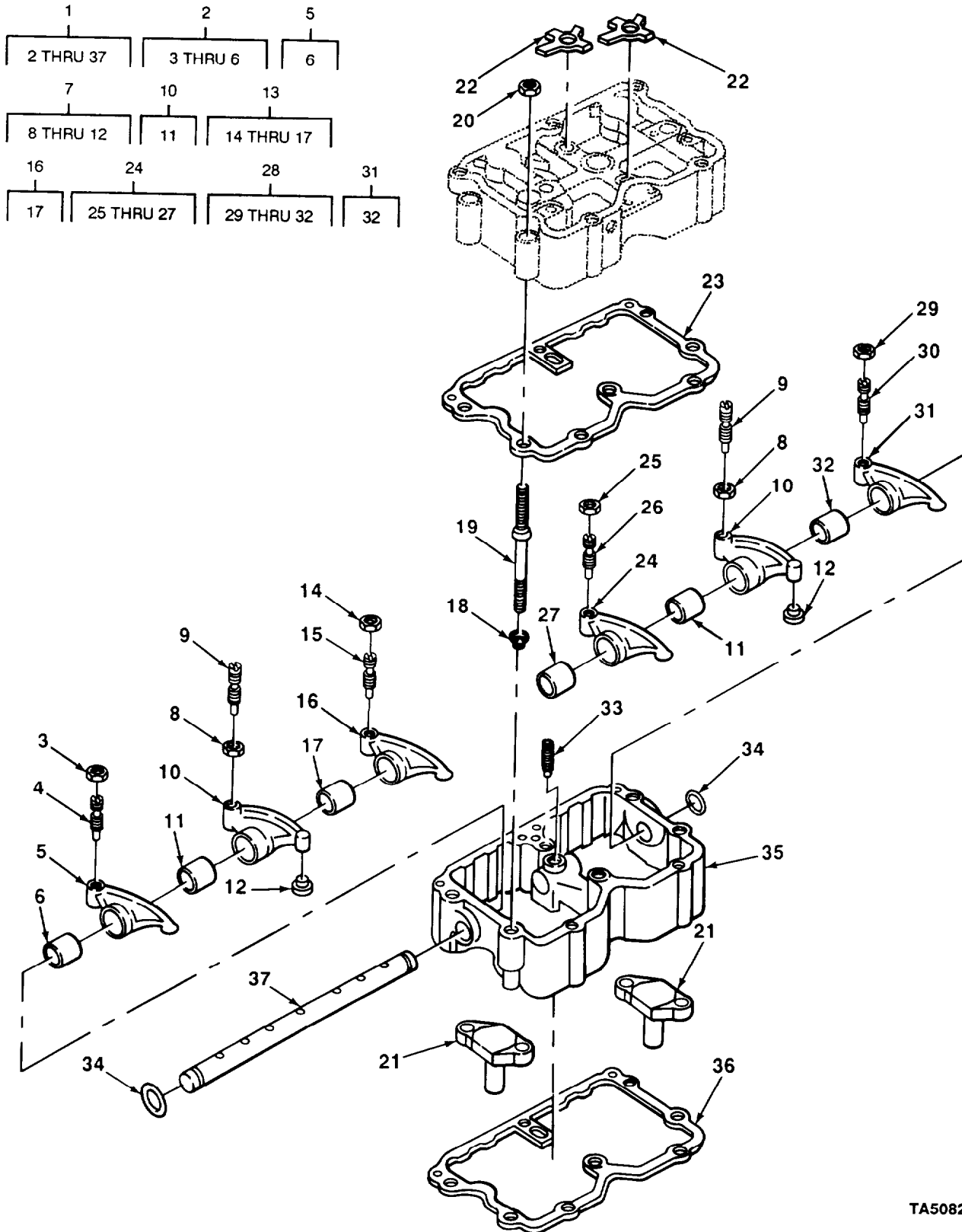


**SECTION II**

**TM 5-2815-241-34&P**

(1) ITEM NO	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
				GROUP 0105 VALVES, CAMSHAFTS, AND TIMING SYSTEM	
				FIG. 11 ROCKER HOUSING COVER AND BREATHER	
1	PAOZZ	15434	131322	CAP, FILLER OPENING	1
2	PAFZZ	15434	3006187	COVER, ENGINE POPPET HOUSING	1
3	PAFZZ	96906	MS90728-66	SCREW, CAP, HEXAGON H COVER MTG	9
4	PAFZZ	96906	MS18154-60	SCREW, CAP, HEXAGON H COVER MTG	6
5	PAFZZ	96906	MS35338-8	WASHER, LOCK COVER MTG	15
6	PAFZZ	96906	MS27183-14	WASHER, FLAT	15
7	PAFZZ	15434	3006183	COVER, ENGINE POPPET	1
8	PAFZZ	15434	3006358	COVER, ENGINE POPPET	1
9	PAFZZ	73165	B90429	GASKET	3

END OF FIGURE



TA508254

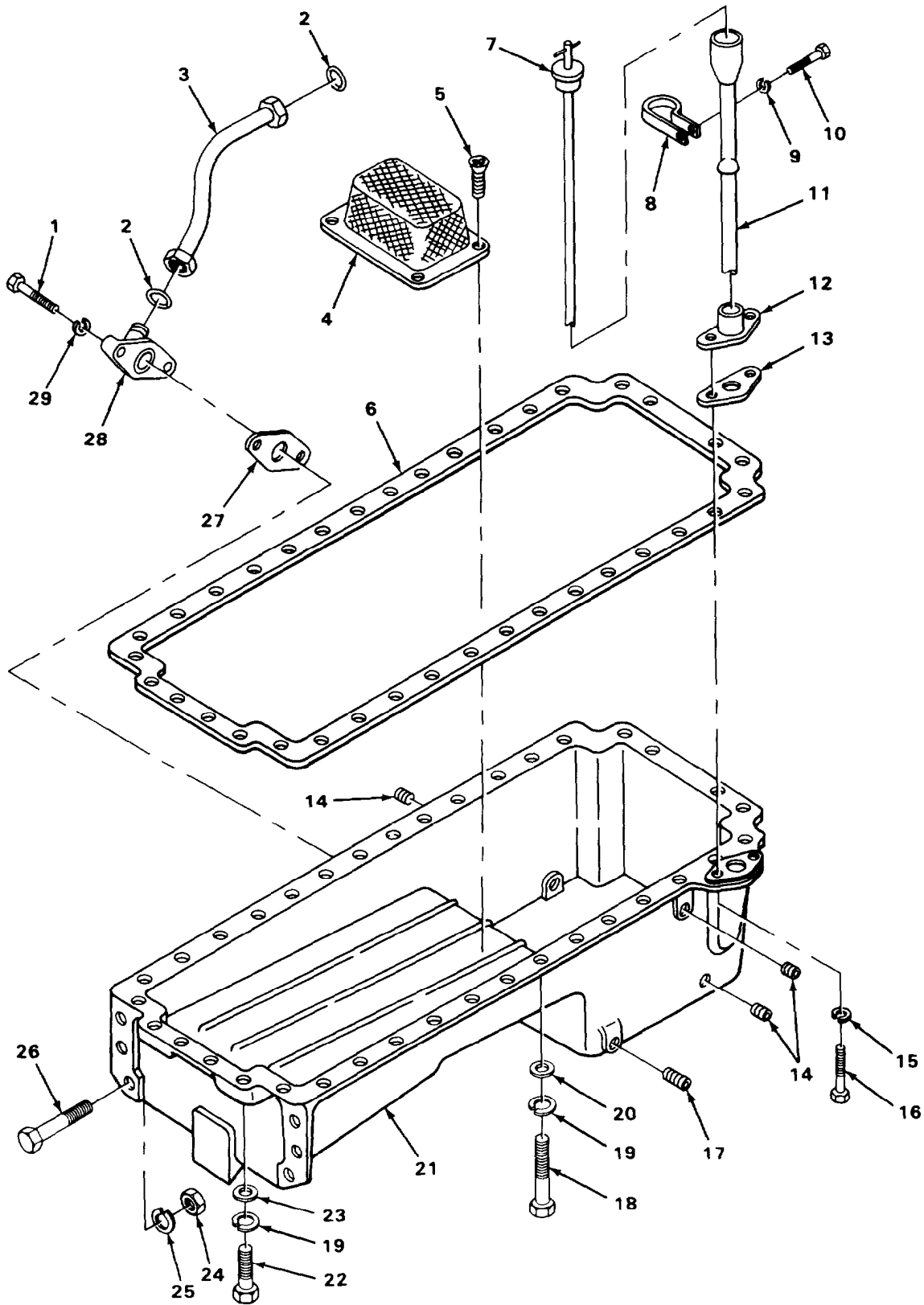
FIGURE 12. ROCKER ARMS AND HOUSING.

## SECTION II

TM 5-2815-241-34&amp;P

(1) ITEM NO	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
				GROUP 0105 VALVES, CAMSHAFTS, AND TIMING SYSTEM	
				FIG. 12 ROCKER ARMS AND HOUSING	
1	XDFFF	15434	AR03307	HOUSING AND ROCKER	3
2	PAFFF	15434	BM95161	. ROCKER ARM, ENGINE P EXHAUST	1
3	PAFZZ	96906	MS51968-14	.. NUT, PLAIN, HEXAGON	1
4	PAFZZ	15434	168306	.. SET SCREW	1
5	XDFFF	15434	169704	.. ARM AND BUSHING	1
6	PAFZZ	15434	140330	.. BUSHING, SLEEVE	1
7	PAFFF	15434	AR-02308	. ROCKER, ARM, ENGINE P INJECTOR	2
8	PAFZZ	96906	MS51968-14	.. NUT, PLAIN, HEXAGON	1
9	XDFZZ	15434	199239	.. SCREW, INJECTOR ARM ADJUSTING	1
10	XDFFF	15434	218152	.. ARM	1
11	PAFZZ	15434	140330	.. BUSHING, SLEEVE	1
12	PAFZZ	15434	194037	.. SEAT, BALL SOCKET	1
13	PAFFF	15434	AR51276	. ROCKER ARM, ENGINE P	2
14	PAFZZ	96906	MS51968-14	.. NUT, PLAIN, HEXAGON	1
15	PAFZZ	15434	168306	.. SET SCREW	1
16	XDFFF	15434	168805	.. ARM AND BUSHING	1
17	PAFZZ	15434	140330	.. BUSHING, SLEEVE	1
18	XDFZZ	75078	2514	. WASHER, BEARING	18
19	PAFZZ	75078	2856	. STUD	10
19	PAFZZ	75078	1232	. STUD, SHOULDERED	8
20	XDFZZ	15434	199224	. NUT, ROCKER	18
21	PAFZZ	15434	011573	. CROSSHEAD, VALVE EXHAUST VALVE	2
22	XDFZZ	75078	2680	. LOCKPLATE	2
23	XDFZZ	15434	3045533	. GASKET, HOUSING	1
24	PAFFF	15434	BM95162	. ROCKER ARM, ENGINE P	1
25	PAFZZ	96906	MS51968-14	.. NUT, PLAIN, HEXAGON	1
26	PAFZZ	15434	168306	.. SETSCREW	1
27	PAFZZ	15434	140330	.. BUSHING, SLEEVE	1
28	PAFFF	15434	BM95160	. ROCKER ARM, ENGINE P	1
29	PAFZZ	96906	MS51968-14	.. NUT, PLAIN, HEXAGON	1
30	PAFZZ	15434	168306	.. SETSCREW	1
31	XDFFF	15434	168803	.. ARM AND BUSHING	1
32	PAFZZ	15434	140330	.. BUSHING, SLEEVE	1
33	PAFZZ	15434	199225	. SCREW SHAFT LOCK	1
34	PAFZZ	15434	3000521	. PACKING, PREFORMED	2
35	PAFZZ	15434	3007242	. HOUSING, ROCKER ARM	1
36	PFFZZ	89346	187589	. GASKET HOUSING TO HEAD PART OF KIT P/N 3801330	1
37	PAFZZ	15434	3801433	. SHAFT, STRAIGHT	1

END OF FIGURE

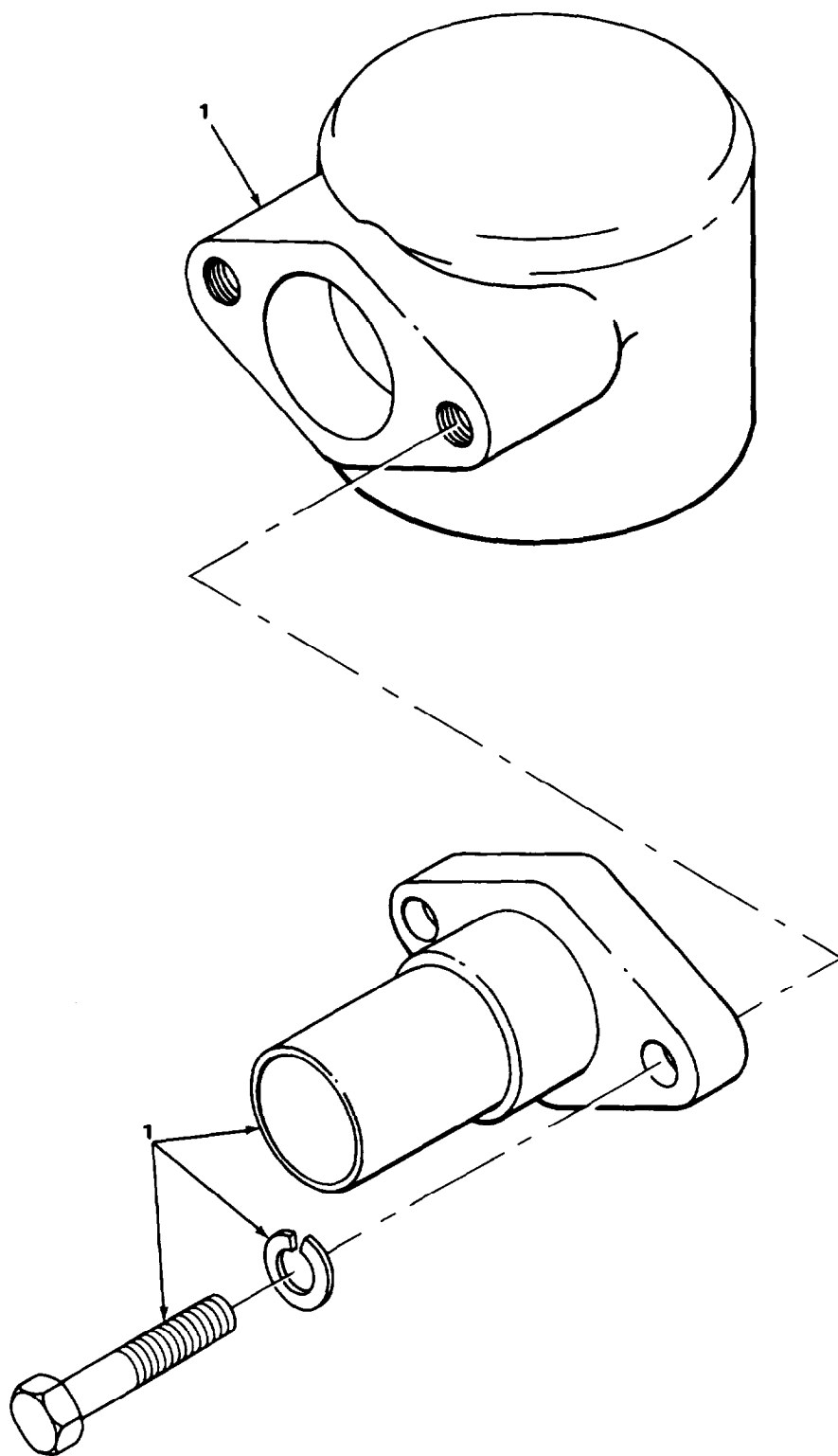


TA508255

FIGURE 13. OIL PAN AND DIPSTICK.

SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)		(5)	(6)
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER		DESCRIPTION AND USABLE ON CODES (UOC)	QTY
GROUP 0106 ENGINE LUBRICATION SYSTEM						
FIG. 13 OIL PAN AND DIPSTICK						
1	XDFZZ	15434	112593		SCREW, CAP, HEXAGON HEAD	2
2	PFFZZ	15434	197230		SEAL	2
3	XDFZZ	15434	3019400		HOSE	1
4	PAFZZ	15434	20622		STRAINER ELEMENT, SE OIL PAN	1
5	PAFZZ	15434	S1354		SCREW, TAPPING, THREA HEAD STRAINER	4
6	PAFZZ	15434	3032861		MTG GASKET OIL PAN PART OF KIT P/N 3018762	1
7	PFOZZ	15434	204657		GAGE ROD, LIQUID LEV OIL	1
8	PAOZZ	15434	200064		CLAMP, LOOP	1
9	PAOZZ	96909	MS35338-46		WASHER, LOCK	1
13	PAOZZ	96906	MS18154-58		SCREW, CAP, HEXAGON	1
11	PFOZZ	15434	211358		TUBE, METALLIC OIL	1
12	XDFZZ	15434	67347-1		BRACKET, OIL GAGE	1
13	XDFZZ	15434	67346		GASKET OIL GAGE BRACKET	1
14	PAOZZ	15434	S-915-A		PLUG, PIPE	4
15	PAFZZ	96906	MS35338-8		WASHER, LOCK	2
16	PAFZZ	96906	MS90727-87		SCREW, CAP, HEXAGON H	2
17	PAOZZ	80218	10003		PLUG, DRAIN	1
18	PAFZZ	15434	70349		BOLT, MACHINE	34
19	PAFZZ	96906	MS35338-47		WASHER, LOCK	38
20	PAFZZ	15434	S622		WASHER, FLAT	34
21	XDFZZ	15434	208461		PAN, OIL	1
22	PAFZZ	15434	185804		SCREW, CAP, HEXAGON H HEAD	4
23	PAFZZ	15434	S626		WASHER, FLAT	4
24	PAFZZ	96906	MS35690-865		NUT, HEXAGON	2
25	PAFZZ	96906	MS35338-48		WASHER, LOCK	2
26	PAFZZ	96906	MS90725-115		SCREW, CAP, HEXAGON	2
27	PAFZZ	15434	157551		GASKET SUCTION FLANGE PART OF KIT P/N 3018762	1
28	PFFZZ	15434	3012527		ELBOW, FLANGE TO TUB OIL SUCTION	1
29	PAFZZ	96906	MS35338-46		WASHER, LOCK	2

END OF FIGURE



TA508256

FIGURE 14. ENGINE BREATHER ASSEMBLY

**SECTION II**

**TM 5-2815-241-34&P**

(1)	(2)	(3)	(4)	(5)	(6)
ITEM	SMR		PART		
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY

GROUP 0106 ENGINE LUBRICATION SYSTEM

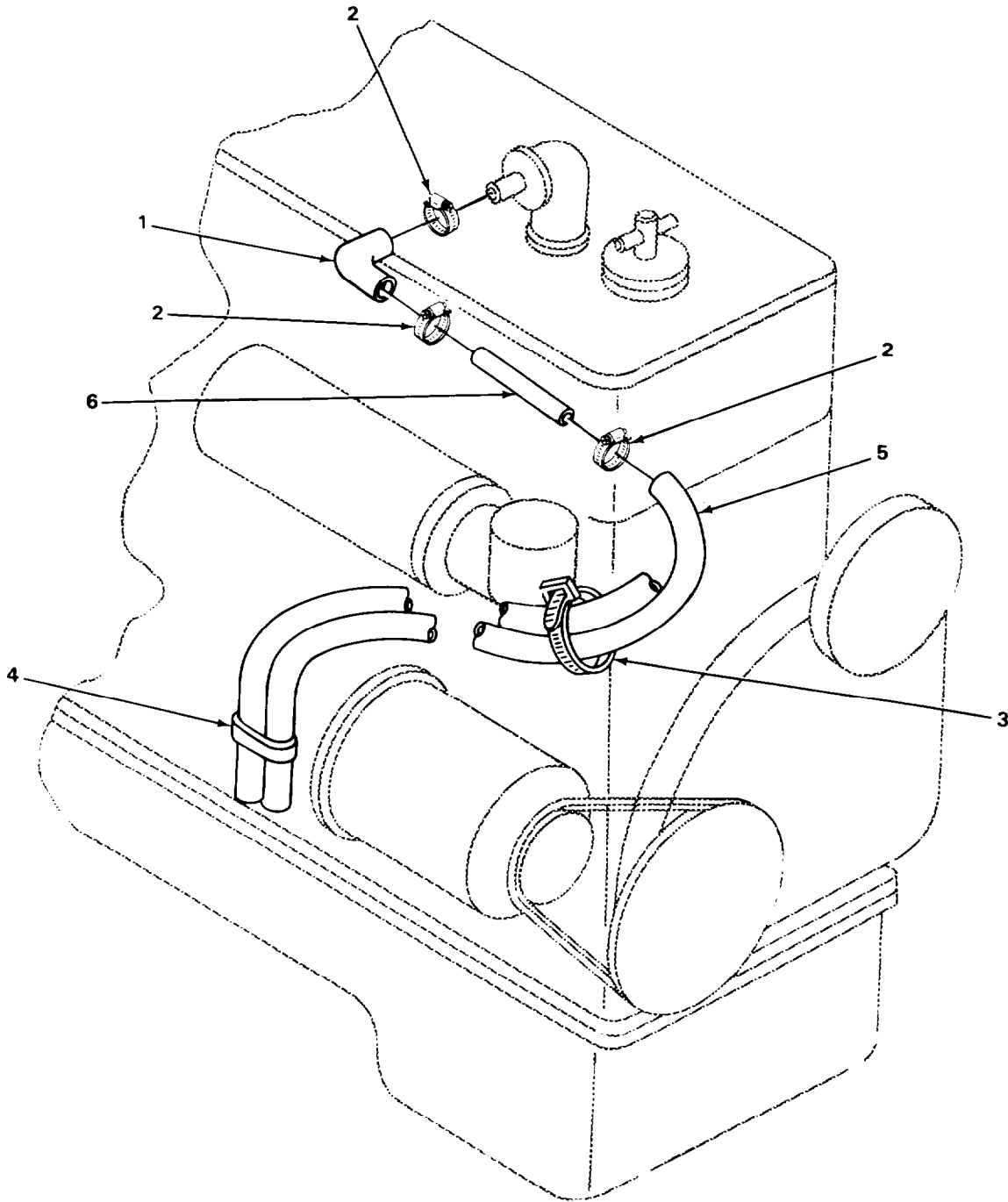
FIG. 14 ENGINE BREATHER ASSEMBLY

1 PAFZZ 33457 2S7225S

BREATHER ENGINE

1

END OF FIGURE



TA508257

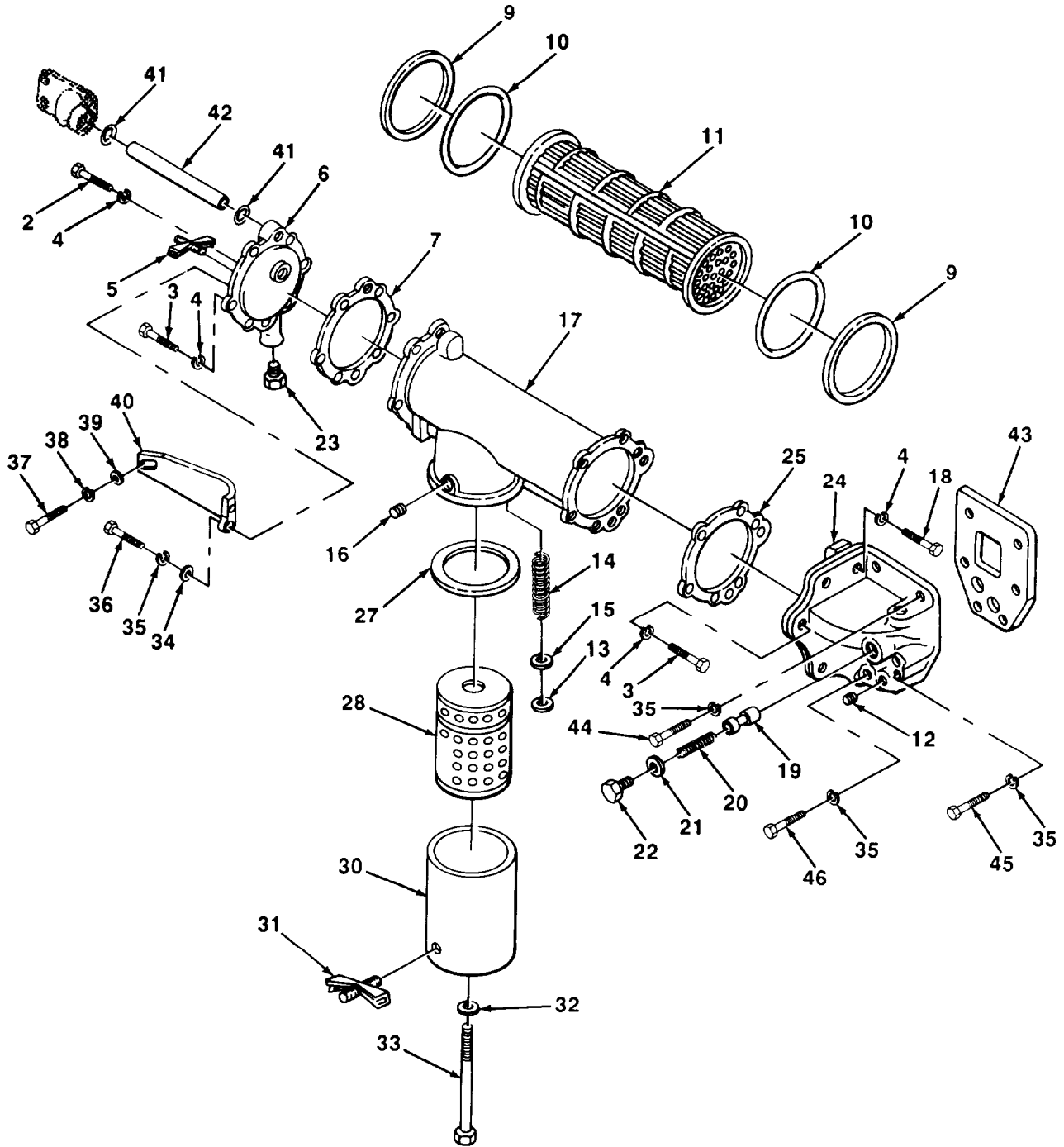
FIGURE 15. ENGINE BREATHER HOSE.



SECTION II			TM 5-2815-241-34&P		(5)	(6)
(1)	(2)	(3)	(4)			
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER		DESCRIPTION AND USABLE ON CODES (UOC)	QTY
					GROUP 0106 ENGINE LUBRICATION SYSTEM	
					FIG. 15 ENGINE BREATHER HOSE	
1	XDFZZ	15434	390782C1		HOSE, HEATER	1
2	XDFZZ	15434	274085R91		CLAMP, HOSE	3
3	XDFZZ	15434	209862C1		STRAP, CABLE LOCK	1
4	XDFZZ	15434	299263091		CLAMP, RUBBER CUSHIO	1
5	MFFZZ	19207	8465575-44		HOSE MANUFACTURE FROM NSN 4720-00-846-5575	1
6	XDFZZ	15434	364319C1		TUBE, HOSE	1

END OF FIGURE

1	8	13	26	29
2 THRU 26	9 THRU 18	14	27 THRU 33	30 THRU 33



TA508258

FIGURE 16. ENGINE OIL FILTER COOLER.

SECTION II			TM 5-2815-241-34&P		
(1)	(2)	(3)	(4)	(5)	(6)
ITEM	SMR		PART		
No	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY
GROUP 0106 ENGINE LUBRICATION SYSTEM					
FIG. 16 ENGINE OIL FILTER COOLER					
1	XDFFF	15434	AR09479	COOLER, OIL	1
2	PAFZZ	96906	MS90728-62	. SCREW, CAP, HEXAGON H	1
3	PAFZZ	96906	MS90725-67	. SCREW, CAP, HEXAGON H	10
4	PAFZZ	96906	MS35338-8	. WASHER, LOCK	12
5	PAFZZ	96906	MS35782-6	. DRAINCOCK	1
6	XDFZZ	15434	213858	. COVER	1
7	PAFZZ	15434	218245	. GASKET OIL COOLER COVER PART OF KIT P/N 3018762	1
8	XDFFF	15434	AR09478	. COOLER, OIL	1
9	PAFZZ	15434	142616	.. RETAINER, OIL COOLER	2
10	PAFZZ	15434	3007713	.. PACKING, PREFORMED PART OF KIT P/N 3018762	2
11	PAFZZ	46529	A331987	.. CORE, OIL COOLER	1
12	PAFZZ	15434	S-910-B	.. PLUG, PIPE	1
13	PAFZZ	15434	179063	.. SEAT, BYPASS FILTER	1
14	PFFZZ	15434	202128	... SPRING, FILLER BY-PA	1
15	XDFZZ	15434	201707	.. DISC, BY-PASS	1
16	PAFZZ	15434	S911B	.. PLUG, PIPE	2
17	XAFZZ	15434	210832	.. HOUSING, FILTER AND	1
18	PAFZZ	96906	MS90728-70	. SCREW, CAP, HEXAGON H	1
19	PAFZZ	15434	127558	. PLUNGER, OIL PUMP RE	1
20	PAFZZ	15434	68274	. SPRING, HELICAL, COMP	1
21	PAFZZ	15434	67946	. SPACER, RING PART OF KIT P/N 3018762	1
22	PAFZZ	15434	3022961	. PLUG, MACHINE THREAD	1
23	PAFZZ	15434	110907	. PLUG, MACHINE THREAD	1
24	XDFZZ	15434	210967	. SUPPORT, COOLER	1
25	PAFZZ	15434	211053	. GASKET OIL COOLER PART OF KIT P/N 3018762	1
26	XDOOO	15434	AR-09265	FILTER, OIL	1
27	PAOZZ	15434	173368	. PACKING, PREFORMED FART OF KIT P/N 3018762	1
28	PAOZZ	15434	158139	. FILTER ELEMENT, FLUI	1
29	XDOOO	15434	184387	. SHELL AND BOLT ASSY	1
30	XDOZZ	15434	184386	.. SHELL	1
31	PAOZZ	96906	MS35782-6	.. DRAINCOCK	1
32	PAOZZ	15434	8265	.. WASHER, FLAT	1
33	XDOZZ	15434	184388	.. BOLT, SHELL	1
34	PAFZZ	96906	MS27183-14	WASHER, FLAT	2
35	PAFZZ	96906	MS35338-8	WASHER, LOCK	8
36	PAFZZ	96906	MS18154-60	SCREW, CAP, HEXAGON H	2
37	PAFZZ	15434	S145	SCREW, CAP, HEXAGON H	1
38	PAFZZ	15434	S608	WASHER, LOCK	1
39	XDFZZ	15434	132756	WASHER, PLAIN	1
40	PFFZZ	15434	210966	BRACKET, ANGLE	1
41	PAFZZ	15434	212161	PACKING, PREFORMED	2
42	PFFZZ	15434	3000907	TUBE, WATER TRANSFER	1
43	PAFZZ	15434	3008017	GASKET COOLER SUPPORT PART OF KIT P/N 3018762	1

SECTION II			TM 5-2815-241-34&P		
(1)	(2)	(3)	(4)	(5)	(6)
ITEM	SMR		PARTS		
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY
44	PAFZZ	96906	MS90728-62	SCREW, CAP, HEXAGON H	2
45	PAFZZ	72582	450517	SCREW, CAP, HEXAGON H	2
46	PAFZZ	15434	5199B	SCREW CAP, HEXAGON H	2

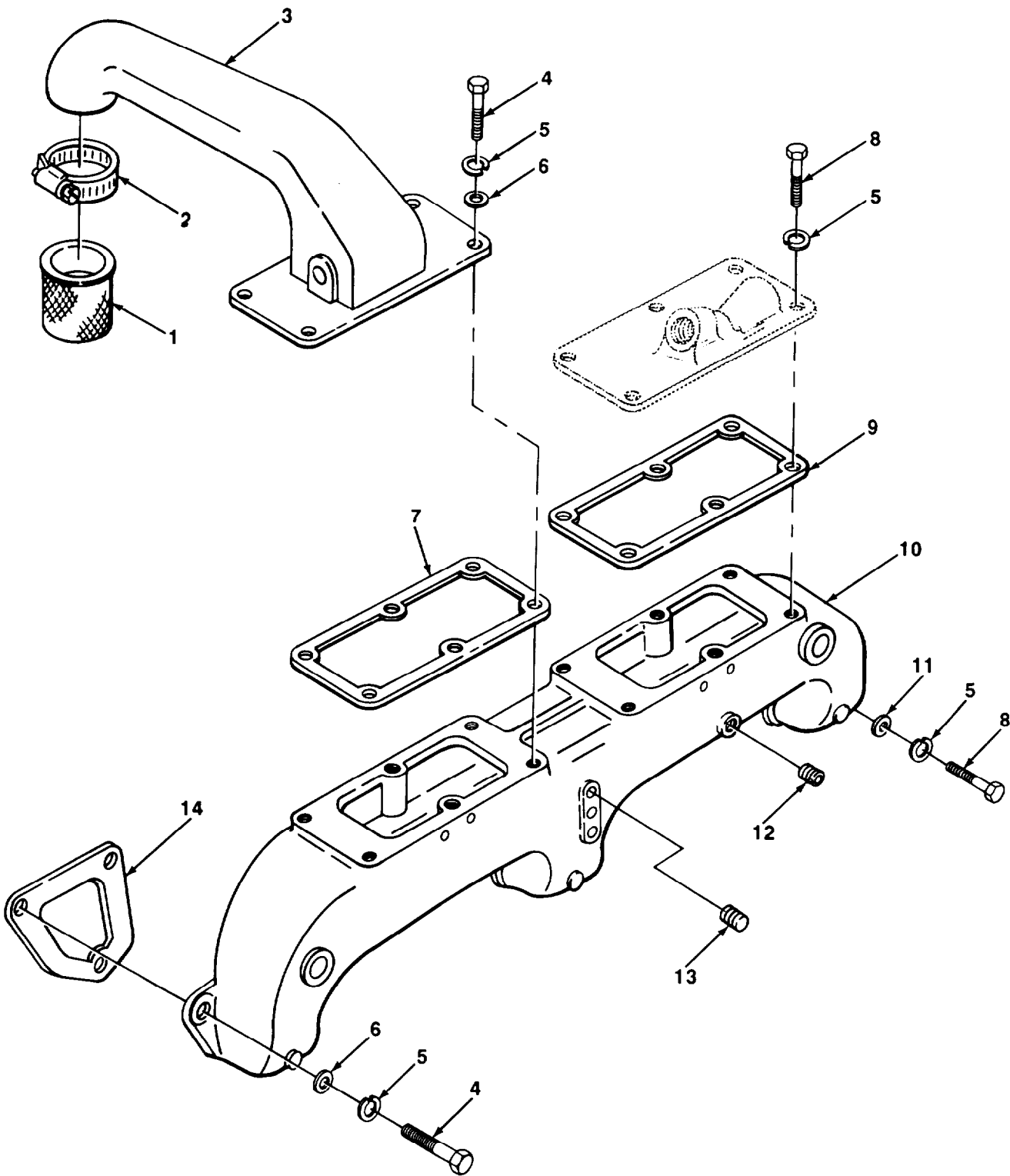
END OF FIGURE





SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM NO	SMR CODE	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
GROUP 0106 ENGINE LUBRICATION SYSTEM						
FIG. 17 LUBRICATING OIL PUMP						
1	PAFFF	15434	AR-10172	OIL PUMP ASSEMBLY, E	1	
2	PAFZZ	96906	MS35756-34	. KEY, WOODRUFF	1	
3	PAFZZ	96906	MS18154-59	. SCREW, CAP, HEXAGON H	1	
4	PAFZZ	15434	109319	. LOCK PLATE	1	
5	PAFZZ	15434	126304	. YOKE, CAP RETAINING	1	
6	PAFZZ	15434	134596	. PLUG, VENT	1	
7	PAFZZ	15434	211939	. SPRING, HELICAL, COMP	1	
8	PAFZZ	15434	109333	. PLUNGER, PRESSURE RE	1	
9	PAFZZ	15434	S995	. PLUG, PIPE	2	
10	PAFZZ	96906	MS35338-47	WASHER, LOCK	5	
11	PAFZZ	15434	S-119-C	SCREW, CAP, HEXAGON H	1	
12	PAFZZ	96906	MS35338-8	WASHER, LOCK	2	
13	PAFZZ	96906	MS90727-83	SCREW, CAP, HEXAGON H	1	
14	PAFZZ	15434	69519	. PIN, STRAIGHT, HEADLE	1	
15	PAFZZ	15434	199587	. GEAR SHAFT, WORM WHEE	1	
16	PAFZZ	15434	3014783	. GEAR, SPUR	1	
17	XDFFF	15434	AR-03636	. GEAR AND BUSHING	1	
18	PAFZZ	15434	68365	. . BUSHING, SLEEVE	2	
19	PAFZZ	15434	177419	. SHAFT, SHOULDERED	1	
20	XDFZZ	15434	117897	CAPSCREW	1	
21	PAFZZ	15434	S101A	SCREW, CAP, HEXAGON H	2	
22	PAFFF	15434	AR09832	. BODY, OIL PUMP WITH	1	
23	PAFZZ	15434	69521	. . BEARING, SLEEVE	2	
24	PAFZZ	15434	204832	. GEAR, HELICAL	1	
25	PAFZZ	15434	203145	. GASKET COVER PART OF KIT P/N 3018762	1	
26	XDFFF	15434	AR08667	. HOUSING, ADAPTER	1	
27	PAFZZ	15434	69521	. . BEARING, SLEEVE	1	
28	PAFZZ	96906	MS35338-45	. WASHER, LOCK	8	
29	PAFZZ	96906	MS90728-36	. BOLT, MACHINE	1	
30	PAFZZ	15434	S-147-B	. BOLT, MACHINE	1	
31	PAFZZ	96906	MS90725-34	. SCREW, CAP, HEXAGON H	6	
32	PAFZZ	15434	3031434	GASKET PART OF KIT P/N 3018762	1	

END OF FIGURE



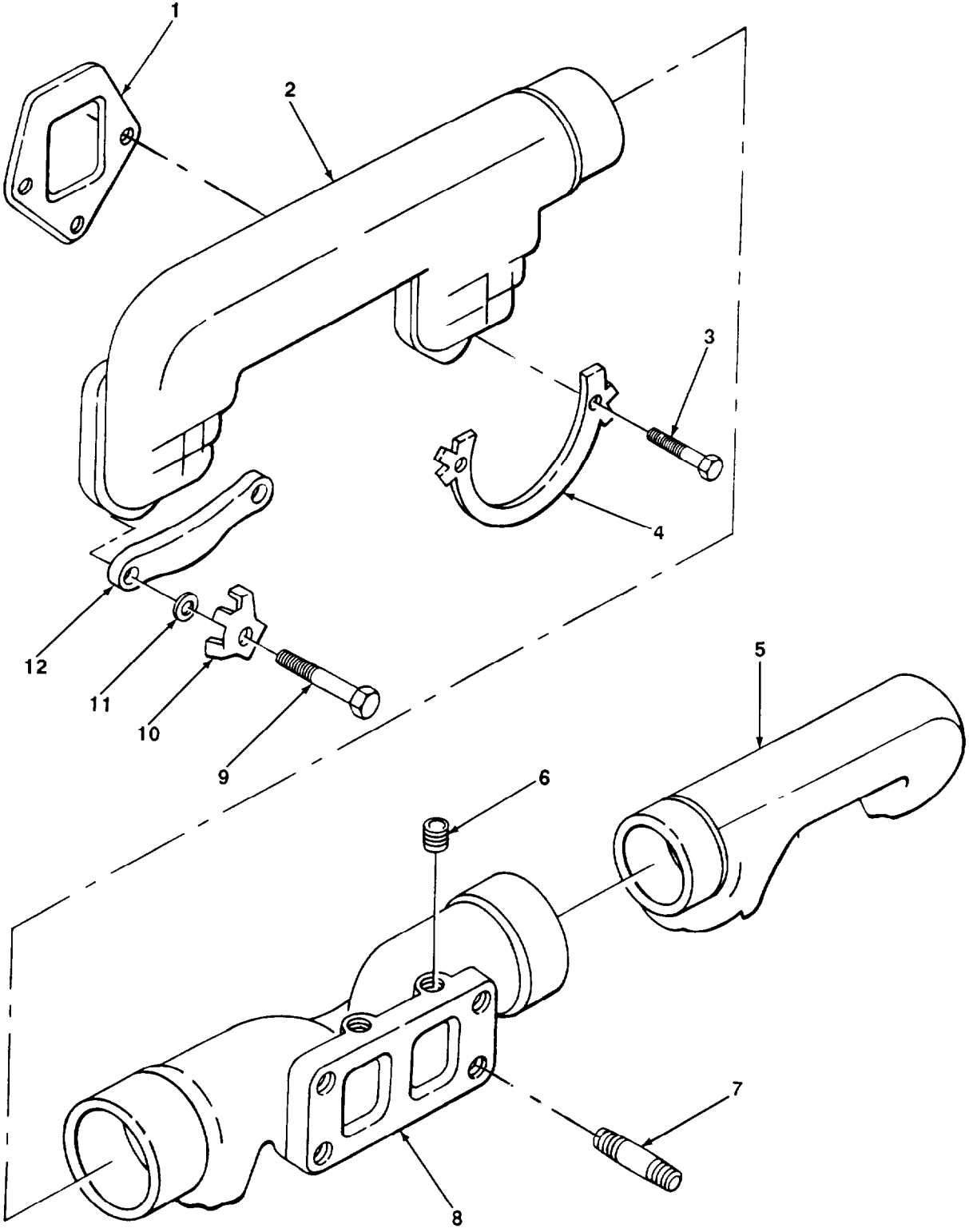
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FIGURE 18. INTAKE MANIFOLD.



SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
				GROUP 0108 MANIFOLDS		
				FIG. 18 INTAKE MANIFOLD		
1	PAFZZ	63483	202994-1011	HOSE, PREFORMED	1	
2	PAFZZ	15434	238326	CLAMP, HOSE	2	
3	XDFZZ	15434	3022205	CONNECTION, AIR CROS	1	
4	PAFZZ	96906	MS90728-64	SCREW, CAP, HEXAGON H	7	
5	PAFZZ	96906	MS35338-8	WASHER, LOCK	17	
6	PAFZZ	96906	MS27183-14	WASHER, FLAT	10	
7	PAFZZ	15434	3012972	GASKET PART OF KIT P/N 3801330	1	
8	PAFZZ	96906	MS18154-60	SCREW, CAP, HEXAGON H	10	
9	PAFZZ	15434	3019227	GASKET	1	
10	PFFZZ	15434	141761	MANIFOLD, INTAKE	1	
11	PAFZZ	15434	63842	WASHER, FLAT	3	
12	PAFZZ	15434	S911B	PLUG, PIPE	1	
13	PAFZZ	15434	112076	PLUG, FUEL OUTLET	3	
14	PFFZZ	15434	202961	GASKET	3	

END OF FIGURE

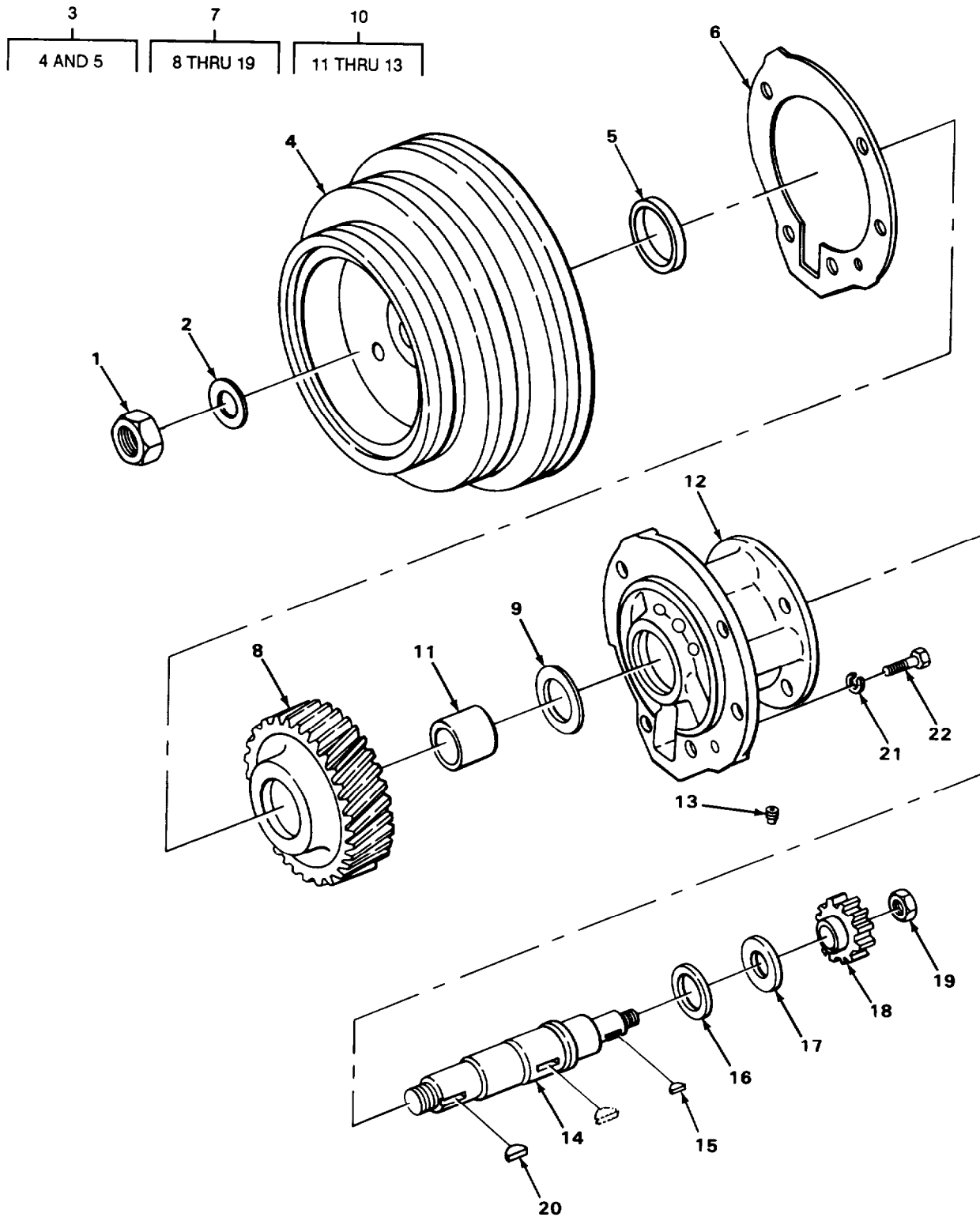


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FIGURE 19. EXHAUST MANIFOLD.

SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM NO	SMR CODE	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
GROUP 0108 MANIFOLDS						
FIG. 19 EXHAUST MANIFOLD						
1	PAFZZ	15434	3020943	GASKET PART OF KIT P/h 3801330	6	
2	PAFZZ	15434	151489	MANIFOLD, EXHAUST	1	
3	PAFZZ	15434	S155	SCREW, CAP, HEXAGON H	8	
4	PAFZZ	15434	116982	LOCKING PLATE, NUT A	4	
5	PAFZZ	15434	151478	MANIFOLD, EXHAUST	1	
6	PAFZZ	15434	112076	PLUG, PIPE	2	
7	PAFZZ	15434	105199	DOWEL, MANIFOLD	4	
8	PAFZZ	15434	200566	MANIFOLD, CENTER SEC	1	
9	PAFZZ	15434	200908	SCREW, CAP, HEXAGON H	4	
10	PAFZZ	15434	114638	WASHER, KEY	4	
11	PAFZZ	15434	109594	REARING, SLEEVE	8	
12	PAFZZ	15434	200919	STRAP, RETAINING	2	

END OF FIGURE



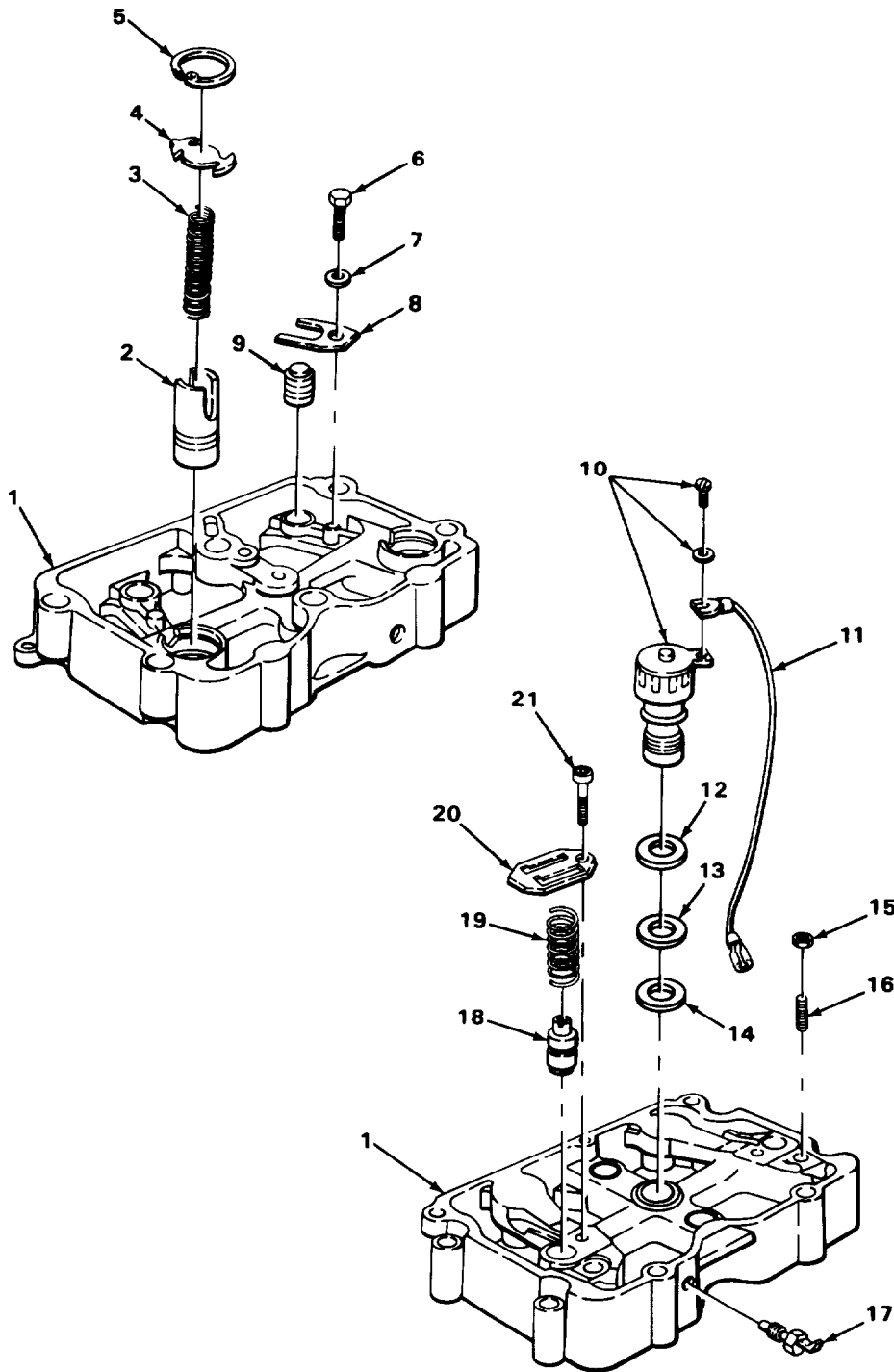
TA508262

FIGURE 20. ACCESSORY DRIVE.

SECTION II			TM 5-2815-241-34&P	(5)	(6)
(1)	(2)	(3)	(4)		
ITEM	SMR		PART		
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY
				GROUP 0109 ACCESSORY DRIVING MECHANISMS	
				FIG. 20 ACCESSORY DRIVE	
1	PAFZZ	15434	191517	NUT, SELF-LOCKING, HE	1
2	PAFZZ	96906	MS15795-824	WASHER, FLAT	1
3	XDFFF	15434	AR09607	PULLEY FAN AND WATER PUMP DRIVE	1
4	XAFZZ	15434	213926	. PULLEY	1
5	PAFZZ	15434	190397	. SLEEVE, PULLEY, PUMP	1
6	PAFZZ	15434	200809	GASKET	1
7	XDFHH	15434	AR08366	DRIVE, ACCESSORY DRI	1
8	PAFZZ	15434	142689	. GEAR, HELICAL	1
9	PAHZZ	15434	3026556	. BEARING, WASHER, THRU	1
10	XDHHH	15434	AR08256	. HOUSING ASSEMBLY	1
11	PAHZZ	15434	116391	. . BEARING, SLEEVE	1
12	XAHZZ	15434	199338	. . HOUSING	1
13	PAHZZ	15434	S911B	. . PLUG, PIPE	2
14	PAHZZ	15434	199969	. SHAFT, SHOULDER	1
15	PAHZZ	96906	MS35756-12	. KEY, WOODRUFF	1
16	PAHZZ	94906	MS35756-18	. BEARING, WASHER, THRU	1
17	PAHZZ	15434	116390	. WASHER, FLAT	1
18	XDHZZ	15434	190769	. COUPLING	1
19	PAHZZ	15434	191517	. NUT, SELF-LOCKING, HE	1
20	PAFZZ	15434	69550	KEY, WOODRUFF PART OF KIT P/N 3018762	1
21	PAFZZ	96906	MS35338-47	WASHER, LOCK	5
22	PAFZZ	96906	MS90728-87	SCREW, CAP, HEXAGON H	5

END OF FIGURE

1  
2 THRU 21



TA508263

FIGURE 21. ENGINE COMPRESSION BRAKE.

SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM	SMR	CAGEC	PART			
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
				GROUP 0112 ENGINE BRAKE		
				FIG. 21 ENGINE COMPRESSION BRAKE		
1	XDFFF	15434	2544	BRAKE, JACOBS ASSEMBLY	1	
2	XDFZZ	15434	1484	. PISTON, SLAVE	2	
3	XDFZZ	15434	1022	. SPRING, SLAVE PISTON	2	
4	XDFZZ	15434	1289	. RETAINER SLAVE PISTON SPRING	2	
5	XDFZZ	15434	1023	. RING, RETAINING	2	
6	XDFZZ	15434	1492	. SCREW, CAP, HEXAGON HEAD SPRING RETAINER	2	
7	XDFZZ	15434	1030	. WASHER, FLAT	2	
8	XDFZZ	15434	1011	. SPRING MASTER PISTON	2	
9	XDFZZ	15434	1017	. PISTON, MASTER	2	
10	XDFZZ	15434	2689	. VALVE ASSEMBLY SOLENOID	1	
11	XDFZZ	15434	2390	. HARNESS	1	
12	XDFZZ	15434	1081	. SEAL, RING SOLENOID UPPER	1	
13	XDFZZ	15434	1082	. SEAL, RING SOLENOID CENTER	1	
14	XDFZZ	15434	1083	. SEAL, RING SOLENOID LOWER	1	
15	XDFZZ	15434	1026	. NUT, PLAIN, HEXAGON ADJUSTING SCREW	2	
16	XDFZZ	15434	1031	. SETSCREW	2	
17	XDFZZ	15434	2299	. TERMINAL BUSHING LEADOUT	1	
18	XDFZZ	15434	1200	. SPOOL ASSEMBLY CONTROL VALVE	2	
19	XDFZZ	15434	1012	. SPRING, CONTROL VALVE	2	
23	XDFZZ	15434	4136	. COVER, CONTROL VALVE	2	
21	XDFZZ	15434	1265	. SCREW, CAP, HEXAGON HEAD AIR BLEED	2	

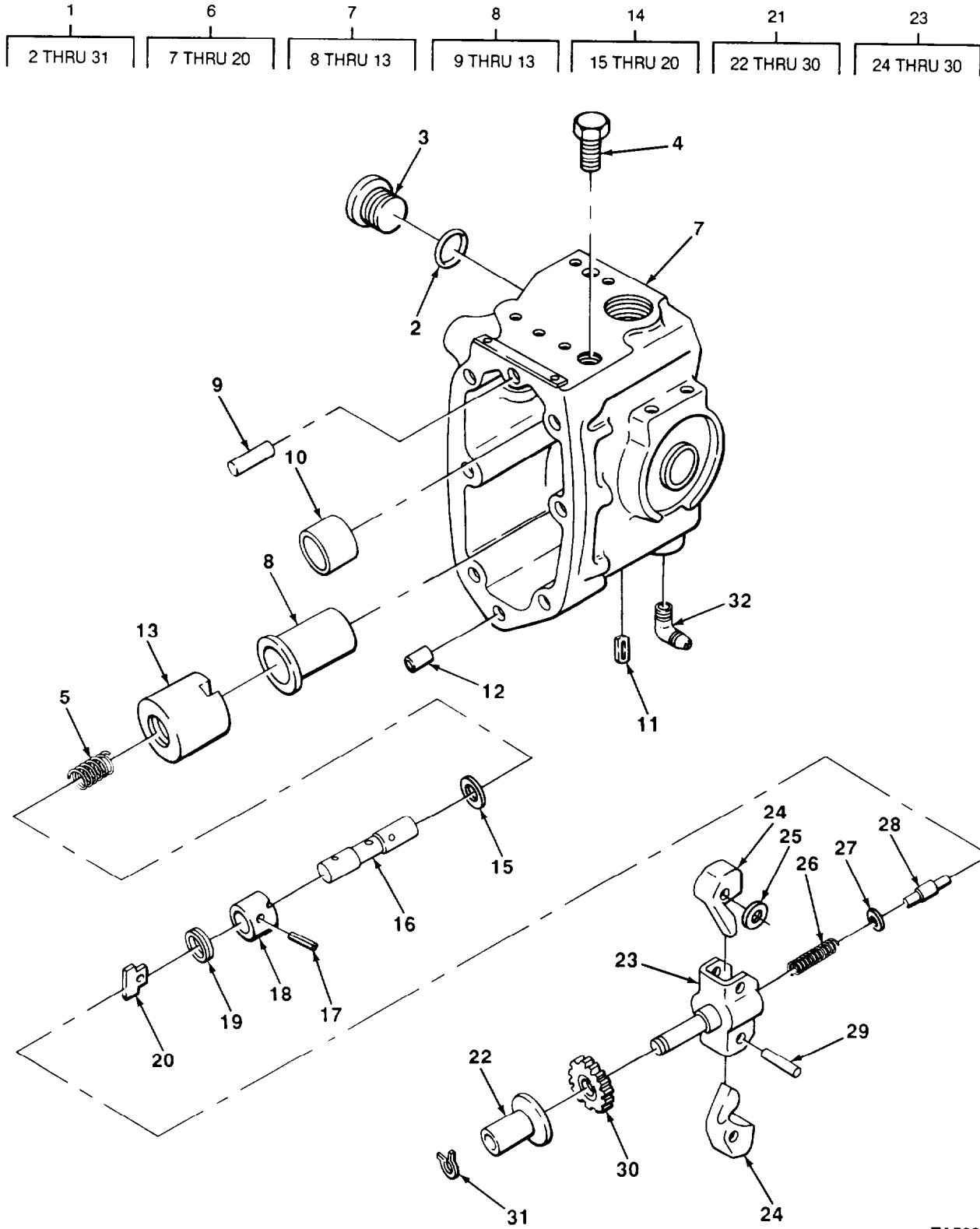
END OF FIGURE





SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
				GROUP 03 FUEL SYSTEM		
				GROUP 0301 CARBURETOR, FUEL INJECTOR		
				FIG. 22 FUEL INJECTOR		
1	PAFZZ	15434	3018323	NOZZLE, FUEL INJECTI	6	
2	PAFZZ	15434	165006	. SCREW, CAP, HEXAGON H CLAMP MTG	2	
3	PAFZZ	15434	3801353	. CLAMP	1	
4	PAHZZ	15434	191916	. PLUNGER, DETENT	1	
5	PAHZZ	15434	3054535	. BARREL AND PLUNGER	1	
6	PAHZZ	15434	167157	.. BALL CHECK, FUEL INJ	1	
7	PAHZZ	15434	166009	. SPRING, HELICAL, COMP INJECTOR	1	
8	PAHZZ	15434	185139	. ADAPTER, INJECTOR	1	
9	PAHZZ	15434	174299	. RING, RETAINING	1	
10	PAHZZ	15434	174298	. STRAINER, ELEMENT, SE	1	
11	PAHZZ	15434	173086	. GASKET	1	
12	PAHZZ	96906	MS9241-024	. PACKING, PREFORMED PART OF KIT P/N 3801330	1	
13	PAHZZ	15434	193736	. GASKET PART OF KIT P/N 3801330	2	
14	PAHZZ	15434	203426	. BOLT, MACHINE	2	
15	PAHZZ	15434	3012537	. CUP, INJECTOR	1	
16	PAHZZ	15434	185138	. RETAINER, CUP	1	

END OF FIGURE



TA508265

FIGURE 23. FUEL PUMP HOUSING.

SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)		(5)	(6)
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER		DESCRIPTION AND USABLE ON CODES (UOC)	QTY
					GROUP 0302 FUEL PUMPS	
					FIG. 23 FUEL PUMP HOUSING	
1	XDFHH	15434	3007300-2764		PUMP ASSEMBLY, FUEL	1
2	PAFZZ	96906	MS9021-116		. PACKING, PREFORMED	1
3	PAFZZ	15434	139473		. PLUG, MACHINE THREAD	1
4	PAFZZ	15434	112076		. PLUG, FUEL OUTLET	1
5	XDHZZ	15434	138782		. SPRING, TORQUE CONTR	1
6	PAHHH	15434	BM79290		. HOUSING, FUEL PUMP	1
7	XDHHH	15434	BM73902		. . HOUSING ASSEMBLY	1
8	PAHHH	15434	BM76665		. . . BARREL ASSEMBLY	1
9	PAHZZ	15434	68549		. . . . PIN, STRAIGHT, HEADLE	1
10	PAHZZ	15434	100193		. . . BEARING, SLEEVE	1
11	PAHZZ	15434	163733		. . . CLIP, GOVERNOR BARRE	1
12	PAHZZ	15434	118227		. . . . PIN, HOLLOW	1
13	PAHZZ	15434	140618		. . . . HOUSING, SPRING PACK	1
14	PAHHH	15434	BM98430		. . PLUNGER, GOVERNOR	1
15	PAHZZ	15434	101841		. . . SHIM	1
15	PAHZZ	15434	101842		. . . SHIM	1
15	PAHZZ	15434	101843		. . . SPACER, RING	1
16	PAHZZ	15434	203350		. . PLUNGER, GOVERNOR	1
17	PAHZZ	72962	590220940406		. . . PIN, SPRING	1
18	PAHZZ	15434	144302		. . . SPACER, FUEL PUMP	1
19	PAHZZ	15434	3027633		. . BEARING, SLEEVE	1
20	PAHZZ	15434	70690		. . DRIVER, PLUNGER, GOVE	1
21	PAHHH	15434	BM73718		. WEIGHT AND CARRIER	1
22	PAHZZ	15434	163944		. . BUSHING, SLEEVE	1
23	XDHHH	15434	AR-00796		. . CARRIER ASSEMBLY	1
24	PAHZZ	15434	146437		. . . WEIGHT, GOVERNOR	2
25	XDHZZ	15434	157594		. . . WASHER, THRUST	4
26	PAHZZ	15434	143847		. . . SPRING, HELICAL, COMP	1
27	XDHZZ	15434	144179		. . . WASHER, FLAT	1
28	PAHZZ	15434	144178		. . . PIN, SHOULDER, HEADLE	1
29	XDHZZ	15434	142204		. . . PIN, WEIGHT PIVOT	2
30	PAHZZ	15434	113244		. . . GEAR, SPUR	1
31	PAHZZ	96906	MS16632-1050		. . . RING, RETAINER	1
32	PAFZZ	15434	175836		. VALVE, CHECK	1

END OF FIGURE

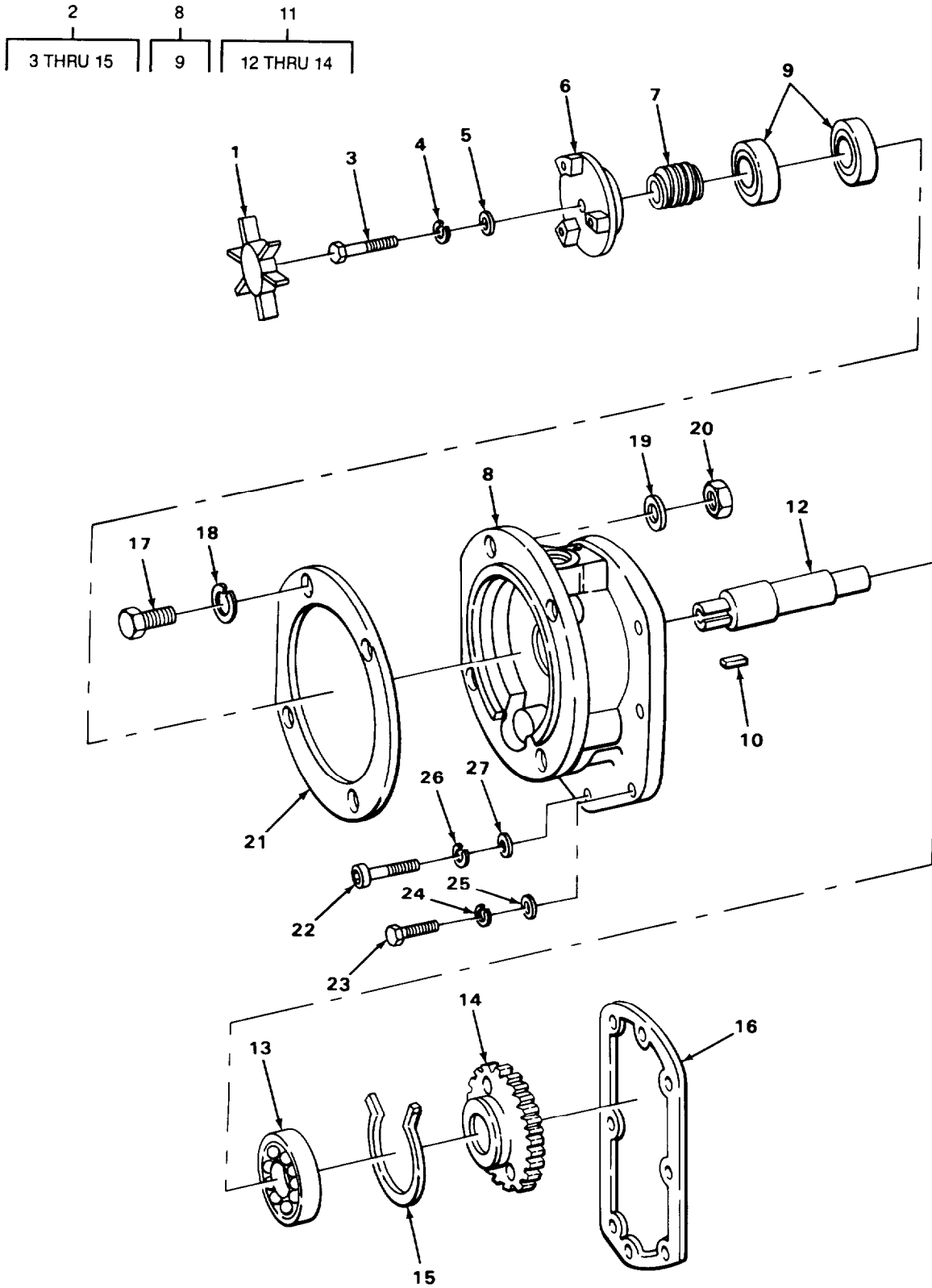
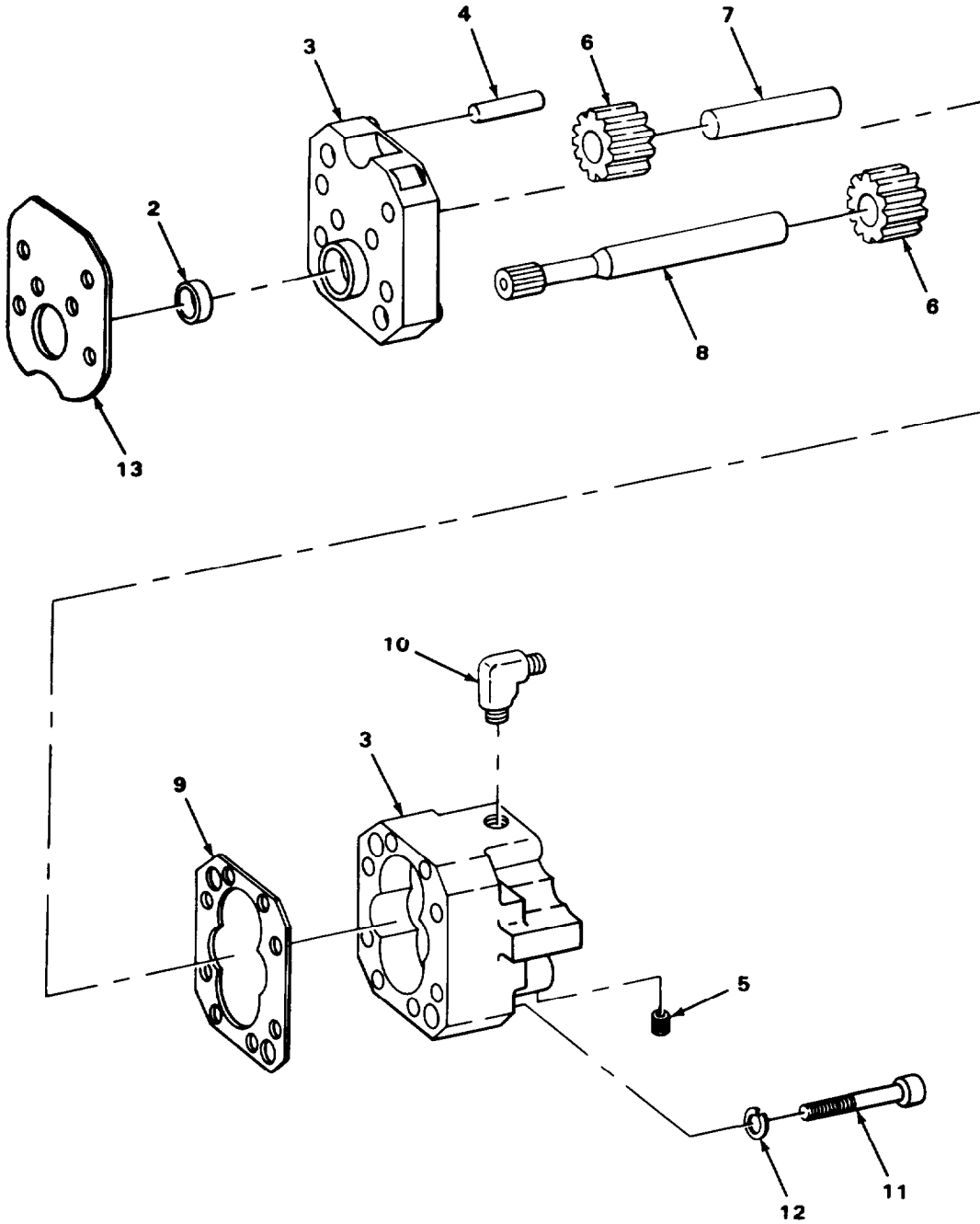
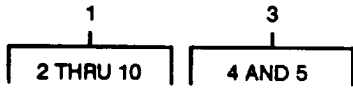


FIGURE 24. MAINSHAFT COVER.

TA508266

SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM	SMR	CAGEC	PART	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
NO	CODE	CAGEC	NUMBER			
GROUP 0302 FUEL PUMPS						
FIG. 24 MAINSHAFT COVER						
1	PAFZZ	15434	162426	. INSERT, FLEXIBLE COU	1	
2	PAFHH	15434	BM69886	. COVER ASSEMBLY MAIN	1	
3	PAHZZ	15434	69793	.. BOLT, MACHINE	1	
4	PAHZZ	96906	MS35338-8	.. WASHER, LOCK COUPLING	1	
5	PAHZZ	15434	108330	.. WASHER, FLAT	1	
6	PAHZZ	15434	101918	.. COUPLING HALF, SHAFT	1	
7	PAHZZ	15434	101983	.. GEAR, HELICAL	1	
8	PAFHH	15434	BM68879	.. HOUSING COVER ASSEM	1	
9	PAHZZ	15434	3045173	.. SEAL, OIL	2	
10	PAHZZ	96906	MS20066-116	.. KEY, MACHINE	1	
11	PAHHH	15434	AR51307	.. GEARSHAFT, SPUR-WORM	1	
12	PAHZZ	15434	100192	.. SHAFT, SHOULDERED DRIVE	1	
13	PAHZZ	24617	903302	.. BEARING, BALL, ANNULA	1	
14	PAHZZ	15434	103036	.. GEAR, SPUR	1	
15	PAHZZ	15434	70699	.. RING, RETAINING	1	
16	PAFZZ	15434	100764	. GASKET COVER TO HOUSING PART OF KIT P/N BM68356	1	
17	XDFZZ	15434	S140	. CAPSCREW	4	
18	PAFZZ	96906	MS35338-47	. WASHER, LOCK	4	
19	PAFZZ	15434	S622	. WASHER, FLAT	4	
20	XDFZZ	15434	S274	. NUT	4	
21	PAFZZ	15434	3035053	. GASKET PUMP TO COMPRESSOR PART OF KIT P/N 3018762	1	
22	PAFZZ	15434	118226	. SCREW COVER TO HOUSING	1	
23	PFFZZ	96906	MS90725-10	. CAPSCREW	6	
24	PAFZZ	96906	MS122032	. WASHER, LOCK	6	
25	PAFZZ	88044	AN960-416	. WASHER, FLAT COVER TO HOUSING	6	
26	PAFZZ	15434	S606	. WASHER, LOCK	1	
27	PAFZZ	96906	MS27183-42	. WASHER, FLAT BODY TO COVER	1	

END OF FIGURE

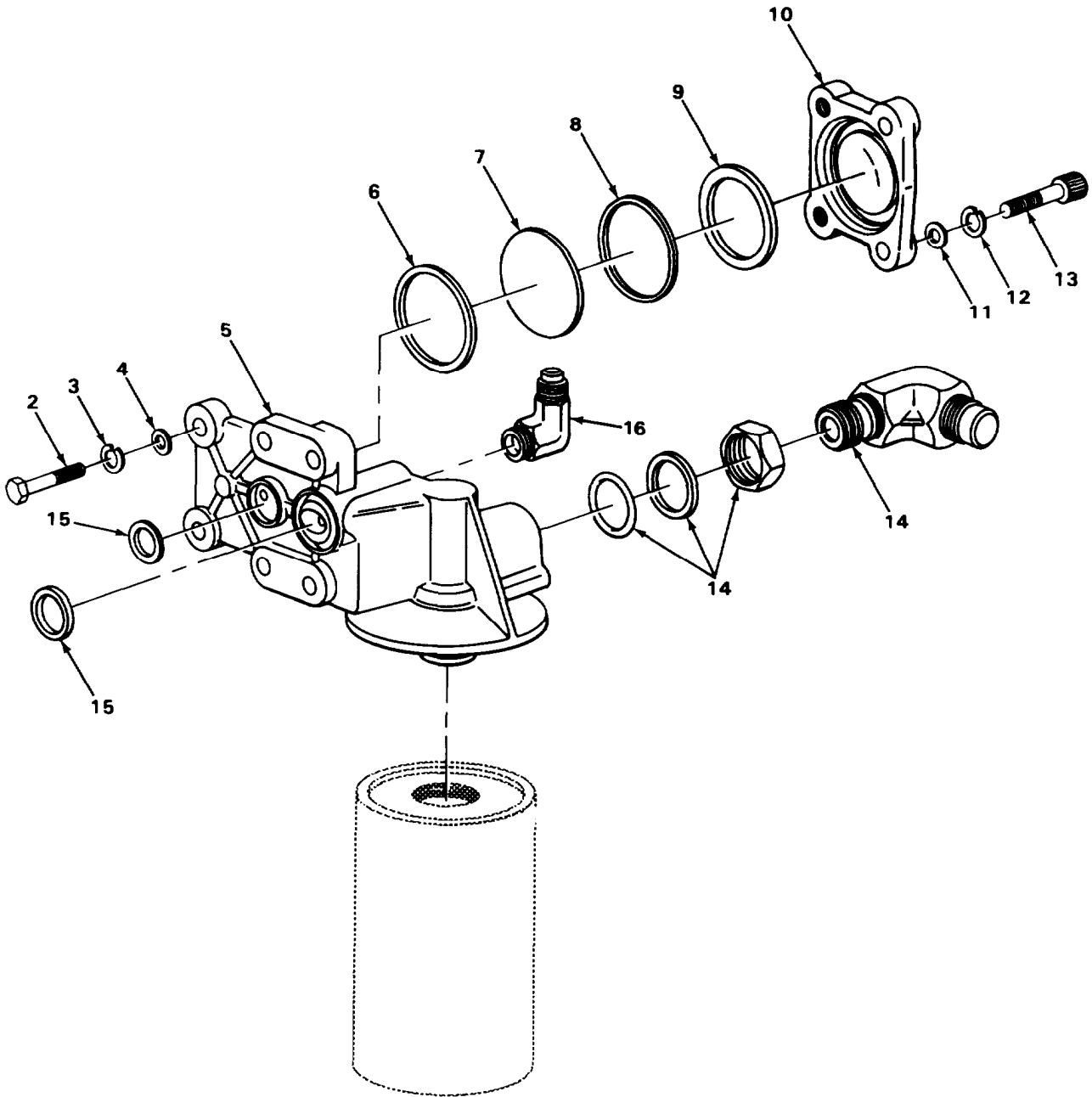
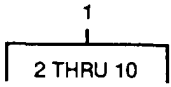


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FIGURE 25. GEAR PUMP

SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
				GROUP 0302 FUEL PUMPS		
				FIG. 25 GEAR PUMP		
1	PAFHH	15434	3334233	. PUMP, GEAR FUEL	1	
2	PAHZZ	15434	101468	.. BUSHING, SLEEVE	1	
3	PAFHH	15434	BM97497	.. HOUSING ASSEMBLY, FU	1	
4	PAHZZ	12204	141244	.. PIN, STRAIGHT, HEADLE COVER TO HOUSING	2	
5	PAFZZ	15434	68606	.. PLUG, MACHINE THREAD	1	
6	PAHZZ	15434	119363	.. GEAR, SPUR	2	
7	PAHZZ	15434	175864	.. SHAFT, IDLER, GEAR PU	1	
8	PAHZZ	15434	100215	.. SHAFT, SHOULDERED	1	
9	PAHZZ	15434	110855	.. GASKET COVER TO HOUSING PART OF KIT P/N BM68356	1	
10	PAHZZ	15434	116936	.. ELBOW, PIPE TO TUBE	1	
11	PAFZZ	15434	70790	. BOLT, MACHINE	4	
12	PAFZZ	15434	181466	. WASHER, LOCK	4	
13	PAFZZ	15434	210647	. GASKET PART OF KIT P/N BM68356	1	

END Of FIGURE



TA508268

FIGURE 26. DAMPER.



SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
				GROUP 0302 FUEL PUMPS		
				FIG. 26 DAMPER		
1	PAFHH	15434	BM76340	. DAMPENER, FLUID PRES	1	
2	PAFZZ	96906	MS90725-10	.. SCREW, CAP, HEXAGON H	2	
3	PAFZZ	96906	MS122032	.. WASHER, LOCK	2	
4	PAFZZ	88044	AN960-416	.. WASHER, FLAT	2	
5	PAHZZ	15434	153336	. . HOUSING, FUEL PUMP	1	
6	PAHZZ	15434	100099	.. PACKING, PREFORMED PART OF KIT P/N BM68356	1	
7	PAHZZ	15434	202897	.. DISK, SOLID, PLAIN	1	
8	PAHZZ	15434	139988	. . PACKING, PREFORMED PART OF KIT P/N BM68356	1	
9	PAHZZ	15434	160514	.. SPACER, RING PART OF KIT P/N BM68356	1	
10	PAHZZ	15434	153338	. . COVER, ACCESS	1	
11	PAFZZ	88044	AN960-416	. WASHER	2	
12	PAFZZ	15434	181466	. WASHER, LOCK	2	
13	PAFZZ	15434	70790	. BOLT, MACHINE, SDC	2	
14	PAFZZ	15434	203849	. ELBOW, TUBE TO BOSS	1	
15	PAHZZ	16954	691-10014	. GASKET PART OF KIT P/N DM68356	1	
16	PAFZZ	15434	116936	. ELBOW, CONNECTION	1	

END OF FIGURE

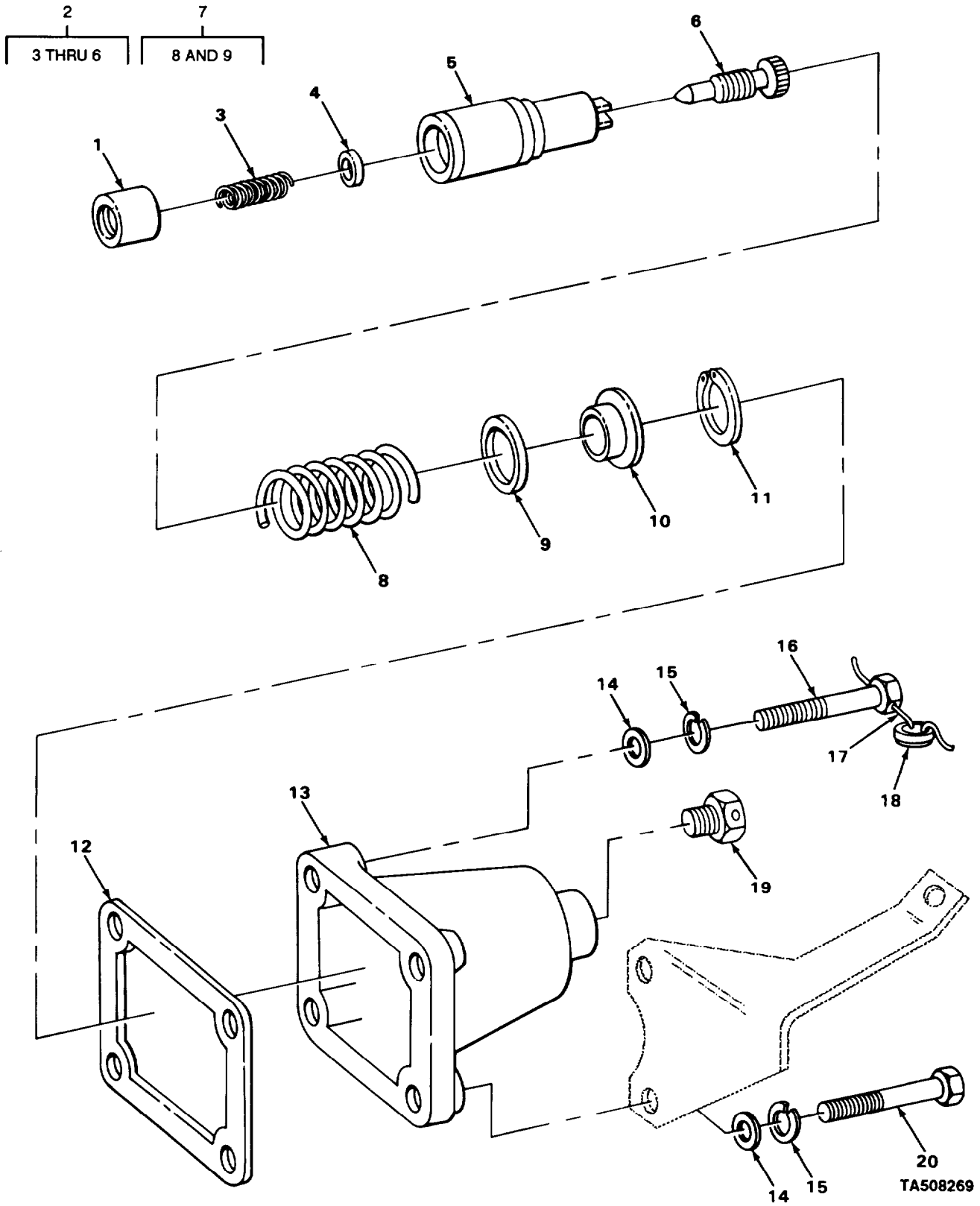


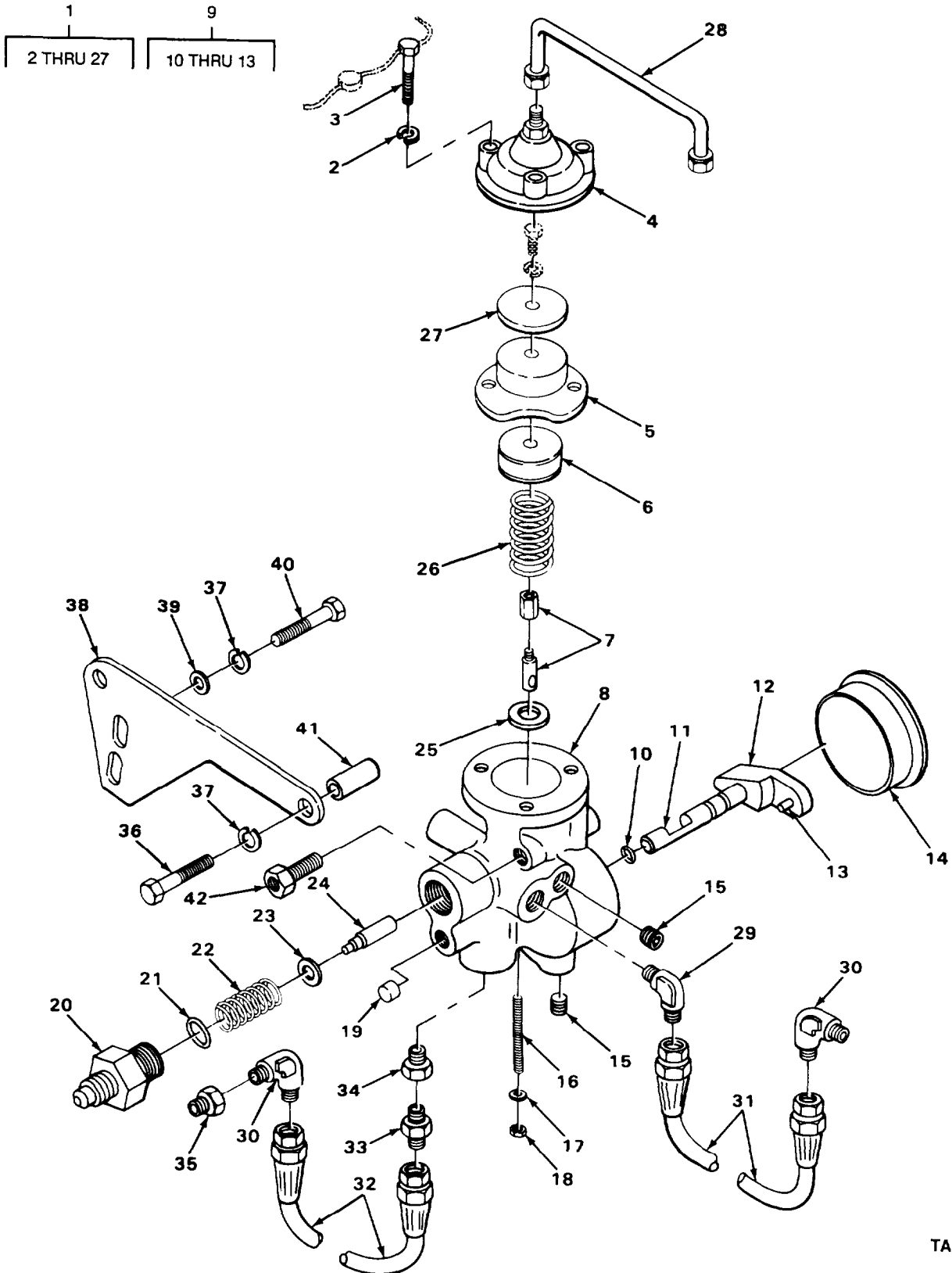
FIGURE 27. SPRING PACK.

## SECTION II

TM 5-2815-241-34&amp;P

(1) ITEM NO	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
GROUP 0302 FUEL PUMPS					
FIG. 27 SPRING PACK					
1	XDFZZ	15434	140925	. PLUNGER, FUEL INJECT	1
2	PAFFF	15434	BM-69886	. COVER AND GOVERNOR IDLING SPRING	1
3	PAFZZ	15434	144195	. . SPRING, HELICAL, COMP	1
4	PAFZZ	15434	70715	.. WASHER, FLAT	1
5	PAFZZ	15434	3038220	.. GUIDE, CLIP ASSEMBLY	1
6	PAFZZ	15434	70716	.. SETSCREW	1
7	XDFFF	15434	BM74747	. SPRING ASSEMBLY	1
8	PAFZZ	15434	143251	.. SPRING, HELICAL, COMP	1
9	PAFZZ	15434	70717	. . SPACER, RING	1
9	PAFZZ	15434	70717A	.. SHIM	V
9	PAFZZ	15434	70717B	.. SHIM	V
9	PAFZZ	15434	189800	. . SHIM GOVERNOR	1
10	PAFZZ	15434	70713	. RING RETAINING	1
11	PAFZZ	96906	MS16625-1100	. RING, SNAP	1
12	PAFZZ	15434	70705	. GASKET PART OF KIT P/N BM68356	1
13	PAFZZ	15434	44678	. COVER, SPRING PACK	1
14	PAFZZ	88044	AN960-416	. WASHER, FLAT SPRING PACK COVER TO HOUSING	4
15	PAFZZ	15434	181466	. WASHER, LOCK SPRING PACK COVER TO HOUSING	4
16	PAFZZ	15434	203619	. SCREW SPRING PACK COVER TO HOUSING	1
17	PAFZZ	15434	124020	. WIRE, SHAFT SEAL	1
18	PAFZZ	15434	124019	. SEAL, FUEL PUMP REGU	2
19	PAFZZ	15434	177999	. PLUG, PIPE	1
20	PAFZZ	96906	MS90725-10	. SCREW, CAP, HEXAGON	3

END OF FIGURE



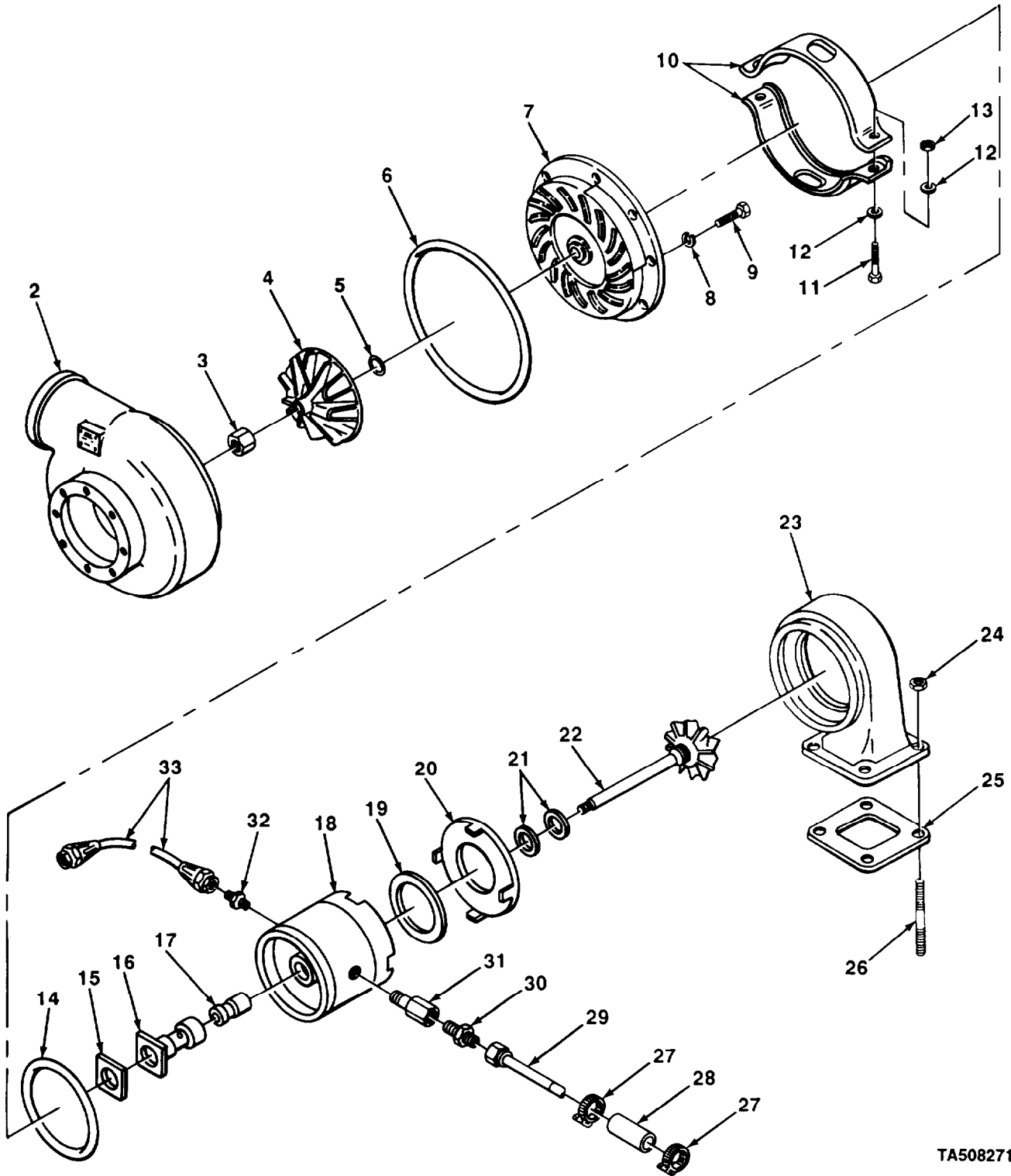
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FIGURE 28. ANEROID CONTROL.

SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)		(5)	(6)
ITEM NO	SMR CODE	CAGEC	PART NUMBER		DESCRIPTION AND USABLE ON CODES (UOC)	QTY
GROUP 0302 FUEL PUMPS						
FIG. 28 ANEROID CONTROL						
1	XDFHH	15434	AR-09454-00EF		CONTROL, ANEROID	1
2	PAHZZ	96906	MS122032		. WASHER, LOCK	3
3	PAHZZ	96906	MS90725-10		. SCREW, CAP, HEXAGON H COVER TO HOUSING	3
4	XDHZZ	15434	114947		. COVER, BELLOWS	1
5	PAHZZ	15434	114739		. BELLOWS, ANEROID CON	1
6	XDHZZ	15434	114755		. PISTON, BELLOWS	1
7	XDHZZ	15434	115033		. SHAFT, BELLOWS ACTUA	1
8	XAHZZ	15434	140357		. HOUSING, CONTROL	1
9	XDHHH	15434	BM69381		. VALVE, LEVER AND P I N	1
10	PAHZZ	15434	114791		.. PACKING, PREFORMED PART OF KIT P/N BM8356	1
11	XDHZZ	15434	140358		.. VALVE	1
12	XDHZZ	15434	115034		.. LEVER	1
13	XDHZZ	15434	114940		.. PIN	1
14	XDHZZ	15434	114773		. COVER, CONTROL	1
15	PAHZZ	15434	S911B		. PLUG, PIPE	2
16	PAHZZ	88044	AN565F428H24		. SETSCREW	1
17	PAHZZ	83259	600-001 1-4		.PACKING WITH RETAIN PART OF KIT P/N BM68356	1
18	PAHZZ	15434	108074		. NUT, SELF-LOCKING, HE ACTUATING SHAFT	1
19	XDHZZ	15434	114765		. PLUG, PLUNGER	1
20	XDHZZ	15434	114764		. RETAINER, SPRING	1
21	PAHZZ	91265	TS33-016		. GASKET SPRING RETAINER	1
22	XDHZZ	15434	114745		. SPRING, HELICAL	1
23	XDHZZ	15434	114795		. WASHER, PRESSURIZING	1
24	XDHZZ	15434	140414		. PLUNGER, PRESSURE	1
25	XDHZZ	15434	114921		. SHIM, SPRING	V 1
26	XDHZZ	15434	124033		. SPRING, BELLOWS	1
27	XDHZZ	15434	114754		. WASHER BELLOWS RETAINER	1
28	XDFZZ	15434	208621		TUBE AIR SUPPLY	1
29	PAFZZ	15434	144372		ELBOW, TUBE TO HOSE	1
30	PAFZZ	03958	MS39230-1		ELBOW, PIPE	2
31	XDFZZ	15434	AS0501900SS		HOSE, CONTROL	1
32	XDFZZ	15434	AS0500760SS		HOSE, CONTROL	1
33	PFFZZ	15434	143950		ADAPTER, STRAIGHT, PI	1
34	XDFZZ	15434	NPN		ADAPTER	1
35	PAFZZ	96906	MS51887-5		BUSHING, PIPE	1
36	PAFZZ	96906	MS90728-66		SCREW, CAP, HEXAGON H	2
37	PAFZZ	15434	S604		WASHER, LOCK	4
38	XDFZZ	15434	204851		BRACKET	1
39	PAFZZ	96906	MS27183-14		WASHER, FLAT	2
40	PAFZZ	96906	MS18154-60		SCREW, CAP, HEXAGON H	2
41	PAFZZ	15434	63385		SPACER	2
42	XDFZZ	15434	213713		FILTER, AIR	1

END OF FIGURE

1  
2 THRU 23



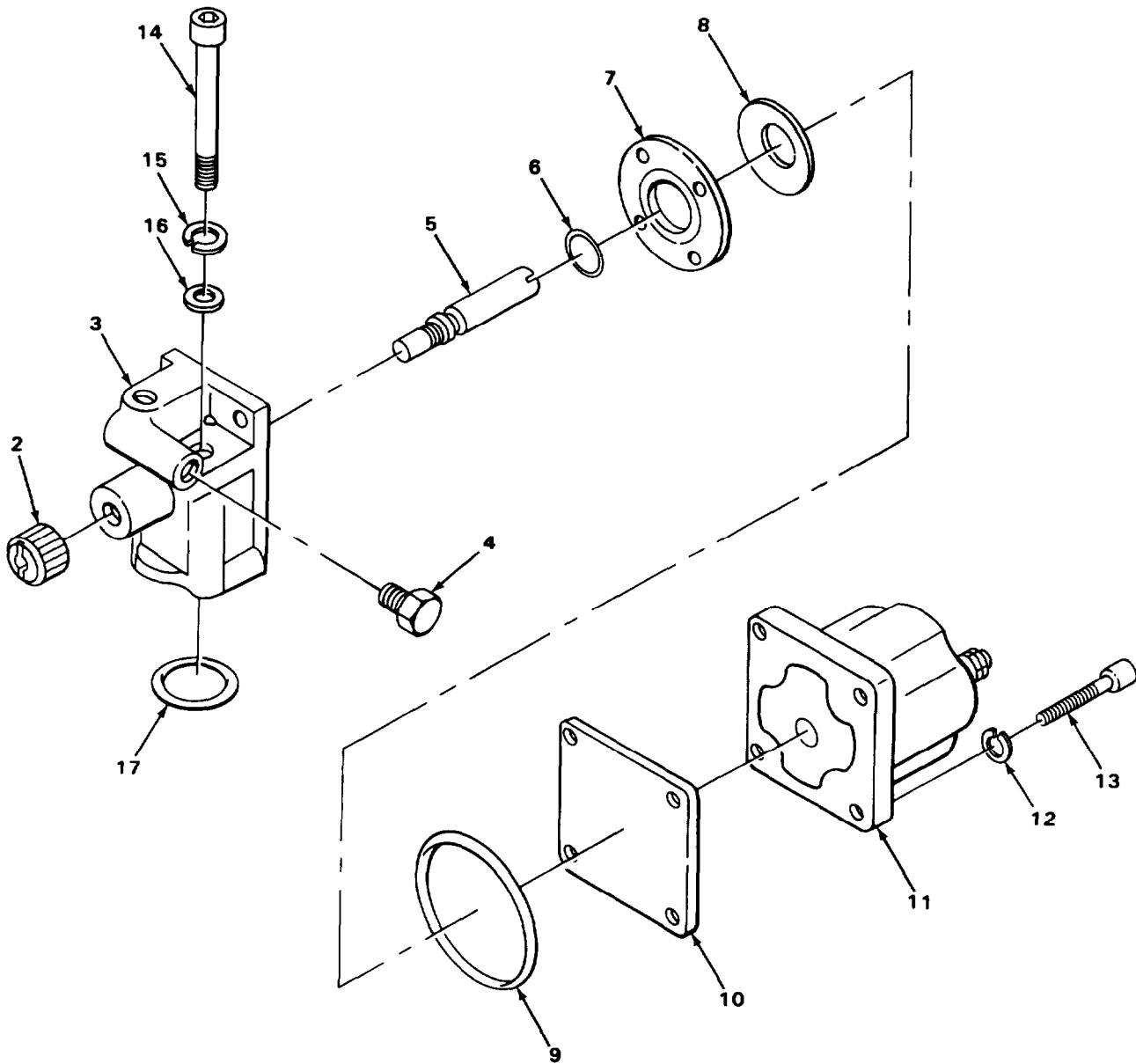
TA508271

FIGURE 29. TURBOCHARGER.

SECTION II			TM 5-2815-241-34&P		(5)	(6)
(1)	(2)	(3)	(4)			
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
				GROUP 0305 SUPERCHARGER, BLOWER, TURBOCHARGER OR ALTITUDE COMPENSATOR		
				FIG. 29 TURBOCHARGER		
1	PBFZZ	15434	AR12604	TURBOCHARGER ASSEMB		1
2	XDFZZ	15434	195469	. HOUSING, TURBINE		1
3	PAFZZ	15434	S222A	. NUT, SELF-LOCKING		1
4	PAFZZ	15434	212563	. IMPELLER, TURBOCHARG		1
5	PAFZZ	15434	156444	. SEAL, TURBO		1
6	PAFZZ	15434	211375	. RING, SEALING		1
7	PAFZZ	15434	203294	. PLATE, DIFFUSER		1
8	PAFZZ	96906	MS122032	. WASHER, LOCK		8
9	PAFZZ	15434	S118A	. SCREW		8
10	PAFZZ	15434	156416	. STRAP, RETAINING		2
11	PAFZZ	15434	194010	. SCREW, CAP, HEXAGON H		2
12	PAFZZ	15434	S631	. WASHER, FLAT		4
13	PAFZZ	15434	167299	. NUT, SELF-LOCKING, HE		2
14	PAFZZ	15434	202457	. PACKING, PREFORMED		1
15	PAFZZ	15434	170510	. GASKET		1
16	PAFZZ	15434	156420	. BEARING, SLEEVE		1
17	PAFZZ	15434	216802	. SEAL, OIL, SLEEVE		1
18	PAFZZ	15434	202376	. HOUSING, BEARING		1
19	PAFZZ	15434	202377	. PACKING, FLAT FIBER		1
20	PAFZZ	15434	171570	. SHIELD, HEAT		1
21	XDFZZ	15434	3022969	. SEAL		1
22	PAFZZ	15434	AR10058	. WHEEL AND SHAFT, TUR		1
23	XDFZZ	15434	202506	. CASING, TURBINE		1
24	XDFZZ	15434	107440	NUT, LOCK		4
25	PAFZZ	15434	190849	GASKET PART OF KIT P/N 3801330		1
24	PAFZZ	15434	3010915	STUD, PLAIN		4
27	PAOZZ	15434	108722	CLAMP, LOOP		2
28	PAOZZ	15434	AC1600300NF	HOSE, NONMETALLIC		1
29	XDOZZ	15434	213936	TUBE, ASSEMBLY		1
30	PAOZZ	15434	183669	ADAPTER, STRAIGHT		1
31	PAOZZ	15434	197733	COUPLING, PIPE		1
32	XDOZZ	15434	208668	ADAPTER		1
33	XDOZZ	15434	209959	HOSE, TEFLON		1

END OF FIGURE

1  
2 THRU 13



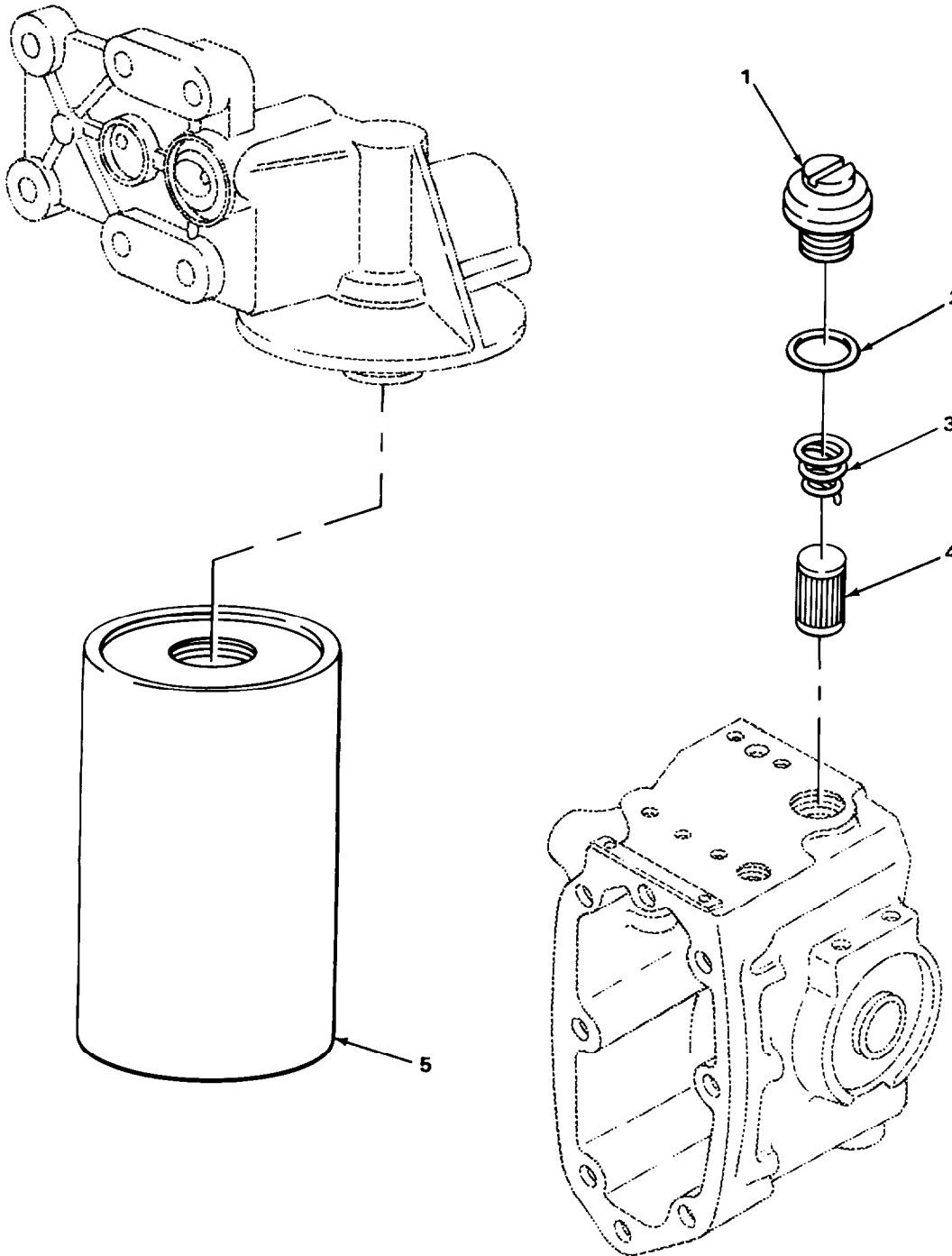
TA508272

FIGURE 30. SHUTDOWN VALVE.



SECTION II			TM 5-2815-241-34&P			
(1)	(2)	(3)	(4)		(5)	(6)
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER		DESCRIPTION AND USABLE ON CODES (UOC)	QTY
					GROUP 0306 TANKS, LINES, FITTINGS, HEADERS	
					FIG. 30 SHUTDOWN VALVE	
1	PAFHH	15434	3035342		VALVE , SOLENOID	1
2	PAFZZ	15434	129838		. KNOB OVERRIDE	1
3	PAHZZ	15434	129826		. HOUSING, SHUT OFF VA	1
4	PAFZZ	15434	70295		. PLUG, PIPE	1
5	PAHZZ	15434	3000266		. SHAFT, SHOULDERED	1
6	PAHZZ	15434	190876		. PACKING, PREFORMED PART Of KIT P/N 8M68356	1
7	PAHZZ	15434	3030970		. DISK, VALUE	1
8	PAHZZ	15434	129768		. WASHER, SPRING TENS	1
9	PAHZZ	15434	129888		. PACKING, PREFORMED PART OF KIT P/N BM68356	1
10	PAHZZ	15434	129839		. COVER, ACCESS	1
11	PAHZZ	15434	3054611		. COIL, ELECTRICAL	1
12	PAFZZ	24617	0120217		. WASHER, LOCK	4
13	PAHZZ	15434	187556		. SCREW, MACHINE	4
14	PAFZZ	15434	S189C		SCREW, CAP, SOCKET HE	2
15	PAFZZ	15434	181466		WASHER, LOCK	2
16	PAFZZ	15434	67684		WASHER, FLAT	2
17	PAFZZ	91265	TS33-016		GASKET PART OF KIT P/N BM68356	1

END OF FIGURE

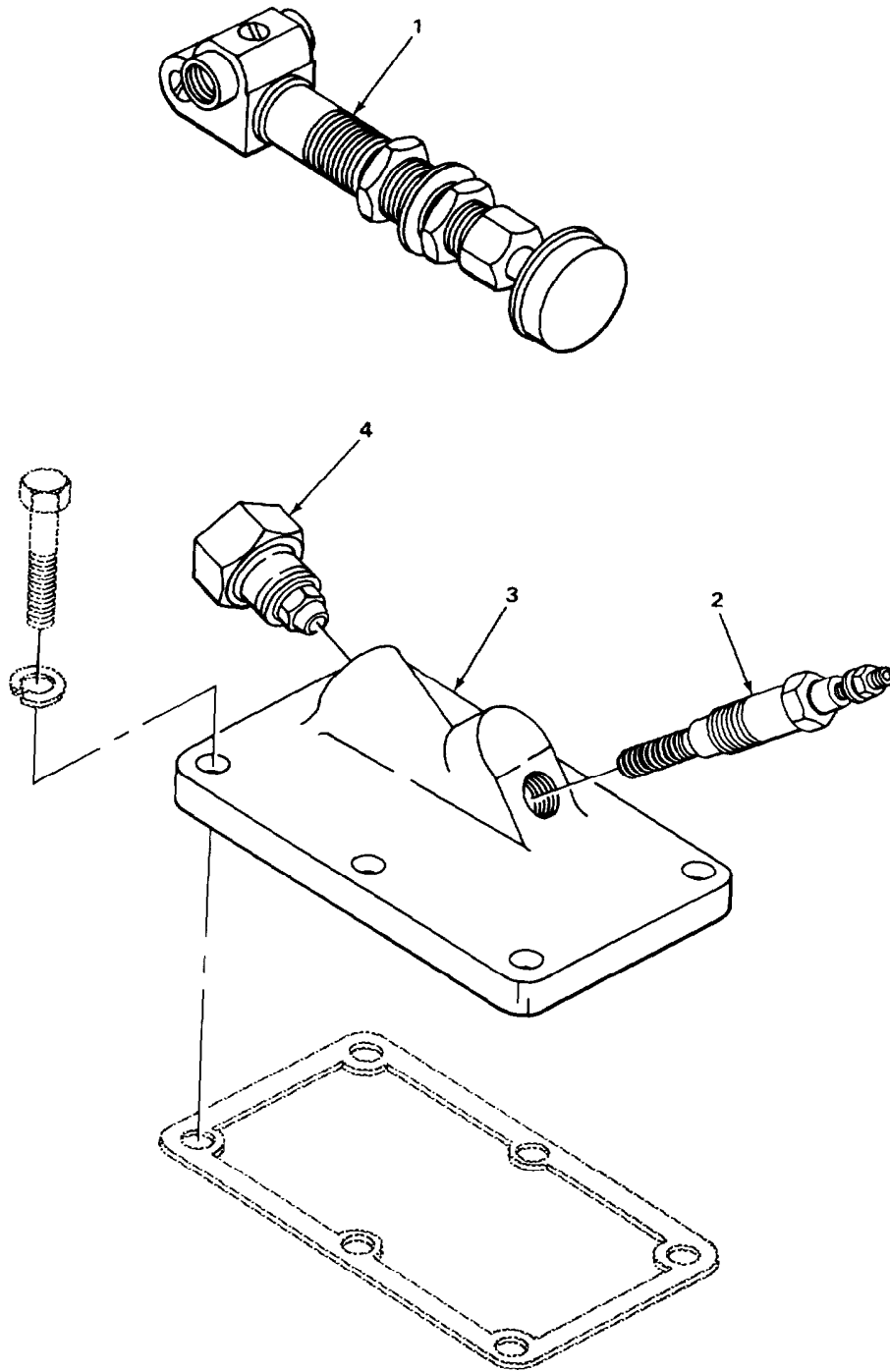


TA508273

FIGURE 31. FUEL PUMP FILTER.

SECTION II			TM5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
				GROUP 0309 FUEL FILTERS		
				FIG. 31 FUEL PUMP FILTER		
1	PAOZZ	15434	157088	PLUG,MACHINE THREAD	1	
2	PAOZZ	15434	154088	SEAL CAP PART OF KIT F/N BM68356	1	
3	PAOZZ	15434	70700	SPRING,HELICAL,COMP	1	
4	PAOZZ	15434	146483	FILTER ELEMENT,FLUI	1	
5	PAOZZ	79396	33341	FILTER ELEMENT,FLUI	1	

END OF FIGURE

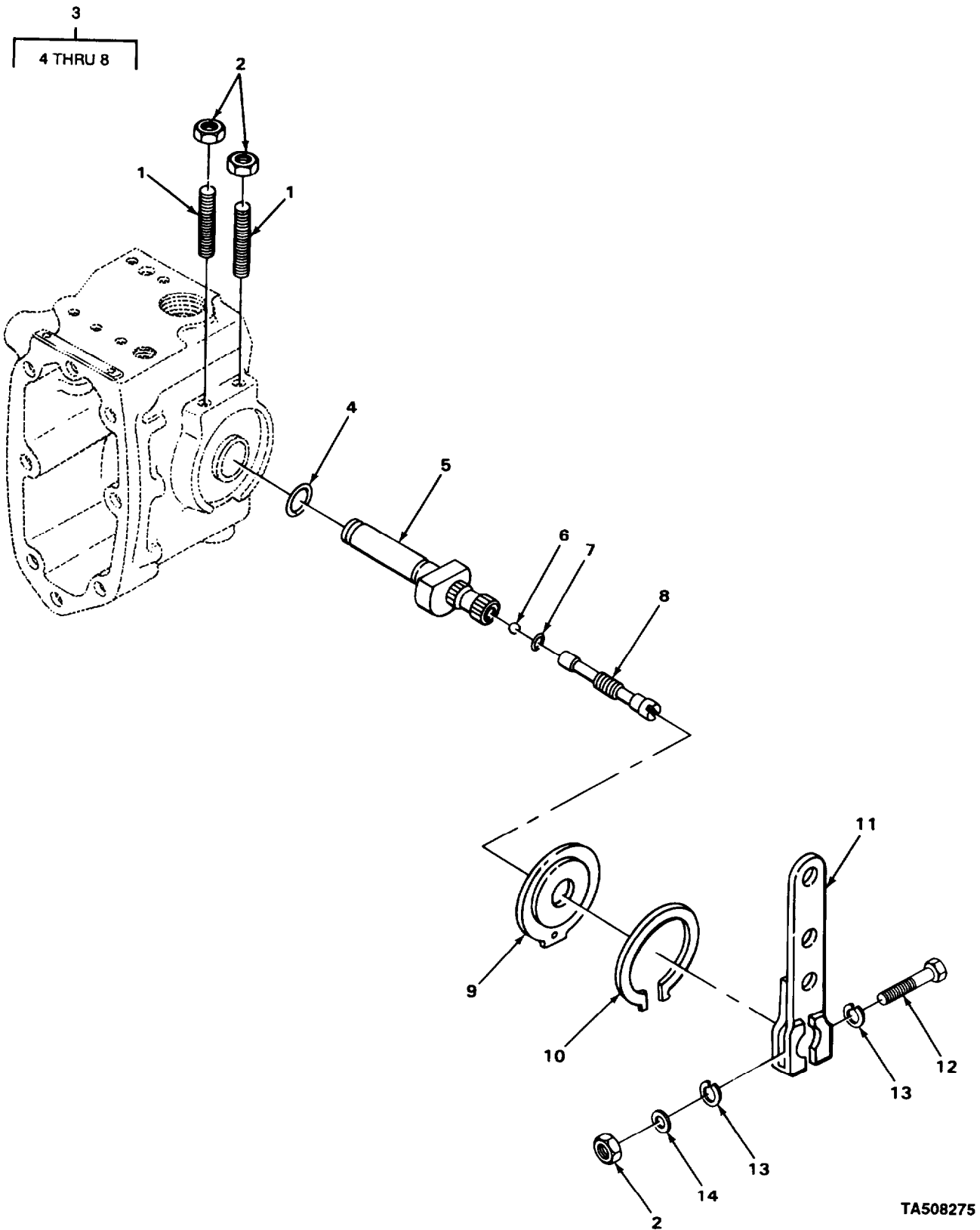


TA508274

FIGURE 32. GLOW PLUG AND PREHEATER.

SECTION II			TM5-2815-241-34&P		
(1)	(2)	(3)	(4)	(5)	(6)
ITEM	SMR		PART		
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY
				GROUP 0311 ENGINE STARTING AIDS	
				FIG. 32 GLOW PLUG AND PREHEATER	
1	XDOZZ	15434	106452R91	PRIMER,HAND ASSEMBL	1
2	XDOZZ	15434	AC9	PLUG,GLOW	1
3	XDOZZ	15434	267627C2	HOUSING ,PREHEATER	1
4	XDOZZ	15434	236985R91	NOZZLE,PREHEATER	1

END OF FIGURE



TA508275

FIGURE 33. THROTTLE SHAFT.

SECTION IX			TM5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
				GROUP 0312 ACCELERATOR, THROTTLE, OR CHOKE CONTROLS		
				FIG. 33 THROTTLE SHAFT		
1	PAOZZ	15434	109915	SETSCREW	2	
2	PAOZZ	96906	MS35691-5	NUT (PLAIN ,HEXAGON LEVER AND THROTTLE ADJUSTING	3	
3	XDFFF	15434	AR 51317	THROTTLE SHAFT ASSE	1	
4	PAFZZ	15434	100478	PACKING,PREFORMED PART OF KIT P/N BM68356	1	
5	PAFZZ	15434	149030	SHAFT, SHOULDERED	1	
6	PAFZZ	15434	213769	PLUG,BALL	1	
7	PAFZZ	15434	213768	PACKING,PREFORMED	1	
8	PAFZZ	15434	149040	PIN,GROOVED,HEADED	1	
9	PAFZZ	15434	148977	PLATE, RETAINING, SHA	1	
10	PAFZZ	15434	S16206	RING RETAINING	1	
11	XDOZZ	15434	AR03034	LEVER,THROTTLE	1	
12	PAOZZ	15434	S159B	SCREW ,CAP ,HEXAGON H	1	
13	PAOZZ	96906	MS122032	WASHER,LOCK	2	
14	PAOZZ	88044	AN 960-416	WASHER	1	

END OF FIGURE

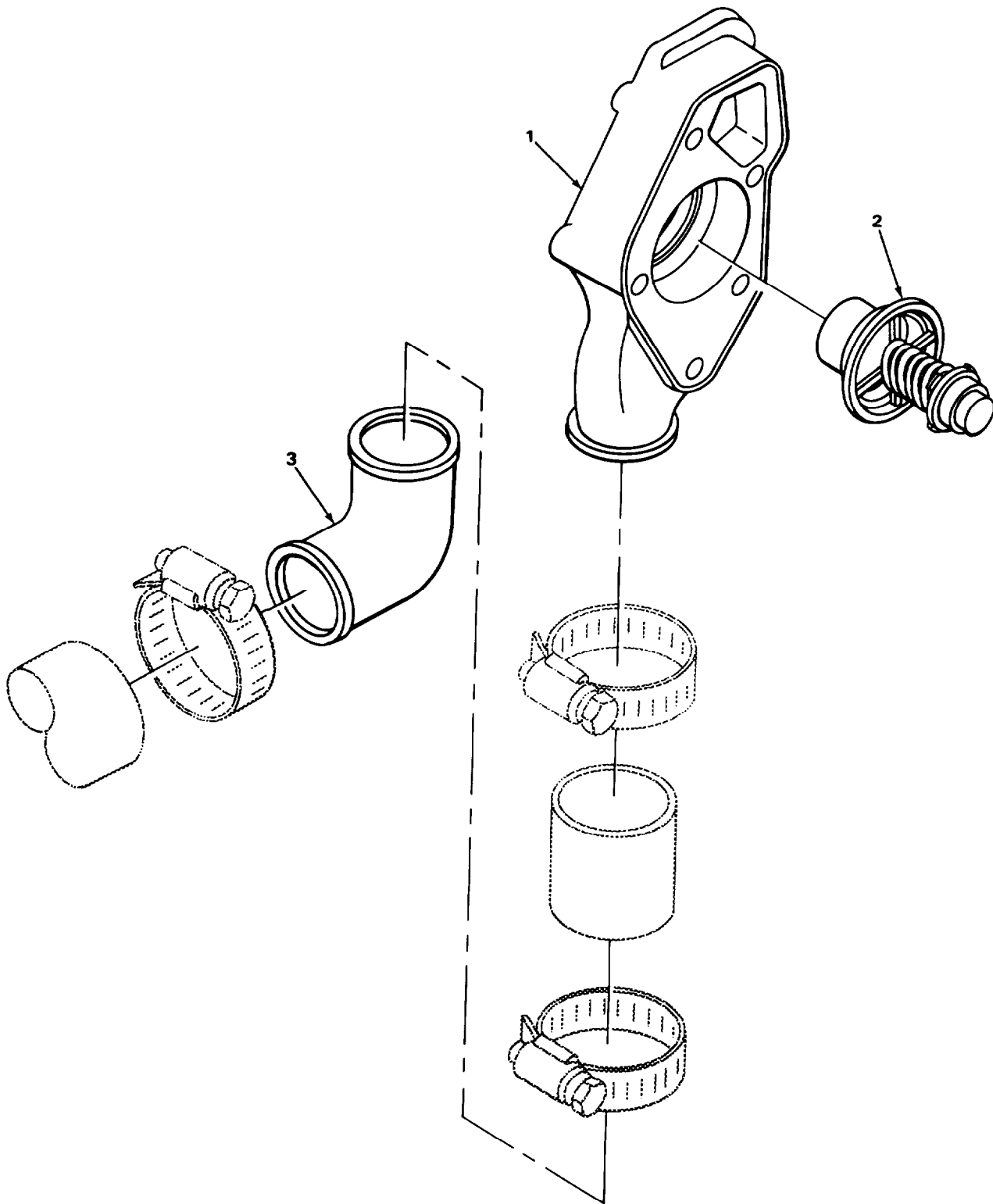
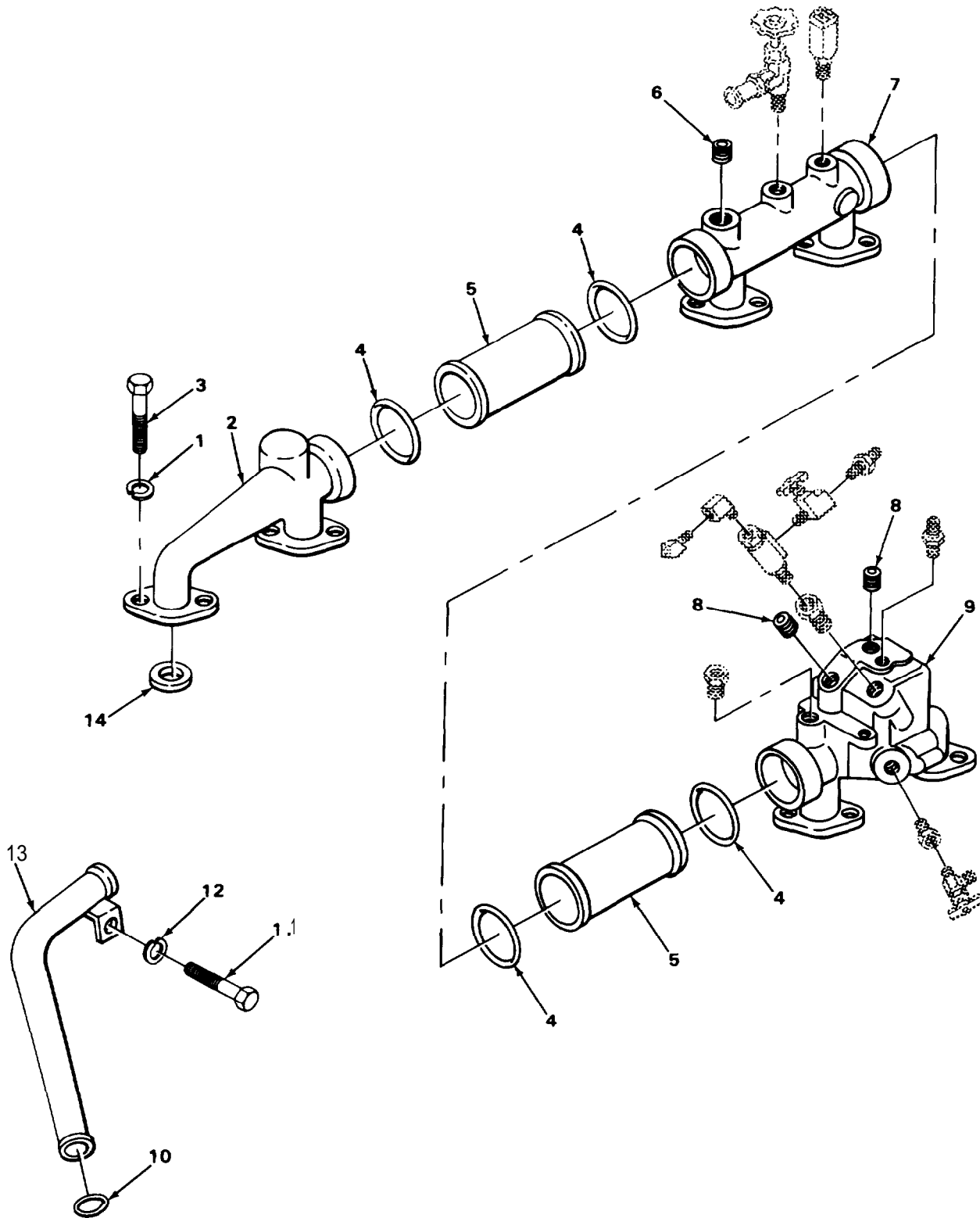


FIGURE 34. THERMOSTAT HOUSING.

TA508276



SECTION II			TM5-2815-241-34&P			
(1)	(2)	(3)	(4)	(5)	(6)	
ITEM	SMR		PART			
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY	
				GROUP 05 COOLING SYSTEM		
				GROUP 0503 WATER MANIFOLD, HEADERS, THERMOSTATS, AND HOUSING GASKET		
				FIG. 34 THERMOSTAT HOUSING		
1	XD0ZZ	15434	102231	HOUSING,THERMOSTAT	1	
2	PAOZZ	15434	145977	VALVE ,TEMPERATURE R	1	
3	XDOZZ	15434	215172	CONNECTION WATER OU	1	
				END OF FIGURE		



TA508277

FIGURE 35. WATER MANIFOLD.

SECTION II			TM5-2815-241-34&P		
(1)	(2)	(3)	(4)	(5)	(6)
ITEM No	SMR CODE	CAGEC	PART NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY
				GROUP 0503 WATER MANIFOLD, HEADERS, THERMOSTATS, AND HOUSING GASKET	
				FIG. 35 WATER MANIFOLD	
1	PAEZZ	96906	MS35338-8	WASHER,LOCK	12
2	XDFZZ	15434	133342	MANIFOLD, WATER REAR	1
3	PAFZZ	94906	MS90728-62	SCREW,CAP,HEXAGON	12
4	PAFZZ	15434	70624	PACKING,PREFORMED PART CF KIT P/N 3801330	4
5	PAFZZ	15434	130394	COUPLING,HANIFOLD	2
6	PAOZZ	15434	S995	PLUG,PIPE	1
7	PAFZZ	15434	130118	MIANIFOLD, FLUID COOL CENTER	1
8	PAOZZ	15434	S-915-A	PLUG,PIPE	3
9	XDFZZ	15434	211016	MANIFOLD WATER FRONT	1
10	PAFZZ	15434	212161	PACKING,PREFORMED PART CF KIT P/N 3801330	2
11	PAFZZ	15434	S110	SCREW,CAP,HEXAGON H	1
12	PAFZZ	96906	MS35338-45	WASHER,LOCK	1
13	PAFZZ	15434	211027	TUBE,BENT,METALLIC	1
14	PAFZZ	15434	148203	GASKET PART of KIT P/h 3801330	6

END OF FIGURE

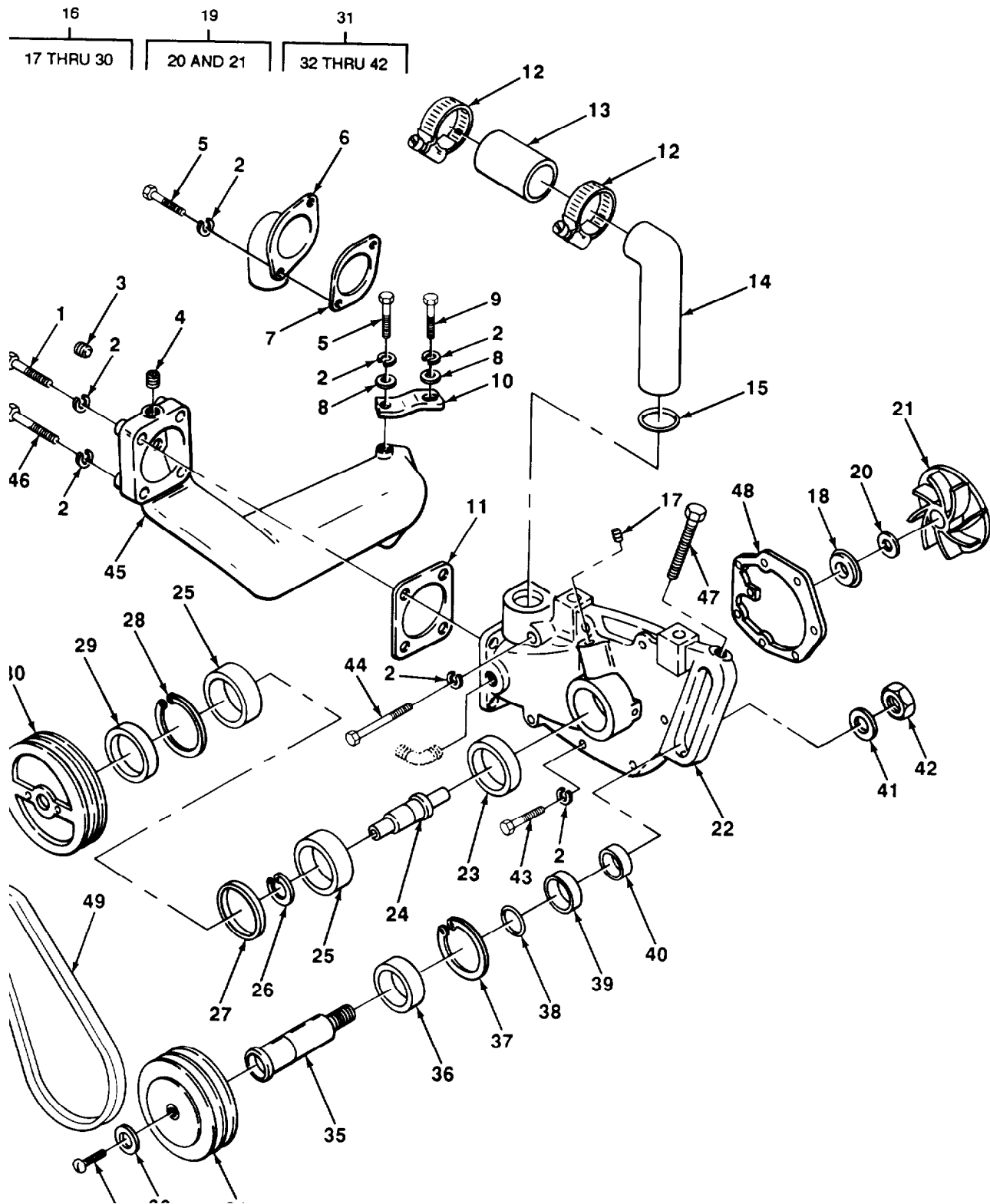


FIGURE 36. WATER PUMP.

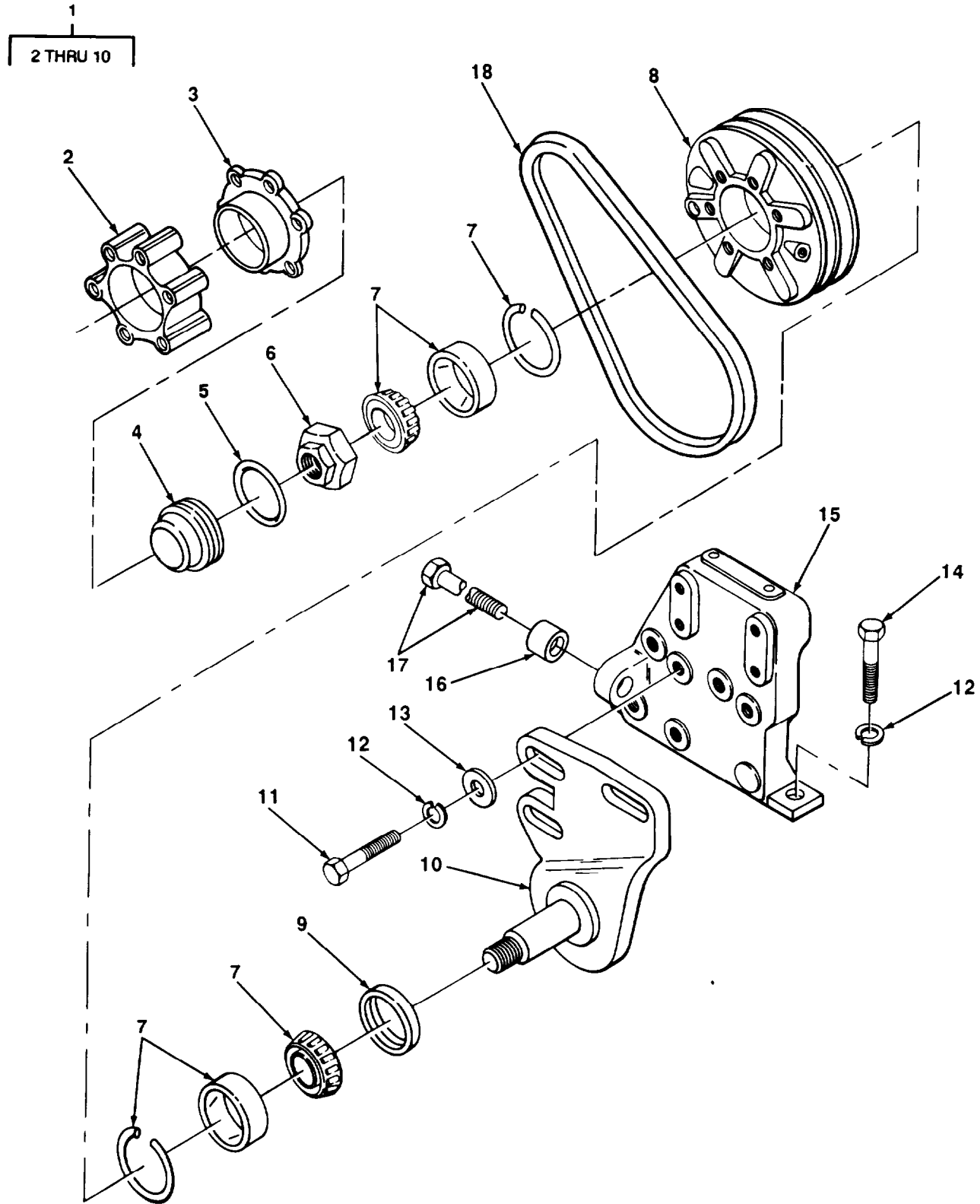
TA508278

## SECTION II

TM5-2815-241-34&amp;P

(1) ITEM NO	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
GROUP 0504 WATER PUWP					
FIG. 36 WATER PUMP					
1	PAOZZ	96906	MS90728-70	SCREW,CAP ,HEXAGON H	2
2	PAOZZ	96906	MS35338-8	WASHER LOCK	15
3	PAOZZ	15434	S-915-A	PLUG,PIPE	1
4	PAOZZ	15434	S962	PLUG,PIPE	1
5	PAOZZ	96906	MS90728-62	SCREW, CAP ,HEXAGON H	3
6	XDOZZ	15434	210806	CONNECTION	1
7	XDOZZ	15434	210805	GASKET	1
8	PAOZZ	15434	108330	WASHER,FLAT	2
9	PAOZZ	96906	MS 90728-64	SCREW,CAP ,HEXAGON H	1
10	XDOZZ	15434	214476	BRACKET,CONNECTION	1
11	XDOZZ	15434	208132	GASKET	1
12	PAOZZ	96906	MS35842-13	CLAMP, HOSE	2
13	XDOZZ	15434	63495-D	HOSE	1
14	XDOZZ	15434	209600	PIPE, WATER BY-PASS..	1
15	PAOZZ	15434	43463-A	PACKING, ,PREFORMED PART OF KIT P/N 3801330 PART OF KIT P/N BM68356	2
16	PA000	15434	AR-045090	PUMP,COOLING SYSTEM	1
17	PAOZZ	15434	S911B	.PLUG ,PIPE	1
18	PFOZZ	15434	3033677	.PACKING WITH RETAIN	1
19	XD000	15434	AR08853	.IMPELLER	1
20	PAOZZ	15434	AR-12732	. .PACKING WITH RETAIN	1
21	XAOZZ	15434	208134	..IMPELLER,WATER PUMP	1
22	XAOZZ	15434	210238	.BODY,WATER PUMP	1
23	PAOZZ	15434	3038997	.SEAL,PLAIN PART OF KIT P/N 3018762.	1
24	XDOZZ	15434	208138	. SHAFT WATER PUMP	1
25	PAOZZ	15434	S16073	.BEARING BALL, ANNULA	2
26	PAOZZ	15434	112302	.RING, RETAINING	1
27	PAOZZ	15434	196844	. SPACER	1
28	PAOZZ	15434	S16255	.RING, BEARING RETAIN	1
29	PAOZZ	15434	3038998	.SEAL, PLAIN ENCASED	1
30	XDOZZ	15434	AR 08854	.PULLEY,WATER PUMP	1
31	XD000	15434	AR08851	IDLER, WATER PUMP	1
32	XDOZZ	15434	210860	.CAPSCKEW ,BUTTON HEA	1
33	PAOZZ	15434	61623	.WASHER,FLAT	1
34	XDOZZ	15434	208118	.PULLEY,IDLER	1
35	PAOZZ	15434	208119	. SHAFT, SHOULDERED	1
36	PAOZZ	15434	S16073	.BEARING,BALL,ANNULA	1
37	PAOZZ	15434	S16255	.RING,BEARING RETAIN	1
38	PAOZZ	15434	145506	.PACKING.PREFORMED	1
39	PAOZZ	15434	3038998	. SEAL ,PLAIN ENCASED	1
40	PAOZZ	15434	208120	.SPACER,SLEEVE	1
41	PAOZZ	15434	213082	.WASHER,FLAT	1
42	PAOZZ	96906	MS51967-20	.NUT,PLAIN,HEXAGON	1
43	PAOZZ	96906	MS90726-67	SCREW ,CAP ,HEXAGON H	5
44	XDOZZ	15434	137797	CAPSCREW	2
45	XDOZZ	15434	210804	CONNECTION, WATER TRANSFER	1
46	PAOZZ	15434	S149A	SCREW,CAP ,HEXAGON H	2
47	PAOZZ	15434	182706	SCREW,CAP, HEXAGUN H	1
48	PAOZZ	15434	130226	GASKET PART Of KIT P/N 3018762	1

END OF FIGURE



TA508279

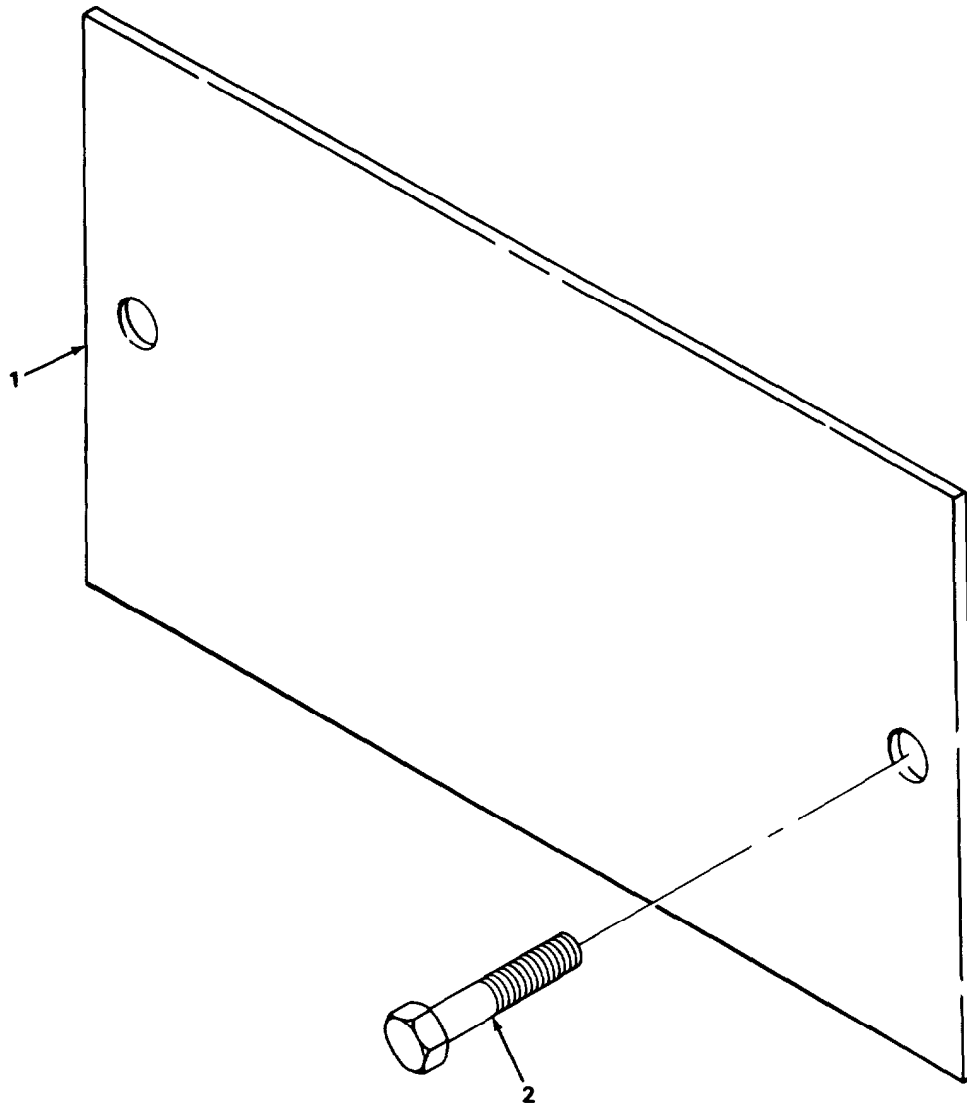
FIGURE 37. FAN HUB.

## SECTION II

TM5-2815-241-34&amp;P

(1) ITEM NO	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
GROUP 0505 FAN ASSEMBLY					
FIG. 37 FAN HUB					
1	XD000	35434	AR10142	HUB,FAN	1
2	XD0ZZ	15434	441432	. SPACER	1
3	XD0ZZ	15434	201124	. SPACER	1
4	XD0ZZ	15434	210996	.RETAINER	1
5	PAOZZ	96906	MS29513-142	.PACKING,PREFORMED	1
6	PAOZZ	15434	142176	.NUT,HUGLOCK	1
7	PFOZZ	60038	LM485548	.BEARING,ROLLER,TAPE	A
8	XDOZZ	15434	211869	.PULLEY	1
9	PAOZZ	15434	200307	. SEAL OIL	1
10	XDOZZ	15434	AR10141	.BRACKET AND SHAFT	1
11	PAOZZ	96906	MS90727-114	SCREW ,CAP ,HEXAGON H	
12	PAOZZ	96906	MS35338-48	WASHER,LOCK	;
13	PAOZZ	96906	MS27183-17	WASHER,FLAT	2
14	PAOZZ	96906	MS90727-113	SCREW ,CAP ,HEXAGON H	2
15	PAOZZ	15434	208829	BRACKET, FAN SUPPORT	1
16	XDOZZ	15434	X-I	SPACER	1
17	PAOZZ	15434	166777	SCREW	1

END OF FIGURE



TA508280

FIGURE 38. ENGINE DATA PLATES.



**SECTION II**

**TM5-2815-241-34&P**

(1) ITEM No	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
				GROUP 22 BODY, CHASSIS, AND HULL ACCESSORY ITEMS	
				GROUP 2210 DATA PLATES AND) INSTRUCTION HOLDERS	
				FIG. 38 ENGINE DATA PLATES	
1	PAOZZ	15434	105375	PLATE, IDENTIFICATION	2
2	PAOZZ	15434	S2286	SCREW	4

END OF FIGURE



## SECTION 11

## TM5-2815-241-34&amp;P

(1) ITEM No	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES(UOC)	(6) QTY
				GROUP 94 REPAIR KITS	
				GROUP 9401 REPAIR KITS	
				FIG. KIT	
1	PAFZZ	15434	3801330	GASKET AND SEAL SET	1
				GASKET ( 1) 3-7	
				GASKET ( 1) 12-37	
				GASKET ( 1) 18-7	
				GASKET ( 1) 19-1	
				GASKET ( 2) 22-13	
				GASKET ( 1) 29-25	
				GASKET ( 6) 35-20	
				PACKING,PREFORMED ( 8) 9- 8	
				PACKING,PREFORMED ( 6) 9-15	
				PACKING,PREFORMED ( 1) 22-12	
				PACKING,PREFORMED ( 4) 35-4	
				PACKING ,PREFORMED ( 2) 35-15	
				PACKING ,PREFORMED ( 2) 35-16	
2	PAHZZ	15434	BM68356	GASKET SET	1
				GASKET 24-27	
				GASKET 25-11	
				GASKET ( 1) 25-17	
				GASKET ( 1) 26-11	
				GASKET ( 1) 27-12	
				GASKET ( 1) 30-16	
				PACKING WITH RETAIN ( 1) 28-21	
				PACKING, PREFORMED ( 1) 30-6	
				PACKING, PREFORMED ( 1) 26-6	
				PACKING, PREFORMED ( 1) 26-8	
				PACKING, PREFORMED ( 1) 28-14	
				PACKING PREFORMED ( 1) 33-9	
				PACKING, PREFORMED ( 1) 33-8	
				PACKING, PREFORMED ( 2) 35-15	
				SEAL CAP ( 1) 31-2	
				SPACER, RING ( 1) 26-9	
3	PAHZZ	15434	3018762	GASKET SET	1
				GASKET ( 2) 2-15	
				GASKET ( 1) 2-7	
				GASKET ( 1) 4-5	
				GASKET ( 1) 5-15	
				GASKET ( 1) 8-6	
				GASKET ( 1) 10-36	
				GASKET ( 1) 10-36	
				GASKET ( 1) 10-36	
				GASKET ( 1) 13-1	
				GASKET ( 1) 13-7	
				GASKET ( 1) 16-7	
				GASKET ( 1) 16-26	
				GASKET ( 2) 16-30	
				GASKET ( 1) 16-50	

KIT-1

**SECTION II****TM5-2815-241-34&P**

(1) ITEM NO	(2) SMR CODE	(3) CAGEC	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES(UOC)	(6) QTY
				GASKET	( 1) 17-19
				GASKET	( 1) 17-26
				GASKET	( 1) 24-22
				GASKET	( 1) 36-43
				KEY,WOODRUFF	( 1) 20-10
				PACKING, PREFORMED	( 1) 2-41
				PACKING, PREFORMED	( 1) 8-17
				PACKING, PREFORMED	( 2) 16- 10
				PACKING, PREFORMED	( 1) 16-28
				SEAL	( 1) 4-7
				SEAL	( 1) 8-4
				SEAL,PLAIN	( 1) 36-19
				SPACER,RING	( 1) 16-22
				WASHER, LOCK	( 2) 5-16

END OF FIGURE

SECTION II			TM5-2815-241-34&P		
(1)	(2)	(3)	(4)	(5)	(6)
ITEM	SHR		PART		
NO	CODE	CAGEC	NUMBER	DESCRIPTION AND USABLE ON CODES (UOC)	QTY
				GROUP 95 GENERAL USE STANDARIZED PARTS	
				GROUP 9501 BULK MATERIEL	
				FIG. BULK	
1	PAOZZ	89346	364359C1	HOSE, NONMETALLIC	v
				END OF FIGURE	

BULK-1



## SECTION IV

## TM5-2815-241-34&amp;P

## CROSS-REFERENCE INDEXES

NATIONAL STOCK NUMBER INDEX					
STOCK NUMBER	FIG.	ITEM	STOCK NUMBER	FIG.	ITEM
5330-00-005-0407	36	18	5305-00-071-2241	24	23
	36	20		26	2
5305-00-005-0666	19	9		27	20
5330-00-005-0857	8	4		28	3
5330-00-005-0858	4	7	2940-00-073-3316	16	28
2815-00-005-7431	12	7	5310-00-081-6034	8	13
5330-00-006-2494	25	13		10	29
5305-00-006-8411	3	11		11	6
5360-00-009-9270	9	13		16	34
4730-00-011-3175	30	4		18	6
2815-00-011-7786	2	7		28	39
5315-30-012-0123	1	14	5360-00-081-8487	23	26
5315-00-014-1195	2	17	5313-00-381-8500	4	2
5315-00-014-1244	25	4	5330-00-081-9289	33	4
5315-00-014-1284	2	16	5310-00-081-9292	20	17
	5	14	5333-00-081-9299	30	9
5310-00-014-5850	24	27	4730-00-081-9618	2	15
4730-00-018-9566	2	27	5360-00-082-0124	27	3
	3	8	5315-00-082-0448	23	28
	16	16	5355-00-082-1189	30	2
	18	12	5365-00-082-1193	28	41
	20	13	5310-00-082-1888	30	8
	28	15	5340-00-084-7787	30	10
	36	17	2815-00-085-7434	9	9
5306-00-019-4227	24	3	3040-00-085-7439	33	5
5330-00-026-2931	20	6	3120-00-090-5504	4	16
5330-90-026-2933	29	14	5305-00-091-4009	5	12
5315-00-041-0915	10	13	5330-00-106-6370	36	48
5315-00-041-0916	10	6	5310-00-109-7638	5	11
5306-00-041-0917	6	14	5305-00-115-9526	13	10
5315-00-043-1787	17	2	5330-00-129-9349	3	6
4730-00-044-4715	2	45	4820-00-130-4820	23	32
	36	4	2815-00-132-0240	9	9
5306-00-050-1237	10	35	5360-00-132-0245	22	7
5340-00-050-1600	2	14	5330-00-132-0247	22	11
4730-00-057-5555	8	6	5330-00-132-0248	16	27
	8	20	5365-00-132-0273	6	13
5330-00-058-1767	2	3	5330-00-132-0274	30	6
5305-00-058-6604	36	47	5330-00-132-0276	22	13
5305-00-062-4378	9	3	2910-00-132-0769	27	5
5305-00-063-5043	28	16	5340-00-132-3203	19	12
5330-00-064-4399	2	5	5340-00-134-3529	22	3
5330-00-065-5544	27	18	5310-00-134-4168	5	3
5305-00-068-0511	16	2	5310-00-134-4165	18	11
	16	44	5310-00-134-4171	6	11
	35	3	5306-00-136-9751	17	30
	36	5	5305-00-138-9848	30	13
2815-00-070-2251	18	10	5310-00-141-1795	24	25
5305-00-071-1788	20	22		26	4
5305-00-071-2071	13	26		26	11

## SECTION IV

## TM5-2815-241-34&amp;P

## CROSS-REFERENCE INDEXES

STOCK NUMBER	NATIONAL STOCK NUMBER INDEX		STOCK NUMBER	FIG.	ITEM
	FIG.	ITEM			
5313-00-141-1795	27	14	5310-00-261-7340	4	8
	33	14		8	12
5330-00-143-8369	35	14		10	28
5330-30-143-8376	13	27		11	5
5330-00-143-8485	9	8		13	15
3110-00-144-8499	24	13		16	4
3110-00-144-8519	36	25		16	35
	36	36		17	12
5330-00-159-1464	36	15		18	5
5310-00-159-6209	5	16		24	4
	24	24		28	37
	26	3		35	1
	28	2		36	2
	29	8	5310-00-262-2986	30	16
	33	13	5305-00-269-2811	36	43
3020-00-160-9092	20	8	5305-00-269-3217	16	3
5305-00-161-0902	24	22	5305-00-269-3240	4	9
5305-00-165-8157	16	45	5365-00-275-8276	29	6
5330-00-171-6600	28	17	2950-00-275-9325	29	22
5330-00-171-7267	2	26	2953-33-275-9344	29	4
5330-00-175-6585	10	36	5310-00-276-2816	36	33
5330-00-194-8385	29	25	5340-00-276-5847	2	39
2815-00-195-5894	12	13		10	24
2815-00-195-5897	12	28	4820-00-276-9041	16	5
4730-00-196-0837	28	35		16	31
5310-00-197-5304	2	30	5315-00-281-7613	2	2
5365-00-197-9327	16	21		2	40
4730-00-203-0549	2	13	4730-00-287-1649	28	30
5310-00-209-0965	8	2	4730-00-289-4770	3	3
	13	19		17	9
	17	10		35	6
	20	21	2815-30-300-3882	9	5
	24	18	2815-03-311-2521	10	7
5310-00-222-7240	6	12	2815-00-338-6839	13	4
5306-00-225-8499	17	31	5305-00-339-1415	10	19
5306-00-226-4829	17	29	3123-00-339-5642	2	35
2515-00-230-0070	12	35	5330-00-349-1219	10	36
5305-00-230-1939	29	9	3120-03-349-6444	4	14
2990-00-237-0058	24	2	5310-00-356-1447	2	21
	27	2	5330-00-361-2955	4	5
5330-00-237-6266	29	5	2815-00-362-1780	10	14
5315-00-238-0882	2	38	5315-00-369-2588	23	9
	8	8	4730-00-369-7824	27	19
5340-00-238-5435	22	4	2910-00-369-8240	24	8
2815-00-242-2992	8	14	3120-00-374-4342	7	4
5310-00-246-0221	16	32	2815-00-375-9892	10	22
5330-00-252-6056	37	5	3040-00-388-3126	10	21
5330-00-252-8888	26	15	5340-00-400-3449	29	27
5365-00-256-2846	23	31	5340-00-400-5178	23	11
5310-00-261-7340	2	24	2930-00-401-9531	20	5



## SECTION IV

## TM5-2815-241-34&amp;P

## CROSS-REFERENCE INDEXES

NATIONAL STOCK NUMBER INDEX					
STOCK NUMBER	FIG.	ITEM	STOCK NUMBER	FIG.	ITEM
5305-00-404-1388	16	46	5310-00-486-2505	24	5
5305-00-404-1390	36	46		36	8
4730-00-404-2906	35	5	5365-00-488-0799	2	6
4730-00-404-2909	2	25	5305-00-493-3959	33	12
5365-00-404-2934	3	2	2815-00-505-5116	10	5
2815-00-404-2940	12	12	2815-00-505-5119	10	9
5340-00-404-2944	7	2		10	16
2910-00-404-9999	23	6	5330-00-506-4866	24	16
2815-00-405-7789	14	1	5330-00-506-4874	35	4
5330-00-406-7789	29	19	5305-00-506-5722	27	6
2815-00-406-8936	17	4	5365-00-507-3224	23	15
5310-00-407-9566	10	34	5365-00-507-3225	23	15
	13	29	5365-00-507-3254	8	16
	17	28	5310-00-507-3259	27	4
	35	12	5365-00-507-3260	27	9
3130-00-408-9041	2	19	5365-00-507-3261	27	9
5310-00-410-6756	24	26	5365-00-507-3262	27	9
5305-00-411-9340	29	11	5365-00-507-3271	31	1
5340-00-417-5800	13	8	5305-00-509-8106	30	14
5365-00-420-9696	36	26	5310-00-521-8595	10	30
5305-00-424-3571	17	21	5315-00-532-9388	2	20
5310-00426-3990	9	4	5330-00-537-2382	2	11
5310-00432-1559	29	18	5365-00-543-3744	23	15
3130-00-437-0567	16	9	5305-00-546-6698	2	23
5310-00-442-6899	20	1		10	38
	20	19	3020-00-562-1173	24	14
3010-00-447-9799	24	1	5330-00-562-1173	27	12
2910-00451-8063	23	24	5310-00-562-6557	8	3
5360-00-461-5738	27	8		13	20
5365-00-462-4504	27	9		24	19
5305-00-463-0428	13	22	5310-00-562-6558	13	23
5340-00-464-7064	27	17	5310-00-562-6560	29	12
5310-00-469-3998	5	13	3120-00-566-0480	17	18
2910-00-470-7075	31	5	5330-00-567-3463	25	9
5315-00-475-2574	17	14	3040-00-567-4338	24	11
4730-00-477-4160	18	2	3040-00-567-4354	25	6
2990-00-477-6159	29	29	3020-00-567-4356	24	7
5305-00-477-6769	9	6	3120-00-573-0391	2	36
5330-00-478-2962	2	18	5330-00-582-7484	23	2
	5	15	5310-00-584-5272	5	4
2815-00-480-4347	6	7		13	25
5330-00-484-1718	25	12		37	12
	26	12	5310-00-584-7796	20	2
	27	15	3120-00-589-3537	12	6
	30	15		12	11
2815-00-484-8359	2	19		12	17
2815-00-484-8360	2	19		12	27
5306-00-485-0790	25	11		12	32
	26	13	2590-00-590-7378	11	1
5340-00-485-0945	10	20	2815-00-590-7385	10	2

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## CROSS-REFERENCE INDEXES

STOCK NUMBER		NATIONAL STOCK NUMBER INDEX		STOCK NUMBER	
	FIG.	ITEM		FIG.	ITEM
3120-00-593-1507	4	19	2815-00-739-6098	9	10
5360-00-597-4570	31	3	2815-00-753-0660	6	10
2930-00-603-1625	16	11	5310-00-757-6367	28	18
2910-00-603-2835	23	8	5310-00-763-8920	36	42
2815-00-603-7264	5	6	5340-00-767-4012	19	4
2815-00-609-7115	10	4	2910-00-767-4018	28	5
5315-00-616-5522	20	15	5310-00-768-0318	13	24
5315-00-616-5527	20	16	2990-00-772-1778	23	20
3120-00-627-6697	17	23	2815-00-772-9434	2	32
	17	27		8	10
5330-00-632-6182	29	15	3040-00-773-9369	24	12
5340-00-632-6239	9	12	5305-00-774-4246	33	1
5330-00-659-3178	19	1	5315-00-777-3544	10	8
3120-00-659-7808	10	11		10	15
3120-00-661-6646	10	37	5330-00-777-3545	10	36
5360-00-664-5343	16	20	5305-00-782-9489	11	3
5310-00-680-6874	29	13		28	36
3120-00-682-7706	29	16	5365-00-786-0102	33	10
5310-00-684-3463	10	25	2910-03-790-8736	31	4
3120-00-695-1232	4	21	3120-00-791-1440	10	18
4810-00-695-3284	30	1	2815-00-791-1453	16	19
3040-00-695-3285	24	6	3120-00-792-9834	20	11
5315-00-695-3292	24	10	5305-00-795-9336	4	1
3020-00-701-1112	23	30	5305-00-795-9353	5	9
3020-00-702-3882	25	6	4730-00-801-8186	13	14
2815-00-705-2851	10	12		35	8
2815-00-705-2856	17	8		36	3
2851-00-705-9257	10	1	4730-00-803-8353	25	10
5365-00-708-3434	16	23		26	16
5305-00-709-8282	17	13	5306-00-804-2468	2	22
5305-00-709-8523	13	16	5305-00-804-6318	38	2
5305-00-709-8537	8	7	5365-00-807-2636	27	11
5305-00-709-8542	8	9	5330-00-809-2667	26	6
5365-00-716-6580	25	5	5330-00-809-3276	26	8
5305-00-719-5221	37	14	5310-00-809-5997	37	13
5305-00-719-5235	37	11	3120-00-810-6032	23	10
5306-00-719-5467	13	18	2815-00-815-0355	36	28
3120-00-719-5719	25	2		36	37
5340-00-721-5329	3	7	2815-00-815-1114	22	10
5365-00-721-7884	24	15	5365-30-815-1137	22	9
5305-00-725-2317	18	4	5330-00-816-8148	28	10
	36	9	5310-00-820-6653	1	4
5330-00-729-4427	2	18		5	10
5310-00-732-0560	12	3	3030-00-821-8242	37	18
	12	8	2815-00-828-7013	17	5
	12	14	2910-00-828-7126	26	1
	12	25	2815-00-829-5227	19	7
	12	29	2910-00-829-5600	30	3
2930-00-732-5206	34	2	2910-00-829-5603	23	13
9905-00-733-7622	38	1	5365-00-829-5604	23	18

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## CROSS-REFERENCE INDEXES

STOCK NUMBER		NATIONAL STOCK NUMBER INDEX		STOCK NUMBER	
FIG.	ITEM	FIG.	ITEM	FIG.	ITEM
2910-00-829-5616	26	5	5305-01-028-8869	19	3
5340-00-829-5617	26	10	5360-01-038-4659	17	7
5340-00-833-7966	17	6	2990-01-046-0171	29	1
5315-00-844-0140	23	12	5330-01-046-0441	8	5
4720-00-846-5575	BULK	1	5330-01-046-1991	16	7
5305-00-846-5703	16	18	5330-01-046-3144	16	25
	36	1	2930-01-046-3493	36	16
2815-00-851-7637	12	24	5330-01-049-0466	2	4
2910-00-858-3522	27	13	5315-01-058-4551	4	18
2990-00-858-3526	33	9	5305-01-060-5958	22	2
5315-00-866-5015	9	15	5330-01-066-3908	11	9
3120-00-877-2213	8	21	5330-01-066-3910	17	25
5330-00-886-2509	10	31	2910-01-070-7979	9	16
5310-00-887-8325	19	10	4720-01-075-8149	18	1
5330-00-888-4988	KIT	2	2910-01-070-9710	22	6
5340-00-898-1497	27	10	5330-01-072-4436	9	14
3120-00-904-9595	23	22	5310-01-072-8821	37	6
3120-00-906-6657	2	37	5330-01-072-8822	37	9
5315-00-907-0711	23	17	5330-01-072-8829	24	9
4730-00-909-8627	36	12	5305-01-072-8831	27	16
2815-00-920-2073	19	5	5330-01-072-8983	33	7
2815-00-920-8356	19	2	3110-01-073-2576	37	7
5307-00-922-2626	29	26	3020-01-077-2229	4	11
5330-00-924-7757	22	12	3020-01-077-4411	4	4
2910-00-928-3505	9	7	2815-01-077-4463	19	8
2930-00-928-3595	35	7	5330-01-077-5228	16	41
5340-00-933-3009	9	1		35	10
3040-00-933-3012	25	7	4730-01-078-9859	26	14
5305-00-942-2196	8	11	3040-01-079-1748	17	15
	11	4	3040-01-079-1799	12	37
	16	36	3040-01-079-3468	36	35
	18	8	3040-01-079-3469	17	19
	28	40	5340-01-079-4678	22	16
5305-00-947-3437	12	4	5315-01-079-6506	22	14
	12	15	5330-01-079-6514	16	43
	12	26	3120-01-079-6527	19	11
	12	30	5315-01-079-6740	4	22
5340-00-951-3536	26	7	3110-01-079-8190	33	6
5330-00-951-3538	28	21	5365-01-080-0409	36	40
	30	17	5330-01-080-2992	36	29
5330-00-961-9470	31	2		36	39
5310-00-962-5610	3	10	5330-01-083-5021	36	5
2815-00-962-5623	9	10	2910-01-080-5570	3	
5365-00-965-0870	26	9	2815-01-083-3157	23	16
5310-00-971-7989	33	2	3020-01-084-9640	4	12
5315-00-973-0414	33	8	4720-01-085-1316	17	16
5365-00-988-3668	23	3	2815-01-085-2573	29	28
2815-00-994-4427	6	3	3040-01-085-2616	17	1
2815-00-944-4429	6	4	2815-01-085-2618	30	5
5305-01-010-2362	17	3	5330-01-085-3580	9	11
				29	17

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## CROSS-REFERENCE INDEXES

STOCK NUMBER	FIG.	ITEM	NATIONAL STOCK NUMBER INDEX STOCK NUMBER	FIG.	ITEM
2815-01-085-3733	9	5	5330-01-147-4071	17	32
2815-01-085-3734	17	22	3120-01-147-5275	20	9
3020-01-085-3779	17	24	5330-01-149-9715	KIT	1
2520-01-085-6128	12	33	2910-01-150-2631	22	1
4710-01-085-6130	35	13	5365-01-150-6257	2	29
2815-01-086-2704	6	1	2815-01-151-8772	4	10
5330-01-086-3991	36	38	2910-01-152-8531	22	15
5340-01-086-6193	3	4	2815-01-156-6224	3	1
5330-01-086-6197	16	10	4730-01-157-8923	28	29
5365-01-086-6759	2	6	2815-01-159-1737	11	2
5365-01-086-7680	2	6	5365-01-160-1832	2	12
5365-01-086-7788	8	16		18	13
3120-01-087-3004	6	9		19	6
5305-01-091-2498	37	17		23	4
2910-01-091-3204	23	14	4730-01-160-3579	16	12
5330-01-092-4143	KIT	3	5330-01-160-7460	24	21
2815-01-096-9198	12	2	3120-01-160-7482	23	19
2910-01-096-9200	25	3	5305-01-165-3300	8	1
5340-01-098-0175	37	15		17	11
2910-01-105-6457	22	8	4710-01-181-1956	16	42
5305-01-114-9275	35	11	5310-01-186-4361	1	7
2920-01-121-8859	30	11	2910-01-191-8470	22	5
5340-01-122-8002	5	1	5970-01-193-0895	1	15
2815-01-127-1060	9	9	2910-01-199-8757	25	1
2815-01-127-3597	9	9	5360-01-200-0323	16	14
2815-01-127-3598	9	9	5310-01-200-1318	16	38
4730-01-128-4598	2	33	5305-01-203-6444	16	37
5365-01-129-4324	16	22	3040-01-203-8549	20	14
5330-01-131-2967	18	7	5330-01-209-3583	13	2
5365-01-132-1984	36	27	4730-01-211-1989	13	28
2815-01-142-1732	11	7	3120-01-214-7779	4	17
5340-01-143-6048	9	2	4710-01-239-7360	13	11
3120-01-143-9547	4	13	5330-01-240-1630	36	23
3120-01-144-8882	4	13	5365-01-241-4318	6	6
5330-01-145-0716	8	17	4730-01-241-4639	28	33
5310-01-145-0762	36	41	3120-01-241-6516	4	15
5330-01-145-5377	2	44	5330-01-242-0722	18	9
5330-01-145-7550	8	18	5340-01-242-0805	16	40
3120-01-145-9132	4	13	6680-01-281-1226	13	7
2815-01-146-1024	11	8	4820-01-300-2759	9	9
4120-01-146-1048	30	7			
2940-01-146-1995	16	13			
2815-01-146-5925	4	6			
5330-01-147-0748	13	6			
5365-01-147-0912	8	16			
5365-01-147-0913	8	16			
5307-01-147-1316	12	19			
4730-01-147-2223	2	28			
	2	31			
5307-01-147-2821	12	19			

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX STOCK NUMBER	FIG.	ITEM
15434	AC1600300NF	4720-01-085-1316	29	28
15434	AC9		32	2
88044	AN565F428H24	5305-00-063-5043	28	16
88044	AN960-416	5310-00-141-1795	24	25
			26	4
			26	11
			27	14
			33	14
15434	AR-00796		23	23
15434	AR-02308	2815-00-005-7431	12	7
15434	AR-03636		17	17
15434	AR-045090	2930-01-046-3493	36	16
15434	AR-07110		4	13
15434	AR-08190		6	5
15434	AR-09265		16	26
15434	AR-09454-00EF		28	1
89346	AR-09912		2	1
15434	AR-10172	2815-01-085-2573	17	1
15434	AR-12732	5330-00-005-0407	36	20
15434	AR01176		8	15
15434	AR03034		33	11
15434	AR03307		12	1
15434	AR08256		20	10
15434	AR08366		20	7
15434	AR08667		17	26
15434	AR08851		36	31
15434	AR08853		36	19
15434	AR08854		36	30
15434	AR09473		8	19
15434	AR09478		16	8
15434	AR09479		16	1
15434	AR09607		20	3
15434	AR09832	2815-01-085-3734	17	22
15434	AR10058	2950-00-275-9325	29	22
15434	AR10141		37	10
15434	AR10142		37	1
15434	AR12604	2990-01-046-0171	29	1
15434	AR51276	2815-00-195-5894	12	13
15434	AR1307	3040-00-567-4338	24	11
15434	AR51317		33	3
15434	AS0500760SS		28	32
15434	AS0501900SS		28	31
46529	A331987	2933-00-603-1625	16	11
15434	BM-37496		13	17
15434	BM-69886	2990-00-237-0058	27	2
15434	BM27253	3120-00-339-5642	2	35
15434	BM37625	2815-00-609-7115	10	4
15434	BM37634	2815-00-505-5116	10	5
15434	BM47777	2815-00-705-9257	10	1
15434	BM52474	2815-00-753-0660	6	10
15434	BM68356	5330-00-888-4988	KIT	2

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX		FIG.	ITEM
			STOCK NUMBER		
15434	BM68879		2910-00-369-8240	24	8
15434	BM69381			28	9
15434	BM69886		2990-00-237-0058	24	2
15434	BM73718			23	21
15434	BM73902			23	7
15434	BM73976		2815-00-375-9892	10	22
15434	BM74747			27	7
15434	BM76340		2910-00-828-7126	26	1
15434	BM76665		2910-00-603-2835	23	8
15434	BM79290		2910-00-404-9999	23	6
15434	BM95160		2815-00-195-5897	12	28
15434	BM95161		2815-01-096-9198	12	2
15434	BM95162		2815-00-851-7637	12	24
15434	BM97497		2910-01-096-9200	25	3
15434	BM98430		2910-01-091-3204	23	14
73165	B90429		5330-01-066-3908	11	9
60038	LM485548		3110-01-073-2576	37	7
96906	MS122032		5310-00-159-6209	5	16
				24	24
				26	3
				28	2
				29	8
				33	13
96906	MS15795-824		5310-00-584-7796	20	2
96906	MS16625-1100		5365-00-807-2636	27	11
96906	MS16632-1050		5365-00-256-2846	23	31
96906	MS18154-58		5305-00-115-9526	13	10
96906	MS18154-59		5305-01-010-2362	17	3
96906	MS18154-60		5305-00-942-2196	8	11
				11	4
				16	36
				18	8
				28	40
96906	MS20066-116		5315-00-695-3292	24	10
96906	MS24665-355		5315-00-012-0123	1	14
96906	MS27183-14		5310-00-080-6004	8	13
				10	29
				11	6
				16	34
				18	6
				28	39
96906	MS27183-17		5310-00-809-5997	37	13
96906	MS27183-42		5310-00-014-5850	24	27
96906	MS29513-142		5330-00-252-6056	37	5
96906	MS35206-279			5	17
96906	MS35338-45		5310-00-407-9566	10	34
				13	29
				17	28
				35	12
96909	MS35338-46			13	9
96906	MS35338-47		5310-00-209-0965	8	2

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX STOCK NUMBER	FIG.	ITEM
96906	MS35338-47	5310-00-209-0965	13	19
			17	10
			20	21
			24	18
96906	MS35338-48	5310-00-584-5272	5	4
			13	25
			37	12
96906	MS35338-50	5310-00-820-6653	1	4
96906	MS35338-8	5310-00-261-7340	10	28
			11	5
			13	15
			16	4
			16	35
			17	12
			18	5
			24	4
			35	1
			36	2
96906	MS35648-8	5340-00-050-1600	2	14
96906	MS35690-805	5310-00-768-0318	13	24
96906	MS35691-5	5310-00-971-7989	33	2
96906	MS35756-12	5315-00-616-5522	20	15
96906	MS35756-18	5315-00-616-5527	20	16
96906	MS35756-34	5315-00-043-1787	17	2
96906	MS35782-6	4820-00-276-9041	16	5
			16	31
96906	MS35842-13	4730-00-909-8627	36	12
03958	MS39230-1	4730-00-287-1649	28	30
96906	MS51069-41	3030-00-821-8242	27	18
96906	MS51052-1	5310-00-684-3463	10	25
96906	MS51887-5	4730-00-196-0837	28	35
96906	MS51967-20	5310-00-763-8920	36	42
96906	MS51968-14	5310-00-732-0560	12	3
			12	8
			12	14
			12	25
			12	29
96906	MS9021-116	5333-00-582-7484	23	2
96906	MS90725-10	5305-00-071-2241	24	23
			26	2
			27	20
			28	3
96906	MS90725-115	5305-00-071-2071	13	26
96906	MS90725-34	5306-00-225-8499	17	31
96906	MS90725-67	5305-00-269-3217	16	3
96906	MS90726-67	5305-00-269-2811	36	43
96906	MS90727-113	5335-00-719-5221	37	14
96906	MS90727-114	5305-00-719-5235	37	11
96906	MS90727-31	5306-00-053-1237	10	35
96906	MS90727-64	5305-00-269-3240	4	9
96906	MS90727-83	5305-00-709-8282	17	13

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX		FIG.	ITEM
			STOCK NUMBER		
96906	MS90727-87		5305-00-709-8523	13	16
96906	MS90727-91		5305-00-709-8542	8	9
96906	MS90727-94		5305-00-709-8537	8	7
96906	MS90728-36		5306-00-226-4829	17	29
96906	MS90728-62		5305-00-068-0511	16	2
				16	44
				35	3
				36	5
96906	MS90728-64		5305-00-725-2317	18	4
				36	9
96906	MS90728-66		5305-00-782-9489	11	3
				28	36
96906	MS90728-70		5305-00-846-5703	16	18
				36	1
96906	MS90728-87		5305-00-071-1788	20	22
96906	MS9241-024		5330-00-924-7757	12	12
15434	NPN			28	34
89346	R9922703			1	1
24617	S-118-A			2	8
15434	S-119-0		5305-01-165-3300	8	1
				17	11
15434	S-147-B		5306-00-136-9751	17	30
24617	S-600			2	9
15434	S-605			2	42
15434	S-908		4733-00-057-5555	8	6
				8	20
15434	S-910-B		4730-01-160-3579	16	12
15434	S-911-B		4733-00-018-9566	2	27
15434	S-915-A		4730-00-801-8186	13	14
				35	8
				36	3
15434	S-966E		4730-00-203-0549	2	13
15434	S101A		5305-00-424-3571	17	21
15434	S106			5	5
15434	S110		5305-01-114-9279	35	11
15434	S118A		5305-00-230-1939	29	9
15434	S129		5305-00-546-6698	2	23
				10	38
15434	S1354			13	5
15424	S140			24	17
15434	S145		5305-01-203-6444	16	37
15434	S149A		5305-00-404-1390	36	46
15434	S155		5305-01-028-8869	19	3
15434	S159B		5305-00-493-3959	33	12
15434	S16073		3110-00-144-8519	36	25
				36	36
15434	S16206		5365-00-786-0102	33	10
15434	S16255		2815-00-815-0355	26	28
				36	37
15434	S189C		5305-00-509-8106	30	14
15434	S199B		5305-00-404-1388	16	46



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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX		FIG.	ITEM
			STOCK NUMBER		
15434	S200		5310-00-469-3998	5	13
15434	S222A			29	3
15434	S223		5310-00-521-8595	10	30
15434	S2286		5305-00-804-6318	38	2
15434	S274			24	20
15434	S601		5310-00-134-4168	5	3
15434	S603		5310-00-820-6653	5	10
15434	S604		5310-00-261-7340	2	24
				4	8
				8	12
				28	37
15434	S606		5310-00-410-6756	24	26
15434	S608		5310-01-200-1318	16	38
15434	S622		5310-30-562-6557	8	3
				13	20
				24	19
15434	S626		5310-00-562-6558	13	23
15434	S631		5310-00-562-6560	29	12
15434	S658		5310-00-109-7638	5	11
15434	S719		5340-00-276-5847	2	39
				10	24
15434	S911B		4730-00-018-9566	3	8
				16	16
				18	12
				20	13
				28	15
				36	17
15434	S962		4730-00-044-4715	2	45
				36	4
15434	S965E		5365-00-404-2934	3	2
15434	S995		4730-00-289-4770	3	3
				17	9
				35	6
91265	TS33-016		5330-00-951-3533	28	21
				30	17
15434	X-1			37	16
15434	011573			12	21
24617	0120217			30	12
80218	10003			13	17
15424	100099		5330-00-809-2667	26	6
15434	100192		3040-00-773-9369	24	12
15434	100193		3120-00-810-6032	23	10
15434	100215		3040-00-567-4354	25	8
15434	100478		5330-00-081-9289	33	4
15434	100670		3120-00-573-0391	2	36
15434	100764		5330-00-506-4866	24	16
15434	1011			21	8
15434	1012			21	19
15434	101322		2593-00-590-7378	11	1
15434	101468		3120-00-719-5719	25	2
15434	1017			21	9

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX		FIG.	ITEM
			STOCK NUMBER		
15434	101841		5365-00-507-3224	23	15
15434	101842		5365-00-507-3225	23	15
15434	101843		5365-00-543-3744	23	15
15434	101918		3040-00-695-3285	24	6
15434	101983		3020-00-567-4356	24	7
15434	1022			21	3
15434	102231			34	1
15434	1023			21	5
15434	1026			21	15
15434	1030			21	7
15434	103036		3020-00-562-1173	24	14
15434	1031			21	16
15434	105199		2815-00-829-5227	19	7
15434	105375		9905-00-733-7622	38	1
15434	105953		5306-00-804-2468	2	22
15434	106289		5305-00-091-4009	5	12
15434	106452R91			32	1
15434	107440			29	24
15434	107738		2815-00-505-5119	10	9
				10	16
15434	108074		5310-00-757-6367	28	18
15434	1081			21	12
15434	1082			21	13
15434	1083			21	14
15434	108330		5310-00-486-2505	24	5
				36	8
15414	108722		5340-00-400-3449	29	27
15434	109319		2815-00-406-8936	17	4
15434	109333		2815-00-705-2856	17	8
15434	109594		3120-01-079-6527	19	11
15434	109915		5305-00-774-4246	33	1
15434	110855		5330-00-567-3463	25	9
15434	110907		5365-00-708-3434	16	23
15434	112076		5365-01-160-1832	2	12
				18	13
				19	6
				23	4
15434	112302		5365-00-420-9696	36	26
15434	112593			13	1
15434	113244		3020-00-701-1112	23	30
15434	114638		5310-00-887-8325	19	10
15434	114739		2910-00-767-4018	28	5
15434	114745			28	22
15434	114754			28	27
15434	114755			28	6
15434	114764			28	20
15434	114765			28	19
15434	114773			28	14
15434	114791		5330-00-816-8148	28	10
15434	114795			28	23
15434	114921			28	25

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX STOCK NUMBER	FIG.	ITEM
15434	114940		28	13
15434	114947		28	4
15434	115033		28	7
15434	115034		28	12
15434	116390	5313-00-081-9292	20	17
15434	116391	3120-00-792-9834	20	11
15434	116936	4730-00-803-8353	25	10
			26	16
15434	116982	5340-00-767-4012	19	4
15434	117897		17	20
15434	118226	5305-00-161-0902	24	22
15434	118227	5315-00-844-0140	23	12
15434	118377	3120-00-791-1440	10	18
15434	118378	3120-00-659-7808	10	11
15434	118939	5315-00-777-3544	10	8
			10	15
15434	119363	3020-00-702-3882	25	6
15434	1200		21	18
15434	120448		5	7
15434	120543		10	10
15434	120819	5330-00-777-3545	10	36
15434	123000		5	8
75078	1232	5307-01-147-2821	12	19
15434	123558	5315-00-866-5015	9	15
15434	124019	5333-00-065-5544	27	18
15434	124020	5340-00-464-7064	27	17
15434	124033		28	26
15434	126304	2815-00-828-7013	17	5
15434	1265		21	21
15434	127316	5310-00-081-8500	4	2
15434	127554	5340-01-143-6048	9	2
15434	127558	2815-00-791-1453	16	19
15434	127935	4820-01-300-2759	9	9
15434	1289		21	4
15434	129768	5310-00-082-1888	30	8
15434	129826	2913-00-829-5600	30	3
15434	129838	5355-00-082-1189	30	2
15434	129839	5340-00-084-7787	30	10
15434	129888	5330-00-081-9299	30	9
15434	130118	2930-00-928-3595	35	7
15434	130226	5333-00-106-6370	36	48
15434	130394	4730-00-404-2906	35	5
15434	131026	5330-00-143-8485	9	8
15434	132648	4730-00-404-2909	2	25
15434	132756		16	39
15434	132880		6	2
15424	133342		35	2
15434	134596	5340-00-833-7966	17	6
15434	135957	2815-00-739-6098	9	10
15434	137797		36	44
15434	138782		23	5

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX		FIG.	ITEM
			STOCK NUMBER		
15434	139289			10	33
15434	139473		5365-00-988-3668	23	3
15434	139988		5330-00-809-3276	26	8
15434	140330		3120-00-589-3537	12	6
				12	11
				12	17
				12	27
				12	32
15434	140357			28	8
15434	140358			28	11
15434	140414			28	24
15434	140618		2910-00-829-5603	23	13
15434	140925			27	1
12204	141244		5315-00-014-1244	25	4
24617	141284		5315-00-014-1284	5	14
15434	141761		2815-00-070-2251	18	10
15434	142176		5310-01-072-8821	37	6
15434	142204			23	29
15434	142616		2930-00-437-0567	16	9
15434	142689		3020-00-160-9092	20	8
15434	143251		5360-00-461-5738	27	8
15434	143450			7	3
15434	143847		5360-00-081-8487	23	26
15434	143938			2	6
15434	143939		5365-00-488-0799	2	6
15434	143946			2	6
15434	143947			2	6
15434	143948		5365-01-086-6759	2	6
15434	143949		5365-01-086-7680	2	6
15434	143950		4730-01-241-4639	28	33
15434	144178		5315-00-082-0448	23	28
15434	144179			23	27
15434	144195		5360-00-082-0124	27	3
15434	144302		5365-00-829-5604	23	18
15434	144372		4730-01-157-8923	28	29
15434	145506		5330-01-086-3991	36	38
15434	145701		2815-00-962-5623	9	10
15434	145977		2930-00-732-5206	34	2
15434	146437		2910-00-451-8063	23	24
15434	146483		2910-00-790-8736	31	4
15434	147100		2910-00-928-3505	9	7
15434	147389		5305-00-062-4378	9	3
15434	147670		2815-00-994-4427	6	3
15434	148203		5330-00-143-8369	35	14
15434	1484			21	2
15434	148977		2990-00-858-3526	33	9
15434	149030		3040-00-085-7439	33	5
15434	149040		5315-00-973-0414	33	8
15434	1492			21	6
15434	150002		2815-00-242-2992	8	14
15434	151478		2815-00-920-2073	19	5

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX		FIG.	ITEM
			STOCK NUMBER		
15434	151489		2815-00-920-8356	19	2
15434	152770			6	13
15434	153336		2910-00-829-5616	26	5
15434	153338		5340-00-829-5617	26	10
15434	154088		5330-00-961-9470	31	2
15434	156226			7	6
15434	156416			29	10
15434	156420		3120-00-682-7706	29	16
15434	156444		5333-00-237-6266	29	5
15434	157088		5365-00-507-3271	31	1
15434	157551		5330-00-143-8376	13	27
15434	157594			23	25
15434	157070		3120-00-906-6657	2	37
15434	158139		2940-00-073-3316	16	28
15434	160514		5365-00-965-0870	26	9
15434	162426		3010-00-447-9799	24	1
15434	163733		5340-00-400-5178	23	11
15434	163944		3120-00-904-9595	23	22
15434	165006		5305-01-060-5958	22	2
15434	166009		5360-00-132-0245	22	7
15434	166777		5305-01-091-2498	37	17
15434	167157		2910-01-070-9710	22	6
15434	167299		5310-00-680-6874	29	13
15434	168306		5305-00-947-3437	12	4
				12	15
				12	26
				12	30
15434	168803			12	31
15434	168805			12	16
15434	169704			12	5
15434	170296		5340-00-933-3009	9	1
15434	170510		5330-00-632-6182	29	15
15434	171570		2990-00-477-6159	29	20
15434	172034		5340-00-632-6239	9	12
15434	173086		5330-00-132-0247	22	11
15434	173368		5333-00-132-0248	16	27
75078	17339		2815-01-085-3733	9	5
15434	174298		2815-00-815-1114	22	10
15434	174299		5365-00-815-1137	22	9
15434	175755		5365-01-241-4318	6	6
15434	175831		5340-00-485-0945	10	20
15434	175836		4820-00-130-4820	23	32
15434	175864		3040-00-933-3012	25	7
15434	177419		3040-01-079-3469	17	19
15434	177999		4730-00-369-7824	27	19
15434	179063		2940-01-146-1995	16	13
15434	181466		5310-00-484-1718	25	12
				26	12
				27	15
				30	15
15434	182706		5305-00-058-6604	36	47

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**CROSS-REFERENCE INDEXES**

CAGEC	PART NUMBER	PART NUMBER INDEX STOCK NUMBER	FIG.	I T E M
15434	183049	5330-00-058-1767	2	3
15434	183669		29	30
15434	184386		16	30
15434	184387		16	29
15434	184388		16	33
15434	185138	5340-01-079-4678	22	16
15434	185139	2910-01-105-6457	22	8
15434	185573	5365-01-086-7788	8	16
15434	185804	5305-00-463-0428	13	22
15434	187420	5365-00-132-0273	6	13
15434	187556	5305-00-138-9848	30	13
89346	187589		12	36
15434	187680	3120-00-593-1507	4	19
89346	187893R1		1	8
15434	188936	5305-00-795-9353	5	9
15434	189800	5365-00-462-4504	27	9
15434	190397	2930-00-401-9531	20	5
15434	190769		20	18
15434	190849	5330-00-194-8385	29	25
15434	190876	5330-00-132-0274	30	6
15434	191517	5310-00-442-6899	20	1
			20	19
15434	191916	5340-00-238-5435	22	4
15434	191970	2815-00-480-4347	6	7
15434	193717		5	2
15434	193736	5330-00-132-9276	22	13
15434	193949	5330-00-129-9349	3	6
15434	194010	5305-00-411-9340	29	11
15434	194037	2815-00-404-2940	12	12
15434	194610	2815-00-994-4429	6	4
15434	195469		29	2
89346	19581R1		1	13
15434	196844	5365-01-132-1984	36	27
15434	197230	5330-01-209-3583	13	2
15434	197733		29	31
15434	199064	5330-00-478-2962	2	18
			5	15
15434	199067	4730-01-147-2223	2	28
15434	199224		12	20
15434	199225	2520-01-085-6128	12	33
15434	199239		12	9
15434	199338		20	12
15434	199587	3040-01-079-1748	17	15
15434	199969	3040-01-203-8549	20	14
33457	2S7225S	2815-00-405-1798	14	1
15434	200064	5340-00-417-5800	13	8
15434	200307	5330-01-072-8822	37	9
15434	200566	2815-01-077-4463	19	8
15434	200809	5330-00-026-2931	20	6
15434	200861	5310-00-134-4171	6	11
15434	200908	5305-00-005-0666	19	9

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX STOCK NUMBER	FIG.	ITEM
15434	200919	5340-00-132-3203	19	12
15434	201124		37	3
15434	201707		16	15
15434	202128	5360-01-200-0323	16	14
15434	202226		2	7
15434	202376	3130-00-432-1559	29	18
15434	202377	5330-00-406-7789	29	19
15434	202457	5330-00-026-2933	29	14
15434	202506		29	23
15434	202897	5340-00-951-3536	26	7
15434	202903	5315-01-058-4551	4	18
15434	202961		18	14
63483	202994-1011	4720-01-070-8149	18	1
15434	203090		6	8
15434	203131	5310-00-426-3990	9	4
15434	203145	5330-01-066-3910	17	25
15434	203294		29	7
15434	203350	2910-01-080-5570	23	16
15434	203426	5315-01-079-6506	22	14
15434	233619	5305-01-072-8831	27	16
15434	203849	4730-01-078-9859	26	14
15434	204165	5305-00-795-9336	4	1
15434	204657	6680-01-281-1226	13	7
15434	204829	5330-00-005-0858	4	7
15434	204832	3020-01-085-3779	17	24
15434	204851		28	38
15434	20622	2815-00-338-6839	13	4
15434	208118		36	34
15434	208119	3040-01-079-3468	36	35
15434	208120	5365-01-080-0409	36	40
15434	208132		36	11
15434	208134		36	21
15434	208138		36	24
15434	208326	4730-00-477-4160	18	2
15434	208411		10	27
15434	208461		13	21
15434	208581		10	32
15434	208621		28	28
15434	208668		29	32
15434	208829	5340-01-098-0175	37	15
15434	209600		36	14
15434	209700	5305-00-006-8411	3	11
15434	209862C1		15	3
15434	209919	2815-01-146-5925	4	6
15434	209959		29	33
15434	210179	5315-01-079-6740	4	22
15434	210238		36	22
15434	210412	5330-01-046-9441	8	5
15434	210647	5330-00-006-2494	25	13
15434	210650		10	3
15434	210685		10	23

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX		FIG.	ITEM	--
			STOCK NUMBER			
15434	210804			36	45	
15434	210805			36	7	
15434	210806			36	6	
15434	210832			16	17	
15434	210858			16	6	
15434	210860			36	32	
15434	210884		5365-01-150-6257	2	29	
89346	210895			2	10	
15434	210926			20	4	
15434	210966		5340-01-242-0805	16	40	
15434	210967			16	24	
15434	210996			37	4	
15434	211016			35	9	
15434	211027		4710-01-085-6130	35	13	
15434	211053		5330-01-046-3144	16	25	
15434	211358		4710-01-239-7360	13	11	
15434	211375		5365-00-275-8276	29	6	
15434	211869			37	8	
15434	211915			4	3	
15434	211918		3020-01-077-4411	4	4	
15434	211939		5360-01-038-4659	17	7	
15434	211999		5360-00-009-9270	9	13	
15434	212161		5330-01-077-5228	16	41	
				35	10	
15434	212563		2950-00-275-9344	29	4	
15434	213082		5310-00-145-0762	36	41	
15434	213713			28	42	
15434	213740		2815-00-011-7786	2	7	
15434	213768		5330-01-072-8983	33	7	
15434	213769		3110-01-079-8190	33	6	
15434	213936			29	29	
15434	214476			36	10	
15434	214950		3120-01-087-3004	6	9	
15434	215090		5330-00-064-4399	2	5	
15434	215172			34	3	
15434	215705		5330-01-145-0716	8	17	
15434	215965		3020-01-077-2229	4	11	
15434	216524		5340-01-086-6193	3	4	
15434	216802		5333-01-085-3580	29	17	
15434	218152			12	10	
15434	218245		5330-01-046-1991	16	7	
15434	2299			21	17	
15434	236985R91			32	4	
15434	2390			21	11	
89346	24874R1			1	5	
75078	2514			12	18	
15434	2544			21	1	
89346	25711R1			1	3	
15434	26762702			32	3	
75078	2680			12	22	
15434	2689			21	10	



## SECTION IV

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	P A R T I N D E X		FIG.	ITEM
			STOCK NUMBER		
15434	274085R91			15	2
75078	2856		5307-01-147-1316	12	19
89346	29922801		5970-01-193-0895	1	15
15434	299263091			15	4
15434	3000140		2815-01-083-3157	4	12
15434	3000266		3040-01-085-2616	30	5
15434	3000521			12	34
15434	3000907		4710-01-181-1956	16	42
15434	3004165		2815-01-151-8772	4	10
15434	3004316		5330-00-005-0857	8	4
15434	3006183		2815-01-142-0732	11	7
15434	3006187		2815-01-159-1737	11	2
15434	3006358		2815-01-146-1024	11	8
15434	3006456		2815-01-085-2618	9	11
15434	3006736		5330-01-145-7550	8	18
15434	3007242		2815-00-230-0070	12	35
15434	3007300-2764			23	1
15434	3007442		5330-01-145-5377	2	44
15434	3007713		5330-01-086-6197	16	10
15434	3007716		2815-01-156-6224	3	1
15434	3007759		5330-01-072-4436	9	14
89346	3007976			2	43
15434	3008017		5330-01-079-6514	16	43
15434	3008100			3	9
15434	3008468		4730-01-147-2223	2	31
15434	3008469			2	34
15434	3008998		5330-01-049-0466	2	4
15434	3009213		5310-00-356-1447	2	21
89346	3010395			2	41
15434	3010915		5307-00-922-2626	29	26
15434	3011935		2910-01-070-7979	9	16
15434	3012527		4730-01-211-1989	13	28
15434	3012537		2910-01-152-8531	22	15
15434	3012972		5330-01-131-2967	18	7
15434	3014149		2815-01-086-2704	6	1
15434	3014622		2915-00-132-0240	9	9
15434	3014623		2815-01-127-1060	9	9
15434	3014624		2815-01-127-3597	9	9
15434	3014625		2815-01-127-3598	9	9
15434	3014783		3020-01-084-9640	17	16
15434	3017759		2815-00-085-7434	9	9
15434	3018049		2815-00-705-2851	10	12
15434	3018323		2910-01-150-2631	22	1
15434	3018762		5330-01-092-4143	KIT	3
15434	3019180		3123-00-695-1232	4	21
15434	3011986		3120-01-241-6516	4	15
15434	3319192			4	20
15434	3019218		3120-01-214-7779	4	17
15434	3319227		5330-01-242-0722	18	9
15434	3019400			13	3
15434	3020943		5330-00-659-3178	19	1

## SECTION IV

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX STOCK NUMBER	FIG.	I T E M
15434	3022205		18	3
15434	3022961	5365-01-129-4324	16	22
15434	3022969		29	21
15434	3023177		7	1
15434	3026556	3120-01-147-5275	20	9
15434	3027215	2815-00-590-7385	10	2
15434	3027633	3120-01-160-7482	23	19
15434	3029852	3120-00-877-2213	8	21
15434	3030970	4820-01-146-1048	30	7
15434	3031434	5330-01-147-4371	17	32
15434	3032861	5330-01-147-0748	13	6
15434	3033677	5330-00-005-0407	36	18
15434	3034233	2910-01-199-8757	25	1
15434	3035053	5330-01-160-7460	24	21
15424	3035342	4810-00-695-3284	30	1
15434	3036065	2815-00-300-0882	9	5
15434	3038220	2910-00-132-0769	27	5
15434	3038997	5330-01-240-1630	36	23
15434	3038998	5330-01-080-2992	36	29
			36	39
15434	3045173	5330-01-072-6829	24	9
15434	3045533		12	23
15434	3047402	5333-01-080-5021	3	5
15434	3054535	2910-01-191--8470	22	5
15434	3054611	2920-01-121-8859	30	11
15434	3065125	3040-00-388-3126	10	21
79396	33341	2910-00-470-7075	31	5
15434	36431901		15	6
89346	36435901	4720-00-846-5575	BULK	1
15434	3801261	3120-01-143-9547	4	13
15434	3501262	3123-01-144-8882	4	13
15434	3801263	3123-01-145-9132	4	13
15434	3801330	5330-01-149-9715	KIT	1
15434	3801353	5340-00-134-3529	22	3
15434	3801433	3040-01-079-1799	12	37
15414	390782C1		15	1
154340	40662A	5330-00-361-2955	4	5
15434	4136		21	20
89346	41408501		1	12
89346	41408901	5310-01-186-4361	1	7
89346	42414002		1	17
89346	42414102		1	17
15434	42645	2815-00-484-8359	2	19
15434	42646	3130-00-408-9041	2	19
15434	42647	2815-00-484-8360	2	19
89346	427820C1		1	2
15434	43463-A	5333-00-159-1464	36	15
15434	43696	5333-00-886-2509	10	31
15434	441432		37	2
89346	44188902		1	10
15434	44383	3120-00-349-6444	4	14

## SECTION XV

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX STOCK NUMBER	FIG.	ITEM
15434	44387	3120-00-090-5504	4	16
89346	446002R1		1	11
15434	44678	2910-00-858-3522	27	13
72582	450517	5305-00-165-8157	16	45
89346	46522502		1	6
89346	47666901		1	9
19207	5329388	5315-00-532-9388	2	20
72962	590220940406	5315-00-907-0711	23	17
83259	600-001 1-4	5330-00-171-6600	28	17
15434	69408	5315-00-238-0882	2	38
			8	8
15434	61623	5310-00-276-2816	36	33
15434	63385	5365-00-082-1193	28	41
15434	63495-D		36	13
15434	63842	5310-00-134-4169	18	11
15434	64482	2815-00-603-7264	5	6
15434	65259-A	5365-01-147-0912	8	14
15434	65259-B	5365-01-147-0913	8	16
15434	65259-C	5365-00-507-3254	8	16
15434	66292	5310-00-197-5304	2	30
15434	67346		13	13
15434	67347-1		13	12
15434	67622	4730-01-128-4598	2	33
15434	67684	5310-00-262-2986	30	16
15434	67946	5365-00-197-9327	16	21
15434	67963	5330-00-171-7267	2	26
15434	68193	5340-00-434-2944	7	2
15434	68274	5360-00-664-5343	16	20
15434	68365	3120-00-566-0480	17	<b>18</b>
15434	68445	5315-00-281-7610	2	2
			2	40
15434	68512	5315-00-041-0915	10	13
15434	68513	5315-00-041-0916	10	6
15434	68549	5315-00-369-2588	23	9
15434	68585	5315-90-014-1195	2	17
15434	68586	3120-00-641-6646	10	37
15434	68606	5365-00-716-6580	25	5
16954	691-10014	5330-90-252-8888	26	15
15434	69519	5315-00-475-2574	17	14
15434	69521	3120-00-627-6697	17	23
			17	27
15434	69550		7	5
			20	20
15434	69699	5310-00-962-5610	<b>3</b>	10
15434	69736	5305-00-339-1415	10	19
15434	69793	5306-00-019-4227	24	3
15434	69901	4730-00-081-9618	2	15
15434	69936	5313-90-222-7240	6	12
15434	70089-1	5333-00-537-2382	2	11
15434	70295	4733-00-011-3175	30	4
15434	70349	5306-90-719-5467	13	18

## SECTION IV

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## CROSS-REFERENCE INDEXES

CAGEC	PART NUMBER	PART NUMBER INDEX		FIG.	I T E M
			STOCK NUMBER		
15434	70459		5340-00-721-5329	3	7
15434	70624		5330-00-506-4874	35	4
15434	70653		2815-00-772-9434	2	32
				8	10
15434	70657		5340-01-122-8002	5	1
15434	70690		2990-00-772-1778	23	20
15434	70699		5365-00-721-7884	24	15
15424	70700		5360-00-597-4570	31	3
15434	70705		5333-00-562-1176	27	12
15434	70713		5340-00-898-1497	27	10
15434	70715		5310-00-507-3259	27	4
15434	70716		5305-00-506-5722	27	6
15434	70717		5365-00-507-3260	27	9
15434	70717A		5365-00-507-3261	27	9
15434	70717B		5365-00-507-3262	27	9
15434	70772		5305-00-477-6769	9	6
15434	70790		5306-00-485-0790	25	11
				26	13
15434	7348-2		2815-00-362-1780	10	14
15434	8265		5310-00-246-0221	16	32
19207	8465575-44			15	5
24617	903302		3110-00-144-8499	24	13
15434	9195-3		5306-00-041-0917	6	14
15434	9226		5315-00-014-1284	2	16
15434	9235-1		3120-00-374-4342	7	4
15434	9237			10	26
15434	9260-1		2815-00-311-2521	10	7
15434	9266		5330-00-175-6585	10	36
15434	9266A		5330-00-349-1219	10	36
15434	9333-1		5330-00-7294427	2	18
89346	969783R1			1	16

## SECTION IV

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## CROSS-REFERENCE INDEXES

FIG.	ITEM	FIGURE AND ITEM NUMBER STOCK NUMBER	INDEX CAGEC	PART NUMBER
BUCK	1	4720-00-846-5575	89346	36435901
KIT	1	5330-01-149-9715	15434	3801330
KIT	2	5330-00-888-4988	15434	BM68356
KIT	3	5330-01-092-4143	15434	3018762
1	1		89346	R9922703
1	2		89346	42782001
1	3		89346	25711R1
1	4	5310-00-820-6653	96906	MS35338-50
1	5		89346	24874R1
1	6		89346	46522502
1	7	5310-01-186-4361	89346	41408901
1	8		89346	187893R1
1	9		89346	47666901
1	10		89346	44188902
1	11		89346	446002R1
1	12		89346	41408501
1	13		89346	19581R1
1	14	5315-00-012-0123	96906	MS24665-355
1	15	5970-01-193-0895	89346	29922801
1	16		89346	969783R1
1	17		89346	42414002
1	17		89346	42414102
2	1		89346	AR-09912
2	2	5315-00-281-7610	15434	68445
2	3	5330-00-058-1767	15434	183049
2	4	5330-01-049-0466	15434	3008998
2	5	5330-00-064-4399	15434	215090
2	6		15434	143938
2	6		15434	143946
2	6		15434	143947
2	6	5365-00-488-0799	15434	143939
2	6	5365-01-086-6759	15434	143948
2	6	5365-01-086-7680	15434	143949
2	7		15434	202226
2	7	2815-00-011-7786	15434	213740
2	8		24617	S-118-A
2	9		24617	S-600
2	10		89346	210895
2	11	5330-00-537-2382	15434	70089-1
2	12	5365-01-160-1832	15434	112076
2	13	4730-00-203-0549	15434	S-966E
2	14	5340-00-050-1600	96906	MS35648-8
2	15	4730-00-081-9618	15434	69901
2	16	5315-00-014-1284	15434	9226
2	17	5315-00-014-1195	15434	68585
2	18	5330-00-478-2962	15434	199064
2	18	5330-00-729-4427	15434	9333-1
2	19	2815-00-484-8359	15434	42645
2	19	2815-00-484-8360	15434	42647
2	19	3130-00-408-9041	15434	42646
2	20	5315-00-532-9388	19207	5329388

## SECTION IV

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## CROSS-REFERENCE INDEXES

FIG.	ITEM	FIGURE AND ITEM STOCK NUMBER	NUMBER INDEX CAGEC	PART NUMBER
2	21	5310-00-356-1447	15434	3009213
2	22	5306-00-804-2468	15434	105953
2	23	5305-00-546-6698	15434	S129
2	24	5310-00-261-7340	15434	S604
2	25	4730-00-404-2909	15434	132648
2	26	5330-00-171-7267	15434	67963
2	27	4730-00-018-9566	15434	S-911-8
2	28	4730-01-147-2223	15434	199067
2	29	5365-01-150-6257	15434	210884
2	30	5310-00-197-5304	15434	66292
2	31	4730-01-147-2223	15434	3008468
2	32	2815-00-772-9434	15434	70653
2	33	4730-01-128-4598	15434	67622
2	34		15434	3008469
2	35	3120-00-339-5642	15434	BM27253
2	36	3120-00-573-0391	15434	100670
2	37	3120-00-906-6657	15434	157870
2	38	5315-00-238-0882	15434	60408
2	39	5340-00-276-5847	15434	S719
2	40	5315-00-281-7610	15434	68445
2	41		89346	3010395
2	42		15434	S-605
2	43		89346	3007976
2	44	5330-01-145-5377	15434	3007442
2	45	4730-00-044-4715	15434	S962
3	1	2815-01-156-6224	15434	3007716
3	2	5365-00-404-2934	15434	S965E
3	3	4730-00-289-4770	15434	S995
3	4	5340-01-086-6193	15434	216524
3	5	5330-01-080-5021	15434	3047402
3	6	5330-00-129-9349	15434	193949
3	7	5340-00-721-5329	15434	70459
3	8	4730-00-018-9566	15434	S911B
3	9		15434	3008100
3	10	5310-00-962-5610	15434	69699
3	11	5305-00-006-8411	15434	209700
4	1	5305-00-795-9336	15434	204165
4	2	5310-00-081-8500	15434	127316
4	3		15434	211915
4	4	3020-01-077-4411	15434	211918
4	5	5330-00-361-2955	15434	40662A
4	6	2815-01-146-5925	15434	209919
4	7	5330-00-005-0858	15434	204829
4	8	5310-00-261-7340	15434	S604
4	9	5305-00-269-3240	94906	MS90727-64
4	10	2815-01-151-8772	15434	3004165
4	11	3020-01-077-2229	15434	215965
4	12	2815-01-083-3157	15434	3000140
4	13		15434	AR-07110
4	13	3120-01-143-9547	15434	3801261
4	13	3120-01-144-8882	15434	3801262

## SECTION IV

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## CROSS-REFERENCE INDEXES

FIG.	ITEM	FIGURE AND ITEM STOCK NUMBER	NUMBER INDEX CAGEC	PART NUMBER
4	13	3120-01-145-9132	15434	3801263
4	14	3120-00-349-6444	15434	44383
4	15	3120-01-241-6516	15434	3019186
4	16	3120-00-090-5504	15434	44387
4	17	3120-01-214-7779	15434	3019218
4	18	5315-01-058-4551	15434	202903
4	19	3120-00-593-1507	15434	187680
4	20		15434	3019192
4	21	3120-00-695-1232	15434	3019180
4	22	5315-01-079-6740	15434	210179
5	1	5340-01-122-8002	15434	70657
5	2		15434	193717
5	3	5310-00-134-4168	15434	S601
5	4	5310-00-584-5272	96906	MS35338-48
S	5		15434	S106
5	6	2815-00-603-7264	15434	64482
5	7		15434	120448
5	8		15434	123000
s	9	5305-00-795-9353	15434	188936
5	10	5310-00-820-6653	15434	S603
5	11	5310-00-109-7638	15434	S658
5	12	5305-00-091-4009	15434	106289
5	13	5310-00-469-3998	15434	S200
5	14	5315-00-014-1284	24617	141284
5	15	5330-00-478-2962	15434	199064
5	16	5310-00-159-6209	96906	MS122032
5	17		96909	MS35206-279
6	1	2815-01-086-2704	15434	3014149
6	2		15434	132880
6	3	2815-00-994-4427	15434	147670
6	4	2815-00-994-4429	15434	194610
6	5		15434	AR-08190
6	6	5365-01-241-4318	15434	175755
6	7	2815-00-480-4347	15434	191970
6	8		15434	203090
6	9	3120-01-087-3004	15434	214950
6	10	2815-00-753-0660	15434	BM52474
6	11	5310-00-134-4171	15434	200861
6	12	5310-00-222-7240	15434	69936
6	13		15434	152770
6	13	5365-00-132-0273	15434	187420
6	14	5306-00-041-0917	15434	9195-3
7	1		15434	3023177
7	2	5340-00-404-2944	15434	68193
7	3		15434	143450
7	4	3120-00-374-4342	15434	9235-1
7	5		15434	69550
7	6		15434	156226
8	1	5305-01-165-3300	15434	S-119-0
8	2	5310-00-209-0965	96906	MS35338-47
8	3	5310-00-562-6557	15434	S622

## SECTION IV

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## CROSS-REFERENCE INDEXES

FIG.	ITEM	FIGURE AND ITEM STOCK NUMBER	NUMBER INDEX CAGEC	PART NUMBER
8	4	5330-00-005-0857	15434	3004316
8	5	5330-01-046-0441	15434	210412
8	6	4730-00-057-5555	15434	S-908
8	7	5305-00-709-8537	96906	MS90727-94
8	8	5315-00-238-0882	15434	60408
8	9	5305-00-709-8542	96906	MS90727-91
8	10	2815-00-772-9434	15434	70653
8	11	5305-00-942-2196	96906	MS18154-60
8	12	5310-00-261-7340	15434	S604
8	13	5310-00-080-6004	96906	MS27183-14
8	14	2815-00-242-2992	15434	150002
8	15		15434	AR01176
8	16	5365-00-507-3254	15434	65259-C
8	16	5365-01-086-7788	15434	185573
8	16	5365-01-147-0912	15434	65259-A
8	16	5365-01-147-0913	15434	65259-B
8	17	5330-01-145-0716	15434	215705
8	18	5330-01-145-7550	15434	3006736
8	19		15434	AR09473
8	20	4730-00-057-5555	15434	S-908
8	21	3120-00-877-2213	15434	3029852
9	1	5340-00-933-3009	15434	170296
9	2	5340-31-143-6048	15434	127554
9	3	5305-00-062-4378	15434	147385
9	4	5310-00-426-3990	15434	203131
9	5	2815-00-300-0882	15434	3036065
9	5	2815-01-085-3733	75078	17339
9	6	5305-00-477-6769	15434	70772
9	7	2910-00-928-3505	15434	147100
9	8	5330-00-143-8485	15434	131026
9	9	2815-00-085-7434	15434	3017759
9	9	2815-00-132-0240	15434	3014622
9	9	2815-01-127-1060	15434	3014623
9	9	2815-01-127-3597	15434	3014624
9	9	2815-01-127-3598	15434	3014625
9	9	4820-01-300-2759	15434	127935
9	10	2815-00-739-6098	15434	135957
9	10	2815-00-962-5623	15434	145701
9	11	2815-01-085-2618	15434	3006456
9	12	5340-00-632-6239	15434	172034
9	13	5360-00-009-9270	15434	211999
9	14	5330-01-072-4436	15434	3007759
9	15	5315-00-866-5015	15434	123558
9	16	2910-01-070-7979	15434	3011935
10	1	2815-00-705-9257	15434	BM47777
10	2	2815-00-590-7385	15434	3027215
10	3		15434	210650
10	4	2815-03-609-7115	15434	BM37625
10	5	2815-00-505-5116	15434	BP37634
10	6	5315-00-041-0916	15434	68513
10	7	2815-00-311-2521	15434	9260-1



## SECTION IV

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## CROSS-REFERENCE INDEXES

FIG.	ITEM	FIGURE AND ITEM STOCK NUMBER	NUMBER INDEX CAGEC	PART NUMBER
10	8	5315-00-777-3544	15434	118939
10	9	2815-00-505-5119	15434	107738
10	10		15434	120543
10	11	3120-00-659-7808	15434	118378
10	12	2815-00-705-2851	15434	3018049
10	13	5315-00-041-0915	15434	68512
10	14	2815-00-362-1780	15434	7348-2
10	15	5315-00-777-3544	15434	118939
10	16	2815-00-505-5119	15434	107738
10	17		15434	BP-37496
10	18	3120-00-791-1440	15434	118377
10	19	5305-00-339-1415	15434	69736
10	20	5340-00-485-0945	15434	175831
10	21	3040-00-388-3126	15434	3065125
10	22	2815-00-375-9892	15434	BM73976
10	23		15434	210685
10	24	5340-00-276-5847	15434	S719
10	25	5310-00-684-3463	96906	MS51092-1
10	26		15434	9237
10	27		15434	208411
10	28	5310-00-261-7340	96906	MS35338-8
10	29	5310-00-080-6004	96906	MS27183-14
10	30	5310-00-521-8595	15434	S223
10	31	5330-00-886-2509	15434	43696
10	32		15434	208581
10	33		15434	139289
10	34	5310-00-407-9566	96906	MS35338-45
10	35	5306-00-050-1237	96906	MS90727-31
10	36	5330-00-175-6585	15434	9266
10	36	5330-00-349-1219	15434	9266A
10	36	5330-00-777-3545	15434	120819
10	37	3120-00661-6646	15434	68586
10	38	5305-00-546-6698	15434	S129
11	1	2590-00-590-7378	15434	101322
11	2	2815-01-159-1737	15434	3006187
11	3	5305-00-782-9489	96906	MS90728-66
11	4	5305-00-942-2196	96906	MS18154-60
11	5	5310-00-261-7340	96906	MS35338-8
11	6	5310-00-080-6004	96906	MS27183-14
11	7	2815-01-142-1732	15434	3006183
11	8	2815-01-146-1024	15434	3006358
11	9	5330-01-066-3908	73165	B90429
12	1		15434	AR03307
12	2	2815-01-096-9198	15434	BM95161
12	3	5310-00-732-0560	96906	MS51968-14
12	4	5305-00-947-3437	15434	168306
12	5		15434	169704
12	6	3120-00-589-3537	15434	140330
12	7	2815-00-005-7431	15434	AR-02308
12	8	5310-00-732-0560	96906	MS51968-14
12	9		15434	199239

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## CROSS-REFERENCE INDEXES

FIG.	ITEM	FIGURE AND ITEM STOCK NUMBER	NUMBER INDEX CAGEC	PART NUMBER
12	10		15434	218152
12	11	3120-09-589-3537	15434	140330
12	12	2815-00-404-2940	15434	194037
12	13	2815-00-195-5894	15434	AR51276
12	14	5310-00-732-0560	96906	MS51568-14
12	15	5305-00-947-3437	15434	168306
12	16		15434	168805
12	17	3120-00-589-3537	15434	140330
12	18		75078	2514
12	19	5307-01-147-1316	75078	2856
12	19	5307-01-147-2821	75078	1232
12	20		15434	199224
12	21		15434	011573
12	22		75078	2680
12	23		15434	3045533
12	24	2815-00-851-7637	15434	BM95162
12	25	5310-00-732-0560	96906	MS51968-14
12	26	5305-00-947-3437	15434	168306
12	27	3120-00-589-3537	15434	140330
12	28	2815-00-195-5897	15434	BM95160
12	29	5310-00-732-0560	96906	MS51968-14
12	30	5305-00-547-3437	15434	168306
12	31		15434	168803
12	32	3120-00-589-3537	15434	140330
12	33	2520-01-085-6128	15434	199225
12	34		15434	3000521
12	35	2815-00-230-0073	15434	3007242
12	36		89346	187589
12	37	3040-01-079-1799	15434	3801433
13	1		15434	112593
13	2	5330-01-209-3583	15434	197230
13	3		15434	3019400
13	4	2815-00-338-6839	15434	20622
13	5		15434	S1354
13	6	5330-01-147-0748	15434	3032861
13	7	6680-01-281-1226	15434	204657
13	8	5340-00-417-5800	15434	200064
13	9		96909	MS35338-46
13	10	5305-00-115-9526	96906	MS18154-58
13	11	4710-01-239-7360	15434	211358
13	12		15434	67347-1
13	13		15434	67346
13	14	4730-00-801-8186	15434	S-915-A
13	15	5310-00-261-7340	96906	MS35338-8
13	16	5305-00-709-8523	96906	MS90727-87
13	17		80218	10003
13	18	5306-00-719-5467	15434	70349
13	19	5310-06-209-0965	96906	MS35338-47
13	20	5310-00-562-6557	15434	S622
13	21		15434	208461
13	22	5305-00-463-0428	15434	185804

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## CROSS-REFERENCE INDEXES

FIG.	ITEM	FIGURE AND ITEM NUMBER INDEX STOCK NUMBER	CAGEC	PART NUMBER
13	23	5310-00-562-6558	15434	S626
13	24	5310-00-768-0318	96906	MS35690-805
13	25	5310-00-584-5272	96906	MS35338-48
13	26	5305-00-071-2071	96906	MS90725-115
13	27	5330-00-143-8376	15434	157551
13	28	4730-01-211-1989	15434	3012527
13	29	5310-00-407-9566	96906	MS35338-45
14	1	2815-00-405-1798	33457	2S7225S
15	1		15434	39078201
15	2		15434	274085R91
15	3		15434	20986201
15	4		15434	299263091
15	5		19207	8465575-44
15	6		15434	36431901
16	1		15434	ARO9479
16	2	5305-00-068-0511	96906	MS90728-62
16	3	5305-00-269-3217	96906	MS90725-67
16	4	5310-00-261-7340	96906	MS35338-8
16	5	4820-00-276-9041	96906	MS35782-6
16	6		15434	210858
16	7	5330-01-046-1991	15434	218245
16	8		15434	ARO9478
16	9	2930-00-437-0567	15434	142616
16	10	5330-01-086-6197	15434	3007713
16	11	2930-00-603-1625	46529	A331987
16	12	4730-01-160-3579	15434	S-910-B
16	13	2940-01-146-1995	15434	179063
16	14	5360-01-200-0323	15434	202128
16	15		15434	201707
16	16	4730-00-018-9566	15434	S911B
16	17		15434	210832
16	18	5305-00-846-5703	96906	MS90728-70
16	19	2815-00-791-1453	15434	127558
16	20	5360-00-664-5343	15434	68274
16	21	5365-00-197-9327	15434	67946
16	22	5365-01-129-4324	15434	3022961
16	23	5365-00-708-3434	15434	110907
16	24		15434	210967
16	25	5330-01-046-3144	15434	211053
16	26		15434	AR-09265
16	27	5330-00-132-0248	15434	173368
16	28	2940-00-073-3316	15434	158139
16	29		15434	184387
16	30		15434	184386
16	31	4820-00-276-9041	96906	MS35782-6
16	32	5310-00-246-0221	15434	8265
16	33		15434	184388
16	34	5310-00-080-6004	96906	MS27183-14
16	35	5310-00-261-7340	96906	MS35338-8
16	36	5305-00-942-2196	96906	MS18154-6C
16	37	5305-01-203-6444	15434	S145

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## CROSS-REFERENCE INDEXES

FIG.	ITEM	FIGURE AND ITEM STOCK NUMBER	NUMBER INDEX CAGEC	PART NUMBER
16	38	5310-01-200-1318	15434	S608
16	39		15434	132756
16	40	5340-01-242-0805	15434	210966
16	41	5330-01-077-5228	15434	212161
16	42	4710-01-181-1956	15434	3000907
16	43	5330-01-079-6514	15434	3008017
16	44	5305-00-068-0511	96906	MS90728-62
16	45	5305-00-165-8157	72582	450517
16	46	5305-00-404-1388	15434	S199B
17	1	2815-00-085-2573	15434	AR-10172
17	2	5315-00-043-1787	96906	MS35756-34
17	3	5305-01-010-2362	96906	MS18154-59
17	4	2815-00-406-8936	15434	109319
17	5	2815-00-828-7013	15434	126304
17	6	5340-00-833-7966	15434	134596
17	7	5360-01-038-4659	15434	211939
17	8	2815-00-705-2856	15434	109333
17	9	4730-00-289-4770	15434	S995
17	10	5310-00-209-0965	96996	MS35338-47
17	11	5305-01-165-3300	15434	S-119-0
17	12	5310-00-261-7340	96906	MS35338-8
17	13	5305-00-709-8282	96906	MS90727-83
17	14	5315-00-475-2574	15434	69519
17	15	3040-01-079-1748	15434	199587
17	16	3020-01-084-9640	15434	3014783
17	17		15434	AR-03636
17	18	3120-00-566-0480	15434	68365
17	19	3040-01-079-3469	15434	177419
17	20		15434	117897
17	21	5305-00-424-3571	15434	S101A
17	22	2815-01-085-3734	15434	AR09832
17	23	3120-00-627-6697	15434	69521
17	24	3020-01-085-3779	15434	204832
17	25	5330-01-066-3910	15434	203145
17	26		15434	ARO8667
17	27	3120-00-627-6697	15434	69521
17	28	5310-00-407-9566	96906	MS35338-45
17	29	5306-00-226-4829	96906	MS90728-36
17	30	5306-00-136-9751	15434	S-147-B
17	31	5306-00-225-8499	96906	MS90725-34
17	32	5330-01-147-4071	15434	3031434
18	1	4720-01-070-8149	63483	202994-1011
18	2	4730-00-477-4160	15434	208326
19	3		15434	3022205
18	4	5305-00-725-2317	96906	MS90728-64
18	5	5310-00-261-7340	96906	MS35338-8
18	6	5310-00-080-6004	96906	MS27183-14
18	7	5330-01-131-2967	15434	3012972
18	8	5305-00-942-2196	96906	MS18154-60
18	9	5330-01-242-0722	15434	3019227
18	10	2815-00-070-2251	15434	141761

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## CROSS-REFERENCE INDEXES

FIG.	ITEM	FIGURE AND ITEM NUMBER INDEX		PART NUMBER
		STOCK NUMBER	CAGEC	
18	11	5310-00-134-4169	15434	63842
18	12	4730-00-018-9566	15434	S911B
18	13	5365-01-160-1832	15434	112076
18	14		15434	202961
19	1	5330-00-659-3178	15434	3020943
19	2	2815-00-920-8356	15434	151489
19	3	5305-01-028-8869	15434	S155
19	4	5340-00-767-4012	15434	116982
19	5	2815-00-920-2073	15434	151478
19	6	5365-01-160-1832	15434	112076
19	7	2815-00-829-5227	15434	105199
19	8	2815-01-077-4463	15434	200566
19	9	5305-00-005-0666	15434	200908
19	10	5310-00-887-8325	15434	114638
19	11	3120-01-079-6527	15434	109594
19	12	5340-00-132-3203	15434	200919
20	1	5310-00-442-6899	15434	191517
20	2	5310-00-584-7796	96906	MS15795-824
20	3		15434	AR09607
20	4		15434	210926
20	5	2930-00-401-9531	15434	190397
20	6	5330-00-026-2931	15434	200809
20	7		15434	AR08366
20	8	3020-00-160-9092	15434	142689
20	9	3120-31-147-5275	15434	3026556
20	10		15434	AR08256
20	11	3120-00-792-9834	15434	116391
20	12		15434	199338
20	13	4730-00-018-9566	15434	S911B
20	14	3040-01-203-8549	15434	199969
20	15	5315-00-616-5522	96906	MS35756-12
20	16	5315-00-616-5527	96904	MS35756-18
20	17	5310-00-081-9292	15434	116390
20	18		15434	190769
20	19	5310-00-442-6899	15434	191517
20	20		15434	69550
20	21	5310-00-209-0965	96906	MS35338-47
20	22	5305-00-071-1788	96906	MS90728-81
21	1		15434	2544
21	2		15434	1484
21	3		15434	1022
21	4		15434	1289
21	5		15434	1023
21	6		15434	1492
21	7		15434	1030
21	8		15434	1011
21	9		15434	1017
21	10		15434	2689
21	11		15434	2390
21	12		15434	1081
21	13		15434	1082

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## CROSS-REFERENCE INDEXES

FIG.	ITEM	FIGURE AND ITEM NUMBER INDEX STOCK NUMBER	CAGEC	PART NUMBER
21	14		15434	1083
21	15		15434	1026
21	16		15434	1031
21	17		15434	2299
21	18		15434	1200
21	19		15434	1012
21	20		15434	4136
21	21		15434	1265
22	1	2910-01-150-2431	15434	3018323
22	2	5305-01-060-5958	15434	165006
22	3	5340-00-134-3529	15434	3801353
22	4	5340-00-238-5435	15434	191916
22	5	2910-01-191-8470	15434	3054535
22	6	2910-01-070-9710	15434	167157
22	7	5360-00-132-0245	15434	166009
22	8	2910-01-105-6457	15434	185139
22	9	5365-00-815-1137	15434	174299
22	10	2815-00-815-1114	15434	174298
22	11	5330-00-132-0247	15434	173086
22	12	5330-00-924-7757	96906	MS9241-024
22	13	5330-00-132-0276	15434	193736
22	14	5315-01-079-6506	15434	203426
22	15	2910-01-152-8531	15434	3012537
22	16	5340-01-079-4678	15434	185138
23	1		15434	3007300-2764
23	2	5330-00-582-7484	96906	MS9021-116
23	3	5365-00-988-3668	15434	139473
23	4	5365-01-160-1832	15434	112076
23	5		15434	138782
23	6	2910-00-404-9999	15434	BM79290
23	7		15434	BM73902
23	8	2910-00-603-2835	15434	BM76665
23	9	5315-00-369-2588	15434	68549
23	10	3120-00-810-6032	15434	100193
23	11	5340-00-400-5178	15434	163733
23	12	5315-00-844-0140	15434	118227
23	13	2910-00-829-5603	15434	140618
23	14	2910-01-091-3204	15434	BM98430
23	15	5365-00-507-3224	15434	101841
23	15	5365-00-507-3225	15434	101842
23	15	5365-00-543-3744	15434	101843
23	16	2910-01-080-5570	15434	203350
23	17	5315-00-907-0711	72962	590220940406
23	18	5365-00-829-5604	15434	144302
23	19	3120-01-160-7482	15434	3027633
23	20	2990-00-772-1778	15434	70690
23	21		15434	BM73718
23	22	3120-00-904-9595	15434	163944
23	23		15434	AR-00796
23	24	2910-00-451-8063	15434	146437
23	25		15434	157594

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## CROSS-REFERENCE INDEXES

FIG.	ITEM	FIGURE AND ITEM NUMBER STOCK NUMBER	INDEX CAGEC	PART NUMBER
23	26	5360-00-081-8487	15434	143847
23	27		15434	144179
23	28	5315-00-082-0448	15434	144178
23	29		15434	142204
23	30	3020-00-701-1112	15434	113244
23	31	5365-00-256-2846	96906	MS16632-1050
23	32	4820-00-130-4820	15434	175836
24	1	3010-00-447-9799	15434	161426
24	2	2990-00-237-0058	15434	BM69886
24	3	5306-00-019-4227	15434	69793
24	4	5310-00-261-7340	96906	MS35338-8
24	5	5310-00-486-2505	15434	108330
24	6	3340-06-695-3285	15434	101918
24	7	3020-00-567-4356	15434	101983
24	8	2910-00-369-8240	15434	BM68879
24	9	5330-01-072-8829	15434	3045173
24	10	5315-00-695-3292	96906	MS20066-116
24	11	3040-00-567-4338	15434	AR51307
24	12	3040-00-773-9369	15434	100192
24	13	3110-00-144-8499	24617	903302
24	14	3020-00-562-1173	15434	103036
24	15	5365-00-721-7884	15434	70699
24	16	5330-00-506-4866	15434	100764
24	17		15434	S140
24	18	5310-00-209-0965	96906	MS35338-47
24	19	5310-00-562-6557	15434	S622
24	20		15434	S274
24	21	5330-01-160-7460	15434	3035053
24	22	5305-00-161-0902	15434	118226
24	23	5305-00-071-2241	96906	MS90725-10
24	24	5310-00-159-6209	9690S	MS122032
24	25	5310-00-141-1795	88044	AN960-416
24	26	5310-00-410-6756	15434	S606
24	27	5310-00-014-5850	96906	MS27183-42
25	1	2910-01-199-8757	15434	3034233
25	2	3120-00-719-5719	15434	101468
25	3	2910-01-096-9200	15434	BM97497
25	4	5315-00-014-1244	12204	141244
25	5	5365-00-716-6585	15434	68606
25	6	3020-00-702-3882	15434	119363
25	7	3040-00-933-3012	15434	175864
25	8	3040-00-567-4354	15434	100215
25	9	5330-00-567-3463	15434	110855
25	10	4730-00-803-8353	15434	116936
25	11	5306-00-495-0790	15434	70790
25	12	5310-00-484-1718	15434	181466
25	13	5330-00-006-2494	15434	210647
26	1	2910-00-828-7126	15434	BM76340
26	2	5305-00-071-2241	96906	MS90725-10
26	3	5310-00-159-6209	96906	MS122032
26	4	5310-00-141-1795	88044	AN960-416

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## CROSS-REFERENCE INDEXES

FIG.	ITEM	FIGURE AND ITEM STOCK NUMBER	NUMBER INDEX CAGEC	PART NUMBER
26	5	2910-00-829-5616	15434	153336
26	6	5330-00-809-2667	15434	100099
26	7	5340-00-951-3536	15434	202897
26	8	5330-00-809-3276	15434	139988
26	9	5365-00-965-0870	15434	160514
26	10	5340-00-829-5617	15434	153338
26	11	5310-00-141-1795	88044	AN960-416
26	12	5310-00-484-1718	15434	181466
26	13	5306-00-485-0790	15434	70790
26	14	4730-01-078-9859	15434	203844
26	15	5330-00-252-8888	16954	691-10014
26	16	4730-00-803-8353	15434	116936
27	1		15434	140925
27	2	2990-00-237-0058	15434	BM-69886
27	3	5360-00-082-0124	15434	144195
27	4	5310-00-507-3259	15434	70715
27	5	2910-00-132-0769	15434	3038220
27	6	5305-00-506-5722	15434	70716
27	7		15434	BM74747
27	8	5360-00-461-5738	15434	143251
27	9	5365-00-462-4504	15434	189800
27	9	5365-00-507-3260	15434	70717
27	9	5365-00-507-3261	15434	70717A
27	9	5365-00-567-3262	15434	70717B
27	10	5340-00-898-1497	15434	70713
27	11	5365-00-807-2636	96906	MS16625-1100
27	12	5330-00-562-1176	15434	70705
27	13	2910-00-858-3522	15434	44678
27	14	5310-33-141-1795	88044	AN960-416
27	15	5310-00-484-1718	15434	181466
27	16	5335-01-072-8831	15434	203619
27	17	5340-00-464-7064	15434	124020
27	18	5330-00-065-5544	15434	124019
27	19	4730-00-369-7824	15434	177999
27	20	5305-00-071-2241	96906	MS90725-10
28	1		15434	AR-09454-00EF
28	2	5310-00-159-6209	96906	MS122032
28	3	5305-00-071-2241	96906	MS90725-10
28	4		15434	114947
28	5	2910-00-767-4018	15434	114739
28	6		15434	114755
28	7		15434	115033
28	8		15434	140357
28	9		15434	BM69381
28	10	5330-00-816-8148	15434	11A4791
28	11		15434	140358
28	12		15434	115034
28	13		15434	114940
28	14		15434	114773
28	15	4730-00-018-9566	15434	S911B
28	16	5305-00-063-5043	88044	AN565F428H24



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28	17	5330-00-171-6600	83259	600-001 1-4
28	18	5310-00-757-6367	15434	108074
28	19		15434	114765
28	20		15434	114764
28	21	5330-00-951-3538	91265	TS33-016
28	22		15434	114745
28	23		15434	114795
28	24		15434	140414
28	25		15434	114921
28	26		15434	124033
28	27		15434	114754
28	28		15434	208621
28	29	4730-01-157-8923	15434	144372
28	30	4730-00-287-1649	03958	MS39230-1
28	31		15434	AS0501900SS
28	32		15434	AS0500760SS
28	33	4730-01-241-4639	15434	143950
28	34		15434	NPN
28	35	4730-00-196-0837	96906	MS51887-5
28	36	5305-00-782-9489	96906	MS90728-66
28	37	5310-00-261-7340	15434	S604
28	38		15434	204851
28	39	5310-00-080-6004	96906	MS27183-14
28	40	5305-00-942-2196	96906	MS18154-60
28	41	5365-00-082-1193	15434	63385
28	42		15434	213713
29	1	2990-01-046-0171	15434	AR12604
29	2		15434	195469
29	3		15434	S222A
29	4	2950-00-275-9344	15434	212563
29	5	5330-00-237-6266	15434	156444
29	6	5365-00-275-8276	15434	211375
29	7		15434	233294
29	8	5310-00-159-6209	96906	MS122032
29	9	5305-00-230-1939	15434	S118A
29	10		15434	156416
29	11	5305-00-411-9340	15434	194010
29	12	5310-00-562-6560	15434	S631
29	13	5310-00-680-6874	15434	167299
29	14	5330-00-026-2933	15434	202457
29	15	5330-00-632-6182	15434	170510
29	16	3120-00-682-7706	15434	156420
29	17	5330-01-085-3580	15434	216802
29	18	3130-00-432-1559	15434	202376
29	19	5330-00-406-7789	15434	202377
29	20	2990-00-477-6159	15434	171570
29	21		15434	3022969
29	22	2950-00-275-9325	15434	AR10058
29	23		15434	202506
29	24		15434	107440
29	25	5330-00-194-8385	15434	190849

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29	26	5307-00-922-2626	15434	3010915
29	27	5340-00-400-3449	15434	108722
29	28	4720-01-085-1316	15434	AC1600300NF
29	29		15434	213936
29	30		15434	183669
29	31		15434	197733
29	32		15434	208668
29	33		15434	209959
30	1	4810-00-695-3284	15434	3035342
30	2	5355-00-082-1189	15434	129838
30	3	2910-00-829-5603	15434	129826
30	4	4730-00-011-3175	15434	70295
30	5	3040-00-085-2616	15434	3000266
30	6	5330-00-132-0274	15434	190876
30	7	4820-01-146-1048	15434	3030970
30	8	5310-00-082-1888	15434	129768
30	9	5330-00-081-9299	15434	129888
30	10	5340-00-084-7787	15434	129839
30	11	2920-01-121-8859	15434	3054611
30	12		24617	0120217
30	13	5305-00-138-9848	15434	187556
30	14	5305-00-509-8106	15434	S189C
30	15	5310-00-484-1718	15434	181466
30	16	5315-00-262-2986	15434	67684
30	17	5330-00-951-3538	91265	TS33-016
31	1	5365-00-507-3271	15434	157088
31	2	5330-00-961-9470	15434	154088
31	3	5360-00-597-4570	15434	70700
31	4	2910-03-790-8736	15434	146483
31	5	2910-00-470-7075	79396	33341
32	1		15434	106452R91
32	2		15434	A09
32	3		15434	267627C2
32	4		15434	236985R91
33	1	5304-00-774-4246	15434	109915
33	2	5310-00-971-7989	96906	MS35691-5
33	3		15434	AR51317
33	4	5330-00-081-9289	15434	100478
33	5	3040-00-085-7439	15434	149030
33	6	3110-01-079-8190	15434	213769
33	7	5330-01-072-8983	15434	213768
33	8	5315-00-973-0414	15434	149040
33	9	2990-00-858-3526	15434	148977
33	10	5365-00-786-0102	15434	S16206
33	11		15434	AR03034
33	12	5305-00-493-3959	15434	S1598
33	13	5310-00-159-6209	96906	MS122032
33	14	5310-00-141-1795	88044	AN960-416
34	1		15434	102231
34	2	2930-00-732-5206	15434	145977
34	3		15434	215172

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35	1	5310-00-261-7340	96906	MS35338-8
35	2		15434	133342
35	3	5305-00-068-0511	96906	MS90728-62
35	4	5330-00-506-4874	15434	70624
35	5	4730-00-404-2906	15434	130394
35	6	4730-00-289-4770	15434	S995
35	7	2930-00-928-3595	15434	130118
35	8	4730-00-801-8186	15434	S-915-A
35	9		15434	211016
35	10	5330-01-077-5228	15434	212161
35	11	5305-01-114-9279	15434	S110
35	12	5310-00-407-9566	96906	MS35338-45
35	13	4710-01-085-6130	15434	211027
35	14	5330-00-143-9369	15434	148203
36	1	5305-00-846-5703	96906	MS90728-70
36	2	5310-00-261-7340	96906	MS35338-8
36	3	4730-00-801-8186	15434	S-915-A
36	4	4730-00-044-4715	15434	S962
36	5	5305-00-068-0511	96906	MS90728-62
36	6		15434	210806
36	7		15434	210805
36	8	5310-09-4862505	15434	108330
36	9	5305-00-725-2317	96906	MS90728-64
36	10		15434	214476
36	11		15434	208132
36	12	4730-00-909-8627	96936	MS35842-13
36	13		15434	63495-0
36	14		15434	209600
36	15	5330-00-159-1464	15434	43463-A
36	16	2930-01-046-3493	15434	AR-045090
36	17	4730-00-018-9566	15434	S911B
36	18	5330-00-005-0407	15434	3033677
36	19		15434	AR08853
36	20	5330-00-005-0407	15434	AR-12732
36	21		15434	208134
36	22		15434	210238
36	23	5330-01-240-1630	15434	3038997
36	24		15434	208138
36	25	3110-00-144-8519	15434	S16073
36	26	5365-00-420-9696	15434	112302
36	27	5365-01-132-1984	15434	196844
36	28	2815-00-815-0355	15434	S16255
36	29	5330-01-080-2992	15434	3038998
36	30		15434	AP08854
36	31		15434	AR08851
36	32		15434	210860
36	33	5310-00-276-2816	15434	61623
36	34		15434	238118
36	35	3040-01-079-3468	15434	208119
36	36	3110-00-144-8519	15434	S16073
36	37	2815-00-815-0355	15434	S16255

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		STOCK NUMBER	CAGEC	
36	38	5330-01-086-3991	15434	145506
36	39	5330-01-080-2992	15434	3038998
36	40	5365-01-080-0409	15434	208120
36	41	5310-01-145-0762	15434	213082
36	42	5310-00-763-8920	96906	MS51967-20
36	43	5305-09-269-2811	96906	MS90726-67
36	44		15434	137797
36	45		15434	210804
36	46	5305-00-404-1390	15434	S149A
36	47	5395-00-058-6604	15434	182706
36	48	5330-00-106-6370	15434	130226
37	1		15434	AR10142
37	2		15434	441432
37	3		15434	201124
37	4		15434	210996
37	5	5330-00-252-6056	96936	MS2513-142
37	6	5310-01-072-8821	15434	142176
37	7	3110-01-073-2576	60038	LM485548
37	8		15434	211869
37	9	5330-01-072-8822	15434	200307
37	10		15434	AR10141
37	11	5305-00-719-5235	96906	MS90727-114
37	12	5310-00-584-5272	96906	MS35338-48
37	13	5310-00-809-5997	96906	MS27183-17
37	14	5305-00-719-5221	96906	MS90727-113
37	15	5340-01-098-0175	15434	208829
37	16		15434	X-1
37	17	5305-01-091-2498	15434	166777
37	18	3030-00-821-8242	96906	MS51069-41
38	1	9905-00-733-7622	15434	105375
38	2	5305-00-804-6318	15434	S2286

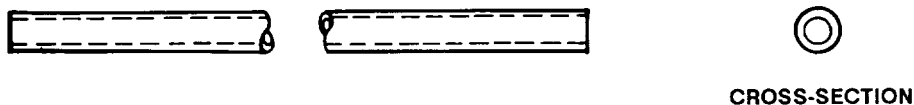
## APPENDIX D ILLUSTRATED LIST OF MANUFACTURED ITEMS

### Section I. INTRODUCTION

This appendix includes complete instructions for making items authorized to be manufactured or fabricated at Direct Support or General Support Maintenance.

All bulk materials needed to manufacture the item are listed by part number or specification number in a tabular list on the illustration.

### Section II. MANUFACTURED ITEMS ILLUSTRATIONS



**DESCRIPTION:** Hose  
**PART NUMBER:** 8465575-44  
**MAKE FROM:** Hose, part number 364359C1  
**TOOLS REQUIRED FOR FABRICATION:** Knife, Pocket Tape, Measuring 78 3/4 inch







**Figure D-1. Hose**



## APPENDIX E

### TORQUE LIMITS

#### CAPSCREW MARKING

Current Usage	Much Used	Much Used	Used at Times	Used at Times
Quality of Material	Indeterminate	Minimum Commercial	Medium Commercial	Best Commercial
SAE Grade Number	1 or 2	5	6 OR 7	8
Capscrew Head Markings			 	 
Manufacturer's marks may vary				
These are all SAE Grade 5 (3 line)				

#### TORQUE VALUES

#### CAUTION

If replacement capscrews are of a higher grade than originally supplied, use torque specifications for that placement. This will prevent equipment damage due to overtorquing.

Capscrew Body Size (Inches) - (Thread)	Torque Ft Lb (N•m)	Torque Ft Lb (N•m)	Torque Ft Lb (N•m)	Torque Ft Lb (N•m)
1/4	20	5 (7)	8 (11)	10 (14)
	28	6 (8)	10 (14)	14 (19)
5/16	18	11 (15)	17 (23)	19 (26)
	24	13 (18)	19 (26)	24 (33)
3/8	16	18 (24)	31 (42)	34 (46)
	24	20 (27)	35 (47)	44 (60)
7/16	14	28 (38)	49 (66)	55 (75)
	20	30 (41)	55 (75)	70 (95)
1/2	13	39 (53)	75 (102)	85 (115)
	20	41 (56)	85 (115)	105 (142)
9/16	12	51 (69)	110 (149)	120 (163)
	18	55 (75)	120 (163)	155 (210)
5/8	11	83 (113)	150 (203)	167 (226)
	18	95 (129)	170 (231)	210 (285)
3/4	10	105 (142)	270 (366)	280 (360)
	16	115 (156)	295 (400)	375 (508)
7/8	9	160 (217)	395 (536)	440 (597)
	14	175 (237)	435 (590)	605 (820)
1	8	235 (319)	590 (800)	660 (895)
	14	250 (339)	660 (895)	910 (1234)
				990 (1342)

**TORQUE VALUES - CONTINUED**

**NOTE**

Always use the torque values listed above when specific torque values are not available.

Do not use above values in place of those specified in other sections of this manual; special attention should be observed when using SAE Grade 6, 7, and 8 capscrews.

The above is based on use of clean, dry threads.

Reduce torque by 10 percent when engine oil is used as a lubricant.

Reduce torque by 20 percent if new plated capscrews are used.

Capscrews threaded into aluminum may require reductions in torque of 30 percent or more of Grade 5 capscrews torque and must attain two capscrew diameters of thread engagement.



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By Order of the Secretary of the Army:

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General, United States Army  
Chief of Staff

Official:

R.L. DILWORTH  
Brigadier General, United States Army  
The Adjutant General

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2-173		2	

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795-6904

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TEAR ALONG PERFORATED LINE







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=0.0386 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

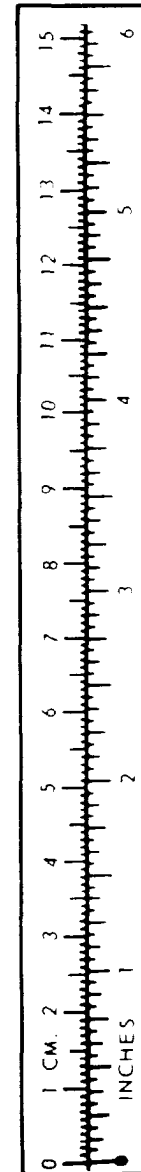
TEMPERATURE

$5/9 ( °F - 32 ) = °C$   
 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 per Square Inch	Kilopascals	5.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per hour	Kilometers per Hour	1.609

<u>TO CHANGE</u>	<u>TO</u>	<u>MULTIPLY BY</u>
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.385
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621



(FOR REFERENCE ONLY)

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